WARBIRD NOTES

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INTRODUCTION

I'd originally written the letter in Warbird Notes #01 to Bill Harrison, President of the E.A.A's "Warbirds of America" in March of 1993. At that time it was suggested that these be published as the first of what would ultimately become a random series of notes/bulletins/contemplations/recollections concerning the operation of warbirds as well as other aircraft utilizing large reciprocating engines.

These bulletins were derived from the collective experiences of many people operating and/or maintaining these aircraft during that period during which they'd been the over-riding majority of the industry. More than a few of those aforementioned people have subsequently "gone west" so I'd imagine that this series probably represents the only record of their experiences. It's been my intent to make every effort to faithfully record their recollections/experiences, along with those that I've encountered during the years we spent with this equipment. In any endeavor of this type it seems of great importance that any of these recollections/beliefs/opinions tainted by "Old Wives' Tales (OWT's) be evaluated, and then sometimes, discarded.

As the reader surely knows, this industry is rife with OWT's. Early on, it became clear to me that many strongly held opinions were based on that alone, an impression that'd caused a strongly held opinion. This became evident while listening to opinions expressed by many people with thousands of hours of experience but, unfortunately, all in turbine equipment. Sad – but true – the two engines are NOT the same and what may be valid on one may be totally invalid on the other.

Mark Watt and Tim Jackson have requested that I write this brief note of introduction/explanation at the front of this series of Warbird Notes. For the reader's information, the small number (within the parenthesis), to the left of the date in the header, indicates how many times the original note was re-written. The reader will also find that several of these notes have "things yet to write" at the end. This is indicative of a "work in progress" and if one of these is encountered please view them as exactly that!

Randy Sohn – 2008

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#01 HYDRAULIC LOCK ON ROUND ENGINES

I originally wrote this letter to Bill Harrison, President of the E.A.A. Warbirds of America on 21 Mar 93. It has been suggested that I include it as the first of what will probably be a series of notes or bulletins concerning the operation of warbirds and other large reciprocating engine aircraft. Also, after publishing the original letter I became aware of some important additional information from Dave Clinton which I'll add to the last page at the end of the original letter. These bulletins are distilled from the experiences of many people with these aircraft over the years; I'll attempt to faithfully record their recollections and experiences.

Dear Bill,

This past weekend at Galveston at the warbird conference left me with a feeling of concern about the confusion that still exists regarding hydraulic lock on round engines. I guess what prompts this letter is the questions people asked me after the meeting; apparently these were what several people were afraid to ask in public in a seminar of over a hundred people. For more years than I care to think about we've talked about this problem all over the country (or world, for that matter) and we are still seeing HIGH dollar damage to the engines of our assorted vintage aerospace vehicles.

Jim Fausz and I discussed this the day preceding the conference and agreed we would re-tackle the subject during the maintenance portion of the first day. When Jim got to this part we were interrupted and never did really get into it as we intended. The next day we did have some discussion of it and that is where I could see evidence of what happens when pilots with flat engine and/or turbine engine backgrounds start operating radials. Unh - upon further reflection and consideration of the above statement I believe I'll modify it and say that I've seen mistreatment of these machines by people whose experience goes back (W-A-A-Y back) to WW II. So, what to do? Maybe including what follows in a subsequent issue of Warbirds Magazine would be helpful and prevent some expensive engine damage and possible injury to someone. This is certainly not rocket science. I seem to remember most of it from way back in cadets or instructor or test pilot school. It's probably available in some old musty USAF mechanic training manual some pack rat saved somewhere. It was common knowledge when jets were new and props were conventional. But back then tailwheels were conventional and nosewheels were not, right? Things change, I guess!

What follows represents my experiences along with those of friends and associates over many years. Other's experiences may cause them to have differing perceptions of some points. I hope the reader views this as a form of "hangar flying" and will feel free to share his/her comments or questions. And keep in mind I'm just an instructor pilot trying to communicate the things we've learned the hard way, not a professional writer!

First, we should probably take a look at why this happens, and then later discuss how to deal with it. Whenever a radial engine remains shutdown for even a short period of time the possibility exists of oil draining into the lower cylinders. Obviously, the longer the period at rest, the greater the possibility that the amount of oil will exceed the combustion chamber volume available at the limit of the pistons' travel, also referred to as Top Dead Center (TDC). Upon subsequent rotation (in a forward direction) as the piston <u>approaches</u> TDC of the compression stroke both valves will be closed. The aforementioned oil (liquid) is incompressible and will stop the piston motion. If the crank continues to rotate, <u>something's gonna give</u>! In many years of association with Jack Sandberg at his engine shop, we saw two manifestations of this, heads loosened or blown right off the cylinder barrel and, more likely, bent or broken connecting rods (Illustration #1). Before you ever get to the point of flying the thing, a good look at the engine on preflight can tell you all sorts of things if you are unacquainted with the particular aircraft you are about to fly. A very close look at the area of the cylinder hold-down studs may reveal either a broken stud or evidence of oil seepage. The same holds true in looking for evidence of leakage at the cylinder barrel/head interface area. A loosened spark plug insert also is a telltale of damage.

A total lock (one which stops crankshaft rotation) while starting is going to result in serious damage to the engine. Bad as this seems, given my druthers, I'd much prefer this to happen than what I'll describe next. This would be the case of a partial lockup that wasn't detected (or, perish the thought, was disregarded as not particularly important) at the time. The piston meets extreme resistance but isn't completely stopped, the engine jerks and slightly hesitates and then completes the start as the succeeding cylinders fire. That particular connecting rod can have a varying amount of bend which will allow the engine to run. What we have here is the equivalent of a time bomb just waiting to fail; the only question is, when? It would probably take a very mechanically oriented pilot attuned to that particular aircraft to detect the slight difference in sight, sound or feel between a normally operating engine and this one and, even if detected, the problem might be blamed on some other mechanical reason. Howard Pardue and "Doc" Christgau come to mind immediately as examples of the above situation, flying the <u>same</u> aircraft <u>often,</u> but very few of us can say the same. The failure will very likely take place under conditions of high power and stress such as a take-off or go-around, just when you'd least want to deal with it. So, if you're going to have it happen, hope it bends something enough to make it obvious, then you won't ever get to the second situation. If you do have it happen, **STOP**. Don't fly it and don't let your buddy fly it!

Now, what have we learned over the years about how to prevent the situation? In the fifties we had about 160 B-25s at Lubbock. In the sixties we operated about 35 DC-3s (Wrights) and about the same number of Convairs on the airline. Everyone was aware of the possibility and the simple procedure of always rotating six blades with the starter on these engines prior to prime and ignition sufficed. As an aside, on the Boeing C-97 Stratocruiser we always counted 20 blades first but this was touted as also being for lubrication of the R-4360’s reduction gearing. At any rate we were taught from the earliest T-6 days and in turn taught our students what we were looking for while starting. Practices vary somewhat among different pilots. Probably it's been fairly commonly accepted that if an engine has been shutdown for 30 minutes or so to check for lock. However, during the process of writing this I talked to two pilots who experienced it after only 10 minutes. A word to the wise!

Pulling the blades through by hand is one way of detecting hydraulicing. What we are looking for here is a feel of <u>sharp</u> or <u>sudden</u> resistance (unlike the buildup of normal compression) to continued forward rotation of the prop. Right here we should mention a very common problem of <u>untrained</u> help from the crowd whose assistance (they only want to help) can cost you, the owner, big bucks! You need to know what hydraulicing feels like and make sure only you or someone who also knows is involved in pulling the prop through. Don't make a gorilla race out of the process - the best description I can think of is just leisurely walk it through while looking (feeling is actually a better word) for a problem. We need to talk also about the number of people. I've always taught one person on an R-670 through 1340. Two people on an 1820 through 2800. Three people on a 3350 or corncob. If you think more, just get a calculator and figure out the foot pounds transmitted to the connecting rod by that many guys really laying into a 13 foot or so propeller (lever). Jack Sandberg could quote you the figure off the top of his head (along with about anything else). I can't, but do know that he didn't want any engines he built and guaranteed to be pulled through by hand. He figured he'd rather rely on the starter clutch than untrained help in preventing damage. I've done and do it both ways, both have pros and cons. While on the subject, I just remembered something else. On a four engine aircraft, don't let people pull through #l and 2 or #3 and 4 simultaneously. One engine's blades will be descending as the other one's are being pushed by guys with their heads down. This got us a pretty severe scalp gash on the B-29 a few years back (yes Virginia, there are more blood vessels in the scalp than anywhere else on the body's surface!).

If you're going to do it with the starter I think it should be done one blade at a time. This never lets enough momentum build up so as to have to rely on the starter clutch. First, mesh the starter and then intermittently energize the starter, "bumping" it through blade by blade while being <u>alert</u> for any blade to jerk to a stop or stall.

You can figure out for yourself the number of blades using either man power or by the starter. For instance, a 16:9 reduction on a B-25 says just over 3 blades will rotate the power section through a complete power cycle. I'm probably conservative – on a 3 blade like the Hellcat I usually "bump" an engine through about 6 blades and then go to continuous starter RPM for another 6 or so. On a four bladder like the P-47, I use 8 instead of 6. My thought on this is that if any oil is residing in the intake pipe I might (see discussion later) suck it into the cylinder at that point while still relying on the starter clutch to prevent damage. During all the aforementioned I've been acting as a mechanic. After this process I stop everything, put on my helmet, harness and whatever, then function as a pilot and start the engine.

Now - the important part. Let's say you detect a lock. **Pull a spark plug and drain it!** Just hope and pray no one found it ahead of you and, out of your sight and knowledge, turned the prop backwards! This is the equivalent of inserting a time bomb in your engine. As Jim Fausz said, "Where DO it GO?" The answer is, the piston pushes it into the intake pipe where it waits like a "snake in the grass" to be sucked out as the engine starts (Illustration #2). Then we're right back to the "something's gotta give" situation. Once someone rotates it backward I don't know of any way to get it out of the intake pipe except to suck it out. An engine shop foreman with years of experience put it in these words: **"DON'T ROTATE IT BACKWARDS OR LET ANYONE ELSE DO SO".** Some feel that a taildragger probably accentuates this problem due to the angle of the intake pipe. If I knew it had been done, I'd pull a spark plug out of all the lower cylinders, disconnect the other plugs on those cylinders, turn it through with the starter several turns, then start the engine and clean up the mess afterwards. It'll blap and snort while blowing oil all over everything but – that's the object, isn't it? I've only been around once while this was done; you don't need to run it more than several seconds to clear it. Too much trouble, you say? Well, O.K., it’s your engine and you can easily calculate the cost of pulling the cowling and plugs vs the cost of an overhaul, you might even get lucky. John Lane at Airpower Unlimited (208-324-3650) can tell you of some failures he's seen and repaired. For those who really want to deal with the above problem professionally he is developing an improved "blowout" plug (rather than the country boy approach we used) to deal with the above problem. The original (but now hard to obtain) version of this plug dates back many years. It temporarily replaces one spark plug with a check valve which allows the cylinder to create suction on the intake but lets the oil blow out on compression. Honest disagreement exists over the need to start the engine. Some people feel that just rotating it through with one plug out at cranking speed will do the trick and they could be right. However, I really question if enough suction is going to be created at cranking speed since viscosity of the oil also enters into this whole equation. On the B-29 a Tech Order requires heating the intake pipes when dealing with this exact problem so we know it is (or was) a matter of concern.

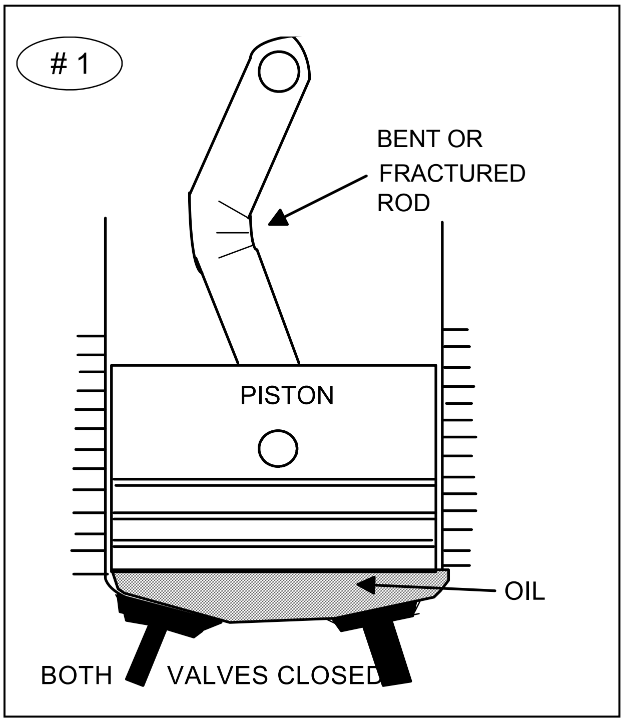
Earlier, I mentioned that abuse occurs even by people whose experience goes back to WW II. Several years ago I remember trying to get to the bottom (pardon the pun) of an R-1820 failure. We, on the investigative board of this particular museum, had heard several people testify that the engine just self-destructed for no apparent reason, yet the teardown revealed a preexisting bent rod. You can imagine our astonishment when a respected mechanic with long time experience on round engines at a major military base said "Well, it **couldn't** have been hydraulic lock, I helped pull it **backwards** after it stopped on the pull through!" (by the way, you're absolutely right, Commander “X” or Colonel “Y”, I didn't mention whether he/she was Navy or Air Force – let alone Marine, now am I a model of political correctness/inter–service rivalry avoidance or what?).

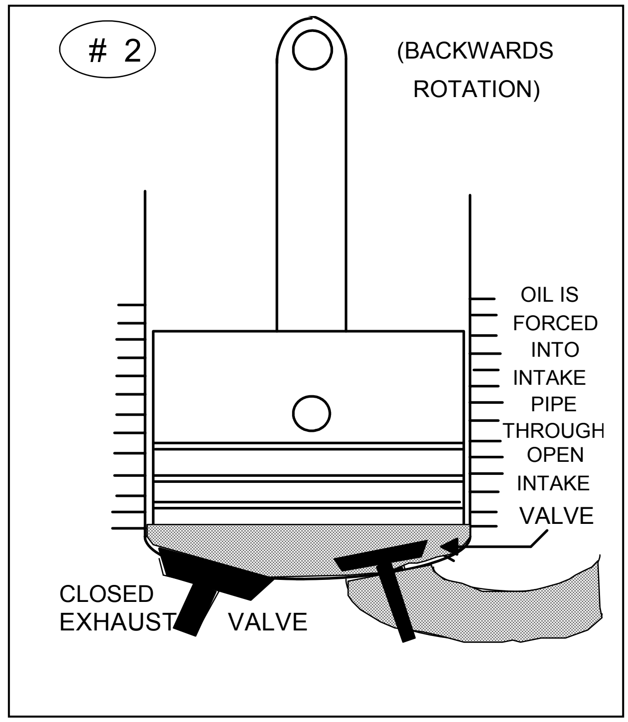
Jim Fausz mentioned two other items that apply. The first is obvious; make sure the ignition is OFF before pulling the prop through. Anyone who's seen a crop duster/ag pilot/aerial applicator (same guy - just different decades) start a 985 or 1340 on a Stearman with a half hearted leisurely tug on one blade while walking past the nose would understand. The other is that many of these problems might be avoided by using the recommended procedure in your aircraft's manual regarding scavenging the engine crankcase at a certain RPM immediately before shutdown. This made me think of a caveat in closing, after start and/or before shutdown you should ALWAYS do a mag grounding check at idle just to make sure the ignition switch is really functioning O.K.

This has gotten much longer then I ever intended when I started. I've talked with a lot of people while trying to write this. It seems that every time I dredged up something from my memory data bank someone else said "Yeah, and while you're on the subject shouldn't you also mention XXX?". I guess what has happened is that we've skipped a generation in passing on what was common knowledge at one time. I hope you can find some place or forum to use it where it might prevent damage or injury and we can "Keep’em Flying". I'll just assume you can sort out the tongue-in-cheek from the serious.

Best - Randy
EAA #2054, WB #71

(15 Dec 93) After writing this Dave Clinton contacted me with some additional thoughts that I wish I could have included in the original letter. He reiterates that the recommended scavenging upon shutdown is, at best, not very efficient. Typically 2 ½ to 3 gallons of oil remains in the front sump and lower cylinders/rocker covers. An additional problem he cites is the "bleed holes" drilled in the oil ring lands of some pistons which will add to this problem. He mentions that most late Wright manuals he has read prohibit moving the prop by hand in either direction. Instead of relying on possibly untrained help they depend on the starter clutch which is typically set at 500-800 pounds of torque. Now, the most important part of his letter! The installation of the Darton Int'l. "Clean Kit" (619-434-0701) would eliminate the lock problem on these engines. This kit has been widely installed in the T-28 fleet over the past few years.





#02 DECELERATING APPROACH

This is intended as sort of a "to whom it may concern" or "hangar flying" discussion of a question recently raised. Some comments have been noted that we should fly a "stabilized" approach in the B-25 as we do in airline and other turbojet operations. Looking at it from a historical perspective, apparently such a good job of training has been done that we now have what could be called an "embarrassment of riches" or "over-success". Let me explain briefly (I hope) how we got here and why we do what we do the way we do it (if you don't want to read through the "why", you can cut to the "way" in the last couple of paragraphs).

Sometime around the turn of the century (in an aeronautical sense, anyway), actually in the late forties and early fifties, the USAF was the not so proud possessor of an abysmal flight safety record. Jets were new but piston mentalities and methods still predominated, after all, that was what had gotten everyone through the war years and no "deskbound Flying Safety or Ops type can tell me how to fly airplanes"! "Break left – power off – gear, flaps and boards; first one to the club is the hottest pilot"! Sounds great, doesn't it? Made great movies, bar stories and – really b-a-a-d accident records. Attempts to make pilots realize that no one was attacking their macho in asking for a change in techniques were met with almost universal derision. The message transmitted was "the characteristics of the machine have radically changed", the message was received/perceived as "those old guys can't contend with these jets with their increased speeds and all". USAF flight safety publications of that era are full of what now is recognized as sensible advice. "Loosen up your pattern, get the base leg far enough out to establish a nice, high drag, 'spooled up' final approach, be prepared for a go-around". Naval Aviation News magazine featured "Grandpa Pettibone" with his sometimes caustic, but always sensible, first person advice. The jet engines of that era were notoriously slow to "spool up" from to full thrust from idle, taking as long as ten seconds <u>or even more</u> in some cases, an eternity on short final. I've talked to some pilots about this who wish to remain anonymous, even after all these years. I'll cheerfully indulge them in that small favor since I can't do anything now about their first and most fervent wish back then. That would have been for the contractor to have built the runway just a few hundred feet longer – **and all on this end!** Many aircraft, such as the B-47, were equipped with releasable "approach drag chutes" to allow a higher RPM to be maintained on final. We flew the T-33 with speedbrakes out on final. Little by little, reason and common sense prevailed when the characteristics finally began to sink in. This change of attitude took years of training and haranguing but, gradually, the broken airplanes and bodies began to intrude enough into the collective consciousness of the pilots to get their attention. Jet engines <u>were</u> different and the stabilized approach <u>finally</u> became the recognized safe way to get a turbojet on the runway safely.

The airlines, being the "Johnny-come-latelys" to jets were the beneficiaries and taught this from their earliest days of jet operations onwards. Those who didn't believe often paid a terrible price, along with their unlucky passengers, for their ignorance and unbelief. High sink rates and un-stabilized approaches were "out" and represented one of the quickest ways for a recalcitrant pilot to be abruptly shown the door, cutting short a promising airline flying career. Nowadays, whole generations of pilots have been brought up with this concept and, in fact, probably have no reason to imagine any other way of flying ever existed. Herein lies the reason I think we may be somewhat victims of our own success! Anyone who has spent much time in the airline training business should feel pride in a job well done, an excellent job has been done over the years convincing everyone that this is the only safe way to do it, and, it is! W - e - l - l, for the jets anyway, it is.

Another change in the machine was occurring in this postwar era. New aircraft designs were required to meet the specifications of the new Transport Category (T-Cat) regulations of the (then) Civil Air Regulations. Wartime twin engine aircraft of the B-25/A-26/B-26 etc., genre were designed to military specifications, engine failure flight characteristics occupied a much lower rung on the design criteria ladder. This deficiency occurred both in the case of an engine loss on take-off and on final approach. There was a period of time after liftoff where continued flight on one engine would not be possible. This is due to the fact that below safe single engine airspeed (145 MPH on the B-25, for example) the available rudder wasn't adequate to control the aircraft. This would necessitate reducing the power so much on the operating engine to prevent an uncontrollable roll that a positive rate of climb could not be obtained.

Once Vsse airspeed is obtained, full power is controllable and the aircraft is capable of single engine flight. Problems are also encountered in the approach regime in aircraft exhibiting this type of aeronautical bad manners, more on that below. All aviation is a series of compromises. Give a little of this to get more of that, etc. The genesis for an aircraft that could lose an engine on take-off, continue, climb out and then land safely goes back to the initial airline requirements specified in a 1932 letter to Douglas Aircraft from Jack Frye of TWA, engendering the DC-1/2/3 series. Further refining of these criteria took a quantum leap during the war years, resulting in the aforementioned T-Cat. These advances greatly benefited the postwar airline fleet and later the business aviation world. Aircraft had to be controllable with engine failure, both on take-off and approach.

Now, as to why we do it and how we do it. Obviously, we aren't going to be able to do anything to solve the problem of engine failure after liftoff if we want to fly these old military machines. The only thing we can do is to give the best instruction we're capable of for this eventuality, insisting on full rudder and aggressive use of controls in managing the aircraft. The other is to really stress what we told our students back then when we were using B-25s in the USAF Basic Multi-Engine pilot training program. "If an engine loss occurs after take-off and you don't have 145 MPH safe single engine airspeed, pull back the power on the remaining engine and belly it in sort of straight ahead, better to land under controlled flight than to try to fly and ultimately roll the aircraft and yourself into a ball".

Now then, on to something we can do something about, the approach phase. And remember, in this paragraph we're talking about a normal two-engine approach. We don't need to fly a stabilized, constant speed, high drag approach as we do in a jet because we have a piston engine capable of furnishing instant power when needed. We are free to select a safer way of doing things, i.e., remain at or above the safe single engine airspeed for a good part of the approach, gradually dissipating this speed along the final approach. Figuring a Vso of 83 MPH in the B-25, 1.3 Vso would be 108 MPH. If we flew it as we do a jet it would mean we'd slow to this speed several miles out. If 145 MPH is Vsse airspeed we'd be operating more than 35 MPH below a safe single engine speed for this entire distance. Nothing would be gained since we have instant power available from the engines but a lot would be lost considering the time exposure at less than a safe speed. The way we want it is to maintain above 145 MPH until on final. Lowering full flaps now will allow us to gradually taper off the speed on a properly flown approach with only a small power reduction being required. We need to cross the threshold around 105-110 MPH. Make no mistake about this however; the approach is still a precision thing. It's just that the precision is applied to arriving at the threshold at a precise speed with some power on, closing the throttles, then flaring and landing. The approach minimizes as much as possible the time spent below Vsse but still puts you at the required speed and point to permit a touchdown at the exact aiming point along the runway.

One final argument we should touch on is advanced by pilots whose sole experience lies in light civilian airplanes with a published "blue line" airspeed. In these airplanes you maintain blue line throughout the final approach until committing to land. Their blue line speeds are usually around 105-110 MPH or very close to their 1.3 Vso where their normal approach speed would be anyway. We don't have a published "blue line" speed for the B-25 but Vsse would be the closest thing to it. If we were to maintain 145 MPH to the threshold we'd never stop on the 4000' runways that a lot of us call home base.

#03 RECIPROCATING LOAD (MP VS RPM)

This is intended to answer a question a friend of mine recently asked. It first was asked of me about 30 years ago during an airline annual recurrent training class of DC-3 and Convair 440 pilots. My friend's question was phrased something like "seems to me a pilot can't go very far wrong by following the military manual for the aircraft he's flying, so why don't we just advance the props to climb RPM on downwind and not worry about using less than 1" of manifold pressure (MP) for every 100 RPM for a couple of minutes during the rest of the pattern". Well, I guess that sounds reasonable, doesn't it? Looking at my "good stuff" (old USAF dash ones) I see what we already know, we did it on T-6s, B-25s, C-47s/C-54s/C-97s and everything the military owned. He continued "and another thing, I just don't get that stuff about the prop driving the engine". I replied that I would try and explain it in writing although it's a lot easier to show someone with a simple training aid or two. I will add the disclaimer that I am not the maintenance expert, what follows is my experience from a cockpit perspective and an attempt to relate what many of the real experts told me as I tried to put this into printed form. Oh, as an aside. If after reading this you think you may have noticed a plug or two for the oft-maligned Wright engine, well, so be it! At least for the garden variety ones, when you get into the later higher horsepower 1820s and 3350s that may get to be somewhat of another story.

The first operator I encountered who didn't do it was when I was just out of the USAF and a newly hired DC-3 co-pilot at North Central back in 1960. Those were Wright R-1820s, I can still recall my first experience with them. Back then I pretty much had the idea that Pratt & Whitney was all it, most of my recent experience had been with 1830s, 2000s, and 4360s. I guess I conveniently managed to forget the dependable old Wright 2600 Twin Cyclone which had gotten me through over twenty-five hundred hours instructing in B-25s with only **two** failures! So much for gratitude and yes, it does say something about taking things for granted, doesn't it? Compared to the characteristically smooth P&W double row of either fourteen or eighteen cylinders, the Cyclone's single row of nine jugs seemed shaky and, undeniably, oilier.

Well, so be it! This was the airline that hired me and, with 35 Wright powered DC-3s; they must not be all that unreliable. Besides, the newly acquired Convairs with 2800s were far beyond my seniority. With only two weeks on the pilot's list all I really cared about was not getting furloughed or fired. Both loomed as very distinct possibilities throughout the probationary first year. The first captain I flew with had flown Thunderbolts and Mustangs in WW II and after. He hired on in 1953 and he made things look very easy. During that trip I asked what he thought of 1820s and his reply was about as easy as his technique. "Well, I've never had one get carb ice or fail". That succinct comment pretty much describes the feelings I encountered those early months when I might still have been caught casting a nervous glance or two at the slightly shaky cowlings and oil spots on the ramp.

Our company procedure was to leave the props at the standard 1900 RPM cruise setting throughout the pattern and then, when closing the throttles during the flare, move the prop levers all the way ahead. Of course, done this way, there was no RPM surge since the blades were already resting against the mechanical stops and nothing changed. Quieter approach, too! It was a pretty effortless operation but I hadn't yet acquired the knowledge to really understand the benefits. All this time I'd been instructing on the C-97 Stratocruiser for the Air Guard and there, across the field, we operated military style with 2350 RPM on downwind and all.

Time passes and after returning from the Berlin crisis recall to active duty with (then) MATS (later) MAC or (whatzit now, ALC?) I was taken into the Flight Training Department to instruct on DC-3s. (and, best of all, I couldn't get furloughed). There is where I started to get an education on a lot of things including airline economics, reliability, maintenance and many other things. Earl Jackson, our power plant engineer, really believed in working with the flight operations people. I was lucky enough to spend a lot of time during those years with him in our hangars and our engine overhauler's shops. Earl was responsible for over two hundred round engines and he could usually tell by looking at something why it had failed. He kept various samples of engine abuse or neglect in his office. One I remember was a piston that showed distinct evidence of ring land problems. One day he brought a bearing and assembly over from his bailiwick to show me what master rod distress and failure looked like.

I'd compare it to a piece of steel that had been held to a grinding wheel until it turned varying shades of orange and blue from overheat. He wanted to make sure that the people training the pilots knew, and could pass along, those things that would prevent an engine from achieving the expected TBO or cause a failure. In Earl's world reciprocating load was a major villain.

There are several names for this villain - "reciprocating load" / "anti-thrust side bearing loading" / "negative thrust" / "underboost" / "detuning" but only one word clearly and unequivocally describes the results, **"B - A - A - D"!** Looking back, "getting the word" on this must have been very slow for those of us involved. We routinely pulled a throttle off on students in B-25s during the middle fifties, and then left the prop synchronized with the good one for many minutes on end while completing the simulated failed engine problem. We'd never heard of reciprocating load and that faithful old 2600 put up with the abuse day after day and year after year. And that's exactly what it was, abuse. I'd like to be able to know what I know now and go back in time to Reese AFB to look at what the records concerning engine shutdown rates were. Also to be present at Aerodex or the Mobile and San Antonio AMA overhaul shops when they tore the failed engines down to see what the removed parts looked like. I imagine that possibly one hand didn't know what the other was doing or maybe it was a form of job insurance for the overhauler not to say anything to the operator. At any rate, nothing was ever mentioned about it to us that I know of.

After I had finished (I thought) this article I received an excellent, highly detailed report on this exact subject written some time ago by Herb Steward. After reading it I went back and rewrote several paragraphs to include the understanding gained as a result of the research described in his article. One of the things he mentioned was that both Wright and P&W spent much engineering time and money during the big radial's heyday trying to eliminate these faults. But economics intervened and by the mid-fifties their best talent was already preoccupied with turbines. By the early sixties serious research and development on the radial had all but ceased.

During the process of writing this I had a discussion with Al Morphew, one of our long time captains, to whom I gave a B-25 type rating last fall and who now flies it regularly. Al is one of the many retired captains here who never had to shut down an 1820 in anger, only in training (the 2800 was another story). Al mentioned the experiences of his dad, Herb Morphew, who came from Douglas as a tech rep right after the big war to work with Northwest setting up their procedures for the (then) new DC-4. One of the first things Herb found was while adapting the military C-54 manual for use in airline operation. The military called for 2300 RPM to be set on the downwind leg (as a side note I just checked my USAF -1 for the C-54, dated 31 Mar 59, which was along about the last time I ever flew one and it still called for 2300 RPM). Herb remembers saying to himself "well, that's something that'll need changing, it's hard on engines".

In defense of the military we should remember that they were dealing with large numbers of three or four or five hundred hour pilots when these high RPM on downwind leg procedures were first promulgated. Given this level of experience they probably placed a higher priority on being ready for a missed approach. Also, and probably more importantly, the military didn't exactly overly concern themselves with cost or how many mechanics something took.

Another source I talked to is JRS Engines. They said that they can tell almost immediately upon engine teardown the habits of the pilot. This is revealed by the condition of the piston ring lands **and** by the backside of the master rod journal. Let's consider some of the thoughts they expressed.

First of all, what can you tell by studying the condition of the ring lands? When subject to a boosted compression pressure the ring is designed to form an efficient seal between the cylinder wall and bottom of the ring land. Most of the supercharged round engines have keystone (wedge) type compression rings. With this design the boosted pressure forces the ring to stay in contact with the ring land. With low MP the ring is relatively free to flutter in the groove. If sustained, this results in (best case) damaged ring lands all the way up to (worst case) broken ring lands and rings. The higher the RPM, the greater the damage potential in the above scenario.

Now, on to the master rod problems. This failure is indicated to the pilot by rising oil temperature and falling oil pressure. When you see it, it's already happened and nothing you can do will undo it. It's bad enough that the engine has reduced itself to hash and a **BIG** buck overhaul. But, the oil cooler is junk until its cut completely apart and cleaned. No amount of flushing is going to fix it. The same is true of the oil tank. Unless it is of the very simplest design where every bit of the interior is visible, it needs to be cut apart for cleaning before reuse. The whole system needs to be really cleaned of all the associated metal contamination.

There are several common causes of master rod failure. I'll mention the more common, however since all but one fall outside the scope of this letter I'll save an extended discussion for the future.

One is metal contamination, usually from some other failure such as a burned piston, broken valve springs, etc.

Another would be improper or complete failure to pre-oil the engine after a period of inactivity or after an overhaul. This is a long subject by itself, suffice it to say a strongly recommended procedure after you have pre-oiled is to remove the front plugs, and then rotate it with the starter until oil pressure is noted on the cockpit gage! Related to this is the case of an air lock in the oil pump after starting, admittedly rare, but a real reason to **check** the oil pressure faithfully at startup.

For those operators who shutdown their engines with the prop in high pitch in order to prevent rust, remember to get a really good oil pressure indication after start before selecting low pitch. This is an excellent opportunity to oil starve the bearing, especially with cold oil.

A common one would be a rapid RPM acceleration with cold oil after starting. Here is one area where my friend is absolutely right about not going far wrong using the military manual! They made sure they had adequate oil temperatures before advancing RPM for run-up (as long as you don't get into that stuff about oil dilution and scramble take-offs).

Now, the cause which we want to discuss in this bulletin. This happens when the pilot pulls the throttle back to a very low MP. I'm trying to think of a good way to describe the damage that can occur. Remember that on a four-cycle engine you'll have an intake stroke, a compression stroke, a power stroke and finally an exhaust stroke. Under normal conditions the master rod thrust bearing is loaded against the crankshaft from a multiplicity of directions as all the pistons progress through their assigned firing order. Remember that all the other connecting rods are linked to this one master rod and the pressures on this master rod journal are the constantly changing resultant of all the pressures exerted by these pistons. The crankshaft is drilled on the thrust side allowing oil access to this area when under power. The heat is carried away with the oil flow. No oil hole is drilled on the anti-thrust side, it's not considered necessary since the hole on the thrust side provides constant lubrication from pressurized oil flowing around the bearing. If this series of alternating forces is severely disturbed by a large reduction in MP then the propeller in effect is turning the engine. It might be helpful here to visualize the unloaded pistons trying to throw themselves out the top of the cylinders. In this case the load is continuously applied to this one (anti-thrust side) area of the master rod journal where no oil hole is located. In short order this "squeeze play" situation causes oil (lubrication and cooling) starvation resulting in failure to dissipate the frictional heat. This rapidly progresses from overheating to self destruction. In some cases during teardown the bleed holes have been found wiped full of silver metal from the multi-layered plating of the master rod bearing.

They also say that, while it's bad for either, the Wright probably has a little better ability to withstand this than the Pratt. This is due to the fact that the Wrights (comparing approximately equal displacements) have more master rod bearing area than the Pratts. As an example, the journal diameter of the 1820 is approximately 3¼" while that of the 1830 is only 2⅝". The 2800 design was improved in this area over earlier Pratts but it is still substantially less than a Wright of comparable size.

Before closing we need to consider another thing my friend mentioned. He said "and besides, it's only for a couple of minutes maximum". Well, let's analyze that for a moment. At a nominal climb RPM the engine would complete something in the order of 9200 to 9600 cycles during this period. Keep these numbers in mind when you read the very last sentence of the last paragraph of this bulletin. Obviously there are times when we simply cannot avoid operating at less than 1" of MP for every 100 RPM. One of these would be on final approach even if we do leave the props at cruise RPM. But why not avoid it whenever we possibly can? It looks to me that here is one opportunity we can easily take advantage of when it's free (and quieter too). Actually, I think the last bit about quiet should probably be one of the first things on everyone's mind these days. In the old days the military pretty much did whatever they wanted and that was that! Nowadays, we are the minority, especially the warbirds. With residential areas encroaching upon many of the airports we use everyone operating an aircraft that might be considered out of the ordinary should constantly have this on his mind. I've spent time on the telephone or ramp trying to explain a T-6 or B-25 to an irate airport neighbor and it ain't easy, friend! So, staying at cruise RPM on downwind has a lot of advantages you might want to try.

I guess I'd be remiss in finishing this discussion if I didn't mention a situation that a very good friend and highly respected aviator, Linc Dexter, has noted since this subject has begun to receive a measure of attention. This has led him to believe sometimes the pendulum swings too far or fast in pilots now attempting to avoid even a hint of underboost. While giving formation dual in T-28s he has seen many times where the pilots have advanced the throttle without regard for the overboost limitations of the engine. He states that if he hadn't been there to grab the throttle to limit MP the limitations would have been exceeded to the point where an engine change would have been required according to USN policy. I really have to strongly reiterate that, if you need the RPM, then get it increased before you shove the throttle up. None of these pages is meant to condone or excuse overboosting; the results of this could be rather instantaneous while the results of underboost is more likely to be a longer term thing. Everyone has to learn and that was the reason for the initial WW II policy of high RPM on downwind, they were playing the percentages considering their high percentage of low time pilots. These pages are written so we can play the percentages also rather than to blindly conform to some fifty year old manual but use your head!

Obviously the 1" of MP for every 100 RPM is only a rule of thumb since those are the only instruments most airplanes have. If you've got a torquemeter or BMEP (Brake Mean Effective Pressure) gauge, then you can really see what you're doing. But the 1" rule has served well over the years and enjoys wide acceptance.

