December 2017
In my early NASA-retirement years, I was frequently asked for my thoughts on becoming an astronaut. In 2003 I provided those thoughts in the following document. To make them more widely available I'm publishing them to this website. Please be aware this is 'dated' material. My comments reference the shuttle-era. I do not know what changes in astronaut selection criteria have occurred in the past 14 years. However, I do believe many of the comments in this document remain applicable to those pursuing the current astronaut program.

I have one timeless suggestion...visit NASA's website and review the biographies of recently selected astronauts. Those bios will give you a very good idea of what 'worked' for astronaut selection. Also, periodically review NASA's website for future announcements on astronaut selection criteria.

What follows are my thoughts written in 2003.

# To Become An Astronaut

## TYPES OF ASTRONAUTS

There are two types of career NASA astronauts: pilot astronauts and mission specialist astronauts. If you are thinking of being an astronaut, it is essential you make an early decision (no later than entering college) as to what type of astronaut you want to be. Your early career path will differ significantly depending upon this decision.

Let me explain the difference in these astronaut positions. As the name implies, pilot astronauts are trained to fly the space shuttle. So, obviously, pilot astronauts must be pilots. While they might receive some training in the mission payload operations or learn to operate various experiments, the majority of their training is devoted to learning how to fly the space shuttle and understanding the space shuttle's various systems.

Mission specialists are the astronauts who are most responsible for space shuttle orbit operations. They spend most of their training time learning how to operate various experiments, use the robot arm, build and maintain the International Space Station, and do space walks. Like the pilots, they will be extensively trained in all the space shuttle systems, but they will not be trained to fly the space shuttle.

For sake of completeness, I should mention there is another astronaut position titled Payload Specialist. Payload specialist astronauts are NOT career NASA astronauts. These are individuals from universities and industry who have unique backgrounds in various

areas of science, backgrounds that are not duplicated by any of the pilot or mission specialist astronauts. For example, a payload specialist might be a cardiologist who will do research on heart function in weightlessness. Payload specialists usually fly only one mission (though some have flown multiple times). Payload specialists are only given emergency and habitability (eating, sleeping, using the toilet, etc) training. If you want to know more about the payload specialist astronaut position, contact NASA. I will not address that position in the following discussion.

## ASTRONAUT ACADEMIC REQUIREMENTS

If you look at the 'Vacancy Announcement' on the NASA web site, you'll notice the academic requirements to be a pilot astronaut and a mission specialist astronaut are identical, that is, a bachelor of science degree in engineering, science or math. But the information goes on to say, "An advanced degree is desirable." I think this could be changed to read, "An advanced degree is REQUIRED." Astronauts without advanced degrees are exceedingly rare. To drive home this point, please look through some astronaut biographies, specifically at their academic backgrounds. It won't take long to appreciate how desirable NASA considers an advanced degree to be. Personally, I don't believe you would be very competitive as a pilot applicant without a minimum of a Master's degree or a mission specialist applicant without a PhD degree.

Be sure to read the website comments on studies that have a technological or science 'ring' to them but are not considered qualifying for an astronaut position.

You should also note the comment which reads, "Quality of academic preparation is important." This doesn't mean your degree must be from MIT or Cal Tech or West Point or some other prestige school. If your degree is from an accredited school (state, private, large, small, Academy, etc) you have met the academic background to apply to be an astronaut. Of course, it doesn't hurt to have a Ph.D. from a 'reputation' school, but it's no guarantee your application will be more favorably differentiated from a person with a Ph.D. from Podunk U. Also, the science/engineering reputation of the school from which you get your advanced degree is probably more important to a selection committee than where you did your undergraduate studies.

Another important point about the astronaut application process is that you will have to submit your college transcripts. GRADES WILL COUNT IN THE ASTRONAUT SELECTION PROCESS. Make sure you study and rack up some good grades!!!

