ARROW
PA-28R-201

SN 2837001 AND UP

PILOT'S OPERATING HANDBOOK

AND

FAA APPROVED AIRPLANE FLIGHT MANUAL

AIRPLANE SERIAL NO. ____________________

AIRPLANE REGIST. NO. ____________________

PA-28R-201
REPORT: VB-1365 FAA APPROVED BY: ____________________

D.H. TROMPLER
D.O.A. NO. SO-1
PIPER AIRCRAFT CORPORATION
VERO BEACH, FLORIDA

DATE OF APPROVAL:
November 29, 1988

THIS HANDBOOK INCLUDES THE MATERIAL REQUIRED TO BE FURNISHED TO THE PILOT BY THE FEDERAL AVIATION REGULATIONS AND ADDITIONAL INFORMATION PROVIDED BY THE MANUFACTURER AND CONSTITUTES THE FAA APPROVED AIRPLANE FLIGHT MANUAL. THIS HANDBOOK MUST BE CARRIED IN THE AIRPLANE AT ALL TIMES.

WARNING

EXTREME CARE MUST BE EXERCISED TO LIMIT THE USE OF THIS HANDBOOK TO APPLICABLE AIRCRAFT. THIS HANDBOOK REVISED AS INDICATED BELOW OR SUBSEQUENTLY REVISED IS VALID FOR USE WITH THE AIRPLANE IDENTIFIED ON THE FACE OF THE TITLE PAGE. SUBSEQUENT REVISIONS SUPPLIED BY PIPER AIRCRAFT CORPORATION MUST BE PROPERLY INSERTED.

Published by
PUBLICATIONS DEPARTMENT
Issued: September 15, 1988

APPLICABILITY

Application of this handbook is limited to the specific Piper PA-28R-201 model airplane designated by serial number and registration 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.

WARNING

INSPECTION, MAINTENANCE AND PARTS REQUIREMENTS FOR ALL NON-PIPER APPROVED STC INSTALLATIONS ARE NOT INCLUDED IN THIS HANDBOOK. WHEN A NON-PIPER APPROVED STC INSTALLATION IS INCORPORATED ON THE AIRPLANE, THOSE PORTIONS OF THE AIRPLANE AFFECTED BY THE INSTALLATION MUST BE INSPECTED IN ACCORDANCE WITH THE INSPECTION PROGRAM PUBLISHED BY THE OWNER OF THE STC. SINCE NON-PIPER APPROVED STC INSTALLATIONS MAY CHANGE SYSTEMS INTERFACE, OPERATING CHARACTERISTICS AND COMPONENT LOADS OR STRESSES ON ADJACENT STRUCTURES, PIPER PROVIDED INSPECTION CRITERIA MAY NOT BE VALID FOR AIRPLANES WITH NON-PIPER APPROVED STC INSTALLATIONS.

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. Insert page numbers followed by a small letter in direct sequence with the same common numbered page.

II. Identification of Revised Material

Each handbook page is dated at the bottom of the page showing the date of original issue and the date of the latest revision. Revised text and illustrations are indicated by a black vertical line located along the outside margin of each revised page opposite the revised, added, or deleted information. A black vertical line next to the page number indicates that an entire page has been changed or added.

Black vertical lines indicate current revisions only. Correction of typographical or grammatical errors or the physical relocation of information on a page will not be indicated by a symbol.

ORIGINAL PAGES ISSUED

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

Title, ii through vii, 1-1 through 1-12, 2-1 through 2-10, 3-1 through 3-16, 4-1 through 4-30, 5-1 through 5-34, 6-1 through 6-12, 7-1 through 7-30, 8-1 through 8-18, 9-1 through 9-90, 10-1 through 10-2.

PILOT'S OPERATING HANDBOOK LOG OF REVISIONS

Current Revisions to the PA-28R-201 Arrow Pilot's Operating Handbook, REPORT: VB-1365 issued September 15, 1988.

Revision Number and Code	Revised Pages	Description of Revisions	FAA Approved Signature and Date
Rev. 1 (PR890310)	2-4	Revised para. 2.9.	
	3-3	Revised para. 3.5b.	
	3-4	Revised para. 3.5d.	
	3-5	Revised para. 3.5e.	
	3-8	Revised para. 3.5m.	
	3-14	Revised para. 3.15a.	
	3-18	Revised para. 3.31.	
	4-5	Revised para. 4.5a.	
	4-7	Revised para. 4.5c.	
	4-10, 4-11	Revised para. 4.5h.	
	4-16	Revised para. 4.9c.	
	4-17	Revised para. 4.9d.	
	4-18	Revised para. 4.13a.	
	4-19	Revised paras. 4.13b and 4.13c.	
	4-22	Revised para. 4.23b.	
	6-12	Revised Fig. 6-15.	
	7-8	Revised Fig. 7-5.	D. H. Trompler May 19, 1989 Date
Rev. 2 (PR891018)	4-16	Revised para. 4.9b.	
	4-17	Revised para. 4.9d.	
	7-9	Revised Figure 7-7.	
	7-31, 7-32	Added Narco ELT 910 info.	
	8-9	Revised para 8.15.	
	9-8	Added para. (d) to Section 3. Deleted info. from Section 4.	D. H. Trompler Nov. 2, 1989 Date

PILOT'S OPERATING HANDBOOK LOG OF REVISIONS (cont)

Revision Number and Code	Revised Pages	Description of Revisions	FAA Approved Signature and Date
Rev. 3	2-10	Added placard.	
(PR891108)	6-13 thru 6-16	Added para. 6.9.	D. H. Trompler Dec. 12, 1989 Date
Rev. 4	vi	Added Revision 4 to Log of Revisions	
(PR900409)	2-10	Correct footer	
	4-16	Correct footer	
	7-10	Correct footer	
	7-30	Deleted info.	
	7-31	Deleted info. Moved text from 7-32	
	7-32	Moved text to 7-31.	
	8-9	Revised para 8.15.	D. H. Trompler
	8-10	Revised para 8.19.	
	8-11	Revised para 8.21b.	Apr. 26, 1990
	9-8	Correct footer	Date
Rev. 5	vi	Added Revision 5 to Log of Revisions	
(PR950508)	2-4	Revised para 2.9	
	3-8	Revised para 3.5m	
	3-14	Revised para 3.15b	
	3-18	Revised para 3.31	
	5-3	Revised para 5.5 (a)	
	5-7	Revised para 5.5 (e, f, & g)	
	5-10a	Added Page & Fig. 5-1a	
	5-23	Revised Fig. 5-23	
	5-24	Added Page & Fig. 5-23a	
	5-25	Revised Fig. 5-25	
	5-25a	Added Page & Fig. 5-25a	

PILOT'S OPERATING HANDBOOK LOG OF REVISIONS (cont)

Revision Number and Code	Revised Pages	Description of Revisions	FAA Approval Signature and Date
Rev. 5 (Cont'd)			
	5-25b	Added Page & Fig. 5-25b.	
	5-26	Revised Fig. 5-27.	
	5-26a	Added Page & Fig. 5-27a.	
	5-26b	Added Page & Fig. 5-27b.	
	5-26c	Added Page & Fig. 5-27c.	
	5-27	Revised Fig. 5-29.	
	5-27a	Added Page & Fig. 5-29a.	
	5-27b	Added Page & Revised Fig. 5-31.	
	5-28	Added Fig. 5-31a.	
	5-29	Revised Fig. 5-33.	
	5-29a	Added Page & Fig. 5-33a.	
	5-29b	Added Page & Fig. 5-33b.	Peter E. Peck
	5-29c	Added Page & Fig. 5-33c.	
	9-7	Revised Title Page	May 8, 1995
	9-25	Revised Para. (d)	Date
Rev. 6 (PR950518)	vi-a	Added Revision 6 to Log of Revisions.	Peter E. Peck
	vi vi-a	Corrected Errors on Log of Revisions pages vi & vi-a.	May 18, 1995 Date
Rev. 7 (PR040607)	iii	Added Warning and moved info. to page iv.	
	iv	Moved info. from page iii.	
	vi-a	Added Rev. 7 to L of R.	
	vi-b	Added Rev. 7 to L of R.	
	7-21	Revised Fig. 7-21 callouts.	
	8-1	Moved info. to page 8-1b and revised para. 8.1.	
	8-1a	Added page and revised para. 8.1.	

PILOT'S OPERATING HANDBOOK LOG OF REVISIONS (cont)

Revision Number and Code	Revised Pages	Description of Revisions	FAA Approval Signature and Date
Rev. 7 (PR040607) (continued)	8-1b	Added page and moved info. from pages 8-1 and 8-2.	
	8-2	Moved info. to page 8-1b and revised para. 8.3.	Albert J. Mill June 7, 2004 Date
Rev. 8 (PR050912)	vi-b	Added Rev. 8 to L of R.	
	2-5	Revised para. 2.15.	Linda J. Dicken Sept. 12, 2005
Rev. 9 (PR060424)	vi-b	Added Rev. 9 to L of R.	
	4-4	Revised para. 4.5a.	Linda J. Dicken
	4-5	Revised para. 4.5a.	April 24, 2006
Rev. 10 (PR090510)	vi-b	Added Rev. 10 to L of R.	
	4-9	Revised para. 4.5f.	
	4-20	Removed text and added note to para. 4.13d. Moved text from Para. 4.17 to pg. 4-21.	
	4-21	Added text to Para. 4.17 from pg. 4-20. Changed text in Para. 4.19.	
	7-18	Revised text in Para. 7.19.	Albert J. Mill
	8-1b	Revised text in Para. 8.1.	May 10, 2009
Rev. 11 (PR121031)	ii	Added copyright.	
	vi-b	Added Rev. 11 to L of R.	
	4-10	Revised Para. 4.5g.	
	4-12	Revised Para. 4.5k.	
	4-22	Revised Para. 4.21.	
	4-25	Revised Para. 4.29	
	4-27	Revised Para. 4.39.	Wayne E. Gaulzetti
	7-6	Revised Para. 7.11.	October 31, 2012

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SECTION 1

GENERAL

SECTION 1

GENERAL

1.1 INTRODUCTION

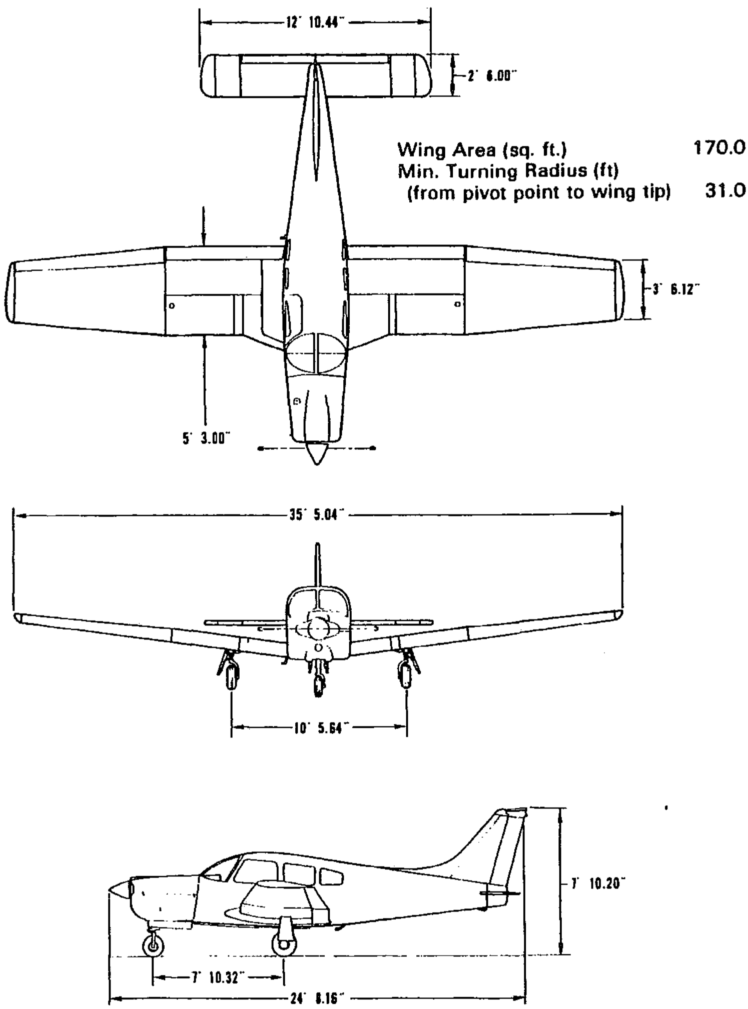
This Pilot's Operating Handbook is designed for maximum utilization as an operating guide for the pilot. It includes the material required to be furnished to the pilot by the Federal Aviation Regulations and additional information provided by the manufacturer and constitutes the FAA Approved Airplane Flight Manual.

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 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 ENGINES

(a) Number of Engines	1
(b) Engine Manufacturer	Lycoming
(c) Engine Model Number	IO-360-C1C6
(d) Rated Horsepower	200
(e) Rated Speed (rpm)	2700
(f) Bore (in.)	5.125
(g) Stroke (in.)	4.375
(h) Displacement (cu. in.)	361
(i) Compression Ratio	8.7:1
(j) Engine Type	Four Cylinder, Direct Drive, Horizontally Opposed, Air Cooled and Fuel Injected

1.5 PROPELLERS

McCAULEY

(a) Number of Propellers	1
(b) Propeller Manufacturer	McCauley
(c) Blade Model	90DHA-16
(d) Number of Blades	2
(e) Hub Model	B2D34C213
(f) Propeller Diameter (in.)	
(1) Maximum	74
(2) Minimum	73
(g) Propeller Type	Constant Speed, Hydraulically Actuated

1.5 PROPELLERS (continued)

HARTZELL

(a) Number of Propellers	1
(b) Propeller Manufacturer	Hartzell
(c) Blade Model	F7666A-2R
(d) Number of Blades	2
(e) Hub Model	HC-C2YK-1( )F/
(f) Propeller Diameter (in.)	
(1) Maximum	74
(2) Minimum	72
(g) Propeller Type	Constant Speed, Hydraulically Actuated

1.7 FUEL

(a) Fuel Capacity (U.S. gal.) (total)	77
(b) Usable Fuel (U.S. gal.) (total)	72
(c) Fuel Grade, Aviation	
(1) Minimum Octane	100/130 - Green or 100 LL - Blue Aviation Grade
(2) Alternate Fuels	Refer to latest revision of Lycoming Service Instruction 1070, except alcohol is **not** approved for use in this airplane. MIL-I-27686D is approved.

1.9 OIL

(a) Oil Capacity (U.S. qts.)	8
(b) Oil Specification	Refer to latest issue of Lycoming Service Instruction 1014
(c) Oil Viscosity	Refer to Section 8 - paragraph 8.19

1.11 MAXIMUM WEIGHTS

(a) Maximum Takeoff Weight (lb.)	2750
(b) Maximum Landing Weight (lb.)	2750
(c) Maximum Weights in Baggage Compartment	200

1.13 STANDARD AIRPLANE WEIGHTS*

(a) Standard Empty Weight (lb.): Weight of a standard airplane including unusable fuel, full operating fluids and full oil.	1603
(b) Maximum Useful Load (lb.): The difference between the Maximum Takeoff Weight and the Standard Empty Weight.	1147

1.15 BAGGAGE SPACE

(a) Compartment Volume (cu. ft.)	24
(b) Entry Width (in.)	22
(c) Entry Height (in.)	20

1.17 SPECIFIC LOADINGS

(a) Wing Loading (lb. per sq. ft.)	16.18
(b) Power Loading (lb. per hp)	13.75

*These values are approximate and vary from one aircraft to another. Refer to Figure 6-5 for the Standard Empty Weight value and the Useful Load value to be used for C.G. calculations for the aircraft specified.

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 Airspeed 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.

1.19 SYMBOLS, ABBREVIATIONS, AND TERMINOLOGY (continued)

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.

1.19 SYMBOLS, ABBREVIATIONS, AND TERMINOLOGY (continued)

(b) Meteorological Terminology

ISA	International Standard Atmosphere in which: (1) The air is a dry perfect gas. (2) The temperature at sea level is 15° Celsius (59° Fahrenheit). (3) The pressure at sea level is 29.92 inches Hg (1013.2mb). (4) The temperature gradient from sea level to the altitude at which the temperature is -56.5°C (-69.7°F) is 0.00198°C (-0.003564°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 millibars).
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.

1.19 SYMBOLS, ABBREVIATIONS, AND TERMINOLOGY (continued)

(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.
MEA	Minimum en route IFR altitude.
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.

1.19 SYMBOLS, ABBREVIATIONS, AND TERMINOLOGY (continued)

(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.

1.19 SYMBOLS, ABBREVIATIONS, AND TERMINOLOGY (continued)

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 the safe operation of the airplane and its systems.

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.	183	186
Maximum Structural Cruising Speed (V_{NO}) - Do not exceed this speed except in smooth air and then only with caution.	146	148
Design Maneuvering Speed (V_A) - Do not make full or abrupt control movements above this speed.		
At 2750 lbs. G.W.	118	120
At 1865 lbs. G.W.	96	96

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.

2.3 AIRSPEED LIMITATIONS (continued)

SPEED	KIAS	KCAS
Maximum Flaps Extended Speed (V_{FE}) - Do not exceed this speed with the flaps extended.	103	103
Maximum Landing Gear Extension Speed - Do not exceed this speed when extending the landing gear.	129	130
Maximum Landing Gear Retraction Speed - Do not exceed this speed when retracting the landing gear.	107	107
Maximum Landing Gear Extended Speed (V_{LE}) - Do not exceed this speed with the landing gear extended.	129	130

2.5 AIRSPEED INDICATOR MARKINGS

MARKING	IAS
Red Radial Line (Never Exceed)	183 KTS
Yellow Arc (Caution Range - Smooth Air Only)	146 KTS to 183 KTS
Green Arc (Normal Operating Range)	60 KTS to 146 KTS
White Arc (Flap Down)	55 KTS to 103 KTS

2.7 POWER PLANT LIMITATIONS

(a) Number of Engines	1
(b) Engine Manufacturer	Lycoming
(c) Engine Model No.	IO-360-C1C6
(d) Engine Operating Limits	
(1) Maximum Horsepower	200
(2) Maximum Rotation Speed (RPM)	2700
(3) Maximum Oil Temperature	245°F
(e) Oil Pressure	
Minimum (red line)	25 PSI
Maximum (red line)	100 PSI
(f) Fuel Flow/Pressure	
Maximum (red line)	21.4 GPH/12 PSI
(g) Fuel Grade (minimum octane)	100 or 100LL Aviation Grade
(h) Number of Propellers	1
(i) Propeller Manufacturer	McCauley or Hartzell
(j) Propeller Hub and Blade Model	
(1) McCauley	B2D34C213/90DHA-16
(2) Hartzell	HC-C2YK-1( )F/ F7666A-2R
(k) Propeller Diameter	
(1) McCauley	
Minimum	73
Maximum	74
(2) Hartzell	
Minimum	72
Maximum	74
(l) Blade Angle Limits	
(1) McCauley	
Low Pitch Stop	12.5 + 0.2°
High Pitch Stop	27.5 + 0.5°
(2) Hartzell	
Low Pitch Stop	14.0 + 0.2°
High Pitch Stop	29.0 + 2.0°
(m) RPM Restriction (McCauley Propeller Only)	Avoid continuous operation between 1500 and 1950 rpm below 15 inches manifold pressure.

2.9 POWER PLANT INSTRUMENT MARKINGS

(a) Tachometer	
Green Arc (Normal Operating Range)	500 to 2700 RPM
Red Line (Maximum Continuous Power)	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	2 GPH/0.05 PSI to 21.3 GPH/12 PSI
Red Line (Maximum)	21.3 GPH/12 PSI

2.11 WEIGHT LIMITS

(a) Maximum Weight 2750 LBS.
(b) Maximum Baggage 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
2750	88.9	91.5
2375 and Below	82.0	91.5

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 straight and tapered section.

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 maneuvers which do not exceed 60° of bank and 30° of pitch:
- Steep Turns
- Lazy Eights
- Chandelles

2.17 FLIGHT LOAD FACTORS

(a) Positive Load Factor (Maximum)	3.8 G
(b) Negative Load Factor (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	77 U.S. GAL.
(b) Unusable Fuel The unusable fuel for this airplane has been determined as 2.5 gallons in each wing tank in critical flight attitudes.	5 U.S. GAL.
(c) Usable Fuel The usable fuel in this airplane has been determined as 36.0 gallons in each wing tank.	72 U.S. GAL.
(d) Fuel remaining when the quantity indicators read zero cannot be used safely in flight.	

2.23 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.

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

In full view of the pilot, the following Takeoff and Landing Checklists will be installed:

TAKEOFF CHECKLIST

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

LANDING CHECKLIST

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

The Air Conditioner Off item in the above Takeoff and Landing Checklists is mandatory for air conditioned aircraft only.

2.23 PLACARDS (continued)

On the instrument panel in full view of the pilot:

MANEUVERING SPEED 118 KIAS
AT 2750 LBS. (SEE P.O.H.)

On the instrument panel in full view of the pilot:

DEMONSTRATED CROSSWIND COMPONENT 17 KTS

On the instrument panel in full view of the pilot:

NO ACROBATIC MANEUVERS,
INCLUDING SPINS, APPROVED

On the instrument panel in full view of the pilot:

GEAR DOWN	129 KIAS (MAX.)
GEAR UP	107 KIAS (MAX.)
EXTENDED	129 KIAS (MAX.)

Near emergency gear lever:

EMERGENCY DOWN

Near gear selector switch:

GEAR UP	107 KIAS MAX.
DOWN	129 KIAS MAX.

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

ENGAGE LATCH BEFORE FLIGHT

On the instrument panel 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.

2.23 PLACARDS (continued)

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

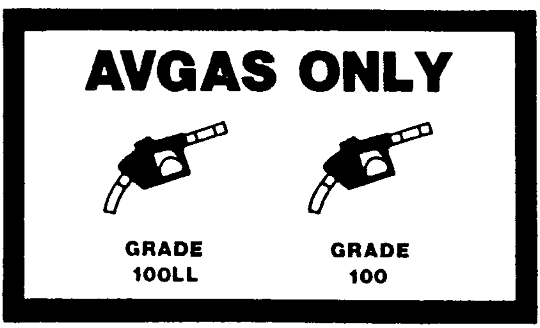
WARNING

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

On inside of baggage compartment door:

BAGGAGE MAXIMUM 200 LBS. SEE WEIGHT AND BALANCE DATA FOR BAGGAGE LOADING BETWEEN 150 LBS. AND 200 LBS.

Adjacent to fuel tank filler caps:



Above fuel quantity gauges:

FUEL REMAINING WHEN QUANTITY INDICATOR READS ZERO CANNOT BE USED SAFELY IN FLIGHT.

2.23 PLACARDS (continued)

On the instrument panel in full view of the pilot in aircraft with McCauley propeller installations only:

AVOID CONTINUOUS OPERATION BETWEEN
1500 AND 1950 RPM BELOW 15" MANIFOLD
PRESSURE.

On the aft baggage closeout:

MAXIMUM BAGGAGE 200 LBS. NO HEAVY
OBJECTS ON HAT SHELF.

In full view of pilot:

CAUTION

COMPASS
CAL. MAY
BE IN ERROR
WITH ELECT.
EQUIPMENT
OTHER THAN
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EMERGENCY PROCEDURES (cont)

SECTION 3

EMERGENCY PROCEDURES

3.1 GENERAL

This section provides the recommended procedures for coping with various emergency or critical situations. All of the emergency procedures required by the FAA as well as those necessary for operation of the airplane, as determined by the operating and design features of the airplane, are presented.

Emergency procedures associated with optional systems and equipment which require handbook supplements are presented in Section 9, Supplements.

This section is divided into two basic parts. The first part contains the emergency procedures checklists. These checklists supply an immediate action sequence to be followed during critical situations with little emphasis on the operation of systems. The numbers located in parentheses after each checklist heading indicate where the corresponding paragraph in the amplified procedures can be found.

The second part of the section provides amplified emergency procedures corresponding to the emergency procedures checklist items. These amplified emergency procedures contain additional information to provide the pilot with a more complete description of the procedures so they may be more easily understood. The numbers located in parentheses after each paragraph heading indicates the corresponding checklist paragraph.

Pilots must familiarize themselves with the procedures given in this section and must be prepared to take the appropriate action should an emergency situation arise. The procedures are offered as a course of action for coping with the particular situation or condition described. They are not a substitute for sound judgment and common sense.

Most basic emergency procedures are a normal part of pilot training. The information presented in this section is not intended to replace this training. This information is intended to provide a source of reference for the procedures which are applicable to this airplane. The pilot should review standard emergency procedures periodically to remain proficient in them.

3.3 AIRSPEEDS FOR SAFE OPERATION

3.3a STALL SPEEDS

2750 lbs (Gear Up, 0° Flap) ....60 KIAS
2750 lbs (Gear Down, 40° Flap).........................55 KIAS

3.3b MANEUVERING SPEEDS

2750 lbs ....118 KIAS
1865 lbs ....96 KIAS

3.3c NEVER EXCEED SPEED

Never Exceed Speed ....183 KIAS

3.3d POWER OFF GLIDE SPEED

2750 lbs (Gear Up, 0° Flap) ....79 KIAS

3.5 EMERGENCY PROCEDURES CHECKLIST

3.5a ENGINE FIRE DURING START (3.9)

Starter..CRANK ENGINE
Mixture..IDLE CUT-OFF
Throttle..OPEN
Electric Fuel Pump..OFF
Fuel Selector..OFF
Abandon if fire continues.

3.5b ENGINE POWER LOSS DURING TAKEOFF (3.11)

If sufficient runway remains for a normal landing, leave gear down and land straight ahead.

If area ahead is rough or if it is necessary to clear obstructions:

Gear Selector Switch..UP

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 as required
If power is not regained, proceed with power off landing (3.5d).

3.5c ENGINE POWER LOSS IN FLIGHT (3.13)

If at low altitude:

Airspeed..MAINTAIN 79 KIAS minimum
Prepare for power off landing (3.5d).

If altitude permits:

Fuel Selector..SWITCH to tank containing fuel

3.5c ENGINE POWER LOSS IN FLIGHT (3.13) (continued)

Electric fuel pump..ON
Mixture. ....RICH
Alternate Air...OPEN
Engine Gauges..CHECK for indication of cause of power loss

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

When power is restored:
Alternate Air ....CLOSE
Electric Fuel Pump..OFF
If power is not restored, prepare for power off landing.
Trim for 79 KIAS.

3.5d POWER OFF LANDING (3.15)

Trim for 79 KIAS.
Locate suitable field.
Establish spiral pattern.
1000 ft. above field at downwind position for normal landing approach.
When field can be easily reached, slow to 72 KIAS for shortest landing.

Gear Down Emergency Landing (3.15a)

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

When committed to landing:
Landing Gear Selector...DOWN
Flaps..... ....AS DESIRED
Throttle. ....CLOSE
Mixture. ....IDLE CUT-OFF
Ignition. ....OFF
BATT MASTR Switch ....OFF
ALTR Switch...OFF
Fuel Selector...OFF
Seat Belts and Harness..TIGHT

NOTE

If battery master switch is OFF, the landing gear cannot be retracted.

3.5d POWER OFF LANDING (3.15) (continued)

Gear Up Emergency Landing (3.15b)

In the event a gear up landing is required, proceed as follows:
Flaps..... ....AS DESIRED)
Throttle. ....CLOSE
Mixture. ....IDLE CUT-OFF
Ignition. ....OFF
BATT MASTR Switch ....OFF
ALTR Switch..OFF
Fuel Selector..OFF
Seat Belt and Harness ....TIGHT
Contact surface at minimum possible airspeed

3.5e FIRE IN FLIGHT (3.17)

Source of Fire..CHECK

Electrical Fire (Smoke in Cabin):

BATT MASTR Switch ....OFF
ALTR Switch..OFF
Vents..... ....OPEN
Cabin Heat..OFF
Land as soon as practical

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 (3.5d).

NOTE

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

3.5f LOSS OF OIL PRESSURE (3.19)

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

3.5g LOSS OF FUEL FLOW/PRESSURE (3.21)

Electric Fuel Pump .... ON
Fuel Selector .... CHECK on tank containing fuel

3.5h HIGH OIL TEMPERATURE (3.23)

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

3.5i ELECTRICAL FAILURE (3.25)

ALT annunciator light illuminated:
Ammeter .... CHECK to VERIFY inop. alt.

If ammeter shows zero:
ALTR Switch .... OFF

Reduce electrical loads to minimum:
ALTNTR. FIELD
Circuit Breaker .... CHECK and RESET as required
ALTR Switch .... ON

If power not restored:
ALTR 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.

3.5j ELECTRICAL OVERLOAD (Alternator over 20 amps above known electrical load) (3.27)

BATT MASTR Switch .... OFF

3.5j ELECTRICAL OVERLOAD (Alternator over 20 amps above known electrical load) (3.27) (Continued)

If ammeter reading does NOT decrease:

ALTR Switch...OFF
Land as soon as possible. Use Emergency Landing Gear Extension (3.5m) to lower landing gear.

If ammeter reading DOES decrease:

BATT MASTR Switch ....ON
Ammeter ....MONITOR

If ammeter reading does NOT begin to decrease within five minutes:

BATT MASTR Switch..OFF
Land as soon as possible.

CAUTION

If the battery is depleted, the landing gear must be lowered using the emergency extension procedure. The gear position lights will be inoperative.

NOTE

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

If ammeter reading DOES begin to decrease within five minutes:

Proceed with flight.
Ammeter ....MONITOR

3.5k PROPELLER OVERSPEED (3.29)

Throttle...RETARD
Oil Pressure...CHECK

3.5k PROPELLER OVERSPEED (continued)

Propeller Control...FULL DECREASE rpm, then set if any control available.
Airspeed..REDUCE
Throttle. ....AS REQUIRED to remain below 2700 rpm

3.5m EMERGENCY LANDING GEAR EXTENSION (3.31)

NOTE

Refer to paragraph 4.39 for differences when emergency gear extension is being performed for training purposes.

Prior to emergency extension procedure:

BATT MASTR Switch ....CHECK ON
ALTR Switch...CHECK ON
Circuit Breakers ....CHECK
NAV LIGHT Switch ....OFF (in daytime)
Gear Indicator Bulbs ....CHECK

If landing gear does not check down and locked:

Airspeed...REDUCE BELOW 87 KIAS
Landing Gear Selector Switch.......................................GEAR DOWN POSITION

If gear has still failed to lock down, move and *hold* the emergency lever down to the Emergency Down position.

If gear has still failed to lock down, yaw the airplane abruptly from side to side with the rudder.

If the nose gear will not lock down using the above procedure, slow the aircraft to the lowest safe speed attainable using the lowest power setting required for safe operation and accomplish the following:

Landing Gear Selector Switch.......................................GEAR DOWN POSITION

If landing gear does not check down, recycle gear through up position and then select gear DOWN.

3.5n SPIN RECOVERY (3.33)

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

3.5o OPEN DOOR (3.35)

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

3.5p ENGINE ROUGHNESS (3.37)

Mixture...................... ADJUST for maximum smoothness
Alternate Air ....OPEN
Electric Fuel Pump....................................... ON
Fuel Selector .... SWITCH TANKS
Engine Gauges.................................... CHECK
Magneto Switch .... L then R then 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.

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3.7 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.

3.9 ENGINE FIRE DURING START (3.5a)

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 of the above cases, if fire continues for more than a few seconds, the fire should be extinguished by the best available external means.

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

3.11 ENGINE POWER LOSS DURING TAKEOFF (3.5b)

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, leave the landing gear down and land straight ahead.

If the area ahead is rough, or if it is necessary to clear obstructions, move the gear selector switch to the UP position.

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

3.11 ENGINE POWER LOSS DURING TAKEOFF (3.5b) (continued)

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 the Power Off Landing procedure (refer to the emergency checklist and paragraph 3.15).

3.13 ENGINE POWER LOSS IN FLIGHT (3.5c)

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 3.15). An airspeed of at least 79 KIAS should be maintained.

If altitude permits, switch the fuel selector to another tank containing fuel and turn the electric fuel pump to 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/pressure 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 and turn OFF the electric fuel pump.

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 the other fuel tank. 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/pressure indications will be normal.

3.13 ENGINE POWER LOSS IN FLIGHT (3.5c) (continued)

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 emergency checklist and paragraph 3.15). Trim for 79 KIAS.

3.15 POWER OFF LANDING (3.5d)

If loss of power occurs at altitude, trim the aircraft for best gliding angle (79 KIAS, air conditioner 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 the engine windmilling, and the propeller control in full DECREASE rpm, the aircraft will travel approximately 1.6 miles for each thousand feet of altitude. If possible, 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 72 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.

Whether to attempt a landing with gear up or down depends on many factors. If the field chosen is obviously smooth and firm, and long enough to bring the plane to a stop, the gear should be down. If there are stumps or rocks or other large obstacles in the field, the gear in the down position will better protect the occupants of the aircraft. If, however, the field is suspected to be excessively soft or short, or when landing in water of any depth, a wheels-up landing will normally be safer and do less damage to the airplane.

Touchdown should normally be made at the lowest possible airspeed.

3.15 POWER OFF LANDING (3.5d) (continued)

3.15a Gear Down Emergency Landing (3.5d)

When committed to a gear down emergency landing, select landing gear DOWN. Flaps may be used as desired. Close the throttle control and move the mixture control to idle cut-off. Shut OFF the ignition, battery master (BATT MASTR), and alternator (ALTR) switches. Turn the fuel selector valve to OFF. The seat belts and shoulder harness should he tightened. Touchdown should normally be made at the lowest possible airspeed.

NOTE

If the battery master switch is OFF, the landing gear cannot be retracted.

3.15b Gear Up Emergency Landing (3.5d)

When committed to a gear up landing, CLOSE the throttle, move the mixture to idle cut-off, and shut OFF the ignition, battery master (BATT MASTR), and alternator (ALTR) switches. Turn OFF the.fuel selector valve. Seat belts and shoulder harness should be tightened. Touchdown should normally be made at the lowest possible airspeed with full flaps.

3.17 FIRE IN FLIGHT (3.5e)

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, character 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 smoke in the cabin indicates an electrical fire, turn the battery master (BATT MASTR) and alternator (ALTR) switches 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 the battery master (BATT MASTR) and alternator (ALTR) switches 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.

3.19 LOSS OF OIL PRESSURE (3.5f)

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.

3.19 LOSS OF OIL PRESSURE (3.5f) (continued)

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.

3.21 LOSS OF FUEL FLOW/PRESSURE (3.5g)

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

If the problem is not an empty tank, land as soon as practical and have the engine driven fuel pump and fuel system checked.

3.23 HIGH OIL TEMPERATURE (3.5h)

An abnormally high oil temperature indication may be caused by a low oil level, an 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.

3.25 ELECTRICAL FAILURE (3.5i)

Loss of alternator output is detected through zero reading on the ammeter. Before executing the following procedure, ensure 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 for an open alternator field circuit breaker.

Next, attempt to reset the overvoltage relay by moving the ALTR 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.

3.25 ELECTRICAL FAILURE (3.5i) (continued)

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

3.27 ELECTRICAL OVERLOAD (Alternator over 20 amps above known electrical load) (3.5j)

An abnormally high alternator output may be caused by a low battery, battery fault, or other abnormal electrical load.

Should an abnormally high alternator output be observed, turn the BATT MASTR (battery master) switch OFF. If the ammeter reading does NOT decrease, turn the ALTR (alternator) switch OFF and land as soon as possible. The landing gear must be lowered using the Emergency Landing Gear Extension procedure (3.33).

If, after turning the BATT MASTR switch OFF, the ammeter reading DOES decrease, turn the BATT MASTR switch ON, and continue to monitor the ammeter. If the ammeter reading does not begin to decrease within five minutes, turn the BATT MASTR switch OFF and land as soon as possible.

CAUTION

If the battery is depleted, the landing gear must be lowered using the emergency extension procedure. The gear position lights will be inoperative.

NOTE

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

If the ammeter reading DOES begin to decrease within five minutes after the BATT MASTR switch is turned ON, proceed with flight while continuing to monitor ammeter.

3.29 PROPELLER OVERSPEED (3.5k)

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 he reduced and throttle used to maintain 2700 rpm.

3.31 EMERGENCY LANDING GEAR EXTENSION (3.5m)

NOTE

Refer to paragraph 4.39 for differences when emergency gear extension is being performed for training purposes.

Prior to initiating the emergency extension procedure, check to ensure that the battery master (BATT MASTR) and alternator (ALTR) switches are ON, and that the circuit breakers have not opened. If it is in daytime, the NAV LIGHT switch should be turned OFF. Check the landing gear indicators for faulty bulbs.

If the landing gear does not check down and locked, reduce the airspeed below 87 KIAS. Move the landing gear selector switch to the DOWN position.

If the gear has still failed to lock down, move and *hold* the emergency gear lever down to the EMERGENCY DOWN position.

If the gear has still failed to lock down, yaw the airplane abruptly from side to side with the rudder.

!f the nose gear will not lock down using the above procedure, slow the airplane to the lowest safe speed attainable using the lowest power setting required for safe operation. Move the landing gear selector switch to the gear DOWN position. If the landing gear does not check down, recycle the gear through the UP position and then select the DOWN position.

3.33 SPIN RECOVERY (3.5n)

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 attitude.

3.35 OPEN DOOR (3.5o)

The cabin door is double latched, so the chances of its springing open in flight at both the top and bottom are remote. However, should the upper latch be overlooked or the side latch not fully engaged, 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 first, and then the top latch.

3.37 ENGINE ROUGHNESS (3.5p)

Engine roughness may be caused by dirt in the injector nozzles, induction system 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.

3.37 ENGINE ROUGHNESS (3.5p) (Continued)

The magneto switch should then be moved 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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SECTION 4

NORMAL PROCEDURES

4.1 GENERAL

This section provides the normal operating procedures for the PA-28R-201, Arrow airplane. All of the normal operating procedures required by the FAA, as well as those procedures which have been determined as necessary for the operation of the airplane, as determined by the operating and designed features of the airplane, are presented.

Normal operating procedures associated with optional systems and equipment which require handbook supplements are presented in Section 9, Supplements.

These procedures are provided to supply information on procedures which are not the same for all airplanes and as a source of reference and review. Pilots should familiarize themselves with these procedures to become proficient in the normal operation of the airplane.

This section is divided into two parts. The first part is a short form checklist supplying an action - reaction sequence for normal procedures with little emphasis on the operation of the systems. Numbers in parentheses after each checklist section indicate the paragraph where the corresponding amplified procedure can be found.

