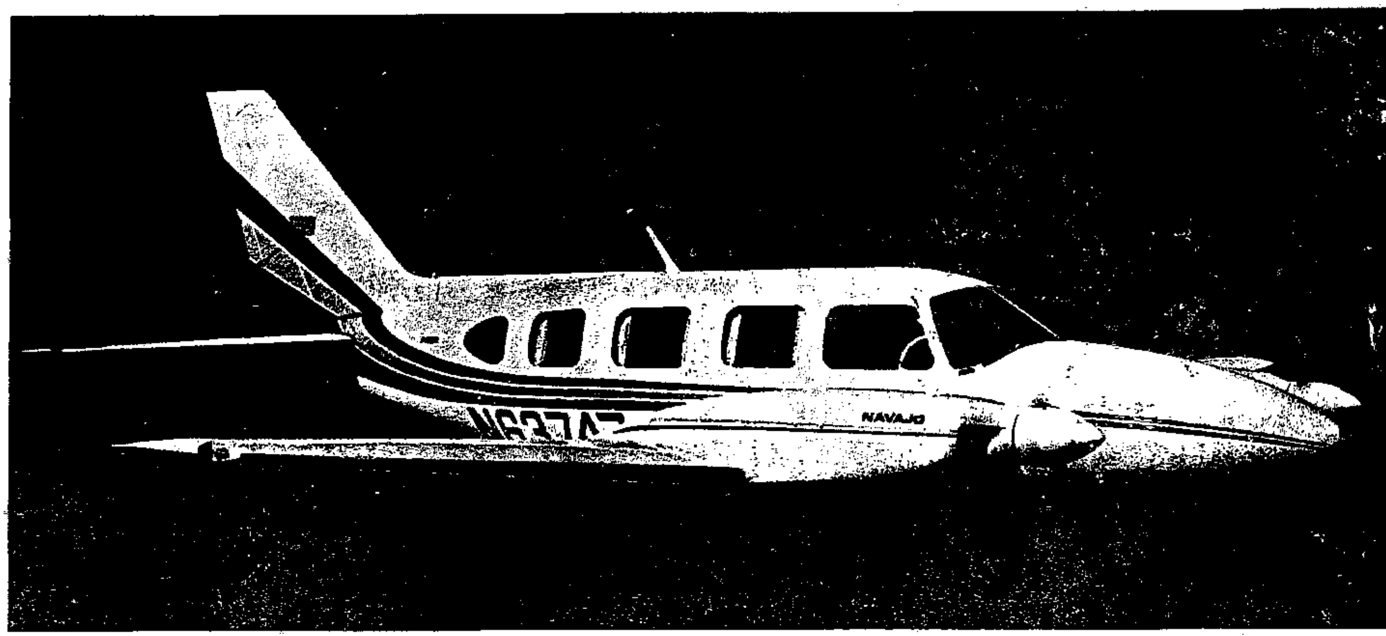
PILOT'S OPERATING HANDBOOK

DUPLICATE

AND

FAA APPROVED AIRPLANE FLIGHT MANUAL

PIPER NAVAJO



FAA APPROVED IN NORMAL CATEGORY BASED ON CAR 3 AND FAR PART 21, SUBPART J. THIS DOCUMENT INCLUDES THE MATERIAL REQUIRED TO BE FURNISHED TO THE PILOT BY CAR 3 AND FAR PART 21, SUBPART J AND CONSTITUTES THE APPROVED AIRPLANE FLIGHT MANUAL AND MUST BE CARRIED IN THE AIRPLANE AT ALL TIMES.

PA-31
REPORT: 2045

FAA APPROVED BY: D H Trompler
D. H. TROMPLER
D.O.A. NO. SO-2
PIPER AIRCRAFT CORPORATION
LAKELAND, FLORIDA

AIRPLANE SERIAL NO. 31-7712021

AIRPLANE REGISTRATION NO. [redacted]

HANDBOOK ISSUED DATE OCTOBER 29, 1976
AIRPLANE APPROVAL DATE FEBRUARY 15, 1966
D.O.A. SO-2 APPROVAL DATE MARCH 6, 1978

HANDBOOK PART NO. 761 626

PIPER

WARNING

EXTREME CARE MUST BE EXERCISED TO LIMIT THE USE OF THIS HANDBOOK TO APPLICABLE AIRCRAFT. THIS HANDBOOK 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
Piper Aircraft Corporation
Issued: October 29, 1976

APPLICABILITY

The aircraft serial number eligibility bracket for application of this handbook is 31-7712001 through 31-7912124. The specific application of this handbook is limited to the Piper PA-31 model airplane designated by serial number and registration number on the face of the title page of this handbook.

REVISIONS

The information compiled in the Pilot's Operating Handbook will be kept current by revisions distributed to the airplane owners.

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

I. Revisions

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

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

II. Identification of Revised Material

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

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

ORIGINAL PAGES ISSUED

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

Title, ii through v, 1-1 through 1-14, 2-1 through 2-14, 3-1 through 3-20, 4-1 through 4-20, 5-1 through 5-38, 6-1 through 6-72, 7-1 through 7-58, 8-1 through 8-20, 9-1 through 9-30, 10-1 through 10-2.

PILOT'S OPERATING HANDBOOK LOG OF REVISIONS

Current Revisions to the PA-31 Navajo Pilot's Operating Handbook, REPORT: 2045 issued October 29, 1976.

Revision Number and Code	Revised Pages	Description of Revision	FAA Approval Signature and Date
Rev. 1 - 761 626 (PR770328)	1-6	Added V_{SSE} to para. 1.19 (a); relocated material to page 1-7.	
	1-7	Added relocated material from page 1-6; relocated material to page 1-8.	
	1-8	Added relocated material from page 1-7.	
	2-1	Revised V_{FE} indicated speeds in para. 2.3.	
	2-2	Revised altitude in para. 2.7 (d) (3).	
	2-4	Revised EGT lower arc limit in para. 2.9 (f).	
	2-13	Added windshield wiper placard to para. 2.29.	
	2-14	Added Cargo Loading placard to para. 2.29.	
	3-i	Revised para. 3.39.	
	3-3	Revised speeds in para. 3.3, added V_{SSE}	
	3-5	Revised Engine Fire on Ground procedure in para. 3.3.	
	3-7	Revised Asymmetric Flap info in para. 3.3.	
	3-12	Revised airspeed in para. 3.7.	
	3-13	Revised info in para. 3.7.	
	3-20	Revised para. 3.39 info.	
	4-1	Revised V_{FE} speeds in para. 4.3 (d).	
	4-2	Added item (j) V_{SSE} and revised existing item (j) to (k) in para. 4.3.	
	4-7	Revised Takeoff and Climb and Cruise procedures in para. 4.5.	
	4-8	Revised V_{FE} speeds in Before Landing procedure in para 4.5.	
	4-13	Revised RPM in para. 4.19.	
	4-14	Added emergency fuel pump info to para. 4.23; relocated material to page 4 15.	
	4-15	Added relocated info from page 4-14; revised info in para. 4.25.	
	4-16	Revised V_{FE} speeds in para. 4.29.	
	5-11	Extended Flaps 0° calibration to V_{NE}; added Flaps 15° calibration in Fig. 5-1.	
	5-12	Extended Flaps 0° calibration to V_{NE}; revised example in Fig. 5-3.	
	5-27	Added BHP percentage, removed 26,000 ft. M.P. limit in Fig. 5-31.	
	5-32	Revised Best Economy fuel flow in Fig. 5-39.	
	5-36	Revised approach speed in Fig. 5-47.	
	5-37	Revised approach speed in Fig. 5-49.	
	6-22	Added cargo barrier and restraining equipment info to para. 6.15.	
	6-33	Added item 68.	
	6-35	Added Dwg. 54507-2, -3 to item 99.	

PILOT'S OPERATING HANDBOOK LOG OF REVISIONS (cont)

Revision Number and Code	Revised Pages	Description of Revision	FAA Approval Signature and Date
Rev. 1 - 761 626 (PR770328) (cont)	6-37	Added Dwg. 99002-3 to item 131.	
	6-49	Added Dwg. 99002-3 to item 247.	
	6-63	Added item 478.	
	6-70	Revised item 615.	
	7-3	Revised alternate voltage in para. 7.5.	
	7-4	Revised info in para 7.5.	
	7-14	Revised cowl flap switches in Fig. 7-13.	
	7-15	Revised wing flap info. in para. 7.17.	
	7-16	Revised wing flap info. in para. 7.17.	
	7-17	Revised info in para. 7.19.	
	7-19	Revised info in para.7.19.	
	7-27	Revised info in para 7.23.	
	7-58	Added ramp hailer info to para. 7.77.	
	8-7	Revised info in para. 8.9 (d).	
	8-18	Added info to para. 8.41 (c).	
	8-19	Added wax info to para. 8.41 (d); added relocated Note from page 8-20.	
	8-20	Relocated Note to page 8-19; added info to para. 8.41 (h).	
	9-9	Added item (g) to Section 2.	
	9-12	Added info to item (d).	
	9-15	Added item (g) to Section 2; relocated material to page 9-16.	
	9-16	Added relocated material from page 9-15; relocated material to page 9-17.	
	9-17	Added relocated material from page 9-16; added info to item (d); relocated material to page 9-18.	Paul E. Everly
	9-18, 9-19, 9-20	Relocated material to accommodate revision on page 9-17.	March 28, 1977
	10-2	Revised V_{FE} in item (p).	PE Eve…
	10-3	Added item (t).	
Rev. 2 - 761 626 (PR770824)	1-11, 1-12, 1-13, 1-14	Revised 1.21, Conversion Factors.	
	2-1	Revised V_{FE}, V_{LE}, and V_{LO}; added ser. no. ident.; relocated V_{MC} to page 2-2.	
	2-2	Added V_{MC} relocated from page 2-1.	
	2-9	Revised item (g).	
	2-11	Revised heading of airspeed placard; added airspeed placard and ser. no. ident.	
	2-12	Revised placard (d).	
	2-13	Revised anti-collision WARNING placard.	
	3-7	Added airspeeds and ser. no. ident. to Emergency Gear Extension.	
	3-19	Added airspeeds and ser. no. ident. to 3.33, Emergency Gear Extension.	

Revision Number and Code	Revised Pages	Description of Revision	FAA Approval Signature and Date
Rev. 2 - 761 626 (PR770824) (cont)	4-1	Added airspeeds and ser. no. ident. in items (d) and (e); relocated items (f) and (g) to page 4-2.	
	4-2	Added items (f) and (g) relocated from page 4-1; added airspeeds and ser. no. ident. to item (f).	
	4-6	Added annunciator test to Before Starting Engines.	
	4-7	Added annunciator check to Engine Run-up.	
	4-8	Added gear and flap extension airspeeds and ser. no. ident. to Before Landing.	
	4-12	Added annunciator test to 4.11, Before Starting Engines.	
	4-16	Added gear and flap extension airspeeds and ser. no. ident. to 4.29, Before Landing.	
	5-9	Added Fig. 5-16, 5-48 and 5-50 to List of Figures.	
	5-11	Added 25° flap setting; added WARNING.	
	5-18a	Added page (Figure 5-16).	
	5-18b	Added page (int. blank).	
	5-36a	Added page (Figure 5-48).	
	5-36b	Added page (int. blank).	
	5-38	Added Figure 5-50.	
	6-22	Revised placard info. in 6.15 Cargo Loading.	
	6-33	Added items 71 and 73.	
	6-36	Added item 120.	
	6-45	Added item 187.	
	6-47	Revised name of item 217; added item 223.	
	6-51	Added items 293 and 295.	
	6-53	Revised items 325 and 327; relocated item 331 to page 6-54.	
	6-54	Added item 331 relocated from page 6-53; revised item 331.	
	6-56	Added items 370 and 372.	
	6-57	Revised items 377 and 385; added item 386.	
	6-60	Added item 430.	
	6-62	Added item 458.	
	6-64	Added items 484 and 486.	
	6-66	Added item 539.	
	6-70	Revised name of item 615.	
	6-71	Added model effectivity to item 623.	
	6-72	Relocated items 625 and 627 to page 6-74; added item 624.	
	6-73	Added page (items 624 cont.).	
	6-74	Added page (items 625 and 627 relocated from page 6-72); added model effectivity and item (h) to item 625.	

Revision Number and Code	Revised Pages	Description of Revision	FAA Approval Signature and Date
Rev. 2 - 761 626 (PR770824) (cont)	6-75	Added page (added item 628).	
	6-76	Added page (added item 628 cont.).	
	7-i	Added 7.24, Annunciator Panel and 7.56, Stall Warning: relocated 7.71 and 7.73 to page 7-ii.	
	7-ii	Added items relocated from page 7-i; added 7.79, Emergency Electrical Power Pack.	
	7-15	Revised flap extension info. and added ser. no. ident. in 7.17, Flight Control System.	
	7- 19	Revised warning light description in 7.19, Fuel System.	
	7-21	Revised circuit breaker description and added annunciator description in 7.21, Electrical System.	
	7-23	Added right C/B panel and ser. no. ident.	
	7-24	Added ser. no. ident. to 18.	
	7-26	Revised door ajar light description.	
	7-27	Revised descriptions in 7.23, Instrument Panel.	
	7-28	Added ser. no. ident. to Figure 7-25.	
	7-28a	Added page (added instrument panel Figure 7-26).	
	7-28b	Added page (int. blank).	
	7-29	Revised compass description and instrument panel description in 7.23, Instrument Panel; added 7.24, Annunciator Panel; relocated material to page 7-30.	
	7-30	Added material relocated from page 7-29; revised alternate static source description in 7.27, Pitot/Static System.	
	7-48	Revised cargo placard info. in 7.49, Cargo Door.	
	7-50	Added 7.56, Stall Warning.	
	7-56	Revised description in 7.69, Cabinetry.	
	7-58	Revised description in 7.71, Folding Tables; added 7.79, Emergency Electrical Power Pack.	
	7-59	Added page (7.79 cont.).	
	7-60	Added page (int. blank).	
	8-5	Revised first CAUTION in 8.9, (a).	
	9-1	Added Supplement No. 7 (AltiMatic X Autopilot Installation) to Contents.	
	9-31 thru 9-42	Added pages (AltiMatic X Autopilot Installation Supplement).	
	10-2	Deleted (o) and renumbered accordingly: revised item (o); added (r) relocated from page 10-3.	
	10-3	Relocated (s) to page 10-2 as (r): deleted page.	Paul E. Everly August 24, 1977 PE Everly

Revision Number and Code	Revised Pages	Description of Revision	FAA Approval Signature and Date
Rev. 3 - 761 626 (PR780306)	Title	Changed FAA Approval from D.O.A. No. EA-1 to D.O.A. No. SO-2; added D.O.A. SO-2 Approval Date. (NOTE: AIRCRAFT DELIVERED WITH HANDBOOKS PRIOR TO THIS REVISION DO NOT REQUIRE THIS REVISION.)	D.H. Trompler D H Trompler March 6, 1978
Rev. 4 - 761 626 (PR780525)	1-4	Revised footnote.	
	2-1	Revised ser. no. effectivity.	
	2-11	Revised ser. no. effectivity.	
	2-12	Added ser. no. effectivity to existing baggage placard; added baggage placard.	
	3-3	Deleted Safe Single Engine Speed; revised Eng. Failure During T.O. (90 KIAS or above).	
	3-7	Revised ser. no. effectivity; added NOTE to Gear Up Landing	
	3-12	Revised Eng. Failure During T.O. (90 KIAS and above).	
	3-19	Revised ser. no. effectivity; added NOTE to 3.37.	
	4-1, 4-2	Revised ser. no. effectivity in Para. 4.3.	
	4-8	Revised ser. no. effectivity.	
	4-16	Revised ser. no. effectivity.	
	6-1	Revised Para. 6.1, General.	
	6-27	Added item 4.	
	6-29	Revised items 17 and 27.	
	6-36	Added item 106; relocated item 123 to page 6-37.	
	6-37	Added relocated item 123 from page 6-36.	
	6-43	Added items 170, 172, 174, and 175.	
	6-47	Revised Dwg. no. in item 219; added items 222 and 225.	
	6-50	Deleted item 257; added items 267 and 269.	
	6-54	Added item 337.	
	6-57	Changed item no. 385 to 384; changed item no. 386 to 385.	
	6-58	Added new item 386.	
	6-60	Added items 420, 422 424 and 428; relocated items 431 and 433 to page 6-60.	
	6-61	Added items 431 and 433 relocated from page 6-60: added item 442: relocated item 449 to page 6-62.	
	6-62	Added item 449 relocated from page 6-61.	
	6-64	Added item 494.	
	6-67	Added headings; added item 540.	
	6-72	Revised Dwg no. of item 624, h.	
	6-76	Added items 629 and 631.	
	7-i	Revised page no. of para 7.61.	

Revision Number and Code	Revised Pages	Description of Revision	FAA Approval Signature and Date
Rev. 4 - 761 626 (PR780525) (cont.)	7-13	Added CAUTION.	
	7 15	Revised ser. no. effectivity.	
	7-19	Revised ser. no. effectivity.	
	7 21	Revised ser no. effectivity.	
	7-24	Revised ser. no. effectivity in item 18.	
	7-28	Revised ser. no. effectivity.	
	7-28a	Deleted item 30 (Autopilot Coupler), and renumbered remaining items accordingly; added Emergency Batt. Pack to item 31.	
	7-29	Added info. to para. 7.24; revised para. 7.25.	
	7-30	Revised para. 7.25; revised para. 7.27.	
	7-53	Revised para. 7.59.	
	7-54	Revised para. 7.59; relocated para. 7.61 to page 7-54a.	
	7-54a	Added page (Added para. 7.59; relocated para. 7.61 to page 7-54a.)	
	7-54b	Added page (Added info. relocated from page 7-55.)	
	7-55	Relocated info. to page 7-54a and 7-54b; added info. relocated from page 7-56.	
	7-56	Relocated info. to page 7-55.	
	7-59	Revised Emergency Power switch location.	
	9-i	Added Supplement 8 to contents.	
	9-5	Added item (b) (4).	
	9-9	Revised Section 2, item (f).	
	9-15	Revised Section e, item (f).	
	9-21	Revised Section 2, items (b) and (d).	
	9-25	Revised item (e), Altitude Hold.	
	9-26	Revised Coupled Approach Operations (a) (1) and (5).	
	9 27	Revised item (b) (2).	
	9-31	Revised Section 2, items (b) and (d).	D. H. Trompler
	9-34	Revised illust., revised Para. 4.2, item (b)	D H Trompler
	9-41	Revised item (c) .	
	9-43 thru 9-52	Added Supplement 8, Nacelle Wing Lockers Installation.	May 25,1978
Rev. 5 - 761 626 (PR780713)	2-1	Revised para. 2.3.	
	6-13	Revised Fig. 6-11.	
	6-14	Revised Fig. 6-13.	
	6-15	Revised Fig. 6-15.	
	6-24	Revised para. 6.15 (a) Example loading.	
	6-50	Added item 271.	D. H. Trompler
	9-43	Revised Section 1 - General.	D H Trompler
	9-50	Revised Fig. 5-13.	
	9-53	Added new page.	July 13, 1978

PILOT'S OPERATING HANDBOOK LOG OF REVISIONS (cont)

Revision Number and Code	Revised Pages	Description of Revision	FAA Approval Signature and Date
Rev. 6 - 761 626 (PR781031)	1-2	Added towing turn radius.	
	1-4	Added new item 1.11 (a), Ramp Weight; revised item letters; revised item 1.13 (b), Max. Useful Load.	
	1-5	Revised VMCA; relocated VNO to pg. 1-6.	
	1-6	Added VNO from pg. 1-5; revised VSSE.	
	1-12	Revised ft.-lb. and kg. conversions.	
	1-13	Corrected spelling.	
	2-2	Changed VMC to VMCA.	
	2-5	Added new item 2.15 (a), Ramp Weight; revised para. 2.17, C.G. Limits (added Max. Ramp Weight).	
	3-i	Added para. 3.39 and 3.41.	
	3-3	Revised para. 3.3 Speed nomenclature.	
	3-7	Added ser. no. effectivity to Asymmetric Flap Condition.	
	3-8	Added Flap System Malfunction.	
	3-20	Added ser. no. effectivity to para. 3.39, Asymmetric Flap Condition; added para. 3.41, Flap System Malfunction.	
	4-i	Added para. 4.39 and 4.41.	
	4-2	Revised item 4.3 (j).	
	4-7	Revised Before Takeoff.	
	4-14	Revised para. 4.21, Before Takeoff info.	
	4-19	Added para. 4.39, VSSE and 4.41, VMCA.	
	4-20	Added VMCA info.	
	5-4	Revised item 5.5 (b), added Ramp Weight.	
	6-7	Changed Gross Weight to Max. Ramp Weight.	
	6-11	Revised para. 6.7, General Loading Recommendations.	
	6-17	Revised Figure 6-17.	
	6-20	Revised Note.	
	6-21	Revised Figure 6-19.	
	6-51	Added items 297 and 299.	
	6-52	Added items 301 and 303.	
	6-53	Revised items 325b., 327b. and 329.	
	6-54	Revised item 331 nomenclature; revised items 331b. and 335.	
	6-55	Added items 352 and 356; relocated item 357 to pg. 6-56.	
	6-56	Added item 357 from pg. 6-55	
	6-57	Revised item nos.; added items 378 thru 381; relocated items to pg. 6-58.	
	6-58	Added items from pg. 6-57; added item 382; relocated items to pg 6-59	
	6-59	Added items from pg. 6-58; revised item nos.:. added items 398, 399, 400; relocated items to pg 6-60.	

Revision Number and Code	Revised Pages	Description of Revision	FAA Approval Signature and Date
Rev 6 - 761 626 (PR781031) (cont)	6-60	Added items from pg. 6-59; revised items 413 and 415; relocated items to pg. 6-61.	
	6-61	Added items from pg. 6-60; added item 436; relocated items to pg. 6-62.	
	6-62	Added items from pg. 6-61; relocated items to pg. 6-63.	
	6-63	Added items from pg. 6-62; relocated items to pg. 6-64.	
	6-64	Added items from pg. 6-63; relocated items to pgs. 6-65 and 6-66.	
	6-65	Added items from pg. 6-64; revised item 484; revised item nos.; added items 487, 488, 490 and 491; relocated items to pgs. 6-66 and 6-67.	
	6-66	Added items from pgs. 6-64 and 6-65; revised item nos.; added items 492, 494 and 495; relocated items to pgs. 6-67 and 6-68.	
	6-67	Added items from pgs. 6-65 and 6-66; added items 5-18 and 5-20; relocated item to pg. 6-68a.	
	6-68	Added items from pg. 6-66.	
	6-68a, 6-68b	Added pgs. (added item 540 from pg. 6-67; added item 541).	
	7-7	Added info. from pg. 7-8.	
	7-8	Relocated info. to pg. 7-7; added new nose wheel description to para. 7.11, Landing Gear.	
	7-15	Added ser. no. effectivity.	
	7-16	Added new flap description.	
	7-23	Revised Figure 7-21.	
	7-24	Added ser. no. effectivity to Figure 7-23.	
	7-24a, 7-24b	Added pgs. (Added new overhead panel Figure 7-23a).	
	7-28a	Revised Figure 7-26 ser. no. effectivity.	
	7-28b	Added Figure 7-26a.	
	7-30	Added info. to para. 7.25, Radio Operation.	
	7-38	Revised Figure 7-33.	
	9-i	Added Supplements 9 and 10.	
	9-14, 9-20	Revised item (g) (3).	D H. Trompler
	9-54	Added pg.	Oct. 31, 1978
	9-55 thru 9-66	Added pgs. (added KFC-200 AFCS With Flight Director).	
	9-67 thru 9-76	Added pgs. (added KFC-200 AFCS Without Flight Director).	
Rev. 7 - 761 626 (PR790411)	2-1	Revised max. flap extended speed	
	2-9	Revised item (f).	
	4-17	Revised para. 4.33	
	6-1	Revised para. 6.1.	

