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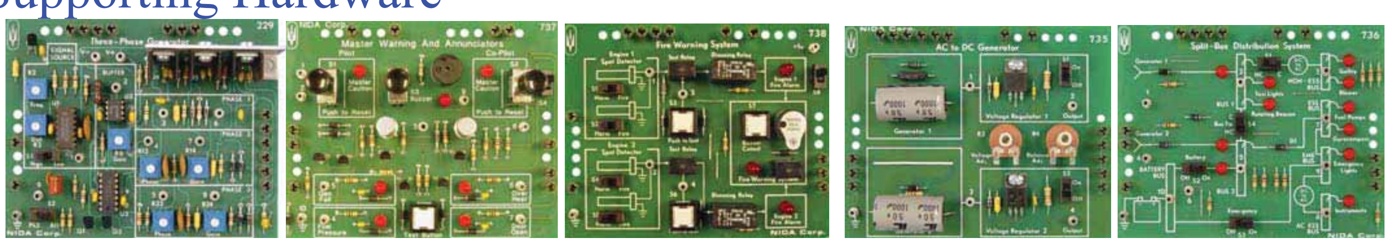

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Diesel Engines:

Inclusion of Emerging Technologies In the FAR 147 Classroom

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ABSTRACT

Title 14 CFR Part 147 aircraft maintenance training is designed to provide a broad base of knowledge, skills and exposure to technologies prevalent in the aircraft inspection and repair field. While current Part 147 training curriculums are adequate for understanding basic aircraft systems and developing entry-level mechanical skills, employers often criticize the syllabus because they must provide supplementary training for new technicians lacking a base of knowledge of current technology aircraft and systems. Over the past several decades, the lack of emphasis on the federal level to update Part 147 curriculums coupled with almost no industry support widens the already huge training disparity between Part 147 classrooms and modern aircraft systems. An inequality that expands exponentially as a variety of advanced aircraft and systems are certified and enter service.

INTRODUCTION

After decades of stagnant growth and little to show in product enhancements, the dawn of the new millennium has seeming ushered in a new period of design and performance expectations for piston powered general aviation aircraft. Miniaturization of electronics, computerization of avionics, composite structures and digital engine controls have allowed manufacturers to produce aircraft that are more affordable and outperform previous designs. One of the more significant highlight of these advances has been in alternate fuels and piston engine technology. These advances come at a critical time in the aerospace industry, faced with rising fuel costs and an emphasis to reduce production of avgas in favor of reduced emissions fuels including diesel and turbine fuels which are simpler to refine and cheaper to produce (Visser, 2008).

A reflection of current price instability and confusing market actions, aviation fuel has become a complex area under discussion on many fronts. In all sectors of the aviation industry, skyrocketing prices and reduced availability not only threaten to severely cripple scheduled air carriers, corporate operations but general aviation as well. While jet fuel is universally available, several petroleum companies have either completely withdrawn or have significantly reduced production and refining of avgas (Visser, 2008).

The expected shortage of avgas in the next decade coupled with rising costs, has been perhaps the strongest motivation for the emergence of diesel engines in general aviation. Another attractive feature of diesel engines is a 4-5 gallon per hour fuel burn as opposed to 8-10 gallon per hour experienced with 100LL avgas (Cox, 2007). Certifying diesel powerplants for airplanes in the 21st century may still be difficult for some aviation enthusiasts to embrace, considering the diesel engine traces its origin back to the late 19th century. In fact, four 1,200 horsepower Daimler-Benz V-16 diesels powered the famous airship Hindenburg (Kane, 2003). As such, the diesel is one of the world's oldest internal combustion engines, dating back to Rudolf Diesel's 1892 patent in Germany (Pahl, 2005).

HISTORY

The word "diesel" is derived from the German inventor Rudolf Christian Karl Diesel (1858 –1913), who in 1892 invented the diesel engine. A refrigeration engineer by training, Rudolf Diesel had a fascination with thermo-dynamics and improving efficiency. Not satisfied with the low efficient steam engines of era, Diesel was determined to design an engine with much higher efficiency ratios. In 1893, Diesel published a paper titled "The Theory and Construction of a Rational Heat Engine." In his paper, Diesel correctly theorized that higher compression in an engine cylinder results in higher efficiency and increased output. As Diesel explained, this happens because when the piston squeezes air with the cylinder, the air becomes concentrated. Originally, Diesel intended to use peanut oil as fuel, because his experiments revealed that peanut oil atomized with the concentrated air at higher concentrations than existing fuels, resulting in increased engine horsepower (Pahl, 2005).

Applying for patents in the United States and Germany, Diesel has publicly introduced his calculations indicating that gasoline engines of the era had compression ratios ranging from 8:1 to 12:1. However, his design compressed at a ratio of 14:1 to as high as 25:1. In the diesel engine, fuel is then injected into the cylinder and ignited by the elevated temperature resulting from the high compression. Diesel's powerplant operated at nearly 75% percent efficiency. This was an amazing accomplishment for the time considering the prevailing efficiency of the steam engine was only 10 percent or less (Pahl, 2005).

Since Diesel demonstrated his engine ran more efficiently than comparable power plants, it soon became a highly desired replacement for the steam engines and the primitive gasoline engines of the era. However, because of its very high compression ratios, the diesel engine required a heavier, more robust construction than a steam or gasoline engine. Consequently, it was not widely accepted in the emerging aviation industry. Nevertheless, the diesel engine gained widespread acceptance in many other applications, including naval vessels, locomotives and trucks. In addition to heavy industrial applications, several modern automotive manufactures offer various diesel powered cars and light trucks. Recently, several diesel engine designs that have overcome size, weight and installation penalties have been certified and flown in light general aviation aircraft. These engines are designed to run on either diesel fuel or jet fuel, which is more commonly available in the United States and Canada (McAulay, 2008).

Sadly, Rudolf Diesel did not live enough to fully appreciate his contributions nor realize the impact of the diesel powerplants in aerospace. The sudden death of Rudolf Diesel is shrouded in mystery and intrigue as intense as any folklore. In late September of 1913, Diesel, along with several of his business partners, boarded a passenger ship in Antwerp for a short cruise to England for a business meeting in London. It is speculated that the purpose of the meeting was to explore the possibility of granting production licenses for diesel engines to the United States and Great Britain to equip an expansion of allied naval forces in the face of rising tensions in Europe (Pahl, 2005).

Diesel and his colleagues ate together that evening and after enjoying drinks and light conversation, each retired to their own stateroom. Diesel left instructions with the steward not to be disturbed during the remaining evening hours. When Diesel failed to meet his associates for breakfast the next morning, an intense search was conducted about the ship with no sign of Diesel anywhere. Despite his belongings still in the stateroom, and his clothes neatly laid out for the next day, Diesel was nowhere to be found. Ten days later, the crew of a Belgian steamer sighted the corpse of a man floating in the water. The body was taken on board and several personal items recovered from its clothing. Because the body was in such an advanced state of decomposition, as was the custom of the time, it was given proper preparation and returned to the sea with a traditional burial at sea ceremony (Pahl, 2005).

Several weeks later, the personal articles recovered from the body were examined and identified by Rudolf's son, Eugen Diesel, as belonging to his father. The exact circumstances surrounding Diesel's death will never be known, because officials never conducted an official investigation, and since the body was never recovered a second time, no official autopsy or government report was ever completed (Pahl, 2005).

