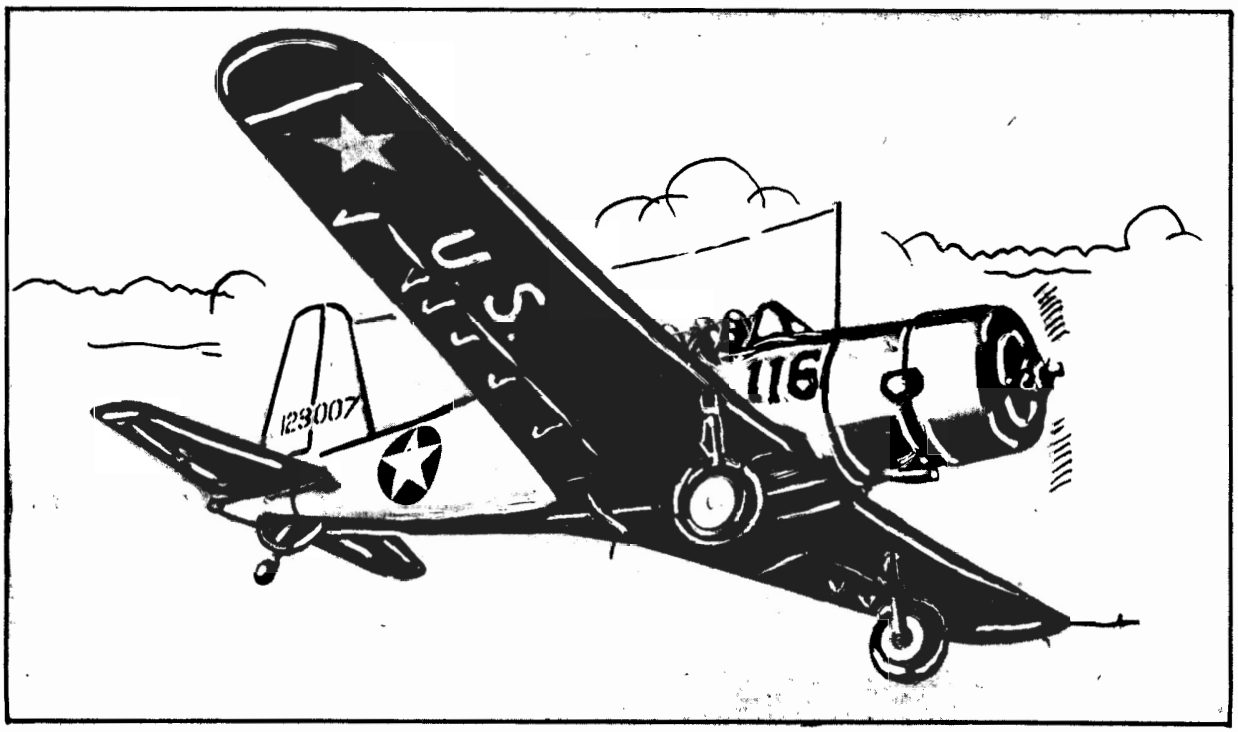
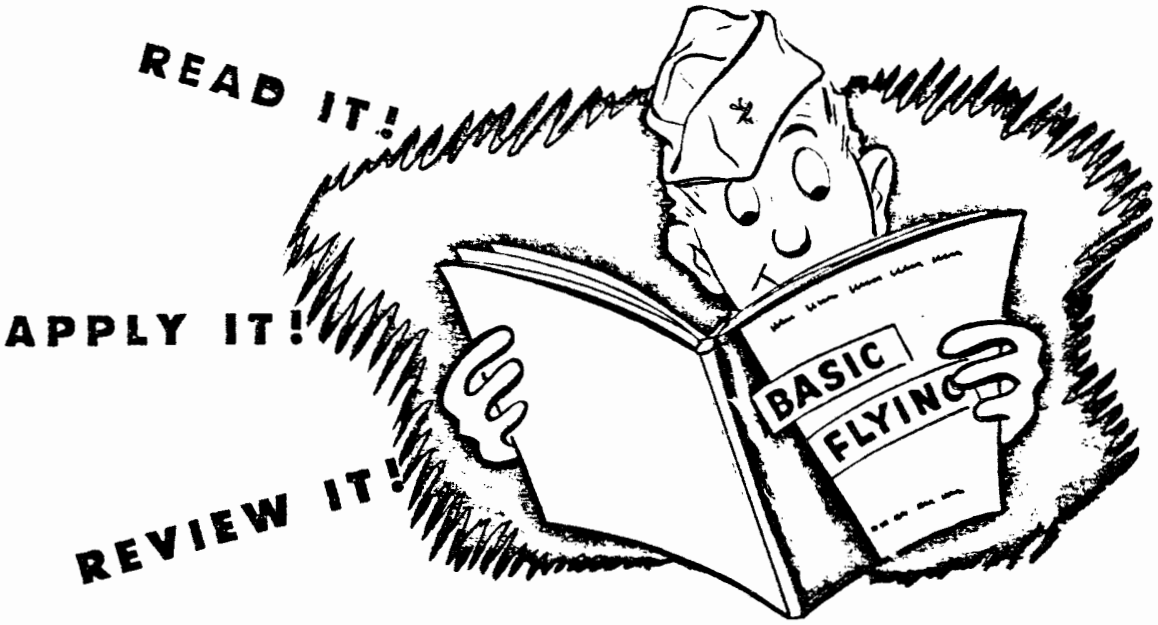
MILITARY

BASIC FLIGHT TRAINING

AEROBATIC MANEUVERS

VULTEE BT - 13A





HOW TO USE THIS MANUAL

This manual was prepared to help you become a better pilot. What you read here will round out what your instructor tells and shows you. To get the most out of an hour's flying, first learn all you can about the operation on the ground. Study it, listen carefully to what your instructor has to say; see it demonstrated in the air, and then try it yourself. Then, when you are back on the ground, review what the manual said about the problem and try to figure out what you will do next time to correct any errors you may have made.

Read from day to day about those operations and maneuvers that are coming up next. Keep your manual handy. If some change in the program gives you a spare hour, study this book! Learn more about radio, lazy eights, night navigation, climbing turns, or whatever you will be practicing next.

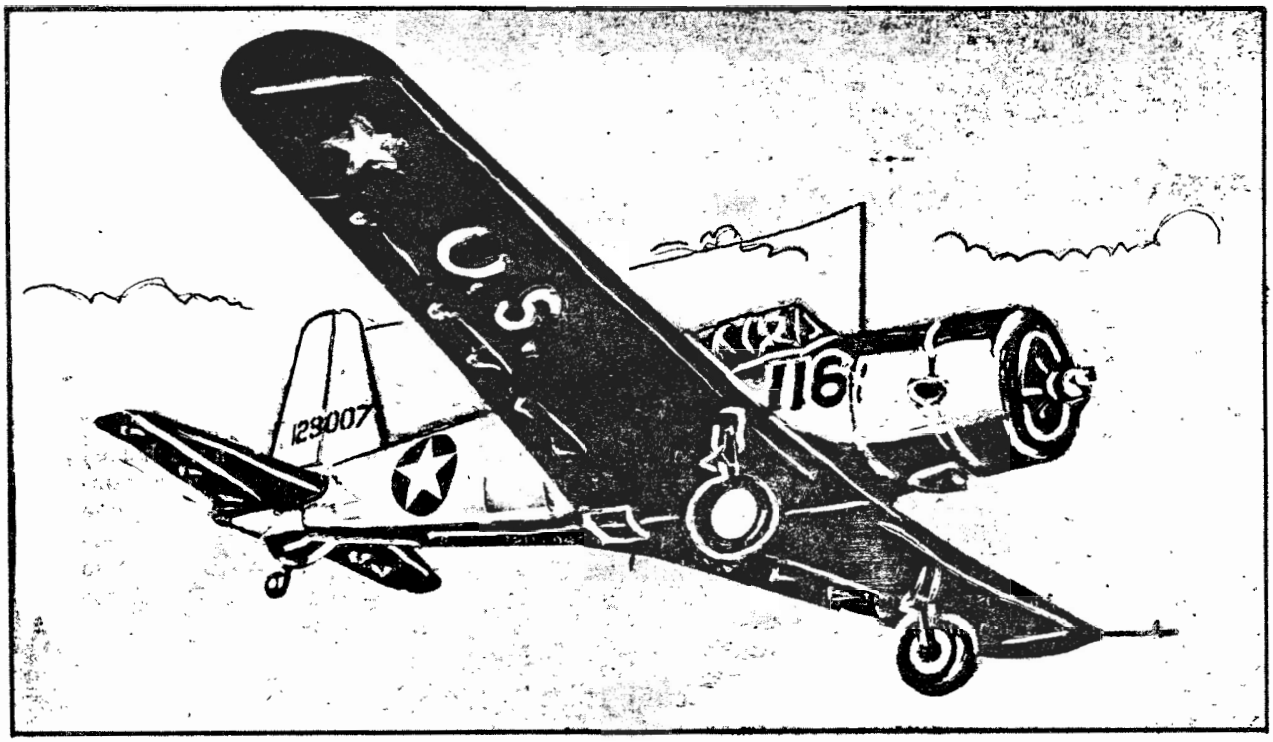
IF IT'S IN THE MANUAL, YOU'RE EXPECTED TO KNOW IT!

EQUIPMENT

Get a well-fitting parachute. Serious injuries can result from poorly fitting chutes

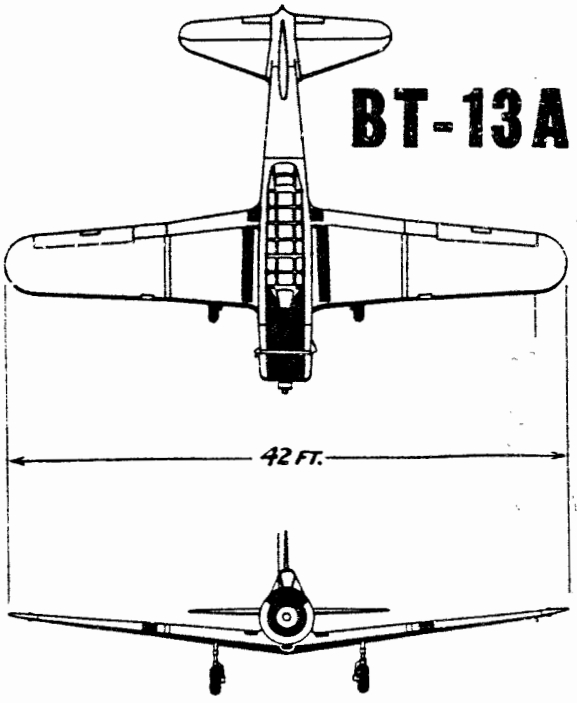
Be sure your goggles don't distort your vision and that your helmet or earphones fit properly. You can't learn if you can't hear. If you have trouble understanding your instructor in the air, tell him immediately. He will help you figure out the difficulty.

To do his best, a pilot must have well-fitting, serviceable equipment. Check yours carefully and change it if necessary.



Features
OF THE BASIC TRAINER

BT-13A

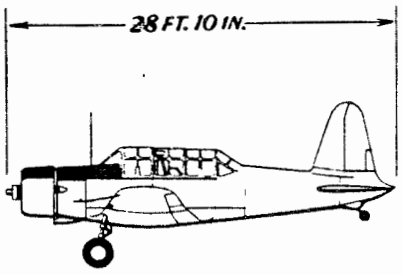


Your new airplane is a good airplane. It's easy to fly but not easy to fly expertly and that is the main object of Basic Training, to teach you precision flying. If you have any questions or doubts about the Basic Trainer, state them frankly to your instructor.

It is important to know your airplane! Here is an example of the kind of information you should learn about any airplane you are learning to fly. Facts given here are for the BT-13A. Get the facts for the type of airplane used in your school.

ENGINE: Pratt & Whitney, 9-cylinder, radial, air-cooled, direct drive type, developing 450 hp. at sea level.

PROPELLER: Hamilton Standard 2-blade, hydrocontrollable 2-position type, 9 ft. in diameter. Low-pitch 12.5°. High pitch 18°.



Cockpit Checklist

A checklist of this type is secured in the cockpit of each Basic Trainer. Go over the checklist word by word again and again. In a few days you'll know it by heart. When you learn the checklist so well that you do the right thing almost automatically, your progress will be much more rapid.

Don't ever get so "sharp" you are ashamed to refer to the checklist. Refresh your memory often and get in the habit of using the checklist. It is indispensable to the safe operation of larger aircraft. The pilot who is so "hot" he never needs the checklist is too "hot" for tactical equipment.

PILOT'S CHECKLIST

BT-13 Airplanes and BT-13A Airplanes
Pratt & Whitney R-985-AN-1 and 3
Use CAPITALIZED words for routine checking

★ ***BEFORE ENTERING COCKPIT***

1. Check PITOT TUBE for COVER, OLEO STRUTS, HYDRAULIC LINES, and TIRES.
2. Check for LOOSE COWLINGS, PANELS, etc.
3. Check REAR COCKPIT if solo. Fasten SAFETY BELT and SHOULDER HARNESS. Check for LOOSE ITEMS (headset, microphone, instrument hood, etc.) Cage GYRO INSTRUMENTS if ACROBATICS are planned.

