CANARD PUSHER

JANUARY 2000 RUTAN AIRCRAFT FACTORY VOL 16, ISSUE 1, NO. 99

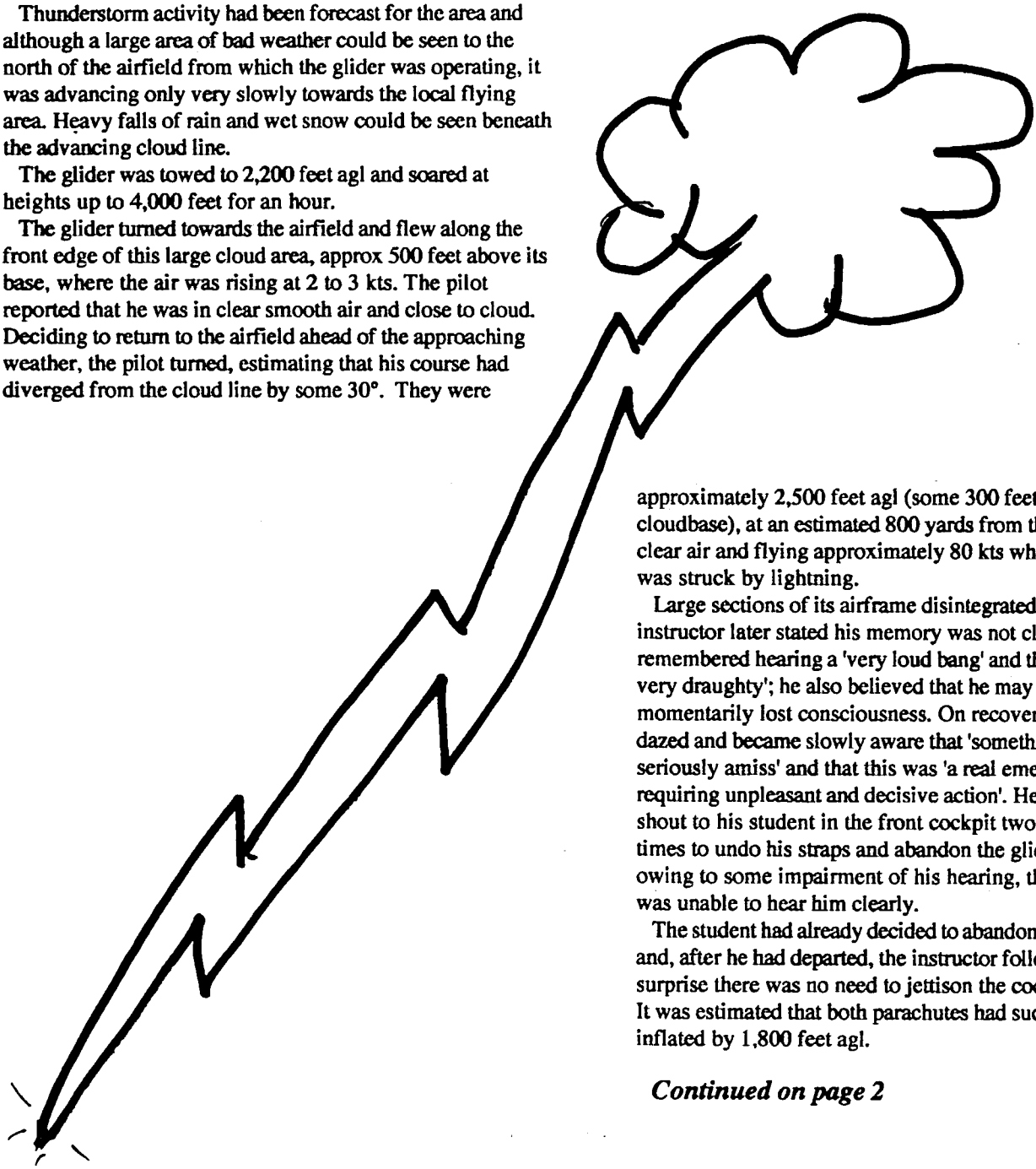
Lightning Strike Report

17 April 1999 at 1609 hrs — A Schleicher ASK 21 two seat glider, operating from a gliding site at Dunstable, Bedfordshire, was being used for a one day training course. At the time of the accident the glider was undertaking the last intended flight of the day for one of two students on that course. Both instructor and student were wearing parachutes and the student had been briefed on the use of his parachute and how to abandon the glider should this be necessary.

Thunderstorm activity had been forecast for the area and although a large area of bad weather could be seen to the north of the airfield from which the glider was operating, it was advancing only very slowly towards the local flying area. Heavy falls of rain and wet snow could be seen beneath the advancing cloud line.

The glider was towed to 2,200 feet agl and soared at heights up to 4,000 feet for an hour.

The glider turned towards the airfield and flew along the front edge of this large cloud area, approx 500 feet above its base, where the air was rising at 2 to 3 kts. The pilot reported that he was in clear smooth air and close to cloud. Deciding to return to the airfield ahead of the approaching weather, the pilot turned, estimating that his course had diverged from the cloud line by some 30°. They were



approximately 2,500 feet agl (some 300 feet above the cloudbase), at an estimated 800 yards from the cloud in clear air and flying approximately 80 kts when the glider was struck by lightning.

Large sections of its airframe disintegrated. The instructor later stated his memory was not clear. He remembered hearing a 'very loud bang' and then 'feeling very draughty'; he also believed that he may have momentarily lost consciousness. On recovering, he felt dazed and became slowly aware that 'something was seriously amiss' and that this was 'a real emergency requiring unpleasant and decisive action'. He was able to shout to his student in the front cockpit two or three times to undo his straps and abandon the glider but, owing to some impairment of his hearing, the student was unable to hear him clearly.

