The Hammerhead

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THE HAMMERHEAD MANEUVER is one of my favorites. It is fun to do and very satisfying when done well. It is also one of the harder maneuvers to teach and it can induce an inverted spin if mishandled. With that being said it is still one a junior aerobat can do well with just a little training, so let's do it right and have fun!

All discussions about maneuvers in this column are geared for those doing recreational aerobatics as well as those who compete.

The hammerhead is also a maneuver that always generates a lot of discussion and re-thinking. It is a great thought exercise when analyzing it with someone who is new to aerobatics as we discuss which control does what on the vertical upline as well as in the pivot. The hammerhead can even be a good discussion about flight control inputs with those pilots who will not be doing aerobatics in the near future. It really gets the brain going in a different direction for those trained in the standard, "car-type driving" flight school.

As Emergency Maneuver Training guru Rich Stowell says, "... the flight controls work in relation to the pilot, not the horizon. Pitch, Roll, and Yaw are 'attitude independent.' Pitch is not nose up/nose down, and yaw is not left/right. Pitch is actually a head-to-foot motion of the tip of the nose. Yaw is an ear-to-ear motion of the tip of the nose. In Roll the wingtip moves from the pilot's head to the pilot's hip. These rules work in any attitude." These statements are the key to understanding how to fly these maneuvers.

The hammerhead also zeros in on the important parts of 1972 World Champion Charlie Hillard's "where to look and when" advice. He felt that if a pilot looked in the right place at the right time the maneuver in question was much easier to perform.

In this discussion, we're in a left hammerhead with a (from the pilot's perspective) clockwise-turning, or American, engine.

Now we're going to fly using the wingtip part of the time. Pilots are initially taught to fly using a tip of the nose reference, from the pilot's perspective, for pitch, roll, and yaw. The hammerhead and most aerobatic maneuvers are instead flown with a wingtip (or wing sight gauge) reference, from the pilot's perspective. Flying by a wingtip reference is not in most pilots' experience. This discussion will be using the left wingtip as a reference.

Wingtips on horizon from *Airplane Flying Handbook (FAA-H-8083-3B, Chapter 3, Fig. 3-7).*

Control of the wingtip with the flight controls is done the same way as if the regular nose reference is used, but the orientation is different. In level flight, a wingtip forward or aft motion is yaw and is done with the rudder. Wingtip up and down motion is done with the roll control. Challenges your brain at first, doesn't it?

The best thing a person new to aerobatics can do in preparation is to learn to do a stall entry and recovery using a left wingtip reference instead of the nose reference. If coordination is maintained throughout the stall entry, break, and recovery, the wingtip will not move

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forward or aft of a spot on the far horizon off the wingtip. Heading will be held constant throughout, and the wingtip will not drop or rise in relation to the horizon as the pitch is increased or decreased.

Just as a good landing is more likely to occur following a good stabilized approach, a good hammerhead pivot or rotation begins with a good upline. The more vertical the upline is the better the pivot is. I have found that once the vertical line has been set the stick cannot be frozen in position. The Decathlon, for instance, will slowly creep on its back (negative) as it goes uphill and slows down. Don't let it.

The engine at full power will "torque" the aircraft as it slows. This will cause the aircraft to roll left, which is a downgrade. This looks to the pilot as the wingtip wanting to walk across the horizon as it is being held vertical in pitch. Put in right aileron as necessary to prevent any rolling on the upline.

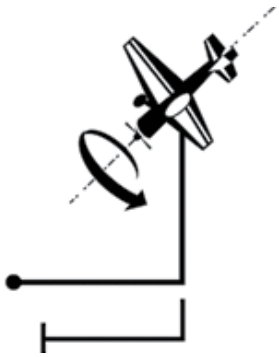
As the aircraft slows on the upline with the engine at full power the left wingtip will start to drop, which is a left yaw motion. The pilot must use some right rudder to keep the wingtip in position on the horizon.

The "kick," or pivot, is really a rapid and smooth push of the rudder to the stop, followed a split-second later by opposite aileron and then forward stick. These movements are not normally done simultaneously but sequentially. The aircraft type will determine the timing. The rudder and elevator are effective immediately because they are in the propeller slipstream. The aileron only becomes effective once the wingtip is moving in yaw and has some relative wind over it.

