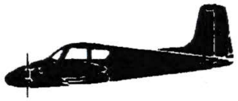

"LOOK FOR THE RED AND BLUE CESSNA PENNANTS FOR THAT EXTRA SERVICE WHERE IT COUNTS WHEN YOU NEED IT."

CESSNA AIRCRAFT COMPANY • WICHITA, KANSAS

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310B

1957-1958

OWNERS MANUAL

Congratulations . . .

■ YOU are now the owner of a truly outstanding airplane. The Cessna 310B has been engineered to give you the ultimate in performance, flying comfort, and economy for business or pleasure.

■ We share your pride as a Cessna owner and have prepared this Owner's Manual as a guide to acquaint you with your airplane and its equipment, operating procedures, and maintenance requirements.

■ Every fine possession is worth caring for, and this is especially true of your Cessna 310B. This book is dedicated to help you get the utmost flying enjoyment and service from your airplane with a minimum of upkeep.

P139A-13—RAND—200—8/73

WARRANTY

■ The Cessna Aircraft Company warrants each new airplane, manufactured by it, to be free from defects in material and workmanship under normal use and service, provided, however, that this warranty is limited to making good at the Cessna Aircraft Company's factory any part or parts thereof which shall, within ninety (90) days after delivery of such airplane to the original purchaser, be returned to the Company with transportation charges prepaid, and which upon Company examination shall disclose to the Company satisfaction to have been thus defective; this warranty being expressly in lieu of all other warranties expressed or implied and all other obligations or liabilities on the part of the Company, and the Company neither assumes nor authorizes any other person to assume for it any other liability in connection with the sale of its airplanes.

■ This warranty shall not apply to any airplane which shall have been repaired or altered outside the Company's factory in any way so as, in its judgment, to affect its stability or reliability, nor which has been subject to misuse, negligence or accident.

(Page numbers followed by * denote illustrations.)

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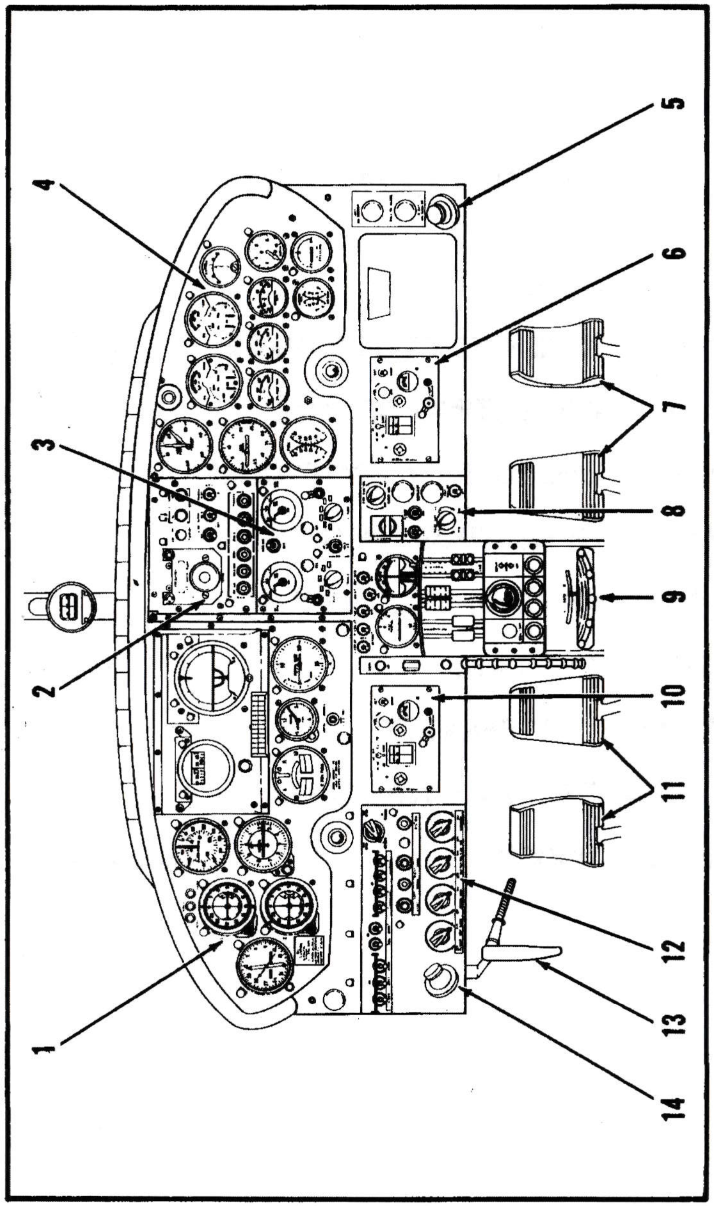


1. Flight Instrument Grouping
2. VHF Communication Control and Switch Panel (Optional Equipment)
3. VHF Navigation Control Panel (Optional Equipment)
4. Engine Instrument Grouping
5. Air Vent
6. Radio Compass (ADF) Control Panel (Optional Equipment)
7. Copilot's Rudder Pedals
8. Right Switch and Control Panel
9. Engine Control Pedestal
10. Radio Compass (ADF) Control Panel (Optional Equipment)
11. Pilot's Rudder Pedals
12. Left Switch and Control Panel
13. Parking Brake Handle
14. Air Vent

Figure 1-1. Front Cabin View

(Page numbers followed by * denote illustrations.)

(Page numbers followed by * denote illustrations.)

SECTION 1

DESCRIPTION

ONE OF THE FIRST STEPS in obtaining the utmost performance, service, and flying enjoyment from your airplane is to familiarize yourself with your airplane's equipment, systems, and controls. You will want to inspect the airplane thoroughly, noting the location of all equipment and its function. The purpose of this section is to aid in this initial familiarization.

ENGINES.

Two horizontally-opposed, six-cylinder, Continental engines, rated at 240 horsepower at 2600 RPM, power your Cessna 310B. The engines utilize wet sump oil systems, dual-magneto ignition systems, pressure-type carburetion, and jet-augmenter exhaust systems.

ENGINE COOLING (See figure 1-2).

Engine cooling air is admitted at the front of the engine cowling and directed around the cylinders to jet-augmenter tubes. The high velocity exhaust gases are released into the jet-augmenter tubes thereby causing a pumping action which pulls cooling air around the cylinders and through all parts of the engine compartment. In this cooling system an increase in power causes a corresponding increase in "pumping action", which in conjunction with the forward speed of the airplane, increases the flow of cooling air throughout the engine compartment. This design feature eliminates the need for cowl flaps.

ENGINE CONTROL PEDESTAL (See figure 1-1).

The engine control pedestal is centrally located forward of the front seats, and contains the throttles, mixture levers, and propeller pitch levers. A knurled friction knob is provided on the right side of the pedestal and can be rotated to control friction pressure on the control levers to prevent creeping.

The pedestal also houses the carburetor alternate air knobs, and the aileron, elevator, and rudder trim tab control wheels. Provisions are made

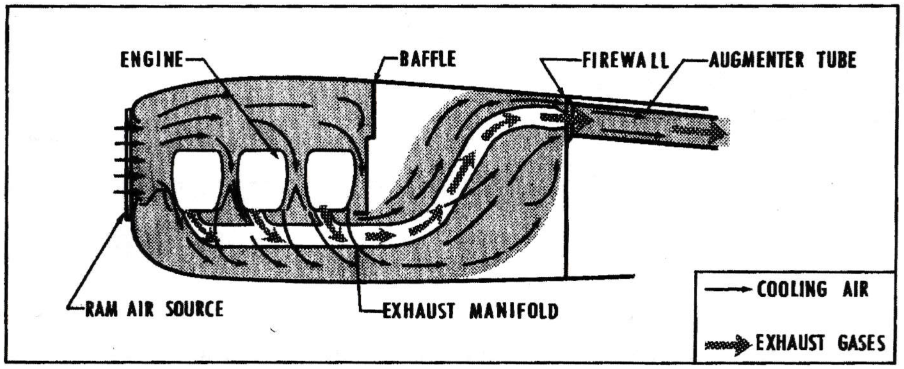


Figure 1–2. Engine Cooling System

on the face of the pedestal for the installation of an automatic pilot control head.

MIXTURE LEVERS.

The mixture levers are located on the engine control pedestal, and are the two levers nearest the right front seat. These levers are distinguished by their sharp-pointed, round knobs. The extreme forward position of the mixture levers is marked FR (full rich), and the extreme aft position is marked ICO (idle cut-off). Manual leaning is accomplished by placing the levers between the FR and ICO positions. Refer to Section II for the procedure to be used during mixture leaning. Numbered index marks are provided between the levers to facilitate mixture lever settings.

CARBURETOR ALTERNATE AIR KNOBS

The carburetor alternate air knobs are located on the engine control pedestal between the aileron and rudder trim tab control wheels. When the knobs are pushed in, cold filtered air is supplied to the carburetor, and when pulled out, heated air is supplied. The knobs may be locked when set in either position by rotating them clockwise.

NOTE

The carburetor alternate air knobs should be pushed full in or pulled full out when selecting carburetor air. Do not use intermediate positions.

Through the use of the carburetor alternate air knobs, cold or heated air may be selected as required to prevent carburetor icing and to assure smooth engine operation.

IGNITION SWITCHES.

Four ignition switches are provided on the left switch and control panel just above the two red-ringed starter buttons. The switches have a bar mounted above them which allows them to be turned off simultaneously. The switches may also be

ALPHABETICAL INDEX

(Page numbers followed by * denote illustrations.)

CRUISE & RANGE PERFORMANCE WITH LEAN MIXTURE AT 15,000 ft

RPM	MP	%BHP	TAS	Gal/Hr	Endurance 100 Gal	Range 100 Gal	Endurance 130 Gal	Range 130 Gal
2450	16	50	190	22.1	4.5	861	5.9	1120
	15	47	181	20.0	5.0	903	6.5	1174
	14	43	169	18.3	5.5	926	7.1	1204
	13	38	155	17.0	5.9	911	7.6	1184
2300	16	47	181	20.0	5.0	903	6.5	1174
	15	43	171	18.4	5.4	929	7.1	1208
	14	39	158	17.2	5.8	917	7.5	1192
	13	35	139	16.2	6.2	857	8.0	1115
2200	16	43	172	18.6	5.4	926	7.0	1203
	15	40	161	17.4	5.7	924	7.5	1201
	14	36	145	16.5	6.1	879	7.9	1142
2100	16	40	163	17.6	5.7	929	7.4	1207
	15	37	150	16.7	6.0	898	7.8	1168

CRUISE PERFORMANCE IS BASED ON STANDARD CONDITIONS, ZERO WIND, LEAN MIXTURE, 100 AND 130 GALLONS OF FUEL, NO RESERVE, AND 4700 POUNDS GROSS WEIGHT.

Shaded Areas Represent Maximum Range Settings

CRUISE & RANGE PERFORMANCE WITH LEAN MIXTURE AT 20,000 ft

RPM	MP	%BHP	TAS	Gal/Hr	Endurance 100 Gal	Range 100 Gal	Endurance 130 Gal	Range 130 Gal
2450	13.5	43	177	20.9	4.8	847	6.2	1101
	13	41	170	20.2	5.0	842	6.4	1095
2300	13.5	40	162	19.6	5.1	827	6.6	1074

CRUISE PERFORMANCE IS BASED ON STANDARD CONDITIONS, ZERO WIND, LEAN MIXTURE, 100 AND 130 GALLONS OF FUEL, NO FUEL RESERVE, AND 4700 POUNDS GROSS WEIGHT.

Figure 7-6. Cruise and Range — Lean Mixture

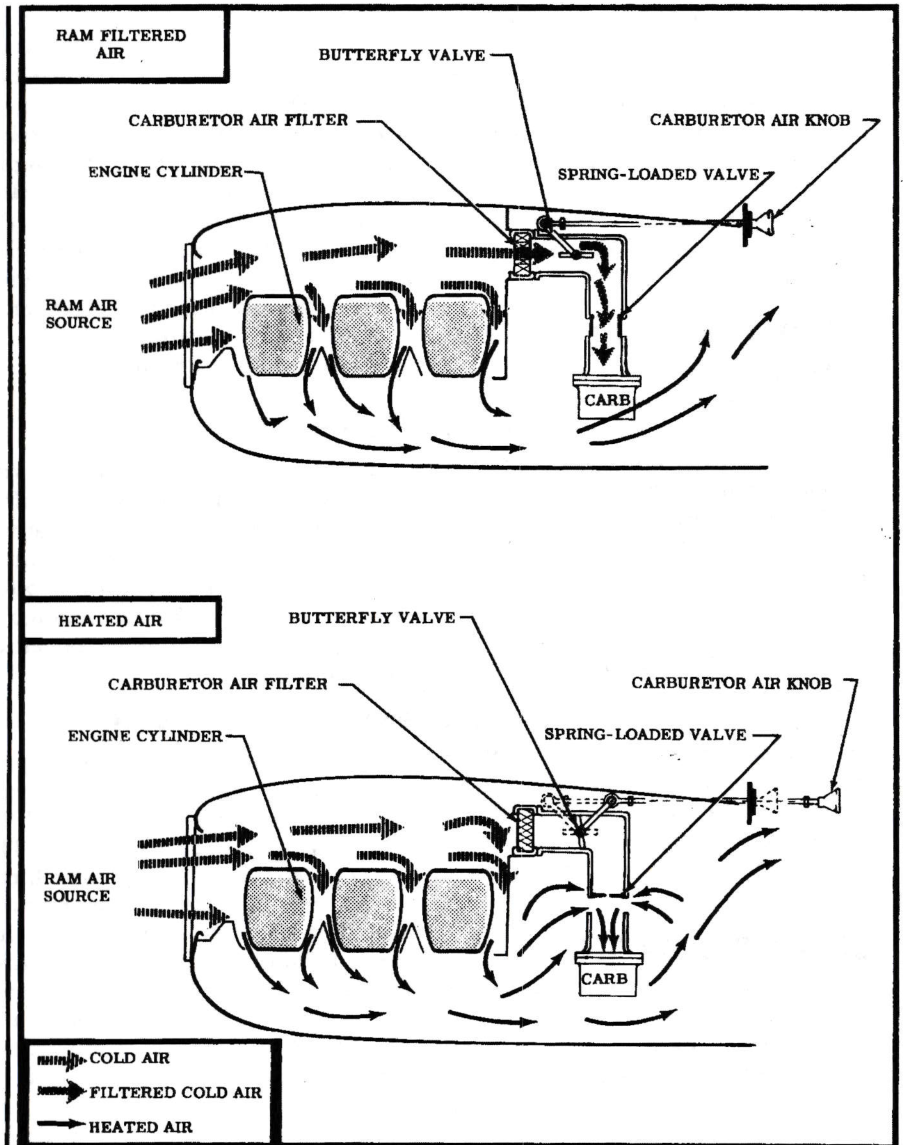


Figure 1-3. Carburetor Air Induction System

turned off individually. The switches control the dual-magneto ignition system on each engine. All switches should be ON (up position) for normal engine operation. The left and right switches for each engine are provided for checking purposes only. All switches should be OFF (down position) when the engines are not operating.

ENGINE PRIMER SWITCH.

An engine primer switch is provided on the left switch and control panel between the red-ringed starter buttons for use during cold weather operation only. When held to the left (L-PRIME), it primes the left engine, or to the right (PRIME-R), it primes the right engine. When the switch is released, it automatically springs back to its off position. The primer switch activates a solenoid valve which allows fuel to flow from the fuel pressure line into primer lines. Fuel is directed through these lines to priming jets located in the cylinder intake chambers. The fuel boost pumps for the engine being started must be turned ON at all times during primer operation.

STARTER BUTTONS.

Two push-button starter switches are provided on the left switch and control panel. Each switch is ringed with a red cup to prevent it from being pushed accidentally. When either starter button is pressed, a solenoid electrically connects the starter of that engine to the bus bar. Electrical power for energizing the starter may be supplied by the aircraft battery or an external power source. When starting the engines, the left engine should be started first. The electrical cable from the batteries to this engine is shorter and will permit more electrical power to be delivered to the starter. In the event of low batteries, the left engine should start more readily; then the left engine generator will supply additional power for starting the right engine.

PROPELLERS.

Your Cessna 310B is equipped with all metal, two-bladed, hydraulically-operated, constant speed, full feathering propellers. Propeller operation is controlled by the propeller pitch lever through a mechanical linkage to the engine-driven propeller governor on each engine.

PROPELLER PITCH LEVERS.

Two propeller pitch levers are provided on the engine control pedestal. These levers are distinguished by their rectangular grooved knobs. The range of control through which the levers may be adjusted is marked INCREASE (full forward) for increase RPM or low pitch, DECREASE (full aft to just forward of the detent) for decrease RPM or high pitch, and FEATHER (full aft behind the detent) for feathering of the propellers. During normal operation the levers may be set to any position between INCREASE and DECREASE for any desired RPM. Refer to Section IV for

CRUISE & RANGE PERFORMANCE WITH LEAN MIXTURE AT 7,500 ft

RPM	MP	%BHP	TAS	Gal/Hr	Endurance 100 Gal	Range 100 Gal	Endurance 130 Gal	Range 130 Gal
2450	22	70	211	24.9	4.0	847	5.2	1101
	21	66	206	23.8	4.2	866	5.5	1126
	20	62	200	22.5	4.4	887	5.8	1154
	19	58	197	21.3	4.7	927	6.1	1205
2300	22	65	204	23.3	4.3	877	5.6	1141
	21	61	198	22.1	4.5	896	5.9	1163
	20	57	192	21.0	4.8	914	6.2	1189
	19	53	186	20.0	5.0	928	6.5	1206
2200	22	61	196	21.7	4.6	915	6.0	1189
	21	57	192	21.0	4.8	914	6.2	1169
	20	53	185	20.0	5.0	927	6.5	1205
	19	50	180	19.0	5.3	946	6.8	1230
2100	21	53	185	20.0	5.0	927	6.5	1205
	20	50	180	19.1	5.2	943	6.8	1226
	19	47	173	18.1	5.5	956	7.2	1241
	18	43	166	17.3	5.8	960	7.5	1248
	17	40	157	16.5	6.1	953	7.9	1239

CRUISE PERFORMANCE IS BASED ON STANDARD CONDITIONS, ZERO WIND, LEAN MIXTURE, 100 AND 130 GALLONS OF FUEL, NO RESERVE, AND 4700 POUNDS GROSS WEIGHT.

Shaded Areas Represent Maximum Range Settings

CRUISE & RANGE PERFORMANCE WITH LEAN MIXTURE AT 10,000 ft

RPM	MP	%BHP	TAS	Gal/Hr	Endurance 100 Gal	Range 100 Gal	Endurance 130 Gal	Range 130 Gal
2450	20	64	207	23.1	4.3	898	5.6	1167
	19	60	200	21.7	4.6	920	6.0	1197
	18	56	194	20.7	4.8	939	6.3	1220
	17	52	186	19.5	5.1	953	6.7	1240
2300	20	59	199	21.5	4.6	925	6.0	1202
	19	55	192	20.5	4.9	938	6.4	1220
	18	51	185	19.4	5.2	954	6.7	1240
	17	48	178	18.4	5.4	970	7.1	1261
2200	20	55	192	20.5	4.9	938	6.4	1220
	19	51	185	19.4	5.1	952	6.7	1238
	18	48	179	18.6	5.4	961	7.0	1249
	17	45	171	17.6	5.7	971	7.4	1262
2100	20	51	185	19.4	5.1	952	6.7	1238
	19	48	179	18.6	5.4	961	7.0	1249
	18	45	172	17.7	5.6	971	7.3	1263
	17	42	164	16.9	5.9	973	7.7	1265
	16	38	153	16.0	6.3	957	8.1	1245

CRUISE PERFORMANCE IS BASED ON STANDARD CONDITIONS, ZERO WIND, LEAN MIXTURE, 100 AND 130 GALLONS OF FUEL, NO RESERVE, AND 4700 POUNDS GROSS WEIGHT.

Figure 7-5. Cruise and Range — Lean Mixture

CRUISE & RANGE PERFORMANCE WITH LEAN MIXTURE AT 2,500 ft

RPM	MP	%BHP	TAS	Gal/Hr	Endurance 100 Gal	Range 100 Gal	Endurance 130 Gal	Range 130 Gal
2450	24	75	209	26.5	3.8	789	4.9	1026
	23	70	204	25.1	4.0	814	5.2	1058
	22	67	199	23.9	4.2	831	5.4	1080
	21	63	193	22.7	4.4	852	5.7	1108
2300	24	69	202	24.5	4.1	824	5.3	1071
	23	65	197	23.4	4.2	842	5.6	1094
	22	61	191	21.8	4.6	876	6.0	1139
	21	58	186	21.2	4.7	879	6.2	1143
2200	23	61	191	22.1	4.5	863	5.9	1121
	22	58	186	21.2	4.7	879	6.1	1143
	21	54	180	20.1	5.0	896	6.5	1165
	20	50	174	19.0	5.3	914	6.8	1189
2100	22	53	179	20.0	5.0	897	6.5	1166
	21	50	174	19.0	5.3	914	6.8	1189
	20	47	168	18.3	5.5	920	7.1	1196
	19	44	162	17.4	5.8	932	7.5	1211
	18	40	155	16.6	6.0	935	7.8	1215
	17	37	147	15.8	6.3	928	8.2	1206

CRUISE PERFORMANCE IS BASED ON STANDARD CONDITIONS, ZERO WIND, LEAN MIXTURE, 100 AND 130 GALLONS OF FUEL, NO RESERVE, AND 4700 POUNDS GROSS WEIGHT.

Shaded Areas Represent Maximum Range Settings

CRUISE & RANGE PERFORMANCE WITH LEAN MIXTURE AT 5,000 ft

RPM	MP	%BHP	TAS	Gal/Hr	Endurance 100 Gal	Range 100 Gal	Endurance 130 Gal	Range 130 Gal
2450	24	76	215	27.1	3.7	794	4.8	1032
	23	73	210	25.8	3.9	816	5.0	1060
	22	68	205	24.4	4.1	839	5.3	1091
	21	64	199	23.1	4.3	860	5.6	1118
2300	24	71	208	25.2	4.0	825	5.2	1073
	23	67	206	23.9	4.2	862	5.4	1121
	22	63	201	22.8	4.4	882	5.7	1146
	21	59	195	21.2	4.7	920	6.1	1196
2200	23	63	200	22.7	4.4	883	5.7	1148
	22	59	191	21.6	4.6	887	6.0	1152
	21	55	185	20.6	4.9	900	6.3	1170
	20	52	179	19.5	5.1	918	6.7	1193
2100	22	55	185	20.5	4.9	904	6.4	1175
	21	52	179	19.5	5.1	918	6.7	1193
	20	49	173	18.7	5.3	924	6.9	1201
	19	45	167	17.8	5.6	938	7.3	1220
	18	42	160	17.0	5.9	943	7.7	1226
	17	39	152	16.2	6.2	939	8.0	1221

CRUISE PERFORMANCE IS BASED ON STANDARD CONDITIONS, ZERO WIND, LEAN MIXTURE, 100 AND 130 GALLONS OF FUEL, NO RESERVE, AND 4700 POUNDS GROSS WEIGHT.

Figure 7–4. Cruise and Range — Lean Mixture

the procedure to be used during feathering.

OIL SYSTEM.

Oil for engine lubrication and propeller governor operation is supplied from a sump located at the bottom of each engine. In the oil system of each engine, oil is picked up by the engine-driven oil pump, forced through an oil thermostat, oil cooler, and then through the engine and propeller governor. Oil returns to the sump by gravity flow.

Oil temperature is regulated automatically by the thermostatically controlled oil coolers. The thermostats allow oil to bypass the coolers whenever the oil temperatures are below 150° F. Oil temperatures and pressures are indicated on two combination gage units located on the right side of the instrument panel.

OIL SPECIFICATION AND GRADE.

Refer to the Servicing Diagram, Figure 6-1 for the recommended engine oil specification and grades.

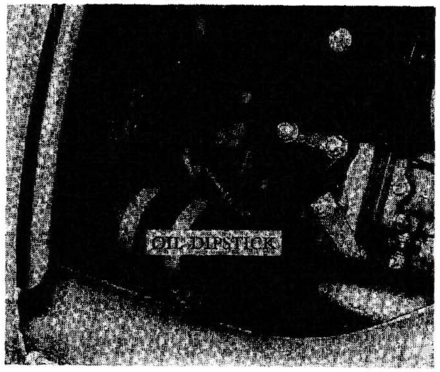
OIL LEVEL.

