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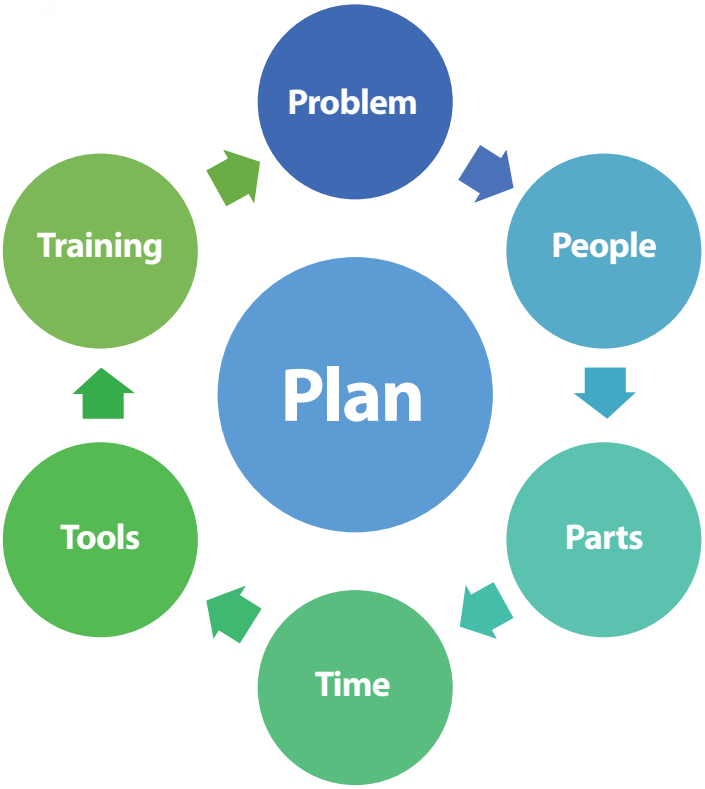
P4T3 Supporting "Ready Now" Maintenance



What is the definition of aviation maintenance? To repair aircraft correctly? Well, it's actually a little more than that. Army Training Publication (ATP) 3-04.7, Army Aviation Maintenance, defines aviation maintenance as follows: "The primary objective of aviation maintenance is to provide safe mission-capable aircraft to satisfy mission requirements." So now that we have a definition of aviation maintenance, how do we perform it safely? On the operations side of the house, the Army utilizes operation orders (OPORDS) to communicate what needs to be accomplished and how it is going to be accomplished. Army Aviation maintenance employs the P4T3 method to safely address scheduled and unscheduled maintenance events. P4T3 is an organizational tool that assists commanders, leaders and maintenance personnel in the management and planning of personnel and resources required to perform maintenance. The utilization of the P4T3 process will ensure a safe, streamlined maintenance program and will normally save you time and resources.* This process supports a "ready now" Army Aviation fleet.

Problem

The maintenance problem must first be identified. This process can be as simple as identifying a particular scheduled maintenance event, such as a 300-hour service or a drive shaft cover rivet replacement service. The failure of an operating aircraft system or subsystem, resulting from improper maintenance procedures, can have catastrophic and deadly consequences to personnel and equipment. Aviation maintainers must adhere to the most current applicable interactive electronic technical manuals (IETM), aircraft technical manuals (TMs) and references when conducting maintenance on aircraft. Prescribed troubleshooting procedures are the first maintenance task crewmembers and maintenance personnel must complete to standard, particularly when maintenance is unscheduled. Are maintainers diagnosing the faults using established troubleshooting procedures? Are the components causing the aircraft fault properly identified and repaired?

Planning

Planning involves implementing measures to correct the problem without discontinuing the mission. The mission dependent unit maintenance SOP and maintenance plan are the first steps toward ensuring a solid basis for production and quality control (QC). In planning maintenance, the production control (PC) officer-in-charge (OIC) will ask: How will we accomplish the task? What is the maintenance plan for performing the task to completion? Who is responsible for performance of the task? Can the maintenance be performed by the owning unit, or will it have to be performed by the aviation maintenance company (AMC)/ aviation maintenance troop (AMT) or an aviation support

company (ASC)? Can the maintenance be performed on-site, or must the aircraft be relocated?

The maintenance plan for scheduled services must contain adequate detail to ensure uniformity. The plan may include reviewing the maintenance task; anticipating mandatory replacement parts; gathering all of the parts in one location; ensuring required consumable material is available; ensuring tools are available in sufficient quantity and type; and ensuring test, measurement, and diagnostic equipment (TMDE) calibration is current.

People

Maintenance managers will assess available resources to ensure adequately trained, proficient personnel are on hand to conduct scheduled and unscheduled maintenance. The maintenance manager and commander should minimize conflicts between maintenance events and scheduled training, such as weapons qualification and driver training, when they are preparing for major maintenance events. Trained personnel will have the MOS classification or additional skill identifier authorizing them to perform the repairs. The maintenance allocation chart (MAC) displays the level of maintenance required to perform repairs. The maintenance manager uses the MAC to determine if repairs can be done internally (AMC, AMT) or externally (ASC, contractors). At every opportunity, new Soldiers should be placed with more experienced Soldiers to conduct specific tasks. This training, captured within the digital job book, will ensure the new Soldiers get the training and experience needed to perform the task on their own in the future.