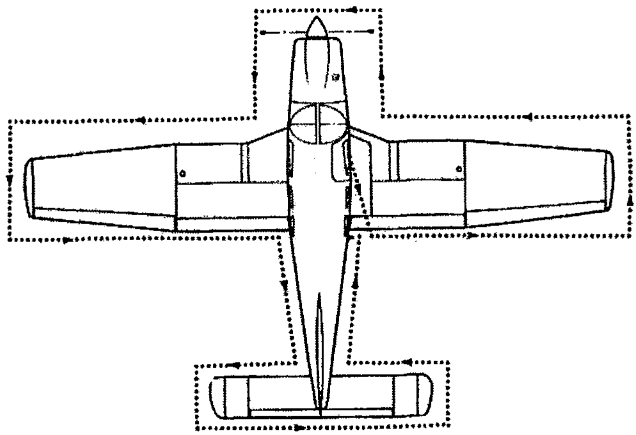
The second part of this section contains the amplified normal procedures which provide detailed information and explanations of the procedures and how to perform them. This portion of the section is not intended for use as an inflight reference due to the lengthly explanation. The short form checklists should be used on the ground and in flight. Numbers in parentheses after each paragraph title indicate where the corresponding checklist can be found.

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	
gear up, flaps up	90 KIAS
gear down, flaps up	78 KIAS
(b) Best Angle of Climb Speed	
gear up, flaps up	78 KIAS
gear down, flaps up	72 KIAS
(c) Turbulent Air Operating Speed (See Subsection 2.3)	118 KIAS
(d) Maximum Flap Speed	103 KIAS
(e) Landing Final Approach Speed (Flaps 40°)	75 KIAS
(f) Maximum Demonstrated Crosswind Velocity	17 KTS



WALK-AROUND
Figure 4-1

4.5 NORMAL PROCEDURES CHECKLIST

4.5a Preflight Checklist (4.9)

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 (4.9a)

Control Wheel....................release restraints
Gear Handle....................DOWN
Parking Brake....................SET
Avionics....................OFF
All Switches....................OFF
Mixture....................IDLE CUT-OFF
Magneto Switch....................OFF
BATT MASTR Switch....................ON

4.5a Preflight Checklist (4.9) (continued)

COCKPIT (4.9a) (continued)

Fuel Gauges ....check QUANTITY
Annunciator Panel..CHECK
BATT MASTR Switch ....OFF
Primary Flight Controls.......................................PROPER OPERATION
Flaps ....PROPER OPERATION
Trim..NEUTRAL
Pitot and Static Systems...DRAIN
Windows ....check CLEAN
Required Papers and POH ....check ON BOARD
Tow Bar and Baggage ....STOW PROPERLY - SECURE
Baggage Door ....CLOSE and SECURE

RIGHT WING (4.9b)

Surface Condition ....CLEAR of ICE, FROST, SNOW
Flap and Hinges ....CHECK
Aileron and Hinges ....CHECK
Static Wicks...CHECK - SECURE
Wing Tip and Lights ....CHECK
Fuel Tank ....CHECK supply visually
- SECURE cap
Fuel Tank Vent..CLEAR

CAUTION

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

Fuel Tank Sump..DRAIN and CHECK
for water, sediment,
and proper fuel
Tie Down and Chock ....REMOVE
Main Gear Strut ....PROPER INFLATION
(2.0 +/- 0.25 in.)
Tire ....CHECK
Brake Block and Disc ....CHECK
Fresh Air Inlet ....CLEAR

4.5a Preflight Checklist (continued)

NOSE SECTION (4.9c)

General Condition....................CHECK
Cowling....................SECURE
Oil....................CHECK QUANTITY
Dipstick....................PROPERLY SEATED
Oil Filler Cap....................SECURE
Engine Baffle Seals....................CHECK
Windshield....................CLEAN
Propeller and Spinner....................CHECK
Air Inlets....................CLEAR
Alternator Belt....................CHECK TENSION
Landing Light....................CHECK
Chock....................REMOVE
Nose Gear Strut....................PROPER INFLATION
(2.75 +/- 0.25 in.)
Nose Wheel Tire....................CHECK

CAUTION

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

Fuel Strainer....................DRAIN

LEFT WING (4.9d)

Surface Condition....................CLEAR of ICE,.FROST, SNOW
Stall Warning Vane....................CHECK
Fuel Tank....................CHECK supply visually
- SECURE CAP
Fresh Air Inlet....................CLEAR
Chock....................REMOVE
Main Gear Strut....................PROPER INFLATION
(2.0 +/- 0.25 in.)
Tire....................CHECK
Brake Block and Disc....................CHECK
Fuel Tank Vent....................CLEAR

CAUTION

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

4.5a Preflight Checklist (continued)

LEFT WING (4.9d) (continued)

Fuel Tank Sump....................DRAIN and CHECK
for water, sediment,
and proper fuel
Tie Down....................REMOVE
Pitot Mast....................REMOVE COVER
- HOLE CLEAR
Wing Tip and Lights....................CHECK
Aileron and Hinges....................CHECK
Flap and Hinges....................CHECK
Static Wicks....................CHECK - SECURE

FUSELAGE (4.9e)

Antennas....................CHECK
Left Static Vent....................CLEAR
Fresh Air Inlet....................CLEAR
Empennage....................CLEAR of ICE,
FROST, SNOW
Stabilator and Trim Tab....................CHECK
Tie Down....................REMOVE
Right Static Vent....................CLEAR
BATT MASTR Switch....................ON
Cockpit Lighting....................CHECK
Navigation and Strobe Lights....................CHECK
Landing Light....................CHECK
Stall Warning....................CHECK
Pitot Heat....................CHECK
All Switches....................OFF
BATT MASTR Switch....................OFF
Passengers....................BOARD
Cabin Door....................CLOSE and SECURE
Seat Belts and Harness....................FASTEN - CHECK
inertia reel

4.5b Before Starting Engine Checklist (4.11)

BEFORE STARTING ENGINE (4.11)

Brakes....................SET
Circuit Breakers....................IN
Alternate Air....................OFF
Propeller....................FULL INCREASE RPM
Avionics....................OFF
Fuel Selector....................DESIRED TANK

4.5c Engine Start Checklist (4.13)

NORMAL START - COLD ENGINE (4.13)

Throttle.....1/2 INCH OPEN
ALTR Switch.....ON
BATT MASTR Switch.....ON
Electric Fuel Pump.....ON
Mixture.....RICH - then IDLE CUT-OFF
Propeller.....CLEAR
Starter.....ENGAGE
Mixture.....FULL RICH
Throttle.....ADJUST
Oil Pressure.....CHECK

NORMAL START - HOT ENGINE (4.13b)

Throttle.....1/2 INCH OPEN
ALTR Switch.....ON
BATT MASTR Switch.....ON
Electric Fuel Pump.....ON
Mixture.....IDLE CUT-OFF
Propeller.....CLEAR
Starter.....ENGAGE
Mixture.....ADVANCE
Throttle.....ADJUST
Oil Pressure.....CHECK

ENGINE START WHEN FLOODED (4.13c)

Throttle.....FULL OPEN
ALTR Switch.....ON
BATT MASTR Switch.....ON
Electric Fuel Pump.....OFF
Mixture.....IDLE CUT-OFF
Propeller.....CLEAR
Starter.....ENGAGE
Mixture.....ADVANCE
Throttle.....RETARD
Oil Pressure.....CHECK

ENGINE START WITH EXTERNAL POWER SOURCE (4.13d)

BATT MASTR Switch.....OFF
ALTR Switch.....OFF
All Electrical Equipment.....OFF

4.5c Engine Start Checklist (4.13) (continued)

ENGINE START WITH EXTERNAL POWER SOURCE (4.13d) (continued)

Terminals .... CONNECT
External Power Plug .... INSERT in receptacle

Proceed with normal start.
Throttle.......................... LOWEST POSSIBLE RPM
External Power Plug .... REMOVE from receptacle
BATT MASTR Switch .... ON
ALTR Switch .... ON - CHECK AMMETER
Oil Pressure .... CHECK

CAUTION

It is possible to use the ship's battery in parallel by turning only the battery master switch ON. This will give longer cranking capabilities, but will not increase the amperage. 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 only the battery 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.

NOTE

For all normal operations using the PEP jumper cables, the battery master and alternator switches should be OFF.

4.5d Warm-Up Checklist (4.15)

WARM-UP (4.15)

Throttle.................................. 1400 to 1500 RPM

4.5e Taxiing Checklist (4.17)

TAXIING (4.17)

Taxi Area....CLEAR
Parking Brake....RELEASE
Propeller....HIGH RPM
Throttle....APPLY SLOWLY
Brakes....CHECK
Steering....CHECK

4.5f Ground Check Checklist (4.19)

GROUND CHECK (4.19)

Parking Brake....SET
Propeller....FULL INCREASE
Throttle....2000 RPM
Magnetos....CHECK
max. drop 175 RPM
- max. diff. 50 RPM
Vacuum....4.8 to 5.2 inches Hg
Oil Temperature....CHECK
Oil Pressure....CHECK
Ammeter....CHECK
Annunciator Panel....PRESS-TO-TEST
Propeller....EXERCISE - then
FULL INCREASE
Alternate Air....CHECK
Engine is warm for takeoff when throttle can be opened without engine faltering.
Electric Fuel Pump....OFF
Fuel Pressure....CHECK
Throttle....RETARD

4.5g Before Takeoff Checklist (4.21)

BEFORE TAKEOFF (4.21)

BATT MASTR Switch....ON
ALTR Switch....ON
Flight Instruments....CHECK

4.5g Before Takeoff Checklist (4.21) (continued)

BEFORE TAKEOFF (4.21) (continued)

Fuel Selector	PROPER TANK
Electric Fuel Pump	ON
Engine Gauges	CHECK
Alternate Air	CLOSED
Seat Backs	ERECT
Mixture	SET
Propeller	SET
Belts/Harness	FASTENED/CHECK
Empty Seats	SEAT BELTS SNUGLY FASTENED
Flaps	SET
Trim	SET
Emergency Gear Extension Lever	UP POSITION
Controls	FREE
Doors	LATCHED
Air Conditioner	OFF

4.5h Takeoff Checklist (4.23)

NORMAL TECHNIQUE (4.23a)

Flaps	SET
Trim	SET

Accelerate to 65 to 75 KIAS.

Control Wheel	back pressure to ROTATE smoothly to CLIMB ATTITUDE

SHORT FIELD, OBSTACLE CLEARANCE TECHNIQUE (4.23b)

Flaps	25Þ (second notch)

Accelerate to 50 to 60 KIAS depending on aircraft weight.

Control Wheel	back pressure to ROTATE to CLIMB ATTITUDE

After breaking ground, accelerate to 55 to 65 KIAS depending on aircraft weight.

Gear	UP

Accelerate to best gear up angle of climb speed - 78 KIAS, slowly retract the flaps and climb past the obstacle.

Accelerate to best gear up rate of climb speed - 90 KIAS.

4.5h Takeoff Checklist (4.23) (continued)

SOFT FIELD TECHNIQUE (4.23b)

Flaps ....25Þ (second notch)
Accelerate to 50 to 60 KIAS depending on aircraft weight.
Control Wheel ....hack pressure to ROTATE to CLIMB ATTITUDE
After breaking ground, accelerate to 55 to 65 KIAS depending on aircraft weight.
Gear ....UP
Accelerate to best gear up rate of climb speed - 90 KIAS.
Flaps ....RETRACT SLOWLY

4.5i Climb Checklist (4.25)

CLIMB (4.25)

Best Rate (2750 lb.) (Gear Up, Flaps Up) .... 90 KIAS
Best Rate (2750 lb.) (Gear Down, Flaps Up) .... 78 KIAS
Best Angle (2750 lb.) (Gear Up, Flaps Up) .... 78 KIAS
Best Angle (2750 lb.) (Gear Down, Flaps Up) .... 72 KIAS
En Route.. 104 KIAS
Electric Fuel Pump..OFF at desired altitude

4.5j Cruise Checklist (4.27)

CRUISE (4.27)

Reference performance charts, Avco-Lycoming Operator’s Manual and power setting table.
Normal Maximum Power 75%
Power.. SET per power table
Mixture..ADJUST

4.5k Approach And Landing Checklist (4.29)

APPROACH AND LANDING (4.29)

Fuel Selector .... PROPER TANK
Seat Backs .... ERECT
Belts/Harness .... FASTEN
Electric Fuel Pump .... ON
Mixture .... SET
Propeller .... FULL INCREASE
Emergency Gear Extension Lever .... UP POSITION
Gear .... DOWN - 129 KIAS max
Flaps .... SET - 103 KIAS max
Air Conditioner .... OFF
Trim to 75 KIAS

4.5m Stopping Engine Checklist (4.31)

STOPPING ENGINE (4.31)

CAUTION

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

Flaps .... RETRACT

Electric Fuel Pump .... OFF
Air Conditioner .... OFF

Avionics .... OFF
Electrical Switches .... OFF
Propeller .... FULL INCREASE
Throttle .... CLOSED
Mixture .... IDLE CUT-OFF
Magnetos .... OFF
ALTR Switch .... OFF
BATT MASTR Switch .... OFF

4.5n Mooring Checklist (4.33)

MOORING (4.33)

Parking Brake ....SET
Flaps .... FULL UP
Control Wheel .... SECURED with belts
Wheel Chocks ....IN PLACE
Tie Downs .... SECURE

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4.7 AMPLIFIED NORMAL PROCEDURES (GENERAL)

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

4.9 PREFLIGHT CHECK (4.5a)

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 and landing distances, 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.

4.9a Cockpit (4.5a)

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.

Upon entering the cockpit, release the seat belts securing the control wheel. Check that the landing gear selector handle is in the DOWN position and set the parking brake. Ensure that all avionics and electrical switches are OFF. Check that the mixture is in the idle cut-off and the magneto switch is OFF. Turn ON the battery master (BATT MASTR) switch; check the fuel quantity gauges for adequate supply and check that the annunciator panel illuminates. Turn OFF the battery master (BATT MASTR) switch. Check the primary flight controls and flaps 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 and POH are on board. Properly stow the tow bar and baggage and secure. Close and secure the baggage door.

4.9b Right Wing (4.5a)

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.

4.9 PREFLIGHT CHECK (4.5a) (continued)

4.9b Right Wing (4.5a) (continued)

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. The fuel tank vent should be clear of obstructions.

CAUTION

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

Drain a fuel sample from the fuel tank into a container, through the quick drain located at the lower inboard rear corner of the tank. Make sure that enough fuel has been drained to ensure that all water and sediment is removed; check for proper fuel. The fuel system should be drained daily prior to the first flight and after each refueling.

Remove the tie down and chock.

Next, a complete check of the landing gear. Check the gear strut for proper inflation, there should be 2.0 +/- 0.25 inches of strut exposure under a normal static load. Check the tire for cuts. wear, and proper inflation. Make a visual check of the brake block and disc.

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

4.9c Nose Section (4.5a)

Check the general condition of the nose section and check for oil or fluid leakage and that the cowling is secure. Check the oil level; make sure that the dipstick has been properly seated and the oil cap properly secured. Check the engine baffle seals. 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 and check the alternator belt for proper tension. The landing light should be clean and intact.

Remove the chock and check the nose gear strut for proper inflation; there should be 2.75 +/- 0.25 inches of strut exposure under a normal static load. Check the tire for cuts, wear, and proper inflation.

4.9 PREFLIGHT CHECK (4.5a) (continued)

4.9c Nose Section (4.5a) (continued)

CAUTION

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

Open the fuel strainer located on the left side of the firewall long enough to remove any accumulation of water and sediment.

4.9d Left Wing (4.5a)

The wing surface should be clear of ice, frost, snow, or other extraneous substances. Check the stall warning vane for condition and freedom of movement. Open the fuel cap and visually check the fuel color. The quantity should match the indication that was on the fuel quantity gauge. Replace fuel cap securely. 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 2.0 +/- 0.25 inches of strut exposure under a normal static load. Check the tire for cuts, wear, and proper inflation. Make a visual check of the brake block and disc.

CAUTION

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

The fuel tank vent should be clear of obstructions. Drain enough fuel into a container to ensure that all water and sediment has been removed; check for proper fuel.

Remove tie down and remove the cover from the pitot mast on the underside of the wing. Make sure the hole is 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.

4.9e Fuselage (4.5a)

Check the condition and security of the antennas and that the ports in the left side static pad are clear. The empennage should be clear of ice, frost, snow, or other extraneous substances. Check that the fresh air inlet on the left side of the fuselage is clear. Check the stabilator and trim tab for damage and operational interference; the trim tab should move in the same direction as the stabilator. Remove the tie down. Check that the ports in the right side static pad are clear.

4.9 PREFLIGHT CHECK (4.5a) (continued)

4.9e Fuselage (4.5a) (continued)

Upon returning to the cockpit, an operational check of the interior lights, exterior lights, stall warning system, and pitot heat should now be made. Turn the battery master switch and other appropriate switches ON. Check the panel lighting and the overhead flood light. Visually confirm that exterior lights are operational. Lift the stall detector on the leading edge of the left wing and determine that the warning horn is activated. With the pitot heat switch ON the pitot head will be hot to the touch. After these checks are complete, the battery master (BATT MASTR) switch and all electrical switches should be turned OFF.

Board the passengers and close and secure the cabin door. Fasten the seat belts and shoulder harness and check the function of the inertia reel by pulling sharply on the strap. Fasten seat belts on empty seats.

4.11 BEFORE STARTING ENGINE (4.5b)

Before starting the engine, set the parking brake ON. Check that all circuit breakers are in and that the alternate air is OFF. Move the propeller control to the full INCREASE rpm position. Ensure that all avionics switches are OFF. Set the fuel selector to the desired tank.

4.13 ENGINE START (4.5c)

4.13a Normal Start - Cold Engine (4.5c)

Open the throttle lever approximately 1/2 inch. Turn ON the alternator and battery master switches, and the electric fuel pump. Move the mixture control to full RICH until an indication is noted on the fuel flow meter. The engine is now primed.

Move the mixture control to idle cut-off, check that the propeller area is clear, and engage the starter by rotating the magneto switch clockwise. When the engine fires, release the magneto switch, advance the mixture control to full RICH and move the throttle to the desired setting. Check the oil pressure.

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

4.13 ENGINE START (4.5c) (continued)

4.13b Normal Start - Hot Engine (4.5c)

Open the throttle approximately l/2 inch. Turn ON the alternator and battery master switches, and the electric fuel pump. The mixture control lever should be in idle cut-off. Check that the propeller area is clear, 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. Check the oil pressure.

4.13c Engine Start When Flooded (4.5c)

The throttle lever should he full OPEN. Turn ON the alternator and battery master switches, and turn OFF the emergency fuel pump. The mixture control lever should be in idle cut-off. Check that the propeller area is clear, 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. Check the oil pressure.

4.13d Engine Start With External Power Source (4.5c)

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 OFF the alternator switch, the battery master switch, and all electrical equipment. 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 and disconnect the jumper cable from the aircraft. Turn the alternator and battery master switches ON. Check the alternator ammeter for an indication of output. DO NOT ATTEMPT FLIGHT IF THERE IS NO INDICATION OF ALTERNATOR OUTPUT.

CAUTION

It is possible to use the ship's battery in parallel by turning only the battery master switch ON. This will give longer cranking capabilities, but will not increase the amperage. 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 only the battery 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.

4.13 ENGINE START (4.5c) (continued)

4.13d Engine Start With External Power Source (4.5c) (continued)

NOTE

For all normal operations using the PEP jumper cables, the battery master and alternator switches should be OFF.

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.

NOTE

Starter manufacturer recommends starter cranking periods be limited to 10 seconds with a 2 minute rest period between cranking periods. Maximum of 5 start periods allowed. If start is not achieved on fifth attempt allow starter to cool for 30 minutes before attempting additional starts.

4.15 WARM-UP (4.5d)

Warm-up the engine at 1400 to 1500 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, provided that the throttle may be opened without backfiring or skipping, and without a reduction in engine oil pressure.

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.

4.17 TAXIING (4.5e)

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.

4.17 TAXIING (4.5e) (continued)

Release the parking brake and apply power slowly to start the taxi roll. Taxi a few feet forward and apply the 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 (4.5f)

Set the parking brake and check that the propeller control is set at high rpm. Advance the throttle to 2000 rpm for checking the magnetos. 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 between 4.8 and 5.2 inches Hg at 2000 rpm. Retard the throttle. Check both 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. The engine is warm enough for takeoff when the throttle can be opened without the engine faltering. Check the ammeter for proper alternator output.

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

The propeller control should be moved through its complete range to check for proper operation, and then placed in full INCREASE rpm for takeoff. To obtain maximum rpm, push the pedestal mounted control fully forward on the instrument panel. 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.

Turn the electric fuel pump OFF after starting or during warm-up and check the fuel flow/pressure gauge 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.

4.21 BEFORE TAKEOFF (4.5g)

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

Verify that the battery master and alternator switches are ON. Check and set all of the night instruments as required. Check the fuel selector to make sure it is on the proper tank (fullest). Turn ON the electric fuel pump. 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 and the seat belts and shoulder harness fastened. Fasten the seat belts snugly around the empty seats.

Exercise and set the flaps and trim. The Emergency Gear Extension Lever should be in the up position to permit normal gear operation. If the Emergency Gear Extension Lever is not in the fully up position prior to ger retraction, the landing gear may not retract when the landing gear switch is selected up. Ensure proper movement and response of all flight controls.

All doors should be properly secured and latched.

On air conditioned models, the air conditioner must be OFF to ensure normal takeoff performance.

4.23 TAKEOFF (4.5h)

4.23a Normal Technique (4.5h)

The normal takeoff technique is conventional for the Arrow. Flaps should be up and the trim should be set slightly aft of neutral, with the exact setting determined by the loading of the airplane. Allow the airplane to accelerate to 65 to 75 KIAS, depending on the weight of the aircraft, and ease back on the control wheel to rotate to climb attitude.

4.23b Short Field, Obstacle Clearance And Soft Field Techniques (4.5h)

The procedure used for a short field takeoff with an obstacle clearance or a soft field takeoff differs slightly from the normal technique. The flaps should be lowered to 25Þ (second notch). Allow the aircraft to accelerate to 50 to 60 KIAS depending on the aircraft weight and rotate the aircraft to climb attitude. After breaking ground, accelerate to 55 to 65 KIAS, depending on aircraft weight and select gear up. Continue to climb while accelerating to the gear up rate of climb speed, 90 KIAS if no obstacle is present or 78 KIAS if obstacle clearance is a consideration. Slowly retract the flaps one notch at a time while climbing out.

4.25 CLIMB (4.5i)

On climb-out after takeoff, it is recommended that the best angle of climb speed (78 KIAS) be maintained only if obstacle clearance is a consideration. The best rate of climb speed (90 KIAS) should be maintained with full power on the engine until adequate terrain clearance is obtained. At lighter than gross weight these speeds are reduced somewhat. An en route climb speed of 104 KIAS or higher is also recommended. This increased climb speed provides better engine cooling, less engine wear, reduced fuel consumption, lower cabin noise level, and better forward visibility.

When reaching the desired altitude, the electric fuel pump may be turned OFF.

To obtain the performance presented in the Performance Section of this handbook, full power (full throttle and 2700 rpm) must be used.

4.27 CRUISE (4.5j)

Following level-off for cruise, the airplane should be trimmed.

The cruising speed of the Arrow 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 2400, 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 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.

4.27 CRUISE (4.5j) (Continued)

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 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.

The pilot should monitor weather conditions while flying and should be alert to conditions which might lead to icing. If induction system icing is expected, place the alternate air control in the ON position.

During flight, keep account of time and fuel used in connection with power settings to determine how the fuel flow and fuel quantity gauging systems are operating. If the fuel flow indication is considerably higher than the fuel actually being consumed, a fuel nozzle may be clogged and require cleaning.

There are no mechanical uplocks in the landing gear system. In the event of a hydraulic system malfunction, the landing gear will free fall to the gear down position. The true airspeed with gear down is approximately 75% of the gear retracted airspeed for any given power setting. Allowances for the reduction in airspeed and range should be made when planning extended flight between remote airfields or flight over water.

In order to keep the airplane in best lateral trim during cuise flight, the fuel should be used 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.

4.29 APPROACH AND LANDING (4.5k)

Check to ensure the fuel selector is on the proper (fullest) tank and that the seat backs are erect. The seat belts and shoulder harness should be fastened and the inertia reel checked.

Turn ON the electric fuel pump. The mixture should be set in the full RICH position. Set the propeller at full INCREASE rpm to facilitate ample power for an emergency go-around.

Prior to landing gear operation, the Emergency Gear Extension lever should be in the up position to permit normal gear extension or retraction in the event of a go-around. The landing gear may be extended at speeds below 129 KIAS. The airplane should be trimmed to a final approach speed of about 75 KIAS with flaps extended. The flaps can be lowered at speeds up to 103 KIAS, if desired. Turn OFF the air conditioner.

The mixture control should be kept in full RICH position to ensure maximum acceleration if it should be necessary to open the throttle again.

The amount of flap used during landings and the speed of the aircraft at contact with the runway should be varied according to the landing surface and conditions of wind and airplane loading. It is generally good practice to contact the ground at the minimum possible safe speed consistent with existing conditions.

Normally, the best technique for short and slow landings is to use full flap and enough power to maintain the desired airspeed and approach flight path. Mixture should be full RICH, fuel on the fullest tank, and the electric fuel pump ON. Reduce the speed during the flareout and contact the ground close to the stalling speed. After ground contact, hold the nose wheel off as long as possible. As the airplane slows down, gently lower the nose and apply the brakes. Braking is most effective when flaps are raised and back pressure is applied to the control wheel, putting most of the aircraft weight on the main wheels. In high wind conditions, particularly in strong crosswinds, it may be desirable to approach the ground at higher than normal speeds with partial or no flaps.

4.31 STOPPING ENGINE (4.5m)

CAUTION

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

At the pilot’s discretion, the flaps should be raised.

4.31 STOPPING ENGINE (4.5m) (continued)

The electric fuel pump, air conditioner, radios, and all electrical switches should be turned OFF. Set the propeller in the full INCREASE position. Stop the engine 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, alternator, and battery master switches must be turned OFF.

4.33 MOORING (4.5n)

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. The flaps are locked when in the UP position and should be left retracted. The aileron and stabilator controls should be secured by looping the safety belt through the control wheel and pulling it snug.

Tiedowns 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.

4.35 STALLS

The stall characteristics of the Arrow 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 of the Arrow with power off and full flaps is 55 KIAS. With the flaps up this speed is increased 5 KTS. Loss of altitude during stalls can be as great as 400 feet, depending on configuration and power.

NOTE

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

During preflight, the stall warning system should be checked by turning the battery master switch ON, lifting the detector and checking to determine if the horn is actuated. The battery master switch should be returned to the OFF position after the check is complete.

4.37 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.

4.39 LANDING GEAR

The pilot should become familiar with the function and significance of the landing gear position indicators and warning lights.

WARNING

The NAV LIGHT switch must be off to obtain full intensity gear lights during daytime flying. When aircraft is operated at night and NAV LIGHT switch is turned on, gear lights will automatically dim.

The red gear warning light on the instrument panel and the gear warning horn operate simultaneously in flight when the throttle is reduced to where the manifold pressure is approximately 14 inches of mercury or below, and the gear is not in the DOWN position. The red gear warning light and horn will also operate simultaneously on the ground when the battery master switch is ON, the gear selector swtich is in the UP position, and the throttle is in the retarded position.

The three green lights on the instrument panel operate individually as each associated gear is locked in the extended position.

When the Emergency Landing Gear Extension Procedure (paragraph 3.31) is performed for training purposes, the hydraulic pump must be deactivated by pulling the LANDING GEAR PUMP circuit breaker in order for the procedure to extend the gear. Upon completion of the procedure, reset the LANDING GEAR PUMP circuit breaker to resume normal operation of the system. Verify that the emergency gear extension lever is returned to the normal/up position.

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).

4.43 NOISE LEVEL

The noise level of this aircraft is 75.5 d B(A).

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 not withstanding 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 FAR 36, Noise Standards - Aircraft Type and Airworthiness Certification. This aircraft model is in compliance with all FAR 36 noise standards applicable to this type.

TABLE OF CONTENTS

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 and 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 the 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.

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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 effecting 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 have been determined for consideration 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	1890 lbs.
(2)	Occupants (2 x 170 lbs.)	340 lbs.
(3)	Baggage and Cargo	70 lbs.
(4)	Fuel (6 lb./gal. x 51.3)	308 lbs.
(5)	Engine Start, Taxi, and Run Up	-8 lbs.
(6)	Takeoff Weight	2600 lbs.
(7)	Landing Weight (a)(6) minus (g)(1), (2600 lbs. minus 73.2 lbs.)	2526 lbs.

The takeoff weight is below the maximum of 2750 lbs., and the weight and balance calculations have determined the C.G. position to be within approved limits.

5.5 FLIGHT PLANNING EXAMPLE (continued)

(b) Takeoff and Landing

Now that the airplane loading has been determined, all aspects of the takeoff and landing must now 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 5-9, 5-11, 5-13 and 5-15) 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	1900 ft.	1900 ft.
(2) Temperature	20°C	20°C
(3) Wind Component	4 KTS	2 KTS
(4) Runway Length Available	3000 ft.	4600 ft.
(5) Runway Required	2550 ft.*	1490 ft.**

NOTE

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

*reference Figure 5-13
**reference Figure 5-39

5.5 FLIGHT PLANNING EXAMPLE (continued)

(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 climb components from the Fuel, Time and Distance to Climb graph (Figure 5-21). After the fuel, time and distance for the cruise pressure altitude and outside air temperature values have been established, apply the existing conditions at the departure field to the graph (Figure 5-21). Subtract the values obtained from the graph for the field of departure conditions for those for the cruise pressure altitude.

The remaining values are the true fuel, time and distance 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	10°C
(3)	Fuel to Climb (4 gal. minus 1.0 gal.)	3.0 gal.*
(4)	Time to Climb (10 min. minus 3.5 min.)	6.5 min.*
(5)	Distance to Climb (17 naut. miles minus 6 naut. miles)	11 naut. miles*

(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, time, and distance for descent (Figure 5-35). 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, time and distance

*reference Figure 5-21

5.5 FLIGHT PLANNING EXAMPLE (continued)

values from the graph (Figure 5-35). Subtract the values obtained from the field conditions from the values obtained from the cruise conditions to find the true fuel, time and distances 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) Fuel to Descend (1.0 gal. minus 0.5 gal.)	0.5 gal.*
(2) Time to Descend (7 min. minus 3 min.)	4 min.*
(3) Distance to Descend (18 naut. miles minus 7.5 naut. miles)	10.5 naut. miles*

(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 Power Setting Table (Figure 5-23 or 5-23a) 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 appropriate Speed Power graph (Figure 5-25 through 5-27c).

For this example, 65% Economy Cruise at 2500 RPM was used. Calculate the cruise flow for the cruise power setting from the information provided by the Best Economy Range chart (Figure 5-31a).

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 flow by the cruise time.

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

(1) Total Distance	130 naut. miles
(2) Cruise Distance (e)(1) minus (c)(5) minus (d)(3), (130 naut. miles minus 11 naut. miles minus 10.5 naut. miles)	108.5 naut. miles

*reference Figure 5-35

5.5 FLIGHT PLANNING EXAMPLE (continued)

(3)	Cruise Power (Best Economy)	65% rated power (2500 RPM)
(4)	Cruise Delta OAT from ISA (10° C - 3° C)	7 ° C
(5)	Cruise Manifold Press. (23.1 + [7/5.5 x .16])	23.3 in Hg
(6)	Cruise Speed	130 Kts TAS*
(7)	Cruise Fuel Consumption	10.3 gph*
(8)	Cruise Time (e)(2) divided by (e)(6), (108.5 naut. miles divided by 130 KTS)	.84 hrs. (51 min.)
(9)	Cruise Fuel (e)(7) multiplied by (e)(8), (10.3 gph mulitiplied by .84 hrs.)	8.7 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)(4) plus (d)(2) plus (e)(8), (.11 hrs. plus .07 hrs. plus .84 hrs.) (6.5 min. plus 4 min. plus 51 min.)	1.02 hrs., 61.5 min.

(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)(3) plus (d)(1) plus (e)(9), (3.0 gal. plus 0.5 gal. plus 8.7 gal.) (12.2 gal. multiplied by 6 lb./gal.)	 12.2 gal. 73.2 lbs.

*reference Figure 5-27c

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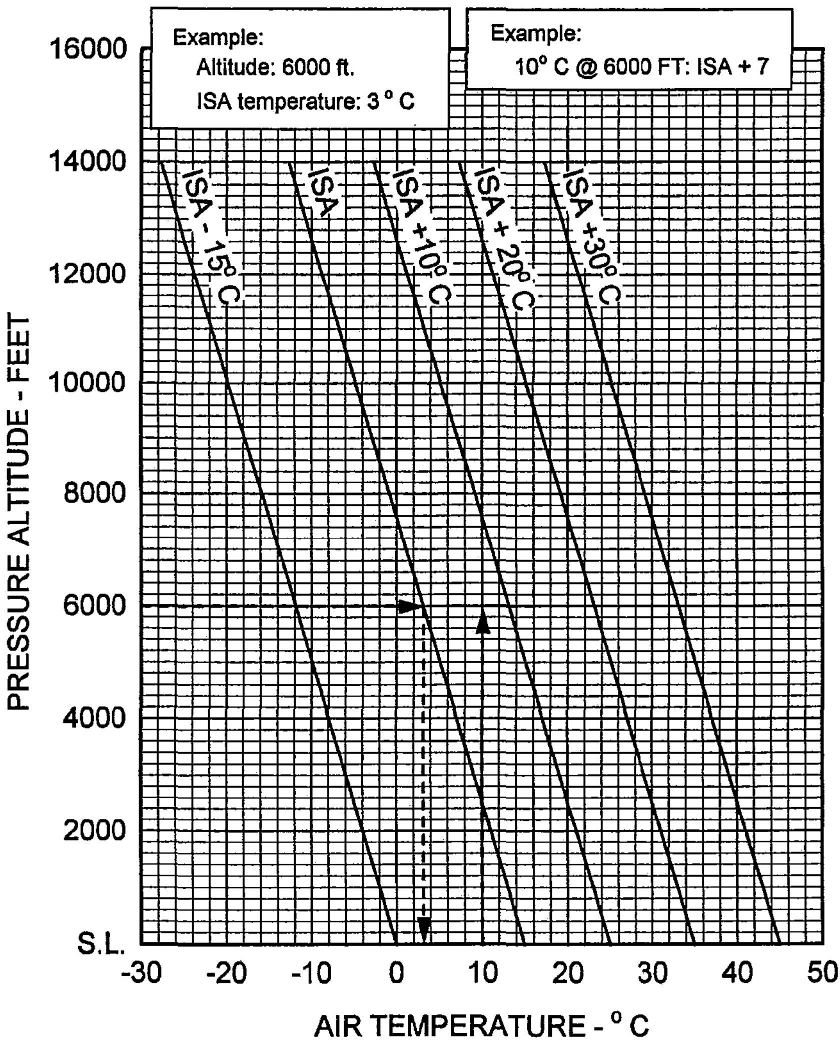
5.7 PERFORMANCE GRAPHS

LIST OF FIGURES

5.7 PERFORMANCE GRAPHS (Cont'd)

LIST OF FIGURES (Cont'd)



