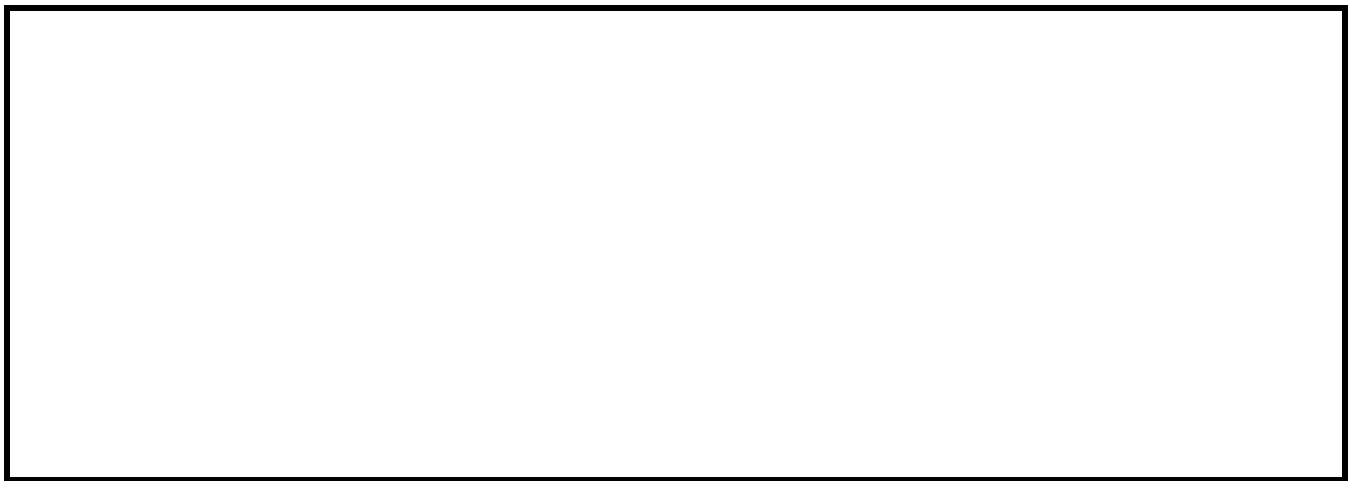
EAA CHAPTER 32 NEWS

Jim Bower, Editor

February, 2006

SPECIAL REPORT: IFR IN WINTER



Winter flying is a totally different animal. In our part of the country, we sometimes have very nice weather, giving us high visibility (no summer haze), great performance due to the denser air, and less sweat stains on the headsets. Unfortunately, this time of year often "blesses" us with inclement weather in the form of ice and snow.

Above is a photo of an unidentified all white aircraft flying IFR in whiteout conditions. This practice can sometimes lead to near-disaster, as experienced a few years ago by an RV-6A pilot whose carb intake screen was clogged with snow, leading to an engine stoppage and forced landing. Fortunately, nobody was injured and there was no damage to the aircraft. Not everyone is so lucky. As you can see, the pilot of the pictured aircraft is in a very unusual attitude, and may not have such a successful outcome.

To alleviate this happening to you, be sure to provide your newsletter editor with sufficient material to put in the newsletter so he doesn't make stuff up.

See you all at the ARC on Sunday, February 26 at 1:00 pm (social hour), or 2:00 pm (meeting)

EAA Chapter 32 Meeting Minutes
January 22, 2006

Turnout was good for the first meeting of 2006: around fifty people in attendance. Unfortunately our regular keeper of the minutes, Mr. Bower, was under the weather and could not make it. Therefore it fell to your new Vice President try and scribble down as much as possible. Food was good and disappeared quickly. The shiny new grill seems to work well on hotdogs. Mr. Bill provided mealtime entertainment with an Oshkosh 2005 DVD.

The meeting began at 2:00 with the Pledge of Allegiance. Karsten then briefed the group on the letter sent to Bryan Cave in response to their accusations towards Gale. An attorney is on retainer, and the motion was made to cover the fee. The motion passed.

