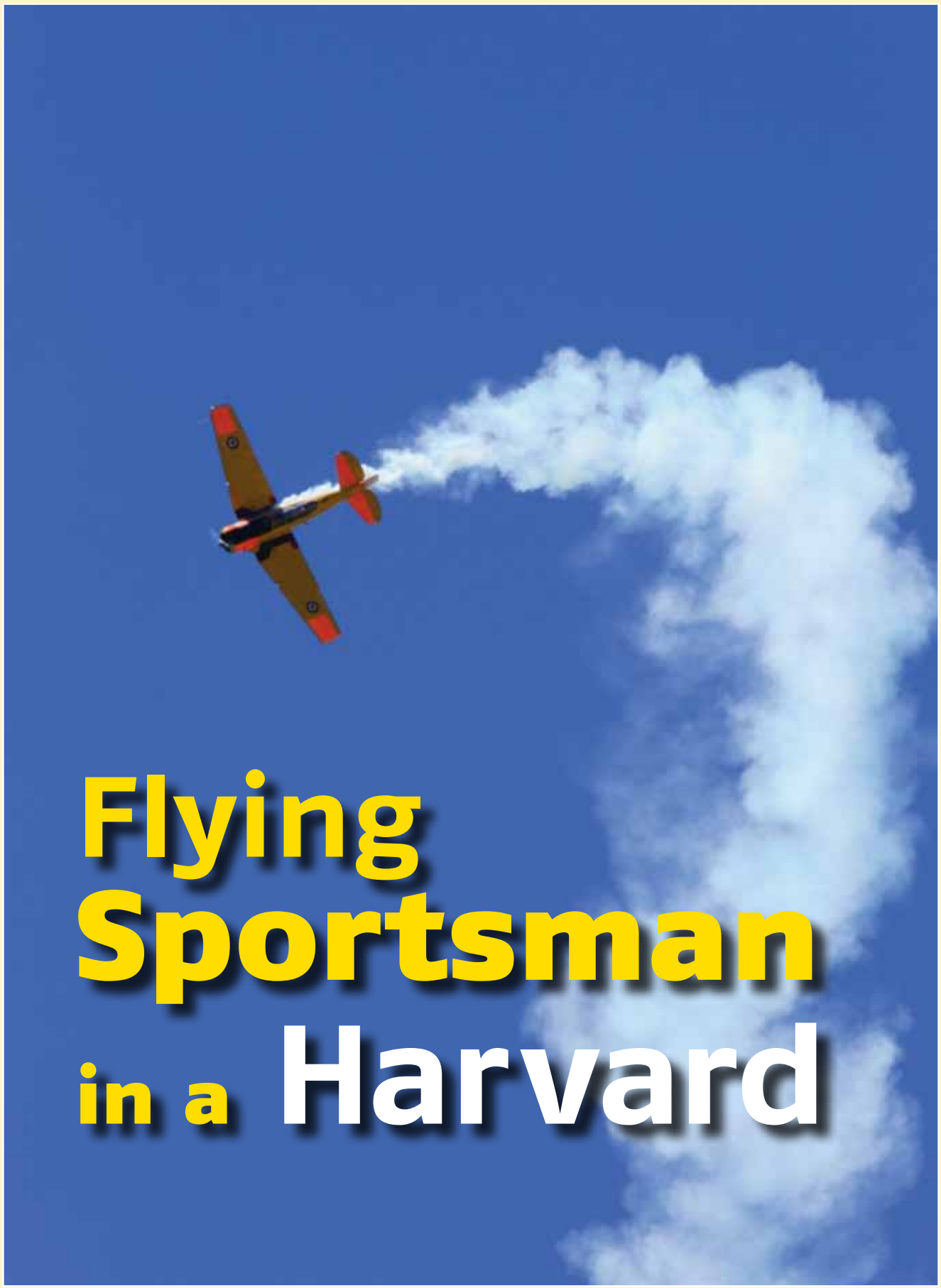

Flying Sportsman in a Harvard

by Rick Volker

The Sportsman category is a perfect starting point for aerobatic pilots with higher goals. It is also a great playground for those who want to have fun with less competitive aircraft. As a competitor who followed the path of Sportsman through Unlimited category, I considered competition to be the only acceptable preparation for realizing my first aviation goal—flying air shows in a Sukhoi 26M. I am as surprised as anyone else that I found my way back to the competition playground.