The student had already decided to abandon the glider and, after he had departed, the instructor followed. To his surprise there was no need to jettison the cockpit canopy. It was estimated that both parachutes had successfully inflated by 1,800 feet agl.

Continued on page 2

BRIEFS

You can find a great Canard Web Site at the following URL:

http://www.canard.com

The site includes a form for getting on the e-mail list for the canard-aviators discussion group, which is intended solely for the use of canard aircraft builders and flyers. The messages are monitored to keep the volume and quality under reasonable control. Problems are posed, advice is offered and occasionally product sources are mentioned. There is no mechanism for summary or for reaching conclusions, which are left as an exercise for the reader! There is also a lot very expert advice, on new epoxies for example, including user trials, tribulations and very often successes. All in all its a valuable resource for the canard builder.

Reported by the San Diego EZ Squadron.

The Canard Pusher
is published quarterly
(January, April, July, October)
by Rutan Aircraft Factory, Inc.
1654 Flightline, Mojave, CA 93501
Editor: Mike Melvill
Publisher: Tonya Rutan

U.S. & Canadian subscriptions
$14; Back issues $3.50
Overseas (Airmail) subscriptions
$16; Back issues $4

RAF is no longer accepting multi-year subscriptions. Please renew only after your current subscription has expired.

If you are building a RAF design, you must have the following newsletters:

VariViggen (1st Ed)
CP 1 to current
VariViggen (2nd Ed)
CP 18 to current
VariEze (1st Ed)
CP 10 to current
VariEze (2nd Ed)
CP 16 to current
Long-EZ
CP 24 to current
Solitaire
CP 37 to current
Defiant
CP 41 to current

A current subscription of the Canard Pusher is mandatory for builders, as it is the only formal means to distribute mandatory changes.

RAF HOURS: Rutan Aircraft is officially open every Wednesday. Please call between 10 am - 2 pm (661) 824-2645 and give your name, serial number and nature of the problem. If you are not in an emergency situation, we ask that you write to Mike.
Note — Sometimes you can catch Tonya at RAF Monday thru Friday. She is in and out. Try and try again.
When writing to RAF, send along a stamped, self addressed envelope, if you have builder's questions that need to be answered. Please put your name and address on the back of any photos you send.

RAF ADDRESS
1654 Flightline, Mojave, CA 93501

RAF PHONE NUMBER
(661) 824-2645

RAF FAX NUMBER
(661) 824-3880

RAF EMAIL ADDRESS
raf@hughes.net

Lightning Strike continued

All witnesses reported the flash of lightning occurred simultaneously with an extremely 'loud crack' and many of these, including one police officer in the centre of the nearby town (Dunstable), expressed the view that it was probably the loudest sound they could remember hearing. It was also recollected by many that this had been the first lightning flash of a series of discharges which had then occurred in that area over a period of some 15 minutes. The lightning strike was witnessed by a few people in the area, but many more saw its immediate aftermath with large items of falling debris, two inflated parachutes, the fuselage descending vertically at high speed and a ball of smoke and fine debris next to the cloud where the glider had been struck.

Apart from the damage to the hearing of both occupants, 'sooting' to the upper part of the instructor's jacket, parachute pack and the hair on the back of his head, neither suffered any major injuries as a result of the lightning strike.

Glider description — The Schleicher ASK 21 was a tandem two seat closed cockpit sailplane constructed almost entirely of glass reinforced plastic (GRP), with foam or honeycomb filled sections bonded together. These materials are electrically non-conductive. It was of conventional layout for a sailplane with a 'T' tail. The ASK 21 has a wing span of 17 metres, a maximum glide ratio of 1:32 and a maximum all up weight of 1,320 lb. The wing skins were fabricated from two thin layers of GRP sheet bonded to a rigid foam core and were bonded together along their leading and trailing edges. Whilst the rear wing spar section was simply formed from several layers of GRP, the main spar was more complex. The web of the main spar was constructed in a similar manner to the wing skins and was capped top and bottom with unidirectional GRP tapered sections from root to tip. The elevator, both ailerons and the two airbrake surfaces were all manually operated from the two cockpits by a series of metal levers, push/pull rods and bellcranks. The rudder was connected to the pedals in the cockpits by steel cables.

In common with most sailplanes, there was no designed-in protection against lightning strikes. Since manufacture in 1985, ASK 21 GBP had flown for a total of some 4,000 hours during some 28,000 flights.

Weather — The general synoptic situation was given as a double centred low heading east across France which maintained a light, unstable and mainly northerly flow across southern Britain that was expected to 'back' steadily during the afternoon. Warnings of severe turbulence, lightning and hail were issued in the vicinity of cumulonimbus (Cb) clouds. Cloud cover for the afternoon was forecast as 4 to 6/8 cumulus (Cu) formations, base 2,500 feet with tops in excess of 10,000 feet by midday, giving scattered showers and becoming 5 to 7/8 stratocumulus (Sc) with embedded Cb during early afternoon.

At the take off time cumulus clouds in the area had not greatly developed and were spaced approximately 2 to 3 miles apart in an otherwise clear sky.

