



On the 'Wing...

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Jim Marske has been designing and building full size tailless sailplanes for nearly fifty years, beginning with his XM-1 which first flew in September of 1957. The evolution of the XM-1 to the Pioneer II took a number of years and several prototypes, but the evolution of Jim's design did not stop there. The fundamental planform has now been used as the basis for the Pioneer III (a very much updated Pioneer II-D), currently nearing completion, the Pioneer IV (15 meter span), and the Pioneer V (16.6 meter span), a two place side-by-side trainer.

Since Bill attended a workshop at Marske Flying Wings in 2000, we've been keeping abreast of the happenings at Marske Flying Wings by visiting the web site <<http://www.continuo.com/marske/>>.

Bill noticed a "flying wing design" workshop announcement on the web site early in 2004 and was seriously considering attending. Plans were quickly firmed up when Mark Nankivil expressed an interest in attending as well.

The plan was for Bill to fly from Seattle to St. Louis, and for the two to take off on a road trip through Muncie (via the AMA Museum) to Marion Ohio, with a side trip to the Air force Museum on the return. The entire trip went smoothly, and some of Mark's photos from the Air Force Museum have already appeared in *RCSD*. (See the CG-4A photos in the September 2004 issue.)

The workshop took place over the weekend of July 17-18 at the Marske facility near the Marion

airport. Participants included an aerodynamicist, a couple of computer code writers/software engineers, a test pilot, and several others with an interest in kit planes, both as private ventures and with an eye to kit production. Mark and Bill were the only modelers in attendance.

Mat Redsell lead the workshop and valiantly tried to follow the predetermined schedule of topics within the allotted time. As is usual with this sort of group, it was natural for participants to link one subject to another and become so entirely engrossed in the path of conversation that it was extremely easy to lose track of time. Although we nearly always gave out groans as Mat brought us back on track, Mark and Bill both agreed the weekend was an excellent blend of short

"lectures" by Mat, Jim, or one of the attendees, and relaxed conversations where representatives of the various disciplines could interact at will.

The "icebreaker" was a discussion focused on the misconceptions about tailless aircraft — instability, a tendency to tumble, complicated control systems, etc. Each of these was dispelled in turn by relating the experiences of Jim and Mat with the Pioneer II-D with photo or video tape evidence.

The Marske planform was then presented as a safe, economical method for achieving exceptional performance given its class and construction materials. Again, everything was supported with photos and videos, then Mat brought out the spreadsheets.

From there, the presentation moved on to the actual design process. This is the one area where the expertise of modelers turned out to be invaluable to the ongoing discussion. Compared to those involved with full size aircraft, modelers tend to design, build and fly a much larger number of aircraft over a given time span. This provides an enormous body of first hand evidence for what does and does not work in practice. And Mark and Bill had arrived with a large mental store of ideas from technical papers, magazine articles, and personal experience regarding tailless planforms.

The last portion of the workshop involved the future of tailless aircraft. Projected improvements in design and construction, and the advances in performance which are expected to result, were balanced with the acceptance of tailless aircraft by the public/consumer.

Mark and Bill came away from the workshop with a number of ideas for tailless designs, predominantly involving planforms with quarter chord lines which are perpendicular to the aircraft centerline or slightly swept forward.

As mentioned in prior columns, such a planform, with taper, provides a large arm for the elevator function and moves the ailerons to a position closer to the CG, allowing use of differential without adversely affecting pitch. If the aspect ratio is held to under ten, stall characteristics are quite benign and the Reynolds numbers are larger. Additionally, tailless aircraft of this type are quite easily constructed, can be very light, and can be designed to have minimal drag. All of this means an expanded speed range, ease of control, and excellent thermal ability.

Mat, until recently, had been flying his Monarch and thrilling in his ability to thermal well in very small areas of lift. When flying the Monarch, the pilot is almost entirely out in the open, and subject to feeling the air warm and cool, smelling the pollen being lifted by thermals, and having to wipe spider webs from his or her glasses. Mat explains that flying the Monarch is the closest thing to actually being a bird that one can imagine.

