SARATOGA INFORMATION MANUAL

Saratoga

PA-32-301

HANDBOOK PART NO. 761 728

Published by
PUBLICATIONS DEPARTMENT
Piper Aircraft Corporation
Issued: January 9, 1980

APPLICABILITY

Application of this handbook is limited to the specific Piper PA-32-301 model airplane designated by serial number on the face of the title page of this handbook.

This handbook cannot be used for operational purposes unless kept in a current status.

REVISIONS

The information compiled in the Pilot's Operating Handbook, with the exception of the equipment list, will be kept current by revisions distributed to the airplane owners. The equipment list was current at the time the airplane was licensed by the manufacturer and thereafter must be maintained by the owner.

Revision material will consist of information necessary to update the text of the present handbook and/or to add information to cover added airplane equipment.

I. Revisions

Revisions will be distributed whenever necessary as complete page replacements or additions and shall be inserted into the handbook in accordance with the instructions given below:

1. Revision pages will replace only pages with the same page number.
2. Insert all additional pages in proper numerical order within each section.
3. Page numbers followed by a small letter shall be inserted in direct sequence with the same common numbered page.

II. Identification of Revised Material

Revised text and illustrations shall be indicated by a black vertical line along the outside margin of the page, opposite revised, added or deleted material. A line along the outside margin of the page opposite the page number will indicate that an entire page was added.

Black lines will indicate only current revisions with changes and additions to or deletions of existing text and illustrations. Changes in capitalization, spelling, punctuation or the physical location of material on a page will not be identified.

ORIGINAL PAGES ISSUED

The original pages issued for this handbook prior to revision are given below:

Title,ii through vii, 1-1 through 1-22, 2-1 through 2-10, 3-1 through 3-15, 4-1 through 4-26, 5-1 through 5-36, 6-1 through 6-58, 7-1 through 7-30, 8-1 through 8-17, 9-1 through 9-20, 10-1 through 10-2.

PILOT'S OPERATING HANDBOOK LOG OF REVISIONS

Current Revisions to the PA-32-301, Saratoga Pilot's Operating Handbook, REPORT: VB-1060 issued January 9, 1980.

Revision Number and Code	Revised Pages	Description of Revision	FAA Approval Signature and Date
Rev. 1 (PR800404)	6-42 9-i 9-21 thru 9-40	Revised info. Added info. Added supplements 6, 7, and 8.	Ward Evans Ward Evans April 4, 1980
Rev. 2 (PR800606)	9-i 9-21 thru 9-40	Revised pg. no. Relocated info.	Ward Evans Ward Evans June 6, 1980
Rev. 3 (PR801003)	1-4 2-2 2-3 2-4 2-9 4-15 4-17 4-26 5-20 5-25 6-i 6-6 6-10 6-23 6-24	Revised para. 1.7 (c). Revised para. 2.7 (g). Revised para. 2.7 g; Relocated para. 2.9 to pg. 2-3. Added para. 2.9 from pg. 2-3. Revised placard. Revised info. Revised para. 4.13 (b). Revised para. 4.37. Revised example in fig. 5-19. Revised fig. 5-27. Revised Table of Contents. Revised fig. 6-6. Revised para. 6.9 (f). Revised item 33. Added new items 49 and 50.	

PILOT'S OPERATING HANDBOOK LOG OF REVISIONS (cont)

Revision Number and Code	Revised Pages	Description of Revision	FAA Approval Signature and Date
Rev. 3 (PR801003) (cont)	6-28	Relocated items 105 and 107 to pg. 6-29; added new item 103 b.	
	6-29	Added items 105 and 107 from pg. 6-28.	
	6-31	Revised item 119.	
	6-32	Revised items 121 and 125.	
	6-34	Relocated items to pg. 6-35; added new items 143 thru 147; renumbered items.	
	6-35	Added items from pg. 6-34; renumbered items.	
	6-42	Added new items 217 and 219.	
	6-42a	Added pg.; added new items 221 thru 229.	
	6-42b	Added pg.; added new items 231 thru 241.	
	6-43 thru 6-46	Renumbered items.	
	6-47	Renumbered items; added new items 285 and 287.	
	6-48	Renumbered items; added new items 295 and 299.	
	6-49 thru 6-51	Renumbered items.	
	6-52	Renumbered items; added new item 334.	
	6-53 thru 6-56	Renumbered items.	
	6-57	Relocated items to pg. 6-58; added new items 389 thru 397.	

Revision Number and Code	Revised Pages	Description of Revision	FAA Approval Signature and Date
Rev. 3 (PR801003) (cont)	6-58	Relocated items to pg. 6-59; added items from pg. 6-57; renumbered items.	
	6-59	Added pg.; added items from pg. 6-58; renumbered items.	
	7-12	Revised para. 7.15.	
	7-14	Revised fig. 7-13.	
	7-18	Revised fig. 7-17.	
	7-22	Revised para. 7.23.	
	7-23	Revised para. 7.25.	
	8-6	Revised para. 8.9 (c).	
	8-12	Relocated para. 8.21 (c) and (d) to pg. 8-12b.	
	8-12a	Added pg.; added new info. to para. 8.21 (b).	
	8-12b	Added pg.; added para. 8.21 (c) and (d) from pg. 8-12.	
	8-13	Revised item.	
	9-i	Added Supplements 9 thru 11.	
	9-5	Revised Section 5 of Supplement 1.	
	9-11	Revised Section 4 (8) a. and b. of Supplement 3.	
	9-41 thru 9-44	Added pgs.; added Supplement 9 (Century 21 Autopilot Installation).	
	9-45 thru 9-54	Added pgs.; added Supplement 10 (Century 41 Autopilot Installation).	
	9-55 thru 9-56	Added pgs.; added Supplement 11 (Piper Control Wheel Clock Installation).	Ward Evans Ward Evans Oct. 3, 1980

PILOT'S OPERATING HANDBOOK LOG OF REVISIONS (cont)

Revision Number and Code	Revised Pages	Description of Revision	FAA Approval Signature and Date
Rev. 4 (PR810211)	3-i	Revised Table of Contents.	
	3-4	Relocated info. from pg. 3-5.	
	3-5	Moved info. to pg. 3-4; changed title and revised procedure; added procedure.	
	3-6	Continued procedure; moved info. to pg. 3-7.	
	3-7	Relocated info. from pg. 3-6.	
	3-13	Revised and retitled para. 3.23.	
	3-14	Added para. 3.24; moved para. 3.27 and 3.29 to pg. 3-15.	
	3-15	Relocated para. 3.27 and 3.29; moved info. to pg. 3-16.	
	3-16	Added page; relocated info. from pg. 3-15.	
	6-21	Revised item 13.	
	6-27	Revised item 97.	
	6-28	Revised items 99, 101 and 103.	
	6-29	Typo correction.	
	6-31	Moved item 119c to pg. 6-32.	
	6-32	Relocated and revised item 119c; moved items 123, 125 and 127 to pg. 6-32a.	
	6-32a	Added page; relocated items 123, 125 and 127 from pg. 6-32.	
	6-32b	New page.	
	6-41	Added item 198.	
	6-46	Added item 270; moved item 275 to pg. 6-47.	
	6-47	Relocated item 275 from pg. 6-46; revised item 287; moved item 291 to pg. 6-48.	
	6-48	Relocated item 291 from pg. 6-47; moved items 299 and 301 to pg. 6-49.	

Revision Number and Code	Revised Pages	Description of Revision	FAA Approval Signature and Date
Rev. 4 (PR810211) (cont)	6-49	Relocated items 299 and 301 from pg. 6-48.	
	6-56	Revised item 287.	
	6-57	Revised items 389 thru 397; moved items 395 and 397 to pg. 6-57a.	
	6-57a	Relocated items 395 and 397 from pg. 6-57; relocated items 399 thru 405 from pg. 6-58.	
	6-57b	Relocated items 407 and 409 from pg. 6-58; relocated items 411 and 413 and info. from pg. 6-59.	
	6-58	Deleted page; moved items 399 thru 405 to pg. 6-57a; moved items 407 and 409 to pg. 6-57b.	
	6-59	Deleted page; moved items 411 and 413 and info. to pg. 6-57b.	
	7-12	Revised para. 7.15; relocated info. from pg. 7-13.	
	7-13	Moved info. to pg. 7-12; added note.	
	7-14	Revised Figure 7-13.	
	7-15	Revised para. 7.15 cont.	
	7-19	Revised para. 7.19.	Ward Evans
	8-14	Revised para. 8.23.	Ward Evans
	9-45	Revised Sec. 2 (c).	Feb. 11, 1981
Rev. 5 (PR810731)	ii	Revised Warning.	
	1-5	Revised para. 1.13.	
	2-i	Changed page no.	
	4-4, 4-5, 4-6	Revised procedure.	
	4-8	Revised procedure.	

PILOT'S OPERATING HANDBOOK LOG OF REVISIONS (cont)

Revision Number and Code	Revised Pages	Description of Revision	FAA Approval Signature and Date
Rev. 5 (PR810731) (cont)	4-11	Added to procedure; moved info. to pg. 4-12.	
	4-12	Relocated info. from pg. 4-11.	
	4-16	Revised para. 4.9; moved info. to pg. 4-17.	
	4-17	Relocated info. from pg. 4-16.	
	4-21	Revised para. 4.21; moved info. to pg. 4-22.	
	4-22	Relocated info. from pg. 4-21.	
	4-24	Revised para. 4.29; moved info. to pg. 4-24a.	
	4-24a	New page; relocated info. from pg. 4-24; added to para. 4.29.	
	4-24b	New page.	
	6-26	Revised items 59, 61 and 63.	
	6-33	Revised item 133.	
	6-34	Revised item 147.	
	6-36	Revised item 169.	
	6-37	Added item 170.	
	6-40	Deleted item 193.	
	6-42	Revised item 219.	
	6-42b	Revised item 241.	
	6-45	Moved renumbered item to pg. 6-45a; moved item 267 to pg. 6-45b.	
	6-45a	Added items 264 and 265; relocated renumbered item from pg. 6-45.	
	6-45b	Relocated item 267 from pg. 6-45; relocated items 269 and 270 from pg. 6-46.	
	6-46	Moved items 269 and 270 to pg. 6-45b; added item 272; relocated items 275 thru 279 from pg. 6-47.	

Revision Number and Code	Revised Pages	Description of Revision	FAA Approval Signature and Date
Rev. 5 (PR810731) (cont)	6-47	Moved items 275 thru 279 to pg. 6-46; relocated items 291 and 293 from pg. 6-48.	
	6-48	Moved items 291 and 293 to pg. 6-47; added item 295.	
	6-54	Revised item 367.	
	6-57a	Delete page; moved items 395 thru 405 to pg. 6-58; revised item 401.	
	6-57b	Delete page; moved items 407 thru 415 to pg. 6-59; added; item 415.	
	6-58	New page; relocated items from pg. 6-57a.	
	6-59	New page; relocated items from pg. 6-57b; delete info.	
	7-13	Revised para. 7.15.	Ward Evans
	8-10	Revised para. 8.15.	Ward Evans
	9-53	Revised (i) (2).	July 31, 1981
Rev. 6 (PR811211)	1-7	Revised para. 1.19.	
	4-4	Corrected error to para. 4.5.	
	4-14, 4-15	Revised para. 4.9.	
	6-4	Revised fig. 6-3 info.	
	6-19	Revised para. 6.13.	
	6-45	Relocated item 264 from pg. 6-45a.	
	6-45a	Moved item 264 to pg. 6-45; relocated item 267 from pg. 6-45b.	
	6-45b	Moved item 267 to pg. 6-45a; relocated items 271 and 272 from pg. 6-46.	

Revision Number and Code	Revised Pages	Description of Revision	FAA Approval Signature and Date
Rev. 6 (PR811211) (cont)	6-46	Moved items 271 and 272 to pg. 6-45b; relocated items 281 and 283 from pg. 6-47.	
	6-47	Revised item 281; moved item 281 and 283 to pg. 6-46.	
	6-52	Added new item 335; moved items 334 and 335 to new pg. 6-52a.	
	6-52a	New pg.; relocated item 334 and new item 335 from pg. 6-52.	
	6-52b	New pg.	
	6-53	Renumbered item to 336; revised item 337.	
	6-58	Added notation to item 405.	Ward Evans
	7-22	Added info. to para. 7.23.	
	9-46	Revised Supplement 10, Section 3 (3) a.	Ward Evans Dec. 11, 1981
Rev. 7 (PR820804)	Title	Revised Title page.	
	iii	Revised para.	
	1-i	Revised Table of Contents.	
	1-1	Revised para. 1.1.	
	1-4	Revised para. 1.5.	
	1-9	Corrected spelling.	
	1-13 thru 1-22	Deleted pages and para. 1.21.	
	2-3	Revised para. 2.7.	
	3-i	Revised Table of Contents.	
	3-3, 3-4, 3-6	Revised procedures.	
	3-10	Revised para. 3.13.	
	4-i	Revised Table of Contents.	
	4-ii	New page, cont. Table of Contents.	

Revision Number and Code	Revised Pages	Description of Revision	FAA Approval Signature and Date
Rev. 7 (PR820804) (cont)	4-8	Revised procedure.	
	4-20	Revised para. 4.19.	
	5-3 thru 5-8	Revised para. 5.5.	
	5-18	Revised title fig. 5-15.	
	6-i	Revised Table of Contents.	
	6-1	Revised para. 6.1.	
	6-2	Revised para. 6.3.	
	6-5	Revised para. 6.5.	
	6-6	Revised fig. 6-5.	
	6-7	Revised fig. 6-7.	
	6-11	Revised fig. 6-9.	
	6-15	Revised para. 6.11.	
	7-13	Revised para. 7.15.	
	7-18	Revised fig. 7-17.	
	7-19	Revised para. 7.19.	
	7-22	Revised para. 7.23; moved info. to pg. 7-23.	
	7-23	Relocated info. from pg. 7-22.	
	7-24	Revised para. 7.25; moved info. to pg. 7-26.	
	7-26	Relocated info. from pg. 7-24; revised para. 7.31; moved info. to pg. 7-27.	
	7-27	Relocated info. from pg. 7-26.	
	7-28, 7-29	Revised para. 7.37.	
	8-2	Revised para. 8.3.	
	9-i	Revised Table of Contents.	
	9-7	Revised Sec. 3 (a).	
	9-57 thru 9-76	Added Supplement 12 (KAP 100 Series Flight Control System).	
	9-77 thru 9-102	Added Supplement 13 (KAP 150 Series Flight Control System).	Ward Evans Ward Evans Aug. 14, 1982

PILOT'S OPERATING HANDBOOK LOG OF REVISIONS (cont)

Revision Number and Code	Revised Pages	Description of Revision	FAA Approval Signature and Date
Rev. 8 (PR831007)	1-9	Revised barometric pressure (mb).	
	1-10	Deleted MEA.	
	2-10	Relocated fuel placard to pg. 2-11.	
	2-11	Added pg. (added new and relocated fuel placards).	
	5-6	Revised item (e).	
	5-7	Revised item (e) (3).	
	5-9	Revised Figures 5-27 thru 5-37.	
	5-23	Revised Figure 5-25.	
	5-25	Revised Figure 5-27 (deleted graph).	
	5-26	Revised Figure 5-29.	
	5-27	Revised Figure 5-31 (deleted graph).	
	5-28	Revised Figure 5-33.	
	5-29	Revised Figure 5-35 (deleted graph).	
	5-30	Revised Figure 5-37.	
	6-11	Revised Figure 6-9.	
	7-15	Added Caution.	Ward Evans
	8-2	Revised para. 8.3 info.	
	8-3	Revised para. 8.5 info.	Ward Evans
	8-4	Deleted para. 8.5 info.	Oct. 7, 1983
Rev. 9 (PR840917)	vii	Revised Table of Contents.	
	1-4	Revised para. 1.7.	
	3-1	Revised para. 3.1.	
	3-3	Revised para. 3.3.	
	3-10	Revised para. 3.13.	
	4-3 thru 4-11	Revised para. 4.5.	
	4-13	Revised para. 4.9.	
	4-17	Revised para. 4.11.	

PILOT'S OPERATING HANDBOOK LOG OF REVISIONS (cont)

Revision Number and Code	Revised Pages	Description of Revision	FAA Approval Signature and Date
Rev. 9 (PR840917) (cont)	4-20	Revised para. 4.17 and 4.19.	
	4-22	Revised para. 4.23.	
	4-25	Revised para. 4.31 and 4.35.	
	4-26	Revised para. 4.37.	
	5-9	Revised para. 5.7.	
	5-25	Added Fig. 5-27.	
	6-21	Revised item 15.	
	7-i	Revised Table of Contents.	
	7-1, 7-2	Revised para. 7.3.	
	7-5	Revised Fig. 7-1.	
	7-7	Relocated info. from pg. 7-8.	
	7-8	Moved info. to pg. 7-7; revised para. 7.11; revised Fig. 7-5.	
	7-8a	New page; added Fig. 7-6.	
	7-8b	New page.	
	7-9	Revised para. 7.13.	
	7-12, 7-13	Revised para. 7.15.	
	7-14	Revised Fig. 7-13.	
	7-18	Revised Fig. 7-17.	
	7-20	Relocated info. from pg. 7-22.	
	7-22	Moved info. to pg. 7-20; revised para. 7.23.	
	7-26	Revised para. 7.31.	
	8-5	Revised para. 8.9.	
	8-12, 8-12b	Revised para. 8.21 (b) and (d).	
	9-i	Revised Table of Contents.	
	9-77 thru 9-106	Revised Supplement 13, King KAP/KFC 150 Series Autopilot.	
	9-107 thru 9-126	Added Supplement 14, Century 31 Autopilot.	
	9-127 thru 9-132	Added Supplement 15, Sperry WeatherScout Weather Radar System.	

Revision Number and Code	Revised Pages	Description of Revision	FAA Approval Signature and Date
Rev. 9 (PR840917) (cont)	10-i 10-1, 10-2	Revised titles; Table of Contents. Revised page and para. titles.	Ward Evans Ward Evans Sept. 17, 1984
Rev. 10 (PR850628)	7-8	Revised para. 7.11.	D.H. Trompler July 8, 1985
Rev. 11 (PR861021)	7-22 9-i 9-133 thru 9-140	Revised para. 7.27. Revised Table of Contents. Added Supplement 16. Auxiliary vacuum System.	D.H. Trompler 12/3/86 Date
Rev. 12 (PR881001)	4-13 7-12 8-1 8-2 8-3 8-11 9-25	Revised para. 4.9. Revised para. 7.15. Revised para. 8.1. Revised para. 8.1 and 8.3. Revised para. 8.3. Revised para. 8.19. Revised para. (a.)	D.H. Trompler Nov. 29, 1988 Date

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SECTION 1

GENERAL

SECTION 1

GENERAL

1.1 INTRODUCTION

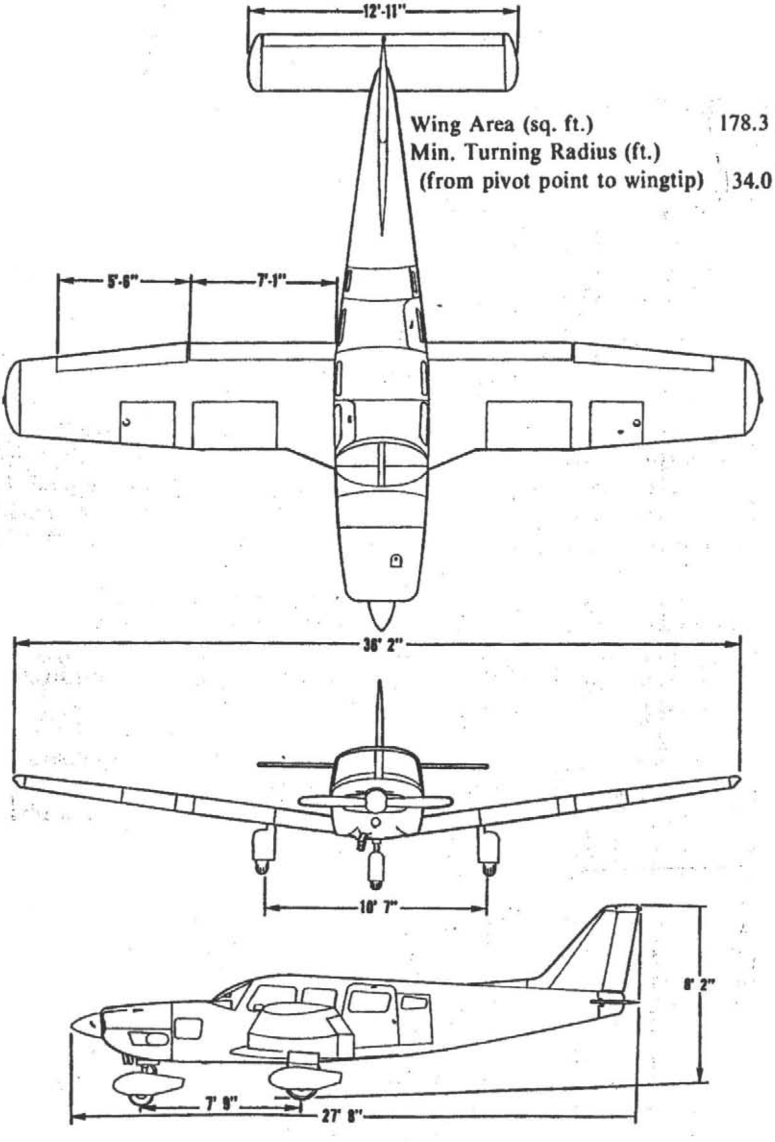
This Pilot's Operating Handbook is designed for maximum utilization as an operating guide for the pilot. It includes the material required to be furnished to the pilot by CAR 3. It also contains supplemental data supplied by the airplane manufacturer.

This handbook is not designed as a substitute for adequate and competent flight instruction, knowledge of current airworthiness directives, applicable federal air regulations or advisory circulars. It is not intended to be a guide for basic flight instruction or a training manual and should not be used for operational purposes unless kept in a current status.

Assurance that the airplane is in an airworthy condition is the responsibility of the owner. The pilot in command is responsible for determining that the airplane is safe for flight. The pilot is also responsible for remaining within the operating limitations as outlined by the instrument markings, placards, and this handbook.

Although the arrangement of this handbook is intended to increase its in-flight capabilities, it should not be used solely as an occasional operating reference. The pilot should study the entire handbook to familiarize himself with the limitations, performance, procedures and operational handling characteristics of the airplane before flight.

The handbook has been divided into numbered (arabic) sections each provided with a "finger-tip" tab divider for quick reference. The limitations and emergency procedures have been placed ahead of the normal procedures, performance and other sections to provide easier access to information that may be required in flight. The "Emergency Procedures" Section has been furnished with a red tab divider to present an instant reference to the section. Provisions for expansion of the handbook have been made by the deliberate omission of certain paragraph numbers, figure numbers, item numbers and pages noted as being intentionally left blank.



THREE VIEW
Figure 1-1

1.3 ENGINE

2 BLADE PROPELLER

(a) Number of Engines		1
(b) Engine Manufacturer		Lycoming
(c) Engine Model Number		IO-540-K1G5
	Max. Cont. Power	T. O. Power- 5 Min. Limit
(d) Rated Horsepower	294	300
(e) Rated Speed (rpm)	2600	2700
(f) Bore (inches)		5.125
(g) Stroke (inches)		4.375
(h) Displacement (cubic inches)		541.5
(i) Compression Ratio		8.7:1
(j) Engine Type		Six Cylinder, Direct Drive, Horizontally Opposed, Air Cooled, Fuel Injected

3 BLADE PROPELLER

(a) Number of Engines	1
(b) Engine Manufacturer	Lycoming
(c) Engine Model Number	IO-540-K1G5
(d) Rated Horsepower	300
(e) Rated Speed (rpm)	2700
(f) Bore (inches)	5.125
(g) Stroke (inches)	4.375
(h) Displacement (cubic inches)	541.5
(i) Compression Ratio	8.7:1
(j) Engine Type	Six Cylinder, Direct Drive, Horizontally Opposed, Air Cooled, Fuel Injected

1.5 PROPELLER

2 BLADE PROPELLER

(a) Number of Propellers	1
(b) Propeller Manufacturer	Hartzell
(c) Blade Model	F8475D-4
(d) Number of Blades	2
(e) Hub Model	HC-C2Y(K,R)-1( )F
(f) Propeller Diameter (inches)	
(1) Minimum	78.5
(2) Maximum	80
(g) Propeller Type	Constant Speed, Hydraulically Actuated

3 BLADE PROPELLER

(a) Number of Propellers	1
(b) Propeller Manufacturer	Hartzell
(c) Blade Model	F7663R-0
(d) Number of Blades	3
(e) Hub Model	HC-C3YR-1( )F
(f) Propeller Diameter (inches)	
(1) Minimum	76
(2) Maximum	78
(g) Propeller Type	Constant Speed, Hydraulically Actuated

1.7 FUEL

AVGAS ONLY

(a) Fuel Capacity (U.S. gal.) (total)	107
(b) Usable Fuel (U.S. gal.) (total)	102
(c) Fuel	
(1) Minimum Grade	100 Green or 100LL Blue Aviation Grade
(2) Alternate Fuels	Refer to latest revision of Lycoming Service Instruction 1070.

1.9 OIL

(a) Oil Capacity (U.S. quarts)		12
(b) Oil Specification		Refer to latest issue of Lycoming Service Instruction 1014.
(c) Oil Viscosity per Average Ambient Temp. for Starting		
	SINGLE	MULTI
(1) Above 60°F	50	40 or 50
(2) 30°F to 90°F	40	40
(3) 0° to 70°F	30	40 or 20W-30
(4) Below 10°F	20	20W-30

1.11 MAXIMUM WEIGHTS

(a) Maximum Takeoff Weight (lbs.)		3600
(b) Maximum Landing Weight (lbs.)		3600
(c) Maximum Ramp Weight		3615
	FORWARD	AFT
(d) Maximum Weights in Baggage Compartments	100	100

1.13 STANDARD AIRPLANE WEIGHTS

Refer to Figure 6-5 for the Standard Empty Weight and the Useful Load.

1.15 BAGGAGE SPACE

	FORWARD	AFT
(a) Compartment Volume (cubic feet)	8.0	17.3
(b) Entry Width (inches)	16.0	48.0
(c) Entry Height (inches)	22.0	26.0

1.17 SPECIFIC LOADINGS

(a) Wing Loading (lbs. per sq. ft.)	20.2
(b) Power Loading (lbs. per hp)	12.0

1.19 SYMBOLS, ABBREVIATIONS AND TERMINOLOGY

The following definitions are of symbols, abbreviations and terminology used throughout the handbook and those which may be of added operational significance to the pilot.

(a) General Airspeed Terminology and Symbols

CAS	Calibrated Airspeed means the indicated speed of an aircraft, corrected for position and instrument error. Calibrated airspeed is equal to true airspeed in standard atmosphere at sea level.
KCAS	Calibrated Airspeed expressed in "Knots."
GS	Ground Speed is the speed of an airplane relative to the ground.
IAS	Indicated Airpseed is the speed of an aircraft as shown on the airspeed indicator when corrected for instrument error. IAS values published in this handbook assume zero instrument error.
KIAS	Indicated Airspeed expressed in "Knots."
M	Mach number is the ratio of true airspeed to the speed of sound.
TAS	True Airspeed is the airspeed of an airplane relative to undisturbed air which is the CAS corrected for altitude, temperature and compressibility.
V_A	Maneuvering Speed is the maximum speed at which application of full available aerodynamic control will not overstress the airplane.
V_{FE}	Maximum Flap Extended Speed is the highest speed permissible with wing flaps in a prescribed extended position.

V_{LE}	Maximum Landing Gear Extended Speed is the maximum speed at which an aircraft can be safely flown with the landing gear extended.
V_{LO}	Maximum Landing Gear Operating Speed is the maximum speed at which the landing gear can be safely extended or retracted.
V_{NE}/M_{NE}	Never Exceed Speed or Mach Number is the speed limit that may not be exceeded at any time.
V_{NO}	Maximum Structural Cruising Speed is the speed that should not be exceeded except in smooth air and then only with caution.
V_S	Stalling Speed or the minimum steady flight speed at which the airplane is controllable.
V_{SO}	Stalling Speed or the minimum steady flight speed at which the airplane is controllable in the landing configuration.
V_X	Best Angle-of-Climb Speed is the airspeed which delivers the greatest gain of altitude in the shortest possible horizontal distance.
V_Y	Best Rate-of-Climb Speed is the airspeed which delivers the greatest gain in altitude in the shortest possible time.

(b) Meteorological Terminology

ISA	International Standard Atmosphere in which the air is a dry perfect gas, the temperature at sea level is 15° Celsius (59° Fahrenheit), the pressure at sea level is 29.92 inches Hg (1013.2 mb); The temperature gradient from sea level to the altitude at which the temperature is -56.5° C (-69.7°F) is -0.00198°C (-0.003566°F) per foot and zero above that altitude.
OAT	Outside Air Temperature is the free air static temperature, obtained either from inflight temperature indications or ground meteorological sources, adjusted for instrument error and compressibility effects.
Indicated Pressure Altitude	The number actually read from an altimeter when the barometric subscale has been set to 29.92 inches of mercury (1013.2 milibars).
Pressure Altitude	Altitude measured from standard sea-level pressure (29.92 in Hg) by a pressure or barometric altimeter. It is the indicated pressure altitude corrected for position and instrument error. In this handbook, altimeter instrument errors are assumed to be zero.
Station Pressure	Actual atmospheric pressure at field elevation.
Wind	The wind velocities recorded as variables on the charts of this handbook are to be understood as the headwind or tailwind components of the reported winds.

(c) Power Terminology

Takeoff Power	Maximum power permissible for takeoff.
Maximum Continuous Power	Maximum power permissible continuously during flight.
Maximum Climb Power	Maximum power permissible during climb.
Maximum Cruise Power	Maximum power permissible during cruise.

(d) Engine Instruments

EGT Gauge	Exhaust Gas Temperature Gauge

(e) Airplane Performance and Flight Planning Terminology

Climb Gradient	The demonstrated ratio of the change in height during a portion of a climb, to the horizontal distance traversed in the same time interval.
Demonstrated Crosswind Velocity	The demonstrated crosswind velocity is the velocity of the crosswind component for which adequate control of the airplane during takeoff and landing was actually demonstrated during certification tests.
Accelerate-Stop Distance	The distance required to accelerate an airplane to a specified speed and, assuming failure of an engine at the instant that speed is attained, to bring the airplane to a stop.
Route Segment	A part of a route. Each end of that part is identified by: (1) a geographical location; or (2) a point at which a definite radio fix can be established.

(f) Weight and Balance Terminology

Reference Datum	An imaginary vertical plane from which all horizontal distances are measured for balance purposes.
Station	A location along the airplane fuselage usually given in terms of distance from the reference datum.
Arm	The horizontal distance from the reference datum to the center of gravity (C.G.) of an item.
Moment	The product of the weight of an item multiplied by its arm. (Moment divided by a constant is used to simplify balance calculations by reducing the number of digits.)
Center of Gravity (C.G.)	The point at which an airplane would balance if suspended. Its distance from the reference datum is found by dividing the total moment by the total weight of the airplane.
C.G. Arm	The arm obtained by adding the airplane's individual moments and dividing the sum by the total weight.
C.G. Limits	The extreme center of gravity locations within which the airplane must be operated at a given weight.
Usable Fuel	Fuel available for flight planning.
Unusable Fuel	Fuel remaining after a runout test has been completed in accordance with governmental regulations.
Standard Empty Weight	Weight of a standard airplane including unusable fuel, full operating fluids and full oil.

-Basic Empty Weight	Standard empty weight plus optional equipment.
Payload	Weight of occupants, cargo and baggage.
Useful Load	Difference between takeoff weight, or ramp weight if applicable, and basic empty weight.
Maximum Ramp Weight	Maximum weight approved for ground maneuver. (It includes weight of start, taxi and run up fuel.)
Maximum Takeoff Weight	Maximum Weight approved for the start of the takeoff run.
Maximum Landing Weight	Maximum weight approved for the landing touchdown.
Maximum Zero Fuel Weight	Maximum weight exclusive of usable fuel.

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SECTION 2

LIMITATIONS

SECTION 2

LIMITATIONS

2.1 GENERAL

This section provides the "FAA Approved" operating limitations, instrument markings, color coding and basic placards necessary for operation of the airplane and its system.

Limitations associated with those optional systems and equipment which require handbook supplements can be found in Section 9 (Supplements).

2.3 AIRSPEED LIMITATIONS

SPEED	KIAS	KCAS
Never Exceed Speed (V_{NE}) - Do not exceed this speed in any operation.	197	189
Maximum Structural Cruising Speed (V_{NO}) - Do not exceed this speed except in smooth air and then only with caution.	154	150
Design Maneuvering Speed (V_A) - Do not make full or abrupt control movements above this speed.		
At 3600 LBS. G.W.	134	132
At 2225 LBS. G.W.	104	103

CAUTION

Maneuvering speed decreases at lighter weight as the effects of aerodynamic forces become more pronounced. Linear interpolation may be used for intermediate gross weights. Maneuvering speed should not be exceeded while operating in rough air.

SPEED	KIAS	KCAS
Maximum Flaps Extended Speed (V_{FE}) - Do not exceed this speed with flaps extended.	112	109

2.5 AIRSPEED INDICATOR MARKINGS

MARKING	IAS
Red Radial Line (Never Exceed)	197 KTS
Yellow Arc (Caution Range - Smooth Air Only)	154 KTS to 197 KTS
Green Arc (Normal Operating Range)	62 KTS to 154 KTS
White Arc (Flap Down)	58 KTS to 112 KTS

2.7 POWER PLANT LIMITATIONS

2 BLADE PROPELLER

(a) Number of Engines		1
(b) Engine Manufacturer		Lycoming
(c) Engine Model No.		IO-540-K1G5
(d) Engine Operating Limits	Max. Cont. Power	T.O. Power- 5 Min. Limit
(1) Maximum Horsepower	294	300
(2) Maximum Engine Speed (RPM)	2600	2700
(3) Maximum Oil Temperature (°F)	245	245
(e) Oil Pressure		
Minimum (red line)		25 PSI
Maximum (red line)		100 PSI
(f) Fuel Flow/Pressure		
Maximum (red line)		35 gal/hr; 14 PSI
(g) Fuel (minimum grade)		100 or 100LL Aviation Grade
(h) Number of Propellers		1
(i) Propeller Manufacturer		Hartzell

(j) Propeller Hub and Blade Model	HC-C2Y(KR)-1( )F F8475D-4
(k) Propeller Diameter (inches)	
Minimum	78.5
Maximum	80
(l) Blade Angle Limits	
Low Pitch Stop	13.5° + 0.2°
High Pitch Stop	34° + 1°

3 BLADE PROPELLER

(a) Number of Engines	1
(b) Engine Manufacturer	Lycoming
(c) Engine Model No.	IO-540-K1G5
(d) Engine Operating Limits	
(1) Maximum Horsepower	300
(2) Maximum Rotation Speed (RPM)	2700
(3) Maximum Oil Temperature (°F)	245
(e) Oil Pressure	
Minimum (red line)	25 PSI
Maximum (red line)	100 PSI
(f) Fuel Flow/Pressure	
Maximum (red line)	35 gal/hr; 14 PSI
(g) Fuel (minimum grade)	100 Green or 100LL Blue Aviation Grade
(h) Number of Propellers	1
(i) Propeller Manufacturer	Hartzell
(j) Propeller Hub and Blade Model	HC-C3YR-1( )F F7663R-0
(k) Propeller Diameter (inches)	
Minimum	76
Maximum	78
(l) Blade Angle Limits	
Low Pitch Stop	12.4° + 0.2°
High Pitch Stop	32.0° + 1.0°

2.9 POWER PLANT INSTRUMENT MARKINGS

(a) Tachometer	
(1) 2 Blade Propeller	
Green Arc (Normal Operating Range)	500 to 2600 RPM
Yellow Arc (5 Minute Limit)	2600 to 2700 RPM
Red Line (Takeoff Power)	2700 RPM
(2) 3 Blade Propeller	
Green Arc (Normal Operating Range)	500 to 2700 RPM
Red Line	2700 RPM
(b) Oil Temperature	
Green Arc (Normal Operating Range)	75° to 245°F
Red Line (Maximum)	245°F
(c) Oil Pressure	
Green Arc (Normal Operating Range)	60 PSI to 90 PSI
Yellow Arc (Caution Range) (Idle)	25 PSI to 60 PSI
Yellow Arc (Caution Range) (Start and Warm Up)	90 PSI to 100 PSI
Red Line (Minimum)	25 PSI
Red Line (Maximum)	100 PSI
(d) Fuel Flow/Pressure	
Green Arc (Normal Operating Range)	0 gal/hr. to 34.9 gal/hr.
Red Line (Maximum)	35 gal/hr.; 14 PSI

2.11 WEIGHT LIMITS

(a) Maximum Takeoff Weight	3600 LBS.
(b) Maximum Ramp Weight	3615 LBS.
(c) Maximum Baggage (100 lbs. each compartment)	200 LBS.

NOTE

Refer to Section 5 (Performance) for maximum weight as limited by performance.

2.13 CENTER OF GRAVITY LIMITS

Weight Pounds	Forward Limit Inches Aft of Datum	Rearward Limit Inches Aft of Datum
3600	90.0	95.0
3200	83.5	95.0
2400 (and less)	78.0	95.0

NOTES

Straight line variation between points given.

The datum used is 78.4 inches ahead of the wing leading edge at the intersection of the untapered and inboard tapered seciton.

It is the responsibility of the airplane owner and the pilot to insure that the airplane is properly loaded. See Section 6 (Weight and Balance) for proper loading instructions.

2.15 MANEUVER LIMITS

No acrobatic maneuvers including spins approved.

2.17 FLIGHT LOAD FACTORS

(a) Positive Load Factor (Maximum) 3.8 G
(b) Negative Load Factor (Maximum) No inverted maneuvers approved
(c) Positive Load Factor - Flaps Down (Maximum) 2.0 G
(d) Negative Load Factor - Flaps Down (Maximum) No inverted maneuvers approved

2.19 TYPES OF OPERATIONS

The airplane is approved for the following operations when equipped in accordance with FAR 91 or FAR 135.

(a) Day V.F.R.
(b) Night V.F.R.
(c) Day I.F.R.
(d) Night I.F.R.
(e) Non icing

2.21 FUEL LIMITATIONS

(a) Total Capacity .... 107 U.S. GAL.
(b) Unusable Fuel .... 5 U.S. GAL.
The unusable fuel for this airplane has been determined as 2.5 gallons in each wing in critical flight attitudes (2.5 gallons is the total per side, each side having two interconnected tanks).
(c) Usable Fuel.................................. 102 U.S. GAL.
The usable fuel in this airplane has been determined as 51 gallons in each wing (51 gallons is the total per side, each side having two interconnected tanks).

2.23 NOISE LEVEL

The corrected noise level of this aircraft is 76.7d B(A) for two bladed propeller installations and 77.5d B(A) for three bladed propeller installations.

No determination has been made by the Federal Aviation Administration that the noise levels of this airplane are or should be acceptable or unacceptable for operation at, into, or out of, any airport.

The above statement notwithstanding the noise level stated above has been verified by and approved by the Federal Aviation Administration in noise level test flights conducted in accordance with F.A.R. 35, Noise Standards - Aircraft Type and Airworthiness Certification. This aircraft model is in compliance with all F.A.R. 36 noise standards applicable to this type.

2.25 FLIGHT WITH REAR CABIN DOOR OR REAR CABIN DOOR AND CARGO DOOR REMOVED

The following limitations must be observed in the operation of this airplane with the rear cabin door or the rear cabin door and cargo door removed:

(a) The airplane may be flown with the rear cabin door or rear cabin door and cargo door removed. Flight with the front door removed is not approved.
(b) Maximum speed - 147 KIAS
(c) No smoking
(d) All loose articles must be tied down and stowed.
(e) Jumper's static lines must be kept free of pilot's control and control surfaces.
(f) Operation approved VFR flight conditions only.

2.27 PLACARDS

In full view of the pilot:

THIS AIRPLANE MUST BE OPERATED AS A NORMAL CATEGORY AIRPLANE IN COMPLIANCE WITH THE OPERATING LIMITATIONS STATED IN THE FORM OF PLACARDS, MARKINGS AND MANUALS. NO ACROBATIC MANEUVERS INCLUDING SPINS, APPROVED.

THIS AIRCRAFT APPROVED FOR V.F.R., I.F.R., DAY AND NIGHT NON-ICING FLIGHT WHEN EQUIPPED IN ACCORDANCE WITH FAR 91 OR FAR 135.

In full view of the pilot, the following takeoff and landing check lists will be installed:

TAKEOFF CHECK LIST

Fuel on Proper Tank
Electric Fuel Pump On
Engine Gages Checked
Alternate Air Closed
Seat Backs Erect
Mixture Set
Propeller Set
Fasten Belts/Harness
Flaps Set
Trim Tab Set
Controls Free
Doors Latched
Air Conditioner Off

LANDING CHECK LIST

Fuel on Proper Tank
Seat Backs Erect
Fasten Belts/Harness
Electric Fuel Pump - On
Mixture - Rich
Propeller - Set
Flaps Set (White Arc)
Air Conditioner Off

The "AIR CONDITIONER OFF" item in the above takeoff and landing check lists is mandatory for air conditioned aircraft only.

On the instrument panel in full view of the pilot:

V_A 134 KIAS at 3600 LBS.
(See A.F.M.)

On the instrument panel in full view of the pilot:

DEMO X-WIND 17 KTS

In full view of the pilot: (For operations with the rear door removed)

FOR FLIGHT WITH THE DOOR REMOVED, SEE THE LIMITATIONS AND PROCEDURES SECTIONS OF THE AIRPLANE FLIGHT MANUAL.

Adjacent to upper door latch (front and rear doors):

ENGAGE LATCH BEFORE FLIGHT

In full view of the pilot:

WARNING

TURN OFF STROBE LIGHTS WHEN IN CLOSE PROXIMITY TO GROUND OR DURING FLIGHT THROUGH CLOUD, FOG OR HAZE.

In full view of the pilot, in the area of the air conditioner controls when the air condtioner is installed:

WARNING — AIR CONDITIONER MUST BE OFF TO INSURE NORMAL TAKEOFF CLIMB PERFORMANCE.

On the inside of the forward baggage compartment:

> MAXIMUM BAGGAGE THIS COMPARTMENT 100 LBS. SEE THE LIMITATIONS SECTION OF THE AIRPLANE FLIGHT MANUAL.

On aft baggage closeout:

> MAXIMUM BAGGAGE THIS COMPARTMENT 100 LBS. NO HEAVY OBJECTS ON HAT SHELF.

On storm window:

> DO NOT OPEN ABOVE 129 KIAS

On executive writing table:

> CAUTION — THIS TABLE MUST BE STOWED DURING TAKEOFF AND LANDING.

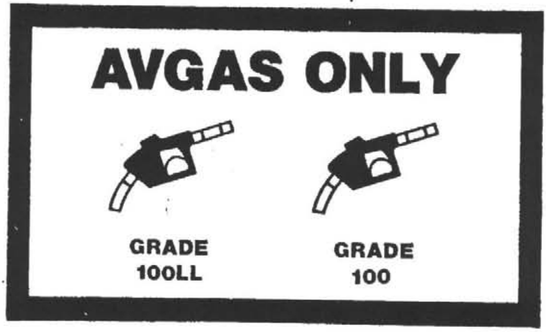
On the face of the tachometer: (2 blade propeller only)

> AFTER 5 MIN.
> REDUCE POWER TO
> 2600 RPM

Adjacent to fuel tank filler caps:

FUEL — 100 OR 100LL AVIATION GRADE

Adjacent to fuel tank filler caps (serial nos. 32-8306013 and up):



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SECTION 3

EMERGENCY PROCEDURES

SECTION 3

EMERGENCY PROCEDURES

3.1 GENERAL

The recommended procedures for coping with various types of emergencies and critical situations are provided by this section. All of the required (FAA regulations) emergency procedures and those necessary for operation of the airplane as determined by the operating and design features of the airplane are presented.

Emergency procedures associated with those optional systems and equipment which require handbook supplements are provided in Section 9 (Supplements).

The first portion of this section consists of an abbreviated emergency check list which supplies an action sequence for critical situations with little emphasis on the operation of systems.

The remainder of the section is devoted to amplified emergency procedures containing additional information to provide the pilot with a more complete understanding of the procedures.

These procedures are suggested as a course of action for coping with the particular condition described, but are not a substitute for sound judgment and common sense. Pilots should familiarize themselves with the procedures given in this section and be prepared to take appropriate action should an emergency arise.

Most basic emergency procedures, such as a power off landings, are a normal part of pilot training. Although these emergencies are discussed here, this information is not intended to replace such training, but only to provide a source of reference and review, and to provide information on procedures which are not the same for all aircraft. It is suggested that the pilot review standard emergency procedures periodically to remain proficient in them.

3.3 EMERGENCY PROCEDURES CHECK LIST

ENGINE FIRE DURING START

Starter .... crank engine
Mixture .... idle cut-off
Throttle .... open
Electric fuel pump .... OFF
Fuel selector .... OFF
Abandon if fire continues

ENGINE POWER LOSS DURING TAKEOFF

If sufficient runway remains for a normal landing, land straight ahead.

If area ahead is rough, or if it is necessary to clear obstructions, maintain a safe airspeed and make only a shallow turn if necessary to avoid obstructions. Use of flaps depends upon circumstances. Normally flaps should be fully extended for touchdown.

If sufficient altitude has been gained to attempt a restart:
Maintain safe airspeed
Fuel selector .... switch to tank containing fuel
Electric fuel pump .... check ON
Mixture .... check RICH
Alternate air .... OPEN
If power is not regained, proceed with power off landing.

ENGINE POWER LOSS IN FLIGHT

Fuel selector .... switch to tank containing fuel
Electric fuel pump .... ON
Mixture .... rich
Alternate air .... OPEN
Engine gauges .... check for indication of cause of power loss

If no fuel flow is indicated, check tank selector position to be sure it is on a tank containing fuel.

When power is restored:
Alternate air .... CLOSED
Electric fuel pump .... OFF
Mixture .... adjust as necessary

If power is not restored prepare for power off landing.
Trim for 80 KIAS

POWER OFF LANDING

Locate suitable field.
Establish spiral pattern.
1000 ft. above field at downwind position for normal landing approach.
When field can easily be reached slow to 79 KIAS for shortest landing.

Touchdowns should normally be made at lowest possible airspeed with full flaps.

When committed to landing:
Throttle .... closed
Fuel selector .... OFF
Mixture .... idle cut-off
Flaps .... set
Ignition .... OFF
Master switch .... OFF
Seat belt and harness .... tight

FIRE IN FLIGHT

Source of fire..check

Electrical fire (smoke in cabin):
Master switch .... OFF
Vents.. open
Cabin heat .... OFF
Land as soon as possible.

Engine fire:
Fuel selector .... OFF
Throttle .... CLOSED
Mixture .... idle cut-off
Electric fuel pump .... check OFF
Heater and defroster .... OFF
Proceed with power off landing procedure.

LOSS OF OIL PRESSURE

Land as soon as possible and investigate cause. Prepare for power off landing.

LOSS OF FUEL PRESSURE

Electric fuel pump .... ON
Fuel selector .... check on tank
containing usable fuel

HIGH OIL TEMPERATURE

Land at nearest airport and investigate the problem. Prepare for power off landing.

ELECTRICAL FAILURES

ALT annunciator light illuminated
Ammeter ....check to verify inop. alt.

If ammeter shows zero
ALT switch .... OFF

Reduce electrical loads to minimum
ALT circuit breaker............................. check and reset as required
ALT switch .... ON

If power not restored
ALT switch .... OFF

If alternator output cannot be restored, reduce electrical loads and land as soon as practical. The battery is the only remaining source of electrical power.

ELECTRICAL OVERLOAD (alternator over 20 amps above known electrical load)

FOR AIRPLANES WITH INTERLOCKED BAT AND ALT SWITCH OPERATION

Electrical load .... reduce

If alternator loads are not reduced
ALT switch .... OFF

Land as soon as practical. Battery is the only remaining source of power. Anticipate complete electrical failure.

FOR AIRPLANES WITH SEPARATE BAT AND ALT SWITCH OPERATION

ALT switch .... ON
BAT switch .... OFF

If alternator loads are reduced
Electrical load .... reduce to minimum

Land as soon as practical.

NOTE

Due to increased system voltage and radio frequency noise, operation with ALT switch ON and BAT switch OFF should be made only when required by an electrical system failure.

If alternator loads are not reduced
ALT switch .... OFF
BAT switch .... as required

Land as soon as practical. Anticipate complete electrical failure.

PROPELLER OVERSPEED

Throttle .... retard
Oil pressure .... check
Prop control .... full DECREASE rpm, then set if any control available
Airspeed .... reduce
Throttle .... as required to remain below 2700 rpm

SPIN RECOVERY

Rudder .... full opposite to direction of rotation

Control wheel .... full forward while neutralizing ailerons

Throttle .... idle
Rudder .... neutral (when rotation stops)

Control wheel .... as required to smoothly regain level flight attitude

OPEN DOOR

If both upper and side latches are open, the door will trail slightly open and airspeeds will be reduced slightly.

To close the door in flight:
Slow airplane to 87 KIAS
Cabin vents .... close
Storm window .... open

If upper latch is open .... latch
If side latch is open .... pull on armrest while moving latch handle to latch position

If both latches are open .... latch side latch then top latch

3.5 AMPLIFIED EMERGENCY PROCEDURES (GENERAL)

The following paragraphs are presented to supply additional information for the purpose of providing the pilot with a more complete understanding of the recommended course of action and probable cause of an emergency situation.

3.7 ENGINE FIRE DURING START

Engine fires during start are usually the result of overpriming. The first attempt to extinguish the fire is to try to start the engine and draw the excess fuel back into the induction system.

If a fire is present before the engine has started, move the mixture control to idle cut-off, open the throttle and crank the engine. This is an attempt to draw the fire back into the engine.

If the engine has started, continue operating to try to pull the fire into the engine.

In either case (above), if fire continues more than a few seconds, the fire should be extinguished by the best available external means.

The fuel selector valve should be OFF and the mixture at idle cut-off if an external fire extinguishing method is to be used.

3.9 ENGINE POWER LOSS DURING TAKEOFF

The proper action to be taken if loss of power occurs during takeoff will depend on the circumstances of the particular situation.

If sufficient runway remains to complete a normal landing, land straight ahead.

If the area ahead is rough, or if it is necessary to clear obstructions, maintain a safe airspeed and maneuver gently to avoid obstacles, making only shallow turns if necessary. Use of flaps depend upon circumstances. Normally, flaps should be fully extended for touchdown.

If sufficient altitude has been gained to attempt a restart, maintain a safe airspeed and switch the fuel selector to another tank containing fuel. Check the electric fuel pump to insure that it is ON and that the mixture is RICH. The alternate air should be OPEN.

If engine failure was caused by fuel exhaustion, power will not be regained after switching fuel tanks until the empty fuel lines are filled. This may require up to ten seconds.

If power is not regained, proceed with Power Off Landing procedure (refer to the emergency check list and paragraph 3.13).

3.11 ENGINE POWER LOSS IN FLIGHT

Complete engine power loss is usually caused by fuel flow interruption and power will be restored shortly after fuel flow is restored. If power loss occurs at a low altitude, the first step is to prepare for an emergency landing (refer to paragraph 3.13). An airspeed of at least 80 KIAS should be maintained.

If altitude permits, switch the fuel selector to another tank containing fuel and turn the electric fuel pump ON. Move the mixture control to RICH and the alternate air to OPEN. Check the engine gauges for an indication of the cause of the power loss. If no fuel flow is indicated, check the tank selector position to be sure it is on a tank containing fuel.

When power is restored move the alternate air to the CLOSED position, turn OFF the electric fuel pump and adjust the mixture control as necessary.

If the preceding steps do not restore power, prepare for an emergency landing.

If time permits, turn the ignition switch to L then to R then back to BOTH. Move the throttle and mixture control levers to different settings. This may restore power if the problem is too rich or too lean a mixture or if there is a partial fuel system restriction. Try other fuel tanks. Water in the fuel could take some time to be used up, and allowing the engine to windmill may restore power. If power loss is due to water, fuel flow indications will be normal.

If engine failure was caused by fuel exhaustion, power will not be restored after switching fuel tanks until the empty fuel lines are filled. This may require up to ten seconds.

If power is not regained, proceed with the Power Off Landing procedure (refer to the emergency check list and paragraph 3.13).

3.13 POWER OFF LANDING

If loss of power occurs at altitude, trim the aircraft for best gliding angle (80 KIAS, Air Cond. off) and look for a suitable field. If measures taken to restore power are not effective, and if time permits, check your charts for airports in the immediate vicinity; it may be possible to land at one if you have sufficient altitude. At best gliding angle with no wind, the engine windmilling and the propeller control, in full DECREASE rpm, the aircraft will travel approximately 1.5 miles for each thousand feet of altitude in a no wind condition. If posssible, notify the FAA by radio of your difficulty and intentions. If another pilot or passenger is aboard, let him help.

When you have located a suitable field, establish a spiral pattern around this field. Try to be at 1000 feet above the field at the downwind position, to make a normal landing approach. When the field can easily be reached, slow to 79 KIAS with flaps down for the shortest landing. Excess altitude may be lost by widening your pattern, using flaps or slipping, or a combination of these.

When committed to landing, close the throttle control, turn the fuel selector valve to OFF and move the mixture to idle cut-off. After final flap setting, turn the master and ignition switches OFF. The seat belts and shoulder harnesses (where installed) should be tightened. Touchdown should be normally made at the lowest possible airspeed.

3.15 FIRE IN FLIGHT

The presence of fire is noted through smoke, smell and heat in the cabin. It is essential that the source of the fire be promptly identified through instrument readings, characteristics of the smoke, or other indications, since the action to be taken differs somewhat in each case.

Check for the source of the fire first.

If an electrical fire is indicated (smoke in the cabin), the master switch should be turned OFF. The cabin vents should be opened and the cabin heat turned OFF. A landing should be made as soon as possible.

If an engine fire is present, switch the fuel selector to OFF and close the throttle. The mixture should be at idle cut-off. Turn the electric fuel pump OFF. In all cases, the heater and defroster should be OFF. If radio communication is not required select master switch OFF. If the terrain permits, a landing should be made immediately.

NOTE

The possibility of an engine fire in flight is extremely remote. The procedure given is general and pilot judgment should be the determining factor for action in such an emergency.

3.17 LOSS OF OIL PRESSURE

Loss of oil pressure may be either partial or complete. A partial loss of oil pressure usually indicates a malfunction in the oil pressure regulating system, and a landing should be made as soon as possible to investigate the cause and prevent engine damage.

A complete loss of oil pressure indication may signify oil exhaustion or may be the result of a faulty gauge. In either case, proceed toward the nearest airport and be prepared for a forced landing. If the problem is not a pressure gauge malfunction, the engine may stop suddenly. Maintain altitude until such time as a dead stick landing can be accomplished. Don't change power settings unnecessarily, as this may hasten complete power loss.

