RIVETING NEWS

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The History of the Polen Special

Just once in your life wouldn't you like to wander into a barn and find a treasure that the owner was willing to sell for a mere fraction of its true value? How about a rare 1954 Oldsmobile F-88, powered by a 250 HP V-8 Rocket engine? One just recently fetched 3.5 million dollars at auction. There were four F-88's built so let's think more exotic. How about a one-off model? What if you found a 1966 Jaguar XJ13, of which only one was ever made? Of course you would have to possess knowledge of that vehicle so that the dust, which had accumulated over the years, didn't fool you into thinking that it was just another beat-up, piece of barn junk.

In aviation, there are very few one-off airplanes still around. Usually they are crashed and junked with little hope of the builder wanting to resurrect them because of the fear that someone might get hurt. A few one-offs are out there, mostly military aircraft, where many were destroyed in the war or subsequently junked when the war was over to be salvaged and rebuilt. There is however one example, where the right person was in the right place at the right time, with the right knowledge and the right price, which still flies today. That airplane is the Polen Special and this is the story of how it came to be and how it came to be Richard Keyt's airplane.

Development of the Polen Special began in 1967 by Dennis Polen, Darryl Usher and Jim Hergert with the idea of improving upon a similar airplane, the Midget Mustang. The Polen Special was designed around a Twin Comanche engine and cowling, but they

substituted an O-360 in place of the Twin Comanche's O-320. The Polen Special made its debut on the cover of Sport Aviation in 1973 to rave reviews. Dennis was overwhelmed with mail from fans who wanted to know more about the airplane and if/when it would be available to the public as a kit. Dennis was a shy man who wasn't an engineer. He built the airplane in a two car garage with surplus materials and parts and common hand tools and never seriously considered making kits available as indicated by the lack of drawings, except for a few on subsystems like the landing gear. He flew the plane to Oshkosh in 1976 and carried home the Reserve Grand Champion Trophy! The airplane was not to return to Oshkosh for two decades.

Parts were made for several copies of the Polen Special by Dennis and his partners, but only one was fully assembled and then as misfortune would have it, Dennis had a debilitating stroke. Four of his friends came together and paid off his home mortgage to remove financial concerns. These four friends took title to the airplane. Their plan was to wait for five years to see if Dennis would recover from his stroke well enough to fly the plane again. The four were having discussions on what to do with the airplane when it was apparent that Dennis would never be able to fly again. They were deciding between donating it to a museum and selling it. They finally decided they would sell and Randy Francis was designated to handle the sale. Randy listed the Polen in Trade-A-Plane and then promptly left for vacation. Upon his return his secretary had 42 responses to the ad. Randy started at the top of the list and contacted the first interested party. This individual came and looked at the airplane and said he would be back the following week with his mechanic. Randy went on to the second person on the list.

About that time Dick Keyt was looking for a propeller for his Thorp project in Trade A Plane and saw the Polen Special advertised. He knew about the airplane from years of collecting articles and salivating over an airplane he knew he would never be able to afford. Dick made contact with Randy and jumped on a plane to Portland, arriving with an armload of magazine articles collected over the years. Randy soon realized that Dick Keyt knew more about the Polen Special than Randy himself. The airplane had been barely cleaned up after five years of sitting in a "barn" accumulating dirt and Dick arrived to an airplane with a dead battery. The two men spent the entire afternoon, first viewing the airplane and then at a bar where they proceeded to try to convince the other to buy the airplane. Dick told Randy that he was the perfect person to buy the Polen because at the time he was selling his car dealership and he had both the time and the money to take the airplane around the country and show it off, something that the introverted Dennis Polen never wanted to do. On the other hand Randy thought Dick was the perfect fit because he was a professional pilot, an A&P, an aerospace engineer and had a machine shop, an important factor when new parts were needed when there was no

source to obtain one-off parts. What Dick didn't know was that the four fellows had a conference the night before and decided to put it in a museum. However, Randy felt obligated to spend the day with Dick, whom he already agreed to meet. Once Randy spent the day with Dick he recommended, or perhaps insisted to the others that Dick Keyt was the person to whom the airplane should be sold and asked Dick what they could do to facilitate the sale. It was as difficult for Dick to negotiate the price down to something that he could afford as it was for the group to lower the price of an airplane which was being sold to help with Dennis's medical bills.

