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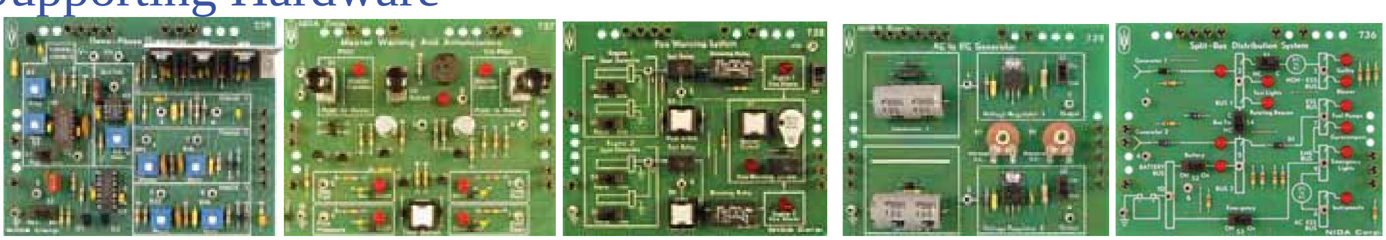

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Investigation of a Landing Gear Failure

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And
Mr. Jeremy Hierholzer
Assistant Professors
Department of Aviation Technologies
Southern Illinois University

The following is the actual summary of an investigation of an incident involving a Piper Arrow. The investigation was performed and submitted by Dr. Charley Rodriguez with assistance from Mr. Jeremy Hierholzer. Dr. Rodriguez was acting as an FAA safety advisor for the Springfield FSDO to gather information on the incident. This is the exact report given to the Springfield FSDO, with pilots' names omitted for privacy. Appendix A is a detailed explanation of the Piper Arrow landing gear system.

On April 12, 2006, I, along with one of my colleagues, Jeremy Hierholzer, completed an inspection of a Piper Arrow, PA-28R-201, N53580, S/# 2844087, involved in a landing incident. Refer to the data plate shown in Figure 1. Mr. Hierholzer assisted in the inspection process because he has considerable experience maintaining Piper Arrow aircraft. The aircraft was hangared at Tate's Aviation at the Southern Illinois Airport (MDH).

Figure 1: _Data plate Piper Arrow_

According to the flight instructor, who was conducting a check ride during the incident, an unusually loud noise occurred upon retraction of the landing gear. He also indicated that an unsafe landing gear condition existed. The pilots attempted to cycle the gear and follow instructions provided in the Pilot's Operating Handbook in an attempt to extend the landing gear. All such action yielded negative results in terms of securing a "THREE GREEN" indication. The immediate cause of the unsafe warning light and the lack of a green nose gear down and locked indication, or green light, was due to the failure of the Link and Brace Assembly Piper P/# 76426-03. See Figure 2. This further resulted in the inability of the switch actuator clip to contact either the gear up switch or gear down switch. See Figures 3 and 4. Unknown to the crew, the nose gear was safely down and locked. In fact, after the down lock link, shown in Figures 3 and 4, severed from the Link and Brace, P/# 76426-03, it was impossible to unlock the gear as mechanical spring action kept the nose gear from retracting.

_Figure 2__: Broken Connection Point for Hydraulically Actuated Down lock Link_

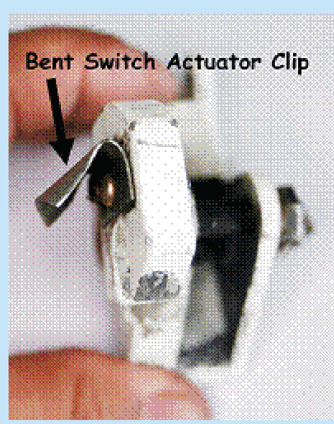

_Figure 3__: Bent Actuator Clip_

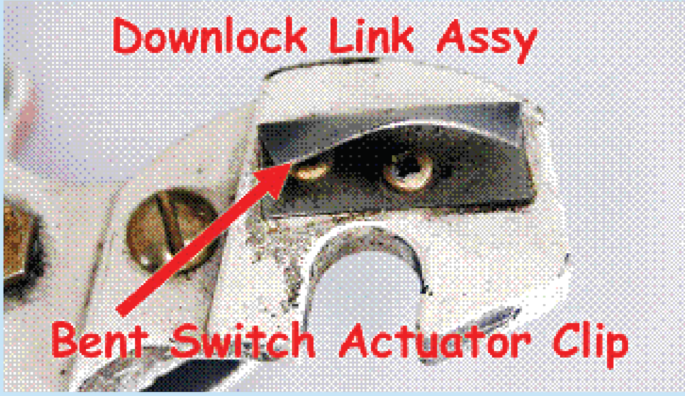

Figure 4: *Bent Switch Actuator Clip*

Photographs of the failed part are provided below in Figures 5 through 8. Close-ups of the failure point are shown in Figure 6, 7, and 8.

Figure 5: *Broken Link Assembly*

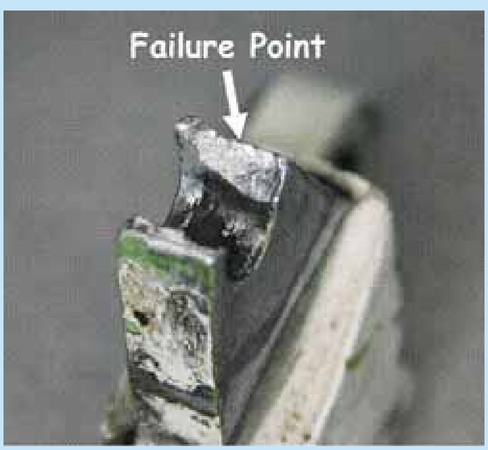

Figure 6*: A Closer View of the Failed Part*

Figure 7: *View of Failed Part*

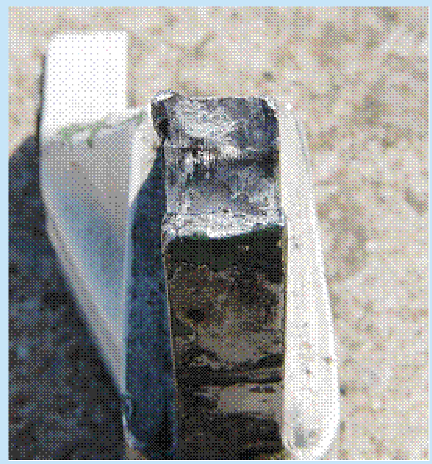

Figure 8*: Another View of the Failed Part*

To comment on the report that the hydraulic pump assembly located aft of the baggage compartment was hot. It is my understanding that when extending the gear in this airplane, or when the gear selector is in the "DOWN" position, the pump continues to run until a "THREE GREEN" condition is attained. Because the nose gear switch actuator clip was unable to activate the nose gear down and locked switch, the hydraulic pump ran in a continuous fashion. This accounted for the hot-to-the-touch condition of the pump assembly. We raised the plane using jacks, placed the gear selector in the "DOWN" position, and manually activated the nose gear down switch using a finger. The hydraulic pump shut down in a normal fashion when all three down switches were activated. Likewise, the lights on the instrument panel functioned as designed during this test. See Appendix A for a full explanation of the Piper Arrow landing gear system.

The loud noise reported by the instructor was probably the result of the nose gear dropping from the retracted position into the down and locked position after the part failed. Two stout springs drove the gear down into the locked position after the failure of the link assembly. This action accounts for the comment from the instructor about the gear aggressively striking something.

Regarding the issue of the popped circuit breaker. We have not found a simple explanation for this occurrence. Apparently, the continuous current draw of the hydraulic motor, as it would not shut off until all three gear down and lock lights were on, caused the down relay to overheat. This, in combination with the two green lights and unsafe warning light may have caused the breaker to pop. According to the flight instructor, the breaker first popped between 5 and 10 minutes after the problem occurred. They were unable to reset the breaker immediately following the failure of the link. After 10 to 15 minutes, they once again tried to reset the breaker. This time the breaker successfully reset and the main gear green lights and unsafe light remained on until the breaker popped for a second time after being on for only a couple of minutes. A visual inspection of the gear down relay suggests that it had endured high heat. See Figure 9 for a photograph of the down relay.

