Aviation Investigation Final Report

Location:	Yuma, Arizona	**Accident Number:**	WPR15FA125
Date & Time:	March 11, 2015, 11:49 Local	**Registration:**	N506XX
Aircraft:	BAE SYSTEMS MK-67 HAWK	**Aircraft Damage:**	Substantial
Defining Event:	Abrupt maneuver	**Injuries:**	1 Fatal, 2 None
Flight Conducted Under:	Public aircraft		

Analysis

The swept-wing advanced trainer/light attack airplane was privately owned and contracted to provide support to the US Air Force (USAF) under public aircraft provisions. It was equipped with wing-mounted external fuel tanks and bomb rack/dispensers loaded with practice ordinance. During takeoff, the airline transport pilot was unable to maintain airplane control following rotation. The airplane did not climb, departed the left side of the runway, and struck a pickup truck, which was involved in construction activities and parked about 150 ft from the runway edge. The occupant of the truck was killed, the pilot and his passenger (who was flying as a "ride along") were not injured, and the airplane sustained substantial damage.

The entire accident sequence was captured by an onboard video camera, which was positioned inside the canopy at the rear of the cockpit. The camera recorded some engine instruments, the primary flight instruments, the back of the pilot's head, and the runway and horizon. Analysis of the recording revealed that the pilot initiated rotation about 8 knots before reaching the correct indicated airspeed and that the airplane lifted off the ground about 10 knots early, about the same time as it reached its target pitch attitude. The video image, which up until this point had been smooth, then began to shudder in a manner consistent with the airplane experiencing the buffet of an aerodynamic stall. The airplane immediately rolled aggressively left, and the main landing gear struck the ground hard. The airplane then pitched up aggressively and began a series of roll-and-pitch oscillations, bouncing from left to right with the outboard bomb dispensers and landing gear alternately striking the ground as the pilot attempted to establish control. The airplane passed beyond the runway edge and reached its target takeoff speed just before striking the truck, but by this time, it had departed controlled flight, was in a steep right bank at almost twice its target pitch attitude, indicating that it had likely aerodynamically stalled.

The pilot reported that he felt the airplane's nose become light as the airplane approached rotation speed, and the video revealed that the nose was oscillating lightly up and down a few seconds before rotation, consistent with his statement. The pilot stated that, before takeoff, he set the pitch trim to 3 degrees nose up, which was consistent with the operator's policy for takeoff with external stores. The policy was in place to relieve stick pressure on rotation; however, the airplane's flight manual specified that 0 degrees pitch trim should be used for takeoff in all configurations. During the postaccident examination, the airplane's pitch trim was found at almost full nose up for reasons that could not be determined. It is likely that the pilot initiated an early rotation instinctively as the airplane's nose became light due to the excessive nose-up pitch trim. The operator stated that the company policy for nose-up trim on takeoff was intended to give the airplane control stick pressures on rotation comparable to other U.S. fighter aircraft, such as the FA-18 and F-16. Although the operator had used this technique without incident on many prior missions, it was in direct contrast with the manufacturer's takeoff recommendations and likely increased the risk of early rotation.

Postaccident examination of the airframe and flight control systems did not reveal any anomalies that would have precluded normal operation. The primary engine components were undamaged, and the video revealed that the engine appeared to operate uninterrupted and at high power levels throughout the accident sequence.

The external fuel tanks were partially filled with fuel, which was allowed per the airplane's flight manual, (assuming the airplane was flown at the correct airspeeds). The bomb dispensers were not on the airplane manufacturer's list of approved weapons; therefore, the operator had commissioned an Federal Aviation Administration (FAA)-designated engineering representative to prepare a structural comparison report to assess the viability of installing the alternate dispensers. Although the report concluded that the use of the alternate dispensers was structurally satisfactory, it did not take into account the aerodynamic effects of using the alternate dispensers. It is possible that the airplane's stall margin was eroded further by the use of the alternate dispensers, along with a shift in the center of gravity due to the partially filled fuel tanks.

The majority of the airport was operated and governed by the Department of Defense (DoD), specifically the US Marine Corps (USMC). It was operated as a "shared use" airport concurrently supporting both military and civilian operations, although the accident runway was used almost exclusively for military flights. A USMC construction crew was preparing the area immediately adjacent to the runway for the installation of an arresting gear system. The operation was composed of about 20 people, along with support vehicles and construction equipment, and the group occupied the space from the runway edge outward about 150 ft. The truck that was struck was located on the outer edge of the space, farthest from the runway, and was occupied by a Marine Lance Corporal who was providing operational escort and safety support for the construction crew. USMC airport-specific station orders did not prohibit construction activities in this area, and no notice to airmen relating to construction was issued at the time of the accident nor was one required. If the airport had been under operating under Part 139 regulations and full FAA oversight, no such construction activities would have been permitted while the runway was active, and the ground fatality would have been avoided.

About 21 months before the accident, the DoD issued a directive that all aircraft owned, leased, operated, used, designed, or modified by DoD must have undergone an airworthiness assessment in accordance with the applicable military department policy and that management authorities within the military departments should be established to provide ongoing oversight. The directive allowed the use of DoD or FAA airworthiness certification standards. Under the auspices of this directive, the operator had undergone a series of oversight inspections from the Naval Air Systems Command and interim flight clearance was granted to perform missions for the USMC. Although the accident flight departed from a USMC base, it was operating in support of the USAF, and the USAF chose to place the responsibility of certification and ongoing oversight with the FAA. However, because the airplane's missions were flown under the umbrella of "public aircraft," the FAA was not providing, nor was it required to provide, any oversight beyond issuance of the airplane's initial airworthiness certificate. As such, the operator was effectively operating without oversight at the time of the accident. This lack of oversight likely enabled the continued operating philosophy, which resulted in the difference in takeoff procedure between the operator and the manufacturer and the use of inadequately evaluated weapons system components.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be:

The pilot's initiation of an early rotation during takeoff, which led to an aerodynamic stall and loss of airplane control. Contributing to the accident were the pilot's use of nose-up pitch trim and the operator's policy to use nose-up pitch trim during takeoff and the lack of oversight of the operator by the US Air Force. Contributing to the severity of the accident were US Marine Corps airport policies that allowed construction activities immediately adjacent to an active runway, which resulted in the airplane's collision with a truck.

