The Flightline

Volume 43, Issue 3 | Newsletter of the Propstoppers RC Club | AMA 1042 | March 2013

President's Message

As we approach the end of another indoor flying season, I think we can all agree, we had many safe and fun indoor flying events. Our last indoor event is planned for Saturday, 03/09/2012 6PM at the Brookhaven Gym.

At our next club meeting, Tuesday 12th March, we need to discuss tentative plans for the scheduling of events in 2013. We will reserve some time for "show and tell" near the close of the meeting.

Lastly, please feel free to bring any unsold items again from our last month's "swap meet" if you would like to do so. And don't forget to bring something for Show and Tell.

Dick Seiwell, President

Agenda for March 12th Meeting
At Middletown Library;
Doors open 6:00, meeting at 6:30

1. Membership Report
2. Finance Report
3. Plans for 1013 Club Events
4. Tag Sale Residue
5. Show and Tell

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Indoor Flying Last Call

Brookhaven Borough Gym 6till 9:30 pm
Saturday March 9
Guests flyers OK with $3 charge, AMA required.

Minutes of the Propstoppers Model Airplane Club
February 12th, 2013 at the Middletown library

The meeting was called to order at 6:50 pm.

The minutes for the January meeting were approved.

The Treasurer gave his report, and informed the meeting that our funds are $1000 lower than at this time last year.

The Membership Secretary announced that dead-line for paying this year's dues was NOW.

The meeting was reminded that the last indoor flying sessions of the year were coming up - March 1 for Tinicum and March 9 for Brookhaven.

The drainage problems at the Christian Academy flying field, especially near the entrance, restricts the flying there, so it is recommended that Elwyn only should be used until conditions improve. The boundaries of the area available for club use at Elwyn have yet to be decided.

Show and Tell

Dave Harding presented a small scale model of the project being developed by the Widener University, which he made to test the flight characteristics of the rather unconventional configuration of the 12 foot span full size monster.

Al Tamboro gave us an update on his interesting developments for electric control-line models - he hopes to publish his results soon so that club members can join in and build and fly this quick and easy type of model.

The Meeting was adjourned so that the Bring & Buy sale could be held, the event being quite well supported

The Acting Deputy Stand-in Secretary

Mick Harris

Calendar of Events

Club Meetings

Monthly Meetings
Second Tuesday of the month.
Middletown Library
Doors open at 6:00, meeting at 6:30 pm.
Next Meeting; 12th March

Tuesday Breakfast Meeting
Tom Jones Restaurant on Edgemont Avenue in Brookhaven. 9 till 10 am. Just show up.
Flying after in the summer at CA Field or Chester Park; 10 am. Weather permitting.

Regular Club Flying

At Christian Academy; Electric Only
Monday through Friday after school till dusk
Saturday 10 am till dusk
Sunday, after Church; 12 pm till dusk
At Elwyn Field; Gas or Electric
Monday through Saturday 8 am till dusk
Sunday 12 pm till dusk

Indoor Flying

Guests OK, AMA required.
Brookhaven Borough Gym 6till 9:30 pm
March 9

Special Club Flying

Saturday mornings 10 am
Wednesday Helicopter evening in summer
Thursday evenings in the summer
Tuesday mornings 10 am weather permitting after breakfast.
Check our Yahoo Group for announcements;
http://groups.yahoo.com/group/propstoppers/

Beginners

Beginners using due caution and respecting club rules may fly GWS Slow Stick or similar models without instructors.
The club also provides the AMA Introductory Pilot Program for beginners without AMA insurance.

Propstoppers RC Club of Delaware County, Pennsylvania.
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Propstoppers Web Site; www.propstoppers.org

Propstoppers at the WRAMS Show

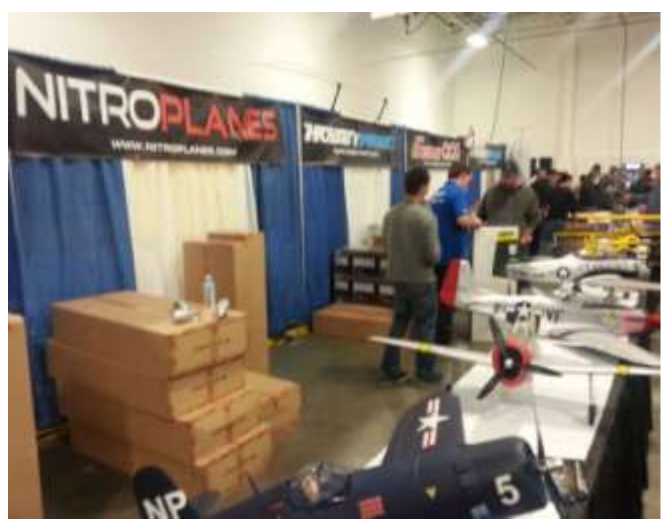
The Westchester Radio Air Modelers Show is the closest true aeromodeling trade show in our area. These shows have been an excellent venue to ogle the new stuff, buy the Show Specials and meet up with old friends. Just less than two hours up the NJ Turnpike it is also an easy drive and this year eight of us made the pilgrimage. Chuck Kime, Mick Harris, Joe Paradine, Bill Tomasco and the editor drove up on Friday so as to catch the most Show Specials while Jeff Frazier, Tom and Ryan Schurman and Phil Whittingham drove up on Saturday.
The show features four areas, the vendors, a flea market, a Concours and an indoor flying area.

As you see, our purchases were modest.

Tom's mind these days is drawn to big and exciting stuff. Ryan probably humors him while flying the really big stuff; a DH Dash 8 for US Airways.

Jeff is also attracted to big models. Here he examines one of the Concours entries, a Bristol Beaufighter and a twin turbofan A-10 Warthog.

Tom, being an engine guy is drawn to exotic engines. He owns a three cylinder radial but here he lusts after the seven cylinder version. But wait; there is a nine cylinder version too.



All in all a worthwhile couple of days.

