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ATEC JOURNAL

ABOUT THE ATEC JOURNAL

The ATEC Journal (ISSN 1068-5901) is a peer-reviewed publication published twice a year by ATEC. The Journal provides an opportunity for educators, administrators, students and industry personnel to share teaching techniques and research. Authors are encouraged to submit their articles for publication consideration, whether scholarly, research, application, or opinion.

Submission deadlines are as follows:

- Spring Issue Closing Date: April 1
- Fall Issue Closing Date: October 1

ATEC JOURNAL PEER REVIEW POLICY

The ATEC Journal is a scholarly peer-reviewed/refereed publication targeted at the aviation maintenance industry. The Journal is focused on assessing developments in the areas of aviation maintenance education, curriculum, pedagogy, FAA certification and technological innovations affecting the maintenance industry. The Journal welcomes submissions reflecting the latest industry and academic thought in these areas. As a refereed publication, submissions will be subjected to a single-blind review by members of the editorial board and a limited number of professionals with expertise in the relevant field. The guidelines below describe the criteria for publication, explain the review process, and detail how to submit an article for review.

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To be published in the ATEC Journal the article must:

- Provide strong evidence for its conclusions,
- Be of interest to educators, researchers and/or those in the aviation maintenance industry,
- Assess unique or novel issues in a way that is likely to influence thinking in the field, and/or
- Introduce innovations in teaching or practical project application.

REVIEW PROCESS

The editorial board evaluates submissions to determine whether the general criteria for publication are satisfied and whether an article warrants formal review and publication. The process consists of a single-blind peer review by members of the editorial board and professionals possessing the requisite education and experience in the relevant field. Each article will be reviewed by at least two editorial board members. The author's identity will be known to the editor but will remain anonymous to other board member referees to ensure an impartial assessment. The referees will evaluate the strengths and weaknesses of a submission and provide those to the editor. On the basis of those comments, the editor will accept or reject a submission, or request that the author make revisions before publication. All papers that are reviewed and approved for presentation at the ATEC annual meeting will be published in the journal.

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Authors should upload their submission by utilizing the online submission form. Submissions shall include the following:

- Cover letter identifying the author(s), contact information, institutional affiliation and a brief description of the author(s) education and experience.
- Abstract of the article.
- Article.
- Data and supporting materials.

Authors are responsible for anonymizing their article by removing all personally identifiable information from the abstract, article and supporting documents. To facilitate electronic review of the submission, all documents should be uploaded in a single combined PDF.

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ABOUT ATEC

The Aviation Technician Education Council (ATEC) was founded in 1961 to further the standing of FAA approved schools with education and industry, and to promote mutually beneficial relations with all industry and government agencies. The Council's mission is to advocate for aviation maintenance schools in the areas of curriculum improvement, technical and financial support, while promoting mutually beneficial relations with related government and industry groups.

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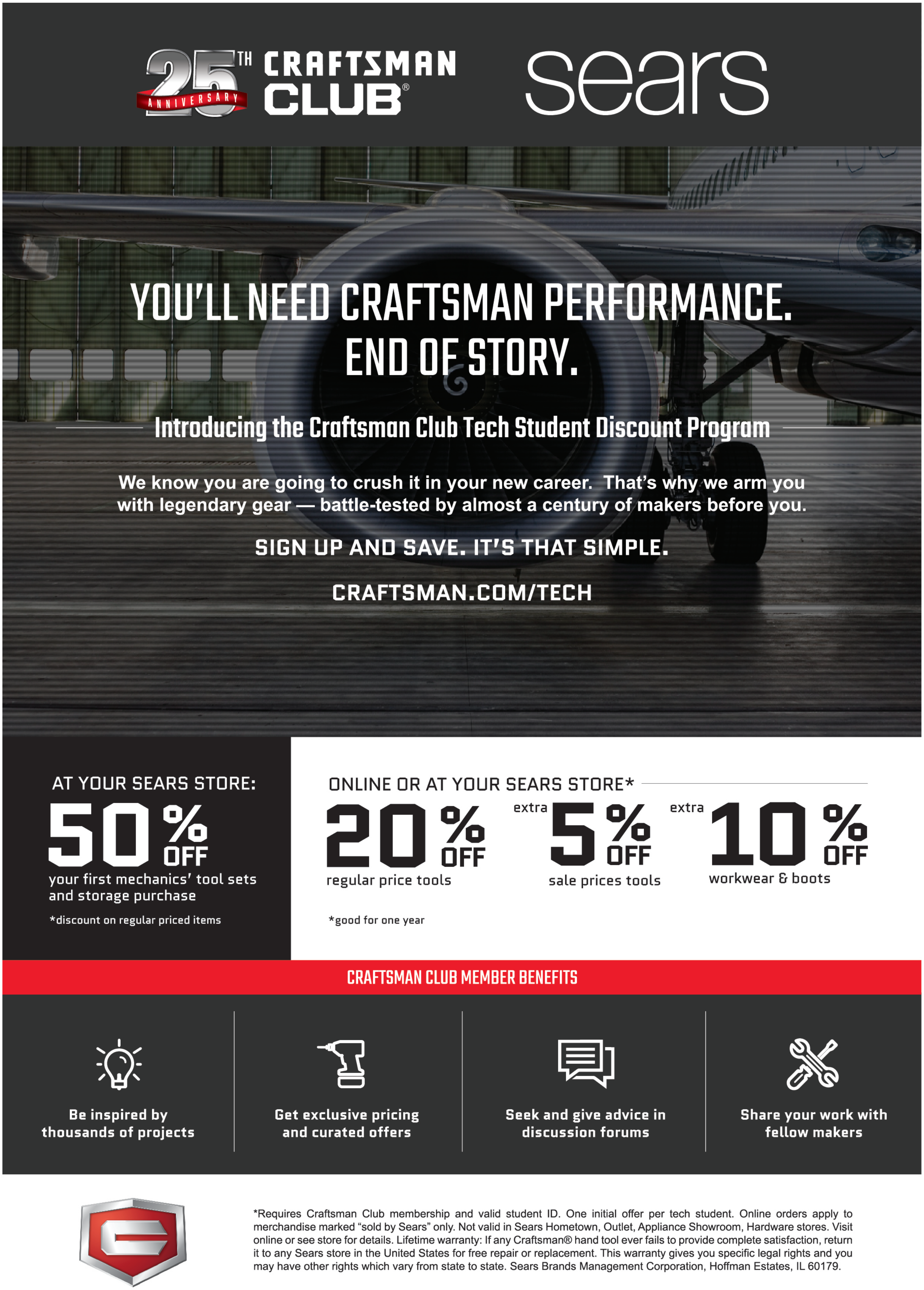
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The Albatross: Design and Construction of a Versatile Systems Trainer for Part 147 Use

Don Morris, Southern Illinois University, Carbondale

Abstract

Anyone desiring to become an aviation technician has various paths by which he/she can acquire the necessary skills to obtain FAA The Albatross is a training system designed to mimic the electrical and fuel system of a "typical" single engine light aircraft in as many configurations as possible. The system is made of welded steel tube for durability, but it is designed to mimic an aircraft as closely as is practicable. Stub "wings" are detachable, and are constructed just large enough to give students experience with routing wires, terminating wires, bundling wires, and installing chafe protection on wires. Appropriate wing disconnects are provided, and component location within the wings is as realistic as possible. At the same time, the entire apparatus is small enough to be cheaply wired over and over again and to be easily moved around the shop. A ground power plug allows it to be used as a 40 amp continuous or 100 amp temporary 12 volt GPU.