So, it's your engine and your pocketbook! A little planning should go a long way in avoiding the need to pull the throttle off and point it at the ground. You've also got the gear and flaps and sometimes another 360^{o} turn doesn't hurt either. Another thing, if you really need less MP you can also pull the RPM back to maintain the loaded balance. This is the same thing we do when simulating a feathered prop, using 15" and 1500 RPM. Formation leaders, keep in mind what your throttle movements do to your last wingman! Finally, in those rare circumstances where you simply can't avoid it, one of our most experienced engine mechanics, Don "Jingles" Dufresne, has a thought you might want to remember. He says every time you pull the throttle off you'd better remember the punch line to the old joke where the engine says, "that's **one**".

#04 MIXTURE MISCUES & MIX-UPS

This concerns the very prevalent habit, origin unknown, of placing the mixture(s) in AUTO LEAN while taxiing (one more form of mental masturbation) to "keep it from loading up". I've seen this habit (I really don't know what else to call it) in pilots with every possible level of experience and type of background. Manuals published by the manufacturers, military services and the airlines (and I've looked way back to just before WW II) make no mention of this procedure. Every manual that I can find – without exception – simply calls for RICH after start, then recheck it prior to the take-off. You'll notice that I've used the word "manual" here, in some cases checklists may be a completely different story! Everyone and his brother seem to have gotten into this act. Contrary to popular belief, a general aviation checklist isn't really examined or looked at for its accuracy by any responsible authority prior to being placed in use. It very easily may be just a list of items by anyone, easily containing one – or more – "old wives' tales". Such is the case of a number of "checklists" I've looked at on some vintage airplanes; this article addresses just one of the more glaring mistakes seen in them. If my aversion to old wives' tales were the only important thing, then I probably couldn't care less. However, this really needs to be addressed as the FLIGHT SAFETY problem that it really is. Sometimes people forget them for run-up but the following is the real problem! I can distinctly remember three times watching pilots get busy, skip them somehow on the before take-off checklist and then start a take-off in AUTO LEAN, causing them some amount of embarrassment when I mentioned it as they were advancing the throttles.

I recently acquired an USAF Manual 52-12 (Powerplant Maintenance for Reciprocating Engines) published in 1953 (it's surprising what you sometimes find at estate sales). In looking through it for a description of how to accomplish an idle mixture check I found something that directly applies to the subject I mentioned in the first paragraph. Quoting from page 182: *"NOTE - On all carburetors, except the Holley Pressure-Type carburetor, effective leaning of the idle mixture will not occur until the mixture control approaches the IDLE CUT-OFF position. On Holley Pressure-Type carburetors, effective leaning of the idle mixture is accomplished between the RICH and LEAN positions as well as between the CRUISING LEAN position and the CUT OFF position".* Everything that I've flown for many, many years has had Bendix-Strombergs. The only Holley around that I'm aware of at this time is the EAA's B-25, although a few others may become known as a result of this article. It would appear that the only person who might offer some sort of an excuse for this might be an old time B-25 pilot from back in the days when (mid-fifties) we had "J" models with Holley carburetors in the USAF. And even then, only if he had a mis-adjusted carburetor. I don't, however, remember ever seeing anyone do it back then when we still had a lot of those WW II pilots around.

A Bendix pressure carburetor functions like this. During the first 10° of throttle travel the mixture control plates aren't really in the picture since the airflow at this low power is not enough to provide a stable idling speed. Instead, back in this idling range, the idle spring contacts the diaphragm poppet valve and holds it partly open, providing a fuel supply deliberately in excess of that required for idle power. This rich flow is then reduced by the idle mixture control valve (manually adjusted with the idle mixture setting screw, more on this later) and enters the engine's induction system. Properly adjusted, this flow will provide a stable idle at a proper fuel / air ratio designed to avoid "loading up". So you can move the mixture control back and forth between RICH and LEAN until the cows come home and absolutely nothing happens. I agonized over how to paint a verbal picture of this operation and finally tried to draw a couple of diagrams figuring a picture is worth a thousand words. Bill Harrison thought about this for awhile and reduced it to a simple analogy. If you've got a river bed (flow of fuel) it doesn't make any difference how many dams (mixture plates and jets) you place downstream if everything has to first pass through a little culvert (idle mixture control valve).

While writing this a friend asked, "why don't you say exactly how you'd perform this idle mixture check"? I think I'd be more comfortable telling how most mechanics I've known and talked to over the years seem to want it done since they're the ones who'll have to adjust the idle screw based on the information you provide them from this check.

First, don't just read this and decide to go out and do a check after pulling the airplane out of the hangar and running it for a few minutes. The engine and carburetor need to be at operating temperature, cleared out and stabilized decently. So, do it after flying it if possible. Find an area on the ramp where you won't have to look outside for a couple of minutes. Run the RPM up to around 1500 for thirty seconds or so to clear it out and then gently close the throttle (remember it's an idle mixture check). During the next step you can save yourself a little time by placing the mixture maybe half way between AUTO LEAN and IDLE CUT OFF (you could start way up in RICH but it wouldn't accomplish anything, the rise in RPM is going to occur when you get the mixture to a position very near IDLE CUT OFF). Note the idling RPM. If the tachometer needle jiggles a little bit "average" it in your mind to a specific RPM. Then, slowly start moving the mixture towards IDLE CUT OFF and keep watching the idling RPM. This is kind of like s-q-e-e-z-i-n-g a trigger during target shooting; it should surprise you when something happens. I should mention here that in talking to Steve Hinton he's had good luck with moving the control pretty normally but most manuals describe the slower method. All of a sudden, the RPM will start a "perceptible" rise to reach a peak (best power) and then start dropping towards zero. In the rare event that the RPM doesn't rise at all, you're idling at best power and the idle mixture needs to be enriched slightly. Another thing that I definitely want to include here is an indication favored by many professional mechanics I've talked to. They keep a close eye on the manifold pressure, you should see a drop of about ¼" while the RPM rises, and any more is too rich. At this point you'll probably want to place the mixture back to a running position and catch the engine to repeat the check; most people need to do so in order to really get a valid or good RPM reading. Or, you can just let it quit if you've seen what you need and are finished.

Let's discuss "perceptible" for just a moment. To me this means that it is a very small amount, but you are able to perceive it. The maintenance manual on your specific engine should tell you how much is allowed. For instance, reading the USAF B-25 -2 for the R-2600 says a 10 RPM rise is allowable. I've always thought that in general if you see anything beyond a 25 rise it's excessively rich and needs to be adjusted. Before starting to write this I don't remember ever seeing one that would rise much more than 50-75 or so but recently I experienced something that gave me a case of the round eyes. I knew it was excessively rich since it was torching at idle, big time! I casually mentioned that we'd do an idle mixture check before shutdown and we might see something like a 100 rise. In the last little bit (¾" at the most) of mixture travel towards IDLE CUT OFF I was astounded to see a rise of 250 RPM or more. Absolutely nothing was happening – until that last little bit of travel.

Now, for those of you that've stuck with me this far, let's go back to the first paragraph. I've debated whether to mention this or not. I think I'll have to briefly touch on this since some of the people reading this possess a level of knowledge acquired from working on these carburetors or otherwise being an long time observer of aeronautical trivia and will have caught it. Maybe I'll expand on it in some future Warbird Note when there's more space. Whatever, I'm sure that someone will observe the last sentence of the first paragraph and say "even if you did forget and leave the mixtures in AUTO LEAN before take-off the fuel flow would be enriched by the power enrichment valve and the fuel flow would be the essentially the same as if the mixtures were in AUTO RICH". This is true, the charts show at high power the flows are the same regardless of whether the mixture control is in AUTO LEAN or AUTO RICH. But, and this is a really big but, you're relying on a fifty year old mechanical device within the carburetor to perform this function. I'm reminded of the pungent observation of a highly experienced old naval aviator whose friendship "Connie" Edwards and I've enjoyed for many years. Art Ward sez, "well, I'm old and sometimes I forget!" Maybe some parts of your carburetor might also forget, I sure wouldn't want to rely on them in this case. Furthermore, after take-off just as soon as you retard the throttles to a point where the power enrichment valve closes, you'll be in a detonation range.

I guess that's pretty much wraps up what I wanted to say about this habit. If something's wrong, then fix it! But, if everything's working correctly, why wear out the mechanical components of the fuel system for a paradigm that turned out to be untrue? It sort of makes me think of that old Johnny Cash song, "bad news travels like wildfire, good news travels slow". I've discussed it with some really experienced aviators and they also can't say where it really came from, it just started to happen somehow over the years. Merrill Wien has a plethora of experiences to share, he agrees that we never saw it in years past but somewhere along the line it started to creep into a lot of procedures. It's amazing how many people cling, almost fanatically and with highly detailed justifications if asked, to this perception in spite of manuals, illustrations and whatever. And this isn't just the inexperienced; it includes people one would expect to know better.

Might be enlightening the next time you see someone automatically moving it to AUTO LEAN after start or landing to ask "would you mind sharing with me just exactly why you're doing that?" If the answer is "to keep it from loading up", that'll tell you something about their level of understanding. If this were true then you could see a noticeable difference in the idling RPM when the mixture control is moved between AUTO RICH and AUTO LEAN. As a friend says, this habit has become pervasive and people have honestly felt they were accomplishing something. But just like believing in ghosts and goblins, it's an understanding thing.

PS – In the interests of trying to make this as technically accurate as possible I should probably add a disclaimer to an earlier paragraph where I said I remember leaning only when I had an improperly adjusted carburetor. When I was sent down to Lloyd Aereo Boliviano to give flight training in the mid-sixties our flight engineers routinely had to manually lean while we taxied our DC-6Bs at La Paz. "El Alto" airport was at 13,500' MSL, field barometric was about 17" of MP. The idle adjustment for Buenos Aires or Lima at sea level obviously wouldn't work up there on the Bolivian altiplano. We had to lean the mixtures to maybe ½" or so short of the IDLE CUT OFF position to keep them running. Putting them in AUTO LEAN accomplished absolutely nothing. At any rate, in this letter I've been talking about airports at normal altitudes.

#05 FEATHER BUTTONS & PROPELLERS

This subject keeps coming up when misconceptions are repeatedly encountered during discussions of these systems on oral exams and/or flight checks. You probably aren't going to get much help from looking at the pilot's manuals of that time period; these systems weren't explained in detail, either in the "run-up" or the "emergency" sections. Probably because this was considered to be a basic part of every aviator's experience or knowledge acquired in ground school. Maybe discussing what we're looking for during the run-up of a piston engine airplane or dealing with while we’re attempting to cope with an emergency would be of some benefit here.

I guess we could start with some of the things we should be looking for during a run-up of a typical piston engine aircraft. Some flight manuals call for initially advancing the throttles to 1500 RPM; others vary and may call for up to 1700 RPM for the propeller check. It seems to me that 1500 RPM should be sufficient to provide an adequate governor function check and, at the same time, minimize any engine heating. The important thing here is don't spend an excessive amount of time (the CHTs are heating up all this time) getting precisely the right RPM’s, close is good enough for this check.

Once the RPM’s are set, pull the prop controls full back to decrease and let the RPM’s decrease a few hundred as engine oil is forced into the dome, thereby moving the blades towards a higher pitch. You don't have to wait to reach the absolute lowest possible RPM’s these first few times, just get a couple of hundred drop and make sure the prop functions correctly as the oil is forced into the dome. Return the prop controls to full increase and let the RPM’s recover as the blades again move towards low pitch. Repeat this action as necessary to get a good prop response as progressively warmer oil from the engine is introduced into the prop dome. Obviously with cold oil it'll take longer to achieve a rapid and correct cycle but don't make a career out of exercising the props.

Then, during the last cycle you intend to perform (after you're satisfied with the response), leave the prop controls in the full decrease RPM position and allow the prop governors to reach their full minimum governing (high pitch) position. This RPM should be spelled out in your flight manual; usually it’s about 1100 - 1200. Checking this is important for the following reason. If you need to feather an engine during flight you'll obviously need the feathering pump to do so. If the feather pump should fail, which happens just often enough to make it more than a subject of idle conjecture, you'll have some **serious** problems staying aloft. You'll have to establish a minimum drag configuration with the throttle closed and the prop blades in the highest pitch you can obtain. If you've got a prop with a high RPM on this check you're going to find the in-flight drag increased a bunch! Kind of like the old Bamboo Bomber (UC-78) which didn't have feathering props. Following this check, return the prop controls to full increase (as a side note, the low pitch blade internal mechanical stops are checked, in a round-a-bout way, during the later engine field barometric power check).

Next, let's discuss the prop feathering check. After completing the previous check spin the red feather button a few turns clockwise to make sure it's screwed tightly onto the feather button shaft. More than one has come loose in the pilot's hand when pulled up to terminate the feather check (more on how to deal with this later). Push the button down and note an increase in loading on the generators as the electrical feathering pump starts to run. Depending on oil temperature and viscosity it may take a little while for the feathering pump pressure to start driving the RPM downwards (during cold weather if this indication doesn't occur within several seconds you would be wise to prevent possible feather pump burn-out by discontinuing the check and re-exercising the props a few more times, introducing warmer oil into the domes). It is only necessary to observe a small amount of drop (100-200 RPM) to confirm the beginning of the feathering process; the holding coil should then be overridden by pulling the feather button back up. At the same time remember to note a corresponding drop in electrical load as the feathering pump is shut off. It's not unknown for the feather pump to keep running so look for this to avoid big troubles. Now, what should you do if the button should pick this extremely inopportune time to come off in your hand? First of all, don't try to screw it back on; you just aren't going to get it done that quickly. Probably you'll find yourself temporarily stymied if it should happen to you but you should keep your wits about you and remember that the holding solenoid is electrically actuated. Immediately knock off all the batteries, then all the generators.

That's all there is to it! When you remove the electrical power from the holding coil (magnet) the button shaft will pop up and voila', the prop goes back to normal governing. Actually, there is one more thought here. Even if you only turned the batteries off, if you then pulled the throttles back on the other engine(s) to below generator cut-out speed the generator on the feathering engine would cut-out when the RPM fell below that speed. The holding coil would then release. I'd strongly recommend that you dry run this procedure for practice every so often, touching each switch so that it would be a matter of second nature without any fumbling around - should you ever have to do it for real.

After you finish the feather check I'd advocate that you do one more check. We didn't do this in the military but learned it on the airline. This check ensures that RPM control has been reacquired by the prop governor from the transfer valve. This valve shuts off governor oil pressure during feathering (discussion later) and, if it hangs up, prevents normal governing. Pull the prop controls back and note an associated drop in RPM, telling you that the prop levers are controlling the prop. You'll only need to see a slight RPM drop to confirm this.

Now let's get to the in-flight stuff. We can pretty much divide into three scenarios what might happen in-flight when you push the feather button, one good and two bad! The good thing would be for the prop to feather and rotation to stop normally. The bad things would be; (a) the prop starts to feather but then doesn't finish or (b) it feathers but then comes back out and starts to rotate again. Almost all the time the good scenario happens and everyone's happy. But, just often enough to make things interesting one of the bad things happen and that's mostly the reason for writing this.

First, let's talk about the things that happen normally when you push the feathering button to feather a prop. The magnetic holding coil is energized by an electrical switch and the button stays down by itself. The feathering pump starts to run and its output pressure of approximately 1000 psi is directed through a transfer valve within the prop governor to the rear side of a piston within the prop dome. This pressure forces the piston (which is mechanically geared to the prop blades) towards the high pitch position and then, going further, over a cam into the feathered position. As the blades reach the fully feathered position the pressure (if you could measure it) would probably be a little less than 300 psi. The pump continues to run, building up more pressure. As it reaches about 400 psi this pressure deactivates the switch which releases the electrical circuit to the holding coil. When this coil releases, the button will "pop" up to its normal position. The prop blades will be nicely feathered, rotation stops and everything's great. Well, at least as great as it gets with a loss of an engine! What I've just described was the normal scenario.

Now let's discuss the second half of the good scenario, unfeathering. Push down on the feather button and the first thing you'll notice is that you must hold it down. Why? Well, remember that the piston inside the dome was shoved all the way over the cam in order to feather the blades and it took somewhere around 300 psi to do that. As you push down on the button the feathering pump starts running and immediately builds up to 400 psi, releasing the electrical circuit to the holding coil as described in the preceding paragraph. As you <u>hold the button down</u> the pump continues to build up pressure towards 600 psi (passing the nominal 300-400 psi it required to feather). That amount of pressure then unseats the <u>distribution valve</u> (within the prop dome) and repositions it, redirecting this pressure to the <u>forward</u> side of the piston within the prop dome. This pressure begins to move the blades in the opposite direction (out of the feather position) and the prop starts to rotate. Pressure from the feathering pump continues to drive (assisted by centrifugal twisting moment) the blades back into the normal range and you'll need to release the button at 800 RPM. <u>Next, ascertain that the RPM stabilizes at the same RPM as you found on your run up check of the minimum governing speed</u>. After you see this indication of governing (because you don't want to start a potential runaway), move the mixture to the AUTO-RICH position and finish your restart checklist.

O.K., the above stuff was the normal way we'd like to see it everyday. But (as Art Ward says), these machines are old and sometimes they forget. They pick inopportune times to become recalcitrant, valves stick or other things happen to confound us with glitches not mentioned in the manuals. You have to possess the mechanical knowledge that will allow you to intercede in the operation and obtain the results that will keep you in the air (at least while you want to be there). Let's cover a few more of those in the last few paragraphs.

Let's say you push down on the feather button and the prop starts to feather. You didn't keep your finger on the button and it pops up before the prop is completely feathered. Unless it's very nearly completely feathered, the RPM (assisted by centrifugal twisting moment) will start to increase and go right back to wherever you have the prop control lever set. This situation has occurred and has caused accidents when the solution is so simple! What happened? Remember that the pressure required to feather a prop is about 300 psi after which the pressure continues building up to about 400 psi, releasing the coil. If the coil switch is weak and releases prematurely the button will pop up before the feathered position is reached. Solution? Just push the button down again and this time hold it down until you see the prop stop rotating. The instant that occurs, release the button and everything's fine!

Another bad thing might happen. If you pushed the button down and the prop feathered and stopped normally but then, to your amazement, immediately started to rotate again and came out of feather, what would you do? What happened now? Well, again, it took 300 psi to feather, the pressure then built up to 400 psi and then the holding coil should have released, right? In this case the pressure switch failed to cut the electrical circuit to the holding coil (or the shaft stuck), the button remained down, and the circuit acted just as it would if you were holding the button down to unfeather. If you see this situation developing, immediately pull the button up to terminate the operation and dump the pressure. Then, push the button down again to begin the operation all over. This time, keep your fingers on the button and, at the exact instant the prop stops rotation, pull the button up. Again, you've interceded, overridden or whatever and everything's cool!

At least one other possibility exists here! If, in the above paragraph, you pull the feather button out but it fails to have an effect, you have big trouble! Another way of determining this is if the electrical loadmeter indicates that the feathering pump motor failed to stop when the feather button was pulled. Most likely the contacts are welded by the electrical current or some other problem is causing the feathering pump to continue running. You must act immediately and quickly turn off all the batteries and generators in order to remove the electrical power to this feathering pump. This will have the same effect as pulling the button out and will allow the feathering pressure to immediately fall to zero. THEN, turn on a single battery or generator and allow that electrical power to again feather the propeller. As soon as the prop stops turning, turn off the electrical switch. You must NOT subsequently restore any source of electrical power since this would again power the feathering pump motor and unfeather the propeller! I've always said that, to the best of my knowledge, no feathering motor circuit protection is located within the cockpit and thereby being available to the pilot. I've just found out that on a few early Beech 18's there were large circuit breakers protecting this circuit on the forward glareshield beneath the windshield. It wouldn't hurt to check YOUR airplane; this information could save you or your airplane!

Now, one final thing. All the above applies to the basic 23E50 constant speed feathering propellers used on B-25's, DC-3's, A-26's, B-17's, DC-4's, etc. It involves a two position feather button that you only push. When you get into the later props with reversing capabilities used on the Convairs, DC-6/7's, etc. the button is a three position push and pull unit. If we want to get into that we'll have to wait until a later (probably much later, these bulletins take forever to write) bulletin, it's far too complicated to include here.

#06 GAUGE INDICATIONS ON A FAILED ENGINE

In many years of instructing in various piston engined airplanes I've found a misconception that, when described, will leave most of you saying "I knew that", others may have to stop and think about it a little bit, and then, the few individuals one really wishes would stop and analyze this situation. Whether it's the pure turbine background or what, I don't know, but they somehow subscribe to a dangerous fallacy, albeit a widespread one. This concerns a discussion of what happens to the indications on a piston engine's gauges when the mixture is moved to IDLE CUT OFF or the fuel supply shut off for training. And, obviously, this also applies to the indications on an engine that has actually failed. Carried to the extreme, this has resulted in feathering the wrong engine and other equally bad scenarios.

Back in the mid-fifties was the first time I remember hearing this question asked during a check ride periodically given to all of us USAF B-25 instructors. I wasn't the recipient of the question but, sitting on the jump seat I did hear it, along with the wrong answer. I remember picturing in my mind the fuel pressure gauge dropping and, in all honestly, I know I would have also given the wrong answer if I'd been the one asked. After thinking about the system for a few minutes I realized that the check pilot was right but it really taught me a lesson larger than this small bit of aeronautica. At the time we probably had less than a thousand total flying hours, most of it in B-25s and could probably fly that aircraft better than nearly anyone with far more experience. <u>But</u>, we had very little practical experience with really knowing the systems and the basic knowledge one gets while acquiring "some salt" in USN parlance. In addition, once we've adopted a preconceived idea, it's sometimes very hard to let go of that idea if we think we'll lose face. I don't know anyone of us in this business who was born "knowing it all". Most of this stuff is acquired over the years the hard way, listening and observing, with varying degrees of pain and sometimes with damage to the equipment. The preceding sentence is the reason for writing these bulletins; if something is passed on here it sure beats trashing some <u>very</u> expensive machinery!

Let's analyze the engine panel instruments one by one and look at just what they indicate and tell us. For all of this, we'll assume we are in cruise flight at cruise power at cruise speed.

Since the fuel pressure was mentioned above, let's look at it first. Think about the system for a minute and you'll remember that the gauge receives its pressure from a location in the fuel line after the boost and engine pumps but before it enters the carburetor. So, if you turned off the fuel tank selector the flow would be cut off and pressure would drop to zero on the gauge. Some instructors have been in the habit of giving "engine failures" to a student by doing this. I've done it sometimes (at altitude) when trying to make a point about the subject we're discussing in this bulletin or so that the student couldn't look at the mixture to determine which engine failed. It does demonstrate, obviously and without question that fuel pressure falls when supply is lost. However, a couple of problems are lurking here. First of all, if you're close to the ground when you do this you'll need a fair amount of time to regain pressure if you need to abort the training process, in other words, <u>this is not a simulated failure, it's real</u>. Secondly, you need to know your aircraft, not just a generic aircraft, <u>but the one you are instructing in</u>. For example, on some B-25's the firewall shut-offs are fuel shut-offs only. On others they are fuel, oil and hydraulic shut-offs, the fuel is mechanical and the others are electrical (interesting how many pilots don't know the answer to this question on the B-25 they're flying). You can tear up some pretty high buck equipment if you try the wrong thing on one of these. There is one other thing you can teach here, if all fuel pressure is lost for real always try the boost pump during the trouble shooting process prior to feathering an engine.

Now, let's say you pulled the mixture to IDLE CUT OFF to initiate this practice engine shutdown. In this case the fuel pressure <u>would not</u> go to zero since it is all accomplished within the carburetor. Again, this is a common misconception when the question is presented "out if the blue" and almost forty years ago I sure bit on it.

Well, we started this with the easy one, the fuel pressure. Now let's go on to something a little more controversial like manifold pressure (MP). What's going to happen here when you cut either the mixture or the fuel supply? Cut a mixture and just leave the throttle alone where it was set at cruise, let's say, for example in this case, 27". If you can visualize a big air pump, that is exactly what the engine is, with the throttle located at the intake. After seeing for yourself that the MP stays unmoving at 27" move the throttle forward some. MP gauge goes right up normally, doesn't it? O.K., now pull it back some. Gauge also follows this reduction normally. Now, equalize the two throttles side by side, and then move them together forward and back. They act the same, don't they? Only when you move the throttle to a setting asking for more than ambient pressure will the indication act differently. Still believe you can just look at the MP gauge and tell your instructor which engine failed?

How about oil pressure and temperature? Cut the mixture, and then take a look. The engine keeps turning and as long as it does the oil pump keeps pumping, right? So the oil pressure stays up and doesn't give you a clue about which one failed. Over the short period we're discussing here the temperature stays up too. However, if the engine actually failed because of an oil pressure or temperature problem, that's a different story and outside the area of this discussion about training.

Now we'll have to get to the real bone of contention. I've listened to people describe some weird indications they experienced when they tried this. I'm reminded of one of the first things Andy Anderson, our instructor in test pilot school, tried to get across to us about filling out a flight test evaluation report. "Write down the test results you see, not the ones you expected or hoped to see"!

If we cut the mixture what's going to happen to the RPM? I listened to someone describing a sustained decrease in a B-25 of several hundred RPM after the mixture was cut. I was most anxious to see this for myself so arranged to fly that particular B-25, as well as one of our local ones. When we cut the mixture at cruise airspeed the RPM sagged about a hundred and then went right back to where it had been. Let's analyze that for a minute. The engine is still turning so the oil pump is still putting out normal pressure. Where does the prop governor get its supply? That's right, from engine oil pressure. So it keeps doing its thing according to your request through the prop control. You had the control set to cruise RPM so, after a second or two of decrease followed by an immediate increase as the blades assume a new angle, that's what it delivers. It will as long as it has oil pressure and, with this proviso, that the cruise speed stays high enough so that the blades don't reach the pitch stops while trying to maintain the requested RPM. On the PBY, if you're cruising above 105 KTS, the prop acts like we described above. Slower than that the RPM will fall somewhat while the MP stays constant. Think of it this way – the oil pressure stays up because the engine's still turning at cruise RPM and the RPM stays at cruise because the oil pressure's still being furnished to the governor. Quid pro quo, right? Oh, and just for the record, I recently tried this while flying B-17's and A-26's, same result.

After all of the above, can you look at the instrument panel and guarantee you can know which engine failed? W - e - l - l, yes. That is, if you're willing to wait, and wait, and wait, and wait, you'd finally see the reading on the CHT gauge slowly decrease. Other than that, pretty much nothing! Looks to me like the old standby we taught forever, "dead foot – dead engine" is still the best game in town.

Another thing just for the record. No, I don't cut the mixture willy-nilly as the paragraphs above would seem to indicate, that was just for illustration. Any good student should be able to see what we're talking about after one or two actual shutdowns so we don't have to abuse some very expensive machinery. Usually retarding the throttle and prop works just fine, whatever we can do to minimize the reciprocating load.

You know, I keep thinking before concluding I should mention something else the aforementioned Andy Anderson taught us. Something else that isn't at all germane to this subject but probably saved my rear end more times than I'll ever know and just seems worth passing on for those of you who didn't know him. "Don't ever let an airplane take you someplace where your brain hasn't arrived at least a couple of minutes earlier!" I guess it could be paraphrased as "Give it a lot of thought before you try and expand the envelope!"

#07 PRE-IGNITION VS DETONATION

This subject comes up periodically, causing a lot of questions by pilots who have mostly a turbine heredity or background. I guess what precipitates this letter is the sometimes expressed opinion that pre-ignition and detonation are sort of one and the same. Tain't so! Really, not so! Pre-ignition is exactly that, ignition previous to the desired moment while detonation is an explosion (same as when you detonate dynamite, B-A-N-G!) of the fuel-air mixture charge instead of the normal smooth and progressive (productive) burning. While it's certainly true that one condition can progress into the other that's getting way ahead of the story. In trying to include all the research material and accumulated bits of knowledge that go into something like this I ultimately had to go way back to the first days of ground school when we were hired at the airline. Our class of neophytes was, I've figured out over the years, lucky. We, (1) were the first class of copilots who came under the new F.A.R. training requirements and (2) had C. G. "Gordy" Amundson to teach us the DC-3. Under the increased training required by the FAA, we got two weeks of ground school and far more actual flight training then the "three bounces and send them out on the line" as had been customary up until that point. In trying to write something that gets as technical as this, and still keep it readable, I'm lucky again to have Gordy as a resource (both mind and library) to help out when I just can't remember everything we've learned and taught since those early days.

(Draft copy)

I recently read a question in the American Bonanza Society's magazine to the technical editor from a reader who used the word "predetonation". Now, picture a puzzled look on my face because that's exactly what I am left with. What does he mean to convey by this? Is it the meaning one would get from the literal interpretation of the term, damage occurring previous to the detonation process? Seems to me there wouldn't be any damage if detonation hadn't yet occurred. Or does he mean detonation itself? Or possibly pre-ignition? From some further description of the damage in his letter we can make assumptions. But we just don't really know; any attempted answer to his question is always a little suspect without further questioning. I only include this to emphasize how important correct terminology becomes; I hear so much of comparing apples and oranges. Thus this attempt at explanation. I say attempt because I can find letters and articles in excruciating detail about this matter in various publications dating back to well before WW II. Truthfully, it probably never will be finally laid to a complete rest.

Before we get into the technical stuff, for the purposes of this writing we need to describe the type of engine that we normally fly in one of our warbirds. That is, a carburetor with IDLE-CUT OFF, CRUISING LEAN, AUTO-RICH and (maybe) EMERGENCY-RICH positions (by the way, if your aircraft has this last mentioned position you can forget it, it really isn't there, these were deleted on all civil carbs by the equivalent of an A.D. note after the war when troubles with the mechanism made it more trouble than it was worth). No provision is made for BMEP gauges or torquemeters on our types of aircraft so the procedure of manually leaning to less than best power by reference to these gauges is not an option and we won't deal with it here.

First of all, we'll need to define normal combustion within the cylinder. The combustion process is rapid but it's important to realize that it is not instantaneous. The fuel-air charge burns evenly and smoothly, the flame front advancing at a measurable rate, about 35 feet per second as combustion begins, increasing to roughly 150 f.p.s. and then slowing down as the combustion process nears completion.

With that said let's begin with detonation. If sufficiently heated and compressed, any combustible mixture of gasoline vapor and air will catch fire. Accordingly, if the temperature and pressure of the unburned portion of the fuel-air charge reach a critical value, a spontaneous and simultaneous explosion of all the remaining unburned charge occurs. This violent process is called detonation. You very likely have noticed it in an automobile, especially upon acceleration. It's audible and you've probably referred to it as "pinging" or "knocking". If you could filter out the myriad of masking noises in an aircraft the knocking would be audible if detonation was occurring. Make no mistake, just because you can't hear it doesn't mean it isn't there! It's important to realize that this spontaneous combustion occurs AFTER normal ignition and after some portion of the charge has burned. The engine is unable to convert this explosive energy into useful work and power is lost. Supersonic pressure waves are set in motion producing harmful effects on combustion chamber parts and cylinder hold down studs.

Examples of damage would include dished piston tops, collapsed valve heads, broken rings and ring lands or eroded portions of valve heads, pistons or cylinder heads. Since light detonation cannot usually be detected from the cockpit through roughness / sound / loss of power, any effective protection from its occurrence must be provided in other ways i.e., prevention. Lighter cases of detonation may not result in as noticeable an increase of cylinder head temperature (CHT) but anything in excess of this causes a rapid rise in CHT and aggravates the conditions which caused it. If visible from the cockpit, irregular puffs of dense, black exhaust smoke will be a warning.

Detonation, remember, is caused by either excessive temperature or excessive pressure of the fuel-air charge. Control of these two factors is what constitutes avoidance of detonation. This control consists of two parts, (a) design of the engine, installation and proper servicing / maintenance and (b) operational, that which you can control from the cockpit.

(Draft copy)

In the design of the engine and installation, cylinder head cooling, fuel grade, compression ratio, ignition timing, induction charge temperature due to the supercharger, etc. are major factors affecting detonation tendencies. They all influence the temperature and pressure of the fuel-air charge just prior to combustion.

Cockpit operational control of detonation also is directed towards keeping the fuel-air charge temperature within those limits established through exhaustive testing as safe and by avoiding excessively lean mixtures at high power. Although proper fuel grade is normally considered a preflight item I do know of several operations where main and reserve tanks contained different grades or octanes of fuel, in other words some tanks were to be used for cruise power only. This takes me back many years ago to South America; however I've also seen a good amount of it since the advent of the auto-gas STC. Limits (both time and values) of manifold pressure, RPM, CHT, carburetor air temp (CAT) and blower selection must all be observed and respected. Maybe not from fear of outright immediate failure but certainly with the knowledge that exceeding the limits will cause damage(s) resulting in failure in the future (time unknown) or extremely high and/or premature overhaul costs.

Next we'll need to define pre-ignition, after that's out of the way we can then discuss how all this is related and how it applies to us. <u>Pre-</u>ignition is the uncontrolled ignition, by an object heated to incandescence, within the combustion chamber of the fuel-air charge <u>before</u> the normal ignition spark. This premature combustion results in excessive pressure being exerted on the piston during the final portion of its upward travel on the compression stroke with attendant destructive tendencies. The same excess heat/pressure conditions that result in detonation are present when pre-ignition is encountered. Unlike most detonation, pre-ignition will usually be detected by roughness and backfiring, you might possibly also detect a rapid increase in CHT. Any <u>sustained</u> operation, even for a brief period, in this condition can result in burned pistons, broken cylinder heads, scuffed cylinder walls and damage to the valves and sparkplugs.

Pre-ignition can be caused by several possibilities, localized hot spots, carbon deposits, machining irregularities, sharp pieces of metal, glowing spark plug electrodes or possibly an accumulation of deposits from leaded fuels. And, although it's unlikely you'll encounter it, you should be aware that in the past, valves ground with too sharp an edge at overhaul were known to initiate this malfunction.

(Draft copy)

Since some discussion of prevention was inherent in describing these two malfunctions, probably only a limited amount remains to be said about how all this applies to our operation. Some indulgence in a little "hangar flying" here with experiences of a variety of aviators who have spent lifetimes dancing around these continuing aviation nemeses might be the best way of illustrating a few points. All these are "real life" incidents and the main actors could sure tell you about it, if that were to add anything.

One of the things that might have helped cause the perception of these two being one and the same is the fact that detonation can progress into pre-ignition, and vice versa. Let's talk about how. If you let detonation exist long enough to cause damage, this damaged area (in the form of broken parts or anything that causes a sharp edge) can be heated to incandescence. This is much like a knife or chisel edge held against a grinding wheel, pretty soon it glows. Same thing here, now you've got an ignition device inside the cylinder(s) and the whole situation will get worse – <u>rapidly</u>.

Conversely, once the pre-ignition process begins, the rapid rise in combustion chamber temperatures can raise the fuel-air charge temperature to its critical value, thereby initiating the detonation process. Remaining stuff yet to write:

- cool the cylinder rapid
- sparks at night
- don't test or use carb heat before take-off to clean out

I need to mention something here while on the subject. In the early sixties, we used to operate our DC-3's on the airline maintaining a constant carburetor air temp of about 15 degrees. Or, more properly, I should say that we attempted to maintain a constant 15 degrees. This duty fell to both pilots, but the myriad other duties sometimes intervened, with this all-important operation sometimes suffering. The theory was that this temperature formed the best possibility of efficient combustion in the Wright 1820's cylinders, thereby delivering the most miles per gallon of fuel expended while also avoiding carburetor ice. Only problem was, if your attention was diverted, sometimes this temperature rose into a range where detonation became a distinct possibility. It didn't take long for it to happen, and it must have. Sometime later, we were advised to cease this procedure and attempts to maintain this CAT and just leave the carb air controls in full cold. Then, if we needed carburetor heat, we could apply it and get rid of the ice. Our detonation problems largely subsided after that.

We had always taxied out with the carburetor heat applied, attempting to keep the CAT's in the 15 degree range. Then, just prior to applying take-off power, we'd place the carb air controls in the full cold position for the take-off. Lo and behold, we found we were asking the impossible of our carburetor Automatic Mixture Controls (AMC's), they simply could not contend with that rapid temperature change and therefore we were risking detonation on our take-offs in cold weather, since we had fooled the aneroids into thinking it was a warm day outside!

- the most immediate and sure counteraction for detonation is a prompt power reduction.
- remember that what combination of rpm/mp that will cause detonation at 91/96 would not at 100/130.
- it is possible that if preignition occurs at high power settings that a rapid power reduction may cause glowing particles of lead or carbon to be chipped off due to the rapid cooling of the cylinder.
- long reach could cause pre-ignition – Steve S.
- unapproved plugs- use chart, don't just remove/replace.
- 1630 degrees will cause pre-ignition.

#08 FIELD BAROMETRIC POWER CHECK

The idea of discussing this subject has occurred to me from time to time. We routinely see some fairly distorted ideas of just what we're attempting to determine by using this check. A search of the flight manuals of the period seems to indicate that this check wasn't very well understood or used during WW II and for some time thereafter. That's probably been a major contributor to the confusion about it.

