Warbird Flyer

The Quarterly Newsletter of the YAK Pilots Association

Number 9 *3rd Quarter 2002*

Spins Unspun

By Bob Moreau

Introduction

During the period of 2000 to 2001 a test program was conducted at the University of Tennessee Space Institute in support of a thesis project aimed at qualitatively evaluating the spin and recovery characteristics of the Yak-52. Good fortune in timing allowed for the use of an inertial data acquisition system, which added greatly to the information gathered. The purpose of this article is to provide a summary of the results obtained during the evaluation and to present it in a "plain language" form to the membership of the Yak Pilots Association. The material presented here is not meant as a "how to" on spinning the Yak-52. It is meant to elevate the knowledge and safety base for the membership and to bring home the fact that without properly qualified training in the Yak-52's spin and recovery characteristics, the membership list will inevitably be pruned from time to time. With the proper training, the Yak-52 is a thoroughly delightful airplane that can be enjoyed by many pilots.

Theory

Even before getting the airplane into the air for a flight test, a slow visual inspection on the ground will reveal much about the probable spin and recovery characteristics of many airplanes. The Yak-52 is no different and so a short description of some of the traditional spin theories is in order.

Of prime importance are the mass distribution and mass density of the airplane. Mass distribution looks at whether the mass is mainly concentrated along the wings, fuselage or is evenly balanced between the two. Historical data suggest the ranges for each category. The importance of this is in determining which is the primary control for effective recovery. For the Yak-52 the mass distribution is borderline neutral when flown solo and slightly fuselage dominant when both seats are occupied. For the pilot, this translates into the rudder being the primary recovery control when neutral and the aileron being the primary recovery control when fuselage dominant. Of course, these statements are general, and as we will see when we get to the data plots, the individual spin mode governs the recovery technique.

The mass density of the airplane is another important factor to consider. The greater the density, the greater the inertia that builds up during the spin requiring that much more of the flight controls to generate the aerodynamic forces that are necessary to effect a recovery. For the Yak-52 the mass density is relatively high and is more akin to a 1940's era advanced trainer or fighter than to the light trainers available for spin training on this side of the Atlantic.

(See Spins Unspun, page 4)

An "inside look" at a Yak-52 inverted spin

In This Issue

Due to the depth of the Yak-52 Spin article and the Summer being our busiest time, this expanded edition of the Warbird Flyer still does not contain all the material submitted. However, we felt it important to keep the Yak-52 Spin piece intact. Our next issue will include many informative pieces on restorations, field repairs, and maintenance items. Please send thoughts and comments to the editor, Barry Hancock, at ypanewsletter@aol.com.

From The Front Cockpit

It is often healthy for an organization to debate policies and procedures. The debate allows for a reevaluation of standing procedures and will normally lead to a validation of the existing policy or the development of a new, better policy or procedure. Right now we have two discussions taking place within our organization, both dealing with our formation program. The first discussion concerns the fingertip position that we are presently teaching and flying. One of our members, Dave King, has submitted a request to evaluate our present fingertip position versus a new position that he favors. This new position is looser than our present fingertip reference, sliding the wing aircraft aft from the present 32-degree stance to approximately 45 degrees. It was thought that this looser position would be safer, allowing for a lead aircraft to freely maneuver in any direction, including turning in front of the wing aircraft (in the case where Lead was confronted with an imminent collision with a bird or other aircraft). Flight testing has shown that even this looser position would not allow Lead to safely turn in front of his/her wing aircraft but there may be some other merits to this position and that is what we are presently evaluating. We got a chance to do some preliminary flight testing of the proposed position at our annual fly-in in Nebraska this summer. We flew a five-ship formation with the fifth ship acting as a camera ship to record the flight test. We will continue flight testing this summer and Skip Slyfield, our standardization chairman, will write the final report. Skip's findings will be available to all interested parties via the website or via hardcopy, on request.

The second debate concerns the use of parachutes during formation flights. One of our FAST Lead Pilots, Walt Fricke, prefers not to wear a parachute when flying in formation. Our formation manual is clear in stating that a chute, among other safety equipment, is required. The FARs, however, do not require the use of a parachute for formation and Walt is challenging the notion of wearing a chute. When we developed our FAST formation program and codified our safety standards, it was based on the concept of providing the best margin of safety for our members, not on what the FARs had to say. We are polling the other FAST signatory organizations to see what policies exist within the FAST community and we will poll the YPA formation participants for feedback as well. All the information will be available on the website for your review.

Fly smart, fly safe. *Mike Filucci*

Announcements

- **Elections, 2002:** By now you should have received your ballot for the YPA BOD positions. We have five top-notch candidates running for the four available positions. As soon as all ballots postmarked by September 30th have been received we will validate them with the current membership list and de-identify the ballots to ensure a "secret" vote. We will announce the results by mid October.
- **Elections, 2003:** Next year the election cycle will involve two more BOD slots and the three current officers' positions — President, Vice-President, and Secretary/Treasurer.
- **BOD/Membership Meeting:** A general BOD and membership meeting was held at the MTW/OSH fly-in this year. There was a discussion of the process by which we elect BOD members. After debating the topic a vote was taken which resulted in a change to the by-laws. With this change, the members now select their directors by popular vote, hence the ballots you have recently received.
- **Regional Fly-In, Ruidoso, NM, 2003:** John Finley is already coordinating a fly-in to take place next year at the Ruidoso, NM airport (SRR) during the last weekend in September. The town of Ruidoso is a resort town in the Sacramento mountains. There are plenty of restaurants, golf courses, and two casinos. Ruidoso is near the town of Lincoln, Billy the Kid's last hangout. Alamogordo and the White Sands National Monument are close at hand and Roswell is 70 miles east if you are interested in aliens from outer space. There is no problem getting waivered airspace and there are large areas for practice. The townsfolk are looking forward to formation fly-bys at the airport. John told them that this bunch of "show-offs" would be happy to accommodate them. John thinks he can get the Rotary or Kiwanis clubs to set up food stands, provide volunteer van drivers, etc. The "airfest" at Portales, NM will be held during that time-frame and they would love to have us come over and do a fly-by. Stay tuned for more details as John gets this thing put together.
- **Pilot Shop:** We are restocking the "Pilot Shop" on the YPA's website. You will find some new items and more variety in the selections offered. We have also upgraded to a higher quality line of products. We will continue to add additional merchandise as we secure dependable, quality vendors.
- **New Address:** The YPA has relocated; please note the new address: PO Box 576, Frederick, MD, 21705-0576

Warbird Flyer

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Just Another Year At Manitowoc? I Don't Think So.