PILOT'S OPERATING HANDBOOK LOG OF REVISIONS (cont.)

Revision Number and Code	Revised Pages	Description of Revision	FAA Approval Signature and Date
Rev 7 - 761 626 PR790411) (cont)	6-11	Revised para. 6.7.	
	6-27	Revised items 3, 4 & 5.	
	6-28	Revised item 9	
	6-29	Revised items 21 & 25.	
	6-35	Revised item 103.	
	6-36	Added items 104 & 118. Relocated items 120 & 121 to pg. 6-37	
	6-37	Added relocated items 120 & 121 from pg. 6-36.	
	6-43	Revised items 170, 171, 174 & 175. Removed items 172 & 173.	
	6-51	Revised items 297 & 299.	
	6-52	Revised items 301 & 303.	D. H. Trompler April 11, 1979
	6-58	Revised items 384 & 389.	
	7-16	Added flap extension speeds.	
	9-i	Revised item 10.	
	9-67	Revised Section 1 - General.	
	9-70	Revised Section 4 (c).	
	9-76	Revised Section 5- Performance.	
Rev. 8 - 761 626 (PR790802)	Title	Changed title from Pilot's Operating Handbook to Pilot's Operating Handbook and FAA Approved Airplane Flight Manual. (NOTE: AIRCRAFT DELIVERED WITH HANDBOOKS PRIOR TO THIS REVISION DO NOT REQUIRE THIS REVISION.)	D. H. Trompler August 2, 1979
Rev. 9 - 761 626 (PR800530)	2-i, 2-4	Removed Flap Indicator Markings para & Revised para. nos.	
	2-5, 2-6, 2-11	Revised para. nos.	
	3-i, 3-3, 3-11, 3-12	Revised Engine Failure During Takeoff info.	
	4-i	Revised index.	
	4-1	Removed reference to takeoff flaps.	
	4-2	Revised item (g).	
	4-7	Revised Takeoff & Climb info.	
	4-14	Revised Takeoff & Climb info., removed reference to takeoff flaps.	
	4-19	Removed reference to takeoff flaps.	
	5-4	Revised takeoff & ground run distance.	
	5-9	Revised index.	
	5-17	Revised Takeoff chart.	
	5-18	Revised Accelerate, Stop Distance chart.	
	5-18a	Remove Figure 5-16 from page.	
	5-19	Removed Climb with Takeoff Flaps chart. Added Accelerate Stop Distance (Heavy Duty Brakes) chart.	

Revision Number and Code	Revised Pages	Description of Revision	FAA Approval Signature and Date
Rev. 9 - 761 626 (PR800530) (cont)	6-36, 6-37, 6-50	Wing flap position indicator no. revised.	
	7-15, 7-16, 9-9, 9-15, 9-21, 9-27, 9-31	Removed reference to takeoff flaps.	
	9-43	Revised para. 2.29.	
	9-44, 9-46, 9-47	Revised Engine Failure During Takeoff info.	
	9-50, 9-51, 9-52	Revised charts.	D.H. Trompler May 30, 1980
Rev. 10-761 626 (PR810220)	ii	Revised Warning.	
	2-3	Revised item 2.7(m).	
	3-i	Revised Table of Contents.	
	3-2	Added info. from pg. 3-3.	
	3-3	Relocated info. to pg. 3-2; added Engine Failure During Short Field Takeoff procedures.	
	3 11	Added Normal to heading titles and revised Warning.	
	3-12	Relocated info to pg. 3-12a; added Engine Failure During Short Field Takeoff procedures.	
	3-12a	Added pg. (added short field info. and info. from pg. 3 12).	
	3-12b	Added pg.	
	4-i	Revised pg. no.	
	4-7	Revised Before Takeoff; added Normal to Takeoff; relocated info. to pg. 4-8; added Short Field Takeoff.	
	4-8	Added info. from pg. 4-7.	
	4-14	Added Normal to Takeoff; relocated para. 4.24 to pg. 4-15; added Short Field.Takeoff.	
	4-15	Added info. from pg. 4-14; relocated info. to pg. 4-16.	
	4-16	Added info. from pg. 4-15.	
	5-9	Revised List of Figures.	
	5-17	Revised Figure 5-13.	
	5-18	Revised Figure title and no.	
	5-18a	Added graph from pg. 5-19.	
	5-18c	Added pg. (added Short Field Takeoff graph).	
	5-18d	Added pg. (added Short Field Acc/Stop graph).	
	5-19	Relocated graph to pg. 5- 18a; added Short Field Acc/Stop graph.	
	6-36	Revised items 113 and 119.	
	6-51	Revised item 285.	
	6-61	Revised item 436.	
	6-69	Revised item 609; added item 610.	
	7-17	Revised para. 7.19.	
	7-23	Revised Figure 7-21.	

Revision Number and Code	Revised Pages	Description of Revision	FAA Approval Signature and Date
Rev. 10- 761 626 (PR810220) (cont)	7-43	Revised para. 7.43.	
	7-45	Revised Figure 7-39.	
	8-7	Revised items (c) (3) and (d) (3).	
	9-5	Revised item (b) (5).	
	9-44	Added Normal to Engine Failure During Takeoff procedures; relocated info. to pg. 9-44a; added Engine Failure During Short Field Takeoff procedures.	
	9-44a	Added pg. (added short field info. and info. from pg. 9-44).	
	9-44b	Added pg.	
	9-46	Added Normal to Engine Failure During Takeoff procedures; revised Warning.	
	9-46a	Added pg. (added info. from pg. 4-47 and Engine Failure During Short Field Takeoff procedures).	
	9-46b	Added pg. (added Engine Failure During Short Field Takeoff procedures).	
	9-47	Relocated info. to pg. 9-46a; added info. from pg. 9-48.	
	9-48	Relocated info. to pg. 9 47.	
	9-49	Revised and relocated Section 5 to pg. 9-50; added para. 4.5.	
	9-50	Relocated Figure 5-13 to pg. 9-50a; added info. from pg. 9-49; added para. 4.23.	
	9-50a	Added pg. (added Figure 5-13 from pg. 9-50).	D. H. Trompler
	9-50b	Added pg. (added Figure 5- 16).	March 13, 1981
Rev. 11 - 761 626 (PR820329)	2-1	Revised para. 2.3 (Flap Limits).	
	2-14	Added placard.	
	3-i	Revised pg. no.	
	3-7	Revised Asymmetric Flap Procedures.	
	3-8	Added continuation of Asymmetric Flap Procedure from pg. 3-7.	
	3-20	Revised para. 3.39 (Asymmetric Flap Condition); relocated para. 3.41 to pg. 3-21.	
	3-21	Added pg. (added para. 3.41 from pg. 3-20).	
	4-1	Revised para. 4.3, item (d); relocated item (e) to pg. 4-2.	
	4-2	Added item (e) from pg. 4-1.	
	4-8	Revised Before Landing (Flap Limits).	
	4-16	Revised para. 4.29, Before Landing (Flap Limits).	
	5-9	Deleted Figures 5-49 and 5-50.	
	5-15	Revised Figure 5-9 (Flap Condition).	
	5-35	Revised Figure 5-45 (Flap Condition).	

Revision Number and Code	Revised Pages	Description of Revision	FAA Approval Signature and Date
Rev. 11 - 761 626 (PR820329) (cont)	5-36	Revised Figure 5-47 (Flap and Power Conditions).	
	5-36a	Revised Figure 5-48 (Flap and Power Conditions).	
	5-37, 5-38	Deleted pgs. (deleted Figures 5-49 and 5-50, Short Field Landing Charts).	
	7-15, 7-16	Revised para. 7.17, Flight Control System (Flap description).	
	9-49	Deleted para. 3.39 (Asymmetric Flap Condition).	
	9-52	Revised Figure 545 (Flap Condition).	
	9-56, 9-68	Revised Section 2, item (c).	D. H. Trompler
	10-2	Revised item (r).	March 29, 1982
Rev. 12 (PR840509)	1-3	Revised para. 1.7.	
	1-6	Revised item (b).	
	1-7	Revised item (c).	
	2-3	Revised item (g).	
	3-i	Revised Index.	
	3-ii	Added new pg.	
	3-1	Revised para.3.1.	
	3-7, 3-8	Revised checklist.	
	3-20	Revised para. 3.39.	
	4-i	Revised Index.	
	4-1	Revised para. 4.1.	
	4-5 thru 4-7	Revised checklist.	
	4-9, 4-10	Revised para. 4.9.	
	4-11	Revised para. 4.11.	
	4-13	Revised para. 4.15.	
	5-4	Revised item (b).	
	6-1	Revised para. 6.1.	
	6-3	Revised para. 6.3.	
	6-6	Revised para. 6.5.	
	6-7	Revised Figure 6.7.	
	6-9, 6-10	Revised Figure 6-9.	
	6-27	Revised para. 3.17.	
	7-10	Revised para. 7.13.	
	8-2	Revised para. 8.3.	
	8-3	Revised para. 8.5.	
	8-5	Revised item (c).	
	8-12	Revised para. 8.25.	
	10-i	Revised Index.	D H. Trompler
	10-1, 10-2	Changed Safety to Operating.	May 9, 1984

Revision Number and Code	Revised Pages	Description of Revision	FAA Approval Signature and Date
Rev. 13 - 761 626 (PR901217)	3-6, 3-7 3-15 3-20 8-1 8-2 8-12 8-13 8-18	Revised checklist. Revised para. 3.19. Revised para. 3.39. Revised para. 8.1. Revised para. 8.3. Revised para. 8.23. Revised Lubricating Oil Recommendations. Added Note. Moved item (c) to pg. 8-13. Relocated item (c) from pg. 8-12. Added Caution.	D.H. Trompler D.H. Trompler January 7, 1991
Rev. 14 - 761 626 (PR970305)	4-5	Revised para. 4.5 by adding caution and warning.	Peter E. Peck Peter E. Peck March 5, 1997

TABLE OF CONTENTS

TABLE OF CONTENTS

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 C.A.R. 3 and FAR Part 21, Subpart J. It also contains supplemental data supplied by the airplane manufacturer.

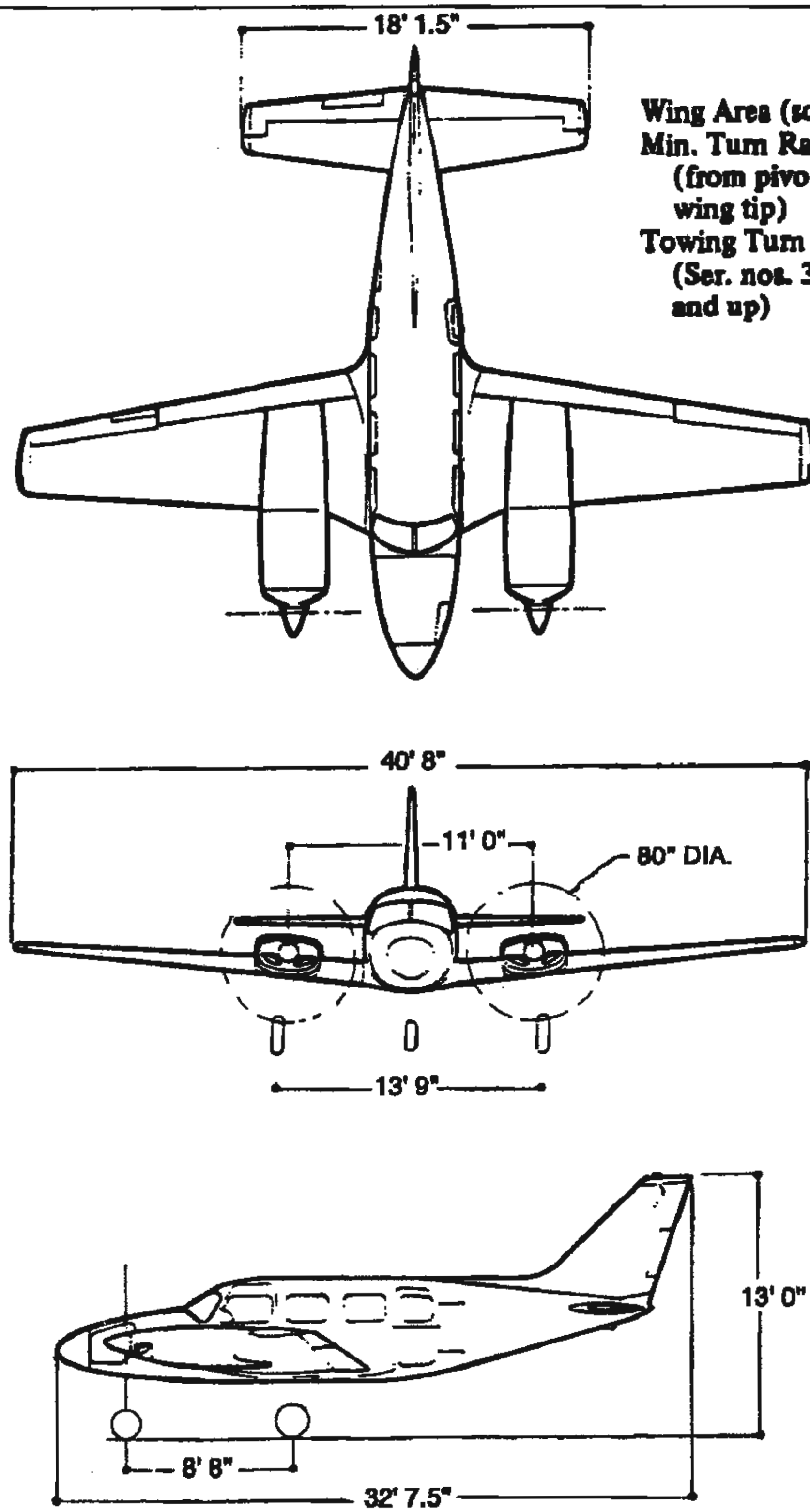
This handbook is not designed as a substitute for adequate and competent flight instruction, knowledge of current airworthiness directives, applicable federal air regulations or advisory circulars. It is not intended to be a guide for basic flight instruction or a training manual and should not be used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

Assurance that the airplane is in an airworthy condition is the responsibility of the owner. The pilot in command is responsible for determining that the airplane is safe for flight. The pilot is also responsible for remaining within the operating limitations as outlined by 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 left blank intentionally.

Wing Area (sq. ft.)	229
Min. Turn Radius (ft.) (from pivot point to wing tip)	43.8
Towing Turn Radius (ft.) (Ser. nos. 31-7812121 and up)	30.7



THREE VIEW
Figure 1-1

1.3 ENGINES

(a)	Number of Engines	2
(b)	Engine Manufacturer	Lycoming
(c)	Engine Model Number	TIO-540-A2C
(d)	Rated Horsepower	310
(e)	Rated Speed (rpm)	2575
(f)	Bore (inches)	5.125
(g)	Stroke (inches)	4.375
(h)	Displacement (cubic inches)	541.5
(i)	Compression Ratio	7.3:1
(j)	Engine Type	Six Cylinder, Direct Drive, Horizontally Opposed, Air Cooled, Fuel Injected, Turbocharged

1.5 PROPELLERS

(a)	Number of Propellers	2
(b)	Propeller Manufacturer	Hartzell
(c)	Blade Model	FC8468-6R
(d)	Number of Blades	3
(e)	Hub Model	HC-E3YR-2ATF
(f)	Propeller Diameter (inches)	
	(1) Maximum	80
	(2) Minimum	78
(g)	Propeller Type	Constant Speed, Hydraulically Actuated

1.7 FUEL

AVGAS ONLY

(a)	Fuel Capacity (U.S. gal)	(total) 192
(b)	Usable Fuel (U.S. gal)	(total) 187.3
(c)	Fuel Grade, Aviation	
	(1) Minimum Octane	100/ 130 - Green
	(2) Specified Octane	100/130 - Green 100 - Green 100 LL - Blue
	(3) Alternate Fuels*	115/145 - Purple Refer to Lycoming Service Instruction 1070, Revision J or later.

*Alternate Fuels refers to military grade with 4.6 ml of TEL. See Section 8.25 concerning use of alternate fuel grades.

1.9 OIL

(a)	Oil Capacity (U.S. quarts)	12
(b)	Oil Specification	Refer to latest isssue of Lycoming Service Instruction 1014.
(c)	Oil Viscosity	Refer to Section 8, Paragraph 8.23

1.11 MAXIMUM WEIGHTS

(a)	Maximum Ramp Weight (lbs)	6536
(b)	Maximum Takeoff Weight (lbs)	6500
(c)	Maximum Landing Weight (lbs)	6500
(d)	Maximum Zero Fuel Weight (lbs)	6200
(e)	Maximum Weights in Baggage Compartments (lbs)	
	(1) Forward (Nose)	150
	(2) Aft	200

1.13 STANDARD AIRPLANE WEIGHTS *

(a)	Standard Empty Weight (lbs): Weight of a standard airplane including unusable fuel, full operating fluids and full oil.	4003
(b)	Maximum Useful Load (lbs) : The difference between the Maximum Ramp Weight and the Standard Empty Weight.	2533

1.15 BAGGAGE SPACE

		FORWARD	AFT
(a)	Compartment Volume (cubic feet)	14	22
(b)	Entry Width (inches)	26.5	27.5**
(c)	Entry Height (inches)	20	47

1.17 SPECIFIC LOADINGS

(a)	Wing Loading (lbs per sq ft)	28.4
(b)	Power Loading (lbs per hp)	10.5

* These values are approximate and vary from one aircraft to another. Refer to Figure 6-7 for the Standard Empty Weight value and the Useful Load value to be used for C.G. calculations for the aircraft specified.

**Aft cargo entry width increased to 45 inches when optional cargo door is installed.

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.
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_{MCA}	Air Minimum Control Speed is the minimum flight speed at which the airplane is directionally controllable as determined in accordance with Federal Aviation Regulations. Airplane certification conditions include one engine becoming inoperative and windmilling; not more than a 5° bank towards the operative engine; takeoff power on operative engine; landing gear up; flaps in takeoff position; and most rearward C. G.
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_{SSE}	Intentional One Engine Inoperative Speed is a minimum speed selected by the manufacturer for intentionally rendering one engine inoperative in flight for pilot training.
V_X	Best Angle-of-Climb Speed is the airspeed which delivers the greatest gain of altitude in the shortest possible horizontal distance.
V_Y	Best Rate-of-Climb Speed is the airspeed which delivers the greatest gain in altitude in the shortest possible time.

(b) Meteorological Terminology

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

(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

(c) 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.
Accelerale-Stop Distance	The distance required to accelerate an airplane to a specified speed and, assuming failure of an engine at the instant that speed is attained, to bring the airplane to a stop.
Route Segment	A part of a route. Each end of that part is identified by: (1) a geographical location; or (2) a point at which a definite radio fix can be established.

(f) Weight and Balance Terminology

Reference Datum	An imaginary vertical plane from which all horizontal distances are measured for balance purposes.
Station	A location along the airplane fuselage usually given in terms of distance from the reference datum.
Arm	The horizontal distance from the reference datum to the center of gravity (C.G.) of an item.

Moment	The product of the weight of an item multiplied by its arm. (Moment divided by a constant is used to simplify balance calculations by reducing the number of digits.)
Center of Gravity (C.G.)	The point at which an airplane would balance if suspended. Its distance from the reference datum is found by dividing the total moment by the total weight of the airplane.
C.G. Arm	The arm obtained by adding the airplane's individual moments and dividing the sum by the total weight.
C.G. Limits	The extreme center of gravity locations within which the airplane must be operated at a given weight.
Usable Fuel	Fuel available for flight planning.
Unusable Fuel	Fuel remaining after a runout test has been completed in accordance with governmental regulations.
Standard Empty Weight	Weight of a standard airplane including unusable fuel, full operating fluids and full oil.
Basic Empty Weight	Standard empty weight plus optional equipment.
Payload	Weight of occupants, cargo and baggage.
Useful Load	Difference between takeoff weight, or ramp weight if applicable, and basic empty weight.
Maximum Ramp Weight	Maximum weight approved for ground maneuver. (It includes weight of start, taxi and run up fuel.)
Maximum Takeoff Weight	Maximum weight approved for the start of the takeoff run.
Maximum Landing Weight	Maximum weight approved for the landing touchdown.
Maximum Zero Fuel Weight	Maximum weight exclusive of usable fuel.

THIS PAGE INTENTIONALLY LEFT BLANK

THIS PAGE INTENTIONALLY LEFT BLANK

1.21 CONVERSION FACTORS

MULTIPLY	BY	TO OBTAIN
acres	0.4047	ha
	43560	sq. ft.
	0.0015625	sq. mi.
atmospheres (atm)	76	cm Hg
	29.92	in. Hg
	1.0133	bar
	1.033	kg/cm^2
	14.70	lb./sq. in.
	2116	lb./sq. ft.
bars (bar)	0.98692	atm.
	14.503768	lb./sq. in.
British Thermal Unit (BTU)	0.2519958	kg-cal
centimeters (cm)	0.3937	in.
	0.032808	ft.
centimeters of mercury at 0°C (cm Hg)	0.01316	atm
	0.3937	in. Hg
	0.1934	lb./sq. in.
	27.85	lb./sq. ft.
	135.95	kg/m^2
centimeters per second (cm/sec.)	0.032808	ft./sec.
	1.9685	ft./min.
	0.02237	mph
cubic centimeters (cm3)	0.03381	fl. oz.
	0.06102	cu. in.
	3.531×10^{-5}	cu. ft.
	0.001	1
	2.642×10^{-4}	U.S. gal.
cubic feet (cu.ft.)	28317	cm^3
	0.028317	m^3
	1728	cu. in.
	0.037037	cu. yd.
	7.481	U.S. gal.
	28.32	1
cubic feet per minute (cu. ft./min.	0.472	1/sec.
	0.028317	m^3/min.

MULTIPLY	BY	TO OBTAIN
cubic inches (cu. in.)	16.39	cm3
	1.639×10^{-5}	m3
	5.787×10^{-4}	cu. ft.
	0.5541	fl. oz.
	0.01639	1
	4.329×10^{-3}	U.S. gal.
	0.01732	U.S. qt.
cubic meters (m^3)	61024	cu. in.
	1.308	cu. yd.
	35.3147	cu. ft.
	264.2	U.S. gal.
cubic meters per minute (m^3/min.)	35.3147	cu. ft./min.
cubic yards (cu. yd.)	27	cu. ft.
	0.7646	m^3
	202	U.S. gal.
degrees (arc)	0.01745	radians
degrees per second (deg./sec.)	0.01745	radians/sec.
drams, fluid (dr. fl.)	0.125	fl. oz.
drams, avdp. (dr. avdp.)	0.0625	oz. avdp.
feet (ft.)	30.48	cm
	0.3048	m
	12	in.
	0.33333	yd.
	0.0606061	rod
	1.894×10^{-4}	mi.
	1.645×10^{-4}	NM
feet per minute (ft./min.)	0.01136	mph
	0.01829	km/hr.
	0.508	cm/sec.
	0.00508	m/sec.