AIR TEMPERATURES ABOVE & BELOW ISA

Figure 5-1a

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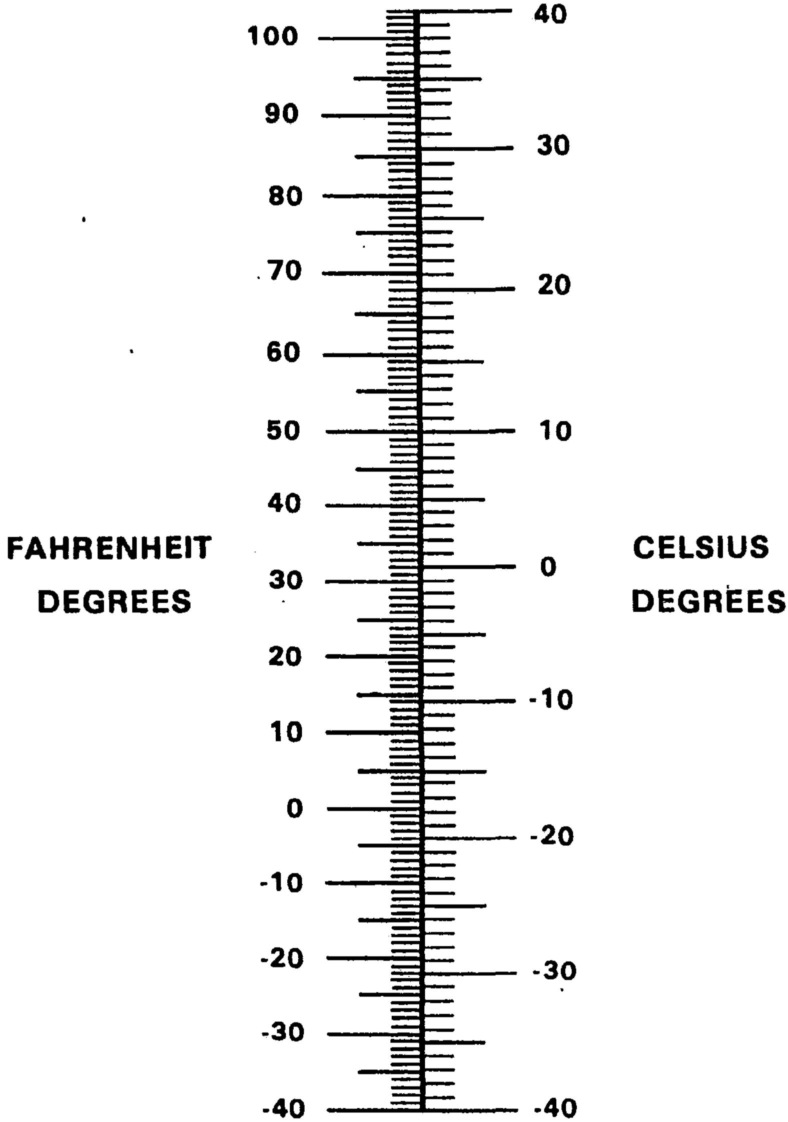
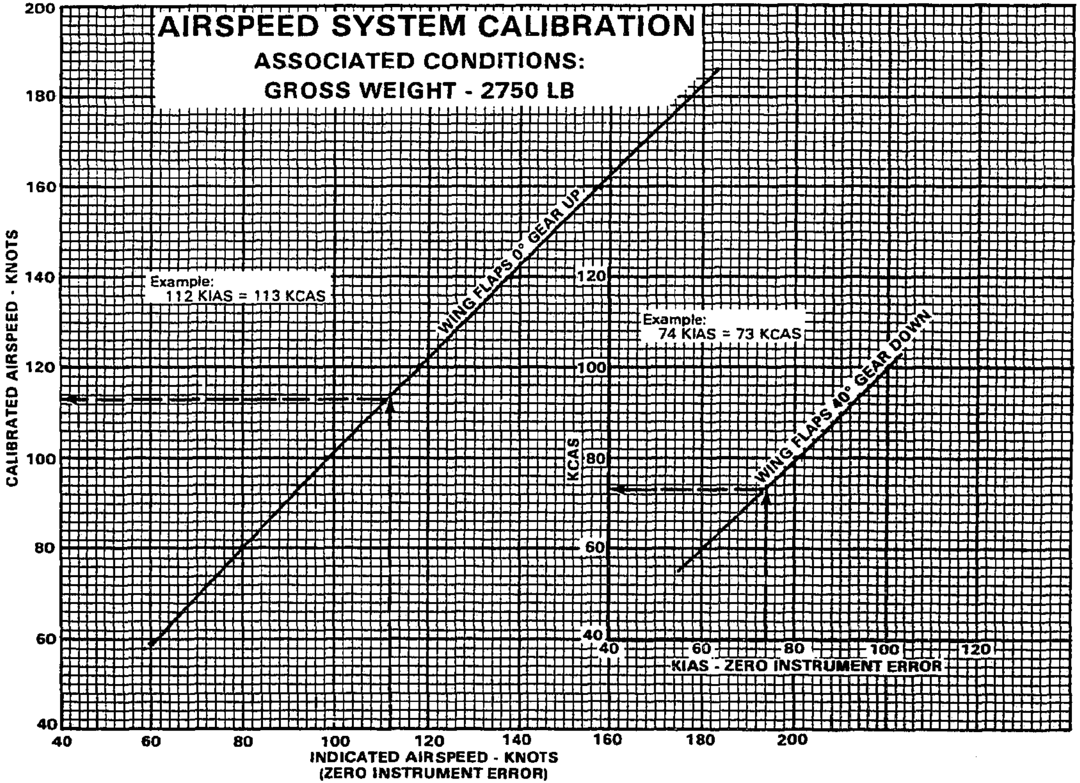
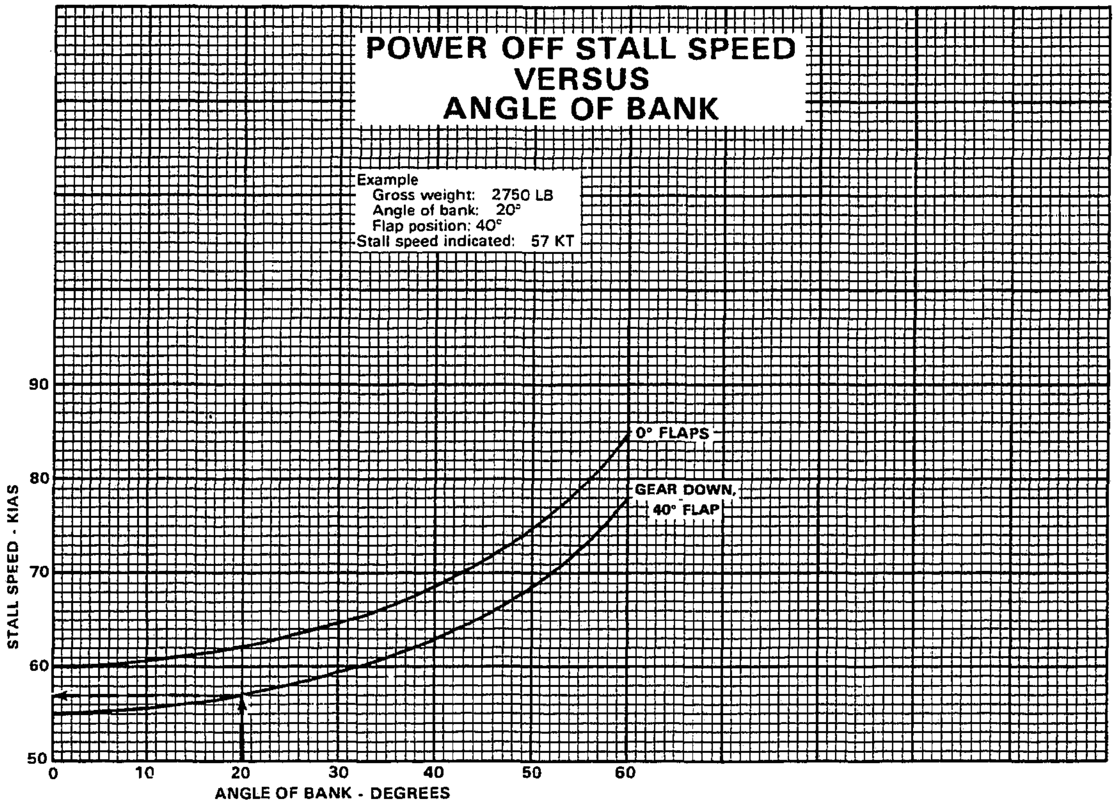


TEMPERATURE CONVERSION
Figure 5-1



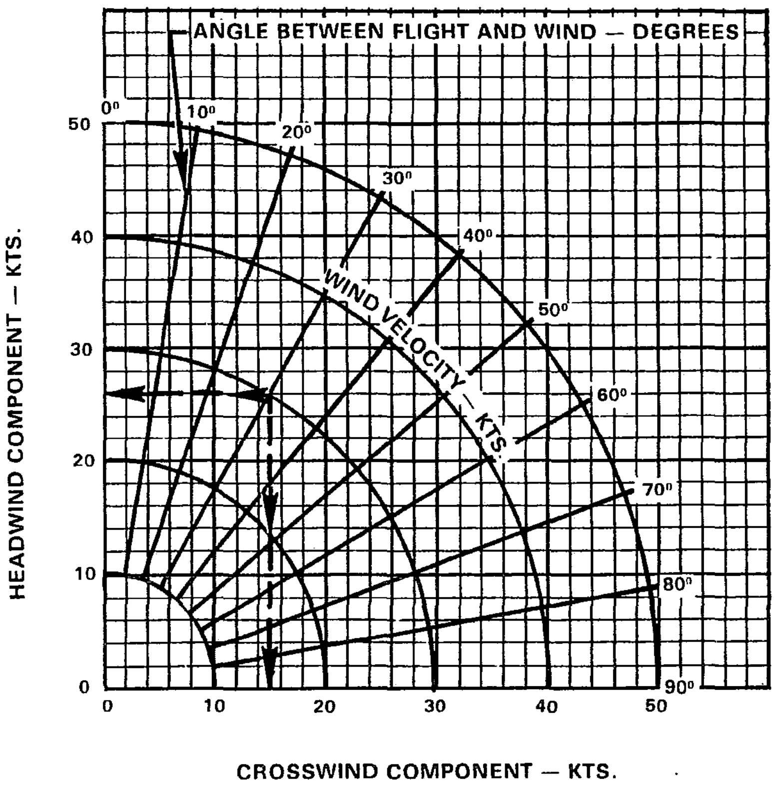
AIRSPEED SYSTEM CALIBRATION
Figure 5-3



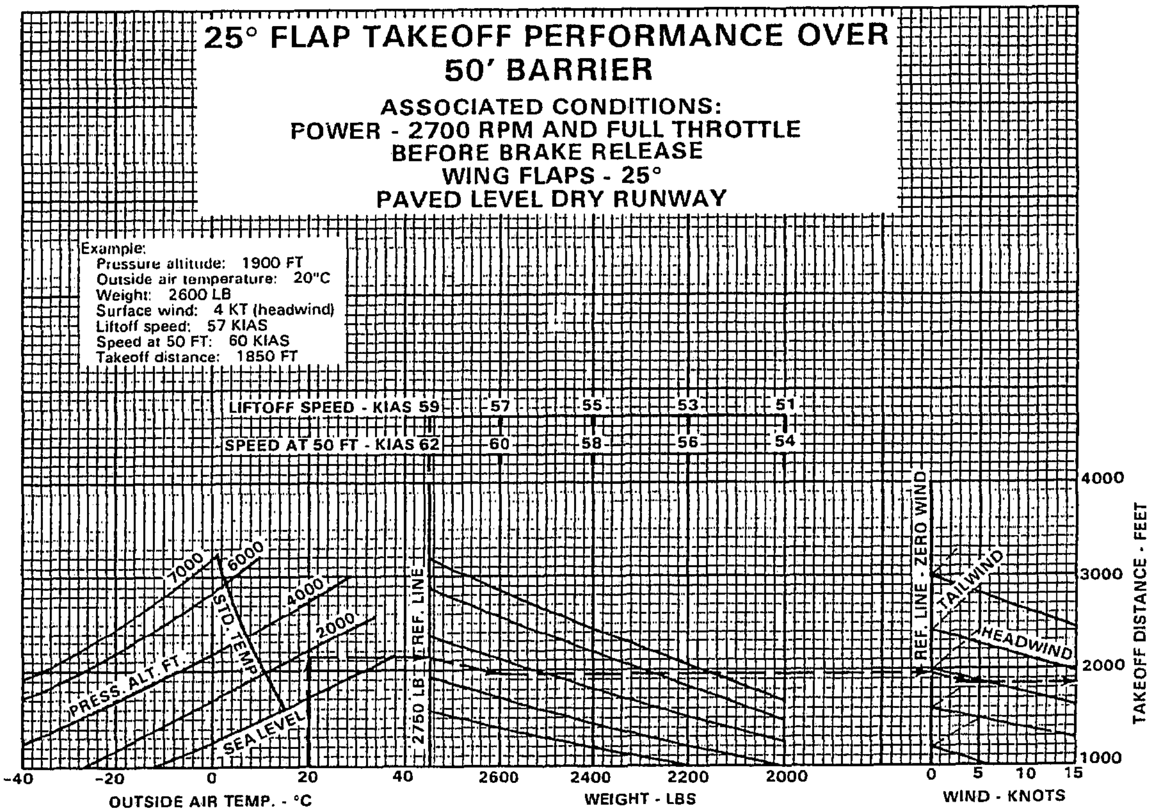
POWER OFF STALL SPEED VS. ANGLE OF BANK
Figure 5-5

WIND COMPONENTS

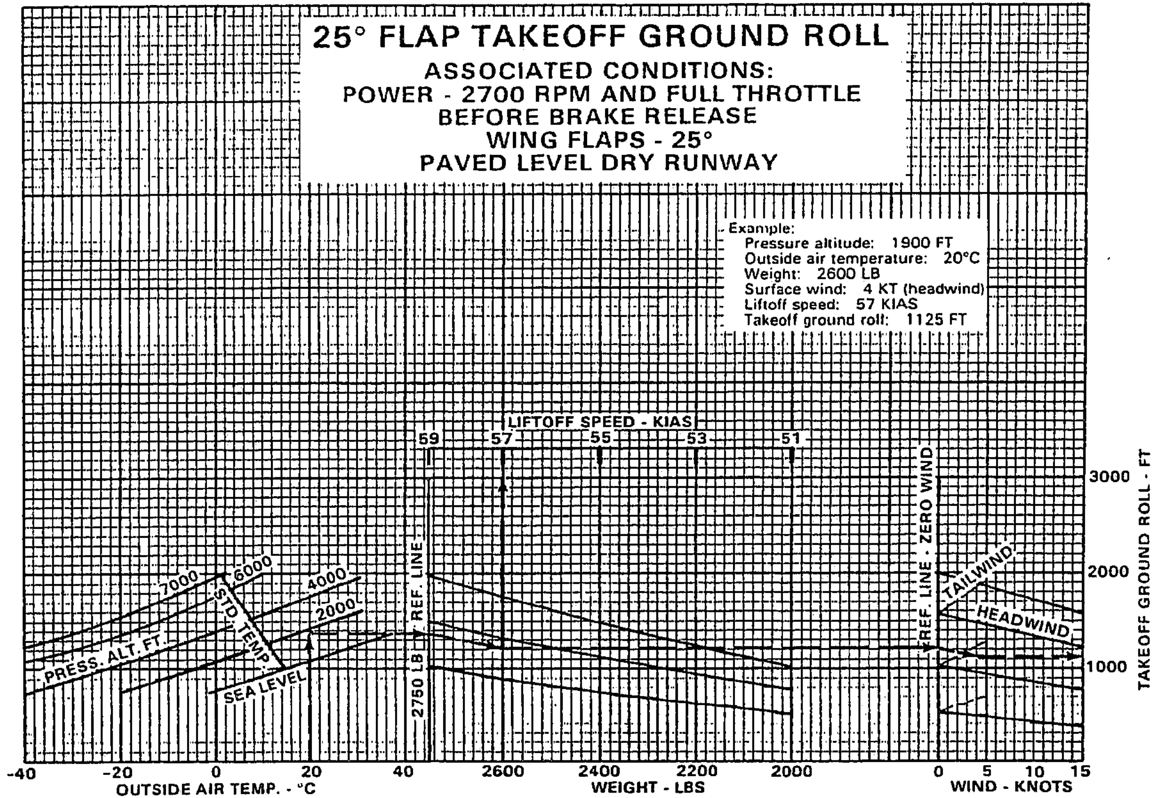
Example:
Wind velocity: 30 knots
Angle between flight path and wind: 30°
Headwind component: 26 knots
Crosswind components: 15 knots



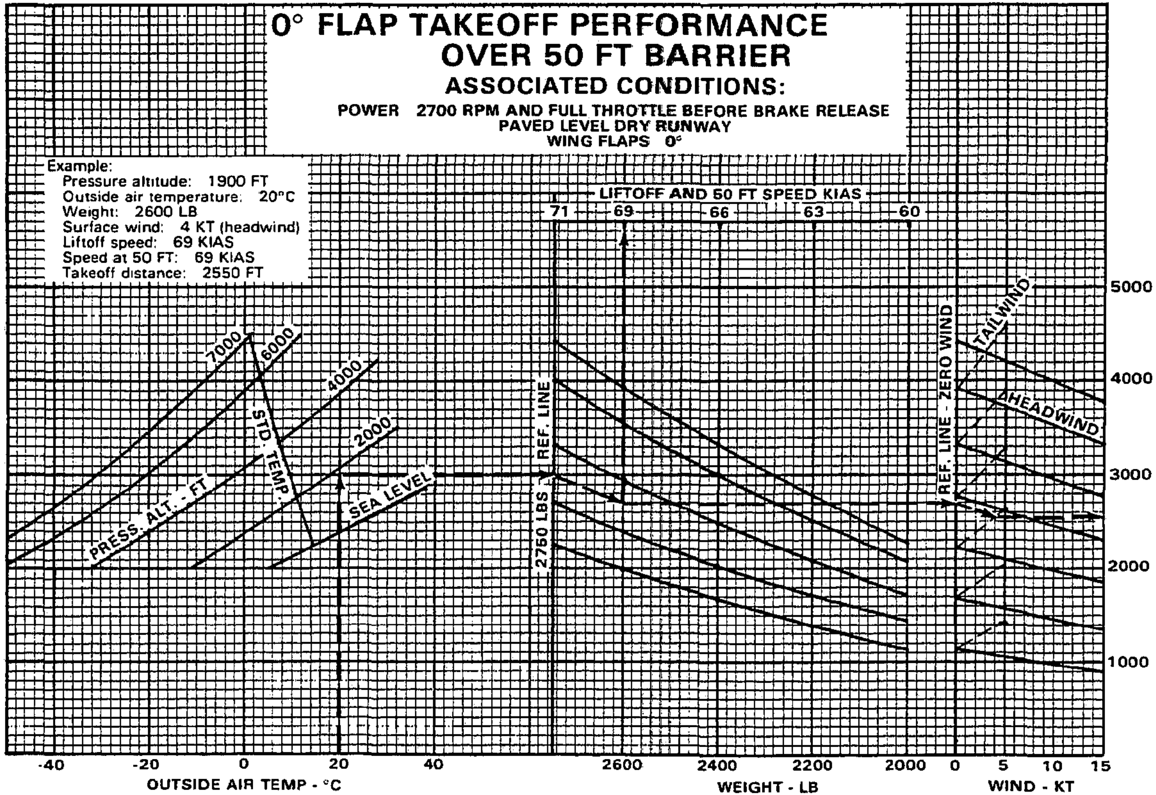
WIND COMPONENTS
Figure 5-7



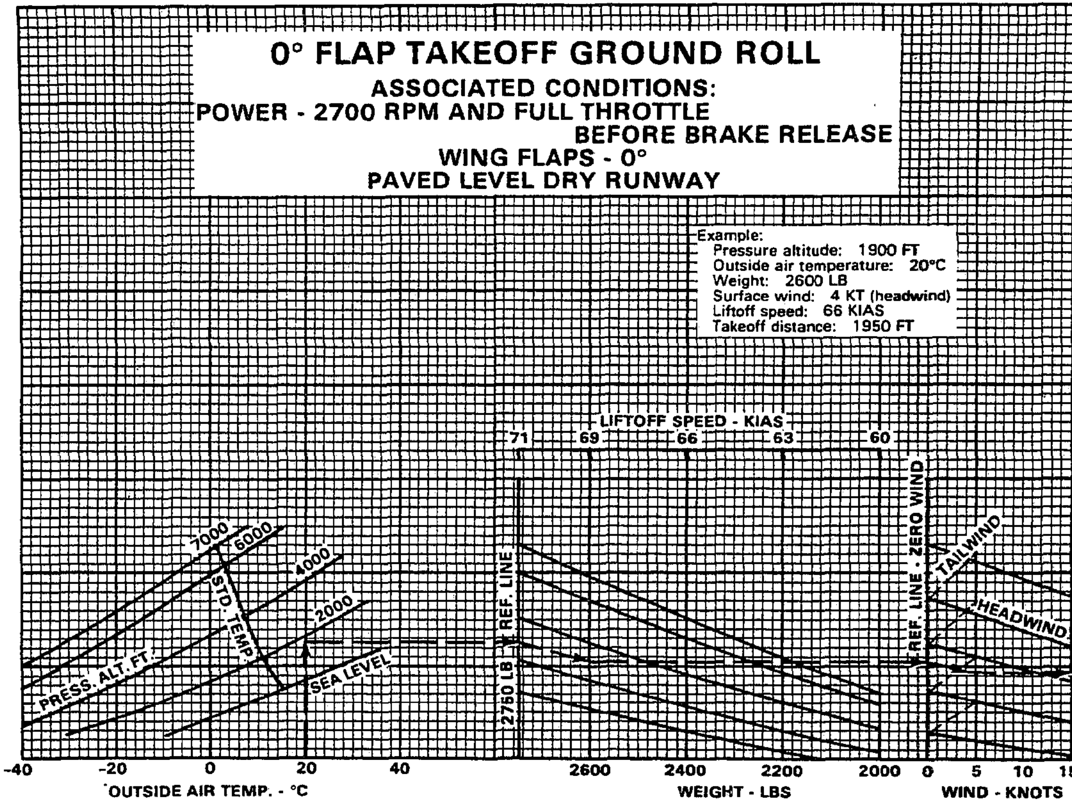
25° FLAP TAKEOFF PERFORMANCE
Figure 5-9



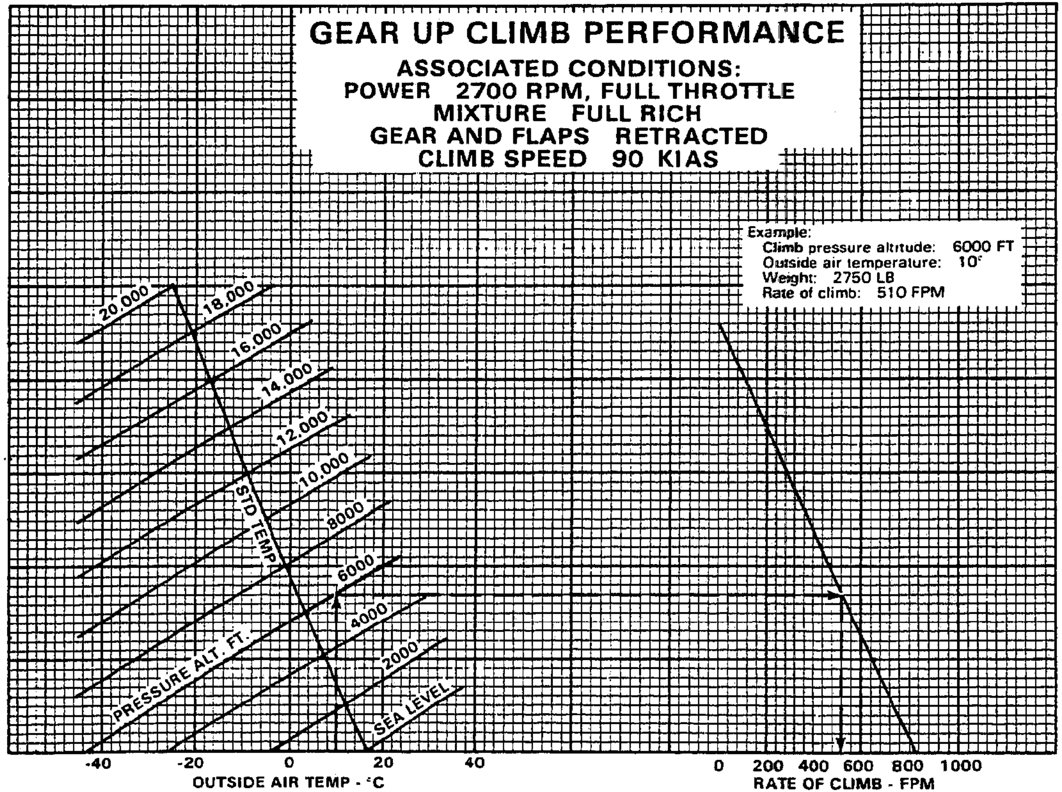
25° FLAP TAKEOFF GROUND ROLL
Figure 5-11



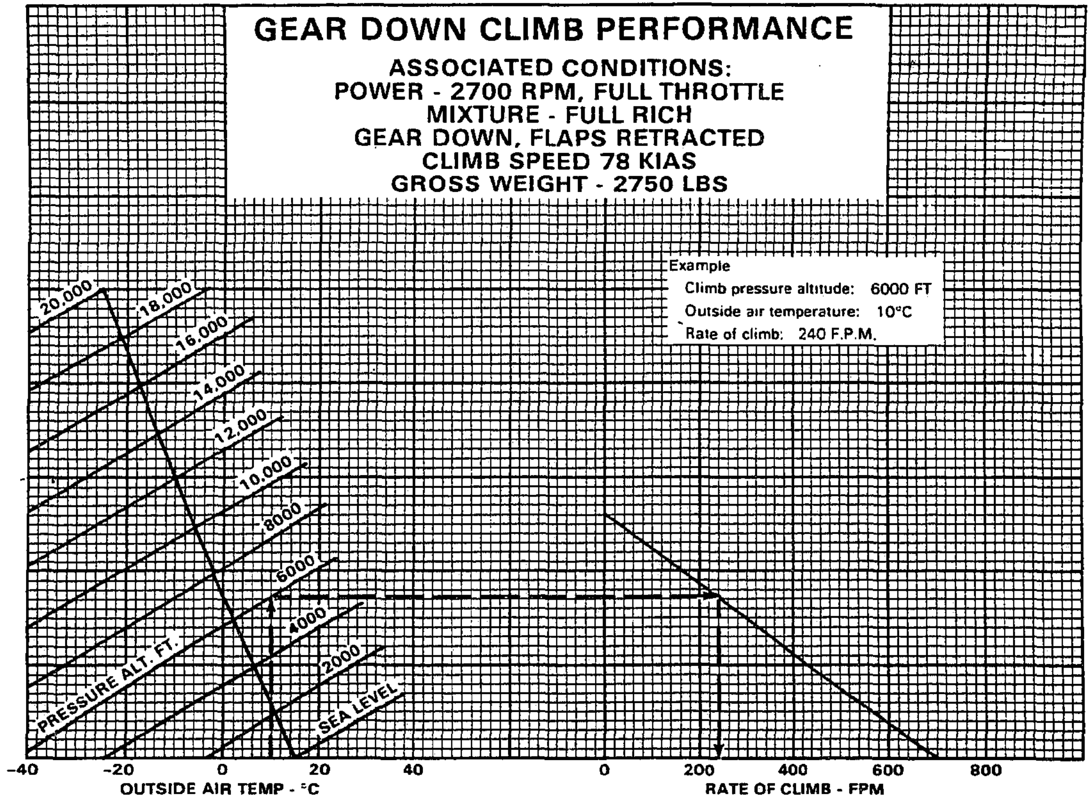
0° FLAP TAKEOFF PERFORMANCE
Figure 5-13



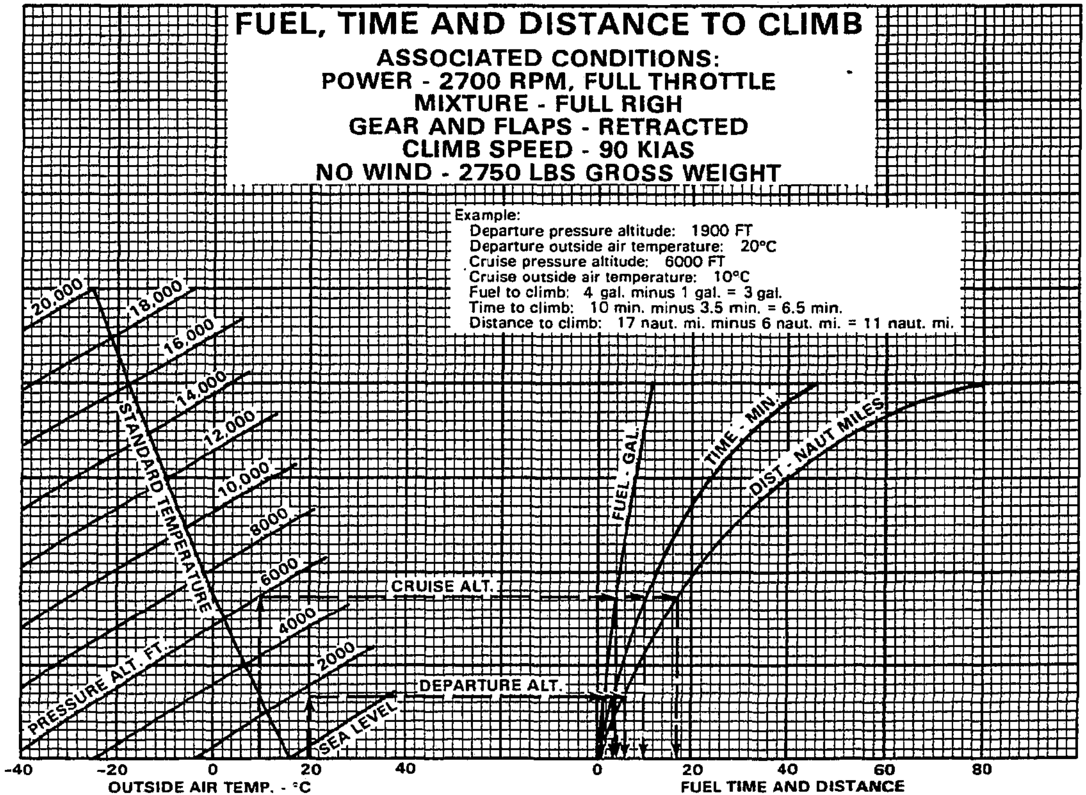
0° FLAP TAKEOFF GROUND ROLL
Figure 5-15



GEAR UP CLIMB PERFORMANCE
Figure 5-17



GEAR DOWN CLIMB PERFORMANCE
Figure 5-19



FUEL, TIME AND DISTANCE TO CLIMB
Figure 5-21

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Power Setting Table for Lycoming Model IO-360-C1C6 Engine as Installed in PA-28R-201 Arrow Best Power Mixture

Pressure Altitude	ISA Temperature		55% power 110 BHP@ Prop Mixture Peak EGT + 100° F RPM and Manifold Press.		65% power 130 BHP @ Prop Mixture Peak EGT + 100° F RPM and Manifold Press.		75% power 150 BHP @ Prop Mixture Peak EGT + 100° F RPM and Manifold Press.	Pressure Altitude
Feet	°F	°C	2200 RPM	2500 RPM	2200 RPM	2500 RPM	2500 RPM	Feet
S.L.	59	15	23.7	21.7	26.1	24.1	26.3	S.L.
1000	55	13	23.4	21.4	25.8	23.7	26.0	1000
2000	52	11	23.0	21.1	25.4	23.4	25.6	2000
3000	48	9	22.6	20.8	25.1	23.1	25.3	3000
4000	45	7	22.3	20.5	24.7	22.8	24.9	4000
5000	41	5	21.9	20.2	24.3	22.4	24.6	5000
6000	38	3	21.6	19.9	24.0	22.1	24.3	6000
6800	35	2	21.3	19.7	23.7	21.9	F.T.	6800
7000	34	1	21.2	19.6	23.6	21.8		7000
7500	32	0	21.0	19.4	F.T.	21.6		7500
8000	30	-1	20.8	19.3		21.5		8000
9000	27	-3	20.5	19.0		21.1		9000
9400	25	-4	20.3	18.9		F.T.		9400
10000	23	-5	F.T.	18.7				10000
11000	19	-7		18.4				11000
12000	16	-9		18.1				12000
13000	12	-11		17.8				13000
14000	9	-13		17.5				14000

Note:

To maintain constant power, correct manifold pressure approximately 0.16" Hg for each 10° F (5.5° C) variation in inlet air temperature from standard altitude temperature. Add manifold pressure for air temperatures above standard: subtract for temperatures below standard.Full throttle manifold pressure values may not be obtainable when atmospheric conditions are non-standard.

POWER SETTING TABLE (Best Power)
Figure 5-23

Power Setting Table for Lycoming Model IO-360-C1C6
Engine as Installed in PA-28R-201 Arrow   Best Economy Mixture

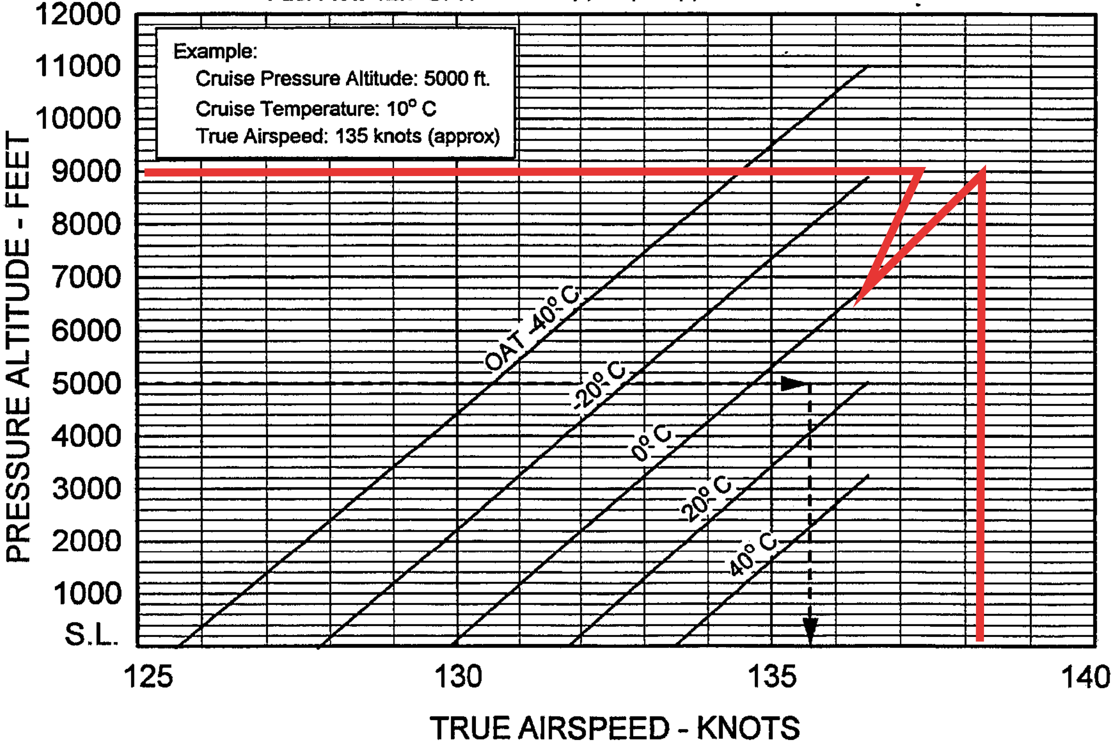
Pressure Altitude	ISA Temperature		55% Power 110 BHP @ Propeller Mixture Peak EGT Manifold Pressure - In. Hg		65% Power 130 BHP @ Propeller Mixture Peak EGT Manifold Pressure - In. Hg		Pressure Altitude
Feet	°F	°C	2200 RPM	2500 RPM	2200 RPM	2500 RPM	Feet
S.L.	59	15	24.8	22.2	27.5	24.5	S.L.
1000	55	13	24.4	22.0	27.1	24.3	1000
2000	52	11	24.0	21.8	26.7	24.1	2000
3000	48	9	23.7	21.5	26.3	23.8	3000
4000	45	7	23.3	21.3	26.0	23.6	4000
5000	41	5	22.9	21.1	25.6	23.3	5000
5250	40	4	22.8	21.0	F.T.	23.2	5250
6000	38	3	22.5	20.8		23.1	6000
7000	34	1	22.1	20.6		22.8	7000
8000	30	-1	21.8	20.4		22.6	8000
8750	28	-2	21.5	20.2		F.T.	8750
9000	27	-3	F.T.	20.1			9000
10000	23	-5		19.9			10000
11000	19	-7		19.7			11000
12000	16	-9		F.T.			12000

Note: To maintain constant power, correct manifold pressure approximately 0.16" Hg for each 10° F (5.5° C) variation in inlet air temperature from standard altitude temperature. Add manifold pressure for air temperatures above standard: subtract for temperatures below standard. Full throttle manifold pressure values may not be obtainable when atmospheric conditions are non-standard.

POWER SETTING TABLE (Best Economy)
Figure 5-23a

BEST POWER CRUISE 75% POWER

MIXTURE: 100° F Rich of Peak EGT 2500 RPM
Fuel Flow 12.7 GPH Gear Up, Flaps Up, 2750 Pounds Gross Wt.

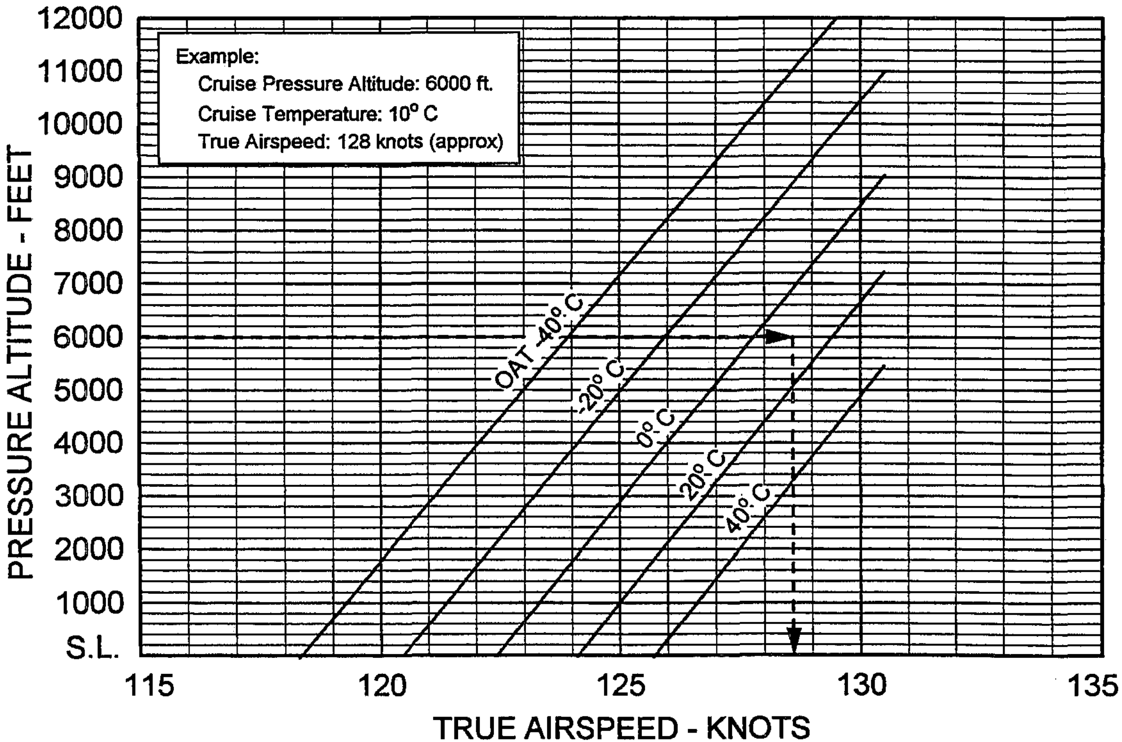


BEST POWER CRUISE (75% Power)
Figure 5-25

BEST POWER CRUISE 65% POWER

MIXTURE: 100° F Rich of Peak EGT 2500 RPM

Fuel Flow 11.4 GPH Gear Up, Flaps Up, 2750 Pounds Gross Wt.

