UNITED STATES AIR FORCE AIRCRAFT ACCIDENT INVESTIGATION BOARD REPORT

C-130H, T/N 88-4404

95TH AIRLIFT SQUADRON

440TH AIRLIFT WING

POPE ARMY AIR FIELD, NC

C-27J, T/N 10-27030

USASOC FLIGHT COMPANY

US ARMY SPECIAL OPERATIONS COMMAND

FORT BRAGG, NC

LOCATION: NEAR POPE ARMY AIR FIELD, NORTH CAROLINA

DATE OF ACCIDENT: 1 DECEMBER 2014

BOARD PRESIDENT: COL MATTHEW G. ANDERER

CONDUCTED IAW AIR FORCE INSTRUCTION 51-503

ACTION OF THE CONVENING AUTHORITY 12 MAR 2015

An accident investigation board investigated the midair collision that occurred 1 December 2014 approximately eight miles south of MacKall AAF, North Carolina, involving a C-130H, T/N 84-4404, assigned to the 440th Airlift Wing, Pope AAF, North Carolina, and a C-27J, T/N 10-27030, assigned to the United States Army Special Operations Command Flight Company, Fort Bragg, North Carolina. The investigation was conducted under the provisions of AFI 51-503, and the report of the board complies with applicable regulatory and statutory guidance. Accordingly, the board's report is approved.

BROOKS L. BASH
Lieutenant General, USAF
Vice Commander

AIRCRAFT ACCIDENT INVESTIGATION BOARD
C-130H, T/N 88-4404 and C-27J, T/N 10-27030
Pope Army Air Field, North Carolina
1 December 2014

EXECUTIVE SUMMARY

On 1 December 2014, at approximately 2022 local time, a C-130H, tail number (T/N) 88-4404, assigned to the 440th Airlift Wing, Pope Army Air Field (AAF), North Carolina and a United States Army C-27J, T/N 10-27030, assigned to the United States Army Special Operations Command Flight Company, Pope AAF, North Carolina collided approximately 8 miles south of Mackall AAF, North Carolina. Both aircraft declared emergencies and landed safely, the C-27 to Mackall AAF and the C-130 to Pope AAF. There were no injuries to the eight C-130 crewmembers or the five C-27 crewmembers. Damage estimates for the C-27 are still ongoing. The government loss for the C-130 and associated cleanup was valued at $1,837,649.93.

At the time of the incident, the mishap C-130 was performing an escape maneuver to egress Luzon Drop Zone (DZ) following completion of a visual Container Delivery System airdrop. The mishap C-27 was departing Laurinburg-Maxton Airport enroute to two waypoint DZs for simulated airdrops. The C-130 was leveling at 1500’ Mean Sea Level (MSL) on a heading of 193 degrees while the C-27 was level at 1500’ MSL, on a heading of approximately 310 degrees passing slightly beneath the C-130 from left to right. The right wingtip of the C-27 grazed the right underside of the C-130 at the nose gear door, damaging the gear door and following a path that tore the flare dispenser hood from the fuselage and then proceeded beneath the C-130’s right wing. The C-27 vertical stabilizer crossed immediately in front of the nose of the C-130 and proceeded between the prop arcs of the C-130’s number 3 and 4 engines. The vertical stabilizer then came into contact with the front of the C-130’s right external fuel tank and continued on a path impacting midway down the inboard side of the number 4 engine and leading edge of the right wing in the vicinity of the engine mount. The C-130 sustained damage to the leading edge of the right wing and number 4 engine. The C-27 sustained significant damage to the top third of the vertical stabilizer and rudder.

The Accident Investigation Board President found by clear and convincing evidence that the cause of the mishap was a breakdown in visual scan resulting in insufficient clearing of the aircraft flight path by both aircrews. The AIB President found that both aircrews were over-reliant on Traffic Collision Avoidance Systems to alert them to potential traffic conflicts and concentrate their visual scan. Additionally, the AIB President found that both aircrews exhibited complacency due to the routine nature of the mission profiles, despite the inherent risk associated with night, low-level, visual flight rules operations on Night Vision Goggles. The AIB President further found that the visibility afforded by the C-27 is limited, presenting a considerably obstructed view for the left-seat pilot who was flying, limiting his ability to see the C-130 approaching from the right with sufficient time to avoid collision. Lastly, the AIB President found the pilot flying from the left seat of the C-130 channelized his attention on aircraft control resulting in a loss of situational awareness and breakdown of visual scan outside the aircraft.

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COMMONLY USED ACRYONYMS AND ABBREVIATIONS

AAF	Army Air Field
AFB	Air Force Base
AFI	Air Force Instruction
AFIP	Armed Forces Institute of Pathology
AFPAM	Air Force Pamphlet
AFPET	Air Force Petroleum Agency
AFRC	Air Force Reserve Command
AFSEC	Air Force Safety Center
AG	Airlift Group
AGL	Above Ground Level
AIB	Accident Investigation Board
AMC	Air Mobility Command
AMXS	Aircraft Maintenance Squadron
ARSOAC	Army Special Operations Aviation Command
AR	Army Regulation
ART	Air Reserve Technicians
AS	Airlift Squadron
ATC	Air Traffic Control
ATCT	Air Traffic Control Tower
ATIS	Automatic Terminal Information Service
AW	Airlift Wing
CDS	Container Delivery System
CF	Carried Forward
CVR	Cockpit Voice Recorder
CW4	Chief Warrant Officer, Four
DA	Department of the Army
DA PAM	Department of the Army Pamphlet
DCMA	Defense Contract Management Agency
DFDR	Digital Flight Data Recorder
DoD	Department of Defense
DZ	Drop Zone
EOR	End of Runway
FA	Flight Authorization
FAA	Federal Aviation Administration
FAY	Fayetteville Regional/Grannis Field Airport
FM	Field Manual
FDAU	Flight Data Acquisition Unit
FDP	Flight Duty Period
FDR	Flight Data Recorded
GFR	Government Flight Representative
GMT	Greenwich Mean Time
HE	Heavy Equipment
Herc	C-130 Hercules
HF	High Frequency
HFACS	Human Factors Analysis and Classification System
HSC	Home Station Checks
HVCDS	High Velocity Container Delivery System
IAW	In Accordance With
IFF	Identification Friend or Foe
IFR	Instrument Flight Rules
IMDS	Integrated Maintenance Data System
INOP	Inoperative
IP	Initial Point
ISO	Isochronal Inspections
LRF	Local Range Forecast
LRS	Logistics Readiness Squadron
LZ	Landing Zone
MEL	Minimum Equipment List
MCP	Mishap Co-Pilot
MFE	Mishap Flight Engineer
MIL	Mishap Instructor Loadmaster
MIP	Mishap Instructor Pilot
ML	Mishap Loadmaster
MN	Mishap Navigator
MP	Mishap Pilot
MSL	Mean Sea Level
MTP	Maintenance Test Pilot
NOTAMS	Notices to Airmen
NM	Nautical Miles
NVD	Night Vision Device
NVG	Night Vision Goggle
ORM	Operational Risk Management
PDM	Programmed Depot Inspections
PHA	Preventative Health Assessment
PFPS	Portable Flight Planning System
PI	Point of Impact
Q-1	Qualified without Restrictions
QCD	Quality Control Designee (QCD)
REL	Required Equipment List
RTB	Return to Base
SIB	Safety Investigation Board
SKE	Station-Keeping Checklist
STAN	Standardization (STAN)
STS	Special Tactics Squadron
TA/RA	Traffic Advisory/Resolution Advisory
TBA	Training Business Area
TCAS	Traffic Collision Avoidance System
TCTO	Time Compliance Technical Order
TI	Technical Inspector
T.O.	Technical Order
TOLD	Takeoff and Landing Data
TOT	Time on Target
TRACON	Terminal Radar Approach Control

UFC	United States Army Special Operations Command Flight Company
USASOC	United States Army Special Operations Command
USSOCOM	United States Special Operations Command
VFR	Visual Flight Rules
VLL	Visual Low-Level
XPDR	Transponder
Z	Zulu or Greenwich Mean Time (GMT)

AIRCRAFT ACCIDENT INVESTIGATION BOARD
C-130H, T/N 88-4404 and C-27J, T/N 10-27030
Pope Army Air Field, North Carolina
1 December 2014

SUMMARY OF FACTS

1. AUTHORITY AND PURPOSE

a. Authority

On 9 December 2014, Lieutenant General Brooks Bash, Vice Commander, Air Mobility Command (AMC), convened an Accident Investigation Board (AIB) in accordance with Air Force Instruction (AFI) 51-503, Aerospace Accident Investigations, to investigate the 1 December 2014 midair collision of a U.S. Air Force C-130H aircraft, tail number (T/N) 88-4404, and a U.S. Army C-27J, (T/N) 10-27030, 31 miles southwest of Pope Army Airfield (AAF), near Mackall AAF, North Carolina (Tab Y-3). The following board members served on the AIB: Colonel Matthew G. Anderer, Commander, 721st Air Mobility Operations Group, Ramstein Air Base, Germany, Board President; a Lieutenant Colonel Medical Member; a Major Pilot Member; a Major Maintenance Member; a Captain Legal Advisor; a Master Sergeant Air Traffic Control Member; and a Staff Sergeant Recorder (Tabs Y-3, Y-6). In addition to the board members, two Functional Area Experts (FAEs) were also appointed: a Lieutenant Colonel Army Investigating Officer FAE, and a Captain Flight Medicine FAE. This investigation was conducted at Pope AAF, North Carolina from 6 January 2014 through 4 February 2015.

b. Purpose

This is a legal investigation convened to inquire into the facts surrounding the aircraft or aerospace accident, to prepare a publicly-releasable report, and to gather and preserve all available evidence for use in litigation, claims, disciplinary actions, administrative proceedings, and for other purposes.

2. ACCIDENT SUMMARY

On 1 December 2014, at 0122 Zulu (Z), 2022 local (L), 1500' MSL approximately 8 miles south of Mackall AAF, North Carolina, a C-130H, T/N 88-4404, assigned to the 440th Airlift Wing, Pope Army Airfield, North Carolina, that was performing a post-drop escape maneuver from the Luzon Drop Zone on a local area training mission, collided with a C-27J, T/N 10-27030, assigned to the U.S. Army Special Operations Command Flight Company, that was conducting pilot proficiency and upgrade training. The right wingtip of the mishap C-27 grazed the right underside of the mishap C-130 at the nose gear door, damaging the right wingtip of the mishap C-27 while damaging the gear door and tearing the flare dispenser hood from the mishap C-130. The mishap C-27's vertical stabilizer then crossed immediately in front of the nose of the mishap C-130 and proceeded between the propeller arcs of the mishap C-130's number three and four engines, striking the front of the right external fuel tank and impacting the inboard side of the number four engine and leading edge of the right wing near the engine mount. The mishap

C-130 sustained damage to the leading edge of the right wing and the number four engine was disabled. The top third of the mishap C-27's vertical stabilizer was shorn. Both aircraft were able to execute emergency landings; the mishap C-130 at Pope Army Airfield approximately 31 miles to the northeast and the mishap C-27 at Mackall Army Airfield.

There were no fatalities, significant injuries, or damage to civilian property. The estimated loss for the mishap C-27 has not yet been determined, but the estimated loss for the mishap C-130 and associated cleanup was valued at $1,837,649.93.

3. BACKGROUND

a. Air Mobility Command

AMC is a major command headquartered at Scott AFB, Illinois. AMC provides worldwide cargo and passenger delivery, air refueling and aeromedical evacuation. The command also transports humanitarian supplies to hurricane, flood and earthquake victims both at home and around the world. AMC's mission is to provide global air mobility…right effects, right place, right time. More than 133,700 active-duty Air National Guard, AFRC and Department of Defense (DoD) civilians make the command's rapid global mobility operations possible (Tab CC-3).

b. Air Force Reserve Command

AFRC, with headquarters at Robbins AFB, Georgia, became the ninth major command of the Air Force on 17 February, as a result of Title XII – Reserve Forces Revitalization – in Public Law 104-201, the National Defense Authorization Act of Fiscal Year 1997. The mission of the AFRC is to provide combat ready forces to fly, fight and win. Reservists support nuclear deterrence operations, air, space and cyberspace superiority, command and control, global integrated intelligence surveillance reconnaissance, global precision attack, special operations, rapid global mobility and personnel recovery. They also perform space operations, aircraft flight testing, aerial port operations, civil engineer, security forces, military training, communications, mobility support, transportation and services missions (Tab CC-6).

c. 440th Airlift Wing

The mission of the 440 AW is to maintain operational readiness for the airlift of tactical units, airborne units, personnel, supplies and equipment into prepared or unprepared areas by landing or airdrop. The peacetime and wartime mission of the 440 AW is global in scope. During wartime, when mobilized, the 440 AW would be under the operational control of AMC (Tab CC-9).

d. 95th Airlift Squadron

The 95 AS is the flying unit of the 440 AW. The 100+ pilots, navigators, flight engineers, load masters and support specialists fall under the 440th Operations Group. The 95 AS flies the C-130H2 Hercules transport aircraft (Tab CC-13).

e. C-130H Hercules

The C-130H Hercules primarily performs the tactical portion of the AMC airlift mission. The aircraft, capable of operation from rough, dirt strips, is the prime transport for airdropping troops and equipment into hostile areas. The C-130H, operating throughout the DoD, executes a wide-range of operational missions in both peacetime and wartime situations. The aircraft is capable of executing diverse missions, including airlift support, Antarctic resupply, aeromedical evacuation, weather reconnaissance, aerial spray, humanitarian relief and wild land firefighting (Tab CC-15).

f. United States Army Special Operations Command

On 1 December, 1989, the Department of the Army established USASOC at Fort Bragg, N.C., as a major Army command to enhance the readiness of Army special operations forces.

In addition to reporting to the Department of the Army, USASOC also functions as the Army component of the U.S. Special Operations Command (USSOCOM), located at MacDill AFB, Florida. USSOCOM is the congressionally mandated, unified combatant command responsible for all DoD special operations forces within the Army, Navy, AF and Marine Corps (Tab CC-19).

g. Army Special Operations Aviation Command

ARSOAC organizes, mans, trains, resources and equips Army Special Operations Aviation units to provide responsive, special operations aviation support to Special Operations Forces and is the USASOC Aviation staff proponent.

This structure provides the appropriate command and control, manning and visibility for the complex and sensitive tasks required of Army Special Operations Forces aviation units and organizations. ARSOAC is a one-star, subordinate command to the USASOC (Tab CC-22).

h. C-27J Spartan

The C-27J Spartan is a twin turboprop medium-sized tactical military transport aircraft with exceptional short takeoff and landing capabilities. It is designed for transporting equipment or troops in combat zones and operating in an austere environment with minimal ground support. The C-27J brings to USASOC the capability to conduct pressurized flight for high altitude jump training, tactical vehicle load training, increased payload for jump and aerial delivery training, and vastly increased speed and range for supporting Army Special Operations Forces (Tab CC-27).

i. Laurinburg-Maxton Airport (KMEB), NC

Laurinburg-Maxton Airport is an uncontrolled airport located approximately three miles north of Maxton, NC and 16 miles southeast of Mackall AAF, NC. The airport is used for military, farming, and parachute operations. Laurinburg-Maxton Airport has two active runways, the 6,503 foot long runway 05/23 and the 3,534 foot long runway 13/31. Fayetteville Air Traffic Control Tower/Terminal Radar Approach Control (FAY ATCT/TRACON) provides approach, departure and clearance delivery functions for aircraft operating under Instrument Flight Rules (IFR) (Tab CC-31).

j. Mackall Army Airfield (KHFF), NC

Mackall AAF is a military airfield located on Camp Mackall near Southern Pines, NC. The airport is used for military operations. Mackall AAF has 2 active runways, the 4,996 foot long runway 04/22 and the 4,794 foot long runway 11/29.