★ ***BEFORE STARTING ENGINE***

1. Check FORM 1A. Fill out FORM 1.
2. Set PARKING BRAKE. Unlock CONTROLS and secure CONTROL LOCK in FLOOR CLIP.
3. Carburetor Heat COLD.
4. Oil Cooler Shutter OPEN.
5. Battery disconnect and Generator switch ON (in airplanes so equipped).
6. Ignition switch OFF.
7. Mixture control FULL RICH.
8. Propeller Control BACK (low rpm).
9. Throttle set ¾ in. OPEN.
10. Check FUEL SUPPLY. Selector Valve on RESERVE.

★ ***STARTING ENGINE***

1. WOBBLE PUMP Fuel Pressure to 3 or 4 lbs.
2. PRIME engine (7 to 9 strokes maximum; little or none for hot engine).
3. Ignition switch ON.
4. Maintain FUEL PRESSURE with WOBBLE PUMP until engine starts. CAUTION: DO NOT PUMP THROTTLE.

DURING WARM-UP

1. After OIL GAGE indicates PRESSURE, run engine at 600 to 800 rpm. CAUTION: IF OIL PRESSURE is not indicated within 30 seconds—STOP ENGINE.
2. Move Propeller Control FORWARD (high rpm) after 60 lbs. pressure is indicated and warm up at 1,000 rpm.
3. OIL PRESSURE 75 to 90 lbs.; maximum, 100 lbs.; minimum, 60 lbs.; idling, 15 lbs.
4. OIL TEMPERATURE 50° to 70° C.; maximum 95° C.
5. FUEL PRESSURE 3 to 4 lbs.
6. Check ENGINE and MAGNETOS at 1,500 rpm. Maximum drop on either magneto, 100 rpm.
7. Check GENERATOR and electric SWITCHES, VOLTMETER and AMMETER.
8. RADIO tuned to tower; Volume UP.

BEFORE TAKE-OFF

1. Check CONTROLS for free movement.
2. Engine controls:
   Mixture FULL RICH.
   Oil Cooler Shutter OPEN.
   CARBURETOR HEAT as required.
   Propeller Control FORWARD (high rpm).
   Check GASOLINE quantity. FUEL SELECTOR VALVE set for RIGHT TANK on first flight after REFUEL. Subsequent take-offs on tank with MOST GAS, either Left or Reserve.
3. Engine RUN UP full rpm. Unit gage readings:
   OIL PRESSURE, 75 to 90 lbs.; Minimum OIL TEMPERATURE, 30° C.
   FUEL PRESSURE, 3 to 4 lbs.
4. POWER LIMIT 2,300 rpm for take-off.
5. Set RUDDER and ELEVATOR TABS at 0°.
6. Flaps DOWN 10 turns, 20°.

DURING FLIGHT

1. CLIMB 20° FLAPS, high rpm. Normal climb 90 mph.
2. OIL COOLER SHUTTER and CARBURETOR HEAT adjusted for proper temperature.
3. Keep FUEL TANKS EQUALIZED within 10 gallons; alternate between LEFT and RESERVE.
4. Maximum DIVING SPEED 230 mph and 2,400 rpm.
5. ALLOWABLE ENGINE OPERATION
   Climb and High Speed—Maximum rpm, 2,300.
   Mixture Control—FULL RICH.
   Climb—Desired rpm, 2,100.
   Cruising—Low rpm; desired rpm, 1,900; maximum rpm, 2,000; mixture control, Full Rich to Smooth Operation.

BEFORE LANDING

1. RADIO tuned to tower; volume UP.
2. FUEL SELECTOR VALVE on tank with MOST FUEL, either Left or Reserve.
3. Mixture FULL RICH.
4. Propeller Control FORWARD (high rpm).
5. Check CARBURETOR HEAT.
6. Flaps as needed. (Do not lower if airspeed is over 120 mph).

AFTER LANDING

NOTE: This engine is equipped with an "Idle Cut-off."

1. FLAPS UP when taxiing.
2. Use OIL DILUTION as required.
3. IDLE Engine at 800 to 1,000 rpm. Move Propeller Control BACK (low rpm).
4. Place MIXTURE CONTROL in "IDLE CUT-OFF."
5. Turn all SWITCHES OFF when PROPELLER STOPS.
6. Set PARKING BRAKE. Lock CONTROLS.
7. Do not hang RADIO HEADSET near Instrument Panel.

BLINDFOLD COCKPIT TEST

Student_____ Date_____

Instructor_____ Grade_____

Student is considered proficient when he can place his hand on any of the controls or switches without hesitation within a period of 3 seconds. Sequence of order should be varied. Student must pass this test prior to solo.

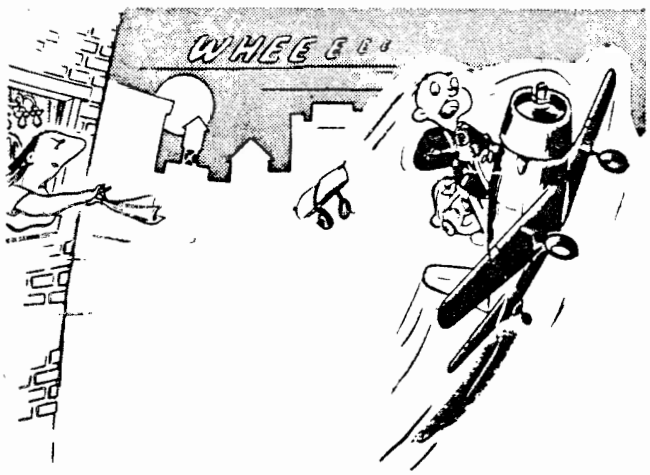
	Grade		Grade
1. Elevator Trim Tab Control		18. High-Low Coil Switch	
2. Rudder Trim Tab Control		19. Pitot Heat Switch	
3. Mixture Control		20. Parking Brake Handle	
4. Throttle		21. Landing Light Switch	
5. Flap Handle		22. Static Pressure Valve Control	
6. Propeller Control		23. Cockpit Light Switch	
7. Fuel Tank Selector Valve Control		24. Passing Light Switch	
8. Wobble Pump Handle		25. Navigation Light Switch	
9. Control Lock		26. Navigation Instrument Light Rheostat	
10. Rudder Pedal Adjustment Levers		27. Ignition Switch	
11. Primer		28. Starter Switch	
12. Radio Interphone Switch		29. Carburetor Heat Control	
13. CW-Voice-Tone Switch		30. Fuel Pressure Warning Light	
14. Off-Auto-Manual Switch		31. Oil Cooler Shutter Control	
15. Receiving Tuning Unit		32. Seat Adjustment Lever	
16. Volume Control Knob		33. Emergency Canopy Release	
17. Microphone			

AIRSPEED LIMITATIONS.

The red line on the airspeed indicator marks the limit dive speed at any altitude. The limit dive speed for the airplane with external loads is the same as for the clean airplane. However, the airplane should not be dived to airspeeds in excess of those where light to moderate airplane or surface control buffet is experienced. The yellow line indicates the maximum airspeed at which the flaps may be lowered to the full down position. The maximum airspeed for landing gear down is not marked on the airspeed indicator but is given below the indicator on figure 5-1. Lowering either the flaps or gear at speeds in excess of the flaps-down or gear-down limit airspeeds may cause structural damage to the airplane. Because of the danger of accidental stalls, the minimum permissible indicated airspeed during sideslips is 90 mph.

PROHIBITED MANEUVERS.

Outside loops, inverted spins, snap rolls in excess of 130 mph, and slow rolls in excess of 190 mph are prohibited. Inverted flight must be limited to 10 seconds, as there is no means of ensuring a continuous flow of fuel or oil in this attitude. Also, prolonged inverted flight can cause an accumulation of hydrogen gas in the battery at sufficient pressure to continuously hold the vents closed until the battery eventually explodes. Since altitude is lost rapidly during a sideslip, this maneuver should not be attempted below 200 feet.



All acrobatic maneuvers performed during training flights should be completed at least 5000 feet above the ground.

ACCELERATION LIMITS.

The airplane is limited to a maximum positive G-load of 5.67 and a maximum negative G-load of −2.33. These limits apply only when the clean airplane gross weight does not exceed 5300 pounds (design gross weight). When airplane gross weight is greater than 5300 pounds, the maximum allowable G-load is less than the maximum limit marked on the accelerometer. Remember that when you pull the maximum G-load (5.67 G), the wings of your airplane must support 5.67 times their normal load. This means that during a maximum G pull-out the wings of the airplane (at design gross weight) are supporting 5.67 times 5300 pounds, or a total of approximately 30,000 pounds (maximum that the wings can safely support). Therefore, when your airplane weighs more than 5300 pounds, the maximum G-load that you can safely apply can be determined by dividing 30,000 by the new gross weight. When external loads are carried, the maximum allowable G-load is limited to 4.3 G. The maximum G-loads we have been talking about apply only to straight pull-outs. Rolling pull-outs are a different story, however, since they impose considerably more stress upon the airplane. The maximum allowable G-load in a rolling pull-out is limited to two-thirds the maximum G-load for a straight pull-out.

OPERATING FLIGHT STRENGTH.

The Operating Flight Strength diagram (figure 5-2) shows the strength limitations of the airplane. Various G-loads are shown vertically along the left side of the chart, and various indicated airspeeds are shown horizontally across the center of the chart. The horizontal red lines at the top and bottom of the chart represent the maximum positive and maximum negative allowable G-loads. The vertical red line indicates the limit dive speed of the airplane. The curved lines show the G-load at which the airplane will stall at various airspeeds. The upper curved line shows, for example, that at 100 mph the airplane will stall in a 2 G turn, while at 150 mph the airplane will not stall until more than 4 G is applied. The upper and lower limits at the right side of the chart illustrate that the maximum positive and negative limit load factors (+5.67 G and −2.33 G) can be safely applied up to the limit dive speed of the airplane.

CENTER-OF-GRAVITY LIMITATIONS.

Any configuration of external load that the airplane is designed to carry may be installed without exceeding the CG limits. There is only one possible loading condition that could cause the airplane CG to exceed its

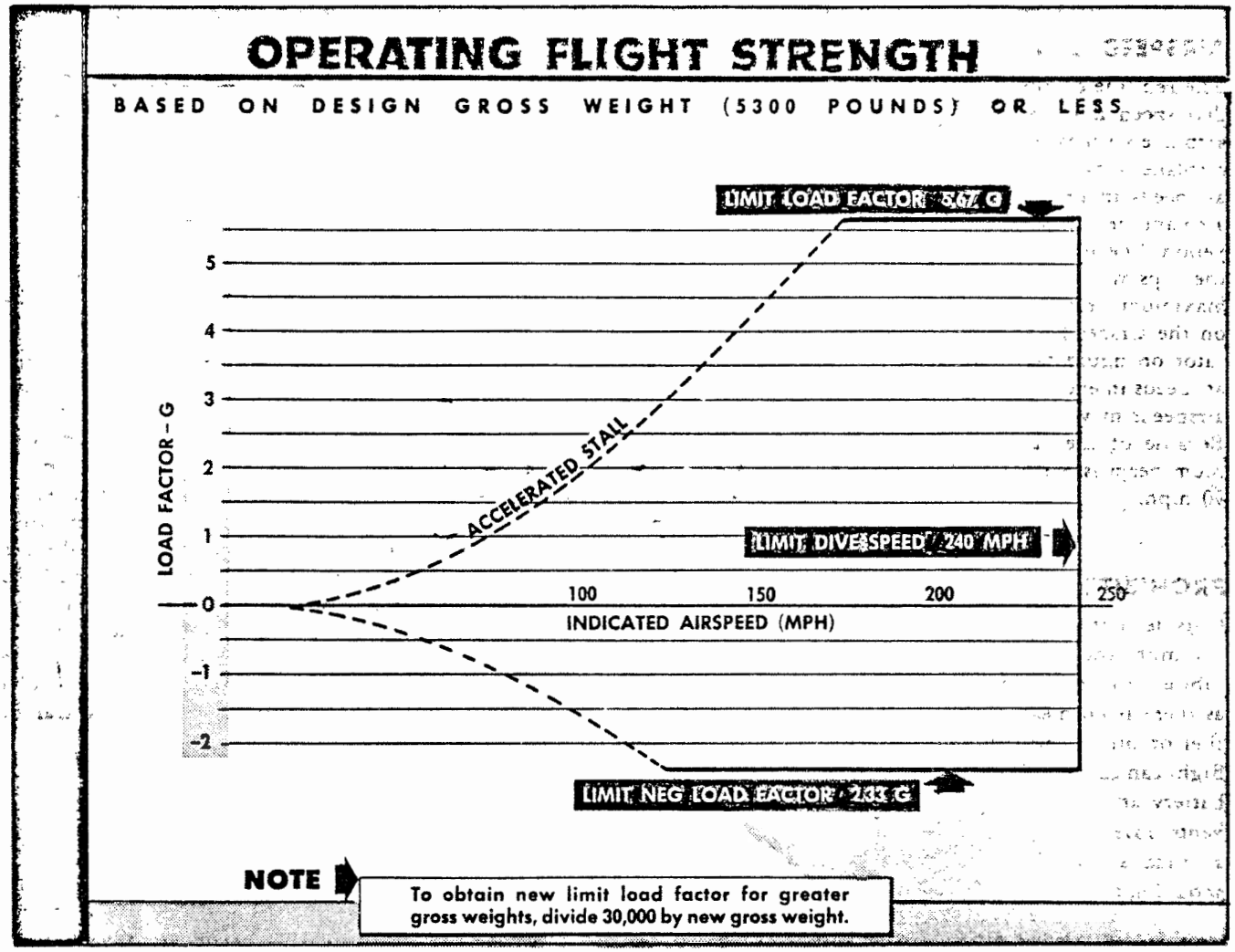
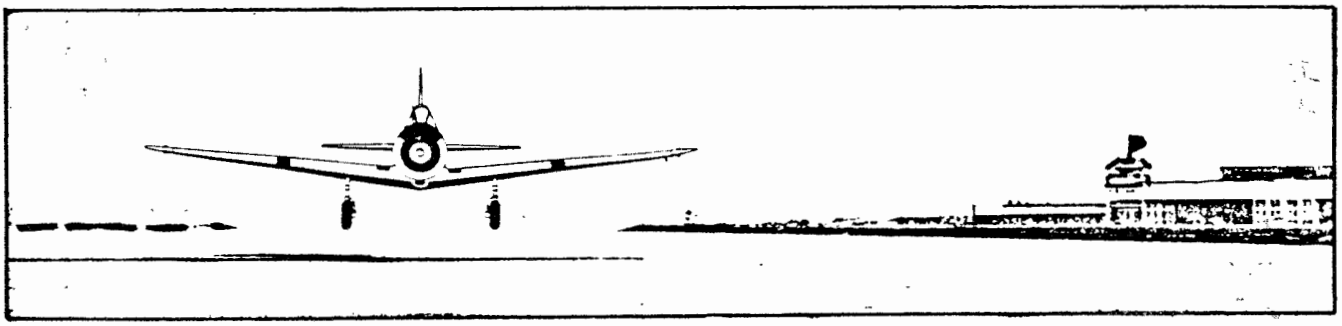