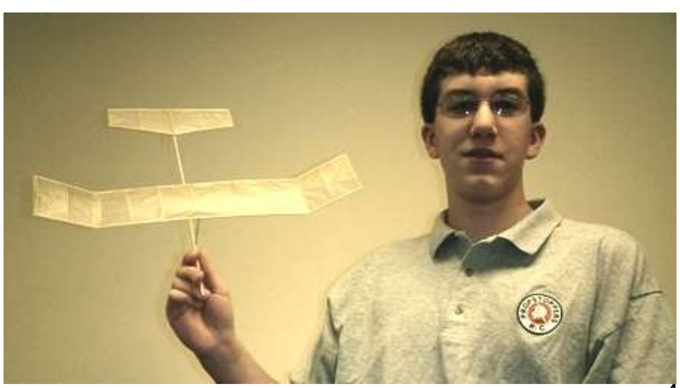
Dave Harding

Propstopper Jr. Member Drew Resweber Accepted to the Air Force Academy

Over the years the Propstopper's club has been blessed with a steady stream of talented youngsters interested in aviation. Some of them have been children or grandchildren of members. Here is my granddaughter Susan showing her rubber winding and HLG launching form.

My grandson Tony flew with us for a while too.

Dave Bevan has been a mentor to countless kids. His classes at the Helicopter Museum are always well attended. He must have taught hundreds over the years.



John Drake was a very active member during his spell with us. Like others he began being chauffeured by his patient parents to all our flying activities. He built all his own planes. Here he shows a very lightweight indoor rubber powered model. Below is a picture of a project we did together, a piggyback pair. He built the balsa tip launched glider and I made the piggyback attachment to my Miss America Old Timer. I would take his plane to altitude whereupon he was released to glide down. Great fun!

Here is his Gentle Lady powered glider. He was driving by the time this picture was taken.

We lost track of John when he went off to Penn to study. But he popped up again sorting out his old planes and getting back into flying. But then he secured a position at Carnegie Mellon working towards his Doctorate so off the radar screen again. But you know, aviation, and particularly model aviation gets into the blood so we may see him again.

Club Treasurer Pete Oetinger's son Phil was an active junior member for some years flying all kinds of models.

He too left us going off to college. Philip Oetinger graduated in 2012 from the University of North Dakota with a Bachelor of Science Degree in Aeronautics with a minor in Air Traffic Control. He is currently employed as an

Associate Professor of Air Traffic Control at the university, and is in the FAA queue to be called up for an ATC opening. Did I say aviation gets into the blood? We wish you well Phil.

Rick Grothman's son Paul flew with us for quite a while. This picture shows him when Dick Bartkowski and I shanghaied him to fly on our postal contest team. He was an excellent pilot and he too is off to college. After several years majoring in Computer Science at West Chester University, he decided to start his own company, w3 Global Solutions. He provides custom web and mobile application development services, as well as hardware and network support for small businesses in the area. While the business has been going well and keeping him busy (along with buying a fixer-upper house), he gets an occasional flight in.

This brings us to Drew Resweber another keen, serious young man thoroughly supported by his patient parents shuttling him to various club activities. Here Drew is shown with the Miss America I loaned him for a while. I also helped him build a Sig Kadet LT-25 shown below. We haven't seen much of him over the last couple of years primarily because he is very active in competitive swimming and his school work. But I was delighted to hear from his parents the other day to say he has been accepted into the most prestigious US Air Force Academy. A wonderful achievement and reward for his diligence in academics and other activities. I expect he will visit us during one of his breaks of service and I hope he will be wearing his uniform.

Ok, did I say aviation gets into your blood. It doesn't get much better than we have seen in our junior members.

Good luck to you guys and remember your Propstopper friends.

Dave Harding

Widener University SAE Aero Team Progress

The Widener University team has made great progress this month, which is just as well because the competition is right around the corner. They will fly at the West Coast location in Los Angeles the weekend of the 12th of April. They finished construction a few weeks ago and began testing.

The initial test was for taxi stability and general shakedown with just the wing center section and fuselage components. The tests were conducted on the Widener hockey field, then the parking lot on a weekend. But the real progress was to obtain permission to fly from the old Bridgeport NJ airport site. Widener students and Dave Bevan used this site years ago but in recent times they and everyone else were chased off by the police. However, the site has been sold and one of the Widener students went over and asked permission to do their testing there. Better yet, the runway has been recently repaved, albeit a rather narrow strip. Nonetheless this is a priceless advantage as they can now fly at maximum weight and not worry about tracking in a soft grass strip.

The site and weather were perfect and so was the takeoff.

Unfortunately the handling qualities were not and Boeing engineer test pilot, Pete Noel, a veteran of twenty years Widener first flights, had a really hard time controlling the model in the roll axis.

This model has a very aggressive airfoil, designed to make at least 50% more lift that a conventional cambered section. The ailerons were set to about 20 degrees up and 10 degrees down in an attempt to provide complementary yaw with roll i.e. given a roll control input the model would also yaw slightly in the direction of the turn. However, in the event the roll control was highly nonlinear, indeed it might have caused a reverse upset as the attitude and control input increased. In the following sequence from the movie you can see the ailerons hard over to pull out of the right roll but the turn remained tight, and may have even tightened up.

There were periods of flight that appeared stable, but the model remained uncontrollable and eventually cart wheeled into the soft mud off the strip. Both removable tips were destroyed and the wing center section damaged. However the eager crew quickly built new wing tips and repaired the center section.

The repaired model design was revised to incorporate parallel chord tips for easy of construction and incorporated full tip-span ailerons which were mechanized to only move in the up direction. The team believed perhaps the outside of turn aileron downwards deflection was causing tip stall with the aggressive airfoil. So to turn left the left aileron moved up while the right aileron stayed in line with the airfoil. More dihedral was also incorporated in a further attempt to improve roll stability and enhance the capability to use rudder in turns.

A second test flight was then made at Bridgeport, also in good weather conditions.

Unfortunately the second flight also exhibited extreme roll uncontrollability and also resulted in a cart wheel arrival. This time the damage was even less than the first, being mostly concentrated to the right hand tip section and fuselage nose, which has a breakaway set of nylon bolts connecting it to the center section wing spar.

For this flight they had an airborne key chain camera mounted above the wing on the tail boom looking aft. They had expected to witness the activities of the elevator and model pitch upsets, but didn't get the aim right. Nonetheless when viewed as side by side videos ground and airborne they were able to get a much better view of the model's behavior. The next flight will aim this camera towards the wing tips and ailerons. The surfaces will also be tufted like the big boys do when trying to understand airflows.

Repairs are at hand and further forensics in work, mostly associated with the effectiveness of the ailerons.

Dave Harding

Dare I ask if there will be some car pooling to this annual event?
Call your buds and arrange one.

Aeronautic Innovations; A Dead End?

