Flightfax
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H-47 Five-year Mishap Review FY14-18

In the five-year period of FY14-18, there were 45 Class A-C aviation mishaps recorded for the H-47 while flying 369,872 flight hours. Six were Class A (five flight and one flight-related); three were Class B (two flight and one flight-related); and 36 were Class C (26 flight, five flight-related and five aircraft ground). Thirty seven of the 45 mishaps had identified or suspected causal factors, with the eight remaining mishaps not yet reported or with an unknown causal factor. Total mishap costs were greater than $55 million, and there was one Army fatality. The H-47 Class A flight mishap rate per 100,000 hours was 1.35, and the Class A-C rate was 9.73. The overall Army manned Class A mishap rate for the same time period was 1.23, and the Army unmanned Class A-C rate was 7.74.

A review of the H-47 mishaps shows human error was the primary cause factor in 26 (70 percent) incidents with a reported cause factor. Nine (24 percent) mishaps were materiel failures, and two (5 percent) were environmental related (bird strikes). The following briefs are a snapshot of some mishaps that occurred during this review period:

Select mishaps

1. The crew was conducting a pinnacle landing in conjunction with high-altitude environmental training when the rotor system contacted a mountainside. The aircraft descended into the ravine and crashed. There was one fatality. (Class A)
2. The aft main rotor system made contact with the fuselage during RL-progression roll-on training. (Class A)

Troopers assigned to Archer Battery, Field Artillery Squadron, 2nd Cavalry Regiment, with support from 12th Combat Aviation Brigade CH-47 Chinook helicopter crews conduct sling load training with M777 howitzers as part of the squadron's Artillery Systems Cooperation Activities at the 7th Army JMRC Grafenwoehr Training Area Germany.
Photo credit Gertrud Zach

3. The crew was on climb-out at approximately 150 feet above ground level and 40 knots indicated airspeed when all three cargo hooks reportedly released and jettisoned the M777 Light Towed howitzer sling load. The M777 was deemed a total loss. (Class A)
4. While the aircraft was in the process of completing a pedal turn, the aft-left landing gear struck a 15-foot stone concrete wall that surrounded the helicopter landing zone (HLZ). (Class C)
5. The crew experienced separation of the left door gunner's window upon departure/climb-out. The crew was able to visually observe the gunner's window fall into the trees and identify the grid location for recovery. (Class C)
6. The aircraft sustained damage during connection of a 155 mm howitzer for sling load operations. A howitzer stabilizing arm contacted the aircraft ramp, resulting in sheet metal damage to the lower edge of the ramp. (Class C)
7. The crew was conducting pinnacle landing training when the aft rotor system made ground contact, causing aircraft damage and crew injuries. (Class A)
8. After the crew departed the forward arming and refueling point (FARP) and returned to aircraft parking, the crew chief noticed the No. 2 aft pylon platform was unlatched and resting on the engine cowling, causing damage. (Class C)
9. During a night vision goggle brownout landing, the aircraft contacted a T-barrier. (Class B)
10. The crew reportedly experienced aircraft attitude anomalies during takeoff, during which the aft wheels made repeated contact with the runway. The crew conducted emergency shutdown procedures. A maintenance test flight (MTF) was pursuant to replacement of integrated lower actuator. (Class B)
11. The crew was ground taxiing at a commercial airport when the aft rotor blades made contact with the corner of a hangar, resulting in damage to all three aft rotor blades, two hangars and two aircraft inside a hangar. (Class A)
12. The aircraft were ground taxiing for refueling at the FARP when Chalk 1 was struck from the rear by the forward rotor blades of Chalk 2. (Class A)
13. While conducting a corrosion control inspection, damage was observed to two first-stage compressor inlet blades on the No. 2 engine. One of the FOD screen securing latches was identified as having a portion of the T-head bolt broken off. A total of seven compressor blades were identified as damaged, requiring engine replacement. (Class B)
14. The aircraft was hot loading a 463L pallet with engines at flight idle. The flight engineer (FE) failed to signal the forklift operator to stop in a timely manner and it contacted the upper rear pylon. (Class C)
15. The reported failure of an aft main rotor blade damper on engine shutdown resulted in blade contact with the fuselage (forward tunnel covers). (Class C)
16. During post-flight shutdown procedures, a fire in the cockpit resulted in damage before being extinguished by responders. The fire was caused by a chaffed hydraulic line in the heater compartment, which atomized hydraulic fluid. Sparks from chaffed electrical wiring ignited the fire. (Class C)

