

Figure 8-3 ILS Approach

ICE AND RAIN

The possibility of engine or airframe icing is often present. If icing conditions are encountered, remember these two serious aspects: first, engine or carburetor ice may seriously affect engine operation. Second, an accumulation of airframe ice destroys lift and increases drag and weight resulting in abnormally high stalling speeds. Structural damage also may result due to vibrations induced by unbalanced loads of ice accumulations.

NOTE: Heavy airframe ice accumulations can greatly increase stalling speed. Extreme caution must be exercised when making approaches and landings and airspeed should be substantially increased under such conditions.

Installations on the aircraft for combating the various icing problems are pitot heat, carburetor heat, and cockpit heat. Entering anything other than very light icing conditions is exceptionally hazardous since light or trace icing can very rapidly change to moderate or heavy icing. If icing conditions are encountered, attempt to get out of the icing area as rapidly as possible.

NOTE:

Ice accumulation on the propeller usually results in heavy vibration. It can sometimes be broken off by rapidly increasing and decreasing the propeller rpm.

Ice and snow accumulated on the aircraft while on the ground can also result in serious aerodynamic and structural effects when flight is attempted, especially during takeoff and climb-out. These hazards can be eliminated by removing snow and ice from the wings, fuselage, and empennage before flight is attempted. Flight in moderate or heavy rain should be avoided because of the probability of rain erosion damage to the leading edge of the propeller. After a flight in any type of rain the propeller should be inspected thoroughly for damage and either repaired as necessary or replaced.

TURBULENCE AND THUNDERSTORMS

CAUTION: Flight in heavy turbulence or thunderstorms should be avoided if at all possible to eliminate the hazard of aircraft damage and loss of control.

Under night or instrument flight conditions, avoiding turbulent areas may be difficult. The following techniques are recommended for flight into turbulence or thunderstorms: (Throttle setting and attitude are the keys to flight in turbulent conditions.) When turbulence is encountered, the aircraft should be slowed to maneuvering speed (145 mph IAS) and kept at or below this speed while in turbulent conditions. All loose equipment in the aircraft should be secured, safety belt and shoulder harness tightened, and instrument lighting turned up full to minimize blinding caused by lighting.

CAUTION: When operating in turbulent conditions, avoid abrupt control inputs and unnecessary maneuvering. These actions may impose severe loads in turbulent conditions.

NIGHT FLIGHT

When flying at night, thoroughly check all lighting systems and be familiar with the location of all switches in the cockpit during the preflight stage. Always carry a flashlight. Night flying may pose the

same problems as instrument flight and should be treated accordingly.

NOTE: When making night VFR takeoffs in areas of limited horizon references, the instrument takeoff procedures are recommended to avoid disorientation.

COLD WEATHER OPERATION

The success of low temperature operation depends primarily upon the preparations made during the post-flight and ground handling of the aircraft in anticipation of the following day's operation. To expedite preflight inspection and ensure satisfactory operation for the next flight, the normal operating procedures outlined in Section 2 should be adhered to with the following additions and exceptions:

Before Entering the Aircraft

Remove all protective covers and check to see that the airframe is free of ice, snow, and frost. Check all fuel drains for free flow, and battery for proper installation, if it was removed after the last flight.

On Entering the Aircraft

Check flight controls for complete freedom of movement and complete other normal procedures.

Starting Engine

The normal engine starting procedures should be used with the possible exception of using the choke. Use the choke steadily until the engine starts firing, then intermittently to keep the engine running if required. Cold starts may require a more retarded throttle setting.

NOTE: **Moisture forms quickly on spark plugs during cold weather starts and can cause plug misfiring.**

Taxiing

Do not taxi through water or slush if it can be avoided. Water or slush splashed on wing and tail surfaces will freeze, increasing weight and drag and possibly limiting control surface movement. If taxiing behind other aircraft maintain a greater than normal interval to prevent ice and slush being blown on the aircraft from the aircraft ahead. Because of the small

tires and very low ground clearance of this aircraft it should never be operated from runways having more than one-inch accumulation of snow or slush.

Before Takeoff

Run the engine up using carburetor heat to eliminate any possible induction system icing then return the carburetor heat control to the COLD position for takeoff.

Takeoff

Make a normal takeoff using caution against possible icing. Carburetor heat should not be used during the takeoff roll.

CAUTION: **Exercise caution in the application of brake steering on slick runways to avoid skidding and loss of directional control.**

After Takeoff—Climb

If conditions require, apply carburetor heat as soon as full power is no longer required. If takeoff is made from a snow- or slush-covered field, operate the landing gear and flaps through several cycles to prevent their freezing in the retracted position.

CAUTION: Do not exceed the gear and flap operating limit airspeed during this operation.

Landing

Make a normal landing pattern and complete the normal checks and procedures. Use pitot heat as required.

CAUTION: Landing gear should be cycled prior to final approach and brakes checked to guard against freezing.

WARNING: Carburetor icing could be severe enough to demand its use in the traffic pattern. Do not use carburetor heat on final. Return the carburetor heat control to the COLD position when turning final.

As soon as the aircraft is firmly on the ground, retract the flaps and use brakes as little as possible on slippery runways.

After Landing

Use carburetor heat as required while taxiing. Exercise the same precautions in postflight taxiing operations as you would before flying.

Before Leaving The Aircraft

When use of the aircraft is planned later in the day or the following day, it should be hangared in a warm hangar if possible. If heated storage is not available, cover the aircraft to protect it against frost and snow.

HOT WEATHER AND DESERT OPERATION

Before Takeoff

Check the aircraft thoroughly for dust and sand and clean such from any parts or operating mechanisms which it could damage.

Takeoff

Under extremely hot conditions a longer ground run will be required. Check takeoff and landing distance data in Appendix A. Performance of both aircraft and engine is dependent on the density altitude at which they operate.