Operationally, the unit is powered by a 7 hp engine with electric start. The engine turns a 40 amp aircraft alternator as well as a 25 amp aircraft style generator. These are connected to the bus through a pair of relays and a master switch which allows either the generator or the alternator to power the system, but not both. Operation of either the generator or alternator is selected by the two-position master switch. A three-coil voltage regulator regulates the generator, while a solid state alternator regulator handles the alternator. Voltage and amperage to the fields of both the generator and alternator are monitored through separate meters on the side of the unit. This allows students to appreciate the practical function of the voltage regulators by monitoring the system response to varying loads. The instrument panel is well equipped with engine instrumentation. Not only are amps and volts monitored, but separate gauges allow for ammeter and loadmeter hookups. One fuel tank is monitored by a capacitance based sender (Westach), while the other tank uses the older float type resistance sender (ISS). Fuel pressure from the boost pump is monitored.

Realistic electrical loads are also provided. Landing and taxi lights are installed in the wing. Strobe lights and position lights are installed. A heated pitot tube allows that long-time favorite to be used to monitor system performance. The boost pump also serves as a load, and a low cost "avionics" system is provided in the form of an automotive stereo - which also provides a surprising boost in interest for certain students.

About the Author: In addition to a lifetime of tinkering, Don Morris has an MS in Aviation Education from Embry Riddle Aeronautical University and a BS in Physics from Illinois State University. He is currently Assistant Professor in the Aviation Technologies Program at Southern Illinois University, Carbondale. He holds A&P certification with Inspection Authorization, and is a CFI. Before working for SIU, Don worked a wide variety of jobs – some of which include Avionics installer, Electronics Technician, and Middle School Shop teacher.

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Figuire 1: The Completed Project

Introduction

Every instructor has occasional glimpses into the minds of their students. The one that launched this project came as I was discussing the Sikorsky Human Powered Helicopter prize (American Helicopter Society, n.d.) as an application to propeller theory. One of the students confidently asserted that the problem of low human power could easily be solved by attaching an alternator to the pedals. The alternator, he maintained, could run a large enough electric motor to sustain flight. I would have smiled at his naiveté had we both not recently spent several weeks in Powerplant electrical systems covering generators and alternators. They convert mechanical energy into electrical energy. They do not manufacture energy from nothing. Clearly, none of the projects or training aides that we had at Arkansas Northeastern College were adequately communicating this concept. I therefore decided to design a new trainer from the ground up, designed to meet the criteria in table 1. Figure 1 shows the end result of the project. The design of the Albatross is based on best practices and on my experiences as a general mechanic, an avionics installer, and as an experienced teacher. In this paper, I will outline the design, creation, and early use of an intermediate level electrical and systems trainer. The name "Albatross" was chosen as a tongue in cheek nod to the classic "Rime of the Ancient Mariner" and as a tribute to the famed Albatross fighter aircraft of WWI.

Basic Concept

When I was young, my Dad told me how he and his brothers used a lawnmower engine to spin a car generator to power a remote campsite. Dad told me that he was impressed by how much the lawnmower engine struggled to turn the generator when car headlights were connected. This seemed to be a very graphic illustration of the exact concept I needed to communicate. My initial concept for the trainer was to hook a generator to an electric motor. I figured that students could monitor field strength with a multimeter as loads were added. This would also help students gain a practical understanding of the function of the voltage regulator in the system, as they could monitor how it continuously adjusts the field strength to ensure the power output is matched to a variable load.

The more I thought about the trainer, the more I realized that the concept needed to grow. Just varying load isn't enough. The regulator also needs to adjust for varying speed. As the speed of the generator or alternator decreases, the strength of the field must increase to maintain a steady output. In order to visualize this, a practical variable speed motor is required.

Variable speed electric motors in the several horsepower category are available, but they are not cheap. On the other hand, small horsepower gasoline engines are readily available for a fraction of the cost. A trainer built around an electric motor could be used indoors, but a trainer built around a gasoline engine should only be used in appropriately vented locations only. However, gasoline engines are generally more familiar to students. They also give an easily understood audible indication as to their power output level. When compared to an electric motor, they allow a much more realistic trainer to be built. Using a gasoline engine would necessitate that the trainer include realistic aviation controls and fuel system – which would expand the functionality of the trainer still farther.

Project Goals

- High quality at low cost: can be built for around $3500 in 2014 dollars, not counting labor.
- Thorough: should introduce most types of wiring activities that are encountered in typical aircraft wiring.
- Flexible: can be used to support many FAA subject areas.
- Small: easily portable and storable. Student rewiring projects will not be cost prohibitive.
- Fabricated using standard techniques and currently available parts: fabrication may be possible by advanced students as part of their other classes.
- Exposed: easy viewing and access to all major parts without time consuming disassembly.
- Engaging to students: components that are familiar to and interesting to students are utilized wherever possible.
- Well documented: available construction manual, an illustrated parts catalog, and a maintenance manual should be available to guide students activity.

Firming Up a Design

In the end, I felt that the advantages of the gas engine were enough to outweigh the disadvantages for my situation. Having made this decision, I was faced with the next decision: generator or alternator. A generator is less common, and so less understood - but the FAA regulations still require that we teach them. An alternator is much more readily available, and more modern aircraft use them – but they are not as simple to visualize operation. It didn't take much wrestling with the issue to realize that the best choice was not to choose at all, but to use both. A toggle switch could trigger relays to operate the unit on one source or the other, but not allow both to operate simultaneously.

Having decided on the most basic equipment, the next choice that I faced was what the basic shape of the trainer would be. I wanted to have realistic wiring locations on the aircraft, and that suggested that the trainer be shaped like a plane - but a scale model doesn't lend itself to realistic wiring. I chose to make the trainer a caricature of an aircraft. An open frame was required for ease of access to wiring. The use of square steel tube for the frame gives simplicity of construction and ruggedness. Detachable wings on the trainer both allow for realistic wing root disconnects and for a potentially smaller storage footprint. The tail of the trainer lends itself well as a maneuvering handle, and the wheels are designed for easy portability using the tail as a handle. The entire trainer is self-contained and very portable (see figure 2).

The trainer's primary purpose is to visualize the performance of an electrical system under varying conditions of load, so electrical loads are required. I began by putting in lights. Landing, taxi, and navigation lights were obvious choices. So, too, was my favorite electrical test load - the heated Pitot tube. An electrical fuel pump also seemed appropriate. Adding strobe lights seemed wise - particularly as this allowed me to introduce the concepts of shielding, bonding, and radio interference. I needed a way to demonstrate faulty shielding, so I added a stereo. For cost reasons, this was an automotive unit. The radio necessitated an antenna and coaxial cable, but this allowed me to teach proper coaxial cable termination and routing techniques. The large variety of wiring projects on the trainer allowed me to expose students to most of the same areas that I received specialty training in while working for industry (Global Jet Services, 2004).

