Unmasking some of the misleading tips you may have heard about care and operation of your powerplant

Fabled Engine Follies

by KEN GARDNER / AOPA 132319

■■ It seems that, no matter what profession you may be in, eventually you will encounter a collection of time-honored "follies" practiced by members of that particular profession.

Aviation is no different and has its share of such beliefs and practices. This is especially true of engines, their attendant systems, and subsequent operation. We will review some of the more popular ones along with the facts. Whether to believe or not to believe must be decided by you.

Oil does not wear out, it only gets dirty; therefore, it really isn't necessary to change the engine's lubricating oil as often as recommended or, for that matter, at all. One simply needs to provide a good filter and change the filter when it becomes dirty. It then becomes a simple process of adding more oil as needed.

Proof that oil does not wear out is substantiated by a U.S. government bulletin on file in Washington. The notion that oil does wear out is probably the work of the oil companies to promote the sale of their product. The only reason that engine manufacturers recommend changing is because they are in cahoots with the oil companies. Oil actually improves in quality when retained in the engine, due to the refining actions imparted by engine heat.

Most of us have been exposed to this "hangar sermonette" in one form or another. Let's examine the facts, if there really are any, to support such a belief.

Although I have never seen it, much less been able to obtain a copy, perhaps there once was such a government enshrined bulletin that stated oil was not subject to wearing out. There was also an attempt on the part of the U.S. government to close the patent office in the 1890s because everything worthwhile had already been invented.

To begin with, the maximum amount of heat that even the best petroleum-based engine lubricating oils can stand without change is less than 300°F. During normal engine operation the lubricating oil contacting various engine parts, such as valves and pistons, is subjected to contact temperatures in excess of 500°F. The result is permanent oxidation damage to the oil, which causes it to thicken. I know of no filter that can correct this situation.

As for the government bulletin, the coming of the electron microscope has proven that engine lubricating oils experience molecular shear. This is another form of permanent damage to the oil that cannot be corrected by filters. Both oxidation and shear damage are cumulative, and eventually impair the oil's ability to perform its function.

Keeping the engine clean makes it run better and last longer—that's ridiculous! The engine doesn't know whether it is clean or dirty, and what's more it wouldn't care if it did. I've never washed an engine down and all of mine ran just as well and just as long as those that were kept clean and cost me less money because I didn't waste any on cleaning.

Have you heard this pitch by Dirty-Engine Dave? That's his infamous contribution to the growing list of myths. The internal combustion engine is able at best to utilize approximately 27% of the thermal energy that it releases within its combustion chambers. Where does the other 73% go? It's passed out the exhaust system and through the cooling system. Ever see an air-cooled engine so adequately endowed with cooling fins that you couldn't overheat it if you tried? I never did.

There is a margin of cooling system capacity; however, it can be exceeded with careless operation. Engines have a tendency to become oily. Oil attracts dust and dirt, which together soon become greasy grime. Grime-coated cooling fins and surfaces reduce heat dissipation, thereby requiring more time, cooling air flow, and/or temperature differential to accomplish the same results as clean cooling surfaces. It doesn't take much grime to make a difference; and the heavier it gets, the greater its effect will be on cooling system efficiency.

Oily grime eventually finds its way into areas where dry-type bearings are employed, such as carburetor air-box bushings and heater control valves. Gritty grime, acting like a grinding compound, enlarges bearing clearances to hasten their replacement. Removal and replacement of parts on a grimy engine will usually result in the introduction of gritty dirt inside the engine, and it takes very little to cause trouble. Still believe dirty engines fare just as well as their clean counterparts?

Don't worry that you might be refueled with the wrong grade of fuel, as long as you check your strainer and sump drains in a glass container prior to departure. All grades of gasoline are color-coded, and mixing fuels of different grades will cause colors to cancel to a clear, colorless condition.

If you believe that, you could leave yourself open to big trouble. Once upon a time that might have been true, but not necessarily so anymore. I have mixed red and green, red and blue, blue and green with the same results every time—namely, a "Muckledun" mixture (something other than either being described), which tells little if anything about what might have caused such a condition.

By all means, do check the strainer and sumps, especially in a clear glass or plastic container, but be there when the aircraft is being refueled to be absolutely certain that you are getting the grade you requested. Check your fuel receipt as well for indication of grade put aboard, but *do not* rely solely on color changes and cancellations.