Club member Tom Tredinnick, a former Boeing Helicopters test pilot, posted the following article (edited);

HITLER'S STEALTH BOMBER

Keep in mind, this aircraft was built in the 1940's. It resembles our Stealth bombers of today. Had Hitler got these into production sooner, the world wouldn't be what it is today. Hitler's stealth bomber: ***The Horten HO 2-229***

With its smooth and elegant lines, this could be a prototype for some future successor to the stealth bomber. But this flying wing was actually designed by the Nazis 30 years before the Americans successfully developed radar-invisible technology.

This full-scale replica of the Ho 2-29 bomber was made with materials available in the 40s and tested to determine its radar signature on the Northrop radar range.

The stealth plane design was years ahead of its time. It was faster and more efficient than any other plane of the period and its stealth powers did work against radar. Experts are now convinced that given a little bit more time, the mass deployment of this aircraft could have changed the course of the war.

First built and tested in the air in March 1944, it was designed with a greater range and speed than any plane previously built and was the first aircraft to use the stealth technology now deployed by the U.S. in its B-2 bombers. Thankfully Hitler's engineers only made three prototypes,

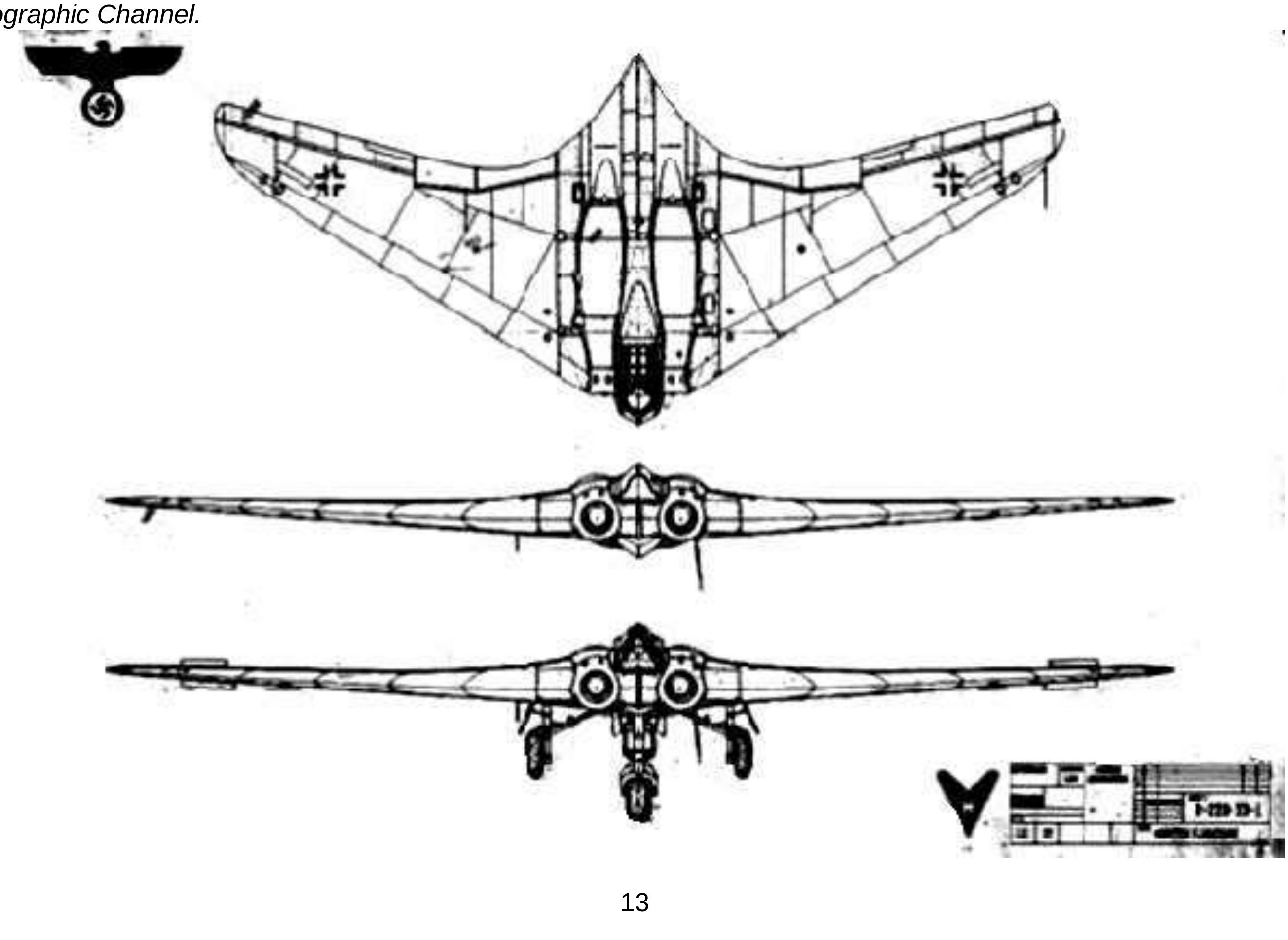
. From Panzer tanks through to the V-2 rocket, it has long been recognized that Germany's technological expertise during the war was decades ahead of the Allies. But by 1943, Nazi high command feared that the war was beginning to turn against them and were desperate to develop new weapons to help turn the tide. Nazi bombers were suffering badly when faced with the speed and maneuverability of the Spitfire and other Allied fighters. Hitler was also desperate to develop a bomber with the range and capacity to reach the United States. In 1943 Luftwaffe chief

Hermann Goering demanded that designers come up with a bomber that would meet his requirements, one that could carry 1,000kg over 1,000km flying at 1,000km/h.(2200 lb, 620 miles, 620 mph)

Two pilot brothers in their thirties, Reimar and Walter Horten, suggested a flying wing design they had been working on for years. They were convinced that with its low drag and lack of wind resistance such a plane would meet Goering's requirements. Construction on a prototype was begun in Gottingen in Germany in 1944. The center pod was made from a welded steel tube, and was designed to be powered by BMW 003 engines. The most important innovation was Reimar Horten's idea to coat it in a mix of charcoal dust and wood glue.