The basic intent here is to measure the power output of the engine against an established standard. A normal aircraft engine is capable of delivering a given amount of horsepower at a given RPM and manifold pressure (MP). This means that, with appropriate precautions, the MP can be used as a measurement of power input and the RPM used as a measurement of power output. The propeller blades must be against their low pitch stops, since this is the only blade position at which the blade angle is a known and doesn't vary. In other words, at this point it's the same as a simple wood or ground adjustable propeller. However, once the blades move off of their low pitch stops all bets are off, the governor will take over and maintain a constant RPM regardless of power input or engine condition.

At a standard air density this power can be measured pretty accurately, it will always require the same RPM to absorb the same horsepower from the engine, day in and day out. If density changes, that's okay, the prop will still require the same power to furnish the same RPM if the relationship between power output and air density is kept constant. This constant relationship is maintained simply by noting the reading on the MP gauge during the pre-starting checklist and then setting the throttle to that reading when accomplishing the field barometric power check. After all this discussion some still try to make this simple procedure a difficult thing, introducing complicated discussions of density and other exotica. Just use what the MP gauge shows before start, period! Okay?

When you set this MP you should obtain a specified RPM on the tachometer. The later the date of your pilot's manual the greater the chances that this specified RPM will be mentioned. Earlier ones didn't seem to mention it; apparently the importance of it wasn't too well accepted back then. In fact, a wide variety of methods seemed to be advocated. Whatever unit or group that wrote the manual or set up the program seemed to do their own thing, along with a lot of the other procedures. Some advocated what would be considered backhanded by the present method, but achieving the same results, setting a certain RPM and then looking at the MP it required. Others just said to run the throttle up and see if the engine seemed to respond well and felt like it was putting out good power. I get the feeling that standardization didn't seem to occur until well past the post war period, probably in the middle fifties.

Looking at the "J" model B-25 manual indicates this power check was included as a revision sometime after the basic flight manual was published in 1949, probably in 1953. The required RPM was 2200 (±50). By the time we started operating the "L"s and "N"s it had been accepted as a standard procedure and was included when that manual was written. By the time I came to North Central Airlines in 1960 it had been pretty well accepted, 2125 (±50) was prescribed for the Wright R-1820-G202As on those DC-3s. A headwind or tailwind will have an effect on this number i.e., any appreciable headwind will have a tendency to increase your RPM due to the change in air load. If the cylinder or carburetor air temperature is high because of factors other than atmospheric conditions, this will tend to give a low RPM. Also, high viscosity caused by low oil temperature will cause a lower RPM due to friction loss.

As an indication of what can be found with this check the following three items provide anecdotal examples. After re-installing an overhauled R-1340 on a T-6 some problems were encountered in getting it to run right and I was asked to take a look at it. After completing a run-up I offered a few ideas and I then asked if the prop had also been worked on. I was told the engine was putting out exceptionally good power, probably due to an excellent job of overhauling. As evidence, they offered the fact that it was turning up about 2200 RPM at field barometric. My reply was, "Yes, and that's exactly the reason I want to know about the prop, I suspect that the pitch stops are at something other than normal for a T-6". That turned out to be the exact problem, the high RPM had nothing to do with power output, a worn out engine would have done the same. Apparently the stops were indexed at a lower setting, more commonly used for a crop duster or a seaplane application in which some operators consider an initially high RPM more desirable (albeit risking some initial overspeeding at first throttle application). When subsequently re-indexed to the normal setting prescribed for a T-6 the engine turned 2000 RPM and, incidentally, the engine has subsequently turned out to be a very good one. But, the RPM was lying when the prop was first installed, it did not indicate a surplus of horsepower.

The second case involved a PBY Catalina (R-1830) that turned about 2450 RPM when set to field barometric. The manual for this particular aircraft doesn't prescribe a RPM, being from the "dark ages" but I've used about 2300 (±50) as a benchmark. At any rate, suspects included short blades, improper blade numbers or low pitch stops set for another application. Further research disclosed the blades were indexed at about 16^{O}, after re-indexing to 19^{O} the field barometric check resulted in a more normal RPM for that engine. This would probably be a good spot to digress slightly and discuss a couple of flight characteristics exhibited by this particular aircraft. On take-off it required a rather slow throttle application at first to avoid an initial RPM overspeed. Also, at a normal 80 knot final approach speed this aircraft would become extremely nose heavy when the throttles were closed. I had to advise my students on checkout in this particular Cat that they might find the use of two hands necessary to raise the nose for landing; otherwise an inordinate amount of nose up trim on short final might be necessary. This is not a normal characteristic of the other Cats I've flown. What's interesting here is that, after re-indexing, the aircraft now flies completely normally, it's easily controllable with one hand and doesn't want to overspeed on initial throttle application. All of which demonstrates what a knowledgeable use of these checks can tell you. I would strongly suspect any aircraft with which I'm unacquainted if I find a high RPM on the field baro check during initial run-up. It very likely will exhibit a nose heavy tendency when the throttles are closed on short final due to a "disking" effect.

The third example involved a B-25 that had newly overhauled engines installed. The cores used for overhaul were of indeterminate age and heredity. The supercharger controls were re-installed, duplicating the installation exactly as removed from the old cores. Upon initial run-up the right engine delivered less than 1900 RPM on the baro check. Although the complete story is too long to include here, investigation revealed that the right supercharger control was reversed with the blower in HIGH when LOW was selected. Loss due to the increased horsepower required to turn the HIGH blower absorbed between 200-300 RPM worth of power.

One of the best "peace of mind" items derived from everyday use of this check is an awareness of long term performance or "health" of the engine(s). Let's say you're operating a B-25 and every time you've flown it both engines have given you a nice 2200 RPM on run-up. One day you're sick or busy or out-of-town or something, whatever. A friend of yours is operating it and he sees that, while it's running as smoothly as any B-25 could ever be accused of, one engine turns up only 2100 at field barometric. If both of you are routinely using this check, the machine is trying to tell you something. The mag check may be O.K. but 100 RPM has gone somewhere from the last time it was flown. It at least provides a starting point, the base line leading up to that point has been constant and now something's wrong. Without both of you using this check the second guy wouldn't really have a clue, this is the only common point of reference between the two of you. Another situation would be if you're the only one that flies this aircraft, in this case you'll be in the position of easily noticing that something's gone wrong since the last time you flew it.

#09 HYGRAULIC LOCK – REVISITED

In the year and some months since I first wrote about the recurring hydraulic lock problem with our engines I've found out some things I wish I'd known back then. Other things have been questioned. We should talk about those things and just kind of revisit this subject. It seems to me that enough time has passed to permit anyone that wished to comment on a developing mini-controversy to have sent a letter to the magazine editor. Unfortunately, every answer seems to have engendered two more questions, so this may become as long as the original.

(Draft copy)

WARBIRD NOTES # 01 was written as a result of the first National Warbird Operator's Conference (NWOC) at Galveston in 1993. I think these meetings have been even more valuable than Bill Harrison envisioned when he almost single-handed put together that first one. However, we encountered the natural reluctance of some to speak up from the floor, either to ask questions or to tell about some experience that they'd had with this problem. That's too bad since almost all the people who've spent any time in this business or who were interested enough to travel that distance probably had something valid to share that would've added to our collective wisdom. Anyhow, that's how these notes originally started. I mentioned in the original bulletin that I hoped others would share their comments or questions, that's how we all can learn. In trying to chronicle the hard won experiences of those (before they've all gone west) who had to deal with these problems I'd hoped to encourage people to recount some experience or insight that might save us all some aeronautical grief.

One fly in the ointment, however, might be that once we've adopted a preconceived idea it's sometimes very hard to let go of that idea if we think we'll lose face. There must have been a lot of red faces around when Columbus didn't sail off the edge of a flat earth. Another false maxim that comes to mind is "never turn into a dead engine". This is one more old wives' tale I observed still being taught in all seriousness a few years ago at a flight instructor renewal course I attended. Another is "climb it a little above cruise altitude and get this thing on the step", thoroughly discredited years ago but still receiving affirmation today, even among those who should know better. A whole litany of items could be cited here but, suffice it to say, the word *"dogmatism"* is probably apropos here. The danger in all this is in the passing on, through a bombastic "I was there" attitude, of things once accepted as certainties but unable to stand the scrutiny of knowledge acquired later on. To someone just getting started it's very easy to listen to "a voice of experience", because many times they talk the loudest. I can remember years ago when Jack Sandberg and I were visiting a now defunct operation in Chino hearing an "old head" expounding on some problem. I commented that this guy must really be the guru with his thirty years of experience. One of his fellow workers quietly observed that what the guy really had was "one year's experience – repeated thirty times". I don't know anyone of us involved in this business who was born "knowing it all" for all time. Most of this stuff is acquired over the years the hard way by listening and observing and thinking, sometimes with pain and unfortunately sometimes after damage to equipment or worse yet, injury or loss of life. And later research might then cause these perceptions to change. The preceding sentence is the reason for trying to sift through and sort out enough recollections to write this stuff, if something valid is passed on here it sure beats trashing some <u>very</u> expensive machinery!

Now, regarding John Mitchell's letter to Air Classics in which he says they'd still be fighting the Japanese if they hadn't turned hydraulic locked engines backwards all the time on Tinian / Saipan / Guam or wherever to make schedule. Yeah, I know, that went on back then. I also know that the Wright 3350 didn't have a very good reputation. Matter of fact, we'd have to admit it had a <u>terrible</u> reputation. Maybe after all these years John has finally revealed <u>part</u> of the reason. Last summer a former W.W.II B-29 pilot and I were discussing this problem. His comment, cleaned up for publication, was that he'd like to talk to the "#*!+(@%" S.O.B. that had turned the "&)@*^>$" prop backwards on the "%&*+(~*#" aircraft he had to ditch with engine failure right after take-off. I've spent a lot of time with the guys who flew it on the raids against Japan, entire books could be filled with what they've told me about those days when the weapon was deployed with the test program uncompleted. Valve problems, cylinder problems, fuel consumption, blister windows, etc. and always – the fires! I am loath to get involved in any dispute between maintenance and flight people. I've done my share of both. Both sides enjoy freely telling their war stories containing, in most cases, a measure of validity. What they disclose mostly, I guess, is a tendency for some folks to feel the other guy's experience, or lack thereof, just doesn't provide enough data base to have a clue. I've been on both ends working; I can really remember using about every word alluded to above about the "dishpan" on # 2 while trying to recowl "FIFI" after a maintenance inspection. I was absolutely convinced, after trying screwdrivers, pry bars, tapered punches and finally a small hydraulic jack, that that particular aluminum assembly had to have started life originally on some other B-29. So I do have experience with removing the spark plugs. Ever since I flew her home from China Lake I've also had the experience (along with countless other volunteers) of trying to sell cockpit tours, a couple of bucks at a time, to generate funds to keep this ancient 400 gph bird (archaeornis?) funded so the public can see her. Several of us volunteers could testify how it gets real personal, real quick, when it's your own VISA or Phillips credit card involved.

(Draft copy)

One could make the observation that the Brits knew as early as 1943 not to turn it backwards, their Fortress II manual specifically prohibited it. Most of the other U.S. military manuals also told our guys it was a no-no. However, a while after I wrote the bulletin I did find one USAAC magazine of that era that had mentioned doing it. It'd be hard to sit here and say some old top sergeant line chief didn't come along and tell his people to do it but, that was then, this is now. These round engines are costing anywhere from 20 to 60 thousand bucks a pop to overhaul and, as Mike O'Leary said, "we're not fighting a war anymore". If John really believes turning one backwards won't hurt it, could he send his VISA card number along with the next letter?

Something we really need to mention are the photos of a bent link rod used as a training aid at the 1994 NWOC in Ft. Worth. These pictures of a P&W 1830-94 provide graphic evidence for any doubters of the destructive possibilities after an engine has been turned backwards moving oil from a cylinder into the intake pipe. This was after the lock had been detected during pull through, the spark plug pulled, cylinder drained, engine turned, plug reinstalled, engine rotated six blades with starter - no more lock and then, switch on and a couple of cylinders begin firing – BAM! By the way, the force behind the backwards rotation wasn't human. It was a tornado, days earlier! This nighttime storm struck from the rear with enough force to damage the elevator hinges of the C-47 aircraft. Later detective work disclosed the props had been seen moving backwards.

One thing that I think now may have been partially in error in the original WARBIRD NOTES # 01 was that I said that oil in the intake pipe would be sucked into the cylinder when the engine started. The oil would remain in the intake like a "snake in the grass" defying all efforts to coax it out by subsequently turning the engine in the correct direction, no matter how many blades! It'd just wait until the engine began firing to strike! In a subsequent discussion with Sam Torvik at the 1994 NWOC I suddenly realized that I had disregarded an important factor while writing the original. Sam had originally discounted to some degree the possibility of damage from the intake pipe theory. However, after looking at the bent rod and reviewing the associated circumstances at the NWOC he changed his mind. Originally we pictured the oil being sucked into the cylinder. I think that equally important weight should be given in explaining the dynamics involved to the plug of oil being shoved out by the force of a ten-to-one impeller coming alive at start-up. I think this is one of the few things I would disagree with in Fred Helmick's letter in which he says oil displaced to the intakes would be returned to the cylinders but would be diluted by the fuel-air mixture. Wish it were so but, unfortunately, there is a high likelihood that glob will be shoved back full strength, incompressible and malevolent. Then, BAM, gotcha! Gasoline is a liquid and just as incompressible as oil. However, the original thought still may not be totally in error since I do know of several cases of hydraulic lock in the smaller Jacobs, Continental and Lycoming engines. Since none of these engines have an impeller, that force is obviously absent as a problem source. In these cases I just don't know whether they were the result of not finding the lock prior to start or from turning backwards when one was found. Now, the question is, did the blown cylinders and bent rods on these smaller (but still expensive, just ask the owners) engines come from failure to pull through prior to start or from the intake pipe problem? Or, could they have come from a backfire (in some cases) through the intake system which shoved the oil into the cylinder. We just don't know and I haven't found anyone who wants to try it on his engine just for the sake of experimenting. At any rate we do know that the end result is disastrous to the checkbook! Bill Jones probably said it best the other day, "who cares whether it sucks or blows out of the intake pipe, the damage is still the same".

Also, in retrospect, I may have tried to oversimplify something. The illustration showing a piston forcing the oil into the intake would be the next in a backwards cycle from a lock but would only force that oil in excess of the combustion chamber volume at TDC into the intake pipe, the chamber will still be totally full at TDC until an exhaust valve opens. Then, to be really technical, you'd have to consider whether intake and exhaust valve locations are on the top or bottom of the cylinder on opposite sides of the engine. And you'd have to consider the placement and design of the pipe's curves. And is it installed on a taildragger? So not every cylinder may be a candidate. Clear as mud? Yeah, me too! This is the area where I question Marty Hall's analysis of where the oil goes. Lock can only occur on the compression stroke and the first valve to open when you start moving the prop backwards from that stroke is the intake. Once you put it in the intake pipe its all luck from then on. I know that people have gotten by with it for years - but it just looks like a poor bet to me. I just have to agree (since we're not at war) with Marty's final comment, just – pull – the – plugs! And I fully appreciate the magnitude of what he's saying, thinking of a Fairbanks, Anchorage or Shemya tarmac! Fred and Marty obviously are both highly experienced and make several valid points between them. It would have been easier to follow their discussions if they had read the original letter along with Mitchell's. Anyway, the bottom line and what's really important - judging from the pictures and descriptions of damage sent to me since the article, the possibility/probability of backwards rotation damage is only too real.

(Draft copy)

Not too long after the bulletin was published Doug Rozendaal sent me his computations of the resultant mechanical forces imposed against a lock. It was based on the piston's position in the cylinder and it really impressed me. Doug takes pains to emphasize that the figures aren't accurate to several decimal points but they are certainly adequate for our purposes. He used a P&W 1340 so as to eliminate gearing complications. Computing the volume of the combustion chamber at top dead center (TDC), calculations show that just over ¾ pint of oil would cause a hydraulic lock. Applying 50 pounds of hand force at the prop tip would result in a 900 pound force being generated in the cylinder at 90° before top dead center (BTDC). This would increase to about 11,000 pounds force at 10° BTDC. As the piston approaches TDC the force generated approaches infinity. This last sentence is the killer! If the quantity of oil in the cylinder is only slightly more than the above amount you can see that the force generated by someone (read: unknowledgeable help) really laying into the prop is almost unbelievable.

I've gotten many copies of procedures used by various organizations and museums since the original bulletin was published. Probably one half advocate or specify a pull through by hand and the other half advocate or specify use of the starter. The latter camp is then further about equally divided, half "bumping" it through and half turning it continuously. I'm acquainted with one grizzled old maintenance chief (of long and unquestionable experience) who reminds me of the salty Joe Patroni in the movie "Airport" in vehemently insisting that all engines must be pulled through by hand. After several years of this "shtick" may the Lord forgive me for imploring Him to please let me show up on the tarmac with a Catalina (maybe all rules have exceptions, hmmm?).

Seriously, my core belief remains that the people responsible are more than welcome to their strong feelings about how they want the prop pulled through, just so long as the bottom line is, knowledgeable people! If you let volunteers from the crowd "help", the chances are that they won't know a hydraulic lock from a hay bale. Almost invariably they'll gang up on the prop with as many people as can get hold of the prop blade while seeking to amaze you with how fast they can run it through. We already know the results of that number of people's unbridled enthusiasm from reading Doug Rozendaal's calculations. It scares me half to death. Now then, doing it with the starter presents a completely different set of potential problems. Is it an inertia or a direct drive? If you can't "bump" it through while diligently watching for a stalled blade and, instead, have to use full starter speed then you're relying on a starter clutch that you hope is set to a low enough torque value to protect your life and investment. Also, I always look at the inertia of that big prop and it also scares me. As for me and mine, I have to admit I still do it both ways depending on the aircraft and situation. If I'm going to do it by hand I want to do it alone or with the absolute minimum of help and slowly walked through. If with a starter, then bump, bump, bump, a blade at a time. Note to me; what about inertia starters?

I've heard people remark that they've never encountered a hydraulic lock in order for them to know what it would feel like. Well, risking being shot for blasphemy, you could induce one for training under strict control some time when the people who need the training are all around. You could pull a plug, put your thumb over the hole and bring it up to near TDC on the compression stroke. Then squirt it full of oil and put the plug back in. Then let everybody turn the prop and <u>let them feel</u> the resistance. There isn't any question in anyone's mind after they feel it that they then realize how sudden and sharp the lock feels compared to normal compression. <u>Then, remove the plug and drain the jug!</u> I'd also leave the plug out and start it to guarantee it was cleared out. And stand way back! After the first bulletin we found a lock on an A-26. When they decided to pull the plugs and run it as described I managed to get oil on me even while standing a good 25-30 feet away.

(Draft copy)

To illustrate the futility of pulling it through blade after blade consider this scenario. A BT-13 sits in a hanger all winter. Pulled through regularly, a drip bucket hangs under the stacks. Springtime comes and the oil is very low in the tank, enough oil is added to bring the level up. Everybody around the hangar sort of contributes to pulling it through, and through, and through by hand. Many blades later, it has to be clear since no hydraulic lock occurs, right? The battery is known to be low so someone says "You'd better turn the mag switch on first so it'll fire on the first couple of cylinders, else we'll have to hunt around for a power cart". Inertia starter winds up, prop turns and fires, BAM! $16,000 later, his sad comment, "I wish you'd written WARBIRD NOTES # 01 a couple of months earlier so we'd of pulled the lower plugs and ran it".

Are we learning anything here? Well, I'll guarantee you the Soviets have. The M-14 engine on the YAK has removable plugs installed in the lower intake pipes. If you get a lock on one of these, <u>DO</u> pull it backwards and force the oil into the intake. Then unscrew the drain plugs, drain, reinstall and go fly! Of course, if you don't know about these plugs and turn it backwards, oh well, new engines for these are fairly cheap and you could sell the cores (two that I'm aware of, one in Tennessee and one in Texas) for boat anchors!

Recently I received a totally unsolicited comment from "Boxcar Willie", a name many of you country music fans will immediately recognize. What follows is probably going to surprise most of his fans. While reminiscing with him in his tour bus before he went on stage I asked him if he'd ever experienced a hydraulic lock on a 3350 or 4360. He said sure and then surprised me with this follow-up – "and I'll guarantee you that anyone who wants to get rid of it by turning it backwards is going to end up with a bent rod". Now I must confess that, no matter how much I <u>admire</u> his ability to finger the hard (for me) “G” chord and sing train songs that make me cry, what has my utmost <u>respect</u> is his real life experience and ability as a B-29/C-97 flight engineer. As Paul Harvey says, "now you know the rest of the story". The guys I flew with in the Air Guard who were running the panel of a C-97 were professionals who had, beyond any doubt, reached the top rung of their ladder. The "Stratocruiser" and the "Connie" represented the pinnacle with spark advance, water injection (ADI), turbo-superchargers or PRTs, ignition analyzer and a host of other complicated devices never to be equaled again. It represented art as much as it did science. After he made this observation I told him about the letter to the editor of Air Classics stating “it (hydraulic lock) wasn't a concern”, therefore it was interesting to hear someone else's unsolicited opinion. "Willie" then added a last succinct comment, "friend, if you don't want to bust something when you get a lock, just get out your wrenches and start pulling some spark plugs!"

Things yet to write about:

- frost on wing - step/terms: cratered/failed/hatched/hashed/totaled/gave up/shelled/trashed/blew.

#10 PRE-OILING WITH THE FEATHER PUMP

A subject that may be a "sacred cow" with several people came up during a discussion this afternoon. Thought it might be of some interest to discuss how different people view the use of this procedure and how their perceptions may influence their viewpoints. Some perceptions may be valid and some not, let's discuss them in turn and see where we end up.

(Draft copy)

First of all, I don't think much serious disagreement exists with the need for pre-oiling of a engine if you're hoping to get anywhere near the projected hours between overhauls we've been told were possible/probable. We touched on failure to do this in WARBIRD NOTES # 03 as being a possible cause of master rod failure. This is especially true nowadays where we usually see a low amount of time being put on an engine compared to the time the military or airlines used to accumulate in the old days. Even back then, very detailed requirements were specified after overhaul or for preserving and then returning to service engines that were to be unused for a period.

One question asked is "does the oil pressure generated by this feather pump pre-oiling furnish lubrication to the rear bearing". To answer that we'll need to look at a schematic of a typical engine. When using this procedure we've seen about 50# indicated on a B-25 engine after the prop traveled through its full cycle reaching its unfeathered position. So, it x.

Another question asked is "what's the prop doing during this process?" If you refer back to WARBIRD NOTES #05 you'll see that as the feathering pump builds up oil pressure it initially moves the blades to feather. As you continue holding it down more pressure builds up and somewhere around 600# it unseats the distribution valve in the prop dome. At this point the pressure is re-directed to the forward side of the piston within the dome, moving the blades towards unfeather. They will continue to move towards the low pitch stops until bleed holes drilled in the xx valve are uncovered, dumping the pressure and blade movement ceases. As you continue holding the feather button down the resultant oil under pressure is directed back through the prop shaft to the internal engine passages, ultimately ending up in the crankcase sump.

Finally, we could address one last perception, to me the most important. We all want to furnish clean oil to the bearings of our engines, right? That's why we install filters on smaller engines where it's practical and when it's not we sure try to prevent any foreign material from entering the lubrication system. While reading this are you by any chance drinking a cup of coffee? Good, go ahead and finish it and then look at the bottom of the cup. See any sediment or grounds from just this one filling of coffee? It was filtered to some degree, wasn't it? Now, let's say that you didn't wash this cup for many years but just kept refilling it with coffee. Where does the feathering system get its supply of oil? Yup, that's right. From the bottom of the tank so as to always be available as a last resort for this task. Don't you think you might want to contemplate for a minute or so how much foreign material and sediment is at the bottom of that standpipe before purposely forcing it through the bearings of an engine you intend to fly afterwards? Of course, you must balance this against the observation that you are doing the same thing every time you check the feather pump before take-off, just not as long or in as high a quantity. Guess all aviation is a compromise, right?

Yet to write:

- press indications/after o'haul recs, air loc/real external pre-oiler does/installed pre-oiler probs/military/airline recs were.

#11 FULL RATED POWER FOR TAKE-OFF

This is another subject that is almost certain to create a fair amount of controversy among the operators of old "piston-pounders". The most often heard explanation is, "Old Joe told me to always baby my engine!" Good idea! But sometimes with unintended results, sometimes financial, sometimes tragic and sometimes both. Or else, commonly heard, "This 100LL is lower in octane than 100/130 so I need to reduce the power because of it!" Again, just another example of an Old Wives' Tale leading to misguided thinking, and (likely) more unintended results!

One particular operator, the CAF, instituted its requirement for the use of full power for take-off many years ago. This is in the form of a flight regulation but, even after being in effect for all those years, it seems to be either forgotten in many cases, or worse, disregarded! This regulation was adopted many years ago specifically due to a take-off accident involving an engine that knowledgeable observers knew was malfunctioning. However, it wasn't detected during the take-off roll by the pilot (unintentionally, I'm sure) since it succeeded in masking its troubles, until very shortly after liftoff!

If one has occasion to visit a carburetor overhaul shop to talk to the person responsible for accomplishing this work, it'd probably be enlightening in obtaining a “feel” or understanding of the gasoline flow rates. And remember, the flow rate is NOT dependent upon throttle position (as some have erroneously stated), it is simply dependent upon the <u>mass airflow</u> through the carburetor.

Also, a perusal of the Pratt & Whitney / Curtiss-Wright / Bendix-Stromberg / military / airline handbooks of that era dealing with this exact problem may prove to be truly instructive! In addition, P&W published a letter/operating bulletin to all operators back in xxxx. This letter stated very specifically that, while they realized that in the past some operators may have misconstrued P&W’s policy, <u>they specifically wanted it known that they DID NOT support or condone in any way the use of reduced take-off power</u>. They then went on to list several reasons where they saw very definite problems if a reduced manifold pressure was used on take-off in a <u>misguided/misinformed</u> attempt to “baby the engine”.

Still to write:

- We also need to mention here that we’ve seen this on almost every kind of engine and airplane, Fords, B-25s, Connies, Twin Beeches, DC-3s, etc.
- Fuel enrichment valve at what point? Power enrichment valve. Economizer.
- Piston ring miles.
- Who does – doesn't.
- Sandberg got PO’ed.
- Fuel grades – Glenn Goldman.
- Carb overhauler’s specs/testing.
- P&W Service Bulletin.
- Precision Engines letter.
- Old pilot’s “I know better”.
- New mechanics (usually turbine experience) "I know betters".
- “Researching” done with limited experienced people of OWT training or experience.
- Turbine experienced people’s well-meaning ideas, creep occurs at the higher EGT's, therefore we can do the same thing with the pistons, apples and oranges, turbines aren’t pistons and v/v.
- OWT’s are always a reinventing of the wheel, a new idea that no one else could <u>possibly</u> ever have thought of before or investigated before!
- Everyone in this biz wants to save a buck and operate these airplanes as cheaply as possible! “Save our engines!” Not new, but a thousand OWT’s are enabled by it.

- Reminds me of what Ray Stits told me a long time ago, “Randy, I’d ten times rather have a preacher or a librarian re-cover an airplane with my stuff, he'll follow the book!" "But if a Grade A mechanic does it, he’ll always “know better” somewhere and then blame me when it doesn’t work out right!”
- Experienced operators might say – “xxxxxxxx”! Unh-huh, they make any other changes at the same time – like pre-oiling?
- Does anyone here know what the performance is with an arbitrarily reduced power setting? What is the certification basis for using it? What altitude would you be at with normal power if an engine fails and you’ve been using reduced power? Who’s gonna have to explain it to the FAA when an accident happens?
- Once this mentality or idea is induced, then it is only natural for many to assume that “the engine will blow up if I go to full power!”
- Idea also that engine will disintegrate if the 1 minute take-off power limit is exceeded by even one second!
- I think that the factory, the overhauler, the engineer, etc., are <u>far</u> smarter than Lt. Sohn is in this matter! I’ll bow to their combined knowledge.

#12 ROUND ENGINE BACKFIRES

This subject came up during a recent conversation with an experienced pilot at a large museum. This subject suddenly became highly personal to him when he experienced a catastrophic engine failure shortly after take-off in a single engine aircraft. Ability (along with some fortuitousness, most likely) resulted in a forced landing with no damage. A subsequent tear down strongly suggested that impeller damage, very possibly the result of backfire(s), had precipitated the failure. It may be that the importance of this highly stressful loading on an aircraft engine hasn't been fully realized or has been minimized to some extent. For that reason, this attempt at pulling together some of the known facts about the problem may be useful.

First of all, an aircraft engine with a gear driven internal impeller (supercharger blower) becomes somewhat of a different animal than one without this mechanism. Probably most pilots don't really give much thought to the impeller's RPM when all that's visible to us is the tachometer. Probably we wouldn't multiply the tach reading we see by a factor of anywhere from 6 to 12 times. But in truth this is what's happening, sometimes a few feet ahead of us or little more than an arm's length off to each side.

Things to write:

- sneeze with oil plug in intake, rhythmic- what means, blown pipes.

Roy Erickson remembers watching a DC-3 startup on the tarmac at the terminal, then hearing it audibly backfiring on the ramp turnout. This resulted in ruptured diaphragms. Roy said he then watched the pilot attempt another start. It was apparent to him that the thing would run on prime but would stop just as soon as the mixture was used. He tells me that this was along about the time of our last operation of DC-3's at North Central, he remembers telling another mechanic to get a spare carburetor from stock, and they'd need one. Using the special wrenches and tools that'd been developed for that particular job, they were able to change the carb and button it up again in exactly 46 minutes. This must be an all time record but given the experience of our mechanics I am not really amazed, pity that other things could not have resulted in this small of a delay for a carb change. All this makes me wonder about the - wonder what diaphragm?

Larry M has now ckd the PBY and is seeing loose intake pipes and busted or cracked rocker box cover at exh side all the way around the fins and we don't know if loose due to backfire or it was before.

#13 CABURATOR ACCELERATION PUMP

During several ground schools lately we've gotten the feeling that some misunderstanding exists about how a carburetor's accelerator pump works on an aircraft engine. And, here we’re talking about carburetors on 1820’s and larger, the float carburetors on 985’s and 1340’s are a different story. Some believe that a rapid throttle movement (with the engine at rest before start) causes a "squirt" of fuel into the throat of the intake, in much the same fashion as your 76 Belchfire V-8 automobile parked out in the garage.

Actually, you just might be tempted to ask, “Why do we need or have an accelerator pump in the first place”? Well, without one, every time you advanced the throttle, you’d likely be confronted with a “stumble” or hesitation, as well as experiencing a backfire almost every time.

Let’s take a look at just how the pressure injection xx carburetors accomplish this task.

#14 CHECKING THE MAGNETOS DURING RUN-UP

The reason for this bulletin becomes increasingly obvious when the many different ways of checking the "mag drop" (the most basic of piston engine checks) are observed. Taught from the very beginning of an aviator's career, the disparity of intents and results is simply amazing to observe. Along with the answer to the question afterwards, "well, what'da you think?"

(Draft copy)

Before we really get into the subject, we probably should touch upon the commonly misunderstood question of which magneto we're actually checking during this test. Obviously when the switch is on BOTH we're operating both magnetos, and when it's on OFF both magnetos are grounded and the engine quits. Now, however, to the interesting part - for some! When you position the switch to LEFT remember that the RIGHT magneto is grounded and you are operating on, and checking the performance of, the LEFT magneto. And vice/versa. While on the subject here, another truism, the LEFT magneto fires the rear (four letters) plugs and the RIGHT magneto fires the front (five letters) plugs. From reading some log book write-ups I'm afraid these simple facts aren't universally understood by everyone operating these airplanes.

The reason we check the furthermost position first on the magneto switch during the run-up is the possibility of returning the switch only one click when we intended to return it to BOTH. If we selected the nearest position for the first check, we could later end up taking off on one mag if we happened to only return the switch one click when we had intended to return to BOTH. Some pilots advance the theory that xxxxxxx TBD. Clear as mud? Try it and see, that's easier than trying to describe it here. By the way, I'm only sharing the "why" here with you, nothing more. I guess you can do whatever you want if you have a strong need to be different.

Something to keep in mind for the rest of your career, "when" you inadvertently move the magneto switch to OFF, when you'd only intended to move it to LEFT, resist the temptation to immediately return the switch to the proper position. I deliberately used "when", not "if", because I don't know of anyone who hasn't made this mistake at least once! If you fall victim to the almost irresistible impulse to attempt to cover up your mistake you'll only succeed in drawing unwanted attention to the mistake, I guaran-dang-tee it! I'd guess that in every instance I've seen it's resulted in a healthy backfire! What you need to do is "don't flinch"; just say to yourself that this is another case of "big deal – so what"! Leave the switch off, get your hand well away from it and put it to use in retarding the throttle to the idle position. Allow the RPM to fall naturally to the idling speed of approximately five hundred RPM. Then you can return the mag switch to BOTH and allow the engine to regain its footing at idle. Now you can restore the power and return to the check you had originally set out to do. You'll need to practice this or at least strongly think about it in order to be able to resist the temptation to "flinch" when it happens to you. And it will!

Now, regarding the time you'll need to spend on one magneto while accomplishing this check. The military maintenance manuals for a number of these engines and airplanes all indicate that operating on one magneto during this check for periods of up to one minute is not considered excessive or likely to damage the equipment. This is decidedly in contrast to the conventionally held wisdom (read "old wives' tales') that this will damage the engine. I don't really think that anyone needs to leave it on a single magneto anywhere near this long in order to determine everything he/she needs to know. This is not an exact thing, so get what you need to know (all that's needed is for the RPM to stabilize), then go back to BOTH. Some pilots might prefer to gently "tap" the tachometer's glass face to eliminate any possible tach binding. If you do this, be aware that the glass can be broken by an excessive knuckle force. On the other hand, the "click - click" drill isn't really going to tell you all that's needed, either. Jack Sandberg used to just sort of "flip" through the magnetos when he was doing this preflight check. He allowed almost no time for the mags to exhibit any "drop", in my mind it'd have detected a "dead" mag and that's about the best I could say.

I'm going to describe the mag check procedure we use for the B-25 here, since that "single pilot" operation lends itself to a good way to describe the whole procedure. If you haven't referred to Warbird Notes #08 (Field Barometric Power Check) lately, then you need to look at it first since the power check is done immediately prior to, and along with the mag check. As soon as you notice the sustained RPM on that check you can then begin the mag check.

Look at the RPM drop, the rather instant drop you'll see first is what can be referred to as the "fast" drop. Then you can turn you head and briefly look at the nacelle and/or prop dome to determine if any excess engine shaking is noticed. Then, return you attention to the tachometer and notice any further drop in RPM since you first looked at it. This is usually known as the "slow" drop. Now repeat the procedure for the LEFT mag. The maximum allowable drop is given in the pilot's flight manual. While we're on the subject, it probably isn't necessary in this particular situation but on any two pilot airplane you need to call out the engine and switch positions as you select them, so that the other pilot can direct his attention to the appropriate engine i.e., "#2 - RIGHT - BOTH - LEFT - BOTH". While doing this, note the engine temperatures and pressures for correct indications.

Now, just what were we looking for or checking while accomplishing this check? First, if you see absolutely no RPM drop on the mag you select, don't congratulate yourself or the mechanic, if it stays absolutely the same it means that you have a bad "P" lead and that switch has no effect on the system. In other words, that mag is hot and unable to be grounded! Get it fixed – all engines are going to have some amount of drop on a single mag.

Although it might be true that you usually are unable to "fix" something from the cockpit, you should be able to adequately describe the characteristics of the "mag drop" later to the mechanics. This, hopefully, might minimize the time they have to spend on trouble shooting. Military manuals for these purposes indicate that when the "drop" is excessive, (1) generally the fast drop is indicative of a fouled/bad plug(s) or a defective ignition harness. On the other hand a slow drop (2) is generally indicative of faulty timing (magneto or distributor) or incorrect valve adjustment i.e., fast-fouled, slow-timing. If you have a fairly definite idea that you have a fouled spark plug you can try one of several time honored methods of clearing it out. A method given some credence over the years is to operate the engine at field barometric manifold pressure and aggressively lean it until it is very nearly ready to die. Be cautious since it will rapidly overheat in this condition. Attempt to burn it out in this fashion for a period of time, observing the CHT, of course. Then enrichen it and do the mag check again. Another thing we used to do in a attempt to cure a fouled plug was to do the procedure immediately above and then simultaneously (1) enrichen it, (2) depress the primer switch, (3) depress the carburetor alcohol switch and (4) retard the throttle to idle quickly. All this was an attempt to "thermal shock" the offending sparkplug, "hopefully" loosening its lead deposits.

