SKYWAYS

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J. FRED HENRY . . . . . Editor and Publisher

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STANLEY M. COOK . . Production Manager
CHARLES W. ADAMS . . . . Art Director
E. E. SCHAFER . . . Circulation Manager

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COMPASS CHECK—Choosing level site and using straight-edge board along which to paint lines, the author trues up straight-edge with astro compass. Using compass rose, ship should be checked in level-flight position (below)

Know your

LINE-UP—After tail is aligned with rose direction line, line up ship's nose. Read compass with engine running

Maybe your X-C's are ragged because your plane's compass is inaccurate

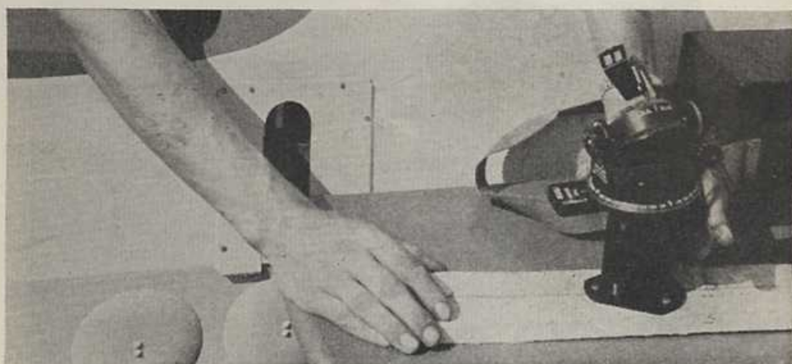
By ROBERT F. SANDERSON

DURING a decade of private, commercial, army, and airline flying, I frequently have been appalled at the crudity of cross-country navigation methods in general use. Amateur and commercial pilots alike, who can skillfully solve complicated wind vector problems on CAA exams, seemingly toss all this valuable technical knowledge out the cockpit window the moment they climb into a ship, and subsequently reach their destination by following railroads, highways, and rivers, occasionally straigtening themselves out by buzzing railroad stations to read the town name.

This unfortunate state of affairs is, in the opinion of the writer, due primarily to the excessive inaccuracies of compasses in general use. True course can be measured, variation taken off the map, and the wind (*Continued on page 47*)

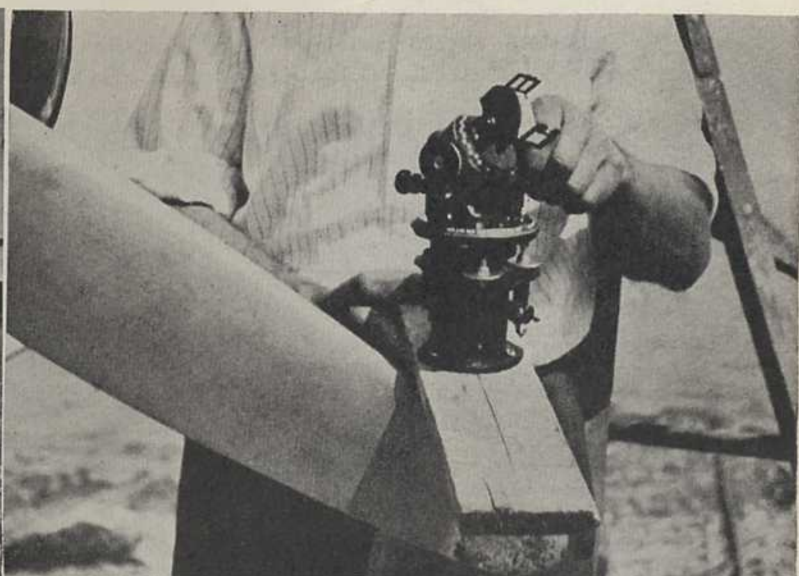
Compass...

FLANGED LEVEL—If ship has no flanged level to use, lay straight-edge along longitudinal markings such as those on horizontal stabilizer (below). Electrical equipment affects reading so have the engine running during check



ALIGNMENT—Align astro compass with flanged fittings parallel to longitudinal axis of ship, then level it

ASTRO CHECK—If compass is being checked with astro compass, mount the astro on short straight-edge board



Know Your Compass

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correction may be estimated with reasonable accuracy, but without knowing the error of the compass itself (all too often different or greater than believed) the rest of the book just doesn't work out.

