ASOS Research Brief

Research Request:

Our department is considering using contract pilots on a limited basis. What are the pros and cons of contract pilots? Are there risk associated with using contract pilots? How can these risk be mitigated?

Research Response:

There are usually two different types of contract pilots. The first type is a pilot who is on a long-term contract, working exclusively for one operator. Additionally, this pilot may be trained with the rest of the full-time pilots; however, is technically a contract pilot. This type of contract pilot does not bring about any concerns. The other type of contract pilot is the pilot who works for a few different operators at the same time (perhaps in multiple different type aircraft) based on what the needs are of the operators he works for. This type of contract work brings about some concerning issues, especially if they are acting as a PIC. While it may be common practice for many, there are possible safety issues to consider and many organizations will not use contract PICs. As an example, the ARG/US tripcheq system does not allow for contract PICs. Our customer base consists of companies such as SentientJet, Citationshares, and Delta Air Elite. The consensus with our customer's is none of them use contract PICs, and some will not use contract SICs either. Below are a few contributing factors to this decision.

Training

This is probably the biggest concern when using a contract pilot. A contract pilot has the option of receiving training on their own from a variety of training vendors such as SimCom and FlightSafety. Each vendor may vary in their methods or procedures. A company may tailor their own SOPs to be incorporated into this training for their full time pilots, creating a gap in knowledge between the contract pilot's training and company SOPs. For example if during an emergency the PIC performs tasks that are not uniform with company standards, it may create confusion in the cockpit.

Multiple Aircraft

Contract PICs may also be acting as PIC in a few different types of aircraft. Normally, a safe limitation on the number of aircraft a pilot is actively flying is two. However, due to the nature of their profession, contract pilots may be actively flying three or more different types of turbine aircraft. This opens the possibility for confusion of aircraft systems, emergency procedures, and each company's SOPs.

Technology

A period of adjustment is associated with any piece of new technology. A contract pilot may have extensive experience in a particular G-IV; however, the G-IV at another operator may be equipped with slightly different avionics, presenting a learning curve. A typical example is EFB's or HUDs.

Extra Flying

The potential exists for a contract pilot to show up to a flight fatigued from a previous flight. He or she may have flown an overnight flight and show up for a 7am flight for your company. The contract pilot may not have had any fatigue countermeasures/ awareness training, creating a potentially hazardous situation in the cockpit.

Sample Accident

The accident report from the NTSB below provides several downfalls with contract pilot situations. This situation was not specifically a contract pilot issue, but rather an agreement between two companies to interchange pilots. Unfortunately, procedural and aircraft differences existed between the two companies that were not addressed. For example, the aborted take-off procedures varied between the two companies and the position and operation of the nosewheel steering select control also differed.

In this accident, the aircraft exited the runway on take-off, and all occupants were fatally injured. Both crew members were highly experienced with excess of 12,000 hours each. The PNF had over 2,000 hours in type and the PF had almost 500 hours. Both pilots received training; however, from two different training vendors. A synopsis and probable cause is at the end of this report.

NTSB Identification: CHI97MA017 .
The docket is stored in the Docket Management System (DMS). Please contact Records Management Division
14 CFR Part 91: General Aviation
Accident occurred Wednesday, October 30, 1996 in WHEELING, IL
Probable Cause Approval Date: 3/31/1998
Aircraft: Gulfstream G-IV, registration: N23AC
Injuries: 4 Fatal.

HISTORY OF FLIGHT

On October 30, 1996, at 1300 central standard time, a Gulfstream G-IV, N23AC, registered to Alberto Culver USA, Inc., collided with the terrain following a loss of control during a takeoff ground roll on runway 34 (5,137' x 100') at the Palwaukee Municipal Airport, Wheeling, Illinois. The 14 CFR Part 91 corporate flight was departing in visual

meteorological conditions with an IFR flight plan on file. The captain, co-pilot, flight attendant, and the sole passenger on board were fatally injured. The airplane was destroyed by impact forces and a post impact fire. The intended destination of the flight was Burbank, California.

The accident flight was operated under the terms of an Interchange Agreement between the Alberto-Culver Corporation and the Aon Corporation. The interchange agreement provided for each company to lease their respective G-IV airplanes to the other company. In regards to the accident flight, the Aon Corporation had requested the use of the Alberto-Culver airplane. Aon furnished one pilot making the flight a mixed crew operation. The pilots of the accident flight were notified of the flight approximately seven days prior to the scheduled departure.

N23AC was scheduled to depart Palwaukee Municipal Airport at 1300 CST on October 30, 1996, for the Burbank-Glendale-Pasadena Airport with a return to Palwaukee the following day. The flight plan was filed by the pilot from Alberto-Culver who occupied the right cockpit seat for departure. Although the aircraft was operated by Alberto-Culver, the pilot from Alberto-Culver listed himself as the co-pilot for the first day of the trip from the Palwaukee Municipal Airport to the Burbank-Glendale-Pasadena Airport. He listed himself as the pilot-in-command on the flight plan for the return flight to Palwaukee Municipal Airport on the following day. The pilot from the Aon occupied the left cockpit seat for the accident flight and was listed on the flight plan as the pilot-in-command. [For the remainder of the report, the pilot from Alberto-Culver will be identified as the pilot not flying (PNF) and the AON pilot as the pilot-in-command (PIC)].

Prior to departure N23AC was parked on the ramp adjacent to hangar #12. A preflight inspection of the airplane was accomplished by an Alberto-Culver aircraft technician. The PNF was also observed performing a preflight inspection of the airplane. The pilots of N23AC received their ATC clearance from clearance delivery at 1242.