Mackall AAF has an air traffic control tower (ATCT), Mackall Tower, responsible for the Class D airspace extending upward from the surface to 2,900’ mean sea level (MSL) within a 4.2-mile radius around Mackall AAF, during its hours of operation. FAY ATCT/TRACON provides IFR approach control services to Mackall AAF and radar advisory services to aircraft exiting Mackall AAF’s Class D airspace upon request (Tab CC-30).

In Class D airspace, aircraft establish two-way radio communications with the servicing ATC facility prior to entering the airspace and maintain communications while in the airspace. ATC facilities are not required to provide separation services to VFR aircraft (BB-33).

k. Fayetteville Air Traffic Control Tower/Terminal Radar Approach Control (FAY ATCT/TRACON)

FAY ATCT/TRACON is located three miles south of Fayetteville, North Carolina at Fayetteville Regional/Grannis Field Airport.

In addition to providing radar approach control services for smaller airfields in the area, FAY ATCT/TRACON is responsible for the class C airspace extending upward from the surface to 4,200’ MSL within a five mile radius around FAY excluding that airspace below 1,400’ MSL within a 1.5-mile radius of Gray's Creek Airport. It is also responsible for Class C airspace within a 10-mile radius around the airport extending upward from 1,400’ MSL to 4,200’ MSL excluding that airspace contained within active Restricted Areas (Tab BB-29).

In Class C airspace, aircraft establish two-way radio communications with the servicing ATC facility prior to entering the airspace and maintain communications while in the airspace. VFR aircraft are only separated from IFR aircraft within the airspace (Tab BB-32 to BB-33).

The mishap C-130 was assigned to the 440th Airlift Wing (440 AW), Air Force Reserve Command (AFRC), and based at Pope Army Airfield (AAF), North Carolina. The mishap C-130 aircrew included six reserve members assigned to the 95th Airlift Squadron (95 AS), augmented by a navigator assigned to the 43rd Airlift Group (43 AG). The 95 AS is a squadron within the 440 AW, while the 43 AG is a component within Air Mobility Command (AMC). The mishap C-27 was assigned to the U.S. Army Special Operations Command Flight Company (UFC), U.S. Army Special Operations Aviation Command (ARSOAC), and based at Pope AAF, North Carolina. The mishap C-27 aircrew included two active duty members and two Army civilian employees assigned to the UFC, which is a component of ARSOAC under the U.S. Army Special Operations Command (USASOC), augmented by one contract employee of LMT Inc.

4. SEQUENCE OF EVENTS

a. Mission

PACKR32, hereafter referred to as mishap C-130, was scheduled for a local tactical training flight from Pope AAF, North Carolina (Tab K-5). The mishap C-130 had a crew composed of one instructor pilot (MIP2), a mission pilot (MP3), a mission co-pilot (MCP), a mission navigator (MN), a mission flight engineer (MFE3), an instructor loadmaster (MIL), and two loadmasters (ML1 and ML2) (Tab K-5). All crew members were current and qualified for the mission with the exception of ML1 who was qualified, but flying supervised by MIL due to loss of currency (Tabs K-5; G-150). Planned mission tasks included a two-ship formation with PACKR31 under the call-sign PACKR30, flying a Station-Keeping Equipment (SKE) Checklist route to a Heavy Equipment airdrop, followed by a VFR low level route to a High Velocity Container Delivery System (HVCDS) airdrop, and finishing with proficiency training for the Pilots at Pope AAF (Tabs V-5.5; V-6.8). SKE is a formation positioning system that allows aircraft to fly in formation in all-weather conditions while a HVCDS airdrop involves placing the aircraft at a slightly nosed-up angle to utilize gravity to cause the load to roll out of the aircraft and parachute out of the aircraft (Tabs V-5.5; V-8.14). Within twenty minutes after takeoff, PACKR31 aborted its mission due to an aircraft malfunction, so the mishap C-130 flew the planned profile single-ship, retaining call-sign PACKR30 (Tab V-5.7). The mission was authorized by the 95 AS Director of Operations (Tab K-5).

GECKO33, hereafter referred to as mishap C-27, was scheduled for a local training flight from Pope AAF (Tab K-6). The mishap C-27 had a crew composed of an instructor pilot (MIP1), two mission pilots (MP1 and MP2), and two flight engineers (Tab K-6; V-17.4). All crew members were current and qualified for the mission (Tabs G-168; G-171; G176; T-7; T-30). MP2 was conducting Night Vision Goggle (NVG) Pilot in Command training while MP1 was conducting NVG Instructor Pilot training (Tab V-16.5). MFE2 was evaluating MFE1 for NVG currency (Tab V-19.4). Planned mission tasks included NVG traffic patterns and two simulated airdrops with MP2 flying in the left seat, then a seat swap amongst the pilots followed by NVG traffic patterns and two more simulated airdrops with MP1 in the right pilot seat, acting as an instructor (Tabs V-17.9; V-17.18). The mission was authorized by UFC (Tab K-6).

b. Planning

The mission planning of the mishap C-130 was accomplished in accordance with 440th Airlift Wing (AW) standards. MP3's duty day began at approximately 1330 Zulu (Z), 0830 Local (L), seven hours and twenty minutes prior to the mission briefing and ten hours and thirty minutes prior to scheduled take-off. MP3 prepared the mission data card, reviewed the weather conditions, reviewed the Notices to Airmen (NOTAMS), verified airdrop scheduling on the Air Movement Table, and signed the DD-175 Flight Plans (Tabs F-2; F-4; F-5; K-2; K-3; K-7 to K-9; K-13). MP3 signed the Operational Risk Assessment, acknowledging a risk level of Green, the lowest category of overall risk (Tab K-10). MP3 also acknowledged an elevated individual Operational Risk Assessment score for seven of eight crew members (Tab K-10). MP3 initialed the Flight Authorization (FA), verifying accomplishment of Go/No-Go checks on all aircrew members, and initialed the Aircraft Commander preflight checklist, verifying accomplishment of all preflight duties (Tabs K-5; K-13). MP3 briefed the formation, as planned, and all crew members understood the mission profile and tasks (Tab V-9.9 to V-9.10).

The mission planning of the mishap C-27 was also accomplished in accordance with UFC standards. MP1 and MP2 prepared the Portable Flight Planning System (PFPS) logs and charts approximating the planned flight path (Tab V-15.6 to V-15.7). MIP1 completed all other mission products and reviewed the weather products and NOTAMS (Tabs K-4; K-6; K-11; K-15). MIP1 signed the Operational Risk Assessment, acknowledging a risk level of Low, the lowest category of overall risk (Tab K-11). MP2 briefed the other two pilots on the training planned for them that night (Tab V-17.17).

c. Preflight

All required maintenance preflight actions for the mishap C-130 were complete and annotated in the aircraft forms (Tabs D-4; D-5; D-8; D-9). With the assistance of MCC1 and MCC2, the crew chiefs, members of the aircrew preflight-checked the aircraft and found it to be ready for flight (Tabs V-9.4; V-9.24 to V-9.25; V-12.3). MP3 reviewed the aircraft maintenance forms binder to confirm the aircraft was in a satisfactory condition for the planned flight (Tab V-3.42).

All required maintenance preflight actions for the mishap C-27 were complete and annotated in the aircraft forms (Tabs D-14; D-16 to D-18). MIP1 reviewed the forms, noting only one entry of significance: the Traffic Collision Avoidance System (TCAS) was reported for failing frequently in flight, but was able to be successfully reset (Tab D-19).

d. Takeoff and Initial Routes

The mishap C-27 performed an uneventful takeoff at 2253Z (1753L), departing to the south-west towards point LORRY, an IFR waypoint recognized by ATC for transitioning out of controlled airspace (Tabs K-4; DD-31). After exiting controlled airspace and arriving at Laurinburg-Maxton Airport, the mishap C-27 experienced difficulties controlling the approach light settings at Laurinburg-Maxton Airport during the NVG traffic pattern training for MP2 (Tab V-17.19). MIP1 assessed it to be the result of another aircraft clicking the microphone to select high light intensity at another airfield in the area that used the same common pilot controlled lighting frequency (Tab V-17.19). The brightness of the high intensity lighting at Laurinburg-Maxton

Airport prevented the mishap C-27 aircrew from being able to effectively see the runway with their NVGs (Tabs V-16.5 to V-16.6; Tab V-17.19; V-15.23 to V-15.24).

The mishap C-27 performed several landings at Laurinburg-Maxton Airport without NVGs, but, rather than waiting for the lighting to go back down to a level suitable for NVGs, the mishap C-27 temporarily discontinued the landing training and transitioned northwest to the Uwharrie Forest area for the planned simulated airdrops (Tabs V-17.9; V-15.26). During one of the landings at Laurinburg-Maxton Airport, the TCAS failed (Tab N-8). MIP1 elected to "store" the TCAS fault that occurred during taxi at Laurinburg-Maxton Airport to avoid the distraction of continual notification (Tab N-8). While en route to the Uwharrie Forest area and passing inside the southwest boundary of Mackall Tower's airspace, MIP1 contacted Mackall Tower (Tab N-72). Upon check-in, Mackall Tower advised the mishap C-27 to recycle the aircraft transponder as its signal was not received (Tab N-72). MIP1 turned off the transponder, then turned it back on and selected the Traffic Advisory/Resolution Advisory (TA/RA) setting (Tab V-17.28). MIP1 informed Mackall Tower that it had recycled its transponder but Mackall Tower stated that its signal was still not received (Tab N-72). There was no further communication regarding the status of the mishap C-27's transponder prior to the mishap C-27 changing frequencies at 0007Z (1907L) before leaving Mackall Tower's airspace (Tab N-72).

At 2356Z (1856L), one hour later after mishap C-27's takeoff, PACKR 31 and the mishap C-130 performed a normal formation takeoff and departed on the SKE23 route, aircrew and ATC (Tabs K-2 to K-3; DD-31). A "common" route, the SKE 23 was also called the "Heavy CDS SKE visual flight route" (Tab V-4.10). PACKR31 aborted the route approximately twenty minutes after takeoff, performed a lead change with the mishap C-130, and recovered back at Pope AAF at 0035Z (1935L) (Tabs V-5.6 to V-5.7; DD-31). The mishap C-130 continued the planned profile and simulated formation lead procedures in order to continue MP3's training (Tab V-5.7 to V-5.8).

At 0015Z (1915L), approximately the time the mishap C-130 was reduced to a single-ship formation, the mishap C-27 contacted Mackall Tower to inform them that they would be transitioning near Mackall Tower's Class D airspace, from the west to the south (Tab N-73). Mackall Tower approved the transition, without additional reference to the Mishap C-27's inoperable transponder (Tab N-73). The mishap C-27 crew stated they would switch frequency as they transitioned back to Laurinburg-Maxton Airport's airspace (Tab N-73). Fifteen minutes later, at 0033Z (1933L), the mishap C-130 reported on frequency with Mackall Tower, inbound for the Heavy Equipment airdrop (Tab N-75). The two aircraft were never using Mackall Tower's frequency for primary ATC at the same time (Tab N-73 to N-79).

e. First Encounter

Beginning at 0033Z (1933L), the mishap C-130 flew the SKE 23 route through the Heavy Equipment airdrop to the escape (Tabs K-2, K-3; N-75). This routing turned the mishap C-130 south from the Luzon Drop Zone (DZ), followed by a turn east to fly around Laurinburg-Maxton Airport for transition to the VFR Low Level route (Tab V-5.32 to V-5.34). MIP2 visually acquired, unaided, what appeared to be co-altitude traffic as the mishap C-130 flew south (Tab V-5.34). MIP2 referenced the TCAS display and noted traffic approximately seven miles away that appeared to be flying near Laurinburg-Maxton Airport (Tab V-5.35).

During the mishap C-130's Heavy Equipment airdrop and escape, the mishap C-27 performed pattern work at Laurinburg-Maxton. Just prior to the mishap C-27's turn from crosswind to downwind for a landing at Laurinburg-Maxton Airport, MIP1, sitting in the right seat of the mishap C-27 and looking out of the right window, visually acquired traffic straight ahead at approximately co-altitude and assessed it as no factor (Tab N-32). Radar showed the mishap C-130 and an unidentified target in the location of the mishap C-27 passing each other at 0045Z (1945L), approximately 2.7 miles apart (Tab DD-44 to DD-45). Both aircraft exercised "see-and-avoid" at this time.

At 0049Z (1949L), the mishap C-27 reported back on frequency with Mackall Tower (Tab N-76). During this exchange, the mishap C-27 queried the traffic status in the Mackall Tower's airspace, at which point the controller advised of another upcoming airdrop (Tab N-76). The mishap C-27 requested permission to perform NVG traffic pattern work at Mackall AAF (Tab N-76). Mackall Tower granted permission, but stated that the policy normally required advance notice in the form of a Prior Permission Request (N-76). The mishap C-27 reported switching frequencies with an estimated return of fifteen minutes. The mishap C-27 continued to Laurinburg-Maxton for another NVG-aided landing and pilot seat swap and continued to monitor the Mackall Tower's frequency on a secondary radio (Tabs N-34; N-76). At 0055Z (1955L), the mishap C-27 landed at Laurinburg-Maxton to switch positions for the pilots (Tabs U-63; V-14.8).

f. HVCDS Run

At 0114Z (2014L), the mishap C-130 turned east at the IP on the run-in for the visual HVCDS airdrop (Tab EE-4). MCP was the Pilot Flying and MP3 was the Pilot Monitoring (Tab EE-4). MP3 reported inbound to the Luzon DZ to Mackall Tower at 0016Z (2016L) (Tab N-76). There was a short exchange between MP3 and Mackall Tower during which the controller relayed airfield information and requested a position report from the mishap C-130 (Tab EE-4). MP3 queried the crew and MN gave an approximate position to report (Tab EE-5). At 0017Z (2017L), MP3 reported the position back to Mackall Tower and Mackall Tower then advised the mishap C-130 it was clear to transition west-to-east, south of the field, over the Luzon DZ, but to report two minutes prior to the drop (Tab N-76 to N-77). The mishap C-130 passed the thirty seconds from the Slowdown point during the exchanges with Mackall Tower, so MN called "30 SECONDS TO SLOWDOWN" late and called "SLOWDOWN" at five seconds (Tab EE-6). Mackall Tower contacted the mishap C-130 shortly thereafter to inquire as to their status and MP3 acknowledged that they were now inside the two minute mark (Tab N-77).