Lightning discharge recordings — EA Technology Limited, a company which specialises in the monitoring and recording of lightning discharges in and around the UK, was commissioned by the AAIB to supply discharge data for an area of 25 km radius centerd near the location of the fuselage wreckage for the period between 1700 and 1720 hrs local on the day of this accident. Of the 15 associated discharges recorded, 10 were identified as being of positive polarity, 2 were of negative polarity and 3 were undetermined. Of the 10 positive discharges, 8 were recorded to have been in excess of 80 kiloAmps (kA). The first recorded discharge occurred at 1708 hrs and 57.5 seconds; this was a positive discharge in excess of 80kA, the location of which was the closest to the accident site.

Wreckage distribution —It was readily apparent that almost all of the right wing, the outer section of the left wing and the center part of the fuselage had detached in flight. Much of this wreckage was recovered from an area downwind from the estimated position of the strike. The main spar pinned joint had remained connected and was easily disassembled prior to re-covery of the wreckage to the AAIB facility at Farnborough.

Structure examination — Most of the glider's structure was recovered, with the notable exception of the ailerons where only the outboard section of the left aileron was found. There were four main areas of the glider's structure which had either fragmented, or had been directly affected by internal overpressure and these were also characterised by heavy soot deposits and some metal spatter. They were the fuselage center section, the right wing tip and the areas aft of the main spar at the inboard end of both ailerons.

Sooting was also present along the forward side of the bond line between the right wing tip and the aileron bellcrank bracket attachment bolts. Most bonded joints within the wings, and the bonded seams in the center of the fuselage, had separated along the adhesive lines. Both cockpit canopy frames had remained securely attached to the fuselage, but all transparency material had fragmented at the time of the strike.

Additional damage had occurred to the cockpit and tail section during ground impact. There was no evidence to indicate that any lightning current had passed along the fuselage.

Flying controls — All flying control system components in the glider were manufactured from steel or aluminium alloy. Steel generally has a higher value of resistivity and lower values of specific heat and conductivity than aluminium, and therefore for a given current density it is likely to sustain more localised damage from Joule heating.

Continued on page 8

REPORT FROM DICK RUTAN

Brake and Starter Solenoid Recommendations

Dick Rutan reports that he has been fighting a severe main gear "walk" or shimmy any time he uses his brakes while taxiing or slowing down after landing. He has been using the heavy duty Cleveland brakes for many years and the shimmy problem has slowly been getting more pronounced. He has even tried machining the brake discs, which helped for a while, but it got bad enough recently that he literally could not fly "old Blue."

Dick was aware that Mike had installed Matco dual caliper brakes on his own Long-EZ some years ago, so he obtained the part numbers and information from Mike, and ordered a set from Aircraft Spruce. Dick has been flying with his new brakes for a couple of months now and tells us that his problem has been completely cured, and that he is very happy with the performance of the brakes.

The Matco wheels are a little narrower than the Clevelands although they do perfectly fit the popular "Lamb" size tires (11.400 by 5). If you use the Matco axles, your wheel pants can actually be slightly narrower (lower drag!) If you use your existing Cleveland axles, they are a bit longer than the Matco axles and a special spacer is required. This spacer will fit in the space between the outboard wheel bearing and the axle nut. You must measure the width of the spacer you will need, and give Phil Mattingly a call at 801-486-7574. He will send them to you at no charge.

The Matco part number for the wheel and brake assembly is: W5OLD. The "D" on the end stands for "dual caliper". Aircraft Spruce has no specific part number for the "W5OLD" but you can use their 06-01860-catalog part number with a special note to include the "D" for the dual calipers.

The Matco brake Pads (4 of them) should give 3-4 times more service and the discs may outlast the aircraft! If you have main gear shimmy while breaking, this should fix the problem. The Matco brakes have a whole lot more parts to them and it's fun getting them all put together. If Dick can do it anyone can! MATCO brakes are RECOMMENDED.

Another suggestion along with the brakes is that ALL EZ's should replace the plastic brake lines. Dick changed his 5 years ago when the Nylaflow tubing broke just by touching it. Use 1/8 inch Stainless Steel tubing which will slide inside the old plastic tubing on the gear legs. You will not even have to damage the paintwork on your gear leg to accomplish this. The 1/8 tubing works just fine for Dick on "Old Blue."

A safety suggestion reference the B&C starter:

On four different occasions my starter solenoid has frozen up and caused my starter to hang up (hung start). I sit there with no way to turn off my starter and the batteries begin to run down and start smoking. All I can do is scramble to find a tool to disconnect the batteries before they catch on fire. My solution was to install a switch in the short 2 inch pig tail lead (located right on the starter) between the built in solenoid and the starter power lead cable. I placed the switch on my instrument panel so that I can easily reach it while in the cockpit. This is also a great safety feature when I am working on the engine, as I can positively "safe" the starter, and It's a super safety back up to a hung start. **Dick Rutan**

We sent a copy of this starter suggestion to B&C Specialties in Newton Kansas, and received this reply:

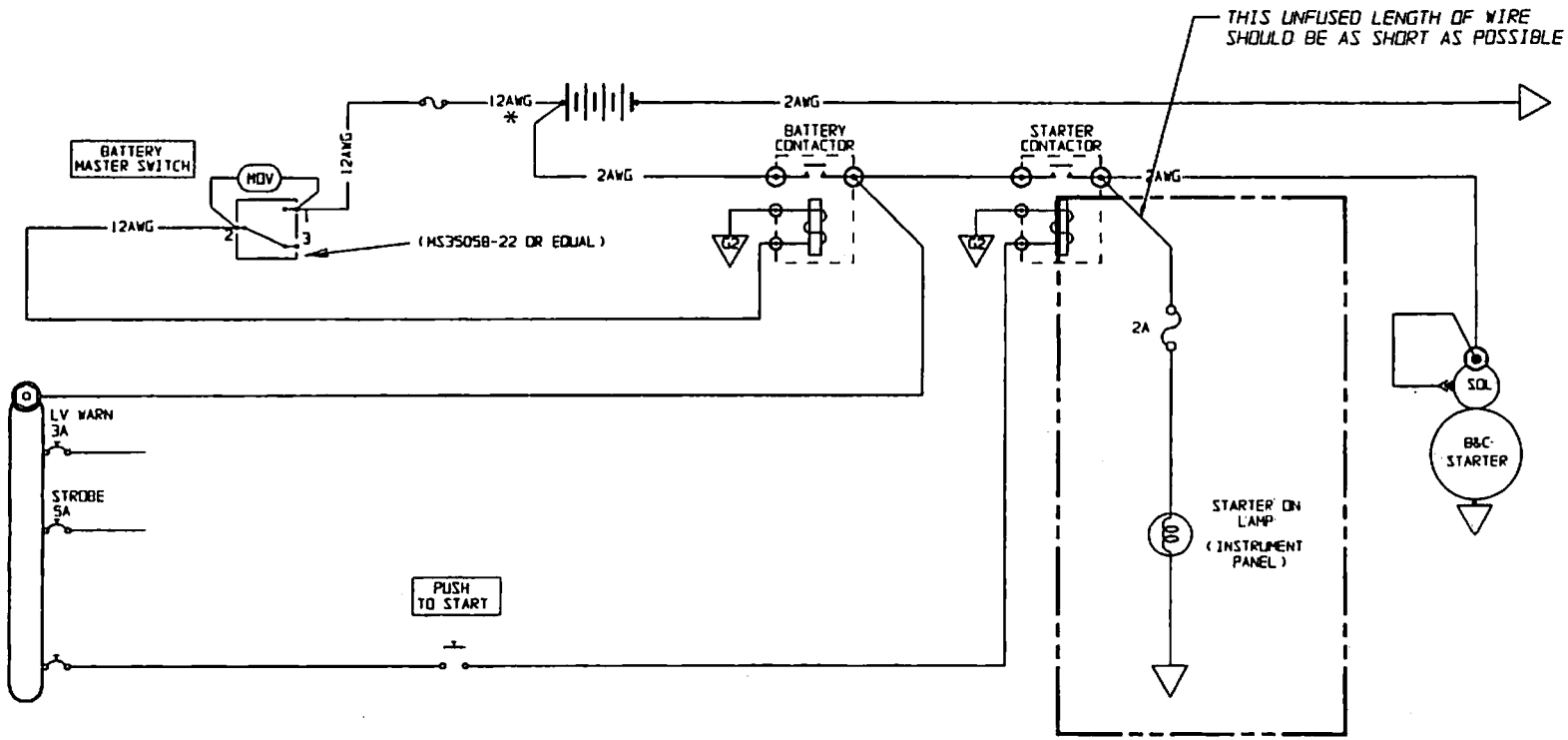
A stuck starter relay ("solenoid") may also be interrupted by the master contactor On most aircraft the correct action would be to simply turn off the Master switch in the described situation. If it is an aerobatic aircraft with a light electrical system that uses no master contactor but only a toggle type Master switch, the starter may be interrupted as Dick described by a second switch installed where the short pigtail would be. Keep in mind that the in-rush current on the starter actuator is approximately 30 amps. So, the additional switch should be rated at 30 amps.

Sometimes a pilot may not be able to detect a starter that is still engaged. We recommend a "Starter On" light to be installed on the instrument panel. A small in-line fuse holder may be installed near the switched side of the starter relay and wired through a lamp on the panel to a convenient ground. If the key switch, start button or starter relay sticks, or "G" forces close the starter relay during a high "G" maneuver, the pilot has a visual indication of starter engagement. We have a simple schematic that can be sent to you if you like. I hope this is of some help to you. If we can be of assistance in any way, let us know.

Tim Hedding Elec. Engr. At B&C

We did indeed receive a copy of the "starter on" light schematic described above, and we have included it in this CP. We believe that this is an excellent safety feature, and recommend incorporating it in your homebuilt.

SYMBOL	REVISION	DRAWN	APPRVD



NOTES:

1. A "STARTER ON" LAMP IS RECOMMENDED ON ALL STARTER INSTALLATIONS. THE LAMP WILL IDENTIFY A STUCK STARTER CONTACTOR OR START SWITCH BEFORE DAMAGE IS DONE.
2. THE UNFUSED WIRE LENGTH INDICATED IN THE DRAWING SHOULD BE KEPT TO LESS THAN 8 INCHES IF POSSIBLE AND BE TIED AWAY FROM CHAFE POINTS.
3. B&C SPECIALTY PRODUCTS HAS A SUITABLE CLEAR AMBER LAMP THAT CAN BE SEEN IN BRIGHT DAYLIGHT. IT IS AVAILABLE IN 14 OR 28 VOLTS.