The PNF called for and received taxi clearance at 1254. N23AC was instructed to taxi on Mike but hold short of runway 34. The flightcrew acknowledged the hold short instructions and began to taxi. At 1257 the local controller who was also working the ground control position cleared N23AC to back taxi and expedite down the active runway to the departure pad. N23AC taxied southeast on runway 16-34 and at 1258 the local controller asked them if they would be ready at the end. N23AC replied they would be ready at the end of the runway. At 1259, the local controller said, "Two Three Alpha Charlie, three four, expedite departure, turn left heading two niner zero, cleared for takeoff."

At 1259, the PNF replied, "Cleared for takeoff, heading two nine zero, we'll hurry it out." The pilots applied power and began the takeoff roll on runway 34. Passing the intersection of 12L-30R, tire tracks indicated the airplane began to diverge to the left of runway heading. As the airplane continued to diverge from the centerline of the runway the nose gear tire tracks ended; however, the main gear tire tracks continued into the

grass bordering the runway.

The airplane remained off the runway and continued across the grass and across taxiways, Yankee, Mike, and November. Landing gear, flight control surfaces, and other airplane components separated once N23AC left the runway. The airplane slid on its belly roughly parallel with the runway and momentarily got airborne when it launched off a small berm near the departure end of runway 34. Once airborne the airplane flew over Hintz Road, contacted the embankment along Wolf Road, and skipped over Wolf Road. It slid across a field and stream gully and came to rest on the edge of an apartment complex parking lot where the airplane was consumed by fire. Both pilots, the flight attendant, and passenger perished as a result of the accident and subsequent fire.

WITNESS STATEMENTS

The Alberto-Culver aircraft technician who performed a pre-flight inspection of the airplane reported that he was positioned on the ramp forward of the airplane during engine start and initial taxi. He stated he observed the control check and the engine start and everything appeared normal. There were no unusual sounds, smoke, or other abnormal indications associated with the airplane. The brakes, gear, control surfaces, and engines all appeared to operate normally.

While N23AC was taxiing for takeoff, a Falcon 900 landed on runway 34. The pilots from the Falcon 900 reported that after they stopped on the runway, they back taxied before turning off at runway 30. The pilots observed the G-IV and reported that everything on the G-IV looked normal. They reported the thrust reversers were stowed, the tires looked normal, and the taxi path was straight. There was no white or black smoke coming from the engines.

A co-pilot of a Falcon 10 was standing on an aircraft ramp on the west side of runway 34. He reported that the G-IV's engine noise was normal during takeoff. He reported that the spool up was normal and that he heard no reduction in engine noise.

An Aon aircraft technician had assisted the Aon executive in boarding the aircraft. He reported that he observed N23AC back taxi to the end of runway 34, turn around, and without holding short, start its takeoff roll. He reported the engine spool-up and acceleration were normal and that the auto-throttles were engaged. He saw the aircraft go off the runway and continue paralleling runway 34 until it was out of his field of view, shedding aircraft parts in the process. The aircraft was on its belly with the nose off the ground, and the engines were running at full power. He did not hear a power reduction.

An aircraft line serviceman observed the main landing gears separate from the aircraft as it continued on its path across the ground. He reported, "...I came out [and] the left main was gone and [the] left wing was dragging on the ground. Two or three seconds later the right main came off. (But all this time the nose wheel never hit the ground.)"

The air traffic controller who had been working local and ground control for 10 to 15 minutes prior to the accident viewed parts of the accident sequence from his position in the tower cab. He reported seeing N23AC begin its takeoff roll, but did not see it departing the runway since he was observing another aircraft at the time. He next saw N23AC as it was sliding on its belly in the grass. He reported that it seemed to decelerate and then accelerate at full power.

A second air traffic controller who was in the tower reported seeing N23AC become airborne and exploding near the north boundary of the field. He saw a fireball encompass the aircraft. He did not recall if the aircraft had been yawing.

An airport employee witnessed the accident from the departure end of runway 34. He had been inspecting the approach lighting system for runway 16 from outside the airport fence, and he was looking down the runway when the aircraft started its takeoff roll. He witnessed the airplane depart the runway, shedding aircraft parts as it passed taxiways Mike and November. He reported that after the aircraft passed taxiway November, the aircraft was turned 2/3 to the right until it hit the berm near the departure end of runway 34. He reported the airplane became airborne and it started yawing back to the left. The back end of the airplane exploded before it departed the airport boundary. He reported that it made it over Hintz Road and the mid-section impacted the curb area of Wolf Road.

A witness reported seeing the airplane on fire. He reported that, "...it appeared the fire was coming from the wing tanks and from the left engine. The angle of ascent was still at a 45 degree attitude and the plane appeared to be a[t] full throttle. At that point the plane exploded [I] think the left engine blew or the fuel tanks and the entire airplane was engulfed in flame[s]."

A witness who observed N23AC from the Airport Administration Office reported seeing a "...white mist-vapor..." trailing the wing. He additionally reported, "The aircraft was in a nose high attitude and appeared to gain about 20 ft of altitude over Hintz Road. At the very next instant a huge explosion erupted... . Black smoke engulfed the aircraft."

A witness who was traveling eastbound on Hintz Road reported seeing, "Large amount of orange and yellow flame[s] and black smoke coming from the underside of the jet on the pilot's side near where the wing meets the fuselage." (See Witness Group Chairman's Factual Report)

PERSONNEL INFORMATION

Both crewmembers were certificated in accordance with Federal Aviation Administration (FAA) certification requirements. No accidents, violations or other enforcement actions were recorded for either crewmember in the Federal Aviation Administration records reviewed.

Pilot in Command (PIC)

The PIC, born January 7, 1943, was hired by Aon Corporation in May 1989. The following background information concerning the PIC was reconstructed from available documents. The PIC held an Airline Transport Pilot certificate with Airplane Multiengine Land and Commercial privileges and Airplane Single Engine Land ratings. The PIC possessed a 2nd Class Medical Certificate, dated July 16, 1996. His medical certificate had the limitation: "Holder shall wear lenses that correct for distant vision and possess glasses that correct for near vision." Co-workers stated the PIC customarily wore glasses, however, it could not be determined if he was wearing glasses at the time of the accident.

