



**NEWSLETTER**

# Carb Heat

Hot Air and Flying Rumours

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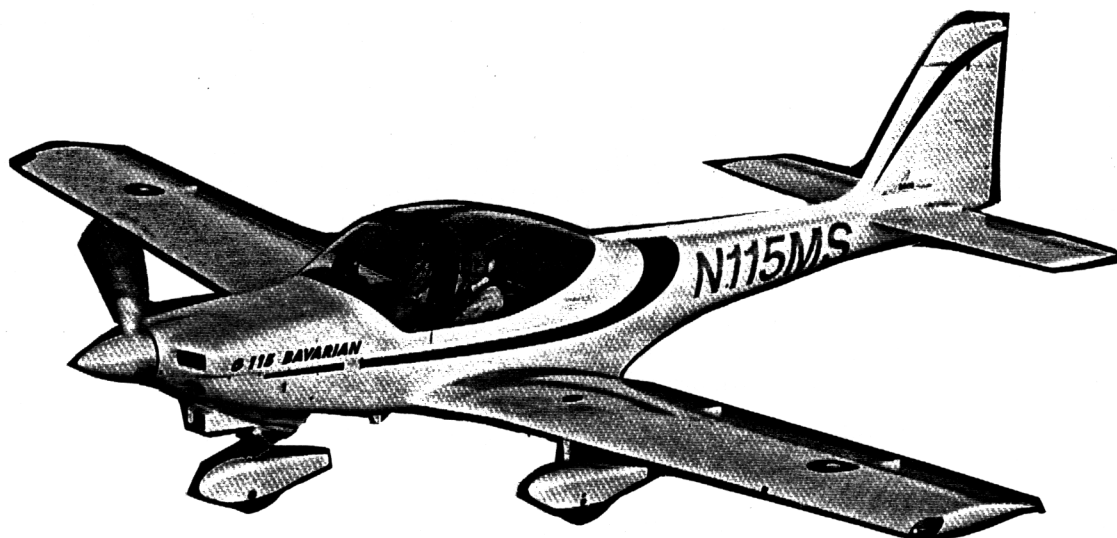
## October 1996

**Next Meeting: Thursday 17th October 2000hrs  
Bush Theatre  
National Aviation Museum**

**Program:** Annual General Meeting and election of officers  
Regular monthly business

**Inside:** Cruising the Aviation Internet by Barney deSchneider  
VHF NAV/COM basics by Tom Rogers, Ph.D. (trogers@avweb.com)

**Guest Speaker:** Introducing Ottawa Aviation Services new Grob  
advanced trainer by Larry Loretto



Grob

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This past weekend saw our first real cold snap, and frost on the wings early in the morning. This was enough to start the annual fall colour show, and things were certainly busy all weekend with an unusually large number of aviators airborne at all area airports.

### Carp Airport Status

Work continues on the Carp reconstruction; those who have been to the airport recently will know that the paving of the runway, and east end apron areas is complete. Saturday Oct 5th saw the runway and taxiway centrelines painted. The paving for the west end taxiway to WestAir remains to be done as does installation of the runway and taxiway lighting systems, along with final grading.

A special **thank you** to **Jim Bradley**, who happened to catch the contractor simply burying our drainage pipe, rather than properly connecting it to the airport drainage system. Jim's persistence resulted in the pipe being properly connected, so hopefully our drainage will remain excellent, and we will suffer a minimum of downtime next spring.

While I have no official opening date, it looks like the end of October, so we may enjoy the new runway for a couple of weeks, before winter puts a crimp in our flying activities.

### Taxiway Project.

I must apologize for falsely raising hopes about paved taxiways on our property as reported in the last newsletter. I was completely out to lunch on two accounts.

The first miscalculation was misreading the initial indication of support from the West Carleton Airport Authority.

There was a 180 degree reversal of position less than 48 hours prior to the meeting where I expected to receive approval. This seems to be due to a continued back room lobbying effort from one of the commercial tenants, who would prefer to see us relocated elsewhere on the airport. Rumour has it that their name starts with H. At least now we have a clearer idea of the white hats vs. the black hats, and the source of the relocation nonsense. Sad to say this same organization purports to represent the tenant's interests, but that clearly doesn't include us. On top of the back room politics, the ownership status of the airport is still completely up in the air. This means that neither WCAA nor Transport Canada are prepared to re-negotiate our lease which expires in October, so we will remain in limbo for the near future at least. None of this uncertainty is likely to have any real effect in the longer term, other than the certainty that our costs will increase as has been noted previously.

