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GROUND SPEED

The usual method of finding ground speed is by adding the true air speed and true heading vector of the aircraft to the wind vector.

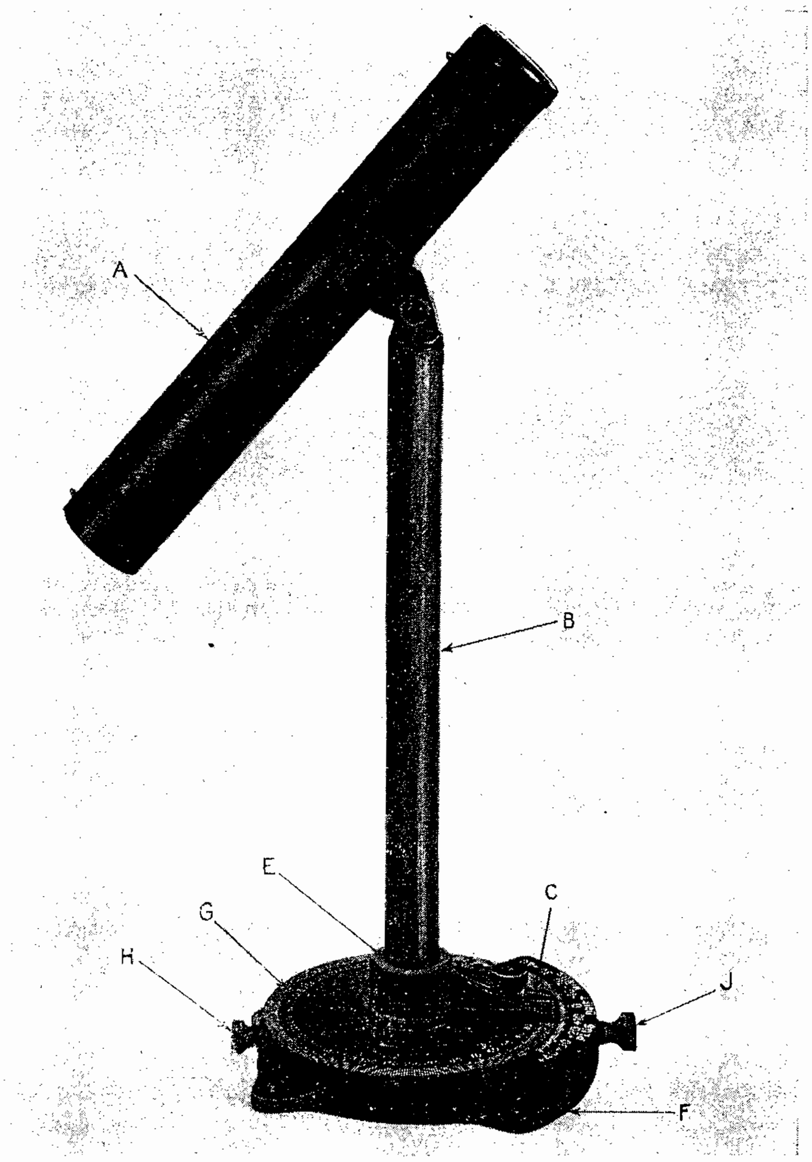

FIGURE 15.—Mark IIB pelorus drift sight.

The result will give the ground speed and track the aircraft is making good over the ground. The true air speed is determined by correcting the indicated air speed as described. The true heading is obtained by correcting the compass indication as will be discussed later. The other quantity, the wind, is obtained by use of the drift sight.

Figure 15 shows the present standard pelorus drift sight Mark IIB.

The sighting tube *A*, support tube *B*, and pointer *C* constitute one assembly. Two base plate assemblies *F* are provided, one for each side of the airplane. In the base plate the sighting tube assembly is secured to the base plate by pulling on the pin *J* which allows the assembly to be inserted in the base plate. Releasing the tension on pin *J* allows it to settle in the groove holding the assembly in place but allowing it to be turned.

Assembled pelorus ring *G* is rotatable through 360°, being locked by stud *H*. This provides for setting the ring to indicate true, relative, or compass bearings.