A copy of the PIC's resume, undated, which was found in the accident aircraft listed his flight times as follows:

Total Time: 17,086 hours

Instrument: 14,658 hours

P.I.C.: 16,812 hours

S.I.C.: 274 hours

Multi-Engine: 16,558 hours

Jet: 6,691 hours

G-IV: 496 hours

The PIC's most current ground training, flight training and flight checks according to Aon and Flight Safety International records were as follows:

October 21-24, 1996: Flight Safety G-IV Pilot Recurrent Ground Instruction

October 22-24, 1996: Flight Safety G-IV Simulator Flight Training

Interviews were conducted with associates who had flown with the PIC or had observed his flight tendencies. The characterization that emerged as a result of the interviews indicated that the PIC was a very experienced pilot who displayed good "stick and rudder" piloting skills in the Citation and Gulfstream IV. The PIC had difficulty with the Flight Management System (FMS) and was not comfortable with the "glass cockpit" procedures. With a "laid back" and quiet personality, he tended to defer to the pilot with more expertise or knowledge, whether that pilot was flying right or left seat. He tended not to initiate checklists and did not verbalize aborted takeoff procedures during pre-

takeoff briefings. The PIC tended to unload the nose wheel on the G-IV during takeoff to make it easier on the airplane on rough runways.

The PIC had successfully completed recurrent G-IV training on October 24, 1996. Crew Resource Management (CRM) had been emphasized during the training since the PIC had been described as being a "little weak in that area." An instructor reported that the PIC was not very assertive, although he possessed good natural piloting techniques.

Pilot not flying (PNF)

The PNF, born on January 17, 1946, was hired by Alberto-Culver on November 19, 1994. He held an Airline Transport Pilot certificate with Airplane Multiengine Land and Commercial privileges and Airplane Single Engine Land ratings. The PNF possessed a 1st Class Medical Certificate, dated September 3, 1996. His medical certificate had the limitation: "Holder shall wear lenses that correct for distant vision and possess glasses that correct for near vision while exercising the privileges of his airman's certificate." Co-workers stated the PNF customarily wore glasses; however, it could not be determined if he was wearing glasses at the time of the accident.

Flight times reconstructed from the PNF's pre-Alberto-Culver employment resume and segments of his logbook were as follows:

Total Time 12,595.1 hours

P.I.C. 9,514.4 hours

G-IV 2,281.4 hours

G-III 1,100.0 hours

G-II 1,405.0 hours

Falcon 20 1,550.0 hours

Grumman E2 1,680.0 hours

The PNF's most current ground training, flight training, and flight checks according to his logbooks and Alberto-Culver records were as follows:

June 3-6, 1996: Simuflight G-IV Pilot Recurrent Ground Instruction

June 4-6, 1996: Simuflight G-IV Simulator Flight Training

June 7, 1996: Simuflight G-IV, Simulator L.O.F.T.

The PNF had been a pilot on the Flight Operations staff of Gulfstream Aerospace, Inc., from May 1983 to August 1985. He had flown the G-II, G-III, and the G-IV while working for Gulfstream.

Interviews were conducted with associates who had flown with the PNF or had observed his flight tendencies. The PNF was described as an excellent airman with very good systems knowledge of the G-IV. He was described as being quiet and professional, but not an assertive, outgoing person. He was comfortable with being the pilot-in-command when he was assigned that position. He made decisions and initiated checklists. As a co-pliot, the PNF was described as someone who would "respect the left seat," and not one to jump in and "take over the airplane."

The PNF had successfully completed recurrent G-IV training on June 7, 1996. He was described by an instructor pilot as being very good at procedures. He would initiate corrective actions to emergencies and did not have to be prompted. He was identified as one of the top 30 pilots the instructor pilot had known.

The PNF's logbook listed at least three previous occasions when he and the PIC comprised the same G-IV flight crew; November 22, 1995, March 10, 1996 and August 11, 1996. (See NTSB Operations Group Chairman's Report) Alberto-Culver aircraft logs indicate that the PNF and PIC had comprised the same G-IV flight crew on April 19 and 22nd, 1996, and also on August 12, 1996.

FLIGHT OPERATIONS INFORMATION

Interchange Agreement and Mixed Crews

Alberto-Culver and Aon leased their respective G-IV's to each other under an Interchange Agreement authorized under FAA regulation 14 CFR 91.501 (c) (2). The Interchange Agreement stipulated that each company would maintain operational control of its respective airplane. Due to operational necessity, mixed crews were occasionally utilized, which meant that a pilot from each company served together and made up the flight crew for the operation. However, there was no mention made in the Interchange Agreement concerning mixed crews, nor was there any reference to mixed crew operations in either company's operations manual. Furthermore, in the event of a mixed crew operation, there were no written or otherwise formal procedures for integrating the differences in company operating procedures.

Airplane and Company Differences

The Alberto-Culver G-IV airplane, N23AC and the Aon G-IV, N18AN, were not identical in the layout of their cockpits. The respective companies also had different operating procedures for some of the airplane components.

Both airplanes had a switch which could disable all nose wheel steering. This switch was commonly called the "Nose Wheel Steering" switch. The "Nose Wheel Steering" switch was a production switch and installed on every G-IV produced. It was located on the nose wheel steering control panel forward of the tiller on the left console. The switch was guarded by a red guard and was in the "ON" position when the red guard was down, allowing nose wheel steering to be controlled by both tiller and rudder pedals. If the switch was in the "OFF" position, nose wheel steering control would be disabled both at the tiller and at the rudder pedals. According to the Alberto-Culver Chief Pilot and the Aon Director of Aviation, it was standard procedure at their respective flight departments to turn the "Nose Wheel Steering" switch "OFF" for the preflight check, otherwise the switch was left in the guarded "ON" position."