Figure 5-2

limitation. This could occur when fuel supply is low on a solo flight with no baggage. The result would be a slightly nose-heavy condition. Therefore, when this situation is encountered, additional care must be exercised during the flare-out (to prevent a two-point touchdown with the possibility of striking the propeller) and immediately after the touchdown (to prevent nosing over). However, this nose-heavy condition can be prevented by carrying a load of approximately 100 pounds in the baggage compartment to keep the CG within limits.

WEIGHT LIMITATIONS.

The maximum allowable gross weight of the airplane cannot be exceeded. However, the baggage compartment should not be loaded in excess of its maximum capacity of 100 pounds.



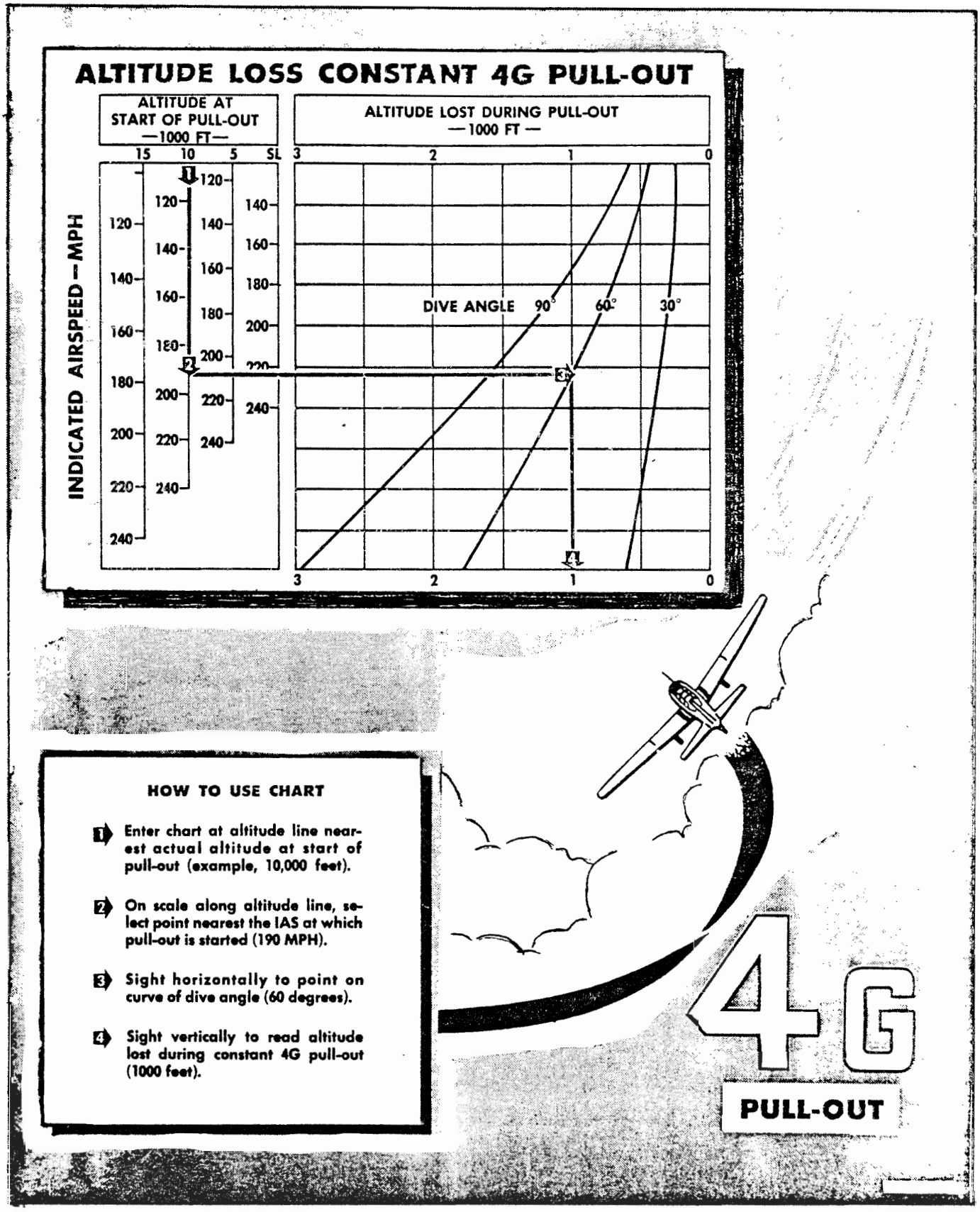


Figure 6-4. Altitude Loss and Dive Recovery

Coordination Exercise

Maximum Performance flying requires proper coordination of controls which comes only with practice. The Basic airplane is new to you and you may have to change many habits formed in Primary. Coordination Exercises teach you the feel of your new airplane.

Good coordination does not stop simply with moving stick and rudder together. It requires constant changing of pressures to establish or to maintain a given attitude of flight. The student who develops a "fine" touch in the Basic airplane can apply the same general principles to tactical aircraft. Do coordination exercises at every opportunity. Don't waste time in the air because you are simply wasting your own chances of becoming a better pilot. Make every minute count.

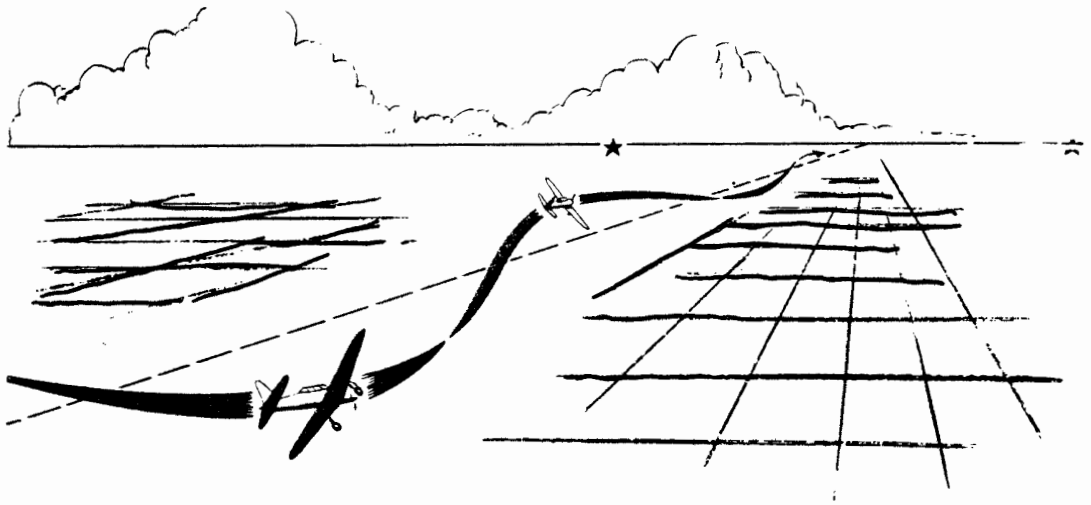
Auxiliary Controls: In cruising positions.

Procedure

1. Pick two points on the horizon separated by an angle of approximately 45° to 60°.
2. Roll into a medium bank that will carry the nose along the horizon to one point and then roll back into an equivalent bank in the opposite direction. The object is to move the nose back and forth from one point to another in a smooth, flowing action, executing uniform degrees of bank in each direction while holding a constant altitude and a constant rate of turn.
3. Start using a medium bank and then steepen it as you become proficient.

Common Errors of Student

1. Fails to maintain constant altitude.
2. Makes bank steeper in one direction than another.
3. Movements are jerky. Lack smoothness.
4. Stays in bank too long before rolling in the opposite direction.
5. Fails to apply rudder and aileron together, or uses too much rudder with too little aileron, or vice versa.



MAXIMUM PERFORMANCE

Climbing Turns

This maneuver is the connecting link between the approach to a stall and a chandelle. In the approach to a stall, you learn to pull directly into the desired attitude in one smooth motion, hold it, and at the last moment roll out. In the Maximum Performance Climbing Turn, the attitude of the airplane is **constantly changing.** The nose continues to rise **gradually** throughout the maneuver, and the bank changes **gradually** from level flight to approximately a medium bank and then back to level flight just as the airplane reaches the maximum angle of climb. In effect, the nose draws a straight line up from the horizon in the direction of the turn.

This maneuver differs from the chandelle in that no definite amount of turn is required. The important thing is proper timing for maximum performance and a uniform, **gradual** change of attitude. Get this down pat and you will have no difficulty with chandelles.

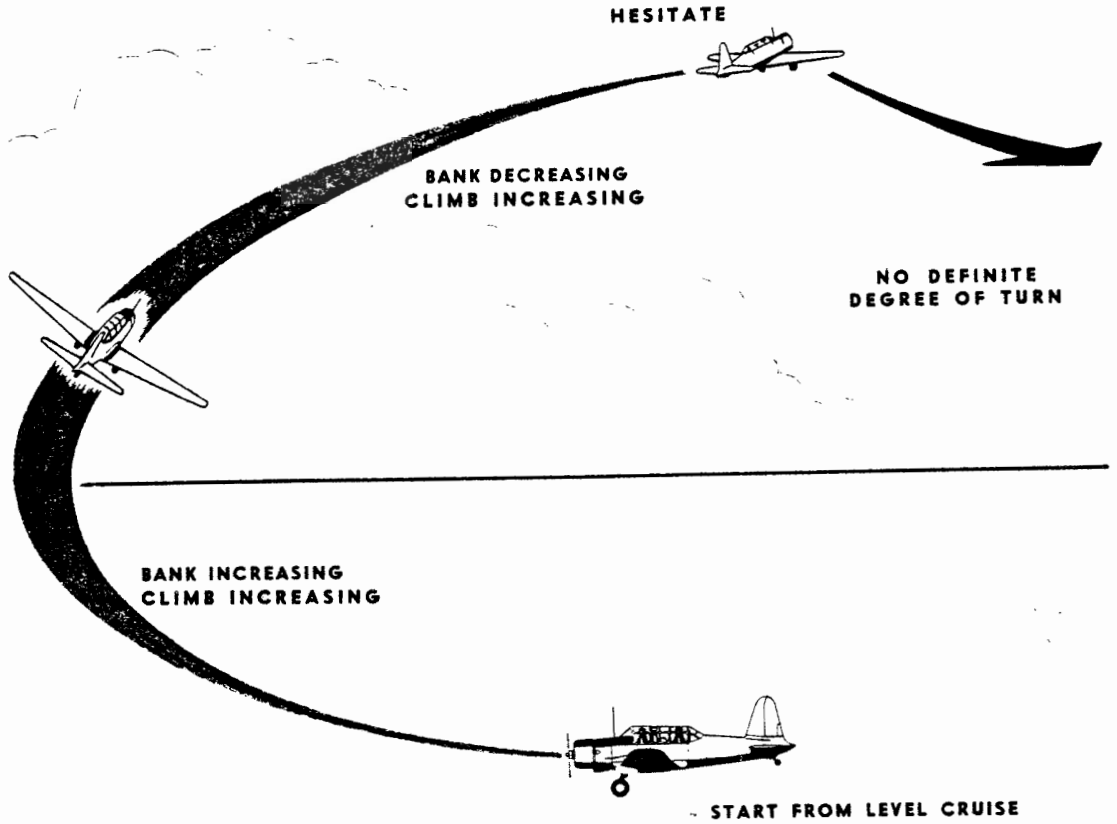
Auxiliary Controls: In cruising positions.