The second major miscalculation was on the actual cost of the paving job. The quote I received from Karson, was 2.5 times my original estimate; an estimate based on 25% above the region's cost on the job. It is clear Karson either don't want small jobs, or think we are rolling in dough.

The silver lining in all of this is that it has got the creative juices flowing a bit, and Dick Moore has come up with the suggestion of soil cement. This technology, which was originally developed for third world economies, seems an almost ideal fit for our cash challenged, long on sweat

equity situation. We will be looking more closely at this over the winter, so don't be surprised if we form another work party late spring next year.

### Recency Requirements

As noted in last month's COPA, and discussed at the last meeting, all of us must satisfy the Recency Requirements of the new CARs by December 1996. For most of us this means completing a self study, open book test of 35 questions, which was published in both the October COPA newsletter and the 4/96 issue of the Aviation Safety Letter you should have received by now. If you haven't been paying close attention to changes introduced in the AIP over the last while, this is your chance to atone for your sins.

### Oct. 17th Mtg. at NAM:

Our next meeting is Thursday October 17th at the **National Aviation Museum**, 8:00 PM start. Our featured speaker will be **Larry Lorretto** of Ottawa Aviation Services who will be introducing the new **Grob** advanced trainer that they will be offering unusual attitude training on (basic aerobatics to some of us). If the weather Gods, and the Transport Canada Certification Gods cooperate, we will also get to see the aircraft in person. Failing that we will try to reschedule to a Saturday or Sunday at Carp, once the new runway is opened. In addition, **Lorna DeBliquy** will fill us in on the status of the Canadian Precision Flight Team. I look forward to seeing you there.

Gary



## VHF Nav/Comm Basics

Ever wonder how a VOR receiver knows what radial you're on? How the localizer needle knows whether you're left or right of runway centerline? Or how much effect power output has on the range of your comm transmitter? AVweb's avionics editor takes you through the basics of the most taken-for-granted radios on your panel, your VHF comm and nav.

by Tom Rogers, Ph.D.  
(trogers@avweb.com)

### VHF Comm

Many years ago it was decided that civil aircraft communications radios would use the 118-137 MHz band, and would use amplitude modulation ("AM"). Like many other things in aviation, this has remained unchanged for many decades. It's a pity, because our air-ground communications would have much better audio quality if we could switch to frequency modulation ("FM") as the majority of commercial broadcast stations have. But it looks like we're stuck with AM for the foreseeable future.

In the old days our aircraft communication radios were limited to ninety channels spaced 200 KHz apart. As more channels were needed, the channel spacing was reduced. Modern aircraft comm radios have 760 channels spaced 25 KHz apart. These comm frequencies lie in the portion of the radio spectrum known

as "Very High Frequency" or VHF, defined as 30-300 Mhz. Military aircraft use a different band in the "Ultra High Frequency" or UHF spectrum (300-3000 Mhz).

### Power, range, and modulation

Frequently I hear a pilot say "I wish I had more power so I could talk to Center while on the ramp." General aviation comm radios transmit at a power output of 2 to 25 watts. In most cases, more power wouldn't help. VHF radios operate strictly line-of-sight. If Center can't hear your 5-watt radio because there's a hill in the way, 100 watts wouldn't do any better. Think about the ELT for a moment. It can send a signal to a satellite thousands of miles away on just one watt of power, because there's a clear line-of-sight. I figure anything over ten watts is a waste and is added load on the radio. Another thing to look for is the way the manufacturer measures power output. Some use phrases like PEP, RMS, average, etc. If you're attempting to compare the power output rating of two radios, make sure you're comparing apples with apples (e.g., PEP with PEP). The best way to improve the range of an aircraft comm radio is by installing a good antenna system. As with all radios, the antenna is the heart of the system and a poor one will do a poor job regardless of how good a radio you have. I recommend that if you're installing a new comm radio, you have the antenna system checked out also. Nothing worse than

paying \$4,000.00 for a new radio, only to find out that it performs no better than the old clunker you pulled out because the antenna is no good.

