ACCELERATION LIMITS

Limitations on the acceleration to which the aircraft may be subjected in maneuvering is determined by the structural load limitations on the wings, expressed as a factor of the force exerted by gravity (G). This aircraft is limited to a maximum positive factor of 4.4 g's clean, and 2 g's with flaps down. The limit negative load factor is 1.76 g's. These limitations are based on the design gross weight of 710 pounds BD-5B or 850 lbs. BD-5D/G, and apply only to straight pull-outs. Rolling pull-outs impose considerably more stress on the aircraft; therefore, they should be less severe. The maximum allowable g-limit for a rolling pull-out is two-thirds the maximum g-limit for straight pull-outs.

OPERATING FLIGHT STRENGTH

Load limits on the aircraft, based on structural limitations, are shown in Figure 5-2.

The normal operating conditions are represented by the green shaded area and prohibited operations are represented by the red shaded area. The curved, dashed lines represent the airspeeds at which the aircraft will stall at various g-loads. Note that the intersection of the dashed line with the 1-g line indicates the stalling speed in straight and level flight.

WARNING: The area shaded red represents operation beyond the structural capabilities of the aircraft. Such operation will result in complete structural failure of one or more airframe components.

CENTER-OF-GRAVITY LIMITATIONS

Location of the center of gravity (cg) of the aircraft is expressed in terms of inches aft of the datum line, which is 10 inches forward of the nose. The forward cg limit is 74.75 inches aft of the datum (17 percent MAC), and the rearward cg limit is 76.97 inches aft of the datum (25 percent MAC). The full range of cg travel can be obtained with various combinations of pilot and fuel weights. The cg limits shown are with gear down; landing gear retraction moves the cg aft 2.4 percent MAC, but will not result in an abnormal cg position. Use the loading information in Figure 5-3 carefully for each flight with a different loading.

CAUTION: **Calculate both the takeoff and landing configuration cg position for each flight with a new type of loading, pilot weight, etc.**

LOADING LIMITATIONS

Loading diagrams and sample loading problems are included in Figure 5-3.

CAUTION: **Modifications and variations in equipment will cause considerable shifting of the aircraft empty weight and cg location. Always use the weight and cg location peculiar to each aircraft. Optional radio and instruments installed may eliminate any need for ballast.**

1. Determine the Empty Weight of the Aircraft From Weighing Data
2. Determine the Empty Moment of the Aircraft From Weighing Data
3. Determine Pilot Weight
4. Find Pilot Moment From Loading Chart.
5. Determine Amount of Ballast Required From Ballast Chart.
6. Find Ballast Moment From Loading Chart.
7. Enter Fuel Weight From Loading Chart.
8. Enter Fuel Moment From Loading Chart
9. Add Up Total Weight
10. Add Up Total Moment
11. Find Total Weight and Moment on Weight Vs Moment Chart

ITEM	WEIGHT (LBS)	MOMENT (1000 IN-LB)
Empty	1	2
Pilot	3	4
Ballast	5	6
Fuel	7	8
TOTAL	9	10

SAMPLE BALLAST CHART

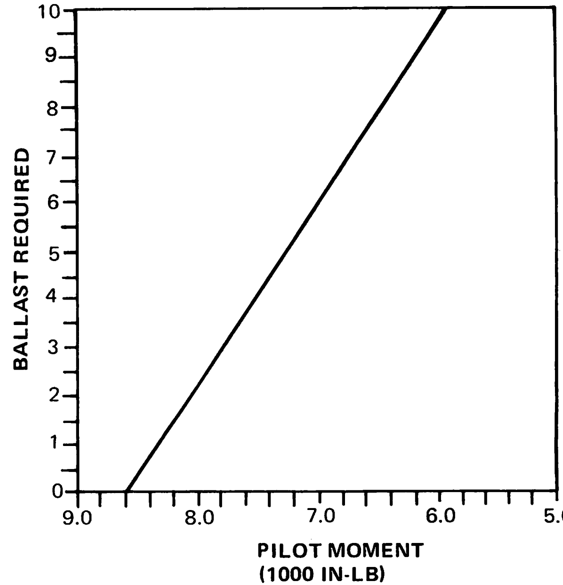

Figure 5-3A Weight and Balance

LIGHT PILOT

TAKEOFF CONDITION

ITEM	WEIGHT	MOMENT (1000 IN-LB)
Empty Aircraft	435.3*	36.38
Fuel	135.0 (22.5 Gal)	10.93
Pilot	120.0	6.36
Ballast	8.3	.10
Total	698.6	53.77

LANDING CONDITION

ITEM	WEIGHT	MOMENT
Empty Aircraft	435.3*	36.38
Fuel	6.0 (1 Gal)	.49
Pilot	120.0	6.36
Ballast	8.3	.10
Total	569.6	43.33

HEAVY PILOT

TAKEOFF CONDITION

ITEM	WEIGHT	MOMENT
Empty Aircraft	435.3*	36.38
Fuel	54.7 (9.1 Gal)	4.43
Pilot	220.0	12.75
Ballast	0	0
Total	710.0	53.56

LANDING CONDITION

ITEM	WEIGHT	MOMENT
Empty Aircraft	435.3*	36.38
Fuel	6.0 (1 Gal)	.49
Pilot	220.0	12.75
Ballast	0	0
Total	661.3	49.62

*Includes Electrical System

Figure 5-3B Weight and Balance Sample (BD-5B)