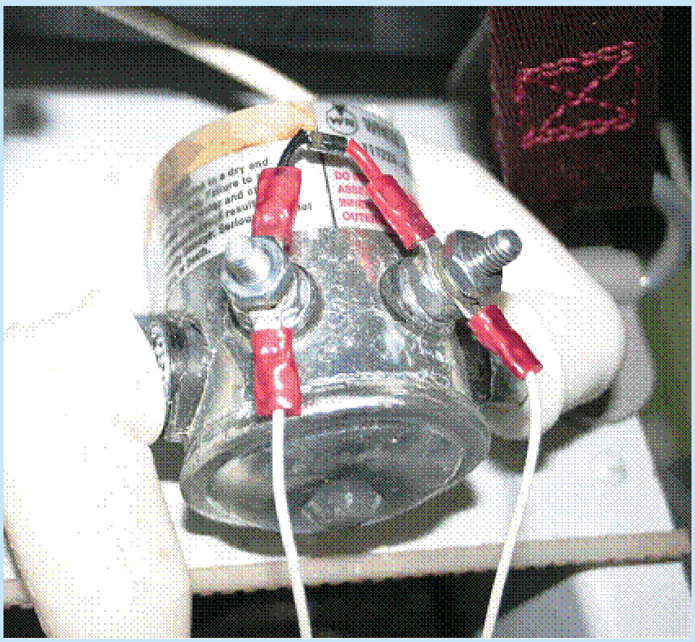

Figure 9*: Gear Down Relay*

The root cause of this problem may be due to an unsecured jam nut or improper gear rigging. The jam nut that secures the rod end to the hydraulic actuator was loose upon disassembly. The question remains, was this nut improperly tightened at the factory or did it come loose after the unit separated from the gear link? Because the crew extended and retracted the actuator in an attempt to secure THREE GREEN, the link may have become bound within the engine compartment, possibly applying a powerful unscrewing action to the rod end. This may have occurred when the switch actuating tab, as seen in Figures 3 and 4, was bent. If the jam nut became loose on its own through normal use, it is possible that the piston rod of the actuator rotated, thereby changing the rigging of the nose gear. This is a very plausible scenario as indicated by the clevis screw used to connect the hydraulic actuator to the down lock link assembly. Note in Figure 11 that the clevis screw is severely deformed.

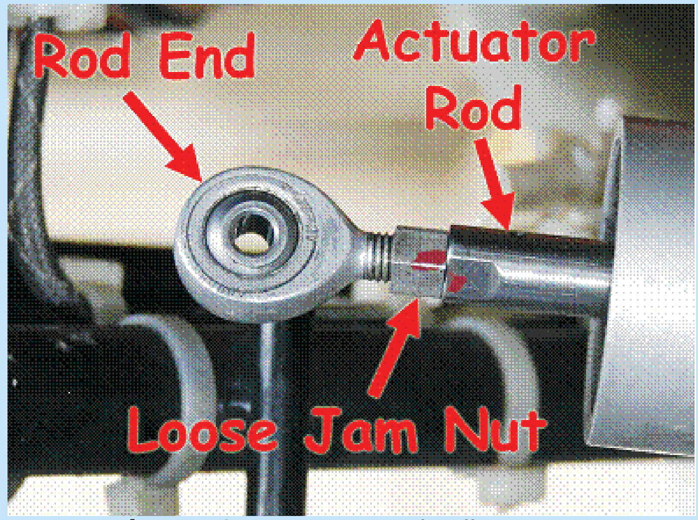

Figure 10*: Nose Gear Hydraulic Actuator, Rod End, and Jam Nut*

Judging the condition of the clevis screw in Figure 11, hydraulic power was involved in the deformation of the part. The same force that distorted the bolt likely acted on the Link and Brace Assembly shown in Figures 2, 5, 6, 7 and 8. Over time, this action likely damaged and weakened the aluminum lug that ultimately failed. If a bulletin does not already exist, a suggestion from Piper to periodically pull this clevis bolt and inspect it for deformation may be appropriate as it may prevent future occurrences of similar failures. Likewise, checking the jam nut that secures the rod end for proper tightness may eliminate the likelihood of similar failures.

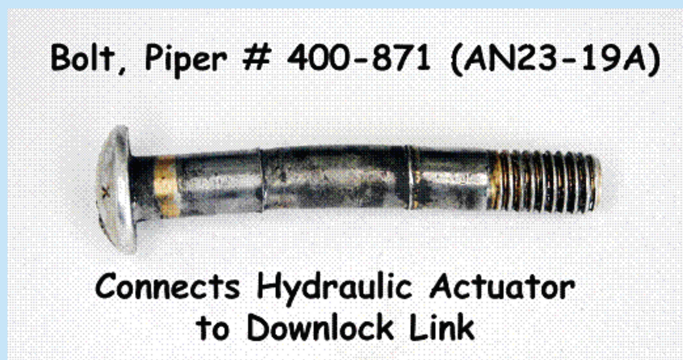

Figure 11*: Note that the Clevis Screw is Bent and Worn*

In closing, design attributes of this gear system averted a serious catastrophe. Similarly, the actions of the crew during this crisis should be commended as they followed procedures provided by the manufacturer and landed the craft without incident.

APPENDIX A: PIPER ARROW, PA28-201 LANDING GEAR SYSTEM

HYDRAULIC SYSTEM

The Piper Arrow utilizes a power pack system for raising and lowering the landing gear. The power pack is a hydraulic system that incorporates an electrically driven pump and hydraulic valves enclosed in one unit – the power pack. Components included in the power pack are as follows: DC electric motor; hydraulic pump; reservoir; filter; thermal relief valve; high pressure control valve; low pressure control valve; and shuttle valve.

The rest of the hydraulic landing gear system, external of the power pack, consists of three actuators, one for the nose gear and one each for the main landing gear, a free-fall, emergency extension valve and a hydraulic pressure switch. See system schematic figure A.

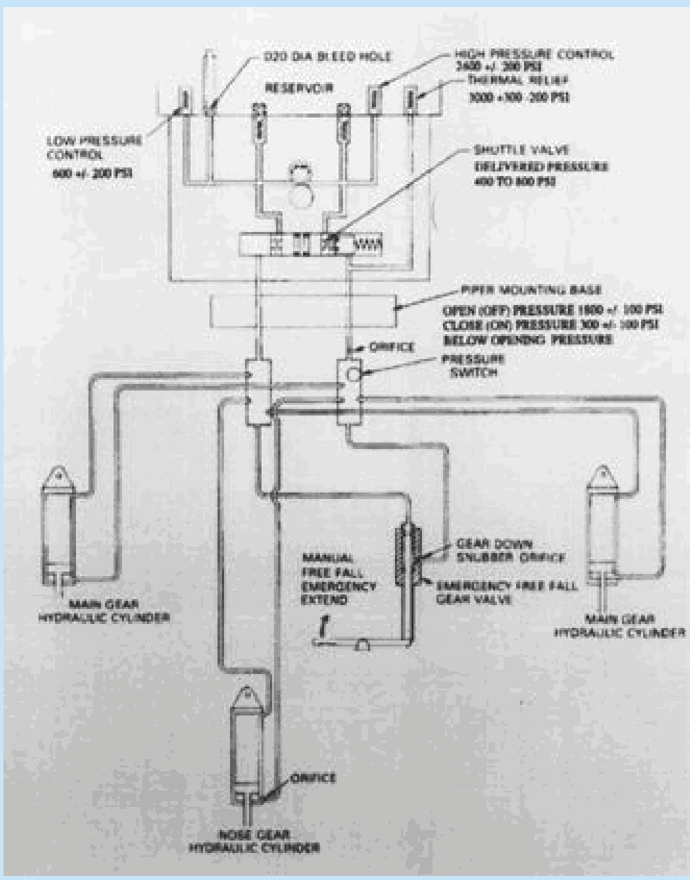

***Figure A**. Power pack schematic.*

ELECTRICAL/POSITION AND WARNING SYSTEM

The electrical system for the landing gear is compromised of a hydraulic switch, three gear down limit switches, UP hydraulic pump relay. DOWN hydraulic pump relay, gear selector switch, gear up limit switches (3), 5-amp circuit breaker, and a 25-amp circuit breaker for the DC motor that runs the hydraulic pump. See electrical schematic figure B.

The electrical components for the position and warning system are three up limit switches, three down limit switches, throttle switch, flap switch, and the squat switch. The down limit switches are used by both the electric pump circuit and the position and warning system.

The position of the landing gear has four indications; up and locked, down and locked, in transit, and gear unsafe. Three green lights will illuminate when the gear is down and locked. The indication for landing gear up and locked is the lack of any visual or aural signal. Also, any gear unsafe position will have a visual indication with some situations incorporating a warning horn. The gear unsafe light will illuminate when the gear is in transit up or down.

The squat switch located on the left main landing gear leg will prevent retraction of the landing gear when the aircraft is on the ground. The squat switch will not allow current flow to the UP relay that controls the electrically driven pump. Raising the gear handle while on the ground will illuminate the gear unsafe light and sound the warning horn.