King makes a little gizmo that is installed between the antenna and the aircraft radio and permits you to plug in a handheld transceiver. When plugged in, the handheld uses the aircraft antenna for its antenna, providing greatly increased range. Normally, at seven thousand feet, you should be able to receive and transmit a range of around fifty miles. This is of course true only if it is line of sight and no big rocks like the Rockies or Sierras in the way.

### The receiver

Another important thing that must be set properly is the modulation level of the transceiver. Most radio manufacturers call for 90% modulation of the carrier by voice. If modulation is too low, your voice will sound weak; if too high, it will be badly distorted. This adjustment must be done by a shop with the proper testing equipment. Newer radios have build-in protection against overmodulation, but most older radios do not incorporate this feature. If you overmodulate the radio, your transmissions will be garbled, and may also interfere with adjacent channels.

The receiver portion of a comm radio is every bit as important as the transmitter. Receivers incorporate a "squench" circuit to eliminate background noise

when nobody is transmitting on the frequency. On most of the older comms, you manually adjusted a squelch knob until you heard the background noise, then backed it off slightly until the noise went away. Most of the newer comms have "auto-squelch" in which the squelch level is pre-set on the bench and the pilot simply has a switch to turn the squelch on or off. Most auto-squelch circuits are set to open at a signal strength of three microvolts (just in case you wanted to know). If the received signal is less than three microvolts, then you hear nothing. If the signal is greater than three microvolts, then you hear whatever is there.

**Reliability**

Older comm transceivers (particularly those from the vacuum tube era) have a high failure rate. The newer solid-state units like the King KX-155 and Narco MK-12D seldom fail. The older radios had crystals to determine the frequency in use. These get out of tolerance often and are expensive to replace. The newer radios use a synthesizer to select the desired frequency and are very reliable.

Many of us use "nav-comm" units that combine a VOR/LOC navigation receiver with a communications transceiver in a single chassis. Even though they share the same box, very few components are shared between the nav and comm sides. So if the nav receiver fails, the comm is still likely to be working...and vice-versa.

**VHF Nav**

The most used piece of navigation equipment in the world today is the VOR or "very-high-frequency omnidirectional range". They are around 800 VOR stations in use today in the U.S. The VOR operates from 108.00 to 117.950 Mhz which is in the VHF band like the comm is. This is good because VHF frequencies are relatively immune to static and interference, making them excellent for navigation. All VOR stations have a three letter identifier and some have voice weather.

The VOR station produces a radial pattern by transmitting a 30-Hz reference and a 30-Hz variable-phase signal. The nav receiver in the aircraft compares the phase of these two signals and figures out what radial from the station it is on. It then compares the computed radial to the radial that the pilot selected with the "omni bearing selector" (OBS) and deflects the "course deviation indicator" (CDI) needle to indicate any deviation between the desired radial and the actual one.

**How it works**

To understand how the receiver can tell what radial it is on, let me give you an analogy. Suppose you have a lighthouse that sends out a powerful light beam which rotates one full revolution each minute. Suppose also that the lighthouse has a strobe light on top which flashes precisely when the beam passes magnetic north. Now if you were flying in visual contact with the lighthouse, you could start a timer when you saw the strobe flash and stop it when

you saw the searchlight beam. The time difference between the two would always tell you what radial you were on relative to the lighthouse. If you saw the beam 15 seconds after the strobe, you'd know you were on the 090 radial from the lighthouse; if 30 seconds, you'd be on the 180 radial, and so forth.

The VOR station and receiver work exactly the same way, except that both the "beam" (variable signal) and "strobe" (reference signal) are replaced by radio signals, and the "beam" rotates 30 times a second. If the reference and variable signals are the same phase, then the nav receiver knows it's on the 360 degree radial. If the variable signal is 90 degrees out of phase with the reference signal, then the nav receiver knows it's on the 90 degree radial.

As with comms, the older nav receivers use crystals for selecting the correct frequency and these fail with age and are expensive to repair. The newer radios use a synthesizer for tuning and are very reliable.

