Flight Advisor Corner by Hobie Tomlinson

March 2012 **Transition to Experimental or Unfamiliar Airplanes ~ Part VI**

For March we will complete our look at Advisory Circular **(AC) Number 90-109**, "*Airman Transition to Experimental or Unfamiliar Airplanes*" which was published by the FAA's Flight Standards Division (AFS-800) on 30 March 2011.

We will continue our review of the remaining FAA Airplane Families, using Comparable Type Certificated (TC'D) Examples where possible, and discuss the specifics related to transitioning into each remaining family type.

Transition Training for Family IV Airplanes (Nontraditional Configuration and/or Controls). A TC'd airplane example is the Lake amphibian.

1) **Defined** as airplanes whose external configuration is sufficiently different from traditional type certificated (TC'd) single-wing, empennage-mounted tail designs so that they display non-traditional handling qualities. Flight control surfaces are different from the typical elevator-aileron-rudder-engine/prop arrangements and/or flight control systems are different from the typical stick/yoke-pedals configurations.

2) **Typical Accident** scenario example would involve a pilot who is unfamiliar with the operation of a cross-wind landing gear. (i.e. Helio Courier aircraft). When the cross-wind gear is "unlocked," the aircraft must be allowed to touch down in a crab. This is so that when the cross-wind gear swivels upon touchdown, the aircraft will still track down the runway. (If the aircraft is "decrabbed" prior to touchdown – with the cross-wind gear unlocked – the aircraft will track off the downwind side of the runway, even though its longitudinal axis is parallel to the runway centerline. This is due to the fact that the crosswind will usually provide enough side loads to swivel the landing gear.) Conversely, if the aircraft is landed in a crab with the crosswind gear locked, it will ground loop – just like any other conventional gear airplane.

3) **Discussion** of transition hazards are as follows:

   a. The External Configuration of TC'd airplanes follow a standard pattern using a single wing with ailerons (and usually flaps) and a tail consisting of a vertical and horizontal stabilizer equipped with trailing edge rudder and elevator. Even though there may be variations on the theme (i.e. a stabilator for the horizontal tail component or a "V-tail" configuration using ruddervators to perform both pitch and yaw functions) all TC'd airplanes will behave in an expected, intuitive and acceptable manner.

   b. The Innovations presented in the experimental aircraft can include non-traditional configurations and controls, canards (Long EZ), and wing mounted pusher engine installations (Lake Amphibians) which produce

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strong thrust-vector effect. Other non-traditional configurations include flaperons (i.e. drooped ailerons – Robertson STOL Conversions) leading edge slats (Helio Courier), cross-wind gear (Cessna 195), differential spoilers (MU-2), and all-moving vertical tails (Mooney M20). Cockpit controls may be a yoke, conventional stick, or outboard side-stick. Side-sticks may pivot conventionally, or translate (slide) for pitch while pivoting for roll control. Throttles may be on the left side, right side (or both), in the center, on the floor, or on the ceiling (flying boats). The obvious hazard in all this is the potential for pilot misuse of the controls due to unfamiliarity with the human-machine interface.

c. Issues Specific to Canards are as follows:

i. While Canards offer several aerodynamic advantages, they also carry some unique risks. Because a canard lifts upward (rather than downward like conventional tails), it reduces the load carried by the wing (rather than increasing the wing's load). This upward lift characteristic produces improved aerodynamic efficiency, but also makes its proper aerodynamic design extremely critical.
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ii. The Canard must be designed to stall before the wing stalls, in order to allow a nose-down pitching moment. If the wing stalls first, while the canard is still producing lift, there is no way to lower the aircraft nose and the stall then becomes unrecoverable (i.e. a deep stall). Additionally, if the canard stalls during the landing flare, the aircraft will be seriously damaged (or worse).

iii. A Canard will typically have a rudder on each swept wing tip, with each rudder only deflecting outward. This feels natural to the pilot and actually helps minimize adverse yaw. Unlike traditional airplanes, both rudders can be deflected simultaneously to act as a speed brake. Because the deflected rudders change the air flow over the outboard wing sections (which are aft of the aircraft's CG), deflecting both rudders simultaneously will produce an unexpected pitching moment, as well as typically reducing aileron effectiveness, due to the disturbed airflow over the outer wing panels.

iv. Canards require a dramatic wing sweep to locate the rudders far enough aft on the airframe to be effective. Their dramatic wing sweep causes a strong rolling tendency during any uncoordinated flight. (A strong yaw-roll coupling effect is a characteristic of all swept wing airplanes.) Whenever a slidslip is produced by rudder usage (or a wind gust), the airplane will weathervane back into the relative wind as well as roll away from the sideslip. (i.e. a "Dutch Roll" tendency which is also characteristic of swept wing airplanes.) During slow flight, this rolling tendency may be more powerful than that which can be countered by the ailerons alone.