Early in my air show days, I was given the opportunity to fly a Spitfire Mk IX in a surface 0-level aerobatic act. I required a T-6/Harvard checkout during the RAF-designed Spitfire training course. After the initial procedural review and flight-testing, my subsequent Harvard experiences were limited to providing a taxi service for the museum owner and as a photo ship for other WWII aircraft. Aerobatic experimentation was not welcome. I was surprised that this bus of an airplane felt so nimble and wondered what it would be like to use its full flight envelope. As soon as I was able to switch to the Spitfire, my Harvard curiosity was abandoned. The Spitfire satisfied my fighter pilot wannabe dreams and gave a taste for commemoration and history that was missing in modern aircraft. I used to joke that a Harvard was a big dumb airplane for big dumb pilots. I am here to eat those words.

After several years of flying the Spitfire, Messerschmitt, and Hurricane, the museum closed its doors, leaving me in warbird withdrawal. I kept thinking of how delightful the Harvard felt and wondered if its bad reputation of biting new recruits was warranted. I needed another warbird fix. The Canadian Harvard Aircraft association, based in Tillsonburg, Ontario, provided the cure. I acquainted myself with its Harvard, finding it to be an "honest" airplane, devoid of any unexpected behavior. The performance envelope seemed much larger than I had anticipated. Quickly falling in love, I decided to buy my own Harvard.

Why a Harvard and not a T-6? The airframes are identical. It is the accessories that differ. Due to the weight and balance of the T-6 as equipped in the U.S. standard category, T-6s are banned from spins. In Canada, the operating limits of the aircraft in Harvard attire permit spins, and thus much more experimentation with maneuvers that may devolve into spins, such as hammerheads and avalanches. Harvards have been used since WWII to teach aerobatics to budding fighter pilots. They are blessed with perfect control harmony, great visibility, and a cockpit layout that prepares for time in virtually any piston fighter of WWII. With a 4,300-pound empty weight and only 600 hp, the Harvard still teaches pilots valuable lessons in energy management. There is no inverted fuel or oil system. The asymmetric wing is not capable of more than -1g from level flight and provides roll rates of 90 degrees/second, typical for the WWII era. The 5.67g limit seems high for a 62-year-old airplane, so most pilots today use a self-imposed limit of 4g to preserve the airframe for the next generation. There are plenty of Harvards and T-6s with more than 11,000 hours on them. How many Unlimited monoplanes will make it that long in one piece? I'll baby mine, thanks.

Moving into a Harvard requires a separate set of skills to handle weight and procedural differences. The Canadian Harvard Aircraft Association averages about 10 hours of ground school and five hours of flight time to give a Harvard checkout to an experienced tailwheel

pilot. A Harvard will likely burn about 16 gallons of gas during a 20-minute aerobatic practice flight. Operating costs are about the same as an Extra due to the fact that the higher fuel burn is offset by hull insurance that is one-third the cost of an aerobatic carbon-fiber monoplane. The airframe and engine are easy to work on. Parts are cheap and plentiful. This is truly what people call a "gas and oil" airplane.

The 2014 air show season was spent showing crowds how a Harvard can fly an interesting and challenging solo. In addition to Sportsman figures, additional maneuvers including avalanches, snap rolls out of hammerheads, simulated tail slides, full slipping "hovers," and a Harvard version of a rolling turn were added. It was great fun flying at the edges of the envelope. The eight-minute air show sequence was built without breaks for energy and was done entirely between the surface and 1,600 feet AGL for maximum crowd shock value.

Other performers constantly remarked that the Harvard and T-6 are perhaps the most dangerous aircraft in which to fly an exciting low-level routine. Why? If you lose fuel pressure on a hammerhead upline, you will not have enough power and rudder authority for the pivot, creating an unapproved tail slide, possibly into the ground. If slow rolls are allowed to dish out at low altitude, there is not enough roll rate or inverted push available to stop from hitting the ground. Ham-handed rolls and overzealous pulls will snap roll. An intentional snap roll at low altitude without commitment may end up as a half-snap with no way to recover. There is simply not enough power or roll rate to save oneself after doing anything stupid at low air show altitudes.