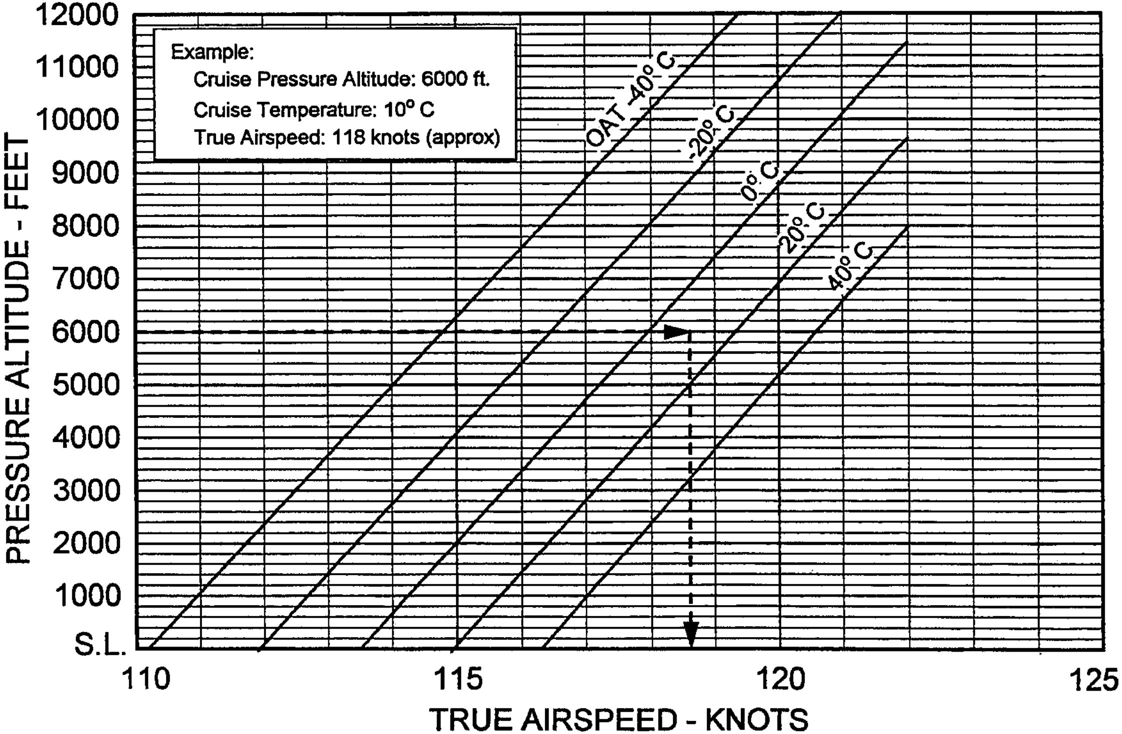


BEST POWER CRUISE (65% Power)
Figure 5-25a

BEST POWER CRUISE 55% POWER

MIXTURE: 100° F Rich of Peak EGT 2500 RPM

Fuel Flow 10.2 GPH Gear Up, Flaps Up, 2750 Pounds Gross Wt.

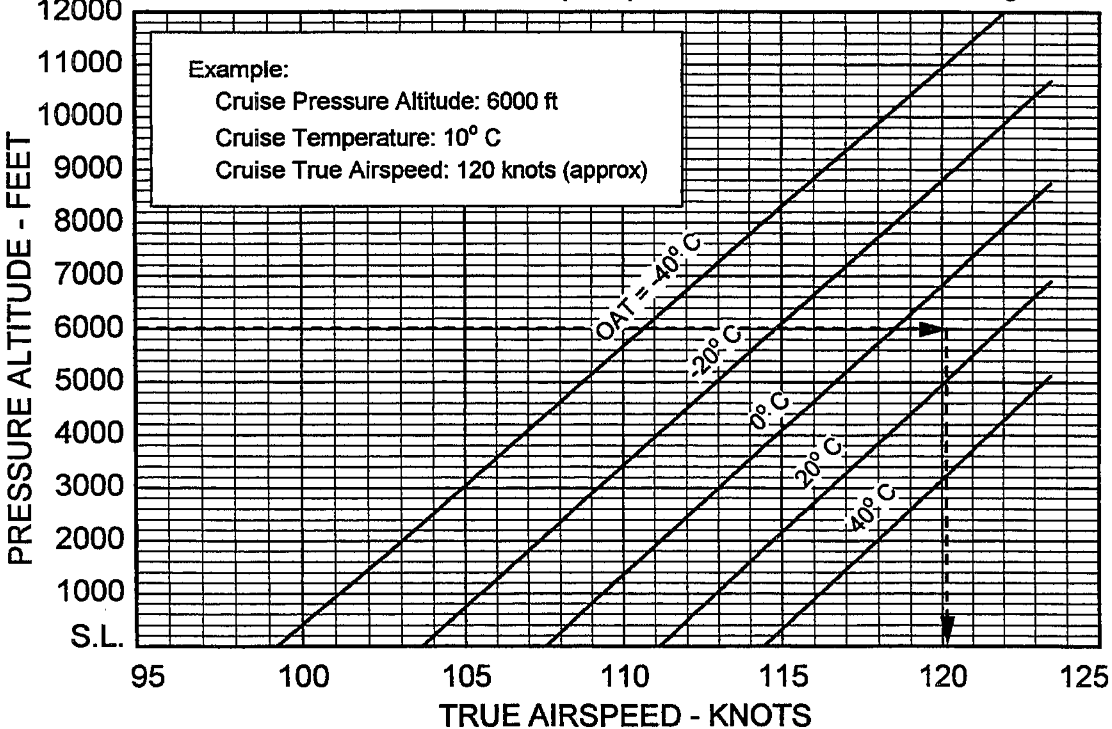


BEST POWER CRUISE (55% Power)
Figure 5-25b

ECONOMY CRUISE 55% POWER

MIXTURE: PEAK EGT CRUISE RPM: 2200

Fuel Flow 8.5 GPH Gear Up, Flaps UP, 2750 Pounds Gross Weight



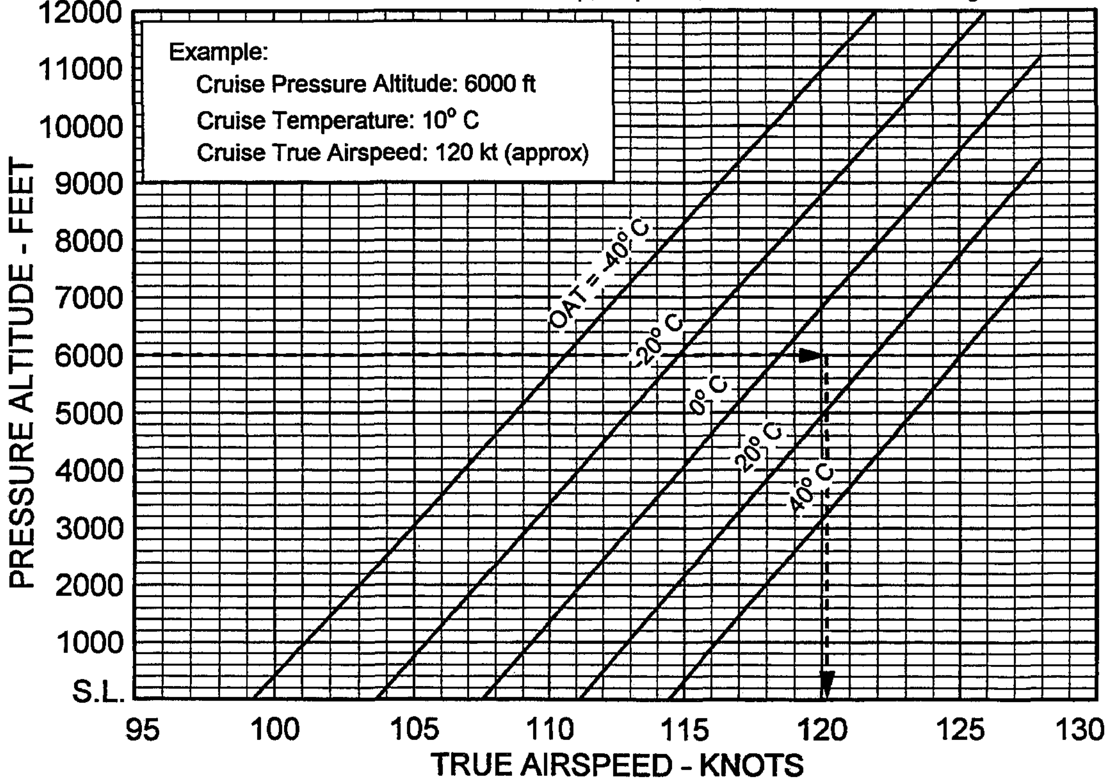
ECONOMY CRUISE (55% Power 2200 RPM)
Figure 5-27

ISSUED: SEPTEMBER 15, 1988
REVISED: MAY 8, 1995

ECONOMY CRUISE 55% POWER

MIXTURE: PEAK EGT CRUISE RPM: 2500

Fuel Flow 9.0 GPH Gear Up, Flaps UP, 2750 Pounds Gross Weight

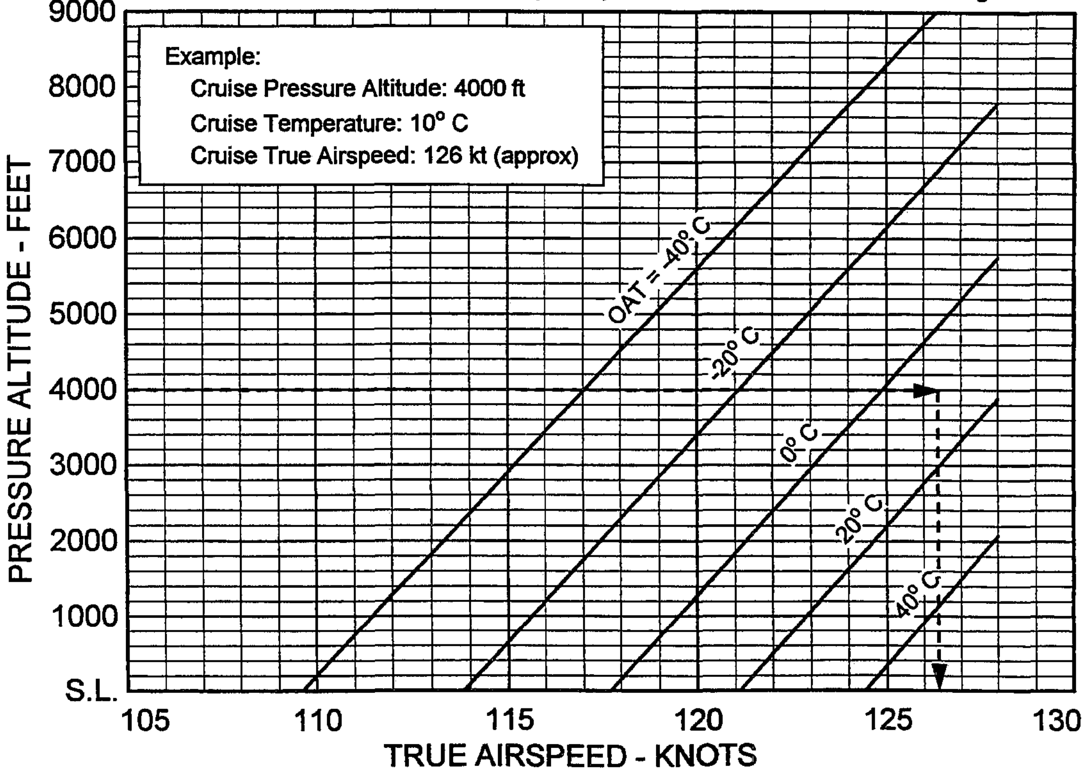


ECONOMY CRUISE (55% Power 2500 RPM)
Figure 5-27a

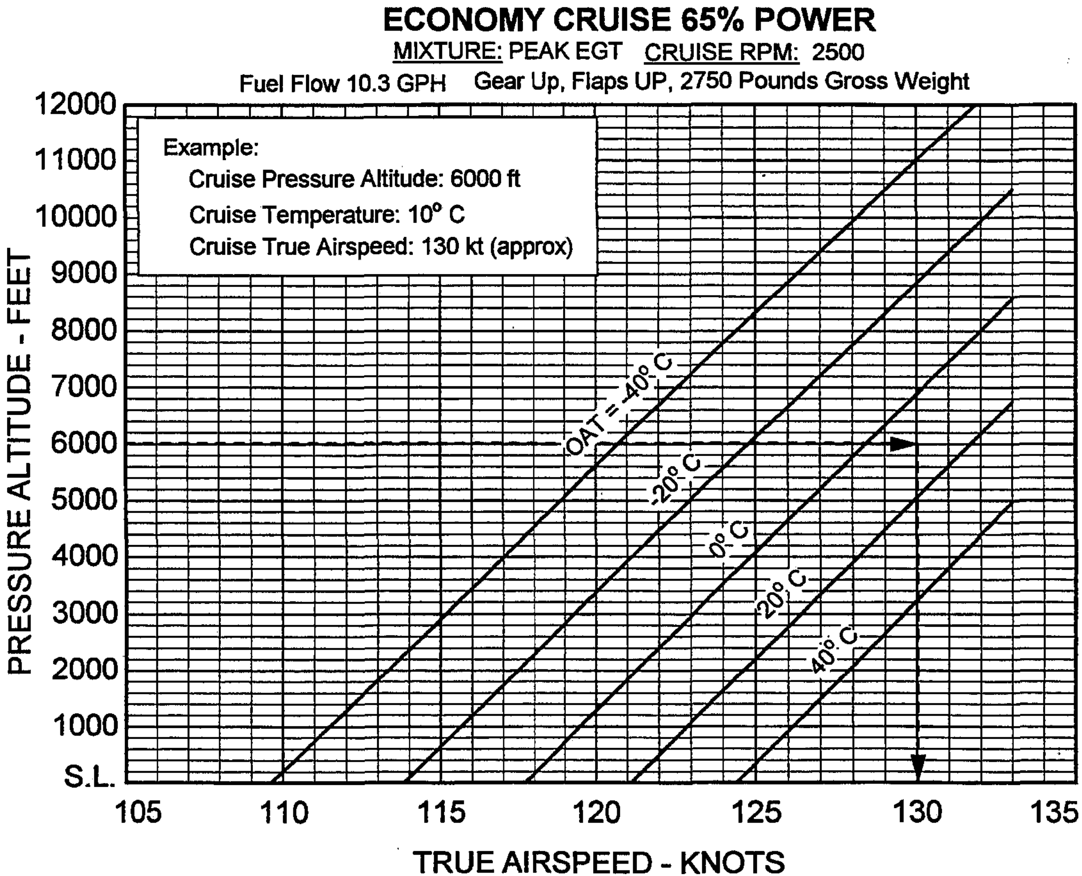
ECONOMY CRUISE 65% POWER

MIXTURE: PEAK EGT   CRUISE RPM: 2200

Fuel Flow 9.8 GPH   Gear Up, Flaps UP, 2750 Pounds Gross Weight



ECONOMY CRUISE (65% Power 2200 RPM)
Figure 5-27b



ECONOMY CRUISE (65% Power 2500 RPM)
Figure 5-27c

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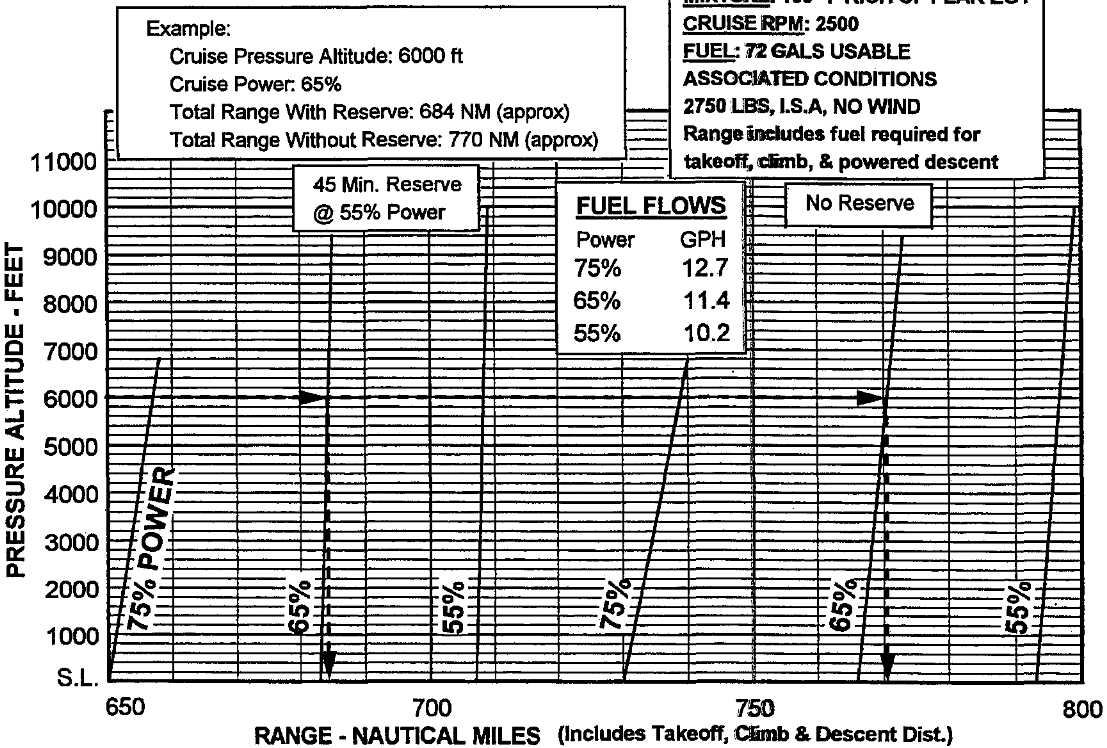
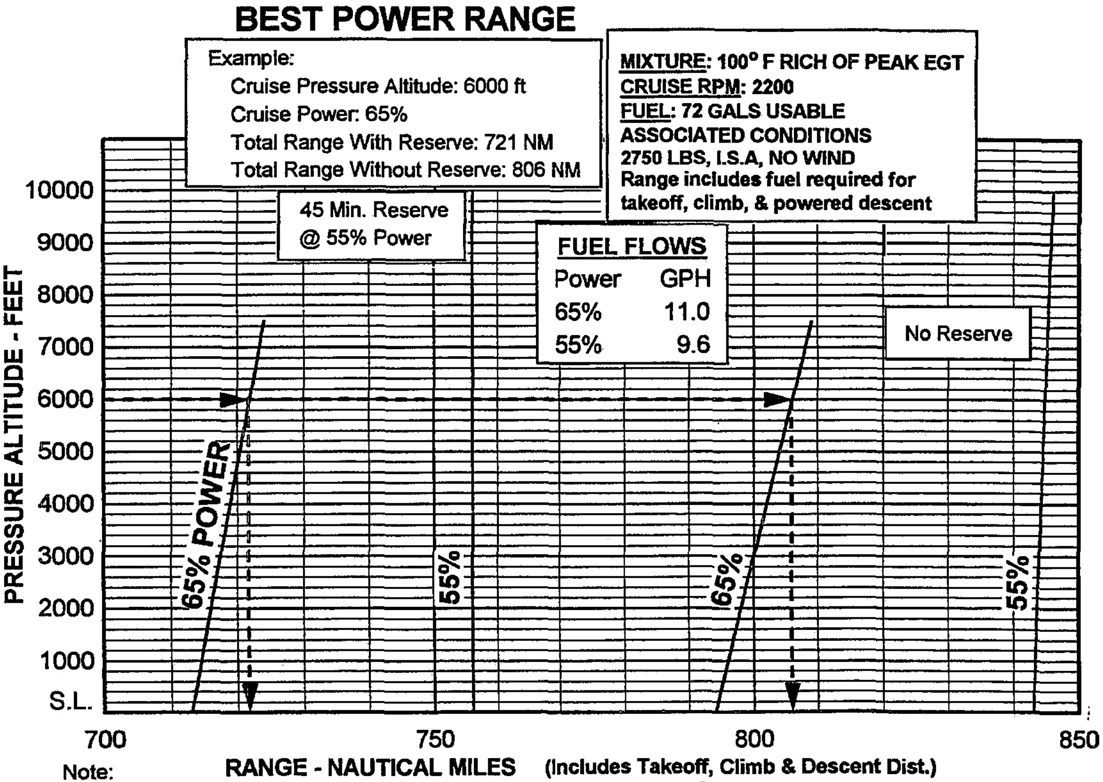
BEST POWER RANGE



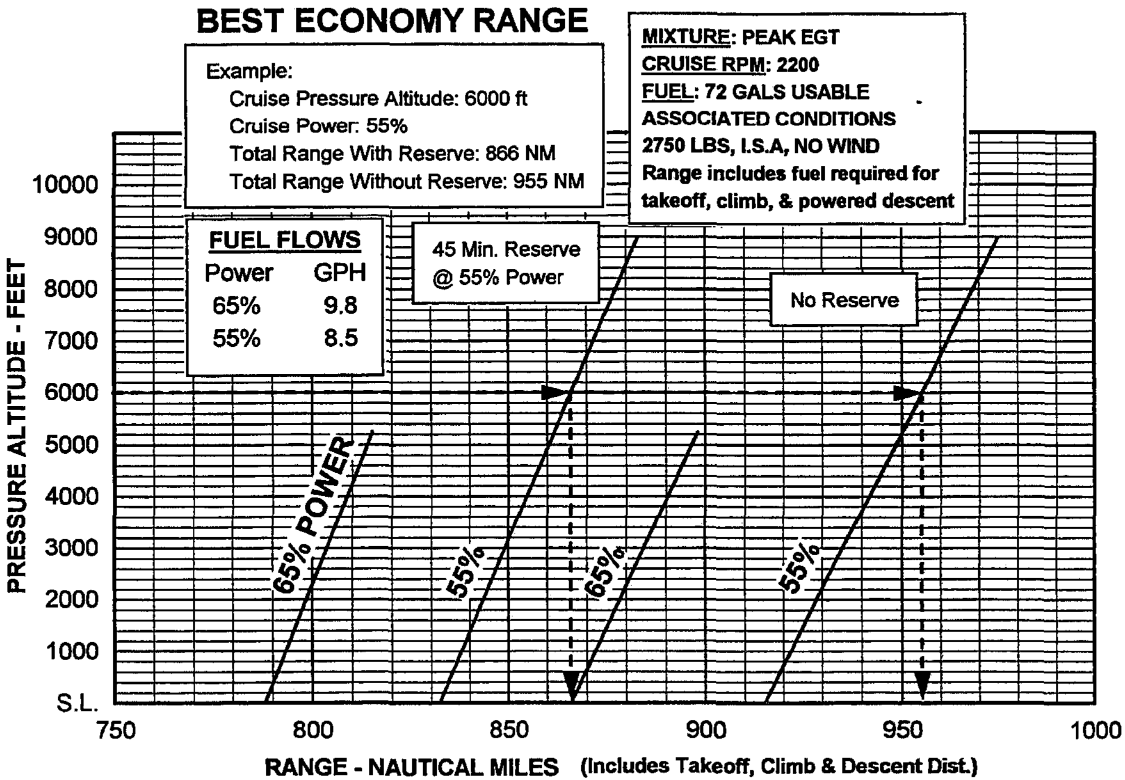
Note: Add 1.5 N.M. for each 10° C above I.S.A: Subtract 1.5 N.M. for each 10° C below. (Applicable to 75% power only)

BEST POWER RANGE (2500 RPM)
Figure 5-29



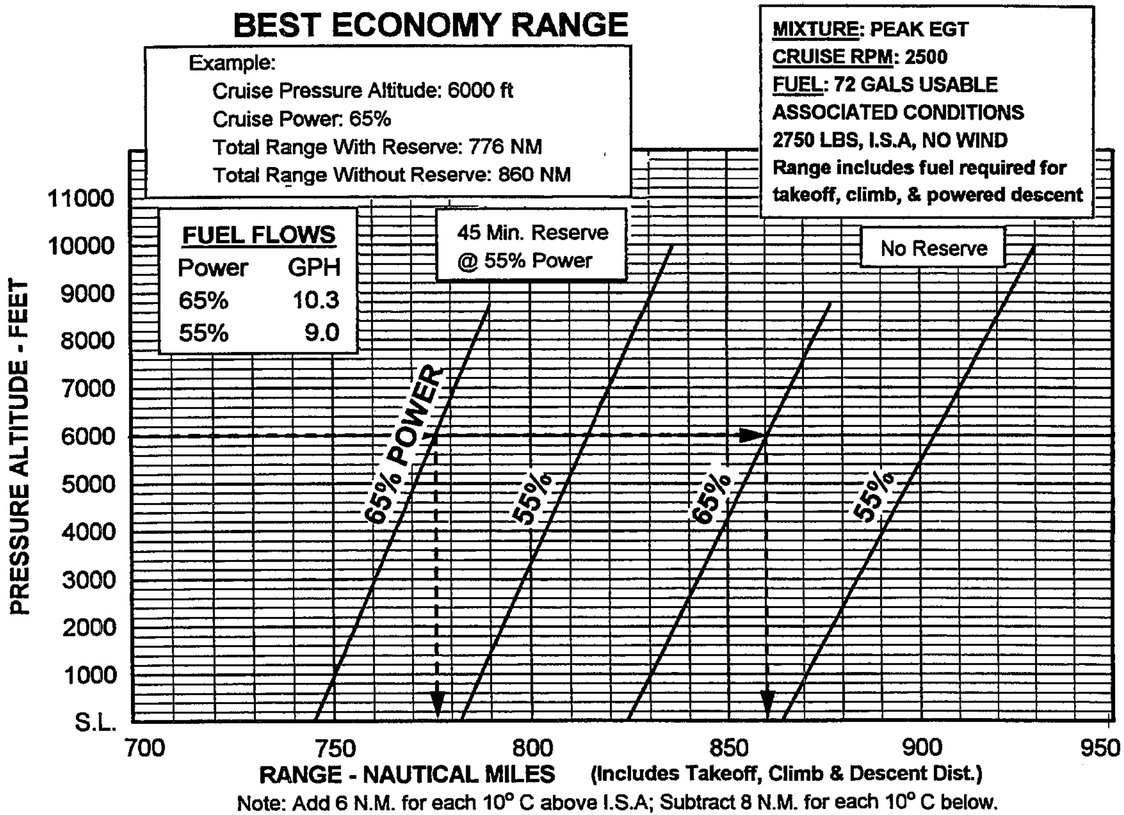
Note:
Add 2 N.M. for each 10° C above I.S.A; Subtract 2 N.M. for each 10° C below. (Applicable to 65% power only)

BEST POWER RANGE (2200 RPM)
Figure 5-29a

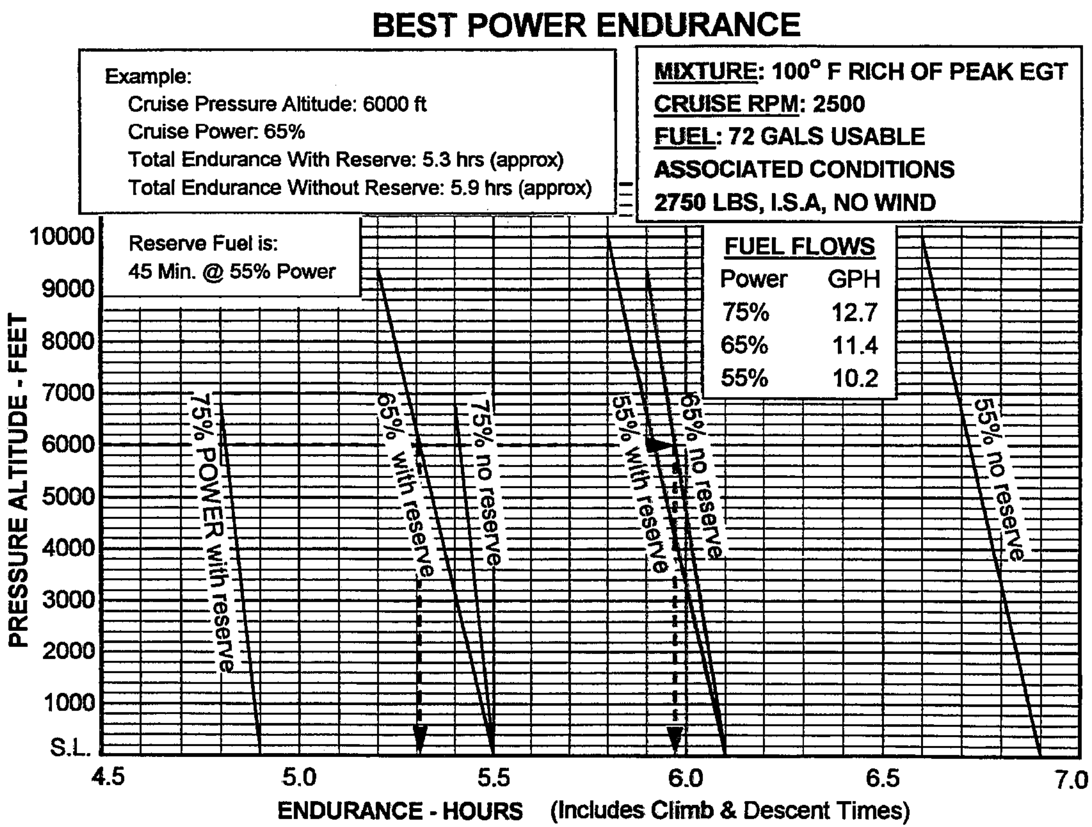


Note: Add 6 N.M. for each 10° C above I.S.A; Subtract 8 N.M. for each 10° C below.

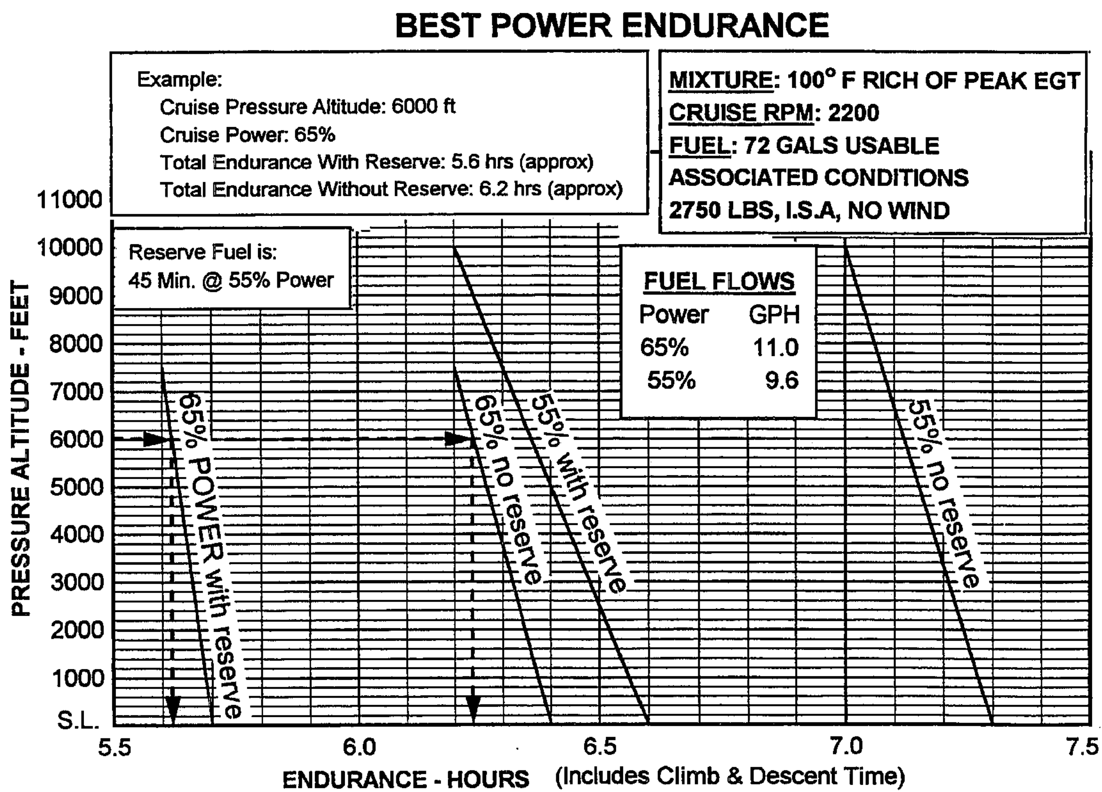
BEST ECONOMY RANGE (2200 RPM)
Figure 5-31



BEST ECONOMY RANGE (2500 RPM)
Figure 5-31a

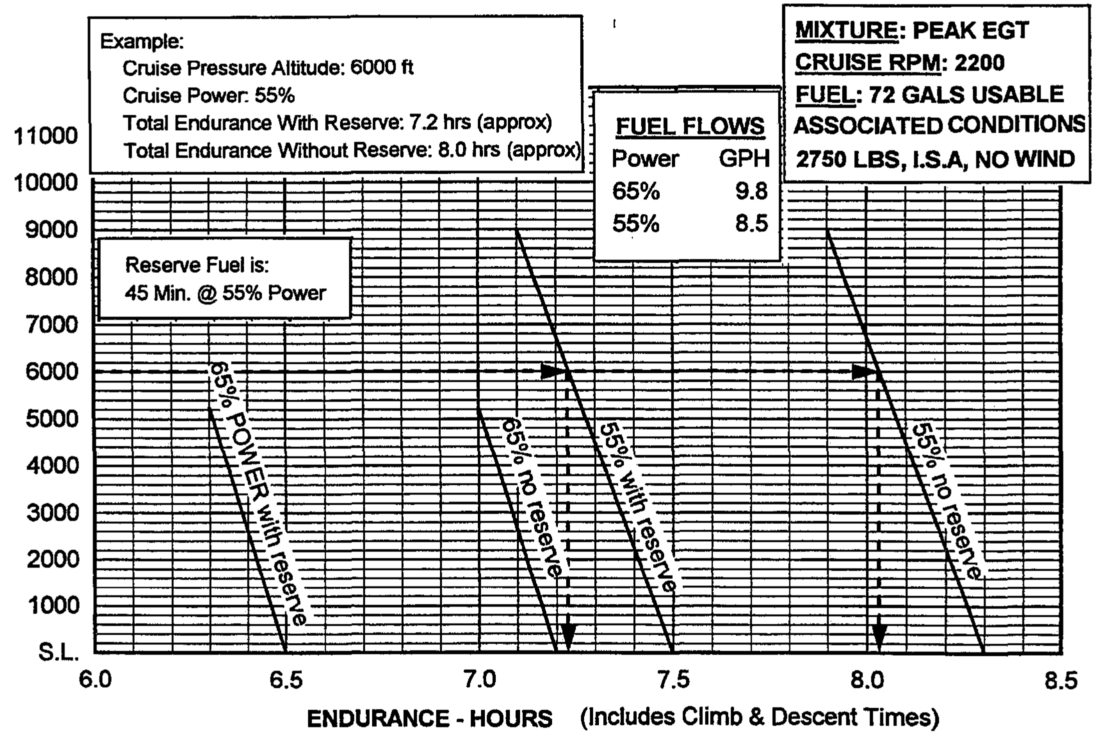


BEST POWER ENDURANCE (2500 RPM)
Figure 5-33



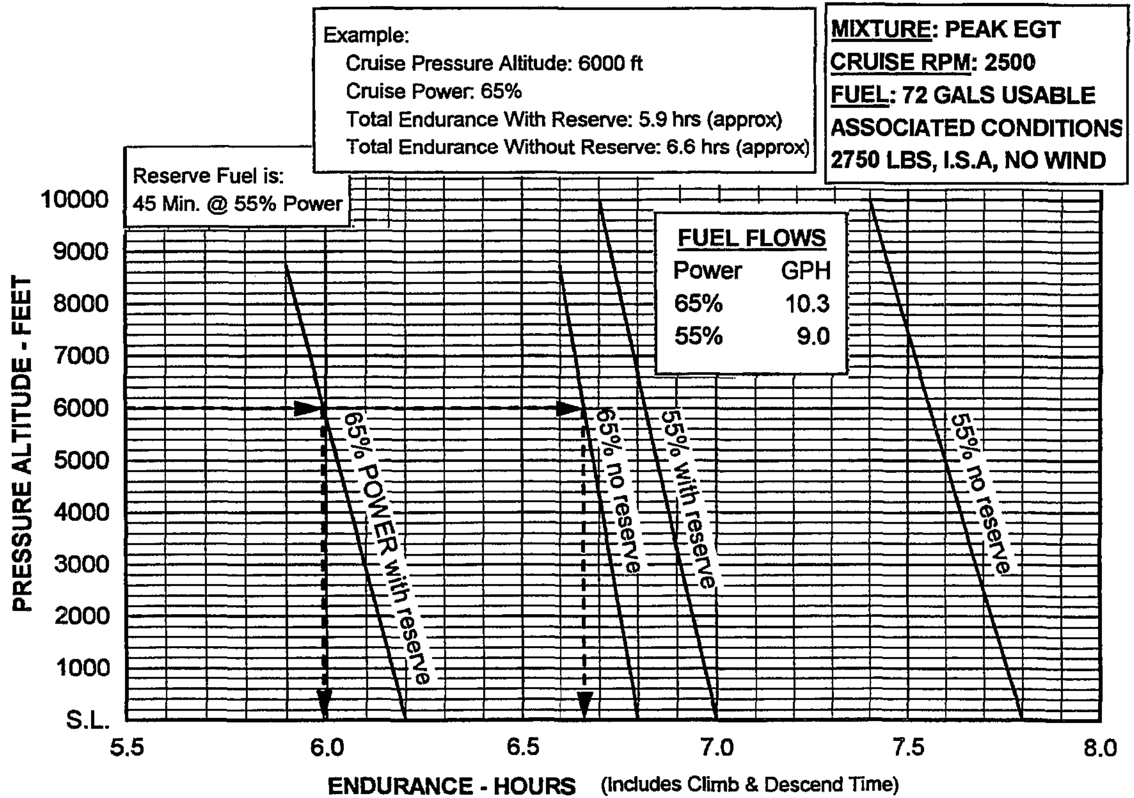
BEST POWER ENDURANCE (2200 RPM)
Figure 5-33a