Unless you really need to run at high power, throttle back and cruise in the low power ranges. This not only saves fuel, but prolongs engine life. Cruising at 45% to 50% power is much easier on your engine than 55% to 65%, or 65% to 75%. It's just good common horse sense that lower powers reduce the strain and, therefore, the wear. The manufacturer recommends those higher power settings because he wants to sell replacement parts and engines.

It's almost certain that you have heard this one, and it's horse sense, all right. Figure 1 shows a piston-to-cylinder clearance comparison between maximum permissible (red line), low cruise, and cold start-up conditions; note the differences. The cylinder walls are steel and the pistons, aluminum. The expansion/contraction coefficient of aluminum is more than three times that of steel.

A certain amount of necessary clearance must be present between piston and cylinder wall with the engine operating at red-line cylinder head temperature (CHT). Notice in Figure 1C how much greater that clearance is under cold start conditions. Wear is most definitely related to clearance. That is, the greater the clearance (looseness), the more rapid the wear-out rate will be. If that is true, and it is, which condition do you think is most conducive to wear rate—one somewhere between A and B, or one between B and C?

As for strain, most opposed-type aircraft engines are designed to satisfactorily accept the loads and temperatures of full power on a maximum continuous basis.

Engine thermal efficiency is, among other factors, relative to cylinder pressures. That means that more of the heat energy is converted into useful work at higher cylinder pressures than at lower cylinder pressures. The more you reduce power, the lower the cylinder pressures become. Thus, ridiculously low power settings may result in greater fuel consumption than settings reasonably higher, as a result of getting less efficient use of the fuel's potential heat energy. Due to the squaring effects of airframe drag and wind resistance, we are not able to experience efficiency benefits as we should from higher power except at high altitudes; however, we will benefit from a wear standpoint.

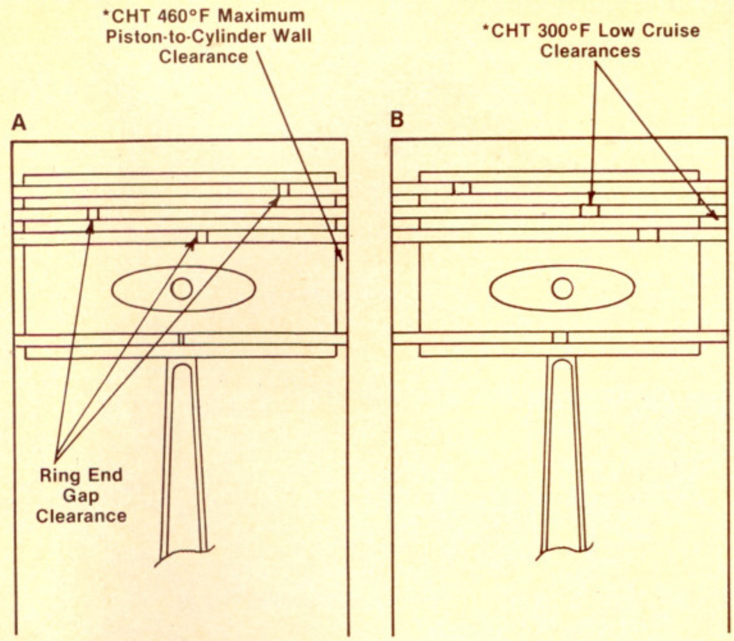
If you land at some airfield where 80-octane fuel is all that is available and your aircraft requires 100-octane, no problem; go ahead and fill all but one tank with grade 80. Take off and climb on the tank with the 100-octane fuel, then throttle back to 60% or less cruise power and switch to the grade 80. Keep some 100-octane for possible go-around at your destination, and you'll be OK. At cruise power you don't really need grade 100 performance.

Now there's a blueprint for trouble if I ever saw one. The odds of doing such a thing and not having engine troubles are definitely not in your favor. If you were down on an ice floe and drifting out to sea, I would say do it, simply because it's the lesser of the two hazards facing you.

Even full-scale detonation can seldom, if ever, be detected in time to prevent damage. Incipient detonation will never be apparent until its damage is already a reality, and just one refueling with substandard fuel can bring it on.

Each year the number of case histories of engine damage and unscheduled landings resulting from this folly increases. The worst part is that the possible engine damage might not produce a failure on that particular flight, thereby leading the pilot to believe that he got away with it. It could be hours down the road when the detona-

Figure 1



*Cylinder Head Temperature
(Clearances exaggerated for illustration ease)

tion-damaged engine does fail and, then, if the pilot survives, he blames the engine, since there is no obvious connection.

