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ADVISORY CIRCULAR

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

SUBJECT: ROLE OF PREFLIGHT PREPARATION

1. PURPOSE. This advisory circular provides information on some elements of flight planning that should be considered in planning and conducting a safe, efficient flight. It is also intended to provide a discussion of the basic elements of preflight preparation and potential hazards associated with some of these elements.

2. BACKGROUND.

   a. One of the most often neglected acts of a pilot contemplating flight in an aircraft is that of proper preflight planning. While the reasons remain obscure, the facts are well supported by aircraft accident statistics. Although the number of general aviation accidents has shown a downward trend in recent years, the accident and fatality/serious injury statistics indicate an increase in the percentage of accidents during TAKEOFF.

   b. Statistics taken from the National Transportation Safety Board files show that from 1970 through 1974, 822 persons died and 741 were seriously injured in 386 takeoff accidents. These accidents are significant to general aviation pilots--annually, they represent about 19 percent of all general aviation accidents and about 16 percent of all fatalities and serious injuries. Traditionally, pilots have emphasized the planning of the en route and approach/landing phases of flight; e.g., the route to be taken, en route and destination weather, en route and terminal facilities, applicable altitudes and fuel requirements. Accident data, however, indicate that too little preparation is made for the actual takeoff of the aircraft. In order for pilots to fulfill their responsibilities to ensure the safety of the entire flight, it is necessary that they have adequate knowledge of elements involved in preflight planning. It is also necessary that they take time to analyze the conditions and study the various factors which would affect the takeoff, en route, and landing phases of flight.

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3. KEY ELEMENTS OF PREFLIGHT PLANNING.

a. Charts.

(1) A basic element of preflight preparation requires the use of current navigational charts on which pilots can mentally review their intended route of flight. They may or may not wish to draw a line on the chart representing the TRUE COURSE. They should, however, review the projected path across the face of the chart for the location of good check points, restricted areas, obstructions, other flight hazards, and suitable airports. For VFR pilot planning by either PILOTAGE OR DEAD RECKONING, the Sectional Aeronautical Chart is an excellent choice. It is scaled at 1:500,000 or eight miles to the inch. The physical characteristics of most landmarks, both cultural and geographic, are shown in great detail. The pilot should have little difficulty identifying the selected landmarks along the route of flight. Another popular chart is the World Aeronautical Chart (WAC). The scale of the WAC is 1:1,000,000, or 16 miles to the inch. Many states print aeronautical charts which are excellent for VFR navigation within their state boundaries. The pilot should realize, however, that all of these charts are designed primarily for VFR navigation and contain only limited information concerning radio aids and frequencies. The pilot should refer to the Airman's Information Manual for more precise coverage of this information.

(2) Most pilots are reluctant to admit to being disoriented or lost. Being lost can be an embarrassing and sometimes frightening experience. Pilots should carry appropriate and current aeronautical charts on all cross-country flights. The use of outdated charts may result in flights into airport traffic areas, control zones, or restricted areas without proper authorization. Having available the information contained in current charts will enhance the pilot's ability to complete the flight with greater confidence, ease, and safety.

b. Route.

(1) It has been proven that the shortest distance between two points is a straight line. Consequently, a majority of pilots desire direct routes for most flights. Quite often there are factors that should be considered that may make a direct flight undesirable. Restricted and prohibited areas present obstacles to direct flights. In single-engine aircraft, pilots should give consideration to

circumnavigating large, desolate areas. In some multiengine aircraft; e.g., aircraft with single-engine service ceiling of 6,000 feet operating over terrain of 9,000 feet elevation, pilots should be aware that the only advantage they may have over a pilot flying a single-engine aircraft may be a wider latitude in selecting a suitable forced landing area.

