Flight Advisor Corner by Hobie Tomlinson

November 2011 Transition to Experimental or Unfamiliar Airplanes ~ Part II

This month we will continue 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 03/30/11

We will pick up our November discussion with the subjects of **Hazard Identification**, **Risk Assessment, Risk Mitigation**, **Acceptable Risk,** and **Stall Characteristics.**

Hazard Identification, Risk Assessment, and Risk Mitigation recognize the fact that all flying comes with some inherent risks. It is up to us as pilots to mitigate those risks in order to provide an acceptable level of safety (i.e. acceptable level of risk) during our flight operations. An industry proven method of accomplishing this goal when transitioning into an unfamiliar airplane is the ***Risk Mitigation (RM)*** approach used by professional test pilots. The Risk Mitigation process uses the following steps:

- **Hazard Identification**
- **Risk Assessment**
- **Risk Mitigation**
- **Acceptance of Residual Risks by Conscious Decision**

Hazard Identification is the process by which you make a determination of all the potential safety hazards which are associated with your proposed flight operation. These safety hazards are then listed and reviewed (one-by-one) in order to make a realistic assessment of their associated risks. As an example, a specific safety hazard associated with the first flight in a new experimental aircraft would be the potential for loss of control in flight – as in an inadvertent stall/spin scenario. A second safety hazard associated with conventional gear aircraft would be the potential for loss of directional control during takeoff or landing.

Risk Assessment is the process by which we look at the following two essential elements of risk: 1) The likelihood of occurrence for a hazard (or your "exposure" to a particular hazard which you have identified) and 2) the seriousness of the consequences, should that identified hazard actually occur.

- **The FAA's *Risk Management Handbook*** categorizes the Likelihood of (or Exposure to) the occurrence of a hazard into the following four groups: ***improbable***, ***remote***, ***occasional***, and ***probable***. It then rates the Severity of the consequences which will result from the hazard actually occurring into the following four groups: ***negligible, marginal, critical and catastrophic.***

- **The Confluence** of our expected exposure to a hazard and the consequence of its occurrence provide us with the resultant **risk level** which we are incurring. This is the level of risk which we are willingly (*or very often unknowingly*) accepting!

- **FAA Risk Assessment Matrix** rates risk levels into the following four categories: **low, medium, serious and high.**

  - **Low Risks** are typically the residual risks which occur during every well-planned and executed flight operation and they are the acceptable risks inherent in any flight activity.

  - **Medium Risks** are those risks which are accepted after a careful evaluation of all the relevant conditions has occurred. Examples of medium risk operations would be flying a single engine aircraft during night and/or Instrument Meteorological Conditions (IMC). Such risks are routinely undertaken by proficient pilots operating suitably equipped and maintained aircraft. A well-planned test flight after extensive maintenance (or rebuild) of an aircraft would come under the medium risk category.