The oil capacity of each engine is twelve quarts. The last six quarts of oil are considered unusable because, in an extreme nose high climb with a low oil level, it is possible to uncover the oil pick-up line resulting in low oil pressure.

The oil quantity is easily checked by opening the left rear access door on each engine nacelle, and reading the oil level on the dipstick located just aft of the rear left cylinder of each engine.

NOTE

To obtain correct oil level readings, it is important that the engines be shut down for at least five to ten minutes prior to the oil check. This permits the engine oil to drain out of the oil passages into the sump giving a more accurate oil level reading. Oil should be added if below nine quarts, and should be full if an extended flight is planned.



The dipstick incorporates a spring lock which prevents it from working loose in flight. The dipstick can be removed by rotating it until the spring lock is disengaged, and pulling it up and out. When replacing the dipstick, make sure that the spring lock is engaged.

The oil filler caps are made accessible by opening the small access door on top of each engine nacelle, and can be removed by rotating them counterclockwise. In replacing the oil filler caps, make sure that they are on firmly and turned clockwise as far as they will go to prevent loss of oil through the filler neck.

An oil drain plug is provided on the underneath side of each engine and is accessible through an access hole in the bottom of the cowl.

OIL DILUTION SYSTEM (OPTIONAL EQUIPMENT).

Cold weather starting is made easier by an oil dilution system which may be installed as optional equipment in your airplane. This system controlled electrically by an oil dilution switch and used just before the engines are shut off, allows gasoline to flow into the engine oil — thinning the oil to make the next start easier. The diluted oil is not deteriorative to the engine, as the gasoline evaporates as the engines are warmed up, leaving only the oil for lubrication. Refer to Section III for the procedure to be used when using the oil dilution system.

NOTE

Change engine oil and clean oil screens after the first oil dilution of the season before operating the engine. This will remove any dirt and sludge which have been loosened by the dilution process.

OIL DILUTION SWITCH

An oil dilution switch is provided when the optional oil dilution system is installed on your airplane. The switch, located on the left switch and control panel below the vacuum source selector valve knob, has three positions: L (left engine), OFF, and R (right engine). When the switch is held to the L and R positions, solenoid valves are electrically activated which allow fuel to flow from the fuel system into the engine oil in the left and right engines respectively. When the switch is released, it automatically returns to the OFF position.

FUEL SYSTEMS.

STANDARD FUEL SYSTEM. (See figure 1-4.)

Fuel is supplied to the engines from two fuel tanks; one located on each wing tip. From each tank, fuel is fed through an electric fuel boost pump, fuel selector valve, fuel strainer, and through the engine-driven fuel pump to the carburetor. Vapor return lines from the pressure carburetors return unused fuel to the main fuel tanks when the engines are running.

FUEL SPECIFICATION AND GRADE.

Refer to the Servicing Diagram, Figure 6-1, for the recommended fuel specification and grades.

FUEL BOOST PUMP SWITCHES.

The fuel boost pumps are operated by boost pump switches located on the left switch and control panel. When the switches are ON (up position), the pumps are operating to provide a positive fuel flow and to serve as emergency pumps in the event of failure of the engine-driven fuel pumps. The boost pumps also pro-

TWIN ENGINE CLIMB DATA

GROSS WEIGHT LBS.	At Sea Level and 59°F			At 5000 Ft. and 41°F			At 10000 Ft. and 23°F			At 15000 Ft. and 5°F			At 20000 Ft. and -12°F		
	Best Climb IAS mph	Rate of Climb Ft/Min	Gal. of Fuel Used	Best Climb IAS mph	Rate of Climb Ft/Min	From S.L. Fuel Used	Best Climb IAS mph	Rate of Climb Ft/Min	From S.L. Fuel used	Best Climb IAS mph	Rate of Climb Ft/Min	From S.L. Fuel used	Best Climb IAS mph	Rate of Climb Ft/Min	From S.L. Fuel Used
4100	117	2020	2	112	1600	4.1	109	1180	6.4	105	760	9.2	101	340	13.3
4400	119	1825	2	114	1420	4.2	111	1020	6.8	107	630	10.1	102	240	15.3
4700	121	1660	2	117	1270	4.5	113	895	7.5	109	515	11.3	104	140	18.6

NOTE: FULL THROTTLE, 2600 RPM, MIXTURE LEANED FOR SMOOTH OPERATION ABOVE 5000 FT., FLAPS AND GEAR UP. FUEL USED INCLUDES WARM-UP AND TAKE-OFF ALLOWANCE.

SINGLE ENGINE CLIMB DATA

GROSS WEIGHT LBS.	At Sea Level and 59°F		At 2500 Ft and 50°F		At 5000 Ft and 41°F		At 7500 Ft and 32°F		At 10000 Ft and 23°F	
	Best Climb IAS mph	Rate of Climb Ft/Min	Best Climb IAS mph	Rate of Climb Ft/Min	Best Climb IAS mph	Rate of Climb Ft/Min	Best Climb IAS mph	Rate of Climb Ft/Min	Best Climb IAS mph	Rate of Climb Ft/Min
4100	106	575	105	460	103	340	101	220	99	100
4400	107	490	106	375	104	255	102	135	100	15
4700	109	415	107	295	105	180	103	65	102	-55

NOTE: FLAPS AND GEAR UP, INOPERATIVE PROPELLER FEATHERED, WING BANKED 5° TOWARD OPERATING ENGINE, FULL THROTTLE, 2600 RPM AND MIXTURE LEANED FOR SMOOTH OPERATION ABOVE 5000 FT. DECREASE RATE OF CLIMB 10 FT/MIN FOR EACH 10°F ABOVE STANDARD TEMPERATURE FOR PARTICULAR ALTITUDE.

Figure 7-3. Climb Data

MODEL 310B TAKE-OFF PERFORMANCE

TAKE-OFF DISTANCE WITH 15° FLAPS FROM HARD SURFACE RUNWAY

Gross Weight Pounds	IAS at Obstacle	Head Wind MPH	At Sea Level and 59°F		At 2500 Ft. and 50°F		At 5000 Ft. and 41°F		At 7500 Ft. and 32° F	
			Ground Run	Total Distance over 50 Foot Obstacle	Ground Run	Total Distance over 50 Foot Obstacle	Ground Run	Total Distance over 50 Foot Obstacle	Ground Run	Total Distance over 50 Foot Obstacle
4100	80	0	600	1130	715	1280	850	1455	1040	1720
		15	400	835	485	950	585	1090	730	1300
		30	240	575	300	660	370	770	420	930
4400	83	0	695	1245	835	1435	995	1650	1220	1990
		15	475	925	575	1070	700	1245	870	1520
		30	290	640	365	750	450	885	575	1090
4700	85	0	810	1410	980	1630	1170	1905	1435	2355
		15	560	1055	690	1235	830	1450	1040	1815
		30	355	745	445	875	550	1030	695	1340

NOTE: INCREASE DISTANCE 10% FOR EACH 25°F ABOVE STANDARD TEMPERATURE FOR PARTICULAR ALTITUDE.

MODEL 310B LANDING CHART

Gross Weight Pounds	Approach Speed At 50'-IAS	Distance Feet	Sea Level 59°F	2500' 50°F	5000' 41°F	7500' 32°F
4600	90	Air Distance	1100	1180	1250	1330
		Ground Roll	620	650	700	740
		Total Distance Over 50' Obstacle	1720	1830	1950	2070
4300	86	Air Distance	1040	1110	1175	1250
		Ground Roll	585	620	660	700
		Total Distance Over 50' Obstacle	1625	1730	1835	1950
4000	83	Air Distance	980	1045	1105	1170
		Ground Roll	550	585	620	660
		Total Distance Over 50' Obstacle	1530	1630	1725	1830

NOTE: WING FLAPS 45°, POWER OFF, HARD SURFACE RUNWAY, ZERO WIND. REDUCE LANDING DISTANCE 10% FOR EACH 6 MPH HEADWIND.

Figure 7-2. Take-off and Landing Chart

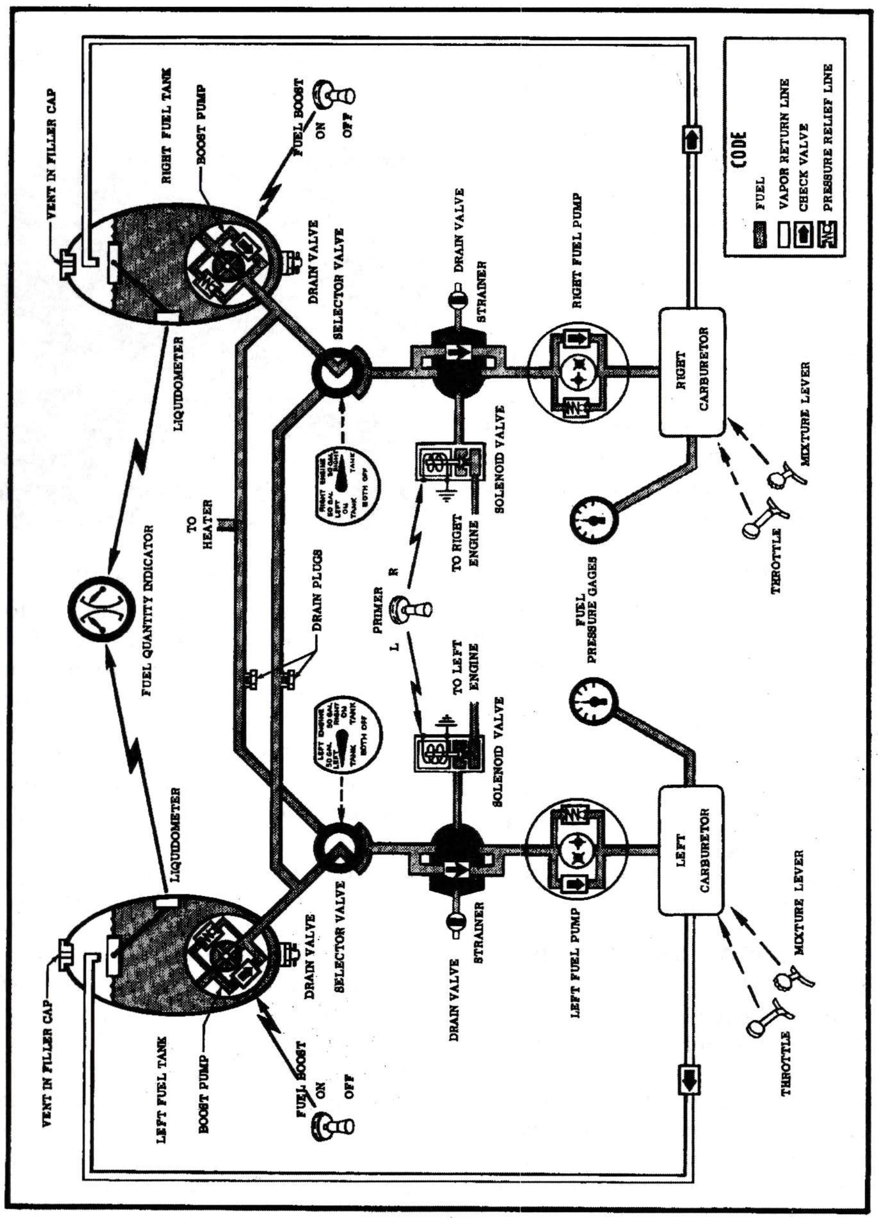


Figure 1-4. Fuel System — Standard Installation

vide fuel pressure for priming and starting. *Always take-off and land with the fuel boost pump switches — ON.*

NOTE

Anytime the fuel boost pump switches are turned ON without the engines running, the mixture levers must be in the ICO position to prevent flooding of the engine intake manifolds.

FUEL SELECTOR VALVE HANDLES.

Two rotary type fuel selector valve handles (one for each engine) are located on the cabin floor just aft of the engine control pedestal. The selector valve handles have three positions labeled BOTH OFF, LEFT TANK ON, and RIGHT TANK ON. *The fuel selector valve handle is the pointer for the fuel selector valve, and indicates the setting of the valve by its position above the selector plate.*

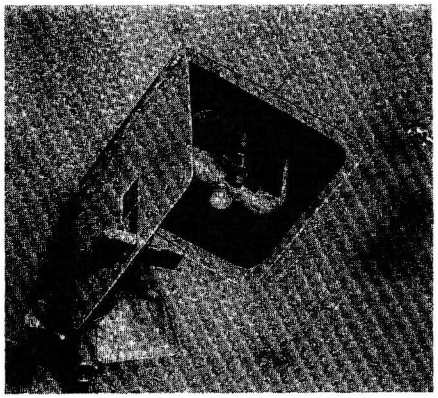
NOTE

The selector valve handles should be turned to LEFT TANK ON for the left engine and RIGHT TANK ON for the right engine during take-off, landing, and all normal operations.

FUEL QUANTITY AND PRESSURE INDICATORS.

Fuel quantity in each tank is shown by a dual-reading fuel quantity indicator mounted on the right side of the instrument panel. The indicator is electrically operated, and indicates in gallons the amount of fuel remaining in each main tank when the battery switch is ON.

Fuel pressures are indicated on two combination gage units located on the right side of the instrument panel.



FUEL STRAINER DRAIN VALVES.

A fuel strainer drain valve is located in the bottom of each fuel strainer. The strainers are mounted on the firewall in each engine nacelle, and are accessible through the small door provided in the bottom of each nacelle. The valves provide a quick method of draining any water or sediment that may have collected in the fuel strainers. *A two-ounce quantity of fuel should be drained from the fuel strainers before the initial flight of the day, or after each refueling operation, to check for any sign of water in the fuel.*

A special, hollow handled screwdriver is provided in the pocket on the baggage door of your airplane to facilitate operation of the fuel drain valves. The drain valves may be opened for small quantity fuel drainage by engaging the special screwdriver with the bottom of the drain

SECTION VII

OPERATIONAL DATA

The OPERATIONAL DATA shown on the following pages are compiled from actual tests with the airplane and engines in good condition, and using average piloting technique and lean mixture. This data, when used in conjunction with the "Power, Fuel and Endurance Computer" furnished with your airplane will prove to be a valuable aid when planning your flights. The data will duplicate information found on the computer in some cases, however, the information presented here in tabular form may prove more valuable for quick reference. Inasmuch as the number of variables involved precludes great accuracy, an ample fuel reserve should be provided. The charts make no allowance for wind, navigational error, pilot technique, warm-up, take-off, climb, etc. All of these factors must be considered when estimating fuel reserve.

To realize the maximum usefulness from your airplane, take advantage of the power your engines can develop. For normal cruising, choose a cruising power setting which gives you a fast cruising speed. If your destination is over 700 miles, it may pay you to fly at lower power settings, thereby increasing your range and allowing you to make the trip non-stop with ample fuel reserve. Use the range charts to solve flight planning problems of this nature.

AIRSPEED CORRECTION TABLE

Flaps 0°		Flaps 15°		Flaps 45°*	
IAS	TIAS	IAS	TIAS	IAS	TIAS
80	85	70	79	70	76
100	103	80	87	80	83
120	122	90	94	90	90
140	142	100	103	100	100
160	160	110	112	110	110
180	179	120	121	120	120
200	200	130	131	130	131
220	219	140	140	142	145
		150	150		
		160	159		

*Maximum flap speed 140 MPH

Figure 7-1. Airspeed Correction Table

valve and pushing up while rotating the screwdriver counterclockwise. (Fuel will flow through the hollow handle of the screwdriver.) The valves are closed by rotating the screwdriver clockwise and releasing pressure sharply, thus permitting the spring load in the valve to shutoff the flow of fuel. Each drain valve incorporates a detent which will hold it open (when released in the full counterclockwise position) for draining a large quantity of fuel.

FUEL TANK SUMP DRAIN VALVES.

A fuel tank sump drain valve is located on the underside of each wing tip (main) tank. These valves are used to drain any water or sediment that may collect in the main tank sumps. The fuel tank sump drain valves are drained by inserting the special hollow handled screwdriver through the hole in the bottom of each main fuel tank and following the procedure described in the preceding paragraph.

NOTE

The main fuel tank sumps should be drained before the first flight each day and after every refueling operation.

AUXILIARY FUEL SYSTEM. (See figure 1-5.)

An optional auxiliary fuel system may be installed in addition to the standard fuel system to increase the airplane's operating range. The auxiliary system installation includes two additional fuel tanks internally mounted in the wings (one located just outboard of each engine nacelle), a four-position selector valve, for each engine (each having an auxiliary tank position), a dual-reading auxiliary fuel quantity indicator, and interconnecting plumbing. Sump drain plugs are provided under each auxiliary fuel tank.

NOTE

Drain a small amount of fuel from the auxiliary fuel tank sumps each 100 hours, or any time that water or sediment is found when draining the fuel strainers.

Operation of the auxiliary fuel system differs from the standard system only in that an additional fuel supply selection is possible for each engine and the boost pumps do not provide pressure when auxiliary fuel is being used. Fuel from each auxiliary tank is fed through the auxiliary fuel selector valve, the standard fuel strainer and engine-driven fuel pump to the carburetor. Auxiliary fuel vapor returns to the main tanks via the standard fuel vapor return lines.

NOTE

Fuel should be used from the main tanks during starting, taxi-

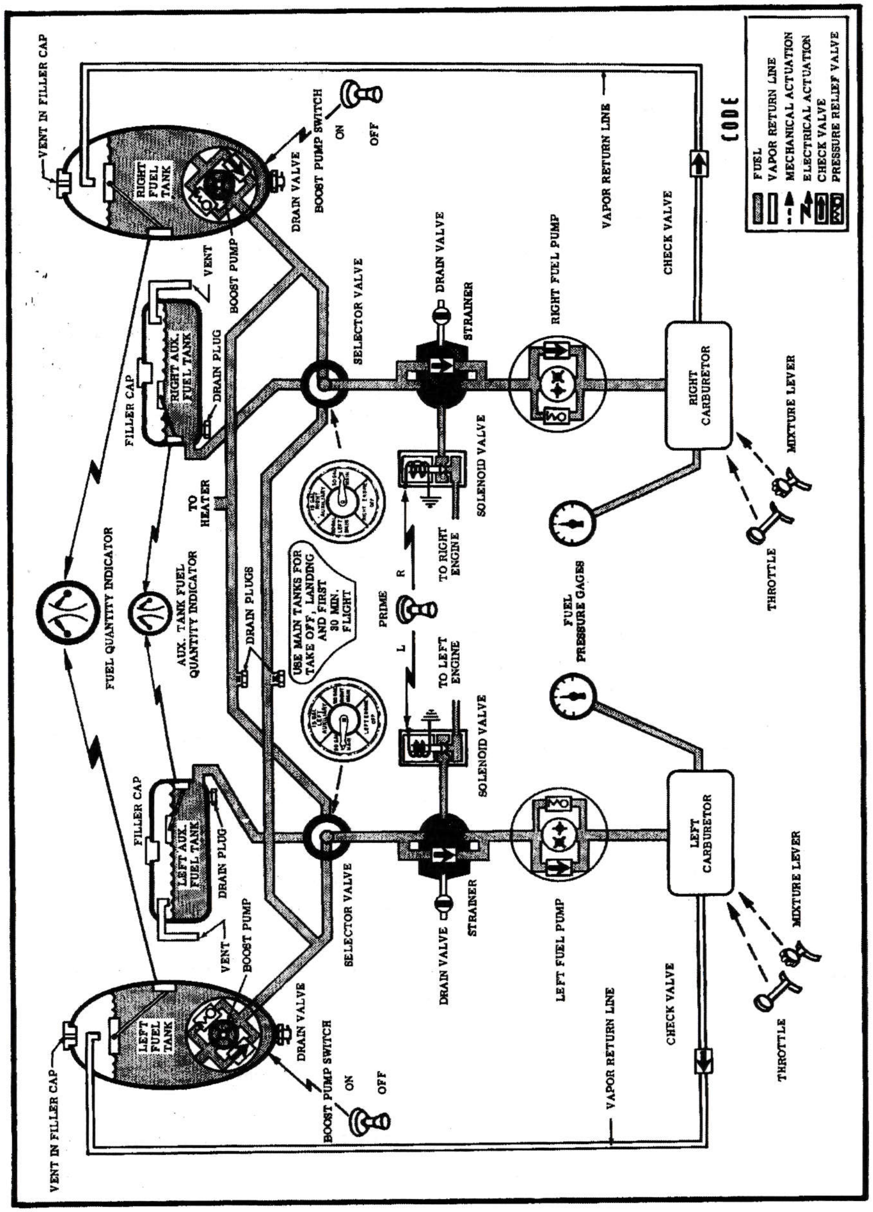


Figure 1-5. Fuel System — With Auxiliary Fuel Tanks

lower cost.

Time studies of the 100 hour inspection at the factory and in the field have developed a standard flat-rate charge for this inspection at any Cessna Dealer. Points which the inspection reveals requiring modification or repairs will be brought to the owner's attention by the Dealer, and quotations or charges will be made accordingly. The inspection charge does not include the oil required for the oil change.

Every effort is made to attract the best mechanics in each community to Cessna service facilities. Many Dealer's mechanics have attended Cessna Aircraft Company schools and have received specialized instruction in maintenance and care of Cessna airplanes. Cessna service instruction activity in the form of service bulletins and letters is constantly being carried on so that your enjoyment and safety in your Cessna airplane will be complete and up-to-date when you have your inspection and service work performed by Cessna Dealer's mechanics.

Dealers carry a full complement of Cessna service parts and possess complete repair and service facilities, including such specialized jigs and toolings as may be necessary.

Your Cessna Dealer will be glad to give you current price quotations on all parts that you might need and will be glad to advise you on the practicability of parts replacement versus repairs that might from time to time be necessary.

CROSS COUNTRY SERVICE

On your cross country travels make it a point to stop at a Cessna service facility for your service requirements. Your Dealer will be glad to supply you with a copy of a current service station list, or if you wish, you may write to the Service Department, Cessna Aircraft Company, Wichita, Kansas, asking for it and it will be promptly mailed to you.

carefully smoothed out to eliminate unnecessary stress concentration in the blades.

AIRPLANE FILE.

There are miscellaneous data, information and licenses that are a part of the airplane file. The following is a check list for that file:

A. To be carried in the airplane at all times:
   1. Aircraft Registration Certificate.
   2. Aircraft Airworthiness Certificate.
   3. Airplane Radio Station License (if transmitter installed).
   4. Pilot's Check List.
   5. Weight and Balance Data.
   6. Airplane Log Book.
   7. Engine Log Book.

B. To be maintained but not necessarily carried in the airplane at all times:
   1. Latest copy of the Repair and Alteration Form.
   2. Equipment List.
   3. A form containing the following information: Model, Registration Number, Factory Serial Number, Date of Manufacture, Engine Number, and Key Numbers (duplicate keys are available through your Cessna dealer).

INSPECTION SERVICE AND INSPECTION PERIODS.

With your airplane you will receive an Owner's Service Policy. This policy has coupons attached to it which entitle you to an initial inspection and the first 100 hour inspection at no charge. If you take delivery from your Dealer, he will perform the initial inspection before delivery of the airplane to you. If you pick up the airplane at the factory, plan to take it to your Dealer reasonably soon after you take delivery on it. This will permit him to check it over and to make any other minor adjustments that may appear necessary. Also, plan an inspection by your Dealer at 100 hours or 90 days, whichever comes first. This inspection also is performed by your Dealer for you at no charge. While these important inspections will be performed for you by any Cessna Dealer, in most cases you will prefer to have the Dealer from whom you purchase the airplane accomplish this work.

The Civil Air Regulations require that all airplanes have a "periodic inspection" performed once a year by a person designated by the administrator. In addition, 100 hour periodic inspections made by an "appropriately rated mechanic" are required if the airplane is flown for hire. The Cessna Aircraft Company recommends the 100-hour periodic inspection for your airplane. The procedure for this 100-hour inspection has been carefully worked out by the factory and is followed by the Cessna Dealer organization. The complete familiarity of the Cessna Dealer organization with Cessna equipment and with factory-approved procedures provides the highest type of service possible at

ing, take-off, landing, and operation for the first 30 minutes of flight. Fuel should then be used from the auxiliary tanks until they are emptied. By using fuel from the main tanks first, adequate space will be provided to accommodate fuel returning to the main tanks via the vapor return lines from the carburetors when operating on the auxiliary tanks. Advance mixture levers to FULL RICH before moving fuel selector valve handles. (Turn fuel boost pump switches to ON when switching to main tanks.) Return controls to cruise settings after power has been regained. A period of 3 to 5 seconds will be required to regain power after running the auxiliary tanks dry and switching to the main tanks.