OPERATION

In design, shape, and function, diesel and gasoline engines are quite similar. They are both internal combustion engines designed to convert the chemical energy available in a combustible fuel into mechanical energy. This mechanical motion moves pistons up and down inside cylinders. The pistons are connected to a crankshaft, and the up-and-down motion of the pistons, known as linear motion, creates the rotary motion necessary to move a vehicle or aircraft propeller (Crane, 2007).

The fundamental operation of a four-cycle diesel is the same as for a gasoline powered engine as explained by the Otto cycle. Similar to gasoline engines, separate intake, compression, power, and exhaust strokes complete the cycle and result in power output. The exceptional differences of the diesel are evident in the intake and compression strokes and the way fuel is mixed and ignited. The diesel internal combustion engine differs from the gasoline powered Otto cycle by using a higher compression of the air in the cylinder to ignite the fuel rather than using a spark plug. This is commonly referred to as "compression ignition" rather than "spark ignition" associated with electric ignition systems of gasoline-powered powerplants. This cycle can operate with a higher compression ratio than the Otto cycle because only air is compressed and there is significantly less occurrence of conditions that may cause auto-ignition of the fuel (Crane, 2007).

The diesel piston's intake stroke caused by the rotation of the crankshaft draws in only air. However, during the compression stroke in a diesel engine, air is compressed to a much higher pressure than gasoline engines. As Rudolf Diesel designed, the typical diesel compresses this air volume with a ratio that can vary between 15 and 20 percent. This elevated compression raises the temperature of the air in the combustion chamber to the ignition temperature of the atomized fuel/air mixture. This compressed charge of air is so hot, that when fuel is injected into the cylinder, it ignites almost instantaneously. Consequently, in a diesel engine, fuel is not in injected until the piston is very near its full travel during the compression stroke and is ready to travel downward on the power stroke.

In cold weather, diesel engines can be difficult to start because the mass of the engine block, pistons, and cylinder head absorb the heat of compression, thus preventing ignition. Gasoline engines equipped with magnetos experience the same problem; however, they have the added benefit of a spark plug that generates ignition of the fuel/air mixture. Each time the intake valve on a diesel opens, a full charge of cold air enters the cylinder. In extreme conditions, the repeated intake of cold air can cool the cylinder below the ignition point of the fuel/air mixture. To avoid this problem, diesels are normally equipped with igniters called glow plugs inside the cylinder to help ignite fuel when starting in low temperatures.

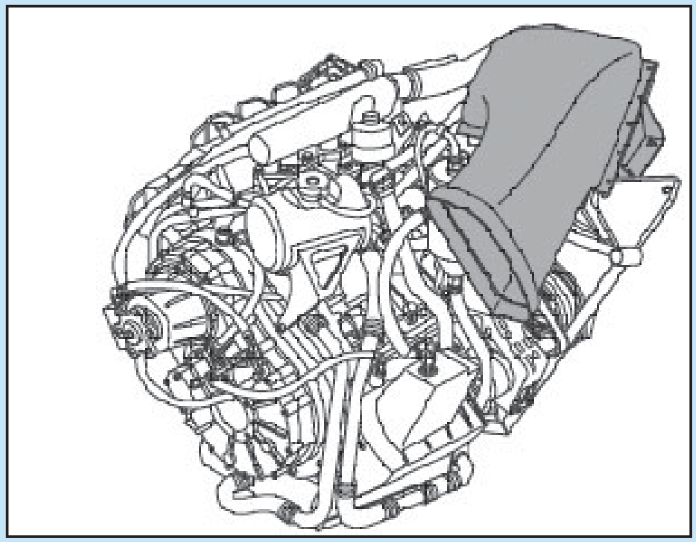
ALTERNATE ENERGY

With memories of the recurring fuel shortages in the mid 1970s and 1980s still fresh, in the late 1990s, aircraft manufacturers began searching for alternative powerplants, both turbocharged and normally aspirated. While performance and durability were important deliberations, fuel economy was also a significant factor. Diesel engines attracted the attention of aircraft engineers because of their simple design, proven durability in ground transportation and marine applications, and their ability to operate on any combustible liquid. In fact, Rudolf Diesel was especially interested in using alternate fuels such vegetable oil, and his 1892 demonstration engine ran very well on peanut oil. Although these fuels have not become immensely popular, recent spikes in fuel prices has led to a more widespread use of diesel in many industries and spurred the search for new forms of alternate energies (Costlow, 2008).

With the growing turbine powered general aviation market coupled with the expected expansion of the Very Light Jet segment, the dominant aviation fuel is becoming Jet A. It is no coincidence that diesel engines run very satisfactory on Jet A. While several airframe manufacturers have diesel engine certification for their aircraft, perhaps the most notable is Canadian manufacturer Diamond Aircraft. The German manufactured Thielert Centurion Model 2.0, a turbocharged diesel producing 270 horsepower (TAE 125), powers the Diamond Twin Star model DA 42. The TAE 125 is a liquid-cooled, inline 4-cylinder, turbo-charged engine with dual camshafts. Like contemporary diesels, the TAE 125 engine has a direct-injection fuel system controlled by stand alone electrical controls and computers. A reduction gearbox incorporating a torsional vibration damper rotates the propeller (Diamond Brochure, 2006).

Fuel from the airplane fuel system goes into the engine fuel filter located in the engine nacelle. The inlet fuel is drawn through the filter by the engine-driven low-pressure fuel pump, supplying fuel to the engine high-pressure pump. The high-pressure pump supplies fuel to injectors mounted in a common rail type system and located between the duel intake valves. A pressure relief combined with a regulator valve controls the fuel pressure. Excess fuel from the valve is returned to the airplane main fuel system. However, because of the elevated pressure in the common rail, this surplus fuel returning from the engine is hot and must pass through a fuel cooler before returning to the aircrafts main fuel tanks (Diamond, 2004).

The TAE 125 is also equipped with a turbo charger to increase the efficiency and power output. Exhaust gases go through a turbine before flowing through a conventional exhaust to atmosphere. A waste gate valve mounted in parallel with the turbine controls the volume of exhaust gas going through the turbine. The turbine turns a centrifugal compressor that supplies air to the engine through an inter-cooler (Diamond, 2004).

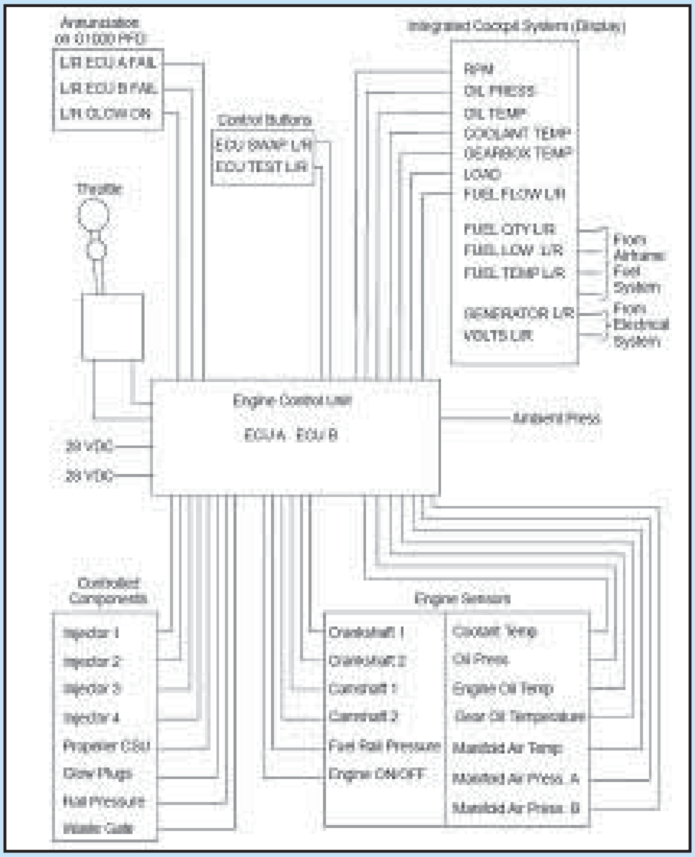


TAE 125-01, 270-horse power diesel engine (Diamond.com).