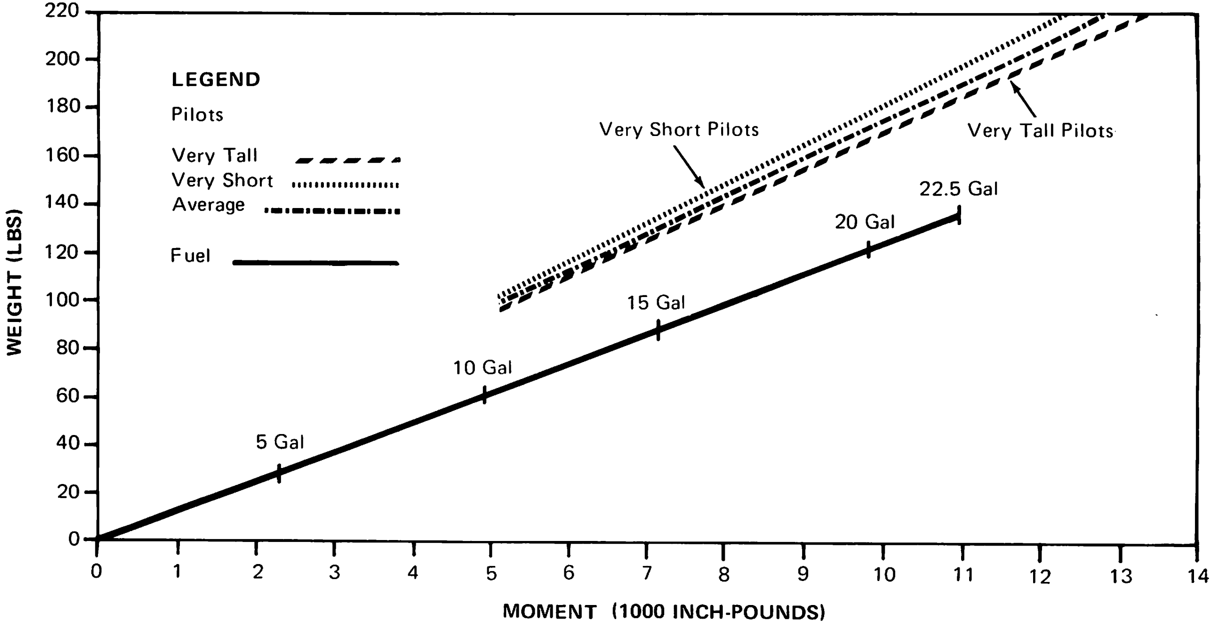

Figure 5-3C Weight and Balance

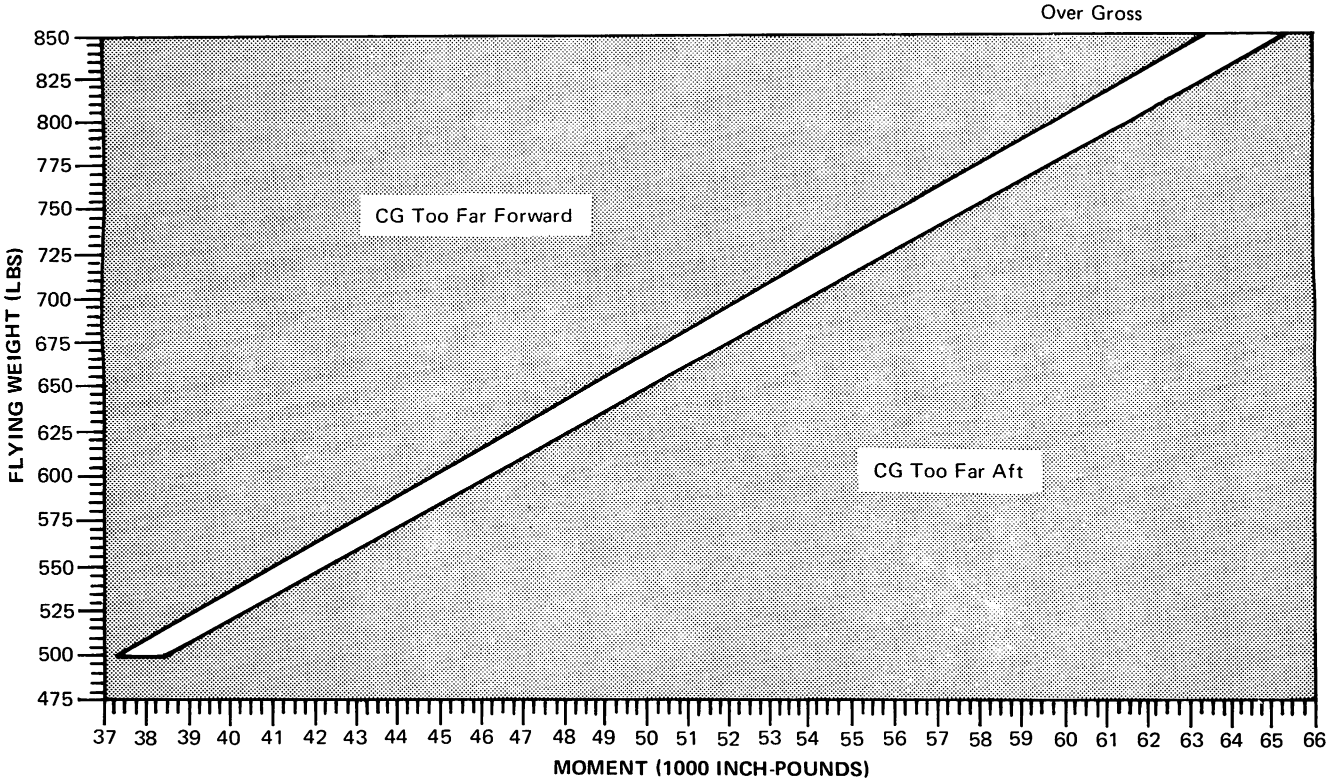

Figure 5-3D Weight and Balance

OPERATING LIMITATIONS

This BD-5D aircraft is certified in the utility category, and the BD-5B/G in the experimental homebuilt category. Limited aerobatic maneuvers are approved as follows:

Maneuver	Entry IAS
Chandelle	160
Wingover	160
Lazy 8	160
Aileron Roll	180
Barrel Roll	180
Loop	190
Immelman	200
Cuban 8	200
Spin	Use slow deceleration

Maximum acceleration +4.4 g, -1.76 g.
Maneuvering speed (Va) 145 mph.

NOTES:

SECTION 6–FLIGHT CHARACTERISTICS

CONTENTS

GENERAL FLIGHT CHARACTERISTICS

The flying qualities of the BD-5 are characterized by excellent stability and handling characteristics and high maneuverability. When properly trimmed, the aircraft tends to maintain straight and level flight, and the controls are effective throughout the speed range from stall to maximum drive speed.