Parts

Before performing maintenance, PC personnel should verify they have the correct type and quantity of parts. Parts assessment is necessary to determine what is required and available to correct deficiencies. If parts or components are not available, a request for the necessary parts or components must be processed immediately. Aircraft maintainers and crew chiefs must ensure removed components are properly cleaned and inspected to determine serviceability. They must properly tag and store serviceable parts removed from an aircraft and inspected by a TI to ensure parts are available and serviceable when it is time to reinstall them. Aircraft maintainers and crew chiefs must properly tag unserviceable components, have QC technically inspect and sign the tag, and promptly turn in components to the technical supply section.

Time

For the maintenance manager, time is critical to mission accomplishment. Maintenance managers must accurately evaluate time constraints when determining if there is adequate distraction-free time available to complete the repair. Additionally,

the estimated completion date is crucial in forecasting combat power availability. Leaders must allow adequate time for aircraft maintainers to perform maintenance on the equipment.

Tools

During assessment, the maintenance manager should assess type and quantity of tools available for task completion. This is especially true during split-based operations. Supervisors must identify tools required to do a job and ensure they are on hand, serviceable and calibrated, if required. Leaders must educate themselves on the different tools and enforce IETM/TM/technical bulletin (TB) standards when aircraft maintenance is performed.

Training

Commanders must afford junior maintenance leaders the opportunity to develop an understanding of maintenance operations and management. This training is an essential building block and is critical to leadership development. Maintenance leadership skills taught and reinforced every day in garrison translate well to tactical, combative and other field environments. Leaders must know the maintenance standards in order to enforce them and must be aware of the measures of effectiveness (MOE) to improve them.

Fundamentals of maintenance management can be observed and learned in regularly scheduled PC meetings. Attendance and involvement in the battalion or ASC PC meeting is only one level of maintenance management and enables the development of junior leaders. Soldiers receive initial technical training (skill-level 1) at Advanced Individual Training (AIT); however, AIT should not be considered the end of individual training for the aviation maintainer. After successful AIT completion, the Soldier is equivalent to that of an apprentice. The gaining aviation unit commander assumes the responsibility for enhancing and expanding the training (skill-level 2) of Soldiers received from AIT. The enhanced unit training increases the maintainer's ability, skill and knowledge. This training includes the integration of airframe and support maintenance specialties. Apprentices possess entry-level knowledge and skills that must be carefully groomed and honed so they can develop into master or seasoned maintainers (skill-levels 3 and 4).

Execution

P4T3 is not the end-all of maintenance operations, but it provides a streamlined, planned approach to the execution of an Army Aviation maintenance program. Leaders utilizing the process have the opportunity to understand the strengths, weaknesses, opportunities and threats (SWOT) to their operation and take positive actions to enhance or overcome the particular SWOT issue. It further informs senior leaders by allowing them to understand what is necessary to execute the maintenance readiness mission of their battalions and brigades. Utilizing the P4T3 methodology streamlines the maintenance process, informs senior leaders, and provides Army Aviation with a ready-now force. ■

**Excerpt from ATP 3-04.7 Army Aviation Maintenance September 2017*

Chuck Brown
Aviation Sustainment Division
Army Futures Command AE-RDD

Operational Risk Management: Expeditionary Operations Lessons Learned

Located on an amphibious ship as part of a Marine Expeditionary Unit (MEU), our four-aircraft CH-53E detachment was attached to a reinforced MV-22B squadron. We were tasked with projecting power forward in support of United States policies and providing a reactionary contingency force throughout our area of operations (AO). One month after embarkation, we settled into a rhythm and were relatively confident in our abilities around the ship. En route to our AO we dodged several large storms, while another massive storm pummeled the Commonwealth of the Northern Marianas Islands and Guam as we completed one of our first tasks. As the nearest contingency force, we were immediately tasked to support the local government in its assessment and recovery from the storm. In order to reduce the risk of mid-air collisions between the numerous aircraft of different type/model/series operating from multiple squadrons and ships, the MEU staff dictated that all flight operations would occur during daylight hours. To reduce the impact of stranded aircraft, the squadron commanding officer directed that aircraft were only to shutdown at Andersen Air Base on Guam.

Our CH-53E detachment's first assigned mission involved an insertion of a Mobile Marine Air Traffic Control Team into one of the local airfields on Tinian that had most of its utility services knocked out. With the sudden influx of survey and relief aircraft, there was concern that conflicts could arise without a knowledgeable team on the radios. After dropping the team off, we were to fly another 40 nautical miles (NM) to the nearest military base to pick up water needed throughout the island chain. We were also tasked to carry several critical maintenance items from the military airfield and bring them back to the ship.