Procedure

1. Clear the area by looking back in the direction of the turn. Start the maneuver from straight and level flight, cruising airspeed.
2. Blend rudder, aileron, and back pressure simultaneously to start a gradual climbing turn. Don't establish a turn and then pull up into a climb.
3. **Gradually** increase both the angle of climb and the angle of bank for approximately two-thirds of the maneuver. Continue to increase the climb but **gradually** reduce the bank so that wings are level again just as you reach the maximum climbing attitude.
4. Hesitate for an instant on the verge of a stall, to check this maximum climbing attitude, and then lower the nose smoothly to the horizon.
5. Hesitate again briefly, and then use a shallow dive to regain cruising speed. Level off at cruising airspeed before starting the next maneuver.

Common Errors of Student

1. Banks before establishing the climb instead of blending the two.
2. Uses too much climb and too little turn, resulting in a high unbalanced maneuver, or vice versa.
3. Fails to vary amount of torque correction as airspeed decreases.
4. Completes maneuver before maximum performance is reached.
5. Prolongs maneuver into a stall.
6. Uses poor timing so that the roll-out must be hurried to prevent a stall.
7. Fails to clear the area before starting the climbing turn.



Chandelles

The Chandelle is a composite maneuver combining a shallow dive, a coordinated maximum performance climbing turn, and a precision roll-out. The Chandelle is a precision maneuver executed through 180° of turn. There are many types of Chandelles, but your first job is to master the standard training Chandelle specified in Basic training. When you can do it perfectly, then you can experiment with others.

Polish up your technique in maximum performance climbing turns before trying Chandelles. The two are very similar except that the Chandelle is entered from a shallow dive, at higher airspeed, and must be timed for exactly 180° of turn.

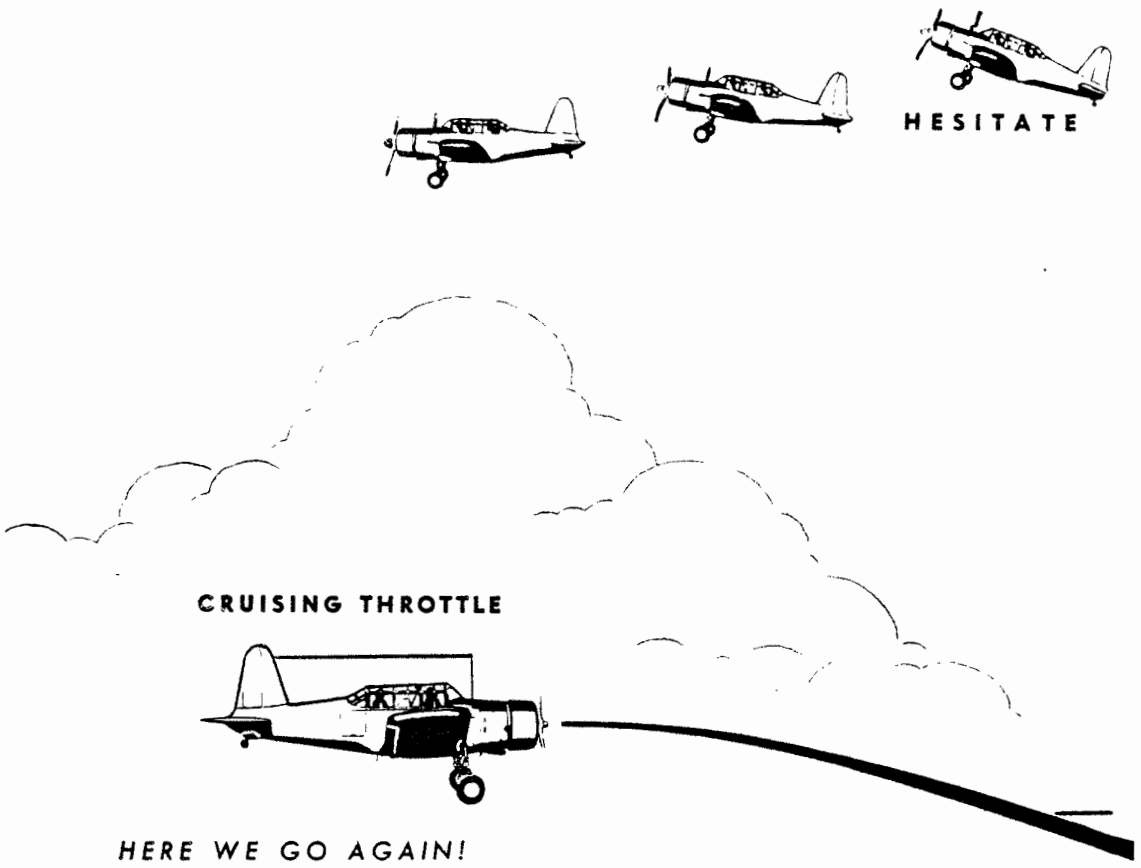
Learn all you possibly can from your instructor. You get less and less dual time as the course progresses. Listen hard, ask questions, and make the most of your time in the air and on the flight line.

Auxiliary Controls: In cruising positions.

Procedure

1. Line up on a road or section line and fly along it. Clear the area by looking back past the tail in the direction of the turn. Lower the nose into a shallow dive and hold it until your airspeed reaches approximately 140 mph.

2. Start a climbing turn, steadily increasing the angle of bank and the angle of climb



exactly as in a maximum performance climbing turn.

3. At approximately 135° to the original flight path (or three-quarters of the way through the maneuver), the bank will be near vertical, but never past.

4. Now continue to **increase** the angle of climb but **gradually decrease** the angle of bank.

5. Properly executed, you will complete 180° of turn just as you reach minimum airspeed and maximum angle of climb (approximately 40°), and just as the wings roll out level.

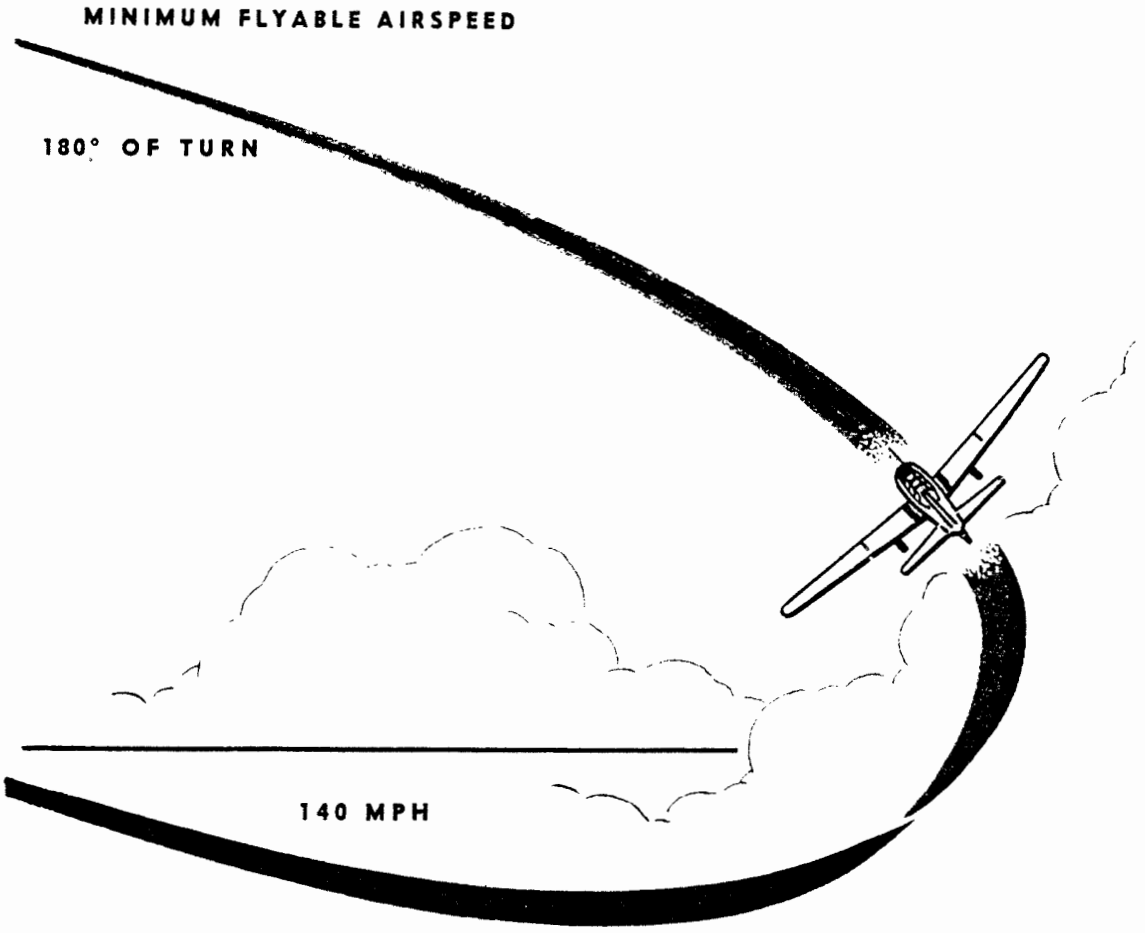
6. Hesitate briefly, with the nose straight ahead, to check the reference line and climbing attitude; then lower the nose smoothly to the horizon to prevent a stall.

7. If you are about to stall while rolling out, lower the nose enough to prevent the stall.

Torque

The perfect pattern for this Chandelle requires a constant rate of turn of the nose, a constant rise of the nose, carefully timed increase and decrease of bank, and a precision roll-out at the 180° point.

The most difficult part of the Chandelle is torque correction, which varies throughout the maneuver. In a Chandelle to the right, torque comes into play soon after you start

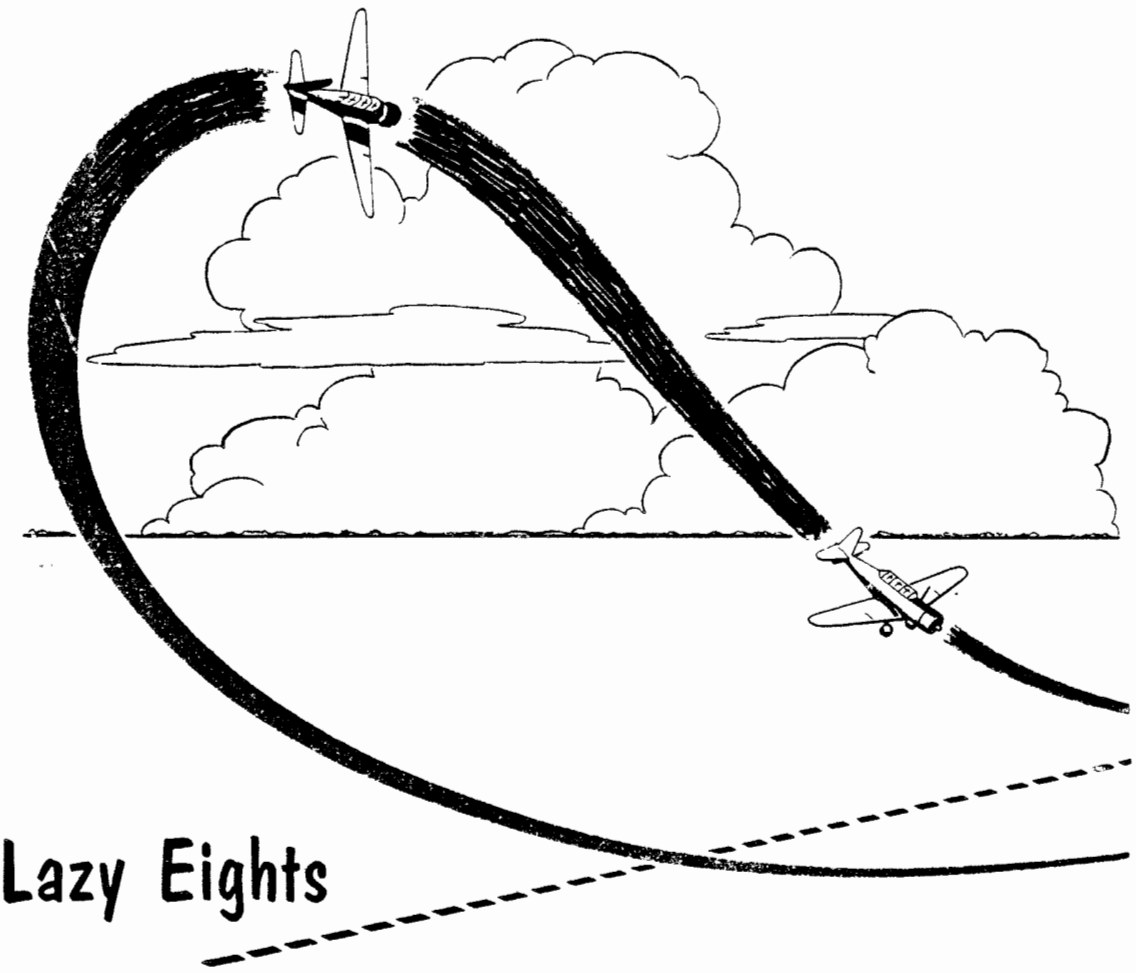


the climbing turn and increases as flying speed decreases. Torque is at a maximum during the roll-out.