Control forces are light and response to the controls is rapid and definite, without being too sensitive. This makes the aircraft excellent for aerobatics; however, due to the light elevator forces, it is recommended that the trim not be used to reduce stick forces during maneuvers, since only slight additional stick forces would then be required to exceed the maximum allowable g-limits. The aircraft is very clean aerodynamically and picks up speed rapidly with the nose down. The light rudder forces permit holding the aircraft straight in a dive to Vne without rudder trim.

The elevator trim is effective at all flight conditions and very little change in trim is required for landing gear and flap extension or retraction or changes in power. Because of the high level of longitudinal stability the trim required will vary noticeably with large speed changes; the pilot can however, easily override any out-of-trim condition by holding stick forces. The trim rate and authority are such that a landing can be made without using the side stick at all; the rudder can be used for roll and directional control, the trim and power for pitch control, and a normal pattern and landing can be made.

The controls are well harmonized and there is very little adverse yaw at cruising speed. Coordination is very easy and there is adequate rudder power available to counteract the adverse yaw resulting from full aileron deflection down to 80 mph IAS.

AEROBATICS

Even though the BD-5D is licensed in the utility category and the BD-5B/G in the experimental homebuilt category they will perform most normal aerobatics with ease. Because of the +4.4 g-limit, however, more attention should be paid to proper entry airspeeds and control usage. Unless an error is made, there is no reason to pull more than 4 g's in any basic aerobatic maneuver. Because of the probability of errors during training, however, it is highly recommended that aerobatics be learned in another aircraft before being flown in the BD-5.

NOTE: **Use of the aircraft at speeds consistently exceeding 4 g's will cause the upper wing skin to permanently wrinkle chord-wise near the leading edge. This is cosmetic damage only and does not affect the strength of the wing or the flying qualities of the aircraft.**

The following entry speeds are recommended for aerobatic maneuvers:

Maneuver	Entry IAS
Chandelle	160
Wingover	160
Lazy 8	160
Aileron Roll	180
Barrel Roll	180
Loop	190
Immelman	200
Cuban 8	200

STALLS

The first indication of an excessive angle of attack in the BD-5 is a moderate intensity high frequency buffet which (at 710 lbs.) begins at about 72 mph and increases in intensity until full aft stick is reached at approximately 68 mph. As the speed decreases through 70 mph, transient lateral roll-offs begin to occur. These roll-offs are easily controllable, however, with normal use of rudder and aileron until full aft stick is reached. No g-break occurs and with the stick held full aft, the airspeed begins to increase from its minimum of 68 mph IAS. The lateral roll-offs become increasingly pronounced as airspeed increases and after approximately 15 seconds and at 90 mph IAS, the aircraft will depart laterally either left or right, and the back pressure on the stick has to be relaxed for recovery.

Full throttle and/or aft cg (27 percent MAC) has very little affect on the stall characteristics, except that the full throttle stall occurs at a higher nose attitude and the aft cg stall takes 20 seconds from full aft stick to departure instead of 15. The airspeeds at buffet and at full aft stick are essentially unchanged.

Accelerated Stalls

Accelerated stalls have been performed in the BD-5 from 90 mph up to 145 mph and 4.4 g (the limit load factor). The aircraft has been stalled in both steep turns and in straight pull-ups with no apparent difference in characteristics due to turning. In all cases, a moderate-to-heavy buffet occurs well before any loss of control and provides more than adequate stall warning. If, after entry into buffet, the stick is pulled full aft, there will still be no g-break. At the same time the aft stop is reached, however, the aircraft will depart smartly, usually to the left. The abruptness of the roll-off and the resulting roll rate are generally proportional to the entry airspeed. Again, recovery is immediate upon relaxation of back pressure. Throttle setting and cg location have very little effect on the accelerated stall characteristics.

CAUTION: The application of full aft stick at any airspeed greater than 90 mph will cause the stabilizer anti-servo tab to blow down and the trim lever will move to its full aft position. On all accelerated maneuvers it is necessary to hold the trim lever at its original position.

Stalls With Gear and Flaps Down

The effect of lowering the landing gear and/or flaps is to increase the nose-down, aerodynamic pitching moment, thereby restricting the angle of attack of the wing due to the decrease in stabilator power. With half flaps and idle power, minimum airspeed is 64 mph IAS. With the stick held full aft, airspeed will increase to 80 mph IAS and stabilize. The lateral roll-offs are still present, but with the proper control inputs the bank excursions can be held to ±10 degrees of wings-level. With full flaps, there is only a *slight* tendency to roll off and the wings can be held level. In this configuration, the stabilator is not powerful enough to hold the aircraft in buffet, and the nose will pitch up and down, in and out of buffet in a "bucking motion," ±10 degrees from level at a frequency of about 1½ cps.

Putting the gear down makes the stall more docile. With gear down and full flaps, the aircraft can be held wings-level in moderate buffet with full aft stick at a constant airspeed of 65 mph. Rate of descent in this configuration at idle power is 1000 to 1500 ft/min. With gear down and full flaps, full aft stick is inadequate to keep the aircraft in buffet, and the "bucking motion" is again present, but with a larger amplitude of ±20 degrees at the same frequency of 1½ cps. Airspeed and rate of descent are, respectively, 60 mph IAS and 1500 to 2000 ft/min. Recovery is immediate upon relaxation of back pressure. A properly rigged aircraft will not stall inverted, and with full forward stick and full rudder will simply make an inverted flat turn with no tendency to depart.

Aggravated Stalls

The first motion of the aircraft following a full aft stick, full rudder deflection stall is primarily a rolling motion in the direction of the rudder input. Recovery after a one-second delay puts the aircraft in about a 90-degree bank. When full aileron is added with the rudder, the roll-off is amplified so that recovery occurs inverted. Full aileron against the rudder will stop the roll-off so that the aircraft will remain in a large amplitude sideslip for about five seconds and then roll in the direction of the aileron.