Depending on the circumstances, it may be advisable to make an off airport landing while power is still available, particularly if other indications of actual oil pressure loss, such as sudden increases in temperatures, or oil smoke, are apparent, and an airport is not close.

If engine stoppage occurs, proceed with Power Off Landing.

3.19 LOSS OF FUEL FLOW

The most probable cause of loss of fuel pressure is either fuel depletion in the fuel tank selected or failure of the engine driven fuel pump. If loss of fuel pressure occurs, turn ON the electric fuel pump and check that the fuel selector is on a tank containing usable fuel.

If loss of fuel pressure is due to failure of the engine driven fuel pump the electric fuel pump will supply sufficient fuel flow.

After fuel pressure and power are regained, turn the electric fuel pump OFF. If fuel pressure starts to drop, turn the electric fuel pump ON and land at the nearest suitable airport as soon as possible and have the cause investigated.

CAUTION

If normal engine operation and fuel pressure are not immediately re-established, the electric fuel pump should be turned off. The lack of fuel pressure indication could indicate a leak in the fuel system, or fuel exhaustion.

3.21 HIGH OIL TEMPERATURE

An abnormally high oil temperature indication may be caused by a low oil level, obstruction in the oil cooler, damaged or improper baffle seals, a defective gauge, or other causes. Land as soon as practical at an appropriate airport and have the cause investigated.

A steady, rapid rise in oil temperature is a sign of trouble. Land at the nearest airport and let a mechanic investigate the problem. Watch the oil pressure gauge for an accompanying loss of pressure.

3.23 ELECTRICAL FAILURES

Loss of alternator output is detected through zero reading on the ammeter. Before executing the following procedure, insure that the reading is zero and not merely low by actuating an electrically powered device, such as the landing light. If no increase in the ammeter reading is noted, alternator failure can be assumed.

The electrical load should be reduced as much as possible. Check the alternator circuit breakers for a popped circuit.

The next step is to attempt to reset the overvoltage relay. This is accomplished by moving the ALT switch to OFF for one second and then to ON. If the trouble was caused by a momentary overvoltage condition (16.5 volts and up), this procedure should return the ammeter to a normal reading.

If the ammeter continues to indicate "0" (zero) output, or if the alternator will not remain reset, turn off the ALT switch, maintain minimum electrical load and land as soon as practical. All electrical load is being supplied by the battery.

3.24 ELECTRICAL OVERLOAD (Alternator over 20 amps above known electrical load)

If abnormally high alternator output is observed (more than 20 amps above known electrical load for the operating conditions) it may be caused by a low battery, a battery fault or other abnormal electrical load. If the cause is a low battery, the indication should begin to decrease toward normal within 5 minutes. If the overload condition persists attempt to reduce the load by turning off nonessential equipment. For airplanes with interlocked BAT and ALT switch operation, when the electrical load cannot be reduced turn the ALT switch OFF and land as soon as practical. The battery is the only remaining source of electrical power. Also anticipate complete electrical failure.

For airplanes with separate BAT and ALT switch operations, turn the BAT switch OFF and the ammeter should decrease. Turn the BAT switch ON and continue to monitor the ammeter. If the alternator output does not decrease within 5 minutes, turn the BAT switch OFF and land as soon as practical. All electrical loads are being supplied by the alternator.

NOTE

Due to higher voltage and radio frequency noise, operation with the ALT switch ON and the BAT switch OFF should be made only when required by an electrical failure.

3.25 PROPELLER OVERSPEED

Propeller overspeed is caused by a malfunction in the propeller governor or low oil pressure which allows the propeller blades to rotate to full low pitch.

If propeller overspeed should occur, retard the throttle and check the oil pressure. The propeller control should be moved to full DECREASE rpm and then set if any control is available. Airspeed should be reduced and throttle used to maintain 2700 RPM.

3.27 SPIN RECOVERY

Intentional spins are prohibited in this airplane. If a spin is inadvertently entered, immediately apply full rudder opposite to the direction of rotation. Move the control wheel full forward while neutralizing the ailerons. Move the throttle to IDLE. When the rotation stops, neutralize the rudder and ease back on the control wheel as required to smoothly regain a level flight altitude.

3.29 OPEN DOOR

The cabin door is double latched, so the chances of it springing open in flight at both the top and side are remote. However, should you forget the upper latch, or not fully engage the side latch, the door may spring partially open. This will usually happen at takeoff or soon afterward. A partially open door will not affect normal flight characteristics, and a normal landing can be made with the door open.

If both upper and side latches are open, the door will trail slightly open, and airspeed will be reduced slightly.

To close the door in flight, slow the airplane to 87 KIAS, close the cabin vents and open the storm window. If the top latch is open, latch it. If the side latch is open, pull on the armrest while moving the latch handle to the latched position. If both latches are open, close the side latch then the top latch.

3.31 ENGINE ROUGHNESS

Engine roughness may be caused by dirt in the injector nozzles, induction filter icing, or ignition problems.

First adjust the mixture for maximum smoothness. The engine will run rough if the mixture is too rich or too lean.

Move the alternate air to OPEN and then turn ON the electric fuel pump.

Switch the fuel selector to another tank to see if fuel contamination is the problem.

Check the engine gauges for abnormal readings. If any gauge readings are abnormal proceed accordingly.

The magneto switch should then be moved to "L" then "R," then back to "BOTH." If operation is satisfactory on either magneto, proceed on that magneto at reduced power with full RICH mixture to a landing at the first available airport.

If roughness persists, prepare for a precautionary landing at pilot's discretion.

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NORMAL PROCEDURES

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SECTION 4

NORMAL PROCEDURES

4.1 GENERAL

This section describes the recommended procedures for the conduct of normal operations for the airplane. All of the required (FAA regulations) procedures and those necessary for operation of the airplane as determined by the operating and design features of the airplane are presented.

Normal procedures associated with those optional systems and equipment which require handbook supplements are provided by Section 9 (Supplements).

These procedures are provided to present a source of reference and review and to supply information on procedures which are not the same for all aircraft. Pilots should familiarize themselves with the procedures given in this section in order to become proficient in the normal operations of the airplane.

The first portion of this section consists of a short form check list which supplies an action sequence for normal operations with little emphasis on the operation of the systems.

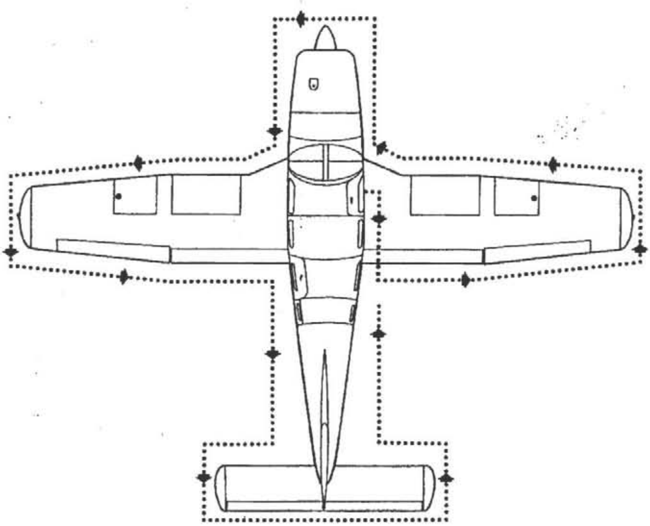
The remainder of the section is devoted to amplified normal procedures which provide detailed information and explanations of the procedures and how to perform them. This portion of the section is not intended for use as an in-flight reference due to the lengthy explanation. The short form check list should be used for this purpose.

4.3 AIRSPEEDS FOR SAFE OPERATIONS

The following airspeeds are those which are significant to the safe operation of the airplane. These figures are for standard airplanes flown at gross weight under standard conditions at sea level.

Performance for a specific airplane may vary from published figures depending upon the equipment installed, the condition of the engine, airplane and equipment, atmospheric conditions and piloting technique.

(a) Best Rate of Climb Speed	90 KIAS
(b) Best Angle of Climb Speed	76 KIAS
(c) Turbulent Air Operating Speed (See Subsection 2.3)	134 KIAS
(d) Maximum Flap Speed	112 KIAS
(e) Landing Final Approach Speed (Flaps 40°)	79 KIAS
(f) Maximum Demonstrated Crosswind Velocity	17 KTS



WALK-AROUND
Figure 4-1

4.5 NORMAL PROCEDURES CHECK LIST

PREFLIGHT CHECK

COCKPIT

Control wheel .... release restraints
Parking brake .... set
All switches .... OFF
Avionics .... OFF
Mixture .... idle cut-off
Master switch .... ON
Fuel gauges .... check quantity
Annunciator panel .... check
Flaps .... proper operation
Master switch .... OFF
Primary flight controls .... proper operation
Trim .... neutral

Pitot and static systems .... drain
Windows .... check clean
Required papers .... check on board
Tow bar and baggage......................... stow properly - secure
Baggage door.................................... close and secure

RIGHT WING

Surface condition .... clear of ice, frost, snow
Flaps and hinges...check
Aileron and hinges ....check
Wing tip and lights...check
Fuel tank .... check supply
visually - secure cap
Fuel tank vent .... clear
Fuel tank sumps ....drain, check for water,
sediment and proper fuel
Fuel quantity gauge ....check
Tie down and chock .... remove
Main gear strut ....proper
inflation (4.5 ± .5 in.)
Tire ....check
Brake block and disc ....check
Fresh air inlet .... clear

NOSE SECTION

General condition ....check
Cowling .... secure
Windshield .... clean
Propeller and spinner.......................................check
Air inlets .... clear
Chock .... remove
Nose gear strut ....proper
inflation (3.25 ± .25 in.)
Nose wheel tire ....check
Alternator belt...check
Oil ....check quantity
Dipstick .... properly seated
Oil filler cap.. secure
Baggage door.................................... close and secure
Landing light ....check

LEFT WING

Surface condition .... clear of ice, frost, snow
Fresh air inlet .... clear
Tie down and chock .... remove
Main gear strut .... proper
inflation (4.5 ± .5 in.)
Tire .... check
Brake block and disc .... check
Fuel quantity gauge .... check
Fuel tank .... check supply
visually - secure cap
Fuel tank vent .... clear
Fuel tank sump .... drain, check for water,
sediment and proper fuel
Pitot/static head .... remove cover - holes clear
Wing tip and lights .... check
Aileron and hinges .... check
Flap and hinges .... check

EMPENNAGE

Antennas .... check
General condition .... check
Baggage .... check
Tail light(s) .... check
Elevator .... check
Rudder .... check
Tie down .... remove

MISCELLANEOUS

Fuel strainer .... drain
Master switch .... ON
Pitot heat switch .... ON
Interior lighting .... ON and check
Exterior lighting switches .... ON and check
Fuel strainer drain .... visually check
contents of container for
water, sediment and proper fuel
and dispose - valve secure
Pitot .... check - warm
Stall warning horn .... check

All lighting switches .... OFF
Pitot heat switch .... OFF
Master switch .... OFF
Passengers .... board
All doors .... close and secure
Seat belt and harness .... fasten/adjust
- check inertia reel

BEFORE STARTING ENGINE

Parking brake .... set
Propeller .... full INCREASE rpm
Fuel selector .... desired tank
Radios .... OFF

STARTING ENGINE WHEN COLD

Throttle .... 1/2" open
Master switch .... ON
Electric fuel pump .... ON
Mixture .... prime - then idle cut-off
Starter .... engage
Mixture .... full RICH
Throttle .... adjust
Oil pressure .... check

STARTING ENGINE WHEN HOT

Throttle .... 1/2" open
Master switch .... ON
Electric fuel pump .... ON
Mixture .... idle cut-off
Starter .... engage
Mixture .... advance
Throttle .... adjust
Oil pressure .... check

STARTING ENGINE WHEN FLOODED

Throttle .... open full
Master switch .... ON
Electric fuel pump .... OFF
Mixture .... idle cut-off
Starter.. engage
Mixture .... advance
Throttle .... retard
Oil pressure .... check

STARTING WITH EXTERNAL POWER SOURCE

Master switch .... OFF
All electrical equipment.. OFF
Terminals.. connect
External power plug.............................. insert in fuselage

Proceed with normal start
Throttle .... lowest possible RPM
External power plug.......................... disconnect from fuselage
Master swtich .... ON - check ammeter
Oil pressure .... check

WARM-UP

Throttle .... 1000 to 1200 RPM

TAXIING

Chocks .... removed
Parking brake .... release
Taxi area .... clear
Throttle .... apply slowly
Prop .... high RPM
Brakes.. check
Steering .... check

GROUND CHECK

Parking brake .... set
Propeller.................................... full INCREASE
Throttle .... 2000 RPM
Magnetos .... max. drop 175 RPM
- max. diff. 50 RPM
Vacuum .... 4.8″ to 5.2″ Hg.
Oil temp. .... check
Oil pressure .... check
Air conditioner .... check
Annunciator panel .... press-to-test
Propeller.................................... exercise - then
full INCREASE
Alternate air .... check
Electric fuel pump .... OFF
Fuel flow .... check
Throttle .... retard

BEFORE TAKEOFF

Master switch .... ON
Flight instruments................................. check
Fuel selector .... proper tank
Electric fuel pump .... ON
Engine gauges .... check
Alternate air .... CLOSED
Seat backs .... erect
Mixture .... set
Prop .... set
Belt/harness.................................. fasten/adjust
Empty seats .... seat belts fastened snugly
Flaps .... set
Trim tab .... set
Controls .... free
Doors .... latched
Air conditoner .... OFF
Parking brake .... release

TAKEOFF

NORMAL

Flaps .... set
Tab .... set
Accelerate to 74 to 80 KIAS depending on aircraft weight.
Control wheel .... back pressure to rotate to climb attitude

SHORT FIELD, OBSTACLE CLEARANCE

Flaps .... 25°
Accelerate to 58 to 66 KIAS depending on aircraft weight.
Control wheel .... back pressure to rotate to climb attitude
After breaking ground, accelerate to 61 to 71 KIAS, depending on aircraft weight, and climb past obstacle.
Accelerate to best rate of climb speed - 90 KIAS and slowly retract the flaps.

SHORT FIELD, NO OBSTACLE

Flaps .... 25°
Accelerate to 58 to 66 KIAS depending upon aircraft weight.
Control wheel .... back pressure to rotate to climb attitude
Accelerate to best rate of climb speed - 90 KIAS and slowly retract flaps while climbing out.

SOFT FIELD, OBSTACLE CLEARANCE

Flaps .... 25°
Accelerate, pull nose wheel off as soon as possible.
Control wheel .... lift off at lowest possible airspeed
Just above the ground, accelerate 61 to 71 KIAS, depending on aircraft weight, and climb past obstacle.
Continue climb while accelerating to best rate of climb speed - 90 KIAS.
Flaps .... retract slowly

SOFT FIELD, NO OBSTACLE

Flaps .... 25°
Accelerate, pull nose wheel off as soon as possible.
Control wheel .... lift off at lowest possible airspeed
Just above the ground, accelerate to best rate of climb speed - 90 KIAS and climb out.
Flaps .... retract slowly

CLIMB

Best rate (3600 lb) .... 90 KIAS
Best angle (3600 lb) .... 76 KIAS
En route .... 100 KIAS
Electric fuel pump .... OFF at desired altitude

CRUISING

Reference, performance charts, Avco Lycoming Operator's Manual and power setting table.
Normal max power 75%
Power .... set per power table
Mixture .... adjust
Electric fuel pump .... OFF

APPROACH AND LANDING

BEFORE LANDING

Fuel selector .... proper tank
Seat backs .... erect
Belts/harness .... fasten/adjust
Electric fuel pump .... ON
Mixture .... set
Propeller... set
Flaps .... set - white arc
Air conditioner .... OFF

NORMAL TECHNIQUE

Flaps .... as required
Trim .... 95 KIAS
Throttle .... as required

SHORT FIELD TECHNIQUE

Flaps .... 40°
Trim .... 79 KIAS
Throttle .... as required

GO-AROUND

Propeller.................................... full INCREASE
Throttle .... full forward
Control wheel .... back pressure to
rotate to climb attitude
Airspeed .... 80 KIAS
Flaps .... retract slowly
Trim .... as required

STOPPING ENGINE

Flaps .... retract
Electric fuel pump .... OFF
Air conditioner .... OFF
Radios and electrical equipment .... OFF
Propeller .... full INCREASE
Throttle .... full aft
Mixture .... idle cut-off
Magnetos .... OFF
Master switch .... OFF

PARKING

Parking brake .... set
Control wheel .... secured with belts
Flaps .... full up
Wheel chocks .... in place
Tie downs .... secure

4.7 AMPLIFIED NORMAL PROCEDURES (GENERAL)

The following paragraphs are provided to supply detailed information and explanations of the normal procedures necessary for operation of the airplane.

4.9 PREFLIGHT CHECK

The airplane should be given a thorough preflight and walk-around check. The preflight should include a check of the airplane's operational status, computation of weight and C.G. limits, takeoff distance and in-flight performance. A weather briefing should be obtained for the intended flight path, and any other factors relating to a safe flight should be checked before takeoff.

CAUTION

> The flap position should be noted before boarding the airplane. The flaps must be placed in the UP position before they will lock and support weight on the step.

COCKPIT

Upon entering the cockpit, release the seat belts securing the control wheel and set the parking brake. Ensure that all electrical switches and the magneto switch are OFF. Turn OFF all avionics equipment (to save power and prevent wear on the units). The mixture should be in idle cut-off. Turn ON the master switch, check the fuel quantity gauges for adequate supply, check that the annunciator panel illuminates and check the flaps for proper operation. Turn OFF the master switch. Check the primary flight controls for proper operation and set the trim to neutral. Open the pitot and static drains to remove any moisture that has accumulated in the lines. Check the windows for cleanliness and that the required papers are on board. Properly stow the tow bar and baggage and secure. Close and secure the baggage door.

RIGHT WING

Begin the walk-around at the trailing edge of the right wing by checking that the wing surface and control surfaces are clear of ice, frost, snow or other extraneous substances. Check the flap, aileron and hinges for damage and operational interference. Static wicks should be firmly attached and in good condition. Check the wing tip and lights for damage.

Open the fuel cap and visually check the fuel color. Check the fuel indicator gauge. Each inboard tank is furnished with an external fuel quantity indicator to assist the pilot in determining fuel quantities of less than 35 gallons. The quantity should match the indication that was on the fuel quantity gauge. Replace cap securely. The fuel tank vent should be clear of obstructions.

Drain the fuel tanks through the quick drain located at the lower inboard rear corner of each tank, making sure that enough fuel has been drained to insure that all water and sediment is removed. The fuel system should be drained daily prior to the first flight and after each refueling.

CAUTION

When draining any amount of fuel, care should be taken to insure that no fire hazard exists before starting engine.

Remove the tie down and chock.

Next, a complete check of the landing gear. Check the gear strut for proper inflation, there should be 4.5 + .5 inches of strut exposure under a normal static load. Check the tire for cuts, wear, the proper inflation. Make a visual check of the brake block and disc.

Check that the fresh air inlet is clear of foreign matter.

NOSE SECTION

Check the general condition of the nose section, look for oil or fluid leakage and that the cowling is secure. Check the windshield and clean if necessary. The propeller and spinner should be checked for detrimental nicks, cracks, or other defects. The air inlets should be clear of obstructions. The landing light should be clean and intact.

Remove the chock and check the nose gear strut for proper inflation, there should be 3.25 + .25 inches of strut exposure under a normal static load. Check the tire for cuts, wear, and proper inflation. Check the alternator belt. Check the oil level, make sure that the dipstick has been properly seated and the oil filler cap properly secured. Place a container under the fuel strainer valve located under the fuselage.

Close and secure the nose baggage door.

LEFT WING

The wing surface should be clear of ice, frost, snow, or other extraneous substances. Check that the fresh air inlet is clear of foreign matter and remove the chock. Check the main gear strut for proper inflation, there should be 4.5 + .5 inches of strut exposure under a normal static load. Check the tire and the brake block and disc.

Open the fuel cap and visually check the fuel color. The quantity should match the indication that was on the fuel quantity gauge. Replace cap securely. (See RIGHT WING for further fuel system description). The fuel tank vent should be clear of obstructions. Drain enough fuel to insure that all water and sediment has been removed.

Remove tie down and remove the cover from the pitot/static head on the underside of the wing. Make sure that holes are open and clear of obstructions. Check the wing tip and lights for damage. Check the aileron, flap, and hinges for damage and operational interference and that the static wicks are firmly attached and in good condition.

EMPENNAGE

Check the condition of any antennas located on the fuselage. All surfaces of the empennage should be examined for damage and operational interference. Fairings and access covers should be attached properly. Check the baggage to be sure it is stowed properly. Check that the lights on the tail are clean and intact. The elevator and rudder should be operational and free from interference of any type. Check the condition of the tabs and insure that all hinges and push rods are sound and operational. If the tail has been tied down, remove the tie down rope.

MISCELLANEOUS

Enter the cockpit and drain the fuel strainer by pressing down on the lever located on the right hand side of the cabin, below the forward edge of center seat. The fuel selector should be positioned in the following sequence while draining the strainer: "OFF," "LEFT" and "RIGHT." This is done to insure that the fuel in the lines between each tank outlet and the fuel strainer is drained, as well as the fuel in the fuel strainer. When the fuel tanks are full, it will take approximately six seconds to drain all the fuel in one of the lines from a tank to the fuel strainer. If the fuel tanks are less than full, it will take a few seconds longer. After draining the fuel strainer, check for leakage at the drain under the aircraft with the fuel selector on a tank position.

Turn the master switch "ON" and begin checking the interior lights by turning "ON" the necessary switches. After the interior lights are checked, turn "ON" the pitot heat switch and the exterior light switches. Next perform a walk-around check on the exterior lights and examine and dispose of the contents in the container placed under the fuel strainer drain.

With 0° flaps, check the stall warning horn by moving the inboard lift detector slightly up. Reset the flaps to 25° or 40° and check the outboard lift detector. Check the heated pitot head for proper heating.

CAUTION

Care should be taken when an operational check of the heated pitot head is being performed. The unit becomes very hot. Ground operation should be limited to three minutes maximum to avoid damaging the heating elements.

When all passengers are on board, the pilot should check the cabin doors for proper closing and latching procedures. The rear door should be closed and the overhead latch button turned to the "LOCK" position. The front door should be gently pulled shut, the door handle firmly latched and the overhead latch button turned to the "LOCK" position. Seat belts on empty seats should be snugly fastened. All passengers should fasten their seat belts and shoulder harness.

NOTE

If the fixed shoulder harness (non-inertia reel type) is installed, it must be connected to the seat belt and adjusted to allow proper accessibility to all controls, including fuel selector, flaps, trim, etc., while maintaining adequate restraint for the occupant.

If the inertia reel type shoulder harness is installed, a pull test of its locking restraint feature should be performed.

4.11 BEFORE STARTING ENGINE

Before starting the engine the parking brake should be set ON and the propeller lever moved to the full INCREASE rpm position. The fuel selector should then be moved to the desired tank. Check to make sure all the circuit breakers are in and the radios are OFF.

4.13 STARTING ENGINE

(a) Starting Engine When Cold

Open the throttle lever approximately 1/2 inch. Turn ON the master switch and the electric fuel pump. Move the mixture control to full RICH for approximately 4 seconds. The engine is now primed.

Move the mixture control to idle cut-off and engage the starter by rotating the magneto switch clock-wise. When the engine fires, release the magneto switch, advance the mixture control to full RICH and move the throttle to the desired setting.

If the engine does not fire within five to ten seconds, disengage the starter and reprime.

(b) Starting Engine When Hot

Open the throttle lever approximately 1/2 inch. Turn ON the master switch and the electric fuel pump. Move the mixture control lever to idle cut-off and engage the starter by rotating the magneto switch clockwise. When the engine fires, release the magneto switch, advance the mixture and move the throttle to the desired setting.

(c) Starting Engine When Flooded

The throttle lever should be full OPEN. Turn ON the master switch and turn OFF the electric fuel pump. Move the mixture control lever to idle cut-off and engage the starter by rotating the magneto switch clockwise. When the engine fires, release the magneto switch, advance the mixture and retard the throttle.

(d) Starting Engine With External Power Source

An optional feature called the Piper External Power (PEP) allows the operator to use an external battery to crank the engine without having to gain access to the airplane's battery.

Turn the master switch OFF and turn all electrical equipment OFF. Connect the RED lead of the PEP kit jumper cable to the POSITIVE (+) terminal of an external 12-volt battery and the BLACK lead to the NEGATIVE (-) terminal. Insert the plug of the jumper cable into the socket located on the fuselage. Note that when the plug is inserted, the electrical system is ON. Proceed with the normal starting technique.

After the engine has started, reduce power to the lowest possible RPM, to reduce sparking, and disconnect the jumper cable from the aircraft. Turn the master switch ON and check the alternator ammeter for an indication of output. DO NOT ATTEMPT FLIGHT IF THERE IS NO INDICATION OF ALTERNATOR OUTPUT.

NOTE

For all normal operations using the PEP jumper cables, the master switch should be OFF, but it is possible to use the ship's battery in parallel by turning the master switch ON. This will give longer cranking capabilities, but will not increase the amperage.

CAUTION

Care should be exercised because if the ship's battery has been depleted, the external power supply can be reduced to the level of the ship's battery. This can be tested by turning the master switch ON momentarily while the starter is engaged. If cranking speed increases, the ship's battery is at a higher level than the external power supply.

When the engine is firing evenly, advance the throttle to 800 RPM. If oil pressure is not indicated within thirty seconds, stop the engine and determine the trouble. In cold weather it will take a few seconds longer to get an oil pressure indication. If the engine has failed to start, refer to the Lycoming Operating Handbook, Engine Troubles and Their Remedies.

Starter manufacturers recommended cranking periods be limited to thirty seconds with a two minute rest between cranking periods. Longer cranking periods will shorten the life of the starter.

4.15 WARM-UP

Warm-up the engine at 1000 to 1200 RPM. Avoid prolonged idling at low RPM, as this practice may result in fouled spark plugs.

Takeoff may be made as soon as the ground check is completed, and the engine is warm.

Do not operate the engine at high RPM when running up or taxiing over ground containing loose stones, gravel or any loose materal that may cause damage to the propeller blades.

4.17 TAXIING

Before attempting to taxi the airplane, ground personnel should be instructed and approved by a qualified person authorized by the owner. Ascertain that the propeller back blast and taxi areas are clear.

After releasing the parking brake, power should be applied slowly to start the taxi roll. Taxi a few feet forward and apply the toe brakes to determine their effectiveness. Taxi with the propeller set in low pitch, high RPM setting. While taxiing, make slight turns to ascertain the effectiveness of the steering.

Observe wing clearances when taxiing near buildings or other stationary objects. If possible, station an observer outside the airplane.

Avoid holes and ruts when taxiing over uneven ground.

Do not operate the engine at high RPM when running up or taxiing over ground containing loose stones, gravel or any loose material that may cause damage to the propeller blades.

4.19 GROUND CHECK

Set the parking brake.

The magnetos should be checked at 2000 RPM with the propeller set at high RPM. Drop off on either magneto should not exceed 175 RPM and the difference between the magnetos should not exceed 50 RPM. Operation on one magneto should not exceed 10 seconds.

Check the vacuum gauge; the indicator should read 4.8" to 5.2" Hg at 2000 RPM.

Check the annunciator panel lights with the press-to-test button. Also check the air conditioner and the alternate air.

The propeller control should be moved through its complete range to check for proper operation, and should then be placed in full INCREASE rpm for takeoff. To obtain maximum rpm, push the pedestal-mounted control fully forward. Do not allow a drop of more than 500 RPM during this check. In cold weather the propeller control should be cycled from high to low RPM at least three times before takeoff to make sure that warm engine oil has circulated.

The electric fuel pump should be turned OFF briefly after starting or during warm-up to make sure that the engine-driven pump is operating. Prior to takeoff, the electric pump should be turned ON again to prevent loss of power during takeoff should the engine-driven pump fail. Check oil temperature and oil pressure. The temperature may be low for some time if the engine is being run for the first time of the day.

4.21 BEFORE TAKEOFF

All aspects of each particular takeoff should be considered prior to executing the takeoff procedures.

If the airplane is to be operated with the rear cabin door removed, it is recommended that all passengers wear parachutes.

After all aspects of the takeoff are considered, a pre-takeoff check procedure must be performed.

Turn ON the master switch and check and set all of the flight instruments as required. Check the fuel selector to make sure it is on the proper tank (fullest). Turn ON the electric fuel pump and check the engine gauges. The alternate air should be in the CLOSED position.

All seat backs should be erect.

The mixture and propeller control levers should be set. Fasten the seat belts snugly around the empty seats. Occupants should fasten their seat belts and shoulder harness.

NOTE

If the fixed shoulder harness (non-inertia reel type) is installed, it must be connected to the seat belt and adjusted to allow proper accessibility to all controls, including fuel selector, flaps, trim, etc., while maintaining adequate restraint for the occupant.

If the inertia reel type shoulder harness is installed, a pull test of its locking restraint feature should be performed.

Exercise and set the flaps and trim tab. Insure proper flight control movement and response. All doors should be properly secured and latched. On air conditioned models, the air conditioner must be OFF to insure normal takeoff performance.

4.23 TAKEOFF

The normal takeoff technique is conventional. The tab should be set slightly aft of neutral, with the exact setting determined by the loading of the airplane. Allow the airplane to accelerate to 74 to 80 KIAS, depending on aircraft weight, and ease back on the control wheel to rotate to climb attitude. Takeoffs are normally made with the flaps retracted.

SHORT FIELD, OBSTACLE CLEARANCE

Lower flaps to 25°, accelerate aircraft to 58 to 66 KIAS, depending on aircraft weight, and ease back on the wheel to rotate. After breaking ground, accelerate to 61 to 71 KIAS, depending on aircraft weight, and climb past obstacle. Continue climb and accelerate to best rate of climb speed 90 KIAS, and slowly retract the flaps.

SHORT FIELD, NO OBSTACLE

Lower flaps to 25°, accelerate aircraft to 58 to 66 KIAS, depending on aircraft weight, and ease back on the wheel to rotate. After breaking ground, accelerate to best rate of climb speed, 90 KIAS, and slowly retract the flaps while climbing out.

SOFT FIELD, OBSTACLE CLEARANCE

Lower flaps to 25°, accelerate aircraft, pull nose gear off as soon as possible and lift off at lowest possible airspeed. Accelerate just above the ground to 61 to 71 KIAS, depending on aircraft weight, and climb past obstacle. Continue climb while accelerating to best rate of climb speed, 90 KIAS, and slowly retract the flaps.

SOFT FIELD, NO OBSTACLE

Lower flaps to 25°, accelerate aircraft, pull nose gear off as soon as possible and lift off at lowest possible airspeed. Accelerate just above the ground to best rate of climb speed, 90 KIAS, and climb out while slowly retracting the flaps.

4.25 CLIMB

The best rate of climb at gross weight and maximum continuous power will be obtained at 90 KIAS. The best angle of climb may be obtained at 76 KIAS. At lighter than gross weight these speeds are reduced somewhat*. For climbing en route, a speed of 100 KIAS is recommended. This will produce better forward speed and increased visibility over the nose during the climb. Monitor the cylinder head temperature during climbs.

Upon reaching a safe altitude, the electric fuel pump may be turned off.

4.27 CRUISING

The cruising speed is determined by many factors, including power setting, altitude, temperature, loading and equipment installed in the airplane.

The normal maximum cruising power is 75% of the rated horsepower of the engine. When selecting cruising RPM below 2300, limiting manifold pressure for continuous operation, as specified by the appropriate "Avco-Lycoming Operator's Manual," should be observed.

To obtain the desired power, set the manifold pressure and RPM according to the power setting table in this manual.

Use of the mixture control in cruising flight reduces fuel consumption significantly, especially at higher altitudes. The mixture should be leaned during cruising operation above 5000 ft. altitude and at pilot's discretion at lower altitudes when 75% power or less is being used. If any doubt exists as to the amount of power being used, the mixture should be in the full "RICH" position for all operations under 5000 feet.

To lean the mixture, disengage the lock and pull the mixture control until the engine becomes rough, indicating that the lean mixture limit has been reached in the leaner cylinders. Then enrich the mixture by pushing the control towards the instrument panel until engine operation becomes smooth. The fuel flow meter will give a close approximation of the fuel being

*To obtain the performance presented in the Performance Section of this handbook, all parameters listed on the performance charts must be followed.

consumed. The low side of the power setting, as shown on the fuel flow meter, indicates best economy for that percent of power, while the high side indicates best power.

If the airplane is equipped with the optional exhaust gas temperature (EGT) gauge, a more accurate means of leaning is available to the pilot. For this procedure, refer to the "Avco-Lycoming Operator's Manual."

Lateral trim is best maintained by using fuel alternately from each tank at one hour intervals.

Always remember that the electric fuel pump should be turned "ON" before switching tanks, and should be left on for a short period thereafter. To preclude making a hasty selection, and to provide continuity of flow, the selector should be changed to another tank before fuel is exhausted from the tank in use. The electric fuel pump should be normally "OFF" so that any malfunction of the engine-driven fuel pump is immediately apparent. If signs of fuel starvation should occur at any time during flight, fuel exhaustion should be suspected, at which time the fuel selector should be immediately positioned to a full tank, and the electric fuel pump switched to the "ON" position. Fuel tank selection at low altitude is not recommended, since little recovery time is available in the event of an error in tank selection. When switching tanks, make sure that the selector drops into a detent and is lined up with the desired tank.

4.29 APPROACH AND LANDING

Accomplish the Landing Checklist early in the landing approach.

NOTE

If the fixed shoulder harness (non-inertia reel type) is installed, it must be connected to the seat belt and adjusted to allow proper accessibility to all controls, including fuel selector, flaps, trim, etc., while maintaining adequate restraint for the occupant.

If the inertia reel type shoulder harness is installed, a pull test of its locking restraint feature should be performed.

Depending on field length and other factors, the following procedures are appropriate:

NORMAL TECHNIQUE (No Performance Chart Furnished)

When available runway length is in excess of required runway length, a normal approach and landing technique may be utilized. The aircraft should be flown down the final approach course at 95 KIAS with power required to maintain the desired approach angle. The amount of flap used during approach and landing and the speed of the aircraft at contact with the runway should be varied according to the landing surface, conditions of wind and aircraft loading. It is generally good practice to contact the ground at the minimum possible safe speed consistent with existing conditions. As landing distances with this technique will vary, performance charts are not furnished.

SHORT FIELD LANDING APPROACH POWER OFF (See Chart, Section 5)

When available runway length is minimal or obstacle clearance to landing is of major concern, this approach/landing technique may be employed. The aircraft should be flown on the final approach at 79 KIAS with full flaps and idle power. The glide path should be stabilized as early as possible. Reduce the speed slightly during landing flareout and contact the ground close to stall speed. After ground contact, retract the flaps and apply full aft travel on the control wheel and maximum braking consistent with existing conditions.

SHORT FIELD LANDING APPROACH POWER ON (No Performance Chart Furnished)

It sometimes may be advantageous to use this approach technique when obstacle clearance during landing is of concern. The aircraft should be flown with full flaps and sufficient power for an approach path that will clear the obstacle. When obstacle clearance is assured, reduce the power and assume the 79 KIAS approach speed to landing flare. After ground contact, close the throttle, retract the flaps, apply full aft travel on the control wheel and maximum braking consistent with existing conditions. As landing distances with this technique will vary, performance charts are not furnished.

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4.31 GO-AROUND

To initiate a go-around from a landing approach, the prop control should be set to full INCREASE, the throttle should be advanced to maximum power while the pitch attitude is increased. Allow the airplane to accelerate to the best angle of climb speed (76 KIAS) for obstacle clearance or to the best rate of climb speed (90 KIAS) if obstacles are not a factor. Slowly retract the flaps when a positive climb is established. Reset the longitudinal trim as required.

4.33 STOPPING ENGINE

Prior to shutdown, all radio and electrical equipment should be turned OFF.

At the pilot's discretion, the flaps should be raised and the electric fuel pump turned OFF.

NOTE

The flaps must be placed in the UP position for the flap step to support weight. Passengers should be cautioned accordingly.

The air conditioner should be turned OFF, the propeller set in the full INCREASE position, and the engine stopped by disengaging the mixture control lock and pulling the mixture control back to idle cut-off. The throttle should be left full aft to avoid engine vibration while stopping. Then the magneto and master switches must be turned OFF.

4.35 PARKING

If necessary, the airplane should be moved on the ground with the aid of the nose wheel tow bar provided with each airplane and secured behind the rear seats. Set the parking brake ON. The aileron and stabilator controls should be secured by looping the safety belt through the control wheel and pulling it snug. The flaps are locked when in the UP position and should be left retracted.

Tie downs can be secured to rings provided under each wing and to the tail skid. The rudder is held in position by its connections to the nose wheel steering and normally does not have to be secured.

4.37 STALLS

The stall characteristics are conventional. An approaching stall is indicated by a stall warning horn which is activated between five and ten knots above stall speed. Mild airframe buffeting and gentle pitching may also precede the stall.

The gross weight stalling speed with power off and full flaps is 58 KIAS With the flaps up this speed is increased 4 KTS. Loss of altitude during stalls can be as great as 500 feet, depending on configuration and power.

NOTE

The stall warning system is inoperative with the master switch OFF.

During preflight, the stall warning system should be checked by turning the master switch on, setting the flaps to 25° or 40° and raising the outboard lift detector to determine if the horn is actuated. The flaps should then be reset to 0° and the inboard lift detector raised to determine if the horn is actuated.

4.39 TURBULENT AIR OPERATION

In keeping with good operating practice used in all aircraft, it is recommended that when turbulent air is encountered or expected, the airspeed be reduced to maneuvering speed to reduce the structural loads caused by gusts and to allow for inadvertent speed build-ups which may occur as a result of the turbulence or of distractions caused by the conditions.

4.41 WEIGHT AND BALANCE

It is the responsibility of the owner and pilot to determine that the airplane remains within the allowable weight vs. center of gravity envelope while in flight.

For weight and balance data, refer to Section 6 (Weight and Balance).

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SECTION 5

PERFORMANCE

SECTION 5

PERFORMANCE

5.1 GENERAL

All of the required (FAA regulations) and complementary performance information is provided by this section.

Performance information associated with those optional systems and equipment which require handbook supplements is provided by Section 9 (Supplements).

5.3 INTRODUCTION - PERFORMANCE AND FLIGHT PLANNING

The performance information presented in this section is based on measured Flight Test Data corrected to I.C.A.O. standard day conditions and analytically expanded for the various parameters of weight, altitude, temperature, etc.

The performance charts are unfactored and do not make any allowance for varying degrees of pilot proficiency or mechanical deterioration of the aircraft. This performance, however, can be duplicated by following the stated procedures in a properly maintained airplane.

Effects of conditions not considered on the charts must be evaluated by the pilot, such as the effect of soft or grass runway surface on takeoff and landing performance, or the effect of winds aloft on cruise and range performance. Endurance can be grossly affected by improper leaning procedures, and inflight fuel flow quantity checks are recommended.

REMEMBER! To get chart performance, follow the chart procedures.

The information provided by paragraph 5.5 (Flight Planning Example) outlines a detailed flight plan using performance charts in this section. Each chart includes its own example to show how it is used.

WARNING

Performance information derived by extrapolation beyond the limits shown on the charts should not be used for flight planning purposes.

5.5 FLIGHT PLANNING EXAMPLE

(a) Aircraft Loading

The first step in planning the flight is to calculate the airplane weight and center of gravity by utilizing the information provided by Section 6 (Weight and Balance) of this handbook.

The basic empty weight for the airplane as licensed at the factory has been entered in Figure 6-5. If any alterations to the airplane have been made affecting weight and balance, reference to the aircraft logbook and Weight and Balance Record (Figure 6-7) should be made to determine the current basic empty weight of the airplane.

Make use of the Weight and Balance Loading Form (Figure 6-11) and the C.G. Range and Weight graph (Figure 6-15) to determine the total weight of the airplane and the center of gravity position.

After proper utilization of the information provided, the following weights are to be considered in the flight planning example.

The landing weight cannot be determined until the weight of the fuel to be used has been established (refer to item (g) (1).

(1) Basic Empty Weight	2100 lbs.
(1) Occupants (6 x 170 lbs.)	1020 lbs.
(3) Baggage and Cargo	60 lbs.
(4) Fuel (6 lb/gal. x 50)	300 lbs.
(5) Takeoff Weight	3480 lbs.
(6) Landing Weight (a)(5) minus (g)(1), (3480 lbs. minus 180 lbs.)	3300 lbs.

The takeoff weight is below the maximum of 3600 lbs. and the weight and balance calculations have determined the C.G. position within the approved limits.

(b) Takeoff and Landing

Now that the aircraft loading has been determined, all aspects of the takeoff and landing must be considered.

All of the existing conditions at the departure and destination airport must be acquired, evaluated and maintained throughout the flight.

Apply the departure airport conditions and takeoff weight to the appropriate Takeoff Performance and Takeoff Ground Roll graph (Figures 5-7, 5-9, 5-11, 5-13, 5-15 and 5-17) to determine the length of runway necessary for the takeoff and/or the barrier distance.

The landing distance calculations are performed in the same manner using the existing conditions at the destination airport and, when established, the landing weight.

The conditions and calculations for the example flight are listed below. The takeoff and landing distances required for the flight have fallen well below the available runway lengths.

	Departure Airport	Destination Airport
(1) Pressure Altitude	1200 ft.	400 ft.
(2) Temperature	16°C	24°
(3) Wind Component	10 KTS Headwind	5 KTS Headwind
(4) Runway Length Available	3000 ft.	4600 ft.
(5) Takeoff and Landing Distance Required (3 Blade Propeller and Standard Brakes)	1600 ft.*	1490 ft.**

*reference Figure 5-15
**reference Figure 5-43

NOTE

The remainder of the performance charts used in this flight plan example assume a no wind condition. The effect of winds aloft must be considered by the pilot when computing climb, cruise and descent performance.

(c) Climb

The next step in the flight plan is to determine the necessary climb segment components.

The desired cruise pressure altitude and corresponding cruise outside air temperature values are the first variables to be considered in determining the climb components from the Fuel, Distance, and Time to Climb graph (Figure 5-23). After the fuel, distance and time for the cruise pressure altitude and outside air temperature values have been established, apply the existing conditions at the departure field to graph (Figure 5-23). Now, subtract the values obtained from the graph for the field of departure conditions from those for the cruise pressure altitude.

The remaining values are the true fuel, distance and time components for the climb segment of the flight plan corrected for field pressure altitude and temperature.

The following values were determined from the above instructions in the flight planning example.

(1) Cruise Pressure Altitude	6000 ft.
(2) Cruise OAT	6° C
(3) Time to Climb (8.5 min. minus 1.5 min.)	7 min.*
(4) Distance to Climb (15.7 nautical miles minus 2.6 nautical miles)	13.1 nautical miles*
(5) Fuel to Climb (4.0 gal. minus .8 gal.)	3.2 gal.*

*reference Figure 5-23

(d) Descent

The descent data will be determined prior to the cruise data to provide the descent distance for establishing the total cruise distance.

Utilizing the cruise pressure altitude and OAT, determine the basic fuel, distance and time for descent (Figure 5-39). These figures must be adjusted for the field pressure altitude and temperature at the destination airport. To find the necessary adjustment values, use the existing pressure altitude and temperature conditions at the destination airport as variables to find the fuel, distance and time values from the graph (Figure 5-39). Now, subtract the values obtained from the field conditions from the values obtained from the cruise conditions to find the true fuel, distance and time values needed for the flight plan.

The values obtained by proper utilization of the graphs for the descent segment of the example are shown below.

(1) Time to Descend (12 min. minus 2 min.)	10 min.*
(2) Distance to Descend (25 nautical miles minus 4 nautical miles)	21 nautical miles*
(3) Fuel to Descend (1.9 gal. minus 0.3 gal.)	1.6 gal.*

(e) Cruise

Using the total distance to be traveled during the flight, subtract the previously calculated distance to climb and distance to descend to establish the total cruise distance. Refer to the appropriate Avco Lycoming Operator's Manual and the Power Setting Table (Figure 5-25) when selecting the cruise power setting. The established pressure altitude and temperature values and the selected cruise power should now be utilized to determine the true airspeed from the Speed Power graph (Figure 5-29).

Calculate the cruise fuel consumption for the cruise power setting from the information provided by the Avco Lycoming Operator's Manual.

*reference Figure 5-39

The cruise time is found by dividing the cruise distance by the cruise speed and the cruise fuel is found by multiplying the cruise fuel consumption by the cruise time.

The cruise calculations established for the cruise segment of the flight planning example are as follows:

(1) Total Distance	282 nautical miles
(2) Cruise Distance (e)(1) minus (c)(4) minus (d)(2), (282 nautical miles minus 13.1 nautical miles minus 21 nautical miles)	248 nautical miles
(3) Cruise Power	65% (economy)
(4) Cruise Speed	136 KTS TAS*
(5) Cruise Fuel Consumption	13.8 GPH
(6) Cruise Time (e)(2) divided by (e)(4), 248 nautical miles divided by 136 KTS	1.83 hrs. (1 hr. 50 min.)
(7) Cruise Fuel (e)(5) multiplied by (e)(6), (13.8 GPH multiplied by 1.83 hrs.)	25.2 gal.

(f) Total Flight Time

The total flight time is determined by adding the time to climb, the time to descend and the cruise time. Remember! The time values taken from the climb and descent graphs are in minutes and must be converted to hours before adding them to the cruise time.

The following flight time is required for the flight planning example:

(1) Total Flight Time (c)(3) plus (d)(1) plus (e)(65), (.12 hrs. plus .17 hrs. plus 1.83 hrs.)	2.12 hrs.
(7 min. plus 10 min. plus 1 hr. 50 min.)	2 hrs. 7 min.

*reference Figure 5-29

(g) Total Fuel Required

Determine the total fuel required by adding the fuel to climb, the fuel to descend and the cruise fuel. When the total fuel (in gallons) is determined, multiply this value by 6 lb/gal to determine the total fuel weight used for the flight.

The total fuel calculations for the example flight plan are shown below.

(1) Total Fuel Required

(c)(5) plus (d)(3) plus (e)(7),	
(3.2 gal. plus 1.6 gal. plus 25.2 gal.)	30 gal.
(30 gal. multiplied by 6 lb/gal.)	180 lbs.

5.7 PERFORMANCE GRAPHS

LIST OF FIGURES

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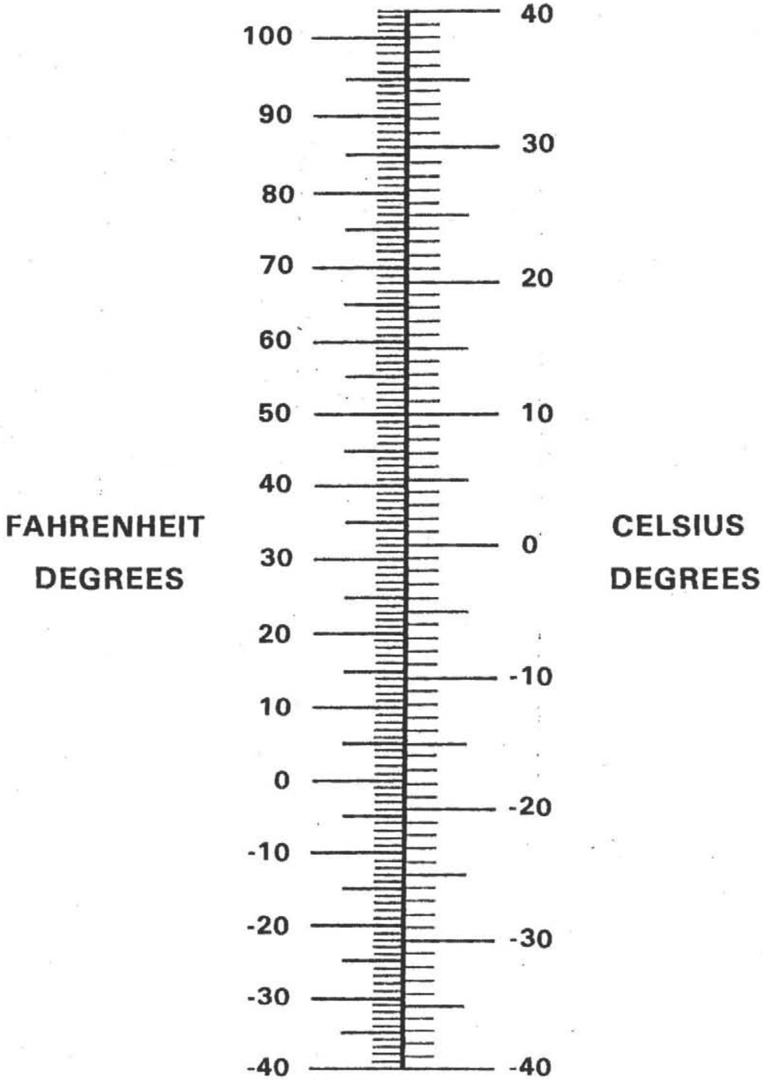
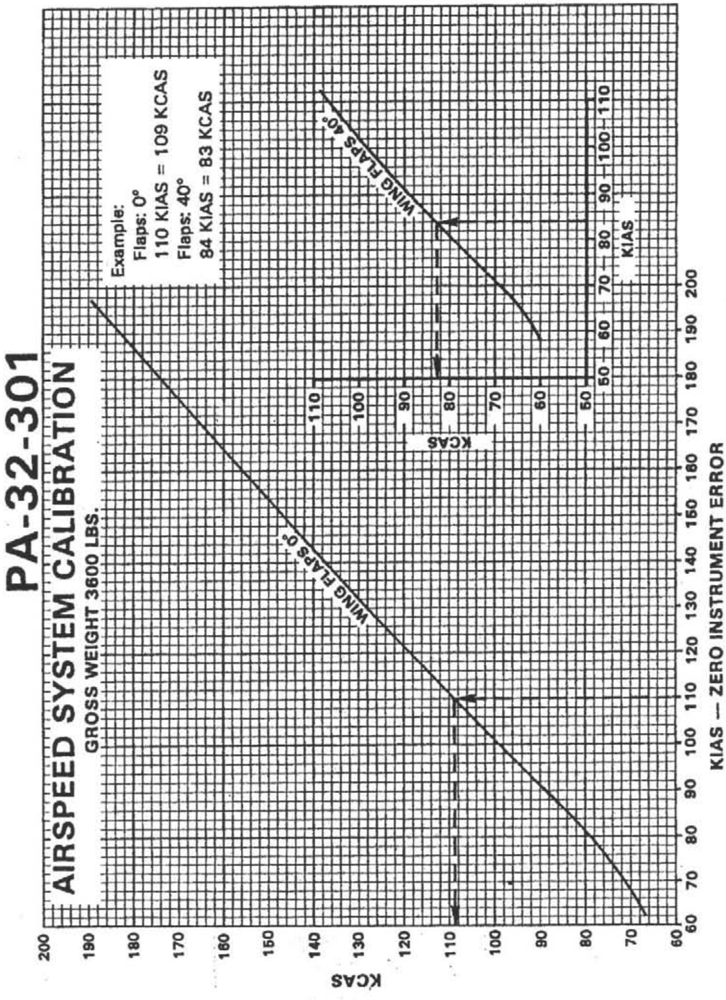
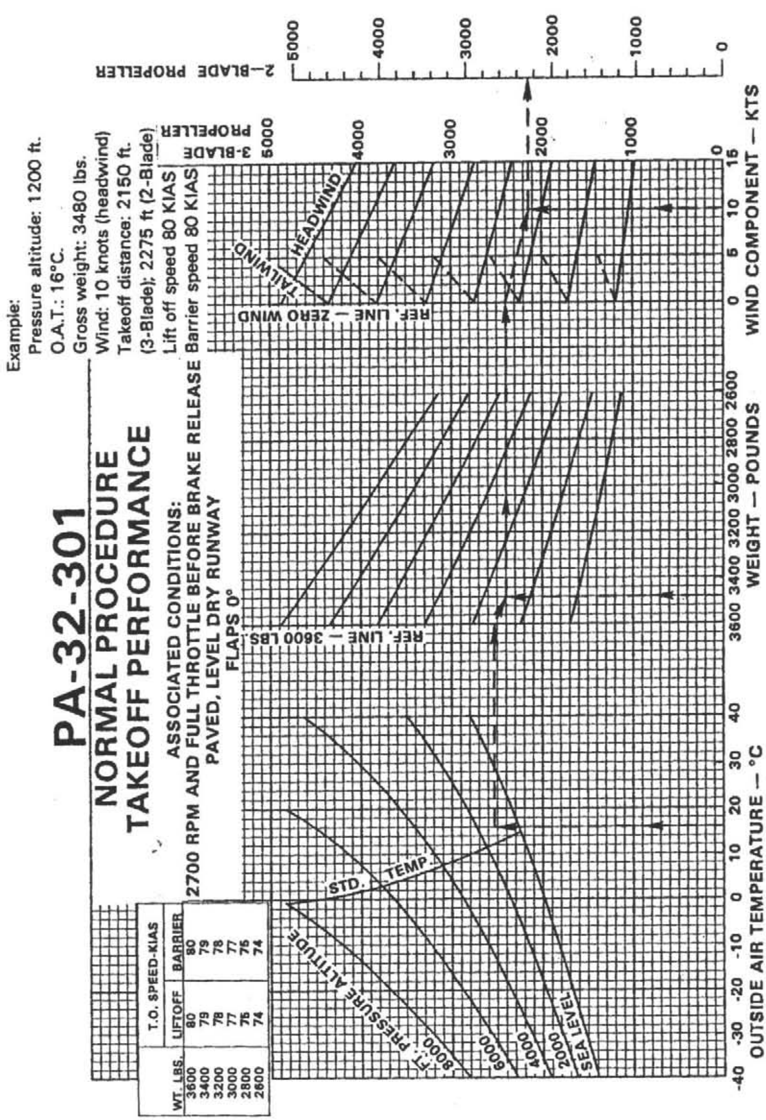