BEST ECONOMY ENDURANCE



BEST ECONOMY ENDURANCE (2200 RPM)
Figure 5-33b

BEST ECONOMY ENDURANCE



BEST ECONOMY ENDURANCE (2500 RPM)
Figure 5-33c

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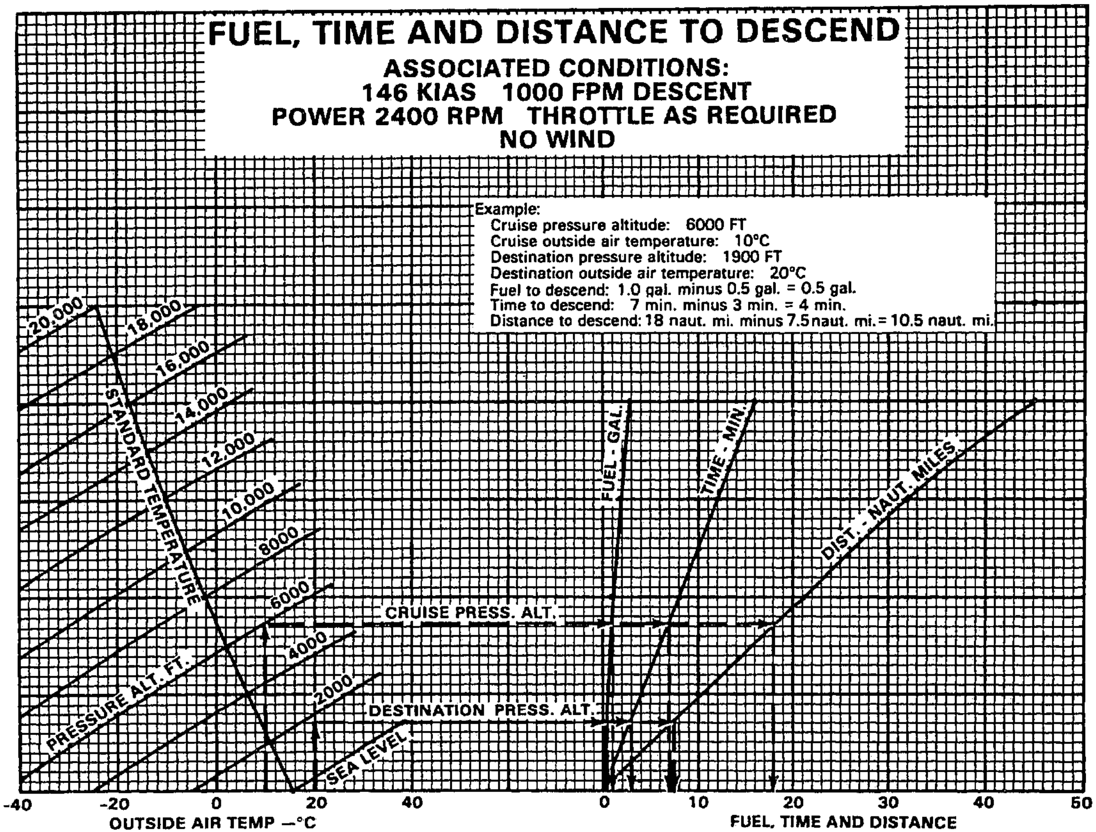
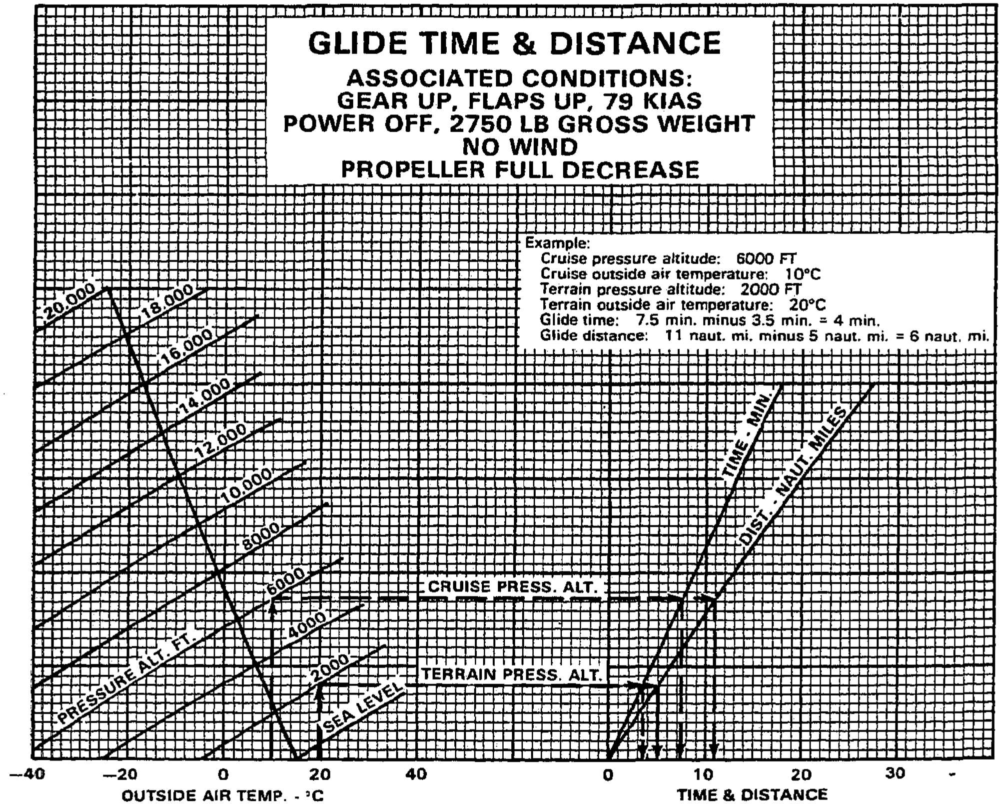
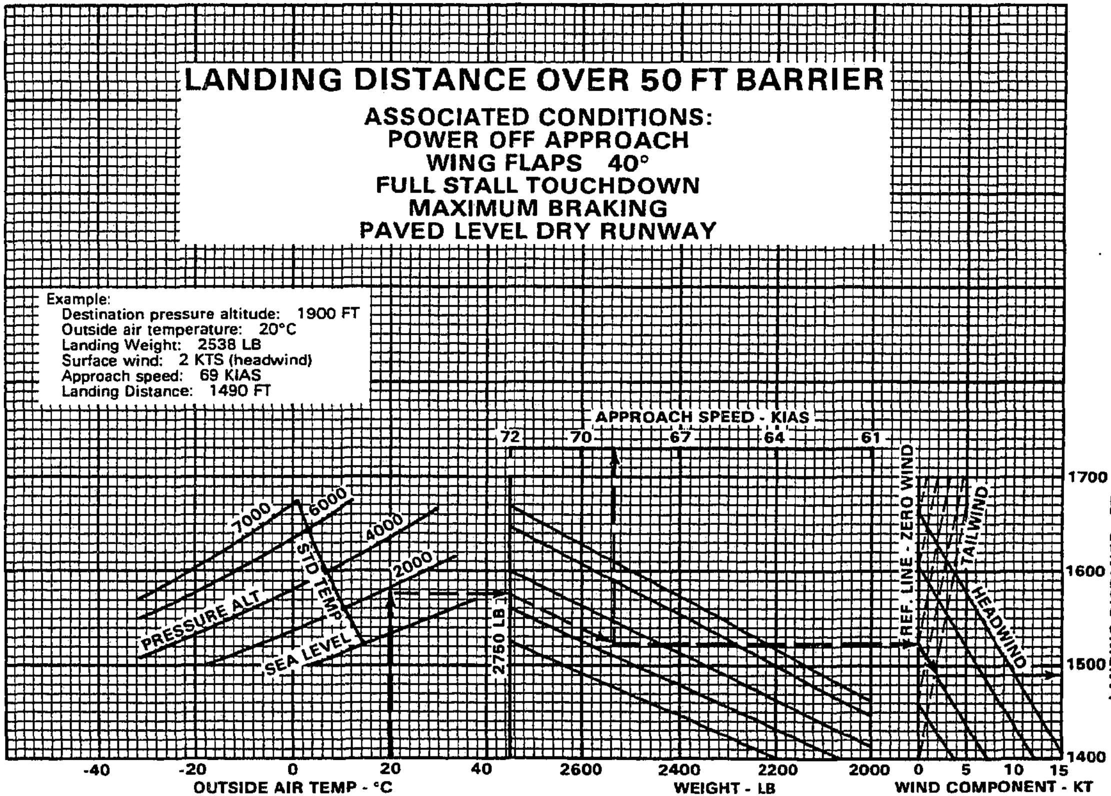


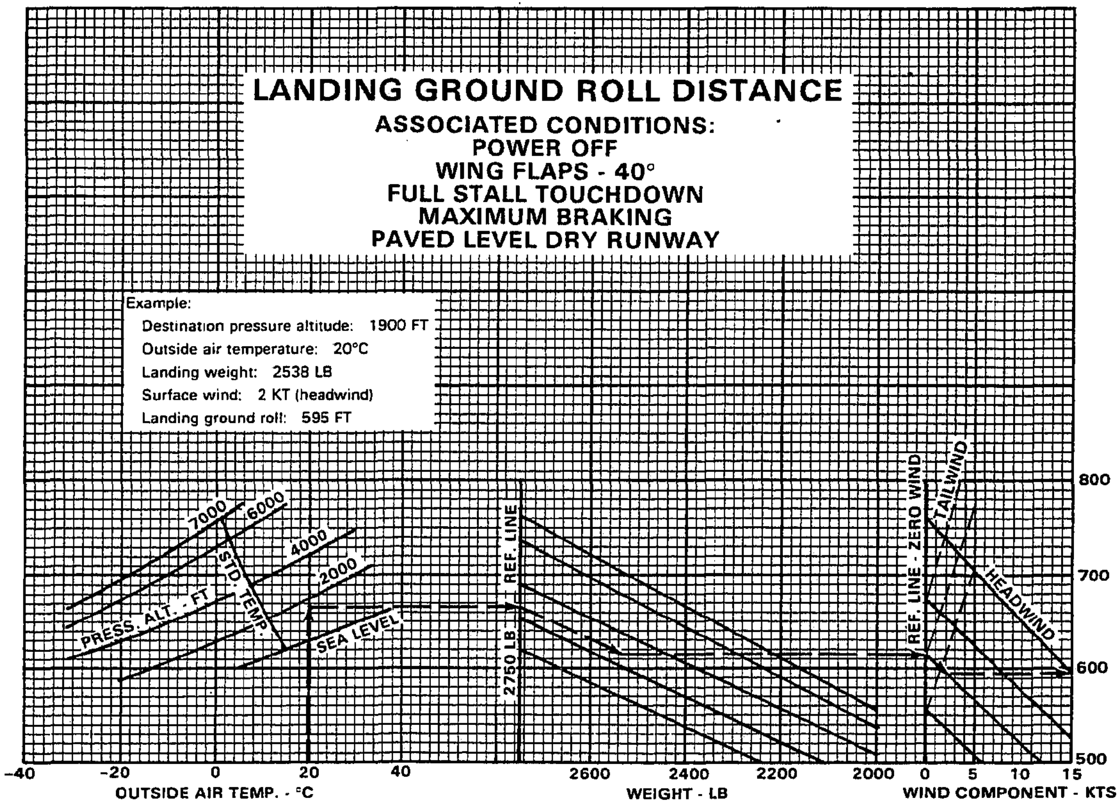
FUEL, TIME AND DISTANCE TO DESCEND
Figure 5-35



GLIDE TIME AND DISTANCE
Figure 5-37



LANDING DISTANCE OVER 50 FOOT BARRIER
Figure 5-39



LANDING GROUND ROLL DISTANCE
Figure 5-41

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SECTION 6

WEIGHT AND BALANCE

Paragraph No. — Page No.

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 a tremendous 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 ensure 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 delivered, 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 easily 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.

6.1 GENERAL (continued)

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 Logbook 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 ensure 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, 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 (5.0 gallons total, 2.5 gallons each wing).

6.3 AIRPLANE WEIGHING PROCEDURE (continued)

CAUTION

Whenever the fuel system is completely drained and fuel is replenished it will be necessary to run the engines for a minimum of 3 minutes at 1000 rpm on each tank to insure 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.

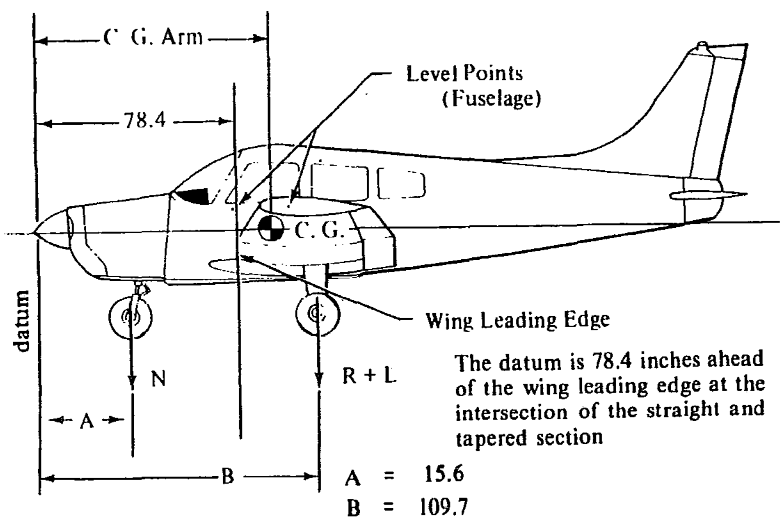
6.3 AIRPLANE WEIGHING PROCEDURE (continued)

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-28R-201 airplane when it is level. Refer to Leveling paragraph 6.3 (b).



LEVELING DIAGRAM
Figure 6-3

6.3 AIRPLANE WEIGHING PROCEDURE (continued)

(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:

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

Where: $T = N + R + L$

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.

6.5 WEIGHT AND BALANCE DATA AND RECORD (continued)

MODEL PA-28R-201 ARROW

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

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

(2750 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

6.5 WEIGHT AND BALANCE DATA AND RECORD (continued)

PA-28R-201	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

6.5 WEIGHT AND BALANCE DATA AND RECORD (continued)

PA-28R-201	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 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.

	Weight (Lbs)	Arm Aft Datum (Inches)	Moment (In-Lbs)
Basic Empty Weight	1890	84.8	160272
Pilot and Front Passenger	340.0	80.5	27370
Passengers (Rear Seats)	170.0	118.1	20077
Fuel (72 Gallons Maximum)	294	95.0	27930
Baggage (200 Lbs. Maximum)	64	142.8	9139
Ramp Weight (2758 Lbs. Maximum)	2758	88.76	244788
Fuel Allowance For Engine Start, Taxi, and Run Up	-8	95.0	-760
Moment due to Retraction of Landing Gear			819
Takeoff Weight (2750 Lbs. Maximum)	2750	89.04	244847

The center of gravity (C.G.) of this sample loading problem is at 89.04 inches aft of the datum line. Locate this point (89.04) 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.

IT IS THE RESPONSIBILITY OF THE PILOT AND AIRCRAFT OWNER TO ENSURE THAT THE AIRPLANE IS LOADED PROPERLY.

SAMPLE LOADING PROBLEM (NORMAL CATEGORY)
Figure 6-9

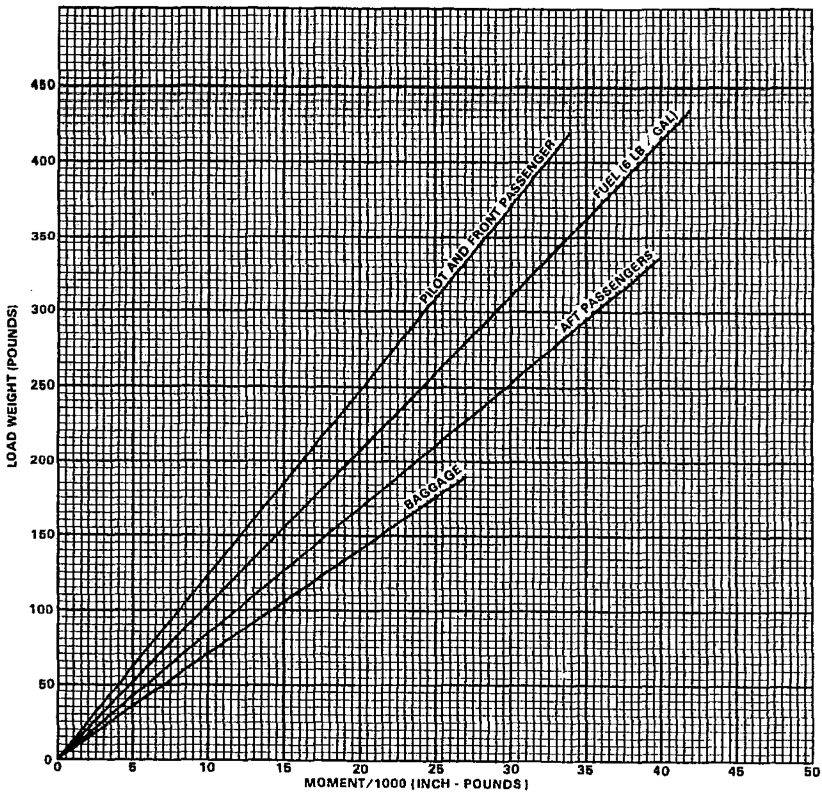
6.7 WEIGHT AND BALANCE DETERMINATION FOR FLIGHT (continued)

	Weight (Lbs)	Arm Aft Datum (Inches)	Moment (In-Lbs)
Basic Empty Weight			
Pilot and Front Passenger		80.5	
Passengers (Rear Seats)		118.1	
Fuel (72 Gallons Maximum)		95.0	
Baggage (200 Lbs. Maximum)		142.8	
Ramp Weight (2758 Lbs. Maximum)			
Fuel Allowance For Engine Start, Taxi, and Run Up	-8	95.0	-760
Moment due to Retraction of Landing Gear			819
Takeoff Weight (2750 Lbs. Maximum)			

Totals must be within approved weight and C.G. limits. It is the responsibility of the airplane owner and the pilot to insure that the airplane is loaded properly. The Basic Empty Weight C.G. is noted on the Weight and Balance Data Form (Figure 6-5). If the airplane has been altered, refer to the Weight and Balance Record for this information.

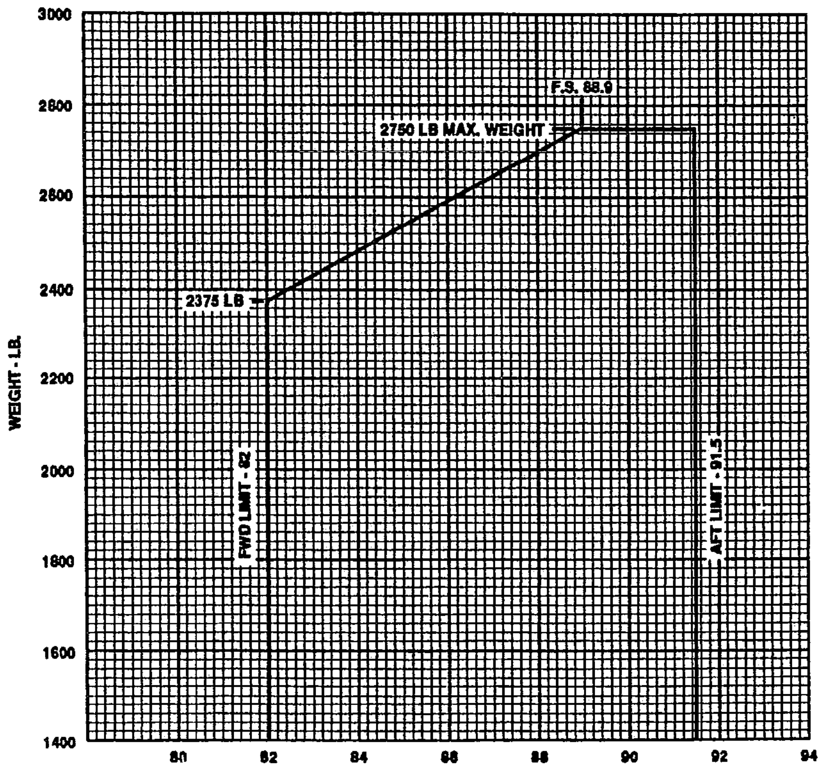
WEIGHT AND BALANCE LOADING FORM
Figure 6-11

6.7 WEIGHT AND BALANCE DETERMINATION FOR FLIGHT (continued)



LOADING GRAPH
Figure 6-13

6.7 WEIGHT AND BALANCE DETERMINATION FOR FLIGHT (continued)



C.G. RANGE AND WEIGHT
Figure 6-15

6.9 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 the load if the 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 Data Form (Figure 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 of in the baggage compartments.

To use the plotter, 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, except fuel, have been drawn in this manner, the end of the segmented line locates the load and the C.G. position of the airplane for zero fuel weight. If this point is not within the allowable envelope, it will be necessary to remove baggage or passengers, and/or to rearrange baggage and passengers to get the point to fall within the envelope.

Position the zero fuel weight end of the fuel slot over this point and draw a line representing fuel load. The end of the segmented line locates the load and C.G. position of the airplane for Ramp Weight. If this is not within the allowable envelope, it will be necessary to remove fuel, baggage, or passengers and/or rearrange baggage and passengers to get this final point to fall within the envelope.

Fuel allowance for engine start, taxi, and runup is 8 pounds.

Subtract the Estimated Fuel Burnoff from the Takeoff Weight to determine the Landing Weight C.G.

Gear movement does not significantly affect the center of gravity.

6.9 INSTRUCTIONS FOR USING THE WEIGHT AND BALANCE PLOTTER (continued)

SAMPLE PROBLEM

A sample problem will demonstrate the use of the weight and balance plotter. Assume a basic weight and C.G. location of 1890 pounds at 84.8 inches respectively. We wish to carry one pilot and one passenger occupying the front seats. Each occupant weighs 170 pounds. We wish to carry 70 pounds of baggage in the baggage compartment and 51.3 gallons of fuel. Will we be within the safe envelope?

(1) Place a dot on the plotter grid at 1890 pounds and 84.8 inches to represent the basic airplane (see Figure 6-17).

(2) Slide the slotted plastic into position so that the dot is under the slot for the forward seats (pilot and front passenger) at zero weight.

(3) Draw a line up the slot to the 340 pound position (170 + 170) and place a dot.

(4) Slide the slotted plastic into position so that the zero end of the bagggage slot is over this dot.

(5) Draw a line up this slot to the 70 pound position and place the third dot.

(6) Slide the slotted plastic into position so that the zero end of the fuel slot is over this dot.

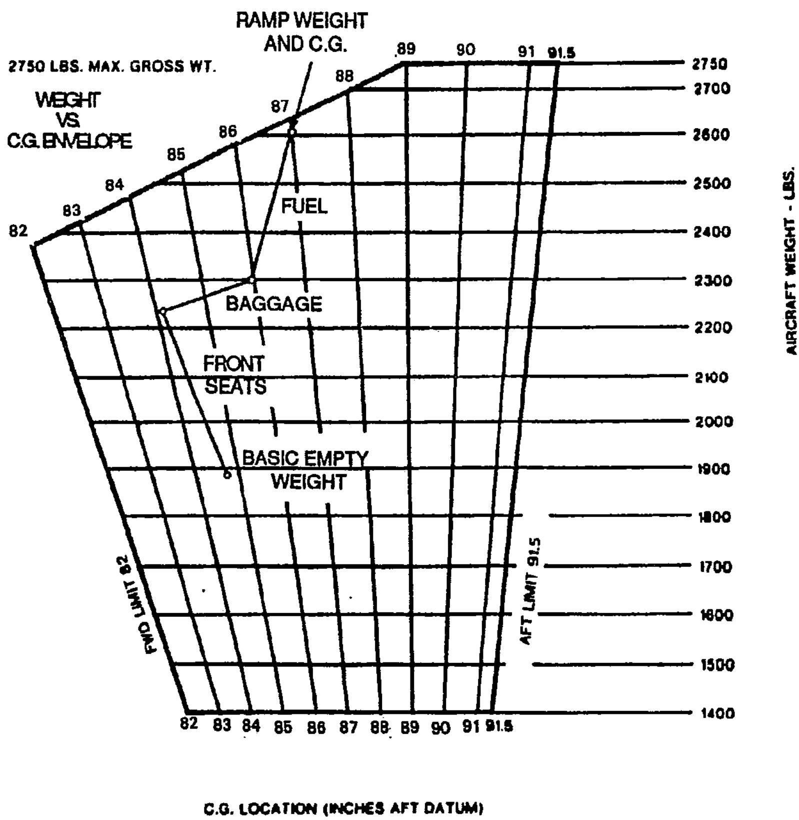
(7) Draw a line up this slot to the 308 pound/51.3 gallon position and place the fourth dot.

(8) As can be seen from Figure 6-17, the final dot shows the total weight to be 2608 pounds with the C.G. at 87.0 inches. This point is within the weight and C.G. limits.

(9) Fuel allowance for engine start, taxi, and runup is 8 pounds.

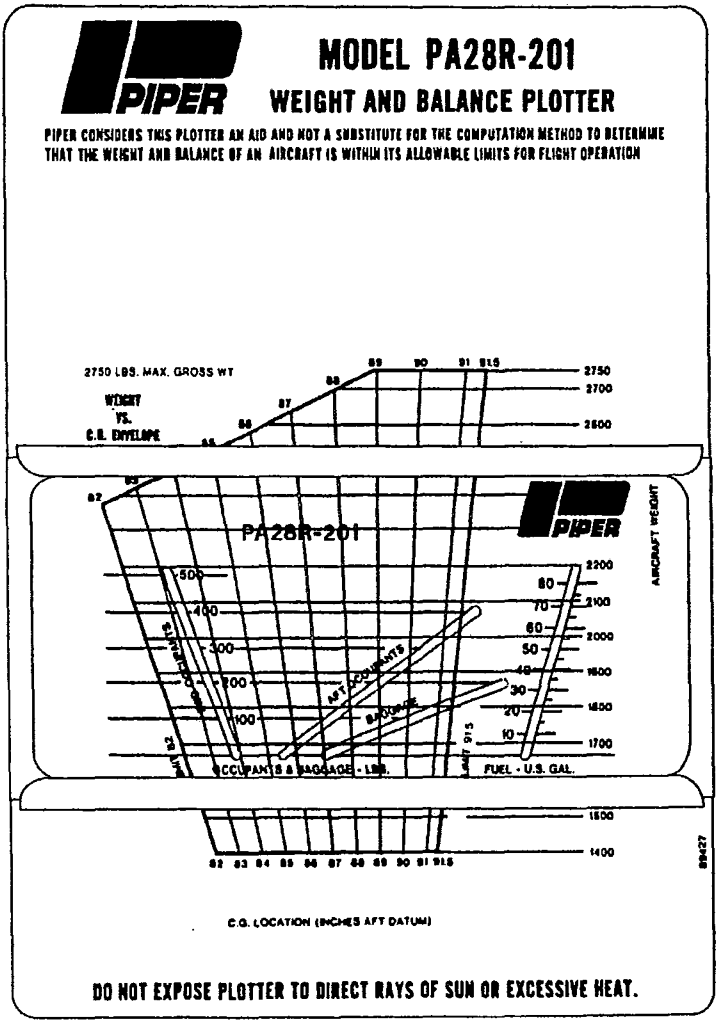
As fuel is burned off, the weight and C.G. will follow down the fuel line and stay within the envelope for landing.

6.9 INSTRUCTIONS FOR USING THE WEIGHT AND BALANCE PLOTTER (continued)



SAMPLE PROBLEM
Figure 6-17

6.9 INSTRUCTIONS FOR USING THE WEIGHT AND BALANCE PLOTTER (continued)



WEIGHT AND BALANCE PLOTTER
Figure 6-19

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SECTION 7

DESCRIPTION AND OPERATION OF THE AIRPLANE AND ITS SYSTEMS

SECTION 7

DESCRIPTION AND OPERATION OF THE AIRPLANE AND ITS SYTEMS

7.1 THE AIRPLANE

The PA-28R-201, Arrow is a single engine, retractable landing gear, all metal airplane. It has seating for up to four occupants, a 200 pound luggage compartment, and a 200 HP engine.

7.3 AIRFRAME

With the exception of the steel engine mount, the landing gear, miscellaneous steel parts, the cowling, and the lightweight plastic extremities (tips of wings, tail fin, rudder 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. A cargo door is installed aft of the rear seat.

The wing is of a conventional design semi-tapered 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 aft 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. The four-position wing flaps are mechanically controlled by a handle located between the front seats. When fully retracted, the right flap locks into place to provide a step for cabin entry. Each wing contains one fuel tank.

7.3 AIRFRAME (continued)

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

7.5 ENGINE AND PROPELLER

The Arrow incorporates a Lycoming IO-360-C1C6 four-cylinder, direct drive, horizontally opposed fuel injected engine rated at 200 horsepower at 2700 rpm. It is furnished with a starter, 60 ampere 14-volt alternator, shielded ignition, vacuum pump drive, fuel pump, propeller governor and a dry automotive type induction air filter. The recommended overhaul period is based on Lycoming service experience. Operation beyond the recommended time is the decision of the operator. Since Lycoming from time to time revises the recommended overhaul period, the owner should check the latest Lycoming Service Instruction No. 1009 at his Piper dealer for the latest recommended overhaul period and for any additional information.

The aircraft is equipped with a constant speed, controllable pitch propeller. The propeller control is located on the power quadrant between the throttle and mixture controls. A mixture control lock is provided to prevent activation of the mixture control instead of the pitch control.

The exhaust system is a crossover type, which reduces back pressure and improves performance. It is constructed entirely of stainless steel and is equipped with dual mufflers. Cabin heat and windshield defrosting are provided by a heater shroud around the muffler.

An oil cooler is located on the forward lower right side of the firewall, with the air inlet for the cooler located on the right side of the bottom cowling. A winterization plate is provided to restrict air during winter operation. (See Winterization in Handling and Servicing.)

7.7 INDUCTION SYSTEM

The induction system incorporates a Bendix RSA-5AD1 type fuel injector. The injector is based on the principle of differential pressure, which balances air pressure against fuel pressure. The regulated fuel pressure established by the servo valve when applied across a fuel control (jetting system) makes the fuel flow proportional to airflow. Fuel pressure regulation by the servo valve causes a minimal drop in fuel pressure throughout the metering system. Metering pressure is maintained above most vapor forming conditions while fuel inlet pressure is low enough to allow use of a diaphragm pump. The servo system feature also checks vapor lock and associated starting problems.

The servo regulation meters fuel flow proportionally with airflow and maintains the mixture as manually set for all engine speeds. The fuel flow divider receives metered fuel and distributes fuel to each cylinder fuel nozzle.

The fuel flow portion of the manifold pressure/fuel flow gauge is connected to the flow divider and monitors fuel pressure. This instrument converts fuel pressure to an indication of fuel flow in gallons per hour and percentage of rated horsepower.

The alternate air source of the induction system contains a door that functions automatically or manually. If the primary source is obstructed, the door will open automatically. It may be opened manually by moving the selector on the right side of the quadrant. The primary source should always be used for takeoff.

The pilot should read and follow the procedures recommended in the Lycoming Operator's Manual for this engine, in order to obtain maximum engine efficiency and time between engine overhauls.

7.9 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. It incorporates a gear up warning horn switch which is activated during the last portion of travel of the throttle lever to the low power position. If the landing gear is not locked down, the horn will sound until the gear is down and locked or until the power setting is increased. This is a safety feature to warn of an inadvertent gear up landing.

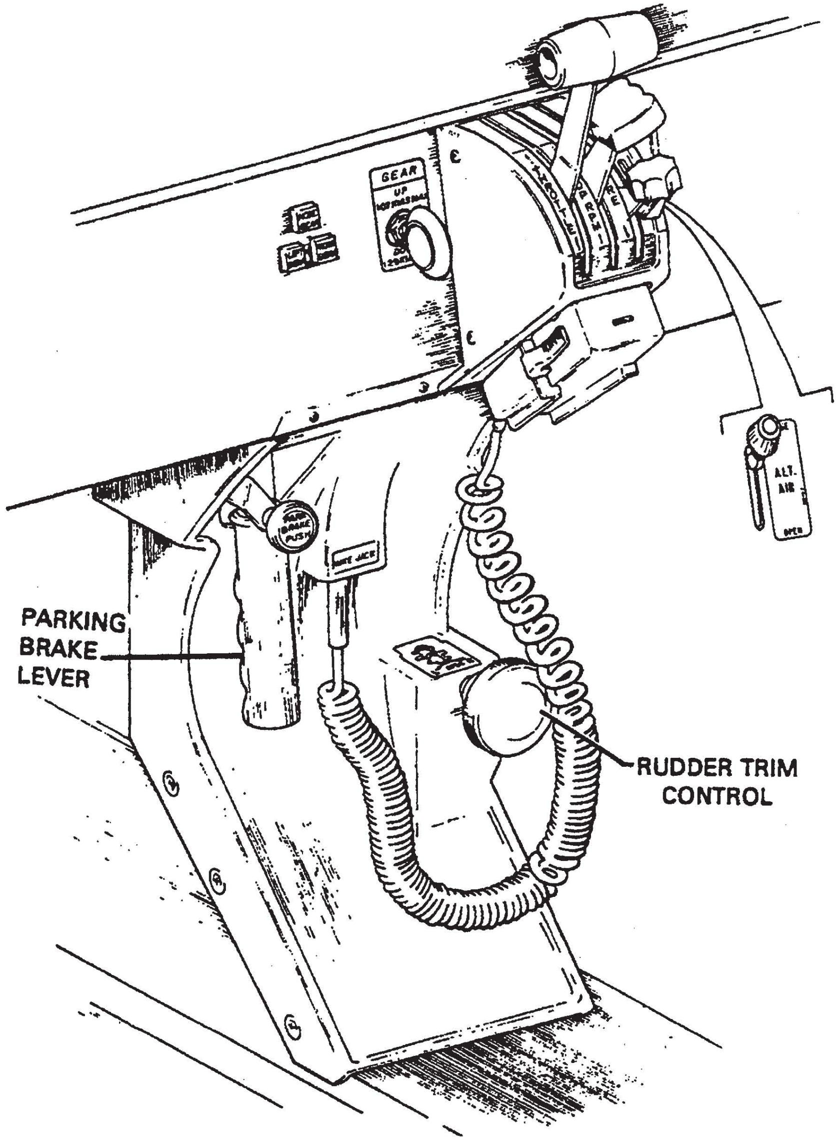
The propeller control lever is used to adjust the propeller speed from high rpm to low rpm.

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.

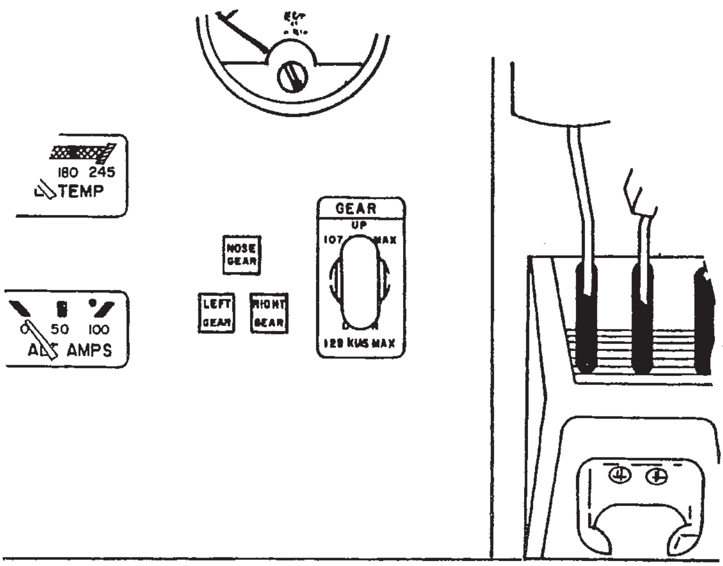
The friction adjustment lever on the right side of the control quadrant may be adjusted to increase or decrease the friction holding the throttle, propeller, and mixture controls in a selected position.

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 (refer to Figure 7-1).

7.7 ENGINE CONTROLS (continued)



CONTROL QUADRANT AND CONSOLE
Figure 7-1



LANDING GEAR SELECTOR
Figure 7-3

7.11 LANDING GEAR

The Arrow is equipped with a retractable tricycle landing gear, which is hydraulically actuated by an electrically powered reversible pump. The pump is controlled by a selector switch on the instrument panel to the left of the control quadrant (Figure 7-3). The landing gear is retracted or extended in about seven seconds.

During normal landing gear operation, the Emergency Gear Extension Lever, located between the front seats to the left of the flap handle (figure 7-9), should be in the up position to permit proper gear retraction/operation. To perform an emergency gear extension, the emergency gear lever must be held in the down position to manually release hydraulic pressure and permit the gear to free fall. The nose gear is spring assisted.

Gear down and locked positions are indicated by three green lights located to the left of the selector. A red WARNING GEAR UNSAFE light, located at the top of the panel, illuminates while the gear is in transit, or not in the full up or locked down position. An all lights out condition indicates the gear is up. The landing gear should not be retracted above a speed of 107 KIAS and should not be extended above a speed of 129 KIAS.

7.11 LANDING GEAR (continued)

The main landing gear uses 6.00 x 6 wheels. The main gear incorporate brake drums and Cleveland single disc hydraulic brake assemblies. The nose wheel carries a 5.00 x 5 four ply tire and the main gear use 6.00 x 6 six ply tires. All three tires are tube type.

A microswitch in the throttle quadrant activates a warning horn and red WARNING GEAR UNSAFE light under the following conditions:

a. Gear up and power reduced below approximately 14 inches of manifold pressure.
b. Gear selector switch UP while on the ground and throttle in retarded position.
c. Whenever the flaps are extended beyond the approach position (10°) and the landing gear are not down and locked.

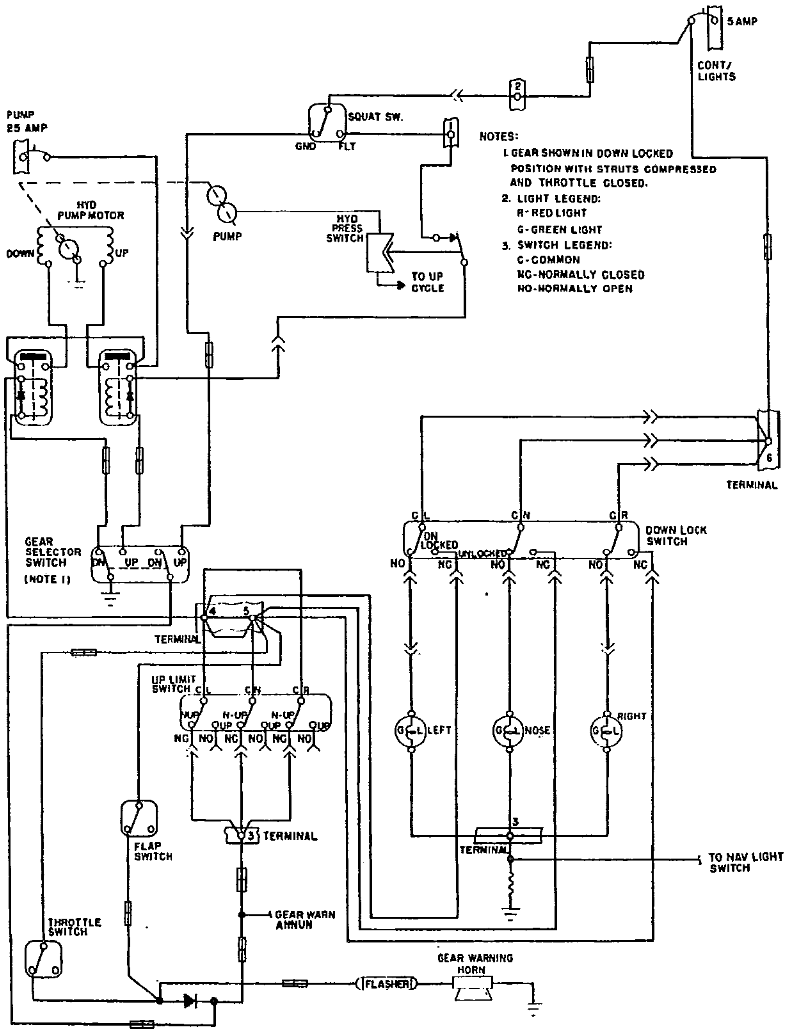
The gear warning horn emits a 90 Hertz beeping sound in contrast to the stall warning horn which emits a continuous sound.