Figure 2: Moving the trainer

At this point, the trainer was rapidly taking shape - and forming what I considered to be an attractive package. It needed instrumentation, and the windshield area of the trainer lent itself well for use as an instrument panel. Non-certified ISS gauges from Aircraft Spruce (often used in the RV line of homebuilts) were selected for most of the display, partly because of small size, and partly because of low cost. The wiring diagram from Van's Aircraft served as a good starting point for my wiring diagrams (Hanna, 1999). Figure 4 shows an excerpt from the completed instrument panel layout, and figure 5 shows the completed unit.

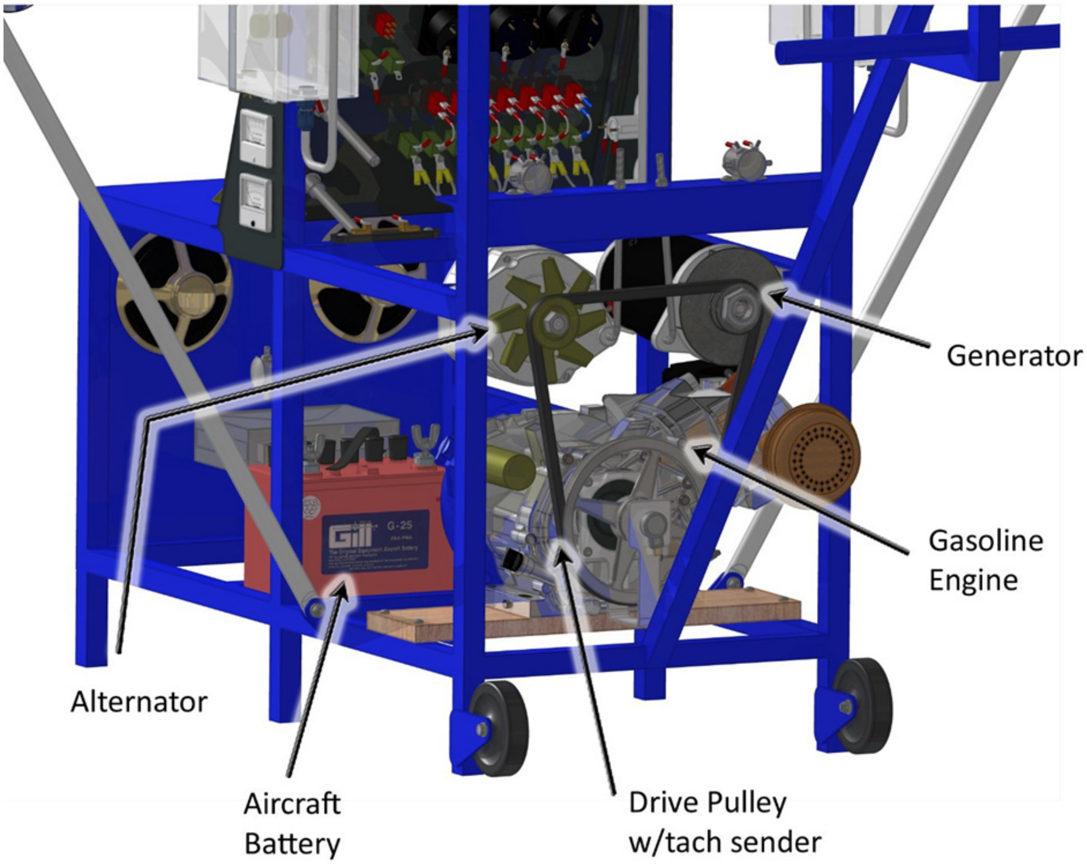


Figure 3: Major components of the trainer

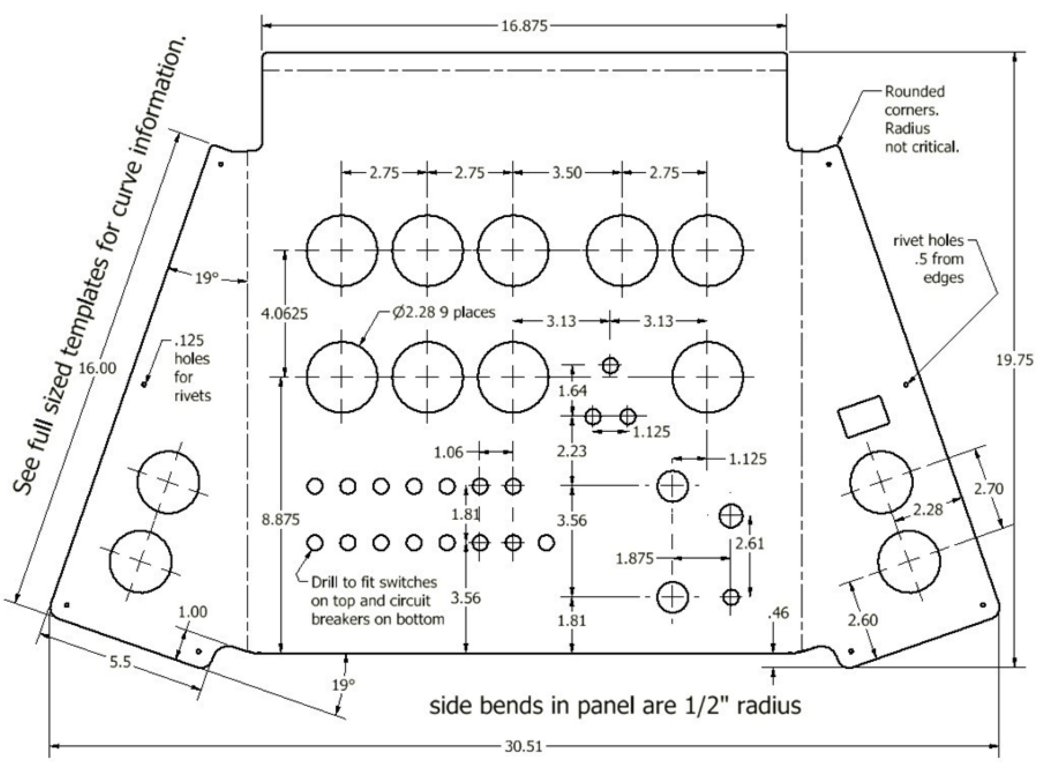


Figure 4: Excerpt from construction drawings

Having made the decision to extend the functionality of the machine as far as practicable, this principal was applied wherever practical. This machine is useful not just as an electrical system trainer. It also hits as many portions of the curriculum as possible. Thus, instead of choosing between a float type fuel sender and a capacitance type fuel sender, both are used. In similar fashion, there is a separate loadmeter and ammeter wired into the system. Having made the decision to extend the functionality of the machine as far as practicable, this principal was applied wherever practical. This machine is useful not just as an electrical system trainer. It also hits as many portions of the curriculum as possible. Thus, instead of choosing between a float type fuel sender and a capacitance type fuel sender, both are used. In similar fashion, there is a separate loadmeter and ammeter wired into the system.