As the operations officer for our detachment, I scheduled myself to fly with a major who had not flown for several years and was refreshing to once again become an aircraft commander. We started up without incident and loaded twelve passengers in preparation for takeoff. Due to the high level of tasking for the day, the flight deck was filled with aircraft preparing to launch and we were sandwiched between spinning aircraft fore and aft of our spot. With all passengers seated and strapped in, we called for breakdown and launch. The landing signal enlisted (LSE) showed four chains, two chocks, cleared the area, and signaled for us to lift. As the aircraft commander, I took the first takeoff of the day. I brought power in and could feel the aircraft get light on the struts. The nose began to rise a little quicker than normal and I responded with a proportional amount of forward stick and continued to pull in power. To my surprise, the nose dropped as the rear wheels came off the deck and the aircraft started to rapidly drift toward the spinning aircraft in front of us. The intercom system exploded with calls from my co-pilot and other aircrew members. Again, I corrected with a pitch input and brought the stick back. The nose snapped up and we struck the tail skid on the deck as we accelerated backward. Realizing that a stable hover and a safe landing were out of the question, and that any delay was placing everyone on the flight deck at risk, I pulled power and shoved the stick left to get us away from the super structure and out over the water. As we slid over the deck edge and gained airspeed, the aircraft seemed to stabilize. A quick glance down at the caution lights showed multiple automated flight control system (AFCS) failures but indicated both computers were working to some degree. I asked the crew if everyone was alright in the cabin. They responded that everyone was shaken but fine and though the tail skid struck the deck, there was no indication that the tail rotor struck

anything. I then asked tower for a holding pattern to troubleshoot. The aircraft was flying but it was obvious something was amiss. Entering the holding pattern, we began our discussion as crewmembers. We talked through all the failure indications and how the aircraft was flying. With concurrence from the other crewmembers, I had my co-pilot attempt a reset of the AFCS computers. Immediately after turning the computers back on, the failures would reappear but not always in the same combination. After multiple attempts and repeated failures, we began discussing viable options.

Accept risks when benefits outweigh the costs.

We determined that flying the aircraft with the AFCS secured was the safest configuration. Though this is a degraded mode, at least then the aircraft was predictable and we knew what we were dealing with. Operating the aircraft in a degraded mode was a risk that was worthwhile to us in order to have a known configuration and predictable flight characteristics. We then began discussing landing options. A landing to the ship with the AFCS secured is to be attempted in an emergency only. We were within 10 NM of the nearest airfield and had twelve passengers on board. We decided that we would head directly for that airfield and drop off the passengers before continuing with our troubleshooting. This airfield would give us a long runway for a running landing if required, and it would reduce the time we had passengers aboard. We accepted the risk of overwater flight with a degraded AFCS because the risk of landing to the ship was too high and the benefit of getting the passengers off the aircraft made it worthwhile. The concept of evaluating risk vs. reward is something we do unconsciously every single day. We will only do something "if it is worth it." By putting this front and center, it forces leaders to go back to the bottom line of every mission order: the commander's intent and end state. Is the end state we are seeking to achieve worth the risk we are considering? This is utilized all the way down to the lowest level. Every crewmember in the aircraft, regardless of rank or experience, has an equal voice when considering risk decisions. Care is taken to ensure that senior crew members do not influence junior members' input.

Accept no unnecessary risk.

After departing the ship's airspace, it was a nervous five minutes to shore. The aircraft flew

well and we made an uneventful rolling landing at Tinian. The passengers disembarked and we began a discussion about our plan. We could shut down in place and attempt to troubleshoot, we could attempt a return flight to the ship, or we could push the 40 NM to Guam and land at Andersen Air Base to troubleshoot and coordinate with higher. The risk of shutting down in place at Tinian was that we could be stranded with little support possible from the ship. Additionally, we would be filling ramp space that was necessary for staging supplies, evacuating casualties, and supporting the following waves from the ships in the area. Returning to the ship would still require us to attempt an AFCS-off landing, not something any of us wanted to do. Pushing to Andersen Air Base required 40 NM overwater flight with an aircraft in a degrade mode. I laid out the options to the crewmembers and asked for feedback. We had an experienced crew with aerial observers from multiple maintenance shops. We considered our own personal risk and the risk to the mission for each of the options. After weighing all the factors and evaluating the performance of the aircraft in the transit from the ship, we decided to push to Guam. The aircraft was behaving predictably and could be flown safely. We accepted the slightly higher risk of continued flight in order to reduce the risk to mission of us shutting down on the Tinian ramp. We determined that as soon as we experienced any doubt about the aircraft's performance, we would seek the nearest divert. Although we incur risks with every single launch from the ship, there are risks that must be accepted in order to achieve the mission. Any risks that are not necessary for mission accomplishment are foolhardy. We place restrictions on ourselves, some from higher, and some personally, to ensure every

flight is conducted with no more than the minimum necessary risk.