In a Chandelle to the left, use minimum aileron pressure but considerable right rudder pressure in the roll-out to overcome torque and to stop the turn. In a Chandelle to the right, you need much less rudder pressure in the roll-out but more aileron pressure.

Common Errors of Student

1. Does not clear the area.
2. Dives improperly, using inconsistent airspeed in pull-ups, and fails to start bank and climb together.
3. Steepens the original bank too rapidly, resulting in nothing more than a steep bank with the nose pulled up rapidly at end of the turn.
4. Keeps bank too shallow but raises nose steadily, resulting in a stall before the turn is completed.
5. Raises nose too high too quickly instead of raising it gradually throughout 180° of turn.
6. Fails to blend movements of controls.
7. Fails to correct for torque, particularly during roll-out.
8. Fails to hesitate briefly after the roll-out to check attitude.
9. Falls short of or turns in excess of 180°.



Lazy Eights

The pilot who can do consistently good Lazy Eights is on his way to the big leagues.

Lazy Eights require the utmost in timing, control touch, and orientation. The airplane must go from climbing turns to diving turns smoothly, without stalling, without developing excessive diving speed, and while maintaining a constant rate of turn.

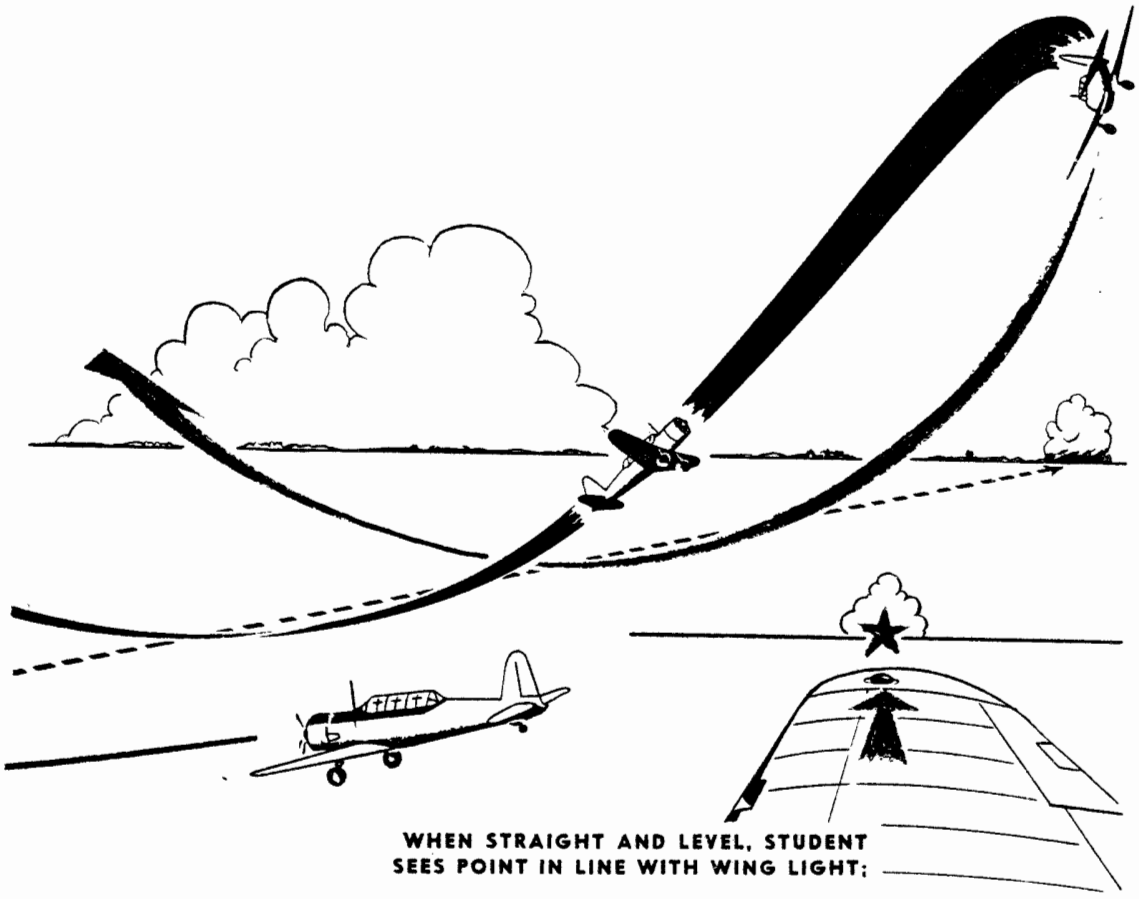
Although there are many varieties, one particular Lazy Eight is taught in Basic Schools to avoid confusion. It is to the student's advantage to learn it well.

Pattern

The flight path of the airplane is not actually that of a figure eight. However, the pilot has the feeling in flight that he is executing an eight, because the nose of the airplane describes equal arcs above and below the horizon.

The pilot flies the airplane smoothly and gradually from climbing turns into diving turns, to produce a rounded, lazy maneuver. The maneuver is started from straight and level flight with one running light on the reference point. The pilot executes a climbing turn with bank and climb gradually increasing.

From the maximum point of climb he flies the nose slowly down through the reference point, and times his change of attitude in the diving turn so that the airplane will momen-



WHEN STRAIGHT AND LEVEL, STUDENT SEES POINT IN LINE WITH WING LIGHT;

tarily return to straight and level flight just as the opposite running light is lined up with the reference point. Smoothly, without hesitation, he starts a similar pattern in the opposite direction.

The object is to produce a steady, lazy, rounded pattern in which the attitude of the airplane never stops changing, but all of the changes are gradual—lazy!

Auxiliary Controls: In cruising positions.

Procedure

1. Select a reference point on the horizon, such as a hill or smokestack, and maneuver the airplane 90° to this point so that you see one running light on the point.

2. Be sure the area is clear and, from level flight and cruising airspeed, start a gentle climbing turn.

3. Gradually increase bank and climb so that when the airplane has turned 45° the nose will be approximately 40° above the horizon, the wings banked approximately 45° and flying speed just below a stall. This is the top of one arc of the 8.

4. Then bring the nose lazily down through the reference point into a lazy dive, forming an arc below the horizon about equal to the one above. Continue the turn as you gradually raise the nose and level the wings.

5. When you have completed 180° of turn you should have the nose back on the horizon,

airspeed back at cruising (approximately 130 mph), running light on the horizon reference point, and the same altitude as when the maneuver began.

6. Don't hesitate in level flight. Start the same maneuver in the opposite direction to complete the last half of the figure 8.

Common Errors of Student

1. Fails to use reference point properly.
2. Fails to establish bank and turn together and time the turn correctly.
3. Banks (or climbs) too steeply instead of gradually increasing the bank (or climb).
4. Tends to slip when approaching the maximum climb from left to right. (More bottom rudder will prevent this but is not needed when going from right to left.)
5. Fails to fly the nose through the point or covers the point with the nose. (It is more accurate to pick a spot on the engine cowling and put it through the reference point.)
6. Dives too steeply, building up too much airspeed.
7. Rolls out, pulls nose up, and then rolls into the next turn. (To make loops of the 8 rounded, roll out of one diving turn directly into the next climbing turn.)

Spins

POWER OFF AND POWER ON

The Basic Trainer is a good airplane in which to practice spins because it has normal spin characteristics and at the same time spins steeply and rapidly enough to adequately demonstrate this maneuver.

Any average student can quickly learn spin recoveries because they are done by formula instead of by feel. You will use the tested and approved *NACA spin recovery developed by the world's best test pilots. Most difficulties in learning spins can be traced directly to a student's own nervousness. Lay your doubts aside, learn the proper entry and recovery point by point, and you'll find that a spin is one of the easiest maneuvers of all.

What Happens in a Spin?

It helps to know what happens in a spin. The airplane is in a stalled condition. It starts to rotate about its center of gravity with the inside wing down slightly and completely stalled. The outside wing is higher, is moving faster and at a lower angle of attack. It is somewhat less stalled and retains a certain amount of lift. This unequal stalled condition of the wings tends to rotate the airplane. Once a spin is started the airplane tends to keep spinning as long as controls are held with the spin. This is called auto-rotation.

The result is that the airplane will not respond to the usual control pressures. The use of ailerons merely stirs up burbles about the wings and aggravates the stalled condition.

A special control technique, simple but different, is necessary. A spin recovery is the one maneuver in flying that is almost entirely mechanical . . . like executing "Left Shoulder —Arms!" You learn a given sequence of movements and that's it.

*National Advisory Committee on Aeronautics.

How Spins Affect the Pilot

It is perfectly normal for too many turns to cause a certain amount of vertigo or dizziness in a healthy pilot. Only deaf mutes and the insane can be whirled about without experiencing dizziness.

Spins of one to three turns won't noticeably affect the vast majority of pilots. However, it is inadvisable to spin more than three turns because each additional turn increases the degree of dizziness.

The pilot who does become dizzy during a spin may have a strong sensation as he recovers that the airplane is spinning in the opposite direction. Instinctively he may try to execute a recovery from this imaginary spin and thus put the airplane into a secondary spin in the same direction as the original one.

The important things to remember are:

1. Don't try spins of more than three turns. You may get dizzy.
2. If you are dizzy as the airplane recovers from a spin, don't let your sensations fool you. Don't try to recover from an imaginary spin.

Spin Schedule

You will have a chance to practice both Power-On and Power-Off spins during the first week of flying and will practice spins during every dual transition flight throughout the course. Your instructor will demonstrate three-turn spins before you solo. Remember that you are not to practice solo spins until they are scheduled.

Keep your mind clear and your eyes and ears open. Your instructor won't solo you until he is confident that you can satisfactorily perform spin recoveries. Stay relaxed and take your time. Memorize the proper entry and recovery and you'll know exactly what to do and when to do it.

Altitudes

Enter spins at or above the following altitudes:

One-turn or two-turn spins — 5,000 ft. above the ground. Spins of more than two turns — 7,000 ft. above the ground. Three-turn spins are the maximum authorized in Basic Training.

Auxiliary Controls: In cruising position.

HOW TO ENTER SPINS

Power-Off Entry

1 Clear the area with special care and fully retard the throttle.

2 Raise the nose 20° to 30° above the horizon. It is a common error to raise the nose too high, producing an irregular spin with the nose dipping up and down.

3 As the airplane approaches the stall, feed in rudder in the direction of the spin.

4 As the stall occurs, use full hard rudder **all the way** in the direction of the spin and bring the stick **straight back all the way** and hold it there. You will immediately enter the spin.

Power-On Entry

Entry is identical with Power-Off Spins except:

1. At cruising throttle raise the nose 30° to 40° above the horizon.
2. Cut the throttle all the way when the nose slices through the horizon into the spin.

IMPORTANT:

Hold controls all the way in these extreme positions to produce a steady spin and to make controls more effective on recovery. If controls are relaxed, you will usually spiral and gain too much diving speed.

Secondary Spins and Emergency Spins

Remember that a spin is just another maneuver. There is no need to get rushed and excited or to lose your head. Keep calm, keep cool, take your time. You can't rush a spin recovery. Snapping the stick back too fast when recovering from the dive may cause a secondary stall and possibly a spin.

Another common error is to fail to neutralize the rudder when the spinning stops so that you snap into a spin in the opposite direction. Combinations of these errors can result in sudden and violent secondary spins.

