GLIDER REVIEW

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BREEZ ★ DAWN ★ Light DREAM

With negligible "billow", tip-oriented sail shift, and no pre-loaded leading edges . . . thus much lower trailing edge tension . . . and lighter weight in a greater span, earning reasonable handling . . . Pro Air's new Dawn holds both surprises and promise/Article and ground photos by Dan Johnson/Factory Statement and air photos from Progressive Aircraft Company.

THE DAWN

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JUST HOW MUCH difference can one see in Progressive Aircraft's newest model, the Dawn? How much of truly new thinking is involved? Can it compete? Will it sell? These are all engaging questions. No one has spent more time pondering them than designer, Dick Boone.

REFLECTIONS

It has not been an easy decade so far for U. S. hang gliding. Besides the well publicized dilemmas of shrinking Association membership and struggle-to-survive combat fought by nearly every retailer and most of the sports' remaining six U. S. manufacturers . . . a problem receiving lesser attention, but perhaps of even greater gravity is the lack of new product development of a sort which has *really* arrested the hang gliding community.

Progress has been marked most saliently by refinement. The double surface superships or bladewings which trailed UP's introduction of the Comet have received such precise attention to detail and structural integrity that many conclude this indicates the end of the rope has been reached for flex wing design. Without a doubt, every manufacturer would resist this allegation. Not only may such a concept be incorrect, but aggressive marketing simply cannot permit this complacent attitude.

Certainly, Delta Wing, via the Streak's impact, has increased its once disproportionately small market share.

Pacific Windcraft entered the foray so recently that its success cannot be positively assessed, with what might be called "the first intermediate double surface craft (the Vision)."

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Seedwings considerable progress with their Sensor 510VG (Variable Geometry) is a phenomenon with which front-runners Wills and UP must reckon. Trampenau's as yet uncertified VG was reportedly back-ordered some thirty five units in March. With a $2,800 price tag, this obviously must please the company whose 1983 unit sales totalled about 125.

As the majors — Wills, UP, and Bennett — rush to answer the retailer's cry for state-of-the-art intermediates (also read "trainers"), the custom builders stand ready to approach the improving 1984 market with an intriguing array of different ideas. Seedwings can be expected to pursue the 510VG's attraction with vigor, and certainly Trampenau's Santa Barbara company *does* now advertise as much or more than the Big Three. They also have plans to introduce a Hang 3 "intermediate Sensor 510." Once their new headquarters is fully organized, we can probably expect more promotion along this line.

Pacific Windcraft has just achieved what may be correctly labeled a "coup d'etat" by linking up with world leader La Mouette to introduce America to aero towing with the reverberations of a nuclear detonation. All manufacturers, retailers, and pilots can expect beneficial results from this effort. Even by itself, this move, certainly not their only one, should likely vault Bernasconi's firm into permanent national prominence. It certainly is an unusual occurrance when one manufacturer earns *both* magazine covers in the same month, for extraordinary achievement, like 221 miles on a Comet.

Mention must also be given to a new firm, developer of the control-bar-fitted Mitchell/Morely U-2 Superwing. Please refer to page 21 for further information on this newest of entrants.

AND NOW, FOR SOMETHING COMPLETELY DIFFERENT

Progressive Aircraft, a firm many industry observers perceive as a relative "sleeper" of late, is ready to unlease an entirely new approach to flex wings on the largely unsuspecting hang glider community. In concert with the newest offerings from every other manufacturer in the USA (and some surprisingly strong contention from foreign suppliers, like Airwave), Dick Boone's Pro Air is preparing the release of their new Dawn, following almost five years of research and development. The performance-attuned reader/pilot would do well to pore over the photos accompanying this article and to thoughtfully ponder what changes are really present. Jumping to unfounded conclusions will only serve to confuse the evaluator.

WHAT'S IT ALL ABOUT?
A LAYMAN'S VIEW

Let us begin with the airframe. Though sail technology is also somewhat different in the Dawn, the more salient departures can be witnessed in the frame design.

Probably the most striking change is the elimination of side wire bracing, top and bottom. But not only are struts doing this duty, their length is much shorter than when this alteration has been tried on earlier models.