Findings

Personnel issues	Incorrect action selection - Pilot
Aircraft	(general) - Not attained/maintained
Personnel issues	Aircraft control - Pilot
Organizational issues	Adequacy of policy/proc - Other government
Organizational issues	Adequacy of policy/proc - Operator
Organizational issues	Oversight of operation - Other government
Personnel issues	Use of equip/system - Pilot
Environmental issues	Ground vehicle - Contributed to outcome

Factual Information

History of Flight

Takeoff	Abrupt maneuver (Defining event)
Takeoff	Aerodynamic stall/spin
Takeoff	Loss of control in flight
Takeoff	Runway excursion
Takeoff	Collision during takeoff/land

On March 11, 2015, at 1149 mountain standard time, a BAe Systems Hawk MK-67, N506XX, call sign BADGER1, collided with a truck during takeoff from the Yuma Marine Corps Air Station (MCAS)/Yuma International Airport (KNYL), Yuma, Arizona. The airplane was owned by Air USA, Inc., and operated as a public aircraft flight in support of the United States Air Force (USAF). The airline transport pilot and pilot-rated passenger were not injured. The driver of the truck sustained fatal injuries. The airplane sustained substantial damage during the accident sequence. The local area flight departed Yuma at 1148. Visual meteorological conditions prevailed, and a Military visual flight rules flight plan had been filed.

The airplane was being utilized along with a second similarly equipped Hawk (callsign BADGER2) by Air USA in support of the USAF as part of the Special Operation Terminal Attack Controller Course (SOTACC). They were performing a 15-second staggered takeoff, and their mission was to provide close air support (CAS) for the training of Joint Terminal Attack Controllers (JTAC's). The airplane was equipped with external fuel tanks on the inboard pylon of each wing, and bomb rack/dispensers loaded with practice ordinance attached to the outboard wing pylons.

At the time of the accident, a construction crew from the United States Marine Corps (USMC) was preparing a concrete pad at the left edge of runway 03L in preparation for the installation of an expeditionary arresting gear system. The pad was located 10 feet from the runway edge, about 6,500 feet from the runway 03L landing threshold. The construction operation, which included support vehicles, crew, and construction equipment, occupied the space from the runway pad outwards about 150 feet. The truck that was struck was located 140 feet beyond the runway edge, and was occupied by a Marine Lance Corporal who was providing operational escort and safety support for the construction crew.

The pilot reported that the preflight, engine start, taxi, and line-up on runway 03L were uneventful. The airplane was positioned on the right side of the runway, with BADGER2 positioned as the wingman to the left and aft. The pilot stated that once cleared for takeoff, he applied engine thrust and the engine spool-up, takeoff roll, and acceleration check speeds were as expected. He stated that he felt the airplane's nose wheel become light about the time they reached rotation speed. The nose of the airplane then lifted, and a short time later the main wheels became airborne. The left wing then dropped, and the nose yawed about 10 degrees to the left. He attempted to maintain a low angle of attack, applying slight rudder and aileron corrections. He considered aborting the takeoff, but due to the airplane's angle relative to the runway he was concerned the airplane might tumble if they entered the undulating adjacent terrain. He continued to apply corrective control inputs, but the airplane did not respond in a positive manner as he expected, and the left drift progressed. The airplane continued to bank left and then right, with the main landing gear and bomb dispensers striking the adjoining shoulder multiple times. The airplane was now flying directly over the gravel shoulder, about 100 feet left of the runway edge, when the construction crew came into view. The right wing struck the truck, and the airplane yawed to the right, coming to rest on the shoulder, about 650 feet beyond the point of impact. The truck came to rest about 160 feet beyond the point of impact.

Pilot Information

Certificate:	Airline transport; Military	**Age:**	36,Male
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Front
Other Aircraft Rating(s):	None	**Restraint Used:**	5-point
Instrument Rating(s):	Airplane	**Second Pilot Present:**	Yes
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Class 1 Without waivers/limitations	**Last FAA Medical Exam:**	August 7, 2014
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	January 19, 2015
Flight Time:	2116 hours (Total, all aircraft), 67 hours (Total, this make and model)		

The pilot held an airline transport pilot certificate with ratings for airplane single-engine and multiengine land along with type ratings, authorized experimental aircraft: AV-L39, Hawk. He held a first-class medical certificate issued on August 7, 2014; it had no limitations or waivers.

At the time of the accident, the pilot was a current and active A-10 pilot for the Air National Guard. The A-10 is a twin-engine, straight-wing, close air support airplane utilized by the USAF.

His aviation career began in 2000, initially as crew chief for the A-10; in 2008 he was commissioned to fly the A-10, having received training in both the T-37 and T-38. In March 2014 he began working as a contractor for Air USA, flying the L39.

The pilot reported a total flight experience of 2,116 hours, the majority of which (about 1,500 hours) took place in Tactical Jet aircraft, and primarily in the A-10. His total flight experience in the 12 months prior to the accident was 328 hours, and his total experience in the Hawk was 67 hours, with 55 as pilot-in-command. His last Federal Aviation Administration (FAA) checkride took place on January 19, 2015, and was for his airline transport pilot certificate.

The pilot's experience with the Hawk was gained exclusively while at Air USA, where he began his Hawk training in August 2014. The training was composed of flight manual study, followed by 2 days of ground school, cockpit familiarization, and ejection seat training. He then flew three graded instructional flights including five cross-country flights to establish basic and advanced aircraft handling along with instrument procedures, after which he was cleared to take the checkride for type rating with an FAA designated pilot examiner (DPE). Having gained his type rating, he went on to receive further instruction gaining initial qualification, mission qualification, air-to-ground qualification, and flight lead upgrade training, and after about 12 hours of total flight time, he was approved by Air USA to fly solo missions. Documentation provided by Air USA revealed that he scored 100 percent on all written examinations, and during air-to-ground training received the following comments, "Had some A-10 pilot tendencies during tight turns," "Has adjusted to the increased speed of the Hawk very well."

Air USA was the only private operator of the Hawk in the United States, and as such, the FAA DPE who performed the pilot type rating checkride did not have direct experience flying the Hawk. (The United States Navy operates the T-45 Goshawk, which is a Hawk variant).

The pilot-rated passenger was not an employee or contractor for Air USA. He had flown on the two previous missions with the pilot in the accident airplane, and was flying as a potential future pilot for Air USA in a "ride along" capacity.