There are several scenarios that result in a gear unsafe light illumination and/or warning horn activation. If the throttle is put into a low power setting (below 14 inches of manifold pressure) with the gear not down and locked, the red light and warning horn will both activate. When the landing gear is not down and locked and flap selection is more than 10 degrees, this will activate the warning horn and red light.

LANDING GEAR OPERATION

When the landing gear lever is moved into the up position the DC motor energizes through the UP relay and spins the pump. Hydraulic fluid is drawn form reservoir and flows out of the power pack and into the hydraulic system. The fluid moves the actuators and raises the landing gear. When the gear is fully retracted, pressure builds up in the system. At 1800 psi, the hydraulic pressure switch will open the circuit to the UP relay and turn off the motor, thus stopping the hydraulic pump. The landing gear is held up by the hydraulic pressure in the system. If the pressure falls below 1500 psi, the pressure switch will close and turn on the hydraulic pump to re-build the pressure. In case of over-pressurization, there is a thermal relief valve located in the power pack that will open at 3000 plus 300 or minus 200 psi allowing fluid to return to the reservoir.

While the gear is in transit up, a red gear unsafe light will illuminate. Once the landing gear legs have reached their full travel up, they will contact the gear up limit switches and extinguish the gear unsafe light. Only when all three up limit switches are contacted will the gear unsafe light go out.

To lower the landing gear, the gear lever is placed in the down position and the motor is energized through the DOWN relay and pump begins to turn. The direction of fluid flow is reversed from the retraction mode and the actuators propel the gear into the down position. Once the landing gear are fully extended they will engage the mechanical down locks and activate the down limit switches. The down limit switches will open the circuit to the DOWN relay for the electric motor and shut down the hydraulic pump. The three gear down lights are also linked to the down limit switches and will illuminate when their perspective gear leg is down and locked. The hydraulic pump will not stop until all three down limit switches are contacted.

In the case of an emergency situation, the landing gear can be extended using the free-fall valve. The free-fall valve is located in the hydraulic system between the actuators and the reservoir. Since hydraulic pressure holds the landing gear up, releasing the pressure will allow it to come down. Actuation of the free-fall valve releases the hydraulic pressure in the system back to the reservoir. Gravity, with the help of a nose-gear mounted spring will extend the landing gear rapidly.

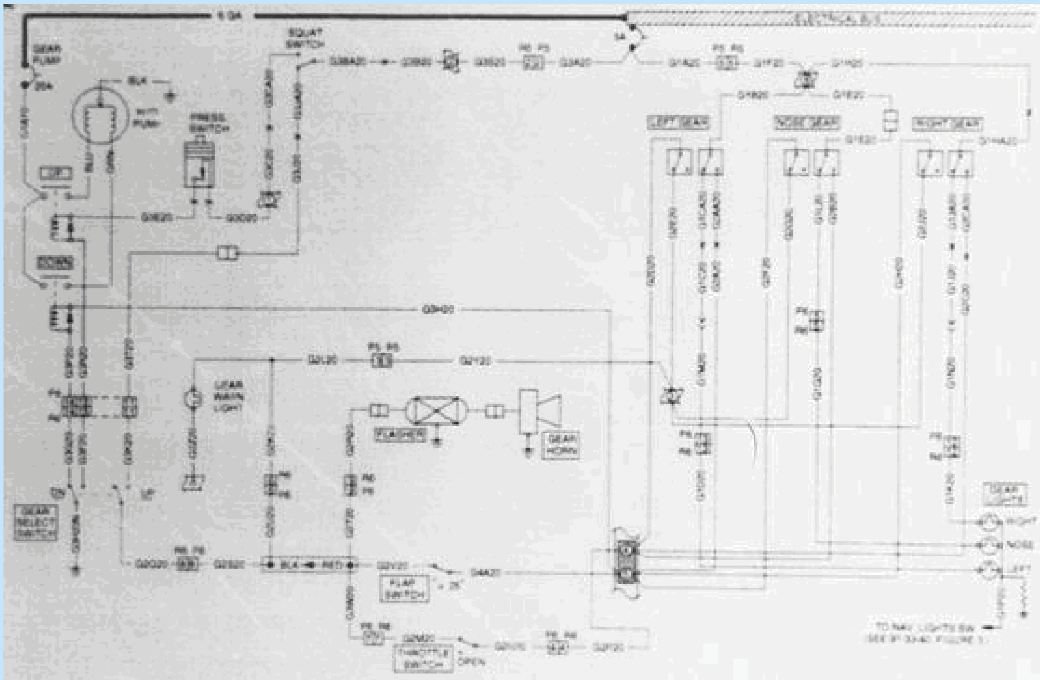

Figure B. *Landing gear electrical schematic.*

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ELECTRONICS & AVIONICS

Assessing the Effectiveness of a Variety of Recruiting Methods of Part-147 AMT Schools.

Michael A. Burgener, Southern Illinois University
Billy Cheek, Southern Illinois University

INTRODUCTION

Enrollment is the lifeblood of any Part-147 AMT school. Schools continuously endeavor to recruit and retain enough students to maintain their programs in demanding economic times. Often, school directors buy advertising, or engage in other recruiting activities, without a clear picture of the return-on-investment derived from their efforts and dollars. They simply do what they think might be successful and hope for the best. They wonder how effective their recruiting activities are, and if their money and time are well spent. They question if anything could be done to better reach their target demographic?

The purpose of this study was to attempt to answer some of these questions. AMT students were surveyed to determine how they first heard about the programs in which they are enrolled, and what influenced their decisions to select one school over another. Among other questions, students were asked to select the recruiting method, or methods, from a list of available choices, that most influenced their decision to enroll. The surveyed students were selected from trade schools, as well as public and private colleges and universities.

Ideally, the results of this study will be valuable to AMT, and other types of aviation schools, faced with the prospects of scarce marketing resources. The data resulting from this study should provide feedback for schools questioning which type of activities will give them the most "bang-for-the-buck".

BACKGROUND

This process was begun due to concern over decreasing enrollment trends at Southern Illinois University. This trend applied not only to the aviation programs, but to most other departments of the University as well. This slowdown in enrollment is unfortunate because the aviation job market, for the past few years, has been flourishing. Currently there are more jobs in aviation waiting to be filled than there are graduating students to fill them. The problem is clear; to meet the demands of the aviation industry, enrollment must be increased.

This decreasing enrollment trend does not seem to be isolated only to SIU's aviation programs. The data in figure 1 shows that A&P certificates issued to graduates of Part 147 schools declined from a high of 7,162 in 2002 to just 4,678 in 2006 (FAA, 2007). Assuming that the ratio of graduating students that complete their certification has not changed, this data indicates a decreasing trend in graduates in all or most of the nation's roughly 170 certificated AMT schools (BLS, 2006).

Year	A&P Certificates Issued to Part 147 School Attendees	Total A&P Certificates Issued
2001	6,159	10,845
2002	7,162	11,475
2003	6,342	9,260
2004	5,413	8,135
2005	5,560	8,444
2006	4,678	7,473

***Figure 1**. Number of certificates issued since 2001*

In an attempt to devise ways of reversing this downward trend, the authors of this study took a systematic approach to determine factors that most influenced student's decisions regarding enrollment in the universities' aviation programs. The authors started by informally questioning their own students, and then, after observing national enrollment trends, expanding on this by developing a survey instrument for other colleges and universities.

METHOD

To gather data for this study, the authors developed an online survey and hosted it on the universities' web server. This "online" form of survey proved to be a fast and effective method for gathering information in a very short period of time. ATEC's directory of Part-147 schools was consulted to identify likely schools to complete the survey. Because the survey notification was to be sent out electronically, the principle criteria used in selecting schools was the presence of an email address. Using this method, just over eighty schools were identified as targets to receive the survey. These target schools consisted of many different types of A&P programs including non-degree vocational programs, high school A&P programs, 2-year college A&P programs, and 4-year University A&P programs.

The authors prepared an email and sent it to the directors of each school. The Email explained the purpose of the survey, the URL location of the survey, and asked that the school representative give the URL location to their students so that the students could go online and complete the survey. The survey was active for roughly six weeks, during which time 106 students responded. After the responses dwindled and stopped coming in, the survey was taken off-line.

Other than general questions such as “age”, “grade”, and “gender”, there were only three main questions for the students to answer. The first two of these were, *“Where did you FIRST hear about the aviation program you are currently attending?”*, and *“Which factor MOST influenced your decision to attend the school you are attending instead of some other school?”* . The online survey included a list of responses for each question that the student could select by pointing and clicking on the choice that applied to them. The authors designed the survey so that only one of each selection could be checked in this manner. This was so that it could be determined where they FIRST had heard about the programs they ultimately decided to attend, as well as the factor that MOST influenced their decision to attend one program, or another.

