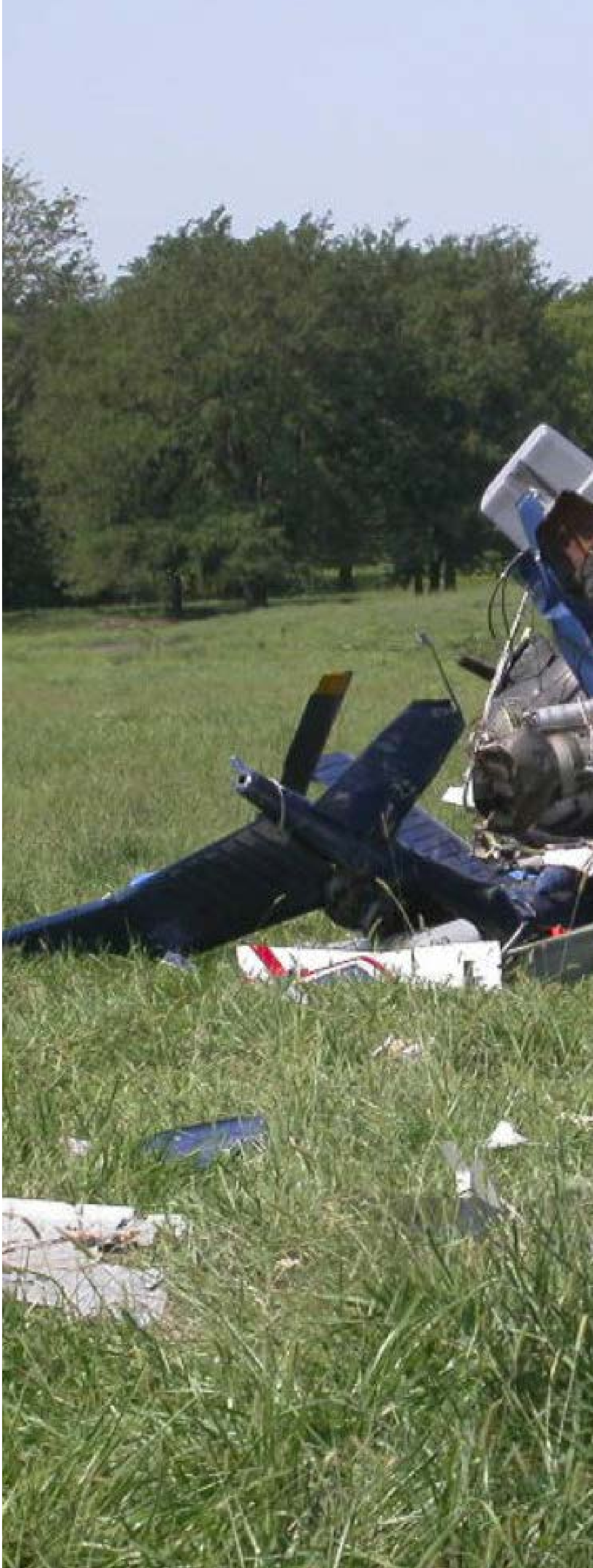
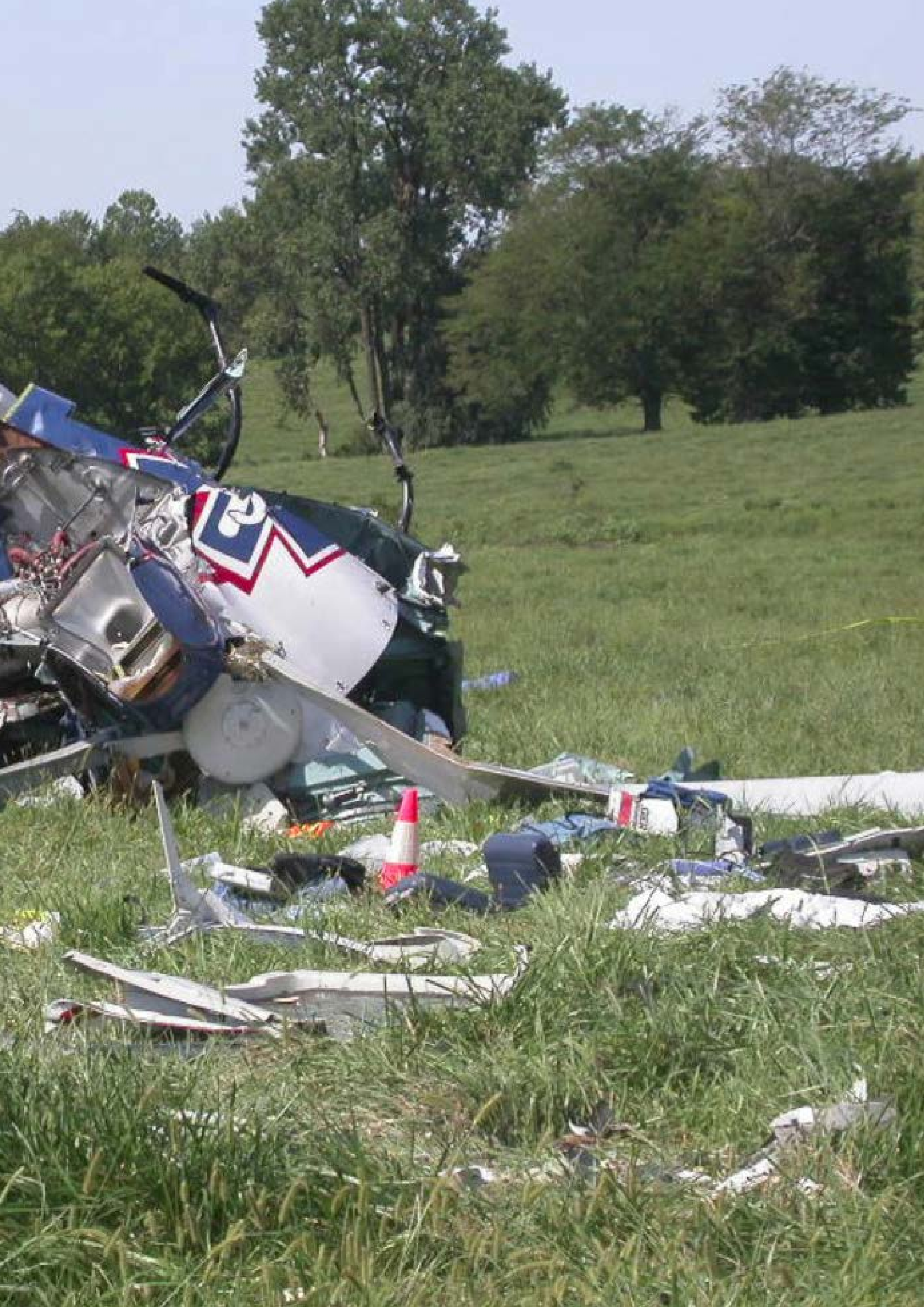
Simple Truths