Spins are never dangerous if the pilot maintains self-control and recovers the way he has been taught. When you are executing a recovery, don't start a new one until you have made **at least three turns** with controls full against the spin. Many an airplane has been unnecessarily abandoned in a moment of excitement because the pilot lost his head or was frightened when the airplane didn't recover immediately. This occasionally occurs because it takes time for the new position of controls to become effective. Normally the airplane will stop spinning if controls are held against the spin **long enough.**

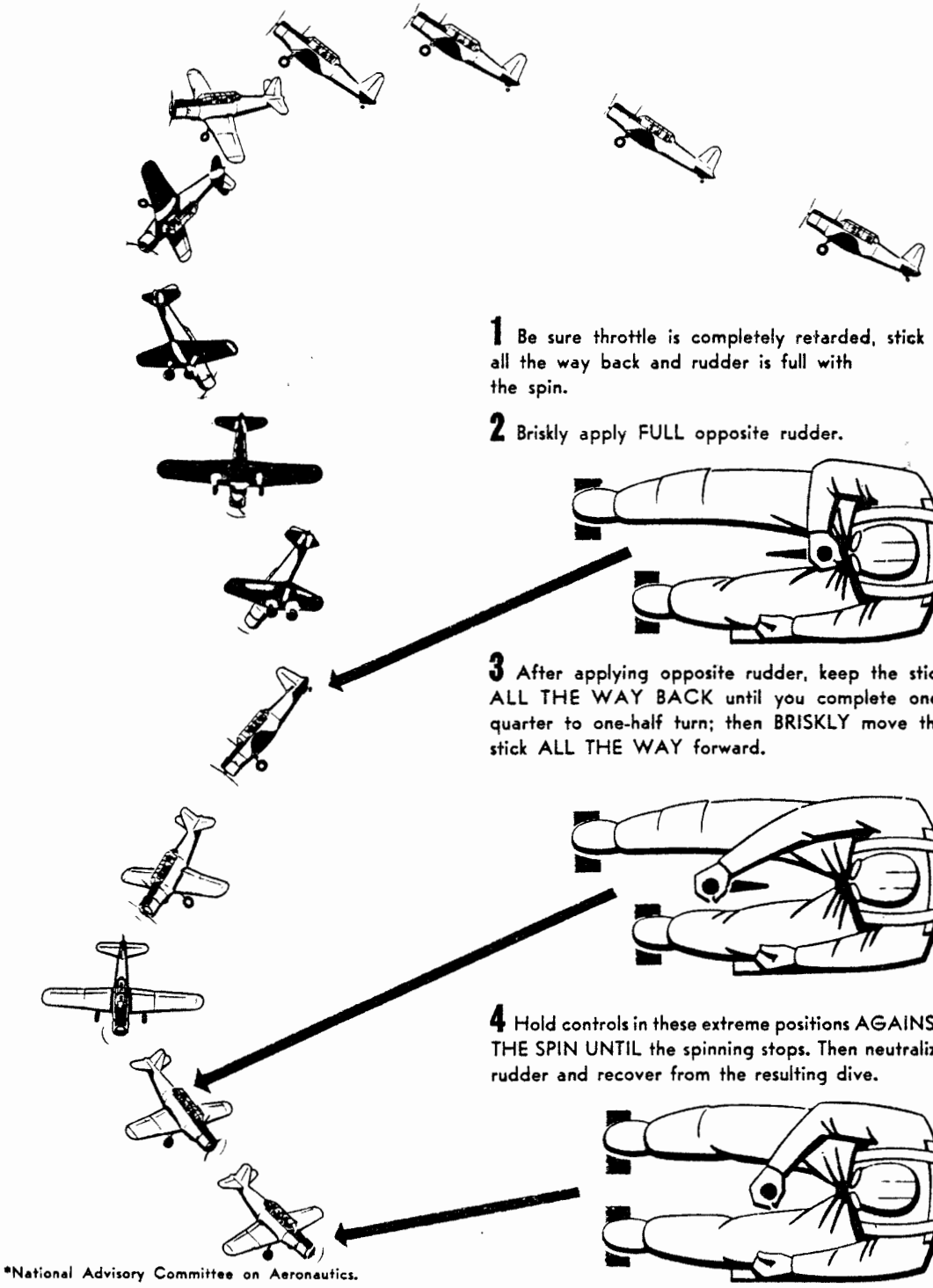
It is practically never necessary to abandon the Basic airplane in spins unless the airfoils have been altered or damaged, or the center of gravity abnormally changed.

When to bail out is a problem of altitude. If you have used the proper recovery techniques, have held the controls for three to five turns against the spin without success, and if you are running out of altitude, then don't wait. Get out! If you decide to bail out, leave the airplane quickly at 1,000 ft. above the ground or higher.

Common Errors of Student

1. Fails to clear the area.
2. Starts the spin at too low an altitude.
3. Makes faulty entry into the spin.
4. Does not hold the controls all the way with the spin. Fails to keep ailerons in neutral.
5. Is unable to orient himself in a spin.
6. Doesn't wait long enough between opposite rudder and forward stick.
7. Doesn't hold controls all the way against the spin long enough.
8. Fails to neutralize controls properly at the right time.
9. Dives airplane excessively in recovery.

STANDARD NACA* SPIN RECOVERY



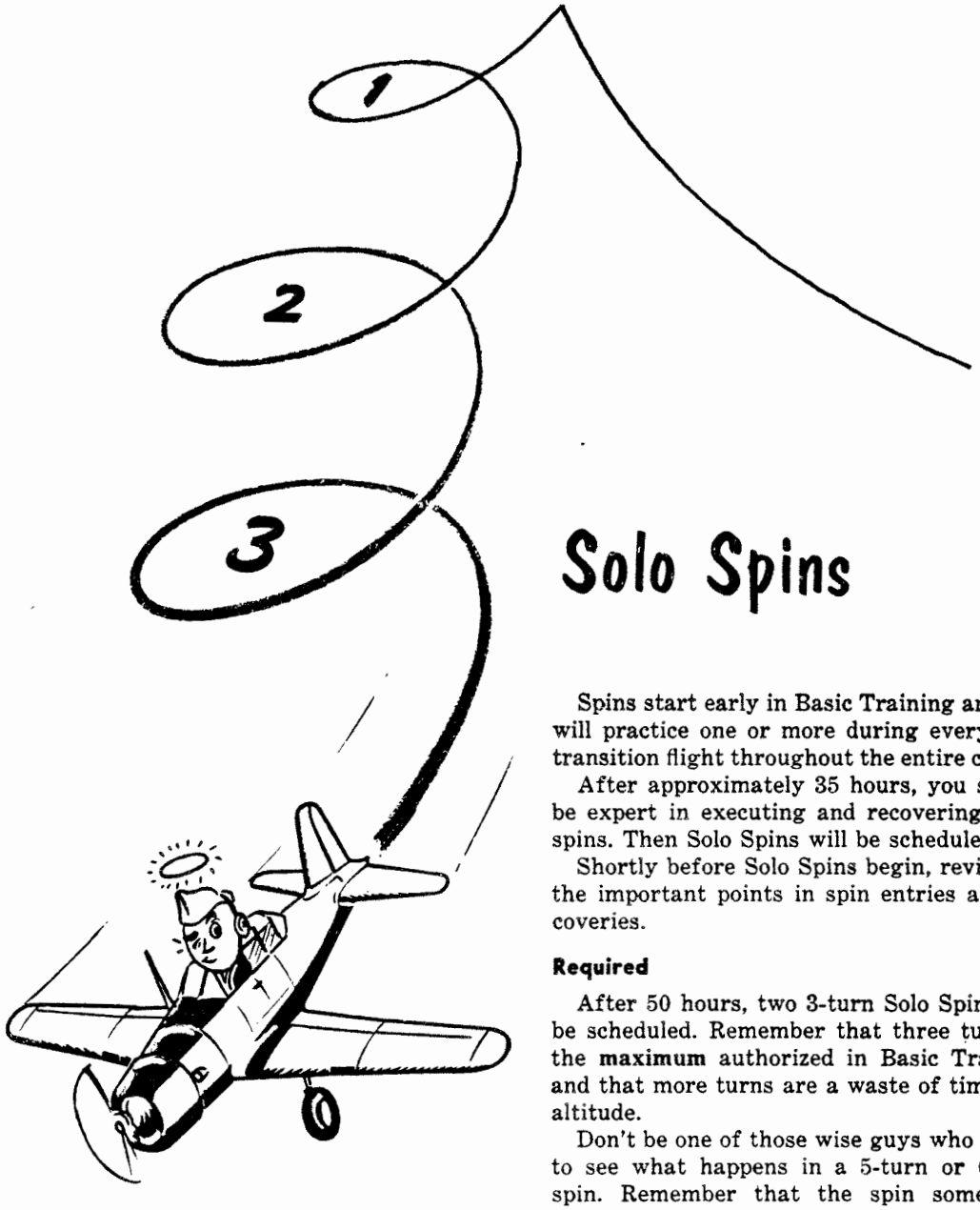
1 Be sure throttle is completely retarded, stick is all the way back and rudder is full with the spin.

2 Briskly apply FULL opposite rudder.

3 After applying opposite rudder, keep the stick ALL THE WAY BACK until you complete one-quarter to one-half turn; then BRISKLY move the stick ALL THE WAY forward.

4 Hold controls in these extreme positions AGAINST THE SPIN UNTIL the spinning stops. Then neutralize rudder and recover from the resulting dive.

*National Advisory Committee on Aeronautics.



Solo Spins

Spins start early in Basic Training and you will practice one or more during every dual transition flight throughout the entire course.

After approximately 35 hours, you should be expert in executing and recovering from spins. Then Solo Spins will be scheduled.

Shortly before Solo Spins begin, review all the important points in spin entries and recoveries.

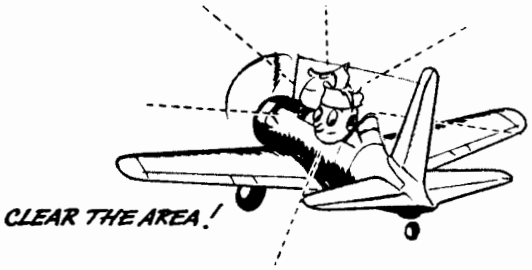
Required

After 50 hours, two 3-turn Solo Spins will be scheduled. Remember that three turns is the **maximum** authorized in Basic Training and that more turns are a waste of time and altitude.

Don't be one of those wise guys who wants to see what happens in a 5-turn or 6-turn spin. Remember that the spin sometimes tightens up after the third turn and that too many turns can make you dangerously dizzy.

KEEP CALM — AND TAKE YOUR TIME!

Acrobatics



Acrobatics in Basic Training consist of Loops, Snap Rolls, Slow Rolls, Half Rolls and Reverse, and Immelmann Turns. Acrobatics are a lot of fun. You get a chance to fly the airplane at higher speeds through intricate patterns. However, they have a very practical purpose—to make you feel at home in the airplane regardless of its attitude.

Acrobatics show you how to orient yourself instantly if the airplane snaps, suddenly flips on its back, or tries some other unexpected antic. But you have to apply yourself to learn all that acrobatics can teach you about flying. Construct a clear mental picture of the maneuver, and try to see and understand more and more each successive time you do it.

Don't get one-sided. Do as many rolls to the right as you do to the left and don't let one or two maneuvers run your life. Practice them all and, if anything, spend extra time on those you don't like or find difficult. Don't cheat yourself out of the varied practice that will give you all-around precision skill.

Maximum Performance

If you use your acrobatic hours to best advantage, they will teach you much about maximum performance that will help you to perfect combat techniques. In dog-fights with the enemy you'll find yourself calling upon the airplane to do all kinds of strange things, and your own knowledge of acrobatics will help you to understand and analyze the enemy's maneuvers.

Stay Smart

Some airplanes can take considerable punishment and some simply aren't built that way. Basic training planes are built for acrobatics and can "take it" up to a given point. You have a good margin of safety if you perform acrobatics as directed in the procedures. But don't be a "slapdamnfool" and try them too close to the ground, at excessive airspeeds, over forbidden areas, or without properly clearing the area. You can run into the ground or tear the wings off any airplane if you try hard enough. Practice acrobatics at the specified time and place.

The Law

Terminate all acrobatics at an altitude of 5,000 ft. above the ground or higher. This is the Law! Try a Slow Roll or an Immelmann over a town some time if you want to get fired out of the Air Forces like a shot.