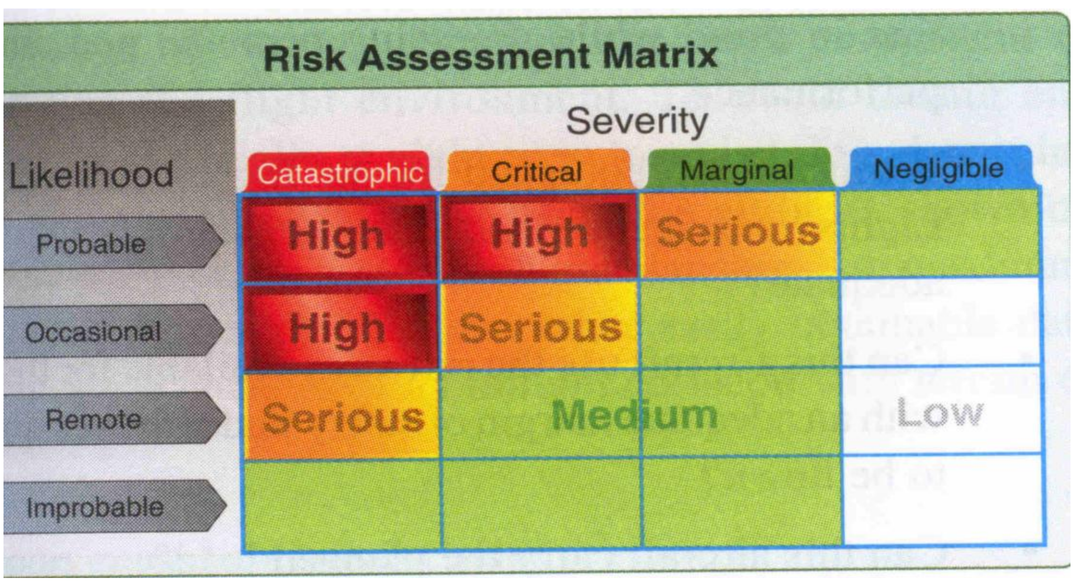

Fig 6-6, FAA-H-8083-2, - *Risk Management Handbook*

  - **Serious Risks** are those risks which start to occur when we elect to undertake flight operations for which we are not suitably qualified or the aircraft involved is not suitable. An example of these types of risks would be attempting a flight operation in an overloaded aircraft – especially when loaded aft of its approved center of gravity (CG) limit, trying to make a nonstop flight beyond your aircraft's reasonable range, or trying to fly in winds beyond your proficiency level.

  - **High Risks** are those risks which occur when pilots "go off the deep end" and start making operational decisions which are seriously flawed. This often occurs when pilots allow themselves to get into a situation where they do not have suitable alternate courses of action available. The result is that they then allow external pressures to override all prudent operational decision making with catastrophic results. As Mr. Bob Miller (A CFI who operates Bob Miller Flight Training in Upstate NY and also writes a newsletter titled *"Over the Airwaves."*) so often says, ***"Always have an out!"*** *Never allow yourself to be put into a position where a suitable alternate course of action does not exist,* should things not go as planned. Examples of this type of hazard would be attempting weather situations for which you are not qualified (i.e. attempting night VFR in marginal weather and/or in mountainous terrain), flying aircraft with serious maintenance deficiencies, and/or flying aircraft in weather for which they are not suitable (i.e. icing conditions in aircraft not certified for known icing). *The best safety word in the English language is still* ***"NO!"***

- **Always Consider** the risk level (i.e. risks) associated with every flight operation to get a realistic appraisal of the dangers to which you are exposing yourself (and any passengers which you may take). Try to envision all possible hazards while remembering that the lack of historical data on a particular hazard does not preclude that hazard from affecting your aircraft and/or flight. Risk levels of ***high*** or ***serious*** are not acceptable for flight operations and need to be reduced! If the situation does not permit these risk levels to be reduced to an acceptable level (***medium*** or ***low***) then the flight operation must be cancelled!

Risk Mitigation is taking the required action necessary in order to understand and mitigate (*minimize, lower and/or eliminate*) all unacceptable risks. These must be actions which the pilot (and/or other responsible parties who may have a direct impact upon the flight) can control. The following is a list (but certainly not an all-inclusive one) of risk mitigation strategies which would be applicable to the first flight in a new type of airplane or a test flight in a newly constructed airplane.

- Obtain type specific training in your new aircraft (or one like it).
- Use appropriate safety equipment (i.e. fire extinguisher, helmet, parachute, etc.)
- Evaluate the maintenance condition of the airplane (i.e. total time, cycles, inoperative components, maintenance, inspection and repair history).
- Evaluate the legality of the airplane (i.e. all required paperwork completed and available as well as a satisfactory insurance status)
- Review the FAA-issued operating limitations (i.e. Aircraft Flight Manual, Pilot Operating Handbook, FAA Type Data Sheets, and the designer/vendor's operational information and recommendations).

- Do not allow (or invite) situations which will result in the creation of external pressures (i.e. arranging an audience to view your first flight in a newly constructed, repaired or purchased aircraft).

- Plan a conservative build-up in your flight test program. Do not take on challenging conditions (i.e. high crosswinds) or advanced maneuvering (i.e. tight, close-in traffic patterns) until you have built up sufficient flight experience in your new aircraft.

- Be aware of your flight environment (i.e. temperature, winds, ceilings and visibilities, etc.).

- Complete performance calculations so you will be aware of what level of performance to expect from your aircraft (i.e. takeoff distance, rate of climb, fuel consumption, power settings, etc.).

- Limit your passengers (or people watching you fly) until you become more familiar with the airplane. The exception to this is – of course – dual flight instruction in your aircraft.

- Always evaluate your own health, fitness and fatigue level. (See the IMSAFE check list in the *Pilot's Handbook of Aeronautical Knowledge,* FAA-H-8083-25).

