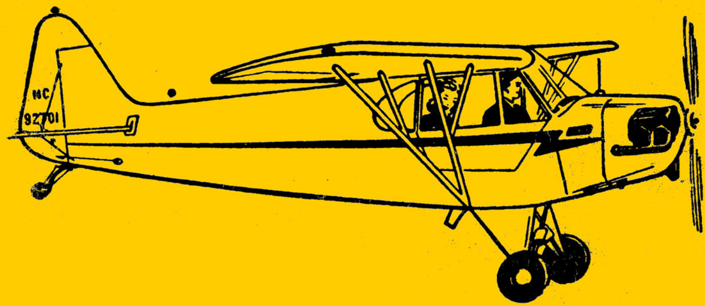
OWNER'S MANUAL



J3C-65

OWNER'S MANUAL

FOR THE

J3C-65

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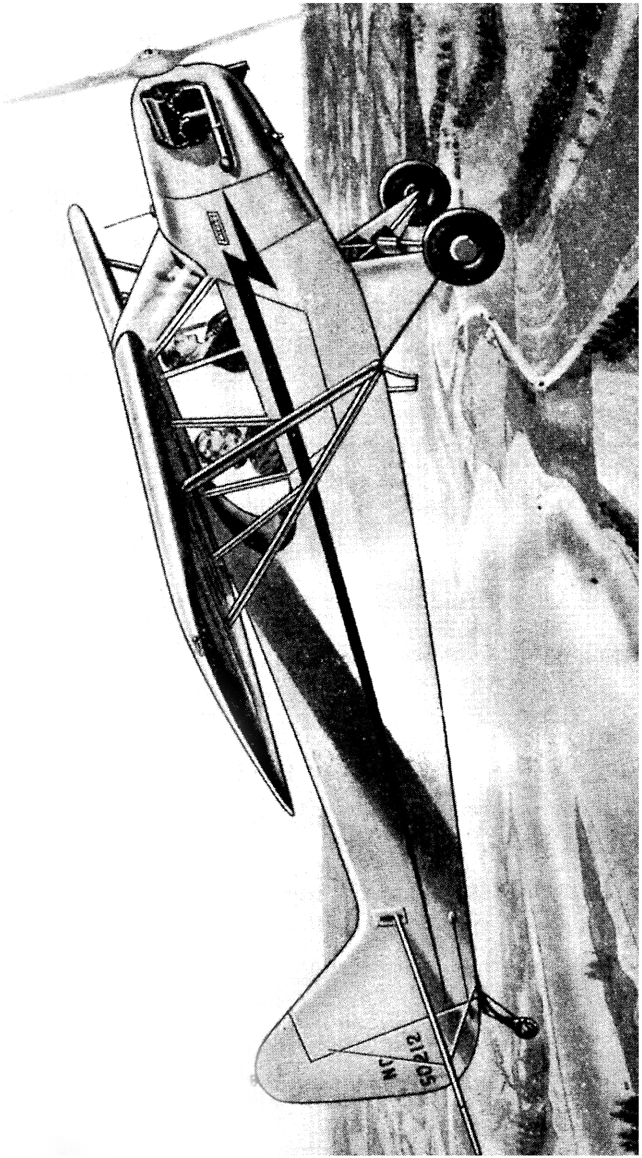


GENERAL DESCRIPTION

TYPE: 2 Place, Tandem, Closed Land or Sea Monoplane.

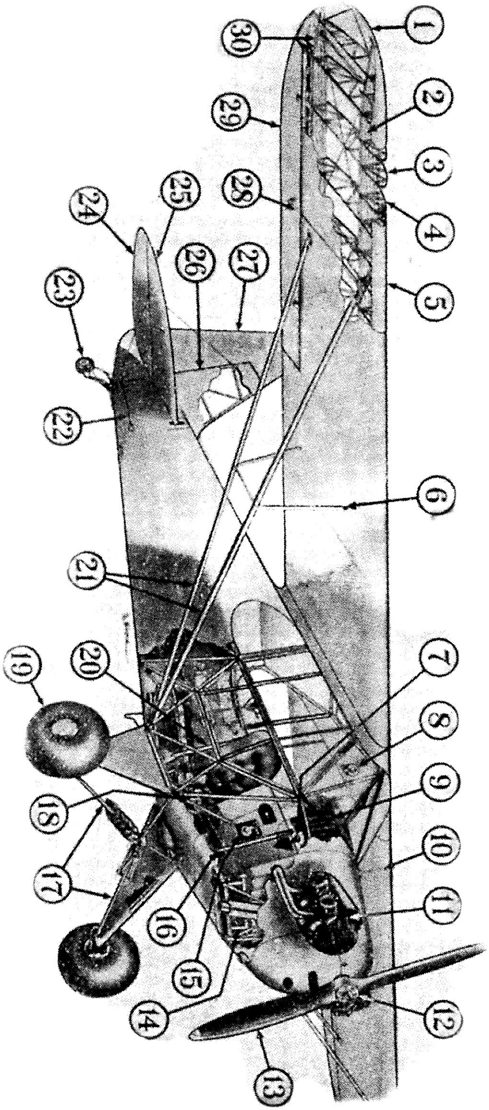
ENGINE INSTALLATION: Single engine in nose of fuselage; Continental A-65-8 dual unshielded ignition engine installed as standard.

WING: Strut braced, two spar, cloth covered, USA 35-B Airfoil.

FUSELAGE: Welded steel tubing cloth covered. Door on right side of cockpit.

CHASSIS: The main gear is the split axle type with rubber cord shock absorbers. 8.00 x 4 low pressure tires and individually controlled hydraulic brakes are installed as standard equipment. A steerable tail wheel with a 2.00 x 6 solid rubber tire is installed as standard equipment. The tailspring structure incorporates 3 formed spring steel leaves.

CONTROL SYSTEMS: Dual control sticks and dual rudder pedals. Cable attachments between control surfaces and cockpit. Dashboard control for cabin heater. Throttle, fuel shut-off, and stabilizer control on left side of cockpit. Ignition switch on left side of ceiling. Carburetor heater control on right side of cockpit.



1. Wing Tip Bow
2. Front Wing Spar
3. Wing Rib
4. Wing Nose Rib
5. Leading Edge Cover
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7. Throttle
8. Ignition Switch
9. Fuel Tank
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12. Propeller Hub
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26. Fin
27. Rudder
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DIMENSIONS

Wing Span—35′ 2½″

Wing Chord—5′ 3″

Wing Area, including Ailerons— 178.5 Sq. Ft.