The authors wanted to keep the survey very short, requiring only a few minutes to complete. In this way, the hope was that more students would respond to a short survey, rather than one that would take a great deal of time and energy to complete.

In addition to these two multiple-choice type questions, one additional question was included in the survey. This question asked their input to describe *“What type of marketing do you think your school should do in order to reach someone like you?”*. This particular question was not multiple-choice, but included a text box that allowed students to write their responses in sentence form. Some of the responses to this item were particularly interesting.

The goal of this survey was to attempt to determine what works in marketing this type of school. If it can be identified WHERE current students are first hearing about their programs, and what FACTORS most influence their decision to attend, then scarce marketing resources can be channeled to only those most effective methods of recruiting.

RESULTS

Of the 106 respondents, the majority were between the ages of 17 and 21, as shown in figure 2. Ninety-three percent of respondents were male, while seven percent were female.

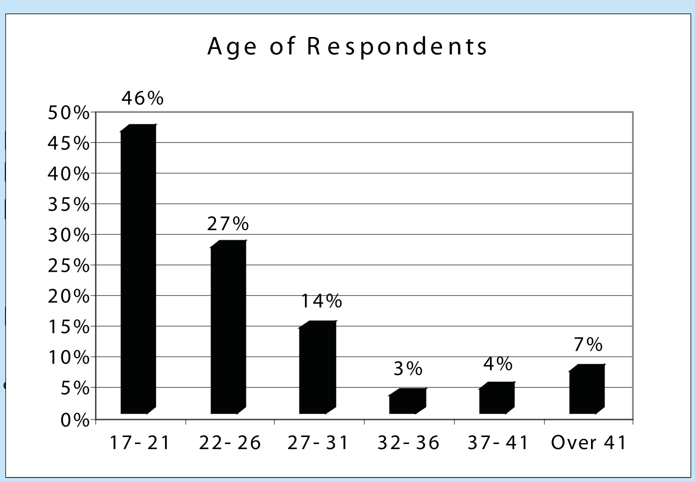


***Figure 2**. Age of Respondents*

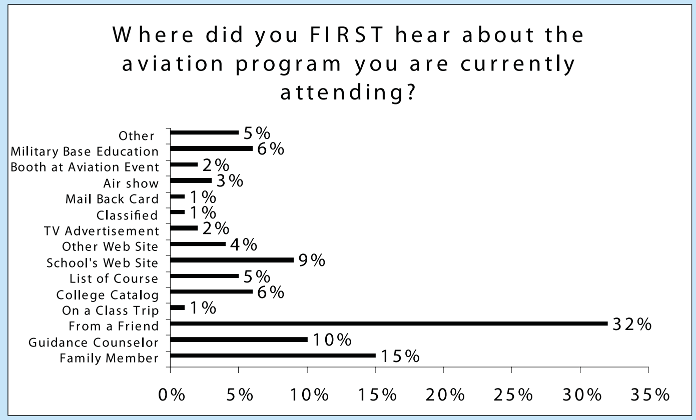


***Figure 3**. Responses to major question one.*

Eighteen percent of respondents were transfer students who had transferred from some other college to a 4-year university program.

Figure 3 contains a breakdown of the results to the question *“Where did you FIRST hear about the aviation program you are currently attending?”*.

Certain responses were not included in the above bar graph because they had 0% of students responding. These 0% responses included the following:

- Direct mailing
- Magazine or newspaper advertisement
- Billboard
- Radio Advertisement
- Booth at State Fair
- Boy/Girl Scouts tour

In analyzing the above results, the authors found it interesting that most of the items with the highest response rates fell into categories that the authors termed “word-of-mouth” categories. These “word-of-mouth” categories were those in which the students heard about their program from a particular person. The following items were further categorized into the “word-of-mouth” categories:

- Military base education office
- A friend
- Guidance Counselor
- Family member

Figure 4 shows the same results as figure 3, except the above four categories have been combined into a single “word-of-mouth” category.

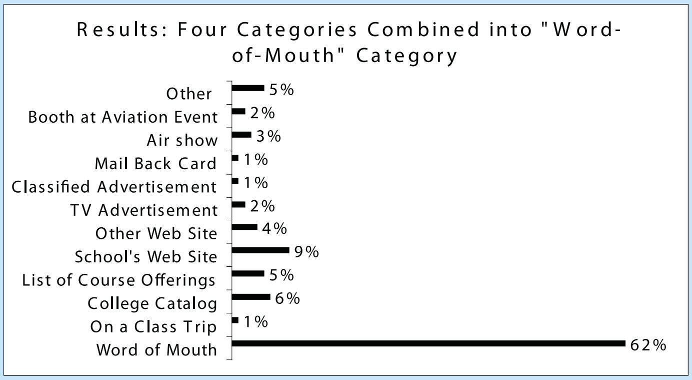


Figure 4. *Responses to major question one, word-of-mouth categories combined.*

With a response rate of 62%, all other categories were dwarfed by this one "word-of-mouth" category. This result was surprising, but clearly indicates that almost two-thirds of students first learn about their school from another person, not through any direct advertising. This finding stresses the importance of "getting the word out". The data further indicates the importance of maintaining quality of program, and quality of instruction. When 62% of respondents FIRST hear about their programs from another person, it is important that that person's opinion is a favorable one. If not, this all important form of advertising could have the opposite of the desired effect.

Figure five contains the results of the second major question *"Which factor most influenced your decision to attend the school you are attending instead of some other school?"*.

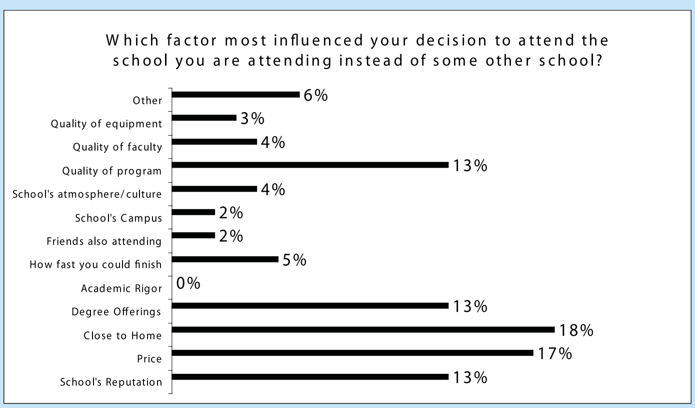


Figure 5. *Responses to major question two.*

The results for this question were more evenly distributed among the available responses. None of the responses were left off the above graph because each of the items had been chosen, with the exception of "Academic Rigor". It seems academic rigor is not such an important or attractive attribute as one might expect. At least this was the case for the 106 students that responded to this survey. Rather, the most important characteristic chosen by our respondents was *"Close to home"*. While this is indeed an important characteristic, it is, unfortunately, one in which schools have no control.

The second highest category, falling one percentage point behind *"close to home"*, was *"price"*. This is a category in which schools do have some control. Although *"academic rigor"* was deemed not to be essential, *"quality of program"* and *"school's reputation"* were important, according to a combined 26% of respondents who chose these as their deciding factors. From the above results, it would seem that schools should have above average success recruiting students close to home, and lure them by focusing discussion on the program's quality, reputation, and price, if these are indeed attributes possessed by the particular program, or school.

The third and last, major question was *"What type of marketing do you think your school should do in order to reach someone like you?"* The authors thought it would be a good idea to allow students to brainstorm, and indeed, some of the student's responses were very good. The following are a selection of the better, and/or more interesting, of the student's responses to this question:

- *"A TV commercial showcasing our airplanes and equipment would be interesting."*
- *"Offer AMT courses at night for active duty service members, from area military bases"*
- *"May not be what you have in mind but advertising on beer boxes, cans, or cases would really spread the word quickly"*
- *"Send out current students to local schools and recruit. Also send flyers or pamphlets to branches of service for end of year tour personnel"*
- *"Any type of ad aimed at reaching juniors and seniors in high school which is posted on www.myspace.com will attract a lot of attention, as well as if the ad were to be placed on television, or if a few alumni would be hired by the school to go around to different high schools in the state and recruit."*
- *"I don't think that they should really do marketing or "advertising". I think they should just become the best school that they can become"*

THE NEXT STEP

Now that the authors have gathered and analyzed the data, the next step will be to brainstorm, and formulate a marketing plan that uses available resources most effectively. The best method to go about this process will probably involve forming a committee consisting of the department's faculty members and academic advisors. This committee's sole assignment will be developing a marketing plan.