The effect of lowering gear and flaps is to make the roll-offs more docile, but otherwise the characteristics are the same.

Accelerated stalls with the same combinations rudder and aileron deflection have similar characteristics but with roll and your rates generally proportional to load factor at departure. Recoveries are immediate with neutralized controls.

SPINS

In the BD-5, as in any experimental aircraft, a parachute should be worn during all aerobatic flights, including spins. Intentional spins in the BD-5 should be entered from a power-off stall. Back stick pressure should be continued through the buffet, and just as full aft stick is reached, full rudder added in the direction of desired rotation. As with the aggravated stalls, the first turn of a normal spin is primarily a roll. The nose drops to the horizon at 90 degrees of bank, slightly below the horizon at inverted, and remains at this attitude for the rest of the first turn. The first turn is quite gentle and recovery can be made by simply neutralizing the controls; the spin will stop in less than one quarter of a turn.

As the second turn begins, the rotation rate increases, the nose drops smartly, and halfway through is pointed almost straight down. The nose then starts back up, and at the end of the second turn is about 45 degrees below the horizon. Recovery is immediate if the controls are neutralized.

In the third and succeeding turns, the pitch attitude continues to oscillate between 60 degrees and 45 degrees nose down, once per revolution. The rotation rate increases up to the fourth turn and remains stable thereafter. If a stable spin is not achieved after three turns, execute a recovery maneuver. Airspeed also increases up to the fourth turn, and the stabilized spin mode is at 100 to 110 mph and 2.5 g. Although the average rotation rate in the stabilized spin is 200 to 300 degrees/second, it is possible to maintain visual orientation and keep up with the number of turns. After the fourth turn, there is no apparent change in the spin or the recovery up to 15 turns in each direction. After the second turn, neutral controls will not stop the spin, and it is necessary to apply anti-spin controls. As a general practice, spinning more than three rotations is not recommended, due to the high rotation rate.

Spin Recovery

Flight tests have shown that both aileron and elevator are very effective in spin recovery and that the rudder is the weakest control. During a spin or deep stall, the airflow over the wing forward of the ailerons does not separate. Consequently, the ailerons remain effective and work in the correct direction throughout the spin. Aileron against the spin will always decrease the rate and if held, will recover the aircraft from the spin in three turns, even with full aft stick and pro-spin rudder. Likewise, full forward stick will stop the spin in one turn (even with pro-spin aileron and rudder) although this recovery results in a vertical diving aileron roll. Rudder only against the spin will slow down the rate slightly but will not result in a recovery. Adding power makes the spin steeper and increases the airspeed and rotation rate but will not recover the aircraft alone. If the controls are released after the fourth turn, the rotation rate will almost double, increasing to 400 to 500 degrees/second, with no tendency toward recovery. The nosedown attitude remains constant, however, and the aircraft will recover immediately from this accelerated mode with normal recovery controls. The optimum spin recovery control inputs for any mode or configuration are simultaneous full anti-spin rudder and a brisk forward stick movement to just forward of neutral. The buffeting and rotation stop simultaneously and the aircraft recovers in a 60 degree to 70 degree nose-down attitude. If recovery controls are input at the nose-high (45 degree nose-down) point in the spin, the rotation will stop in one-quarter of a turn; if recovery is initiated at the steep part of the spin (60 degree, nose-down), recovery takes up to one-half of a turn. If recovery controls are put in slowly, the accelerated mode will begin and up to two turns can be required for recovery. However, if the recovery control inputs are brisk (one second or less from pro- to anti-spin controls), the recovery from either mode is immediate. The altitude loss during the stabilized spin is approximately 300 feet per turn. Recovery from the resulting dive with a 3-g pullout requires an additional 1000 feet. A ten-turn spin and recovery requires 4000 feet.

Snap Rolls

A snap roll is basically just a high-g horizontal spin. The entry and recovery are the same as for normal spins, although the resulting roll rate and g-load will be proportional to the entry airspeed.

When stabilized at the desired airspeed, briskly apply full aft stick and full rudder in the desired direction of rotation, and hold this control position until 90 degrees of roll before the desired recovery attitude. Then, briskly apply full opposite rudder and forward stick, neutralizing both as the buffeting and rolling cease. A fair amount of practice is required to be able to consistently recover at a desired attitude. Start at low speed (90 mph) first and work your way up; a 4-g snap is a pretty spectacular maneuver, with roll rates greater than 400 degrees per second. Snap rolls are prohibited with more than five gallons of fuel in each wing.

Snap rolls put a large amount of vibratory, airload, and inertial stress on the airframe and will significantly reduce the fatigue life of the aircraft.

DIVING

Since the aircraft is very clean aerodynamically, care should be taken not to exceed the airspeed redline (230 mph IAS). The throttle should be retarded to idle during high speed descents. With the overrunning clutch, the engine will remain at idle, and the propeller rpm will limit itself when the prop tip mach number becomes high enough. The only items the pilot has to monitor are airspeed and CHT, to prevent the engine from overcooling.

SUMMARY

1. BD-5B/D/G stall characteristics are normal and straight-forward. There is inadequate elevator power to cause a g-break and the stall consists mainly of a lateral departure once full-aft stick is reached. It is not possible to stall a properly rigged aircraft inverted.

2. Lowering gear, flaps, or adding power makes the stall more docile.

3. The BD-5B/D/G has no unrecoverable spin modes and is qualified for an unlimited number of spin turns.

4. Snap rolls are approved with less than five gallons of fuel in each wing.

5. Optimum recovery controls for any condition are simultaneous full anti-spin rudder and brisk forward stick.

6. Releasing or neutralizing the controls after one turn of the spin will result in an accelerated mode without stopping the spin.

7. Spins with gear and flaps down are more docile. Flaps must be raised during the recovery to prevent exceeding flap limit airspeed.

SECTION 7–SYSTEMS OPERATION

CONTENTS

INTRODUCTION

A thorough understanding of each system aboard a BD-5 is essential for safe operation. Correct operating procedures will result in an increase in service life, economy, and safety.

