62592

DEPT. OF TRANSPORTATION DOCKETS

99 SEP -2 AM 10:19

Comments Regarding

Notice of Proposed Rulemaking
Docket No. FAA-99-5926 & FAA-99-5927
U.S. Department of Transportation
400 Seventh Street SW, Room Plaza 401
Washington DC 20590

FAA-99-5926 -31

Submitted by:
Stemme USA, Inc
Suite 760
1401 South Brentwood Blvd
St. Louis, MO 63144

FAA-99-5927 -31

3 September, 1999

Stemme USA, Inc, endorses the FAA's intention to restore to the Grand Canyon the "natural quiet" as defined by the National Park Service. As a means to reduce or eliminate noise, the proposed rule making would reduce the number flights and routes available to commercial air-tour operators, expand Flight-Free Zones (FFZ's) and eliminate the availability of new air-tour licenses. Unfortunately, however, the proposed rulemaking needlessly bars operation of aircraft that can operate without making noise.

The new rules should be adjusted to correct this oversight and, furthermore, lift all flight restrictions for private and commercial overflight, including air-tour operations, when conducted in aircraft that can be operated silently. By doing so, the FAA would serve the interests of all its constituents. Citizens enjoying the park at ground level would be unaware of the activity overhead, commercial air-tour operators would profit, a larger number of visitors would be permitted a memorable "bird's eye view" of the Grand Canyon and general aviation would retain normal access to very desirable airspace.

With the exception of flight rules normally imposed by FAR Part91, gliders, motorgliders and self-launching sailplanes should be exempt from all overftight limitations, if such flight is conducted over the Canyon without making noise audible from the ground. The STEMME S10 marketed by Stemme USA, Inc. illustrates the practicality and desirability of such an exemption. Other aircraft that have similar flight characteristics should similarly be exempt from Canyon overflight restrictions.

The STEMME S10 exemplifies a class of aircraft that are capable of operating within even the most stringent noise parameters set forth the National Park Service. Commercial tour operators successfully employ the Stemme S10 to conduct profitable sightseeing operations throughout the world. In the United States, locations include numerous ski resorts, desert and mountainous locations, beach areas, and islands. Two STEMME S10 aircraft are currently in use by the U.S.

STEMME USA, Inc.
1401 SOUTH BRENTWOOD BLVD, SUITE 760, SAINT LOUIS, MISSOURI 63144
314-721-5904 VOICE 314-726-5114 FAX

Air Force at the Air Force Academy. The **STEMME** SIO-VT is a type certificated, turbo-charged two seat aircraft with a glide ratio of **50-to-1**.

Typical missions for Air Tour operators adjacent to the Grand Canyon would include a powered take-off and short powered flight to the edge of the FFZ. While powered, the **STEMME S10** is extremely quiet (57 **dB** at 1,000 ft). Prior to entering the FFZ the pilot would transition to "silent" soaring flight and enter the "natural quite" area. In absolutely still air, the **STEMME S10** sinks at a rate of 112 **ft/min,** or more than 20 minutes of gliding flight if started from an altitude of 3,000 ft above the rim. The air over the Canyon, however, is rarely still and a soaring pilot would be able to use natural lift to stay aloft indefinitely, all without use of the engine. In a typical scenario, three minutes of powered climb would be sufficient to launch a multi-hour flight, if desired. For readers unfamiliar with cross country soaring in general or the **STEMME S10** in particular, a written account is attached describing a 3,000 nautical mile trip which consumed a total of 8 gallons of fuel.

Air Tour operators could operate a large number of **STEMME S10** aircraft to provide glider sightseeing opportunities for the general public. These aircraft could easily operate under the **3,000-ft** floor imposed on traditional powered aircraft thereby posing no interference to other scenic flights, yet operate silently. Even if a large number of **STEMME S10** aircraft were operating directly overhead, unless park visitors were to look up, they would be unaware of the aircraft soaring silently above. Soaring flight is absolutely silent to persons on the ground.

Video and additional literature regarding **STEMME S10** aircraft is enclosed for those members of the decision-making body unfamiliar with this class of plane.

For the aforementioned reasons, we strongly urge the FAA to exclude the **STEMME S10,** as well as other aircraft that can operate silently, from all current and future flight restrictions over the Grand Canyon whose goal is the limitation of noise.

We can be reached at 314-721-5904 and would be pleased to address any additional questions these comments may stimulate.

Respectfully submitted,

Marc Arnold
Vice President
Stemme USA, Inc.

AVAILABILITY OF NON-SCANNABLE ITEMS

FAA-99-5926-31
FAA-99-5927-31

Document Number

Old Docket Number, If any

3 copies of the VHS Tape: "The Best of Both Worlds"

Name / Description of Item(s) non-scannable

MAY BE VIEWED IN

FAA Headquarters
Docket Office
800 Independence Avenue, S.W., Room 915-G
Wash., D.C. 20591

Agency / Office Name / Room Number / Contact Person (if any)

during the hours of 9-5 p.m.

(word7.0;\ R:\nscanitm)

FAA RECLASSIFIES ALL AIRSPACE IN U.S.

REPRINTED FROM

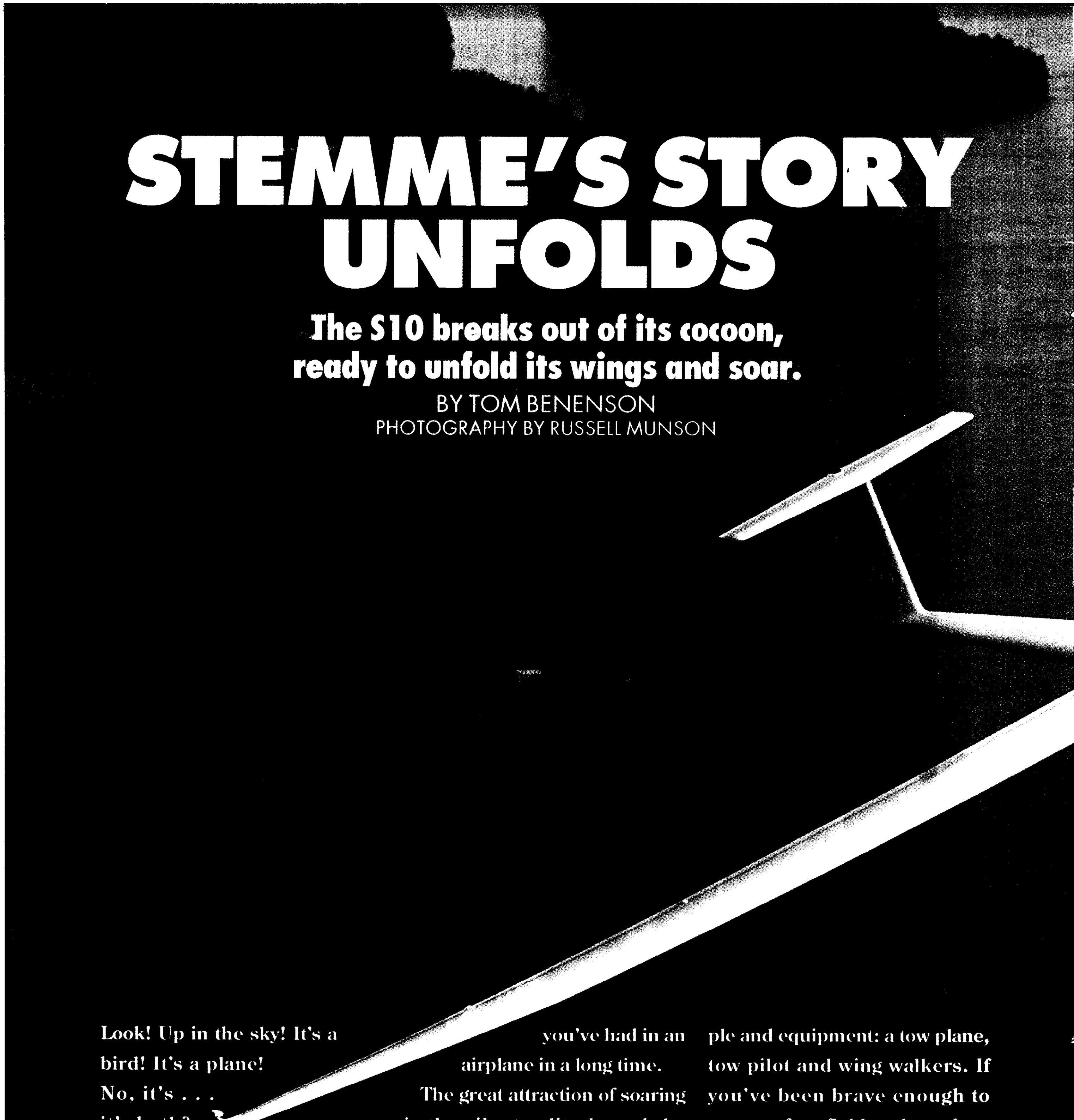
FLYING®

World's Most Widely Read Aviation Magazine

October 19[illegible]

A36 BONANZA TURNS 25
HOWARD 500: LAST HURRAH FOR PISTON BIZPLANES

Stemme's Story Unfolds: The S10 "Chrysalis"



STEMME'S STORY UNFOLDS

The S10 breaks out of its cocoon, ready to unfold its wings and soar.

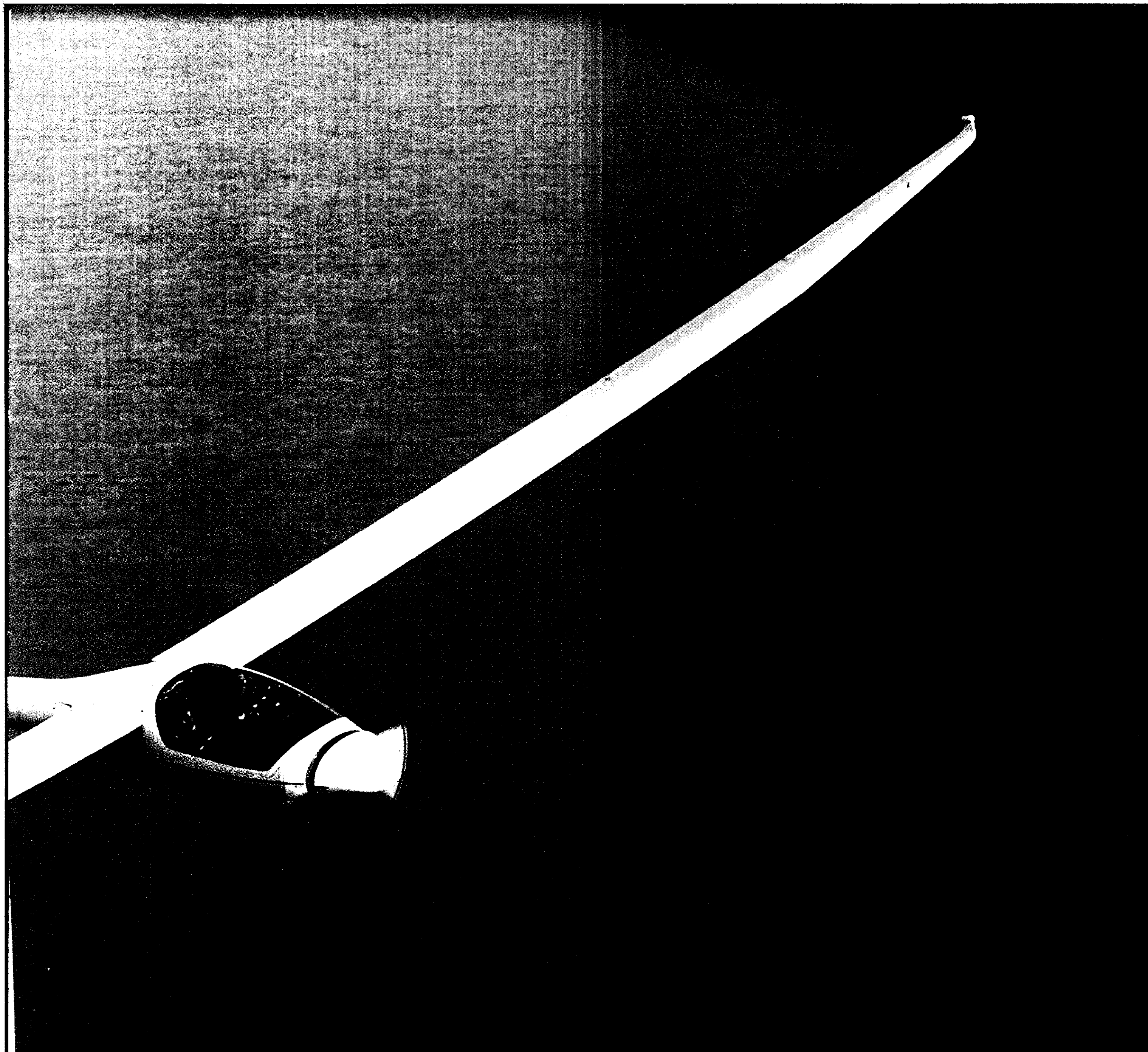
BY TOM BENENSON

PHOTOGRAPHY BY RUSSELL MUNSON

Look! Up in the sky! It's a bird! It's a plane! No, it's . . . it's both?

Yep, both. Although its FAA pedigree papers call it the Stemme (pronounced "Stem-ee") S10 Chrysalis and define it as a self-launching glider, what it really is, is both an airplane and a glider—and more fun than you've had in an airplane in a long time.

The great attraction of soaring is the silent solitude and the challenge of pitting your skills against the elements. Unfortunately, catching some lift and getting a good ride only come after getting high. If you're flying a non-self-launching glider you require a cadre of support people and equipment: a tow plane, tow pilot and wing walkers. If you've been brave enough to venture far afield and you lose your lift, you'll need a team of friends to come carry you out of the field and truck you home. Soaring with the eagles sours pretty quickly when you're stuck having to coordinate and cooperate with turkeys on the



ground. But now, by hiding a real engine in the fuselage of a sleek high-performance glider, Stemme has made getting up there half the fun.

I was introduced to the S10 Chrysalis at Bi-States Park Airport in Cahokia, Illinois, just across the Mississippi River from the St. Louis Gateway Arch. Bi-States is a tower-controlled field with parallel runways and lots of training traffic tucked under the St. Louis TCA. Except for the Cahokia Indian Mounds it's pretty flat territory. Not a place where you'd find a great deal of ridge lift and not a site that would seem particularly hospitable to glider operations. But St. Louis is in the middle of the country and that's where Barbara Pfifferling, president of Stemme USA, the U.S. marketing arm for the German manufacturer, and Marc Arnold, vice president and demo pilot, have based their operation. (They have since moved their demonstrator to Spirit of St. Louis Airport, 20 miles southwest of St. Louis.)

Once they got it clear of the

hangar doors (the S10 can live in a normal-size T-hangar since its double-jointed long thin wings fold back from about halfway out the span, tuck in just ahead of the vertical T tail, and rest on the back of the fuselage), Marc and Barbara quickly rigged the glider. The wings were unfolded and the male end of the spar on the folding section slipped into a pocket on the inner section of the wing. Electrical wires for the optional position lights on the end of the wing and a hip-and-socket joint for

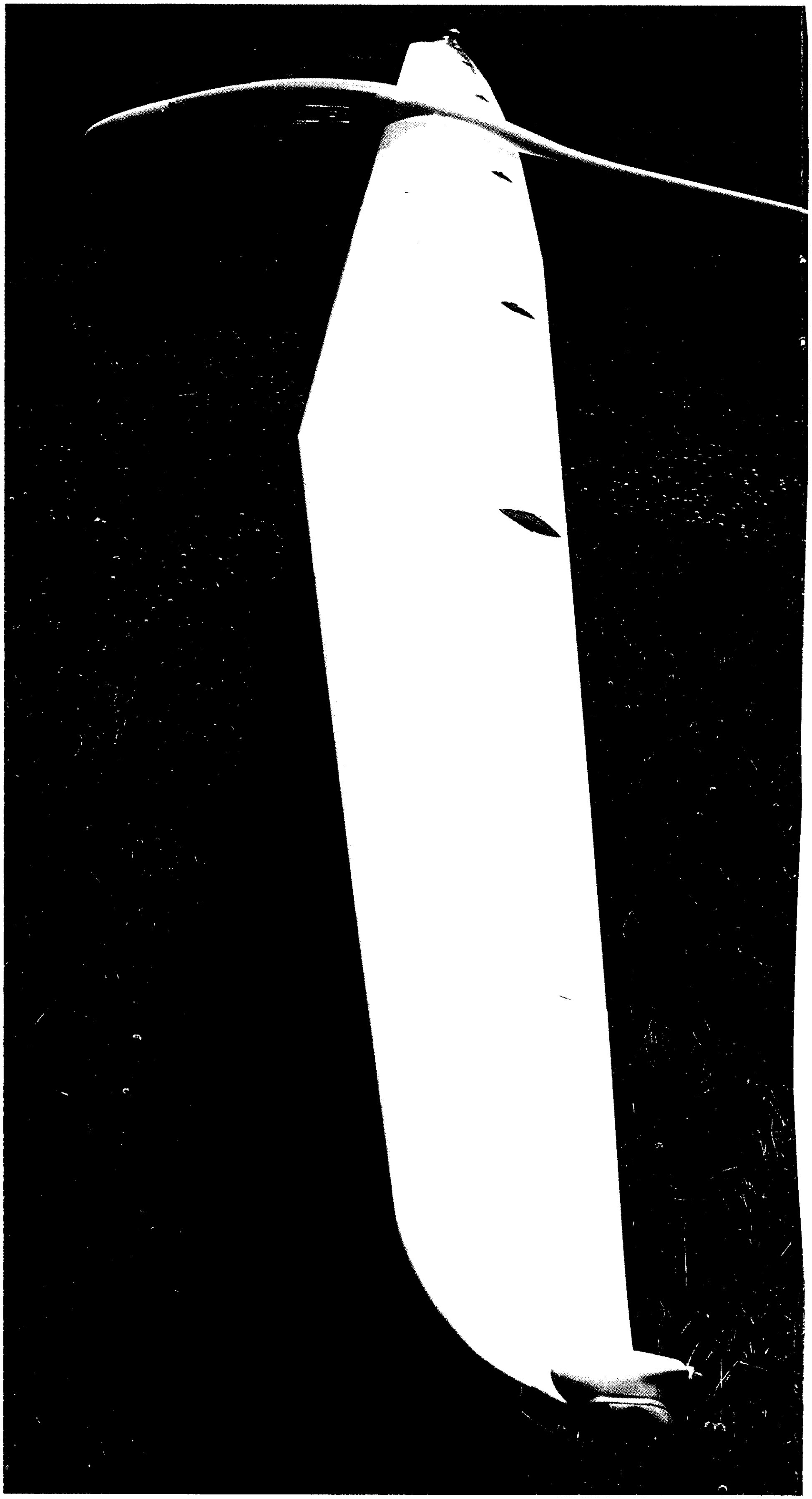
The S10 can live in a normal-size T-hangar since its wings fold back and tuck in just ahead of the T tail.

the control rods for the flaps, ailerons and air brakes were connected. Finally, a thick pin secured the spar extension in the pocket. A two-foot-long pitot tube was screwed into the front of the nose, and the Chrysalis was ready to go.

Before a glider can soar it has to be launched. That's when the Chrysalis turns heads and brings lapsed soarers back to the fold. A four-stroke, four-cylinder 93-hp Limbach L2400 engine is buried behind the pilot seats and connected through a long carbon-fiber propshaft to a two-blade folding prop mounted in the nose cone.

When stowed, the only indication that there's a propeller lurking about is the "warning propeller" notice painted on the nose. To deploy the propeller, a T-handle in the cockpit is moved forward, pushing the nose cone forward and creating a gap in which the folded propeller can open. The T-handle also opens air intakes on either side of the fuselage.

The engine start procedure is simple. The choke is opened, the throttle put in idle and the master switch (for avionics) and an engine master switch turned on. The electrical fuel pump on the right tank (the left tank has a mechanical pump; there are also backup emergency pumps for both tanks) is turned on and then the starter switch is pushed until centrifugal force has fully extended the propeller blades. Finally,



The keys to the S10's personality are its double-jointed wings and the shy folding prop that hides away when not needed for get-up-and-go (held in view by Barbara Pfifferling and Marc Arnold).

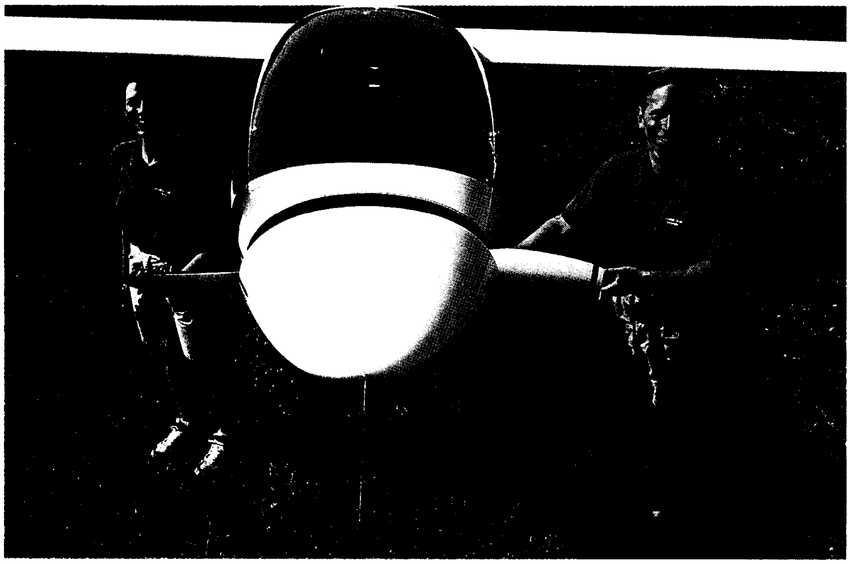
the ignition is switched on and the engine fires.

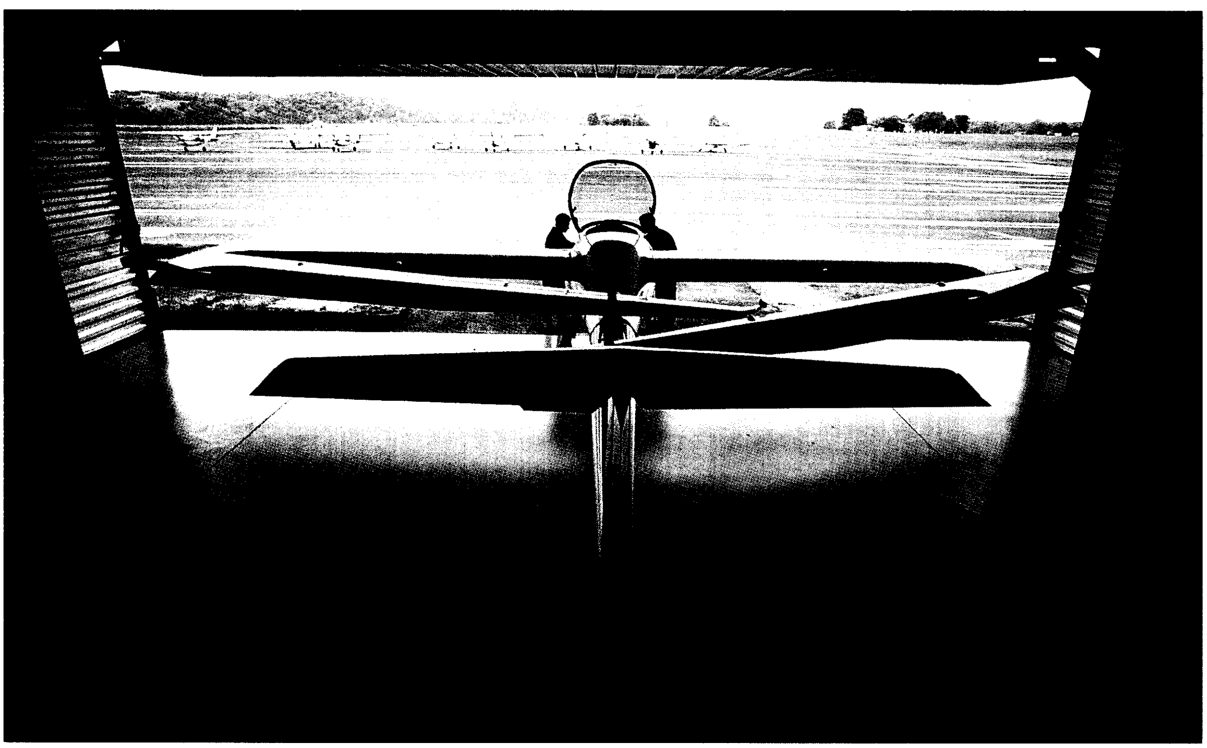
Taxiing presents no special challenges. Although there is no differential braking-each control stick has a bicycle-like hand brake that grabs both wheels simultaneously-the ground track is easily controlled through the steerable tailwheel. Unlike in some tailwheel planes, the pilot can comfortably see ahead around the curve of the instrument panel during ground operations. The view of the wingtips is not so good. The airplane is 76 feet wide and, unless the optional position lights are installed, it's impossible to see the wingtips from the cockpit. Taxiing between hangars or along narrow runways with signs or snowbanks requires extra vigilance.

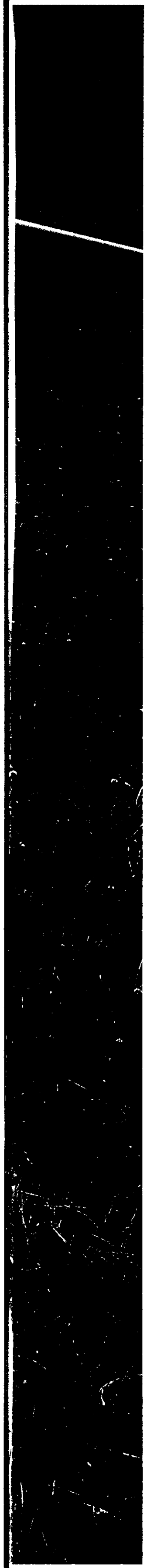
Takeoff calls for raising the tail at 40 knots and lifting off at 46 knots. Once off the ground you accelerate to 60 knots in horizontal flight (and ground effect) and then transition to the climb. Best-rate-of-climb speed is 62 knots. The takeoff profile reminded me of a helicopter negotiating the height-velocity curve. Once the tail came up, the S10 seemed to levitate vertically until it was a couple feet above the runway, then it scooted along picking up speed before climbing away. Full power (3,200 rpm) can be used for up to five minutes.

It was hard to know how much of our climb was from the engine and how much from rising air-even under lousy gliding conditions-but the VSI was indicating between 500 and 800 fpm most of the way up to 4,400 feet, where we leveled off just under a layer of the TCA.

The Chrysalis moniker implies that the Stemme S10 metamorphoses from an ugly caterpillar to a graceful butterfly, but,







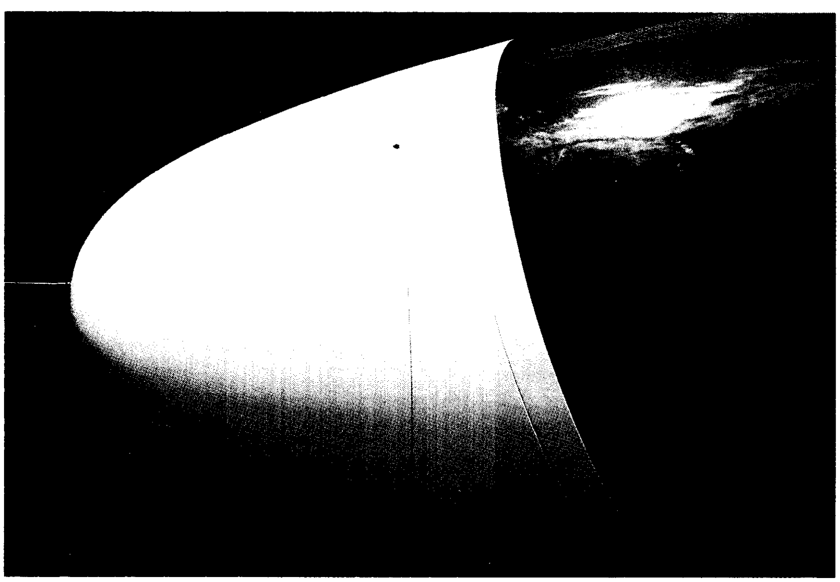
frankly, as a caterpillar the S10 is no slouch. With the variable-pitch prop op tion, the two-seater will climb at 750 fpm, motor along at some 121 knots while burning approximately 4.5 gallons an hour, and span more than 800 nm. (The demonstrator we flew was fitted with the fixed-pitch system, which gives it a cruise speed of about 90 knots and a rate of climb of about 600 fpm.)

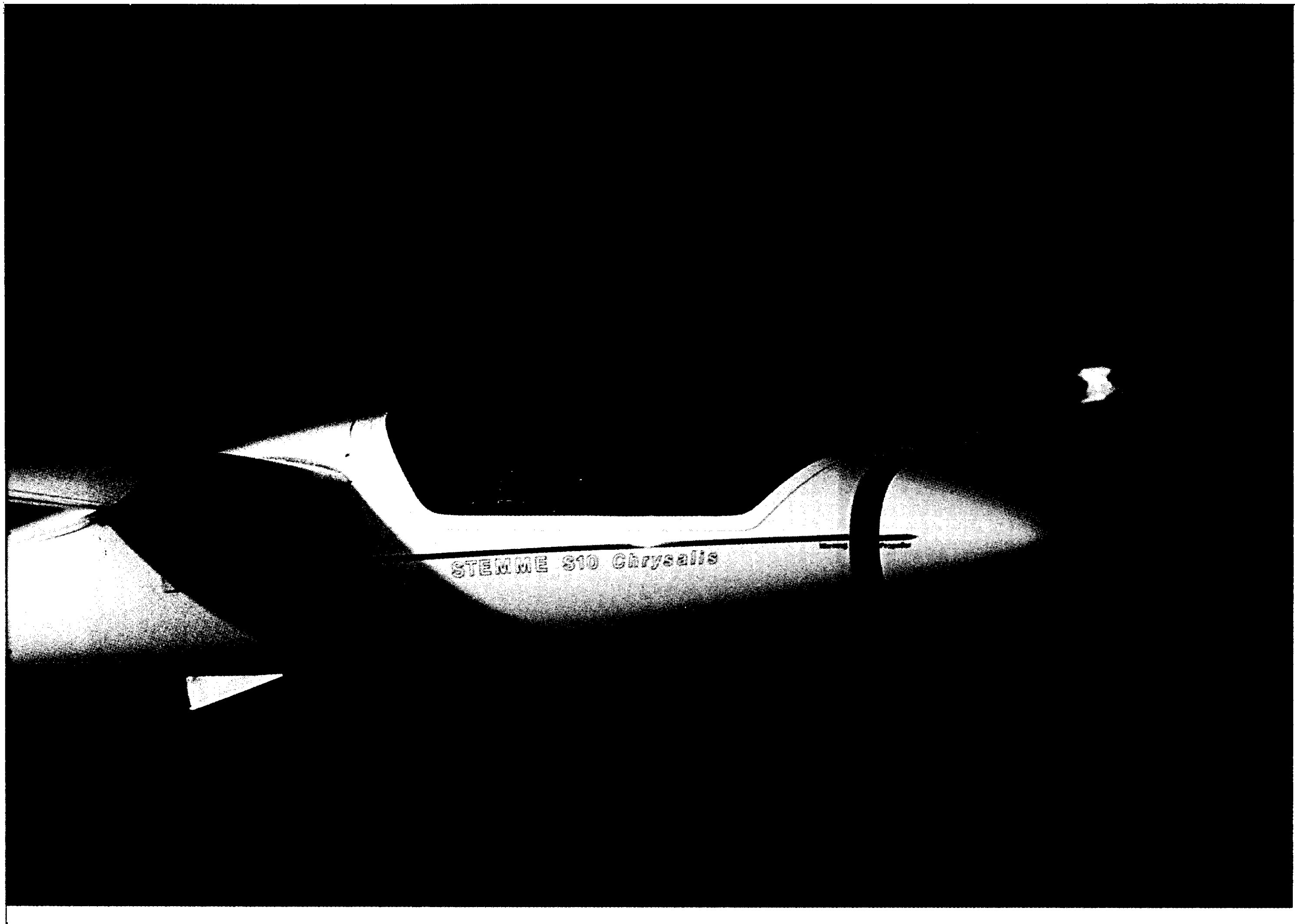
The only negative about the Chrysalis as a cross-country machine derives from the same factor that makes it such a good glider—the long smooth wing. The pilot's flight manual warns: "During flight in rain the stalling speed increases by up to 10 percent. Accordingly the approach speed for landing has to be increased by up to 10 percent. The takeoff run can increase by up to 50 percent . . . The climb rate can be reduced by up to 50 percent. For these reasons it is strongly advised not to fly with wet wings and/or during rain."

The change from powered flight to gliding flight is simple and quick. With the airspeed reduced to 48 knots, the ignition and engine master are switched off. A propeller brake is pulled to stop the prop's rotation, which allows the spring system to fold the blades. A second cable is pulled to position the blades so they won't interfere with the retraction of the nose cone. The T-handle that extended the nose cone is pulled and locked into place, retracting the nose cone and closing the air intakes.

The first thing that surprises a short-

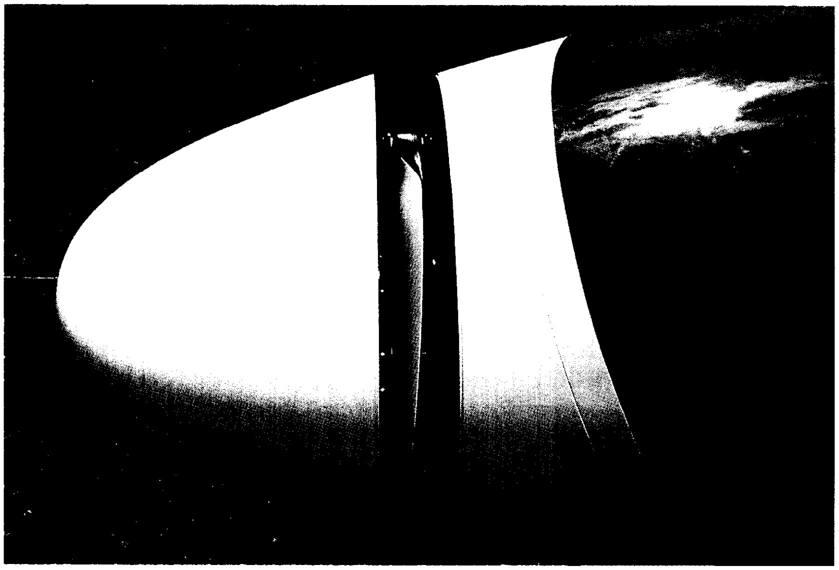
The sleek nose cone (below) pulls closed to contain the folding prop and preserve the S10's reputation as a competitive glider.





wing power-plane pilot about flying gliders is how much rudder is required to keep the yaw-string centered. Essentially a string of wool that's taped to the windscreen, the yaw-string is a constant reminder of how effectively you're coordinating the turns. Lots of leverage is provided by the ailerons way out at the end of the long thin wings, and adverse yaw is a constant concern of glider pilots, who are true minimalists when it comes to drag, particularly when they're trying to eke out lift from a weak thermal. Marc told me I needed to lead with the rudder as I banked, but it took awhile for me to be as aggressive with the rudder as I needed to keep the yaw-string from pointing its finger at me.

With the nose cone pushed forward, the folded propeller is free to pop out of its shell like a chick emerging from the egg.



The stall warning system operates only when the engine is running, and provides a two-tone, European-police-siren sound. With the engine stowed, the stall warning is limited to aerodynamic buffeting. As I was concentrating on how much rudder it took to keep the yaw-string centered, I inadvertently nibbled at the edge of the stall. "You want to see how it stalls?" Marc asked. I did. It was nothing out of the ordinary. It broke very gently, and releasing the back pressure had us soaring again almost before I knew it.

Unlike in power airplanes where you normally try to avoid turbulence, when you're flying a glider you seek it out, since it's often a sign of lift. As Marc and I flew around on a gray day, we flit-

TOM BENENSON

With its sports-car-like seats and an avionics panel fitted out for serious traveling, the S10 is almost as reluctant as its pilots to give up soaring and sink back to earth.

Approach speed is 59 knots and speedbrakes (spoilers) on the upper surface of the inboard wings are used to control the approach. "Just as you'd use the throttle to control your approach path," Marc explained, "you go forward with the spoiler lever to go faster, and pull back to slow down."

As we landed, there were planes waiting to take off and I couldn't help imagining what was going through the pilots' minds. Here was a glider landing on the active runway-and no one nearby to get it off and out of the way. Not to worry. On the roll-out, Marc pushed the nose cone open, pushed the starter button and when the prop had unfolded, hit the ignition and we taxied off just like any other airplane.

The price of the basic Stemme S10 is just under $140,000. A trailer adds about $21,000 to the package. The demonstrator we flew was fitted out with just about everything you could put in it, including the Hudis HUD, an Argus 3000 moving map and a GPS. Loaded the way it was, it goes out the door at close to $200,000. Not a paltry sum, but Marc pointed out that a lot of pilots who own high-performance airplanes have lost some of the fun of flying. It's hard to take a 210, Bonanza or Mooney up for a couple of hours to get back to basics. Imagine the seduction if you had something like the Chrysalis in your hangar singing its siren song when you're in need of a lift.

Although glider licenses are restricted to the type of launch that was demonstrated during the practical flight test (that is, aero tow or ground tow), under current regulations any person with a glider rating, regardless of the tow demonstrated, automatically has self-launch privileges. Unfortunately, since the Chrysalis is certified as a glider, it doesn't work the other way. A pilot with single-engine privileges can't fly a "self-launching" glider without a glider rating. Too bad. It means I'll have to get my glider rating before I can legally leave the turkeys behind and take the Chrysalis up to soar with the eagles. cl ted below the clouds trying to find rising columns of air. When we felt a bump we'd quickly circle back, trying to find the core of the climbing column. The VSI, actually a more precise variometer, and the HUD above the panel helped us find the "elevator going up" or the area where we would descend most slowly. The optional HUD depicted current gliding conditions, including airspeed, groundspeed, altitude, vertical trend, rate of climb, VNE given the current conditions and, if you're flying competitively, the best speed for a dash to the finish line from your current altitude.

When they thermal, glider pilots circle in rising columns of air beneath the clouds. At the base of the clouds they set off for the next cloud, losing as little altitude as possible between the areas of lift. The S10's glide ratio of 50 to one (the demonstrator's N-number is N5021, "fifty-to-one") qualifies it as a true high-performance glider. The minimum sink rate is 110 fpm, and VNE, to scurry between pedestals of rising air, is 146 knots. The flaps can be set five degrees up to make the wing even more efficient for the high-speed, low-sink-rate dashes. Flaps are typically set at five or 10 degrees down when climbing in a thermal and 16 degrees down for landing.

When you run out of lift-or playtime-and it's time to motor again, powering up is as quick and easy as shutting down. The airspeed is reduced to less than 75 knots; the nose cone is moved forward by lifting the T-handle out of the locked position and pushing it forward. The engine master switch is turned on, the throttle set to idle, the fuel cock opened, the starter activated until the propeller blades are extended, and then the ignition is engaged until the engine fires. The entire operation takes less time to do than to read about.

Marc and I had been out "thermaling," finding little patches of lift—mostly resulting from uneven ground heating where the weak sun was able to find its way to the ground around the scattered layer-and finally, because of time constraints, decided to glide back to the airport.

STEMME S10

The airplane flown for this report was equipped with VFR instruments, Hudis head-up display, Garmin GPS, Argus 3000 moving map, ELT, Terra transceiver, Terra transponder, folding wings, large fuel tanks and standby avionics battery. Options added 91 pounds, bringing the aircraft empty weight to 1,501 pounds, leaving a useful load of 373 pounds. The aircraft's price, as flown, was $179,310. Performance figures are taken from the pilot's operating handbook and reflect maximum takeoff weight and standard day conditions at sea level.

Standard price	approx. $139,700
Engine	Limbach L2400 EB1.D, 93 hp
TBO	900 hrs
Prop	Stemme 10AP-N
Seats	2
Length	27.6 ft
Height	5.74 ft
Wingspan	75.5 ft
Wing area	201.64 sq ft
Wing aspect ratio	28.22
Max takeoff weight	1,874 lbs
Standard empty weight	1,410 lbs
Max useful load	464 lbs
Max landing weight	1,874 lbs
Wing loading	9.29 lbs/sq ft
Power loading	20.2 lbs/hp
Max usable fuel	23 gals
Best-rate-of-climb airspeed	62 kts
Max rate of climb	590 fpm
Best glide ratio	50: 1
Minimum sink rate	110 fpm
Never-exceed speed (Vne)	146 kts
Cruise, 3,000 rpm	89 kts
Fuel flow, 3,000 rpm, sea level	3.4 gph
Endurance, 3,000 t-pm, 45 min. reserve	
standard tanks (23.8 gals)	6.9 hrs
optional tanks (31.8 gals)	9 hrs
Stalling speed, engine idling, flaps zero, gear down, air brakes open	47 kts
Stalling speed flaps/gear down	42 kts
Turbulent-air penetration speed	97 kts

Chrysalis™

STEMME S-10 Motorglider*

Crew	Seats two pilots, side-by-side	
Limbach Engine	93 hp	69 kw
Wingspan	23 m	75.5 ft
Length	8.4 m	27.6 ft
Max Gross Wt.	850 kg	1,874 lbs
Empty Wt.	640 kg	1,410 lbs
Best Glide	50:1 ratio	50:1 ratio
Min Sink Rate	0.55 m/sec	110 ft/min
Vne	146 kts	168 mph
Stall Speed	42 kts	48 mph
Cruise Speed	121 kts	140 mph
Climb Rate	3.7 m/sec	750 ft/min
Fuel Capacity	120 liters	31.7 gal
Range	1180 nm	1350 miles

* With "Variable pitch" propeller option.
Specifications subject to change.

For more information, or to arrange for your transformational flight in Chrysalis, call, write or fax:

STEMME GmbH & Co KG
Am Flugplatz
15344 Strausberg
Berlin, Germany
(03341) 31.11.70 phone 31.11.73 fax

STEMME USA, Inc.
200 South Brentwood Blvd, Suite 21 B
St. Louis, Missouri 63105 USA
314.721.5904 phone 314.726.5114 fax

A Solo Soaring Safari over the Rockies:

3,000 NM in a Stemme S10 Chrysalis Self-Launching Sailplane

Marc Arnold

It isn't possible to capture the beauty and splendor of soaring the entire length of the American Rockies in a high performance sailplane. You have to experience it yourself. I can only hope to describe a unique kind of soaring adventure available to pilots of self-launching sailplanes.

In the summer of 1994, I toured the Rockies in Stemme S10, N5021, for two weeks. Starting in Aspen, Colorado, my route zig-zagged the Rockies as far north as Kalispell, Montana and as far south as Phoenix, Arizona. The trip covered just over 3,000 nautical miles of America's most beautiful terrain.

The first 20 years of my flying experience was powered flight, mostly 3,000 hours of single pilot IFR while conducting business in my Cessna 421 throughout the U.S. Over the years, I earned an ATP and attended Flight Safety recurrent training sessions semiannually to stay current. Although I enjoyed the mobility of flying and the aesthetics of flight, my flying was strictly for business purposes. Then, three years ago, my horizon expanded with the addition of a glider rating. Within a year I bought the first Stemme S10 in the U.S.* and since that time, my logbook shows thousands of miles of cross country soaring.

The Stemme S10 *Chrysalis* is a high performance two place side-by-side self launching sailplane with a glide ratio of 50 to 1. Equipped with a 93hp four stroke aircraft engine, it can taxi at any municipal airport on its conventional landing gear, self-launch without any ground support and cruise at 120kts more than 900 nautical miles. Where can you soar in a Stemme S10 sailplane? Anywhere! This is a brief account of highlights from the Northern leg of my Summer, 1994 adventure soaring among the Rockies.

7/14/94 Aspen, CO

I stowed my luggage in the baggage compartment and strapped additional gear into the right seat. Aspen ground control cleared me to taxi to the active runway behind a Gulfstream IV. The only similarity was our wingspan. In spite of a 12,500 foot density altitude, the Stemme's ground roll was less than 1,500 feet and it climbed away from the runway nicely. Throttling back to 3,000 RPM, I proceeded down the valley, wandering about the valley exploring the air, looking for the first lift of the morning. Would the first thermals[2] happen on the east facing slopes due to the rising sun? Or would the light wind blowing up the valley provide ridge lift3 on north facing slopes? In soaring there is only one thing that can be said with certainty about lift: Lift is where you find it!

Only 15 minutes after takeoff, the first thermal kicked off a couple miles south of Glenwood Springs airport. Banking and pulling up sharply to take full advantage of the thermal, I turned off the motor and retracted the propeller: Throttle - idle, magneto - off, propeller - brake to stop rotation, propeller positioning control - pull to position prop, nose cone handle - pull to close. The total elapsed time to transition from powered to soaring flight: 5 seconds.