Aircraft and Owner/Operator Information

Aircraft Make:	BAE SYSTEMS	**Registration:**	N506XX
Model/Series:	MK-67 HAWK	**Aircraft Category:**	Airplane
Year of Manufacture:	1992	**Amateur Built:**	
Airworthiness Certificate:	Experimental (Special)	**Serial Number:**	67-506
Landing Gear Type:	Retractable - Tricycle	**Seats:**	2
Date/Type of Last Inspection:	March 10, 2015 Continuous airworthiness	**Certified Max Gross Wt.:**	20056 lbs
Time Since Last Inspection:	5 Hrs	**Engines:**	1 Turbo jet
Airframe Total Time:	5625.3 Hrs as of last inspection	**Engine Manufacturer:**	Rolls Royce
ELT:	Not installed	**Engine Model/Series:**	Adour MK.861
Registered Owner:	AIR USA INC	**Rated Power:**	5700 Lbs thrust
Operator:	AIR USA INC	**Operating Certificate(s) Held:**	None

The Hawk MK-67 was a swept-wing, two-seat, advanced trainer/light attack airplane, powered by a single Rolls-Royce Adour turbofan engine. The accident airplane was manufactured in 1992 by BAe Systems in the UK as part of a group of 20 Hawks configured specifically for export to the Republic of Korea Air Force (ROKAF). The airplane was then utilized by the ROKAF for training until it was sold to Air USA, along with 11 other Hawk MK-67's in September 2013. The sale included documentation for the fleet, along with a series of spare parts. The airplane was subsequently exported to, and registered in, the United States, where it was issued a special airworthiness certificate by the FAA in the experimental/exhibition category in March 2014.

The later variants of the Hawk remain in production, with over 900 built since 1974.

Maintenance

Maintenance was performed in-house by Air USA mechanics on a continuous airworthiness basis, utilizing an OEM (original equipment manufacturer) inspection program. At the time of the accident, the airplane had accrued a total flight time of 5,625.3 hours. The engine total time was 3,782.7 hours, with the last overhaul occurring 155.7 flight hours prior.

Fuel System

The airplane's fuel system was comprised of an internal fuselage bag tank connected to integral wing tanks, with a total system capacity of 3,006 pounds. Two wing-mounted external "drop" tanks, mounted to the inboard wing pylons, increased fuel capacity by an additional 1,078 pounds per side. Fuel flowed from each external tank to the fuselage tank, and during transfer the integral tank system was automatically kept above 2,400 pounds until the external tanks were empty.

The external tanks structural integrity was maintained through a series of internal ribs and stringers; the tanks did not contain baffles, and the fuel was free to move within the tanks during flight. The external tank fuel quantities were the subject of handling and maneuvering limitations in-flight, but no limitation existed regarding the fuel quantity held in the tanks during takeoff. The airplane's flight manual, "External Wing Fuel Tank - Limits" section noted the following, "10 seconds of straight-and-level flight is recommended before jettison to permit the fuel contents to stabilize."

The accident pilot reported that the Hawk was the only airplane he had flown that does not place limitations on partially filled external tanks during takeoff, and that in his experience, takeoff with partially filled tanks is not recommended due to the increased sensitivity of pitch control, decrease in lateral directional control at low speeds, and the potential for tank damage. A BAe test pilot was interviewed during the investigation. He stated that although there are no external tank quantity limitations for takeoff, his personal practice is to always takeoff with the external tanks either full or empty, so that should they need to be jettisoned during departure, they will fall from the airframe in a predictable manner. The Air USA Chief Pilot reported that 75 percent of all Air USA missions were conducted with the external tanks partially filled at takeoff, and that they had no previous issues.

The airplane had been experiencing intermittent external tank fuel transfer problems in early February 2015, when it was performing live fire exercise for the USMC in North Carolina. The external tanks were not consistently transferring fuel automatically to the internal tanks, and the airplane was flown to Air USA's primary maintenance facility in Quincy, Illinois, on February 13 for further diagnosis. Maintenance personnel replaced the internal tank high level float switch and refuel valve, and the airplane was placed back into service on February 20. During the repositioning flight from Quincy to MCAS Yuma, the external tanks again failed to transfer, so the pilot diverted to Salinas, Kansas. During the descent, the tanks started to transfer, and upon landing the transfer to the internal tank was complete. The pilot refueled the external tanks with 500 pounds of fuel per side, and flew to MCAS Yuma uneventfully.

The airplane was not flown again until the day prior to the accident. On that morning (March 10), mechanics performed a pre-flight inspection, and serviced the airplane with fuel. The airplane flew two uneventful missions that day with fuel transferring normally from the partially filled external tanks. The third flight was a night mission, and was flown by the accident pilot. The airplane departed with full fuel; however, the external tanks again would not transfer, so he ended the mission early, returning with about 1,000 pounds of fuel in the internal tanks, and about 1,000 pounds in each external tank.

On the morning of the accident, the Chief of Maintenance performed a ground run with the airplane in order to duplicate the transfer problem. The system operated normally, and after additional troubleshooting steps he concluded that the problem was still most likely an intermittent high level float switch in the internal tank. He instructed the ground crew to disconnect and secure the external tank transfer valves (commanding the valves to the normally open position, thereby allowing fuel to transfer directly to the internal tank). He briefed the pilot of the findings, advising him that the tanks may still not transfer, and he fueled the internal tanks to 3,000 pounds, and left the external tanks with about 600 pounds in each.

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	KNYL,213 ft msl	**Distance from Accident Site:**	0 Nautical Miles
Observation Time:	18:57 Local	**Direction from Accident Site:**	270°
Lowest Cloud Condition:	Scattered / 12000 ft AGL	**Visibility**	10 miles
Lowest Ceiling:	Broken / 18000 ft AGL	**Visibility (RVR):**	
Wind Speed/Gusts:	3 knots /	**Turbulence Type Forecast/Actual:**	/
Wind Direction:		**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	30.05 inches Hg	**Temperature/Dew Point:**	27°C / 1°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Yuma, AZ (NYL)	**Type of Flight Plan Filed:**	Military VFR
Destination:	Yuma, AZ (NYL)	**Type of Clearance:**	VFR
Departure Time:	11:48 Local	**Type of Airspace:**	Class C

An automated surface weather observation for MCAS Yuma was issued 8 minutes after the accident. It indicated variable wind at 3 knots, 10 miles or greater visibility, with scattered clouds at 12,000 ft, broken clouds at 18,000 ft and 25,000 ft, temperature 27 degrees C, dew point 01 degrees C, and an altimeter setting at 30.06 inches of mercury.