Inventors Reimar and Walter Horten were inspired to build the Ho 2-29 by the deaths of so many Luftwaffe pilots in the Battle of Britain. The 142-foot wingspan bomber was submitted for approval in 1944, and it would have been able to fly from Berlin to NYC and back without refueling, thanks to the same blended wing design and six BMW 003A, or eight Junker Jumo 004B turbojets. (Really? Ed.) He thought the electromagnetic waves of radar would be absorbed and in conjunction with the aircraft's sculpted surfaces the craft would be rendered almost invisible to radar detectors. This was the same method eventually used by the U.S. in its first stealth aircraft in the early 1980s, the F-117A Nighthawk. The plane was covered in radar absorbent paint with a high graphite content, which has a similar chemical make-up as charcoal. After the war the Americans captured the prototype Ho 2-29s along with the blueprints and used some of their technological advances to aid their own designs. But experts always doubted claims that the Horten could actually function as a stealth aircraft. Now using the blueprints and the only remaining prototype craft, Northrop-Grumman (the defense firm behind the B-2) built a full-size replica of a Horten Ho 2-29. Luckily for Britain the Horten flying wing fighter-bomber never got much further than the blueprint stage, above. Thanks to the use of wood and carbon, jet engines integrated into the fuselage and its blended surfaces, the plane could have been in London eight minutes after the radar system detected it.

It took them 2,500 man-hours and $250,000 to construct, and although their replica cannot fly, it was radar-tested by placing it on a 50ft articulating pole and exposing it to electromagnetic waves. The team demonstrated that although the aircraft is not completely invisible to the type of radar used in the war, it would have been stealthy enough and fast enough to ensure that it could reach London before Spitfires could be scrambled to intercept it. If the Germans had had time to develop these aircraft, they could well have had an impact, says Peter Murton, aviation expert from the Imperial War Museum at Duxford, in Cambridgeshire. In theory the flying wing was a very efficient aircraft design which minimized drag. It is one of the reasons that it could reach very high speeds in dive and glide and had such an incredibly long range. The research was filmed for a forthcoming documentary on the National Geographic Channel.



In response to this breathless piece our club VP Jeff Frazier asked:

"I have always wondered - isn't this basically the base design for the stealth bomber? I mean, it seems to the layman that the stealth bomber was basically invented in the 40's, but made MUCH better due to computers and other innovations - like building materials for radar absorption etc."

"Just wondered what your thoughts were. Seems like all the real base innovation / designs has just been there since WWII and just built upon. You know what I mean - like the 737 and others - same plane today as the 60's or whenever it came to market. Why does it seem the innovation has slowed so much? I mean F-35 and F-22 are awesome, but sill not THAT revolutionary compared to the stuff the Nazis did in the 40's."

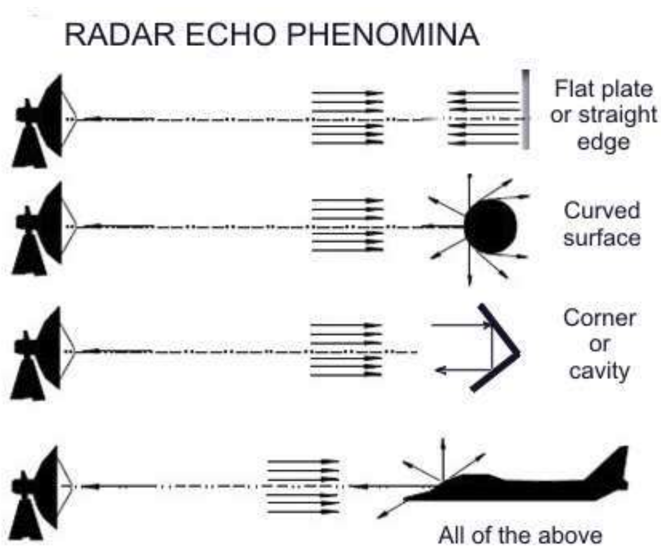
"Would like your perspective."

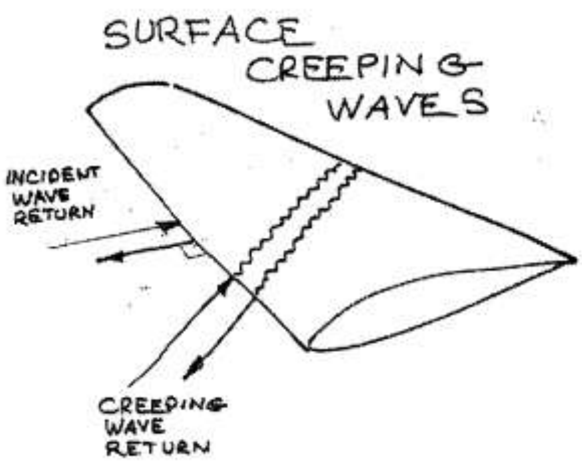
Wow, enough meat in there for the next few years of articles! But let us break the issues down to bite sized pieces, well, maybe not bite sized, but let us at least see if we can separate the thoughts into separate pieces starting with Jeff's first paragraph.

Is the Horton IX the basis for the stealth bomber? The answer is not directly, although as we will see it has some characteristics attractive to designs that are stealthy. So let's first consider the factors that affect detection by radar.

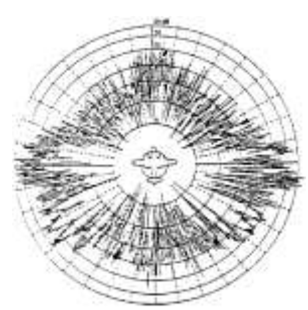
The simple description of radar detection is the radar sends out a beam of radio frequency energy which bounces off the "target" and returns to the radar receiver. The energy bounces from conductive surfaces and edges but behaves in a more complicated way in striking non metallic surfaces.

The strongest bounce, that which returns the greatest energy is one off a surface perpendicular to the radar beam or an edge, like a leading or trailing edge of a wing.
A somewhat lower return is from the perpendicular to a curved surface.
Strong returns can come from surface of edge corners and these are particularly troublesome because it is not necessary to be perpendicular to either edge or surface.
Similar returns come from cavities, like engine inlets or exhausts.