---

1 As of June, 1995, there are ten S10's in North America, 72 flying worldwide, and two in the fleet operated by the U.S. Air Force in Colorado Springs, Colorado.

2 Once a sailplane pilot finds a column of air, he or she circles slowly to gain altitude. Summertime thermals over the mountains frequently rise to over 20,000 feet.

3 Ridge lift occurs when wind blows against a steeply rising topographical feature from a roughly perpendicular direction. By flying close to the terrain, updrafts can be used to stay aloft or climb.

I "centered" the thermal using the beeping of the electronic HUDIS/light variometer[4] to confirm my seat-of-the-pants feel of the rising air, a process of minutely moving the circle's center to maximize the rate of climb. A few minutes of circling in lift, and my altitude was 14,000 feet. Instead of looking up at the valley walls, my view now encompassed the valley below and an extensive mountain range in all directions beyond. I looked to the northwest in the direction of my planned destination, Kemmerer, Wyoming 230 nautical miles away.

An Airmet was active for smoke along the direct line, so I headed northeast along Highway 70. I pushed the nose down and left the thermal at 100 kts looking for more lift. Altitude is distance. Altitude is time. As I glided down the valley, I was loosing both. After continuing down the valley for another 10 minutes, the sides of the valley began to loom upward. The head up display indicated enough energy[5] to glide all the way to Eagle. Nevertheless, I prepared to start motor: Switches-on, fuel pump-on, fuel selectors-on. Propeller deployment and engine start is now less than 4 seconds away.

Just as I reached to extend the nose cone, and only 5 NM from Eagle airport, a thermal bumped. Rather than a symmetrical bump, the left wing rose more so I banked steeply to the left and happily found the welcome lift. At first, the lift was weak -- only two knots (about 200 feet per minute) and narrow. As my altitude climbed, however, the strength and diameter of the thermal grew as well. At 10,000 feet it was up to 3 knots; at 14,000 feet, 4 knots; and at 17,000 feet, 5 knots. Such is the fascination of soaring. Each thermal is unique and learning how best to find and utilize lift is the lifelong ambition of cross country soaring pilots. At 17,500, the lift was stronger than ever, but without clearance from ATC to enter Class A airspace, I took up a heading and flew on course, mindful to avoid climbing further.

Heading to the north, there was considerably more lift than I could use. To avoid climbing, I pushed the nose further down and converted the lift to speed. The airspeed nibbled at the placarded Vne[6] for much of the time. High altitude, high speed flight in a straight line normally offers an opportunity to enjoy the scenery. In this case, however, the visibility was marred by smoke from a forest fire to the west. I diverted somewhat to the east, but it did little good. The smell of smoke grew as the forward visibility fell to a few miles. I considered my options: Higher, lower, left, right, or return.

Flight Service was unavailable in my location, but a helpful TWA crew above me was willing to come up on 123.3 to relay their view from FL370: Tops of the smoke were above FL240 (the certified limit of my oxygen system). Smoke was considerably thicker to the west. Strong lift to the east had kicked off a squall line with towering CU's to FL350. We compared our relative positions. Continuing another ten miles north, they estimated, would take me out of the smoke. The ground was still visible below, but the horizon became less and less clear. Forward visibility was difficult to judge. The electric attitude gyro was on, just in case it deteriorated suddenly. Just as predicted, only a few minutes later the boundary of the smoke ended, revealing an area of fair weather cumulus clouds with bases above 20,000 feet, indication of ideal soaring conditions.

For the next 45 minutes, the flight alternated between high speed dash in areas of sink and slow thermalling flight to regain altitude. Equipped with 76 feet of full span flaperons, the S10 is ideally suited to both flight regimes. With flaps at 10" positive, the wing is optimized to achieve a minimum sink rate of

---

4 Looking much like a Vertical Speed Indicator, a variometer also integrates changes in the plane's airspeed to give a better representation of the actual vertical movement of the air around the plane. A well calibrated variometer will hardly move if the airspeed is varied while gliding in still air.

5 High performance soaring computers calculate and display whether for a given altitude and airspeed (energy), you can glide to the destination.

6 Unlike powered aircraft, a high performance sailplane's Vne varies with altitude due to flutter phenomena. In the case of the Stemme S10: 146 kias at sea level; 120 kias at 13,000 feet; 107 kias at 19,500 feet; 96 kias at 26,000 feet; 85 kias at 32,500 feet.

110 fpm. When flaps are set to minus 10°, the sink rate at high speed is minimized. l since it allows the pilot to make good progress towards the destination, spend the least amount of time in sink, and cover the most distance in search of lift. Based on the rate of lift expected in the next thermal[7], a calculation can be done to yield the optimum speed-to-fly. The greater the sink rate, the faster you fly. The relationship used to be indicated by a moveable ring on the face of the airspeed indicator. Thanks to advances in avionics, this calculation is now done in real-time by a flight computer. After entering the plane's weight, abundance of bugs on the wings, and MacCready number, the head up display indicates the speed to fly and up/down command arrows directing you to the ever changing optimal target airspeed. Even with the help of modem flight computers and GPS, one's ability to go from A to B in a sailplane is still a challenging and rewarding experience which depends on reading subtle meteorological clues to find lift. No instrument exists today which allows the pilot to "see" lift before entering it.

Proceeding further north, the air became still. For power pilots accustomed to bumping along at lower altitudes, utterly smooth air is a welcome change. For a sailplane pilot, silky smooth air at lower altitude signals the lack of convection and its corresponding lift. Had there been CU's to one side of the course, it would have been easy to divert. The blue sky in all directions, though, gave no clue of where the lift might be. So from 16,500 feet, I entered a long glide in the direction of rolling hills in the distance where the chances of lift would be greater. For more than 50 NM, there was nothing but serene quiet at 80 Kias as the descent continued unabated at 200 fpm. If there was no lift, I would restart the motor[8] and power the remaining few miles to Kemmerer.

This time, the theory and practice coincided. There was weak lift over the hills which was enough to get into a mass of cooler air over the desert southwest of Rowlings, Wyoming. The desert terrain produced a solid 3 kts of lift to 16,000 ft. Proceeding west above 16,000 feet, the outside air temperature was a cool 20°F. Nevertheless, the greenhouse effect kept the cockpit warm. Convective activity to the south was generating build-ups and the sun was casting long shadows on the staggeringly picturesque scene below.

The oxygen supply was down to 300 PSI and in need of replenishment. Unable to reach Kemmerer unicorn, landing at Rock Springs immediately below seemed more prudent. AWOS was reporting wind from the southwest at 23kts, gusting to 45kts! The reason wasn't hard to find: An old cumulus was giving up its moisture in a large shaft of virga. With the luxury of excess altitude, I explored the air beneath the virga and found the narrow core descending at more than 2,300 fpm. Is it any wonder such phenomena can produce microburst phenomena at the surface?

An uneventful landing ended my first flight. Although only 225 NM from Aspen, my route took me nearly 300 NM over six flight hours for an average speed over the ground of just over 50 kts. Not bad when you consider the engine operated enroute for less than 10 minutes and fuel burn was less than a gallon.

7/15/94 Rock Springs, WY

The morning weather forecast was favorable: Good VFR with scattered to broken mid-level clouds with isolated thunderstorms in the afternoon. My VFR flight plan was soon filed to Bozeman, Montana, 266 NM to the northwest. The briefer was surprised to hear my estimated time enroute of seven hours and 14 hours of fuel on board[9]. Since my speed and route of flight would depend my skill in finding and using

---

[7] This value is referred to as the MacCready number, in honor of its inventor, Paul MacCready.

[8] It is not uncommon for cross country soaring flights to end in an "outlanding". A ground crew locates the plane and pilot by dismantling the sailplane and loading it into a trailer for transport.

[9] No fuel had been added since Aspen. More than 30 gallons remained on board. Fuel consumption at cruise is 2.1 gal/hour yielding more than 14 hours on board. By soaring most of this leg, I expected to travel the distance and use less than one gallon.

lift, I padded the ETE considerably. Once underway, regular position reports along the way would give accurate information of my route and progress.

I arrived at Rock Springs airport at 9 am. Fifteen minutes later the wings were unfolded[10], the refilled oxygen tank reinstalled, luggage loaded, drinking water and snacks replenished, and preflight complete. Winds were light and variable, temperature 48°, clear, and unlimited visibility.

Moments later the engine purred along at cruise while the desert floor slipped beneath the perfectly smooth carbon fiber wing 1500 feet below. The sun's morning rays beat through the canopy and heated my right leg. Certainly the dry terrain below was absorbing the same infrared energy and radiating it back to the air. Nothing to do but enjoy the scenery until the trigger temperature is reached. Then bubbles of warmer air start to rise and make themselves felt. In the meantime, the flight proceeded in the absolutely smooth morning air.

Twenty minutes into the flight and half way to Big Piney the first bumps reached up to meet the Stemme. Cautiously at first, I thermaled in the weak lift with the engine at idle. Once centered, the lift was stronger and the engine was no longer needed. Up and up I went. The view from 14,000 feet over Big Piney encompassed a broad landscape. Wisps of cumulus clouds to the west marked columns of warm rising air cooling below its dew point. The lift, which began weak grew to 400 fpm and continued to strengthen. All the indicators were positive, so I optimistically headed off to the mountains north.

Mountainous terrain is welcomed by a soaring pilot in search of lift. Valleys heat unevenly as the sun hits different sides of canyons throughout the day. Gentle breezes over complex topography dislodge heated bubbles of air to kick off thermals. Stronger wind flows up the face of inclined terrain generating ridge lift. And the smooth flow of wave lift can be found high over mountains where air resembles the laminar flow of water over a boulder in a stream.

The sport of cross country soaring instills a valuable discipline of thinking about alternatives. In spite of all the positive indicators, I was sinking through 10,000 foot MSL as I approached the 9,000 foot high terrain ahead. If lift was not found, I would fall back on Plan B: Gliding back to Big Piney. At 50:1, the Stemme can glide more than 7.5 NM per 1,000 feet in still air. Given my proximity to Big Piney, there was still enough altitude to make it back. And, of course, starting the Stemme's Limbach engine was the third alternative. Fortunately, Plan A worked.

A band of violent lift flexed the wings upward as my flight path passed just 300 feet above and south of the vertical face of a 1000 foot high cliff. The shaft of lift coming off the face was narrow. Each circle was marked by violent transitions between light and very strong lift. The HUDIS computer indicated an average lift of 7.8 knots (780 feet per minute), but the instantaneous readouts varied from 3 to over 15 knots. Passing in and out of the strongest lift was like riding a bucking bronco. Before long, the digital head up display read 16,000 feet and Jackson Valley spread out before me.

The cliff proved to be a good omen. The strong lift over the hills bordering the east side of the valley were perfect for "dolphin flight". By pulling up to go slow in the areas of lift and pushing the nose down to go fast in areas of sink, high speed can be accomplished in a straight line. Based on the strength and prevalence of lift in the area, I entered a high MacCready number into the glide computer. Thirty miles zipped by in half as many minutes as I followed the aggressive nose down commands displayed by the glide computer.

---

10 The Stemme's 76 foot wings are folded down to a normal 38 feet in 5-6 minutes by one person. This allows tie down, taxi, and hangering in normal sized spaces.

Straight dolphin flight offers a good opportunity to take care of housekeeping chores. First, I contacted Jackson Hole to provide a position report and check on the weather along the route. Next came a timely use of the urinal. Then a snack of food followed by a deep draught of water. Rehydrated and refreshed, it felt like the start of a new flight.

The cumulus clouds gave way to blue sky and smooth air over Yellowstone National Park. With lift or signs of lift for twenty miles ahead, I turned the MacCready number to zero and followed the slower speed commands to optimize the glide for distance (at the expense of speed). It was now more important to conserve my altitude and arrive at the next area of lift with the most altitude possible.

For many pilots, much of the joy offered by flying stems from the opportunity to exercise their judgment in varying circumstances. For the VFR pilot, accurate flight planning and execution offers its rewards. For the IFR pilot, a sense of accomplishment comes from shooting a precision approach to minimums in actual conditions. For a sailplane pilot, each mile of a two hundred mile flight is a triumph!

Barring mechanical failure or unforecast weather deterioration, the pilot of a powered plane progresses from Point A to B with little call on his judgment. Cross country soaring, on the other hand, is a continuous challenge to the pilot's judgment: Is that wisp of a cloud 5 miles straight ahead likely to develop into lift by the time I get there, or should I divert to the cloud off course to the right which clearly marks lift now, but which is past its prime and may only have sink by the time I get there? Should I take the time to pick my way around the perimeter of the blue "hole" ahead where there isn't likely to be lift, or do I have enough altitude to go straight across and find lift on the other side?

How the soaring pilot answers the myriad judgment questions determines the outcome of the flight. To put this in perspective, a world class sailplane pilot racing during a typical four hour flight makes a decision critical to his success every ten seconds.

Now approaching Yellowstone Lake, I was now confronted by a typical judgment question. The minor bumps on the south side of the lake showed little evidence of lift and my altitude was down to 2,000 AGL. There wouldn't be any lift over the cool surface of the lake ahead, yet an area of promising CU's lay on the far side of the lake. Is it wiser to use the altitude to glide across the lake, or use the altitude to search for lift on this side of the lake, then cross with ample reserve? I decided to exploit what lift could be found on this side before crossing the water.

Turning into the first thermal, it soon became apparent that it only offered enough lift to achieve zero sink. I searched for and found another, then another. But finding and centering each weak thermal cost altitude. After ten minutes, I'd lost 1,000 feet and was now trying to work a weak thermal over an open meadow. This is the pattern that leads to an "outlanding" in an unpowered sailplane. As altitude is lost, the search area is further constrained more and more by the necessity to stay in the proximity of a suitable landing site. A few more minutes, and the outcome became clear. I was boxed in and wouldn't be soaring away from this field today.

Rather than just start the engine and fly away, I went through the process of setting up for an outlanding. This practice keeps me current in off-field landing technique and ensures a viable alternative in the unlikely event the engine fails to start. A close observation of the field revealed no hazards such as boulders or fences or power lines. The surface of the lake revealed the wind direction and velocity. Set up on final and ready to go through with the landing, I deployed the propeller and started the engine in five seconds.

Only six minutes of climbing under power northwest and I was back in a solid 4 KT thermal climbing in sight of Old Faithful. Back up to 12,000 feet, I turned northeast and dashed into the mountains of Yellowstone. Flying around the summit of a peak, I traded waves with a Park Ranger staffing a lookout station. There was good lift over the peak so he had the pleasure of watching me circle many times as I gained a thousand feet and set off to the next peak.

For the remaining 30 NM to Bozeman, the lift was widespread. The eagles were up in numbers and they marked the better thermals for me. I hopped from one gaggle of eagles to the next, marveling at their superior skill in finding the strongest core of the thermal. Sharing thermals with eagles is surely the best way to view Yellowstone National Park, a vantage point rarely seen.

Five and a half hours after leaving Rock Springs, I was cleared to land at Bozeman, Montana after an arriving Challenger. We both taxied to Sunbird aviation where a sociable Bar-B-Q was in progress. Newly found soaring friends graciously opened their home to me where I spent the night.

7/16/94, Bozeman, MT

After ridge soaring with my new friends in the morning, my bags were packed once again and I was aloft once again in a northwesterly direction, this time to my northernmost destination, Kalispell, Montana. I shut the motor down about 10 minutes into the flight, just east of Three Forks. The early morning thermals were very weak and it was difficult to hold my altitude. Once again, my search area had narrowed to a small area within gliding distance to an open field. It looked like a repeat of my experience the previous day and I began to think an engine restart would be necessary.

It was south facing ridge line with green pastures forming a patchwork quilt below. My shadow passed a farmer pulling a hay wagon. He pulled his tractor over to the side of the road and waved. Only a few hundred feet away it was easy to see him and I waved back. He climbed up onto the hay, took out what seemed to be a lunch, and sat watching me circle low over the field. Evidently, he was interested in my search for lift. My broad looping circles took me over each of the objects which might "trigger" a thermal -- a small shed, the bare rock at the summit of a small hill, the paved road -- Anything which might radiate more heat than the surrounding terrain.

Visualize the triggering of thermals by imagining droplets of water hanging from the ceiling of a damp basement. If you reach up and touch one droplet, not only does it run down your finger, but many nearby droplets run to the point of your finger and follow the first droplet. Now turn that image upside-down and picture a layer of air a few hundred feet thick heated by warm ground. The warmer air is ready to break loose and rise in many places, but it takes one particular spot to trigger the start. Experienced glider pilots in search of a low "save" pass over potential trigger points. Once the bubble breaks loose, other warm air flows in and up the same path, just like the droplets of water down your arm.

Then, I felt a significant bump and focused my full attention on centering this little thermal. It would be my last chance before starting the motor. Where did this particular thermal come from? I couldn't be sure which of the likely candidates was responsible. Nonetheless, I doggedly stayed with it and found it grew stronger as my altitude increased. Having attached myself to this bubble of air, we drifted together along the ridge line. Constantly turning, the bank angle of 30" and airspeed of 45 Kias remained nearly constant. Each revolution, however, wasn't symmetrical. Small adjustments of bank angle during each rotation moved the center of the circle small but critical amounts. These minute adjustments exploit the thermal and extract the most kinetic energy possessed by the bubble of air. At 12,000 feet, I made one last turn and saw the farmer's tiny vehicle where he'd pulled over. It's nice having an audience.

Negative 10" flaps and 110 kts across the next valley. Cumulus clouds were forming ahead over higher terrain. There was strong lift under the clouds. Climbing at 1,000 fpm, it only took a few turns before I approached cloud base, then headed on course.

The strong lift of my previous thermals and the nearby large runways at Helena International gave me confidence. I passed several good thermals and continued abeam the airport getting lower over the mountains south of airport. My thinking was that the northerly winds would flow against the hills and kick up thermals, but I was wrong. There was only sink.

Only ten minutes earlier I optimistically passed useable lift. Now I was scratching for any lift I could find, no matter how weak. Ultimately, I started the motor and headed north in search of lift. After four minutes, I pulled up and centered a very weak thermal at less than 1,000 feet. Once established in a climb, I shut down the motor.

At only 60 fpm, it was hard work-a balance of intense concentration to stay centered in the thermal, yet relaxed enough to avoid over controlling. It's a very Zen process of "relaxed concentration". Fluidity is key in manipulating the controls. It's similar to many sports when trying harder leads to worse results-- your actions become jerky and forced. When you become more skilled, the movement is automatic. In tennis, for example, the racket meets the ball at just the right spot, your feet move you to the right location without direction imparted by you-it all just flows! The soaring became effortless as I forgot about the bank angle, airspeed, flap settings, speed-to-fly calculations, rate of climb and G-force leaving only the air around the plane. It's like staring at a high-contrast picture and suddenly seeing the negative space around the object. Without any conscious effort, my body, my mind and the ship flowed into the lift, meeting it at just the right speed and bank and configuration. I was truly soaring.

When I first entered learned to soar, it was more a mechanical set of actions--Pull up, check the airspeed, bank into the turn, check the variometer, think about which side of the thermal was strongest, lessen the bank to move the center, tighten the bank to stay closer to the center, etc. Now, without effort, the rate of climb in this thermal had grown from its initial value of 0.6kt (60 fpm) to a solid 9 kt (900 fpm) and my altitude was now over 13,000 feet. And in the process of climbing from a few hundred feet to thousands, my field of view expanded as well. With the help of one more thermal over Lincoln airport I headed off into the mountains leading to the Swan Valley.

Jagged peaks rose on the right, each topped by a roiling cumulus cloud revealing strong updrafts caused by the sun's heat throughout the day. This resulted in a "cloud street", a band of lift topped by a row clouds. Using this street I speed along the tops of the peaks on the east side of the valley. Emerald colored high lakes passed under my wings. Each lake a windswept surface of water surrounded by near vertical walls of rock. Verdant tree farms stretched on the left. Thousands of feet above the ridge line, altitude was not an issue-the strong uplift made dolphin flight easy. Diving in the sink, pulling high G's in the lift, it was a dance with kinetic energy. The nearby scenery was breathtaking. Swan Lake passed by on the left. Then, all too soon, I rejoined the world of conscious aviation. Radio chatter replaced quiet serenity in my Plexiglas chrysalis. A moderate crosswind combined and narrow runway kept my attention high during the landing at Kalispell, MT, only a few miles from Canada.

7/17/94 Kalispell, MT

I flew under power about ten minutes to the north end of Swan valley. The previous day I flew northbound in this valley at high altitude, above the peaks on the east side in late afternoon thermals. Today, however, the morning sun was still too low in the eastern sky to heat the west-facing slopes. Fortunately, the wind was blowing strongly from the west creating strong ridge lift. This allowed me to fly below the peaks and in the valley, instead of above it. On the northbound leg the previous day, the conditions took me ***above*** the valley at an altitude of 17,000 feet. The valley and its tree farms could be seen as a whole. Now my view comprised individual trees less than 100 feet away. A pause to "S" turn in front of the slope instantly causes my altitude to zooms up and I can look down on the peaks, though most of the 60 miles was spent looking **up** at the peaks and **at** the trees off my left wing. Soaring a ridge is the provides ultimate challenge in opportunistic decision making. When the topography of the slope ten seconds ahead is likely to force the perpendicular wind upward, you keep the nose down and push for speed. When a gap in the ridge opens up ahead, you judge whether you have enough energy to cross, or whether it is necessary to slow for a period to gain altitude and store energy. The violent turbulence, high G pull-up's in lift, zero G push over's in sink and close proximity to terrain make ridge soaring the most dynamic flight regime I know. It is exhilarating!

All too soon, the valley came to an end, and I converted my 140 kts of kinetic energy to altitude over the broad open valley ahead. The rush of pounding along at high speed close to the trees and rocks gave way to the serene quiet once again of a well-sealed world class sailplane in smooth air. Cumulus clouds moving in from the west are obvious indicators of lift. The first provided 4 kts, as did the second and third. It was a normal progression of circling in thermals followed by brief dashed through sink to the next. Then I saw an unusual cloud formation ahead. The thin wisp of condensation seemed to be the start of a standing lenticular cloud. I diverted to investigate. Suddenly the air became silky smooth-all motion stopped. The wave was condensing on the leading edge of the cloud and evaporating on the trailing edge. Slowly "S" turning into the wind, the wave carried me vertically up the face of the "lennie". I surfed the rising, growing cloud. It was silent and perfectly smooth. It was a magic carpet lifting me straight up. With the permission of ATC (and mode C transponder), I rode this vertical elevator up to 24,000 feet. Then I left the wave and headed south having experienced the most amazing flight in more than 20 years of flying.

A long glide to Three Forks, Montana and Bozeman was in easy gliding range. Still exhilarated from the earlier flight, I went to the nearby ridge instead. Joining up with a Ventus A 15m sailplane, we chased each other back and forth along the 25 MI long ridge. Cavorting in the severe turbulence brought all the loose items up to the top of the canopy. Heavy G's bent the wing tips up more than 5 feet. And always the Ventus above or below or swooping alongside. The pilot was practicing for the National Championship the following week.

My perfect day of flying adventure ended as the sun set. Once again on the ramp at Sunbird Aviation, a number of local soaring pilots came out to see the Stemme. They were well acquainted with the local ridge and nearby soaring, but few had ventured across Yellowstone to the south or the Swan Valley to the north. They were able to appreciate the freedom provided by the Stemme's Limbach motor standing by.

7/18/94 Bozeman, MT

After three hours of ridge soaring with a number of the local pilots, the CU's began to pop. With baggage packed, I headed southwest. Passing Livingston, Montana, the lift was weak. I scratched along a wide valley to the south, just barely holding my altitude. The terrain was rising as I flew south. Then, over a plateau in the center of the valley a thermal bumped. With a lot of work, I extracted a few hundred feet. Then jumping to the east side of the valley, I discovered very strong lift of more than 1,000 fpm on the south face of Sheep Mountain. Whammo: 14,000 feet. Then east down the Yellowstone River valley, high speed down the valley, swooping past hundreds of tourists at a scenic overlook, through Sylvan Pass, followed by a good thermal to 17,000 feet. I stayed high and fast over Wind River mountain range, then enjoyed a long calm glide towards Rock Springs, Wyoming. This flight in particular demonstrated the different kind of challenge presented by cross country soaring. There is no steady state as in the cruising phase of powered flight. Instead it is a kind of three dimensional sailing in which you are constantly in one of two states: Loosing or gaining altitude. And no matter what, you are always employing all your knowledge of meteorology and flying to find more lift.

With daylight fading, I landed at Saratoga, Wyoming and spent the night at a delightful resort with outdoor natural hot springs.

7/19/94 Saratoga, WY

Ten minutes under power, then the motor was off once again to soar east to Medicine Bow Peak. Circling low over a landable meadow, I prepared to restart the motor, but a small bump grew. Soon I was at cloud base and turned south. Unfortunately, lower cloud bases and rain showers to the south made the prospect of continued soaring unlikely. I flew on, expecting to finish the flight under power when a fascinating phenomenon occurred.

A mass of cooler moist air was flowing upslope from the east forming lower stratus layers to my left. Drier unstable air was being heated by the afternoon sun permitting convective cumulus with bases at 2500 to 3000 feet AGL to the right. As I flew along the confluence of these two air masses, I found a zone of weak lift along my southbound course -- about 80 fpm. With fog and haze on the left and low cloud bases to the right, I was able to ride along slowly without losing altitude from Medicine Bow to South Bald Mountain, a distance of 60nm at 70 knots. Nothing the soaring books I've read described this condition other than the general proviso: Lift is where you find it.

Eventually the ceiling deteriorated and continued VFR was not possible over the higher elevations. A recent weather report confirmed good visibility beneath a 1,000 foot ceiling at Boulder and Jeffco, so I glided down the Poudre River Valley under the solid status overcast then flew under power the rest of the way to Boulder.

A friend at Boulder's Cloudbase Soaring center wanted a ride, so we took off under the stratus layer. The short, ten minute introduction flight turned into an hour long soaring flight when I discovered the second unusual source of lift in the same day. My attention was first drawn by an unusual circular dome in the status above and to the left. Sure enough, the first lift of the day was there. There was weak but usable lift as bubbles of warm air punched up against the thinning status layer above. After exploiting the first one, we were able to go directly to these "negative CU's" of clear, warm air rising into the uniform stratus layer above. We could have stayed up the rest of the day -- Truly amazing given the prevalence of stratus which generally marks the impossibility of lift. Yet another fascinating day of learning and exploration in the Stemme!

7/20/94 Boulder, CO

I spent the morning flying with Bruce Miller, a glider pilot who flies instrumented gliders in thunderstorms for the National Center for Atmospheric Research. Then I was soaring again along the Flatirons southbound to Denver's Centennial airport to meet a friend. Flying in and around high density traffic posed no difficulty. By entering downwind at 110 kts, the whole pattern can be flown with the engine off while the speed slowly decays. Even 360's on short final can be accomplished without the motor if necessary for spacing. Normally, I land with the motor off, then start it as I'm rolling off the runway to taxi to parking. I launched after lunch and soared to Colorado Springs for the night. The ramp was so full, I had to fold the wings to fit between a Lear and a Challenger. Several of the local people were aware of the Air Force Academy's decision to purchase Stemme S10's. After some interesting hanger flying, this short flying day came to an end.

7/21/94 Colorado Springs, CO

Lift off was at 10 am. I took off and immediately headed west towards Pike's Peak. Finding morning lift on the east side, I turned off the motor and retracted prop at 1,000 feet AGL and thermaled up to 14,000 before realizing that I'd forgotten to retract the gear! The electric gear switch has three positions: Down, Off, and Up. Distracted by a missed transponder code assignment, I inadvertently moved the selector from Down to Off, the middle position. Although embarrassing, it certainly wasn't as bad as forgetting to extend the gear, a situation I've not yet experienced.

Soaring around the summit of Pike's Peak, hundreds of tourists photographed 'the Stemme as I flew round and round. Then west to thermals over Tincup Pass. Soaring over a hiker at the top of Mt. Shavano, I used the huge updraft flowing into the base of a building thunderstorm to hitch a ride to 17,500 feet at over 1,500 fpm. As I fully enjoyed the mixture of terrain and weather phenomena at that moment, it occurred to me that only a few abnormal flights in over twenty years of flying power became vivid, permanent memories. All the rest were "uneventful" and soon forgotten. Almost by definition, every cross country soaring flight, on the other hand, has been memorable. Each leg is a challenge with no chance to become complacent, even for a minute. Perhaps this is the greatest appeal of soaring. Leaving the big lift, I soared west to Gunnison, then Montrose to visit with friends. Thunderstorms were forecast over night, so I folded the wings and put the S10 in a hanger for the night.

7/25/94, Montrose, CO

The next morning, I took off and found lift a few miles east of the airport. Climbing at several hundred feet per minute, the temperature dropped quickly. At 17,000 feet the outside temperature was down to 0°F. Leaving the lift, I flew through virga south of Crested Butte and emerged with a thin coating of ice on the plane, spoiling its laminar flow. A few thousand feet lower and it disappeared. I thermaled over Crested Butte, then explored the Elk Mountains south and west of Aspen. Then I soared for two hours with a friend already soaring around Aspen in his sailplane and then, all too soon, ended the Northern half of my Rockies tour with a landing back at Aspen.

In ten days, my travels took me 1,552 NM, not counting the numerous excursions off course in pursuit of lift and entertainment. While enroute, the average amount of time under power was just 12 minutes per day which lead to a fuel consumption of just under four gallons of gas. After a week hiatus, I resumed my travels and over another ten days, traveled south along the Rockies and San de Cristo ranges, then to Tucson and Phoenix before returning to Aspen. Total enroute fuel consumption for both legs was eight gallons in 63 flight hours aloft, covering more than 3,000 memorable miles. What a way to go!

Marc Arnold lives in St. Louis, MO and can be reached at (314) 721-5904
email: MarcArnold@aol.com

NOVEMBER 1992 VOLUME 54, NUMBER II

COMPLETE OSHKOSH '92 COVERAGE

Air Progress

OSHKOSH '92—AND YOU ARE THERE!

INSPECT THE NEW CERTIFIED AIRCRAFT

FLY WITH THE WARBIRDS FROM WWII TO MODERN JETS

FEATURE ARTICLE

WE FLY THE

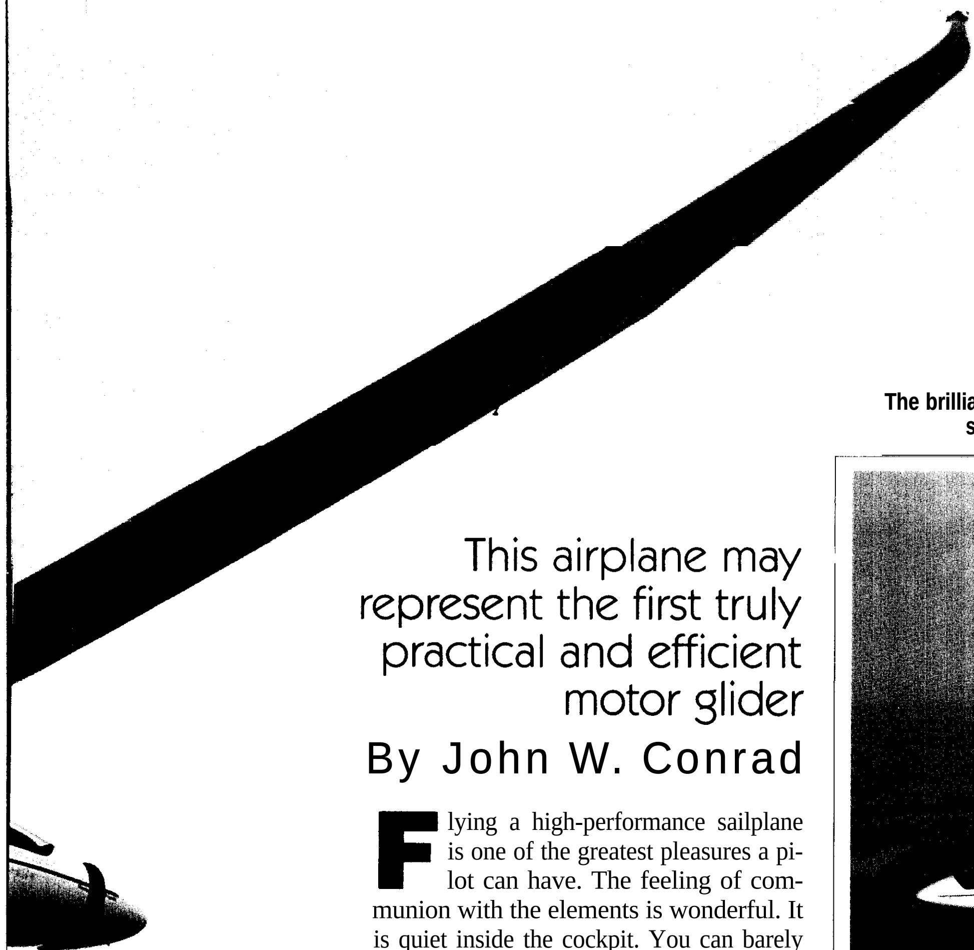
STEMME S10 *CHRYSALIS*

...THE FIRST TRULY PRACTICAL AND EFFICIENT MOTOR GLIDER

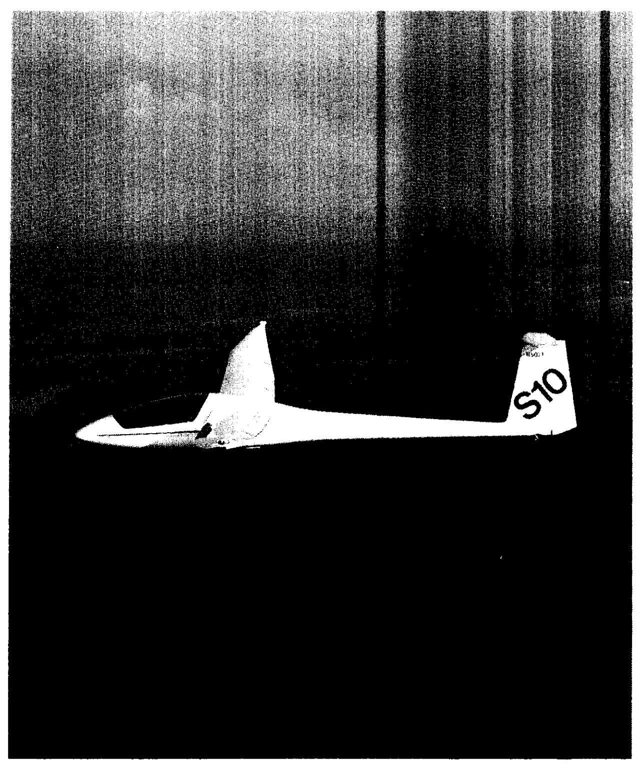
DELMAR BENJAMIN'S REPLICA GEE-BEE RACER

TAKE A TRIP TO THE EAA SEAPLANE BASE

WE FLY THE STEMME S10 CHRYSALIS



The brilliantly designed Stemme S10 Chrysalis is a true unlimited sailplane which can also be flown as a powered aircraft.



This airplane may represent the first truly practical and efficient motor glider

By John W. Conrad

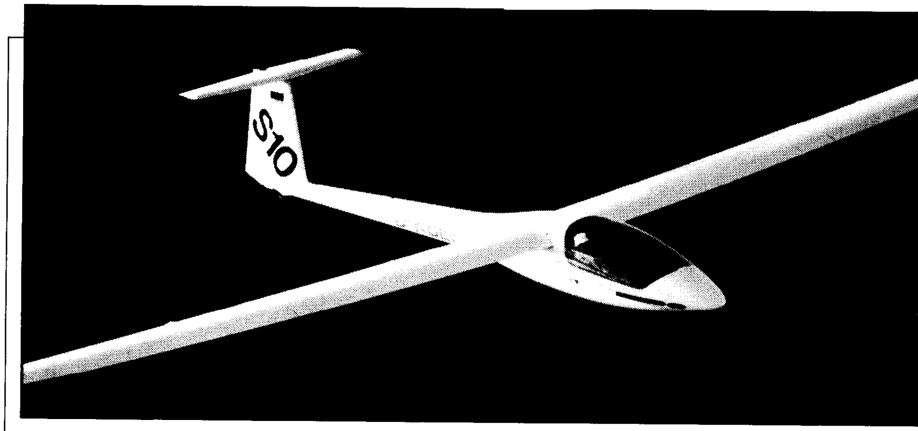
Flying a high-performance sailplane is one of the greatest pleasures a pilot can have. The feeling of communion with the elements is wonderful. It is quiet inside the cockpit. You can barely hear the wind whispering past the streamlined fuselage. The wings seem to stretch to the horizon and the craft rides for free, on the currents of air.

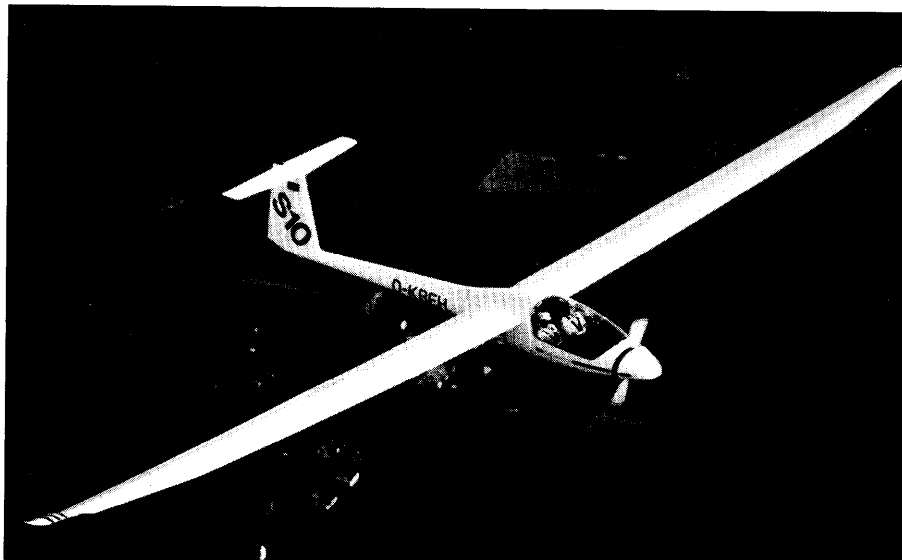
Unfortunately, there is a down side to sail plane flying. In order to get up to where you can begin soaring, you have to either be launched by a winch or, more commonly, towed aloft by another airplane. Hence, your ability to go flying is dependent upon someone else and, to a large degree, your success or failure depends upon the tow pilot. On more than one occasion, I have been towed aloft into the worst sink around, only to begin my run back to the runway with plenty of lift available, in the other direction.

Part of the freedom of soaring flight is lost because sailplane flying is often reduced to a matter of waiting in line; waiting for the tow plane, or waiting for other pilots to complete their flights so that you can rent the sailplane. It seems to be a paradox, but the best freedom of flight comes after a whole lot of expense and inconvenience.

The obvious solution to this dilemma is a self-launching sailplane — one that can haul itself aloft under its own power and then soar once up to altitude. Unfortunately, like most simple solutions to complex problems, the end result has been less than ideal.

There have been several attempts at powered sailplanes, or motorgliders, through the years. These airplanes can be grouped into two categories: Airplanes where the engine can be stopped to allow the airplane to glide, and gliders with an engine strapped on to power the airplane into the air. Both of these groups are unsatisfactory in the final analysis.





Is it a bird or a plane? The Stemme Chrysalis with a retractable prop is actually both!

Gliding airplanes really can't do much soaring. The drag induced by the engine, cooling inlets, and propellers, makes for a short ride. Even if the wingspan and aspect ratio are extended to the practical limit, the drag induced by the engine makes for a short ride in all but the best of conditions.

On the other hand, there are several examples of gliders that use engines to haul them aloft. The most successful uses an engine on a pylon that folds back into the fuselage when it's time to go soaring. The problem with this system is that there is still a lot of drag when the engine is deployed. So in the event that the pilot gets low and needs the engine to save his bacon, once the engine is deployed out into the slipstream it better start, and start fast, or an immediate landing will follow. Furthermore, when the engine is deployed, the glide angle changes substantially, which means that a pilot who gets too low has to have two landing spots picked out — one for a normal glider operation, and another much closer if the engine won't start. It takes some fancy flying to put all this together when close to the ground.

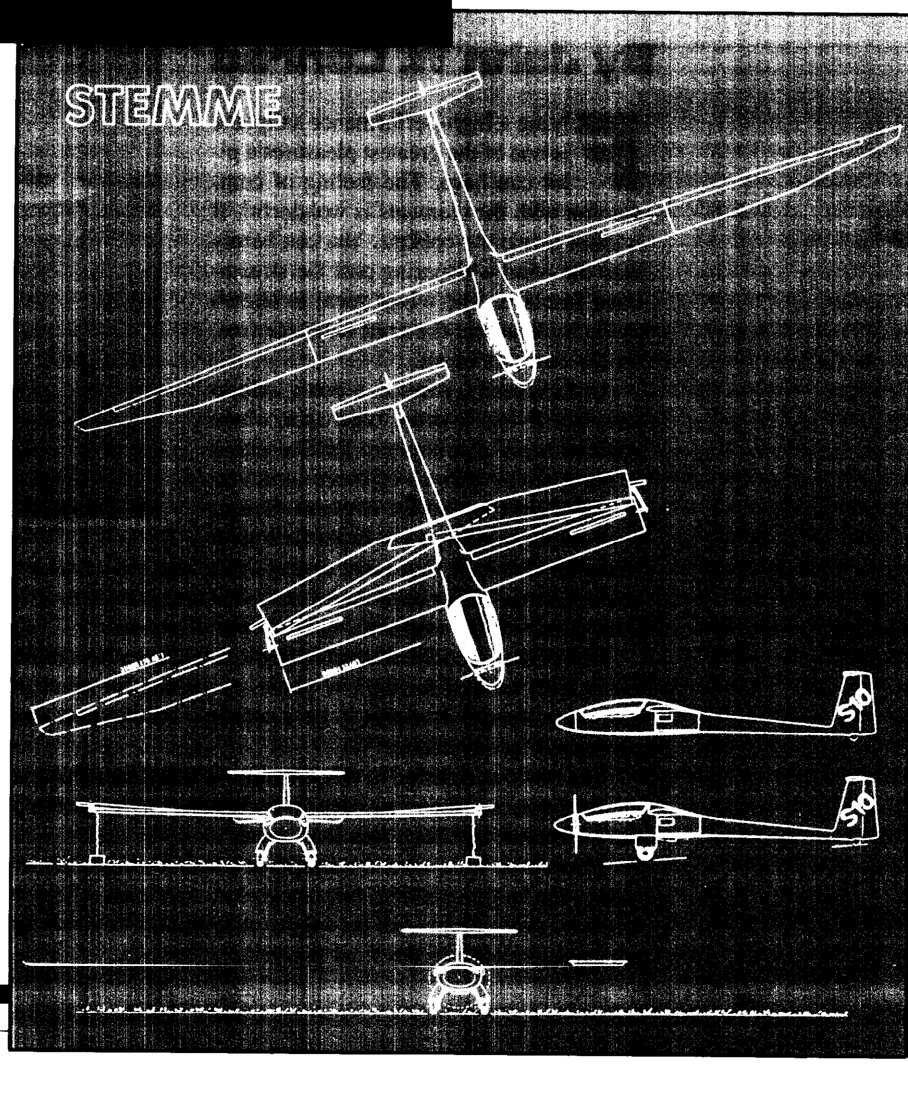
Enter the Stemme S10 Chrysalis, a motor glider that really works.

The S10 is, first of all, a high-performance sailplane. With a wingspan of 75 feet, the airplane is capable of delivering a 50:1 glide ratio with two people aboard. This is better than most single-place competition sailplanes.

The pilot and co-pilot, instructor or passenger, sit under a plexiglas bubble in glider fashion. The seats are very comfortable and fully adjustable by both mechanical stops and inflatable air bags. By simply pulling a lever between the knees, one can adjust the rudder pedals to provide maximum comfort.

The cockpit of the airplane that surrounds the pilot is state-of-the-art sailplane. On the left side of the fuselage there is the flap control and dive brake. Both are made of machined aluminum bars and are rock-solid. To activate the spoilers, the pilot just pulls back and the lever which moves past a friction catch to allow the mechanism to come into play. The flaps are adjusted by moving the lever inboard and setting it in one of several detents. Up to ten degrees of reflex flap positioning can be added to increase cruise performance and penetration.

The instrument panel has room for full flight instrumentation and avionics. The instruments are logically placed and each



occupant has an unobstructed view of the entire panel. Aileron and elevator are controlled by a stick mounted between the legs and conventional rudder pedals are provided. Brakes are applied by a grip-type lever on the control stick.

If the S10 were nothing but a sailplane, all these amenities would be average for a state-of-the-art machine. But what makes this airplane unique is the powerplant and drive train.

