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National Transportation Safety Board

Washington, D.C. 20594

Aircraft Accident Brief

Accident Number:	DCA11PA075
Operator/Flight Number:	Omega Aerial Refueling Services, Flight 70
Aircraft and Registration:	Boeing 707, N707AR
Location:	Point Mugu Naval Air Station, California
Date:	May 18, 2011
Adopted:	January 2, 2013

HISTORY OF FLIGHT

On May 18, 2011, about 1727 Pacific daylight time,[1] a modified Boeing 707, registration N707AR, operating as Omega Aerial Refueling Services (Omega) flight 70 crashed on takeoff from runway 21 at Point Mugu Naval Air Station, California (KNTD). The airplane collided with a marsh area to the left side beyond the departure end of the runway and was substantially damaged by postimpact fire. The three flight crewmembers sustained minor injuries. The flight was conducted under the provisions of a contract between Omega and the US Naval Air Systems Command (NAVAIR) to provide aerial refueling of Navy F/A-18s in offshore warning area airspace. According to the Federal Aviation Administration (FAA), Omega, and the US Navy, the airplane was operating as a nonmilitary public aircraft under the provisions of 49 *United States Code* Sections 40102 and 40125.

The accident flight crew consisted of a captain, first officer, and flight engineer who had flown with each other many times previously. The crewmembers reported conducting a normal preflight inspection. As the airplane taxied toward the runway, the reported wind was from 280º magnetic at 24 knots, gusting to 34 knots; the flight crew reported that the windsock showed very little change in the wind direction and a slight amount of gust. The crew had calculated a takeoff decision speed (V_1) of 141 knots and a rotation speed (V_r) of 147 knots. The crew elected to add 5 knots to the rotation speed to compensate for the wind gusts and briefed a maximum power takeoff. The first officer, who was the pilot monitoring, stated that he advised the captain, who was the pilot flying, about advancing the power relatively smoothly to avoid a compressor stall with the crosswind, and the captain agreed.

About 1723, air traffic control cleared the flight for takeoff from runway 21 and instructed the crew to turn left to a heading of 160º after departure. The captain applied takeoff thrust, and the first officer told investigators that, as the pilot in the right seat, he applied forward

[1] Unless otherwise noted, all times in this brief are Pacific daylight time based on a 24-hour clock.

pressure on the yoke and right aileron input to compensate for the right crosswind. According to the crew, the takeoff roll was normal. At rotation speed, the captain rotated the airplane to an initial target pitch attitude of 11º airplane nose up. Shortly after liftoff, when the airplane was about 20 feet above the runway and about 7,000 feet down the runway, all three crewmembers heard a loud noise and observed the thrust lever for the No. 2 (left inboard) engine rapidly retard to the aft limit of the throttle quadrant. The captain stated that he applied full right rudder and near full right aileron to maintain directional control and level the wings, but the airplane continued to drift to the left. The captain reported that he perceived the airplane would not continue to climb and decided to "put it back on the ground."

Witnesses and a cell phone video from another Omega 707 crewmember observing the takeoff indicated that the No. 2 (left inboard) engine separated and traveled up above the left wing as the airplane was passing abeam taxiway A2. The inlet cowling for the No. 1 (left outboard) engine separated immediately thereafter, consistent with being struck by the No. 2 engine nacelle.

The airplane began to descend with the remaining three engine power levers at maximum power, and the left wing dipped slightly (Pratt & Whitney indicated that loss of the inlet cowling on the No. 1 engine would increase drag, effectively resulting in less than zero thrust output). The captain said he lowered the nose and leveled the wings just as the airplane touched down on the runway between taxiway A2 and A1. The airplane made multiple contacts with the runway before drifting left and departing the runway surface before the airplane reached taxiway A1. The airplane crossed taxiway A and came to rest in the marsh area.

According to the flight crewmembers, they observed flames in the cabin area and did not have time to perform an engine shutdown or evacuation checklist. The crew reported difficulty exiting the cockpit due to mud and debris blocking the cockpit door. All three crewmembers successfully evacuated through the left forward entrance via the escape slide.

INJURIES TO PERSONS

The three crewmembers sustained minor injuries.

DAMAGE TO AIRCRAFT

The airplane sustained substantial damage due to impact forces and was partially consumed by a postcrash fire. See the Wreckage and Impact Information section in this brief for more information.

OTHER DAMAGE

Minor gouges were observed in the runway surface. The runway arresting gear and runway signage also sustained minor damage.