ELECTRICAL SYSTEM.

Electrical energy is supplied by a 24-volt, direct-current system, powered by two engine-driven generators. Two 12-volt storage batteries, connected in series, are located in the left wing just outboard of the engine nacelle. An external power receptacle can be provided, as optional equipment, in the left wing under the batteries to permit the use of a battery cart for cold weather starting.

BATTERY AND GENERATOR SWITCHES.

A battery switch and two generator switches are provided on the left switch and control panel. These switches are grouped together under a hinged bar which allows them to be switched OFF simultaneously. The switches may also be switched OFF individually.

The separate battery and generator switches are provided as a means of checking for a malfunctioning generator circuit, and to permit such a circuit to be cut off. If a generator circuit is found to be malfunctioning, it should be turned OFF. Operation should be continued on the functioning generator, using required equipment only. If for some reason both generator circuits should become malfunctioning, equipment can be operated at short intervals and for a limited amount of time on the battery circuit alone. In either case, operation for any length of time is not recommended and a landing should be made as soon as possible to check and repair the circuits.

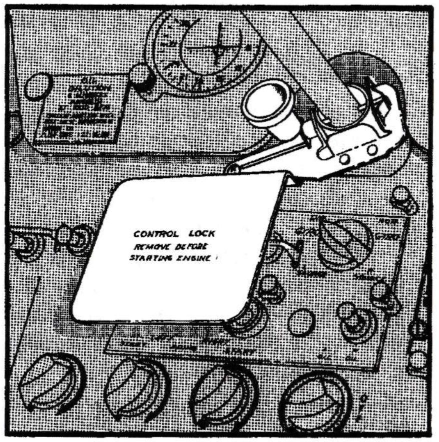
CIRCUIT BREAKERS.

All of the electrical systems in the airplane are protected by "push-to-reset" type circuit breakers located in a circuit breaker panel on the left cabin wall. The panel is covered by a metal door which is hinged along the bottom edge. If your airplane is equipped with an optional 50-amp generator installation, two additional circuit breakers are provided on a small panel below and slightly forward of the main panel.

If a circuit is inoperative, wait approximately three minutes for the thermal unit to cool off, then press the circuit breaker button to reset the breaker. If this does not restore power to the circuit, it should be checked for shorts, defective parts, or loose connections. If a circuit breaker pops out a second time, do not attempt to reset the breaker, but turn off the controlling switch for that circuit and have the malfunction corrected after arriving at your destination.

FLIGHT CONTROL SYSTEM.

Conventional wheel and rudder pedal controls are provided to operate the primary flight control surfaces. (The co-pilot's control wheel and rudder pedals are optional equipment.) Manually-operated trim tab control wheels are provided for the rudder, elevator, and aileron trim tabs and are located on the engine control pedestal.



CONTROLS LOCK.

The controls lock assembly is provided to secure the pilot's control column when the airplane is parked outside. The lock assembly incorporates a sliding pin that passes completely through the socket and tube of the pilot's control column. The lock assembly also has a red metal flag which, when the lock is installed, covers the ignition switches and starter buttons making it impossible to start the engines with the controls locked.

To install the controls lock:

1. Slide lock up under pilot's control tube socket.
2. Align holes in control tube with holes in socket.
3. Push locking pin of controls lock through aligned holes until pin engages the catch on inboard side of lock.

To remove the controls lock, pull locking pin outboard until controls lock is disengaged. Stow the controls lock in the map compartment during flight.

ELEVATOR TRIM TAB CONTROL WHEEL.

The elevator trim tab control wheel is mounted vertically on the left, or pilot's side, of the engine control pedestal. Its position indicator is installed in the pedestal beside the control wheel and is marked NOSE DOWN, NOSE UP, and TAKE-OFF. At the take-off marking, there is a small arrowhead which shows the most satisfactory position for the indicator during normal take-offs.

RUDDER TRIM TAB CONTROL WHEEL.

The rudder trim tab control wheel is mounted on the face of the engine

SERVICE EVERY 100 HOURS:

13. Master Brake Cylinders	Check fluid level and fill every 100 hours with MIL-O-5606 hydraulic fluid.
14. Fuel Line Drain Plugs	To drain fuel lines, remove right hand wing root fairing, cut safety wire, and remove plugs. Drain every 100 hours or more often if required.
15. Fuel Tank Sump Drains	Drain a small amount of fuel every 100 hours, or at any time that water or sediment is found when draining the fuel strainers.

SERVICE EVERY 500 HOURS:

16. Nose Gear Shock Strut	*Check fluid level and fill every 500 hours.
17. Main Gear Shock Struts	*Check fluid level and fill every 500 hours.

*The servicing procedure for the three landing gear shock struts is identical. Service the struts as follows:

1. Loosen the valve plug (2½ turns maximum) to deflate strut.
2. With strut fully compressed, remove valve plug and fill with fluid (MIL-O-5606).
3. Replace valve plug and inflate strut to 10 psi (do not extend strut).
4. Remove valve plug, and add or bleed fluid to bottom of filler hole.
5. Replace valve plug, and inflate strut to 2" extension under design gross weight. (This dimension may vary slightly with wide temperature changes.)

PROPELLER CARE.

Standard periodic inspection and lubrication of the propellers and spinners will disclose any minor propeller troubles before they have a chance to become serious. Occasional wiping of the propeller blades with an oily cloth will result in cleaning off grass and bug stains and will assist materially in corrosion-proofing in salt water areas. Oil and grease stains may be removed with carbon tetrachloride or any non-alkaline grease solvent. Sharp nicks in the leading edge of the propellers should be

SERVICE EVERY 25 HOURS:

4. Batteries	Maintain electrolyte level at horizontal baffle plate (plate with holes). Service every 25 hours or more often if required.
5. Engine Oil	Drain and refill every 25 hours, or as required. Use aviation grade straight mineral oil; SAE 30 (MIL-L-6082B, grade 1065) below 40° F, and SAE 50 (MIL-L-6082B, grade 1100) above 40° F. Oil capacity, each engine, is 12 U. S. Qts., 10 Imp. Qts., or 11.4 Liters. Minimum oil for adequate lubrication, each engine, is 6 U. S. Qts., 5 Imp. Qts., or 5.7 Liters.
6. Oil Drain Plugs	Cut safety wire and open drain plugs to drain engine oil. Resafety drain plugs.
7. Carburetor Air Filter	Remove every 25 hours and clean with suitable solvent. After cleaning, dry with filtered compressed air. Soak filter in light engine oil and allow to drip dry. Reinstall filter.
8. Shimmy Dampener	Check. Fill each 25 hours, or as required, with MIL-O-5606 hydraulic liquid.
9. Nose Gear Tire	Check pressure. Maintain 22 psi.
10. Main Gear Tires	Check pressure. Maintain 37 psi.
11. Anti-Ice Fluid	Check fluid level every 25 hours or more often if required. Fill with MIL-F-5566 anti-ice fluid (Isoprophyl Alcohol). Reservoir capacity: 4.5 U. S. Qts., 3.8 Imp. Qts., or 4.3 Liters.
12. Oxygen Cylinder	Check oxygen pressure gage. Recommended pressure range: 300 psi to 1800 psi. Recharge oxygen cylinder to 1800 psi when pressure drops to 300 psi.

control pedestal just above the carburetor alternate air knobs. It is mounted horizontally in the pedestal with its position indicator located directly above it. The indicator is marked NOSE, with L (nose left) and R (nose right) on their respective sides.

AILERON TRIM TAB CONTROL WHEEL.

The aileron trim tab control wheel is located on the face of the engine control pedestal just below the carburetor alternate air knobs. The indicator for the control wheel is located immediately above it and is labeled ROLL, with L (roll left) and R (roll right) on their respective sides.

WING FLAPS SYSTEM.

The wing flaps are of the split type and can be extended to any angle between 0° and 45°. Under normal conditions at 4700 pounds gross weight, the use of 45° flaps will lower the power-off stalling speed approximately 10 mph (84 mph to 74 mph TIAS). This enables a slow, steep approach for short field landings over an obstacle. The flaps can be lowered to 45° at any airspeed below 140 mph, and to 15° at any speed below 160 mph, but should never be lowered above this speed. During take-off, over 15° of flaps should never be used at any time.

The flaps are controlled by a flap switch located on the right switch and control panel. The UP and DOWN positions of the switch are momentary hold-on positions, and the switch automatically returns to the middle (OFF) position when released. The flaps can be lowered or raised to any position between 0° and 45°, and stopped at this position by allowing the flap switch to return to the OFF position. The flaps will remain in the selected position until the switch is moved to raise or lower them. When the flaps are extended or retracted to their limits, the electric flap actuator motor is automatically turned off by limit switches.

Flap position is shown by a flap position indicator located just above the engine control pedestal. The indicator shows, in degrees, the position of the flaps.

LANDING GEAR SYSTEM.

The landing gear is of the fully retractable, tricycle type incorporating two main wheels and a steerable nose wheel. The gear is electrically operated by an electric motor which actuates a gear box mechanism and linkage. Up and down limit switches are provided in the system to automatically stop the motor as the full up or down position is reached. An electrical landing gear switch controls the retraction and extension cycles. An automatic safety switch is provided on the left shock strut and opens the UP circuit whenever the weight of the airplane is on the strut, thus preventing accidental retraction of the landing gear on the ground.

Landing gear doors fully enclose the landing gear when retracted, and are opened by mechanical linkage when the gear is extended. A two tread assist step is also mechanically connected to the landing gear linkage, and extends down out of the fuselage when the gear extends to provide easy access to the right wing walk and cabin door. The landing gear doors, with the exception of the inboard main gear doors, remain open until the gear is retracted. The inboard main gear doors close again after the main gear is extended.

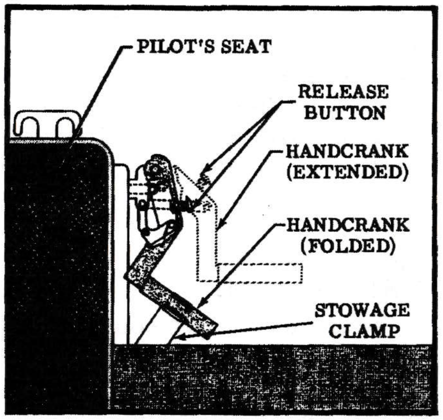
Position lights and a warning horn provide visual and audible gear position indications to the pilot. A push-to-reset circuit breaker protects the landing gear motor circuit in the event of an overload. A manually-operated hand crank is provided to extend the landing gear in case of other malfunctions in the landing gear motor.

LANDING GEAR SWITCH.

The landing gear switch is located just to the left of the engine control pedestal and can be identified by its small wheel knob. The switch knob must be pulled out before the switch is moved from one position to another. The switch knob, when released, automatically locks in the slot of the selected position. The switch is marked GEAR, and the positions are labeled UP (to raise the landing gear), and DOWN (to lower the landing gear). A center (OFF) position, for manual lowering of the gear, is provided to disconnect the electrical circuit during cranking operation.

MANUALLY-OPERATED HAND CRANK.

A hand crank is provided beside



the pilot's seat to manually operate the landing gear mechanism should the landing gear motor fail to extend the gear. The hand crank is normally folded and stowed in a clip beside the seat.

NOTE

> The handcrank must be in the stowed position to operate the gear electrically.

The hand crank is ready for use after pulling it from its stowage clip, and unfolding it until it automatically locks in the operating position.
The hand crank is stowed by pushing the lock release button provided on the crank handle, folding the handle, and inserting it into the stowage clip.

Refer to Section IV for the procedure to be used when manually extending the landing gear.

LANDING GEAR POSITION LIGHTS.

Two landing gear position lights are provided, one above and the other below the landing gear switch. The

2. Fuel Tanks	Service daily, or as required with grade: 91/96 aviation gasoline, MIL-F-5572. Acceptable alternate grade: 100/130. Lead content should not exceed 4.66 cc. per gallon. Capacity, each main tank: 51 U. S. Gals., 42.5 Imp. Gals., or 193 Liters. Usable fuel, each main tank: 50 U.S. Gals., 41.6 Imp. Gals., or 189.3 Liters. Capacity, each auxiliary (optional) tank: 15.5 U. S. Gals., 12.9 Imp. Gals., or 58.7 Liters. Usable fuel, each auxiliary (optional) tank: 15 U. S. Gals., 12.5 Imp. Gals., or 56.8 Liters.
3. Fuel Strainers	Drain small amount of fuel to check for presence of water or sediment before the first flight of the day, and after each refueling operation.

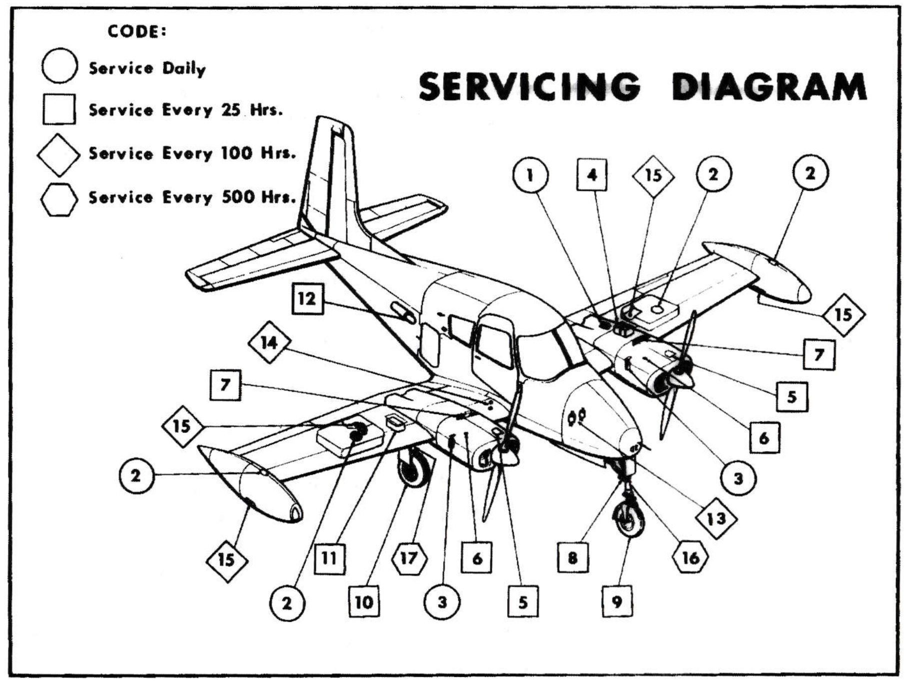


Figure 6–1. Servicing

clean the airplane and increase the surface lustre. A wax, recommended for enamels, may also be used to brighten the paint and facilitate subsequent cleaning.

3. Gasoline spilled on the paint should be immediately washed off with water to avoid permanent stains.

UPHOLSTERY.

Keeping the inside of your airplane clean is no more difficult than taking care of rugs and furniture in your home. It is a good idea occasionally to take the dust out of the upholstery with a whisk broom and a vacuum cleaner.

If spots or stains get on the upholstery, they should be removed as soon as convenient before they have a chance to soak and dry. Cleaning fluids having a carbon tetrachloride or a naptha base are recommended. Soap or detergents and water are not recommended for use on the seats since they will remove some of the fire retardant with which the seats have been treated. When using recommended cleaners, the following method is suggested.

1. Carefully brush off and vacuum all loose particles of dirt.
2. Wet a small, clean cloth with the cleaning solution and wring out thoroughly. Then open cloth and allow the fluid to evaporate a trifle. Do not use too much fluid. The seat cushions are padded with foam rubber and since volatile cleaners attack rubber, these pads may be destroyed if the material gets soaked with cleaner.
3. Tap the spot lightly with the cloth, but don't rub it. This will pick up particles which are too embedded to be removed by brushing. Repeat several times, using a clean part of the cloth each time.
4. Moisten another piece of clean cloth with the cleaner and allow to evaporate until barely damp. Now rub the spot lightly, working from the outside in toward the center. (This keeps the spot from spreading and is less likely to leave a ring). If necessary, repeat several times.
5. Brush again to remove any further particles which may have become loosened.

SERVICING.

Figure 6-1 outlines the servicing requirements for the airplane. Some systems shown are offered as optional equipment and may not be installed in your airplane. It is recommended that each system be serviced at the prescribed time interval. At the same time, all systems requiring service at more frequent intervals should be serviced.

SERVICE DAILY:

1. External Power Receptacle	Use 24-volt DC power source as required.

upper light is red, and is on at all times when the gear is fully retracted. The lower light is green, and illuminates only when the landing gear is fully extended and locked. The green light is connected in series with three down indicator switches, one on each wheel strut. If the landing gear is not fully extended and locked, the green light will not illuminate. When neither light is on, the landing gear is in an intermediate position.

LANDING GEAR WARNING HORN.

The landing gear warning horn is controlled electrically by the throttles, and will sound if either throttle is retarded below 13 inches of manifold pressure with the gear up. A flasher unit is provided in the warning horn circuit which makes the horn sound intermittently. The warning horn is also electrically connected to the UP position of the landing gear switch, and will sound if the switch is placed in the UP position while the airplane is on the ground.

STEERING SYSTEM.

The nose wheel is steerable with the rudder pedals up to 15°, either right or left of center, after which it becomes free-swiveling up to a maximum deflection of 55° right or left of center. Using brakes and throttles, this deflection of 55° permits the airplane to be turned in a relatively small radius.

NOTE

Avoid locking a brake and spinning the airplane on one wheel to turn it whenever possible. This action causes tire scuffing and wear.

The steering linkage automatically disconnects from the nose wheel as the wheel is retracted, and the nose wheel is automatically straightened as it goes into the wheel well.

BRAKE SYSTEM.

The hydraulic brakes on the main wheels are conventionally operated by applying toe pressure to the pilot's or the co-pilot's (optional) rudder pedals. Depressing the pedals actuates the brake cylinders, resulting in a braking action on the main landing gear wheels. The brakes may also be set by operation of the parking brake handle.

PARKING BRAKE HANDLE.
(See figure 1-1).

The parking brake handle is located below the instrument panel on the left cabin wall. It is connected to the pilot's rudder pedals by cables. When the parking brake handle is pulled, it pulls the pilot's rudder pedals down, thus applying the brakes at the main landing gear wheels. Applying foot pressure to the brake portion of the rudder pedals, as the parking brake handle is pulled, aids in applying the parking brakes. The parking brake mechanism has a ratchet device which holds the handle in any applied position. Turning the handle in a counterclockwise direction releases this ratchet, allowing the spring-loaded parking brake handle to retract and release the brakes.

PITOT-STATIC SYSTEM.

The pitot-static system provides pitot and static pressure to operate the airspeed indicator, and static pressure to operate the rate-of-climb indicator and altimeter. The system is composed of an electrically heated pitot tube mounted on the nose of the fuselage, two external static pressure ports (one located on each side of the fuselage aft of the baggage compartment), and the associated plumbing necessary to connect the instruments to the source.

NOTE

The static pressure openings should be kept free of polish, wax, and dirt for proper instrument operation.

A static pressure alternate source valve is installed in the static system for use when the external static sources are malfunctioning. This valve also permits drainage of condensate from the static lines. The static pressure alternate source valve is located adjacent to the parking brake handle, and is opened by pulling the valve lever aft.

PITOT HEATER SWITCH.

The pitot heater switch is located on top of the engine control pedestal and is labeled PITOT. The switch is ON in the forward position and OFF in the aft position. When the switch is ON, heating elements in the pitot tube and stall warning transmitter are electrically heated to maintain proper operation of the two systems during icing conditions. Both systems are protected by a single circuit breaker.

VACUUM SYSTEM.

A vacuum system is provided to operate the directional gyro and gyro horizon. A suction gage, located on the right side of the instrument panel is provided in the system for checking purposes.

Suction gage readings may be obtained from any of four sources in the vacuum system with a manually-operated "push-to-turn" vacuum source selector valve knob. The available sources are, as marked on the left switch and control panel, DIR GYRO (directional gyro), HOR GYRO (gyro horizon), L SOURCE (left pump), and R SOURCE (right pump).

STALL WARNING SYSTEM.

A red stall warning indicator light located in the upper right portion of the instrument panel, and a separately mounted stall warning horn are provided to give both visible and audible warning as a stall is approached. The light and horn operate concurrently, and are ready for operation after the battery switch is ON. They provide protection from inadvertent stalls in that they give warning whenever a stall is approached regardless of speed, attitude, altitude, acceleration, load, or other factors which change the stalling speed. The light and horn are set to give warning approximately 5 to 10 mph above the stalling speed.

The stall warning transmitter, mounted on the left wing leading edge, incorporates a heater element to

mended that the opposite main wheel and the nose wheel be chocked prior to jacking as a safety measure.

PLEXIGLAS WINDSHIELD AND WINDOWS.

To clean the plexiglas windshield and windows, wash with plenty of soap and water, using the palm of the hand to feel and dislodge any caked dirt or mud. A soft cloth, sponge, or chamois may be used but only as a means of carrying water to the plastic. Dry with a clean, damp chamois. Rubbing with a dry cloth builds up an electrostatic charge on the glass so that it attracts dust particles from the air. Wiping with a damp chamois will remove this charge as well as the dust and is therefore recommended.

Remove oil and grease by rubbing lightly with a cloth wet with kerosene.

NOTE

Do not use gasoline, alcohol, benzene, acetone, carbon tetrachloride fire extinguisher, or de-icing fluid, lacquer thinner or glass window cleaning spray as they will soften the plastic and will cause crazing.

If after removing dirt and grease, scratching is visible, the plexiglas should be waxed with a good grade of commercial wax. These waxes will fill in minor scratches and help prevent further scratching. The wax should be applied in a thin even coat and brought to a high polish by rubbing lightly with a clean, dry, soft flannel cloth.

Covers should not be used to protect the windshield and side windows. Covers made of canvas are particularly harmful in that they scratch the plastic surface.

PAINTED SURFACES.

The painted surfaces on your new airplane are finished with a vinyl paint noted for its toughness and weather resistance. If maximum endurance and beauty are to be obtained, certain procedures are recommended for care of the paint, especially during the first 90 days after you receive the airplane. The time required for complete curing of the paint varies, depending upon the climate, from 30 to 90 days.

For the first 90 days, care for the painted surfaces as follows:

1. Wash with clean, cold water and a small quantity of Lux or Ivory Flakes. Rinse with clear water, and dry with a soft cloth or chamois.
2. Use no polish or wax, and do not rub or buff the surface.
3. Avoid flying through rain, sleet or hail whenever possible.

After the first 90 days, clean and preserve the painted surfaces as follows:

1. Wash with clean, cold water and a small quantity of Lux or Ivory Flakes. Rinse with clear water, and dry with a soft cloth or chamois.
2. Light rubbing compound, sparingly applied by means of a wet cloth, may be used to

pounds tensile strength) or chains to the wing tie-down fitting located on the underside of each wing, and secure the opposite ends to tie-down rings suitably anchored in the ground.

2. Caster the nose wheel to the extreme left or right position to protect the rudder from buffeting and wind damage.
3. Secure a rope or chain to the lug located on the aft side of the nose gear strut directly behind the upper torque link attaching point. Secure the opposite end to a tie-down ring in the ground. An alternate tie-down location on the nose gear strut is around the strut just above the torque links. However, only ropes should be tied to this location and care should be exercised when securing the rope so that the adjustment of the taxi light (if installed) will not be altered.
4. Tie a rope or chain to the tail skid, and secure the other end to a tie-down ring in the ground.
5. Install the control lock at the pilots control column.
6. Set the parking brake or use wheel chocks.

STORAGE.

The all metal construction of your airplane makes outside storage of it practical. However, inside storage will increase its life just as it does for your car. Cleanliness is important under any condition. Dirt and mud have the same effect as salt, only to a lesser degree.