v. Canard's wheel brakes are typically operated by applying force to the rudder pedal after the rudder is fully deflected. This design saves both weight and space, but it means that there is no braking without fully deflecting the rudder. This works well for taxiing, but warrants consideration (and familiarity) for crosswind operations.

d. Other Configurations which may cause problems are as follows:

i. Hand lever operation of the wheel brakes can be found in some earlier Piper Cherokee Aircraft which did not incorporate the toe-brake option. Hand brakes require the pilot to release either the stick or throttle control to operate the hand brake lever and it's your arm strength that determines the braking effectiveness. If brakes are cable actuated (via a single brake lever) cable rigging becomes a critical issue in order to prevent asymmetric brake application.

ii. High-wing-mounted engine configurations (usually pushers) cause a reverse thrust-vector effect in which increasing power pitches the nose down (instead of up) and reducing power pitches the nose up (instead of down). Although pilots adapt to this effect, it complicates maneuvers such as a rejected landing go-around. Becoming thoroughly familiarity with the airplane's pitch-power interface is essential to safe flight.

iii. Pilot interface with the control surfaces has a large influence on workload, handling qualities, and overall satisfaction with the aircraft. A short side-stick, which requires a lot of effort to move, will limit maneuverability and this disadvantage will grow as the airplane's speed increases. Quickly finding the neutral stick position after an airplane upset can also be very difficult with side-stick controls.

iv. Pilots typically enjoy a tactile reference for their stick arm, usually resting their forearm on their thigh. Side-stick designs, without an arm rest, deprive the pilot of this reference and make fine adjustments difficult, leading to unwanted control inputs during turbulence. In designs with single side-stick between the seats, poor implementation can limit roll control due to interference with the pilot's or passenger's leg.

4) **Recommended Training** is as follows:

   a. Ground Training should allow the pilot to become thoroughly familiar with the location, force required, displacement, and operative sense requirement of all the cockpit controls. Know your airplane's systems, limits and recommended procedures, before you begin flying. Practice simulated emergency procedures while on the ground. Consult the kit vender, type club members, and other owner/builders of your airplane model for additional information.

   b. Flight Training recommendations are as follows:

      i. Best Training is accomplished in your specific airplane with a well-qualified instructor who is experienced in the specific make and model.
      ii. Second Best Training Source is from the kit vendor, either in your airplane or in their demonstrator of the same model airplane.
      iii. Third Best Training Source is information from and flying with the previous owner, if you purchased your aircraft already built.
      iv. All Training should emphasize the unique aerodynamic behavior of your airplane's non-traditional configurations, as well as any pilot compensation required to safely fly the airplane. If any of your airplane's cockpit controls are different from what you are accustomed to, insure that you have become familiar with the advantages and disadvantages of the design. Be sure that you explore your plane's handling qualities under safe, supervised conditions.

Transition Training for Family V Airplanes (Nontraditional or Unfamiliar Airplane Systems Operations). A Light-Sport Certified example is the Flight Design CTSW.

1) **Defined** as aircraft with engine, avionics, fuel systems, etc., that require operational practices that are outside the normal procedures utilized in standard category airplanes, i.e. Rotax engines.

2) **Typical** accident would be similar to the iconic accident of John Denver.

   Wikipedia states the following information on the John Denver accident: "The Singer-songwriter John Denver died while flying a LongEz on October 12, 1997. The NTSB believes that he inadvertently pushed on his right rudder pedal while twisting to the left in his seat as he struggled to operate the fuel selector valve. Contributing factors in the crash were other pilot errors, a design that led to an overly optimistic pre-flight fuel-check estimate, a known defective (very hard to turn) fuel valve, and non-standard placement of the fuel selector valve by the kit plane's builder, at variance with Burt Rutan's specs."

Even though Denver was aware of the faulty valve prior to take off, he had not refueled the aircraft. Although an experienced pilot, he had only flown the aircraft for a thirty minute orientation flight previous to the day of the accident.

The NTSB cited the original builder's decision to locate the unmarked fuel selector handle in a hard-to-access position and the use of unmarked, non-linear, fuel quantity sight-gauges. The NTSB also cited Denver's inadequate transition training and his total lack of experience in this type airplane.