Comparing the amounts of the two "drops" is a part of the check; they should be roughly comparable to one another. Let me quote from a particular manual I just have to have handy here as an example only. "The normal drop is 75 while the maximum drop is 100, with a difference between the two mags of not to exceed 40". In other words, if you see only a 10 drop on one and a 100 drop on the other, then there's probably something wrong, even though both are permissible according to that particular airplane's manual. It's a good bet that the timing is xxxxxxxx TBD.

Remember these to write:

- airborne

We should mention somewhere here that we used what was referred to as a "running mag check" on the airline. This entailed a complete standing mag check upon the originating run-up, as discussed (ad-nauseum) in this article, then a quick lower power one on all subsequent stops of that flight. The '"running mag check" involved finding a convenient taxiway while taxiing out, then running both engines up to approximately 1900 RPM on the R-1820 DC-3's or 2100 RPM on the Convairs. Sometimes one might have to ride the brakes slightly to avoid an unwanted acceleration. Then quickly cycle the mag switches through all the appropriate positions before gaining too much speed. In truth, while it was FAA approved, this procedure probably would have accomplished little more than to detect a "dead" mag! But it remained in existence for as long as I flew the "piston pounders" at North Central Airlines.

The preceding paragraph reminds me of something else we need to discuss here; a manifold pressure that is provides an adequate internal cylinder pressure for a valid mag check. However, if less is used, the firing of the spark plug is probably not going to be indicative of much of anything. My feeling is xxxxxxxxx TBD.

If you haven’t been routinely doing an “idle mag grounding check”, you need to start right now - on your very next flight! You owe that much to the mechanics working around your airplane, or anyone else for that matter! If the magneto doesn’t stop firing when you turn the switch off, then all that's needed for a terrible accident is for someone to just move the prop blade a little bit with a “hot mag”. Someone “pulls the props through” before starting, right? Or you turn or “bump” the prop through a number of blades with the starter? Be a big surprise, either way, to discover a “hot mag” when you didn't know it, right? Three times during my career I’ve seen the engine fail an “idle mag grounding” check. Just a quick word of advice, though, do it at idle, otherwise you may get a fair backfire if you’re up at a thousand RPM or so. Also, minimize the time spent with the ignition off, as soon as you can tell that it’s grounded the magneto, return the switch to BOTH in order to minimize any possibility of a backfire.

Some have advanced the theory that they didn’t want to do the “idle grounding check” right after start - until the engines had warmed up. I think that they are confusing two different scenarios here, sometimes an engine doesn’t want to keep running right after start and you might have to “squirt” it with the primer a few times while it’s cold. However, this has absolutely nothing to do with the “idle grounding check” in any way! This check can be done at anytime, start, middle or shutdown, it doesn’t make any difference at all. Just another “old wives’ tale”, I guess. We did agree to do it right after start on the B-17 while all four are running because so many times the inboards are cut when turning off the runway upon terminating. That way we’ve gotten it at least once during the flight, even though it’d be preferable to do it just prior to shutdown upon termination. One point here, scavenging, in the near future this all may shortly become a moot point since we are contemplating leaving all the engines running, then to do a complete scavenging at 1100-1200 RPM immediately prior to shutdown.

Randy:

I'd like to throw something in here about the mag checks. I was reading JD's response to that item and I suddenly realized why I had an uncomfortable feeling about it. Since day one I was taught by two old grizzled pilots, Lyle Mungeon and Ken Lynde (may they both rest in peace. I think Ken's license had been signed by Orville) to go one click, check the mag, back to both, and then two clicks to check the next mag, and then back to both. It was always "One-one, two-two". I personally never had a problem with this and didn't realize there was another way till you started advocating the other way. I now remember Lyle, who was the first to explain it, I think, saying that you checked the first one so that you didn't pass over a dead mag with the resultant "bang” on the way to the good mag. That was the piece I was missing. This summer I have made a conscious effort to do it your way.

I've had to stop before each mag check, look at the switch and think about what I'm going to do. It was like batting right handed all your life and now being told to hit "left". We've occasionally had dead mags. Could JD's point be valid enough to change your mind?

I'm thinking how your mind works. You'll say that each mag selection should be a deliberate move and if the engine dies on the first mag, throttle to idle and then reselect both. I think the chances of someone rapidly cycling through the mags and "missing" or not reacting quickly enough to the dead mag are better than someone leaving the mags in some position other than "both" at the conclusion of the mag check. Besides, everyone that follows your procedures also uses a checklist that calls for rechecking the mags in "both" during the take-off check. If someone doesn't have the discipline to use the checklist properly what are the chances they'll do the mag check properly? And vice-versa.

#15 PROP FEATHERING SEQUENCE AND ACTIONS

Whenever this becomes the "subject du jour" it's guaranteed to create an intense discussion (and deservedly so) among experienced aviators and pilot examiners. And this sequence is inevitably going to be far more important to some pilots than it is to others. It must also be noted that the sequence has undergone a change in focus and intent (to some degree) as flight training methods and objectives changed over several decades. We've undergone sort of a metamorphosis from that of operating round engined airplanes every day as a business to one of operating them more as a hobby. And the pilots have also changed both in their level of knowledge and in the training procedures they've been exposed to. At the same time, however, we can't simply abandon flying safety in this equation simply because the pilot finds it "more difficult" in the current or modern world. Not if we still want to operate these old propeller airplanes. In other words, we may not be able to expect an airline level of competence or performance, as in years long gone by, but we certainly can (and need to) expect a safe one.

(Draft copy)

Some of the older flight manuals are likely to describe a feathering sequence that differs substantially from one contained in the more modern manuals. Back in those earlier days, little thought was apparently given to this. As experience was gained and standardization became more important, it's obvious that more thought was applied to this subject. Later, the jet mentality came along and that philosophy also had an effect on the procedures. With the advent of the jets, we easily took full advantage of their different design philosophy. The jet engine was enclosed within a pod or a nacelle that'd burn or break away from the airplane's structure. Accordingly, the training philosophy then became "don't worry about it this instant", it just wasn't as important in the overall scheme of things as it had been earlier. "You don't have to deal with it immediately", as had been the case of a propeller where it had to be feathered (either manually or by auto-feather) if you were going to have any hope of surviving an engine failure shortly after take-off. Accordingly, we happily acquired the luxury of using the checklist as a "do list" for the failure instead of having to immediately feather it to provide a hope of salvation. There's a big difference between the jet engine and a prop that must be feathered in order to extract even a modicum of performance from an airplane whose performance has been suddenly, and radically, reduced by an engine failure with a windmillling propeller. Even in the more current manuals some differences in procedures are likely to exist, depending upon the author's background.

Stuff to write:

An airplane with propellers always has, and always will, demand an extra amount of proficiency from the pilot, especially if the engine fails at a critical time on take-off. Jets have spoiled people over the past few decades, because of this difference. With props, you simply cannot "dawdle" as some might describe the prescribed drill in modern day jets; the best description I can think of is to "proceed with all deliberate haste!"

Many propellers utilize an electrical "step-head" motor mounted on the prop governor for blade pitch control. This was installed in a few early airplanes, one of which happened to be the Consolidated-Vultee C-87. If you've read "Fate is the Hunter" by Ernie Gann, this is the four engined aeronautical contraption that Ernie wrote about with such undisguised affection (tongue-firmly-in-cheek-mode)! In his personal descriptions to me, this beast certainly occupied a position of respect, intermingled with contempt, in his memories. In spite of its early teething troubles, after the war this method of prop control became almost universal. With this arrangement (in its most basic form), the prop had a three-position electrical switch on the console for controlling the propeller's pitch. The switch utilized electrical wiring to control the step-head motor on the engine's nose case mounted hydraulic prop governor. On the upside, this eliminated the unwieldy system of cables and pulleys; the downside was that this system took much longer to traverse between the governor's limits than just manually moving the prop lever. It also relied totally upon having electrical power available. In a typical installation, the switch might have to be actuated for a total of TBD seconds for the step-head to traverse the entire distance between governor limits (low lights to high lights or vice-versa). Obviously this time factor makes it impractical to move the prop control to the LOW RPM setting as a routine precondition for feathering. Also, if one anticipates a possible loss of electrical power, then one might wisely prepare for this eventuality by setting the RPM setting to something higher right away, thus not limiting one's options later. A form of insurance, if you will.

← Mixture, prop, throttle, drag reduction, throttle, prop, mixture, feather. Easy to remember, but it also seems to help because it makes a little more time to think available. This is the way it was done at Capital Airlines. I should mention that I describe those last four steps as an "increasing degree of irrevocability".

By the way, right up front here, we should discuss or mention always taking care of the drag reduction, as "retraction of gear and flaps, unless otherwise required".

↑ Mixture, prop, throttle, drag reduction, throttle, feather. This takes less time, it was taught this way in the USAF in B-25's.

→ Mixture, prop, throttle, drag reduction, throttle, mixture, feather. This was the way it was done at North Central Airlines.

↓ Throttle, feather. This procedure has one extremely vocal and ardent advocate. Problem here was involving pilots on a computer forum without a (in general) clue in the decision making process, sort of a decision by poll, generally of the unknowing. It does have the advantage of being about the simplest procedure possible, sort of a latter day jet reactive deal. Or, easier to teach in a training situation.

Some of the recognized downsides of each of the above procedures are discussed below:

Those procedures that don't move the mixture control to IDLE CUT-OFF will let the fuel run right through the carburetor – if – the booster pump is ON at the time.

Not pulling the prop control back to the minimum RPM stop entertains the strong possibility of unfeathering to a low pitch (more RPM than you desire) or overspeed since we're been unfeathering almost as soon as we shut down during training/checking maneuvers. This problem has surfaced in the more recent times because the focus or intent of this procedure has changed over the years. We now devote a lot of attention to reducing as much as possible the possibility of damaging an engine during this maneuver. We used to worry much less about this, truth be told. The training concept has changed over the years.

Not advancing the power (mixture, prop, throttle) will allow the airplane to stagger and/or lose airspeed while you are attempting to deal with the failure. It might prove to be anywhere from disastrous on take-off to merely an inconvenience in cruise. It also may not provide enough of a difference in the unbalanced power between sides to enable you to correctly determine the failed engine. To say, "Well, we'll get to that later as a checklist item" probably will prove to be too late, unfortunately these are not jet airplanes we're dealing with.

Clearly, the number of memory items to be performed increases the difficulty of the procedure. However, the downsides of this recognized problem have been discussed in the paragraph immediately above.

By the way, we're only discussing here the type of propeller that has a separate feather button, not the type used on light general aviation twins where moving the lever all the way to the rear (around and past a detent) feathers it.

The Catalina PBY demands an extra amount (if that's possible) of attention to identifying the correct "failed" engine, some pretty adept aviators have misidentified the failed one and started to shut down the good one! You'll need to go to <u>at least</u> METO, and possibly more, to establish sufficient differential power and yaw to make a correct determination. Centerline (or nearly so) engines are a bitch-kitty, in my book!

I hate the thought that anyone would/could entertain the thought (seriously, that is) not immediately adding a substantial amount of power on the good engine(s) if he loses 50/33/25 percent of his available power. And, if you're adding power, I'd again doubt the sanity of anyone who would use anything other than the time tested and honored (for good reasons) mixture, prop and throttle while increasing it. If you then reduce, or at least think about it, the drag of gear and flaps, then that only leaves the relative order of the shutdown and feathering for us to have this discussion and/or argument about here.

I've always slapped my leg that wasn't doing anything, "dead foot - dead engine"! Several instructors have confided in me that, while they initially laughed at this procedure, they later came to appreciate the value of it. By the way, it isn't my idea; it was taught to me by an old timer in the multi-engine instruction business. He said he'd not had a misidentification of the failed engine since he started teaching it that way. Even if I'd had the inclination to do so, I sure wouldn't have argued with him! Perish the thought; he'd previously been a lineman at Texas A&M! (and yes, I know almost all of those "Aggie" jokes).

A little background on feathering systems might be interesting and, at the same time, add a little to this discussion. A study of the original manual for the Hamilton-Standard overhaul manual for the 23E50 prop shows that the feather system had.

If you're faced with feathering an engine.

Al Bergum, Tom Truax and the DC-3

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17 OCT 97

Dear John,

Thanks for taking the lead on a subject that for some causes considerable confusion. I agree with you 100% that there needs to be a consensus on how the warbird community will handle engine failures. I'll tell you right from the beginning though, I'm going to be a hard sell on what you have proposed as a solution, but you might already know that.

In my mind, the keys to a good procedure are:

1. based on fact
2. work in as many situations as possible.

The 11 item procedure (I skip the carb. ht and only have 10 items) I have used since 1982 when I was trained to fly multi-engine airplanes by former RCAF pilots. Since then I have used this basic Power UP, Clean Up, Identify, Verify, Shutdown/Feather procedure for dozens of check rides in some 20 different propeller driven aircraft (both piston and turboprop) for 5500 hours. Although I've only had to use it in anger once, it has never failed me in training or during a checkride.

I like it. It works for me. It works for the people I've trained over the years and I'd be delighted it everyone would use it. Besides, it works <u>for</u> <u>real</u>, is based on fact and works in every situation I can think of.

I'd like to share my views on the "long list" memory items (flow).

Power (mixtures, carb heat, props, throttles)

Are you trying to tell me that if you take off in the big jet at a power setting reduced from maximum allowable, you won't push the power up to maximum if you have an engine failure after you lift off? This would surprise me.

This procedure is not there to determine if we do or do not need additional power, it is there to make sure we've done everything we could, as soon as we could. The way I interpret what the FAA expects during the loss of a powerplant comes from AC 61-21A, Flight Training Handbook, Engine-Out Procedures. The first thing done following and engine failure: "Set mixture and prop controls as required; power controls should be positioned for maximum power to maintain at least Vmc". As you may recall, the loss of 50% of an aircraft's powerplants means the loss of about 75% of its performance. This is not a good thing. So add power before it is too late. If it's too much of a good thing you can always take it off.

Gear and Flaps

You seem to think that in all cases any airplane will make it after take-off with if the gear is forgotten and left down. Losing one of four likely won't be a big deal, but losing one of two is a big deal to me. If an airplane makes it or not may depend on the airplane, the conditions that day or the pilot. Just because it worked last time when it was cool does not mean it will make it when you are high and hot. We need a procedure that works in as many situations as possible, not a procedure for one condition and another if the conditions change. The same goes for the flaps.

Throttle (for identification)

This is, as you say, a most worthwhile item. However, it does not keep you from feathering the wrong engine. It just helps you identify the offending engine. Feathering the wrong engine is always just a finger tip away no matter how long or short the memory flow. I too believe that the pilot flying should accomplish this to feel for a change. I think you will agree with me if I add the fact that we should stay away from terms like push, pull, forward, back etc. as not all airplanes work the same. I could however be convinced, in the case of the throttle, to use the term move toward idle. This should cover every situation.

I have heard of a case in a B-25 where the pilot being examined was so nervous that he reduced power on the good engine without even noticing it. So let's not forget what the copilot might have to say.

Pull back the prop lever.

On most light twins and small turboprop airplanes, pulling the prop lever back was the only way to feather the prop. It wasn't until I flew the F-27 that I realized there was another way to feather a failed engines prop. So when we train pilots with a light twin background we need to make sure they understand that we are not going to move the prop toward (seems to work here) high pitch/low rpm to accomplish the feathering. We are doing this to further verify that we have the correct engine and positioning the propeller to its lowest governing rpm just in case the feathering system does not work. If the prop can not be feathered, this is where you will want the prop for minimum drag.

What we are looking for in the verification process when we pull the prop back is the degree of change in rudder pressure. If you pull the dead engines prop back you get very little change. If you pull the good engines prop back you get significant change. Go try it. Let me know if I'm wrong.

I'm not sure which airplane you've been flying with a Hamilton Standard that "ports high-volume governor oil to the front or the prop dome to feather the prop". However, I do know that the Hamilton Standards on the B-25, B-17, A-26, PBY, B-29, B-24 and DC-3 have some variation of the 23E50 hub. This hub moves the prop blades toward high pitch/low rpm by supplying oil to the back side of the prop dome and is also where the feathering oil goes to feather the prop. So moving the prop toward low rpm moves the prop blades a portion of the way toward the feathered position.

I concur with placing the prop in low rpm for start. It will hopefully help prevent and overspeed.

In your letter you really did not discuss in detail what kind of procedure you use to identify. You state Throttle (identify), but are you using rudder pressure, engine instruments or something else. I think that the procedure can be too easy and mistakes made too easily. The long checklist really does not take that long if practiced. It also comes as close as you can in making sure beyond a shadow of a doubt that you have identified which engine is to be feathered.

I could go on and on about how I think this procedure is better than some others, however the fact is we can't please everyone. I've been around the group that says that "when it comes to the real thing I'm going to do what needs to be done". Well just watch them and they will botch that up so fast it will make your head spin if the airplane already isn't. Yet the majority of new pilots are younger and less experienced in these airplanes. They don't know what to do and we will teach them a procedure. The pilots I've taught the long procedure accomplish it quickly and thoroughly and never seem to have a problem with it because they understand it and believe in it. Just as I do.

Now that I've shared my opinion, I would suspect that we won't have a shortage of things to discuss when we meet again. I think it will take a sit down meeting to resolve this issue.

Regards,

Tim Jackson

cc Randy Sohn

#16 FORCED LANDING MEMOERY ITEMS

This is going to be an excursion down memory's path. A couple of months ago I noticed an ad placed in ALPA magazine by a retired Delta pilot who wanted to contact as many former aviation cadets as possible. He's writing a book about this program and also trying to arrange an all class reunion sometime in the next couple of years. While helping him with some of the records I happened to still have from forty years ago we talked at great length about this program and some of the lifetime friendships we formed. More important, however, are the habits and/or thought patterns indelibly etched in our minds during that period of intense training so many years ago.

Deep in southern Georgia at Spence Air Base, the USAF operated one of their nine civilian contract primary flight training schools. I can still vividly recall that trip, starting in Minnesota's cornfields and ending amid Georgia's cotton fields. The odyssey for me began with walking across the ramp at Rochester's historic old Lobb Field near downtown; its famous "ear of corn" water tower now long since vanished, along with all the other traces of an airport ever existing there. A short flight on a Northwest "red tail" DC-4 to Chicago barely allowed time to contemplate the journey I was undertaking. In my mind I can still visualize walking up the airstairs at Midway Airport while boarding an Eastern Lockheed "Connie", its dolphin-like silver fuselage illuminated by the ramp's floodlights, the entire scene bathed in ghostly moonlight. A placard near the passenger entry door proudly proclaimed the capability of this aeronautical behemoth to produce an amazing total of 13,000 horsepower! After an all night trip, the load of unshaven passengers disembarked in front of Atlanta's historic old airline terminal, "deep in the heart of Dixie". Later, the sun's first rays endeavored to peek through the fluffy cotton clouds of the Georgia spring morning. They bounced upon the hail pocked skin of a venerable Douglas DC-3, its white and blue paint scheme identifying it as a member of the Southern Airways (not Airlines) fleet. Quietly wakened from its overnight slumber on the tarmac, the ancient pelican's three-pointed stance seemed to portray its eagerness to leap into the air and begin yet another day. The pre-flight experiences of San Antonio suddenly became just another hazy and receding memory to me. Just a few hours more of traveling and I'd finally be experiencing the sights and sounds of an actual flying U. S. Air Force airbase.

Two stops later, we arrived at the small municipal airport serving Moultrie, surrounded by cotton plantations, peanut fields and pine trees. On the other side of town, Hawthorne Aeronautics operated a flight school with one Beverly "Bevo" Howard, famous old time airshow pilot, in charge. Bevo's airshow mount of choice was the agile little Bucker Jungmeister. Kept tucked away in the corner of a hangar, this red and white biplane had once been the proud possession of the legendary Alex Papana. These nine civilian schools were widely scattered across the southern states of the U.S. Spence was approximately 50 miles west of the great Okefenoke swamp; the airfield was surrounded by peanut fields laboriously cleared randomly from among the hovering pine forests. These odd-shaped fields permitted our instructors ample choices from which to evaluate our practice forced landing techniques, every day!

In the early spring of 1954 our cadet class found ourselves deposited in the middle of this beehive of yellow Supercubs (used for screening) and snarling T-6's. Everywhere we turned we found continuous reassurance that we were "dodos", probably of very little use to anyone, especially to the military. Each and every mistake was ample reason to be assigned time to be spent "walking the tour path" the following weekend, those hours affording us ample time to ponder the error of our ways.

The forced landing procedure drilled into us from the first day on at that school has remained just one level down in my subconscious all these years, and that's probably exactly where the military authorities intended it to dwell. In modern parlance, it became a part of my CD-ROM, impossible to be erased. In turn, I've taught it to all my single engine students, hoping that they'll stash it some place where it's instantly retrievable, should they ever need it while falling out of the air in some fighter.

Possibly other mnemonics (if that's the word) would have worked as well but this is the way it was. GLIDE-GAS, GEAR-FLAPS, MIXTURE-PROP, IGNITION-HEAT, CANOPY-HARNESS. Let's break them down according to how they were taught to us. Then, at the end, I'd like to discuss a possible addition we should consider.

GLIDE – GAS: This is the first thing to establish. I've recently read letters in Aviation Safety discussing whether or not you should initially begin a climb if you have a lot of speed in an effort to immediately establish your best glide speed. I guess you can do whatever you feel is going to work for you at the time if your engine quits, this isn't going to be an exact scientific aerodynamic analysis. This is slanted more towards the practical, on the order of what Jim Orton always preached "fly it to the ground, don't fall it to the ground!" We know that you must get this in hand right away or else everything else goes for naught. Next, the gas selector. Thinking of the T-6, who hasn't been embarrassed by running a tank dry on one side? Along with that goes the boost pump, if the engine driven one fails, then get this on. Obviously, the T-6 didn't have one but, if you have an electrical one, get it on without delay.

GEAR – FLAPS: Maybe the engine quit with your gear down. If the engine's turning you still have hydraulic pressure so retract it, if the situation demands. On the other hand, if you're low and have already pretty much figured out someplace suitable where you can land, you might leave/put it down. The important thing is to decide what to do with it and make sure that it's already where you want it, or moving towards that position. If you've been caught with your flaps down, you'll need to retract them also. But if you're going to land and have established a glide based on them, then you'll obviously need to leave them out. Nothing in this paragraph, as you can see, is cast in concrete. These two items are included in an effort to make sure that you give them some thought.

MIXTURE – PROP: I can remember that we were taught to run through a quick checklist at 3000 feet while descending before we got involved in the traffic pattern. This included moving the mixture to the rich position and the canopy wide open for landing, just in case you ended up on your back during the rollout. I only mention the canopy item to find an excuse to describe why I spent eight hours walking the tour path the next Saturday. I did open the canopy at 3000 feet but later encountered a rain shower when nearing the field. I reached back and re-closed it halfway in an effort to keep the rain out of the cockpit. Upon rollout the mobile controller said, "Blacksheep forty eight - report to the control shack after you park". Amazing how eight hours walking the tour path in Georgia's summer heat and humidity will focus your attention and strengthen your resolve to never again do something dumb, at least not that! I digress, the thing here is to enrich the T-6's mixture when descending because otherwise, it might quit! It's included here to see if it might help. Second comes the prop's position. Doesn't mean to shove it up, doesn't mean to pull it back and it doesn't mean to leave it alone. It means think about it and place it where your brain says it will do you whatever you need done. If you need maximum glide, then pull it way back. If you need to bleed off altitude, shove it up. Or maybe the situation says leave it where it is. All situations are different and it's up to you to make this checklist work for you as the items scroll by on your memory screen or monitor.

IGNITION – HEAT: Quite honestly these two items were not on the memory aid used in T-6 training. Over the years I've always recited the other items but at some point I added these two because I found them to be really necessary. To tell the truth, the first item was something that I added when a FAA Airworthiness Directive was published on my Stearman's ignition switch. It also represents an event where we could cite name and circumstances of the event. This involved a guy I had checked out in the FG-1D Corsair who encountered an engine problem and this specific magneto switch problem occurred. If the engine quits and you get to this point you need to realize that just because the thing won't run on BOTH doesn't mean it won't run on maybe LEFT or RIGHT. Maybe it's a bad switch or maybe it's a bad mag but try both LEFT and RIGHT switch positions, it just might work. Next is carburetor ice, get the carb heat on. To tell you the truth I sometimes think this should have been included several steps earlier in the chain so that the carb heat is applied while it's still available. If I hadn't gotten this far along in life and had it so consigned to memory, I probably would have memorized and taught it differently. The Corsair pilot I mentioned above says he definitely would get to it earlier. This would provide a source of heat while it was still readily available. If you're just starting or considering using this, you might wish to do so.

CANOPY – HARNESS: These last two are "O.K., I give up" items. They recognize the fact that very likely the engine's not going to start running again and you need to prepare for a forced landing! Probably you're going to be somewhat in shock, not believing that this could actually be happening to you, and these two items should run across your memory screen to maximize your chances during the inevitable. In the T-6/SNJ/Harvard, with your right hand, reach across and move the canopy all the way to the rear and lock it so it will stay open under the "G" load that's very likely to come.

I say with your right hand because, if you try it with your left, you'll get all bollixed up due to the arm's physical characteristics and most likely you won't be able to get it all the way open and locked in this time critical situation. Next, with your right hand, pull both shoulder harness straps tight because shortly you're about to investigate, up close and personal, how near your face is going to come to fitting in among all the flight instrument knobs and protrusions.

Now for one last thing, based on later equipment and knowledge. Last week I spent some time talking to John Ellis. He feels, in what he fully acknowledges as Monday morning quarterbacking, that this last ditch item might possibly have enabled an on-airport forced landing in a recent F8F incident. If you're ever caught in a situation where the engine stoppage might possibly be caused by carburetor malfunction, actuating the electric primer might provide some minimal power. I've advocated this for many years in a variety of aircraft in the event of carburetor malfunction in an attempt to obtain enough minimum power to make feathering unnecessary. In fact, we had a position placarded "CONTINUOUS PRIME" on the Convair 340/440 aircraft that would provide about 2000 RPM in this exact circumstance. This certainly is as valid in single engine aircraft (well, let's face it, really much more so!) as in multi-engine. Obviously we only had a hand primer on the T-6 but almost everything later used electricity and it really needs to be part of your thought process. In fact, I believe the USN T-28 NATOPS manual does make reference to this.

Again, none of these items are meant to tell you what to do, they should run across a visual memory screen in your brain to tell you what to think about accomplishing during an extremely stressful time.

#17 NO FLAP LANDINGS

I've just recently read a very informative book on flying written by a highly experienced instructor in both piston and jet aircraft. However, in reading it I was amazed at one particular recommendation. This was that if you are faced with a no flap landing that you *"should fly a flatter than normal approach and also raise the seat in order to provide a better view"*. I was really impressed with the entire book, up until this point! These two points above represent, in my mind, a recipe for disaster!

I remembered reading this recommendation somewhere in the dim and distant past in a DC-9 handbook. I always wondered where in the world this particular bit of bad advice came from and always included it in my briefings or instructions for a no-flap landing. Let's discuss why I believe this to be so and some of the possibilities.

If you are ever faced with a no-flap landing you are going to be (at least) a little bit more concerned and alert than during a routine landing. Actually, if you are in a machine considered to be (by today's standards) of moderate speed then you probably aren't too bad off. I routinely give a no-flap landing at the finish of a B-25 type rating checkride on a runway just about 4000' long, as much to give the applicant confidence in his own ability as for me to see his performance of the maneuver. With decent airspeed control he won't have any trouble at all. I don't think it makes good sense to hand-crank the flaps down on a B-25 to avoid a no-flap landing if you consider the potential difficulties should you need to retract them during a go-around. The B-17 presents a similar situation; both of these aircraft need only about 10 MPH added to the normal threshold speed and require only a moderately increased requirement in runway length. Obviously on the bigger jets we have a different story but they aren't part of this discussion, we don't need to mix apples and oranges in this warbird article.

Every pilot has his own idea of an acceptable height above the threshold on a landing approach. A duster pilot probably would be comfortable with 10' (or less), another pilot would routinely want to see 35' or 50' or whatever and in the 747 we needed more. The important thing is to have a standard with which you're comfortable; the sight of anything else will cause your personal alarm system to activate. Now, for the purposes of this article, let's say you need 25'. If you fly a normal (just like an ILS) $2^1/_2{}^O$ to 3^O glidepath that crosses the end of the runway at 25' you'll probably touch down at 500'-700' down the runway using pretty normal piloting techniques. O. K., let's do the same thing all over again but this time purposely flatten the approach or "drag it in" as advocated by some, including the author mentioned at the beginning of this article. If you fly the approach this way you'll notice right away that your rate of descent is noticeably (a lot) less. After you cross the end of the runway at 25' you'll find that the continued flat angle of descent carries you much further down the runway prior to touchdown than in the first example. If you increase your descent rate after you're over the runway, or cut the power, you're purposely destabilizing the approach and setting yourself up for a hard landing or a porpoise or whatever. And all for no good reason!

Now we can get around to talking about the second of the book's recommendations, that of readjusting the seat higher to give you a better view of the runway. If you've already got an emergency of some magnitude going, why in the world would you choose to deliberately compound it by adding another element of unfamiliarity to that already existing? I'm referring to the fact that the no-flap situation already is occupying your attention. Your judgment, day to day, has been developed with your seat in the position you've considered normal for hundreds or thousands of hours, whatever. Your sight picture has been developed using that seat position. And now you say you're going to alter this sole remaining element of comfort and stability and recognition and familiarity? Come-mon! It's old advice but it still seems to make good sense to dance with the one who brought you.

Maybe things to include:

Now, consider something radically different, the Grumman F6F Hellcat, for instance. Normally this aircraft provides adequate (everything's relative!) vision for the final approach with the flaps down. With no flaps it becomes a radically different animal with the nose much higher and forward vision totally unavailable when lined up with the runway.

#18 CONTROLLED QUANTITY ENGINE START

A description of this starting procedure is included in the military pilot's manuals for many aircraft. It also can be found in a plethora of airline operating manuals of the period. I should mention at the outset that I certainly wasn't the one who decided upon this way of starting these round engines, it goes back much farther than my first experience with these machines. It was included in the USAF 51-42 "Aircraft Engineering for Pilots" manual in an effort to standardize starting techniques. While an occasional backfire, in earlier days, may have been considered somewhat humorous and a cause for rolling of the eyes among those nearby when a garden variety round engine was being started it was definitely not funny on the R-4360 "corncobs". I'll guarantee you it instantly called down the wrath of the maintenance officer and line chief upon the unfortunate one at the flight engineer's panel when it occurred. Since that time every occasion that I've watched, or more correctly, heard a backfire during starting I am instantly reminded of one of our pilots on the old piston Convair 340/440s. This captain was an outstanding example of the salesman's art, possessing – in spades – all the warmth and "bon-homme" fellowship endemic to that breed. However, known among the copilots as "tickle-tickle, boom-boom", he had never really quite mastered the primer starting technique contained in the title of this piece. And, in truth, I didn't attach a name to it even though it was in common usage by that time, in the early sixties. One caveat, this discussion pertains to carbureted engines only, fuel injected engines would have to be a subject for another article. A few years ago an expanded checklist was needed when we started flying the newly restored, locally based B-25 "Miss Mitchell". In that expansion we wrote a fairly lengthy and detailed section discussing the whys and wherefores of the USAF starting procedure. The following (in italics) is a direct quote from that section.

At this point we need to stop and briefly discuss how this prescribed start differs from the one commonly used prior to and during the WW ll era. As aircraft radial engines developed from a single to two and then four rows of cylinders the resultant growth in complexity of the intake/exhaust systems made them much more vulnerable to backfires and other symptoms of improper starting procedures. The need for a standardized procedure that could be successfully used on all USAF round engines resulted in the development of what was referred to as a "controlled quantity" start in the training manuals of the period. It basically involves all starts beginning from a known mixture condition of no fuel and then progressively enriching the stoichiometric fuel/air ratio with the primer until combustion occurs. In this way you should always know where you are, mixture-wise, eliminating the sometimes rich and sometimes lean (searching for a combustible mixture) random movements of throttle, primer and mixture with the associated backfires and problems. This procedure was subsequently adopted by other operators along with the airline industry and continues in use today.

The following description of a normal start includes the procedures to be utilized after all pre-start procedures have been completed in the BEFORE START checklist.

- *During start, the pilot's right hand is used solely for the primer, energize and engage switches.*
- *The left hand is used for the throttle, then the magneto switch, then back to the throttle to control the starting RPM and then for the mixture (or as otherwise needed), i.e., a "free safety".*
- *Actuate the energize switch for a few seconds (actually, just enough time to note that the fuel pressure drops off and then recovers from electrical load), then the mesh switch also, noting free rotation of propeller indicating absence of hydraulic lock.*
- *After minimum of six blades, turn the magneto switch to BOTH.*
- *Actuate primer switch and hold (a warm engine may need only intermittent prime).*
- *When engine begins firing, transfer attention to tachometer and control RPM with throttle.*
- *Release energize and mesh switches, continue actuating primer.*
- *Stabilize the RPM at 800-1000 while running on the primer, primer switch may have to be intermittently toggled depending upon OAT / engine temperature / primer flow rate. The primer technique can only be developed through experience.*
- *After RPM stabilizes, advance mixture to RICH, then release primer switch after the RPM starts to sag from an over-rich mixture.*

- *After the first engine has been started, check four things: Oil pressure, hydraulic pressure, suction and then fuel pressure after turning OFF the boost pump (when terminating shut this engine down first so that the other engine's vacuum and hydraulic pumps can be checked).*
- *Repeat the above items and start the remaining engine.*
- *After starting the second engine there are only two things to check: Oil pressure, then fuel pressure after turning OFF the boost pump.*

So, that's what we've included in the training of all new B-25 pilots. Using this procedure eliminates the snarfing and cracking which all too many people assume is characteristic of any B-25 start.

In talking with a lot of crews I've noticed one commonly encountered mis-perception that a backfire can occur from either a too lean or too rich mixture. This should be laid to rest for all time! A backfire occurs only from a too lean mixture. If it's too rich you might get some afterfire and the engine may tend to die but not a backfire. The most common cause of backfire is excessive throttle, a setting beyond that which would provide approximately 800-1000 RPM. The “before start” part of Miss Mitchell's checklist calls for the throttles to be set at an approximation of this position.

With very low O.A.T.s you can pull the throttle back a little bit so as to provide less airflow. This has the effect of creating a slightly richer mixture for these conditions. With exceptionally cold O.A.T.s we used to try everything out on the line to enrichen the mixture on those North Central DC-3s, including dumping in alcohol from the auxiliary carburetor de-icing system. Anything to get something that would ignite. But, looking back, this was really a situation where the engine shouldn't have been started; it should have been pre-heated more before ever attempting a start. Just one more example of the abuse those poor old 1820 Wrights absorbed and one that I don't believe would ever be duplicated with our present day pampered warbirds.

I've been advised of one technique being advocated in which the throttle is opened to a setting that would provide enough air to properly consume the amount of fuel from a continuously actuated primer. The problem here is that the throttle very likely will be advanced far enough to cause a backfire on a significant number of occasions. Also, it very likely may be up in the RPM range where the carburetor functions through the main metering circuit rather than through the idle mixture circuit, leading to a rapid acceleration and a bunch of RPMs immediately after start. This, of course, results in an instantaneous lack of adequate lubrication to the moving parts along with other bad things.

Now, let's discuss some anomalies, at least those that I'm aware of. I'm sure that there are engines that lie outside of my experience in starting. The procedures in this article are derived from USAF and airline manuals written back when the big radials were king and that needs to be kept in mind here!

First off, single row radials like the 1820. I've always gotten great starts on the B-17 or the Wright DC-3 with just priming normally and then, when the engine fires, moving the mixture to RICH and getting off the primer slightly later. Keep your finger near the primer switch. Sometimes it'll want to die, if it does just give it a brief shot of prime each time the RPM starts to fall to keep it running for those first few seconds.

Next in my experience is the 1830 on the PBY where the thing has an antique type primer system with spider lines to the top cylinders only instead of the more modern type where the system discharges directly into the supercharger diffuser. This thing, in my mind, is a fire trap and should have been replaced l-o-n-g ago. But, some are still around and, in this case, the fuel distribution pattern just can't support a normal start RPM of 800-1000. In this case we've had better luck in using the mixture start in which the mixture is moved to RICH while cranking just long enough to note some fuel discharge from the blower drain, then placed back to IDLE CUT-OFF. Avoid a throttle position more than that which would correspond to 800-1000 RPM. After the engine fires, return the mixture to RICH (as a side note here, we've had a problem with achieving a full IDLE CUT-OFF on one of the PBY's engines. In this special case we had to wait until we wanted fuel before turning ON the fuel boost pump because of the internal carburetor leak).