The innovative Thielert diesel powerplant is equipped with a stand-alone, two channel Full Authority Digital Engine Control (FADEC) electronic control system. Separate but identical digital circuits provide redundancy with each channel providing all the required engine functions and indications. In case of a sensor failure or another anomaly in either channel, the unaffected channel is designed to optimum engine efficiency. The FADEC controls each engine cylinder independently for optimum fuel injection and ignition of the fuel/air mixture.

Consequently, the need for the pilot to monitor and control mixture is eliminated. In addition, because diesel engines do not require a battery on magneto ignition system, repetitive, costly maintenance associated with the magneto, spark plugs, and ignition leads is eliminated. In addition, since diesels are "heat compression" engines, carburetors, mixture controls and engine priming systems are not necessary (Thielert com).

Whether installed on a single or twin-engine aircraft, each Thielert engine has a dedicated power level located in the aircraft's console. These power levers control the separate and independent electrical FADEC systems. The levers operate electrical potentiometers that give signals in proportion to the power lever position to the Engine Control Units (ECU) A and B to set the power output. Either channel can control the engine in back-up or failure mode.



TAE 125-01 FADEC Control Schematic (Diamond.com).

The engine control system also establishes propeller RPM through the constant speed unit to provide the best power setting. Both ECU A and ECU B channels are contained in a single box located in each engine nacelle. A robust harness connects the box to the various engine sensors, the power lever and the integrated cockpit system (ICS). For normal operations, the alternator supplies power for the system. In case of alternator failure, ECU channel B assumes engine control and the self-contained backup battery provides power for the FADEC system (Diamond, 2004).

Diamond is not the lone manufacturer to offer diesel-powered aircraft. In November of 2007, Cessna Aircraft announced, that it would begin production of a diesel version of its popular 172 Skyhawk model. The new aircraft would also be powered by a Thielert Centurion turbo diesel. The particular Thielert model installed in the 172 under provisions of the Thielert Supplemental Type Certificate will produce 155 horsepower and actually weigh slightly more than a Lycoming O-360 gasoline powered engine. While slightly heavier than a conventional gasoline engine, Cessna is confident the significantly reduced fuel consumption along with increased climb performance and aircraft range outweigh any installation drawbacks of the Thielert diesel (Thurber, 2007).

French engine manufacturer Société de Motorisations Aéronautiques (SMA) has also developed and certified a diesel powerplant, this one for the Cessna 182 series aircraft. The SMA SR 305-230-1 diesel is available for installation on Cessna 182Q and 182R models. It is a four cylinder horizontally opposed diesel, that similarly to the Thielert, incorporates a turbo charger and is controlled by a single lever connected to electronic engine control system (Benenson, 2008).

Maule Aircraft has also introduced a diesel-powered aircraft, the Maule M-9-230 Diesel. The Maule M-9-230 Diesel is also powered by the French designed SMA SR 305-230 turbo diesel. The SMA SR 305-230 is an air and oil cooled that incorporates a unique design allowing engine oil to circulate thorough the cylinder head to control engine temperatures. (Cox, 2007).

CONCLUSION

In its report, "FAA Needs to Update Curriculum and Certification Requirements of Aviation Mechanics," the General Accounting Office (2003), observes that FAR 147 programs are centered upon lesson plans developed in the pre-World War II years and focused on small uncomplicated aircraft and systems. Realizing the need of modernizing aircraft maintenance training, the Federal Aviation Administration (FAA) established a Part 147 Aviation Maintenance Technology schools subcommittee of the Aviation Rulemaking Advisory Committee (ARAC) to examine and make recommendations for change in the curriculum. This effort marks an important change in the aviation industry regarding learning and teaching in technical environments.

Along with advanced composites, avionics and expanded electronics exposure, one of the newer concepts that should be included in the curriculum update is the diesel powerplant. In an era of rising energy costs combined with an emphasis to find environmentally cleaner fuels while improving performance, the diesel engine appears to be earning increasing acceptance.

As diesel power plants become more popular and efficiency improves, it will certainly become important for aircraft maintenance training schools to provide the necessary practical training and troubleshooting skills for these advanced powerplants.

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Start Pac Power Supply Awarded To MTSU

An $825.00 equipment grant by Rotorcraft Enterprises of Las Vegas to the Aerospace Department at Middle Tennessee State University (MTSU) is the first of a new emphasis on partnerships with Aviation Maintenance Technical schools across the United States. The grant was formally announced at the 48th Annual Aviation Technician Education Council Conference recently held in Las Vegas. Administered by the Northrop Rice Foundation, the award was presented by Judith Wurith, President of Rotorcraft Enterprises to Joe Hawkins, an Assistant Professor at MTSU. According to Hawkins, "MTSU is extremely pleased with the Rotorcraft Enterprises Start Pac Power equipment grant, which further demonstrates the commitment of both the Northrop Rice Foundation and Rotorcraft Enterprises to support the advancement of aviation maintenance training and careers."

MTSU is an approved Title 14 CFR Part 147 aviation maintenance technician school for airframe and power-plant maintenance. Incorporating new technologies so students are learning the knowledge and skills of the core aviation maintenance curriculum is an ongoing challenge for faculty. Participating in project-based lab activities along with experiential learning concepts students are introduced to the latest technological advances. These technological practicums are one of the many tools available to help students comprehend difficult course content while mastering a particular concept or skill.

According to Hawkins, the Rotorcraft Enterprises Start Pac battery and ground power units has become an integral part of several maintenance training classes, including airframe and powerplant inspection, systems and troubleshooting. In addition to providing ground power for maintenance trainers and shop related equipment, the Start Pac equipment also provides power for demonstrating the advanced avionics installed on the universities flight training fleet. Currently, MTSU training feet consists of 25 planes from Diamond Aircraft and The New Piper Aircraft Inc. The majority of the aircraft are equipped with electronic flight displays along with Global Positioning Satellite systems, Traffic Collision Avoidance systems and NEXRAD Weather Radar. The Rotorcraft Enterprises Start Pac has proven ideal for powering up these aircraft equipped with advanced technology glass cockpits for ground instruction of new pilots and routine updates. When utilizing the Mini Portable Power Supply, the entire aircraft electrical system can be powered up for GPS programming or other electrical needs, saving the on board battery for engine starting.

The university also operates a King Air 200 as part of the Air Charter Lab that is available to Professional Pilot majors. The Rotorcraft Enterprises Start Pac battery is also used to power the King Air aircraft systems during routine checks as well as unscheduled maintenance. As Hawkins states: "The Rotorcraft Enterprises Start Pac battery really makes the rounds across our airport campus. Whether in a training lab, flight school maintenance or on the King Air, it has become a valuable piece of equipment."