**Localizers and glideslopes**  
Almost all VHF nav receivers handle localizers as well as VORs. The localizer is in the same band as the VOR, and uses certain channels in the lower portion of the nav band that are dedicated for that use. Localizers have four letter identifiers starting with "I" (for ILS).

The localizer beam is produced by two transmitters operating on the same frequency but modulated with different audio signals. The

transmitter on the left has 90 Hz signal on it and the right one has a 150 Hz on it. The two signals are carefully aligned so that they are of equal strength precisely on the extended runway centerline. If the aircraft is left of course, the 90 Hz signal is stronger than the 150 Hz signal, and the nav receiver deflects the CDI to show a "fly-right" indication. Conversely, if the aircraft is right of course, the 150 Hz signal is stronger than the 90 Hz signal, and the receiver produces a "fly-left" indication. Basically, that's all there is to it. Interestingly enough, although we're required to check and log the accuracy of our VOR receivers every 30 days for IFR operation, there's absolutely no regulation that requires the localizer or glideslope receivers to be checked...EVER! But I'd strongly suggest checking them at least once a year if you do IFR approaches. Can you imagine shooting an ILS in low weather and discovering that the indicator is three dots off? Most radio shops have a portable battery-powered checker that allows checking the VOR, LOC, and GS calibration right on the ramp in just a few minutes.

Tom Rogers is avionics editor for AVweb. Tom operates Avionics West, Inc., at Santa Maria, California, one of the finest radio shops on the West Coast. Tom is an instrument pilot, an FAA Designated Engineering Representative (DER) for avionics, and has a Ph.D. in nuclear physics.

(We're not sure why he got the doctorate, but we call him "Dr. Tom" and he seems to like that.) You can send Tom your avionics questions at [trogers@avweb.com](mailto:trogers@avweb.com).

Avionics West operates the on-line discount avionics store in the AVweb on-line shopping area. There you can purchase handheld radios such as the Garmin GPS-90, the Apollo Precedus and the ICOM IC-A22 at deep-discount prices...the lowest you'll find anywhere...while at the same time supporting continued free access to AVweb. If you're in the market for a handheld GPS or nav/comm, we'd sure be grateful for your business!

### THE INTERNET FOR FLYERS

by Barney de Schneider  
([schneid@magi.com](mailto:schneid@magi.com))

Recently I read an article in which science fiction author William Gibson, the person who coined the word 'Cyberspace' was quoted as saying that the World Wide Web "offers us the opportunity to waste time, to wander aimlessly, to daydream about the countless other lives, the other people, on the far sides...". He goes on to say that it offers the added advantage that "people who see you doing it might even imagine you're working." Perhaps this explains the incredible rate at which we see people rushing to get on the 'Net'. Or, is there really some value out there for pilots like ourselves

that goes beyond daydreaming?

Our household joined the fray about six months ago, in what seemed like the next logical step after a few years on the National Capital FreeNet. We like it. We use it. We certainly waste some time 'surfing'. However, we also find it incredibly valuable at times.

For those of you who are not familiar with the Internet, the term "Information Highway" is a good descriptor. There are highways, superhighways, and sideroads for exchanging information. You put in the road from your home to the Internet by owning a computer with a modem and access to a phone line. You link up to the overall road system at a local interchange - known as an Internet Service Provider. There are many providers and, again using the analogy to roads, you should check with any perspective provider to ensure that they have adequate access. Is their 'road' to the superhighway a one-lane dirt trail or a highway capable of handling the peak traffic that occurs just about the time you want to use the system. Once you're on the Internet, anywhere in the participating world is within a few keystrokes.

So, what's in this for the Aviation community? Well, in short, 'the answer to almost any question you might have'. Finding the answer may take some time, but hopefully you get some help along the way so that your searching can be done as efficiently as possible.

This article is intended to provide some basic information, and I can assure you that there are always people on the net who seem to be dedicated to helping you find the answers you need. Remember, though, that the information you receive may be worth what you paid for it, so it's definitely a buyer beware environment.

In the paragraphs that follow, I will describe a few of the web sites that I have found. Rather than list the Internet address alongside each, I have provided a list of addresses at the end of the article.