Wing Incidence (Root)—2°

Overall Length—22′ 4½″ with Engine

Front Seat—
  Width—14″
  Height above Floor—8½″
  Height of back—21″

Rear Seat—
  Width—24″
  Height above Floor—8″
  Height of back—18½″

Seat Back to Control Stick—
  Front—16½″
  Rear—15″

Control Stick Grip Above Floor—
  Front—22″
  Rear—22″

Seat Back to Rudder Pedals—
  Front—34″
  Rear—36″

Width of Luggage Compartment—25″

Breadth of Luggage Compartment—11″

Depth of Luggage Compartment—13″

Baggage Capacity—20 lbs.

Width of Firewall—21⅞″

Depth of Firewall—28⅞″

Width of Instrument Panel—26"

Stabilizer Area (Two Sides)—15.1 Sq. Ft.

Elevator Area (Two Sides)—11.7 Sq. Ft.

Stabilizer Span (Overall)—9' 6"

Fin Area—4.7 Sq. Ft.

Rudder Area—6.55 Sq. Ft.

Rudder Height—4' 5⅞"

Aileron Chord—13¼"

Aileron Span—8' 6⅛"

Aileron Area (Each)—9.6 Sq. Ft.

Wheel Tread—71" (Static)

Tire Size—8.00 x 4

Air Pressure—15 lbs.

Wing Leading Edge to Axle Centerline—2½"

Axle Centerline to Tail Post—15' 7½"

Tail Wheel Size—2.00 x 6

Overall Height—6' 8"

SECTION I

WING

WING: The fabric covered wing incorporates either laminated or solid Sitka spruce wood or extruded aluminum alloy spars. Maintenance on the wood spars includes inspection for loose or worn fittings and checking or peeling of the spar finish. Maintenance on the metal spars includes inspection for loose fittings and prevention or correction of corrosive action. The assembly parts of the metal spar wing are not interchangeable with the assembly parts of a wood spar wing. The fabric cover is made of Intermediate Grade or SAE Specification AMS-3804 fabric. Drain grommets are provided on the under side of the wing at the trailing edge. Check these grommets to see that they are open to allow moisture to drain out.

DRAG BRACING: Drag bracing in the wing is accomplished by means of round or square steel tubular compression struts and high tensile steel drag brace wires. The compression struts and steel drag wire pulls are bolted to the spars. These attachment points should be inspected at regular intervals for looseness and corrosion.

The drag brace wires have 6-40 right hand threads at each end. The drag brace wires should run straight out of the nipple connections. Bent drag brace wires should be replaced. Adjustments to the drag brace wires should be made with extreme care so as to avoid scratching or marking the wires with the wrench or pliers. Do not draw the lock nut too tight as high stresses in the drag brace wires may result. Inspection openings have been provided in the wing fabric to facilitate inspection of the drag brace wires and attachments.

LEADING EDGE: The leading edge of the wing, from the front spar forward, is covered with formed aluminum alloy sheets. These sheets are attached to the metal spar by means of self-tapping sheet metal screws. In the wood spar wing, the leading edge sheets are attached to the ribs by means of self-tapping screws. The leading edge and the aluminum alloy channels under the cover sheets tend to stiffen the structure and provide a contour for the fabric covering. Check the surfaces for corrosion and looseness. Dents should be worked out to provide a smooth surface.

WING TIP BOW: The wing tip bow is a formed ash strip attached to the spars by steel fittings and to the leading and trailing edges of the outboard aileron rib and the wing tip rib by machine screws. "U" channel braces between the wing tip bow and the spars provide additional stiffeners. Pressure should be applied to the wing tip bow only at the spar attachment areas during ground handling.

AILERON FALSE SPAR: The aileron false spar is a formed aluminum alloy channel attached to the trailing edges of the ribs by means of self-tapping sheet metal screws. Check the false spar for corrosion and looseness.

AILERON HINGE BRACKETS: The aileron hinge brackets are fabricated of steel tubes with sheet

metal fittings for attaching to the wing spar and aileron false spar. The attaching rivets and bolts should be regularly inspected for looseness and corrosion. The hinge pin holes in the hinge bracket should be checked at regular intervals, i. e., the 100 hour periodic inspection for elongation. Replace the blocks or bushings when elongation is found. On metal spar wings, each bearing block is beveled on two corners where it fits into the hinge bracket tube. Keep these spaces open to allow drainage of any moisture which may collect in the hinge bracket.

SPAR FITTINGS: The spar strut fittings are fabricated of carbon steel straps. The wing hinge fittings are fabricated of extruded aluminum alloy "H" sections. These fittings are attached to the spar by means of steel bolts. Inspect these fittings for corrosion, evidence of wear, and looseness.

LIFT STRUTS: The lift struts are fabricated of carbon steel streamlined tubing with threaded end fittings for adjustment. The lift struts are attached to the lift strut fittings in the wing and the special fitting on the fuselage at the rear landing gear fitting. Check these attachments for evidence of corrosion, wear, and looseness. Do not push or pull on the lift struts near the middle of the lift strut column. If any pressure is applied on the lift struts, it should be applied close in to the fuselage. Check the jury strut attachments for corrosion or wear. Do not draw the jury strut bolts too tight as excessive tightening may crush the lift strut. Check the lift struts for dents and corrosion. Corroded spots should be cleaned by sanding and repainted.

SECTION II

RIGGING PROCEDURE

RIGGING PROCEDURE: Raise the wheels by lifting and pulling the wings at the lift strut to spar attachment points. Place an adjustable jack under each axle extension. Do not let the jack rest against the brake lines or brake line fittings. Raise the tail to approximate level flight position and place an adjustable jack on a tripod under the tail spring clamp.

LEVELING: Before making any adjustments for rigging, level the airplane as follows:

Laterally: Prepare two wood blocks 2½ inches long by ½ inch square; these blocks must be of equal length. Place these blocks on end on the rear wing butt fittings of the wings and place a 30 inch level across them. Adjust the jacks under the axles to bring the bubble in the level to center.

Longitudinally: Place the 20 inch level along the left longeron in the cockpit between the throttle levers and the windows. Raise or lower the tail to bring the bubble in the level to center.

DIHEDRAL ANGLE: To check the dihedral angle of the wing:

Stretch a string along the top of the wings at the front spar location from wing tip to wing tip. Draw it tight and have a measurement made from the string to the top of the

center section. The proper dimension is 2⅛ inches. Adjusting the front lift strut clevises out will increase the dihedral and the distance between the string and the center section. Adjusting the front lift strut clevises in will decrease the dihedral and the distances between the string and the center section.