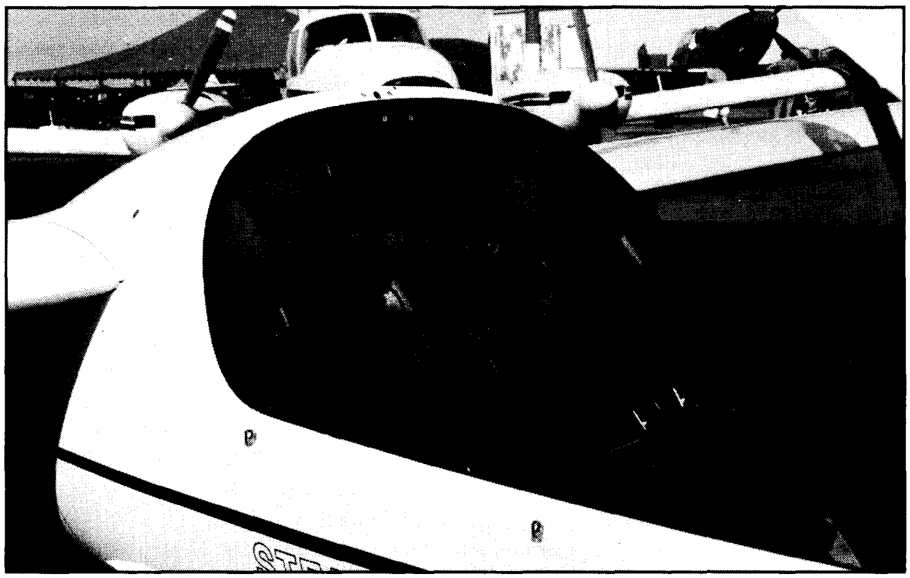
Located behind the seats, a 93 hp Limbach engine delivers power to a carbon fibre drive shaft which runs through the cockpit (enclosed is a composite fairing) to a belt reduction drive in the nose of the aircraft. The belt reduction turns one of the most innovative pieces of engineering to come around in a long time.

Instead of one long propeller, the S10 uses a folding propeller which extends by centrifugal force when the engine is started. The blades are spring-loaded into retracted position and when the engine starts they are forced out and function normally. The propeller is hidden within the nose cone of the aircraft which is extended for engine operation and retracted to completely streamline the airframe during soaring operations. The same single lever that controls the nose cone also opens and shuts the cooling air vents for the engine which are aft of the canopy. The easiest way to see how all this comes together is to go fly the airplane, which is what I did during the EAA airshow. I imposed upon the US distributors for the airplane and got them to fly it over to the Fon du Lac airport for our evaluation.

At first glance the airplane looks like any other sailplane, with two exceptions. The wings are remarkably long, and the landing gear is a two-wheel affair instead of the single wheel normally associated with sailplanes. The outside of the aircraft is sleek and smooth, with gap seals covering up even the smallest spaces between control surfaces and wing. The horizontal stabilizer and elevator are mounted precariously atop the vertical fin. I got a kick out of the custom registration number, N5021. Get it? Fifty to One is the glide ratio. The only indication that there is an engine aboard the aircraft is the small fuel tank caps flush-mounted in the tops of the wings, and a placard on the nose of the aircraft which says, "Attention — Propeller." But there is no propeller there.

To enter the cockpit, the pilot first puts a key into the small lock on the storm window. Then, by reaching inside, the canopy latches can be released and the canopy opens forward, with air shock absorbers provided to take up the strain. Then one sits

The cockpit design of the Chrysalis is nothing short of inspired. Many American lightplane designers would do well to study this sailplane's ergometry.



For those wearing chutes, the cushions on these incredibly comfortable seats can be easily removed. However, with a motor up front and a 50:1 glide ratio, many, we're sure, will choose to forgo the chute and enjoy the factory chairs.

on the cockpit edge, which is very strong composite material, wings the legs into position, and slides the feet under the instrument panel.

I might preface this by saying that the S10 pilot would either already know where to set the seat back for comfortable flying, or a friend outside the cockpit could help with the adjustment. The seats are fully supporting, from the back of the neck to the calves, and are very, very comfortable. As mentioned earlier, the rudder pedals can be adjusted so that they fit the pilot's legs perfectly. Though I've never been an astronaut, I've marveled at the seating arrangements in some of the spacecraft. I wouldn't imagine that they are any more comfortable than they would be in an S10. It feels like sitting in a Lazy Boy rocker.

The amount of recline in the seatback is very important for large people. When the canopy closes, it nearly touches the top of your head, so everything has to be set just right. But when it is, it is wonderful.

With both parties strapped in, the first step in starting the engine is to move the lever forward just in front of the throttle. This opens the nose cone as well as the two cooling air intake doors on either side of the fuselage and the cooling air discharge door on the bottom. There is a single magneto which needs to be turned on and then the starter button is depressed. That's all there is to it. Of course, you have to have the fuel selector turned on.

In the European model of the aircraft, there are two fuel selectors located between the seats. Each selector turns a tank on or off. On one tank there is an electric back-up fuel pump and on the other there is the engine-driven mechanical fuel pump. The system works great on the Continent, but it isn't good enough for us Colonials. Over here, our big brother FAA requires that there be a single valve and that all fuel pumps be between the valve and the engine. In order to meet this requirement, the aircraft I flew had two electric fuel pumps in line running off the right tank. The left tank had the mechanical fuel pump. On all future aircraft brought into the United States, a single fuel valve will be provided. Nevertheless, it is interesting to note that our aviation bureaucracy found it necessary to meddle with a fuel system that worked fine for years in Europe. I wouldn't be the least bit surprised if problems developed in the modified system where no problems existed before. "If it ain't broke, don't fix it," is obviously a maxim which the government hasn't heard.

Once the engine is started, there comes the business of taxiing. With a wingspan of 75 feet, the airplane may not be as wide as an Airbus, but it seems like it. Furthermore, the wings sits low, so obstacles such as runway or VASI lights, which would not be a problem to an aircraft with more ground clearance, are not a consideration. There is no differential braking, so turns are made with full rudder and a lot of power. It is a ponderous affair.

It might be important to point out that this should not be a problem to glider pilots because they can't taxi anyway. You think taxiing is difficult in an S10, try it in a Schweitzer 2/33! You could sit there for hours. Seriously, though, it is difficult to move an airplane around with this kind of wingspan. On the more positive side, one man or woman can fold the wings in less than five minutes, which reduces the entire span to a much more conventional 32.5 feet. So, in tight places, it may be necessary to hop out and fold the wings before proceeding on into close quarters. On the positive side, the S10 can fit into a conventional aircraft T-hangar when most gliders cannot.

Once you herd the thing out to the end of the runway, and get it turned around, all that is required is full power to get the airplane rolling down the runway. It should be pointed out that the same aerodynamics which give the S10 a suburb glide ratio do nothing for the short-field performance. Imagine a Cessna 150 with three times the wingspan and you get the idea. It takes a lot of runway to get the airplane flying, but once it is flying it climbs at an acceptable rate. After there is no chance of landing back on the runway, the landing gear retraction switch is thrown and the gear comes up, one at a time, into the bottom of the fuselage pod.

Once you get a couple of thousand feet of altitude, and into some lift, the fun really begins. First, you shut off the engine by bringing the throttle back to idle and throwing the switch. Then a tug on the propeller shaft brake handle stops the prop rotation and, of course, when the wheel stops spinning, the spring-loaded propeller blades retract back. Then a tug on the next handle centers the propeller mechanism and, finally, a tug on the central handle closes the nose cone as well as the cooling air intake and exhaust ports aft.

Now the airplane is very sleek. There is no hint on the outside of the fuselage of landing gear, propeller, cooling ducts, or exhaust pipes. It is as close to aerodynamic perfection as you can get this side of angel's wings. Which is why the airplane will deliver a fifty to one glide ratio. By the way, the entire engine shut-down procedure costs less than 20 feet of altitude. In fact, the glide performance of the aircraft is so good that during the demonstration at the EAA Airshow at Oshkosh, the pilot was getting 300 fpm of lift over the runway. He could have stayed up there all day, but I suspect that some of the other performers, like Bob Hoover, who has his own twin-engine glider act, would have been upset.

Once up to altitude, the airplane will perform as well as any sailplane around. But sooner or later the sun will set, or the ridge lift will diminish, and in an ordinary glider it is time to land, wait for the chase vehicle to arrive, take the glider apart, put it into the trailer, and begin the long drive home. In the S10, on the other hand, it is time to start the engine and fly home.

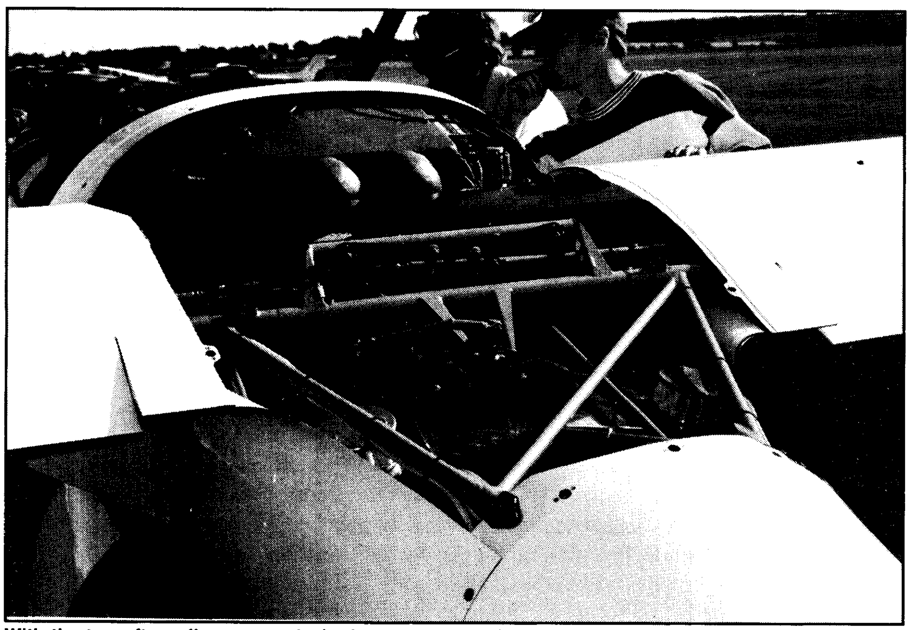
Starting the engine is even simpler than stopping it. One need only open the nose cowl, crack the throttle and start the engine. If the engine fails to start, the open nose cowl creates very little drag and the airplane flies much the same as it would otherwise. The pilot can continue to try to start the engine on the way down (bad choice) or just make an ordinary landing.

Here, the difference between this motorglider and others should be pointed out. This airplane does not impose a huge drag penalty on the airframe during the engine start procedure. Remember, the propeller is hidden behind the nose cowl and doesn't extend until the engine starts running. Also, the start-up procedure is not particularly complicated. Which means that the airplane will behave like a glider, even if the engine doesn't start, thus eliminating one of the potential hazards of other motorgliders.

At this point, the reader might be asking, "Why hasn't it been done before? Why is this aircraft the first to deliver this kind of performance?" The answer lies in technology. This is the first aircraft to bring modern composite construction to its fullest potential.

The S10 is built around a steel tube framework which forms the mountings for the wings, undercarriage, and engine. The engine is mounted low, near the center of gravity, behind the seats and under the wing. The steel tube framework is covered with aluminum panels which are attached by Dzus fasteners. All coverings in this area can be removed for easy access to the engine and systems.

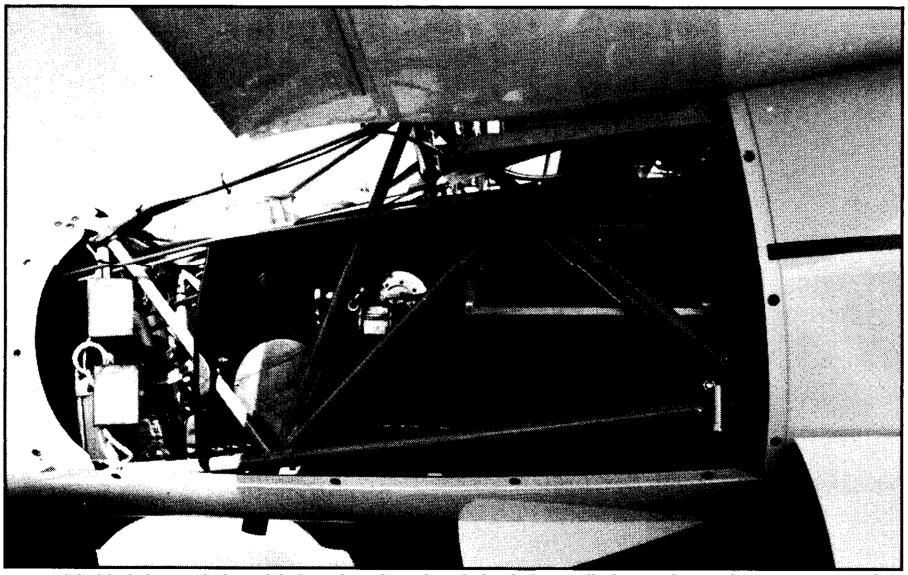
The control linkages and connections for

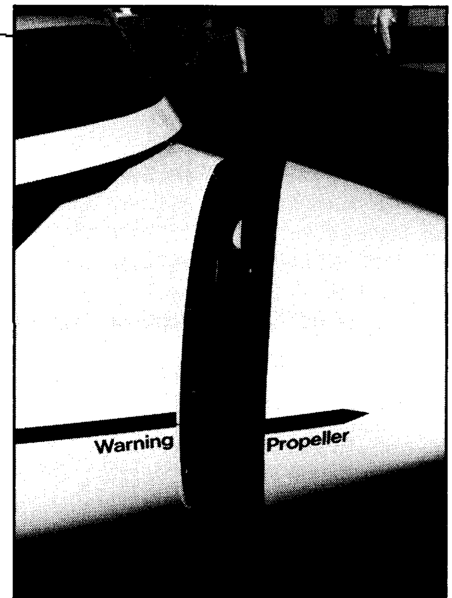


With the top, aft cowling removed, the inner workings of the airplane are revealed.

the wings are located at the top of the steel structure, above the horizontal firewall separating the engine compartment from the cockpit. The wings, tail boom, and fuselage pod are all bolted on to this central steel structure. The fuselage, wings, and tail assembly are made of carbon fibre composite.

The electrically retractable undercarriage is attached below the tube structure and uses two five-inch main landing gear wheels that are supported by air shock absorbers in a trailing-beam linkage. The wheels are fitted with disc brakes which are actuated by a lever attached to the control


Located behind the cockpit and below the wing, the Limbach four-cylinder, 90 hp engine connects to the prop by means of a long prop shaft which runs through the center of the cockpit.



The central element of the revolutionary quality of the Stemme S10 Chrysalis is its centrifugal, retractable propeller. Its design is pure genius.

stick. Though the landing gear is ordinarily operated electrically, there is a manual override to allow the landing gear to lower into position in the event of electrical failure. At the end of the composite tail boom there is a steerable tailwheel which provides adequate control while tracking the runway and about as much maneuverability as the *QE II* when the airplane is on the ground.

In the bottom of the steel tube superstructure, a Limbach 2400, four-cylinder engine provides up to 93 horsepower for takeoff and climb. The engine is attached to a composite drive shaft which runs through the cockpit to the belt reduction in the nose of the aircraft. The installation is very quiet and there is no vibration communicated to the cockpit.

Of course, what makes the S10 truly special are those huge wings, which are a completely new development. The wings are made from carbon fibre construction in three sections. Fuel tanks and air brakes are installed in both ends of the center section. Folding tips are attached which increase the span from 32.5 feet to over 75 feet. If you wonder why the S10 performs so well, consider this: Have you ever tried to design a 75-foot fully cantilevered wing out of conventional material?

The Stemme S10 Chrysalis is an absolute joy to fly. But it is certainly not for everyone. It is a special-purpose aircraft and it does that job better than any other. But at a list price of $165,000, it certainly isn't for everybody. Yet, if you can afford the price, you won't find anything to equal the experience. Those interested in more information should contact Stemme USA at 200 South Brentwood Blvd., #21B, Saint Louis, Missouri, 63105, or you can call (314) 721-5904. **AP**

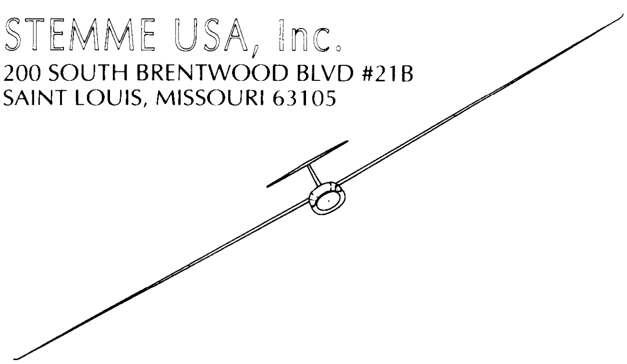
STEMME S10 *Chrysalis*

TECHNICAL SPECIFICATIONS*

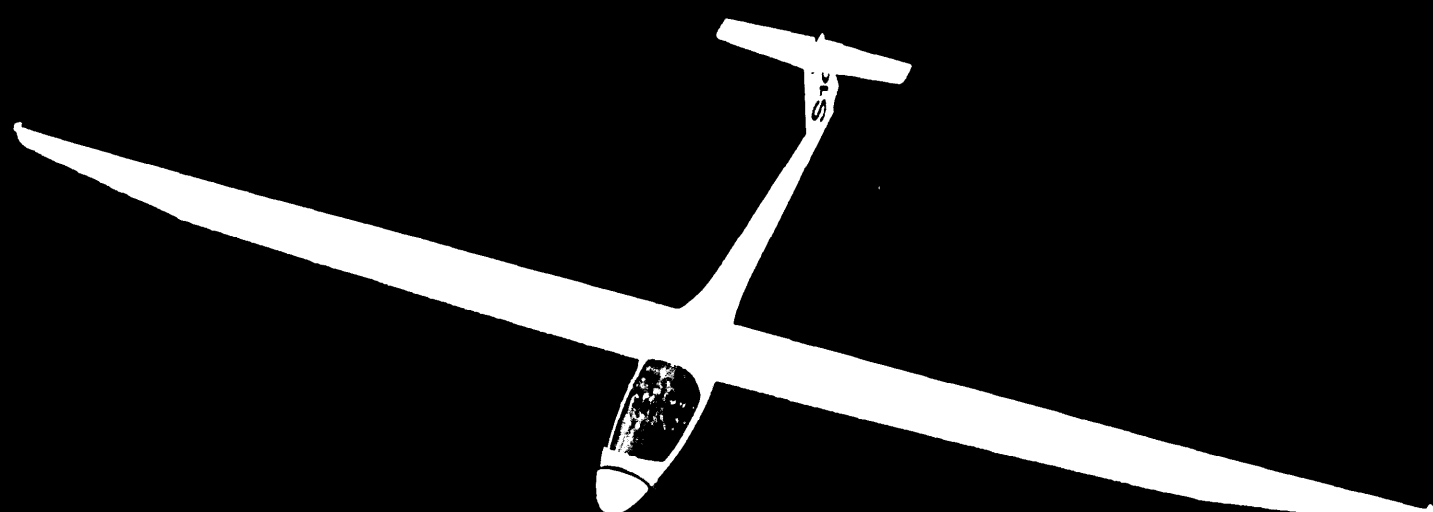
Crew:	Seats two pilots, side-by-side ,	
Limbach Engine:	93hp	69 kw
Wingspan:	23 m	75.5 ft
Length:	8.4 m	27.6 ft
Max Gross Wt:	850 kg	1,874 lbs
Empty Wt:	640 kg	1,410 lbs
Best Glide:	50:1 ratio	50:1 ratio
Min Sink Rate:	33.5 m/min	110 ft/min
Vne:	146 kts	168 mph
Stall Speed:	42 kts	48 mph
Cruise Speed:	121 kts	140 mph
Climb Rate:	229 m/min	750 ft/min
Fuel Capacity:	120 l.	31.7 gal
Range:	860 nm	990 miles

* Equipped with "Variable pitch" propeller option.
Specifications subject to change.

STEMME USA, Inc.
200 SOUTH BRENTWOOD BLVD #21B
SAINT LOUIS, MISSOURI 63105



SOARING



A Flight Test Evaluation
Of the STEMME S10 Motorglider

By Richard H. Johnson

For further information:
STEMME USA INC.
1401 S. Brentwood Blvd. Suite 760
St. Louis, Missouri 63144
314-721-5904 314-726-5114 fax

A Flight Test Evaluation of the

STEMME S-10 MOTORGLIDER

by Richard H. Johnson

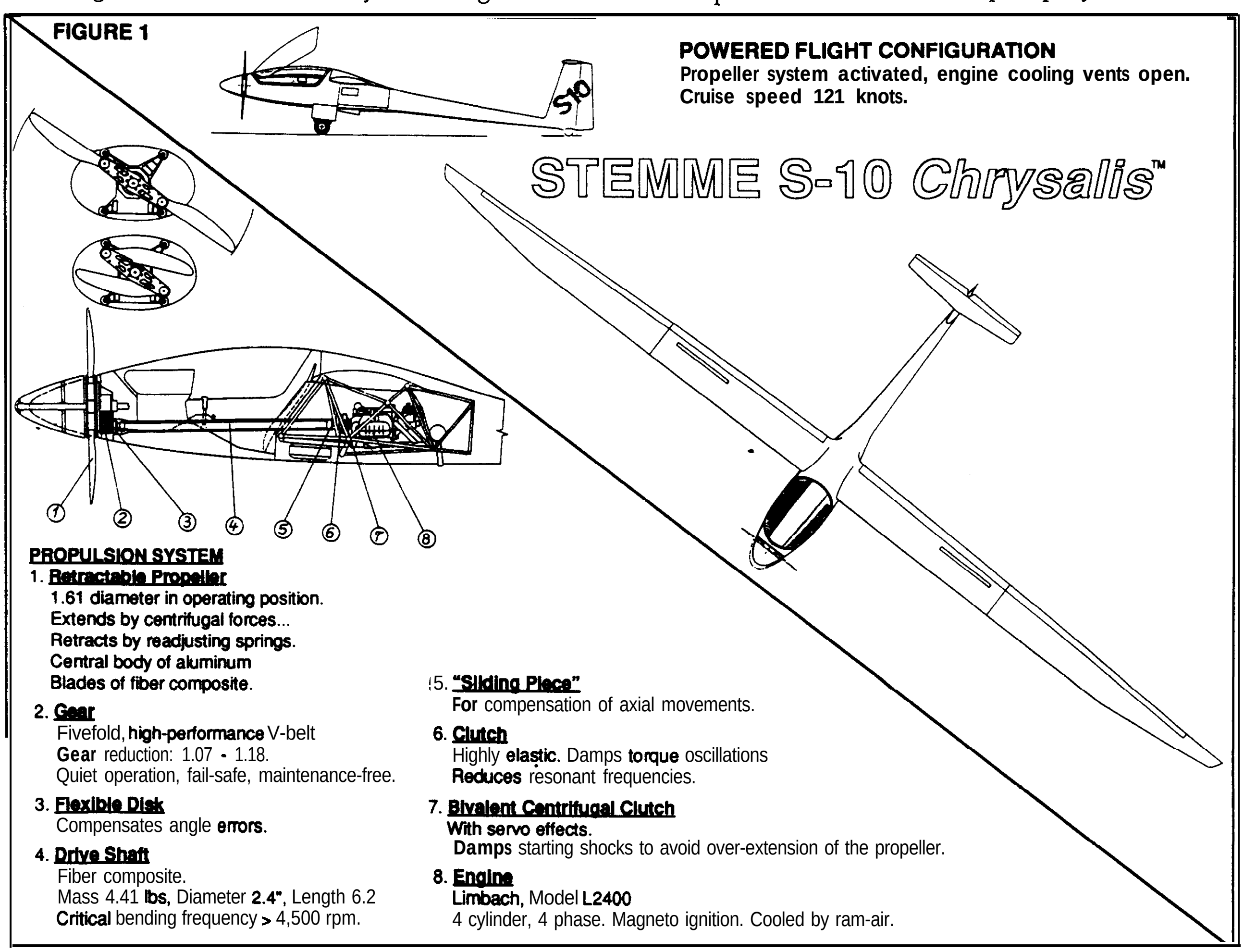
All Photography ©Tom Tyson

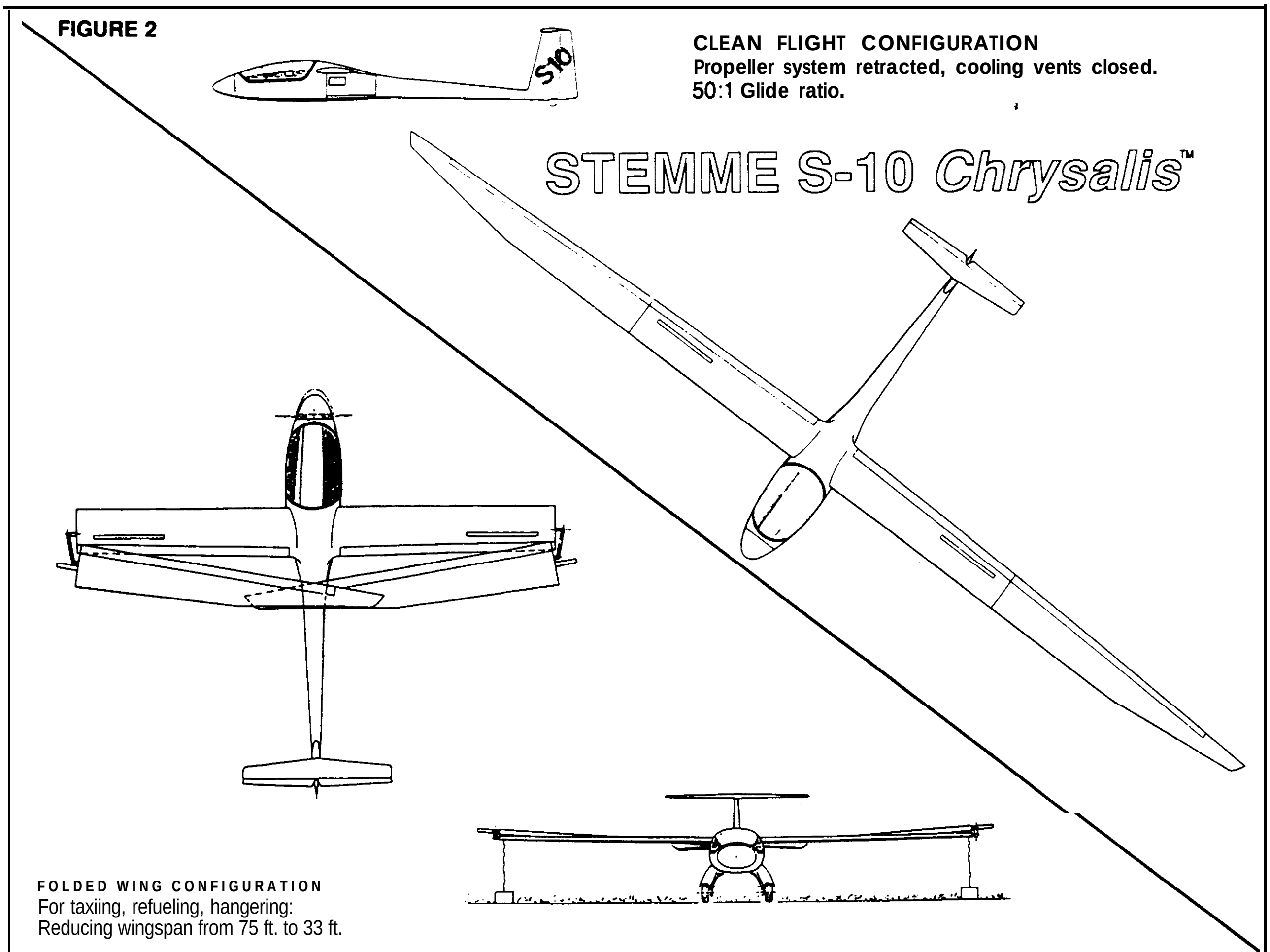
The Stemme S-10 two-seated motorglider is the brainchild of Dr. Reiner Stemme of Berlin, Germany, and it is in production at his STEMME GmbH & Co. KG factory, also located in Berlin. The aircraft enjoys an exceptionally well designed installation of the internally mounted engine located behind the two side-by-side seats. This engine installation when combined with its thru-the-cockpit carbon fiber drive shaft which turns a uniquely designed centrifugally extended propeller, results in a truly marvelous engineering accomplishment. The FAA granted the craft Utility Category Type Certificate number G58EU in 1992.

The unique power plant, when combined with the elegant 3 piece 23-meter span foldable carbon wing provides a high level of both motor gliding and soaring performance. Dr. Stemme and his engineers are to be congratulated for creating what appears, at this time, to be the new king of motorgliders.

Figure 1 is a 3-view outline drawing of the Stemme S-10 in its motorglider configuration. Figure 2 shows it after it has transformed (from a chrysalis) to its beautiful sailplane configuration. A forward push on a large handle, located at the instrument panel lower center, opens the engine compartment inlets/outlets and simultaneously moves the fuselage nose cone forward about 4 inches, thereby exposing the folded propeller assembly. To start the engine, the fuel valves are opened, the fuel pumps energized, and the electric starter button pressed. Only after the propeller blades are centrifugally extended is the ignition switched to "on." If the ignition is switched "on" before the propeller blades are fully extended, damage to the propeller can occur thru a too rapid blade snap deployment. It is said

FIGURE 1





that the new variable pitch propeller does not require that the propeller blades have to be fully extended before the ignition is switched to "on."

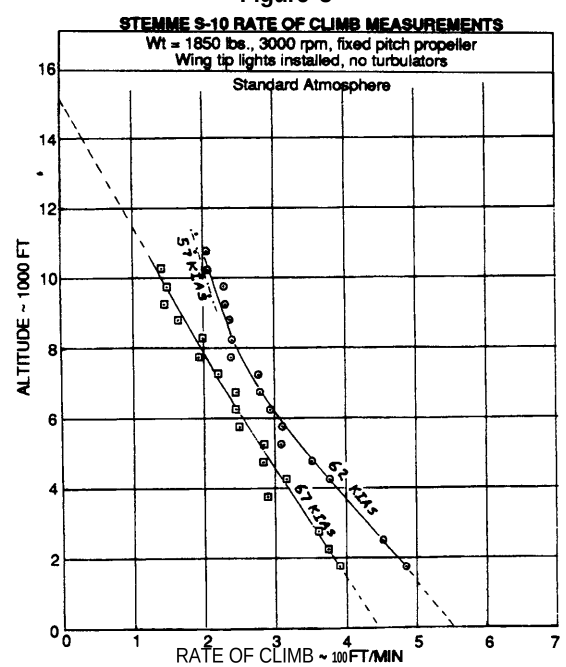
The powerplant used with the Stemme S-10 is the 4 cylinder, 4 cycle, air cooled LIMBACH L 2400EB1.D aircraft engine. It is rated at 93 hp at 3400 rpm at takeoff, and 80 continuous hp at 3000 rpm. A 1.18 to one gear reduction ratio is achieved thru a 5 Vee belt drive at the forward drive shaft/propeller interface. The engine is located in mid-fuselage, below and just aft of the main wing spar. To protect the structure from the engine's heat and any possibility of fire, the engine compartment is completely enclosed by a stainless steel housing. By turning the fuel valves to "off" when the engine is not in operation, the possibility of an engine compartment fire is minimized.

The fuel is carried in two integral wing leading edge tanks located at the outboard portions of the wing center section, much like most modern sailplanes carry water ballast. However, no fuel dump valves are provided. The normal fuel tanks each have a capacity of 45 liters (11.9 gal), with optional larger 60 liter (15.9 gal) tanks available. Since cruising flight fuel flow is only about 4 gallons/hour, the standard fuel tanks are quite adequate for most operations.

Our test Stemme S-10 was equipped with a fixed pitch propeller. A variable pitch propeller is now offered as an option. Although cruising range measurements were not included in our flight testing at Caddo Mills, the factory estimates that a range of about 1000 nm is achievable at 120 kts. with the 60 liter tanks combined with the variable pitch propeller. Considerably longer ranges likely can be achieved by cruising at a more efficient airspeed of between 70 to 90 kts.

The main landing gear are electrically retractable and consists of left and right hand 5.00 x 5 inch wheels mounted on steel tube struts. The two wheels are equipped with hydraulically actuated disc brakes that work well. In the event that electrical power is not available for gear extension, they may be extended

Figure 3



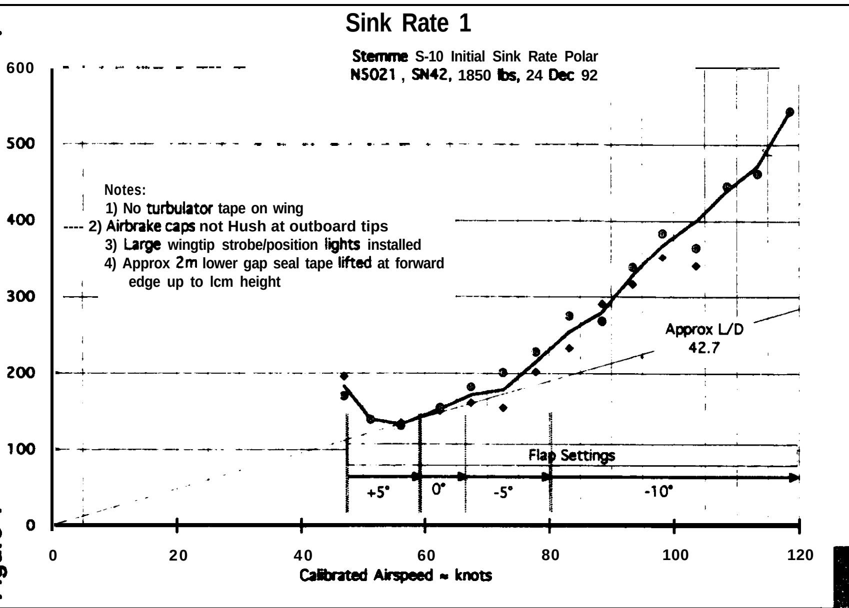


Figure 4

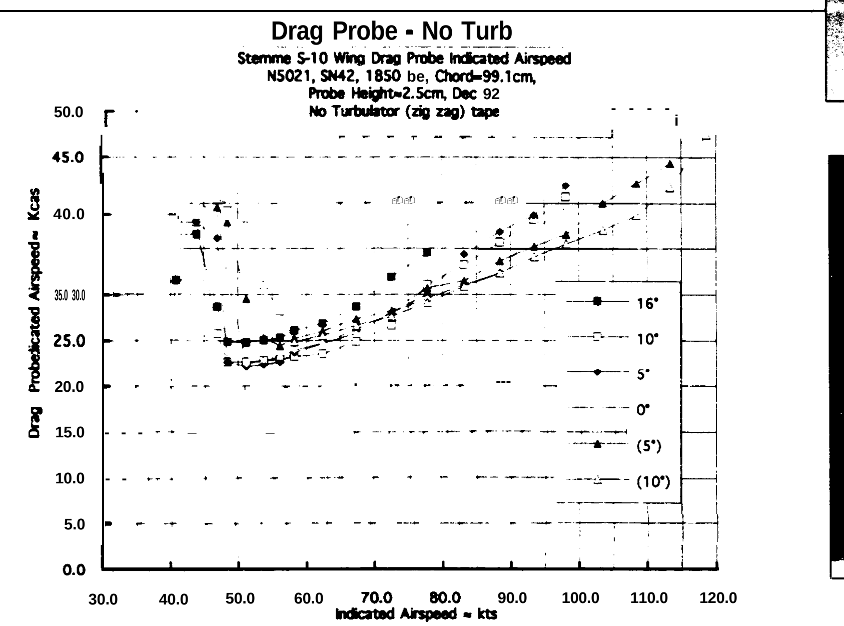


Figure 5

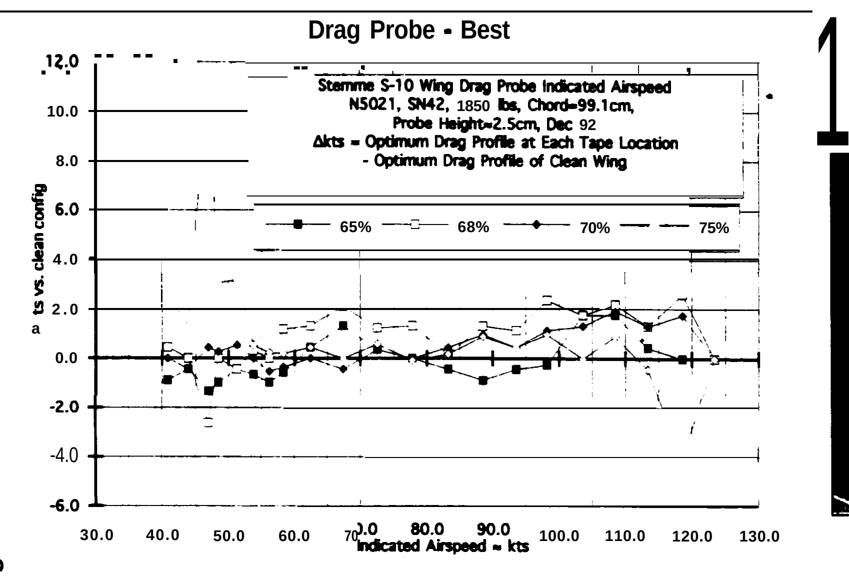
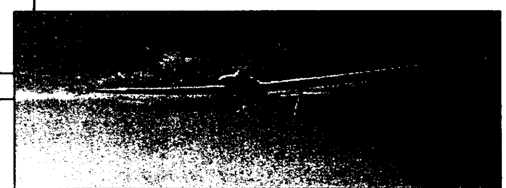


Figure 6

manually. A steerable but non-retractable 210 by 65 mm tail wheel completes the landing gear. The track on the main gear is a fairly narrow 1.15 meters (3.77 ft). That is narrow by airplane standards, but it appeared to be adequate for taxiing the S-10 in crosswinds up to about 25 mph. Its relatively heavy 850 kg (1874 lb) maximum gross weight added significantly to its ground taxiing stability.

Those of us in the Dallas Gliding Association flight test group were elated when Marc Arnold and Barbara Pfifferling of Stemme USA offered to bring their demonstrator S-10 to Caddo Mills for flight testing during the winter of '92-93. They



Test flight take-off with main gear retracting.

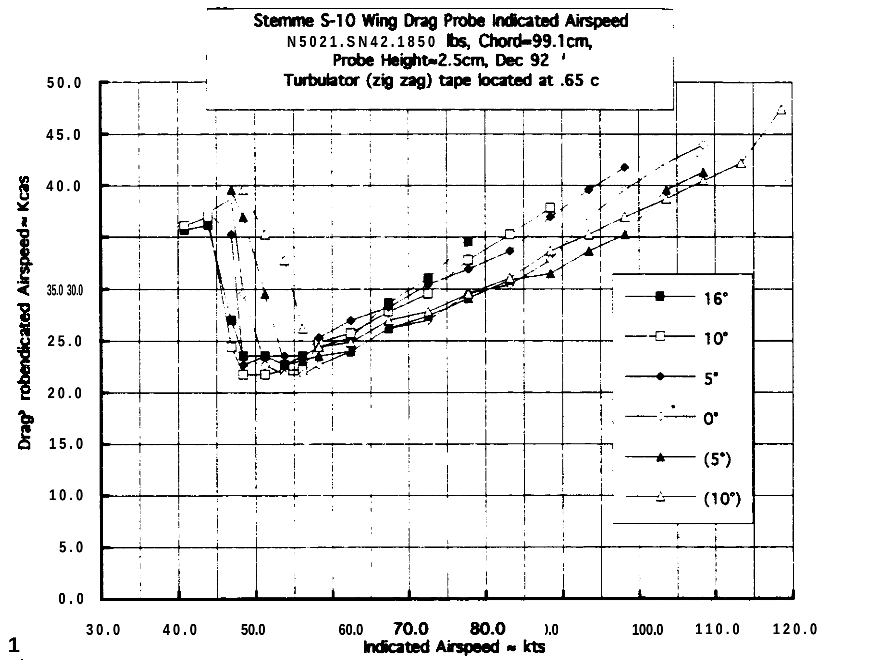
Forward hinged canopy provides good cockpit access.

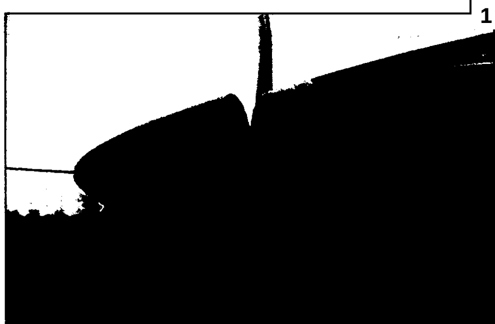
enjoyed a very pleasant flight in their Stemme S-10 when they flew from St. Louis to Caddo Mills, Texas, arriving on the afternoon

Wing fold detail, features unique integral aluminum tube swivels to support outer panel root.

before Christmas. Since the weather that afternoon was calm and suitable for polar sink rate measurements, we soon had the Stemme back in the air, climbing to 11,500 ft. before shutting off the engine and starting sink rate measurements. We had time for two high flights before darkness arrived. Marc Arnold piloted both flights while I, and Darrel Watson, directed and recorded data on the first and second flights, respectively. The gross weight of our fully equipped flight test Stemme S-10, N5021, was about 1850 lbs. The Stemme's aerodynamic configuration for these initial tests was just-as-arrived. Large strobe and nav lights adorned each wingtip and tail, no taping or sealing of the engine compartment, and some unnoticed loose tape existed along the flap hinges. During my flight we climbed at the Flight Handbook recommended airspeed of 62 kts. calibrated. During Darrel's flight the

Figure 7: Drag Probe - **Turb*65%**





Nose cone extended, engine running.

climb airspeed was increased to 67 kts., to measure the climb rate at the 5 kt. higher-than-optimum airspeed.

The measured climb rates versus altitude for those two flights are shown in Figure 3. Some later data that was measured at 5 kts. slower-than-optimum are also included there, indicating little performance was lost by climbing at the slower airspeed. The 62 kt. data indicated a sea-level climb rate of about 550 fpm, whereas the 67 kt. R/C indicated about 110 fpm less. Both the 57 kt. and 62 kt. data extrapolations indicate a 100 fpm service ceiling at about 15,000 ft, whereas the 67 kt. data shows a service ceiling of only about 11,500 ft.

These climb performance data were taken with a fixed pitch propeller turning at 3000 rpm. We experienced some poor fuel/air mixing by the engine automatic fuel mixture system above about 7000 ft., causing the engine to misfire every 5 to 10 seconds. That has since been corrected through a carburetor adjustment by LIMBACH USA, and the high altitude climb performance will now likely be better than those shown here. The now available controllable pitch propeller would permit the use of higher manifold pressures at the specified maximum continuous 3000 rpm. That would provide higher climb rates, at least at the lower altitudes, than were measured with the fixed pitch propeller that was available on our test aircraft.

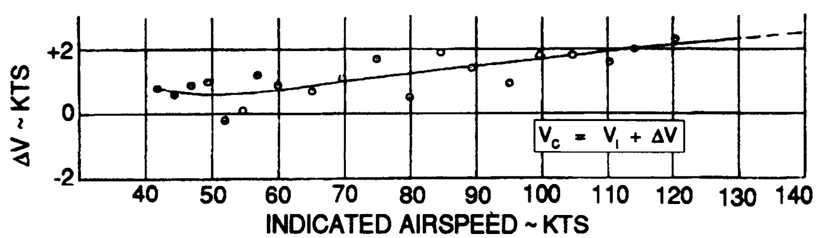
After each of the two initial high climbs, the Stemme's engine was shut off, propeller stowed, and sink rate measurements commenced via stop watch and calibrated altimeter. No significant amount of engine cool-down was needed because the engine's cooling air scoops are closed when the nose cone is moved aft to cover the manifold pro-

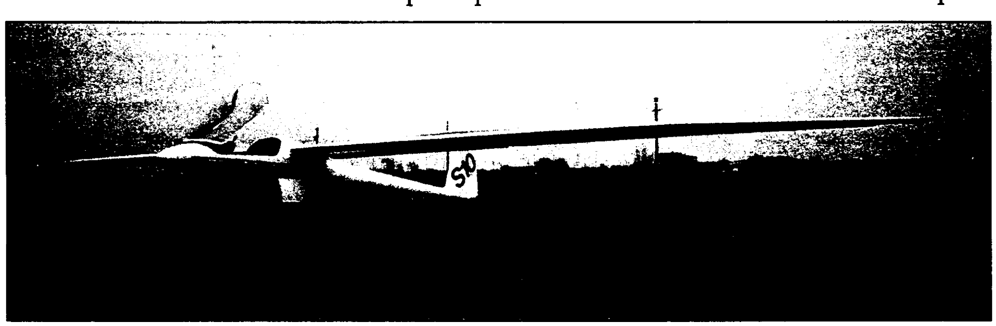
Figure 8

STEMME S-10 AIRSPEED SYSTEM CALIBRATION

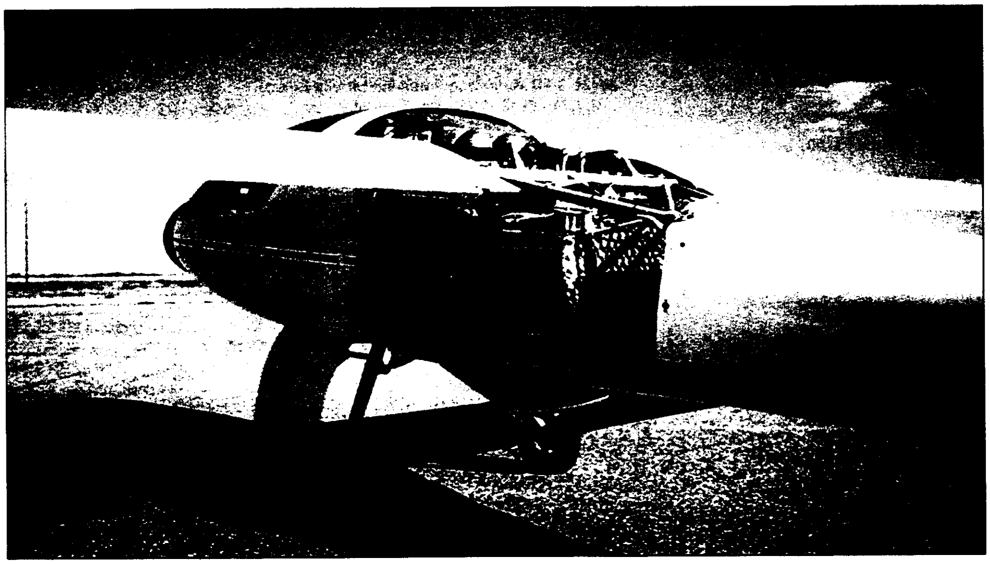
N5021, SN 42, 1850 lb., January 5, 1993 test

Pitot tube on nose, Mid fuselage sides static





Stemme S-10 ready to fly.