Do not neglect the engines when storing the airplane. Pull the propellers through several revolutions every few days to keep the engine bearings, cylinder walls, and other internal parts lubricated. Fuel tanks should be serviced to the prescribed quantity during storage. Condensation in the tanks will be greatly eliminated and fuel tank life will be increased. Correct tire pressure and strut inflation is also important.

Regular use of your airplane will tend to keep it in good condition. An airplane left idle for any great length of time is likely to deteriorate more rapidly than if it is flown regularly.

Your airplane should be carefully checked over before being put back into service after storage for any great length of time.

JACKING.

The airplane is equipped with four jack pads for use when it is desired to raise the entire airplane for landing gear functional checks, etc. However, if only tire changes are necessary, the individual wheels may be raised as follows:

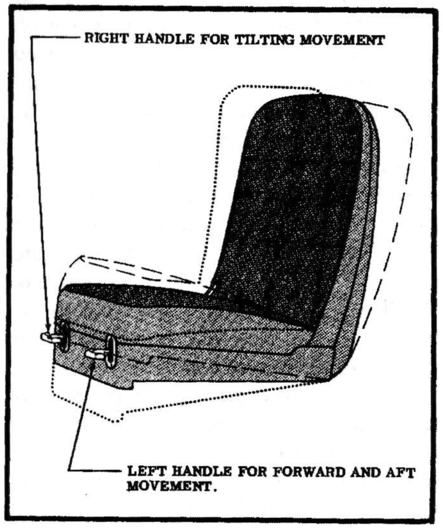
1. To raise the nose wheel, place weights (sandbags, etc.) on each side of the horizontal stabilizer near the fuselage until the tail rests securely on the tail skid. The main wheels should be chocked or the parking brakes set when raising the nose wheel in this fashion.
2. To raise either main wheel, jacking points are provided on the aft side of each strut. It is recom-

prevent ice from hampering its operation. The heater element is controlled by the pitot heater switch. Both the stall warning transmitter heater element and the pitot tube heater element are protected by the same circuit breaker. The stall warning indicator light and warning horn are protected by a separate circuit breaker.

SEATS.

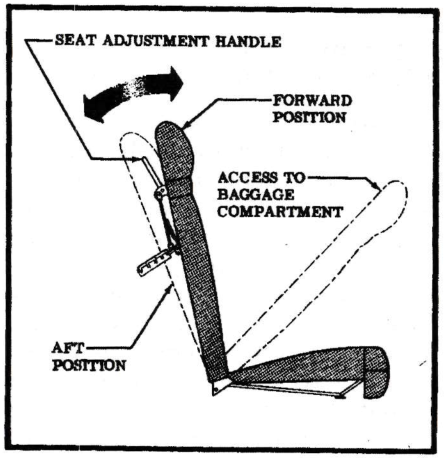
FRONT SEATS.

The front seats are individually mounted on tracks and are adjustable fore and aft. They are also adjustable through three reclining positions. The seat adjustment handles are located within easy reach on the front of the seats. The front seat backs fold forward to provide room for entrance to the rear seat. Entrance to the left front seat may be made by stepping in behind the right front seat, and forward through the aisle to the left front seat.



To adjust each seat fore and aft, simply pull up on the left handle and slide the seat to the most comfortable position.

To adjust the reclining angle of each seat, pull up on the right handle and lean forward or back to the desired position.



REAR SEAT.

The rear seat is designed to accommodate three people. The seat back is hinged at the two lower attachment points, and can be moved forward or aft through five adjustments to provide the most comfortable reclining angle as desired by the passengers. The seat back adjustment handle is accessible by reaching to the center of the seat back along the top edge. The seat back adjustment handle mechanism also disengages completely from position adjustment brackets, allowing the seat back to be pulled forward permitting access to the baggage compartment from within the cabin.

The arm rest, provided on each cabin wall, must be removed when the rear seat back is pulled full forward to gain access to the baggage compartment from inside the airplane. These arm rests are removed by pulling them up and out of their retaining brackets.

INDIVIDUALLY RECLINING REAR SEATS. (OPTIONAL EQUIPMENT.)

Individually reclining rear seats may be installed in your airplane as optional equipment. The seats are designed to accommodate either two passengers in individually reclining seats, or three passengers when the seats are positioned together. Safety belt facilities are available so that the seats may be used in either configuration. The reclining angle of each seat is controlled by a separate adjustment handle capable of eleven adjustments. Each seat is adjusted by pushing the seat adjustment handle (located outboard of each seat) forward, and sliding the seat to the most desirable position.

A removable arm rest fits between the seats for use when the seats are used individually by two passengers. The arm rest is removed by pulling it up and out of its retaining bracket. An additional arm rest is provided on each cabin wall, and may be removed if desired. These arm rests are removed by pulling them up and out of their retaining brackets.

HEATING, VENTILATING, AND DEFROSTING SYSTEM.

A cabin heating, ventilation, and windshield defrosting system is provided as standard equipment in your airplane. The system consists of an air inlet in the nose of the airplane, a ventilating fan, a gasoline combustion type heater, ducting, and ten controllable air outlets.

HEATING AND DEFROSTING SYSTEM.

Fresh air is picked up from the front opening in the nose of the airplane, is heated by the heater, and is ducted into the front and rear cabin compartments. The heated and ventilating air is not recirculated for heater operation, but is exhausted into the slip-stream through an exhaust vent located under the rear seat. Heated air enters the front compartment through four outlets: two registers mounted just forward of the rudder pedals, and two defroster outlets located at the base of the windshield. Heat is supplied to the rear cabin compartment through two registers, one on each cabin wall, located just aft of the rear seat. Controls are provided to regulate cabin air temperature, and to regulate the flow of air through each cabin air outlet. The heater and ventilating fan are controlled by a toggle switch.

If at any time during heater operation, the temperature of the heated air streams should exceed 220° F, a duct temperature limit switch, located on the heater shroud, will automatically

SECTION VI

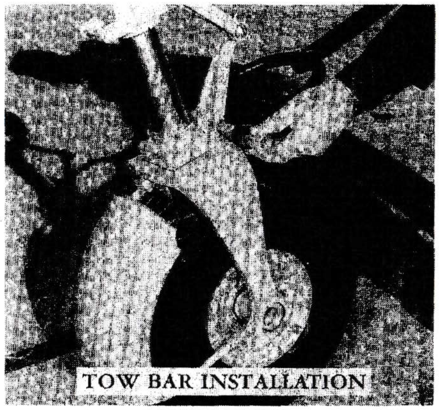
CARE OF THE AIRPLANE

IF YOUR AIRPLANE is to retain that new plane performance and dependability, certain requirements in its care must be followed. It is wise to follow a planned schedule of inspection, servicing, and preventive maintenance based on the climatic and flying conditions encountered in your locality.

Keep in touch with your Cessna dealer, and take advantage of his knowledge and experience. He knows your airplane and how to maintain it. He will remind you when lubrications and oil changes are necessary, and about other seasonal and periodic services.

GROUND HANDLING.

A tow bar is stored in the baggage compartment of your airplane. When the tow bar is attached to the swivel nose gear, the airplane may be steered by hand and positively controlled in all ground handling operations. Always pull or push horizontally on the tow bar when moving the airplane to keep the weight on the nose wheel for positive steering action. Do not lift on the tow bar.



TOW BAR INSTALLATION

MOORING YOUR AIRPLANE.

Proper tie-down procedure is your best protection against damage to your parked airplane by gusty or strong winds. To tie down your airplane securely, proceed as follows:

1. Tie sufficiently strong ropes (700

open, and electrically shut off the fuel metering solenoid valve in the heater, and the main fuel supply solenoid valve located in the right wing. With the fuel supply cut off, combustion will cease, and the heater will cool. When the heater has cooled sufficiently, the duct temperature limit switch will close, fuel will begin flowing, and the heater will automatically restart.

The cabin heater depends upon the airplane fuel system for its fuel supply. Fuel is taken from a tee in the fuel crossfeed line in the right wing. Fuel pressure is supplied by a diaphragm type fuel pump mounted on the heater assembly, therefore, the main fuel system boost pumps do not have to be turned on for proper heater operation.

On the ground, the cabin heating system can be utilized for ventilation by placing the heater switch in the FAN position. The fan provides unheated, fresh air to the cabin through the cabin heat registers. In flight, the fan becomes inoperative and the heating system can be utilized as a ventilating system by turning the heater switch to the OFF position and opening the heat registers as desired.

CABIN HEATER SWITCH. (See figure 1-6).

The cabin heater and ventilating fan are controlled by a three-position toggle switch located on top of the engine control pedestal. The switch positions are HEAT (forward position), OFF (middle position), and FAN (aft position). Placing the switch in the HEAT position starts and maintains heater operation. Placing the switch in the FAN position operates the ventilating fan only.

CABIN AIR TEMPERATURE CONTROL KNOB. (See figure 1-6).

The cabin air temperature control knob is located on the right switch and control panel and is labeled TEMP CONTROL, OFF (counterclockwise position), and MAX (clockwise position).

Heater output is controlled by adjustment of the cabin air temperature control knob. This knob, when rotated, adjusts a thermostat which in turn controls heated air temperature in a duct located just aft of the heater. When the temperature of the heated air exceeds the setting of the thermostat, the thermostat automatically opens, and electrically shuts off a fuel metering solenoid valve in the heater. Thus, combustion ceases and the heater is allowed to cool until the heated air temperature recedes to within the thermostat setting. The heater is therefore continuously cycling on and off to maintain an even air temperature in the heater ducts and in the cabin.

DEFROST KNOB. (See figure 1-6).

Windshield defrosting and defogging is controlled by operating a push-pull type control knob located on the right switch and control panel. The knob is labeled DEFROST. When the knob is pulled out, air is emitted from the defroster outlets at the base of the windshield. When the

HEATING, VENTILATING, AND DEFROSTING SYSTEM

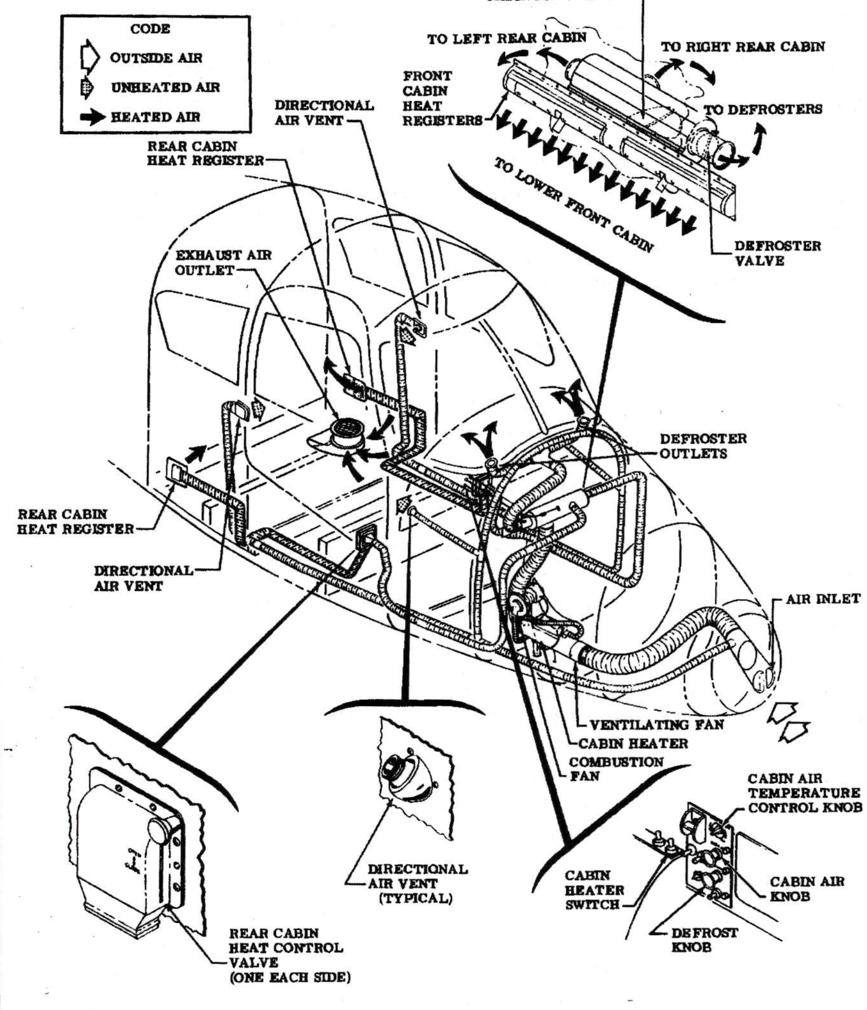


Figure 1-6. Heating, Ventilating and Defrosting System

SAMPLE PROBLEM

Example for an aircraft with a licensed empty weight of 2965.5 lbs, a moment of 100.8 lb. inches, 24 qts. of oil, a pilot and front seat passenger, three rear seat passengers, 100 gals. of fuel in the main tanks, no fuel in the auxiliary tanks, and 180 lbs. of baggage.

NOTE

The circled numbered steps in this example correspond with the circled numbered points on the Loading Chart and Center of Gravity Envelope.

	Weight in lbs.	Moment in thousands of lb. inches. (Obtained from Loading Chart.)
● OBTAIN EMPTY WEIGHT AND MOMENT FROM AIRCRAFT WEIGHT AND BALANCE SHEET.	2965.5	100.8
● OIL (24 QTS. x 1.875 LBS. = 45 LBS.)	45.0	0.0
● PILOT AND FRONT SEAT PASSENGER (170 LBS. + 170 LBS. = 340 LBS.)	340.0	12.6
● REAR SEAT PASSENGERS (170 LBS. + 170 LBS. + 170 LBS. = 510 LBS.)	510.0	36.2
● FUEL (MAIN TANKS)(100 GALS. x 6 LBS. = 600 LBS.). .	600.0	21.0
● BAGGAGE	180.0	19.0
● TOTAL TAKE-OFF WEIGHT AND MOMENT	4640.5	189.6
● SUBTRACT TOTAL FUEL LISTED IN STEP ●	-600.0	-21.0
● ADD MINIMUM FUEL RESERVE (40 GALS. x 6 LBS. = 240 LBS.)	+240.0	+8.4
● TOTAL WEIGHT AND MOMENT WITH MINIMUM FUEL RESERVE	4280.5	177.0

● LOCATE VALUES OF STEPS ● AND ● ON THE CENTER OF GRAVITY ENVELOPE. SINCE THE POINTS FALL WITHIN THE ENVELOPE, THE ABOVE LOADING MEETS ALL BALANCE REQUIREMENTS.

WARNING

IF EITHER OR BOTH POINTS DO NOT FALL WITHIN THE ENVELOPE, THE LOAD OF THE AIRCRAFT MUST BE REARRANGED BEFORE TAKE-OFF.

NOTE

The above problem is an example of only one of many different loading configurations. To best utilize the available payload for each aircraft, the loading charts should be consulted to determine proper load distribution.

Figure 5-3.

planned, the airplane should be loaded to less than maximum take-off gross weight to permit landing at 4600 pounds or less. Under emergency conditions, landings may be made at gross weights above 4600 pounds without danger of structural failure, and with an adequate margin of safety, if the sinking rate of the airplane is held at or below the maximum given for the airplane weight. The maximum allowable sinking rate for 4700 pounds gross weight is 568 feet/minute, and for 4600 pounds gross weight is 590 feet/minute. These descent speeds are based on a maximum limit load factor of 3.8 on the landing gear. At 4700 pounds gross weight, the airplane is approved for flight load factors up to 3.8.

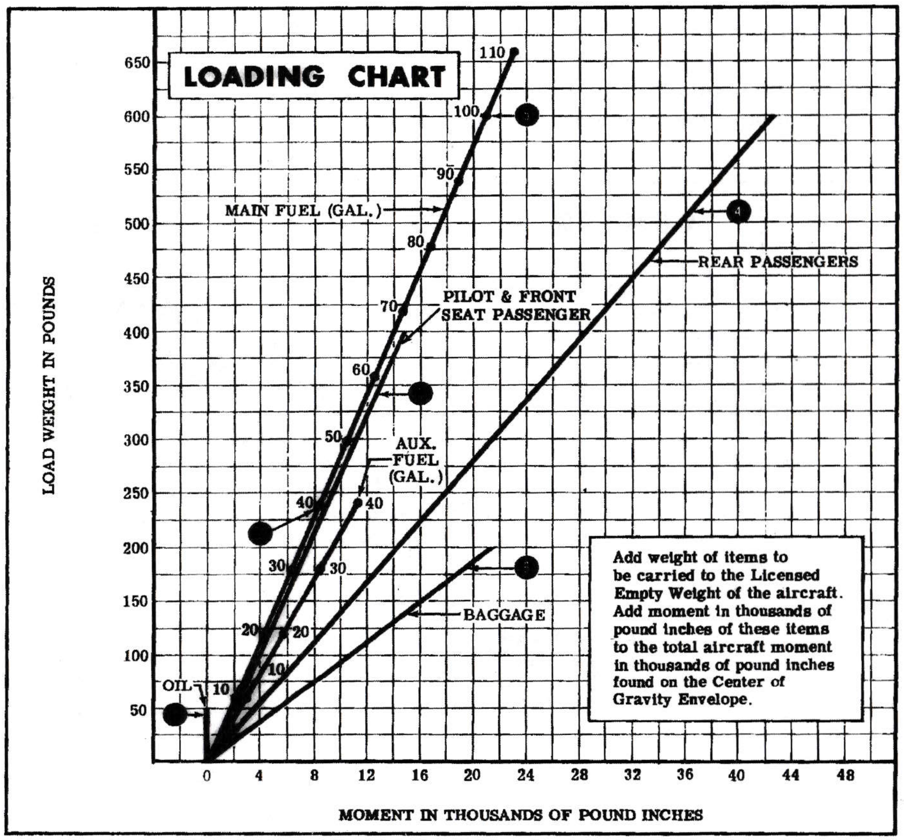


Figure 5-2.

knob is pushed all the way in, air flow to the defroster outlets is shut off. The knob may be set in any intermediate position to regulate the quantity of air used for defrosting or defogging.

CABIN AIR KNOB. (See figure 1-6).

The air flow to all cabin heat registers is controlled by operating a push-pull type cabin air knob located on the right switch and control panel. The knob is labeled CABIN AIR. When the knob is pulled out, air flows to all heat registers in the cabin except the two defroster outlets. Air flow to the heat registers is completely shut off by pushing the knob all the way in. The knob may be set in any intermediate position to regulate the quantity of air to the cabin heat registers.

FRONT COMPARTMENT HEAT REGISTERS.

One heat register is located just forward of each set of rudder pedals to provide heated air fôr the pilot and front seat passenger. Each register incorporates a slide valve with a tab for toe operation. The valves are OPEN when the tabs are in the inboard position and CLOSED when the tabs are moved to the outboard position. The valves may be placed in any intermediate position to regulate the quantity of air passing through the registers.

REAR COMPARTMENT HEAT REGISTER CONTROL VALVES.

Two rear compartment heat register control valves are installed on the aft side of the front spar to provide control of air flow through the heat registers located in each cabin wall just aft of the rear seat. These valves may be adjusted by hand or foot. The valves are OPEN when the control knob is in the up position.

OVERHEAT WARNING LIGHT.

An amber overheat light is located on the instrument panel just below the clock, and is labeled HEATER-OVERHEAT, T & B TEST. When the overheat warning light illuminates, it indicates that the heater overheat switch has been actuated and opened the heater ignition, fuel control, combustion blower and heater fuel pump electrical circuits and has closed the warning light circuit. This condition occurs only when the temperature of the air in the heater exceeds 325° F and the heater will not operate until a landing can be made and the overheat switch reset. The overheat switch is mounted on the aft end of the heater which is located in the nose of the fuselage to the right of the nose wheel well. To reset the overheat switch, press the reset button on the switch.

NOTE

To determine the reason for the malfunction, the heater should be inspected thoroughly prior to resetting the overheat switch.

HEATER OPERATION FOR HEATING AND DEFROSTING.

The heater is operated for heating and windshield defrosting in accordance with the following steps:

1. Battery switch — ON.

2. Cabin air knob — Full out.
3. Defrost knob — Adjust as desired (if windshield defrosting is desired).
4. Cabin air temperature control knob — Full clockwise to MAX.
5. Cabin heater switch — HEAT.
6. Heat registers — OPEN (as desired).

NOTE

Warm air should be felt coming out of the heat registers within one minute. If the heater does not start, return the heater switch to OFF, and check the circuit breaker labeled CABIN HEAT. Place the cabin heater switch in the HEAT position and attempt another start. If the heater still does not start, service is required and no further starting attempt should be made.

7. Cabin air temperature control knob — Adjust as desired (after heater has been operating for one minute).

HEATER SHUT-DOWN.

To shut-down the heater place the cabin heater switch in the OFF position.

VENTILATING SYSTEM.

In addition to the ventilation provided by the cabin heating system, a separate ventilation system is provided which obtains ram air from the air inlet at the nose of the airplane, and ducts it to four air vents. The ventilating system is operative in flight only, since it depends entirely on ram air pressure. For ground ventilation, the ventilating fan of the heating system should be utilized.

AIR VENTS.

Four manually-adjustable air vents are provided to control the amount of fresh, ventilating air entering the cabin. Two of these air vents are located on the lower corners of the instrument panel for use by the occupants of the front seats. Two additional air vents are located, one on each wall, in the rear cabin compartment for use by the rear seat passengers. The volume of air is regulated by turning a knurled ring which circumscribes the air vent opening. The air vents are OPEN when the knurled ring is rotated counterclockwise, and CLOSED when rotated clockwise. The air vent is mounted in a socket so that it can be positioned to direct air as desired.

LIGHTING EQUIPMENT.

NAVIGATION LIGHTS.

Conventional wing tip and tail navigation lights are provided. A resistor is included in the navigation light circuit which dims the landing gear position indicator lights when the navigation lights are ON. This aids in subduing glare in the cabin during night operation. A blinker is also installed in the circuit to turn the lights on and off at regular intervals when the navigation lights switch is ON.

The navigation lights switch is located on the instrument panel just above the engine control pedestal.

CENTER OF GRAVITY LIMITATIONS.

The center of gravity envelope, located at the end of this section, shows the center of gravity limitations of your airplane. A sample problem is also provided which shows one of the many possible loading arrangements. By using the sample problem as a guide, you can determine if any particular loading configuration is within the balance requirements of your airplane. If the forward and rear c. g. points, when plotted on the center of gravity envelope, fall within the envelope, your airplane meets all balance requirements.

WEIGHT LIMITATIONS.

The maximum take-off gross weight for this airplane is 4700 pounds. The maximum landing gross weight is 4600 pounds. When loaded to maximum take-off gross weight, it takes approximately 40 minutes to use the 16.7 gallons of fuel (100 pounds) required to lighten the airplane to the maximum landing gross weight of 4600 pounds. If a flight of shorter duration than 40 minutes is

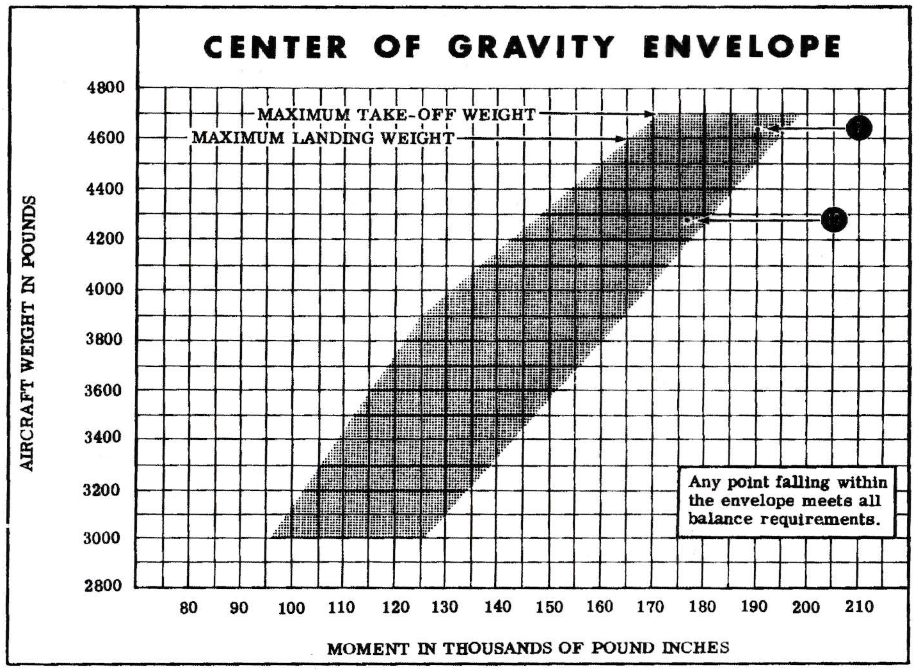


Figure 5-1.