To check for equal dihedral in each wing proceed as follows:

Using the 30-inch level (without any spacer blocks) hold it spanwise against the bottom of the wing under the front spar in the space between the jury struts and lift strut attachments. Note the position of the bubble and do the same on the other wing. Re-adjust the front struts until both wings show the same amount off-level, being careful with each adjustment to set the left strut out the same number of turns as the right one is set in, and vice versa.

WASH OUT: To adjust the wash out in the wings (dihedral of the rear spar) proceed as follows:

Set a ⅜ inch spacer block on top of the 30-inch level at one end.

Working on the rib adjacent to the outer end of the aileron, hold the level fore and aft along the bottom of the rib with the spacer block at the rear and the front end of the location of the front spar. The correct wash out will exist when the bubble is centered. Adjust the rear struts in or out to obtain this condition.

TAIL ASSEMBLY: With the airplane in level position the stabilizers should be leveled at their rear spars. The hinge line should be straight from tip to tip. The tail brace wires can be adjusted at the nipples to bring the stabilizers into level. When adjusting the wires, do not mark the wires with pliers or wrenches as this may lead to fatigue failures.

Plumb the fin at the rudder hinges. This is no provision made for adjusting the fin to bring the rudder hinges into line. Moderate pressure on the fin trailing edge in the direction required will accomplish the necessary adjustment.

SECTION III

CHASSIS

CHASSIS: The main gear on the Cub Special Trainer consists of individually sprung wheels on which are mounted low pressure tires.

TIRES: 8.00 x 4. It is important that the tires be kept fully inflated to 15 lbs. per square inch pressure at all times, as operation of the hydraulic brakes when the tires are soft may cause the tires to creep with consequent damage to the valve stem.

It is advisable when installing a tire on a wheel to check to make certain that the beads on the tire are seated on the wheel rim. The tire should then be inflated to about 35 pounds pressure to force the tire beads out onto the taper of the rim. Air should then be let out until the correct pressure of 15 pounds per square inch is reached. This will assist materially in preventing tire "creep."

At the first sign of wear on the tire, reversing the tire on each wheel will equalize wear and give longer tire life.

WHEELS: Cast aluminum wheels with Timken tapered roller bearings are lubricated at the factory and should not require additional lubrication for several hundred hours. When removing wheels, dust and dirt should be kept out of the bearings. When reinstalling wheels or to remove end play of wheel on axle, do not tighten axle nut enough to cause binding of the roller bearings as this will result in excessive wear. The proper procedure in adjusting the axle nut is to tighten nut while rotating wheel until a slight drag is felt, then back nut off one castellation and cotter.

WHEEL BRAKES: A full dual hydraulic system of individual wheel braking is standard. Heel type brake pedals are mounted in the front, one on each side. The front pedals are mounted on a bearing shaft which is located under the floor and pressure on the pedals is transmitted through push rods to hydraulic pressure units which incorporate the rear set of pedals. Each pedal is thus connected to a hydraulic pressure unit for individual control of the wheels for ground maneuvering.

The brake cylinders each incorporate a small reserve of hydraulic fluid. The complete system, brake cylinder, lines, and expansion units in the wheel are completely enclosed necessitating only enough fluid to fill the complete system. It is important that air bubbles do not get in the system during filling or bleeding operations. An evidence of air bubbles in the system is a "fading pedal"—a soft pedal which travels to its limit without the usual solid feeling. Use Univis 40 hydraulic fluid for refilling. Use the following procedure for refilling or bleeding.

Equipment necessary:

1. 1 slot head screw driver.
2. 1 adjustable crescent wrench.
3. 1 No. 50 drill.
4. 1 drill press, drill motor, or hand brace.
5. 1 bleeder tee assembly. (Part 460 770.)
6. 1 10-32 x ½ countersunk Phillips head machine screw.

7. 1 10-32 hex nut.
8. 1 hand pump.
9. 1 pt. Univis No. 40 hydraulic fluid.

Procedure:

1. Remove the compression nut from the bleeder tee assembly (item 5) and remove the rubber and steel washers.

2. Drill a No. 50 hole from the bottom of the Phillips recess through the screw shank to the end of the machine screw (items 3, 4, 6).

3. Place the screw with the head inside in the compression nut. Put the nut (item 7) on the screw and draw it tight. Reassemble the bleeder tee assembly.

4. Remove the slotted screw from the bleeder tee valve on the airplane between the brake line and the wheel. Use screw driver (item 1).

5. Attach the reworked bleeder tee (3 above) to bleeder tee valve. Attach this assembly to the hand pump (item 8). Remove pump plunger and put hydraulic fluid in pump barrel (item 9). Replace plunger.

6. Open bleeder tee valve with crescent wrench (item 2). Apply pressure to pump until system is full of hydraulic fluid. Hold pressure on pump and close bleeder tee valve.

7. Open hex cap screw on top of hydraulic pressure unit ½ turn.

8. Press front brake pedal in about 1 inch and hold it while the capscrew is tightened. This will give a free wheel when the brake is

off and allow sufficient brake when the pedal is in.

9. Remove excess fluid from floorboard which was forced out of hydraulic pressure unit by the pedal action.

10. Remove pump assembly from bleeder tee valve and replace the slot head screw after the brake has been checked for proper operation. Check all connections to see if they are tight.

11. Do not let any fluid get on the brake-lining or on the fabric of the airplane. Do not apply pressure to the brakes at any time when the wheels are removed.

12. A rountine inspection of the brake system for leakage is advisable.

LANDING GEAR FITTINGS: All hinge fittings should be lubricated regularly with engine oil and a check for wear or looseness should be made. As the hinge fittings are bushed with steel inserts, these may be replaced to remove play. Bolts should also be inspected for wear and replacement should take place at the first signs of wear. End play should be removed by the insertion of washers of correct thickness.

TAIL WHEEL: A steerable tail wheel with a 2.00 x 6 solid tire wheel is standard equipment.

SECTION IV

FUSELAGE

FUSELAGE FRAME: The fuselage frame is constructed of steel tubing welded at the joints to form a rigid, braced, truss-type structure. A number of highly stressed members are of chrome-molybdenum steel; all other members are of 1025 steel.

If it becomes necessary to replace any fuselage members, sleeve type splices should be made in accordance with practices outlined in Civil Aeronautics Manual 18. Use only aircraft grade of tubing as specified on Piper Aircraft drawings.

After replacing members, clean scale from the welded joints and apply an effective protective coating, such as zinc chromate primer or Roxalyn Paladin Primer No. 12412, to prevent corrosion. Use Roxaprene Corrosion Resistant Finish No. 1-C-202491 on all the metal frame members if the airplane is to be used in highly corrosive atmospheres such as is found along the sea coast.