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3) **Discussion** of transition hazards are as follows:

   a. **TC'd Airplanes** have standardized instrument panel layouts and system control locations which are very similar between airplanes. Pilots who are accustomed to operating flaps, fuel systems, retractable landing gear, and engine controls in TC'd airplanes can usually transition between models without the need for extensive training.

   b. **Experimental Airplanes** can have every aspect customized to the individual builders preference, which includes installing systems not found in TC'd airplanes. Also, even familiar instruments and controls can be placed in unfamiliar locations on the panel or in the cockpit area. Because these airplanes are custom built, there are likely to be significant differences even between identical models of a particular design. *One large hazard in operating these airplanes is the potential for system misuse or mismanagement, which can result in an inadvertently induced abnormal or emergency situation!*

   c. **Unlike TC'd Airplanes,** experimental airplanes do not usually have extensive operating handbooks (POH) or other documentation outlining the unique nature of the airplanes' installed systems or controls. This places the entire burden of becoming familiar with the airplane's specific systems and controls upon the pilot. *Insure that you can identify every system and control location and function on the airplane before flying it!*

4) **Recommended Training** is as follows:

   a. Ground Training must provide sufficient time sitting in the cockpit (while on the ground) to learn the location and correct function of all controls and switches. This recommendation even extends to the point when the pilot is capable of performing a military style "blind cockpit test," that requires controls and switches to be located from memory. *It is important for the pilot not to fly the airplane until gaining a thorough familiarity with the cockpit layout, including seeking any available advice from previous airplane operators and the kit vendor.*

b. Flight Training recommendations are as follows:

i. Best Training is accomplished in your specific airplane with a well-qualified instructor who is experienced in the specific make and model.

ii. Second Best Training Source is information from and flying with the previous owner, if you purchased your aircraft already built.

iii. All Training should emphasize the reasons why the installed controls are the way they are and what operational characteristics they have. This should include covering any unusual handling characteristics that may arise from application of a control or system that may catch the pilot off-guard. Again, be sure that you explore your plane's handling qualities under safe, supervised conditions.

Transition Training for Family VI Airplanes (Nontraditional or Unfamiliar Airplane System or Component Maintenance Requirements) A Light-Sport airplane example in development is the Terrafugia Transition roadable airplane.

1) **Defined** as aircraft which have engine, propellers, fuel systems, avionics, etc. that require practices outside of the normal procedures utilized in standard category airplanes.

2) **Typical Accident** involves aircraft component failure due to improper assembly or maintenance. The example provided was of a stainless steel horizontal stabilizer "L" attachment bracket which failed in flight, causing the right horizontal stabilizer to separate from the fuselage. Fortunately, the on-board flight instructor was able to land the airplane after some abrupt pitch excursions. The accident was determined to be caused by a fatigue failure of the attachment bracket. In turn, this was the result of a loose bolt in the fitting caused by improper maintenance procedures.

3) **Discussion** of transition hazards are as follows:

a) **Manufacturers of TC'd Airplanes,** as well as their systems and components, provide supporting maintenance and repair documentation that shows owners and maintenance personnel how to properly maintain and repair their airplane. These documents are readily available from several sources and easily accessed by anyone maintaining or repairing the airplane.

b) **Experimental Airplanes** typically do not have extensive maintenance and repair documentation available. In addition, they may incorporate components and systems not found on TC'd airplanes. Maintenance and repair information on these components and systems may be difficult to find, or even unavailable.

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4) **Recommended Training** is as follows:

a) Ground Training, on the specific maintenance procedures, is the main requirement for this group, as it is defined by unique maintenance requirements that lead to issues of improper maintenance. Owners and operators should seek all possible information sources and develop maintenance procedures that will insure early detection of potential maintenance problems or continued airworthiness issues. Regular attendance at aviation events will also expose the owner/operators to others who operate similar airplanes, thus providing a venue for information sharing.

b) EAA offers both print and electronic publications that will support the maintenance and operation of experimental airplanes. Type clubs and their related web sites provide a good source of information on the operation and maintenance of these airplanes, as well as a method of contacting other operators.

c) The Current Edition of AC 43.13-1 (Acceptable Methods, Techniques, and Practices – Aircraft Inspection and Repair) contains methods, techniques, and practices acceptable to the Administrator for the inspection and repair of non-pressurized areas of civil aircraft only when there are no overriding manufacturer maintenance or repair instructions.

c. Flight Training recommendations are as follows:

i. Best Training is accomplished in your specific airplane with a well-qualified instructor who is experienced in the specific make and model.
ii. Second Best Training Source is information from and flying with the previous owner, if you purchased your aircraft already built.
iii. All Training should emphasize the reasons why the installed controls and systems are the way they are and what special operational characteristics they have. This should include covering any unusual handling characteristics that may arise from application of a control or system that may catch the pilot off-guard. Again, be sure that you explore your plane's handling qualities under safe, supervised conditions.