## PILOT ASTRONAUT - OTHER REQUIREMENTS

Refer to the 'Basic Qualification Requirements-Pilot Astronaut Candidate'. What does it say about pilot experience? It says you need "at least 1000 hours of pilot-in-command time in jet aircraft. Flight test experience is highly desirable." Notice it doesn't say you HAVE to be a military pilot. Nor does it say you HAVE to be a test pilot, though it's highly desirable. In fact, reading this requirement would lead you to believe an airline pilot (with the proper academic credentials) could compete for a pilot astronaut position. Most airline pilots have many thousands of hours of pilot-in-command jet flying time. But the reality is, all the NASA pilot astronauts selected during the shuttle era, beginning

in 1978, are graduates of the Air Force or Navy test pilot schools. (Marine test pilots are usually graduates of the Navy test pilot school. Also, the Air Force and Navy test pilot schools have an exchange program with test pilot schools in various foreign countries. Some pilot astronauts are graduates of those foreign test pilot schools.)

Don't be fooled by literature you might have read about civilian pilot astronauts. There have been some of those. For example, Neil Armstrong was a civilian pilot astronaut when he landed on the moon. But, if you look at his biography, he is a former Navy pilot and graduate of the Navy test pilot school. NASA's website would be more correct to say, "You MUST be a graduate of a military test pilot school." Someday, NASA might select civilian, non-test pilots as pilot astronauts and the vacancy announcement leaves that door open. But they haven't done so yet. This means, if you are dreaming of being a pilot astronaut, you MUST make plans to enter the military and aim for pilot training and test pilot school.

Before you do that, however, you should investigate your physical qualifications for pilot training. It would be a big disappointment to make plans to be a military test pilot as you enter college, only to find out years later you are not physically qualified. So, I would strongly recommend, before you get too deep into college, you take an FAA-type of physical exam. With that exam in hand, you should call the Air Force and/or Navy to determine if you are pilot qualified. The military pilot physical requirements might be more stringent than those of the FAA (military eyesight requirements frequently are). Call any Navy, Marine or Air Force base with flying operations. Then, ask the base operator to connect you to Flight Medicine or to the Flight Surgeon’s Office. People in those offices would be the ones to ask about current eye-sight requirements, acceptance of corrective eye-surgeries, asthma conditions, heart murmurs, etc.

If you find you would physically qualify for a military flying program, then you need to make decisions on entering the military. To make those decisions, you need to know a couple things. First of all, to be a military pilot, you MUST be an officer. To be an officer, you MUST have a college degree. The best ways to complete these requirements are to enter one of the Academies (the Air Force Academy or Naval Academy) or to enter an Air Force or Navy university/college ROTC program. When you graduate from the Academy or complete an ROTC program, you would have a college degree and be a commissioned officer. In other words, you would be qualified to apply for pilot training (assuming you are physically qualified).

One word of caution on routes into the military. If you intend to be a military pilot, DO NOT ENLIST. While it is true, as a college-degree-holding enlisted person, you might be able to get into officer training school, get a commission as an officer and then enter pilot training, there are no guarantees of that career path. Once you enter the military you are at the mercy of a giant bureaucracy and it might be very difficult to convince that bureaucracy to send you to an officer training school. It would be MUCH better to enter the military as a commissioned officer from an ROTC or Academy program. Also, you will note, I did not mention my alma mater, West Point, or Army ROTC as a suggested path to pilot astronaut. While a number of army helicopter pilots have become mission

specialist astronauts, none have become pilot astronauts. So, I would recommend you pursue the Air Force or Navy flying programs (Marine pilots are trained by the Navy). Also, be aware the Air Force and Navy (and NASA) won't care about the source of your commission, be it ROTC or one of the Academies. So, if you don't think you would like the discipline and limited social life of an Academy, then shoot for college ROTC.

Assuming you are successful at completing a Navy or Air Force pilot training program, then you should focus on getting into one of those service's test pilot schools. Then, as a test pilot, you can apply to NASA for a pilot astronaut position (through whatever procedures your service would have for that application process).

## MISSION SPECIALIST ASTRONAUT - OTHER REQUIREMENTS

To be a mission specialist astronaut you do NOT have to be in the military. You do NOT have to be a pilot.

## OTHER THOUGHTS ON BEING AN ASTRONAUT

1. Many people ask me if being a private pilot will help in the selection process for mission specialist astronaut. This is difficult to answer. Many mission specialist astronauts have been selected who had no flying background whatever, while some are very experienced private pilots when they apply. Being a private pilot could be one of those "tie breakers" to a selection committee. It certainly indicates you like to fly. I would say, if you want a private pilot's license, go for it. If you don't have the money or time or talent to be a private pilot, I wouldn't sweat it. Just make sure the rest of your application shines.