In the current configuration — others have been used over the four years of development, but abandoned — cables *do* brace the control bar, fore and aft, as well as tension this plane of support. However, when you examine the photos, you see no top wires. A clever arrangement uses a kingpost which stands no taller than the keel pocket, thus concealing it, but also the erection of the kingpost occurs simultaneously with the rearward movement (tensioning) of the crossbar (read "cross-spar" for more accuracy).

Another obvious omission is that of luff lines, and the way-inboard location of the washout strut or defined tip. At a point we would guess to be just outboard of mid-span, you will discover a long, stout member which serves as the primary pitch stabilizer. A most interesting down-stream concept could employ this same component as a control surface lever arm (more on this in a later issue).

FEATURES
of the Dawn

1— Production Dawns are designed to be equipped with faired side struts and no top rigging.

2— The Pro-Dawn uses an inboard washout strut and has no bridle lines.

3— The tip is a combination of a curved aluminum tube to provide washout and a fibeglass rod for flexibility.

4— The crossbar (wing-spar in the case of the Pro-Dawn) is designed to support 75% of the designed flight loads, while most of the leading edge is under only tension loads. This innovative design feature makes the Pro-Dawn light while keeping the sail twist low.

5— Two mylar insert pockets per side.

6— Lexan/aluminum battens using three different sizes of tubing for ideal weight and strength.

7— Enclosed keel pocket, completely hiding all set-up hardware.

8— Unattached lower surface at tips.

But the main change about which all others hinge is the use of the crossbar as the main flight load support. Hmmm? Most unusual? Let's look at the idea.

Though it may seem inappropriate in a discussion of a new *glider*, let us look first at common (powered) ultralight construction. Perhaps the most similar, or copied, airframe design resembles the Eipper Quicksilver line. A leading edge tube is separated from a trailing edge tube by a series of compression struts. The leading edge carries the main flight loads, but the trailing edge comes in to sharp use when G load increases. The increased pull upward on the sail at the maximum camber point tugs forward on the sail's trailing edge, increasing load on that trailing edge. But no support member is positioned chordwise under the wing's center of lift. The resultant forces cause the need for adequately strong compression struts, with frequent usage of drag/anti-drag bracing. Ah, but hang gliders have no trailing edge member, you say?

True enough. And the lack of such a spar (except in the likes of fixed wing designs as the Fledgling, Easy Riser, or Mitchells) causes another whole range of problems.

Since the initial rogallo concept led us to triangulated airframes, the leading edge — as with the Quicksilver layout — is the main flight load support. The crossbar holds the leading edges at the proper angle and tensions the sail's otherwise unsupported trailing edge. What results is amazingly tight sails, pulled taut along the trailing edge by intense leading edge rigidity. This offers reduced twist (washing out) so that performance is enhanced. The leading edge, however stout (and correspondingly heavy), bows under this application, thus requiring complex sail design, construction, and fitting. While sailmaking has been honed to an artform by leading manufacturers, one very undesirable situation develops.

The tight-as-a-drum sail of modern gliders does not flex as well as on earlier models (more billow-y designs). Hence, handling suffers relatively in proportion to the effort which reduces twist (to heighten performance).

Various mechanisms have been employed to benefit handling, like tall control bars which give the pilot's weight shift more authority, floating crossbars (actually a floating keel), and shifting sails via tall keel pockets, which produce effective anhedral. Much experimentation with cloths — both "soft" and "hard" — has also played a role, as have several inventions to vary billow in flight.

AIRPLANES ARE NOT
SO CONSTRUCTED

To my knowledge (almost) every conventional airplane manufacturer uses another system to support in-flight loads. Very simply this is called a wing spar, but that term is not so very descriptive relative to this article. What *is* more informative is to say such flight load bearing spars run the span of the wing at a point within the wing directly under the center of lift.

But your average Beechcraft, Cessna,

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or Piper does not rely on weight shift, so no flexibility is required of its wing. Here, our modern sailgliders differ. And here is where the British Hiway Explorer got the conventional construction idea wrong. [See Explorer photo.] They too ran the all important cross-spar under the wing's center of lift. But in so doing, they sacrificed tip flex and inhibited sail shift. They were thus forced to add tip rudders to turn the Explorer, losing the simplicity of pure weight shift.

In Pro Air's Dawn, Boone has run the cross-spar from the same general point at the keel (root), but to a point *forward* of the center of lift at the tip. The cross-spar is bolted to the leading edge at approximately three quarters of the way to the tip. What happens there is that the tip then is set free of flexibility restraints imposed by a full length cross-spar (as on the Explorer). So the best aspect of weight shift works in harmony with this sensible-sounding idea of a cross-spar for flight load support.