The rudder begins the left yaw motion, giving the right wingtip more relative wind. This pulls the right wingtip into a left roll. The opposite aileron input, in this case right aileron, is added to prevent this roll. Enough aileron must be added so the aircraft yaws "in plane" with no rolling motion present. Any roll is a downgrade.

We should be pivoting around a point within a half wingspan of the pilot. See diagram 8.5.11 on Page 22. Most people kick too early. This causes what we call a "flyover," when the airplane flies up and over in an arc instead of rotating about a point close to or within the dimensions of the aircraft.

In a flyover, the aircraft still has some energy left over when the rudder input is initiated. It also doesn't feel good. The pilot is thrown to the high side of the aircraft during the rotation.



"Torquing" is rotation about the longitudinal axis during a hammerhead pivot.

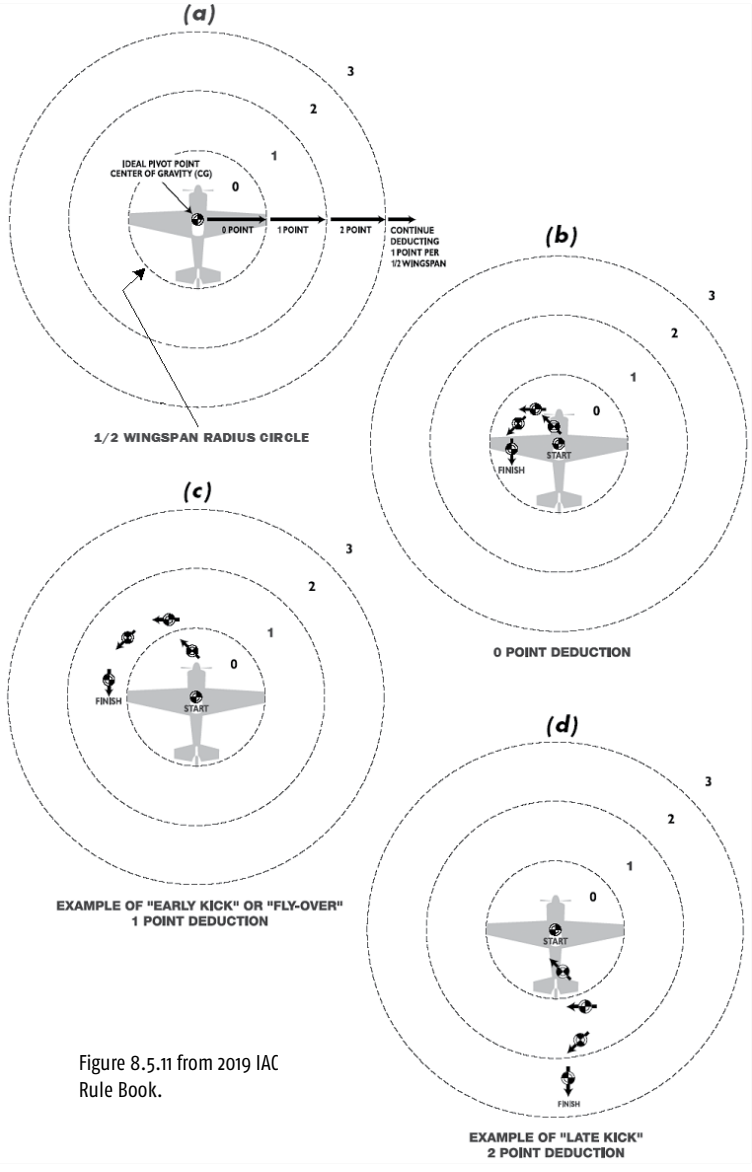


Figure 8.5.11 from 2019 IAC Rule Book.

Beware of kicking late and getting into a tailslide. Many airplanes cannot handle a tailslide.

Each airplane is different, but kicking at the proper time will cause the aircraft to pirouette around a point close to the aircraft without much fuss. Kicking too early or too late, however, will cause the aircraft to buck and snort, and it will look like a partially unfolded lawn chair thrown out of the back of a moving pickup truck. It also doesn't feel good to the pilot.

In the case of the Decathlon, there is a very gentle shudder the aircraft gets when the time is right.