FLIGHT CREW INFORMATION

The captain, age 41, was hired by Omega in September 2008 and qualified as captain on the Boeing 707 shortly after being hired. At the time of the accident, he held an airline transport pilot certificate with type ratings on the Boeing 707 and 720, BE-200, and A320. He held a current first-class medical certificate. He reported a total pilot time of 5,117 hours with 2,730 in the Boeing 707. He was formerly a Navy pilot and flew the Boeing 707 and E6A (a Navy electronic and reconnaissance airplane based on the Boeing 707 airframe) based in Pensacola, Florida, and Corpus Christi, Texas. He also flew Beechcraft King Air twin-turboprop aircraft in Europe, where he was the head Naval Air Training and Operating Procedures Standardization (NATOPS) instructor on King Air 200s and was an assistant NATOPS instructor on Boeing 707s. He was a McDonnell Douglas T45 Goshawk instructor in Kingsville, Texas, and worked for United Airlines as a first officer flying Airbus A320s based in Chicago before being furloughed in January 2009. He reported flying a few trips on Boeing 707s with Principal Air but had not flown for that company since October 2010. He flew both internationally and domestically with Omega. The captain stated he had no major changes in his personal life or financial situation, and he characterized his overall health as “excellent.” Review of the captain’s preaccident activities revealed no abnormalities. The accident flight was his first of the day. The captain was current and qualified under FAA Part 91 and Part 61 requirements. A review of FAA records revealed no prior accidents, incidents, or enforcement actions.

The first officer, age 45, was hired by Omega in October 2008. He was qualified as captain, with his time in the Boeing 707 split about equally between serving as captain or first officer. He reported that, because the majority of pilots at Omega were qualified as captains, they would take turns flying in that role. The first officer began his flight training with the Navy in 1995, flying Raytheon T-1 Jayhawks, Boeing E6s, and Beechcraft C12s. He had been an instructor pilot in the E6 and the NATOPS instructor for the C12 in Rota, Spain. The first officer reported 4,052 hours total time, with 2,900 hours in the Boeing 707. He was dual-qualified for the McDonnell Douglas DC-10 and the Boeing 707 at Omega, with about 300 hours in the McDonnell Douglas DC-10. At the time of the accident, the first officer held an FAA airline transport pilot certificate, with type ratings in the BE-200, 707, 720, and DC-10. He held a current first-class medical certificate and classified his overall health as “outstanding.” Review of the first officer’s preaccident activities revealed no abnormalities. The accident flight was his first of the day. The first officer was current and qualified under FAA Part 91 and Part 61 requirements. A review of FAA records revealed no prior accidents, incidents, or enforcement actions.

The flight engineer, age 50, was hired by Omega in November 2002. His flight training began in the US Air Force. He became a flight engineer in 1983 on Lockheed C141Bs at Andrews Air Force Base and flew Boeing 707s and 747s from 1992 until his retirement in 2002. At the time of the accident, he was the chief flight engineer at Omega, as well as the acting assistant facilities security officer; he was previously the facilities security officer. He did not perform ground or flight training but was dual-qualified on the Boeing 707 and McDonnell Douglas DC-10. His total time was around 9,000 hours, with 6,500 hours in the Boeing 707, all of which was as an engineer. He had a private pilot license, with single-engine instrument rating. He held a current second-class medical certificate. Review of the flight engineer’s preaccident activities revealed no abnormalities. The accident flight was his first of the day. The flight engineer was current and qualified under FAA Part 91 and Part 61 requirements. A review of FAA records revealed no prior accidents, incidents, or enforcement actions.

The flight crewmembers received annual recurrent ground school and simulator training on the Boeing 707 from Pan Am International Flight Academy in Miami, Florida, and were trained under 14 *Code of Federal Regulations* (CFR) Parts 61 (captain and first officer) and 63 (flight engineer).

AIRCRAFT INFORMATION

The accident airplane was a modified Boeing 707-321B, registration number N707AR, serial number 20029. It was originally constructed in 1969 as a passenger-transport airplane. At the time of the accident, the airplane had 47,856 total hours with 15,186 total cycles. The airplane was powered by four Pratt & Whitney JT3D-3B engines. The No. 2 engine (the first to separate) had accumulated 48,119 hours and 14,576 cycles. Five operators owned the airplane before Omega acquired it on July 29, 1994.

In 1996, Omega initiated the tanker conversion process in conjunction with BAE Systems and TRACOR. The tanker conversion employed a centerline refueling station located in the aft fuselage with dual redundant hoses capable of probe and drogue refueling.[2] None of the tanker conversion changes was in the area of the engine nacelle struts. The US Navy conducted qualification tests on the modified airplane in 1999 and accepted it as meeting the requirements for the proposed contract. Omega had flown the airplane a total of 9,811 hours and 2,656 cycles since purchase, most of which were flown for developing the tanker modification and operating under the provisions of the US Navy contract.

The weight and balance data for the accident flight were destroyed by the postimpact fire. National Transportation Safety Board (NTSB) investigators determined estimated weight and balance information for the accident airplane using the onboard computer of an identical Boeing 707 (N707MQ) and the weights associated with the accident airplane. The estimated takeoff weight of the airplane was 304,179 pounds (lbs), with a center of gravity (CG) at 21.5 percent mean aerodynamic chord (MAC). Maximum takeoff weight specified for the airplane was 331,600 lbs, with a CG range of 17 to 35 percent MAC.

Boeing 707 Engine Nacelle Strut and Previous Events

The No. 2 engine nacelle strut attaches to the wing at four primary locations: an upper connection, which consists of the overwing support fitting and the front spar fitting; lower connections, which consist of the lower spar fitting, diagonal brace (thrust link), and the wing aft drag fitting; and two middle connections, which consist of the midspar and wing drag support fittings and the vertical attach fittings. As shown in figure 1, the midspar fitting is of a right-angle configuration in which the vertical tang attaches to the pylon bulkhead and the horizontal upper and lower tangs sandwich the midspar of the pylon. The lug at the center of the fitting is attached to the forward drag support fitting on the underside of the wing. Fractures of the midspar fitting were observed at the upper and lower horizontal tangs (as indicated by the red and green lines in figure 1) at the radius (indicated by the red arrows), where the tangs merge with the lug at the fitting's center.