MULTIPLY	BY	TO OBTAIN
feet per second (ft./sec.)	0.6818	mph
	1.097	km/hr.
	30.48	cm/sec.
	0.5921	kts.
foot-pounds (ft.-lb.)	0.138255	m-kg
	3.24×10^{-4}	kg-cal
foot-pounds per minute (ft.-lb./min.)	3.030×10^{-5}	hp
foot-pounds per second (ft.-lb./sec.)	1.818×10^{-5}	hp
gallons, Imperial (Imperial gal.)	277.4	cu. in.
	1.201	U.S. gal.
	4.546	l
gallons, U.S. dry (U.S. gal. dry)	268.8	cu. in.
	1.556 x 10-1	cu. ft.
	1.164	U.S. gal.
	4.405	l
gallons, U.S. liquid (U.S. gal.)	231	cu. in.
	0.1337	cu. ft.
	4.951×10^{-3}	cu. yd.
	3785.4	cm^3
	3.785×10^{-3}	m^3
	3.785	l
	0.83268	Imperial gal.
	128	fl. oz.
gallons per acre (gal./acre)	9.353	l/ha
grams (g)	0.001	kg
	0.3527	oz. avdp.
	2.205×10^{-3}	lb.
grams per centimeter (g/cm)	0.1	kg/m
	6.721×10^{-2}	lb./ft.
	5.601×10^{-3}	lb./in.
grams per cubic centimeter (g/cm^3)	1000	kg/m^3
	0.03613	lb./cu. in.
	62.43	lb./cu. ft.

MULTIPLY	BY	TO OBTAIN
hectares (ha)	2.471	acres
	107639	sq. ft.
	10000	m^2
horsepower (hp)	33000	ft.-lb./min.
	550	ft.-lb./sec.
	76.04	m-kg/sec.
	1.014	metric hp
horsepower, metric	75	m-kg/sec.
	0.9863	hp
inches (in.)	25.40	mm
	2.540	cm
	0.0254	m
	0.08333	ft.
	0.027777	yd.
inches of mercury at 0°C (in. Hg)	0.033421	atm
	0.4912	lb./sq. in.
	70.73	lb./sq. ft.
	345.3	kg/m^2
	2.540	cm Hg
	25.40	mm Hg
inch-pounds (in.-lb.)	0.011521	m-kg
kilograms (kg)	2.204622	lb.
	35.27	oz. avdp.
	1000	g
kilogram-calories (kg-cal)	3.9683	BTU
	3087	ft.-lb.
	426.9	m-kg
kilograms per cubic meter (kg/m^3)	0.06243	lb./cu. ft.
	0 001	g/cm^3
kilograms per hectare (kg/ha)	0.892	lb./acre
kilograms per square centimeter (kg/cm^2)	0.9678	atm
	28.96	in. Hg
	14.22	lb./sq. in.
	2048	lb./sq. ft.

MULTIPLY	BY	TO OBTAIN
kilograms per square meter (kg/m^2)	2.896×10^{-3}	in. Hg
	1.422×10^{-3}	lb./sq. in.
	0.2048	lb./sq. ft.
kilometers (km)	1×10^{-5}	cm
	3280.8	ft.
	0.6214	mi.
	0.53996	NM
kilometers per hour (km/hr.)	0.9113	ft./sec.
	58.68	ft./min.
	0.53996	kt
	0.6214	mph
	0.27778	m/sec.
	16.67	m/min.
knots (kt)	1	nautical mph
	1.689	ft./sec.
	1.1516	statute mph
	1.852	km/hr.
	51.48	m/sec.
liters (1)	1000	cm^3
	61.02	cu. in.
	0.03531	cu. ft.
	33.814	fl. oz.
	0.264172	U.S. gal.
	0.2200	Imperial gal.
	1.05669	qt.
liters per hectare (l/ha)	13.69	fl. oz./acre
	0.107	gal./acre
liters per second (1/sec.)	2.12	cu. ft./min.
meters(m)	39.37	in.
	3.280840	ft.
	1.0936	yd.
	0.198838	rod
	6.214×10^{-4}	mi.
	5.3996×10^{-4}	NM
meter-kilogram (m-kg)	7.23301	ft.-lb.
	86.798	in.-lb.
meters per minute (m/min.)	0.06	km/hr.
meters per second (m/sec.)	3.280840	ft./sec.
	196.8504	ft./min.
	2.237	mph
	3.6	km/hr.
microns	3.937×10^{-5}	in.
miles, statute (mi.)	5280	ft.
	1.6093	km
	1609.3	m
	0.8684	NM
miles per hour (mph)	44.7041	cm/sec.
	4.470×10^{-1}	m/sec.
	1.467	ft./sec.
	88	ft./min.
	1.6093	km/hr.
	0.8684	kt
miles per hour square (m/hr. sq.)	2.151	ft./sec. sq.
millibars	2.953×10^{-2}	in. Hg
millimeters (mm)	0.03937	in.
millimeters of mercury at 0°C (mm Hg)	0.03937	in. Hg
nautical miles (NM)	6080	ft.
	1.1516	statute mi.
	1852	m
	1.852	km
ounces, avdp. (oz. avdp.)	28.35	g
	16	dr. avdp.
ounces, fluid (fl. oz.)	8	dr. fl.
	29.57	cm^3
	1.805	cu. in.
	0.0296	1
	0.0078	U.S. gal.

MULTIPLY	BY	TO OBTAIN
ounces, fluid per acre (fl. oz./ acre)	0.073	l/ha
pounds (lb.)	0.453592	kg
	453.6	g
	3.108×10^{-2}	slug
pounds per acre (lb./acre)	1.121	kg/ha
pounds per cubic foot (lb./cu. ft.)	16.02	kg/m^3
pounds per cubic inch (lb./cu. in.)	1728	lb./cu. ft.
	27.68	g/cm^3
pounds per square foot (lb./sq. ft.)	0.1414	in. Hg
	4.88243	kg/m^2
	4.725×10^{-4}	atm
pounds per square inch (psi or lb./sq. in.)	5.1715	cm Hg
	2.036	in. Hg
	0.06804	atm
	0.0689476	bar
	703.1	kg/m^2
quart, U.S. (qt.)	0.94635	l
	57.749	cu. in.
radians	57.30	deg. (arc)
	0.1592	rev.
radians per second (radians/sec.)	57.30	deg./sec.
	0.1592	rev./sec.
	9.549	rpm
revolutions (rev.)	6.283	radians
revolutions per minute (rpm or rev./min.)	0.1047	radians/sec.
revolutions per second (rev./sec.)	6.283	radians/sec.

MULTIPLY	BY	TO OBTAIN
rod	16.5	ft.
	5.5	yd.
	5.029	m
slug	32.174	lb.
square centimeters (cm^2)	0.1550 .	sq. in.
	0.001076	sq. ft.
square feet (sq. ft.)	929	cm^2
	0.092903	m^2
	144	sq. in.
	0.1111	sq. yd.
	2.296×10^{-5}	acres
square inches (sq. in.)	6.4516	cm^2
	6.944×10^{-3}	sq. ft.
square kilometers (km^2)	0.3861	sq. mi.
square meters (m^2)	10.76391	sq. ft.
	1.196	sq. yd.
	0.0001	ha
square miles (sq. mi.)	2.590	km^2
	640	acres
square rods (sq. rods)	30.25	sq. yd.
square yards (sq. yd.)	0.8361	m^2
	9	sq. ft.
	0.0330579	sq. rods
yards (yd.)	0.9144	m
	3	ft.
	36	in.
	0.181818	rod

TABLE OF CONTENTS

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 PA-31 Navajo 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	KCAS	KIAS
Never Exceed Speed (V_{NE}) - Do not exceed this speed in any operation.	236	236
Maximum Structural Cruising Speed (V_{NO}) - Do not exceed this speed except in smooth air and then only with caution.	187	188
Design Maneuvering Speed (V_A) - Do not make full or abrupt control movements above this speed.	159	159
Maximum Flaps Extended Speed (V_{FE}) - Do not exceed this speed with a given flap setting.		
Flaps extended speeds		
15° flap (serial numbers 31-7712001 through 7712103)	152	164
15° flap (serial numbers 31-7812001 and up)	160	174
25° flap (full flaps) (serial numbers 31-7712001 through 31-7812129)	130	140
25° flap (serial numbers 31-7912001 and up)	160	174
40° flap (full flaps) (serial numbers 31-7912001 and up)	130	140
Maximum Gear Extended Speed (V_{LE}) - Do not exceed this speed with landing gear extended.		
Serial numbers 31-7712001 through 7712103	130	129
Serial numbers 31-7812001 and up	156	156
Maximum Landing Gear Operating Speed (V_{LO}) - Do not extend or retract landing gear above this speed.		
Extend		
Serial numbers 31-7712001 through 7712103	130	129
Serial numbers 31-7812001 and up	156	156
Retract	130	129

	KCAS	KIAS
Air Minimum Control Speed (V_{MCA}) - Lowest airspeed at which airplane is controllable with one engine operating and takeoff flaps.	74	76
Stall Speed (full flaps, gear down, power off, 6500 lb) (See Section 5, Performance, for stall speeds at reduced weights.)	63	70

NOTE

The maximum altitude loss during a single engine stall, gear and flaps retracted is 500 feet. The altitude loss is less for all other aircraft configurations.

Demonstrated Crosswind Velocity — 20 KT

2.5 AIRSPEED INDICATOR MARKINGS

MARKING	KIAS
Green Arc (Normal Operating Range)	76 to 188
Yellow Arc (Caution Range - Smooth Air)	188 to 236
White Arc (Flaps Extended Range)	70 to 140
Radial Red Line (Never Exceed - Smooth Air)	236
Radial Red Line (Minimum Control Speed - Single Engine)	76
Radial Blue Line (Best Rate of Climb Speed - Single Engine)	94

2.7 POWER PLANT LIMITATIONS

(a) Number of Engines	2
(b) Engine Manufacturer	Lycoming
(c) Engine Model Number	TIO-540-A2C
(d) Engine Operating Limits	
(1) Maximum Horsepower	310
(2) Maximum Rotational Speed (RPM)	2575
(3) Maximum Manifold Pressure (Inches of Mercury)	
To 15,800 ft. altitude	46
From 15,800 ft. to 24,000 ft. altitude	46 minus 1.6 per 1000 ft. altitude increase
(4) Maximum Cylinder Head Temperature	500°F
(5) Maximum Oil Temperature	245°F
(6) Maximum Exhaust Gas Temperature	1650°F
(e) Oil Pressure	
Minimum (red line)	25 PSI
Maximum (red line)	100 PSI

(f)	Fuel Pressure	
	Normal Operating Range (green arc)	25 PSI to 45 PSI
	Minimum (radial red line)	25 PSI
	Maximum (radial red line)	45 PSI
(g)	Fuel Grade (AVGAS ONLY) (minimum octane)	100/130 Green
(h)	Number of Propellers	2
(i)	Propeller Manufacturer	Hartzell
(j)	Propeller Hub Model	HC-E3YR-2ATF
(k)	Propeller Blade Model	FC8468-6R
(l)	Propeller Diameter	
	Maximum	80 IN.
	Minimum	78 IN.
(m)	Propeller Pitch Settings at 30 Inch Station	
	Low Pitch Stop	13.2° ± 0.1°
	High Pitch Stop (Feathered)	82° ± 1.0°
(n)	Type	Constant Speed, Feathering

2.9 POWER PLANT INSTRUMENT MARKINGS

(a)	Tachometer	
	Green Arc (Normal Operating Range)	500 RPM to 2575 RPM
	Radial Red Line (Maximum)	2575 RPM
(b)	Fuel Pressure	
	Green Arc (Normal Operating Range)	25 PSI to 45 PSI
	Radial Red Line (Minimum)	25 PSI
	Radial Red Line (Maximum)	45 PSI
(c)	Cylinder Head Temperature	
	Green Arc (Normal Operating Range)	100°F to 475°F
	Yellow Arc (Caution Range)	475°F to 500°F
	Radial Red Line (Never Exceed)	500°F
(d)	Oil Temperature	
	Green Arc (Normal Operating Range)	120°F to 245°F
	Yellow Arc (Caution Range)	50°F to 120°F
	Radial Red Line (Never Exceed)	245°F
(e)	Oil Pressure	
	Green Arc (Normal Operating Range)	60 PSI to 90 PSI
	Yellow Arc (Caution Range)	25 PSI to 60 PSI
	Yellow Arc (Caution Range)	90 PSI to 100 PSI
	Radial Red Line (Minimum)	25 PSI
	Radial Red Line (Maximum)	100 PSI
(f)	Exhaust Gas Temperature	
	Green Arc (Normal Operating Range)	Zero or lower scale limit to 1650°F
	Radial Red Line (Never Exceed)	1650°F
(g)	Manifold Pressure	
	Radial Red Line	46 IN HG

2.11 POWER PLANT DOOR AND FLAP SETTINGS

Cowl flaps will be positioned to maintain temperatures at or below maximum temperatures.

2.13 WEIGHT LIMITS

(a)	Maximum Ramp Weight	6536 LBS
(b)	Maximum Takeoff Weight	6500 LBS
(c)	Maximum Landing Weight	6500 LBS
(d)	Maximum Zero Fuel Weight	6200 LBS
(e)	Maximum Weights in Baggage Compartments	
	Forward (Nose)	150 LBS
	Aft	200 LBS

NOTE

It is the responsibility of the airplane owner and pilot to assure that the airplane is properly loaded. Maximum allowable gross weight is 6500 pounds. See "Weight and Balance Section" for loading instructions.

2.15 CENTER OF GRAVITY LIMITS (GEAR EXTENDED)

Weight Pounds	Forward Limit Inches Aft of Datum	Aft Limit Inches Aft of Datum
6536 (Max. Ramp Weight)	134.0	138
6500 (Max. Takeoff Weight)	134.0	138
6000	128.5	138
4800 or less	120.0	138

NOTES

Straight line variation between the points indicated.

Datum is 137 inches forward of the wing main spar centerline.

2.17 MANEUVER LIMITS

This is a Normal Category Airplane. No acrobatic maneuvers (including spins) approved.

2.19 FLIGHT LOAD FACTOR LIMITS (MANEUVERS)

(a)	Positive Load Factor (Maximum)	3.6 G
(b)	Negative Load Factor (Maximum) (No Inverted Maneuvers Approved)	-1.44 G
(c)	Positive Load Factor (Flaps down) (Maximum)	2.00 G

2.21 CREW LIMITS

The minimum crew for operating this airplane is one pilot unless the type of operation (air taxi, for example - see FAR's) requires a copilot.

2.23 ALTITUDE LIMITS

The maximum approved operating altitude for this airplane is 24,000 feet.

2.25 TYPES OF OPERATION LIMITS

The Federal Aviation Regulations make the operator of an aircraft responsible for insuring that sufficient and proper instruments and equipment are installed, operating, and calibrated for the type of flight being undertaken. These regulations (for example, see FAR 91.3(a), 91.25, 91.33, 91.97 and 91.170) also specify the minimum instruments and equipment which must be available for the various types of flight, i.e., VFR, IFR, night, commercial, air taxi, high altitude, icing and so on. It is recommended that pilots of this aircraft make themselves familiar with these regulations in order to avoid violating them. While the regulations list minimum instruments and equipment, experienced pilots realize that the minimum practical instruments and equipment depends on the pilot's capability, weather, terrain, the flight plan, facilities to be used, whether flight is during daylight or night, at high or low altitude, for hire or not, in icing conditions or not, and so on. Pilots are cautioned to consider all factors in determining whether they have all the required equipment for making a particular flight.

When properly equipped this airplane may be flown day or night, VFR or IFR, and in light to moderate icing.

The certificating regulations of the FAA for this airplane require the manufacturer to specify in the Pilot's Operating Handbook the types of operation for which the airplane is equipped.

The equipment installed in this aircraft has been substantiated to 24,000 feet.

When this airplane was delivered it contained the properly installed equipment listed in the Weight and Balance Section of this Handbook and, therefore, was satisfactory for the types of operation indicated below by an asterisk.

(a) ______ Day VFR

(b) ______ Night VFR

(c) ______ Day and night IFR after adequate communication and navigation radio has been installed in an FAA approved manner.

(d) ______ Day and night IFR

(e) ______ Light to moderate icing after deicing and icing equipment listed on page 2-9 for operation in icing conditions has been installed in accordance with Piper drawings or in an FAA approved manner.

(f) ______ Light to moderate icing.

Operators are warned that if any of the equipment listed as having been installed at time of delivery is changed, not operating, or not properly maintained and calibrated, the airplane may not be properly equipped for all the conditions noted above. It is the responsibility of the pilot to determine whether the lack of a piece of equipment limits the conditions under which he may fly the airplane.

AIRCRAFT

______________________ ______________________
REGISTRATION NO. SERIAL NO.

Owners desiring to make changes or additions to the equipment must have these modifications done in an FAA-approved manner. All PA-31 aircraft are delivered equipped for day and night VFR flight, and for IFR flight when sufficient communication and navigation radio equipment is installed.

The performance, handling qualities and structure of the airplane are approved for instrument flight.

If an owner of an airplane which is approved for VFR flight only desires to extend his operations to IFR, he should have radio equipment installed in accordance with Piper-approved drawings or other FAA-approved data (or data approved by the aviation agency of the country of registration). The owner should insure that the radio equipment is adequate for the ground facilities to be used, is of sufficiently high quality and reliability, is properly functioning, adjusted and calibrated, and that it is compatible with previously installed equipment before authorizing it to be flown under instrument conditions.

When the original equipment or FAA-approved equivalent equipment is installed as originally or in an FAA-approved manner, functioning properly and calibrated in accordance with the Federal Aviation Regulations, and when adequate radio communications and navigation equipment is installed as indicated above, this airplane is approved for day and night VFR and IFR flight.

If the airplane is approved for night IFR, but is not approved for flight in icing conditions when delivered, it will be necessary for an owner to add all the equipment listed in this section as required for flight in icing conditions if he desires to operate in icing conditions. If this equipment is properly installed in accordance with Piper-approved drawings and all the other equipment required for night IFR flight is installed in an FAA-approved manner, is adequate for the ground facilities to be used, is of sufficient quality, is functioning properly, and is calibrated in accordance with the FAR's, the airplane is approved for IFR flight in light to moderate icing conditions. If anti-icing and deicing equipment is not installed in accordance with Piper drawings, FAA approval or approval of the aviation agency of the country of registry must be obtained in order to legally conduct flight in icing conditions.

Flight through known or forecast heavy icing conditions is prohibited, and flight through any icing conditions should be avoided if any of the anti-icing or deicing equipment is missing or not functioning.

Pilots are also reminded that oxygen must be available to passengers and crew for flight to high altitude and that special electronic equipment is required for flight above specified altitude.

FAR 135 places special requirements on air taxi and commercial operators.

In accordance with the FAR's, this airplane is not properly equipped for the condition of flight indicated if any of the equipment listed below is not properly installed, functioning, properly maintained and calibrated according to the FAR's. Pilots are responsible for complying with the latest ammendments to FAR 91 concerning required equipment.

(a) Day VFR
 (1) Airspeed indicator
 (2) Altimeter
 (3) Magnetic direction indicator
 (4) Tachometer - each engine
 (5) Oil pressure gauge - each engine
 (6) Stall warning indicator
 (7) Oil temperature gauge - each engine
 (8) Manifold pressure gauge - each engine
 (9) Fuel gauges
 (10) Fuel pressure indicator - each engine
 (11) Exhaust gas temperature gauge - each engine
 (12) Landing gear position indicator
 (13) Seat belts - each occupant
 (14) Very pistol and flotation gear - if over water for hire
 (15) Above 12,500 feet - transponder with automatic altitude reporting capability

(b) Night VFR
- (1) All equipment required for Day VFR
- (2) Position lights
- (3) Anti-collision lights
- (4) Alternator - each engine
- (5) Instrument lights
- (6) Landing light, if for hire

(c) Day IFR
- (1) All equipment required for Day VFR
- (2) Two-way radio for communication
- (3) Suitable and adequate navigation radio equipment
- (4) Gyroscopic rate of turn indicator
- (5) Bank indicator
- (6) Clock with sweep second hand
- (7) Sensitive altimeter adjustable for barometric pressure
- (8) Alternators - each engine
- (9) Gyroscopic bank and pitch indicator
- (10) Gyroscopic direction indicator

(d) Night IFR
- (1) All equipment required for day and night VFR
- (2) All equipment required for Day IFR

(e) Flight in Positive Control Areas
- (1) Transponder

(f) Light to Moderate Icing

For flight in light to moderate icing conditions the following equipment must be inslalled in accordance with Piper drawings or in a FAA approved manner:
- (1) All equipment required for night IFR
- (2) Wing and tail deicing system
- (3) Heated windshield
- (4) Static wicks
- (5) Shielded antennas
- (6) Heated pitot tube
- (7) Propeller deicing
- (8) Elevator horn deicing boot

(g) Flight with Third and/or Fourth Seats in the Aft Facing Position
- (1) When the third and/or fourth seats are installed in the aft facing position, 10 inch minimum height headrests must be installed.

THIS PAGE INTENTIONALLY LEFT BLANK

2.27 PLACARDS

On top right side of instrument Panel:

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

FOR TYPES OF OPERATION
SEE PILOT'S OPERATING HANDBOOK

On left side, center of pilot's panel (serial numbers 31-7712001 through 7712103):

MINIMUM CONTROL SPEED	76 KIAS
MAXIMUM SPEED LANDING GEAR OPERATION	129 KIAS
DESIGN MANEUVERING SPEED	159 KIAS

SEE PILOT'S OPERATING HANDBOOK FOR ADDITIONAL SPEEDS

On left side, center of pilot's panel (serial numbers 31-7812001 and up):

MINIMUM CONTROL SPEED	76 KIAS
MAXIMUM SP. LG. - RET. 129 KIAS	EXTEND 156 KIAS
DESIGN MANEUVERING SPEED	159 KIAS

SEE PILOT'S OPERATING HANDBOOK FOR ADDITIONAL SPEEDS

On floor between pilot and copilot seats:

EMERGENCY GEAR EXTENSION
REMOVE COVER
EXTENSION INSTRUCTIONS ON REVERSE SIDE

On underside of emergency gear extension door:

EMERGENCY GEAR EXTENSION

1. PLACE GEAR SELECTOR HANDLE IN DOWN POSITION
2. PULL EMERGENCY PUMP HANDLE OUT AS FAR AS POSSIBLE
3. PUMP HANDLE UP AND DOWN UNTIL ALL 3 GREEN LIGHTS COME ON. CONTINUE PUMPING UNTIL PRESSURE BUILDS UP AND SELECTOR HANDLE RETURNS TO NEUTRAL

On fuel system console:

(a) On right end of fuel system control console:

RIGHT FIREWALL
FUEL
SHUT OFF

(b) On both ends of fuel system control console under cover:

OFF

(c) On left end of fuel system control console:

LEFT FIREWALL
FUEL
SHUT OFF

(d) On the fuel control console for outboard tank:

LEVEL FLIGHT ONLY

On window post between the second and third window on the right side of cabin:

EMERGENCY EXIT RELEASE
REMOVE COVER
PULL HANDLE DOWN
PUSH EMERGENCY
EXIT OUT

At top of emergency exit window on moulding:

EMERGENCY EXIT

On forward baggage compartment door:

BAGGAGE CAPACITY
150 LBS MAX
SEE LOADING SCHEDULE

On rear bulkhead in rear baggage compartment: (Serial numbers 31-7712001 through 7712103):

MAXIMUM BAGGAGE 200 LBS
INCLUDES 50 LBS ON SHELF
SEE LOADING SCHEDULE

On rear bulkhead in rear baggage compartment: (Serial numbers 31-7812001 and up):

MAXIMUM BAGGAGE 200 LBS
SEE LOADING SCHEDULE

On the pilot's window moulding:

WARNING

TURN OFF ANTI-COLLISION LIGHTS WHEN TAXIING IN VICINITY OF OTHER AIRCRAFT OR DURING FLIGHT THROUGH CLOUD, FOG OR HAZE. STANDARD POSITION LIGHTS TO BE TURNED ON FOR ALL NIGHT OPERATIONS.