Engine compartment cowling removed.

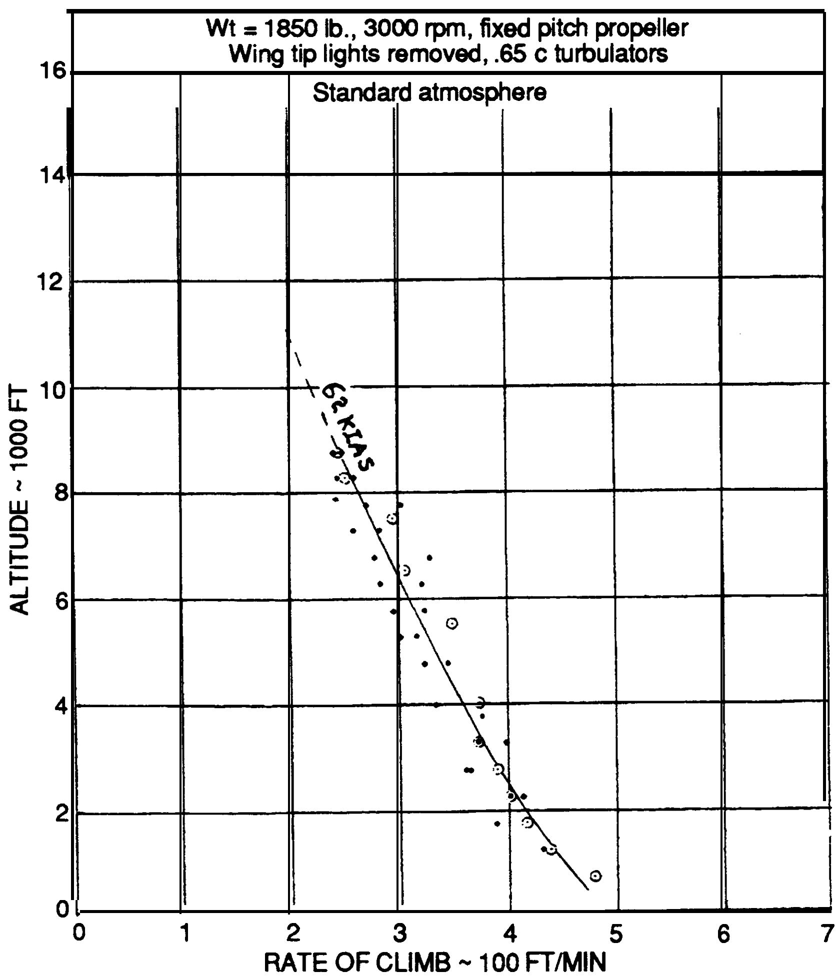
peller. That provides for a gentle engine cool-down with reduced thermal shock to the cylinders.

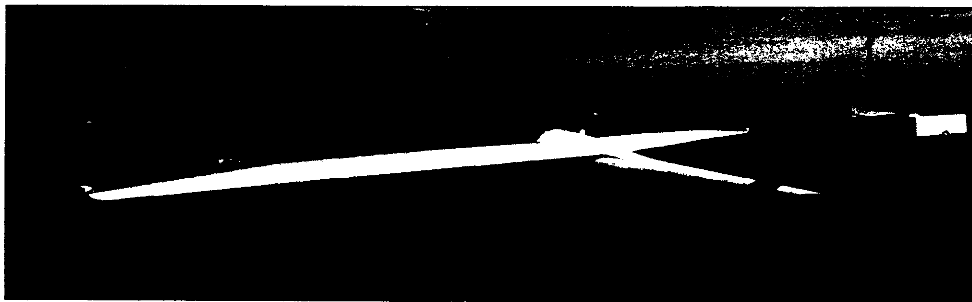
The sailplane configuration sink rates that were measured during the initial two flights in its "as arrived" condition are shown in Figure 4. Included are the then estimated best flap settings that were used. A minimum sink rate of about 135 fps was shown at 56 kts., and a maximum glide ratio of about 42.7 was indicated in the 60 kt. region. That performance was reasonably impressinve considering its "as arrived" configuration which needed considerable aerodynamic cleanup, and its 9.2 psf flight test wing loading.

The next few days were spent improving the Stemme's aerodynamic configuration. Loose tapes were replaced, the large wingtip lights were removed, the airbrakes flushness improved, and the effect of turbulators on wing profile drag experiments begun. The wing profile drag rake (Reference A) was installed on the right wing trailing edge 58 inches outboard from the fuselage side. Wing relative profile drag measurements were then performed over a full range of airspeeds, for each of the Stemme's +16 to -10 degree flap settings. Thus the optimum (least drag=least kts) flap setting could be determined for each airspeed, at least at the probe location on the one wing. With more time, we would like to perform the wing profile measurements on at least two locations for each wing.

Figure 9

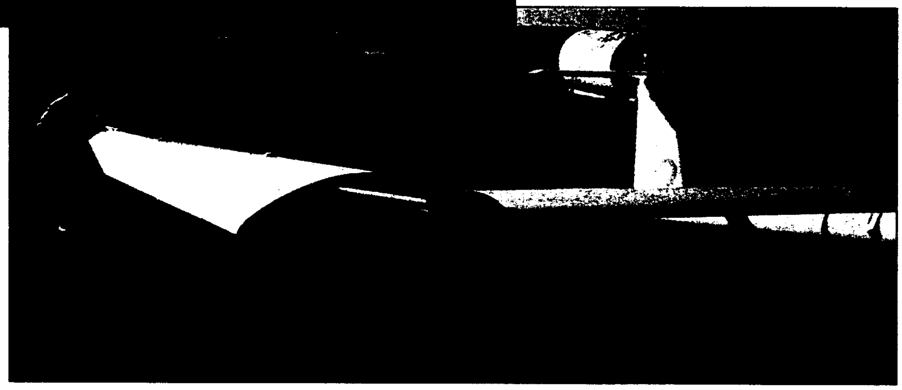
STEMME S-10 RATE OF CLIMB MEASUREMENTS





With large wing tip lights installed.

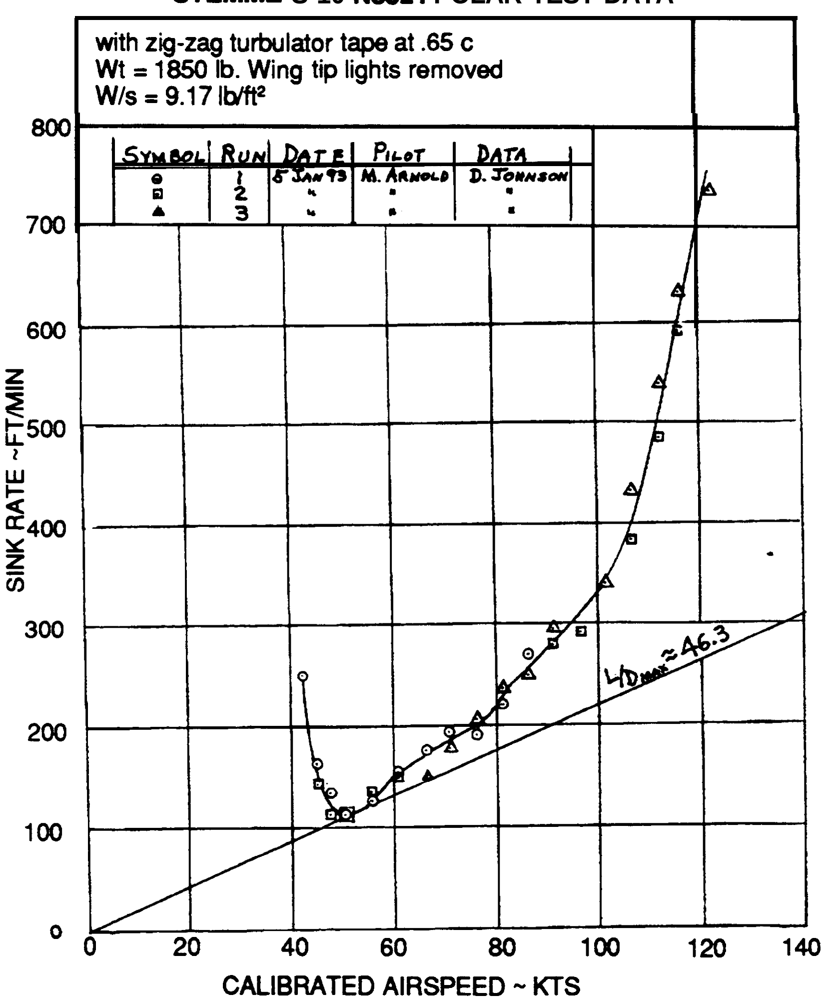
The first wing profile drag tests were performed with the wing clean and smooth, without any turbulators installed. Those test data are shown in Figure 5. Those data indicate that the optimum flap setting for airspeeds between 45 and 74 kts. to be +10 degrees, which is an unusually large flap setting for airspeeds above 50 kts. Above 74 kts a full -10 degree flap setting provided the lowest drag. That is a most unusual airfoil behavior and suggests that turbulators might be beneficial. The wing airfoil is a relatively new German HQ 41/14.35. The HQ stands for DFVLR Braunschweig's engineers Horstmann and Quast. They are reputed to be the current top low speed airfoil designers in the world.



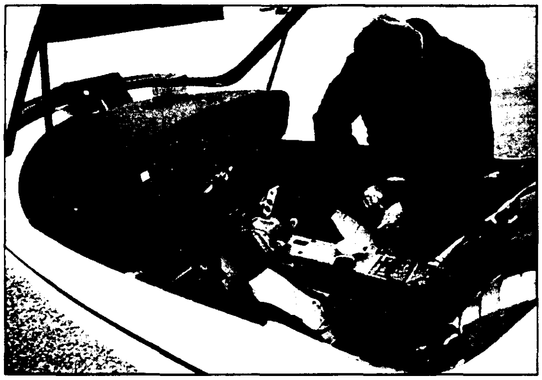
Easily folded outer wing [illegible]

Figure 10

STEMME S-10 N5021 POLAR TEST DATA



Next, a 30 inch long Zig-Zag turbulator tape strip was added to the wing bottom surface ahead of the drag probe. The wing drag was again measured with the flaps set at each of the previously tested 6 flap settings; with the turbulator strip moved between flights to different forward and aft locations. One test flight each was made with the turbulator located at .65, .675, .70, .75, and .81 chord fraction aft of the wing leading edge. For space reasons it was decided not to present all of those 5 plots here; but instead present Figure 6 which is a summary plot comparing the lowest drag values measured without turbulators (Figure 5), to those measured with them located at the above discussed locations.



Author preparing cockpit for entry.

Negative values in Figure 6 indicate that the turbulators reduced the drag of the wing, compared to that without turbulators, and positive indicate the turbulator actually increased the wing drag. Those data indicate that in the low and mid-airspeed regions, the .65c turbulator location was best, at least at the single probe test location. Above 100 kts. the .75c turbulator location appeared to be optimum.

Figure 7 presents the full data set for the .65c turbulator location, from which the optimum flap settings can be noted. Although the indicated airfoil performance improvements thru the turbulator tape installation were not very large, it did provide a normal succession of optimum flap settings, with +16° now being optimum below 45 kts., right thru -10° being optimum above 100 kts.

The factory supplied Zig-Zag turbulator tape was then applied to the full span of the wing at the .65c location, and the remainder of the Stemme flight tests were conducted in that configuration. After waiting thru 10 days of unsuitable sink rate performance measurement test weather, the skies finally cleared and the winds calmed on January 5. Three (3) high climbs were made to remeasure climb and sink rates, and to perform a final airspeed calibration.

The airspeed calibration data is shown in Figure 8. The Stemme's measured system errors were small, amounting to less than 2 kts. from near stall up to 110 kts. A very good system indeed. The new climb rate data is shown in Figure 9, where all 3 climbs were flown at the recommended 62 kts indicated. For some reason, the indicated climb rate performance at low altitudes was not quite as good as the initial tests had shown.

The Figure 10 plot shows the sink data that were measured on that final day of testing. There the minimum sink clearly measures about 110 fpm at 48 to 50 kts., which is remarkably low considering the 9.2 psf wing loading. A maximum L/D ratio of about 46.3 is shown between 50 and 55 kts., and that is roughly 8 percent better than the initial testing had shown. The drag appears to be quite low at 50 kts., and between 75 and 105 kts. For some reason the Stemme's drag appears to be somewhat higher than expected in the 55 *to 70* kt. range.

It is very possible that the airfoil turbulator configuration needs further optimization. The canopy appeared to be properly sealed, but no seals were installed on the engine compartment inlets/outlets or on the landing gear doors, and a soon-to-be-available tail wheel fairing was not installed. Had more time been available, further refinements could have been implemented.

The handling qualities of the Stemme S-10 are quite good and 45-degree-to-45 degree rolls could be accomplished in a surprisingly short 4.5 seconds at 60 kts. That is really remarkable for a 23 meter span sailplane. When the ailerons are deflected, the wing flaps also follow, thus increasing the Stemme's roll rates. Adequate rudder control is provided by the relatively large vertical tail combined with a fairly long tail boom. The stalls are gentle, both in straight and turning flight. With +16 degree landing flap, the power off stalling speed at the 1850 lb. flight test gross weight calibrated at about 43 kts., increasing to about 43.5 kts. with +10 degree thermaling flap setting.

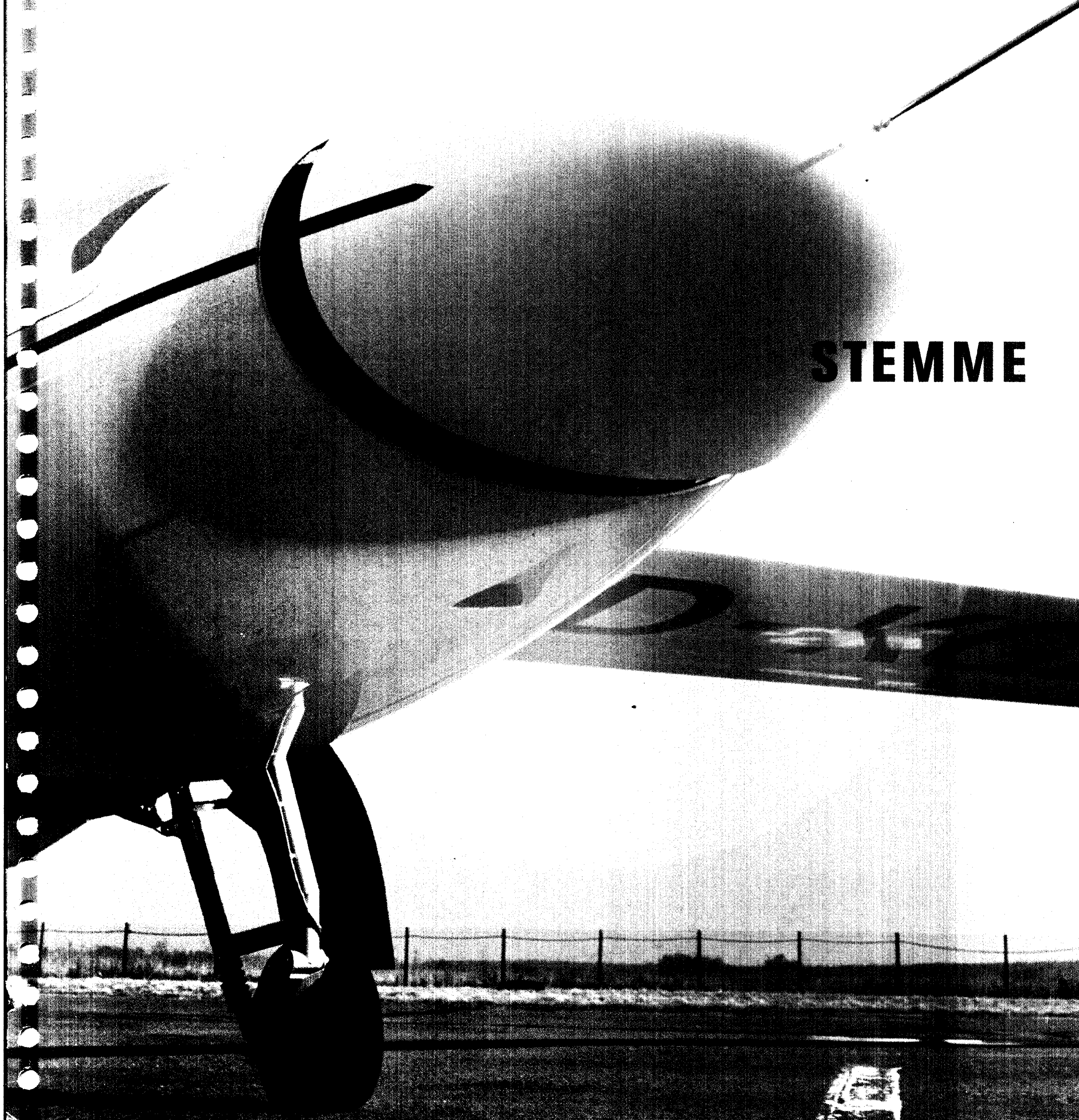
The side-by-side seated cockpit is adequately large and comfortable, and the large canopy provides both the pilot and passenger with a very good outside view. Although our test motorglider was equipped with an intercom system, I preferred to operate without it, even when the well muffled engine was operating. Since the time of last winter's testing, I had the pleasure of coaching Marc Arnold thru a simulated 3 hour POST task during a mostly blue rest day at the recent Sports Class Nationals at Hobbs, New Mexico. We found that the S-10 climbed well in the summer thermals there, despite its 9.2 psf wing loading. Marc, with little thermaling experience, successfully thermaled away from an 1100 ft. low at one of the turn points.

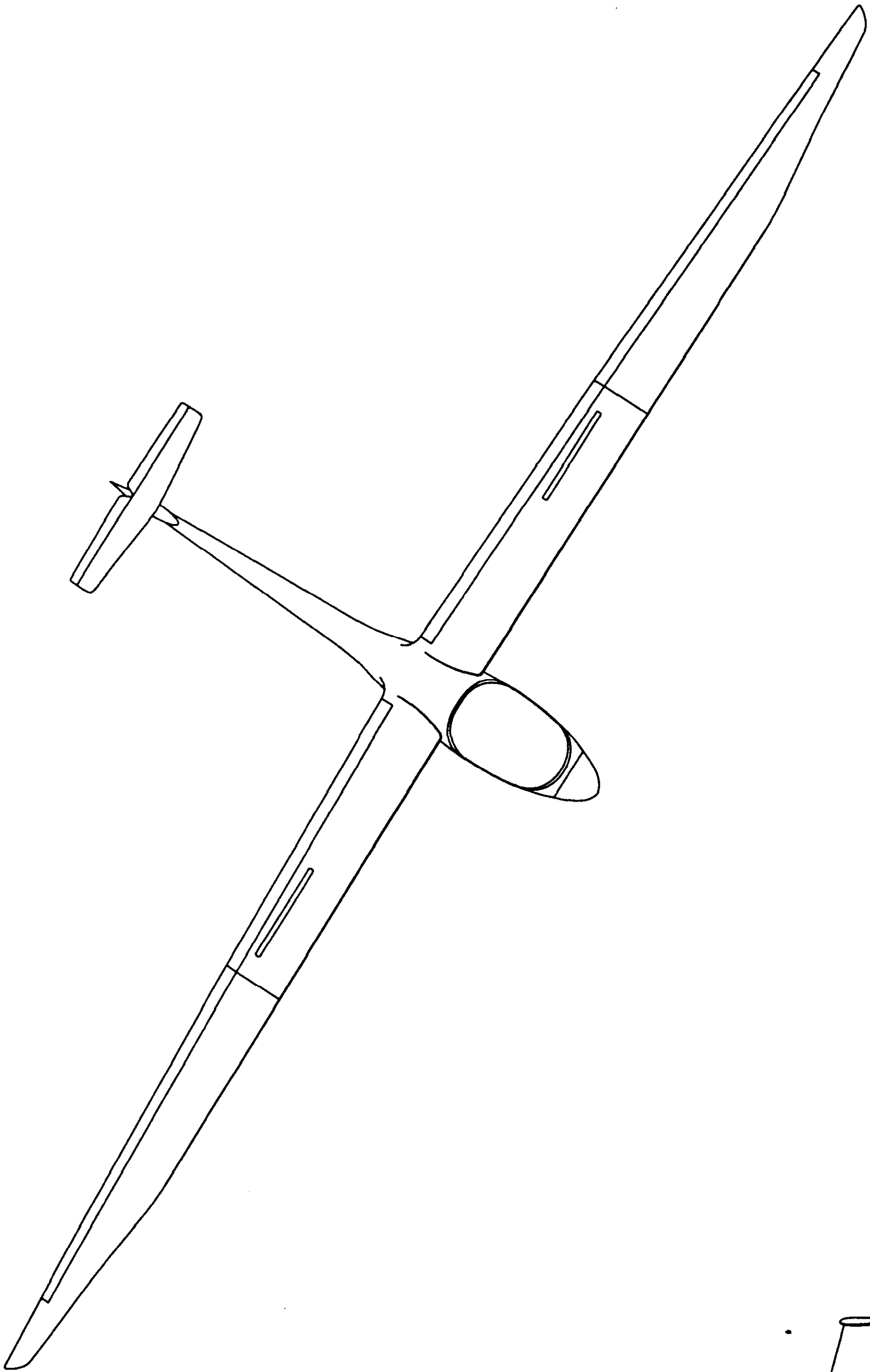
Overall, the Stemme S-10 is certainly an outstanding motorglider, and Dr. Stemme is certainly to be congratulated for developing such a high quality and well performing sailplane-airplane combination. There is little doubt that its excellent 46.3 maximum glide ratio performance measured during our brief winter test period can be improved with further sealing, tail wheel fairing, and turbulator optimization. Perhaps next winter Stemme USA will be able to bring N5021 back to Caddo Mills for a second period of flight tests. It is possible that the Althaus bump turbulator tape will provide lower wing drag in the needed 55 to 65 kt. region than did the Zig-Zag tape tested. Also, additional wing spanwise locations need to be evaluated for turbulator optimization.

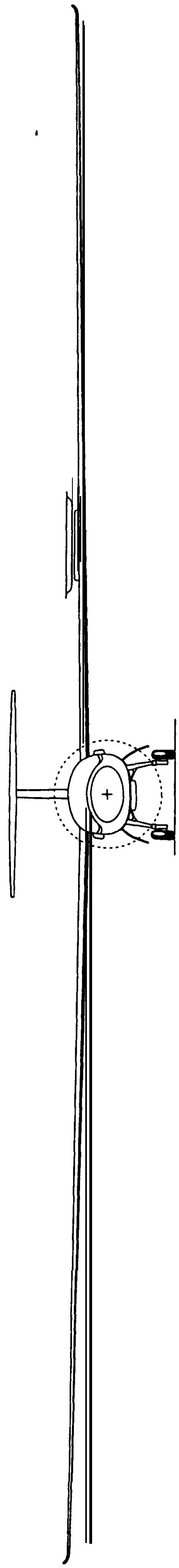
Thanks go to Barbara and Marc of Stemme USA for the use of their new S-10, to Tom Tyson for the excellent photos, to the Dallas Gliding Association for providing hangarage, the small amount of fuel used (no tows!), and instrument calibrations. Also to the DGA members who assisted with the testing.

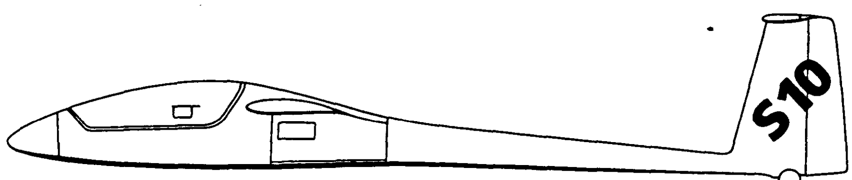
Reference A: Johnson, R. H., "At Last: An Instrument That Reads Drag," *Soaring* Magazine, October,1983. ■

STEMME

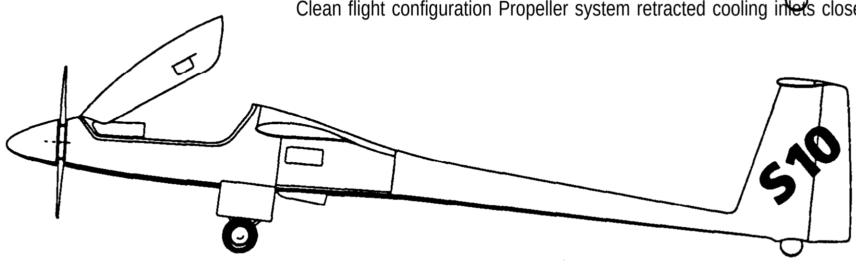








Clean flight configuration Propeller system retracted cooling inlets closed



Take of and landing configuration: Propeller system activated, engine cooling air inlets/outlet opened, landing gear extended

The Company

The Company manufactures light aircraft and aircraft components as well as provides services for aircraft production and development. The Company was founded in 1984 in Berlin as a joint venture of experienced entrepreneurs to develop new markets. Aircraft production in Berlin was prohibited at that time by Allied mandate since World War II. The first production and development licence was issued for the STEMME S10 (with the exception of the installation of the propulsion unit). The ample resources of the Berlin Universities for research and development provided an excellent foundation. Today the production facilities are located East of Berlin at Strausberg Airfield which gives excellent flight test capabilities as well as training opportunities for company's customers.

Our first product is the STEMME S10 two-seater, high-performance motorglider. The S10 is the synthesis of highly developed aerodynamics of sailplane technology combined with a revolutionary powered aircraft concept. The centrally-mounted engine drives forward through a carbon shaft and reduction gear to a folding propeller in the nose. These aircraft are manufactured utilising the latest composite/fibre materials (carbon, glass and Kevlar). With its configuration and performance, the S10 is the pace-maker for an entirely new generation of aircraft: Glide angle of 50:1 (engine off); cruise-speed in powered flight of 225 km/h (121 kts); extremely low noise level and fuel consumption.

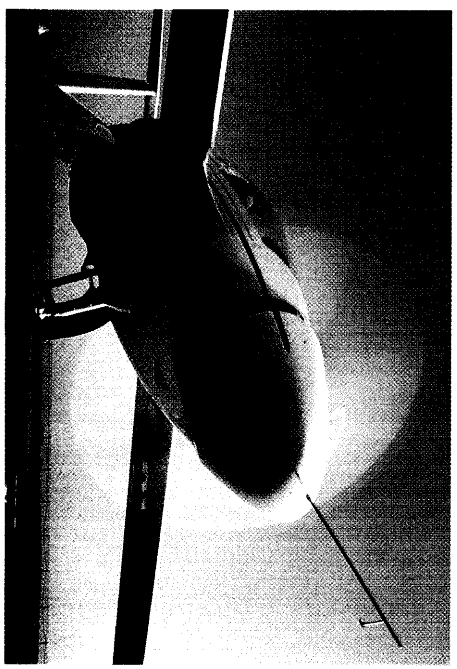
In 1995, five years after production of the initial series commenced, the 75th aircraft was delivered – to a Brazilian customer. This indicates the basis for the continued success of the S10 series – the export rate is in excess of 70% world-wide, from Australia to South Africa and Alaska.

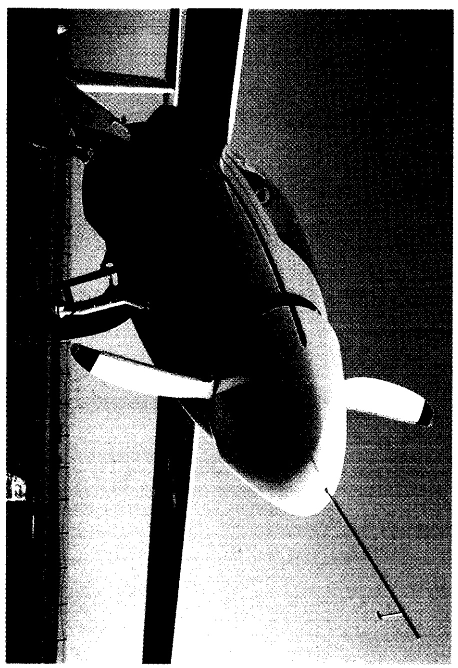
The unique technical concept of the S10 also provides the basis for future 'Light Surveillance and Reconnaissance Aircraft', S15, for use in environmental and various other kinds of monitoring, atmospheric physics and geographic research. Highly sensitive sensorics are mounted in fuselage and external underwing pods.

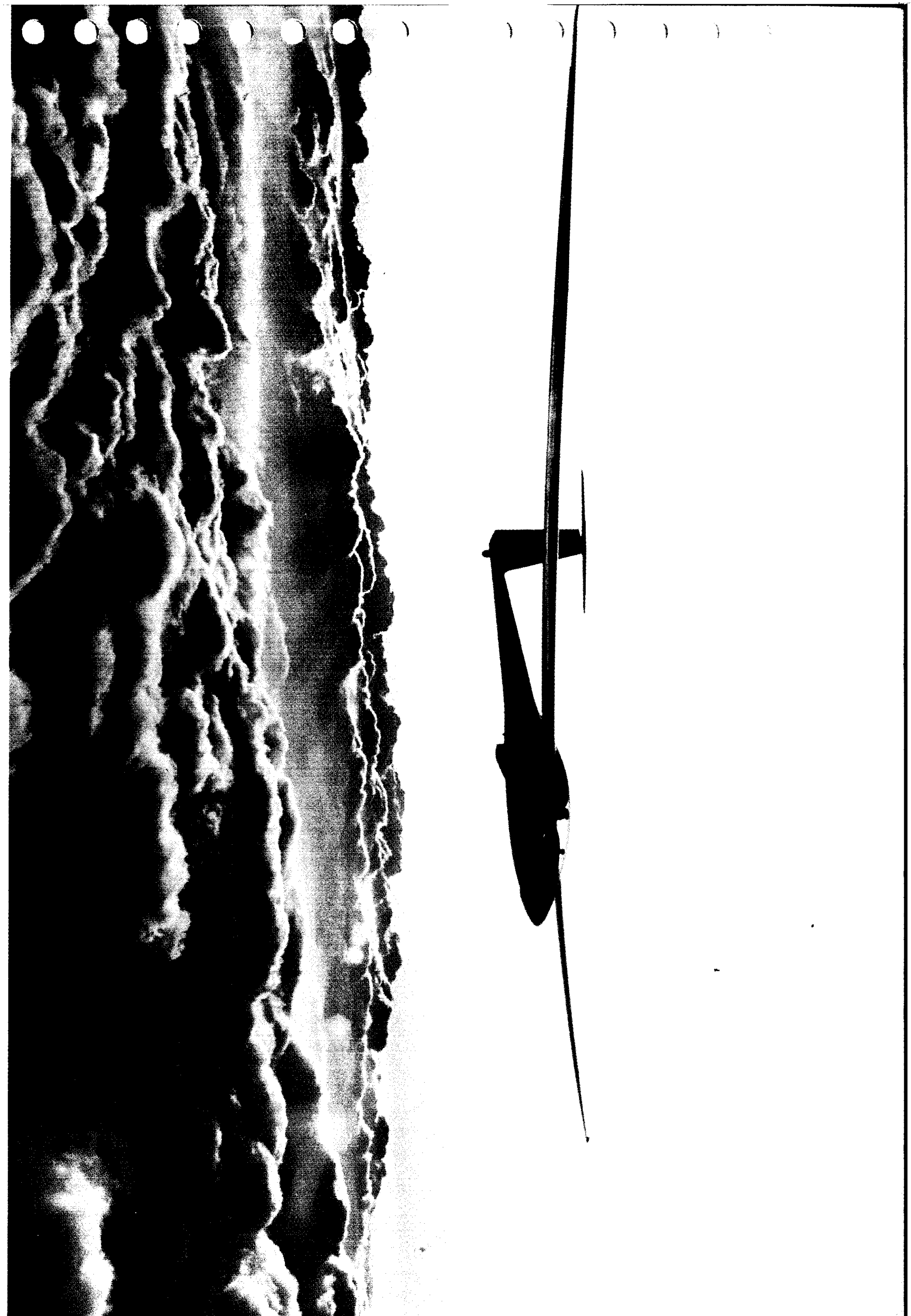
The workforce and their expertise are decisive in the development and production of highly resilient composite components. Exclusive aircraft*like the S10 or S15 are dependent on the qualification and the motivation of the workforce. The foundation for our personnel was laid during the five years development of the S10 series. The team comprises engineers and specialists in all essential disciplines, such as aerodynamics, materials research, propeller development, propulsion technology and electronics.

So consequently STEMME is further involved in pinoneer research projects spanning from simulation of bird wing stall behaviour until HALE-designs.

The location, Berlin-Brandenburg has a long tradition in the production of aircraft, aero-engines and aircraft equipment. Lilienthal's first experimental flights were made only a hundred years ago; Berlin-Tempelhof Airport is regarded as the birthplace of German air transport.







A Dream Comes True

The Philosophy

Uncompromised performance, independence, safety and convenience – the underlying philosophy of the high-performance S10 motor glider. Independence and the immeasurable sense of freedom make soaring the greatest form of sport aviation. We equipped the S10 with a powerful aircraft engine and aerodynamically clean fuselage to assure a maximum level of safety. Features such as the retractable twin undercarriage and the revolutionary propulsion system put the S10 in a class by itself. A side-by-side 2 seater, the S10 enables you to share the joy of gliding with a friend while enjoying every comfort. The S10 embodies the perfection every member of the STEMME team has worked for. It uniquely combines the qualities of a high-performance sailplane and a comfortable power plane without compromise.

Safety... «4 SEC-RE-START»

To re-start the engine the nose cone is pushed forward and this also opens the cooling vents. Only when the engine is started do the propeller blades extend into the air-stream. Therefore, the S10 suffers negligible drag or trim change during the re-start period, and it can perform a normal glider circuit and landing if the engine fails to start. This is much safer than the situation of a fold-out engine motor glider which fails to start – becoming very dangerous very quickly.

The superb handling of the 510, both on the ground (aided by the twin undercarriage) and in the air - even at the stall, makes the S10 easy and safe to operate.

Performance... The Sailplane

The soaring performance of the S10 is outstanding by any measure. With a 23 m (75.5 ft) wing span, the S10 achieves a glide ratio of 50:1 at 105 km/h (57 kts) with a maximum wing loading of 45 kg/m² (9.3 lb/ft²) at a sink rate of only 0.56 m/s (112 Wmin). The wing (state-of-the-art HQ41 profile) is optimised for both turning and straight flight. Six position flaps yield outstanding flight qualities for all speeds between V_{S0} at 77 km/h (42 kts) and V_{NE} at 270 km/h (146 kts). The S10 is the easiest to handle and most good-natured open class sailplane. Decelerating to 74 km/h (40 kts), it banks very gently without spinning. In all flap positions it is easy to control - taking only four seconds to bank through 90° from one side to the other.

	S10	S10-V	S10-VT
Engine	4-cyl./4-stroke	4-cyl./4-stroke	4-cyl. turbo-charged
Take-off Power	69kW (93 hp)	69 kW (93hp)	85.7 kW (115hp)
Fix Pitch Propeller	+		
Variable Pitch Propeller		+	+
Cruising Speed (MSL)	165km/h (89 kts)	225 km/h (121 kts)	235 km/h (127 kts)
Range (120 l)	1600km (860 nm)	>2000 km (1100 nm)	1450 km (780 nm)

In a mere four seconds the S10 transforms from sailplane into power plane.

Performance...The Power Plane

In a mere four seconds the S10 transforms from sailplane into power plane. Once the patented folding propeller is deployed, the **4-cyl./4-stroke-engines** deliver ample power to yield convenience and independence equal to any full fledged power plane. Together with the unique variable pitch propeller the powerful engine provides for short take off runs: 195 m (640 ft) on concrete. Fuel efficiency of the S10 at 42 mpg exceeds modern automobiles and noise at ground level (57.3 dB) is barely audible. The only pilots who fly in a more environmentally friendly way than S10 have feathers!

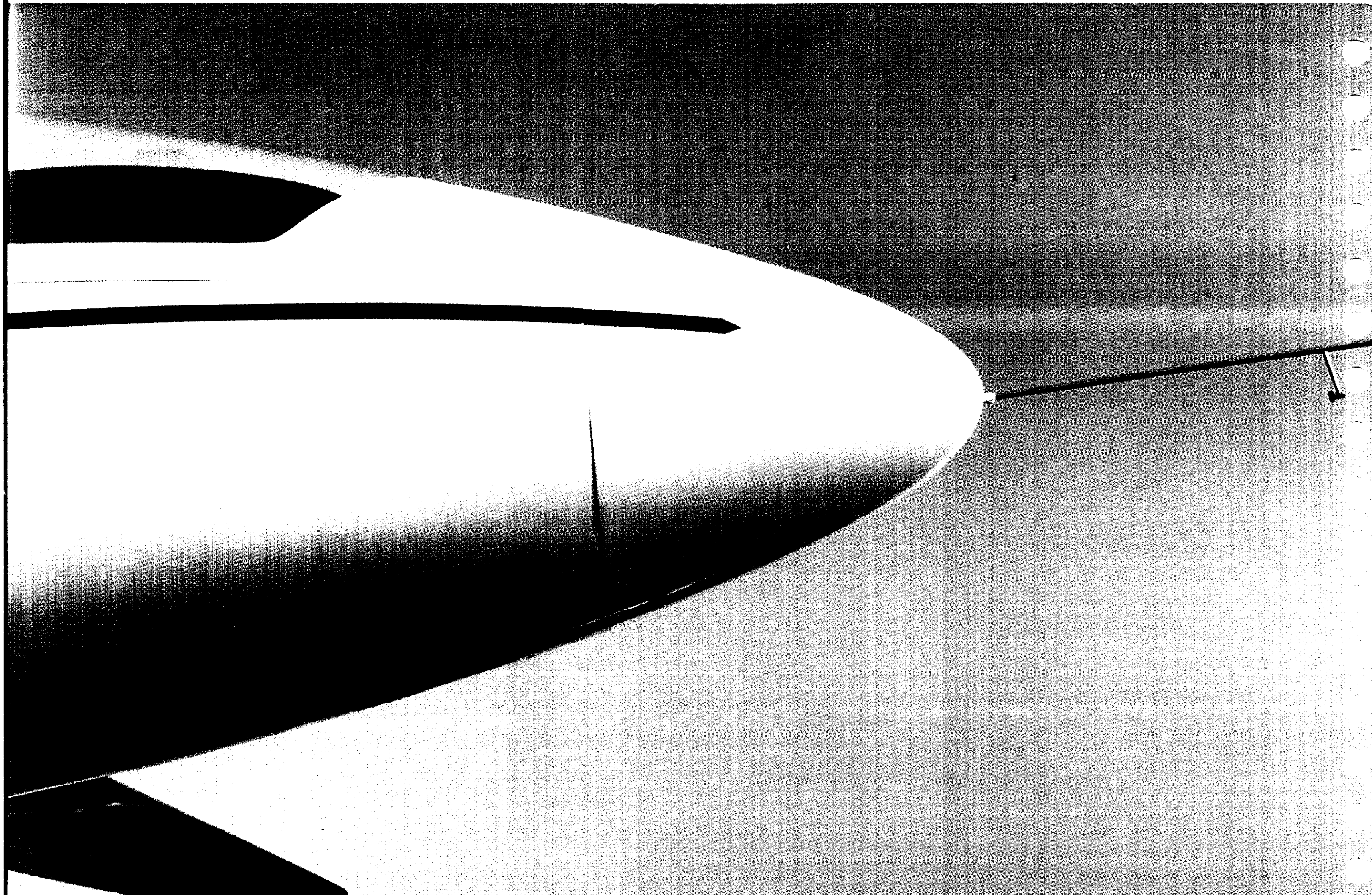
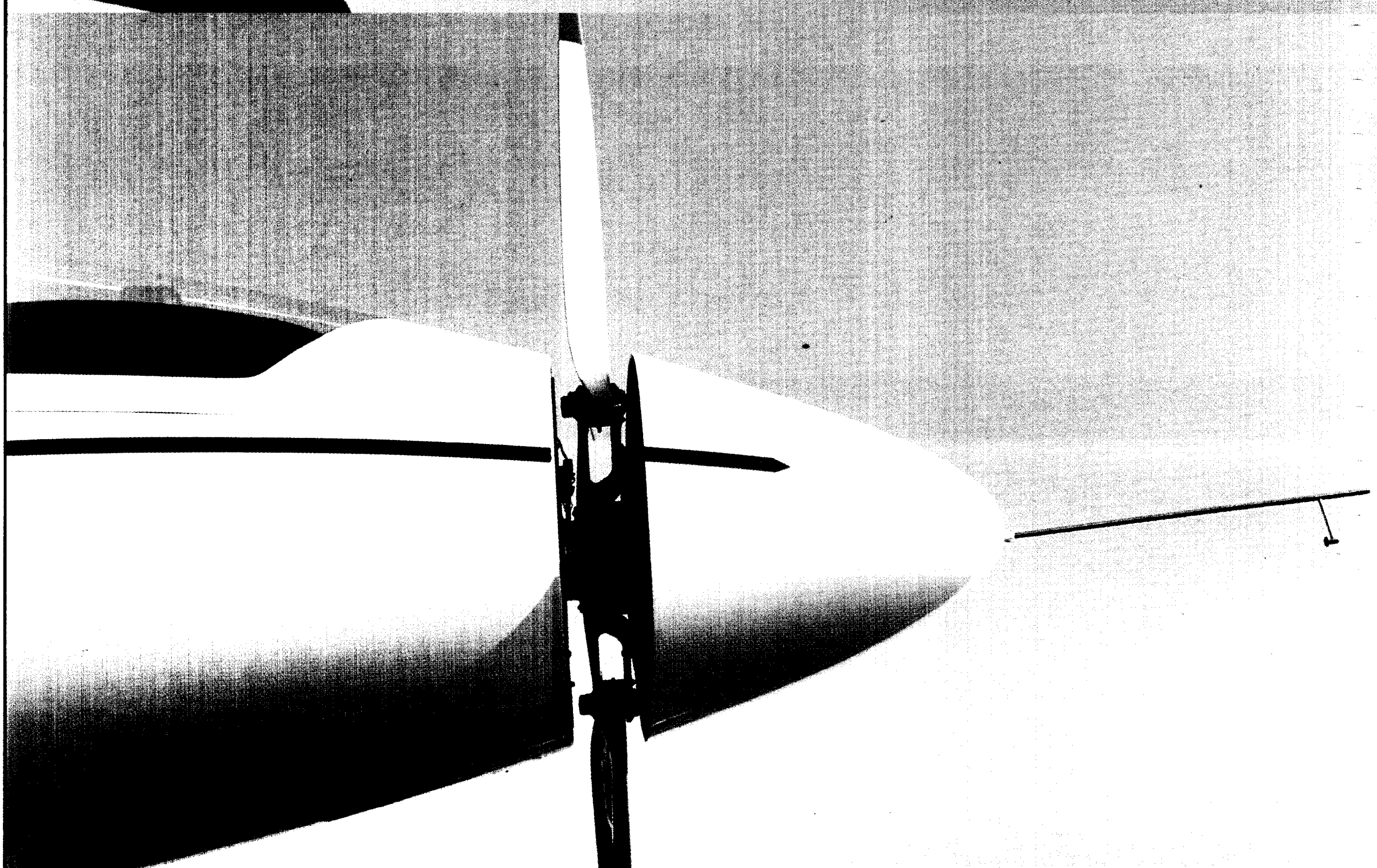
Comfort...The Cockpit

Apart from ideal soaring and power flight performance, the S10 ensures the ultimate pleasure of flying in unparalleled **comfort. The S10's** side-by-side seating is an ideal environment for social, competition or instructional flying. The ergonomically designed cockpit provides the pilot unmatched comfort on even the longest flights. Plentiful headroom, easily adjusted rudder pedals and six point adjustment of the seats match the needs of short and tall pilots alike. Ambient temperature is controlled by an ample supply of fresh air through an adjustable air distribution system. And the S10 offers a unique option to owners in colder climates – a heating system for comfort throughout the year and at high altitudes – another first among self-launching sailplanes brought to you by STEMME!