Construction

The prototype cost around $3000 to build, with most of the construction being completed by me. However, this figure did include a fair amount of scrounging. Appendix A shows a parts list and 2014 parts prices.

The frame was welded up first, and painted with a blue enamel paint. I made the wings look and feel like aircraft parts by riveting aluminum ribs to the frames. Supporting wing struts from conduit tubing were added. I installed a 7 hp horizontal shaft engine with an electric start, a used 25 amp generator, an older style 40 amp Ford alternator, and a 12 volt aircraft battery. A used three coil regulator fed the generator field. A typical transistorized aircraft voltage regulator fed the alternator field.

The fuel tanks were fabricated out of polycarbonate containers, so that the fuel senders could watched as they operated. An aircraft fuel valve added realistic two wing operation. A low cost Facet fuel pump pulled the fuel up out of the tanks, and through appropriate fuel lines. Quick drains on the bottom of the tanks added to the realistic aircraft feel of the trainer. The engine was controlled by Vernier throttle and mixture knobs and cables. I modified the carburetor of the engine to allow back suction mixture control in a similar manner to what is described by Hart (n.d.). This allowed students to practice setting the mixture by rpm or by EGT without risking damage to costly aircraft engines.

The instrument panel of the trainer was fabricated from .060 aluminum. The instrument holes were cut with a fly type circle cutter. I mounted all the electrical load items on the structure, and prepared wiring diagrams for the entire project. This was as far as I was going to personally take the construction project – the rest was up to the students.

Trainer in Use

The first use for the trainer was in an Airframe Electrical Systems class. The systems on the craft were divided between different groups. The students enthusiastically wired the unit as per the wiring diagrams. The variety of wiring tasks required to complete the unit created the natural opportunity to discuss wire routing, bundling, securing, and chafe protecting. The differences between required wire gauges, types of wiring, and shielding requirements became very real to the students. Surprisingly, it was the radio that seemed to generate the most enthusiasm. Almost all of the students had either installed or considered installing a stereo system in their own vehicles, and so were quite motivated to understand the coaxial cable antenna installation and proper wiring.

I looked forward to using the trainer in many different classes. However, shortly after completing the trainer, I switched jobs. I am unsure how many of the planned roles for the trainer have actually been realized. As it was built, it was suitable for use in Basic Electricity, Airframe Electrical Systems, Powerplant Electrical Systems, Aircraft Instrument Systems, Position and Warning Systems, Fuel Systems, Ground Operations and Servicing, Reciprocating Engines, and Engine Fuel Systems. In addition, it could be used as a ground power unit or battery charger for any 12 volt aircraft on the flight line. It could even be used as a source of outside lighting while working outside in the dark during night classes.

Lessons Learned

I would have enjoyed being able to incorporate this trainer into these classes and write curriculum for it, but circumstances did not allow this to happen. Over time, however, I have gradually worked on the documentation, and am finally ready to release it to anyone who would like to build or use these trainers. It is my hope that the design effort I have put into the project will help many students learn. I would also like to share a few thoughts about this project with anyone contemplating this or a similar project.

If I were to build again, I would hire a professional metal fabricator to create the frame. My fabrication skills are not commensurate with my teaching skills, and so fabrication is not my most useful function. The help of advanced students in sheet metals classes could also be enlisted to build the aluminum sheet metal parts of the airframe. The rest of the projects could easily be wired in electrical classes, and the students could learn a great deal while fabricating something useful and lasting.

Another thing that would greatly aid in the usefulness of the trainer would be to have the wires laser stamped before assembly. Several low-cost services wire marking services are available for this type of project, and the additional cost would be low compared to the benefit. A Google search for such services turned up several. While I do not endorse any particular service, Alan Wire seemed relatively typical (Alan Wire, n.d.). You give them a list of the wires you need with their labels, and they give a return quote. See Appendix B for the complete list of wires and markings for this project as documented.

The biggest problem experienced with the prototype unit was the modified back suction carburetor. While it did function, it never functioned well enough to allow students use it without supervision. If I were to re-do the project I would either eliminate the adjustable mixture or try to use a derivative of an Ellison throttle body fuel injector system to make a more reliable carburetor (Ellison, 1985). Rotec is currently marketing just such a carburetor, although it is not matched

well in size for such a small engine. A derivative of this carburetor would seem ideal for this application.

The next biggest problem with the prototype was the mounting for the tach sender. In addition to being awkward, the mounting kept the drive belt from being easily removed and reinstalled. In future versions of the trainer, I would probably fit a magnetic pickup on the drive pulley and hook up a Hall Effect sensor to drive the tachometer.

I would strongly suggest that you not install a larger engine. If anything, a smaller engine would be better. The correct engine size is one that struggles to carry the full electrical load of the trainer. This is so that students can develop a practical understanding of the fact that electrical power is not free- it comes at the expense of horsepower from the engine.

Finally, if I were to equip a program with several of these trainers, I would paint each of their frames in contrasting colors. While I personally like the multicolored image, this isn't just for aesthetic reasons. This would allow each group to readily identify the unit they were assigned to. These units will probably find their way all around the hangar, due to their useful features such as lighting, sound, and GPU functions.

Documentation

A bill of materials and a complete set of wiring diagrams are included as appendices A and B. I think you will agree that a lot of time and effort has gone into the development of the trainer. An extensive construction manual and IPC is available. Simply email me and request a copy if you are interested. My only request is that if you write any laboratory exercises or make any improvements to the design, you make these available to the public as well. If there is sufficient interest, perhaps ATEC could provide an area for the Albatross in the shared curricular materials section of the web site. I'd be happy to dub this the ATEC Albatross!

References

Alan Wire (n.d.). Laser Marking. Retrieved from http://www.alan-wire.com/Laser-Marking.html

American Helicopter Society, International (n.d.). Human Powered Helicopter Regulations. Retrieved from https://vtol.org/awards-and-contests/human-powered-helicopter/hph-rules

Ellison, B. L. (1985). Patent Identifier No. US 4524034 A. Location: USPTO

Global Jet Service, Inc. (2004). Practical Aircraft Wiring. W. Simsbury, CT.