If the fuselage has been "Metallized" for corrosion proofing, remove all of the "Metallized" coating from the area which is to be welded. This is necessary as a satisfactory weld cannot be made over a surface which is covered by the "Metallizing." This cleaning is best accomplished by painting a strong solution of sodium hydroxide (caustic soda) over the area to be welded. Apply sufficient amounts of this solution to clean off all traces of the aluminum "Metallizing" and then rinse thoroughly with water.

NOTE: Accumulations of dirt in the cockpit and in the crevices between the fuselage tubes and the fabric covering should be removed occasionally as moisture will be absorbed by the dirt with the possibility of corrosion or fabric rot. A regular inspection of the lower longerons near the tailpost should be made to guard against corrosion.

ENGINE MOUNT: The engine mount is similar to the fuselage in construction. An occasional check of the bolts attaching the mount to the fuselage should be made to see that these bolts and also the engine attaching bolts are snug. Do not draw these bolts too tight as a failure in one of the bolts may result. It should be remembered that terrific loads can be put on a bolt by overtightening. Cracked engine mounts should be replaced with a new mount since repairs are generally not satisfactory.

In handling the plane on the ground, care should be taken to prevent the application of loads at points other than fuselage clusters as bowed or kinked members may result. Wood fairing strips are used to give the fuselage its form and these may be damaged by rough handling.

SECTION V

CONTROL SURFACES

AILERON: The aileron structure is of aluminum alloy with fabric covering. A formed aluminum alloy channel runs the length of the aileron and serves as a main spar to which is attached the nose former ribs, nose cover sheet, trailing edge, ribs, hinges, and horn fittings. Soft aluminum rivets are used to attach the component parts to the spar. When it becomes necessary to recover the aileron, it is advisable to check all riveted joints for looseness. The security of the hinges and control attachment should be determined. Lubricate hinges occasionally with light engine oil and check for cotter pins in hinge pins.

VERTICAL FIN: The vertical fin has a steel tube leading edge and rear post. The ribs are of carbon steel channel. A short stub of steel tube is welded to the lower end of the leading edge spar and fits into a tubular socket in the fuselage. AN bolts fasten these parts together. During periodic inspections these bolts should be checked for tightness and proper safety.

RUDDER: The rudder has a steel tube leading edge and trailing edge and channel steel ribs. No maintenance other than an inspection for corrosion during overhaul is necessary. Drain grommets in the rudder fabric cover should be kept open. The hinges attaching the rudder to the tailpost and fin rear spar should be lubricated with light engine oil. Accumulations of dust and dirt on hinges should be removed.

STABILIZERS: The stabilizers have a steel frame consisting of steel tubular leading and trailing edges and channel steel ribs. The leading edge has a tubular steel liner joining the two sides of the stabilizer through the stabilizer link tube. The link tube is attached to the stabilizer yoke which incorporates a screw mechanism. A pulley on the lower end of the screw is turned by means of an endless cable from a crank on the left side of the cockpit. By means of this mechanism the incidence of the stabilizer may be adjusted over a range of several degrees.

A tubular steel liner joins the two sides of the stabilizer at the trailing edge and this liner passes through a short tube installed in the fuselage. An occasional check should be made to see that the bolts attaching the leading and trailing edges to the liners are drawn snug and that cotter pins are in place.

Steel tie rods brace the stabilizers to the fin and fuselage. These tie rods should not be rigged tighter than necessary as high loads may be imposed on other parts of the tail surfaces or fuselage. It should be remembered that even with the tie rods rigged "flabby," they will be tensed by a very slight deflection of the surfaces and thus will do their work as well as if they were rigged very tightly. In adjusting the tension of the tie rods, care should be taken so that marring of the rods will not result. Friction tape should be wrapped around the rods near the threads. Pliers may then be used to grip the wires but be certain to grip on the tape. The nipple may then be turned with a wrench after the lock nuts have been loosened. The threads at each end of the rod must be visible through the end of the nipple.

A line inspection of the tie rod end fittings should be made to check cotter pins and lock nuts. See that drain grommets on the under surfaces permit free drainage of any moisture which may accumulate.

ELEVATORS: The elevator structure is very similar to the rudder. No maintenance other than inspection for corrosion is needed. The hinges attaching the elevators to the stabilizer should be cleaned and lubricated with light engine oil at frequent intervals. Keep the drain grommets open for free drainage of the accumulated moisture.

A final word of caution in regard to proper care of the tail surface bracing. Do not use the tail tie rods for purposes of lifting or handling the airplane. See that this rule is strictly enforced.

SECTION VI

CONTROL SYSTEM

ELEVATORS: The fore and aft motion of the control sticks is transmitted back through the fuselage to the elevators by means of the following linkage: The sticks are mounted on a torque tube which passes beneath the front seat above the floor board. The lower ends of the sticks are connected to a push-pull tube which passes through the torque tube and imparts action to a bellcrank located behind the rear seat. Two 1/8 inch 7 x 19 flexible steel cables are attached to this bellcrank and are connected at the rear to the elevator horns by means of turnbuckles.

An occasional lubrication of the elevator bellcrank located behind the rear seat will reduce control system friction and prolong bearing life. See that all turnbuckles are free to rotate on the horns.

AILERONS: The lateral motion of the control sticks rotates the torque tube, to the rear end of which is attached a torque tube aileron arm. Control cables are attached to this arm and pass over phenolic pulleys at the edge of the floor, up the rear edge of the front lift struts through the wings to the upper aileron horns. Where the cables enter the wings, as well as at turns within the wings, they pass over phenolic pulleys. A balance cable connecting the lower aileron horn in each wing passes along the rear of the front spar. Lubricate all moving parts in the aileron control system regularly with light engine oil to

reduce friction. Inspect all cables for wear at pulleys and fairleads.

If it becomes necessary to rig the ailerons, the following method should be employed:

1. Locate control sticks at midpoint of lateral travel.
2. Line up trailing edge of aileron with the inboard wing trailing edge.
3. If the aileron is too high, open the turnbuckle on the cable attached to the upper aileron horn and then draw up turnbuckle on cable attached to lower aileron horn the same amount.

   If the aileron is too low, the above turnbuckle adjustments are reversed. Not more than two threads are to be visible at either end of the turnbuckle barrel.
4. Check to see that there is no play or looseness in the action of the ailerons when the control stick is moved.
5. Safety all turnbuckles and nuts. Use 1 strand of .040 brass wire to safety the turnbuckles. It may be necessary to check through the rigging several times in order to get the proper positioning of all parts.