A South Carolina Army National Guard CH-47 Chinook heavy-lift cargo helicopter assigned to Detachment 1, Company B, 2-238th GSAB, support the South Carolina Forestry Commission to contain a remote fire. The aircraft is equipped with a Bambi Bucket, which can be filled with any available water to be transported and dumped on the fire. Photo credit Staff Sgt. Roberto Di Giovine

Photo credit Staff Sgt. Roberto Di Giovine

17. The crew was attempting a confined area landing in an approved landing zone while under NVG when the aircraft's aft main rotor blades contacted trees. The aircraft landed safely with no injuries to crew. Damage occurred to all three aft blades. (Class C)
18. While conducting shutdown procedures, rotor wash from another aircraft repositioning nearby caused damage to the airframe and flight controls as the result of blade contact with No. 1 tunnel cover. (Class C)

Summary

The H-47 five-year period of FY14-18 demonstrated a positive reduction in mishaps and rates from the previous five-year period:

- Total A-C mishaps were down 58 percent from 108 in FY09-13 to 45 in FY14-18.
- Class A mishaps fell from 15 to six, a 60-percent decrease.
- The H-47 Class A flight rate decreased from 2.52 per 100,000 flight hours to 1.35 for the most recent five-year period, a 46-percent reduction.
- The Class A-C rate dropped 33 percent from 14.53 to 9.73.

The most prominent mishap events during this period included object strikes, overspeed/overtemp/overtorques, external load issues, ground taxi incidents and door jettison events.

Typically, in manned aviation mishaps, human error is the primary contributing factor in 75-80 percent. Whether operating or maintaining the aircraft, strict adherence to established standards and procedures, coupled with good supervision, remains the most effective countermeasure to reduce human error mishaps. ■

Jon Dickinson
DAP, Aviation Division

HFACS

Human Factors Analysis and Classification System

The purpose of the Human Factors Analysis and Classification System (HFACS) is to assist mishap investigators in root cause analysis. The guide can also be used to develop interview questions and detect human error trends.

The Department of Defense (DoD) utilizes HFACS because of its benefits to assist in determining mishap causes that are rarely attributed to one cause. This method of analysis allows investigators to determine root cause and other errors in the accident chain that typically lead to the mishap.

The benefits attained by DoD from utilizing HFACS are:

- **A structured analysis of human error**
  - Sophisticated, complete – yet operational
  - Detects error patterns
- **Gets to the "why," not just the "what"**
  - More insightful root cause determination
  - Better command decisions, more effective operational risk management (ORM)
- **A data-driven approach**
  - Supports research across the uniformed services
  - Easily applied to a large body of existing data
  - Easily applied to new incidents and mishaps
- **Can be used for more than operational purposes**
  - Can be a tool for ORM brainstorming
  - Can help develop interview questions
  - Applies to both on-duty and off-duty evolutions

HFACS Principles

The DoD has five fundamental HFACS principles that crosswalk to our underlying philosophy and/or assumptions about aviation operations. These DoD principles are:

Principle 1: The DoD is similar in nature to other complex systems.

Principle 2: Human errors are inevitable within such a system.

Principle 3: Blaming an error on the service member is like blaming a mechanical failure on the equipment.

Principle 4: A mishap, no matter how minor, is a failure of the system.

Principle 5: Mishap investigation and error prevention (risk management) go hand in hand.

When cross walking these DoD principles to Army aviation operations, we find:

Aviation Principle 1: Aviation is similar to other complex productive systems. The framework commonly used to describe productive systems can also be used to understand aviation flight operations. Using a systems approach helps identify the underlying causes of mishaps and provides a better understanding of how system components may interact to affect safety.

Aviation Principle 2: Human errors are inevitable within productive systems. Humans make errors; therefore, we should strive to reduce the consequences of human error rather than prevent it.