2. While there is nothing in the NASA Vacancy Announcement information to indicate a fluency in a foreign language is desirable, I can't help but believe such fluency would be a tie-breaker with other applicants. NASA's space program is no longer an American program. It is international in scope. The International Space Station (ISS) is being developed not only by the USA, but also by Russia, Canada, Japan, and Europe. Because of the various languages spoken, this multi-national effort complicates the process of forming crews for the ISS. So, I believe a fluency in a foreign language like Russian, French, German, Japanese, etc., would help in the application process. If you are fluent in ANY foreign language, I would make sure that NASA was aware of that fluency when you submit your application.

3. Occasionally I receive mail from young men and women which read something like this, "Mr. Mullane, when I was in college I didn't really know what I wanted to do, so I partied a lot and my grades were poor as a result. But now, I really want to be an astronaut. What can I do to correct my college experience?" Can everybody guess the answer to this question? I hope so. Sadly, I have to write these people and say they've dug a deep hole for themselves and it's going to be difficult, if not impossible, to climb out of it. They can attempt graduate school, I tell them, and hope that good grades there will offset their earlier disappointing grades. But, most colleges probably will not accept

somebody into graduate school without a solid undergraduate performance. And most people don't have the option of going back to redo college. Or, if they do have that option, they'll probably be too old to enter pilot training or, perhaps, too old to be competitive in an astronaut application. PLEASE....EVERYBODY...Understand this fact of life: Everything you have done in your past life and everything you will do in the future will eventually count in your lives. Make sure it counts to the good. Even if you don't know what you want to be in life, ALWAYS do your best. Later, when you do figure out what career you want, you'll have a good background from which to launch your dream.

4. If you are pursuing the pilot astronaut position, you should be aware the military flying programs DO NOT require a science, engineering or math degree. You are only required to have a college degree. It could be in English or history or business or other liberal arts. The Navy and Air Force won't care when you apply for pilot training. But NASA will sure care when you apply to be a pilot astronaut. So, when you are attending an Academy or ROTC program to get a commission as an officer, make sure you are simultaneously getting a degree in science, math or engineering.

5. DO NOT JOIN THE MILITARY JUST BECAUSE YOU WANT TO BE AN ASTRONAUT! You should only join the military because you want to be in the military. If you also want to be an astronaut, that's fine. But the military is unlike any other job in our society and I think you would be very unhappy if you only joined because you wanted to get the training necessary to be a pilot astronaut. The military services don't exist to train astronauts. Their sole purpose is to fight and win the Nation's wars. Don't misunderstand me. I think the military is a wonderful way of life, but you need to understand, when you join, you surrender a lot of freedoms the rest of the population take for granted. For example, you are assigned to jobs and moved to various locations as the needs of the military dictate. Not YOUR needs, but the needs of the military. While you can request things like pilot training or test pilot school, there are no guarantees the military will give you those things. Instead, you might find yourself living in far away, uncomfortable places while separated from your family. You might never be given a pilot training slot or be approved for test pilot school. And you might find yourself abruptly thrown into combat situations. This fact in particular needs to be understood by anybody contemplating entering a military service. When Desert Storm occurred (our first Iraqi war), I read in the papers that some Reservists and National Guard personnel were shocked to find they were going to have to leave their families to go fight a war. They had joined a peace-time military and, apparently, didn't envision they might actually find themselves in a shooting war. Nobody who puts on a military uniform should be shocked to get such a call to arms. That is the purpose of the military. At a moments notice, you might be called to grab a weapon or jump in a fighter or bomber or climb aboard a ship and leave your family and go off to fight a war. I suspect, right now, everybody understands this because of our on-going war against terror. But even in a truly peace-time military, there is the risk of injury and death due to accidents. Every military pilot can tell you of friends who died in training accidents. So, if you want to join the military, go for it. But, have your eyes open to the risks you will be assuming. If you also want to simultaneously pursue your astronaut dream while in the military, that's great. But never

join the military if you wouldn't want that career by itself, because it may never make you an astronaut.