Anticipate and manage risk through planning.

Our mission that day had been thoroughly planned and briefed. Risks to the force and mission had been thoroughly studied and mitigations had been briefed to the MEU commander. The restriction of allowing only daytime operations was designed to protect the force by reducing the risk of mid-air collisions ashore and controlled flight into terrain (CFIT) around the ship. The restriction of shutting down only at Andersen Air Base was designed to protect the mission by preventing aircraft from being stranded throughout the island chain. En route to Guam, we began to plan what we would do upon our arrival at Andersen Air Base. We talked through the mechanics of a running landing and taxi. Our crew that day included aerial observers from both the avionics and airframes divisions. Combined with our crew chief, this gave me experts on every aspect of the aircraft. We talked through our troubleshooting and came up with a plan for our arrival. Our transit was uneventful and we called Andersen Tower to request a space for troubleshooting. The landing was smooth and we taxied for shutdown. Though we could not plan for every contingency, we planned what we could so no one was ever wondering, "what next?" It was a relief that we were not trying to solve these problems at night over the water. The early planning and mitigation made this problem a manageable one. Any decision that can be made ahead of time reduces the workload of the crew and allows crewmembers to focus on the task at hand.

Make risk decisions at the right level.

When we departed the ship's airspace, I updated higher and let them know that we would be proceeding for troubleshooting. En route to Guam we reached back and sent updates of our plan. At no time was our decision making questioned. The MEU air officer merely offered his assistance and requested that we update him when able. This allowed us to function as a team without outside influence on our risk evaluation. The risks we were incurring were ours to own, and we had the freedom to accept, deny or mitigate those risks as we saw fit. It is key that risk decisions be made at the right level. After shutdown at Andersen Air Base, my avionics technician got to work. He discovered a threaded rod preventing one of the AFCS computers from seating entirely. When I pulled pitch for takeoff from the ship, the vibration caused that computer to rapidly connect and disconnect. This flooded the other computer with random input signals causing specific functions to rapidly engage and disengage as we lifted off the deck. We reinstalled the computers, ensuring the connections were firmly seated, ran a full battery of ground tests, and launched without incident back to the ship.

Did we do the right thing? Our planning was thorough and detailed. We were executing the mission in the absolute safest way possible and in full compliance with all higher directives. The split-second decision I made to continue to pull in power when the nose first pitched up was very much the wrong one. I failed in that moment to appropriately execute time-critical operational risk management (ORM). I should have reduced power and called for chocks and chains. From that point on, though, my crewmembers and I functioned flawlessly to assess the situation; balance the resources we had in fuel, daylight, and airfields; communicate within the aircraft and with higher aboard the ship; and execute our planned course of action. We conducted an extensive debrief. That day we got a second chance, but a do-over is never guaranteed. I now brief before every shipboard takeoff that if aircraft performance is not acceptable prior to breaking deck, we will immediately reduce power. Shipboard aviation is inherently risky. The management of risk is everyone's responsibility and is what allows for mission accomplishment in the most demanding environments. ■

Capt Darrin "Slider" Carrier ASO
Marine Heavy Helicopter (HMH) Squadron 463
darrin.carrier@usmc.mil

Mishap Review - AH-64D Engine Failure

During climb out of a ground effect hover, the AH-64D Apache helicopter experienced a Number 2 engine failure. The aircraft weight and environmental conditions precluded single engine flight. As a result, crewmembers were unable to maintain the rotor speed above 101 percent revolutions per minute, causing the aircraft to descend rapidly and crash. The aircraft sustained severe damage and there were no injuries.

History

The mission was to conduct live-fire training with 30mm cannon and aerial rockets. Mishap crewmembers conducted run-up, performed communication checks, hover checks, and departed the airfield. Crewmembers arrived at a range for prep to conduct 30mm and M274 rocket training. The aircraft was loaded with 360 rounds of 30mm training rounds and 10 M274 training rockets (five on each side). Before leaving the arming and refueling pad, the crew conducted hover power checks and departed for their assigned firing point. After arriving at the firing point, the aircraft landed and conducted a firing pad brief and forced landing plan review. Crewmembers brought the aircraft to a hover with the pilot (PI) on the controls in preparation to conduct live fire training at a pre-planned height of 160 feet above ground level. During the climbing hover, the mishap aircraft abruptly stopped then rapidly descended and crashed into the ground on the firing pad.

Crew

The instructor pilot (IP) had 231 hours in MTDS and 998 hours total time. The PI had 47 hours in MTDS and 915 hours total time.

Commentary

The engine Number 2 failure was caused by a fracture in a compressor blade on the Stage 2 compressor bladed disc. The fractured blade separated, resulting in catastrophic downstream compressor damage. High cycle fatigue is the most likely cause of the blade fracture and the result of the engine failure. This type of failure has been recognized and addressed in Airworthiness Impact Statement (AWIS) 06-007. There have been 34 instances recorded since 2002. As a result, changes to the internal compressor blade clearances have been implemented and are put in place during depot level maintenance. The accident engine had not undergone the modification.