Loop

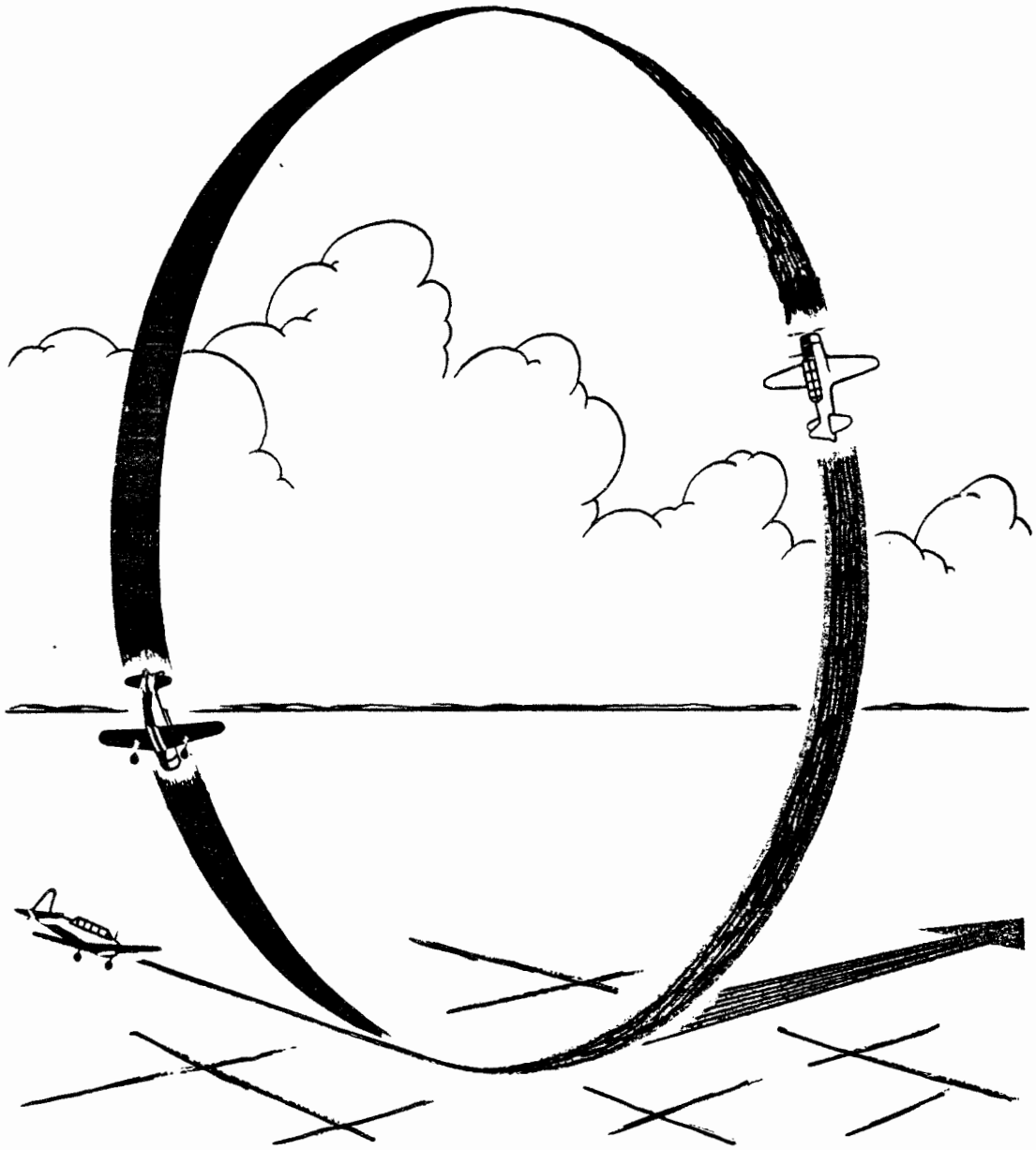
You will catch onto Loops in no time. You may feel a little squashed down in the pull-up the first few times, but so does everyone else. Try leaning forward and pressing down if the pull-up bothers you.

One of the main things is to keep track of where you are all the way around. You will get so you can see more and more, the more you practice. Remember that almost anyone can take an airplane through a Loop—but a military pilot should be able to make a balanced pattern in a vertical plane and come out smack on the reference line.

Auxiliary Controls: In cruising positions, throttle changing.

Procedure

1. Clear the area with exceptional care.
2. Choose a road, section line or fence line —for orientation.
3. From straight and level cruising flight, ease into a fairly steep dive parallel to your reference line and retard the throttle enough to keep from exceeding maximum rpm. When you reach a speed of approximately 165 mph, use considerable back pressure to start the airplane up on the arc of a circle and maintain the arc with steady pressure.
4. As the airplane starts upward, ease the throttle to the full advanced position for maximum power. Keep an eye on the reference line as long as you can see it.



Loop

5. Gradually relax the back pressure as speed decreases or you'll stall before you reach the inverted position at the top of the Loop.

6. As the airplane approaches the inverted position, throw your head back to pick up your reference line again and make corrections in attitude.

7. When the airplane is well started on the downward path, ease the throttle back well below cruising setting to avoid excessive loss of altitude, excessive rpm, and excessive speed.

8. As the airplane reaches the horizon and starts upward again, use full throttle and climb to gain altitude. When you slow down to cruising airspeed, resume level flight and adjust the throttle to cruising rpm.

Suggestions

Smooth, positive back pressure is necessary to start the Loop but violent back stick causes too rapid loss of speed and may cause a stall near the top of the Loop. Judge the amount of back pressure necessary by the resistance of the stick.

If the nose of the airplane moved to the right of the intended flight path in the Loop, you probably either lowered the right wing during the pull-up (tendency to pull the stick toward the right shoulder), or used too much right rudder. If it moved to the left, there was probably insufficient correction for torque.

Common Errors of Student

1. Does not clear the area.
2. Fails to use a reference point.
3. Starts maneuver at wrong airspeed.
4. Does not come straight back with stick.
5. Doesn't relax the stick properly when approaching top of the Loop.
6. Fails to correct for torque.
7. Doesn't adjust the throttle properly.
8. Doesn't throw head back to pick up the reference line.
9. Fails to make corrections in inverted position.
10. Dives too steeply.
11. Misses reference line because of poor orientation.
12. Doesn't regain lost altitude.

Snap Roll

Snap Rolls show you how a particular combination of control pressures will produce sudden "snaps" and how you can recover quickly.

The Snap Roll in Basic Training is a graceful, smoothly controlled maneuver. The entry calls for a smooth, positive buildup of pressure, rather than violent application of full stick and rudder. Likewise, the recovery requires a gradual relaxation of rudder pressure followed by gentle application of opposite rudder, rather than rough, full control movements.

Auxiliary Controls: In cruising positions.

Procedure

1. Clear the area, establish a speed of 115 mph in the BT-13A (for the most satisfactory results), and raise the nose approximately 20° above the horizon in line with a reference point.

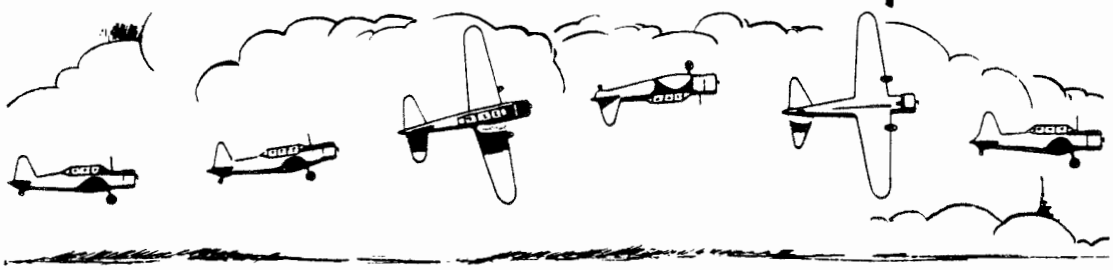
2. Build up positive back stick and rudder pressures simultaneously in the direction of the snap.

3. When these pressures reach a given point, the airplane will suddenly stall and enter the Snap Roll. Don't increase your back pressure after the stall occurs because you want to avoid a violent stall. The more complete the stall, the rougher the entry and the more difficult the recovery.

NOTE:

In entering a Snap Roll to the right, in the BT-13A, there is a tendency for the stick to jerk to the right. Resist this tendency, since the use of ailerons makes the snap more difficult to control.

Snap Roll



4. When about one-half the way around, relax the rudder pressure used to enter the snap and smoothly apply opposite rudder. At approximately three-fourths of the way around, if the timing is correct, the rotation will begin to slow down. Then move the rudder smoothly toward the neutral position.

5. When wings roll out level, hold only sufficient rudder pressure to correct for torque. This is the most difficult part of the maneuver and requires good timing and considerable practice to stop wings in a level position with the nose on the reference point. Throughout the maneuver, hold the stick in approximately the same position fore and aft as when the stall occurred. With the stick in this position, you can recover with the nose of the airplane slightly above the horizon.

Slight variation in rigging causes airplanes of the same type to react differently in Snap Rolls and this requires changes in the use of controls.

Because of torque, more rudder is required to start a snap to the right than to the left and more rudder is required in recovering from a right snap than from a left snap.

Common Errors of Student

1. Fails to look around before starting the maneuver.
2. Enters at wrong speed and holds the nose too high or too low.
3. Moves controls abruptly when entering or stopping the roll.
4. Uses ailerons before the snap occurs.
5. Uses rudder at the wrong time during recovery.
6. Holds too much rudder after recovery.

Slow Rolls

This maneuver is accurately described by its name. It is a slow, complete rotation of the airplane around its longitudinal axis. It gives you practice in analyzing the use of controls in continuously changing and unfamiliar attitudes. Slow Rolls also show you how easy it is to fly upside down when you know how. Throughout most of a Slow Roll you are flying by the "pit of your stomach" instead of the "seat of your pants." You'll find this is great stuff when you get used to it.

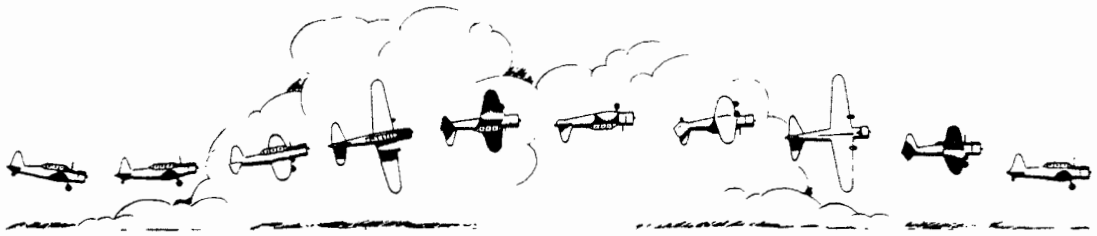
Slow Rolls are a real test of your progress as a pilot. The man who can turn out consistently good Slow Rolls is getting there fast. Use every bit of skill you have and you will rapidly become more proficient.

Auxiliary Controls: In cruising positions.

Procedure

1. Be sure the area is clear and select a small cloud or landmark on the horizon to be used as a reference point.
2. Dive the airplane enough to gain a speed of approximately 140 mph and smoothly apply full throttle as you raise the nose approximately 20° above the horizon in line with the reference point.

Slow Rolls



3. To execute a Slow Roll to the left, use left aileron and left rudder pressure to start the roll.

4. At approximately 45° through the roll, gradually shift from left to right rudder pressure to hold the nose on the point.

5. Use left aileron pressure throughout the maneuver to keep the airplane rolling. At the inverted position, the stick should be well forward and over to the left.

6. Shortly after passing the inverted position, relax right rudder and gradually increase left rudder together with forward stick to hold the nose on the point.

7. As the airplane passes the vertical bank position, gradually move the stick in an arc from forward and left toward a point slightly back of neutral. Time it so the stick reaches neutral just as the airplane rolls out in level flight with the nose on the horizon in line with the reference point.

8. Reduce the throttle to cruising when back in level flight.

9. You will notice as you recover that the airplane is in a slight skid and controls are slightly crossed. This is normal. Neutralize controls slowly so the airplane won't veer.

Note:

In Slow Rolls to the right use exactly opposite movements with extra rudder pressure to counteract torque. Satisfactory Slow Rolls in the Basic Trainer require movements of the controls through a large range. Students with short legs should use cushions and make necessary rudder pedal adjustments before take-off.

Common Errors of Student

1. Fails to look around, to use a reference point, or to gain proper airspeed.
2. Fails to start with nose above the horizon.
3. Doesn't coordinate stick and rudder during roll-in.
4. Fails to use top rudder soon enough after starting roll.
5. Lets nose down when inverted because of insufficient forward stick.
6. Relaxes on aileron pressure, causing roll to slow up or stop. (This is a frequent error during the early part of Slow Roll practice.)
7. Allows the nose to "slice" out while wings are in the vertical position during last half of maneuver. (This is caused by relaxing the forward pressure on the stick and by insufficient top rudder. Even experienced pilots persistently make this mistake.)
8. Does not hold the point.