By Jim Goolsby

At "o dark thirty" on the 19th of July, I found myself pushing N21710 from her hangar just as the sun touched the horizon at FD44. What I could see of it anyway. There were broken clouds at 1,200 feet and visibility 4 miles, as I picked my 30-nm route to Spruce Creek (7FL6). Here I picked up my GIB, **Jose Rivera,** and wingman, **Ray Gage,** in his Yak-52W.

The first leg we zigzagged between clouds in poor visibility to 4,500 feet, then had to go higher. The skies cleared north of the Georgia-Florida state line and the stop at Perry Huston, Ga. (PXE) was made in sultry heat. From there, on to Shelbyville (SYI) TN, and then to Robinson, IL (RSV). Then on to Kankakee (IKK), picking our way around rain showers on the way. We flew west around the Chicago Class B in deep haze, and 1:45 later we were chowing down on the promised brats and beer (courtesy of the **EAA Chapter 383**). After 9:35 en route, I REALLY needed that beer.

Mike Filucci and **Julie Boatman** were already there, having arrived the day before to get the logistics set up. The building we had used last year had burned down and our hosts, **EAA Chapter 383**, had been busy building their own meeting place. Still under construction, they had made it usable for us. When it's done, they will deserve a real sense of pride

"Number One Groupie" **Vanessa**, now a blossoming 12-year-old, long-haired blonde was there too. She spent the next two days (before going to OSH) bringing cold water to the arriving flights as they shut down.

The next morning I opened the acrobatic box for the first time and it was used by nine different pilots - from flip-floppers like me to World Champ and US team coach **Sergei Boriak**. The association wanted more participation from those interested in aerobatics this year and we made real progress. Watching Sergei put the -52 through its paces was a real treat. Both CJ-6 and Yak pilots took lessons from him there and all came away much better off.

We also had **Vladimir Yastremski** there for a few days. Not only did he serve up a class on the pneumatic system but helped yours truly with an air problem. During the class, both Yak and CJ-6 pilots got to ask questions that Vladimir had years of experience in answering.

The first three days we flew a lot. **Russ Dycus** as Airboss kept us busy. With his laptop, he kept accurate track of who was flying, when, where, how much, and with whom. The instructors/check pilots - **Mike Filucci, Don Andrews, Skip Slyfield**, and I, - were not allowed to rest for long. Other qualified Leads put in duty too.

On Monday (22nd) afternoon, we put up our first big formation. This was briefed as a practice fly over OSH and return to MTW. The formation was 19 aircraft.

Well, it went as planned. We passed over OSH as the EAA Warbirds were having their picnic. We later heard that they were very impressed with comments like, " That can't be Yaks. They're too close!" The message that the association was serious rang loud and clear.

At some point, the local newspaper noticed us overhead. **Rodger Modglin** and I were interviewed and the next day we made the front page of the MTW paper. After that most folks in town knew who we were and we had to behave ourselves. Each night Jose Rivera arranged reservations at different restaurants for us. The nice thing about staying at MTW was that we didn't have the crowds competing for the table space like at Oshkosh.

Tuesday (23rd) I led the first formation (20 aircraft) into OSH. The plan was to sortie en masse overhead OSH then break into individual flights that would then use the normal warbird arrival procedures into OSH. This freed us from a set arrival time. What happened was not planned, but we *and* 20 **NATA** T-6, Texans, up from their clinic at Kenosha, arrived at the same time.

What happened next was a tribute to good formation discipline, staying close to the brief, and the tower personnel. We did our fly-over in our special "Arrow" formation. The NATA guys then did their low fly-by. I took our formation out to the NE over the lake and broke into separate flights, timing it so as to tag onto the end of the NATA formation as they made their initial for the landing overhead break. It worked perfectly — more than a few folks on the ground thought we planned it that way. The ATC guys were very complimentary over the radio. We landed 40 aircraft in less than four minutes (from the first aircraft to break, to last one to touchdown). We really looked good.

Again, on the morning of the 24th, we flew a 6-ship into OSH with the late risers arriving later. Since Runway 36 at OSH is quite wide, we briefed for two, 3-ship element landings. It went almost perfectly and my GIB **Mark Shelley** has video to prove it. We made 3-ship takeoffs for the flight home and that evening the Chinese treated the whole group to dinner, appropriately at a Chinese restaurant in Manitowoc. Some really high "muckity-mucks" were there, including the president of the Nanchang factory, the Minister of Aviation, plus a number of senior engineers in charge of CJ-6G production. Some short speeches were made, then they presented the planned changes that will be incorporated in the new CJ-6G.

The 26th, Friday, was our first big show day. We arrived en masse and the FNGs headed off to the "First Timers Briefing." EAAWB magazine sent a photographer over to get some aerial shots. The schedule, weather, and photo equipment problems didn't work in our favor. After the regular 1130 airshow brief, we did our own brief and readied our ships. As in the past we were stuck to the tail of the T-34s. Join-up was fine and we flew our "Arrow" mixed with diamonds-in-trail. The only complaint at debriefing was the T-34s' turbulence. Little did we know that the next day, this would be the least of our problems. At the end of the show, part of our formation split and followed some of the T-34s back into OSH.

The rest of us headed for MTW. That evening, during dinner, some of the wives who had taken videos showed that our formations were perfect.

(See Oshkosh on page 10)

Spins Unspun *(Continued from page 1)*

Fuselage shape is another important factor in predicting how an airplane might recover from a spin. For the Yak-52, the aft fuselage is more or less oval in shape and provides good anti-spin moments during the spin, which helps to recover. The forward fuselage is circular, which is neutral, thus providing neither pro-spin nor anti-spin moments for recovery.

A review of the literature concerning spins will reveal a lot of references to such things as the "tail damping power factor, tail damping ratio, unshielded rudder volume coefficient and the inertia yawing moment parameter," all resulting in something called the "tail design requirement." This material dates back to work done in the 1930s by NACA, the purpose of which was to give engineers parameters to use in designing an airplane for good spin recovery characteristics. Although the Yak-52 is predicted to exhibit good behavior based on these parameters, it is worth noting that this method has fallen out of favor based on problems with some of the original assumptions and how the available data was interpreted at the time to produce the parameter requirements. Unfortunately, even in recent publications concerning spins, this methodology is still quoted as being gospel, when in fact it provides only a general "feel" at best.

A more recently developed methodology looks at the ratio of the length between the center of gravity and the rudderpost and the center of gravity and the propeller plane to determine the relative control power available for recovery. The Yak-52 falls in the good category on this scale.