Maximum Speed, Landing Light Extended .... 160 mph
Maximum Speed, Pilot's Window Open .... 130 mph
Maneuvering Speed* .... 164 mph

*(The maximum speed at which you can use abrupt control travel or fly through extremely turbulent air without exceeding the design load factor.)

AIRSPEED INDICATOR INSTRUMENT MARKINGS.

The following chart lists the certificated true indicated airspeed (TIAS) limitations for the airplane.

Never Exceed (glide or dive, smooth air) .... 248 mph (red line)
Caution Range .... 200-248 mph (yellow arc)
Normal Operation Range .... 84-200 mph (green arc)
Flap Operating Range (0°-45°) .... 74-140 mph (white arc)

ENGINE OPERATION LIMITATIONS.

Maximum Power and Speed (for all operations) .... 240 bhp at 2600 RPM

ENGINE INSTRUMENT MARKINGS.

OIL TEMPERATURE GAGES.

Normal Operating Range .... 75-225° (green arc)
Maximum Temperature .... 225° (red line)

OIL PRESSURE GAGES.

Idling Pressure .... 10 psi (red line)
Normal Operating Range .... 30-60 psi (green arc)
Maximum Pressure .... 100 psi (red line)

FUEL PRESSURE GAGES.

Normal Operating Range .... 9-15 psi (green arc)
Minimum and Maximum Pressures .... 9 and 15 psi (red line)

MANIFOLD PRESSURE GAGE.

Normal Operating Range .... 15-24 in. Hg (green arc)

CYLINDER HEAD TEMPERATURES.

Normal Operating Range .... 275-470° F (green arc)
Maximum Temperature .... 470° F (red line)

TACHOMETER.

Normal Operating Range .... 2100-2450 rpm (green arc)
Maximum (Engine rated speed) .... 2600 rpm (red line)

The switch is labeled NAV LT, and is ON in the up position and OFF in the down position.

The wing tip navigation lights may be checked at night for operation by observing the lights through the small "peep window" just inboard of each light.

LANDING LIGHTS.

A retractable landing light is mounted in the bottom of the left wing as standard equipment. Provision is made for an identical light under the right wing as optional equipment. Each light is controlled by a separate three-position switch located on the instrument panel just above the engine control pedestal. The switches are labeled L LDG LT (left landing light) and R LDG LT (right landing light), and their positions are ON (up position), OFF (middle position), and RETRACT (down position). When the switches are moved to ON, the landing lights extend and automatically illuminate when fully extended. When in the extended position, the lights may be turned off or on as desired by moving the switches to OFF (middle position) and ON (up position). When the switches are moved to RETRACT (down position), the landing lights will automatically go off, if on, and begin retracting. The landing lights will automatically stop when they reach the fully retracted position.

TAXI LIGHT (OPTIONAL EQUIPMENT).

An optional taxi light may be installed on the nose wheel shock strut to provide illumination of the area just forward of the airplane during night ground operation and taxiing. The taxi light switch is mounted on the instrument panel just above the engine control pedestal. The switch, labeled TAXI LT, is ON in the up position and OFF in the down position.

ROTATING BEACON (OPTIONAL EQUIPMENT).

A rotating beacon may be installed as optional equipment on top of the fuselage just forward of the dorsal fin. The light serves as an anti-collision light, and rotates through 360° at all times when the rotating beacon switch is ON.

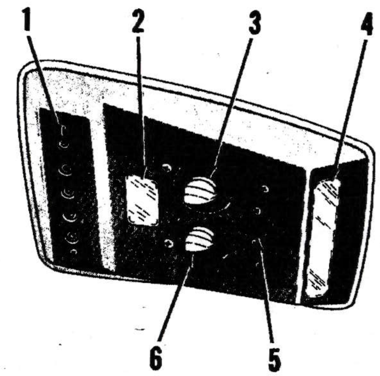
NOTE

The rotating beacon should be turned off during flight through clouds or haze to prevent distracting glare.

A rotating beacon switch is provided when the optional rotating beacon is installed on your airplane. The switch, labeled ROT BCN, is located on the instrument panel just above the engine control pedestal, and is ON in the up position and OFF in the down position.

INSTRUMENT AND RADIO CONTROL PANEL LIGHTS.

All instruments mounted on the instrument panel are illuminated by post type lights. The control panels for optional radio communication and



1. Oxygen System Outlet Couplings (Optional Equipment)
2. Front Dome Light
3. Overhead White Instrument Panel Light Rheostat Knob
4. Overhead Red and White Instrument Panel Lights
5. Front Dome Light Switch
6. Overhead Red Instrument Panel Light Rheostat Knob

OVERHEAD CONSOLE PANEL

navigation systems are illuminated by both post type and edge mounted lights depending upon the type of installation in your airplane. The instrument light circuits are controlled by two separate lighting rheostat knobs. Lighting for all flight instruments and radio control panels is controlled by the knob labeled FLIGHT INST-RADIO, and lighting for all engine instruments and other system instruments is controlled by the knob labeled ENGINE INST. These knobs are located on the left switch and control panel, and are OFF in the extreme counterclockwise position. As the knobs are rotated clockwise, the lights are ON, and their intensity is increased. With separate instrument lighting control knobs, the pilot may reduce the intensity of all engine instrument lights, and leave only the flight instrument lights brightened, thus reducing glare to a minimum.

Additional instrument panel lighting is provided by two overhead red lights, and one overhead white light mounted in the forward end of the overhead console panel on the cabin ceiling. The two overhead red instrument panel lights are controlled by the left rheostat knob located halfway back on the overhead console panel. The overhead white instrument panel light is controlled by the right rheostat knob on the overhead console panel. The lights are OFF when the knobs are rotated full counterclockwise. As the knobs are rotated clockwise, the lights are ON, and their intensity is increased. The red lights are provided as an emergency source of instrument lighting in case of malfunction of the regular instrument lighting circuits. The white light is extremely useful during night flights in thunderstorms as it may be turned on to reduce the glare and blinding effect of lightning flashes.

SWITCH AND CONTROL PANEL LIGHTS.

The left and right switch and control panels are illuminated by post type lights. The lights are arranged to give maximum illumination with as few lights as possible to keep glare during night operation to a minimum.

SECTION V

OPERATING LIMITATIONS

OPERATIONS AUTHORIZED.

Your airplane, with standard equipment as certificated under CAA Type Certification No. 3A10, is approved for day and night operation under VFR or IFR.

MANEUVERS — NORMAL CATEGORY.

The airplane exceeds the requirements of the Civil Air Regulations, Part 3, set forth by the United States Government for airworthiness. Spins and aerobatic maneuvers are not permitted in normal category airplanes in compliance with these regulations. In connection with the foregoing, the following gross weights and flight load factors apply:

Maximum Take-off Gross Weight . . . . 4700 lbs.
Flight Load Factor*
Flaps Up . . . . +3.8 −1.52
Flaps Down . . . . +2.0

*The design load factors are 150% of the above and in all cases the structure exceeds design loads.

Your airplane must be operated in accordance with all CAA approved markings, placards and check lists in the airplane. If there is any information in this section which contradicts the CAA approved markings, placards and check lists, it is to be disregarded.

AIRSPEED LIMITATIONS (TIAS).

Maximum Structural Cruising Speed . . . . 200 mph
(level flight or climb)
Maximum Speed
Flaps Extended 15° . . . . 160 mph
Flaps Extended 15°-45° . . . . 140 mph
Maximum Speed, Gear Extended . . . . 140 mph

The lights are controlled by a single rheostat knob labeled SWITCH PNL—FUEL SEL. The lights are OFF when the knob is rotated full counterclockwise. As the knob is rotated clockwise, the lights are ON, and their intensity is increased.

FUEL SELECTOR VALVE LIGHT.

The fuel selector valve handles and the lower pedestal are illuminated by a light mounted on the forward side of the front spar. The light is controlled by the rheostat knob labeled SWITCH PNL—FUEL SEL. The light is OFF when the knob is rotated full counterclockwise. As the knob is rotated clockwise the light is ON, and its intensity is increased.

MAGNETIC COMPASS LIGHT.

The magnetic compass, mounted on the windshield centerstrip, contains an integrally mounted light for illumination during night operations. The light is controlled by the rheostat knob labeled COMPASS. The light is OFF when the knob is rotated full counterclockwise. When the knob is rotated clockwise, the light is ON, and its intensity is increased.

DOME LIGHTS.

Two dome lights are mounted in the cabin ceiling and provide illumination of the entire cabin area. The front dome light is mounted in the overhead console panel. The rear dome light is mounted directly over the rear seat. Each light is controlled by a slide switch.

BAGGAGE COMPARTMENT LIGHT.

A light is provided to illuminate the baggage compartment as an aid to loading and unloading the compartment at night. The light is mounted just above the baggage compartment door. A slide switch is provided to operate the light.

LEFT WING LIGHT (OPTIONAL EQUIPMENT).

An optional left wing light may be installed on the outboard side of the left engine nacelle. The light is especially useful on night flights during cold weather as it may be turned on to illuminate the wing leading edge so that ice formations may be observed, and corrective action taken.

The left wing light switch is located on the right switch and control panel. The switch is labeled L WING LIGHT, and is ON in the up position, and OFF in the down position.

OXYGEN SYSTEM (OPTIONAL EQUIPMENT).

An optional oxygen system may be installed in your airplane to permit flight operations at altitudes where the atmospheric oxygen is insufficient for safe pilot and passenger consumption. The system will automatically supply the demands of a pilot and four passengers for an average of better than two hours (refer to the Oxygen Duration Chart, figure 1-7). System components include a high pressure oxygen cylinder utilizing an external filler valve, a pressure gage, automatic pressure regulator, five continuous flow couplings and connecting lines. Hoses incorporating flow indicators and disposable face masks are also provided. Oxygen is stored under a pressure of 1800 PSI in the oxygen cylinder located just aft of the baggage compartment, and is reduced to a breathing pressure by the preset automatic pressure regulator before being routed to the continuous flow couplings located in the overhead console panel in the cabin ceiling. Oxygen is automatically routed through the continuous flow couplings, hoses, and flow indicators to the face masks whenever the hoses are connected to the continuous flow couplings.

FACE MASKS.

The face masks used with this oxygen system are of the disposable, partial-rebreathing type. They can be re-used many times if marked for identification by the frequent user, or can be thrown away after each use Normal conversation, including use of the microphone, can be carried on while wearing the masks. Each face mask receives oxygen through a rubber hose into a rebreather bag. On exhalation, the first air exhaled (which is rich in oxygen because it never reaches the lungs) is exhaled into the bag, combining with the incoming oxygen. As soon as the bag is filled, the remainder of the exhaled breath (which is low in oxygen, because it has been in the lungs) is exhaled to the atmosphere through the upper sides of the bag. On inhalation, the user inhales the oxygen-enriched contents of the bag. When the bag is emptied, air is drawn through the upper sides of the bag to finish satisfying the inhalation volume of the user.

OXYGEN FLOW INDICATORS.

An oxygen flow indicator is provided in each face mask hose. It provides a visual indication that oxygen is flowing to the mask in that a red indicator disappears when oxygen is flowing. The oxygen flow indicators operate in any position.

OXYGEN PRESSURE GAGE.

An oxygen pressure gage is centrally mounted on the aft portion of the utility shelf when the optional oxygen system is installed in your airplane. The gage indicates oxygen cylinder pressure, and should indicate 1800 PSI when the system is fully charged. When the pressure indication is reduced to 300 PSI, the oxygen system should be recharged.

OXYGEN SYSTEM OPERATION.

The oxygen system operation is automatic in that no manual regulation is required to compensate for change in altitude, or to shut off the oxygen flow when the system is not in use. To operate the system, proceed as follows:

Prior to flight:

1. Oxygen cylinder shut-off valve — Check OPEN (valve handle rotated full counterclockwise).
2. Oxygen pressure gage — Check for sufficient pressure for anticipated requirements of the flight (see Oxygen Duration Chart, figure 1-7).

8. Depress button on hinged crank link, and stow the hand crank in the stowage clip.
9. Readjust seat to the upright position if desired for landing.

NOTE

The landing gear should never be retracted by use of the manual system as undue loads will be imposed and cause excessive wear on the cranking mechanism. If the gear will not retract electrically, land and have the malfunction corrected.

FLIGHT PROCEDURE WITH OPEN CABIN DOOR.

Airflow over the curved cabin door produces negative pressure over the door surface, resulting in an outward pull force that increases with speed. Consequently, if the door should open accidentally in flight because of insecure latching, it will float outward enough to disturb the airflow over the tail. This effect is shown by moderate buffeting of the tail. This buffeting attains its maximum with gear up, flaps 20°, and 80 mph, and occasionally produces a noticeable nose down pitch and possibly a slight roll as the door pops open. Although these motions are controllable, it is best to avoid this situation close to the ground. Therefore, checking the door handle before take-off is important.

on the extent of damage to nose and main gear doors, tip tanks, nacelle firewalls, fuselage bottom and wings. However, it is believed that the airplane would settle rather slowly, especially with empty fuel tanks.

SYSTEM EMERGENCY PROCEDURES.

FUEL SYSTEM — EMERGENCY OPERATION.

In the event of an engine-driven fuel pump failure, turn the fuel boost pump switch (on the inoperative side) to "ON." This pump will develop normal fuel pressure.

IMPORTANT

In the event that both an engine-driven fuel pump and a boost pump fail, fuel pressure may be supplied to the failing engine by feeding it from the tank with the operative fuel boost pump. The engine with the operative engine-driven fuel pump should be fed from the tank containing the inoperative fuel boost pump. This will permit all fuel to be used from the main tanks. However, it is impossible to use fuel from the auxiliary fuel tank on the same side as the inoperative engine-driven fuel pump.

Land as soon as practical if fuel pressure indication remains below normal.

LANDING GEAR SYSTEM — EMERGENCY OPERATION.

When the landing gear will not extend electrically, it may be extended manually in accordance with the following steps:

1. Before proceeding manually, check landing gear circuit breakers with landing gear switch "DOWN." If circuit breakers need to be reset, allow 3 minutes for them to cool before resetting.
2. If circuit breaker is not tripped, put landing gear switch in the "OFF" (middle) position.
3. Pull upward on the seat right adjustment handle to tilt seat back for easier hand cranking.
4. Remove hand crank from stowage clip.
5. Extend hand crank until hinged link is straight by rotating crank slightly clockwise to engage extension mechanism gear teeth.
6. Crank gear down approximately two turns past the point where the gear down indicator light (green) comes on (approximately 60 turns).

NOTE

During manual extension of the gear, never release the handcrank to let it turn freely of its own accord.

7. Check gear down indicator light and gear warning horn with throttle retarded.

During Flight:

1. Mask and hose — Select from plastic bag on utility shelf. If mask and hose are not connected, attach by inserting short plastic tube on mask securely into end of rubber hose.
2. Mask — Attach in place over face.

IMPORTANT

It is recommended that no smoking be permitted when using the oxygen system.

3. Select oxygen continuous flow coupling in overhead console panel and insert fitting of mask hose into coupling.

NOTE

The extreme left coupling in the overhead console panel is labeled PILOT, and is intended for his use. It contains a .023 diameter orifice which meters approximately double the volume of oxygen metered to the four remaining passenger cou-

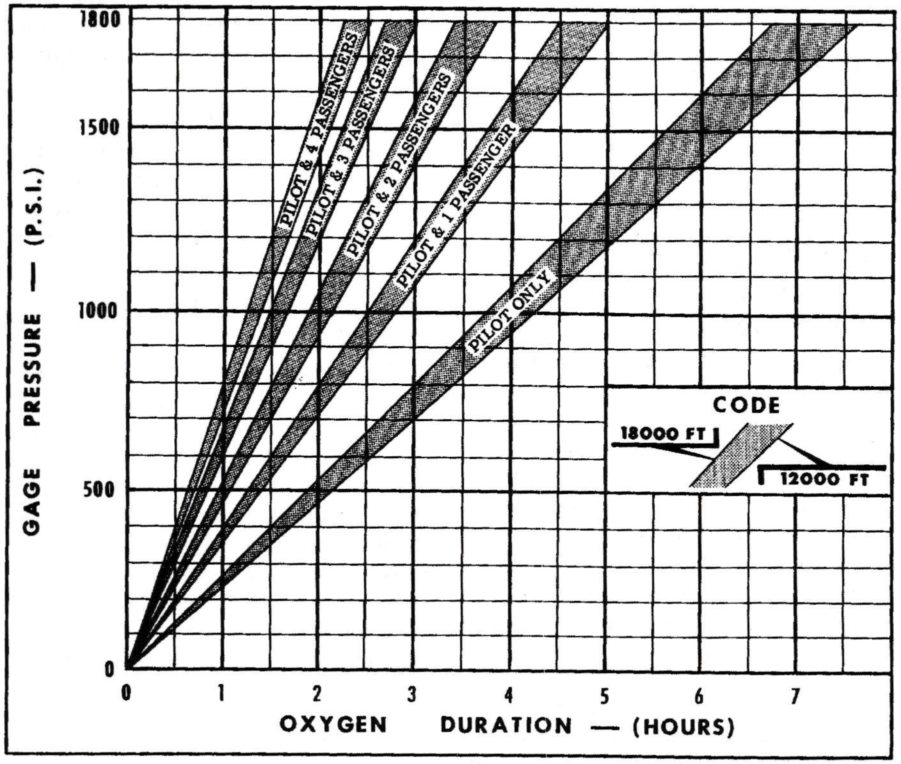


Figure 1-7. Oxygen System Duration Chart

plings. The passenger couplings contain .016 diameter orifices. However, the pilot's couplings may be used for any of the passengers who desire additional oxygen.

4. Oxygen flow indicator — Check that red indicator disappears when hose is inserted into coupling to insure that oxygen is flowing.
5. Disconnect mask hoses from overhead console panel when not in use.

OXYGEN SYSTEM SERVICING.

Refer to the Servicing Diagram, Figure 6-1, for the type of oxygen to be used when servicing the oxygen system.

PROPELLER ANTI-ICE SYSTEM (OPTIONAL EQUIPMENT).

A propeller anti-ice system may be installed as optional equipment in your airplane. System components include an anti-ice fluid reservoir, a pump, propeller spinner slinger rings, connecting lines, a main power switch and a rheostat. The reservoir, which holds four and one-half quarts of fluid, and the anti-ice fluid pump are located in the right wing just outboard of the nacelle. The pump is controlled by a two-position, toggle type main power switch and a rheostat switch, wired in series. Both switches, labeled PROP ANTI-ICE, are mounted on the right switch and control panel. The main power switch is ON in the up position and OFF in the down position, and must be turned on prior to operation of the rheostat switch. Index, markings are provided for the control knob of the rheostat switch. The markings are MIN (minimum pump flow) ½, ¾, and MAX (maximum pump flow), and the rheostat control knob may be adjusted to any setting between these marks to adjust the speed and flow of the pump. When the pump is operating, anti-ice fluid is pumped through lines to the propeller spinner slinger rings which distribute the fluid to the propeller blades.

NOTE

The pump's maximum output (extreme clockwise position of the rheostat knob) is approximately one quart every four minutes per propeller.

PROPELLER ANTI-ICE SYSTEM OPERATION.

To operate the propeller anti-ice system, proceed as follows:

1. Anti-ice main power switch — ON (up position).
2. Anti-ice rheostat knob — MAX (full clockwise position) for one minute to wet blades just before entering suspected icing conditions.
3. Anti-ice rheostat knob — MIN (counterclockwise position) and note sound of ice against the fuselage.

NOTE

A slush sound against the fuselage is desired, and fluid should be added if necessary until the slushing sound is heard. Sharp

8. Mixture levers — "IDLE CUT-OFF" (both engines).
9. Use full aileron in landing roll to lighten the load on the defective landing gear.
10. Apply brake only on the operative landing gear to maintain directional control and minimize the landing roll.
11. Fuel selector valve handles — "OFF."
12. Evacuate the airplane as soon as it stops.

LANDING WITH DEFECTIVE NOSE GEAR.

Attempt to extend the gear manually using the procedure described in paragraph LANDING GEAR SYSTEM — EMERGENCY OPERATION. If a malfunction is then verified by observers in the control tower or other aircraft, prepare for a wheels down landing as follows:

1. Move disposable load to baggage compartment and passengers to available rear seat space.
2. Select a smooth hard surface or sod runway.
3. Landing gear switch — "DOWN."
4. Approach at 95 mph with flaps down 20°.
5. All switches except ignition switches — "OFF."
6. Land in a slightly tail low attitude.
7. Mixture levers — "IDLE CUT-OFF" (both engines).
8. Ignition switches — "OFF".
9. Hold nose off throughout ground roll.
10. Fuel selector valve handles — "OFF".
11. Evacuate the airplane as soon as it stops.

DITCHING.

1. Plan approach into the wind if wind is high and seas are heavy. With heavy swells and light wind, land parallel to swells being careful not to allow a wing tip to hit first.
2. Approach with the landing gear retracted, flaps 45°, and enough power to maintain approximately 300 ft/min. rate of descent at approximately 95 mph at 3500 lbs. to 108 mph at 4600 lbs. gross weight.
3. Maintain a continuous descent until touchdown to avoid flaring and touching down tail first, pitching forward sharply, and decelerating rapidly. Strive for initial contact at fuselage area below rear cabin section (point of maximum longitudinal curvature of fuselage.)

It is expected that the airplane will skip clear of the water once or twice using the optimum technique outlined above. If the final contact is made in the desired level attitude, the nose will submerge completely during two or three seconds of moderately abrupt deceleration, and then the airplane will float for a short time in a nearly level attitude. The length of floatation time will depend

LANDING WITH FLAT NOSE GEAR TIRE.

If a blowout occurred on the nose gear tire during take-off, prepare for a landing as follows:

1. Landing gear switch — Leave "DOWN."

IMPORTANT

Do not attempt to retract the landing gear if a nose gear tire blow-out occurs. If retraction is attempted, the nose gear tire may be distorted enough to bind the nose wheel strut within the wheel well and prevent later gear extension.

2. Move disposable load to baggage compartment and passengers to available rear seat space.
3. Flaps switch — "DOWN." Extend flaps from 0° to 20° as desired.
4. Land in a nose high attitude with or without power.
5. Maintain back pressure on control wheel to hold nose wheel off the ground in landing roll.
6. Use minimum braking in landing roll.
7. Throttles — Retard in landing roll.
8. As landing roll speed diminishes, hold control wheel fully aft until airplane is stopped.
9. Avoid further tire damage by holding additional taxi to a minimum.

LANDING WITH DEFECTIVE MAIN GEAR.

Attempt to extend the gear manually using the procedure described in paragraph LANDING GEAR SYSTEM — EMERGENCY OPERATION. If a malfunction is then verified by observers in the control tower or other aircraft, reduce the fuel load in the tank on the side of the faulty main gear as explained in paragraph LANDING WITH FLAT MAIN GEAR TIRE. When fuel load is reduced, prepare to land as follows:

1. Fuel selector valve handles — "RIGHT MAIN" for right engine and "LEFT MAIN" for left engine.
2. Select a wide hard surface runway, or if necessary a wide sod runway. Select a runway with crosswind from the side opposite the defective landing gear if a crosswind landing is required.
3. Landing gear switch — "DOWN."
4. Flaps switch — "DOWN." Extend flaps to 30°.
5. In approach, align airplane with edge of runway that is opposite from defective landing gear allowing room for a ground loop in landing roll.
6. Battery switch — "OFF."
7. Land slightly wing low toward the operative landing gear and lower the nose wheel immediately for positive steering.

bangs indicate that the ice is solid, and more fluid is required.

Under average icing conditions, the above procedure will provide approximately one-half hour of anti-icing operation before the fluid is exhausted.

PROPELLER ANTI-ICE SYSTEM SERVICING.

Refer to the Servicing Diagram, Figure 6-1, for the propeller anti-ice fluid specification.

DE-ICE SYSTEM (OPTIONAL EQUIPMENT).