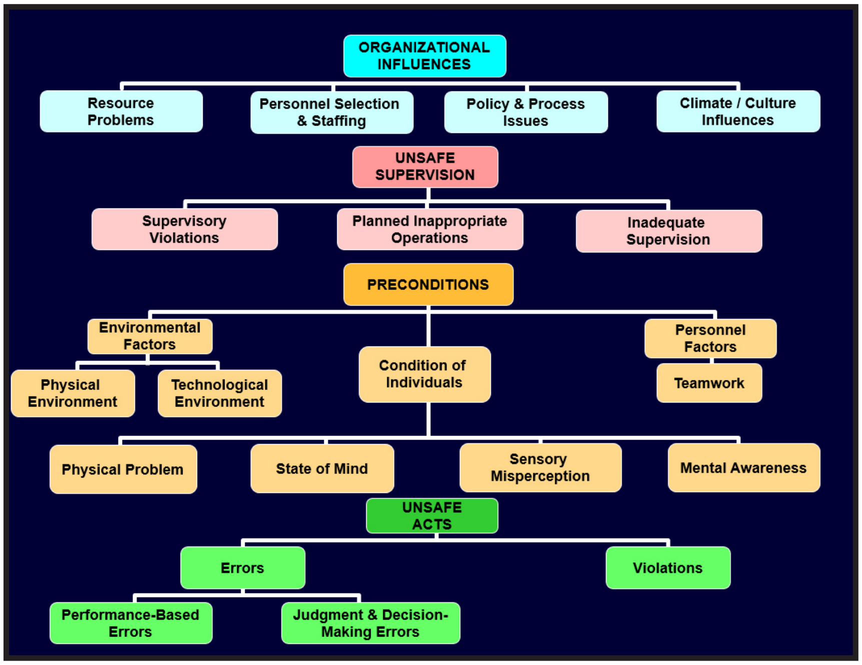
Aviation Principle 3: Blaming an error on the pilot is like blaming a mechanical failure on the aircraft. The aircrew often serve as the last barrier to stop a sequence of events from causing a mishap. When errors do occur, they are often only a symptom of the system's underlying problem.

Aviation Principle 4: A mishap, no matter how minor, is a failure of the system. Systemic problems are often the cause of aircrew error. We must search the system to determine why the errors occurred. We look at the entire sequence of events and the multiple factors that contributed to the mishap.

Aviation Principle 5: Mishap investigation and error prevention go hand in hand. The search for why an error occurred is not to reassign blame or liability, nor to excuse the error. Rather, it is to identify the underlying system(s) deficiencies that might cause a mishap to recur. Prevention, not punishment, should be the goal.

HFACS Model

The figure below displays HFACS model's factor classes:



How it works

HFACS allows for the investigation of mishaps in a synchronized and methodical, yet simple, process to determine the what and why. It provides the guidance on how to find each of the errors in the system, thereby providing leaders with the ability to see the errors in the mishap chain and take actions to mitigate them.

Based on historical empirical data, the majority of mishaps occur due to a chain of errors. So the process to determine the cause of a mishap does not stop with the prima facie evidence. An example is a hovering aircraft loses tail rotor control and has a hard landing with Class A damage. At first look, an investigator may see an aircraft that crashed from a hover. The pilot's statements tell the story of the tail rotor malfunction and subsequent hard landing. So at first sight, an investigator may believe the pilots didn't execute the proper emergency procedure when the tail rotor had a mechanical failure.

While this could be the what and why of the mishap, as the investigator uses the guide and goes through the steps, he or she is able to find all the errors that attributed to the mishap. The following example is not an exhaustive detail of an investigation using HFACS, but rather a simple look at HFACS process. The likely process would lead the investigator through this sequence, starting with acts:

1. Starting at the lowest level (acts) for an aircraft mishap begins with the logbook. A thorough review of the logbook, followed by quality control paperwork, allows the investigator to determine if the proper procedures were completed when preparing the aircraft for flight. For this example, the investigator finds that the write-ups are in error, with work signed off as completed but without the technical inspectors (TI) stamp. (Multiple failures by the mechanic, the TI and the aircrew.)
2. Next, the investigator would look for the preconditions that contributed to the mishap. He or she tries to identify why the unsafe act occurred (e.g., why didn't the mechanic get the TI to inspect and sign off the work, not paying attention, task oversaturation).
3. Now that the investigator has details on the acts and preconditions leading to the mishap, he or she turns the investigation toward the command's role in the mishap. Was there a lack of supervision? Does the unit typically operate in contravention to its SOP or authorize unqualified individuals for a task?
4. The final look is at the organization. The investigator — armed with the actions, preconditions and supervision elements of the mishap — can now look at the organizational level to determine if there are organizational influences that contributed as a part of the error(s) chain of events that resulted in the mishap. (For example, failure to provide adequate funding for training maintainers.)

With the investigation complete, the investigator now has all the details. Through utilization of HFACS guide, he or she can subsequently identify all the errors that occurred in the mishap chain of events leading to Class A aircraft damage and brief the unit leadership. The facts gained from this systems approach to mishap investigation now allows the leaders in the field to apply corrective measures to fix errors. In the example above, the leadership of the fictional organization that may be inclusive of the Army level can use the investigation findings to correct the issues they now understand are impacting safety and operational readiness in each of the aviation areas identified.