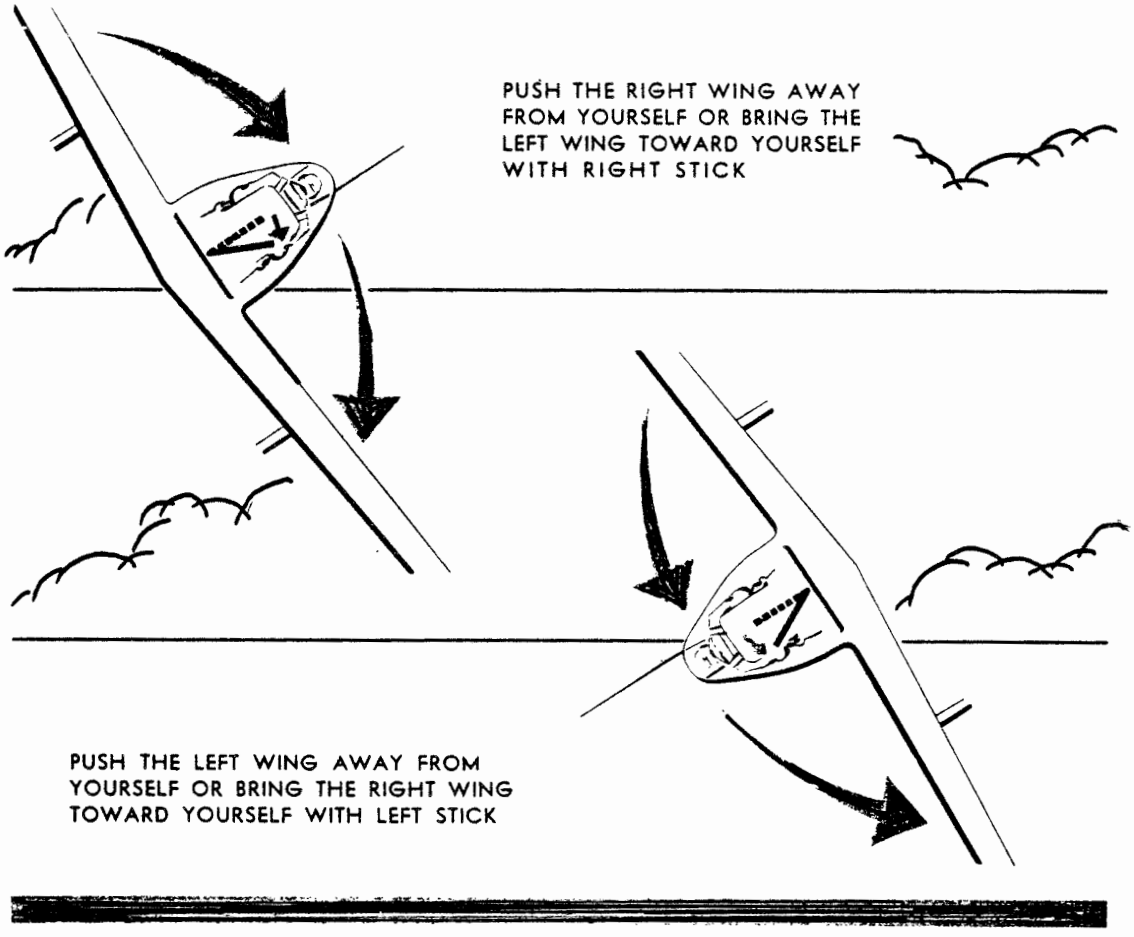
SAFETY BELT FASTENED?

" Use Yourself as the Pivot Point "

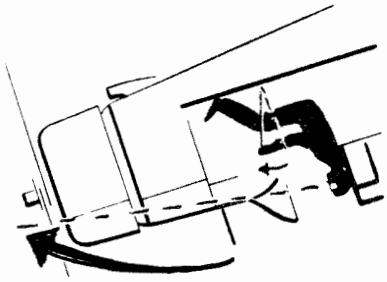
Think hard on this one because it will be a big help to you when you understand it. One of the easiest ways to orient yourself in Slow Rolls (and in other acrobatics) is to use yourself as the pivot point and to remember that control movements in relation to the pilot always remain the same regardless of the attitude of the airplane.

Try this out. Select a cloud or the end of a road on the distant horizon as a reference point. If the reference point is to your right, you will use right rudder to bring the nose back on the point. This is true when the airplane is in level flight, when the wings are vertical, when the airplane is inverted or in any other attitude.

Likewise remember that you can always bring the nose "toward yourself" by back stick pressure and move the nose "away from yourself" by using forward pressure. You can move the left wing "away from yourself" and bring the right wing "toward yourself" with left aileron, and vice versa. By thinking of the problem in this way, and through practice in relating directions to yourself, you can much more easily determine which controls to use when the airplane is in unusual attitudes.

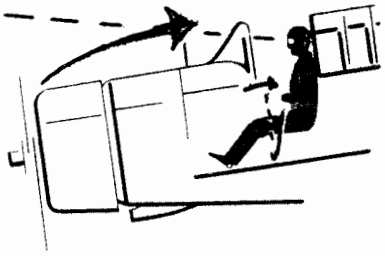


PUSH THE NOSE AWAY FROM
YOURSELF WITH FORWARD STICK

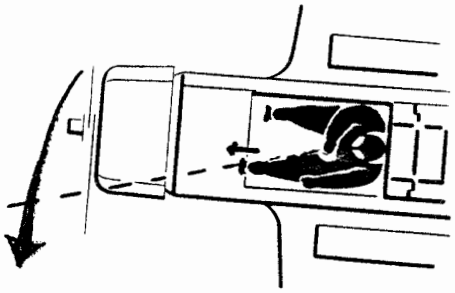


REFERENCE
POINT

BRING THE NOSE
TOWARD YOURSELF
WITH BACK STICK

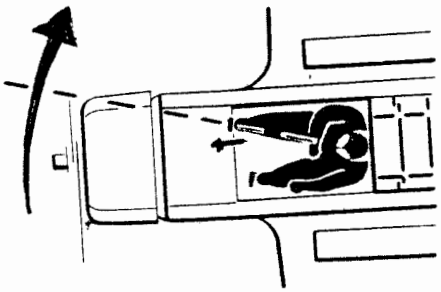


MOVE THE NOSE TO YOUR
LEFT WITH LEFT RUDDER

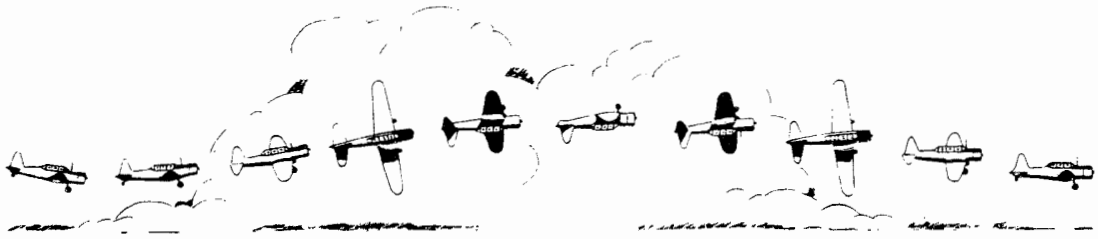


REFERENCE
POINT

MOVE THE NOSE
TO YOUR RIGHT WITH
RIGHT RUDDER



Half Roll and Reverse



This is a difficult maneuver but it is well worth the time and attention of every pilot. Half Rolls teach you how to roll smoothly out of an inverted position back to straight and level flight. It is important for a pilot to know how to do this in case his airplane should be thrown into an upside-down position close to the ground.

This maneuver requires unusually good coordination, precision blending of controls, and careful judgment. The test of proficiency lies in not losing altitude below the lowest point of the entering dive.

Auxiliary Controls: In cruising positions.

Procedure

1. Start the maneuver exactly as you would a slow roll, except you enter it at a speed of approximately 150 mph.
2. Slow roll the airplane onto its back; stop it there momentarily with the nose slightly above the reference point.
3. Then slow roll back to level flight in the direction opposite to the roll-in.

NOTE:

This maneuver is preferred over the "diving" recovery from inverted flight because in a diving recovery the modern, "clean" airplane gains too much speed and loses too much altitude.

Common Errors of Student

1. Holds the airplane on its back for too long a time.
2. Loses excessive altitude.
3. Stalls in the inverted position.

Other errors are the same as in Slow Rolls.

The Immelmann

An Immelmann is a composite maneuver combining the first half of a loop with the last half of a slow roll. Proper execution in the Basic Trainer requires excellent timing, good orientation, and precision coordination of controls from the moment you start the upward arc until you roll out in upright, level position at the top of the loop.

Consistently good Immelmanns require maximum performance of the airplane . . . one of the most important objectives of Basic Training. It takes good flying to do a good Immelmann in the Basic Trainer. When your Immelmanns are consistently smooth, you know you are beginning to master the technique of maximum performance.

Auxiliary Controls: In cruising positions, throttle changing.

Procedure

1. Clear the area thoroughly, line up on a straight road, section line, or other suitable reference line, and ease into a fairly steep dive. As you increase speed, retard throttle so as not to exceed maximum engine rpm.
2. At approximately 180 to 185 mph apply definite back pressure to start the airplane up on the arc of a loop. As the climb begins, smoothly apply full throttle.
3. As speed decreases, relax back pressure on the stick, or the airplane may stall before reaching the top of the loop.

4. As you near the inverted position throw back your head to observe the horizon and to hold a straight flight path.

5. Just as the nose reaches a point approximately 20° above the horizon, execute the last half of a slow roll.

6. For example, to start the roll to the left, apply strong left aileron pressure and simultaneously use a slight amount of right rudder. Then relax right rudder and apply left rudder to hold the nose on the point. Maintain left aileron pressure throughout to keep the airplane rolling.

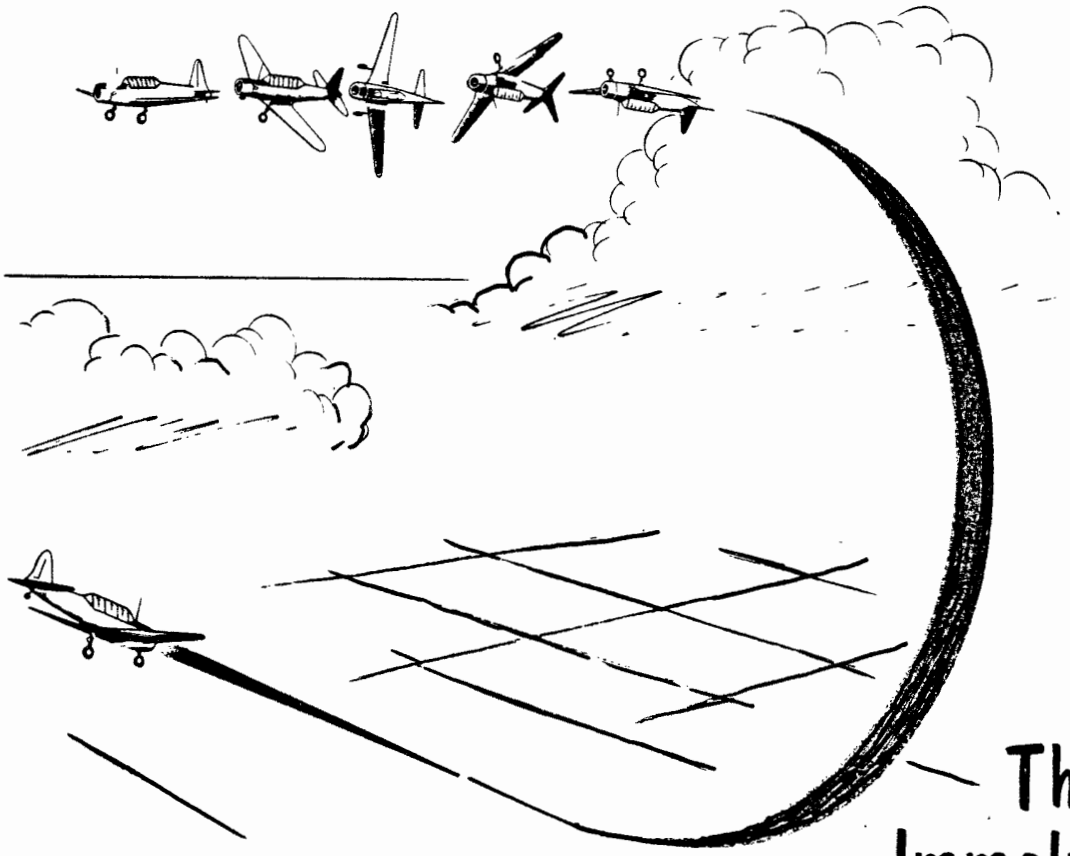
7. Use exactly opposite controls in the roll-out to the right except that you will need much more opposite rudder at the start of the roll.

8. Check your position against the reference line as soon as you complete the maneuver. Properly executed, this roll will bring the airplane back to straight and level flight with 180° of change in heading.

9. As you regain cruising speed, retard the throttle to cruising setting.

Common Errors of Student

1. Fails to clear the area properly.
2. Uses insufficient airspeed.
3. Uses insufficient pull-up at the start of the loop with too large a pattern, and stalls.
4. Fails to relax back pressure as speed decreases.
5. Begins roll with nose too far above or too far below the horizon.
6. Snaps airplane at the top of loop instead of slow rolling out.
7. Uses insufficient aileron pressure and (or) excessive top rudder.
8. Moves controls erratically during recovery.
9. Loses track of flight path . . . poor orientation.
10. Doesn't roll out properly. (Review and practice of slow rolls may be necessary.)



The Immelmann

MANUFACTURER'S RECOMMENDED ENTRY SPEED FOR APPROVED AEROBATIC MANEUVERS

BT-13A

MANEUVER	RECOMMENDED ENTRY SPEED
CHANDELLE	140 MPH
LAZY EIGHT	130 MPH
SPINS	Slow Deceleration
SNAP ROLL	115 MPH
SLOW ROLL	150 MPH
BARREL ROLL	150 MPH
SPLIT "S"	120 MPH
LOOP	165 MPH
CLOVER LEAF	165 MPH
IMMELMANN	180 MPH
CUBAN EIGHT	180 MPH
AVALANCHE	180 MPH

NOTE: All airspeeds listed are **IAS** and are based on the aircraft's typical gross weight in solo flight, or as specified in the Owner's Manual.