MN and MCP reported the DZ in sight two minutes prior to the airdrop and the Luzon DZ controller cleared the crew for the airdrop (Tab EE-7). At this point, the only step remaining in the slowdown section of the checklist was to reset the flaps to a specific setting calculated for airdropping CDS at the aircraft weight of 107,000 pounds (Tab EE-7 to EE-8). There were continuous radio and interphone communications, often simultaneously, for the remainder of the time until the airdrop, including: five course alignment guidance corrections from MN; ten radio calls among MP3, MIP2, Mackall Tower, and the Luzon DZ controller; seven checklist verbalizations, three airspeed corrections from MFE3, and a request from MCP for MFE3 to engage altitude hold (Tab EE-7 to EE-9). MP3 never verbally acknowledged the checklist call to reset the flaps to the HVCDS setting, but the Slowdown checklist was called complete (Tab EE-8 to EE-10). MN called “Green Light” at 2019:47L and the HVCDS exited seven seconds later at which point ML2 reported “Load Clear” (Tab EE-10) MCP initiated an immediate escape and changed received the “strike report” from the Luzon DZ controller, providing a location on where the HVCDS landed (Tab EE-10 to EE-11). MN began briefing the next turn to the pilots while the crew completed the Post-Drop Checklist (Tab EE-12 to E-14).

From 0055Z (1955L) up to the point where the mishap C-130 had been within two minutes of its HVCDS drop, the mishap C-27 had remained on the ground at Laurinburg-Maxton Airport during which time MIP1 moved from the right to the left pilot seat, MP1 moved into the right pilot seat, and MP2 assumed jump seat pilot duties in the rear. (Tab V-17.21 to V-17.23). The mishap C-27 took off from Runway 05 at 0118Z (2018L), turning left on departure to head northwest towards the Uwharrie Forest area (Tabs N-63 to N-64; N-67).

g. Collision

At 0120Z (2020L), as the mishap C-27 climbed to 1500’ MSL, Mackall Tower gave the mishap C-130 a frequency change approval following their airdrop shortly before the mishap C-27 completed the After Takeoff checklist (Tab N-67 to N-68). MIP1 then engaged the auto throttle as well as the navigation function of the auto-pilot (Tab N-68). After leveling, MIP1 directed MP1 to input a plot of Mackall Tower’s airspace for viewing on the Multi-Function Display at 0121:56Z (2021:56L) (Tab N-69). MP1 inputted the plot but had to look down at the controls at the center pedestal to verify the accuracy of the plot (Tabs N-69; V-15.26 to V-15.27; V-16.21). The mishap C-27 began on a heading of approximately 310 degrees at 160 knots (Tabs N-67 to N-68; DD-34). MP2 was behind MIP1 and MP1 in the jump seat position monitoring the mishap C-27’s fuel on an overhead panel (Tabs V-17.23; V-16.11 to V-16.12).

At 0122:06Z (2022:06L) MP3 informed MCP that he would be taking over Pilot Flying duties (Tab EE-14). MCP assumed Pilot Monitoring within four miles of the next turn-point (Tab EE-14). Eleven seconds later MN pointed out a tower two miles away that is on the far side of the turn-point, a road intersection (Tab EE-15). MCP and MN then viewed and discussed the turn-point through the right side of the window (Tab V-4.15). The mishap C-130 was on a heading of 193 degrees at 211 knots leveling down to 1500’ MSL (Tab DD-34; EE-34).

After the mishap C-27 climbed to 1500’ MSL, the mishap C-130 and mishap C-27 approached each other at relative bearings of approximately 340 and 160 degrees (DD-45). From 0120:40Z to 0122:40Z, the relative bearing remained nearly constant (Tab DD-45 to DD-48). At approximately 0122:40Z (2022:40L), the aircraft collided midair at N34°54’14.47272” W079°27’4.67316” (Tab DD-48).

On the mishap C-130, MN saw a brief impression of an aircraft light and airplane portals prior to impact and remarked “I think we hit another aircraft” as soon as the impact occurred (Tabs V-6.14; EE-14). MCP saw a flash of light that seemed to occur simultaneously to the sound of the impact (Tab V-4.15). The mishap C-130 crew felt a yaw to the right accompanied by a slight right roll upon contact (Tab V-5.22; V-4.31; V-6.16; V-9.16; V-7.18; V-10.8).

On the mishap C-27, MIP1 sensed the presence of another aircraft immediately prior to the midair due to a darkening of all ambient light on the right side of the mishap C-27 save for the appearance of a single light reflecting off the bottom of the dark shape (Tab V-17.40 to V-17.41). The mishap C-27 crew did not sense any noticeable pitch, roll, or yaw upon impact, but noticed a momentary vertical acceleration akin to being jerked or driving over a speed bump at a rapid speed (Tabs V-17.30 to V-17.31, V-15.30 to V-15.31, V-16.14 to V-16.15, V-19.11, V-18.8).

Flying at 1500' MSL, the right wing tip of the mishap C-27 grazed the right underside of the C-130 at the nose gear door. The mishap C-130 was at 1511' MSL at the time of impact (Tab EE-34). The right wing tip of the mishap C-27 damaged the mishap's C-130's gear door, followed a path that tore the mishap's C-130 flare dispenser hood from its fuselage, and then proceeded beneath the C-130's right wing (Tabs S-4 to S-6; S-9; Figures 1; 2).

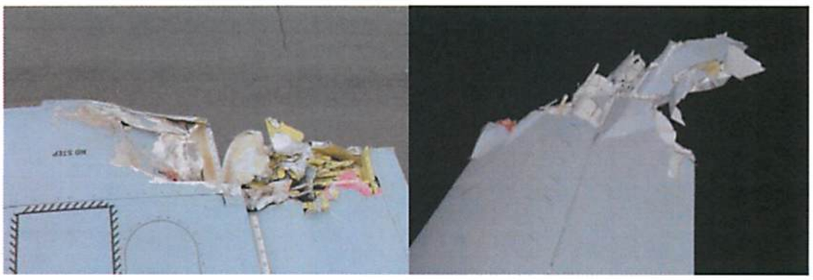


Figure 1. Mishap C-27 Right Wing Tip

Figure 2. Mishap C-130 Gear Door and Flare Dispenser Hood

The mishap C-27's vertical stabilizer crossed immediately in front of the nose of the C-130 and proceeded between the prop arcs of the C-130's number 3 and 4 engines (Tabs S-3; S-8). The mishap's C-27 vertical stabilizer then came into contact with the front of the C-130's right external fuel tank and continued on a path impacting midway down the inboard side of the number 4 engine and leading edge of the right wing in the vicinity of the engine mount (Tabs S-2 to S-3; S-6 to S-8). The mishap C-130 sustained damage to the leading edge of the right wing and number 4 engine (Tab S-3). The C-27 sustained significant damage to the top third of the vertical stabilizer and rudder (Tab S-8).

Figure 3. Mishap C-27 Vertical Stabilizer (left); Mishap C-130 Right Wing and Number Four Engine

h. Initial Actions and Recovery.

One second after impact, the propeller rotations per minute on the mishap C-130's number four engine began reducing rapidly (Tab EE-15). MP3 directed an Emergency Shutdown Procedure on engine number four (Tab EE-15). From impact through the recovery, the aircraft experienced constant vibrations that were significantly greater than any turbulence experienced by aircrew members prior to the night of the incident (Tabs V-3.23; V-5.19; V-6.16 to V.6.17; V-7.24; V-8.11; V-10.8 to V-10.9). MCP verified the selection of the number four engine Condition Lever with MFE3, and moved it to the "feather" position to stop the propeller from spinning (Tab V-4.26). The propellers failed to move to the feathered position, but instead continued to rotate, generating significant drag (Tabs EE-17; V-7.13; V-8.12). The mishap C-130 turned 27 degrees right, climbed 519', and lost 49 knots of airspeed over the course of one minute before MP3 began to stabilize control of the aircraft (Tab DD-35).

For the mishap C-27, there were no noticeable changes to aircraft performance, no visible damage detected, and no systems loss following the initial impact (Tabs V-17.32). Nevertheless, the mishap C-27 declared an emergency and performed a full stop landing at Mackall AAF in order to inspect the aircraft for damage (Tab V-17.32 to V-17.34). The emergency landing was accomplished uneventfully on Runway 04 at approximately 0126Z (2026L) (Tabs U-60; V-17.32). The mishap C-27 crew elected to shutdown engines on the landing runway due to the unknown extent of damage sustained (Tab V-17.34).

Shortly after impact, MIP2 contacted Mackall Tower and learned that the mishap C-27 had declared an emergency and would be landing there (V-5.17 to V-5.18). The mishap C-130 crew then made the decision to recover to Pope AAF via the most direct route possible, foregoing a controllability check due to the unknown condition of the aircraft and its ability to remain flyable (Tabs V-3.26; EE-28). MIP2 recommended climbing to 3000' MSL and accelerating to 180 knots (Tab EE-16 to EE-17). MP3 maintained left wing down yoke inputs and significant left rudder inputs to counteract the right roll and yaw induced by the additional drag on the right wing (Tab EE-18). He advanced the throttles to increase power and climb, but only climbed to 2700' MSL (Tab DD-35). MCP notified FAY ATCT/TRACON that the mishap C-130 crew had shut down their number four engine and was possibly involved in a midair collision with another aircraft (Tab EE-19). Upon notification from MIL that the number four propeller was continuing to rotate, MFE3 referenced the Propeller Fails to Feather emergency checklist (Tabs V-7.13; V-7.19 to V-7.20). The propeller still failed to feather, so MCP reset the Fire Handle in accordance with to the checklist in order to continue to restore lubricating fluid to the rotating propeller; the Fire Handle was reset two minutes after it was initially pulled during the Emergency Shutdown Procedure (Tab EE-25 to EE-27).

MP3 proceeded direct to Pope AAF and chose to land without extending flaps due to the unknown damage to the aircraft (Tabs V-3.26; V-5.19; V-6.17 to V.6.18). The emergency landing was conducted safely at 0143Z (2043L) (Tab DD-31). Once stopped, fuel leaking from the right wing was now visible to the crew and the mishap C-130 crew initiated emergency ground egress procedures (Tab EE-52 to EE-53). Airfield Operations personnel conducted a Foreign Object Debris sweep of the runway and discovered fuel along the length of the runway as well as some pieces of aircraft (Tab N-81).

i. Life Support Equipment.

Not applicable.

j. Emergency Response

In response to the mishap C-27 declaration of emergency, Mackall Tower initiated activation of the primary crash phone at 2025:14L (Tab N-78). The mishap C-130 established radio contact with FAY ATCT/TRACON, informed control that they had shut down their number four engine, then advised control that they were involved in a possible midair (Tab EE-19 to EE-20). The mishap C-130 declared an emergency and was given priority handling and a direct VFR route to Pope AAF (Tab EE-25). FAY ATCT/TRACON relayed the emergency information to the Pope AAF Control Tower, who activated the primary crash phone at 2031L (Tab N-81). Inflight emergency responders were activated and on the scene at Mackall AAF for the mishap C-27 and at Pope AAF for the mishap C-130 (Tab N-75).

k. Recovery of Aircraft Parts.

Recovery efforts were supported by 27 personnel from 440 AW, 43 AG and 2/504 PIR in addition to the maintenance board member (BB-4). Difficulties associated with recovery efforts included terrain and the relative small size of missing aircraft pieces prevented the team from finding any additional aircraft parts (BB-4).

l. Recovery of Remains.

Not applicable.

5. MAINTENANCE

a. Mishap C-130

(1) Forms Documentation

The 440th Aircraft Maintenance Squadron (440 AMXS) and the 2nd Airlift Squadron (2 AS), maintained the aircraft maintenance forms for the mishap C-130. Pursuant to T.O. 00-20-1, all maintenance was documented on Air Force Technical Order (AFTO) 781 forms (Tab BB-18). The data is then entered into an electronic database, the Integrated Maintenance Data System

(IMDS), in accordance with T.O. 00-20-2 (Tabs BB-23; DD-3). IMDS is a core-automated database used for tracking aircraft discrepancies, repair events, and aircraft flight history (Tab BB-23; DD-3). The IMDS history and the 781 forms from July 2014 to December 2014 showed no evidence of mechanical, structural, or electrical failures that could have contributed to the mishap (Tab DD-3).

Time Compliance Technical Orders (TCTOs) provide instructions for modifying military systems within specified time limits or initiate special “one time” inspections to impose temporary restrictions and track support system and equipment configuration on systems or equipment (Tab BB-15). T.O. 00-5-15 prescribes the procedures for the TCTO process (Tab BB-15). No TCTOs restricted the Mishap C-130 from flying and all required TCTOs had been accomplished in accordance with the applicable guidance (Tab DD-3).

(2) Inspections

The C-130H undergoes aerospace vehicle manufacturer inspections in intervals pursuant to T.O. 00-20-1 (Tab BB-18 to BB-20). A review of the historical and active records revealed that the mishap C-130 had its Isochronal Inspections (ISO) completed on 7 March 2014 and its Home Station Checks (HSC) completed on 20 November 2014 (Tab DD-3). The mishap C-130 was due to have Programmed Depot Maintenance completed in November 2016 (Tab DD-3). All major inspections were completed on time and none were due at the time of the incident (Tab V-11.12 to V-11-13). On 13 November 2014, the aircraft weight and balance record was recertified (Tab U-9 to U-10). A Combined Basic Post-Flight/Pre-Flight inspection was accomplished on 25 November 2014 and a Pre-Flight was accomplished on 1 December 2014 at 1700 Zulu Time. (Tab D-4 to D-5).

The Production Superintendent cleared the mishap C-130 for flight and signed the exceptional release prior to flight (Tab D-4). “Exceptional release” is a forms inspection performed by a qualified senior non-commissioned officer or other equivalent personnel to ensure the aircraft is safe for flight. The mishap C-130’s inspections were current and did not contribute to the mishap (Tab DD-4).

(3) Maintenance Procedures

A complete review of the maintenance records was conducted for the mishap C-130 from July 2014 through December 2014 which showed all maintenance actions and documentation were accomplished in accordance with standard maintenance practices and applicable T.O.’s (Tab DD-3). This review included each entry entered into IMDS (Tab DD-3). No discrepancies were found (Tab DD-3).

(4) Maintenance Personnel and Supervision

For at least the six months prior to the mishap, 440 AMXS and 2 AS Air Reserve Technicians (ARTs) and Active Duty personnel performed the scheduled and unscheduled maintenance on the mishap C-130 (Tab DD-4). Training records for the personnel involved with maintenance actions on the mishap C-130 demonstrated that maintenance was performed by properly trained and qualified personnel (Tab DD-4).

(5) Fuel Analyses

The 43rd Logistics Readiness Squadron (43 LRS), Pope AAF, North Carolina, sent fuel samples from the truck that refueled the mishap C-130, each of the four mishap C-130 engines, the mishap C-130 external fuel tanks, and the mishap C-130 auxiliary fuel tanks to the Air Force Petroleum Agency (AFPET) at Wright-Patterson AFB, Ohio for analysis. AFPET determined that the fuel samples were within limits and free of contamination (Tabs D-92 to D-100).