The pointer *C* has two reference points, the inner one being a wire for reading the bearing on the pelorus ring, the outer one being a mark for reading opposite the drift scale. The drift scale is fixed in relation to the thrust line of the plane and graduated in single degrees from 0 to 40 left and right. One side of the scale is marked plus, the other minus.

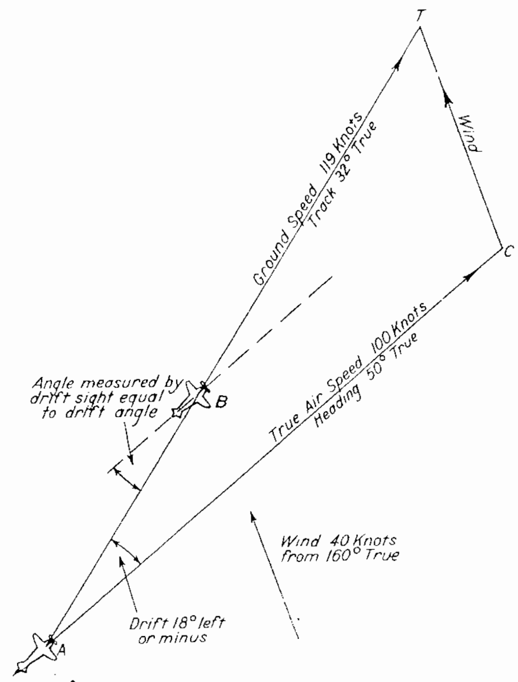

FIGURE 16.—Illustration of drift angle.

The support tube is adjustable in height, sliding through the collar and being locked by the stud at *E*.

Open vane sights are provided on the top side of the sighting tube to permit the observer to locate his objects before using the small aperture in the sighting tube.

The drift sight is used to measure the drift of the aircraft caused by the wind. Referring to figure 16 an object directly below the aircraft at *A* is used for the observation. If over land this is some landmark, if over water a smoke bomb is dropped at this point. *AC* represents the true heading of the aircraft, which in this case is 50° T. *AC* in length represents to scale the true air speed of the aircraft, in this case 100 knots. It is absolutely essential while taking the sight that the speed and course be held constant. Because of the wind the aircraft will not move along *AC*, but with a wind of 40 knots from 160° T it will be blown to the left of this heading and move along the track *AT* which is 32° T. When the aircraft reaches point *B* which is any point along line *AT* the drift sight is taken by sighting at object at *A* through the drift sight. The reading of pointer *C* of the drift sight is 18° minus or left as shown. This is the drift angle.

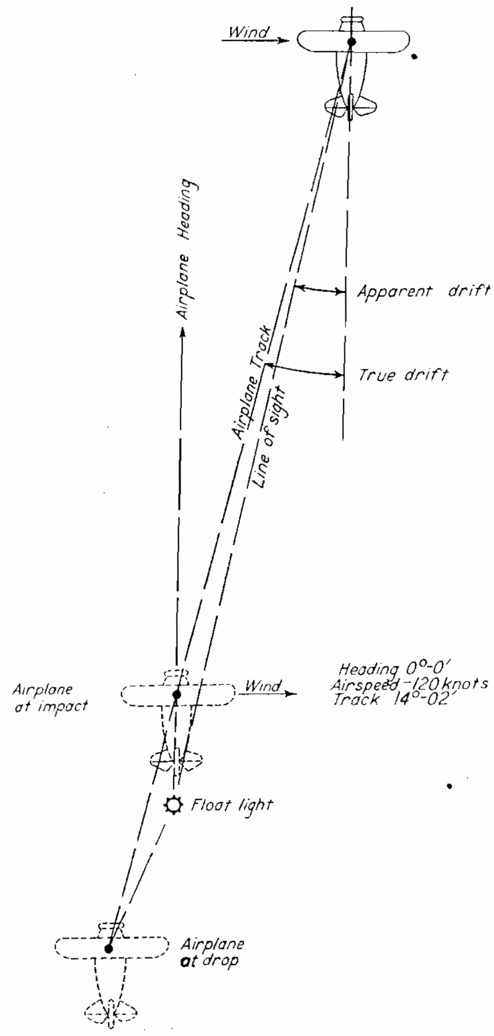

FIGURE 17.—Cross trail of float light.