Before Leaving The Aircraft

Leave the canopy slightly open when parking in the sun so the cockpit temperature will not become excessive.

CAUTION: High temperatures can cause fluid in the compass to boil away, dry out electrical insulation, and cause paint to pull away from the skin.

Whenever possible, protect all air inlets, vents, operating mechanisms, and cockpit from blowing dust and sand.

NOTE:

Sand and dust in the air inlets and vents may restrict airflow during subsequent operations or cause engine damage.

APPENDIX A—PERFORMANCE CHARTS AND GLOSSARY

A series of charts is provided on the following pages to furnish the pilot with sufficient data to make an intelligent and safe flight plan. The charts include data on takeoff, climb, landing, and operational data for cruising flight. Because the number of variables involved makes precise predictions impossible, the pilot should be alert to conditions which are not accounted for in the charts. No allowance has been made for navigational error, formation flight, fuel used during climb, or any number of other variables. Appropriate allowances for these items should be dictated by local requirements and should be accounted for when the fuel required for cruise is determined.

GLOSSARY OF TERMS AND ABBREVIATIONS

The following terms may be found in this Appendix:

IAS — Indicated airspeed corrected for instrument error.

CAS — Calibrated airspeed; IAS corrected for installation error in the pitot-static system.

TAS — True airspeed; CAS corrected for density altitude.

BHP — Brake Horsepower.

RPM — Engine revolutions per minute.

Density Altitude — The altitude in a standard atmosphere at which the density of the air is the same as the local air density.

TEMPERATURE CONVERSION

A temperature conversion chart (Figure A-1) is included to facilitate conversion between Centigrade and Fahrenheit temperatures.

Figure A-1 Temperature Conversion Chart

CONVERSION METHOD:

[illegible]

DENSITY ALTITUDE CHART

A Density Altitude Chart (Figure A-2) is provided to determine the density altitude for a known free air temperature and pressure altitude. Many of the performance charts are based on density altitude rather than pressure altitude to allow for temperature compensation. At the right side of the chart, a conversion factor (reciprocal square root of the density ratio) is given to provide a means of computing true airspeed from indicated airspeed at a known density altitude. For example, at an IAS of 180 mph and a density altitude of 4000 feet, the TAS is $180 \times 1.061 = 191$ mph TAS.

NOTE:

To obtain the pressure altitude, set 29.92 in the aircraft altimeter setting window, and read the pressure altitude directly. Another method is to compute the difference in pressure between the local altimeter setting and 29.92. Multiply this difference by 1000 to obtain feet. If the local altimeter setting is above 29.92, subtract the computed feet from the local elevation to obtain pressure altitude. If the local altimeter setting is below 29.92, add the value to the local elevation.