Improper maintenance procedures result in mishaps. While the mishap may not occur immediately following the incorrect procedure being performed, at some point the improper maintenance will culminate in failure up to the level of catastrophic. The whole maintenance team must ensure the correct procedures are conducted and that safety of flight and other maintenance messages are processed. The quality control team of each maintenance activity from company and above is the last mechanism which should break the accident chain. Their signature or technical inspector (TI) stamp is the last "safety" in the maintenance chain where the actual section of aircraft that was worked on was visually seen and work verified.

Commanders and maintenance leaders should be on the lookout for substandard maintenance performance by repairers and TIs. In fast paced operations, confidence in the maintenance operations of the unit is built by leaders being visible and actively engaged in identifying maintenance operation shortcomings. They can then affect positive change by increasing training, supervision or duties for Soldiers exhibiting substandard performance. ■

Class A - C Mishap Tables

	Manned Aircraft Class A – C Mishap Table									as of 9 Jul 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	4	0
	November	0	1	4	0		0	0	5	0
	December	1	0	8	0		1	1	2	0
2nd Qtr	January	1	1	4	2		1	1	0	0
	February	0	0	2	0		2	0	0	0
	March	0	1	11	0		0	1	5	0
3rd Qtr	April	1	2	4	2		0	1	3	0
	May	1	0	5	0		2	3	5	1
	June	1	1	5	0		0	0	4	0
4th Qtr	July	1	0	6	0		1	0	0	0
	August	3	1	8	1					
	September	1	1	8	1					
	Total for Year	11	10	72	6	Year to Date	8	8	28	1
	Class A Flight Accident rate per 100,000 Flight Hours									
	5 Yr Avg: 1.23		3 Yr Avg: 0.97			FY 18: 1.19			Current FY: 1.07	

UAS Class A – C Mishap Table									as of 9 Jul 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	5	1	2	8
MQ-5	1	0	0	1	Hunter	1	0	0	1
RQ-7	0	7	20	27	Shadow	0	9	18	27
RQ-11	0	0	0	0	Raven	0	0	0	0
RQ-20	0	0	0	0	Puma	0	0	1	1
SUAV	0	0	0	0	SUAV	0	0	0	0
UAS	4	8	23	35	UAS	6	10	21	37
Aerostat	4	2	1	7	Aerostat	1	1	0	2
Total for Year	8	10	24	42	Year to Date	7	11	21	39

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

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Accident Review: UH-60 Test Flight

Synopsis

A UH-60 was on a maintenance test flight. An unsafetied retention bolt for the main rotor pitch change rod vibrated free. The unrestrained upper pitch change rod resulted in loss of control over the main rotor system. The aircraft crashed in an open field.

History of flight

Work began on a UH-60 to comply with a TSARCOM maintenance information message (MIM). The MIM required the removal of rubber boots from around the upper pitch change link rod end bearings and installation of protective phenolic washers on both the rod end bearings and the damper bearings. Application of the MIM required disassembly of the rod end bearings, which is a grounding fault requiring an entry in the aircraft logbook.

Removal of the rubber boots was begun by the crew chief, who was directly supervised by the aviation maintenance officer. Following the removal of the boots, the maintenance officer gauged the rod end bearings and dampers to determine their serviceability. He found that the yellow main rotor blade pitch change link rod end bearing and three damper bearings exceeded allowable tolerances. The maintenance officer told the crew chief to complete the washer application but to leave all the boots unsafetied and finger tight until replacement of the unserviceable parts could be completed. Logbook entries were made which accurately reflected the above, to include the unserviceable pitch change link and three dampers.

Ten days later, the maintenance officer announced that he wanted to test fly the aircraft the next morning instead of the first of the following week as originally planned. This change concerned the crew chief, who asked his platoon sergeant to postpone the test flight to give him enough time to complete all of the work required. The platoon sergeant refused to postpone the flight but agreed to get him some assistance. The personnel assigned to assist were unaware of the modification begun 10 days earlier.

Work began on the aircraft. The platoon sergeant and another mechanic began to replace the unserviceable pitch change link and three dampers. The sergeant removed the old pitch change link, bench-rigged the new one, and told the mechanic to install, torque, and cotter-pin the link. The sergeant cannibalized three serviceable dampers from another aircraft and left these for the mechanic to install. The mechanic completed his work. In the meantime, the assigned crew chief had finished mounting the stabilator on the aircraft and was making entries in the logbook. The crew chief asked the mechanic if he had completed everything on the rotor head. The mechanic, not having seen the logbook, responded that he had. Hearing this, the crew chief signed off the MIM and replacement of the pitch change link and dampers as being completed.