#19 PRIMER SYSTEMS

Delving into the systems on a recently acquired PBY "Catalina" caused us to uncover a few things. These discoveries engendered some comments such as, "I didn't know that" and "Wow, that's really an old system"! I'll run one of them by you below and you can see how the particular aircraft you happen to be flying might fit into this picture.

(Draft copy)

You really need to know before you initiate the start just what kind of primer system you're dealing with. And it's probably going to depend (but not necessarily) upon how old the airplane is! The systems that I've encountered are of three types; (1) manual, (2) electrical ("spider") and (3) electrical ("throat"). I'll describe some things about each of these types below.

One concern of mine is the silver-soldered connections, as well as the nipples and hardware on some primer lines. As far as I'm concerned the "spider" systems on larger round engines (see below) should be banished, banned, run out of town, AD'd out of existence and done away with, period! Do you get the feeling here that I don't like them? You'd be absolutely right in that assumption! I think they're a fire hazard of the worst kind, this is from personal experience!

While learning to fly in the Aeronca 7AC "Champ", my first primers were the manual "pull-out and push-in" Lunkenheimers/Kohlers. My N-2S Stearman also has one of this type, but it's mounted externally near the inertia starter handcrank. I've also used it on the T-6 and the P-47 Thunderbolt. The BT-13 had one and the pilot's manuals for the B-17s show them also. Seemed to me that invariably they'd leak around the packing gland and spray some small amount of av-gas into the cockpit! Due to the limited capacity of the manual plungers, the output was delivered only to several upper cylinders on the engine via what I've always referred to as the "spider" system of small stainless steel tubes. On the systems of this type but with electrical power, they still delivered their fuel only to the top cylinders. Obviously, while this made it impossible to run the engine on that system, it represented a vast improvement over the miniature funnel and/or oil-can systems that the early aviators utilized!

I always kept one "shot" in the manual primer when starting. By this I mean that, after I'd finished with my priming, I pulled the plunger fully out once more and left it that way during the start in order to have a "shot" of fuel available for the almost invariable cough or hesitation as the engine is first started. Sometimes I'd need to (hastily) recharge the primer and repeat the priming process when the engine wanted to die after the first few seconds of running. Obviously, the problem "lurking in the weeds" here is that you may forget to push the primer in and lock it after completely started. If left out or unlocked the engine will burp and snarf and, in general, run rough. And ease it in when you push the plunger in to lock it; don't just abruptly shove it totally in, thereby momentarily flooding the engine!

Now, regarding the later electrical priming system. With this system, a spring-loaded (momentary) switch in the cockpit opens and closes a solenoid operated valve to control the flow of pressurized fuel through the priming system. That fuel then is sent to the engine via either the "spider" system or the "throat" system, whichever is installed on that particular airplane.

The installation that I've always referred to as the "throat" system furnishes fuel to all the engine's cylinders. Actuating the primer switch enables the fuel (assuming you have the boost pump switch ON) to be delivered through two or three adapters on the carburetor throat to the impeller where it is atomized and sent to all the cylinders through the normal induction system. I've always tested this system just before starting to ascertain that it working. The method I use for this is to simply "flick" the primer switch and while noting a corresponding fuel pressure flicker (assuming again that you have the boost pump switch ON). Of course, it should be noted here that this only guarantees you that the primer is functioning at that time and it's possible that it might not during the start.

Our airline's Convair 340s/440s all had the "continuous prime" selector switch installed on them. I've also seen this on the DC-6s that I flew. Most likely, other airplanes may also have had them, but this is outside the range of my experience as I write this. This selector was to be utilized if it ever became necessary to operate almost totally on the fuel furnished by the primer system if the carburetor malfunctioned or became affected by "bleed icing". I'm aware of at least one time that this system "saved the crew's bacon" when they encountered a severe case of bleed icing near the Duluth airport on a scheduled flight. With this system the primer delivered a fixed quantity of fuel, the throttle needed to be adjusted so that the engine would keep running. In general, it would support approximately 2000 or so RPM.

Even if the airplane does not have the "continuous prime" system installed, many times you can obtain a usable amount of RPM from it (in the event of carburetor failure) by asking the co-pilot to actuate and hold the primer switch continuously (if it is of the electrical type). One particular B-25 that I've experimented with will support about 1400 RPM on the fuel furnished by the primer alone, a considerably better situation than feathering, plus allowing the hydraulic pump, vacuum pump and generator to continue operating. Otherwise all of these would be lost when that engine was feathered.

Several years ago I was administering a type rating on the PBY Catalina out in California. The applicant correctly performed all the procedures required to start the left engine, things were going well. However, as soon as it fired, it backfired, even though I could see that he was not using an excess of throttle, thus not an excess of air from that! He tried it again with the same result. At this point I intervened and tried a start myself. Same deal! After xxxxxx

I purposely haven't included the "how to" use of the primer for engine starting in this article. For a detailed discussion concerning that, you'll find the subject completely covered in Warbird Notes #18 (CONTROLLED QUANTITY ENGINE START), also some mention is made in #12 (ROUND ENGINE BACKFIRES). If the primer system is inoperative, then looks like you're going to be faced with doing a "mixture start" or something, and again, that's outside the discussion in this article.

Things yet to write:

- C-46, number of adapters and technique, results.

#20 FOAMED RUNWAY FOR BELLY LANDING?

"Shot your wad, huh?" Yeah, I know, a barnyard expression, but probably the exact feeling you're gonna have if the foam you desperately need from the fire/crash truck is uselessly sprayed over several thousand feet of runway, and all of it **behind** where the airplane finally came to rest after landing on its belly. And now there's none left in the crash truck's tank to smother that little-bitty fuel fire that just ignited under the fuselage! Yeah, that fire that's now going to destroy one perfectly good (albeit with its belly and flaps slightly bent from the landing) airplane! Couldn't happen, you say? Oh boy, been there and done that! Let's discuss it a little bit here, OK?

(Draft copy)

If you ask a hundred experts, I'd bet that the preponderance of them will allow as to how any idiot knows that "we always foamed the runway for a belly landing!" And, like many other WW II or postwar "old wives tales", that certainly was the conventional wisdom back then. For sure! Well, let me take you out beside the runway with a hand held communication radio, as I've had to do a few times. Let's watch a belly or crippled landing, might be educational or edifying, you never know.

Anyone ever try to flare out and land an airplane that has its landing gear retracted. Nope, I haven't either! But, I've sure talked to a bunch of pilots that have that dubious distinction in their resume and their descriptions of the experience all share something in common. The lack of drag! With the gear up it's obvious that the drag is going to be less, just how much is anyone's guess but it's been described to me as very noticeable.

Let me share some observations of a landing I can recall with vivid clarity. This involved monitoring and talking to (with a hand held transceiver), from the side of the concrete runway, a Convair 580 with Allison turbo-prop engines. The 580 has steel propeller blades so it was considered best to E (emergency) – handle the left engine several miles out on final. This simultaneously shut down the engine and feathered that propeller. From that point on it was a simple single engine landing. Then we'd have the co-pilot (upon the captain's command) pull the E-handle for the right engine as they commenced the landing flareout. As the big four bladed Aero-Products propeller "X"ed it provided what amounted to two steel sled runners on each side of the airplane for the airplane to rest upon during its skid to a stop along the runway.

What we need to stress here is the altering of the drag characteristics of the aircraft with feathered propellers, it is considerably less than the drag that propeller "disking" creates during a normal landing. The pilot told me that it almost seemed to him as if he had added power to the engine when the E-handle was pulled. So, keep this effect in mind if you're ever faced with this! Also, added to this is a tendency on the part of the pilot to hold it off just a tad longer than normal in order to touchdown as lightly as possible in this stressful situation. All of these things will very likely conspire to ensure an unintended result; it's very likely that the aircraft will float much further than normal down the runway prior to touchdown. If you or someone has informed the crash crew how far from the runway's threshold the aircraft will touch down, it's very likely that this estimate may be substantially in error for those reasons. If the crash crew opts to use your estimate, very likely the aircraft will partially or completely overfly the foam strip prior to touching down. And, the aircraft will get only one chance, if the estimate proves wrong and the foam application on the runway is overflown, tough!

Yet to write:

Let's discuss another problem, duration of the foam as a layer. Estimates vary, but most would agree that the foam has a lifetime of x. So, this means that you can't dawdle once the foam is spread out on the runway, if you decide to have them apply it. The chemical breakdown and decomposition begins almost immediately.

Alleged spark suppressant. I hear all about the fact that people **know** it reduces the temperature of the grinding metal. In actuality, I honestly don't think it really does. The metal has to support a certain amount of weight, and this is the same if the surface of the runway is wet or dry. The only thing that I can see it **possibly** doing is to retard or smother any sparks being thrown up. However, in reviewing a good number of films taken of these incidents, I see what appears to be a "shower of sparks" thrown far behind the airplane as a "rooster tail", not into it. Also, many of the pilots I've talked to mentioned another result or observation. This is the strong tendency of the airplane to slide far out of the foam strip that was laid for it, ending up far beyond it. They also mention that no difference was apparent to them in the sparks thrown behind it during the slide.

Slipperiness:

Also, another down-side for you to consider in evaluating the situation and whether you really want to use the foamed runway. If you do and are landing with only one gear retracted, therefore needing either or both the brakes and nosewheel steering during rollout, beware! You may just have guaran-dang-teed yourself that you won't have the use of these directional controls after touchdown. If any tire's in the foam strip, wouldn't you expect it to act just as it would if it were on glare ice? Braking or nosewheel steering? I think you can pretty well forget that!

I don't wanna be discussing effort of turning single engine prop with starter and glide maybe deal.

Pervasive foreign OWTs.

#21 FUEL BOOSTER PUMPS – USE AND MISUSE

The idea of writing this occurred to me some time ago when I noticed a pilot (whom I generally had a good amount of respect for as an aviator) exhibit a completely "strange" idea of the fuel booster pump's function. The checklist on the Douglas B(A)-26 we were flying calls for these pumps to be placed in HIGH on the downwind leg of the traffic pattern, just prior to lowering the landing gear. When I read the item, he placed them in the LOW position and left them there. I made a mental note of this, determining in my mind that this was another item I wanted to ask about on the ground, so as to not divert his attention during the checkride.

(Draft copy)

Later, after shutdown, I asked if he might share with me why he wanted them in LOW. His answer was that he thought the engines had been running richer than normal and he didn't want to "flood" them in the air. Which, of course, left me with a puzzled look (to say the least) on my face!

Let's briefly take a quick look at how the fuel system and pressure-injected carburetor works on these reciprocating engined airplanes in an effort to remove this old wives' tale before it does any more damage!

Fuel boost pumps have three purposes for being included in the fuel system: (1) provide pressure for starting, (2) condition the fuel and, (3) substitute for the engine driven pump if it fails. These pumps are generally located.

Another use that we probably should touch on here is the use of the pump in the low speed position to "condition" the fuel at those higher cruise altitudes where you might see a fuel pressure fluctuation. This fluctuation very likely is the result of fuel vapors/bubbles as altitude begins to affect the fuel in the aircraft's tanks.

And, in conclusion, let's not forget the seemingly elementary, but often forgotten, flight manual requirement that they first be placed in NORMAL, **then** in EMERGENCY. There's probably some amount of dissension among the troops about this. I can still remember the first time I encountered it, about 1955 or so. Along about that time, the USAF's B-25 fleet was being converted by Hayes Aircraft of Birmingham to the Bendix-Stromberg pressure injected carburetor. This carburetor required a much higher fuel pressure, on the order of xx PSI, to operate properly. The older Holley carb only needed around 6 to 8 psi, and accordingly, had a simple two-position OFF-ON fuel booster pump switch. In order to avoid a creating a sudden "surge" of high fuel pressure to the Bendix-Stromberg carburetor's diaphragms, a new fuel booster pump switch was part of this conversion. The new procedure called for this three-position switch to first be positioned to NORMAL and the fuel pressure stabilized, **then** the switch could be moved to EMERGENCY for starting. What's that? Well sure, I can hear your question already, so before going any further, let's talk about it! Yes, the diaphragms can "take it" as concerns the fuel pressure, but the concern here (on some people's part) is the "surge" of fuel pressure. As I said before, competent people, with an intimate knowledge of this carburetor's inner workings, may disagree on the need for this procedure. Some will insist that there is no need to worry about the "surge" hurting the diaphragms. I just do it, that's the way we were taught, it's in the B-25 flight manual, and it's the way we subsequently trained thousands of cadets in this procedure. This habit pattern became so thoroughly ingrained in pilots that they are likely to habitually do this - even with the engine already running. There's no reason to do this, it's either from habit or a misunderstanding, but only necessary when you're beginning from a zero fuel pressure condition.

Yet to write:

- holleys will flood, red bordered b-25 dash 1 page.
- will one run on LOW?
- why LOW, then?

#22 BELLY LANDING VS ONE GEAR RETRACTED?

This old bug-a-boo/old wives' tale/belief (call it whatever you wish) came up as an item of discussion the other day on the AVSIG (Aviation Safety Information Group) computer forum.

(Draft copy)

#23 BELLY LANDING – SOD OR PAVEMENT?

This is another of those old wives' tales that surface – inevitably – every so often and, to my mind, are capable of a vast amount of personal injury and property damage if these aforementioned OWT's are blindly adhered to without thought! This procedure was also a subject of a discussion within the recent past on the AVSIG (Aviation Safety Information Group) computer forum. I was just happily going along, reading comments on a rather un-related subject when this belief surfaced during the discussion.

(Draft copy)

Not very long ago I had occasion to observe the results of a Mustang's landing with a gear problem at Oshkosh. Later that evening I was seated on a park bench at a large gathering of warbird pilots. Seated next to me were two "old timers" and I couldn't help but overhear their discussion of that afternoon's event. I don't know whether they had personally observed the event, but they certainly had strongly held (and voiced) opinions on it!

Recent occurrence - death wish not.

Piper's experience with this.

From durden

As part of the full scale g.a. crash tests NASA did in the '70s impacts were made on concrete and on relatively soft soil. With any kind of a descent angle/vector, the damage to the aircraft and projected injury to the occupants was far worse on soft soil than on more resistant surfaces. Concrete would not "give" when the vertical velocity was significant, and simply translated the impact to cause the airplane to slide...in some of the impacts the airplane damage was minor enough it could be rebuilt and crashed again. The same impact on soft soil resulted in the soil "giving" slightly, to form a crater, and then stopping the aircraft very fast, either within the crater or causing the airplane to flip over.

Unless I knew the sand was firm enough to land on (as they used to do at Daytona Beach), I think I'd put it in the water. My airplane is adequately insured, so I'll take the water just offshore and a high chance of survival versus the sand.

One of the nasty little things that has been learned from accident investigation is that pilots dealing with a forced landing have a very disturbing tendency to stall the airplane at about 5-10 feet above the ground, thus developing a heck of a sink rate, with the airplane out of control. The saying of "fly it all the way into the crash" is only too true. It's also another argument for selecting a surface that is not soft sand or dirt.

Pile up of dirt.

Possibility of "dropping" and making a depression in the dirt's surface.

Killed dick and ca skiles – 75,000 hours in cockpit.

#24 THOUGHTS ON LANDING THE "GOONEYBIRD"

When I think about landing the DC-3 I'm pretty happy with seeing a guy at about 80 knots over the fence, cutting his power just before the round out. This is the way we did it at North Central, best I recall about 18 landings a day. Maybe I got down to around 70 knots once on the approach to the ultra-short (at the time) 11L. But Pete Wahl, in the left seat, said something and corrected me! 75 knots would probably be much more reasonable. Bill Wall's friend mentioned something about "driving it on" as he does the T-6. I honestly am at a loss here as to just what he meant by that comment.

I <u>think</u> that we'd all agree that one thing that none of us likes to see is the DC-3 "three pointed". If they want to try that I'd just as soon not be anywhere around; I'd rather be somewhere else, like a thousand miles away! We had guys on the airline that thought, repeat <u>thought,</u> that they were good enough to accomplish this consistently. The problem with that was, we had more than thirty DC-3's, and every one of them flew just a little bit differently from any other! From the vantage point of one who was riding along with some of these "aviators", it worked fine, in about nine out of ten cases. However, during that tenth case it bit them in the rear end, hard! I've sat through some amazing leaps and swerves during some of these "arrivals". As I said, the majority of the times the guy was able to successfully make it work. But, once in awhile, the pilot (never-mind who) might have been in a bit of a "crab" or misalignment with the hard-surfaced runway when he touched down three-point. From watching it, it appears to me that directional control is severely reduced in this touchdown attitude. In other words, if you were pointed off to one side or the other of the runway at touchdown, then that was exactly where you were going to go, regardless of all your good intentions! In the expressive words of an old crop-duster friend of mine down in Texas, "Hold'er Newt, she's a-headed for the buckwheat!" Actually, at that particular moment in history, he was watching the arrival of an ill-fated Staggerwing Beech. And his unheard advice from the ramp didn't do a bit of good to aid the hapless pilot when the inevitable runway departure occurred! In my experience, this is exactly the situation you'll place yourself in if you attempt to three-point the venerable old "Douglas racer". You'll use all the rudder and aileron that both God and Donald Douglas made available, along with whatever amount of power that Pratt & Whitney or Wright can muster on short notice, while you attempt to control the swerve! And remember that those Pratts are a little bit slower to accelerate than the Wright's. I'd still bet that we'll hear a squalling of the brakes and tires to keep it on the runway!

Now, something good! Unlike the B-17 (which, by the way, CAN be comfortably, consistently and easily three-pointed) this airplane lends itself well to the pilot "pinning" it when the inevitable slight bounce occurs! You don't need to exaggerate the "pinning" motion by raising the tail to a ridiculous stance. Just move the control yoke smoothly forward slightly (it doesn't take a lot) to regain your footing and continue a normal landing.

The easiest and most consistent landings that I've experienced in the DC-3 were those with a power off, "tail low" touchdown. A knowledgeable bystander, watching from the tarmac, can always detect an amateur or inexperienced DC-3 pilot in two ways. First, the carrying of even a small amount of power through touchdown and obvious "chopping" of the throttles immediately <u>after</u> the "chirp" of the tires. Second, the exaggerated tail high posture of the airplane being forced onto the runway for landing. These two things will always betray the pilot's inner hidden anxieties and lack of mastery of the machine. Now, to be perfectly honest, this technique works OK – well, that is, as long as the owner doesn't mind absorbing the increased brake and tire wear! And as long as you, the pilot, don't have a problem contending with the knowledgeable observer's smirk.

Also, we need to mention what might be considered an advanced technique, but one that we commonly used when operating into a short runway or attempting to make a certain taxiway. This required a feel for the airplane and a degree of currency (eighteen landings made a day's work for us in the airplane's local service airline heyday) that none of us are likely to completely re-achieve today. While you're still in a touchdown attitude after landing, smoothly apply braking action with the tail in the air during the rollout. This technique enabled pilots to maintain their braking until very near the turnoff point. Smooth coordination of the rudder and brakes, along with the elevator, is absolutely essential to performing this maneuver. At the completion, smoothly lower the tailwheel to the runway while you still have elevator authority, <u>then</u> unlock the tailwheel and accomplish the turnoff.

#25 ENGINE RUN-UP BEGORE TAKE-OFF

I've lost track of how many times I've heard, "Now, what do we need to do on this engine run-up?" Or, "This checklist is incomplete; it doesn't have a section telling me how to do the run-up!" I agree that checklists are important and necessary in our flying lives, but I also utterly refuse to let them dictate my life or thought processes!

Many checklists include two sections that're almost guaran-dang-teed to drive me bonkers, "starting" and "run-up". If a pilot is absolutely dependent upon reading a checklist in order to start a machine or to accomplish the run-up, then I guess I'd also have to seriously question his ability to fly it! Think about it, do you believe that one needs to (or does) carefully look at each checklist item, in sequence, while he's engaged in starting a B-17? As "proof-of-the-pudding", consider a deliberate omission on the B-17 checklist several years ago. The first year out on tour, a majority of the pilot group felt that the B-17 absolutely needed an "engine starting checklist", how in the world else would we ever start it! So, we included it, but then noticed that no one referred to it in anyway during the starting, it just sort of provided a source of comfort and satisfaction to know that all was right with the world because it was – there!

So the second year, operating with the same pilot group, that section was quietly removed when the checklist was revised. More than halfway through that flying year, someone finally noticed that it wasn't there and, in high dudgeon, wanted to know why not? Of course, the obvious answer was that it had been gone for nigh onto a year by that time and no one had ever missed it or looked for it or needed it. The "gouge"/"cheat sheet"/"procedures" for the airplane is in the B-17 pilot's manual, if one needs to research the starting procedure at the beginning of the year, he only needs to open his manual to that section and it's right there, written in exhaustive detail! But it only takes up valuable space on the cockpit checklist, one that could better be devoted to a larger type or on some subject that we don't do every day. So, this is also a thought on the "run-up" section, why would anyone need a checklist telling him/her what to do on a preflight check of the engines and such?

With this proviso in mind then, let's just describe a generic run-up, an all-purpose one that will serve the purposes of the vintage reciprocating engined fleet that we're trying to write about in the these Warbird Notes. And, before we get started, if you haven't read Warbird Notes #14 (Magneto Check) and Warbird Notes #08 (Field Barometric Power Check) lately, you'll need to read them first, or again, before reading this one.

First of all, a brief commercial here, if you'll permit me! Years ago this wouldn't have even needed to be said, but almost none of the <u>present day</u> air carrier fleet needs to do a run-up! Many's the time I've come clattering merrily along a taxiway in a two or three or four engine jet – and all of a sudden found my way blocked by a <gasp> relic, a piston engine airplane doing a run-up! Now it used to be so that the airport authorities knew that all, repeat all, airplanes required a run-up and testing of their engines before take-off, so they provided large concrete run-up pads at the ends of runways. No more! Now the world had passed us by and if you really want to be looked at with disfavor and re-ignite a discussion of removing these old artifacts from polite society, just block a jet's access to the runway. It's a source of continual amazement to me that no one seems to consider the other guy; we really are not all alone. Seriously, take a quick look behind you and remember that they are probably going to be ready to go when they get there. So, in addition to making sure that our prop blast is not going to blow someone over, we also need to not block the taxiway. More things we need to think about before setting the brakes for our run-up. OK?

OK, airplane straightened out and either the tail wheel locked or the nosewheel not cramped? Area behind's clear of objects? Another thing to think about here is any limit on propeller crosswinds during run-up, sometimes mentioned in the limitations section of the flight manual. Something to consider, just in case you weren't in the habit. Engine temperatures all warm enough to permit the run-up RPM's?

1st, the RPM on all engines can be advanced to whatever's prescribed by the pilot's manual. In general, I've found that 1500 RPM works fine for the B-17's and Wright DC-3's. The Pratt DC-3's and B-25's, etc. seem to work better at 1700 RPM. You do need enough that the generators "cut in" and operate because they'll be checked during this procedure. Just be aware that you probably shouldn't use any more RPM than necessary since the excess just heats the engine(s) up faster, a situation to be avoided if at all possible. And while we're on the subject, don't "dawdle" setting a precise and exact RPM, close enough for government work will be just fine!

2nd, pull the prop controls full back to decrease and let the RPM's decrease a few hundred as engine oil is forced into the dome, moving the blades towards a higher pitch. You don't have to wait to reach the absolute lowest possible RPM this time, just make sure the prop functions correctly as the oil is forced into the dome. Return the prop controls to full increase and let the RPM recover as the blades again move towards low pitch.

3rd, this is a good time to check the carburetor heat. When you pull the prop levers back the first time, pull the carburetor heat levers to full hot on both engines. As soon as the CAT gauge indicates an adequate rise, return the carburetor heat lever to the cold position and check for an associated CAT drop. This is an important step; otherwise the carburetor heat may remain stuck on.

4th, repeat the propeller cycling as necessary to get a good prop response as progressively warmer oil from the engine is introduced into the prop dome. During the last cycle you're going to perform (after you're satisfied with the response), let the prop controls remain in the full decrease RPM position long enough that the prop governors reach their full minimum governing (high pitch) position of approximately 1100-1200 RPM. Note this RPM to ascertain that the propeller governors are performing their job and to determine the minimum governing RPM (this is the same RPM you would expect to see later in flight after unfeathering a propeller). Following this check return the prop controls to full increase and note that the RPM re-achieves the value you first set.

5th, check the feathering circuits. Twist the red feather button a few turns clockwise to assure it's screwed on securely, lest it later come off in your hand when you attempt to pull it out. Next, press the button down and check that it is magnetically held in by the electrical "holding coil". Check that an appropriate load from the electrical feathering pump shows on the generator electrical meters and that the RPM decreases. As soon as a decrease of a couple of hundred RPM is seen, pull the button out to interrupt the feathering cycle. As you pull the feathering button out again, note a corresponding decrease in the electrical load as the feather motor ceases to operate. If the feather button should stick in the FEATHER position or the button comes off in your fingers the electrical holding solenoid can be released by immediately turning all batteries and generators off. Repeat the check on the other engine(s). As soon as that check is complete pull the propeller levers back and note an associated decrease in RPM, then return the props to full increase to assure that the propeller governor has resumed control of the RPM. You don't need to wait for the propeller to recover from the feathering check before you do this; all that is necessary is to see a slight RPM drop to indicate that the propeller controls are functioning.

6th, accomplish the power check (Warbird Notes #08) by advancing the throttle to the MP (field barometric pressure) you noted before start. By the way, a part of this portion of the run-up is to set the throttle friction for the ensuing take-off. The desired friction setting is that which allows throttle movement as desired without changing the friction lock but also tight enough to prevent "creep" if left unguarded. After you set "field barometric pressure" the RPM should be that given in the appropriate airplane manual. If your manual is an early one and does not provide this figure, then you'll have to use one derived from past experience, day-to-day operation, discussions with past owners, etc. In addition to rereading the referenced Warbird Notes #08 I'd also suggest to be suspicious of prop settings from shops that may have improperly indexed the low pitch stops for whatever reasons, even good ones! Now then, back to the run-up. While doing this, note the engine temperatures and pressures for correct indications. You can check two engines at a time if ambient and cylinder head temperatures permit. If desirous of the least possible increase in CHT this check may be accomplished on each engine, one at time, if the nosewheel and the pilot's manual permit it.

7th, check each engine's magnetos (Warbird Notes #14), looking at both the tach and the engine cowling for excessive drop/roughness. Max allowable is as described in the appropriate airplane manual. For trouble shooting purposes, a fast drop is indicative of a fouled plug(s), a slow drop is indicative of retarded timing (fast-fouled, slow-timing), and a zero drop indicates that either the mag switch or "P" lead probably is bad with no grounding taking place. Retard the throttles after the mag check is completed. The engine instruments are an integral and continuous part of the above checks.

There now, you've completed a workmanlike run-up of a garden variety vintage airplane with normal 23E50 (or equal) propellers without reference to a checklist or any stumbling around or inordinate delay, all the while with the engines heating up. I can't imagine making it any shorter and still getting everything checked. If there is, then I'm sure that we'd like to hear about it to include it in this procedure.

#26 GEAR RETRACTION AFTER TAKE-OFF

This subject rears it ugly head now and again on the airshow/fly-in circuit, each time quickly provoking a heated discussion. Loud voices are heard, "I'm right!" No, I am!" "NO WAY, THIS IS THE ONLY RIGHT WAY!" And so it goes. Along with what controls airspeed, pitch or power, it's another one of those aviation arguments that's just never gonna be settled, looks like to me! Do I have some feelings about it? Sure, and we could discuss them here, they might be of some value to someone who is trying to analyze the pros and cons so he can approach it with a better understanding (well, at least he can say he listened to some of the arguments - on both sides).

(Draft copy)

One camp opines, “I don’t retract my gear until I can’t land on the remaining runway.” The other says, “I retract it immediately after take-off and start getting rid of the drag”. Obviously, (well, I think they do, anyway) both sides have a credible point. But still the question remains, “who’s right?” Further discussion probably lends ammunition to both sides; it’s just that the situations and the airplanes may be completely different.

A very experienced pilot, after reading this, related one of his earlier (mis)adventures. He feels (I do also) that the above wording should be changed to “I don’t retract the gear until I can't land on the remaining suitable surface”. In other words, don’t just consider the runway; take into account the overrun and area beyond the runway. You and he and I all know that this is one of those situations that are different each take-off. He recalls taking off from an 8,000’ runway in a Cessna 172, the instructor cut the engine at about 30’. He said that he finally got the thing stopped, using the maximum technique, about 50’ into the overrun. Just for the record here, they both said, “That just can’t be right”, since they still had about 5,000’ of runway remaining when the engine failed! So, they did it again, this time he held it in level flight for a little bit while the flaps were extending with slightly better results. But the fact remains that you aren’t gonna get any warning here, you'll have to play the cards as they were dealt and it‘s probably gonna take a lot more than you figured on to get it stopped.

Several years ago I had the pleasure of checking out a pilot in the Hellcat and the Corsair. I use the word pleasure for several reasons, mostly because he happened to be one of the best “sticks” I’ve been associated with. For his checkout, I’d done all I could standing on the wing of the Hellcat talking to him. I then jumped into the Corsair and followed him out to the runway to observe his flying from a “chase” plane. I watched his initial take-off from a position directly behind him, all control usage was perfect. Liftoff followed shortly and I just about had heart failure at that point, I barely discerned any daylight under his wheels when his gear started to retract! After my heart made it back out of my throat I joined on his wing and we briefly discussed it on a discreet frequency. To make a long story short, he had always flown USN combat airplanes in this fashion, it made perfect sense to do that off a carrier, given the instant altitude and considering the lack of runway ahead. To my USAF eyes, however, it was just the opposite. By the way, the session from then on was absolutely devoid of other problems and I was unable to find even one small item - other than the retraction - to debrief at the conclusion of the flight.

So, what’ve we learned here? First off, I’d say that if you’re operating off a carrier, then you may as well retract the gear immediately - as soon as you can reach the gear lever. Now, let’s briefly discuss a landing gear with a rather complicated retracting system, maybe something like a Mustang with its sequencing valves. Once you start the gear retracting, you really need to let it fully complete the retraction process before you put the handle down again, else you are probably gonna really screw up the sequence with who knows what results. So, if you’re on a runway that offers adequate runway after liftoff to land on, then maybe you'd save a lot of explaining if you’d delay retraction just a bit so that if the engine snarfed and gave up, you’d be in a position to land immediately.

We should mention a characteristic of the P-47. In my experience a good percentage of the Jugs seemed to want to “skip” once after liftoff, just seemed to be the nature of the beast. So I sure wouldn't want to be explaining to the owner or the FAA why I’d started the gear retraction and then inadvertently touched down again, cause all sorts of damage, don’t you know! And, while we’re on this subject, this is another airplane that the pilot’s manual very specifically cautions you to let the gear completely reach whatever position you put the gear handle in before you reverse the handle position.

Well, fine. Now then, how about a gear of a simple design with no sequencing valves, able to have its sequence reversed without any problems? Well, if you think you're able to contend with the multiple demands of a failing or malfunctioning engine, extreme rudder changes and still be capable of remembering to put the gear handle back down, then more power to you! But you really need to think about it now, not then!

We absolutely need to mention here that some airplanes demand that you initiate the gear retraction process immediately after being absolutely sure you're airborne. Among them is the Grumman F8F Bearcat. This airplane has a comparatively low airspeed by which the gear must be completely stowed in the wells, otherwise the hydraulic system simply cannot contend with the pressures required to finish the job. And, (whooooo-wheeeeee!), this Cat accelerates very rapidly.

Now what about a WW II bomber? Well, here we need to obtain SSES (Safe Single Engine Speed) just as soon a possible after liftoff. Most of those things had somewhere in the vicinity of 20 or 30 MPH between liftoff and SSES. For instance, the B-25 lifts off at around 115-120 MPH if you raise the nosewheel about 6 inches or so off the runway. Then it needs 145 MPH for its SSES. So, you need to retract the gear and start drag reduction just as soon as you are absolutely sure you are airborne and not gonna touch the runway again.

Still writing:

- Bam! gear up quick, “must be a hot pilot, huh”? mentality, sorta like low flying always impresses me (the wrong way).
- Hellcat interceptor climb.
- Be careful of dogma / “always” / “nevers”!
- FAA sez?

#27 SCAVENGING BEFORE SHUTDOWN

This has been a subject of discussion for a long time. And, many times, it's been given a sort of "lick and a promise" consideration in the checklist or the operating procedures. In truth, probably not too much documented knowledge has really existed about it. Now, after discussing it at length with Larry New and Linc Dexter during the latest round of B-17 recurrent training, I'm developing second thoughts that we may have been giving it short shrift for all these years.

(Draft copy)

Ever since I can remember, we've generally followed the procedures in the military manuals on this. They generally seemed to have regarded 30 seconds at a prescribed RPM being adequate to achieve the desired oil scavenging results before shutdown i.e., less residual oil remaining in the sump to help enable a "liquid lock" the next time the engine is started. This prescribed RPM varies from as low as 900 on aircraft such as the C-54 to as high as 1500 on the B-25. Personally, I think that 1500 is too much; it'd seem to me that it would rapidly heat up the engines – and for no good reason. Almost universally, all the manuals indicate that the engines must be idled in order to cool them down to a reasonable CHT prior to shutdown. This only seems to make good sense to me. It also appears that the manuals seem to exhibit the same fault as they do in prescribing a proper RPM for the power check i.e., the later the manual, the greater the probability that you'll find a specific RPM recommendation for the scavenging process. I know that some manuals have shown 1500 RPM for scavenging, but again, this to me appears unnecessarily high.

Generally we've landed, shut down two engines on the four-engine equipment as we turned off the runway, then taxied in and then shutdown the last two after scavenging. The engines have been idling during all this taxiing and (if no one is too close behind where we park) we've just run the RPM up some in an effort to return a goodly portion of the engine lubricating oil to the tank. Anecdotal evidence indicates that a substantial amount of oil remains in the sump of the engine if this procedure isn't utilized. Dave Clinton told me that his figures show that about 2½ to 3 gallons remain in the sump of an R-1820, even after utilizing a proper period of scavenging time.

In those aircraft equipped with an oil quantity indicator, the T-28 is one; this gauge shows how much oil the tank contains. In this case, it's possible to watch the gauge and see that oil is still being returned from the engine's sump to the tank after at least a minute of advancing the RPM to a setting where we know that scavenging action is occurring.

We've always figured that if we shut down the applicable engines immediately after turning off the runway that they must've been pretty well scavenged, since they were turning at higher RPM's on final just before landing. Well, maybe and maybe not, it appears that this may be a case where the perception perhaps hasn't been really been too accurate. Probably the "proof-is-in-the-pudding". We haven't generally had a history of hydraulic locks on the airplanes to point at so that's a point in favor of doing it the way we've always done it. On the other hand, maybe we could do a better job of scavenging if we religiously shut down immediately after running the engine up to a RPM that is known to scavenge the oil.

We've been experimenting with the DC-3 as to how long we can twiddle our thumbs while scavenging them for sixty seconds before cutting the mixtures. Seems to be an awfully l-o-n-g time waiting on the second hand on the clock, I'd describe it as "the longest minute in the world!

So from now on we're utilizing the procedure of leaving all four engines on the B-17 running during the taxi-in. After parking, perform any necessary idle mixture checks or any other required items. Then, after making absolutely sure that the prop-blast will not damage or cause any problems behind the aircraft's tail, advance all the RPM's to between 1000-1200 RPM and scavenge for at least 60 seconds. After that period of time, place all the mixtures in the IDLE CUT-OFF position. In other words, complete all the items beforehand that call for any period of idle RPM, then scavenge and shut it off.

Write yet:

- JD sez hot vs cold oil on the C-46.

#28 INERTIA VS DIRECT CRANKING STARTERS

Comments and thoughts I've received about "hydraulic lock" has raised some questions about the "pulling through" by hand vs "bumping" or "turning through" with the aircraft starter. As we all realize by now, strong personalities (given to equally strong statements) exist on both sides of the fence on this perpetual argument. And both Warbird Notes that I'd written on this subject only seemed to add further discussion. They've also provoked the inevitable recitations of procedures used by the various operators. I discussed this in Warbird Notes #09 (Hydraulic Lock – Revisited), which was itself written in response to the loud arguments that Warbird Notes #01 (Hydraulic Lock) had caused! And, as in so many things, their arguments all contain certain elements of truth (both anecdotal and documented) offered as justifications.

(Draft copy)

If we take a look at the way an "inertia" type starter works and then an equal look at the way a "direct" drive does the same job, we'll find that xxxxx.

Yet to write:

A great deal of concern has been expressed over whether "bumping'" the starter causes, or could cause, welding of the electrical contacts within the starter's actuating mechanism.

We also get into the question of how to properly actuate the starter switches to "bump" the propeller through.