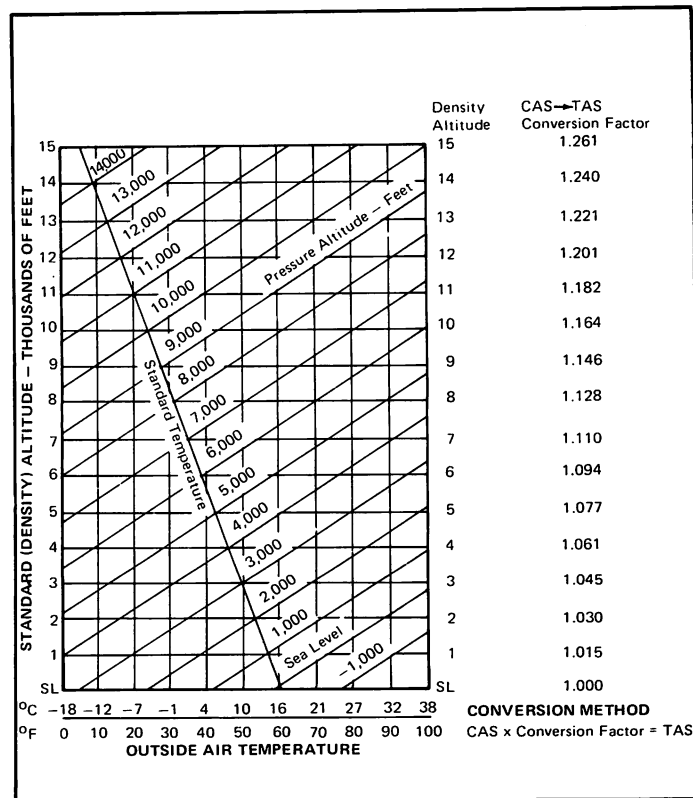


Figure A-2 Density Altitude Chart

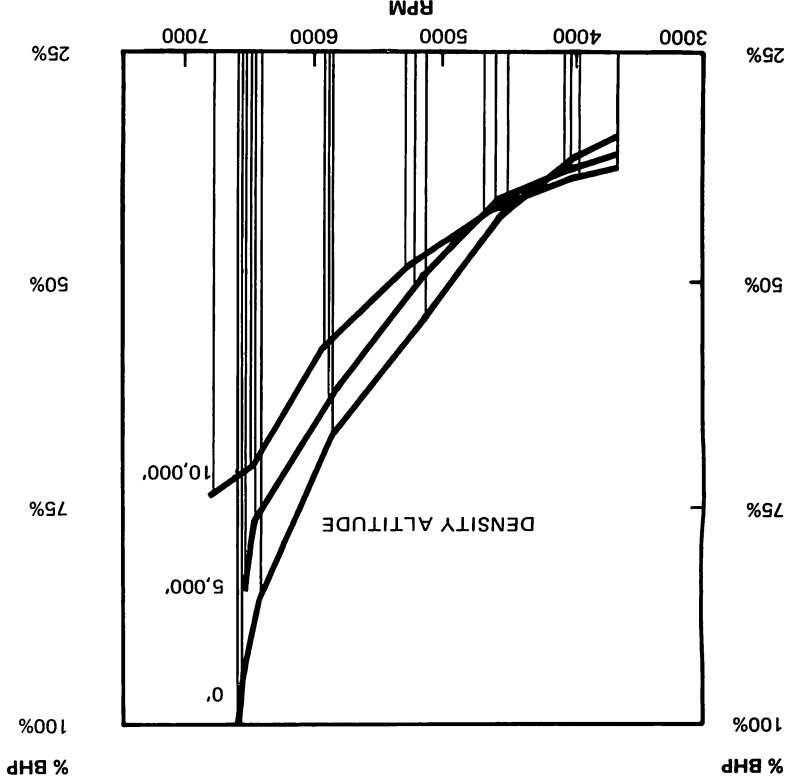
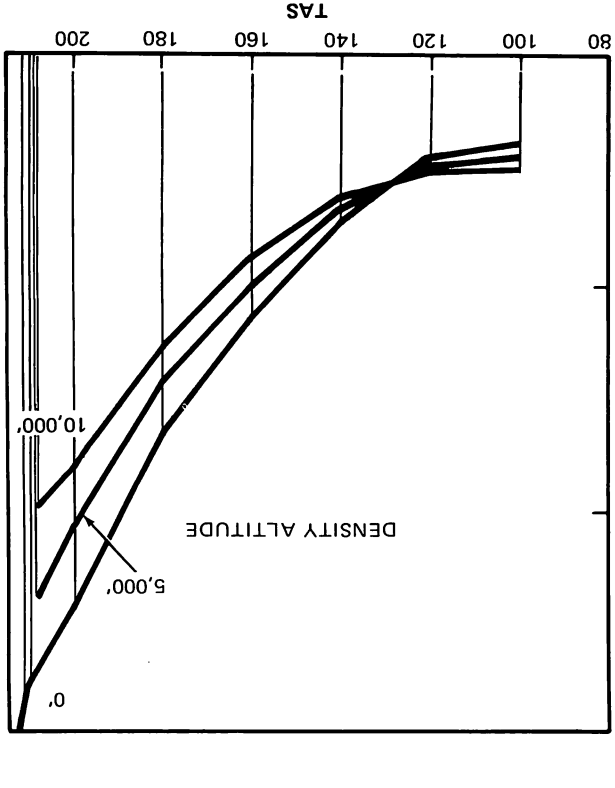


Figure A-3 Speed Power Charts

NOTE: Charts assume level flight condition with 46-inch diameter/53-inch pitch propeller.



SPEED/POWER CHARTS

For any selected BHP, the power curve (Figure A-3) will define the rpm to achieve that power at the designated altitude. The maximum BHP percent for cruising flight is 75 percent. The Speed Curve will show a TAS to expect at various BHP's and density altitudes.

FUEL FLOW

Fuel flow corresponding to any selected brake horsepower may be determined by reference to the fuel flow chart (Figure A-4).

TAKEOFF DISTANCE

The takeoff distance chart (Figure A-5) predicts total distance required to clear a 50-foot obstacle when density altitude and takeoff weight are known. The chart assumes a hard surface with no incline and no wind.