Utilization of Donated Equipment in Aviation Technologies Education –

Fabricating an S-Tec 55X Autopilot Trainer

Dennis R. Hannon, Southern Illinois University

INTRODUCTION

In the field of technical and vocational education, the acquisition of training aids to enhance the learning experience with hands-on practice can be difficult and expensive. Programs at both the community college and university level have limited budgets and in many cases rely heavily on donated equipment to augment their existing resources. The Department of Aviation Technologies at Southern Illinois University Carbondale is no exception to this. Our program has been very successful in years past in acquiring training aids such as simulators and system mock-ups, but in recent years, these resources have dwindled substantially while the level of sophistication in airborne systems, especially those relying on avionics, has increased markedly. Although the aerospace industry is by its nature conservative in adopting cutting edge technologies, the digital revolution which began in the 1980s has not escaped its attention. With the development and adaptation of the NAVSTAR Global Positioning System for aviation use, the further development of a host of related navigational technologies such as GPS integrated Automatic Dependent Surveillance B, Traffic and Collision Avoidance Systems and Flight Management Systems has blossomed. Proven reliability and reasonable cost for these systems due to the increased use of off-the-shelf digital components has made them widely acceptable and available to commercial transport aviation as well as to the corporate and private echelons of general aviation including aircraft of the new light sport category.

Until the phase-in of the new digital technologies in the 1990s, aviation communication and navigation systems were primarily based on systems developed during and shortly after World War II. While there is no question that these systems have survived the test of time with regard to reliability and maintainability, there are better, more efficient and accurate technologies out there. Newer companies such as Garmin, Meggitt Technologies, Blue Mountain Avionics, as well as the legacy companies such as Bendix-King-Honeywell and Rockwell-Collins have introduced a host of cutting-edge integrated glass cockpit systems to the market as older, discrete components are being phased out. The problem in aviation systems training venues is introducing these new technologies into the learning environment without breaking the departmental budget.

Our department was fortunate in the recent acquisition of a Meggitt/S-Tec 55X autopilot system in the form of a donation from the company based in Mineral Wells, Texas. Our tasking with this acquisition was two-fold. First, to build an autopilot trainer platform suitable for classroom use with movable flight control surfaces around the S-Tec 55X and second, to develop a training curriculum on autopilot technology based on the functioning model. The purpose of this paper is to discuss the efforts and results involving the initial tasking.

DISCUSSION

To provide a platform for the autopilot system trainer, a model airframe was constructed by the author using ½" plywood. The structure was painted with two coats of white latex semi-gloss to improve its rough appearance. Dimensionally, the model measures approximately 5 feet in length with about a 4 foot wingspan. Complementary left and right airframe forms were templated, cut out with a jig saw, sanded and mounted side by side to support the structure for use on a six by three foot 30" table (Figures 1 and 2). A hinged rudder assembly was constructed concurrently with the basic airframe while design and fabrication of the ailerons and elevators was left to the imagination and ingenuity of the students involved in the project.

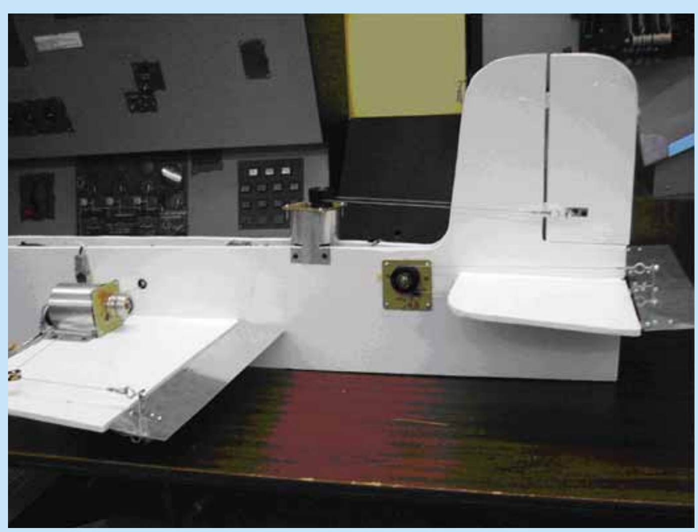

Figure 1. S-Tec 55X Autopilot trainer and rigging cables

Figure 2. Completed trainer with platform with servos instrumentation, yoke and computer/controller

The design and fabrication group consisted of 5 students, all seniors in the Department of Aviation Technologies Avionics Specialization curriculum and planning to graduate in the summer or fall of 2007. Each volunteered to undertake the project as part of their laboratory requirements for the spring 2007 inter-session Avionics Flight Line Maintenance class. The students had varying professional experience in electrical systems either as the result of military service or private sector employment. Two were licensed aircraft pilots and one had previous experience in railroad electronics control systems. All had completed the technology course curriculum for the avionics specialization with the exception of the Avionics Flight Line Maintenance course.

Donated equipment from S-Tec/Meggitt consisted of the S-Tec 55X autopilot programmer/controller/computer module, three servo motors for ailerons, elevator and trim, a barometric pressure transducer to sense altitude and a specially designed gyroscopic turn-and-bank coordinator. In addition, the manufacturer provided access to the on-line bench maintenance manual for the system. Each component was designed for operation on a typical 14/28 volt d.c. general aircraft electrical system with a power drain rated at 5 amps at 14 volts d.c. or 3 amps at 28 volts d.c. maximum. All switches, connectors, harnesses and wiring were procured locally and required fabrication by the students from the wiring diagrams contained in the bench manual.

Fabrication of the system was begun with construction of the wiring harnesses and connectors. Typical computer-type pin connectors requiring soldering were utilized to give the students experience in enhancing their soldering skills. Two of the connectors were the 50-pin type requiring close attention to detail and some fairly precision soldering techniques. Approximately 100 feet of 22 gauge, tinned and stranded aircraft grade wiring was utilized to interconnect the servos, switches and transducer to the computer/controller. Ample wiring test points were employed to permit checking of each harness/connector segment as it was completed (Figure 3). The students also installed component disconnect points to permit testing and evaluation of the various system elements during assembly and for use in the future to simplify transport. Continuity or "ring out" testing with an Ohmmeter was performed at each stage of harness completion and following the final assembly to assure proper connection and routing of each wire segment. Following rough construction of the harnesses, temporary interconnections were made to test each servo in relation to the various control switches, the computer/controller and the turn coordinator gyro instrument.

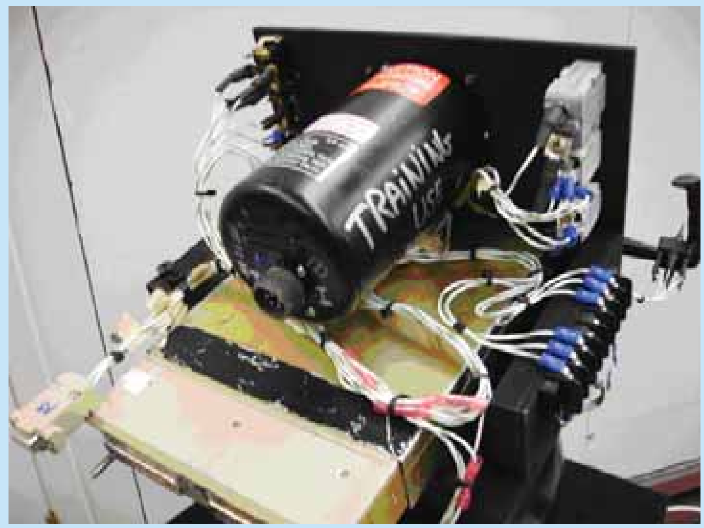

Figure 3. Wiring interconnects to the turn coordinator, switches and computer/controller

As autopilots operate on a system of inputs, outputs and feedback signals which can originate from or be transmitted to a variety of sources or devices, each of these aspects needed to be tested prior to the final assembly of the trainer. Inputs can be derived from navigation systems and instruments such as a VHF Omnidirectional Range system (VOR), radio direction finder, inertial navigational system, altimeter, attitude gyro, instrument landing system or global navigation satellite system such as GPS. In this case, the system was set up to use inputs from the pressure transducer sensor and orientation of the turn coordinator and computer/controller in space. The outputs which operate the three servo motors to move various flight control surfaces to a desired configuration were also checked as were the feedback signals relay positional, status and monitoring information back to the computer/controller. As many of these actions could be checked with the servos free standing, the students set each up with its respective connections and manipulated the controller/computer settings to assure proper direction and point of the servo capstan movements before mounting and rigging the servos in the platform.

