Flight Advisor Corner by Hobie Tomlinson

May 2013 **2013 Annual Safety Issue** **"Old Airplanes"**

<u>This month</u> we will temporarily interrupt our series on the Multiengine **<u>P</u>**ractical **<u>T</u>**est **<u>S</u>**tandards (**PTS**) ***FAA-S-8081-12C*** (***Commercial Pilot for Airplane Single- and Multi-Engine Land and Sea)*** that became effective on June 1, 2012 to publish the 2013 Annual May Safety Issue of the Flight Advisor Corner.

<u>The Topic</u> for this year's Annual May Safety Issue is **"Old Airplanes"** and their Acquisition, Care, and Maintenance. They say that "Old Airplanes" are like Aging Aviators – "The older they get, the more inspections and repairs they require."

"Classic" Cub & Waco YMF-5 over Lake Champlain

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WW II ended over sixty seven years ago on August 14, 1945. Immediately after the war's end, a major post-war "bubble" of civilian General Aviation aircraft production occurred that lasted approximately three years. General Aviation aircraft production then collapsed and remained at relatively low ebb until the second big General Aviation aircraft production bulge began in the early 1960s. That "production bulge" lasted until the early 1980s when it finally succumbed to the duo of economic pressures and product liability lawsuits.

The Cost of newly manufactured aircraft has risen exponentially faster than the rate of inflation, making them unaffordable to all but those individuals and organization that have considerable resources at their disposal. The rapid rise in technology that enabled light aircraft to be equipped with very advanced avionics, the insatiable demand for more performance, the increase in new aircraft certification costs, and the ever present product liability lawsuits have been major contributors to the large price increases experienced by the current manufacturers of production GA aircraft. The net result is that, for a large segment of General Aviation, we are currently stuck with an aging aircraft fleet that was produced during the second large GA "production bulge" which ended in the 1980s. Even the newest of these aircraft are now 30+ years old and most of those aircraft that have been used commercially are in the 6,000 to 12,000 hour range.

The Second Law of Thermodynamics states that the entropy of an isolated system never decreases, thus all things (including aircraft) deteriorate over time and will eventually fail. Because the mainstay of the general aviation, "light aircraft" fleet will continue to be these aircraft and, as the movie ***"Apollo 13"*** stated, ***"Failure is not an option!"*** Thus it behooves those of us who continue to operate these aircraft to understand some of the issues associated with the continued operation of an aging aircraft.

The First Issue to understand is that there are the two types of aircraft age, as follows:

I. **Chronological Age** is based on the aircraft's actual date of manufacture and is easy to compute.

II. **True Age** is based upon how much of an aircraft's service (useful) life has been used up. An aircraft's "True Age" is difficult to compute and is based on an expert analysis of the aircraft's service history including the **use** and the **conditions** under which that use occurred. Manufacturers are increasingly defining the service (useful) life of critical aircraft components in order to insure their viability under the most severe usage scenarios. As an example, Piper now specifies a 12,000 hour service life limit on the wings of many of their popular training aircraft.

The Big Three Questions used in determining an aircraft's "**True Age**" are as follows:

1) **How** was the aircraft used?

2) **Where** and **How** was the aircraft stored?

3) **How** and by **Who** was the aircraft maintained?

The Aircraft's Use History is an important component in determining its true age. Aircraft that have been exposed to "heavy use" over prolonged periods will show excessive true age relative to their actual chronological age. Heavy Use is defined as operations that regularly expose the aircraft to heavy loads, turbulence, and/or repeated hard landings. Some typical "heavy use" operations are flight instruction, sky diving, pipeline patrol, banner towing, aerobatics, mountain flying, air combat and air freight.

Heavy Aircraft Use, which are not involved in a continuous and rigorous maintenance program involving on-going periodic inspections, regular maintenance repairs, and a continual parts replacement program, are guaranteed an impending mechanical failure. *Mechanical Failure* accidents have remained relatively constant at a rate of approximately 16% of the total general aviation accidents. The absolute best prevention strategy for avoiding these types of accidents is an aggressively proactive maintenance program. ***"If you take care of the small things, the big things will take care of themselves" – Emily Dickinson, Author.***

The Aircraft's Storage History is the next consideration and is composed of both the Location of Storage and the Method of Storage**.**

1) **Regional Climates** produce variations on the type of deterioration an aircraft experiences during unprotected storage.

   a. **Southwest Areas** (deserts) contain climates with high sunlight and low moisture environments. Aircraft stored in these locations typically exhibit high ultra-violet (UV) damage to paint, plastics and fabrics. Conversely the low humidity means that there is a very low corrosion risk to metal structures.

   b. **Coastal Areas** (oceans), especially in the warm Southern areas, contain climates with high moisture environments that often contain industrial contaminate. Aircraft stored in these locations typically exhibit high moisture damage (corrosion) as well as the potential for "musty" interiors.

   c. **Northern/Interior Areas** (plains & mountains) contain climates that are probably the best available combination of both relatively low UV exposure and corrosion risks. Aircraft stored in these locations typically exhibit both low UV and corrosion damage.

