

NATIONAL TRANSPORTATION SAFETY BOARD

AIRCRAFT ACCIDENT REPORT

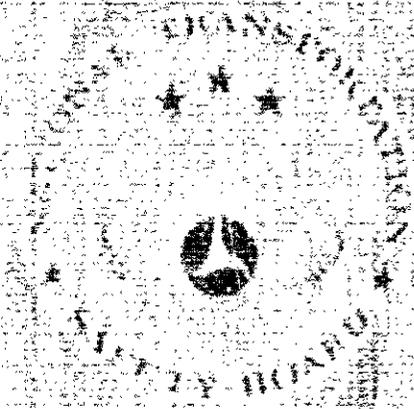
SEABOARD WORLD AIRLINES, INC.

DOUGLAS DC-8-63F, N8634

STOCKTON METROPOLITAN AIRPORT

STOCKTON, CALIFORNIA

OCTOBER 16, 1969



NATIONAL TRANSPORTATION SAFETY BOARD

Washington, D. C. 20591

REPORT NUMBER: NTSB-AAR-70-24

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OCTOBER 16, 1969

SYNOPSIS

On October 16, 1969, at 1545 P.d.t., Seaboard World Airlines, McDonnell Douglas DC-8-63F, N8634, overran the departure end of Runway 29R at Stockton Metropolitan Airport, California, during the performance of a crew training flight. The aircraft struck a roadway thereby collapsing the left main and nose landing gears. The aircraft came to rest 792 feet beyond the end of the runway. The aircraft was destroyed by fire. The five crewmembers aboard were uninjured.

Seaboard World Airlines DC-8, N8634, on October 16, 1969, was scheduled for use for recurrent training and annual proficiency checks of first officers in DC-8 equipment. The flight originated at the Oakland International Airport (OAK) and was to terminate at OAK. Training maneuvers were to be conducted in the Stockton, California, area, with landing and takeoff practice to be performed at the Stockton Metropolitan Airport. During a touch-and-go landing on Runway 29R at the Stockton Metropolitan Airport, the captain rejected the takeoff because of the sounding of a takeoff warning horn and the activation of a ground spoiler extend light. The crew was not able to stop the aircraft on the remaining runway.

The Safety Board determines that the probable cause of this accident was a false ground spoiler position indication during the takeoff portion of a touch-and-go landing that induced the captain to discontinue the takeoff at a point too far down the runway to permit him to stop the aircraft on the runway.

Recommendations and Corrective Action

On the basis of this investigation, the Safety Board recommends that:

The Administrator, Federal Aviation Administration, take the required action to insure an appropriate warning note be included in all DC-8 Operations Manuals which states essentially that:
"The ground spoiler selector lever shall be manually positioned to the spoiler extend setting on all rejected takeoffs, regardless of ground spoiler light indications."

1. INVESTIGATION

1.1 History of the Flight

On October 16, 1969, Seaboard World Airlines (SWA) DC-8, N8634, was scheduled for use in the recurrent training and annual proficiency checks of first officers in DC-8 equipment. The flight originated at the Oakland International Airport (OAK) and was to terminate at OAK. Training maneuvers were to be conducted in the Stockton, California, area, with landing and takeoff practice performed at the Stockton Metropolitan Airport.

The instructor pilot met with the other crewmembers at the SFO Helicopter 1/ Maintenance Base, Oakland International Airport, California, where the oral portion of the training and proficiency checks began.

An IFR 2/ flight plan was filed for 7,000 feet from Oakland to Stockton. The captain occupied the left seat and one of the first officers occupied the right seat upon departure at 1250 P.d.t. 3/ When the flight arrived at Stockton, the IFR clearance was cancelled and a VFR 4/ flight was continued at 7,500 feet, where slow flight, stalls, and emergency procedures were accomplished with each first officer. Each proficiency check included hydraulic emergencies, engine fire shutdown and relight, jammed and runaway stabilizer, electrical fire, engine failure, etc.

A VFR descent to the Stockton area was started but this was changed to IFR due to other inbound IFR traffic.

The first officer completed his proficiency check involving VOR 5/ holding and approaches, three-engine approaches, with missed approach, and touch-and-go and full-stop landings. Another first officer then moved into the right seat, and the landing and takeoff portion of his proficiency check began. The captain made three ILS 6/ approaches which consisted of a touch-and-go, one missed approach, and one demonstrated missed approach. At approximately 1540, a coupled autopilot and autothrottle approach was initiated on the ILS facility at Stockton. The autopilot was erratic on the No. 1 navigation receiver and was transferred to the No. 2 navigation receiver, which functioned normally. The captain stated that a very good approach was made and, at a radar altitude of 200 feet, the first officer disconnected the autopilot and autothrottles and continued a visual approach for a touch-and-go landing. Descent at the time was slightly below the glideslope and at a reference speed of 136 plus 5 knots. Full 50° flaps were being utilized with the

1/ San Francisco and Oakland Helicopter Airlines, Inc.

2/ Instrument flight rules.

3/ All times used herein are Pacific daylight, based on the 24-hour clock.

4/ Visual flight rules.

5/ Visual omni directional range.

6/ Instrument landing system.

reverse standby hydraulic pump on. The ground spoilers were armed, the gear was down, and three green lights showed on the gear position indicator. After touchdown 1,000 feet beyond the threshold of Runway 29R, the first officer moved his hand as if to initiate engine reversing. The captain stated that he immediately placed his hand on the first officer's, which was on the thrust levers, to discontinue this action. He advised the first officer that this was a touch-and-go landing and then started to clean up the aircraft. The first officer was instructed to spool the engines to 1.30 EPR. ^{7/} After the four engines were matched at 1.30 EPR, the command was given to proceed to full takeoff power of 1.87 EPR. Immediately following the initial application of power, the takeoff warning horn sounded intermittently and the blue ground spoiler warning light was on, denoting ground spoilers extension. The captain further stated that he then reached across the first officer's hand to verify that the spoiler lever was in the retract or stowed position, and that after the second or third sounding of the takeoff warning horn, he rechecked the blue light again (spoilers extended) and made the decision to abort the takeoff. The throttles were retarded, the four engines were reversed, and the brakes were applied simultaneously. The captain stated he did not deploy the ground spoilers nor did he ask for them to be deployed, since his cockpit indication showed that they were in the extended position.