Having said all of this, it is worth pointing out that two identical types of airplanes, loaded identically, and spun on at the same time may, or may not, exhibit the exact same spin and recovery characteristics. Small variations allowed for during manufacture, slight differences in rigging, minor hanger rash or twists and turns from age, can all result in huge variations in how the airplane responds.

Spin Nomenclature

Briefly, so everyone is talking about the same thing, some definitions, since not every author uses the same meaning or words to describe the same thing. The incipient spin is that portion during which the flight path vector of the airplane is in transition from the horizontal to the vertical. The fully-developed spin is that portion after the incipient phase during which the aerodynamic and inertia forces and moments are more or less in equilibrium. An accelerated spin is one where the rotation rate is measurably increased through the use of either forward elevator or out-spin aileron control input. A flat spin is one where the wing maintains an angle of attack exceeding 60 degrees, either by natural aerodynamic or inertial means, or by the use of increased propeller thrust over the tail surfaces. In-spin aileron means deflecting the control stick in the direction of the spin. Out-spin aileron means deflecting the control stick opposite the rotation of the spin. The axes of the airplane as viewed from the cockpit are the x-axis (roll about the line running from nose to tail, positive when the rotation is clockwise when looking at the nose), the y-axis (pitching about the line running from wingtip to wingtip, positive when the rotation is clockwise when looking at the right wingtip), and the z-axis (yaw about the line running vertically and perpendicular to the other two axes, positive when the rotation is clockwise when looking down along the z-axis).

Test Airplane and Instrumentation

The airplane used for the tests was a 1985 Yak-52, which differed from the production standard in the following ways: the shutters at the front of the cowling were removed and a large diameter spinner was installed, the centering springs in the flight control system were removed, aileron spades were installed, the flight data recorder and ADF system were removed, the flight control fabric was replaced with Stits, the wheels and tires were replaced with western equipment and the brakes were converted to hydraulic toe brakes for the front cockpit.

For the tests conducted at forward CG (18%) the rear seat was removed and a MEMS-based (Micro Electro Mechanical System) inertial data acquisition system (AVS-18H, on loan from the U.S. Army) was installed on a specially built platform. Rotary potentiometers, known as string pots, were installed to provide the AVS-18H with control position inputs for elevator, aileron and rudder. A laptop computer was installed to capture the data for later analysis. Although the AVS-18H was capable of capturing 14 different parameters, for the purposes of this test the parameters of interest were the body axis rates, control positions and the y-axis magnetic vector (explained later when we get to the data plots) all plotted against time.

The right wing was tufted and a video camera was installed in the rear cockpit to capture airflow visualization data at forward CG (18%) to supplement the data from the AVS-18H.

Tests were also performed at aft CG (25%). The AVS-18H was not available for these tests as it was returned to the U.S. Army for the helicopter dynamic flight testing for which it was designed. It was necessary to have the rear seat installed and obtain a volunteer to act as spin ballast (no easy task) to get the CG aft. Although manually gathered, and hence not as accurate, the data at aft CG was in keeping with the known characteristics of the airplane.

A hand-held force gauge was utilized to get stick force data during the stall evaluation but was not used during the spin tests due to safety considerations. Control force measurement during the spin evaluation was done subjectively after performing pilot force calibrations utilizing measurable weight lifting machines — more on this later.

Test Methods

All spins were conducted from coordinated, 1-G, level flight. The recovery techniques used were those as specified in the translated airplane manual. As a qualitative evaluation it is important to keep in mind that this was not a full-up certification flight test program, which typically would entail well over a thousand individual spins for an airplane certified under FAR Part 23 in the aerobatic category. The intent was to evaluate the published techniques and to examine and document the dynamics behind them.

(See Spins Unspun, page 5)

Spins Unspun *(Continued from page 4)*

The techniques for entry were as follows:

- Normal Upright – Full aft stick, neutral aileron, full rudder (right or left) at the stall to initiate the spin.
- Accelerated Upright – Full aft stick, neutral aileron, full rudder (right or left) at the stall to initiate the spin followed immediately by full out-spin aileron.
- Flat Upright – Same as accelerated except that the power was increased to full throttle simultaneously with out-spin aileron.
- Inverted – Full forward stick, neutral aileron, full rudder (right or left) at the stall to initiate the spin.

The entry controls were held in place until initiation of recovery. The techniques for the recoveries were as follows:

- Normal Upright – Full opposite rudder, neutral aileron and neutral elevator. Controls were immediately neutralized when the spin stopped.
- Accelerated Upright – Full opposite rudder, full forward stick and full in-spin aileron. Controls were immediately neutralized when the spin stopped.
- Flat Upright – Same as for accelerated.
- Inverted – Full opposite rudder, full aft stick and neutral aileron. Controls were immediately neutralized when the spin stopped.

Test Results

Before getting to the data plots I would like to start with the airflow visualization video data obtained from the tufted-wing flights. Normally when you see pictures of tufted wings during stalls or spins the tufts everywhere on the wing, including the ones on the ailerons, go from smooth airflow to reversing direction at the moment of stall to flying about in all directions in very chaotic air-flow. When the wing stalls on the Yak-52 the airflow on the wing itself is seen to separate, starting at the aft wing root area and progressing outward along the wing. In a bit of a surprise the airflow on the ailerons themselves does not separate at all. This non-stalled condition continued throughout the spin, regardless of spin mode and position, up or down, if the aileron was deflected, as during the accelerated and flat spins. This is a result of the large aileron to wing gap brought about by the Frise-type aileron de-sign. The open slot allows for high-energy airflow from the underside of the wing to flow over the aileron upper surface keeping the airflow attached all the while the airflow on the wing itself is completely separated.

(See Spins Unspun, page 6)

Mode	Left Normal	Left Accelerated	Left Flat	Right Normal	Right Accelerated	Right Flat	Inverted
Average Pitch Attitude	-60°	-55°	-35°	-60°	-55°	-30°	-45°
Fully Developed Rotation Rate	102°/s	165°/s	111°/s	126°/s	160°/s	143°/s	145°/s
Recovery Rotation Rate	-	240°/s	192°/s	-	218°/s	228°/s	-
Average Pitch Oscillation	±15°	±20°	+20°/-70°	±20°	±10°	±15°	±15°
Number Of Turns To Recovery	0.50	1.25	1.00	0.75	1.25	1.75	0.75

Table 1 Spin Data; Forward Center of Gravity

Spins Unspun *(Continued from page 5)*

The importance of this is two-fold. First, the ailerons are powerfully effective on the Yak-52 regardless of flight condition. Second, traditional spin theory states that aileron input against a spin will create strong differential drag forces which will act to increase the yaw rate thus hindering recovery attempts, although before spin dynamics were better understood this was precisely what was taught as a spin recovery technique for many World War II-era fighters. With the ailerons of the Yak-52 retaining airflow throughout any spinning maneuver, out-spin aileron input adds an additional force-moment couple to the equation. Using a right upright spin as an example, with out-spin aileron applied there is now a lift vector, which is deflected rearward, coming off the right aileron and a lift vector, which is deflected forward, coming off the left aileron. The net result is that not only is there an increase in differential drag adding to the yawing inertia, but there are now lift vectors from the ailerons acting in the direction of the spin to further increase the yawing inertia. As you can see from the data presented in Table 1 there is a marked increase in the rotation rates for the accelerated and flat spin modes.