2) **Storage Method** also produces variations on the type of aircraft damage exposure experienced.

   a. **Hangars** (paved floor and climate control) are the absolute best method for aircraft storage. Hangars provide excellent protection from both UV and moisture exposure. While climate controlled hangars are the absolute best storage method, paved floor hangars, without climate control, are the second best storage method available.

   b. **Dirt Floor Enclosures** produce high moisture environments and are one of the worst aircraft storage options. They produce environments with both a <u>high corrosion risk</u> and a <u>high risk of "critter damage</u>" from birds, mice, squirrels, etc. If an aircraft must be stored in a dirt floor location, it is much better to leave the doors open in order to provide as much ventilation as possible.

   c. **Tie Downs** (Outside Storage) are also undesirable and produce a high deterioration risk from UV, Corrosion, and Critter Damage.

3) **Aircraft Inactivity** <u>exacerbates any high deterioration risk</u> that an aircraft is exposed to. It is preferable that aircraft be flown at least weekly. Aircraft, which are not going to be flown over period of longer than 30 days, should be properly prepared for storage by your favorite aircraft maintenance technician (AMT). Long periods of inactivity produce a <u>high risk of internal engine corrosion</u> as well as <u>increasing the risk of regional climate and critter damage</u>.

<u>The Aircraft's Maintenance History</u> is the third consideration and is composed of the aircraft's <u>damage history</u>, <u>modifications</u>, <u>maintenance condition</u>, <u>and maintenance records</u>.

1) **Damage History** is an important part of any aircraft's evaluation. Documented damage should be closely inspected and evaluated on the basis of the type of damage, how that damage was repaired, and the qualifications/expertise for the repairing agency or person. The aircraft should also be closely inspected for undocumented damage, which is far more common. This type of damage being quite common on older aircraft.

2) **Aircraft Modifications** are also very common on older aircraft.

   a. <u>A Comprehensive List</u> of all installed Modifications should be made. Typical modifications to older aircraft may include higher horsepower (including turbine engine conversions), increased gross weight, greater fuel capacity, vortex generators (VGs), STOL (**<u>S</u>**hort **<u>T</u>**ake**<u>o</u>**ff and **<u>L</u>**anding) modifications, tundra tries, upgraded wheels and/or bakes, modernized electrical systems, glass panels, high tech. avionics, etc.

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b. Verify that the aircraft weight and balance data is current (and accurate).

c. Aircraft Rigging should be checked by performing a static control check without the engine running. During the static control check, all controls should move smoothly with no unusual noises and no control binding. All control tabs should be checked for correct tab indexing. All controls should be measured for the correct control defection, proper contact with the control stops, proper control cable tension and for the proper rigging of the control column/stick when the controls are in the neutral position. A maintenance test flight should then be performed to validate the aircraft's flying characteristics.

d. Aircraft STCs (**S**upplemental **T**ype **C**ertificates) should be checked to insure that all modifications are properly documented in the Aircraft's Maintenance Records and AFM (**A**ircraft **F**light **M**anual). Insure that documented STC are actually installed and that installed STC are actually documented!

e. Unapproved Parts installation is very common on older aircraft and is especially prevalent for carburetors, magnetos, alternators, and/or voltage regulators, etc. (It is common to find that unapproved auto parts have been installed in a light aircraft's electrical systems.) Part numbers should be checked and validated against the part numbers listed in the Type Certification Data Sheets (TCDS), Original Equipment Manufacturer (OEM) Data, and parts/maintenance manuals. It is very important to confirm that all installed equipment is listed and all listed equipment is actually (correctly and legally) installed. (**Note:** *It is important to note that only "certified" parts and equipment may be installed in a certified aircraft!* This is very unlike experimental (amateur built) aircraft which are legally allowed to use "uncertified" parts and equipment.

The Aircraft's Maintenance Condition involves carefully inspecting the aircraft for metal fatigue, corrosion, and other undocumented/unrepaired damage.

1) **Metal Fatigue** is indicated by cracking. Inspection for metal fatigue can be made visually, by dye penetrant and black light inspection, and/or by non-destructive testing (NDT) such as eddy current or x-ray inspection. High Fatigue areas, such as spar caps, may have an airworthiness directive (AD) requirement for periodic NDT. Any parts which have been exposed to overstress damage (i.e. an engine crankshaft involved in a prop strike) require NDT to validate their continued structural integrity. Factors, which affect metal fatigue, are as follows: type of flight activity, amount of exposure, improper maintenance, accident/incident damage, metal deformities and/or defects, and parts placed under stress during installation (common with exhaust manifolds).