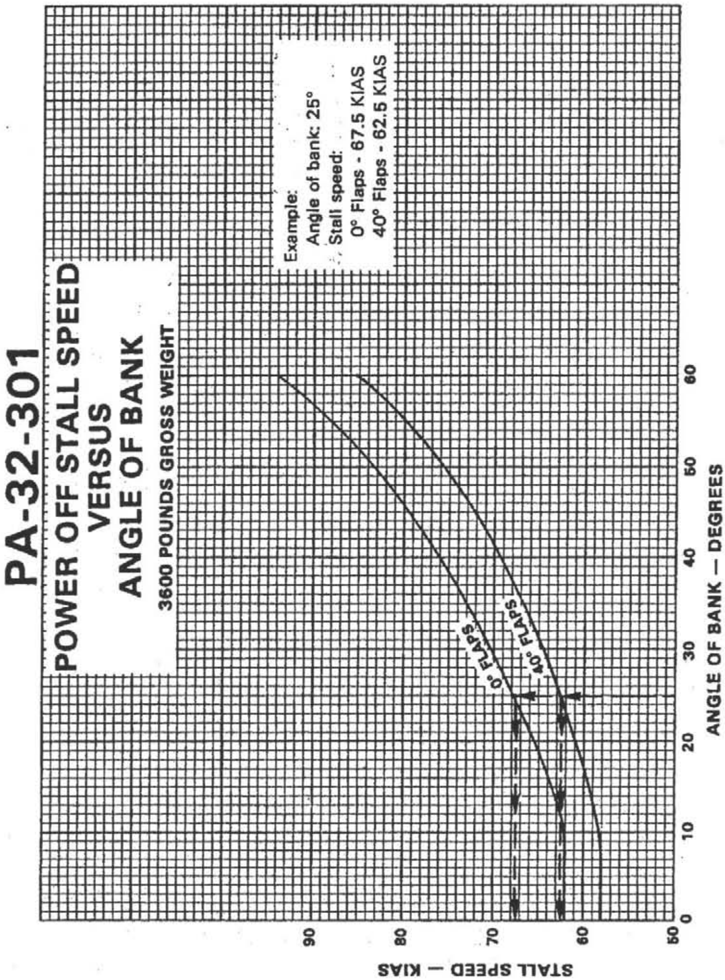
TEMPERATURE CONVERSION
Figure 5-1



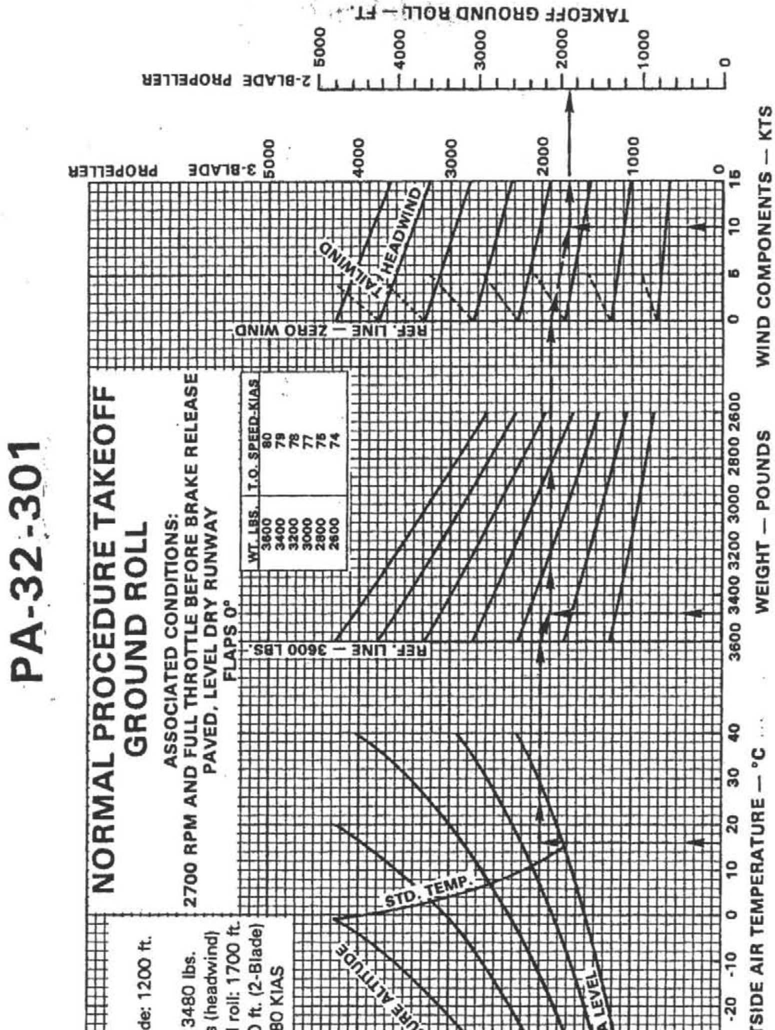
AIRSPEED SYSTEM CALIBRATION
Figure 5-3



NORMAL PROCEDURE TAKEOFF PERFORMANCE
Figure 5-7

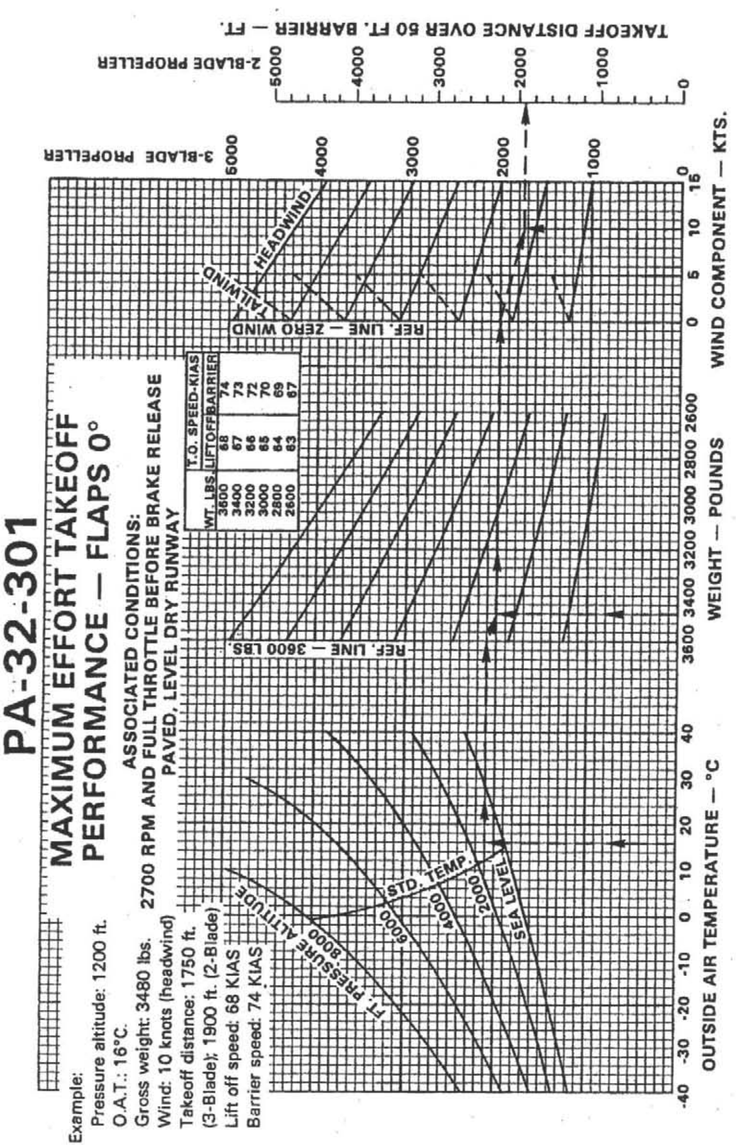


POWER OFF STALL SPEED VERSUS ANGLE OF BANK
Figure 5-5

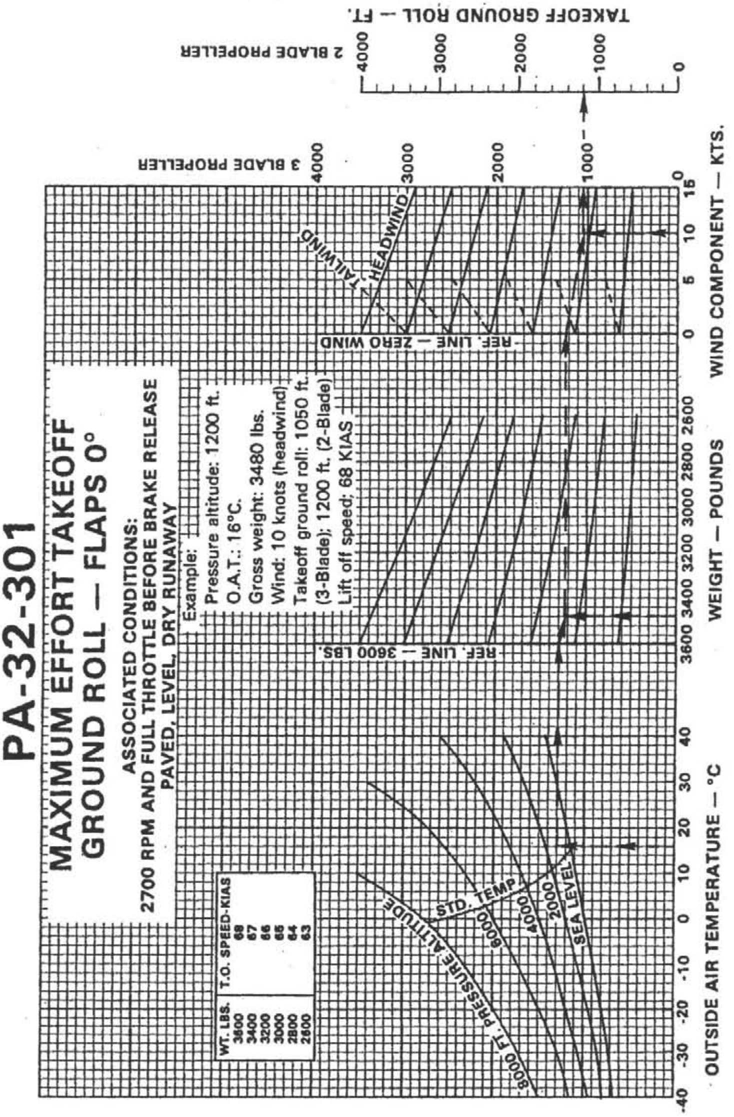


WT. LBS.	T.O. SPEED-KIAS
3600	80
3400	79
3200	78
3000	77
2800	75
2600	74

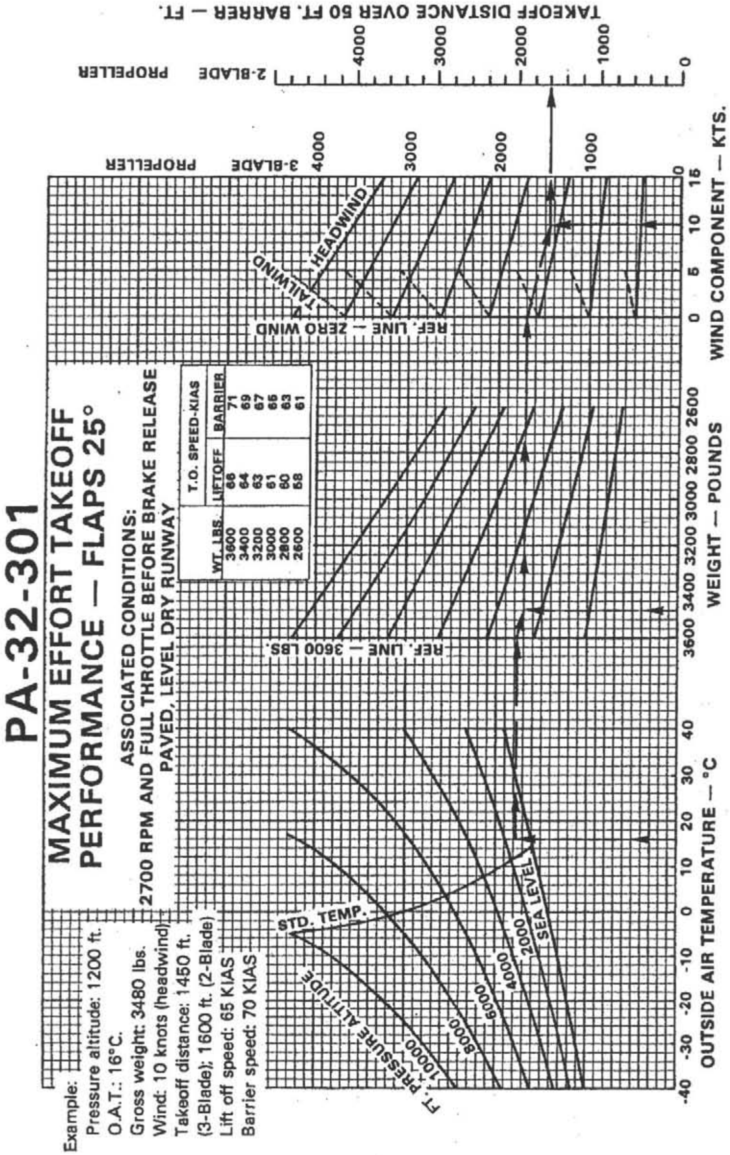
NORMAL PROCEDURE TAKEOFF GROUND ROLL
Figure 5-9



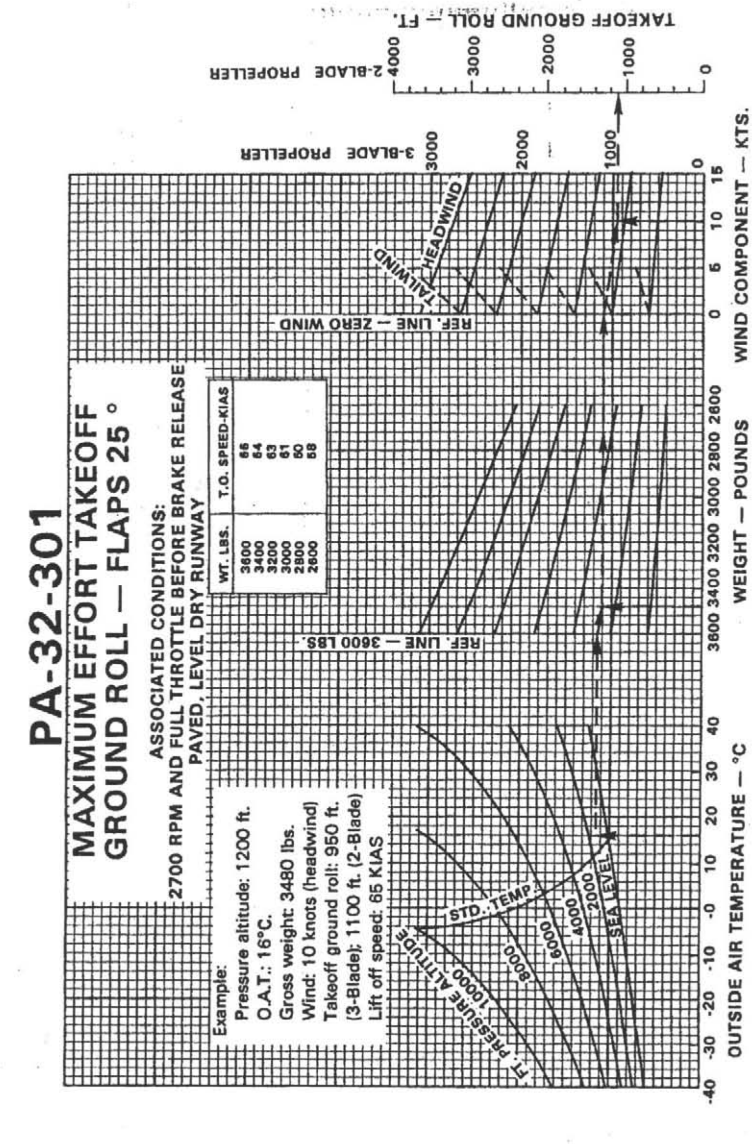
MAXIMUM EFFORT TAKEOFF PERFORMANCE - FLAPS 0°
Figure 5-11



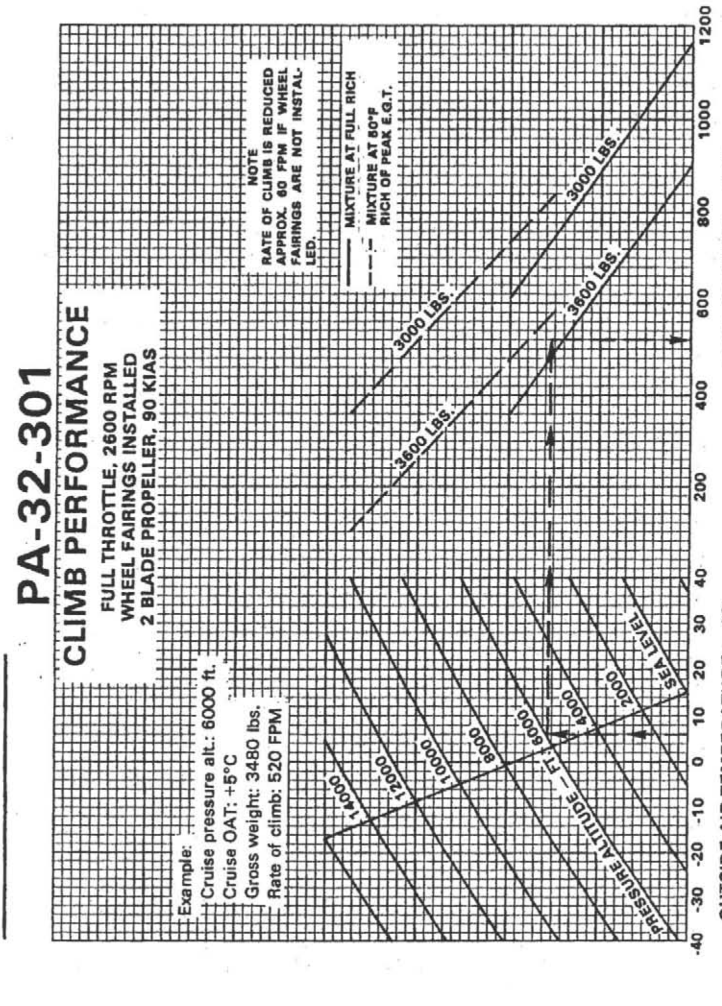
MAXIMUM EFFORT TAKEOFF GROUND ROLL - FLAPS 0°
Figure 5-13



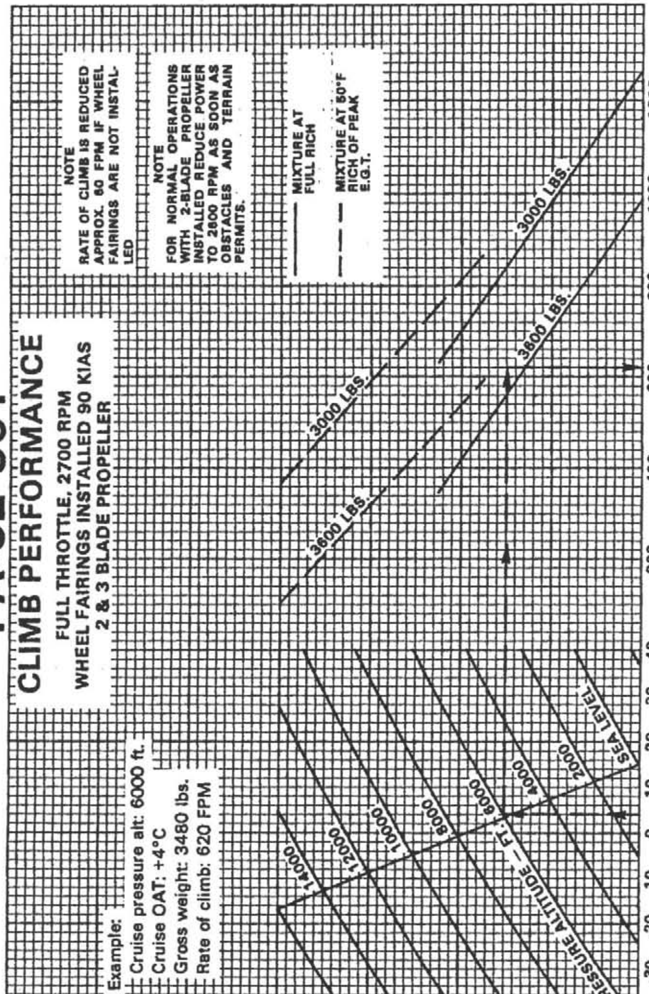
MAXIMUM EFFORT TAKEOFF PERFORMANCE - FLAPS 25°
Figure 5-15



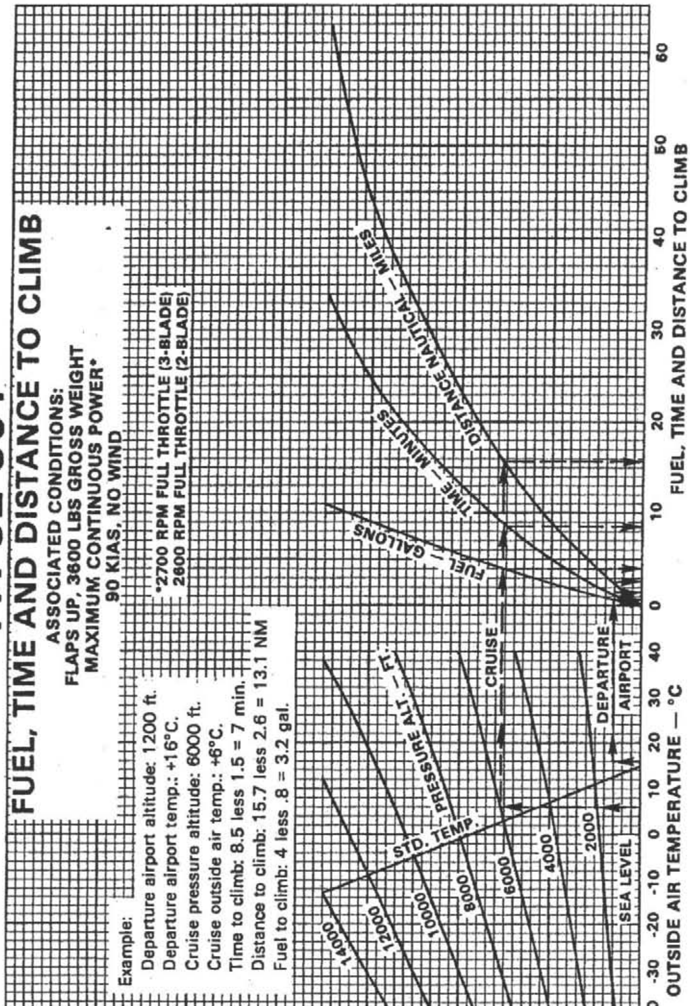
MAXIMUM EFFORT TAKEOFF GROUND ROLL - FLAPS 25°
Figure 5-17



CLIMB PERFORMANCE (2 BLADE PROPELLER - 2600 RPM)
Figure 5-19



CLIMB PERFORMANCE (2 BLADE PROPELLER - 5 MIN LIMIT)
(3 BLADE PROPELLER - NO TIME LIMIT)
Figure 5-21



FUEL, TIME AND DISTANCE TO CLIMB
Figure 5-23

POWER SETTING TABLE — LYCOMING I0-540K ENGINE

PRESS. ALT. FEET	STD. ALT. TEMP. °C	55% POWER					65% POWER					75% POWER				
	RPM	2200	2300	2400	2500	2600	2200	2300	2400	2500	2600	2200	2300	2400	2500	2600
		MANIFOLD PRESSURE — INCHES MERCURY														
S.L.	15	22.9	22.1	21.6	21.1	20.7	25.8	24.8	24.0	23.5	23.1	28.2	27.1	26.4	25.7	25.1
1000	13	22.5	21.8	21.3	20.7	20.4	25.3	24.4	23.7	23.1	22.7	27.6	20.6	25.9	25.3	24.8
2000	11	22.1	21.4	21.0	20.5	20.1	24.8	24.0	23.3	22.8	22.4	27.0	26.2	25.5	25.0	24.5
3000	9	21.8	21.1	20.7	20.2	19.8	24.3	23.6	23.0	22.4	22.1	26.5	25.8	25.2	24.7	24.2
4000	7	21.5	20.8	20.4	20.0	19.5	23.8	23.3	22.6	22.1	21.8	—	25.5	24.8	24.4	24.0
5000	5	21.2	20.5	20.1	19.7	19.3	23.4	22.9	22.3	21.8	21.5	—	—	24.6	24.1	23.7
6000	3	20.8	20.3	19.9	19.4	19.0	23.0	22.5	22.0	21.5	21.2	—	—	—	23.9	23.5
7000	1	20.5	20.0	19.6	19.1	18.8	22.6	22.2	21.7	21.2	20.9	—	—	—	—	23.3
8000	-1	20.2	19.7	19.3	18.9	18.5	22.2	21.8	21.4	20.9	20.6					
9000	-3	19.9	19.5	19.1	18.6	18.3	—	—	21.1	20.6	20.3					
10000	-5	19.6	19.2	18.8	18.4	18.0	—	—	—	20.3	20.0					
11000	-7	19.3	19.0	18.6	18.2	17.8	—	—	—	—	19.7					
17000	-9	—	18.7	18.4	17.9	17.6										
13000	-11	—	—	—	17.7	17.4										
14000	-13	—	—	—	—	17.2										

To maintain constant power, correct manifold pressure approximately 0.15" Hg for each 5°C variation in induction air temperature from standard altitude temperature. Add manifold pressure for air temperature above standard; subtract for temperature below standard.

APPROXIMATE FUEL FLOW

55% Power	11.9 GPH
65% Power	13.8 GPH
75% Power	16.0 GPH

NOTE: Full throttle manifold pressure values may not be obtainable when atmospheric conditions are non-standard.

POWER SETTING TABLE
Figure 5-25

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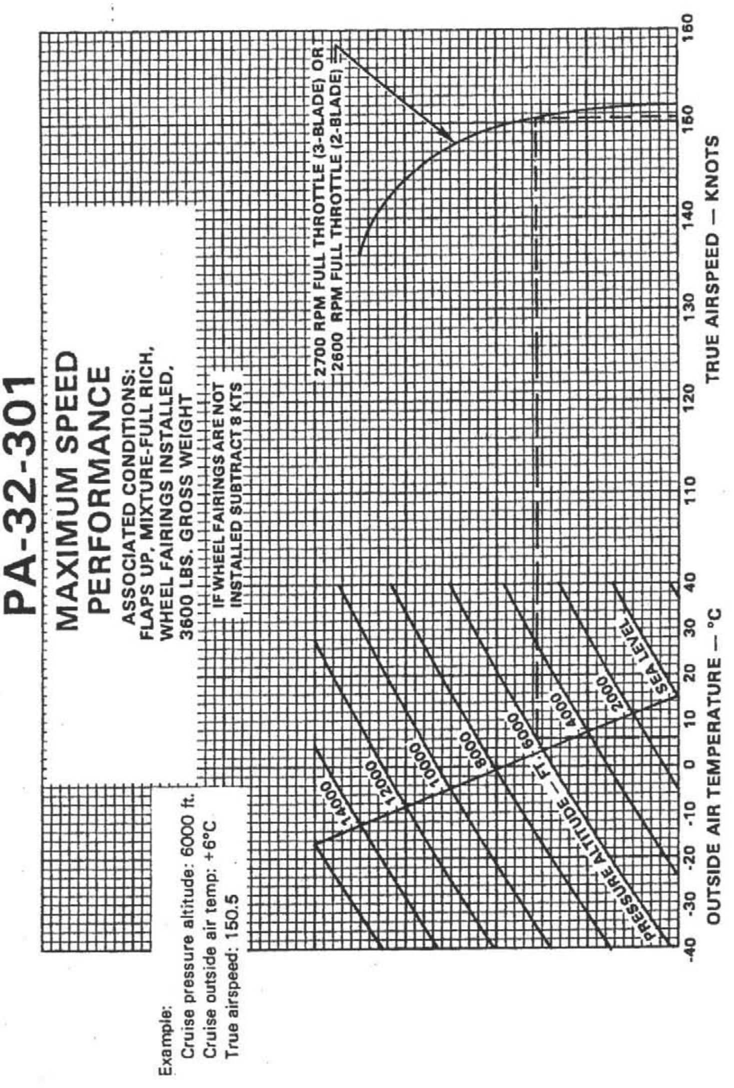
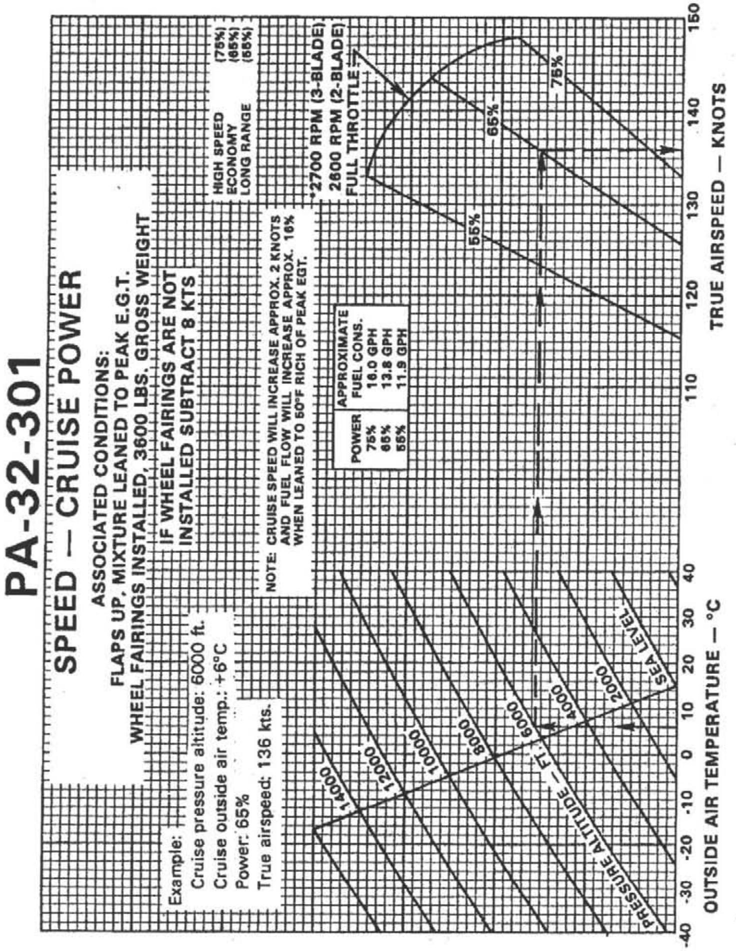


MAXIMUM SPEED PERFORMANCE
Figure 5-27



SPEED - CRUISE POWER
Figure 5-29

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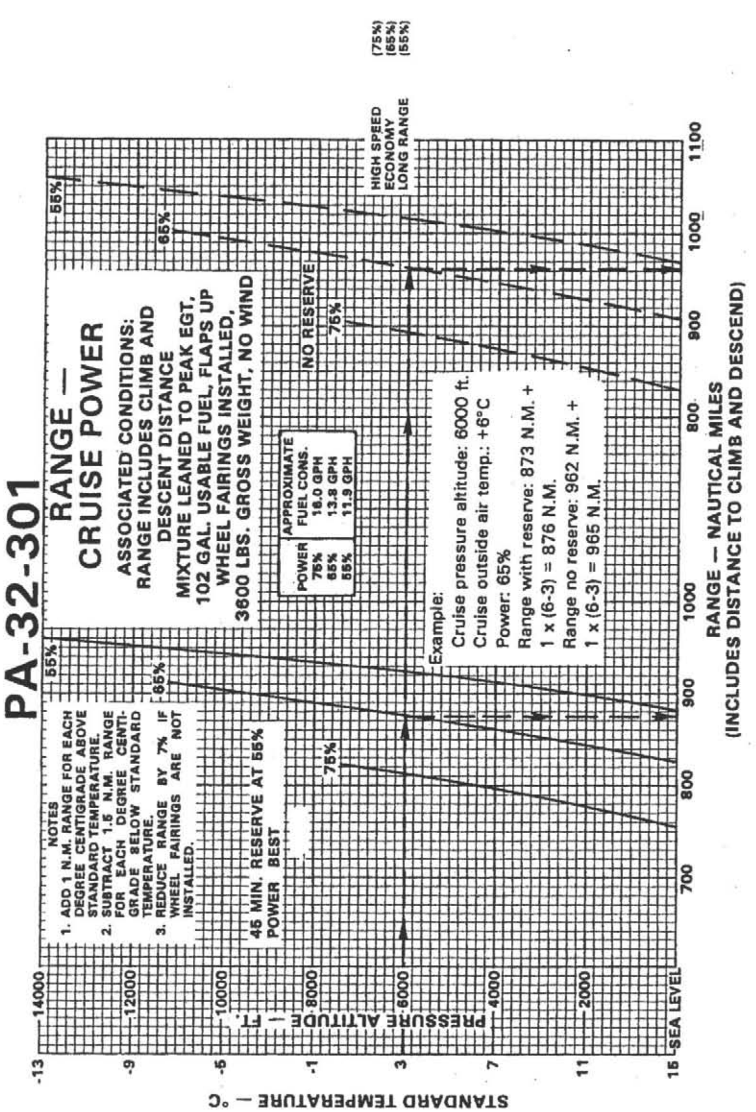
Figure 5-31



RANGE - CRUISE POWER
Figure 5-33

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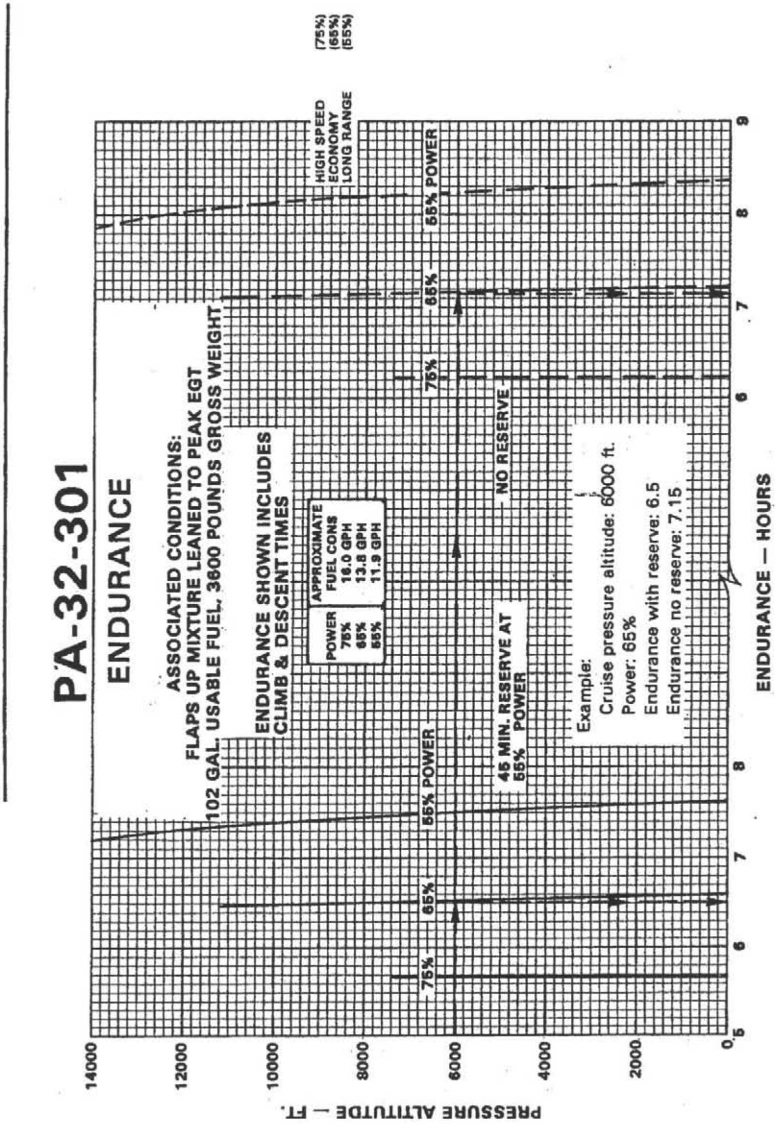
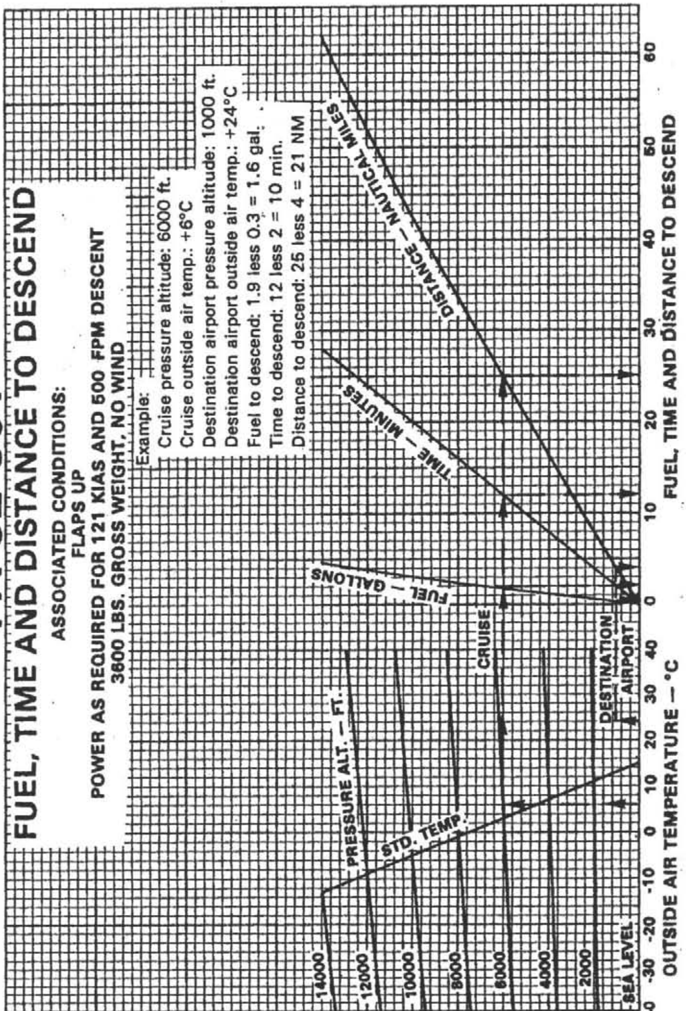
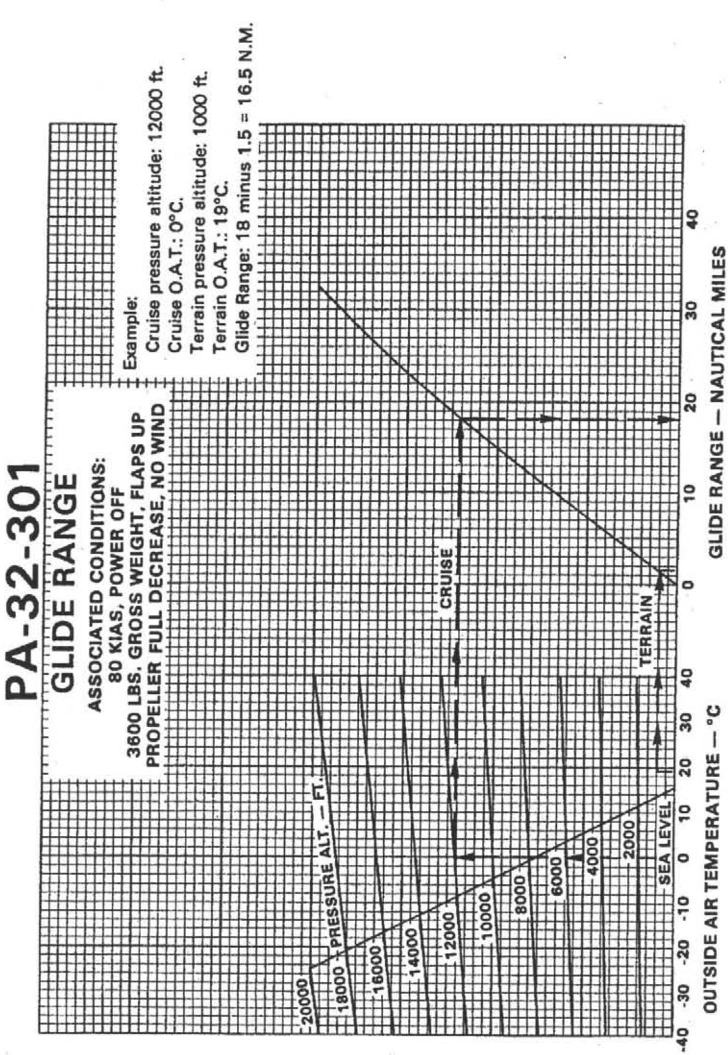
Figure 5-35



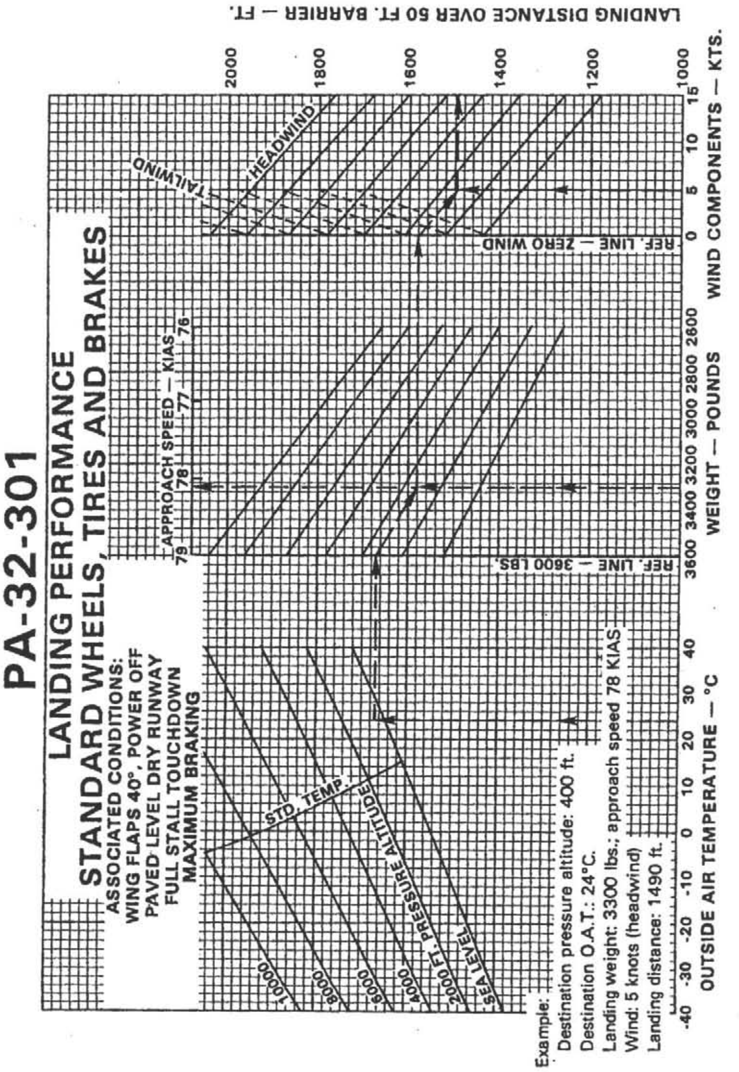
ENDURANCE
Figure 5-37



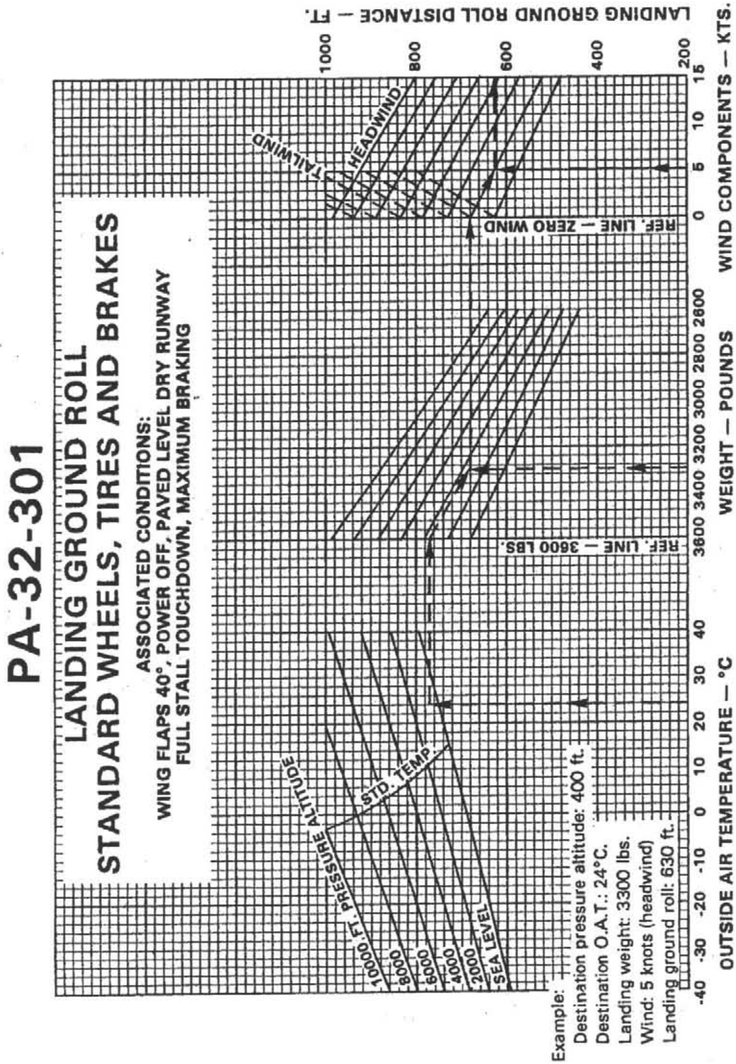
FUEL, TIME AND DISTANCE TO DESCEND
Figure 5-39



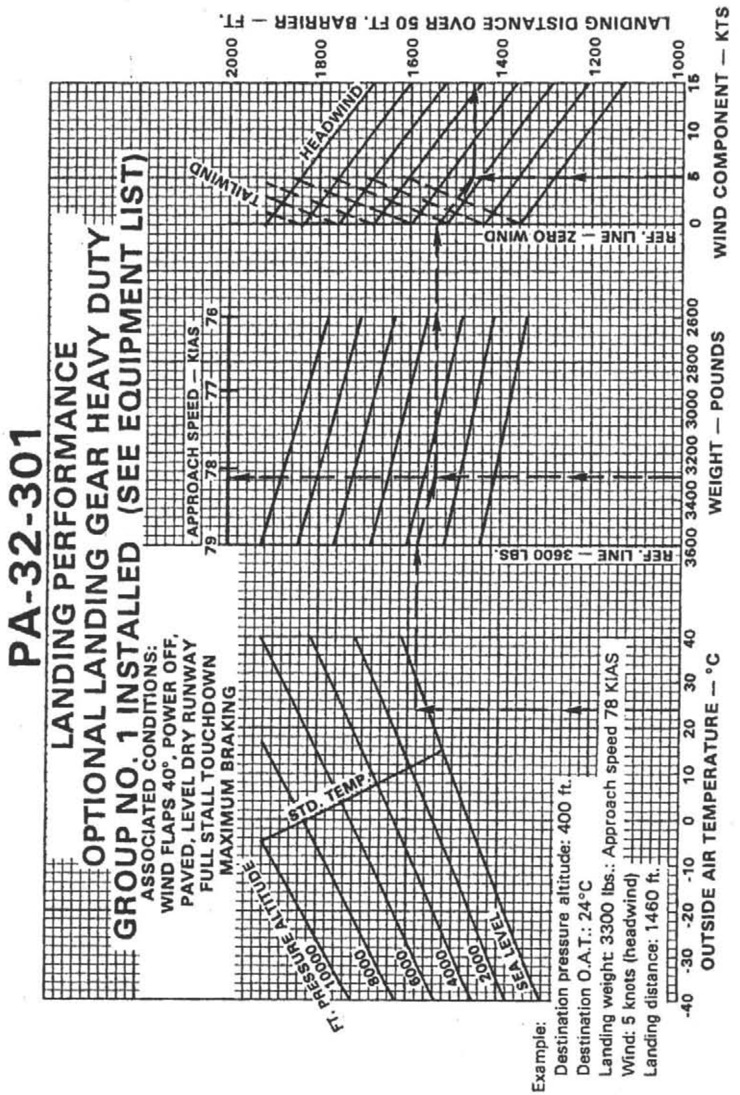
GLIDE RANGE
Figure 5-41



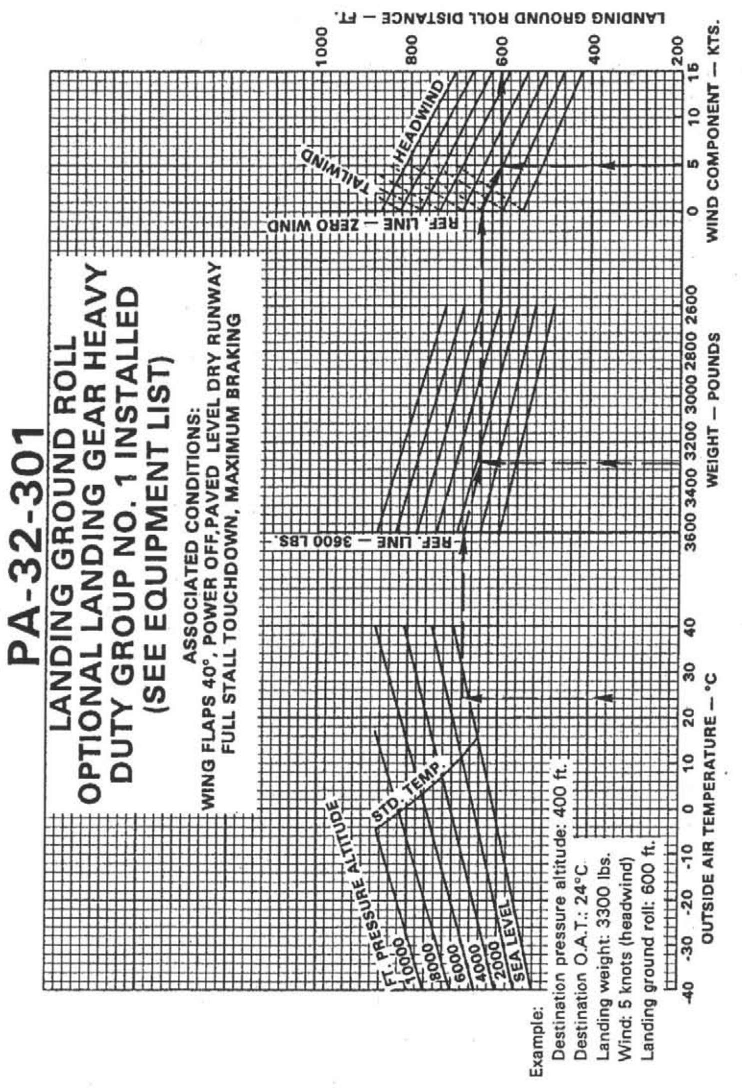
LANDING PERFORMANCE - STANDARD WHEELS, TIRES AND BRAKES
Figure 5-43



LANDING GROUND ROLL - STANDARD WHEELS, TIRES AND BRAKES
Figure 5-45



LANDING PERFORMANCE - OPTIONAL LANDING GEAR HEAVY DUTY GROUP NO. 1 INSTALLED
Figure 5-47



LANDING GROUND ROLL - OPTIONAL LANDING GEAR HEAVY DUTY GROUP NO. 1 INSTALLED
Figure 5-49

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SECTION 6

WEIGHT AND BALANCE

SECTION 6

WEIGHT AND BALANCE

6.1 GENERAL

In order to achieve the performance and flying characteristics which are designed into the airplane, it must be flown with the weight and center of gravity (C.G.) position within the approved operating range (envelope). Although the airplane offers flexibility of loading, it cannot be flown with the maximum number of adult passengers, full fuel tanks and maximum baggage. With the flexibility comes responsibility. The pilot must insure that the airplane is loaded within the loading envelope before he makes a takeoff.

Misloading carries consequences for any aircraft. An overloaded airplane will not take off, climb or cruise as well as a properly loaded one. The heavier the airplane is loaded, the less climb performance it will have.

Center of gravity is a determining factor in flight characteristics. If the C.G. is too far forward in any airplane, it may be difficult to rotate for takeoff or landing. If the C.G. is too far aft, the airplane may rotate prematurely on takeoff or tend to pitch up during climb. Longitudinal stability will be reduced. This can lead to inadvertent stalls and even spins, and spin recovery becomes more difficult as the center of gravity moves aft of the approved limit.

A properly loaded airplane, however, will perform as intended. Before the airplane is licensed, it is weighed, and a basic empty weight and C.G. location is computed (basic empty weight consists of the standard empty weight of the airplane plus the optional equipment). Using the basic empty weight and C.G. location, the pilot can determine the weight and C.G. position for the loaded airplane by computing the total weight and moment and then determining whether they are within the approved envelope.

The basic empty weight and C.G. location are recorded in the Weight and Balance Data Form (Figure 6-5) and the Weight and Balance Record (Figure 6-7). The current values should always be used. Whenever new equipment is added or any modification work is done, the mechanic responsible for the work is required to compute a new basic empty weight and C.G. position and to write these in the Aircraft Log Book and the Weight and Balance Record. The owner should make sure that it is done.

A weight and balance calculation is necessary in determining how much fuel or baggage can be boarded so as to keep within allowable limits. Check calculations prior to adding fuel to insure against improper loading.

The following pages are forms used in weighing an airplane in production and in computing basic empty weight, C.G. position, and useful load. Note that the useful load includes usable fuel, baggage, cargo and passengers. Following this is the method for computing takeoff weight and C.G.

6.3 AIRPLANE WEIGHING PROCEDURE

At the time of licensing, Piper Aircraft Corporation provides each airplane with the basic empty weight and center of gravity location. This data is supplied by Figure 6-5.

The removal or addition of equipment or airplane modifications can affect the basic empty weight and center of gravity. The following is a weighing procedure to determine this basic empty weight and center of gravity location:

(a) Preparation

(1) Be certain that all items checked in the airplane equipment list are installed in the proper location in the airplane.

(2) Remove excessive dirt, grease, moisture, and foreign items such as rags and tools, from the airplane before weighing.

(3) Defuel airplane. Then open all fuel drains until all remaining fuel is drained. Operate engine on each tank until all undrainable fuel is used and engine stops. Then add the unusable fuel (5 gallons total, 2.5 gallons each wing).

CAUTION

Whenever the fuel system is completely drained and fuel is replenished it will be necessary to run the engine for a minimum of three minutes at 1000 RPM on each tank to insure that no air exists in the fuel supply lines.

(4) Fill with oil to full capacity.

(5) Place pilot and copilot seats in fourth (4th) notch, aft of forward position. Put flaps in the fully retracted position and all control surfaces in the neutral position . Tow bar should be in the proper location and all entrance and baggage doors closed.

(6) Weigh the airplane inside a closed building to prevent errors in scale readings due to wind.

(b) Leveling

(1) With airplane on scales, block main gear oleo pistons in the fully extended position.

(2) Level airplane (refer to Figure 6-3) deflating nose wheel tire, to center bubble on level.