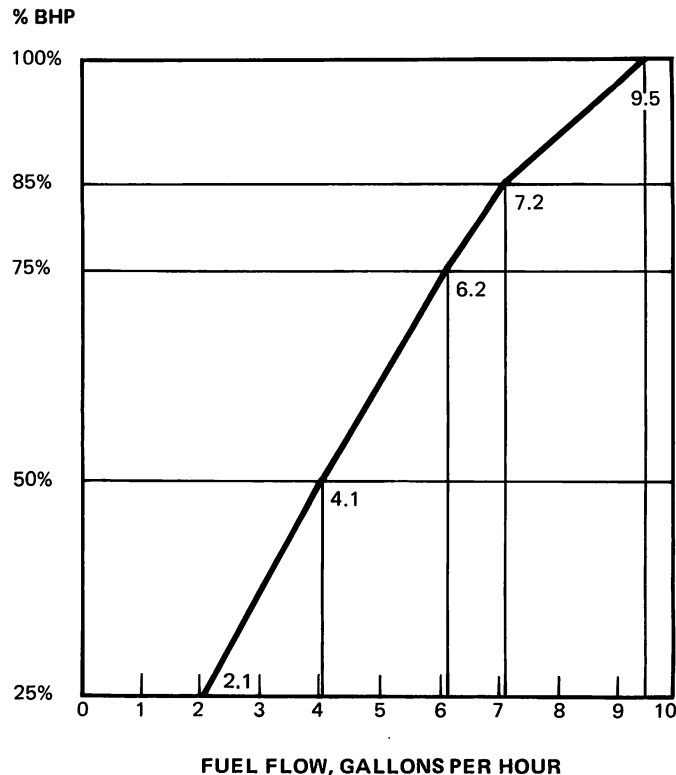


Figure A-4 Fuel Flow Chart

GROSS WEIGHT,
POUNDS

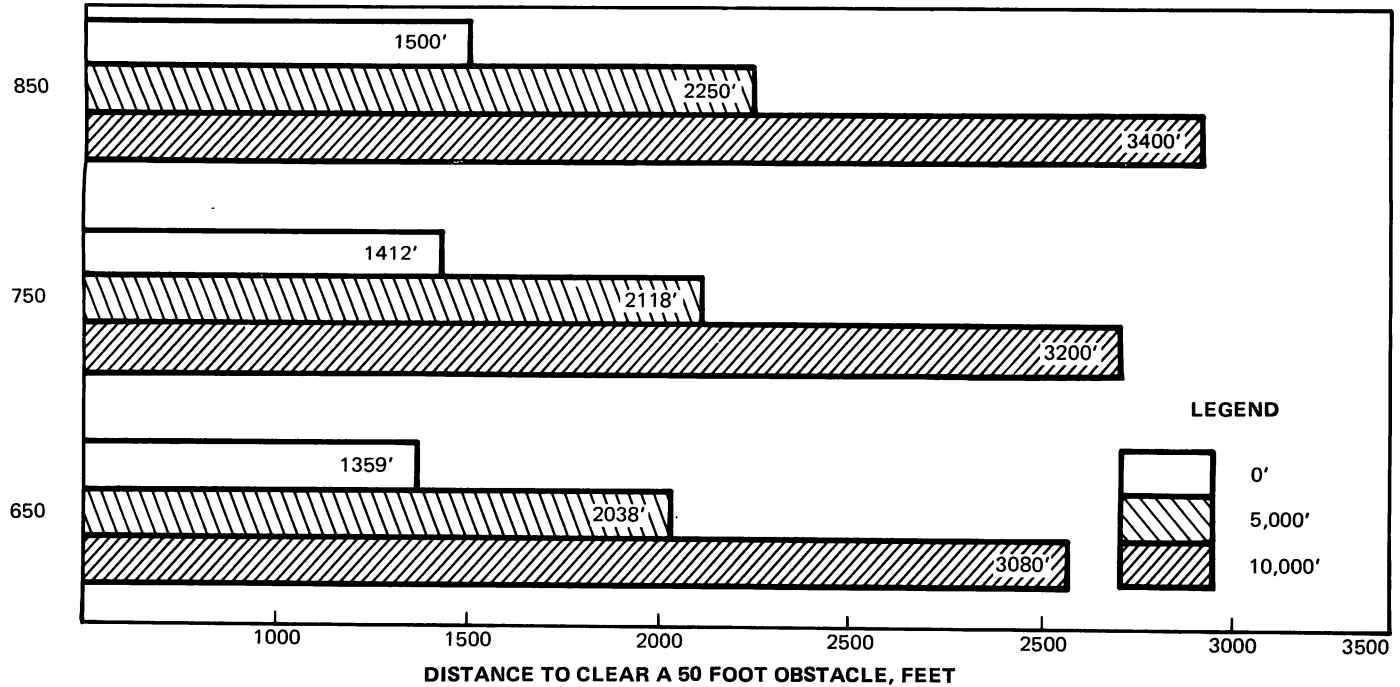


Figure A-5 Takeoff Distance Chart

**RATE OF CLIMB,
FEET PER MIN.**

BD-5G AT GROSS WEIGHT, 850 LBS.

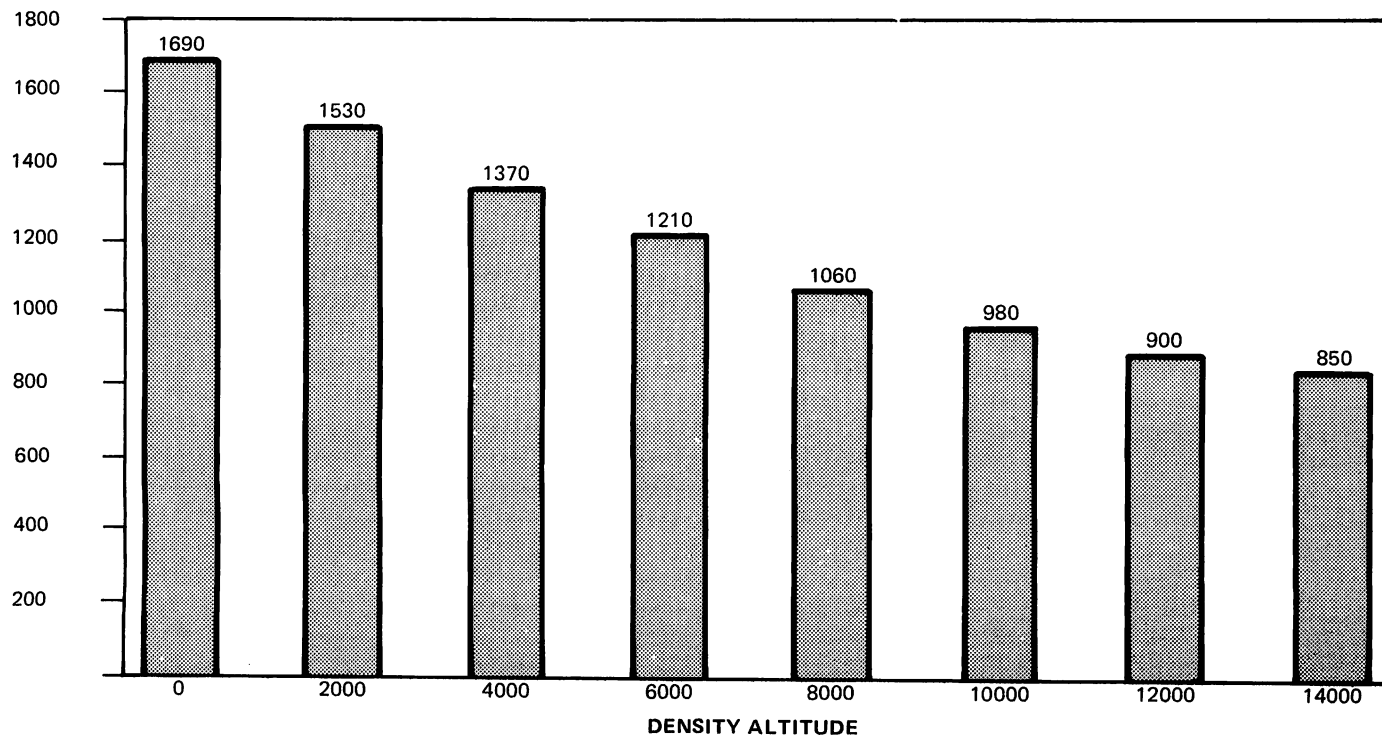


Figure A-6 Rate of Climb Chart

RATE OF CLIMB

The Rate of Climb Chart (Figure A-6) shows the rate of climb to be expected at gross weight under various density altitude conditions.