Hanna, A. (1999). Van's Aircraft, Inc. Gauge Installation. Retrieved from https://www.vansaircraft.com/pdf/Gauge_Install.pdf

Hart, J. B. (n.d.) Fine Tuning the Bing for the Victor 1+ #II Air/Fuel Mixture Control. Retrieved from http://www.jackbhart.com/firefly/firefly146.html

Appendix A: Bill of Materials

(Based on 2014 Availability)

Part	Source	Estimated Cost
Steel for frame – 1" square. 50 lineal ft	www.speedymetals.com	$100
Misc Steel for brackets, etc	Local Source	$20
DuroMax 7 HP engine w/Elec Start.	eBay.com	$200
Corvair or other CCW rotation generator	www.californiacorvairparts.com	$180
3 Unit Regulator	Auto Zone	$45
40 amp Ford Style Alternator	Auto Zone	$50
Lawn Tractor Battery (or G25 aircraft battery)	Local Source	$30
License Plate Light (tail position)	Walmart	$3
Fuel Tanks (2) – BHG 4x8x8 Transparent Canister	Walmart	$16
4 inch diameter rubber wheels (2)	Local Source	$20
Misc fasteners, rivets, bolts, screws	Scrounge	$25
Automotive 12 volt Audio system w/speakers	Local Source	$50
Pulley and Belt	Local Source	$35
Misc Fuel line and 3/8 fittings	Aircraft Spruce	$25
Heated Pitot Tube	Scrounge or Aircraft Spruce	$200
Headlights (off road lights for automotive) (2)	Auto Zone	$20

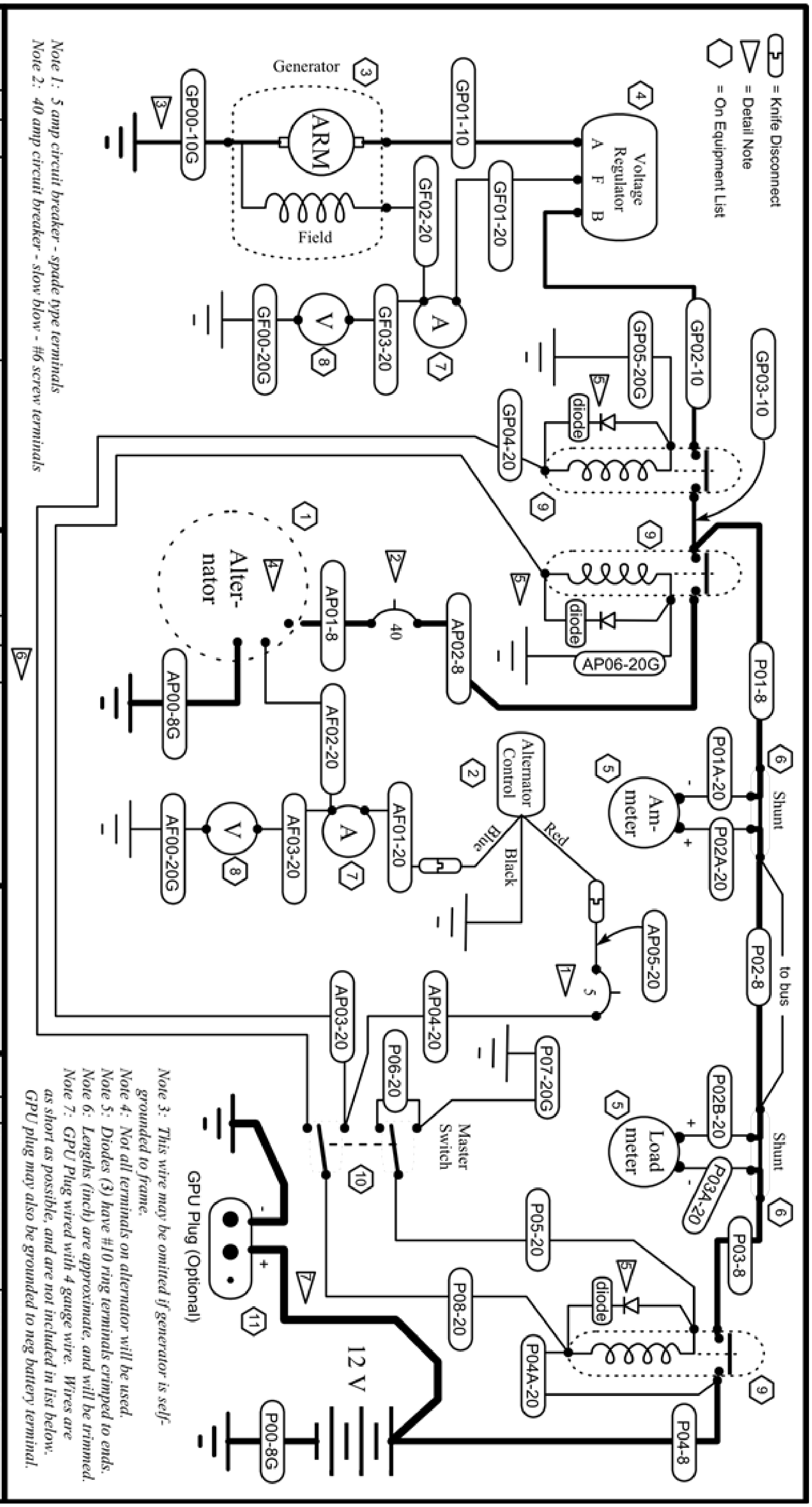
Specialty Electronics Parts	Source and p/n	Estimated Cost
Terminal Ground Block - Amphenol	Mouser - M81714/63-20F	$40
Left Wing Disconnect A	Mouser - 654-PT02A-12-8P	$15
Left Wing Disconnect B	Mouser - 654-PT06A-12-8S-SR	$30
Right Wing Disconnect A -	Mouser - 654-PT02A-8-4P	$10
Right Wing Disconnect B	Mouser - 654-PT06A-8-4S-SR	$25
3 Amp Circuit Breaker (1)	Mouser - CLB-033-11-B-3-A-B-A	$4
5 Amp Circuit Breaker (5)	Mouser - CLB-053-11-B-3-A-B-A	$21
7 Amp Circuit Breaker (2)	Mouser - CLB-073-11-B-3-A-B-A	$6
10 Amp Circuit Breaker (1)	Mouser - CLB-053-11-B-3-A-B-A	$3
40 Amp Circuit Breaker (1)	Mouser - CLB-053-11-B-3-A-B-A	$4
SPST Toggle Switch (7)	Mouser - DA100-PB-B	$18
DPST Toggle Switch (Master Switch) (1)	Mouser - M2023SS1W01	$5
Momentary Switch (Stall Warning)	Mouser - 30-1UL	$3
Stall Warning Horn	Mouser - PKB30SPCH2001-B0	$3
Panel Mount Meter – 0-15 Volts or similar (2)	MCMelectronics - PM-2/15V	$30
Panel Mount Meter – 0-5 Amps or similar (2)	MCMelectronics - PM-2/5A	$30

Aviation Parts	Source	Estimated Cost
ISS Fuel Level Gauge	Aircraft Spruce pn 10-01108	$37
ISS Fuel Sender RH 6-12 Tank	Aircraft Spruce pn 10-01101	$33
ISS Voltmeter Gauge	Aircraft Spruce pn 10-01092	$37
ISS Ammeter Gauge (2)	Aircraft Spruce pn 10-01080	$74
ISS Ammeter Shunt (2)	Aircraft Spruce pn 10-01081	$37
ISS Fuel Pressure Gauge	Aircraft Spruce pn 10-01082	$39
ISS Fuel Pressure Sender	Aircraft Spruce pn 10-01083	$36
ISS Electric Tach	Aircraft Spruce pn 10-01076	$46

Appendix A (continued)