Just last Sunday the owner of a new ship called me out to check the deviation on the compass. The first headings checked showed an error of only one or two degrees, but the error on later headings increased and before we'd finished we found as much as 15° error. If this owner had started on a cross-country to a point due south, the book-rule navigation would have worked out excellently since the deviation on that heading was only two degrees west. However, on the return trip the deviation of 15° would have pulled him 'way off course. The resultant confusion and discouragement from several such efforts is apt to result in another recruit for the "iron beam" school of navigating railroad tracks. In passing, we might mention the factory deviation card gave three degrees as the maximum deviation on any heading.

As in ascertaining how much gas you have before take-off, the only way to know the accuracy of your compass is to check it yourself. The two most satisfactory methods of doing so are with either a compass rose or an astro-compass. Neither is difficult to do once learned, and the result will do marvels for your navigation.

The compass rose method, while requiring more time than the astro-compass, uses less mental energies and can be used on a cloudy day whereas the other method is generally used with the sun. A compass rose is simply the points of the compass laid out on the ramp or airport surface by paint or other markers in such a manner that the longitudinal axis of the plane can be aligned over the compass points and the ship's compass readings compared with the actual headings of the rose. The difference in reading gives us the error.

The ship is aligned with the established directions of the rose by placing the tailwheel on the reciprocal direction and centering the front of the ship over the desired point on the rose. This can be done by hanging a plumb line (any weight on the end of a string will do) from the propeller shaft just behind the prop. If the compass rose is laid out in magnetic directions, then the difference between your compass and the rose is the deviation. If laid out in true directions, variation will have to be considered. This will be taken up later in an example.

One of the disadvantages of the compass rose is that airports possessing them are few and far between. Another disadvantage is the excessive maneuvering necessary to get the ship accurately lined up on eight different lines, the minimum number of points that should be checked. Since for exact work the engine should be running, as the ignition system affects the magnetic lines of force, the astro-compass requires much less backwork or caution.

The astro-compass is a simple instrument now sold as Army surplus for about $10. With it you will need a Nautical Almanac, obtainable for $1.50 from the government printing office. (The Air Almanac is somewhat handier to use but one volume does not cover the entire year.) The initial investment can often be turned to a profit by checking deviation for other plane owners at a nominal fee.

To use the astro-compass, we need the time to the nearest 10 minutes. Time past noon must be converted to the 24-hour clock: 03:40 PM would be 15:40. This time must now be converted to Greenwich time, which is the time used in the almanac. Simply add five hours to EST, six hours to CST, etc., and the result is Greenwich time.

From the almanac we discover two things about the sun. First is the longitude of the sun, called GHA (Greenwich Hour Angle) in the almanac. Second is the latitude of the sun, called declination in the almanac. From a local map we find our own approximate latitude and longitude, and the variation.

For June 20, Eastern Daylight Time 02:40 PM, we compute EST 13:40, and add five hours to get 18:40 GCT (Greenwich Civil Time). Entering the Nautical Almanac, we find the sun for this date on page 20, near the bottom of the middle column. Entering from the left margin with 18:00 GCT the longitude of the sun is given as 89 degrees 38 minutes. On the right-hand side of page 21 we find the interval to add for the additional 40 minutes—10°. For 18:40 GCT on June 20, the longitude of the sun is thus 99 degrees and 38 minutes. Alongside of the GHA we find the latitude or declination of the sun, in this instance 23 degrees and 27 minutes. In summer the declination is always North, in winter always South. We can now throw the almanac away and pick up the astro-compass.

In using this instrument one thing must be remembered. Any place north of the equator, use the white numbers only and ignore the red numbers. The red numbers are for use south of the equator only. Starting at the top of the astro-compass, set the declination halfway between 23 and 24 degrees on the white numbers on the "N" side. Below this adjustment, on the side of the instrument are two round knobs one of which is marked for latitude. On this we set our own latitude, in our case approximately 41 degrees North.

Now we must set the knob on the other side, which is the LHA, or in simple words merely the difference in longitude between us and the sun, measured west from our position. Since we are 74 degrees West, and the sun is 99 degrees 38 minutes West, the sun is west of us by 25 degrees and 38 minutes. Set this number with the knob marked LHA. (Remember that in the hours before your local noon hour, the sun is east of you, and to get the LHA west you must subtract the LHA east from 360 degrees. Example, sun's longitude 50 degrees, your own longitude 74 degrees. Longitude difference 24 degrees east. 360 minus 24 is 336 longitude west difference, which is the number you set on the instrument. If this confuses you, just use the astro-compass in the afternoon and you do not need to worry about subtracting from 360.)