The nose gear is steerable through a 30 degree arc each side of center through the use of the rudder pedals. As the nose wheel retracts, the steering linkage disengages to reduce rudder pedal loads in flight. The nose wheel is equipped with a hydraulic shimmy damper to reduce nose wheel shimmy. A bungee assembly is also included to reduce ground steering effort and to dampen shocks and bumps during taxiing.

The oleo struts are of the air-oil type, with normal extension being 2.75 +/- 0.25 inches for the nose gear and 2.5 +/- 0.25 inches for the main gear under normal static load (empty weight of airplane plus full fuel and oil).

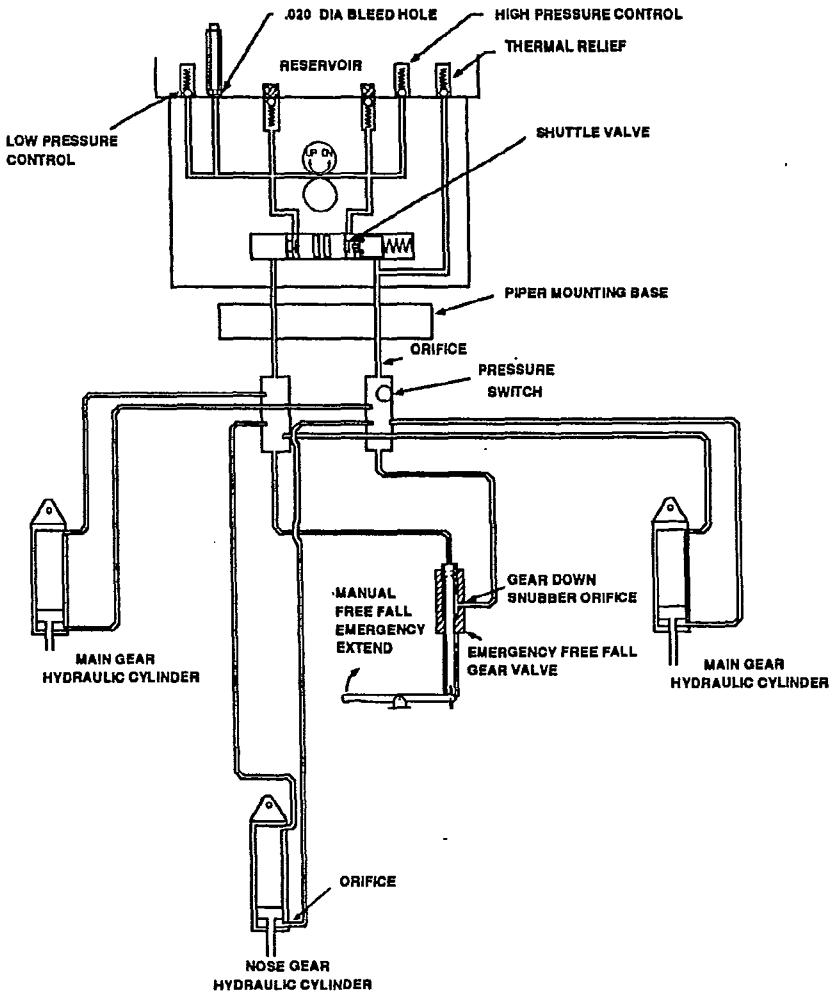
The standard brake system includes toe brakes on the left and right set of rudder pedals and a hand brake located below and near the center of the instrument panel. The toe brakes and the hand brake have individual brake cylinders, but all cylinders use a common reservoir. The parking brake is incorporated in the lever brake and is operated by pulling back on the lever (Figure 7-1) and depressing the knob attached to the top of the handle. To release the parking brake, pull back on the brake lever; then allow the handle to swing forward.

7.11 LANDING GEAR (continued)

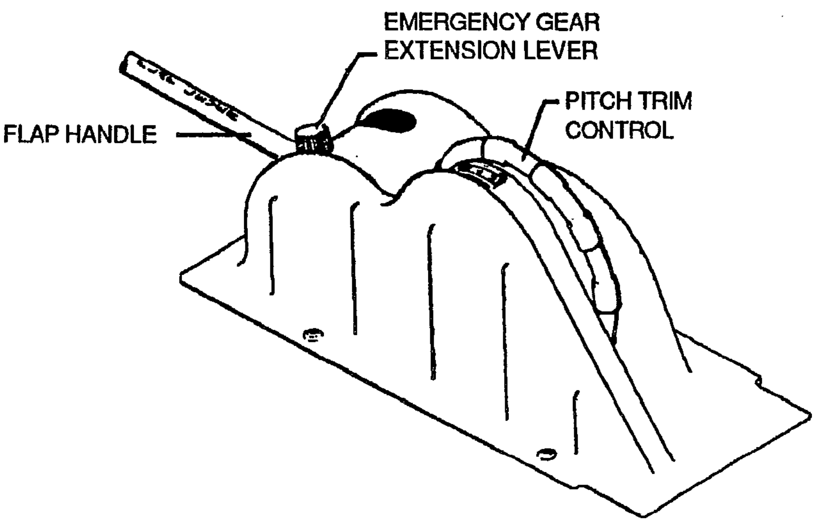


LANDING GEAR ELECTRICAL SCHEMATIC
Figure 7-5

7.11 LANDING GEAR (continued)



LANDING GEAR HYDRAULIC SCHEMATIC
Figure 7-7



FLIGHT CONTROL CONSOLE
Figure 7-9

7.13 FLIGHT CONTROLS

Dual flight controls are provided as standard equipment. A cable system provides actuation of the control surfaces when the flight controls are moved in their respective directions.

The horizontal surface (stabilator) features a trim tab/servo mounted on the trailing edge. This tab serves the dual function of providing trim control and pitch control forces. The trim function is controlled by a trim control wheel located on the control console between the two front seats (Figure 7-9). Rotating the wheel forward gives nose down trim and rotation aft gives nose up trim.

The rudder is conventional in design and incorporates a rudder trim. The trim mechanism is a spring-loaded recentering device. The trim control is located on the right side of the pedestal below the throttle quadrant (Figure 7-1). Turning the trim control clockwise results in nose right trim and counterclockwise rotation results in nose left trim.

7.13 FLIGHT CONTROLS (continued)

Manually controlled flaps are provided. They are extended by a control cable and are spring-loaded to the retracted (up) position. The control is located between the two front seats on the control console (Figure 7-9). To extend the flaps pull the handle up to the desired flap setting of 10, 25, or 40 degrees. To retract, depress the button on the end of the handle and lower the control.

The airplane will experience a pitch change during flap extension or retraction. This pitch change can be corrected by either stabilator trim or increased control wheel force. When the flaps are in the retracted position the right flap, provided with a over-center lock mechanism, acts as a step.

NOTE

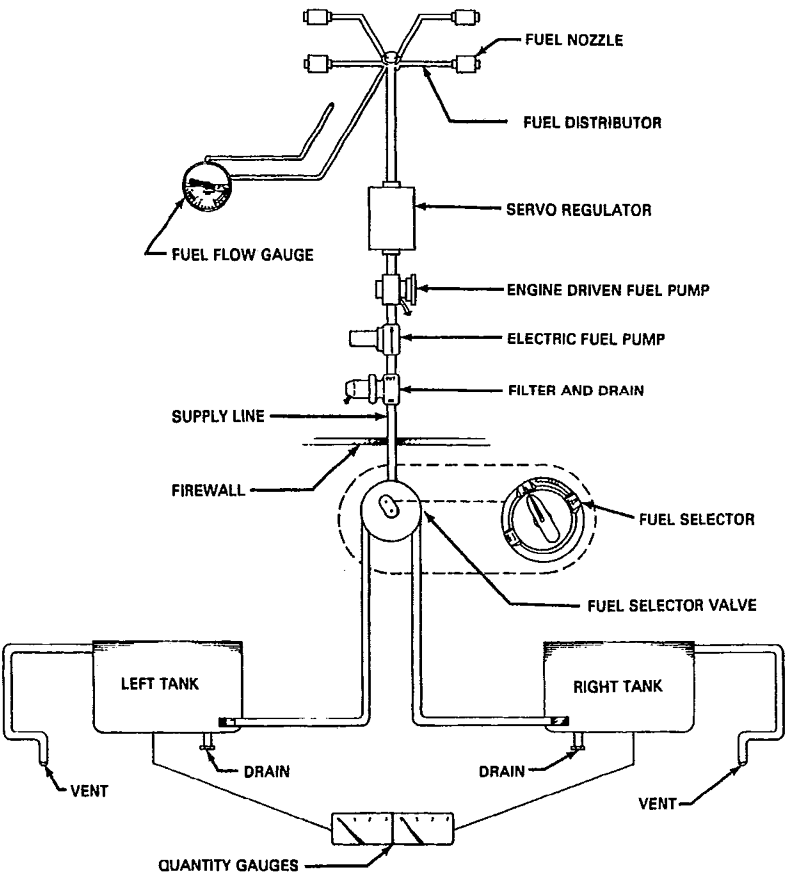
The right flap will support a load only in the fully retracted (up) position. When loading and unloading passengers make sure the flaps are in the retracted (up) position.

7.15 FUEL SYSTEM

The fuel system was designed with simplicity in mind. Fuel is contained in two 38.5 U.S. gallon tanks, one in each wing. Of the total 77 gallon capacity, only 72 gallons are usable. Each tank is equipped with a filler neck indicator tab to aid in determining fuel remaining when the tanks are not full. Usable capacity tab to the bottom of the indicator tab is 25 gallons. The minimum fuel grade is 100 octane (green) or 100LL (blue). The tanks are attached to the leading edge of the wing with screws and are an integral part of the wing structure. This allows removal for service. The tanks are vented individually by a vent tube which protrudes below the bottom of the wing at the rear inboard corner of each tank. The vents should be checked periodically to ensure they are not obstructed and will allow free passage of air.

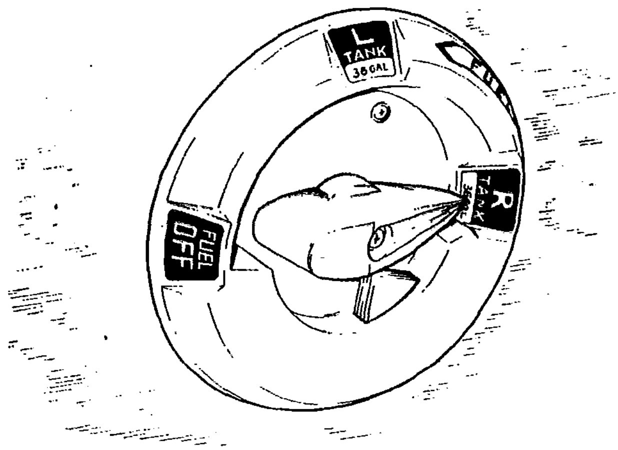
Each fuel tank has an individual quick drain located at the bottom inboard rear corner. The fuel strainer also incorporates a quick drain, located on the left lower portion of the firewall. The quick drain protrudes thru the cowling to allow easy draining of the fuel strainer. To avoid the accumulation of water and sediment, and to check that the tanks contain the proper grade fuel, the fuel tank sumps and strainer should be drained daily prior to first flight and after refueling.

7.15 FUEL SYSTEM (continued)



FUEL SYSTEM SCHEMATIC
Figure 7-11

7.15 FUEL SYSTEM (continued)



FUEL SELECTOR
Figure 7-13

CAUTION

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

A fuel tank selector allows the pilot to control the flow of fuel to the engine, and is located on the left side wall below the instrument panel. It has three positions: OFF, LEFT TANK and RIGHT TANK. The arrow on the handle of the selector points to the tank which is supplying fuel to the engine. The valve also incorporates a safety latch which prevents inadvertently selecting the OFF position.

Normally fuel is supplied to the engine through an engine-driven fuel pump. An electric fuel pump serves as a back-up feature. The electric fuel pump is controlled by a rocker switch on the switch panel above the engine control quadrant. The electric fuel pump should be ON when switching fuel tanks and during takeoffs and landings.

Fuel quantity and flow/pressure are indicated on gauges on the instrument panel. There is a separate fuel quantity gauge for each tank.

7.17 ELECTRICAL SYSTEM

All switches are grouped in a switch panel above the power quadrant. The circuit breaker panel is located on the lower right side of the instrument panel. Each breaker is clearly marked to show which circuit it protects. Also, circuit provisions are made to handle the addition of communications and navigational equipment.

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

The annunciator panel includes alternator, low oil pressure, and low vacuum indicator lights. The annunciator panel lights are provided only as a warning to the pilot that a system may not be operating properly, and that he should check and monitor the applicable system gauge to determine when or if action is required.

Optional electrical accessories include navigation, ground recognition, anti-collision, landing, instrument panel, and cabin dome lights. The navigation lights are controlled by a rocker switch on the main switch panel. Radio, panel, and switch lights are controlled by rheostat switches located below and to the right of the pilot's control wheel adjacent to the engine instruments.

An optional light, mounted in the overhead panel, provides instrument and cockpit lighting for night flying. The light is controlled by a rheostat switch located adjacent to the light. A map light window in the lens is actuated by an adjacent switch.

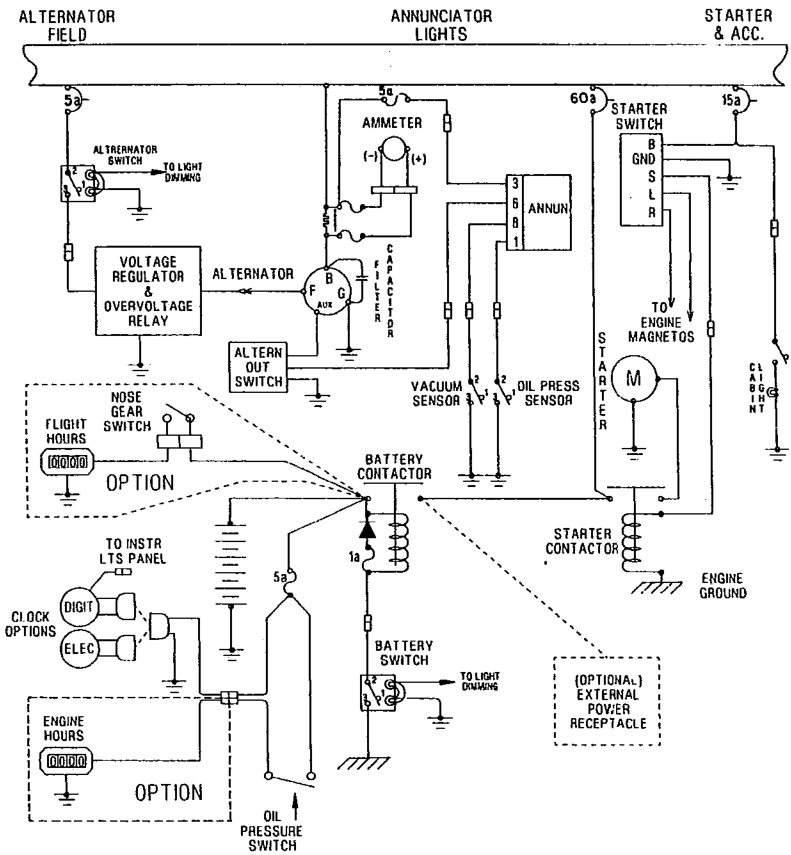
The optional wing tip recognition light consists of two lights, one in each wing tip, and is operated by a rocker type switch in the main switch panel.

WARNING

The navigation lights (NAV LIGHT) switch must be off to obtain full intensity gear lights during daytime flying. When the airplane is operated at night and the NAV LIGHT switch is turned on, the gear lights will automatically dim.

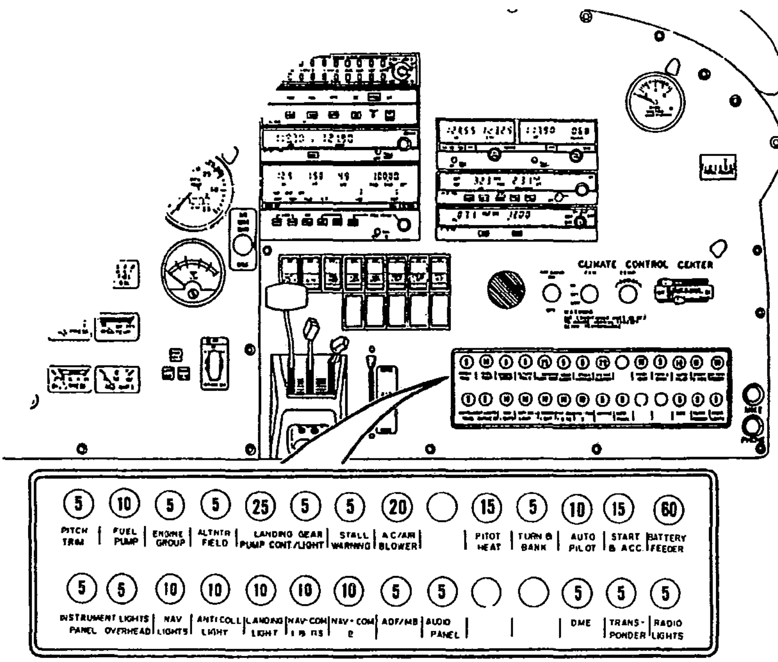
The anti-collision and landing lights are controlled by rocker switches on the main switch panel.

7.17 ELECTRICAL SYSTEM (continued)



ALTERNATOR AND STARTER SCHEMATIC
Figure 7-15

7.17 ELECTRICAL SYSTEM (continued)



CIRCUIT BREAKER PANEL
Figure 7-17

WARNING

Strobe lights should not be operating when flying through overcast and clouds since reflected light can produce spacial disorientation. Do not operate strobe lights in close proximity to ground, during takeoff and landing.

The primary electrical power source is a 14-volt, 60-amp alternator, that is protected by an alternator control unit that incorporates a voltage regulator and a overvoltage relay. The alternator provides full electrical power output even at low engine rpm. This provides improved radio and electrical equipment operation and increases battery life by reducing battery load.

7.17 ELECTRICAL SYSTEM (continued)

Secondary power is provided by a 12-volt, 35-ampere-hour battery.

The ammeter as installed does not show battery discharge; rather it shows the electrical load placed on the system. With all the electrical equipment off, and the battery master (BATT MASTR) and alternator (ALTR) switches on, the ammeter will indicate the charging rate of the battery. As each electrical unit is switched on, the ammeter will indicate the total ampere draw of all the units including the battery. For example, the average continuous load for night flying with radios on is about 30 amperes. The 30 ampere value plus 2 amperes for charging the battery will then show on the ammeter, indicating the alternator is functioning properly.

Solenoids, provided in the battery and starter circuits, are used to control high current drain functions remotely from the cabin.

7.19 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 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, (refer to Figure 7-21) 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.

7.19 VACUUM SYSTEM (continued)

A vacuum regulator is provided in the system to protect the gyros. The valve is set so the normal vacuum reads 4.8 to 5.2 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.

If equipped with the optional auxiliary vacuum system, refer to Section 9, Supplement 3, for operation procedures.

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 pressure is 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. Static pressure is sensed by button type vents on each side of the aft fuselage. Push-button type pitot and static drains are located on the lower left sidewall of the cockpit.

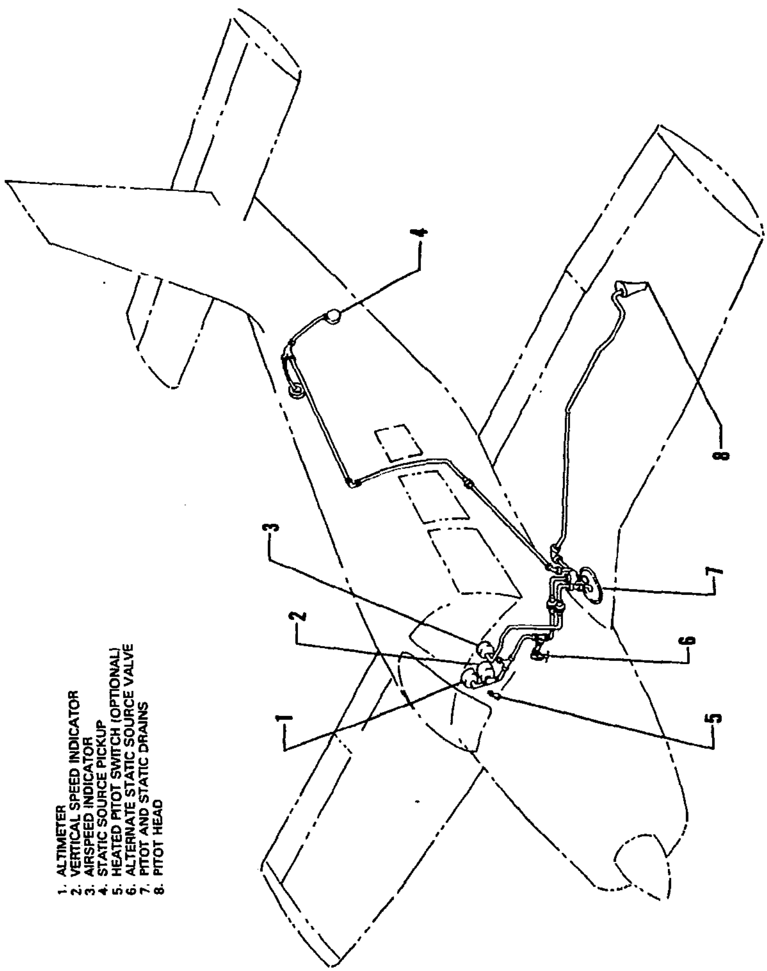
An alternate static source is available as optional equipment. The control valve is located below the left side of the instrument panel. When the valve is set in the alternate position, the altimeter, vertical speed indicator and airspeed indicator will be using cabin air for static pressure. The storm 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 pressure hole 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

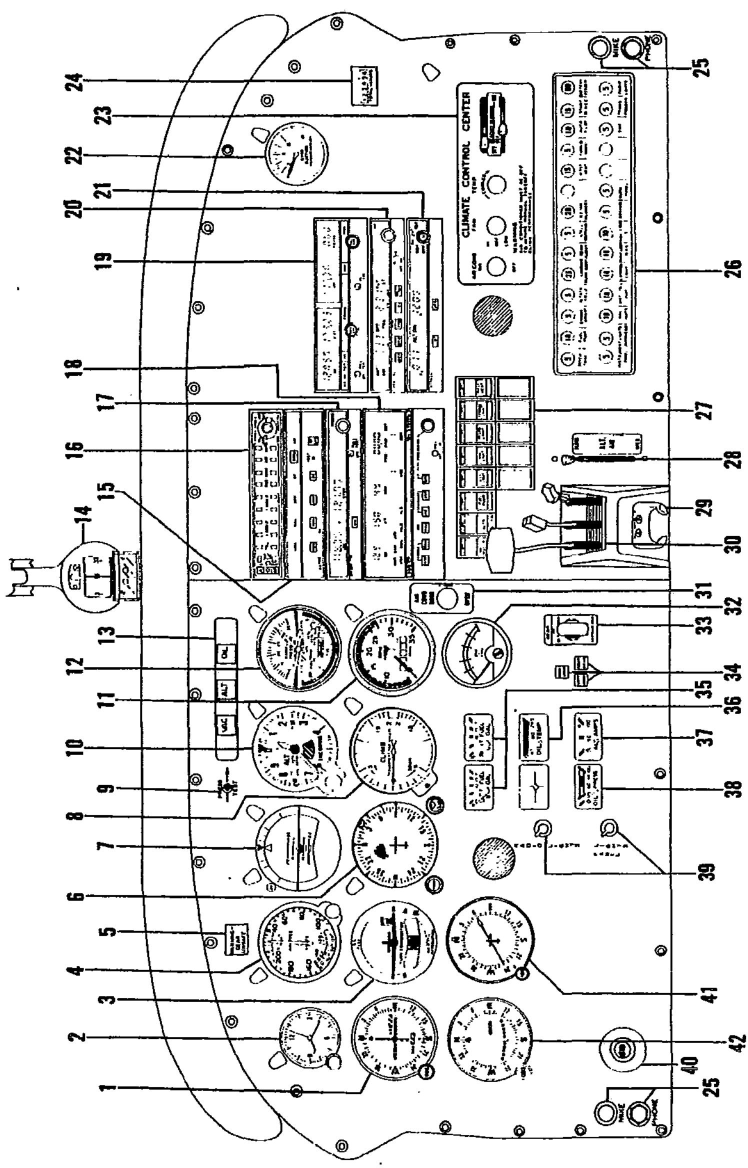
During preflight, check to make sure the pitot cover is removed.

7.21 PITOT-STATIC SYSTEM (continued)



PITOT-STATIC SYSTEM
Figure 7-19

7.23 INSTRUMENT PANEL



INSTRUMENT PANEL
Figure 7-21

7.23 INSTRUMENT PANEL (continued)

1. VOR/LOC/GLIDESLOPE INDICATOR
2. CLOCK
3. TURN COORDINATOR
4. AIRSPEED INDICATOR
5. WARNING - GEAR UNSAFE LIGHT
6. DIRECTIONAL GYRO
7. ATTITUDE GYRO
8. VERTICAL SPEED INDICATOR
9. ANNUNCIATOR TEST SWITCH
10. ALTIMETER
11. TACHOMETER
12. MANIFOLD PRESSURE AND FUEL FLOW/PRESSURE GAUGE
13. ANNUNCIATOR LIGHTS
14. MAGNETIC COMPASS
15. AUTOPILOT
16. AUDIO CONTROL PANEL
17. COMMUNICATIONS TRANS-CEIVER
18. AREA NAVIGATION RECEIVER
19. NAVIGATION/COMMUNICATIONS TRANSCEIVER
20. ADF RECEIVER
21. RADAR TRANSPONDER
22. GYRO SUCTION GAUGE
23. CLIMATE CONTROL CENTER
24. HOUR METER
25. MIKE/PHONE JACKS
26. CIRCUIT BREAKERS
27. ELECTRICAL SWITCHES
28. ALTERNATE AIR CONTROL
29. MICROPHONE HOLDER
30. ENGINE CONTROLS QUADRANT
31. AIR CONDITIONER DOOR LIGHT
32. E.G.T. GAUGE
33. LANDING GEAR SELECTOR
34. LANDING GEAR POSITION
35. LEFT AND RIGHT FUEL GAUGES
36. OIL TEMPERATURE GAUGE
37. AMMETER
38. OIL PRESSURE GAUGE
39. RADIO/SWITCH/INSTRUMENT LIGHTS CONTROL
40. IGNITION (MAGNETO) SWITCH
41. RADIO COMPASS (ADF)
42. VOR/LOC INDICATOR

INSTRUMENT PANEL
Figure 7-21

7.23 INSTRUMENT PANEL (continued)

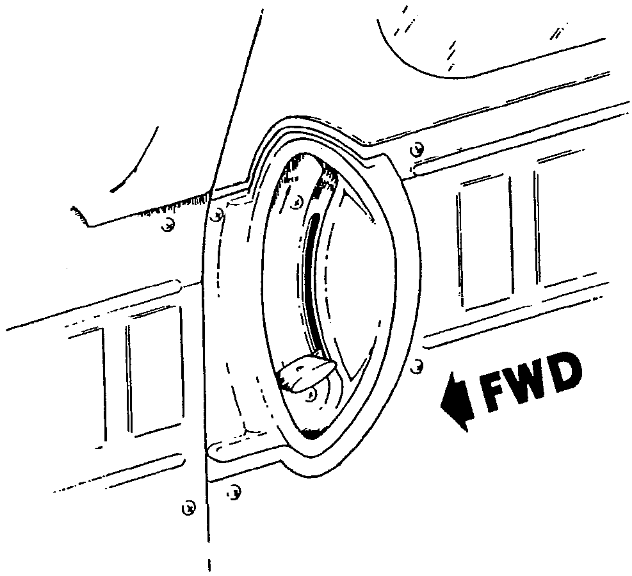
The instrument panel is designed to accommodate the customary advanced flight instruments and the normally required power plant instruments. The altitude and directional gyros, located in the center of the left hand instrument panel, are vacuum operated. The vacuum gauge is located on the right hand instrument panel. The turn indicator, on the left side, is electrically operated. The optional Horizontal Situation Indicator (HSI), when installed in place of the directional gyro, is also 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 annunciator panel is mounted in the upper instrument panel to warn the pilot of a possible malfunction in the alternator, oil pressure, or vacuum systems.

If installed, the optional radio master (RADIO MASTR) switch is located on the bottom row of the main switch panel. When the battery master (BATT MASTR) switch is turned ON, power is supplied to the avionics master relay switch, opening the contactors, and preventing current flow to the radios. When the radio master (RADIO MASTR) switch is turned ON, power is removed from the avionics master relay, allowing the contactors to spring closed, permitting current flow to the radios.

A ground clearance energy saver system is available to provide direct power to the number one communications (COMM 1) transceiver without turning on the battery master (BATT MASTR) switch and, if equipped, the radio master (RADIO MASTR) switch. An internally lit ground clearance (GND CLC) rocker switch, located on the instrument panel, provides annunciation for engagement of the system. When the switch is ON, direct airplane battery power is applied to the number one communications (COMM 1) transceiver audio amplifier (speaker) and radio accessories. During periods when the engine is shutdown, and communications is not required, the ground clearance (GND CLC) switch must be turned OFF to prevent depletion of the battery.



CABIN DOOR LATCH
Figure 7-23

7.25 CABIN FEATURES

All seat backs have three positions: normal, intermediate and recline. The adjustment lever is located at the base of the seat back on the outboard side of the seat. The front seats adjust fore and aft for ease of entry and occupant comfort. An armrest is located on the side panels adjacent to the front seat. The rear seats are easily removed to provide room for bulky items. Rear seat installations incorporate leg retainers with latching mechanisms, which must be released before the rear seats can be removed. Releasing the retainers is accomplished by depressing the plunger behind each rear leg. Optional headrests are available.

Seat occupants are protected by individual lap belts and single strap shoulder harnesses. Each shoulder harness is controlled by an inertial reel located above the side window. The shoulder strap is routed over the shoulder adjacent to the window and attached to the lap belt in the general area of the occupant's inboard hip. A check of the inertial reel mechanism can be made by pulling sharply on the strap and checking that the reel will lock in place under sudden stress; this locking feature prevents the strap from extending

7.25 CABIN FEATURES (continued)

and holds the occupant in place. Under normal movement the strap will extend and retract as required. Shoulder harnesses should be routinely worn during takeoff, landing and whenever an in-flight emergency situation occurs.

Additional features include pilot storm window, two sun visors, ash trays for each occupant, map pockets located on the side panels below the instrument panel, miscellaneous pockets on the rear of the front seat backs, armrests for the front occupants, cabin or baggage door locks and ignition lock.

The Arrow cabin door is double locked. To close the cabin door, hold the door closed with the armrest while moving the side door latch to the LATCHED position; then engage the top latch. Both latches must be secured before flight.

7.27 BAGGAGE AREA

A large baggage area, located behind the rear seats, is accessible either from the cabin or through a large outside baggage door on the right side of the aircraft. Maximum capacity is 200 lbs. Tiedown straps are provided and should be used at all times.

NOTE

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

7.29 HEATING, VENTILATING, AND DEFROSTING SYSTEM

The heating system is designed to provide maximum comfort for the occupants during winter and cool weather flights. The system includes a heat shroud, heat ducts, defroster outlets, heat and defroster controls.

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.

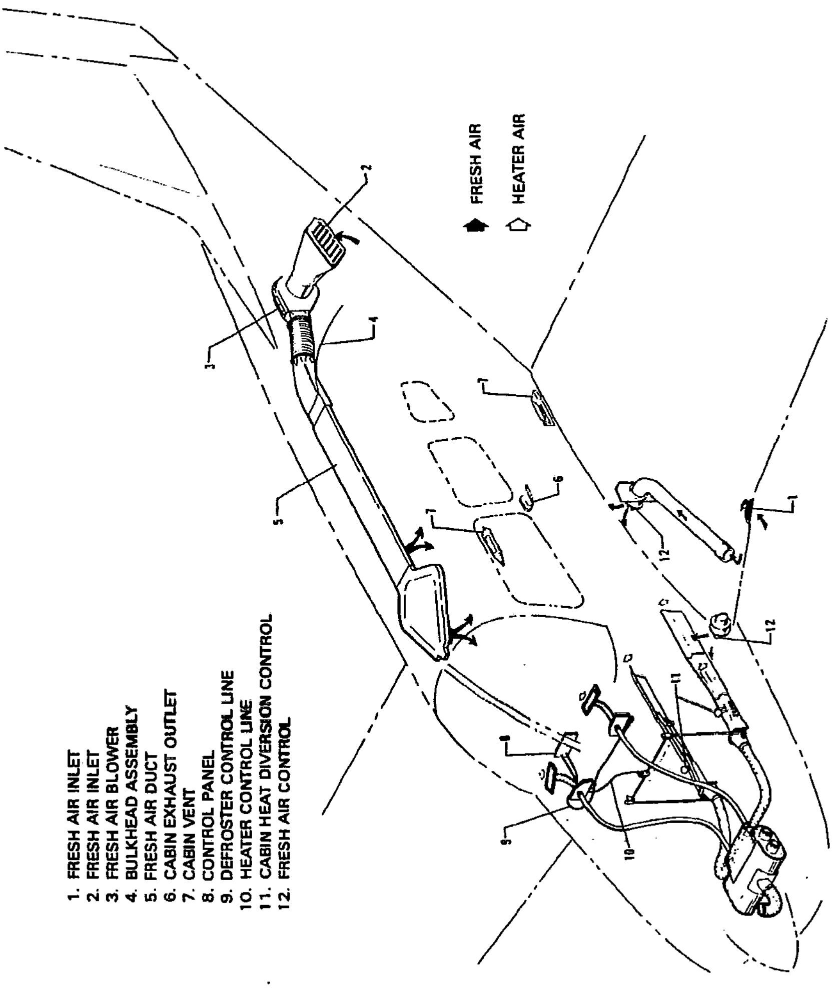
An opening in the front of the lower cowl admits ram air to the heater shroud and then the air is ducted to the heater shut-offs on the right and left side of the firewall. When the shut-off's are opened the heated air then enters the heat ducts located along each side of the center console. Outlets in the heat duct are located at each seat location. Airflow to the rear seats can be regulated by controls in the heat ducts located between the front seats. The temperature of the cabin is regulated by the heater control located on the right side of the instrument panel.

Defrosting is accomplished by heat outlets located on the right and left side of the cowl cover. Heated air is ducted directly to defroster shut-off valves at the firewall, then to the defroster outlets. The airflow is regulated by a defroster control located below the heat control.

To aid air distribution, the cabin air is exhausted overboard by an outlet located on the bottom of the fuselage. Cabin exhaust outlets are located below and outboard of the rear seats. The above features are removed when air conditioning is installed.

Optional individual overhead fresh air outlets supply fresh air from a louvered air inlet located on the side of the left aft fuselage beneath the dorsal fin. The air is directed to a plenum chamber at the base of the fin, then ducted to the individual outlets. For individual comfort, the amount and direction of air can be regulated to control the amount of air and direction of desired airflow. An optional blower is available which forces outside air through the overhead vents for ground use. The blower is operated by a FAN switch with three positions - OFF, LOW, or HIGH.

7.29 HEATING, VENTILATING, AND DEFROSTING SYSTEM (continued)



HEATING, VENTILATING AND DEFROSTING SYSTEM
Figure 7-25

7.31 STALL WARNING

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. Stall speeds are shown on graphs in the Performance Section. The stall warning horn emits a continuous sound in contrast to the gear warning horn, which emits a 90 Hz beeping sound. The stall warning horn is activated by a lift detector installed on the leading edge of the left wing. During preflight, the stall warning system should be checked by turning the battery master (BATT MASTR) switch ON, lifting the detector and checking to determine if the horn is actuated.

7.33 FINISH

All exterior surfaces are primed with etching primer and finished with acrylic lacquer. To keep the finish attractive looking, economy size spray cans of touchup paint are available from Piper Dealers.

7.35 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 controls.

The evaporator is located on the left side of the fuselage 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.

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.

*Optional equipment

7.35 AIR CONDITIONING* (continued)

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.

A condenser door light, located to the right of the tachometer, illuminates when the door is open and is extinguished when the door is closed.

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

Whenever the throttle is in the full forward position, it actuates a micro switch which 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 ¼ inch, the clutch will engage, the scoop will extend, and the system will again supply cool, dry air.

*Optional equipment

7.37 PIPER EXTERNAL POWER*

An optional starting installation known as Piper External Power (PEP) is accessible through a receptacle located on the right side of the fuselage aft of the baggage compartment door. 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.

7.39 EMERGENCY LOCATOR TRANSMITTER*

The Emergency Locator Transmitter (ELT) meets the requirements of FAR 91.52. It operates on self-contained batteries and is located in the aft fuselage section. It is accessible through a rectangular cover on the right hand side. A number 2 Phillips screwdriver is required to remove the cover.

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 tests must be made at any other time, the tests should be coordinated with the nearest FAA tower or flight service station.

NARCO ELT 10 OPERATION

On the ELT unit itself is a three position switch placarded ON, OFF 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 it should remain in that position.

*Optional equipment

7.39 EMERGENCY LOCATOR TRANSMITTER* (continued)

NARCO ELT 10 OPERATION (continued)

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 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 press the reset button and return the switch to ARM. Recheck with the receiver to ascertain the transmitter is silent.