RUDDER: The rudder control system is fairly simple and very little maintenance is necessary. Inspect control cables at the fairleads under the seat, and those at the rear of the fuselage near the tail where the cables pass through the fuselage cover. See that rudder pedal return springs are operating to hold the pedals forward. Check the turnbuckles for proper adjustment and safety. Check the tail wheel connector cords or springs to see that they are in good condition.

STABILIZERS: The forward or backward motion of the crank on the left side of the cockpit is transmitted to the stabilizer adjustment screw by means of an endless, flexible steel, 1/16 inch 7 x 7 stranded cable. The cable passes around a "V" groove pulley attached to the crank, then back through the fuselage to another "V" groove pulley on the lower end of the stabilizer adjusting screw. Turning the crank forward or backward rotates the screw which in turn raises or lowers a stabilizer yoke attached to the front of the stabilizer. This alters the angle of stabilizer incidence which compensates for "nose heavy" or "tail heavy" conditions.

Under no circumstances should the stranded cable from the cockpit to the rear of the fuselage be lubricated as this may cause slippage. If it becomes necessary to increase the tension on this cable, an idler pulley adjustment is located at the tail near the front of the stabilizer and is accessible by removal of the inspection plate on the left side of the fuselage. Do not tighen this adjustment excessively as binding of the driving mechanism may result.

The stabilizer indicator is operated by a fine steel wire passing back from the control crank in the cockpit, over a composition pulley in the tail of the fuselage, to the stabilizer yoke. If any adjustments are made to the stabilizer indicator system, check to assure correct functioning of the stabilizer.

A return spring on the stabilizer indicator mechanism is located above the stabilizer adjustment crank and is accessible by removal of the indicator face plate.

SECTION VII

FUEL SYSTEM

FUEL TANK: The fuel tank is located in the fuselage just behind the firewall, and has a capacity of twelve gallons (U. S.). This fuel tank is supported by flat steel straps lined with felt to prevent chafing. If it becomes necessary to remove the fuel tank, drain fuel, disconnect fuel line and shutoff valve control wire. Remove filler cap and all lines and controls which run under the tank to the instrument panel. Then remove the diagonal fuselage tube running from the upper right longeron to the center of the fuselage cross tube at the floor behind the firewall. This is easily done by removing the bolt in each end of the tube, sliding the tube upward until it clears the lower fitting, and then sliding it downward outside the lower fitting. The tank may then be removed from the cockpit without removing the cowling.

PRIMER: A primer to assist in starting the engine is mounted on the instrument panel. A fuel line runs from the fuel strainer up to the primer pump and a return line runs back to the engine. Always see that the primer plunger seats firmly as irregular operation of the engine may result from a leaking needle valve in the primer pump. It is recommended that the primer be used sparingly; raw gas washes the oil film off the cylinder walls with subsequent excessive wear resulting.

CARBURETOR HEATER: A carburetor heater is installed on the engine and is controlled by a push-pull control on the right side of the cockpit below the door. The pilot can regulate the temperature of the air entering the carburetor by adjusting this control. For most economical and efficient operation, set the heat control to provide just enough heat to result in smooth operation of the engine. Excess heat merely reduces power. It is always advisable to set heat control to "Full On" position during long glides such as an approach for a landing as this will tend to keep the engine warm and reduce the possibility of the engine failing to accelerate when the throttle is opened suddenly. When icing conditions are prevalent it is recommended that heat be applied "Full On" to prevent ice formation. Preventative measures are easier than corrective measures.

Extreme care should be taken in hot weather to see that no carburetor heat is used otherwise overheating of the engine may result.

The points of the fuel system which require regular servicing are:

1. Fuel Strainer.
2. Drain in fuel tank.
3. Strainer in fuel tank.

FUEL STRAINER: The fuel strainer is located in the engine compartment and should be inspected daily for accumulations of water or sediment. It is a good habit to remove bowl and screen from the fuel strainer at least every ten hours and clean both and flush the lines by allowing fuel to flow through with bowl removed.

Always safety nut under bowl after servicing.

TANK DRAIN: A drain is located at the rear of the gasoline tank and is accessible from the cockpit. Remove the drain plug at frequent intervals to allow water and sediment to drain from the tank.

TANK STRAINER: A finger strainer is incorporated in the fuel tank outlet fitting to which the fuel line attaches. This finger strainer is intended to prevent large particles of foreign matter entering the fuel lines. The finger strainer should be removed and cleaned every 100 hours by removing the fuel line and all fittings from the bottom of the tank.

SECTION VIII

ELECTRICAL SYSTEM

ELECTRICAL SYSTEM: An electrical system is not standard equipment on a Cub Special Trainer. The ignition switch support panel incorporates several punched holes for mounting the navigation light switch, etc.

IGNITION SYSTEM: The ignition system for the engine is composed of two magnetos which are connected to the switch on the left side of the ceiling.

The wires connecting the switch to the magnetos pass through a rubber grommet protected opening in the firewall. The wires are covered with a formed aluminum alloy channel where they follow the left front fuselage member from the instrument panel to the top of the windshield.

SECTION IX

LINE INSPECTION

1. Engine mount and attachment.
2. Manifolds securely attached.
3. Fuel strainer (flush).
4. Propeller.
5. Cockpit controls operate freely and move surfaces without excessive play.
6. All bolts, nuts, and cotters in lift struts and jury struts.
7. Hinge pins safetied in aileron hinges.
8. Hinge pins in tail surfaces and brace wires and fittings in good order.
9. Main landing gear bolts safetied.
10. Tires properly inflated.
11. All covering in good condition.

20 HOUR INSPECTION

1. All items under "Line Inspection."
2. Remove drain plug in bottom of gas tank with tail on ground to drain off water.
3. Inspect elevator and rudder controls for corrosion.
4. Lubricate all moving parts of control system and landing gear. (Do not oil or grease stabilizer drive cable from cockpit to tail.)

   Note: Wipe excessive oil as this will collect dirt forming an abrasive which is injurious to bearings.

5. Check brake action.
6. Remove exhaust stack or muffler shrouds and inspect complete exhaust manifold system for excessive scaling, cracks or leaks. If damaged, replace with new exhaust system.
7. Check all engine controls and piping.
8. Clean oil and dirt from engine compartment.
9. Check tail wheel fittings for excessive play or damage. Lubricate spindle. Check end play in spindle shaft.
10. Remove inspection cover at tailpost and inspect elevator cable terminals at horn and stabilizer screw mechanism.
11. Remove and clean and re-oil carburetor air filter.