Moving on to the data plots, Table 2 presents the legend for the rate and control deflection plots as well as the y-axis magnetic vector plots. Keeping in mind the earlier definitions of the x, y, and z-axes as viewed from the cockpit, the axis rate plots are pretty self-evident. The control deflection plots assume that the neutral position is at the 50 percent of full travel position for each given control. The y-axis magnetic vector is a parameter derived from the fact that each axis of the AVS-18H had a small magnetic flux valve installed to measure the magnetic field strength along that axis. This proved of great value in that it allowed a means to accurately determine the rotation rate of the whole aircraft within the earth-based fixed magnetic field, regardless of aircraft attitude. The resulting plot is a wave where one full turn of rotation can be measured by simply noting the distance from peak to peak, trough to trough, or any similar points in the wave and deriving the rotation rate by measuring this distance in terms of time. This was also highly useful in determining the exact number of turns from the point of initial rudder input for recovery to actual termination of the spin as marked by the rapid reversal and return to neutral of the rudder.

Now for the actual data plots. For brevity, I am presenting only the plots for the right normal, accelerated and flat spin modes . The information to be learned illustrates the characteristics of the Yak-52 very well and is no different from the left spin modes with the exception that the left spins exhibited greater pitch oscillations than did the spins to the right.

The right normal spin was initiated with full right rudder and full aft longitudinal stick being applied 1.1 seconds (Figure 1). The yaw rate increased smoothly with variations in pitch and roll rates. The spin was fully developed at 4.5 seconds, which corresponded to 1.25 turns. The peak roll rate was 170 deg/sec and the peak yaw rate was 75 deg/sec. Recovery was initiated at 9.0 seconds by a rapid reversal of rudder a reversal of longitudinal stick toward neutral. Aileron was not applied as a method of recovery. An immediate decrease in yaw rate was observed. The difference between yaw rate and roll rate at the point of yaw rate decrease was 90 deg/sec. A movement toward neutral rudder occurred at 10.2 seconds, indicating the end of the spin. This corresponded to 0.75 turns to recovery. The rotation rate determined from the y-axis magnetic vector was 126 deg/sec for the fully developed portion of the spin. The recovery was too rapid to determine an average rotation rate for the recovery portion of the spin.

The right accelerated spin was initiated by reaching full right rudder and full aft longitudinal stick at 2.3 seconds (Figure 2). Left lateral stick, aileron against the spin, was applied beginning at 2.3 seconds. The yaw rate increased smoothly with variations in pitch and roll rates until the spin was fully developed at 4.5 seconds, which corresponded to 0.75 turns. The variations in pitch and roll rates between 4.5 to 10.5 seconds again appear to indicate strong coupling due to gyroscopic precession. At 7.5 seconds the yaw rate exceeded the roll rate. Recovery was initiated at 10.5 seconds by a rapid reversal of rudder deflection followed by a rapid reversal of lateral stick to aileron with the spin and longitudinal stick to well forward of neutral. The yaw rate showed a modest decrease from the maximum value achieved of 135 deg/sec to 120 deg/sec.

(See Spins Unspun, page 9)

Table 2 Rate and Control Deflection Plot Legend

RATE/DEFLECTION	CONTROL MOVEMENT PERCENT	STICK/RUDDER DISPLACEMENT	CONTROL SURFACE ANGLES
Pitch Rate/ Longitudinal Control	± 100	±17.2cm	Elevator ±25°
Roll Rate/ Lateral Control	±100	±14cm	Left Aileron 22^0 Up
Yaw Rate/ Yaw Control	±100	±21.1cm	Rudder ±27°

On the *F.A.S.T. Track*

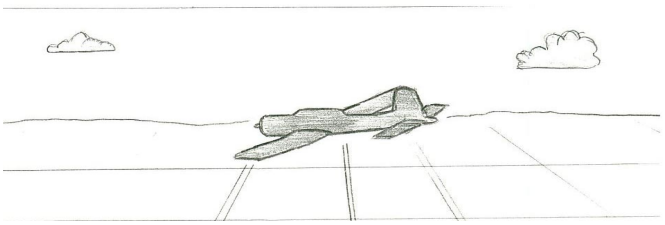
By Jeff Linebaugh

Formation Tips for the Quarter: Turning Rejoins

The proper rejoin picture seems elusive for students new to turning rejoins. The idea is to make each rejoin look the same so that it is predictable. With practice, you will learn the pace and timing of the rejoin and better know the power changes needed to complete the rejoin expeditiously.

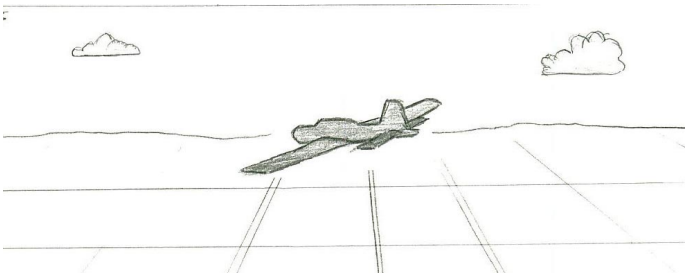
The Rejoin Sight Picture:

The rejoin picture we teach is to superimpose the Lead air-



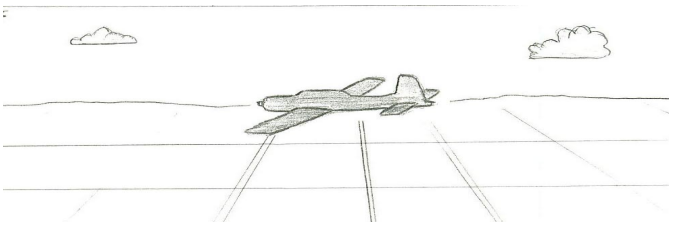
craft's tail on its outside wingtip, with the aircraft on the horizon. This picture should look like the figure above.