(c) Weighing - Airplane Basic Empty Weight

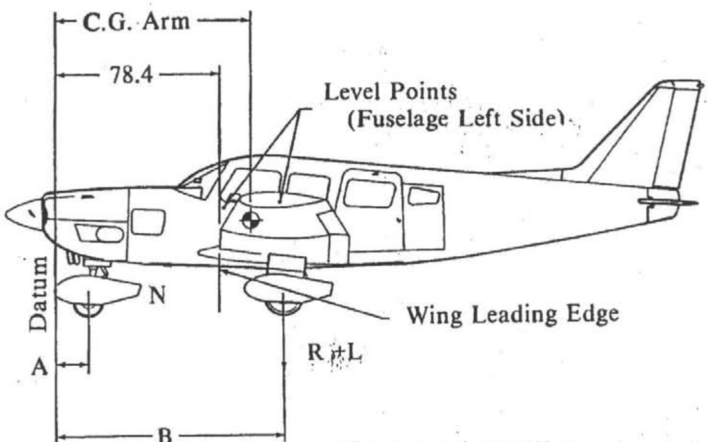
(1) With the airplane level and brakes released, record the weight shown on each scale. Deduct the tare, if any, from each reading.

Scale Position and Symbol		Scale Reading	Tare	Net Weight
Nose Wheel	(N)			
Right Main Wheel	(R)			
Left Main Wheel	(L)			
Basic Empty Weight, as Weighed	(T)			

WEIGHING FORM
Figure 6-1

(d) Basic Empty Weight Center of Gravity

(1) The following geometry applies to the PA-32-301 airplane when it is level. Refer to Leveling paragraph 6.3 (b).



A = 16.7
B = 109.7

The datum is 78.4 inches ahead of the wing leading edge at the intersection of the untapered and tapered section.

LEVELING DIAGRAM
Figure 6-3

(2) The basic empty weight center of gravity (as weighed including optional equipment, full oil and unusable fuel) can be determined by the following formula:

$$\text{C.G. Arm} = \frac{N\,(A) + (R + L)\,(B)}{T} \quad \text{inches}$$

$$\text{Where:} \quad T = N + R + L$$

6.5 WEIGHT AND BALANCE DATA AND RECORD

The Basic Empty Weight, Center of Gravity Location and Useful Load listed in Figure 6-5 are for the airplane as licensed at the factory. These figures apply only to the specific airplane serial number and registration number shown.

The basic empty weight of the airplane as licensed at the factory has been entered in the Weight and Balance Record (Figure 6-7). This form is provided to present the current status of the airplane basic empty weight and a complete history of previous modifications. Any change to the permanently installed equipment or modification which affects weight or moment must be entered in the Weight and Balance Record.

MODEL PA-32-301 SARATOGA

Airplane Serial Number ____________________

Registration Number ____________________

Date ____________________

AIRPLANE BASIC EMPTY WEIGHT

Item		Weight (Lbs)	x C.G. Arm (Inches Aft of Datum)	= Moment (In-Lbs)
Standard Empty Weight*	Actual Computed			
Optional Equipment				
Basic Empty Weight				

*The standard empty weight includes full oil capacity and 5.0 gallons of unusable fuel.

AIRPLANE USEFUL LOAD - NORMAL CATEGORY OPERATION

(Ramp Weight) - (Basic Empty Weight) = Useful Load

(3615 lbs) - (lbs) =   lbs.

THIS BASIC EMPTY WEIGHT, C.G. AND USEFUL LOAD ARE FOR THE AIRPLANE AS LICENSED AT THE FACTORY. REFER TO APPROPRIATE AIRCRAFT RECORD WHEN ALTERATIONS HAVE BEEN MADE.

WEIGHT AND BALANCE DATA FORM
Figure 6-5

PA-32-301	Serial Number		Registration Number				Page Number	
Date	Item No.	Description of Article or Modification	Added (+) Removed (-)	Weight Change			Running Basic Empty Weight	
				Wt. (Lb.)	Arm (In.)	Moment /100	Wt. (Lb.)	Moment /100
		As licensed						

WEIGHT AND BALANCE RECORD
Figure 6-7

PA-32-301	Serial Number		Registration Number				Page Number	
Date	Item No.	Description of Article or Modification	Added (+) Removed (-)	Weight Change			Running Basic Empty Weight	
				Wt. (Lb.)	Arm (In.)	Moment /100	Wt. (Lb.)	Moment /100

WEIGHT AND BALANCE RECORD (cont)
Figure 6-7 (cont)

6.7 GENERAL LOADING RECOMMENDATIONS

The following general loading recommendation is intended only as a guide. The charts, graphs, instructions and plotter should be checked to assure that the airplane is within the allowable weight vs. center of gravity envelope.

(a) Pilot Only
Load rear baggage compartment to capacity first. Without aft baggage, fuel load may be limited by fwd. envelope for some combinations of optional equipment.

(b) 2 Occupants - Pilot and Passenger in Front
Load rear baggage compartment first. Without aft baggage, fuel load may be limited by fwd. envelope for some combinations of optional equipment.

(c) 3 Occupants - 2 in front, 1 in middle
Load rear baggage compartment to capacity first. Baggage in nose may be limited by fwd. envelope. Without aft baggage, fuel may be limited by fwd. envelope for some combinations of optional equipment.

(d) 4 Occupants - 2 in front, 2 in middle
Load rear baggage compartment to capacity first. Baggage in nose may be limited by fwd. envelope. Without aft baggage, fuel may be limited by fwd. envelope for some combinations of optional equipment.

(e) 5 Occupants - 2 in front, 2 in middle, 1 in rear
Investigation is required to determine optimum loading for baggage.

(f) 5 Occupants - 1 in front, 2 in middle, 2 in rear
Load fwd. baggage to capacity first. Rear baggage and/or fuel load may be limited by aft envelope.

(g) 6 Occupants - 2 in front, 2 in middle, 2 in rear
With six occupants fuel and/or baggage may be limited by envelope. Load fwd. baggage compartment to capacity first.

(h) 7 Occupants - 2 in front, 3 in middle, 2 in rear
With seven occupants fuel and/or baggage may be limited by envelope.

For all airplane configurations, it is the responsibility of the pilot in command to make sure that the airplane always remains within the allowable weight vs. center of gravity while in flight.

6.9 WEIGHT AND BALANCE DETERMINATION FOR FLIGHT

(a) Add the weight of all items to be loaded to the basic empty weight.

(b) Use the Loading Graph (Figure 6-13) to determine the moment of all items to be carried in the airplane.

(c) Add the moment of all items to be loaded to the basic empty weight moment.

(d) Divide the total moment by the total weight to determine the C.G. location.

(e) By using the figures of item (a) and item (d) (above), locate a point on the C.G. range and weight graph (Figure 6-15). If the point falls within the C.G. envelope, the loading meets the weight and balance requirements.

(f) Add the fuel allowance (15 lbs.) for engine start, taxi and runup to the airplane takeoff weight determined in part (a).

	Weight (Lbs)	Arm Aft Datum (Inches)	Moment (In-Lbs)
Basic Empty Weight	2176	82.4	179302
Pilot and Front Passenger	340.0	85.5	29070
Passengers (Center Seats) (Forward Facing)		118.1	
Passengers (Center Seats) (Aft Facing) (Optional)		119.1	
Passengers (Rear Seats)	340.0	157.6	53584
Passenger (Jump Seat) (Opt.)		118.1	
Fuel (102 Gallon Maximum)	612	94.0	57528
Baggage (Forward) (100 Lb. Limit)	100	42.0	4200
Baggage (Aft) (100 Lb. Limit)	47	178.7	8399
Ramp Weight (3615 Lbs. Max.)	3615	91.9	332083
Fuel Allowance for Engine Start, Taxi & Runup	-15.0	94.0	-1410
Take-off Weight (3600 Lbs. Max.)	3600	91.9	330673

The center of gravity (C.G.) for the take-off weight of this sample loading problem is at 91.9 inches aft of the datum line. Locate this point (91.9) on the C.G. range and weight graph. Since this point falls within the weight - C.G. envelope, this loading meets the weight and balance requirements.

Take-off Weight	3600	91.9	330673
Minus Estimated Fuel Burn-off (climb & cruise) @ 6.0 Lbs/Gal.	-520	94.0	-48880
Landing Weight	3080	91.5	281793

Locate the center of gravity of the landing weight on the C.G. range and weight graph. Since this point falls within the weight - C.G. envelope, the loading may be assumed acceptable for landing.

IT IS THE RESPONSIBILITY OF THE PILOT AND AIRCRAFT OWNER TO INSURE THAT THE AIRPLANE IS LOADED PROPERLY AT ALL TIMES.

**SAMPLE LOADING PROBLEM
(NORMAL CATEGORY)**
Figure 6-9

	Weight (Lbs)	Arm Aft Datum (Inches)	Moment (In-Lbs)
Basic Empty Weight			
Pilot and Front Passenger		85.5	
Passengers (Center Seats) (Forward Facing)		118.1	
Passengers (Center Seats) (Aft Facing) (Optional)		119.1	
Passengers (Rear Seats)		157.6	
Passenger (Jump Seat) (Opt.)		118.1	
Fuel (102 Gallon Maximum)		94.0	
Baggage (Forward) (100 Lb. Limit)		42.0	
Baggage (Aft) (100 Lb. Limit)		178.7	
Ramp Weight (3615 Lbs. Max.)			
Fuel Allowance for Engine Start, Taxi & Runup	-15.0	94.0	-1410
Take-off Weight (3600 Lbs. Max.)			

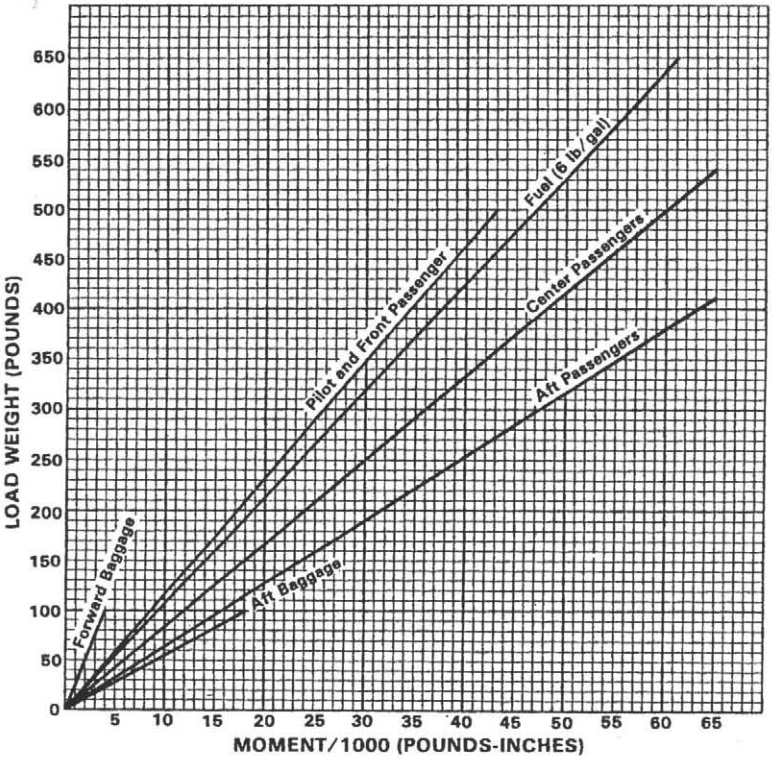
The center of gravity (C.G.) for the take-off weight of this sample loading problem is at inches aft of the datum line. Locate this point ( ) on the C.G. range and weight graph. If this point falls within the weight - C.G. envelope, this loading meets the weight and balance requirements.

Take-off Weight			
Minus Estimated Fuel Burn-off (climb & cruise) @ 6.0 Lbs/Gal.		94.0	
Landing Weight			

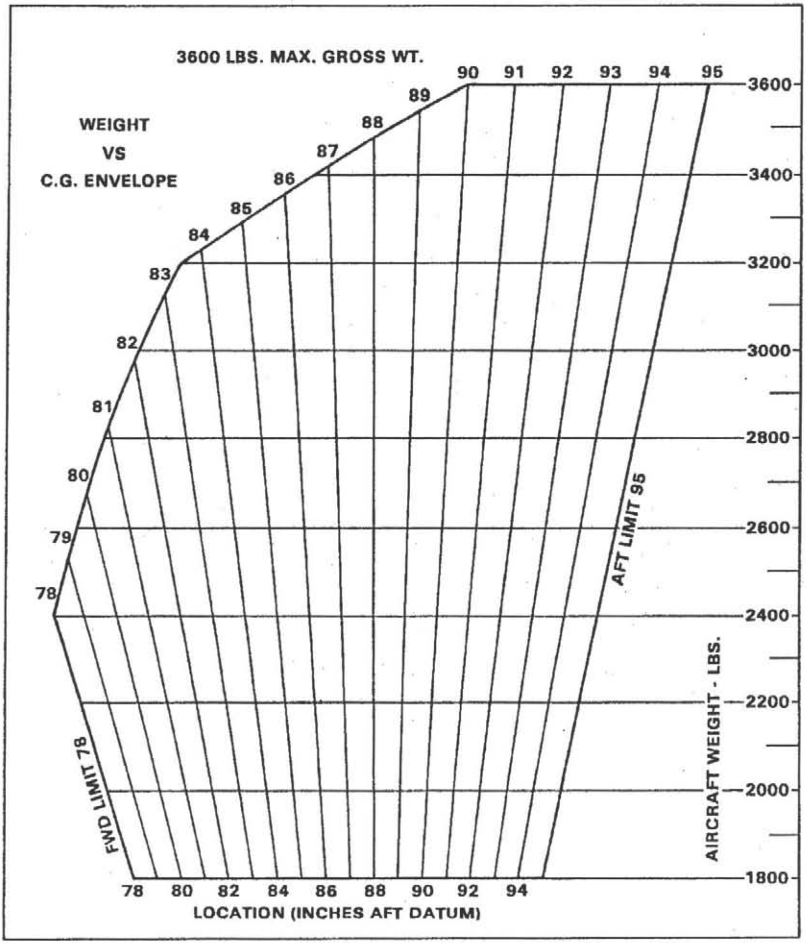
Locate the center of gravity of the landing weight on the C.G. range and weight graph. If this point falls within the weight - C.G. envelope, the loading may be assumed acceptable for landing.

IT IS THE RESPONSIBILITY OF THE PILOT AND AIRCRAFT OWNER TO INSURE THAT THE AIRPLANE IS LOADED PROPERLY AT ALL TIMES.

WEIGHT AND BALANCE LOADING FORM
(NORMAL CATEGORY)
Figure 6-11



LOADING GRAPH
Figure 6-13



C.G. RANGE AND WEIGHT
Figure 6-15

6.11 INSTRUCTIONS FOR USING THE WEIGHT AND BALANCE PLOTTER

This plotter is provided to enable the pilot quickly and conveniently to:

(a) Determine the total weight and C.G. position.

(b) Decide how to change his load if his first loading is not within the allowable envelope.

Heat can warp or ruin the plotter if it is left in the sunlight. Replacement plotters may be purchased from Piper dealers and distributors.

The "Basic Empty Weight and Center of Gravity" location is taken from the Weight and Balance Form (Firgure 6-5), the Weight and Balance Record (Figure 6-7) or the latest FAA major repair or alteration form.

The plotter enables the user to add weights and corresponding moments graphically. The effect of adding or disposing of useful load can easily be seen. The plotter does not cover the situation where cargo is loaded in locations other than on the seats or in the baggage compartments.

Brief instructions are given on the plotter itself. To use it, first plot a point on the grid to locate the basic weight and C.G. location. This can be put on more or less permanently because it will not change until the airplane is modified. Next, position the zero weight end of any one of the loading slots over this point. Using a pencil, draw a line along the slot to the weight which will be carried in that location. Then position the zero weight end of the next slot over the end of this line and draw another line representing the weight which will be located in this second position. When all the loads have been drawn in this manner, the final end of the segmented line locates the total load and the C.G. position of the airplane for takeoff. If this point is not within the allowable envelope it will be necessary to remove fuel, baggage, or passengers and/or to rearrange baggage and passengers to get the final point to fall within the envelope.

Fuel burn-off does not significantly affect the center of gravity.

SAMPLE PROBLEM

A sample problem will demonstrate the use of the weight and balance plotter.

Assume a basic weight and C.G. location of 2150 pounds at 83.5 inches respectively. We wish to carry a pilot and 5 passengers. Two men weighing 180 and 200 pounds will occupy the front seats, two women weighing 115 and 135 pounds will occupy the middle seats and two children weighing 80 and 100 pounds will ride in the rear. Two 25 pound suitcases will be tied down in the front baggage compartment and two suitcases weighing 25 pounds and 20 pounds respectively, will be carried in the rear compartment. We wish to carry 60 gallons of fuel. Will we be within the safe envelope?

(a) Place a dot on the plotter grid at 2150 pounds and 83.5 inches to represent the basic airplane. (See illustration.)

(b) Slide the slotted plastic into position so that the dot is under the slot for the forward seats, at zero weight.

(c) Draw a line up the slot to the 380 pound position (180 + 200) and put a dot.

(d) Move the slotted plastic again to get the zero end of the middle seat slot over this dot.

(e) Draw a line up this slot to the 250 pound position (115 + 135) and place the 3rd dot.

(f) Continue moving the plastic and plotting points to account for weight in the rear seats (80 + 100), forward baggage compartment (50), rear baggage compartment (45), and fuel tanks (360).

(g) As can be seen from the illustration, the final dot shows the total weight to be 3415 pounds with the C.G. at 91.6. This is well within the envelope.

(h) There will be room for more fuel.

(i) Fuel allowance for engine start, taxi and runup is 17 lbs.

As fuel is burned off, the weight and C.G. will follow down the fuel line and stay within the envelope for landing.

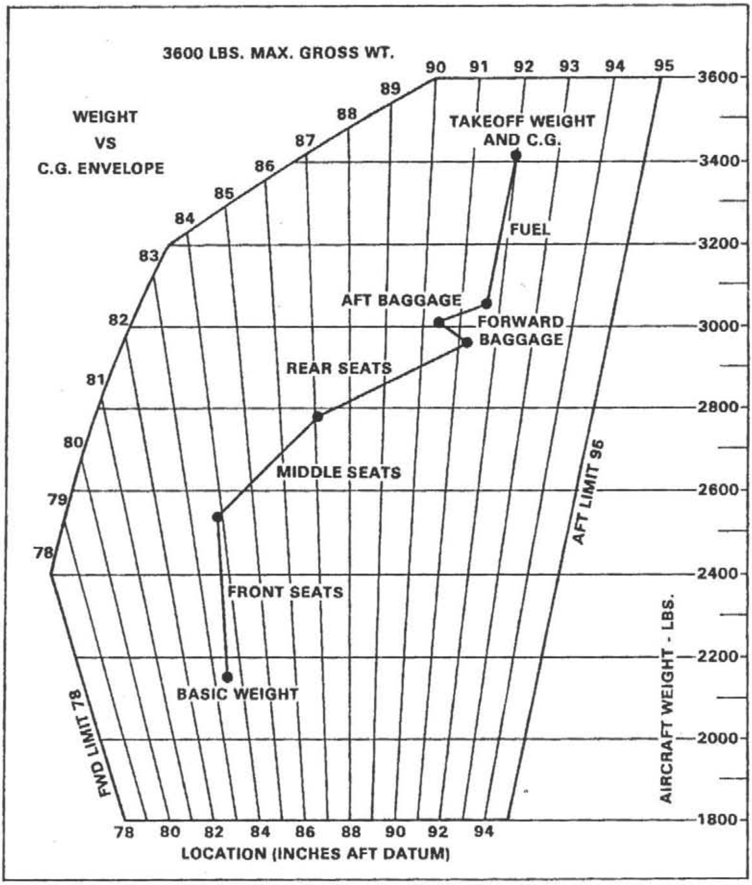

3600 LBS. MAX. GROSS WT.
WEIGHT
VS
C.G. ENVELOPE
TAKEOFF WEIGHT
AND C.G.
FUEL
AFT BAGGAGE
FORWARD
BAGGAGE
REAR SEATS
MIDDLE SEATS
FRONT SEATS
BASIC WEIGHT
AFT LIMIT 95
FWD LIMIT 78
AIRCRAFT WEIGHT - LBS.
3600
3400
3200
3000
2800
2600
2400
2200
2000
1800
90 91 92 93 94 95
89 88 87 86 85 84 83 82 81 80 79 78
78 80 82 84 86 88 90 92 94
LOCATION (INCHES AFT DATUM)

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TABLE OF CONTENTS

SECTION 7

DESCRIPTION AND OPERATION OF THE AIRPLANE AND ITS SYSTEMS

SECTION 7

DESCRIPTION AND OPERATION OF THE AIRPLANE AND ITS SYSTEMS

7.1 THE AIRPLANE

The PA-32-301 is a single engine, low wing airplane. It is all metal, seats up to seven occupants, and has two separate one hundred pound capacity baggage compartments.

7.3 AIRFRAME

With the exception of the steel engine mount, parts of the landing gear, miscellaneous steel parts, the cowling, and the lightweight plastic extremities (tips of wings, tail fin and stabilator), the basic airframe is of aluminum alloy. Aerobatics are prohibited in this airplane since the structure is not designed for aerobatic loads.

The fuselage is a semi-monocoque structure. There is a front door on the right side and a rear door on the left. A cargo door is installed aft of the rear passenger door. When both rear doors are open, large pieces of cargo can be loaded through the extra-wide opening. A door on the right side of the nose section gives access to the nose baggage compartment.

The wing is of a semi-tapered design and employs a laminar flow NACA 65_2-415 airfoil section. The main spar is located at approximately 40% of the chord aft of the leading edge. The wings are attached to the fuselage by the insertion of the butt ends of the spar into a spar box carry-through, which is an integral part of the fuselage structure. The bolting of the spar ends into the spar box carry-through structure, which is located under the center seats, provides in effect a continuous main spar. The wings are also attached fore and aft of the main spar by an auxiliary front spar and a rear spar. The rear spar, in addition to taking torque and drag loads, provides a mount for flaps and ailerons. Each wing contains two interconnected fuel tanks. Both tanks on one side are filled through a single filler neck located in the outboard tank.

A vertical stabilizer, an all-movable horizontal stabilator, and a rudder make up the empennage. The stabilator incorporates an anti-servo tab which provides longitudinal stability and longitudinal trim. This tab moves in the same direction as the stabilator, but with increased travel.

7.5 ENGINE AND PROPELLER

TheLycoming engine is rated at 300 horsepower at 2700 rpm. This engine has a compression ratio of 8.7 to 1 and requires 100 minimum grade fuel. The engine is equipped with a geared starter, a 60 ampere alternator, dual magnetos, vacuum pump drive, a diaphragm-type fuel pump, and fuel injection.

The exhaust system consists of individual exhaust pipes routed in pairs to three heavy gauge stainless steel mufflers. Exhaust gases are directed overboard at the underside of the engine cowling. The mufflers are surrounded by a shroud which provides heat for the cabin and for windshield defrosting.

The cowling is designed to cool the engine in all normal flight conditions, including protracted climb, without the use of cowl flaps or cooling flanges.

An induction scoop is located on the left side of the lower cowl. An intake air box is attached to the inside of the cowl adjacent to the air filter box. The air filter box is located at the aft end of the induction scoop. Access to the filter is gained through a detachable plate located on the outside of the lower cowl.

The intake air box incorporates a manually operated two-way valve designed to allow induction air either to pass through the filter or to bypass the filter and supply heated air directly to the engine. Alternate air selection insures induction air flow should the filter become blocked. Since the air is heated, the alternate air system offers protection against induction system blockage caused by snow or freezing rain, or by the freezing of moisture accumulated in the induction air filter. Alternate air is unfiltered; therefore, it should not be used during ground operation when dust or other contaminants might enter the system. The primary (through the filter) induction source should always be used for takeoffs.

The fuel injection system consists of a servo regulator which meters fuel flow in proportion to airflow to the engine, giving the proper fuel-air mixture at all engine speeds, and a fuel flow divider which receives the metered fuel and accurately divides the fuel flow among the individual cylinder fuel nozzles.

A combination fuel flow indicator and manifold pressure gauge is installed in the left side of the instrument panel. The fuel flow indicator is connected to the fuel flow divider and monitors fuel pressure. The instrument converts fuel pressure to an indication of fuel flow in gallons per hour and percentage of cruise power.

The constant speed propeller is controlled by a governor mounted at the left forward side of the crankcase. Control from the engine control quadrant is provided by a push-pull control.

7.7 ENGINE CONTROLS

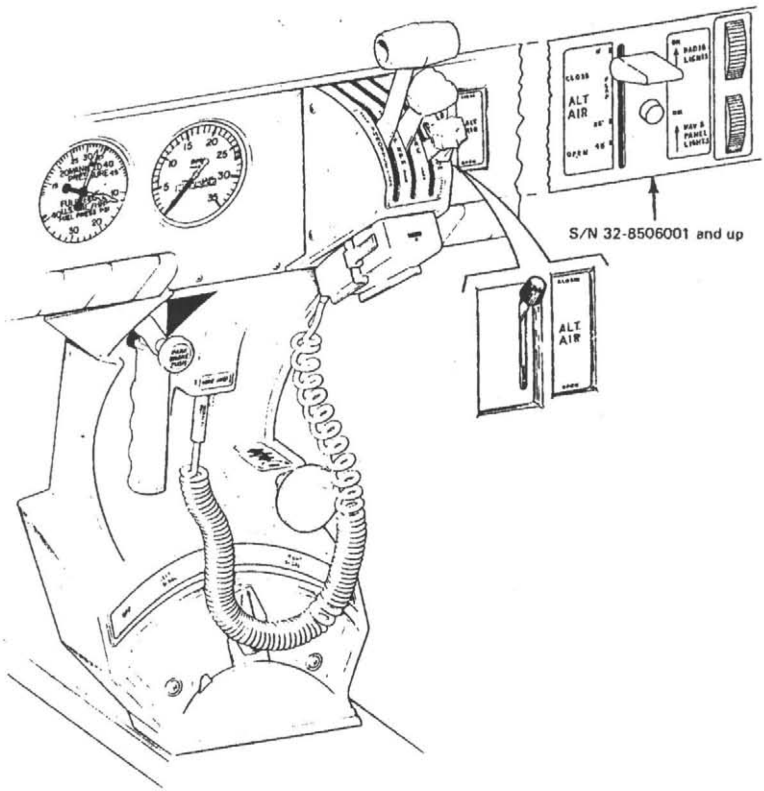
Engine controls consist of a throttle control, a propeller control and a mixture control lever. These controls are located on the control quadrant on the lower center of the instrument panel (Figure 7-1) where they are accessible to both the pilot and the copilot. The controls utilize teflon-lined control cables to reduce friction and binding.

The throttle lever is used to adjust the manifold pressure. The propeller control lever is used to adjust the propeller speed from high RPM to low RPM.

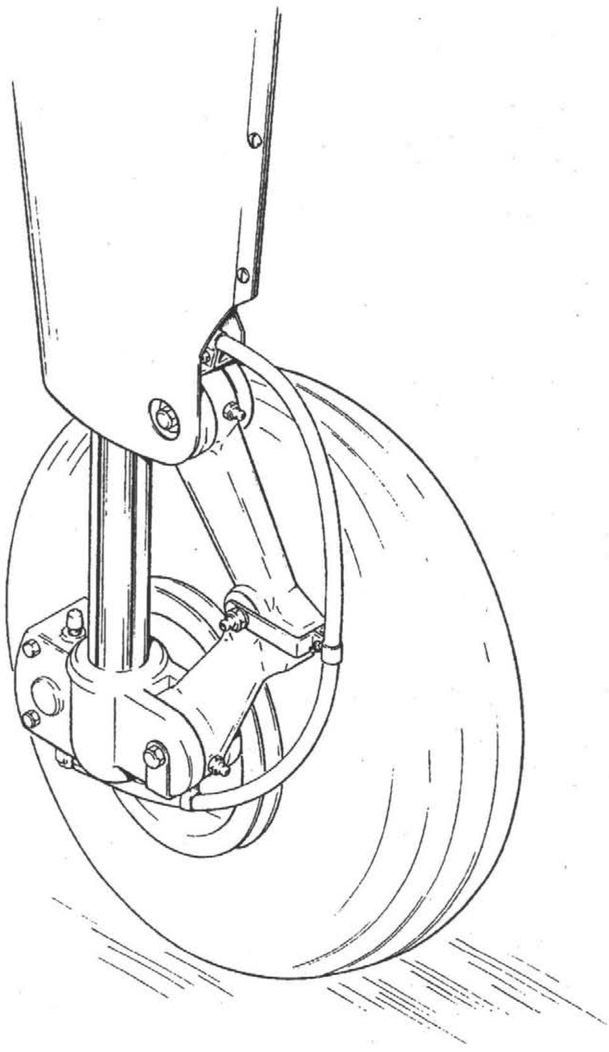
The mixture control lever is used to adjust the air to fuel ratio. The engine is shut down by the placing of the mixture control lever in the full lean position. In addition, the mixture control has a lock to prevent activation of the mixture control instead of the pitch control. For information on the leaning procedure, see the Avco-Lycoming Operator's Manual, and the leaning procedure in Section 4 of this handbook.

The friction adjustment lever on the right side of the control quadrant may be adjusted to increase or decrease the friction holding the throttle, propeller, and mixture controls or to lock the controls in a selected position.

The alternate air control is located to the right of the control quadrant. When the alternate air lever is in the up, or closed, position the engine is operating on filtered air; when the lever is in the down, or open, position the engine is operating on unfiltered, heated air. The control is operated by pressing the knob to the left to clear the retaining gate and then moved in the desired direction (refer to Figure 7-1).



CONTROL QUADRANT AND CONSOLE
Figure 7-1



MAIN WHEEL ASSEMBLY
Figure 7-3

7.9 LANDING GEAR

The main landing gear uses Cleveland 6.00 x 6 wheels with 6.00 x 6 eight-ply tires, brake drums and Cleveland double disc hydraulic brake assemblies (Figure 7-3). The nose wheel comprises a Cleveland 5.00 x 5 wheel with a 5.00 x 5 six-ply tire or an optional Cleveland 6.00 x 6 wheel with a 6.00 x 6 six-ply tire. All tires are tube type.

The nose gear is steerable using a combination of full rudder pedal travel and brakes. The nose gear can be turned 24° each side of center. A spring device is incorporated in the rudder pedal torque tube assembly to aid in rudder centering and to provide rudder trim. The nose gear also includes a shimmy dampener.

The oleo struts are of the air-oil type. The normal extensions are 3-1/4 inches for the nose gear and 4-1/2 inches for the main gear under normal static load (empty weight of airplane plus full fuel and oil).

The brakes are operated by toe pedals attached to the rudder pedals or by a hand lever and master cylinder located below and behind the left center of the instrument sub-panel. Hydraulic cylinders are located above each pedal and adjacent to the hand lever. The brake fluid reservoir is on the top left front of the fire wall. The parking brake is incorporated in the lever brake and is engaged by pulling back on the lever and depressing the knob attached to the top of the handle. To release the parking brake, pull back on the brake lever to disengage the catch; then allow the handle to swing forward.

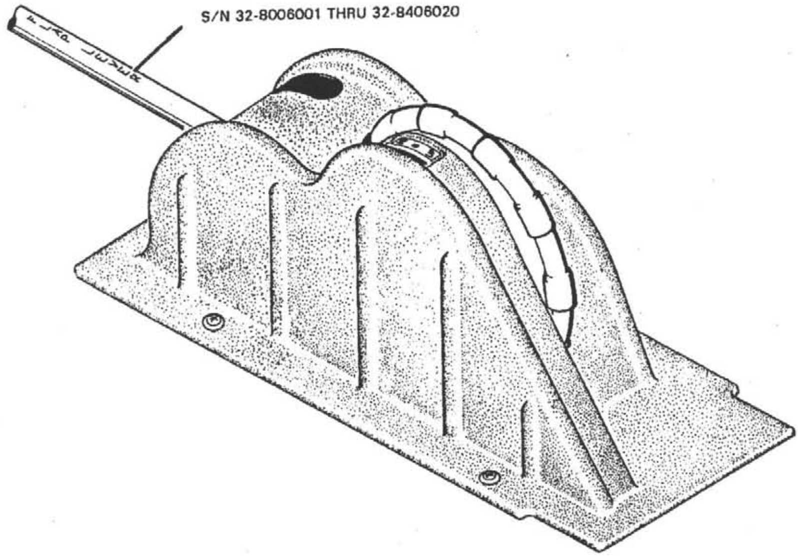
7.11 FLIGHT CONTROLS

Dual controls, with a cable system between the controls and the surfaces, are installed as standard equipment.

The horizontal tail is of the all-movable slab type (stabilator).

An anti-servo tab which also acts as a longitudinal trim tab, is located on the horizontal tail. This tab is actuated by a control mounted on the control tunnel between the front seats (Figure 7-5).

On aircraft serial numbers 32-8006001 thru 32-8406020, the flaps are manually operated, and spring-loaded to return to the up position. A past-center lock incorporated in the actuating linkage holds the flap when it is in the up position so that it may be used as a step on the right side. Since the flap



FLIGHT CONTROL CONSOLE
Figure 7-5

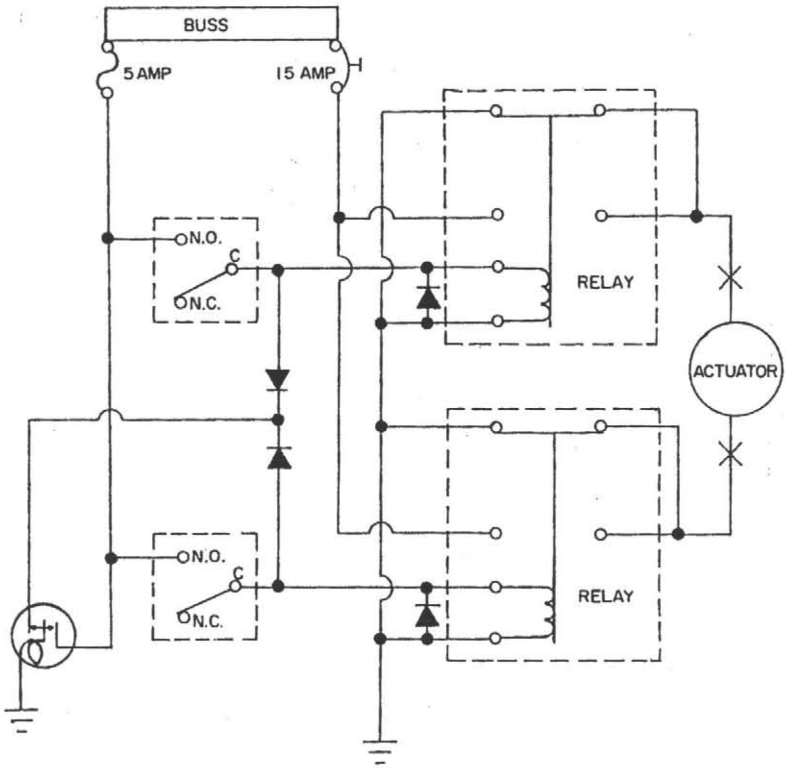
will not support a step load except in the full up position, it should be completely retracted when the airplane is on the ground. The flaps have three extended positions, 10, 25, and 40 degrees.

On aircraft serial numbers 32-8506001 and up, the flaps are electrically operated. A control lever and indicator light are located on the lower right instrument panel. Selection of a new flap position will activate the flap motor and the light. When the flaps reach the desired position, the flap motor is automatically switched off and the indicator light goes out.

In the event of a flap drive malfunction; move the flap lever until the light goes out. The position of the flap lever relative to the instrument panel markings indicates the approximate flap position.

On aircraft serial numbers 32-8506001 thru 32-8506021 there are three stops for the flap control lever, full up (0° flap), 1st notch (25° flap), and full down (40° flap).

On aircraft serial numbers 32-8606001 and up there are four stops for the flap control lever, full up (0° flap), 1st notch (10° flap), 2nd notch (25° flap) and full down (40° flap).



ELECTRIC FLAP SCHEMATIC
Figure 7-6

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7.13 FUEL SYSTEM

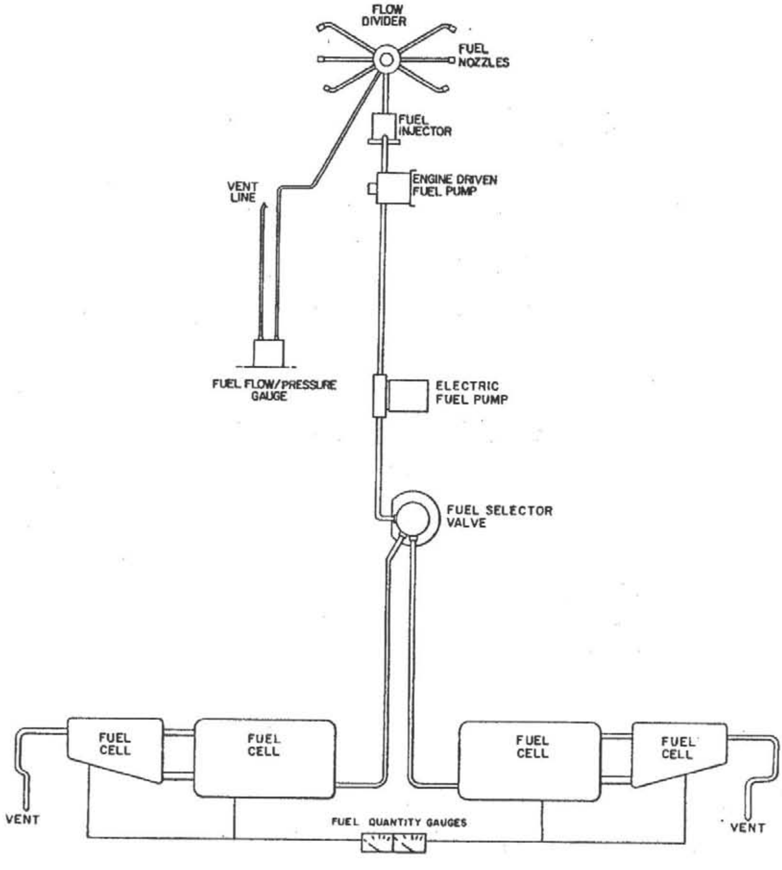
The standard fuel capacity of the airplane is 107 gallons, of which 102 gallons are usable. The inboard tank is attached to the wing structure with screws and nut plates and can be removed for service or inspection. The outboard tank consists of a bladder fuel cell that is interconnected with the inboard tank. A flush fuel cap is located in the outboard tank only.

When using less than the standard 107 gallon capacity of the tanks, fuel should be distributed equally between each side.

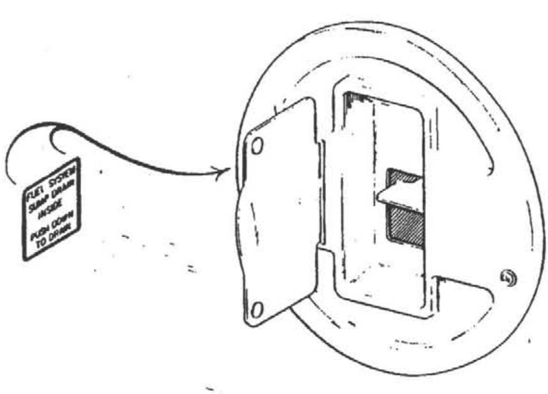
The fuel selector control is located below the center of the instrument panel on the sloping face of the control tunnel (refer to Figure 7-1). It has three positions, one position corresponding to each wing tank plus an OFF position.

To avoid the accumulation of water and sediment, the fuel tank sumps and strainer should be drained daily prior to first flight and after refueling. Check for proper fuel after refueling. Each tank is equipped with an individual quick drain located at the lower inboard rear corner of the tank. The fuel strainer and a system quick drain valve are located in the fuselage at the lowest point of the fuel system. It is important that the fuel system be drained in the following manner:

(a) Drain each tank sump through its individual quick drain located at the lower inboard rear corner of the tank, making sure that enough fuel has flowed to insure the removal of all water and sediment. Check for proper fuel.
(b) Place a container beneath the fuel strainer sump drain outlet located under the fuselage.
(c) Drain the fuel strainer sump by pressing down on the lever located on the right side of the cabin on the forward edge of the wing spar housing (Figure 7-9). Move the selector through the following sequence: OFF position, left, right, while draining the strainer sump. Make sure that enough fuel has flowed to drain the fuel line between each tank outlet and the fuel strainer, as well as the strainer itself. With full fuel tanks, it will take approximately 6 seconds to drain all of the fuel from the line from either tank to the fuel strainer. When the tanks are less than full, it will take a few seconds longer.
(d) Examine the contents of the container placed under the fuel sump drain outlet for proper fuel. When the fuel flow is free of water and sediment, close the drain and dispose of the contents of the bottle.



FUEL SYSTEM SCHEMATIC
Figure 7-7



FUEL DRAIN LEVER
Figure 7-9

CAUTION

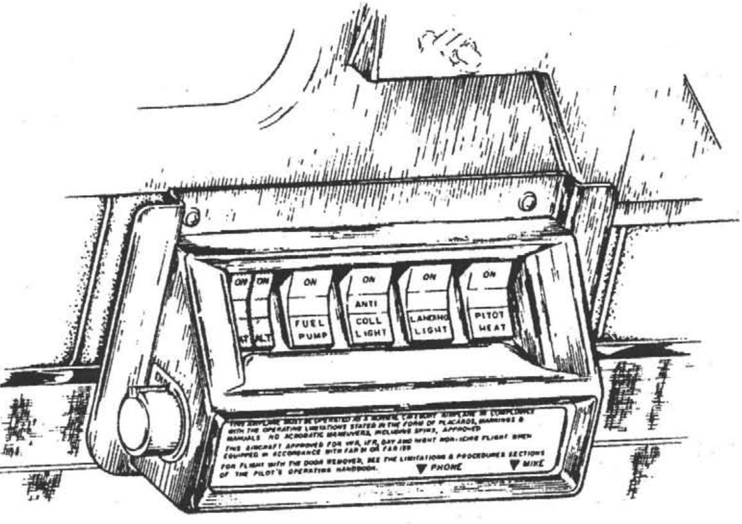
When draining fuel, care should be taken to insure that no fire hazard exists before starting the engine.

After using the underseat quick drain, check from the outside to make sure that it has closed completely and is not leaking.

Fuel quantity gauges for each of the tanks are located in the engine gauge cluster on the left side of the instrument panel.

A fuel quantity indicator to measure the fuel not visible through the filler neck in each wing is installed in the inboard fuel tank. This gauge indicates usable fuel quantities from 5 gallons to 35 gallons in the ground attitude. The sole purpose of this gauge is to assist the pilot in determining fuel quantities of less than 35 gallons during the preflight inspection.

An electric fuel pump is provided for use in case of failure of the engine driven pump. The electric pump operates from a single switch and independent circuit protector. It should be ON for all takeoffs and landings.



SWITCH PANEL
Figure 7-11

7.15 ELECTRICAL SYSTEM

The 14-volt electrical system includes a 12-volt battery for starting and to back up alternator output (Figure 7-13). Electrical power is supplied by a 60 ampere alternator. The battery and master switch relay, along with the voltage controller (a voltage regulator and voltage relay on earlier models), are located beneath the floor of the forward baggage compartment. Access to each is obtained by removing the floor.

Electrical switches are located on a panel to the pilot's left (Figure 7-11) and all circuit breakers are on the lower right instrument panel (refer to Figure 7-15). A switch panel light is available as optional equipment. The light is installed above the switch panel and is controlled by a rheostat switch mounted on the left side of the panel. Two thumb-wheel rheostat switches to the left of the circuit breakers control the navigation lights and the intensity of the instrument panel lights.

Standard electrical accessories include the starter, the electric fuel pump, the stall warning horn, the ammeter, and the annunciator panel.

The annunciator panel includes alternator and low oil pressure indicator lights and provisions for optional baggage door ajar, air conditioner door open and low vacuum (gyro system) lights. The annunciator panel lights are provided only as a warning to the pilot that a system may not be operating properly, and that the applicable system gauge should be checked and monitored to determine when or if any corrective action is required.

Optional electrical accessories include the navigation lights, anti-collision strobe lights, wing tip/recognition light system, instrument panel lighting and cabin courtesy lights operated by switches in the pilot's switch panel. The cabin courtesy light installation consists of two light/switch panels, one mounted above each cabin entrance. Make sure the lights are off when leaving the aircraft. Leaving the lights on for an extended period of time could cause depletion of the battery.

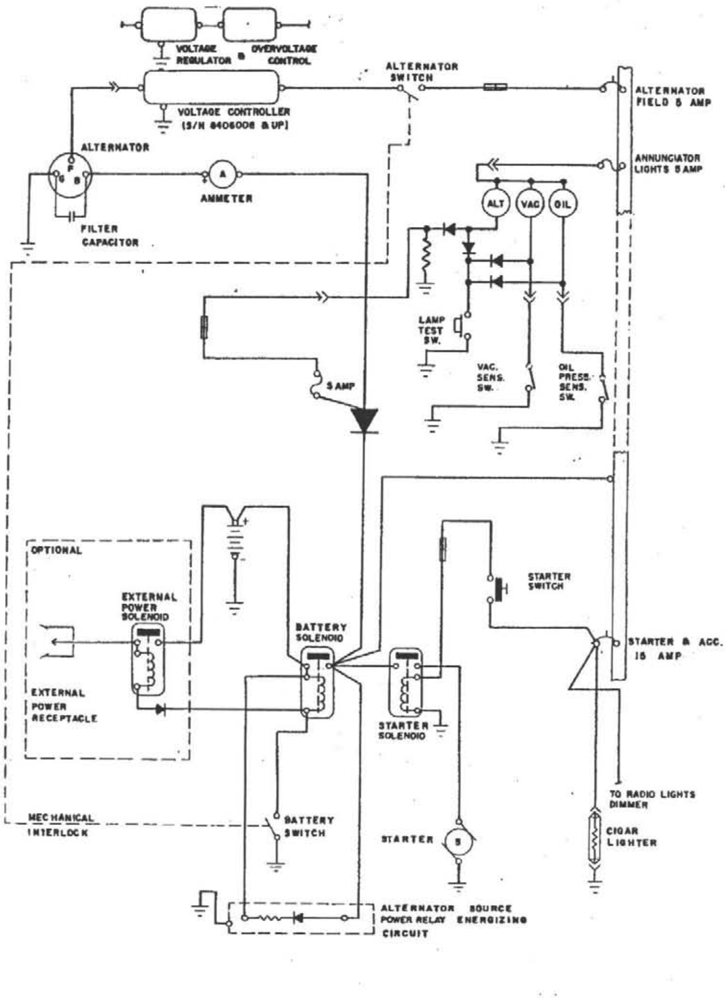
Two optional lights, mounted in the overhead panel, provide instrument and cockpit lighting for night flying. The lights are controlled by rheostat switches located adjacent to them. A map light window in each lens is actuated by an adjacent switch.

Circuit provisions are made to handle the addition of communications and navigational equipment.

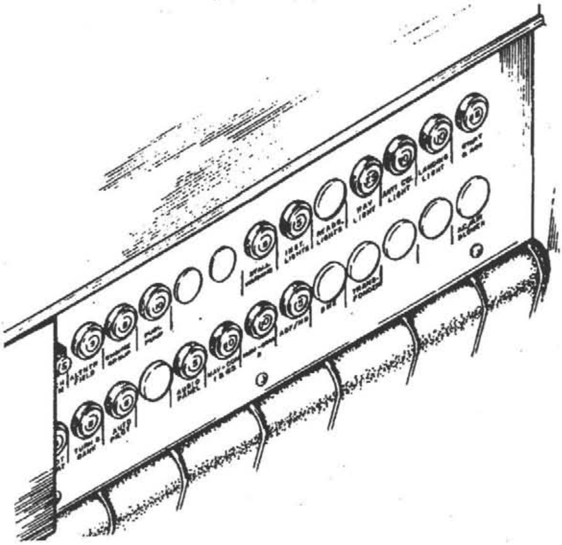
The ammeter in the alternator system displays in amperes the load placed on the alternator. It does not indicate battery discharge. With all electrical equipment off (except the master switch), the ammeter will be indicating the amount of charging current demanded by the battery. As each item of electrical equipment is turned on, the current will increase to a total appearing on the ammeter. This total includes the battery. The average continuous load for night flight, with radios on, is about 30 amperes. This 30 ampere value, plus approximately 2 amperes for a fully charged battery, will appear continuously under these flight conditions.

NOTE

On airplanes with interlocked BAT and ALT switches, the ALT switch is mechanically interlocked with the BAT switch. When ALT switch is turned ON, the BAT switch will also be turned ON. On airplanes with separate BAT and ALT switch operations, the switches may be positioned independently as desired.



ALTERNATOR AND STARTER SCHEMATIC
Figure 7-13



CIRCUIT BREAKER PANEL
Figure 7-15

For abnormal and/or emergency operation and procedures, see Section 3.

WARNING

Anti-collision lights should not be operating when flying through cloud, fog or haze, since the reflected light can produce spatial disorientation. Strobe lights should not be used in close proximity to the ground such as during taxiing, takeoff or landing.

CAUTION

Do not use cigar lighter receptacles as power sources for any devices other than the cigar lighters supplied with the airplane. Any other device plugged into these receptacles may be damaged.

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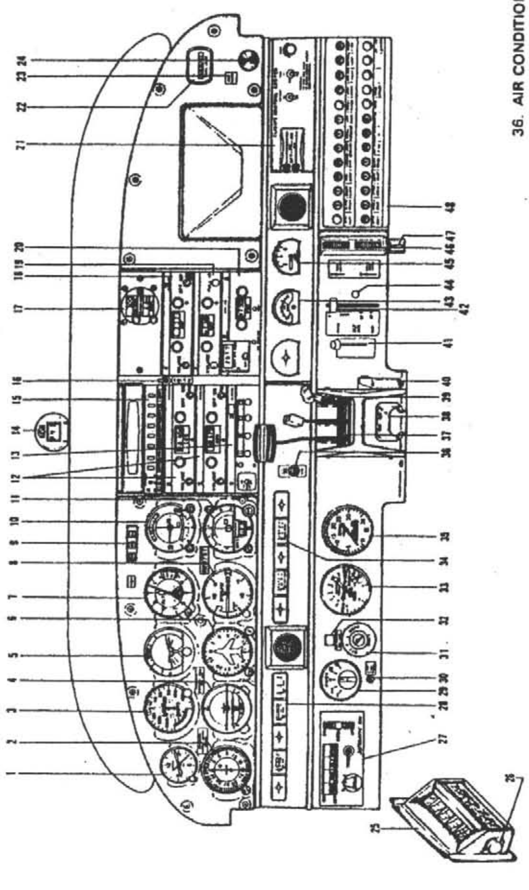
7.17 VACUUM SYSTEM

The vacuum system is designed to operate the air driven gyro instruments. This includes the directional and attitude gyros when installed. The system consists of an engine driven vacuum pump, a vacuum regulator, a filter and the necessary plumbing.

The vacuum pump is a dry type pump which eliminates the need for an air/oil separator and its plumbing. A shear drive protects the engine from damage. If the drive shears the gyros will become inoperative.

The vacuum gauge, mounted on the right instrument panel to the right of the radios, (refer to Figure 7-17) provides valuable information to the pilot about the operation of the vacuum system. A decrease in pressure in a system that has remained constant over an extended period, may indicate a dirty filter, dirty screens, possibly a sticking vacuum regulator or leak in system (a low vacuum indicator light is provided in the annunciator panel). Zero pressure would indicate a sheared pump drive, defective pump, possibly a defective gauge or collapsed line. In the event of any gauge variation from the norm, the pilot should have a mechanic check the system to prevent possible damage to the system components or eventual failure of the system.

A vacuum regulator is provided in the system to protect the gyros. The valve is set so the normal vacuum reads 4.8 to 5.1 inches of mercury, a setting which provides sufficient vacuum to operate all the gyros at their rated RPM. Higher settings will damage the gyros and with a low setting the gyros will be unreliable. The regulator is located behind the instrument panel.



1. CLOCK
2. ADF INDICATOR
3. AIRSPEED INDICATOR
4. TURN AND BANK
5. ATTITUDE GYRO
6. DIRECTIONAL GYRO
7. ALTIMETER
8. VERTICAL SPEED INDICATOR
9. ANNUNCIATOR PANEL
10. GS/LOC/VOR INDICATOR
11. VOR INDICATOR
12. COM 1 AND COM 2
13. TRANSPONDER
14. COMPASS
15. AUDIO SELECTOR PANEL
16. RADIO MASTER SWITCH
17. R NAV
18. ADF RADIO
19. NAV 1 RADIO
20. DME RADIO
21. HEAT, DEFROST, A/C AND VENT BLOWER CONTROLS
22. HOUR METER
23. GROUND CLEARANCE SWITCH
24. CIGAR LIGHTER
25. MASTER AND ACCESSORY SWITCH PANEL
26. SWITCH PANEL LIGHT (OPTION)
27. AUTOPILOT
28. ENGINE INSTRUMENT CLUSTER
29. VOR/LOC COUPLER
30. NAV SELECTOR SWITCH
31. MAGNETO AND STARTER SWITCH
32. PITCH TRIM SWITCH
33. MANIFOLD PRESSURE AND FUEL FLOW GAUGE
34. FUEL QUANTITY GAUGE
35. TACHOMETER
36. AIR CONDITION DOOR LIGHT
37. THROTTLE QUADRANT
38. MICROPHONE BRACKET
39. MIXTURE CONTROL LOCK
40. FRICTION LOCK
41. ALTERNATE AIR CONTROL
42. WING FLAP SELECTOR (S/N 32-8506001 AND UP)
43. EGT GAUGE
44. FLAP INTRANSIT LIGHT (S/N 32-8506001 AND UP)
45. GYRO SUCTION GAUGE
46. NAV AND PANEL LIGHT SWITCHES
47. EMERGENCY BUS SWITCH
48. CIRCUIT BREAKER PANEL

TYPICAL INSTRUMENT PANEL
Figure 7-17

7.19 INSTRUMENT PANEL

The instrument panel of the airplane is designed to accommodate the customary advanced flight instruments and the normally required power plant instruments. The artificial horizon and directional gyro are vacuum operated and are located in the center of the left-hand instrument panel. The vacuum gauge is located on the right-hand instrument panel. The turn indicator, on the left side, is electrically operated.

The radios are located in the center section of the panel, and the circuit breakers are in the lower right corner of the panel. An optional radio MASTER switch is located near the top of the instrument panel between the radio stacks. It controls the power to all radios through the aircraft MASTER switch. The radio power switch has an OFF and ON position. An emergency bus switch is also provided to give AUXILIARY power to the avionics bus in the event of a radio MASTER switch circuit failure. The emergency bus switch is located behind the lower right shin guard, left of the circuit breaker panel.

A ground clearance energy saver system is available to provide direct power to Comm #1 without turning on the master switch. An internally lit pushbutton switch, located on the instrument panel, provides annunciation for engagement of the system. When the button is engaged direct aircraft battery power is applied to Comm #1, audio amplifier (speaker) and radio accessories. The switch must be turned off or depletion of battery could result.

An annunciator panel is mounted in the upper instrument panel to warn the pilot of a possible malfunction in the alternator, oil pressure, or vacuum system.