STORY BY **GLEN WHITE**

PHOTOS COURTESY
FAA & NTSB





Even for the southwestern desert this day seemed to be warmer than most. A dry oppressive morning that was sure to culminate to a heat soaked and sweltering evening. The arid wind that blew across the bleak landscape just north of the Mexico border did little but remind everyone that the summer of 2010 was now in full bloom and the months ahead would hold more of the same.

Since a good part of the day would be spent in the front seat of a helicopter dressed in Nomex and wearing a flight helmet the prospects of relaxing in the chilling comfort of the base were all but a lost desire, though today had a silver lining. The bases' new AS350B3 2B1 that had been in maintenance was now ready to be returned to its rightful home.

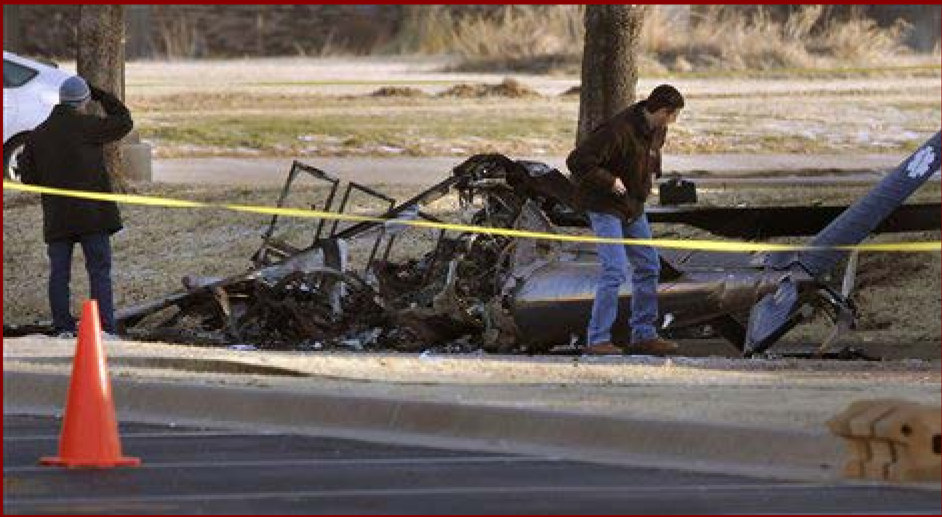
Because of a coking issue that had developed in the slinger wheel of the engine the helicopter had been taken to a base just north of Tucson to perform the maintenance needed to replace the manifold. This involved removing the powerplant from the airframe, dissembling module 3 of the engine and replacing the injection manifold that had become coated with carbon deposits.

During the helicopters absence from the base, a replacement helicopter had been brought in as a back up. Like most spare helicopters used to cover a base during routine or not so routine maintenance events this one had made its way around the company and showed its wryness. A seemingly unloved aircraft, shuffled from home to home, never finding a crew to embrace its aging and fading beauty. One would have to feel bad knowing that in just 3 years the aircraft would be substantially damaged in a crash in Grand Prairie, TX.

But today the thoughts were not on the promiscuous ship out on the ramp but rather the idea of trading back to the new triple channel FADEC, dual hydraulic AS350B3. The idea of getting back into the comfort of its crash attenuating seat seemed to be worth the hour flight in each direction on this feverous summer morning.

Like most EMS companies the mission profile objectives have the helicopter and crew ready for a call at any given time. This means where the pilot and helicopter go, the medical crew needs to be present and ready for action. So the med crew strapped into the aging beauty one last time for the helicopter swap before it would go to its next unwelcome residence.

The flight from Douglas, AZ to Marana Regional Airport took a little under an hour and even with the helicopters air conditioning running at full blast the heat permeated into the cabin from the suns rays. The AS350 is an excellent EMS platform for the transportation of critical care patients but provides little comfort for the medical crew in the back of the helicopter. Between the crew, medical equipment, monitor and patient one feels as if they there are being enveloped by the airframe instead of sitting in the seat of an aircraft.