ENGINE

The BD-5 is unique among present day high performance aircraft in its use of a two-cycle power plant. This power plant is light in weight, has a high power-to-weight ratio, and has inherent mechanical reliability due to its small number of moving parts. However, the aerothermodynamic events occurring within the engine are complex in nature, and can be upset by improper operating techniques. Therefore, strict adherence to the correct operating procedures for the conditions encountered is necessary for engine dependability.

Gasoline/Oil Mixture

Operation of the two-cycle engine differs from a conventional four-cycle engine in several important respects. The most obvious of these differences is its need for a gasoline/oil mixture. The Xenoah power plant has no oil sump, and oil must never be added to the engine crankcase. To provide lubrication to the engine's moving parts, the oil tank must be filled with a *two-cycle* engine oil of a brand recommended by Bede Aircraft, each time gasoline is added to the wing tanks. The engine is approved for only 100/115 octane low lead aviation fuel.

CAUTION: **Each time fuel is added to the wings, the oil tank should be filled to within 1/4 quart of full, to ensure a sufficient supply of oil.**

NOTE: **Some engines (upon customer request) may not be equipped with an oil injection system. In this case the oil must be mixed with the fuel prior to putting it in the aircraft fuel tanks. Fuel and oil should be mixed at 25 parts fuel to 1 part oil.**

Fuel/Air Mixture Control

Unlike a four-cycle engine, a Xenoah two-cycle engine must never be leaned beyond the best power mixture, or engine overheating and probable piston seizure will occur. Insufficient lubrication is delivered to the engine beyond the best power setting when the mixture control is turned toward lean, since not only the gasoline/air mixture but also the oil/air mixture is reduced. As a result the mixture control is only used to control the engine temperature and smooth operation, not fuel flow. Practice will enable you to find a mixture control setting which will give good engine efficiency at different altitudes. Keep in mind that although mixture will tend to be overrich at altitude with the mixture control in FULL RICH, an overrich mixture is preferable to a lean setting. Be particularly conscious of the mixture setting whenever it is leaned, especially during descents.

CAUTION: **A two-cycle engine must not be leaned past the best power mixture, and the only indication of an excessively lean setting will be high cylinder head and/or exhaust gas temperature. Maximum EGT temperature is 1050°F.**

A two-cycle engine which is excessively rich loses power and enters a "four-cycling" condition, which is characterized by the engine running rough and firing intermittently. During a low power/high speed descent, this is a normal condition. This "four-cycling" condition can be used at altitude as a mixture setting reference point. In a climb to high altitude, a "four-cycling" will be encountered at some altitude if the mixture control is left FULL RICH. At this altitude, the mixture must be leaned in order to cruise or continue climbing. At this altitude and higher altitude (the indicated altitude will vary with temperature and humidity), the mixture control should either be placed 1/8-turn leaner than the "four-cycling" reference point, or set to EGT = 1000°F, if an EGT system is available.

Spark Plug Fouling

Spark plug fouling, which is an accumulation of deposits which cause misfiring or prevent firing across the spark plug electrodes, can have several causes. Lead fouling is due to the tetraethyl lead found in most brands of gasoline. If lead fouling should occur in flight and cause misfiring, each ignition circuit should be checked, and the unfouled circuit selected for the duration of the flight. The fouled plug must be replaced or cleaned before the next flight. Carbon fouling is generally caused by prolonged ground running at low power. Ground running time should be kept to a minimum to avoid carbon fouling of spark plugs.

Exhaust System

The Xenoah engine exhaust system consists of an expansion chamber which leads into a venturi duct. The chamber is shock mounted and isolated from engine vibration by gimbal joints. The exhaust system has been carefully matched to the engine to produce the desired performance. Any change in the exhaust system will cause the fuel/air mixture to become non-linear with rpm, thus requiring an internal change in carburetor mixture calibration. Under no circumstances should the exhaust system of a BD-5 be modified in any way.

Cooling System

Ground cooling is provided by the exhaust gases passing through the venturi duct and drawing air along with it from the engine compartment. As with most tightly cowled aircraft engines, prolonged ground operation should be avoided to prevent overheating. Engine run-up should be performed into the wind, and the throttle should be used sparingly while taxiing.

Inflight cooling is provided by an air-scoop on the bottom of the BD-5 fuselage.

Engine Instrumentation

Cockpit engine instrumentation in the BD-5 includes a tachometer, a cylinder head temperature gage, or exhaust gas temperature gage and a fuel pressure gage. The tachometer red-line rpm is 6250. Care should be taken to never exceed this rpm in flight, particularly in high speed descents, since engine damage can result. The cylinder head temperature redline is 440°F, and operation above this temperature can also result in engine damage. Overheating in flight should be corrected by applying FULL RICH mixture, reducing the power setting, and increasing the airspeed to supply more cooling air.

The fuel pressure gage is connected to the carburetor interconnection line, and senses the fuel pressure in all three carburetors. The normal pressure (2 to 4.5 psi) will drop suddenly to half its normal value in the event of a fuel pump failure.

Ignition System

A dual-capacitor discharge ignition system fires the six spark plugs, two of which are in each cylinder. The front and rear spark plug on each cylinder are connected to completely independent ignition circuits. Cockpit switches control each ignition circuit, and can be set so that the engine runs on either or both circuits.

Induction System

A foam air filter provides clean air to the carburetors. The carburetors are enclosed in a fireproof box which also serves as a plenum chamber for the incoming air. If icing conditions are encountered, the foam air filter may become blocked, and the carburetor heat door must be opened to supply alternate air. The carburetors are resistant to the formation of carburetor ice. In moist cold air, however, an unexplained drop in rpm will signal the formation of carburetor ice, and carburetor heat must be applied until normal rpm is recovered with the heat control off.