Both Alberto-Culver and Aon had an additional switch installed on their respective airplanes which affected nose wheel steering. This switch was commonly referred to as the "Nose Wheel Steering Select Control." This modification allowed the tiller to control nose wheel steering while disabling nose wheel steering by the rudder pedals. It was a two position switch labeled "NORMAL" and "HANDWHEEL ONLY". In the "NORMAL" position, nose wheel steering could be controlled by both tiller and rudder pedals. In the "HANDWHEEL ONLY" position, the rudder pedals input to the nose wheel steering would be disabled, but the tiller input would remain enabled. There was a blue light located adjacent to this switch which illuminated whenever the switch was in the "HANDWHEEL ONLY" position.

The "Nose Wheel Steering Select Control" was installed in a different location on the Alberto-Culver airplane than on the Aon airplane. On the Alberto-Culver G-IV it was located on the left console aft of the tiller while on the Aon G-IV it was located on the center console.

In addition to the different locations of the "Nose Wheel Steering Select Control" there were procedural differences in the use of this switch between Alberto-Culver and Aon pilots.

According to the Alberto-Culver Chief Pilot, use of the "Nose Wheel Steering Select Control" switch was at the discretion of the flying pilot. Alberto-Culver pilots were varied in their usage of the switch. The Alberto-Culver Chief Pilot, for example, reported that he usually left the switch in the "HANDWHEEL ONLY" position for the entire flight. He reported that the PNF usually left the switch in the "Normal" position for the entire flight.

According to the Aon Director of Aviation, Aon pilots left the "Nose Wheel Steering Select Control" switch in the "NORMAL" position all the time and turned the red guarded "Nose Wheel Steering" switch "OFF" during the preflight control check, and then back on prior to taxi. (See Operations Group Chairman's Factual Report)

The Alberto-Culver Chief Pilot reported that he had flown N23AC the night before the

accident and had landed at Palwaukee Airport. He reported that he had landed the airplane with the "Nose Wheel Steering Select Control" in the "HANDWHEEL ONLY" position, and that the blue light had illuminated. He reported that he left the switch in the "HANDWHEEL ONLY" position when he had departed the airplane. The aircraft was not flown until the next day by the crew of the accident flight.

Aborted Takeoff Procedures

Alberto-Culver's operations manual specified procedures for aborting a takeoff. The ABORT PROCEDURES stated the following:

Either pilot may command an abort by stating "ABORT."

When an abort is commanded, the Captain will immediately apply wheel brakes and simultaneously retard the power levers to idle, [and] initiate reverse thrust. The First Officer will hold forward pressure on the yoke and manually deploy the speed brakes. The Captain will guard the nose wheel steering control and apply nose wheel steering as necessary.

Any of the following malfunctions are cause to abort:

1. ENGINE FAILURE

2. ENGINE FIRE

3. OIL PRESSURE LIGHT

4. ENGINE HOT LIGHT

5. GROUND SPOILERS

6. THRUST REVERSER UNLOCK LIGHT

7. PYLON HOT LIGHT

The Aon operations manual stated the following concerning emergency situations:

The PIC may, at his/her discretion, declare an emergency when any circumstances or conditions jeopardize the safety of a flight. The PIC is responsible for issuing appropriate orders to be followed in the handling of an emergency. Positive delegation of flying and checklist responsibilities is imperative... .The PIC will be guided by the rules and regulations as set forth in the FAR, ATC instructions, and the Airplane Flight Manual. In an emergency requiring immediate action, the PIC is authorized to deviate from prescribed methods, procedures, or landing weather minimums, and from any rule in the General Subpart A and Flight Rules, Subpart B.

The Aon flight operations manual did not state specific procedures for an aborted take-off.

The G-IV Airplane Flight Manual produced by Gulfstream Aerospace did not specify procedures for aborted takeoffs. The airplane flight manual did specify procedures for Engine Failure During Takeoff Below V-1 Speed, and for Engine Failure During Take-off Above V-1 Speed.

Neither the Alberto-Culver operations manual, the Aon operations manual, or the G-IV Airplane Flight Manual specify procedures for aborted takeoffs due to loss of directional control during takeoff.

AIRCRAFT INFORMATION

Alberto-Culver operated N23AC, a Gulfstream IV, s/n 1047. The airplane was powered by Rolls Royce MK 611-8 engines. The airplane was being maintained in accordance with 14 CFR Part 91.409 (f) (3), utilizing Gulfstream's computerized maintenance program (CMP). The aircraft was in current inspection status, with regard to hourly, cycles, and calendar criteria. All Airworthiness Directives applicable to the aircraft had been complied with within the specific time frame listed in those Airworthiness Directives. At the time of the accident, the airplane had accumulated 2,938.0 hours total time, and 1,219 cycles or landings. (See Airworthiness Inspection Investigation Report)

The maximum certificated takeoff weight for N23AC was 73,200 pounds. The takeoff weight for the accident departure was 66,202 pounds. The center of gravity (CG) computed for departure was approximately 34.2% mean aerodynamic chord (MAC). The calculated CG limits for 66,202 pounds gross weight were 31.0% and 36.7% MAC. (See Operational Factors Group Chairman's Factual Report)

Reduced V-1 Speed

The Flight Management System (FMS) on the Gulfstream IV provided the pilots with the computed V-1, V-R, and V-2 speeds. On long runways the V-1 and V-R speeds were the same (V-1/V-R). On short runways, or on slush or ice covered runways, the V-1 speed could be reduced to the minimum V-1 speed, or V-1mcg. The purpose for using the reduced V-1 was to provide a shorter Accelerate-Stop Distance.

