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Instrument Flight for Army Aviators

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Preface

Field manual (FM) 3-04.240 is specifically prepared for aviators authorized to fly Army aircraft. This manual presents the fundamentals, procedures, and techniques for instrument flying and air navigation.

FM 3-04.240 facilitates adherence to Army regulation (AR) 95-1 by providing guidance and procedures for standard Army instrument flying. Aircraft flight instrumentation and mission objectives are varied, making instruction general for equipment and detailed for accomplishment of maneuvers. Guidance found in this manual is both technique and procedure oriented. Aircraft operator manuals provide the detailed instructions required for particular aircraft instrumentation or characteristics. When used with related flight directives and publications, this publication provides adequate guidance for instrument flight under most circumstances but is not a substitute for sound judgment; circumstances may require modification of prescribed procedures. Aircrew members charged with the safe operation of United States Army, Army National Guard (ARNG), or United States Army Reserve (USAR) aircraft must be knowledgeable of the guidance contained herein. This manual applies to all military, civilian, and/or contractor personnel who operate Army aircraft, and adherence to its general practices is mandatory.

The Aeronautical Information Manual (AIM) published by the Federal Aviation Administration (FAA) is not regulatory; however, the AIM provides information that reflects examples of operating techniques and procedures required in other regulations. AIM is not binding on Army aircrews. Furthermore, the AIM contains some techniques and procedures not consistent with Army mission requirements, regulatory guidance, waivers, exemptions, and accepted techniques and procedures. However, AIM is the accepted standard for civil aviation and reflects general techniques and procedures used by other pilots. Much of the information contained in this manual is reproduced from AIM and adapted for Army use. If a subject is not covered in this manual or other Army regulations, follow guidance in the AIM unless mission requirements dictate otherwise.

All figures and tables that display partial or complete navigational excerpts from other publications (such as instrument approach charts, legends, and low-altitude en route charts) are provided for reference only and should not be used in planning for or the conduct of any flight.

This publication applies to the Active Army, the Army National Guard/Army National Guard of the United States, and the United States Army Reserve unless otherwise stated.

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Note. For immediate assistance on issues affecting this FM, contact the Directorate of Training and Doctrine (DOTD), Doctrine Division, at DSN 558-3551, commercial 334-255-3551, or via e-mail at the following address: av.doctrine@us.army.mil.

Unless this publication states otherwise, masculine nouns and pronouns do not refer exclusively to men.

This publication has been reviewed for operations security considerations.

Chapter 1

Flight Instruments and Systems

The efficiency and utility of Army aircraft depend largely on flight instruments and systems accurately depicting what the aircraft is doing in flight and how well its power plants and components are functioning. Important navigation instruments are the magnetic compass, slaved gyro compass system, heading indicator, airspeed indicator, and altimeter. These instruments provide information concerning direction, airspeed, and altitude. The attitude indicator allows the aviator to control the aircraft by showing the attitude of the aircraft in relation to the natural horizon. The performance of an aircraft in a given attitude and with a certain power setting is indicated by the airspeed indicator, heading indicator, altimeter, vertical speed indicator/vertical velocity indicator, and turn-and-slip indicator. Flight instruments are grouped into three systems: pitot-static, compass, and gyroscopic.

SECTION I – PITOT-STATIC SYSTEMS

1-1. Most aircraft instrument panels have three basic pressure-operated instruments: the altimeter, airspeed indicator, and vertical speed indicator (VSI). All three receive the pressures that they measure from the aircraft pitot-static system. Flight instruments depend on accurate sampling of ambient atmospheric pressure to determine the height and speed of aircraft movement through the air, both horizontally and vertically. Ambient atmospheric pressure is sampled at two or more locations outside of the aircraft by the pitot-static system.

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1-2. Static pressure, or still air, is measured at a flush port where air is not disturbed. On some aircraft, this air is sampled by static ports on the side of the fuselage (Figure 1-1). A pitot-static head is a combination pickup used to sample pitot and static air pressures. Other aircraft pick up the static pressure through flush ports on the side of the electrically heated pitot-static head. These ports are in locations proven by flight tests to be in undisturbed air, and they are normally paired, one on either side of the aircraft. This dual location prevents lateral movement of the aircraft from giving erroneous static pressure indications. The areas around the static ports may be heated with electric heater elements to prevent ice forming over the port and blocking the entry of static air.

1-3. Pitot pressure, or impact air pressure, is taken in through an open-end tube pointed directly into the relative wind flowing around the aircraft. The pitot tube connects to the airspeed indicator, and the static ports deliver pressure to the airspeed indicator, altimeter, and VSI (Figure 1-1, page 1-2).

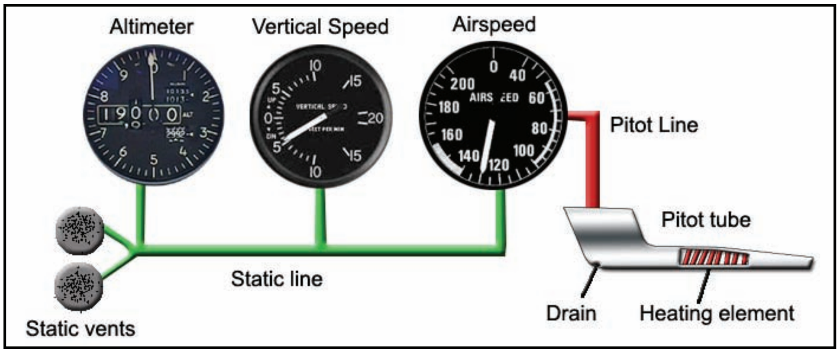

Figure 1-1. Pitot-static head

ALTIMETER

1-4. An altimeter is an aneroid barometer that measures the absolute pressure of ambient air and displays that absolute pressure in terms of feet or meters above a selected pressure level. The sensitive element in an altimeter is a stack of evacuated, corrugated bronze wafers (Figure 1-2). The air pressure tries to compress the wafers against their natural springiness, which works to expand them. As a result, their thickness changes as air pressure changes.