If you are behind the rejoin line, you are not using angular cut-



off to your advantage and will delay the rejoin.

If you are ahead of the proper line, safety might be compromised due to your high angle off Lead as you close in creating a

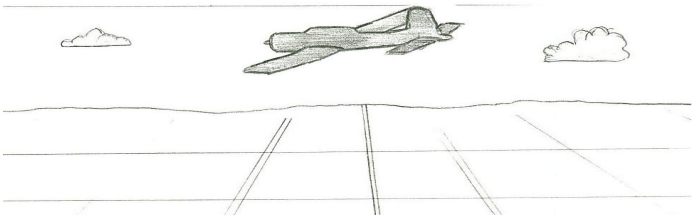


high closure rate.

In the heat of the moment, some students have trouble remembering which way to turn to correct for being off the proper line. Here's a tip: think of Lead as a VOR Indicator. Lead's tail is your CDI needle and the wingtip is the center dot. Whichever way the tail (CDI needle) moves in relation to the wingtip (center dot) is the way you need to turn to correct. Peruse the diagrams and see if this makes sense.

Many pilots tend to fly below the desired rejoin line; it tends to be more comfortable and seems easier. If lead is above the horizon, as in the picture below, you are too low.

Keeping Lead on the horizon is important for two reasons. Flying low and climbing towards Lead tends to delay the rejoin since it puts you in a lower energy state than Lead. As #2, this



may not be too noticeable, but try a rejoin as #4 if #2 and #3 are flying low. You will have to fly lower than the two previous aircraft to keep them in sight, forcing you way down "in the hole." As you climb towards Lead you will run out of power to maintain your airspeed, thus delaying the rejoin.

Another reason not to climb towards Lead: should you need to overshoot, you will have to make a *larger* flight path change to avoid Lead. The under-run maneuver is easy if you are in the proper position. To pass behind and below Lead, just roll out of some of your bank and release a slight amount of backpressure. If Lead is above the horizon on the rejoin, you have to reduce your pitch to arrest your climb toward Lead, level off, and then pass below and behind Lead. So work on keeping Lead on the horizon while closing on the rejoin line...it is safer and helps expedite the rejoin.

For Leads:

Your primary job as Lead during a rejoin is to clear for the formation and fly a stable platform (constant pitch, bank and airspeed.) However, to maintain situational awareness, you should monitor your wing pilots during the rejoin. The rejoin picture we discussed should look the same from Lead's seat looking back at the wing pilots. By glancing back you can readily tell how the rejoin is going, whether the wing aircraft are ahead of or behind the rejoin line. You can then anticipate any developing problems (i.e. overshoots.) If at any time a safe rejoin is in doubt, take positive action. Tell the wing pilot to break out, and maneuver your aircraft as necessary to maintain safe separation.

When you have students trying their first rejoins on your wing, consider using a longer pitchout interval (5 seconds or more). This gives the wing pilots greater spacing- and therefore more time- to learn the proper rejoin picture. Yes, it will delay the rejoin, but wing pilots gain proficiency faster with a longer opportunity to practice staying on the rejoin line.

I hope these tips help. Comments or questions? E-mail me at linedog@peoplepc.com

Until next time– keep your paint to yourself!

MTW Aerobatics

By Bob Fitzpatrick (a.k.a. Boris)

Through the graces of the YPA, we were blessed at MTW this year with Sergei Boriak, a world-class competitor/instructor/coach with 1800 hours in the -52 and thousands more in our kind of airplanes. My first acro ride with him was not unlike my first formation ride with Jim Goolsby a year earlier. Both inspired the feeling of confidence that comes from having a master as GIB, but the question: Will any of that talent rub off?

We began with my demonstration of what I do for fun with the Yak. He was about as impressed as a jockey visiting the farm and finding a Thoroughbred being used as a plow horse.

> "How much you pay for this plane?"
> "You are only using $25,000 worth of it."
> "Plane can do much more, I show you."
> And he showed me.

I do NOT intend to pass on second-hand instruction here but some of the moments need to be shared, so take them for what they are worth: observations of an amateur.

Much (too much) of our time was spent trying to overcome bad habits. The lesson here is to get good instruction early on and stick to it. We spent a half-hour just looping, a no-brainer, right? If you can't loop properly you are going to have trouble with Cubans and all vertical maneuvers. Sergei used 330 km/hr as an entry speed and expected the canopy brace to be parallel with EVERY section line as we went through the arc. Always look ahead. Never turn your head while pulling G's (it confuses your inner ear). Years of watching the wing turn over was a hard habit to break. So was pulling prematurely on the back side of the loop and approaching a stall. "What are you trying to do, kill me? NEVER pull stick until you feel pressure." The stick is your ASI-don't look at instruments.

Spins were another surprise. During the past three years, I've only spun the Yak-52 on three occasions, each time with an instructor. Trouble was, during that time I'd rolled it hundreds of times. When recovering from a spin it is important to keep ailerons neutral when breaking the stall, but I kept putting in opposite aileron (subconsciously trying to reverse a roll). The results were not pretty. One time I actually reversed the rotation of the spin before recovering. Finally he said, "This airplane can fly better than you can. Next time let go of everything." I held the spin for one turn, let go of the stick and got off the pedals and within another revolution it came out of the spin by itself. Amazing.

During a hammerhead my heel stuck momentarily between the pedal and the end of the cable covers on the floorboard. Sergei explained (rather emphatically) that he had watched a friend spin in and die because of this problem and in Europe all of these covers have been shortened or removed. He refused to get in the airplane again until the covers were shortened. If you own a Yak — do this NOW. Hal Morley had a similar quirk he can explain about an instrument panel mod and stick travel.

Most of you doing formation have accepted rather abrupt throttle moves. I have not. When doing hammerheads right, Sergei's method was to look forward until vertical, glance at the pitot tube for angle and then look upper right to see that the wingtip and cowl are in line when full rudder is pushed. If full forward stick didn't keep the nose in line, he would chop power to reduce torque and let the nose fall through. This full-closed-full throttle action bothered me so I asked what if I don't want to pull the power back. "It is simple. You go into inverted flat spin and die. Save engine or save life, your choice, I won't be there." Ah, simple eloquence.

Those of you who have observed my dainty nature may find this hard to believe, but I tend to get heavy-handed with equipment. Being a seasoned professional, Sergei was able to spot this flaw. What I had been considering "crisp" movements were really clumsy jabs in the general direction of a roll without follow-through. He moves firmly to the stops when rolling and holds it there until time to recover. The effect is crisp, yet smooth. Hmm, think maybe he's done this before?