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As the doors were opened after landing the air conditioner that seemed feeble just moments ago now enter into the category of “you don’t know what you have until its gone”. With the sun now directly overhead the task of transferring all the medical equipment to the newly repaired helicopter held less appeal than normal.

Now two hours later, the medical equipment was situated in its rightful place and the helicopter had been preflighted for its flight back home. Since the planned flight back to Douglas was projected to take 55 minutes and the required fuel load for mission was 2 hours, a 105 gallons were added to the airframe to bring the takeoff fuel load to 90% or approximately 2 hours and 55 minutes of fuel. This would alleviate the need to fuel once back at the Douglas base.

With nearly full fuel, 310 pounds of medical equipment, 470 pounds of medical crew and a 210 pound pilot the helicopter was just 35 pound shy of its max gross weight of 5225 pounds. But this was a B3, an aircraft that laughs in the face of max gross weight as if carrying an 8th grade cheerleading squad.

At 1:34 pm the first radar return was received with an aircraft heading of 112° at an altitude of 250 feet and climbing. The aircraft would soon settle in at a mildly fluctuating altitude of 800 feet and a ground speed of 125 kts as it made its way over the Northern City limits of Tucson.

The normality of the day ended in just 6 minutes into the flight. With a sputter, as if to catch its last breath, the engine that had been turning at nearly 40,000 rpm now went deafeningly silent. As if to compensate for the sudden loss of the clamorous whine that once encompassed the aircraft the low rotor audio blared in the earpieces of the pilots’ helmet.

In the cramped quarters in the back of the passenger cabin the crewmembers felt the helicopter abruptly fall out from underneath them. The sudden weightlessness added to the unsettling change in noise, which had become a habit of aural conditioning. As the helicopter pitched down to an almost vertical descent the horrifying view of the ground became ever closer.

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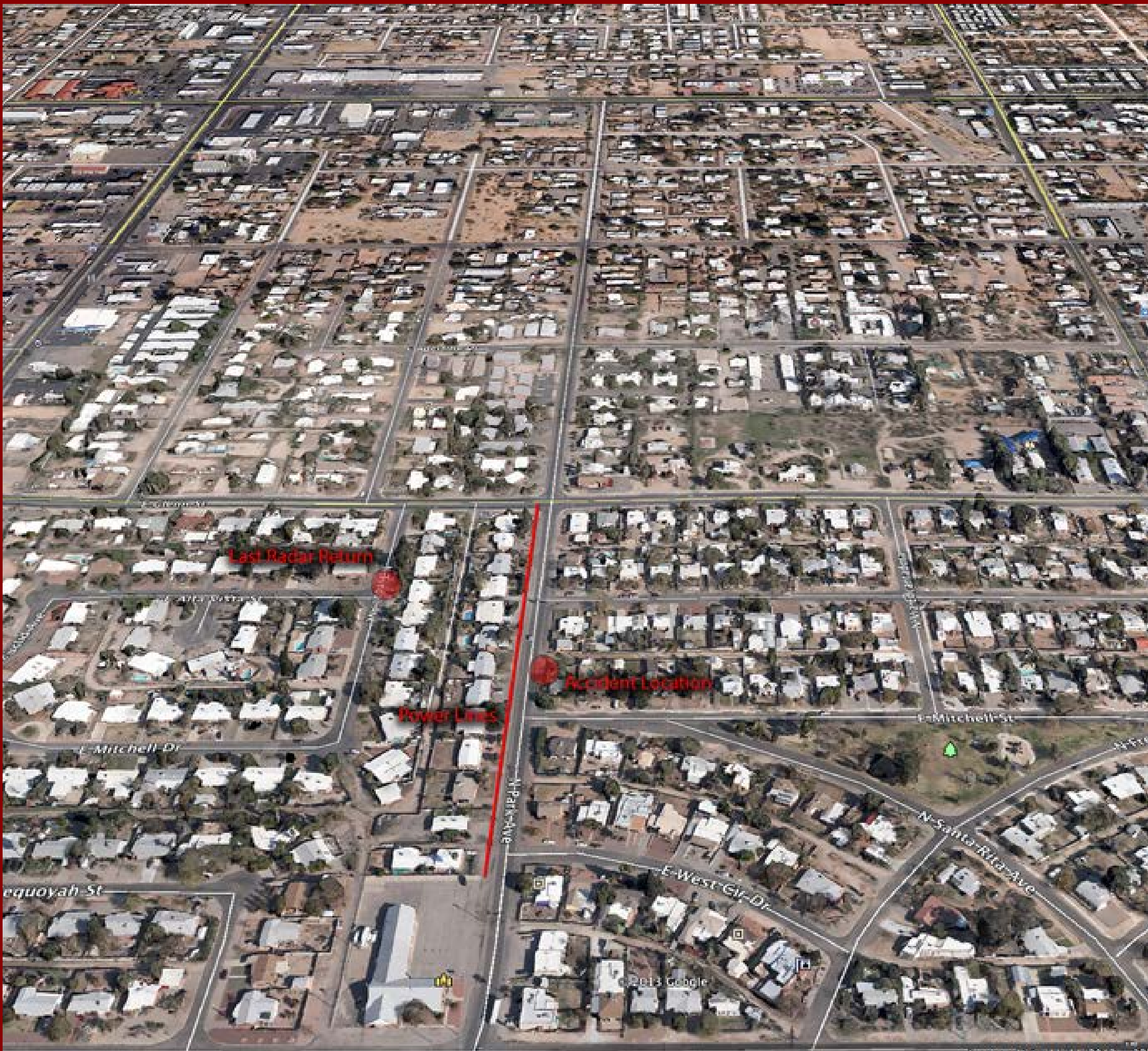

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The chilling conclusion of this event took the lives of all three brave members of the crew. Upon impact the helicopter was at a rate of decent so great that the landing gear and structure collapsed under the staggering force. The crash resistant fuel cell located in the center of the airframe ruptured within the flattening structure and whose fuel fed the post impact fire. To add to the horror of this tragic tale there is evidence that two of the crewmembers survived the initial impact but perished in the post impact fire.