A de-icing system for the wings and horizontal stabilizer is available as optional equipment. Air pressure and suction is supplied by two engine-driven air pumps (one on each engine). Check valves in the lines prevent loss of air in the event one pump fails. The control for this system is an electrical switch mounted on the right switch and control panel. The switch, labeled DE-ICE, is ON in the up position and OFF in the down position. When the switch is turned on, it allows an electrical timer to control valves which distribute air pressure and suction to the boots in alternate impulses. When the system is not in operation, the pumps are continuously supplying suction to hold down the boots in flight.

A left wing light may be installed as optional equipment on your airplane, and used in conjunction with the de-ice system. Refer to Lighting Equipment, Left Wing Light, for further discussion of the light.

DE-ICE SYSTEM OPERATION.

Ice may be removed from the wing and horizontal stabilizer by use of the de-ice system as follows:

1. Left wing light switch — ON (when icing conditions are anticipated). Observe build up of ice on wing leading edge.
2. De-ice switch — ON (after ice has accumulated to a thickness of one-fourth inch).
3. De-ice switch — OFF (after all ice is broken off).

NOTE

Repeat the cycle as necessary. However, continuous flight operation at an icing level is not recommended. You cannot obtain the utmost performance from any airplane in icing conditions, therefore, it is advisable that upon encountering icing condition you immediately seek a non-icing level.

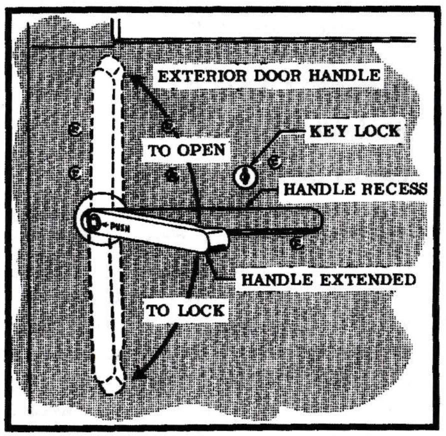
MISCELLANEOUS EQUIPMENT.

CABIN DOOR.

A large cabin door, incorporating a fixed window, is provided on the right side of the airplane for passenger entrance and exit. It is equipped with a key lock, a flush type door handle on the outside, a conventional type door handle on the inside, and a door stop. The key lock, located above the outside door handle, is operated by turning the key approximately 180 degrees. The key which operates the door lock also operates the baggage door lock.

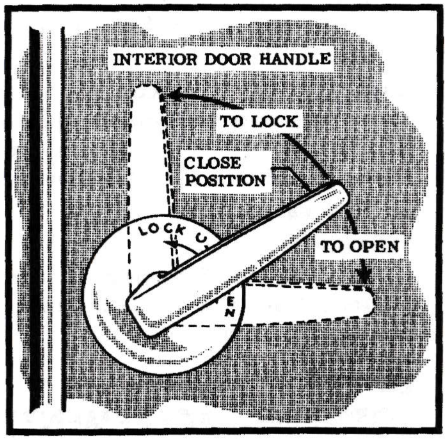
EXTERIOR DOOR HANDLE.

A flush, pop-out type, exterior door handle is installed on the outside of the cabin door. The cabin door is opened from the outside by pushing on the aft end of the exterior door handle, pulling the handle out, and rotating it in a counterclockwise direction. The door handle should be returned to its recess after the door is opened. When closing the cabin door from the outside, the interior door handle should first be placed in the CLOSE position. The cabin door may then be pushed shut, and it will latch securely. The cabin door may be locked from the outside by grasping the exterior door handle in the usual manner, and rotating it clockwise to its stop (approximately 90 degrees), then returning it to its recess.



INTERIOR DOOR HANDLE.

The interior door handle, located below the cabin door window near the forward edge of the door, has



three positions marked LOCK, CLOSE, and OPEN. The cabin door is opened from inside the cabin by rotating the interior door handle clockwise to the OPEN position and pushing the door out until it engages the door stop provided at the bottom edge of the door. The cabin door may be closed from inside the cabin by placing the interior door handle in the CLOSE position, grasping the door arm rest, and pulling the door closed. The door may be locked from inside the cabin by first checking that the door is securely latched, then rotating the interior door handle in a counterclockwise direction to the LOCK position.

NOTE

The cabin door must be securely locked before take-off as it is difficult to lock in flight.

EMERGENCY EXIT.

The left rear window is provided as an emergency exit in that the whole

and increase engine speed to 2600 RPM.
2. Retract landing gear.
3. Reduce flap setting to 15°.
4. Climb at 109 mph (95 mph with obstacles directly ahead).
5. Trim airplane for single-engine climb.
6. Retract flaps as soon as all obstacles are cleared and a safe altitude and airspeed are obtained.

LANDING EMERGENCIES (EXCEPT DITCHING).

Landing emergencies including landing with a flat main gear tire, flat nose gear tire, defective main gear, and defective nose gear, and the corrective action to be taken in each condition, are described in the following paragraphs. During each condition, the landing approach is to be performed using normal throttle, mixture lever, and propeller pitch lever settings.

LANDING WITH FLAT MAIN GEAR TIRE.

If a blowout occurred during take-off, and the defective main gear tire is identified, proceed as follows:

1. Landing gear switch — "UP".
2. Fuel selector valve handles — Turn to main tank on same side as defective tire. Proceed to destination to reduce fuel load.

NOTE

Fuel should be used from this tank first to lighten the load on this wing prior to attempting landing if in-flight time permits. However, an adequate supply of fuel should be left in this tank so that it may be utilized during landing.

3. Fuel selector valves handles — "RIGHT MAIN" for right engine. "LEFT MAIN" for left engine (prior to landing).
4. Select a runway with a crosswind from the side opposite the defective tire if a cross wind landing is required.
5. Landing gear switch — "DOWN" (below 140 mph).
6. Check landing gear down indicator light (green) for indication.
7. Flaps switch — "DOWN". Fully extend flaps to 45°.
8. In approach, align airplane with edge of runway that is opposite from defective tire allowing room for mild turn in landing roll.
9. Land slightly wing low on side of inflated tire and lower nose wheel to ground immediately for positive steering.
10. Use full aileron in landing roll to lighten load on defective tire.
11. Apply brake only on the inflated tire to minimize landing roll and maintain directional control.
12. Stop airplane to avoid further tire and wheel damage unless active runway must be cleared because of other traffic.

FORCED LANDING. (Complete Engine Failure)

1. Feather propellers and rotate them to a horizontal position with starter if time permits.
2. Mixture levers in "IDLE CUT-OFF."
3. Fuel selector valve handles "OFF."
4. All switches "OFF" except battery switch.
5. Approach at 105 mph.
6. If field is smooth and hard, extend landing gear within gliding distance of field.
7. Extend flaps as necessary within gliding distance of field.

IMPORTANT

The glide path is extremely steep with flaps and gear down and propellers windmilling.

8. Turn battery switch "OFF."
9. Make a normal landing, keeping nose wheel off ground as long as practicable.
10. If terrain is rough or soft, plan a wheels up landing as follows:
    (a) Approach at 105 mph with gear and flaps retracted.
    (b) Extend flaps to 20° within gliding distance of field.
    (c) Turn battery switch "OFF."
    (d) Unlatch cabin door prior to flare-out.
    (e) Land in a slightly tail low attitude.
    (f) Attempt to hold tail low throughout slide.

SINGLE ENGINE LANDING.

1. Approach at 105 mph with excess altitude.
2. Delay extension of landing gear until within gliding distance of field.
3. Avoid use of flaps until landing is assured.
4. Decrease speed below 95 mph only if landing is a certainty.

NOTE

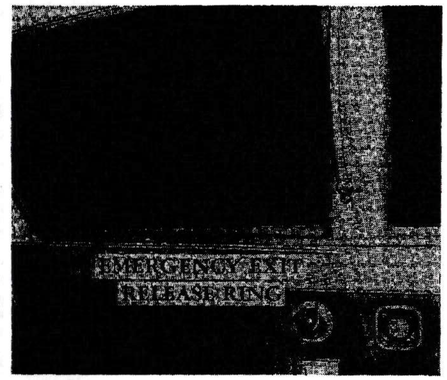
When speed drops below 95 mph, the airplane is usually committed to land because an immediate climb out is often difficult at any speed lower than the minimum safe single-engine climb speed.

5. Land with some excess speed to allow for gusts, poor technique, etc.
6. Maintain enough momentum to turn off the active runway without power because single-engine taxi is difficult at slow speed in certain wind conditions.

GO-AROUND. (SINGLE ENGINE)

1. If absolutely necessary and speed is above 95 mph, apply full throttle

window is jettisonable when the emergency release ring is pulled. The emergency release ring is mechanically connected to the window. The release ring is installed in a flush-mounted



box on the left cabin wall below the left rear window. The box contains a plexiglas cover drilled with a hole to facilitate its removal. The cover is marked EMERGENCY WINDOW RELEASE, PULL. The left rear window is marked EMERGENCY EXIT, PULL RING — PUSH WINDOW OUT.

COAT HANGER HOOKS.

Two coat hanger hooks are provided in the cabin ceiling above the back of the rear seat. Coats can be hung, full-length and wrinkle-free, between the back of the seat and the utility shelf, without interfering with the comfort of rear seat passengers.

BAGGAGE COMPARTMENT.

A baggage compartment is located aft of the rear seat. A door is provided just aft of the wing on the right side of the fuselage for access to the baggage compartment from outside of the airplane. A recessed push-button on the aft side of the door opens the baggage door. A lock is provided just forward of this push-button and is operated by the same key that operates the cabin door lock. The door is closed by pushing the door shut until the latch catches. Access to the baggage compartment is gained from inside the cabin by actuating the rear seat adjustment handle, and pulling the back of the rear seat forward and down. Illumination of the baggage compartment is provided by a baggage compartment light.

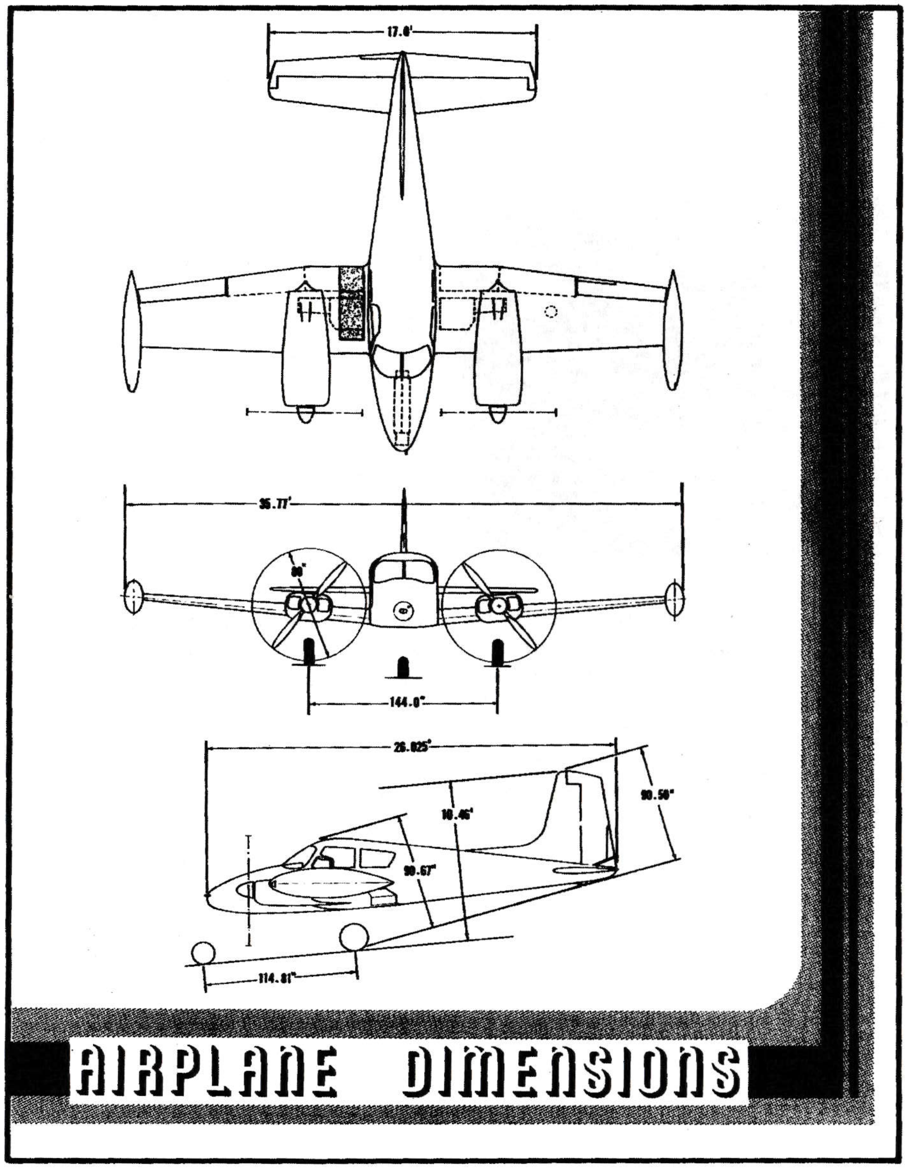


Figure 1-8.

NOTE

If start is unsuccessful, turn ignition and boost pump switches "OFF", retard mixture lever to "IDLE CUT-OFF", open throttle fully, and engage starter for several revolutions. Then repeat air start procedure.

10. Increase power slowly until cylinder head temperature reaches 200° F.

MAXIMUM GLIDE.

In the event of failure of both engines, a maximum gliding distance can be obtained by feathering both propellers, and maintaining 107 mph with the landing gear and wing flaps up. Refer to the Maximum Glide Diagram, Figure 4-2, for maximum glide data.

FORCED LANDING. (Precautionary Landing With Power)

1. Drag over selected field with flaps 15° and 95 mph airspeed, noting type of terrain and obstructions.
2. Plan a wheels down landing if surface is smooth and hard (pasture, frozen lake, etc.).
3. Execute a normal short field landing, keeping nose wheel off ground until speed is decreased.
4. If terrain is rough or soft, plan a wheels up landing as follows:
   (a) Approach with flaps down 20° at 95 mph.
   (b) Turn all switches "OFF" except ignition switches.
   (c) Unlatch cabin door prior to flare-out.

IMPORTANT

Be prepared for mild tail buffet as cabin door is opened.

   (d) Reduce power to a minimum during flare-out.
   (e) Prior to contact, turn ignition switches "OFF."

IMPORTANT

If flare-out is sustained with moderate power, cutting power suddenly will result in a hard landing. To avoid this reduce power to a minimum in flare out before turning ignition switches "OFF."

   (f) Land in a slightly tail low attitude.
   (g) Hold wheel fully back in initial slide to keep nacelles from possibly "digging in" in rough terrain.

NOTE

Airplane will slide straight ahead about 500 feet on smooth sod with very little damage.

6. Depress starter button.
7. After several engine revolutions, turn fuel boost pump "ON".
8. In cold weather, engage engine primer switch ½ second at a time if required.
9. After engine starts, turn fuel boost pump "OFF".

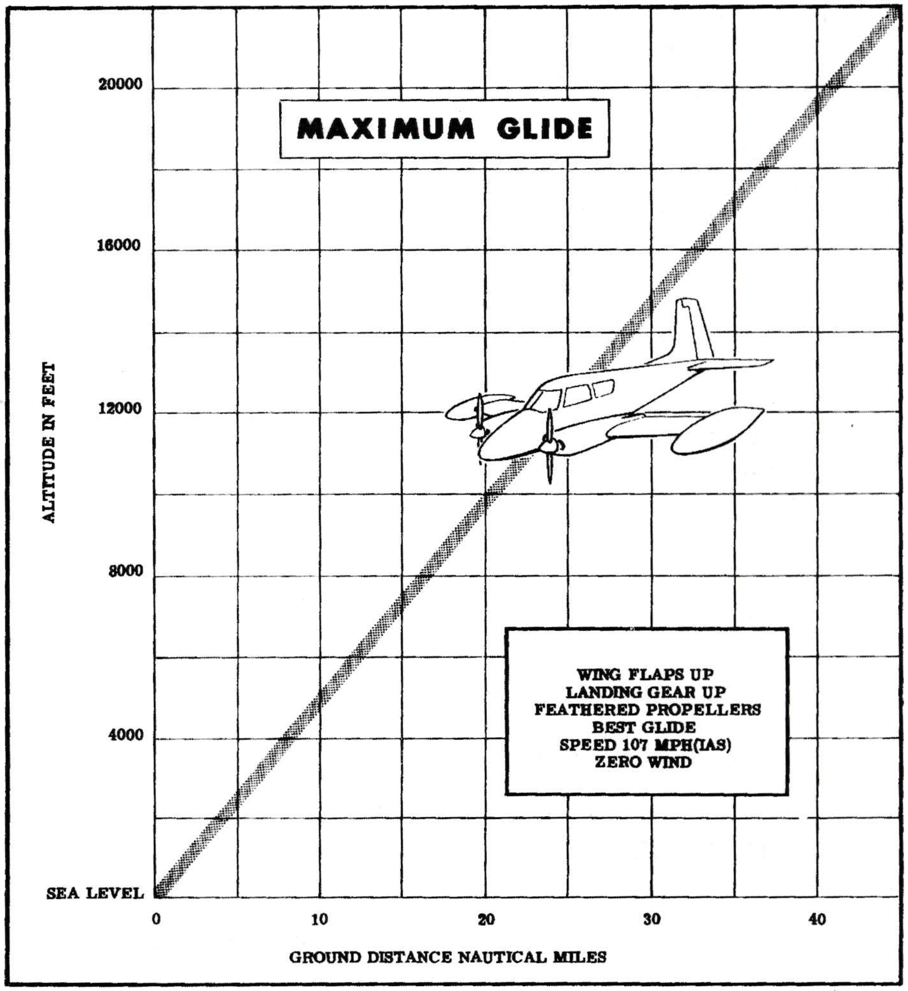


Figure 4–2. Maximum Glide

SECTION II

NORMAL PROCEDURES

AFTER FAMILIARIZING YOURSELF with the equipment of your airplane, your primary concern will be its operation. This section lists in Pilot's Check List form, the normal procedures necessary to operate your airplane efficiently and safely.

This section is intentionally condensed to include only normal "day to day flying" procedures, and is one of your best sources of normal flying information. It is supplemented by Section III, which contains a narrative description of operating procedures, and Section IV, which describes emergency procedures. This subdivision of information permits quick and easy reference to any flight procedure desired.

All airspeeds mentioned in Sections II, III, and IV are indicated airspeeds. Corresponding true indicated airspeeds may be obtained from the airspeed correction table in Section VII.

BEFORE ENTERING AIRPLANE.

1. Perform an exterior inspection (see figure 2-1).

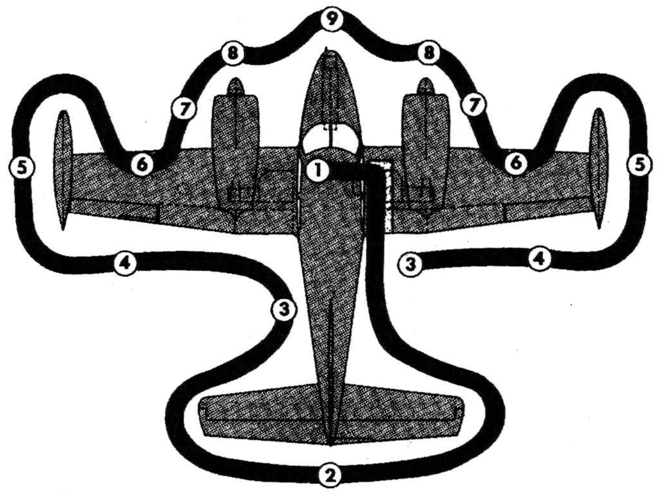
BEFORE STARTING ENGINE.

1. Adjust and lock seats in a comfortable position, and fasten safety belts.

IMPORTANT

After a seat is moved either forward or aft, it should be tested firmly to see that the locking pins are latched securely.

2. Lock cabin door.
3. Remove control lock if used and stow in glove compartment.
4. Check landing gear switch "DOWN."
5. Generator switches "ON."



(1) a. Remove control lock.
b. Turn master switch on momentarily to check fuel quantity gages.

(2) a. Remove rudder lock if installed.
b. Inspect elevator, rudder and trim tab hinges,and hinge and actuating rod bolts for general condition.
c. Disconnect tie down chain.

(3) a. Check static pressure source hole in fuselage for stoppage.
b. Check baggage door for security (right side only).

(4) a. Check aileron and tab hinges,and hinge and actuating rod bolts.

(5) a. Check main fuel tank filler cap and fairing cover for security.

(6) a. Check auxiliary tank filler cap and cover for security.
b. Inspect battery compartment cover panel for security (left side only).
c. Disconnect tie down chain.

(7) a. Check oil level for a minimum of nine quarts or twelve quarts for extended flights.
b. Check landing gear for proper tire and strut inflation and gear door security.
c. On first flight of day, drain a two-ounce quantity of fuel from the strainer. If water is detected in strainer check for additional water by draining fuel tank sumps.

(8) a. Check propeller and spinner for nicks and security.
b. Inspect oil filler cap through cooling air inlet in cowl nose cap.
c. Check cowl access doors for security.

(9) a. Inspect nose gear doors for security and check condition and inflation of tire and strut.
b. Inspect pitot tube opening for stoppage.
c. Disconnect tie down chain.

Repeat steps "3" through "8."

Figure 2-1. Exterior Inspection

4. Landing gear switch — "UP" (if not previously retracted).
5. Wing flaps switch — "UP" (in small increments if not previously retracted).
6. Climb at 109 mph if no obstacles are ahead.
7. Climb at 95 mph with obstacles ahead.

NOTE

For maximum single-engine climb, bank the airplane 5° toward the operating engine. Refer to Section VII for single-engine climb data.

ENGINE FAILURE DURING FLIGHT.

1. Throttles — "FULL FORWARD".
2. Propeller pitch levers — "FULL INCREASE RPM".
3. Mixture levers — "FULL RICH".
4. Determine inoperative engine (idle engine same side as idle foot).
5. Trim rudder for single-engine flight.
6. Check fuel pressure and, if deficient, turn fuel boost pump "ON".

NOTE

If fuel selector valve handle is on "AUXILIARY TANK", switch to "MAIN TANK".

7. Check fuel quantity and switch to opposite tank if necessary.
8. Check oil pressure and oil temperature indications, and shut down engine if oil pressure is low.
9. Check ignition switches.
10. If proper corrective action was taken, engine will restart.
11. If cause of failure was not determined, put mixture lever in "IDLE CUT-OFF".
12. Feather inoperative propeller.
13. Secure dead engine by turning boost pump switch, generator switch, ignition switches, and fuel selector valve handle "OFF".
14. Turn electrical equipment "OFF" as required to eliminate a negative reading on the ammeter, thus preventing unnecessary battery drain.
15. Select cruise power setting on operative engine.
16. Trim airplane 3-5° wing low on the side of the operative engine.
17. Land at the nearest suitable airport.

RESTARTING ENGINE IN FLIGHT (After Feathering).

1. Check fuel selector valve handle on "MAIN TANK".
2. Advance throttle forward until gear warning horn is silent.
3. Advance propeller pitch lever forward of feathering detent.
4. Set mixture lever full forward for "FULL RICH".
5. Turn ignition switches "ON".

Corresponding distances for a 3000 foot field elevation under conditions of zero wind and 4700 pounds gross weight are 2950 feet and 7700 feet respectively. With conditions more unfavorable than these, a successful take-off is improbable unless the airspeed and height above the runway at engine failure are great enough to allow a slight deceleration and altitude loss while the airplane is being prepared for a single-engine climb.

During single-engine take-off procedures over an obstacle, only one condition presents any considerable advantage, and this is headwind. A decrease of approximately 20% in ground distance required to clear a 50 foot obstacle can be gained for each 10 mph of headwind. Excessive speed above best single-engine climb speed at engine failure is not nearly as advantageous as one might expect since deceleration is rapid and ground distance is used up quickly at the higher speeds while the airplane is being cleaned up for climb. However, the extra speed is important for controllability.