The aircraft overran the west end of Runway 29R, slightly left of the runway centerline, and rolled onto soft earth. It came to rest 792 feet beyond the end of the runway. The spoiler extend light was reported to be still on as the aircraft stopped. The aircraft was secured, the firewall shutoffs were pulled, and the switches for all four engine fire extinguishers were closed.

Five witnesses observed and/or heard the accident. These witnesses were on the ramp about 2,100 feet from the west end of Runway 29R. A consensus derived from their statements indicated that the aircraft was in the last one-third of the runway when they heard a loud and prolonged reversing sound. The witnesses believed the aircraft was moving too rapidly to stop on the runway. Two of these witnesses reported that the sound of reversing terminated just after the aircraft rolled beyond the end of runway. None of the witnessed could recall having observed the position of either the flaps or ground spoilers.

1.2 Injuries to Persons

All five crewmembers evacuated the aircraft through the left forward main cabin door. None of the crewmembers was injured.

^{7/} Engine pressure ratio.

1.3 Damage to the Aircraft

The aircraft traversed an unprepared area beyond the west end of Runway 29R. While the aircraft was traveling across this area, impact with ditches and a raised farm road resulted in substantial damage to the aircraft's structure. The ensuing ground fire completely destroyed the aircraft.

1.4 Other Damage

Other damage was limited to the destruction of one threshold light on the west end of Runway 29R and crop damage (sugar beets and milo maize destroyed along the ground swath). There were no injuries to personnel on the ground.

1.5 Crew Information

All crewmembers were properly certificated for the flight involved. Detailed information concerning each participating flight crewmember is set forth in Appendix B.

1.6 Aircraft Information

N8634, a DC-8-63F Aircraft, S/N 46021, was manufactured in 1968 and placed in service with SWA on January 9, 1969. The total flying time on the aircraft at the time of the accident was 3,441.96 hours, with 38.18 hours since the last major inspection.

The aircraft was powered by four Pratt & Whitney JT3D-7 fan jet engines. Engine operating times were as follows:

<u>Mfg. Serial No.</u>	<u>Total Time</u>	<u>Hours Since Last Overhaul</u>
No. 1 P671273DSL	2050.25	None
No. 2 P671067DSL	1530.59	None
No. 3 P671016DSL	4499.53	None
No. 4 P671062DSL	3877.03	None

The aircraft records show that it had been maintained in accordance with Seaboard World Airlines and FAA procedures and regulations. The maintenance program outlined in the Seaboard World Airlines DC-8 operation specifications is a continuous maintenance inspection system. Maximum time limitation for the accomplishment of routine checks, periodic inspections, and overhaul of the aircraft and its component parts and accessories are contained in their maintenance manual. Aircraft and engine overhaul is accomplished by United Air Lines in accordance with a contract agreement and the United maintenance reliability program.

The last three checks accomplished on this aircraft are listed:

<u>Type Check</u>	<u>Date</u>	<u>Aircraft Time</u>
D	10-6-69	3359.26
A/B1	10-12-69	3398.44
A/B2	10-15-69	3439.04

Significant discrepancies extracted from the aircraft logs prior to the "D" check relating to the ground spoiler system are listed:

- 3-16-69 Spoiler extend light on in flight. Turning spoiler pump on no help. Visual check showed all spoilers down. Corrective action - replaced light and spoiler switch. Checks OK.
- 4-11-69 After spoilers were retracted, light came back on during taxi-in. Replaced right hand spoiler lock microswitch. Checked OK.
- 4-18-69 Spoiler extend light came on shortly after takeoff. Visual check appears OK. Corrective action - Replaced right hand spoiler unit switch. OK on ground.

In the "D" maintenance check mentioned earlier, the two inboard spoiler cables were replaced because of a chafed condition and visible broken wires. No spoiler system discrepancies were noted following the last "D" check accomplished on October 6, 1969. Other discrepancies (pilot squawks, the corrective action taken, and routine maintenance items) were found in the aircraft record relating to brakes, thrust reversers, and the antiskid system. These items are not considered to be significant to the accident. All Airworthiness Directives applicable to N8634 had been accomplished.

The maximum certificated takeoff weight for N8634 was 355,000 pounds. The maximum landing weight was 254,000 pounds. On the morning of the accident, the aircraft was refueled to a fuel weight of 100,000 pounds. The weight of the aircraft at takeoff from OAK was 266,080 pounds. The computed weight of the aircraft at the time of the accident, allowing for 35,000 pounds fuel burnoff, was 231,080 pounds. The aircraft's computed center of gravity (c.g.) was 23.3 percent of the mean aerodynamic chord. On the basis of these computations, the aircraft was well within its takeoff and landing weights and c.g. limits.

According to the crew, the takeoff roll was progressing normally until the intermittent takeoff warning horn was activated and the blue spoiler extend light was observed. This horn sounds when either the No. 1 and/or No. 3 engine thrust levers are advanced about 3 inches or 35° of angular travel from the idle stop when the aircraft is on the ground; and (1) the ground spoilers are not in the stowed position; and/or (2) the flaps are set at less than 10° or more than 30°. Regardless, the ground spoiler indicating light illuminates at any time when the ground spoilers are out of their stowed position.