As an industry these kinds of stories continue to plague us in horrifying regularity. The vast majority of helicopter pilots in the United States know at least one pilot that has perished in a helicopter accident. How many jobs exist where coworkers frequently die at work? Could you imagine if secretaries regularly had tragic accidents within the workplace?

Could this be a freak accident? An event that was such a fluke of compiled missteps that it is very unlikely to happen again?

On February 22, 2013 in Oklahoma City, OK an AS350B2 EMS helicopter crashed after a suspected engine failure at night. The crash scene and the helicopter condition after ground contact was eerily similar to the Tucson accident. After the crash one crewmember was drug out of the wreckage by a person near the accident prior to flames engulfing the aircraft. The other two-crew members died either in the post crash fire or from blunt trauma.

On August 26, 2011 in Mosby, MO an AS350B2 helicopter crash after fuel starvation. The pilot knew of the low fuel situation, and in the process of trying to make a nearby airport encountered an engine failure. All three crewmembers and the patient on board perished of blunt trauma from the impact of the helicopter to the ground.

January 02, 2013 in Seminole, OK an EC130B4 encountered an engine failure during day VFR conditions. The pilot and three crewmembers were seriously injured by the autorotative landing in an open country field. The helicopter sustained substantial damage, which included a collapse of the landing gear; the fenestron detaching from the tail boom and the deformation of the structure.

THE EXAMPLES ARE SADLY ENDLESS

The challenge within our industry is preventing these devastating events; figuring out the reason the tragedy occurred, and putting steps in place to prevent them from happening again. But here is the issue in our industry; it is almost impossible to do so.

Good people died on July 28th, 2010. The pilot was a high time experienced aviation professional respected by his family and friends. To review our deceased comrades actions as anything but perfect is most often met with emotions of betrayal. So as a collective group anyone who looks at a pilot in an event such as the one that occurred in Tucson in a less than flattering light is encouraged by social pressures to ignore any possible missteps.

When tragedies occur, we as humans need to "come to terms" with the event. In other words we need an acceptable reason why the occurrence happened and a manner in which to deal with the emotions which were created.

There is also the need to protect ourselves from the realization that if we were in a very similar situation the outcome could be identical. It is far more comforting to believe that "I would have done it differently." To believe that the situation was so obscure "it could never happen to me."

With the emotional blockades deterring the helicopter aviation community from looking at an occurrence with an analytical mindset, one would have to think that any aviation company involved in such an event

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would do anything to prevent it from happening again. To a large extent any company that wishes to stay in business is very limited in their analyzation of their policies.

A company by definition needs to have a positive income flow, which then is translated into profit. This income then provides the salaries to the employees, owners and sometimes shareholders. If expenditures are created to increase operational safety that money is no longer available for salaries and profit, and whoever is in charge of said profit will be judged by the number on the bottom of their profit and loss statement. No one will pat anyone on the back for an accident that never happened.

In the United States if someone is hurt or killed in an aviation incident there WILL be a law suit. If multiple areas of blame can be attached to any given company the financial repercussions will be so great that the organization will no longer have the income flow to continue to operate (people loose jobs). So the company by necessity needs to relieve itself of fault and or attempt to narrow the blame to a simple or small "fix".

So the aviation community at large has psychological barriers from looking too closely at an event. The company that operated the helicopter cannot put too great of a microscope on the tragedy in order to continue to stay in business.

THEN THE NTSB/FAA WILL FIX THE SITUATION, RIGHT?

The NTSB's task is to compile a description of the events surrounding a transportation incident/accident. In most cases part of the report indicates a very brief probable cause; key word here being "probable". That is the extent of their powers within the aviation industry. The NTSB has no enforcement or punitive authority; they simply do their best to report what occurred. So their job, in simplistic terms, is to find an acceptable reason why an accident occurred.

The FAA is like the pilot community and the aviation companies combined. It is made up of primarily pilots and has in its charter the task to promote aviation within the United States. Outside the aviation regulations, which are most often vague and open to interpretation, the FAA personnel have very little power to change the mindset of an aviation company.

The only chance we have as an industry, if we want to stop these tragedies from recurring over and over again, is to challenge ourselves to change the mindset within our culture. To challenge ourselves to review accidents with an analytical and open mindset.

The tragic event that occurred on July 28th, 2010 in Tucson can be used as a learning event within our cultural mindset on how we address an aviation accident. When reviewing such an accident you have to ask yourself, "do we revere the memories of the fallen by allowing it to happen again" or "do we respect the memories of the fallen by utilizing the tragedy to ensure it doesn't happen again?" I can think of no better way to honor their memory than to utilize their sacrifices to learn from the tragedy.