Independence...The Handling

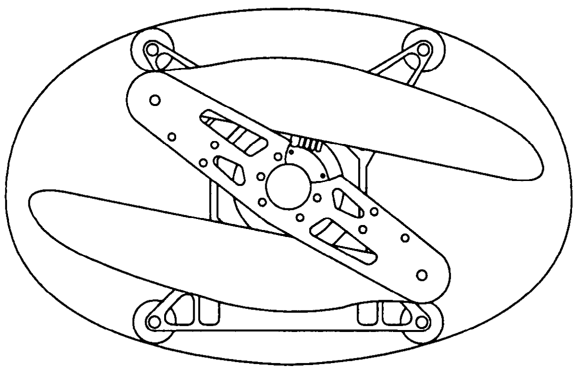
The engine and twin-undercarriage provide maximum operational independence while taxiing and flying. As a sailplane pilot, you will never need a person to run your wing. While the S10 can be easily flown cross country under power, we have also considered your independence during ground transportation. An ingenious trailer is available which permits a «One-and-a-half-person» to stow or rig the plane. Between flights, you can store the S10 in a normal size T-Hangar since a single person can fold the wings in less than five minutes to a span of 11.2 m (37 ft).

All these features contribute to the unique capabilities of the S10 which make it the undisputed champion in a wide variety of roles: Private ownership, partnerships, or club flying. The S10 is the perfect cross country aircraft, whether soaring or under power. Above all, the S10 is a plane which offers the gift of flight in perfect harmony with nature.

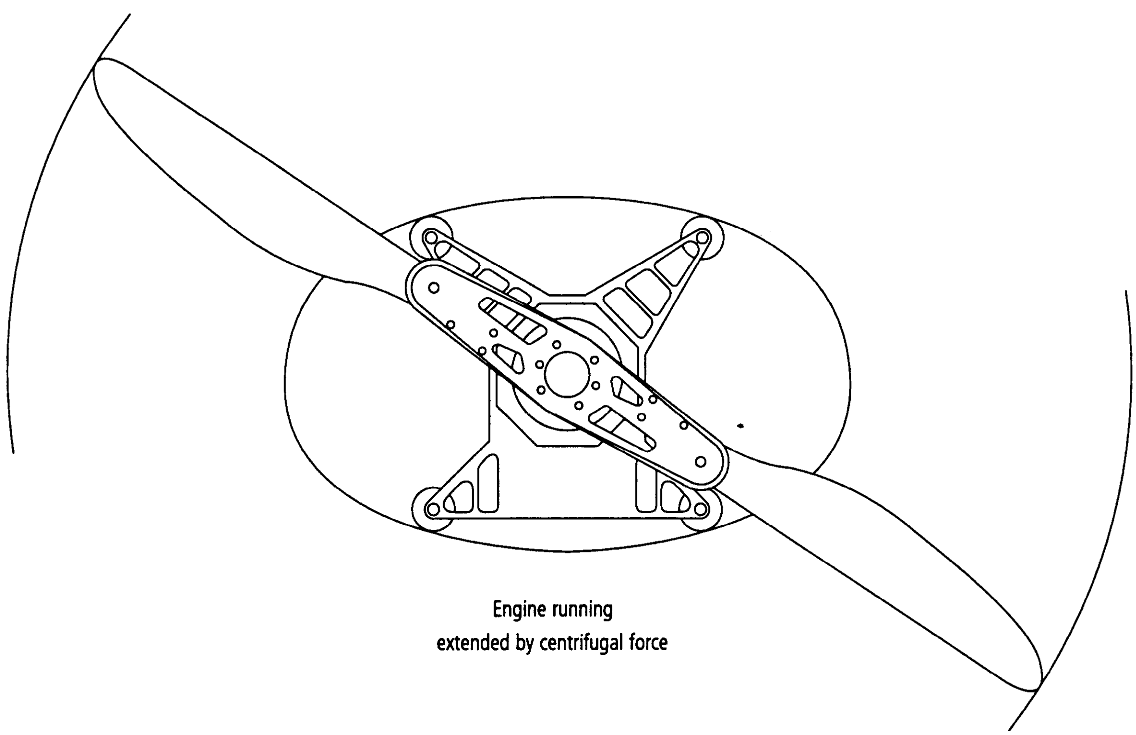



Propulsion System

How Does It Work?



Soaring position



Engine running
extended by centrifugal force

Retractable propeller

1,63m diameter in operating position, extended by centrifugal force, retracted by spring loading. The central body is of aluminium, the blades are of fibre composite.

510: Fixed pitch propeller

S1 0-V/VT: Variable pitch propeller

Gear

S10/S10-V: Fivefold high-performance V-belt gear reduction: 1.18÷ 1

S1 O-VT: Cog wheel transmission gear reduction: 0.9÷1

Flexible coupling

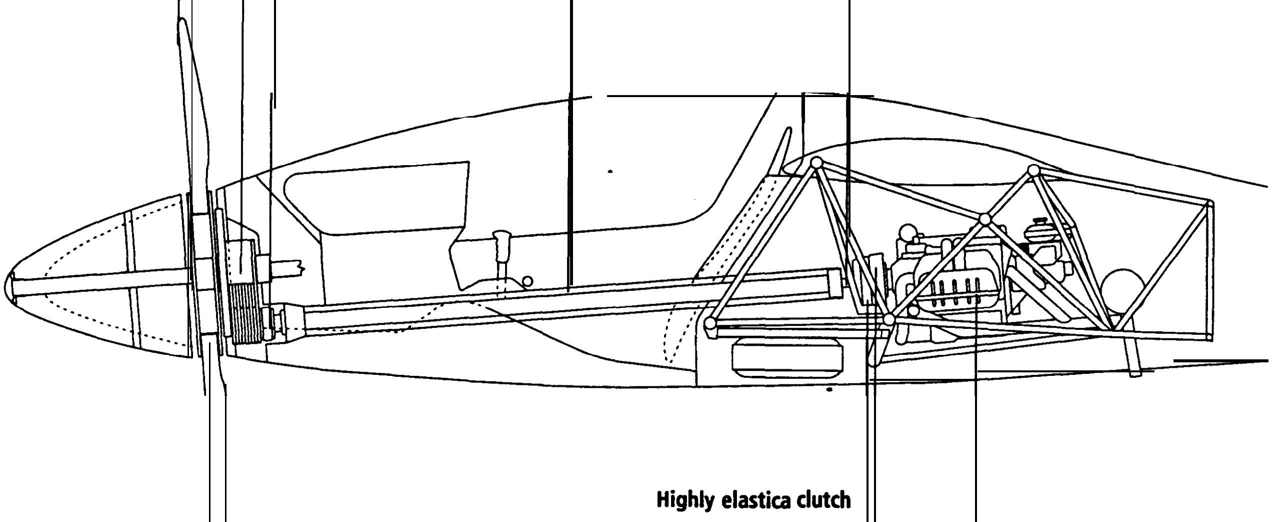
for angular alignment

Drive shaft

carbon fibre composite, running in a kevlar tunnel.
Mass: 2 kg, Diameter: 60 mm, Length: 1.9 m,
Critical bending frequency: 5,200 rpm.

Splined sliding joint

for compensation of axial movements



Highly elastica clutch

for damping of torque oscillations and for reducing the resonant frequencies

Bivalent centrifugal clutch

with servo effects. It damps starting shocks which could be critical for the extension of the propeller, protects against overspeeding, and allows a decoupled slow down of the folding propeller after turning off the engine.

Engine

4-cylinder/4-stroke flat engine

S10/S10-V: Limbach L2400

S10-VT: Rotax 914, turbo-charged

General Design Description

Fuselage

A central steel tube framework forms the mountings for the wings, undercarriage and fixed engine, and gives unobstructed access for engine servicing. All control linkages and connections for the wings are located above a horizontal firewall separating them from the engine compartment. Onto this central framework is bolted the rear fuselage which is a carbon fibre construction.

The cockpit is a carbon fibre shell, kevlar-lined for impact safety. Inside width is 1.16 metres and the one piece canopy hinges from the front with supporting gas springs. The seat backs have 6 mounting positions, and are further adjusted for angle. The «T»-tail has a dampened elevator, and the rudder size is ample for good control co-ordination.

Undercarriage

The electrically retractable undercarriage is sprung, uses two 5 inch wheels with a track of 1 .15 metres and is fitted with disc brakes. There is a manual over-ride system to lower the gear in the event of electrical failure. The tailwheel is steerable with the rudder. Optional wide-tyred landing gear is available (using two 6 inch wheels) for shorter take-off runs on soft grass fields.

Propeller

The patented propeller consists of central section and two jointed blades. In gliding configuration the blades are folded into the contour of the fuselage and are covered by the movable nose cone to leave an aerodynamically clean fuselage.

Start-up readiness is achieved simply by pushing the nose cone forward via its lever with no perceptible change in trim or drag. Therefore, a critical situation at low altitude does not emerge from a sudden reduction in gliding performance. The propeller blades extend into the airstream automatically by centrifugal force only when the engine is started.

When the engine has been stopped and the prop has come to rest, the blades fold inwards automatically by spring loading. Once the blades are aligned the nose cone is retracted enclosing the propeller completely to leave a clean, aerodynamic fuselage again.

A variable pitch propeller (S10-V, S10-VT) with two positions for take-off and cruise improves significantly the take-off runs and cruising performance.

Engine

The S10 model family is equipped with flat-four engines. Air cooling is achieved by air inlet and outlet ducts which are opened by the extension of the nose cone.

The 2.4 litre Limbach engine «L 2400» with its magneto ignition, used in the S10 and S10-V, has been selected for its reliability and economy. Recent cylinder head upgrading provides power of 69 kW (93 hp). One litre Avgas/Gasoline (specified acc. Flight Manual) will give a launch to about 1,500 ft.

The more powerful S10-VT engine, the turbo-charged Rotax 914, produces 85.7 kW (115 hp). The engine is equipped with water cooled cylinder heads, automatic adjustment by hydraulic valve tappet, optional intercooler and integrated reduction gear i=2.43. Additionally the electronic dual ignition offers increased safety.

Wings

The wings are a completely new development. This has given the opportunity to incorporate the very latest technology and aerodynamics, achieving significant benefits in handling and performance – confirmed by many satisfied owners.

The wings are of carbon fibre construction in three sections. A 45 litre fuel tank, and Schempp-Hirth air-brakes are installed in both ends of the central section of the wing. Optional 60 litre fuel tanks are available.

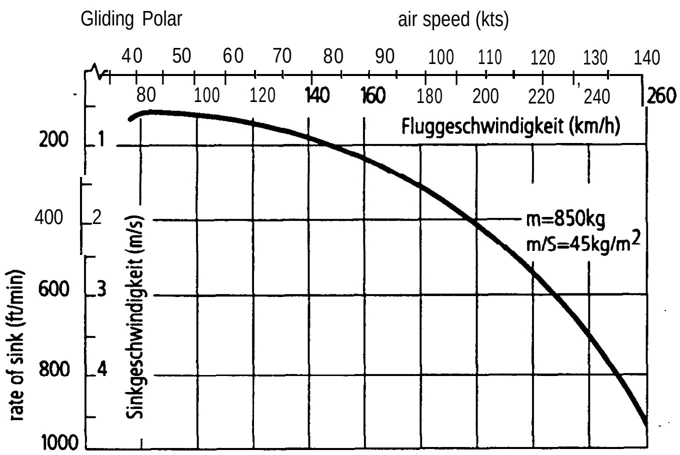
The optional, removable winglets improve further the excellent flight characteristics when thermalling and diminish the sink rate in circular flight without impairing the spectacular gliding performance in fast, straight flight.

Soaring at its Best

Member of the Top Glider Class

The huge wing span of 23 metres, in combination with the high performance HQ41 wing section and the «clean» fuselage, offer a best glide ratio of about 50:1 and a minimum inherent sink rate of only 0.56 m/s (112 ft/min). This performance makes the STEMME S10 one of the very best high performance sailplanes ever built. The S10 is the easiest to handle and most good-natured open class sailplane. The new design of flap/aileron interaction leads to a high degree of manoeuvrability in slow flight. And 18.7 m^2 of wing area enables the S10 to exploit weak thermals with ease.

The state-of-the-art HQ laminar profile was specially developed for the wing of the S10 to achieve outstanding soaring performance. It was designed by the distinguished experts on airfoil profiles, Horstmann and Quast at the Institute of Aerodynamic Design of the DLR Braunschweig, Germany. The use of artificial turbulators underneath this profile prevent formation of the drag inducing laminar separation bubble. Accumulation of bugs or rain on the wings have very little effect on gliding performance.



The unique propulsion system and the twin-undercarriage offer you a fully fledged power plane which enables taxi,, take-off and landing without outside help. You can take full advantage of this independence to spend your precious time soaring – not waiting for other people and ground procedures. The S10 takes you to the thermals very quickly – high cruising speeds put even distant soaring opportunities within easy reach and will get you home again after a day's soaring. The highly reliable «4-Sec-Re-Start» gives you safety when soaring cross country. With negligible drag or trim change, even low height re-starts are easy – and should the engine fail to start a normal glider circuit and field landing can be performed.

All technical data is subject to alteration -May 19%

Extract

«An Evaluation of the STEMME S10 Competition capabilities))

Richard H. Johnson, 8 May 1994, Private Letter.

Having recently flown the STEMME S10 as copilot with Marc Arnold during the 11 days (2 practice and 9 competition days) U.S. Motorglider Nationals, held 16-28 May at Winterhaven, Florida, it is perhaps appropriate that I present my impressions of the S10's capabilities demonstrated there and the contest in general.

First, the soaring conditions there were only fairly good with tropical humid/soggy cumulus forming early every day. Cloud bases were usually about 3,000 ft AGL at the starts, increasing to perhaps 4,000 ft in the mid-afternoons, except for the last day where about 5,000 ft was achieved in the best portions of the task area. Achieved thermal climb rates were generally 2 to 3 kts with occasional 4 to 5 kts encountered during most mid-afternoons. Summertime showers formed during most days after about 3 PM.

Though the thermal conditions were somewhat weaker than expected, the STEMME S10 proved to be capable of climbing with the best. The competition fleet consisted of 8 extended wing Ventus's, 2 Nimbus 3DM's, and 1 each STEMME 510, PIK-30 and DG-800. Most of the S1 O's thermalling was performed with + 10 degree flap, but occasionally + 16 degree flap was used where smaller turn radius was needed. Marc and I shared the piloting about evenly, with each flying for roughly 30 minute periods. Though Marc had no prior contests and little thermalling experience, he proved quite capable under my coaching.

I insisted that thermalling airspeeds be kept below 55 kts, and I complained when airspeeds exceeded that. Though airspeed sometimes dropped momentarily to as low as 45 kts while thermalling, I do not recall that the S10 ever once stalled. The gentle low speed flying characteristics of the S10 contributed greatly to its excellent thermalling capability. Most inter-thermal cruising was performed at 70 to 80 kts with the MacCready set to 1 to 2 kts, and again the S10 demonstrated that it could cruise with the best. Many long glides were made with just a straight-ahead pull-up made in weak thermals, when altitude permitted that.

Admittedly our S10 pilotage included a number of errors, but none of them were serious enough to prevent the S10 from placing high in the standings. Unhandicapped scoring placed the S10 in first place overall, with a 17.7 meter Ventus CM in second place.

The S10 was the only motorglider competing there that was equipped with 4 cycle engine, and its Limbach 2400 engine performed flawlessly. There was never any doubt about its starting at any time. The side-by-side seating providedexcellent cockpit visibility for both pilots, and a pleasant environment for coaching and team flying. Thank you, Dr. Stemme, for creating such a fine motorglider.

Biographie:

RICHARD «DICK» JOHNSON, Chief Aerodynamicist, Texas Instruments (ret.), 4000 hours power, 8000 hours soaring, eleven times national soaring champion, world renown for his performance of many Flight Test Evaluations of sailplanes as reported by the SSA.

Individual

Three STEMMES for Individual Purpose

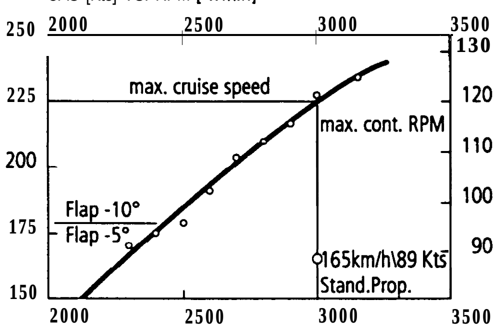
STEMME S10

Limbach 12400 engine

Fixed Pitch Propeller

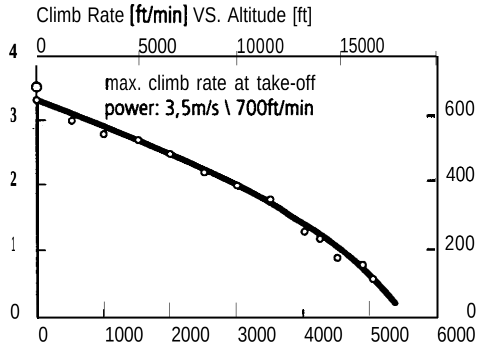
Our basic model S10 combines the powerful 69 kW (93 hp) Limbach «L 2400» engine with the fixed pitch propeller. The 2.4 litre engine based on a flat four-engine design. No turbo charger, a simple air cooling of cylinder and cylinder heads, and an electric independent magneto ignition make this engine suitable for rough everyday life. This concept has proved its reliability over several decades. Fuel consumption of the «L 2400» is very small, giving the S10 a long range. The fixed pitch folding propeller consists of only few parts. This makes it very reliable even in rough operating conditions. Its low maintenance is also easy to handle. Its main advantage over the variable pitch propeller is 4.5 kg lower weight. For mostly pure local soaring purposes this is the cost-effective choice.

CAS [Kts] VS. RPM [1/min]

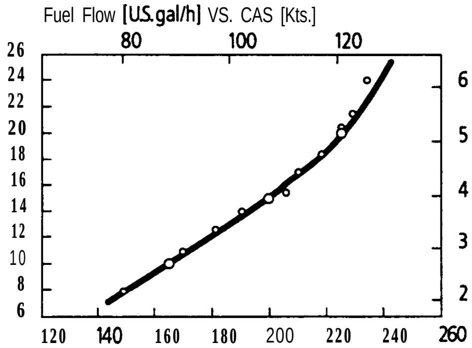


CAS [km/h] VS. RPM [1 /min]

Climb Rate [ft/min] VS. Altitude [ft]



Fuel Flow [U.S.gal/h] VS. CAS [Kts.]



Fuel Flow [l/h] VS. CAS [Kts.]

STEMME S10-V

Limbach L2400 engine

Variable Pitch Propeller

To provide greater safety on short grass strips and higher cruising speeds, we have developed a variable pitch propeller. With the propeller pitch at take-off position, the take-off run shortens down to 240 m (790 ft) on concrete and the climb rate increases significantly up to excellent 3.5 m/s (700 ft/min). At cruising position, the S1 O-V became the world fastest powered sailplane at a cruising speed of 225 km/h (121 kts). The unique pitch control by thermal expansion elements is fail-safe. These elements expand when heated by electric power, and adjust the propeller blades into cruising position. Any failure of the electrical system causes the expansion elements to cooling down again. The blades then return to the take-off pitch position automatically by either spring loading and aerodynamic forces. Even "fixed" in this take-off position the S10-V can still cruise at 165 km/h (89 kts).

As an FAA-official commented...

«A highlight in propeller development: the innovative S10 propeller folding concept, supplemented by variable pitch change using maintenance free, thermo expansion elements, is unprecedented.,

Description of System...

- New geometry of propeller blade gives higher levels of efficiency.
- Pitch control by fail-safe thermal expansion system.
- Simple fail-safe electric operation: take-off (electric current «off »), cruising (electric current «on») – disabled with undercarriage down.
- Adjustment of engine air cooling vents for temperature control and reduced drag.
- Shock absorption for propeller blades at start-up.
- Special surface protection of propeller blade's leading edge.

Advantages compared to standard Fixed Pitch Propeller...

- shorter take-off run
- better climb rate
- highest cruising speed
- longest range
- lowest fuel consumption
- lower noise
- lower engine use

Combined with the fuel efficient Limbach «L 2400» engine, the S10-V provides the lowest fuel consumption and the longest range of all S10 models. Thinking of «mother naturen you will choose the S10-V.

STEMME S10-VT

Turbo-charged

Variable Pitch Propeller

Soaring at Its Best – But Power has Its Own Appeal

Since we have invented and developed the unique folding variable pitch propeller (S10-V), we have improved the climb rate up to 700 Wmin and made the S10 already to the world's fastest motor glider with a cruising speed of 225 km/h (121) kts. Our latest development goes one step further to achieve the ultimate. One of the most fascinating soaring events is the high mountain soaring. Flights in the Rockies, Alps, Andes (meet the condor!) and Himalayas open a tremendous world of adventure. But just there, strong and dangerous down-drafts can destroy your thirst for adventure. Also the mountain ridges are at such an altitude that normal engines will loose performance and will fail to start in the thin air. Safe passage, relying on the engine's help, seems not possible.

For these reasons we decided to offer a turbo-charged aircraft engine for the 510: the Rotax 914. The S10-VT is born.

Safety...the Turbo-charged Power Plane

Still retaining its excellent soaring capabilities, the S10-VT with the turbo-charged engine offers a multitude of safety. The additional power (115 hp) shortens the take-off run significantly. Once airborne at sea level you will be at 20,000 ft in only 30 minutes. The already excellent climb capabilities of the S10-V are improved again: At MSL the S10-VT climbs at a rate of 4.0 m/s (800 ft/min), and even in 16,000 ft still achieves 3.0 m/s (600 ft/min). High elevation airfields in particular will achieve short take-off runs even in hot weather conditions. The cruising speed is improved once more up to 235 km/h (127 kts) at MCP (100 hp) at MSL.

The Rotax 914 engine is equipped with an electronic dual ignition. The water-cooled cylinder heads avoid temperature peaks and keep the CHT within a moderate range. This will reduce the sign of wear. Furthermore the SlO-VT has a fuel system with redundancy.

Forward To New Frontiers...

All these improvements open up the whole sky to you with virtually limitless flying opportunities. The S10-VT gives you the safety you need either at short airstrips and in high mountain regions. It offers possibilities for true exploration into areas of the world and weather conditions not yet known or exploited. Hence, take this challenge – forward to new frontiers!

Technical Data

	Unit	S10	S10-V	S10-VT
Crew				2 pilots, side by side
Propulsion System				
Engine			Limbach L2400EB1 .AD	Rotax 914
Type			4-cyl./4-stroke	4-cyl./4-stroke turbo-charaed
Take-off power	kW\hp		69\93	87.7\115
Max. continuous Power	kW\hp		59\80	74.5\100
Cooling System			air cooled	liquid/air cooled
Transmission				
Gearbox type			V-belt	cog-wheels
Reduction ratio	i		1.18:1	0.9: 1
Length of drive shaft	m\ft		1.90\6.23 (carbon fibre composite)	
Propeller				
Type			patented STEMME folding propeller system 2 blades	
Outer diameter	m\ft	1.61\5.28 (fixed pitch)		1.63\5.35 (variable pitch)
Maximum RPM	1/min		2880	2650
Noise	dB	57.3		
Wings (3 sections)				
Wing span	m\ft			23\75.5
Wing area	qm\ft			18.7\201
Aspect Ratio	^			28.2
Profile				HQ41\14.35
Dihedral				1.0
Fuselage				
length	m\ft			8.42\27.6
Cockpit width outside	m\ft			1.18U.9
Cockpit width inside	m\ft			1.16U.8
Cockpit height	m\ft			0.93\3.1
Overall height at tailplane	m\ft			1.80\5.9

		S10	S10-V	S10-VT

Undercarriage

2 mainwheels with disc breaks, electrically operated with manual override

	Unit	S10	S10-V	S10-VT
Tyre size				
standard	mm			355 x 112\5.0"
optional	mm			369 x 136\6.0"
Tailwheel, steered by ruder	mm			210 x 65
Track between mainwheels	m\ft			1.15\3.8

Weights

	Unit	S10	S10-V	S10-VT
Maximum take-off weight	kg\lbs			850\1874
Empty weight	kg\lbs	640\1410		645\1420
Maximum weight non-lifting parts	kg\lbs			570\1250
Minimum wing loading	kg\qm			38.3
Maximum wing loading	kg\qm			45.3

Gliding Flight Performance

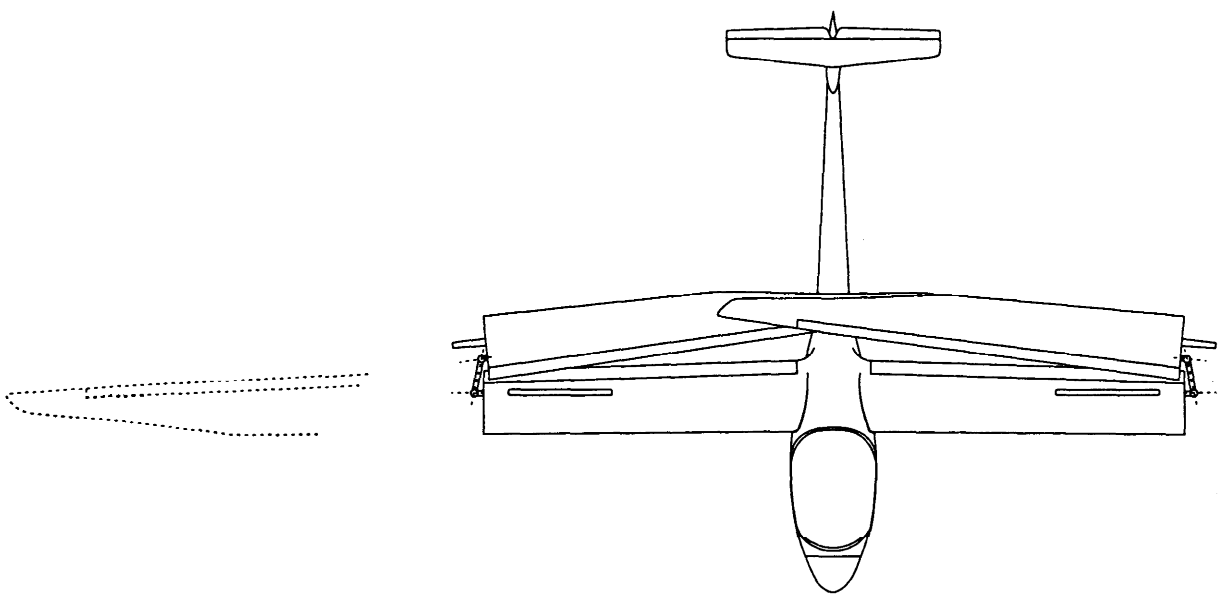
	Unit	S10	S10-V	S10-VT
Best glide ratio	L/D			50:1
Minimum sink rate at 38 kg/qm	m/s\ft/min			0.56\112
Stall speed at 45 kg/qm	km/h\kts			78\42
Maximum permitted airspeed				
in smooth air (V_{NE})	km/h\kts			270\146
in rough air (V_A)	km/h\kts			180\97
45°-45° reversal time	s			4.0

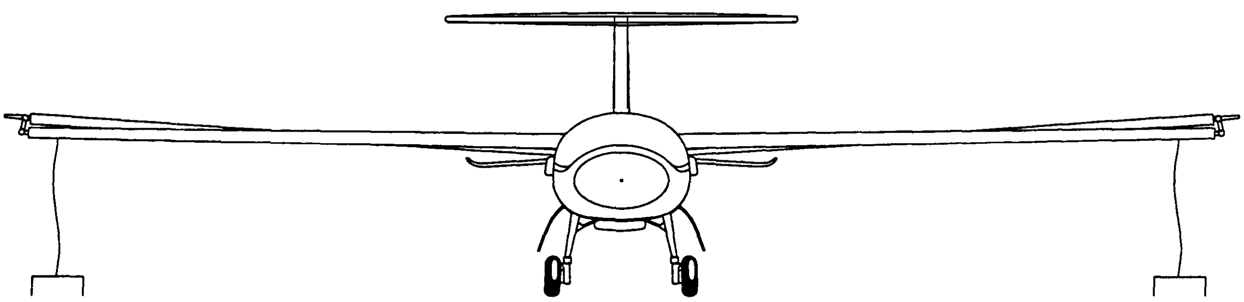
Powered Flight Performance (MSL, 15°C, MTOW)

	Unit	S10	S10-V	S10-VT
Climb rate	m/s\ft/min	2.51500	3.5\700	4.0\800
Cruising speed	km/h\kts	165/90	225\121	235\127
Fuel tank capacity	l	2 x 45 standard (2 x 60 optional)		
Range 90 l	km\nm	1200\650	1600\860	1090\590
Range 120 l	km\nm	1600\850	2200\1180	1450\780
Take-off run concrete	m\ft	300\990	195\640	180\590

Special Options

Wing folding System
for Taxiing, Service, Refueling, Hangaring
landing gear
winglets
Replacement
Instrumentation





In less than 5 minutes one man/one woman is able to transform the STEMME S10 from folded wing span of 11.2 m (37 ft) to «ready-for-flight» high performance wing span of 23 m (75.5 ft) and vice versa.

Wide-tyre Landing Gear

During the design stage of the **S10** we were more than satisfied to accommodate the landing gear within the limited space between cockpit and the drive train/engine. Nobody wanted to even think of wider tyres at that time.
By optimising the available space, we can now offer the wide **tyre** landing gear which is especially useful for soft and difficult grass runways.

Advantages compared to standard landing gear

. **«footprint»** 30% bigger
- **less** sinking on grass
- **less** rolling resistance
- **more** airfields/landing strips usable also in soft/wet conditions
- **tyre** pressure only 2.9 bar instead of 3.1
- **further** damping of landing shock loads.

Replacement

All of the **STEMME S10** delivered up to date can be retrofitted – resulting in the use of more landing strips and higher value.

Winglets

One of the essential characteristics of **STEMME S10** is its exceptional soaring and flight performance. We have now taken this a step further: In the highest ranking competitions, the latest generation sailplanes with **winglets** have proven themselves to be superior to comparative models without winglets. The specific advantages are simplest to explain for shorter span wings **(15** to 18 m). The **winglets** create the effect of an increased aspect ratio of the wing, thereby diminishing the induced drag in slow flight.
But clear evidence of performance improvement has also been observed with high aspect ratio wings. These positive results have led us to develop **winglets** for the high aspect ratio wing of the 510. It was a paramount importance to us, not only to improve flight characteristics when thermalling and diminish the sink rate in circling flight, but also not to impair the spectacular gliding performance in fast, straight flight.

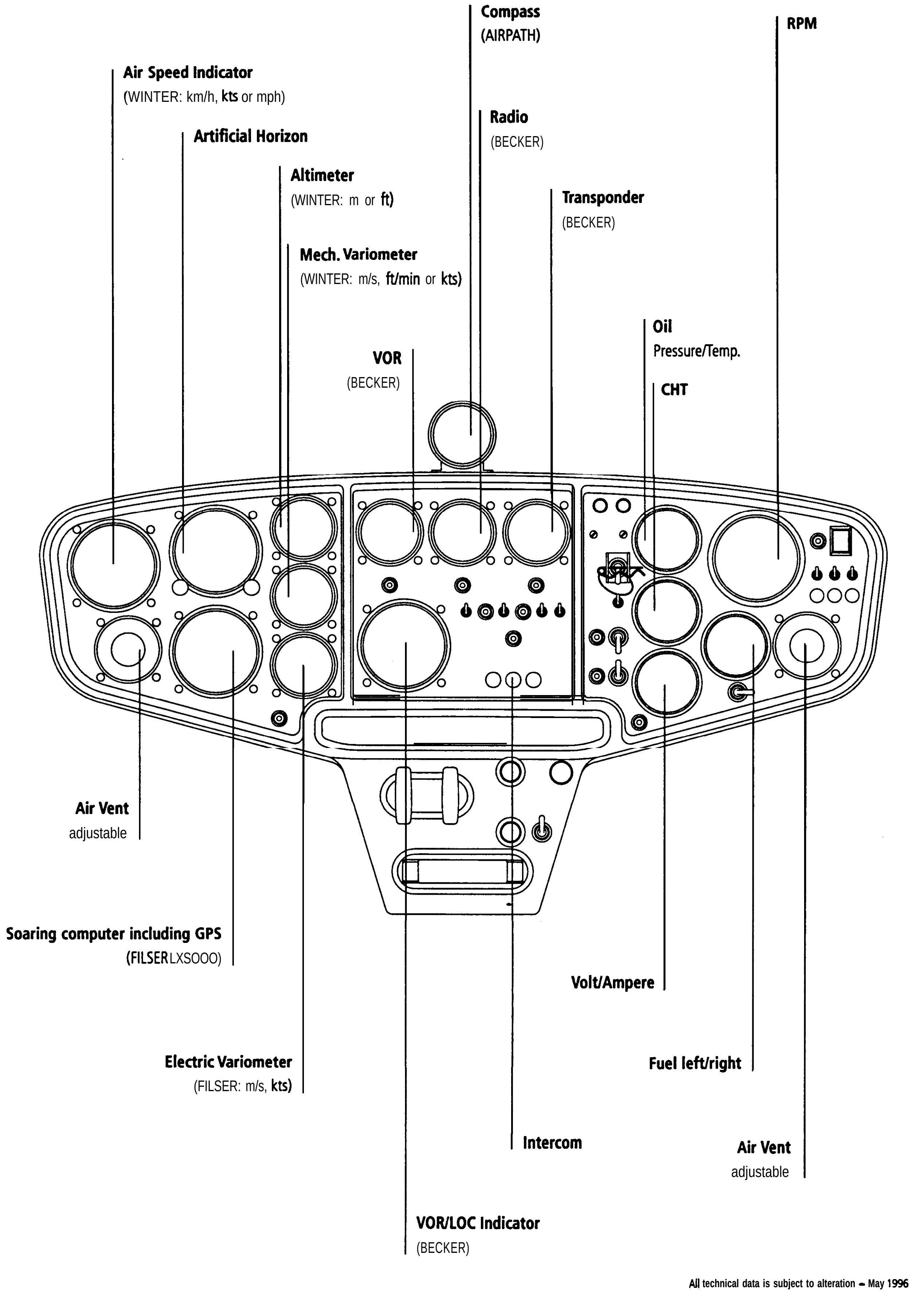
The advantages are thus...Improved best glide ratio

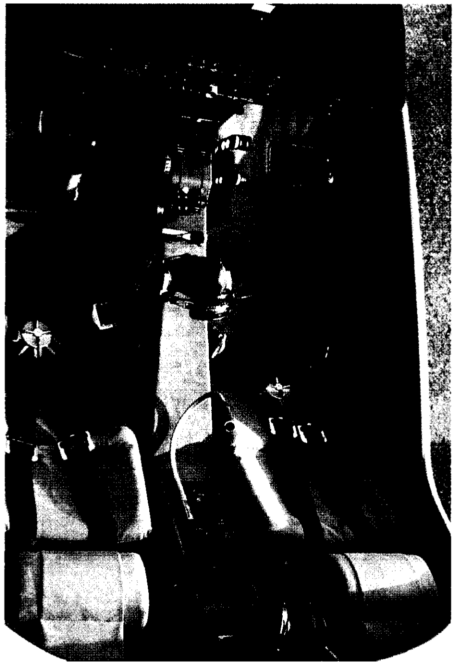
- **Diminished** inherent sink rate in slow flight
- **Increased** cross country flight speed when soaring
- **Higher** rate of roll (quicker timed bank)
- **Low** control inputs in circular flight (further improvement of the agreeable circling flight characteristics and comfortable the rmalling)
- **Winglets** facilitate precise **wingtip** visibility, even with this majestic wing-span (simple taxiing from the apron to the runway)

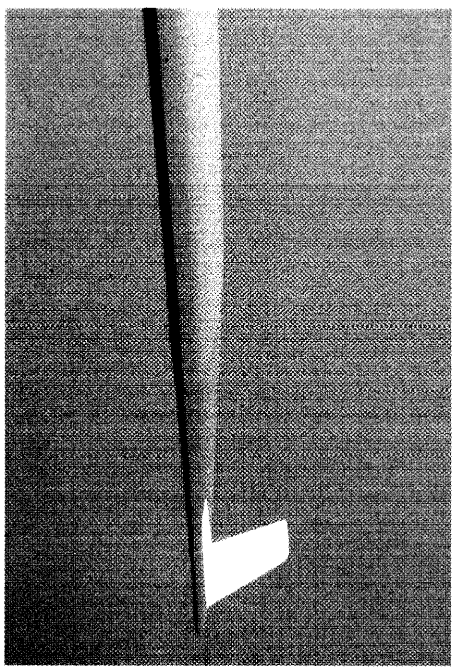
>From 1996 on, the **S10** can be equipped with these optional winglets.
The **S10 / S10-V / S10-VT** can then be flown with or without its **«ears».**
see extended list **«Options** for **STEMME S10»**

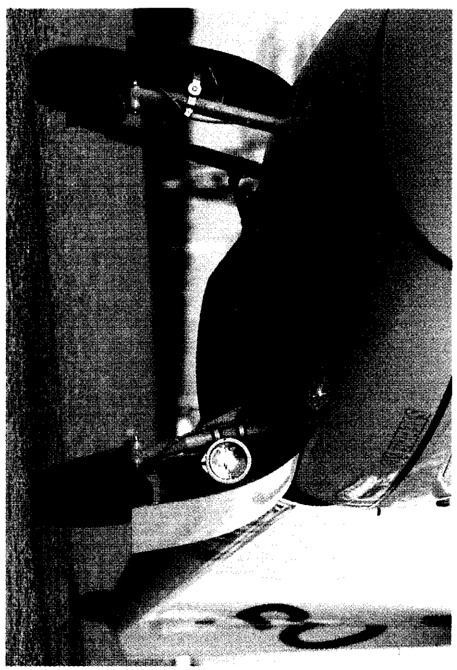
Instrumentation

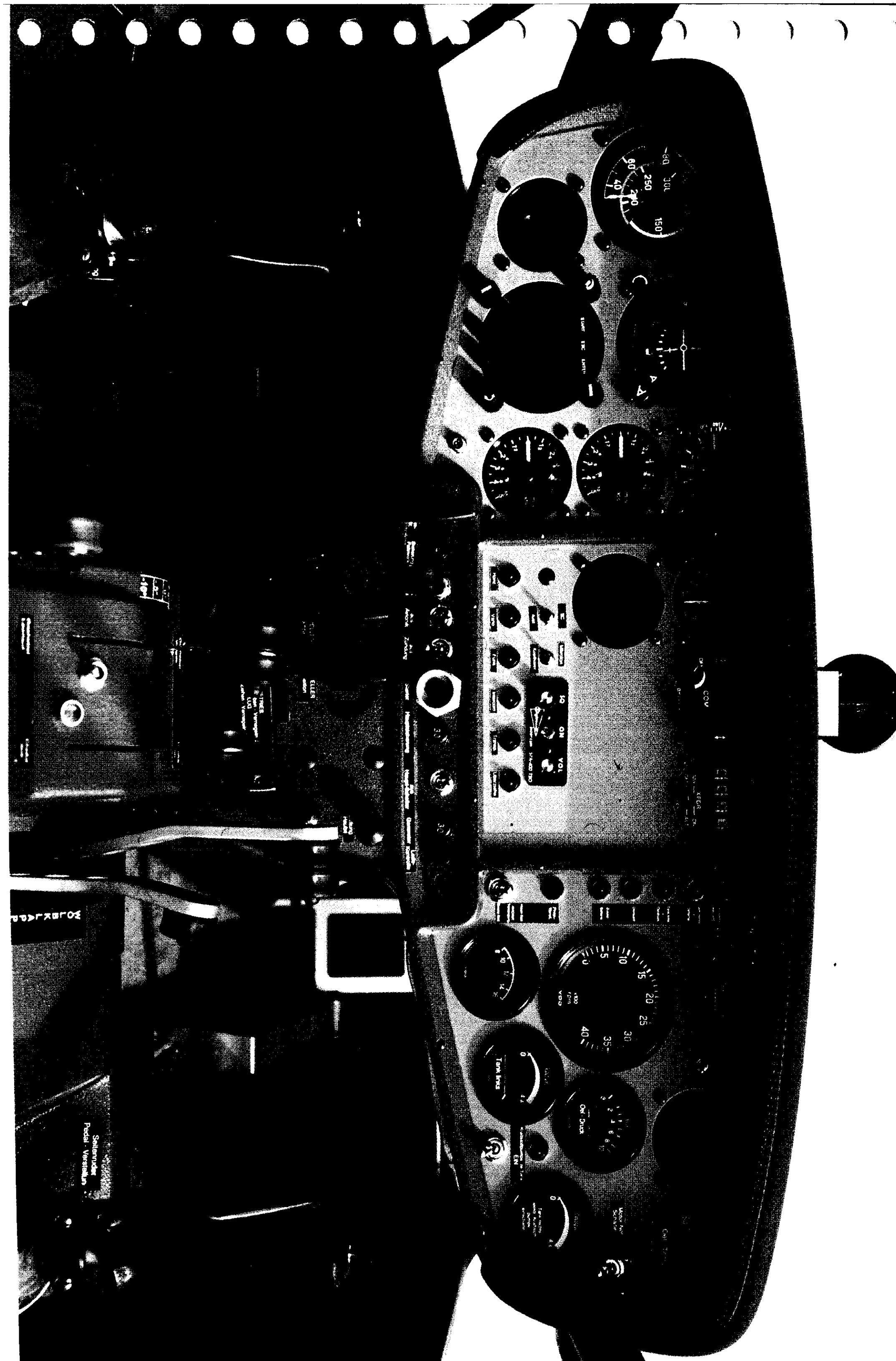
Choose from a selection of panel proposals. You will find the right solution to match your individual needs.