NOW TO THE SAIL

In conventional (rogallo-type) configurations, when increased in-flight loads are imposed, the sail pulls forward from the trailing edge (as on the Quicksilver) because the support spar (leading edge) is forward of the center of lift. The resultant distortion causes more billow, or perhaps more correctly, increased twist. This increase in twist defeats performance, and is thereby undesirable. To combat this loss, high tensions are imposed on the trailing edge to restrict most of the twist. But two disadvantages reveal themselves.

Firstly, the airframe structure must handle the trailing edge tension, which necessitates heavier components. The trailing edge tension is transmitted to the leading edge — which bends rearward under the load — and in turn the leading edges cause a significant increase of column load on the crossbar. Another by-product of this first disadvantage is the extra effort needed to design and craft a sail to precisely fit such compound curves. Secondly, because of the great tension on the trailing edge, tip flexibility and sail shift are reduced, which stiffens handling.

Since the Dawn's sail is supported right below the center of lift, billow or twist distortion is demonstrably lower. And because of all this, greater span relative to sail area — or higher aspect ratio — can be used, usually credited with offering greater performance.

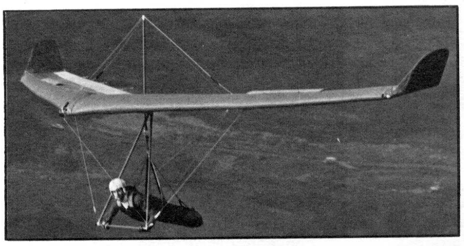
CONCLUSIONS

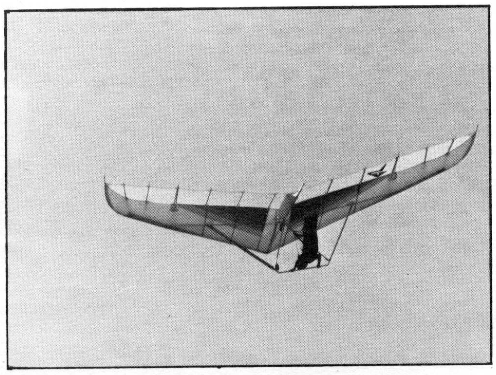
The Dawn is too new to know, absolutely, if performance is greater than other top performers of today. Comparative testing plans are underway, employing aero tugs pulling up two gliders to high altitudes in neutral air for long straight runs. This may help quantify values gained in the breakthrough inherent with construction used in the Dawn.

But certainly we can see new technology here. Boone's design may be able to suggest much greater increases in span, while holding weight down. The pilot might be moved closer to the wing, which may enhance performance. Sails will not be under such stress and may last longer. Augmented weight shift control using moveable washout struts could bring un-heard-of controllability. And cleanliness of the overall package may accompany the reduction in aircraft weight to produce the wings of tomorrow.

Is this the beginning of "Good Bye" to the faithful rogallo? As the first rays of a new summer soaring season begin to light up the day, we can see a whole new Dawn out there.

(Left) The Hiway Explorer, discontinued from production when Hiway collapsed. (Right) The new Dawn from Progressive Aircraft.





In looking at the above wings, little similarity is obvious, yet more is present than initially meets the eye. Both craft use "wing spars" to bear in-flight loads. The primary difference, and the one causing Hiway to employ the rudders you see, relates to the positioning of the wing spar. By having it forward of the center of lift line at the tip, Pro Air's Dawn retains weight shift control simplicity.

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SPECIFCATIONS

Leading Edge	Primary 16' 8" ..... Tip 4'
Keel Length	7 feet
Nose Angle	130°
Sail Area	155 square feet
Wing Span	34½ feet
Aspect Ratio	7.68:1
Weight	53 pounds (ready to fly)
Pilot Weight Range	150-240 pounds (hook in)

NOTE: Because of its light weight, to achieve your desired wing loading, less glider area is required. A 150 pound pilot would have the same wing loading as in a 172 ft² glider weighing 74 pounds.

Battens per Side	6 upper ..... 3 lower
Set-up Time	10 minutes
Price	$2,395
Introductory Pricing	$2,095

PROGRESSIVE AIRCRAFT FACTORY STATEMENT ON THE DAWN DESIGN

THERE WILL BE a new glider on the market this spring. Designed and manufactured by Progressive Aircraft Company, the Dawn represents a totally new concept in hang glider design. This concept may very well lead the industry into a new era.