The computed Reduced V-1 speed for the accident takeoff was 117 knots which provided an Accelerate-Stop Distance of 3,400 feet. The V1/V-R speed was 135 knots which provided an Accelerate-Stop Distance of 4,500 feet. Runway 34 at Palwaukee was 5,137 feet long. Therefore, had the takeoff been aborted between Reduced V-1 (117 knots) and V-1/V-R (135 knots), the performance data indicates that sufficient runway length remained to safely stop the airplane on the runway.

V-1, Takeoff Decision Speed, is defined as: Speed from which decision to continue takeoff results in takeoff distance that will not exceed available accelerate-go distance, or from which decision to bring airplane to full stop will not exceed accelerate-stop distance available.

In an interview with Aon Director of Flight Operations, he reported that, "...once you hit V-1, Decision Speed, you go for it." If there was a problem like an engine failure, the safest thing to do is continue the takeoff after V-1.

The Alberto-Culver's Flight Operations Manual's takeoff procedures stated the First Officer [pilot in the right seat] was to call out the V-1 and V-R speeds. Aon's Flight Operations Manual did not specify takeoff and climb procedures. During the accident takeoff, it was not possible to determine if the V speeds were called out, nor if there was any "Abort" call made for an aborted takeoff, due to the poor quality of the CVR tape.

Performance calculations were made using the takeoff conditions that existed at the time of the accident. The V-1, V-2, V-R speeds were calculated as follows:

V-1 = 117 KCAS ("Reduced V-1", .87 V-1)

V-1 = 135 KCAS (1.0 V-1)

V-R = 135 KCAS

V-2 = 141 KCAS.

The Accelerate-Stop Distance with winds at 20 knots was:

4,500 feet @ V-1/V-R = 1.0

3,400 feet @ V-1/V-R = .87

The Accelerate-Stop Distance with winds at 40 knots was:

4,250 feet @ V-1/V-R = 1.0

3,250 feet @ V-1/V-R = .87

The airplane's minimum unstick speed (Vmu) at 66,000 pounds with the center of gravity at the forward limit and flaps at 20 degrees was 116 knots.

The rudder effectiveness was calculated for a crosswind component from 280 degrees at the following velocities:

24 knot crosswind: Rudder control speed was about 68 knots.

35 knot crosswind: Rudder control speed was about 96.7 knots.

40 knot crosswind: Rudder control speed was about 110.9 knots.

The G-IV maximum demonstrated 90 degree crosswind component for takeoff and landings was 24 knots. This was not a limitation. (See N23AC Takeoff Performance Calculations Appendix)

Meteorological Conditions

The weather conditions reported on the "Foxtrot" ATIS transmission which was recorded on N23AC's Cockpit Voice Recorder (CVR) at 1229:25 CST was as follows: Wind estimated at 280 degrees at 20 knots with gusts to 35 knots, visibility greater than 10 miles, sky conditions estimated 2,500 feet overcast, altimeter 29.75. (Temperature and dew point were not recorded)

The air traffic air controller reported that as N23AC was taxiing, another aircraft had called for a wind check. The winds he issued were 280 degrees at 24 knots. The controller reported that he used a combination of wind sock for wind direction and the analog wind speed indicator for wind speed.

The Captain of the Falcon 900 which landed shortly before the G-IV's takeoff roll, reported that he had received winds of 280 degrees at 25 knots on final. He indicated that the air traffic controller's wind information was accurate.

AIRPORT INFORMATION

The Palwaukee Airport is located approximately 18 miles northwest of Chicago, Illinois, and is owned and operated by the cities of Prospect Heights and Wheeling, Illinois. The airport is not certificated (and is not required to be certificated) under 14 CFR 139.

Runway 34 is 5,137 feet long and 100 feet wide. Runway 16-34, a precision instrument runway, had a runway safety area (RSA) which did not meet the recommended minimum criteria as specified in the FAA Advisory Circular (AC) 150/5300-13, "Airport Design." A RSA is defined as:

"A defined surface surrounding the runway prepared or suitable for reducing the risk of damage to airplanes in the event of an undershoot, overshoot, or excursion from the runway."

The AC 150/5300-13 specifications called for a RSA of 300 feet in width and 600 feet beyond each runway end of runway 16-34. Drainage ditches of varying depths are located along both sides of runway 16-34 within the RSA. After departing the runway, the accident airplane traversed a drainage ditch located parallel to and west of the run-

way at varying distances of +/- 20 feet from the runway pavement edge.

On December 3, 1993, the Illinois Department of Transportation, as authorized by the FAA through its state block grant authority, issued 16 waivers to RSA and runway object free area (ROFA) standards, that are contained in AC 150/5300-13, including waivers of standards for RSA length and width for runway 16-34 in its approval of the Palkwaukee Airport Layout Plan. (See Airport Specialist's Factual Report)

FLIGHT RECORDERS

Flight Data Recorder

There was no Flight Data Recorder (FDR) installed on N23AC.

Cockpit Voice Recorder

The airplane was equipped with a Fairchild Model A100, serial number 56281, cockpit voice recorder (CVR). The playback time of the recording was approximately thirty minutes and fifty-five seconds (30:55). All times incorporated into the transcript are in central standard time, correlated with a copy of the Palwaukee Air Traffic Control Tower tape.

The audio quality of the four-channel CVR recording was extremely poor. The cockpit area microphone (CAM) track was dominated by a 400 Hz tone which effectively masked the crewmember conversation.

At 1229:25 the ATIS information "Foxtrot" was heard over the communications channel of the CVR. Between 1229:59 and 1259:18, the pilots can be heard going through the aircraft checklists, but due to the poor tape quality, only fragments on their checklist challenge and responses can be heard.

At 1242:26, the air traffic controller issued the airplane its flight clearance.

At 1253:39, the PNF could be heard going through the checklist items for the nose wheel steering and the pedal steering, but the responses were unintelligible.

At 1254:39, the aircraft was cleared to taxi to runway 34.

At 1255:04, the PNF indicated that the flaps were set at 20.

At 1255:26, the PNF call for, "...crew brief."