The day prior to the accident, work on the aircrafts' engine was complete, and the powerplant was re-installed on the helicopter. The maintenance action needed on the engine required a Level 3 maintenance event. Since the mechanics at Marana were authorized to perform up to a level 2 maintenance action, a Turbomeca approved outside contractor was brought in. The outside contracted mechanic had worked for Turbomeca for 23 years and had been performing level three maintenance for 12 years.

Between July 24 and July 26, the company's maintenance personnel removed the engine, and the engine modules were separated. During the work on the engine, module 3 was disassembled, the fuel injection manifold was replaced and the engine was reassembled by the contract technician. After the engine was reassembled the contract technician inspected his own work.

In interviews with the company's mechanics and contract technician, they all reported feeling a sense of pressure to complete the maintenance and return the helicopter to service.

Here lies the first link in the accident chain for the fatal event. Unknown to anyone at the time, the bolts on the fuel inlet union (the attachment of the fuel line to the powerplant) was only finger tight. The engine was inspected by the contract technician, by the company's mechanics, by the pilot that performed the maintenance test flight, and by the pilot of the fatal flight.

Logic would dictate that realizing the fuel line had not been torqued down is a difficult discrepancy to find. The contract technician and company mechanics were experienced and well trained in their duties. A contributing factor in the oversight of not tightening the fuel line very well could have been the sense of pressure to complete the job. As the old saying goes "rushing is the mother of all mistakes."

This fact for many is the "end all" for the need for any further analyzation for this accident. They have a direction to point the preverbal finger at and this will satisfy the need for blame and allow us an understanding of the tragedy. If we stop here we may be able to feel better about the situation but we have done nothing to prevent the occurrence from happening again.

The bottom line is helicopters are going to have mechanical failures. Mechanics are human, and sooner or later something is going to be overlooked no matter how many policies are put into place or the expertise of the technician. Can you imagine how the mechanics feel that worked on this aircraft? I would have to think that it is a devastating life long weight on their shoulders.

The engine failed in part to the maintenance mistakes (along with many other mistakes after the maintenance was complete, which we will get to shortly), but it is not the reason the occupants of the helicopter perished. We need to dig deeper.

On July 26th an engine run up and leak check was performed in order to ensure no oil or fuel lines were leaking. During the run up a fuel leak was found originating from the HMU of the FADEC controlled fuel control system. The next day the leak was resolved and another run up was performed which found no abnormalities. After the leak check the Marana duty pilot was given permission to put the base out of service while he performed the post maintenance test flight.

The helicopter departed Marana at 17:43 for the test flight and return at 17:50. The test flight lasted a total of 7.5 minutes. During the test flight the pilot reported that a droop check, rate of climb check, cruise power check, flight limit indicator check, flame out check, and an autorotation were performed. No record of the parameters of the test flight were created or retained.

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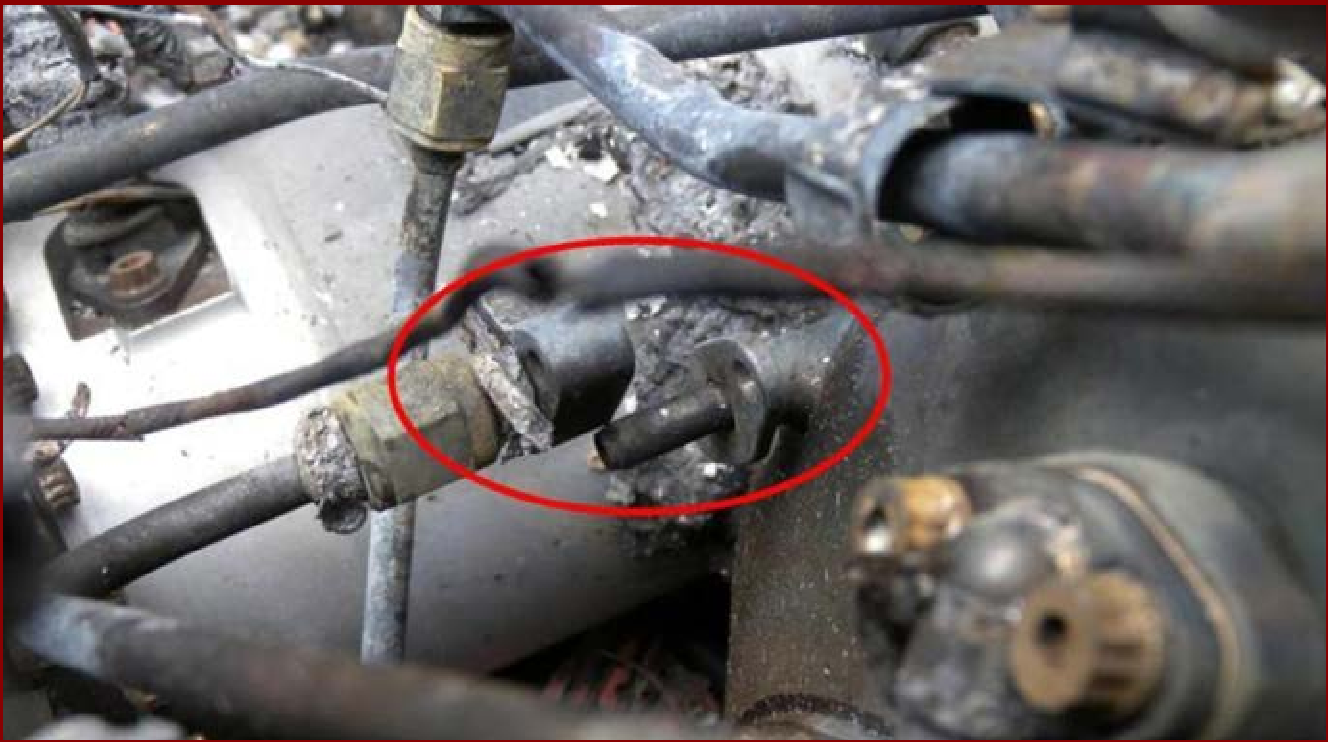