Conclusion

HFACS provides Army aviation leaders with an investigation process tool that maximizes the potential to identify all errors involved in the mishap chain of events. This process holds the key to preventing the same errors from occurring again and should not be limited to use for just the "big" mishaps. These same human factor elements can be utilized to investigate near misses, which have errors involved but didn't materialize into the Class A accident. If these are left to continue due to a lack of investigative response by the commander and the aviation safety officer, at some point they could lead to the next Class A mishap for the Army. ■

DAP Aviation Division

Mishap Review: HH-60L Dust Landing

During an approach to a helicopter landing zone (HLZ) for patient pickup, the HH-60L experienced brownout conditions. As the aircraft touched down tail wheel first, it entered a right rearward drift. The right main landing gear then contacted the ground, creating a pivot point. The aircraft rolled laterally about the right main landing gear and onto its right side. The pilots completed the aircraft shutdown, and the crew egressed the helicopter.

History

The crew began the duty day at 0900L hours with an aircrew brief at the battalion tactical operations center (TOC) with their chase aircraft crew. At 0304L, the TOC received a 9-Line MEDEVAC request. The crew departed the airfield at 0330L. After arriving at the point of injury (POI) site and determining the location for landing, the crew began their approach. During the first approach, the aircraft conducted a go-around due to the pilots' loss of visual reference and obstacles in the approach path that were communicated to the crew by nonrated crewmembers. At this point, the joint tactical air controller (JTAC) gave the aircraft a secondary HLZ.

On the second attempt, the aircraft encountered brownout conditions. At 0344:22L, the tail wheel contacted the ground in a small ditch next to a road short of the intended LZ, while the main landing gear was above the road. As the pilot lowered the collective for landing, the right main landing gear contacted the ground (road) in a right, slightly rearward drift and became the pivot point for the rollover sequence. The left-front wheel never came in contact with the ground during the landing sequence. The helicopter came to rest on its right side, and the main rotor blades and the tail rotor blades were destroyed by ground impact.

Crew experience

The pilot in command (PC) had 803 hours total time. The pilot had 816 hours total time.

Commentary

When crews are required to conduct rotary-wing aircraft operations that involve the possibility of confronting the hazard of degraded visual environments (DVE), they must be trained thoroughly. The ability to identify hazards and respond to them properly cannot be underestimated. While the Army is currently in the process of acquiring a DVE solution that allows aircraft to see through obscurants, crews must rely on hard, realistic training to mitigate the associated risk from DVE. Leaders, instructor pilots and aviators gain the experience to brief and operate in demanding environments that involve DVE, such as over water, snow and brownout conditions, by conducting training in those environments so they learn the techniques necessary to successfully negotiate the hazard. Adherence to the digital aircrew training module procedures for the applicable airframe and utilizing techniques trained during mission and continuation training at home station in conditions Army aircrews can be called upon to operate in should be mandatory. Army leaders and crews understand DVE operations are a fact for Army aviation. Brownout landings are required in arid and desert environments where we must be able to operate. The method to achieve a "T" in brownout and DVE flight operations is to train crews in the techniques necessary to overcome these hazards, and leaders applying the commensurate risk associated with these factors. ■

Class A - C Mishap Tables

	Manned Aircraft Class A – C Mishap Table									as of 13 Feb 19
	Month	FY 18					FY 19			
		Class A Mishaps	Class B Mishaps	Class C Mishaps	Fatalities		Class A Mishaps	Class B Mishaps	Class C Mishaps	Fatalities
1st Qtr	October	1	2	7	0		1	1	3	0
	November	0	1	4	0		0	0	5	0
	December	1	0	8	0		1	1	1	0
2nd Qtr	January	1	1	3	2		1	1	0	0
	February	0	0	2	0					
	March	0	1	11	0					
3rd Qtr	April	1	2	4	2					
	May	1	0	5	0					
	June	1	1	5	0					
4th Qtr	July	1	0	6	0					
	August	3	1	6	1					
	September	1	1	8	1					
	Total for Year	11	10	68	6	Year to Date	3	3	9	0
	Class A Flight Accident rate per 100,000 Flight Hours									
	5 Yr Avg: 1.23		3 Yr Avg: 1.05			FY 18: 1.30			Current FY: 1.04	