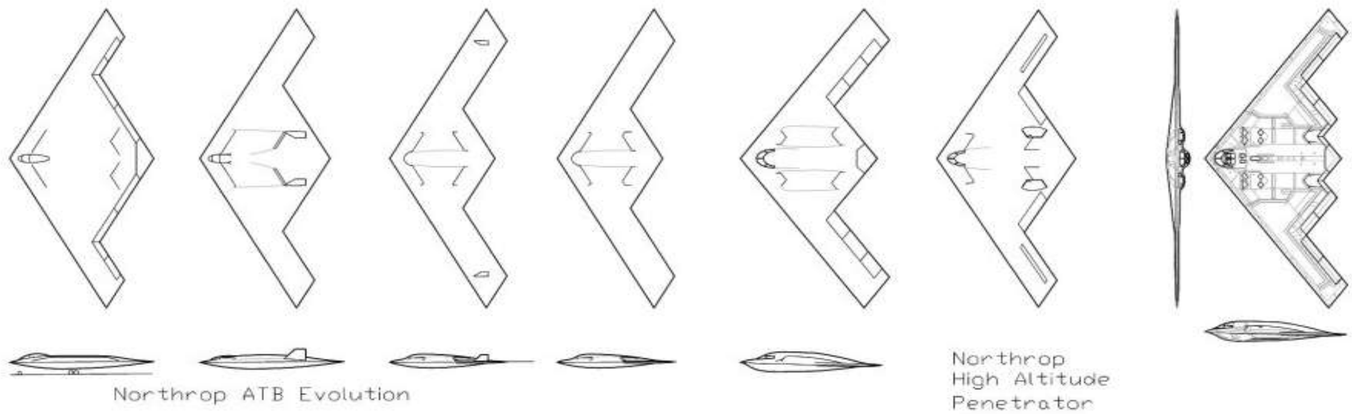


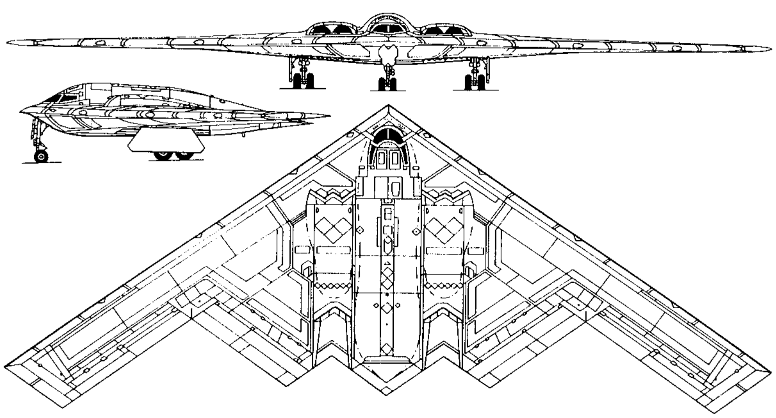


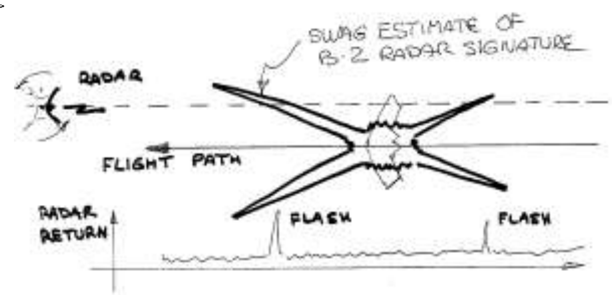
Another mechanism for returning waves arises from the currents induced on conductive surfaces. These waves pick up on the surface and travel in the same direction as the original radar wave however they bounce back when running into a discontinuity in the surface. The primary concern for these kinds of returns is from the trailing edge of wings, stabs and flattish fuselage surfaces.
The sum total of all these elements make up what is known as the Radar Cross Section or RCS of the vehicle A typical un-stealthy aircraft has a radar signature, viewed in planform (looking down) like the accompanying figure. This is a polar plot where strength of the return is the distance from the center.



So if you want to design a stealthy airplane you make the shape with no vertical surfaces, few edges, align the edges and hide the cavities. It would appear that it is not possible to entirely reduce the return from edges so the current method is to design a vehicle with a minimum of edges. They did rather well on the B-2, an airplane made to fly pretty much in cruise mode straight and level. Here is a depiction of the development of the B-2 configuration. Interestingly enough, the design started with a more simple shape but probably ran into balance or other issues during development causing them to add area aft and reshape to the final design.



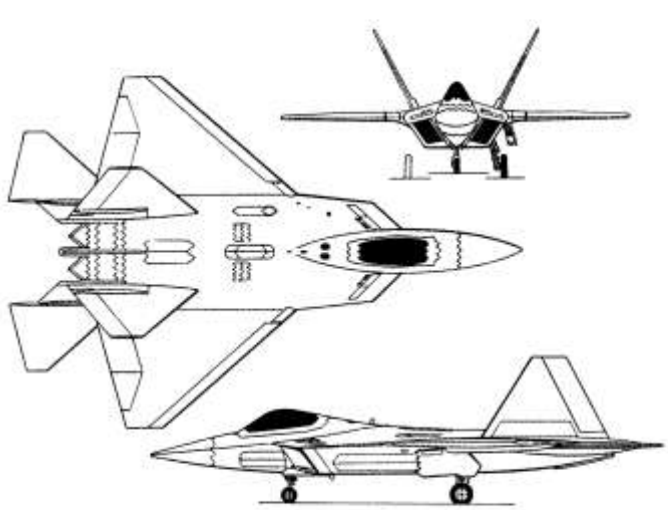


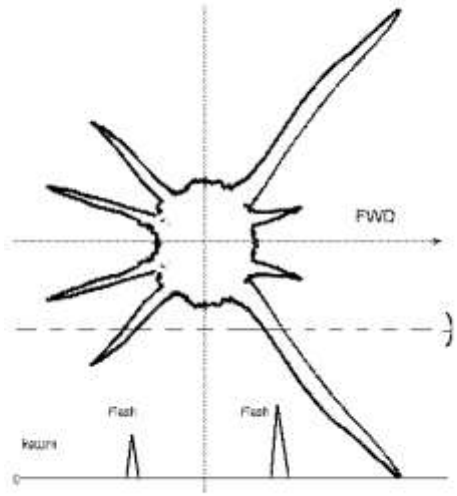


The effect of these signature patterns is the aircraft is undetectable except when the radar is perpendicular to the leading and trailing edges. This of course occurs when the radar is off to one side of the flight path. As the aircraft flies through the radar site the leading edge may return a "flash" to the receiver, then goes quite again. Since all modern military aircraft have radar detectors onboard they know where the threats are and I assume the judicious pilot could "hit the rudder pedals" and sweep the leading edge through the threat site before it is detected. Why you could even automate such a maneuver.

Aircraft that require stealthy signature over a range of maneuver conditions, like a fighter must, end up with a more complex shape to accommodate the features necessary for maneuver.