Now we are ready to go to work. For small ships, fasten the astro-compass mount

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Avro Jet Airliner for British

A. V. Roe, Ltd., of Canada, has a new one they are readying for flight sometime this spring. Called the C-102, it is a four-jet airliner that will carry from 36 to 40 passengers, will cruise at 400 mph at 30,000 feet. It has pressurized cabin.

Know Your Compass

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to a straight-edge board which can be aligned in some manner with the longitudinal axis of the ship. Before mounting the instrument itself, make certain that the fore and aft points of the mount are parallel to the straight edge. With the "aft" marking toward the rear, it is ready for use.

The best location for use varies with different ships. The Luscombe, for example, has a flange on top of the cabin which is perfect to align with. If you align with the flat side of the tail fin remember some ships have a slight offset to counteract torque (as much as three degrees, usually less). Such an offset, unless allowed for, will naturally cause the readings to err by that amount.

In use, the instrument must be perfectly level. For this purpose there are, built into the base, two bubble levels easily adjusted by knurled wheels at the bottom sides. Before each individual reading, and there should be eight readings (one on each heading), check the bubbles to make sure they are in the center.

Now rotate the instrument on its base until the small black bar in the square at the top casts a shadow directly between the two black lines in the center of the white plastic plate behind the bar. When so set, the numbers on the front base will give you the true heading. Apply variation and compare with the reading of the ship's compass. During the process the engine should be running and the radio, if any, switched off and on to ascertain interference. Repeat the procedure until you have readings on the four cardinal points and the points halfway between. Below is a sample of our results.

Astro-Compass	Var. W	Mag. Hdg.	Ship's Comp.	Deviation
334	11	345	360	15W
020	11	031	045	14W
067	11	078	090	12W
117	11	128	135	07W
167	11	178	180	02W
214	11	225	226	01W
260	11	271	270	01E
314	11	325	315	10W

Once proficient with the astro-compass, you can set it up in five minutes and complete the check in half the time it would take you with a compass rose. With an astro-compass your headings do not have to be exact. That is, anywhere from 35 to 55 degrees will have nearly the same deviation as 45 degrees. On the compass rose the ship must be aligned *exactly* to 45 degrees on the line, and this takes time.

In ascertaining whether the ship's compass reads higher or lower than the astro-compass, we determine whether deviation is east or west. If the ship's compass reads higher, deviation is west, if lower, deviation is east. With an astro-compass reading of 270 degrees (this is true direction), ship's compass 284, variation 11W, the compass deviation is 3 degrees west, since it should read 281. With the same variation and true heading, if the ship's com-

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Dilbert

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just to plain ordinary inattentiveness.

Every aviator knows that an airplane will stall when the airspeed falls below a certain minimum. But he often overlooks this basic principal during take-off climb. Airplanes do not stall of their own accord —they are pilot-stalled.

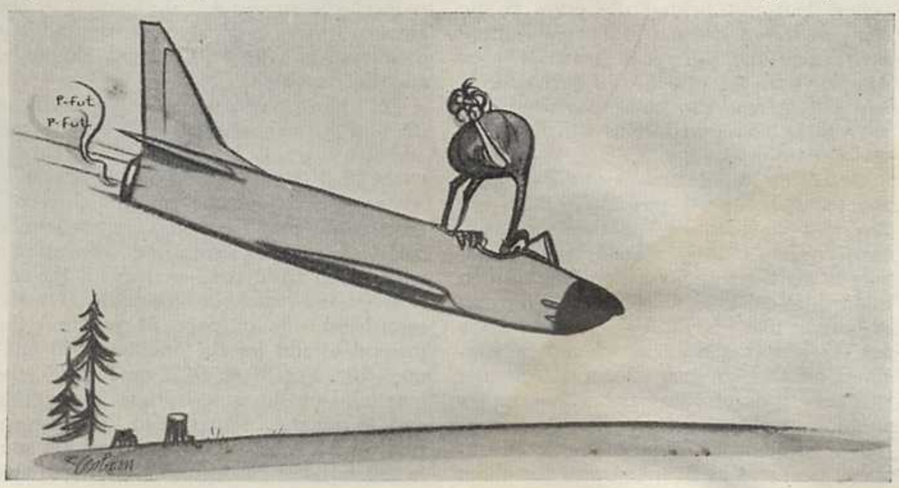
Most stalls and spins during take-off can be traced to one or more of these common errors:

a. *Pulling the plane off before attaining adequate airspeed.* Usually caused by lack of attention and undue haste, by attempting to take off with insufficient room, by losing directional control and pulling off, or by failing to use sufficient throttle early in the take-off run. Obviously, get safe flying speed before leaving the ground.

b. *Stalls during take-off upon encountering slipstream of plane ahead.* Most of these occur during touch-and-go landing practice. Lack of flight discipline is a common factor here, arising from non-standard take-off patterns and insufficient interval between planes. It is up to the following pilot to insure adequate interval and see that he has sufficient airspeed for control in any unexpected turbulence.

c. *Abrupt climbs and steep turns* before adequate airspeed has been attained. Such climbs are not only dangerous, but unnecessary. Engines often misbehave right after take-off. Get your flying speed first, then start a gentle climb and turn, if necessary. It's unspectacular, but healthy.

d. *Incorrect tab settings.* Crash investigators frequently find elevator tabe in the full "UP" position, indicating the pilot did not check them. Other tab maladjustments reveal either poor instruction or lack of attention, resulting in the same unhappy termination. Tab settings on high-performance aircraft can create forces greater than the pilot can overcome. Results can be disastrous even with settings only a few



degrees off, particularly if the pilot's attention is diverted during take-off.

e. Briefly noted, other mistakes include retracting flaps too soon, using insufficient rpm, and failing to appreciate the aerodynamic effects of heavy loading, external gear, etc.

Just remember that a plane in its take-off climb needs airspeed to sustain it. Don't stall! *Don't Stall!* DON'T STALL!

Landing Routine — Year after year, approximately one-third of all aircraft accidents occur during landing. This doesn't include crashes during forced landings, but only those accidents which occur while the pilot is attempting to make a voluntary landing on a predetermined field. Evidently they must involve considerable pilot error.

Due to the high incidence of landing accidents, it would seem smart to review the rules for preventing them, and to make sure they are incorporated in your landing procedure.

1. Know the traffic rules of any airport at which you intend to land.
2. Clear your engine frequently during a glide and use heat control as necessary.
3. Keep looking around for other aircraft.
4. Check your safety belt.
5. When approaching an unfamiliar field, spot obstructions, watch for holes, ditches, high weeds and construction work.
6. Be positive of wind direction. Land directly into it where possible. Practice cross-wind landings under favorable conditions at a familiar field.
7. Watch that airspeed! Avoid too much, to prevent overshooting. Be sure you have enough. Don't s-t-r-e-t-c-h a normal glide.
8. Avoid over-use of brakes. Don't attempt to turn during a fast roll.
9. Above all, never commit yourself to a landing too far ahead of time. Be on the alert for any dangerous situation which may develop. Don't wait too long under such circumstances, or let pride show you up for a greenhorn. Give her the gun and go around again, like an old timer.

The Cockpit Ostrich — Case 1. An experienced pilot was making an approach for a practice landing. Observes stated that he appeared to be leaning over in the cockpit making some adjustment immediately prior to the crash.

Who in blazes do you think is going to fly your plane while you fiddle around with your head in the cockpit? The natural tendency is to push the stick forward when you lean down. Common sense should warn you of the danger of keeping your head in the cockpit for more than a second or two at low altitude.

To Paint or . . .

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a painted plane might run only about half or less than the unpainted price.

Atlantic also suggests that owners of larger planes who run into the problem of expensive aircraft cleaning and yet do not wish to paint their planes might do well to investigate the contract arrangement run by the R. M. Hollingshead Corp., at Camden, N. J., under which a regular monthly cleaning job is done on planes flown to Camden, priced at a flat rate covering an extended period of time. Hollingshead, of course, is the well-known cleaner and finish manufacturer and their treatment covers every part of the aircraft.