2) **Metal Corrosion** can be surface (chemical & electro-chemical), pitting (tiny holes), filiform (occurs under paint exposed to high humidity environments), fritting (caused by movement between adjoining surfaces – i.e. loosened rivets), intergranular (decomposing of the molecular metal structure), and dissimilar metals (common on magnesium structures – i.e. control surfaces and/or wheels). *A corrosion inspection needs to be very through to including using a Boroscope and possibly NDT methods*. (Corrosion damage repair is always expensive.)

Aircraft High Risk Areas are as follows:

1) **Exterior Symptoms** of potential aircraft damage can include non-structural cracks and deformations, propeller corrosion, wheel corrosion, tire degradation, gear attach-point deformation, wing strut and wing strut attachment fitting corrosion, general areas of rust and corrosion, exhaust-trail area contamination, windshield and window degradation, rivet and skin joint corrosion, antenna deterioration and antenna mount damage, piano hinge corrosion and paint deterioration. (**Note:** Metal wing struts and other sealed tubular fuselage structures are typically lightly tapped with a flat faced punch at progressive locations – much like using a fabric tester – to validate their continued structural integrity. The punch will penetrate tubes whose wall thicknesses have been seriously eroded by non-visible, internal corrosion. This is a lower cost version to "official" NDT).

2) **Interior Symptoms** of potential aircraft damage can include control cable & pulley deterioration, battery compartment corrosion, wooden structure deterioration, internal structure corrosion & fatigue (use NDT), fuel tank condition and integrity, damage caused by fuel leakage, under floor-board/fluid line corrosion and/or contamination, water damage from door and window seal leakage, excessively worn seats and/or seat tracks, cabin interior deterioration, junk and/or inoperative aircraft wiring, outdated and/or inoperative avionics or other cockpit "gismos," inoperative cockpit instrumentation (not atypically fuel quantity gages) or systems, and hardware deterioration and/or corrosion.

3) **Engine Symptoms** of potential aircraft damage can include valve leakage (Make a slow/static engine "pull-thru" while carefully listening at the exhaust stacks for any valve "blow-by" sounds – only after insuring that the "switches" are in the "OFF" position and the wheels are chocked), next complete a comprehensive, maintenance-type engine run-up – including a "hot-mag" continuity check, and then do a full engine compression and Boroscope check. Pull and replace the oil filter and then cut the old oil filter open to inspect it for the type and amount of any trapped particles. Check the engine mounts for proper installation and condition; check the exhaust system for leaks and cracks; carefully check the condition of all engine cooling baffles; and check all fluid lines for leakage and corrosion. Finally, check all engine hoses and belts for wear, damage, chaffing, and proper tension; check all engine gasket

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locations for leakage; and check all engine hardware for corrosion and/or damage.

4) **Specific Cessna Aging Issues** are predominately corrosion based issues and include the wing "spar-beam," overhead panel, elevator trailing edge, inner wing skin, magnesium wheels, and wing-spar attachment corrosion-prone areas. Other issues include belly-Interior contaminate build-up, engine and/or propeller control cable deterioration and/or moisture contamination, exhaust system cracks, 400-series spar fatigue cracks, and stabilizer jack screw "play" on those aircraft which trim by the use of a moveable stabilizer (i.e. CE-180 & 185 aircraft).

5) **Specific Piper Aging Issues** are also predominately corrosion based issues and include spar-cap, fuel tank, stabilizer, cabin floor, battery box, torque tube, and bulkhead corrosion-prone areas. Piper also has had consistent problems with leaking door and window seals, leading to corrosion damage and cabin interior deterioration in those areas so affected.

6) **Restored or Experimental Aircraft Issues** include aircraft logbooks "missing;" shallow or undetailed maintenance entries; lack of cleanliness on the aircraft belly and in the engine compartment; freshly "painted-over" corrosion areas; propeller corrosion and/or bent propeller blades (Check for a "wave" in blades. This is typically caused by pulling the aircraft by the middle or outer end of the propeller blade, which will overstress the blade without the presence of rotationally-induced centrifugal force); out-of-time (either operational or chronological time) engines; under-used engines; rare engines (i.e. Franklins, Warners, Rangers) which may have a parts availability problem; installed "homemade" trim tabs (usually indicates that the aircraft has been "bent" or is seriously "out-of-rig,"); delaminating bonded-honeycomb structure (Grumman-American Aircraft); and structural defects in any composite based aircraft structure.