ISS Tach Sender	Aircraft Spruce pn 10-01077	$84
ISS EGT Gauge	Aircraft Spruce pn 10-01094	$50
Falcon EGT Probe	Aircraft Spruce pn 10-00488	$32
ISS CHT Gauge	Aircraft Spruce pn 10-01093	$50
GRT CHT Probe	Aircraft Spruce pn 11-09537	$18
Capacitance based Fuel Level System w/probe	Aircraft Spruce pn 10-04502	$180
Aeroflash Nav/Strobe Light Kit	Aircraft Spruce pn 156-0039-12V	$375
Hobbs Hour Meter	Aircraft Spruce pn 15000	$27
A-790 Vernier Throttle Cable	Aircraft Spruce pn 05-08048	$76
A-790 Vernier Mixture Cable (Optional)	Aircraft Spruce pn 05-08148	$75
Fuel Tank Shutoff Valve	Aircraft Spruce pn 05-01032	$30
Gascolator	Aircraft Spruce pn. 06-00441	$85
Alternator Regulator	Aircraft Spruce or Scrounge	$150
Continuous Duty Solenoids (3 total)	Aircraft Spruce pn. X61-0028	$180
Facet Fuel Pump – 3/8 flare and 4-6 psi	Aircraft Spruce pn. 40108	$45
Fuel Proof Sealant (for fuel tank)	Aircraft Spruce pn. 09-00532	$23
Antenna	Aircraft Spruce pn. AV-529	$140
Battery	Local Source	$200
Total		$3425

Appendix B: Wiring Diagram



Wire ID	Ga	inch	Terminals (stud size)		Notes
P00-8G	8	18	1/4 ring	1/4 ring	4 Ga if GPU plug inst.
P01-8	8	30	5/16 ring	1/4 ring	
P01A-20	20	24	#6 ring	#6 ring	
P02A-20	20	24	#6 ring	#6 ring	#10 ring is 3/16 ring
P02-8	8	6	1/4 ring	1/4 ring	
P02B-20	20	30	#6 ring	#6 ring	
P03A-20	20	30	#6 ring	#6 ring	
P03-8	8	24	5/16 ring	1/4 ring	
P04-8	8	12	5/16 ring	1/4 ring	Female spade terminal
P04A-20	20	4	#10 ring	#10 ring	to fit back of switch
P05-20	20	18	#10 ring	Fem. spade	
P06-20	20	4	Fem. spade	Fem. spade	P06-20 and P06-20G
P07-20G	20	12	w/ p06-20	Terminal Pin	crimped in single term
P08-20	20	18	#10 ring	Fem. spade	
AP00-8G	8	12	#10 ring	1/4 ring	
AP01-8	8	30	1/4 ring	#6 ring	
AP02-8	8	30	#6 ring	5/16 ring	

Wire ID	Ga	inch	Terminals (stud size)		Notes
AP03-20	20	30	Fem. spade	#10 ring	AP03-20 and AP04-20
AP04-20	20	6	w/ AP03-20	Fem. spade	crimped in single term
AP05-20	20	30	Fem. spade	Knife disc.	Knife disc's also on
AF00-20G	20	6	#6 ring	#6 ring	red + black wires on
AF01-20	20	20	Knife disc.	#6 ring	alternator regulator.
AF02-20	20	24	#6 ring	#10 ring	
AF03-20	20	6	#6 ring	#6 ring	
GP00-10G	10	12	1/4 ring	1/4 ring	See note 3 above
GP01-10	10	36	1/4 ring	#10 ring	
GP02-10	10	36	#10 ring	5/16 ring	
GP03-10	10	10	5/16 ring	5/16 ring	
GP04-20	20	30	Fem. spade	#10 ring	
GP05-20G	20	6	#10 ring	1/4 ring	
GF00-20G	20	6	#6 ring	#6 ring	
GF01-20	20	24	#10 ring	#6 ring	
GF02-20	20	24	#6 ring	1/4 ring	
GF03-20	20	6	#6 ring	#6 ring	

1	1	Alternator (14 volt)	40 Amp - Ford Style
2	1	A. Regulator (14 volt)	Lamar B00371-8 or similar
3	1	Generator	25 amp as avaialble
4	1	G. Regulator	3 coil 25 amp unit
5	2	Ammeter (Loadmeter)	ISS VAM40 40-0-40 Ammeter
6	2	Shunt	ISS VAM shunt 40
7	2	Ammeter	Panel mount 0-5 amps
8	2	Voltmeter	Panel mount 0-15 volts
9	3	Contactor	Continuous duty
10	1	DPDT Switch	Rated 5 amps
11	1	GPU Plug	Model 4621B or similar

Original Drawing
5/9/2012

Albatross - Main Power Circuit Diagram
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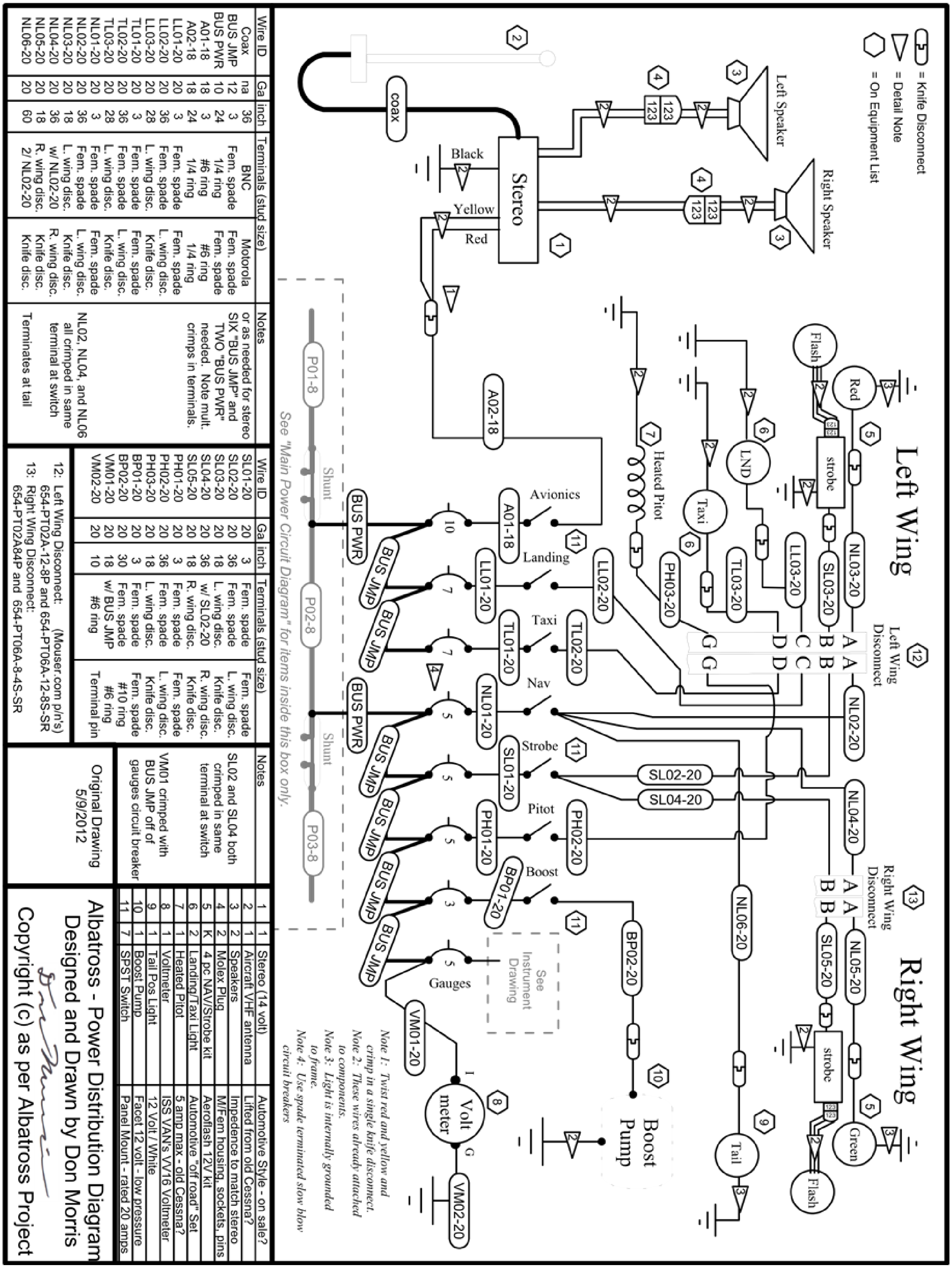
[signature]