Preventive Maintenance

The engine manufacturer recommends that all external nuts and bolts be retightened after the first hour of engine operation. Spark plugs will normally last 35 hours, with cleaning and regapping to .020 inch possibly necessary at 25 hours. Each time a spark plug is removed, a new spark plug gasket must be installed. Nominal spark plug torque is 18 foot-pounds, with anti-seize compound applied to the threads. If the plugs have been cleaned, be sure that all cleaning grit is removed from the threads. Care must be taken to not damage the cylinder head temperature thermocouple rings and wires when removing and installing the spark plugs. The foam air filter generally needs cleaning in gasoline at 25 hours, depending on operating conditions. The fuel filter requires replacement every 100 hours. At approximately 500 hours, the engine will need a top overhaul, which is replacement of the piston, wrist pin clips, upper rod bearings, rings, and possibly cylinder and head, depending on wear.

Run-In Procedures

The Xenoah engine should be run at a low power setting (2000 to 3000 rpm) for the first 30 minutes of operation. A cooling fan should be directed into the air scoop to keep cylinder head temperature below 425°F.

Normal Operation

The power settings for takeoff, climb, and maximum continuous power are identical for this engine (full throttle). However, this does not imply that the engine is designed to operate wide open at all times. Continued use of extreme high power substantially shortens engine life by increasing wear, and the higher loads and temperatures reduce the safety margin of your operation. Full throttle should be a normal operation for takeoff and climb only. Climb and cruise charts are to be consulted for normal power settings in prevailing conditions. The greatest engine efficiency and reliability can be gained by using the lowest power setting consistent with the desired performance. Gradual power changes place the least amount of stress on the engine. Rapid power changes can cause extreme temperature differences and cause damage to the engine. The maximum recommended cruise power condition is 75 percent of full power.

POWER TRANSMISSION SYSTEM

The power transmission system consists of a lower drive shaft and two, soft-rubber couplings connected to the engine; a toothed belt and two pulleys which reduce the speed of the propeller by a ratio of 1.6 to 1; a one-way clutch which eliminates torsioned vibrations during engine start-up; and, a lightweight, upper driveshaft going back to the propeller. This lightweight, highly efficient power transmission system is virtually maintenance free.

FUEL SYSTEM

Proper preflight fuel planning is the main prerequisite for use of this system. Each wing is a fuel tank, which feeds through a right/left fuel selector valve to a fuel filter, two engine-driven pumps, and then to the carburetors. A fuel pressure gage registers the fuel pressure entering all three carburetors. The fuel gages read accurately only in level flight; for more accurate and dependable determination of fuel remaining, use fuel consumption data based on known operating conditions. Fuel capacity of the BD-5B is 26 gallons, BD-5D/G 29 gallons. BD-5 fuel, which is a gasoline/ oil mixture, weighs 5.9 pounds per gallon. The position of the right/left selector valve should be changed. after every half hour of flight to maintain lateral balance. The fuel selector valve OFF position is mainly for use during emergency power-off landings and for extinguishing engine compartment fuel fire.

CONTROL SYSTEM

A side stick controller is utilized in the BD-5 control system. The pilot sits in a semi-reclined position, and his right hand grasps the side stick located on the right armrest console. As in a conventional, center-stick design, side-to-side motion controls ailerons (roll), fore-aft motion controls the horizontal stabilizer (pitch). Advantages of a side stick include more precise control of the aircraft with a significant reduction in pilot workload. The left hand operates the throttle, and the fingertips reach around the throttle to adjust the trim. A friction lock on the left console can be turned clockwise to increase the trim and throttle friction. The feet operate conventional rudder pedals with toe brakes. The flap system is operated by a handle located between the legs and to the left of the landing gear handle. Maximum flap deflection is 40 degrees. To raise the flaps, pull rearward and outboard on the handle and allow it to return to the forward position.

ELECTRICAL SYSTEM

The ammeter located on the right console indicates the charging (or discharging) rate of the battery. If a discharge condition is noticed, electrical load on the system should be reduced to a minimum or, preferably, the master switch should be turned OFF. Circuit breakers which open should not be reset unless the cause is known.

LANDING WHEEL BRAKE SYSTEM

The hydraulic brake system is operated by applying pressure with the toes to the top of the rudder pedals. The use of care when applying brakes will minimize wear and achieve the longest useful service. Careful application of the brakes immediately after touchdown or at any time when there is considerable lift on the wings, will prevent skidding of the tires which causes flat wear spots. The brakes, which are a dual-puck disc type, can stop the wheel from turning entirely; however, for optimum braking the tire should be in a 15 to 20 percent rolling skid: i.e., the wheel continues to rotate but has approximately 15 to 20 percent slippage on the surface so that rotational speed is 80 to 85 percent of a free roll. Beyond this amount of skid, the coefficient of friction (braking action) decreases. Normally, a full landing roll should be utilized to take advantage of aerodynamic braking and to use the brakes as little and as lightly as possible. For maximum braking, lift should first be decreased by raising the flaps and lowering the nose before applying the brakes. For short landing rolls, a single, smooth application with constantly increasing pedal pressure is most desirable. If the brakes have been used excessively for an emergency stop and are in an overheated condition, taxi operations should be conducted cautiously and at reduced speed, since possible brake fading may occur.

Ground Steering

Ground maneuvering of the BD-5 is accomplished by differential braking. For least brake wear the rudder should be deflected to its stop in the direction of turn before applying brake. The BD-5 has a free-castering nosewheel and can turn in a tighter radius than most other aircraft.

LANDING GEAR SYSTEM

A large handle located between the pilot's legs actuates the landing gear. Since the landing gear are mechanically actuated, no emergency extension system is necessary. The actuation time is the fastest of any light aircraft. A rearward motion of the handle swings the gear into an up and locked position, and a forward pushing motion swings the spring-assisted gear into a down and locked position. Each landing gear over center link has a switch which illuminates a green light on the right console when the strut is down and locked. If a light does not come on when the gear is lowered in flight, first give an extra push forward on the landing gear handle. If no light appears, check the bulb by switching it with another. If the bulb was not burned out, try recycling the gear, and if this fails to illuminate the light, consult Section 3, Emergency Procedures. The landing gear warning consists of a horn (BD-5D only), which actuates when the throttle is retarded to one-quarter or less (as must be done for a landing), and the gear is in the up position. The horn stops when the gear is down and locked. On the BD-5D, the horn also will sound when the flaps are extended while the gear is in the up position.