ITEM	PART NO.	DESCRIPTION
-1		
USED ON		

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
DECIMAL 0.XX ± 0.03
DECIMAL 0.XXX ± 0.005
ANGLES ± 0.5 DEGREES

B & C Specialty Products
P.O. Box 8, Newton, Kansas 67114

	NAME	DATE
ENGINEER		
DRAWN	TH	12/30/99
CHECKED		
PROJECT		

TITLE: SCHEMATIC, STARTER ON LIGHT

DRAWING NO. ON_LITE | REVISION | DATE

SCALE FULL | JOB NO | PAGE 1 OF 1

RECEIVED FEB 2 2 2000

990114

Accident Report

Phil Collins, LongEz ser#1241 — I attended the fly-in at Rough River, KY in October and heard discussion regarding the importance of double checking aileron to wing clearance to insure 1/8" separation. A pilot discussed his experience with a smaller clearance. The controls functioned properly under normal conditions, but with aileron deflection at higher G loading the pilot experienced a repeatable condition where the ailerons could not be returned to neutral unless the aircraft was "unloaded" (backpressure released). I have no experience in understanding aircraft accidents, and less than 50 hours in ez's, but my first impression in reading the NTSB's report on a fatal Longez crash earlier this month is that aileron clearance may have been a factor. (The ATP rated pilot was apparently operating in a high G condition and stated he was unable to level the wings). The report is available online at:
http://www.ntsb.gov/aviation/IAD/00A003.htm

This aileron clearance issue was written up in a recent issue of the Central States newsletter. If not already published, please consider publishing an article in the CP on the aileron clearance issue.

Accident occurred OCT-17-99 at JEAN, NV Aircraft: MINTZ VARIEZE, registration: N86KM Injuries: 2 Uninjured. On October 17, 1999, at 0920 hours Pacific daylight time, an amateur-built Mintz Vari-eze, N86KM, landed in the desert short of runway 2L at the Jean, Nevada, airport, following a pilot reported rough running engine. The aircraft, constructed, owned, and operated by the pilot under 14 CFR Part 91 of the Federal Aviation Regulations, sustained substantial damage. The private pilot and one passenger, the sole occupants, were not injured. Visual meteorological conditions prevailed at the time of the accident and no flight plan was filed. The personal flight originated at the Jean airport about 0910 for a local area personal flight According to Federal Aviation Administration inspectors from the Las Vegas, Nevada, Flight Standards District Office, the pilot was giving rides as part of an Experimental Aircraft Association Discover Aviation program. The pilot departed runway 2L and was on a downwind departure when the engine began to run rough. The pilot turned toward the runway but had insufficient altitude and power to make the airport. The aircraft landed short of the runway in desert terrain and sustained substantial damage.

NTSB Identification: DEN00FA007 **Accident occurred OCT-18-99** at QUEMADO, NM: Aircraft: Gardner VARIEZE, registration: N13WM : Injuries: 1 Fatal.

This is preliminary information, subject to change, and may contain errors. Any errors in this report will be corrected when the final report has been completed.

On October 18, 1999, approximately 1010 mountain daylight time, a Gardner VariEze experimental homebuilt, N13WM, was destroyed when it nosed over during a forced landing following a loss of engine power while in cruise flight 20 miles southwest of Quemado, New Mexico. The private certificated instrument rated pilot was fatally injured.

Visual meteorological conditions prevailed, and no flight plan was filed for the personal cross-country flight being conducted under Title 14 CFR Part 91. The flight originated from St. Johns, Arizona, at an unknown time, with a final destination of McKinney, Texas. According to preliminary information, the pilot had recently purchased the aircraft in California, and was ferrying it back to his home town of McKinney, Texas. At 1001, the pilot contacted Albuquerque Air Route Traffic Control Center (ARTCC). He advised them that he was level at 13,500 feet mean sea level (msl) and that his aircraft was experiencing a rough running engine.

The pilot was asked what his exact location was, but he failed to acknowledge. He requested vectors to the closest airport. He was provided a discreet transponder code, but was never identified on radar. The last transmission ARTCC received from the pilot was at 1008.

A search of surrounding airports was initiated but unsuccessful. An ALNOT (alert notice) was issued at 1312, and the aircraft was located by a local rancher at 1400. The aircraft landed in a field heading on a southerly direction parallel to a forest road, then nosed over. According to a deputy with the Catron County Sheriff's Department, the weather conditions at the time were light winds and unlimited visibility.

NTSB Identification: IAD00FA003— Accident occurred **NOV-01-99** at REMINGTON, VA: Aircraft: Coughlin LONG-EZ, registration: N743TC : Injuries: 1 Fatal, 1 Serious.

This is preliminary information, subject to change, and may contain errors. Any errors in this report will be corrected when the final report has been completed.

On November 1, 1999, at 1530 eastern standard time, a homebuilt Long-EZ, N743TC, was destroyed during a collision with trees and terrain while maneuvering over the Rappahannock River, Remington, Virginia. The airplane was consumed by post-crash fire. The certificated airline transport (ATP) rated passenger was seriously injured, and the ATP rated pilot died as a result of his injuries on November 3, 1999.

Visual meteorological conditions prevailed for the personal flight that originated at the Culpeper Regional Airport (CJR), approximately 1515. No flight plan was filed for the flight conducted under 14 CFR Part 91.

In telephone interviews, two witnesses who were fishing in the Rappahannock River at the time of the accident described seeing the accident airplane earlier in the day and at the time of the accident. Both witnesses described the airplane's flight path from east to west over their heads and then returning from the

continued on pg 7

south over the river. The first witness said: "They flew over us. They were up fairly high heading [west]. They circled around and when they came back over the river he was making an extreme hard left to go back [west] and when I saw him, I could see the underbelly. The wings were at about a 60 or 70 degree angle and it sort of fluttered a little bit. "It looked like he was gonna make it but he hit the very, very, top of the trees. He just kept clipping off the tops. They were really big tall trees. There was no explosion, just a big 'woof' and a black cloud of smoke."

When questioned about the sound of the airplane's engine, the witness said: "The engine sounded fine. I commented to my son how good it sounded. The plane sounded outstanding. Good running, real smooth running machine."