[2] A drogue is a conical basket that is attached to a flexible hose that extends from the tanker; a fixed probe is inserted into the basket to transfer fuel.

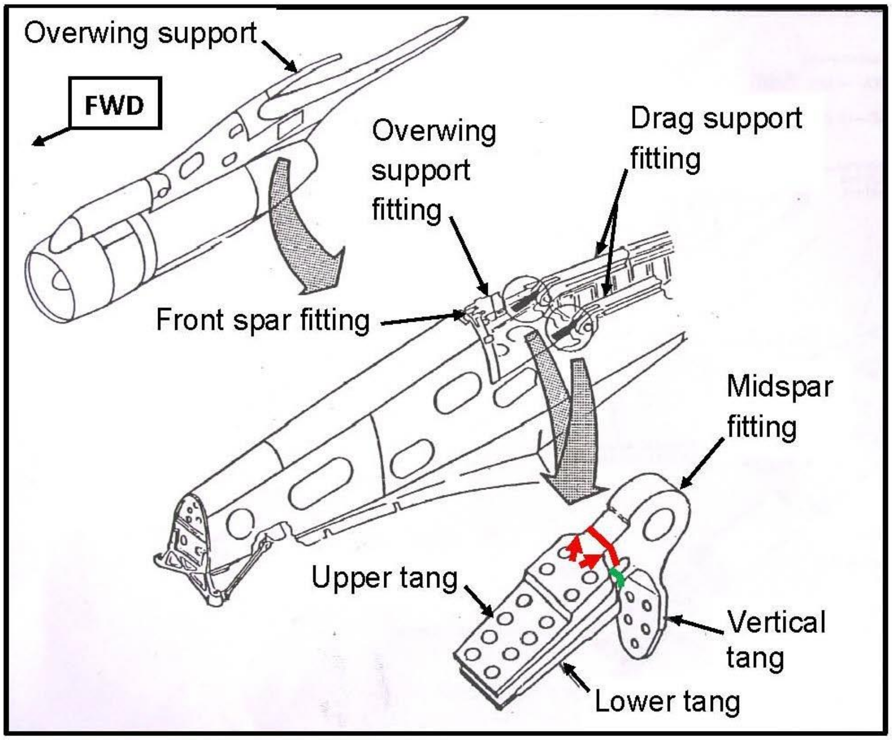

Figure 1. Diagram of a Boeing 707 engine nacelle strut, showing the fracture area on the midspar fitting.

According to Boeing, before the accident involving N707AR, operators had reported cracks on more than 45 midspar fittings. The fitting cracks occurred either vertically at the lug hole or across the double horizontal tangs at the radius where the tangs merge with the lug. At least three accidents have occurred in which the fatigue cracking led to failure of the fittings and engine separations.

In March 1992, the No. 3 engine nacelle strut on a Nigeria-registered Trans-Air Service Boeing 707 separated from the airplane near the top of climb and contacted the No. 4 engine nacelle strut, which also separated from the airplane. The flight crew performed an emergency landing in France, and the five occupants evacuated the airplane, which was substantially damaged by fire. One month later, the No. 3 engine nacelle strut on a Colombia-registered Trans Aeros Mercan Pan Am (TAMPA) Boeing 707 separated from the airplane and contacted the No. 4 engine nacelle during takeoff. The flight crew was able to return to the airport and safely land the airplane, which was subsequently repaired and returned to service.[3] Laboratory analysis of the midspar fittings from the 1992 events indicated that the cracks resulted from stress corrosion and/or fatigue at the lug and tangs. On November 14, 1998, the No. 3 engine separated from an IAT Cargo Boeing 707 after the airplane encountered turbulence at 24,000 feet. The flight crew returned to Ostend Airport, Ostend, Belgium, for an emergency landing during which the airplane overran the runway by 328 feet. The five occupants evacuated the airplane, which was substantially damaged.

[3] More information about this accident, NTSB case number MIA92FA115, can be accessed at http://www.ntsb.gov/aviationquery/index.aspx.

Laboratory analysis revealed a fatigue crack on the inner midspar fitting of the No. 3 engine. The investigation determined that the No. 3 pylon fittings that failed were of an older design, contrary to an applicable directive in effect at the time (see the next section).