On window moulding adjacent third and fourth passenger seats:

REQUIREMENTS FOR OCCUPANCY OF AFT FACING SEAT
1. SEAT HEADREST (10" MIN. HT.) INSTALLED.
2. SEAT BACK BOLTED IN UPRIGHT POSITION.

On pilot's door widow moulding (when pilot's door is installed):

OPEN DOOR CLOSED
CLOSE DOOR PRIOR TO STARTING ENGINES

THEFT LOCK
PULL TO UNLOCK
PRIOR TO FLIGHT

On inside of nacelle locker doors:

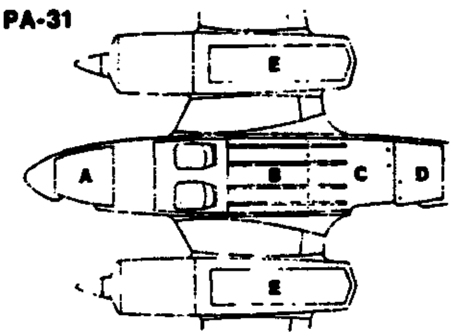
BAGGAGE CAPACITY
150 LBS MAX.
SEE LOADING SCHEDULE
DO NOT EXCEED
10 LBS/SQ. FT. FLOOR LOADING
OR 100 LBS DIFF. BETWEEN LOCKERS

On lower left instrument panel (when windshield wiper is installed):

WINDSHIELD WIPER
DO NOT OPERATE ABOVE 129 KIAS
OR ON DRY WINDSHELD

On top center of aft cabin panel (cargo loading placard):

PA-31



MAXIMUM CAPACITY

AREA	FLOOR LOAD LBS/SQ. FT.	ALLOWABLE LBS.	
A	100	150	
B	150	640	1478 TOTAL
C	150	640	
D	100	200	
E	IF WING LOCKERS ARE NOT INSTALLED THIS LINE DOES NOT APPLY		

MAXIMUM TIEDOWN CAPACITY

PER FOOT OF TRACK 200 LBS
PER TRACK 600 LBS
PER TIEDOWN RING 200 LBS

CARGO MUST BE LOADED WITHIN THE WEIGHT AND BALANCE LIMITS OF THIS AIRCRAFT

CODE NO. 582 062

On pilot's side window moulding (serial numbers 31-7712001 through 31-7812129):

FLAP SETTINGS IN EXCESS OF 25° ARE NOT APPROVED.
DISENGAGE THE AIRCRAFT AUTOPILOT PRIOR TO OPERATING FLAPS.
OPERATE FLAP CONTROL IN SMALL INCREMENTS TO ASSURE FLAP SYMMETRY.

TABLE OF CONTENTS
SECTION 3
EMERGENCY PROCEDURES

TABLE OF CONTENTS (cont)

SECTION 3 (cont)

SECTION 3

EMERGENCY PROCEDURES

3.1 GENERAL

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

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

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

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

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

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

3.3 EMERGENCY CHECK LIST

SPEEDS

Air Minimum Control.......................................76 KIAS
Best Single Engine Angle of Climb..................90 KIAS
Best Single Engine Rate of Climb....................94 KIAS
Maneuvering..159 KIAS
Never Exceed..236 KIAS

ENGINE INOPERATIVE PROCEDURES

ENGINE SECURING PROCEDURE (FEATHERING PROCEDURE)

Throttle..close
Propeller ....FEATHER (1000 RPM min.)
Mixture..IDLE CUT-OFF
Cowl flaps ....close
Magneto switch..OFF
Emergency fuel pump...OFF
Fuel selector ....OFF (detent)
Alternator CB switch ....OFF
Prop Sync ....OFF
Electrical load...reduced
Crossfeed...considered

ENGINE FAILURE DURING NORMAL TAKEOFF (Below 83 KIAS)

If sufficient runway remains for a safe stop:
Throttles ....immediately close
Brakes ....as required
Stop straight ahead

If insufficient runway remains for a safe stop:
Throttles ....immediately close
Brakes ....as required
Mixtures...idle cut-off
Master switch..OFF
Fuel selectors ....OFF
Magneto switches..OFF

NOTE

Maintain directional control and maneuver to avoid obstacles.

ENGINE FAILURE DURING NORMAL TAKEOFF (83 KIAS or above)

Directional control...maintain
Power (operating engine)......................max. continuous
Propeller control
  (inoperative engine) ....feather
Landing gear (in level
  or climbing flight)...retract
Bank..5°, into operating engine
Airspeed ....accelerate to 89 KIAS
Cowl flaps (inoperative
  engine) ....close
Airspeed...94 KIAS. after
all obstacles hare
been cleared
Engine securing procedures.............................complete
Trim ....as required

NOTE

Land as soon as practical at the nearest suitable airport.

ENGINE FAILURE DURING SHORT FIELD TAKEOFF (Above 91 KIAS)

If sufficient runway remains for a safe stop:
Throttles ....immediately close
Land ....on remaining runway
Brakes ....as required

If insufficient runway remains and the decision is made to abort the takeoff:
Throttles ....immediately close
Landing gear ....extend

NOTE

Depending on terrain, it may be advisable to land with the gear retracted.

Flaps..extend
Airspeed..89 KIAS min.
Master switch ....OFF
Mixtures ....IDEL CUT-OFF
Fuel selectors ....OFF
Magneto switches..OFF
Land avoiding obstacles

If insufficient runway remains, the terrain ahead is unsuitable for a safe landing and the decision is made to continue the takeoff:
Directional control..maintain
Power (operating engine)..max. continuous
Propeller control (inoperative engine) ....FEATHER
Landing gear (in level or climbing flight) ....retract
Bank..5° into operating engine
Flaps ....retract in increments
Airspeed..maintain 91 KIAS until all obstacles have been cleared then accelerate to 94 KIAS
Engine Securing Procedures ....accomplish

WARNING

Negative climb performance may result from an engine failure occurring after lift-off and before the gear and flaps have been retracted, the failed engine propeller has been feathered, and the cowl flap on the failed engine is closed. Refer to "Single Engine Climb" chart, Figure 5-21, for clean configuration positive climb performance.

ENGINE FAILURE DURING SHORT FIELD TAKEOFF (91 KIAS or below)

If sufficient runway remains for a safe stop:
Throttles ....immediately close
Land (if airborne) ....on remaining runway
Brakes ....as required

If insufficient runway remains tor a safe stop:
Throttles ....immediately close
Mixtures ....IDLE CUT-OFF
Master switch ....OFF
Fuel selectors ....OFF
Magneto switches..OFF
Land (if airborne) avoiding obstacles

ENGINE FAILURE DURING CLIMB

Airspeed ....maintain 94 KIAS
Directional control..maintain
Inop. engine ....identify and verify
Inop. engine..complete Engine Securing Procedure
Land as soon as practical at nearest suitable airport.

ENGINE FAILURE DURING FLIGHT
(Below 76 KIAS)

Rudder....................apply towards operative engine
Throttles (both engines)....................retard to stop turn
Pitch attitude....................lower nose to accelerate above 76 KIAS
Operative eng....................increase power as airspeed increases above 76 KIAS
If altitude permits, a restart may be attempted.

If restart fails or altitude does not permit:
Inop. eng. prop....................FEATHER
Trim....................adjust 5° toward operative eng.
Inop. eng....................complete Engine Securing Procedure
Cowl flap (operative eng.)....................as required

ENGINE FAILURE DURING FLIGHT
(Above 76 KIAS)
Inop. eng....................identify
Operative eng....................adjust as required

Before securing inop. engine:
Fuel flow....................check (if deficient - emergency fuel pump ON)
Fuel quantity....................check
Fuel selector (inop. eng.)....................switch to other tank containing fuel
Oil pressure and temp....................check
Magneto switches....................check

If engine does not start, complete Engine Securing Procedure.

Power (operative eng.)....................as required
Mixture (operative eng.)....................adjust for power
Fuel quantity (operative eng. tank)....................sufficient
Emergency fuel pump (operative eng.)....................as required
Cowl flap (operative eng.)....................as required
Trim....................adjust 5° toward operative eng.
Electrical load....................decrease to min. required
Land as soon as practical at nearest sutable airport.

SINGLE ENGINE LANDING

Inop. engine....................Engine Securing Procedure complete
Hydraulic pump....................check
Seat belts/harnesses....................secure
Heater....................FAN position
Emergency fuel pump (operative eng.)....................ON
Mixture (operative eng.)....................RICH
Propeller (operative eng.)....................full FORWARD
Fuel selector on operative engine side....................ON INBOARD tank
Crossfeed....................OFF
Cowl flap (operative eng.)....................as required
Airspeed....................maintain 104 KIAS min. Until landing is assured
Altitude....................higher than normal until landing is assured

When landing is assured:
Gear....................DOWN
Flaps....................DOWN
Power....................retard slowly and flare airplane
Trim....................as power is reduced (airplane will yaw in direction of operative engine)

SINGLE ENGINE GO-AROUND

(Not possible from a full flap position unless sufficient altitude is available to raise flaps in a descent.)

Avoid if possible, if necessary:
Airspeed .... hold 94 KIAS
Power .... max. on operating engine
Flaps .... retract
Landing gear .... retract
Cowl flaps .... as required
Trim .... as required

AIR START (UNFEATHERING PROCEDURE)

Fuel selector .... ON
Throttle .... open 1/2 inch
Propeller .... forward
Mixture .... slowly forward
Magnetos .... ON
Starter .... engage until prop unfeathers
Propeller .... pull back to low RPM position as propeller speed accelerates through 1000 RPM
Throttle .... reduced power till warm; 2000 RPM max.
Alternator .... ON
Engine instruments .... check
Prop Sync .... ON

ENGINE ROUGHNESS

Emergency fuel pumps .... ON
Engine instruments .... scan for cause
Mixture .... adjust as required
Alternate air .... OPEN
Cowl flaps .... adjust for proper CHT
Fuel .... switch tanks if fuel in second tank
Magnetos .... check

ENGINE OVERHEAT

Cowlflaps .... OPEN
Mixture .... richen
Power .... reduce
Airspeed .... increase (if altitude permits)

LOSS OF OIL PRESSURE

Engine .... secure per Engine Securing Procedure

ROUGH AIR OPERATION

Slow to maneuvering speed or slightly less (6500 lbs. 159 KIAS)
Fly attitude and avoid abrupt maneuvers.
Seat belt and shoulder harness - tighten.

ENGINE FIRE ON GROUND (Engine start, taxi and takeoff with sufficient distance remaining to stop)

Firewall shutoff .... OFF
Emergency fuel pump .... OFF
Brakes .... as required
Throttle (affected engine) .... OPEN
Radio .... call for assistance
Mixture (if fire persists) .... IDLE CUT-OFF
External fire extinguisher .... use

NOTES

If fire continues, shut down both engines and evacuate.
If fire is on the ground, it may be possible to taxi away.

ENGINE FIRE IN FLIGHT

Firewall fuel shutoff....OFF
Throttle....IDLE
Propeller....FEATHER
Mixture....IDLE CUT-OFF
Inoperative Engine....SECURE

Land as soon as possible.

ELECTRICAL FIRE

Flashlight (at night)....located
Master switch....OFF
Circuit breakers....checked & pulled
All electrical switches....OFF
Master switch....ON
CB and switch for each unit (one at a time)....ON
CB and switch for failed unit....OFF

CROSSFEED

Fuel selector (inop. eng.)....either tank
Emergency fuel pump (inop. eng.)....ON
Crossfeed....ON
Fuel selector (op. eng.)....OFF
Emergency fuel pump (op. eng.)....OFF

COMING OUT OF CROSSFEED (PRIOR TO LANDING)

Fuel selector (op. eng.)....INBOARD tank
Emergency fuel pump (op. eng.)....ON
Crossfeed....OFF
Emergency fuel pump (inop. eng.)....OFF
Fuel selector (inop. eng.)....OFF

ONE ALTERNATOR INOP. LIGHT ON

Electrical load....reduced
Approp. side of master switch....OFF
Tripped CBs....reset
Approp. side of master switch....ON
Elec. Load (if light goes out)....reinstated
If light remains lit or alt. CB has tripped:
Approp. side of master switch....OFF
Electrical load....reduction continued

TWO ALTERNATOR INOP. LIGHTS ON

Repeat above procedure for each side.
If both lights stay on:
Master switch (both sides)....ON
Alternator CB switches....OFF
Electrical load....minimum
Land as soon as practical.

PROPELLER/GOVERNOR MALFUNCTIONS

RPM UNDERSPEED

Power....reduced
Mixture....RICH
If prop. moves to feather:
Mixture....IDLE CUT-OFF
Prop control....FEATHER
Engine....Engine Securing Procedures complete

NOTE

Propeller will move to feather if engine oil pressure is lost.

RPM OVERSPEED

Power ....reduced
Airspeed ....reduced
Prop control (if prop speed cannot be kept below 2575 RPM) ....FEATHERED

NOTE

If prop will not feather, do not shut down engine.

Engine ....Engine Securing Procedures complete if prop will feather

EMERGENCY GEAR EXTENSION

Airspeed (S/N 31-7712001 thru 7712103 ....129 KIAS max.
Airspeed (S/N 31-7812001 and up) ....156 KIAS max.
Gear selector ....DOWN
Emerg. gear extender cover ....opened
Emerg. gear extender ....extended
Extender handle (till 3 green lights AND selector returns to neutral) ....pumped

EMERGENCY EXIT

Exit (second window from front on right side) ....locate
Plexiglas cover ....remove
Handle ....pull down
Emergency exit window ....push out

GEAR UP LANDING

Ground persormel ....inform (if possible.)
Fuel ....burn off (If time allows)
Passengers ....briefed
Normal landing check list ....complete
Gear selector ....UP
Autopilot ....OFF
Master switch ....OFF
Make a normal approach
When runway is made and landing assured:
Propellers ....FEATHER
Mixtures ....IDLE CUT-OFF
Firewall fuel shutoffs ....OFF
Fuel selectors ....OFF
Touch down at minimum airspeed and level attitude
Master switch (night) ....OFF
Evacuate

NOTE

If nose gear is not extended, the landing light will not be functioning.

ASYMMETRIC FLAP CONDITION (SER. NOS. 31-7712001 THROUGH 31-7812129)

DURING FLAP OPERATION

Flap switch ....OFF
Aileron ....maintain wings level
Flap switch ....ACTUATE, in increments (to obtain flap symmetry 0.5 sec. max.)

If symmetry is obtained or asymmetry stays the same or worsens:
Flap switch ....OFF
Flap control CB ....PULL

AFTER FLAPS HAVE BEEN POSITIONED

Autopilot ....disengage
Aileron ....maintain wings level
Flap switch ....ACTUATE, in increments (to obtain flap symmetry 0.5 sec. max.)

If symmetry is obtained or asymmetry stays the same or worsens:
Flap switch ....OFF
Flap control CB ....PULL

LANDING WITH ASYMMETRIC FLAPS

Approach speed ....106 KIAS min.
Power ....as required for 500-800 ft/min rate of descent. Slowly reduce during landing flare.

WARNING

Flight with maximum flap asymmetry (0° and 25°) will require an aileron deflection of approximately 85% of the total available travel to maintain wings level. Considering the decreased lateral control maneuvering capability (in the direction of the maximum deflected flap), minimize bank angles and roll rate while maneuvering.

FLAP SYSTEM MALFUNCTION (SER. NOS. 31-7912001 AND UP)

ANNUNCIATOR LIGHT ON

Flap selector ....reposition slightly
If flaps move ....replace amplifier prior to next flight
If flaps do not move.......................................check for split flap
If flaps are split.......................................pull flap motor CB and land in this condition
If flaps are not split.......................................pull and reset flap motor CB
If flaps still do not operate.......................................pull flap motor CB and land in this condition

FLAPS FAIL TO RESPOND TO FLAP SELECTOR (WITH FLAP INDICATOR POINTING TO OFF)

Flap control CB.......................................pull and reset
If indicator remains "OFF" ....the flap control is inoperative and flaps cannot be repositioned for landing or go-around
If indicator shows flap position.......................................use following checklist

FLAPS FAIL TO RESPOND TO FLAP SELECTOR (WITH FLAP INDICATOR POINTING TO FLAP POSITION)

Flap test switch ....push
If annunciator fails to light.......................................follow ANNUNCIATOR LIGHT ON checklist
If annunciator lights.......................................pull and reset flap motor CB
If flaps fail to respond ....a flap drive fault may exist and further effort to reposition flaps may cause damage

THIS PAGE INTENTIONALLY LEFT BLANK

THIS PAGE INTENTIONALLY LEFT BLANK

3.5 AMPLIFIED EMERGENCY PROCEDURES (GENERAL)

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

3.7 ENGINE INOPERATIVE PROCEDURES

ENGINE SECURING PROCEDURE (FEATHERING PROCEDURE)

The engine securing procedure should always be accomplished in a sequential order according to the nature of the engine failure (ie., practice, engine failure during takoff, engine failure during climb, etc.).

Begin the securing procedure by closing the throttle of the inoperative engine and moving its propeller control to "FEATHER" (fully aft) before the propeller speed drops below 1000 rpm. The inoperative engine mixture control should be moved fully aft to the "IDLE CUT-OFF" position. "CLOSE" its cowl flaps to reduce drag. Turn "OFF" the magneto switch, the emergency fuel pump switch and the fuel selector. Turn "OFF" the alternator circuit breaker switch of the inoperative engine. The propeller synchrophaser (if installed) should be OFF. Complete the procedure by reducing the electrical load and considering the use of the fuel crossfeed if the fuel quantity dictates.

ENGINE FAILURE DURING NORMAL TAKEOFF (Below 83 KIAS)

A preflight determination of runway length and computation of accelefate/stop distance will aid in determining the best course of action in the event of an engine failure during takeoff. If enginé failure occurs while sufficient runway remains for a deceleration and a safe stop, cut power immediately and stop straight ahead.

If an engine failure occurs before an airspeed of 83 KIAS is attained, and there is not adequate runway remaining for deceleration and a stop, immediately retard the throttle and mixture levers fully aft and brake as required. Turn "OFF" the master switch. the fuel selectors, and the magneto switches. During these procedures, maintain directional control and maneuver to avoid obstacles if necessary.

ENGINE FAILURE DURING NORMAL TAKEOFF (83 KIAS or Above)

If an engine fails during takeoff at an airspeed of 83 KIAS or above the pilot must decide whether to abort, following the above procedures, or to continue the takeoff and climb on a single engine. The pilot's decision must be based on a personal judgement, taking into consideration such factors as remaining runway, obstacles, the type of terrain beyond the runway, density altitude, weight and loading, weather, airplane condition, and the pilot's own proficiency and capability.

WARNING

> Certain combinations of aircraft weight, configuration, ambient conditions and airspeeds will result in negative climb performance. (Refer to specific chart in performance section.)

If takeoff is continued the airplane will tend to turn in the direction of the inoperative engine, since one engine will be inoperative and the other at maximum power. Rudder pedal force on the side of operating engine will be necessary to maintain directional control. If rotation for takeoff has begun or the aircraft is just airborne, maintain the takeoff attitude. The aircraft may skip along the runway or settle back to the runway, if airborne. Do not force the aircraft off the ground or raise the gear. but continue to maintain maximum power on the operating engine and the aircraft directionally aligned with the runway. Once the faulty engine is identified and its power loss verified feather its propeller. The drag reduction resulting from feathering the windmilling propeller will provide a rate of climb increment which will allow the aircraft to accelerate to and remain airborne at the 50 feet barrier airspeed (89 KIAS). If the aircraft will maintain level flight or a positive rate of climb, retract the landing gear. Maintain 89 KIAS until clear of obstacles and close the cowl flap on the inoperative engine. When above all obstacles accelerate to the best single engine rate of climb speed (94 KIAS), trim as necessary and CLOSE the cowl flaps on the operating engine as much as possible without exceeding engine temperature limits. After a climb has been established complete the "Engine Securing Procedure" on the inoperative engine. Continue a straight ahead climb until sufficient altitude (minumum of 1000 ft. above ground elevation) is reached to execute the normal "Single Engine Landing" procedure at the nearest suitable airport.

ENGINE FAILURE DURING SHORT FIELD TAKEOFF (Below 91 KIAS)

Should an engine failure occur prior to reaching the barrier speed (91 KIAS), the takeoff should be aborted. If the failure occurs while the aircraft is still on the ground and sufficient runway or suitable overrun remains, retard the throttles and apply braking as necessary. If insufficient runway or suitable overrun exists, retard the throttles, apply braking as required, pull the mixtures to idle cut-off, turn the master switch, fuel selectors, magneto switches off and steer the aircraft to avoid obstacles.

Should the engine failure occur after the aircraft is airborne, lower the nose to maintain airspeed, retard the throttles and land on the remaining runway, the runway overrun or the most suitable area straight ahead avoiding obstacles. If the landing cannot be accomplished on the remaining runway or overrun prior to touchdown, pull mixtures to idle cut-off, turn the master switch, fuel selectors and magneto switches to the off position.

ENGINE FAILURE DURING SHORT FIELD TAKEOFF (Above 91 KIAS)

Should an engine failure occur above the barrier speed (91 KIAS), the decision to abort or continue the takeoff will be based on several factors including altitude, aircraft weight, suitable landing areas, pilot proficiency and ambient conditions. The two most important considerations, however, are the altitude gained prior to the engine failure and the availability of suitable landing areas ahead of the aircraft at the time of the failure.

Should a suitable landing area (remaining runway, overrun or an area relatively free of obstructions) be accessible from the point where the engine failure occurs, the takeoff should be immediately aborted and a power landing should be accomplished within that area.