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In fact Eurocopter takes it so seriously that they spell out in amazing detail what needs to be performed during the check and has the pilot/mechanic document all parameters of the test flight. The test sheets for all maintenance test flights for the Eurocopter products are located in Section 8 of the Eurocopter rotorcraft flight manual.

The checks spelled out in Section 8 have the pilot/mechanic document parameters before start, after start, in a hover, inflight and after shutdown. Within the test sheets the check/test that needs to be performed is detailed and the results of the tests are then documented on the pages. Depending on the proficiency of the pilot/mechanic in performing these checks it takes approximately 1 to 1.5 hours to perform and log all checks.

The Marana duty pilot stated that he had not received any training specific to post maintenance test flights and that any company pilot qualified in the model can perform a maintenance test flight. This is the next link in the chain of events that lead to the Tucson accident.

Had a proper test flight been performed, the engine failure would have occurred at approximately the time the pilot would have been doing the hovering checks. Obviously a much easier situation to survive. In a worse case scenario the engine failure would have occurred in flight with two people on board with a much lighter airframe weight.

Now, many would say that the need for any further analyzation is over. Again we have a direction to point the preverbal finger at and this will satisfy the need for blame and allow us an understanding of the tragedy. Again if we stop here we may be able to feel better about the situation but we have done very little to prevent the occurrence from happening again.

The pilot that performed the test flight did not conduct it in the manner in which he did out of laziness or ineptitude. He was also an experienced pilot, but simply did not have the training required to perform the task that was assigned to him.

Another aspect of test flights is that they will not always indicate an issue with the airframe immediately. The failure in Tucson very well could have

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occurred many hours later (an example would be the Duke University AS355 accident that occurred in October of 2000).

The issue with the fuel line was not discovered in part because the test flight was not performed properly, but it is not the reason the occupants of the helicopter perished. We need to dig deeper.

The fatal flight departed Marana Airport at approximately 1:30 pm, in the desert heat, at near maximum gross weight. The decision to fuel the helicopter to 90% would have been made to either get the aircraft back into service quickly once back at the base, or out of convenience. There is nothing in itself wrong with making this fuel load decision, but logic dictates that should an engine failure occur, the autorotational properties of the helicopter would be affected.

At approximately 6.5 minutes into the flight, at approximately 800 feet above the surface, and traveling at a speed of approximately 125 knots, the bolts that held the fuel union to the engine backed off enough to discontinue the fuel delivery to the powerplant. The rotor at this point would have initially decreased in speed, producing a noticeable change in rotor sound to the pilot. The sound produced by the engine would have rapidly diminished to an unsettling silence. The FLI (first limit indicator, displays temperature, NG and torque as one gauge) on the VEMD (the digital display of engine parameters) would have deceased and the display would have changed to the 3 pack display (parameters displayed individually). The generator, fuel pressure, engine pressure lights on the caution/warning panel would then have illuminated along with an aural "doink" sound in the headset which indicates a red light has illuminated. Once the rotor RPM deceased below 360 a steady aural warning would have been produced in the pilots' helmet.

The proper procedure at this point is to lower the collective to bring the rotor back into the green arc of the rotor RPM gauge (375-405) and to adjust the airspeed to Vy (65 kts minus 1 knot per 1000 feet).

The helicopter would then need to be turned into the wind and a landing area would need to be established within the glide path of the helicopter. The predominate wind direction on the day of the accident was from the south and the majority of the residential streets over which the helicopter was flying ran north and south and east and west.

The remaining analyzation of the flight (autorotation) can only be surmised from the radar returns, map of the area, a photo of the helicopter in autorotational descent, and the resulting crash.

There is no way to know if the pilot established the proper collective position/rotor RPM and or airspeed during the entry in to the autorotation. The only clue into the stability of the autorotation is a photo that was taken by a witness. It shows the helicopter at approximately 300-400 feet above the ground in a near vertical descent. This would have been halfway from engine failure to ground contact. The question then is "why did the pilot find it necessary to place the helicopter in this flight profile"?

The normal steady state autorotation in an AS350 is a near level to slightly nose down attitude when the airspeed is properly set and the rotor RPM is in the green. Assuming that the pilot was reacting properly to an abnormality in the autorotational profile the only reason to place the helicopter in this attitude would have been a severe loss in airspeed. With the decrease in altitude it would have taken from powered flight to the profile depicted in the photo, a conclusion could be made that airspeed was lost in the entry and the required correction was a very nose down attitude.