There were three principals who originally were building the Polen Special: Dennis Polen, Darryl Usher and Jim Hergert. Three airplanes were to be built. Jim was documenting the project before he went off to college and eventually on to work in the computer industry. Darryl owned a machine shop and later became a big supplier for Van's RV kits. What happened to the other copies of the Polen? Darryl's copy of the aircraft progressed to the point where the fuselage was on the wings and it began to look like an airplane. Since then that airplane has changed hands about six times. One of the subsequent owners of the incomplete project was in Arizona. The purchaser had been an admirer of the Polen Special for many years, a bachelor who had pictures of the airplane all over his home. As he proceeded with the project it diverged further from the original Polen Special as extra wing stiffeners were installed and the gear doors were changed from square ones which Dennis designed to round ones. However the gentlemen passed away and the project was offered for sale to settle the estate.

"I had the opportunity to buy it but the estate wanted too much money, something like $12,000 and I though that was too much", Dick told me.

The project now is believed to be with a man in California, who to the best of Dick's knowledge isn't working on it.

According to Dick,

"It would be a monumental task to finish as it's not a kit and there are no plans"

Along the way Dick and Dennis became good friends. Five years after Dennis's stroke, he had partially recovered, minus the use of one of his arms and needed a leg brace to assist with walking. At that time Dennis was about 65, having had the stroke at the young age of 59. He took Dick under his wing and not only shared his knowledge of the airplane but of the geographic area of the country where it was built. Dennis had grave concerns that the person who purchased the airplane would kill himself in it. It was hard to tell how much time Dennis, the only one who had flown the plane up to that point, had logged in the airplane because Dennis wasn't one to write things down. Only the

condition inspections were logged and it could only be estimated how many hours were on the engine and airframe. Dick estimated that there could have been 500-600 hours on the airplane

The airplane was flown to the Dallas/Ft. Worth area from Portland, but that would be skimming the facts if I just told you it was a normal flight. In retrospect Dick said

"It was the biggest case of buyer's remorse I ever had".

Several issues developed on the flight back to Texas, highlighting the concerns that Dennis had about selling the airplane to just anyone. The only checklist that Dick had to work with was one that Dennis published in a flying magazine.

"The checklist was one to make you fall in love with the airplane but was filled with fluff"

The only description of the flying qualities as told to Dick by Dennis, at a time when Dennis was having a hard time forming thoughts and words, was "The flight controls are very powerful!" This was to be Dick's entire checkout on the airplane.

Dennis had calculated two weight and balance conditions. The first was full fuel at max gross weight and the second was 50 pounds of fuel (or about 8 gallons) at minimum weight. Dick's first mistake was transposing that 50 pounds of fuel to 50 pounds of cargo so he loaded the space behind the headrest with his luggage for the trip home. This made the balance extremely aft only to be discovered once he took off and found the airplane extremely difficult to fly due to the rearward center of gravity. This had Dick wondering whether the weight and balance that Dennis computed was accurate.

As mentioned earlier, Dennis was not an aeronautical engineer. Dennis had been a mechanic in the Portland Air National Guard and was a corporate pilot. He previously built a formula one type racer with fixed gear and an O-200 engine, which is now displayed in a museum in Portland. Darryl Usher had built a Midget Mustang and made it into a retractable gear aircraft to obtain greater speed. In order to accommodate the retracting gear Darryl built strakes on the leading edge of the wings near the fuselage intersection. Unfortunately the interference drag of the strakes, in close proximity to the cowl cheeks, caused enough drag to negate the reduction in drag that the retracting gear gained. The two men began discussing ways to make a faster airplane and decided that a clean sheet of paper would be the best start.

Upon Dick's takeoff for his trip back to Texas, the tower requested a fly-by. Dick complied and when passing the tower, in traditional fashion, he rocked his wings. The

airplane wallowed in pitch and yaw forewarning of some of the difficulties that he would encounter during his maiden trip home.