SECTION 8-ALL WEATHER OPERATION

CONTENTS

INTRODUCTION

Except for some repetition necessary for emphasis, clarity, or continuity of thought, this section contains only those procedures that differ or are in addition to the normal operation instructions covered Section 2. Systems operations are covered in Section 7.

INSTRUMENT FLIGHT PROCEDURES

NOTE: **The basic BD-5B/D/G model aircraft is equipped for VFR operations only. This section assumes that a full instrument/avionics package has been added to the aircraft.**

This airplane has the same stability and handling characteristics during Instrument Flight Conditions as when flown under VFR conditions. However, like most single engine aircraft, it requires constant attention to the indications of the flight instruments. The stability, flight strength, instruments, and communications equipment are sufficient for instrument cross-country flights under most weather conditions. Flight in icing conditions should not be attempted as there are no provisions for deicing. The following techniques are recommended from takeoff to touchdown under instrument conditions.

IFR TAKEOFF

Complete the normal TAXI and PRE-TAXI-OFF check as described in Section 2. If taxiing and take-off are to be made in visible moisture, a check for indication of carburetor icing should be made.

NOTE: **A drop in engine rpm or an increase in engine roughness are good indications of carburetor icing.**

If carburetor icing is indicated, adjust the carburetor heat knob to provide heat for deicing prior to takeoff; return the heat control to the COLD position just prior to the takeoff roll. After lifting off the runway and establishing the initial climb, carburetor heat may be reapplied as required.

NOTE: **When visible moisture is present, turn pitot heat switch ON just prior to beginning takeoff roll.**

After taxiing into takeoff position set the directional gyro to the runway heading. Crosscheck the directional gyro setting with the magnetic compass and note any discrepancy.

NOTE: **To be certain of proper operation of the gyro instruments, allow three minutes minimum for them to reach full operating speed.**

Apply full power by smoothly advancing the throttle to the OPEN position and release the brakes. Use differential braking for directional control until the rudder becomes effective at approximately 35 mph. During the takeoff roll the directional gyro is the primary instrument for maintaining directional control; however, while runway markings remain visible they should be used as an aid in maintaining heading. At approximately 65 mph IAS apply back pressure to the stick to establish a takeoff attitude of about two horizon bar widths nose high on the attitude indicator. As the aircraft leaves the ground the attitude indicator is the primary instrument for pitch and bank and continues to be until the climb is established. When the altimeter and vertical speed indicator indicate a climb, retract the landing gear and maintain a one bar width climb until the desired climb speed is obtained.

IFR CLIMB

Maintain best rate of climb speed by cross-referencing the airspeed indicator and attitude indicator. If the aircraft is equipped with the optional angle-of-attack system the climb may be optimized by adjusting the aircraft attitude to give an angle-of-attack indication on the blue line (best rate of climb). Turns should not be attempted below 500 feet AGL and the angle of bank should not exceed 30 degrees while establishing the climb. Maintain directional control with reference to the directional gyro and, as the climb airspeed stabilizes at approximately 100 mph IAS, adjust the aircraft trim to maintain this airspeed for best rate of climb. Use carburetor heat as required when induction system icing is indicated.

IFR CRUISE

After leveling off at the desired altitude, it is recommended that full power be maintained until cruising airspeed is established. It is seldom necessary in routine flight to exceed a 30 degree angle of bank; however, the aircraft can easily be controlled in turns up to 60 degrees of bank.

NOTE: **The directional gyro should be cross-checked with the magnetic compass at least once every 15 minutes and reset as required.**

The use of pitot head should be liberal when conditions indicate that icing is possible. Under most conditions the cockpit heater will be sufficient to keep the canopy clear; however, in the event of heavy fogging inside the canopy the outside air vent may be opened to clear the fogging.

NOTE: Avoid opening the outside air vent while flying through rain.

IFR DESCENT

Slow the aircraft to the desired descent airspeed before initiating the descent since it is difficult to slow the aircraft once the descent is established. Check mixture, carburetor heat, pitot heat, and retrim as necessary. Complete the normal pre-traffic pattern checks prior to initiating an approach to landing.

INSTRUMENT APPROACHES

Since the aircraft is not equipped with ADF or DME equipment, approach procedures utilizing these instruments are not available. VHF Omnirange approaches, ILS Localizer/Localizer Backcourse approaches, Precision Radar approaches, and ILS approaches are available. Flying the aircraft on instrument approaches is not difficult due to the excellent stability and low stalling speeds. Always reduce airspeed well in advance of necessary airspeed changes. Proper trim technique is very important during approaches; with each change in power, attitude, configuration, or airspeed it is necessary to retrim the aircraft in order to avoid the need for holding constant control pressures.