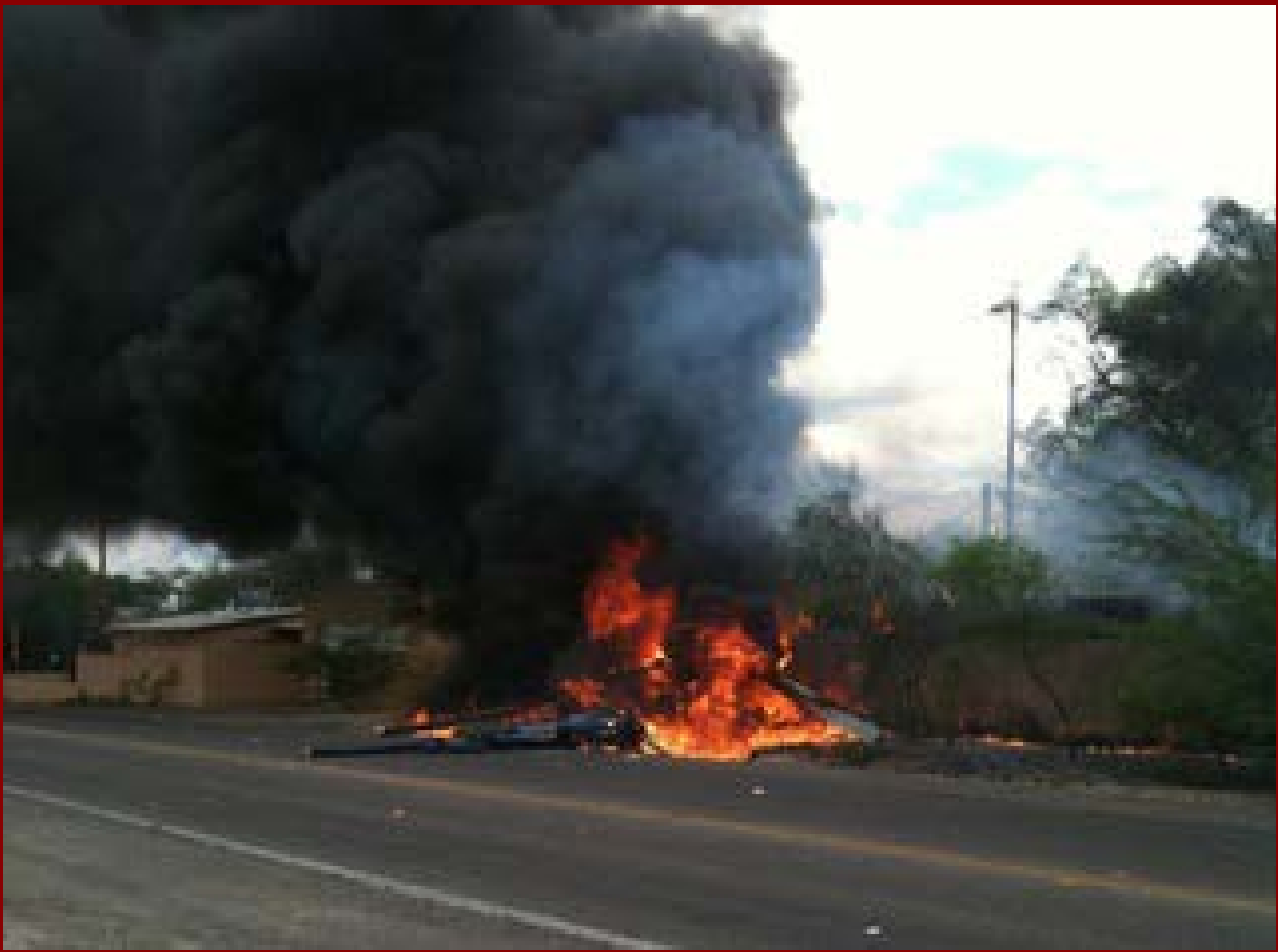
When a helicopter is maneuvered into a near nose down flight attitude during an autorotation, the induced wind flow into the rotor system decreases. Logic would dictate that during this portion of the descent the NR would have been at a very low value.

With the helicopter in the attitude depicted in the photo the location of the inevitable landing would be directly in front of the helicopter. At this point the helicopter was located approximately over North Tyndall Ave, with an approximate heading of 132°.

Within the NTSB and company reports they surmise that the intended landing area was the "V" intersection of East Mitchell St and North Santa Rita Ave. By the course of the helicopter it would be logical to assume they are correct. By the altitude/attitude of the helicopter depicted in the photo and the eventual contact location the helicopters glide path would take it 600 feet short of the intended landing zone.

A decision would have been needed to be made at this point to establish a new intended landing zone. Of course this is very easy to proclaim sitting in the comfort of my home analyzing the event from 2010.

Let's look again at what was happening in the helicopter at that very moment. The normality of flight was gone; an extremely high stress event just occurred requiring immediate responses. The displays within the helicopter



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were completely out of the norm. Aural warnings were going off repeatedly. The airspeed and rotor parameters were out of their needed positions and the helicopter was in a severe nose down attitude with the ground racing toward the pilot.

During a high stress situation the analytical portion of the brain has very little participation in our reactions to the event. The body operates on automatic responses, which are learned reactions to the task at hand. As long as the brain has learned reactions or references from learned events, it will continue to react within the parameters of available references. If the parameters or input of the occurrence become too many, or there is no available memory reactions to reference, the brain becomes overloaded. As the brain becomes overloaded it begins to, for the lack of a better word, "freeze up." The reactions to the event become less and less; dwindling down to single responses. Very similar to the deer in the headlights scenario.

During the thousands and thousands of full down autorotations in the AS350 I have taught, I have come to a conclusion that we have very little analytical participation in the maneuver. We don't so much learn how to perform a full down autorotation; but rather teach our bodies and subconscious how to perform the maneuver.