If a suitable landing area is not available and sufficient altitude has been obtained, the pilot may elect to continue the takeoff. Should the decision be made to continue the takeoff, it is of the utmost importance to realize that the aircraft will have negative single engine climb performance until the gear and flaps have been retracted. As altitude may be lost during gear and flap retraction, the decision to continue the takeoff should primarily be based on the altitude gained prior to the failure. Flight tests have indicated that as much as 100 feet may be lost during gear and flap retraction. The altitude loss is a difficult variable to quantify and is primarily predicted on pilot proficiency; however aircraft weight and ambient conditions must also be considered. Prior to takeoff, the pilot should always review the performance section to determine that adequate single engine climb performance exists for the takeoff weight and associated ambient conditions.

Should the decision be made to abort the takeoff, the throttles should be closed, the landing gear extended (terrain permitting), the flaps extended and a minimum airspeed of 89 KIAS should be maintained. If possible, plan to to land in an area free of obstructions. Prior to touchdown, position the mixture controls to idle cutoff and turn the master switch, fuel selectors and magneto switches off.

Should the decision be made to continue the takeoff, maintain directional control, identify and then feather the inoperative engine. In level or climbing flight, retract the landing gear. Apply 5° of bank into the operating engine and retract the flaps incrementally (recommend 3-5° increments). Maintain 91 KIAS until all obstacles have been cleared and then accelerate to 94 KIAS. Complete the engine securing procedures and land at the nearest suitable airport.

WARNING

Negative climb performance may result from an engine failure occurring after lift off and before the gear and flaps have been retracted, the failed engine propeller has been feathered and the cowl flap on the failed engine is closed. Refer to "Single Engine Climb" chart, Figure 5-21, for clean configuration positive climb performance.

ENGINE FAILURE DURING CLIMB

If engine failure occurs during climb, a minimum airspeed of 94 KIAS should be maintained. Since one engine will be inoperative and the other will be at maximum power, the airplane will want to turn in the direction of the inoperative engine. Rudder pedal force on the side of the operating engine will be necessary to maintain directional control. After the faulty engine has been identified and power loss verified, complete the "Engine Securing Procedures." Continue a straight ahead climb until sufficient altitude (minimum of 1000 feet above ground elevation) is reached to execute the normal "Single Engine Landing" procedure at the nearest suitable airport.

During climbs, the best single-engine rate of climb speed of 94 KIAS is recommended; however, in high ambient temperatures, airspeed may be increased to 103 KIAS if necessary for improved cooling. Normally, cylinder head temperatures can be maintained within limits through cowl flap adjustments. Climb rate will be reduced by approximately 50 FPM.

ENGINE FAILURE DURING FLIGHT (Below 76 KIAS)

Should an engine fail during flight at an airspeed below 76 KIAS, apply rudder towards the operative engine to maintain directional control. The throttles should be retarded to stop the yaw force produced by the inoperative engine. Lower the nose of the aircraft to accelerate above 76 KIAS and increase the power on the operative engine as the airspeed exceeds 76 KIAS.

After an airspeed above 76 KIAS has been established, an engine restart attempt may be made if altitude permits. If the restart has failed, or altitude does not permit, the engine should be secured. Move the propeller control of the inoperative engine to FEATHER and complete the "Engine Securing Procedure." Adjust the trim to 5° toward the operating engine. The cowl flap on the operative engine should be adjusted as required to maintain engine temperature within allowable limits.

THIS PAGE INTENTIONALLY LEFT BLANK

ENGINE FAILURE DURING FLIGHT (Above 76 KIAS)

If an engine fails at an airspeed above 76 KIAS during flight, begin corrective response by identifying the inoperative engine. The operative engine should be adjusted as required after the loss of power has been verified. Once the inoperative engine has been identified and the operating engine adjusted properly, an engine restart may be attempted if altitude permits.

Prior to securing the inoperative engine, check to make sure the fuel flow to the engine is sufficient. If the fuel flow is deficient, turn ON the emergency fuel pump. Check the fuel quantity on the inoperative engine side and switch the fuel selector to the other tank if a sufficient supply is indicated. Check the oil pressure and oil temperature and insure that the magneto switches are ON.

If the engine fails to start it should be secured using the "Engine Securing Procedure."

After the inoperative engine has been secured, the operative engine can be adjusted. Power should be maintained as required and the mixture control should be adjusted for power. Check the fuel supply and turn ON the emergency fuel pump if necessary. The cowl flaps on the operative engine should be adjusted as required to maintain engine temperatures within allowable limits. Trim 5° toward the operating engine. The electrical load should be decreased to a required minimum. Land as soon as practical at the nearest suitable airport.

SINGLE ENGINE LANDING

If a single-engine landing is necessary, a check should be performed to determine whether or not the hydraulic pump is functioning for normal gear extension. This check is accomplished by placing the landing gear control in the "UP" position with the gear retracted. If the hydraulic pump is functioning, pressure will return the control to the neutral position. This check should be performed before entering the traffic pattern so that there will be time to pump the gear down with the hand pump if necessary.

The "Engine Securing Procedure" should be complete on the inoperative engine. Fasten the seat belts and shoulder harnesses and select the "FAN" position of the heater switch. The operative engine electric fuel pump should be ON and the mixture RICH. Advance the propeller control (operative engine) full forward. Check to ensure that the fuel selector is ON the main (inboard) tank on the same side as the operating engine. The fuel crossfeed valve should be OFF. The cowl flap on the operative engine should be adjusted as required.

Maintain an airspeed of 104 KIAS or above and an altitude higher than normal until a landing is assured. When a landing is assured, extend the gear and flaps. Slowly retard the power on the operative engine and flare out the airplane for a normal landing. Trim as necessary as power is reduced. The airplane will tend to yaw toward the operative engine.

SINGLE ENGINE GO-AROUND

A single engine go-around should be avoided if at all possible. A go-around from a full flap position is not possible unless sufficient altitude is available to raise flaps in a descent. A final approach speed above 94 KIAS will place the airplane in the best configuration should a go-around be necessary.

To execute a single engine go-around, advance mixture, throttle, and propeller controls fully forward for maximum power on the operating engine. Retract flaps and landing gear. Maintain the airspeed at or above 94 KIAS. Set the trim and cowl flaps as required.

WARNING

A go-around should not be attempted after the airspeed is decreased below the best single engine angle of climb speed (90 KIAS).

During climbs, the best single-engine rate of climb speed of 94 KIAS is recommended; however, in high ambient temperatures, airspeed may be increased to 103 KIAS if necessary for improved cooling. Normally, cylinder head temperatures can be maintained within limits through cowl flap adjustments. Climb rate will be reduced by approximately 50 FPM.

AIR START (UNFEATHERING PROCEDURE)

Turn ON the fuel selector of the inoperative engine side and open the throttle 1/2 inch. Turn ON the magnetos. Move the propeller control full forward and the mixture control slowly forward. Engage the starter until the propeller is unfeathered. As the RPM passes 1000 coming out of feather, pull the propeller control back to the low RPM position to prevent excessive engine speed. Maintain the engine speed between 1800 and 2000 RPM, not exceeding 2000 RPM. This low power setting must be held until the engine is warmed up and oil pressure and temperature are stabilized within limits. Turn the alternator ON and check the engine instruments. The propeller synchrophaser (if installed) can then be turned ON.

3.9 ENGINE ROUGHNESS

If an engine falters or runs erratically, the cause may be fuel flow interruption, fuel contamination, icing or air starvation, or ignition problems. If roughness occurs, turn the emergency fuel pumps ON. Scan the engine instruments to see if the cause can be determined. Adjust the mixture controls for maximum smoothness; if the mixture is too rich or too lean, engine roughness may result. Open the alternate air control; a blocked induction system can cause roughness. If cylinder head temperatures are too high or too low, adjust the cowl flaps as required.

If the problem is in the fuel system, selecting another tank containing fuel may remedy the situation. A check of the magnetos will determine if they are operating properly.

3.11 ENGINE OVERHEAT

If engine temperatures become excessive, open the cowl flaps. Enriching the mixture and reducing power will also reduce engine temperature. If a more rapid reduction of engine temperature is desired, increase the airspeed by establishing a shallow dive.

3.13 LOSS OF OIL PRESSURE

Loss of oil pressure could be caused by a faulty pump, oil exhaustion, or a leak. A loss of oil pressure indication could be the result of a faulty gauge. In any event, continued operation of the engine could result in a serious emergency situation or severe engine damage.

Complete the "Engine Securing Procedure" (paragraph 3.7) on the faulty engine.

3.15 ROUGH AIR OPERATION

In conditions of extreme turbulence, slow the airplane to maneuvering speed or slightly less. Maneuvering speed will decrease with the weight of the airplane - e.g., 159 KIAS at 6500 lbs., 151 KIAS at 5400 lbs. A reduction in speed will ease the stress to which the airplane is subjected by turbulence. Fly attitude and avoid abrupt maneuvers. Fasten seat belts and shoulder harnesses as a precaution against buffeting and lurching. When flying in extreme turbulence or strong vertical currents and using the autopilot, the altitude-hold mode should not be used.

3.17 ENGINE FIRE ON GROUND (Engine start, taxi and takeoff with sufficient distance remaining to stop)

The first step to extinguish the fire is to move the firewall shutoff valve to "OFF." Next, turn OFF the emergency fuel pump. This will stop the flow of fuel to the burning engine. The brakes should be used as required. OPEN the throttle and use the radio to call for assistance.

If the fire persists, move the mixture control to "IDLE CUT-OFF," shut down the engines and evacuate; the fire should be extinguished by an external means.

If the fire is on the ground near the airplane, it may be possible to taxi to safety.

3.19 ENGINE FIRE IN FLIGHT

If an engine fire occurs in flight, position the firewall fuel shutoff valve of the faulty engine to OFF. Then, CLOSE the throttle, FEATHER the propeller, and set the mixture control to IDLE CUT-OFF. Use the Engine Securing Procedures (paragraph 3.7) to complete the engine shutdown.

Land as soon as possible.

3.21 ELECTRICAL FIRE

The presence of smoke in the cabin or the distinctive odor of smouldering insulation are indications of an electrical fire. The first step in coping with an electrical fire is to turn the master switch OFF. During night flight, be sure that a flashlight is in hand before turning off the master switch. Check for open circuit breakers; then pull all circuit breakers, and turn OFF all electrical switches and avionics switches.

Return the master switch to ON and, one unit at a time, turn ON the electrical switches and press in the circuit breakers for the individual units required for flight. When the faulty unit is located, pull its circuit breaker and turn its switch OFF. The failed unit should be left OFF for the remainder of the flight.

3.23 CROSSFEED

Crossfeed should be employed only when it is necessary to extend range during single-engine operation. Crossfeed must be OFF for takeoffs and landings.

To activate the crossfeed system, place the fuel selector valve of the inoperative engine side on either of the tanks on that side containing sufficient fuel quantity. Turn ON the emergency fuel pump of the inoperative engine.

Turn ON the crossfeed valve located at the base of the control pedestal. Then, on the side of the operating engine, turn OFF the fuel selector and turn OFF the emergency fuel pump.

3.25 COMING OUT OF CROSSFEED (PRIOR TO LANDING)

To return to normal operation during a single-engine landing when the crossfeed system has been in use, first place the fuel selector on the operating engine side in the "INBOARD" tank position. Turn ON the emergency fuel pump for the operating engine side and turn OFF the crossfeed valve. Then, on the inoperative side, turn OFF the emergency fuel pump and the fuel selector. It is recommended that the fuel system be returned to normal in sufficient time to determine normal operation prior to entering the landing pattern.

3.27 ONE ALTERNATOR INOPERATIVE LIGHT ON

In the event one of the alternator inoperative warning lights on the instrument panel illuminates, indicating an alternator failure, reduce the electrical load to the minimum necessary to sustain a safe flight. Turn OFF the side of the master switch corresponding to the side of the inoperative alternator. This will open the field circuit of the inoperative alternator. Reset any circuit breakers which may have popped. Return the appropriate side of the master switch to the ON position, and, if the alternator inoperative light has extinguished, reinstate the electrical load. If the warning light remains lit or if the alternator circuit breaker has tripped, return the corresponding side of the master switch to the OFF position, and continue the flight with a reduced electrical load.

3.29 TWO ALTERNATOR INOPERATIVE LIGHTS ON

If both alternator inoperative lights come on, repeat the above procedure individually for each side. Should both warning lights remain lit even after corrective action, turn ON both sides of the master switch and turn OFF both alternator circuit breaker switches. Reduce electrical load to an absolute minimum and terminate the flight as soon as possible, since all electrical power is being supplied by the airplane battery.

CAUTION

The alternator circuit breaker switches should not be opened manually when the alternators are functioning properly.

In case of the loss of both alternators, reduce electrical load by disconnecting the following equipment, as appropriate to the airplane:

(a) Turn OFF switches for the following:
  (1) Right pitot heat
  (2) Cabin heater
  (3) Heated windshield
  (4) Autopilot
  (5) All unnecessary avionic equipment
  (6) Prop deicing
  (7) Alternator field switches

(b) Open the following circuit breakers:
  (1) Right turn indicator
  (2) Trim indicating system
  (3) Instrument panel lighting (use flashlight)
  (4) Map lights
  (5) Cabin reading lights

CAUTION

If load shedding procedures have been carried out, the battery will provide electric power for approximately 35 minutes to complete a landing under IFR conditions including only a single flap extension and use of landing lights for a limited time. The above time depends upon the condition of the battery, temperature, and the time elapsed between alternator failure and load shedding.

3.31 PROPELLER/GOVERNOR MALFUNCTIONS

An internal malfunction of the propeller or governor could cause loss of RPM control and uncommanded movement of the propeller blades into high pitch or feather, or against the low pitch blade stop. A proper preflight check of the propeller governing and feather functions should indicate such malfunctions before takeoff. Should such a failure occur while airborne, the following actions are recommended:

PROPELLER RPM UNDERSPEED

If an uncommanded RPM decrease occurs while operating at high power settings, immediately retard the throttle to a low cruise power setting and advance the mixture control to full RICH. If the propeller moves to feather, as indicated by a very low RPM and attendant vibration, shut down the engine with the mixture control (idle cut-off) and move the propeller control to FEATHER. (Refer to Engine Securing Procedures.)

NOTE

The propeller will move to feather if engine oil pressure is lost.

PROPELLER RPM OVERSPEED

An uncommanded RPM increase could indicate an internal failure that has caused the propeller to move to full low pitch. Initiate corrective action by immediately reducing the throttle setting and decreasing the airspeed with a nose-up attitude. If the propeller has moved to the low pitch stop, it is effectively a very low pitch fixed-pitch propeller and will exceed the 2575 RPM limit until both airspeed and manifold pressure have been reduced.

At idle throttle, airspeed must be reduced below 127 KIAS to maintain the propeller speed below 2575 RPM. Once airspeed has been reduced, usable power for low-speed cruise (near single engine best rate of climb speed) and approach will be available without exceeding 2575 RPM.

Once the propeller speed has been reduced to 2575 RPM by airspeed and power reductions, the pilot can test for regained RPM control with the propeller lever.

The engine should not be shut down if the propeller cannot be feathered since high drag would result from a windmilling propeller in low pitch. If engine shut down is desired, the pilot should first test for feathering ability with the engine running at idle throttle. (Refer to Engine Securing Procedures if propeller will feather.)

NOTE

Do not secure the engine if the propeller cannot be feathered.

3.33 EMERGENCY GEAR EXTENSION

If the landing gear fails to extend when the gear selector is placed in the "DOWN" position, the hand-operated emergency gear extender should be employed. The emergency gear extender is located beneath the access plate on the cabin floor, between the crew seats.

Before the gear is extended, the airspeed must be reduced below a maximum of 129 KIAS (serial numbers 31-7712001 through 7712103) or 156 KIAS (serial numbers 31-7812001 and up). To extend the gear by use of the emergency extender, the gear selector must be in the "DOWN" position.

When the emergency gear extender cover is lifted, note that instructions are printed inside. Extend the emergency gear handle completely, and pump the handle until the three green lights on the instrument panel indicate that all three gear are locked down. The master switch must be ON for the gear lights to illuminate. Continue pumping until hydraulic pressure builds and the gear selector lever returns to the neutral position.

3.35 EMERGENCY EXIT

An emergency exit is located on the right side of the fuselage, and is the second sindow from the front. With the cockpit-cabin divider installed, the emergency window will appear as the most forward window on the right side of the cabin.

To use the emergency exit, remove the plexiglas cover over the handle; then pulll the handle and push out on the window.

3.37 GEAR UP LANDING

If all normal and emergency gear extension procedures have failed, a gear up landing will be necessary. Select a suitable landing area. If possible, inform ground personnel of the emergency situation. If time allows, burn off excess fuel. Brief passengers on the use of the emergency exit and be sure that all occupants have seat belts and shoulder harnesses secured properly.

When ready to land, complete the landing check list as for a normal landing, except that the gear selector should be in the "UP" position. Turn OFF the autopilot, and, in daylight, turn OFF the master switch. During a night landing when the master switch is left ON, the gear warning horn may sound when the throttles are retarded.

Make a normal approach, and when the runway is "made" and landing is assured FEATHER both propellers, place mixtures in "IDLE CUT-OFF," and turn OFF firewall fuel shutoff and fuel selectors. Land smoothly, touching down in a level attitude. At night, turn OFF the master switch after touchdown. All occupants should evacuate as soon as the airplane has stopped.

NOTE

The landing light is attached to the nose gear. Therefore, if the nose gear is not extended, the landing light will not be functioning.

3.39 ASYMMETRIC FLAP CONDITION (SER. NOS. 31-7712001 THROUGH 31-7812129)

An asymmetric flap condition occurs when the wing flaps become unsynchronized and each flap assumes a different deflection angle.

Should this condition occur, the aircraft will exhibit a tendency to roll towards the flap with the lesser deflection.

An asymmetric flap condition may occur during flap operation or after the flaps have been positioned. If, while operating the flaps, the aircraft exhibits an uncommanded roll tendency, immediately position the flap switch to the OFF position. Briefly activate the flap switch and then return to the OFF position (assuring that the switch does not remain in the UP or DOWN position longer than 0.5 seconds) to determine if the rolling tendency moderates. If the roll tendency moderates, continue the same incremental retraction until symmetry is obtained, and upon achieving symmetry, position the flap switch to the OFF position and pull the flap control circuit breaker.

If symmetry is obtained or asymmetry stays the same or worsens, immediately position the flap control to the OFF position and pull the flap control circuit breaker.

Should the aircraft exhibit an uncommanded rolling tendency after the flaps have been positioned, immediately disengage the autopilot (if engaged) and utilize the aileron control to maintain wings level. If the rolling tendency persists, utilize the previously mentioned incremental retraction technique to obtain flap symmetry. If symmetry is obtained or asymmetry stays the same or worsens, position the flap control to the OFF position and pull the flap control circuit breaker

Aircraft lateral control with full asymmetric flaps (0° and 25°) can be maintained by utilizing approximately 85% of the total aileron travel in the direction of the flap with the higher deflection angle. Aileron deflection does not vary appreciably with airspeed; however, the aileron force decreases proportionately with airspeed. The effects of power (symmetrical) have a small proportional effect on control deflection and force.

CAUTION

Although flight tests have shown the aircraft to be controllable with symmetrical power, brief application of asymmetric power (increased power on the side of lesser flap deflection) may enhance roll control. Prolonged flight with large power asymmetry is not recommended.

The landing approach should be planned to provide a higher and wider pattern than normal considering the aircraft's reduced lateral control capability. After turning final approach, configure the aircraft for landing. Set the power for a 500-800 ft. rate of descent and establish a final approach airspeed of 106 KIAS. During the landing flare, gradually reduce power. Touchdown in a level flight attitude.

WARNING

Considering the aircraft's reduced roll capability, always select a landing runway which will minimize the crosswind component. Should a landing become necessary in a crosswind condition, maintain a wings level attitude while varying the aircraft's heading for runway alignment until the aircraft has touched down.

3.41 FLAP SYSTEM MALFUNCTION (SER. NOS. 31-7912001 AND UP)

In the event of a flap system failure which causes asymmetric ("Split") flaps, the flap drive stops automatically and the "flaps" annunciator lights when the difference between the flaps reaches five degrees. If this occurs, no further control of the flaps is provided and the remainder of the flight including the landing and go-around if necessary, must be planned without repositioning the flaps. Asymmetric flaps may usually be identified by a rolling tendency, depending on the lift characteristics of the flaps at the positions where they fail.

A "FLAP" annunciator warning without asymmetric flaps can be caused by a failed amplifier. In this case, the flight may be continued with the knowledge that, in the event of asymmetric flaps, no further annunciator warning will exist. The amplifier should be replaced prior to the next flight.

Failure of the flaps to move without an asymmetric condition can be caused by a tripped flap control circuit breaker or flap motor circuit breaker at the circuit breaker panel on the left wall of the cockpit. If neither circuit breaker is tripped, a fault exists in the flap drive and further effort to reposition the flaps should be carefully considered so as not to compound the problem.

If a flap malfunction should occur and the flap control circuit breaker or the flap motor circuit breaker is not tripped, proceed accordingly to the Emergency Procedure Checklist on page 3-8.

CAUTION

Do not reset a tripped flap motor circuit breaker if a split flap condition exists.

TABLE OF CONTENTS

SECTION 4

NORMAL PROCEDURES

SECTION 4

NORMAL PROCEDURES

4.1 GENERAL

This section describes the recommended procedures for the conduct of normal operations for PA-31 Navajo airplanes. All of the required (FAA regulations) procedures and those necessary for the operation of the airplane as determined by the operating and design features of the airplane are presented.

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

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

The first portion of this section is a short form checklist which supplies an action sequence for normal procedures with little emphasis on the operation of the systems.

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

4.3 AIRSPEEDS FOR SAFE OPERATION

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 normal conditions at sea level. For additional airspeed information see Section 2.

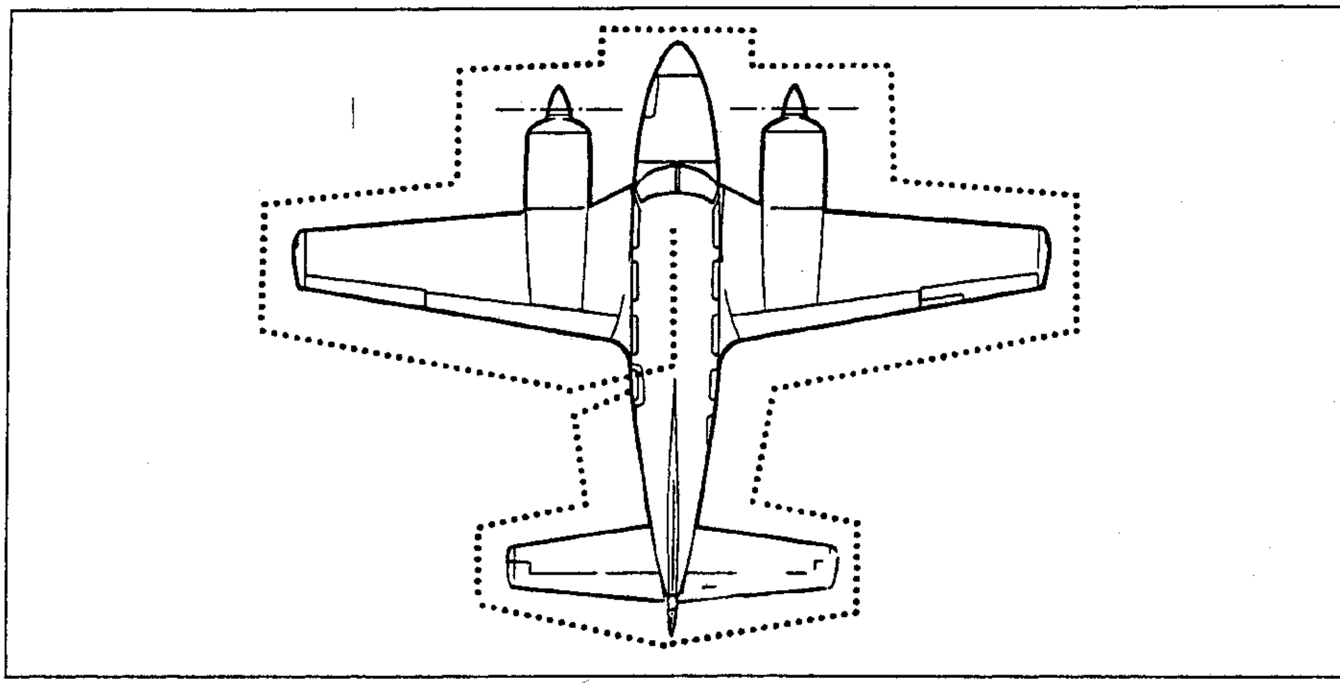
Performance for a specific airplane may vary from published figures depending upon the equipment installed, the condition of the engines, airplane, and equipment, atmospheric conditions and piloting technique.