(6) Unscheduled Maintenance

Several unscheduled maintenance actions were performed within the previous twelve months prior to the mishap (Tab DD-3). A comprehensive review of the IMDS history and AFTO 781 forms disclosed that all actions were performed in accordance with applicable guidance (Tab DD-3). No unscheduled maintenance action was contributory to the mishap.

b. Mishap C-27

(1) Forms Documentation

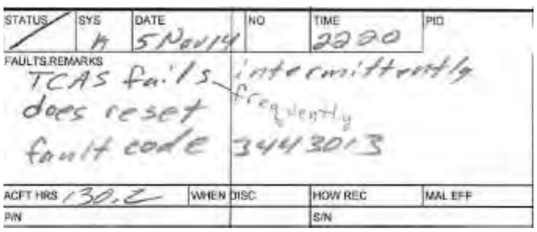
The UFC maintained the aircraft maintenance forms for the mishap C-27. Pursuant to Department of the Army Pamphlet (DA PAM) 738-751, maintenance was documented on Department of the Army (DA) forms 2408-12 and 2408-13-1. The United States Army operates the C-27J under the Federal Aviation Administration Service Bulletin program, which provides notices of deficiencies with time to correct. A number of service bulletins were in place for this type and serial number aircraft but no service bulletin addressed an issue that was a factor in the mishap (Tab U-9 to U-10).

A review of the maintenance forms showed two issues with the mishap C-27: a recurring intermittent failure of the TCAS and Identification Friend or Foe (IFF) transponder.

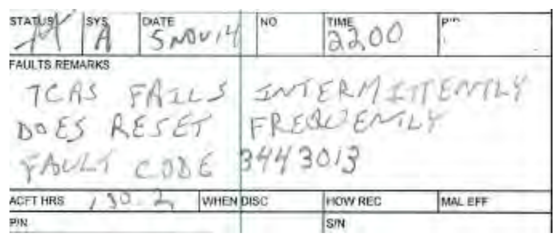
On 30 October 2014, a discrepancy with the TCAS was recorded on the maintenance documentation for the mishap C-27. The discrepancy stated, "Flt 1 TCAS fails intermit. Does reset/fault code 3443013" and annotated with a "circle X" status symbol (Tab D-88). A "circle X" is defined by DA PAM 738-751, *Functional User's Manual for the Army Maintenance Management System–Aviation*, 28 February 2014, paragraph 1–8a(2), to indicate that "a fault, deficiency, or condition (actual or potential) exists allowing the aircraft to fly under specific restrictions or limitations as specified or directed by higher authority, or as directed locally, until corrected." The example for the definition is provided in paragraph 1–8a(2)(a), which states, "an aircraft with an inoperable landing light would have a status of circled X restricting the aircraft from night flight."

On 3 November 2014, the correcting information for the discrepancy was entered as "CF," meaning that it would be carried forward and reentered on another maintenance form. From 30 October 2014, the mishap C-27 continued to be flown with this discrepancy remaining as an active "circle X" condition in the maintenance documentation until 5 November 2014. During this timeframe, a note was overwritten on the fault information section which added "repeatedly during each flight" to the TCAS discrepancy (Tab D-61). On the night of 5 November 2014, the maintenance officer instructed that the discrepancy symbol be downgraded to a "diagonal" on the maintenance documentation (Tabs D-55; V-21.7 to V-21.8). DA Pam 738-75, paragraph 1–8a(2), states that a "diagonal" indicates, "a known fault or deficiency exists…[and] that an unsatisfactory condition exists on aircraft, system, or associated equipment that is not urgent or dangerous enough to ground the aircraft or stop the use of the aircraft, system, or associated equipment." The "circle X" was initialed through and signed off in the corrective action block and a new discrepancy placed below it with a "diagonal" status symbol (Tab D-55).

At some point after 5 November, the word "frequently" was overwritten on the maintenance form (Tabs D-55; V-21.6). This was carried forward and rewritten as "TCAS fails intermittently and does reset frequently fault code 3443013" (Tab D-49).


STATUS / SYS A DATE 5Nov14 NO TIME 2220 PID
FAULTS REMARKS
TCAS fails intermittently frequently
does reset
fault code 3443013
ACFT HRS 130.2 WHEN DISC HOW REC MAL EFF
P/N S/N

Discrepancy as written on 5 November 2014 Aircraft Inspection and Maintenance Record (Tab D-55).


STATUS SYS A DATE 5Nov14 NO TIME 2200 PID
FAULTS REMARKS
TCAS FAILS INTERMITTENTLY
DOES RESET FREQUENTLY
FAULT CODE 3443013
ACFT HRS 130.2 WHEN DISC HOW REC MAL EFF
P/N S/N

Discrepancy as carried forward on 7 November 2014 Aircraft Inspection and Maintenance Record (Tab D-49).

After the discrepancy was entered 7 November 2014, the discrepancy was corrected by maintenance with the explanation that a self-test was run on the processor with no fault and the system "checks good" (Tab D-49). On 13 November 2014, a new entry appeared as a "circle X" stating "TCAS Fail" (Tab D-44). The circle X was crossed out and corrective action was entered as "TCAS Self-Test Checked Good IAW 1C-275-2-10-2" (Tab D-44). The issue reappeared on 14 November 2014 as, "Flt #1 TCAS Fail, Can Reset in Flight" on a diagonal status symbol and the corrective action was "CF" (Tab D-45) On 25 and 26 November 2014, it was again carried forward (Tab D-30, 25). It was reentered for corrective action on the date of the mishap (Tab D-19)

On 12 November 2014, a discrepancy with the IFF transponder was recorded on the maintenance documentation (Tab D-50). The discrepancy stated, XPDR INOP after three resets" and annotated with a "Dash" status symbol (Tab D-50). In the corrective action portion, the notation "symbol entered in error" was written and the status symbol was initialed and signed off by maintenance (Tab D-50). The discrepancy was not reentered prior to the mishap (Tabs D-14 to D-50).

(2) Inspections

From 2013-2014, United States Special Operations Command (USSOCOM) through the divestiture of aircraft from United States Air Force, received seven C-27Js, including the mishap C-27,and placed them into service with the United States Army Special Operations Command for the UFC. The aircraft received an Airworthiness Release on 30 June 2014 (Tab DD-4). The last daily inspection was completed on 1 December 2014 and the aircraft was released for flight at that time (Tab D-18). All other inspections were complete at the time and no inspections were due at the time the aircraft was released for flight (Tab D-13).

(3) Maintenance Procedures

A complete review of the maintenance records for the mishap C-27 showed all maintenance actions and documentation were accomplished in accordance with standard maintenance practices (Tab DD-3). All aircraft inspections are completed in accordance with manufacturer's technical manuals and the Air Force issued technical orders used by UFC for the C-27J (Tab DD-3). "X" and "circle X" conditions are signed off in the Aircraft Inspection and Maintenance Record with a technical order reference. Diagonal and dash symbol conditions do not require a reference in accordance with DA PAM 738-751.

(4) Maintenance Personnel and Supervision

In addition to UFC active duty personnel, employees of Akima Technical Solutions, LLC performed scheduled and unscheduled maintenance on the mishap C-27 (Tabs V-22.2 to V-22.3). Training records for the personnel involved with the maintenance actions on the mishap C-27 demonstrated that maintenance was performed by properly trained and qualified personnel (Tab DD-4).

(5) Fuel Analyses

The 43 LRS sent fuel samples from the truck that refueled the mishap C-27 and each mishap C-27 fuel tank to AFPET for analysis. AFPET determined that the fuel samples were within limits and free of contamination (Tabs D-92; D-101 to D-102).

(6) Unscheduled Maintenance

Several unscheduled maintenance actions were performed since the Airworthiness Release and documented on the Aircraft Inspection and Maintenance Records (Tabs D-14 to D-89). A review of the forms shows the TCAS system is listed in Table 1-1 of the Combined Minimum Equipment List/Required Equipment List (MEL/REL) as a category B item (Tab U-83). Category B indicates that items shall be repaired within three consecutive calendar days from the time of the initial discrepancy (Tab U-81). On 30 October 2014 there was no maintenance action for eight days after the first maintenance action was taken and the system failed again the aircraft system was intermittent from 14 November 2014 through the day of the mishap flying three additional times during this period (Tab D-88 to D-49). Upon troubleshooting post mishap, maintenance found and replaced a faulty ground in the aircraft avionic rack (Tab U-75 to U-77).

6. AIRFRAME SYSTEMS

a. Mishap C-130 Airframe Structures and Systems

Following the mishap and recovery, the mishap C-130's Digital Flight Data Recorder (DFDR) was removed from the mishap C-130 at Pope AAF and sent to the Air Force Safety Center

(AFSEC) at Kirtland Air Force Base for download and conversion. The DFDR system recorded the last 50 hours of airplane flight performance (Tab DD-4). AFSEC successfully recovered all DFDR data, which showed normal functioning of systems up to the time of the mishap (Tab E-32).

Damage assessments showed the mishap C-130's nose landing gear door, flare dispenser hood, right wing external fuel tank and the number four engine, along with the wing leading edge section where the engine mounts, were significantly damaged on impact (Tab P-3 to P-27). The AIB performed a thorough inspection of the mishap C-130 systems and reviewed the DFDR data. All systems performed normally up to the time of the mishap.

b. Mishap C-130 Evaluation and Analysis

Flight Control System

DFDR data showed that the mishap C-130 flight control system was functioning normally until the point of impact (Tabs EE-32; EE-34). Following impact, the aircraft was substantially damaged on the right wing inboard of the number four engine. MP3 felt vibrations following impact, but the aircraft was able to maintain sufficient aileron and rudder authority to remain airborne until landing (Tab EE-18). The crew performed a "flaps up" landing instead of extending the flaps because they could not verify the condition of the right wing structure (Tab EE-28). Inspection post flight had not revealed anything visibly deficient with the flaps but an operational check was not performed (Tab S-3).

Avionic Systems

DFDR data showed that the mishap C-130's avionic systems were functioning normally throughout the flight. After impact, there were no indications that any of the avionics systems had failed. (Tabs EE-32; EE-34).

Engines

DFDR data showed that the mishap C-130 engines were functioning normally until the point of impact (Tabs EE-32; EE-34). After impact, the number four engine began to shut down (Tab EE-34). As the engine shut down the crew pulled the "T handle" for the number four engine which discontinued the flow of hydraulic fluid, fuel and oil to the engine. After the engine shut down, the number four propeller failed to "feather," meaning the blades did not rotate parallel to the airflow (Tab V-7.13). The crew attempted unsuccessfully reset the fire handle to restore the flow of fluid to the engine since the propeller continued to turn and create drag (Tabs EE-25 to EE-27). The crew landed the aircraft with the number four engine shut down and the propeller not in feather (Tab V-12.4)

Fuel System

DFDR data showed normal fuel flow and fuel quantity information until the point of impact (Tabs EE-32; EE-34). The impact caused a fuel leak but the mishap C-130 aircrew was able to land successfully with fuel continuing to come out of the right wing (Tab V-12.4).

Hydraulic Systems

DFDR data showed normal levels of hydraulic pressure for the mishap C-130 systems. During the cessation and restoration of hydraulic pressure to the number four engine following impact, hydraulic systems continued to operate normally (Tab EE-32).

c. Mishap C-27 Airframe Structures and Systems

Following the mishap and recovery, the mishap C-27's DFDR was removed at Mackall AAF and sent to AFSEC. The mishap C-27's FDAU transmitted to its DFDR until the time of impact (Tab DD-4). AFSEC was able to recover DFDR data prior to the mishap.

The mishap C-27 sustained damage to the vertical stabilizer, rudder, right outboard wing, right aileron, and empennage on impact (Tab S-7 to S-9). The AIB performed a thorough inspection of the all mishap C-27 systems and reviewed the FDR data. All systems are required for aircraft airworthiness performed normally up to the time of the mishap. However, the mishap C-27's IFF transponder and TCAS were not functioning prior to impact (Tab U-13 to U-65).

d. Mishap C-27 Evaluation and Analysis

(1) Flight Control Surfaces

DFDR data shows that the mishap C-27 flight control system was functioning normally until the point of impact (Tab U-13 to U-65). After impact, the aircraft had sustained damage to the right aileron and rudder, but the aircraft flew normally with no abnormal control inputs from the pilot (Tab V-17.31).

(2) Avionic Systems

After the impact, the mishap C-27's DFDR and Cockpit Voice Recorder (CVR) failed to continue recording data (Tab DD-4). After recovery, however, the recorded data showed that the mishap C-27's transponder was inoperative at the time of the incident and its TCAS was intermittent with several failures and resets during flight (Tab U-13 to U-65). The transponder emits a radio signal that is visible to air traffic control and displays aircraft position, heading, airspeed and altitude. This transponder signal, when operating is also visible to other aircraft via their TCAS to assist in traffic avoidance during flight. The TCAS system receives transponder signals from other aircraft and gives the pilot a visual indication of aircraft in the vicinity (Traffic Advisory) and in some cases avoidance instructions (Resolution Advisory) (Tab BB-26).

The mishap C-27's TCAS had been intermittently operational since 30 October 2014 and had multiple failures on the night of the mishap, including just before takeoff at Laurinburg-Maxton airport (Tab U-13 to U-65). A functioning TCAS was not required for this flight without passengers and the mishap C-27 aircrew continued their mission after the reset failed to correct the TCAS problem (Tabs U-83; V-17.42 to V-17.43).

At 2312:01Z, the mishap C-27's transponder failed and did not recover (Tab U-54). The transponder failure occurred while on the ground taxiing the aircraft at Laurinburg-Maxton airport, a designated stop on the mishap C-27 aircrew's flight plan (Tab U-54). The crew was not aware of the fault until 0004:35Z, when a controller at Mackall Tower requested that the mishap C-27 "recycle" its transponder, turning it off and back on in an attempt to restore its operation (Tab N-72).

The TCAS incorporates the use of the transponder system to provide the interrogation transmit and receive response signal interface to the TCAS (Tab BB-26). With the IFF inoperative, the TCAS system would not operate properly (Tab U-54 to U-65). The absence of a functioning IFF transponder on the mishap C-27 prevented the mishap C-130's functioning TCAS from detecting the mishap C-27's presence in the immediate area (Tab V-5.23). The absence of a functioning TCAS due to the IFF failure on the mishap C-27 prevented it from properly detecting the mishap C-130's actively transmitting IFF transponder (Tab V-15.27 to V-15.28).

(3) Engines

DFDR data showed normal engine performance throughout the flight. (Tab U-13 to U-73).

(4) Fuel System

Cockpit data showed normal fuel flow and fuel quantity information throughout the flight. (Tabs V-17.31; U-13 to U-73).

(5) Hydraulic Systems

Cockpit data showed normal levels of hydraulic pressure for the mishap C-27 systems throughout the flight (Tabs V-17.31; U-13 to U-73).

7. WEATHER

a. Forecast Weather

Prior to their missions, Fort Bragg Local Range Forecast (LRF) delivered the weather forecast to both mishap aircrews (Tabs F-2; F-4). At takeoff for both the mishap C-27 and mishap C-130, 2250Z and 2355Z respectively, forecast weather was winds from the southwest at nine knots, visibility of seven statute miles, clear skies with no ceiling, no significant weather hazards, 70% lunar illumination, and an altimeter setting of 30.33 inches of mercury (Tabs F-2; F-4).

b. Observed Weather

Prior to the mishap, the most recent weather observation near the area of the mishap was taken by Mackall AAF at approximately 0200:56Z. The observed weather was winds from the south at one knot, visibility of 10 statute miles, clear skies with no ceiling, no significant weather hazards, and an altimeter setting was 30.33 inches of mercury (Tab F-5). At the time of the mishap, there was a waxing gibbous moon, positioned due south with 70% illumination (Tabs F2; F-4).

c. Space Environment

Not applicable.

d. Operations

Both mishap aircraft were flying VFR for the duration of their missions, to include at the time of the mishap and recovery (Tabs V-4.6; V-15.30; V-17.8; Tab EE-25). Prior to and at the time of the mishap, both mishap aircraft left-seat and right-seat pilots were using NVGs (Tabs V-3.19; V-4.24; V-15.42; V-17.47). No mishap aircrew member identified any weather-related performance issues with the mishap aircraft or aircrew equipment, to include NVGs (Tabs V-6.8; V-7.6; V-10.5; V-19.6 to V-19.7; V-18.5; V-15.45; V-16.21 to V-16.22; V-17.10; V-18.5; V-19.11). There is no indication that weather was a factor in the mishap.