At 1256:22, there were several seconds of unintelligible conversation.

At 1257:28, the air traffic controller instructed N23AC to expedite down runway 16 to

the runway 34 pad.

At 1257:33, the PNF responded, "We'll hustle down to the 34 pad, Alpha Charlie."

At 1258:00, the ground controller asked N23AC, "...will you be ready at the end?"

At 1258:03, the PNF responded, "Yes we will, Alpha Charlie."

At 1259:13, the tower controller instructed N23AC, "Two Three Alpha Charlie, 34 expedite departure, turn left heading two niner zero. Cleared for takeoff."

At 1259:18, the PNF responded, "Cleared for takeoff, heading two nine zero. We'll hurry it out."

At 1259:35, sounds similar to an increase in engine rpm were heard.

At 1259:48, several unintelligible words were recorded.

At 1259:53, the PNF said, "Larry."

At 1259:56, a sound similar to a human grunt was recorded.

At 1259:58, the PNF said, "Larry."

At 1300:01, rumbling sounds similar to that of an aircraft departing the runway were recorded.

At 1300:02, the sound of a triple caution chime was recorded.

At 1300:03, the PNF said, "Reverse."

At 1300:04, the following words were recorded: "No no no." (The CVR group could not determine which pilot made the statement).

At 1300:05, the following words were recorded: "Go go go go, go." (The CVR group could not determine which pilot made the statement).

At 1300:06, the sound of an unidentified tone of increasing frequency was heard.

At 1300:06, the sound of a triple caution chime was recorded.

At 1300:07, the CVR stopped recording. (See CVR Specialist's Factual Report)

WRECKAGE AND IMPACT INFORMATION

The wreckage path began 1,340 feet from the approach end of runway 34 (all distances are referenced from the approach end of the runway) where three sets of dual tire marks started veering toward the left side of the runway on a 335 degree heading. The marks proceeded toward the left side of the runway at a 5.14 degree angle. The center set of tire marks ended at 1,705 feet and 35 feet right of the left edge of the runway. The left set of tire marks departed the left side of the runway at 1,810 feet and a set of two ruts began in the soft dirt and grass. The right set of tire marks departed the left side of the runway at 1,950 feet, and an additional set of two ruts began in the mud and grass. The tire marks did not veer back toward runway centerline, nor were there marks present that indicated braking action.

The airplane traversed a shallow sloped drainage ditch that paralleled runway 34. The ditch was about 2.5 feet deep at its deepest and 20 feet wide.

A 90 foot wide spray of mud fanned out onto the runway beginning at 1,940 feet and extended down the runway for 400 feet. At 1,995 feet, a 3,000 foot remaining marker was found broken off, 30 feet off the left side of the runway.

At 2,119 feet, and 21 feet from the runway's left edge, a 12 inch wide scrape began in the dirt on a 335 degree heading. Several pieces of the airplane's bottom aft fuselage were found embedded in the dirt along the scrape. The airplane's rotating beacon was located at 2,405 feet, and the number two VHF antennae was found embedded in the ground at 2,478 feet.

The airplane's left wing flap was found resting along the 12 inch wide scrape in the dirt at 2,369 feet and 43 feet left of the left edge of the runway.

At approximately 2,565 feet and 49 feet from the runway's edge, a five foot long piece of 3/16 inch steel aileron control cable was found. A ball and connector was located at one end of the cable. The other end of the cable was frayed.

From 2,673 feet to 3,247 feet on a 335 degree heading, the airplane skidded across taxiway Mike, transferring metal onto the asphalt taxiway.

The right main landing gear separated from the airplane and was located at 2,830 feet, and 10 feet from the left edge of the runway.

The right wing flap separated from the airplane and was broken in two. The inboard one-third of the flap was found along the parallel taxiway at 2,872 feet. The outboard two-thirds of the flap was found on the high speed taxiway, at 3,501 feet and 53 feet left of the runway.

The airplane continued to skid and skip along the ground after traversing taxiway Mike at 3,247 feet. It became airborne when it hit a small berm at 4,664 feet, shedding numerous aircraft parts in the process. At this point the airplane had traveled a distance

of 2,864 feet since the left gear departed the runway. The ground scars indicate that the airplane's heading veered back to the right. When it impacted the berm, the airplane's heading was about 343 degrees. An aileron bellcrank and cable were found at 3,442 feet. The left main landing gear was located at 3,725 feet and 225 feet west of the runway's left edge.

The first smell of jet fuel began 10 feet prior to the berm. A 21 inch long piece of metal bulkhead and fuel tank was located 4,764 feet and 225 feet from the runway edge. The fuel ignited and the explosion created a 275 foot long charred area on the airport and heavily damaged the left side of the airplane. An anti-cavitation valve screen was located at 4,873 feet and 188 feet from the runway edge. The burn area started at 4,987 feet.

The airplane became airborne on about a 354 degree heading until it impacted the road embankment at Wolf Road, at 6,043 feet from the approach end of the runway and 50 feet west of the runway centerline. The airplane skidded across Wolf Road, skipped over the north side of the road embankment, and landed in a vacant lot. The airplane skidded on its bottom fuselage across the vacant lot into Buffalo Creek.

The airplane's main wreckage came to rest predominately on the north and south banks of Buffalo Creek and in the south parking lot of the Foxboro Apartment complex. It was located 380 feet west of Wolf Road and 6,646 feet from the approach end of the runway, and 53 feet east of the extended centerline on a 354 degree heading. The main wreckage consisted predominantly of the airplane's fuselage, the left and right wing sections, the tail section including the empennage, both engines, both thrust reversers, and the forward landing gear.