As all pilots know, where aircraft are involved, the government regulators won't be far away. Both Transport Canada and the United States Federal Aviation Administration (FAA) have prominent and interesting sites.

Thinking of buying an aircraft? After having decided not to follow up on the dog-eared, fly-specked ad that has been prominently displayed for two years at the local flying club, and after having found nothing under '798' in the *The Citizen* ads for ages, and after reading the COPA ads for the month, where do you go next? Well, you could do some checking on the World Wide Web. Here are a few that have caught my eye. The first that comes to mind is *The Western Producer*. Having grown up on the Prairies, I knew this newspaper well and was aware of the fact that it remains probably the leading medium for advertising aircraft for sale in

British Columbia, Alberta, Saskatchewan, and Manitoba. In fact, Frank Hendriksen and I bought our Aeronca Chief in 1992 as a result of seeing an ad for it in *The Western Producer*. Gone are the days when you had to subscribe to the newspaper to see what's for sale. Just go to their web site and check out the latest ads. Locally, Steve Assaly, owner of C&S Enterprises in Hawksbury has a prominent site on the web selling new American Champion Aircraft as well as used planes. North Star, out of Toronto also has a site. Further afield, there are major web sites that support U.S. brokers. One good U.S. example is Aircraft Shopper On Line. The availability of information on aircraft for sale around the world certainly allows the buyer to ascertain if their local market prices are reasonable. With the prices of aircraft as high as they are, it is rational to shop a larger market for the best price.

Well, maybe the 'store-bought' aircraft are too expensive, too old, or both, and you want to shop for a kit and build your own. Many manufacturers are heavily into on-line advertising of their kits. They also provide invaluable services such as posted replies to frequently asked questions (FAQ) and an e-mail address; builders can send a message at two a.m. when they've finally given up guessing which one of the four different bolts, noted on different pages of their plans, really is the correct size. Send an e-mail and when you get home from work the next day, the

answer is waiting and you can get back to building.

Equally as prevalent as manufacturers are builders who have decided to share their experiences. Some go into great detail, including pictures, of their progress. You may want to do a bit of research into these if you have narrowed down the aircraft types that interest you. I've noticed that these people tend to identify problems they have encountered and this certainly can reduce problems for other builders.

For those of us with factory aircraft we are used to Type Clubs. While some must be excellent, I have to admit to being less than impressed with any of the three that support Aeronca aircraft. Much of this activity is now starting to migrate to the Internet. I have found a good site for Aeronca aircraft that is being supported by the owner of a 7AC. He continues to gather names of Aeronca owners and keeps an updated list of message traffic under various headings. It is wonderful to be able to mention a problem and have half a dozen suggestions within a day or so, all from people who own the same aircraft type. I find the information from our group to be quite reliable because membership is limited to owners and they tend to speak only when they have an intelligent answer or experience to convey. I have not done any real searching for other Type Clubs so I can't be much help there, other than to suggest that you simply type in your aircraft

type and then try the various Internet search engines to see what you can find. You should note that all search engines are not equal, so try a variety before giving up.

Whether you are an owner or a builder, there is always some new electronic instrument (aka gadget) that makes it over from the 'wants' to the 'needs' category. Complement your sifting through the ads in magazines with a bit of comparison shopping on-line. Interested in a new handheld GPS? Try 'The Handheld GPS Page' where the specifications of the various makes and models are posted, along with specifications for handheld Nav/Coms. Maybe you are the homebuilder who wants to also build the radio, intercom and headsets you will need - try RST. They provide an extensive line of electronic kits that will keep you occupied on those days

where the weather is unfit for flying. If you are simply looking for parts, many of the best known suppliers are on-line, including their detailed catalogues and an ordering capability. Univair and Aircraft Spruce and Specialty are good examples.