UAS Class A – C Mishap Table									as of 13 Feb 19
	FY 18					FY 19			
	Class A Mishaps	Class B Mishaps	Class C Mishaps	Total		Class A Mishaps	Class B Mishaps	Class C Mishaps	Total
MQ-1	3	1	3	7	W/GE	2	0	0	2
MQ-5	1	0	0	1	Hunter				
RQ-7	0	7	20	27	Shadow	0	2	7	9
RQ-11	0	0	0	0	Raven				
RQ-20	0	0	0	0	Puma				
SUAV	0	0	0	0	SUAV				
UAS	4	8	23	35	UAS				
Aerostat	4	2	1	7	Aerostat				
Total for Year	8	10	24	42	Year to Date	2	2	7	11

Blast From The Past: *Articles from the archives of past **Flightfax** issues*

VOL. 2, NO. 38, JUNE 1974

Do You Know?

DO YOU KNOW about the inaccuracy of the pressure altimeter when used as an altitude indication on a 100-¼ PAR approach?

There is an inherent error in nearly all pressure altimeters that is unique to each altimeter. This error is due primarily to the irregular expansion of the altimeter aneroid wafers and will vary with altitude. It is possible to have a positive error at sea level with a negative error at altitude or vice versa. This altimeter scale error is neither arithmetical nor linear, but is an ever-varying curve. It is important to understand that each altimeter has its own curve (see Figure 1 for an example) and because of this curve, it would be nearly impossible for a pilot to apply the variations in altimeter error with the accuracy needed for a 100-¼ approach. To allow for this inherent error in the pressure altimeter, TM 1-215, Attitude Instrument Flying, Department of the Army 1958, page 2-34, allows a ±70 feet deviation from a known altitude. While this error is an acceptable deviation for other conditions, it may have an adverse effect on a low PAR approach (100-¼).

PILOT INDUCED ERROR

Another factor in total altimeter error is the position upon the airport surface where the above error is determined. Often when the reported altimeter setting is broadcast, the pilot will be sitting on the ramp. In determining the above error, the pilot will adjust his altimeter to the broadcast altimeter setting and compare it to the airport elevation. The published airport elevation is the highest elevation on the surface of that airport and may or may not be the elevation of the ramp. If the pilot uses the ramp area to determine his altimeter error and the ramp elevation is not the airfield elevation, he could unknowingly have an additional 20- to 30-foot error.

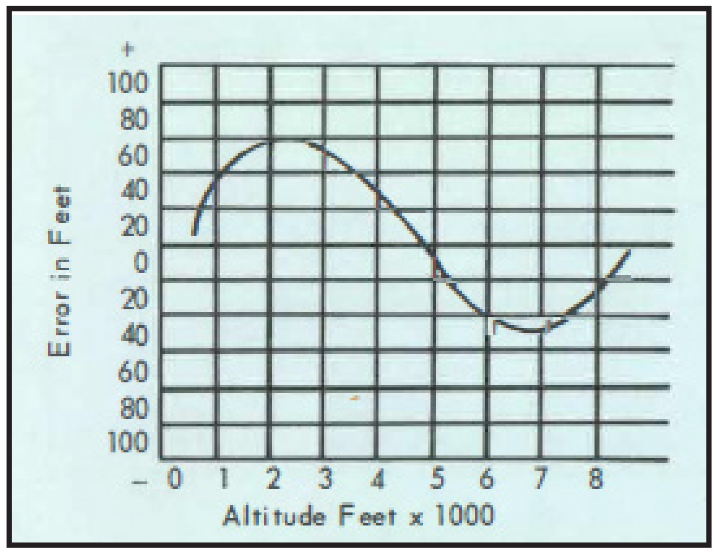


Figure 1

Temperature also affects the pressure altimeter. When the altimeter setting is reported, it has had a temperature correction applied. However, it is possible to have an error due to the interpolation process. While this error may be small 10 to 15 feet, it could be significant on a low approach.

While on a precision radar approach, the controller is required to advise the pilot when he is at decision height. He does this by saying three words, "at decision height," and then continues to give glide slope and course information. If the pilot's altimeter is showing above decision height or if he is distracted, he may not correctly perceive this information. The pilot could not request a clarification because at this point on the approach the controller's mike is constantly keyed, blocking the frequency. This could lead to the pilot continuing the approach to his altimeter decision height.