The actual (or at least the first) inertia starter was one of the type I have on my Stearman. Insert a crank in a receptacle on the side of the cowling and start cranking to build up the speed of the flywheel. Faster and faster, airplane rocking more and more on the gear, the cranker-person exhausted and ready to drop, after a crescendo of whining noise is reached, remove the crank and pull the T-handle to engage the starter.

#29 COWL FLAPS ON THE GROUND

Not too long ago I watched a pilot attempt to hasten the warm-up by partially closing the cowl flaps. I'd first heard of this technique more than forty years ago, and I must admit, back then it made some amount of sense to me. Knowing what I do now, it makes a person wonder how many people believe in this Old Wives' Tale, using it in a misguided attempt to speed up the operation. Probably a fair amount of people, just from guessing. I know that several people have mentioned it to me. Allowing for the normal number of practical jokers just trying to get a rise out of me, I'd guess that a number of pilots really do use this technique.

(Draft copy)

The first time that I ever remember needing a really long time to warm up the engines occurred the first time it turned cold during my new-hire year with North Central Airlines. There, in the wintertime, we preheated the engines at overnight stations such as Minot, Grand Forks, International Falls, Fort William/Port Arthur, well, you get the idea! The airline pretty well had this preheating down to a science; it was done by a station agent who arrived at the airport in the middle of the night, several hours prior to the scheduled departure. Canvas enclosures for the cowlings and wheel wells helped trap most of the heat generated by the Herman Nelson gasoline heaters. Even after all of this effort, the airplane had to be started and then required a really l-o-n-g time with the engines running prior to returning to the gate for passenger boarding and a scheduled departure. I'd remembered hearing somewhere in the distant past that the use of cowl flaps would speed up this heating process. It was left for a captain to tell me why this was just another Old Wives' Tale and useless in practicality. He pointed out that obtaining an adequate cylinder head temperature was never any problem for us; rather the problem was obtaining an adequate oil temperature. North Central's power plant engineers would have probably looked askance at us if we'd baked the ignition harness while trying to accelerate the CHT warm-up for no good reason. Wouldn't have been considered smart, I'd guess!

These same power plant engineers wanted the oil temperature to be at least 20^o and rising prior to exceeding 1200 RPM. Then, after we'd advanced to this RPM we needed to see an indication of 40^o and rising to permit the RPM and power for the engine run-up. By the term "and rising" I meant to convey the following meaning. When you observe the gauge, you'll see that the oil temperature usually fluctuates as it's rising. This is due to the fact that it's passing through a mechanical system within the cooler that'll show indications of opening and closing as the oil is warmed i.e., it might rise to 25^o but then the needle would suddenly fall back to 15^o, giving an average of 20^o. Not good enough, the lowest observed temperature at the bottom of the fluctuation had to be 20^o, not be just an average. The same applied equally to the requirement for 40^o.

I've discussed this with a test pilot/engineer who is familiar with the workings of a major aircraft manufacturer's test facility. He tells me that their testing disclosed that partially closing the cowl flaps on the ground resulted in temperature hot spots within the nacelle. Without the use of some rather sophisticated test equipment these areas were impossible to detect, or locate. But baking of the ignition harness and other problems are endemic.

Another thing that should be mentioned on this subject is the "venturi" effect the open cowl flaps create when the propeller airflow is driven past or over the cowling. Some pilots may not realize the significance of this; however, remember that this airflow does create a low pressure area at the cowl flap position. If you partially close them you'll partially negate the benefits derived from this effect.

I'm aware of one B-25 operator who routinely closes the cowl flaps just as soon as he's shut down the engines after terminating. Looks like the height of something here to me. If one were looking for a guaranteed way of baking his ignition harness, I'd suspect that this would have to be at the very top of that list. I asked another operator whom I respect highly about this; he said he closes them later - after things cool down. This makes slightly more sense to me; his reasoning was "it keeps the birds out". But all the while I'm thinking, "Hmmmmmmm, must be pigeons or something, the gap I've seen on the closed cowl flaps would all let a pretty big bird get through". To tell you the truth, I've never closed them at all in moderate climates. Except for maintenance, they can stay open on the ground from now until eternity (or at least the next overhaul) as far as I'm concerned. On the airline, we did close them during the winter on a turn around, after the CHT fell to 100^o or so, in an attempt to preserve some of the engine's heat for the next flight. But, in light of what I know now, I'm not entirely convinced that it wasn't another of those "Old Wives' Tales".

I've perused some military manuals about this; they universally fail to condone this procedure.

Last week I happened to notice a "booby-trap", if I've ever seen one. Unintentionally, and done with good intentions, but still a booby-trap! During a turn-around on the B-17, a couple of mechanics needed to gain access to an engine for some minor work. About that time, a rain shower decided to come over. A highly experienced mechanic closed the cowl flaps, "to keep the rain out". When we came back out, I happened to notice it and asked why, the above answer was given. Now the problem, as I see it. We've been experimenting with an "intermediate stop" checklist on the airplane, one that would cut down on those items that the crew must check each and every flight. This would result in a check of only those items that need to be checked for each flight if the crew has not left. Oh-oh! A problem, right here, since no one expected the cowl flaps to be closed since we hadn't done so. By the way, my thought when I asked why they had been closed and listened to the answer was, "Well, how about the Ford Tri-motor or any other airplane without cowl flaps?"

Stuff yet to write:

- More about military above.
- Autrline.

#30 COWL FLAPS IN FLIGHT

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The last article concerned itself with the common use - or misuse - of the cowl flaps on the ground for warm-up and other bad things. The following is slanted more towards operations, applying itself to in-flight usage and a little history of the cowl flaps. This can be a flight safety thing, believe it or not! Airplanes have been lost from cowl flap misuse.

(Draft copy)

The DC-3's cowl flap controls have a detent position placarded TRAIL. This simply means that hydraulic pressure is removed from both sides of the actuating piston and the cowl flaps are free to move to whatever position the airflow drives them; usually this results in being approximately halfway open.

On the EAA's B-17 we utilized the halfway position for take-off for the first few years, sometimes verbally referring to it as the "TRAIL" position. However - in actuality - this wasn't really the same thing. The B-17 cowl flap system has no equivalent to the trailed position, instead it allows the cowl flaps to be positioned to any position visually, then to be locked in that position by selecting the LOCK position. This position traps hydraulic pressure on both sides of the actuating piston.

In later years we've adopted the procedure of taking off with the cowl flaps open on the B-17. This relieves the pilots of actuating the hydraulic selectors at a time when it is far more important that their attention be directed outside the airplane when taking the runway for take-off. In actuality, all the military pilot's manuals prescribed this procedure for B-17's. However, it's also been largely true that all B-17's in civil service seemed to use a halfway setting for take-off. This was probably influenced by the preponderance of DC-3 operators after the war with the inevitable spillover. We've been unable to detect a noticeable degradation of take-off performance with the cowl flaps fully open. However it does require the pilot to subsequently partially close them for the climb (after checking temperatures). I also should mention here that many of the other operators of B-17's that I'm aware of still use the mid/half/trail/x position for take-offs.

On the B-25 we always took off with the cowl flaps fully open. After take-off we'd move them to about halfway, after checking the cylinder head temperatures.

On the other hand, and there always seems to be at least one other hand, there's the matter of the F6F Grumman Hellcat. With the cowl flaps open, this airplane's rudder capability (in my experience, anyway) for counteracting "P" factor and torque is marginal at best. It possesses one of the more marginal rudders during a high power "wave off" of any airplane that I've ever flown. I'm sure that this characteristic was more than adequately impressed upon fledgling naval aviators back in the airplane's heyday. It's rudder characteristics were sort of left for me to puzzle about, until I happened to describe my impressions to either Steve Hinton or Johnny Maloney, one or the other, one day during a photo shoot. One of them was able to immediately diagnose the problem when he asked if I had been taking off with the cowl flaps open. When I answered in the affirmative, he mentioned that all Hellcats displayed this rudder airflow interference from wide open cowl flaps. When I made the next take-off I used the halfway position and noticed a radical difference in the effectiveness of the rudder. Now, the problem with this. Unlike many other airplanes, the Corsair for instance, the Hellcat's cowl flaps are completely independent in their movement. They've, of course, been wide open on the ground. Prior to the take-off roll, as you move the control towards close, one side may move rapidly all the way to closed before the other moves at all. So you then finish closing them and then try it again from closed to open, striving to obtain some semblance of a halfway position. It usually takes several attempts; each side seems to have a mind of its own! Ultimately, you're satisfied that they're good enough for government work so you can then make the take-off.

Some airplanes are placarded against flight with the cowl flaps opened beyond a certain number of degrees or inches. Witness the Boeing B-29, which has a prohibition against flight with cowl flaps opened beyond x degrees x inches. With this airplane and its inherent ground heating problem, the flight engineer characteristically partially closes the cowl flaps on the early part of the take-off roll, <u>not before</u>. The Boeing 377 Stratocruiser (in military colors the C-97) has at least one accident on its record due to cowl flaps. This involved a dual qualified Lockheed Connie/Boeing Stratocruiser flight engineer, combined with switches on the two airplanes being the reverse of each other for the Open-Close operation. The resulting elevator buffet caused an apparent increase in the stall speed and was serious enough that I used to demonstrate it to all pilots newly checking out in the airplane. In the C-97 a prohibition existed that the cowl flaps not be opened more than 3 inches in flight.

We should probably also mention the 1,000# additional allowable gross weight that the Convair 440 was certificated with, beyond that of the nearly identical 340. This was the partially the result of a rather (to us) controversial method of obtaining a small increase in demonstrated single engine climb performance after take-off. The manufacturer redefined the MID position of the cowl flaps from that used on the 340. On the 340 the four cowl flap doors were all partially, but uniformly, closed in the MID setting for take-off. The engine's cylinder head temperatures all remained within limits using the openings of this position. On the 440 however, for the MID position, the manufacture faired the upper cowl flap doors, while retaining the true mid position on the cowl flaps on the lower portion of the nacelle. This allowed some small reduction in drag, but at the expense of a noticeable increase in the CHT after operating the engines at full power during the take-off. Accordingly, anyone who flew this machine much as a co-pilot quickly learned to, immediately after retracting the gear on take-off, automatically reach up and give them about a "one potato - two potato" count towards open. As in their method of ice protection, General Dynamics (Convair) used some rather interesting tradeoffs; I know I wasn't alone in thinking these made some excessive demands upon the R-2800 engines. But, so be it, life went on in the big city!

Things to write yet:

- DC-3 – trail, B-17 – open/locked, B-25 – half?
- Is "one thousand one-one thousand two" clearer?
- F Y I from some manuals I just happen to have here, sampling, some mention excess runway required or else buffeting, must be test pilots reports or finding, I don't really need to find out at this late date.
- Connie – 50% with curtis electrics or 30% with hamiltons.
- Hellcat – ½ approximately.
- B-17 – open.
- Corsair.
- AD – open.
- TBM – open.
- Consolidated PB-4 Privateer.
- PBY – open.
- Albatross.
- A(B) – 26 – half.
- DC-3 – trail.
- A-20 – closed top and open bottom.
- Convair – mid.
- DC-4 – trail.
- DC-6 – trail.

#31 PROPBLAST VELOCITY BEHIND THE TAIL

A long time ago, when I'd just begun working in North Central Airline's flight training department, the chief pilot called me into his office one fine day. He asked me to go over to the local Weather Bureau's office and borrow a wind anemometer. I can still recall carrying that three cupped thing back to the airline's hangar offices, all the while wondering what in the world he intended to do with it when I got back!

Captain Hinke didn't leave me waiting in suspense for very long! He told me that we had an airport on the system with an engine overhaul shop located next to the small lean-to serving as our passenger terminal. Every time one of our DC-3's taxied away from this terminal (four times a day) and made a right turnout, they'd blow up dust and grit from the ramp. Invariably, some of it entered the shop. This small engine shop proprietor had rather heatedly discussed the matter with the local station manager and it was left up to us to do something and preferably sooner rather than later!

I guess you can see it coming, can't you? I've won some bets in more recent years, but back in those days Art Hinke won most of them with me. He asked me whether the wind velocity behind the airplane was greater with the flaps up or down. I, of course, bit and opined that everyone knew that the good guy always lowered his flaps to prevent blasting the people behind the fence any more than necessary with the props. Art just slyly grinned and asked me if I wanted to bet ten bucks (a goodly amount of money at the time) on it? Well, certainly I would! This was something that everyone knew, be really easy money! Beware; a fool and his gold are soon parted, especially when dealing with some US Naval Aviation Reserve aviator!

So, we took the anemometer out to the ramp and positioned it about fifty feet or so behind the DC-3's tail. Cut me some slack on the exact distance, this was a long time ago but it was a representative distance. A couple of us stood behind the airplane to hold the anemometer and record the results on a paper tablet. Art climbed into the cockpit and fired up both Wright engines. We faithfully recorded the results at (as best I recall) idling speed, 800 RPM and 1000 RPM, with flaps up and flaps down. I was amazed; you could watch the little aluminum cups on the anemometer spin faster as the flaps were lowered and slow as they were raised.

Now, who's going to be the first to answer why? I guess we need to picture in our mind the venturi effect. Lowering the flaps creates a venturi behind the engines at the wing's trailing edge, resulting in an increase in velocity of the airflow from the propeller. Raising them increases the clearance under the wing through which the air must pass, lowering the velocity. Simple, when you see it. I wish I still had the bulletin written back then to all the line pilots, in which we described the results.

Now, what did we do at Worthington, you say? We sent out a bulletin asking the pilots to taxi their DC-3 ahead a hundred feet or so before turning around on the ramp. That way the prop blast wouldn't needlessly dust off the overhaul shop for Howard Libersky and his opened engines in the shop. But Old Wives' Tales die hard, popular opinion on the part of the public still thinks that the considerate pilot always lowers his flaps in order to lower the prop wash, even though the exact opposite is actually true! And it only cost me ten bucks to acquire this particular bit of knowledge. Looks to me like another of those "danged if you do and danged if you don't" deals - that simply can't be won!

#32 V2 ATTITUDE AFTER TAKE-OFF

Yes, it's true that there is a difference in the flight profile after liftoff between, for example, the B-25 and the DC-3. But for a very good reason! Again, let me clearly say up front that these two airplanes are used here only as an example, not as specific ones or the only ones. Another aside on this subject, the matter that I'm talking about in the paragraphs below applied, in my experience, to twin engine airplanes. When they had an engine fail, it represented a fifty-percent loss of power. This is a severe handicap by anyone's standards. In the case of the four-engine airplanes, they might not have required the extreme attention given to the V2 attitude with the twins. But, even with those, Paul Soderlind at Northwest developed and prescribed a precise attitude to be rotated to, it also delivered the most "bang for the buck" out of a sometimes rather reluctant airframe on take-off.

(Draft copy)

In the B-25 you'll need to read Warbird Notes #02 (Decelerating Approach) to get a feel for what we are discussing here. Suffice it to say, with the B-25 or others of its ilk, we have an overriding need to obtain airspeed just as quickly as possible because, if one engine should fail below SSES (Safe Single Engine Speed) you'd have no choice but to quickly reduce the power on the remaining engine in order to avoid the resulting uncontrollable roll. So, in this case, airspeed is obviously of the essence! Conversely, consider the case of the DC-3, an airplane possessing a much lower VMC and having a V2 airspeed. Yes, I know the DC-3 was, and is, operated under a special waiver of the regulations but the fact remains that the manuals define a V2 for it. Incidentally, the B-25, with its military design background, never did have a V2 airspeed defined, listed, prescribed, written or whatever. Seems to me that anyone trying to tell you differently is spreading some BS or, to put the best face on it, just perpetuating one of those “Old Wives' Tales”. Might be informative to both of you if you'd say, "Could you show me where that is in the book, please?" In the case of the DC-3, once you've attained sufficient airspeed to control it and climb on one engine, you are far better off to obtain as much altitude as possible before (or) if, an engine fails.

Flight instructors (in that part of the trade) know the attitude that will accomplish this for you as the "V2 attitude". So, to make life as simple as possible for yourself after liftoff, rotate the aircraft to a V2 attitude. Until you can do this in your sleep on a dark night with a bad artificial horizon, this attitude is roughly the same as the DC-3 at rest on the ramp in a three-point attitude. After placing the aircraft in this attitude and retracting the landing gear, allow the aircraft to accelerate to V2+10. Maintain this V2 attitude and reduce to METO power. Continue the climb in this attitude (and V2 plus 10) until reaching the obstruction clearance altitude (OCA). We always used 300' above field elevation on the airline; others may have some specific circumstance that required the use of a higher OCA. For now and for this operation, however, let’s use 300'. After attaining this altitude, lower the nose slightly and allow the aircraft to accelerate to climb speed (for the DC-3, that's 105 knots), then you may reduce to CLIMB power.

Due to what some might call serendipity, if you're maintaining this attitude and V2+10 on two engines, this is the same attitude that will pretty much result in a decrease to V2 if you suffer an engine loss and you reapply MAX power. Actually, it really isn't serendipity, it's the result of a lot of experimentation and applied thought by some pretty experienced aviators of the past. They didn't have a plethora of aircraft performance to work with; accordingly they were masters at obtaining the best performance out of a marginally performing airplane. And I think they were also masters at transferring this knowledge to those of us that came along later. Another thing here, if you're holding a V2 attitude and notice that you've slightly overshot the V2+10, don't abruptly raise the nose in an attempt to reacquire (chase) the airspeed! Most likely you'll again overshoot in the opposite direction and just end up in a series of pitch changes. Conversely, if you notice a momentary loss of the V2+10 airspeed, don't abruptly lower the nose and chase it, just attempt to influence it slightly in the correct direction. These aircraft attitudes, to some degree, are approximations but will be of inestimable help to you in avoiding the frantic need to hastily adjust the pitch while you're also trying to deal with all the other distractions of an engine loss close to the ground.

If, or maybe I should say when, an engine fails after liftoff, you'll be awfully glad you religiously used this habit and have the altitude already in your hip pocket. If you'd flattened your climb (a la the military) obviously you'd have more speed. But, after watching this hundreds of times, you'd be unsuccessful in converting this excess airspeed into an usable altitude, all the while trying to also get the offending engine shutdown and feathered.

So, that's why the difference in the way certain airplanes are handled. Unfortunately, they're not all the same. Some were designed for the military with a really high VMC, they were obviously expendable! And, for that matter, so was their crew and occupants, no matter how fervently we might wish to not admit that fact. Other airplanes might benefit from the more controllable characteristics and benign aeronautical mannerisms of a transport design. Let me digress briefly to the matter of the B-29, an airplane plagued by engine heating problems from day one. In this particular case we fly it the same way we do in the B-25 i.e., hold it flat and get the maximum airspeed as quickly as possible because of its overriding cooling problems. This cooling problem isn't evident on the DC-3 or the Convair, etc., therefore the differences. All different, it looks to me like a case of "you pays your money and you takes your choice!" All have valid reasons for being, it's up to you to provide the human intelligence to manage the machine to obtain those results that you both want and need.

#33 SPOILERS ("SNAKES") ON THE WINGS

Many years ago I learned something on one of our airline overnights that's stood the test of time for me. I'd written a letter about this almost five years ago and was reminded of it again this very morning when someone called me about wind damage he'd experienced on his DC-3. So far, in every case of this I've always been impressed with (1) the person involved feeling a sense of outrage mixed with a feeling of "how did this ever happen to me" and (2) his feelings of "if I'd just have known the wind was coming, I could have done something". This seems to be a universal feeling, shared by anyone who's had it happen to them. Well, in this case, they shouldn't be so hard on themselves since they aren't alone. However, there is a solution. Perhaps not a perfect and all encompassing one, aviation things just aren't, in my experience. If you want to believe they are, then I've got some "ocean front property in Arizona", and just for you, it happens to be for sale!

(Draft copy)

In 1994 I'd written the letter quoted below to Bob Thompson, who was at the time Chief of the General Staff of the Confederate Air Force. I'll just quote the original letter below, and then add a few remarks from today's perspective.

"*In the last letter to the members of the Flight Safety Board I wanted to answer a question from some of them concerning the status of the attempt to minimize the possibility of wind damage to CAF equipment out on tour. I mentioned this almost in passing at the end of the last letter. I've just gotten some feedback on this and wanted to touch base with you about it.*

If you recall, at the Midland FSB meeting we discussed the wind damage the CAF has encountered over the years and this past summer in particular. After the FSB meeting I had to report our recommendations to you gentlemen on the General Staff. One of our recommendations was based on our airline's experience with DC-3s remaining outside on the ramps in all kinds of weather. I specifically remember one night in Battle Creek when the winds had exceeded 75 knots. No damage occurred and the airplane remained exactly where we had left it. I remember that was the first time I had seen what were called "snakes", which were nothing more than 3 or 4 inch surplus fire hose filled with fine sand. These were in short enough lengths that they could be thrown up on the top of the wing by a couple of people. Once there they conformed to the shape of the airfoil and didn't move. This simple device destroyed the airflow and prevented the wing from doing what it does best - lift!

Bob, you can tie aircraft down until eternity but you cannot argue with the basic laws of nature. Let's use the DC-3 for an example. A wing designed to create 25,000 pounds of lift will generate that lift when the wind exceeds the take-off speed. Power on I can get a 3 down in the high 60s before stalling, with no power it's a little faster. Now remember the airplane is parked in a three-point attitude, an attitude that places the wing in its maximum lift-generating stance. Any rope/chain/cable tiedowns aren't going to stand a snowball's chance when Mother Nature creates forces like this. The only thing that works is to destroy (spoil) the lift. We've had pilots on the airline that wouldn't use the automatic spoiler feature of the DC-9 simply because they are so effective, creating a "dump" when the guy was tying to get a smooth touchdown.

During the GS meeting when I presented the FSB's recommendations I remember that Steve Miller was seated beside me. When the GS approved it I really didn't know that any further action was required on the part of the FSB to implement it, we only advise. I really thought we had discussed it to death and had gone over-ad infinitum-all the things I've written down again above. Now I get a letter from a maintenance officer on the C-46 who describes it as "ludicrous". I really don't know if he is in full possession of the facts or whether he simply chooses to misread them along with the "reliable aerodynamic engineers" he quotes. I talked with Billy Thomas and he is only in possession of a skeletal set of recommendations adopted by the GS. In the letter that maintenance officer says that "sixteen tons" of sand wouldn't have had an effect. I can't believe that someone thinks that I think the weight of the sand matters like it's going to hold the airplane down with muscle. I only described what works at a home base or other location where the "snakes" can be kept. Obviously the same thing can be accomplished for an airplane out on the road with 2 x 4s nailed to 1 x 4s or water filled hose or whatever a motivated sponsor/operator's ingenuity provides. We've used old tires on the Catalina this *summer. He also mentioned that serious damage could have resulted if the C-46 wing had been cabled. That is exactly my point! Tiedowns have no chance against the lift generated by the wings. This is not to negate, however, the tiedown's function in restraining the tailwheel as described by Billy Thomas.*

We can never completely eliminate the hazards to these aircraft; we can only do everything in our power, utilizing our combined experiences, to minimize them. For someone to deliberately fight the efforts to do so raises serious doubts about our goals. Billy Thomas and Joe Coleman (and perhaps others I am unaware of) performed an exceptional (and largely unrecognized) service to the CAF this past summer in expeditiously returning the C-46 to service. The tragedy is that it might have been unnecessary! It sounds as though it was one of those acts of nature that man cannot prepare for. We don't know and will never know but we should certainly direct our efforts towards preventing a reoccurrence. This will take all our experiences and efforts in concert, not in bitching about why it can't be done. We simply cannot absorb the losses we've incurred lately and stay in business. When I saw the airplanes parked in close proximity as they were at Millville I think that we haven't learned anything. With the rate of accidents we've had I really don't have time to be composing letters like this explaining what was explained in the past. Probably in truth this occurrence is not technically a Flight Safety Board problem but we are all in this together, aren't we?"

So - that's what I had to say about it back then in 1994! Certainly nothing that's occurred since then has caused me to change my opinion in the slightest. One worry that I've recently heard that needs to be addressed is the matter of how much wind it would take to blow the "snakes" off of the wing. These "snakes" were, to the best of my memory, thrown up on top of the wing from the nacelles out almost to the tips. I know they remained in that location in some winds that exceeded 80 knots. They did this because their sand filling wasn't stuffed to a "sausage like" consistency, allowing them to roll off. They were more "squishy", which let them adhere closely to the top of the wing.

Anyway, here we are, five years later and we're still standing around open mouthed and figuratively wearing knickers. By the way, I am impressed, it's just in the opposite direction of what one might hope, I guess!

#34 AIRFLOW WITH A NACELLE FUEL LEAK

During the last several weeks we've spent thinking about which of various procedures should be included in the B-17, DC-3, B-25, etc. emergency checklists, the subject of fuel leaks has reared its head more than once. If I remember correctly, it seems that it was one of the first really serious discussions brought up w-a-a-y back at Reese AFB when we were buck USAF B-25 instructors sitting around the flight shack on a bad weather day, involved in another of our endless bull sessions about "what would you do if – – –".

(Draft copy)

A consensus developed back then and nothing's really changed in the decades since that would cause me to think it was invalid. If you haven't caught on fire by the time you notice the problem, then DON'T CHANGE NUTH'IN! To be very precise in describing the problem, <u>if</u> (and that's admittedly a big if) you have a bona-fide fuel leak out in the nacelle, then you'd seem to be far better off to let the existing airflow remain unchanged. Your exhaust flame, (look at it during the night) exits the collector ring or exhaust stacks, and is visible for several inches to several feet aft of that point. If the fuel leak is somewhere back in the accessory section, the fact that it hasn't ignited, so far, seems "prima facie" evidence that the exhaust flame hasn't touched it. It should stand to reason then, that some measure of equilibrium exists in that area and will continue to exist, provided the existing airflow balance is not altered. Right? I think so. The fuel is under some pressure and most likely is being atomized (to some extent) as it exits to the atmosphere just outside the nacelle. Now, anything that you do that would alter that balance, MIGHT just cause the exhaust flame to impinge upon that fuel leak and - P-F-F-F-F-T! Maybe, anyhow! Me, I think I'd "dance with the one who brung me"! In other words, I wouldn't take a chance of altering that airflow in the slightest, figuring I've been lucky, so far! I'm reminded here of what one of my good friends, Connie Edwards, always says. "I'd ten times rather be born lucky than smart!"

One of the things that invariably arises during a discussion on this subject is night flight. Lets say you notice that this problem manifests itself as a partial loss of fuel pressure on the cockpit gauge but the engine continues to run fine. This is just one of the possible scenarios you could be presented with. Turning the booster pump off could eliminate pressurizing some fraction of the fuel line. If the leak occurs in daylight, there is some chance that you or another crew member will be able to visually scan the nacelle and area and possibly determine whether the gauge indication is correct. If it's during the nighttime, I'd think your chances of successfully eyeballing it would be almost nil. That's just one of the several reasons that I think we should seriously think of prohibiting night flight in the EAA's B-17. Another is smoke in the cockpit, but that's an entirely different matter for another time.

One contributor did offer the suggestion of pulling the throttle back to control the potential propeller overspeed in the event the fuel supply became erratic or interrupted. My thought is that <u>that's the one single thing that we've long insisted was the most important thing not to do</u>. Any change in power affects the airflow and again, I'd submit that this is the one thing I'd want to absolutely not alter!

Another thought here is your location and flight condition when you first become aware of the problem. If you're on top of an overcast or have some distance remaining to your destination, you might decide to proceed to that destination without feathering. I'd probably buy into that decision, as long as you made no change in your configuration or airspeed, etc. Then, approaching your destination (before you changed any flight condition) manage the situation as we've discussed elsewhere here. I personally think I'd be ill at ease (at the best) for the entire trip under those conditions, but every situation's different and that's the meaning of judgment, I guess.

In the best of all worlds, once I'd decided to feather it, I think I'd rather manage it by turning the fuel supply off at the tank. As the fuel is consumed it relieves the pressure in the fuel line, preventing any tendency for the combustible fuel to be sprayed. Then, as soon as the fuel pressure indication falls off, move the mixture to IDLE CUT OFF and feather. A slightly less perfect solution to me would be to just move the mixture to IDLE CUT OFF, which would immediately remove the exhaust flame as a source of combustion. After that, feather it.

#35 PROP UNFEATHERING PROBLEMS

We've seen enough problems with this during the power plant failure item on type ratings and/or FAR 61.58 check rides that we thought it might be advantageous to discuss it here. This would seem to be a better place than during the oral or the flight test. I certainly don't mean to say here that we don't see problem areas during the feathering portion, perish the thought. But this is also a vital bit of propeller knowledge, and maybe we can separate it from the other part long enough here to shed a little bit light on it.

(Draft copy)

First of all, on the propellers we're discussing, the feather button is a simple push button. When pushed into the depressed (feather) position, it's held there by an electrical holding coil. Some of the later ones i.e., postwar and later, had reverse and all those goodies. On these, the feather button became a push in – pull out type. That complicated life a bunch and is outside the area of this discussion! Let's just confine this to the 23E50 propellers, commonly used in the airplanes we are directing this discussion towards.

Now then, to unfeather the prop, all that you should really have to do is push the feather button and hold it down! Obviously, it's going to want to "pop" up all by itself because the oil pressure that built up in the dome to feather it also released the holding coil, it's up to you to hold it down for the unfeathering process to occur. Hold it down until reaching 800 RPM, by that time the prop has reached a blade angle where it'll finish unfeathering by itself. If the tachometer malfunctions (which, by the way, happens fairly often) you'll have to substitute your own judgment for the 800 RPM. A good way (that we used to teach) to do this is to release it when you can no longer detect the individual propeller blades.

As soon as the propeller has unfeathered, you need to immediately check for engine oil pressure. Also, don't immediately place the mixture into the RICH position, wait long enough to check that the tachometer rises to and then stabilizes at the same RPM you experienced when checking the propeller for minimum RPM governing during your pre-take-off run-up. This is usually in the vicinity of 1100-1200 RPM. Also remember that one reason you checked it on run-up is that this is the only solution you'll have available if the feathering pump fails during flight when you need to feather after an engine failure. After it stabilizes you can move the mixture to RICH and begin the warming-up process. If you disregard this important RPM check you just might be putting a mixture to a potential runaway since the prop governor may not have assumed control.

Another thing here, or

One last thing here, how about the situation of your releasing the button - but the contacts weld (stick) or something causes the feather motor to continue running. In this case the propeller blades would be driven by the feather pump to the low pitch stops, another way of saying high RPM, or can you say "an overspeed"? In this case, what can you do to immediately stop the feather motor? You can simply (and immediately) place both generators to OFF and all battery switches to OFF. This eliminates all electrical power and, voi-la and eureka, since the feathering pump is electrically powered, it stops!. Then, in this case, I believe I'd then utilize one battery switch only to "bump" the feather motor to feather (stop) the propeller, easier to control that way, I believe. But if you ever do this, remember that you cannot subsequently restore any source of electrical power! If you do, the feather motor will again start to operate. You're stuck with this situation for the duration! Hope you've kept adequate track of your position on a map since you are now without radios.

Well, O.K., that takes.

#36 WHEEL LANDINGS

This is a subject that only a week ago, I would have sworn was completely unnecessary to write! Or for that matter, even discuss. For the same reason, I'm finding it exceedingly difficult to write, since a pilot whose abilities we highly respect has apparently been teaching this maneuver in a manner completely opposite from most of us.

(Draft copy)

For several decades that I can remember, we've always done and/or taught them in a way that, according to this article, is completely wrong, and to quote, "the worst of both worlds" i.e., a power off, tail low touchdown. Well, maybe, and then again, maybe not. All I know is what we've always done in Champs, Mustangs, DC-3's, Corsairs, Stearmans, T-6/SNJ, B-17's, Twin Beeches, etc, etc. That was to make a power off, tail low landing if we made (or ended up with) a wheel landing. Lord knows that we've certainly done both kinds in our time. Some airplanes certainly lend themselves more to one kind than the other, for instance, I don't want to be anywhere around, or even within a thousand miles, when someone attempts to three-point a DC-3. Conversely, the B-17 works exceedingly well with these, as does the F8F Bearcat. Matter of fact, I don't think that I've ever made anything but a three-point landing (or take-off either, for that matter) in the Bearcat. I do know that when I check someone out in a Grumman F6F Hellcat, I go to great pains to make absolutely sure that he understands that he must never ever apply forward stick if he bounces. Either go-around if it's high enough to concern you, or else just touch down again and keep that stick back. Otherwise you'll be buying a new Hellcat propeller! And they ain't cheap these days! Tail low wheel landing or three-point landing, I really don't care! Just so's they never poke the nose down if they bounce!

Realizing that we can always learn something new, I've subsequently talked to people on at least three continents about this subject. All these pilots have been teaching and doing this for a l-o-n-g time, and have my utmost respect. Some have written extensively on many subjects, including this very one. Their backgrounds are both civil and military!

When we --

Well, we should --

And, then, there's the --

T-6G unlocks the tailwheel when holding it up with forward stick, same as the Mustang.

#37 REQUIRED USE OF SEATBELTS

Like a bad penny that keeps returning again and again, this subject seems to keep resurfacing! What brought it up this time, specifically, was the B-17, however it applies equally well to the PBY, B-25, DC-3/C-47 or a plethora of other multi-engine aircraft as well. We've addressed this matter several times before in various publications and training sessions, but seemingly without closure. Or, always being aware of a niggling disbelief, a feeling of "But it just CAN'T apply to us, we've ALWAYS done it the old way!"

(Draft copy)

Several other airline pilots that possess some "personal experience" with this subject could probably tell you more about this, I'd guess. I first became aware of it back when we began needing a verbal OK from the lead flight attendant; she/he would advise us when <u>all</u> the passengers were seated so we could begin the pushback. Even sitting in the front office of a 747, one story above the main passenger cabin and "out of the loop", I've been decidedly aware of this uncomfortable fact. <u>Absolutely no movement is permitted until every passenger is seated</u>. I'm sure that everyone reading this has experienced a PA announcement to this effect when in the passenger cabin of an airliner waiting to depart. This became somewhat of a "cause celebre" when an unnamed airline (famous for their short turn-around times) became legally ensnared in this problem. I can distinctly remember another airline being assessed a big buck fine over a pushback started with a few passengers still standing in the aisle.

The regulations don't seem to make a lot of bones about it, they place the responsibility (what's new?) squarely on the shoulders of the pilot-in-command. "Brief them how, tell them where and see that they do". When you accept the PIC position, then you accept the responsibility that comes along with it! Even if you'd like to be the good guy, it all falls back on you! In other words, the PIC can have his/her certificate jerked if things should go awry! And the only aeronautical contraption I've ever succeeded in getting to move backwards is a simulator i.e., you can't go back and make things different <u>after</u> the accident! Whether you might "need <u>your</u> airman's certificate to put bread on your family's table" seems to be a vital concern commonly expressed by the many people I've talked to about this. I've seen an ad for cable TV that seems to be repeated, month after month, on our cable network. In the words of the actress on it, "You might just want to think about it!"

Also, to tell you the truth, I don't think I'd get too complacent about this if I were the co-pilot. I don't have the slightest doubt that the FAA will take the stance in court (as they increasingly have) and say "Hey, what was the SIC doing and saying while all this was happening?" Again, you might just want to give this matter some thought.

Another thing here that bothers, or occurs to me, is the strong likelihood that the organization under whose auspices you're operating the airplane also could be left legally holding the bag for the violation and/or unnecessary injury.

We probably need to discuss "policy" v/s "regulation". Some organizations have a policy to not allow anyone to occupy the nose compartment of the B-17 during take-offs or landings. The theory here (and I am convinced of its validity) is that we, as the pilots, couldn't get someone out of there if we belly-landed and the airplane caught on fire or something. Written for our own operation, after much thought and experience. And, by the way, one apparently complied with by our crews. But policies, like checklists, can be changed. They're published by the organization because of a specific need or desire. A regulation, on the other hand, is just that. It's published by the FAA and is about as plain as the nose on your face, seems to me! No one outside of Washington (or even there) can just say, "it isn't so". The record of fighting a FAR in the courtroom has a rather bleak box score.

On this same thought, some might say that they've written their ops manual to use an unbelted third crewmember (flight engineer) to watch over the throttles, propellers, etc., during the take-off or landing. Just like they did in WW II. The last time I looked, the B-17 is certificated as a two-pilot airplane and I'm stymied in finding any sort of a way to get around the applicable FAR. This in spite of an expressed need or desire for a flight engineer. And, yes, I've heard all that talk about "I'll hold on tight if something happens!" Unh-huh, you bet! The experts in this type of high "G" decelerating process tell me that this will ultimately prove to be a futile hope, given the multiplicity of vectors and forces involved in an accident of this type.

Some of our pilots have opined that"when I'm the pilot they can stand up or set down, whatever they want". Well, again, in spite of the natural desire to be a "good guy", no one that I'm acquainted with or aware of can "void" a FAR by simply saying, "it doesn't apply to us", whether it's said to a passenger or a crewmember.

