AIRPLANE INSTRUMENTS (chapters 3 and 9)

COMPASS TURNING ERRORS

1. During flight, magnetic compasses can be considered accurate only during straight-and-Ievel flight at constant airspeed.

2. The difference between direction indicated by a magnetic compass not installed in an airplane and one installed in an airplane is called deviation.

    a. Magnetic fields produced by metals and electrical accessories in an airplane disturb t -the compass needles.

3. In the Northern Hemisphere, acceleration/deceleration error occurs when on an east or west heading. Remember ANDS: Accelerate North, Decelerate South.

    a. A magnetic compass will indicate a turn toward the north during acceleration when on an east or west heading.

    b. A magnetic compass will indicate a turn toward the south during deceleration when on an east or west heading.

    c. Acceleration/deceleration error does not occur when on a north or south heading.

4. In the Northern Hemisphere, compass-turning error occurs when turning from a north or, south heading.
    a. A magnetic compass will lag (and at the start of a turn indicate a turn in the opposite, direction) when turning from a north heading.

        1) If turning to the east (right) , the compass will initially indicate a turn to the west and then lag behind the actual heading until your airplane is headed east (at which point there is no error).

        2) If turning to the west (left), the compass will initially indicate a turn to the east, and then lag behind the actual heading until your airplane is headed west (at which point there is no error).

    b. A magnetic compass will lead or precede the turn when turning from a south heading.

    c. Turning errors do not occur when turning from an east or west heading.

5. These errors diminish as the acceleration/deceleration or turns are completed.

PITOT -STATIC SYSTEM

The pitot-static system is a source of pressure for the:

    a. Altimeter
    b. Vertical-speed indicator
    c. Airspeed indicator

2. The pitot tube provides impact (or ram) pressure for the airspeed indicator only.

3. When the pitot tube and the outside static vents or just the static vents are clogged, all three instruments mentioned above will provide inaccurate readings.

    a. If only the pitot tube is clogged, only the airspeed indicator will be inoperative

AIRSPEED INDICATOR

1. Airspeed indicators have several color-coded markings

   a. The white arc is the full flap operating range.

      1) The lower limit is the power-off stalling speed with wing flaps and landing gear in the landing position (Vso).

      2) The upper limit is the maximum full flaps-extended speed (V_{FE}).

   b. The green arc is the normal operating range.

      1) The lower limit is the power-off stalling speed in a specified configuration (V_S1). This is normally wing flaps up and landing gear retracted.

      2) The upper limit is the maximum structural cruising speed (V_{NO}) for normal operation.

   c. The yellow arc is airspeed, which is safe in smooth air only.

      1) It is known as the caution range.

d. The red radial line is the speed that should never be exceeded (V_{NE}).

      1) This is the maximum speed at which the airplane may be operated in smooth air (or under any circumstances).

2. The most important airspeed limitation which is not color-coded is the maneuvering speed (V_A).

   a. The maneuvering speed is the maximum speed at which full deflection of aircraft controls can be made without causing structural damage.

   b. It is usually the maximum speed for flight in turbulent air.

AL TIMETER

1. Altimeters have three hands (e.g., as a clock has the hour, minute, and second hands.

2. The three hands on the altimeter are the
   a. 10,000-ft. interval (short needle)
   b. 1,000-ft. interval (medium needle).
   c. 100-ft. interval (long needle)

3. Altimeters are numbered 0-9. 4. To read an altimeter,

   a. First, determine whether the short needle points between 0 and 1 (1-10,000) , 1-2 (10,000-20,000), or 2-3 (20,000-30,000).

   b. Second, determine whether the medium needle is between 0 and 1 (0-1,000), 1 and 2 (1,000-2,000), etc.

   c. Third, determine at which number the long needle is pointing, e.g., 1 for 100 ft., 2 for 200 ft., etc.

TYPES OF ALTITUDE

1. Absolute altitude is the altitude above the surface, i.e., AGL.

2. True altitude is the actual distance above mean sea level, i.e., MSL It is not susceptible to variation with atmospheric conditions.

3. Density altitude is pressure altitude corrected for nonstandard temperatures.

4. Pressure altitude is the height above the standard datum plane of 29.92 in. of mercury. Thus, it is the indicated altitude when the altimeter setting is adjusted to 29.92 in. of mercury (also written 29.92" Hg).

5. Pressure altitude and density altitude are the same at standard temperature.

6. Indicated altitude is the same as true altitude when standard conditions exist and the " altimeter is calibrated properly.

7. Pressure altitude and true altitude are the same when standard atmospheric conditions (29.92" Hg and 15°C at sea level) exist.

8. When the altimeter is adjusted on the ground so that indicated altitude equals true altitude at airport elevation, the altimeter setting is that for your location, i.e., approximately the setting you would get from the control tower.