Gale then spoke to the group regarding acquiring a bending brake. Several are available that used to belong to TWA, but now are in the posession of the city of St. Louis who is auctioning them off via silent bids. We agreed to bid on an eight foot brake, a potentially useful item that is a bit too big and heavy for the typical home workshop. In fact, from Gale's description, it sounds like it'll take a trailer and a sizable crew to get such a monster into the ARC if and when it becomes ours.

Karsten then asked the group for nominations for standing committees. The Membership Committee is taken care of: Gale and Dave are already conspiring to expand the ranks. Bill Jagust was nominated to head up the Education Committee, although he has previously compiled a good bit of documentation so that any one of us should be able to act as presenter. George will again be on the Young Eagles committee but suggested that it might be time for someone new to help out and provide some fresh ideas. Gary Unruh volunteered to work with George in this role. Fund Raising Committee stays in the same hands as well. Ron Burnett and Dave Doherty were both on hand with Dierbergs and Schnuck's coupons, as well as extra Entertainment coupon books. Dave has some of these left at $25 apiece. There were no nominations for Executive, Communications Liaison, Safety, or Scholarship committees. If you have an interest in heading up any of these groups please let me or Karsten know.

Young Eagles Pilots are reminded to update their information.

Leo Lang has stepped up as our point of contact with the AOPA. They can be a more effective resource if a member is able to act as a representative of a particular airport.

At this particular moment a buzzer sounded and a yellow light flashed. This was the signal that the sceptic tank was full. As the membership was conveniently present the motion was made to approve the necessary expenditure to have it pumped out. Motion was seconded and approved.

Gale Derosier then introduced new members. Tom McFadden's been in the area about a year, working as a contractor. When this turned into a permanent position Tom bought a lot at the Troy Air Park and soon his family (currently in Virginia,) will join him. He has a Zenith 601XL homebuilt. Terry Lahey is a Boeing mechanic. He currently flies a 150 but is planning to construct a homebuilt. Neil Wall moved to the area a few months ago and is taking flight lessons. He has a good bit of experience with ultralights and plans to apply his skills to a Sport Pilot category vehicle, something with folding wings. Dave's Ridge Runner was nearby to provide futher inspiration.

Karsten asked if there was further business, and George asked if we could revisit the water purification issue we discussed in 2005. We went over some of the ideas and concerns covered at that time and agreed to bring this up again at our February meeting.

Roger Moore brought up an RV-4 issue. He was looking at his firewall and found cracks near the attachments. When he called to report this to Van's they suggested this was the result of flying from a rough, grass strip, (despite the fact that the plane has always flown from asphalt,) and also denied knowledge of similar problems, (even though Roger knew of several similar instances). This is apparently an issue with early RV-4's since the firewall was been redesigned.

Jim Hahn arrived in full pilot regalia, having landed scarcely a half an hour before. He fulfilled his role as the new treasurer by reminding us that dues are, well, due. He'll have a treasurer's report for us at the next meeting.

Gale asked if someone could build a box for a 2-way radio we have available at the ARC. It needs a battery and a speaker, and would be handy to have at Young Eagles events for communicating with pilots in flight. Bob Jude will take on this project.

This was the last bit of business, after which the meeting adjourned.

Thanks to VP Dave for taking great minutes - ed.

Learning As We Go
"THINGS WE PILOTS DO"

mr.bill

This is where we have our field day as pilots doing the Monday morning quarterback thing. What was he or she thinking? Were they thinking?

Occasionally there is the "OOHHH SSHHiinola thing? Just bad karma dude!

But sometimes it is something rather humorous.

TWO BLIPS ON THE RADAR SCREEN: ONE IS THE PLANE AND ONE IS THE PILOT

There are occasions when we should not have been flying. Just this past weekend let's say I have this "friend" who awoke in Peoria with a splitting headache, head cold, and sinus infection. It is a 23 minute flight. What could go wrong from Peoria to Chicago??? Well, that is why there are two pilots up there. My "friend" had a tough time just keeping his eyes open because of his illness. He claimed to be two or three seconds behind the airplane and he was not on any medication. Needless to say "they" survived the flight with one guy really laughing at my "friend."

WHERE ARE WE NOW?