Flying at altitude and needing to switch maps, Dick contemplated how he was going to retrieve his next sectional. Even though he had full nose-down trim, the system did not have enough authority at cruise speed and he was holding an abnormal amount of forward stick.

"I never thought at the time, of powering back and slowing down to reduce the forward pressure on the stick, but I thought what could be the worst thing that could happen? The plane might pitch up and stall but I could recover, so I let go of the stick".

When he let go of the stick the airplane not only pitched up violently but dug-in, as if you had pulled the stick back forcefully attempting an accelerated stall. The G-meter pegged at six G's!. In most airplanes the stick-force-per-G increases with increased Gs so that when pulling the stick back in a banking turn, the force on the stick becomes greater. When you let go, most airplanes recover from the added G's. In the Polen when you enter an 80 degree bank and pull the stick back, you could let go of the stick and the airplane elevator would stay in that position and it would hold those G's. Dick was able to retrieve the sectional while wrestling control of the Polen but decided that that was the last map he would use until he landed at the nearest airport whereupon he removed everything from the aft compartment except a shaving kit, a change of socks, underwear and his maps. Everything else went into a box and was shipped home. He cut and taped the remainder of his maps together so he could progress along his route by unfolding them in accordion like fashion. The Polen had no autopilot at that time and flying through the mountain turbulence caused pitch excursions of plus 2 g's, minus 1/2 g which made the remainder of the trip a challenge.

"Though I wasn't hitting the canopy, by the time I got home I had a roaring headache. It was a miserable trip"

Dennis had no intention of selling the Polen so there was no motivation for him to fudge the performance numbers, as Spam-can manufacturers tend to do to increase sales. Dennis had labeled the fuel tanks as holding 24 gallons. It seemed like the tanks were going down at a fast rate and when they hovered at 1/4 tank Dick would land and fill the tanks.

"I was puzzled about this whole thing and it turns out they didn't have 24 US gallons in each wing, but 18 gallons, which I didn't find out until I got back to

Texas and drained both tanks. I didn't understand this as all the magazine articles indicated 24 US gallons. There was a lot of inaccurate information in the paperwork and the magazine articles versus the actual performance and specifications."

The airplane was no longer turbocharged so the performance numbers weren't even close to what was published in the magazines. Articles claimed that the airplane would do over 300 mph on 10 gallons of 100LL when in fact, at most, it would achieve 240 mph. Dick's goal became a quest to return the airplane to the performance that Dennis had attained with the engine turbocharged.

Early modifications by Dick included adding a turbocharger. An early article written about the airplane indicates that Dennis flew the Polen between Portland and Seattle and back while climbing to 18,000 feet on an IFR flight plan. Performance numbers were published that indicated it was turbocharged. In speaking to Dennis later, Dick asked about the turbocharging system, interested in obtaining the brackets that were originally used for his installation. Dennis said he removed it, because it was difficult to manage, and placed it in his storage shed. That building later collapsed and Dennis was unable to locate any parts of the turbo system. Dick added a turbocharger by building all of the brackets to mount a Rajay turbo. This is the same turbocharger used on the Twin Comanche. This project was completed without modifying the cowling. The exhaust system crossed in front of the cowl exit and this blockage created cooling issues. The manual waste-gate system was a "bitch" to manage according to Dick. An intercooler was added a year later, but the turbo system was creating a substantial amount of cooling drag due to the way the air flowed through the cowling. A new cowling was planned but most of Dick's time was taken up with constant repairs of the airplane including the landing gear system and rudder flutter problems. When a new cowl was designed the engine was moved forward to better balance the airplane.

The first incident after he got back to Texas occurred at a retirement party for a fellow pilot. When asked to do a fly-by, at a high speed, the rudder began to flutter.

"It sounded just like someone firing a Gatling-gun and lasted about a second. It shook all the instruments and the entire airplane."