The second witness provided a telephone interview, a written statement, and a diagram of the airplane's flight path. He said the airplane crossed over head from east to west and turned left over the woods on the west side of the river. The witness stated the airplane continued in a left turn and reappeared over the river, heading north towards his position. He said: "He banked down left into the river channel and never came out of his bank. He was flying about 200 to 250 feet then he banked it down into the river like the biplanes do. It was something around a 45-degree bank. Halfway between 90 degrees and zero. It was a fairly aggressive bank. I don't know where he lost control, whether it was over the trees or over the channel. He appeared to be back under control before he hit the trees; he just couldn't get the nose up. When he dove into the river, I didn't think anything of it. But he just didn't pull out. The pilot said, 'I don't understand. I just couldn't get it out of my bank."

When questioned about the sound of the airplane's engine, the second witness said: "I didn't notice any unusual sounds. If there was smoke, or a sputter, or a stall, I think I would have recognized it."

The wreckage was examined at the site on November 2, 1999, and all major components were accounted for at the scene. The wreckage path was oriented 210 degrees and measured approximately 460 feet from the initial point of tree contact to the main wreckage. The wreckage path was divided into one-foot increments called wreckage points (WP). The first tree contact (WP zero) was 60 feet west of the river's edge, approximately 45 feet above the ground. Structural foam, aircraft skin, and composite propeller fragments were scattered along the wreckage path from WP 160 to the main wreckage. The left rudder and the left winglet were at WP 220 and 235 respectively. Several angular cut branches were found along the wreckage path. The main wreckage came to rest upright, oriented 320 degrees, and was consumed by post-crash fire. An elliptical burn scar, approximately 90 feet long and 30 feet wide, surrounded the main wreckage. Trees inside the scar were burned to heights approximately 40 feet above the ground. The airframe, instruments, gauges, and controls were destroyed by fire. Power control cable continuity was established from the cockpit to the engine. Routing of flight control cables, push-pull tubes, and bellcranks was determined from the cockpit to the flight control surfaces. Control continuity could not be determined. Excessive deformation, melting, and complete destruction of components by fire was noted throughout the flight control system.

The engine was removed from the site and examined in a maintenance garage in Remington, Virginia, on November 2, 1999. The engine and its associated components were extensively damaged by fire. Impact and fire destroyed the accessory case. The composite propeller blades were fragmented and fire damaged. Impact and fire destroyed the oil sump and carburetor. The fragmented, melted accessory case and its associated components were removed from the back of engine to facilitate rotation of the internal components. The spark plugs were intact and the electrodes were tan and gray in color. The cylinders, pistons, and valves were examined by borescope. These components displayed uniform wear and no anomalies. The engine was rotated by hand and continuity was established throughout the powertrain and valvetrain. Compression was confirmed using the thumb method.

Examination of fuel records revealed that N743TC was serviced with 18.5 gallons of 100LL aviation fuel prior to the accident flight. The pilot's logbook and the airplane's maintenance records were not recovered. The pilot's most recent FederalAviation Administration (FAA) first class medical certificate was issued July 13, 1999.

The pilot reported 3,000 hours of flight experience on that date. The passenger's most recent FAA first class medical certificate was issued May 12, 1999. The pilot reported 2,400 hours of flight experience on that date. Weather reported at Manassas Regional Airport, 20 miles northeast of CJR, was clear skies with winds from 130 degrees at 9 knots.●

To report accidents and incidents

Call RAF
(661) 824-2645

Fax RAF
(661) 824-3880

Write RAF
1654 Flightline
Mojave, Ca 93501

Email RAF
raf@hughes.net

Letters

Bruce Vinnola — Several issues ago, The Canard Pusher Newsletter told of a method of using a squeegee and pure epoxy to fill pinholes. The CP also mentioned that epoxy weighs much less than primer. It was also told that Mike Melvill did not use primer on his Long EZ just an UV blocking polyurethane paint.

Well, I tried the squeegee process with some West System 105/205 epoxy and I love it!

For comparison I used poly fiber's Smooth Prime on the bottom of the fuselage, hard to apply, easy to sand and it took several coats to fill all the pits. I tried DuPont's gray primer on the top of the fuselage.

Easy to apply, easy to sand, looked like it filled the pits until I shot Centari enamel over it and then I saw some real serious pits, (Centari shrinks and levels, which makes you look like a good painter, but it also caved-in my primer covered pits). Filling pits with your topcoat is a [son-of-a-gun].

I painted my fuselage last year and now it's time to finish the flying surfaces. So here is the method I used: first, sand the micro to satisfaction then vacuum the micro to expose all of the pits, apply pure west systems epoxy (105/205) with a 10 inch drywall tool. Put it on as smooth as possible. Let it cure, about 4 hours, then add another coat. Then let that cure, then WET sand with 320. Wet sanding keeps the paper from clogging and actually removes lots of material. If the micro layer is smooth enough, one sanding session is all that is needed. But I found that with a nice shiny and smooth surface I could see imperfections I couldn't see before. But not a problem, sand smooth and apply more epoxy. The epoxy is a bit tougher to sand than Super fil, but it also makes a tougher surface.

I will never use primer to fill pinholes again, period. (I might include a primer for UV paranoia, but that's another issue.)

Well, it worked for me and I'm happy. Thanks to the Canard Pusher for the really great tip.