8. CREW QUALIFICATIONS

a. Mishap Pilot 3.

MP3 was a current and qualified C-130H Mission Pilot and had good flying continuity. MP3 averaged three sorties per week in the month prior to the mishap (Tab DD-39). The mishap occurred on MP3's first Flight Lead Upgrade flight. MP3 had a total of 1591.8 flight hours, of which 780.6 was as primary and 526.5 was as secondary (Tab G-65). MP3 had 107.4 flight hours using Night Vision Goggles (Tab G-65). MP3 was graded Q-1 with no downgrades on his most recent Instrument, Qualification, and Mission flight evaluations (Tabs G-186 to G-189).

MP3 30/60/90 Look-back:

	Hours	Sorties
30 days	19.6	12
60 days	40.3	31
90 days	69.7	48
(Tabs G-78; DD-39)		

b. Mishap Co-Pilot.

MCP was a current and qualified C-130H Flight Pilot and had good flying continuity. MCP averaged six sorties per week in the month prior to the mishap (Tab DD-39). MCP had a total of 539.8 flight hours, of which 296.1 was as primary and 178.2 was as secondary (Tab G-80). MCP had 67.6 flight hours using NVGs (Tab G-80). MCP was graded Q-1 with no downgrades and two Commendable graded areas on his most recent Instrument, Qualification, and Mission flight evaluations (Tabb G-191 to G-194).

MCP 30/60/90 Look-back:

	Hours	Sorties
30 days	47.9	24

60 days	93.9	51
90 days	150.1	88
(Tabs G-95; DD-39)		

c. Mishap Instructor Pilot 2.

MIP2 was a Command Pilot, current and qualified C-130H Evaluator Pilot, and had mediocre flying continuity. MIP2 averaged less than one sortie per week in the month prior to the mishap (Tab DD-39). MIP2 had a total of 1121.7 C-130H flight hours, of which 391.9 was as primary and 289.2 was as secondary (Tab G-97). MIP2 had 283.8 C-130H instructor flight hours (Tab G-97). MIP2 had 185.0 flight hours using NVGs (Tab G-98). MIP2 was graded Q-1 with no downgrades on his most recent Instrument, Qualification, and Mission flight evaluation (Tab G-196 to G-197).

MIP2 30/60/90 Look-back:

	Hours	Sorties
30 days	2.8	1
60 days	27.9	21
90 days	35.9	30
(Tabs G-109; DD-39)		

d. Mishap Navigator.

MN was a Master Navigator, current and qualified C-130H Evaluator Navigator, and had mediocre flying continuity. The MN averaged one sortie per week in the month prior to the mishap (Tab DD-39). MN had a total of 2852.8 flight hours, of which 2045.7 was as primary and 10.8 was as secondary (Tab G-112). MN had 186.3 flight hours using NVGs (Tab G-112). MN was graded Q-1 with no downgrades on his most recent Qualification and Mission flight evaluation (Tab G-199 to G-200).

MN 30/60/90 Look-back:

	Hours	Sorties
30 days	12.3	4
60 days	20.1	10
90 days	22.1	13
(Tabs G-121; DD-39)		

e. Mishap Flight Engineer 3.

MFE3 was a current and qualified C-130H Mission Flight Engineer and had mediocre flying continuity. MFE3 averaged one sortie per week in the month prior to the mishap (Tab DD-39). MFE3 had a total of 760.1 flight hours, of which 747.7 was as primary (Tab G-123). MFE3 had 142.9 flight hours using NVGs (Tab G-123). MFE3 was graded Q-1 with one downgrade on her most recent Qualification and Mission flight evaluation (Tab G-202 to G-203).

MFE3 30/60/90 Look-back:

	Hours	Sorties
30 days	7	4
60 days	28.1	15
90 days	35	20
(Tabs G-131; DD-39)		

f. Mishap Instructor Loadmaster.

MIL was a current and qualified C-130H Instructor Loadmaster and had good flying continuity. MIL averaged two sorties per week in the month prior to the mishap (Tab DD-39). MIL had a total of 1721.9 flight hours, of which 1633.3 was as primary (Tab G-133). The MIL had 70.7 instructor flight hours (Tab G-133). MIL was graded Q-1 with no downgrades and two Commendable graded areas on his most recent Qualification and Mission flight evaluations (Tab G-205 to G-206).

MIL 30/60/90 Look-back:

	Hours	Sorties
30 days	22	16
60 days	62.5	45
90 days	92.1	80
(Tabs G-143; DD-39)		

g. Mishap Loadmaster 1.

ML1 was a Senior Airman Aircrew member and qualified C-130H2 Evaluator Loadmaster, but was non-current for Proficiency Sortie (Tab G-150). ML1 averaged less than one sortie per week in the month prior to the mishap (Tab DD-39). ML1 had a total of 2379.0 flight hours of which 1944.4 was primary and 10.7 was secondary (Tab G-145). ML1 was graded Q-1 with no downgrades on his most recent Qualification and Mission flight evaluation (Tab G-208 to G-209).

ML1 30/60/90 Look-back:

	Hours	Sorties
30 days	0	0
60 days	0	0
90 days	2	1
(Tabs G-153; DD-39)		

h. Mishap Loadmaster 2.

ML2 was a current and qualified C-130H2 Mission Loadmaster and had good flying continuity. ML2 averaged two sorties per week in the month prior to the mishap (Tab DD-39). ML2 had a total of 147.7 flight hours of which 147.5 was primary (Tab G-155). ML2 was graded Q-1 with no downgrades on his most recent Qualification and Mission flight evaluation (Tab G-211 to G-212).

ML2 30/60/90 Look-back:

	Hours	Sorties
30 days	19.5	11
60 days	42.5	32
90 days	70.2	58
(Tabs G-163; DD-39)		

i. Mishap Instructor Pilot 1.

MIP1 was a current and qualified C-27J Evaluator Pilot and had good flying continuity. MIP1 averaged four sorties per week in the month prior to the mishap (Tab G-6). MIP1 had a total of 11994.0 flight hours, of which 138.3 was in the C-27J (Tabs G-6; G-11). MIP1 had 632.3 flight hours using NVGs (Tab G-7 to G-11).

MIP1 30/60/90 Look-back:

C-27J, only	Hours	Sorties
30 days	24.5	16
60 days	46.2	31
90 days	66.3	50
(Tab G-5 to G-6)		

j. Mishap Pilot 1.

MP1 was a current and qualified C-27J Instructor Pilot and had mediocre flying continuity. MP1 averaged less than one sortie per week in the month prior to the mishap (Tab G-32). MP1 had a total of 5037.5 flight hours, of which 424.9 was in the C-27J (Tab G-34). MP1 had 95.8 flight hours using Night Vision Goggles (Tab G-33 to G-34).

MP1 30/60/90 Look-back:

	Hours	Sorties
30 days	4.6	3
60 days	4.6	3
90 days	29.5	16
(Tab G-32)		

k. Mishap Pilot 2.

MP2 was a current and qualified C-27J Pilot and had good flying continuity. MP2 averaged three sorties per week in the month prior to the mishap (Tab G-39). MP2 had a total of 11704.1 flight hours, of which 89.1 was in the C-27J (Tabs G-39; G-45). MP2 had 446.4 flight hours using Night Vision Goggles (Tab G-42 to G-44).

MP2 30/60/90 Look-back:

	Hours	Sorties
30 days	11.4	11
60 days	32.5	23
90 days	50	35
(Tab G-38 to G-39)		

l. Mishap Flight Engineer 1.

MFE1 was a current and qualified C-27J Flight Engineer. MFE1 had a total of 5,196 flight hours, of which 347 was in the C-27J (Tab DD-9). MFE1 had 648 flight hours using Night Vision Goggles (Tab DD-9).

m. Mishap Flight Engineer 2.

MFE2 was a current and qualified C-27J Flight Engineer. MFE2 had a total of 2,686 flight hours, of which 136 was in the C-27J (Tab DD-9). MFE2 had 1,642 flight hours using Night Vision Goggles (Tab DD-9).

9. MEDICAL

a. Qualifications.

At the time of the mishap, the mishap C-130 and mishap C-27 aircrews had current Preventive Health Assessments (PHAs) and were medically qualified for flight duty without restrictions (Tab DD-6). Physical and medical qualifications were not factors in the mishap.

b. Health and Lifestyle.

The AIB aerospace physiologist and human factors expert reviewed their 72-hour/14-day histories. Records show and testimonies confirmed that all members were in good health, revealed no lifestyle factors, including unusual habits, behavior, stress that contributed to the mishap and had no recent performance limiting illnesses prior to the mishap (Tab DD-6 to DD-7).

c. Toxicology

Immediately following the mishap, all members of the mishap C-130 and mishap C-27 aircrew submitted to toxicology testing. Blood and urine samples were submitted to the Armed Forces

Institute of Pathology (AFIP) for toxicological analysis. This testing included carbon monoxide and ethanol levels in the blood and drug testing of the urine. The AIB's flight medicine FAE reviewed the results of the tests for all members and found no elevated carbon monoxide levels, no ethanol, and no evidence of use of amphetamines, barbiturates, benzodiazepines, cannabinoids, cocaine, opiates, or phencyclidine for any member (Tab DD-7).

d. Pathology.

Not applicable.

e. Crew Rest and Crew Duty Time.

Air Force Instruction AFI 11-202, Volume 3, *General Flight Rules*, 7 November 2014, paragraph 2.1, requires pilots to have proper "crew rest," defined as a minimum 12-hour non-duty period, before the designated flight duty period (FDP) begins. During this time, an aircrew member may participate in meals, transportation or rest as long as he or she has the opportunity for at least eight hours of uninterrupted sleep. A review of the 72 hour/14-day histories and pre-flight documentation corroborated the testimony of the mishap aircrews that no one suffered from stress, pressure, fatigue or lack of rest prior to the mishap sortie (Tabs K-10 to K-11; V-3.66 to V-3.76; V-4.47 to V-4.57; V-5.44 to V-5.54; V-6.33 to V.6.43; V-7.33 to V-7.43; V-9.26; V-15.53 to V-15.63; V-16.20; V-17.54 to V-17.64).

10. OPERATIONS AND SUPERVISION

a. Operations

At the time of the mishap, the 95th and 2nd Airlift Squadrons had a reduced operations tempo, this sortie being the first flown by all of the mishap C-130 crewmembers after a long Thanksgiving weekend. This mission was not flown in preparation for impending deployment or other taskings.

Pope AAF is an installation with a long history and seemingly continuous transition. Beginning in 2005, pursuant to the Base Realignment and Closure Act, the 43rd Airlift Wing (43 AW) inactivated, the 43rd Operations Group was re-designated the 43 AG, the 43 AW's C-130Es moved to Little Rock AFB, Arkansas and the 440 AW, with its C-130Hs, moved from General Mitchell Air Reserve Station, Milwaukee, Wisconsin to Pope AFB, making the 440 AW the first active associate unit in the Air Force (Tab CC-35). Then, on 28 February 2011, Pope Air Force Base (AFB) was transferred to Fort Bragg, becoming Pope AAF (Tab CC-35 to CC-36). As of late, reports had circulated in the Fayetteville area that the Air Force was considering the Wing's inactivation which raised uncertainly among some aircrew (Tabs V-5.4; V-4.8). Pope AAF continues to evolve as recent release of the FY15 NDAA has confirmed those reports.

At the time of the mishap, the UFC has also experienced a reduced operations tempo following the Thanksgiving weekend. In addition to the extended weekend, C-27 operations had been reduced due to aircraft availability but not to the point of being detrimental to aircrew currency or proficiency. UFC operations are limited to training. Therefore, this mission was not flown in preparation for impending deployments or other taskings.

b. Supervision

The 440 AW is not an exceptionally large organization, rather it is a close-knit unit and leadership permeates throughout. Squadron supervision of this mission was adequate. All required approval forms were reviewed and signed prior to the mission (Tabs K-2; K-5; K-13). All mission objectives and the mission profile were planned and briefed using approved materials in accordance with applicable regulations (Tab V-3.38 to V-3.42). MP3 planned the mission in accordance with squadron standards (Tab V-3.38 to V-3.40). MP3 accomplished oversight of Operational Risk Management (ORM) via a locally-derived 440th Operations Group ORM worksheet, which was filled out and signed primarily by MP3 after individual crew members inputted their personal factor scores (Tab K-10). The Air Force ORM program is a logic based, common sense approach to making calculated decisions on human, material, and environmental factors before, during and after all operations. As defined by Air Force Pamphlet (AFPAM) 90-803, *Risk Management (RM) Guidelines and Tools*, 11 February 2013 paragraph 1.1, risk management is a decision-making process to systematically identify risks and benefits and determine the best course of action for any given situation. MP3's risk assessment for the mission was "Low Risk" with a total score of 37 (Tab K-10). According to the worksheet, a total score of 0-39 was "Green," meaning the risk acceptance remained at the Aircraft Commander level (Tab K-10).

UFC supervision of this mission was adequate. All required approval forms were reviewed and signed prior to the mission (Tabs K-4; K-6; K-15). All mission objectives and the mission profile were planned and briefed using approved materials in accordance with applicable regulations (Tabs V-15.6 to V-15.8; V-16.3 to V-16.6). MIP1, MP1 and MP2 planned the mission in accordance with squadron standards (Tabs V-15.6 to V-15.10; V-16.3 to V-16.6). MIP1 accomplished the ORM via a locally-derived UFC ORM worksheet, which was filled out primarily by MIP1 as a part of the standard crew briefing. MIP1 assessed and scored the risk "Low" with a total score of 20 (Tab K-11). According to the worksheet, a total score of 0-30 was "Low," meaning the UFC Pilot is the mission approving authority (Tab K-11).

11. HUMAN FACTORS

a. Overview

As explained in AFI 91-204, *Safety Investigations and Reports*, 12 February 2014, Attachment 6, paragraph A6.1 to A6.3, human factors is the inter-relationship between the human, machine (e.g., aircraft, flight control systems, NVGs, etc.) and the environment as well as how tools, tasks, and the working environment affect human performance and safety in the flying environment. AFI 91-204, Attachment 6, provides the Department of Defense's Human Factors Analysis and Classification System (HFACS) taxonomy as a means to investigate the C-130 and C-27 aircrews' performance and ascertain which factors were causal or contributed to the mishap. The HFACS taxonomy identifies acts, preconditions, supervision and organizational categories and includes a separate analysis of each type of factor. According to the HFACS, acts are, "those factors that are most closely tied to the mishap and are active failures or actions committed by aircrew that result in human error or an unsafe situation." Preconditions are environmental or personnel factors affecting procedures, conditions or actions which result in human error or an unsafe situation. Organizational or supervisory factors are typically pressures or standards of professionalism that "lead to either elevated levels of risk-assumption or complacency." Based on CVR recordings, witness testimony, radar logs, and mission documentation, a comprehensive analysis of all human factors were performed.

b. Causal Factor:

Breakdown In Visual Scan – (MIP1, MP1, MP3, MCP)

HFACS Definition: A breakdown in visual scan is a factor when the crew member fails to effectively execute learned and highly-practiced internal or external visual scan patterns leading to a reduced ability to recognize unsafe situations.