A warning note in the DC-8 Operations Manual states: "The ground spoilers must be in the retracted position before a takeoff is attempted." (For detailed information concerning the ground spoiler system, the ground spoiler warning system, and the wing flap takeoff warning system, see Appendix C.)

1.7 Meteorological Information

The following weather sequence information was provided by the Stockton Weather Bureau Office located on the Stockton Metropolitan Airport:

1455 Measured ceiling 3,300 broken, 15 miles visibility, temperature 70° F., dew point 53° F., wind 290° at 14 knots, altimeter 30.00, towering cumulus all quadrants.

1547 Ceiling 3,000 broken, 20 miles visibility, wind 310° at 12 knots, altimeter 30.00, towering cumulus all quadrants, "aircraft accident."

1.8 Aids to Navigation

The Stockton Airport is served by a full Instrument Landing System as well as ADF 8/ and VOR facilities. The ILS glideslope and course are aligned for Runway 29R.

1.9 Communications

Communications between the aircraft and the Stockton Control Tower were normal.

1.10 Airdrome and Ground Facilities

Runway 29R at Stockton is 8,650 feet long, 150 feet wide, and is 29 feet above sea level. The runway is constructed of bituminous material and has an average gradient of -0.07 percent. The asphalt concrete surface of this runway was resealed with an asphaltic emulsion on

8/ Automatic direction finding.

October 7, 1969. Approximately 2,800 feet of airport property is accessible on the west end of Runway 29R, but is leased out by the Stockton Airport for farming. No overrun is provided.

The ILS localizer antenna is located 1,400 feet beyond the west end of the runway on the extended centerline for 29R. Sugar beets and milo maize crops were growing between the localizer antenna and the runway end. A dirt farm road, diagonal to the runway, traversed this area separating the two crops. The roadbed was graded to a height of approximately 10 inches above the surrounding terrain and was well packed and firm. This dirt road extended along a magnetic bearing of approximately 155° and 335°. The farmed land on either side of the road was soft from rain which terminated the day before the accident.

1.11 Flight Recorders

a. Cockpit Voice Recorder (CVR)

N8634 was equipped with a United Control Model V-557 CVR, S/N 2271. The unit was removed from the wreckage subsequent to the accident and transported to the Washington Office of the Safety Board for examination.

The exterior and electronics section of the CVR were damaged extensively by postimpact fire. The tape magazine evidenced some damage as a result of prolonged heat exposure. The tape was kinked at the extremity of each loop and was deformed in shape as a result of heat exposure. The level of signal on the cockpit area microphone channel was found to be of such low intensity as to necessitate the services of the recorder manufacturer's facilities to amplify the signal for better voice intelligence.

The following is a summary of information obtained from a readout of the CVR:

At 1541:20, the captain reported over the outer marker inbound, and the tower cleared the flight for the option. 9/
At 1543:41, the captain asked the first officer to "have a look." This was followed by the autothrottle disconnect. The captain then told the first officer to fly it in straight and he would "take care of everything." At 1543:59, the first officer was advised that reversing would not be utilized after landing, implying that this was a touch-and-go landing. Three seconds later, the sound of the spoiler handle slapping into the extended position was heard. Again there were instructions not to reverse and that the engines were to be spooled up to 1.30 EPR's and stabilized. Six seconds after the sound

9/ The pilot may elect to execute a missed approach, a touch-and-go landing, or a full stop landing.

suggesting ground spoiler extension, there occurred a series of takeoff warning horn beeps. The warning horn sounds continued as 1.87 EPR's were called for. After the seventh beep, 12 seconds from the start of the warning horn, the captain reported that the spoilers were extended. Four seconds later, the sound of engine spooldown began; 4 seconds later the sound of reverse thrust began. Seven seconds later the crew was told to hang on. In 3 seconds, impact sounds started and continued for 7 seconds. The audible stabilizer trim horn did not sound during the ground roll. This horn normally sounds at each one-half percent of stabilizer trim change.

b. Flight Data Recorder

N8634 was equipped with a Fairchild Flight Data Recorder Model F-5424, S/N 5566, which impresses on metal foil information from four parameters concerning pressure altitude, indicated air speed, magnetic heading, and vertical accelerations. The recorder was removed from the aft section of the aircraft on the day following the accident. Examination revealed that both the recorder and its recorder foil had been extensively damaged by the postimpact fire.

Approximately the last 6 minutes of the tape record was destroyed by fire. This precluded the readout of any recorded information relative to the last landing and the rejected takeoff which resulted in the accident. A readout of a previous touch-and-go landing which was executed approximately 45 minutes prior to the accident revealed a touchdown speed of 142 KIAS 10/ and a ground roll elapsed time to lift-off of 22.8 seconds. During the ground roll, the aircraft decelerated to 131 KIAS and accelerated to 144 KIAS for lift-off.

1.12 Aircraft Wreckage

The first discernible tire marks relating to N8634 began at a point 3,210 feet from the west end of the runway. The beginning track was approximately 3 inches wide and light in nature, but traceable to the right main gear outboard tires. The next discernible tire tracks began 95 feet farther down the runway and were identified as tracks from the right main gear inboard tires. These tracks were also light and narrow. The next discernible tracks were dual tracks which began 3,058 feet from the departure end of the runway, and each of the dual tracks was approximately 3 inches wide and very light. These tracks were traceable to the left main gear tires. Both the left and right main gear tracks gradually became wider in nature and slightly more distinct to a point 1,700 to 1,800 feet from the end of the runway. At this point, both the left and the right gear tracks became intermittent in nature, and the width of each track became wider and more distinct. On the last 1,200 to 1,000 feet of the runway, both right and left main gear tracks displayed vivid

10/ Knots indicated airspeed.