*Optional Equipment

7.39 EMERGENCY LOCATOR TRANSMITTER* (continued)

NARCO ELT 910 OPERATION

On the ELT unit itself is a three position switch placarded ON, OFF 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 it should remain in that position.

A pilot's remote switch, placarded ON and ARM, is located on the left side panel to allow the transmitter to be armed or turned on from inside the cabin. The switch is normally in the ARM position. Moving the switch to ON will activate the transmitter. A warning light, located above the remote switch, will blink continuously whenever the ELT is activated.

NOTE

The warning light will not blink if the ELT is activated by an incident that also results in severance of the airplane's power supply lines.

Should the ELT be activated inadvertently it can be reset by either positioning the remote switch to the ON position for two seconds, and then relocating it to the ARM position, or by setting the switch on the ELT to OFF and then back to ARM.

In the event the transmitter is activated by an impact, it can be turned off by moving the ELT switch OFF. Normal operation can then be restored by resetting the switch to ARM. It may also be turned off and reset by positioning the remote switch to the ON position for two seconds, and then to the ARM position.

The transmitter can be activated manually at any time by placing either the remote switch or the ELT switch to the ON position.

The ELT should be checked during postflight to make certain the unit has not been activated . Check by selecting 121.50 MHz on an operating receiver. If a downward sweeping audio tone is heard the ELT may have been activated. Set the remote switch to ON. If there is no change in the tone it is probably you. Setting the remote switch back to ARM will automatically reset the ELT.

*Optional Equipment

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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 Arrow. For complete maintenance instructions, refer to the PA-28R-201/201T Maintenance Manual.

WARNING

Inspection, maintenance and parts requirements for all non-PIPER approved STC installations are not included in this handbook. When a non-PIPER approved STC installation is incorporated on the airplane, those portions of the airplane affected by the installation must be inspected in accordance with the inspection program published by the owner of the STC. Since non-PIPER approved STC installations may change systems interface, operating characteristics and component loads or stresses on adjacent structures, PIPER provided inspection criteria may not be valid for airplanes with non-PIPER approved STC installations.

WARNING

Modifications must be approved in writing by PIPER prior to installation. Any and all other installations, whatsoever, of any kind will void this warranty in it's entirety.

8.1 GENERAL (CONTINUED)

WARNING

Use only genuine PIPER parts or PIPER approved parts obtained from PIPER approved sources, in connection with the maintenance and repair of PIPER airplanes.

Genuine PIPER parts are produced and inspected under rigorous procedures to insure airworthiness and suitability for use in PIPER airplane applications. Parts purchased from sources other than PIPER, even though identical in appearance, may not have had the required tests and inspections performed, may be different in fabrication techniques and materials, and may be dangerous when installed in an airplane.

Additionally, reworked or salvaged parts or those parts obtained from non-PIPER approved sources, may have service histories which are unknown or cannot be authenticated, may have been subjected to unacceptable stresses or temperatures or may have other hidden damage not discernible through routine visual or nondestructive testing. This may render the part, component or structural assembly, even though originally manufactured by PIPER, unsuitable and unsafe for airplane use.

PIPER expressly disclaims any responsibility for malfunctions, failures, damage or injury caused by use of non-PIPER approved parts.

8.1 GENERAL (CONTINUED)

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 systems.

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 available on the Piper.com website. 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. These are available on the Piper.com website. 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.

Maintenance manuals, parts catalogs, and revisions to both, are available from Piper Service Centers.

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

8.3 AIRPLANE INSPECTION PERIODS

WARNING

All inspection intervals, replacement time limits, overhaul time limits, the method of inspection, life limits, cycle limits, etc., recommended by PIPER are solely based on the use of new, remanufactured or overhauled PIPER approved parts. If parts are designed, manufactured, remanufactured, overhauled and/or approved by entities other than PIPER, then the data in PIPER'S maintenance/service manuals and parts catalogs are no longer applicable and the purchaser is warned not to rely on such data for non-PIPER parts. All inspection intervals, replacement time limits, overhaul time limits, the method of inspection, life limits, cycle limits, etc., for such non-PIPER parts must be obtained from the manufacturer and/or seller of such non-PIPER parts.

Piper has developed inspection items and required inspection intervals for the PA-28R-201/201T (see the latest revision of the PA-28R-201/201T Maintenance and Inspection Manuals). The PA-28R-201/201T Inspection Manual contains appropriate forms, and all inspection procedures should be complied with by a properly trained, knowledgeable, and qualified mechanic at a Piper Authorized Service Center or a reputable repair shop. Piper 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, 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.

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 spectrographic 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 airplance 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.

8.7 AIRPLANE ALTERATIONS (continued)

(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. The steering bar is engaged by inserting it into the nose wheel axle.

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 15 feet, and a qualified person should ride in the pilot's seat to maintain control by use of the brakes.

8.9 GROUND HANDLING (continued)

(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 shutdown procedures as well as taxi techniques should be covered. When it is ascertained that the propeller back blast and taxi areas are clear, power should be 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 it 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.

8.9 GROUND HANDLING (continued)

(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 tiedown ropes to the wing tiedown rings and to the tail skid 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 upper cowl.
(2) Remove the wing nuts securing the filter box cover. Remove the filter.

(b) Cleaning Engine Air Filter

The induction 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

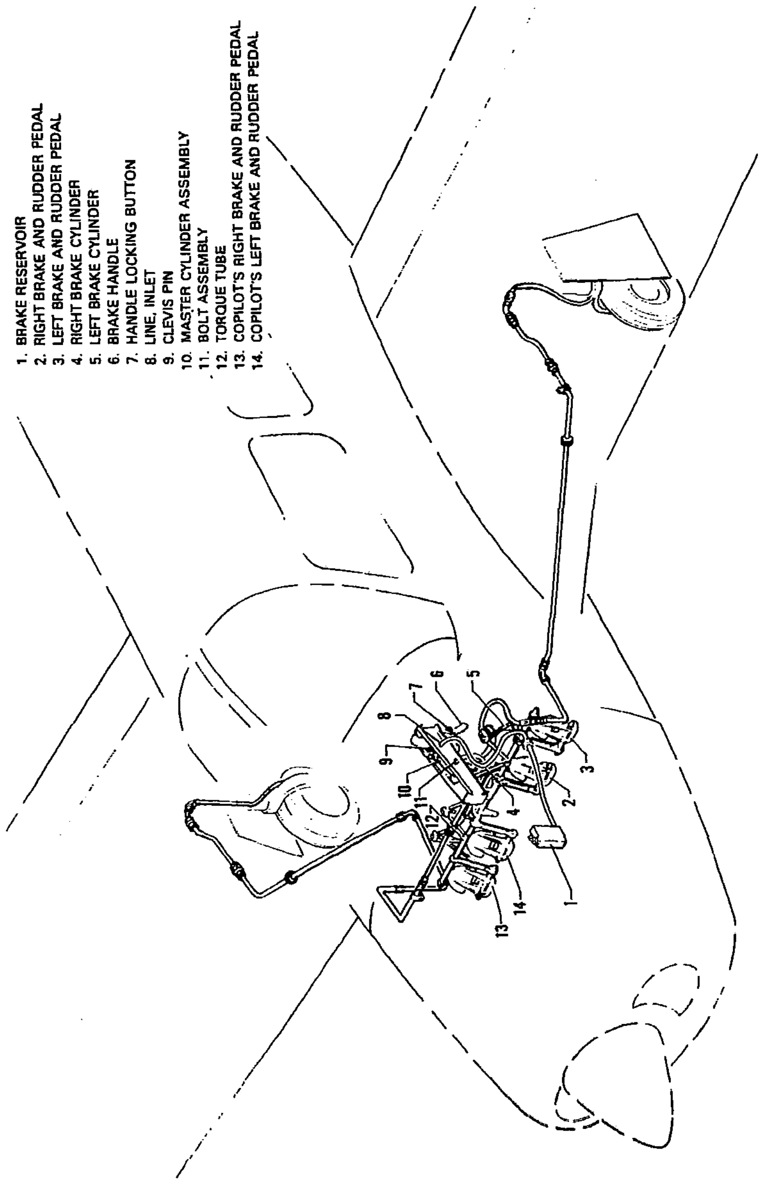
After cleaning or when replacing the filter, install the filter in the reverse order of removal.

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 firewall 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.

8.13 BRAKE SERVICE (continued)



BRAKE SYSTEM
Figure 8-1

8.15 LANDING GEAR SERVICE

The main landing gear uses 6.00 x 6 wheels with 6.00 x 6, six-ply rating tires and tubes. The nose wheel uses a 5.00 x 5 wheel with a 5.00 x 5 four-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 on the Arrow should be serviced according to the instructions on the units. The main oleos should be extended under normal static load until 2.0 +/- 0.25 inches of oleo piston tube is exposed, and the nose gear should show 2.75 +/- 0.25 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 stem and pump up the strut as mentioned 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 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 30° in either direction and is factory adjusted at stops on the bottom of the forging.

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-360 series engine is 8 quarts, and the minimum safe quantity is 2 quarts. It is recommended that the oil be drained and renewed, and oil filter be changed, every 50 hours, or sooner under unfavorable operating conditions. The interval between oil and oil filter change is not to exceed four (4) months. The following grades are recommended for the specified temperatures:

Average Ambient Air Temperatures	MIL-L-6082B Mineral SAE Grade	MIL-L-22851 Ashless Dispersant SAE Grades
All Temperatures	--	15W-50 or 20W-50
Above 80°F	60	60
Above 60°F	50	40 or 50
30°F to 90°F	40	40
0°F to 70°F	30	30, 40 or 20W-40
Below 10°F	20	30 or 20W-30

When operating temperatures overlap indicated ranges, use the lighter grade oil.

NOTE

Refer to the latest issue of Lycoming Service Instruction 1014 (Lubricating Oil Recommendations) for further information.

8.21 FUEL SYSTEM

(a) Servicing Fuel System

At every 50-hour inspection, the fuel screen in the strainer must be cleaned. The fuel strainer is located on the forward left lower side

8.21 FUEL SYSTEM (continued)

(a) Servicing Fuel System (continued)

of the firewall. It is accessible by removing the lower cowling. After cleaning, a small amount of grease applied to the gasket will facilitate reassembly.

(b) Fuel Requirements (AVGAS ONLY)

Aviation grade fuel with a minimum octane of 100/130 is specified for this airplane. Since the use of lower grades can cause serious engine damage in a short period of time, the engine warranty is invalidated by the use of lower octanes. Refer to latest issue of Lycoming Service Instruction 1070 for approved alternate grade fuels.

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 (Avco Lycoming Specified Fuels).

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-5572F)		
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
91/96	blue	2.0	*100LL	blue	2.0	100/130	blue	2.0
100/130	green	3.0	100	green	**3.0	none	none	none
115/145	purple	4.6	none	none	none	115/145	purple	4.6

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

** -Commercial fuel grade 100 and grade 100/130 having TEL content of up to 4 ml/U.S. gallons are approved for use in all engines certificated for use with grade 100/130 fuel.

8.21 FUEL SYSTEM (continued)

(b) Fuel Requirements (AVGAS ONLY) (continued)

The operation of the aircraft is approved with an anti-icing additive in the fuel. When 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 0.15% by volume of the refueled quantity, and to ensure its effectiveness should be blended at not less than 0.10% by volume. One and one half liquid ozs. per ten gallons 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.

CAUTIONS

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 tanks.

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

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

(c) Filling Fuel Tanks

WARNINGS

Do not operate any avionics or electrical equipment on the airplane during refueling. Do not allow open flame or smoking in the vicinity of the airplane while refueling.

During all refueling operations, fire fighting equipment must be available. Two ground wires from different points on the airplane to separate approved grounding stakes shall be used.

8.21 FUEL SYSTEM (continued)

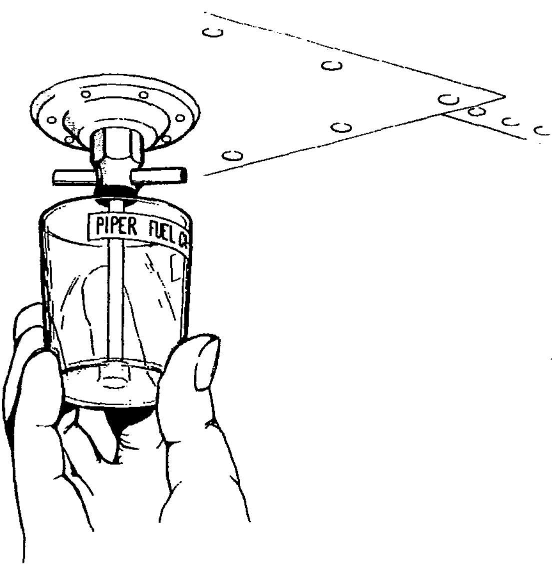
(c) Filling Fuel Tanks (continued)

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 38.5 U.S. gallons. When using less than the standard 77 gallon capacity, fuel should be distributed equally between each side.

NOTE

Aircraft should be refueled in a wing level condition. At times this will require alternate filling of left and right tanks until the full condition is reached.

(d) Draining Fuel Strainer, Sumps and Lines



FUEL DRAIN
Figure 8-3

8.21 FUEL SYSTEM (continued)

(d) Draining Fuel Strainer, Sumps and Lines (continued)

The fuel strainer, located on the lower left side of the firewall, is provided with a quick drain which should be drained before the first flight of the day or after refueling, to check for fuel contamination. If contamination is found, fuel should be drained until the contamination stops. If contamination persists after draining fuel for a minute, contact a mechanic to check the fuel system.

Each fuel tank is provided with a fuel quick drain to check for contamination. Each tank should be checked for contamination in accordance with the above procedure.

(e) Draining Fuel System

The bulk of the fuel may be drained from the fuel cells by the use of a siphon hose placed in the cell or tank through the filler neck. The remainder of the fuel may be drained by opening all the drain valves.

CAUTION

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

8.23 TIRE INFLATION

For maximum service from the tires, keep them inflated to the proper pressure of 27 psi for nose tire and 30 psi for main tires. All wheels and tires are balanced before original installation, and the relationship of tire, tube and wheel should be maintained upon reinstallation. In the installation of new components, it may be necessary to rebalance the wheels with the tires mounted. Unbalanced wheels can cause extreme vibration in the landing gear. When checking tire pressure, examine the tires for wear, cuts, bruises and slippage.

8.25 BATTERY SERVICE

The 12-volt, 35-ampere-hour battery is located just behind the aft close out panel. Access is gained through the baggage compartment. The battery container has a plastic drain tube which is normally closed off with a cap. The cap should be opened periodically to remove battery acid which may have collected in the tube.

The battery fluid level must not be brought above the baffle plates. It should be checked every 30 days to determine that the fluid level is proper and the connections are tight and free of corrosion. Do not fill the battery with acid - use water only.

If the battery is not properly charged, recharge it starting with a rate of four amperes and finishing with a rate of two amperes. The battery should be removed from the airplane for charging, and quick charges are not recommended.

The external power receptacle, if installed, is located on the right side of the fuselage aft of the baggage compartment door.

Refer to the PA-28R-201/201T Maintenance Manual for battery servicing procedure.

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.

8.27 CLEANING (continued)

(a) Cleaning Engine Compartment (continued)

(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.

(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.

CAUTION

Do not brush the microswitches.

(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 sufaces or could cause corrosion of metal. Cover areas where cleaning solution could cause damage. To wash the airplane, use the following procedure:
(1) Flush away loose dirt with water.

8.27 CLEANING (continued)

(c) Cleaning Exterior Surfaces (continued)

(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 the surface longer.
(4) To remove stubborn oil and grease, use a cloth dampened with naphtha.
(5) Rinse all surfaces thoroughly.
(6) Any good automotive 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.

8.27 CLEANING (continued)

(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. Carefully follow the manufacturer's instructions. 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 nonflammable dry cleaning fluid. Floor carpets may be cleaned like any household carpet.

8.29 WINTERIZATION

For winter operation a winterization kit is installed on the inlet opening of the oil cooler outboard chamber of the plenum chamber. This kit should be installed whenever the ambient temperature is 50° F or less. When the kit is not being used it can be stowed on the bracket provided for this purpose on the top side of the oil cooler plenum chamber.

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SECTION 9

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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PILOT'S OPERATING HANDBOOK
AND
FAA APPROVED AIRPLANE FLIGHT MANUAL

SUPPLEMENT 1
FOR
AIR CONDITIONING INSTALLATION

This supplement must be attached to the Pilot's Operating Handbook and FAA Approved Airplane Flight Manual when the Air Conditioning System is installed in accordance with Piper Drawing No. 99598-2. 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 basic Pilot's Operating Handbook and FAA Approved Airplane Flight Manual.

FAA APPROVED D H Trompler
D.H. TROMPLER
D.O.A. NO. SO-1
PIPER AIRCRAFT CORPORATION
VERO BEACH, FLORIDA

DATE OF APPROVAL November 29, 1988

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.

SECTION 2 - LIMITATIONS

(a) To ensure 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 ENSURE NORMAL TAKEOFF
CLIMB PERFORMANCE.

In full view of the pilot, to the right of the tachometer (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 tachometer 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 measureable difference in climb, cruise or range performance of the airplane.

NOTE

To ensure 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 6 KTS at all power settings.
(b) The decrease in range may be as much as 40 nautical miles for the 72 gallon usable fuel 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 a full throttle position is selected. When the 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 at all altitudes. 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.

PILOT'S OPERATING HANDBOOK AND FAA APPROVED AIRPLANE FLIGHT MANUAL

SUPPLEMENT 2 FOR PIPER ELECTRIC PITCH TRIM

This supplement must be attached to the Pilot's Operating Handbook and FAA Approved Airplane Flight Manual when the Piper Electric Pitch Trim System is installed in accordance with Piper Drawing No. 67496-3. 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 basic Pilot's Operating Handbook and FAA Approved Airplane Flight Manual.

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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.

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

The following information applies in case of electric trim malfunction:

(a) In case of malfunction, disconnect electric pitch trim by activating pitch trim switch on pilot's control yoke to OFF position.

(b) In case of emergency, electric pitch trim may be overpowered using manual pitch trim, and/or control wheel pressure.

(c) In cruise configuration, a malfunction can result in a 20° pitch change and 500 ft. altitude variation.

(d) In approach configuration, a malfunction can result in a 20° pitch change and a 500 ft. altitude variation.

SECTION 4 - NORMAL PROCEDURES

The electric pitch trim may be turned ON or OFF by a switch located on the left horn of the pilot's control yoke adjacent to the trim control 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.

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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PILOT'S OPERATING HANDBOOK AND FAA APPROVED AIRPLANE FLIGHT MANUAL

SUPPLEMENT 3 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. 89311-2. 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 basic Pilot's Operating Handbook and FAA Approved Airplane Flight Manual.

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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

(a) The auxiliary vacuum system is limited to standby function only, do not take off with the engine driven dry air pump inoperative.

(b) Discontinue flight in Instrument Meteorological Conditions (IMC) if vacuum pressure falls below 4.8 In. Hg.

(c) 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

(a) VAC OFF or Low VAC Warning illuminated - Auxiliary Vacuum Switch AUX ON.

(b) Verify vacuum system suction is 4.8 to 5.2 In. Hg., VAC OFF annunciator is extinguished, and AUX ON annunciator illuminated.

CAUTION

Compass error may exceed 10° when auxiliary vacuum system is in operation.

(c) Monitor electrical load - verify alternator capacity is not being exceeded as indicated by the ammeter. If required, turn off nonessential electrical equipment.

(d) Land at the earliest opportunity to have primary system repaired.

SECTION 4 - NORMAL PROCEDURES

(a) Preflight Check.

(1) Turn battery master (BATT MASTR) switch ON and verify that the VAC OFF light is illuminated.

NOTE

Due to the electrical power requirement of the auxiliary vacuum pump it is suggested that the engine be operating while making the following checks.

(2) Turn the auxiliary vacuum pump ON and verify that the AUX ON light is illuminated and an electrical load increase of approximately 15 amps on the ammeter.

(3) Turn off the auxiliary vacuum pump and verify that the AUX ON light has extinguished.

(b) Inflight Check.

(1) Turn off non-essential electrical equipment.

(2) Turn the auxiliary vacuum pump ON and verify that the AUX ON light is illuminated and an electrical load increase of approximately 15 amps on ammeter.

(3) Turn off auxiliary vacuum pump and verify that the AUX ON light has extinguished and resume normal flight using engine driven pump.

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 Basic 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.

The auxiliary pump is mounted on the forward side of the firewall and 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.

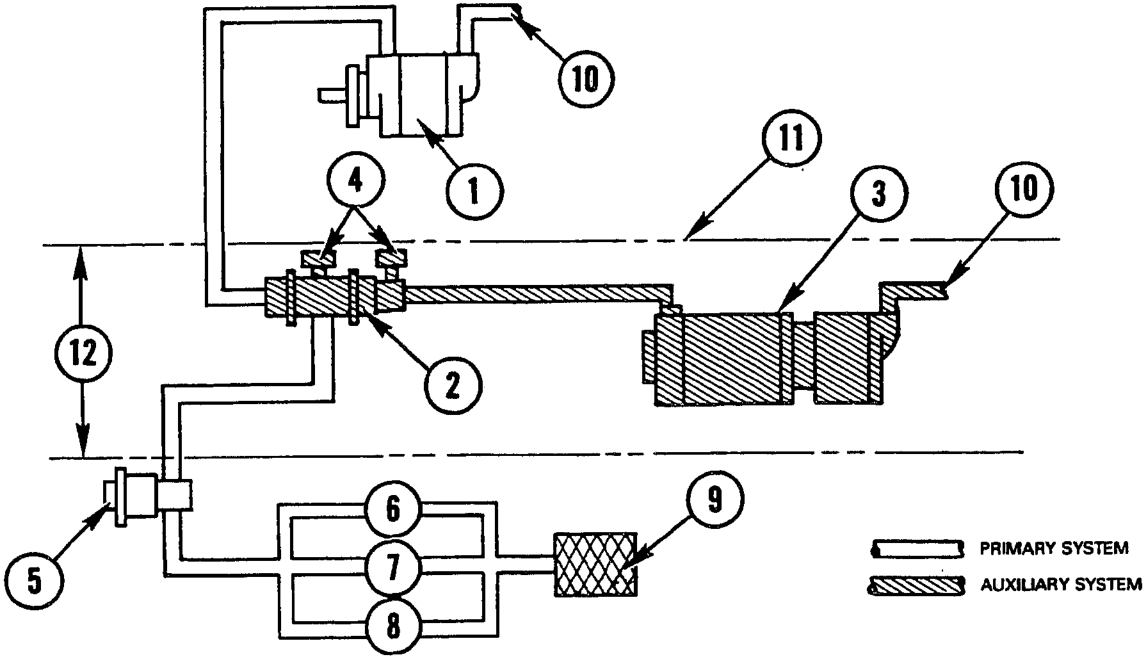
The control switch (labeled AUX VAC) for the auxiliary pump system is located on the main electrical switch panel in the center of the instrument panel above the throttle quadrant. The control switch operating modes are push-for-on and push-for-off.

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.

SECTION 7 - DESCRIPTION AND OPERATION (cont)

The annunciator lights do not incorporate a press-to-test feature. If the lights do not illuminate as expected, check for burned out lamps, replace with MS 25237-330 bulbs and retest the system.

The pump motor electrical circuit is protected by a 20 amp AUX VAC breaker installed in the circuit breaker panel. The switch annunciator light is protected by a 5 amp in-line fuse.



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

VACUUM SYSTEM SCHEMATIC

PILOT'S OPERATING HANDBOOK AND FAA APPROVED AIRPLANE FLIGHT MANUAL

SUPPLEMENT NO. 4 FOR PIPER CONTROL WHEEL CLOCK INSTALLATION

This supplement must be attached to the Pilot's Operating Handbook and FAA Approved Airplane Flight Manual when the optional Piper Control Wheel Clock is installed per Piper Drawing No. 87347-2. 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.

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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.

(d) 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.

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PILOT'S OPERATING HANDBOOK AND FAA APPROVED AIRPLANE FLIGHT MANUAL

SUPPLEMENT NO. 5 FOR KING KNS-80 AREA NAVIGATION SYSTEM

This supplement must be attached to the Pilot's Operating Handbook and FAA Approved Airplane Flight Manual when the King KNS-80 Area Navigation System is installed per Piper Drawing No. 89964-2. 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.

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SECTION 1 - GENERAL

This supplement supplies information necessary for the operation of the airplane when the optional King KNS-80 Area Navigation System is installed in accordance with FAA Approved Piper data.

SECTION 2 - LIMITATIONS

(a) The Area Navigation or VOR PAR mode can only be used with co-located facilities (VOR and DME signals originating from the same geographical location).

SECTION 3 - EMERGENCY PROCEDURES

No change.

SECTION 4 - NORMAL PROCEDURES

GROUND TEST PROCEDURES

The following test can be used to determine if the system is operating properly.

(a) Tune the KNS 80 to a VORTAC (VOR/DME) within 25 NM of the airplane.

(b) Place the KNS 80 in VOR mode and rotate the OBS until the course deviation needle centers with the TO/FROM flag giving a FROM indication.

(c) Using the appropriate controls, select a value for the waypoint radial equal to the OBS value determined in Step (b). In addition, select a value for the waypoint distance equal to the indicated DME value in Step (b).

(d) Place the KNS 80 in RNAV ENR mode. The system is operating properly if the distance to station is +/- 1.0 NM and the course deviation needle is within a dot of being centered.

ENROUTE NAVIGATION

(a) Load Waypoint 1 Data

(1) Put waypoint 1 in the DSP window by depressing the DSP button. (If there is a 2 in the DSP window initially, push the DSP button three times to go through the 2-3-4-1 sequence to reach 1.)

The previously selected frequency (stored in memory) for waypoint 1 will be displayed and "1" will be flashing unless USE and DSP are the same.

(2) Select a waypoint 1 frequency using the data input controls which are the two concentric knobs on the right. The smaller of the 2 knobs controls the .1 MHz and .05 MHz digits. The outer knob changes the 1 MHz and 10MHz displays. The selected frequency will appear in the display and be placed in memory.

(3) Select a waypoint 1 radial by first depressing the DATA button. This will cause the radial for the previous waypoint 1 to appear in the data display over the annunciation RAD. Select the radial with the data input controls. The outer knob controls the 10° and 100° digits; the center knob IN position controls the 1° and the center knob OUT position controls the 0.1° digit. The selected radial will appear in the display and be placed in memory.

(4) Select a waypoint 1 distance by again depressing the DATA button, causing display of the previous waypoint 1 distance in the data display over the annunciation DST. Select the distance with the data input controls. The outer knob controls the 10 NM digit, the center knob IN position controls the 1 NM digit, and the center knob OUT position controls the 0.1 NM digit. The selected distance will appear in the display and be placed in memory.

NOTE

Throughout this sequence, the number 1 over DSP annunciation will blink. It will stop blinking and remain steady only when the waypoint number in DSP is the same as the waypoint number in USE. This is a safety feature.

(b) Load Remaining Waypoint Data

(1) Put waypoint 2 in the DSP window by depressing DSP button. The data display will automatically display the frequency of the last selected number 2 waypoint and FRQ will be annunciated. All other displays will remain as before. Waypoint 2 may now be loaded the same as waypoint 1 was previously.

(2) The remaining waypoints may be loaded in a similar manner.

(c) Takeoff and Fly to Waypoint 1

Before takeoff, check to be sure that RNV/ENR is still the active mode, then depress the DSP button to place waypoint 1 in the DSP position. The selected waypoint 1 frequency will automatically appear in the data display.

Depress the DATA button to check the radial, and again to check distance in the data display.

Now depress the USE button to place waypoint 1 in the USE position. The number 1 in the DSP position will stop blinking, indicating that the displayed data and "in use" data are the same.

After takeoff, and line of sight altitude is reached, the DME will lock on. The dashes that were present in the distance display of the KNS 80 will disappear and display distance to waypoint 1. CDI or HSI will also be flagged until both VOR and DME are valid.

Ground speed and time-to-station information will not be accurate unless flying directly to or from the VORTAC or waypoint.

CAUTION

When installed, an RMI will continue to display the bearing to the VOR station; it will not display bearing to the RNAV waypoint.

Soon after being on course direct to waypoint 1, ground speed and TTS will become accurate.

At this point you may also want to check the ident of the VOR by pulling the ON/ OFF/ Volume switch to place it in the OUT position. When satisfied, return the switch to the IN position to mute the ident tones.

(d) Change Over to Waypoint 2

Depress the DSP button and the number 2 will appear (blinking) over the DSP annunciation and the waypoint 2 frequency will appear in the data display. The DME display will not change because waypoint 1 data is still "in use". At this point, if desired, waypoint 2 radial and distance data may be rechecked by depressing the DATA button for each.

When satisfied, depress the USE button to put waypoint 2 data "in use". The number 2 will appear in the USE annunciated space; the number 2 in the DSP space will stop blinking. Waypoint 2 frequency will automatically appear.

Following VOR/ DME receiver acquisition of the new VORTAC frequency, distance display will begin reading distance (NM), ground speed (KT) and TTS (MIN) to waypoint 2. The CDI TO/ FROM flag will move to the TO position and continue flying course directly to waypoint 2.

(e) Flying Direct to a VOR/DME Facility

(1) Depress the VOR button and RNV /ENR will disappear from the mode annunciator and VOR will appear. The distance display will change to show distance to the VORTAC instead of to the waypoint. Ground speed (KTS) and time-to-station (MIN) displays will also change accordingly.

Center the needle to the CDI and you will be on a course direct to the VORTAC. However, the CDI will display conventional (angular) crosstrack deviation of +/- 10° full scale.

(2) Push the VOR button again and VOR/ PAR mode will appear with linear crosstrack deviation displayed on the CDI as +/- 5 NM full scale (as in RNV/ ENR). This permits flying accurately direct to the station or on a parallel course up to 5 NM either side of the direct course.

CAUTION

Whenever flying directy to or from a VORTAC facility, always select either the VOR or VOR/ PAR mode.

(f) Tune an ILS Frequency Without Losing DME

To retain DME, depress the HOLD button. Now select the ILS frequency using the data input controls and checking it in the data display. HLD will now annunciate. The distance will continue to read to the VORTAC and VOR/ PAR function will remain annunciated along with the active ILS function.

Now reselect the same VOR and the ILS annunciation will cancel and it will revert back to VOR/ PAR mode. HLD will cancel since VOR and DME frequency are again the same. The DME HOLD button will remain depressed (it is a two position button). Thus the HOLD button functions as a Hold ARM when in the IN position and actual Hold (HLD) annunciation occurs only when VOR/ ILS and DME frequencies are different.

If the HOLD function is mistakenly used in the RNAV modes, as soon as the frequency is changed, the HLD function will annunciate. DME displays (NM, KT, and MIN) will flag (display dashes) and the CDI or HSI will flag since this is not a valid RNAV signal. Use of HOLD in VOR PAR mode will result in a CDI or HSI flag and the DME displays will be to the VORTAC on HOLD.

(g) RNAV Approach

The RNV APR mode may be used for runway location (by placing a waypoint at the approach end of the runway) during an approach to an airport.

If in the RNV ENR mode, depress the RNAV pushbutton and RNV APR mode is immediately activated. In RNV APR the deviation needle on the CDI will display crosstrack deviation as +/- 1¼ NM full scale, or ¼ NM (1519 ft.) per dot. All other aspects of the RNV APR mode are identical with the RNV ENR mode.

Prior to beginning the approach, it is recommended that the waypoints and corresponding waypoint numbers be assigned as follows to reduce pilot workload during the final approach segment:

Waypoint Number	
1	Use repetitively for initial and intermediate fixes. See note below.
2	Final Approach Fix (FAF) Coordinates.
3	Missed Approach Point (MAP) Coordinates.
4	Missed Approach Fix (MAF) Coordinates.

NOTE

If flying an autopilot coupled approach, the pilot should revert to HEADING mode at the waypoint to make the required course corrections while revising the KNS 80 waypoint number 1. Do not adjust the controls for setting waypoint when in RNAV mode or the VOR frequency when USE and DSP are showing the same number and the autopilot is coupled to the KNS 80 system.

FINAL APPROACH PLANNING

If the length of the final approach segment for a given angle of intercept is less than the figures given below, a satisfactory approach will not be obtainable. The figures are in accordance with FAA Advisory Circular 90-45A, Appendix D, guidelines for establishment of IFR approaches.

MINIMUM LENGTH OF FINAL APPROACH SEGMENT
IN NAUTICAL MILES

Approach Category	Category Approach Speed Requirements	Magnitude of Turn Over Final Approach Waypoint (Intercept Angle)					
		10°	20°	30°	40°	50°	60°
A	Less than 91 knots	1.0	1.5	2.0	3.0	4.0	5.0
B	91 to 120 knots	1.5	2.0	2.5	3.5	4.5	5.5
C	121 to 140 knots	2.0	2.5	3.0	4.0	5.0	6.0

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 KNS 80 is a panel mounted navigation system consisting of a VOR/Localizer Receiver, DME Interrogator, RNAV Computer, and Glide Slope Receiver in a single unit. When combined with an appropriate CDI Indicator, the unit becomes a complete navigation system featuring two modes of VOR, two modes of RNAV, and ILS. The unit also simultaneously displays distance to station (waypoint), velocity to station (waypoint), time to station (waypoint), and chosen parameter (frequency, radial or distance) of one of the four waypoints. Separate system flexibility is maintained with a DME HOLD button which allows "freezing" the DME frequency while tuning to a different ILS or VOR frequency. The various modes, (VOR, VOR PAR, RNV ENR, and RNV APR), are selected by pressing the appropriate VOR or RNAV pushbutton. If an ILS frequency is placed in the active data, the system will automatically go to the ILS mode. When switched out of an ILS frequency the system will revert back to the mode in which it was at the time the ILS frequency was selected.

When energized, the system will go to the mode in which it was when switched off. In addition, it will retain all waypoint data through a power shutdown.

Additional features include an automatic dimming circuit to compensate for changes in ambient light level, and a CMOS memory powered by two silver-oxide watch cells enabling long term waypoint storage (2 years typical cell life). If the batteries should become weak, waypoint storage will be lost and the radio will tune to 110.00 MHz, waypoint 1 in USE and DSP, VOR mode, and dashes in the DME display. The unit may then be operated normally during the flight, but no memory will be retained after turning the radio master switch OFF.

The KNS 80 Digital Area Navigation System consists of the following controls and displays:

DISPLAYS

(a) NM Display
  (1) VOR and VOR PAR (VOR Parallel) Modes
      Displays DME distance.
      0 to 99.9 NM in 0.1 NM steps, 100 to 200 NM in 1 NM steps.
      Most significant digit is zero blanked.
      Displays dashes whenever DME goes into search.

(2) RNV APR and RNV ENR Modes
Displays RNAV distance to waypoint.
0 to 99.9 NM in 0.1 NM steps, 100 to 400 NM in 1 NM steps.
Displays dashes if DME is in search, if VOR flags, if DME and VOR are tuned to different frequencies.

(b) KT Display
(1) VOR and VOR PAR Modes
Displays ground speed to the DME ground station.
0 to 999 knots in 1 knot steps.
Update rate is once per second.
Most significant digit is zero blanked.
Displays dashes whenever DME goes into search.
(2) RNV APR and RNV ENR Modes
Displays ground speed to the active waypoint.
0 to 999 knots in 1 knot steps.
Update rate is once per second.
Most significant digit is zero blanked.
Displays dashes whenever DME goes into search.

(c) ILS Display
Indicates that the frequency in use is an ILS frequency.

(d) MIN Display
(1) VOR and VOR PAR Modes
Displays time to DME ground station.
0 to 99 minutes in 1 minute steps.
Most significant digit is zero blanked.
Displays dashes whenever DME goes into search or when calculated value exceeds 99 minutes.
(2) RNV APR and RNV ENR Modes
Displays time to the active waypoint.
0 to 99 minutes in 1 minute steps.
Most significant digit is zero blanked.
Displays dashes if DME is in search, if VOR flags, if DME and VOR are tuned to different frequencies, or if calculated value exceeds 99 minutes.

(e) FRQ, RAD, DST Display

(1) FRQ Mode

Displays frequency from 108.00 to 117.95 MHz.
1 MHz digit overflows into (or underflows from) 10 MHz digit.
Rolls over from 118 to 108 or vice versa.
Least significant digit displays only zero or five.

(2) RAD Mode

Displays ground station radial on which the waypoint is located from 0.0 to 359.9 degrees.
The two most significant digits are zero blanked.
10 degree digit overflows into (or underflows from) 100 degree digit.

(3) DST Mode

Displays the distance offset of the waypoint from the ground station over range of 0.0 to 199.9 NM.
The two most significant digits are zero blanked.
10 NM digit overflows into (or underflows from) 100 NM digit.
The two most significant digits roll over from 190 to 0 NM and vice versa.

(f) USE Display

Displays waypoint number of data actually being used by system.
In VOR Modes only the frequency has meaning.
Range 1 to 4.
When changed always takes on new value equal to DSP value.

(g) DSP Display

Displays waypoint number of data being displayed.
Range 1 to 4.
When changed increments by 1.
Rolls over at 4 and blinks when not equal to USE value.

(h) PAR, VOR, ENR, APR, RNV Displays

System status lights.

(i) HLD Display

Indicates when the frequency to which the DME is actually tuned is different from the frequency to which the VOR is tuned.

(j) Course Deviation

Located on remote indicator. When flagged, the needle centers.

(1) VOR Mode

Full scale sensitivity equals +/- 10°.

(2) VOR PAR Mode
Full scale sensitivity equals +/- 5 NM.
Flagged if VOR or DME data is invalid, or if the VOR and DME are tuned to different channels.

(3) RNV ENR Mode
Full scale sensitivity equals +/- 5 NM.
Flagged if VOR or DME data is invalid, or if the VOR and DME are tuned to different channels.

(4) RNV APR Mode
Full scale sensitivity equals +/- 1.25 NM.
Flagged if the VOR or DME data is invalid, or if the VOR and and DME are tuned to different channels.

(5) ILS Mode
Full scale sensitivity equals 3 to 6 degrees (depending upon ground facility).
Flagged if localizer data is invalid.

CONTROLS

(a) VOR Button
Momentary pushbutton.
When pushed while system is in either RNV mode causes system to go to VOR mode.
When pushed while system is in either VOR mode causes system to toggle between VOR and VOR PAR modes.

(b) RNAV Button
Momentary pushbutton.
When pushed while system is in either VOR mode causes system to go to RNV ENR mode.
When pushed while system is in either RNV mode causes system to toggle between RNV ENR and RNV APR modes.