Service Bulletins and Airworthiness Directives

To address the midspar cracking issue, a series of Boeing service bulletins (SB) and FAA airworthiness directives (AD) were published between 1975 and 1993, beginning with Boeing SB 707-3183 (dated June 27, 1975). Subsequently revised and updated (revision 1, dated May 13, 1977), SB 707-3183 called for an initial inspection of inboard and outboard midspar fittings on the No. 2 and No. 3 engines, followed by repetitive close visual inspections at varying flight cycles (depending on airplane configuration) and eventual replacement of the fittings with an improved design that incorporated larger radii of 1.0 inch in critical areas. Replacing the fittings was a terminating action for the repetitive inspections. The bulletin also included instructions to enlarge the pylon access cover over the fitting for better access (for both inspection and cleaning). Revision 2 of SB 707-3183 (dated January 28, 1988) incorporated SB 707-3377 (dated November 21, 1979), which gave instructions for the installation of nacelle droop stripes to facilitate visual detection of broken nacelle support structures, such as midspar or overwing fittings, by indicating a misalignment between the nacelle strut skin and the fairing skin. The FAA required the actions recommended in SB 707-3183 and its revisions via ADs 77-09-03, 88-24-10, 92-19-15,[4] and 93-11-02.

Omega records indicated that the company conducted the first visual inspection in 1996, shortly after the conversion. Omega observed that the AD list for the airplane indicated that AD 93-11-02 was completed, but inspections per the Boeing SB were entered into the maintenance program and continued until 2003, when a records review found that, in 1983, a previous owner/operator had marked the compliance status of the AD in effect at the time (77-09-03) with "C" (meaning complete).[5] This status reconfirmed to Omega that the records showed the fittings had been replaced and inspections were no longer necessary, and Omega deleted the inspection requirement from its maintenance plan.[6] Following the accident involving Omega flight 70, an examination of the No. 2 and 3 nacelle struts confirmed that both the inboard and outboard midspar fittings were of the older design and had not been replaced with the improved design in accordance with the AD. The examination also noted that droop stripes had been installed on the accident airplane nacelles, as required by the AD.

Maintenance Program

Omega maintained the airplane to an FAA-approved Boeing maintenance program. In accordance with FAA Advisory Circular 20-76, "Maintenance Inspection Notes for

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[4] AD 92-19-15 was issued in response to NTSB Safety Recommendation A-92-38, which asked the FAA to revise AD 88-24-10 to significantly decrease the times between inspection intervals and require an improved means of inspection to detect small cracks.

[5] According to the status codes in the previous owner/operators records and the requirements in AD 77-09-03, the compliance status for the AD should have been recorded as "REP" for repetitive. Section 91.417 requires that an owner selling an aircraft provide the new owner/operator a list of the current status of applicable ADs, including the dates and methods of compliance, whether a recurring action is involved, and, if so, when the next action is required.

[6] Federal regulations do not require an owner/operator acquiring an aircraft to physically verify the compliance of every AD for which compliance has been recorded.

Boeing B-707/720 Series Aircraft" (dated October 21, 1971), the Omega structural inspection program consolidated "Boeing 707 Maintenance Planning Document D6-7552 Dec 80"; "Corrosion Prevention and Control Program D6-54928 Rev E"; "Aging Airframe Service Action Requirement, Model 707/720 D6-54996 Rev E (Inspection Only)"; and "Supplemental Structural Inspection Program D6-44860 Rev P." Compliance with ADs and manufacturer SBs was written into the program, as applicable. Written records of major repairs did not indicate any work on the pylons performed by Omega.

Airworthiness Certificate

Due to the nature of the tanker conversions performed on the accident airplane, the FAA determined that the original airplane transport-category airworthiness certificate was no longer valid. During the tanker conversion development process, the FAA granted Omega a supplemental type certificate (STC) for the airplane with the initial part of the tanker modification, termed the "A-kit," which comprised certain components permanently installed in the airplane that have no ability to activate the refueling equipment. Once critical refueling components, such as control panels, hoses, drogues, and pumps were installed, the provisions of the airplane's type certificate and STC no longer applied, and the airplane was given a Special Airworthiness Certificate, Experimental – Market Surveys. The certificate operating limitations stated that the airplane's logbook must note "public aircraft" for any government contract flights and that operations for compensation or hire are prohibited unless they are conducted under the public aircraft declaration. Further, the operating limitations authorized air-to-air refueling, detailed the recording requirements for configuration changes, and specified logbook entries for changing to and changing back from research and development operations.

Omega used the provisions of the certificate for flight training, demonstrating compliance for international operations, and maintaining compliance with the provisions of the Navy contract. A designated airworthiness representative (DAR) renewed the certificate every 90 days on each of Omega's contracted airplanes, although, at the time of the accident, FAA regulations required an annual renewal only. Each renewal required the DAR to visit the airplane and assess aircraft serviceability and maintenance status. Omega also supplied the status of inspection items, such as ADs, to the DAR every 90 days for review. Omega was obliged to inform the Navy of any noncompliance that would prevent the issuance of the certificate. A total of 95 hours 56 minutes (34 cycles) of the airplane's recorded time was operated solely under the provisions of the experimental certificate of airworthiness; the remainder of the time was under the provisions of the Navy contract and public aircraft operations. NAVAIR, which managed the Omega contract, noted that it understood that the experimental airworthiness certificate did not hold any regulatory status during the conduct of public aircraft operations but that NAVAIR would use the provisions of the certificate as part of its oversight program (see Public Aircraft Operation in the Organizational and Management Information section of this brief for more information).