The flutter was not the control surface moving about the hinge-line, but rather the top of the rudder bending left and right! It destroyed the rudder and pulled it away from the vertical stabilizer. All that was keeping it from falling off was a small, one half inch wide strip piece of aluminum. The entire rudder had to be rebuilt. A two and a half year project in collaboration with the University of Texas began. The first half was done at the

university while Dick commuted down in his Bonanza. The last half was completed in Dick's shop. The research discovered seven modes of flutter. The simplest was wing bending where the tips go up and down at a very high frequency, none of which could be felt in the controls, but any one of the seven modes could destroy the airplane in a very short amount of time. A flutter velocity was calculated and a flutter maximum speed was determined, never to be exceeded. In addition, the weight of the counter balance was changed. Dennis said the redline speed of the airplane was 300 knots and he said he went there many times. The lowest of the seven flutter speeds was determined to be 270 knots and thus the redline speed was lowered to 248 knots indicated after extensive studies.

The Polen, since it has been in Dick's custody, has had 21 major incidents, including multiple engine failures. Three were immediately after takeoff and all but one he was able to stop before the end of the runway. Those were mostly attributed to the turbocharging system which he re-installed. As the throttle was advanced to takeoff power the engine was demanding more air than the ducting could provide and the tubing would collapse causing the engine to roll back toward idle power. There were several dead-stick landings and a few where the gear collapsed or failed to extend fully, but perhaps the scariest incident was self-induced.

While landing at his home base Dick extended the gear but forgot to turn on the hydraulic pump. In this situation, only the tail wheel came down creating a draft on the back of the pilot's neck distracting him. The main, gear-down indicator lights were not in an obvious location and went un-noticed. The landing flare was a "floater" and Dick decided to go around. As the power was added, the tail wheel touched down. With full aft stick, the airplane could not rotate until sufficient speed was attained. Because of the airplane's reduced speed it took considerable time, running down the runway with the stick full aft and the propeller striking the runway to achieve enough lift to fly out of the situation. When it finally broke ground the airplane pitched up 30 degrees because Dick had the stick full aft. He shuddered around the pattern making an uneventful landing. In an obvious understatement, Dick said that

"The engine doesn't run very well with a bent prop".

Nothing on the airframe was damaged, but the prop and the engine were in need of an overhaul.

Another time, on the way to the 2014 Air Venture Cup race, loss of the oil necessitated the shutdown of the engine and feathering of the propeller. The prop stopped in a horizontal orientation and the airplane became very difficult to control in pitch. In the horizontal position, even with the propeller feathered, the prop surfaces were creating

lift. This lift ahead of the wing was de-stabilizing. Dick was 20 plus miles from a useable airport and the controller he was talking to didn't think he could make it. Dick had been cruising at 17,500 feet and made it overhead the airport with 12,000 feet to spare. The gear and the flaps were put down early to determine a rate of descent and establish a "high key and low key" altitude. During the base to final turn, the strong surface winds became VERY OBVIOUS! An immediate turn was made toward the airport. The closest surface to land on was the parallel taxiway. Dick considered this, but the taxiway was so narrow that it would not have been visible during the landing roll. The airplane was still in a turn to align with the runway when the left gear touched down. The touchdown did not put any side loads on the gear and with the headwind the plane was stopped at approximately 1,000 feet from the threshold. He found himself in the middle of nowhere with no assistance. The sirens of fire trucks could be heard in the distance (the ATC controller had notified the local fire department). When the trucks did arrive, they were not able to get through the airport security fence. The firefighters did say that they would have driven through the gate if they had needed to. The reason for the engine shutdown was because of the loss of oil from the oil cooler due to a defective weld.

"I still would like to set more records with the airplane but the airplane is wearing me out. I've gone about eight to ten years of working a thousand hours per year on the airplane"

When asked whether he would entertain selling the airplane to someone else Dick said:

"The airplane is very difficult to fly and is the most difficult airplane to maintain that I have ever seen."

The airplane was raced 15 or 16 times and never lost a race but surprisingly only one record was ever set with the Polen. That was the 500 kilometer, closed course speed record for the FAI/NAA c1b weight category. This record had been previously held by the Questair Venture prototype which sported a much more powerful, six cylinder 550cu.in. engine.

