

Most Accidents after Engine Failure Can Be Prevented

Improvement of Aviation Regulations and Airplane Flight Manuals Required

Five years after the beginning of aviation, Orville Wright and his passenger Lt. Thomas Selfridge took off to conduct a test flight in a new aircraft. In a turn, at a height of approximately 150 ft, one of the propellers broke and Orville lost control; the plane plunged to the ground. Lt. Selfridge was killed and Orville Wright himself was seriously injured. Although the Wright brothers' aircraft had only one engine, it did drive two propellers and was therefore to be considered a multi-engine airplane. Aviation claimed its first victim, the cause being the loss of control due to a propulsion system malfunction.

Today, 100 years later, propulsion system malfunctions of multi-engine airplanes continue to take their toll. All around the globe, accidents with both small and big multi-engine airplanes continue to happen quite frequently during takeoff, go-around and during training, despite the fact that all airplane types are carefully designed and thoroughly flight-tested, and that operational limitations are published in the airplane's flight manual. Orville did not know yet how to control an airplane after the failure of one of the propellers. Since accidents continue to happen, the pilots of today's multi-engine airplanes are still not made fully aware of the control limitations that apply after engine failure. The question how accidents after propulsion system malfunction can be prevented has not been answered adequately since the beginning of aviation.

Harry Horlings of AvioConsult, a USAF Test Pilot School graduate flight-test engineer and retired Lt Col – Chief Flight Test – of the Royal Netherlands Air Force and therewith one of the top aircraft experts in the world knows how multi-engine airplanes are flight-tested and what the real value is of the test data. Using that knowledge, he researched many engine failure related accident investigation reports and included in his research also engine emergency checklists and engine failure related text in airplane flight manuals, student pilot textbooks and other publications on asymmetrical powered flight. He also reviewed Federal Aviation Regulations (FAR) and the European (EASA) equivalent Certification Specifications (CS) 23 and 25.

He noticed that somehow the design methods used by multi-engine airplane manufacturers to size the vertical tail and the test methods and conditions that are used by experimental flight-test crews to determine V_{MCA} never made it to be incorporated appropriately in many, if not most engine emergency procedures, airplane flight manuals and pilot textbooks. Pilots and accident investigators do therefore not realize that the listed V_{MCA} is only valid during straight flight while a small bank angle is being maintained away from the inoperative engine. This bank angle should be the same as the one that design engineers used to calculate the required size of the vertical tail, which in turn is the same as the test pilots used to determine V_{MCA} , provided it is maximum 5 degrees away from the inoperative engine, as approved in FAR/ CS 23 and 25.149. Any other bank angle, as is the case after initiating a turn, changes the forces and moments that act on the airplane in such a way that the one-engine inoperative equilibrium can no longer be guaranteed if the power setting of the operating engine(s) is high and the airspeed is close to V_{MCA} . If a bank angle of 5 degrees away from the inoperative engine was used to determine V_{MCA} , then the listed V_{MCA} is no longer valid and the actual V_{MCA} will be at least 8 knots higher if the wings are kept level on small twins and up to 60 kt higher on big airliners. The takeoff safety speed V_2 , which should be at least 10% higher than V_{MCA} , is mostly not even higher than this increased V_{MCA} and hence does not provide the safety that it is expected to provide. Keeping the wings level or banking into the dead engine causes loss of control if the airspeed is low and the thrust setting high.

FAR's and CS's do however neither require manufacturers to list the bank angle that was used to determine V_{MCA} with the V_{MCA} data, nor to clearly describe that V_{MCA} is a minimum speed at which only straight flight can be maintained while an engine is inoperative, provided the required bank angle is being maintained, i.e. no turns!

Many pilots don't believe what Harry says, but professors at aviation colleges and at test pilot schools, as well as real test pilots and flight-test engineers confirm that he's right. Universities teach airplane design engineers the same thing. But nobody seems to listen, so don't be surprised that accidents following a propulsion system malfunction that happen since the beginning of aviation will continue to happen as long as asymmetrical engines are used on airplanes, unless authorities, manufacturers, accident investigators and training companies read the many reports and analyses that AvioConsult published on its website.

Not for publication:

Most airline and certification pilots are neither familiar with the design methods of the vertical tail of multi-engine airplanes nor with the experimental flight-test methods and conditions that are used to determine V_{MCA} . Therefore, the material written by Harry Horlings can only be verified or confirmed (if required) by formally trained experimental test pilots or flight-test engineers and by either one of the formal Test Pilot Schools. For addresses, please refer to the links page on www.avioconsult.com or ask AvioConsult for one or more names.

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