The jury is still out as to how much I absorbed from all this. Six hours goes by quickly when you cover four kinds of rolls, loops, spins, hammerheads, tail slides, Cubans, reverse Cubans, humpty bumps, a "parachute maneuver" and more inverted than I'm used to. Through it all Sergei was careful not to exceed my personal limits. (We never came close to the plane's limits). After the first "tumble" he asked how I felt. My response was there must be something wrong with us because this was really fun. He keyed on the word "wrong", "Wrong, wrong, what is wrong?" He got the message right when I yelled it a second time. I can still hear his belly laugh through the headset. You really feel at ease with someone who finishes one acro ride on a 100 degree day, inhales 3 pieces of pizza, a cup of coffee and a cigarette and then says, "Let's fly." I can still smell the mixture of testosterone and 100LL.

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Spins Unspun *(Continued from page 6)*

There was a rapid increase in roll rate to a peak value of 230 deg/sec. A marked decrease in yaw rate did not occur until the roll reached a value of 190 deg/sec, a difference of 70 deg/sec from the yaw rate. A movement toward neutral controls occurred at 12.8 seconds, indicating the end of the spin. This corresponded to 1.25 turns for recovery. The rotation rate determined from the y-axis magnetic vector was 160 deg/sec for the fully developed portion of the spin and 218 deg/sec for the recovery portion of the spin.

The right flat spin was initiated with full aft longitudinal stick and right rudder being applied at 2.3 seconds (Figure 3). Although not indicated on the plot the engine power was increased to approximately 90 percent at 2.6 seconds. Left lateral stick, aileron against the spin, was applied beginning at 3.4 seconds. The yaw rate increased smoothly with variations in roll and pitch rates until the spin was fully developed between 4.5 and 5.3 seconds. The yaw rate continued to increase until it reached a maximum value of approximately 135 deg/sec at 9.0 seconds, where it also exceeded the roll rate. Again, the pitch and roll rate variations appear to be strongly coupled due to gyroscopic precession. Recovery was initiated by a rapid reversal of rudder deflection at 9.8 seconds, with no corresponding decrease in yaw rate. The lateral stick was also reversed, aileron with the spin, at 9.8 seconds. The longitudinal stick was reversed to a point well forward of neutral beginning at 10.5 seconds. There was a rapid increase in roll rate beginning at 9.8 seconds, which continued to a maximum value of 230 deg/sec at 12.0 seconds. There was no decrease in yaw rate observed until 11.7 seconds, which corresponded to the roll rate value exceeding the yaw rate value by 70 deg/sec. A movement toward neutral controls occurred at 12.8 seconds, indicating the end of the spin. This corresponded to 1.75 turns to recovery. The rotation rates determined from the y-axis magnetic vector was 143 deg/sec for the fully developed portion of the spin and 228 deg/sec for the recovery portion of the spin.

Table 3 presents the control force data obtained. Of particular note is the increase when going from a normal spin to an accelerated or flat spin and the sharp increase when the CG is in the aft position. Remember, these values were obtained subjectively without accurate measuring devices so are general in nature, but they are in keeping with those values found in the translated material that accompanies the airplane.

Data Analysis

All three data plots show that the incipient phase takes about one full turn. Not reflected in the plots is the fact that regardless of entry, if the recovery was initiated during this incipient phase an immediate recovery was possible. This is vitally important to understand for several reasons. For most pilots trained in the west (discounting military trained and CFIs), if they have spin training at all, it rarely goes beyond one full turn. This means that the spin and recovery characteristics experienced are quite docile indeed. Even for aerobatic pilots, most spins are one turn spins (I haven't seen the Yak-52 compete in anything higher than the Sportsman category), although for this year the Sportsman category calls for a 1 ¼ turn spin, which means that the recovery is applied at precisely the moment the spin is changing from the incipient phase to the fully developed phase. Perhaps someone with far more talented feet and hands than mine can discern a difference here.

Figure 1 shows that there was an immediate response to the initiation of recovery controls. For an upright normal (and all inverted spins for that matter) the meaning is that the controls surfaces are capable of generating the aerodynamic forces necessary to counter the inertia forces to terminate a spin precisely as commanded by the pilot. This is true whether the spin is in the incipient or fully developed phase.

For the fully developed accelerated spin shown in Figure 2 and flat spin shown in Figure 3 the situation is something quite different. With the yaw rate exceeding the roll rate, initiation of recovery controls shows that the control surfaces are not capable of generating the necessary aerodynamic forces to immediately terminate the spin. With in-spin aileron applied as part of the recovery technique it clearly takes time for the roll rate to accelerate to the point where it exceeds the yaw rate by a margin great enough for the aerodynamic forces to overcome the inertia forces and terminate the spin. This aspect is even more so at aft CG. The Yak-52 will recover, but it takes time. At forward CG it is 1.5 to 1.75 turns. At aft CG it can take up to 3.5 or so turns before this condition necessary for recovery is reached. These characteristics are directly attributable to the mass distribution and mass density of the Yak-52, especially when compared to western light aircraft available for spin training. Notice from Table 1 that the rotation rates are increasing all the while you are waiting for the roll rate to exceed the yaw rate enough for recovery. This translates directly into a very disorienting ride for the untrained and when coupled with the high control forces encountered at aft CG certainly argues against the self-taught method.

(See Spins Unspun, page 11)

Table 3 Control Forces During Recovery (Lbs/Ft)

Spin Mode	Stick Force FWD CG	Stick Force AFT CG	Rudder Force FWD CG	Rudder Force AFT CG
Normal	7-10	10-15	30-35	35-40
Accel-erated	35-45	65-75	160-170	185-195
Flat	40-45	75-85	180-190	195-205
In-verted	5	7-10	30-35	35-40

Oshkosh *(Continued from page 3)*

On the morning of the 27th we flew to OSH. At the 1130 briefing we had a surprise. The T-34 guys did not show. Not one. There was poignant silence. Then airboss Dave Schneider said, "OK, the T-34s are out. Yaks you've got it. Yes, justice is served." For once we had the airspace to ourselves.

This time Mike Filucci**,** "**The Big Head**," led the formation and I was Deputy Lead. And this time the weather gods tried to interfere with our solo début. Rain showers started to encroach from the SW and the show was delayed about 15 minutes. When finally getting the crossing time, we hit it right on! With the T-28s coming out of the west and us out of the east, we crossed head-on, dead center of the field, separated by 500 feet. All this as the T-6s were making their takeoff on runway 18. The excitement in the airboss's voice over the radio was evident: "Perfection! Absolute perfection!"