Reflecting back on the years of ownership, Dick again mentioned the buyers remorse he suffered right after he bought it. That all went away when he arrived home with the Polen. His wife had arranged a party for him and the airplane. Her only request was that she see the airplane first. He arrived and did the obligatory pass, then landed while all the invitees of the party started showing up. After festivities and cake they decided to fly to a well known local airport. Enroute to the airport several friends in airplanes including Bonanzas and a Siai-Marchetti 260 where flying in loose formation when one of the pilots asked Dick to show them what the airplane could do. He blew past the gaggle and then asked himself, what do I do now? He had done only a few loops prior, while test

flying it in Portland, so he decided to start a loop. It does a fairly large loop of 1500-1800 feet. As he came over the top of the loop, there below him was the Bonanza whistling along. At the bottom he again went zooming by the group and then repeated the loop. That maneuver brought back all of his fighter pilot experiences. He later figured out that if he flew past his Dad in their Bonanza, waited 55 seconds and began the loop, he could end up right next to the Bonanza again. The difference in performance between the two airplanes took away all the buyers remorse he originally suffered.

During ownership, the Polen was modified with an extra fuel tank, a turbo-charger, improved gear, new glass instruments, new tail wheel and the engine moved forward, not because it was necessary for weight and balance (thought that helped) but to accommodate the new cowl. A benefit of that was he was able to put weight in the small aft storage area without undue aerodynamic effects. Other plans to improve the airplane included adding oxygen and fuel to increase the legs for additional records.

Some flying characteristics of the Polen

The rudder was not powerful enough to control the direction of the airplane while taking off. It had a locking tail wheel but once you brought the tail up you had to stop adding power. The rudder deflection would be at the stop if power was added too quickly. Full throttle is attained after liftoff about the time you raise the gear. On takeoff or go around you could not move the power full forward immediately. The tail wheel weight was very heavy. With Dick in the airplane the tail wheel weight was 190 pounds, greater than a Stearman. If you taxi the airplane in grass the tail wheel would leave a furrow, thus Dick always towed the airplane to the runway when hard surfaces weren't available. It also had no air cleaner which was another reason for towing it over unimproved surfaces.

The gear was the weak point. The Polen has been on its belly at least three times with Dennis doing it once. After flying the plane several hundred hours, Dennis turned off the runway and the gear collapsed. This was attributed to the way Dennis had plumbed the hydraulics and when testing the gear it would merely free fall and not be powered down and the issue wasn't diagnosed right away. Dick had an incident where one main gear would not extend. The other one was down and could not be retracted. The plane had to be landed with the right main and the tail wheel extended. This incident caused damage in an area, which was not visible to inspection. A year later the gear collapsed during a landing roll. The wing was been built around the gear system and was not designed to be removed. To repair the gear, the gear and their attachment fittings needed to be removed and the wing rib, just outboard of the gear, had to be cut away to allow the unit to be slid outboard through the wing. The shaft that gave structure to the side brace was found to be cracked.

Dick always wore a helmet and oxygen. I though this just part of the fighter-pilot experience but in fact there was a legitimate reason for doing so. When the gear was down exhaust fumes would come up through the gear openings. If the gear could not be retracted and the inboard doors closed, the exhaust could asphyxiate the pilot. Without the oxygen the flight would be short.

The airplane was never vetted like other experimental airplanes, where continuous testing over time, by many pilots, would find all the aircraft's flaws. Only two people flew the Polen and it took Dick as long to learn the finer points of the airplane as it took Dennis.

It's also incredibly lucky that Dennis and his friends found the right person in Dick Keyt to continue to improve the legend of the Polen Special.

The next landing for the Polen will be at a museum and only there will the legend continue for future generations to enjoy.

"It's absolutely phenomenal that Dennis designed this airplane with the little background he had."

The Smithsonian would like the airplane. The curator in charge of the acquisition remembers the airplane from the articles that he read in the past. He was somewhat disappointed that a new cowling was installed and would have rather had the original cowling which Dick has kept and would be more than willing to re-install. After hearing of the extent of Dick's work on the Polen, he reconsidered his position and thought perhaps the new cowling should remain, preserving Dick's contribution to the aircraft's history. Dick would like to make one more flight and fly it to Dulles and hand over the keys but because the Smithsonian currently has 375 aircraft and room to display only about 200 there is no guarantee that the aircraft would be showcased right away. Chances are greater that the aircraft would be trucked away to a storage facility to await such time that a turnover of the current aircraft would allow the museum to have room to display it.