METEOROLOGICAL INFORMATION

The KNTD weather observation for 1654 indicated wind from 270º at 22 knots, gusts to 33 knots, visibility at 7 statute miles with scattered clouds at 4,000 feet and 20,000 feet. Recorded temperature was 16ºC, dew point 9ºC, and sea level barometric pressure was 29.76 Hg. The automated observation included a remark indicating peak wind of 280º at 36 knots at 1559.

A special observation taken 3 minutes after the accident indicated wind from 280º at 24 knots, gusts to 34 knots, visibility at 7 statute miles with scattered clouds at 5,000 feet. Temperature was 15ºC, dew point was 9ºC, and sea level barometric pressure was 29.75 Hg.

AIDS TO NAVIGATION

No problems with any navigational aids were reported.

COMMUNICATIONS

No communications problems were noted at any time during the accident sequence.

AERODROME INFORMATION

KNTD is part of Naval Base Ventura County, which also includes Port Hueneme and San Nicholas Island. The base is about 35 miles west-northwest of Los Angeles, California.

Runway 21 is 11,102 feet long and 200 feet wide, with an asphalt surface and a 900-foot paved overrun area. The heading for runway 21 is 210º magnetic and 224º true. Runway 21 departures are restricted from turning after departure until reaching an altitude of 500 feet and 0.5 mile offshore.

FLIGHT RECORDERS

Cockpit Voice Recorder

The airplane was equipped with a Sundstrand model V-557 cockpit voice recorder (CVR), serial number 2942, which can record 30 minutes of analog audio on a continuous loop tape in a four-channel format: one channel for each flight crewmember and one channel for the cockpit area microphone. The CVR did not sustain any heat or structural damage. Removal of the magnetic recording tape from the unit revealed that the tape was broken where it exits the transport reservoir, before it enters the erase/record head area. The tape was removed from the transport mechanism and played back on a commercial-grade, reel-to-reel recorder. The audio information recorded on the tape was extracted from the recorder normally, without difficulty. None of the audio was pertinent to the accident investigation. The audio was consistent with the airplane being stationary on the ground at a location other than the accident flight location; therefore, no transcript was created.

Flight Data Recorder

The flight data recorder (FDR) on board the accident airplane was an LAS 109-C oscillographic foil-type recorder. Typically for this recorder type, the foil medium is spooled on a supply reel, spanned over an open strip where styli inscribe data traces, then wound by a take-up reel. No exposed foil medium was observed when the cartridge was examined in the NTSB Vehicle Recorder Laboratory. Removal of the top cover revealed that one reel was full of foil and the other was empty. The full reel had been secured with clear adhesive tape, which indicated that the recorder was not operating at the time of the accident flight and for an undetermined time beforehand. Thus, no accident data were recorded on the unit.

Applicable Directives

Certain portions of the Federal Aviation Regulations (FARs) do not apply to public aircraft operations. Omega's contract with NAVAIR did not make any mention of voice or data recorders; however, section C14 stated that "the aircraft must be maintained in accordance with a[n] FAA approved Maintenance and Inspection Program" and "Each aircraft utilized under this contract must possess and maintain a[n]…FAA airworthiness certificate." Certified in the experimental category, the accident airplane would be operated in accordance with the certificate and applicable FAA operating regulations, principally 14 CFR Part 91, when not operating under the NAVAIR contract as a public aircraft operation. Omega did not operate the airplane under the provisions of 14 CFR Parts 135 or 121.

In accordance with 14 CFR 91.213,[7] Omega had a letter of authorization for the accident aircraft authorizing use of a master minimum equipment list, which stated that the FDR or CVR may be inoperative provided that the other recorder operates normally and repairs to the inoperative recorder are made within 3 flight days. On the basis of 14 CFR 91.609[8] and the airplane's date of manufacture, Omega did not consider the FDR to be a required item on the airplane. Nonetheless, a recorder operational test consistent with the Boeing Maintenance Manual was included on the preflight/transit checklist and called for a maintenance check of the circuit breakers to ensure that the recorder was powered. The maintenance manual for N707AR also describes a system test that inputs certain parameters and calls for the recorder to be opened and the foil media observed. According to Omega, this test was never performed on N707AR. Maintenance records indicate that an FDR check occurred during the last C-check maintenance in August 2009. The flight engineer checks the CVR during the preflight inspection by activating

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[7] Title 14 CFR 91.213 states, in part, that "…no person may take off an aircraft with inoperative instruments or equipment installed unless … The aircraft has within it a letter of authorization (LOA), issued by the FAA Flight Standards district office having jurisdiction over the area in which the operator is located, authorizing operation of the aircraft under the Minimum Equipment List."

[8] Title 14 CFR 91.609(c)(1) states that "No person may operate a U.S. civil registered, multiengine, turbine-powered airplane or rotorcraft having a passenger seating configuration, excluding any pilot seats of 10 or more that has been manufactured after October 11, 1991, unless it is equipped with one or more approved flight recorders that utilize a digital method of recording and storing data and a method of readily retrieving that data from the storage medium." Section 91.609(e) states that "Unless otherwise authorized by the Administrator, after October 11, 1991, no person may operate a U.S. civil registered multiengine, turbine-powered airplane or rotorcraft having a passenger seating configuration of six passengers or more and for which two pilots are required by type certification or operating rule unless it is equipped with an approved cockpit voice recorder." The accident airplane had 24 seats.

an audio test button to observe the volume meter motion. The check does not test the recording media.