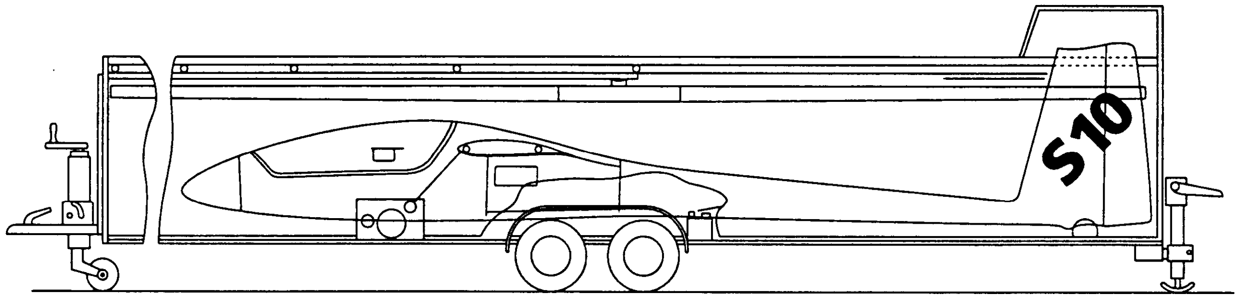




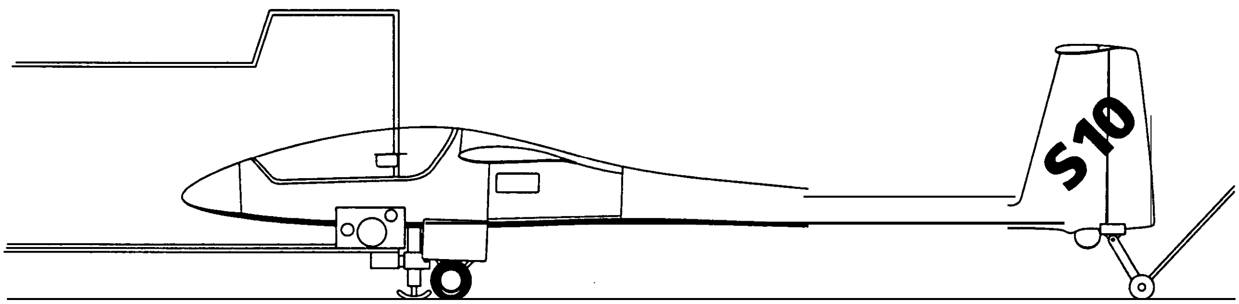
Trailer

STEMME S10 – Trailer

Rigging system for STEMME S10
Complete independence with custom-made trailer
and rigging devices – your own hangar –



disconnect trailer from car



To take the fuselage out of the trailer

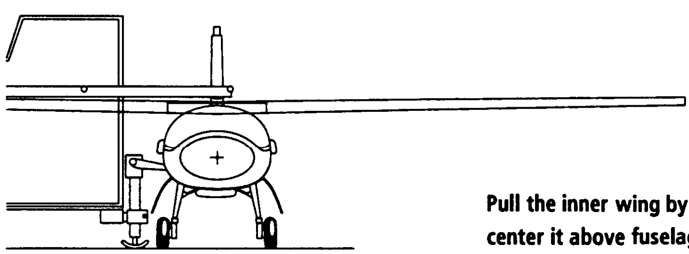
1 lift the rear part of the trailer by hydraulic device

2 pull the **fuselag** along the rail all the way out

Move Fuselage into ground position for rigging the inner wing

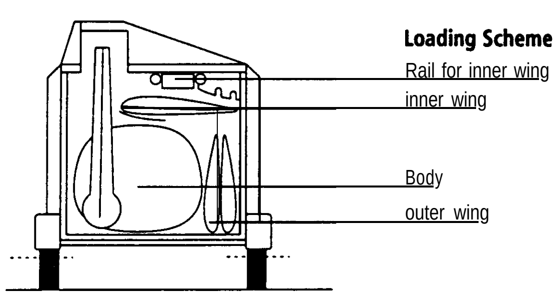
1 undercarriage down

2 **turn** the fuselage by **90°**



Pull the inner wing by hand along the rail to center it above fuselage

Loading Scheme



Storys

Outstanding Flying Events Exeptionally Possible by «S10»

Report from Tug Willson on 1012 km flown in his S10

On 10th June 1992 I departed from Quesada (near Alicante) at 2.14 in very good weather on a 500 km out and return. The outbound track was directly inland towards Madrid and straight into a headwind of 20 kts at cloudbase of 11,000 ft. The clouds were streeting well and lift was so good that exploratory turns during dolphin flight were only considered when the Cambridge maximum reading coincided with a particularly strong surge.

The first leg was flown between 8,000 ft and cloudbase which rose to 12,000 ft. I was over the T/P at 17.16 – not a particularly fast speed considering the day, but from this point on things truly began to happen. Conditions simply continued to improve and a superb street enabled me to climb directly on track without turning to 7,600' at which point I took a 1200 fpm climb to 11,000'. From here I dolphined home at close to cloudbase until the descent point. The return downwind dash had taken 1 hr 12 mins for 254 kms!

Had the day ended there it would have been remarkable enough - but it was really only beginning. Directly over the A/F was the most remarkable sea breeze front stretching as far as the eye could see both to north and south. I set off to the south to explore it. The frontal lift on it was very strong and consistent. I raced along it climbing all the time without turning and before long I was again at cloudbase which was variable on the front but mostly about 12,000' on the upwind edge. VNE at 12,000' in the S10 is 133kts indicated, so I encountered the problem of having to use airbrakes to prevent too much speed whilst remaining below cloudbase in moderate turbulence. Rather than use the A/Bs I opted to move upwind of the cloud for the hopefully smoother air. I suppose that on a god given day like this then the wave that was riding the front was almost inevitable! In the magnificent smooth air I was able to go to VNE beside the superb pure white billowing cumulus which were wonderfully outlined by the lowering sun.

In this sublime peace I was able to select a GPS waypoint just beyond Granada which was 252 kms. I rode the wave to abeam the T/P. On the return leg the frontal wave died with the convection but I was able to use lee wave to complete 1012 kms easily. The second 504 kms had been flown in 2 hr 34 mins at 196 kph, and the last 758 kms in 3hr 46mins at 201 kph (that is 108.6 knots!!).

Just what is possible in Utopia only time will tell – but on the morning of 10th June I played a golf fourball and the cumulus formed at 10.30 hrs!

Oh what a day it was!

Tug Willson

Biographie:

Captain B.J. «Tug» Willson

Tug Willson, began a very active gliding career in 1959 during his days flying as a pilot in the British RAF. In 1974 he left the RAF fo fly Jumbo Jets for Cathay Pacific in HongKong. He continued his gliding in HongKong for 17 years, operating Motor Gliders out of Kai Tak anlongside the heavy commercial aircraft. During those years he soared all over Europe, the length of Japan, from Sidney to Perth across Australia and from San Diego to Vancouver and back, also competing in the Wold Gliding Championships.

His first view of the S10 was of a mock-up of the front fuselage at Friedrichshafen Show in 1981. This started his dream of «Utopia»-retirement with an 510. The reality began in December 1991 when he flew S10 No. 30 from Berlin to his base in Spain.

For the record, by March 1996 No. 30 had made 760 flights, totalling 2050 flying hours and using only 137 engine hours.

Munich to Berlin in a Stemme S10 Motorglider

(c) Marc Arnold 1993 (Extract)

We became the proud new owners of an FAA type certified Stemme S10 Chrysalis motorglider in June, 1992. A strong believer in flight training, I went to Berlin, Germany to receive factory flight training in the new ship and mountain flying training in the Bavarian Alps. The trip turned out to be even more memorable than I had anticipated.

My first day in Berlin, I got checked out on the S10 Chrysalis. We covered normal and abnormal procedures, pilot accessible maintenance items, systems, assembly, ground handling, and a full syllabus of powered and unpowered maneuvers. The most notable feature of the Chrysalis is its retractable propeller which disappears completely into the nosecone while soaring. After a few practice operations, it quickly became second nature and I was able to switch between soaring and powered configurations in less than 5 seconds. Then I was introduced to a Lufthansa 747 captain and part owner of an S10 based at a small airport near Munich, in close proximity to the Alps. He and I set off in the S10 from Berlin to his home airport, a distance of roughly 200 nautical miles. The factory training had prepared me well for the flying portion of the trip and the ship performed as advertised.

Airspace restrictions were more complicated than I expected. Germany had only recently reunited and the majority of the trip from Berlin to Munich was over former East German territory. The VFR procedures required the avoidance of numerous restricted areas, each with a specific minimum and maximum altitudes. Curiously, many of the altitudes change with the day of the week. As we sat side by side in the S10's cockpit, my German instructor explained the various rules and soon I was able to make sense of the system. The flight ended easily with a picturesque final glide over rolling green hills and golden church steeples lit by the setting sun.

The flight training in the Alps was even more breathtaking than I anticipated. Soaring among starkly beautiful mountains in a world class 23m sailplane is indescribably scenic. I was thrilled by the performance of the ship. We found and used thermals in the wider valleys. As we dashed along the near vertical westerly faces of cliffs, ridge lift gave us altitude. Above the peaks, we found welcome areas of wave. Certainly a wider variety lift than I usually find at my home base in St. Louis! In addition to shear enjoyment, the experience also offered a wonderful opportunity to recall lessons I learned years before, learn new skills and to better appreciate what I still don't know about mountain flying. I was surprised to see the popularity of soaring in the Bavarian Alps. If I studied nearly any mountain, I was able to make out one or more sailplanes sharing lift above the peak. At times we soared with another S10 which offered playful competition.

At the close of an extraordinary soaring day in the Alps, my gracious hosts walked me through a detailed weather briefing. The news wasn't good: Within 12 hours cloud cover would move in ahead of a cold front with ceilings of 2,000 to 5,000 feet. Once the cold front arrived from the northwest, low IFR due to ceilings and fog would blanket the area and make a timely return in the Stemme S10 impossible. It was nearly irresistible stay longer in the Alps, but doing so would have played havoc with our itinerary which included non-refundable discounted tickets back to St. Louis.

I departed immediately at 4:30pm with an anticipated time enroute of 3+15. Even though the S10 was equipped for night flying, Germany prohibits night Right in an airplane certified as a motorglider. I anticipated landing with 15 minutes to spare before official nightfall. The dual time received during my flight along the same route from Berlin to Munich a few days earlier proved to be valuable.The earlier flight had also prepared me to anticipate German or Russian spoken on the airwaves, but no English. The formerly East German controllers had begun learning English, but few were up to speed yet. Since my language training stopped with high school level Spanish, I planned the enroute portion of my flight without access to ATC.

The takeoff was normal: Accelerate to 40kts, lift the tail, accelerate further to about 50kts, then rotate after a total ground roll of about 600 feet. Soon the picturesque German farmland was passing beneath the wings. Years of flying in the IFR system back home made my pilotage skills somewhat rusty so I paid close attention to the terrain. After a short time, the copper clad church steeples marking each village ceased to look the same and the rivers became meaningful landmarks. My route crossed the autobahn a number of times and it was interesting to watch the occasional Porsche or BMW passing me in spite of my 95 kt ground speed (with fixed pitch propeller).

Biographie:

Marc Arnold, 3500 hours, ATP, multi, land, sea, glider. 20 and more years power flying, 5 years and more soaring. Competition at national level and extensive cross country experience in STEMME S10 motorglider. Demonstration pilot for STEMME USA, Inc..

It was thoroughly enjoyable flight. The rolling farmlands slowly passed by less than a 1,000 feet below. The Limbach motor purred along. About two hours into the flight, the effects of the approaching cold front became apparent. Flashes of direct sunlight through the scattered layer above became less frequent, then ceased all together, shielded by a solid overcast. Visibility was good under the overcast, but isolated rain showers appeared ahead and the air grew increasingly turbulent. Repeated attempts to get updated weather from stations along the way failed due to lack of a common language. I took stock of my situation. The ceiling and visibility were marginally VFR, and dusk was falling rapidly. The fuel gauges bounced momentarily to the «E» as turbulent air shook the wings. To make matters worse, an organized line of heavy rain now blocked the path to my final destination. Although only 45nm from my intended destination, I decided «enough is enough, and planned a precautionary landing.

The map showed the closest airport to be Altes Laga AFB, but since no tower frequency was indicated, I radioed Tegel airport, a large international airport serving Berlin. «Please standby, we'll call Altes Laga tower and get permission for you to land», the Tegel controller assured me. After a few minutes which seemed like eons, the answer came back. «Do NOT land at Altes Laga, it is an active Russian military base! Please acknowledge!, Reluctantly, I acknowledged the instruction and flew on to the next closest airfield, Holtzdorf AFB, to repeat the process. Circling southwest of the field I could see the nearest end of what looked to be the longest runway on earth. From the air, the huge black runway seemed at least 15,000 feet long, if not actually infinite. Under the circumstances, it was certainly the most inviting runway I'd ever seen.

Night was falling quickly as I circled and circled, waiting for the controllers at Tegel to give me permission to land. As I waited for them to check the conditions at Holtzdorf, I considered my choices. If they did not grant permission to land here, would I honor an instruction to fly on in the dark with low fuel and an impending storm? Or would I go ahead and land on this huge runway anyway? Before I decided, the Tegel answered, «The tower is closed and does not answer the phone. You may land at your own risk.» I was overjoyed. I entered the downwind mid-field to avoid the heavier rain east of the field.

Power back to idle... landing gear down... flaps to 16x... ignition off... retract the propeller... deploy spoilers on base leg. I established a stable final approach at the recommended 62kt approach speed plus 5kts in view of the light rain over the final approach path. Although it was getting dark, sufficient sunlight remained to make the landing. Touching down midway down the huge runway would provide ample room for the landing roll. Everything looked right. All that remained was to flair the graceful ship and land on the S10's sturdy landing gear.

The runway below looked like an long black rectangle reaching to a vanishing point over the horizon. And then, at fifteen feet above the runway, I experienced the greatest shock of my 20+ year flying career. At first I didn't believe what I saw ahead through the dark, rain streaked canopy. Stretching to infinity, were row upon row of steel spikes reaching upward toward the belly of my plane! The spikes were about three feet high and spaced about five feet apart. The grid pattern stretched across the 200 foot width and as far as I could see down the runway. There was no room to land without disastrous results.

I immediately initiated a go-around. Primary Controls: Fly the Plane! Nose Cone: Forward! Starter: Engage! Ignition: On! Throttle: Advance! Gear Selector: Up! Flaps: 5x! Airspeed: Accelerate to 62 kts! I can't be sure of the actual elapsed time, but I'm sure it was faster than the normal 5-second transition from gliding to powered flight.

As I flew down the runway, it dawned on me that the phrase «the tower is closed, really meant the «airport is closed,. The airport was under construction! Taxiways were torn up. New concrete would soon cover the reinforcing bar «spikes» embedded in a base layer of blacktop. Fortunately, construction of the runway's west end was further along than the rest of the runway. Four to five hundred feet of fresh white concrete lay at the end. After a careful flyby to confirm the surface condition, I made a short, but otherwise uneventful landing.

Within an hour I was in the office of the base's commanding officer. The Lieutenant Colonel was a career officer in the West German Air Force had assumed responsibility for the base and its 5,500 soldiers only 30 days earlier. We spent the evening discussing Germany's dramatic political and social changes since reunification. We talked late into the night. The colonel's stories of the differences between the East and West German ways of running an airforce base were fascinating. We became fast friends.

Early the next morning, we refueled the plane. The Colonel and his staff waved good-bye as I took off from the partial section of runway. My first solo cross-country flight in the Stemme S10 was an adventure I will never forget!

The Site

Aircraft construction in Berlin
Flying in Berlin
How to come to STEMME

Aircraft Construction in Berlin

Berlin/Brandenburg has a long history in the construction of aircraft, aircraft engines and equipment. Lilienthal's glides lie less than 100 years ago. Berlin-Tempelhof Airport is regarded as the cradle of German commercial aviation.

At the end of World War II this development was suddenly interrupted. But four years later Berlin wrote aviation history again: The blockade of land routes triggered an achievement of aviation that remains unique until today: With the famous «Luftbrucke» a city of 2 million inhabitants was supplied with basic goods by aircraft.

However, aircraft construction itself remained forbidden by allied law. For the first time a development and production licence was granted to the STEMME S10 in the Western sector of Berlin. With this, a new start was made. All the flight tests of the STEMME S10 were made in West Germany (Braunschweig) - a last limitation of the Berlin status.

Flying in Berlin

When the wall came down in 1989 the sky over Berlin became free. In 1991 the company moved its flight operations and production facilities to an airfield very close to Berlin: Strausberg, 40 km East of Berlin city centre, but which still has a S-Bahn connection.

How to come to STEMME

By land...By S-Bahn to Strausberg Nord (S5). By car go on the Berliner Ring. Leave at exit Strausberg and then follow the signs to Strausberg Nord and Flugplatz.

By air...Directly to Strausberg airfield or to one of Berlin's 3 major airports (Tegel, Tempelhof, Schonefeld) with an airline.

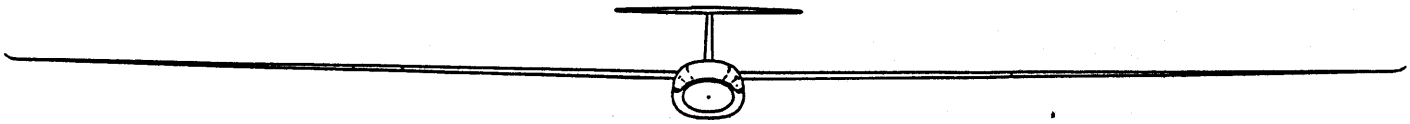
Call us in good time, we are looking forward to your visit and will gladly help you with your hotel reservations.

We will also send you some entertainment brochures so that you can enjoy Berlin's attractions. For visits into Berlin's surroundings which were not accessible for such a long time, we can also give you a few tips.

STEMME GmbH & Co. KG
Flugplatz Strausberg
15344 Strausberg
Germany
Telefon . ..49.3341.31 1170
Telefax . . .49.3341.31 1173

STEMME USA, Inc.
1401 S. Brentwood Blvd. Suite 760
St. Louis, Missouri 63144

314.721.5904 Phone 314.726.5114 Fax



STEMME S10-VT

FLIGHT MANUAL

NOT FOR OFFICIAL USE!
(Extracted Version From Original Document)

Stemme GmbH & Co. KG - Gustav-Meyer-Allee 25 - D-13355 Berlin

FLIGHT MANUAL

for the powered sailplane STEMME S10-VT

Document No.: A40-1I-I 12

Date of Issue: Aug. 08,1997

Pages identified by "LBA approved" are approved by the
Luftfahrt-Bundesamt, Federal Republic of Germany.
These pages are printed on yellow and red paper. Red color indicates the emergency procedures.

....	(Signature)
Luftfahrt-Bundesamt	(Authority)
....	**(Stamp)**
....	(Original date of approval)

This powered sailplane flight manual is FAA-approved for U.S. registered aircraft in accordance with the provisions of 14 CFR Section 21.29, and is required by FAA Type Certificate Data Sheet No. G 58 EU.

Translation of this document and conversion of technical data have been done by best knowledge and judgment.

Model: **STEMME** S IO-VT	Serial number: **11-**
Type Certification Data Sheet (basic model): LBA No. 846 / FAA No. G 58 EU	Registration:

This powered sailplane is to be operated in compliance with information and limitations contained in this manual.

Non-standard equipment or systems with effect to the contents of this manual, if installed, are entered in the table on page ii

Section 1 - General

1 .1 Introduction

This flight manual was compiled to give pilots and instructors all necessary information for a safe, appropriate and performance-optimized operation of the motor glider.

The manual includes all the data required to be furnished to the pilot by JAR-22. It further contains a number of other data and operating hints which may be useful to the pilot from the manufacturer's point of view.

The operating instructions for the engine, type ROTAX 914 F2/S1 and for the propeller, type STEMME 11 AP-V are integrated in this Flight Manual. So the Operating Manual for the engine ROTAX 914 F2 is not required for a safe aircraft operation; nevertheless it is delivered with the powered glider since it contains some additional information. The engine model ROTAX 914 F2/S1, modified by STEMME, is different concerning structural design from data given in the Operating Manual for the ROTAX 914 F2, which is not representative in this respect.

There is no separate handbook for the propeller.

1.1.1 Conversation table

For the conversion of technical data the following factors have been used:

1 lb.	0.4536 kg	1 ftlb.	0.1356 Nm
1 dr.	1.772 g	1 hp	0.7457 kW
llbf =1 lb.(wt)	4.45 N	1 kts	1.852 km/h
lin.	25.4 mm	1 mph	1.609 km/h
1ft.	0.3048 m	1 Imp.gal.	4.546 l
1 sqft.	0.0929 m^2	1 US gal.	3.785 l
100 fpm	0.5081 m/s	1 p.s.i.	0.06895 bar

1 .1.2 Abbreviations

The following abbreviations are being used for clarity:

a/c	aircraft
AGL	above ground level
AUW	all-up-weight
CB	circuit breaker
CFRP	carbon-fiber-reinforced-plastic
CG	center-of-gravity
CHT	cylinder head temperature
DCDI	dual capacity discharge ignition
GFRP	glass-fiber-reinforced-plastic
KIAS	knots indicated airspeed
LH	left hand
MAP	manifold pressure
OAT	outside air temperature
R/C	rate-of-climb
RH	right hand

RPM	revolution per minute
RWY	runway
PPC	propeller Ditch control
T/O	take-off
TCU	turbo charger control unit

1.2 Certification Basis

The powered glider STEMME SIO-VT is a derivative of the S10, which was certified by the Luftfahrtbundesamt on Dec. 31, 1990, Type Certificate No. 846.

This powered sailplane STEMME SIO-VT was certificated by the Luftfahrt-Bundesamt in accordance with Joint Airworthiness Requirements for Sailplanes and Powered Sailplanes JAR-22 issue June 27, 1989 (Change 4 of the English original), including JAR 22.375 (Winglets), Amendment 22/90/1. The Type Certificate for the model SI 0-VT has been issued on Aug. 15, 1997.

Category of Airworthiness is “Utility”.

Noise Certification Basis for the model SIO-VT: “Laermschutzforderungen fuer Luftfahrzeuge (LSL)” (Noise Protection Requirements for Aircraft; German equivalent to and based on the ICAO, Annex 16), dated 1 .1.1 991, published in the “Bundesanzeiger Jahrgang 43, No. 54a, dated 19.03.1991". Noise certification is in accordance with Chapter X.

1.3 Warnings, Cautions and Notes

Remarks in the manual of particular importance to flight safety and handling have been specially marked by use of one of the following terms:

WARNING: means that non-observation of corresponding procedure leads to an immediate or important degradation of flight safety.

CAUTION: means that non-observation of corresponding procedure leads to a minor or to a more or less long-term degradation of flight safetv.

NOTE: draws attention on any special item not directly related to safety but which is important or unusual.

1.4 Description and Technical Data

The model STEMME S1 O-VT is a derivative of the S10 and differs from base type by:

- installation of the variable-pitch propeller type 11 AP-V,
- installation of the turbocharged engine ROTAX 914 F2/S1,
- installation of the redesigned drive-shaft with a frontal spur gear.

The STEMME SIO-VT is a two-seat, self-launching powered glider, a carbon fiber design and a high performance aerodynamic layout. Seats are arranged side-by-side (forward of the wing) and are equipped with dual controls.

The wing is mounted to fuselage in the upper third. It consists of an inner wing with flaps and Schempp-Hirth ai brakes and two outer wings with continuous ailerons. Flaps and ailerons of inner and outer wing are interconnected for drooping.

Tailplane is of "T"-tail design.

The two-wheel main landing gear can be retracted electrically, it contains hydraulic brakes.

The Engine of the STEMME SIO-VT is based on the ROTAX 914 F2, for which the manufacturer ROTAX, Austria, received the certification. STEMME modified the arrangement of some accessories (induction anr exhaust system including charger, engine mounts etc.) to adapt the systems to specific requirements of the S10-VT. These modifications are certified in the STEMME SIO-VT as engine model ROTAX 914 F2/S1.

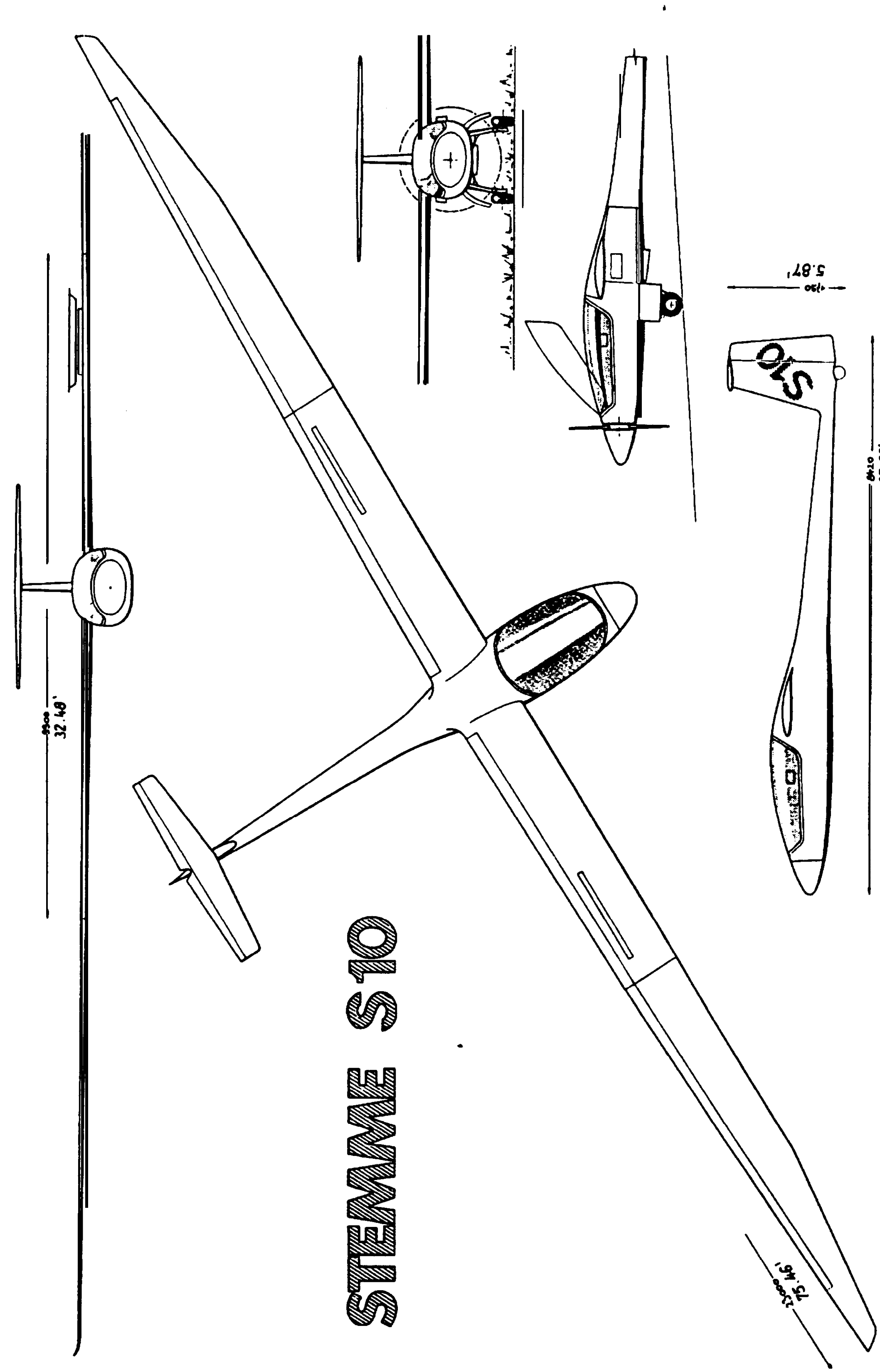
- Engine description: Four-cylinder, four-stroke opposed type Otto-engine, turbocharged with electronic charge-control (TCU=Turbocharger Control Unit); a central cam shaft and tappets-OHV; liquid cooled cylinder heads, cylinders cooled by ram air; dry-sump lubrication; Dual Capacity Discharge Ignition (DCDI); 2 CD-carburetors; integrated reduction gear with mechanical vibration absorber and overload clutch.

The engine is mounted in the fuselage in a central steel tubing frame near the a/c's CG. Engine power ir transmitted via a propeller shaft made of composites and a diagonal spur gear to the variable pitch propeller in fuselage nose. During soaring, the propeller is folded and covered by a movable nose cone (propeller cone' Propeller pitch control from take-off into cruise position is accomplished by electrically heated expansion elements, from cruise to take-off position (elements unheated) by spring force.

Two fuel tanks, one in each outer section of inner wing, supply by gravity a small collector tank above the landing gear box; from which the engine is supplied by two electrically driven fuel pumps.

Technical data

Fuselage	Design	Front section CFRP-Kevlar-GFRP-structure, center steeltube frame, GFRP-fairing, tail boom with integrated rudder fin (CFRP)
	Length	27,6 ft / 8,42 m
	Height	5,74 ft / 1,75 m
	Width	3,87 ft / 1,18 m
Wing	Design	3 sections spar CFRP skin CFRP/GFRP-sandwich
	Span	75,46 ft / 23,00 m
	Wing area	201,6 sqft / 18,74 m^2
	Aspect ratio	28,22
	Dihedral (V-form)	0,75°
	Mean aerodynamic chord	2,86 ft I 0,873 m
	Wing profile	HQ 41/14,35
Airbrakes	Type	two-level Schempp-Hirth position outer part of inner wing
	Length	4,92 ft / 1,5 m
Horizontal tail	Design	web CFRP skin CFRP-Sandwich elevator GFRP-Sandwich
	Span	10,17 ft / 3,10 m
	Area	15,28 sqft / 1,46 m²
	profile	FX71 -L-l 50/25
Vertical tail	Design	web GFRP skin CFRP rudder GFRP-sandwich
	Span	5,25 ft/ 1,60 m
	Area	16,25 sqft / 1,51 m²
	profile	FX7 1 -L-l 50/35
Masses	Max. T/O-mass	1874 lbs / 850 kg
	empty mass	1455 lbs / 660 kg (approx., min. equipment.)
	Max. wing loading	9,3 lbs/sqft / 45,36 kg/m^2
	certified CG range	10,0-16,5 in / 254-420 mm aft of Ref. plane


STEMME S10
S10
32.48'
27.62'
5.87'
75.46'

Section 2 - Limitations

2.1 Introduction

This section includes operating limitations, instrument markings and the information signs which are necessary for the safe operation of the powered glider, its engine, standard systems and standard equipment.

The operating limitations included in this section and in section 9 have been approved by the LBA.

2.2 Airspeed

Airspeed limitations and their meaning for operation of the a/c:

	Speed	IAS	Remarks
V_{NE}	Never exceed speed (maximum permissible airspeed in calm weather, with flap positions 0°, -5° and -10° only)	146 knots 168 mph 270 km/h	This speed must not be exceeded and control movement must be not more than $^1/_{3rd}$.
V_{RA}	Maximum airspeed in rough air	97 knots 112 mph 180 km/h	Do not exceed this speed except in smooth air and then only with caution. Examples of rough air are lee-wave rotors, thunderclouds etc.
V_A	Design maneuvering speed	97 knots 112 mph 180 km/h	Above this limit the controls must not be moved fully or abruptly because the powered glider structure could be over-stressed under certain conditions.
V_{FE}	Permissible maximum airspeed for operation of flaps and with flaps extended: • positive position +5°, +10°	97 knots 112 mph 180 km/h	This airspeed may not be exceeded during flap operation and with flaps in indicated position.
	• Landing position L (+16°)	76 knots 87 mph 140 km/h	
V_{LO}	Permissible maximum airspeed for the operation of the landing gear and with gear extended	76 knots 87 mph 140 km/h	This airspeed may not be exceeded during landing gear operation and with gear extended.
V_{PO}	Permissible maximum airspeed for engine start	76 knots 87 mph 140 km/h	Above this airspeed if propeller is folded engine may not be started.

2.3 Airspeed Indicator Markings

The following table gives the airspeed indicator markings and the meaning of the colors (AUW = all-up weight).

Marking	IAS (Value or Range)	Meaning
White arc	46-97 knots 53-112 mph 85-180 km/h	Positive flap operation range. (Lower limit is 1.1 V_{S0} in landing configuration with maximum AUW. Upper limit is the maximum airspeed with positive flap position.)
Green arc	49-97 knots 56-112 mph 90-180 km/h	Normal operating range. (Lower limit speed is 1.1 V_{S1} at max. AUW and most forward C.G. with flaps neutral; upper limit is rough air speed.)
Yellow arc	97-146 knots 112-168 mph 180-270 km/h	Maneuvers must be conducted with caution and only in smooth air.
L	76 knots 87 mph 140 km/h	Max. permissible airspeed with flaps in landing position and for landing gear operation.
Red line	146 knots 168 mph 270 km/h	Max. airspeed for all operations.
Blue line	62 knots 71 mph 115 km/h	Best rate of climb speed V_Y.
Yellow triangle	59 knots 68 mph 110 km/h	Approach speed at max. AUW.

2.4 Propulsion System and Fluids

2.4.1 Engine, Propeller, Fuel

Engine	
Manufacturer	BOMBARDIER-ROTAX GmbH Motorenfabrik Gunskirchen, Österreich
Engine modification	STEMME GmbH & Co. KG Strausberg, Deutschland
Engine / Model	ROTAX 914 F2/S1
Max. T/O RPM for 5 minutes	5800 RPM
Max. cont. RPM	5500 RPM
Idle RPM	1400 ··· 1600 RPM
T/O power (ISA)	113,2 hp / 84,5 kW at 5800 RPM, 1300 hPa (38,4 in HG)
Max. cont. power (ISA)	98,4 hp / 73,4 kW at 5500 RPM, 1150 hPa (34,0 in HG)
Altitude band for const. power: T/O power: max. cont. Power:	up to max. 8000 ft / 2450 m MSL up to max. 16000 ft / 4500 m MSL
Max. cylinder head temperature:	135 °C / 275°F
Oil temperature maximal: minimal:	130°C / 266°F 50°C / 122°F
Temperature for T/O maximal: minimal:	50°C / 122°F -25°C / -13°F
Oil pressure minimum: maximum pressure: Normal:	22 psi / 1,5 bar 101,5 psi / 7,0 bar (peak press. for cold eng. start) 22-72,5 psi / 1,5 - 5,0 bar
Fuel pressure maximal: minimal: normal:	Airboxpressure + 5,08 psi / + 0,35 bar Airboxpressure + 2,18 psi / + 0,15 bar Airboxpressure + 3,63 psi / 0,25 bar
Propeller	
Propeller-manufacturer	STEMME GmbH & Co. KG Strausberg, Deutschland
Propeller-type	11 AP-V
Data sheet-No.	32.100/3
Fuel System	

Maximal volume	2x11,9 US gal. / 2x9,9 imp.gal / 2x45 l (wing tanks) + 0,87 US gal / 0,73 imp.gal / 3,3 l (collector tank)
Max available fuel quantity	23,9 US gal / 19,9 imp.gal / 90,3 l
Unusable fuel	0,79 US gal / 0,66 imp. gal. / 3 l

2.5 Power-Plant Instrument Markings

The following table shows the markings of the engine instruments and the meaning of the colors used.

Instrument		Red line = Minimum limit	Green arc = Normal Operating Range	Yellow arc = Caution Range	Red line = Maximum Limit
Tachometer[1]	[rpm]	-	1400···5500	5500···5800	5800
Oil temperature[2]	[deg. C]		50···110	···50 / 110···130	130
	[deg. F]		122···230	-122 / 230···266	266
Cyl. Head Temp.[2]	[deg. C]		50···135		135
	[deg. F]		122···275		275
Oil pressure[3]	[p.s.i.]	22	22···73	73···102	102
	[bar]	1,5	1,5···5,0	5,0···7,0	7
Fuel quantity gauge:		"0" at white line = empty Red point (beyond "full" mark) means: "no electrical connection"			

Notes:

1) reading error ± 50 RPM

2) display in [°C]

3) display in [bar]

2.6 Weights

maximum permissible take-off weight: 1874 lb. / 850 kg
maximum permissible landing weight: 1874 lb. / 850 kg
maximum weight: of all non-lifting parts: 1256.5 lb. / 570 kg (including load)
maximum weight in luggage compartment: 48.5 lb. / 22 kg

2.7 Center of Gravity

Independent of AUW the limits of the in-flight center of gravity are:

- forward limit: 10 in. / 254 mm aft of reference plane
- rear limit: 16.5 in. / 420 mm aft of reference plane

The reference plane is the vertical plane which contains the leading edge of the inner wing at given angle of the longitudinal axis. This is defined as the longitudinal inclination, at which the top edge of a wedge of 1.000:84, lying on the upper surface of the tail boom, is horizontal (see Maintenance Manual).

WARNING: The actual CG must not be aft of the certified most aft CG; at minimum permissible load, the CG is in limits. The minimum permissible load is given in the weighing logsheet and on a cockpit placard. Missing mass has to be compensated by installing ballast, see section 6.2 "Weighing Logsheet and oermissible load limits".

2.8 Approved Maneuvers

The Sl O-VT is certificated in the category "utility, self-launching".

WARNING: Acrobatic maneuvers and cloud-flying are not certified!

2.9 Maneuvering Load Factors

The following maneuvering load factors (related to earth gravity g) must not be exceeded:

a) Air-brakes stowed

up to maneuvering speed V_A = 97 kts / 180 km/h	positive **5,3 g,**	negative **2,65** g
up to maximum speed V_{NE} = 146 kts / 270 km/h	positive 4,0 g,	negative **1,5** g

b) Air-brakes extended

up to maximum speed V_{NE} = 146 kts / 270 km/h positive **3,5** g

c) Flaps in Landing position

up to maximum speed $V_{FE,+16°}$ = 75 kts / 140 km/h positive 4,0 g

2.10 Flight Crew

The crew of the SIO-VT consists of 2 persons; minimum crew is one person. When operated solo, the left seat is for the pilot in charge.

WARNING: Minimum load must be observed! To have at least the minimum load, it might be required to install ballast. See section 6.2 "Weighing Logsheet and Permitted Payload Range".

2.11 Kinds of Operation

The SIO-VT is certificated for operation VFR at daytime with the required minimum equipment operable (see section 2.12, "Minimum Equipment List").

2.12 Minimum Equipment List

Instruments and other components of the minimum equipment and the air navigation and communication equipment must be of accepted standards or type certificated. Parts provided by STEMME are listed in the Maintenance Manual.

SIO-VT minimum equipment is:

- Airspeed Indicator up to 160 kts / 300 km/h with colored markings acc. section 2.3
- Altimeter
- Magnetic compass
- RPM-indicator with colored markings acc. section 2.5
- T/O-position-indicator (green lamp ON means, propeller blades in T/O-position)
- Engine-elapsed-time-indicator
- Oil pressure indicator
- Oil temperature indicator
- Fuel quantity indicator (right/left)
- Cylinder head temperature indicator
- Voltmeter
- Four-element straps (symmetric) in each seat
- Stall warning system
- Parachute or back-cushion (approx. 2 in / 5 cm compressed)

CAUTION: For structural strength reasons the weight of the equipped instrument panel may not exceed 26.5 lbs / 12 ka.

2.13 Towing by aircraft, winch launching

It is not allowed to tow the SIO-VT by aircraft or launch by winch!

2.14 Other Limitations

Operation of the variable pitch propeller has been proved up to a temperature of +38°C / 100°F (OAT). Since operation of the pitching mechanism is influenced by OAT and starts actuating at 55°C / 131°F, indication of the green T/O-position light during take-off must be observed particularly at higher OAT´s. T/O should not be attempted if the indicator is not illuminated (green).

The only permitted color for the aircraft exterior painting is white due to the necessity of protecting the structure from high temperatures caused by sunlight (approved up to +54°C / 129°F structural component temperature). For colored warning paintings the areas of the propeller dome and the wing tips are to be used.

For the glazing of the canopy only the use of material of an accepted type is permitted. The luminous transmittance value of these materials may not be less then 70 per cent and colors may not be falsified. These characteristics may not be reduced by the use of tinted canopies.

The luggage load must not exceed 22 lb. (10 kg) in each of the compartmentsat the sides of the cabin and 4.4 lb. (2 kg) in the center compartment. Single pieces weighing more than 1.1 lb. must be fastened securely and must load the bottom of the luggage compartment on a sufficient area.

Section 4 - Normal Operating Procedures

4.1 Introduction

Normal procedures for additional and optional equipment is described in section 9.

This section provides normal procedures for rigging and fueling, the daily and preflight inspection. In addition checklists as well as descriptions of the normal operating procedures and the recommended airspeeds are given.

4.2 A/C Assembly

4.2.1 Rigging

- Prior to rigging clean and grease any connecting points of fuselage, wing, empennage and controls.

4.2.1 .1 Fuselage:

- Place fuselage on lowered landing gear. Check locking of folding struts of the landing gear legs.
- Select flap lever position "L".
- Remove side cowlings and wing fairings.

4.2.1.2 Wing

- Place inner wing on the fuselage. Take care not to jam fuel lines and connecting cables.
- Insert the four wing bolts with operating lever (on-board tools) against the stop in the bushings of the inner wing and secure with safety bolts and Fokker-needle and recheck.
- Connect the operating rods for flaps, ailerons and air-brakes on both sides with the proper locking bolt and secure with the attached spring pin through the control pinholes and recheck carefully.
- Connect the common wing tank pipes with the quick connectors to the fuselage mounted fuel-supply and fuel ventilation lines. To guarantee good sealing, the connecting elements must be clean.

CAUTION: Pay attention to correct (i.e. audible) engagement of the tank quick-connector fittings. Pull to test for secure fit!

- Insert plugs for the electrical connector of the fuel quantity transmitter into the bushing in the wing root rib; lock bayonet connector.
- Push left wing into the spar pocket of the inner wing until about 1,5 in. / 40 mm clearance.
- Connect aileron push rods and secure the push wedge of the quick connector with a spring pin through the control pinhole. If position lights are fitted, plug in connectors and recheck securely.
- Push in outer wing fully and observe the engagement of the wing shear pins in the bushings of the inner wing. When bolts are snugly fitted to the bushings, insert the main bolt fore-aft using the rigging tool and push until the safety pin is in line with the borehole in the main bolt. Remove the rigging tool.

CAUTION: The main bolts of the wing connection are secured by safety pins, which are flush to the upper wing surface in properly secured position. The safety pin must not protrude above the surface!

Install and secure right outer wing the same way.

CAUTION: Recheck all bolts, pins and safety devices for proper fitting and all flight controls for clearance and proper operation!

4.2.1.3 Horizontal Tail

The elevator is provided with an automatic connector. It is pushed from the front to the fuselage centering bolts until the front fitting tongue fits into the receptacle slot. Then unlock the receptacle with the on-board rigging tool, push the tailplane downwards into the fitting until the spring bolt is freed. The spring bolt must engage.

- The interlocking bolt must not stick out beyond the leading edge of the fin. Only then the connection is properly secured.
- Check correct fitting of the horizontal tailplane by pushing the leading edge upwards.

4.2.1.4 Fuselage Fairings

- Install side and upper fairings. Following this, engage the two bowden cables for the cowl flaps.

NOTE: Before installing fairings, the checks of sections 4.3.1 and 4.3.2 ("Daily Inspection"), have to be completed.

4.2.2 Fueling

Fuel is filled into the wing tanks via the filler caps in the outer area of the center wing. To open the tank caps the slotted screw is pushed in and turned to the left with a screw-driver; to close the cap, push and turn right the screw simultaneously.

Certified fuels see section 2.4.2 "Fluids", maximum fuel volume see section 2.4.1 "Engine, Propeller, Fuel".

NOTE: Fuel tank inlets are close to the upper part of the tanks; therefore wings must be level before opening the caps or when fueling to avoid an overflow of fuel overboard.

NOTE: At high temperatures or when high temperatures have to be expected, tanks should not be filled completely to allow for temperature expansion and to avoid overflow through the ventilation tube.

4.3 Daily Inspection

Before commencing flight duties the responsible pilot has to carry out a visual inspection of the a/c.

It is highly important to have the a/c properly checked following each assembly or working at the a/c or the systems. The daily check prior to the first flight of a day is obvious, many accidents could have been avoided, if a proper check would have been performed.

A first walk-around is to check the surfaces for cracks in coating, for local bucklings and for roughness. If something deems unusual ask a specialist. During walk-around check any drainage and ventilation borings and pick clean if necessary (see Maintenance Manual section 6.7).

Sequence for visual check (Ignition and master switch check OFF!):

4.3.1 Engine

- remove upper and both lateral portions of the cowling;
- visual inspection of the engine - inspect cooling air ducts for foreign objects,
- check oil-, liquid cooling and fuel systems for leakage's;
- check level of cooling fluid in overflow reservoir when the system is cold; quantity should be between min and max marking; fill up if necessary; for details see section 2.4.2.2 "Coolant Fluid".
- check oil quantity between min and max marking and refill if necessary; for flight-times of more than 8 hours oil level should at least indicate middle between min and max marking; for details see section 2.4.2.3 Lubrication Fluids.

- reinstall side parts of engine cowling and fix;
- cooling air flaps: check for proper function by operating the Propeller dome (move forwards and backwards several times);
- cooling air flap control: check for proper function by operating several times;
- check fuel vent outlet open and unobstructed;
- visual inspection of fuel contents through fuel cap;

  drain fuel system by pressing the drainer in the landing gear well. Drain into a suitable container as much fuel as is necessary to make sure that possible dirt and water has been removed, Collect drained fuel in a vessel and examine for water and dirt.
- check throttle and choke mechanics for clearance and proper operation.

CAUTION: The a/c must have been parked wings level for sufficient time (some hours) before draining.

CAUTION: After having pushed the drain valve, check it for closed position and no leakage. A leakage could mean contaminated fuel.

CAUTION: Draining of fuel increases the danger of fire. Make sure before engine start up that immediate fire risk does not exist.

4.3.2 Wing connecting area

- Wing pins (4) properly secured (Fokker needles);
- flight controls connected secured by safety spring-pins - two connectors for ailerons, flaps and air-brakes;
- flight controls check for free movement;
- fuel supply and ventilation lines (two quick connectors) connected and no leakage;
- both connectors for fuel quantity transmitters attached and secured;

CAUTION: If the wing tank is not connected to the fuselage tank, this is shown by the yellow caution lamp for fuel low level in the collector tank and this could be well after T/O. In this case, only 0,53 US gal / 0,44 imp.gal / 2 l are available for approach and landing after the caution lamps comes ON.

CAUTION: If a fuel quantity transmitter is not properly connected, the indicator points to the red mark above “full” mark meaning, the system is inop (not “overfill”!)!

WARNING: If the wing-fuselage ventilation line is not properly connected, this may lead to a leakage of fuel from the open end of the wing-tank ventilation onto the firewall, which means a high risk of fire!

- check for foreign objects
- re-install upper engine-cowling and check oil filler cap properly closed.

4.3.3 Propeller, Propeller Dome and Front Gear

- Check engine master switch for proper functioning: Are engine electrics switched off (read generator light extinguished and voltmeter reading "0"), when propeller dome operating handle is unlocked in the forward position of dome (and vice versa)?
- Visual inspection of propeller - central part and pitch control unit. Check for loose connections and local damages;
- Propeller blades can be moved freely from inner stop to outer stop?
- Propeller blades free of damage, protecting strip on leading edge in good condition?