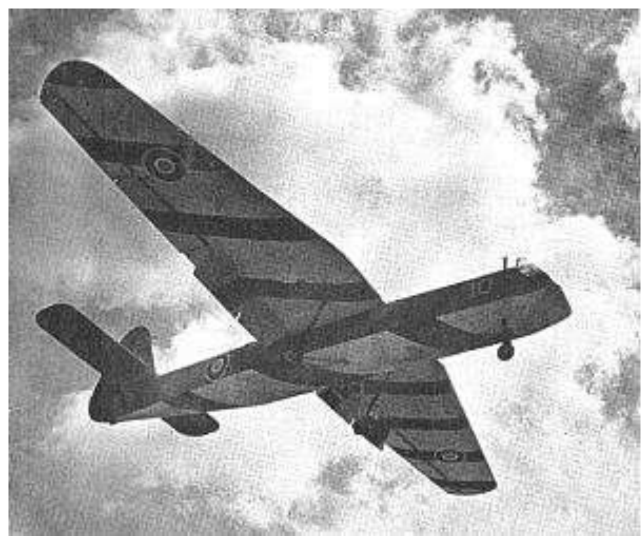
The F-22 is an excellent example. Notice the planform has not one but two dominant edge lines in each side in planform, unlike the B-2 which has only one. Note also that where there is an edge or discontinuity running perpendicular to the line of flight the treatment is to "saw tooth" the edge with the segments also aligned with the primary edges.
In maneuvering flight this kind of aircraft would also just offer radar flashes to the threat radars and the maneuver would make the duration of the flashes even less.





So, the Horton IX Indeed had a planform with some similarities to the current crop of stealth airplanes, but so did many other flying wings built over the history of aviation.
http://www.century-of-flight.net/Aviation%20history/flying%20wings/Early%20Flying%20Wings.htm

The wing leading and trailing edges were not parallel, so unless the carbon coating was an extraordinary absorber the wing would have two flashes per side. But the curved trailing edge would have produced a significant return over the angles subtended, fore and aft. Certainly the engine intakes would have swamped the forward aspect RCS as would the exhausts from the rear. The coating of carbon attributed to the Horton design would have helped attenuate the creeping wave had the wing surface been metal, but if it was wood, as described in the various articles then another interesting facet comes to life.



In my early days with Boeing during the 1960's I worked with a Polish man who was an engineer, and pilot who, with his brother and many other Poles escaped to England during the early part of WWII. He and many others worked in the aircraft industry or flew with the RAF during the war. He told me while people thought all-wood airplanes, for instance the gliders, would be invisible to radar, in fact they could see them for miles due to the steel control cables running the span of the wings. (*His brother flew in the Polish squadron flying Spitfires during the Battle of Britain; (go see the movie Battle of Britain again*!)).

However, the results of the Northrop radar test claimed RCS testing showed that a hypothetical Ho 229 approaching the English coast from France flying at 550 mph at 49–98 ft above the water would have been visible at a distance of 80% that of a Bf 109. This implies an RCS of only 40% that of a Bf 109, from the front at the Chain Home frequencies. The most visible parts of the aircraft were the jet inlets and the cockpit.
http://en.wikipedia.org/wiki/Horten_Ho_229

So how about the performance claim for the Horton?

"It was designed with a greater range and speed than any plane previously built"

Well, for a start when the powered Horton IX started flight testing both the British Meteor and German Me-262 were flying with 600 mph capability, so the speed claim doesn't hold.

And range? None of the early jet planes had much range as the engines were so thirsty. The Horton used engines of the same family.

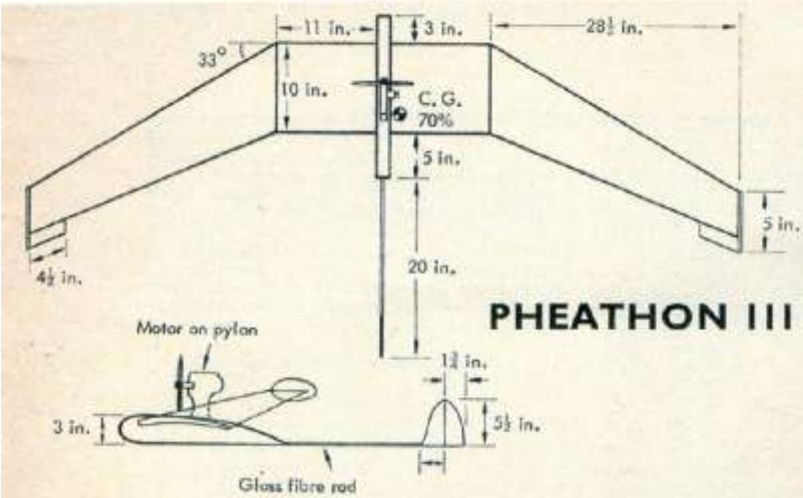
There is no reason to think the structure weighed less than any contemporary plane so the fraction of the all up weight attributed to fuel would not be greater than normal in those years.

But one of the claims for the Horton and other flying wings is they have less drag than a conventional layout. Maybe, but if you compare the projected performance of the Horton to the DH Mosquito, a piston powered plane and the Gloster Meteor a jet plane, both about the same size as the Horton, you find the performance not much different. Of course the jet is faster though. Notice the Horten and Meteor make the 600 mph speed at quite different altitude; The Meteor at 10.000 ft and the Horten at 39,000ft. Air density at the lower altitude is about three times that at the higher altitude and since drag varies linier with density that explains why the Meteor has almost twice the thrust. The range of the Mosquito is twice that of the Meteor and the "Göring Goal" of 1000 km, which was the aim of the Horten (but the actual range is not stated in available sources). This is probably mostly due to the much more efficient propulsion as drag is probably in the same region as the Horten.
There may be a drag difference for the flying wing but it is not game changing, indeed there is a twist to the flying wing drag story (so to speak). See below.