Again we split up, some to OSH and the rest for MTW – we thought. That same weather had crossed Lake Winnebago and the route to MTW was IFR. Harry soon called "Joker" fuel. To our NW was Appleton (ATW) where we diverted. Guessing the weather wouldn't improve, we rented two cars, drove to MTW and left the aircraft in hangars over night.

Sunday the 28th dawned clear at MTW. We drove to ATW to fetch our aircraft. Those at ATW and MTW were heading for home. I headed for OSH 10 nm to the south. Surprise! OSH was IFR. I held twenty minutes until a small cloudbank cleared.

There were only two CJ-6s left to fly the show. **Craig Payne** and I carried the flag in the afternoon show. The T-6 group continued to have strong participation, putting up 10 aircraft for the last day of the show. With the show over, Craig headed for ARR and I set course for Waukegan (UGN). After refueling, I traced the Lake Michigan shoreline south. I turned east at the end and I headed for Ft. Wayne. As I approached FWA, CBs to the south crept in closer to my course. They were just 4nm SW of the field when I landed and called it a day.

The plane count this year was 5 Yaks, 1 FW-149, 1 Piper something, and 14 CJ-6As. In 69 sorties we flew over 210 formation hours according to Russ's computer. Three years ago we logged only 47 hours. We burned in excess of 2,300 gallons of fuel and used over 78 quarts of oil. I heard no complaints about the service from the FBO, Magnus Aviation, and the association left tips for the line boy and line girl.

We flight checked and passed a new Lead Pilot, **Mark Shelley**, plus a significant number of FNG are near ready for their Wing patches. We had the best of the aerobatic instructors and a number of pilots gained from that. All sorties into OSH and the show went as briefed and NOBODY BENT ANYTHING. It was safe.

So to the participants of YPA @ MTW/OSH 2002:

Don Andrews, Russ Dycus, Vladimir Yastremski, Al DeVere, Bob Watts, Carolyn Watts, Craig Payne, Roger Modglin, Bonita Hyatt, Mike Filucci, Harry Dutson, Julie Boatman, Bob Fitzpatrick, Mark Shelley, Bill Wade, Violet Wade, Ray Gage, Jose Rivera, Hal Morley, Sergei Boriak, Dan Fortain, Skip Slyfield, John Amy, Walt Fricke, Ron Kalemba, Terry Calloway, Denise Calloway, Keith Harbour, Janace Harbour, Jim Kelley, Forrest Johnson, Lance Fisher, Bob Schroeder, and the folks at Chapter 383.

I raise the Honey Weiss in toast…

Thank you for another memorable year at Manitowoc.

Aerobatics *(Continued from page 8)*

During our preflight interview, I confessed that I sometimes felt like a passenger when flying due to a lack of understanding the machine and the maneuver. He made a mental note of the fact but didn't comment until later when I asked if and when he ever jumped out of a plane. Yes, when an elevator linkage broke and he realized he was no longer flying the plane. "When you realize you are a passenger, it's time to get out."
Subtle, isn't he?

This experience has made me less passenger and more pilot. Thanks to Sergei and YPA for the opportunity.

Sergei, (looking fresh), Boris (not), Natasha and crew at MTW. Ready for another flight, Bob?

Spins Unspun *(Continued from page 9)*

Conclusions

There is no question that for the untrained pilot the Yak-52 can provide a truly exciting ride, regardless of a pilot's level of experience or background, civilian or military. It is also true that the Yak-52 lives by the same rules of physics as the rest of the universe. It is very important that the pilot is properly educated. The key is to obtain the proper training. Being experienced in spinning other types of airplanes, such as western training types or even military types does not necessarily translate into the requisite skills to handle the Yak-52 in all of its modes, nor does it translate into being qualified to teach spins in the Yak-52. Good training is out there and I can't recommend enough seeking it out.

Editor's Note 1: There are two very important things to think about as you consider this in-depth analysis of the Yak-52 spin characteristics. First, the aircraft used in this flight-test program was modified significantly as Bob points out in his description of the test airplane. Second, Bob also points out that "two identical types of airplanes, loaded identically, and spun on at the same time may, or may not, exhibit the exact same spin and recovery characteristics." This is similar to the observation made by Richard Goode and Gennady Elfimov in the ***Warbird Flyer****, 2nd Quarter 2001 (Page 7, The Mail Run) where they point out that "We know of at least two Yak-52 aircraft that after a fully developed flat spin (i.e. four or so turns) will NOT recover with the conventional spin recovery..." You should not have the expectation that your aircraft will behave the way this test aircraft did in a spin recovery. You should also make every effort to get proper spin training from a qualified instructor in your specific aircraft.*
Editor's note 2: The "figures" referred to in Bob's article will be available on the YPA website. Space constraints allowed for publication of the "tables" only.

Fred Ihlenburg Memorial Fly-In

By Mike Filucci

The 2002 Fred Ihlenburg Memorial Fly-In was held at Columbus, Nebraska, this year and hosted by Janace and Keith Harbour. When Keith volunteered to subject himself to the pain of hosting the fly-in while simultaneously participating in the clinic and running his business (the on-field FBO), I asked him if he was sure he wanted to go through with it. He and Janace jumped right in with all four feet. Their advance planning really showed in the execution of all the logistical details that make for a smoothly operating fly-in. When the advance party arrived we found we had full run of the place to set up our classroom, our brief/debrief areas and our ops area. Keith even commandeered a school bus to shuttle the arriving troops back and forth between the hotel, airport and various restaurants for breakfast and dinner. Even this whole cast of characters failed to overwhelm the local restaurateurs because Keith and Janace had warned the locals that the Yak hordes would be descending upon them "en masse." Each evening, after the day's flying activities were wrapped up, we gathered at that night's featured eatery for drinks, a fine meal, and the usual lie-swapping session.

Columbus (KOLU) offers a unique field for our specialized activities. The airport is non-towered, the airspace is wide-open, and the runway is suitably long and wide enough for our mission. A remarkable feature of the field was Keith's ability to hangar all 18 participating aircraft overnight when it looked like a thunderstorm might sweep in from the west. I saw one huge hangar that was packed with two spam-cans and eight Yaks. Another attractor was Keith's offer to price avgas at just 25 cents over his cost. We launched wave after wave of training sorties and managed to accommodate everyone from the new Yakers to the qual'ed guys looking to "knock the rust off."