After making the logbook entries, the crew chief summoned the technical inspector (TI). They went through the logbook together and began the inspection, with the crew chief indicating the work which had been completed. The assisting mechanic pointed out to the TI work he had done on the rotor head. The TI inspected the work he was shown and found it to be correct. The TI then took the logbook to his office and completed the required entries, signing off both the replacement of the unserviceable parts and the MIM application which he did not completely inspect. The aircraft was released for the test flight.

The copilot, who was assigned to fly with the maintenance officer, was told to preflight the aircraft for an early morning flight. The copilot did a brief preflight inspection of the aircraft, which did not include the rotor head, while the crew chief cleaned and prepared it to be moved from the hangar. The logbook, which was still in the quality control office, was not checked. The

maintenance officer was having problems with another aircraft he was test flying, so the UH-60 flight was delayed until after lunch.

Another crew chief was assigned to replace the regular crew chief, who had been given the afternoon off. Also, the unit maintenance technician had volunteered to help prepare the aircraft for the test flight. About mid-afternoon, the maintenance officer arrived. He inspected the stabilator, checked the logbook, and asked the maintenance technician if the rotor head was okay. The technician said it was.

The aircraft was run up and some adjustments made to three of the pitch change links. Following the last adjustment, the maintenance officer directed that the pitch change link upper and lower jam nuts be torqued but not safetied. The aircraft was then returned to the parking area where the crew chief got out. The maintenance test pilot, copilot, and maintenance technician then began the test flight.

About 14 minutes after takeoff, the crew contacted the airfield tower for landing clearance to a heliport. A minute or so later, the UH-60 broke up in flight and crashed. All three occupants were killed.

Crewmember experience

The 26-year-old maintenance test pilot had more than 650 rotary wing flight hours, with more than 450 in the UH-60. The 27-year-old copilot had more than 750 rotary wing flight hours, with almost 500 in the UH-60.

Commentary

A series of errors and oversights related to maintenance, as well as an inadequate preflight inspection of the aircraft, resulted in the aircraft being test flown with three upper pitch change link rod end bearing retaining bolts unsafetied and incorrectly torqued. This ultimately resulted in the blue pitch change link rod end bearing retaining nut being vibrated off its bolt, the bolt being thrown from the mount, and the rod end bearing separating from the pitch horn. This separation resulted in an uncontrolled main rotor blade causing vibrations great enough for an in-flight structural failure.

The assigned crew chief did not comply with TM 38-750 when he signed off as completed work he did not complete. The mechanics helping to prepare the aircraft for the test flight were unaware that the pitch change link retaining bolt/nuts had been left loose and unsafetied after previous maintenance actions. When they were asked by the crew chief if they had finished the work on the rotor head, they said they had. At this time, the crew chief signed off, as completed, both the replacement of the unserviceable parts and completion of the installation of the phenolic washers to the pitch change rod end bearing as required by the maintenance information message.

The TI signed off, as inspected, the phenolic washer application although he did not inspect it. When the TI arrived at the rotor head, the individual who had replaced the unserviceable pitch change link and dampers pointed out the items he had replaced. The TI inspected that work and returned to his office where he mistakenly signed off, as inspected, the MIM application, as well as the other faults listed in the logbook, even though the pitch change rod end bearing retaining bolt nuts were loose and unsafetied. This action released the aircraft for test flight.

The pilot and copilot did not correctly perform the required preflight inspection. The copilot did not inspect the rotor system or review the logbook. The pilot, who was in a hurry to complete the flight because of an appointment he wished to keep, did not inspect the rotor system faults for which the aircraft was being test flown. This action resulted in the aircraft being flown with loose and unsafetied nuts.

Without adequately considering the amount of work to be completed on the aircraft, the maintenance officer directed that the test flight be rescheduled to the earlier date. This action required the assignment of several other personnel to help the crew chief and introduced an element of haste which ultimately resulted in the aircraft being released for a test flight while still in a non-flyable status.

Although errors in maintenance procedures resulted in the aircraft being flown with loose and unsafetied retaining nuts, the design of the retaining bolt allowed it to separate from the pitch horn assembly. In TM 55-1520-237-23P, the bolt is described as a self-retaining bolt. It is, in fact, an impedance-type bolt as opposed to a self-retaining bolt. Because of the oscillating loading present in the rotor system above the swashplate, the bolt vibrated free after the loss of the nut. When this occurred, control of the blue blade was lost. ■

Forum

Op-ed, Opinions, Ideas, and Information

(Views expressed are to generate professional discussion and are not U.S. Army or USACRC policy)

One-off errors in aviation maintenance, can we do anything to prevent them?