HFACS Contributing Factors:
- Visual Restriction
- Instrument Sensory Feedback System
- Vision Restricted by Meteorological Conditions
- Distraction
- Channelized Attention

Analysis:

Over 80% of a pilot's perception and decision making comes from what he or she sees (Tab DD-16). As a result, the visual system is one of the most important senses used to safely operate an aircraft. The visual system works like a transducer – it changes visible energy (light) into electrical energy (Tab DD-16 to DD-17). The eye, in essence, captures information (i.e., image) and the brain decodes or processes it. If the eye doesn't capture critical visual information (e.g., not scanning, blind spots, night time), then the brain cannot effectively assess and direct action (e.g., see and avoid) (Tab DD-16 to DD-17).

Scanning is not just a task, but an art that must be consistent and deliberate. There is no infallible scan and pilots must develop a scan that works for them in various phases of flight and meteorological conditions. Pilots are trained on the differences between looking (or glancing) and seeing. Visual scanning is a requirement and one of the basic fundamentals of piloting (Tab BB-6). As stated in AFI 11-202, Volume (Vol) 3, *General Flight Rules*, 7 November 2014, paragraph 3.18, Vigilance must be maintained and is the primary means used by each person operating an aircraft to see and avoid other aircraft regardless of whether an operation is conducted under instrument or visual flight rules. Scanning is not just a task, but an art that must be consistent and deliberate. There is no infallible scan. Pilots must develop a scan that works for them in various phases of flight and environmental conditions. Seeing takes conscious processing and the time it takes to "see" varies due to physiological limitations of the eye. For example, a pilot can see more during the day and also has better visual acuity. Seeing at night has the opposite effect, so pilots must increase their scan as regardless of the type of NVG utilized. The field of view NVGs are able to provide is less than the naked eye, particularly reducing peripheral vision (AFMAN 11-217, Vol 3, paragraph 12.8.1). Additionally, optical flow is the angular rate and direction of movement of objects as a result of aircraft velocity measured relative to the aviator's eye point. This provides a pilot's visual system the information necessary to interpret speed and direction of motion. If there is no relative motion, there is no optical flow. We use central vision to obtain optical flow information and since visual acuity is degraded with NVGs, the optical flow cues will be degraded when compared to daytime cues (AFMAN 11-217, Vol 3, paragraph 12.9.2.2).

This mishap occurred at night and the mishap pilots in both aircraft were wearing NVGs. NVGs work much like eyes in that they capture energy and produce an image. NVGs, however, are designed to capture not only visible energy (light), but also infrared energy. NVGs absorb these two energy sources and produce an image (Figure 4) on a small screen that rests approximately 1-inch from the pilot's eyes when helmet-mounted (Figure 5). The use of NVGs allows aircrews to see objects at night that could not be seen during unaided operations. However, pilots must use focal vision to interpret the NVG image. Since interpretation of focal vision is a conscious process, more time and effort is required to maintain spatial orientation during NVG operations than during daytime operations. Additionally, due to the goggles reduced field of view (FOV) and the lack of visual cues in the periphery, more reliance is placed on focal vision. This reliance on focal vision can increase the aviator's workload and susceptibility to spatial disorientation (AFMAN 11-217, Vol 3, paragraph 12.3).

All aircraft are equipped with external lighting sources to improve their ability to be seen. Both mishap aircraft displayed overt external lightning to include steady position lights and navigation lights as well as white anti-collision strobe lights. This visible energy would be easily acquired by the pilots wearing NVGs, but "halos" surrounding external lights from aircraft may change in appearance (AFMAN 11-217, Vol 3, paragraph 12.13.2.1; Tab DD-21 to DD-22).

Figure 4.

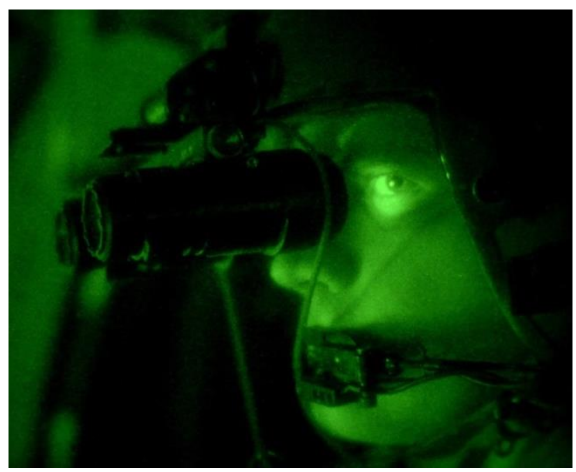


Figure 5.

The mishap C-130 co-pilot, MCP, flew the visual CDS airdrop at Luzon DZ and the escape (Tab EE-3 to E-14). After the completion of the airdrop checklist, approximately 6 miles from the DZ, MP3 assumed aircraft control worked to level at escape altitude of 1,500' MSL (Tabs V-3.12; DD-35; EE-14). MP3 was actively scanning outside but was also focused on establishing the aircraft on course and altitude (Tab V-3.21 to V-3.22). Concurrently, MN was actively looking for the next turn point and talking MP3 on to the point (Tab V-6.13). MCP testified his attention was to the right because he was clearing in the direction of the impending turn (Tab V-4.15), placing the mishap C-27 in his peripheral view. These actions channelized MP3 and distracted MCP, resulting in a break down in their visual scans.

The mishap C-27 pilot flying, MIP1, took off from Laurinburg-Maxton Airport, turned left, leveled at 1,500' MSL and engaged the autopilot en route to a simulated airdrop northwest of Mackall AAF (Tab V-17.21). MIP1 was flying in the left seat and asked MP1 to load a tactical plot in the flight mission computer for display on the PFD and to report on frequency with the Mackall Tower controller (Tab N-69). Although these tasks were appropriate pilot monitoring duties, they distracted MP1, taking attention away from scanning the right side of the aircraft (Tab V-15.46). MIP1 was actively scanning outside, but his field of view was significantly restricted due to the limited field of view on NVGs and cockpit obscurants (Tab V-17.38 to V-17.39).

Both aircraft had additional aircrew on board who normally would assist in scanning, but they were each performing other duties in the moments prior to impact. On the mishap C-27, MP2 was adjusting the fuel balance on the overhead panel (Tabs V-17.23; V-16.11 to V-16.12; V-16.21). On the mishap C-130, MIP2 was about to sit down on the cockpit bunk to take de-brief notes on MP2's flight lead upgrade performance while MN was reviewing navigational maps and assisting MP3 in identifying the next turn point (Tabs V-5.17; V-6.13). MN was periodically scanning to the left and was the only crew member who actually saw the mishap C-27 before impact (Tab V-6.14). MFE3's focus was "inside" the cockpit computing takeoff and landing data (Tab V-7.14).

c. Contributory Factors

(1) Visibility Restrictions – (MIP1, MP1, MP3, MCP)

HFACS Definition: Visibility Restrictions are a factor when the lighting system, windshield/windscreen/canopy design, or other obstructions prevent adequate visibility and create an unsafe situation. It includes obscurants, such as glare or reflections on the canopy/windscreen/windshield.

HFACS Contributing Factors: Instrument Sensory Feedback System

Analysis:

Limited visibility at night and obscurants inside the cockpit reduce the ability of the pilots to acquire targets, requiring pilots to exercise a more deliberate scan to mitigate the risk (Tab V-6.4). The mishap pilots were aware of these challenges (Tabs G-7 to G-11; G-33 to G-34; G-42 to G-44; DD-39).

The C-130H and C-27J windshields were designed with segmented sections separated by window posts (Figures 6; 7; 8; 9). This design increases strength during pressurized flight, increases resilience to bird strikes and reduces maintenance costs. Although justified, this common large aircraft design impedes pilots' ability to conduct an uninterrupted visual scan. The Aeronautical Information Manual, paragraph 8-1-8.j, directs pilots to "move their heads to see around blind spots caused by fixed aircraft structures" or even maneuver the aircraft to facilitate their scans (Tab DD-13).

The Plan Position Indicator (PPI) is a scope that displays aircraft position relative to other aircraft in a station keeping equipment formation (Figure 6). The particular scope on the mishap C-130 can also display the programmed flight route, weather radar, and TCAS targets (Tabs V-3.45; V-4.28 to V-4.29). The location of this piece of equipment, when installed, impedes both pilots' ability to conduct an effective cross-cockpit scan as it is affixed in the middle of the center windshield section (Figure 11). Its position severely limits the cross-cockpit scan of each pilot.

At the time of the midair, MIP1 was flying and conducting scanning duties in the C-27J (V-15.26 to V-15.27). However, his view out the right side of the aircraft was significantly obscured by large window posts and the helmeted MP1 (Figures 8 and 9). MP1's attention was distracted as he was looking down and to the left at the center pedestal performing support pilot duties (Tab V-15.25 to V-15.27). Had he been scanning outside, his view from the right seat would have been impeded by some of the same aircraft structure (Figure 10).

MP3 and MCP had been scanning, but their views were obscured by window posts on the C-130H (Figures 6; 10; 11). Additionally, at the time of impact, MP3 was channelized on maintaining aircraft control prior to the next turn point (Tab EE-34). The MCP was distracted with turn point identification and scanning to the right to clear for the upcoming turn (Tab V-4.15).

Figure 6. C-130H Canopy

Figure 7. C-27J Canopy

Figure 8. C-27J Left Seat Pilot Right Side View

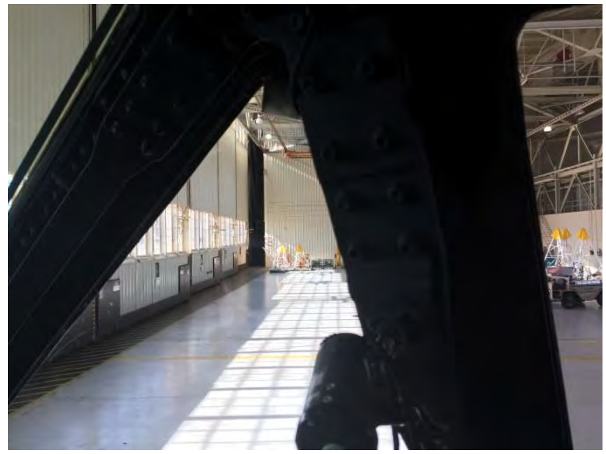


Figure 9. C-27J Right Seat Pilot Right Side View

Figure 10. C-130H Left Seat Pilot Left Side View

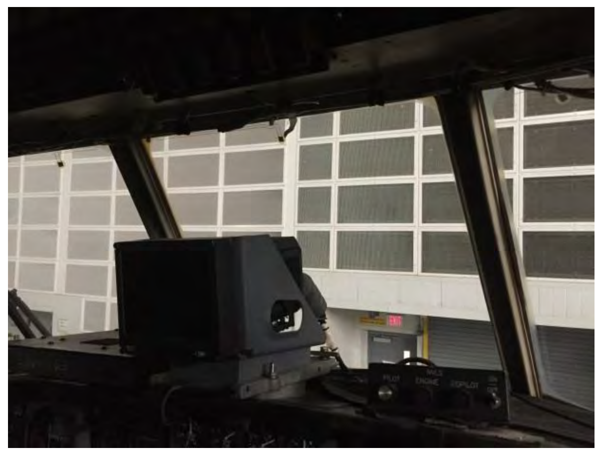


Figure 11. Right Seat Pilot C-130H Left Side View

(2) Instrumentation and Sensory Feedback Systems – (MIP1, MP1, MP3, MCP)

<u>HFACS Definition:</u> Instrumentation and sensory feedback systems are a factor when system (NVGs, TCAS, etc.) design, reliability, lighting, location, symbology or size are inadequate and create an unsafe situation.

<u>HFACS Contributing Factors</u>: Visibility Restrictions
Vision Restricted by Meteorological Conditions

<u>NVG Analysis</u>:

Night flying is challenging as objects are more difficult to see, therefore less information is transmitted to the brain for processing (Tab DD-47 to DD-48). To enhance night visibility capabilities and safety, the military integrates various night vision systems and devices into its flight operations. Night vision goggles are one such device that enhances a pilot's ability to see, perceive and react, thereby improving see and avoid, threat detection, and maneuvering response times (Tab DD-24 to DD-25). The majority of energy at night is infrared. NVGs take ambient light and near-infrared energy, intensify it and display it on a screen that rests approximately 1-inch from the pilot's eyes when helmet-mounted (Figure 5). NVG performance is based on the amount of ambient and infrared energy captured and the scanning technique employed to maximize their effectiveness

Per AFI 11-2C-130, Volume 1, Aircrew Training, 21 August 2012, paragraph 5.8, C-130 aircrew members are instructed and trained in NVG function and operation and undergo a training program to ensure they understand the capabilities and limitations of NVGs. The mishap C-27 aircrew members also underwent instruction and training to ensure they understand the capabilities and limitations of NVGs (Tabs G-7 to G-11; G-33 to G-34; G-42 to G-44). MIP1, MP1, MP3 and MCP completed required NVG pre-flight procedures and verified they were functioning properly (Tabs V-3.6; V-4.9; V-15.17 to V-15.18; V-17.14 to V-17.16).

NVG resolution, the capability to present an image that makes clear and distinguishable the separate components of a scene and object, is directly related to the available light. Current NVGs typically have a resolution of between 20/25 and 20/40 when optimally adjusted (Tab DD-26 to DD-28). Due to degraded environmental light, NVG resolution can decrease to 20/200 or worse (Tab DD-26 to DD-28). To put this into perspective, 20/200 vision is 200% worse and is considered legally blind by the Social Security Administration. The weather forecast for 1 December 2014 showed the moon's position and illumination was high (70%), allowing maximum NVG performance (Tabs F-2; F-4), which was verified by MIP1, MP1 and MCP (Tabs V-4.16 to V-4.17; V-15.44 to V-15.45; V-17.10). It was a "good night" for NVGs (Tabs V-4.30; V-17.10; V-19.6).

The use of NVGs allows aircrews to see objects at night that could not be seen during unaided operations. However, pilots must use focal vision to interpret the NVG image. Since interpretation of focal vision is a conscious process, more time and effort is required to maintain spatial orientation during NVG operations than during daytime operations. Additionally, due to the NVG's reduced field of view (FOV) and the lack of visual cues in the periphery, more reliance is placed on focal vision. This reliance on focal vision can increase the aviator's workload and susceptibility to spatial disorientation (AFMAN 11-217, Vol 3, paragraph 12.3) The NVG's field of view is determined by design and correct pre-flight; it varies between 30 to 40 degrees (Tab DD-28 to DD-29). Regardless of the field of view, it is considerably less than the normal visual field of approximately 200 degrees horizontally and 120 degrees vertically (Figure 12; Tab DD-28 to DD-29). With this limited field of view, pilots must actively and deliberately "scan" the scene outside the aircraft in order to achieve an adequate field of regard.

