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Posts on the BeechTalk Forum, CrashTalk
Accident Beech 300, KADS, June 30, 2019

Post Nov. 24, 2022[1]

Dear readers,

On July 21, 2019, on page 77 of this thread I wrote a post at the request of one of the members. I understood that this post was appreciated very much. As mentioned in the post, I wrote it using the knowledge gained during my year of flight-test training at the USAF Test Pilot School and the books used by aeronautical universities on the subject control after engine failure. This post is about the very disappointing Final NTSB report, sorry for being a little late with it.

In the beginning of the year 2021 I started looking for the NTSB reports of this accident. I found several Studies that were already finished and published in the docket, and started reading these. I was a bit disappointed about the Performance Study, the Sideslip Thrust and Rudder Study and the Video Study. I also concluded that THE most important step in the engine failure procedure was and might be still missing in the POH of the B-300. I didn't want to wait till the final report was submitted, but asked the NTSB right away to improve the Studies of this tragic accident, because I know that the next of kin of pilots and pax all want to know the real cause. So, I contacted the NTSB Lead Investigator in the Denver office and e-mailed my notes on the Studies on March 2, 2021. She thanked me for the message and responded that she would share this with her team. But after reading the final report, I noticed that this regrettably did not happen.

The final report blames the pilot for initially commanding a left rudder input because the airport video showed a large sideslip to the left. But it is very hard to believe that a pilot responds with left rudder after failure of the left engine, rather than with right rudder. So how did the NTSB specialist conclude in the Performance Study that left rudder was used? This was by calculation (!), because the Performance Study states on page 5 that "Control surface deflections could not be determined from the videos", there were no FDR data available. But how accurate and truthful is this calculation?
Most CFI's, pilots and accident investigators believe that a bank angle results in a turn, but that is not the case when the thrust is asymmetrical. Aeronautical engineers and experimental test pilots work with equations of motion in the body axis system to analyze forces and moments that act on an airplane.
In the Study, the NTSB specialist also used equations of motion, but only one of the three lateral-directional equations while all three are necessary for proper analysis of the effect of rudder and sideslip on the lat-dir motions of the airplane. Amongst others, the influence of aileron deflection on (adverse) yaw,

[1] This post and the first one (below) can also be downloaded from the Accidents Page of my website under B300.

and the effect of weight and bank angle on the side forces, and therewith on the sideslip, were not included, which shows a shortfall of knowledge. Refer to paper 3 (Airplane Control and Analysis of Accidents after Engine Failure) on the Downloads Page of my website to learn more about body axes and the effect of weight and bank angle. It is difficult to believe that NTSB specialists and their leads are not educated at a higher aeronautical level; now the conclusion was inappropriate, and the possibility to learn from this accident is deprived from safety-minded pilots who want to return home safely after every flight. The annotated studies and my notes to the NTSB Lead Investigator can be downloaded in one file from the Accidents Page of my website under the head Beech 300 KADS.

The real cause of this accident was that the pilots were obviously never made aware, in course books, flight manuals and during flight training, of the conditions that apply immediately after engine failure while the airspeed is low (near V_{MC} / V_{MCA} and up to V_2): maintain straight flight (heading) with rudder while banking 5 degrees into the good engine (same side as rudder) until reaching a safe altitude (which might take up a long time). The POH/AFM published V_{MCA} is definitely not valid during turns. During banking, the actual V_{MCA} increases to a lot higher value. The vertical tail is not sized large enough to maintain balance of side forces (i.e. to prevent loss of control) when the actual bank angle deviates from the bank angle used for sizing the tail, which is 5° away from the failed engine, and which is also used to determine V_{MCA}. If a pilot allows yawing and an increasing bank angle into the failed engine, there is no return possible, at low airspeeds. Loss of control cannot be avoided, neither during turns at V_{MCA}, not even at V_2. Over 400 fatal accidents after engine failure, with more than 4,000 casualties during the past 25 years, prove this.

Not only the NTSB analysis of flying qualities and performance after engine failure of this accident is inadequate. I still have not seen a single accident investigation report (by any TSB) in which an accident after engine failure is correctly analyzed, i.e. in accordance with airplane design methods as taught at aeronautical universities, and with flight test techniques to evaluate the controllability and to determine V_{MCA} of multi-engine airplanes after engine failure as presented in FAA Flight Test Guides (in Advisory Circulars) and as taught at Test Pilot Schools. It seems that the TSB's suffer from knowledge poverty, despite the fact that sometimes PhD's lead investigations. We want to learn from accidents, so we want excellent reports, don't we?

Although some POH/ AFM's of multi-engine airplanes are correct on maintaining engine-out controllability, most contain inappropriate V_{MC} or V_{MCA} definitions and engine emergency procedures that will not prevent accidents, including the Beech 300 POH. Most multi-engine pilot training and demonstration of V_{MC} at flight schools and during check rides are also incorrect and inadequate. The overviewing FAA obviously accepts this, because they approved the manuals, but they should not have. Please refer to the Downloads Page of my website for lots of (free) papers and learning material. In Paper 3 already mentioned above, a chapter on training and demonstration of V_{MCA} is included, as is a review of POH/AFM definitions and also the most important steps in an engine emergency procedure. These free papers are my contributions to improving aviation safety, to help prevent you from getting involved in a fatal accident. Please take some time to read, or view my video on YouTube. This will get you home safely when disaster strikes. For readers who have doubts about my papers, URL's to download formal Test Pilot School course books from the USArchives and Advisory Circulars of the FAA are given on the Links page of my website.