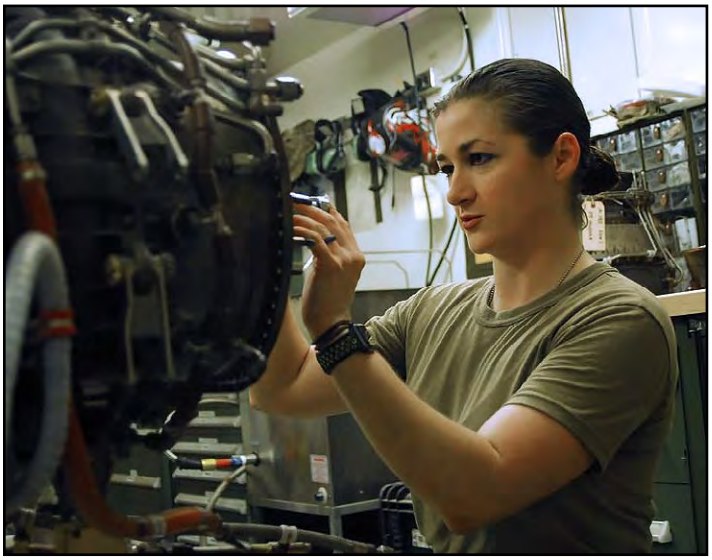
Some human errors are "one-off," meaning they happened once and likely won't happen again. One-off errors are difficult to anticipate, so it is unlikely that one can devise meaningful changes in standard operating procedures to prevent them.

Army aviation maintenance errors have contributed to mishaps, ranging from small near-misses to catastrophic failures with resulting fatalities. From a review of numerous maintenance-related mishaps contained in the data files of the Army Combat Readiness Center, there is a mixture of factors. The most perplexing are the mishaps associated with one-off human errors. While the Army implements numerous procedures and standardizes as much as possible, the one-off human errors are very hard to anticipate and some defy logic.

So can we do anything to prevent one-off errors that we cannot anticipate, and in some cases, cannot even conceive of? A simple example of a one-off error would be the following scenario:

> *A Soldier is working on re-torqueing the bolts on the main rotor head on an aircraft. He completes the task and while passing his tools down to a Soldier on the ground, the torque wrench is banged against another wrench, not very hard, but they make contact. The Soldier then turns the torque wrench into the tool room and moves out smartly to his next task. The next day another Soldier signs out the torque wrench and completes her task on torqueing the bolts on a tail rotor. No one is aware that the torque wrench is out of calibration due to the slight impact the day before. During the maintenance test flight hover checks, the tail rotor bolts back off, resulting in aircrew members executing an emergency procedure due to the malfunctioning tail rotor.*

In the fictional example, the one-off minor human error of letting the torque wrench slightly bang against another tool resulted in a faulty torque procedure that caused an unforeseen mishap. Additionally, you cannot institute a procedure of every torque wrench going back to calibration after every use. In the example, all the right procedural actions were taken: the Soldier used the book; the Soldier used the torque wrench as specified; a technical



inspector reviewed, inspected and signed the work off appropriately; and the maintenance test pilot correctly performed a preflight and other necessary checks. Yet based on the one-off initial wrench collision, a mishap occurred.

So is there any way to make a difference and minimize the one-off error? Well, probably the most effective measure to minimize these one-off errors is information. The ability of leaders at all levels to make an impact on Soldiers and their perceptions about how they can operate more effectively by reducing the one-offs is not a novel solution. There are leaders currently leading Army aviation maintenance operations who do inform and counsel their Soldiers on a daily basis about minimizing the simple errors that can result in major mishaps. Two examples of simple errors include, a mechanical pencil that isn't secured and falls into the flight control area and remains unaccounted for after conducting maintenance, or spilled water that seeps into the AFCS computer and isn't wiped up. These are small things when viewed first person but they become large, deadly things once they create a catastrophic event.

So maintenance officers and noncommissioned officers, take time each day to inform your Soldiers just how important not letting that torque wrench hit any other object is or how important it is to conduct a post maintenance personal item inventory to make sure one of your tools or utensils didn't find it's way into the flight controls or engines. Pick the topic and create awareness of the one-off mishap possibility. Inform your team members that they are the first line of defense in preventing a catastrophe just as regularly as you inform them of the hazards of drunk or distracted driving.

Maintainers, you make the difference! ■

[1]*Human error in high-biocontainment labs: a likely pandemic threat. Lynn Klotz, Bulletin of the Atomic Scientist, February 25, 2019, online: https://thebulletin.org/2019/02/human-error-in-high-biocontainment-labs-a-likely-pandemic-threat/. 040419*

Warren
Retired Aviator

Mishap Briefs #78

ROTARY WING

Attack

H-64

E Model - Post-flight inspection revealed damage associated with apparent ground debris contact during a pinnacle-landing training demonstration. (Class C)

Utility

H-60

L Model - Crewmembers reported 30-40 seconds of hail while proceeding on the flight route. Post-flight inspection identified damage to all main rotor blades (MRB), with replacement of one required. (Class C)

L Model - #2 Engine TGT exceedance during engine start-up, requiring engine replacement. (Class C)

L Model - Aircraft touched down hard during dust-landing training. Damage reported to the undercarriage, forward looking infrared (FLIR) and wire strike protection system (WSPS). (Class C)