Appendix B: Wiring Diagram (continued)



Wire ID	Ga	inch	Terminals (stud size)		Notes
Coax	na	36	BNC	Motorola	or as needed for stereo
BUS JMP	12	3	Fem. spade	Fem. spade	SIX "BUS JMP" and
BUS PWR	10	24	1/4 ring	Fem. spade	TWO "BUS PWR"
A01-18	18	3	#6 ring	#6 ring	needed. Note mult.
A02-18	18	24	1/4 ring	1/4 ring	crimps in terminals.
LL01-20	20	3	Fem. spade	Fem. spade	
LL02-20	20	36	Fem. spade	L. wing disc.	
LL03-20	20	28	L. wing disc.	Knife disc.	
TL01-20	20	3	Fem. spade	Fem. spade	
TL02-20	20	36	Fem. spade	L. wing disc.	
TL03-20	20	28	L. wing disc.	Knife disc.	
NL01-20	20	3	Fem. spade	Fem. spade	
NL02-20	20	36	Fem. spade	L. wing disc.	NL02, NL04, and NL06
NL03-20	20	18	L. wing disc.	Knife disc.	all crimped in same
NL04-20	20	36	w/ NL02-20	R. wing disc.	terminal at switch
NL05-20	20	18	R. wing disc.	Knife disc.	
NL06-20	20	60	2/ NL02-20	Knife disc.	Terminates at tail

Wire ID	Ga	inch	Terminals (stud size)		Notes
SL01-20	20	3	Fem. spade	Fem. spade	
SL02-20	20	36	Fem. spade	L. wing disc.	SL02 and SL04 both
SL03-20	20	18	L. wing disc.	Knife disc.	crimped in same
SL04-20	20	36	w/ SL02-20	R. wing disc.	terminal at switch
SL05-20	20	18	R. wing disc.	Knife disc.	
PH01-20	20	3	Fem. spade	Fem. spade	
PH02-20	20	36	Fem. spade	L. wing disc.	VM01 crimped with
PH03-20	20	18	L. wing disc.	Knife disc.	BUS JMP off of
BP01-20	20	3	Fem. spade	Fem. spade	gauges circuit breaker
BP02-20	20	30	Fem. spade	#10 ring	
VM01-20	20	18	w/ BUS JMP	#6 ring	
VM02-20	20	10	#6 ring	Terminal pin	

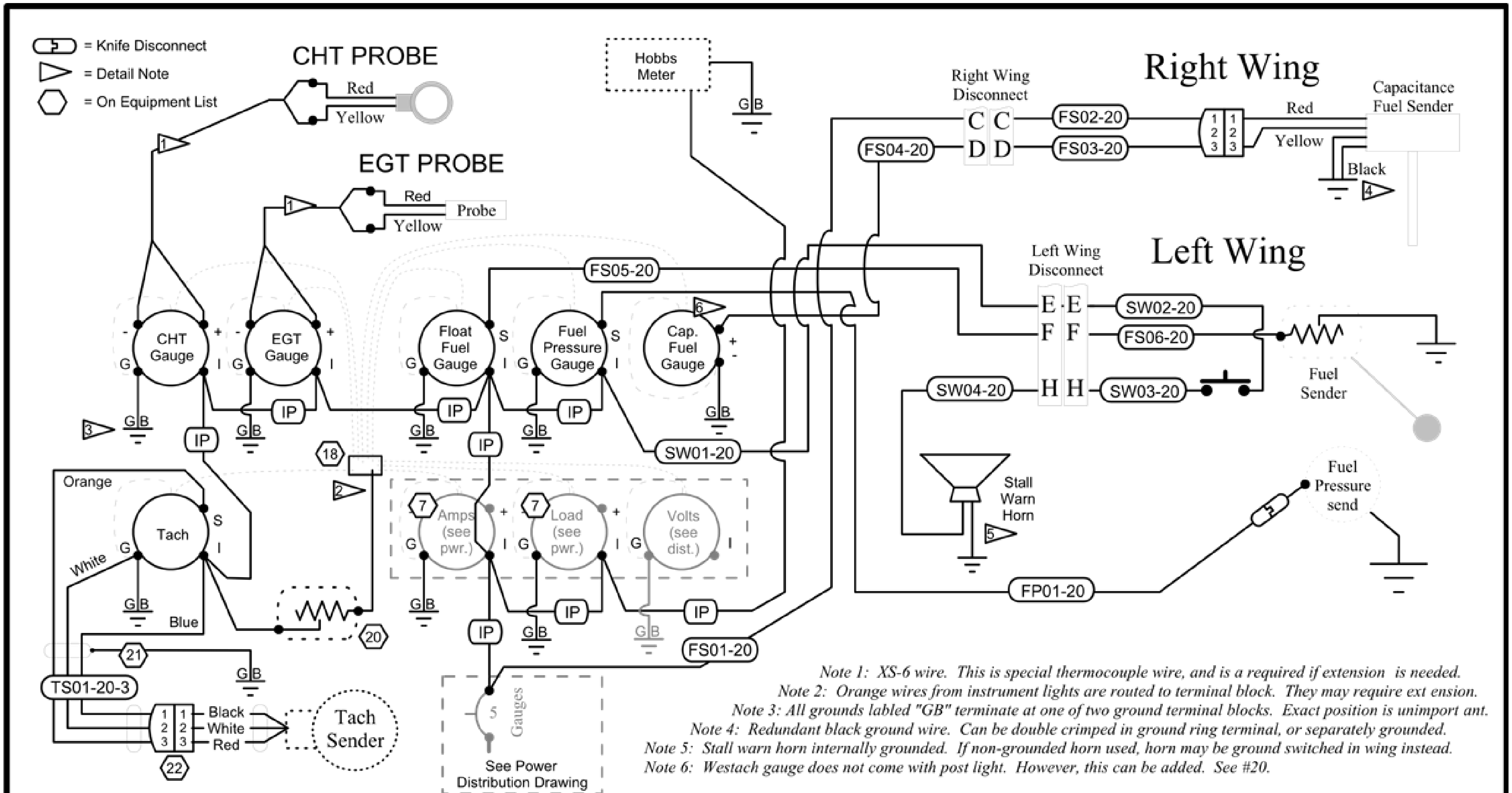
12: Left Wing Disconnect: (Mouser.com p/n's) 654-PT02A-12-8P and 654-PT06A-12-8S-SR
13: Right Wing Disconnect: 654-PT02A84P and 654-PT06A-8-4S-SR