Other Miscellaneous Maintenance Issues include ballistic parachute repack due-date; Emergency Locator Transmitter type (121.5 MHz or 406 MHz) and battery replacement due-date; availability of adequate performance data; outdated and/or inoperative instruments or avionics; "rats nest" wiring behind the instrument panel; and the status of all parts, that are either "life-limited" or have mandatory or recommended overhaul and/or replacement times.

Aircraft Document Research is a mandatory and required part of all aircraft evaluations and probably has the greatest potential for actual cost savings. aircraft documents, which must be reviewed, include the maintenance logbooks (all three – airframe, engine & propeller), all airworthiness directives (ADs) for the type aircraft, any special airworthiness information bulletins (SIAB), all service letters, bulletins, instructions and difficulty reports, a title search, any aviation maintenance alerts, aircraft type certificate data sheets (TCDS), a FAA records search, an aircraft accident data base search for that type aircraft, a comprehensive part number list including a parts compatibility check, and lastly, information from 'type" clubs, type "gurus," and type specialty shops.

Most Desirable Aircraft will have excellent maintenance histories and no damage history. They were not subjected to "hard-use" operations, were stored in climate controlled hangars with paved floors, typically had regular normal usage and were preheated during cold weather operations.

Least Desirable Aircraft will have poor maintenance histories, multiple damage incidents, have had substantial "hard-use" operational time, were stored outdoors, have either very high usage or were severely under-utilized, and were seldom preheated during cold weather operations

Aircraft Care Tips that are considered to be industry "Best Practices" include keeping the aircraft clean and waxed, keeping the aircraft properly inspected, flying the aircraft regularly (for at least a ½ Hour minimum flight time, at normal cruise power, once per week), properly preparing the aircraft for any planned low use periods (i.e. the winter season flying lull), doing routine preventative maintenance, applying adequate, improved corrosion treatment to the aircraft, monitoring all maintenance, keeping the aircraft hangared, and joining the EAA and/or the appropriate aircraft type club.

The "Bottom Line" of aging aircraft is this: *while older aircraft are cheaper to purchase than newer aircraft, when it comes to operation and maintenance, the reverse is true "in spades!"* The most important thing to understand is that the cost of operating and maintaining an aircraft is based on what that aircraft would cost if purchased new today, not on what it was actually purchased for. (I.e. The actual cost experienced in operating a used Cessna 172N, manufactured in 1976, is closely related to the cost of operating a new $300K Cessna 172S and is not based on the average $50K purchase price of the typical 172N). This is true because the costs associated with all parts, labor and services involved are based on the current cost structure, not the one which existed at the time of the aircraft's manufacture. While there is nothing more beautiful (and functional) than a properly restored, older aircraft, anyone who has ever done a restoration of anything (aircraft, boat, automobile, house, etc.) can attest to the fact that it is not for the "faint of heart."

Anyone Contemplating the purchase, restoration, and/or operation of an older aircraft would be wise to do his/her homework in talking with type clubs, current owner/operators of similar aircraft, and the resident aircraft "type-gurus." The cost of employing of experts who are knowledgeable in that particular aircraft type – including its pre-purchase inspection, return to active service, on-going operations, and adequate pilot proficiency training – will be returned multiple times over by the avoidance of very costly mistakes. Many of these mistakes may not be readily apparent to persons who are inexperienced in that particular aircraft type. I would love to say that aviation does not suffer from unscrupulous types; unfortunately, aviation just represents a cross-section of our current society and suffers from the same maladies that exist everywhere else. I can't begin to tell you the number of times that I, or people that I know and respect, have been called in to do damage control on costly mistakes that could have been easily avoided had they been involved earlier in the process.

Useful Resources for additional information are AOPA.org, EAA.org, VAA.org, Type Clubs, and Specialty Shops for your particular type aircraft.

Next month we will return to our series on the **Commercial Pilot – Airplane Practical Test Prerequisites** imbedded in the **Introduction Section** of the PTS as we continue working our way through the Multiengine **P**ractical **T**est **S**tandards (**PTS**) ***FAA-S-8081-12C*** (***Commercial Pilot for Airplane Single- and Multi-Engine Land and Sea)*** that became effective on June 1, 2012.

The thought for this month is: "**Aviation in itself is not inherently dangerous. But to an even greater degree than the sea, it is terribly unforgiving of any carelessness, incapacity, or neglect." ~ *Capt. A. G. Lamplugh, WW I Aviator.***

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

1945 Beechcraft D18S (S/N A286) @ KBTV- Fall 1972

1035 D18S Aircraft were Produced (N80386 destroyed Jul 77 – Ldg Accident @ Moses Point, AK)
Hobie Tomlinson Image

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