Airport Information

Airport:	YUMA MCAS/YUMA INTL NYL	**Runway Surface Type:**	Concrete
Airport Elevation:	213 ft msl	**Runway Surface Condition:**	Dry
Runway Used:	03L	**IFR Approach:**	None
Runway Length/Width:	13300 ft / 200 ft	**VFR Approach/Landing:**	None

The majority of MCAS Yuma, including all runways, is owned, operated, and governed by the

Department of Defense (DoD), and operated as a "shared use" airport with Yuma County Airport Authority (YCAA)/Yuma International Airport, who maintain an FAA Part 139 Certificate.

The Department of the Interior granted an easement for public airport purposes in 1956 to the facilities YCAA, thereby granting the right to use the airport for the landing, takeoff, and parking of civilian aircraft in common with aircraft owned and controlled by the government. The YCAA and MCAS Yuma are entirely separate organizations, and there is no owner/tenant relationship. As such, the airport is considered a "shared use" facility rather than "joint use."

The airport is primarily operated in accordance with the MCAS Yuma Station Order P3710.4L W/CH 5, Airfield Operations Manual. Conversely, YCAA operates in accordance with an FAA Approved Airport Certification Manual (ACM). The two entities coordinate operations via a series of letters of agreement (LOA), and although there is no requirement for MCAS to meet FAA part 139 requirements, according to the agreements, they do to "the extent possible."

The airport is composed of four runways, with the majority of civilian aircraft operations occurring on runways 8/26 and 17/35. The two longer "tactical" runways 3L/21R and 3R/21L are equipped with arresting systems, and used primarily for military operations.

The FAA Advisory Circular 150/5370-2f defines a runway safety area (RSA) as a surface surrounding the runway prepared or suitable for reducing the risk of damage to airplanes in the event of an aircraft undershoot, overshoot, or excursion. Construction is generally not permitted within an RSA while the runway is open, although the temporary use of declared distances and/or partial runway closures may provide the necessary RSA under certain circumstances.

The DoD Unified Facilities Criteria (UFC) 3-260-01, "Airfield and Heliport Planning and Design" utilize a different set of criteria for runway and taxiway design, and no specific RSA environment exists. Instead the term "primary surface" is utilized to define the areas both including and immediately adjacent to runways. Examination of Station Order P3710.4L W/CH 5 and UFC 3-260-01 did not reveal any prohibitions to performing work on the primary surface while the runway was in operation, nor was there any requirement that a notice to airman (NOTAM) be issued advising of such operations, and no NOTAM was issued at the time of the accident.

Construction Crew

The construction crew consisted of about 20 workers, accompanied by 5 vehicles. The vehicles included two "7-ton" dump trucks, a "7-ton" large flatbed cargo truck, a back hoe loader, an M1152 "high back" high mobility multipurpose wheeled vehicle. Also present were a generator, hydroseeder, and an engineering equipment trailer.

Wreckage and Impact Information

Crew Injuries:	1 None	**Aircraft Damage:**	Substantial
Passenger Injuries:	1 None	**Aircraft Fire:**	On-ground
Ground Injuries:	1 Fatal	**Aircraft Explosion:**	None
Total Injuries:	1 Fatal, 2 None	**Latitude, Longitude:**	32.649723,-114.615554

Medical and Pathological Information

The pilot, along with the mechanic who worked on the airplane that day, voluntarily submitted for both breath alcohol and urine drug toxicological testing at 1615 on the day of the accident. The results were negative for all screened drug substances and alcohol.

Survival Aspects

The pressurized cabin structure was not compromised, and the crew was able to open the canopy unhindered after the airplane came to rest. The airplane was equipped with ejection seats; however the pilot elected not to utilize them out of concern that the airplanes bank angle while still close to the ground would put them into an unsafe ejection profile.

Tests and Research

The pilot-rated passenger, positioned in the rear seat, had mounted a GoPro Hero HD1 digital video camera to the right inner side of the canopy, adjacent to his head. The camera captured the entire accident sequence.

Airframe and Engine Examination

Examinations of the airframe and engine were performed in the presence of the NTSB IIC, and technical representatives from the NTSB, BAe Systems, and Air USA.

Horizontal Stabilizer

The moving tailplane (horizontal stabilizer) structure remained attached to the tailcone. Tailplane control continuity was established from the power control unit (PCU) through to both the front and rear cockpit control columns. All idler levers and push-pull tubes were examined aft of the cockpit bulkhead, and all remained attached to their respective fittings and did not exhibit any indications of binding.

Vertical Stabilizer

The vertical stabilizer sustained thermal damage to its skin on both sides, with its primary structure remaining largely intact and attached to the tailcone. The rudder sustained more extensive fire damage, revealing its charred inner honeycomb core, but remained attached to the vertical stabilizer by all but the lower hinge bolts which had sheered. Rudder control continuity was established to both the front and rear cockpit pedals, and movement of the pedals resulted in free and full movement of the rudder to its stops. All idler levers and push-pull tubes were examined aft of the cockpit bulkhead, all remained attached to their respective fittings and moved freely with no indication of binding.

Wings

The left and right wings remained connected to each as a single unit at the center strap, with the assembly separating at the fuselage mount points. The entire structure sustained varying degrees of thermal damage, consuming the right wing inboard trailing edge and forward upper skins. The right wing leading edge sustained a semi-circular 18-inch-wide indentation 5 ft inboard from the tip consistent with contact with the truck. Both of the external wing fuel tanks, weapons stores, and associated pylons had detached.

Ailerons

Within the fuselage, aileron control continuity was established from the front and rear cockpit control columns through to the intermediary push-pull tube just aft of the rear cockpit bulkhead, in the area were the wings had separated from the airframe. Movement of the control columns resulted in free movement of the push-pull tube.

Within the wings, the aileron push-pull tubes, idler levers, and bellcranks sustained varying degrees of bending and separation damage through to the aileron PCU's (power control units). All idlers moved freely within their fittings, and no binding was observed. Each separation was examined and exhibited either bending and separation of the tubes, or granular surface features with 45-degree shear lips, which the group determined was consistent with impact damage.