(c) HOLD Button
Two position pushbutton.
When in depressed position inhibits DME from channeling to new frequency.

(d) USE Button
Momentary pushbutton.
Causes active waypoint to take on same value as displayed waypoint and data display to go to FRQ mode.

(e) DSP Button
Momentary pushbutton.
Causes displayed waypoint to increment by 1 and data display to go to FRQ mode.

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

(g) OFF/ON/Ident Control
(1) Power OFF-ON/Volume Function
Rotate clockwise for power ON.
(2) VOR Audio Level Control
Rotate clockwise for increased audio level.
(3) VOR IDENT Mute Function
Push-Pull switch.
Enables the VOR Ident tone to be heard in OUT position.

(h) Data Input Control
Dual concentric knobs. Center knob has IN and OUT positions.
(1) Frequency Data
Outer knob varies 1 MHz digit.
A carry occurs from units to tens position.
Rollover occurs from 117 to 108.
Center knob varies frequency in 50 KHz steps.
(2) Radial Data
Outer knob varies 10 degrees digit.
A carry occurs from the tens to hundreds position.
Rollover to zero occurs at 200 NM.
Center knob IN position varies 1 NM digit.
Center knob OUT position varies 0.1 NM digit.
(3) Distance Data
Outer knob varies 10 NM digits.
A carry 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.

(i) Course Select Knob
Located in remote unit.
Selects desired course through the VOR ground station or waypoint.

For additional information consult the King KNS-80 Pilot's Guide.

PILOT'S OPERATING HANDBOOK
AND
FAA APPROVED AIRPLANE FLIGHT MANUAL

SUPPLEMENT NO. 6
FOR
KING 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 SA1563CE-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.

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VERO BEACH, FLORIDA

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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.

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 airplane 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. Airplane - 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. AVIONICS MASTER switch - ON

NOTE

When the KAP 100 is installed in this model of aircraft, it may be equipped with a Piper manual electric trim system, the King manual electric trim system or none. Whenever the King manual electric trim system is not installed, the following is normal: the trim warning light will illuminate momentarily on initial power application; the trim warning light will not flash during the preflight test sequence. The successful completion of the autopilot preflight test does not indicate the operational status of the Piper trim system.

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 left side of split switch unit 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 trim 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. AP ENG button - PRESS to engage autopilot.

6. CONTROL WHEEL - MOVE left and right to verify that the autopilot can be overpowered.
7. Autopilot - DISENGAGE by pressing the AP ENG Button or the optional A/P DISC/TRIM INTER switch. Verity that the autopilot disconnects and all modes are cancelled.
8. TRIM - SET to take off position.

B. AUTOPILOT OPERATION

1. Before takeoff
   a. Autopilot - DISENGAGE by pressing the AP ENG Button or the optional AP DISC/TRIM INTER switch

2. Inflight Autopilot Engagement
   a. 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 (with optional CWS Button only)
   a. Manual Heading Changes (with optional CWS Button only)
      (1) CWS button - PRESS and MANEUVER airplane to the desired heading.
      (2) CWS button - RELEASE. Autopilot will maintain airplane in wings level attitude.

NOTE

Airplane heading may change in the wings level mode due to an airplane 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)
      (1) 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.
(a) 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.
(b) 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 sequency 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.

(a) 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.
(b) 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.
         (a) 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.
         (b) 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.

(a) 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.

(b) 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.
         (a) 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, the BC and APR annunciators will illuminate steady and the selected course will be automatically captured and tracked.
         (b) If the D-Bar is less than 2 to 3 dots: the HDG mode will.disengage upon selecting BC mode; the APR BC annunciator 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.

(a) 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 APR annunciators will illuminate steady and the selected course will be automatically captured and tracked.
(b) If the D-Bar is less than 2 to 3 dots: the HDG mode will disengage upon selecting BC mode; the BC and APR annunciators will illuminate steady and the capture/track sequence will automatically begin.

7. Missed Approach
   a. Autopilot - DISENGAGE by pressing the AP ENG button or the optional AP DISC/TRIM INTER switch.
   b. MISSED APPROACH - EXECUTE.
   c. AP ENG Button - PRESS (if AP operation is desired). Note AP annunciator ON.

8. Before Landing
   a. Autopilot - DISENGAGE by pressing the AP ENG button or the optional AP DISC/TRIM INTER switch.

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

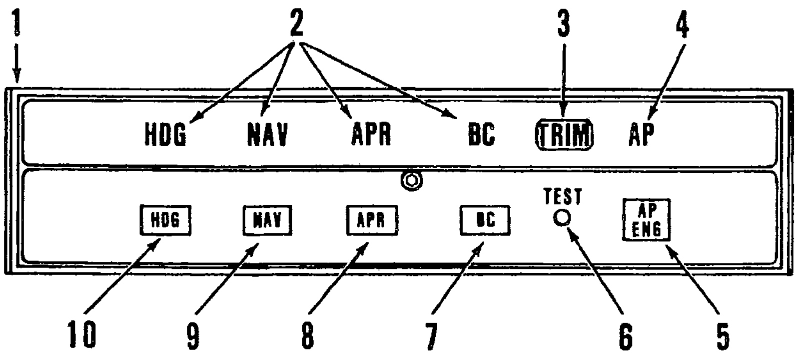
The KAP 100 Autopilot is certified in this airplane with roll axis control. The various instruments and the controls for the operation of the KAP 100 Autopilot are described in Figures 7-1 thru 7-11.

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 16° per second will cause the autopilot to disengage except when the CWS switch is held depressed.

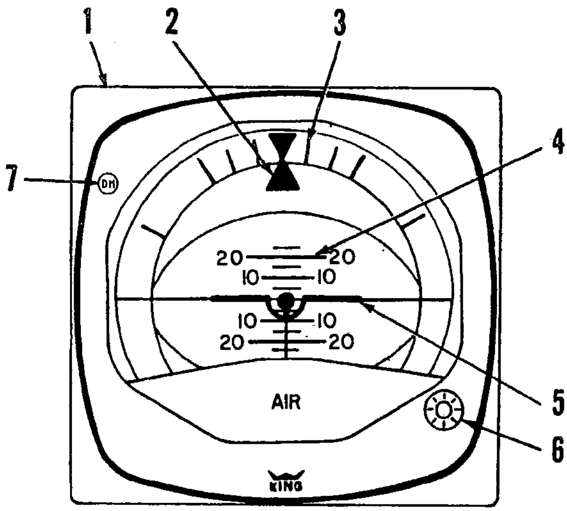


KC 190 AUTOPILOT COMPUTER
Figure 7-1

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 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.

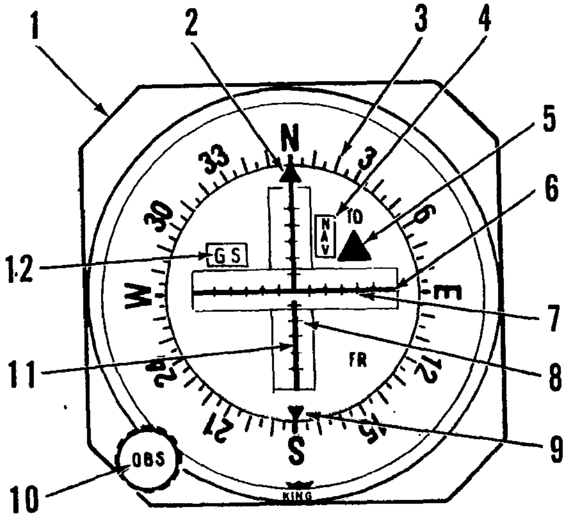
Figure 7-1 (cont)

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 autopilot preflight tests are 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 22°. 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. (Not applicable for some aircraft of foreign registry.)
7. DECISION HEIGHT (DH) ANNUNCIATOR LIGHT - Optional light for use with the aircraft's optional radar altimeter.

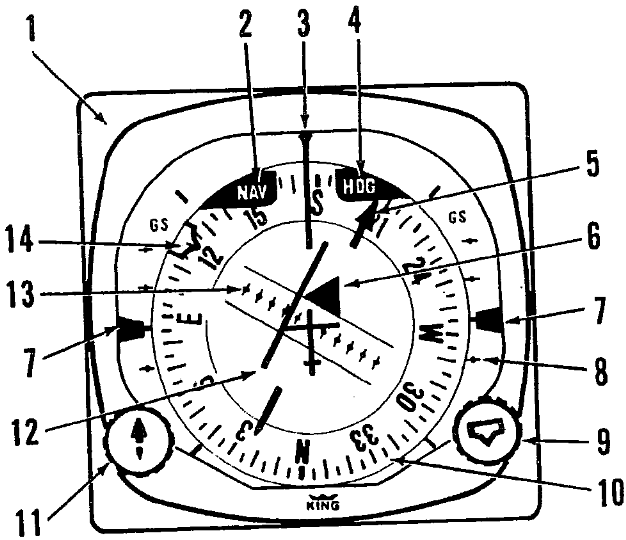


KI 204/206 VOR/LOC
GLIDESLOPE INDICATOR (TYPICAL)
Figure 7-5

1. VOR/LOC/GLIDESLOPE INDICATOR - Provides rectilinear display of VOR/LOC and Glideslope 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 ensure that the Autopilot is tracking valid navigation information.
5. TO/FROM INDICATOR FLAG - Indicates direction of VOR station relative to selected course.
6. GLIDESLOPE DEVIATION NEEDLE - Indicates deviation from ILS glideslope.
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. GLIDESLOPE SCALE - Indicates displacement from glideslope beam center. A glideslope deviation needle displacement of 5 dots, represents full scale (0.7°) deviation above or below glideslope 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. GLIDESLOPE (GS) FLAG - Flag is in view when the GS receiver signal is inadequate.



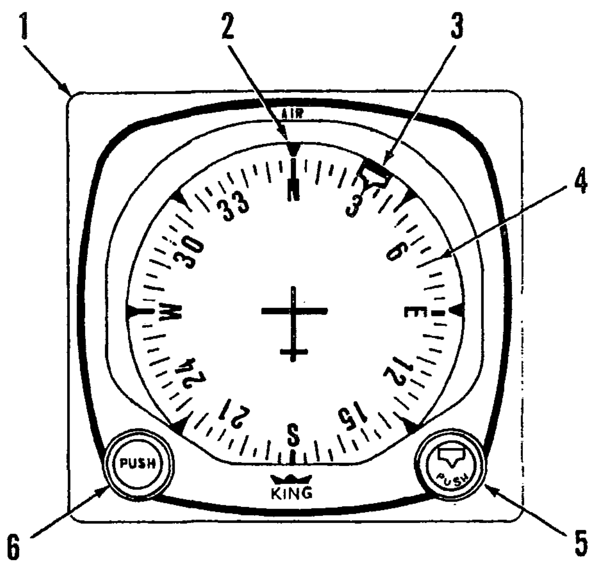
KI 525A HORIZONTAL SITUATION INDICATOR
Figure 7-7

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 glideslope 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 ensure that the Autopilot is tracking valid navigation information.
3. LUBBER LINE - Indicates airplane 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 manually maneuver the airplane 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 GLIDESLOPE POINTERS - Indicate on glideslope scale (8) aircraft displacement from glideslope beam center. Glideslope pointers in view indicate a usable glideslope signal is being received.
8. GLIDESLOPE SCALES - Indicate displacement from glideslope beam center. A glideslope deviation bar displacement of 2 dots, represents full scale (0.7°) deviation above or below glideslope 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 or DG.
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 airplane 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)

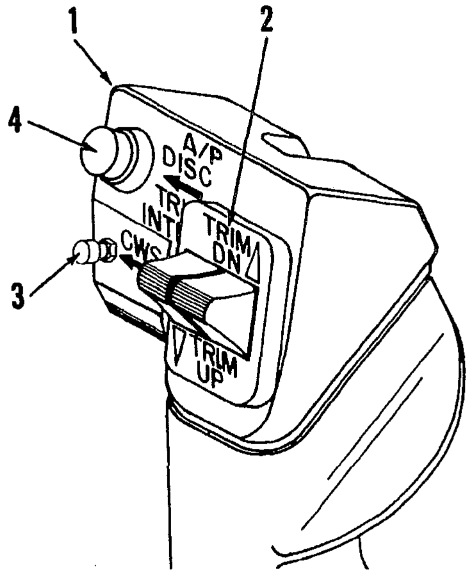
13. COURSE DEVIATION SCALE - A course deviation bar displacement of 5 dots represents full scale (VOR = +/-10°, LOC = +/-2 1/2°, RNAV = +/-5NM, RNAV APR = +/-1 1/4NM) deviation from beam centerline.
14. HEADING BUG - Moved by ( ) knob (9) to select desired heading.



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 airplane 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 HSI or 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 AVIONICS MASTER 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.

COMPASS 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. 7
FOR
KING 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 150 Series Flight Control System is installed in accordance with STC SA1563CE-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.

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DATE OF APPROVAL November 29, 1988

SECTION 1 - GENERAL

This supplement supplies information necessary for the operation of the airplane when the optional King KAP 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 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. Autopilot flap limitation: Maximum flap extension 10° (first notch).
E. Autopilot airspeed limitation: Maximum 170 KIAS.

NOTE

In accordance with FAA recommendation (AC00-24A), use of basic PITCH 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.

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	550′
Maneuvering	100′
APPR	100′

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. AVIONICS MASTER 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 autotrim did not pass preflight test. The autopilot circuit breakers should be pulled. The autopilot and manual electric trim will be inoperative.

4. MANUAL ELECTRIC TRIM - TEST as follows:
   a. Actuate left side of split switch unit 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 trim 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. AP ENG Button - Press to engage autopilot.
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
   a. AP DISC/TRIM INTER Switch - PRESS.

2. Inflight 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.

CAUTION

Do not help the autopilot as the autopilot will run the pitch trim to oppose your help.

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 airplane attitude at a rate of 0.7 deg/sec up to the pitch limits of +15° or -10°.
   (2) VERTICAL TRIM Control - RELEASE when desired airplane attitude is reached. The autopilot will maintain the desired pitch attitude.

4. 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.)
         (a) CWS Button - PRESS and fly airplane to desired pressure altitude.
         (b) 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.)
         (a) VERTICAL TRIM Control - PRESS either up or down. Vertical Trim will seek an altitude rate of change of 500 fpm.
         (b) VERTICAL TRIM Control - RELEASE when desired pressure altitude is reached. The autopilot will maintain the desired pressure altitude.

5. Heading Changes
   a. Manual Heading Changes
      1. CWS Button - PRESS and MANEUVER airplane to the desired heading.
      2. CWS Button - RELEASE. Autopilot will maintain airplane in wings level attitude.

NOTE

Airplane 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 airplane to the selected heading.

c. Command Turns (Heading Hold mode ON)
   (1) HEADING Selector Knob - MOVE BUG to the desired heading. Autopilot will automatically turn the aircraft to the new selected heading.

6. 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.
         (a) 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.
         (b) 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.

(a) 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.
(b) 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.

7. 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.
   (a) If the Course Deviation Bar is greater than 2 to 3 dots: the airplane 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 auto matically captured and tracked.

(b) 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.

(a) 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.

(b) 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.

8. 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.
   (a) 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 BC and APR annunciators will illuminate steady and the selected course will be automatically captured and tracked.
   (b) If the D-Bar is less than 2 to 3 dots: the HDG mode will disengage upon selecting BC mode; the BC and APR 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.

   (a) If the D-Bar is greater than 2 to 3 dots: the autopilor will annunciate HDG (unless HDG not selected) and BC modes with APR flashing; when the computed capture point is reached the HDG annunciators will go out, the BC and APR annunciators will illuminate steady and the selected course will be automatically captured and tracked.

(b) If the D-Bar is less than 2 to 3 dots: the HDG mode will disengage upon selecting BC mode; the BC and APR annunciators will illuminate steady and the capture/track sequence will automatically begin.

9. Glideslope Coupling

NOTE

Glideslope coupling is inhibited when operating in NAV or APR BC modes. Glideslope coupling occurs automatically in the APR mode.

a. APR Mode - ENGAGED.
b. At glideslope centering - NOTE GS annunciator ON.

NOTE

Autopilot can capture glideslope from above or below the beam while operating in either pitch attitude hold or ALT hold modes.

10. Missed Approach
  a. AP DISC/TRIM INTER Switch - PRESS to disengage AP.
  b. MISSED APPROACH - EXECUTE.
  c. CWS Button - PRESS (KFC 150 Systems 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.

11. 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

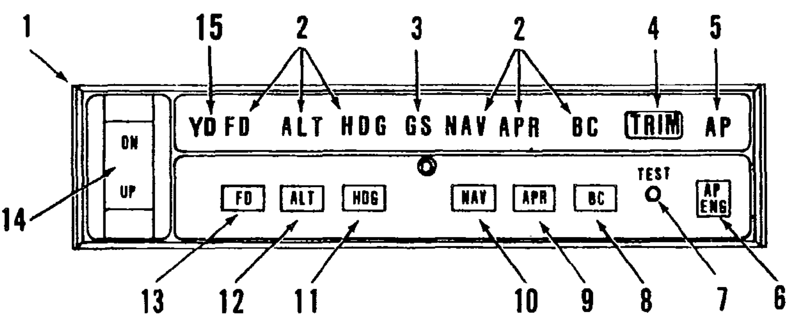
The 150 Series AFCS is certified in this airplane with 2 axis control, pitch and roll. The various instruments and the controls for the operation of the 150 System are described in Figures 7-1 thru 7-15.

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 16° per second will cause the autopilot to disengage except when the CWS switch is held depressed.
E. Pitch rates in excess of 6° 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

1. KFC 150 SYSTEM KC 192 AUTOPILOT COMPUTER - Complete Flight Director and Autopilot computer includes 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).

Figure 7-1 (cont)

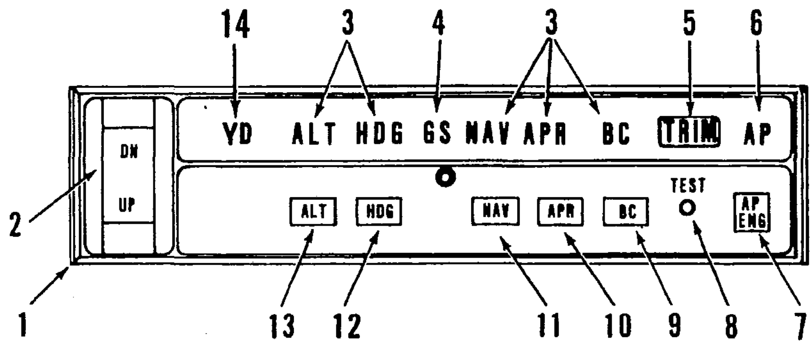
3. GLIDESLOPE (GS) ANNUNCIATOR - Illuminates continuously whenever the autopilot is coupled to the glideslope signal. The GS annunciator will flash if the glideslope signal is lost (GS flag in CDI or absence of glideslope pointers in KI 525A). The autopilot reverts to pitch attitude hold operation. If a valid glideslope 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 glideslope returns and the aircraft passes thru the glideslope. 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. The TRIM warning light flashes and is accompanied by an audible warning whenever a manual trim fault is detected. The Manual Trim System is monitored for the trim servo running without a command. 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 pitch trim circuit breaker 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 autopilot preflight tests are 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. Glideslope 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 Glideslope 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. On the KA 185 Remote Mode Annunciator, APR ARM will annunciate until the automatic capture sequence is initiated. At beam capture, APR CPLD will annunciate.
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. On the KA 185 Remote Mode Annunciator, NAV ARM will annunciate until the automatic capture sequence is initiated. At beam capture, APR CPLD will annunciate.
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 22°. 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 glideslope is captured.
13. FLIGHT DIRECTOR (FD) MODE SELECTOR BUTTON - When pushed, will select the Flight Director mode (with KC 192 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.

Figure 7-1 (cont)

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 and will cancel GS couple. The aircraft must pass through the glideslope again to allow GS recouple.
15. NOT USED.



KC 191 AUTOPILOT COMPUTER
Figure 7-3

1. KAP 150 SYSTEM KC 191 AUTOPILOT COMPUTER - Complete Autopilot computer, including 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 and will cancel GS couple. The aircraft must pass through the glideslope again to allow GS recouple.
3. MODE ANNUNCIATORS - Illuminate when a mode is selected by the corresponding mode selector button (PUSH ON - PUSH OFF).
4. GLIDESLOPE (GS) ANNUNCIATOR - Illuminates continuously whenever the autopilot is coupled to the glideslope signal. The GS annunciator will flash if the glideslope signal is lost (GS flag in CDI

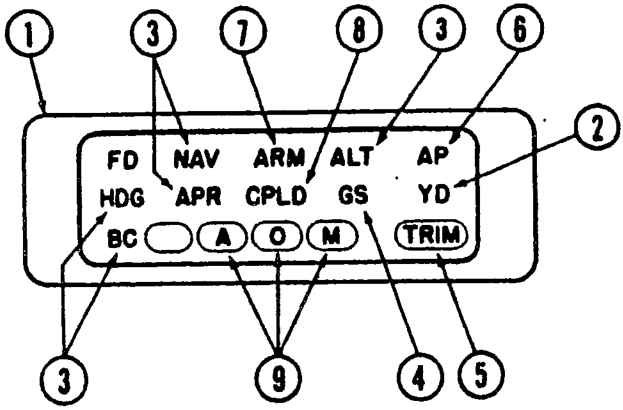
Figure 7-3 (cont)

or absence of glideslope pointers in KI 525A). The autopilot reverts to pitch attitude hold operation. If a valid glideslope 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 glideslope returns and the aircraft passes thru the glideslope. At that point GS couple will re-occur.

5. TRIM WARNING LIGHT (TRIM) - Illuminates continuously whenever trim power is not on or the system has not been preflight tested. The TRIM warning light flashes and is accompanied by an audible warning whenever a manual trim fault is detected. The Manual Trim System is monitored for the trim servo running without a command. The TRIM warning light will illuminate and be accompanied by an 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 pitch trim circuit breaker 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 autopilot preflight tests are 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.

Figure 7-3 (cont)

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 Glideslope 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 on the Autopilot computer will flash until the automatic capture sequence is initiated. On the KA 185 Remote Mode Annunciator, APR ARM will annunciate until the automatic capture sequence is initiated. At beam capture, APR CPLD will annunciate.
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. On the KA 185 Remote Mode Annunciator, NAV ARM will annunciate until the automatic capture sequence is initiated. At beam capture, NAV CPLD will annunciate.
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 22°. 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 glideslope is captured.
14. NOT USED.



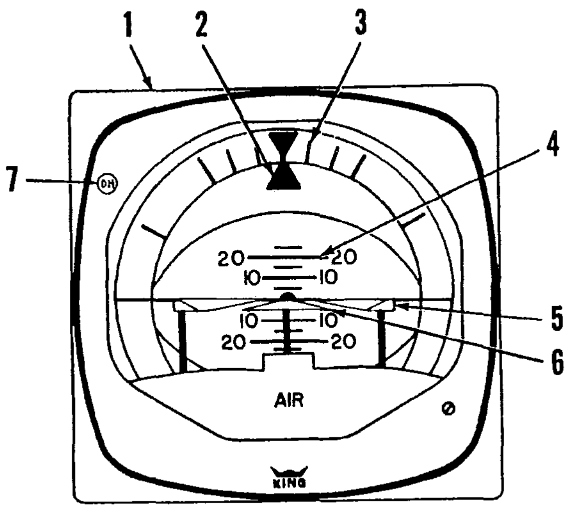
KA 185 REMOTE MODE ANNUNCIATOR (OPTIONAL)
Figure 7-5

1. KA 185 REMOTE MODE ANNUNCIATOR (OPTIONAL) - Provides mode annunciation in the pilots' primary scan area as well as three Marker Beacon lights.
2. NOT USED
3. MODE ANNUNCIATORS - Illuminate when a mode is selected by the corresponding mode selector button (PUSH ON - PUSH OFF).
4. GLIDESLOPE (GS) ANNUNCIATOR - Illuminates continuously whenever the autopilot is coupled to the glideslope signal. The GS annunciator will flash if the glideslope signal is lost (GS flag in CDI or absence of glideslope pointers in KI 525A). The autopilot reverts to pitch attitude hold operation. If a valid glideslope 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 glideslope returns and the aircraft passes thru the glideslope. At that point GS couple will re-occur.
5. TRIM WARNING LIGHT (TRIM) - Illuminates continuously whenever trim power is not on or the system has not been preflight tested. The TRIM warning light illuminates and is accompanied by an audible warning whenever a manual trim fault is detected. The Manual Trim System is monitored for the Trim Servo running without a command. The TRIM warning light will illuminate and be accompanied by a steady audible tone whenever an autotrim failure occurs. The autotrim system is monitored for the following failures: trim servo

Figure 7-5 (cont)

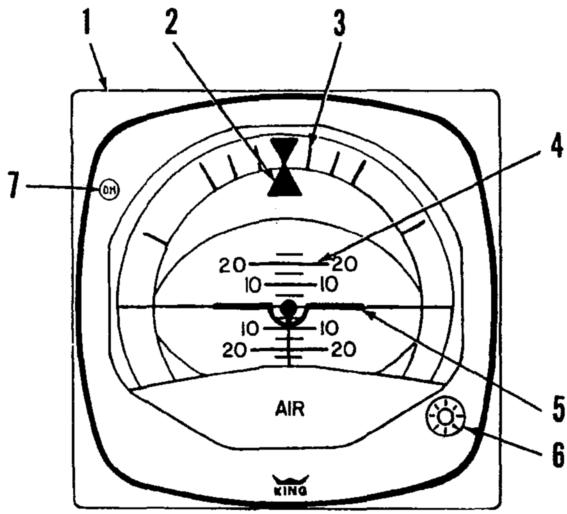
running without a command; trim servo not running when commanded to run; trim servo running in the wrong direction. The Pitch Trim Circuit Breaker may be cycled off to silence the continuous tone, but the trim fail light will remain on. Manual Electric Trim may be used but the autopilot should not be engaged.

6. AUTOPILOT (AP) ANNUNCIATOR - 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. ARMED (ARM) ANNUNCIATOR - Illuminates continuously along with NAV or APR when either the NAV or APR mode selector button is depressed. The ARM annunciator will continue to illuminate until the automatic capture sequence is initiated at which time ARM will extinguish and CPLD will annunciate.
8. COUPLED (CPLD) ANNUNCIATOR - Illuminates continuously along with NAV or APR at the initiation of automatic beam capture sequence in either the NAV or APR modes. Normally the CPLD condition follows an ARM condition but may be entered into directly if the beam capture criteria is met when NAV or APR is selected.
9. REMOTE MARKER BEACON LIGHTS - Remote Airway, Outer and Middle Marker Beacon Lights driven by the Marker Beacon receiver.



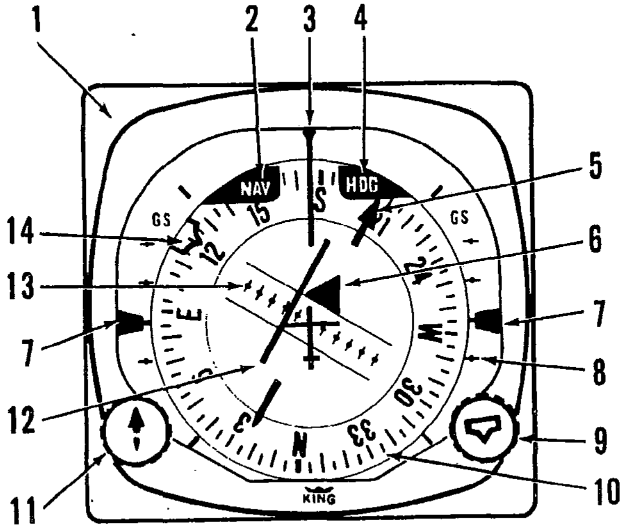
KI 256 FLIGHT COMMAND INDICATOR
Figure 7-7

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 airplane's optional radar altimeter.



KG 258 VERTICAL GYRO
Figure 7-9

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 airplane. Airplane pitch and roll attitudes are displayed by the relationship between the fixed symbolic airplane and the movable background.
6. SYMBOLIC AIRCRAFT ALIGNMENT KNOB - Provides manual positioning of the symbolic airplane for level flight under various load conditions. (Not applicable for some aircraft of foreign registry.)
7. DECISION HEIGHT (DH) ANNUNCIATOR LIGHT - Optional light for use with the airplane optional radar altimeter.

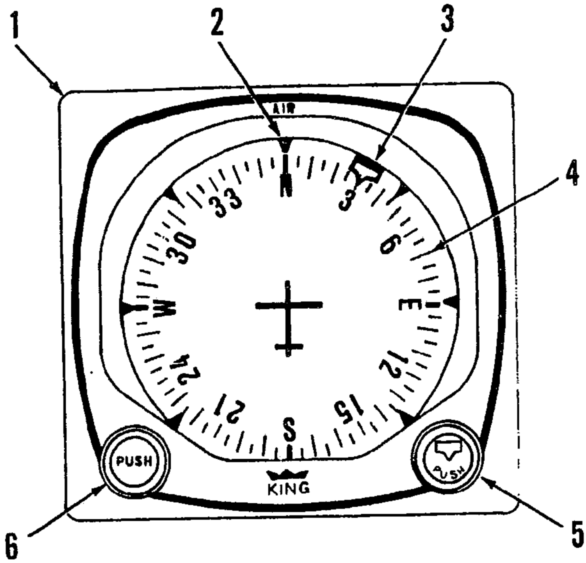


KI 525A HORIZONTAL SITUATION INDICATOR
Figure 7-11

1. KI 525A HORIZONTAL SITUATION INDICATOR (HSI) - Provides a pictorial presentation of airplane deviation relative to VOR radials or localizer beams. It also displays glideslope 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 ensure 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 manually maneuver the aircraft laterally.

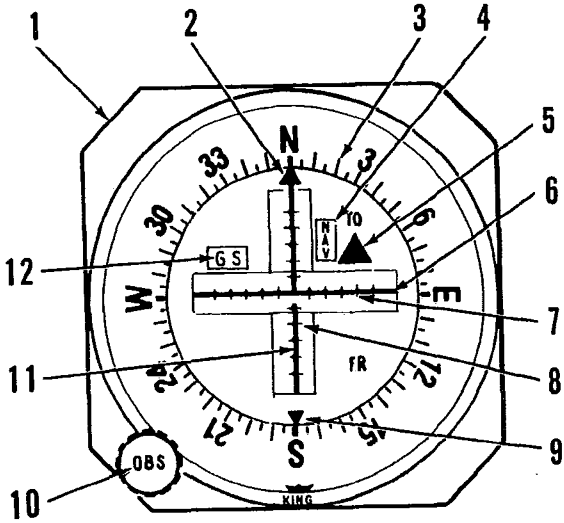
Figure 7-11 (cont)

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 GLIDESLOPE POINTERS - Indicate on glideslope scale (8) aircraft displacement from glideslope beam center. Glideslope pointers in view indicate a usable glideslope signal is being received.
8. GLIDESLOPE SCALES - Indicate displacement from glideslope beam center. A glideslope deviation bar displacement of 2 dots, represents full scale (0.7°) deviation above or below glideslope 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 or DG.
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 7-13

1. KG 107 NON-SLAVED DIRECTIONAL GYRO (DG) - Provides a stable visual indication of airplane 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 HSI or 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.

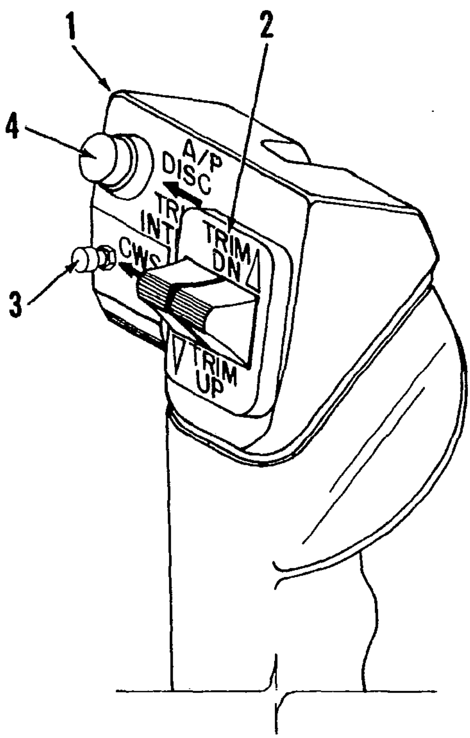


KI 204/206 VOR/LOC/
GLIDE SLOPE INDICATOR (TYPICAL)
Figure 7-15

1. VOR/LOC/GLIDESLOPE INDICATOR - Provides rectilinear display of VOR/LOC and glideslope 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 ensure 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. GLIDESLOPE DEVIATION NEEDLE - Indicates deviation from ILS glideslope.
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 7-15 (cont)

8. GLIDESLOPE SCALE - Indicates displacement from glideslope beam center. A glideslope deviation needle displacement of 5 dots, represents full scale (0.7°) deviation above or below glideslope 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. GLIDESLOPE (GS) FLAG - Flag is in view when the GS receiver signal is inadequate.



AUTOPILOT CONTROL WHEEL SWITCH CAP
Figure 7-17

Figure 7-17 (cont)

1. AUTOPILOT CONTROL WHEEL SWITCH ASSEMBLY - Switch assembly mounted on the pilot's control wheel 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 pitch and roll 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 glideslope again to allow GS recouple. The CWS button will not disengage the Yaw Damper Servo.
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.

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 AVIONICS MASTER 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 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.

COMPASS SYSTEM - Supplies power to the optional KCS 55A Compass System.

PILOT'S OPERATING HANDBOOK
AND
FAA APPROVED AIRPLANE FLIGHT MANUAL

SUPPLEMENT NO. 8
FOR
KING KAS 297B VERTICAL SPEED AND ALTITUDE SELECTOR

This supplement must be attached to the Pilot's Operating Handbook and FAA Approved Airplane Flight Manual when the King KAS 297B Vertical Speed And Altitude Selector is installed per STC SA1563CE-D. 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 basic Pilot's Operating Handbook and FAA Approved Airplane Flight Manual.

FAA APPROVED D H Trompler
D. H. TROMPLER
D.O.A. NO. SO.-1
PIPER AIRCRAFT CORPORATION
VERO BEACH, FLORIDA

DATE OF APPROVAL November 29, 1988

SECTION 1 - GENERAL

This supplement supplies information necessary for the operation of the airplane when the optional King KAS 297B Vertical Speed And Altitude Selector is added to the King KFC 150 or a KAP 150 Flight Control System. The Vertical Speed And Altitude Selector 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 KAS 297B Vertical Speed And Altitude Selector is installed.

SECTION 2 - LIMITATIONS

Altitude select captures below 800 feet agl are prohibited.

SECTION 3 - EMERGENCY PROCEDURES

No change.

SECTION 4 - NORMAL PROCEDURES

A. PREFLIGHT

1. PREFLIGHT TEST BUTTON (KC192 OR KC 191) - PRESS momentarily and NOTE:
   a. All legends and digits are displayed on the KAS 297B.

B. VERTICAL SPEED AND ALTITUDE SELECTOR OPERATION

1. Vertical Speed Select
   a. VERTICAL SPEED SELECT knob - PULL small knob to the OUT position.
   b. VERTICAL SPEED SELECT knob - ROTATE until desired vertical speed is displayed.
   c. VERTICAL SPEED MODE (ENG) button - PUSH to engage the Vertical Speed Hold mode.

2. Changing Vertical Speed
   a. Using CWS
      (1) CWS button - PRESS and HOLD.
      (2) Airplane - Establish desired vertical speed.
      (3) CWS button - RELEASE.

   b. Using Vertical Trim Control
      (1) VERTICAL TRIM CONTROL - PRESS either up or down to increase or decrease the vertical speed. Displayed vertical speed changes 100 fpm for every second control is held down.

CAUTION

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.

CAUTION

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.

SECTION 5 - PERFORMANCE

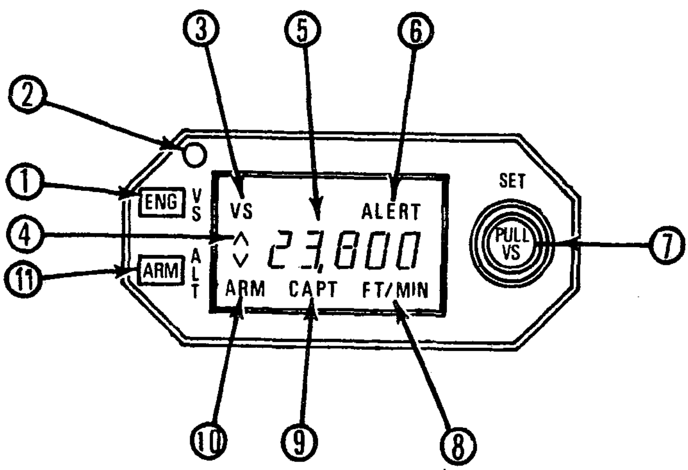
No change.

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 KAS 297B provides the pilot with the following features: ability to select vertical speed hold; ability to select, arm and, upon approaching the selected altitude, automatically transfer into Altitude Hold; altitude alerting as specified by F.A.R. 91.51. The KAS 297B controls and display are further described in Figure 7-1.



KAS 297B VERTICAL SPEED AND ALTITUDE SELECTOR
Figure 7-1

Figure 7-1 (continued)

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 ($\wedge \vee$) - 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.
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 signified that the 300 feet "safe band" has been exceed 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.

Figure 7-1 (continued)

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.
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.
12. CONTROL WHEEL STEERING (CWS) BUTTON (Not Shown) - 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 (Not Shown) - 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 down. If altitude is being displayed at the time the rocker switch is depressed, vertical speed will be displayed until 1 to 2 seconds after the rocker switch is released.

The following circuit breakers are used to protect the following elements of the King KAS 297B.

LABEL	FUNCTION
AUTOPILOT	Supplies power to the KC 192 or the KC 191 computer, the autopilot pitch and roll servos, the ELV TRIM circuit breaker, and the KAS 297B.
ENC ALTM	Supplies power to the King KEA 130A/KEA 346 Altimeter.

NOTE

At the installer's discretion, power for the KAS 297B may be provided thru separate one amp pullable circuit breaker labeled ALT SEL.

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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 Arrow.

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) The best speed for takeoff is about 70 KIAS under normal conditions. 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 103 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) Strobe lights should not be operating when flying through overcast and clouds, since reflected light can produce spatial disorientation. Do not operate strobe lights when in close proximity to ground, such as during taxiing, takeoff, or landing.

10.3 OPERATING TIPS (continued)

(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.