Can you believe that in this day and age of GPS (Global Position Systems) and computers that a pilot could land at the wrong airport? Several years ago an airliner was heading west for Louisville, Kentucky (KY). After setting up for the approach and landing at "Louisville" the crew realized that they had landed at Lexington, KY instead. Quick thinking had a public address (PA) announcement made telling the people that they were so far from the gate that it would be easier to take off and land on the other side of the airport instead of taxiing all the way over to the terminal. After the takeoff the crew flew a little further west this time and landed at the Louisville, KY airport. The escapades would have worked if not for a little on-board radio transmitter that tells an agent's computer that the aircraft is on the ground. It does not say where it is on the ground; ¦just that it IS on the ground! Understand-ably at the "FOCUS TRAINING" of those two pilots they were told Don't Ever Land There Again! (We're learning to fly and it shows!)

NOBODY WAS FLYING THE AIRPLANE!

Some of those long all night freight flight that left New York City for Los Angeles back in the day had the whole crew falling asleep. There is a radio signal SELCAL that can signal a selected aircraft in the sky and chime the cockpit crew. Good midnight, this is your wake up call!

WHAT WERE THEY THINKING?

Those EXPERIMENTAL pilots have their share too! There was a man flying his gyrocopter in wintry weather conditions who landed to get a pair of goggles because the freezing rain was hurting his face. Can you believe that he put the goggles on and took off, again??? His friends watched as his gyrocopter fell out of the traffic pattern and crash landed in a field. Upon arrival at the accident site the friends were horrified at seeing the gyro and the gyro nut loaded up with ice lying motionless on the ground.

Sometimes we are thrice unlucky. This good old boy ran out of fuel so he landed on a road near a gas station. Lucky Break #1. Although, on the rollout the airplane hit a pole with his wing leading edge. Strike #1. After fueling the airplane and some F,R,&D-ing, that is Fiddling, Repairing, & Duct taping, our good old boy took off over the hills back to his home field. Lucky Break #2. Well, the airplane ran out of fuel again and crashed in the hills on the way back to its home base. Strike #2. The pilot survived (Lucky Break #3) only to tell the FAA that he should have stayed put after the first accident. Can you say Strike #3!!! You're outta there!

Electrical Systems Simplified - Part 1

Sport Aviation - 8/98
By Ron Alexander

Somewhere during the aircraft building process you will encounter the often-dreaded task of installing the electrical system. It is likely that you will not receive a lot of help from your plans or assembly manual. The amount of instruction varies from one airplane to another. Usually, however, you will be left to design and install an electrical system specific to your needs. The first question to ask yourself is, "Do I want an electrical system?" You may not. If you are building a very simple airplane and have no desire for a radio or a starter, then save yourself a lot of work and the airplane a lot of weight by not installing an electrical system. Most of us will want to take advantage of the benefits derived by having a starter, radios, lights, etc. Putting in your electrical system need not be a complicated process. Like everything else involved in aircraft building, you need to know a few basic concepts. This does not mean you are required to gain the knowledge necessary to become an electrical engineer. The wiring process can be as simple or as complicated as you would like to make it. As an example, the Airframe and Powerplant Mechanics General Handbook contains over 200 pages on basic electricity, generators and motors. You can spend a considerable amount of time learning about electricity. You may decide that you want to do that for your own personal satisfaction. Personally, I am not interested in learning all of the fundamentals of electricity. I am simply concerned with how to wire my airplane. The point is, if you have a longing to learn all about electricity, the information is certainly available. Many builders do.

If you are like me and want to know only the fundamentals, then read on. Understand that I am not an expert on electrical systems but I have researched the material available and I have condensed it down to what I think you need to know to properly wire your aircraft. As Tony Bingelis so aptly states in his book Sportplane Construction Techniques, wiring an aircraft involves two basic activities:

- Installing the electrical equipment where it needs to be or where you want it to be.
- Connecting it to a power source (battery/bus bar, etc.) using wires.

I like that. Very simple and to the point. Each component part has a power source that is connected by a wire that has only two ends. One end is connected to the piece of equipment and the other end to a power source. Is this an oversimplification? I really don't think so. Of course, there is a lot more involved in a proper electrical system installation but if we keep it in-perspective it really is not that complicated.