Well, finally the plane is bought or built. The gadgets are installed, and there's money left over for some flying - maybe that's what was referred to by the author Gibson as 'daydreaming'. Anyway, the world wide web can continue to assist you. Interested in knowing what the weather conditions are or will be? Try Environment Canada. If you are going cross-country maybe there is a community that you have thought about visiting but were never quite ambitious enough to write to for visitors information. In many cases, cities or one their citizens have taken the time to build a

web site about that community. For instance, many in the flying community have heard about Old Rhinebeck - Isn't that the place somewhere in the north-east U.S. where they have a bunch of old airplanes? Wonder no more. Visit their extensive web page and you will know where they are, what their activity schedule is for the year, and of course you can see pictures of some of their aircraft. Similarly, most aircraft museums including the beautiful new Warplane Heritage Museum have web pages. By investing a bit of time visiting the web site of attractions such as these you can quickly identify the dates of events that interest you and the exhibits that you most want to see. After all, who wants to travel all the way to Wally World only to find out it's closed for renovations?

## ADDRESSES

Transport Canada	<a href="http://www.tc.gc.ca">http://www.tc.gc.ca</a>
FAA	<a href="http://www.faa.gov/">http://www.faa.gov/</a>
Western Producer	<a href="http://www.producer.com/class/0400.html">http://www.producer.com/class/0400.html</a>
C&S Enterprises	<a href="http://www.cs-ent.ca/">http://www.cs-ent.ca/</a>
Aeronca Aviators	<a href="http://pulsar.westmont.edu/aeronca/">http://pulsar.westmont.edu/aeronca/</a>
Canadian Warplane Heritage	<a href="http://www.warplane.com/cwh.html">http://www.warplane.com/cwh.html</a>
HandiLinks™ to Aviation	<a href="http://www.ahandyguide.com/cat1/a/a257.htm">http://www.ahandyguide.com/cat1/a/a257.htm</a>
Aircraft Shopper Online	<a href="http://www.ahandyguide.com/cat1/a/a257.htm">http://www.ahandyguide.com/cat1/a/a257.htm</a>
San Jose State University	<a href="http://www.sjsu.edu/depts/aviation/index.html">http://www.sjsu.edu/depts/aviation/index.html</a>
North Star Aviation	<a href="http://www.toronto.com/flyer/">http://www.toronto.com/flyer/</a>
The Kit Fox Builder	<a href="http://home.navisoft.com/kitfoxbuilder/index.htm">http://home.navisoft.com/kitfoxbuilder/index.htm</a>
RST Engineering	<a href="http://www.rst-engr.com/">http://www.rst-engr.com/</a>
Univair	<a href="http://www.univair.com/index.html-ssi">http://www.univair.com/index.html-ssi</a>
The Glass Cockpit	<a href="http://rampages.onramp.net/~gcraze/">http://rampages.onramp.net/~gcraze/</a>
Hovan's RV Web Page	<a href="http://atlantis.austin.apple.com/people/pages/jhovan/home.html">http://atlantis.austin.apple.com/people/pages/jhovan/home.html</a>
Old Rhinebeck	<a href="http://www.mainstream.com/rhinebeck.html">http://www.mainstream.com/rhinebeck.html</a>
Links to Aviation Webservers	<a href="http://lpd700.lpd.supelec.fr:1999/herve/Links.html">http://lpd700.lpd.supelec.fr:1999/herve/Links.html</a>
Environment Canada	<a href="http://www.cmc.ec.gc.ca/indexe.html">http://www.cmc.ec.gc.ca/indexe.html</a>

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**ADS DEADLINE IS THE**  
**1<sup>st</sup> OF THE MONTH**  
**PLACE YOUR ADS BY PHONING ANDY**  
**AT 591-7622**  
**Classifieds Editor**

**CLASSIFIEDS**  
 08 October 1996

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**Propeller, McCauley 1B90-74-44**

Jim Robinson 830-4317 4/95

**OTHER**

**Services:**

**Oxygen/acetylene welding, brazing and silver soldering available from Lionel Robidoux, 195 Crestview Rd., Ottawa (613) 738-1066 (9/96)**

**CHAPTER CRESTS:**

Sew-on, \$6.50 each. Luc 744-5347

All kinds of aviation magazines going back some 30 years Ron MacMillan 837-6865

**Commercial ads**

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# GROB - TRAINING AIRCRAFT

On the 22nd of March 1987 the basic G 115 received type certification. Since then, the G 115 has proven itself worldwide and has become increasingly popular. This encouraged us to redesign the basic version and develop a new generation of training aircraft complying with all requirements of modern military and civil pilot training: the G 115 C, G 115 D and G 115 T. All of these aircraft have one thing in common, they are completely manufactured using composite materials with the known advantages such as: no corrosion, no material fatigue, high strength, high stiffness, high quality surface finish, low-cost, quick and easy accidental damage repairs.