ENDURANCE

The endurance chart (Figure A-7) provides flight/time versus BHP information. No allowances are made for taxi, takeoff, or climb.

RANGE

The range chart shows range versus BHP information (Figure A-8). The chart assumes that 28 gallons of fuel are consumed in level flight. For a smaller amount of fuel, reduce the range proportionately to the percentage of 28 gallons used. No allowances are made for taxi, takeoff, or climb.

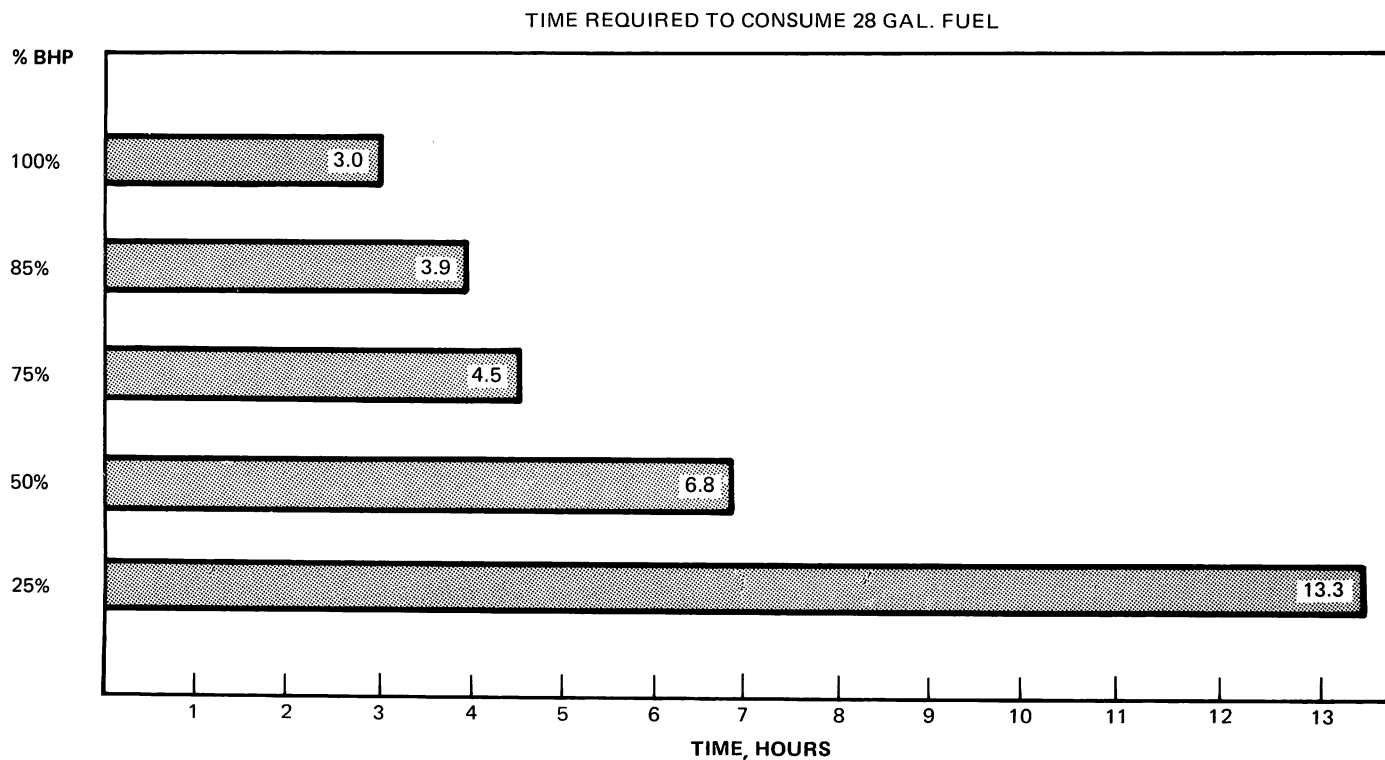
LANDING DISTANCE

The landing distance chart (Figure A-9) is provided for computing the landing distance over a 50-foot obstacle when moderate braking is used. The landing distance chart assumes a hard surface runway, 100-percent flaps, no runway incline, and no wind.