Acceptable Risk is the ***low (***or ***medium)*** residual risk which remains after you have applied all of the risk mitigations possible under the circumstances. At the expense of repeating myself, I must again state that ***serious** or **high** risk levels are never acceptable*! They must either be eliminated, mitigated to a low (or medium) level, or the flight operation must be cancelled until circumstances will allow an acceptable level of risk.

Stall Characteristics are an especially important consideration in test flying amateur-built, experimental aircraft. As it turns out, there may be a significant variation in the stall characteristics for a given design of experimental airplane (even between different individual airplanes of the same type) due to a host of reasons (i.e. improper rigging, small variations in construction and/or modifications to the design). The airplane may produce unexpected stall characteristics (including stalls with violent and/or extreme attitude changes) which can occur with little or no warning. This can result in disorientation, departure from controlled flight, and/or difficulty in recovering from the stall. *Irrespective of the airplane's stall warning and/or stall behavior, the stall may also produce a significant altitude loss!*

- **Type Certificated (TC'd) Small Airplanes** require adequate stall warning – in addition to fairly benign stall and stall recovery characteristics – to obtain certification from the FAA. The stall warning must be obvious and readily discernible by the pilot under all conditions. It must also provide enough of an airspeed margin for recognition and stall avoidance to occur. The allowable change in the airplane's attitude caused by the stall is very limited and recovery from the stall must not require any unusual skill, strength or alertness. In addition, if the altitude lost during a stall recovery is excessive, this figure must be published in the Airplane Flight Manual (AFM).

- **Experimental Airplanes** have no rules for stall behavior. While some experimental airplanes can be flown in a relaxed manner with the elevator in the full UP position, others can dramatically depart controlled flight without any perceptible warning. The reasons for these differences in stall characteristics might be found in the airplane design, construction differences, improper control rigging, and/or a host of other reasons. Because amateur-built airplanes are built by different individuals, there can be a wide variation in the stall characteristics of identical airplane models. It is essential that all experimental airplane pilots be aware of the variety of different stall characteristics possible among experimental airplanes. *It is especially important to become familiar with the specific stall characteristics of your individual airplane!*

- **Whether Stall Warning** is a natural airframe buffet, or a warning device triggered by an angle of attack (AOA) sensor, it needs to give the stall warning several knots faster than the actual stall speed (but not so much faster that it becomes a nuisance which the pilot learns to ignore). A sufficient stall margin must exist for all flap and landing gear configurations; it must also provide a reliable stall warning when maneuvering. The stall warning must be obvious enough to ensure the pilot notices its occurrence. A weak stall horn in a noisy cockpit or a very gentle buffet masked by turbulence may go unnoticed.

- **Measures You Can Take** to avoid insufficient stall warning and a subsequent stall are as follows:

    - Ensure the airplane's construction meets the kit vendor's specifications.
    - Consult the kit vendor to determine if your airplane's stall warning is representative of the design.
    - Add stall warning devices or stall characteristic improvements (with manufacturer's concurrence) such as a stall warning horn, AOA system, and/or stall strips.
    - Insure that existing and new systems receive proper calibration regardless of what stall warning system (if any) you install.
    - You should receive training in stall warning recognition from a qualified instructor in your specific airplane. Practice stall warning recognition and stall avoidance until you are proficient and comfortable with the process. (***Note: All aircraft design modifications must be thoroughly evaluated during initial flight tests)***

- **Airplane Response** to control inputs typically degrades at slower airspeeds, requiring larger control deflections to achieve the desired aircraft response. *These larger control surface deflections may actually precipitate a stall!* This makes it incumbent on experimental airplane pilots to become familiar with their individual airplane's control response behavior in case it displays this particular characteristic. In an ideal world all airplanes would stall with a clearly defined, slight pitch break without rolling off to one side. *Unfortunately, that is not always the case with experimental airplanes*. They may abruptly drop a wing to 45 degrees of bank or more. The intuitive application of an opposite aileron control input may actually aggravate this roll-off and cause yaw in the same direction. *As a stalled wing and yaw provide the two essential ingredients for a spin, this is not a desirable characteristic!*

- **It is Possible** for a seemingly carefree handling airplane to achieve a "deep stall." *During a "deep stall" there is insufficient nose-down pitch control authority available to break the stall, thus creating an unrecoverable situation*. (This is similar to what happens during a flat spin, except for the absence of rotation which occurs in a spin.) It is also possible for some airplanes to rapidly pitch nose-up just before a stall. This results in a rapid stall entry – unless the pilot counters with a conscious down-elevator input.