7.21 PITOT-STATIC SYSTEM

The system supplies both pitot and static pressure for the airspeed indicator, altimeter and vertical speed indicator (when installed).

Pitot and static pressure are picked up by the pitot head on the bottom of the left wing. An optional heated pitot head, which alleviates problems with icing or heavy rain, is available. The switch for pitot heat is located on the switch panel to the pilot's left. Push-button type pitot and static drains are located on the lower left sidewall of the cockpit.

An alternate static source is available as optional equipment. The control valve is located below the left side of the instrument panel. When the valve is set in the alternate position, the altimeter, vertical speed indicator and airspeed indicator will be using cabin air for static pressure. The storm window and cabin vents must be closed and the cabin heater and defroster must be on during alternate static source operation. The altimeter error is less than 50 feet unless otherwise placarded.

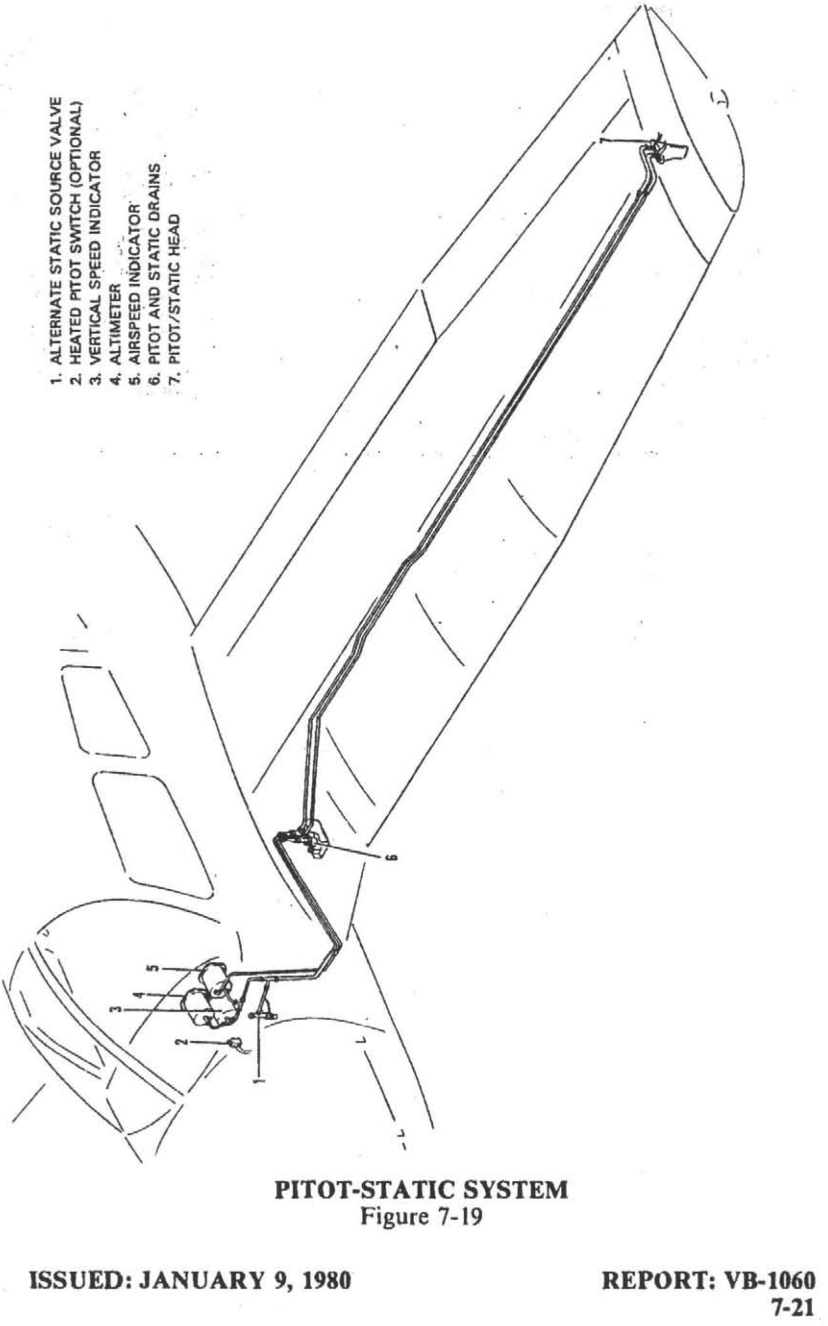
To prevent bugs and water from entering the pitot and static pressure holes when the airplane is parked, a cover should be placed over the pitot head. A partially or completely blocked pitot head will give erratic or zero readings on the instruments.

NOTE

During preflight, check to make sure the pitot cover is removed.

7.23 CABIN FEATURES

For ease of entry and exit and for pilot and passenger comfort, the front seats are adjustable fore and aft. All seats recline and have armrests and are available with optional headrests. The front seats can be equipped with optional vertical adjustment. The center and rear seats may be removed for additional cargo space.



PITOT-STATIC SYSTEM
Figure 7-19

NOTE

To remove the center seats, retainers securing the back legs of the seats must be unlocked. This is accomplished by depressing the plunger behind each rear leg. Any time the seats are installed in the airplane, the retainers should be in the locked position. To remove the rear seats, depress the plunger behind each front leg and slide seat to rear.

An optional jump seat can be installed between the two middle seats to give the airplane a seven-place capacity.

Shoulder harnesses with inertia reels are standard equipment for the front seats.

On aircraft serial numbers 32-8006001 through 32-8406020, shoulder harnesses with inertia reels are offered as optional equipment for the third, fourth, fifth and sixth seats, but not for the seventh seat.

On aircraft serial numbers 32-8506001 and up, shoulder harnesses with inertia reels are standard equipment on the third, fourth, fifth and sixth seat. A shoulder harness with inertia reel is also provided when the optional seventh seat is installed.

The inertia reel should be checked by tugging sharply on the strap. The reel will lock in place under this test and prevent the strap from extending. Under normal movement, the strap will extend and retract as required.

On earlier aircraft provided with a single strap adjustable shoulder harness for each front seat the shoulder strap is routed over the shoulder adjacent to the windows and attached to the lap belt in the general area of the person's inboard hip. Adjust this fixed strap so that all controls are accessible while maintaining adequate restraint for the occupant.

Shoulder harnesses should be routinely worn during takeoff, landing and whenever an inflight emergency occurs.

An optional club seating interior is also available. In the club seating interior the center seats face aft. These seats are equipped with lap belts and adjustable shoulder harnesses.* Removal of the seats is accomplished by removing the two bolts holding the aft attach points and sliding the seat aft.

*Ealier aircraft are equipped with lap belts only.

An optional refreshment console is located between the center seats. It is removed in a manner identical to the removal of the center seats.

An optional cabin work table, serving the two seats on the right side of the passenger cabin, is offered to the club seating arrangement. The table must be stowed during takeoff and landing. If the table is to be used, it should be set up after a level cruise is established.

To remove the cabin work table from the aft baggage compartment, unlock the stud located on the bottom of the close-out bulkhead. Loosen the white tie-down strap and remove the table from the mounting brackets by lifting the table two inches straight up until it clears the mounting brackets. Do not twist the table while it is in the brackets.

To install the cabin work table during flight, hold the table in place and tilt the free end of the table upward 30° until the lobed upper knobs on the table supports align with the top holes of the escutcheons located below the right cabin window trim. Hold the upper lobes in place and lower the free end of the table to the level work position. The retaining springs will click when secure.

To stow the cabin work table, remove the table by lifting the free end of the table upward to disengage the bottom lobes of the table supports. Lift until the top support lobes disengage at approximately 30° of tilt and remove the table. Position the table in the stowage area and, with the table work surface facing forward, place the slots in the table support into the receptacle clips mounted on the hat shelf. Make sure the white tie-down strap is not behind the table. With the table fully placed in the clips, bring the white tie-down strap across the face of the table and lock over the stud located on the bottom of the close-out bulkhead.

7.25 BAGGAGE AREA

The airplane has two separate baggage areas, each with a 100 pound capacity. A 8 cubic foot forward luggage compartment, located just aft of the fire wall, is accessible through a 16 x 22 inch door on the right side of the fuselage. A 17.3 cubic foot aft compartment is located behind the fifth and sixth seats and is accessible through the cargo door on the aft side of the fuselage and during flight from inside the cabin.

An automatic forward baggage light feature is available which utilizes a magnetic reed switch and a magnet for activation. The switch and magnet are mounted just above the hinge line of the forward baggage door.

Opening the baggage door fully causes activation of the switch which illuminates the baggage light. The baggage light is independent of the aircraft master switch; therefore, the light will illuminate regardless of the position of the master switch. The baggage door should not be left open for extended time periods, as battery depletion could result.

An optional forward baggage door ajar annunciation system is available which senses baggage door latch pin position. Failing to latch the forward baggage door will illuminate an amber light located on the pilot's annunciator panel. The annunciation, when illuminated, is BAGGAGE DOOR advising the pilot of this condition.

NOTE

It is the pilot's responsibility to be sure when the baggage is loaded that the airplane's C.G. falls within the allowable C.G. range. (Refer to Weight and Balance Section.)

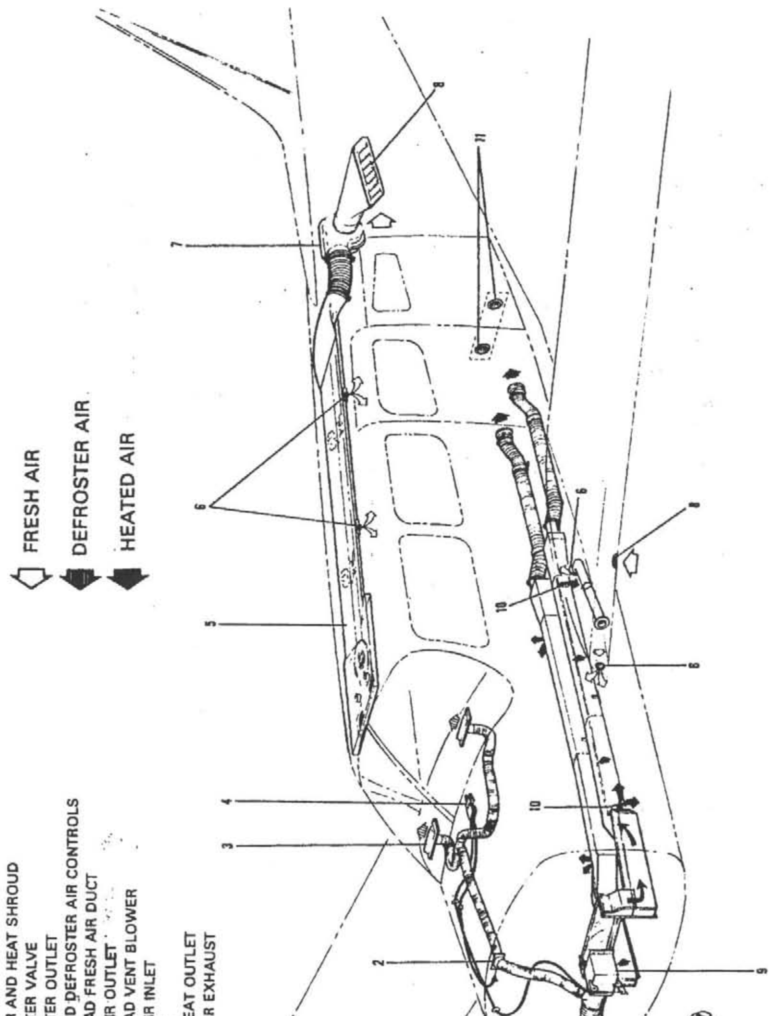
7.27 HEATING AND VENTILATING SYSTEM

Fresh air is ducted from the aft lower right engine baffle to the heater muff by a flexible hose. Hot air from the heater muff is routed through a flexible hose on the right side of the engine compartment, to the valve box mounted on the fire wall just above the tunnel cut out. It is then ducted down each side of the tunnel below the baggage floor to the cabin ducting and outlets (Figure 7-21).

CAUTION

When cabin heat is operated, heat duct surface becomes hot. This could result in burns if arms or legs are placed too close to heat duct outlets or surface.

Defrost heat is bled off from the main flow at the heater muff and routed through flexible hose to a shut-off valve located to the right of center at the top of the fire wall. From this point, it is ducted to the defroster outlets.



HEATING AND VENTILATING SYSTEM
Figure 7-21

Fixed air inlets are located in the leading edge of each wing at the intersection of the tapered and straight sections, and in the left hand side of the tailcone. Two adjustable outlets are located on each side of the cabin, one forward and one aft of the front seat near the floor. There are also adjustable outlets above each seat. In airplanes without air conditioning, an optional blower may be added to the overhead vent system to aid in the circulation of cabin air.

7.29 STALL WARNING

An approaching stall is indicated by a stall warning horn which is activated between five and ten knots above stall speed. Mild to moderate airframe buffeting may also precede the stall. Stall speeds are shown on graphs in the Performance Section. The stall warning horn emits a continuous sound. The stall warning horn is activated by lift detectors installed on the leading edge of the left wing. During preflight, the stall warning system should be checked by turning the master switch ON, lifting the detectors and checking to determine if the horn is actuated.

7.31 FINISH

All exterior surfaces are primed with etching primer and finished with acrylic lacquer or polyurethane (optional).

7.33 AIR CONDITIONING*

The air conditioning system is a recirculating air system. The major components include an evaporator, a condenser, a compressor, a blower, switches and temperature control.

The evaporator is located behind the rear baggage compartment. This cools the air used for the air conditioning system.

The condenser is mounted on a retractable scoop located on the bottom of the fuselage and to the rear of the baggage compartment area. The scoop extends when the air conditioner is ON and retracts to a flush position when the system is OFF.

*Optional equipment

The compressor is mounted on the forward right underside of the engine. It has an electric clutch which automatically engages or disengages the compressor to the belt drive system of the compressor.

Air from the baggage area is drawn through the evaporator by the blower and distributed through an overhead duct to individual outlets located adjacent to each occupant.

The switches and temperature control are located on the lower right side of the instrument panel in the climate control center panel. The temperature control regulates the temperature of the cabin. Turning the control clockwise increases cooling; counterclockwise decreases cooling.

The fan speed switch and the air conditioning ON-OFF switch are inboard of the temperature control. The fan can be operated independently of the air conditioning; however, the fan must be on for air conditioner operation. Turning either switch off will disengage the compressor clutch and retract the condenser door. Cooling air should be felt within one minute after the air conditioner is turned on.

NOTE

If the system is not operating in 5 minutes, turn the system OFF until the fault is corrected.

The fan switch allows operation of the fan with the air conditioner turned OFF to aid in cabin air circulation. "LOW" or "HIGH" can be selected to direct a flow of air through the air conditioner outlets in the overhead duct. These outlets can be adjusted or turned off individually. The

condenser door light is located on the instrument panel in front of the pilot. The door light illuminates when the door is open and is off when the door is closed.

A circuit breaker on the circuit breaker panel protects the air conditioning electrical system.

Whenever the throttle is moved forward to takeoff power, a manifold pressure switch disengages the compressor and retracts the scoop. This allows maximum power and maximum rate of climb. The fan continues to operate and the air will remain cool for about one minute. When the throttle is retarded approximately 1/4 inch, the clutch will engage, the scoop will extend, and the system will again supply cool, dry air.

7.35 PIPER EXTERNAL POWER*

An optional starting installation known as Piper External Power (PEP) is accessible through a receptacle located on the left side of fuselage forward of the wing. An external battery can be connected to the socket, thus allowing the operator to crank the engine without having to gain access to the airplane's battery.

7.37 EMERGENCY LOCATOR TRANSMITTER*

The Emergency Locator Transmitter (ELT), when installed, is located in the aft portion of the fuselage just below the stabilator leading edge and is accessible through a plate on the right side of the fuselage. This plate is attached with slotted-head nylon screws for ease of removal; these screws may be readily removed with a variety of common items, such as a dime, a key, a knife blade, etc. If there are no tools available in an emergency, the screw heads may be broken off by any means. The ELT meets the requirements of FAR 91.52.

A battery replacement date is marked on the transmitter. To comply with FAA regulations, the battery must be replaced on or before this date. The battery must also be replaced if the transmitter has been used in an emergency situation or if the accumulated test time exceeds one hour or if the unit has been inadvertently activated for an undetermined time period.

NOTE

If for any reason a test transmission is necessary, the test transmission should be conducted only in the first five minutes of any hour and limited to three audio sweeps. If the tests must be made at any other time, the tests should be coordinated with the nearest FAA tower or flight service station.

*Optional equipment

NARCO ELT 10 OPERATION

On the ELT unit itself is a two-position switch placarded ON and ARM. The ARM position sets the ELT so that it will transmit after impact and will continue to transmit until its battery is drained. The ARM position is selected when the ELT is installed in the airplane, and the switch should remain in that position.

To use the ELT as a portable unit in an emergency, remove the cover and unlatch the unit from its mounting base. The antenna cable is disconnected by a left quarter-turn of the knurled nut and a pull. A sharp tug on the two small wires will break them loose. Deploy the self-contained antenna by pulling the plastic tab marked "PULL FULLY TO EXTEND ANTENNA." Move the switch to ON to activate the transmitter.

In the event that the transmitter is activated by an impact, it can only be turned off by moving the switch on the ELT unit to OFF. Normal operation can then be restored by pressing the small, clear plastic reset button located on the top of the front face of the ELT and then moving the switch to ARM.

A pilot's remote switch, located on the left side panel, is provided to allow the transmitter to be turned on from inside the cabin. The pilot's remote switch is placarded ON and ARMED. The switch is normally in the ARMED position. Moving the switch to ON will activate the transmitter. Moving the switch back to the ARMED position will turn off the transmitter only if the impact switch has not been activated.

The ELT should be checked to make certain the unit has not been activated during the ground check. Check by selecting 121.50 MHz on an operating receiver. If there is an oscillating chirping sound, the ELT may have been activated and should be turned off immediately. This requires removal of the access cover and moving the switch to OFF, then pressing the reset button and returning the switch to ARM. Recheck with the receiver to ascertain that the transmitter is silent.

7.39 RADAR*

A weather radar system can be installed in this airplane. The basic components of this installation are an R-T/Antenna and a cockpit indicator. The function of the weather radar system is to detect weather conditions along the flight path and to visually display a continuous weather outline on the cockpit indicator. Through interpretation of the advance warning given on the display, the pilot can make an early decision on the most desirable weather avoidance course.

NOTE

When operating weather avoidance radar systems inside of moderate to heavy precipitation, it is advisable to set the range scale of the radar to its lowest scale.

For detailed information on the weather radar system and for procedures to follow in operating and adjusting the system to its optimum efficiency, refer to the appropriate operating and service manuals provided by the radar system manufacturer.

WARNING

Heating and radiation effects of radar can cause serious damage to the eyes and tender organs of the body. Personnel should not be allowed within fifteen feet of the area being scanned by the antenna while the system is transmitting. Do not operate the radar during refueling or in the vicinity of trucks or containers accommodating explosives or flammables. Flashbulbs can be exploded by radar energy. Before operating the radar, direct the nose of the airplane so that the forward 120 degree sector is free of any metal objects such as other aircraft or hangars for a distance of at least 100 yards, and tilt the antenna upward 15 degrees. Do not operate the radar while the airplane is in a hangar or other enclosure.

*Optional equipment

TABLE OF CONTENTS

SECTION 8

AIRPLANE HANDLING, SERVICING AND MAINTENANCE

SECTION 8

AIRPLANE HANDLING, SERVICING AND MAINTENANCE

8.1 GENERAL

This section provides guidelines relating to the handling, servicing, and maintenance of the Saratoga. For complete maintenance instructions, refer to the PA-32-301 Maintenance Manual.

Every owner should stay in close contact with an authorized Piper Service Center or Piper's Customer Service Department to obtain the latest information pertaining to their airplane, and to avail themselves of Piper Aircraft's support system.

Piper Aircraft Corporation takes a continuing interest in having owners get the most efficient use from their aircraft and keeping it in the best mechanical condition. Consequently, Piper Aircraft, from time to time, issues service releases including Service Bulletins, Service Letters, Service Spares Letters, and others relating to the airplane.

Service Bulletins are of special importance and Piper considers compliance mandatory. These are sent directly to the latest FAA-registered owners in the United States (U.S.) and Piper Service Centers worldwide. Depending on the nature of the release, material and labor allowances may apply. This information is provided to all authorized Service Centers.

Service Letters deal with product improvements and servicing techniques pertaining to the airplane. They are sent to Piper Service Centers and, if necessary, to the latest FAA-registered owners in the U.S. Owners should give careful attention to Service Letter information.

Service Spares Letters offer improved parts, kits, and optional equipment which were not available originally, and which may be of interest to the owner.

Piper Aircraft Corporation offers a subscription service for Service Bulletins, Service Letters, and Service Spares Letters. This service is available to interest persons, such as owners, pilots, and mechanics at a nominal fee, and may be obtained through an authorized Piper Service Center or Piper's Customer Services Department.

Maintenance manuals, parts catalogs, and revisions to both, are available from Piper Service Centers or Piper's Customer Services Department.

Any correspondence regarding the airplane should include the airplane model and serial number to ensure proper response.

8.3 AIRPLANE INSPECTION PERIODS

Piper Aircraft Corporation has developed inspection items and required inspection intervals (i.e.: 50, 100, 500, and 1000 hours) for the specific model aircraft. Appropriate forms are contained in the applicable Piper Service/Maintenance Manual, and should be complied with by a properly trained, knowledgeable, and qualified mechanic at a Piper Authorized Service Center or a reputable repair shop. Piper Aircraft Corporation cannot accept responsibility for the continued airworthiness of any aircraft not maintained to these standards, and/or not brought into compliance with applicable Service Bulletins issued by Piper Aircraft Corporation, instructions issued by the engine, propeller, or accessory manufacturers, or Airworthiness Directives issued by the FAA.

A programmed inspection, approved by the Federal Aviation Administration (FAA), is also available to the owner. This involves routine and detailed inspections to allow maximum utilization of the airplane. Maintenance inspection costs are reduced, and the maximum standard of continued airworthiness is maintained. Complete details are available from Piper Aircraft Corporation.

In addition, but in conjunction with the above, the FAA requires periodic inspections on all aircraft to keep the Airworthiness Certificate in effect. The owner is responsible for assuring compliance with these inspection requirements and for maintaining proper documentation in logbooks and/or maintenance records.

A spectographic analysis of the engine oil is available from several sources. This inspection, if performed properly, provides a good check of the internal condition of the engine. To be accurate, induction air filters must be cleaned or changed regularly, and oil samples must be taken and sent in at regular intervals.

8.5 PREVENTIVE MAINTENANCE

The holder of a Pilot Certificate issued under FAR Part 61 may perform certain preventive maintenance described in FAR Part 43. This maintenance may be performed only on an aircraft which the pilot owns or operates and which is not used to carry persons or property for hire, except as provided in applicable FAR's. Although such maintenance is allowed by law, each individual should make a self-analysis as to whether he has the ability to perform the work.

All other maintenance required on the airplane should be accomplished by appropriately licensed personnel.

If maintenance is accomplished, an entry must be made in the appropriate logbook. The entry should contain:

(a) The date the work was accomplished.
(b) Description of the work.
(c) Number of hours on the aircraft.
(d) The certificate number of pilot performing the work.
(e) Signature of the individual doing the work.

8.7 AIRPLANE ALTERATIONS

If the owner desires to have his aircraft modified, he must obtain FAA approval for the alteration. Major alterations accomplished in accordance with advisory Circular 43.13-2, when performed by an A & P mechanic, may be approved by the local FAA office. Major alterations to the basic airframe or systems not covered by AC 43.13-2 require a Supplemental Type Certificate.

The owner or pilot is required to ascertain that the following Aircraft Papers are in order and in the aircraft.

(a) To be displayed in the aircraft at all times:
  (1) Aircraft Airworthiness Certificate Form FAA-8100-2.
  (2) Aircraft Registration Certificate Form FAA-8050-3.
  (3) Aircraft Radio Station License if transmitters are installed.

(b) To be carried in the aircraft at all times:
  (1) Pilot's Operating Handbook.
  (2) Weight and Balance data plus a copy of the latest Repair and Alteration Form FAA-337, if applicable.
  (3) Aircraft equipment list.

Although the aircraft and engine logbooks are not required to be in the aircraft, they should be made available upon request. Logbooks should be complete and up to date. Good records will reduce maintenance cost by giving the mechanic information about what has or has not been accomplished.

8.9 GROUND HANDLING

(a) Towing

The airplane may be moved on the ground by the use of the nose wheel steering bar that is stowed in the rear baggage compartment or by power equipment that will not damage or excessively strain the nose gear steering assembly. Towing lugs are incorporated as part of the nose gear fork.

CAUTION

When towing with power equipment, do not turn the nose gear beyond its steering radius in either direction, as this will result in damage to the nose gear and steering mechanism.

CAUTION

Do not tow the airplane when the controls are secured.

In the event towing lines are necessary, ropes should be attached to both main gear struts as high up on the tubes as possible. Lines should be long enough to clear the nose and/or tail by not less than fifteen feet, and a qualified person should ride in the pilot's seat to maintain control by use of the brakes.

(b) Taxiing

Before attempting to taxi the airplane, ground personnel should be instructed and approved by a qualified person authorized by the owner. Engine starting and shut-down procedures as well as taxi techniques should be covered. When it is ascertained that the propeller back blast and taxi areas are clear, the parking brake is released and power is applied to start the taxi roll, and the following checks should be performed:

(1) Taxi a few feet forward and apply the brakes to determine their effectiveness.
(2) Taxi with the propeller set in low pitch, high RPM setting.
(3) While taxiing, make slight turns to ascertain the effectiveness of the steering.

(4) Observe wing clearance when taxiing near buildings or other stationary objects. If possible, station an observer outside the airplane.
(5) When taxiing over uneven ground, avoid holes and ruts.
(6) Do not operate the engine at high RPM when running up or taxiing over ground containing loose stones, gravel, or any loose material that may cause damage to the propeller blades.

(c) Parking

When parking the airplane, be sure that is is sufficiently protected from adverse weather conditions and that it presents no danger to other aircraft. When parking the airplane for any length of time or overnight, it is suggested that it be moored securely.

(1) To park the airplane, head it into the wind if possible.
(2) Set the parking brake by pulling back on the brake lever and depressing the knob on the handle. To release the parking brake, pull back on the handle until the catch disengages; then allow the handle to swing forward.

CAUTION

Care should be taken when setting brakes that are overheated or during cold weather when accumulated moisture may freeze a brake.

(3) Aileron and stabilator controls should be secured with the front seat belt and chocks used to properly block the wheels.

(d) Mooring

The airplane should be moored for immovability, security and protection. The following procedures should be used for the proper mooring of the airplane:

(1) Head the airplane into the wind if possible.
(2) Retract the flaps.
(3) Immobilize the ailerons and stabilator by looping the seat belt through the control wheel and pulling it snug.
(4) Block the wheels.

(5) Secure tie-down ropes to the wing tie-down rings and to the tail ring at approximately 45 degree angles to the ground. When using rope of non-synthetic material, leave sufficient slack to avoid damage to the airplane should the ropes contract.

CAUTION

Use bowline knots, square knots or locked slip knots. Do not use plain slip knots.

NOTE

Additional preparations for high winds include using tie-down ropes from the landing gear forks and securing the rudder.

(6) Install a pitot head cover if available. Be sure to remove the pitot head cover before flight.
(7) Cabin and baggage doors should be locked when the airplane is unattended.

8.11 ENGINE AIR FILTER

(a) Removing Engine Air Filter
(1) Remove the access door on left side of lower cowling.
(2) Remove the wing nuts securing the filter. Remove the filter.

(b) Cleaning Engine Air Filter

The injector air filter must be cleaned at least once every 50 hours and more often, even daily, when operating in dusty conditions. Extra filters are inexpensive, and a spare should be kept on hand for use as a rapid replacement.

To clean the filter:
(1) Tap the filter gently to remove dirt particles, being careful not to damage the filter. DO NOT wash the filter in any liquid. DO NOT attempt to blow out dirt with compressed air.

(2) If the filter is excessively dirty or shows any damage, replace it immediately.
(3) Wipe the filter housing with a clean cloth soaked in unleaded gasoline. When the housing is clean and dry, install the filter.

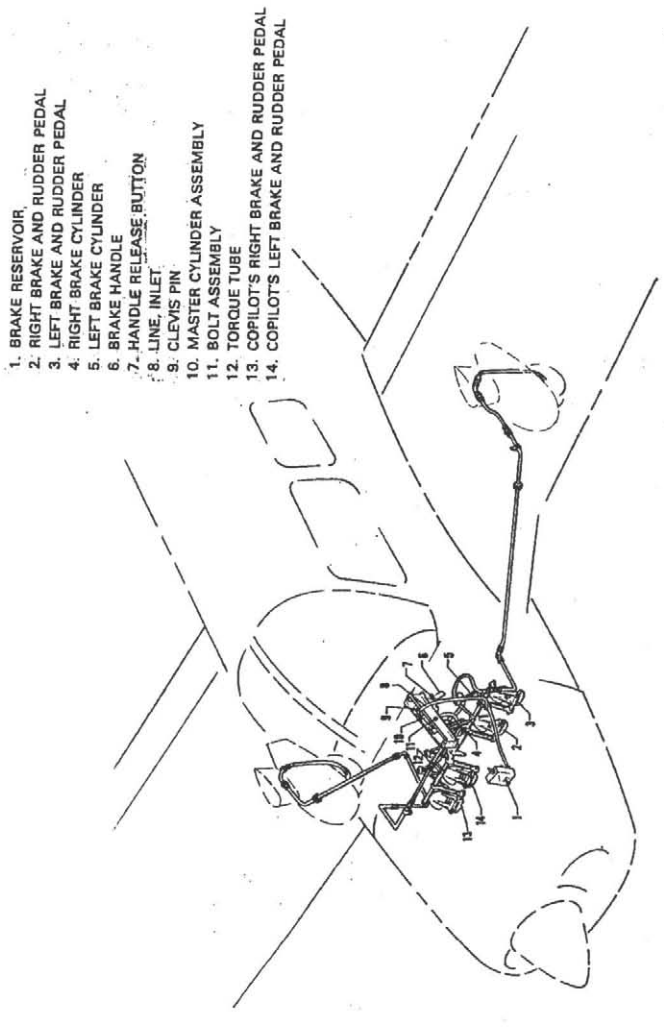
(c) Installation of Engine Air Filter

After cleaning or when replacing the filter, install the filter in the reverse order of removal.

8.13 BRAKE SERVICE

The brake system is filled with MIL-H-5606 (petroleum base) hydraulic brake fluid. The fluid level should be checked periodically or at every 100-hour inspection and replenished when necessary. The brake reservoir is located on the left side of the fire wall in the engine compartment. If the entire system must be refilled, fill with fluid under pressure from the brake end of the system. This will eliminate air from the system.

No adjustment of the brake clearances is necessary. If, after extended service, brake blocks become excessively worn they should be replaced with new segments.



BRAKE SYSTEM
Figure 8-1

8.15 LANDING GEAR SERVICE

The main landing gear uses Cleveland Aircraft Products 6.00 x 6 wheels with 6.00 x 6, eight-ply rating tires and tubes. The nose wheel uses a Cleveland Aircraft Products 5.00 x 5 wheel with a 5.00 x 5 six-ply rating, type III tire and tube or an optional Cleveland Aircraft Products 6.00 x 6 wheel with a 6.00 x 6 six-ply rating, type III tire and tube.(Refer to paragraph 8.23.)

Wheels are removed by taking off the hub cap, cotter pin, axle nut, and the two bolts holding the brake segment in place. Mark tire and wheel for reinstallation; then dismount by deflating the tire, removing the three through-bolts from the wheel and separating the wheel halves.

Landing gear oleos should be serviced according to the instructions on the units. The main oleos should be extended under normal static load until 4.5 + .5 inches of oleo piston tube is exposed, and the nose gear should show 3.25 + .25 inches. To add air to the oleo struts, attach a strut pump to the valve assembly near the top of the oleo strut housing and pump the oleo to the desired position. To add oil, jack the aircraft, release the air pressure in the strut, remove the valve core and add oil through this opening with the strut extended. After the strut is full, compress it slowly and fully to allow excess air and oil to escape. With the strut still compressed reinsert the valve core and pump up the strut as above.

In jacking the aircraft for landing gear or other service, two hydraulic jacks and a tail stand should be used. At least 250 pounds of ballast should be placed on the base of the tail stand before the airplane is jacked up. The hydraulic jacks should be placed under the jack points on the bottom of the wing, and the airplane jacked up until the tail skid is at the right height to attach the tail stand. After the tail stand is attached and the ballast is added, jacking may be continued until the airplane is at the height desired.

The steering arms from the rudder pedals to the nose wheel are adjusted at the rudder pedals or at the nose wheel by turning the threaded rod end bearings in or out. Adjustment is normally accomplished at the forward end of the rods and should be done in such a way that the nose wheel is in line with the fore and aft axis of the plane when the rudder pedals and rudder are centered. Alignment of the nose wheel can be checked by pushing the airplane back and forth with the rudder centered to determine that the plane follows a perfectly straight line. The turning arc of the nose wheel is 22.5° + 2° in either direction and is limited by stops at the rudder pedals.

8.17 PROPELLER SERVICE

The spinner and backing plate should be cleaned and inspected for cracks frequently. Before each flight the propeller should be inspected for nicks, scratches, and corrosion. If found, they should be repaired as soon as possible by a rated mechanic, since a nick or scratch causes an area of increased stress which can lead to serious cracks or the loss of a propeller tip. The back face of the blades should be painted when necessary with flat black paint to retard glare. To prevent corrosion, the surface should be cleaned and waxed periodically.

8.19 OIL REQUIREMENTS

The oil capacity of the Lycoming IO-540 series engine is 12 quarts, and the minimum safe quantity is 2-3/4 quarts. It is recommended that the oil be changed, and the oil filter replaced, every 50 hours or sooner under unfavorable operating conditions. The following grades are recommended for the specified temperatures:

Average Ambient Air Temperature For Starting	Single Viscosity Grade	Multi-Viscosity Grades
Above 60° F	SAE 50	SAE 40 or SAE 50
30° to 90° F	SAE 40	SAE 40
0° to 70° F	SAE 30	SAE 40 or 20W-30
Below 10° F	SAE 20	SAE 20W-30

8.21 FUEL SYSTEM

(a) Servicing Fuel System

At every 50 hour inspection, the fuel screens in the strainer and in the injector must be cleaned. The screen in the injector is located in the housing where the fuel line connects to the injector. The fuel strainer is located under the floor panel and is accessible for cleaning through an access plate on the underside of the fuselage. After cleaning, a small amount of grease applied to the gasket will facilitate reassembly.

(b) Fuel Requirements (AVGAS ONLY)

The minimum aviation grade fuel for the PA-32-301 is 100. Since the use of the lower grades can cause serious engine damage in a short period of time, the engine warranty is invalidated by the use of lower octanes

Whenever 100 or 100LL grade fuel is not available, commercial grade 100/130 should be used. (See Fuel Grade Comparison Chart.) Refer to the latest issue of Lycoming Service Instruction No. 1070 for additional information.

A summary of the current grades as well as the previous fuel designations is shown in the following chart:

FUEL GRADE COMPARISON CHART

Previous Commercial Fuel Grades (ASTM-D910)			Current Commercial Fuel Grades (ASTM-D910-75)			Current Military Fuel Grades (MIL-G-5572E) Amendment No. 3		
Grade	Color	Max. TEL ml U.S. gal.	Grade	Color	Max. TEL ml/U.S. gal.	Grade	Color	Max. TEL ml/U.S. gal.
80/87	red	0.5	80	red	0.5	80/87	red	0.5
91/98	blue	2.0	*100LL	blue	2.0	none	none	none
100/130	green	3.0	100	green	**3.0	100/130	green	**3.0
115/145	purple	4.6	none	none	none	115/145	purple	4.6

* - Grade 100LL fuel in some overseas countries is currently colored green and designated as "100L."

**- Commercial fuel grade 100 and grade 100/130 (both of which are colored green) having TEL content of up to 4 ml/U.S. gallon are approved for use in all engines certificated for use with grade 100/130 fuel.

The operation of the aircraft is approved with an anti-icing additive in the fuel. When an anti-icing additive is used it must meet the specification MIL-I-27686, must be uniformly blended with the fuel while refueling, must not exceed .15% by volume of the refueled quantity, and to ensure its effectiveness should be blended at not less than .10% by volume. One and one half liquid ozs. per ten gallon of fuel would fall within this range. A blender supplied by the additive manufacturer should be used. Except for the information contained in this section, the manufacturer's mixing or blending instructions should be carefully followed.

CAUTION

Assure that the additive is directed into the flowing fuel stream. The additive flow should start after and stop before the fuel flow. Do not permit the concentrated additive to come in contact with the aircraft painted surfaces or the interior surfaces of the fuel tanks.

Some fuels have anti-icing additives preblended in the fuel at the refinery, so no further blending should be performed.

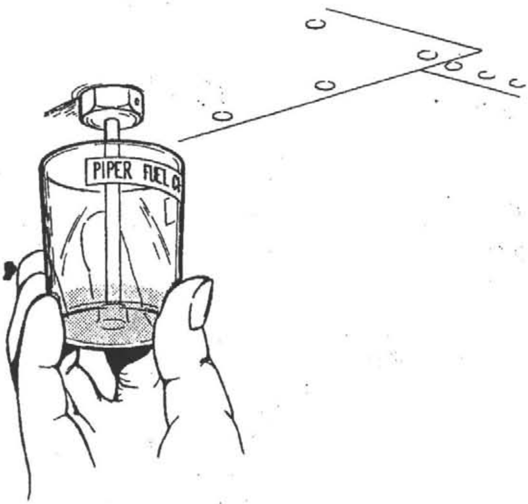
Fuel additive can not be used as a substitute for preflight draining of the fuel system drains.

(c) Filling Fuel Tanks

Observe all safety precautions required when handling gasoline. Fill the fuel tanks through the filler located on the forward slope of the wing. Each wing holds a maximum of 53.5 U.S. gallons. When using less than the standard 107 gallon capacity, fuel should be distributed equally between each side.

(d) Draining Fuel Strainer, Sumps and Lines

The fuel tank sumps and strainer should be drained before the first flight of the day and after refueling to avoid the accumulation of water and sediment, and to check for proper fuel. Each fuel tank has an individual quick drain at the lower inboard corner. A fuel strainer with a fuel system quick drain is located at the lowest point in the system. Each tank sump should be drained through its individual quick drain until sufficient fuel has flowed to ensure the removal of any contaminants. The fuel strainer sump quick drain, operated by a lever inside the cabin on the right forward edge of the wing spar housing, should be opened while the fuel selector valve is moved through the two tank positions. Enough fuel should flow at each position to allow the fuel lines and the strainer to ensure removal of contaminants. A container is provided for the checking for proper fuel and for fuel clarity. (See Description - Airplane and Systems Section for more detailed instructions.)



FUEL TANK DRAIN
Figure 8-3

CAUTION

When draining fuel, be sure that no fire hazard exists before starting engine.

After using the fuel system quick drains, check from outside the airplane to be sure that it has closed completely and it is not leaking.

(e) Draining Fuel System

The bulk of the fuel may be drained by opening the individual drain on each tank. The remaining fuel may be drained through the fuel strainer.

CAUTION

Whenever the fuel system is completely drained and fuel is replenished it will be necessary to run the engine for a minimum of three minutes at 1000 RPM on each tank to insure that no air exists in the fuel supply lines.

8.23 TIRE INFLATION

For maximum service from the tires, keep them inflated to the proper pressures (35 psi for the nose gear and 50/55 psi for the main gear). All wheels and tires are balanced before original installation, and the relationship of tire, tube, and wheel should be maintained upon reinstallation. Unbalanced wheels can cause extreme vibration in the landing gear; therefore, in the installation of new components, it may be necessary to rebalance the wheels with the tires mounted. When checking tire pressure, examine the tires for wear, cuts, bruises, and slippage.

8.25 BATTERY SERVICE

Access to the 12-volt battery is through a removable panel in the floor of the forward baggage compartment. The battery box has a plastic tube which is normally closed off with a cap and which should be opened occasionally to drain off any accumulation of liquid. The battery should be checked for proper fluid level. DO NOT fill the battery above the baffle plates. DO NOT fill the battery with acid - use water only. A hydrometer check will determine the percent of charge in the battery.

If the battery is not up to charge, recharge starting at a 4 amp rate and finishing with a 2 amp rate. Quick charges are not recommended.

8.27 CLEANING

(a) Cleaning Engine Compartment

Before cleaning the engine compartment, place a strip of tape on the magneto vents to prevent any solvent from entering these units.

(1) Place a large pan under the engine to catch waste.
(2) With the engine cowling removed, spray or brush the engine with solvent or a mixture of solvent and degreaser. In order to remove especially heavy dirt and grease deposits, it may be necessary to brush areas that were sprayed.

CAUTION

Do not spray solvent into the alternator, vacuum pump, starter, or air intakes.

(3) Allow the solvent to remain on the engine from five to ten minutes. Then rinse the engine clean with additional solvent and allow it to dry.

CAUTION

Do not operate the engine until excess solvent has evaporated or otherwise been removed.

(4) Remove the protective tape from the magnetos.
(5) Lubricate the controls, bearing surfaces, etc., in accordance with the Lubrication Chart in the applicable Service Manual.

(b) Cleaning Landing Gear

Before cleaning the landing gear, place a plastic cover or similar material over the wheel and brake assembly.

(1) Place a pan under the gear to catch waste.
(2) Spray or brush the gear area with solvent or a mixture of solvent and degreaser, as desired. Where heavy grease and dirt deposits have collected, it may be necessary to brush areas that were sprayed, in order to clean them.
(3) Allow the solvent to remain on the gear from five to ten minutes. Then rinse the gear with additional solvent and allow to dry.
(4) Remove the cover from the wheel and remove the catch pan.
(5) Lubricate the gear in accordance with the Lubrication Chart.

(c) Cleaning Exterior Surfaces

The airplane should be washed with a mild soap and water. Harsh abrasives or alkaline soaps or detergents could make scratches on painted or plastic surfaces or could cause corrosion of metal. Cover areas where cleaning solutions could cause damage. To wash the airplane, use the following procedures:

(1) Flush away loose dirt with water.
(2) Apply cleaning solution with a soft cloth, a sponge or a soft bristle brush.
(3) To remove exhaust stains, allow the solution to remain on on the surface longer.
(4) To remove stubborn oil and grease, use a cloth dampened with naphtha.
(5) Rinse all surfaces thoroughly.
(6) Any good automative wax may be used to preserve painted surfaces. Soft cleaning cloths or a chamois should be used to prevent scratches when cleaning or polishing. A heavier coating of wax on the leading surfaces will reduce the abrasion problems in these areas.

(d) Cleaning Windshield and Windows

(1) Remove dirt, mud and other loose particles from exterior surfaces with clean water.

(2) Wash with mild soap and warm water or with aircraft plastic cleaner. Use a soft cloth or sponge in a straight back and forth motion. Do not rub harshly.
(3) Remove oil and grease with a cloth moistened with kerosene.

CAUTION

Do not use gasoline, alcohol, benzene, carbon tetrachloride, thinner, acetone, or window cleaning sprays.

(4) After cleaning plastic surfaces, apply a thin coat of hard polishing wax. Rub lightly with a soft cloth. Do not use a circular motion.
(5) A severe scratch or mar in plastic can be removed by rubbing out the scratch with jeweler's rouge. Smooth both sides and apply wax.

(e) Cleaning Headliner, Side Panels and Seats

(1) Clean headliner, side panels, and seats with a stiff bristle brush, and vacuum where necessary.
(2) Soiled upholstery, except leather, may be cleaned with a good upholstery cleaner suitable for the material. Avoid soaking or harsh rubbing.

CAUTION

Solvent cleaners require adequate ventilation.

(3) Leather should be cleaned with saddle soap or a mild hand soap and water.

(f) Cleaning Carpets

To clean carpets, first remove loose dirt with a whisk broom or vacuum. For soiled spots and stubborn stains use a noninflammable dry cleaning fluid. Floor carpets may be cleaned like any household carpet.

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SUPPLEMENTS

SECTION 9

SUPPLEMENTS

9.1 GENERAL

This section provides information in the form of Supplements which are necessary for efficient operation of the airplane when equipped with one or more of the various optional systems and equipment not provided with the standard airplane.

All of the Supplements provided by this section are "FAA Approved" and consecutively numbered as a permanent part of this Handbook. The information contained in each Supplement applies only when the related equipment is installed in the airplane.

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SUPPLEMENT 1

AIR CONDITIONING INSTALLATION

SECTION 1 - GENERAL

This supplement supplies information necessary for the efficient operation of the airplane when the optional air conditioning system is installed. The information contained within this supplement is to be used in conjunction with the complete handbook.

This supplement has been "FAA Approved" as a permanent part of this handbook and must remain in this handbook at all times when the optional air conditioning system is installed.

SECTION 2 - LIMITATIONS

(a) To insure maximum climb performance the air conditioner must be turned OFF manually prior to takeoff to disengage the compressor and retract the condenser door. Also the air conditioner must be turned OFF manually before the landing approach in preparation for a possible go-around.

(b) Placards
In full view of the pilot, in the area of the air conditioner controls when the air conditioner is installed:

"WARNING - AIR CONDITIONER MUST
BE OFF TO INSURE NORMAL TAKEOFF
CLIMB PERFORMANCE."

In full view of the pilot, to the right of the engine gauges (condenser door light):

"AIR COND DOOR
OPEN"

SECTION 3 - EMERGENCY PROCEDURES

No changes to the basic Emergency Procedures provided by Section 3 of this Pilot's Operating Handbook are necessary for this supplement.

SECTION 4 - NORMAL PROCEDURES

Prior to takeoff, the air conditioner should be checked for proper operation as follows:

(a) Check aircraft master switch ON.

(b) Turn the air conditioner control switch to ON and the fan switch to one of the operating positions - the "AIR COND DOOR OPEN" warning light will turn on, thereby indicating proper air conditioner condenser door actuation.

(c) Turn the air conditioner control switch to OFF - the "AIR COND DOOR OPEN" warning light will go out, thereby indicating the air conditioner condenser door is in the up position.

(d) If the "AIR COND DOOR OPEN" light does not respond as specified above, an air conditioner system or indicator bulb malfunction is indicated and further investigation should be conducted prior to flight.

The above operational check may be performed during flight if an in-flight failure is suspected.

The condenser door light is located to the right of the engine instrument cluster in front of the pilot. The door light illuminates when the door is open and is off when the door is closed.

SECTION 5 - PERFORMANCE

Operation of the air conditioner will cause slight decreases in cruise speed and range. Power from the engine is required to run the compressor, and the condenser door, when extended, causes a slight increase in drag. When the air conditioner is turned off there is normally no measurable difference in climb, cruise or range performance of the airplane.

NOTE

To insure maximum climb performance the air conditioner must be turned off manually before takeoff to disengage the compressor and retract the condenser door. Also the air conditioner must be turned off manually before the landing approach in preparation for a possible go-around.

Although the cruise speed and range are only slightly affected by the air conditioner operation, these changes should be considered in preflight planning. To be conservative, the following figures assume that the compressor is operating continuously while the airplane is airborne. This will be the case only in extremely hot weather.

(a) The decrease in true airspeed is approximately 5 KTS at all power settings.
(b) The decrease in range may be as much as 30 nautical miles for the 102 gallon capacity.

The climb performance is not compromised measurably with the air conditioner operating since the compressor is declutched and the condenser door is retracted, both automatically, when full throttle position is selected. When full throttle position is not used or in the event of a malfunction which would cause the compressor to operate and the condenser door to be extended, a decrease in rate of climb of as much as 100 fpm can be expected. Should a malfunction occur which prevents condenser door retraction when the compressor is turned off, a decrease in rate of climb of as much as 50 fpm can be expected.

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SUPPLEMENT 2

PIPER ELECTRIC PITCH TRIM

SECTION 1 - GENERAL

This supplement supplies information necessary for the operation of the airplane when the optional Piper Electric Pitch Trim is installed. The information contained within this supplement is to be used in conjunction with the complete handbook.

This supplement has been "FAA Approved" as a permanent part of this handbook and must remain in this handbook at all times when the optional Piper Electric Pitch Trim is installed.

SECTION 2 - LIMITATIONS

No changes of the basic limitations provided by Section 2 of this Pilot's Operating Handbook are necessary for this supplement.

SECTION 3 - EMERGENCY PROCEDURES

(a) In case of malfunction, activate disconnect switch located above the ignition switch to OFF position.
(b) In case of malfunction, overpower the electric trim at either control wheel.
(c) Maximum altitude change with a 4-second delay in recovery initiation is 350 feet and occurs in the cruise configuration. Maximum altitude change in the approach configuration with a 2 second recovery delay is 150 feet.

SECTION 4 - NORMAL PROCEDURES

The electric trim system may be turned ON or OFF by a switch located above the ignition switch. The pitch trim may be changed when the electric trim system is turned on either by moving the manual pitch trim control wheel or by operating the trim control switch on the pilot's control yoke. To prevent excessive speed increase in the event of an electric trim run-away malfunction, the system incorporates an automatic disconnect feature which renders the system inoperative above approximately 169 KIAS. The disconnected condition does not affect the manual trim system.

SECTION 5 - PERFORMANCE

No changes to the basic performance provided by Section 5 of this Pilot's Operating Handbook are necessary for this supplement.

SUPPLEMENT 3

KNS 80 NAVIGATION SYSTEM

SECTION 1 - GENERAL

This supplement supplies information necessary for the operation of the airplane when the optional KNS 80 Navigation System is installed. The information contained within this supplement is to be used in conjunction with the complete handbook.

This supplement has been "FAA Approved" as a permanent part of this handbook and must remain in this handbook at all times when the optional KNS 80 Navigation System is installed.

SECTION 2 - LIMITATIONS

No changes to the basic limitations provided by Section 2 of this Pilot's Operating Handbook are necessary for this supplement.

SECTION 3 - EMERGENCY PROCEDURES

No changes to basic Emergency Procedures provided by Section 3 of this Pilot's Operating Handbook are necessary for this supplement.

SECTION 4 - NORMAL PROCEDURES

(a) KNS 80 OPERATION

The KNS 80 can be operated in any one of 3 basic modes: (a) VOR, (b) RNAV, or (c) ILS. To change from one mode to another, the appropriate pushbutton switch is pressed, except that the ILS mode is entered automatically whenever an ILS frequency is channeled in the USE waypoint. The display will annunciate the mode by lighting a message above the pushbutton. In addition to the standard VOR and RNAV enroute (RNV ENR) modes, the KNS 80 has a constant course width or parallel VOR mode (VOR PAR) and an RNAV approach mode (RNV APR). To place the unit in either of these secondary modes the VOR pushbutton or the RNAV pushbutton, as the case may be, is pushed a second time. Repetitive pushing of the VOR button will cause the system to alternate between the VOR and VOR PAR modes, while repetitive pushing of the RNAV button causes the system to alternate between RNV ENR and RNV APR modes.

(b) CONTROLS

(1) VOR BUTTON

Momentary pushbutton.

When pushed while system is in either RNV mode causes system to go to VOR mode. Otherwise the button causes system to toggle between VOR and VOR PAR modes.

(2) RNAV BUTTON

Momentary pushbutton.

When pushed while system is in either VOR mode causes system to go to RNV ENR mode. Otherwise the button causes system to toggle between RNV ENR and RNV APR modes.

(3) HOLD BUTTON

Two position pushbutton.

When in depressed position, inhibits DME from channeling to a new station when the VOR frequency is changed. Pushing the button again releases the button and channels the DME to the station paired with the VOR station.

(4) USE BUTTON

Momentary pushbutton.

Causes active waypoint to take on same value as displayed waypoint and data display to go to FRQ mode.

(5) DSP BUTTON
Momentary pushbutton.
Causes displayed waypoint to increment by 1 and data display to go to frequency mode.

(6) DATA BUTTON
Momentary pushbutton.
Causes waypoint data display to change from FRQ to RAD to DST and back to FRQ.

(7) OFF/PULL ID CONTROL
   a. Rotate counterclockwise to switch off power to the KNS 80.
   b. Rotate clockwise to increase audio level.
   c. Pull switch out to hear VOR Ident.

(8) DATA INPUT CONTROL
Dual concentric knobs. Center knob has "in" and "out" positions.
   a. Frequency Data
      Outer knob varies 1 MHz digit.
      A carryover occurs from the units to tens place.
      Rollover occurs from 117 to 108.
      Center knob varies frequency in .05 MHz steps regardless of whether the switch is in its in or out position.

   b. Radial Data
      Outer knob varies 10 degree digit.
      A carryover occurs from tens to hundreds position. A rollover to zero occurs at 360 degrees.
      Center knob "in" position varies 1 degree digit.
      Center knob "out" position varies 0.1 degree digit.

   c. Distance Data
      Outer knob varies 10 NM digit.
      A carryover occurs from the tens to hundreds place.
      A rollover to zero occurs at 200 NM.
      Center knob "in" position varies 1 NM digit.
      Center knob "out" position varies 0.1 NM digit.

(9) COURSE SELECT KNOB
Located in CDI unit.
Selects desired course through the VOR ground station or way point.

SECTION 5 - PERFORMANCE

No changes to the basic performance provided by Section 5 of this Pilot's Operating Handbook are necessary for this supplement.

SUPPLEMENT 4

ANS 351 AREA NAVIGATION COMPUTER

SECTION 1 - GENERAL

This supplement supplies information necessary for the operation of the airplane when the optional ANS 351 Area Navigation Computer is installed. The information contained within this supplement is to be used in con-junction with the complete handbook.

This supplement has been "FAA Approved" as a permanent part of this handbook and must remain in this handbook at all times when the optional ANS 351 Area Navigation Computer is installed.

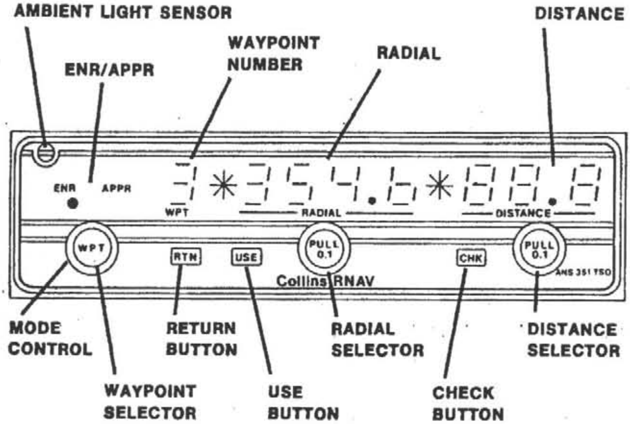
SECTION 2 - LIMITATIONS

No changes to the basic limitations provided by Section 2 of this Pilot's Operating Handbook are necessary for this supplement.

SECTION 3 - EMERGENCY PROCEDURES

No changes to basic Emergency Procedures provided by Section 3 of this Pilot's Operating Handbook are necessary for this supplement.