100 HOUR PERIODIC INSPECTION

The 100 hour periodic inspection should include all pertinent items of CAA Form 319 and must be accomplished by owners of airplanes operated for hire at the expiration of each such period. Pertinent items of CAA Form 319 must be accomplished by private owners (those who do not operate their airplanes for hire) at the time of their annual inspection prior to relicensing. However, in the interest of continued safety, it is recommended that private owners accomplish the inspection at more frequent intervals than that set up as required.

FLYING HINTS

The Piper Cub Special represents more than 15 years of diligent aircraft engineering and manufacturing experience. Its simplicity of design and construction, its low operating and maintenance costs, its inherent stability, ruggedness, and its outstanding safety and ease of flying, have made it the most popular airplane in aviation history. The Piper Cub Special is the time-tested product of millions of hours of flying under all conceivable conditions both in the military and in peace time.

There are hints on starting, flying, stopping, and other related topics that are important to the owner who wants to conserve his airplane —keep it in maximum airworthy condition— and enjoy a full measure of flying satisfaction.

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First, each pilot should become familiar enough with his Piper Cub Special that he can accomplish a satisfactory pre-flight inspection. This check is simple and requires only a few minutes. See Section IX for check list. Daily check of airplane prior to flight should be the first in a number of safe flying habits the pilot should acquire.

A. BEFORE STARTING ENGINE

(1) Make routine check of gasoline supply. Visible fuel gauge is integral part of gas tank cap; it will not show number of gallons but will show proportion of fuel in tank by length of rod which extends upward from cap. A full tank of 12 U. S. gallons will be indicated

by 11 inches of rod extending beyond cap. Keep gas gauge rod clean and smooth with crocus cloth for accuracy and freedom of movement.

(2) Check oil level in engine sump by removing oil cap and gauge. Oil stick should indicate oil level up to index mark of 4 quarts.

(3) Check freedom of movement of flight and engine controls.

B. STARTING ENGINE

(1) Chock wheels, or have occupant who is familiar with controls set brakes in cabin.

(2) Ignition switch OFF. Verify.

(3) Set throttle approximately 1/10 open.

(4) Push fuel shut-off ON.

(5) Turn propeller through several times.

(6) Turn ignition switch ON.

(7) Start engine by pulling propeller through with a snap.

CAUTION — Always handle propeller as if switch were "ON." Stand as far in front of propeller as possible. Use both hands and grasp one blade approximately midway from tip. Do not overgrasp blade. Do not wear long, loose clothing. Make sure footing is sure to preclude possibility of feet slipping.

(8) If engine does not start, turn switch OFF. Turn primer knob to unlock, pull

out, pump three or four times, then reseat primer and lock by turning in opposite direction. In extremely cold weather a few strokes of the primer as the engine starts will enable it to keep running. NOTE—Avoid excessive priming as it causes raw gasoline to wash lubricating oil from engine cylinder walls. Do not prime warm engine.

(9) Repeat starting procedures 6, 7.

(10) If engine loads up and refuses to start, turn ignition switch "OFF," open throttle wide and turn propeller through backwards several times to unload excessive gas mixture in cylinders. Then close throttle and repeat starting procedure.

C. ENGINE WARM-UP

(1) As soon as engine starts, advance throttle slightly to idle at 700 R.P.M. Check engine instruments. If oil pressure gauge does not indicate pressure within 30 seconds, stop engine immediately, check and correct trouble before any further operation. Oil temperature during operating should not rise above 220° F. and oil pressure should not fall below 30 pounds. With engine warm, idling speed should be 550-600 R.P.M.

(2) Rev engine up to 2100 R.P.M. on both magnetos. Switch to LEFT and RIGHT magnetos. R.P.M. drop should not be over 75 R.P.M. CAUTION—Do not operate engine on either single magneto for more than 30 seconds at a time, as this tends to foul the non-operating spark plugs in the ignition circuit of the magneto that is switched off.

D. STOPPING ENGINE

(1) Never cut switch immediately after landing as this causes engine to cool too rapidly.

(2) Idle engine, especially in high temperature operating conditions, for several minutes. It is advisable to switch to each magneto for 30 second intervals to allow gradual cooling of engine. This helps to prevent overheating of spark plug insulators and will lessen tendency for "after-firing."

(3) Check for carburetor heat OFF during idling.

E. TAXIING

(1) Open throttle to start airplane in motion; then close throttle to a setting sufficient to keep airplane rolling. Do not keep throttle advanced so that it is necessary to control taxi speed of airplane with brakes. This causes unnecessary wear and tear on brakes and tires.

(2) Taxi slowly (speed of a fast walk) controlling direction with rudder which is connected to a steerable tail wheel. Use brakes only for positive, precision ground control when necessary.

(3) Taxi upwind with stick back; downwind with stick forward. When ground winds are in excess of 15 M.P.H., turn into wind using ailerons in direction of turn; apply ailerons away from the turn when turning downwind. This procedure helps to prevent the wind "picking up" a wing during windy, gusty conditions. Always make ground turns slowly.

F. GENERAL FLYING

(1) For takeoff use full throttle, headed into wind. Airplane loaded will become airborne at approximately 39 M.P.H. Best climb speed is at an indicated 55 M.P.H.

(2) Indicated R.P.M. for cruising speed of 73 M.P.H. is 2150. Take-off R.P.M. is 2300. Do not fly at full throttle over 3 minutes.

(3) Use CARBURETOR AIR HEAT when engine runs "rough" and tachometer shows drop in R.P.M. which may be due to ice forming in carburetor. Tachometer should recover to within 50 R.P.M. below normal when using carburetor heat. Push heater to "OFF" position, and if icing condition has been cleared, R.P.M. should return to normal. Continued use of carburetor heat will only cause increased fuel consumption and loss of power.

(4) Maximum permissable diving speed is 122 M.P.H.

G. APPROACH AND LANDING

(1) Push carburetor heat ON prior to throttling back for glide, or for any other flight maneuver.

(2) Glide between 50-60 M.P.H. depending upon loading of airplane and gust conditions.

NOTE—"Clear" engine by opening throttle gently, every 200-250 feet of descent during a long glide so that engine temperature will be maintained.

Throttle action on the part of the pilot should be smooth and gentle at all times.

H. PARKING AND MOORING

(1) After termination of flight, enter flying time in aircraft and engine log books.

(2) Turn ignition and fuel OFF.

(3) Chock the wheels of airplane.

(4) If airplane is not to be flown for some time, it should be hangared or tied down. Use good quality ½″ - ⅝″ diameter rope. Secure to lift assist handle at aft end of fuselage; also at upper end of both front wing lift struts where they attach to wing. Make sure that rope passes between aileron cable and lift strut. Mooring ropes, when airplane is tied down, should have no slack.