Let's talk a little bit here about that old saying, "rots a ruck, G.I". That expression was fairly common back in the post WW II – Korean fracas days; I really don't know what the current saying is. Anyhow, if you ever happen to have an accident I think you could talk for ten years afterwards and never satisfactorily explain to the widow just what you felt was so overridingly important when you told her husband he didn't have to use the seat belt. I've dealt with notifying widows before, and it ain't pretty, chum! In the litigious society we've become this is what'd happen if someone was injured due to this type of thing. Or, imagine yourself explaining (actually attempting to!) to the management of your particular organization why it was so all-fired important that someone's ego had to be assuaged by standing up during a take-off or landing. Or why you chose to put the organization in this legal position by knowingly not complying with a regulation. The unsecured crewmember that chooses to not comply needs to realize that, besides risking himself, he's also placing the PIC's certificate at risk if something happens. I, for one, wouldn't want to "bet on the come" with survivors or widows, I've "been there and done that", thanks!

Finally, this regulation wasn't dreamed up by anyone around here to make your life harder. Easy to understand a natural desire to "shoot the messenger", but in truth, if you want to argue about it, you need to take it up with the FAA administrator! FAR 91.107 (a) (1) (2) (3) reads as follows (I've deleted the extraneous information and placed it in italics below for convenience):

91.107 Use of safety belts, shoulder harnesses, and child restraint systems.

(a) Unless otherwise authorized by the Administrator:

(1) No pilot may take-off a U.S.-registered civil aircraft unless the pilot in command of that aircraft ensures that each person on board is briefed on how to fasten and unfasten that person's safety belt.

(2) No pilot may cause to be moved on the surface, take-off, or land a U.S.-registered civil aircraft unless the pilot in command of that aircraft ensures that each person on board has been notified to fasten his or her safety belt.

(3) Except as provided in this paragraph, each person on board a U.S.-registered civil aircraft must occupy an approved seat or berth with a safety belt properly secured about him or her during movement on the surface, take-off, and landing. Paragraph (a)(3) of this section does not apply to persons subject to 91.105.

Now, the last sentence above references FAR 91.105, which addresses itself to "Flight crewmembers at stations". Briefly, it says that required crewmembers must be at their station at all times. Again, the B-17 was certificated as a two person aircraft if I read it correctly. So again, I cannot find a place anywhere, that permits a deviation from this FAR.

#38 "JUG" CHANGE AND BREAK-IN

Well, here we go again! Once more we're confronted with a procedure that has at least one OWT (old wives' tale) imbedded within it. Like all OWT's, this one seems to contain just enough "common sense" to help make it believable. And it may very well have been done this way in the past, in some military units or in other places. After all, any one several different methods of a proper "break-in" of the cylinder after it's replaced certainly possess some amount of validity. And they might accomplish that particular objective, but very likely at the expense of the other cylinders or the engine itself!

(Draft copy)

In attempting to obtain a real life procedure that we could both advocate, and expect to see utilized, we consulted a goodly number of engine overhaul shops while writing this. These shops are not as numerous as they once were, but the following certainly represents as wide a view of the current practices as is likely to ever be obtained nowadays.

Stuff yet to write:

Oil grade mineral/AD

Ground run for 45 minutes? I guess that one might see a perceived need to "break-in" a fresh cylinder by running the engine on the ground for a substantial period of time, in one case I've even heard of 45 minutes. While this might satisfy someone's hope or desire, I'm sure that it'd also "cook" the engine from overheating. I've run overhauled engines in test cells with wooden "test clubs" made especially for that purpose and still have worried about the resultant overheating.

On the airline we certainly didn't have the luxury or opportunity to carefully break-in the replacement cylinder in the manner some have recently advocated. In talking to some of our power plant engineers and mechanics (all long retired) they say that both the R-1820's and the R-2800's.

Oil Type?

#39 METAL RESIDUE IN THE OIL/PROPELLER SYSTEM

Another OWT concerns the extensive, but necessary, work that has to be accomplished in order to remove any contaminants from the oil system after changing an engine that "made metal" during its failure. Metal particles and slivers circulating through the veins of your expensive replacement engine can easily spoil your whole day! And it can easily be even worse; it sometimes has been the replacement, for the replacement, engine.

(Draft copy)

Things to write:

Obviously, no one wants to go to all the trouble and expense of this work, it very likely will appear to be economically unfeasible. A hundred voices will sing some version of "We don't need to do all that stuff, I know how better/cheaper/quicker", "We never did that at X (pick an operator), "I can flush it out just as good as new!" or other refrains, and all in good faith! But, when the replacement engine fails, ah-hah, then everyone very quickly will start pointing fingers!

If the engine hashes/trashes/craters (whatever you wish to call it), the contaminating metal from that failure is likely to be completely circulated throughout the oil system and the propeller system (unless it's an electrical prop or a propeller with a separate reservoir) by the time the pilot notices it and the engine is either feathered or shut down. This metal can be either (a) ferrous or (b) non-ferrous. Then, it can be further defined as (1) aluminum (2) steel, (3) chrome (4) brass (5) tin (6) silver (7) x Sometimes, as the saying goes, you can almost read the part numbers on the metal pieces that come out when the screens are removed for checking.

Potential in the above scenario.

An excerpt from an earlier Warbird Note follows: "When you see it, it's already happened and nothing you can do will undo it. It's bad enough that the engine has reduced itself to hash and a BIG buck overhaul. But, the oil cooler is junk until its cut completely apart and cleaned. No amount of flushing is going to fix it. The same is true of the oil tank. Unless it is of the very simplest design where every bit of the interior is visible, it needs to be cut apart for cleaning before reuse. The whole system needs to be really cleaned of all the associated metal contamination".

When I’d originally written the above, it was knowledge I'd gained from an engine shop that stood behind its warrantees, they'd furnished a replacement engine when the freshly overhauled one had failed shortly after installation. It didn't take very many instances of seeing the replacement also make metal (fail) in order to realize that there was something totally amiss.

Remember that a typical oil tank on the types of airplanes we use is likely to contain a reservoir or hopper tank, whose interior remains hidden from view of even the most discerning and careful inspector. The feathering system consists of many hoses, lines, valves, and assorted paraphernalia, any of which could harbor contaminants that might be trapped, stubbornly resisting even the most valiant efforts to dislodge them by flushing.

X-rays taken of the oil cooler certainly should show whether the flushing process worked and whether it’s cleaned out, huh?

#40 TRIM DURING A CROSSWIND LANDING

I've really hesitated to believe that this elementary matter merited discussion, and if it did, perhaps somewhere at the student pilot level! However, a few events and/or incidents that have occurred lately demonstrated rather clearly that it does! Let me briefly <very big grin> describe these events to you, and see what you might think about it!

Consider the first one. This was in a four-engine WW II bomber with a tailwheel. We were approaching a hard surfaced runway for a landing to the west. Wind was from the south (left), brisk, but well within the limitations. In this case, the pilot-in-command was sitting in the right seat, due to a requirement existing at that time concerning giving rides, not germane to this story. At any rate, about a mile or so out on final, I observed that he began to lower the left wing into the wind, and at the same time, it seemed to me that he began to oppose this bank with an appropriate amount of right rudder. So far, so good, right? Using this technique while still w-a-y out on final seemed like a lot of work to me. But then I thought about it a little bit more.

I reminded myself of the fact that we used to teach this technique to beginning students new to the B-25 back in the USAF multi-engine flying training program. Simply because the new student was not yet exactly sure of where straight ahead was in a new, to him, side-by-side airplane! So, I kept the thought in mind that we'd utilized this exaggerated maneuver in order to give the student plenty of time for him to get the sight picture of what straight ahead looked like! And also to allow him to experience the constantly changing effects of a crosswind and appropriate control usage to deal with it. But I'll guarantee you we never expected him to continue this exaggerated technique into his future flying assignments as a military pilot. It was just an interim thing, a training aid to help him get the sight picture.

Now, back to the crosswind landing in the B-17. Very shortly after he applied the cross-controls, I looked down and noticed that my rudder pedals were NOT where I expected them to be. They seemed to be roughly equalized, not in the unequal position one would expect under these conditions. My first thought was "Shoot, I've somehow forgotten to set them correctly on the pre-flight before departure". First time for everything, I remember thinking. Then, I looked at the throttles! They were widely split, the left side engines had in the area of 5 to 8 inches more manifold pressure than the ones on the right side. I can remember next glancing over my shoulder at the jumpseat rider (who just happened to be a FAA inspector) to see what his impression might be of this. His only reaction was to roll his eyes upward towards the sky or the roof overhead as if to say, "I haven't the slightest idea what he's doing either!" So, I guess we'll just ride this horse to the end, be interesting to see what happens!

A short while later, we neared the touchdown. He landed in this condition, pretty well on the centerline, touchdown was OK. For a little while, I thought that it was all going to work out just fine. Then, we began a slow, apparently inexorable, digression towards the right side. Shortly, a departure from the pavement was imminent. This runway has runway lights, approximately two or three feet high, installed a few feet off to the side of the pavement. At this point, I grabbed the controls and took over, not wishing to explain to any observers the destruction of several runway lights by an airplane in which I was seated up front. Lifted the right wing w-a-y up to clear those lights and, with power added, re-established the airplane on the center of the runway and got it stopped.

Now, we finally get to the point of this illustration or story! When I regained my breath and asked what in the world he had been trying to do, he proffered this comment,"I didn't have any access to the aileron trim!" Now, I'm totally sure that most of you reading this might have an incredulous, or questioning, expression on your face just now, as I also did back then! What in the world does aileron trim have to do with a crosswind landing, you might ask? Others however (I suspect) might have it lurking, malevolently, somewhere in their flight training or previous experience backgrounds!

Yet to write:

- Bearcat.
- Elevator.
- Plaster a load of 400 paying passengers against an airplane's cabin sidewall and just imagine the letters you'd get from them and the system chief pilot.
- Go around, either Torque/P-factor or loss of one or two engines.
- Reduced control effectiveness.
- Loss of "feel".
- Short term trim to relieve the control loads, constant change of x winds on final, gusts, etc.

#41 "DUTCH" ROLLS VS "COORDINATION" ROLLS

Here's another example of a term being used in error. I'd never thought this would need any discussion, however several computer forum exchanges within the past few months have gotten into this subject, and in the words of one student of my acquaintance: "Wow, those guys must be really misinformed, huh?"

(Draft copy)

Before we get into a discussion of the "rolls" we're talking about here, I should mention a couple "tongue-in-cheek" definitions of "rolls" and aerobatics from the CAF dictionary of the past (circa 1967); they just somehow seemed apropos to this subject. The "sweet roll" (as well as the "Puerto Rican sixteen") found their way into that dictionary as maneuvers.

Anyhow, back to the serious stuff. Over the years, I've seen this maneuver taught in two or three ways. And I've taught different ways of doing it, depending upon the objective. So I guess we have a consensus among flight instructors of the maneuver's validity, but not of the terminology.

(1) One method would be while in straight and level flight to pick a point on the horizon and enter a turn away from it for some amount of turn and then, without stopping, reverse the turn to pass through the original point in the opposite direction, then again reverse the turn and so on, while all the time coordinating the flight controls (especially the rudder and ailerons). (2) Another variation or method used is to pick a straight road or a point on the horizon. Then precisely hold that point while initiating a bank (takes opposite rudder), then reverse the bank to an equal amount in the opposite direction. This is repeated over and over while using the flight controls to precisely maintain that point (especially the rudder and ailerons). This variation especially lends itself to getting the student ready for the aggressive use of the rudder in acrobatic flight.

Evidently, to a certain number of instructor pilots, the above aileron/rudder coordination exercises (especially #2, the one that holds the reference point) that we all give our new students are called "dutch rolls".

Well, we've got some news for you, chum! Those aren't "dutch rolls", they're simply plain old garden variety "coordination exercises" or "coordination rolls". And, undeniably, they're extremely useful for teaching coordination or for quickly evaluating an aircraft's handling qualities! I've used them from the very first time I took my first lesson in an Aeronca Champ right up until the present. When we were aviation cadets in "Bevo" Howard's USAF T-6 school, we were taught them from the very first day of our flight training. BUT THOSE ARE <u>NOT</u> DUTCH ROLLS! You copy that? "Sorry Charlie" but no cigar, those are NOT dutch rolls! No big deal, you say? Well, OK, but you need to realize that when you use an incorrect term it's teaching your student something completely wrong. It's sort of like the media using the term "Piper Cub" for every airplane less than a medium sized jet. And, besides perpetrating a falsehood, it can later kill him/her! And if you don't think or realize that a dutch roll can easily become lethal, look up the Braniff/Boeing 707 (N-7071) flight training accident involving the tossing of a couple of pylon mounted engines off the wings in the fall of 1959.

So you say, "well then, just what IS a dutch roll?" In test pilot school we were provided with a detailed description of the phenomenon. While that description seems to be far more technical than required for this discussion you can look it up in your copy of "Aerodynamics for Naval Aviators" or any other reliable reference book available. I've never been able to induce a satisfactory "dutch roll" in any straight-wing training type airplane. This roll/yaw coupling phenomenon is usually found only in swept-wing types. One might ask where the term "dutch roll" originated, most seem to think that it probably found its genesis in the rolling motion of a speed skater on the frozen ice canals of Holland. At any rate, I can attest that the recovery from this potentially violent and lethal maneuver is completely non-intuitive! In fact, I'd describe it as the antithesis of coordination. It is a good portion of the reason for the development of yaw dampers (when first developed they were often referred to as dampeners) on modern day jet transports. It is also the reason why, if one experiences a yaw damper becoming inoperative on the Boeing 727, that the overriding priority is to extend the spoilers and descend NOW to a cruise altitude in the twenties.

Stuff yet to write:

Research into some possibilities for erroneous use reveals that it might have had it's origin in a Cessna approved Part 141 student pilot training syllabus in which it appears that the term was used incorrectly. This according to Steve Barber. Also, a FAA source tells me that his instructor also used the term incorrectly years ago in a Piper Warrior while teaching him to fly. So, no wonder huh? It's sort of like that line in that old song by Johnny Cash, "bad news travels like wildfire!"

One also mentioned that "since swept wings are a relatively new aviation development". Yup, like the Germans weren't conducting research with them about six or seven decades ago!

Any instructor hopes that his student will later proudly recall him as a font of knowledge regarding the things he taught, imagine that same student's disillusionment and disappointment years later if he learns that his instructor was just plain wrong. One instructor says he feels "it's shorter to say "dutch roll" than "coordination exercise". Well, that might very well be, however it's also shorter to call an aileron a flap, but no one that I know does! Also, he said "aerobatic pilots in particular have a long tradition of giving their maneuvers colorful names". That's certainly true and some of them certainly are descriptive, the "torque roll", "top hat", "humpty-bump" and others immediately come to mind here. One instructor who's always used the correct term told me that it most likely was because a school that included "dutch rolls" in their literature or syllabus could ask for higher fees from students. Oh, if it were only that simple!

Mentioned in "Fly The Wing" by Webb. Mentioned in "Basic Aerobatics" by Kershner. Mentioned in USAF 51-1 "Primary Flying". Mentioned in:

YOU MIGHT CONSIDER TELLING THOSE WHO DO NOT UNDERSTAND THAT THE "DUTCH ROLL" IS SOMETHING SWEPT WING PILOTS LEARN THE RECOVERY FROM!

To dos:

Isn't exactly upon the pedestal the student imagined, what instructor would want to have his student later remember him for telling him or using erroneous or outdated stuff.

Note to self, check this statement out: Pilots generally don't get offended that the "roll off the top" is also commonly known in the U.S. as an "Immelman," even though Immelmann's airplane was incapable of performing this maneuver.

Verne Jobst – "Civil Pilot Training Manual". It (1941 edition) refers to them under "coordination exercises".

Dutch Roll - Bill Howell

Many swept wing aircraft suffer a dynamic instability problem known as Dutch Roll. Dutch roll happens when the aircraft has relatively strong static lateral stability (usually due to the swept wings) and somewhat weak directional stability (relatively.) In a Dutch roll the aircraft begins to yaw due to a gust or other input. The yaw is slow damping out so the aircraft begins to roll before the yaw is stopped (due to the increased speed of the advancing wing and the increased lift due to the swept wing effect.)

By the time the yaw stops and begins to swing back toward zero slip the aircraft has developed a considerable roll rate and due to momentum plus the slip angle the aircraft continues to roll even once the nose has begun returning to the original slip angle.

Eventually the yaw overshoots the zero slip angle causing the wings to begin rolling back in the opposite direction.

The whole procedure repeats, sometimes with large motions, sometimes witch just a small churning motion. Like all dynamic stability problems, Dutch roll is much **worse at high altitudes** where the air is less dense.

Dutch roll is almost certain to happen in a jet aircraft is the Yaw dampener is turned off at high altitude. Therefore, the first thing to check if an aircraft begins to exhibit Dutch roll is that the Yaw Dampener is on. The pilot should then try to minimize the yawing oscillations by blocking the rudder pedals i.e., hold the rudder pedals in the neutral position. Next apply aileron (spoiler) control opposite to the roll. The best technique to use is short jabs of ailerons applied opposite to the roll. Try to give one quick jab on each cycle i.e., turn the wheel toward the rising wing, and then return it to neutral. Finally accelerate to a higher speed, where directional stability will be better, or descend into more dense air, for the same reason.

The movie below shows graphically what a steady Dutch roll looks like. However, it is critical to realize that Dutch rolls are often dynamically divergent. In other words in this movie the Dutch roll is exhibiting neutral dynamic stability, but it may well be negative dynamic stability in a given aircraft, at certain speed and air densities.

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<u>Coordination Exercises</u>

Banks without turns.-Definition. - This maneuver differs from those previously described in an important way. Those all teach coordination of types used in practical flying. This one teaches a different coordination, which is of no direct practical use, though it is closely related to the coordination often used in slipping in a gliding approach to an airport so as to steepen the approach without gaining speed. Its use here is primarily as an exercise in learning new coordinations.

This maneuver consists of flying level and banking the ship first to one side and then to the other, meanwhile holding the longitudinal axis horizontal and not permitting it to swing form side to side. In other words, the banks are to be made without allowing the airplane to turn or its nose to rise or fall. Naturally, a certain amount of slip is to be expected.

Execution.- For this exercise also a straight road is needed or else a fixed point on the horizon. The exercise is performed as follows, assuming that the ship is flying straight and level and that the first bank is to be made to the right: pressure on the stick toward the right should be exerted and at the same time, in most airplanes, a slight pressures on the right rudder pedal, depending on the rate of roll. As the right wing drops, the nose will tend to swing to the right. This should be checked by pressure on the left rudder pedal. When the desired degree of bank has been reached it should be held momentarily. This means that the pressure on the stick may be eased slightly, but not removed, while the pressure on the rudder pedal is maintained. At the same time a slight forward pressure on the stick may be required to keep the nose from coming up.

Recovery.- In recovering from the bank and rolling into the opposite bank, pressure to the left must be exerted on the stick and the pressure on the left rudder pedal increased (the amount depending upon aileron pressure), until the ship has rolled past the level position. Before the airplane begins to yaw, the pressure on the left rudder pedal is removed and pressure applied gradually to the right pedal.

Again, when the proper bank has been acquired, the ship is rolled into the opposite bank by reversing the procedure just outlined. The banks to alternated sides must be equal, and the timing rhythmic. The flight path must be straight and the nose of the ship must not rise of fall.

Reasons for specified use of controls. It will be noted that if the ship is banked with the rudder held either in neutral or left free, it will attempt at first to yaw toward the side of the low aileron, or high wing. This tendency is due to the fact that the aileron that is turned down has more drag than the one turned up. It must be checked by using opposite rudder. In other words, while the ship is rolling to the right, it will attempt to turn to the left until the roll is partly completed, and the right rudder must be applied to hold it straight. After the ship is banked and begins to slip, the nose will tend to swing to the side of the low wing. This tendency is due to the pressure of the air against the low side of the tail fin in the slip. Pressure on the upper rudder pedal will then be needed to keep the nose from swinging. This will result in a slight sideslip to the right and wind on the right side of the face.

Since pressure is being applied on the upper rudder pedal (the left pedal in a right bank), there may be a tendency for the nose to rise slightly. It is for this reason that slight forward pressure on the stick may be needed.

Common faults:

(1) Allowing ship to yaw toward high wing at beginning of bank. This is caused by not applying enough pressure on the lower rudder pedal.

(2) Allowing the nose to swing away from the low wing. This is caused by too much pressure on the upper rudder pedal.

(3) Allowing the nose to swing toward the side of the low wing after the bank has been established. This is caused by not applying enough pressure on the upper rudder pedal.

(4) Failure to keep the longitudinal axis horizontal. As previously explained the nose tends to rise because of pressure on the top rudder pedal. Failure to apply sufficient forward pressure on the stick is the cause of this fault.

(5) Allowing the nose to yaw toward the side of the low wing when recovering from bank. This is caused by failure to increase pressure on upper rudder pedal as aileron pressure is applied.

(6) Failure to maintain uniform banks and timing. This fault can be corrected by practice.

The above was copied directly on pages 137 and 138. I was taught it by the name of “Advanced Coordination Exercise”. Same thing as “Banks without turns”.

The other coordination exercise was called by the Civil Pilot Training Manual as “rolling from bank to bank”. We call it the “Elementary Coordinations”.

Vern with an “e”

While in Mattoon for the “Wings Weekend”, I discussed the terminology of “Dutch Rolls”. CFI’s of ‘experience’ agreed that “Dutch Rolls” were a jet phenomenon only due to the jet swept wing. The way we were taught (and had to demonstrate) was after getting into a TRUE ”Dutch Roll”, we applied ½ speed brake to correct the situation. Very effective.

16.5 Coordination Exercises

Here is a good maneuver for learning about your plane's roll-axis inertia and adverse yaw, called “coordinated wing rocking”. The procedure is: roll rather rapidly into a 45 degree bank to the left. Pause for a moment, then roll to wings level. Pause again, and then roll 45 degrees to the right. Pause again; roll wings level, and repeat.

Refer to chapter 11 for a discussion of various techniques for perceiving whether or not your maneuvers are accurately coordinated.

The rolls should be done sufficiently rapidly that significant aileron deflection is required. Do the maneuver at cruise airspeed, and then do it at approach speed and even slower speeds, so you can see how the amount of rudder required increases as the speed decreases. Do the maneuver while looking out the side (wings should go up and down like a flyswatter, with no slicing) and while looking out the front (rate of turn proportional to amount of bank, no backtracking on roll-in, no overshoot on roll-out). Pay attention to the seat of your pants.

You should do the maneuver two ways: once with large aileron deflection applied gradually, and once with large aileron deflection applied suddenly. The difference between the two demonstrates adverse yaw.

16.6 Constant-Heading Slips

Unlike the previous exercise (which involved *coordinated* wing rocking) this one involves intentionally uncoordinated wing rocking. Put the airplane in a slight bank (15 degrees or so), then apply top rudder to keep it from turning. Hold it there for a few seconds, then roll back to wings level, hold it there, then roll to the other side, etc., maintaining constant heading throughout. This is grossly uncoordinated, but it is amusing and educational because it lets you learn the feel of the controls and the response of the airplane.

When you first put the airplane into a bank, it has a sideways force but no sideways motion, so there is no weathervaning tendency and no need to apply top rudder. It takes a couple of seconds for the airplane to build up sideways velocity, during which time you feed in progressively more top rudder. The same logic applies in reverse when you roll out: keep the rudder deflected during the roll-out, to maintain heading; then, as the sideways velocity goes away, gradually relax the rudder pressure.

For a discussion of the physics of the situation, see the end of section 16.8.

You might think this exercise is good practice for crosswind landings, but it's not directly relevant. That's because it involves a change in direction of motion, while a crosswind landing involves a transition from crabbing flight to slipping flight without any change in direction of motion. Slipping along a road (section 16.8) is a more-relevant exercise.

Constant-heading slips are essentially the same as the top three “points" of an aerobatic 8-point roll.

Constant-heading slips are sometimes mistakenly called Dutch rolls, but they are not the same as the natural aerodynamic Dutch roll oscillations discussed in **section 10.6.1**. Both involve slipping to one side and then the other, like a Dutch kid on skates, making a series of slips (left, right, left, right) without much change in “direction”, depending on what you mean by “direction”. But note the differences:

- Natural aerodynamic Dutch roll oscillations change the heading, with more-or-less unchanging direction of motion.
- Constant-heading slips change the direction of motion, with unchanging heading.

Another amusing and educational exercise is called “drawing with the nose”. It goes like this: keeping the wings level at all times, yaw the nose to the left with the rudder. Then raise the nose with the flippers. Then yaw the nose to the right with the rudder. Then lower the nose with the flippers, and repeat. Imagine you are drawing a rectangle on the sky in front of you, using the axis of the airplane as your pencil. Because of the slip-roll coupling described in section 9.2, while pressing right rudder you will need to apply left aileron to keep the wings level. The purpose of this exercise is to illustrate yaw-axis inertia, yaw-axis stability, and yaw-axis damping. That is, you will notice that if you make a sudden change in rudder deflection, the nose will overshoot before settling on it steady-stage heading once again, the combination of controls used here is very different from proper turning procedure).

#42 HYDRAULIC LOCK – AGAIN

"To limber the oil up" was the answer (no, I'm NOT making this up!) given recently when asked why we do this on the pre-flight. Then he was asked, "What would you do if you detected a hydraulic lock"? The first answer was great, "Remove the lower spark plugs". But then he was asked if you could turn the propeller backwards to clear the lock? "Yeah, that'd work too!" was the answer!

Seems to me that we need to open this can of worms once more!

A "question and answer" entry noticed within a major aviation publication reveals an appalling example of unknowing or misperception, to put the best face on it! No, the purpose of pulling the prop through on pre-flight is NOT to clear the cylinder; it is done simply to detect that a lock is present!

If you do get xxxxxx.

#43 THROTTLE ADVANCEMENT ON TAKE-OFF

A week or so ago, I was conducting a proficiency check in a North American B-25. The pilot moved the throttles forward noticeably slower than I would have. Certainly within a rate that would be normal, but still far slower than I do. They reached the maximum manifold pressure around the time we'd accelerated to approximately 70 MPH or thereabouts. When we discussed it afterwards, he mentioned the case of another pilot that also flies this airplane; his rate of throttle advancement is even slower! In his case, the throttles might not reach the take-off manifold pressures until liftoff, or later. Hmmmm! I asked him if he knew why the other pilot used such a slow throttle movement. As I'd suspected, his answer was "makes it easier on the cylinders, doesn't build up the pressure as quickly". Now, I don't like "burst" accelerations either (just think of those poor supercharger impellers having to accelerate to about ten times faster than the reading on the tachometer), but all aviation is a compromise. Now let's examine this thought a little further, OK? And keep in mind that we're discussing airplanes without turbo-superchargers here, the needs of those airplanes may, or may not, differ.

(Draft copy)

A grizzled chief pilot once told me to always "wiggle" or "walk" the throttles with your wrist. You simply cannot jam the throttles with your elbow while simultaneously wiggling them with your wrist, it appears to be impossible! It works in either direction, both for power being advanced for take-off or power being retarded for the landing. Now, as to the rate of application, or how fast to do it. Use of the phrase, "apply it normally", could very likely have a different meaning to each person reading this. So, you'll have to be able to determine this for yourself – and utilizing this method, you can! In an attempt to make this as clear as possible, let's just say to apply the throttle(s) as rapidly as possible, but without overspeeding the propellers. That's more descriptive of what we're trying to say here. If you apply them so rapidly that you hear an overspeed taking place followed by the governors returning them to the desired RPM, and then obviously you've applied them too rapidly! Conversely, if you "dawdle" in the application (even though it may fit your particular definition of normal), taking many seconds and noting no overspeed, then that also is indicative that you're taking too long to get this accomplished!

Take a look at the tachometer; do you see that little-bitty lettering down there in the middle of that instrument? Says "Revolutions Per Minute", right? That's "Per MINUTE". Well, it's fairly easy to figure out about how many engine cycles will be made as we advance the throttles (the tach measures the engine's RPM, not the propeller's RPM, right?) And remember that every other stroke is a power stoke on a four-cycle engine. To make it easier to visualize, we can convert that tachometer reading to cycles per second. Let's use the B-25 engine's 2600 RPM here. 2600 divided by the 60 seconds in a minute equals about 44 engine cycles per second, and then divide that in half to get the number of power strokes, about 22. Now we've got a figure that we can work with here. If it takes you about 5 seconds to advance the throttles to the limiting MP, then that means about 110 power strokes. If we "dawdled" and used 10 seconds to reach the maximum power, the figure would be 220 power strokes. Even if you'd "jammed" the throttles to the redline in 3 seconds, that'd still be 66 power strokes; however in that case the impeller's acceleration would be extremely rapid! So, from the above analysis, it's readily apparent that the RPM of a normal throttle application permits a plethora of power strokes, allowing a perfectly adequate combustion pressure increase. In other words, not a good reason to utilize a more leisurely or slower throttle application.

So, move those throttles up, remember that as (or) if you "dawdle", the runway's rapidly disappearing behind you, and you'll not be accomplishing at all what you'd thought you were doing!

Write yet:

- Check of instruments afterwards, Braly?

#44 "TORQUE" VE "P-FACTOR" TERMINOLOGY

(1) Definition of torque – (Aerodynamics for Naval Aviators): "

(2) Definition of torque – (Webster): "a twisting or wrenching effect or moment exerted by a force acting at a distance on a body".

(3) Definition of P-factor – (Aerodynamics for Naval Aviators): "

Torque is the reason that the left tire's tread on a Mustang invariably wears faster than the right one. Did'ja ever notice that? Well, take a quick look at one the next time you see a Mustang parked at an airshow, many times you'll find it to be so! When I start a take-off in a Mustang, it's with the stick fully to the right and full right rudder before I ever add the throttle. Initially the ailerons aren't going to do anything, but as they start to gain effectiveness with an increase in airspeed, they'll counteract the effects of torque. Until then the Mustang definitely will "tromp" or "twist" downwards on its left side. That's torque! Also, even without wind, it'll also want to swerve off towards the left side of the runway! That's P-factor, a different thing from torque. That attempt to swerve towards the left is a common characteristic of our American-built airplanes!

I'm able to demonstrate torque in a Mustang, Corsair or airplanes like that; however I cannot in a Swift or even a T-6! The latter two simply don't possess adequate power to exhibit any readily noticeable amounts of "torque" effect to the student.

Yet to write:

An abrupt change in angle-of-attack? I.e., raising the tail during the take-off roll. Precession force.

Len Dolny in the back seat of a TF-51 over at STP's Holman Field, that balked/rejected landing with the left wingtip dragging the ground.

Elevators have twice the area of the rudder; any fool can raise the tail before enough rudder is available to control yaw! Expression out in west Texas about "getting a 90 degree change of scenery without ever moving your neck"!

Raise the tail abruptly? Well, maybe you deserved what you got from that rash act of yours!

In the end analysis, all the above discussion attempts to precisely define the terminology or the forces for the flight instructor to enable him to fix the correct terms in his/her student's mind. After all is said and done, however, what we're really looking for here is the innate ability of the pilot to apply a copious amount of controls BEFORE needing them to keep the airplane from abruptly turning towards the left (or for the Limeys in the Sea Furys, to the right!).

From the "Swift Association" Newsletter, Feb 02
ED THE RUDDER MAN.

Subject: Rudder

From: Jack Gladish gladish@adams.net

Hi Ed, Jack Gladish here proud owner of N3321K. My conventional gear time here doesn't play a roll here in my question, 15000+ in just taildragger, from Pitts to DC-3's, but something here that I'd like to bring up, I've been flying 21K that last few days, and I'm using full right rudder, and even had to drag a brake on take-off... landings are fine! I used RW 31, the winds where 280 to 300 at 10 to 15 mph. This happened when I was raising the tail, after a little speed was bit up, my rudder came back, but I used a lot of right rudder during climb. Once at cruise, alls ok, a little like my Cessna 195, it had a lot of torque, and a long fuselage...My prop is a 73-59, and I'm running a 0-300D...what do you think ED? I'm almost sure it's just lack of rudder in a critical phase, but it doesn't hurt to ask! Thanks Jack Gladish N3321K.

Jack,

Hmmmm. The first thing that comes to mind is cable tension on the rudder cable. Should be 70#. The thing that puzzles me is that it "comes and goes". That would be explained though since you're having the problem in a hi-power situation and torque enters in. You wouldn't have torque at cruise and on landing. If the tension is off or low on the rudder cable, you would notice it more on take-off and in a climbing situation at hi power settings. Another thought that comes to mind is the rudder bellcrank in the belly being restricted by something. Pull the panel just aft of the firewall and make sure all is the way it's supposed to be there. No obstruction or restriction. The next thing I would check is in the aft fuselage behind the cockpit. Open up the access and look into the tail to see if all looks normal. If you have the bulkhead for 'carbon monoxide' installed, it possibly could have come loose and is causing some restriction. Closing thought, I would start with checking the rudder cable tension, but go through the remainder of the points I mention just to make sure. I'm going to cc this to Jim Montage and Steve Wilson and see what they might add. Cheers.....Ed

Lloyd HERE IS WHAT STEVE HAS TO ADD
From: Steve Wilson SteveWlson@aol.com
Subject: Re: Rudder
Hi Jack (can we say that?)...

For the sake of brevity I will assume the airplane is rigged right and you have read and heeded Ed's note.

The Swift is a peculiar animal. I have flown numerous tail draggers, and the Swift is like none of them! Well, maybe BE-18 has similar traits. The stock airplane has a straight engine mount, unlike some of the higher power versions. The airplane has a rather forward CG compared to common taildraggers of the period. If you have experience with the C-195 you know that on take-off, if the cowling moves 1" to the left, the tail has moved 1' to the right! OTOH, the nose of the Swift moves dramatically in relation to the tail. Don't get fooled though, where the nose goes, shortly thereafter goes the tail!

Here is what I teach newcomers to the "stock" Swift on take-off procedure. It doesn't matter to me how much time the "student" has in tailwheel... line up the airplane in the center of the runway and let it roll forward a little to center the tailwheel. With brakes off, start with the wheel (stick) all the way back and bring power up continually to full power. Assuming you have a steerable tailwheel you will find just application of rudder in the desired direction will steer the airplane OK. With non-steerable, just a small amount of brake in the desired direction will do the same. If you run into a problem with directional control at this point, reduce power and regroup.

As the airplane accelerates keep an eye on the airspeed. Do not release back pressure until you see the airspeed is alive. I've seen a lot of folks start to rotate onto the main gear way too early! One thing to remember is the elevator authority is much more effective on the Swift than is the rudder at low speed. Somewhere about 40-45 MPH, you need to come forward with the stick. Not abruptly, but with authority and continual movement until the weight is firmly on the main gear, with the tail high. I know that several forces are at work here... gyroscopic effect from the prop wanting to turn 90 degrees to the direction of rotation (which means left), transition from tailwheel steering to rudder, Left turning tendency from the straight mount (torque). So, you will need to feed in rudder to counteract this turning tendency. It may vary from full right rudder and some right brake with a strong left crosswind, to nearly neutral or maybe a touch of left rudder in a right crosswind condition. I would not choose a take-off with a tailwind component (if at all possible); however, given the choice of a left or right crosswind, I would opt for one from the right.

Here is the one place I find Many/Most people get into trouble. They do NOT get the tail up high enough. You have to get the airplane into a negative angle of attack! There is three degrees of incidence built into the wing, so the nose will seem very low! Plenty of weight on the main gear! This allows the rudder to become effective (gets it up in the breeze), and allows you to "drive" the airplane with the rudder and if necessary brakes. If you become aware that you are not maintaining directional control, before you do anything else, start with more forward pressure. You probably do not have the tail up high enough. More pressure on the man gear will allow you to use more brake (if needed) and the higher the tail will allow more rudder authority. May seem hard to do, but a lot of Swifts have been lost at this point. Either you are a pilot or a passenger. If directional control is lost, you are a passenger. Use what you have working for you! An RTO at this point is problematical at best. Not impossible, but tricky. If you reduce the power abruptly what will happen to the rudder authority? Where is the airplane going to want to go? It is very easy to go from limited control, to over-control, to loss of control in the wink of an eye!

As the airplane accelerates through 60-65 MPH you can release forward pressure and allow the airplane to transition to a positive angle of attack and it will liftoff. I find with my airplane, I frequently use full right rudder during the initial phase of the take-off roll and more often than not a little brake to keep the airplane going straight down the runway. There is a definite difference between the 125 HP and the 145 HP at this point! You don't have to be a test pilot to notice the difference! I suggest use of this technique until you are completely familiar with your airplane, then you can modify the technique to what is comfortable to your style of take-off; however, in the initial learning process, you will be a "happy camper" if you go through the take-off procedure as I describe it. This is regardless of wind condition.