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interruptions associated with distinct antiskid action. At a point 1,359 feet from the departure end of the runway, dual nose gear tire tracks were discernible. These dual tracks displayed long intermittent skips continuing to the end of the runway. As the tracks progressed toward the end of the runway, the right track became longer and considerably wider simultaneously, the left nose gear tire became shorter and appreciably narrower. These runway tire tracks began astride the runway centerline and continued straight down the runway to a position about 1,300 feet from the runway end, at which point they began to veer toward the left side of the runway. At the end of the runway, the left main gear track was 26 feet inboard of the left inboard runway edge or 49 feet left of the runway centerline.

The terrain over which the aircraft traveled after leaving the west end of Runway 29R contained three ditches at about right angles to the runway. They were about 3 feet in width and 20 inches in depth, and were within 100 feet of the runway. The tire imprints from the aircraft were relatively shallow in this area. There was no evidence of structural breakup in this area. About 400 feet beyond the end of the runway, the tire tracks reached the diagonal, firm dirt, farm road separating the sugar beet field from the milo maize field. Just prior to reaching the dirt road, these tracks were 2 to $2\frac{1}{2}$ feet deep. The left main gear struck this roadbed, which was elevated about 19 to 12 inches, and collapsed rearward, $407\frac{1}{2}$ feet from the runway end. The nose gear contacted this roadbed $413\frac{1}{2}$ feet from the runway and collapsed rearward and to the right. As the aircraft continued its forward movement, the No. 1 and No. 2 engine nacelles contacted the terrain. Wide left flap marks were visible along the ground. The engine nacelle ground markings were continuous for about 240 feet from the point where the left main gear collapsed and the point at which the aircraft stopped. The No. 2 engine and pylon separated from the left wing structure.

The right wing flaps were fully extended. The left wing flaps were destroyed by fire. The right wing flap actuators were measured as follows: inboard $9\frac{1}{2}$ inches; midflap $5\frac{1}{2}$ inches; outboard $4\frac{1}{2}$ inches. The left wing flap actuators were measured as follows: inboard $6\frac{1}{2}$ inches; midflap $3\text{-}3/8$ inches; outboard $4\frac{1}{2}$ inches. The flap actuating lever was in the full down detent. The ground spoilers were found stowed. The over center actuator linkage mechanism was in the stowed over center position. The horizontal stabilizer was found set at the 6.2° noseup trim position.

The Nos. 1, 2, and 4 thrust levers were in the forward idle position; the No. 3 thrust lever was in the reverse idle detent. The Nos. 1, 3, and 4 fuel control units were in the off position; the No. 2 engine fuel control unit was in an intermediate position between off and on.

The Nos. 3 and 4 engine thrust reverser translating rings were in a forward stowed position. Nos. 1 and 2 engine thrust reverser translating rings were extended approximately 24 inches rearward on the No. 1 engine and 26 inches on the No. 2 engine. Debris, mud, and grass were trapped within the reverser track area on the Nos. 3 and 4 engines. All four engines were damaged in their compressor sections from foreign

object ingestion. No turbine damage was found on any of the four engines. No evidence of preimpact failure or malfunction was discovered in any engine or engine accessory.

1.13 Fire

Postimpact fire, which originated in the area where the No. 2 engine and pylon separated from the left wing, gutted most of the aircraft. The entire fuselage, from the vertical fin forward to the cockpit forward pressure bulkhead, was consumed by fire. The left wing was destroyed by fire from the No. 1 engine inboard to the fuselage. There was extensive damage in the right wing root as a result of fire. The right inboard flaps were partially burned away, and the inboard leading edge tank between the fuselage and the No. 3 engine was consumed by fire. Extensive heat damage was evident in the right wing root. The remainder of the right wing was relatively intact.

All systems (hydraulic, electronics, pressurization, etc.) were consumed by fire. Plumbing within the right wing associated with the entire fire canister system was intact. The right wing inboard canister was found under pressure reading 600 pounds. The right outboard fire canister had been discharged electrically. Both left wing fire canisters had been fired from overheating. The burned out remains of two portable fire extinguishers were found in the debris of the destroyed fuselage.

Two pieces of firefighting equipment arrived at the departure end of Runway 29R. While proceeding to the aircraft, one truck became mired and could not move. The driver of the other truck followed a different route and approached to within approximately 350 feet in front of the aircraft, but stopped because of a ditch. A fire hose was pulled from this truck by two firefighting personnel and the aircraft crew. The crew estimated that approximately 17 minutes elapsed before foam was actually applied to the burning aircraft. In this elapsed time, an explosion occurred within the left wing, and flame engulfed most of the aircraft.

1.14 Survival Aspects

The five crewmembers were the only persons aboard the aircraft. They evacuated through the forward left main cabin door without injury.

1.15 Tests and Research

Several component parts of the aircraft were removed and functionally tested and checked by their respective manufacturers in the presence of a representative of the Safety Board. The thrust brake and throttle interlock actuator were tested at the manufacturing facility and were found to be operable. All brake clearances were found to be normal, averaging three-eighths of an inch clearance. Two antiskid control valves were tested and were found to be operational. Other antiskid valves

were destroyed by fire. The eight wheel brake transducers were recovered, tested, and found to be within the tolerances specified for proper operation.

Inasmuch as Runway 29R was resurfaced with an asphalt emulsion on October 7, 1969, and was very smooth, the braking coefficient was questioned. On October 20, 1969, at 1130, the runway surface braking coefficient was tested utilizing a James Brake Decelerometer. Eight tests were conducted on different positions along the last 3,000 feet, or west end, of Runway 29R. The average of these recordings indicated an RCR 11/ of 25.