(5) Lock aileron and elevator controls by wrapping front seat belt completely around rear control stick, tighten and buckle.

(6) Under excessively windy conditions, airplane should be tailed into wind for mooring.

LOAD FACTORS

INFORMATION FOR PILOTS

It is necessary that every effort be made to determine in advance the worst loads likely to be put on an airplane during its lifetime. Any pilot can make a very hard landing or an extremely abrupt pull-up from a dive resulting in loads that might be called abnormal. For that matter, he might even fly the airplane into a brick wall. These abnormal loads must be ignored entirely if we are to build airplanes that will take off quickly, land slowly, and carry a good payload. We must decide that the airplane will sustain certain loads and that the pilots are aware of the fact that abnormal loads are not provided for in the design of the airplane. These requirements must be carefully calculated so as to produce efficient as well as safe airplanes. An efficient airplane must be light while a safe airplane must be strong. Extra strength means extra weight which means reduced payloads. An airplane, unlike a bridge or building, cannot afford to have any excess structural weight beyond that which is essential for safety.

In level flight, the net result of all air pressure acting on the wing is an upward load just about equal to the entire weight of the airplane (it would be exactly equal if there were no airloads acting on the fuselage or tail surfaces). Instead of giving this value in pounds, the term load factor is used. The load factor is simply the ratio between the total airload on the wing and the design gross weight of the airplane. Thus, when the wing is producing a "lift" equal to twice the weight of the airplane, the load factor is 2. In the case of the Piper Special Trainer, the design wing load factor is 6.15.

This means that the airplane is designed to take a flight load 6.15 times the weight of the airplane. Loads greater than this will cause the structures to break. The maximum safe load factor for occasional application of loads is 4.1; loads greater than this may cause permanent deformation of structural members.

Now to consider how such load factors might be obtained in actual flight, and what they mean to the pilot. Let us assume that the load factor of 3 is the maximum we will achieve; this gives us a slight margin of safety. A pilot flying level pulls back on the stick thus increasing the angle of attack of the wing and producing additional wing lift which causes the airplane to accelerate upward and follow a curved flight path. The acceleration depends on the amount of lift of the wing. Since the wing is lifting 3 times the design gross weight of the airplane in this accelerated flight condition, it is the same as saying the wing is loaded to a load factor of 3. We could just as well think of this load factor as representing the centripetal force required to keep the airplane in this curved path. If you tie a heavy object to a string and swing it in an arc, you will notice a stronger pull on the string than when the object was at rest. This is due to centrifugal forces acting on the object—forces which tend to pull the object away from the center of the circle and keeps it moving in a straight line. You have increased the pull on the string to overcome these forces thus creating the centripetal forces noted above—forces which tend to push the object toward the center of the circle and produce a curved path of travel. In our case, the airplane is the object and the pull on the string is replaced by the lift of the wing.

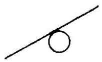
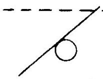
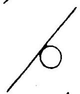
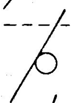
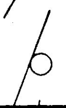
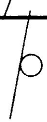
Thus, we can see that whenever the airplane

is in a curved flight path an excess load factor is imposed on the wings. The airplane has one load factor in level flight and extra load factors are added to produce the curved flight path. When an airplane is in a dive, the load factor is approaching zero because the wings are not lifting the airplane. An abrupt pull-up after a dive will "load up" the wings with a factor of 3 or even more very quickly. During a steep turn, it is necessary to add extra load factors on the wing in order to produce a centripetal force to overcome the centrifugal forces tending to produce straight and level flight. This load must be great enough to overcome the pull of gravity as well as the centrifugal force.

The load factors required to hold a given bank without slipping or skidding are given in the following table. A slip is produced when you bank too steeply for the amount of rudder applied. The extra lift produced centripetal force by the excess bank tends to push the airplane toward the inside of the turn. A skid is produced when you do not bank steeply enough for the amount of rudder applied. The centrifugal forces, in this case, are tending to pull the airplanes to the outside of the turn.

From the table on the next page, it can be seen that a 70 degree bank is within the assumed load factor limit of 3. This degree of bank is usually considered a "vertical" bank in small commercial airplanes. Note how much the load factor has increased from 70 degrees to 80 degrees. It is very important that the angle of bank be held below 70 degrees in order to avoid the possibility of exceeding a safe load factor.

An abrupt pull-up at high speed is very likely to cause structural failure. No matter how strong an airplane has been designed there is

Angle of Wings to Horizontal	Example	Load Factor Required
0 degrees		1
(Gentle Bank) 10 degrees		1.01
20 degrees		1.06
30 degrees		1.15
40 degrees		1.31
(Medium Bank) 50 degrees		1.56
60 degrees		2.0
(Steep Bank) 70 degrees		2.92
80 degrees		5.75

a speed above which it is possible to break the wings. Some military airplanes are so strong that the pilot "blacks out" before he can put enough load on the wings or reach a speed which would break the wings. Practically all cases of structural failures in flight are caused by too abrupt pull-ups at high speed. As a rough approximation, we can say that the max-

imum safe speed for abrupt pull-ups is about twice the design gross weight stalling speed. To be safe it is advisable to confine such maneuvering to speeds lower than this.

A wing will stall if a high load is imposed on it at a relatively low speed. The stalling speed usually referred to in specifications is the stalling speed in level flight conditions. The stalling speed increases as the load factor increases; the increase in stalling speed is proportional to the square root of the load factor. Thus, if we raise the load factor from 1 to 4, the stalling speed is doubled. If a steep bank is attempted at insufficient speed, the wing will stall before the necessary speed can be developed to overcome the imposed load.

The following table shows the minimum speeds necessary to safely execute banked turns based on the 38 mph stalling speed of the Piper Special Trainer:

Angle of Wings to Horizontal	% Increase in Normal Stalling Speed	Actual Stalling Speed
0 degrees	0	38.0 mph
10 degrees	.5	38.2 mph
20 degrees	3.0	39.2 mph
30 degrees	7.0	40.7 mph
40 degrees	14.4	43.5 mph
50 degrees	25.0	47.5 mph
60 degrees	41.4	53.7 mph
70 degrees	71.0	65.0 mph
80 degrees	240.0	91.2 mph

From the above table it will be seen that, because of the extra load factor added to the wings in order to make a proper banked turn, the speed must be increased to keep from stalling out in the banked turn.