UNMANNED

MQ-1

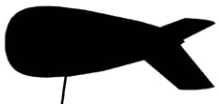
C Model - Crewmembers lost link on takeoff climb-out and system was located and subsequently destroyed following removal of sensitive items. (Class A)

C Model - Crewmembers experienced loss of link during climb-out to programmed location and system was subsequently located and destroyed following recovery of sensitive items. (Class A)

RQ-7

BV2 Model - Aircraft reportedly departed the runway during post-touchdown rollout and contacted the arresting gear before coming to rest on an embankment. (Class C)

Aerostat



PTDS - Aerostat experienced a breakaway while aloft at 4,100 feet above ground level (AGL). Forecast winds were maximum 25 knots (KTS) while reported winds during event were 45-55 KTS. Downed system located and recovery initiated. (Class A)

Flightfax

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AR 385-10, AR 385-40, DA Pam 385-40, DA PAM SF 368/PQDR

How much do you know about a SF 368? Do you know what a PQDR is? Have you ever heard of a Product Quality Deficiency Report (PQDR)? Do you know when a PQDR is required?

Let's assume that your unit has experienced a Class C (flight, flight related, aircraft ground, or UAS) aviation accident, without injuries, and you have been selected to investigate the accident. The initial Estimated Cost of Damage (ECOD) is determined to be $50,000. According to AR 385-10, this accident, will be investigated, in accordance with AR 385-40, by a board of at least one member. The exception to this one member board would be if the appointing authority or the Commander, USACR/Safety Center believes the accident may involve a potential hazard serious enough to warrant an investigation by a multimember board. Of note, for one-member Class C boards, the board president must be senior in grade to the aircraft crewmembers. Also, Class C UAS accidents do not require a rated Army aviator board member.

During your field investigation, as the sole board member, after collecting the data, reviewing record, conducting the interviews, etc.…you have determined there to be a suspected evidence that a part failure occurred during the operation and that the failure of the primary structure was caused by faulty design (improper material, incorrect assembly, previously weakened parts). For this suspected material failure, maintenance records and operating history of the equipment must be reviewed for conditions that may have initiated or contributed to the failure. IAW AR 385-40, suspected failed parts, that may have contributed or caused the accident, should be selected for laboratory analysis to determine the type and mode of failure. Being that you are only a one member board, and that you may not be qualified to complete the laboratory analysis, you must request Tear down Analysis (TDA) assistance. AR 385-40 states that TDA requests should be made to the Analytical Investigation Division (AID), Corpus Christi, TX. AID is the prime recipient and evaluator of all Army aircraft components/parts selected for TDA. The Commander, USACRC; Commander, U.S. Army Aviation and Missile Command (AMCOM); commanders of field organizations/units; aviation safety officers; maintenance officers; and presidents of accident investigation boards are authorized to select components/parts for TDA. Requests for TDA will be made in the interest of establishing or discounting materiel deficiencies, regardless of accident/incident classification. The results of TDA are for use in accident prevention or to establish causes of accidents. However, before shipping any components/parts that you, as the one member accident investigation board, suspect to have contributed directly to the cause of the accident, you must complete and include a product quality deficiency report/equipment improvement report (PQDR/EIR) according to the instructions in DA PAM 738-751, Functional User's Manual for Army Maintenance Management System – Aviation.

A PQDR (SF368) must be included, as substantiating data, for each failed or suspected failed part/system when a materiel failure is the sole cause of the accident. When a PQDR is not submitted, the accident will be charged to the accident unit in accordance with AR 385-10. However, a design-induced failure or malfunction, as determined by the TDA process, will be recorded as a "materiel" accident and will be charged to a special HQDA accident account and not to the unit.

According to DA Pam 738-751, Aviation Standard Form (SF) 368 (Product Quality Deficiency Report (PQDR)) are submitted to suggest corrections and improvements to aircraft, UAS subsystems, and aviation associated equipment, including mission-related equipment, and to alert AMCOM/CECOM/TACOM to problems encountered by the user due to receipt of defective equipment. There are two categories of product quality deficiency reports. They are Category I and Category II. Category I are to be submitted within 24 hours after discovery of the fault or failure and Category II must be submitted to the appropriate screening point within three workdays. PQDRs can be submitted or transmitted electronically (instructions in Chapter 3). However, they may also be submitted, by e-mail, FAX, or regular mail following the SF 368 format. When an accident board has recognized and documented a materiel failure as an actual or possible cause of the accident, the board will submit a Category I SF368. The SF368 shall include all available failure data and refer to the Mishap Report per DA Pam 385-40. For further information regarding SF368/PQDRs, refer to DA Pam 738-751.

5 Questions

1. True or False, according to AR 385-40, suspected failed parts, that may have contributed to or caused the accident, should be submitted for laboratory analysis?
2. Who conducts a Tear Down Analysis (TDA), when requested, for an accident investigation?
3. What is a PQDR/EIR?
4. What form is used to submit a PQDR?
5. Name three ways to submit a PQDR?