The above braking coefficient tests were made on a clear, sunny day with a temperature of 75° F., and on completely dry, paved surfaces. On October 16, 1969, the date of the accident, the runway was completely dry. Deceleration values ranging from 24 to 32 represent excellent braking qualities. Deceleration values ranging from 21.5 to 24 represent good braking qualities.

2. ANALYSIS AND CONCLUSIONS

2.1 Analysis

The captain's decision to reject the takeoff resulted directly from the illuminated spoiler extend light. The prolonged sounding of the takeoff warning horn alerted him to an unsafe condition and he noticed the illuminated ground spoiler extend light. The captain and first officer both stated that this was the reason for aborting. This was confirmed by information gained from a playback of the CVR tape, in which seven beeps of the takeoff warning horn could be heard. This was followed by the captain stating, "Wait a minute, spoilers are extended." The captain's decision to abort the takeoff is considered prudent. Any other action would have defeated the purpose of the warning system, which is installed in the aircraft to indicate an unsafe take configuration. Also, a warning note in the DC-8 Operations Manual states: "The ground spoilers must be in the retracted position before a takeoff is attempted."

The crew of the aircraft further indicated that the blue spoiler extend light remained illuminated until the aircraft stopped, and the aircraft's electrical system was deactivated. The ground spoilers were in the stowed position after the accident. It is, therefore, apparent that the activated spoiler extend light was giving a false indication. A maintenance records check revealed that three prior discrepancies had occurred in the ground spoiler electrical system as the result of faulty microswitches. Most of the aircraft was consumed by fire. The takeoff warning system and the ground spoiler position indicating system were destroyed. This precluded recovery and testing

11/ Runway conditions reading.

of these system components. Action taken by the captain to assure that the ground spoiler control lever was in the stowed position immediately prior to the aborted takeoff, plus the illuminated blue spoiler extend light, indicates that again a malfunctioning micro-switch was most probably the cause of this false indication. The captain stated that he did not deploy the ground spoilers nor did he ask for them to be deployed, since his cockpit indications showed that had remained in the extended position.

The takeoff warning horn is utilized for both the flap warning system and the ground spoiler system. This horn, which alerted the captain to the illuminated spoiler extend light, is activated when the No. 1 and/or No. 3 engine thrust levers are advanced for takeoff, if the ground spoilers are not in the retracted position, and/or the wing flaps are not positioned within the takeoff range. Conversely, flap positions will not cause activation of the spoiler extend light. In this instance, the warning horn could have been activated by either the spoiler system or the flap system, or possibly by both, simultaneously.

The ground spoiler indicating light circuit and the audible takeoff warning horn circuit are activated by the closing of one or both of two microswitches when the ground spoilers move out of their stowed position. It is considered most probable that one of the two ground spoiler system microswitches failed to open when the spoiler retract lever was automatically tripped to the stowed position as the throttles were advanced for takeoff. This caused the spoiler extend light to remain on. With one of these ground spoiler indicating light microswitches remaining closed, the warning horn sounds when the thrust levers are advanced, regardless of the wing flap position.

The aircraft was placed in service by SWA on January 9, 1969. Maintenance records disclosed that as of March 16, 1969, the first of three separate discrepancies in the ground spoiler electrical system had occurred. In each instance, the corrective action was to replace a faulty microswitch. This action appeared to correct the discrepancy each time the microswitch was replaced.

The wing flap selector handle was found in the full down detent and the flaps were in the down position. Following the landing in which full flaps were utilized, the flap selector may have been placed in the 23° detent early in the takeoff roll as stated by the captain. If this occurred, then someone, most probably the first officer, repositioned the flap lever to the full down position during the abort process. This action by the first officer is considered most probable in that the captain took over control of the aircraft when he determined that the spoilers were extended, and was thereafter actively occupied. Instinctively, the first officer may have placed the flaps in the full down position to enhance aircraft deceleration. None of the flightcrew recalled repositioning the flap lever and it may, in fact, have been left in the full down position from the preceding landing.

The first 1,800 feet of visible tire marks made by the main landing gear commenced 3,210 feet from the departure end of Runway 29R. These tire marks were light and narrow in nature and displayed no intermittency of markings associated with brake antiskid cycling. This would indicate that the aircraft was in a near-airborne condition and that there was only slight brake effectiveness during this portion of the roll. The narrowness and lightness of these marks would also be indicative of a ballooning effect of an aircraft caused by high-speed with the landing flaps in transit from 23° to the full flap configuration. The tire marks found on the remaining 1,400 feet of runway became much heavier and wider and displayed evidence of multiple anti-skid cycling, which is indicative of maximum braking effects. At approximately 1,300 feet from the end of the runway, the aircraft started a gradual turn to the left of the centerline and, for the last 1,000 feet, the right main landing gear tire marks showed evidence of more antiskid cycling than those made by the left main gear tires. The nose gear tire marks were intermittent and fluctuated markedly in width, indicating that the nose was bouncing, probably due to high reverse thrust enhanced by 6.2° ANU ^{12/} trim. The optimum stabilizer trim setting was 4.5° ANU; however, 6.2° ANU was found to be the setting on the aircraft following the accident. The right nose gear tire track was much heavier and much more distinct than that of the left nose gear tire. For some distances, there was no left nose tire track at all. This indicates that the pilot was steering the nose gear to the right in an attempt to maintain directional control.