The fly-in culminated in a banquet and awards ceremony at the local micro-brew/restaurant. We officially dedicated the annual fly-in to the memory of Fred Ihlenburg with a video that Fred's son, Kirk, put together. The video was a poignant, representative sampling of the life and times of Fred, his passions and his relationships with his family and friends. It was particularly moving for those of us who were fortunate enough to share our lives with him for a time.

What would an awards ceremony be without awards? We had some fine contenders this year. Memorable among them was Bob Watts' award for "Most Improved Wing Pilot." It was deemed necessary to duct tape Bob's hands together to prevent him from doing all those "fighter-pilot" gestures during his acceptance speech. Jim Goolsby received the "Alabaster Eagle" award that night. If you haven't been to a fly-in with Jim you may not know that there is always a FedEx box turning up with spare parts to repair his airplane. Columbus was no exception. Somehow, during the presentation, Jim's plaster-of-Paris eagle ended up getting broken (but we're sure a FedEx box was on its way with spare eagle parts). Bill Helvey received the "Five Second Lead" award. When we launched one of our mass formations Bill was doing an element takeoff as the number two ship. During the takeoff roll Bill slid forward of Lead and assumed the Lead for five seconds. Said Bill at the debrief, "I always dreamed of leading a big formation." That's what the YPA is all about - making peoples' dreams come true. The final award went to Hal Morley for "Most Loquacious Lead." It's been rumored that Hal's briefings and in-flight comments can get pretty wordy, but the competition is fairly stiff in this area.

It looks like we may have found a home in Columbus for our annual event. I don't know if Keith and Janace are prepared for another round, but I do know that many of the participants are already looking forward to next year's fly-in. I also know that Fred would have enjoyed being there, flying with all his fellow Yak drivers.

Cast of characters: Keith Harbour, Janace Harbour, Chad Harbour, Ron Kalemba, Hal Morley, Robert Schroeder, Lance Fisher, Al DeVere, William Helvy, Kendra Spak, Sharon O'Leary, Daniel Feeney, Scott McMillan, Allen Tinnes, Bob Watts, Russ Dycus, Craig Payne, Buck Bender, Jeff Brown, Terry Calloway, Kirk Ihlenburg, Skip Slyfield, Charlie Lynch, Rodger Modglin, Jim Goolsby, Mike Filucci

What Goes Up, Must Come Down By Al DeVere

It was the end of another routine formation training hop. I was flying deputy lead off Terry Calloway in Dragon Flight. The formation had been up for 50 minutes and I was just coming out of the break onto downwind. After putting the gear lever down, I checked the gear lights: 2 green. The right main light was out. No problem, just a bad bulb that happens regularly with these gear indicators, right? I touched the lamp check switch for the gear indicators and it showed 3 good red lights and 3 good green lights. Checking outside I noticed that the gear indicator on the right wing was completely out of sight, and suddenly time slowed way down.

Ok, so we don't have the gear down, I'm on short final with two CJs in front of me and one behind. I informed my back-seater, Mike Filucci, of the problem and made the call "Dragon 3 going around." The air pressure gauges read 45 and 55 respectively, so I recycled the gear twice while simultaneously pulling Gs while we circled the field. We had ample fuel and therefore time to work this out. When the gear was up, all three red lights showed the gear was up and locked. With the "barber pole" not extending at all, we figured the gear was locked in the well.

That out of the way, we proceeded to the emergency checklist. I attempted to walk through the emergency gear extension checklist while continuing the fly the airplane. Mike recommended that we share the duties and he either fly the airplane or call out the procedures. I declined. My first pass through the checklist didn't go well so I asked Mike to run through the checklist while I flew the plane and called out the completion of each item. Help was also on the way as Terry Calloway launched to look us over.

While TC climbed up to join us, we talked through the air boss to Vladimir Yastremski and others about potential reasons for the problem and recommendations. Terry joined up and reported that the nose and left gear looked down and locked. The right main gear was down, but the arm was not over-center. This was news to Mike and I since we didn't think the gear was even out of the well. Wanting to relieve some of the stress, I radioed our situation to the ground and told them "we might have to make a landing with the gear up" on the grass runway. In the meantime, we wanted to bleed off the emergency air in the gear down system that we had just energized so that we could retract the gear for a possible wheels-up landing. We relieved the pressure by closing the main and emergency air valves and actuating the flaps up and down as well as applying the brakes and then raised the gear.

Before we resigned ourselves to a gear up landing, Mike suggested that we try one more thing. With the gear up, the gear handle in the neutral position and both normal and emergency valves closed, we bled off the residual system pressure. Good idea. When I then placed the gear handle directly from neutral to down, all three gear locked down with a loud bang. Three green indicators—but, still no pole on the right wing. Terry in Dragon Lead confirmed that that gear arm now looked over-center. Time to land.

I instructed Dragon Lead to land first in case we fouled the runway. Mike also recommended that we roll the fire/rescue equipment. Once the equipment was in place, we made a nice slow and smooth landing on the gear and then taxied to the ramp. Once on the ramp we found the cause of the gear issue was that the gear indicator (red-striped barber pole) in the wing had backed out, fallen down into the gear mechanism, and prevented it from full extension.

We discussed the situation and the lessons learned with the YPA members at the clinic during the following morning's safety brief:

1. **Don't let an issue cause distraction and become a true emergency.**
   We didn't attempt to fix the problem down low, we climbed and left the airport pattern to resolve the problem.
2. **Stay calm.**
   A gear issue is not a time for rapid or instant action. Consider the fuel situation and use the time effectively.
3. **Know your aircraft and its systems.**
   Without thorough understanding of the air and gear systems, diagnosing problems in flight can be extremely difficult.
4. **Communicate effectively.**
   Apparently the folks on the ground thought I stated that we were going to "crash land " rather than land on the grass. Be clear on the radio.
5. **Use cockpit resources effectively.**
   Mike reading the checklist was a big help. I should have utilized his assistance much sooner.
6. **Keep trying.**
   Don't give up until the issue is resolved or fuel or other issues dictate that it is time to go with plan B. While I wasn't ready to give up, my comments were construed as my being ready to give in and land with the gear up, rather than being humorous.
7. **Stay over the airport.**
   I left the airport pattern and went 3-5 miles east to give folks inbound to the airport the opportunity to land. It was recommended that vertical separation would have been a better choice and therefore I should have climbed directly over the airport.
8. **Declare an emergency.**
   It was recommended that we should have declared the emergency earlier and had the fire rescue equipment dispatched immediately.

Hopefully this never happens to you. If it does, I hope my experience will give you a better chance at a successful outcome.