The aft eyebolt of the aft push-pull tube had failed halfway around its perimeter, separating it from the aileron center wing bellcrank. The rod was sent to the NTSB materials laboratory for further assessment. Inspection utilizing a scanning electron microscope revealed dimple ruptures to the eyebolt fracture surfaces, indicative of overstress failure, along with post-failure smearing damage. The materials engineer who examined the eyebolt concluded that the fracture features were consistent with an overstress failure.

The right aileron had been partially consumed by fire, and remained attached at the inboard hinge. The left aileron remained attached to the wing and the PCU output rod.

Airbrake

The airplane was equipped with a hydraulically actuated airbrake located in the belly of the tailcone. The airbrake was in the retracted position, and no scrape marks score damage was observed to its trailing edge, suggesting that it remained retracted during the accident.

Flaps

The airplane was equipped with double slotted trailing edge flaps on each wing, which were driven by a single hydraulically operated actuator powered by the number 1 hydraulic system. The flaps were controlled by a 4-position lever in the front cockpit and a spring-loaded 3-position switch in the rear cockpit. The 4-position lever settings were UP-1/2-3/4-DOWN, and the 3-position switch were UP-PUPIL-DOWN. A flap position indicator was installed in each cockpit.

The pilot reported that he set the flaps to the 3/4 position for takeoff, as required by the airplane's flight manual. Examination of the front cockpit flap lever following the accident revealed that it was in the 3/4 position, with the rear cockpit switch in the PUPIL position. The flaps appeared to be in the deployed position following the accident, however, due to impact and fire damage, a definitive flap angle could not be determined.

The onboard video recorded a reflection through the aft right rear view mirror of the inboard section of the right wing trailing edge. The flap could not be viewed in the reflection, so a comparative video study was performed in an effort to determine the actual flap position at takeoff. Based on the study, it was determined that once the flap moved to the 1/2 flap position and beyond, it could no longer be viewed in the mirror.

The flaps were hydraulically driven, and electrically controlled, with their positions determined by an electro-mechanical "drumswitch" located in the trailing edge of the left wing. The switch was the subject of a Special Technical Instruction (STI) issued by the UK Royal Air Force, (RAF) in 2005 requiring replacement. The STI documented the discovery of contaminants within a switch, which had the potential to cause an uncommanded flap movement. Additionally, in 2008, uncommanded flap movement was observed on an RAF Hawk during a formation takeoff. Disassembly of the switch in the RAF Hawk revealed that all of the internal termination screws were loose, and one screw had come completely free from its termination, and was free within the housing.

The accident switch was removed from the airplane and examined by the IIC. No evidence of internal contamination or arcing was observed, and all terminations screws were tight.

Hydraulic System Actuators

The airplane was equipped with a dual independent hydraulic system driven by the engine. Both systems operated the powered flight controls through separate circuits, with hydraulic system number one also powering the landing gear, airbrake, wheel brakes, and nosewheel steering. Loss of pressure to one of the hydraulic systems will not affect the operation of the primary flight controls.

The flap actuator, tailplane PCU, and both aileron PCU's were removed from the airframe and examined in the UK at the facilities of their original manufacture, under the supervision of the NTSB investigator-in-charge (IIC), an investigator from the UK Air Accidents Investigation Branch, and parties to the investigation. Complete examination reports are contained within the public docket.

The flap actuator and tailplane PCU did not appear to have sustained damage during the accident, and disassembly revealed that their screens were clear and all units contained clear cherry-red colored fluid, which was free of debris or contamination. Examination did not reveal any anomalies which would have precluded normal operation, and the flap actuator ramrod extension length at the time of the accident could not be definitely ascertained.

Both the left and right aileron PCU sustained varying degrees of impact damage. The rod end on the right PCU remained connected to the feedback bar but had separated from the end of the ramrod. The servo input lever remained attached, but exhibited bending damage such that its input arms were offset from each other. For the left PCU, the rod end remained attached to the ramrod, which was bent about 5-degrees midspan. The servo input lever remained attached, and exhibited similar bending damage to the right PCU. The feedback bar remained attached at the rod end, but was detached at the servo end. The detached portion exhibited scratch marks and stretched separation features consistent with impact damage. The underside of the servo exhibited similar scratch damage. Both units were disassembled; all screens were clear, and cherry-red colored fluid was present throughout. Examination did not reveal any anomalies which would have precluded normal operation.

Hydraulic System Filters

The bypass valve button for the hydraulic system one return filter was found in the extended "bypass" position. The filter was removed and cloudy brown/red colored fluid and water droplets were present in the filter bowl. The filter contained about ten 0.5mm to 0.25mm wide metallic shavings varying in length from 10mm to 20mm. The shavings and filter were sent to the NTSB Materials Laboratory for further examination. Utilizing energy dispersive spectroscopy analysis, the material was determined to most likely be 4320, 4340, or 4720 alloy steel. The shavings were then examined under a scanning electron microscope, and exhibited machining marks on one side similar to debris caused by a milling or lathe turning process. The filter medium area was in excess of 50 square inches, and as such, the debris would not have been sufficient to create a noticeable obstruction to fluid flow.

The hydraulic system one supply side filter was free of debris, and the bowl contained cloudy brown/red fluid and water droplets. The filter bypass valve was in the depressed, "filter" position. The system two supply side filter was free of debris, and the bowl contained clear cherry-red colored fluid. The filter bypass valve was in the extended, "bypass" position.

The hydraulic system two case drain side filter was free of debris, and the bowl contained clear cherry-red fluid and water droplets. The filter bypass valve was in the depressed, "filter" position.

The supply and return lines for both hydraulic systems were compromised during the accident sequence as the wings separated from the airframe. The open lines resulted in a film of hydraulic fluid coating the wing cavity area under the cabin as both system reservoirs rapidly depleted. The hydraulic pumps were designed to vary output flow dependent on system demand, and as the lines were breached, maximum output would be demanded at a rate directly proportional to engine speed. Examination of the on-board video revealed that aircraft rescue and firefighting (ARFF) truck began applying fire retardant to the airframe while the engine was still spooling down and the, "Attention Getter" light illuminated after the airplane struck the truck. Therefore, the discoloration and water contamination observed in the filter bowls were a result of foreign matter and water ingestion during the accident sequence and subsequent firefighting effort. Similarly, with no significant obstructions in any hydraulic system filters, the two tripped bypass valves appeared to have activated as a result of the impact.

Airspeed Indicating System

The airspeed indicating system was functionally tested utilizing a calibrated Pitot static test set. The Pitot tube was intact and appeared undamaged, and the static and drain ports were clear.