No meaningful information could be obtained from the flight data recorder relating to the last landing, inasmuch as this portion of the recorder foil was consumed by fire. Flight performance data was obtained on the previous touch-and-go landing. This information, correlated with information obtained from the readout of the cockpit voice recorder tape, was utilized to construct the probable profile of the last landing roll and aborted takeoff. According to the flight recorder data of the previous touch-and-go landing, the touchdown was at 142 KIAS, with an elapsed time of 22.8 seconds between touchdown and lift-off. During the ground roll, the aircraft decelerated to 131 KIAS and accelerated to 144 KIAS before lift-off. The average airspeed during the ground roll was computed at 137 knots. A 14-knot headwind existed at the time of this landing, thereby making the average ground speed 123 knots, or 207 f.p.s. x 22.8 seconds, for a total ground roll of 4,270 feet.

The flightcrew reported that the last landing was made on target, which was 1,250 feet beyond the runway threshold at V_{ref} ^{13/} 135 plus 5 knots, and that the aircraft had accelerated to approximately the same speed of earlier touch-and-goes at the time the takeoff was aborted.

^{12/} Aircraft nose up.

^{13/} V_{ref} - reference speed.

During the ground roll, the interval from ground spoiler extension, as heard on the CVR, until the decision was made to abort the take-off, was timed at 18 seconds. Assuming that the aircraft decelerated to 130 KIAS and allowing for a reported 10-knot headwind component at the time of the accident, the average groundspeed was computed to be 125 knots, or 211 f.p.s. for 18 seconds. This computation places the point of decision in rejecting the takeoff at 5,078 feet beyond the runway threshold with 3,602 feet of runway remaining. Again, based on timing of the CVR tape, the reaction time for power reduction (beginning of engine spooldown) after the reject decision was recorded as 4 seconds. At 130 knots groundspeed the aircraft would have traveled an additional 876 feet before deceleration began. Therefore, only 2,726 feet of runway remained as reverse thrust was heard applied. An additional 4 seconds of time elapsed before maximum thrust reversing occurred. Consequently, only 1,900 feet of runway remained during maximum deceleration.

Twelve seconds of time elapsed after the takeoff warning horn commenced sounding before the abort decision was made. This may appear excessive, but it must be remembered that during a full flap touch-and-go landing, the takeoff warning horn will sound during takeoff acceleration while the flaps are in transit from full down to the takeoff setting of 23°. Tests showed that the warning horn will beep three times during an elapse time of 5 seconds when the thrust levers are advanced and while the flaps are retracting from the full flap position to the takeoff position. Pilots use this warning horn during the 5-second interval until it is silenced; as an indicator that the flaps have passed the 30° position. In this accident, the warning horn continued to sound and the captain became aware of a problem and reacted (began the abort) after four additional beeps, a time interval of 7 seconds. During this 7-second interval, the captain reached across to the ground spoiler lever on the right of the pedestal and positively affirmed that the spoiler lever was forward in the spoiler retract or stowed position, then took over control of the aircraft from the copilot. It is estimated that this affirmation of the spoiler lever position and the decision to reject the takeoff would have required approximately 3 to 4 additional seconds, thus leaving approximately 3 to 4 seconds for the captain to begin the abort action. The captain did not deploy the ground spoilers, thereby enhancing aircraft deceleration, because the cockpit indications, the sounding takeoff warning horn, and the illuminated ground spoiler extend light, indicated to him that the ground spoilers were extended and resulted in his decision to reject the takeoff. Also the SWA Operation Manual did not specify a procedure for aborting takeoff except in the case of a power loss prior to V_1 . 14/ (See Appendix D for SWA operation data.)

The captain stated that he retrimmed the stabilizer to a 4° noseup setting; however, the stabilizer was found to be at 6.2° noseup trim position. The captain apparently was diverted from retrimming the stabilizer by the takeoff warning horn. This appears evident since the sound

14/ V_1 --the critical-engine-failure speed.

of the stabilizer in-transit horn, which is a lower toned sound than the takeoff warning horn, and sounds intermittently at each one-half degree of stabilizer pitch change, was not recorded on the CVR tape at any time during the ground roll. It is believed that this 6.2° noseup stabilizer trim position would have presented no particular operational difficulty during the takeoff. There is, however, the possibility that the higher noseup trim setting might have delayed compression of the nose gear shock strut during the takeoff reject, as more than normal forward yoke pressure would have been required to compress the nose gear strut. The thrust brake interlock control system installed for the outboard engines prevents movement of the outboard thrust levers beyond the reverse thrust idle detent until the nose gear oleo is compressed. Some slight delay in obtaining maximum reverse thrust might have occurred. However, the 4 seconds for reverse thrust actuation, as heard on the CVR tape, is considered a reasonable time interval.

As the aircraft traversed the unprepared area on the west end of Runway 29R, impact with ditches and a raised farm road resulted in intensive damage to the aircraft structure. A ground fire followed which completely destroyed the aircraft. The entire fuselage, from the vertical fin forward to the cockpit forward pressure bulkhead, was consumed by fire. Therefore, all systems, hydraulic, electronics, cabin pressurization, etc., were destroyed. The ground spoiler warning system's electrical circuitry and associated microswitches were consumed by fire and were unavailable for inspection or testing.

Several component parts of the aircraft associated with the brake antiskid system, engine thrust reversers, wheel brake components, etc., were removed and tested by their respective manufacturers. The units inspected and those on which functional tests could be made displayed no significant discrepancies.

The unprepared area into which the aircraft traveled contributed substantially to the destruction of the aircraft. Impact of the aircraft against the firm roadbed resulted in collapse of the nose gear and the left main landing gear.

The condition of the unprepared area also delayed materially the movement of firefighting equipment into proximity with the aircraft. The larger firefighting unit became stuck in soft ground and could not be moved. A smaller pumping unit, which took a different route, moved to a point approximately 350 feet in front of the aircraft. The aircraft crew assisted in dragging a fire hose the remaining distance. The crew estimated that approximately 17 minutes elapsed before foam was actually applied to the burning aircraft. Before foam was applied, a low order explosion occurred within the left wing. This was followed immediately by the engulfment in flames of most of the aircraft.