A useful tool in brainstorming for the development of a plan is the "SWOT Analysis". "SWOT" is an acronym that stands for "Strengths", "Weaknesses", "Opportunities", and "Threats". It involves identifying internal and external factors that contribute to the marketing environment of the organization in both positive and negative ways (Thompson & Strickland, 1998).

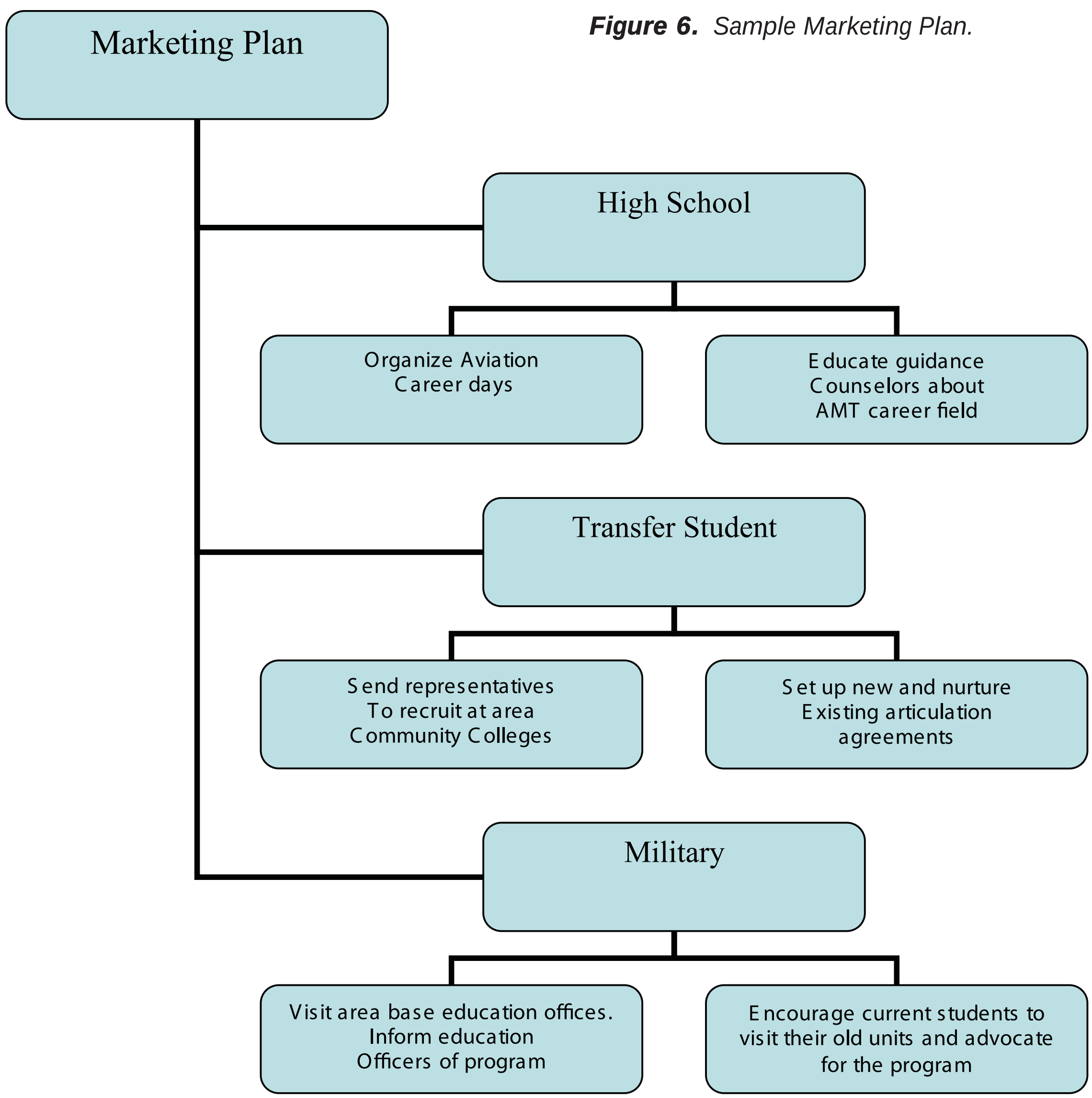
To conduct a "SWOT", the organization first performs an analysis of factors *internal* to the organization. These two factors are organizational Strengths and Weaknesses. Strengths are those attributes internal to the organization that are helpful in attaining the desired outcome, or goal. Weaknesses are identified as the negative factors within the organization that are harmful to achieving the desired outcome or goal. A school's strengths might include excellent faculty, or state-of-the-art facilities. Weaknesses might include high student fees, or low operating budgets.

After internal Strengths and Weaknesses are identified, Opportunities and Threats must be analyzed. Opportunities are defined as external factors that are helpful to achieve the desired outcome, or goal. Threats are external conditions that are harmful to achieving the desired outcome, or goal. A school's opportunities might include a military base close by, providing a large pool of potential students, or the ready availability of state grants. Threats might include a lack of aviation industry nearby that would hire your graduates and drive new students into the program. It might also include competition from other similar programs in the same area.

It is important to identify these factors before developing a marketing plan, so that marketing efforts can be directed toward strengths and opportunities, and away from weaknesses and threats. It is also important to define an agreed upon goal before conducting the "SWOT", so that results pertain directly to the objective in mind, and do not wander over several other problems that do not pertain to the ultimate goal (Bowen et al, 1999).

For Southern Illinois University, Department of Aviation Technology, preliminary data would indicate a marketing plan such as the one in Figure 6 above. This marketing plan would focus on three primary target demographics; graduating high school students, students transferring from 2-year colleges, and military members who will be separating from the armed forces.

Figure 6. *Sample Marketing Plan.*



Each target demographic will be further broken down into smaller demographics with ideas for recruiting listed for each. For example, Figure 6 indicates that for the "Transfer Student" demographic, marketing ideas will include sending representatives to recruit at nearby community colleges, and setting up new and nurturing existing articulation agreements. This is just a sample. The eventual marketing plan will include many more items for each demographic, as the brainstorming sessions dictate.

CONCLUSION

This study was helpful in identifying which factors really influence a student's decision to attend a particular school. It also provided valuable insight into where these students are hearing about their programs, and may provide needed guidance for allocating marketing resources toward the most effective means.

The next step, after conducting all analysis and developing the marketing plan, will be to implement the plan. In doing so it is important to remember that marketing must not be an "event", but a continuous process. Outcomes must be measurable so that results can be followed up, and the plan tweaked as necessary to accommodate new data, or changing conditions. It is also important that the plan be "do-able". It will do an organization little good to have a fine marketing plan, but inadequate resources to implement it.

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BIOGRAPHICAL INFORMATION

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FLORIDA JETS

An event held each year in Lakeland, Florida, is Florida Jets which features R/C models that use gas turbine engines (jets) for propulsion. The models use engines from 30 to 40 and higher lbs. of thrust. The detail is unbelievable with brakes, flaps, spoilers, and retractable landing gears. If you enjoy the top-of-the-R/C world, you would like this event.

Troubleshooting the new Cessna 172 Electrical System

Jeremy Hierholzer
Assistant Professor
Southern Illinois University
Department of Aviation Technologies

Troubleshooting aircraft electrical systems can be a daunting and frustrating task for many aircraft technicians. The process can be full of intermittent failures and incorrect diagnosis. Removing and installing new components can get expensive and is also time consuming.

The Cessna Aircraft Company has addressed the issue of troubleshooting electrical systems on small aircraft with their new model 172 aircraft. Starting with the model 172R and continuing with the model 172S, Cessna introduce the new electrical system junction box. The junction box centralizes the electrical system components that are normally spread out on the firewall of previous 172 aircraft. Included in the junction box are the following components: alternator relay; alternator control unit (ACU); ground power receptacle; ground power relay; battery relay; starter relay; and the bus circuit breakers (Figure 1).

There are several benefits of having the electrical components centrally located in the junction box. According to a review of the Cessna 172R on the AvWeb website: "The J-box protects these components from engine heat, exhaust and fluids, confines electrical noise that might otherwise cause radio interference, keeps critical lead lengths to an absolute minimum, and provides a single-point ground for the entire electrical system." All of this makes troubleshooting the electrical system easier than previous models.