WRECKAGE AND IMPACT INFORMATION

As shown in figure 2, a 4,120-foot debris field began about 7,500 feet from the approach end of runway 21, near taxiway A2. Main landing gear tire marks indicated that the airplane regained contact with the runway about 900 feet into the debris field, departed the runway on a 218º heading near taxiway A1, and continued across the grass infield and taxiway A before coming to rest in a saltwater marsh where it caught fire. The first pieces of wreckage found along the debris path were a fragment of the No. 2 engine pylon torque bulkhead and a piece of the No. 2 pylon overwing fitting, located just past taxiway A2. The No. 1 engine nose cowl was found in the grass infield near taxiway A about 450 feet further into the debris field and left of the runway surface; it exhibited crush damage consistent with contact with the No. 2 engine. The No. 2 engine nose cowl was located near the runway arresting gear on the left side of the runway at the 8,500 foot point. The No. 2 engine was found about 230 feet further, on the left side of the runway surface. Intermittent scrape marks leading to the No. 2 engine were observed on the runway beginning about 7,800 feet, consistent with the engine tumbling after separating from the wing.

Figure 2. Aerial photograph of the debris field.

Fire consumed the top of the cabin and the cockpit (see figure 3). The main wreckage, which came to rest in the wetland marsh, consisted of the cockpit and cabin; the right wing with the No. 3 (right inboard) engine partially attached; the empennage; and the inboard half of the left wing, which sustained thermal damage and was submerged in water. Scattered debris aft of the main wreckage included the nose gear, remnants of the burned outboard left wing, right main landing gear truck, and No. 4 (right outboard) engine.

Figure 3. Aerial photograph of airplane wreckage.

The No. 2 pylon separated from the wing at the overwing fitting, the midspar fittings, and the lower spar fitting. The No. 2 engine remained attached to the pylon. The fracture face on the upper tang of the inboard midspar fitting displayed a flat smooth surface at the transition from the upper and lower tangs to the lug. Located in one corner of the rectangular-shaped fracture face was a dark colored area with a smooth appearance and an arced terminus (thumbnail), consistent with fatigue propagation. The fatigue region was located at the upper inboard corner of the upper tang. A portion of the pylon containing all of the midspar fitting fracture faces and the mating section of the inboard midspar fitting, including the fatigue region, was recovered for detailed examination at the NTSB's Materials Laboratory (see the Tests and Research section of this brief for more information).

The No. 1 pylon separated from the wing at the forward end of the overwing fitting, the midspar fittings, and the lower spar fitting. The No. 1 engine separated from the pylon at the forward and aft mounting points. All of the examined fracture surfaces had features consistent with overstress, with no evidence of fatigue.

The No. 4 (right outboard) engine was found attached to its pylon. The cowlings, except for the inlet cowl, appeared intact. The No. 3 engine was found with the airplane fuselage at the main wreckage site, partially attached to the airplane's right wing.

MEDICAL AND PATHOLOGICAL INFORMATION

The accident flight crew was transported to Ventura County Hospital following the accident. According to a statement provided by the attending physician, no postaccident drug or alcohol screening was conducted on the flight crew. Federal regulations do not require such testing for public aircraft operations.

SURVIVAL ASPECTS

The flight crew observed flames in the cabin area and reported that they did not have time to perform an engine shutdown or evacuation checklist. They exited the cockpit with difficulty due to mud and debris blocking the cockpit door and evacuated through the left forward entrance via the escape slide. Airport rescue and firefighting personnel arrived after the crew had exited and proceeded to suppress the postcrash fire.

TESTS AND RESEARCH

Metallurgy

The Nos. 1 and 2 engine pylon fitting components were brought to the NTSB Materials Laboratory for examination. Metallurgical examination revealed that the No. 1 pylon-to-engine bolts, the No. 1 engine pylon-to-wing fittings, and the No. 2 engine pylon-to-wing fittings all failed in an overload event with the exception of the upper and lower tangs of the inboard midspar fitting on the No 2. pylon, which failed due to fatigue.

The upper tang of the No. 2 pylon inboard midspar fitting failed in the reduced section between the lug where the drag support fitting was normally attached and the chromium-coated radius, with the fatigue initiating at its upper inboard corner and occupying approximately 15 percent of the fracture surface. Corrosion product covered the fatigue fracture surface, consistent with it being exposed to the atmosphere for a significant time. Chemical cleaning of the fatigue fracture surface revealed that mechanical damage had obliterated any fatigue fracture features that may have been generated in the upper inboard corner and the corrosion product had obliterated any fine fatigue features, such as striations, leaving only vestiges of crack arrest marks. The lack of striations prevented a striation count analysis. The cleaning procedure also revealed surface fissures on the fatigue fracture surface that were oriented parallel to arc-shaped crack arrest marks and are consistent with high-stress, low-cycle fatigue propagation.