c. Airman's Information Manual. Part 91 of the Federal Aviation Regulations (FAR) states, in part, that "Each pilot in command shall, before beginning a flight, familiarize himself with all available information concerning that flight." The Airman's Information Manual (AIM) contains information relative to any cross-country flight. Part I contains basic fundamentals required to fly in the U.S. National Airspace System. Part II is an airport directory that lists services available, except communications. Part III lists communications, operational data, and notices to airmen. Pilots should avail themselves of the information in the AIM, not only to enhance compliance with the FARs, but also to enhance the pilot's ability to conduct a safe flight.

d. Notices to Airmen (NOTAMS). In addition to NOTAM information contained in the AIM, pilots should check with the nearest flight service station (FSS) for an update on the latest NOTAMs.

e. Weather. Review weather maps and forecasts, current weather reports, winds aloft forecasts, pilot weather reports, Sigmets, Airmets, NOTAMS, and other information. Although weather information may be obtained by telephone, it is strongly recommended that a personal visit be made to the nearest National Weather Service office, FSS, or other flight service facility. The weather information should be weighed very carefully in considering the go/no-go decision. This decision is the sole responsibility of the pilot and compulsion should never take the place of good judgment.

f. Navigation Log. Precise flight planning of log items, such as precomputed courses, time and distance, navigational aids, and frequencies to be used will make en route errors in these items less likely. Special attention should be given to fuel requirements, keeping in mind the need for an ample reserve as well as location of refueling points available as the flight progresses.

g. Flight Plan (VFR). This is NOT REQUIRED by FARs, but is DICTATED BY GOOD OPERATING PRACTICE. A flight plan not only assures prompt search and rescue in the event the aircraft becomes overdue or missing, but it also permits en route stations and the destination station to render better service by having prior knowledge of your flight. It costs only a few minutes of time to file a flight plan and may be the best investment the pilot ever makes.

h. Aircraft Manual. Aircraft manuals contain operating limitations, performance, normal and emergency procedures, and a variety of other operational information for the respective aircraft. Traditionally, aircraft manufacturers have done considerable testing to gather and substantiate the information in the aircraft manual. Pilots should become familiar with the manual and be able to refer to it for information relative to a proposed flight.

4. KEY ELEMENTS DURING TAKEOFF PHASE. The importance of thorough preflight preparation which considers possible hazards to TAKEOFF cannot be over-emphasized. The following elements, which should be carefully considered, continue to emerge as factors in takeoff accidents:

a. Gross Weight.

(1) Maximum allowable gross weight is established for an aircraft as an operating limitation for both safety and performance considerations. The gross weight is important because it is a basis for determining the takeoff distance. If gross weight increases, the takeoff speed must be greater to produce the greater lift required for takeoff. The takeoff distance varies with the square of the gross weight. As an example, for an aircraft with a relatively high thrust-to-weight ratio, a 10 percent increase in takeoff gross weight would cause:

(a) a 5 percent increase in the speed necessary for takeoff velocity;

(b) at least a 9 percent decrease in acceleration; and,

(c) at least a 21 percent increase in takeoff distance.

Note. For aircraft with relatively low thrust-to-weight ratios, the figures are slightly higher.

(2) Operations within the proper gross weight limits are outlined in each operator's manual. Gross weight and center of gravity (CG) limits should be considered during preflight preparation. Weight in excess of the maximum certificated gross weight may be a contributing factor to an accident, especially when coupled with other factors which adversely affect the ability of an aircraft to take off and climb safely. These factors may range from field elevation of the airport to the condition of the runway. The responsibility for considering these factors before each flight rests with the PILOT.

b. Balance.

(1) A pilot must not only determine the takeoff weight of the aircraft, but also must assure that the load is arranged to fall within the allowable CG limits for the aircraft. Each aircraft manual provides instructions on the proper method for determining if the aircraft loading meets the balance requirements. The pilot should routinely determine the balance of the aircraft since it is possible to be within the gross weight limits and still exceed the CG limits.

(2) An airplane which exceeds the forward CG limits places heavy loads on the nose wheel and, in conventional landing gear airplanes, may, during braking, cause an uncontrollable condition. Furthermore, performance may be significantly decreased and the stall speed may be much higher.