How about this one? Never mix different brands of lubricating oils. I did that once, and suddenly there I was at 10,000 feet when oil began streaming out of the cowling, the engine roughed up, and I barely made it down. Later, I learned that the oil companies put stuff in their oil that doesn't mix. Needless to say, my engine used oil from that day on, and my mechanic told me that it was all because I mixed two different brands.

Now there's one that makes for good telling in a comfortable corner of the hangar on one of those dark, stormy nights. I know more than one pilot who has made a nerve-racking trip home with low oil quantity out of fear to bring up the level because he believed that myth. While it is true that there are some differences between oil brands, those differences are compatible with one another if mixed.

I have never encountered any actual proof of a case where any name brand of petroleum oil failed or refused to mix with any other name brand or caused any engine difficulties whatsoever.

It is true that engine manufacturers recommend that you select a name brand of lubricating oil and then stay with it. However, there is no harm in mixing, especially when you need oil and your brand is not available. Your engine would much rather have some other brand than operate with insufficient oil.

Once you have established approach power, don't suddenly reduce it because, if the engine is going to fail, that's when it will happen.

That folly should rate Category 1 of "Old Witches Tales," and it is the most unfounded suggestion I ever heard. I have never seen any statistics or engineering data whatever to support such a belief. There isn't any reason why you shouldn't adjust approach power, whether it be more or less, to satisfy whatever the need may be.

When shooting touch-and-go's in the pattern, just leave the carburetor heat on. It won't hurt anything, and that way you needn't worry about the possibility of forgetting to apply it each time before landing.

That is a poor excuse for absence of professionalism in one's flying habits, and could well be detrimental to your engine. The high induction-inlet temperatures resulting from such a practice, especially in the high power ranges, could quickly lead to full-blown detonation and subsequent damage, or to complete engine failure. Furthermore, such a practice reduces engine performance, thereby increasing the takeoff run and initial pattern ascent. Always take off with the carburetor heat off.

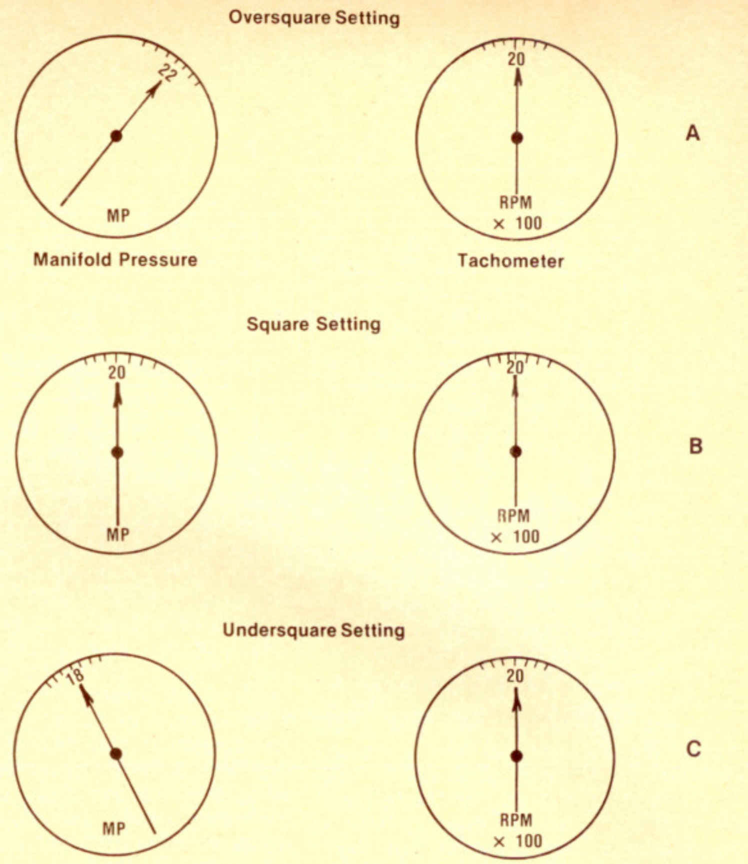
When hand-propping an older airplane not equipped with an electric starter, a flooded start condition is best cleared up by closing the throttle and propping the engine backward for several revolutions of the engine to clear the flooded cylinders.