With its completely new blend of aerodynamics and structure, the Dawn is not just a new generation of comtemporary design, but rather a new family of design in a class all its own. Compared to rogallo glider design and to rigid wing glider designs, the Dawn is strikingly new and different.

Francis Rogallo's twin lobed weight shift design — two leading edges, crossbar, and keel — is the basic concept in use by 95% of modern hang gliders. Progressing step-by-step, today's gliders, although refined, has a structure almost identical to that of the original standard, with the exception of much higher loads. Current designs have made compromises of performance/handling and weight/complexity. Presently the limitations of this basic design (rogallo) is shown in high performance gliders of today which have all met a similar performance barrier.

The advantage of the rogallo design is weight shift control, which is achieved through the interaction of forces present during flight. On the given airfoil of a glider, total upward force (lift) is located behind its support point, the leading edge, making the rear of the sail rotate up when loads are increased. This upward rotation is called washout or twist. Washout at the tips is needed to prevent tip stalling in turns. In the center of the glider it could mean a loss of lift and an increase in drag. Washout (or twist) is controlled by tensioning the sail along the trailing edge. This creates substantial loading on the leading edges and cross-bar resulting in a heavier structure.

In comparison, wing spar construction is used in almost every modern airplane. Flying load support points (spars) are balanced around the total lift force of the wing. In this design the wing will want to lift uniformly, preventing the washing or twisting up of the wing. This construction prevents excess trailing edge tension, but does not allow for weight shift roll control. The Fledgling, Easy Riser, and Quicksilvers are some examples.

The concept behind the development of the Dawn is one of selecting the best points of both structures. The majority of the flight loads are supported by the Dawn's cross-spar (crossbar), so very little twisting is present. With little twisting load, excess sail tension is not needed to control the washout. Without this additional trailing edge load, the structure can be made lighter. This same location of the cross spar will prevent the sail from blowing down at low angles of attack. This is nearly the same function that normal bridle lines of conventional weight shift gliders, in supporting the center trailing edge of the glider for pitch stability.

The outboard areas of the Dawn operate much like the normal weight shift hang glider. Measured on the trailing edge, the length of the tip on the Dawn which must be supported from excessive twist is about 60% less than normal weight shift gliders. This means that loads, other than flight loads, are much lower. Thus again, the structure can be made lighter.

NOTE: Though in the photographs a significant amount of twist can be seen, the effect is a visual illusion. On "conventional" state-of-the-art gliders, effective anhedral at the leading edge gives the trailing edge a very flat look. On the Dawn, with effective dihedral, the trailing edge appears to have more twist. However, on both configurations, if one examines the tip angles contrasted to root angle of attack, one sees the twist on the Dawn is held very low.

Turning weight shift gliders is complicated. A major contributor to this is the twisting (billowing) of the sail when it is assymmetrically loaded. This twisting of the sail is made less effective by the load created by high sail tension needed for low sail twist.

The Dawn "billows" more with less pilot input, due to its lower trailing edge sail tension. With the center section of the glider structurally supporting the twist, the Dawn will tend to twist up much further out towards the wing tips. Being that the twist (drag) is further out toward the tip, less drag is needed to start the turn. This will result in a glider that has the benefit of lower structural weight and low sail twisting, yet is very easily weight shift controlled. The Dawn is such a glider.

Another difference is the location of the side support (usually side wires). It is placed on the cross-spar since this is the load bearing member. This places the support in from the leading edges.

This point, along with the fact that bridle lines are not needed (described in earlier paragraph) led to the use of side struts, thus eliminating the need for a