The next aspect of the planning operation was to decide how to mount the servos, rig the control surfaces and set up a simulation scheme for three-axis movement of the trainer platform. It was decided that the turn coordinator gyro and computer/controller, which normally sense the attitude of the aircraft, should be arranged to be manipulated separately while the larger, more cumbersome airframe remained static. The design, construction and use of a 3-axis gimbal to support the entire trainer was felt to be too cumbersome and unstable. In a novel and innovative approach to the problem, the team decided to drill and insert an aircraft control yoke into old bowling ball with the turn coordinator and the computer/controller containing all the gyroscopic measuring components mounted on top. A platform with a cut out to accommodate and support the bowling ball as well as permit relatively easy manipulation of the yoke was constructed and would stand separately from the airframe. As the yoke was manipulated, three dimensional movement simulating that of an aircraft in flight could be applied permitting the gyroscopes in the computer/controller and the turn coordinator to respond accordingly. The team wired the yoke-controller assembly with Molex® modular and Cannon® plug interconnects to permit easy uncoupling and for servicing and transport of the trainer from place to place as needed (Figure 4).

Figure 4. Yoke, computer/controller

Once the yoke controller assembly was built, thought was directed to the placement of the servos and rigging. One student with sheet metal experience fabricated mounting brackets to support the rudder and elevator servos while the aileron servo was mounted in the left side of the airframe (Figure 5). This process took some careful planning and layout to ensure the cable rigging would lie straight and not bind on the servo capstans or brackets during movement.

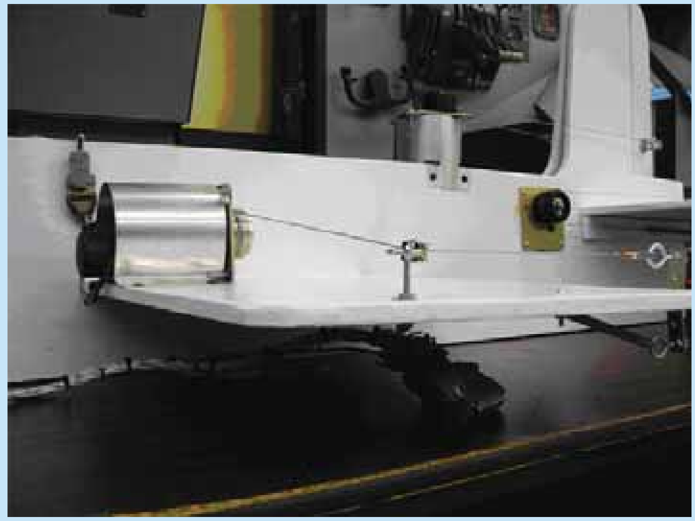

Figure 5. Servos and mounting brackets (arrows)

After installation in the airframe, each servo with its associated controlling mechanism was rigged to the movable flight control surface and tested. Springs and/or turnbuckles were added in rigging applications to adjust and maintain constant cable tension and keep the flight control surfaces neutral when the servos were not operating.

In addition to the computer/controller servos, rigging, and wiring, a number of control switches were employed and placed as they would appear in an actual aircraft. A battery and autopilot master switch as well as a spring loaded up/down manual trim and trim master switch was installed. Since the only inputs to the system were those initiated by the yoke movement and pressure transducer, a navigation source selector switch was not used. Final testing of the trainer was accomplished with all the components in place and demonstrated the system operated well.

An autopilot training module built around the trainer assembly will be incorporated into the curriculum in the autopilot theory section of our Digital Data Bussing and Flight Management Systems course. Section 2 of the Bench Maintenance Manual for the S-Tec 55X contains an excellent discussion on system bench testing procedures and will be used as a guide for a combination demonstration/laboratory project undertaking. Although the S-Tec 55X Manual incorporates recommended testing protocol with a special test set and break out box, a modified testing procedure using existing in-house avionics test equipment should not pose significant problems in development.

CONCLUSION

This project has shown that ingenuity, imagination and some basic materials can be utilized to produce significant results at a low cost while providing excellent hands on training for current and future students in aviation technologies programs. The key ingredient in this case, of course, was the donation of a system which would otherwise entail a substantial outlay of funds. The total cost to the Department for this project was under $50.00 and, excluding the construction of the basic airframe, was completed in a 4 week inter-session period. Technology programs of any kind tend to be expensive, not only to set up but to maintain. Without the generous assistance of our partners in industry, much potential for valuable, hands-on learning experiences would be lost. Our graduates not only fill the vacancies created in industry through attrition, but will also provide the foundation for new innovations as the digital revolution continues to encompass the field of integrated avionics systems. Our educational institutions are not able to accomplish these requirements in a vacuum. Help from industry such as that received from Meggitt/S-Tec is essential to maintain the continued availability of well trained and highly skilled technicians to pilot our industry into the 21st century.

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Industry News

News Release – Aviation Technician Education Council

For Immediate Release – August, 2008

John Wing, President of Wing Aero Products, announced this week Wing's appointment by Jeppesen (*a Boeing Company*) as Master Distributor of its Training Product line. Wing said the appointment comes after having successfully distributed the Jeppesen product line to its broad customer base throughout the United States for years. Dallas area based Wing Aero is a leading distributor of Flight and Aviation Maintenance Training products and pilot supplies founded in 1986.

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ASA has a new online tool to help you with your pursuits as you consider changes to your student pilot kits or pursue Part 141 certification. This free online tool simplifies the Training Course Outline (TCO) application process with streamlined templates, providing an easy way to compile the necessary information for the Part 141 application packet. Flight Schools and FBOs can use TCO Wizard to complete application paperwork for issuance, amendment or renewal of Part 141 certification. **TCO Wizard** features include:

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Contact Greg Robbins for Details Regarding PACKs and TCO Wizard

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New FAA Handbook for AMTs

Aviation Maintenance Technician Handbook – General

Newcastle, WA— The FAA has released a new edition of the *Aviation Maintenance Technician Handbook, General* textbook. Originally written in 1970 as an Advisory Circular and last updated in 1999, this new FAA-H-8083-30 handbook replaces AC 65-9A and reflects current operating procedures, regulations, and equipment.

This book was developed as the first of a series of three handbooks for persons preparing for mechanic certification with airframe or powerplant ratings, or both – those seeking an Aviation Maintenance Technician (AMT) Certificate, also called an A&P license. An effective text for both students and instructors, this handbook will also serve as an invaluable reference guide for current technicians who wish to improve their knowledge.

This edition contains information on mathematics, aircraft drawings, weight and balance, aircraft materials, processes and tools, physics, electricity, inspection, ground operations, and FAA regulations governing the certification and work of maintenance technicians. New to this edition is a section addressing how successful AMTs incorporate knowledge and awareness of ethics, professionalism, and human factors in the field.