To begin with, "flooded cylinders" is generally construed to mean that the starting mixture admitted to the cylinders has become so rich it won't ignite and must therefore be cleared by rotation of the engine and admission of air only. Rotation of the engine backwards with the throttle closed is a dead-end street; air admitted to the engine by way of the exhaust valve has nowhere to go when the intake stroke becomes the exhaust stroke. If you open the throttle, the overly rich mixture will be pushed back into the induction system, only to be later readmitted to the cylinders again.

The correct procedure to clear a flooded engine is forward rotation with the throttle full open and the magnetos off. A full-open throttle will provide little, if any, fuel flow at normal hand-propping speed. Thus only air will be admitted, causing the cylinders to be cleared by way of the exhaust system.

The engine should be propped as if it were expected to start, and not slowly pulled through. Even then, such

Figure 2



a procedure should never be attempted by anyone not properly experienced with hand propping. A pilot or mechanic should be in the cockpit and the aircraft securely chocked. Hand propping is a very dangerous practice at best, and reverse propping to clear flooded starting conditions is pure folly.

Never operate an engine continuously with an "oversquare" (more inches of manifold pressure than hundreds of rpm, i.e., 24 in mp and 2,300 rpm) power setting. Such power settings "lug" the engine down and will cause it to detonate. Oversquare operation will also damage the bearings from lugging and cause overheating. Square operation is O.K., but undersquare is even better. It is better to let the engine do its work with rpm's than manifold pressure because manifold pressure is what blows cylinder heads off and breaks crankshafts.

This particular folly has always amazed me because it would be nearly impossible to fly many of the earlier aircraft, according to such a belief. For example, the 165-horsepower Kinner only turns a maximum of 1,875 rpm and cruises in the 1,600 rpm range. Can you imagine what kind of peformance a "square" 16 inches of manifold pressure at 1,600 rpm would give you? For many of the aircraft engines built in the 1940 and 1950 era, 2,200 rpm was maximum, and numbers like 22 inches manifold pressure over 1,900 rpm were quite common cruise settings. Even the early opposed engines seldom exceeded 2,300 rpm.

Many of the early airplanes had fixed-pitch propellers. In such instances, power was controlled solely by rpm so manifold pressure gauges were not installed. Thus the pilot was unaware that an oversquare condition existed throughout his takeoff and most of his cruise power settings. Furthermore, if an engine is rated for a maximum continuous manifold pressure of 28.5 inches, how could a lesser pressure produce more strain? It couldn't and it didn't. Like most follies, this one is also ridiculous when applied to naturally aspirated (non-supercharged) engines. If you are not familiar with the terminology, Figure 2 illustrates examples of oversquare, square, and undersquare. Do not confuse oversquare with overboost. The term overboost defines manifold pressure in excess of maximum allowable limits with supercharged engines.

A good way to keep your engine clean inside is to drain the old oil, replace the drain plug, and pour about 2 gallons of solvent or kerosene into the engine and then start it up and let it idle fast for two or three minutes. Shut it down, drain out the solvent, and you would be surprised what that will do for the engine.

Amazing as it may seem I have encountered A&P mechanics who believe in that practice. To put it mildly, the engine manufacturers take a dim view of the practice. Indeed, you would be surprised at what undesirable things that could do to your engine. Very little lubrication is derived from such cleaning solutions, consequently engine bearing damage could easily result. If the engine being so treated had accumulated any appreciable sludge, the sudden loosening of such deposits could cause extreme contamination and plugging of oil passages and a rash of malfunctioning hydraulic valve lifters. This is certainly one of the most ludicrous follies I ever heard of. The judicious use of a good brand of ashless dispersant lubricating oil, frequently changed, makes such a treatment totally unnecessary, even if it were practical.

Keep a package of those styrofoam coffee cups on board for checking fuel contamination after each refueling. If your aircraft was refueled with jet fuel, you'll know by simply draining fuel from each sump into the cup and then checking for oiliness on the outside of the cup. Styrofoam will let the jet fuel come through, but not the gasoline. This is a sure-fire method, and you can depend on it.

You can get yourself killed if you believe that one. Jet fuel is more viscous (resistant to flow) than gasoline; therefore, if the jet fuel could get through the cup so would the gasoline. Water has a much finer molecular structure, and so it would get through the cup with more ease than either of the two fuels, but it doesn't. Alcohol has an even finer molecular structure than water, and I have held more than one styrofoam cup with spirits within. Oh, they came out, but only from the top where they were supposed to.

I shall conclude with that one, and leave you with this thought. It is only man who can be fooled by another's folly, never the engine, because *it* obeys the laws of physics. □