(a) Never Exceed Speed	236 KIAS
(b) Maximum Structural Cruising Speed	188 KIAS
(c) Design Maneuvering Speed	159 KIAS
(d) Maximum Flaps Extended Speeds	
0° to 15° Flaps	
Serial numbers 31-7712001 through 7712103	164 KIAS
Serial numbers 31-7812001 and up	174 KIAS
25° Flaps (full flaps) (Serial numbers 31-7712001 through 31-7812129)	140 KIAS
25° Flaps (Serial numbers 31-7912001 and up)	174 KIAS
40° Flaps (full flaps) (Serial numbers 31-7912001 and up)	140 KIAS

(e)	Maximum Gear Extended Speed	
	Serial Numbers 31-7712001 through 7712103	129 KIAS
	Serial Numbers 31-7812001 and up	156 KIAS
(f)	Maximum Gear Operating Speed	
	Extend	
	Serial numbers 31-7712001 through 7712103	129 KIAS
	Serial numbers 31-7812001 and up	156 KIAS
	Retract	129 KIAS
(g)	Best Rate of Climb Speed	
	0° Flaps	94 KIAS
(h)	Best Angle of Climb Speed	80 KIAS
(i)	Final Approach Speed	100 KIAS
(j)	Intentional One Engine Inoperative Speed	90 KIAS
(k)	Maximum Demonstrated Crosswind	20 KTS

THIS PAGE INTENTIONALLY LEFT BLANK

THIS PAGE INTENTIONALLY LEFT BLANK



WALK-AROUND
Figure 4-1

4.5 NORMAL PROCEDURES CHECKLIST

PREFLIGHT CHECK

COCKPIT

Controls .... release
Magneto switches .... OFF
Electrical switches .... OFF
Flap switch .... OFF
Mixtures .... IDLE CUT-OFF
Master switch .... ON
Gear lights .... 3 green
Parking Brake .... set
Fuel quantity .... sufficient
Trim .... neutral
Cowl flaps .... OPEN
Master switch .... OFF
Airplane papers .... checked
Emergency window .... secure
Oxygen pressure .... sufficient
Oxygen masks .... in place

LEFT WING

Surface .... checked
Flap and flap tracks .... checked
Aileron .... checked
Fuel tanks and filler caps .... checked
Fuel tank vents .... clear
Tie down .... removed
Fuel drains (4) .... drained and check for water, sediment and proper fuel
Landing gear .... checked
Chock .... removed
Nacelle .... checked
Oil .... checked
Cowl flap area .... checked
Engine cowl .... check condition

CAUTION: Check that the four screws securing the nose bowl are present and secure. A screw driver may be needed to do this. Check that the six (three per side) side cowling fasteners are present and secure. Check for both the proper alignment of the paint stripes on the cowling and fastener and for the extension of the locking pin indicator in the fastener slot.

WARNING: Failure to insure the presence and security of nose bowl and cowl side fasteners may result in inflight cowl separation and loss of aircraft control.

Propeller .... checked
Accessory section (engine) .... checked
Gear mirror .... checked

NOSE SECTION

General condition .... checked
Baggage .... secure
Baggage door .... locked
Battery vents .... clear
Nose gear .... checked
Chock .... removed
Pitot tubes .... clear
Landing lights .... checked

RIGHT WING

Check as for left wing (3 fuel drains).

FUSELAGE (RIGHT SIDE)

General condition .... checked
Static openings .... clear
Antennas .... checked

EMPENNAGE

Surface condition .... checked
Tie down .... removed
Trim tabs .... neutral and checked for play
Hinges and push rods .... checked

FUSELAGE (LEFT SIDE)

General condition .... checked
Static openings .... clear
Doors .... checked

BEFORE STARTING ENGINES

Preflight inspection .... completed
Cabin doors .... secure
Passenger briefing .... completed
Seats .... adjusted
Belts and harness .... secure
Parking brake .... set

WARNING

Braking may not occur if parking brake handle is pulled and held prior to brake pedal application.

Controls .... checked
Fuel selectors .... INBOARD
Crossfeed .... OFF
Fuel firewall shutoffs .... ON
Alternate air .... OFF (in.)
Circuit breakers .... checked
Electrical switches .... OFF
Alternator CB switches .... ON
Avionics switches .... OFF
Alternate static source .... OFF
Mixtures .... IDLE CUT-OFF
Master switch .... ON
Cowl flaps .... OPEN
Gear lights .... 3 green
Annunciator panel (S/N 31-7812001 and up) .... press-to-test
Alternator inop. lights .... ON
Pneumatic source malf. lights .... ON
Door ajar lights .... OUT
Fuel flow lights .... checked
Emergency fuel pumps .... OFF
Prop synch .... OFF
AP/FD switch .... OFF
Seat belts and no smoking sign .... ON

ENGINE START

NORMAL START

(Master switch off when using APU.)
Throttle .... cracked
Prop control .... forward
Mag switches .... ON
Mixture .... RICH
Emergency fuel pump .... ON till 6 gph then OFF
Mixture .... IDLE CUT-OFF
Prop .... clear
Starter .... engaged
Mixture (when eng. starts) .... advance
Oil and fuel pressure .... checked
Alternator inop. light .... OUT
Pneumatic malf. light .... OUT
Gear handle (hydraulic check) .... DOWN then returns to neutral
Second engine .... repeat first 10 steps thru "pneumatic malf. light - OUT"

HOT START

Throttle .... cracked
Prop control .... forward
Mag switches .... ON
Emergency fuel pump .... ON (do not prime)
Prop .... clear
Starter .... engaged
Mixture (when eng. starts) .... advance
Emergency pumps .... OFF after approx. 3 min.
Normal start procedure .... complete

FLOODED START

Mixture....IDLE CUT-OFF
Mag switches....ON
Throttle....full OPEN
Prop....clear
Starter....engaged
When engine starts:
Mixture....advance
Throttle....1000 RPM

BEFORE TAXIING

APU....removed
Master switch....ON
Lights....as required
Heater....as required
Gyros....set
Altimeter and clock....set
Electric trim....ON and checked
Avionics switches....ON
Autopilot....checked and OFF
Fuel valves (all positions)....checked
Radios....checked
Parking brake....released

TAXIING

Brakes....checked
Flight instruments....checked

ENGINE RUN-UP

Parking brake....set
Mixtures....RICH
Prop controls....forward
Cowl flaps....OPEN
Engine instruments....checked
Throttles....1500 RPM
Prop controls (max. drop 500 RPM)....feather checked
Gyro pressure (4-6 psi)....checked
Alternator output....checked
Alternator inop. lights....OUT
Annunciator panel lights (S/N 31-7812001 and up)....OUT
Throttles....2300 RPM
Mags (max. drop 175 RPM; max. diff. 50 RPM)....checked
Prop controls (max. drop 300 RPM)....exercised
Throttles (600-650 RPM)....idle checked
Throttles....1000 RPM
Friction....set

BEFORE TAKEOFF

Seat belts and no smoking sign....ON
Fuel selectors....INBOARD
Fuel quantity....sufficient
Mixtures and props....forward
Flaps....checked and set 0° for normal takeoff; checked and set 15° for short field takeoff
Autopilot....OFF
Trim....set
Surface deice....OFF
Pitot and prop heat....as required
Windshield heat....as required
Avionics....as required
Direction indicator....set
Transponder....as required
Controls....checked
Emergency fuel pumps....ON
Parking brake....released

NORMAL TAKEOFF

Throttles....full forward
Manifold pressure....checked
Prop speed....2575 RPM
Rotate....83 KIAS min.
Gear....UP
Accelerate to....barrier speed (89 KIAS)

SHORT FIELD TAKEOFF

Brakes....hold
Throttles....full forward
Manifold pressure....checked
Prop speed....2575 RPM
Brakes....release
Rotate....76 KIAS
Accelerate to....Barrier speed — 91 KIAS

After the barrier has been cleared:
Gear....retract
Flaps....retract
Accelerate to....Best Single Engine Rate of Climb Speed (94 KIAS)

CLIMB

Climb power (when safely clear of obstacles or terrain) ....35" MP 2400 RPM
Mixture (26 GPH min. 450° CHT max., 1550° EGT max.) ....LEAN
Cowl flaps ....as required
Emergency fuel pumps ....OFF
Seat belts and no smoking sign ....as required
Oxygen ....as required
Emergency fuel pumps ....as required

CRUISE

Emergency fuel pumps ....as required
Fuel selectors ....OUTBOARD OR INBOARD
Power ....set
Cowl flaps ....as required
Mixture ....leaned

DESCENT

Mixtures ....min. 1350° EGT
Fuel selectors ....INBOARD
Power ....as required
Oxygen (below 10,000 ft.) ....OFF
Pitot and windshield heat ....as required

BEFORE LANDING

Seat belts and no smoking sign ....ON
Emergency fuel pumps ....ON
Mixtures ....RICH
Prop synch ....OFF
Prop controls ....2400 RPM
Gear ....DOWN
(below 129 KIAS in S/N 31-7712001 thru 7712103)
(below 156 KIAS in S/N 31-7812001 and up)
Gear lights ....3 green
Gear mirror ....checked
Brake pressure ....checked
Autopilot ....OFF
Wing flaps ....as required down in steps
(164 KIAS max. 15° S/N 31-7712001 thru 7712103)
(174 KIAS max. 15° S/N 31-7812001 and up)
(174 KIAS max. 25° S/N 31-7912001 and up)
(140 KIAS max. full flaps)
Landing lights ....as required

BALKED LANDING

Power ....as required
Gear ....UP
Wing flaps (15° till clear of obstacles) ....UP in steps

AFTER LANDING (CLEAR OF RUNWAY)

Radar ....OFF
Cowl flaps ....OPEN
Wing flaps ....UP
Emerg. fuel pumps ....OFF
Heater switch (if used) ....FAN
Prop controls ....forward
Strobes ....OFF

SHUTDOWN

Parking brake ....set
Avionics ....OFF
AP/FD ....OFF
Throttles ....IDLE
Mag grounding ....checked
Throttles ....1000 RPM
Lights ....OFF
Heater switch ....OFF
Electrical equipment ....OFF
Mixture (1st eng. started) ....IDLE CUT-OFF
Gear handle ....DOWN
Gear handle (hydraulic check) ....returned to neutral
Mixture (2nd eng.) ....IDLE CUT-OFF
Mags ....OFF
Master switch ....OFF

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

The airplane should be given a thorough preflight and walk-around check. The preflight should include a determination of the airplane's operational status, a check that necessary papers are onboard and in order, and a computation of weight and C.G. limits, takeoff distance, and in-flight performance. Baggage should be weighed, stowed, and tied down. A weather briefing for the intended flight path should be obtained, and other factors relating to a safe flight should be checked before takeoff.

COCKPIT

Upon entering the cockpit, release the controls if they have been secured. After insuring that magneto switches, electrical switches and flap switch are OFF and that mixture levers are in "IDLE CUT-OFF," turn the master switch ON. Check that the fuel quantity gauges are operating and that there is sufficient fuel for the flight. Fuel quantity gauges indicate the amount of fuel in the tanks selected on the fuel selector valves. Check that the three green gear position lights illuminate. Set the parking brake. Set all trim controls to neutral and fully open the cowl flaps. Turn OFF the master switch.

While still inside the airplane, check that the emergency window is secure and that an oxygen mask is present and operational and properly stowed if installed. Check the oxygen pressure gauge on the lower left instrument panel to ascertain that the oxygen supply is sufficient. Check that the oxygen control knob is pushed into the OFF position.

A complete walk-around check should be routinely performed during each preflight. A set pattern should be established, starting at the cabin door and proceeding forward, completely around the airplane, and terminating upon return to the cabin door.

LEFT WING

Proceed first along the trailing edge of the left wing, checking the wings, control surfaces, and hinges for damage and operational interference. The wings and control surfaces should be free of ice, snow, frost, or other extraneous substances. Static wicks should be in place and in good condition. The fuel supply should be checked visually, and fuel caps securely in place. Fuel vents should be clear of obstructions. If surface deicing is installed, the boots should be free from defects and flat against the wing surface. If tie-downs and chocks have been employed, they should be removed before flight. The wing tip and lights should show no signs of damage.

On the underside of the left wing are four fuel drains which should be briefly drained during the preflight check to allow the removal of any possible accumulation of moisture or sediment in the fuel system, and to verify fuel octane by checking the color. Pushing up on the arm of each fuel drain valve for a few seconds should allow sufficient fuel to flow to allow the removal of contaminants. Collecting drained fuel in a clear container and examining it visually is recommended.

The landing gear should be examined. The strut should be inflated to expose about 3.25 inches of piston tube when supporting an empty airplane with full fuel tanks and full oil and operating fluids. The condition of components of the strut, the gear doors, the brakes, the gear micro switch, etc., should appear sound, and fittings, attachments, screws, hinges, etc., should be secure. The tire should be inflated to 60 psi, and should be examined for breaks, cuts, bruises, cracks, and excessive wear.

At the engine nacelle, access panels should be secure. The engine cowl flap area, wheel wells, and nacelle intakes should be clear of debris, bird nests, etc. Oil quantity can be checked through the access door on the top of the nacelle. The oil filler must be replaced securely.

The propeller blades and spinner should be checked for nicks, cracks, dents, or other defects. There should be no indication of leakage of oil, fuel, or other fluids in the area of the wing or on or about the nacelle and landing gear. Inboard of the nacelle, the gear mirror should be clean and intact, and the wing root fillet should show no signs of stress.

NOSE SECTION

Continue from the left wing forward around the nose section of the airplane. All access plates should be secure, and the general condition of the nose section should appear sound. Baggage should be securely stowed and the baggage compartment door completely closed and locked. Battery vents and heater inlets and outlets should be open and clear. The nose gear should be checked in the same manner as the main gear, with a proper strut piston tube exposure of about 3.25 inches, and a proper tire inflation of 42 psi. No leakage of hydraulic or brake fluid should be present. If a chock has been employed, it should be removed. Landing and taxi lights should be clean and intact.

If pitot tube covers have been installed, they must be removed, and the pitot head opening checked and ensured clear of insects, dirt, or other obstructions. When pitot heat operation is to be checked, the master switch and pitot heat switch must be turned on, and the pitot head found hot to touch.

The windshield and pilot and copilot side windows should be clean and the windshield wipers in good condition.

RIGHT WING

Continuing aft and around the right wing, the same checks and procedures as performed on the left wing should be completed in reverse order. There are three fuel valves which must be drained under the right wing. The right aileron includes a trim tab which must be checked.

FUSELAGE (RIGHT SIDE)

Check the general condition of the right side of the fuselage. The emergency exit window should be secure and flush with the fuselage skin, and all side windows should be clean and without defects. Antennas and cables should be in place and securely attached. The openings in the static pads should be clean and unobstructed.

EMPENNAGE

All surfaces of the empennage should be examined for damage and operational interference. Fairings and access covers should be attached and in good condition. Deicer boots should be in good condition and flat against the surface. The elevator and rudder should be free and in good condition. With the trim controls set neutral, all trim tabs should be neutral. Check the condition of the tabs, and ensure that all hinges and push rods are secure and in good condition. If the tail has been tied down, remove the tie-down rope.

FUSELAGE (LEFT SIDE)

On the left side of the fuselage, the static openings should be clear, side windows clean and sound, and cabin door attachments and hinges operational. If night flight is anticipated, before completing the walk-around ensure that all exterior lights are operational; the master switch must be ON for this check.

When all occupants are boarded, the pilot should check that all cabin doors are properly closed and latched. The door support cables should be held in position, if necessary, so that they will not interfere with the closing of the door.

4.11 BEFORE STARTING ENGINES

After preflight interior and exterior checks have been completed and the airplane has been determined ready for flight, the cabin door should be secured, and all occupants seated. Check that the aft baggage compartment and the cabin cargo area if it is loaded are secure and that tie-downs are used where necessary. Passengers should be briefed on the use of seat belts and shoulder harnesses, the emergency exit, supplementary oxygen, ventilation controls, seat adjustment, comfort facilities, etc. The pilot should advise the passengers when smoking is prohibited and caution them against handling controls, equipment, door handles, and the emergency exit. It may be advisable to inform passengers of sounds or sensations which may not be familiar to them, but which are associated with normal flight. All seats should be adjusted and secured in position and seat belts and shoulder harnesses properly fastened.

Set the parking brake by first depressing and holding the toe brake pedals and then pull out on the parking brake handle.

WARNING

Braking may not occur if parking brake handle is pulled and held prior to brake pedal application.

Check that control levels move smoothly, and adjust the friction control as desired. Fuel selectors should be set on the inboard tank position, the crossfeed turned OFF, and the fuel fire wall shutoffs checked open.

Check that the manual alternate air controls on the lower instrument panel are pushed in and OFF. All circuit breakers should be IN and alternator circuit breaker switches ON. All other electrical switches and all avionics switches should be OFF. Check that all radio switches, light switches and the pitot heat switch are OFF to avoid an electrical overload when the starter is engaged. The alternate static source control under the left side of the instrument panel should be OFF, and the mixture controls should be in the "IDLECUT-OFF" position.

Turn ON the master switch. Three green gear lights should illuminate. The alternator inoperative lights and pneumatic source malfunction lights should come on and remain on until the engines are started. The door ajar lights on the overhead panel should both be out. Check that both cowl flaps are open. Check the function of the fuel flow warning lights by using the press-to-test feature. In airplanes with serial numbers 31-7812001 and up, check the annunciator panel by using the press-to-test switch. Before starting the engines, turn ON the seat belt and no smoking signs, and check that passengers comply.

4.13 ENGINE START

NORMAL START

If an external auxiliary power unit (APU) is used for starting, the master switch and all avionics switches should be OFF until both engines are running and the power unit is removed. When an APU is used, it is recommended that the right engine be started first. Crack the throttle of the first engine to be started about 1/2 inch, advance the propeller control forward, and turn the magneto switches ON. Advance the mixture control to "RICH" and turn ON the emergency fuel pump to prime the engine until a fuel flow of 6 gallons per hour is indicated, then pull the mixture control aft to "IDLE CUT-OFF." Visually confirm that the propeller area is clear, and engage the starter. When the engine starts, advance the mixture control slowly toward the "RICH" position. Adjust the throttle as necessary to maintain a speed below 1000 RPM. Check the oil pressure gauge for an indication. Normally there should be an indication of oil pressure within 30 seconds. In cold weather it may take a few seconds longer. If after allowing sufficient time there is no oil pressure, shut down the engine until the cause is determined and remedied. Check the fuel pressure gauge.

Check to see that the alternator inoperative light and the pneumatic malfunction light for the running engine are extinguished. To check the function of the hydraulic pump of the first engine started, place the gear selector lever in the "DOWN" position. If the pump is functioning properly, the gear lever will automatically return to neutral.

Start the second engine following the same procedure. The hydraulic pump check should be eliminated from the starting procedures for the second engine. When both engines are running, all warning lights should be extinguished.

HOT START

If the engines are still warm from previous operation, the mixture control should remain in "IDLE CUT-OFF" and the priming steps eliminated. Crack the throttle, and advance the propeller control. Turn ON the magneto switch and the emergency fuel pump. Do not prime! Engage the starter. When the engine starts, advance the mixture control. Leave the emergency fuel pump on for approximately 3 minutes to purge the fuel lines to the engine and proceed as in a Normal Start (see above).

FLOODED START

If an engine is flooded (by overpriming, for example), the mixture should be pulled to "IDLE CUT-OFF." After turning ON the magneto switches, advance the throttle to the fully "OPEN" position and engage the starter. Advance the mixture control only after the engine has started, and retard the throttle lever to 1000 RPM.

4.15 BEFORE TAXIING

If an APU has been used for start, it should be disconnected and the master switch turned ON.

Lights and heater may be turned on as desired. Set gyros and clocks as required. Set the altimeter to field elevation. Turn ON and check electric trim. Turn ON the avionics master switch. Check the autopilot (see Section 9), then turn it OFF. Check the fuel selectors in all positions, at the same time observing that fuel warning lights should not illuminate. Check the radios, and set them as desired. Release the parking brake by first depressing and holding the toe brake pedals and then push in on the parking brake handle.

4.17 TAXIING

While taxiing, apply the brakes to determine their effectiveness. Check the flight instruments to see that they are functioning.

4.19 ENGINE RUN-UP

Set the parking brake ON. Advance mixture and propeller controls, and open the cowl flaps. Check engine instruments to see that they are functional and that readings are within limitations. (See Section 2.)

The engines are equipped with a dynamic counterweight system and must be operated accordingly. Use smooth steady movements of the throttle controls, and avoid rapid opening and closing. Set the throttles to an engine speed of 1500 RPM. Retard the propeller controls aft to check feathering; however, do not allow a drop of more than 500 RPM. Check that the gyro pressure gauge is reading within the green arc.

Check alternator output by pressing first one and then the other momentary push button located on either side of the ammeter. Alternator output readings should be approximately equal.

Advance the throttles until engine speed reaches 2300 RPM. Check the magnetos on each engine by turning OFF, then ON, each of the four magneto switches in turn. The normal drop when a magneto is turned off is about 90 RPM. The maximum allowable drop is 175 RPM. The maximum differential between the magnetos on one engine is 50 RPM. After checking one magneto, do not check the next until the engine speed returns to 2300 RPM. Operation of an engine on one magneto should be kept to a minimum.

Exercise the propeller levers through their range to check their operation. Response should be normal. Do not allow speed to drop more than 300 RPM.

Retard the throttles to 600-650 RPM to check idling. Set the throttles at 1000 RPM; recheck the flight instruments, and reset them if necessary. Set the desired amount of friction on the engine control levers.

4.21 BEFORE TAKEOFF

Seat belts and no smoking signs should be ON for takeoff. Inboard fuel tanks must be used for takeoff; therefore ensure that both fuel selectors are on the inboard tank positions and that the fuel quantity is sufficient.