With the test set configured at a pressure altitude of 1,000 ft, and airspeed of 130 knots, the forward cabin airspeed indicator indicated 127 knots, with the rear 126 knots.

Engine

The engine did not appear to sustain any discernable damage. The fuel filter was removed and was free of debris, and the filter bowl contained fluid consistent in color and odor with Jet-A fuel. The inner surfaces of the engine exhaust were coated in light brown/grey soot, and both the low pressure compressor blades on the inlet side and low pressure turbine outlet blades were intact, with no indication of blade liberation, or foreign object ingestion. The three lower magnetic chip plugs were removed, and no debris beyond light "fuzz" was noted. The engine throttle control telescopic cable was continuous from the cockpit controls through to the engines throttle input arm.

Bomb Dispenser

The airplane was approved by BAe to carry two wing-mounted CBLS-200 (Carrier Bomb Light Stores) practice bomb dispensers on the outboard pylons. These dispensers were 97 inches long, 16.66 inches in diameter, weighed 117 pounds, and were capable of carrying four 25-pound practice bombs.

At the time of the accident, two SUU-20 Bomb Dispenser/Rocket Launchers were installed on the outboard pylons rather than the CBLS-200's. The SUU-20 was capable of carrying six 25-pound practice bombs and four 2.75-inch rockets. It was 122 inches long, 36 inches wide, 10 inches high, weighed 276 pounds, and utilized the same pylon mounting lugs as the CBLS-200. At the time of the accident, each dispenser was loaded with its full complement of six practice bombs. According to Air USA, the SUU-20 units were on loan from the USAF.

The SUU-20 had not been evaluated by BAe and was not listed as an approved device in the Hawk Weapons Manual, and as such in April 2014, Air USA commissioned an FAA Designated Engineering Representative (DER) to prepare a structural comparison report to assess the viability of installing the

SUU-20, along with a series of other non-BAe evaluated munitions and stores. The report utilized the comparative dimensions of the CBLS-200, MK-83 free fall bomb, and the fuel tank. The MK-83 was nearly identical in length to the SUU-20, and weighed 987 pounds. Any intended use of the fuel tank as a basis for comparison was erroneous, as the tank was not capable of being fitted to the outboard pylon.

The report was structural only in nature, and did not take into account the aerodynamic effects of utilizing the alternate munitions and stores. The report concluded that the use of the alternate stores was, "structurally satisfactory."

Representatives from Air USA reported that at the time of the accident they had conducted operational tests with the SUU-20, and had flown over 80 sorties utilizing it to deliver about 900 practice bombs uneventfully.

Organizational and Management Information

Previous Accident

On October 18, 2014, an Air USA Hawk, N509XX, was involved in an accident after it departed the runway during the ground roll, just prior to takeoff (NTSB accident number CEN15TA019). The pilot reported that having reached about 90 knots, the airplane turned hard left, and he was unable to regain directional control. Subsequent examination did not reveal any mechanical anomalies to account for the turn, and the NTSB issued the probable cause, "Loss of directional control during the takeoff roll for reasons that could not be determined during postaccident examinations and testing."

DoD Airworthiness Policy

Air USA was established in 1994, and during the period from 1999 through 2010, operated exclusively as a DoD military contractor, specifically for the Navy, in "threat presentation" missions. In the summer of 2010 Air USA took part in a "fly-off" competition supporting live close air support training for the USMC JTAC's. Following the competition, they were awarded a contract with the USMC, and for the first time the USAF Special Operations Command (AFSOC). The close air support missions involved delivery of practice munitions during day and night operations, as part of JTAC training support.

Air USA's fleet consisted primarily of Alpha Jets, with according to Air USA, oversight provided by the FAA until May 2013, when the DoD issued Directive 5030.61 (subsequently updated in June 2015) to the U.S. military service branches. The directive established policy and assigned responsibilities for DoD airworthiness, specifically:

"All aircraft and air systems owned, leased, operated, used, designed, or modified by DoD must have completed an airworthiness assessment in accordance with Military Department policy. The airworthiness assessment provides DoD personnel (to include Service members and DoD civilians) and DoD contractors the appropriate level of safety of flight and risk management adapted to DoD-unique mission requirements.

DoD airworthiness authorities, within their respective airworthiness guidance, will provide commanders the ability to conduct missions while employing prudent risk mitigation measures in cases where a timely airworthiness assessment is not feasible."

The directive required the military departments to designate within their organizations both technical and airworthiness management authorities for initial airworthiness approval, along with continued airworthiness. The directive allowed the military departments the option of adopting DoD or FAA airworthiness certification standards. With regard to FAA standards, the directive current at the time of the accident specifically stated:

"Utilization of FAA airworthiness certification by a DoD airworthiness authority as a basis of certification is permissible provided the flight profile, operating environment, and continued airworthiness program as certified for that aircraft and the air system is similar to the intended usage of DoD. The DoD airworthiness authority will assess and certify the airworthiness of any existing gaps between the intended usage of the FAA certification and the intended usage of DoD. Where required, interface with the FAA for aircraft and air systems certification issues will be coordinated through the FAA Military Certification Office. Interface with the FAA regarding DoD operations will be coordinated as described in DoDI 4540.01 and DoD Directive 5030.19."

Following the directive, the U.S. Naval Air Systems Command (NAVAIR) chose to adopt DoD airworthiness certification standards. As such, contractors were required to demonstrate a series of more stringent standards including the utilization of a NAVAIR approved aircraft inspection program (FAA approved inspection programs and clearances were unacceptable, including the DER approval for the SUU-20 bomb dispenser), engineering "reach back" support for airframe and engine components, and original equipment manufacturer support (or parts supplied from a source with NAVAIR approved engineering substantiation data). NAVAIR allowed a grace period of continued operations with the Alpha Jets based on the past history of the aircraft and Air USA, but advised that the Alpha Jets must be replaced, or flight operations must cease beyond the grace period unless OEM parts support was achieved.

The Hawk was still being manufactured by BAe, and therefore, Air USA presumed that OEM support would be available, allowing them to more readily meet the NAVAIR requirements. The Hawk fleet was then purchased, and after undergoing a series of inspections by NAVAIR, Air USA was granted a series of interim flight clearances for the Hawk from NAVAIR valid through January 31, 2016, with the understanding that beyond that period OEM support had to be achieved, along with reach back support.