The G 115 C can be powered by either a 160 HP Lycoming engine in combination with a fixed pitch propeller or by a more powerful 180 HP version and a constant speed propeller. Both versions are available with control wheel or stick.

The G 115 D is equipped with a 180 HP Lycoming engine with inverted flight fuel and lubrication systems. Furthermore a Hoffmann constant speed propeller

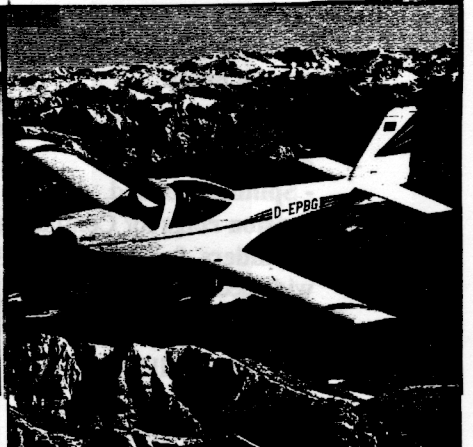
forms standard equipment. Due to its aerobatic capabilities, the G 115 D is the ideal follow-on to the G 115 C. If desired, the G 115 D may also be equipped with a 160 HP engine and a fixed pitch propeller. Both versions have a control stick installed.

The fully acrobatic capable G 115 T is the flagship of the 115-series. A 260 HP Lycoming engine ensures plenty of power under all flying conditions. The composite construction and the installation of a retractable landing gear provides greatly enhanced performances.

These three aircraft open a new era of professional pilot training. Please take a seat in the cockpit of one of the 115's - we are very certain you will enjoy both, the aircraft and the flight.



FORMATION  
NIGHT FLYING  
INSTRUMENTS  
NAVIGATION  
AEROBATIC TRAINING  
BASIC TRAINING  
AB-INITIO



Technical Data	
Lycoming engine	
Performance	HP
Propeller	
Control wheel (CW)/-stick (CS)	
Landing gear	
Wing span	m/ft
Overall length	m/ft
Height	m/ft
Max. take-off weight	kg/lbs
Payload	kg/lbs
Usable fuel capacity	ltr/U. S. gal
Wing loading max.	kg/m <sup>2</sup> /lbs/ft <sup>2</sup>
Max. horizontal speed	
MSL/ISA	kts/km/h
Cruise speed	
75 % , 5000 ft ISA	kts/km/h TAS
Rate of climb	
MSL/ISA, MTOW	ft/min
Stall speed	kts/km/h
Take-off run	
MSL/ISA, MTOW	m/ft
Take-off distance over 50 ft obstacle, MSL/ISA:MTOW	m/ft
Range at 45 % BHP	
5000 ft ISA, rsv = 45 min	km/nm
"g"-limits	—

AEIO-360-B1F 180	AEIO-320-D1B 160
Hoffmann 3-blade constant speed	Hoffmann 2-blade fixed pitch
CS	
fixed	
10.0/32.8	
7.6/24.9	
2.4/7.9	
920/2028 (990/2182)	
250/551 (320/705)	
142/37.5	
75.4/15.4 (81.1/16.6)	
136/252	131/243
121/224	118/219
1080	1020
48/88 (50/93)	49/91 (51/95)
215/705 (250/820)	305/1000 (340/1115)
370/1214 (450/1476)	503/1650 (570/1870)
760/410	1050/567
+6/-3 (+4.4/-1.76)	

O-320-D1A 160	O-360-A1F6 180
Sensenich 2-blade fixed pitch	Hartzell/McCauley 2-blade const. speed
CW (CS optional)	
fixed	
10.0/32.8	
7.53/24.7	
2.4/7.9	
990/2182	
320/705	
143/38	
81.1/16.6	
125/231	140/260
116/214	124/230
1020	1200
48/88	50/13
260/853	244/800
450/1476	439/1440
1030/556	780/421
+4.4/-1.76	