Proper planning of your electrical system is absolutely essential. Do not wait until you are in the middle of the building process to think about this. You will need to route electrical wiring, determine the best location for your battery, think about where to put a bus bar, etc. during the initial building stages. The basic steps involved in planning your electrical system are as follows:

- Determine what electrical equipment you want to install,
- Locate these components within the aircraft structure
- Locate your battery, bus bars and circuit breaker panels
- Protect the components by determining proper wire size and circuit breaker/fuse requirements
- Connect component parts to an adequate power source
- Ground and bond necessary items
- Install proper instrumentation to monitor the system
- Draw a detailed schematic of the system for reference

As previously stated, you should design your system to suit your needs. Are you going to fly in marginal or adverse weather (IFR)? Will you be flying at night? If so, you will want to pay close attention to preventing a system failure. You must plan your system to operate the essential equipment for the necessary period of time you will need to land the airplane. FAR Part 23, that regulates the airworthiness of production aircraft, states that essential elements must be powered by the battery for a minimum of 30 minutes. Stop and think for a minute - 30 minutes is not that long when you are operating on a standby system. It may seem like a long time but in actuality it is minimal. On the other hand, if you are simply going to fly day VFR then you are not going to install a very elaborate system. You may only need an engine starter and a radio. No matter what your choice the basics remain the same, only the complexity of installation varies.

Prior to discussing the steps of system installation outlined earlier, I will discuss the very basics of electricity and I mean very basics. There are only a few things you really need to understand to accomplish your installation. As I mentioned earlier, if you want to plunge in deeper you certainly have that opportunity.

Basic Electricity

Let's begin with the old familiar ohm's law. This law is the very foundation of all principals of electricity. The law itself simply shows the relationship between electrical current flow, pressure and resistance. Current flow is measured in amperes (amps). Electrical resistance is measured in ohms. This resistance is simply an opposition to electrical flow. The pressure of electricity is measured in volts. One volt is the amount of electrical pressure required to push one amp of electrical flow through one ohm of resistance. Or another way of stating this is to say that when you pass one amp of current through a conducting object having a resistance of one ohm, the result will be a voltage drop of one volt. The formula is shown in Figure 1.

E stands for voltage or pressure, R equals resistance, and I equals current in amps.

One additional formula that you will find helpful involves determining power. Power is expressed in watts and is found by multiplying the voltage times the current ... P=E x I. One volt of pressure forcing one amp of flow will produce one watt of power. A watt is a unit of energy. Concerning the chart in Figure 1, if you will place your thumb over the value you wish to calculate you will either divide the other two values or multiply as indicated. As an example, if you wish to calculate R, hold your thumb over the R and divide as indicated. The temptation is to go on with basic electricity but I will easily overcome that temptation. Knowledge of these formulas will assist you in designing your electrical system.

Batteries and Alternators

Your system will undoubtedly contain a battery. We are all familiar with a battery, but what is its purpose? First and foremost it provides the necessary power to start the aircraft engine. In some aircraft that do not have an alternator or generator it may be the only source of power for all electrical items. The battery also provides electrical power in the event the generator/altemator fails. When it comes to choosing your battery you have a number of choices. Lead acid batteries are probably the most common. This type of battery has been around for years and is quite common on automobiles and aircraft.

These batteries are usually fairly inexpensive. Lead acid batteries emit explosive gases that must be vented. This will be discussed later. Another common battery is the so-called gel-cell. This is also a lead acid battery that has a material added to the electrolyte converting it into a gel state. This type of battery is less likely to spill and is often used in acrobatic aircraft. Nickel-cadmium batteries are also available. These batteries do present some maintenance problems and are not widely used on smaller aircraft. A very good choice of battery today is the recombinant gas battery (RG). They do not leak and they can be mounted in any position. The disadvantage is the price - they are usually more expensive.