(3) An airplane loaded in a manner that the CG exceeds the aft limit will have decreased static and dynamic longitudinal stability. This condition can produce sudden and violent stall characteristics and can seriously affect recovery from the stall. The aircraft will also be much more susceptible to overstress by any control movements or when encountering rough air.

(4) Pilots exceeding CG limits in helicopters may experience insufficient cyclic controls to safely control the helicopter. This can be extremely critical while hovering downwind with the helicopter load exceeding the forward CG limit.

c. Ice and Frost.

(1) Ice or frost can affect the takeoff performance of an aircraft significantly. Pilots should never attempt takeoffs with any accumulation of ice or frost on their aircraft. Most pilots are aware of the hazards of ice on the wings of an aircraft. The effects of a hard frost are much more subtle. This is due to an increased roughness of the surface texture of the upper wing and may cause up to a 10 percent increase in the airplane stall speed. It may also require additional speed to produce the lift necessary to become airborne.

(2) Once airborne, the airplane could have an insufficient margin of airspeed above stall such that gusts or turning of the aircraft could result in a stall. Accumulation of ice or frost on helicopter rotor blades results in potential rotor blade stalls at slower forward air speeds. It could also result in an unbalanced rotor blade condition which could cause an uncontrollable vibration.

d. Density Altitude.

(1) Aircraft instruments are calibrated to be correct under one set of conditions. Standard conditions represent theoretical sea level conditions, 59 degrees Farenheit and 29.92 in Hg. As higher elevations are reached, both temperature and pressure normally decrease. Thus, density altitude is determined by compensating for pressure and temperature variances from the standard conditions. A pilot must remember that as density altitude increases, there is a corresponding decrease in the power delivered by the engine and the propellers or rotor blades. For airplanes, this may cause the required takeoff roll to increase by up to 25 percent for every 1,000 feet of elevation above sea level. The most critical conditions of takeoff performance are the result of a combination of heavy load, unfavorable runway conditions, winds, high temperatures, high airport elevations, and high humidity.

(2) The proper accounting for the pressure altitude (field elevation is a poor substitute) and temperature is mandatory for accurate prediction of takeoff data. The required information will be listed in the aircraft manual and should be consulted before each takeoff, especially if operating at a high density altitude or with a heavily loaded aircraft.

e. Effect of Wind.

(1) Every aircraft manual gives representative wind data and corresponding ground roll distances. A headwind which is 10 percent of the takeoff airspeed will reduce the no-wind takeoff distance by 19 percent. A tailwind which is 10 percent of the takeoff airspeed, however, will increase the no-wind takeoff distance by about 21 percent.

(2) Although this consideration is basic to a successful takeoff, the number of accidents involving the selection of the wrong runway for the existing wind and taking off into unfavorable wind conditions indicates a need for many pilots to reevaluate their preflight planning to ensure that the effect of wind is considered fully.

f. Runway Condition.

(1) There are more than 12,000 airports in the United States, each with runways having various surface compositions, slopes, and degrees of roughness. Takeoff acceleration is affected directly by the runway surface condition and, as a result, it must be a primary consideration during preflight planning.

(2) Most aircraft manuals list takeoff data for level, dry, hard-surfaced runways. The runway to be used, however, is not always hard-surfaced and level. Consequently, pilots must be aware of the effect of the slope or gradient of the runway, the composition of the runway, and the condition of its surface. Each of these can contribute to a failure to obtain/maintain a safe flying speed.

(3) The effective runway gradient is the maximum difference in the runway centerline elevation divided by the runway length. The FAA recognizes the effect of runway gradient on the takeoff roll of an aircraft and has published limits on the maximum gradients. For general aviation VFR airports, the maximum longitudinal runway grade is 2 percent and the longitudinal runway grade change is 2 percent maximum. Furthermore, the takeoff length for a runway must be increased an additional 20 percent for each 1 percent of change in effective gradient to a maximum allowable effective gradient change of 2 percent.