Chromium electroplated coating had been applied to the upper tang radii, and machining marks in the coating adjacent to the fracture face indicated that a machining operation had been performed after the electroplating. It is probable that the machining operation was intended to remove any excess coating that might have interfered with the fit of the lug in the drag support fitting. The examination noted that machining marks would have intersected with the inner edge of the fracture face at the inboard upper corner and may have been the fatigue initiator, but mechanical damage in the corner prevented a determination.

The lower tang of the No. 2 pylon inboard midspar fitting failed in the inboard chromium-plated radius with the fatigue initiating at multiple locations in the upper portion of the inboard edge and occupying approximately 1 percent of the fracture face.

The plated radii in the No. 2 pylon midspar fittings were measured at a nominal 0.38 inch, identifying them as the older style fittings that should have been replaced in accordance with the effective AD. The new midspar fittings have radii of 1.0 inch.

ORGANIZATIONAL AND MANAGEMENT INFORMATION

The Company

Omega Aerial Refueling Services is headquartered in Alexandria, Virginia, and conducts commercial in-flight refueling services under contract to the US Navy. Omega Air Inc., headquartered in San Antonio, Texas, owns the accident airplane and associated support equipment and has a contractual agreement with Omega to supply the equipment in support of the Navy contract.

At the time of the accident, Omega used two Boeing 707-300s and a McDonnell Douglas DC-10 specially converted for probe and drogue air-to-air refueling, which is the method most used by Navy tactical aircraft.

Navy Contract

From 2001 to 2004, Omega operated tankers for the US Navy as a subcontractor to Flight International/L-3Com, which had an existing Navy contract flying Learjets. In 2004, Omega was created to manage most aspects of the refueling program and to enable future growth in the market. The Department of the Navy was the main customer for Omega via a commercial air services (CAS) contract managed by NAVAIR. According to the contract work performance statement, CAS

> [P]rovides contractor owned and operated aircraft to United States Navy (USN) Fleet customers and other Department of Defense (DoD) agencies for tanking of USN and other US Government agencies, in support of Foreign Military Sales (FMS) cases, Government contractors and other CAS aircraft capable of in air refueling.

The Navy contract was also expanded or amended as necessary to cover Omega refueling activity in support of joint training with Royal Australian Air Force F/A-18 Hornets, UK Royal Air Force GR-4A Tornadoes, and Canadian Air Force CF-18s. The contract specified that "each aircraft utilized under this contract must possess and maintain a Federal Aviation Administration (FAA) airworthiness certificate" and the "aircraft must be maintained in accordance with a FAA approved Maintenance and Inspection Program."

Public Aircraft Operation

Omega and NAVAIR representatives indicated during the NTSB's investigation that the accident airplane was operated as a public aircraft at all times when operating under the provisions of the Navy contract. NAVAIR recognized that the airplane was not on an exclusive use lease and could be operated outside the contract under the FAA experimental certificate and civil FAA regulations. After qualification in 1999 and receipt of the Experimental–Market Surveys airworthiness certificate, Omega finalized the Navy contract. Omega understood that the FAA's position at that time was that aerial refueling flights could not be operated in accordance with FARs and, therefore, had to be flown under the provisions of the public aircraft statute. The Navy also understood that a commercial operation with an experimental certificate could not be conducted within the provisions of the FARs. Subsequent meetings and discussions in the mid-2000s between the FAA, Navy, and others, concluded that the Omega operation could continue unchanged, although various parties expressed concern over the division of oversight and use of the "Market Surveys" certificate type.

On March 23, 2011, the FAA published a proposed rules notice in the *Federal Register* stating its policy that "ALL contracted operations [are presumed] to be civil aircraft operations, unless the contracting government entity provides the operator with a written declaration (from the contracting officer or higher-level official) of public aircraft status for designated, qualified flights." In July and September 2011, in response to FAA requests, NAVAIR provided letters stating that the Omega tankers were operated as public aircraft when operating under the Navy contract.

Safety Oversight

The FAA noted that public aircraft operations are "generally exempt from compliance with the Federal Aviation Regulations" and that "the status of an aircraft as 'public aircraft' or 'civil aircraft' depends on its use in government service and the type of operation that the aircraft is conducting at the time." In response to an NTSB request, the FAA concluded that the N707AR operation was "a public aircraft operation within the meaning of the statute, the positions of the parties, and…FAA guidance material."

NAVAIR confirmed that it assumes safety oversight responsibility for contracted aircraft engaging in public aircraft operations. To exercise an appropriate level of safety oversight, NAVAIR stated it had been "leveraging the processes identified and defined in the DoD Defense Contract Management Agency Instruction 8210.1,"[9] as well as the FAA engineering, inspection, and oversight standards associated with the experimental certificate, which NAVAIR requires by contract. Both NAVAIR and Omega acknowledged that the experimental certificate was not binding in a legal or regulatory manner under public aircraft operations but that they used it as part of the overall oversight program. Further, NAVAIR stated that it performed a gap analysis in safety provisions related to refueling and added additional operational guidelines and requirements as deemed appropriate to ensure the public aspects of the refueling mission were adequately addressed through the contract with Omega.

[9] Defense Contract Management Agency Instruction 8210.1 "establishes requirements for ground and flight operations involving all contracted work performed on aircraft where [the] instruction is incorporated as a contract requirement, as well as procedures to be followed by government flight representatives."