In October 2014, Air USA submitted a formal proposal requesting OEM support from BAe; however, according to Air USA, no formal response was received. BAe reported that they initially received a request for support from Air USA on September 2, 2014, and replied stating that they did not support the continued operation of the Hawk by Air USA, but would be willing to attend a meeting with Air USA to discuss the matter further. The October request from Air USA was then received, but BAe did not respond in part because the first Air USA Hawk accident had just occurred and BAe wanted to understand its circumstances before providing a reply. BAe provided technical assistance to the NTSB during that accident investigation, and at the time of publication of this report, their decision to not provide support to Air USA remained in effect.

At the time of the accident maintenance was being performed utilizing OEM replacement components, which were acquired from the ROKAF during the initial sale of the airplanes.

According to Air USA, the USAF opted to utilize FAA certification standards for continued airworthiness, and operations for the USAF continued largely unchanged.

The contract in place with the USAF at the time of the accident included a core requirement stating that the USAF or its designated representatives may perform an annual inspection of aircraft operations, flight crew certification/currency and qualifications and aircraft maintenance procedures, and that this inspection can commence within 6 months after award of contract. The accident occurred about 5 months after the contract was awarded, and therefore, no inspection had occurred. Air USA stated that they had never undergone any type of inspection from the USAF since being awarded their first contract in 2010, with the exception of an ordinance inspection in 2011. Unlike NAVAIR, the USAF contract allowed for the use of alternate bomb dispensers, as long as approval had been granted by a DER.

Air USA voluntarily ceased Hawk operations immediately following the accident, instead supporting the current USAF contract with their fleet of L-39 airplanes. Following completion of the initial phase of the investigation, Air USA restarted Hawk operations on April 20, as part of a live CAS support mission for the USAF. The USAF continued to utilize Air USA for close air support missions until the contract expired in September 2015.

NAVAIR immediately withdrew Air USA's flight clearance following the accident, a decision which remained in effect at the time of this report's publication.

On November 9, 2015, the USAF issued a memorandum directing that all Major Commands immediately cease conducting live contracted close air support (CCAS) missions. The memorandum stated that the prohibition would stay in effect pending a review of contract, airworthiness, and aircrew training related to the missions, and that the goal was to ensure that the relevant contracts adequately protected public interests. This prohibition remained in effect at the time of this reports publication.

FAA Oversight Responsibilities

Air USA's headquarters were based at Quincy Regional Airport, and FAA oversight was provided by the Springfield FAA Flight Standards District Office (FSDO). The Principle Maintenance Inspector (PMI) and Principle Operations Inspector (POI) responsible for Air USA operations at the time of the accident were interviewed. The PMI reported that he had provided maintenance oversight for Air USA for about 10 years, and that he was the inspector who reviewed and subsequently approved the application for airworthiness for N506XX and a similarly equipped sister ship in March 2014. Air USA provided him with data indicating that the airplanes could be used as exhibition category aircraft, and as such they were certified in the experimental/exhibition category.

With regard to ongoing oversight, he stated that Air USA was a Part 91 operation; therefore oversight was no different to other Part 91 operators, limited mainly to "on-request" items such as aircraft system upgrades. They were not subject to the stricter surveillance and oversight requirements of part 135 operators, and due to funding limitations both he and other inspectors would sometimes visit Air USA concurrent with visiting the other operators on the airfield in Quincy.

He stated that no oversight was provided, nor was it required by regulation, for any aspects of Air USA's public-use/military operations. With regard to continued airworthiness and maintenance, it was his understanding that for the Hawks, Air USA chose to adopt a manufacturer approved maintenance program, which Air USA had told him was a stipulation from NAVAIR. The PMI stated that because Air USA chose to utilize the manufacturer approved inspection program, no FAA airworthiness inspection program was created, nor was one required. Therefore, he had not inspected N506XX since its original airworthiness certification.

The POI stated that the extent of operational oversight was limited to the issuance of a flight waiver covering the 60-day period following the airplane's experimental airworthiness certification, so that Air USA could gain flight and training experience in the Hawk. During that period it was his understanding that training was provided by private individuals with fighter-jet experience, and that Air USA pilots were certificated by a designated pilot examiner.

Additional Information

Horizontal Stabilizer Trim

Pitch trim was adjusted directly by incremental movement of the horizontal tailplane structure. Trim was set within the cockpit through a trim switch on the control stick; and its angle was observed utilizing a 1-inch-wide horizontal stabilizer position indicator on the aft portion of the pilot's left console. The accident pilot reported that the company standard was to set the horizontal stabilizer trim to "3 tics aft" (3 degrees nose up) and that this was the trim setting he used for accident takeoff.

The Air USA Chief Pilot stated that the company policy at the time of the accident was to use between 3 to 3.5 degrees nose up (aft) trim during takeoff when external stores were attached, in order to relieve stick pressure during rotation. He further stated that the nose up trim setting gave the airplane control stick pressures on rotation comparable to other U.S. fighter aircraft such as the FA-18 and F-16.

Both the Hawk flight manual and flight checklists provided details regarding trim settings. In all takeoff configurations, the recommended trim setting for the horizontal stabilizer was zero, with the rudder and aileron neutral. The BAe test pilot reiterated that the recommended horizontal stabilizer setting at takeoff was zero degrees, and that rotation should not be initiated until the correct indicated airspeed had been reached. He acknowledged that earlier in his career, on an earlier versions of the Hawk, he had used two degrees nose-up trim under certain stores configuration, but that subsequently in all configurations nose trim has been set to zero, with the pilot accepting any higher stick forces required at rotation. He cautioned that in his experience any trim setting higher than 2 degrees nose-up can cause excessive pitch sensitivity.

The trim system was examined, and according to BAe representatives, the dimension from the locking bolt of the trim transducer actuator rod plate to the actuator case corresponded with a tailplane trim of -4.3 degrees (tailplane leading edge down, airplane nose up). The tailplane trim range is -4.5 degrees to +2.5 degrees.

Flight Instrument Evaluation

The passenger provided the SD memory card from the camera, which was sent to the NTSB Recorders Division for data extraction. The video images recorded the rear cockpit TGT, fuel flow, and N1 engine gauges along with the primary flight instruments, the back of the pilots head, and the runway and horizon.