Jim flew his own Monarch at Harris Hill a few years ago and surprised everyone with a flight



Mat Redsell takes his Monarch up on auto tow. This launch method is quite inexpensive. A strain gauge readout visible to the driver makes sure the line tension remains consistent. Photo by Bill Kuhlman taken during the May 2000 workshop.



Mike Coutts at the controls as the Pioneer II-D starts its aerotow to altitude. This 'ship originally belonged to Lloyd Watson who had purchased it in nearly complete form from another owner. The Marske Flying Wings team rebuilt the entire aircraft. The wing surfaces were contoured to match the original airfoil and the fuselage underwent some modifications, including addition of a nose wheel. Wing tip extensions were added, increasing the wing span to just over 15 meters. Not readily apparent in this photo are the fences which separate the inner edge of the elevator from the fuselage fillet. This addition nearly eliminated the separated turbulent flow at the aft end of the fuselage. Photo by Bill Kuhlman/

in excess of four hours from a reasonable launch height.

Jim and Mat have recently experimented with a moveable CG for the Pioneer II-D. This opens even more vistas, as trim drag is substantially reduced. A ten pound weight has been installed, and it travels the length of the fuselage inside a tube, pulled along by a continuous cable attached to a rotary dial. The weight is slid forward for high speed cruising, to the rear for thermalling.

When Mike Coutts landed the Pioneer after the workshop demonstration flight, it seemed like the rollout was extremely long. Mike later related that once the nose wheel touches the ground, the glider just continues to travel in a straight line, and it's easy to run off the runway if the aircraft is canted on landing due to a cross-wind. When the main wheel touched the ground, Mike had simply moved the weight to the extreme rear of the aircraft and was able to hold the nose wheel off the ground for an extended run. Rudder authority was good enough that he could steer the aircraft down nearly the entire length of the runway.

Was the workshop worthwhile? Bill and Mark agree they learned a lot from the workshop, particularly because of the varied disciplines involved in the frequent discussions both during the workshop and during breaks. Additionally, watching the advanced Pioneer II-D fly was an awesome experience.

Mark is currently in the last stages of designing a TD 'wing which he hopes to campaign in local contests, and Bill is ready to start building two competition aircraft for the 2005 Visalia Fall festival — a two meter and an unlimited.

The one other item which Mark and Bill agree on is the need for scale models for preliminary flight testing of a new design and the desire to construct scale models just because it's so cool to be flying the closest thing to a full size aircraft without leaving the ground. In fact, Marske Flying Wings is well on the way to building a quarter scale Pioneer IV. And a future "On the 'Wing..." column will give details of the Monarch G, in hopes an *R/C Soaring Digest* reader will take on the challenge.

Until next time...



The Pioneer III takes shape at Marske Flying Wings in Marion Ohio. This is how the airframe appeared in July 2004. Both photos by Mark Nankivil.

Left: The fuselage consists of a welded steel tube internal frame and a fiberglass shell. The canopy will be hinged from the front. When the photo was taken, the instrument panel was cut out and in place. The rudder was constructed but was not attached. As is in keeping with what we have seen as a trend, the airfoil has minimal reflex and the pitching moment is only slightly positive.

Right: The wings are resting in plywood cradles, leading edge down. Jim Marske's Monarch wings serve as a backdrop. Notice the wing tips carry the same elliptical leading edge planform as the new tips which have been installed on the Pioneer II-D. The ailerons are fabricated but not installed as yet. The aileron and air brake pushrods are in evidence. The ribs are specially corrugated fiberglass with lightening holes cut out. The fabrication of the Pioneer III owes a lot to a prior building project, an essentially all carbon Monarch. The weight savings and additional strength made a big impression on the team, and a good portion of the technology was transferred to the fiberglass composite Pioneer II design.

Opposite page: The highly modified Pioneer II-D on tow over the Marion airport. The Pioneer behaves in excellent fashion when using the bridle system. Positioning relative to the tow aircraft wake is not critical. Photo by Mark Nankivil.

Page 30: Mike Couets brings the Pioneer II-D in for a smooth landing. Photo by Bill Kuhlman