The right fuel tank was broken open as the airplane slid across Wolf Road and tumbled into Buffalo Creek. The ensuing post-impact fire charred, melted, and/or consumed the majority of both wing tanks, engines, fuselage, and cockpit. (See Structures Group Chairman's Report)

The cockpit was destroyed by fire. An inspection on the cockpit wreckage revealed that the left and right high pressure cock levers were in the open position. The left and right engine fire handles were in the stowed position. The left power lever was at 120 degrees forward of idle stop. The right power lever was at the idle stop. The thrust reverse levers were stowed. The speed brake was in the retract position. The landing gear handle was up. The flap selector lever indicated 20 degrees. The nose wheel steering switch had its guard cover up with the switch in the on position.

The cockpit, engines, engine mounts, nacelles, each aft cowl assembly and thrust reverser, and the auxiliary power unit were examined. The examination of the engines did not reveal any preexisting failures or conditions that would have prevented normal engine operation. Damage to both engines, cowl assemblies, and thrust reversers was consistent with ground impact with the thrust reversers in the stowed position. Exami-

nation of the left engine found evidence of low power or no power rotation damage and extensive post-crash fire damage. Examination of the right engine found evidence of high power rotation damage and less extensive post-crash fire damage. The examination of the cockpit revealed that the engine related levers and handles were configured for engine operation. The examination of the controls did not reveal any pre-existing failures or conditions that would have prevented normal engine operation. (See Powerplant Group Chairman's Factual Report)

The nose wheel steering select control switch was removed for detailed examination. The examination revealed that the Allen set screws indicated that the switch was in the HANDWHEEL ONLY position as found at the accident site (See Systems Group Chairman's Report)

The examination of the flight controls did not reveal any pre-existing anomalies which would have prevented the pilots from controlling the airplane prior to it departing the runway.

The rudder was found at approximately 22 degrees right deflection. The sector (rudder torque tube, rudder drive horn, and rudder stops) which attached to the bottom of the rudder was separated from the rudder. The bulkhead (shearweb) where the sector attached to was folded over the sector, and the rudder sector was found in the full right rudder position. All three hinges were intact on the rudder. The rudder moved freely when tested following the accident. All four balance weights on the rudder were found attached, with no signs of any rubbing or binding were noted.

Both right and left aileron and the left aileron trim tab were found in a neutral position. The left primary control cable sector and cable were found near taxiway Mike on the airport.

The elevators were found in the neutral to slight trailing edge down position. Both primary control cables were still attached to the elevator sector in the tail. Both elevator cables showed signs similar to an overload failure. (See Systems Group Chairman's Report)

Both right and left main landing gears, including both main gear tires, brake assemblies, shock struts, and a 22 inch piece of metal bulkhead, had separated from the airplane and were located on the airport. Examination of the main landing gear assemblies and brakes revealed no pre-existing anomalies. (See Structures Group Chairman's Report)

MEDICAL AND PATHOLOGICAL INFORMATION

A Forensic Toxicology Fatal Accident Report was prepared by the FAA's Civil Aeromedical Institute on the four persons on board the airplane. The results of the examinations were as follows:

PIC

47.00% Carboxyhemoglobin detected in blood. 2.250 (ug/ml) Cyanide detected in blood. No Ethanol detected in vitreous fluid. 5.90 (ug/ml, ug/g) salicylate detected in urine.

PNF

Carbon monoxide analysis was not performed due to a lock of suitable specimen. Cyanide analysis was not performed due to a lack of suitable specimen. No Ethanol detected in vitreous fluid. No Ethanol detected in muscle. No Drugs detected in liver fluid.

Flight Attendant

Carbon monoxide analysis was not performed due to a lack of suitable specimen. Cyanide analysis was not performed due to a lack of suitable specimen. No Ethanol detected in muscle fluid. No Ethanol detected in brain fluid. No Drugs detected in muscle fluid.

Passenger

56.00% Carboxyhemoglobin detected in blood. 2.620 (ug/ml) Cyanide detected in blood. No Ethanol detected in vitreous fluid. No Drugs detected in urine.

Autopsies were performed on the four persons who were on board the airplane by the Medical Examiner of Cook County, Illinois.

FIRE

The airplane's left fuel tank ignited and exploded shortly after it impacted the berm at the departure end of runway 34. A burn area within the airport boundary measuring 225 feet by 45 feet resulted. The airplane's right wing fuel tank was ruptured as it impacted Wolf Road and the vacant lot. A burn area of approximately 300 by 200 feet stretched on the north and south sides of Buffalo Creek from Wolf Road to the main wreckage.

Witnesses reported that the airplane was engulfed in flames by the time it came to a stop in the parking lot of the Foxboro Apartment complex. They reported that rescue or evacuation of the persons on board the aircraft was not possible due to the fire and smoke.

The Wheeling Fire Department responded to the airplane accident and was on scene at 1306, about four minutes after the notification. The Wheeling Fire Department's personnel were trained in airplane Crash, Fire, and Rescue procedures. They immediately

delivered water and foam fire retardants to the flames. The fire department stayed on scene until the entire accident site was secured.

Survival Aspects

Witnesses at the scene reported that the fire and smoke prevented any evacuation or rescue to the airplane's personnel.

The pilot's seat was consumed by fire. The seat belt and shoulder harness were also consumed by fire.

The PNF's seat was not consumed by fire. It could not be determined if the seat belt and shoulder harness were fastened at the time of impact. The PNF's shoulder harness straps were found inside the inertial reel and undamaged by fire or smoke. However, pilots who had flown with the PNF stated during interviews that he routinely secured his seatbelt and shoulder harness for every takeoff and landing.

The flight attendant was found near the bulkhead near the main cabin door. She was not in a seat and it could not be determined where she was originally positioned during takeoff.

The passenger was located in his seat in the main cabin. His seatbelt had been destroyed.

TESTS AND RESEARCH

Fault Warning Computer

The Gulfstream IV, N23AC, was equipped with a Honeywell FC-880 Fault Warning Computer (FWC). The FWC had trend and limit monitoring software that acted as a data acquisition and storage system for recording aircraft, engine and auxilary power unit data under various circumstances. The data storage function operated automatically with no operator interface required.