SECTION 4 - NORMAL PROCEDURES



ANS 351 AREA NAVIGATION COMPUTER,
CONTROLS AND INDICATORS

(a) CONTROLS

CONTROL OR INDICATOR	FUNCTION
Mode Control	Selects ENR (enroute) or APPR (approach) modes of operation. In the enroute mode, CDI deviation is 1 mile/dot, 5 miles full scale. In approach, CDI deflection is 1/4 mile/dot, 1-1/4 miles full scale.
Waypoint Selector	Sequences display waypoints from 1 through 8. Winking waypoint number indicates inactive waypoints; steadily-on-waypoint number indicates active waypoint.
Return Button	Depressing RTN (return) button returns the display to the active waypoint when an inactive waypoint is currently being displayed.

CONTROL OR INDICATOR	FUNCTION
Use Button	Depressing the USE button converts the waypoint being displayed into the active waypoint.
Radial Selector	Two concentric knobs set radial information into the display. Knobs control information as follows: Large knob: Changes display in 10-degree increments. Small knob pushed in: Changes display 1-degree increments. Small knob pulled out: Changes display in 0.1-degree increments.
Distance Selector	Two concentric knobs set distance information in nautical miles into the display. Knobs control information as follows: Large knob: Changes display in 10-mile increments. Small knob pushed in: Changes display 1-mile increments. Small knob pulled out: Changes display in 0.1-mile divisions from 00.0 through 100 miles. Beyond 100 nmi, changes display in 1-mile increments.
Check Button	Depressing CHK (check) button causes DME and bearing indicators to display raw distance and bearing information. RNAV computation, CDI deviation, to/from display, and autopilot tracking of RNAV path remain unaffected. The check button is spring-loaded to prevent permanent actuation.
Ambient Light Sensor	Automatically adjusts display lighting intensity as a function of cockpit ambient light.

(b) AREA NAVIGATION WAYPOINT PROGRAMMING

(1) Presentation Of Waypoint On Ground

Waypoints are entered after engine start, since the waypoint information will probably be lost during the low-voltage condition occurring during engine cranking. Waypoint data should always be written in flight planning form to facilitate checking later in flight. When power is first applied to the ANS 351 and the system is in the RNAV mode, waypoint number 1 will be active, (waypoint number not blinking) and waypoint bearing and distance preset to zero will appear.

a. Waypoint number 1 coordinates are set into the ANS 351 using concentric knobs under bearing and distance display fields.
b. The waypoint selection knob is then rotated to select waypoint number 2. Note that the waypoint number is blinking, indicating that the waypoint is at this point inactive. Waypoint number 2 bearing and distance definitions are then set into the ANS 351.
c. Set up the rest of the desired waypoints as described above.
d. Press the RTN (return) pushbutton to display the active waypoint.

(2) Changing Waypoints In Flight

To change a waypoint in flight, rotate the waypoint selector until the desired waypoint number and coordinates are displayed on the ANS 351.

a. Verify that the waypoint definition is correct by comparing the display with the flight plan.
b. Uncouple the autopilot if tracking RNAV deviation.
c. Select the desired reference facility frequency on the associated NAV receiver.
d. Depress the USE pushbutton and note that the waypoint identification number stops winking.
e. Select the desired course on OBS.
f. Recouple the autopilot after deviation and distance-to-waypoint indications have stabilized.

SECTION 5 - PERFORMANCE

No changes to the basic performance provided by Section 5 of this Pilot's Operating Handbook are necessary for this supplement.

SUPPLEMENT 5

RCA WEATHERSCOUT WEATHER RADAR SYSTEM

SECTION 1 - GENERAL

This supplement supplies information necessary for the operation of the airplane when the optional RCA WeatherScout Weather Radar System is installed. The information contained within this supplement is to be used in conjunction with the complete handbook.

This supplement has been "FAA Approved" as a permanent part of this handbook and must remain in this handbook at all times when the optional RCA WeatherScout Weather Radar System is installed.

SECTION 2 - LIMITATIONS

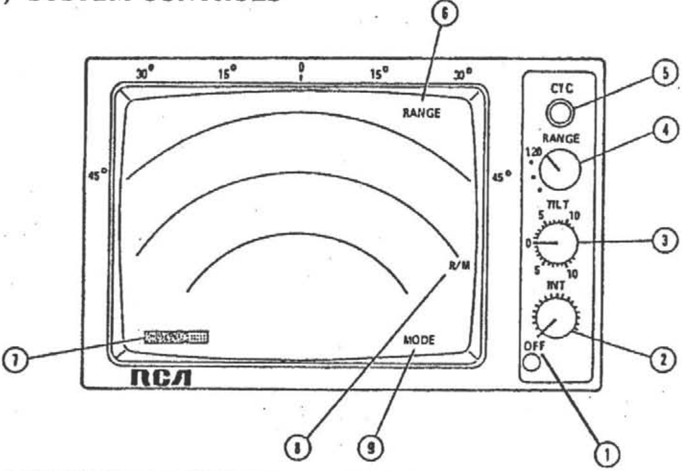
No changes to the basic limitations provided by Section 2 of this Pilot's Operating Handbook are necessary for this supplement.

SECTION 3 - EMERGENCY PROCEDURES

No changes to basic Emergency Procedures by Section 3 of this Pilot's Operating Handbook are necessary for this supplement.

SECTION 4 - NORMAL PROCEDURES

(a) SYSTEM CONTROLS



INDICATOR CONTROLS AND DISPLAY FEATURES

(1)	OFF	On/Off function: full CCW rotation of INTensity control places system in OFF condition.
(2)	INT	Rotary control used to regulate brightness (INTensity) of display.
(3)	TILT	Rotary control used to adjust antenna elevation position. Control indexes increments of tilt from 0 to 12 degrees up or down.
(4)	RANGE 12/30/60/90 or 12/30/60/120	Rotary switch used to select one of four ranges.

(5)	CYC	Pushbutton switch used to select cyclical contour mode. Data is presented alternately as normal for 0.5 seconds, then contoured for 0.5 seconds. Pressing switch a second time restores normal or WX mode.
(6)	Range Field	Maximum selected range is displayed. Maximum range is always displayed when indicator is in on-condition.
(7)	Test Field	Test block displays three illumination levels.
(8)	Range Mark Identifier	Individual label displayed for each range mark.
(9)	Mode Field	Operating mode is displayed as WX or CYC. When system is first turned on, WAIT is displayed until system times out (30-40 seconds).

(b) PRELIMINARY CONTROL SETTINGS
Place the Indicator controls in the following positions before applying power from the aircraft electrical system:

INTensity control .... Fully counterclockwise, in OFF
TILT control .... Fully upward
RANGE switch .... 12 nautical miles

(c) OPERATIONAL CONTROL SETTINGS
(1) Rotate INTensity control clockwise to bring system into ON condition.
(2) Note that WAIT is displayed during warm-up period of 30-40 seconds.
(3) When WX is displayed, rotate INTensity control clockwise until display brightness is at desired level.
(4) Set RANGE switch to desired range.
(5) Adjust TILT control for desired forward scan area.

(d) PRECAUTIONS

If the radar is to be operated while the aircraft is on the ground:

(1) Direct nose of aircraft such that antenna scan sector is free of large metallic objects (hangars, other aircraft) for a distance of 100 yards (90 meters), and tilt antenna fully upward.

WARNING

Do not operate the radar during refueling operations or in the vicinity of trucks or containers accommodating flammables or explosives; do not allow personnel within 15 feet of area being scanned by antenna when system is transmitting.

SECTION 5 - PERFORMANCE

No changes to the basic performance provided by Section 5 of the Pilot's Operating Handbook are necessary for this supplement.

SUPPLEMENT 6

AUTOFLITE II AUTOPILOT INSTALLATION

SECTION 1 - GENERAL

This supplement must be used in conjunction with the FAA Approved Airplane Flight Manual, dated 1-9-80, when Piper AutoFlite II Autopilot, Model AK304 is installed in accordance with STC SA3167SW-D. The information contained herein supplements the information of the basic Airplane Flight Manual; for limitations, procedures and performance information not contained in this supplement, consult the basic Airplane Flight Manual.

This supplement has been "FAA Approved" as a permanent part of this handbook and must remain in this handbook at all times when the optional AutoFlite II Autopilot is installed.

SECTION 2 - LIMITATIONS

(a) Autopilot operation prohibited above 175 KIAS.
(b) Autopilot must be OFF for takeoff and landing.

SECTION 3 - EMERGENCY PROCEDURES

(a) In case of malfunction, depress interrupt switch on pilot's control wheel, or overpower autopilot at either control wheel.
(b) AutoFlite II master switch - OFF.
(c) In climb, cruise or descent configuration a malfunction with a 3 second delay in recovery initiation may result in a 58° bank and a 300 foot altitude loss.
(d) In approach configuration, coupled or uncoupled; a malfunction with a 1 second delay in recovery initiation may result in a 15° bank and a 60 foot altitude loss.

SECTION 4 - NORMAL PROCEDURES

PREFLIGHT INSPECTION

(a) AutoFlite II master switch - ON.
(b) Rotate turn command knob to left and right. Aircraft control wheels should rotate in corresponding directions.
(c) With AutoFlite II on, rotate aircraft control wheel to left and right. Only light forces should be required to override roll servo clutch.
(d) AutoFlite II master switch - OFF - rotate control wheel left and right to assure disengagement.

IN-FLIGHT PROCEDURE

(a) Engagement
    (1) Check turn command knob in center detent position.
    (2) AutoFlite II master switch - ON.

(b) Disengagement
    (1) AutoFlite II master switch - OFF.

(c) Heading Changes
    (1) Move trim knob on instrument for drift correction from a constant heading.
    (2) Move turn command knob for left or right banked turns. Rotation of knob to stop will yield an appropriate bank angle to obtain an approximate standard rate turn. Intermediate settings may be used for lesser turn rates.

(d) OMNI Tracker
    (1) Turn command knob - move to center detent position and push IN to engage tracker. Aircraft will track desired radial established on NAV 1 (or as selected, if equipped with a NAV selector switch).

NOTE

Tracker must be engaged within 10° of being "on course," i.e. VOR course needle centered and aircraft heading within a 10° of VOR course.

(2) Trim knob - push IN for high sensitivity. Use high sensitivity position for localizer tracking and as desired for OMNI tracking.

(e) Maintain directional trim during all autopilot operations.

SECTION 5 - PERFORMANCE

No changes to the basic performance provided by Section 5 of this Pilot's Operating Handbook are necessary for this supplement.

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SUPPLEMENT 7

AUTOCONTROL IIIB AUTOPILOT INSTALLATION

SECTION 1 - GENERAL

This supplement must be used in conjunction with the FAA Approved Airplane Flight Manual, dated 1-9-80, when Piper AutoControl IIIB Autopilot, Model AK174 is installed in accordance with STC SA3173SW-D. The information contained herein supplements the information of the basic Airplane Flight Manual; for limitations, procedures and performance information not contained in this supplement, consult the basic Airplane Flight Manual.

This supplement has been FAA Approved as a permanent part of this handbook and must remain in this handbook at all times when the optional Piper AutoControl IIIB Autopilot is installed.

SECTION 2 - LIMITATIONS

(a) Autopilot operation prohibited above 175 KIAS (Autopilot V_{MO}).
(b) Autopilot OFF for takeoff landing.

SECTION 3 - EMERGENCY PROCEDURES

(a) In an emergency the autopilot can be disconnect by pushing the roll ON-OFF rocker switch - OFF.
(b) The autopilot can be overpowered at either control wheel.
(c) An autopilot runaway, with a 3 second delay in the initiation of recovery, while operating in climb, cruise or descending flight, could result in a 58° bank and a 300 foot altitude loss. Maximum altitude loss measured at 175 KIAS in a descent.
(d) An autopilot runaway, with a 1 second delay in the initiation of recovery, during an approach operation, coupled or uncoupled, could result in a 15° bank and a 60 foot altitude loss.

(e) Emergency operation with optional NSD 360A (HSI) - Slaved and/or Non-Slaved:

NSD 360A

(1) Appearance of HDG flag:
   a. Check air supply gauge (vac or pressure) for adequate air supply (4 in. Hg. min.)
   b. Check compass circuit breaker.
   c. Observe display for proper operation.

(2) To disable heading card - pull circuit breaker and use magnetic compass for directional data. (Factory installation may utilize NSD and electric trim circuit breaker.)

NOTE

If heading card is not operational, autopilot should not be used.

(3) With card disabled, VOR/Localizer and Glide Slope displays are still functional; use card set to rotate card to aircraft heading for correct picture.

(4) Slaving Failure - (i.e. failure to self-correct for gyro drift):
   a. Check that gyro slaving switch is set to No. 1 position (if equipped with Slave No. 1 - No. 2 switch) or "Slaved" position when equipped with Slaved and Free Gyro Mode Switch.
   b. Check for HDG flag.
   c. Check compass circuit breaker.
   d. Reset heading card while observing slaving meter.

NOTE

Dead slaving meter needle or a needle displaced fully one direction indicates a slaving system failure.

   e. Select slaving amplifier No. 2, if equipped. If not equipped, proceed with item g below.
   f. Reset heading card while checking slaving meter. If proper slaving indication is not obtained.
   g. Switch to free gyro mode and periodically set card as unslaved gyro.

NOTE

In the localizer mode, the TO-FROM arrows may remain out of view, depending upon the design of the NAV converter used in the installation.

SECTION 4 - NORMAL PROCEDURES

PREFLIGHT INSPECTION

(a) AUTOPILOT
   (1) Place Radio Coupler (if installed) in HDG mode and place the AP ON-OFF switch to the ON position to engage roll section. Rotate roll command knob left and right and observe that control wheel describes a corresponding left and right turn, then center knob.
   (2) Set proper D.G. heading on D.G. and turn HDG bug to aircraft heading. Engage HDG mode rocker switch and rotate HDG bug right and left. Aircraft control wheel should turn same direction as bug. Grasp control wheel and manually override servo, both directions.

(b) RADIO COUPLER - (OPTIONAL)
   (1) Tune and identify VOR or VOT station. Position Radio Coupler to OMNI mode. Engage autopilot ON and HDG switches. Set HDG bug to aircraft heading and rotate O.B.S. to cause OMNI indicator needle to swing left and right slowly. Observe that control wheel rotates in direction of needle movement.
   (2) Disengage AP ON-OFF switch, Reset Radio Coupler control to HDG.

IN-FLIGHT

(a) Trim airplane (ball centered).

(b) Check air pressure/vacuum to ascertain that the directional gyro and attitude gyro are receiving sufficient air.

(c) Roll Section
   (1) To engage, center ROLL knob, push AP ON-OFF switch to ON position. To turn, rotate console ROLL knob in desired direction (Maximum angle of bank should not exceed 30°.)
   (2) For heading mode, set directional gyro with magnetic compass. Push directional gyro HDG knob in, rotate bug to aircraft heading. Push console heading rocker (HDG) switch to ON position. To select a new aircraft heading, push D.G. heading knob IN and rotate, in desired direction of turn, to the desired heading.

(d) Radio Coupling VOR-ILS with HSI Type Instrument Display - (Optional)
   (1) VOR Navigation
      a. Tune and identify VOR station. Select desired course with O.B.S. (HSI Course Knob).
      b. Select OMNI mode on radio coupler.
      c. Select HDG mode on autopilot console to engage coupler. Aircraft will turn to a 45° intercept angle to intercept the selected VOR course. Intercept angle magnitude depends on radio needle off course magnitutde, 100% needle deflection will result in 45° intercept with the intercept angle diminishing as the needle off set diminishes.
      d. NAV mode - NAV mode provides reduced VOR sensitivity for tracking weak, or noisy VOR signals. NAV mode should be selected after the aircraft is established on course.

   (2) ILS-LOC Front Course
      a. Set inbound, front, localizer course on O.B.S. (HSI Course Knob).
      b. Select LOC-Normal on radio coupler to intercept and track inbound on the localizer. Select LOC-REV to intercept and track outbound to the procedure turn area.
      c. Select HDG mode on autopilot console to engage coupler.

(3) ILS - Back Course
   a. Set inbound, front localizer course on O.B.S. (HSI Course Knob).
   b. Select LOC-REV on radio coupler to intercept and track inbound on the back localizer course. Select LOC-NORM to intercept outbound on the back course to the procedure turn area.
   c. Select HDG mode on autopilot console to engage coupler.

(e) Radio Coupling - VOR/ILS with standard directional gyro-(optional)
Radio Coupler operation in conjunction with a standard directional gyro and VOR/LOC display differs from operation with an integrated display (HSI) only in one respect. The HDG bug is used as the radio course datum and therefore must be set to match the desired VOR course as selected on the O.B.S.
   (1) For VOR Intercepts and Tracking:
   Select the desired VOR course and set the HDG bug to the same heading. Select OMNI mode on the coupler and HDG mode on the autopilot console.
   (2) For ILS Front Course Intercepts and Tracking:
   Tune the localizer frequency and place the HDG bug on the inbound, front course heading. Select LOC-NORM mode on the coupler and HDG mode on the autopilot console.
   (3) For LOC Back Course Intercepts and Tracking:
   Tune the localizer frequency and place the HDG bug on the inbound course heading to the airport. Select LOC-REV mode with coupler and HDG mode on the autopilot console.

SECTION 5 - PERFORMANCE

No changes to the basic performance provided by Section 5 of this Pilot's Operating Handbook are necessary for this supplement.

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SUPPLEMENT 8

ALTIMATIC IIIC AUTOPILOT INSTALLATION

SECTION 1 - GENERAL

This supplement must be used in conjunction with the FAA Approved Airplane Flight Manual, dated 1-9-80 when Edo-Aire Mitchell Piper AltiMatic IIIC Autopilot Model AK775 is installed in accordance with STC SA3305SW-D. The information contained herein supplements the information of the basic Airplane Flight Manual; for limitations, procedures and performance information not contained in this supplement, consult the basic Airplane Flight Manual.

This supplement has been "FAA Approved" as a permanent part of this handbook and must remain in this handbook at all times when the optional AltiMatic IIIC Autopilot is installed.

SECTION 2 - LIMITATIONS

(a) Autopilot operation prohibited above 175 KIAS. (Autopilot V_{MO})
(b) Autopilot OFF during takeoff and landing.
(c) A Placard stating "Conduct trim check prior to flight - (See AFM)" to be installed in clear view of the pilot.

SECTION 3 - EMERGENCY PROCEDURES

This aircraft is equipped with a Master Disconnect/Interrupt Switch on the pilot's control wheel. When the switch button is depressed it will disconnect the autopilot. When depressed and held it will interrupt all Electric Elevator Trim Operations. Trim operations will be restored when the switch is released. If an autopilot or trim emergency is encountered, do not attempt to determine which system is at fault. Immediately depress and hold the Master Disconnect/Interrupt button. Turn off autopilot and trim master switch and retrim aircraft, then release the interrupt switch.

NOTE

During examination of this supplement, the pilot is advised to locate and identify the autopilot controls, the trim master switch and circuit breakers for both systems.

(a) In the event of an autopilot malfunction the autopilot can be:
  (1) Overpowered at either control wheel.

CAUTION

Do not overpower autopilot pitch axis for periods longer than 3 seconds because the autotrim system will operate in a direction to oppose the pilot and will cause an increase in the pitch overpower forces.

  (2) Disconnected by depressing the Master Disconnect/Interrupt Switch.
  (3) Disconnected by depressing the Trim Switch "AP OFF" bar.
  (4) Disconnected by pushing the roll rocker switch "OFF."

(b) In the event of a trim malfunction:
  (1) Depress and hold the Master Trim Interrupt Switch.
  (2) Trim Master Switch - "OFF." Retrim aircraft as necessary using manual trim system.
  (3) Release Master Interrupt Switch - be alert for possible trim action.
  (4) Trim Circuit Breaker - Pull. Do not operate trim until problem is corrected.
  (5) If the trim system operates only in one direction, pull the circuit breaker and do not operate the trim system until corrective action is taken. Monitor autopilot operation closely when operating without trim follow-up.

(c) If a trim runaway occurs with the autopilot operating, the above procedures will disconnect the autopilot which will immediately result in higher control wheel forces. Be prepared to manually retrim, as necessary to eliminate undesirable forces.

(d) Altitude Loss During Malfunction:

(1) An autopilot malfunction during climb, cruise or descent with a 3 second delay in recovery initiation could result in as much as 58° of bank and a 400 foot altitude loss.

(2) An autopilot malfunction during an approach with a 1 second delay in recovery initiation could result in as much as 15° of bank and 60 foot altitude loss. Maximum altitude loss measured in approach configuration and operating either coupled or uncoupled.

(e) Emergency Operation With Optional NSD 360A (HSI) - Slaved and/or Non-Slaved:

NSD 360A

(1) Appearance of HDG Flag:
   a. Check air supply gauge (vac or pressure for adequate air supply (4 in. Hg. min.)
   b. Check compass circuit breaker.
   c. Observe display for proper operation.

(2) To disable heading card - pull circuit breaker and use magnetic compass for directional data.

NOTE

If heading card is not operational, autopilot should not be used.

(3) With card disabled, VOR/Localizer and Glide Slope displays are still functional; use card set to rotate card to aircraft heading for correct picture.

(4) Slaving Failure - (i.e. failure to self-correct for gyro drift):
   a. Check that gyro slaving switch is set to No. 1 position (if equipped with Slave No. 1 - No. 2 switch) or "Slaved" position when equipped with Slaved and Free Gyro Mode Switch.
   b. Check for HDG Flag.
   c. Check compass circuit breaker.
   d. Reset heading card while observing slaving meter.

NOTE

Dead slaving meter needle or a needle displaced fully one direction indicates a slaving system failure.

e. Select slaving amplifier No. 2, if equipped. If not equipped, proceed with item g below.
f. Reset heading card while checking slaving meter. If proper slaving indication is not obtained.
g. Switch to free gyro mode and periodically set card as unslaved gyro.

NOTE

In the localizer mode, the TO-FROM arrows may remain out of view, depending upon the design of the NAV converter used in the installation.

SECTION 4 - NORMAL PROCEDURES

PREFLIGHT INSPECTION

(a) Roll Section
 (1) Place Radio Coupler in "Heading" mode and place roll rocker switch "ON" to engage roll section. Rotate roll command knob left and right and observe that control wheel describes a corresponding left and right turn, then center knob.
 (2) Set proper D.G. Heading on D.G. and turn heading bug to aircraft heading. Engage "Heading" mode rocker switch and rotate heading bug right and left. Aircraft control wheel should turn same direction as bug. Grasp control wheel and manually override servo, both directions.
 (3) Disengage autopilot by depressing trim switch. Check that aileron operation is free and autopilot is disconnected from controls.

(b) Pitch Section
 (1) Engage "Roll" rocker switch.
 (2) Center pitch command disc and engage "Pitch" rocker switch.
 (3) Rotate pitch command disc UP and DOWN and check that control yoke moves same direction. Check to see that servo can be overriden by hand at control wheel.

NOTE

Autopilot might not be able to raise elevators, on ground, without assistance from pilot.

(4) Hold control yoke and disengage autopilot by pressing master autopilot disconnect/trim interrupt switch button. Check roll and pitch controls to assure autopilot has disconnected.

TRIM SYSTEM

General
This aircraft is equipped with a command trim system designed to withstand any type of single malfunction, either mechanical or electrical, without uncontrolled operation resulting. The preflight check procedure is designed to uncover hidden failures that might otherwise go undetected. Proper operation of the electric trim system is predicated on conducting the following preflight check before each flight. If the trim system fails any portion of the procedure, pull the trim circuit breaker out until trim system is repaired. Substitution of any trim system component for another model is not authorized. For emergency interrupt information, refer to Emergency Procedures section of this Supplement.

The command electric trim switch on the left hand portion of the pilot's control wheel has two functions:
(1) When the top bar (AP OFF) is pressed, it disconnects the autopilot.
(2) When the top bar is pressed AND the rocker is moved forward, nose down trim will occur, when moved aft, nose up trim will occur.

(a) Preflight: Command Trim - Before Each Flight
   (1) Check trim circuit breaker - IN.
   (2) Trim master switch - ON.
   (3) AP OFF - Check normal trim operation - UP. Grasp trim control and check override capability. Check nose down operation. Recheck override.
   (4) With trim operating - depress interrupt switch - trim should stop - release interrupt switch - trim should operate.
   (5) Activate center bar only - Push rocker fore and aft-only. Trim should not operate with either separate action.

(b) Autotrim - Before Each Flight
   (1) AP ON - (Roll and Pitch Sections) Check automatic operation by activating autopilot command UP then DN. Observe trim operation follows pitch command direction.

NOTE

In autopilot mode, there will be approximately a 3-second delay between operation of pitch command and operation of trim.

   (2) Press center bar (AP OFF) - release - check autopilot disengagement.
   (3) Rotate trim control to check manual trim operation. Reset to takeoff position prior to takeoff.

IN-FLIGHT PROCEDURE

(a) Trim airplane (ball centered).

(b) Check air pressure or vacuum to ascertain that the directional gyro and attitude gyro are receiving sufficient air.

(c) Roll Section
   (1) To engage - center ROLL knob, push ROLL rocker to ON position. To turn, rotate console ROLL knob in desired direction.
   (2) For heading mode, set directional gyro and magnetic compass. Push directional gyro HDG knob in, rotate to select desired heading. Push console heading rocker (HDG) to ON position. (Maximum angle to bank will be 20° with heading lock engaged.)

(d) Pitch Section (Roll section must be engaged prior to pitch section engagement).
   (1) Center pitch trim indicator with the pitch command disc.
   (2) Engage pitch rocker switch. To change attitude, rotate pitch command disc in the desired direction.

(e) Altitude Hold

Upon reaching desired or cruising altitude, engage altitude hold mode rocker switch. As long as altitude hold mode rocker is engaged, aircraft will maintain selected altitude. For maximum passenger comfort, rate of climb or descent should be reduced to approximately 500 FPM prior to altitude hold engagement. For accurate altitude holding below 90 KIAS lower flaps one or two notches.

(f) Radio Coupling VOR-ILS with H.S.I. type instrument display. (Optional)

(1) VOR Navigation

a. Tune and identify VOR Station. Select desired course with OBS (OMNI Bearing Selector).

b. Select OMNI mode on radio coupler.

c. Select HDG mode on autopilot console to engage coupler. Aircraft will turn to a 45° intercept angle to intercept the selected VOR course. Intercept angle magnitude depends on radio needle off - course magnitude, 100% needle deflection will result in 45° intercept angle, diminishing as the needle off-set diminishes.

d. NAV mode - NAV mode provides reduced VOR sensitivity for tracking weak, or noisy, VOR signals. NAV mode should be selected after the aircraft is established on course.

(2) ILS-LOC Front Course

a. Set inbound, front, localizer course on OBS.

b. Select LOC-Normal on radio coupler to intercept and track inbound on the localizer. Select LOC-REV to intercept and track the localizer course outbound to procedure turn area.

c. Select HDG mode on autopilot console to engage coupler.

(3) ILS-Back Course
  a. Set inbound, front, localizer course on OBS.
  b. Select LOC-REV, on radio coupler to intercept and track inbound on the back localizer course. Select LOC-NORM to intercept and track outbound on the back course to the procedure turn area.
  c. Engage HDG mode on autopilot console to engage coupler.

(g) Radio Coupling - VOL/ILS with standard directional gyro. (Optional)
Radio Coupler operation in conjunction with a standard directional gyro and VOR/LOC display differs from operation with an integrated display (H.S.I.) only in one respect. The HDG bug is used as the radio course datum and therefore must be set to match the desired VOR/ILS course as selected on the O.B.S.
  (1) For VOR Intercepts and Tracking:
  Select the desired VOR Course and set the HDG bug to the same heading. Select OMNI mode on the coupler and HDG mode on the autopilot console.
  (2) For ILS Front Course Intercepts and Tracking:
  Tune the localizer frequency and place the HDG bug on the inbound, front course heading. Select LOC-NORM mode on the coupler and HDG mode on the autopilot console.
  (3) For LOC Back Course Intercepts and Tracking:
  Tune the localizer frequency and place the HDG bug on the inbound course heading to the airport. Select LOC-REV mode with coupler and HDG mode on the autopilot console.

(h) Coupled Approach Operations
  (1) VOR or LOC
    a. After arrival at the VOR Station, track outbound to the procedure turn area as described in Section 4 (f) or (g) as appropriate, and slow to 90 - 95 KIAS while inbound to FAF and lower flaps as desired.
    b. Use HDG mode and Pitch or altitude hold modes as appropriate during procedure turn.

c. At the F.A.F. inbound, return to pitch mode for control of descent and reduce power.
d. At the M.D.A. select altitude hold mode and add power for level flight. Monitor altimeter to assure accurate altitude control is being provided by the autopilot.
e. Go-Around - For missed approach select desired pitch attitude with pitch command disc and disengage altitude hold mode. This will initiate the pitch up attitude change. Immediately add takeoff power and monitor altimeter and rate of climb for positive climb indication. After climb is established, retract flaps. Adjust attitude as necessary for desired airspeed and select HDG mode for turn from the VOR final approach course.

(2) ILS - Front Course Approach With Glide Slope Capture. (Optional)
a. Track inbound to LOM as described in Section 4 (f) or (g) above and in altitude hold mode.
b. Inbound to LOM slow to 90 - 95 KIAS and lower flaps as desired.
c. Automatic glide slope capture will occur at glide slope intercept if the following conditions are met:
   1. Coupler in LOC-Normal mode.
   2. Altitude hold mode engaged (altitude rocker on console).
   3. Under glide slope for more than 20 seconds.
   4. Localizer radio frequency selected on NAV receiver.
d. At glide slope intercept immediately reduce power to maintain approximately 90-95 KIAS on final approach. Glide slope capture is indicated by lighting of the green glide slope engage annunciator lamp and by a slight pitch down of the aircraft.
e. Monitor localizer and glide slope raw data throughout approach. Adjust power as necessary to maintain correct final approach airspeed. All power changes should be of small magnitude and smoothly applied for best tracking performance. Do not change aircraft configuration during approach while autopilot is engaged.

f. Conduct missed approach maneuver as described in (h) (1) e. above.

NOTE

Glide slope coupler will not automatically decouple from glide slope. Decoupling may be accomplished by any of the following means:

1. Disengage altitude mode.
2. Switch radio coupler to HDG mode.
3. Disengage autopilot.

SECTION 5 - PERFORMANCE

No changes to the basic performance provided by Section 5 of the Pilot's Operating Handbook are necessary for this supplement.

SUPPLEMENT 9

CENTURY 21 AUTOPILOT INSTALLATION

SECTION 1 - GENERAL

This supplement supplies information necessary for the operation of the airplane when the optional Century 21 Autopilot Model AK864 is installed in accordance with STC 3362SW-D. The information contained within this supplement is to be used in conjunction with the complete handbook.

This supplement has been "FAA Approved" as a permanent part of this handbook and must remain in this handbook at all times when the optional Century 21 Autopilot is installed.

SECTION 2 - LIMITATIONS

(a) Maximum airspeed for autopilot operation is 175 KIAS.
(b) Autopilot OFF during takeoff and landing.

SECTION 3 - EMERGENCY PROCEDURES

(a) AUTOPILOT
In the event of an autopilot malfunction, or anytime the autopilot is not performing as commanded, do not attempt to identify the problem. Regain control of the aircraft by overpowering and immediately disconnecting the autopilot by depressing the AP ON-OFF switch on the programmer OFF.

Do not operate until the system failure has been identified and corrected.

(1) Altitude Loss During Malfunction:
   a. An autopilot malfunction during climb, cruise or descent with a 3 second delay in recovery initiation could result in as much as 60° of bank and 300′ altitude loss. Maximum altitude loss was recorded at 175 KIAS during descent.
   b. An autopilot malfunction during an approach with a 1 second delay in recovery initiation could result in as much as 18° bank and 60′ altitude loss. Maximum altitude loss measured in approach configuration, gear down, and operating either coupled or uncoupled.

(b) COMPASS SYSTEM
   (1) Emergency Operation With Optional NSD 360A (HSI) Slaved and/or Non-Slaved:

   NSD 360A
   a. Appearance of HDG Flag:
      1. Check air supply gauge (vac or pressure) for adequate air supply (4 in. Hg. min.).
      2. Check compass circuit breaker.
      3. Observe display for proper operation.
   b. To disable heading card - pull circuit breaker and use magnetic compass for directional data.

NOTE

If heading card is not operational, autopilot should not be used.

   c. With card disabled VOR/Localizer and Glide Slope displays are still functional; use card set to rotate card to aircraft heading for correct picture.
   d. Slaving Failure - (i.e. failure to self correct for gyro drift):
      1. Check gyro slaving switch is set to No. 1 position (if equipped with Slave No. 1 - No. 2 switch) or "Slaved" position when equipped with Slaved and Free Gyro Mode Switch.
      2. Check for HDG Flag.
      3. Check compass circuit breaker.
      4. Reset heading card while observing slaving meter.

NOTE

Dead slaving meter needle or a needle displaced fully one direction indicates a slaving system failure.

5. Select slaving amplifier No. 2, if equipped.
6. Reset heading card while checking slaving meter. If proper slaving indication is not obtained, switch to free gyro mode and periodically set card as an unslaved gyro.

NOTE

In the localizer mode, the "TO-FROM" arrows may remain out of view, depending upon the design of the NAV converter used in the installation.

SECTION 4 - NORMAL PROCEDURES

Refer to Edo-Aire Mitchell Century 21 Autopilot Operator's Manual, P/N 68S805, dated 1-79 for Autopilot Description and Normal Operating Procedures.

(a) PREFLIGHT PROCEDURES

NOTE

During system functional check the system must be provided adequate D.C. voltage (12.0 VDC min.) and instrument air (4.2 in. Hg. min.). It is recommended that the engine be operated to provide the necessary power and that the aircraft be positioned in a level attitude, during the functional check.

(b) AUTOPILOT WITH STANDARD D.G.
  (1) Engage autopilot.
  (2) Control wheel movement should correspond to HDG command input.
  (3) Grasp control wheel and override roll servo actuator to assure override capability.
  (4) With HDG bug centered select NAV or APPR mode and note control wheel movement toward VOR needle offset.
  (5) Select REV mode and note control wheel movement opposite VOR needle offset.
  (6) Disengage autopilot.
  (7) Check aileron controls through full travel to assure complete autopilot disengagement.

(c) AUTOPILOT WITH COMPASS SYSTEM (NSD 360A)
(For other compass systems, refer to appropriate manufacturer's instructions)
  (1) Check slaving switch in slave or slave 1 or 2 position, as appropriate. (Slaving systems with R.M.I. output provide only slave and free gyro positions.)
  (2) Rotate card to center slaving meter - check HDG displayed with magnetic compass HDG.
  (3) Perform standard VOR receiver check.
  (4) Perform Steps (1) - (7) in Section 4 item (b) except in Steps (4) and (5) substitute course arrow for HDG bug when checking control wheel movement in relation to L/R needle. HDG bug is inoperative with NAV, APPR, or REV mode selected.

(d) IN-FLIGHT PROCEDURE
  (1) Trim aircraft for existing flight condition (all axes).
  (2) Rotate heading bug to desired heading. Engage autopilot.
  (3) During maneuvering flight - control aircraft through use of the HDG bug. (HDG mode)
  (4) For navigation operations select modes as required by the operation being conducted and in accordance with the mode description provided in the Century 21 Operator's Manual.

SECTION 5 - PERFORMANCE

No changes to the basic performance provided by Section 5 of this Pilot's Operating Handbook are necessary for this supplement.

SUPPLEMENT 10

CENTURY 41 AUTOPILOT INSTALLATION

SECTION 1 - GENERAL

This supplement supplies information necessary for the operation of the airplane when the optional Century 41 Autopilot Model AK865 or Century 41 Flight Director Autopilot Model AK865FD is installed in accordance with STC 3361SW. The information contained within this supplement is to be used in conjunction with the complete handbook.

This supplement has been "FAA Approved" as a permanent part of this handbook and must remain in this handbook at all times when the optional Century 41 Autopilot or the Century 41 Flight Director Autopilot is installed.

SECTION 2 - LIMITATIONS

(a) Autopilot use prohibited above 175 KIAS.
(b) Autopilot OFF during takeoff and landing.
(c) Required Placard, P/N 13A990-1 stating "Conduct trim check prior to first flight of day - (See A.F.M.)" to be installed in clear view of pilot.
(d) Autopilot coupled Go-Around maneuvers prohibited ^{s}See Section 4 item (a)⅛.
(e) Category 1 operations only.

SECTION 3 - EMERGENCY PROCEDURES

(a) AUTOPILOT

In the event of an autopilot malfunction, or anytime the autopilot is not performing as commanded, do not attempt to identify the problem system. Regain control by overpowering and immediately disconnecting the autopilot. This will disable both the autotrim system and the autopilot system. If the malfunction was in the autotrim system there may be residual control wheel force after the system is OFF. Be prepared for any residual trim force and retrim, as necessary, using the aircraft's primary trim control system.

NOTE

Do not overpower autopilot in pitch for more than approximately 3 seconds as the autotrim system will cause an increase in pitch overpower forces.

(1) Autopilot may be disconnected by:
   a. Depressing "AP OFF" bar on pilot's trim switch.
   b. Depressing the AP ON-OFF switch on the programmer.
   c. Depressing master disconnect switch on pilot's control wheel.
(2) Autotrim may be disconnected by:
   a. Depressing the autopilot ON-OFF switch - OFF.
   b. Placing the autotrim master switch - OFF.
   c. Depressing master disconnect switch on pilot's control wheel.

   After failed system has been identified, pull system circuit breaker and do not operate until the system has been corrected.
(3) Altitude Loss During Malfunction:
   a. An autopilot malfunction during climb or cruise with a 3 second delay in recovery initiation could result in as much as 60° bank and 450′ altitude loss. Maximum altitude loss measured at 175 KIAS during descent.
   b. An autopilot malfunction during an approach with a 1 second delay in recovery initiation could result in as much as 18° bank and 80′ altitude loss. Maximum altitude loss measured in approach configuration, gear down, and operating either coupled or uncoupled.

(b) COMPASS SYSTEM

(1) Emergency Operation With Optional NSD 360A (HSI) Slaved and /or Non-Slaved:

NSD 360A

a. Appearance of HDG Flag:
   1. Check air supply gauge (vac or pressure) for adequate air supply (4 in. Hg. min.).
   2. Check compass circuit breaker.
   3. Observe display for proper operation.
b. To disable heading card - pull circuit breaker and use magnetic compass for directional data.

NOTE

If heading card is not operational, autopilot should not be used.

c. With card disabled VOR/Localizer and Glide Slope displays are still functional; use card set to rotate card to aircraft heading for correct picture.
d. Slaving Failure - (i.e. failure to self correct for gyro drift):
   1. Check gyro slaving switch is set to No. 1 position (if equipped with Slave No. 1 - No. 2 switch) or "Slaved" position when equipped with Slaved and Free Gyro Mode Switch.
   2. Check for HDG Flag.
   3. Check compass circuit breaker.
   4. Reset heading card while observing slaving meter.

NOTE

Dead slaving meter needle or a needle displaced fully one direction indicates a slaving system failure.

   5. Select slaving amplifier No. 2, if equipped. If not equipped, proceed with No. 7.

6. Reset heading card while checking slaving meter. If proper slaving indication is not obtained,
7. Switch to free gyro mode and periodically set card as an unslaved gyro.

NOTE

In the localizer mode, the "TO-FROM" arrows may remain out of view, depending upon the design of the NAV converter used in the installation.

SECTION 4 - NORMAL PROCEDURES

(a) NORMAL OPERATING PROCEDURES

NOTE

This autopilot is equipped with an A/P "OFF" warning horn that will sound for approximately 4 seconds anytime the autopilot is disengaged. This will be accompanied by an "A/P" message flash on the autopilot remote annunciator for approximately 5 seconds.

The horn may be silenced before the 4 second time limit is up by:
(1) Pressing "T" bar atop command trim switch.
(2) Pressing Autopilot/Trim Master Disconnect Switch.
(3) Or by re-engaging the autopilot.

NOTE

If this autopilot is equipped with a Flight Director steering horizon the F/D must be switched on before the autopilot may be engaged. Any autopilot mode may be preselected and will be retained upon autopilot engagement.

CAUTIONS

Flight Director Autopilot versions only are equipped with a remote go-around switch. When G/A mode is selected the AUTOPILOT WILL DISCONNECT and warning horn will sound. Pilot may use Flight Director steering for missed approach guidance and after aircraft is stabilized in a proper climb with gear and flaps up autopilot may be re-engaged and will retain G/A mode. Autopilot only versions do not have a G/A switch.

To avoid inadvertent or false glideslope captures while operating on the localizer use NAV mode instead of APR mode.

Refer to Edo-Aire Mitchell Century 41 Operator's Manual, P/N 68S803, dated 1-79 for additional System Description and Normal Operating Procedures.

(b) PREFLIGHT PROCEDURES

NOTE

During system functional check the system must be provided adequate D.C. voltage (12.0 VDC min.) and instrument air (4.2 in. Hg. min.). It is recommended that the engine be operated to provide the necessary power and that the aircraft be positioned in a level attitude, during the functional check.

(1) AUTOPILOT (F/D Switch ON if F/D Equipped)
   a. Engage autopilot by pushing programmer OFF - ON switch ON.
   b. Rotate D.G. HDG bug left then right and verify that control wheel movement corresponds to HDG command input.
   c. Press pitch modifier button first up then down and note that pitch control follows pitch command input. Autotrim should follow pitch command input after approximately three second delay.

d. Grasp control wheel and override roll and pitch servo actuators to assure override capability.
e. Hold control yoke and disengage autopilot by activating the control wheel trim switch.
f. Check controls through full travel in roll and pitch to assure complete autopilot disengagement.
g. Retrim aircraft for takeoff.

(c) TRIM SYSTEM

The autopilot is provided with an electric elevator trim system having two modes of operation. When the autopilot is engaged and the trim master switch is ON, automatic electric trim (autotrim) is provided. When the autopilot is disengaged, command electric elevator trim is available by use of the control wheel switch provided or by use of the primary trim control wheel. The electric elevator trim system has been designed to withstand any type of single failure, either mechanical or electrical, without uncontrolled operation resulting. The automated system self test circuit provided, in conjunction with a functional check, described below, will uncover internal failures that otherwise could remain undetected and thus compromise the fail-safe properties of the system. Proper operation of the system is, therefore, predicated on conducting the following preflight check before first flight of each day. If the trim system fails any portion of this test, turn the autotrim master switch OFF and pull the autotrim circuit breaker, until the system is corrected.

The command electric trim switch on the left portion of the pilot's control wheel has two functions:
(1) When the top bar (AP OFF) is pressed, it disconnects the autopilot.
(2) When the top bar is pressed and the rocker is moved forward, nose down trim will occur; when moved aft, nose up trim will occur.

Command Trim - Before the First Flight of Each Day
(1) Trim master switch - ON.
(2) Verify normal trim UP and DOWN operation with control wheel switch.
(3) Press - center bar only - then release center bar.
(4) Push rocker fore and aft - only. Trim should not operate with either separate action.

Any failure of the preceding operations indicates that a failure exists in the system and the Command Trim shall not be operated until the failure has been identified and corrected.

Autotrim - Before the First Flight of Each Day

(1) Check trim master switch ON, autopilot OFF.
(2) Press and hold TEST pushbutton on Mode Annunciator. Verify the following sequence. (Each sequence will last approximately two seconds.):
    a. All annunciations light with FAIL and AP flashing.
    b. Autotrim flashes, goes steady, then flashes.
    c. All lights go steady.
    d. After three to five seconds, AUTOTRIM and FAIL flash continually.
(3) With TEST button on the Mode Annunciator still depressed, verify Trim will not operate in either direction with the Control Wheel Switch.
(4) Release TEST pushbutton. All lights except HDG and ATT shall extinguish.

Any deviation from the above sequence indicates that a failure exists in either the primary system or in the monitor circuits. The autopilot and trim system shall not be operated until the failure has been identified and corrected.

CAUTION

Recheck trim position prior to initiating take-off.

(d) FLIGHT DIRECTOR
  (1) Check circuit breaker - IN.
  (2) Flight director switch on steering horizon - ON. (Adjacent to instrument on single cue horizon, if installed)
  (3) Pitch modifier DN - UP - check pitch steering indicator moves appropriately.
  (4) HDG bug RT - LT - check roll steering indicator moves appropriately.

(e) COMPASS SYSTEM (NSD 360A)
(For other compass systems, refer to appropriate manufacturer's instructions)
(1) Check slaving switch in slave or slave 1 or 2 position, as appropriate. (Slaving systems with R.M.I. output provide only slave and free gyro positions.)
(2) Rotate card to center slaving meter - check HDG displayed with magnetic compass HDG.
(3) Perform standard VOR receiver check.
(4) NAV - APPR - Engage NAV or APPR mode switch and observe steering bar indicates turn toward the VOR needle.

NOTE

If the Omni Bearing Selector is more than 45° from the aircraft heading, the flight director steering bar will only indicate a turn toward the omni bearing.

(f) IN-FLIGHT PROCEDURE - FLIGHT DIRECTOR
(1) Century 41 circuit breaker - IN. Flight director switch - ON.
(2) Adjust HDG bug to aircraft heading and select desired pitch attitude by activation of the CWS (Pitch Synch) switch or the modifier switch.
(3) Maneuver aircraft manually to satisfy the commands presented. Select other modes as desired; refer to Century 41 Operator's Manual for mode description.

(g) IN-FLIGHT PROCEDURE - AUTOPILOT/FLIGHT DIRECTOR AUTOPILOT
(1) Flight director switch - ON, if F/D equipped. Rotate heading bug to desired heading.
(2) Trim aircraft for existing flight condition (all axes). Engage autopilot.
(3) During maneuvering flight - control aircraft through use of the HDG bug and the pitch modifier. (HDG-ATT modes) (For use of pitch synch switch see Operator's Manual.)
(4) For navigation operations select modes as required by the operation being conducted and in accordance with the mode description provided in Operator's Manual. For specific instructions relating to coupled instrument approach operations, refer to Special Operations and Information Section 4, item (i).

(h) IN-FLIGHT PROCEDURE - COMMAND/AUTOTRIM SYSTEM
   (1) Trim master switch - ON.
   (2) When the autopilot is engaged, pitch trim is accomplished and maintained automatically.
   (3) With the autopilot OFF, command trim is obtained by pressing and rocking the combination TRIM-AP disconnect bar on the pilot's control wheel trim switch.

(i) SPECIAL OPERATIONS AND INFORMATION
   (1) Altitude Hold Operation:
   For best results, reduce rate of climb or descent to 1000 FPM before engaging altitude hold mode.
   (2) Instrument Approach Operations:
   Initial and/or intermediate approach segments should be conducted between 95-110 KIAS with the flaps extended as desired. Upon intercepting the glide path or when passing the final approach fix (FAF), reduce the power for approximately 80-95 KIAS on the final approach segment. Adjust power as necessary during remainder of approach to maintain correct airspeed. Monitor course guidance information (raw data) throughout the approach. All power changes should be of small magnitude and smoothly applied for best tracking performance. Do not change aircraft configuration during approach while autopilot is engaged. For approaches without glide path coupling, adjust pitch attitude in conjunction with power to maintain desired airspeed and descent rate.

NOTE

Flight director or autopilot will not decouple from the GS or localizer in the event of radio failure, however, warnings will flash in the mode appropriate to the failure. Monitor course guidance raw data during the approach to assure signal quality.

(3) Instrument Approach Go-Around Maneuver (Flight Director Version Only):

a. Select GA mode at the remote GA switch. Autopilot will disconnect and warning horn will sound.
b. Add takeoff power, or power as desired.
c. Check the correct attitude and that a positive rate of climb is indicated, then raise gear and flaps.
d. Pilot may hand fly aircraft with reference to flight director steering information.
e. After aircraft is established in climb, gear and flaps up, autopilot may be re-engaged by pushing "ON" button on console if flight director steering is switched on.
f. Set desired HDG and select HDG mode for lateral maneuvering.

SECTION 5

No changes to the basic performance provided by Section 5 of this Pilot's Operating Handbook are necessary for this supplement.

SUPPLEMENT 11

PIPER CONTROL WHEEL CLOCK INSTALLATION

SECTION 1 - GENERAL

This supplement supplies information necessary for the operation of the airplane when the optional Piper Control Wheel Clock is installed. The information contained within this supplement is to be used in conjunction with the complete handbook.

This supplement has been "FAA Approved" as a permanent part of this handbook and must remain in this handbook at all times when the optional Piper Control Wheel Clock is installed.

SECTION 2 - LIMITATIONS

No changes to the basic limitations provided by Section 2 of this Pilot's Operating Handbook are necessary for this supplement.

SECTION 3 - EMERGENCY PROCEDURES

No changes to the basic Emergency Procedures provided by Section 3 of this Pilot's Operating Handbook are necessary for this supplement.

SECTION 4 - NORMAL PROCEDURES

(a) SETTING
While in the CLOCK mode, the time and the date can be set by the operation of the RST button.

(b) DATE SETTING
Pressing the RST button once will cause the date to appear with the month flashing. Pressing the ST-SP button will advance the month at one per second, or at one per push, until the right month appears.

Pressing the RST button once again will cause the date to flash, and it can be set in a similar manner.

(c) TIME SETTING
The RST button must now be pressed two times to cause the hours digits to flash. The correct hour can be set in as described above.

Pressing the RST button once again will now cause the minutes digits to flash. The minutes should be set to the next minute to come up at the zero seconds time mark. The RST button is pressed once more to hold the time displayed. At the time mark, the ST-SP button is pressed momentarily to begin the time counting at the exact second.

If the minutes are not advanced when they are flashing in the set mode, pressing the RST button will return the clock to the normal timekeeping mode without altering the minutes timing. This feature is useful when changing time zones, when only the hours are to be changed.

(d) AUTOMATIC DATE ADVANCE
The calendar function will automatically advance the date correctly according to the four year perpetual calendar. One day must be added manually on Feb. 29 on leap year. The date advances correctly at midnight each day.

(e) DISPLAY TEST
Pressing both the RST and ST-SP buttons at the same time will result in a display test function.

SECTION 5 - PERFORMANCE

No changes to the basic performance provided by Section 5 of this Pilot's Operating Handbook are necessary for this supplement.

PILOT'S OPERATING HANDBOOK
AND
FAA APPROVED AIRPLANE FLIGHT MANUAL

SUPPLEMENT NO. 12
FOR
KING KAP 100 SERIES FLIGHT CONTROL SYSTEM

This supplement must be attached to the Pilot's Operating Handbook and FAA Approved Airplane Flight Manual when the King KAP 100 Series Flight Control System is installed in accordance with STC SA1567CE-D. The information contained herein supplements or supersedes the information in the basic Pilot's Operating Handbook and FAA Approved Airplane Flight Manual only in those areas listed herein. For limitations, procedures and performance information not contained in this supplement, consult the basic Pilot's Operating Handbook and FAA Approved Airplane Flight Manual.

FAA APPROVED Ward Evans
WARD EVANS
D.O.A. NO. SO-1
PIPER AIRCRAFT CORPORATION
VERO BEACH, FLORIDA

DATE OF APPROVAL AUGUST 4, 1982

SECTION 1 - GENERAL

This supplement supplies information necessary for the operation of the airplane when the optional King KAP 100 Series Flight Control System is installed. The Flight Control System must be operated within the limitations herein specified. The information contained within this supplement is to be used in conjunction with the complete handbook.

This supplement has been FAA Approved as a permanent part of this handbook and must remain in this handbook at all times when the optional King KAP 100 Series Flight Control System is installed.

SECTION 2 - LIMITATIONS

(a) The autopilot must be OFF during takeoff and landing.
(b) Maximum fuel imbalance - 12 gallons.

SECTION 3 - EMERGENCY PROCEDURES

(a) SYSTEM WITH AUTOPILOT ONLY

(1) In case of Autopilot malfunction: (accomplish items a. and b. simultaneously)
   a. Airplane Control Wheel - GRASP FIRMLY and regain aircraft control.
   b. AP ENG Button - PRESS to disengage autopilot.

(b) SYSTEMS WITH AUTOPILOT AND OPTIONAL MANUAL ELECTRIC TRIM

(1) In case of Autopilot malfunction: (accomplish items a. and b. simultaneously)
   a. Airplane Control Wheel - GRASP FIRMLY and regain aircraft control.
   b. AP DISC/TRIM INTER Switch - PRESS.

(2) In case of Manual Electric Trim malfunction:
   a. AP DISC/TRIM INTER Switch - PRESS and HOLD.
   b. PITCH TRIM Circuit Breaker - PULL.
   c. Aircraft - RETRIM manually.

SECTION 4 - NORMAL PROCEDURES

(a) PREFLIGHT (PERFORM PRIOR TO EACH FLIGHT)

(1) GYROS - Allow 3-4 minutes for gyros to come up to speed.
(2) RADIO POWER Switch - ON
(3) PREFLIGHT TEST BUTTON - PRESS momentarily and NOTE:
   a. All annunciator lights on (TRIM annunciator flashing).
   b. After approximately 5 seconds, all annunciator lights off except AP which will flash approximately 12 times and then remain off.

NOTE

If trim warning light stays on then the manual electric trim did not pass preflight test. The pitch trim circuit breaker should be pulled. The autopilot can still be used.

(4) MANUAL ELECTRIC TRIM (if installed) - TEST as follows:
   a. Actuate the left side of the split switch to the fore and aft positions. The trim wheel should not move on its own. Rotate the trim wheel manually against the engaged clutch to check the pilot's overpower capability.
   b. Actuate right side of split switch unit to the fore and aft positions. The trim wheel should not move on its own and normal trim wheel force is required to move it manually.
   c. Press the AP DISC/TRIM INTER switch down and hold. Manual Electric Trim should not operate either nose up or or nose down.
(5) AUTOPILOT - ENGAGE by pressing AP ENG button.
(6) CONTROL WHEEL - MOVE left and right to verify that the autopilot can be overpowered.
(7) AP DISC/TRIM INTER Switch - PRESS. Verify that the autopilot disconnects and all modes are cancelled.
(8) TRIM - SET to take off position.

(b) AUTOPILOT OPERATION

(1) Before takeoff
AP DISC/TRIM INTER Switch - PRESS.

(2) Autopilot Engagement
AP ENG Button - PRESS. Note AP annunciator on. If no other modes are selected the autopilot will operate in the wings level mode.

(3) Heading Changes
a. Manual Heading Changes
1. CWS Button - PRESS and MANEUVER aircraft to the desired heading.
2. CWS Button - RELEASE. Autopilot will maintain aircraft in wings level attitude.

NOTE

Aircraft heading may change in the wings level mode due to an aircraft out of trim condition.

b. Heading Hold
1. Heading Selector Knob - SET BUG to desired heading.
2. HDG Mode Selector Button - PRESS. Note HDG mode annunciator ON. Autopilot will automatically turn the aircraft to the selected heading.

c. Command Turns (Heading Hold Mode ON)
HEADING Selector Knob - MOVE BUG to the desired heading. Autopilot will automatically turn the aircraft to the new selected heading.

