WARBIRD NOTES # 8 16 Feb 95 (19)
FIELD BAROMETRIC POWER CHECK

The idea of discussing this subject has crossed my mind from time to time. We routinely see some fairly distorted ideas of 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.

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 proper 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 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 carb 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 reinstalling 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 runup I offered a few ideas and I wondered 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, "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 a setting used on a normal 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 reindexing 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 takeoff 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 runup. 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 runup 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 runup. 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.