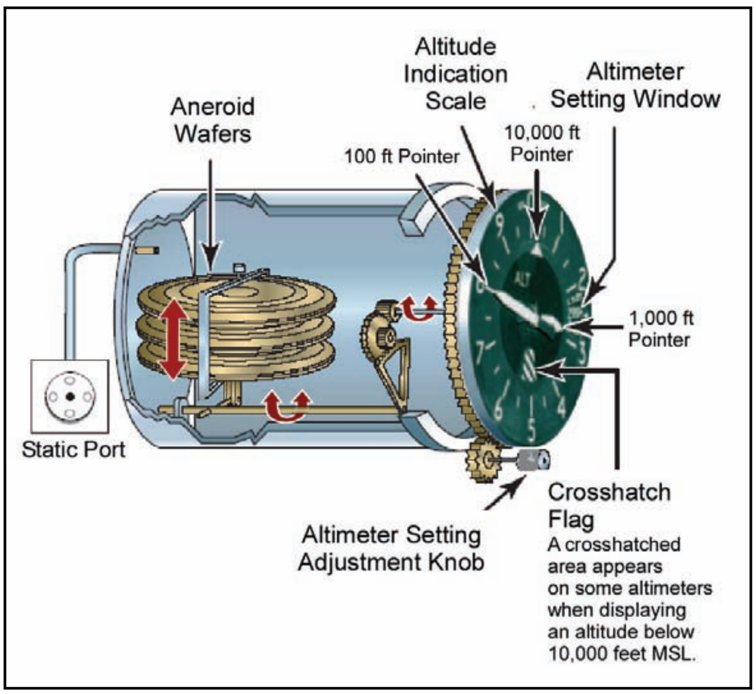

Figure 1-2. Altimeter components

1-5. An altimeter has an adjustable barometric scale that allows the aviator to set the reference pressure from which the altitude is measured. This scale is visible in the Kollsman window (altimeter setting window) and adjusted by a knob on the instrument. The range of the scale is from 28.00 to 31.00 inches of mercury (Hg), or 948 to 1,050 millibars.

1-6. Rotating the knob changes both the barometric scale and altimeter pointers in such a way that a change in the barometric scale of 1 inch Hg changes the pointer indication by 1,000 feet. This is the standard pressure lapse rate below 5,000 feet. When the barometric scale is adjusted to 29.92 inches Hg, or 1,013.2 millibars, the pointers indicate the pressure altitude. To display indicated altitude, adjust the barometric scale to the local altimeter setting. The instrument then indicates the height above the existing sea-level pressure.

TYPES OF ALTITUDE

1-7. The five types of altitude are indicated, absolute, true, pressure, and density. Figure 1-3 compares pressure, true, and absolute altitudes. Indicated altitude is altitude as read on the dial with a current altimeter setting (sea-level pressure) set in the Kollsman window. Absolute altitude is the altitude above the surface or terrain where the aircraft is flying, also called above ground level (AGL). True altitude is the altitude above mean sea level (MSL).

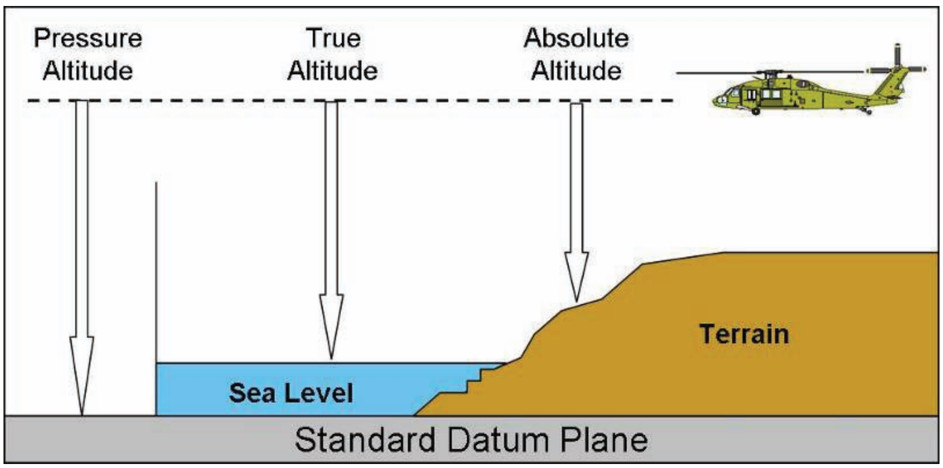

Figure 1-3. Types of altitude

1-8. Pressure altitude is the height measured above the 29.92-inches-of-mercury pressure level (standard datum plane). If the Kollsman window is set to 29.92 Hg, the hands of the dial indicate pressure altitude. This setting is called the standard altimeter setting. In the United States, the use of pressure altitudes (standard altimeter setting) begins at 18,000 feet. These altitudes are referred to as flight levels (FLs). The following are examples of conversions of altitude in feet to flight levels.

Examples of Conversions to Flight Levels
18,000 feet equals FL180; 35,000 feet equals FL350.

1-9. Density altitude is the altitude for which a given air density exists in the standard atmosphere. If the barometric pressure is lower or the temperature is higher than standard, then density altitude of the field is higher than its actual elevation such as in the following example. Density altitudes can be obtained from many airfield towers or may be computed on the dead reckoning computer (CPU-26A/P).

WARNING

Because higher density altitude requires a greater takeoff distance and reduces aircraft performance, failure to calculate density altitude could be fatal.