An onboard image recorder group convened at the NTSB Vehicle Recorders Laboratory to review, document, and tabulate the video footage. Flight instrument and tailplane movement data was derived from the recording through direct observation, and then through the use of gauge-tracking software.

The video recording revealed that neither the combat flap, airbrake, caution warning system failure indicators illuminated at any point, and that the master caution warning, "Attention Getter" indicator illuminated 4 seconds after the airplane struck the truck. Although the two needles for the left and right external fuel tank quantity indications were visible, they could not be identified by associated tank; one needle indicated 500 pounds, and the other 600 pounds. Only the top portion of the internal contents fuel gauge could be observed, corresponding to the 1,000 and 2,500 pounds demarcation points; the needle was not observed in those areas.

The fuel flow needle remained at 60 pounds per minute throughout, N1 reached 101 percent during the initial stages of the ground roll, and remained between 98 and 97.5 percent after the rotation began; the turbine gas temperature (TGT) remained between 625 and 630 degrees C throughout.

The flight instrument observations indicated that the airplane started the ground roll and accelerated with the nose pitching up about 1 degree once a speed of about 117 KIAS was reached. The nose then pitched up, consistent with rotation, at a speed of about 120 KIAS, and before the airspeed needle reached the bug which was set at about 129 knots. Review of the video utilizing outside visual references rather than instruments revealed that about 4 seconds prior to rotation the nose of the airplane pitched up about 1 degree, and began to lightly oscillate up and down during that period.

The airplane pitched up to 10 degrees and lifted off having reached about 124 KIAS. The video image, which up until this point had been smooth, now began to shudder, consistent with the camera shaking, and the airplane immediately rolled left, reaching a bank angle of 28 degrees. The airplane then rolled level, and the passengers hands dropped out of view consistent vertical deceleration as both main landing gear touched the ground. The nose then pitched back up, and the airplane rolled left, transitioning beyond the left side of the runway edge and over to the adjacent gravel area. The main landing gear again appeared to strike the ground, and the airplane rolled 30 degrees to the right about the same time as the construction crew came into view directly ahead. The airplane rolled level, bounced again, and then rolled right as the right wing struck the truck.

Throughout the diversions the horizontal stabilizer could be seen moving, the pilot's head swung from side to side, and the ball of the inclinometer swung back and forth, fluctuating between maximum left deflection and a right deflection beyond the camera's view. The highest pitch angle (19 degrees), roll angle (30 degrees right), and airspeed (135 KIAS) were achieved a few seconds before collision. The fluctuations in pitch, roll, and yaw were accompanied by dust trails observed in the rear view mirrors consistent with the main landing gear and bomb dispensers striking the gravel surface. Scratches on the runway surface and longitudinal scratches to the lower surface of the bomb dispensers corroborated this observation.

An engineer from the NTSB Vehicles Performance Division performed a video study of the initial rotation phase utilizing external visual cues rather than instrument gauges. The study provided comparative data for ground speed, longitudinal acceleration, along with pitch and roll angle. The data indicated that the nose pitched up consistent with rotation at a ground speed of 118 knots, reaching a pitch angle of 10 degrees about 2.5 seconds later.

The camera continued to record as the crew egressed. The ARFF truck arrived and began administrating fire retardant 78 seconds after the airplane came to rest. The smoke drift was consistent with light headwind primarily down the runway.

After observing the takeoff portion of the video, the BAe test pilot indicated that although he could not see the exact rotation speed on the airspeed indicator, he recognized that rotation was at a premature speed, based solely on the position of the needle on the instrument face. He reported that in his experience the Hawk will "drop" a wing if rotation occurs early, with the direction of roll depending on many factors such as airplane build variations, fuel loading, or aileron trim.

Performance

The pilot submitted a takeoff and landing data card (TOLD) for the accident flight. The card listed a takeoff gross weight of 14,350 pounds, temperature 27 degrees C, pressure altitude of 200 ft, and flaps set to 3/4. The card indicated that with these values the rotation speed would be 128 KIAS, with takeoff occurring at 134 KIAS. An acceleration check speed of 105 KIAS would have been achieved 2,000 ft along the runway.

The pilot reported that the rotation and takeoff speeds were conservative, because he had rounded up the aircraft weight. Following the accident he recalculated the TOLD card, and disclosed that he had inadvertently utilized an aircraft weight configured for the CBLS-200 rather than the SUU-20. This represented an increase of the original weight by 180 pounds, however, because the pilot had overstated the original weight, the calculated speeds remained essentially unchanged.

Utilizing the airplane's basic empty weight, along with full center tanks and external tanks filled to 550 and 600 pounds (as observed by the pilot during taxi), respectively, the airplane's weight at the time of the accident would have been about 14,580 pounds. The airplane's 3/4 flap takeoff speed performance chart dictated that at this weight, the rotation speed was 128 KIAS, with an anticipated liftoff speed of 134 KIAS.

Had the aircraft been fully fueled, and thereby at a gross weight of about 15,030 pounds, the rotation and liftoff speed would have been 130 and 135 KIAS, respectively. The airplane's maximum takeoff weight was 20,056 pounds.

The Hawk flight manual takeoff procedures section recommended that at 15 knots prior to rotation speed, the nosewheel should be lifted approximately 2 degrees and remain at that attitude until rotation speed is achieved. At rotation speed, the nose is then lifted to 10 degrees to get airborne. The manual goes on to describe that with external stores attached:

"Minimum nosewheel lift-off speed is increased for a given center of gravity position because of increased aircraft weight. It is important that the nose of the aircraft is not lifted too high. This will reduce aircraft acceleration and increase take-off distance,"

"At a high aircraft weight the 10 degrees attitude on rotation must be set accurately if maximum performance is necessary. Use the ADI initially then when airborne the AOA. Do not select more than 10 AOA. Pre-stall buffet at 11 to 12 AOA will limit the maximum rate of rotation. At low aircraft weight, and if rotation is delayed, the aircraft will hop from one mainwheel to the other. [E]specially if the nose attitude is too high."

Administrative Information

Investigator In Charge (IIC):	Simpson, Eliott
Additional Participating Persons:	Jack T Ogle; Federal Aviation Administration FSDO; Scottsdale, AZ Ben Breslin; Air USA; Quincy, IL Adrian Cope; Air Accidents Investigation Branch; Aldershot
Original Publish Date:	April 14, 2016
Last Revision Date:	
Investigation Class:	Class
Note:	The NTSB traveled to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=90860