ADDITIONAL INFORMATION

Boeing 707 Accident History

The first flight of the Boeing 707 occurred in 1954. In all, 858 Boeing 707s were produced (-100, -200, -300, and E3 series), and production ended in 1991. There have been 145 fatal hull-loss accidents involving the Boeing 707, and 11 nonfatal hull-loss accidents. Boeing reported five previous occurrences of pylon separation; on two of those occasions, an inboard engine separated and collided with the outboard nacelle, as was the case in this accident.

Safety Changes

Boeing Alert Service Bulletin (ASB) 707-00A3537-00, issued on January 30, 2012, gives instructions to inspect for the correct engine No. 2 and 3 nacelle strut midspar fittings and to perform immediate replacement if the wrong fitting is found. The ASB also calls for application of a droop stripe, inspection of the engine Nos. 1, 2, 3, and 4 nacelle struts for droop, and a high-frequency eddy current inspection for any crack of the visible lug area of the inboard and outboard strut midspar fittings (new design) on the No. 2 and 3 engines. A drooped nacelle strut indicates that a midspar fitting may have fractured. Installation of an incorrect midspar fitting can result in a fatigue crack, which can cause the fitting to fracture. A fractured midspar fitting can result in a separation of the nacelle strut and engine from the airplane in flight. On August 17, 2012, the FAA published AD 2012-16-12, effective September 21, 2012, requiring the provisions of ASB 707-00A3537-00.

ANALYSIS

There were no relevant anomalies during the preflight check and taxi of the accident airplane. On the takeoff roll, shortly after liftoff, the No. 2 engine pylon separated from the left wing. The No. 2 engine nacelle and pylon assembly struck the No. 1 engine nacelle, causing the No. 1 engine inlet cowl to separate, which degraded the engine's ability to produce thrust and resulted in a significant loss of thrust on the left side of the airplane. The captain decided to reject the takeoff and attempt to land on the remaining runway. The loss of thrust from both left engines made it highly unlikely that the airplane would be able to continue with a successful takeoff and, considering the possibility of serious structural damage, the pilot's decision to reject the takeoff was appropriate and properly executed.

The No. 2 engine pylon midspar fitting had a preexisting fatigue crack that had propagated to a critical length before or during the accident flight takeoff. The fatigue crack initiated at the upper inboard corner of the reduced section between the lug where the drag support fitting is normally attached and the chromium-coated radius. Corrosion product covered the fatigue fracture surface, consistent with it being exposed to the atmosphere for a significant time. The reduced section radius was measured and found to be a nominal 0.38 inch. The 0.38-inch radius is consistent with an older fitting design that was subject to a series of Boeing SBs and FAA ADs calling for repetitive visual inspections and eventual replacement with a more fatigue-resistant design incorporating a 1.0-inch radius. Replacing the older fitting design was a terminating action for the repetitive inspections.

Omega records indicated that the company conducted visual inspections in 1996 shortly after the conversion. Omega observed that the AD list for the airplane indicated that AD 93-11-02 was completed, but inspections per the Boeing SB were entered into the maintenance program. Omega continued to conduct the inspections until 2003, when a records review found that, in 1983, a previous owner/operator had marked the compliance status of the effective AD with "C" (meaning complete). This status reconfirmed to Omega that the records showed the fittings had been replaced and inspections were no longer necessary, and Omega deleted the inspection requirement from its maintenance plan. The records review and termination of the repetitive inspections based on the completion entry were in accordance with applicable practice and regulations. If the erroneous entries had not been made, Omega would have either continued its inspections of the midspar fitting or noted the termination requirement in AD 93-11-02 and replaced the older design fittings, thereby avoiding the accident. Although an experimental airworthiness certificate had been issued for the airplane and it mostly operated under the statute governing public aircraft operations, there were no additional or different civil airworthiness or operating requirements that would have led to a specific inspection of the fittings to verify compliance with the AD once the maintenance record reflected the completed status for the AD.

At least three accidents have been associated with failures of the 0.38-inch-radius fitting. Failure due to a fatigue crack in the midspar fittings on the No. 3 engine nacelle strut was noted in the investigation of the November 14, 1998, accident involving an IAT cargo Boeing 707 at Ostend, Belgium. The investigation revealed that the No. 3 pylon fittings that failed were the older design, contrary to the applicable AD (93-11-02) in effect at the time. The April 25, 1992, accident involving a Colombia-registered TAMPA Boeing 707 was attributed partly to "the inadequate inspection requirements of the manufacturer and the FAA to detect cracks in the midspar fitting." The Bureau d'Enquêtes et d'Analyses pour la Sécurité de l'Aviation Civile investigation of a March 1992 engine separation accident involving a Trans-Air Service Boeing 707 also noted that the required "periodic monitoring of the midspar fitting proved to be insufficiently effective" and recommended redesigned fittings.

PROBABLE CAUSE

The NTSB determines that the probable cause of this accident was the failure of a midspar fitting, which was susceptible to fatigue cracking and should have been replaced with a newer, more fatigue-resistant version of the fitting as required by an airworthiness directive. Also causal was an erroneous maintenance entry made by a previous aircraft owner, which incorrectly reflected that the newer fitting had been installed.

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