Based on the above, it is possible for a pilot to have a ±70-foot error in the altimeter, to have another 20- to 30-foot error due to position on the airfield, and a small error due to temperature. If all of these errors are combined, it is possible for his true altitude to be 100 or more feet below his indicated altitude. This fact coupled with not fully perceiving three words, "at decision height," could have serious consequences. ■

***Note:** For the current information on altimeter settings, errors, corrections and details see Training Circular (TC) 3-04.5, Instrument flight for Army Aviators, you can access this TC at the following web address: https://armypubs.army.mil/epubs/DR_pubs/DR_a/pdf/web/ARN3042_TC%203-04x5%20final%20web.pdf.*

Hot Topics

NTC Observations on D3SOE

Point 1: The ability to foresee when enemy or commercial satellites will be within view (or earshot for electronic intelligence (ELINT) collection platforms) of your assembly area (AA) or tactical assembly area (TAA) should be a commander's critical information requirement (CCIR). The product that provides this information is referred to as the satellite reconnaissance advanced notice (SATRAN). Your division space support element should provide these products if requested, but, realistically, anyone with access to SIPR can pull the same products. However, they require a little study on identifying

which satellites to care about.

Why? If you want to jump your TAA when the enemy can't observe you from space, this gives you an exact window of time based on location. If you're worried about making radio calls back to higher for fear of being geolocated by ELINT satellites, now you'll know when to broadcast (taking into account the enemy could still have ground-based collectors). I'll admit as space becomes ever more congested with satellites capable of providing intelligence, surveillance, and reconnaissance (ISR), these windows of time will continue to shrink.

Point 2: Your joint capabilities release (JCR) tracker is sending multiple signals up to satellites each minute. This signal is on one frequency in a band not used by a lot of other military devices. Any emitted signal can be detected if you know where to look, especially if it's a singular frequency and not frequency hop. If the enemy knows the JCR frequency and has the right equipment, they can easily geolocate your TAA with line-of-sight devices on the ground or space-based ELINT collection platforms.

The National Training Center (NTC)/Cyber Electromagnetic Activity (CEMA) team and I invited the program manager for Joint Battle Command-Platform (JBC-P) to observe what the JCR's signal looks like from a ground-based collector. We're working with their team to make our fighters less of a target while still enabling these mission command systems. Until the JBC-P devises a better product to reduce the likelihood of detection, my recommendation is to minimize your signature by turning off the majority of JCRs anytime an aircraft is sitting at the TAA and only turn them on when getting ready to fly. I say the majority, as the brigade commander will likely want to maintain situational awareness. If only one aircraft has its JCR on, the TAA won't look like a TAA from an ELINT perspective, and the enemy will be less likely to target one signature as opposed to a collection of several signatures.

One last thing: If it is an organic satellite and they have refined their processes, geolocation information can be disseminated to a fires element in less than 20 minutes from time of satellite capture. For our ground-based collectors here at the NTC, we can have rounds on target in less than five minutes from collection. ■

CPT Patrick Jones
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Forum

How Does the COSPAS-SARSAT System Work?

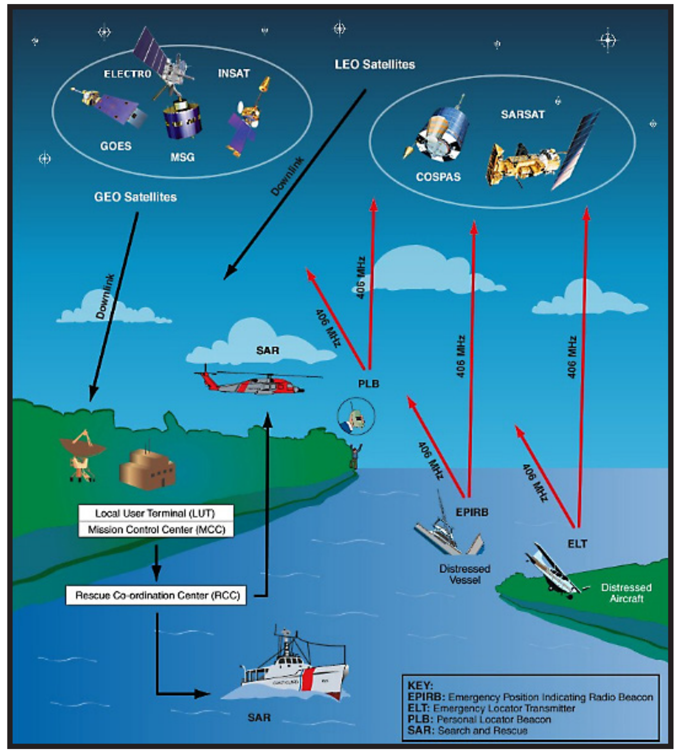
The COSPAS-SARSAT* System provides distress alert and location information to search-and-rescue (SAR) services throughout the world for maritime, aviation and land users in distress. The System is comprised of:

- Satellites in low-altitude Earth orbit (LEOSAR) and geostationary orbit (GEOSAR) that process and/or relay signals transmitted by distress beacons.
- Ground receiving stations, called local user terminals (LUTs), that process the satellite signals to locate the beacon.
- Mission Control Centres (MCCs) that distribute the distress alert information to SAR authorities.