The surface of Runway 29R was resealed with an asphaltic emulsion material 9 days prior to the accident. The sealant applied contained no abrasive additive. The runway surface was examined immediately following the accident, and it displayed a glazed smooth and slippery appearance when compared to the texture of adjacent unsealed surfaces. The comparative surface braking coefficient tests which were run utilizing the James Brake Decelerometer show nearly identical RCR values between the resealed runway surface and that of unsealed taxiways and ramp areas. The significance of these braking values is questionable when it is considered that these values were obtained using a standard passenger vehicle traveling at 25 m.p.h. as compared to an aircraft traveling at a much higher velocity, whose weight per square inch of tire bearing surface far exceeds that of an automobile. Under conditions of heavy braking at much higher velocities and weight per square inch of tire bearing surface, it is envisioned that oils in the runway sealant may undergo a frictional temperature rise and display a tendency to become fluid, thereby reducing the runway braking coefficient over and above the values ascertained in the braking tests.

2.2 Conclusions

a. Findings

1. The flight crewmembers were properly certificated and qualified for the operation involved.
2. The aircraft gross weight and center of gravity were within limits.
3. Weather was not a factor in the accident.
4. The ground spoiler extend indicator light remained on and the takeoff warning horn sounded due to a faulty electrical circuit.
5. The captain, believing that the ground spoilers failed to retract when power was applied for takeoff, rejected the takeoff with insufficient runway remaining on which to stop the aircraft.
6. The captain's decision to abort the takeoff was reasonable under the circumstances involved.
7. The captain's reaction time in aborting the takeoff is not considered excessive under the conditions involved.
8. The captain made no attempt to deploy the ground spoilers, since he believed that they had remained in the extended position.

9. The aircraft was destroyed by fire after having been substantially damaged by impact with a roadbed while traversing an unprepared and soft area.
10. The runway had been recently resealed with a nonabrasive asphaltic emulsion material.
11. Firefighting equipment was delayed in reaching the burning aircraft because of soft terrain conditions.
12. The rejected takeoff was begun too far down the runway for the aircraft to stop on the runway remaining.

b. Probable Cause

The Safety board determines that the probable cause of this accident was a false ground spoiler position indication during the takeoff portion of a touch-and-go landing that induced the captain to discontinue the takeoff at a point too far down the runway to permit him to stop the aircraft on the runway.

3. RECOMMENDATION

On the basis of this investigation, the Safety Board recommends that:

The Administrator, Federal Aviation Administration, take the required action insure an appropriate warning note be included in all DC-8 Operations Manuals which states essentially that: "The ground spoiler selector lever shall be manually positioned to the spoiler extend setting on all rejected takeoffs, regardless of ground spoiler light indications."

BY THE NATIONAL TRANSPORTATION SAFETY BOARD:

/s/ JOHN H. REED
Chairman

/s/ OSCAR M. LAUREL
Member

/s/ FRANCIS H. McADAMS
Member

/s/ LOUIS M. THAYER
Member

/s/ ISABEL A. BURGESS
Member

September 30, 1970

APPENDIX A

1. INVESTIGATION

The Board received notification of the accident at approximately 1610 On October 16, 1969. Investigators from the Oakland Field Office were immediately dispatched to the scene, and technical personnel were dispatched from Washington, D. C. Working groups were established for Operations and Witnesses, Powerplants and Structures, Systems, and Aircraft Maintenance Records. Parties to the investigation were: Seaboard World Airlines, the Federal Aviation Administration, Douglas Aircraft Co., Pratt & Whitney Aircraft Division, and Air Line Pilots Association. The on-scene phase of the investigation was completed in 7 days; however, additional tests, research, and analysis continued for several months thereafter.

2. HEARING

No public hearing was convened.

3. PRELIMINARY REPORT

A summary of all early information gained in the investigation was released by the Board in a preliminary report on January 23, 1970.

APPENDIX B

CREW INFORMATION

Captain William E. Headley

Captain Headley, aged 49, was employed by Seaboard World Airlines in September 1951. He was upgraded to captain in January 1959, rated in the DC-8 in July 1967, and was upgraded to Administrative Check Pilot on DC-8 equipment in October 1967.

Captain Headley satisfactorily completed his last 6 months' check on May 5, 1969.

Pilot data from company records are as follows:

	<u>Approximate Hours</u>
A. Total pilot time	19,308
B. Total pilot time in DC-8 equipment	1,747
C. Total pilot time in last 90 days	237:23
D. Certificate No. and Ratings Held	

Airline Transport Pilot Certificate No. 312341, with ratings in DC-4, DC-8, CL-44, L-1049; and commercial privileges for airplane, single engine, multiengine, land and sea.

- E. Date of last physical examination for first-class medical certificate was September 3, 1969, with no limitations.
- F. Captain Headley had not flown in the last 24 hours prior to this accident.

First Officer James M. Grant

First Officer Grant, aged 29, was employed by Seaboard World Airlines on August 26, 1968. First Officer Grant completed his last annual check on November 2, 1968.

Pilot data from company records are as follows:

	<u>Approximate Hours</u>
A. Total pilot time	4,210
B. Total pilot time in DC-8 equipment	725
C. Total pilot time in last 90 days	217:33
D. Certificate No. and Ratings Held	

Airline Transport Pilot Certificate No. 1550908, airplane, single-engine, multiengine, land.

- E. Date of last physical examination for first class medical certificate was August 13, 1969, with no limitations.
- F. First Officer Grant had not flown in the last 24 hours prior to this accident.

Flight Engineer Charles Johnson

Flight Engineer Johnson, aged 26, was employed by Seaboard World Airlines on September 15, 1968.