STALL SPEEDS

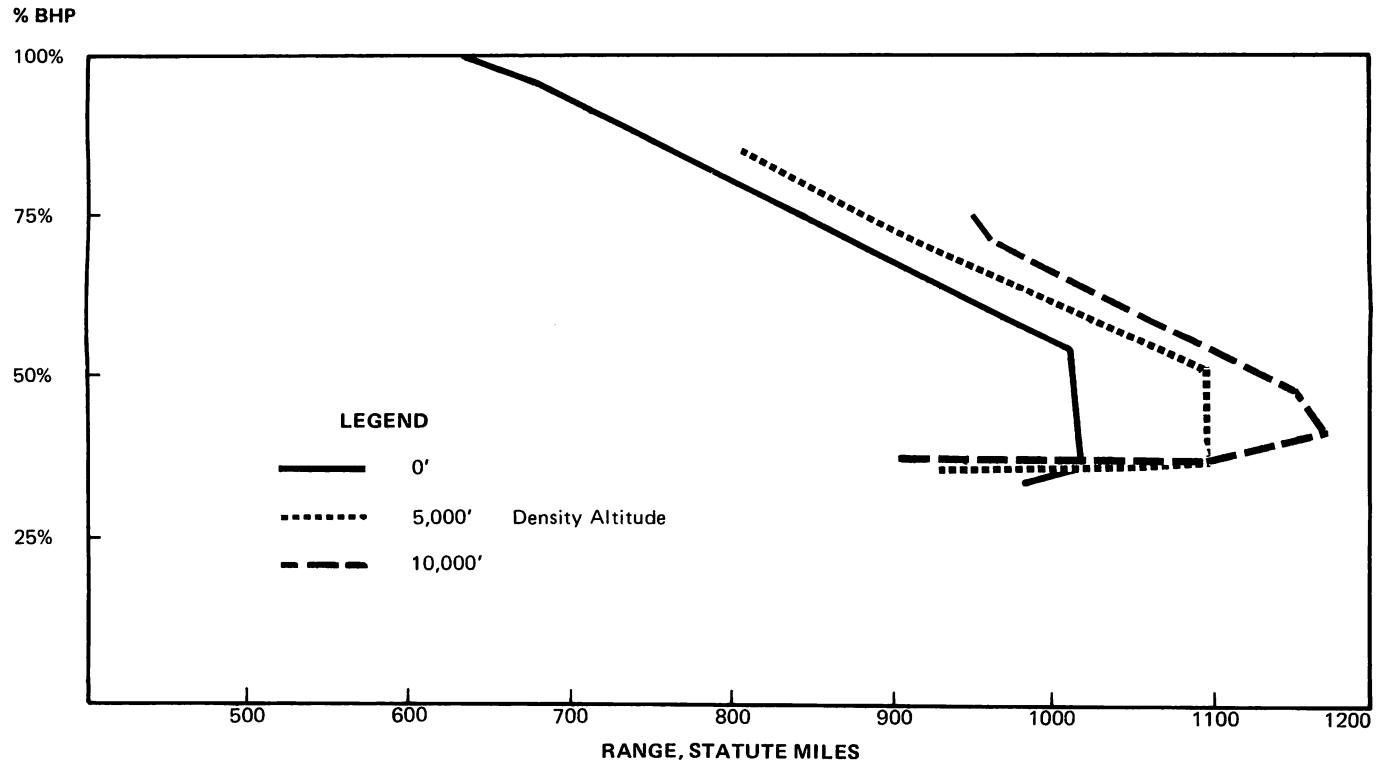
The stall speed chart (Figure A-10) depicts the relationship of stall speed to angle of bank (and g-level) for various flap settings. Note that the chart is good only at sustained altitude or at the indicated g level. This chart assumes gross weight condition of 850 pounds, and a GAW airfoil. Deviations from prescribed rigging and airfoil sections will result in different stall speeds.

For the most accurate and consistent indication of the aircraft's margin over stall, equip the aircraft with an angle-of-attack indicator. This instrument will automatically compensate for variations in weight, airfoil section, g-level, and angle of bank, thereby providing extremely valuable information during all flight conditions.



NOTE: No allowance has been made for taxi, take-off, or climb.

Figure A-7 Endurance Chart



NOTE: No allowance has been made for taxi, takeoff or climb.

Figure A-8 Range Chart

GROSS WEIGHT
POUNDS

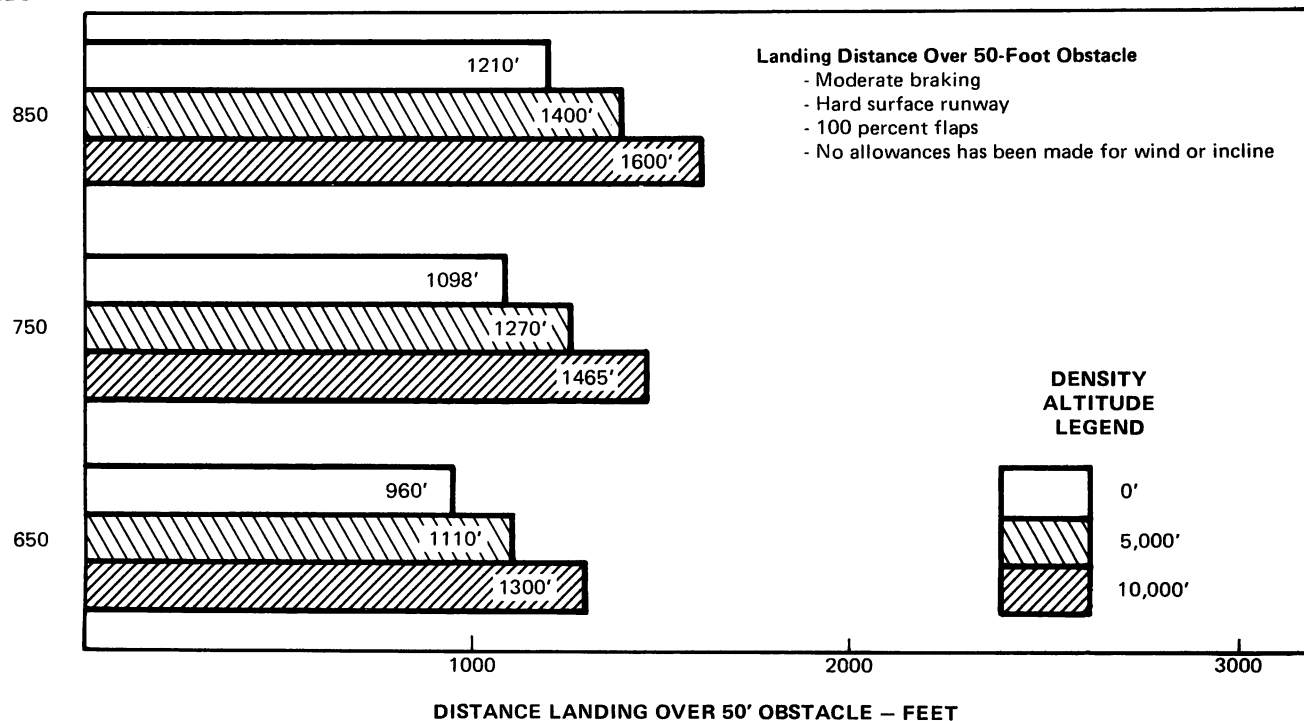


Figure A-9 Landing Distance Chart

Figure A-10 Stall Speeds Chart

"G" LEVEL	ANGLE OF BANK	0 FLAPS			50% FLAPS		100% FLAPS	
		1.0	45°	60°	75°	77°	1.4	3.8
1.0	0°	79	93	112	154	166	AIRCRAFT IS LIMITED TO 2 g, FLAPS EXTENDED	
1.4	45°	88	80	105	96			