Streamlining the troubleshooting process requires the use of a special electrical system test unit. The test unit is the model TE04 manufactured by Lamar Technologies, a Precision Airmotive company (Figure 2). The Lamar tester connects into the junction box and has the ability to test for faults in the alternator, alternator control unit, alternator filter capacitor, field wire, alternator feed wire, current sensor, and ammeter

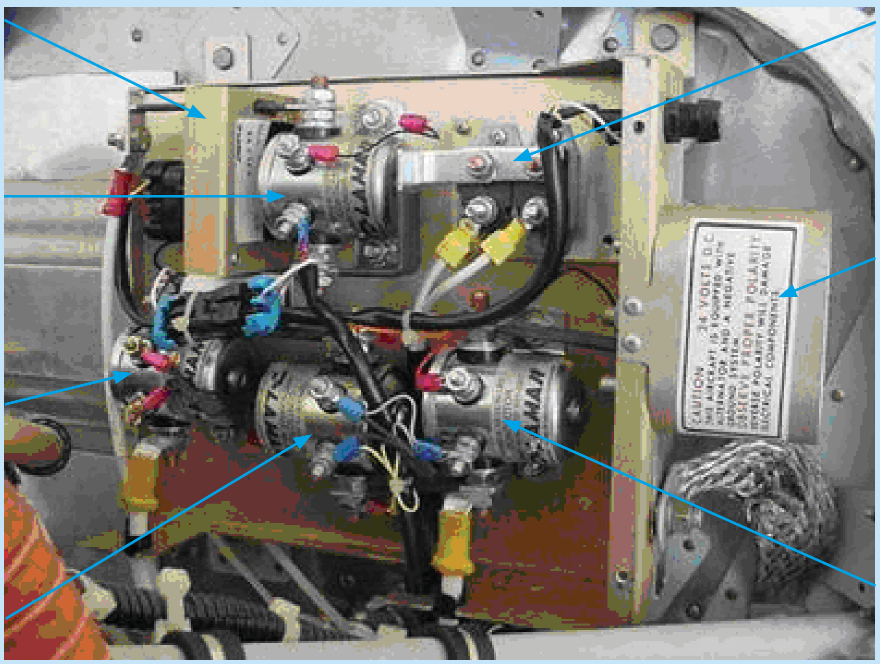

Figure 1. *Electrical Junction Box*

The aircraft to be used for troubleshooting is a Cessna 172SP manufactured in 2002. The owner stated that the VOLTS light came on during flight and would not extinguish. The VOLTS light on the annunciator for the new Cessna 172's will illuminate when main bus voltage falls below 24.5 volts.

Figure 2. *Lamar TE04 MCU Tester*

The first step in troubleshooting a system after learning the system is to verify the problem. To verify the low voltage indication, run the engine at various speeds up to take-off power and verify the VOLTS light stays illuminated. On this aircraft the VOLTS stayed illuminated during the engine run.

Gathering information on the aircraft revealed some interesting data about the electrical system. The alternator installed on the aircraft is an Aero Electric model number 9910591-11RX. This alternator is required by Cessna Service Bulletin 98-24-01. The service bulletin describes the alternator as "incorporating a rotor installation designed to enhance the reliability of the alternator." Also the model number on the junction box is MC01-2A, with the "A" denoting it is post Cessna Service Bulletin 99-24-01. Service bulletin 99-24-01 modifies the electrical system by installing a new alternator control unit (ACU) and providing extra shielding to the alternator wiring. Removing the cover of the junction box revealed the new ACU. Also, the junction box for this aircraft has main bus circuit breakers instead of fuses used by 172's from previous years. The circuit breaker modification is part of Cessna Service Bulletin 00-24-01. Figure 3 details the difference in pre and post service bulletin junction boxes.

Connecting the Lamar test unit into the junction box is made easy by the use of illustrations and written instructions. The leads of the test unit are long enough it can sit inside the cabin and the wires routed through the pilot side window and then into the junction box. The connectors on the test unit are color coded to match the receptacles on the junction box. Once all the connections are set the testing can begin (Figure 4).

The initial testing using the Lamar unit is conducted with the engine off. The first few steps of the testing involve verifying that the test unit is operating properly. (The detailed procedure

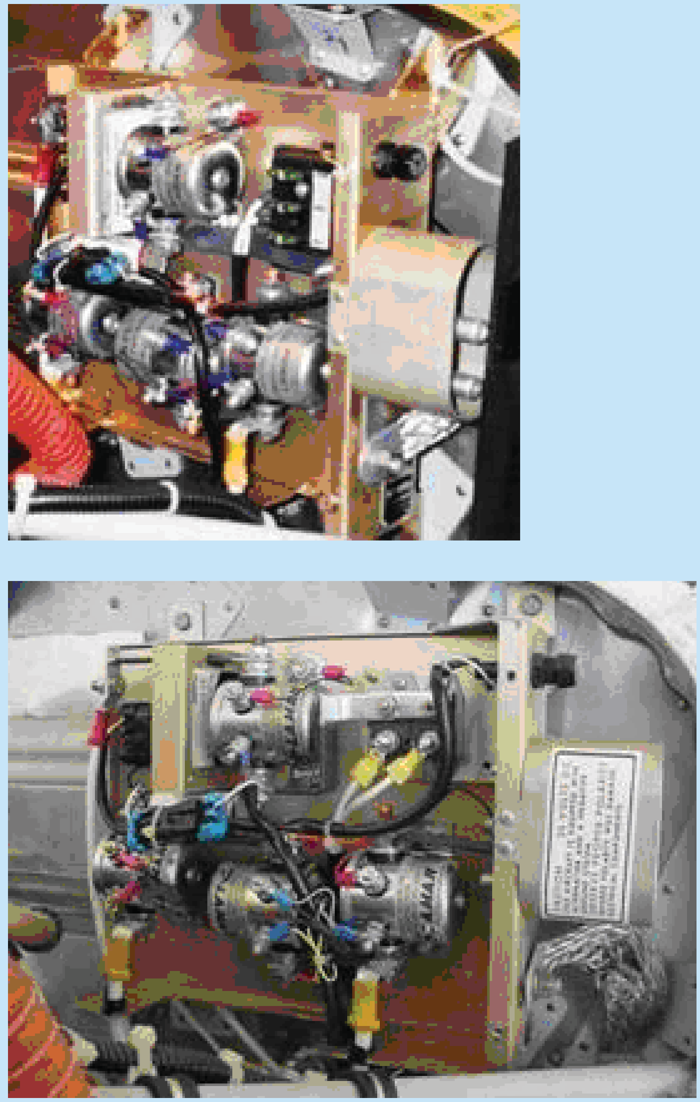

Figure 3. *The picture on the top, is the pre-service bulletin junction box.*

and the indicator lights from the Lamar unit are omitted from the article due to their length.) Once the test unit is operating properly, testing of the electrical system can begin. The first test of the electrical system checks the alternator feeder wire and the alternator for fault to ground with the alternator relay open. Other indications of the first test can lead to suspecting the ACU or a shorted field wire to the alternator feeder wire. The next test applies a larger than normal load to the field. If the ACU is operating properly it should shut down. The final test with the engine static creates a fault in the alternator feeder causing the ACU to shut down.

Once the electrical system passes all the tests with the engine off, testing with the engine running can begin. Start the engine using the normal operating procedure, although the master switch and the alternator switch on the Lamar unit are used instead of the switches on the aircraft panel. Start the engine and set to 1000 RPM. Turn on the alternator relay and field switches on the test unit. At this point the ammeter on the aircraft instrument panel should indicate a charge and the BUS=28V light on the test unit should illuminate. This particular aircraft