Also, as I'm looking to the horizon at my wingtip sight reference, it seems that when the time is right I am still moving slowly upward. Although I perceive this slight upward movement, a ground observer will see the aircraft stop. Here is where some ground coaching can help. When the pilot sees all motion stop, however, the ground observer sees backward motion.

Now we enter the possible inverted spin zone. The left yaw motion causes gyroscopic forces in the propeller to pitch the airplane on its back. Pushing the stick forward during the pivot cancels out this pitching to keep the aircraft yawing "in plane."

Preventing the inverted spin entry is all about not overdoing the forward stick input.

Rich Stowell taught me a neat trick that helps the pilot use the correct amount of forward stick.

At the end of the vertical line, the pilot is looking at the sight gauge or the wingtip in relation to a spot on the left horizon. It is natural for the eye to want to follow the wingtip down across the ground as the rotation begins, but you must resist it.

Instead, keep the eyes on that spot on the horizon and let the wingtip drop out of sight. Then, apply just enough forward stick to put the tip of the nose through the same spot on the horizon the wingtip or sight gauge just vacated.

It is very hard to keep the Pitts Specials from torquing around during the rotation. I was taught to pull power a little just before the rotation begins, which really helps. Don't pull power too much, though, or the rotation will stop working. It sure takes a lot more forward stick to counteract the gyroscopic pitching in the Pitts than it did in the Decathlon.

When the nose reaches straight down just neutralizing the rudder pedals will bring about a pendulum effect, which is a downgrade. To avoid this, put in full opposite (right) rudder when about 30 degrees away from straight down, and then quickly go to neutral. That will stop the nose quite smartly, with it pointing straight down. Once the pivot stops you don't need as much forward stick, so ease off. Avoid pushing negative on the downline.

I mentioned before that the control inputs for beginning the hammerhead rotation could also inadvertently cause an inverted spin. Kicking at the right time and using the Rich Stowell method with the forward stick, as outlined earlier, will usually prevent an inverted spin entry.

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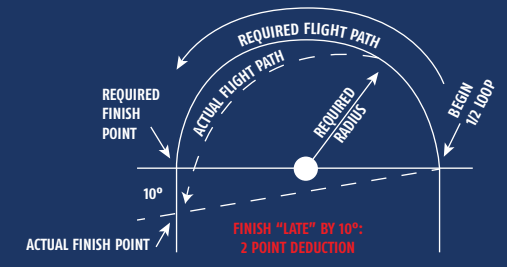
However, as soon as you find the airplane doing anything you didn't expect, discontinue the maneuver *immediately*. As they say in *Top Gun*, "Don't push a bad position." Center the rudder, aileron, and elevator controls, and once the nose is at or below the horizon, pull the throttle to idle. The heavy end of the aircraft will seek the center of the earth, and it will begin flying again. If you stop using the offending inputs as soon as things start getting ugly, the aircraft should never fully enter the spin. If a spin does result, using the PARE spin recovery procedure (power idle, ailerons neutral, rudder full opposite the spin, elevator sharply through neutral) works whether upright or inverted.

I am assuming, of course, that when practicing this maneuver you have obtained sufficient altitude, put your parachute on, loaded the aircraft within the *aerobatic* CG, and already had spin training. You can also see that you should not teach yourself this or any other aerobatic maneuver. Get proper training first.

I love flying the hammerhead, and I love teaching it. It is one of the most satisfying maneuvers when done well — whether competing or not. It definitely has a sweet spot. Learn it safely and enjoy!

Retraction

In the July issue of *Sport Aerobatics* there was an error in the article titled "The Humpty Bumps." An incorrect illustration with a description of "Finishing Late" appeared on Page 31. The correct illustration has been provided by the author, Gordon Penner, along with the correct description.



The statement from *2019 Rule Book*, Chapter 8, Pages 8-21, Family 8.4:

"These figures, whether vertical or performed with 45-degree lines, are judged as a combination of lines and part-loops. None of the part-loops are required to have the same radii, though they must still have a constant radius from start to finish. **For vertical humpty bumps, this means that the half-loop must complete at the same altitude from which it began.**

"The lines in these figures may be of different lengths. Therefore the entry and exit altitudes need not be the same. Rolls on any of these lines must be centered."