APPENDIX B INITIAL CHECKOUT

Perhaps the most difficult part of preparing for a first flight in the BD-5 will be to overcome the erroneous and completely unfounded feeling that the airplane will be tricky to handle and hard to fly because of its small size and high speed capability. In truth, the BD-5 is a very stable, gentle, and easily controllable aircraft that can be flown safely by any proficient pilot, given an adequate checkout. The term "adequate checkout" is the key to a successful and enjoyable first flight for any pilot.

To begin with, the pilot should be thoroughly familiar with the aircraft, the engine, all systems, normal operating procedures, emergency procedures and operating limitations. He should have read and understood the entire owner's handbook, with emphasis on engine characteristics and operation. Some important engine operating experience will have been gained during the break-in period described in Section 7, and more will be gained during the taxi tests. Cockpit familiarization should be thorough enough that the pilot can locate every switch and control the first try with his eyes closed. Systems

checkout should include lifting the aircraft off the ground on sawhorses, sitting in the cockpit and retracting and extending the landing gear with the left hand until there is no movement of the right arm or hand on the sidestick. Flap operation should also be practiced with simulated airloads by having one person pull up on each flap trailing edge with a force of 10 pounds while the flaps are being put down. During all the cockpit familiarization and all the initial testing the pilot should use the same seat position and should wear all the equipment he plans to use on the first flight. It is highly recommended that both a parachute and protective helmet be worn until the airspeed/load factor envelope expansion flight tests have been completed and the pilot is familiar with all the flight characteristics. During the cockpit checkout, the aircraft should be tipped back on the tailskid with the pilot in the cockpit so he can see at what nose attitude the tail hits the ground. Takeoff attitude should also be simulated by raising the nosewheel six inches off the ground.

Once the pilot has a comprehensive knowledge of the aircraft and its systems, flight manual procedures, cockpit layout, and engine operating characteristics, he is ready to begin low speed taxiing.

The objective of the low speed taxiing practice is to acquaint the pilot with the aircraft's handling characteristics on the ground below the speed at which he has aerodynamic control. These initial tests should be conducted with a wind velocity less than 10 mph, with little or no crosswind. The first aircraft motion should be straight ahead, very slowly, with several stops to test the brakes and to practice braking symmetrically. Gentle turns should be tried next, and then tighter ones until the pilot is able to pivot the aircraft around at constant speed with the inside wheel rolling just slightly. In general, the tighter the turn, the more power required to maintain taxi speed. When using brakes for sharp turns it is better to depress the rudder pedal fully instead of trying to hold the opposite pedal in a neutral position. When the pilot feels he has complete control of the aircraft and feels at ease, he may begin high speed taxiing.

The purpose of the high speed taxi tests is to develop the ability to track straight ahead at higher speeds and to become familiar with the stick forces and technique required during rotation and tracking with the nosewheel off the runway. High-speed taxiing gives the pilot his first look at aerodynamic control of the aircraft. At speeds above 30 mph, both the ailerons and rudder will be effective and at 40 mph it is possible to maintain directional control with the rudder alone. The elevator becomes effective enough to lift the nosewheel off at about 55 mph power-on and 40 mph at idle. To use the minimum amount of runway, and to simulate a takeoff, full throttle should be applied after lineup, held until the desired airspeed is reached, and then retarded to idle. During initial attempts at rotation, care should be taken not to hit the tail of the aircraft. It's better to use too little stick force at first and work up to nosewheel lift-off rather than start out with too much stabilator and hit the tail. All high-speed, taxi tests should be done with the flaps up or down and airspeed less than 60 mph to prevent an inadvertent lift-off.

Once the pilot is proficient at high-speed taxiing he will have developed the ability to handle the aircraft during all phases of both the takeoff and landing roll, and should be prepared for short flights down the runway.

Before the first flight of the BD-5, or of any experimental aircraft, at least one, (and preferably more) lift-offs and low level flights down the runway should be made. These flights are very important since they allow the pilot/builder to determine if the trim in any axis is grossly out of adjustment, that the flight controls operate in the correct direction without binding with lift on the wings, that there are no control or aeroelastic problems up to a speed greater than that to be used during climb and that the engine operates within temperature limits with no unusual vibrations at full throttle and climb speed.

The first lift-off should be accomplished just like the high speed taxi, except that full flaps should be used, and the aircraft should be allowed to accelerate to 70 mph, at which time the throttle should be retarded to idle and the nose raised to lift-off attitude. As the aircraft lifts off, the nose will have to be lowered just slightly to prevent ballooning. A con-

stant altitude of approximately one foot (wheel height) should be maintained, increasing angle of attack as required until the same attitude used for takeoff is reached. The pilot should then hold this attitude constant and allow the aircraft to settle onto the main gear, hold the nosewheel off until the air-speed has decreased to 40 mph, lower the nose gently and use moderate braking to stop. Total runway required for this type of lift-off will be approximately 2500 feet. When this maneuver can be performed proficiently, a power-on, full-flaps, lift-off should be tried.