Most amateur-built aircraft will require a 12-volt battery instead of a 24-volt. Most designs call for a 14-volt electrical system versus a 28-volt due largely to cost and weight differences. A 14-volt system utilizes a 12-volt battery. Even though a battery is rated at 12 volts the actual voltage will vary depending upon the charge state. Battery amperage also comes into play as we make the decision as to what type to install. Should you buy a 25 amp or 35 amp battery? Starting performance in addition to operation of essential equipment must be taken into consideration. Generally speaking, a 25 ampere-hour battery is adequate for most light aircraft. When you purchase your battery keep this thought in mind - it may be operating your emergency equipment while you shoot that low approach in bad weather after the loss of your alternator.

Alternators are simply generators that produce alternating current. They are the most common forms of electrical power on aircraft today. An alternator converts mechanical energy into electrical energy that can power our electrical components. Most alternators today are lightweight (6-8 pounds) and provide a considerable amount of amperage (typically 40 amps or more). You must calculate the needs of your entire system prior to selecting the alternator. Common ratings are 30 to 50 amps.

Relays, Contactors and Solenoids

A relay or contactor is usually installed to activate an engine starter.It serves to eliminate the need to run a heavy cable from the battery and starter all the way to the master switch. A contactor or relay is simply an electromagnetic switch that operates a heavy current circuit. These are often called solenoids. A large wire (usually 4 gauge) is installed between the contactor, the battery, and the starter. A smaller gauge wire (usually 18 gauge) is then run between the relay and the master switch.

Voltage Regulators

A voltage regulator must be present to protect the battery. The charging voltage going into the battery must be controlled within a relatively small range - as an example, 13.8-14.2 volts for a typical lead acid battery at normal temperatures. This voltage varies with the ambient temperature. The voltage regulator is going to prevent battery overcharging by decreasing the alternator output as the battery nears a full charge state. Most other equipment within your airplane can withstand a wide range of voltage. Just about any solid-state regulator will control most alternators.

Circuit Protection

We must protect individual electrical circuits from overloads. This is usually accomplished using a fuse or a circuit breaker. Fuses and circuit breakers are not intended to protect the equipment, rather, they are installed to protect the cable (electrical wire) attaching the power source and the equipment. Of course, in protecting the cable the equipment is also protected. Fuses will be cheaper to purchase and lighter in overall weight than circuit breakers. During flight it is easier to reset a circuit breaker than change a fuse. If you closely analyze most electrical faults they are produced by failure of an electrical device that in turn causes it to draw an extremely high amount of current. In reality, how often will you be able to solve the problem by resetting a circuit breaker or replacing a fuse? Probably not very often.

A short in a wire will also cause an electrical fault.

The bottom line is that you must select the right size circuit breaker or fuse for the size wire you are running to the component part. The circuit protection should open before the wire gets hot enough to begin smoking. Another point worth mentioning is that if the circuit protection is too small for the wire size you will get a nuisance protection requiring you to reset the circuit breaker or replace the fuse even though a major problem may not exist. The following chart found in FAA Advisory Circular 4313 shows the comparison between wire size and circuit protection.

Wire AN Gauge Copper	Circuit Breaker Amps	Fuse Amps
22	5	5
20	7.5	5
18	10	10
16	15	10
14	20	15
12	25/30	20
10	35/40	30
8	50	50

What would happen if we did not comply with these guidelines? Let's assume we install a 10-amp circuit breaker in a circuit connected by a 22 gauge wire. As long as everything is normal you will probably not know the difference. However, should an electrical fault occur in this circuit, the breaker may not trip until the wire gets so hot that it causes an electrical fire.

Electrical Wiring and Connectors

The primary concern is that you use the proper type of wire. Do not go down to your local electronic store and expect to get the proper wire for your aircraft. The best type of wire to use in your airplane is MIL-W-22759/16 unshielded wire or MIL-C-27500 shielded wire. Both types of wire are manufactured to the military specification number given and they are insulated with a Teflon-type of material called tefzel. The wire is rated for 600 volts. Teflon and PVC wire is also often used but after researching the problems involved I would stay with tefzel wire. Sure, you can probably save a few dollars on surplus electrical wire but is it really worth it? Wires are manufactured in various sizes with 22 gauge being the smallest you will normally encounter on your airplane. To provide an example, 22-gauge wire is about .025 inches in diameter and is comprised of several strands of smaller wires.