For instance, a common scenario that I have seen is a low time pilot going through an initial class learning full down autorotations for the first time. As he progresses through the autorotation's he will do very well as we address the correction of one parameter of the autorotation at a time. Then many autorotations into the flight we come to an out of ground effect hover at 1000 feet, and I induce the engine failure. The sensory input of new information is overwhelming. The helicopter falls out from underneath the pilot, the rotor goes low along with the associated aural warning, the nose of the helicopter yaws, and as the nose is pushed over the near vertical view of the ground is a dramatic sight picture. It is very common at this point that the corrective inputs are not induced into the flight controls and the pilot somewhat freezes up. Of course the corrections to the pilots' inputs, or lack there of, are made by the instructor, and as the helicopter comes closer to the ground, which is more of a familiar situation, the pilots' abilities return.

This maneuver is then performed repeatedly. Each time becoming more and more familiar until the pilot is performing them with complete proficiency as the brain learns the sensory inputs and the reactions to the stimuli it becomes muscle memory.

Of course the pilot of the helicopter in Tucson was not a new or low time pilot. This was a pilot with nearly 10,000 hours of rotorcraft time over an

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approximately 40 year career. He was highly experienced in the AS350 model and had flown in the Army and US Border Patrol.

Whether you are a 100 hour pilot or 10,000 hour pilot all of our brains work the same. Any overload of stimuli without the learned appropriate response will cause a reduction in performance.

With the overload that was occurring during the Tucson engine failure, the ability to analytically choose a new landing area was not available. As the helicopter descended at an extremely rapid rate, in an approximately west to east direction, the helicopters trajectory was taking it to a road that ran approximately north and south. The helicopter did not turned to a southerly direction, but rather made contact to the road widthwise.

It is very unlikely with the overloaded situation that was at hand that this was a conscious decision, but rather simply where the helicopter came to rest. It is surmised within the company and NTSB reports that the pilot needed to avoid 40 foot tall power lines which were located on the west side of the two lane street that the helicopter came to rest on. The thinking is that he had to pull collective to avoid the power lines, which then caused the low rotor situation, which resulted in the hard landing and blunt trauma fatal injuries.

Since the flare height for the AS350 is a minimum of 70 feet, and if the trajectory would have taken the helicopter into the wires, if the collective was then pulled with proper rotor RPM and speed the crash location would have been much further past the power lines. By injuries that were sustained and the condition of the airframe and main rotor blades the helicopter came out of the sky much higher in altitude, with almost no rotor speed.

The more likely scenario is that in response to the very low airspeed the pilot nosed the helicopter over at approximately 300-400 feet. This created an exponentially rapid descent rate and with the reduction of induced flow into the rotor system caused the rotor RPM to decay. If the aircraft did not regain needed autorotational forward speed, and the flare was induced, the helicopter would have fallen through the flare. At that point the normal reaction to the helicopter falling out from underneath the pilot would have been to pull full collective. With already low rotor speed, no forward movement, and at a high altitude, the helicopter would have fallen out of the sky.

When the helicopter made ground contact, by the markings on the ground, it had almost no forward speed. By the condition of the main rotor blades there was almost no rotation at the time of the crash. By the condition of the fuselage that was remaining after the post impact fire the ground contact was severe. For blunt trauma to occur after a helicopter crash, with the flexibility of the crosstubes, the height that the helicopter fell from had to be much higher than 40 feet.

And here we find ourselves back to our finger pointing stage. Our need to find a simple solution to this horrific event would have us point the finger of blame at the pilot. But once again to simply say this was a botched autorotation will not stop this type of event from happening again and was not the reason for the result at landing.

We need to ask ourselves, why a high time experienced aviator was not able to autorotate this helicopter to a point that was at least survivable? Why is it that time and time again that when faced with an engine failure in a single engine helicopter that the occupants of the helicopter die from blunt trauma and or the helicopter is completely destroyed?

THE ANSWER IS QUITE SIMPLE.

They had no experience or no recent experience in landing their airframe without an engine.

But wait... these pilot's did power recovery autorotations every year during training. The sad truth is a power recovery autorotation is not an autorotation. It is a rapid descent which terminates at a powered hover. The inputs at the bottom of a power recovery autorotation are completely different than in a really "no engine" landing. Going back to the automatic learned inputs that a pilot experiences during flight would have a pilot making the completely wrong inputs on the bottom of the autorotation if the learned inputs are achieved from power recovery autorotations.

Without the knowledge or learned situational sensory input at the landing phase of an autorotation, again, the brain has no reference to recall. Without this reference, again the brain simply "freezes" or has no learned reaction to perform in the situation. It would be similar to as if a pilot were taught how to takeoff and fly straight and level but were only taught simulated landings. The first time you had to land the helicopter for real would not turn out well.

The overwhelming question at this point is then "why in our industry are we not doing full down autorotations"? It is by far the most important skillset you can have as a pilot of a single engine.

The simple truth is that they are perceived as a high-risk maneuver to the aircraft. The mindset is that the pilot will be trained to the level that he may be able to survive the outcome. By studying accident reports this level of survivability is low.

The truth is that full down autorotations, when facilitated by an experienced instructor, to a runway environment, are no more dangerous than any other helicopter maneuver. The stress on the airframe during a full down autorotation when landing to a runway environment is lower than the induced torque that is applied to the helicopter during a power recovery autorotation.

The question then stands, how many of these accidents need to occur before we realize this simple truth? HO

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