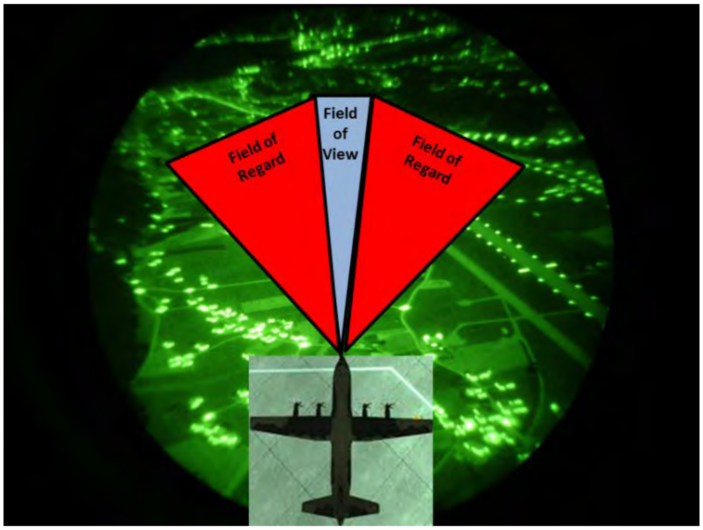


Figure 12.

The military flies with various types of NVGs. Some have enhanced design specifications and, therefore, better image quality than others. The C-130H and C-27J pilots were wearing F4949G and AN/AVS-6 goggles, respectfully (Tabs V-15.19; V-16.12). Both models functions the same but with one noticeable difference: the F4949G used by the C-130H aircrew has an enhanced image intensification tube that improves image quality (Tab V-15.19). However, considering both goggles have the same 40 degree field of view and the favorable environmental conditions (e.g., high illumination, contrast) on the night of the mishap, the type of NVGs worn by the C-27J pilots was not a factor in this mishap (Figure 12).

<u>TCAS Analysis</u>:

As explained in AFMAN 11-217, Volume 3, *Supplemental Flight Information*, 23 February 2009, Chapter 6, many civilian and military aircraft are equipped with TCAS to improve the traffic awareness of aircrews and provide de-confliction guidance to avoid aircraft on collision courses. Not all aircraft have TCAS installed and depending on their missions and operating areas, they may not require its operability if installed. As with any system, TCAS does have limitations. TCAS does not reference ground-based systems, but relies on onboard systems to operate. An operable TCAS will "communicate" with transponder-equipped aircraft to provide position data relative to other aircraft; it can also provide Traffic Advisories (TA) and Resolution Advisories (RA) (commands to avoid traffic) based on the proximity of other aircraft. The TCAS will coordinate the RAs if TCAS systems are installed on both conflict aircraft. TCAS is not radar, but a system utilizing radio signals; therefore, TCAS will neither track nor display non-transponder equipped aircraft or aircraft with an inoperable transponder. TCAS does not alter or diminish the pilot's basic authority and responsibility to ensure safe flight. Since TCAS does not track aircraft that are not transponder equipped or whose transponder is inoperative, TCAS alone does not ensure safe separation in every case (AFMAN 11-217, Vol 3, paragraph 6.12). It is particularly important that pilots maintain situational awareness and continue to use good operating practices and judgment when using TCAS and following RAs. Maintain a frequent outside visual scan and continue to communicate with ATC. This limitation is particularly important for pilots to remember in order to ensure they continue to use good visual scanning practices and judgment to maintain situational awareness.

The C-130H had operable TCAS and transponder, but the mishap C-27 had a history of intermittent TCAS malfunctions and there was an open entry in the aircraft forms for an intermittent TCAS on the night of the incident (Tabs D-19; D-25; D-30; D-44; D-49; D-55; D-88). Multiple aircrews had dealt with repeated ACAWS alerts associated with the TCAS which were able to be "reset" in flight by the crew (Tabs D-44; D-45; D-55; D-88). Additionally, and unknown to the crew, radar data indicates a transponder failure at some point in the flight profile while either airborne below radar coverage or on the ground at Laurinburg-Maxton Airport (Tab EE-41).

The MIP1, MP1 and MP2 are experienced aviators and are qualified in multiple aircraft types (Tabs G-5; G-6; G-32). Both pilots stated they weren't relying on the TCAS for alerts as not all of the aircraft they have flown have TCAS installed and their aviation experience had taught them the importance of outside vigilance and scanning (Tabs V-15.48; V-16.23; V-17.5).

TCAS significantly enhances aircrew situational awareness and safety and should be used to assist in visual acquisition of traffic. There are, however, systems limitations that reinforce the importance of maintaining an effective scan (AFMAN 11-217, Vol 3, paragraph 6.4.2). Although MIP1, MP1, MP2, MP3 and MCP stated that scanning was the primary means of seeing and avoiding other aircraft (Tabs V-3.20; V-3.35; V-5.38 to V-5.39; V-4.6; V-15.41; V-16.23; V-17.5), to varying degrees the deliberateness of the mishap pilot's scan relaxed as they trusted other systems to alert them when a greater need to clear their flight path existed. They didn't expect to see traffic, didn't see traffic, and that perception was reinforced by the lack of a TCAS traffic advisory (Tabs V-3.62; V-4.14; V-4.28; V-5.12; V-5.39; V-6.27; V-15.27; V-17.48).

(3) Vision Restricted by Meteorological Conditions – (MIP1, MP1, MP3, MCP)

HFACS Definition: Vision restricted by meteorological conditions is a factor when weather, haze, or darkness restricts the vision of an individual to a point where normal duties are affected.

HFACS Contributing Factors: Instrumentation and Sensory Feedback Systems

Analysis:

Humans are primarily daylight creatures, but have the unique ability to adapt and operate in low-light environments (Tab DD-20 to DD-21). However, this adaptability has limitations. Eyes require some light to see and visual acuity can dramatically change depending on the brightness of light sources. During low-light environments, it is more difficult to see and perceive an object and therefore takes more time for the eyes to focus and subsequently conduct outside scanning and cockpit tasks (Tab DD-20 to DD-21).

Although the mishap pilots stated they maintained consistent outside scanning, as discussed earlier, conducting an effective NVG scan takes much longer when compared to the human eye under daylight conditions. Vision is limited while utilizing NVGs—detection ranges decrease and recognition of objects, terrain and targets can be severely limited (AFMAN 11-217, Vol 3, paragraph 12.7.3). Due to the NVG's reduced field of view and the lack of visual cues in the periphery, more reliance is placed on focal vision which can increase the aviator's workload (AFMAN 11-217, Vol 3, paragraph 12.3). Pilots must slow their outside scan, allowing their eyes increased time to focus. Likewise, completing instrument crosschecks and adjusting aircraft systems by looking underneath the goggles takes additional time to complete.

MIP1 and MP3 stated they were conducting vigilant scans before the mishap, but the effectiveness of their scans was degraded due to the low light environment. MP1 and MCP were periodically scanning as well but were primarily conducting cockpit duties (Tabs N-69; V-4.15; V-15.26 to V-15.27; V-16.21). These tasks take little time to complete during the day, but take longer with reduced lighting.

(4) Distraction – (MP1, MP3, MCP)

HFACS Definition: Distraction is a factor when an individual has an interruption of attention and/or inappropriate redirection of attention by an environmental cue or mental process, causing degraded performance.

HFACS Contributing Factors: Vision Restricted by Meteorological Conditions

Analysis:

Humans are easily distracted and must constantly prioritize the continuous flow of internal and external information received from their senses (e.g., sight, sound). Distractions may be caused by legitimate tasks or thought processes, but they can cause misprioritization and channelized attention if not managed appropriately. Due to the inherent risks, it is even more important for pilots to minimize distractions during critical phases of flight.

MIP1 conducted the takeoff from Laurinburg-Maxton Airport and leveled the mishap C-27 at 1500' MSL heading northwest (Tab N-67 to N-68). MIP1 asked MP1 to load a tactical plot in the flight mission computer for display on the PFD and to report on frequency with the Mackall Tower controller (N-69). Although these were necessary co-pilot duties, they diverted MP1's attention inside the cockpit (Tab V-15.26 to V-15.27). The night environment prolonged the time required to perform the tasks, delaying his scan on the right side where the midair occurred (Tab V-15.26 to V-15.27).

Within the mishap C-130, MN was actively looking for the next turn point and navigating MP3 and MCP to the ground reference point (Tab V-6.13). MCP testified his attention was to the right in order to clear for the impending right hand turn (Tab V-4.15). These actions distracted MP3 and MCP resulting in a break down in their visual scan in the direction from which the C-27J approached.

(5) Channelized Attention – (MP3)

HFACS Definition: Channelized attention is a factor when an aircrew member focuses their conscious attention on a limited number of environmental cues to the exclusion of others of a subjectively equal or higher or more immediate priority, leading to an unsafe situation. It may be described as a narrow focus of attention that leads to the exclusion of necessary situational information.

HFACS Contributing Factors: Distraction
Instrumentation and Sensory Feedback Systems

Analysis:

MCP exchanged control of the aircraft to MP3 shortly after the mishap C-130 crew completed the completion of airdrop checklist (Tab V-4.15). MN gave navigation guidance and briefed the upcoming turn point and heading change (Tab V-6.13). MP3 lost situational awareness and channelized his attention on maintaining aircraft control, leveling the aircraft at 1,500' MSL (Tabs V-3.21 to V-3.22; DD-35). This caused a breakdown of his scan to the left, preventing him from seeing the mishap C-27 prior to the mishap.

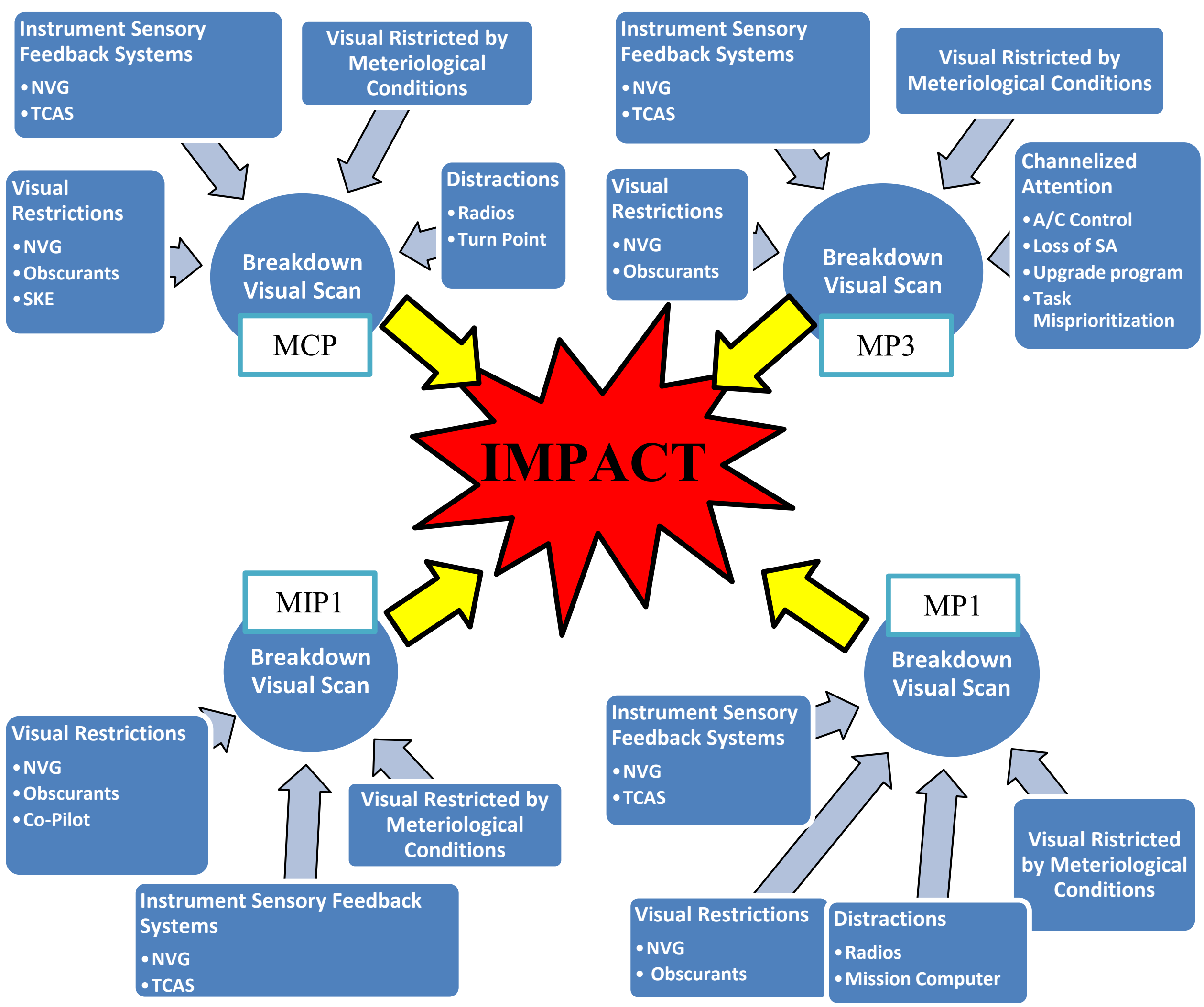


Figure 13. Human Factors Contributing to Breakdown of Visual Scan

d. Human Factors Summary

Neither aircrew visual acquired the other with sufficient time to maneuver to avoid a collision. Human factors that affect a breakdown in visual scan are both controllable (cockpit resource management) and not (aircraft structure). In the mishap C-130, MP1, MCP and MN stated that were distracted performing other duties that directed their attention away from the aircraft flight path (Tabs V-4.15; V-6.13; V-15.26 to V-15.27). In the mishap C-27, MIP1, while visually clearing, was unable to see the conflict develop with the mishap C-130 as it was outside his field of view and his field of regard was obscured (Figure 12). MP3 in the mishap C-130 channelized his attention on general aircraft and altitude control placing the mishap C-27 beyond his field of view (Tabs V-3.21 to V-3.22; DD-35). Aircrew over-reliance on TCAS to queue their visual scan resulted in a relaxed scan outside the aircraft V-3.62; V-4.14; V-4.28; V-5.12; V-5.39; V-6.27; V-15.27; V-17.48). The lack of visual cues in the periphery at night can be compounded by the lack of relative motion of offending aircraft (optical flow) and the restricted field of view provided by the NVGs (Tab DD-45 to DD-48; Figure 12).