	Horten	***DH Mosquito***	***Gloster Meteor Mk 8***
General characteristics			
Crew:	1	Crew: 2: pilot, bombardier/navigator	Crew: 1
Length:	24 ft 6 in	44 ft 6 in	44 ft 7 in
Wingspan:	55 ft 0 in	54 ft 2 in	37 ft 2 in
Wing area:	540.35 ft²	454 ft²	350 ft²
Empty weight	10,141 lb	14,300 lb	10,684 lb
Loaded weight:	15,238 lb	18,100 lb	15,700 lb
Max. takeoff weight:	17,857 lb	25,000 lb	
Powerplant:	2 × Junkers Jumo 004B turbojet, 1,956 lbf each	2 × Rolls-Royce Merlin liquid-cooled V12 engine, 1,710 hp each	2 × Rolls-Royce Derwent 8 turbojets, 3,500 lbf each
Thrust	~ 4000 lbf		7000 lbf
Performance			
Maximum speed:	607 mph at 39,000 ft	415 mph, at 28,000 ft	600 mph (Mach 0.82) at 10,000 ft
Range	1000 km (620 miles)?	1,500 mi, with full weapons load	600 mi
Service ceiling:	52,000 ft	37,000 ft	43,000 ft
Wing loading:	28.2 lb/ft²	39.9 lb/ft²	44.9 lb/ft²
	Thrust/weight: 0.26	Power/mass: 0.189 hp/lb	Thrust/weight: 0.45
Armament			
Guns:	4 × 30 mm MK 108 cannon		4 × 20 mm British Hispano cannons
Bombs:	2 × 1,100 lb	4,000 lb	2 x 1.000 lb

The drag of a pure flying wing, like the Horten can be quite low in theory, say if every element is flying at its most optimum condition. This is the way wings are designed on conventional airplanes that also have an empennage. But at this condition the flying wing is not stable.
Flying wing stability is achieved either by twisting the outboard segments nose down or by incorporating a reflex into the airfoil. Both methods reduce the effective lift and hence reduce the airplane's L/D ~ a primary element of range. This is clearly seen in the model described and depicted in this article;

Tailless *(competition with tailless models is a very British thing. They fly gliders, rubber and gas power)*
About forty years ago I re-read F. C. Smith's *Tailless Creations* published in the January 1955 *AeroModeller.* The main features of the *Southern Cross MFC* layout he originated were a short, flat, very low aspect ratio centre-section with long, tapered and dihedralled tips swept back about 30° at the leading edge, and progressive washout of the tips from 0° at the dihedral break to -10° at the extremity. The latter feature being achieved by blocking up the trailing edge at a constant height above the building board and leaving the taper to provide the increasing twist.
I decided to try this approach on a power model (the *Southern Cross* club designs had all been gliders) and produced *Pheathon Mark I* - the name, like the shape, is a derivative of Smith's *Pheon.*



It is not that the rest of the world has ignored the flying wing, quite the reverse. There have been many built over the years. Here are a few noteworthy examples.

Since the Horton was a bomber first let us examine the elements relating to range in such a flight mode. From the beginning aviation designers, developed engineering analysis processes to understand the performance of their designs and thereby gained insights into the interrelationship between the various factors. One early insight came from ***the Breguet Range Equation***, the fundamental math that relates the key elements of aerodynamics, propulsive efficiency and weight to range;

Range is a function of ~ Propulsive Efficiency, L/D and $\dfrac{\textbf{Gross Weight}}{\textbf{Empty Weight}}$

- L/D is the lift to drag ratio in cruise flight; it is the primary aerodynamic metric in all flight vehicle performance, even our models.
- Gross weight is the Empty weight plus fixed useful load, plus payload plus fuel. For a purely range flight, like a ferry flight or record attempt the payload may be zero. The fixed useful load will include crew, radios etc.

Here are some L/D numbers for a wide variety of airplanes. Remember, L/D is only one of the factors in range. We may discuss the other elements; propulsive efficiency and weight efficiency another time. But just a little heads up, there have been vast improvements in propulsive efficiency and weight fraction.

Flight article	Scenario	L/D ratio	Range Mi.
Modern Glider	Cruise glide	45-70	NA
Virgin Atlantic GlobalFlyer	Cruise	37	25,000
Lockheed U-2	Cruise	28	6,400
Rutan Voyager	Cruise	27	25,000
Boeing 787	Cruise	21	9,800
Boeing 747	Cruise	17	9,200
Boeing B-29	Cruise	16.9	5,600*
Ryan NYP****	Cruise	~10	3,600
Vickers Vimy***	Cruise	~6	1,890
Helicopter	100 kts speed	4.5	1,740**

Ferry Range
*** Hughes OH-6 Edwards AFB to Key West 1966*
**** First Transatlantic Flight 1919*
***** Lindberg's Transatlantic flight to Paris*

But it is interesting to note that at the highest performing end of aviation there are no flying wings, well, one but that is a special case!

Dave Harding

Multicopters

Wretched Excess; a Multicopter seen at the AMA Expo

Getting Started with Multicopters

By Phil Whittingham

I've recently become interested in building and flying multicopter aircraft. The term "multicopters" covers a wide variety of configurations, including tricopters, quadcopters, hexacopters, octocopters etc. Within these categories there are sub variants based on motor and frame layouts. This leaves the newcomer with a bewildering array of designs to choose from. In order to narrow down the options available you need to better understand your requirements. Important factors to think about would be:

- Payload capacity - how much weight do you need to lift? Typically more motors means more payload.
- cost - lots of motors and ESCs increases costs
- simplicity of build and repair
- stability vs. maneuverability, do you want a stable platform or the ability to do aerobatics?

Flight Controllers

Multicopters are inherently unstable, and therefore need a flight controller to provide stability. Typical flight controllers will use MEMS (microelectromechanical systems) based gyros and accelerometers to detect movement direction and velocity. Together these sensors are known as an inertial measurement unit or IMU. These sensors are utilized by an onboard microprocessor running a software program, also known as firmware, which is responsible for controlling the motor speed controllers. The flight controller takes inputs from the radio receiver to understand what movement the pilot requires, and it outputs signals to the electronic speed controllers and motors to move the airframe as intended, whilst hopefully maintaining stability!

More sophisticated flight controllers will augment the gyro and accelerometers with barometers, optical flow sensors and ultrasounds range finders, in order to provide improved position and altitude holding capabilities. In addition there may be the option to utilize a GPS receiver with the flight controller board, which will allow waypoint navigation, return to home functionality, geo fencing etc.

As with most things there are simple flight controllers that are relatively low cost http://www.hobbyking.com/hobbyking/store/__24354__Hobbyking_i86L_Multi_Rotor_Control_Board_Lite_Edition_.html

With increasing cost providing better functionality and accuracy, example 2 http://www.hobbyking.com/hobbyking/store/__31138__Multiwii_and_Megapirate_AIO_Flight_Controller_w_FTDI_ATmega_2560_V2_0.html

Some of the first DIY flight controllers were based on the sensors developed by Nintendo for the Wii game console. The Wii console controller used an IMU based sensor to determine how the player was moving the controller, and this was "hijacked" by DIY multicopter users. These days the IMU sensors are much more widely available, so there's no longer the need to cut apart a Wii Controller!