For information on cleaning and painting larger planes, SKYWAYS survey went to Willis Air Service, at Teterboro, now an authorized Douglas maintenance operator and long an all-around base for non-scheduled and foreign airline planes. Willis has done successful work with one type of painting that some other operators either will not attempt or with which they have had no success, namely, putting only one coat on the aircraft without using a primer or bonding coat. A FAMA Argentine airline DC-4 inspected at Willis had a single, broad blue stripe painted around the fuselage a year ago at Willis, without priming, and the paint appeared as glossy and firm as when applied. The same success is reported with several other aircraft that were given either trim or full paint jobs and, strangely enough, one order that came through from a Latin-American company specified that no primer was to be used under the finish paint, possibly to allow easier stripping in case of a later change.

The Willis technique consist of a complete cleaning of the plane with WO No. 1, made by Turco Products, Inc., where skin grime and corrosion demand it, followed by a wash job with Gunk and then the plane is sprayed with S. G. Enamel, a synthetic gum paint made by Randolph Products of Carlstadt, N. J.

Some idea of how a company like Willis arrives at its prices for cleaning and painting is given by its man-hour estimates. These all apply in this case to a DC-3, but they would be scaled proportionately for any other aircraft, whether a *Lodestar*, or any of the twin-engined planes in executive use, according to the skin area and man-hours necessary.

After October 1, Willis raised their labor rates per man-hour to $2.50. Multiplying this by the man-hours necessary for any specific task plus the cost of the materials used would give the price of a job. Thus, the average machine polishing and hand cleaning of a DC-3 might require an average of 150 to 200 man-hours, at a job price of about $375 to $500, or possibly more. An ordinary wash job, though, would cost $60 to $75 for the same plane if that was all it needed to clean it up.

Preparing for a complete exterior paint operation would involve about 25 to 50 or more hours of cleaning with the higher figure in force if the condition of the craft requires the use of WO 1. A single coat of enamel figures at about 50 man-hours, actually requiring about five gallons to completely cover a DC-3, (thinning is the answer to the seemingly low figure). Naturally, if a zinc chromate primer is requested that will take about the same time and then the paint will require an additional 50. The average price of the S. G. Enamel per gallon, depending on the color, runs about $7.20. In case the job demands it, additional time is required to remove and replace all control surfaces, which would also be coated with pigmented dope to match the main color as required. A total of at least 70 hours is figured for the removal and replacement work on the fabric-covered surfaces. Thus an average paint job would run in about the same price range as the average cleaning and polishing, with the very important factor that the painted plane would later require washing and some hard polishing attention, while the complete machine polishing operation on an unpainted craft might be required again two or three months later, depending on how particular the owner might be about his plane's appearance.

Out on the West Coast we queried Pacific Airmotive and Grand Central, both outfits being standouts in the field of service and maintenance, particularly in the executive or corporate plane category.

Pacific Airmotive's C.C. Cole reported that to wash, polish and paint a Lockheed *Lodestar*, using a pre-paint followed by zinc chromate primer with a finish coat of either synthetic enamel Dulux or laquer, would cost about $950. A twin-Beech, reported Mr. Cole, would run a pretty even $100 less, or $850. Cole hastened to add, however, that these prices were based on a "clean" airplane, not a conversion job or one covered with a lot of oil and guk.

Keith Brainard at Grand Central reported it would cost $160 just to wash and polish a twin-Beech if the ship were not in bad condition, and $275 or more to wash and polish a *Lodestar*. For painting a twin-Beech, Brainard reported, using pre-paint followed by zinc chromate primer and synthetic enamel, an owner would have to shell out $900. This same paint job on a Lockheed *Lodestar*, he said, would run between $1,250 and $1,300. None of these paint costs include trim work or insignia.

That, then, is the story on painting and cleaning. All estimates depend on the type of plane,the condition of its aluminum surface which includes the amount of corrosion present, and also how a shop is set up and how much painting it has done in the past. It all boils down to one important point. If an airplane owner feels that giving his plane a complete exterior paint job will enhance its looks, prolong its life and cut his cleaning costs, he should fly it to a dependable, experienced operator and get various estimates on just what it will take. If he can make cleaning arrangements that will keep his costs down below the painted level, or if he prefers the shine of untouched Alclad, then he should not be pressurized into something he may regret later because removing paint may cost as much or more than applying it.

It's up to the owner to add up the score and make his choice, but thus far it seems weighted on the side of painting.