12. GOVERNING DIRECTIVES AND PUBLICATIONS

a. Flight Operations

14 C.F.R. §91.3, *Responsibility and authority of the pilot in command*, 24 April 1990
14 C.F.R. §91.113, *Right-of-way rules: Except water operations*, 27 July 2004
14 C.F.R. §91.155, *Basic VFR weather minimums*, 27 July 2004
AFI 11-2C-130, Volume 1, *C-130 Aircrew Training*, 21 August 2012*
AFI 11-2C-130, Volume 2, *C-130 Aircrew Evaluation Criteria*, 25 July 2014*
AFI 11-2C-130, Volume 3, *C-130 Operations Procedures*, 23 April 2012*
AFI 11-202, Volume 3, *General Flight Rules*, 7 November 2014*
AFI 11-401, *Aviation Management*, 10 December 2010*
AFI 91-204, *Safety Investigations and Reports*, 12 February 2014*
AFMAN 11-217, Volume 3, *Supplemental Flight Information*, 23 February 2009
AFPAM 90-803, *Risk Management (RM) Guidelines and Tools*, 11 February 2013*
AR 40-8, *Temporary Flying Restrictions Due to Exogenous Factors Affecting Aircrew Efficiency*, 16 May 2007**
AR 95-1, *Flight Regulations*, 11 March 2014**
AR 95-2, *Airspace, Airfields/Heliports, Flight Activities, Air Traffic Control, and Navigational Aids*, 10 April 2007**
ARSOA 27 Aircrew Training Manual, 1 July 2014
Federal Aviation Administration *Aeronautical Information Manual; Official Guide to Basic Flight Information and ATC Procedures*, April 3, 2014 (Change1 1: 7/24/14, Change 2: 1/8/15)
FM 3-04-203, *Fundamentals of Flight*, 7 May 2007**
TC 3-04-93, *Aeromedical Training for Flight Personnel*, 31 August 2009
FORT BRAGG REG 95-1, *Aviation Flight Regulation*, 1 November 2010
Pope AFB Pamphlet, *Mid-Air Collision Avoidance*, March 2014

b. Maintenance

DA PAM 738-751, *Functional Users Manual for the Army Maintenance Management System–Aviation*, 28 February 2014
T.O. 00-20-1, *Aerospace Equipment Maintenance Inspection, Documentation Policies and Procedures*, 30 May 2014
T.O. 00-20-2, *Maintenance Data Documentation*, 15 November 2009
T.O. 00-5-15, *Air Force Time Compliance Technical Order Process*, 22 September 2014
T.O. 1C-C7J-10-2, *Maintenance Instructions, Radio Communications, Navigation and Identification Systems, C-27J Aircraft*, 15 November 2011

c. Other Directives and Publications

FAA Order JO 7110.65V, *Air Traffic Control*, 3 April 2014
FAA Order JO 7400.9W, *Airspace Designations and Reporting Points*, 8 August 2014
FAA Aeronautical Information Manual, *Official Guide to Basic Flight Information and ATC Procedures*, 3 April 2014
Andrew D. Woodrow and James T. Webb, *Handbook of Aerospace and Operational Physiology*, July 2011
*Available digitally at http://www.e-publishing.af.mil.
**Available digitally at http://armypubs.army.mil.

d. Known or Suspected Deviations from Directives and Publications

Not applicable.

13. ADDITIONAL AREAS OF CONCERN

At the time of impact, both mishap aircraft were operating VFR in the uncontrolled airspace surrounding Laurinburg-Maxton Airport (Tab DD- 48). Due to the mishap C-27's transponder failure, any radar return would not have provided altitude information or identified it as an aircraft for any air traffic control agency in contact with the aircraft (Tab V-20.15; DD- 42 DD-45 to DD-48). Mackall Tower had provided traffic advisories throughout the night to aircraft, including the mishap C-27, that requested it (Tab N-72 to N-77). However, the mishap C-130 had changed frequency from Mackall Tower three minutes prior when it was still within Mackall Tower's airspace (Tabs N-77; CC-30). The mishap C-27, while it had been monitoring the Mackall Tower, had only taken off four minutes prior to the collision and had not yet checked in with the Mackall Tower (Tabs N-63 to N-64; N-67 to N-68). Air Traffic Control was not a factor in the mishap.

In addition, both aircraft had their position lights and anti-collision strobe lights on at the time of impact (Tab V-7.11; V-14.6; V-17.51; V-18.8; V-19.12). Aircraft lighting was not a factor in the mishap.

MATTHEW G. ANDERER, Colonel, USAF
President, Accident Investigation Board

AIRCRAFT ACCIDENT INVESTIGATION BOARD
C-130H, T/N 88-4404 and C-27J, T/N 10-27030
Pope Army Air Field, North Carolina
1 December 2014

STATEMENT OF OPINION

1. Under 10 U.S.C. 2254(d) any opinion of the accident investigators as to the cause of, or the factors contributing to, the accident set forth in the accident investigation report may not be considered as evidence in any civil or criminal proceeding arising from an aircraft accident, nor may such information be considered an admission of liability of the United States or by any person referred to in those conclusions or statements.

2. OPINION SUMMARY:

I find clear and convincing evidence this accident was caused by a breakdown in visual scan resulting in insufficient clearing of the aircraft flight path by both aircrews. Both aircraft commanders were ultimately responsible for collision avoidance which required, *regardless of whether an operation is conducted under instrument flight rules or visual flight rules, vigilance shall be maintained by each person operating an aircraft so as to see and avoid other aircraft* (Federal Aviation Regulation §91.113) (emphasis added). Both aircraft were airworthy with all radio, navigation and external lights operating within Federal Aviation Administration, United States Air Force and United States Army applicable regulations and instructions for flight in the airspace at the time of the incident and the missions flown. Complacency channelized attention, loss of situational awareness, obstructed views due to aircraft design, over-reliance on Traffic Collision Avoidance Systems and diverted attention of support pilots to other inflight duties significantly contributed to the overall breakdown of exterior visual scan.

The mishap C-27 was crewed by highly experienced aviators with combined flying time nearing 30,000 hours. The mission profile was a "common" profile flown regularly in support of local US Army training. The C-27 airframe was newly acquired by United States Army Special Operations Command (USASOC) and the crewmembers on the night of the incident were executing pilot proficiency and upgrade training, flying low level routes to simulated airdrops and NVD-aided transition training. The mishap C-27 had a history of intermittent Traffic Collision Avoidance System (TCAS) malfunctions and TCAS was an open write-up in the forms on the night of the incident. Departing Pope Army Air Field (AAF)'s Class C airspace, enroute to Laurinburg-Maxton Airport for their initial transition work, all aircraft systems operated normally. Radar data collected from Fort Bragg Range Control, however, points to a transponder system failure at some point later in the flight profile while either airborne below radar coverage or on the ground at Laurinburg-Maxton Airport. Radar showed a primary return only for the mishap C-27. On departure, enroute to their first low level waypoint to the northwest, the mishap C-27 visually acquired the mishap C-130 out the right window as it passed, nearly co-altitude, north of their flight path. Upon subsequent contact with Mackall Tower, the controller advised negative transponder and directed the mishap C-27 to "recycle."

The mishap C-130 crew was a mix of experienced crewmembers with lower-time "traditional" Reservists. The mission profile planned was also a "common" profile familiar to all on board, a

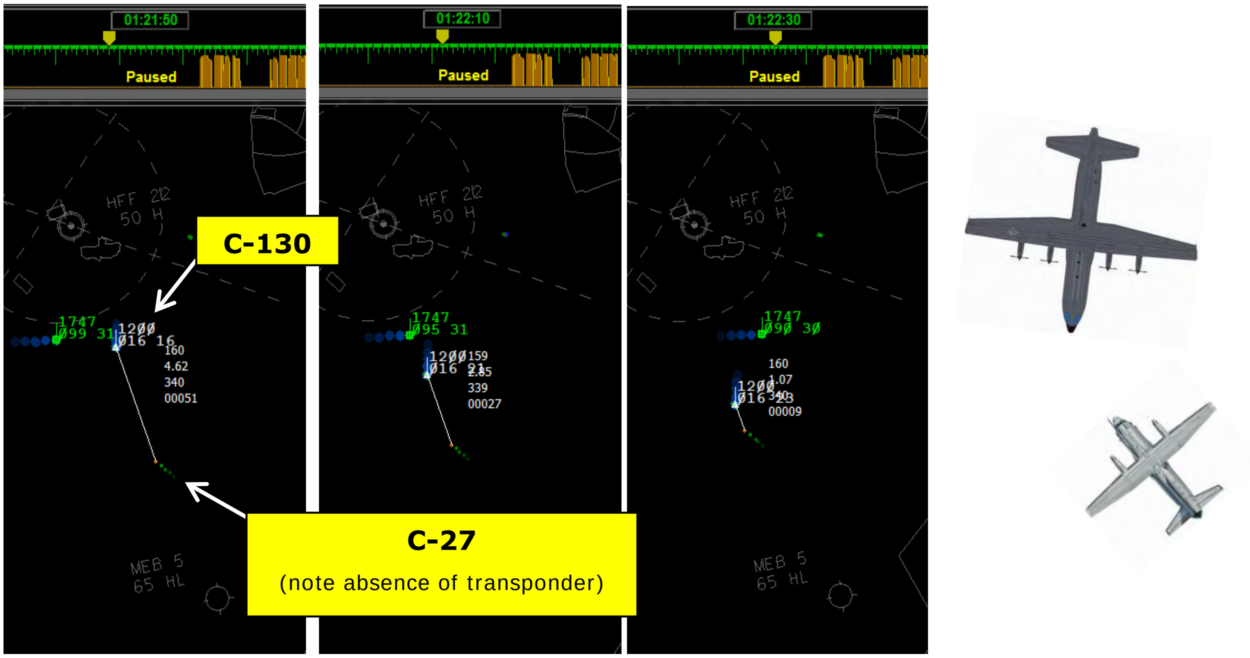
“2-ship SKE-Vis to Luzon.” The mission was a lead upgrade sortie for MP3, receiving training from MIP2, standing. The mishap C-130 departed as “number 2,” however, prior to the 20 minute advisory, the lead aircraft aborted due to a mechanical malfunction and the mishap C-130 continued, now single ship, simulating lead procedures for MP3 training. Post drop, and after their first turn to the east, beginning their transition to the VFR low level, the mishap C-130 visually acquired the mishap C-27 out the right side of the aircraft. MIP2 visually acquired an aircraft and later estimated its position as 7 miles south.

Radar recordings show the mishap C-130 and C-27 passed in opposite directions approximately 2.7 miles of each other, after each aircraft completed their respective left hand turns on course. Neither crew stated TCAS traffic advisories during this phase of flight.

The mishap C-27 crew executed their mission profile west of Mackall AAF and returned to Laurinburg-Maxton Airport for the pilots to swap seating positions prior to repeating the same route of flight. The mishap C-27 performed the seat swap, loaded the flight mission computer and set departure time for 2020L. They departed on time, climbing on runway heading before commencing a left turn to a heading of 310 degrees on course. En route, MIP1, the pilot flying from the left seat, leveled the aircraft at 1500’ MSL, engaged the autopilot and directed MP1to accomplish the normal after takeoff checklists, change radio frequencies to contact Mackall Tower and set a “Tac plot” marking Mackall airspace. MP1 was looking down at the center pedestal accomplishing the Tac plot immediately prior to impact.

The mishap C-130 executed the VFR low level as planned. As the mishap C-130 approached the Initial Point (IP) for the run-in and CDS airdrop, the crew was behind. Checklist challenges had to be repeated, numerous, reiterative radio calls were made to ATC and the DZCO; the “Slowdown Checklist” was completed 16 seconds prior to “Green Light.” MP3, the aircraft commander and pilot monitoring, did not provide any guidance to MCP, flying the aircraft, to correct his alignment and speed control. The mishap C-130 executed the drop uneventfully at 2020:04L. On the escape, after the completion of drop checklist, MP3 assumed aircraft control and continued to accelerate and climb to escape altitude of 1500’ MSL. MN briefed the turn point and talked MCP visually on to the turn point. MCP cleared to the right and upon turning his head to look forward saw a flash through his NVGs.

The aircraft closed on a flight path that remained at a nearly constant bearing, resulting in no relative movement on either windscreen.



Radar data depicting relative bearing (160 & 159) prior to impact (times in Zulu)

At 0122:40Z (2022 local) in uncontrolled Class G airspace, the mishap C-27 passed slightly below the mishap C-130. The right wing of the mishap C-27 grazed the right underside of the C-130 at the nose gear door, damaging the gear door, then followed a path that tore the flare dispenser hood from the fuselage and proceeded beneath the C-130's right wing. The C-27 vertical stabilizer crossed immediately in front of the nose of the C-130 then proceeded between the prop arcs of the C-130's number 3 and 4 engines, coming into contact with the front of the right external fuel tank and continued on a path impacting midway down the inboard side of the number 4 engine and leading edge of the right wing in the vicinity of the engine mount.

The C-27 sustained damage to the aft portion of the right wingtip and aileron and trim tab in addition to the top third of the vertical stabilizer and rudder, some of which (anti-collision light control box) was lodged in the leading edge of the C-130. The C-27 empennage also sustained internal structural damage.

Upon impact, though the aircraft flew normally, the mishap C-27 declared an emergency and recovered to Mackall AAF. They stopped straight ahead, shutdown and egressed on the runway.

Upon impact, the mishap C-130 yawed and rolled to the right as the number 4 engine began to "roll back." MFE3 quickly recognized the engine failure and recommended immediate shutdown, which MP3 directed. The engine did not shut down normally and the propeller continued to windmill. The mishap crew declared an emergency and recovered to Pope AAF. They taxied clear of the runway and after observing leaking fuel leaking in the vicinity of the damage, shutdown and egressed the aircraft.

While both crews performed well to prevent this incident from deteriorating into a more catastrophic event, a breakdown in visual scan causing in insufficient outside vigilance and clearing of the aircraft flight path resulted in the collision of these aircraft. I found a number of factors contributing to the crewmember's breakdown in visual scan:

MIP1 & MP2: The failure of the C-27 pilot flying in the left seat and the jump seat pilot to see the mishap C-130 was significantly impeded by visual restriction. The physical structure of the C-27 restricted the ability of both crewmembers to see the mishap C-130 on a 30 degree bearing (2 o'clock) slightly above the horizon.

MP1: Though appropriate support pilot duties, the pilot not flying in the mishap C-27 was distracted with other duties that contributed to his visual scan breakdown. MP1 was in the best position to see the C-130 traffic but was "heads down" setting the appropriate radio frequency and manipulating the flight mission computer, a period of time prolonged by vision restricted by meteorological conditions.

MCP & MN: Not unlike MP1, MCP and MN in the mishap C-130 were distracted with other duties. Appropriately, as they approached their turn-point, both the MCP and MN were clearing the route of flight to the right in advance of the impending turn to the west.

MP3: Contributing significantly to the visual scan breakdown for the pilot flying in the left seat of the mishap C-130 was a loss of situational awareness due to channelized attention. MP3 was in the best position to see the C-27 traffic but was focused on maintaining aircraft control as he accelerated and leveled the aircraft at 1500'. Though VFR, he channelized on pitch, power and airspeed as he sought altitude capture after he assumed control of the aircraft in an untrimmed climb.

Both aircrews were also negatively influenced by instrument sensory feedback. There is no doubt flight deck personnel in both aircraft were consistently clearing the flight path of their aircraft on the night of 1 December 2014 (both MP2 and MIP2 saw each other and other traffic that night). In both aircraft, however, what aircrew perceived to be clear airspace visually was reinforced by an over-reliance on TCAS. To varying degrees, the deliberateness of their scan relaxed as they trusted other systems to alert them when a greater need to clear their flight path existed. They didn't expect to see traffic, didn't see traffic, and that perception was reinforced by the lack of a TCAS traffic advisory.

While pilots are ultimately responsible for clearing the flight path of their aircraft, the inoperative transponder on the mishap C-27 and subsequent lack of TCAS information potentially available to the both mishap aircrews also contributed to their failure to visually acquire and avoid the other aircraft.

I found no evidence to suggest this incident was due to dereliction of duty or failure to perform assigned duties.

MATTHEW G. ANDERER, Colonel, USAF
President, Accident Investigation Board