Errors in drift observations by float lights, due to cross trail.—When an airplane heading is constant and the wind is steady, a float light dropped from the airplane hits the water directly behind. The float light will be on the track of the airplane only if there is no drift.

An example of cross trail showing the relative positions of the airplane and float light is shown in figures 17 and 18. For this example a true heading of north, a true airspeed of 120 knots, a wind of 30 knots from west, and an altitude of 8,000 feet are taken. For this set up the float light will hit the water approximately 1 nautical mile astern of the airplane.

The float light does not begin showing smoke or light until about 15 seconds after the impact on the water. The surface distance of the airplane from the float light when the latter hits the water (not when it ignites) is the distance which determines the error in the drift angle, as shown in figure 18.

The true drift angle is 14°02′. In figure 18 the apparent drift angles, observed as relative angles with such a drift sight as the Mk. II-b, are shown at *a*, *b*, *c*, and *d* at the end of 1, 2, 3, and 4 minutes from the time of the float light impact. The air distances covered are respectively 2, 4, 6, and 8 nautical miles. Airplane positions are respectively *A′*, *B′*, *C′*, and *D′*.

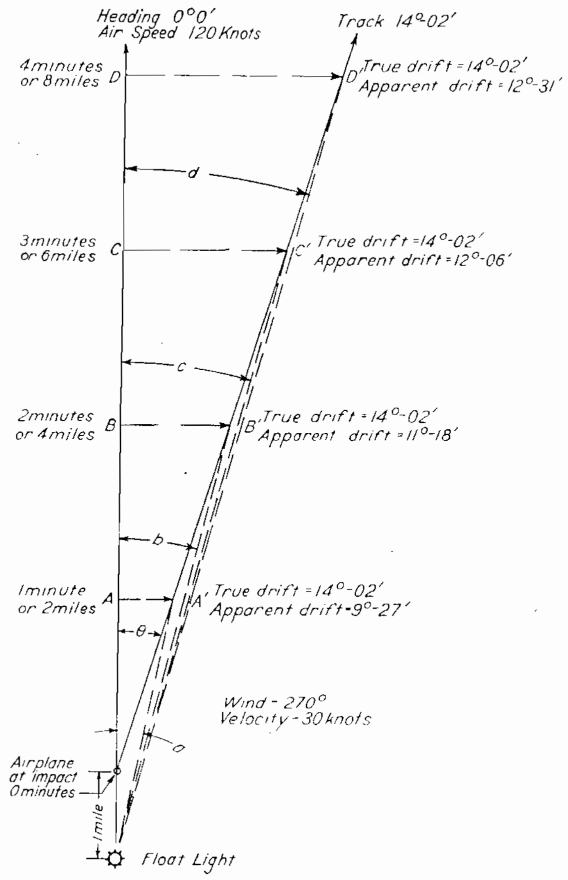

FIGURE 18.—Drift error due to cross trail.

It should be clear from the diagram that the drift observations should be made at the latest possible time in order to have the apparent drift as close as possible to the true drift.

This cross trail error is apparent only when using the Mk. II-b drift sight or similar method of observing a relative bearing. The error is always additive and depends upon the speed, altitude, and drift of the airplane. It is recommended that, at altitudes of more than 5,000 feet and drift of more than 10 degrees, a flat correction of plus one degree be applied to the observed drift.

After the drift angle is thoroughly understood the student is ready to proceed with its solution to obtain the wind. There are two methods of doing this i. e., the one speed two course or "wind star" method and the two speed one course method. The former is the one in use today and will be discussed here.

The results of taking "wind stars" show that with practice the direction of the wind can be determined within ±20° in direction and ±3 knots in velocity.

The results of wind determination both in an airplane and by balloon observation from the ground show that at times the wind may vary in direction by 35 degrees and in velocity by 9 knots.