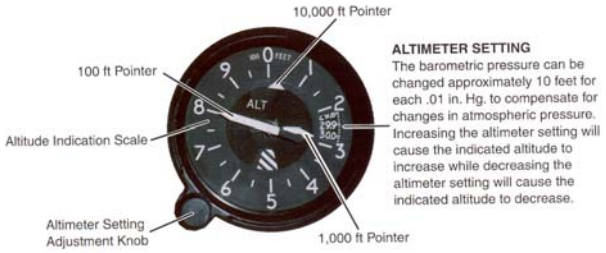
SETTING THE AL TIMETER

1. The indicated altitude on the altimeter increases when you change the altimeter setting to a higher pressure and decreases when you change the setting to a lower pressure.

    a. This is opposite to the altimeter's reaction due to changes in air pressure.

2. The indicated altitude will change at a rate of approximately 1,000 ft. for 1 in. of pressure change In the altimeter setting.

    a. EXAMPLE: When changing the altimeter setting from 29.15 to 29.85, there is a 0.70 in. change in pressure (29.85- 29.15). The indicated altitude would increase (due to a higher altimeter setting) by 700 ft. (0.70 x 1,000).



ALTIMETER ERRORS

1. Since altimeter readings are adjusted for changes in barometric pressure but not for temperature changes, an airplane will be at lower than indicated altitude when flying in colder than standard temperature air when maintaining a constant indicated altitude.

    a. On warm days, the altimeter indicates lower than actual altitude.

2. Likewise, when pressure lowers en route at a constant indicated altitude, your altimeter will indicate higher than actual altitude until you adjust it.

3. Remember, when flying from high to low (temperature or pressure), look out below.

    a. Low to high, clear the sky.

GYROSCOPIC INSTRUMENTS

1. The attitude indicator, with its miniature aircraft and horizon bar, displays a picture of the attitude of the airplane

    a. The relationship of the miniature aircraft to the horizon bar is the same as the relationship of the real aircraft to the actual horizon.

    b. The relationship of the miniature airplane to the horizon bar should be used for an indication of pitch and bank attitude, i.e., nose high, nose low, left bank, right bank.

    c. The gyro in the attitude indicator rotates in a horizontal plane and depends upon rigidity in space for its operation.

    d. An adjustment knob is provided with which the pilot may move the miniature airplane up or down to align the miniature airplane with the horizon bar to suit the pilot's line of vision.

2. The turn coordinator shows the roll and yaw movement of the airplane (Figure 5, page 49). W"

    a. It displays a miniature airplane, which moves proportionally to the roll rate of the airplane. When the bank is held constant, the turn coordinator indicates the rate of turn.

    b. The ball indicates whether the angle of bank is coordinated with the rate of turn. .

3. The heading indicator is a gyro instrument, which depends on the principle of rigidity in space for its operation

    a. Due to gyro precession, it must be periodically realigned with a magnetic compass.

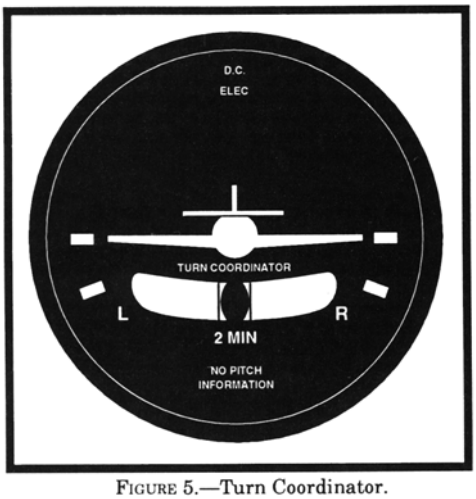


FIGURE 5.—Turn Coordinator.

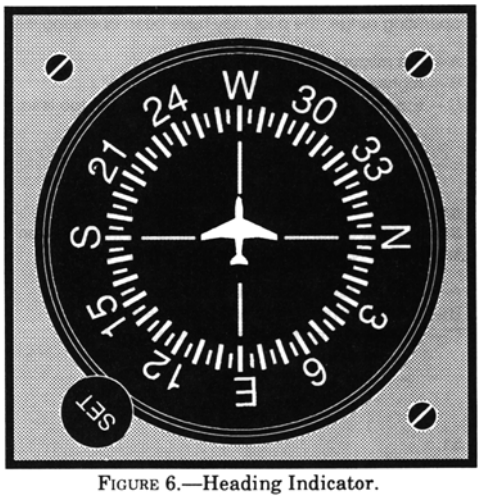


FIGURE 6.—Heading Indicator.

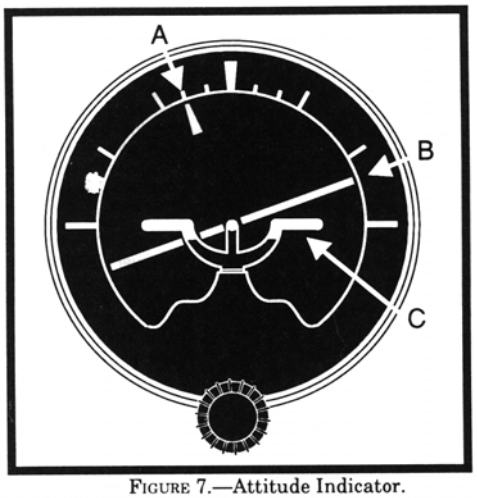


FIGURE 7.—Attitude Indicator.