- Check pitch control mechanism for ease of movability by extending one blade up to approx. 90” and pull blade tip in flight direction (induce force into the outer third of blade and give a slight support to blade root hinge). Doing so, the blade suspension is subject to a torque around its longitudinal axis and the control mechanism is forced to move the complete working travel. It must return easily to the initial position when the blade tip is released.
- Check clearance in power transmission path of pitch control mechanism by pushing blade tip (in 90” position) slightly in and opposite to flight direction. There must be no significant rotation of the suspension forks before the control mechanism starts moving. Check both blades one after the other.
- Extend blades successively into fully deployed position and check play of articulation needle bearing - in and against flight direction, as well as in pitch direction (check for torsion around longitudinal axis of blades). This is to check for unusual high abrasion of the blade hinge bearings. A total of 0,16 in. / 4 mm free motion at the blade tips is acceptable, in pitch direction the play must be nearly zero.
- Fold propeller. Push blade mounting at the hinge back and forward with moderate force. By doing so observe (a) the variable pitch bearing and (b) the bearing in the gear. There must be no significant clearance in either of these bearings.
- Check front gear housing for leaks. A light film of oil on housing due to oil fume passing the circumferential joint is acceptable.
- Check oil quantity in front gear: oil quantity, wings level, must show between min and max marking. Fill up oil if required (specification see section 2.4.2 “Fluids”).

NOTE: The described simple checks can only help to discover sudden, rough changes. Since the gearbox is able to move as a whole due its flexible suspension (shockmounts), exact results cannot be expected with these methods. For further information refer to the Maintenance Manual.

WARNING: Front gear never may use more oil than what could have passed as oil fume the circumferential joint. A higher oil consumption during short operation time has to be checked for reasons and must be eliminated before continuing a/c-operation. In any case, the manufacturer must be informed.

4.3.4 Landing gear

• Air pressure:	main wheels	46.5 ±1.5 p.s.i. / 3.2 ± 0.1 bar
·	tailwheel	36 ± 3 p.s.i. / 2.5 ± 0.2 bar

- Check tire slip marks and tread
- Check master switch ON, landing gear lever DOWN and both landing gear indicators “GREEN”
- Examine elements for emergency landing gear release: Check attachment of spindles to radius struts, locking plate attaching spring in correct position, cables drawn downward completely (min. 1,2 in. / 30 mm overhang), cable coverings unobstructed and free to move and not jammed or blocked.
- Examine position switches for foreign bodies and dirt. Position switch for gear down & locked is located on the radius strut and the one for gear retracted at the support plate on the forward frame strut.
- Check quantity of brake fluid. Container is located in the landing-gear bay, right hand cabin rear wall.

4.3.5 Wings

- Check aileron, flaps and air brakes for condition, unobstructed movement and play (axial and radial; limits see maintenance manual section 7.3).
- Check inner-to-outboard wing connection - safety bolt must be flush with wing surface.

4.3.6 Empennage

- Check horizontal tail plane for proper rigging - front arresting bolt (colored red) must not protrude from leading edge of the vertical fin.

- Examine rudder and elevator for unobstructed movement, play (maintenance manual section 7.3) and damage.

4.3.7 Fuselage

- Examine for damage.
- Check static pressure ports on both sides of tail boom (and, if installed, at the left and right cockpit walls).
- Check pressure orifices of stall warning system on propeller-dome below pitot-static probe.

4.3.8 Cockpit

- Canopy emergency release locked (arresting bolt on central canopy mounting must be in marked position)
- Clean canopy with care. Examine cockpit for foreign objects and loose items.

4.4 Pre-Flight Inspection

4.4.1 Checks before entering cockpit

- Has daily inspection been carried out?
- Check oil quantity and replenish if necessary (use oil filler cap on the upper engine cowling).
- Check cooling-fluid quantity, replenish if necessary (visual check in gear bay).
- Check fuel content: insert dip stick (appr. 8 in. / 20 cm) into tank to the bottom, wings level. If **both** tanks indicate a readout of appr. 0.4 in / 10 mm, fuel content is sufficient for take-off and a minimum cruise time of 30 min; confirm indication on fuel quantity indicator in cockpit; close caps of tanks carefully.
- Insert pitot tube into the opening of the nose cone, twisting it slightly.
- Grease the opening from time to time with a thin coating of Vaseline (to seal systems from each other).

Note: It is recommended to secure the pitot tube with adhesive tape or with a suitable plastic sleeve of about 1 in. / 25 mm length.

Note: To avoid damages of the pitot tube, after each flight, at least before parking, the pitot tube should be removed and stored at exposed position, (i. e. at Instrument panel). Reinstall directly before flight.

Warning: If the pitot tube is not installed, the air speed indicator will have a substantial under-read of up to 50% **at speeds below 54 kts / 100 km/h!**

- Calculate T/O performance: T/O field length available, pressure altitude for the airfield, OAT compare with data in section 5.2.3.2. For high field elevation check RPM-limits for preliminary decision on T/O-procedure and calculate T/O field length required with corresponding T/O-Procedure.

CAUTION: Depending on selected T/O-procedure, T/O field length required can differ noticeably.

WARNING: T/O length given in section 5.2.3.2 are determined with a climb speed of V_x = 56 kts / 104 km/h and are shorter than those which have to be expected for a recommended initial climb according to section 4.5.2.3 with a climb speed of V_y = 62 kts / 115 km/h.

4.4.2 Check of flight controls and pressure probes

To check flight controls concerning function, stiffness, power transmission, backlash and deflection, an assisting person is needed. Flight control structure is checked by moving control elements, flap- and airbrake-handles while the assisting person is holding the relevant surface cautiously in position to check for mechanical failures. Deflections, specially aileron-flap-interconnect, and backlash are checked visually and by moving cautiously up and down. Also the pressure probes are checked for cleanness and damage.

Recommended sequence for outside-check:

LH airbrake	CHECK stiffness, backlash, full deflection
LH aileron, flaps 0”	CHECK stiffness, backlash, full deflection
LH flap	CHECK stiffness, backlash, movement from +16° to -10”
Elevator	CHECK stiffness, backlash, full deflection
Rudder	CHECK stiffness, backlash, full deflection
RH flap	CHECK stiffness, backlash, movement from +16° to -10”
RH aileron, flaps 0”	CHECK stiffness, backlash, full deflection
RH airbrake	CHECK stiffness, backlash, full deflection
Dynamic and static pressure	CHECK airspeed and R/C indicators when blowing slightly (and dry!) versus the end of the pressure tube

4.4.3 checks before engine start

• Load and trim sheets	COMPLETED and CHECKED
• Parachute/cushion	INSTALLED and properly secured
• Seat belts	FASTENED and TIGHT
• Back rest and rudder pedals	FIXED, comfortable position
• Control elements and instruments	WELL WITHIN RADIUS of-action
• Canopy	LATCHED (left, right and top rear)
• Flight controls and flaps	FREE movement
• Altimeter	SET local pressure

4.5 Normal Operating Procedures and Recommended Airspeeds

4.51 Engine Start, Warm-up and Taxi Procedures

4.5.1 .1 Engine start

• Parking brake	SET
• All switches	OFF
• Engine back-up switch	OFF (guarded position)
. TCU-isolation switch	OFF (guarded position)
• Landing gear lever	DOWN
• Master switch	ON, (normal voltage indication, green gear lights ON)
• Propeller-dome handle	OPEN and LOCKED, (TCU performs self-test, main fuel pump cycles, engine instruments are activated, red battery charge control lamp ON)

CAUTION: When TCU is energized (master switch ON and propeller-dome OPEN and LOCKED), TCU-warning and -caution lamp are activated for 1-2 seconds and off again. If this is not observed, TCU may malfunction.

• Cowling flaps	fully OPEN
• Fuel quantity	CHECK, SUFFICIENT for intended mission
• Fire-warning	TEST by pressing indicator (notice acoustic and optical warning)
• Propeller switch	T/O position, check green position lamp ON
• Fire-cock	OPEN in vertical position
• Auxiliary fuel pump	ON, green status lamp ON
• With cold engine - Choke	ON

NOTE: If the engine is warm, do not use choke.

• Throttle	IDLE (max 10%)
• Propeller area	FREE of persons and obstacles
• Starter	START

- As soon as engine starts, release starter key; this deselects the starter motor. If the engine does not fire after 10 seconds of starter operation, stop and wait for at least 2 minutes for starter cool-down, then try again.

CAUTION: Propeller blades unfold when starter motor starts rotating. To avoid unnecessary loading of the propeller-blade stops during rough engine starting, throttle should be in idle position when actuating **starter.-After both propeller blades are fully unfolded, engine starting can be improved by opening throttle slightly, this may improve starting a warm engine.**

• Engine RPM	SET approx. 2000 RPM
• Oil pressure	GREEN arc after 10 seconds

NOTE: Minimum oil pressure 22 psi / 1,5 bar; with cold engine at low RPM, up to 102 psi / 7 bar are normal.

WARNING: If the minimum oil pressure is not indicated within 10 seconds, stop engine immediately!

- Generator switch — ON (red battery charge control lamp OFF)
- Auxiliary fuel pump — OFF (green status lamp OFF)
- Warnings and Cautions — CHECK all OFF
- COM, NAV, gyros — ON
- Choke — REDUCE (pull in) with increasing engine temperature

4.5.1.2 Engine warm-up

- Cooling-air flaps — CLOSE as required (position I-5) for engine warm-up

> **NOTE:** Only with cold OAT it is recommended to close cooling-air flaps; they should be opened the latest when oil temperature attains 50°C / 122°F or CHT 100°C / 212°F /.

- wheel brakes — LOCKED
- Throttle — 2500 RPM (after about 2 minutes 2000 RPM)
- Oil pressure — GREEN ARC
- Engine temperatures — WAIT for green range

> **CAUTION:** To avoid engine damage, engine has to be warmed-up until minimum temperatures attained, before engine power is increased and RPM selected above values for the warm-up period.
>
> **CAUTION:** To avoid engine and systems (in engine bay) overheat, extended ground runs with high power should not be performed, because sufficient cooling for extended high power settings is only granted in flight.

4.5.1.3 Taxiing

- Cowl flaps — FULLY OPEN
- Brakes — RELEASE
- Directional control — with RUDDER
- Taxi area — OBSERVE
- Throttle — AS REQUIRED
- Brakes — AS REQUIRED

> **CAUTION:** Seating position as well as wing span do not allow the crew to observe the outer wing outside of the leading edge sweep-back. This must be considered absolutely during taxiing.
>
> **CAUTION:** When taxiing slowly, operate wheel brakes with caution.
>
> **CAUTION:** Depending on surface conditions and because of the large moment of inertia the function of the tailwheel steering is delayed.
>
> **CAUTION:** To avoid damaging the propeller, taxi on surfaces with loose stones and gravel using low propeller RPM.

4.5.2 Take-off and Climb

WARNING: It is highly advised against T/O with wet wing or during rain (see section 4.5.7)!

4.5.2.1 Checks before take off

In run-up area:

- Parking brake — SET
- Choke — OFF (pushed in)
- Elevator — PULL to stop and hold
- Engine indications — CHECK green ranges
- Throttle — FULL POWER **(115%),** for high field elevation see remarks below
- Engine RPM — CHECK 5200 + 60 RPM per 1000 ft elevation[1]) ± 200 RPM tolerance

[1]) 5200 + 200 RPM per 1000 m, respectively

CAUTION: Because of the manually controlled two-position propeller in combination with the turbocharged engine, a remarkable increase of RPM with altitude at constant power-setting has to be considered (about 60 RPM per 1000 ft / 200 RPM per 1000 m).This rule-of-thumb is valid for ISA. **If actual temperature differs noticeably from ISA, at high field elevations > 6600 ft / 2000 m and if uncertain, refer to diagrams for 115% and 110% power settings in section 5.2.3.1.**

WARNING: At very high field elevations take care not to exceed max T/O RPM of 5800 RPM. Therefore it is recommended to **set 100%** (throttle on soft stop) for engine run-up on airfields **above about 6600 ft / 2000 m.** The RPM observed may not differ more than +/-200 RPM from the value, taken from second diagram in section 5.2.3.1, valid for 100% power setting.

CAUTION: The a/c should be **directed into the wind** for run-up and magneto-check to have a good airflow in the cowl flap area. In crosswind or tailwind conditions there is a inadequate cooling and engine temperatures can steadily increase.

CAUTION: Run-ups with high power settings should be reduced to a minimum. The SlO-VT cooling system is designed for airborne operation, not for extended ground-runs with T/O or max continuous power setting.

- Magneto check — SET 4150 RPM (mag switch position BOTH)
- Separate magnetos — CHECK RPM drop of rotational speed < 300 RPM
  difference between M_1 and M_2 < 120 RPM

NOTE: For correct magneto check wait until RPM with both magnetos is stabilized. Select left magneto and wait until RPM is stabilized before reading indicator. Select both and wait for stabilized RPM. Select right magneto and again let RPM stabilize before reading indicator.

WARNING: If RPM's during run-up or magneto check differ more than the limits given, T/O is not allowed, malfunction of engine or propeller must be expected.

- Canopy — LOCKED (LH, RH, rear)
- Flap position — CHECK +5°
- Air-brakes — IN and LOCKED
- Cowl flaps — OPEN
- Trim for climbspeed Vy — NEUTRAL, depending on load, slightly nose-up
- Warnings and cautions — CHECK OFF
- Landing gear lever — EXTEND (both green lamps ON)
- Engine instruments — CHECK GREEN range
- Propeller position — T/O (green lamp ON)
- Auxiliary fuel pump — ON (green lamp ON)
- Ignition switch — BOTH
- Fire-cock — OPEN

CAUTION: Always check fuel cocks carefully to be open. When fuel cocks are closed, the engine will run for about 1 - 3 minutes. Closed fuel cocks mav lead to a loss of engine power in the take-off phase.

- Decide on **T/O procedure** due to conditions and **check field length** available and required.

Because the S10-VT has no constant speed propeller control and only the T/O-position of the propeller is to be used for takeoff, the power of the turbocharged engine, which is independent of density over a wide range, results in an increase of RPM vs. altitude at constant indicated speeds. To avoid engine overspeeds in T/O without active control of the power lever by the pilot, **three T/O-procedures** have been established for special pressure altitude ranges, which avoid engine overspeeds up to a safety altitude of about 500 ft / 150 m AGL while climbing with v_y = 62 kts / 115 km/h IAS.

The Decision on the T/O-procedure can be made with the **RPM observed while checking engine at 115% full power:**

static RPM at 115%	T/O procedure	Power setting for T/O
< 5500	**No. 1**	115% power setting
5500 - 5600	**No. 2**	100% power setting
> 5500 RPM	**No. 3**	T/O with reduced power for static 5400 RPM

4.5.2.2 Interpretation of the three T/O procedures

The three T/O procedures define throttle positions depending on pressure altitude and OAT, which can be kept from brake-release until reaching a safety altitude of about 500 ft / 150 m without exceeding max T/O limit 5800 RPM at v_y = 62 kts / 115 km/h. For these three power settings, required ground runs and T/O distances as a function of pressure altitude and OAT are given in section 5.2.3.2 "T/O performance", though valid for a climb speed of V_x = 56 kts / 104 km/h only recommended for short airfields instead of V,.

Basically T/O procedure is defined via static RPM for 115% power setting, using the RPM-limits of above. At very high airfields even static RPM (a/c stationary) at 115% may exceed 5800 1/min. In this case check engine at 100% and decide, using the diagram in section 5.2.3.1 valid for 100%, if T/O with 100% is either allowable or T/O-procedure No. 3 has to be used. Further, in any case of doubt, refer to RPM diagrams for 115% and 110% in section 5.2.3.1. These diagrams include RPM limit lines, which show if takeoff is allowable with 115% or with 1 00%, respectively.

T/O procedure 1: Static RPM at 115% power setting < 5500 RPM

Throttle is set to maximum T/O power 115%. T/O ground run and T/O distance (hard surface, no slope, nc wind) see page 5-9 "T/O-distance (50 ft) and ground run with power setting 115%".

T/O procedure 2: Static RPM at 115% power setting 5500 - 5600 RPM

Throttle is set to maximum continuous power 100%. T/O ground run and T/O distance (hard surface, no slope, no wind) see page 5-l 1 "T/O-distance (50 ft) and ground run with power setting 100%".

T/O procedure 3: Static RPM at 115% power setting > 5600 RPM

Throttle is manually set to a position for static 5400 RPM, to be stabilized at the take-off point prior to brake release. T/O ground run and T/O distance (hard surface, no slope, no wind) see page 5-14 "T/O-distance (50 ft) and ground run with reduced power for 5400 RPM static".

WARNING: To avoid excessive RPM after T/O from high airfields in the first part of a climb with V_y, the correct static T/O power setting must be selected, **In case of doubt, diagrams in section 5.2.3.1 are effective,** giving static RPM's for 115% and 100% and RPM limits for T/O. If static full power check on a high altitude airfield **was** performed with 100% power setting, it can be decided with the observed RPM and the diagram for 100%, if a T/O with 100% power setting is allowed.

CAUTION: The throttle has two stops: a first stop which can be felt when moving the throttle straight forward - this is for the 100% power setting. To come to the second stop and 115%, the throttle lever must be pushed slightly to the left and then more forward beyond the first stop. The reduced power for high altitude take-off (T/O procedure 3) must be set manually until 5400 RPM are indicated on the tachometer.

CAUTION: T/O length can differ noticeably depending on T/O procedure!

4.5.2.3 T/O and climb

In T/O position:

- A/C on runway — ALIGN
- Wheel brakes — ACTUATE until a/c is standing
- Throttle — SET POWER according to selected T/O procedure
- Stabilized RPM — WAIT (for reduced power T/O adjust for 5400 RPM)
- Wheel brakes — RELEASE
- PITCH attitude — PUSH slightly to lower the nose so as to lift-off at about 46 kts / 85 km/h, accelerate in ground effect to 62 kts / 115 km/h and maintain.

CAUTION: If the a/c tends to oscillate in pitch due to roughness of ground surface, hold elevator and do not try to counteract, this might cause pilot-induced-oscillations.

CAUTION: The elevator down-spring effects a nose-down force, pushing the stick forward during T/O-roll and thus unloading the tail. With increasing airspeed the stick moves due to increasing aerodynamic forces towards a center position, which is ideally correct for lift-off and climb. If trim is set too much nose-down, there might be a tendency to lift the tail too much without pilots counteraction. Therefore pitch attitude must be controlled actively until lift-off.

- Climb speed — 62 kts I 115 km/h for best rate of climb

WARNING: T/O length in section 5.2.3.2 are valid with airspeed for best angle-of-climb v_x = 56 kts / 104 km/h and are shorter compared to those which must be expected for a climb with best rate-of-climb speed v_v = 62 kts / 115 km/h.

NOTE: For an airfield with short runway or obstacles in departure sector, initial climb can be performed with v_x = 56 kts / 104 km/h (best angle-of-climb) to gain altitude on a shorter distance. T/O diagrams in section 5.2.3.2 are valid for this case. For safety reasons, the airspeed never should be chosen below v_x = 56 kts / 104 km/h, this would not reduce T/O field length.

CAUTION: Monitor oil temperature (max 130°C / 266°F) and CHT (135°C / 275°F) during climb. Increase airspeed if close to limits.

- Landing gear — RETRACT at a safe altitude (red lights will flash during retraction)
- Landing gear lights — OFF
- Landing gear lever — NEUTRAL

NOTE: During gear retraction the red warning lamp appropriate for the moving gear leg, is flashing (left side first, then right side). The gear is fully retracted, when red gear lamps are OFF. The gear-CB's to the left of the gear lever should be checked additionally. Select landing gear lever to NEUTRAL when the landing gear is fully UP to de-energize the system.

CAUTION: If the automatic circuit breaker of the landing gear releases during retraction, a not properly retracted position of the gear will not be indicated because both lights are not energized. On trying to deploy the landing gear, this might be noticed too late and could lead to a crash-landing. So check circuit breaker before setting gear lever to neutral position.

- Auxiliary fuel pump — OFF (green status lamp OFF)
- T/O power — REDUCE after max 5 minutes
- Max cont. Power — SET (max 100%, max 5500 RPM)
- Cowl flaps — ADJUST (recommended temperatures: OIL 90-l 10°C / 194-230°F, CHT ≈ 100°C / 212°F

CAUTION: Cowl flaps must be fully open as long as T/O power (115%) is set. For a long climb with reduced power setting (max continuous or less) cowl flap angle may be reduced if engine temperatures are well below limits. In this case, only the first two notches of the cowl flap handle should be selected. Engine temperatures must be checked carefully.

WARNING: Due to the combination of the fixed position propeller and the turbocharged engine, RPM must increase with altitude for constant power setting and constant IAS. Therefore, depending on pressure altitude and temperature, during climb with v_y it could be necessary to reduce-power even immediately after T/O initial climb to avoid exceeding of max RPM. The RPM limits are 5800 RPM for 5 minutes and 5500 RPM continuouslv.

4.5.3 Cruise and cross-country flying

4.5.3.1 General remarks

Thanks to the unique propulsion concept of the S10-VT, flight characteristics are almost similar in the different configurations and in transitions. The powered glider S10-VT has good handling characteristics at all speeds, loading and is **easy** to fly as well as glider as with the propeller system driving the a/c.

With CG in center range, trim is possible from approx. 50-124 kts / 90-230 km/h.

With aft CG, change of stick position with speed is small. However a speed change can always be realized by positive stick forces.

System reliability is high, but it is not wise to rely on an ever functioning drive system. When flying in glider configuration, it is always safer to organize the flight path and track so as if there would be no engine - if the engine fails, you simply land as a glider.

CAUTION: Areas and meteorological conditions, where lightning strikes could be expected must be avoided.

4.5.3.2 Powered flight

a) Cruise

To change configuration and to verify cruise conditions, proceed as follows:

- PPC switch CRUISE

CAUTION: If external generator is not in use (not ON or malfunctioning, red warning lamp ON) propeller will not change blade angle to cruise position.

NOTE: Propeller pitch change from T/O to CRUISE position takes, depending on OAT, 2 - 5 minutes. Cruise position is not verified by an indication.

CAUTION: During propeller blade angle transition, RPM changes at constant power setting. Specially during change from CRUISE to T/O, RPM must be monitored not to exceed the allowed limits (max continuous 5500 RPM), reduce power if necessary!

- Cowl flaps ADJUST (recommended temperatures: OIL 90-l 10°C / 194-230°F, CHT ≈ 110°C / 230°F

CAUTION: Cowl flap angle can be selected by lever in 5 steps. The center (3.) notch is found to be a suitable position for good engine temperatures with normal cruise power.

CAUTION: Recommended temperatures are: oil 90-l 10°C / 194-230°F, CHT about 110°C / 230°F. Continuous oil temperatures below 90°C / 194°F may result in increased sedimentation in the engine and to condensed water in engine oil.

WARNING: Cowl flaps should not be kept fully closed during cruise (5th notch), because insufficient cooling air is streaming into the engine bay in this position. Lever position 5 should only be used during descent with reduced power and during engine warm-up on ground.

- Flaps SET, depending on speed position 0 to -10"
- Throttle SET cruise RPM, max 5500 RPM, recommended 4300 - 5000 RPM

For power settings, speeds, fuel consumption and other data refer to section 5.3.1 "Performance in powered-configuration"

WARNING: Engine RPM will rise at constant power setting with altitude at constant airspeed! Above about 6600 ft / 2000 m altitude (ISA) engine RPM would exceed the max continuous limit of 5500 RPM for 100% engine power. Therefore engine power must be reduced to keep engine RPM below max 5500 RPM.

b) Slow flight and stall behavior in powered configuration ·

Approach to stall speed in powered configuration is indicated by an acoustic warning, set about 3-7 kts / 5-8 km/h above stall speed.

Speed has to be increased immediately at acoustic stall warning onset. Minimum speeds are given in section 5.2.2 a "Stall and minimum speeds in powered-configuration" for unaccelerated straight and level flight.

Procedures to recover from unintended stall or spin are given in section 3.4 "Stall Recovery" and 3.5 "Spin Recovery".

4.5.3.3 Gliding Flight

a) Glider configuration

With the engine stopped, propeller blades folded and propeller-dome closed the SIO-VT is a normal glider with flaps.

The SIO-VT has good balanced flight characteristics and well harmonized flight controls. Bank can be changed from **+45°** to **-45°** within about **4,5** seconds without side-slipping (59 kts / 110 km/h, MTOW).

The speed-polar (envelope curve for optimal flap settings) is given in section 5.3.3 “Gliding Flight Polar”.

b) High speed

UP to V_{NE} = 145 kts / 270 km/h the SIO-VT is well controllable.

Above V_A = 97 kts / 180 km/h flight controls must not be deflected fully or abruptly.

At V_{NE} = 145 kts / 270 km/h the control movement must not be more than 1/3. Limit load factors are given in section 2.9.

If strong turbulence must be anticipated like in rotors of lee-waves, in thunderstorms or when passing mountain ridges, the maximum airspeed in rough air V_{RA} = 97 kts / 180 km/h must not be exceeded.

Airbrakes may be deployed up to V_{NE} = 145 kts / 270 km/h.

Flight path during dive at V_{NE} = 145 kts / 270 km/h, airbrakes fully extended, is about 30”.

WARNING: Above V_A = 97 kts / 180 km/h airbrakes should be deployed with caution, because of the high deceleration rate with airbrakes extension at high airspeeds. It has to be taken care that seat belts are well tightened and objects in cockpit area are properly secured.

c) Slow flight and stall behavior in glider configuration

Gliding and looking for thermals means flying at low speed.

When flying with forward CG, minimum airspeed can be limited by aft stop of elevator and only dynamic stalling is possible. Indication of stall in glider configuration is by aerodynamic buffeting (in level flight and in turns), when vortices of separated airflow of wing root area passes tail surface. This aerodynamic buffeting occurs about 3 - 7 kts / 5 - 8 km/h above stall speed. At first indication of stall warning (aerodynamic buffeting) release elevator to reduce angle-of-attack and increase airspeed.

If speed is not increased at stall warning onset and reduced further, the a/c may stall with a wing-drop. Up to wing-drop aileron and rudder are effective and correct; controllability is restored immediately even during stall upon elevator release. An uncontrollable tendency to spin was not observed.

WARNING: Altitude loss for recovery from stall in **level flight** may be up to **100 ft / 30m,** out of a **turn** up to **130** ft / 40 **m** and for a **delayed reaction** up to 200 ft / 60 **m.**

Minimum speeds are given in section 5.2.2 0 “WARNING: Altitude loss for recovery from stall in **level flight ma**y be up to **100 ft / 30m,** out of a **turn** up to **130** ft I40 **m** and for a **delayed reaction** up to 200 **ft /** 60 **m.**

Stall and minimum speed in glider-configuration” for unaccelerated straight and level flight. During turns, depending on bank and corresponding g-load, minimum speeds are higher. Example: minimum speed and stall during stationary turns with 60” of bank and a g-load of 2, are expected to be higher by a factor of $\sqrt{2} \approx 1{,}4$ compared to unaccelerated level flight.

Procedures to recover from unintended stall or spin are given in section 3.4 “Stall Recovery” and 3.5 “Spin Recovery”.

4.5.3.4 Change of a/c configurations (powered-, gliding flight)

a) change from powered- to glider-configuration

- Throttle — IDLE
- Air speed — REDUCE to approx. 54 kts / 100 km/h
- Propeller — T/O position
- Cowl flaps — FULLY OPEN

CAUTION: With cowl flaps fully open, the engine cools down fast and the risk of unintentionally overheating engine after engine restart is reduced. When reopening propeller-dome again, cowl flaps are moving to fully open position.

- Engine temperature — WAIT for cool-down, CHT and oil temperature < 100°C / 212°F
- Ignition — OFF (switch position OFF, tachometer reads "0" RPM)

WARNING: If the engine is operated with load, a sudden shut-down can result in overheat of the turbocharger system and damage it.

CAUTION: If the engine is shut-down without a sufficient cool-down period prior to shut-down, this can result in local overheat of the engine and cooling fluid can flood. To avoid, engine should cool down with idle power until engine temperatures are <100°C / 212°F (CHT and oil temperature) before shut-down.

- Propeller-brake — PULL until propeller stops

CAUTION: The propeller should not windmill for longer periods with the engine stopped because this would unnecessarily cause parts of the clutch to be worn.

- Propeller positioning — PULL handle cautiously until stop

CAUTION: If the propeller positioning handle is pulled too fast, the propeller may be driven passed the correct position for dome closure. If the propeller-dome cannot be closed, the propeller positioning must be repeated; never pull handle for closing propeller-dome powerful, if in doubt about correct propeller position repeat positioning.

- Generator switch — OFF (red warning lamp ON)
- Fire-cock — CLOSE
- Electric equipment — OFF, if not needed for gliding
- Cooling of engine bay — WAIT for 3 minutes

CAUTION: Before cowl flaps are closed with the propeller-dome, the engine should cool down for three minutes after shut-down, cowl flaps fully open, to avoid overheat areas in engine bay.

- Propeller-dome — CLOSE and LOCK (red generator warning lamp OFF)

NOTE: When closing and locking propeller-dome, engine master switch and the avionics, which is only required during powered flight, are switched off.

CAUTION: Take care to operate only essential electrical equipment during soaring to avoid discharging battery too much; engine restart and electrical landing gear operation need power from battery with the engine stopped.

b) Change from glider- to powered-configuration

- Airspeed — < 76 kts / 140 km/h (recommended 54 kts / 100 km/h)
- Fire-cock — OPEN
- Propeller-dome — OPEN and LOCKED (engine instruments on)
- Cooling air flaps — FULLY OPEN
- Propeller — T/O position
- auxiliary fuel pump — ON (green status lamp ON)
- Choke — ON for cold engine
- Throttle — IDLE (max 10%)
- Ignition — START

NOTE: As soon as engine starts, release starter key; this deselects the starter motor. If the engine does not fire after 10 seconds of starter operation, stop and wait for at least 2 minutes for starter cool-down, then try again

CAUTION: Engine airstart: The propeller may continue turning with the engine not running (following an unsuccessful engine airstart), because engine and propeller are isolated by a centrifugal clutch. A **running engine is indicated by the RPM-indicator** not by observing the propeller turning.

CAUTION: Propeller blades are unfolded when starter motor starts rotating. To avoid unnecessary loading of the propeller-blade stops during rough engine starting, throttle should be in idle position when actuating starter. **After both propeller blades are fully unfolded, engine starting can be improved by opening throttle slightly (about IO%),** this may improve starting a warm engine.

CAUTION: If the drive system was not operated for > 5 minutes, propeller blades are in T/O-position regardless of actual switch position. If switch is in position cruise, pitch control mechanism begins to move blades with the engine start.

CAUTION: If engine starter does not operate for restart, refer to section 3.7.3.

WARNING: If OAT is extremely low, i.e. at high altitudes or in cold areas, battery capacity after longer soaring time might be too low for engine restart. Successful engine restart might only be possible at higher temperatures and lower altitudes. This must be taken into account for flight and route planning.

- Ignition switch — BOTH
- Throttle — about 2000 RPM
- Oil pressure — GREEN ARC after max 10 seconds

NOTE: Minimum oil pressure 22 psi / 1,5 bar; with cold engine at low RPM, up to 102 psi / 7 bar are normal.

WARNING: If the minimum oil pressure is not indicated within 10 seconds, stop engine immediately!

- auxiliary fuel pump — OFF (green status lamp OFF)
- Generator switch — ON (red warning lamp OFF)
- Warnings and cautions — OFF
- Electrical systems — ON as required and switched off for gliding
- Engine warm-up — 2500 RPM, adjust choke for smooth engine running

WARNING: The engine must be warmed-up at reduced power setting. If power setting is too high with a cold engine, engine may run rough, splutter or even stop.

CAUTION: During engine warm-up, oil temperature and CHT have to be monitored continuously. In case of a malfunction of the cowl flaps, a danger of overheat and engine damage exists!

4.5.3.5 Flying in strong turbulence

When encountering areas with strong turbulence or crossing strong thermals airspeed must be reduced to below V_{RA} = 97 kts / 180 km/h.

4.5.3.6 Cold weather operation

Before operating the a/c in cold areas, an inspection is recommended. Specially cooling fluid and lubrication fluid must be checked (refer to section 2.4.2 “Fluids”).

Engine starting at low OAT:

- Start engine with throttle IDLE (max 10%) and with choke ON (open throttle renders starting carb ineffective!)
- Be aware, no spark below crankshaft speed of 220 RPM!
- as performance of electric starter is greatly reduced when hot and the battery capacity is low at cold temperatures, limit starting to periods not much longer than 10 seconds. With a well charged battery, adding a second battery will not improve cold starts.

CAUTION: If water is in the fuel system, it will descend to the lowest areas of the fuel system and freeze at low temperatures. This can block fuel pipes, filters and orifices. Therefore it is highly important to drain the fuel system properly to remove contained water specially when low OAT must be expected. Refer to section 4.3 “Daily Inspection”.

WARNING: If OAT is extremely low, i.e. at high altitudes or in cold areas, battery capacity might be too low to turn the engine with more than 220 RPM for ignition. Successful engine restart might only be possible at higher temperatures and lower altitudes. This must be taken into account for flight and route planning.

4.54 Approach

Landing can be done either in gliding or in powered configuration.

a) Approach in powered-configuration

- PPC switch position TAKE-OFF

CAUTION: The change-over of propeller-blade pitch can take up to 5 minutes, therefore PPC has to be activated in time. If, in case of a go-around, the propeller is not in T/O position, be aware of a considerably reduced rate of climb.

Landing pattern should be arranged so, that landing could be performed with idle power. On downwind:

• Fuel cock	OPEN
• Cowl flaps	FULLY OPEN
• Wing flaps	+5°
. Auxiliary fuel pump	ON (green lamp ON)
• Throttle	AS REQUIRED
• Airspeed	60 kts / 110 km/h (yellow triangle on airspeed indicator scale)
• Landing gear selector	DOWN (extension time about 30 seconds)
• Landing gear indicator	CHECK 2 GREEN lamps

CAUTION: During gear extension the two landing gear lights flash RED (right first, then left). In case of lacking indication after selecting landing gear switch down, check CB (left side of switch) and push if necessary. If both indicator lights are not on and green after max 45 seconds, operate emergency gear extension (refer to 3.9.4.19).

NOTE: If airbrake handle is unlocked prior to gear-down indication, gear warning horn will sound and both gear warning lamps will flash RED until the landing gear is down and locked.

On final approach:

• Wing flaps	L (+16°)
• Throttle	IDLE
• Approach speed	59 kts / 110 km/h (yellow triangle on airspeed indicator scale)
• Propeller pitch indicator	GREEN for T/O position
• Airbra kes	AS REQUIRED

NOTE: It is recommended to arrange the approach so, that touch-down area can be reached with engine in idle In this case flight path corrections are only done by applying airbrakes.

CAUTION: If propeller T/O-position is not indicated within an adequate time (max 5 minutes) by green lamp, propeller pitch position can be checked as follows:

- Airspeed **110 km/h / 59 kts**
- Throttle FULL POWER but max 5500 RPM
- If 5400 RPM or more are attained, T/O blade-position most probably is reached.

WARNING: If propeller blades are not in T/O position, a considerably reduced rate of climb rate must be expected. In this case it is recommended to perform another pattern and to check PPC switch position and CB.

WARNING: If the a/c is wet and in rain increase approach speed by 10 %! (refer to section 4.5.7).

CAUTION: If strong turbulence or strong wind have to be encountered with, select flap position **+10°** or **+5°** to achieve better effectiveness of lateral control. Increase approach speed by 10%.

b) Approach in glider-configuration

Landing pattern must be arranged so, that landing area can be reached in a safe flight path.

• Wing flaps	+5°
• Airspeed	59 kts / 110 km/h (yellow triangle on airspeed indicator scale)
• Landing gear switch	DOWN (extension time is about 30 seconds)
• Landing gear indicator	both GREEN for down and locked

CAUTION: During gear extension the two landing gear lights flash RED (right first, then left). In case of lacking indication after selecting landing gear switch down, check CB (left side of switch) and push if necessary. If both indicator lights are not on and green after max 45 seconds, operate emergency gear extension (refer to 3.9.4.19).

NOTE: If airbrake handle is unlocked prior to gear-down indication, gear warning horn will sound and both gear warning lamps will flash RED until the landing gear is down and locked.

On final approach:

• Wing flaps	L (+16°)
• Approach speed	59 kts / 110 km/h (yellow triangle on airspeed indicator scale)
• Airbrakes	AS REQUIRED

NOTE: With airbrakes fully extended, propeller dome closed and 59 kts / 110 km/h glide ratio is about 1:7

WARNING: If raining increase approach speed by 10%! (refer to section 4.5.7 "Flight in Rain").

CAUTION: If strong turbulence or strong wind have to be encountered with, select flap position +10° or +5° to achieve better effectiveness of lateral control. Increase approach Speed bv 10%.

4.5.5 Landing, Taxi and parking

4.5.5.1 Landing

On short final:

• Airbrakes	AS REQUIRED
• Attitude	maintain WINGS LEVEL
• Directional control	stay on center-line
• Elevator	APPLY for touch-down in three-point attitude

CAUTION: Do not flare too low (high landing gear)! Close to the ground maintain wings level and use rudder only for directional control. Reduce speed to the minimum until touch-down with main landing gear and tail wheel simultaneously in three-point attitude.

Roll out after touch-down:

• Airbrakes	FULLY EXTENDED and HOLD
• Elevator	HOLD on aft stop
• Wheel brakes	AS REQUIRED with caution

CAUTION: During roll out apply rudder cautiously, sensitivity is increased because pedals actuate rudder and tailwheel.

CAUTION: Off-field landing: It is the pilots decision on whether to land with landing gear up or down; decision depends on surface and status of selected area. Several landings were performed on dry, solid, level and flat ground without any harm to the crew or damage to the a/c ('crew had seat belts well fastened and tightened).

4.5.5.2 Taxi and ground operation:

If a/c was landed in glider-configuration, engine may be restarted to taxi to parking position:

• Fire-cock	OPEN
• propeller-dome	OPEN and LOCK
• Cooling air flap	FULLY OPEN
• Auxiliary fuel pump	ON
• Choke	ON for cold engine
• Throttle	IDLE (max 10%)
• Ignition	START
• Oil pressure	GREEN range
• Auxiliary fuel pump	OFF

4.5.5.3 Parking and Shut-down

On park position:

• Parking brake	SET and LOCK
• Throttle	SET about 2200 RPM
• Cooling air flaps	FULLY OPEN
• Engine cool-down	WAIT for CHT and oil temperature < 100°C / 212°F

CAUTION: Engine cool-down: Shut-off the engine after engine temperatures are below 100°C / 212°F (CHT and OIL temperature), but maximal after 5 minutes; for cool-down set 2000 - 2500 RPM and open cooling air flaps fully. Normally, the engine is cooled-down during approach and taxi.

CAUTION: During cool-down run the a/c should be **directed into the wind** to have a good airflow in the cowl flap area. In crosswind or tailwind conditions cooling is inadequate and engine temperatures can steadily increase. If at high OAT's or poor wind conditions the engine temperatures do not decrease to below 100°C / 212°F the engine may be shut-down after 5 minutes cool-down run.

WARNING: If the engine is operated under load during shut-down, a sudden engine-stop may result in overheatina and damaaina turbocharaer.

CAUTION: If the engine is shut-down without a sufficient cool-down period prior to shut-down, this can result in local overheat of the engine and cooling fluid can flood.

• COM and NAV	OFF
• Generator switch	OFF
• Ignition	OFF
• Fire-cock	CLOSE
• If parking area is not level	WHEEL CHOCKS as required
• Cooling of engine bay	WAIT for 10 minutes
• Propeller-dome	CLOSE

CAUTION: Propeller-dome and with it cooling air flaps should be closed about 10 minutes after engine shut-down to avoid heat accumulation and local overheat.

4.5.6 High Altitude Flight

It must be considered, when flying at high altitude, that true airspeed (TAS) is higher than indicated airspeed (I AS).

Justification of flutter behavior of the type STEMME SIO-VT has been performed at altitudes of 6600 ft / 2000 m MSL. Based on these tests the maximum permissible airspeed (never exceed speed) V_{NE} = 146 kts / 270 km/h (IAS) has been established between 0 and 6600 ft MSL.

In order to avoid exceeding of the maximum permissible **true airspeed** above 6600 ft / 2000 m MSL the maximum permissible **indicated airspeed** is reduced with increasing altitude. This is due to the installed airspeed indicator system, the reading of which depends on the pitot/static air pressure and thus also on the air density which decreases with increasing altitude. Based on the ICAO-Standard Atmosphere (ISA) reduction of V_{NE} (IAS) - deviating from the ASI marking - is as follows:

Flight Altitude		never exceed speed V_{NE}		
[ft MSL]	[m MSL]	[kts (IAS)]	[mph (IAS)]	[km/h (IAS)]
0 to 6500	0 to 2000	146	168	270
10.000	3.000	139	159	257
13.000	4.000	132	151	244
16.500	5.000	125	144	231
19.500	6.000	118	136	219
26.000	8.000	105	121	195
33.000	10.000	93	107	173
39.500	12.000	81	93	150

The above speed limits are to be observed with special care since freedom of flutter for the type STEMME S 10 can be granted up to these limits only.

WARNING: If OAT is extremely low, i.e. at high altitudes or in cold areas, battery capacity might be too low to turn the engine with more than 220 PM for ignition. Successful engine restart might only be possible at higher temperatures and lower altitudes. This must be taken into account for flight and route planning.

ROTAX indicates a minimum OAT for engine start of -25°C / -13°F

These limitations have to be considered when planning the flight, and during engine restart after high altitude flight, respectively.

4.5.7 Flight in Rain

Rain, hoarfrost and ice on wing and control surfaces change aerodynamics of the aircraft, changing a/c performance, flight characteristics and controllability remarkably. Therefore following procedures following unintended flight into rain or icing area are recommended:

- Keep margin of at least 6 kts / 10 km/h above any given minimum speeds.
- Be aware that the climb rate decreases by up to 50%.
- Be aware that cruise speed decreases up to 30% with consequences to maximum range (replan flight).

Section 7 - Description of the **S10-VT** and its Systems and Equipment

7.1 Introduction

This section provides description and operation advice of the powered glider and its systems and equipment. Section 9 includes flight manual supplements, if required, related to non-standard systems and equipment. More information about components and systems see maintenance manual.

7.2 Cockpit Controls

a) Cockpit controls at the airframe

Following overview includes the controls at the airframe.

I. Control Stick	Middle in front of each seat.
2. Rudder Pedals	For each seat and adjustable. The pedals also steer the tail wheel, which is coupled to the rudder via spring device.
3. Airbrake Lever	For each seat LH side. Blue lever at LH cockpit side and on the center console between seats, respectively.
4. Flap Lever	For each seat LH side. Black lever at LH cockpit side and on the center console, respectively. Indication of settings (-10, -5, 0, +5, +10, L) in center console. Dislocking is by moving lever to the right against spring force, which locks the flap positions.
5. Pedal Adjustment Handle	In front of each seat. Dislocking is by pulling the handle.
6. Canopy Locks	Two white handles with red colored ring, one on left and one on right side of the canopy frame, to open and lock the canopy, and one white handle at rear top, which keeps hold of the rear canopy at the first moment of emergency canopy jettison ("Roger-Hook").
7. Brake Lever	Lever at LH control stick, at RH stick optional. The brake lever can be locked with a pin for parking.
8. Trim Lever	One green lever on center console between seats. To trim push down (dislock) and shift lever forward or aft. Locking is by a spring device.
9. Throttle Lever	One black lever on center console with two forward stops (for max. continuous and max. T/O-power). It is coupled with a spring acting forward in direction FULL POWER. Its position is fixed by friction discs, which can be adjusted with a milled-nut on LH side of the center console.
IO. Choke Lever	Black lever on center console, RH side of the throttle lever. It is coupled with a spring acting rearward in direction CHOKE OFF. Its position is fixed by friction discs, which can be adjusted with a milled-nut on RH side of the center console.
I I. Propeller Pitch Control	Switch on center console. The forward position is the TAKE-OFF position.
12. Fuel Cock	Red handle on the rear console between the seat back rests. Turning handle horizontal (fuel cock CLOSED) cuts off the fuel supply between

collector tank and carburetors.