The air-show experience raised the big question: Can a Harvard be flown safely and competitively in Sportsman category aerobatic competition? Breaks in the contest sequence are not heavily penalized in Sportsman, and are required of the Harvard pilot to maintain a high enough energy state to avoid violating the edges of the envelope, both personal and mechanical. The 1,500-foot floor provides an adequate safety margin for any conceivable known sequence. The lack of an inverted fuel and oil system affects the ability to gain a perfect score in a majority of Sportsman maneuvers. The penalty for losing fuel pressure is that the engine rpm drops off, the constant speed prop unit (CSU) tries to boost the rpm, and when the fuel pressure returns, the CSU is too slow to respond and overspeeds the engine. Bad. Expensive. So, why not fly Primary? Primary category was quickly ruled out as too simple and easy for a Harvard, as this year's sequence criminally lacked a spin.

With two weeks of Sportsman sequence practice after the 2014 air show season ended, the decision was made to compete in the Sportsman category at the Bill Thomas Can/Am Aerobatic Challenge in Olean, New York. This was enough time to sort things out, but not enough time to make it perfect. Bill Thomas had been my only aerobatic instructor, and I was his last student. I still remember Bill Thomas yelling, "Do another one!" in my ear over the same Olean airport in my first aircraft, a Pitts S-2B. Bill gave me a good "idiot proofing" that has hopefully lasted to this day. Surrounded by Pitts and Extras, the Harvard would make its stand here.

Bill Thomas used this Olean, New York, airport as his classroom during the summer.

The Sportsman Challenge

This is a description of a flight through the maneuvers that challenge the Harvard the most:

Reverse half-Cuban goldfish

Approaching the box in level flight at climb power (30 inches, 2000 rpm), the forward visibility is better than is found in any modern aerobatic plane. Tracking that Pitts bogey at your 2 o'clock in the hold is effortless. However, there is no way to look straight down. The wing blocks the whole airport! Where did the box go? Downline wing-wags meted out until the last second will save the day. Pulling for the reverse half-Cuban goldfish with a 4g pull feels perfect at 165 knots (max level speed), with 140 knots as the minimum speed to achieve a round looping segment. If one rolls to inverted and tries to draw a 45 line, the engine will

quit, inducing the dreaded prop surge upon fuel pressure return. Instead, the pilot should attempt to produce a short, shallow line after the roll that barely avoids losing fuel pressure, helped by a marked pull to enter the looping segment. Distracted by the sound of the R-1340 engine, the judges might overlook that this short line is almost parabolic. During the looping segment, the Harvard feels very stable in pitch, as if on a railroad track all the way around, albeit with a pinched top. An attempt to keep the top round requires a great amount of stick relaxation to give almost zero g, with all energy seemingly gone. The pilot feels like a ballistic projectile with no motor! Where did those 600 horses all go? Loops are likely to look segmented without the benefit of prior ground critique. The end of the maneuver is a 45 positive upline, with the Harvard pilot unable to push to level with less than .1g on the meter. This goldfish eats up the box like a piranha! The fuel system is the master again.

180-degree turn

The pilot is now forced to ask the Harvard to accelerate from what tiny amount of speed is left in level flight with less than half the box remaining in preparation for the 180-degree turn. The Harvard probably could use a mile to get up to the proper speed, so subterfuge must be committed. Coax it up to 100 knots and accept that it will be marginal. Pulling a hair over 2g at that speed will result in the demonstration of a beautiful half snap roll and a big fat zero on the score card. What to do? Use an initial high nose position in the turn, attempt to help it along by slightly descending, and cheat with some top rudder. This deception pays off with scores of 9 across the board.

One-turn spin

With power off, the prop is pulled all the way to full coarse to prevent an overspeed on recovery. The Harvard breaks cleanly. The spin behavior of less than a 1-1/2-turn spin is textbook perfect with recovery inputs started one-half turn before the finish. To recover consistently in a Harvard, the pilot needs to use the same fuel and passenger load each time to get the timing right. The manual recommends half of a fuel load balanced between the two wing tanks for consistency. The push to a vertical line down requires negative g, which can only be done respectfully in this idle condition. The fuel and oil pressure overload demands a break after the spin to ease the engine back up to fighting form. Take planned break No. 1. Fellow competitors will say that the engine sounds funny on recovery. Intelligent people find Harvard noise to be quite stimulating. Any prolonged quiet from the big radial is felt as a disturbance in the force.