(4) Since the runway gradient has a direct bearing on the component weight of the aircraft, a runway gradient of 1 percent would provide a force component along the path of the aircraft which is 1 percent of gross weight. In the case of an upslope, the additional drag and rolling friction caused by a 1 percent upslope can result in a 2 percent to 4 percent increase in the takeoff distance and subsequent climb.

(5) Frequently, the only runway at an airport has a slope. When determining which direction to use for takeoff, pilots must remember that a direction uphill, but into a headwind, is GENERALLY preferred to a downwind takeoff on a downsloping runway. Factors such as steep slope, light wind, etc., may, however, make an uphill takeoff impractical.

(6) It is difficult to predict the retarding effect on the takeoff run that water, snow/slush, sand, gravel, mud, or long grass on a runway will have, but these factors can be critical to the success of a takeoff. Since the takeoff data in the aircraft manual is predicated on a dry, hard surface, each pilot must develop individual guidelines for operations from other type surfaces.

(7) A typical general aviation aircraft manual states, "For operation off a dry, grass runway, increase distance (both 'ground run' and 'total to clear 50 ft. obstacle') by 7 percent of the 'total to clear 50 ft. obstacle' figures." Advisory Circular 61-23A, The Pilot's Handbook of Aeronautical Knowledge, states that grass, sand, mud, or deep snow can easily double the takeoff distances. The pilot is responsible for determining this effect in light of existing conditions.

g. Cold Weather Takeoffs. The following is an excerpt taken from Advisory Circular 91-13A, Cold Weather Operation of Aircraft:

"Takeoffs in cold weather offer some distinct advantages, but they also offer some special problems. A few points to remember are as follows:

"(1) Do not over-boost supercharged or turbine engines. Use the applicable power charts for the pressure altitude and ambient temperature to determine the appropriate manifold pressure or engine pressure ratio. Care should be exercised in operating normally aspirated engines. Power output increases at about 1% for each ten degrees of temperature below that of standard air. At -40 degrees F, an engine might develop 10% more than rated power even though RPM and MP limits are not exceeded.

"(2) On multiengine aircraft it must be remembered that the critical engine-out minimum control speed (Vmc) was determined at sea level with a standard day temperature. If the appropriate power charts are not available to limit maximum rated power for takeoff, Vmc will be higher than that published at below sea level density altitudes.

"(3) With reciprocating engines, use carburetor heat as required. In some cases, it is necessary to use heat to vaporize the fuel. Gasoline does not vaporize as readily at very cold temperatures. Do not use carburetor heat in such a manner that it raises the mixture temperature barely to freezing or just a little below. In such cases, it may be inducing carburetor icing. An accurate mixture temperature gauge is a good investment for cold weather operation. It may be best to use carburetor heat on takeoff in very cold weather.

"(4) If icing conditions exist, use the anti-ice and deice equipment as outlined in the Airplane Flight Manual. If the aircraft is turbine powered, use the appropriate power charts for the condition bearing in mind that the use of bleed air will in most cases change the maximum load to be carried and the runway requirements."

5. SUMMARY. Preflight preparation is the foundation of safe flying. Accident statistics of recent years indicate that adequate preflight preparation is lacking in many cases. As a result, while the number of general aviation accidents and approach and landing accidents has declined, takeoff accidents have increased. Statistics indicate that takeoff accidents occur because elements of the preflight preparation were:

   a. not assigned the proper importance,

   b. not incorporated into the preflight routine, or

   c. pilots did not anticipate potential takeoff emergencies and the required procedures to follow.

6. RECOMMENDATION. To enhance the safety of flying, pilots are encouraged to:

   a. form good preflight planning habits and review them continually,

   b. be thoroughly knowledgeable of the hazards and conditions which would represent potential dangers, particularly during takeoff, and,

   c. be aware of the capabilities and limitations of their aircraft.

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