The text is a cooperative effort of the FAA and ASA written by industry experts experienced in AMT education and practice, including Ann Riley, Bob Aardema, Pete Vosbury, Mary Ann Eiff, H.G. Frautschy, Ron Serkenburg, Don Shaffer, Tom Wild, and Terry Michmerhuizen. Includes colored charts, tables, illustrations and photographs throughout, and an extensive glossary and index. Soft cover, 8-3/8" x 10-7/8", 656 pages.

Title	Order Number	Suggested List Price
AMT Handbook, General ISBN 978-1-56027-716-3	ASA-8083-30	$49.95

Companion handbooks available in the series:
(These editions are expected to be current through 2010.)

Title	Order Number	Suggested List Price
AMT Handbook, Airframe	ASA-AC65-15A	$19.95
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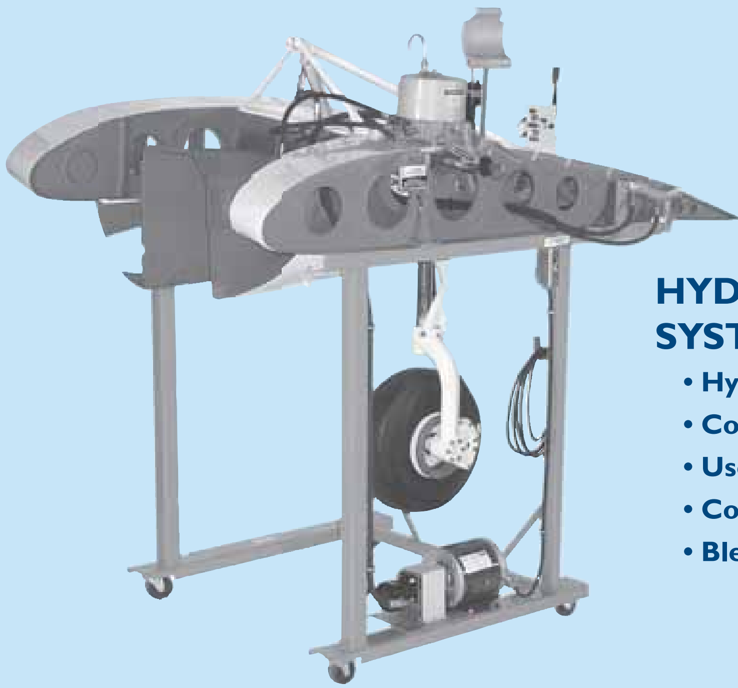

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Holiday Inn International Drive Resort
April 19-21, 2009
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PRELIMINARY AGENDA

Sunday, April 19

10:00-12:00 NOON	ATEC Board Meeting
1:00-3:00 PM	**Workshop I: "New Instructional Technology in the Classroom"**
3:00-5:00 PM	**Workshop II: "3D Technologies and Rotor Wing in the Classroom"**
5:30-7:00 PM	Icebreaker Reception – Exhibit Area

Monday, April 20

7:30-8:30 AM	Continental Breakfast – Exhibit Area
8:30-8:45 AM	Welcome-Laurie Johns, President ATEC (Board Floor Nominations)
8:45-9:30 AM	**Keynote – "Airbus Maintenance Technologies"**
9:30-10:15 AM	**"Advanced Engines Technology in Light Sport Aircraft"**
10:15-10:45 AM	Break in Exhibit Area
10:45-11:30 AM	**"Latest Trends in Distance Education"**
11:30-1:15 PM	Lunch (Awards and Scholarships Banquet) **"NCATT Update"**
1:15-1:45 PM	Board candidate speeches – 3 minutes each
1:45-4:30 PM	Voting (Registration Area)
1:45-3:15 PM	**"Technical Paper Presentations"**
3:15-3:45 PM	Break in Exhibit Area
3:45-4:30 PM	**"Maintenance Trends in Unmanned Aerial Systems"**
4:30-5:30 PM	**"Networking Reception in Exhibit Area"**

Tuesday, April 21

7:30-8:15 AM	Continental Breakfast – Exhibit Area
8:15-9:00 AM	**Annual Business Meeting**
9:00-10:15 AM	**"147 ARAC Overview of Proposed Recommendations and FAA Update"**
10:15-11:00 AM	Break in Exhibit Area (Door Prize Drawing)
11:00-12:00 NOON	**"Legal Issues for AMTs"**
12:00 NOON	Adjourn (box lunches to go)
12:30 PM	**Bus Tour to Local Aviation Facility (Optional)**

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ATEC Update

147 ARAC

The 147 ARAC Report is due to be finalized by the end of 2008. You may find it useful to review the following three reports that were completed over the last 15 years and form the foundation for the current 147 ARAC. Many of the same suggestions made in these historical documents are being considered or repeated in the current 147 ARAC. To view the reports go to www.atec-amt.org and click on 147 ARAC at the left.

- GAO Report
- White-Kroes Document
- Goldsby Report

BOARD APPOINTMENTS

The Board accepted ATEC Vice-President Ray Thompson's resignation since his institution has closed in Dubai and he is currently not employed in aviation.

The Board then appointed Tom Stose to complete Ray Thompson's term until 2010.

In other action, the Board appointed Bill Ostheimer from Boeing to the open Industry seat.

Andrew Smith was appointed Chair of the Government Relations Committee.

Attached is a Board of Director's listing. This may also be found on the ATEC website.

YOUR INSTITUTIONAL LISTING NEEDS TO BE UPDATED

Please go to www.atec-amt.org. Click on 147 Institutional Members then click on your state.

Review your listing for accuracy. If it needs to be changed, print it out, make changes and fax it to 717-540-7121 by December 5.

WING EXPANDS

John Wing, President of Wing Aero Products, announced Wing's appointment by Jeppesen (a Boeing Company) to be Master Distributor of its Training Product line. Wing said the appointment comes after having successfully distributed the Jeppesen product line to its broad customer base throughout the United States for years. Dallas area based Wing Aero is a leading distributor of Flight and Aviation Maintenance Training products and pilot supplies.

For more information, contact John Wing (800) 942-9464, 972-463-6080, www.wingaero.com.

LOOKING FOR MAINTENANCE ARTICLES

Martin Bailey, FAA Acting Repair Station Branch Manager, is looking for maintenance related articles that pertain to GA maintenance topics, for example, how to ensure a maintenance technician is following the process correctly.

Students, instructors or administrators considering an article should contact Mr. Bailey at (202) 267-7404 or email Martin.J.Bailey@faa.gov.

VIDEOS TO DVD'S

A majority of the ATEC instructional videos have been converted into a DVD format and are available through the ATEC Office. The numbering system should be the same with a "D" qualifier after the number to signify the DVD format. Regular video tapes can still also be purchased.

To order, go to www.atec-amt.org. Click on Curriculum Resources. Then click on Maintenance Training Video Tape Availability List and Order Form.

NEW SCHOLARSHIP SPONSOR

The Board of the Cliff Ball Wing, OX5 Aviation Pioneers, unanimously decided to be a Scholarship Sponsor for the programs administered by the Northrop Rice Foundation. The CB Wing will conduct fundraising activities and the funds raised will be donated to the NRF to be used to supplement the student and instructor scholarship and award programs. Donated funds will also be used to supplement the James Villnave Scholarship Program that assists recently discharged veterans from the Aviation Branches of the US Armed forces who are preparing to sit for the FAA Airframe & Powerplant certifications.