From a study of the preceding facts, it is apparent that (1) discontinuation of take-off upon engine failure is advisable under most circumstances, (2) altitude is more valuable to safety after take-off than is airspeed in excess of the best single-engine climb speed since excess airspeed is lost much more rapidly than is altitude, (3) climb or continued level flight at moderate altitude is improbable with the landing gear extended and the propeller windmilling, and (4) in no case should the airspeed be allowed to fall below the engine-out best angle-of-climb speed, even though altitude is lost, since this speed will always provide a better chance of climb, or a lower altitude loss, than any lesser speed. The engine-out best rate-of-climb speed will provide the best chance of climb or the least altitude loss.

Engine failure procedures should be practiced in anticipation of an emergency. This practice should be conducted at a safe altitude, with full power operation on both engines, and should be started at a safe speed of at least 110 mph. As recovery ability is gained with practice, the starting speed may be lowered in small increments until the feel of the aircraft in emergency conditions is well known. Practice should be continued until (1) an instinctive corrective reaction is developed, and the corrective procedure is automatic, and (2) airspeed, altitude, and heading can be easily maintained while the airplane is being prepared for a climb. In order to simulate an engine failure, set both engines at full power operation, and at a chosen speed pull the mixture setting of one engine into the "IDLE CUT-OFF" position, and proceed with single-engine emergency procedures.

SINGLE-ENGINE CLIMB.

1. Throttle — "FULL FORWARD".
2. Propeller pitch lever — "FULL INCREASE RPM".
3. Mixture lever — "FULL RICH".

6. Battery switch "ON."
7. Check circuit breaker panel for faulty circuits.
8. Check fuel quantity indicators.
9. Check left engine fuel selector valve handle on "LEFT MAIN TANK," and right engine fuel selector valve handle on "RIGHT MAIN TANK."
10. Adjust elevator trim tab position indicator to "TAKE-OFF" range.
11. Adjust rudder trim tab position indicator to neutral position.
12. Adjust aileron trim tab position indicator to neutral and check tab position visually.
13. Set altimeter and clock.
14. Turn all radio switches "OFF."
15. Release parking brake and test operate brakes, noting any "spongy" action or excessive brake pedal travel.
16. Check flight controls for free and correct movement.
17. Set parking brake.
18. For night flying, test operate all lights and check flashlight.

STARTING ENGINE. (Left engine first)

1. Set mixture lever full forward for "FULL RICH."
2. Set propeller pitch lever full forward for "HIGH RPM."
3. Open throttle approximately ½ inch.
4. Turn ignition switches "ON."
5. Clear the propeller.
6. Depress starter button.
7. After several engine revolutions turn fuel boost pump "ON."
8. In cold weather, engage primer switch ½ second at a time if required.

NOTE

If engine fails to start, it is probably loaded since downdraft carburetors tend to load easily. Repeat starting procedure with throttle open approximately ½, mixture lever in idle cut-off, and fuel boost pump "OFF." As engine fires, move mixture lever to full rich and decrease throttle to idle position. Avoid leaving mixture lever in full rich position with fuel boost pump turned on.

9. Check for an oil pressure indication within 30 seconds in normal weather and 60 seconds in cold weather. If no indication appears, shut off engine and investigate.
10. Disconnect external power source — if used.

WARM-UP AND GROUND TEST. (During taxiing).

1. Set both engines at 800 to 1000 RPM.
2. Turn radio "ON" if required.
3. Continue the warm-up while taxiing out to the active runway.

4. In extremely cold weather, use carburetor alternate air ("HEAT" position) only if necessary for smooth engine operation.
5. Stop the airplane at the "run up" location with the nose wheel straight, and set parking brake. To avoid propeller tip abrasion, do not run up engines on loose cinders or gravel.
6. Turn fuel boost pumps "OFF" momentarily to check engine driven fuel pump pressure and operation.
7. Advance throttle to 1700 RPM with control wheel neutral or forward.

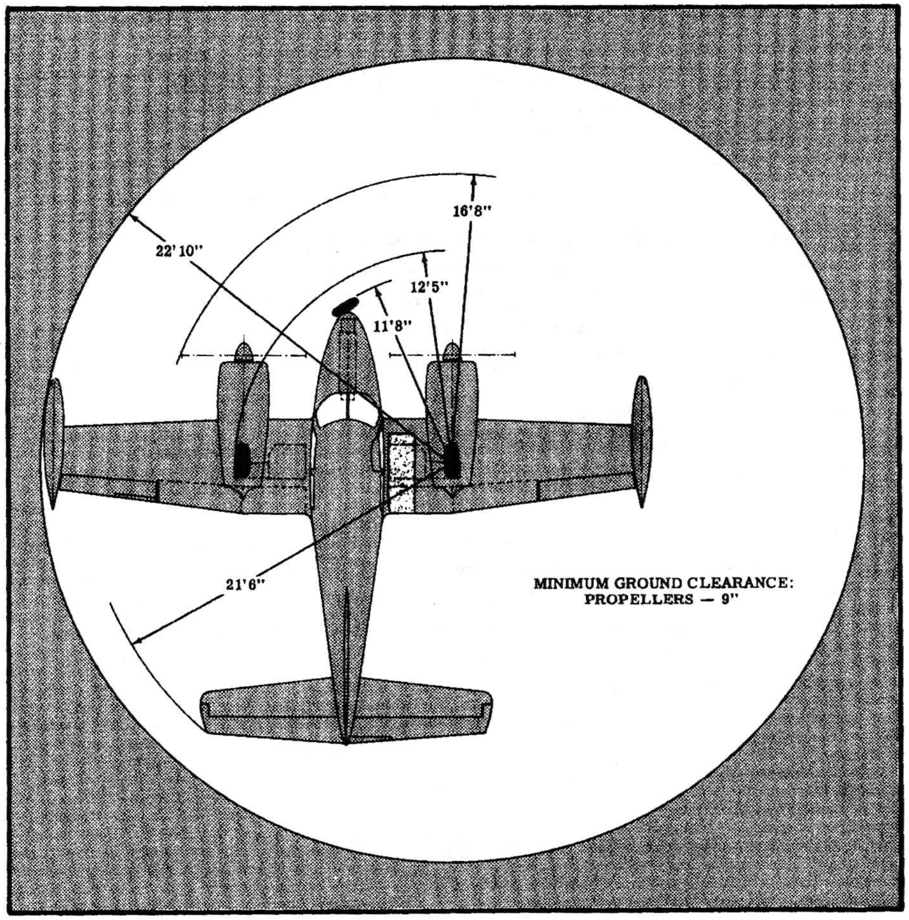


Figure 2-2. Minimum Turning Radius

because rate of climb is appreciably greater with flaps up than with flaps 15°. The variation of flaps up best rate-of-climb speed with altitude is shown in Section VII. For best climb performance, the wings should be banked 5° toward the operative engine.

Upon engine failure after reaching 95 mph on take-off, the twin-engine pilot has a significant advantage over a single-engine pilot, for he has the choice of stopping or continuing the take-off. This would be similar to the choice facing a single-engine pilot who has suddenly lost slightly more than half of his take-off power. In this situation, the single-engine pilot would be extremely reluctant to continue the take-off if he had to climb over obstructions. However if the failure occurred at an altitude as high or higher than surrounding obstructions, he would feel free to maneuver for a landing back at the airport.

Fortunately this airplane accelerates through this area where the airplane is "slow and low" in just a few seconds. However, to make an intelligent decision in this type of emergency, one must consider field length, obstruction height, field elevation, air temperature, head wind, and gross weight. The flight paths illustrated in the figure below indicate that the "area of decision" is bounded by (1) the point at which 95 mph is reached and (2) the point where obstruction altitude is reached. An engine failure in this area requires an immediate decision. Beyond this area, the airplane, within the limitations of single-engine climb performance shown in Section VII, may be maneuvered to a landing back at the airport. At sea level, with zero wind and 4700 pounds gross weight, the distance to accelerate to 95 mph and stop is 2500 feet, while the total unobstructed area required to take-off and climb over a 50 foot obstacle after an engine failure at 95 mph is 5350 feet. This total distance over an obstacle can be reduced appreciably under more favorable conditions of gross weight, headwind, or obstruction height. However, it is apparent that in most cases it would be better to discontinue the take-off since the accelerate stop distance is so much shorter.

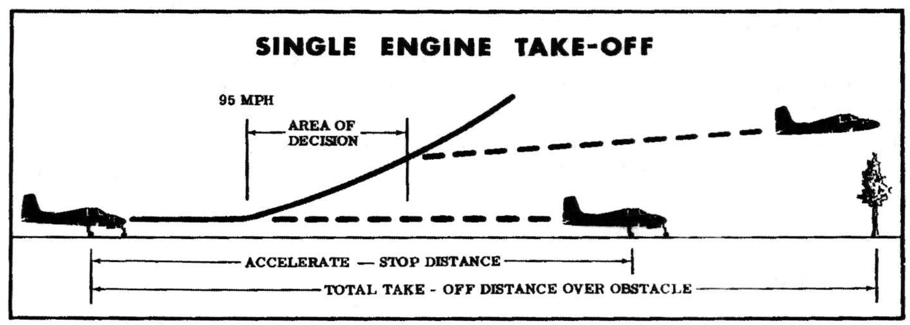


Figure 4-1. Single-Engine Take-off

is accelerating to a safe engine-out climb speed. A detailed knowledge of the following recommended single-engine airspeeds is essential for safe operation of this airplane:

Single-Engine Airspeed Nomenclature	IAS-MPH
1. Minimum control speed	80
2. Minimum safe climb speed	95
3. Best angle-of-climb speed	95
4. Best rate-of-climb-speed (flaps up)	109

They should be memorized for instant recollection in an emergency, and it is worthwhile to mentally review these speeds prior to every take-off. The following paragraphs will present a detailed discussion of the problems associated with engine failures during take-off.

A multi-engine airplane does not have an advantage over a single-engine airplane until the engine-out minimum control speed is reached. This speed is defined as the minimum speed at which controlled flight can be maintained with one engine inoperative, and full power operation on the other engine. Under these conditions, full control surface deflection of any one control is normally required to counteract extreme yawing and rolling tendencies of the airplane. This airplane has an engine-out minimum control speed of 80 mph. Since this speed is so far below the optimum climb speed, it is not suitable for single-engine flight near the ground, especially with the landing gear and flaps extended and the inoperative propeller windmilling. A more suitable minimum safe single-engine climb speed is 95 mph, since altitude can be maintained more easily at this speed while the landing gear is being retracted and the propeller is being feathered.

The best angle-of-climb speed for single-engine operation is defined as the speed which gives the greatest increase in altitude in a given distance. This speed becomes important when there are obstacles ahead on take-off, because after the best single-engine angle-of-climb speed is reached, altitude becomes more important than airspeed until the obstacle is cleared. The best single-engine angle-of-climb speed is approximately 98 mph with flaps up and 91 mph with flaps 15° for an average single-engine altitude. For convenience, a speed of 95 mph may be used for any flap setting between 0-15°, since it is an average speed which also is identical to the recommended minimum safe single-engine climb speed.

The best rate-of-climb speed for single-engine operation is defined as the speed that gives the greatest increase in altitude in the least time. This speed becomes important when there are no obstacles ahead on take-off, or when it is difficult to maintain or gain altitude in single-engine emergencies. The best single-engine rate-of-climb speed is 109 mph with flaps up, and 101 mph with flaps 15° at sea level. The flaps-up speed of 109 mph is of primary importance,

8. Check engine instruments for operation.
9. Check generator operation by turning off each generator switch individually and noting amperage.
10. Set flight instruments (check operation of each vacuum pump through use of vacuum source selector valve knob).
11. Check magnetos (100 RPM maximum allowable drop).
12. Check carburetor alternate air source operation by noting RPM and manifold pressure drop.
13. Retard propeller pitch lever until engine speed drops to 1000 RPM, then advance to full forward position.

NOTE

If propeller operation has been unusually sluggish or erratic, feather propeller twice to 600 RPM in run up, retarding throttle as necessary to avoid excessive manifold pressure at low RPM. Exercising the propeller in this manner insures optimum propeller governing in flight.

14. If each engine accelerates smoothly and oil pressure remains steady at some value between 30 and 60 PSI, the engines are warm enough for take-off.

BEFORE TAKE-OFF OR DURING TAXIING.

1. Recheck free and correct movement of flight controls.
2. Recheck elevator trim tab position indicator for "TAKE-OFF" range.
3. Recheck rudder trim tab position indicator for neutral position.
4. Recheck aileron trim tab position indicator for neutral, and check tab visually.
5. Check carburetor alternate air source at "COLD."

IMPORTANT

Maximum power is reduced approximately 7% when carburetor alternate ("HEAT" position) air is applied. Avoid intermediate positions of the carburetor alternate air knob for proper engine operation.

6. Recheck propellers in "HIGH RPM" position (full forward).
7. Check fuel boost pumps "ON."
8. Check that cabin door and pilot's window are closed and locked.

NORMAL TAKE-OFF.

1. Flaps 0° — 15°.
2. Apply full throttle smoothly to avoid propeller surging.
3. Maintain airplane in level attitude in take-off run.
4. Keep heels on floor to avoid dragging brakes.

5. Apply slight back pressure to raise nose wheel as airplane approaches 80 mph (minimum single engine control speed).
6. After take-off, level off and accelerate to 95 mph (minimum safe single engine climb speed).
7. Apply brakes momentarily to stop wheel rotation.
8. Retract landing gear.
9. Accelerate to 121 mph (best rate-of-climb speed).
10. Retract flaps after reaching a safe altitude and airspeed.
11. Turn fuel boost pumps "OFF" individually, checking final fuel pressure indications.

CLIMB. (Twin Engine).

1. In normal operation, if no obstacle is ahead, climb out with flaps retracted at 130-140 mph, with 24 inches of manifold pressure and 2450 RPM.
2. For maximum rate of climb, use full throttle and 2600 RPM at 121 mph, decreasing climb speed to 113 mph at 10,000 feet.
3. Mixture should be full rich if power settings are higher than 24 inches of manifold pressure and 2450 RPM.

CRUISING.

1. Select cruising power setting from range charts (See Section VII). Normal cruising power settings are 23 inches and 2300 RPM and maximum cruising power settings are 24 inches and 2450 RPM.
2. After speed is stabilized, trim airplane.
3. Lean engines individually until slight roughness or loss of power is preceptible; then enrich mixture slightly beyond the setting required for smooth engine operation. Check cylinder head temperature for abnormal change after leaning.
4. Adjust friction knob to prevent engine control levers from creeping.

LET DOWN.

1. Set mixture lever full forward for "FULL RICH".
2. Reduce power to obtain desired let down rate at cruising speed.
3. For steep let downs, decrease speed to 160 mph or less and extend flaps 15°. If necessary, for steeper let downs, reduce speed to 140 mph and extend landing gear.

BEFORE LANDING.

1. Check right engine fuel selector valve handle to "RIGHT MAIN TANK" and left engine fuel selector valve handle to "LEFT MAIN

SECTION IV

EMERGENCY PROCEDURES

ENGINE FAILURE.

ENGINE FAILURE DURING TAKE-OFF BELOW 95 MPH.

1. Cut power on operative engine and decelerate to a stop.

NOTE

The airplane can be accelerated from a standing start to 95 mph on the ground, and then decelerated to a stop with heavy braking within 2500 feet of the starting point of the take-off run at sea level, and within 3300 feet of the starting point at 5000 feet altitude (zero wind, hard surface runway, standard conditions, full gross weight.)

ENGINE FAILURE AFTER TAKE-OFF ABOVE 95 MPH WITH OBSTRUCTIONS AHEAD.

1. Throttles — "FULL FORWARD".
2. Propeller pitch levers — "FULL INCREASE RPM".
3. Landing gear switch — "UP".
4. Determine inoperative engine (idle engine same side as idle foot).
5. Propeller pitch lever — "FEATHER" (inoperative engine).
6. Climb out at 95 mph.
7. Trim tabs — Adjust for climb with airplane banked 3-5° toward operative engine.
8. Accelerate to 109 mph after obstacle is cleared.
9. Flaps switch — "UP" (in small increments).
10. Secure dead engine by turning boost pump switch, generator switch, ignition switches, mixture lever, fuel selector valve handle "OFF".
11. Fuel selector valve handle (operative engine) — Select tank to maintain lateral balance.

SUPPLEMENTARY INFORMATION CONCERNING ENGINE FAILURE DURING TAKE-OFF.

The most critical time for an engine to fail in a twin engine airplane is during a two or three second period late in the take-off run while the airplane eration during warm-up, the carburetor alternate air knobs should be returned to the full "COLD" position prior to application of full power.

TAKE-OFF.

Take-off procedures are normal in all respects.

CLIMB AND CRUISE.

Carburetor alternate air should be utilized as required to maintain smooth engine operation. Periodically (half-hour intervals) the propellers should be exercised to flush the cold oil from the governor and propeller hub. Electrical equipment should be managed to assure adequate generator charging throughout the flight since cold weather adversely affects battery capacity.

LET DOWN AND LANDING.

During let down, monitor engine temperatures closely and carry sufficient power to maintain them above operating minimums. Alternate air may be used for improved fuel vaporization, but be prepared to change to ram filtered air ("COLD" position) should a go-around be necessary.

If erroneous instrument readings are suspected due to water or ice in the static pressure lines, the alternate source valve should be opened. Since this valve vents to the relatively low static pressure of the cabin, the airspeed indicator and altimeter will show slightly higher readings than normal. Therefore, the alternate static source should be used primarily as a drain valve to restore the original system.

OIL DILUTION SYSTEM OPERATION.

During oil dilution, the engines should be idled at 1000 RPM. At this speed when the switch is pressed, fuel will flow into the engine at the rate of one quart every 90 seconds. The fuel boost pump switches must be turned "ON" during the dilution operation. Holding the switch for three minutes will normally provide adequate oil dilution for cold weather starts. With the oil at its normal 12 quart level, the switch may be held for a maximum of six minutes — further dilution will cause an overflow of the oil sumps resulting in a fire hazard. When severe cold conditions are anticipated and it is desirable to dilute the oil of each engine for longer than six minutes, it will be necessary to drain oil from the engines unless the oil is already below the 12 quart level. Drain one quart of oil from each engine for each 90 seconds of oil dilution time required over six minutes.

IMPORTANT

Care should be exercised to avoid over dilution since the normal engine sump capacity is 12 quarts. With a total diluted oil volume of 16 quarts the engine may discharge an excessive amount of oil in an extreme nose up or nose down flight condition. The pilot should warm up engines sufficiently on the ground to reduce the total diluted volume to a minimum before take-off.

TANK" (if there is sufficient fuel in both tanks).
2. Recheck mixture lever full forward for "FULL RICH".
3. Extend flaps to 15° in 5° increments below 160 mph.
4. Carburetor alternate air source should be "COLD" unless severe icing conditions prevail.
5. Turn fuel boost pumps "ON."
6. Extend landing gear below 140 mph.
7. Check green landing gear indicator light for illumination.
8. Set propeller pitch levers for 2600 RPM (full forward) for maximum power in case of a go-around.
9. Lower flaps below 140 mph to 30 — 45°.
10. Approach at approximately 95 mph with or without power.

NORMAL LANDING.

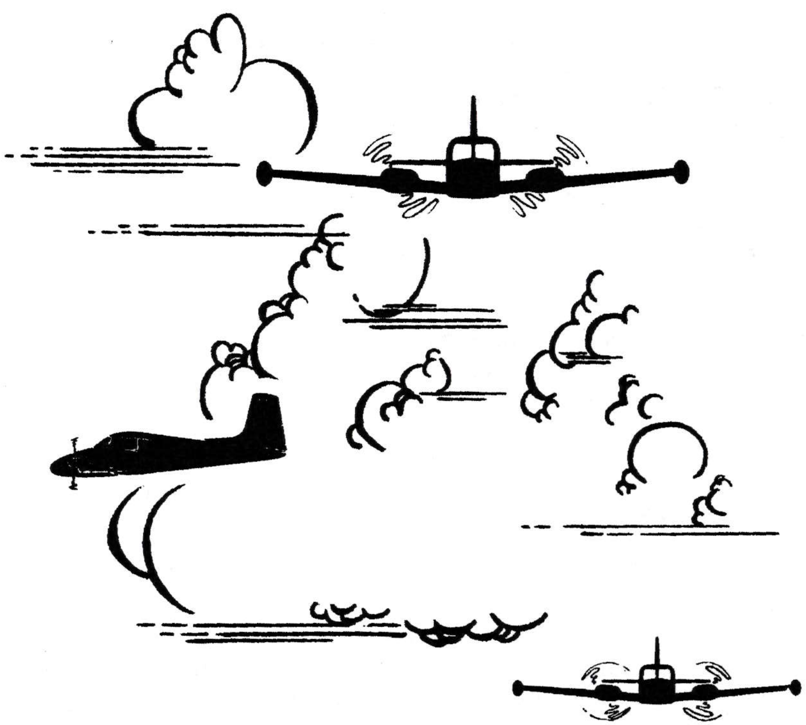
1. Land on main wheels first.
2. Lower nose wheel gently to the runway after speed is diminished.
3. Avoid excessive braking unless obstacle is ahead.

GO-AROUND. (Twin engine).

1. Apply full throttle and increase engine speed to 2600 RPM if necessary.
2. Retract landing gear.
3. Reduce flap setting to 15°.
4. Trim airplane for climb.
5. Retract flaps as soon as all obstacles are cleared and a safe altitude and airspeed are obtained.

AFTER LANDING.

1. Retract flaps.
2. Park with nose wheel aligned straight ahead if possible. (If gusty wind conditions prevail, caster the nose wheel to the extreme right or left position. This action will protect the rudder from wind damage.)
3. Turn fuel boost pumps "OFF."
4. Stop engines by putting mixture levers in "IDLE CUT-OFF."
5. After engines stop, turn ignition switches "OFF."
6. Turn switches "OFF."
7. Set parking brakes.
8. Install control lock, if required.



avoided with the landing lights extended. In the engine run-ups, special attention should be directed to generator operation by turning the generator switches individually "OFF" and "ON" and noting the response on the ammeter.

Night take-offs are conventional, although the gear retraction operation is usually delayed slightly to insure that the airplane is well clear of the runway. The landing lights, if used, should be retracted before the airspeed exceeds 160 mph.

In cruising flight the interior lighting intensity is usually decreased even further for better vision outside of the airplane.

COLD WEATHER OPERATION.

STARTING.

Prior to starting in cold weather it is advisable to pull the propeller through by hand several times to "break loose" or "limber" the oil, thereby conserving battery energy. Whenever possible, external power should be utilized due to the higher cranking power required coupled with the decreased battery capacity associated with cold temperatures.

When very cold temperatures are anticipated, oil dilution should be employed prior to engine stoppage if external preheat is not available. The starting procedure is normal, although additional priming will probably be required.

The use of external pre-heat will considerably improve cold weather starting and materially reduce the severity of conditions imposed on both the engines and the electrical system. Pre-heat will also thaw the oil trapped in the oil cooler which will probably be congealed prior to starting in very cold temperatures. Engine warm-up should then be held to a minimum to prevent re-congealing the oil coolers before the take-off can be completed.

WARM-UP.

Should external pre-heat not be available, the engines should be allowed to warm-up using full carburetor alternate air ("HEAT" position) if rough engine operation is encountered due to poor fuel vaporization. Where the oil pressure gage is extremely slow in indicating pressure it may be advisable to fill the pressure line to the gage with kerosene. No temperature indication need be apparent on the oil temperature gage prior to take-off if outside air temperatures are very cold. After a suitable warm-up period (2 to 5 minutes at 1000 RPM if pre-heat is not used), accelerate the engines several times to higher RPM. If the engines accelerate smoothly and the oil pressure remains normal and steady, the airplane is ready for take-off.

BEFORE TAKE-OFF.

The engines should accelerate smoothly and oil pressure should remain normal and steady. The propeller should be operated through several complete cycles to warm the governor and propeller hub. If alternate air is necessary for smooth engine oprudder. The landing is made in a nearly three point attitude, and the nosewheel is lowered to the runway immediately after touchdown. A straight course is maintained with the steerable nose wheel and occasional braking if necessary.

AFTER LANDING.

Heavy braking in the landing roll is not recommended because of the probability of skidding the main wheels, with resulting loss of braking effectiveness and damage to the tires. It is best to leave the flaps fully extended throughout the landing roll to aid in decelerating the airplane. After leaving the active runway, the flaps should be retracted. Be sure the flaps switch is identified before placing it in the "UP" position. The boost pump switches are normally turned "OFF" while taxiing to the hangar, except in extremely hot weather where boost pumps may be needed to maintain fuel pressure.