- **An Airplane** which stalls wings-level, but loses an excessive amount of altitude during the stall recovery, can be dangerous if an inadvertent stall occurs at a low altitude. Also, *airplanes which exhibit benign handling characteristics during slow flight may inspire a false confidence if they tend to develop a high rate of descent at low airspeeds*.

- **Experimental Airplanes** which have very powerful engines turning large propellers have a performance advantage – but these same airplanes may exhibit more violent departures from controlled flight during a stall at high-power settings. Their stalls may involve significant variations in attitude, with rate and acceleration changes, even possibly including violent disorientating motions. This tendency makes go-around accident scenarios probable when the pilot rapidly advances the throttle without controlling the resultant pitch and yaw tendencies. (This was a classic WWII fighter accident and was how the Navy's F4U Corsair acquired the nickname of "*Ensign Eliminator.*")

- **The Steps You Can Take** if your airplane's stall characteristics are not what you would consider benign are as follows:

    - Ensure the airplane is built according to the kit vendor's specifications.
    - Consult the kit vendor to determine whether your airplane's stall behavior is representative of the design.
    - Receive training in your airplane on stall avoidance and recovery from a qualified instructor.
    - Adhere to stall-free flying by establishing minimum airspeeds and proper airspeed discipline for all phases of flight.

- **It's Possible** for an airplane to have perfectly acceptable stall warning traits and yet still have a nasty stall. Conversely, an airplane may be lacking in adequate

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stall warning but have benign stall characteristics. Either of these situations may be acceptable (or not acceptable) in an experimental airplane; however, the pilots of such airplanes must know whether or not their respective airplanes display these characteristics and what flight procedures to use in order to maximize safety.

- **Stall recovery** should be easy to perform any time during the stall warning phase or after the stall actually occurs. The airplane should respond as expected to intuitive control inputs with no tendency for a control-induced secondary stall. *Knowing whether your specific experimental airplane performs this way is essential knowledge for the safe operation of your airplane!*

- **While Some Altitude Loss** may occur during an actual stall, an excessive altitude loss following a stall is obviously problematic. Ensure your specific airplane meets the kit vendor's specifications. Consult your kit vendor to determine whether your specific airplane's stall and stall recovery characteristics are typical for the design. Ensure that your engine and propeller combination is performing properly.

- **Obtain instruction** from a properly qualified flight instructor on stalls and stall recoveries (at a safe altitude). Learn how to optimize your airplane's stall recovery performance without entering a secondary stall. Record the maximum altitude loss in a worst-case stall scenario and keep this figure in mind when maneuvering at low altitude or during takeoffs or landings in gusty wind conditions.

- **Stall Characteristics** of all airplanes can vary significantly due to changes in the following factors:

    - Weight
    - Center of Gravity (CG) – especially aft CGs
    - Wing Contamination (such as dirt, dings or frost/ice – especially near the leading edge of laminar flow airfoils)
    - Sideslip or yaw (raises stalling speed and results in a rolling/yawing departure – including spin entry)
    - Rate of speed decay (deceleration)
    - Acceleration (G Load) increase
    - Engine Power (Thrust Vector effects)

- **A Thorough Check-Out** in your airplane model by a well-qualified flight instructor (with experience in your particular airplane make and model) is always a good idea. If it is an experimental airplane, which you have built yourself, consider obtaining this training from the kit vendor or owners group, preferably in your airplane. If you purchased your airplane from a previous owner, learn all you can from him or her.

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- **Periodically practice** stall avoidance and stall recovery at a safe altitude (***after*** you have received adequate flight instruction and feel confident in your stall recovery abilities). *Stall recognition and recovery should not be self-taught!*

- **It is especially important** that you do not discover your airplane's individual stall characteristics from an inadvertent stall that catches you by surprise. *They say the trouble with experience as a teacher is twofold: 1) Experience gives the test first and provides the learning second and 2) Experience sometimes kills her students!*

This looks like a good place to break for this month. Next month we will resume our discussion with Part III on **Aircraft Stability and Controllability.**

The thought for this month is ***"The best safety device in any aircraft is a well-trained crew"*** ~ **Albert Lee Ueltschi,** *founder* - ***Flight Safety International***

So, until next month, be sure to ***Think Right*** to ***FliRite!***

Happy Thanksgiving! ~ *Hobie*

Example of the Low-Inertia and/or High-Drag Family of Airplanes

Ken Tomlinson with Northern Airways Piper J3 at KBTV – Summer of 1957 **Image by Hobie Tomlinson**

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