Transition Training for Family VII Airplanes (Specialty Airplane Family)

1) **Defined** as aircraft which fall into one of the following categories:
a) One-of-a-kind or Highly Modified
b) Limited kit production
c) Unique

d) Unstable
e) Extremely High power to weight ratio
f) Jet-Powered
g) Turboprop Powered
h) Rocket Powered
i) Other unconventional Powerplant

2) **Typical Accident** involves aircraft loss of aircraft control and/or structural failure during initial flight testing, as typified by the Hughes H-1 Replica aircraft accident.

   Wikipedia states the following information on the Hughes H-1 Replica aircraft accident: "Jim Wright of Cottage Grove, Oregon built a full scale replica of the H-1 that first flew in 2002. So exact was the replica to the original that the FAA granted it serial number 2 of the model. The achievement in recreating the aircraft was heralded in virtually every well-known aviation magazine of the time. On August 4, 2003, after a successful unveiling of the replica at the 2003 AirVenture at Oshkosh, Wisconsin, Wright fatally crashed. On his way home to Oregon, he had landed briefly in Gillette, Wyoming, to refuel. While on the ground, Wright met briefly with local reporters and indicated that the aircraft had been having propeller "gear problems." He then departed, crashing just north of the Old Faithful Geyser in Yellowstone National Park about an hour later. The replica, originally slated for use in the film *The Aviator*, was completely destroyed, and Wright was killed. The official accident report points to a failure of a counterweight on the constant speed propeller."

   Interesting enough, the replied aircraft was so true to the original that its subsequent crash and destruction was due to the very design weakness the original aircraft suffered from; a harmonics problem created by that particular engine-propeller combination!

3) **Discussion** of transition hazards are as follows:

   a) **One of the Core Principles** of the experimental aircraft movement is the freedom to design, create or modify aircraft to produce a unique machine. Nowhere is this as evident as in this family of airplanes with its very special one-of-a-kind designs and/or it highly modified existing designs.

   b) **While the creation of leading-edge products** is probably the most exciting form of homebuilding, *it is also the highest risk category due to the very high degree of undetected hazards and flaws!* (To quote Donald Rumsfeld, a previous Secretary of Defense – ***"There are things we don't know we don't know."*** Those are the things that can get you into a lot of trouble with this family of airplanes.)

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c) **Becoming Highly Familiar with Every Aspect** of your airplane, prior to its first flight, is very critical for pilots who are interested in pursuing an airplane model from this category. Because these airplanes are – by their very nature – unique, there is no "beaten path" to follow and you are assuming all risks, both the known and the unknown!

i. It is Highly Recommended that an analysis of likely performance and handling characteristics be obtained from the aviation department of a university or college using aircraft design software or from another experienced source of aeronautical design analysis.
ii. This Category is not for the weak of heart or financially challenged individuals. It is a high-end, high-risk endeavor and requires the ability and resources to obtain the services of organizations and/or personnel who possess the required expertise in the fields of aircraft design and structures, fabrication and construction processes and initial flight test procedures.
iii. Not Taking Advantage of every opportunity to understand your unique aircraft prior to attempting a first flight can result in a catastrophic outcome!

4) **Recommended Ground and Flight Training** for this family of airplanes requires the development of a specific, customized training plan for your specific airplane. This plan must encompass all the specific parameters that make your specialty airplane unlike most other airplanes.

a) Seek Specialty Training from an instructor who has experience in your type airplane or an airplane type that is very similar to your airplane.

b) Do Not Think that you can just "feel" you way through an initial flight test program in this family of airplanes. Their special characteristics require dedicated training to master!

c) When Using Turbine, turboprop, or other specialty engines, utilize the training resources of companies who have established training courses for that specific engine.

Transition Training Guidance can also be found in the following publications:

- AC 61-107, Operations of Aircraft at Altitudes Above 25,000 Feet MSLK and/or Mach Numbers (Mmo) greater than .75.
- AC 6-67, Stall and Spin Awareness Training.
- FAA-H-8083-3, Airplane Flying Handbook.
- FAA-H-8083-25, Pilots Handbook of Aeronautical Knowledge.

- Turbine Pilot's Flight Manual by Gregory N. Brown and published by ASA.
- The Advanced Pilot's Flight Manual, by William K. Kershner and published by Blackwell Publishing.

Additional Information can be found at the following sources:

- EAA, http://www.eaa.org.
- AOPA, Online, http://www.aopa.org/.
- GAMA, http://www.gama.aero
- FAA Safety Team, http://faasafety.gov/.

That "wraps up" our series on ***Airmen Transition to Experimental or Unfamiliar Airplanes.*** Next Month we will begin taking a look at ***Advanced Avionics Systems***.

The thought for this month is "**Not being known doesn't stop the truth from being true." -** ***Richard Bach,*** American Author. So, until next month, be sure to **Think Right to FliRite.**

Jim Wright's Hughes H-1 Replica @ Oshkosh, WI in 2003

Wikipedia Image

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