In this maneuver, full power is applied as before, the nose is rotated to lift-off attitude at 55-60 mph, and the aircraft is flown off the runway with full throttle. After leveling off at 1 to 2 feet and upon reaching 80 mph IAS, the power should be reduced to idle. A power reduction when airborne causes a nose-up trim change, so some forward stick pressure will be required as the throttle is retarded. Use the same landing technique as before. This power-on lift-off to 80 mph and the landing will require approximately 3500 feet of runway.

The power-on lift-offs should be continued until at least 100 mph IAS is reached. During these flights down the runway the pilot should be especially alert to any out-of-trim condition, unusual noise or vibration, or binding in the control system. All malfunctions should be repaired before going on to the next higher airspeed. Enough fuel should be carried on these flights down the runway to make a go-around if necessary. About three gallons of fuel in each wing should be sufficient. Approximately 6000 feet of runway will be required for a lift-off, acceleration to 100 mph IAS, deceleration to touchdown speed, and the landing roll.

Once these series of lift-offs have been successfully completed, both the aircraft and the pilot should be ready for the first flight away from the runway.

The optimum weather conditions for first flight are a calm wind and no turbulence with at least a 5000 foot ceiling and 10 miles visibility. It is possible, of course, to make the first flight in far worse conditions but it should be noted that the first several flights are training flights for the pilot as much as they are

test flights on the aircraft, and it is nearly impossible to learn anything about the flying qualities of an aircraft if the air is rough.

The takeoff roll and lift-off will already be familiar maneuvers and the first difference between the lift-offs and the first flight will be the gear and flap retraction. Once the aircraft is airborne, allow it to climb and accelerate until both 80 mph IAS and 20 feet AGL are reached. Since there is both a trim change and a tendency to push on the stick during gear retraction, a reasonable ground clearance is desirable during this slight but inevitable pitch oscillation. If the gear does not come all the way up on the first try, put it in the full down and locked position before attempting the second retraction. It is much more difficult to retract the gear from an intermediate position. Once the gear is up and locked, the flaps can be fully retracted. Bringing the flap handle full forward in about three seconds minimizes the abruptness of the trim change and allows the aircraft to continue acceleration without settling. When the airspeed reaches 100 mph, raise the nose slightly to maintain a normal climb speed of 105 mph.

As soon as 400 feet AGL is reached, begin a turn to downwind leg, in order to reach a low key position (1000 ft. AGL, opposite the approach end of the runway) as quickly as possible. Don't level off at pattern altitude but continue climbing until a turn back to the end of the runway would put the aircraft at high key position (1500 ft. AGL directly over the approach end of the runway). Continue climbing in a racetrack pattern directly over the airport, always keeping either high or low key position within gliding distance, until 5000 feet AGL is reached. This altitude allows a reasonable range from the airport and is plenty high for stalls and maneuvering.

Level off at 5000 feet AGL and leave the throttle full forward until the airspeed is 140 to 150 mph IAS. Throttle back to maintain this speed and then spend about 15 minutes doing turns, 30 degree bank-to-bank rolls, lazy 8's, etc., to get the feel of the aircraft. Try a few steep turns (2g, 60 degree bank) and learn to roll in and out at constant altitude. Slow down to 80 mph (gear and flaps up) and try a few turns in slow flight. Retard the throttle to 4000 rpm and do an approach to a stall, recovering at the first indication of buffet and noting the airspeed. Do this a

couple of times until you have a good feel for the approaching stall, and then continue to increase back stick pressure through the buffet until the lateral roll-off occurs; recover by relaxing back pressure, and adding power.

Stabilize and trim at 100 mph IAS and cycle the landing gear up and down about three times, getting used to the trim change so there is no pitch oscillation upon extension or retraction of the gear. Leave the landing gear down and lower the flaps to half, and then full, noting the trim and attitude change. With the gear and flaps down, do a couple of stall approaches to buffet and then continue to either the roll-off or until full aft stick is reached. Recover from the stall, retract the gear and flaps and accelerate back up to 100 mph IAS. Return to the airport, descending as required to arrive at high key at 100 mph IAS and idle power. Use a medium banked 30 degree gliding turn to downwind and lower the landing gear. Put down half flaps at low key and make a gliding turn to base leg, slowing to 90 mph IAS. Lower full flaps on base leg and maintain 90 mph until crossing the runway threshold. Begin the flare at about 10 feet, remembering that the tendency

is to flare high because of the low ground clearance of the aircraft. It generally takes about five landings before one can consistently make good touchdowns.

After the first flight and the next three or four flights, all doors and access panels should be removed and the aircraft inspected carefully for damage, misalignment, or loose objects.

On each succeeding flight, the airspeed and g-load should be increased in small increments (10 to 20 mph +1 g per flight) until the redline airspeed and limit load factor have been reached. There should be no unusual vibration, noise or control system or flying qualities problems at any point within the flight envelope. All systems should have been operated throughout their limits and at least one flight with full fuel made (including switching tanks) before the aircraft is flown out of gliding distance of the runway.

After about five flights in the BD-5, everything will have become familiar and one can relax and begin to enjoy the excellent flying qualities and maneuverability of the aircraft. At this stage most pilots will feel that this is the easiest airplane they have ever

flown and can't understand how anyone could have any problems with it. The BD-5 is very easy to fly and the only difficulty is adjusting to its unique size, novel design features, and its deceptively high speed. The first time an overwhelming urge for a "buzz job" comes over you, think it over for a few minutes, and then don't do it. Remember at 230 mph IAS you will be traveling the length of a football field in less than one second, and your radius of turn or pullup at 2 g will be almost a half mile!

Another good general rule for longevity in flying the BD-5 or any other experimental aircraft is: never do anything at low altitude you haven't already done several times at high altitude with a parachute on. Treat the aircraft with respect and enjoy a long and illustrious flying career. Happy Landings!

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