Motor and Prop and ESC choices

Typically multicopters utilize relatively low Kv motors. These will turn large diameter high pitch props; usually slow flyer props are utilized. Examples would be the Hobbyking DT750 motors using 10 inch or 11x4.7 inch slow flying props. One point to note is that several multicopter formats rely on using a mixture of conventional and pusher props. This can reduce prop choice considerably as well as increase costs. ESCs are an important component with mulicoptors. You typically want an ESC that will respond as quickly as possible to commands coming from the flight controller. Many DIY builders use ESCs that can be reflashed with updated custom firmware, in order to speed up the response times to inputs from the flight controller. (See RCGroups and the SimonK firmware thread)

Video & FPV
Please remember when flying FPV vehicles at an AMA field to follow the recently published AMA guidelines! Multicopters lend themselves to use for photography and FPV piloting. These platforms can be very stable, as well as lifting large payloads due to the multiple motors used. Simple setups can involve using a camera and video transmitter fixed to the multicopter frame. More sophisticated systems will use a gimbal for the camera, which is controller by servos. These servos can be controlled by the mulitcopter flight controller to help smooth out and stabilize camera movements. These configurations can provide features such as camera leveling when the airframe tilts during fast forward flight. FPV is a deep and complicated subject which would justify its own article which we will cover in more detail.

Safety Third!
As discussed multicopters involve multiple large rotor blades and sophisticated electronics. Furthermore the radio receive is no longer in control of the motors and ESCs, it’s the flight controller outputs that control the motors. This means that care should be taken when integrating these components, with comprehensive bench testing without prop blades attached. I learned this lesson the hard way and have the scars to remind me why there should be no short cuts taken.

My Progress
I was initially drawn to the quadcopter platform, as this is one of the most popular multicopter layouts. I did a lot of research and reading and settled on a design for my first build. This was a simple H-Copter frame using 4 motors. Frame construction was quick and easy consisting of a sandwich of ½ wooden arms and lite plywood top and bottom. Connecting 4 motors to the 4 ESCs took a little time, with lots of soldering etc. Simple zip ties were used to mount the motors onto the arms, which have proved very durable. I decided to use one of the very simple flight controllers, to get some experience under my belt. This was mounted to the frame using double sided mounting foam tape. This helps reduce vibrations being transmitted from the motors to the flight controller IMU. Balancing of props and motors is important with multicopters in order to try and reduce vibrations as much as possible.

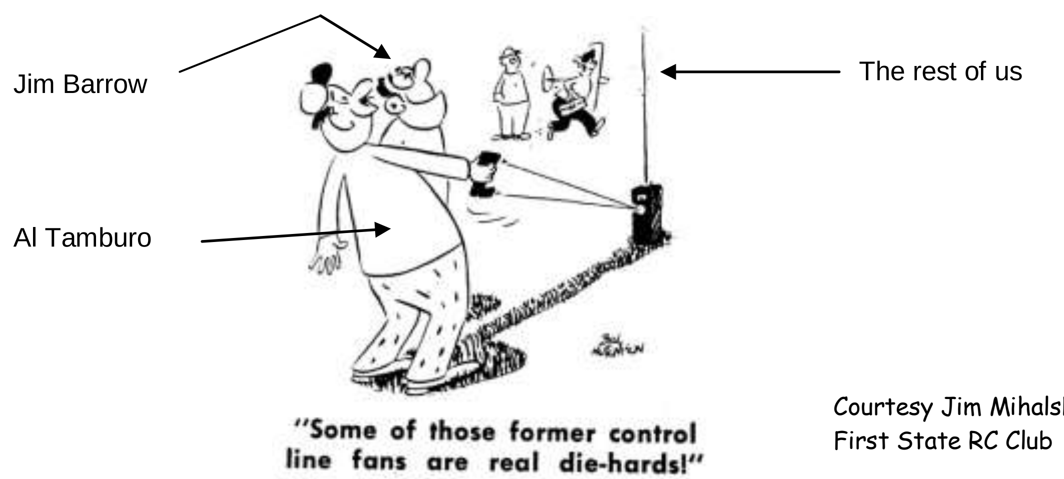
This initial quadcopter was flown successfully, however I was a little disappointed with the lack of yaw authority. This is a common problem with quads due to the fact that they rely on torque differential from the counter rotating propellers to turn the air frame. The tricopter design however incorporates a tail servo, which tilts the tail motor and prop to directly turn the airframe. Here's a photo of the tail servo configuration I built for my tricopter based second design. I also decided to use a fiberglass based material for the top and bottom body plates, to increase durability.

You will also notice the use of brightly colored propellers on this second design. This greatly helps with orientation when flying at a distance. This is a common problem with multicopters and you will see a variety of devices such as LEDs and colored frame components used to help the pilot understand orientation of the aircraft.

Next Steps
I'm currently looking to upgrade the flight controller on the tricopter to one of the more sophisticated models. I'm looking for a controller that will give me the ability to program a rescue switch on my transmitter, which will help save the model when I get into erm difficulties. I'm hoping the additional cost of the upgraded controller will pay for itself in saved repair bills!

The flight controllers I've been looking at utilize an open source approach to the development of their firmware. This means that there's typically a vibrant community of pilots helping support newcomers such as myself. In addition there's rapid progress made in developing new features, which can be downloaded onto the flight controller by reflashing the firmware from a PC.

Phil Whittingham



Courtesy Jim Mihalski, First State RC Club

***TRI COUNTY WING SNAPPERS ANNUAL SWAP MEET*.**
3/23/2013 -- Hamburg, PA (E)
Site: Hamburg Field House. Frank Lacorte CD PH: 862.432.9350-
-CELL Email: frankb24@ptd.net. Doors open at 6AM for
vendors. 8AM to the public. General admission $5
Sponsor: TRI COUNTY WING SNAPPERS INC

Membership Renewal For 2013

Membership renewal for 2013 is now required. You can renew by mail or at the club meeting in March.
Don't lose your club privileges!
Bring cash or check and your AMA card.
Dues are $60.

Ray Wopatek
1004 Green Lane
Secane, PA. 9018
Please enclose a ***copy*** of your current A. M. A. Membership card,
And Please, Please enclose a Stamped self- addressed envelope.
Ray Wopatek Membership Chairman