ATEC WEBSITE

Be sure to check out the updated ATEC website for:

2009 Preliminary Conference Agenda (April 19-21 in Orlando)

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New ARAC information

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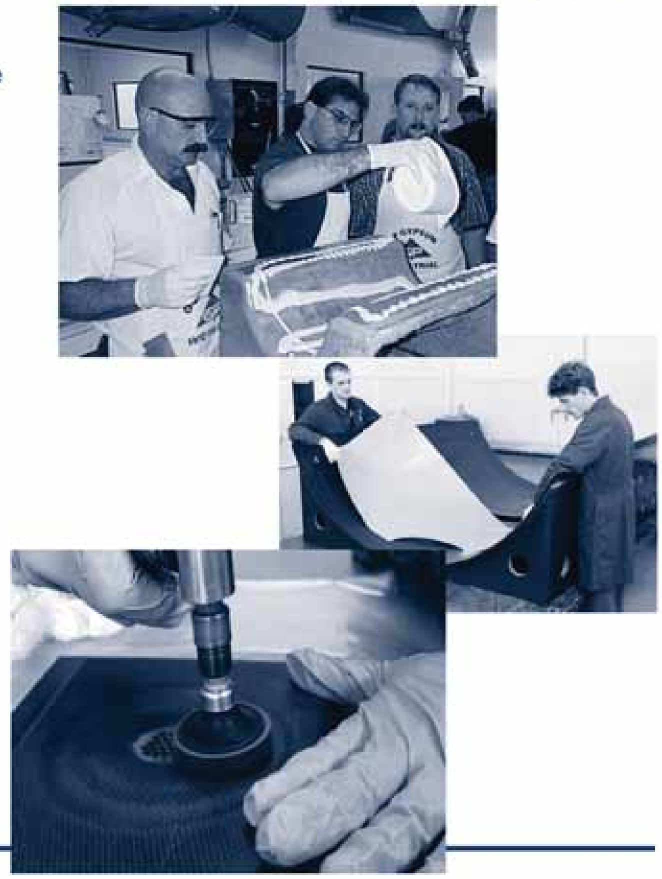

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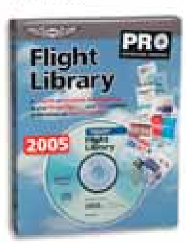

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EDUCATOR OF THE YEAR AWARD

September 2008

Dear Member:

The ATEC awards committee is pleased to solicit nominations for the 20th annual Ivan D. Livi Aviation Maintenance Educator of the Year Award. You will find the criteria for eligibility and appropriate forms on the ATEC Website at www.atec-amt.org. Click on Livi (Educator) Award. Or, request a form from ATEC fax (717) 540-7121. I sincerely encourage each member institution to carefully review these forms and forward a nomination to the selection committee as specified in the instructions.

Through this award, we have potential to recognize some of our many outstanding instructors. It has become a regular part of ATEC's activities. In addition, the school of the winning educator will receive a framed picture of the "Flying Wing" donated by the Northrop Rice Foundation.

ATEC pays all the travel expenses "and a free conference registration" to the ATEC Conference for the winner. The twentieth annual award will be presented on April 21, 2009 at our Orlando Conference. Forward your nomination by **December 5, 2008** to the ATEC Business Office, 2090 Wexford Court, Harrisburg, PA 17112.

Upon receipt of your application material, the ATEC Business Office will send you a confirmation of receipt. If you do not receive a confirmation within two weeks of sending your material, contact the ATEC Office immediately.

Sincerely,

Laurie Johns

ATEC President

LJ:ld

Attachments

ATEC

AVIATION TECHNICIAN EDUCATION COUNCIL

2009

IVAN D. LIVI AVIATION MAINTENANCE EDUCATOR OF THE YEAR AWARD

Purpose: This award recognizes the outstanding achievement of an aviation maintenance technology instructor. This achievement can be in the form of a single event or long term outstanding performance but must have had a direct impact on the Aviation Maintenance student.

This award will be presented at the annual ATEC Conference April 19-21, 2009 in Orlando. The winner will be contacted in late February.

CRITERIA FOR ELIGIBILITY

TO BE ELIGIBLE for the ATEC outstanding educator award, the nominee must:

1. Be employed by an institution and/or organization that is a member of the Aviation Technician Education Council.

2. Be an active instructor of Airframe and/or Powerplant Technicians. The applicant's workload must be of such a nature that they spend 80% of their workload time in contact with students teaching actual aviation maintenance technology classes.

3. Present a completed application with appropriate signatures by **December 5, 2008** to ATEC, Awards Committee, 2090 Wexford Court, Harrisburg, PA 17112.

4. Nominations may be made for one particular outstanding achievement by a person. They may also be made for a person who has consistently contributed above average performance.

5. Nominees are not eligible if they are a current member of the Executive Board or, as regular members, they are serving on the Public Relations Committee.

CRITERIA USED FOR EVALUATION

1. Initiative/creativity: What did this person do, what new ideas or applications were used and what was the outcome?
Total value in per cent...45%

2. Attitude/performance: What was the direct impact to the student(s)? How was the attitude and/or performance of the student effected by the event, ideas, or performance?
Total value in per cent...25%

3. Education/training: What education and training does the nominee possess? How did this influence the event, idea, or performance?
Total value in per cent...15%

4. Recommendation(s) and/or nomination statements from the benefit and effect of the event, idea or performance.
Total value in per cent...15%

IVAN D. LIVI AVIATION MAINTENANCE EDUCATOR OF THE YEAR AWARD

NOMINATION FORM

DATE: ______________________________

NOMINEE: ____

POSITION/TITLE: ____

LENGTH OF SERVICE IN THIS POSITION: ____

NOMINEE ADDRESS: ____

PHONE NO.: Business _________________________ Home ___________________________

INSTITUTION AND/OR COMPANY: ____

INSTITUTION AND/OR COMPANY ADDRESS: ___________________________________

____ Phone No. ___________________

NOMINATOR: __________________________________ Phone No. ___________________

NOMINATOR POSITION/TITLE: ____

NOMINATOR ADDRESS: ____

NOTE: Nomination statements must be limited to this form and not exceed these pages. Recommendations (separate attachments) are limited to three, no more than one page each. They must be signed and the organization name stated.

NOMINATION STATEMENT

____

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____

____

1. INITIATIVE/CREATIVITY: ______

2. ATTITUDE/PERFORMANCE: ______

3. EDUCATION/TRAINING: ____

4. RECOMMENDATIONS AND/OR EFFECT OF PERFORMANCE:

All information given on this application is correct. I hereby authorize release of all information contained on this application to any authorized awards committee member or board member.

Nominee Signature ______________________________ Date ____________

Nominator's Signature ____________________________ Date ____________

STUDENT OF THE YEAR AWARD

September 2008

Dear Member:

The ATEC awards committee is pleased to solicit nominations for the 10th annual award of the James Rardon Aviation Maintenance Technician Student of the Year. You will find the criteria for eligibility and appropriate forms on the ATEC Website at www.atec-amt.org. Click on Rardon (Student) Award. Or, request a form from ATEC fax (717) 540-7121. I sincerely encourage each member institution to review carefully these forms and forward a nomination to the selection committee as specified in the instructions.

Through this award, we have potential to recognize some of our outstanding students.