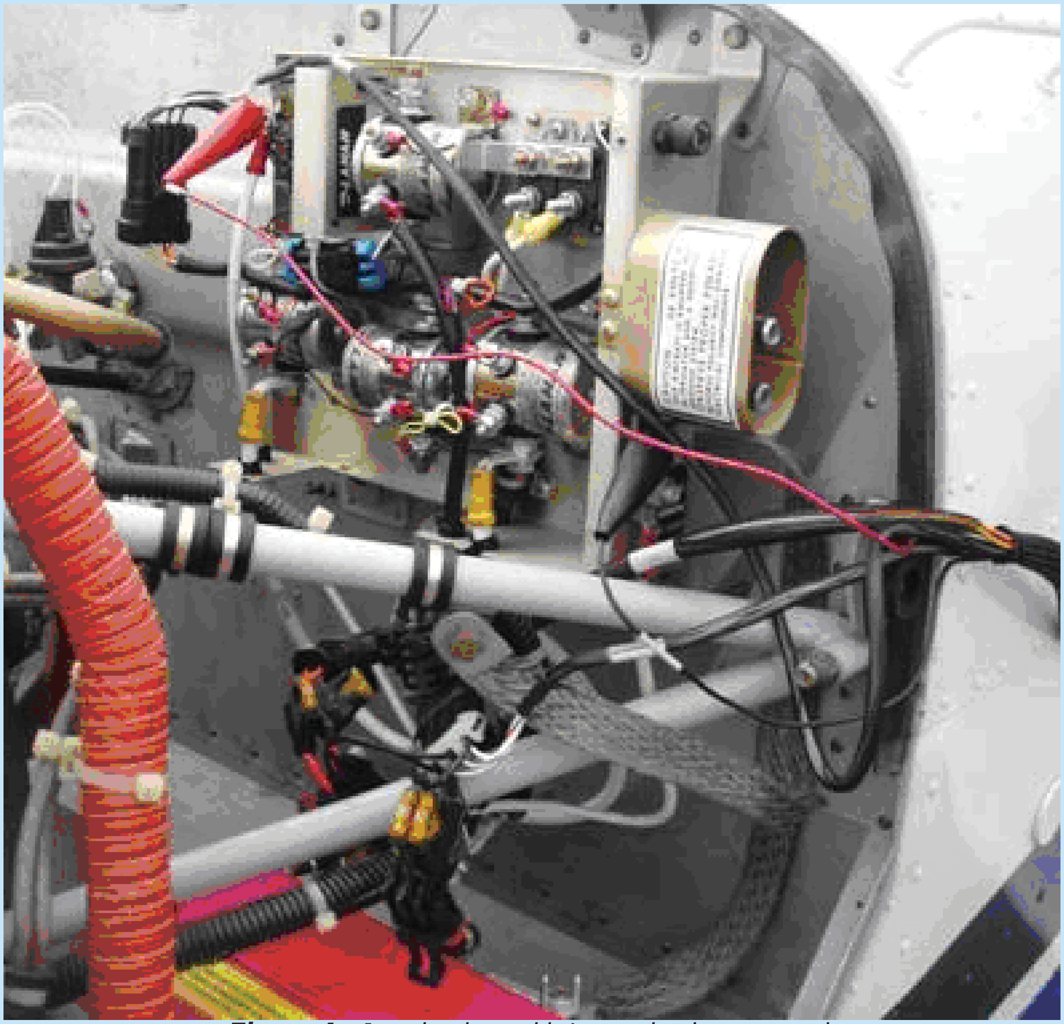

Figure 4. *Junction box with Lamar leads connected.*

showed a discharge on the ammeter and the BUS = 28V light did not illuminate. The engine was then shut down and voltage was checked at the alternator field terminal. According to the Lamar instructions, if voltage is present at the field terminal the alternator is at fault. The aircraft in question showed 20 volts at the field terminal, thus indicating the alternator needs replacement.

Using the Lamar test unit definitely streamlines the troubleshooting process on the electrical system on the new Cessna 172 aircraft. Following the procedures systematically eliminates components that could cause problems in the system. Once the faulty component is detected the rest of the test procedure can be skipped and the fault repaired. The Lamar test unit can then be used to verify that the repaired or replaced component fixed the original fault.

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“The primary purpose of allowing the plan to be created online instead of using a template”, stated by Alan Rosenauer, Publisher of Regulatory Products with Compliance Publishing, “is that these programs were not getting done, or were taking an incredible amount of time, and employees are being put at risk. This is a huge step in getting companies into compliance and keeping their employees safe”.

Every workplace contains chemicals, many of them hazardous. In order to ensure chemical safety in the workplace, information must be available about the identities and hazards of the chemicals. OSHA’s Hazard Communication Standard (HCS) requires the development and dissemination of such information in a Hazard Communication Program.

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ATEC Update

ATEC 2007

This year's conference in Orlando, April 1-3, featured some of the best presentations in several years according to attendee evaluations. In addition, employers from four companies exhibited at the conference, looking for A&P graduates. Sixty-nine schools from across the country were represented and 149 people were in attendance.

Next year, the conference will be held in Las Vegas, April 6-8, at The Riviera Hotel.

ELECTION RESULTS

The following are the Board members who were elected at the conference:

Joe Fisher – Treasurer, Hallmark Institute

Robert Drake, Redstone College, LAX

Joseph Dudek, Del Mar College

LaVern Phillips, Aviation Institute of Maintenance

Domenic Proscia, Vaughn College

Andrew Smith, Kansas State University at Salina

Attached is a copy of the complete Board member list.

GOVERNMENT RELATIONS

Ray Thompson, Chair of the Government Relations Committee and ATEC liaison with the FAA made the following announcements at the conference:

1. The ARAC process, to deal with limited modifications to PART 147, has been agreed to and should be starting soon.
2. ATEC has submitted their PMI Handbook suggested changes to the FAA and is looking forward to the final document sometime in the next few months.
3. The FAA Symposium meeting in June in Indianapolis will deal with a marketing strategy for the AMT career.
4. The ATEC Board will be reviewing ASNT, NCATT and others in order to decide who we want to support to certify schools and AMTs. ATEC is helping to foster certification partnerships. ATEC is not in the role of accreditor but will act to facilitate the various groups that are currently active.
5. ATEC has also agreed to act as facilitator to help schools interested in providing Light Sport Aircraft inspector and repairman training. ATEC, however, will not be developing a curriculum.
6. Finally, ATEC has been able to bring a number of individual school issues to the FAA in Washington through a process designed last year. Contact ATEC if you have an issue that has not been resolved with your local FSDO.

SURVEY RESULTS

The results of two surveys are attached. The first indicates the number of students enrolled, graduated and working in aviation between 1998 and 2005.

The second survey, which was conducted at the April 1-3 conference shows participant interest in the location and timing of the 2009 and 2010 ATEC conferences.

ATEC FINANCES AND DUES CHANGE

The 2005-2006 Annual Financial Report was reviewed at the conference. ATEC had a small surplus this year. Additional CD's were purchased in order to increase the interest impact on our reserve.

ATEC is changing to a calendar year payment schedule in May of 2007 and a flat dues rate of $210/year. As a result, a one time rate of $315 will be charged for one and a half years of dues. The next dues cycle will then start on January 1, 2009.

MEMBER SERVICES AND SCHOLARSHIPS

The CAT Source Book is a listing of manufacturers and operators that provide training to the Industry. The listing includes contact information and listings of training that they provide. The Source Book can be accessed through a link on the ATEC website.

The Northrop Rice Foundation is monitoring and maintaining a Sale, Trade, and Exchange Listing Form that can be accessed through the NRF link on the ATEC website. Any ATEC school that wants to post information in regards to need or availability of items of interest to other schools may do so through the NRF link.

Items donated to the Northrop rice Foundation are available to ATEC schools. A donated Items Listing that shows what items are available and the procedures and conditions for requesting them is available from the NRF website that can be accessed by a link on the ATEC website.

The following are scholarship and award programs administered by the MSC:

Programs	Sponsors
S&K Tool Scholarships	S&K Hand Tool Company
Wing Aero Aviation Books Scholarships	Wing Aero Products Company
NIDA Training Equipment Awards	NIDA Corporation
Dale Hurst Memorial Scholarship	AVOTEK
NRF Instructor Assistance Award	Northrop Rice Foundation
Ivan D. Livi Instructor of the Year Award	ATEC
James Rardon Student of the Year Award	Northrop Rice Foundation

General Information Sheets and Applications may be downloaded from these websites:

ATEC – www.atec-amt.org

Northrop Rice Foundation – www.northropricefoundation.org

or request by e-mail from Ivan D. Livi, ivan.livi@verizon.net

THE NEWS FROM FLIGHTSAFETY

FlightSafety International announced that the Michigan Institute of Aviation and Technology (MIAT) will incorporate FlightSafety's Principles of Troubleshooting course into its curriculum.

MIAT is adding FlightSafety's Principles of Troubleshooting to its curriculum in order to help their students develop a more complete understanding of the latest technology used in today's advanced aircraft as they prepare for careers as professional aircraft technicians.

The course uses an advanced software simulation program that exposes the technicians to a wide variety of scenarios as they practice and perfect their troubleshooting techniques.

For additional information contact:

Nick Sergi
FlightSafety International
Marine Air Terminal
LaGuardia Airport
Flushing, NY 11371
718-565-4125
718-565-4134 FAX

ATEC MEMBERSHIP

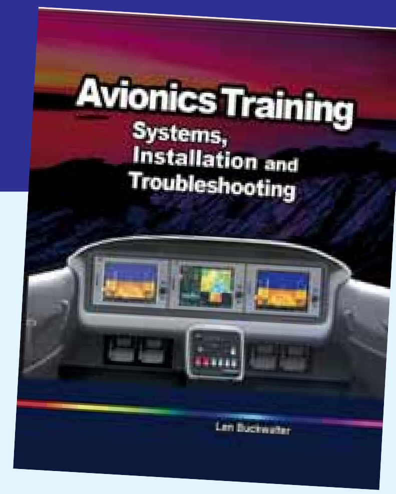
Industry members help support ATEC's work. With the number of A&P schools declining, industry membership is an important growth area for ATEC.