As a final word, in the small commercial airplane, a pilot can withstand more than the airplane; therefore, it is suggested that the pilot should not depend entirely on his feeling for proper maneuvering. Let the statistics be a basis upon which he builds his safe flying habits. In rough weather let the rule be—*The rougher the weather the slower the airplane should be flown.* Gusts place excessive loads on the airplane structures. Because of this, it is good practice to reduce the maneuvering loads to a minimum so that, with the additional momentary gust loading, the airplane will not be loaded beyond a safe point.

EVERYDAY CARE OF YOUR AIRPLANE

Thousands of hours of dependable flying have been built into your Piper Cub Special. How many hours? That depends upon you. As the owner and pilot, your responsibility is to give your airplane the everyday attention and care it deserves—in addition to the routine major inspections. You want to help maintain the original efficiency and dependability of your airplane. Avail yourself of the manufacturer's suggestions contained in these pages.

"BREAKING IN."—Although no extra care is necessary in the first twenty-five hours or so, it is wise to keep your engine throttled back to cruising R.P.M. (2150) or less as much as possible. Engine "warm-up" to oil temperature of 90° F. gradually increasing throttle from 800 to 1200 R.P.M. is recommended. Do not overheat engine with prolonged running on ground at high R.P.M.

GASOLINE AND OIL — Gasoline used should be minimum of 73 octane; aviation grade is preferrable.

Oil of aviation grade will give best results. Following grades are recommended:

VISCOSITY	*OUTSIDE AIR TEMPERATURE*
SAE No. 20	Below 32° F
SAE No. 30	32° to 70° F
SAE No. 40	70° to 100° F

APPEARANCE—Your airplane should be washed frequently especially when operated under muddy conditions. Cleanliness is most important item of care of airplane fabric. Sponging frequently with warm water and alkali-free soap will remove dirt and grease without injury to fabric. Rinse with sponge or low pressure stream of water, as high pressure water stream will injure fabric and will force water into plane's interior, causing damage.

Auto wax of good quality occasionally applied, will help preserve the finish and prevent deterioration.

Windshield and Windows — Your airplane has a one-piece formed windshield and windows made of clear Plexiglas. This transparent material is not as hard as glass and tends to scratch readily unless care is taken. Windows should be washed with mild soap and cool water, using the bare hand rather than a cloth, since it picks up grit which will scratch surface. Surface scratches may be filled in by applying a thin coat of clear wax to entire surface and polishing with a soft dry cloth.

GENERAL—Keep drain grommets open in under surface of wings and control surfaces as this will allow accumulated moisture to escape and prevent fabric damage.

Repair small holes, tears and cracks in fabric and finish to prevent further injury.

Check Parker-Kalon sheet metal screws in wing fairings and other points for security. These are a self-tapping sheet metal screw and if kept tight will not vibrate loose and enlarge hole. If screws are lost, replace with next larger size. Dipping in shellac will help prevent screws from loosening.

Inspect tail wheel springs for security to fuselage. If any looseness is noted, tighten castellated nut until snug, and resafety with cotter key.

Check tail wheel for condition and security. Lubricate weekly with wheel bearing grease; if operating under extremely muddy or dusty conditions, lubricate daily.

Inspect rubber cowl support washers for condition. When properly fitted, these prevent engine cowl from vibrating and causing cracks in metal.

Cowl opening plate is to be used to close cowl opening only when outside air temperature is 40° F. or below. Use of this plate during winter weather increases engine efficiency by raising engine operating temperature.

GENERAL HANDLING — Common sense rules apply in handling the airplane on the ground. Do not push your airplane by wing trailing edge or tail brace wires. A wing can be lifted by pushing up on wing lift struts at junction of wing; also by pulling down on wing tip at point of the front and rear spar.

Lift struts should not be used as entrance steps, nor should any lift or pushing force be exerted along the middle of the struts.

Stabilizers are not to be used for lifting tail of airplane. Use lift assist handle at aft end of fuselage.

Landing gear shock struts should not be used as a step since this causes bowing and results in excessive wear or malfunctioning of landing gear. The shock struts should be disassembled at 250 hours and lubricated with a high temperature grease.

Propeller should be left in horizonal position when airplane is moored outdoors for long periods of time, especially in rainy climate. The wood blades absorb moisture causing unbalance and propeller roughness which is especially evident when propeller is left in vertical position. This is due to lower blade collecting more moisture and causing an unbalanced condition.

In an excessively dry climate, propeller may loosen due to slight shrinkage of wood. Check and tighten hub bolts, particularly on a new propeller.

Whenever possible, airplane should be hangared or sheltered since direct rays of strong sunlight hasten deterioration of finish. Windows or upper enclosure door should be left open to dissipate excessive heat which may cause some warpage of windows.

TEN COMMANDMENTS

For Safe Flying

1. THOU SHALT NOT BECOME AIRBORNE WITHOUT CHECKING THY FUEL SUPPLY: It only takes a few minutes to gas up . . . it may save you a forced landing.

2. THOU SHALT NOT TAXI WITH CARELESSNESS: Taxi slowly and make S turns to clear the area in front of the nose. Know the proper use of the controls for taxiing in a strong wind.

3. THOU SHALT EVER TAKE HEED UNTO AIR TRAFFIC RULES: Keep a constant lookout for other aircraft. Follow the rules so that pilots of other planes will know what you are going to do.

4. THOU SHALT NOT MAKE FLAT TURNS: This is particularly important when making power-off turns. You steer with the ailerons, not the rudder.

5. THOU SHALT MAINTAIN THY SPEED LEST THE EARTH ARISE AND SMITE THEE: Don't be fooled by the increase in ground speed resulting from a downwind turn. Keep sufficient airspeed.

6. THOU SHALT NOT LET THY CONFIDENCE EXCEED THY ABILITY: Don't attempt instrument flying in adverse weather conditions unless you have the proper training and the necessary instruments. Instrument flying is a highly developed science. Don't pioneer.

7. THOU SHALT MAKE USE OF THY CARBURETOR HEATER: The carburetor heater is your friend. Know when to use it. Remember that it's easier to *prevent* ice in the carburetor than to eliminate it after it has formed.

8. THOU SHALT NOT PERFORM AEROBATICS AT LOW ALTITUDES: Aerobatics started near the ground may be completed six feet under the ground. There's safety in altitude.

9. THOU SHALT NOT ALLOW INDECISION IN THY JUDGMENT: Be certain! You can't afford to make errors of judgment. "I think I can make it" is on the list of famous last words.

10. THOU SHALT KNOW ALWAYS—THE GOOD PILOT IS THE SAFE PILOT: It's better to be an old pilot than a bold pilot.