To be completely honest, I use a little different technique myself for a take-off with no wind/no crosswind; however, when a crosswind is present or anytime it is gusty, I revert back to this technique. It has served me well for 38 years...Happy Swifting! Steve Wilson.

#45 MANIFOLD PRESSURE – FINAL APPROACH

This concern arises nearly every time we discuss operating and/or flying large airplanes with piston engines. I've heard it – and so have many others – during various seminars, ground schools, forums, impromptu conversations, etc. It appears to me that some pilots or mechanics are letting their good sense be overridden by something they'd heard. It's based upon good intentions – but part of their conclusion somehow went completely awry.

If I remember correctly, this "day's work for a day's pay" philosophy was applied on the airline. Meaning that our chief pilot (Art Hinke) asked the pilots to make an honest effort to operate our aircraft engines by the "one inch of manifold pressure for every hundred RPM" rule of thumb <u>all day long</u>. This effort was how the airline attempted to deal with the "reciprocating loading" problem. However, he also recognized that it was also a matter of both practicality and necessity to operate at less than this on base leg and final approach. In other words, "don't put yourself, the passengers and the airplane in a dangerous situation by <u>mindlessly</u> following a rule".

To write yet:

- Bad low approaches.
- Trees waving in front of the runway lights at night?
- At low airspeeds, is the R/L 1"/100 RPM valid? Concept of prop driving the engine?
- An everyday, normal approach should look just like an ILS glide-slope to you, (2½ or 3 degrees on average). This is where your perception should be at its sharpest, after all this is the same approach that you fly everyday so your judgment should tell you very accurately if it isn't according to this, things just won't look right. Right?

#46 REJECTED LANDING" VS "MISSED APPROACH

This maneuver, required by the FAA's Practical Test Standards (PTS), for an aircraft type rating or a proficiency check is certainly capable of igniting an endless discussion among pilots. As a friend of mine once said, "just mention it, then walk away for a cup of coffee and you can come back hours later and the argument will still be going on!"

Somewhere in here I need to clearly state the "design intent" of this bulletin! I'm going to limit this to only the "all engines operating" situation. In other words, you need to be aware of the fact that no mention is made in this bulletin of either approaches or go-arounds with a failed engine. That operation/condition is a vastly different (a'nuth'r kettle of fish) and a discussion of it is not germane to or included in the following!

I'd assure the reader that I totally agree that this is a necessary maneuver that one must know how to accomplish or to be required during a flight check. It's realistic to expect that a pilot will normally experience at least one <u>or more</u> of these situations during his career. However, a lot of confusion exists between this "balked"/"rejected landing"/"go-around" maneuver and the "missed approach". I guess, simply put, that the first represents the abandonment of an incipient landing – <u>however near to the surface you might be</u> – and for any number of reasons. On the other hand, the second one represents the abandonment (on instruments) of an instrument approach at a minimum prescribed instrument approach altitude.

First, let's discuss the "balked/rejected landing/go-around" maneuver. As we said before, this required maneuver can be performed at <u>any</u> height above the landing surface – including <u>on</u> the runway! It's surprising to find how many experienced pilots have the mistaken impression that this can only be done at or above a certain height above the runway. In one case, (believe it or not) I found one person who insisted (in a B-25 on both engines), that it could only be done at 600' or more above the airport. Wow! Sort of makes one wonder how he ever expected that airplane to have gotten airborne in the first place, huh? Let's get this straight right off the bat, this maneuver can be - and is – accomplished even when a touchdown's incipient. Or for that matter, even later, since the touchdown may have already occurred.

Obviously the very first thing that must be accomplished is to immediately apply maximum power. I'm at somewhat of a loss here regarding how to describe the rapidity of advancing the throttles. Probably the best way to say it is to walk them forward as fast as possible while avoiding over-speeding the propellers. Change the attitude of the aircraft to stop – or partially stop – the descent as the case may be. Pilots of a certain training background seem to have a high degree of difficulty with letting the aircraft "rare up" on them as full power is being applied, probably because they're used to raising the nose of a jet aircraft in this situation. <u>Avoid this "rare up"</u>. If contact is going to happen, fine, put the aircraft into an attitude for the touchdown and at the same time start the flap retraction process towards the flap setting normally utilized for takeoffs. If the examiner gives you this maneuver and you realize that you'll have to touchdown on the runway during its execution, do whatever you need to in order to make sure that you're in alignment with the runway when you touchdown. This is where many people seem to make their basic mistake and probably why many seem to be reluctant or unable to accomplish this maneuver. You must (1) contend with the touchdown <u>while at the same time</u> (2) reconfiguring the aircraft into a takeoff configuration. The following is one of the most important parts of this whole maneuver! Since the landing gear will already be down and locked for the landing, <u>leave it in that position</u>! This is in the likely event that contact with the runway will occur during the go-around. Having the gear down and locked eliminates the concern over this happening.

Usually the flaps are already going to be fully extended or at a landing setting. Play your attitude/altitude while the flaps are retracting, remembering that a touchdown may or may not occur, the maneuver's outcome is not going to be affected by it. Each situation is going to be different and only you, the pilot, can determine the needs at that time. This maneuver is accomplished by visual contact with the runway; therefore the pilot's eyesight and judgment must tell him when the gear may be retracted. As soon as **you** determine that touchdown is **not going to occur**, start the gear retraction (<u>it isn't necessary to have a positive rate of climb for this - you are not on instruments</u>).

Sometimes this is going to be almost as soon as you start the go-around maneuver and, at other times, you may already be on the ground. In that case it's going to be the same as a regular takeoff.

During the process don't climb at a steep angle, the intent here is to climb very slightly – If at all – while increasing the airspeed as rapidly as possible, accelerating as the aircraft changes into its takeoff configuration. Use the elevator control aggressively to either (1) maintain a slight climb if necessary or (2) accelerate in level flight. When the flaps reach the desired setting, stop their retraction. From this point onwards, it's the same as a normal takeoff. When you've attained the desired airspeed, fully retract the flaps. When reaching the desired airspeed, you can reduce the power to the METO setting. Later, when reaching the desired airspeed for climb, reduce the power setting to CLIMB power.

OK, all that stuff above was for the rejected landing. Now let's discuss the missed approach. As we'd said earlier, this one is done on instruments and is simply an aborted instrument approach. After making the decision to discontinue it, the obvious first thing that must be done is to apply the correct power (not necessarily MAX power). Your airplane's flight manual will tell you what's appropriate here; it might be CLIMB or METO or MAX power, it's impossible to say in this note. Simultaneously (with all engines operating) raise the nose to the correct attitude required to not only stop the descent but to create a climb. Again, the manual might tell you the attitude (expressed in degrees or in bar-widths) that's appropriate for use in this situation.

Things yet to write:

"I always like the part during checkrides where the victim thinks that they will get a go around/rejected landing and they carry extra speed – then they get all ansy as the runway gets close so they pull all the power off then I say go around and all hell breaks loose." TJ

"Might add something making the need to "hold 'er down, newt, she's a rarin' on ya!" I tell 'em if they go above 10' above the runway before they're back in the full takeoff configuration, I'll kill 'em. <g> They all end up exceeding 10', but it helps get the idea across that "speed comes first," and "this ain't no jet." Airline pilots have a TOUGH time with this, too used to pulling with the left hand and pushing with the right. Usually gotta push HARD with the stick hand. Hate it when someone in the T-6 lets it rear up, and they end up at 60 knots, 300 feet in the air, still unable to clean it up. Do it right, and it comes out of the landing configuration like its shot out of a cannon – or off a carrier deck." JD

#47 EXAMINER GIVING DUAL DURING THE CHECKRIDE

The subject of avoiding this has arisen many times during the course of innumerable type ratings and/or proficiency checks. Therefore, I thought it easily deserved the amount of ink it'd take for a discussion on here of its rationale and some background on this subject.

I can still see (in my mind's eye) the classroom instructor at the Designated Pilot Examiner (DPE) school in Oklahoma City telling our room full of aspirants, "If you're so danged smart and great an instructor then why don't you give the dual and let someone else administer the checkride?"

Those guys at the FAA academy in OKC are smarter than I am, this was their rationale – based upon experience. "The applicant will watch you demonstrate it and then say to himself "So THAT'S how the SOaB wants it done" and then do it that way to pass the checkride. As a good friend of mine and a long time examiner says, "Monkey see – Monkey do!" Just as soon as the applicant has the certificate tucked safely in his pocket and is out of the DPE's sight, he then (probably) reverts to the way he was first taught."

If you're wondering just what prohibition in the FAR or handbook the OKC instructors mentioned, the 8710.3C (examiner's handbook), page 5-2, 9.A was cited to me. Just quoting it here seems the easiest, "If the examiner gives advice to the applicant or assists the applicant in manipulating the flight controls except in situations not caused by the applicant's performance and requiring that the examiner intercede to ensure the safety or continuity of the flight, the assistance or advice would constitute unsatisfactory performance on the part of the applicant". This handbook again makes reference to this on 5-5 19. A(2) with an "examiner must terminate the test and issue a notice of disapproval". I guess we don't need to tell you what color the form given to you by the DPE afterwards is gonna be, right?

Another problem, let's say the recommending instructor correctly instructed the applicant before recommending/sending him for the checkride. However, the DPE has his own way of doing things and shows the applicant an incorrect way (that that DPE may believe is better than the recommended way). Can anyone say "Old Wives' Tales"? This decidedly might not be true in all cases, but it certainly is true in many instances. It might work well either way – or it might not – it's impossible to say here. But I'll guarantee you it'll sure confuse the applicant or leave him with some questions that either cannot be or never will be answered. Or it could leave him with a possibly dangerous habit or procedure that never will be corrected.

Now – having said all that – you might question whether I've ever provided any help or instruction? Yup, sure have. And every other DPE that I talked to during the process of writing this also has! Guess that's just human nature, nothing that I know of can be done about it. However, it surely doesn't obviate the problems cited above. And that's also human nature, seems to me.

As long as you've stuck with me this far, let's discuss briefly something good for a change, just so's you don't think that this whole thing is all "doom and gloom". Most applicants don't know this and possibly some DPE's don't cover it too well in their pre-flight briefings to the applicant. Seems a pity! Did you know that you can momentarily exceed the published limits without it being considered a "bust"? True, the PTS (Pilot Test Standards) allows the DPE to note that the applicant is "correcting back to the published values" and allows it! Seems to be another good reason for the applicant to have read the PTS ahead of time, not for the purpose of "sharp shooting" it, but rather to have a clear understanding of what the checkride entails.

Yet to write:

Often cited reason for a non-renewal of the DPE certificate (and properly so, I think), xxx

Seems as good a place as any to mention this. The use of a hastily hand-drawn approach chart is NOT permissible according to 8710.3C (the examiner's handbook again). Page 11-2 specifically refers to the "use of makeshift and/or non-approved instrument approach procedures" as not being permissible for utilization during the test.

Some conversations, both on a computer forum and within an AOPA instructor's newsletter, have made me aware that a perception is floating around that the PTS's purpose is only to standardize any maneuvers the DPE wishes to require. Anyone holding this belief fails to understand that the PTS also exists to prescribe the maneuvers that the FAA requires to be accomplished during the checkride. We should probably also state here that this particular misunderstanding may sometimes be erroneously shared by an FAA person administering the checkride.

Stuff yet to write, comments, etc.

A reason for interrupting the check, doing training, then resuming the check is.....most Vintage airplane operators do not want to do the recurrent type of training (call it practice if you wish) to keep their costs down. This is understandable. This does happen at a facility you and I know of. None the less, it has to be impressed we need to follow the PTS. If training or practice is needed, that is just the price one has to pay to INSURE SAFETY for the operator and those who are exposed to whatever flights are planned. I feel especially strong when many of these flights are made with passengers, whether they are paying or non-paying passengers. The airlines and those who utilize such schools as Flight Safety or Simuflite get the needed recurrent training the day before the actual check.

Referring to "Hand Drawn" approaches, my feeling is NO, NO, NO. There are many reasons for not doing this but one that has high priority with me is the fact there is so much more information on a Jepp or NOS chart that would NOT be on a "hand drawn" approach. Unless one is blessed with a simulator where an approach can be made to any airport in the world, whether it be Hong Kong or Tim Buck Too, there is another way to throw in a "variety of approaches". For instance, take a published approach to a high altitude airport. Use the approach at your low altitude airport but AT the higher altitudes. This would keep you well above the local traffic but yield the variety needed. I am not sure that a DPE would be legal to do this. I do not think it jeopardizes safety, etc., etc. This is something we should run past JD for his insight/concurrence.

#48 PROP FEATHERING DURING A CHECKRIDE

I'm reminded – as I write this – of that day I'd **assumed** that the left prop on our Catalina was functioning correctly (it'd been checked **on the ground** several weeks prior). Afterwards, it'd been flown out to California, then at the time the following incident occurred – we were in-flight to Mesa on our way back home.

Things yet to write/talk about/discuss/mention/etc:

A letter here concerning this requirement that I *think* I'd received about 10 years or so ago: "I didn't mean to get in a maintenance v/s pilot argument, but I guess I did. First of all I know that military and airline procedures do call out for a in flight feather check. The FAA requires to feather and un-feather on certification rides, but according to my local FAA ops guy who also happens to do DC-3 rides and has flown one for years, he "hates to feather an engine in flight and only does it on certification rides not on PPE rides". Military and airline engine shops ran engines on the test cell for over 10-15 hours, a sampling of shops (Precision, Blakey, and others), run them for 4 hours. These shops don't recommend shutting down engines in flight. Pratt & Whitney frowned on it but gave procedures to follow if you had to. Mike Hedon with Precision says "it's crazy to feather an engine anytime but especially during break in, P & W did not recommend it, but the military and some airlines had it listed in their procedures. P & W gave specific procedures to follow if you were going to do it anyway". Teledyne Continental technical rep. John Black says "except in an emergency, never feather or otherwise shut down an engine until it is completely broken in , and then you shouldn't do it unless absolutely necessary. Check feathering on the ground not in the air". Shutting down an engine in flight is hard on it, but not as hard as restarting it in-flight. Feathering is a function of the governor, prop and feathering pump. These items are to be checked by maintenance for proper operation to include blade angles at feather. I understand the desire to check feathering in flight, but I don't think it's in the best interest for the engine especially on break-in. If checked properly on the ground there is no reason to check it in flight. The only reason the airlines and military checked them in flight was to make sure the engine came to a complete stop. If the prop is set properly and everything works properly on the ground there is no reason to put the strain on the engine. The idea that you want to make sure it is going to feather and un-feather. I would rather know that before I flew. I wear a parachute when I fly, but I've never felt the necessity to check it in flight. When we are asked to serve on a board and give opinions I would expect to give them and have rebuttals. That's why there is more than one person on the board, to get different opinions, and to get discussions going".

Cannot find the original Warbird Note that I'd (anyhow, possibly in my mind) written back when this WB note is dated in 2003, guess that I'll need to rewrite this and use a revision/rewrite number from later?

Left prop-dome removed after landing that PBY, bent distributor valve.

Probably the very last time that most airplanes were checked for proper feathering operation was during their time in the military.

Bill Dodd's experience and his subsequent abrupt "about face".

Verne Jobst's experiences.

#49 "S" TURNING WHILE TAXIING

A recent taxiing accident involved a Grumman TBM aircraft and caused the following discussion to be written. The NTSB/FAA accident report has not yet become available but I'd guess we should – once again – discuss some of the factors and/or principles involved in this unfortunate (but lethal) problem.

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Stuff yet to write:

Visual ability

<u>Accidents</u>
Paul Finefrock/Mark Foutch
John Trainor/Frank Strickler
Taxiing P-39 v/s fire bottle
Ronnie Gardner/APU
Ray Kinney P-40/Val (Tora-Tora group) wing

John, in a T-6, immediately behind Frank in the formation takeoff at Ft. Worth used "timing". Splat! His propeller ate Frank's (aborted takeoff) T-6 rear empennage/fuselage/canopy up to the turnover structure.

Tail-wheel lock mechanism.

Only one I cannot see ahead from while taxiing is probably the WWI Fokker Tri-plane.

My "Jug"' at the Green Bay airport, taxiing to the N-S runway, off the end of the taxiway onto sod.

The Messerschmitt is one that I'm able to see ahead from (IF you "S turn" it).

While researching this I heard about one DC-3 co-pilot who could see a preceding Cessna that the captain didn't see, Iver Shoberg.

Taxiing B-17 I can see ahead of around the navigator's plexi-glass dome.

P-47's Curtiss Electric propellers usually replaced by Hamilton Standard props.

#50 DITCHING – GEAR UP OR GEAR DOWN

The recent ditching of the USAIR 737 into the Hudson river has….

#51 JET ENGINE INLET SCREEN

A television anchorwoman (out of sympathy for her ignorance I'll NOT mention her name in this discussion) recently offered her question/idea/concern while reporting on the recent US Airways 320 Hudson river ditching. She wondered why airliner's engines didn't simply have an inlet screen to protect them from birds.

Yet to write:

Certification test, 4# bird carcass, old joke, thawed/frozen

Icing on the bars

Performance

#52 ICING AND AIRPLANES WITH BOOTS

The recent commuter airline aircraft accident at Buffalo has caused a great deal of discussion the last few days.

#53 B-29 FLIGHT CHARACTERISTICS

Inquiries from various people, along with some of my own thoughts, have led me to write (while I'm still able) some comments about various flight characteristics of the CAF's venerable Boeing B-29 "Superfortress". This is sort of a compilation of things that I've learned about this aircraft over the past 39 years.

First-off, I need to tell you that most of the things that I'm writing about here were either told or shown to me in the past by pilots who have much more experience on the aircraft than I. Accordingly, the importance of each merited their inclusion during the training of pilots wanting to check out in this "one of a kind" - "queen of the fleet" aircraft. I'm also sure that the recent conversion to the much improved later version of the 3350, as well as the plethora of other system changes, have added many more things that you'll be learning about. I just wanted to add my observations here to all the things that Charlie and his guys will be passing on and making you cognizant of.

1. One of the things we need to talk about here concerns some peculiarities encountered while taxiing this ancient "aerospace vehicle". Contrary to popular opinions among various observers, this airplane has <u>no</u> nosewheel steering. If you do a smooth job of taxiing, the ground marshallers (or anyone else watching) might be led to believe otherwise. Again – It doesn't – Boeing didn't include that feature until the B-50 came along. Taking this aircraft into strange airports during tours exposes it to a phethora of hazards – the occasional/random/higher than the others taxiway light (especially at some northern airports where snowfall is a consideration), narrow taxiways, structures, etc. – so extreme attention on the part of both pilots is vitally important. In addition, emphasis was placed upon the necessity of using the waist scanners for their help in detecting and avoiding ground hazards. We also pointed out that adequate clearance for the outboard props along the sides of taxiways was becoming less of an airport's design criteria since the advent of jet aircraft. The ground clearance (nominal) on the outboard props is only a scant 24" (you might also want to keep this in mind when you make a crosswind landing). <u>After landing (actually, anytime) don't turn off the active runway onto the taxiway until you've shut down the outboards and X'd their props</u>. Taxiway lights and other obstacles have already cost us two props and the associated "out-of-service" downtime (two separate incidents that I'm aware of)!

2. I refer to this aircraft as an "electric Boeing", i.e., since all the landing gear and wing flaps are electrically actuated/powered (the later Boeings utilized hydraulics for the same functions). The significance to you is that you'll lose the ability to extend the landing gear in a normal manner if you shut down the electrical system by turning off the generators and batteries. And yes, this has already (at least once) happened to us during a malfunction of a propellor's electrical feathering system.

3. Many people are amazed to find that the B-29 has <u>no</u> hydraulically boosted flight controls, i.e., <u>all</u> the flight controls - rudder, aileron and elevator - are solely manually operated. Obviously then, this places some rather high physical demands on the pilot. In fact, Vic Agather told me that during testing of the first couple of B-29s they'd found the strength required on the ailerons to be so high that the control wheel's travel had to be increased an additional amount to provide adequate leverage. The first Boeing that I flew with a hydraulic rudder boost (800#) was the C-97, a design of a few years later and a derivative of the B-29. Accordingly, expect to expend some high amounts of strength to operate the flight controls. At Oshkosh in 1989, Vladimir Tersky (aircraft commander of the Soviet's gigantic Antonov AN-124) exchanged flights with me and I was amazed at his adept handling of the B-29 while out over Lake Winnebago. I've usually found that pilots, upon first being exposed to Fifi's handling qualities, need an extensive amount of time to develop adequate control. Vladimir exhibited none of those usual hesitant tendencies, in fact, after only a short time he was doing "wingovers' and "lazy eights". I marveled at his abilities until, after our arrival back at show-central, I learned through our interpreter that Vladimir had flown the Tupolov TU-4 "Bull" (the Soviet copy of the B-29) for 19 hours while he attended the Russian military's equivalent of our Edwards AFB test pilot school.

4. Drop your heels to the floorboards before starting the takeoff roll (<u>tires on the B-29 currently cost about $4,000 *each*!</u>). The B-29 demonstrates strong leftist tendencies on takeoff, so you'll have to lead with the left engines and then reserve control of the throttles to prevent the engineer from advancing them until you are absolutely sure that you have – <u>and will continue to have</u> – directional control (I've been surprised more than once on this deal).

5. You'll notice a <u>big</u> difference between the definite "rotation" to the liftoff attitude that we've all become used to on our modern day jet aircraft, in contrast to this relic from a now long-gone era. Attempt to achieve a flatter liftoff; there are two reasons ("A" and "B") for this. "A" is to gather (as rapidly as possible) a cooling airflow for the engines. I became aware of this during the very first takeoff that I'd ever made in this aircraft. The temperature at China Lake NAS was approaching 100 degrees when we took off early that morning. As a side note here, I never did like those old front exhaust engines and I'm really happy to see that a long time wish of mine is about to become reality, that of retrofitting much later (and improved) Wright 3350 engines to Fifi. This change alone should largely eliminate the immediate cooling airflow needs of the old engines. Reason "B" is to eliminate the possibility of striking the tailskid during rotation.

6. While re-qualifying Paul Tibbets, he'd told me about making a sharp turn (such as he did over Hiroshima). Using the aileron, you can twist the wheel until reaching the stops along with moderate rudder being applied and the aircraft only slowly enters a turn. However, if you apply the same full aileron together with what would appear to be a <u>lot of</u> (full) rudder the aircraft acts as "if you sawed the wing off". While filming the movie simulating Hiroshima over San Luis Obispo, California, I used exactly that same control technique and the results obviously satisfied the movie's director on the first take. During airshows – despite providing advance warning – I've seen Mustangs or other fighter type aircraft left very surprised as you enter a turn in this manner.

7. While training USAF multi-engine pilots in B-25s we taught them to keep the wings level during and after feathering an engine. We were well aware of the aerodynamics involved but taught it that way because of that old saw "give someone an inch and he'll take a mile". The student would attempt to tell me that they were using 2 degrees of bank when they were actually more like 10 degrees. Years later, during flight with either outboard prop feathered on the B-29 I found a noticeable "buck" or "slap" of the rudder when we kept the wings level. If you lowered the wing <u>very</u> slightly (2 or 3 degrees) it would cease and the aircraft would perform slightly better.

8. Years ago someone - who we'll forevermore just refer to as "unknown" – decided to remove the capability of transferring fuel across the centerline of the aircraft. Before going any further, the reader must understand that the B-29 <u>does not possess</u> a "crossfeed" capability, only a "transfer" capability. Unfortunately, this modification removed the flight engineer's ability to laterally balance the fuel load in the event that becomes necessary. I'm afraid that this situation was not considered very well before making that change. My comment was - " so now if you feather an engine on Fifi, you'd better start looking for and thinking about an airport to land at!" If I recall correctly, on the 727s we had a permissible lateral fuel imbalance of 1,200#. I also seem to remember an equally attention grabbing restriction while flying the 747s. At any rate, this is a <u>big</u> deal. Upon becoming aware of this, I called Bob Robbins (retired Boeing test pilot, he'd taken over testing the XB-29 after Eddie Allen's death in the crash of the #2 prototype) about it, mentioned to Bob that I'd never seen a maximum imbalance figure spelled out in any B-29 flight manual. He told me that this was a military aircraft and no limitations were spelled out. I guess that I'll never forget his succinct reply, probably using a shorthand language of one test pilot to another regarding limitations. It was just as I'd surmised, "when you lose control, you've just exceeded the limit".

9. One final thing we need to discuss here is something that I'd noticed from the very beginning in checking out pilots new to this machine. On final approach, they'd align themselves with the runway – *according to their perspective*. The problem was that they were tracking to the left side of the runway, not by a lot - but still noticeable. In their defense, I must mention that the B-29's windshield is made up of many small panes of glass, each pane set at a different angle from the others, with a final design purpose of creating a rounded nose on the aircraft. After cautioning them that they were lined up with their left main gear out in the grass they all – almost universally – expressed disbelief. The final approach would continue and then – around two or three hundred feet in the air – they'd suddenly recognize their error and then indulge in varying amounts of extreme maneuvers in an attempt to align themselves prior to landing. Many times, this last minute maneuvering resulted in a go-around. I really am unable to offer any substantial advice as to how to cope with this. It's recognized as real problem in these aircraft and one simply has to deal with it. The best advice I can offer is simply to "look through the windshield, not at it". By way of an admission, I encountered my worst experience with this illusionary effect one night in the rain during an ILS to Indianapolis. And also, avoid the attempt to allow for your seat being offset towards the left side of the cockpit, *just line up with and land on the centerline's stripe on the runway.*

In closing, going back to something I'd said much earlier, I'm sure Charlie and his crew will be waiting to tell you about all the things that have been changed and many other characteristics that are unique to this aircraft. In fact, so many changes have been made to this aircraft during the period that we've had it that I almost think that we should call it a B-29M (the "M" to stand for "modified").

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#54 BRAKE/TIRE/WHEELWELL FIRES

Discussions concerning this particular problem go w-a-y back. In fact, they go so far back that we'd considered the matter as one that was settled and not needing any further discussion. But, some recent conversations and questions lead me to believe that either it wasn't a totally settled matter or else the dangers or problems associated with it may have been forgotten over the years.

Years ago (more years than I'd care to admit) an arriving transient aircraft parked on the base operation's ramp at Reese AFB. One of the main gear on that aircraft had an overheated brake, causing a lot of smoke. I believe the tower must have called the fire station because, in a very short time, a huge fire truck arrived at the scene complete with requisite flashing red lights and blaring sirens. A fireman promptly hopped out and began discharging a fire extinguisher onto the tire and wheel. After a short exposure to being drenched with the chemical agent, the wheel abruptly exploded. Fortunately, the fireman wasn't standing at the side of the wheel, he was (and this is the reason for recounting this story) standing to the front of it. A portion of the rim, impelled by the explosion's force, flew completely across the ramp and found an unfortunate new Chevrolet in its path (some of you might know, or recollect, that the first year for the Chevy 265 V-8 was 1955). The small metal portion first impacted the automobile's front fender well. After passing completely through all the sheet metal it finally lodged in the engine's crankcase. The good thing about this whole deal was that no human happened to be in the path of that hurtling metallic projectile. I'm well aware of the procedure that JAL (Japan Air Lines) routinely used for cooling the brakes of their 727s, DC8s and 747s with water. This caused immense stem clouds. I think however, that it's germane to point out that the agent contained in a fire extinguisher is f-a-r more frigid than water. I guess that this recollection only serves to point out a couple of things that I learned/remembered from that incident. (1) Don't discharge a *supercooling* extinguishing agent onto a hot brake. (2) Don't stand at the side of a hot brake/tire fire if you are trying to extinguish the fire, stand either in front of or to the rear of the tire.

"Hot brakes?" "Never gonna happen to me", you say? Yup, I always had precisely the same thought – and then it happened to me! A high speed rejected takeoff. Unlike the practice ones at low speeds that we've all done, this was a real life "do or die" situation. Resulted in some hot (like *really* hot) brakes!

Some of the things that we've already talked about in past Warbird Notes simply recount various experiences that people have related to me. One concerns the matter of preventing hydraulic fluid from being dumped on a hot brake or fire from a ruptured/burnt hose – while still preventing aircraft movement. Having a nosewheel steering system makes this a lot easier; you can simply apply (while the aircraft is stopped) brake pressure to *only* the other (good) side. Without a nosewheel steering system, you can do as we taught in those aircraft, "cramp" the aircraft's nosewheel fully towards the side the fire is on, then apply some prop blast (power) to that side while applying the brake on the other side. Because of the cocked nosewheel, the aircraft isn't going to move. For anyone in a jet type aircraft, tough luck, it doesn't work. However, with a prop type it may either blow the fire out or blow it towards the rear enough to allow ground personnel to extinguish or fight the blaze. Nothing's perfect but this might be one way to deal with a really b-a-d situation. Another thing on this, as an experienced friend once told me "don't create or add to the problem by dumping fuel (hydraulic fluid) onto the fire!" He meant to be sure that you didn't apply the brake on the side where the problem already exists. And another thing just came to mind – beware of the propeller if you are going to stand ahead of the fire while attempting to fight it!

Something else that we probably should discuss is evacuating an aircraft on fire or during some other similarly dire situation. Recognizing that most who read this will never be piloting an aircraft with a large number of passengers on board, it still might prove advantageous to be privy to some of the things to be dealt with in that situation. Undeniabally, one of the more important aeronautical improvements (now an FAA airline requirement) were the "escape slides/chutes". I don't think any reader will be involved with using them so I'll make no further mention here about them. However, something connected with them has to be considered – a fire outside the aircraft. Either you, or else some other person in the passenger area, will have to note the location of the fire outside and then <u>not</u> open an emergency exit on that side. Yes, I know, the aircraft's aluminum provides a rather flimsy protection but it <u>is a far better barrier</u> than an opened window or door exit. Besides, no one should exit the aircraft into a fire. If you, as the pilot, have a choice then consider the wind's direction as it strikes the aircraft, attempt to stop so the wind will blow the fire <u>away</u> from the aircraft.

Things yet to write:

Skydrol.

Loss of a (some South American airline's, IIRC a wheelwell fire?) 727. Short segment flights (SAC-SFO comes to mind here), brake temperature gauges on the series fifty DC-9s. Brake cooling endeavors, extend early, leave extended after takeoff, remember doing it in a 747 once after Bangkok or Singapore.

#55 ATTEMPTING TO STEER WITH B-25 AILERONS

This problem's one that I'd suddenly recalled while I was engaged in attempting to explain another matter. This apparent conflict had happened to me (as well as several of my fellow instructors) at Reese AFB in Lubbock, Texas while we were training undergraduate student pilots in the B-25.

A substantial number of our students were receiving USAF flight training under the auspices of the **M**utual **D**efense **A**llied **P**act (MDAP) program. Among the Asian nations in this group were the Philippines, Viet Nam (South), Formosa (Nationalist Chinese), and Thailand. I'm fairly certain that there may have also been other students from Asia but, at this point, I really can't recall. We also had many European MDAPs, however they're not germane to the following "extra cushions" discussion.

A problem we faced involved the fact that the B-25 was usually the first aircraft the student had flown with side-by-side pilot seating. This held true for all of our students, those from the USA, those from a European nation or those from Asia/western Pacific nations, there was no difference. My solution – or stop-gap training solution – was to make a grease penciled vertical reference line on the windshield at the location that they told me was straight ahead while seated (I also made a grease pencil horizontal line on the windshield where the student saw the horizon). I need to also mention here that the B-25 had a control wheel, not a stick, so that also was probably a "first" for almost all of them.

At any rate, many of our Asian students were of a fairly small stature. During engine cuts (as well as at other times) the application of immediate and *full* rudder was absolutely necessary. In order to cope with this we soon determined that the accepted practice was to place an extra seat-cushion behind the *short* student's back. This enabled him to move the rudder pedals to full travel. Given the addition of this aid, these students became able to overcome the significant pressure they encountered while fully actuating the rudder in order to maintain control of the aircraft.

Now, to discuss the problem mentioned in the title above. We'd noticed that, during the student's takeoff roll on his first few flights, he'd attempt to "steer" (stay on the runway's centerline) by turning the aileron wheel instead of using degree of difference throttles. This interesting tendency, however, occurred only among the USAF students, *but not* among the students from Asia. When first noticed, it caused a few quizzical looks among us instructors; however, a question posed to one of the students soon answered the question. The typical student from an Asian country had never driven an automobile. If he was lucky – or from a well-to-do family – he possibly had ridden a bicycle. However, maybe not even that, walking or in a cart pulled by an animal would've been a more normal thing. On the other hand, our students from the USA had grown up around cars and therefore, had always steered a vehicle by using a steering wheel.

Overall, there's probably a good lesson here, don't jump to conclusions by automatically assuming that one group is superior to another. There might instead be a reason that'll take some effort or research to figure out. (A sidenote here, I'd started writing this many years ago but I'm just now completing it in 2010. Therefore, something obvious has changed over the intervening years. So, please replace the word "group" in the preceding sentence with "gender". One could say that it's more PC that way – but – It just makes more sense to me considering what we've learned in the past years.)

Let me offer one final observation here. *And please understand that this has absolutely nothing to do with the above subject*. I really don't know where to comment upon it but it's something that I'd observed on the CAF's "Miss Mitchell" B-25 while preparing for the first test flight following a maintenance/rebuilding process of many years. Sometime during that period the pilot's seat track channels had been replaced. These channels have a succession of holes to permit fore and aft seat adjustment. While seating myself I positioned the pilot's seat to its forward position. I was surprised to find that it had no forward stop or limit to prevent interference with the control yoke's rearward movement. I could only move the yoke to about three inches short of its fully aft position before it would hit the seat when the seat was locked in the foremost hole. We had to cease further flight testing until the mechanism was altered to install a limiting stop on *both* seats.

#56 PROPELLER'S ARC

I first started writing this many years ago after we'd taken the CAF's Boeing B-29 to an aircraft museum located on the Charlotte, North Carolina airport. After parking it, I'd noticed a spectator's movement that triggered a flashback to a nearly heart-stopping incident in my past. This incident precipitated a nearly life long quest on my part to advocate something that should become a totally involuntary habit around **any** aircraft. Then, just this past week at Oshkosh I was around the B-29 on the ramp. Someone came over to talk to me and I realized that this person was directly within the arc of the #3 propeller while tours were being conducted. The props were at rest but all it would take is for someone to inadvertently move a switch.

First, I should tell you how this concern originated. Many years ago while serving as an instructor on the North American B-25 at Reese AFB in Texas, we had a lot of what we referred to as "MDAP" (Mutual Defense Allied Pact Nations) students. Scattered amongst our many USAF undergraduate students these MDAP's hailed from a wide variety of the free world's nations. These two students of mine happened to come from some Asian nation, at this time I really cannot remember where they were from and need to stress that it easily could've happened to a student from any nation. Part of what made it stand out in my memory is their use of English as a second language.

During a normal training day we'd take two students aloft for a four-hour period. During the pre-flight inspection, one student would climb inside the cockpit to inspect the interior and also to turn a boost pump on to pressurize the fuel system. After this, he'd turn the pump off. In the meantime, we'd take the other student and conduct the exterior pre-flight inspection. With the fuel system pressurized, it allowed us to check for any evidence of fuel leakage during the exterior inspection. Then, the next time we flew, we'd swap the students so that they'd both obtain equal training on each half of the pre-flight inspection.

Most military aircraft commonly share some markings as a part of their paint jobs. Usually you'll see a "No Smoking Within 50 Feet" stenciled on the nosewheel doors. Another thing that I believe is common to all reciprocating engine military aircraft is the red "Danger-Propeller" stripe painted on each side of the fuselage.

I'd taken the second student along to perform the exterior portion of the pre-flight and clearly remember telling him why you should always place the rear of your head against the aircraft's aluminum skin any time that you walk/pass through the area between the fuselage and the propeller. Just as I was demonstrating this and why it was an absolute necessity, my eyes must have suddenly opened wide as I saw the tip of the propeller slash past my nose, scant inches away. I immediately looked up at the cockpit's side window; the occupant's face having suddenly appeared in it. Looking down at me the student excitedly exclaimed "So solly, sir, so solly!" He'd mistakenly actuated the starter switch, not the booster pump switch! I cannot remember now what their nationality was, although his pronouncing the "R" as an "L" would indicate that it may have been in Asia. That part really isn't germane to this story at all, what mattered to me of course, is that I wasn't mortally injured. This incident caused a life-long desire of mine; that of never seeing another person exposed to a possible injury like this.

I'm pretty much convinced that for this thing to work, it has to become instinctive, sort of like fastening your seat belt. It's simply not going to work if you must first stop to consider your movements each time that you traverse that area near an airplane's propellers. So, put your head against the fuselage when passing between the fuselage and the propeller. If it's a four-engine airplane, then either walk between the outboard and inboard propeller's arc, or else simply walk around the propeller(s).