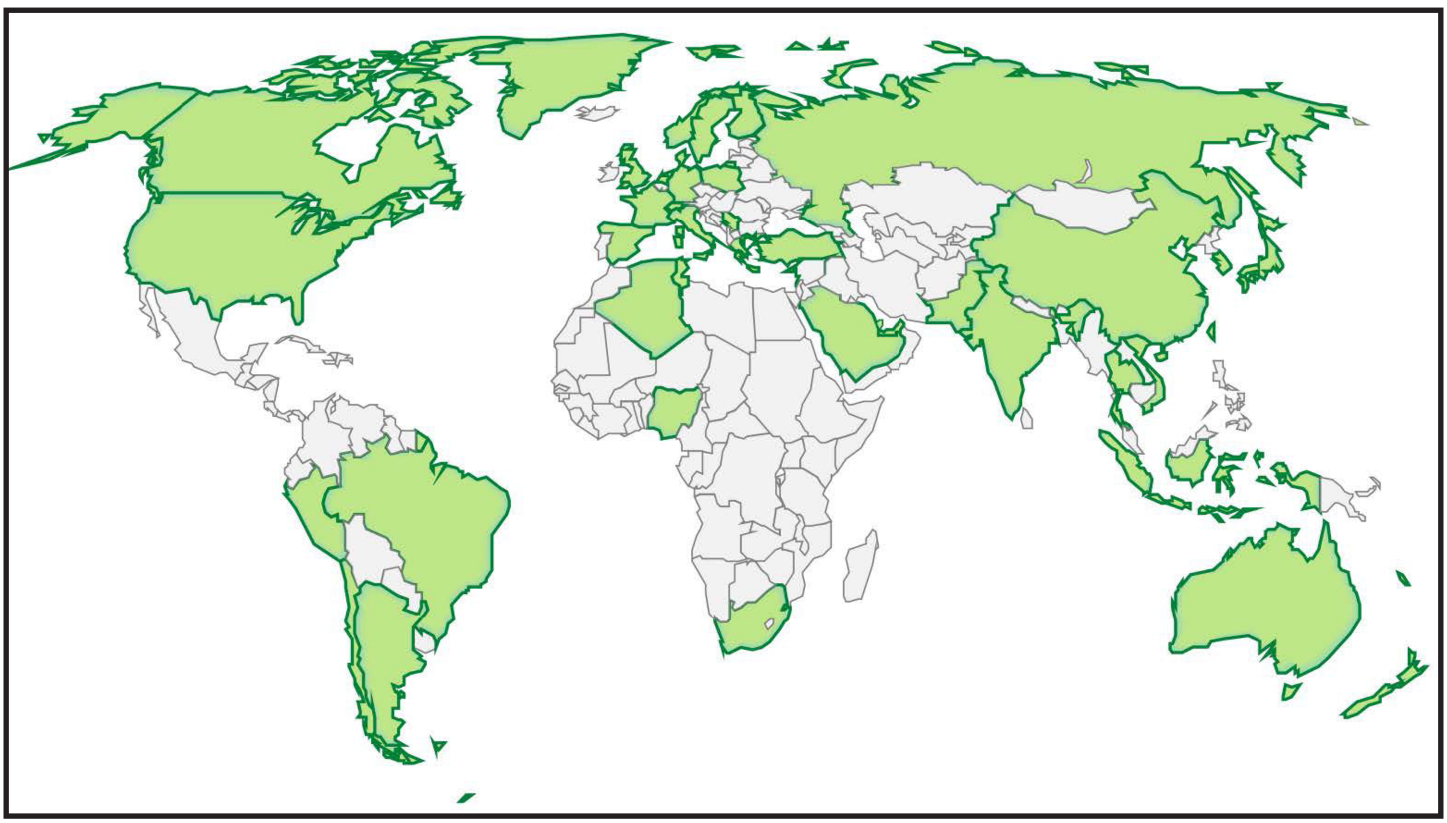
The COSPAS-SARSAT System detects distress beacons that operate at 406 MHz. Satellite reception and processing of legacy analogue technology 121.5- MHz beacon signals ended 1 February 2009.