Check that the mixture and propeller controls are full forward. Check the wing flaps for proper operation. Extend wing flaps 15°. Visually confirm that right and left wing flaps are equally extended. Retract the flaps. After the flaps begin to move, press and hold the flap test switch, (S/N 31-7912001 and up). The flaps should stop and the FLAP annunciator should illuminate. Release the flap test switch; the annunciator should extinguish and the flaps retract to 0°. Confirm flaps are at 0°. Check to be sure that the propeller, synchrophaser, autopilot, and surface deicers are OFF, if installed. Set trim for takeoff.

Recheck alternator output. Turn pitot, propeller, and windshield heat on if necessary. Set avionics as required. Set the direction indicator if necessary and set the transponder as required. Make certain that controls are free and that all engine instruments are reading within limits. Turn emergency fuel pumps ON for takeoff. Check that no warning lights are lit. Do not take off if a fuel flow warning light is illuminated.

4.23 TAKEOFF

NORMAL

While holding the brakes with the mixture and propeller levers full forward, advance the throttles slowly to a manifold pressure of 30 inches of mercury; then continue to advance the throttles at a normal rate and release brakes, but do not allow manifold pressure to exceed 46 inches. Use smooth steady throttle movements, and avoid rapid opening and closing. Propeller speed for takeoff should be 2575 RPM.

The engines are adjusted to provide 40 inches Hg. manifold pressure at full throttle in standard temperature at sea level. Depending upon an altitude and temperature it is possible to reach higher (up to 46 inches) or lower manifold pressures.

Each engine density controller is set to produce rated takeoff power for that engine. The takeoff power manifold pressure for each engine will not necessarily be the same. However, if the spread in manifold pressure exceeds three inches during a full throttle climb, the density controller settings should be checked and serviced.

At 83 KIAS, rotate the aircraft and allow it to fly off. Maintain pitch attitude which will result in acceleration of the aircraft to 89 KIAS at 50 feet. Before airspeed exceeds 129 KIAS, retract the landing gear. Continue acceleration to the desired climb airspeed.

SHORT FIELD

The initial segment of the short field takeoff procedure is identical to the normal procedure except that the brakes shall be held until it has been determined that each engine is operating normally at maximum continuous power. After it has been determined that each engine is operating normally at maximum continuous power, release the brakes, neutralize the elevator control and initiate the take-off roll. Maintain directional control with the nose wheel steering system only. Avoid making steering inputs with brakes as this may result in increasing the takeoff ground roll distance.

At 76 KIAS, rotate the aircraft to achieve an altitude that will result in an initial climb airspeed of 91 KIAS. Maintain 91 KIAS until the barrier has been cleared. After the barrier has been cleared, retract the landing gear, the flaps and accelerate to 94 KIAS (best single engine rate of climb).

4.24 CLIMB

When clearance above obstacles and terrain permits, reduce to Climb Power by setting the throttles to 35 inches Hg. manifold pressure and the propellers to 2400 RPM. Lean the mixture to a minimum fuel flow to 26 gallons per hour at a maximum exhaust gas temperature of 1550°F and maximum cylinder head temperature of 450°F. Adjust cowl flaps and mixture as necessary to maintain engine temperatures within limits.

Turn the emergency fuel pumps OFF one at at time, and check fuel gauges and warning lights. At power settings above 75%, maintain the mixture controis in the full RICH position except with the Climb Power setting when the mixture may be leaned as stated in the preceding paragraph.

Although the maximum approved operating altitude for this airplane is 24,000 feet, under standard atmospheric conditions and at maximum gross weight the multi-engine service ceiling and absolute ceiling are 26,300 feet and 27,300 feet, respectively.

4.25 CRUISE

During cruise, it is recommended that when the airplane is loaded to a rearward C.G., fuel from the outboard tanks be used first. This will tend to move the C.G. forward with fuel burn-off. Outboard tanks should be used during coordinated level flight only. If outboard tanks are used during climbs, descents or prolonged uncoordinated level flight, power loss may result even if there is appreciable fuel remaining.

Since inboard tanks must be used for landing, be sure to retain sufficient fuel in the inboard tanks for normal descent and landing in addition to reserve fuel for a possible go-around. It may be necessary to turn ON the emergency fuel pumps during cruise to stabilize fuel pressure.

The cruising speed of the Navajo is determined by many factors, including power setting, altitude, temperature, load and equipment installed. Refer to Section 5 - Performance - for power settings and performance under various conditions.

The Lycoming engines on this airplane can be cruised at any power level from 230 BHP to 170 BHP. An engine speed of 2500 RPM , may be used for maximum cruise performance, while a lower engine speed down to 2200 RPM may be used for more economical cruising conditions. (Refer to the Power Setting Table in Section 5 - Performance - for recommended power settings.)

During power changes, move the throttles slowly to the desired power setting, wait a few seconds for the system to stabilize, and then make critical adjustments, if necessary, after leaning the engines. Always return the mixtures to full rich before increasing power. To increase power, always increase RPM (propeller control) before increasing manifold pressure (throttle control). To decrease power, always decrease manifold pressure first, then RPM.

For maximum service life from the engines, maintain cylinder head temperatures below 435°F during high performance cruise operation and below 400°F for economy cruise power. At high altitudes the cylinder head temperatures can be maintained within normal limits through careful leaning and proper adjustment of the cowl flaps. It may be necessary at high altitudes to enrich the mixture, with partial cowl flap, to maintain normal temperatures.

Do not lean the engines above 75% power. Never exceed 1650°F EGT. Refer to Paragraph 4.37 for Leaning Procedures.

Fuel flow warning lights indicate an impending fuel flow interruption which could result in power loss. Any time fuel pressure drops below 25 psi the emergency fuel pump should be turned ON.

During cruise, propellers should be synchronized as close as possible. The control levers can be secured in their settings by use of the friction knob on the right side of the control pedestal. During flight, monitor fuel gauges and engine gauges.

4.27 DESCENT

During power reduction for descent, be sure EGT is maintained at a minimum of 1350°F. Throttling back at high altitudes (above 15,000 feet) without first checking that the mixture has been so leaned could result in engine power loss.

Set fuel selectors on INBOARD tanks and set power as required for descent. Adjust cowl flaps as necessary to maintain engine temperatures within limits.

At altitudes below 10,000 feet, turn OFF the oxygen system. The pitot heat and windshield heat may be used as required.

4.29 BEFORE LANDING

When preparing for landing, turn ON seat belt and no smoking signs and ensure that all occupants comply. Turn ON emergency fuel pumps, and set mixture controls to full "RICH." If a propeller synchronizer system is installed, turn it OFF.

Set the propeller controls to 2400 RPM. Landing gear may be lowered at airspeeds below 129 KIAS (serial numbers 31-7712001 through 7712103) or 156 KIAS (serial numbers 31-7812001 and up). Determine landing gear extension by checking the gear position lights. Secondary indications of gear extension are the return of the selector lever to a neutral position and the appearance of the nose gear in the gear mirror on the inboard side of the left nacelle.

Operate the toe brakes to determine if there is sufficient pressure for normal braking and make sure that the parking brake is not set. The autopilot should be OFF for landing.

Extend the wing flaps as required. Flaps should be extended in steps (see Paragraph 7.17) to preclude the possibility of a large asymmetric ("splits") flap extension in the event of a failure in the flap actuation system. The maximum speed for 15° flap extension is 164 KIAS (serial numbers 31-7712001 through 7712103) or 174 KIAS (serial numbers 31-7812001 and up); the maximum speed for full flap extension is 140 KIAS. In airplanes with serial numbers 31-7912001 and up, up to 25° of flaps may be extended at airspeed below 174 KIAS.

Landing lights should be turned on as required.

4.31 BALKED LANDING

In a balked landing situation, apply power as required, set the flaps to 15° and retract the landing gear. Flaps should be set at 15° until obstacles are cleared, and then retracted in steps.

The Before Landing checklist should be completed before all landings; landings after go-arounds or balked landings are no exception.

4.33 AFTER LANDING (CLEAR OF RUNWAY)

After landing is completed turn OFF the radar. When the airplane is taxied clear of the active runway, cowl flaps should be fully opened; wing flaps should be fully retracted, and trim set to neutral. The emergency fuel pumps and strobe lights should be turned OFF.

It may be necessary to use emergency fuel pumps during ground operation when the outside air temperature is above 75°F.

If the heater is in use, place the heater switch in the "FAN" position for a few minutes to allow the heater to cool down before turning it off. This cooling down period is only necessary during ground operation, not when the heater is turned off in flight.

Taxi with the propeller controls full forward. Unnecessary radio and electrical equipment may be shutdown.

4.35 SHUTDOWN

After the airplane is taxied to a stop, set the parking brake. If the temperature is below freezing and the brakes are wet, they should not be set if there is a possibility of the brakes being frozen. Turn OFF avionics and the autopilot AP/FD master switch. The heater switch may be turned OFF after it has cooled down. Turn OFF all other electrical equipment.

Retard the throttle levers to idle power before checking magneto grounding. Turn both magnetos on one engine OFF, then immediately back ON. An engine will stop briefly if magnetos are grounded. During this check, do not allow engines to come to a complete stop.

Advance the throttles to 1000 RPM to check the battery. With both engines turning 1000 RPM and all electrical equipment off, if the ammeter shows a battery charging rate in excess of 25 amps, the battery has a low charge. In this case, do not stop engines until current drops below 25 amps or there may not be sufficient battery current for starting.

Leave throttles at 1000 RPM. Since one engine's hydraulic pump was tested at start, the other should be tested at shutdown. Place the mixture control of the first engine started in "IDLE CUT-OFF." When the engine has stopped, place the gear selector handle "DOWN." If the hydraulic pump on the running engine is functioning, the selector will return to neutral. After this check, place the mixture control of the second engine in "IDLE CUT-OFF." Switch magnetos OFF, and, lastly, turn the airplane master switch OFF.

For mooring instructions refer to Paragraph 8.9.

4.37 LEANING PROCEDURES

When leaning below best power is permitted (refer to Maximum Manifold Pressure Vs. Altitude graph in Section 5 - Performance), the engines may be operated at peak EGT or on the lean side of peak EGT as long as stable engine operation results without exceeding any engine limitations during steady state or transient conditions.

BEST POWER

To lean the mixture to best power, proceed as follows:

(a) Lean the mixture slowly until EGT has stabilized at peak.

NOTE

Do not exceed 1650°F EGT.

(b) Enrich the mixture 125°F.

(c) At high power setting if 1650°F is reached before peak EGT, refer to Lycoming Operator's Manual for correct procedure.

BEST ECONOMY

To lean the mixture to best economy, proceed as follows:

(a) Lean the mixture slowly until EGT has stabilized at peak.

NOTE

Do not exceed 1650°F EGT.

LEAN SIDE OF PEAK

To lean the mixture on the lean side of peak, proceed as follows:

(a) At the desired power setting, lean the mixture slowly until EGT has stabilized at peak.

NOTE

Do not exceed 1650°F EGT.

(b) If peak EGT is 1650°F or less, continue to lean until a maximum of 50° reduction in EGT is obtained. Readjust manifold pressure as necessary to maintain the desired power setting.

(c) If 1650°F EGT is reached before peak EGT is obtained, lean according to the following procedure:
   (1) With the mixture leaned to 1650°F, reduce manifold pressure until EGT is reduced approximately 75°.
   (2) Lean the mixture slowly until peak EGT is obtained.
   (3) Lean the mixture additionally until 50° - 100° on the lean side of peak is obtained. Do not lean into engine roughness.
   (4) Slowly increase manifold pressure to the desired power setting without permitting EGT to exceed 1650°F.
   (5) Carefully adjust the mixture until EGT is 1625° to 1650°F.

NOTE

Enriching the mixture will increase the EGT when operating on the lean side of peak EGT.

   (6) Before enriching the mixture, reduce the manifold pressure as in step (1) to prevent exceeding 1650°F EGT.

4.39 VSSE - INTENTIONAL ONE ENGINE INOPERATIVE SPEED

VSSE is a speed selected by the aircraft manufacturer as a training aid for pilots in the handling of multi-engine aircraft. It is the minimum speed for intentionally rendering one engine inoperative in flight. This minimum speed provides the margin the manufacturer recommends for use when intentionally performing engine inoperative maneuvers during training in the particular airplane.

The intentional one engine inoperative speed, VSSE, for the PA-31 is 90 KIAS.

4.41 VMCA - AIR MINIMUM CONTROL SPEED

VMCA is the minimum flight speed at which a twin-engine airplane is directionally controllable as determined in accordance with Federal Aviation Regulations. Airplane certification conditions include one engine becoming inoperative and windmilling; not more than a 5° bank toward the operative engine; landing gear up; flaps up; and most rearward center of gravity.

VMCA for the PA-31 has been determined to be 76 KIAS.

The VMCA demonstration which may be required for the FAA flight test for the multi-engine rating approaches an uncontrolled flight condition with power reduced on one engine. The demonstration and all intentional one engine operations should not be performed at an altitude of less than 5000 feet above the ground. The recommended procedure for VMCA demonstration is to reduce the power to idle on the simulated inoperative endne at or above the intentional one engine inoperative speed, VSSE, and slow down at approximately one knot per second until the FAA Required Demonstration Speed, VMCA, or stall warning is obtained.

VSSE is a minimum speed selected by the manufacturer for intentionally rendering one engine inoperative in flight for pilot training.

VSSE for the PA-31-350 is 90 KIAS.

V_{MCA} DEMONSTRATION

(a)	Landing Gear	UP
(b)	Flaps	UP
(c)	Airspeed	at or above 90 KIAS (V_{SSE})
(d)	Propeller Controls	HIGH RPM
(e)	Throttle (Simulated Inoperative Engine)	IDLE
(f)	Throttle (Other Engine)	MAX ALLOWABLE
(g)	Airspeed	reduce approximately 1 knot per second until either V_{MCA} or STALL WARNING is obtained

CAUTIONS

Use rudder to maintain 5° bank towards the operative engine (lateral attitude). At the first sign of either V_{MCA} or stall warning (which may be evidenced by: Inability to maintain heading or lateral attitude, aerodynamic stall buffet, or stall warning horn) immediately initiate recovery; reduce power to idle on the operative engine, and immediately lower the nose to regain V_{SSE}.

One engine inoperative stalls are not recommended.

Under no circumstances should an attempt be made to fly at a speed below V_{MCA} with only one engine operating.

TABLE OF CONTENTS

SECTION 5

PERFORMANCE

SECTION 5

PERFORMANCE

5.1 GENERAL

All of the required (FAA regulations) and complementary performance information applicable to the Navajo is provided in this section.

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

5.3 INTRODUCTION TO PERFORMANCE AND FLIGHT PLANNING

The performance information 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 airplane. This performance can, however, be duplicated by following the stated procedures in a properly maintained airplane.

Effects of conditions not considered on the charts, such as the effect of a soft or grass runway surface on takeoff and landing performance, or the effect of winds aloft on cruise and range performance, must be evaluated by the pilot. 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 in item 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.

THIS PAGE INTENTIONALLY LEFT BLANK

5.5 FLIGHT PLANNING EXAMPLE

The following Flight Planning Example illustrates the correct utilization of pertinent data presented in this section of the manual.

(a) Associated Conditions

Certain basic information must be gathered when planning a flight. This information includes departure and destination airport conditions, en route conditions, and basic aircraft conditions. Such factors as weather, the status of the runway, the distance of the flight, the number of passengers, etc., must be determined. Assume, for example, the following conditions:

(1) Departure Airport Conditions

Outside Air Temperature	17°C
Pressure Altitude	2000 ft.
Wind and Direction	15 kts at 360°
Runway Direction	300°

(2) Cruise Conditions

Outside Air Temperature	-5°C
Pressure Altitude	10,000 ft.
En route Distance	500 naut. mi.
Power Setting	200 BHP
Mixture Setting	Best Economy

(3) Destination Airport Conditions

Outside Air Temperature	20°C
Pressure Altitude	2000 ft.
Wind and Direction	10 kts at 330°
Runway Direction	270°

(4) Aircraft Configuration

Basic Weight (assumed for example)	4000 lbs.
Fuel Tanks (total)	187 gal.
Occupants	6 at 170 lbs. each
Baggage	350 lbs.

(b) Aircraft Loading

The airplane weight and center of gravity may be determined by utilizing the information given in Section 6 (Weight and Balance) of this handbook.

The basic empty weight for the airplane as licensed from the factory has been entered in Figure 6-7. If any alternations to the airplane affecting weight and balance have been made, reference to the aircraft logbook, Weight and Balance Record (Figure 6-9) or the latest FAA Major Repair or Alteration Form should be made to determine the current basic empty weight of the airplane.

Use the Weight and Balance Loading Chart (Figure 6-15) and the Weight, Moment and C.G. Limit graph (Figure 6-17) to determine the total weight of the airplane and the center of gravity position.

After proper utilization of the information provided, assume that the following weights have been determined for consideration in the Flight Planning Example:

(1)	Basic Weight	4000 lbs.
(2)	Occupants (6 at 170 lbs. each)	1020 lbs.
(3)	Baggage	350 lbs.
(4)	Fuel (187 gal. at 6 lbs./gal.)	1122 lbs.
(5)	Ramp Weight (total of above)	6492 lbs.
(6)	Landing Weight (takeoff weight minus item (h), Total Fuel Required)	5975 lbs.

The landing weight cannot be determined until the weight of the fuel to be used has been established.

Ramp weight is below the approved maximum of 6536 lbs. Determine that weight and balance calculations have shown the C.G. position to be within the approved limits.

(c) Takeoff Distance

After determining the aircraft loading, all aspects of takeoff must be considered. Conditions of the departure airport and takeoff weight should be applied to the appropriate Takeoff Distance graph to determine the length of runway necessary. Takeoff conditions for the Flight Planning Example are listed below:

(1)	Wind	15 kts at 360°
(2)	Angle between Fight Path and Wind	360° -300° = 60
(3)	Head Wind Component (from Wind Component Graph, Figure 5-11)	8 kts
(4)	Outside Air Temperature	17°C
(5)	Pressure Altitude	2000 ft.

Using the Takeoff Over 50 Feet graph (Figure 5-13) the takeoff distance are as follows:

Total Distance	2260
Ground Run	1700

(d) Climb

Entering the example conditions of the departure airport and the cruise altitude into the Time, Fuel and Distance to Climb graph (Figure 5-25) yields the following:

(1)	Time to Climb	7.0 - 1.5	=	5.5 minutes
(2)	Fuel to Climb	45.0 - 9.0	=	36.0 lbs.
(3)	Distance to Climb	12.0 - 2.0	=	10.0 naut. miles

NOTE

The effect of winds aloft must be considered by the pilot when computing climb, cruise, and descent performance.

(e) Descent

Entering the cruise and destination airport conditions into the Time, Distance and Fuel to Descend graph (Figure 5-43) yields the following:

(1)	Time to Descend	10 - 2	=	8 minutes
(2)	Distance to Descend	30.0 - 3.5	=	26.5 naut. miles
(3)	Fuel to Descend	17.0 - 4.0	=	13.0 lbs.

(f) Cruise

Subtracting the previously calculated distance to climb and distance to descend figures from the total en route distance yields the total cruise distance. For example:

Cruise Distance = En route Distance - Climb Distance - Descent Distance
= 500 -10.0 - 26.5
= 463.5 naut. miles

From the True Airspeed Vs. Pressure Altitude graphs (Figure 5-27 and 5-29) for 200 BHP, Best Economy Mixture, the cruise airspeeds are 175 kts at 6500 lbs. and 180 kts at 5500 lbs.

The average cruise weight is estimated as:

$$\text{Average Cruise Weight} = \text{Takeoff Weight} - \frac{\text{Cruise Distance x Cruise Fuel Flow}}{\text{Cruise Airspeed @ 6500 lbs. x 2}}$$

$$= 6492 - \frac{500 \times 164}{175 \times 2}$$

$$= 6258 \text{ lbs.}$$

Interpolating these values for 6258 lbs. (preliminary cruise weight), the cruise speed is 176 kts.

Fuel Flow is 27.3 gallons/hour (164 lbs./hr.)

Cruise time and fuel may be calculated by the following formula:

Cruise Time = Cruise Distance/Cruise Speed
= 463.5/176
= 2.634 hours or 158 minutes

Cruise Fuel = Fuel Flow x Cruise Time
= 164 x 2.634
= 432 lbs.

The above data can be used to calculate an average cruise weight in the following manner:

$$\text{Average Cruise Weight} = \text{Takeoff Weight - Ramp Fuel - Climb Fuel} - \frac{\text{Cruise Fuel}}{2}$$

$$= 6492 - 36 - 36 - \frac{432}{2} = 6204 \text{ lbs.}$$

If the average cruise weight was found to be significantly different from the estimated average cruise weight, the cruise airspeed would be changed to coincide with the weight by interpolating between the approximate aircraft weights. For example, had the average cruise weight been found to be 5700 lbs., then the average cruise speed would be corrected to 179 kts.

(g) Total Flight Time

The total flight time is determined by adding the time to climb, cruise time, and time to descend. The following flight time is required for this Flight Planning Example:

Total Flight Time = Time to Climb + Cruise Time + Time to Descend
= 5.5 + 158 + 8.0
= 171.5 minutes

(h) Total Fuel Required

Determine the total fuel required by adding fuel for taxi and takeoff, fuel to climb, cruise fuel, and fuel to descend. When the total fuel (in pounds) is determined, dividing this value by 6 lbs./gal. will give the total fuel in gallons to be used for the flight. Total fuel calculations for the Flight Planning Example are shown below:

Total Fuel Required = Fuel for taxi and takeoff + Fuel to Climb + Cruise Fuel + Fuel to Descend
= 36 + 36 + 432 + 13
= 517 lbs. (86.2 gallons)

(i) Landing Distance

Subtracting the total fuel required from the takeoff weight of the airplane gives the landing weight:

Landing Weight = Takeoff Weight - Total Fuel Required
= 6492 - 517
= 5975 lbs.

Destination airport conditions applied to the Wind Component graph (Figure 5-11) gives the following headwind component for the Flight Planning Example:

The angle between the flight path and wind is 330° - 270° or 60°.

Therefore, the Headwind Component is 5 kts.