1	1	Stereo (14 volt)	Automotive Style - on sale?
2	1	Aircraft VHF antenna	Lifted from old Cessna?
3	2	Speakers	Impedence to match stereo
4	2	Molex Plug	M/Fem housing, sockets, pins
5	K	4 pc NAV/Strobe kit	Aeroflash 12V kit
6	2	Landing/Taxi Light	Automotive "off road" Set
7	1	Heated Pitot	5 amp max - old Cessna?
8	1	Voltmeter	ISS VAN's VV16 Voltmeter
9	1	Tail Pos Light	12 Volt / White
10	1	Boost Pump	Facet 12 volt - low pressure
11	7	SPST Switch	Panel Mount - rated 20 amps

Original Drawing 5/9/2012

Albatross - Power Distribution Diagram
Designed and Drawn by Don Morris

Appendix B: Wiring Diagram (continued)



Wire ID	Ga	inch	Terminals (stud size)		Notes
(cut 8) IP	20	36 tot	#6 ring	#6 ring or Terminal pin	Length as needed. F. spade crimped w/ FS01 at breaker.
(11) GB	20	60 tot	#6 ring or		Length as needed. Solder zap to sheild of TS01-20-3.
FS01-20	20	36	w/ IP at bkr	R. wing disc.	
FS02-20	20	12	R. wing disc.	Molex	
FS03-20	20	12	Molex	R. wing disc.	
FS04-20	20	18	R. wing disc.	#6 ring	
FS05-20	20	24	#6 ring	L. wing disc.	
FS06-20	20	12	L. wing disc.	#10 ring	
TS01-20-3	20	28	Molex	#6 ring	Twisted triple, shielded. Shield grounded one side only.
FP01-20	20	36	#6 ring	Knife disc.	P06-20 and P06-20G crimped in single term
SW01-20	20	30	#6 ring	L. wing disc.	
SW02-20	20	18	L. wing disc.	Fem. spade	
SW03-20	20	18	Fem. spade	L. wing disc.	
SW04-20	20	24	L. wing disc.	Knife disc.	

Num	Qy	Item	Details
1	1	ISS CHT Gauge	2 1/4"
2	1	ISS EGT Gauge	2 1/4"
3	1	ISS Fuel Qty. Gauge	2 1/4" match w/ sender
4	1	ISS Fuel Press. Gauge	2 1/4" Low pressure markings
5	1	Westach Fuel Gauge	0-5V for Cap based system
6	1	ISS Tachometer	2 1/4" match w/sender
7	2	ISS 40 amp Ammeter	See "Main Power"
8	1	ISS Voltmeter	See "Power Distribution"
9	1	CHT Probe	Recommend IE P-100
10	1	EGT Probe	Recommend IE P-110
11	?	CHT/EGT Extension	See note 1
12	1	ISS Fuel Float Sender	Match w/ gauge
13	1	Fuel Pressure Sender	Low pressure range
14	1	Cap. Fuel probe/comp	Centroid Products
15	1	ISS Tach Sender	8 pulses per/rev
16	1	ISS Hobbs Meter	12 volt
17	1	Stall Warning Horn	12 volt alarm
18	1	Terminal Block (20 ga)	12 pos - non grounded
19	2	Ground Block (20 ga)	12 pos. Internally grounded.
20	1	Inst. Light Dimmer	1 1/2 amp rating
21	1	Solder Zap	For shield grnd termination
22	2	Molex Plug	Male, Fem, pins, and sockets
23	1	Right Wing Disconnect	See "Power Distribution"
24	1	Left Wing Disconnect	See "Power Distribution"

Original Drawing
5/10/2012

Albatross - Instrument Circuit Diagram
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Implementing Creative Teaching Techniques in the Technical Classroom

Thomas W. Wild

In the first article, we looked at establishing a basis for teaching the material that we present in the classroom, making it clear that those old methods of student motivation were just not effective for this new generation of learners. To establish student interest and motivation, time needs to be set aside discussing why class material and activities will be helpful and needed for their future success. Once the student interest has been established, then creative and interesting learning activities should take place which enable the student to become an active participant in the process of accomplishing the learning goal as set forth in the specific learning object. We need to transform the student from passive learners into active partners in every learning experience they encounter.

At this point we have explained to the student why this material is important and will be needed for future success, now we need to teach the material to the student in a way that is meaningful and understandable so they can retain as much information as possible. The term "class" has traditionally been defined as approximately an hour of time with the instructor spends talking to the class, covering the material from the book. When this approach is used exclusively, some students tend to tune out or simply not pay attention; this type of teaching is just out of date learning mythology. Generally speaking, students have become part of the look-up-the-answer generation; an example is the way they use internet search engines that provide information on any subject in a few seconds.

Current students are ready problem solvers if directed with appropriate structure. The use of classroom and lab or shop work can be coordinated with organization and structure from the course instructor to create an excellent learning environment where the student motivation and learning can be maximized. One suggestion that can either substitute for or surrogate lecture, includes group learning, where students are divided into small groups to research required class material. Then this material can be presented to the class or each group may report on the same material. This simple act (finding and studying the material for the subject matter) involves the student as an active participant in his or her own learning process. An example could be timing a magneto to an engine, where the students have little or no knowledge of the subject matter. They are given the task of listing the steps in timing a magneto and explaining each step. This task will present the students with a problem that will require knowledge of the subject matter to solve the problem of how to time a magneto. During the process of solving that problem, as an example, students will need to research, understand, and apply information from the required curriculum.

The use of guided learning is another example in that students are given a task that involves research into information necessary to accomplish a project, which takes the learners from a passive, somewhat disinterested role, into more of an active learning approach. The use of a student worksheet can render guidance to the student (group) and may start with simple material and develop into more difficult material or problems as more knowledge is obtained.

Following these methods, students assume an active role in the learning process. Activities that require students to prepare for class and be involved with the class proceedings will increase the students' active class role. The more the students are directly involved in the learning process they more they seem to learn.

As I mention before these are just a few thoughts on teaching. Hope they may be helpful, remember each teaching situation and instructor/student dynamic is unique and requires proper adjustments to be successful.

Thomas Wild has been a professor of Aeronautical Engineering Technology at Purdue University for 32 years now retired. He has written several text books by different publishers.