While on this subject of risk, I should also mention the risks of flying the space shuttle are not insignificant. As I write this, we have lost 2 space shuttles (Challenger and Columbia) and 14 astronauts. I'm not saying this to discourage anybody from applying to be an astronaut, but just do so as an informed person as to the risks involved. In just 8 ½ minutes, the space shuttle will convert 4 million pounds of propellant into a speed of nearly 5 miles per second and an altitude of about 200 miles. In other words, a shuttle launch is a controlled explosion. It will NEVER be routine. It will always carry some significant dangers.

6. Remember there are things you cannot control in your quest to be an astronaut, for example, things associated with your body. When I entered West Point my dream was to ultimately get my commission in the Air Force and become a fighter pilot. But, at graduation four years later, I was unable to pass the pilot training physical exam because my eyesight had changed. (I flew in the back seat of reconnaissance jets in my Air Force career, not as a pilot.) Through diet and exercise we can control some aspects of our health, but there are things beyond our control, for example, disease, eyesight acuity or color blindness or our height (read the vacancy announcement on those limits).

7. Notice there is no age limit specified for astronaut applicants. However, most people who are selected as astronauts are in their early thirties. It's rare to see someone over 40 selected as an astronaut. If you go straight from high school into college and then into the military (if you are trying to be a pilot astronaut), you'll probably be okay from an age point of view when it comes time to apply to be an astronaut. However, if you graduate from high school and bum around for a few years, or only get a year or two of college and then drop out for a while, you might later regret the lost time. For most young people it's difficult to conceive of doors closing on various careers because of age. But it's a fact of life. Age does matter. For example, the military has restrictions on age to enter pilot training. The academies have age restrictions to enter their programs. I would strongly encourage anybody trying to be an astronaut to make every moment count. Enjoy the occasional time off, but don't get lulled into thinking there is an infinite number of tomorrows to get the education and experience you'll need to be competitive for an astronaut position. There aren't.

8. When I was interviewed by the NASA Astronaut Selection Panel, I was never asked any technical questions and I've never heard of anybody being asked anything technical. What NASA wants to know is what type of a person you are. They are looking for well rounded, good-communicating, team-oriented people to be astronauts. So, they typically ask general life questions. "What are your hobbies? What jobs have you had? Tell us about your life. What have you found most rewarding? Most challenging? What do you feel is your greatest accomplishment?" If you answer, "I have no hobbies. I've never done anything but study. I have 3 Ph.D.'s and I've won the Nobel Prize in astrophysics", you might be surprised to be rejected. Sure NASA wants very smart people, but they want those smart people to be team players, to have demonstrated an ability to work with

others, to be people with varied life experiences. (Basically, NASA wants what every other employer wants.) So, I would strongly encourage young people to get involved with other activities besides academics that show an ability to interact with other people, e.g., team sports, bands, clubs, Scouts, student government, etc. Just imagine you are on an astronaut selection committee and you have 10 folders in front of you with nearly identical backgrounds in academics, age, and work experience. You will start looking for small things that might make one of these ten people stand out. Maybe you see that one person pitches for the company softball team, plays drums in the company band and has been part of a sailboat crew that sailed the Atlantic one summer. Who are you going to pick out of that pile of 10 applicants? I call these tie-breakers . You should work to accumulate some of those through your life. Not only will they make you more competitive in the astronaut application process, they will also make you a better person and a better candidate for employment anywhere.

9. As you pursue a dream of being an astronaut, always keep in mind the limited number of astronauts being selected. Obviously, you can have superior credentials and still not make the cut. The odds are very long. But the odds are zero if you don't try. So, give it your best shot, while you simultaneously maintain the attitude it's not the end of the world and it's not a waste of time if you don't make it. In attaining the academic and professional background necessary to even apply to be an astronaut, you have set yourself on the road to a very successful life. Good luck!

## To Become An Astronaut

December 2017.
A closing thought. Do NOT take anything I've said above as absolute fact! As I said in my introduction, I wrote this in 2003 during the space shuttle era. While I believe some of the advice is still relevant, major changes in the astronaut selection process, physical requirements, academic requirements, work-history requirements, etc. could have occurred in the past 14 years. Go to the NASA website for the best and most current information. I wish you all Godspeed in your dream-quests, whatever those might be.