As mentioned under circuit protection, the size of the wire is of utmost importance. The wire size will be selected based upon the amount of current the wire will carry and the required length of the wire. The voltage drop resulting from a long length of wire can be significant. Fortunately, AC43-13 provides charts showing the relationship between wire length, size and amperage.

A large number of electrical problems are the result of poor connections between the electrical cables and the various components of the system. Most cables are corrected with "crimp-on" connectors, such as ring-end terminals or butt splices. Often a solder joint will be used to complete the connection. I would recommend the use of "crimp-on" connectors whenever possible. Solder joints are subject to breaking or weakening when subjected to vibration. If you use a solder joint, be sure to support the wire near the joint to prevent flexing. You will find the need for soldering to be more common during your radio installation.

Selection of the proper solderless connector is easy because the connectors are color coded. The coding is as follows:

Color of Connector	Size of Wire
Red	18-20-22 Gauge
Blue	14-16 Gauge
Yellow	10-12 Gauge

A special tool is used to crimp the connection. Approximately 3/16 inch is stripped away from the wire, using wire strippers, and the wire inserted into the connector. The tool is then used to make the crimp. You then check the connection by slightly pulling on the terminal and wire.

It is also recommended that you insulate the terminal connection using heat shrinkable tubing. You must remember to place the tubing over the wire prior to assembly.

Bus Bars

No doubt you have heard the electrical term bus bar. A bus bar is very simply a central point where wires from electrical equipment are grouped together and attached to a metal bar that is then attached to a power source. Without a bus bar we would have to connect every electrical component directly to the power source. This would be very complicated and impractical. Normally, one terminal of each circuit protector (circuit breaker or fuse) running from the electrical component is attached to the bus bar. The power to operate all of your electrical items is then obtained from one common point. This is generally accomplished using a strip of copper large enough to tap a hole for each circuit breaker required. This would usually be about 1/8-inch to 1/4-inch thick and 1/2-inch wide. They must be long enough to accommodate the number of breakers. If using fuses, a heavy copper wire is often used that is soldered across one terminal of each fuse. Doing either of these creates a bus bar.

Switches

A lot of text could be written concerning electrical switches. You will need to determine what type of switch you desire and where you want it located. Even though there are many switch types they all provide the same type of function. That function is the control of an electrical component. Listed below are various types of switches you may encounter and their description.

Single-pole, single-throw:
Used for one circuit

Single-pole, double-throw:
Two circuits but not at the same time

Double-pole, single-throw:
Two circuits at the same time

Double-pole, double-throw:
Two circuits with each throw

A pole is the movable metal contactor of the switch. The number of poles will equal the number of external terminals on the switch. The throw is the number of circuits each pole can complete. As an example, a simple toggle switch with an on-off position is an example of a singlepole, single-throw. A rocker switch is another example.

Another available switch option is the combination switch/circuit breaker. This switch also serves a dual function as a circuit breaker. Many custom builders are using this type of switch. Whatever type of switch you install you must be sure the voltage and amperage ratings are adequate for the circuit you are completing.

Grounding and Bonding

Grounding is the electrical connecting of a conducting object to the primary structure to provide a return path for the electrical current. On metal aircraft the main frame, fuselage, or wing is used. The battery is generally grounded to the engine crankcase and from the crankcase a ground wire is run to a ground bus behind the instrument panel. Bonding, on the other hand, is the electrical connecting of two or more conducting objects not otherwise connected. Often, in composite and wood aircraft, the bonding connection will also provide the ground connection for an electrical component. Bonding provides a conductor for the purpose of eliminating the build-up of static charges. This will also reduce radio interference. Specific methods of grounding and bonding will be discussed in the next issue.

So, as you can see, installation of your electrical system need not be complex. There are a number of sources for information concerning basic wiring practices. Tony Bingelis' books are excellent. Bob Nuckolls is also a recognized electrical expert and has written many articles concerning the subject.

Next month I will expand upon the actual steps needed to install your electrical system. Those steps are listed earlier in this article.

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WWW.EAA32.ORG

Laura Million, Web Designer

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