CAUTION: Throttle positions for I 15% and 100% can be selected by feeling. The first stop is the 100% throttle position. To select 115% the throttle lever must be moved through a throttle gate to the left and then pushed to the next stop.

b) Controls at instrument panel

The following overview includes controls at the lower area of the instrument panel. These elements are included in the picture of the instrument panel (see Fig. 7-I page 7-7):

I. Emergency Canopy Release	Red pull-handle on LH side of the switch panel. It is pulled for emergency canopy jettison after opening the canopy locks on LH and RH side of the canopy frame.
2. Cowl Flap Reduction	Black T-handle on LH side of the lower middle section of the instrument panel to reduce engine cooling in cruise condition. The foremost position means cowl flaps fully OPEN, 5 settings aft are available to reduce the opening of the cowl flaps.
3. Propeller Dome Operation	Black handle in the middle foot of the instrument panel to open, close and lock the propeller dome, linked to the engine electric master switch. Dislock by lifting, lock by pushing down the handle. In the forward position (Dome OPEN) the engine master switch comes ON when dome is LOCKED.
4. Propeller Brake	Black T-handle on RH side of the cowl flap reduction to brake the propeller to fullstop after engine switched off in flight. Braking is by pulling the handle.
5. Propeller Positioning	Black T-handle on RH side of the propeller brake to position the propeller so as it fits into the propeller dome contour. Operation is by rapid, not too fast pulling the handle to its stop.
6. Air Vents	Two adjustable air vents for cockpit ventilation, one on LH and one on RH side of the Instrument panel, are provided.
7. Canopy Defroster	Knob on RH side of the ignition/starter switch to defrost the canopy. The pulled position means canopy defroster OPEN.

WARNING: The most closed position of cowl flaps (nodge 5) is only for low-power or idle-descent and for engine warm-up on ground. During all other operation cowl flap should be more open to allow for higher cooling air flow into engine bay.

7.3 Instrument Panel

Following description gives an overview of instruments, controls, monitor devices and CB´s installed in the instrument panel. The positions of the elements is shown in the picture of the instrument panel (Fig. 7-I page 7-7), valid for the serial number as indicated on the title page of this flight manual.

The flight control instruments include at least one ASI (airspeed range 27 - 162 kts / 50 - 300 km/h), one Altimeter and one magnetic compass. These instruments are located directly in the view area of the PIC (in front of LH seat). Double-instrumentation is possible to provide an optimum view on flight control instruments from the RH seat (i. e. instruction flights).

Additional avionics may be installed on customer demands. Related Switches and CB´s are always located in the same section of the instrument panel.

Engine monitoring includes at least:

- tachometer,
- oil pressure and oil temperature,
- cylinder head temperature (CHT) RH and LH,
- voltmeter and ammeter
- fuel quantity in LH and RH wing tanks
- Engine-elapsed-time-indicator

These instruments are located as a rule, with the exception of the engine-elapsed-time-indicator, in the RH area of the panel, if not installed (i. e. with double-instrumentation) in the center area. The engine-elapsed-time-indicator is located on the center console between the seats.

The red fire-warning lamp (test by pushing lamp for optic and acoustic signal) is adjacent to engine instrumentation.

The following warning and monitoring lamps are combined in a group, arranged independently of its location on the instrument panel. They inform the pilot about the proper condition of the a/c at a glance. The group is always located at the upper instrument panel below the glareshield to allow for dazzle-free reading.

Arrangement from left to right is:

I. red fuel pressure warning,
2. yellow caution lamp for fuel quantity in collector tank,
3. green status indication for fuel aux pump operation,
4. red warning lamp for manifold pressure (boost pressure),
5. yellow caution lamp for malfunction of TCU,
6. red warning lamp for malfunction external generator (battery charge control).

The landing gear position and warning indication, consisting of two lamps, indicating the situation with green ore red steady or flashing light, are also located below the glareshield.

The following CB´s are combined in a group, arranged independently of its location at the panel:

- master CB,
- landing gear CB,
- CB´s for internal and external generator,
- CB´s for main and auxiliary fuel pump.

The **lower, central section** of the instrument panel comprises a row of levers and switches. All switches, except for avionics, are systematically arranged here. The red handle for canopy emergency jettison is installed LH of the row of switches. Sequence of levers and switches, starting from the left, is:

I. red handle for canopy emergency jettison,
2. 3-position lever for landing gear (down: lowering, center: neutral (electrically de-energized), up: retraction),
3. spare,
4. switch for auxiliary fuel pump,
5. electric master switch,
6. switch for external generator,
7. TCU emergency switch to isolate wastegate actuator and TCU control in case of malfunction (switch is guarded with a red protecting plate for unintended operation),
8. engine-back-up switch to bypass engine master switch in case of malfunction of the microswitch at the propeller-dome (switch is guarded with a black protecting plate for unintended operation).

The control elements for propeller and propeller-dome (propeller brake, propeller positioning and propeller dome handle) are arranged below the row of switches in the center console. In the same area the canopy defroster knob and the ignition/starter switch (positions OFF, Right, Left, BOTH and START) are installed.

Following drawing shows layout and arrangement of the instrument panel of the serial number as indicated on the title page, including control elements, monitoring devices and CB´s.

7.4 Landing Gear

The landing gear (L/G) consists of a tail wheel and two retractable main landing gear legs, hinged at the center fuselage frame with the hinge axis in flight direction and locked in the extended position by means of an over-center locking strut ("elbow lever") for each leg. The wheel is beard on a trailed single swing arm that is supported against the leg's frame by a biased elastomeric spring for shock absorbtion purposes.

Retracting of the L/G legs and doors is managed by an electrically driven linear actuator for each leg that is built up around a high precision ball screw. Each of the linear actuators is hinged with the top end at the fuselage frame; the bottom end is coupled to the respective elbow strut by means of a locking mechanism which can be released for an emergency let-down by pulling a T-handle in the cockpit (one for each of the legs) and via a bowden cable. In case of an emergency let-down the two legs have to be released in succession (order is proposed, wrong order not critical), they are then coming out by gravitational force. Secure locking in the extended position is achieved by a spring that forces the elbow lever into its over-center position.

The actuators are controlled by limit switches, the ones for EXTENDED being integrated in the elbow struts and detecting the over-center position, those for RETRACTED mounted at the fuselage frame and detecting the top position of each L/G leg. All these switches are in duplicate, the second one giving the signal for the indication and warning system, which is processed by a TTL-logic and displayed by focused green and red LED's on the right face of the instrument panel (ref. to the Flight Manual).

The right L/G door is coupled directly to the right UG leg via a spring device, the left door is operated by means of a bowden cable which is actuated by the right leg during its last few degrees of travel. The bowden cable operates a separate elbow strut that locks the left door in the opened position. In the closed position the doors are locked by means of magnetos.

The tail wheel is without springing and guided in a trailed fork that is pivoted bottom in a thin section ball bearing, top in a combined radial/axial sleeve bearing. The journal is constructed so that a certain friction damping is produced at the axial sleeve surfaces when loaded in axial direction in order to avoid tail wheel flutter whilst taxiing. For steering on the ground the tail wheel fork is coupled with the rudder by means of two pre-tensioned tensile springs.

The disk brakes on the main UG wheels are operated hydraulically. The main cylinder for both the left and right wheel is located in the wheel well at the front wall, connection to the hand operating lever on the left stick is realized by a bowden cable, adjustable at the main cylinder. The hand lever can be locked in the operated position for use as a parking brake. A second lever on the right stick, NOR-type coupled to the system, is available as an option. Plumbing from the main cylinder to the wheel cylinders is realized by a short metal tube, T-type distributor and metal-armed brake hoses.

7.5 Seats and Seat Belts

The seats are deepenings in bottom fuselage secondary structure (integrated seating) and multiple adjustable back rests made of GFP.

Each seat is equipped with 4-point seatbelts and a central harness. The belly bends are supported at the sides of each seat. The shoulder harness is fastened to a tube behind each back rest.

Certified seat belts are indicated in the maintenance manual, section 9.1.

7.6 Pitot and Static Pressure System

Total pressure, static pressure and TEC (total energy compensated pressure) are measured with a pitot tube on the propeller-dome. The pressures are transmitted via pressure tubes to the instrument panel.

In addition, static pressure is measured on both sides of the tail boom and guided to the instrument panel, predominantly designed for airspeed indication. If possible, no further instruments should be connected, except for a coded altimeter, which may be installed in the forward tail boom.

WARNING: Static pressure from the front pressure probe (propeller-dome) must not be used for airspeed' indicator system, because speed indication will differ from the system calibration curve (see section 5.2.1. page 5-I.

Some devices (i.e. Bohli variometer) require additional static pressure probes near the widest section of the front fuselage. These are installed optionally only, if ordered with the initial equipment ex works.

Total pressure from the pitot tube and a reference pressure, taken from an inclined part of lower side of propeller-dome, are used to supply the stall warning system.

Any pressure transmission tubes are provided with water separator and filter elements. A filter for a coded altimeter is installed in the forward tail boom.

The following drawing (Fig. 7-2) shows the pitot and static pressure system of the SIO-VT with the certified connections.

einkleben: Borddrucksystem englisch

A: TEK-connection (pitot tube)

B: static pressure connection (pitot-tube)

C: total pressure connection

D: static pressure connection (both sides of tail boom)

E: static pressure connection (optional, both sides of cockpit)

F: flask connection

Fig. 7-2 Pitot and static pressure system

Certified installations:

	Device	*line*	*remarks*
1	Altimeter	B	
2	Air speed indicator	C, D	
3	Variometer (except for Bohli 68 PVF1 and Bohli 68 PVF2)	A, F	jet compensated (TEK)
		B, F	not compensated
		E, F	not compensated
4	Variometer Bohli 68 PVF1 (without internal expansion diaphragm)	C, E, F	only, if no variometer acc. (3) installed
5	Variometer Bohli 68 PVF2 (with internal expansion diaphragm)	C, E	
6	E-variometer or gliding computer	B, C, (A)	line *A* may be required depending on

		or: C, E, (A)	type
7	Coded altimeter	D	

7.7 Airbrakes

Double paddle Schempp-Hirth air brakes are fitted on the upper surface of the inner wing.

Airbrakes are driven by torsion-tubes with an over-centering mechanism in center fuselage. interconnection of wing and fuselage parts of airbrakes drive is by inserting and securing coupling bolts for LH and RH airbrakes.

7.8 Baggage Compartment

Aft of each backrest a lower baggage compartment is installed, each may be loaded with up to 22 Ibs / 10 kg if weight calculation allows.

Another baggage compartment is in the upper part of aft cabin spar, maximum load is 4,4 Ibs / 2 kg. Do not load solid items and no objects with more than 1 ,1 Ibs / 0,5 kg per piece unless secured.

7.9 Power-Plant

The turbocharged engine ROTAX 914 F2/S1 of the SIO-VT is based on the ROTAX 914 F2, adapted for the specific requirements of the S1 O-VT. (Four-cylinder, four-stroke opposed type Otto-engine, turbocharged with electronic charge-control (TCU=Turbocharger Control Unit); a central cam shaft and tappets-OHV; liquid cooled cylinder heads, cylinders cooled by ram air; dry-sump lubrication; Dual Capacity Discharge Ignition (DCDI); 2 CD-carburetor; integrated reduction gear, mechanical vibration absorber and overload clutch).

Engine power is transmitted via following elements, looking from the engine:

- Flywheel-clutch with overload protection and flexible couplings
- Drive-shaft with sliding element for linear displacement and flexible coupling
- Frontal spur reduction gear
- Variable pitch propeller STEMME 1 1AP-V with folding blades

Bild einkleben: Schema Antriebssystem

Fig. 7-3: Propulsion System Engine - Propeller

1. Retractable variable pitch propeller

Diameter unfolded **5,35** ft. **/ 1,63** m. Extension by centrifugal forces, folding by retraction springs; blade pitch actuation by electrically heated dilation elements; central body (hub and blade suspension) and pitch control mechanism are of aluminum alloy, blades are of fiber composite.

2. Gear

Gear with cogging, gear ratio: i **=** 0,902.

3. Flexible disk

for compensation of angle errors and angular movements.

4. Drive shaft

Carbon fiber composite, mass: about **6,6** lbs **/** 3 kg **/,** diameter: **2,6** in I 65 mm, length: **5,25 ft / 1,9** m, first critical bending freq. **>** 5200 RPM.

5. Splined sliding joint

for compensation of axial movements.

6. Bivalent centrifugal clutch

with servo effects. It damps starting shocks which could be critical for the extension of the propeller, protects against overload, and allows a discoupled slow down of the retractive propeller after shutting-down the engine.

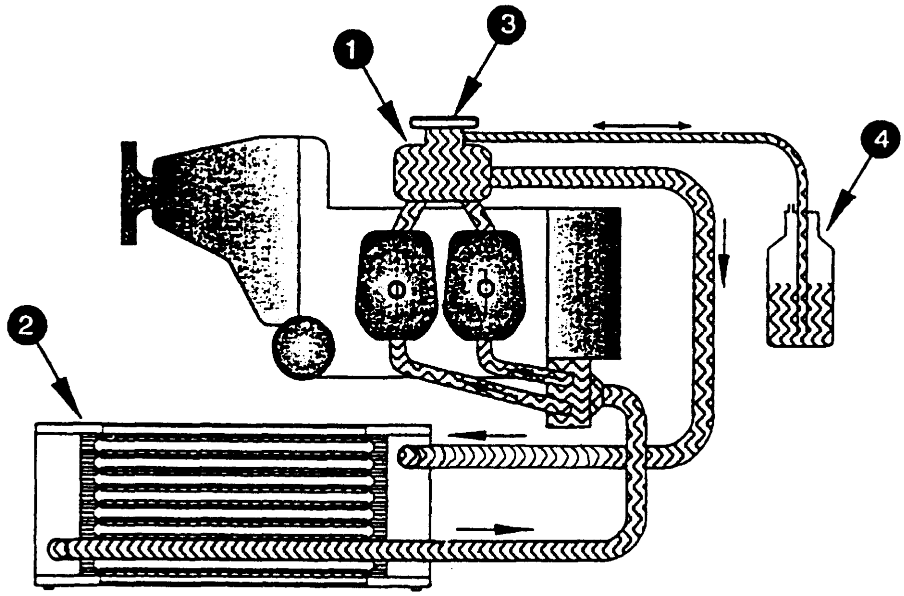
7. Engine

turbocharged, 4 cylinders, 4 stroke opposed-type engine, dual capacity discharge ignition, cylinder bodies ram-air cooled, cylinder heads liquid cooled; reduction gear (i = 0,412)

7.9.1 Engine

7.9.1 .1 Cooling

Engine is cooled in different ways. Cylinder blocks are cooled by ram-air with cooling air flow from RH cooling air flap. Cylinder heads are cooled by liquid, radiator for heat transfer is installed behind LH cooling air flap. Heat transfer for engine oil is via a separate oil-cooler aft of RH cooling air flap.



1. Expansion reservoir

The expansion reservoir is installed on lower left side of fire-wall; it contains an over-pressure and breather valve, connected to the overflow container (4).

2. Radiator for liquid cooling

The radiator for liquid cooling is installed on LH side of center fuselage frame and is cooled by ram-air form LH cooling air flap.

3. Filling hole

The filling hole of the expansion reservoir (1) is closed pressure sealed by filler cap on top; cooling system is filled here, but not replenished.

4. Overflow container

The overflow container, installed in landing gear bay, is a buffer for cooling fluid expansion. Cooling fluid quantity is checked at the overflow container, marked “min” and “max”.

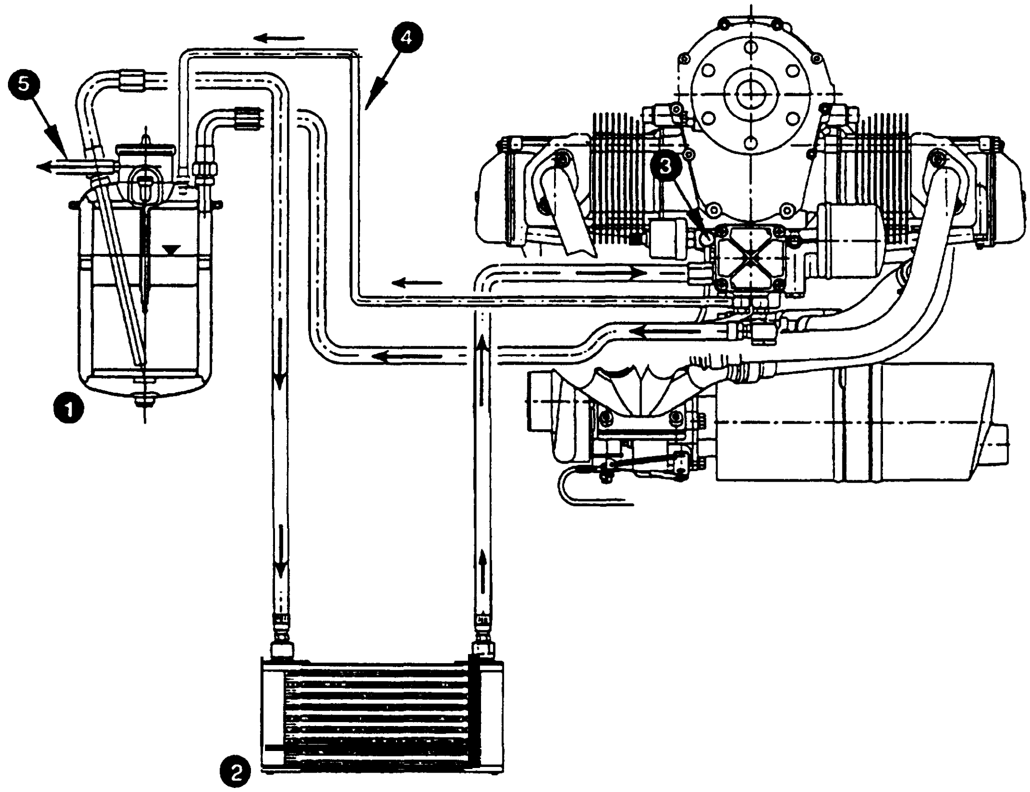
Cooling fluid circulation is a closed system. Fluid is pumped by a water-pump, driven in connection with the camshaft. Expansion reservoir has an over-pressure valve, releasing fluid to the overflow container in case of fluid expansion. When fluid cools down again, it is sucked back from overflow container. Cooling fluid system is self-ventilated via expansion reservoir.

NOTE: Because of the pressure valve, missing cooling fluid in overflow container (4) cannot be replenished into expansion reservoir (1).

CAUTION: Do not open locking cap on expansion reservoir when engine is warm! Cooling fluid system is pressurized: Danger of burning by hot spraying fluid!

7.9.1.2 Lubrication system

The ROTAX 914 F2/S1 is equipped with a dry-sump pressure lubrication; main oil pump is integrated with pressure regulator and additional scavenge pump. Oil pumps are driven with camshaft.



1. Oil tank with filler neck

2. Oil-cooler

3. Oil supply pipe for turbocharger

4. Oil return pipe for turbocharger

5. Ventilation pipe

Engine oil is sucked from oil tank through oil cooler and pressed through the oil filter to the different points of lubrication. Oil from points of lubrication is flowing to floor of crankshaft housing and pressed back to oil tank by over-pressure in crankshaft housing.

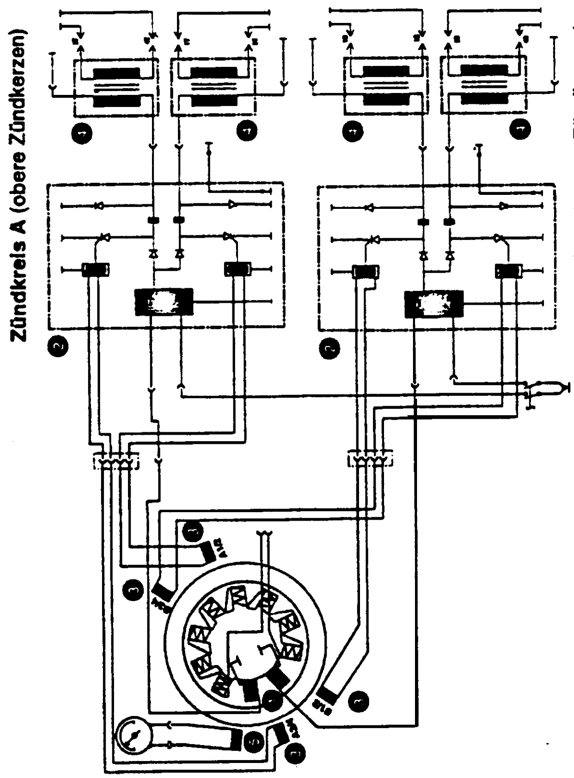
Turbocharger bearings are lubricated and cooled by separate oil line from main oil pump. Turbocharger has a separate scavenge pump to return oil to tank.

Oil tank is ventilated by a ventilation line at the tank.

Sensor for oil temperature is installed at oil pump socket and senses oil pump inlet temperature.

7.9.1.3 Ignition system

The ROTAX 914 F2/S1 is equipped with a contactless dual capacity discharge ignition (DCDI) system with an integrated generator. Ignition system is free of scheduled maintenance and requires no external energy.



1. High voltage coil

2. Electronic module

3. Ignition unit

4. Ignition voltage transformer

5. Sensor for RPM signal

Two independent high voltage coils on generator stator, one for each ignition circuit, are installed in crankshaft housing. Energy is accumulated in capacitors on the electronic module. For ignition, 2 of the 4 externally arranged sensors control discharge of capacitors via primary coil of the dual ignition transformers.

Sequence of igniting: 1 - 4 - 2 - 3

7.9.1.4 Turbocharger and -Control Unit

The ROTAX 914 F2/S1 is equipped with an exhaust-turbocharger, extracting kinetic energy from exhaust gas to compress intake-air.

Turbocharger RPM and pressure in airbox (manifold pressure), is controlled by deflection of wastegate, discharging turbocharger outlet pressure to engine exhaust gas system. The electric servo drive, actuating wastegate, is controlled by the electronic turbocharger control unit (TCU). Manifold pressure is commanded by position of carburetor flap, actuated by pilot's throttle lever.

WARNING: Close to max T/O position, between power settings for 108 and 1 10%, manifold pressure is increased unsteadily. In this range, exact power setting is not possible and control system and engine RPM may oscillate. Range between 110 and 115% corresponding to throttle settings between first and second stop should be avoided. For selection of max T/O power, throttle should be moved steadily and not slowly.

To avoid engine damage, manifold pressure is reduced automatically in case of excessive RPM or intake air temperature.

Manifold pressure control is monitored by red warning lamp for high manifold pressure and yellow caution lamp for TCU malfunction. After switching on electrical system, both lamps are on for I-2 seconds during system self-test.

CAUTION: If self-test is unsuccessful, one or both lights stay on, the engine must not be operated.

Yellow caution lamp for TCU:

OFF:	Turbocharger operable
Flashing:	Turbocharger not operable, refer to section 3.9.4.5

Red warning lamp for manifold pressure:

OFF:	Engine is operated in limits
ON:	Allowed manifold pressure is exceeded, refer to section 3.9.4.4 a
Flashing:	5 minutes T/O-power setting is exceeded, refer to section 3.9.4.4 b

CAUTION: If red manifold pressure warning lamp comes on, reduce power immediately!

7.9.2 Drive Shaft and Front Gear

Propeller hub is bolted to the drive shaft of front gear. Front gear is a helical gear in cast-metal housing, ratio 1 ,1 09 (see page 7-I 3); it is bolted to an aluminum structure, which is supported by 4 silent blocks in front spar.

Front gear oil is checked at an inspection glass with MIN/MAX markings. Filler hole on front side is closed by screw. Oil is changed every 200 engine-hours or every two years (refer to maintenance manual, section 7.4.12). Normally it is not necessary to fill up oil in this period.

WARNING: The front gear never may use more oil than what could have passed as oil vapor the circumferential joint. A higher oil consumption during short operation time has to be checked for reasons and must be eliminated before continuing a/c-operation. In any case, the manufacturer must be informed.

Power transmission from engine to front gear is with a drive shaft, made of carbon-fiber-composites (see page 7-13). A flexible disk is installed for compensation of angle errors and angular movements and at aft end are splines to allow for compensation of axial movements. Engine and drive shaft are isolated by a bivalent centrifugal clutch with servo effects. It damps shocks during engine starting, it protects against overload and it is a freewheel.

7.9.3 Variable Pitch Propeller

7.9.3.1 General

The two-blade variable pitch propeller 1 1AP-V has two operating positions: TAKE-OFF and CRUISE. Once rotation has stopped blades fold inwards at any blade angle; folded propeller must be brought into a certain position before propeller-dome can be closed by retracting nose-cone. In this configuration the **STEMME S10-VT** is prepared for high-performance gliding.

Propeller-blade angles, TAKE-OFF (low pitch) and CRUISE (high pitch), allows an adaption to different flight conditions and improves powered flight performance, like shorter take-off distances, higher climb rates and higher cruise speeds.

7.9.3.2 Principle Operation

Propeller hub is pivoted to allow for variation blade angle; blade attachment and actuating mechanism are made of high strength aluminum alloy.

Blades are actuated with electric energy from T/O to cruise position. Electric power (8 Amp.) is transferred via double sliding contact rings to the rotating propeller and heats up two thermo-elements which expand above a certain temperature. and actuate a piston with a mechanism to turn propeller blade.

High pitch position (CRUISE) is sustained by a position-dependent two-point regulator for the heating circuit and is supported by two fly-weights, the force of which increases with propeller rpm. The temperature corresponding to the cruise position is about 70°C / 158°F, limited to 85°C / 185°F by means of a protection circuit.

Replacement of blades after switching to TAKE-OFF (or de-energizing heating-elements) starts with cooling down of thermo-elements and is terminated at 55°C / 131 °F; it takes about 1 to 4 minutes depending on OAT and propeller rpm. It is achieved by springs, supported by aerodynamic forces which always try to turn the blades to low pitch, momentum depending on RPM. Aerodynamic forces plus spring always tend to turn blades towards low pitch, and only a relatively small actuator forces are needed to shift and sustain cruise position.

Heating circuits are disconnected by PPC switch or by a limit switch for “propeller-dome open but not locked”. This guarantees that propeller-blades are in take-off position when required, independent of actual PPC switch position.

The maximum time required for full change in pitch position in each direction in an OAT range between -30°C and +38°C / -22°F and +100°F remains below 5 min. Experience in service showed under all normal atmospheric conditions a mean time for the full pitch travel of 2% min. with only little divergence.

7.9.3.3 Desian

Propeller hub, blade suspension forks and, for most part, pitch control unit, are machined of aluminum alloys. Protection against corrosion is achieved by anodization. Blades are suspended in full needle bearings, fork pivot bearing for blade angle variation is a combination of two grooved full ball bearings for shear forces and an axial needle bearing.

Propeller blades are made of fiber reinforced plastic (FRP), constructed of two composite shells. Shear forces, centrifugal forces and bending moments are transferred by a double-spar to the suspension eye at the blade root. Spar flanges are of carbon rovings and are integral part of the shells, the four webs are of GFRP. In the root area spar rovings are looped around the eye bushing for best transition of forces from blade to suspension hub.

Protection against erosion is achieved by means of an impact resistant resin coating at the leading edge (gluing is made of same material) and, additionally, a PU-tape on leading edge of the blade. Ventilation is provided by a small opening in blade tips.

Folding of blades is accomplished by a coupling lever and torque springs, located in the hinge axis. The required bias of springs is achieved by twisting axis before final fastening.

The entire pitch control mechanism is located in front of propeller-blade plane. Attachment to blades is achieved by two couplings which allow fine adjustment of pitch angle and thus ensure synchronization of the two blades.

7.9.3.4 Special Remarks on Operation

Change in propeller pitch from TAKE-OFF to CRUISE and back is controlled by heating (or cooling down respectively) of two thermo-elements, with a characteristic influenced by OAT. External temperature-isolation is optimized so that time required for full change of pitch for each direction and under any OAT within the specified limits of -30°C to +38°C / -22°F to +100°F does not exceed 5 minutes.

On a standard day (+1 5°C / +60°F) times required for change in pitch in both directions have been found on repeated tests to be about 2½ min.

To avoid a go-around in landing configuration but with propeller in cruise position, propeller pitch control is to be switched to TAKE-OFF at least 5 minutes before entering airfield traffic pattern. The green take-off position indicator light should be illuminated before entering airfield traffic pattern.

Additionally the procedures described in sections 3 and 4 must be followed.

7.9.3.5 Limits and Technical Data

• Max. propeller RPM	2650 RPM
• Max. engine RPM	5800 RPM
• OAT limits	-30°C to +38° / -22 to +100°F
• Range of pitch angle	6,4°
• Voltage	min. 12 V, max. 14,7 V
• Current required	max. 10 Amp.
• CB for propeller blade control	15 Amp

7.9.3.6 Protective Circuits

Protection of battery discharge: Power supply for heating circuit is monitored by a power relay which is actuated by D_F (regulator circuit) of the generator. System layout is such that under the most probable malfunctions of charging circuit propeller blade is not actuated into cruise position in order to avoid battery discharging.

Protection against overheating: Maximum temperature of thermo-elements is limited to 85°C / 185°F by means of a protective circuit with an NTC-Resistor integrated in actuation element.

Protection against radio interference: Radio interference which may be caused by commutator is prevented by an interference suppresser condenser.

Test circuit: A test circuit can be activated by pressing a push button at front bulkhead with master switch ON. Doing so, propeller pitch control is operated on ground and with the engine stopped from battery in order to verify correct functioning of variable pitch propeller.

7.10 Fuel system

The S1 O-VT fuel system is a gravity system with two wing tanks and a small collector tank in the fuselage. Two fuel pumps are supplied from the collector tank. The fuselage tank contains a sump for the entire system for drainage, with a drain valve installed in the landing gear bay.

7.10.1 Design of fuel-tank and -pipe system

Two fuel tanks, one in each outer section of the inner wing, have a capacity of 11,9 US gal / 9,9 Imp gal / 45 l each. The wing tank ventilation pipes, layed from the highest points of the tanks to the center wing, are coupled with a "T" to a central ventilation and discharge pipe. For rigging and derigging, a quick-disconnect-valve is installed. The outlet of the central ventilation and overflow pipe is in the area of the RH landing gear fairing.

In each oufflow pipe of the wing tanks, a coarse filter is installed. The two oufflow pipes are connected with a check valve and a quick-disconnect valve to the fuselage mounted collector tank. Between collector tank and pumps a fine filter is installed. Pressurized fuel passes the fire-cock in cockpit area and is guided to the pressure-regulating valve before entering carburetor. Excess fuel is returned directly to the collector tank. The collector tank is vented through a pipe including a float-valve to the central ventilation and discharge pipe.

The fuel system is drained with a single, self-sealing drain valve on a plate between radius rods of the landing gear; installation is so, that there is no danger for damage when landing with gear retracted.

7.10.2 Fuel pump system

The electrically driven main fuel pump is supplied by the engine-integrated generator; it is separately fused. With this layout it is assured, that the main fuel pump is always energized, as long as engine is running, even if main electric system is switched off. The auxiliary fuel pump is energized by the external generator and can manually be selected on if needed. Fuel may pass pumps only in one direction. Fuel is sucked through a fine-filter from collector tank and supply carburetors through the fire-cock.

7.10.3 Fuel indication and warning system

The fuel tank system is controlled by three lamps and two quantity indications on the instrument panel.

The red fuel pressure warning lamp is steady ON, if fuel pressure is below limit, it flashes, if fuel pressure is above limit, both as a function of airbox-pressure (manifold pressure). A yellow fuel quantity caution lamp is ON, if an optical sensor in collector tank senses fuel level below sensor. A green status lamp is ON, if the auxiliary fuel pump is energized. A quantity sensor in each wing tank is connected to respective fuel quantity indicator.

Following diagram shows the fuel system scheme, including indications but without fuel pump control.

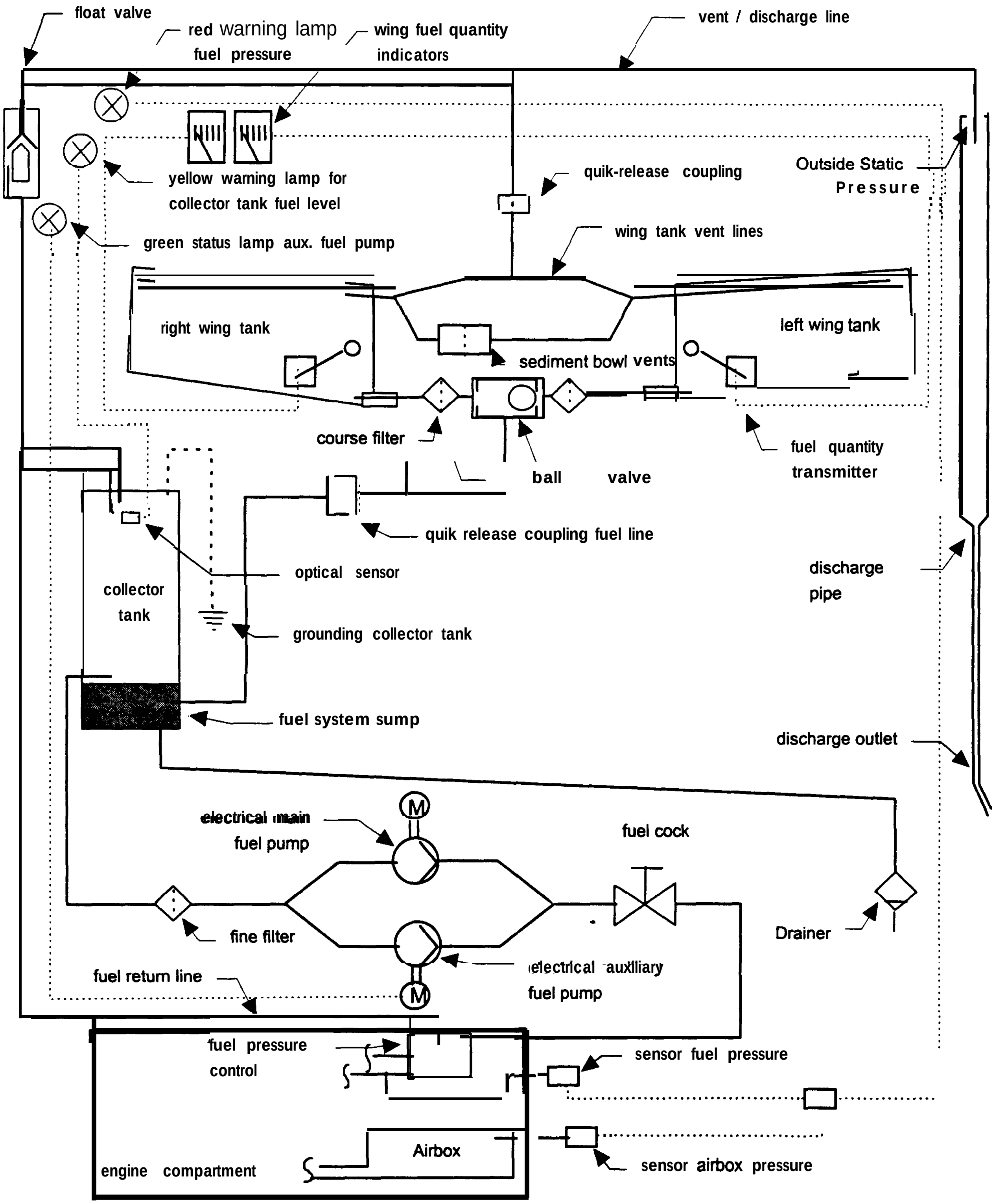


Fig. 7-7: Diagram of fuel system

7.11 Electrical System

The electrical system is supplied by a master battery and a 600 Watt generator, flanged to the engine. The master battery is placed in the forward end of the tail boom, aft of the engine.

All electrical consumers are protected by automatic circuit breakers. The primary circuits of the relays are protected by fuses located under glareshield.

In addition to the following descriptions of switching functions refer to section 7.3 “Instrument Panel”.

Master Switch: Disconnects all power supply from main bus bar.

System switches:

Engine bus master switch: Connects or disconnects all electrical engine equipment except main fuel pump to or from battery and generator: starter, propeller pitch control, engine instrumentation etc. Engine master switch is coupled to propeller-dome lock such that, with the propeller dome in OPEN position, it is automatically operated when propeller-dome actuating handle is unlocked (OFF) or locked (ON).

Engine bus back-up switch: Connects main bus to engine bus and enables to restart engine in flight in case of a malfunction of engine master switch. It is protected against unintended operation by secured plate.

Ignition key: Positions of ignition key: OFF RIGHT LEFT BOTH START

The ignition switch selects the two ignition systems and the electric starter motor.

TCU isolation switch: Isolates, if selected if necessary, wastegate actuator from TCU. Isolation is only necessary in case of TCU malfunction; therefore TCU switch is protected. Normal wastegate operation is in lower, protected switch position, isolation is with switch up.

Auxiliary fuel pump: Selects auxiliary fuel pump. Aux fuel pump is operating in parallel to the main fuel pump to increase redundancy or if fuel pressure is low. Green status lamp on instrument panel is ON if aux fuel pump is energized.

Landing gear selector:

- upper position: Gear retraction
- center position: system de-energized
- lower position: Gear extension

It is recommended to select center position for cruise, soaring and parking to avoid holding current. .

PPC switch: TAKE-OFF / CRUISE (propeller pitch control);

In CRUISE position current flow is depending on OAT to hold propeller blades in cruise position. In TAKE-OFF position or when main bus is not energized propeller blades are pushed by spring force into TAKE-OFF position. When the propeller blades have reached the allowable pitch range for take-off, this (not the switch position!) is indicated by green light below switch, if master switch and engine master switch are ON (engine bus energized).

Section 8 - Handling, Servicing and Maintenance

8.1 Introduction

This section deals with manufacturer's recommended procedures for proper ground handling, servicing and maintaining of the S10-VT. It also lists certain inspection and maintenance requirements which must be observed if the powered glider is to retain that new-plane performance and reliability.

CAUTION: It is highly advised to follow lubrication schedule as listed in maintenance manual, section 6.5 and tc carry out, more frequent if unfavorable climatic or environmental conditions are encountered, preventive maintenance.

8.2 Inspection Periods

Maintenance activities are described in Maintenance Manual S10-VT (STEMME Doc. Nr. A40-11-122). For a new a/c first inspection is after 25 h of operation and thereafter following maintenance and inspection schedules are effective:

Airframe: (refer to Maintenance Manual STEMME SIO-VT) shortest interval: 50h

Engine: (refer to Maintenance Manual STEMME S10-VT) shortest interval: 50h

Power Transmission System: (refer to Maintenance Manual STEMME SIO-VT) shortest interval: 50h

Variable Pitch Propeller: (refer to Maintenance Manual STEMME S10-VT) shortest interval: 50h

To maintain airworthiness, an annual inspection type III (100 h-inspection, refer to Maintenance Manual SlO-VT) independent of actual operating-hours, must be performed.

Inspections of the a/c must be performed by a certified inspector according to the actual requirements. In Germany, such an inspection is required annually ("annual inspection"). Prior to the inspections, maintenance items and checks have to be completed according to Maintenance Manual sections 5.2 and 5.3.

8.3 Alterations and Repairs

Details of who is authorized to perform alteration and repair works on the powered sailplane and information on the limits between minor and major repairs can be found in the FAR pt. 43. These regulations are to be respected with first priority.

For standard maintenance and minor repairs please refer to the Maintenance Manual, Doc. No. A40-1 l-122.

a) Alterations

It is essential that the responsible FAA office be contacted **prior to** any alterations on the powered sailplane to ensure that the airworthiness of the aircraft is not compromised. In any case, the manufacturer has to comment the request for modification and to agree.

b) Repairs

Before commencing flight duties, especially after a non-operation period, a thorough inspection of the powered glider should be performed, refer to section 4.3 "Daily Inspection". Check surfaces for cracks in coating, for local bucklings, roughness, holes and delamination of coatings and structure.

If something deems unusual or significance of a damage is questionable, a specialist for CRFP/GFRP should always be consulted. Minor damages without influence to the airworthiness may be repaired by **a** qualified person. Definitions to decide on grade of damage are given in supplement "Repair Instructions" to the maintenance manual.

Any "major damage" may be repaired by appropriately rated repair stations only. Do contact the manufacturer concerning major repairs.

WARNING: Repair work or embellishment at control surfaces have an influence on airworthiness, if allowed masses and moments are not kept (refer to maintenance manual section 6.4).

8.4 Ground Handling / Road Transport

a) Towing / Pushing

Due to the big wing span, it is recommended to have a person for checking clearance of wing tips.

If the S10-VT is towed by car, only use properly fixed and suitable towing equipment, move slowly and do not make tight turns to reduce loads to tail wheel and aircraft structure. If the S10-VT is town by rope, it is recommended to fix it on both landing gear struts and to have someone prepared to decelerate and stop the a/c.

- Pushing backwards: Directional control at rudder fin and push only at inner wing.

b) Storing:

The SlO-VT should only be stored in well ventilated rooms. A closed, weatherproof trailer or container must be provided with sufficient ventilation ports or facilities. Take care for stress-free deposit of a/c and components.

c) Parking

If the a/c is not derigged for a year, connection bolts, nuts and elements at fuselage, wing and empennage have to be properly protected for corrosion. Dust covers should be commonplace for high quality surfaces and materials like at the S10-VT. When parked outside, the a/c should be securely tightened to ground or sufficient ballast.

- Tightening: Insert ring-screws in inlets of outer part of inner wing.
- Parking: Set parking brake with lockpin at brake handle on control stick.

CAUTION: Wings should be level for parking; otherwise there may be some leakage through tank vents.

d) Preparation for Transportation on Road

Especially the one-piece inner wing must be carefully supported in a trailer because of its high weight. If the inner wing is transported upright, supported on nose, at least three wide supporting areas well adapted to wing section shape are recommended. Fuel from wing tanks must be drained for transportation on road and filled into approved fuel containers (refer to relevant regulations). The best way to empty wing tanks is with an optional device (available from STEMME) for the quick release coupling.

If the fuselage is transported with wheels retracted, it musf be supported in a wide-area, well shaped rests below cockpit back spar and close to the tail wheel.

It is recommended to transport the horizontal tail surface in well shaped supports.

All supports should be covered by soft material (i.e. carpet) to protect the high quality a/c surfaces and components.

- Road transport: see manual for trailer.

8.5 Cleaning and Care

The surface of plastic-aircraft should be maintained in spite of sturdiness and strength. For cleaning and maintenance following procedures should be noticed (for additional information refer to maintenance manual):

- Surfaces should be cleaned periodically with clear water, sponge and skin cloth, especially nose areas of wing and empennage, if possible after each flight; to remove mosquitoes, insects and dirt catapulted by propeller, special mosquito-sponges are recommended;
- Keep pitot and static ports clean of dirt and water, control water drain holes regularly;
- Do not use cleaning additives too often;
- Polishing medium free of silicon can be used;
- Fuel and alcohol may be used temporarily; it is not recommended to use any dilution liquid; never use chlorinated hydrocarbon (Tri, Tetra, Per a.m.)!
- Best method to polish surfaces is to use a buffing machine in greater periods (approx. every ½ year).

WARNING: Before starting to work with a buffing machine, handling should be explained by a specialist. Wrong direction of turning of buffing wheel can result in heavy damage especially at the sensitive trailing edges of wings and tail surfaces. Never hold buffing machine too long at one point - this will heat up the area and can damage surface and structure!

- Canopy can be cleaned preferably with special cleaning fluid for plexi-glass but also with pure water. Never rub dry on plexi-glass, use a wet, clean, soft skin cloth!
- The a/c should be protected against moisture; if water penetrated parts of the a/c, it should be stored in a dry environment and components should periodically be turned around.
- It is suggested not to store the a/c outside unnecessarily, since the paint can get brittle and crack due to UV radiation.

WARNING: Composite structure, exposed to sun radiation, must have a white surface, except for identification, caution and warning markings. Other colors than white may result in excessive heating up of surface and structure, which could reduce structural strength of components.

8.6 Engine - Troubleshooting

WARNING: Only qualified mechanics, trained for this engine, are authorized for engine-repair or maintenance. If following procedures are unsuccessful, an authorized service station should be consulted. The engine must not be operated before repair.

No engine starting:

• Propeller-dome	LOCK propeller-dome
• Fire-cock	OPEN fire-cock
• Fuel-quantity	CHECK and REFUEL
• Starter RPM too low	CHECK battery voltage
• Engine too cold	PREHEAT engine, use high quality engine oil, allow starter to cool down after prolonged operation

Rough engine running after warm-up:

• Choke	CLOSE choke, check mechanism

Oil pressure too low:

• Oil quantity	CHECK, refill if required

Engine firing after shut-down:

• Engine overheated	COOL-DOWN at about 2000 RPM

Oil quantity increasing:

• Oil temperature too low	ADJUST cowl flaps for normal oil temperatures in flight

Engine knocks when loaded

• Fuel quality	REFUEL with higher antiknocking rating or higher octane number

Problems at cold environment:

• Starter RPM too low	PREHEAT engine
• Battery voltage low	INSTALL a fully charged battery or
·	CONNECT suitable external power source
• Oil pressure high	NORMAL up to 101 psi / 7 bar or when cold
·	CHANGE oil if necessary
• Oil pressure low after cold start?	SHUT-DOWN engine and PREWARM oil (viscosity is too high in suction-line at low temperature)

STEMME USA, Inc.
1401 S. Brentwood Blvd. Suite 760
St. Louis, Missouri 63144

314.7215904 Phone 314.726.5114 Fax

www.stemme.com