WEB SITES

National Transportation Safety Board Accident Reports

http://www.ntsb.gov/aviation/Accident.htm

Canard fliers website

http://www.ez.org/

Lightning Strike continued

From the examination, it was apparent that damage attributable to the lightning strike had only occurred within the aileron system, with evidence of differing degrees of damage present throughout this system. The adjacent airbrake operating mechanism in the wing and center fuselage, and the elevator and rudder mechanisms, had only been damaged by the in-flight break-up and impact with the ground. (The lack of lightning related damage, particularly to the airbrake operating mechanism, indicated that the strike was likely to have been of positive polarity).

As a result of these observations, only the aileron system was examined in detail.

Examination of the aileron system — The outermost item recovered was the steel bracket which supported the aileron bellcrank. This had remained attached to the spar, but the apex of this bracket, through which the pivot bolt fitted, was missing and it was clear that this had been severely affected by heat. This bracket was attached with three cadmium plated M6 steel bolts, which passed through a hard area on the spar. The bolt heads bore upon the bracket and were secured by nylon insert locknuts which themselves bore against thick steel washers onto the forward face of the spar.

Close examination of these nuts and washers revealed evidence of arc attachment and the lowermost of the three bolts had failed by becoming extremely hot and soft in the threaded region. Metallurgical examination determined that this section of the bolt had reached a temperature in the region of 1,000°C; it was thus apparent that this bolt had experienced a high Action Integral.

The bellcrank and the outer articulation rod were not recovered but most of the long center rod, which was made from an aluminium alloy tube of 16 mm outside diameter and 1 mm wall thickness, was recovered in one section. This tube had suffered burning and arc erosion at each end close to its jointed connections, which were missing, and it exhibited an unusual form of damage over its entire length. It had 'collapsed' as a result of the intense magnetic field generated by the conduction of the lightning current, to form an almost solid irregularly shaped 'bar'.

Metallurgical examination indicated that the temperature of the rod was unlikely to have risen much above 200°C, and that the folds in the tube wall had retained their original thickness. There was an absence of sooting in this middle section of the right wing, indicating that no arc formation had occurred and therefore that this deformed control rod had probably conducted all of the lightning current.

The right inboard articulating rod was missing, but both fuselage mounted bellcranks had remained attached to their support brackets.

Continued on page 9

Lightning Strike continued

However it was notable that both of these bellcranks had been deformed in an identical fashion, but not by ground impact. Both bellcranks also had missing Hotellier 'balls' and both self aligning ball bearings were burnt out. The pivot bearings in these bellcranks were undamaged. The two vertical push rods connected between these bellcranks and the crossbeam were also missing, as were the two fork ends of the crossbeam itself, where there was evidence of severe heating and softening/melting of the steel. There was some evidence to indicate that the two vertical rods had been forced outwards, inducing damage to the edges of two holes in the structure through which they had passed.

Continued on page 10

Such repelling of adjacent conductors in which high currents flow, in opposite directions, is characteristic and a similar mechanism was also considered responsible for the deformation of the two bellcranks described above.

Although there was no evidence of lightning attachment elsewhere in the center fuselage, the long center rod in the left wingdid not exhibit the same damage characteristics as its partner from the right wing. The remnants of the inboard joint remained attached to this rod, although it had been severely heated, but over most of its length it had suffered damage only from the wing structural failure and ground impact. However towards the burnt and eroded outboard end, indications of collapse were present.

The last components examined in this system were the left aileron bellcrank and its support bracket, to which it had remained attached. These were only slightly heat damage, but the self aligning ball bearings at the ends of the two arms were both missing.

Previous accidents involving lightning — The most recent known severe lightning strike to a glider in the UK occurred to a LS-4 glider on 31 July 1988. Despite receiving a shock from the control column, the pilot managed to land the glider. There was severe delamination of the left wing tip and aileron, and delamination of the elevator trailing edge. The right wing tip had many holes of several mm in length present in the surface. The exam-ination of that glider concluded that the lightning discharge had traversed through the glider, wing tip to wing tip, and that arcs had formed within the wing. The explosive forces generated by these arcs were sufficient to cause the delam-inations.

Mechanism of this strike — The evidence of damage caused by this lightning strike, and the recorded lightning data, indicated that it had been a positive polarity strike of high magnitude which had entered the glider at the left aileron actuator rod and exited via the tip region of the right wing and the right aileron actuator rod. It was considered likely that in the right wing a junction leader had propagated outboard from the nuts of the three bolts attaching the aileron bellcrank support bracket mounted on the rear of the main spar. This junction leader had tracked along the intersection of the forward face of the rear spar and lower wing skin before puncturing and exiting through the upper wing skin, near the tip. (A similar scenario had occurred in the previously mentioned strike to the at GRP glider on 31 July 1988, but at a much lower energy level).

It is known that for even moderate lightning strikes of, for example, 20 kA that overpressures of several atmospheres occur near to the arc. It was also considered likely that a leader had exited from the aft end of the right aileron actuator rod, but since this rod was not recovered this could not be directly confirmed. However, given the extent and similarity of structural damage to that on the left wing, aft of the spar, the available evidence suggested that a leader had in fact emanated from the end of this rod and that at least part of the return stroke attached at that point. The enclosed arc within the wing structure between the three bolts and the tip area, produced by part of the return stroke, would have produced a combined shock/overpressure which appeared to have failed the bonded joints and shattered the upper wing skin local to the wing tip.

Slipstream effects were also considered to have generally assisted the structural disintegration once the process of delamination had begun.