Don't wait for FAA and NTSB to improve their performance. They made mistakes during the past 40 years in reviewing and approving POH's and AFM's, and while analyzing accidents after engine failure (and don't want to admit - I wrote them several letters and e-mails). It is fair to say though, that

FAASafety.com (SAC FSDO) is using my video and papers in their FAASTeam Safety Seminar since the beginning of the year 2022.

Always willing to assist. Fly safely.
Harry Horlings, AvioConsult, Lt-Col ret.
Graduate FTE USAF Test Pilot School (1985)
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Post July 21, 2019, page 77

San Ferguson invited me to join this forum, being a graduate Flight Test Engineer of the USAF Test Pilot School (1985), one of the handful of Test Pilot Schools in the world that provide the highest-level flight training. Following reviewing many investigation reports of accidents after engine failure, I noticed that multi-engine rated pilots don't get to hear/learn anymore about the flight-limitations that apply after engine failure, that the airplane design engineer was allowed to use for sizing the vertical tail and that we also use in flight test to determine the minimum control speed. In an attempt to bridge this knowledge gap and reduce the huge number of accidents, I published many papers and made a video on flying safely with an inoperative engine; these were already referenced in posts above. I did so, because pilots have the right to be made well aware of, and to learn the right stuff about the controllability of their airplane after engine failure, and how to continue the flight and land safely. In most of the 400 reports I reviewed, the mishap pilots were blamed post-mortem which is, as I believe, not only very unfair, but also obscuring the real cause of these accidents, which is to my opinion the lack of appropriate knowledge on the subject that manufacturers, manual and course writers, certifying and manual-approving authorities, accident investigators and flight schools currently have. The definitions of V_{MCA} and other V-speeds, the theory of flight with an inoperative engine and the engine emergency procedures in flight manuals and course books, and the analyses of accidents I've seen do not agree with the airplane design and flight test techniques as taught by Aeronautical Universities and Test Pilot Schools. Loss of knowledge led to loss of control.
The cause of this KADS accident is not yet clear, let's therefore not jump to conclusions, although it seems obvious that control was lost. The discussions in the posts above therefore seem to focus on asymmetrical flight; they show me that the writers are hungry for knowledge; pilots do not want to get killed because they were not made aware. I've seen many good posts, but also posts that show that the knowledge of flight with an inoperative engine is not as it should be. I am not blaming anyone of the pilots, but only recommending to read my free papers and view the video on my YouTube channel (AvioConsult).
If you don't like to read papers, here is briefly what you definitely need to remember:
The red-lined V_{MC}, today also called V_{MCA}, on your ASI is only valid while banking 5° into the good engine, to the same side as the foot pressure that is required to counteract the yawing after engine failure, and is also only valid while maintaining straight flight. Banking away from this favorable bank angle causes the actual V_{MCA}, the V_{MCA} that you will experience in-flight, to increase, possibly even above VYSE. Keeping the wings of small twins level increases the actual V_{MCA} already 8 – 10 kt above the red-lined V_{MCA}. V_{MCA} applies in anticipation of the failure of either engine.
As soon as you notice an uncommanded yaw during takeoff or initial climb, don't delay increasing rudder and hold to maintain heading, and also immediately attain the 5° bank angle, before conducting the other engine failure checklist items. Maintain straight flight, never ever turn at or close to V_{MCA} to either side! If you would at low airspeeds, you will most certainly lose control, by design: the rudder is not sized large enough to counteract the yawing caused by the asymmetrical thrust plus the yaw due to

sideslip, or the fin might stall if banked more into the good engine due to the increased sideslip angle. Take your time to climb out straight, even if the rate of climb is only 50 fpm, or less. At VYSE, a small bank angle of 3° reduces the [sideslip angle, hence the] drag, and maximizes your climb performance (after cleaning-up the airplane i.a.w. the checklist).
It is very rare that the other engine fails as well, so there is no need to be in a hurry returning to the departure runway. Once you climbed to a safe altitude, which can take 20 minutes or more, and need to turn at climb speed V_{YSE}, consider reducing the asymmetrical thrust a bit during the turn, and there with the rudder; the actual V_{MCA} will decrease. You might lose some altitude during the turn, but not the control of your airplane. Consider a long straight-in approach to avoid having to add asymmetrical thrust in the traffic pattern and during the final turn for maintaining the glide slope. Loss of control during the final turn happened quite frequently as well.
A safe return with OEI can be done; in flight test we have to demonstrate [this]. Don't let a failing engine turn into a killing engine.
The V_{MCA} presented in your Flight Manual is a worst-case V_{MCA}. Many variables and parameters have influence on its magnitude. It might be that during a demo, V_{MCA} was hardly a factor. But don't count on it that this will always be the case. Don't be afraid of V_{MCA}, respect it, just like you do respect the stall speed of your airplane.
If you'd rather read more formal documents than my papers, or want to learn more, please review the lists of references on the Downloads and Links pages of my website. In the lists, you'll find links to the courses on engine-out theory as taught at Test Pilot Schools, to the Flight Test Guides of the FAA in Advisory Circulars and of the EASA, to formal regulations of FAA and EASA, etc.
My objective is to make aviation even safer than is already is today. And yours?

Harry Horlings
https://www.avioconsult.com/downloads.htm

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If you would like me to review the flight manual of your airplane, send me an email and attach a pdf of the manual.
Many years ago, I wrote letters and emails to FAA, NTSB (incl. Board member Dr. Weener), and other authorities, but received no response. The FAASafety.gov Airplane Flying Handbook, Chapter 12 on the transition to multi-airplanes does regrettably not agree with airplane design and flight test techniques prescribed by the same organization, either. I wrote the manager two years ago, regrettably no response.
I am here for you, as long as I can.