Hammerhead

Use an 85-degree upline. The engine will quit with any minute negative correction on this upline, rendering the rudder useless and producing a beautiful tail slide. Sorry, tail slides are no longer approved, though they had been done for years by ham-handed recruits at altitude, with little problem. Accepting the positive upline penalty ensures this gem will be passed on to another generation without any abuse. The hammerhead pivot is slow and will take at least a full wing width. Some judges will even register the dreaded "flown over the top" insult. Have you ever picked up a Harvard prop? It feels like it weighs 200 pounds. Imagine the crank barking out, "Drop and give me 50 pushups, soldier!" Despite all power and control timing choices, there is a tendency to torque toward the negative on the downline. Using 85 degrees up seems to grant 90 degrees down. For some unknown reason, the engine runs fine on the 90-degree vertical down with one-quarter roll. Flying the downline after this roll demands great attention to timing and speed. It is a runaway freight train downhill, and the 225 V_{NE} would be easy to blow through with any delay for the 4g pull. Respect your elders! Pull out to level after a "one-one-thousand" count at 180 knots.

Hammerhead in the box at the Bill Thomas Can/Am Aerobatic Challenge.

Immelmann

This works well from 165 knots. Start the roll at 20 degrees before inverted, finishing in level

flight at 75 knots. It will snap roll if you wait too long to roll upright, and leaves no time to accelerate to the 160 knots needed for the following slow roll. Enter planned break No. 2!

Slow Roll

A slow roll seems impossible due to the limits imposed by the inverted system. Go to max continuous power (32 inches/2200 rpm). Using 32 inches of manifold pressure brings in a different fuel jet in the carb for a super rich condition that barely defeats a momentary passage through -1g. The asymmetric wing requires full forward stick and 160 knots to hold inverted level flight through a slow roll. V_A is 165 knots. If it had an inverted system, this wing and elevator setup could not push up from level inverted flight into any negative maneuvers, unable to exceed minus 1g. Be content to briefly experience close to -1g during the slow roll. Rolling to the left is faster than to the right and can be done with imperceptible barreling. The first third of the roll is slowed down significantly with right rudder, and the final third of the roll speeds up as left rudder is reintroduced. Working very hard to keep the roll level, changes in roll rate during the roll are the only factor to downgrade one

The Harvard continues the roll of "pilot-maker" during Sportsman competition.

slightly. Stick movements needed in the Harvard during the slow roll are large enough to challenge the short of arm.

Add up the scores. Two breaks are unavoidable. Subtract penalties for three of the maneuvers that have short and shallow lines after a half-roll. Subtract for the positive upline of the Hammerhead. After that, is the Harvard still competitive? Yes, though a mid-pack finish is probably the best that can be achieved in this aircraft.

So, how did the Harvard fare? It wasn't last! It was especially satisfying to beat one Pitts S-1S

Make big friends or bring an AC Air Technology tug!

with a score of 82.68 percent in the Sportsman category. Other competitors were close enough to declare that the Harvard was good competition in this category. There was never a moment in practice flights or during the contest when safety was in question. There is room for improvement as tricks are learned to manage the fuel system. Passengers in the rental car felt guilty enough to ask, "Can we chip in for the rental?" I replied, "No, but you can all risk hernias and slipped discs helping me push the Harvard!" It took about five people to move it safely into a crowded group hangar when thunderstorms threatened. Many remarked how amazing it was to see and hear the old trainer march through the sequence with apparent ease. Suggestions were offered for inverted systems, weight removal, streamlining, and the Harvard's own spot OUTSIDE of the group hangar.

What do you call this experience? I call it Sportsman. Exactly what it was meant to be. Fly what you have. Learn and respect your own limitations and laugh at them. Have fun. Extras and Pitts now dominate Primary and Sportsman aerobatic competition. Let us encourage the clipped-wing Cubs, Chipmunks, Fairchilds, Stearmans, and yes, even the Harvard to show up for Sportsman and remind us all why they were called the "pilot-makers." The Harvard Mk IV is registered in the experimental exhibition category in the United States. IAC