As the name infers the one speed two course method makes use of a drift sight on each of two different headings at the same airspeed. Taking these two drift sights the following information is obtained.

	First sight	Second sight
Heading True	045°	315°
Airspeed True	110 K	110 K
Drift	[1] 15°	[2] 10°

[1] Plus or right. [2] Minus or left.

With the above information the Mk. III plotting board may be used to solve for the wind. Referring to figure 19 *WP*1 is the first heading and airspeed as shown. The drift angle of 15° plus or

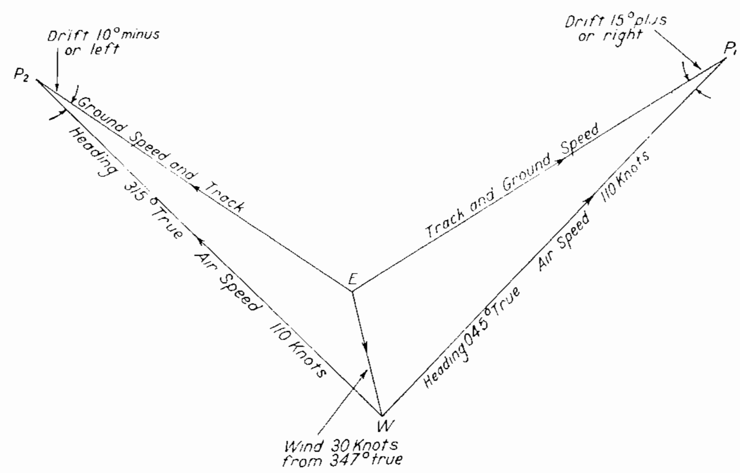

FIGURE 19.—Double drift method of solving for wind.

right is used to determine the track *P*1*E* which is drawn as a solid line of indefinite length. The second heading and airspeed is represented by the line *WP*2. Using the drift angle of 10° minus or left the second track *P2E* is drawn. It is drawn long enough to intersect *P1E*. A line is drawn from point of intersection *E* to the center of the board *W*. This represents the force and direction of the wind. Measuring this wind using the true index we find it to be force 30 knots from 347°T. As the wind is usually different at the different altitudes it must be remembered that THIS IS THE WIND AT THE ALTITUDE OF THE AIRCRAFT WHEN THE DRIFT SIGHTS WERE TAKEN.

The use of the Mk. III plotting board in solving two drift sights for wind as well as solving the true heading, true airspeed, and wind for track and ground speed will be further discussed in a later chapter. The actual use of the drift sight in taking a drift indication, together with an understanding of the drift angle is all that is required at this point.

Among other methods of determining ground speed are, (*a*) plotting of successive positions on a chart, noting time over each and calculation of run between, (*b*) runs over a measured course, (*c*) neutralizing apparent motions of objects on the ground by rotating telescopes and similar devices.

Rate of Climb Indicator

The rate of climb indicator shows the rate at which an aircraft is ascending or descending. It does not indicate the angle of the aircraft to the horizontal, but it is operated by the rate of change of atmospheric pressure which accompanies change of altitude. In other words it shows the vertical component of the speed of the aircraft.

The purpose of the rate of climb indicator is to show the pilot whether he is maintaining level flight or the rate at which he is ascending or descending. This is especially important under conditions of poor visibility as in fog, clouds, or at night.

The rate of climb indicator is a sensitive differential pressure gage and differs from the sensitive altimeter in that it measures the rate of change of atmospheric pressure rather than the atmospheric pressure.

Figure 20 shows a schematic diagram of a typical instrument. The indicator consists primarily of an airtight diaphragm assembly (*D*), and a simple auxiliary mechanism (*B*), for temperature and altitude compensation. The entire mechanism is housed in an airtight case. The static line (*V*) is connected to the interior of the diaphragm and the capillary tube (*C*) connected to the same line, dampens the rate of pressure balancing of the interior and exterior of the diaphragm. The capillary tube (*C*) is a glass tube with a small bore, which restricts the flow of air.