Between the aileron actuator rods in the right and left wings, the interconnected linkages of the aileron control system provided a continuous conductive path, albeit with various joints and connections of higher resistance/impedance than the rods or bellcranks. All of these joints had been seriously damaged or destroyed. Although these linkages could have survived a strike of much lower energy (as in the 1988 event), the forces induced by the intense magnetic fields associated with the high currents in this strike had forced apart and distorted many components and were responsible for the remarkable 'crushing' phenomenon apparent on the aileron center push rod over its entire length in the right wing.

The subsequent arcs which formed in the opened gaps in the aileron linkage, all of which were associated with joints in the system, had resulted in shocks, overpressures and consequent adhesive bond and material failures throughout the wings and center fuselage. Both canopy transparencies had been blown out by the same overpressure pulse, which destroyed the fuselage central structure, the blast travelling forward from that area to impinge upon the instructor's head and upper parts of his jacket and parachute.

The break-up of the left wing was less complete than the right, although delamination of the inboard wing had occurred from overpressures generated in similar locations to that on the right wing. The tip region was different to the right wing in that there was no evidence of arcing outboard of the aileron actuator rod and this region appeared to have delaminated in large sections as a result of the overpressure generated in the area of this rod.

Tests and calculations — Because of the few conductive paths within the right wing of this glider which exhibited distinctive signs of lightning damage, and the lack of arc tracking evidence (sooting), it was possible to be

Continued on page 10

SOUTH ATLANTIC FLIGHT 1998

A Diary by Hans Georg Schmid

Part IV

DAY 12, MO 16NOV98: Porto Alegre/Brazil
At AEROMOT **Claudio Viana,** my host for the day, showed me his operation and provided a mechanic who helped me do the 50 H inspection on my aircraft. AEROMOT is a customer of UNISON Industries, the world's leading manufacturer of ignition systems. Otto Oppliger, Vice President Marketing of UNISON, who actively sponsored my flight, met me when I landed in Porto Alegre.
I worked on my plane in the morning to have as much completed as possible, before Claudio Viana invited me to a lunch with about twenty guests in honour of my flight.
Later that afternoon I completed my inspection. **Eng. Sergio Bica Jr.** of AEROMOT was present the whole day and whenever he felt I was in need of something, he was immediately at my disposal. Next on the agenda was, at 1730, an invitation by VARIG for a visit of their aviation museum with cocktails. It was a very interesting visit to this small museum with lots of unique memorabilia.

DAY 13, TU 17NOV98: Porto Alegre/Brazil – Buenos Aires/Argentina (04:20 H)
At 0600 I was up again. Surprise at the reception desk: the hotel charged double the price for 24-hour laundry turnaround. The price was almost the same as when I bought the clothes.
Arriving at 0700 at the airport I had the help an AEROMOT test pilot. Without going into details we needed almost two and a half hours to file the flight plan and to pass immigration. They asked for double the landing fee (US$ 180) stating INFRAERO in Rio was not correct in lowering their fee. Immigration did not want me to leave the country stating they needed prior notice of 24 hours. This was in every respect, the worst in red tape I had seen worldwide in almost 30 years of flying!
At long last I was able to say farewell to my new friends at AEROMOT. Under a gray sky I flew at around 1000 ft towards Uruguay. There was a stationary cold front between Argentina and Brazil but nobody could tell me how active the front was and whether I would have a chance to pass beneath it. It was "look and see" again. Soon the small widely scattered towns looked very poor, the villages even more so. Most of the roads consisted of packed earth, the houses appeared to be in poor shape. In sharp contrast were those few haciendas I overflew, which had fine white gleaming buildings with barns and smaller houses besides, where the wealth of the owners was visible from far away.
An hour before approaching the border of Uruguay, the weather turned really nasty. The cloud base was very low, there was drizzle and in marginal VFR I continued to the south, again often as low as 100 ft, fighting against a headwind of 25 knots. The terrain was flat and almost at sea level and it was always possible to turn back or to proceed along the shore. With the help of my two GPS I always knew exactly where I was, as the ONC-maps were absolutely useless. Still over Brazil, I crossed large herds of sheep, cattle and horses which scattered in panic as I crossed overhead, otherwise it was empty everywhere. The main danger was the many large birds that always seemed to fly at the same altitude and directly in front of me.
After battling for almost two hours, the weather over Uruguay started to improve slowly. The green, wet and windswept flats and later the hilly country were empty with very few signs of life. Between showers I passed about 100 NM to the north of Montevideo on a direct track to Buenos Aires. I landed at the busy general aviation airport of Don Torcuato in sunshine after a demanding flight of four hours and twenty minutes.
SWISSAIR's station manager **Hugo Schreier** was expecting me together with his wife and his mother-in-law and I received a warm welcome. After he left for work, I met **Diego Cersosino**, a local captain on a LET-410. He was off duty this afternoon and he organized accommodations at **TIMEN-Aviation** for me, a local fixed base operator. Thereafter he offered a comprehensive city tour of Buenos Aires.

Continued on page 11

Lightning Strike continued

confident that the crushed control rod from the aileron control system in the mid section of the wing had experienced the entire current waveform of the strike. The failed bracket attachment bolt had clearly experienced a high Action Integral, but it was not certain that it had been subjected to the complete current waveform since its two partner bolts has also sustained arc damage, and it was also considered likely that a pro-portion of the lightning discharge had entered the bracket through the aileron actuator rod.

This failure should, therefore, have been an indicator of the minimum energy available and, by the testing of identical bolts and control tube sections to similar levels of damage, enable the energy of this strike to be quantified within upper and lower boundaries. Such tests to establish the action integral of the strike to GBP were carried out at three different lightning test establishments in the UK, USA and Germany.●