The FWC recorded engine trend data during cruise flight and takeoff. The FWC was designed to record engine and aircraft parameters if it detected an engine limit being exceeded.

The FWC was also designed to take a "snapshot" of engine data during takeoff for trend analysis purposes. The snapshot was recorded when the airplane reached 100 knots (+ a possible one second delay) during the takeoff roll for every flight.

The non-volitale memory of the N23AC's FWC was "read-out" after the accident. The read-out indicated that there had not been any engine exceedences recorded by the FWC during the entire takeoff and accident sequence. Since no engine exceedences

had occurred, there was no data acquired.

The FWC did record the "snapshot" at 100 knots during the takeoff roll. It could not be determined exactly where on the runway the snapshot occurred, nor could it be correlated to the CVR tape. The following information was included in the snapshot:

Date of Engine Trend Recording 10/30/96

Time GMT 1859

Pressure Altitude 798 ft.

Mach 0.162

Gross Weight 66,050 lbs.

Static Air Temperature 5.5 C

Calculated Airspeed 112.5 kts.

Angle of Attack 0.258

Auto Throttle Mode On

Left Engine Right Engine

Engine Pressure Ratio 1.703 1.708

N-2 93.9% 93.6%

N-1 90.6% 91.1%

Turbine Gas Temp. 694 C 695 C

Fuel Flow 6262 pph 6372 pph

Fuel Quantity Left Side: 11,625 pounds

Fuel Quantity Right Side: 10,672 pounds

Ground Proximity Warning System (GPWS)

The Gulfstream IV, N23AC, had a Sundstrand, model MKV, GPWS installed. The non-volatile memory read-out indicated that no significant faults monitored by the GPWS had occurred on the 9 previous flights prior to the accident flight.

Nose Wheel Steering System

Components from N23AC's brake and steering system were shipped to the Gulfstream facilities in Savannah, Georgia, for examination and testing. The results indicated that no pre-existing anomalies were present at the time of the accident. (See Systems Group Chairman's Report)

Powerplants

The engines and engine components were shipped to the Rolls Royce facilities in Montreal, Canada, for examination by the Powerplants Group. The examination did not reveal any pre-existing failures or conditions that would have prevented normal engine operation.

Warning Messages, Lights, and Tones

The airplane was equipped with a Crew Alerting System (CAS) message system which provided for Warning (red), Caution (amber), and Advisory (blue) messages to the flight crew. A tone generator also provided various tones to alert the flight crew. Any red message would cause three chimes to be emitted, and any amber message would cause two chimes to be emitted, and any blue message would cause a single chime to be emitted.

The CVR revealed that numerous chimes sounded while the flight crew was conducting the preflight and before takeoff checks. The CVR indicated that no chimes were emitted between the time when the flight crew received the clearance for takeoff at 1259:13, and when the rumbling sounds similar to that of an aircraft departing the runway were recorded at 1300:01. At 1300:02, the sound of a triple chime was recorded.

ADDITIONAL INFORMATION

Parties to the investigation included the Federal Aviation Administration, Gulfstream Aerospace Corporation., Rolls-Royce, Inc., Alberto-Culver USA, Inc., Aon Corporation, National Business Aircraft Association, Inc. (NBAA), Honeywell Inc., Hydro-Aire, Inc., Gar-Kennon, Inc., Pneudraulics, Inc., Messier-Dowty, Inc., Aircraft Braking Systems, Tactair Fluid Controls, Inc., and the National Air Traffic Controllers Association (NATCA).

The aircraft wreckage and CVR tape were released to the Associated Aviation Underwriters. The rudder actuator was not recovered from the wreckage site. (See Rudder Actuator Appendix) The Gulfstream Computerized Maintenance Program, COP's pilot logbook, N23AC's engine logbooks (2), N23AC's aircraft logbook, and Illustrated Parts Manual, Vol. 1 and 2 were released to Alberto-Culver.

Synopsis

The flightcrew of a Gulfstream G-IV began taking off on Runway 34 with a crosswind from 280 deg at 24 kts. About 1,340 feet after the takeoff roll began, the airplane veered left 5.14 deg to a heading of 335 deg. It departed the runway, and tire marks indicated no braking action was applied. One of the pilots said, "Reverse," then one said, "No, no, no, go, go, go, go, go." The airplane traversed a shallow ditch that paralleled the runway, which resulted in separation of both main landing gear, the left and right flaps, and a piece of left aileron control cable from the airplane. The airplane became airborne after it encountered a small berm at the departure end of the runway. Reportedly, the left wing fuel tank exploded. The main wreckage was located about 6,650 ft from the start of the takeoff roll. Examination of the airplane indicated no pre-existing anomalies of the engines, flight controls, or aircraft systems. The Nose Wheel Steering Select Control Switch was found in the "Handwheel Only" position, and not in the "Normal" position. The pilot-in-command (PIC) routinely flew with the switch in the "Normal" position. The PIC and copilot (pilot-not-flying) comprised a mix crew in accordance with an Interchange Agreement between two companies which operated G-IV's. The companies' operation manuals and the Interchange Agreement did not address mixed crews, procedural differences, or aircraft difference training.

Probable Cause

The National Transportation Safety Board determines the probable cause(s) of this accident as follows: failure of the pilot-in-command (PIC) to maintain directional control of the airplane during the takeoff roll in a gusty crosswind, his failure to abort the takeoff, and failure of the copilot to adequately monitor and/or take sufficient remedial action to help avoid the occurrence. Factors relating to the accident included the gusty crosswind condition, the drainage ditch, the flight crew's inadequate preflight, the Nose Wheel Steering Control Select Switch in the "Handwheel Only" position, and the lack of standardization of the two companies' operations manuals and Interchage Agreement.