Flight Engineer data from company records are as follows:

	<u>Approximate Hours</u>
A. Total Flight Engineer time in DC-8 equipment	710
B. Total Flight Engineer time in last 90 days	182:30
C. Certificate No. and Ratings Held	

Flight Engineer Certificate No. 1889250 for Flight Engineer and Airplane and Powerplant Mechanic.

He also possesses a Commercial Pilot Certificate No. 1749010 for airplane, single- and multiengine, land.

- D. Date of last physical examination for first-class medical certificate was May 5, 1969, with no limitations.
- F. Flight Engineer Johnson had not flown in the last 24 hours prior to this accident.

APPENDIX C

SYSTEMS DESCRIPTION

Ground Spoiler System Operations

The ground spoiler system is mechanically controlled and hydraulically operated. The spoilers may be armed in flight to deploy automatically on touchdown, but the main landing gear spin-up or a pickup system is incorporated whereby spoilers will be extended through action of the (nose gear) ground shift mechanism in the event wheel spin-up does not deploy the spoilers. Manual operation of the spoilers can be accomplished by manually moving the spoiler control lever to the extend position when the nose gear strut is compressed. Conversely, after initial touchdown and after ground spoilers have been deployed and immediate take-off is planned or becomes necessary, spoilers may be retracted manually or accomplished automatically. The spoiler control lever is mechanically interconnected with the No. 4 engine throttle so that as the throttle is advanced, the spoiler control lever is moved from the extended position to the spoiler retract position. During the crew interview, Captain Headley stated that on all approaches and landings, including planned touch-and-goes, the ground spoilers are armed for automatic deployment by the spin-up feature of the main landing gear. Also, that manual retraction prior to executing the takeoff is not normally accomplished, but instead the practice of allowing the mechanical interconnect feature of the No. 4 engine thrust lever to reposition mechanically the ground spoiler control lever for spoiler retraction is followed.

Ground Spoiler Takeoff Warning System

The takeoff warning system is a mechanically actuated electrical system that provides an intermittent audible warning if the engine thrust levers are advanced for takeoff with the spoiler panels not in the retract position. The system also causes an indicating light on the instrument panel to illuminate when the spoiler panels are not retracted.

The takeoff warning system consists of two spoiler takeoff warning switches connected electrically to components of the takeoff warning (and cabin pressure warning) circuit. The switches are located adjacent to the inboard spoiler panel actuating linkage. Each switch has two sets of contacts, one included in the takeoff warning circuit, and one included in the indicating light circuit.

When the spoiler panels are not fully retracted, the takeoff warning switch controls are closed by the spoiler actuator linkage. If the airplane is on the ground (ground control relays energized), and the No. 1 or No. 3 engine thrust levers are advanced for takeoff with warning switches in this position, a 28 d.c. circuit is closed, actuating the takeoff warning horn. The warning horn cannot be silenced unless the thrust levers are retarded or the spoiler panels are retracted.

When the spoiler takeoff warning switch contacts are closed, a second 20 d.c. circuit is completed, causing a spoiler extend indicating light on the main instrument panel to come on. The spoiler extend light is on when the spoiler panels are not retracted, regardless of the position of the engine thrust levers or ground control relays.

A warning note in the DC-8 Operations Manual states: "The ground spoilers must be in the retracted position before a takeoff is attempted."

Wing Flap Takeoff Warning System

The wing flaps are hydraulically operated from 0° through a minimum of 46° in the full down position. Full down flaps are used for all normal landings. Two positions are used for takeoff, either 18° or 23°, depending upon takeoff performance required. If a wing flap setting of less than 10° or more than 30° is used for takeoff, a warning horn will sound intermittently when either No. 1 or No. 3 thrust levers are advanced more than 1½ inches from the idle position. The same horn is utilized for the flap warning system as for the ground spoiler warning.

Tests were conducted on a similar DC-8, while in a static condition, utilizing auxiliary hydraulic pressure, to determine the elapsed time the takeoff warning horn sounds while the flaps are transitioning from full down to the takeoff position. It was found that the takeoff warning horn beeped three times before the flaps passed the 30° setting, which deactivated the takeoff warning horn system. The beeps were of approximately 1 second duration, followed by a 1 second silent interval between beeps, for a total elapsed time of 5 seconds.

APPENDIX D

SEABOARD WORLD AIRLINES DC-8F OPERATION MANUAL

The SWA DC-8F Operation Manual in use on October 16, 1969, did not contain information covering the procedure to be used by crewmembers when discontinuing takeoffs for any reason other than for the loss of an engine before reaching V_1 , the critical-engine-failure speed. For this condition the manual contains the following instructions:

LOSS OF AN ENGINE BEFORE V_1

- (1) Throttles - IDLE.
- (2) Spoiler - UP.
- (3) Apply Full Brakes.
- (4) Stay in the center of the runway using brakes and nosewheel steering.
- (5) Co-Pilot should hold yoke forward and keep wings level.
- (6) Reverse all three engines and apply thrust as required.

The Operation Manual contained the following instructions with regard to the takeoff warning horn:

"The take-off warning horn will sound, during ground operation, intermittently when the number one (1), or number three (3) throttle is advanced past 35° (approximately 3 inches) from the idle stop and the flaps are not positioned between 6° and 35° and/or if the ground spoilers are not fully retracted.

"Should the warning horn sound during take-off and prior to reaching V_1 speed it is required that the take-off be aborted unless, in the judgment of the Captain, it would be safer and more prudent to continue the take-off."

"If the take-off is aborted, the cause of take-off warning should be determined and corrected, before another take-off is attempted. If take-off is continued, the cause of take-off warning should be determined and corrected, or if the Captain elects as the safest procedure, the flight should return to the departure airport."