ATEC and Northrop Rice Foundation pays coach airfare, lodging for three nights, $75 stipend "and a free conference registration" to the ATEC Conference for the winner. The tenth annual award will be presented on April 21, 2009 at our Orlando Conference. Forward your nomination by December 5, 2008 to the ATEC Business Office, 2090 Wexford Court, Harrisburg, PA 17112.

Upon receipt of your application material, the ATEC Business Office will send you a confirmation of receipt. If you do not receive a confirmation within two weeks of sending your material, contact the ATEC Office immediately.

Sincerely,

Laurie Johns

ATEC President

LJ:ld

JAMES RARDON AVIATION MAINTENANCE TECHNICIAN STUDENT OF THE YEAR AWARDS

Purpose: These awards recognize the outstanding achievement of Aviation Maintenance Technician students. These achievements must be demonstrated through academics as well as through involvement that makes a direct impact on the student's associates, school and/or community.

Eligibility: To be nominated, an individual must be a full-time AMT student at an institution that is a member of the Aviation Technician Education Council.

Nomination Process: Nominators must complete a Nomination Form with appropriate signatures by December 5, 2008 and forward it to ATEC, Awards Committee, 2090 Wexford Court, Harrisburg, PA 17112.

Review Process: Following receipt of the nominations, they will be reviewed by the ATEC Awards Committee and Northrop Rice Foundation Board of Directors to determine ten (10) finalists. The ATEC Awards Committee will then select the James Rardon AMT Student of the Year award winner from the finalists. The winner will be contacted in late February 2009.

Selection Criteria:

Leadership/Motivation: What has the student done to encourage and lead his/her students to newer and higher levels of learning, or to promote aviation maintenance as a career?

Total value in per cent. 35%

Academics: How has the student approached his/her own learning, and what grade level has the student achieved?

Total value in per cent. 30%

School/Community: What has the student done to assist the school faculty develop new/better training methods, maintain necessary records and maintenance requirements, and/or promote the institution in the community?

Total value in per cent. 25%

Recommendation(s): Additional (up to 3) recommendations or nomination statements will be considered to become as familiar as possible with the attributes, abilities and achievements of the nominated student.

Total value in per cent. 10%

Awards: The 2009 James Rardon AMT Student of the Year award winner will receive transportation costs (airfare, hotel, meals, etc.) to attend the ATEC Annual Conference in Orlando on April 19-21, 2009. The recipient will be honored during the Awards Luncheon and will receive the "James Rardon Aviation Maintenance Technician Student of the Year" plaque. The other nine (9) finalists will receive by mail a "James Rardon Outstanding AMT Student" certificate. These ATEC awards are sponsored and funded by the **Northrop Rice Foundation**. Registration at the ATEC Annual Conference for the James Rardon award winner is provided by ATEC.

JAMES RARDON AVIATION MAINTENANCE TECHNICIAN STUDENT OF THE YEAR AWARD

NOMINATION FORM

DATE: ______________________________

NOMINEE: ____

LENGTH OF TIME AT THE SCHOOL: ____________________________________

NOMINEE ADDRESS: ____

PHONE NO.: School______________________ Home ______________________

INSTITUTION AND/OR COMPANY: ___________________________________

INSTITUTION AND/OR COMPANY ADDRESS: __________________________

____Phone No. __________________

NOMINATOR: __________________________ Phone No. __________________

NOMINATOR POSITION/TITLE: ______________________________________

NOMINATOR ADDRESS: ____

NOTE: Nomination statements must be limited to this form and not exceed these pages. Recommendations (separate attachments) are limited to three, no more than one page each. They must be signed and the organization name stated.

NOMINATION STATEMENT

1. LEADERSHIP/MOTIVATION: ____

2. ACADEMICS: ____

3. SCHOOL/COMMUNITY: ____

4. RECOMMENDATIONS/ADDITIONAL ACHIEVEMENTS

All information given on this application is correct. I hereby authorize release of all information contained on this application to any authorized awards committee member or board member.

Nominee Signature ____ Date ____________

Nominator's Signature _____________________________________ Date ____________

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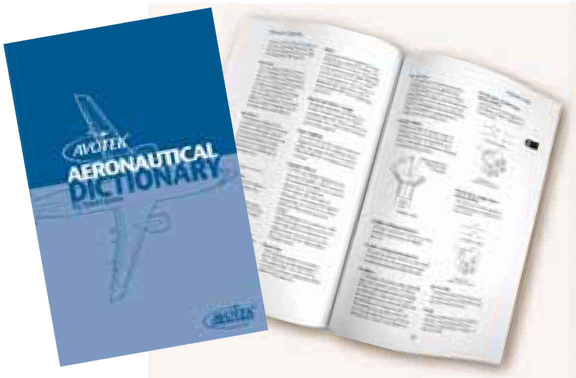

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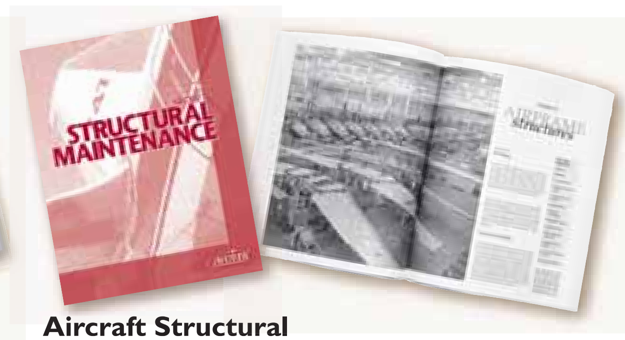

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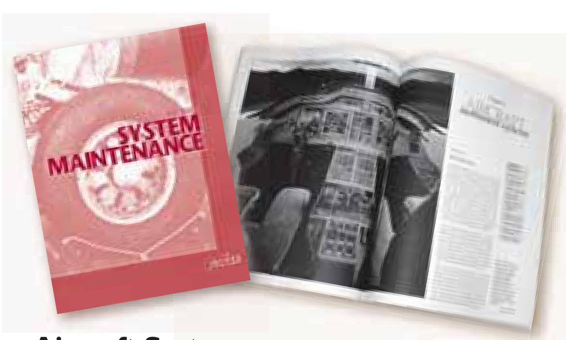

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Call For Papers

The Aviation Technician Education Council is seeking papers for presentation at ATEC 2009, Orlando, FL, April 19-21, 2009. Papers for presentation on the following topics are sought as they relate to the instruction and administration of FAR Part 147 programs:

Capstone Experiences

Development (fund raising)

Distance Education/ Computer Based Education

Industry Advisory Boards

Innovative Laboratory Projects

Multimedia in the Classroom

New Trends in Airframes & Powerplants

Outcome Based Assessment

Professional Development

Program Assessment

Recruitment & Retention

Strategic Planning

Abstracts (400 words maximum) must be electronically submitted in Microsoft Word by December 1, 2008. All abstracts will be reviewed and authors of accepted abstracts will be invited to submit a full paper. Authors must supply their own laptop computer or make other arrangements with ATEC prior to the convention. Authors must register for and present their work at Orlando, Florida, April 19-21 (as scheduled), at the Holiday Inn International Drive Resort.

Deadlines

December 1, 2008: Abstract Submission

January 26, 2009: Notification of Acceptance/ Rejection

February 23, 2009: Submission of Draft Full Paper/ Audio and Video requirements

March 14, 2009: Electronic Submission of Final Paper

Please direct any questions and or submissions to:

Harry Whitehead

Aviation Center

Lansing Community College

3428 W. Hangar Dr.

Lansing, MI 48906

Office 517-267-5942

Fax 517-886-0530

whitehh@lcc.edu