Please ask your school's program advisory committee members to support ATEC as an industry member for $325. The application form is on the website www.atec-amt.org.

VIDEOS TO DVDS

Twenty-one of the more than 200 ATEC videos have been converted to DVD format. The 21 DVDs were the most often requested instructional films by ATEC members. Based on school's suggestions, additional DVD's will be copied.

A 'Hands-On' Avionics Book for the Aviation Maintenance Technician



This new book covers subjects now most in demand; including servicing and troubleshooting on the ramp and flight line.

The text is easy to understand---no electronic knowledge required. Instead of formulas and schematics, the book clearly explains over 30 different systems, then shows how to do an installation, run wires and fix problems. Everything is illustrated in full color for fast comprehension.

Already adopted as a text by A&P schools and other training organizations.

The author, Len Buckwalter, founded Avionics Magazine and has been writing about the subject for 25 years.

Order from www.avionics.com or aviation book distributors.

All images in book also available on CD for projection.

Published by Avionics Communications Inc.
Leesburg, VA. Tel: 800-441-4224, 703 -777-9535
E-mail: avionics@avionics.com
Web: www.avionics.com

Avionics Training: Systems, Installation and Troubleshooting.
ISBN 1-88-55544-21-9. Pages: 320
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To see full Table of Contents and 50-page excerpt from the book, visit ***www.avionics.com***

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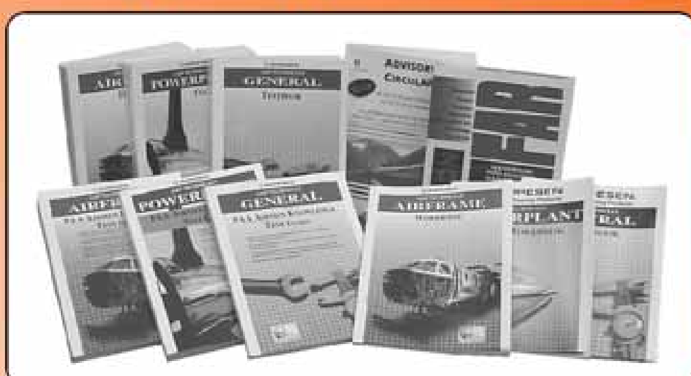

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ATEC Awards

Awards presented

The Jim Rardon Student of the Year award was presented by Jim Lukins of the Northrop Rice foundation to Brenda Wallace a student at Aviation Institute of Maintenance Virginia Beach.

The Ivan D. Livi Educator of the year award was presented to Ronald Sterkenburg from Purdue University.

Fred Mergal was presented an award for 25 years service on the ATEC Board. The award was presented by President Laurie Johns.

2007 SCHOLARSHIP AWARDS

S&K TOOL SCHOLARSHIPS

1.	Kenneth Mounts	Salt Lake Community College, Salt Lake City, UT
2.	Rodolfo Zamora	Redstone College, Inglewood, CA
3.	Paulette Harrison	Louisiana Technical College, LaFayette, LA

WING AERO BOOK SCHOLARSHIPS

1.	Jacob Kohntopp	Utah State University, Logan, UT
2.	Jordan Manns	Pittsburgh Institute of Aeronautics, Pittsburgh, PA
3.	Adam Young	Idaho State University, Pocatello, ID
4.	Bryan Dudas	Lane Community College, Eugene, OR
5.	Trevor Halverson	St. Phillips College, San Antonio, TX
6.	Nathan Schuler	Kansas State University, Salina, KS
7.	James Knuth	Toledo public Schools, Swanton, OH
8.	Brandon Royer	Aviation Institute of Maintenance, Lawrenceville, GA
9.	Geovanny Rodriguez	George Baker Aviation School, Miami, FL
10.	Cynthia Vega	St. Phillips College, San Antonio, TX

NIDA SCHOOL AWARDS

1. Teterboro School of Aeronautics, Teterboro, NJ
2. National Aviation Academy, Clearwater, FL
3. Aviation Institute of Maintenance, Virginia Beach, VA
4. Lane Community College, Eugene, OR

DALE HURST MEMORIAL SCHOLARSHIP

Tom Stose, Fairmont State College, Fairmont, WV

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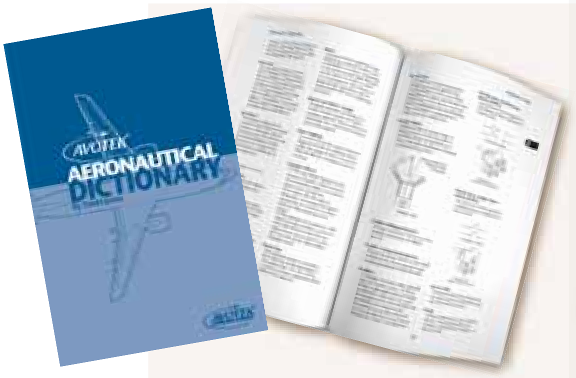

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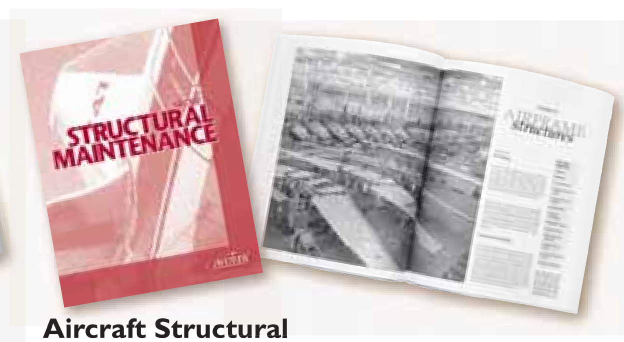
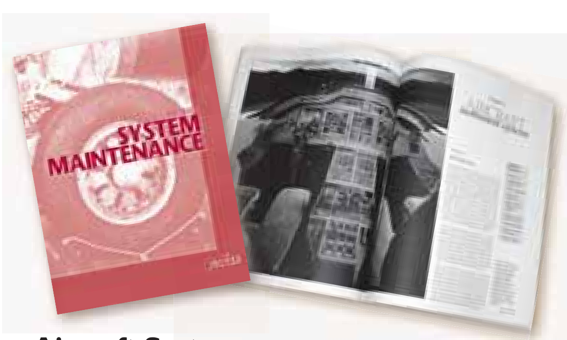


Aircraft Structural Maintenance



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SUN 'N FUN

Sun 'N Fun is held in April of each year at the Linder Airport in Lakeland, Florida. I would describe it as one of the best air-shows of the year. It incorporates aircraft from every area of aviation. War birds, antique, homebuilt, new production, military, light sport and ultra-light aircraft are all on display at the show. There is an air-show every day including a night air-show. From country singers to too many different aircraft, engine and aviation service providers to mention are all available as part of the show. Technical seminars are every where, from FAA information, aircraft engine and airframe manufacturers to hands-on-training seminars that teach how to build homebuilt aircraft. Several areas are offered such as welding, composites, sheet-metal, woodworking, engines, and fabric covering and more. Come for a day or all week and enjoy the flavor of general aviation which prevails during the Sun "N Fun..

SURVEY RESULTS

Each year ATEC surveys all PART 147 programs to assess enrollments, graduates and those who accepted a position in aviation.
Note: Not all schools return the survey each year.

The following are the results for 1998-2005.

	1998 n=143 schools	1999 n=107 schools	2000 n=114 schools
Enrollments	11,699	14,209	13,827
Graduates	4,510	3,872	4,978
Grads Who Went to Work in Aviation	3,338	3,709	4,039

	2001 n=107 schools	2002 n=94 schools	2003 n=83 schools
Enrollments	12,328	11,199	10,862
Graduates	5,658	4,190	3,818
Grads Who Went to Work in Aviation	4,700	2,480	2,589

	2004 n=83 schools	2005 n=86 schools
Enrollments	11,791	7,680
Graduates	3,601	3,226
Grads Who Went to Work in Aviation	2,381	2,047

Tools of the Trade

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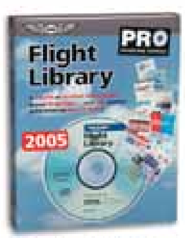
FAR-AMT, Aviation Mechanic Handbook, Dictionary of Aeronautical Terms

ASA's references provide mechanics with the essentials. These handbooks are the definitive source for regulations, terms, definitions, and encyclopedic information and data fundamental to every AMT toolbox.



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