(4) NAV Coupling
a. When equipped with HSI.
1. Course Bearing Pointer - SET to desired course.

NOTE

When equipped with NAV 1/NAV 2 switching and NAV 2 is selected, set OBS to the desired course.

2. HEADING SELECTOR KNOB - SET BUG to provide desired intercept angle.

3. NAV Mode Selector Button - PRESS.

   If the Course Deviation Bar is greater than 2 to 3 dots: the aircraft will continue in HDG mode (or wings level if HDG not selected) with the NAV annunciator flashing; when the computed capture point is reached the HDG will disengage, the NAV annunciator will illuminate steady and the selected course will be automatically captured and tracked.

   If the D-Bar is less than 2 to 3 dots: the HDG mode will disengage upon selecting NAV mode; the NAV annunciator will illuminate steady and the capture/track sequence will automatically begin.

b. When equipped with DG
   1. OBS Knob - SELECT desired course.
   2. NAV Mode Selector Button - PRESS.
   3. Heading Selector Knob - ROTATE BUG to agree with OBS course.

NOTE

When NAV is selected, the lateral operating mode will change from HDG (if selected) to wings level for 5 seconds. A 45° intercept angle will then be automatically established based on the position of the bug.

   If the D-Bar is greater than 2 to 3 dots: the autopilot will annunciate HDG mode (unless HDG not selected) and NAV flashing; when the computed capture point is reached the HDG annunciator will go out, the NAV annunciator will illuminate steady and the selected course will be automatically captured and tracked.

   If the D-Bar is less than 2 to 3 dots: the HDG mode will disengage upon selecting NAV mode; the NAV annunciator will illuminate steady and the capture/track sequence will automatically begin.

(5) Approach (APR) Coupling

a. When equipped with HSI

1. Course Bearing Pointer - SET to desired course.

NOTE

When equipped with NAV 1/NAV 2 switching and NAV 2 is selected, set OBS to the desired course.

2. HEADING Selector Knob - SET BUG to provide desired intercept angle.
3. APR Mode Selector Button - PRESS.
   If the Course Deviation Bar is greater than 2 to 3 dots: the aircraft will continue in HDG mode (or wings level if HDG not selected) with the APR annunciator flashing; when the computed capture point is reached the HDG will disengage, the APR annunciator will illuminate steady and the selected course will be automatically captured and tracked.

   If the D-Bar is less than 2 to 3 dots: the HDG mode will disengage upon selecting APR mode; the APR annunciator will illuminate steady and the capture/track sequence will automatically begin.

b. When equipped with DG

1. OBS Knob - SELECT desired approach course.
2. APR Mode Selector Button - PRESS.
3. Heading Selector Knob - ROTATE Bug to agree with OBS course.

NOTE

When APR is selected, the lateral operating mode will change from HDG (if selected) to wings level for 5 seconds. A 45° intercept angle will then be automatically established based on the position of the bug.

If the D-Bar is greater than 2 to 3 dots: the autopilot will annunciate HDG mode (unless HDG not selected) and APR flashing; when the computed capture point is reached the HDG annunciator will go out, the APR annunciator will illuminate steady and the selected course will be automatically captured and tracked.

If the D-Bar is less than 2 to 3 dots: the HDG mode will disengage upon selecting APR mode; the APR annunciator will illuminate steady and the capture/track sequence will automatically begin.

(6) BC Approach Coupling
   a. When equipped with HSI
      1. Course Bearing Pointer - SET to the ILS front course inbound heading.

NOTE

When equipped with NAV 1/NAV 2 switching and NAV 2 is selected, set OBS to the ILS front course inbound heading.

      2. HEADING Selector Knob - SET BUG to provide desired intercept angle.
      3. BC Mode Selector Button - PRESS.
      If the Course Deviation Bar is greater than 2 to 3 dots: the aircraft will continue in HDG mode (or wings level if HDG not selected) with BC annunciated steady and APR annunciator flashing; when the computed capture point is reached the BC and the APR annunciators will illuminate steady and the selected course will be automatically captured and tracked.

      If the D-Bar is less than 2 to 3 dots: the HDG mode will disengage upon selecting BC mode; the APR and BC annunciators will illuminate steady and the capture/track sequence will automatically begin.

   b. When equipped with DG
      1. OBS Knob - SELECT the ILS front course inbound heading.
      2. BC Mode Selector Button - PRESS.

3. Heading Selector Knob - ROTATE Bug to the ILS front course inbound heading.

NOTE

When BC is selected, the lateral operating mode will change from HDG (if selected) to wings level for 5 seconds. A 45° intercept angle will then be established based on the position of the bug.

If the D-Bar is greater than 2 to 3 dots: the autopilot will annunciate HDG (unless HDG not selected) and BC modes with APR flashing; when the computed capture point is reached the HDG annunciator will go out, the BC and the APR annunciators will illuminate steady and the selected course will be automatically captured and tracked.

If the D-Bar is less than 2 to 3 dots: the HDG mode will disengage upon selecting BC mode; the APR and BC annunciator will illuminate steady and the capture/track sequence will automatically begin.

(7) Missed Approach
  a. AP DISC/TRIM INTER - PRESS to disengage AP.
  b. MISSED APPROACH - EXECUTE.
  c. AP ENG Button - PRESS (if AP operation is desired). Note AP annunciator ON.

(8) Before Landing
  AP DISC/TRIM INTER - PRESS to disengage AP.

SECTION 5 - PERFORMANCE

No change.

SECTION 6 - WEIGHT AND BALANCE

Factory installed optional equipment is included in the licensed weight and balance data in Section 6 of the Basic Pilot's Operating Handbook.

SECTION 7 - DESCRIPTION AND OPERATION

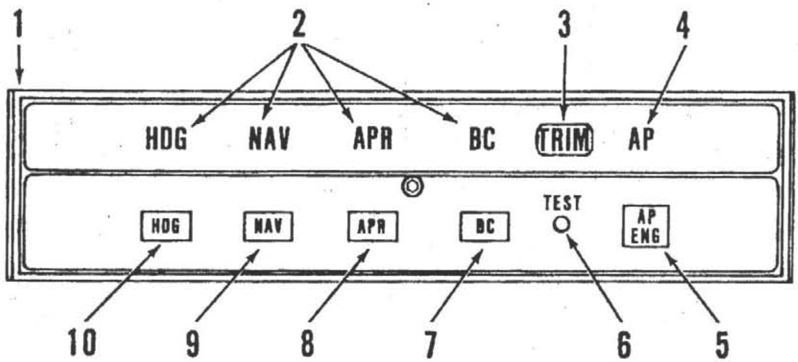
The KAP 100 Autopilot is certified in this airplane with roll axis control. The various instruments and the controls for the operation of the KAP 100 Autopilot are described in Figures 7-1 thru 7-11.

The KAP 100 Autopilot has an optional electric pitch trim system. The trim system is designed to withstand any single inflight malfunction. A trim fault is visually and aurally annunciated.

A lockout device prevents autopilot engagement until the system has been successfully preflight tested.

The following conditions will cause the Autopilot to automatically disengage:

(a) Power failure.
(b) Internal Flight Control System failure.
(c) With the KCS 55A Compass System, a loss of compass valid (displaying HDG flag) disengages the Autopilot when a mode using heading information is engaged. With the HDG flag present only the autopilot wings level mode can be selected.
(d) Roll rates in excess of 14° per second will cause the autopilot to disengage except when the CWS switch is held depressed.

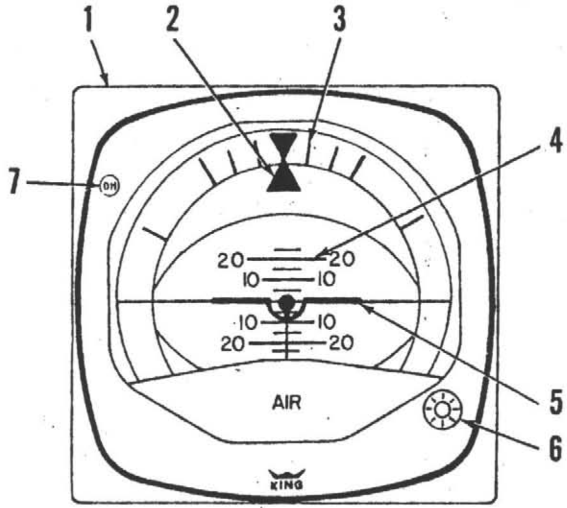


KC 190 AUTOPILOT COMPUTER
Figure 7-1

1. KAP 100 AUTOPILOT COMPUTER - Complete Autopilot computer to include system mode annunciators and system controls.
2. MODE ANNUNCIATORS - Illuminate when a mode is selected by the corresponding mode selector button (PUSH ON - PUSH OFF).
3. TRIM WARNING LIGHT (TRIM) - Illuminates continuously whenever trim power is not on or the system has not been preflight tested. The TRIM warning light, located on the right side of the computer, will flash and be accompanied by an audible warning whenever a manual pitch trim malfunction occurs (trim running without being commanded to run).
4. AUTOPILOT ANNUNCIATOR (AP) - Illuminates continuously whenever the autopilot is engaged. Flashes approximately 12 times whenever the autopilot is disengaged (an aural alert will also sound for 2 seconds).
5. AUTOPILOT ENGAGE (AP ENG) BUTTON - When pushed, engages autopilot if all logic conditions are met.

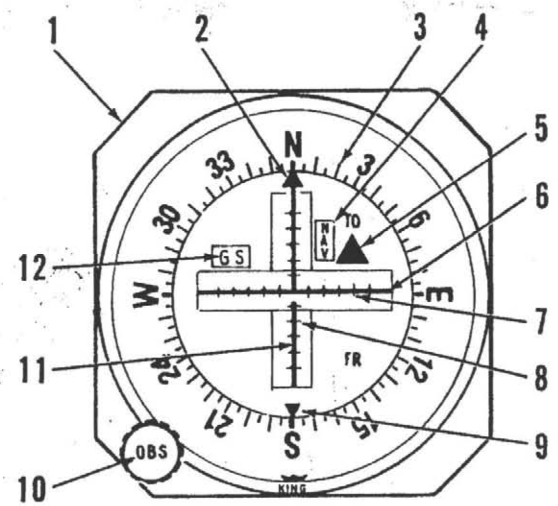
Figure 7-1 (cont)

6. PREFLIGHT TEST (TEST) BUTTON - When momentarily pushed, initiates preflight test sequence which automatically turns on all annunciator lights, tests the roll rate monitor, checks the manual trim drive voltage, checks the manual electric trim monitor and tests all autopilot valid and dump logic. If the preflight is, successfully passed, the AP annunciator light will flash for approximately 6 seconds (an aural tone will also sound simultaneously with the annunciator flashes). The autopilot cannot be engaged until the preflight test is successfully passed.
7. BACK COURSE APPROACH (BC) MODE SELECTOR BUTTON - When pushed, will select the Back Course Approach mode. This mode functions identically to the approach mode except that response to LOC signals is reversed.
8. APPROACH (APR) MODE SELECTOR BUTTON - When pushed, will select the Approach mode. This mode provides all angle intercept (with HSI) or a fixed angle intercept of 45° (with DG), automatic beam capture and tracking of VOR, RNAV or LOC signals. The tracking gain of the APR mode is greater than the gain in the NAV mode. The APR annunciator will flash until the automatic capture sequence is initiated.
9. NAVIGATION (NAV) MODE SELECTOR BUTTON - When pushed, will select the Navigation mode. The mode provides all angle intercept (with HSI) or a fixed angle intercept of 45° (with DG), automatic beam capture and tracking of VOR, RNAV or LOC signals. The NAV annunciator will flash until the automatic capture sequence is initiated.
10. HEADING (HDG) MODE SELECTOR BUTTON - When pushed, will select the Heading mode, which commands the airplane to turn to and maintain the heading selected by the heading bug on the DG or HSI. A new heading may be selected at any time and will result in the airplane turning to the new heading with a maximum bank angle of about 20°. Selecting HDG mode will cancel NAV, APR or BC track modes.



KG 258 VERTICAL GYRO
Figure 7-3

1. KG 258 VERTICAL GYRO - Displays airplane attitude as a conventional attitude gyro. The gyro is air driven.
2. ROLL ATTITUDE INDEX - Displays airplane roll attitude with respect to the roll attitude scale.
3. ROLL ATTITUDE SCALE - Scale marked at 0, ±10, ±20, ±30, ±60 and ±90 degrees.
4. PITCH ATTITUDE SCALE - Moves with respect to the symbolic airplane to present pitch attitude. Scale graduated at 0, ±5, ±10, ±15, ±20 and ±25 degrees.
5. SYMBOLIC AIRPLANE - Serves as a stationary symbol of the aircraft. Aircraft pitch and roll attitudes are displayed by the relationship between the fixed symbolic aircraft and the movable background.
6. SYMBOLIC AIRCRAFT ALIGNMENT KNOB - Provides manual positioning of the symbolic aircraft for level flight under various load conditions.
7. DECISION HEIGHT (DH) ANNUNCIATOR LIGHT - Optional light for use with the aircraft's optional radar altimeter.

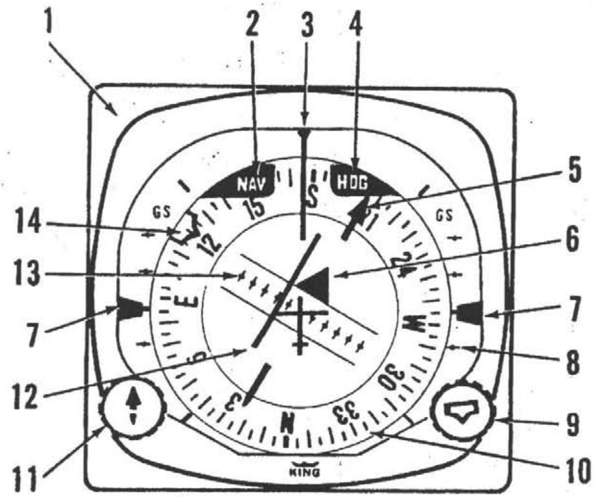


**KI 204/206 VOR/LOC/
GLIDE SLOPE INDICATOR (TYPICAL)**
Figure 7-5

1. VOR/LOC/GLIDE SLOPE INDICATOR - Provides rectilinear display of VOR/LOC and Glide slope deviation.
2. COURSE INDEX - Indicates selected VOR course.
3. COURSE CARD - Indicates selected VOR course under course index.
4. NAV FLAG - Flag is in view when the NAV receiver signal is inadequate. When a NAV flag is present in the navigation indicator (CDI or KI 525A) the autopilot operation is not affected. The pilot must monitor the navigation indicators for NAV flags to insure that the Autopilot is tracking valid navigation information.
5. TO/FROM INDICATOR FLAG - Indicates direction of VOR station relative to selected course.
6. GLIDE SLOPE DEVIATION NEEDLE - Indicates deviation from ILS glide slope.
7. COURSE DEVIATION SCALE - A course deviation bar displacement of 5 dots represents full scale (VOR = ±10°, LOC = ±2 1/2°, RNAV = 5NM, RNAV APR - 1 1/4NM) deviation from beam centerline.

Figure 7-5 (cont)

8. GLIDE SLOPE SCALE - Indicates displacement from glide slope beam center. A glide slope deviation needle displacement of 5 dots, represents full scale (0.7°) deviation above or below glide slope beam centerline.
9. RECIPROCAL COURSE INDEX - Indicates reciprocal of selected VOR course.
10. OMNI BEARING SELECTOR (OBS) KNOB - Rotates course card to selected course.
11. COURSE DEVIATION NEEDLE - Indicates course deviation from selected omni course or localizer centerline.
12. GLIDE SLOPE (GS) FLAG - Flag is in view when the GS receiver signal is inadequate.



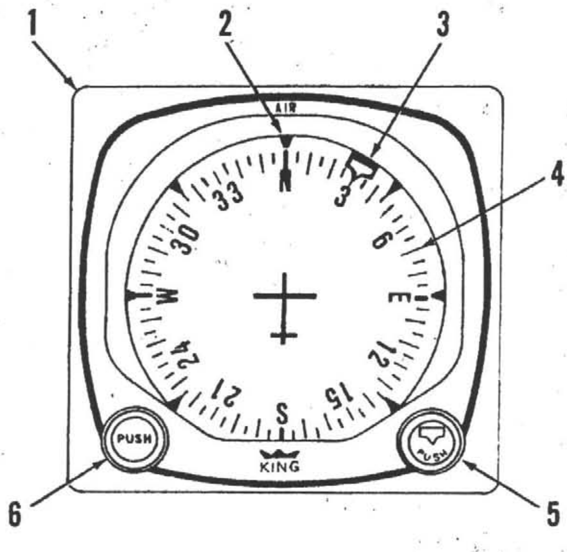
KI 525A HORIZONTAL SITUATION INDICATOR
Figure 7-7

Figure 7-7 (cont)

1. KI 525A HORIZONTAL SITUATION INDICATOR (HSI) - Provides a pictorial presentation of aircraft deviation relative to VOR radials or localizer beams. It also displays glide slope deviations and gives heading reference with respect to magnetic north.
2. NAV FLAG - Flag is in view when the NAV receiver signal is inadequate. When a NAV flag is present in the navigation indicator (CDI or KI 525A) the autopilot operation is not affected. The pilot must monitor the navigation indicators for NAV flags to insure that the Autopilot is tracking valid navigation information.
3. LUBBER LINE - Indicates aircraft magnetic heading on compass card (10).
4. HEADING WARNING FLAG (HDG) - When flag is in view the heading display is invalid. If a HDG flag appears and a lateral mode (HDG, NAV, APR or APR BC) is selected, the Autopilot will be disengaged. The Autopilot may be re-engaged in the basic wings level mode. The CWS switch would be used to maneuver the aircraft laterally.
5. COURSE BEARING POINTER - Indicates selected VOR course or localizer course on compass card (10). The selected VOR radial or localizer heading remains set on the compass card when the compass card (10) rotates.
6. TO/FROM INDICATOR FLAG - Indicates direction of VOR station relative to selected course.
7. DUAL GLIDE SLOPE POINTERS - Indicate on glide slope scale (8) aircraft displacement from glide slope beam center. Glide slope pointers in view indicate a usable glide slope signal is being received.
8. GLIDE SLOPE SCALES - Indicate displacement from glide slope beam center. A glide slope deviation bar displacement of 2 dots, represents full scale (0.7°) deviation above or below glide slope beam centerline.
9. HEADING SELECTOR KNOB ( ) - Positions heading Bug (14) on compass card (10) by rotating the heading selector knob. The Bug rotates with the compass card.
10. COMPASS CARD - Rotates to display heading of airplane with reference to lubber line (3) on HSI.
11. COURSE SELECTOR KNOB - Positions course bearing pointer (5) on the compass card (10) by rotating the course selector knob.
12. COURSE DEVIATION BAR (D-BAR) - The center portion of omni bearing pointer moves laterally to pictorially indicate the relationship of aircraft to selected course. It indicates in degrees of angular displacement from VOR radials and localizer beams or displacement in nautical miles from RNAV courses.

Figure 7-7 (cont)

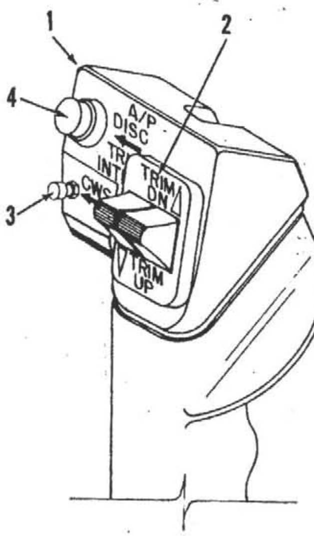
13. COURSE DEVIATION SCALE - A course deviation bar displacement of 5 dots represents full scale (VOR = ±10°, LOC = ±2 1/2°, RNAV = 5NM, RNAV APR - 1 1/4NM) deviation from beam centerline.
14. HEADING BUG - Moved by (⏍) knob (9) to select desired heading.



KG 107 NON-SLAVED DIRECTIONAL GYRO
Figure 7-9

Figure 7-9 (cont)

1. KG 107 NON-SLAVED DIRECTIONAL GYRO (DG) - Provides a stable visual indication of aircraft heading to the pilot. The gyro is air driven.
2. LUBBER LINE - Indicates aircraft magnetic heading on compass card (4).
3. HEADING BUG - Moved by ( ) knob (5) to select desired heading.
4. COMPASS CARD - Rotates to display heading of airplane with reference to lubber line (4) on DG.
5. HEADING SELECTOR KNOB ( ) - Positions heading Bug (3) on compass card (4) by rotating the heading selector knob. The Bug rotates with the compass card.
6. GYRO ADJUSTMENT KNOB (PUSH) - When pushed in, allows the pilot to manually rotate the gyro compass card (4) to correspond with the magnetic heading indicated by the magnetic compass. The unslaved compass card must be manually reset periodically to compensate for precessional errors in the gyro.



AUTOPILOT CONTROL WHEEL SWITCH CAP
Figure 7-11

1. AUTOPILOT CONTROL WHEEL SWITCH CAP - Molded plastic unit mounted on the left horn of the pilot's control wheel which provides mounting for three switch units associated with the autopilot and manual electric trim systems (only used with optional manual electric trim).
2. MANUAL ELECTRIC TRIM CONTROL SWITCHES - A split switch unit in which the left half provides power to engage the trim servo clutch and the right half to control the direction of motion of the trim servo motor. Both halves of the split trim switch must be actuated in order for the manual trim to operate in the desired direction.
3. CONTROL WHEEL STEERING (CWS) BUTTON - When depressed, allows pilot to manually control the aircraft (disengages the servo) without cancellation of any of the selected modes.
4. AUTOPILOT DISCONNECT/TRIM INTERRUPT (AP DISC/ TRIM INTER) Switch - When depressed and released, will disengage the autopilot and cancel all operating autopilot modes. When depressed and held, will interrupt all electric trim power (stop trim motion), disengage the autopilot, and cancel all operating autopilot modes.

The airplane MASTER SWITCH function is unchanged and can be used in an emergency to shut off electrical power to all flight control systems while the problem is isolated.

The RADIO POWER switch supplies power to the avionics bus bar of the radio circuit breakers and the autopilot circuit breaker.

The following circuit breakers are used to protect the following elements of the King KAP 100 Autopilot:

AUTOPILOT - Supplies power to the KC 190, the autopilot roll servo, and the Pitch Trim Circuit Breaker.

PITCH TRIM - Supplies power to the optional manual electric pitch trim system.

COMP-SYSTEM - Supplies power to the optional KCS 55A Compass System.

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PILOT'S OPERATING HANDBOOK
AND
FAA APPROVED AIRPLANE FLIGHT MANUAL

SUPPLEMENT NO. 13
FOR
KING KAP/KFC 150 SERIES FLIGHT CONTROL SYSTEM

This supplement must be attached to the Pilot's Operating Handbook and FAA Approved Airplane Flight Manual when the King KAP/KFC 150 Series Flight Control System is installed in accordance with STC SA1567CE-D. The information contained herein supplements or supersedes the information in the basic Pilot's Operating Handbook and FAA Approved Airplane Flight Manual only in those areas listed herein. For limitations, procedures and performance information not contained in this supplement, consult the basic Pilot's Operating Handbook and FAA Approved Airplane Flight Manual.

FAA APPROVED Ward Evans
WARD EVANS
D.O.A. NO. SO-1
PIPER AIRCRAFT CORPORATION
VERO BEACH, FLORIDA

DATE OF APPROVAL AUGUST 4, 1982

SECTION 1 - GENERAL

This supplement supplies information necessary for the operation of the airplane when the optional King KAP/KFC 150 Series Flight Control System is installed. The Flight Control System must be operated within the limitations herein specified. The information contained within this supplement is to be used in conjunction with the complete handbook.

This supplement has been FAA Approved as a permanent part of this handbook and must remain in this handbook at all times when the optional King KAP/KFC 150 Series Flight Control System is installed.

SECTION 2 - LIMITATIONS

(a) During autopilot operation, a pilot with seat belt fastened must be seated at the left pilot position.
(b) The autopilot must be OFF during takeoff and landing.
(c) The system is approved for Category I operation only (Approach mode selected).
(d) Maximum fuel imbalance - 12 gallons.
(e) Autopilot airspeed limitation: Maximum 180 KIAS.
(f) When equipped with a KAS 297B, altitude select captures below 800 feet AGL are prohibited.

NOTE

In accordance with FAA recommendation, use of "altitude hold" mode is not recommended during operation in severe turbulence.

SECTION 3 - EMERGENCY PROCEDURES

(a) In case of Autopilot malfunction: (accomplish items 1. and 2. simultaneously)

(1) Airplane Control Wheel - GRASP FIRMLY and regain aircraft control.
(2) AP DISC/TRIM INTER Switch - PRESS and HOLD.
(3) AP DISC/TRIM INTER Switch - RELEASE while observing pitch trim wheel. If pitch trim wheel is in motion, follow the Electric Trim Malfunction Procedure.

(b) In case of Electric Trim Malfunction (either manual electric or autotrim):

(1) AP DISC/TRIM INTER Switch - PRESS and HOLD throughout recovery.
(2) PITCH TRIM Circuit Breaker - PULL.
(3) Aircraft - RETRIM manually.

CAUTION

When disconnecting the autopilot after a trim malfunction, hold the control wheel firmly; up to 45 pounds of force on the control wheel may be necessary to hold the aircraft level.

Maximum Altitude losses due to autopilot malfunction:

Configuration	Alt Loss
Cruise, Climb, Descent	330 ′
Maneuvering	110 ′
APPR	80 ′

SECTION 4 - NORMAL PROCEDURES

(a) PREFLIGHT (PERFORM PRIOR TO EACH FLIGHT)

(1) GYROS - Allow 3-4 minutes for gyros to come up to speed.
(2) RADIO POWER Switch - ON.
(3) PREFLIGHT TEST BUTTON - PRESS momentarily and NOTE:
   a. All annunciator lights on (TRIM annunciator flashing).
   b. When equipped with KAS 297B, all legends and digits are displayed on the KAS 297B.
   c. After approximately 5 seconds, all annunciator lights off except AP which will flash approximately 12 times and then remain off.

NOTE

If trim warning light stays on then the autotrim did not pass preflight test. The autopilot circuit breakers should be pulled. Manual electric trim cannot be used.

(4) MANUAL ELECTRIC TRIM - TEST as follows:
   a. Actuate the left side of the split switch to the fore and aft positions. The trim wheel should not move on its own. Rotate the trim wheel manually against the engaged clutch, to check the pilot's overpower capability.
   b. Actuate right side of split switch unit to the fore and aft positions. The trim wheel should not move on its own and normal trim wheel force is required to move it manually.
   c. Press the AP DISC/TRIM INTER switch down and hold. Manual Electric Trim should not operate either nose up or nose down.

(5) FLIGHT DIRECTOR (KFC 150 ONLY) - ENGAGE by pressing FD or CWS button.
(6) AUTOPILOT - ENGAGE by pressing AP ENG button.
(7) CONTROL WHEEL - MOVE fore, aft, left and right to verify that the autopilot can be overpowered.
(8) AP DISC/TRIM INTER Switch - PRESS. Verify that the autopilot disconnects and all flight director modes are cancelled.
(9) TRIM - SET to take off position.

(b) AUTOPILOT OPERATION

(1) Before takeoff
   AP DISC/TRIM INTER Switch - PRESS.

(2) Autopilot Engagement
   a. FD Mode Selector Button (KFC 150 Only) - PRESS.
   b. AP ENG Button - PRESS. Note AP annunciator on. If no other modes are selected the autopilot will operate in wings level and pitch attitude hold.

(3) Climb or Descent

a. Using CWS

1. CWS Button - PRESS and MOVE aircraft nose to the desired attitude.
2. CWS Button - RELEASE. Autopilot will maintain aircraft pitch attitude up to the pitch limits of +15° or -10°.

b. Using Vertical Trim

1. VERTICAL TRIM Control - PRESS either up or down to modify aircraft attitude at a rate of .7 deg/sec. up to the pitch limits of +15° or -10°.
2. VERTICAL TRIM Control - RELEASE when desired aircraft attitude is reached. The autopilot will maintain the desired pitch attitude.

(4) Vertical Speed and Altitude Select, when equipped with KAS 297B

a. Vertical Speed Select

1. VERTICAL SPEED SELECT knob - PULL small knob to the OUT position.
2. VERTICAL SPEED SELECT knob - ROTATE until desired vertical speed is displayed.
3. VERTICAL SPEED MODE (ENG) button - PUSH to engage the vertical speed hold mode.

b. Changing Vertical Speed

1. Using CWS

CWS button - PRESS and HOLD, while establishing the desired vertical speed.

CWS button - RELEASE, when the desired vertical speed is obtained.

2. Using Vertical Trim Control

VERTICAL TRIM CONTROL - PRESS either up or down to increase or decrease the vertical speed. Displayed vertical speed changes 100 fpm for every second the control is held down.

CAUTIONS

When operating at or near the best rate of climb airspeed and using vertical speed hold, it is easy to decelerate to an airspeed on the back side of the power curve (a decrease in airspeed results in a reduced rate of climb). Continued operation on the back side of the power curve in vertical speed hold mode will result in a stall.

When operating at or near the maximum autopilot speed, it will be necessary to reduce power in order to maintain the desired rate of descent and not exceed the maximum autopilot speed.

c. Altitude Preselect
  1. ALTITUDE SELECT knob - PUSH small knob to the IN position.
  2. ALTITUDE SELECT knob - ROTATE until the desired altitude is displayed.
  3. ALTITUDE SELECT MODE (ARM) button - PUSH to arm the altitude select mode.
  4. Airplane - ESTABLISH ATTITUDE necessary to intercept the selected altitude.

(5) Altitude Hold
  a. ALT Mode Selector Button - PRESS. Note ALT mode annunciator ON. Autopilot will maintain the selected pressure altitude.

  b. Change selected altitudes
    1. Using CWS (recommended for altitude changes greater than 100 ft.)
       CWS Button - PRESS and fly aircraft to desired pressure altitude.

       CWS Button - RELEASE when desired pressure altitude is reached. The autopilot will maintain the desired pressure altitude.

2. Using Vertical Trim (Recommended for altitude changes less than 100 ft.)
   VERTICAL TRIM Control - PRESS either up or down. Vertical Trim will seek an altitude rate of change of 600 + 100 fpm.

   VERTICAL TRIM Control - RELEASE when desired pressure altitude is reached. The autopilot will maintain the desired pressure altitude.

(6) Heading Changes
   a. Manual Heading Changes
      1. CWS Button - PRESS and MANEUVER aircraft to the desired heading.
      2. CWS Button - RELEASE. Autopilot will maintain aircraft in wings level attitude.

NOTE

Aircraft heading may change in the wings level mode due to an aircraft out of trim condition.

   b. Heading Hold
      1. Heading Selector Knob - SET BUG to desired heading.
      2. HDG Mode Selector Button - PRESS. Note HDG mode annunciator ON. Autopilot will automatically turn the aircraft to the selected heading.

   c. Command Turns (Heading Hold mode ON)
      HEADING Selector Knob - MOVE BUG to the desired heading. Autopilot will automatically turn the aircraft to the new selected heading.

(7) NAV Coupling
   a. When equipped with HSI.
      1. Course Bearing Pointer - SET to desired course.

NOTE

When equipped with NAV 1/NAV 2 switching and NAV 2 is selected, set OBS to the desired course.

2. HEADING Selector Knob - SET BUG to provide desired intercept angle.
3. NAV Mode Selector Button - PRESS.

   If the Course Deviation Bar is greater than 2 to 3 dots: the aircraft will continue in HDG mode (or wings level if HDG not selected) with the NAV annunciator flashing; when the computed capture point is reached the HDG will disengage, the NAV annunciator will illuminate steady and the selected course will be automatically captured and tracked.

   If the D-Bar is less than 2 to 3 dots: the HDG mode will disengage upon selecting NAV mode; the NAV annunciator will illuminate steady and the capture/track sequence will automatically begin.

b. When equipped with DG
   1. OBS Knob - SELECT desired course.
   2. NAV Mode Selector Button - PRESS.
   3. Heading Selector Knob - ROTATE BUG to agree with OBS course.

NOTE

When NAV is selected, the lateral operating mode will change from HDG (if selected) to wings level for 5 seconds. A 45° intercept angle will then be automatically established based on the position of the bug.

If the D-Bar is greater than 2 to 3 dots: the autopilot will annunciate HDG mode (unless HDG not selected) and NAV flashing; when the computed capture point is reached the HDG annunciator will go out, the NAV annunciator will illuminate steady and the selected course will be automatically captured and tracked.

If the D-Bar is less than 2 to 3 dots: the HDG mode will disengage upon selecting NAV mode; the NAV annunciator will illuminate steady and the capture/track sequence will automatically begin.

(8) Approach (APR) Coupling
   a. When equipped with HSI
      1. Course Bearing Pointer - SET to desired course.

NOTE

When equipped with NAV 1/NAV 2 switching and NAV 2 is selected, set OBS to the desired course.

      2. HEADING Selector Knob - SET BUG to provide desired intercept angle.
      3. APR Mode Selector Button - PRESS.
         If the Course Deviation Bar is greater than 2 to 3 dots: the aircraft will continue in HDG mode (or wings level if HDG not selected) with the APR annunciator flashing; when the computed capture point is reached the HDG will disengage, the APR annunciator will illuminate steady and the selected course will be automatically captured and tracked.

         If the D-Bar is less than 2 to 3 dots: the HDG mode will disengage upon selecting APR mode; the APR annunciator will illuminate steady and the capture/track sequence will automatically begin.

   b. When equipped with DG
      1. OBS Knob - SELECT desired approach course.
      2. APR Mode Selector Button - PRESS.
      3. Heading Selector Knob - ROTATE Bug to agree with OBS course.

NOTE

When APR is selected, the lateral operating mode will change from HDG (if selected) to wings level for 5 seconds. A 45° intercept angle will then be automatically established based on the position of the bug.

If the D-Bar is greater than 2 to 3 dots: the autopilot will annunciate HDG mode (unless HDG not selected) and APR flashing; when the computed capture point is reached the HDG annunciator will go out, the APR annunciator will illuminate steady and the selected course will be automatically captured and tracked.

If the D-Bar is less than 2 to 3 dots: the HDG mode will disengage upon selecting APR mode; the APR annunciator will illuminate steady and the capture/track sequence will automatically begin.

(9) BC Approach Coupling
  a. When equipped with HSI
    1. Course Bearing Pointer - SET to the ILS front course inbound heading.

NOTE

When equipped with NAV 1/NAV 2 switching and NAV 2 is selected, set OBS to the ILS front course inbound heading.

    2. HEADING Selector Knob - SET BUG to provide desired intercept angle.

    3. BC Mode Selector Button - PRESS.
    If the Course Deviation Bar is greater than 2 to 3 dots: the aircraft will continue in HDG mode (or wings level if HDG not selected) with BC annunciated steady and APR annunciator flashing; when the computed capture point is reached the HDG will disengage, and the APR annunciator will illuminate steady and the selected course will be automatically captured and tracked.

    If the D-Bar is less than 2 to 3 dots: the HDG mode will disengage upon selecting BC mode; the APR and BC annunciators will illuminate steady and the capture/track sequence will automatically begin.

  b. When equipped with DG
    1. OBS Knob - SELECT the ILS front course inbound heading.

2. BC Mode Selector Button - PRESS.
3. Heading Selector Knob - ROTATE Bug to the ILS front course inbound heading.

NOTE

When BC is selected, the lateral operating mode will change from HDG (if selected) to wings level for 5 seconds. A 45° intercept angle will then be established based on the position of the bug.

If the D-Bar is greater than 2 to 3 dots: the autopilot will annunciate HDG (unless HDG not selected) and BC modes with APR flashing; when the computed capture point is reached the HDG annunciator will go out, the BC and the APR annunciators will illuminate steady and the selected course will be automatically captured and tracked.

If the D-Bar is less than 2 to 3 dots: the HDG mode will disengage upon selecting BC mode; the APR and BC annunciators will illuminate steady and the capture/track sequence will automatically begin.

(10) Glide Slope Coupling

NOTE

Glide slope coupling is inhibited when operating in NAV or APR BC modes. Glide slope coupling occurs automatically in the APR mode.

a. APR Mode - ENGAGED.
b. At glide slope centering - NOTE GS annunciator ON.

NOTE

Autopilot can capture glide slope from above or below the beam while operating in either pitch attitude hold or ALT hold modes.

(11) Missed Approach

a. AP DISC/TRIM INTER Switch - PRESS to disengage AP.
b. MISSED APPROACH - EXECUTE.
c. CWS Button - PRESS (KFC 150 only) as desired to activate FD mode during go-around maneuver.
d. AP ENG Button - PRESS (if AP operation is desired). Note AP annunciator ON.

NOTE

If it is desired to track the ILS course outbound as part of the missed approach procedure, use the NAV mode to prevent inadvertent GS coupling.

(12) Before Landing

AP DISC/TRIM INTER Switch - PRESS to disengage AP.

(c) FLIGHT DIRECTOR OPERATION (KFC 150 SYSTEMS ONLY)

NOTE

The flight director modes of operation are the same as those used for autopilot operations except the autopilot is not engaged and the pilot must maneuver the aircraft to satisfy the flight director commands.

SECTION 5 - PERFORMANCE

No change.

SECTION 6 - WEIGHT AND BALANCE

Factory installed optional equipment is included in the licensed weight and balance data in Section 6 of the basic Pilot's Operating Handbook.

SECTION 7 - DESCRIPTION AND OPERATION

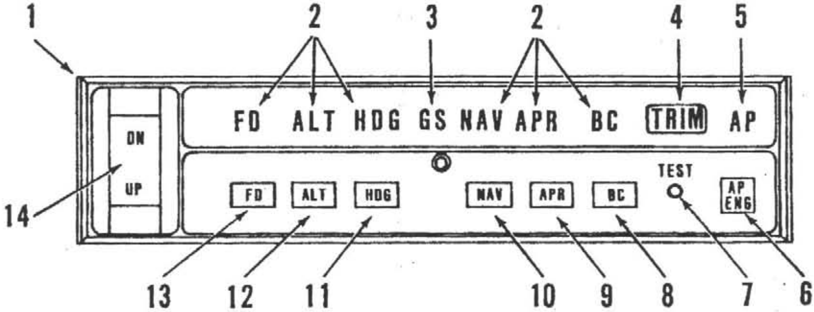
The 150 Series AFCS is certified in this airplane with 2 axis control, pitch and roll. The various instruments and the controls for the operation of the 150 System are described in Figures 7-1 thru 7-17.

The 150 Series AFCS has an electric pitch trim system which provides autotrim during autopilot operation and manual electric trim for the pilot. The trim system is designed to withstand any single inflight malfunction. Trim faults are visually and aurally annunciated.

A lockout device prevents autopilot engagement until the system has been successfully preflight tested.

The following conditions will cause the Autopilot to automatically disengage:

(a) Power failure.
(b) Internal Flight Control System failure.
(c) With the KCS 55A Compass System, a loss of compass valid (displaying HDG flag) disengages the Autopilot when a mode using heading information is engaged. With the HDG flag present, the Autopilot may be re-engaged in the basic wings level mode along with any vertical mode.
(d) Roll rates in excess of 14° per second will cause the autopilot to disengage except when the CWS switch is held depressed.
(e) Pitch rates in excess of 8° per second will cause the autopilot to disengage except when the CWS switch is held depressed.



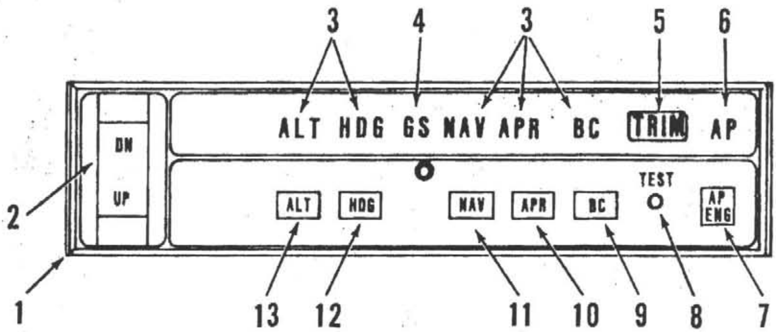
KC 192 AUTOPILOT & FLIGHT DIRECTOR COMPUTER
Figure 7-1

Figure 7-1 (cont)

1. KFC 150 SYSTEM KC 192 AUTOPILOT COMPUTER - Complete Flight Director and Autopilot computer to include system mode annunciators and system controls.
2. MODE ANNUNCIATORS - Illuminates when a mode is selected by the corresponding mode selector button (PUSH ON - PUSH OFF) or when the glide slope (GS) mode is automatically engaged.
3. GLIDE SLOPE (GS) ANNUNCIATOR - Illuminates continuously whenever the autopilot is coupled to the glide slope signal. The GS annunciator will flash if the glide slope signal is lost (GS flag in CDI or absence of glide slope pointers in KI 525A). The autopilot reverts to pitch attitude hold operation. If a valid glide slope signal returns within six seconds, the autopilot will automatically recouple in the GS mode. If the valid signal does not return within six seconds, the autopilot will remain in pitch attitude hold mode until such time that a valid glide slope returns and the aircraft passes thru the glide slope. At that point GS couple will re-occur.
4. TRIM WARNING LIGHT (TRIM) - Illuminates continuously whenever trim power is not on or the system has not been preflight tested. Flashes and is accompanied by an audible warning whenever a manual trim fault is detected. The TRIM warning light will illuminate steady and be accompanied by a steady audible tone whenever an autotrim failure occurs. The autotrim system is monitored for the following failures: trim servo running without a command; trim servo not running when commanded to run; trim servo running in the wrong direction. The trim power switch may be cycled off to silence the continuous tone but the trim fail light will remain on. The manual electric trim may be used but the autopilot should not be engaged.
5. AUTOPILOT ANNUNCIATOR (AP) - Illuminates continuously whenever the autopilot is engaged. Flashes approximately 12 times whenever the autopilot is disengaged (an aural alert will also sound for 2 seconds).
6. AUTOPILOT ENGAGE (AP ENG) BUTTON - When pushed, engages autopilot if all logic conditions are met.
7. PREFLIGHT TEST (TEST) BUTTON - When momentarily pushed, initiates preflight test sequence which automatically turns on all annunciator lights, tests the roll and pitch rate monitors, tests the autotrim fault monitor, checks the manual trim drive voltage and tests all autopilot valid and dump logic. If the preflight is successfully passed, the AP annunciator light will flash for approximately 6 seconds (an aural tone will also sound simultaneously with the annunciator flashes). The autopilot cannot be engaged until the preflight test is successfully passed.

Figure 7-1 (cont)

8. BACK COURSE APPROACH (BC) MODE SELECTOR BUTTON - When pushed, will select the Back Course Approach mode. This mode functions identically to the approach mode except that response to LOC signals is reversed. Glide slope coupling is inhibited in the Back Course Approach mode.
9. APPROACH (APR) MODE SELECTOR BUTTON - When pushed, will select the Approach mode. This mode provides all angle intercept (with HSI) or a fixed angle intercept of 45° (with DG), automatic beam capture and tracking of VOR, RNAV or LOC signals plus glide slope coupling in the case of an ILS. The tracking gain of the APR mode is greater than the gain in the NAV mode. The APR annunciator will flash until the automatic capture sequence is initiated.
10. NAVIGATION (NAV) MODE SELECTOR BUTTON - When pushed, will select the Navigation mode. The mode provides all angle intercept (with HSI) or a fixed angle intercept of 45° (with DG), automatic beam capture and tracking of VOR, RNAV or LOC signals. The NAV annunciator will flash until the automatic capture sequence is initiated.
11. HEADING (HDG) MODE SELECTOR BUTTON - When pushed, will select the Heading mode, which commands the airplane to turn to and maintain the heading selected by the heading bug on the DG or HSI. A new heading may be selected at any time and will result in the airplane turning to the new heading with a maximum bank angle of about 20°. Selecting HDG mode will cancel NAV, APR or BC track modes.
12. ALTITUDE HOLD (ALT) MODE SELECTOR BUTTON - When pushed, will select the Altitude Hold mode, which commands the airplane to maintain the pressure altitude existing at the moment of selection. Engagement may be accomplished in climb, descent, or level flight. In the APR mode, altitude hold will automatically disengage when the glide slope is captured.
13. FLIGHT DIRECTOR (FD) MODE SELECTOR BUTTON - When pushed, will select the Flight Director mode (with KC 292 Autopilot Computer only), bringing the Command Bar in view on the KI 256 and will command wings level and pitch attitude hold. The FD mode must be selected prior to Autopilot engagement.
14. VERTICAL TRIM CONTROL - A spring loaded to center rocker switch which will provide up or down pitch command changes: while in ALT will adjust altitude at rate of about 500 fpm; when not in ALT will adjust pitch attitude at a rate of .7 deg/sec. Will cancel GS couple. The aircraft must pass through the glide slope again to allow GS recouple.



KC 191 AUTOPILOT COMPUTER
Figure 7-3

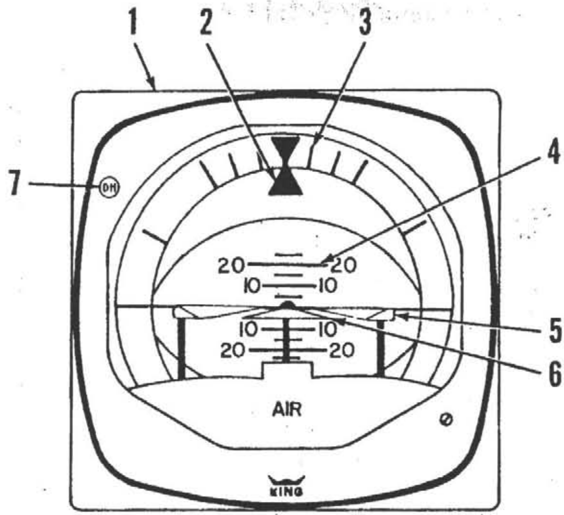
1. KFC 150 SYSTEM KC 191 AUTOPILOT COMPUTER - Complete Flight Director and Autopilot computer to include system mode annunciators and system controls.
2. VERTICAL TRIM CONTROL - A spring loaded to center rocker switch which will provide up or down pitch command changes: while in ALT will adjust altitude at rate of about 500 fpm; when not in ALT will adjust pitch attitude at a rate of .7 deg/sec. Will cancel GS couple. The aircraft must pass through the glide slope again to allow GS recouple.
3. MODE ANNUNCIATORS - Illuminate when a mode is selected by the corresponding mode selector button (PUSH ON - PUSH OFF) or when the glide slope (GS) mode is automatically engaged.
4. GLIDE SLOPE (GS) ANNUNCIATOR - Illuminates continuously whenever the autopilot is coupled to the glide slope signal. The GS annunciator will flash if the glide slope signal is lost (GS flag in CDI or absence of glide slope pointers in KI 525A). The autopilot reverts to pitch attitude hold operation. If a valid glide slope signal returns within six seconds, the autopilot will automatically recouple in the GS mode. If the valid signal does not return within six seconds, the autopilot will remain in pitch attitude hold mode until such time that a valid glide slope returns and the aircraft passes thru the glide slope. At that point GS couple will re-occur.

Figure 7-3 (cont)

5. TRIM WARNING LIGHT (TRIM) - Illuminates continuously whenever trim power is not on or the system has not been preflight tested. Flashes and is accompanied by an audible warning whenever a manual trim fault is detected. The TRIM warning light will illuminate steady and be accompanied by a steady audible tone whenever an autotrim failure occurs. The autotrim system is monitored for the following failures: trim servo running without a command; trim servo not running when commanded to run; trim servo running in the wrong direction. The trim power switch may be cycled off to silence the continuous tone but the trim fail light will remain on. The manual electric trim may be used but the autopilot should not be engaged.
6. AUTOPILOT ANNUNCIATOR (AP) - Illuminates continuously whenever the autopilot is engaged. Flashes approximately 12 times whenever the autopilot is disengaged (an aural alert will also sound for 2 seconds).
7. AUTOPILOT ENGAGE (AP ENG) BUTTON - When pushed, engages autopilot if all logic conditions are met.
8. PREFLIGHT TEST (TEST) BUTTON - When momentarily pushed, initiates preflight test sequence which automatically turns on all annunciator lights, tests the roll and pitch rate monitors, tests the autotrim fault monitor, checks the manual trim drive voltage and tests all autopilot valid and dump logic. If the preflight is successfully passed, the AP annunciator light will flash for approximately 6 seconds (an aural tone will also sound simultaneously with the annunciator flashes). The autopilot cannot be engaged until the preflight test is successfully passed.
9. BACK COURSE APPROACH (BC) MODE SELECTOR BUTTON - When pushed, will select the Back Course Approach mode. This mode functions identically to the approach mode except that response to LOC signals is reversed. Glide slope coupling is inhibited in the Back Course Approach mode.
10. APPROACH (APR) MODE SELECTOR BUTTON - When pushed, will select the Approach mode. This mode provides all angle intercept (with HSI) or a fixed angle intercept of 45° (with DG), automatic beam capture and tracking of VOR, RNAV or LOC signals plus glide slope coupling in the case of an ILS. The tracking gain of the APR mode is greater than the gain in the NAV mode. The APR annunciator will flash until the automatic capture sequence is initiated.

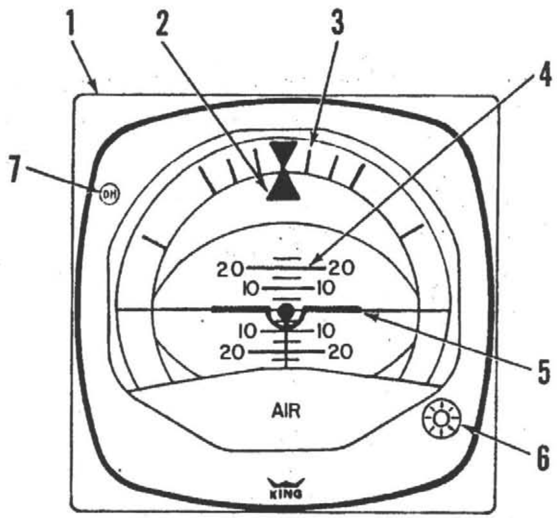
Figure 7-3 (cont)

11. NAVIGATION (NAV) MODE SELECTOR BUTTON - When pushed, will select the Navigation mode. The mode provides all angle intercept (with HSI) or a fixed angle intercept of 45° (with DG), automatic beam capture and tracking of VOR, RNAV or LOC signals. The NAV annunciator will flash until the automatic capture sequence is initiated.
12. HEADING (HDG) MODE SELECTOR BUTTON - When pushed, will select the Heading mode, which commands the airplane to turn to and maintain the heading selected by the heading bug on the DG or HSI. A new heading may be selected at any time and will result in the airplane turning to the new heading with a maximum bank angle of about 20°. Selecting HDG mode will cancel NAV, APR or BC track modes.
13. ALTITUDE HOLD (ALT) MODE SELECTOR BUTTON - When pushed, will select the Altitude Hold mode, which commands the airplane to maintain the pressure altitude existing at the moment of selection. Engagement may be accomplished in climb, descent, or level flight. In the APR mode, altitude hold will automatically disengage when the glide slope is captured.



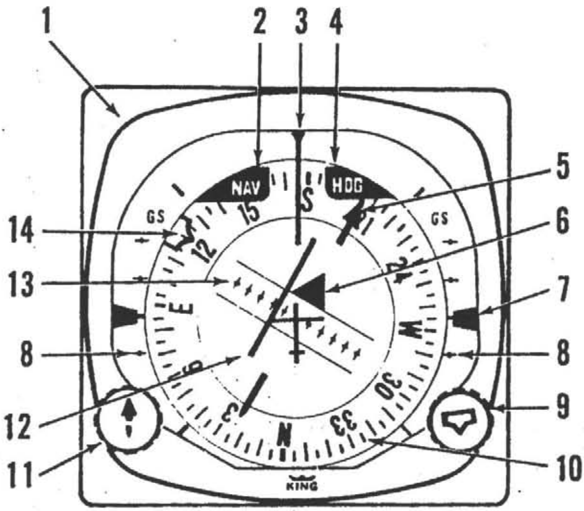
KI 256 FLIGHT COMMAND INDICATOR
Figure 7-5

1. KI 256 FLIGHT COMMAND INDICATOR (FCI) - Displays airplane attitude as a conventional attitude gyro and displays commands for flight director operation. The gyro is air driven.
2. ROLL ATTITUDE INDEX - Displays airplane roll attitude with respect to the roll attitude scale.
3. ROLL ATTITUDE SCALE - Scale marked at 0, ±10, ±20, ±30, ±60 and ±90 degrees.
4. PITCH ATTITUDE SCALE - Moves with respect to the symbolic airplane to present pitch attitude. Scale graduated at 0, ±5, ±10, ±15, ±20 and ±25 degrees.
5. COMMAND BAR - Displays computed steering commands referenced to the symbolic airplane. The command bar is visible only when FD mode is selected. The command bar will be biased out of view whenever the system is invalid or a Flight Director mode is not engaged.
6. FCI SYMBOLIC AIRPLANE - Airplane pitch and roll attitude is displayed by the relationship between the fixed symbolic airplane and the movable background. During flight director operation, the symbolic airplane is flown to align it with the command bar to satisfy the flight director commands.
7. DECISION HEIGHT (DH) ANNUNCIATOR LIGHT - Optional light for use with the aircraft's optional radar altimeter.



KG 258 VERTICAL GYRO
Figure 7-7

1. KG 258 VERTICAL GYRO - Displays airplane attitude as a conventional attitude gyro. The gyro is air driven.
2. ROLL ATTITUDE INDEX - Displays airplane roll attitude with respect to the roll attitude scale.
3. ROLL ATTITUDE SCALE - Scale marked at 0, ±10, ±20, ±30, ±60 and ±90 degrees.
4. PITCH ATTITUDE SCALE - Moves with respect to the symbolic airplane to present pitch attitude. Scale graduated at 0, ±5, ±10, ±15, ±20 and ±25 degrees.
5. SYMBOLIC AIRPLANE - Serves as a stationary symbol of the aircraft. Aircraft pitch and roll attitudes are displayed by the relationship between the fixed symbolic aircraft and the movable background.
6. SYMBOLIC AIRCRAFT ALIGNMENT KNOB - Provides manual positioning of the symbolic aircraft for level flight under various load conditions.
7. DECISION HEIGHT (DH) ANNUNCIATOR LIGHT - Optional light for use with the aircraft's optional radar altimeter.