Parking is normally accomplished with the nose wheel aligned straight ahead. This simplifies the steering during subsequent departures from the parking area. However, if gusty wind conditions prevail, the nose wheel should be castered to the extreme right or left position. This forces the rudder against the rudder stop which minimizes buffeting of the rudder in gusty wind.

With the mixture levers in "IDLE CUT-OFF", the fuel flow is effectively blocked at the carburetor. Thus it is unnecessary to place the fuel selector valve handles in the "OFF" position if the airplane is receiving normal usage. However, if a long period of inactivity is anticipated, it is recommended that the fuel selector valve handles be turned "OFF" to preclude any possible fuel seepage that might develop through the idle cut-off valve.

NIGHT FLYING.

Before starting the engines for a night flight, sufficient interior illumination is desired to check all switches, controls, etc. Rheostats located on the left switch and control panel and on the overhead console panel should be turned "ON" and adjusted to provide the required lighting intensity. In addition, the dome lights may be used if desired.

Navigation lights are then checked by observing illumination in the small windows in the inboard leading edges of the wing tip tanks and reflection from the pavement or ground below the tail light. The retractable landing lights (the right landing light is optional equipment) may be extended and checked momentarily. Returning the landing light switches to "OFF" switches the lights off but leaves them extended ready for instant use if desired.

Before taxi, the interior lighting intensity is normally decreased to the point where all controls and switches are discernible. The optional taxi light if installed, should be turned "ON" prior to taxiing at night. The landing lights, if used during taxiing, should be used intermittently to avoid excessive electrical drain on the batteries. Taxiing over loose gravel should be

SECTION III

OPERATING DETAILS

THIS SECTION GIVES in narrative form detailed information on those check list items in Section II that require further explanation.

PREFLIGHT CHECK.

The exterior inspection described in Section II is recommended for the first flight of the day. Inspection procedures for subsequent flights are normally limited to brief checks of the tail surface hinges, fuel and oil quantity, and security of fuel and oil filler caps. If the airplane has been subjected to long period storage, recent major maintenance, or operation from marginal airports, a more extensive exterior inspection is recommended.

After major maintenance has been performed the integrity of the flight and trim tab controls should be double checked for free and correct movement. The security of all inspection plates on the airplane should be checked following periodic inspections on the airplane. Since maintenance on the radios or heater requires the mechanic to work in the nose compartment, the nose gear doors are often disconnected to allow more room. Therefore, it is important after such maintenance to double check the security of these doors. If the airplane has been waxed and polished it is good practice to check the external static pressure source holes for stoppage.

If the airplane has been exposed to much ground handling in a crowded hangar, it should be checked for dents and scratches on wings, tip tanks, fuselage, and tail surfaces, as well as damage to navigation and landing lights, de-icer boots, and radio antennae. Outside storage for long periods may result in water and obstructions in airspeed system lines, condensation in fuel tanks, and dust and dirt on the carburetor air filters and engine cooling fins.

If the airplane has been operated from muddy fields or in snow and slush, it is necessary to check the nose wheel mud shield and main gear wheel wells for obstructions and cleanliness. Operation from a gravel or cinder field will require extra attention to propeller tips and abrasion on leading edges of the horizontal tail.

Stone damage to the outer six inches of the propeller tips can seriously reduce the fatigue life of the propeller blades.

Airplanes that are operated from rough fields, especially at high altitudes, are subjected to abnormal landing gear abuse. A frequent check of all components of the landing gear retracting mechanisms, shock strut and tire inflation, and brake condition is important.

If the airplane is equipped with auxiliary fuel tanks, it is necessary to check that the filler caps are tightly sealed to prevent the loss of fuel in flight. The auxiliary fuel tank vents beneath the wing should also be inspected for obstruction, especially after operation from muddy fields.

The interior inspection will vary according to the mission and the optional equipment installed. Prior to high altitude flights, it is important to check the condition and quantity of oxygen face masks and hoses. The oxygen supply system should be functionally checked to insure that it is in working order. The oxygen pressure gage should indicate between 300 and 1800 psi depending upon the anticipated requirements.

Satisfactory operation of the pitot tube and stall warning transmitter heating elements is determined by observing a discharge on the ammeter when the pitot heat switch is turned "ON". The effectiveness of each element may be verified by cautiously feeling the heat of both devices while the pitot heat switch is "ON".

Night flights and cold weather flights involve a careful check of other specific areas that will be discussed in separate sections.

STARTING ENGINES.

Since the wing obscures ground crew personnel when they are draining the fuel strainers or connecting the external power source to the airplane, it becomes doubly important to clear the airplane properly before starting. Calling out "clear" in loud tones or giving a "thumbs up" hand signal to a responsible ground crew member is best. An answering "clear" or "thumbs up" hand signal from visible ground crew personnel is the required response.

The use of an external power source for starting is recommended in cold weather, or for airplanes that are normally used extensively in instrument or night flying. With the external power source connected, it is preferable to start the airplane with the battery switch "OFF". If the battery switch is "ON" during the engine start, weak airplane batteries will drain off part of the current supplied by the external power source, resulting in less electrical power available for the start. After the external power source is disconnected, the battery switch should be turned "ON" to supply power to electrical equipment.

Although either engine may be started first, and the procedure is identical for both, the left engine is normally started first. The cable from the battery is much shorter to this engine which permits more electrical power

tanks because of prolonged single engine flight, it is desirable to balance the fuel load by operating both engines from the fullest tank. However, if there is sufficient fuel in both tanks, even though they may have unequal quantities, it is important to switch the left and right engine selector valves to the left and right main tanks respectively for the landing. This will allow an adequate fuel flow to each engine if a full power go-around is necessary. In airplanes equipped with auxiliary fuel tanks, the selector valves should be switched to main tanks for landing because the auxiliary tanks are not equipped with fuel boost pumps.

Landing gear extension before landing is easily detected by a slight change in airplane trim and a slight "bump" as the gear locks down. Illumination of the gear down indicator light (green), and the absence of an intermittent sound from the gear warning horn with the throttles retarded below 13 inches of manifold pressure are further proof that the gear is down and locked. If it is reasonably certain that the gear is down and the gear down indicator light is still not illuminated, the malfunction could be caused by a burned out light bulb. This can be easily checked by replacing it with a bulb from either the compass light, turn and bank test light, or the landing gear up indicator light (red).

A simple last minute recheck on final approach should confirm that the top row of switches on the left switch and control panel are "ON", the gear down indicator light (green) is illuminated, and the propeller pitch levers and mixture levers are "FULL FORWARD".

LANDING.

Landings are simple and conventional in every respect. If power is used in landing approaches it should be eased off cautiously near touchdown because the "power-on" stall speed is considerable less than the "power-off" stall speed. An abrupt power reduction at five feet altitude could result in a hard landing if the airplane is near stall speed.

Short field landings on hard surface runways are performed with 45° flaps from an 80 to 90 mph approach using as little power as practicable. A normal flare out is made, and power is reduced in the flare-out. The landing is made on the main wheels first, and remaining engine power is cut immediately after touch down. The nosewheel is quickly lowered to the ground and heavy braking is applied as required. Short field landings on rough or soft runways are done in a similar manner except that the nosewheel is lowered to the runway at a lower speed to prevent excessive nose gear loads.

Crosswind landings are performed with the least effort by using the crab method. The airplane is crabbed into the wind in a normal approach using a minimum flap setting for the field length. Immediately before touchdown, the airplane is aligned with the flight path by applying downwind

5. Pull out of dive with smooth steady control pressure.

FLIGHT CONTROLS.

Elevator control forces are relatively light in cruising flight at all airplane loadings. Reducing power and extending the flaps and landing gear increases the elevator control forces appreciably thereby enhancing the control feel at low airspeeds. Aileron control forces are light and aileron control is much more effective than is at first apparent from control feel. This is more pronounced at slow speeds with full wing tip (main) tanks where the time response to aileron deflection is increased slightly. Rudder forces are comparatively light and only slight rudder pressure is required when rolling into and out of turns. All trim tabs are effective throughout the speed range of the airplane with the rudder and elevator trim becoming very effective at cruising airspeeds.

LEVEL FLIGHT CHARACTERISTICS UNDER VARIOUS SPEED CONDITIONS.

The airplane is conventional in all respects throughout the level flight speed range. Slow flying is easily accomplished either with wing flaps up or down or landing gear up or down. No special technique is required other than to realize that the airplane is very clean and, therefore, sensitive to power adjustment.

MANEUVERING FLIGHT.

No acrobatic maneuvers are approved in this airplane. The airplane is, however, conventional in all respects throughout the maneuvering range encountered in normal flight.

DIVING.

Dives should be limited to the maximum diving airspeed (248 mph) marked on the airspeed indicator. Although trim changes and flight characteristics are conventional, caution should be exercised because the airplane picks up speed rapidly, and if rough air is encountered unexpectedly, it is difficult to slow the airplane down to a safe speed. Pull outs should be very gentle to avoid excessive stresses in the airplane as well as discomfort to the passengers.

LET DOWN.

Let downs should be initiated as much as an hour before estimated landing time to permit a gradual rate of descent at cruising speed using enough power to keep the engine warm and the cylinders clear. Since the airplane is so aerodynamically clean, it is difficult to descend rapidly without reducing the engine power to a very low power setting. This results in undesirably low cylinder head temperatures, which in turn lead to spark plug fouling. The optimum engine speed in a let down is usually the lowest one in the RPM green arc range that will allow cylinder head temperatures to remain in the recommended operating range.

BEFORE LANDING.

If fuel has been consumed at uneven rates between the two main

to be delivered to the starter. In the event of low batteries the left engine should start more readily.

Since the engines are equipped with downdraft carburetors and fuel boost pumps, they will flood more easily than conventional lightplane engines. For this reason the starting procedure is arranged to prevent flooding or loading. For example, the boost pump is not operated until the engine has been turned over several revolutions. If by accident the mixture lever is in "FULL RICH" position and the fuel pump is "ON" with the engine not turning over, fuel will flow through the carburetor into the intake manifold. Depending upon the time interval, it is possible to collect as much as one to two pints of solid fuel in the intake manifold. If this happens it is advisable to wait several minutes while the fuel drains through automatic drain valves located in the intake manifold.

Engine mis-starts characterized by weak intermittent explosions followed by puffs of black smoke from the exhaust stacks indicate overpriming or flooding. This is a typical difficulty in hot weather or hot engine starts, and the corrective action is explained in Section II. If the engine is underprimed, which is more likely in cold weather with a cold engine, repeat the starting procedure and energize the electrical primer at more frequent intervals.

If serious engine starting problems persist, it is important to allow the starter motor to cool in frequent intervals since it is possible for excessive heat to damage the wiring on the starter armature.

TAXIING.

A steerable nose wheel mechanism provides positive control up to 15° left or right, and free turning from 15° to 55° for sharp turns during taxiing. In addition to the nose wheel steering, which is preferred whenever practical, steering may be accomplished with the aid of the rudder, differential power, and differential braking on the main wheels. These aids are listed in the preferred order of use.

IMPORTANT

If the airplane is parked with the nose wheel castered in either direction, initial taxiing should be done with caution. To straighten the nose wheel, it is recommended that full opposite rudder and differential power be applied instead of differential braking. After several feet of forward travel, the nose wheel will steer normally.

At some time early in the taxi run, it is recommended that the brakes be tested, and any unusual reaction, such as uneven braking, should be noted. If brake operation is not satisfactory, the airplane should be returned to the tie-down location and the malfunction corrected. The operation of the turn and bank indicator and directional gyro should also be checked during taxiing.

Most of the engine warm-up should be accomplished during taxiing. Engine speeds should not exceed 1600 RPM while the oil is cold. Taxiing should be accomplished using the minimum power setting necessary to keep the airplane moving.

Taxiing in loose gravel, or cinders should be done at low engine speed to avoid abrasion and stone damage to the propeller tips.

BEFORE TAKE-OFF.

The pilot is encouraged to use the Pilot's Check List in the airplane for the "before take-off" check to prevent the possibility of overlooking an important check item because he is usually distracted by other important duties at this time such as appraising the field length, reviewing engine-out emergency procedures, communicating with the tower, setting up navigation radio frequencies, and observing other traffic.

Most of the warm-up will have been conducted during taxi, and additional warm-up before take-off should be restricted to the checks outlined in Section II. Since the engines are closely cowled for efficient in-flight cooling, precautions should be taken to avoid overheating on the ground. Full throttle checks on the ground are not recommended unless the pilot has good reason to suspect that the engines are not turning up properly. Engine run-ups should not be performed over loose gravel or cinders because of possible stone damage or abrasion to the propeller tips.

If the ignition system check produces an engine speed drop in excess of 100 rpm, the warm-up should be continued a minute or two longer prior to rechecking the system. If there is doubt concerning the operation of the ignition system, checks at higher engine speed may confirm the seriousness of the deficiency. In general, a drop in excess of 100 rpm with a warm engine at 1700 rpm is not considered acceptable.

If instrument flights are contemplated, a careful check should be made of vacuum pump operation by switching the vacuum source selector valve knob to all positions. The minimum and maximum allowable suctions are 3.5 and 4.5 inches of mercury, respectively on the instruments, and 6.5 to 8.0 inches of mercury respectively on the left and right sources. The condition of the generators is also important for instrument flight since satisfactory operation of all radio equipment and electrical instruments is essential. The generators are checked by observing the charging rate on the ammeter during an engine run-up to 1700 rpm while the generator on the opposite engine is switched off momentarily.

A simple last minute recheck of important items should include a glance to see that the top row of switches on the left switch panel are "ON", that the mixture and propeller pitch levers are "FORWARD", and that all flight controls have free and correct movement.

TAKE-OFF.

Since the use of full throttle is not recommended in the static run-up, it

STALL SPEED CHART
MPH - TIAS
4700 POUNDS GROSS WEIGHT

Configuration	Angle of Bank 0°	20°	40°	60°
Gear and Flaps Up	84	87	96	119
Gear Down and Flaps 15°	80	83	92	113
Gear Down and Flaps 45°	74	77	85	105

Figure 3-1. Stall Speed Chart

or without flaps, and it is difficult to inadvertently stall the airplane during normal maneuvering. The stall characteristics in all configurations are characterized by a clean drop of the nose accompanied by increased buffet during the stall. The rudders should be used to prevent yaw during the approach to the stall since a rolling tendency will result if the airplane is allowed to yaw. Recovery is effected very quickly with little loss of altitude if the nose is not lowered excessively and full available power is applied to both engines. Landing gear and flap position have little effect on the stall characteristics except that the stalling speed will be lowered in proportion to the degree of flap extension. Power-off stall speeds at maximum gross weight are presented as true indicated airspeeds in Figure 3-1 because indicated airspeeds are inaccurate near the stall.

ACCELERATED STALLS.

Stalls in accelerated flight are preceded by both the stall warning indicator light and warning horn indications, and by light aerodynamic buffet. The structural limitations of the airplane will be exceeded if accelerated stalls are performed above 163 mph.

SPINS.

Intentional spins are not permitted in this airplane, and due to the excellent stall warning system provided, it is not probable that an inadvertent spin will be encountered. Should a spin occur, however, the following recovery procedure should be employed:

1. Cut power on both engines.
2. Apply full rudder opposing the direction of rotation.
3. Approximately ½ turn after applying rudder, push control wheel forward briskly.
4. To expedite recovery, add power to the engine toward the inside of the direction of turn.

only one propeller. To avoid a slack in controls the final movement of levers should be made in a "DECREASE RPM" direction.

In airplanes equipped with auxiliary fuel tanks it is important to burn approximately 30 minutes of fuel from the main tanks before switching to auxiliary tanks. This is necessary to provide space for approximately 3 gallons of auxiliary tank fuel and vapor that are returned from the carburetors through vapor return lines to the main tanks. If sufficient space is not available in the main tanks for this diverted fuel the tanks may overflow through the filler cap vent hole. Since part of the fuel from the auxiliary tanks is diverted back to the main tanks instead of consumed in the engine it is not possible to obtain the normal endurance one would expect from 15 gallons of fuel. However this endurance is regained when this diverted fuel is used from the main tanks.

Since the auxiliary fuel tanks are designed for cruising flights they are not equipped with fuel boost pumps. Under cruising conditions a failure of an engine driven fuel pump would not be critical because there would be ample time to switch to main fuel tanks and turn the fuel boost pumps "ON". However, operation near the ground using auxiliary fuel tanks is not recommended because of this limitation.

The pressure carburetors on these engines are considered to be a non-icing type. In addition, the internal location of the carburetor air intake should preclude the possibility of impact ice covering the intake air filter. Therefore, the only need for carburetor alternate air would be to provide warm air to the carburetor to improve fuel vaporization and mixture distribution in extremely cold temperature. If rough engine operation in cold weather indicates this need the carburetor alternate air knobs should be fully opened (out position). As the knobs are pulled out, a suction is created in the air intake ducts, and spring-loaded valves in the ducts are opened allowing warm air to flow from the accessory compartment into the carburetors.

FLIGHT CHARACTERISTICS.

The stability and control characteristics of the airplane are very satisfactory. Control forces are light and adequate control is available throughout the operating speed range. When properly trimmed the airplane will remain in straight and level flight with little attention from the pilot.

NORMAL STALLS.

The stall characteristics of the airplane are conventional in all configurations. Both visual and aural warnings are provided by the stall warning indicator light and warning horn between 5 and 10 mph above the stall in all configurations. The stall is also preceded by mild aerodynamic buffet which increases in severity as the stall is approached. The power-on stall occurs at a very steep angle either with

is important to observe full throttle engine operation early in the take-off run. Any signs of rough engine operation, unequal power between engines, or sluggish engine acceleration is good cause for discontinuing the take-off. If this occurs the pilot is justified in making a thorough full throttle static run-up before another take-off is attempted.

Full throttle operation is recommended on take-off because it is important that a speed well above minimum single-engine control speed (80 mph) be obtained as rapidly as possible. It is desirable to accelerate the airplane to 80 mph while still on the ground for additional safety in case of an engine failure. This safety may have to be compromised slightly where short and rough fields would prohibit such a high speed before take-off.

After take-off it is important to accelerate to a minimum safe single-engine climb speed (95 mph) as rapidly as possible in level flight. As the airplane is accelerated still further to best single-engine rate of climb speed (109 mph), it is good practice to gain altitude rapidly for additional safety in case of an engine-out emergency. After obstruction height is reached, power may be reduced and climb speeds may be established as described in Section II. The landing gear should be retracted at the point over the runway where a wheels down forced landing on that runway would become impractical.

The use of 15° flaps reduces the ground run and the total distance over a 50 foot obstacle by approximately 13 percent. Minimum run and soft field take-offs are performed with flaps 15° by lifting the nose wheel as the airspeed approaches 60 mph so that the airplane will leave the ground in a tail low attitude. However, the airplane should be immediately leveled off and accelerated to 95 mph as rapidly as possible.

Obstacle clearance take-offs from soft fields are conducted in the same manner except that a climb at 85 mph is established after take-off. From hard surface runways the airplane will climb at a given airspeed over an obstacle in approximately the same total distance using any lift-off speed between 65 and 85 mph. The best technique is to lift-off as the airspeed approaches 80 mph and then establish an 85 mph climb. Performance data for this type of take-off is presented in Section VII.

Crosswind take-offs are performed with a minimum flap setting necessary for the runway length to minimize the drift angle after take-off. Additional power may be carried on the upwind engine until the rudder becomes effective.The airplane is accelerated to a slightly higher than normal take-off speed, and then is pulled off abruptly to prevent possible settling back to the runway while drifting. When clear of the ground, a coordinated turn is made into the wind to correct for drift.

A take-off with one tip tank full and the opposite tank empty creates a lateral unbalance at take-off speed This is not recommended since gusty air or premature lift-off could create a serious control problem.

AFTER TAKE-OFF.

The procedure for placing the airplane in climb configuration is to retract the landing gear, adjust power for climb, retract the flaps at a safe altitude and airspeed, and turn off the fuel boost pumps individually while checking final fuel pressure.

Power reduction will vary according to the requirements of the traffic pattern or surrounding terrain, gross weight, field elevation, temperature, and engine condition. However, a normal "after take-off" power setting is 24 inches of manifold pressure and 2450 RPM.

Prior to retracting the landing gear, the toe brakes should be applied momentarily to stop wheel rotation. A rapidly rotating wheel causes the tire to "grow" due to centrifugal force. If an accumulation of mud or ice is present in the wheel well it is possible to get a rubbing action from the rotating wheel as it is retracted into the wheel well.

CLIMB.

A cruising climb at 24 inches of manifold pressure, 2450 RPM, and 130 to 140 mph is recommended for saving time and fuel for the overall trip. In addition, this type of climb provides better engine cooling, less engine wear, and more passenger comfort due to lower noise level. The mixture may be leaned in this type of climb at any altitude providing the power settings do not exceed 24 inches of manifold pressure and 2450 RPM. Since power is important for climb performance it is desirable to operate at best power mixture. This mixture setting can be approximated by leaning to peak cylinder head temperature and then enrichening the mixture six or eight notches.

If it is necessary to climb rapidly to clear mountains or reach favorable winds at high altitude, the best rate-of-climb speed should be used with maximum power. This speed varies from 121 mph at sea level to 109 mph at 15,000 feet. During maximum performance climbs below 5000 feet the engines should be operated with full rich mixture. The only exception would be when thin black smoke is noted trailing from the augmentor tubes. In this case the mixture should be leaned to the point where the smoke disappears.

If an obstruction ahead requires a steep climb angle, the airplane should be flown at the best angle-of-climb speed with flaps up and maximum power. This speed varies from 88 mph at sea level to 98 mph at 15,000 feet.

CRUISE.

Tabulated cruising information for normal cruising power and altitudes is presented in Section VII. These charts are based on 100 and 130 gallons of fuel for cruise, lean mixture, 4700 pounds gross weight, zero wind, and no fuel reserve. Allowances for warm-up, take-off, and climb (see figure 7-3), headwinds, variations in mixture leaning technique, and fuel reserve should be estimated, and the endurance and range shown in the charts should be modified accordingly.

Since the main advantage of the airplane over ground transportation is speed, one should use the high cruising speeds obtainable. However, if a destination is slightly out of reach in one flight at normal cruising speed, it would save time and money to make the trip non-stop at some lower speed. An inspection of these cruising charts shows the long ranges obtainable at lower cruising speeds.

Normal cruising is done between 60% and 70% power. The power settings required to obtain these powers at various altitudes and outside air temperature can be determined by using the Cessna Model 310 Power Computer according to instructions on the face of the computer. A maximum cruising power of approximately 75% is allowable with 24 inches of manifold pressure and 2450 RPM.

To achieve the level flight performance shown in the cruising charts in Section VII, each engine should be leaned individually until a slight engine roughness is detected, and then enriched approximately six notches beyond the point where smooth engine operation is obtained. To reduce the chances of momentary engine stoppage while searching for the mixture that produces rough operation, the numbered index mark on the mixture lever quadrant corresponding to the typical lean mixture setting should be identified. During subsequent leaning procedures the mixture lever may be quickly moved to this mark and then adjusted carefully as instructed above. This mark may be a very representative lean mixture setting for a variety of power settings and altitudes in normal outside air temperatures.

If maximum range is desired, the mixture may be leaned to the minimum setting at which smooth engine operation can be maintained. In hot weather, where mixture distribution to each cylinder is quite uniform, this type of leaning may result in a 5 to 15 mph speed loss, depending upon altitude, power setting, and air temperature. At normal cruise power (below 75% power), operation at maximum lean mixture is not detrimental to engine life providing that the engines are running smoothly and the cylinder head temperatures are maintained within the recommended (275° to 470° F) operating range.

It is suggested that for a given throttle setting one should select the lowest engine speed in the green arc range that will give smooth engine operation with no evidence of engine laboring.

Synchronization of the propellers for cruising is accomplished by setting one propeller at the desired engine speed, turning the friction control knob to prevent propeller pitch lever creep, and then adjusting the other propeller pitch lever until the tachometer needles are aligned one over the other. If synchronization is slightly off, as indicated by an intermittent noise "beat", one propeller pitch lever should be adjusted to eliminate this beat. Synchronization is simplified by limiting the adjustments to