Participating Countries and Organizations

Algeria
Argentina
Australia
Brazil
Canada
Chile
China (P.R. of)
Cyprus
Denmark
Finland
France
Germany
Greece
Hong Kong
India
Indonesia
Italy
ITDC
Japan
Korea (R. of)
Netherlands (The)
New Zealand
Nigeria
Norway
Pakistan
Peru
Poland
Russia
Saudi Arabia
Serbia
Singapore
South Africa
Spain
Sweden
Switzerland
Thailand
Tunisia
Turkey
UAE
UK
USA
Vietnam
Total: 42



Countries participating in COSPAS-SAR are shown in green



COSPAS-SARSAT distress alert and location data are provided to national SAR authorities worldwide without discrimination, and independent of whether their government is formally associated with the Programme.

For more information on COSPAS-SARSAT, check out: http://www.cospas-sarsat.int/en/pro. ■

**COSPAS-SARSAT: Cosmitscheskaja Sistema Poiska Awarinitsch Sudow (Russian: space system for search of vessels in distress)-Search-and-Rescue Satellite*

Mishap Briefs #72

Attack Aircraft

AH-64

E Model – Reported power loss on departure from FARP at 15-50' AGL and descended to ground contact. (Class A)

D Model – Reported bird strike on downwind for landing. Damage reported to main rotor blade tip cap. (Class C)

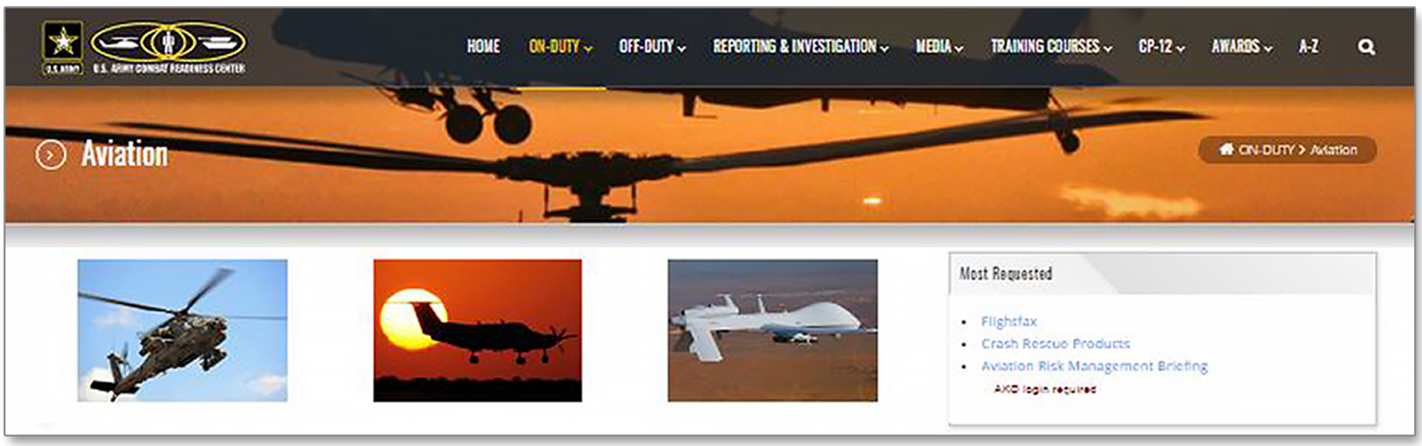
Unmanned Aircraft

RQ-7

B Model – During the mission, the air vehicle (AV) experienced a propulsion failure. The parachute was deployed and the AV has been recovered. (Class B)

B Model – AV sustained damage when it touched down hard during tactical automatic landing system (TALS) recovery, resulting in separation of the main landing gear and damage to the payload. (Class C)

Visit the U.S. Army Combat Readiness Aviation Division at: https://safety.army.mil/ON-DUTY/Aviation



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U.S. ARMY


UNMANNED ≠ EXPENDABLE
✓ Conduct deliberate mission planning and reasses as mission dictates
✓ Secure proper mission approval and update as risk elements change
✓ Know your equipment
✓ Stay in the fight, follow your checklist
U.S. ARMY
U.S. ARMY COMBAT READINESS CENTER
https://safety.army.mil