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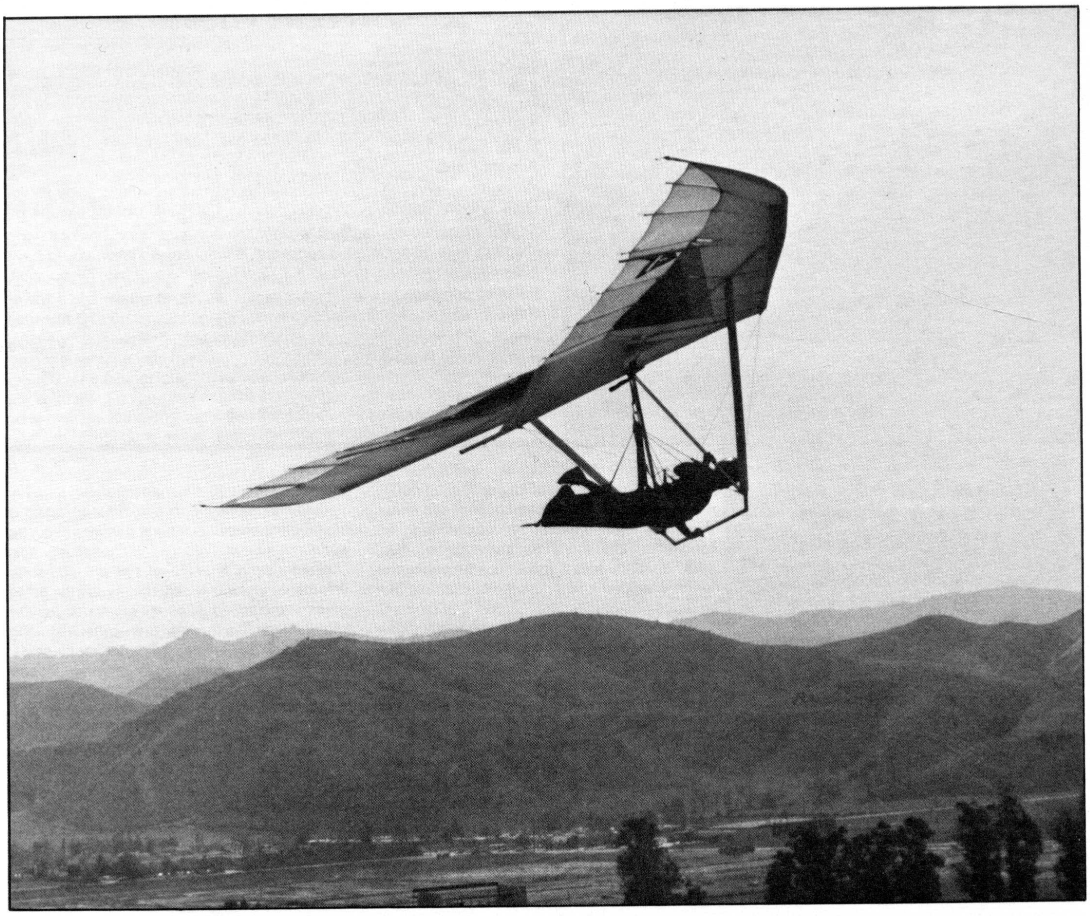

kingpost. The strut is much shorter, lighter, and stronger than ever before possible. The overall frontal drag of the front side struts are not necessarily less than that of the kingpost, top wires, and lower side wires, but there is additional lift loss and drag gain from the disturbance of the airflow caused by the wires being close to the sail and leading edge. There is even more loss of lift and gain of drag located behind the kingpost and created by the kingpost hole. All of these additional performance losses are not found on the strutted Dawn.

There is almost no bending on the leading edges of the frame, so no curved sail cut is needed. This makes an exceptionally clean glider. Two mylar pockets are used. The one located around the leading edge is stiffened with additional foam to supply an exacting leading edge radius. The second is above the first and supplies additional support to the sail camber along the leading edges.

A mid span washout strut is located to support maximum area for additional stability. This is inserted into a pocket and then located into place. This position supports the greatest amount of sail area. It is allowed to float up with the sail, and locks into a set angle in the negative direction.

The Dawn is designed with a very high span ratio for its given area. This is very desirable for performance, but is normally very hard to achieve in conventional gliders. The Dawn's structure allows greater span, *without excessive weight gains.* Usually a larger span on normal gliders means more trailing edge sail tension, causing heavier frame weights.

To finish off the glider, fiberglass round tips were chosen to provide a cleaner air flow and flexibility. The tips are drilled at a set positive angle of attack, providing even more pitch stability.

The Dawn represents a breakthrough into a new era in hang glider design. This glider represents years of work by many individuals at Progressive Aircraft Company. We are proud to present this glider into your world of flying enjoyment. Hopefully the future will bring such advancements as cantilevered wings and enclosed pilot pods, yet the simplicity of breakdown and transportation. §