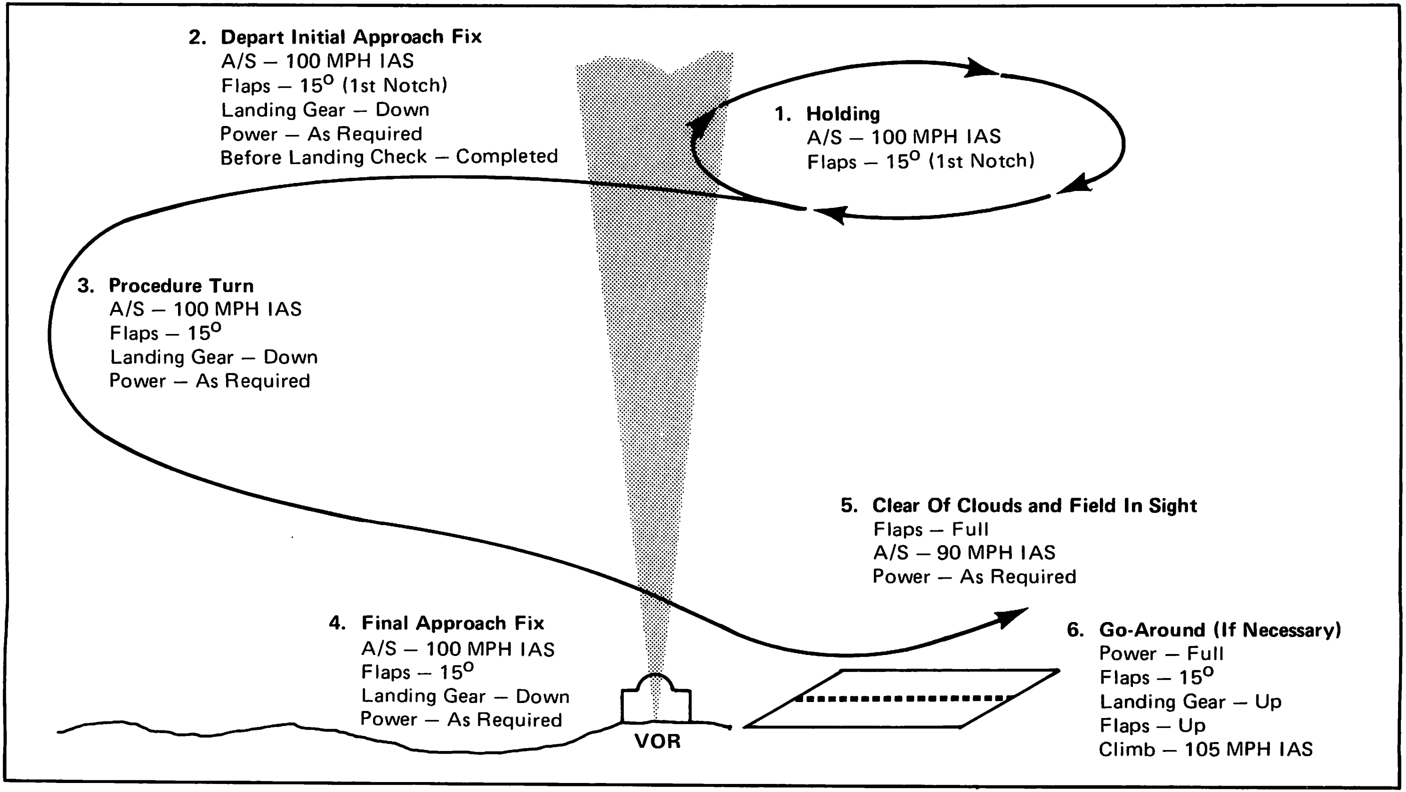

Figure 8-1 VOR Approach

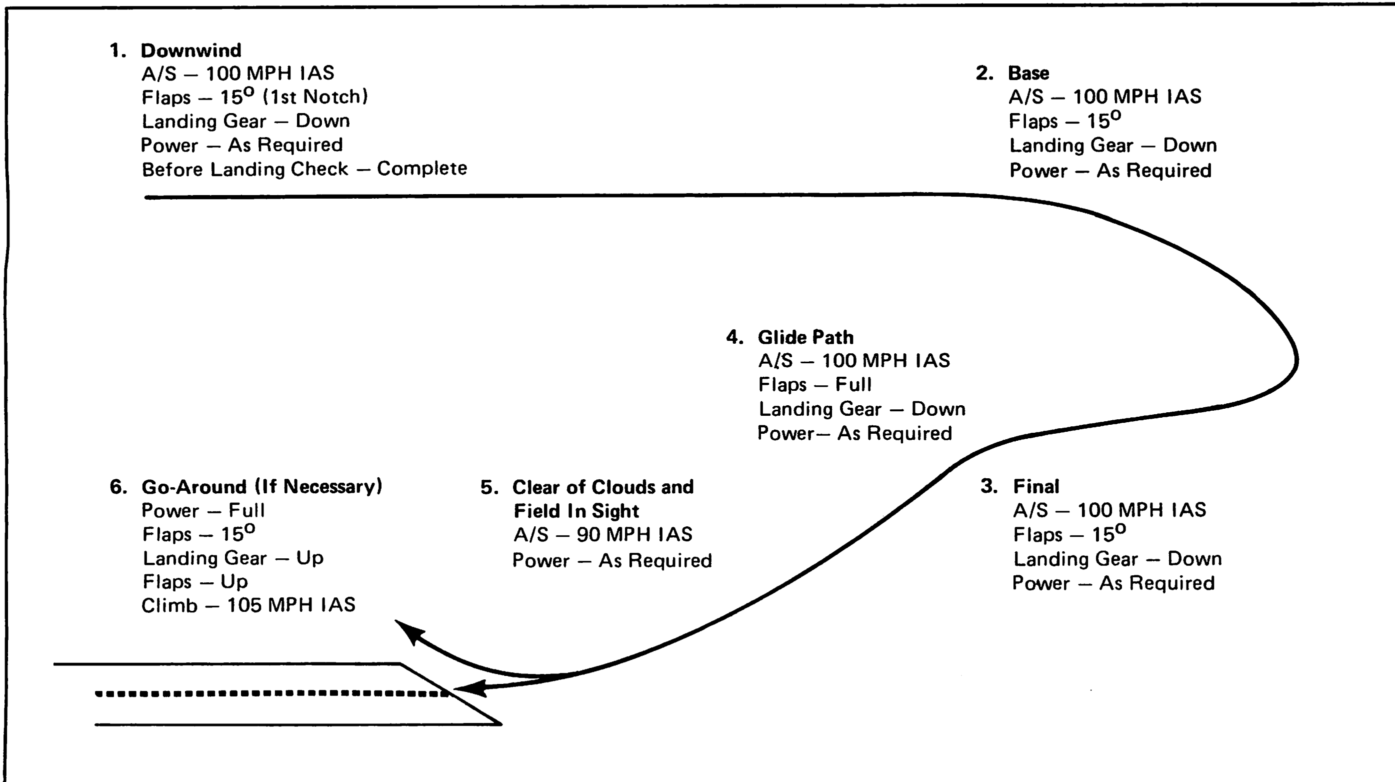

Figure 8-2 PAR Approach