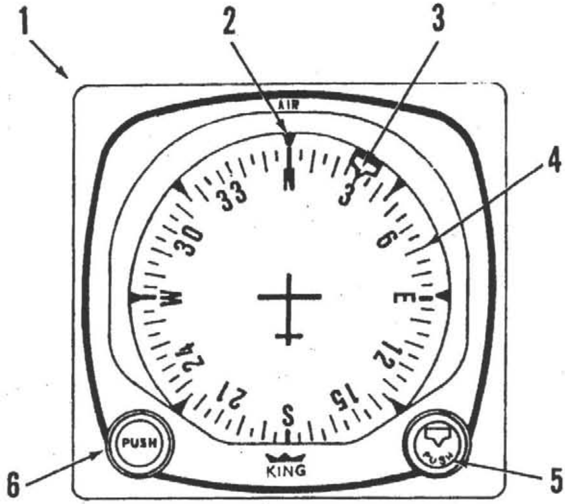


KI 525A HORIZONTAL SITUATION INDICATOR
Figure 7-9

1. KI 525A HORIZONTAL SITUATION INDICATOR (HSI) - Provides a pictorial presentation of aircraft deviation relative to VOR radials or localizer beams. It also displays glide slope deviations and gives heading reference with respect to magnetic north.
2. NAV FLAG - Flag is in view when the NAV receiver signal is inadequate. When a NAV flag is present in the navigation indicator (CDI or KI 525A) the autopilot operation is not affected. The pilot must monitor the navigation indicators for NAV flags to insure that the Autopilot and/or Flight Director are tracking valid navigation information.
3. LUBBER LINE - Indicates aircraft magnetic heading on compass card (10).
4. HEADING WARNING FLAG (HDG) - When flag is in view, the heading display is invalid. If a HDG flag appears and a lateral mode (HDG, NAV, APR or APR BC) is selected, the Autopilot will be disengaged. The Autopilot may be re-engaged in the basic wings level mode along with any vertical mode. The CWS switch would be used to maneuver the aircraft laterally.

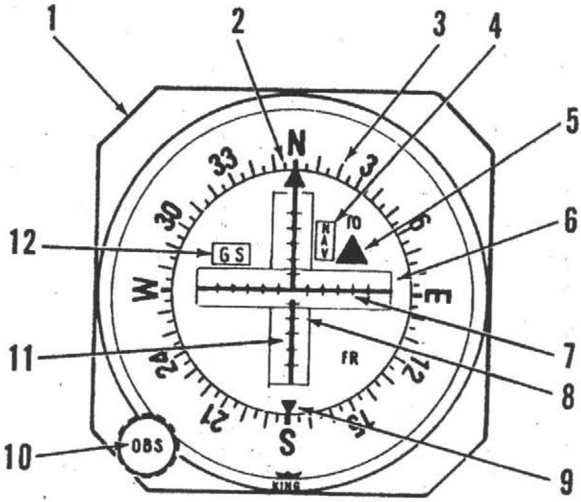
Figure 7-9 (cont)

5. COURSE BEARING POINTER - Indicates selected VOR course or localizer course on compass card (10). The selected VOR radial or localizer heading remains set on the compass card when the compass card (10) rotates.
6. TO/FROM INDICATOR FLAG - Indicates direction of VOR station relative to selected course.
7. DUAL GLIDE SLOPE POINTERS - Indicate on glide slope scale (8) aircraft displacement from glide slope beam center. Glide slope pointers in view indicate a usable glide slope signal is being received. The glide slope pointers will bias out of view if the glide slope signal is lost.
8. GLIDE SLOPE SCALES - Indicate displacement from glide slope beam center. A glide slope deviation bar displacement of 2 dots, represents full scale (0.7°) deviation above or below glide slope beam centerline.
9. HEADING SELECTOR KNOB ( ) - Positions heading bug (14) on compass card (10) by rotating the heading selector knob. The Bug rotates with the compass card.
10. COMPASS CARD - Rotates to display heading of airplane with reference to lubber line (3) on HSI.
11. COURSE SELECTOR KNOB - Positions course bearing pointer (5) on the compass card (10) by rotating the course selector knob.
12. COURSE DEVIATION BAR (D-BAR) - The center portion of omni bearing pointer moves laterally to pictorially indicate the relationship of aircraft to the selected course. It indicates degrees of angular displacement from VOR radials and localizer beams, or displacement in nautical miles from RNAV courses.
13. COURSE DEVIATION SCALE - A course deviation bar displacement of 5 dots represents full scale (VOR = ±10°, LOC = ±2 1/2°, RNAV = 5NM, RNAV APR = 1 1/4NM) deviation from beam centerline.
14. HEADING BUG - Moved by ( ) knob (9) to select desired heading.



KG 107 NON-SLAVED DIRECTIONAL GYRO
Figure 7-11

1. KG 107 NON-SLAVED DIRECTIONAL GYRO (DG) - Provides a stable visual indication of aircraft heading to the pilot. The gyro is air driven.
2. LUBBER LINE - Indicates aircraft magnetic heading on compass card (4).
3. HEADING BUG - Moved by ( ) knob (5) to select desired heading.
4. COMPASS CARD - Rotates to display heading of airplane with reference to lubber line (2) on DG.
5. HEADING SELECTOR KNOB ( ) - Positions heading bug (3) on compass card (4) by rotating the heading selector knob. The Bug rotates with the compass card.
6. GYRO ADJUSTMENT KNOB (PUSH) - When pushed in, allows the pilot to manually rotate the gyro compass card (4) to correspond with the magnetic heading indicated by the magnetic compass. The unslaved compass card must be manually reset periodically to compensate for precessional errors in the gyro.

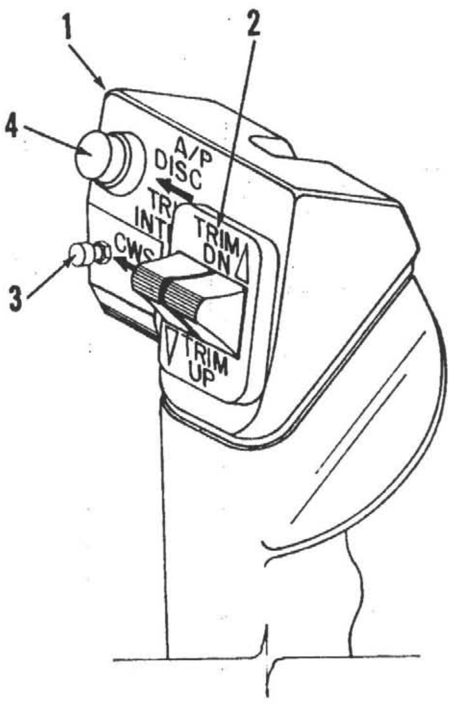


KI 204/206 VOR/LOC/
GLIDE SLOPE INDICATOR (TYPICAL)
Figure 7-13

1. VOR/LOC/GLIDE SLOPE INDICATOR - Provides rectilinear display of VOR/LOC and glide slope deviation.
2. COURSE INDEX - Indicates selected VOR course.
3. COURSE CARD - Indicates selected VOR course under course index.
4. NAV FLAG - Flag is in view when the NAV receiver signal is inadequate. When a NAV flag is present in the navigation indicator (CDI or KI 525A), the autopilot operation is not affected. The pilot must monitor the navigation indicators for NAV flags to insure that the Autopilot and/or Flight Director are tracking valid navigation information.
5. TO/FROM INDICATOR FLAG - Indicates direction of VOR station relative to selected course.
6. GLIDE SLOPE DEVIATION NEEDLE - Indicates deviation from ILS glide slope.
7. COURSE DEVIATION SCALE - A course deviation bar displacement of 5 dots represents full scale (VOR = ±10°, LOC = ±2 1/2°, RNAV = 5NM, RNAV APR = 1 1/4NM) deviation from beam centerline.

Figure 7-13 (cont)

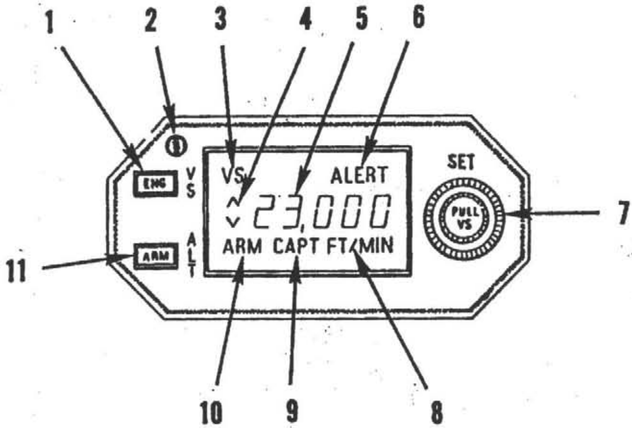
8. GLIDE SLOPE SCALE - Indicates displacement from glide slope beam center. A glide slope deviation needle displacement of 5 dots, represents full scale (0.7°) deviation above or below glide slope beam centerline.
9. RECIPROCAL COURSE INDEX - Indicates reciprocal of selected VOR course.
10. OMNI BEARING SELECTOR (OBS) KNOB - Rotates course card to selected course.
11. COURSE DEVIATION NEEDLE - Indicates course deviation from selected omni course or localizer centerline.
12. GLIDE SLOPE (GS) FLAG - Flag is in view when the GS receiver signal is inadequate.



AUTOPILOT CONTROL WHEEL SWITCH CAP
Figure 7-15

Figure 7-15 (cont)

1. AUTOPILOT CONTROL WHEEL SWITCH CAP - Molded plastic unit mounted on the left horn of the pilot's control wheel which provides mounting for three switch units associated with the autopilot and manual electric trim systems.
2. MANUAL ELECTRIC TRIM CONTROL SWITCHES - A split switch unit in which the left half provides power to engage the trim servo clutch and the right half to control the direction of motion of the trim servo motor. Both halves of the split trim switch must be actuated in order for the manual trim to operate in the desired direction. When the autopilot is engaged, operation of the manual electric trim will automatically disconnect the autopilot.
3. CONTROL WHEEL STEERING (CWS) BUTTON - When depressed, allows pilot to manually control the aircraft (disengages the servos) without cancellation of any of the selected modes. Will engage the Flight Director mode if not previously engaged. Automatically synchronizes the Flight Director/Autopilot to the pitch attitude present when the CWS switch is released, or to the present pressure altitude when operating in the ALT hold mode. Will cancel GS couple. The aircraft must pass through the glide slope to allow GS recouple.
4. AUTOPILOT DISCONNECT/TRIM INTERRUPT (AP DISC/ TRIM INTER) Switch - When depressed and released will disengage the autopilot and cancel all operating Flight Director modes. When depressed and held will interrupt all electric trim power (stop trim motion), disengage the autopilot, and cancel all operating Flight Director modes.



KAS 297B VERTICAL SPEED AND ALTITUDE SELECTOR
Figure 7-17

1. VERTICAL SPEED MODE (ENG) BUTTON - When pressed will engage the vertical speed hold mode. When pressed a second time will disengage the vertical speed hold mode. When pressed with altitude displayed, will engage the vertical speed hold mode and re-sync the vertical speed hold mode to the current vertical speed of the airplane.
2. PHOTOCELL - Automatically dims display according to the cockpit ambient light.
3. VERTICAL SPEED (VS) ANNUNCIATOR - Illuminates when the vertical speed hold mode is engaged.
4. VERTICAL SPEED UP/DOWN CARETS (^ v) - Indicates whether the selected vertical speed is up or down.
5. GAS DISCHARGE DISPLAY - Displays selected altitude from 100 to 35,000 feet or the selected vertical speed from 0 to 3,000 feet per minute up or down.

Figure 7-17 (cont)

6. ALTITUDE ALERT (ALERT) ANNUNCIATOR - The ALERT annunciator is illuminated 1000 feet prior to the selected altitude, goes out 300 feet prior to the selected altitude and illuminates momentarily when the selected altitude is reached. Once the selected altitude is reached the light signifies that the 300 feet "safe band" has been exceeded and will remain on until 1000 feet from the selected altitude. The alert light is accompanied by a 2 second aural tone anytime the light initially comes on or the selected altitude is reached.
7. VERTICAL SPEED/ALTITUDE SELECT KNOB - Concentric knobs which allow easy setting of altitude or vertical speed. The small knob (inner) has an in and out position.

   Altitude is displayed and selected when the small knob is in the IN position. When rotated the small knob selects altitude in 100 foot increments with roll over into the 1000 digits. The larger knob (outer) selects altitude in 1000 foot increments with roll over into the 10,000 digits.

   Vertical speed is displayed and selected when the small knob is in the OUT position. When rotated the small knob selects vertical speed in 100 fpm increments. The larger knob selects vertical speed in 1000 fpm increments up to a maximum of 3000 fpm.
8. MODE (FT or FT/MIN) ANNUNCIATOR - Indicates FT/MIN when in the vertical speed hold mode and FT when in the altitude select mode.
9. ALTITUDE CAPTURE (CAPT) ANNUNCIATOR - Indicates the KAS 297B has switched the autopilot from pitch attitude hold or vertical speed hold mode into the pitch roundout mode (CAPT). The point, just prior to transfer into altitude hold, at which the CAPT mode becomes active varies with the vertical speed, i.e.

   The higher the rate of climb, the sooner the CAPT mode becomes active; at low rates of climb the activation of the CAPT mode and transfer to altitude hold occur almost simultaneously.
10. ALTITUDE SELECT ARM (ARM) ANNUNCIATOR - Indicates that the altitude select mode is armed to capture the selected altitude.

Figure 7-17 (cont)

11. ALTITUDE SELECT MODE (ARM) BUTTON - When pressed and the selected altitude is displayed, will arm the altitude select mode. The altitude select (ARM) mode will cancel altitude hold (ALT) if ALT is already engaged. If altitude select (ARM) mode is present when GS couple occurs, the GS mode will cancel altitude select (ARM) mode. The engagement of ALT by the pilot's use of the ALT switch will cancel the altitude select (ARM) mode. Reselection of a new altitude will also cycle the altitude select (ARM) mode off.
12. CONTROL WHEEL STEERING (CWS) BUTTON (Figure 7-15) - When pressed, in addition to the normal autopilot functions the CWS also interfaces with the KAS 297B. When operating in the vertical speed hold mode, the CWS will re-sync the vertical speed hold mode to the current vertical speed of the airplane. If altitude is displayed when the CWS is pressed, the display will automatically display vertical speed as long as the CWS is depressed. CWS does not affect the altitude select mode.
13. VERTICAL TRIM CONTROL (Figure 7-15) - When in the vertical speed hold mode this control can be used to slew the vertical speed up or down at 100 fpm for every second the rocker switch is held. If altitude is being displayed at the time the rocker switch is depressed, vertical speed will be displayed for 1 to 2 seconds after the rocker switch is released.

The airplane MASTER SWITCH function is unchanged and can be used in an emergency to shut off electrical power to all flight control systems while the problem is isolated.

The RADIO POWER switch supplies power to the avionics buss bar of the radio circuit breakers and the autopilot circuit breaker.

The following circuit breakers are used to protect the following elements of the King 150 Series Autopilot:

AUTOPILOT - Supplies power to the KC 192 or the KC 191 Computer, the autopilot pitch and roll servos, and the Pitch Trim Circuit Breaker.

PITCH TRIM - Supplies power to the autotrim and manual electric pitch trim systems.

COMP-SYSTEM - Supplies power to the optional KCS 55A Compass System.

PILOT'S OPERATING HANDBOOK
AND
FAA APPROVED AIRPLANE FLIGHT MANUAL

SUPPLEMENT NO. 14
FOR
CENTURY 31 AUTOPILOT MODEL AK896

This supplement must be attached to the Pilot's Operating Handbook and FAA Approved Airplane Flight Manual when the Century 31 Autopilot System Model AK896 is installed in accordance with STC SA3405SW-D. The information contained herein supplements or supersedes the information in the basic Pilot's Operating Handbook and FAA Approved Airplane Flight Manual only in those areas listed herein. For limitations, procedures and performance information not contained in this supplement, consult the basic Pilot's Operating Handbook and FAA Approved Airplane Flight Manual.

FAA APPROVED Ward Evans
WARD EVANS
D.O.A. NO. SO-1
PIPER AIRCRAFT CORPORATION
VERO BEACH, FLORIDA

DATE OF APPROVAL SEPTEMBER 17, 1984

SECTION 1 - GENERAL

This supplement supplies information necessary for the operation of the airplane when the optional Century 31 Autopilot Model AK896 is installed in accordance with "FAA Approved" Piper data.

SECTION 2 - LIMITATIONS

(a) Autopilot OFF during takeoff and landing.
(b) Maximum airspeed for autopilot operation is 180 KIAS.
(c) Autopilot operation prohibited with more than 25° flaps extended.
(d) Placard (P/N 13A990-1) - in full view of the pilot:

CONDUCT TRIM CHECK
PRIOR TO FIRST FLIGHT
OF DAY (SEE AFM).

SECTION 3 - EMERGENCY PROCEDURES

(a) AUTOPILOT
In the event of an autopilot malfunction, or anytime the autopilot is not performing as commanded, do not attempt to identify the problem system. Regain control of the aircraft by overpowering and immediately disconnecting the autopilot. Be prepared for any residual trim force and retrim, as necessary, using the aircraft's primary trim control.

CAUTION

Do not overpower autopilot in pitch for more than approximately 3 seconds as the autotrim system will cause an increase in pitch overpower forces.

(1) Autopilot may be disconnected by:
  a. Pressing "AP OFF" bar on pilot's trim switch.
  b. Pressing the AP ON-OFF switch on the programmer OFF.
  c. Depressing Master Disconnect switch.

(2) Autotrim may be disconnected by:
  a. Any action in (1) above, or
  b. Pushing the trim master switch OFF.
  After failed system has been identified, leave system circuit breaker open and do not operate until the system failure has been identified and corrected.

(3) Altitude Loss During Malfunction:
  a. An autopilot malfunction during climb, cruise or descent with a 3 second delay in recovery initiation could result in as much as 60° of bank and 250 foot altitude loss. Maximum altitude loss was recorded at 180 KIAS during descent.
  b. An autopilot malfunction during an approach with a 1 second delay in recovery initiation could result in as much as 22° bank and 100 foot altitude loss. Maximum altitude loss measured with 25° flaps extended, gear down, and operating either coupled or uncoupled.

(b) COMPASS SYSTEM

(1) Emergency Operation with Optional NSD 360A (HSI) Slaved and/or Non-Slaved:
  a. Appearance of HDG Flag:
    1. Check air supply gauge (vac or pressure) for adequate air supply (4.2 in. Hg. min.).
    2. Check compass circuit breaker.
    3. Observe display for proper operation.

b. To disable heading card - pull circuit breaker and use magnetic compass for directional data.

NOTE

If heading card is not operational, autopilot should not be used.

c. With card disabled VOR/Localizer and Glide Slope displays are still functional; use card set to rotate card to aircraft heading for correct picture.
d. Slaving Failure - (i.e. failure to self correct for gyro drift):
   1. Check gyro slaving switch is set to No. 1 position (if equipped with Slave No. 1 - No. 2 switch) or SLAVED position when equipped with Slaved and Free Gyro Mode Switch.
   2. Check for HDG Flag.
   3. Check compass circuit breaker.
   4. Reset heading card while observing slaving meter.

NOTE

Dead slaving meter needle or a needle displaced fully one direction indicates a slaving system failure.

   5. Select slaving amplifier No. 2, if equipped.
   6. Reset heading card while checking slaving meter. If proper slaving indication is not obtained, switch to free gyro mode and periodically set card as an unslaved gyro.

NOTE

In the localizer mode, the TO FROM arrows may remain out of view, depending upon the design of the NAV converter used in the installation.

SECTION 4 - NORMAL PROCEDURES

(a) PREFLIGHT PROCEDURES

NOTE

During system functional check the system must be provided adequate D.C. voltage (12.0 VDC min.) and instrument air (4.2 in. Hg. min.). It is recommended that the engine be operated to provide the necessary power and that the aircraft be positioned in a level attitude, during the functional check.

(1) AUTOPILOT/AUTOTRIM - To be performed before the first flight of each day.

a. Trim system switch - on.
b. Engage autopilot.
c. Move the heading bug left and right of the lubber line. Observe that the control wheel moves in the direction of the heading bug displacement.
d. Press the DN switch - verify that the control wheel moves in the down direction. Verify that after approximately a 3 second delay, the trim moves in the down direction.
e. Press the UP switch - verify that the control wheel moves in the up direction. Verify that after approximately a 3 second delay, the trim moves in the up direction.
f. Grasp control wheel and override roll and pitch servo actuators to assure override capability.
g. Hold control yoke and disengage autopilot by activating the AP OFF switch on the control wheel.
h. Check controls through full travel in roll and pitch to assure complete autopilot disengagement.
i. Press and hold the TEST switch - all mode annunciators light with AP flashing.
j. Release the TEST switch after all annunciator lights except HDG, ATT, and TEST turn off.
k. Press the DN switch - HDG, ATT and TEST remain on.
l. Press the UP switch - HDG, ATT and TEST remain on.
m. Momentarily press the TEST switch - HDG and ATT remain on, TEST flashes.

n. Press the DN switch - the TEST light remains OFF as long as the DN switch is held.
o. Press the UP switch - the TEST light remains OFF as long as the UP switch is held.
p. Momentarily press the TEST switch - HDG and ATT lights remain on and the TEST light turns off.

(2) COMMAND TRIM SYSTEM - To be performed before the first flight of each day.
a. Using the control wheel trim switch, verify normal trim up and down operation.
b. Press and hold the center bar on the control wheel trim switch. Observe that the trim system does not operate.
c. Release the center bar on the control wheel trim switch. Move the control wheel trim switch fore and aft. Observe that the trim system does not operate.

This completes the test sequences.

CAUTIONS

Any failure of the above procedures indicates that a failure exists in the system and the system shall not be operated until the failure has been located and corrected.

Check the elevator trim setting before takeoff.

(3) COMPASS SYSTEM (NSD 360A)
(For other compass systems, refer to appropriate manufacturer's instructions)
a. Check slaving switch in SLAVE or SLAVE No. 1 or No. 2 position, as appropriate. (Slaving systems with R.M.I. output provides only slave and free gyro positions.)
b. Rotate card to center slaving meter - check HDG displayed with magnetic compass heading.
c. Perform standard VOR receiver check.

(b) IN-FLIGHT PROCEDURE - AUTOPILOT
(1) Rotate heading bug to desired heading.
(2) Trim aircraft for existing flight condition (all axes). Engage autopilot.
(3) During maneuvering flight - control aircraft through use of the heading bug and the pitch modifier. (HDG-ATT modes)

(4) For navigation operations select modes as required by the operation being conducted and in accordance with the mode description provided in Section 7.1. For specific instructions relating to coupled instrument approach operations, refer to Special Operations and Information.

(c) IN-FLIGHT PROCEDURE - COMMAND/AUTOTRIM SYSTEM

(1) Trim master ON.

(2) When the autopilot is engaged, pitch trim is accomplished and maintained automatically.

(3) With the autopilot OFF, command trim is obtained by pressing and rocking the combination TRIM-AP disconnect bar on the pilot's control wheel trim switch.

(d) SPECIAL OPERATIONS AND INFORMATION

(1) Altitude Hold Operation
For best results, reduce rate of climb or descent to 1000 FPM before engaging altitude hold mode. For smooth control, changes in flap extension should be made one notch at a time allowing time between changes for airspeed to stabilize.

(2) Instrument Approach Operations
Initial and/or intermediate approach segments should be conducted between 100-106 KIAS with flaps positioned 0° to 25°. Upon intercepting the glide path or when passing the final approach fix (FAF) immediately lower the landing gear and reduce the power for approximately 80-90 KIAS on the final approach segment. Adjust power as necessary during remainder of approach to maintain correct airspeed. Monitor course guidance information (raw data) throughout the approach. All power changes should be of small magnitude and smoothly applied for best tracking performance. Do not change aircraft configuration during final approach while autopilot is engaged. For approaches without glide path coupling, adjust pitch attitude in conjunction with power to maintain desired airspeed and descent rate.

NOTE

The autopilot will not decouple from the GS or localizer in the event of radio failure, however, warnings will flash in the mode appropriate to the failure. Monitor course guidance raw data during the approach to assure signal quality.

(3) Instrument Approach Go-Around Maneuver
   a. Disconnect the autopilot and manually control the aircraft.
   b. Add takeoff power, or power as desired.
   c. Check that correct attitude and a positive rate of climb is indicated, then raise gear and flaps.
   d. Set the heading bug to the desired missed approach heading.
   e. Re-engage the autopilot.

SECTION 5 - PERFORMANCE

No change.

SECTION 6 - WEIGHT AND BALANCE

Factory installed optional equipment is included in the licensed weight and balance data in Section 6 of the basic Pilot's Operating Handbook.

SECTION 7 - DESCRIPTION AND OPERATION

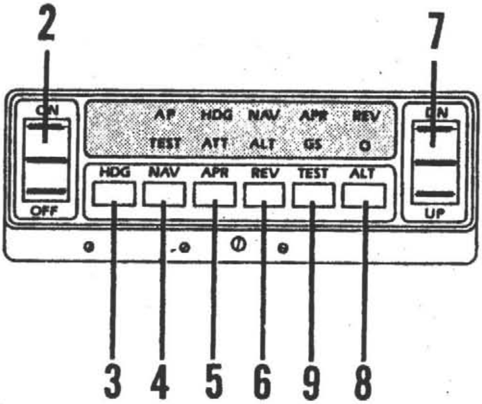
The Century 31 Autopilot is a light weight electronic autopilot system utilizing vertical and directional gyro signals and D.C. electric servos to provide three axis sensing and two surface control. The system includes lateral and vertical radio coupling, command and automatic elevator trim; and navigation and autopilot failure monitor and warning systems.

The Century 31 is activated with the aircraft master switch and operates in a low power state until the autopilot is engaged. Mode selection is made by pushing the desired mode switch on the mode programmer. The selected mode will illuminate on the annunciator panel.

The annunciator panel contains an ambient light level sensor which will automatically dim the annunciator light level during night operations. The programmer contains mode recognition lights and dimming is provided by the panel light dimmer switch.

The electric elevator trim system is a fully redundant type in both the manual and autotrim modes. The trim system is powered through a separate system master switch that must be "ON" during autopilot operations, and for the control wheel trim command switch to function when the autopilot is OFF.

7.1 COCKPIT CONTROLS AND FUNCTIONS



CONTROLLER/FLIGHT COMPUTER
Figure 7-1

1. Trim System Master Switch (Figure 7-3) - provides power for all autotrim and control wheel electric trim operations.
2. Autopilot ON - OFF Switch - Momentary rocker type switch which engages or disengages the autopilot roll, pitch and trim servos and lights or extinguishes autopilot (AP) annunciator, as appropriate.

NOTE

The autopilot will switch to HDG and ATT modes upon engagement or disengagement with automatic pitch attitude synchronization.

3. HDG Mode Selector Switch - provides turn control and heading hold through use of the heading index (bug) on the D.G. or H.S.I. heading instrument.

Figure 7-1 (cont)

4. NAV (Navigation) Mode Selector Switch - provides automatic 45° VOR-LOC intercept angle; tracking and crosswind correction. The autopilot utilizes the HDG bug as the VOR course reference and a separate VOR indicator instrument for left-right information when using a D.G. or the course indicator and left-right needle for reference inputs when using an H.S.I. type compass/VOR display. The NAV mode provides automatic gain and rate reductions and bank limiting to improve tracking performance. NAV mode should normally be used as an enroute function. Select APR mode for LOC and VOR approaches.

   NOTES

   The heading bug is disabled when using an H.S.I. and NAV, APR or REV is selected, except when using selected angle intercept feature (refer to Special Modes and Operations).

   With a D.G., the heading bug must be set to the desired radio course when using NAV, APR or REV modes.

   Select desired course on H.S.I. course selector (or OBS and D.G.) and select NAV mode for VOR tracking.
5. APR (Approach) Mode Selector Switch - provides automatic 45° VOR-LOC intercept angle, tracking and crosswind correction during instrument approach operations. D.G./H.S.I. operation and function are identical to NAV mode. Select the desired course on H.S.I. (or O.B.S. and D.G.) course selector and select APR mode.
6. REV (Back Course) Mode Selector Switch - for use in tracking the LOC front course outbound, or the LOC back course inbound, or the published VOR approach course outbound. When using an H.S.I. display always set the course selector on the inbound front localizer course or VOR inbound published approach course when using REV mode. When using a D.G. the heading bug must be set to the final approach course.
7. Pitch Modifier/Attitude Selector Switch
   The pitch data modifier is a momentary type switch that is used to select the ATT mode or modify the aircraft attitude. When the autopilot is engaged, automatic pitch synchronization is provided to the attitude existing at engagement. In ATT mode, actuation of the modifier UP or DN will cause a pitch attitude change at a rate of

Figure 7-1 (cont)

.7° per second. In ALT mode, actuation of the pitch modifier will cause the autopilot to enter the ATT mode with subsequent operation as described above.

8. ALT (Altitude) Mode Selector Switch
Selection of ALT mode will cause the autopilot to maintain the pressure level (altitude) at the point of engagement. Because of the pitch rate control provided by the autopilot, altitude mode may be engaged from any rate of climb or descent, however, for maximum passenger comfort, rate of climb or descent should be reduced to 1000 FPM or less prior to ALT mode engagement.

(a) SPECIAL MODES AND OPERATIONS

(1) Glide Slope (GS) Mode - The GS mode is fully automatic, therefore, no GS engage switch is used. The GS mode may be entered from either ATT mode or ALT mode, from above the GS centerline or below the centerline.

Activation of the GS mode depends upon satisfying two sets of conditions; completion of the ARMING sequence and the satisfying of an equation relating to the aircraft's position relative to the GS centerline and the rate at which the aircraft is approaching or departing from the GS centerline.

For GS mode arming, the following conditions must exist simultaneously:

a. No. 1 NAV radio must be channeled to a localizer frequency.
b. Localizer deviation must be less than 80%.
c. Localizer flag not extended - valid LOC signal.
d. GS Flag not extended - valid GS signal.
e. System in APR mode.
f. System in either ATT or ALT mode.

When the GS mode arming conditions are met, the GS mode annunciator will illuminate in conjunction with the active pitch mode. Loss of any arming condition prior to GS capture will cause the GS annunciator to extinguish.

GS mode activation (GS capture) is indicated by the active pitch mode annunciator extinguishing, leaving only the GS annunciator lighted. Since GS mode activation results from a combination of position and rate information, GS capture will probably occur before the GS needle centers in such a manner that the transition on to the GS centerline will be anticipated and therefore, very smooth.

After GS capture, loss of valid GS signal will cause the GS annunciator to flash. Also selection of HDG, NAV or REV mode will cause GS to flash, indicating an inconsistent GS tracking condition. APR mode must be selected while tracking glide slope.

The GS mode may be deactivated by selection of any other pitch mode (ATT, ALT), however, automatic reactivation is possible from any pitch mode if APR mode is selected.

NOTE

If valid glide slope data is lost after coupling, the autopilot will NOT automatically decouple, however the GS light will flash. The pilot must monitor raw course guidance data during the approach to assure signal quality.

Since GS arm and capture are automatic when the arming and capture sequence is met, the GS must be locked out for holding operations on the localizer at the L.O.M. When localizer holding is desired, localizer tracking must be performed in NAV mode which will offer the same tracking dynamics as APR mode but will inhibit GS arm and capture. When APR clearance is received, select APR mode for completion of the approach.

(2) Selected Angle Intercepts - If an H.S.I. type heading system is installed, selected angle intercepts may be made during VOR or localizer intercept situations by selecting HDG and NAV, HDG and APR, or HDG and REV, simultaneously, as appropriate. During a selected angle intercept operation, the autopilot will follow the heading bug until reaching the computed On Course Turn Point at which time capture is indicated by extinguishing of the HDG mode annunciator. Selected angle intercepts of over 60° are not recommended.

NOTE

If radio information becomes invalid (Flag) after initiation of a selected angle intercept the applicable navigation mode annunciator will flash and the autopilot will remain in HDG mode. The automatic mode shift to the invalid radio mode will not occur.

(3) CWS Mode - The system is equipped with a control wheel steering switch on the pilot's control wheel. When depressed and held, this switch will disengage the autopilot roll and pitch servos to allow manual aircraft maneuvering. When released, the servos will re-engage with the lateral (roll) mode previously in use activated. The pitch mode previously engaged will remain programmed in the following condition:

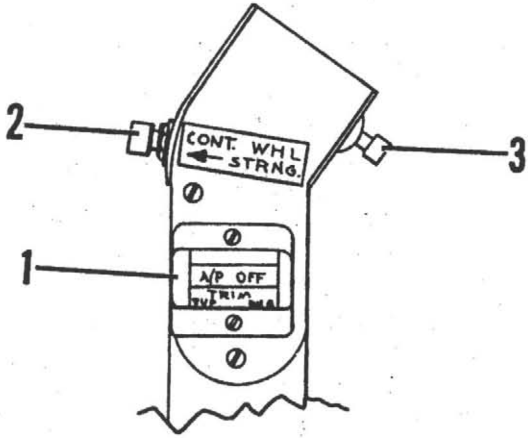
a. ALT Mode - If ALT mode had been in use, the ALT mode will synchronize at the new pressure altitude existing at release of the CWS switch.
b. ATT Mode - If the ATT mode had been in use, the system will synchronize with the aircraft attitude existing at release of the switch.

(4) System Test (Ground Operations Only) - The system is equipped with a comprehensive test circuit which, when activated, will test the failure monitor circuits and all the annunciator lamps. Activation of the TEST switch will initiate the system test only when the autopilot is NOT engaged. When autopilot is engaged, activation of the TEST switch will test the annunciator lamps. If the autopilot is engaged during the test sequence, the sequence will terminate immediately. Refer to Section 4 for tests required before the first flight of each day.

(5) Warning System and Interlocks - The Century 31 System includes a number of automatic interlocks that will prevent system operation or individual mode operation if the input information is not valid or if other prerequisite conditions do not exist. In addition to the interlocks, the system will annunciate various failure conditions as advisory information for the pilot. Following is a brief description of the interlocks and warnings provided.

a. Interlocks
    1. Autopilot engagement is inhibited unless an excitation signal is being provided to the attitude gyro.
    2. Selection of ALT mode is inhibited if the system altitude information is unreliable or if the entire system has not been powered for approximately 3 minutes to allow stabilization of the altitude source.
    3. During Dual Mode (selected angle) intercepts, if the navigation information becomes invalid the appropriate NAV/APR/REV annunciator will flash and automatic mode switching from HDG to the coupled navigation mode will be inhibited.
b. Warnings
    1. Low Voltage - When the aircraft bus voltage falls below the minimum required for reliable system function, any mode annunciator not already ON will flash.
    2. Attitude Gyro Excitation - Absence of valid gyro excitation will cause the autopilot to disengage and the AP annunciator to flash. The autopilot cannot be re-engaged until this condition is corrected.
    3. AP Disengagement - Anytime the autopilot is disengaged the AP annunciator will flash for approximately 5 seconds, then remain OFF.
    4. Navigation Information Invalid - The appropriate navigation mode annunciator will flash when selected and invalid navigation signals are present (NAV Flag in view). Additionally, the appropriate navigation mode annunciator (NAV/APR/REV) will flash during a dual mode intercept if invalid navigation information is present.
    5. GS Information Invalid - The GS annunciator will flash when GS information (GS Flag in view) is invalid after the GS mode is active or when HDG, NAV or REV mode is selected after GS capture. If valid GS information is not available during the arming sequence, the system will not arm and GS capture will not occur.

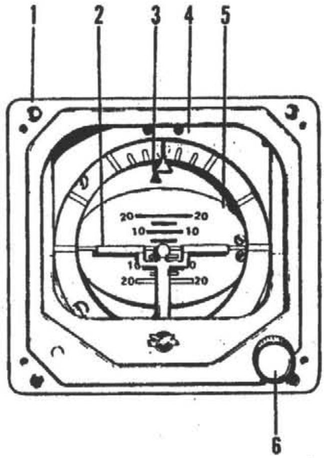
(b) REMOTE CONTROL SWITCHES



AUTOPILOT CONTROL WHEEL SWITCH CAP
Figure 7-3

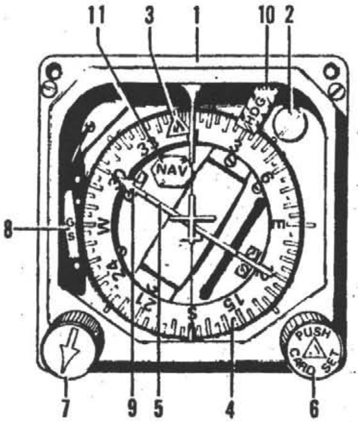
(1) Command Trim Switch - Dual action type switch requiring the top bar to be depressed and the rocker to be moved fore or aft to cause the electric trim to function from the control wheel switch. Depressing the center bar will disconnect the autopilot.
(2) Control Wheel Steering (CWS) Switch
See explanation in Special Modes and Operations Section.
(3) Master Disconnect Switch - Pressing this switch will disconnect autopilot and interrupt command/autotrim operation while depressed. Trim operation will resume when the switch is released.

7.3 INSTRUMENTS



ATTITUDE GYRO
Figure 7-5

1. Standard 3 Inch Air Driven Attitude Indicator Gyro.
2. Symbolic Airplane - Serves as a stationary symbol of the aircraft. Aircraft pitch and roll attitudes are displayed by the relationship between the fixed symbolic aircraft and the movable background.
3. Roll Attitude Index - Displays airplane roll attitude with respect to the roll attitude scale.
4. Roll Attitude Scale - Scale marked at 0, ±10, ±20, ±30, ±60 and ±90 degrees.
5. Pitch Attitude Scale - Moves with respect to the symbolic airplane to present pitch attitude. Scale graduated at 0, ±5, ±10, ±15, ±20 degrees.
6. Symbolic Aircraft Alignment Knob - Provides manual positioning of the symbolic aircraft for level flight under various load conditions.



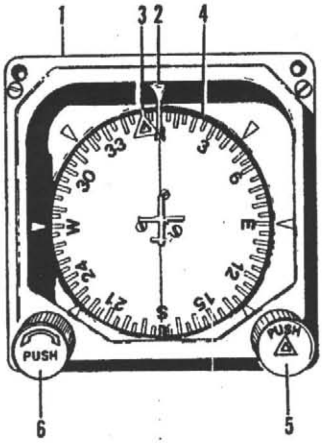
NSD-360A NAVIGATION SITUATION DISPLAY
Figure 7-7

1. NSD-360A Compass System - (For details of any other compass system, refer to manufacturer's information.)
2. Slaving Meter - Oscillation of needle indicates that compass is slaved to magnetic flux detector. Needle maintained in either extreme position for more than 2 - 3 minutes indicates system failure.

NOTE

NSD-360A System includes a slaving selector switch allowing the selection of free gyro mode. Refer to emergency procedures for failure instructions.

3. HDG index (bug) for autopilot heading control.
4. Compass card.
5. Left-right portion of VOR-LOC Course Needle.
6. HDG Control Knob - push in for initial compass setting.
7. VOR Course Needle Set Knob (O.B.S.).
8. GS Indicator with Flag Alarm.
9. VOR-LOC Bearing Selector Course Needle and Omni Bearing Indicator.
10. Heading Warning Flag.
11. Navigation Warning Flag.



DIRECTIONAL GYRO
Figure 7-9

1. Non-Slaved Directional Gyro - Provides a stable visual indication of aircraft heading to the pilot. The gyro is air driven.
2. Lubber Line - Indicates aircraft magnetic heading on compass card (4).
3. Heading Bug - Moved by (△) knob (5) to select desired heading.
4. Compass Card - Rotates to display heading of airplane with reference to lubber line (2) on DG.
5. Heading Selector Knob (△) - Positions heading bug (3) on compass card (4) by rotating the heading selector knob. The bug rotates with the compass card.
6. Gyro Adjustment Knob (PUSH) - When pushed in, allows the pilot to manually rotate the gyro compass card (4) to correspond with the magnetic heading indicated by the magnetic compass. The unslaved compass card must be manually reset periodically to compensate for precessional errors in the gyro.

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PILOT'S OPERATING HANDBOOK AND FAA APPROVED AIRPLANE FLIGHT MANUAL

SUPPLEMENT NO. 15 FOR SPERRY WEATHERSCOUT WEATHER RADAR SYSTEM

This supplement must be attached to the Pilot's Operating Handbook and FAA Approved Airplane Flight Manual when the Sperry Weather-Scout Weather Radar System is installed per Piper Drawing 87425-5. The information contained herein supplements or supersedes the information in the basic Pilot's Operating Handbook and FAA Approved Airplane Flight Manual only in those areas listed herein. For limitations, procedures and performance information not contained in this supplement, consult the basic Pilot's Operating Handbook and FAA Approved Airplane Flight Manual.

FAA APPROVED Ward Evans
WARD EVANS
D.O.A. NO. SO.-1
PIPER AIRCRAFT CORPORATION
VERO BEACH, FLORIDA

DATE OF APPROVAL SEPTEMBER 17, 1984

SECTION 1 - GENERAL

This supplement supplies information necessary for the operation of the airplane when the optional Sperry WeatherScout Weather Radar System is installed.

SECTION 2 - LIMITATIONS

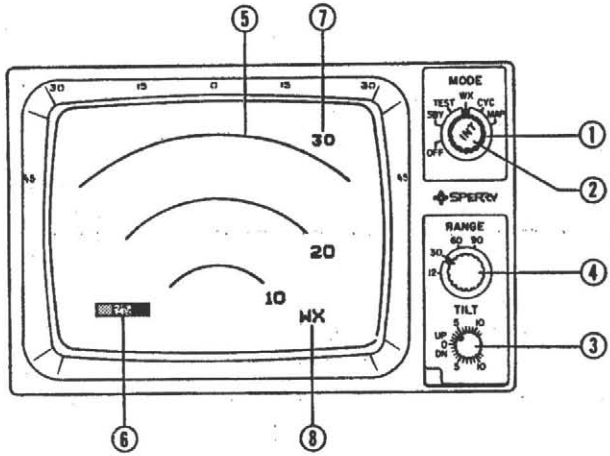
Do not operate the radar during refueling operations or in the vicinity of trucks or containers accommoding flammables or explosives. Do not allow personnel within 15 feet of area being scanned by antenna when system is transmitting.

SECTION 3 - EMERGENCY PROCEDURES

No change.

SECTION 4 - NORMAL PROCEDURES

(a) SYSTEM CONTROLS



INDICATOR CONTROLS AND DISPLAY FEATURES

(1)	MODE Selector	
	a. OFF	All power is off.
	b. SBY	Standby mode is used for system warmup. The antenna is not radiating energy in SBY.
	c. TEST	Weather colors are displayed for preflight test.
	d. WX	Normal weather detection mode.
	e. CYC	Cyclic contour mode activated alternate flashing of red, intense storm cells, with a black background color for added warming emphasis.
	f. MAP	Activates groundmapping for identification of prominent terrain features.
(2)	INT	Rotary control used to regulate brightness (INTensity) of display.

(3)	TILT	Rotary control used to adjust antenna elevation position. Control indexes increments of tilt from 0 to 12 degrees up or down.
(4)	RANGE 12/30/60/90	Rotary switch used to select one of four ranges.
(5)	Range Field	Maximum selected range is displayed. Maximum range is always displayed when indicator is in on-condition.
(6)	Test Field	Test block displays three illumination levels.
(7)	Range Mark Identifier	Individual label displayed for each range mark.
(8)	Mode Field	Operating mode is displayed as WX or CYC. When system is first turned on, WAIT is displayed until system times out (30-40 seconds).

(b) PRELIMINARY CONTROL SETTINGS
Place the Indicator controls in the following positions before applying power from the aircraft electrical system:

MODE selector .... OFF
INTensity control .... Fully counterclockwise
TILT control .... Fully upward
RANGE switch .... 12 nautical miles

(c) OPERATIONAL CONTROL SETTINGS
(1) Rotate MODE selector clockwise to SBY to bring system into ON condition.
(2) Note that WAIT is displayed during warm-up period of 30-40 seconds.
(3) Rotate MODE selector to desired operating mode.
(4) Set RANGE switch to desired range.
(5) Adjust TILT control for desired forward scan area.

(d) PRECAUTIONS

(1) If the radar is to be operated while the aircraft is on the ground, direct nose of aircraft such that antenna scan sector is free of large metallic objects (hangars, other aircraft) for a distance of 100 yards (90 meters), and tilt antenna fully upward.

WARNING

Do not operate the radar during refueling operations or in the vicinity of trucks or containers accommodating flammables or explosives; do not allow personnel within 15 feet of area being scanned by antenna when system is transmitting.

(2) Flash bulbs can be exploded by radar energy.

(3) Since storm patterns are never stationary, the display is constantly changing. Continued observation is always advisable in stormy areas.

SECTION 5 - PERFORMANCE

No change.

SECTION 6 - WEIGHT AND BALANCE

Factory installed optional equipment is included in the licensed weight and balance data in Section 6 of the basic Pilot's Operating Handbook.

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PILOT'S OPERATING HANDBOOK
AND
FAA APPROVED AIRPLANE FLIGHT MANUAL

SUPPLEMENT No. 16
FOR
AUXILIARY VACUUM SYSTEM

This supplement must be attached to the Pilot's Operating Handbook and FAA Approved Airplane Flight Manual when the Piper Auxiliary Vacuum System is installed in accordance with Piper Drawing No. 87778-2. The information contained herein supplements or supersedes the basic Pilot's Operating Handbook and FAA Approved Airplane Flight Manual only in those areas listed herein. For limitations, procedures, and performance information not contained in this supplement, consult the Pilot's Operating Handbook and FAA Approved Airplane Flight Manual.

FAA APPROVED D H Trompler
D.H. TROMPLER
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PIPER AIRCRAFT CORPORATION
VERO BEACH, FLORIDA

DATE OF APPROVAL DECEMBER 3, 1986

SECTION 1 - GENERAL

This supplement supplies information necessary for the operation of the airplane when the optional Piper Auxiliary Vacuum System is installed. The information contained within this supplement is to be used in conjunction with the complete handbook.

SECTION 2 - LIMITATIONS

1. The auxiliary vacuum system is limited to standby function only, do not take off with the engine driven dry air pump inoperative.
2. Discontinue flight in Instrument Meteorological Conditions (IMC) if vacuum pressure falls below 4.8 In. Hg.
3. The auxiliary pump/motor assembly and elapsed time indicator must be removed from service after 500 hours accumulated operating time or 10 years, whichever occurs first.

SECTION 3 - EMERGENCY PROCEDURES

1. VAC OFF or Low VAC Warning - Auxiliary Vacuum Switch AUX ON.
2. Verify vacuum system suction 4.8 to 5.2 In. Hg.

CAUTION

Compass error may exceed 10° when auxiliary vacuum system is in operation.

3. Monitor electrical load - verify alternator capacity is not being exceeded as indicated by the ammeter. If required turn off non-essential electrical equipment
4. Land at the earliest opportunity to have primary system repaired.

SECTION 4 - NORMAL PROCEDURES

1. Preflight Check.
   a. Turn on battery switch and verify that VAC OFF light illuminated.

NOTE

Due to electrical power requirements of the auxiliary vacuum pump it is suggested that the engine be operating while making the following checks.

b. Turn on auxiliary vacuum pump and verify AUX ON light is illuminated and electrical load (approximately 15 amps) on ammeter.
c. Turn off auxiliary vacuum pump and verify AUX ON light extinguished.

2. Inflight Check.
   a. Turn off non-essential electrical equipment.
   b. Turn on auxiliary vacuum pump and verify AUX ON light illuminated and electrical load (approximately 15 amps) on ammeter.
   c. Turn off auxiliary vacuum pump and verify AUX ON light extinguished and return to normal flight.

NOTE

For maximum service life, avoid continuous non-emergency operation of the auxiliary vacuum pump.

SECTION 5 - PERFORMANCE

No change.

SECTION 6 - WEIGHT & BALANCE

Factory installed optional equipment is included in the licensed weight and balance data in section 6 of the Pilot's Operating Handbook.

SECTION 7 - DESCRIPTION AND OPERATION

The auxiliary dry air pump system provides an independent back-up source of pneumatic power to operate the gyro flight instruments in the event the engine driven air pump fails. Neither the auxiliary nor the engine driven gyro vacuum system provides air for deice boot inflation and hold-down. These functions are provided by a separate engine driven air pump system.

The control switch labeled (AUX VAC) is located on the right side of the instrument panel below the vacuum suction gage.

The switch button incorporates two annunciator light sections labeled VAC OFF and AUX ON. The VAC OFF section is controlled by a vacuum switch in the primary pneumatic system and illuminates an amber light when the engine driven pump is inoperative or when the system vacuum falls below the switch activation level. The AUX ON section is controlled by a vacuum switch in the auxiliary pneumatic system and illuminates a blue light when the auxiliary pump is operating and creating a vacuum in the system. When the auxiliary pump is activated at high altitude, or if the system has developed air leaks, the AUX ON light may fail to illuminate. This indicates that the system vacuum is still below the AUX ON switch activation level even though the auxiliary pump is operating and can be verified by observing the vacuum system indicator.

The annunciator lights do not incorporate a press-to-test feature. If the lights do not illuminate, check for burned out lamps. Replace with MS25237-330 bulbs and retest the system.

System electrical protection is provided by a 20 amp circuit breaker in the pump motor circuit and a 5 amp circuit breaker in the annunciator light circuit. The breakers are mounted on the circuit breaker panel.

The auxiliary pump is in the forward baggage compartment under the right side floor board. The auxiliary system connects to the primary system at a manifold downstream of the vacuum regulator. Isolation of the primary and auxiliary systems from each other is accomplished by check valves on each side of the manifold. The primary system vacuum switch is located in the center of the manifold and senses vacuum supplied to the gyros. The auxiliary system vacuum switch is located on the manifold between the check valve and the auxiliary pump and senses vacuum generated by the auxiliary pump. In order to assure high reliability of the auxiliary air pump system as a back-up power supply for gyro instruments, the pump/motor assembly must be removed and replaced after a time in service as specified in the limitation Section 2 of this handbook. An elapsed time indicator is incorporated into the auxiliary pump electrical system to show accumulated hours of operation.

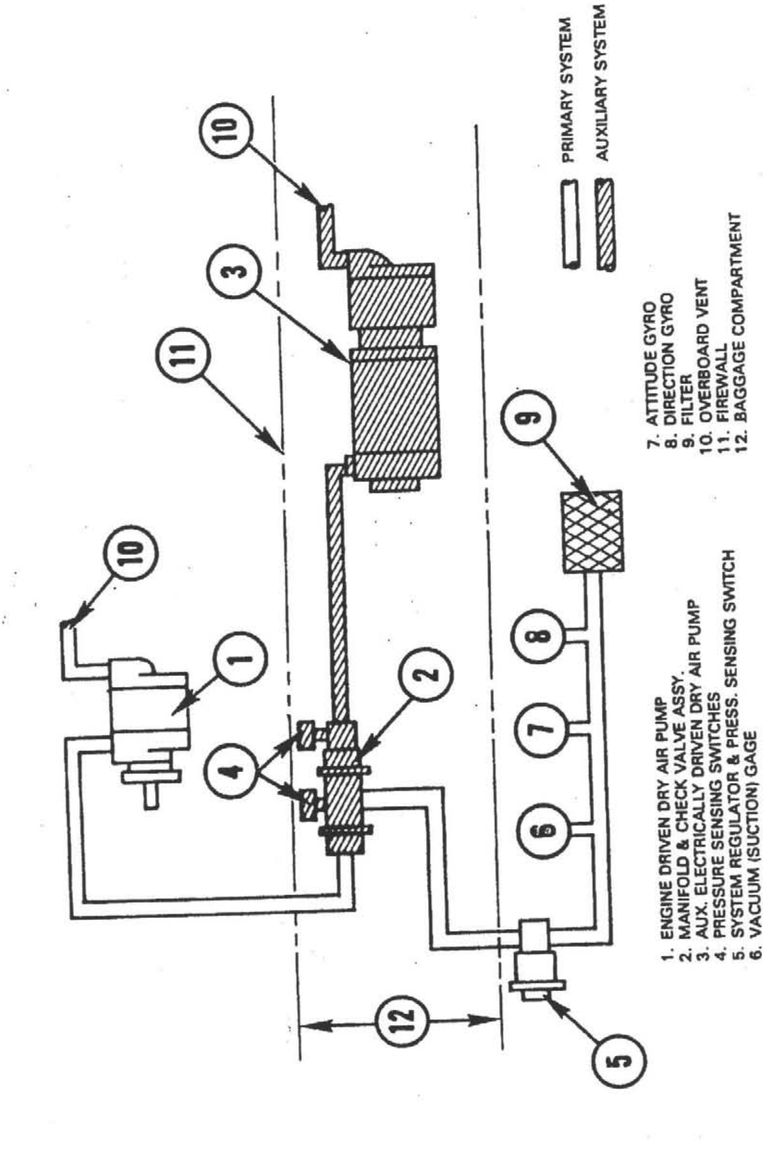
PRIMARY SYSTEM
AUXILIARY SYSTEM
1. ENGINE DRIVEN DRY AIR PUMP
2. MANIFOLD & CHECK VALVE ASSY.
3. AUX. ELECTRICALLY DRIVEN DRY AIR PUMP
4. PRESSURE SENSING SWITCHES
5. SYSTEM REGULATOR & PRESS. SENSING SWITCH
6. VACUUM (SUCTION) GAGE
7. ATTITUDE GYRO
8. DIRECTION GYRO
9. FILTER
10. OVERBOARD VENT
11. FIREWALL
12. BAGGAGE COMPARTMENT

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TABLE OF CONTENTS

SECTION 10

OPERATING TIPS

SECTION 10

OPERATING TIPS

10.1 GENERAL

This section provides operating tips of particular value in the operation of the airplane.

10.3 OPERATING TIPS

(a) Learn to trim for takeoff so that only a very light back pressure on the control wheel is required to lift the airplane off the ground.

(b) Trying to pull the airplane off the ground at too low an airspeed decreases the controllability of the airplane in the event of engine failure.

(c) Flaps may be lowered at airspeeds up to 112 KIAS. To reduce flap operating loads, it is desirable to have the airplane at a slower speed before extending the flaps. The flap step will not support weight if the flaps are in any extended position. The flaps must be placed in the "UP" position before they will lock and support weight on the step.

(d) Before attempting to reset any circuit breaker, allow a two to five minute cooling off period.

(e) Before starting the engine, check that all radio switches, light switches and the pitot heat switch are in the off position so as not to create an overloaded condition when the starter is engaged.

(f) Anti-collision lights should not be operating when flying through cloud, fog or haze, since reflected light can produce spacial disorientation. Strobe lights should not be used in close proximity to the ground such as during taxiing, takeoff or landing.

(g) The rudder pedals are suspended from a torque tube which extends across the fuselage. The pilot should become familiar with the proper positioning of his feet on the rudder pedals so as to avoid interference with the torque tube when moving the rudder pedals or operating the toe brakes.

(h) In an effort to avoid accidents, pilots should obtain and study the safety related information made available in FAA publications such as regulations, advisory circulars, Aviation News, AIM and safety aids.

(i) Prolonged slips or skids which result in excess of 2000 ft. of altitude loss, or other radical or extreme maneuvers which could cause uncovering of the fuel outlet must be avoided as fuel flow interruption may occur when tank being used is not full.