From the Normal Landing Distance over 50 Feet graph (Figure 5-47), with the destination airport conditions, the distances required for landing for the Flight Plan Example are as follows;

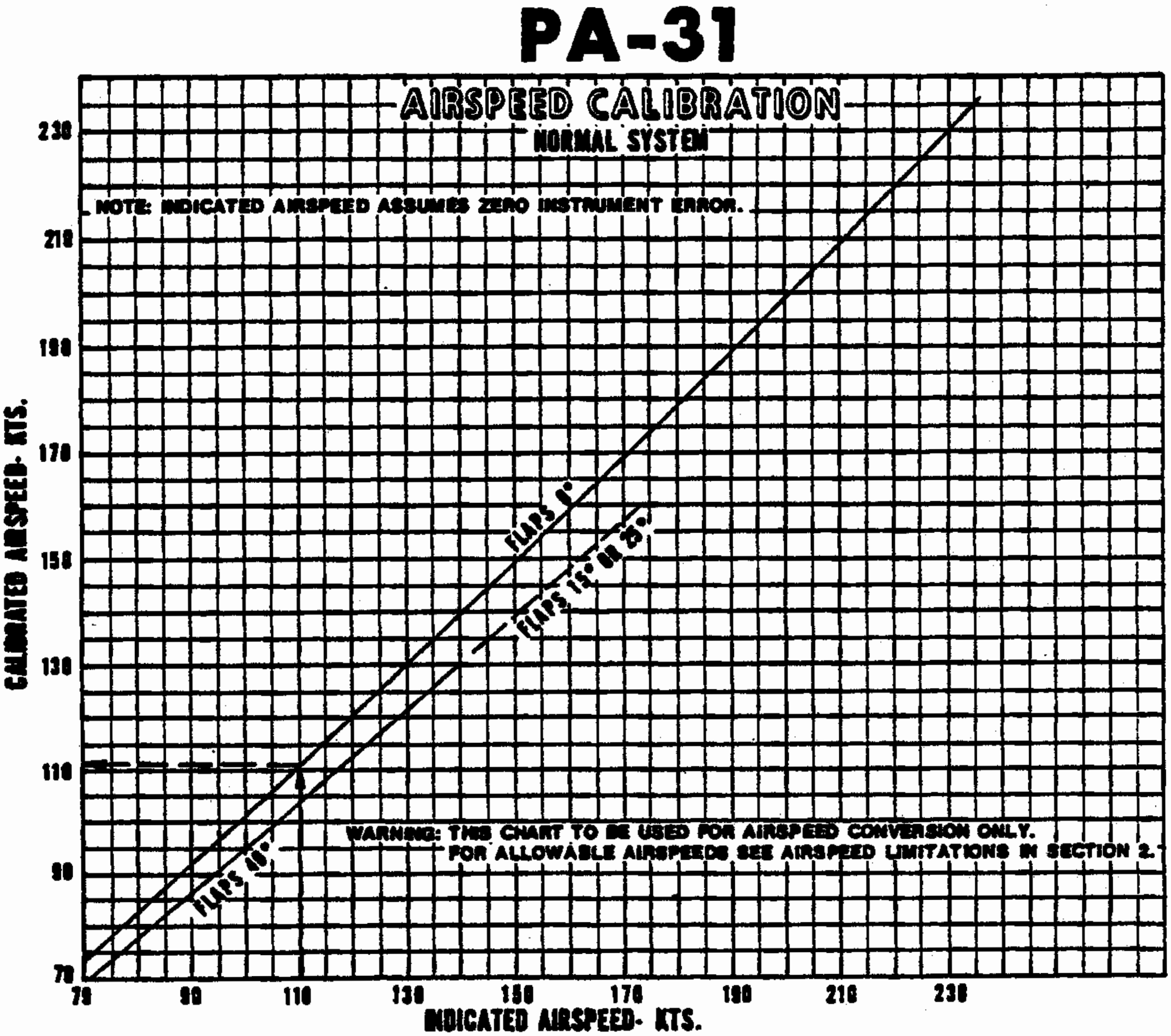
(1) Total Distance 2030 ft.
(2) Ground Roll 1620 ft.

THIS PAGE INTENTIONALLY LEFT BLANK

5.7 PERFORMANCE GRAPHS

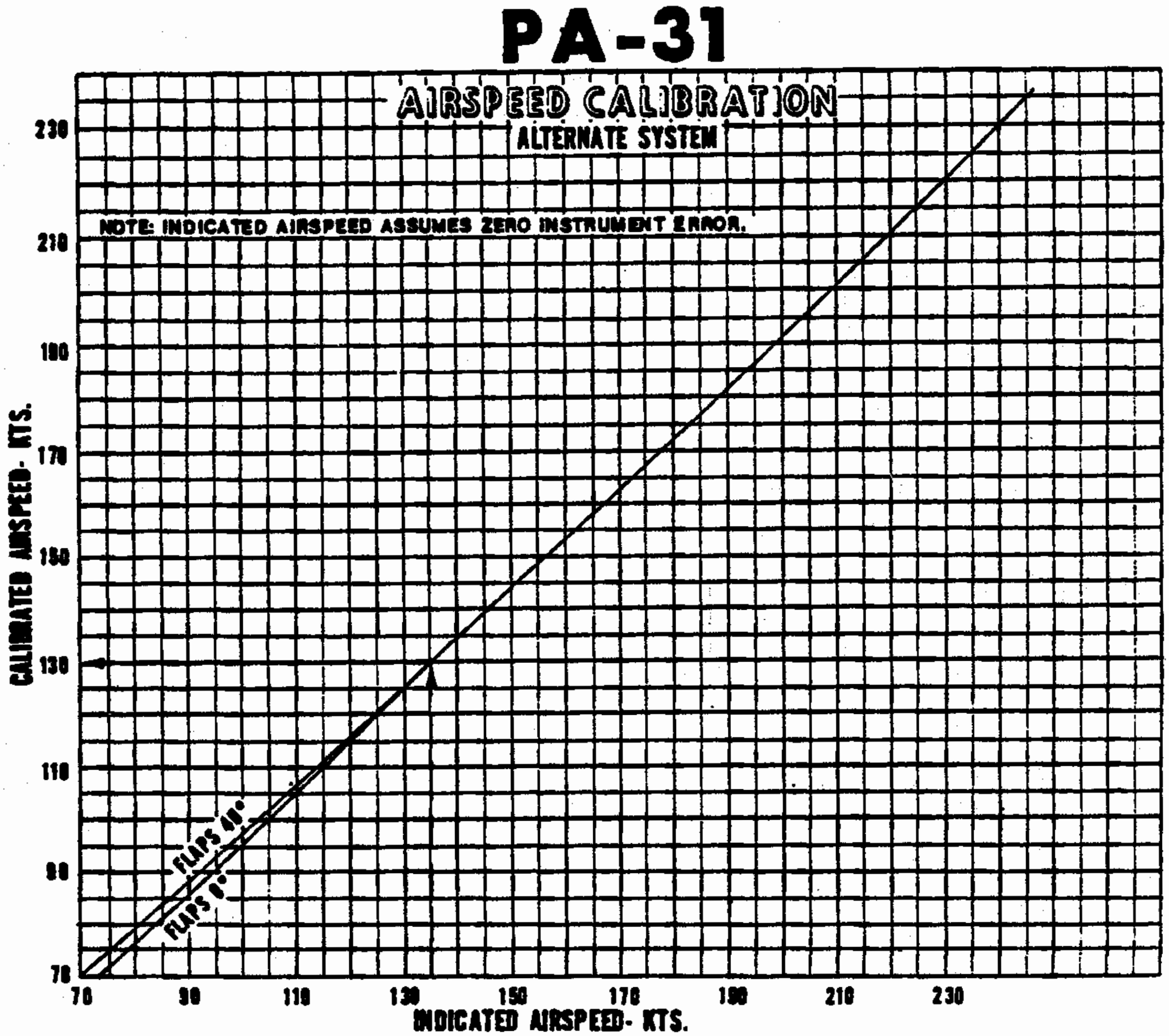
LIST OF FIGURES

THIS PAGE INTENTIONALLY LEFT BLANK



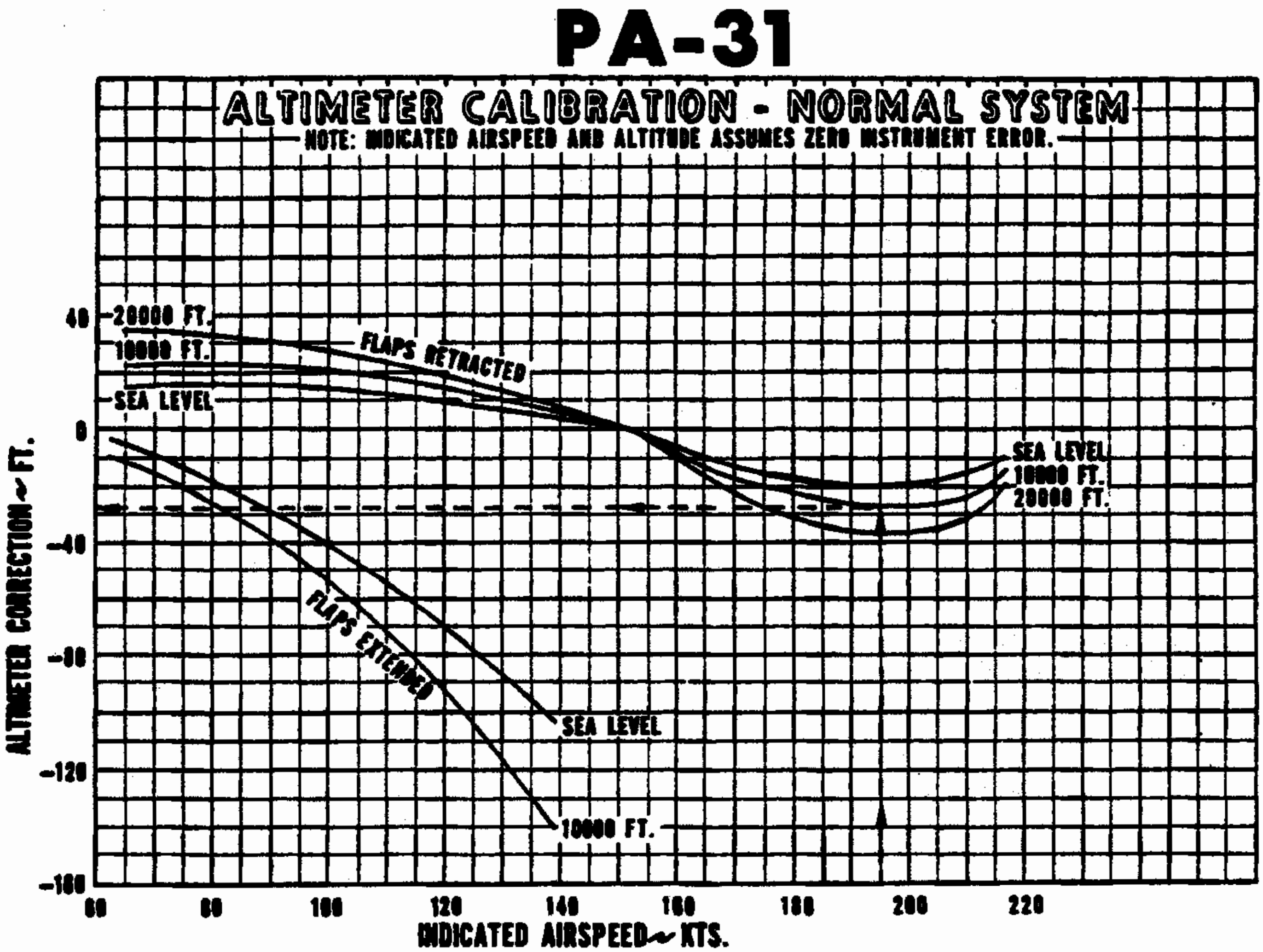
Example:
IAS: 110 knots
Flaps: 0°
CAS: 111 knots

AIRSPEED CALIBRATION - NORMAL SYSTEM
Figure 5-1



Example:
IAS: 135 knots
Flaps: 0° or 40°
CAS: 130 knots

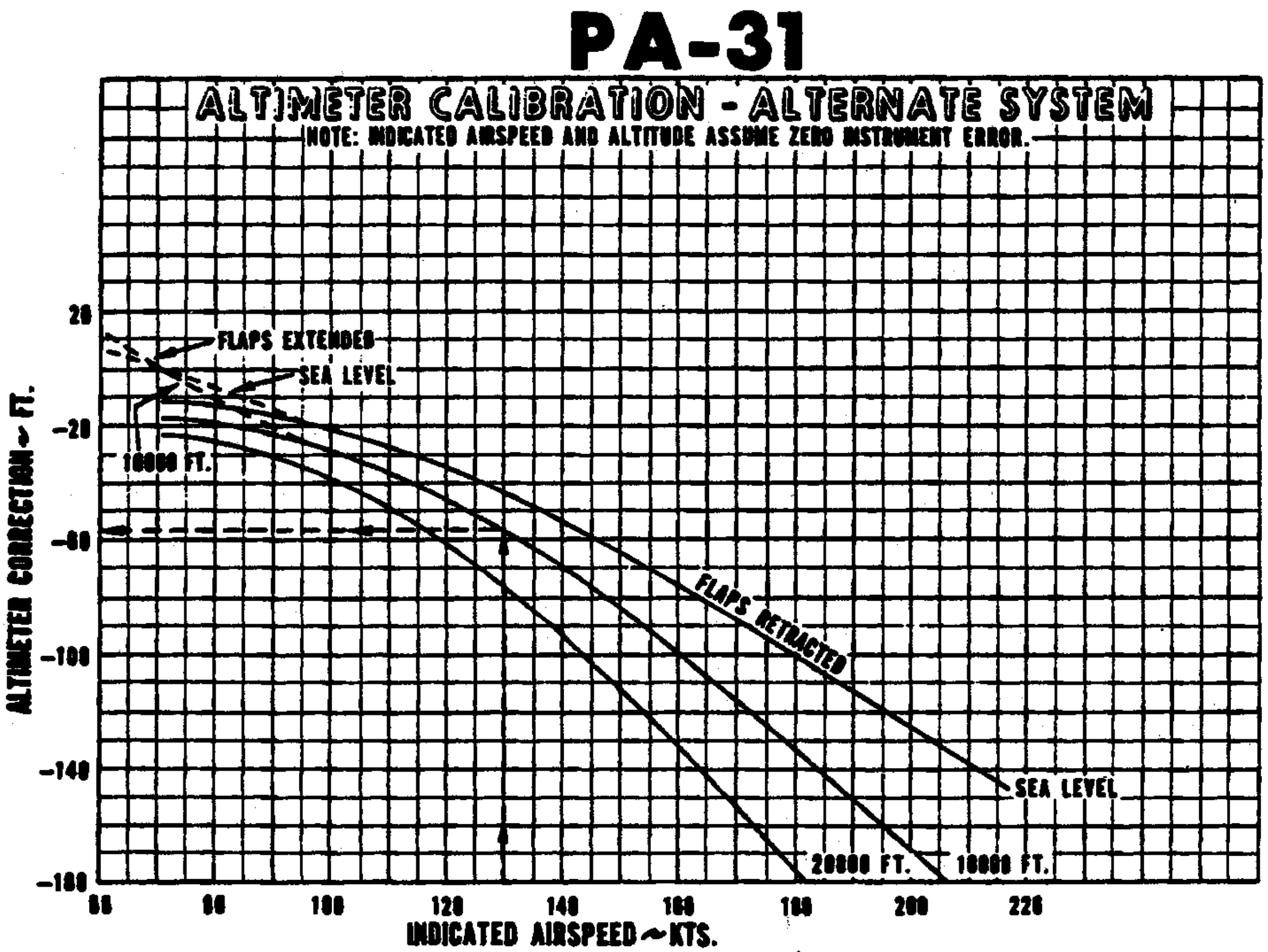
AIRSPEED CALIBRATION - ALTERNATE SYSTEM
Figure 5-3



Example:

Flaps: retracted
IAS: 195 knots
Altitude: 10,000 ft.
Altimeter correction: -28 ft.
Calibrated altitude: 9972 ft.

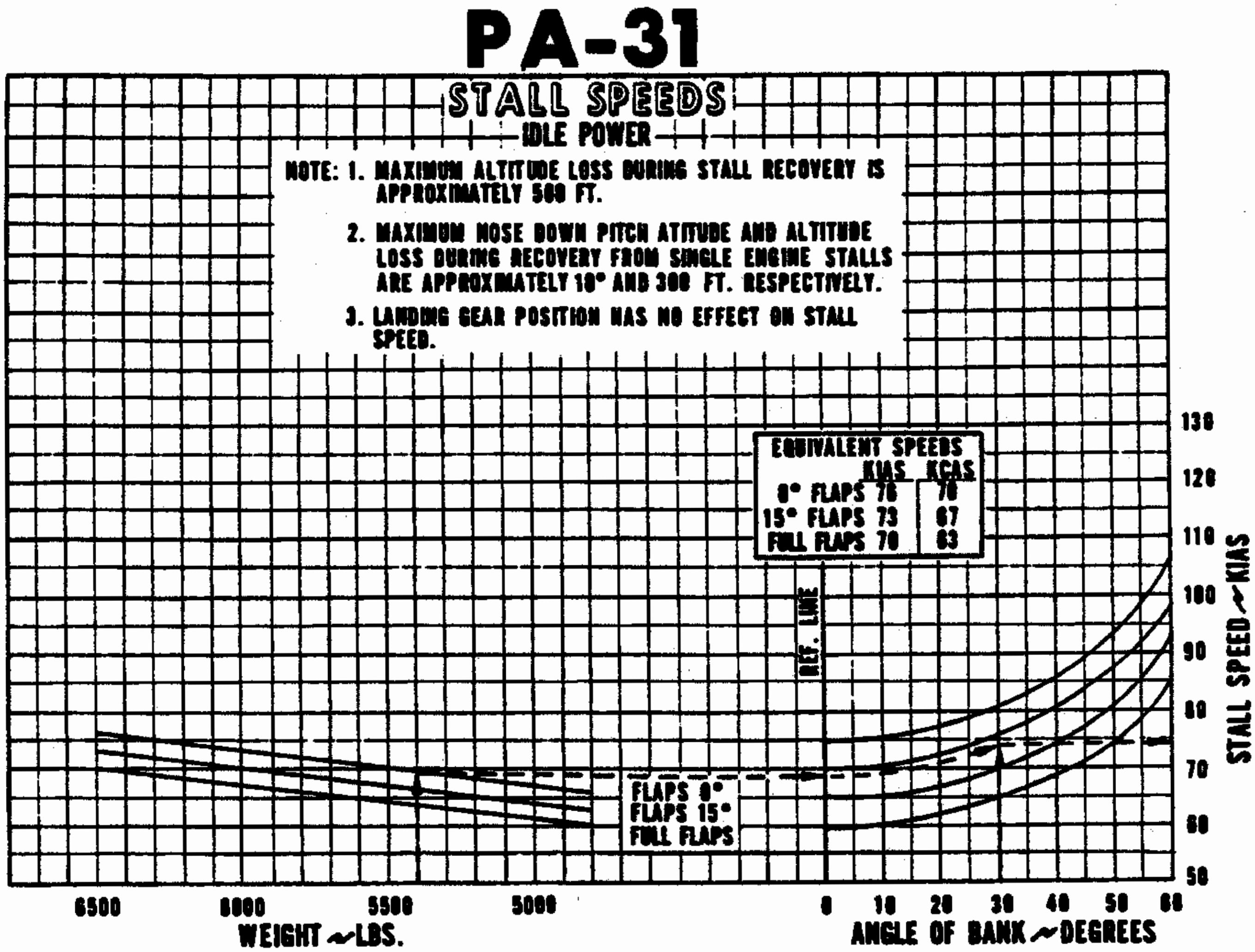
ALTIMETER CALIBRATION - NORMAL SYSTEM
Figure 5-5



Example:

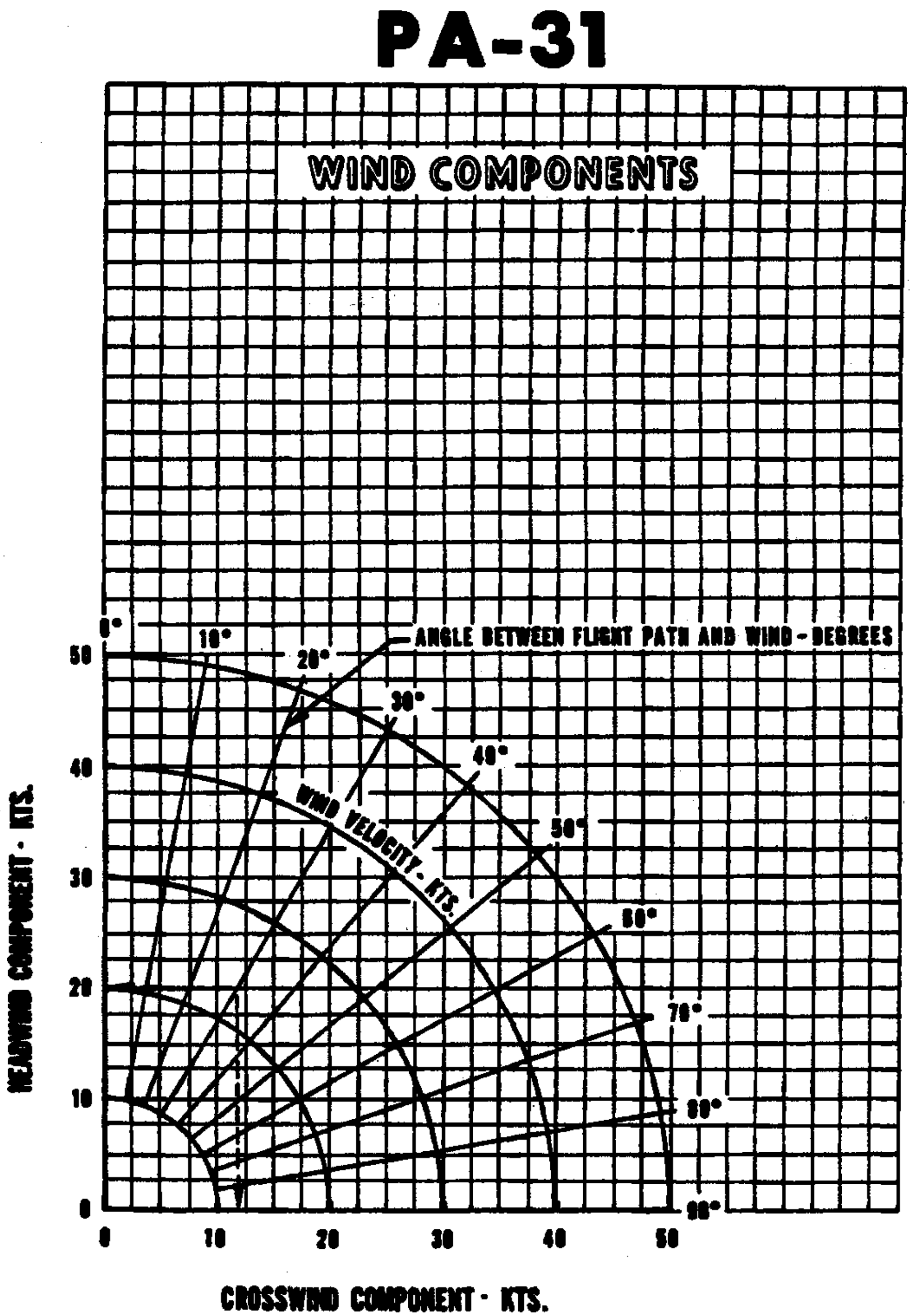
Flaps: retracted
IAS: 130 knots
Altitude: 10,000 ft.
Altimeter correction: -58 ft.
Calibrated altitude: 9942 ft.

ALTIMETER CALIBRATION - ALTERNATE SYSTEM
Figure 5-7



Example:
Weight: 5400 lbs.
Flap position: 0°
Angle of bank: 30°
Stall speed: 74 KIAS

STALL SPEEDS
Figure 5-9

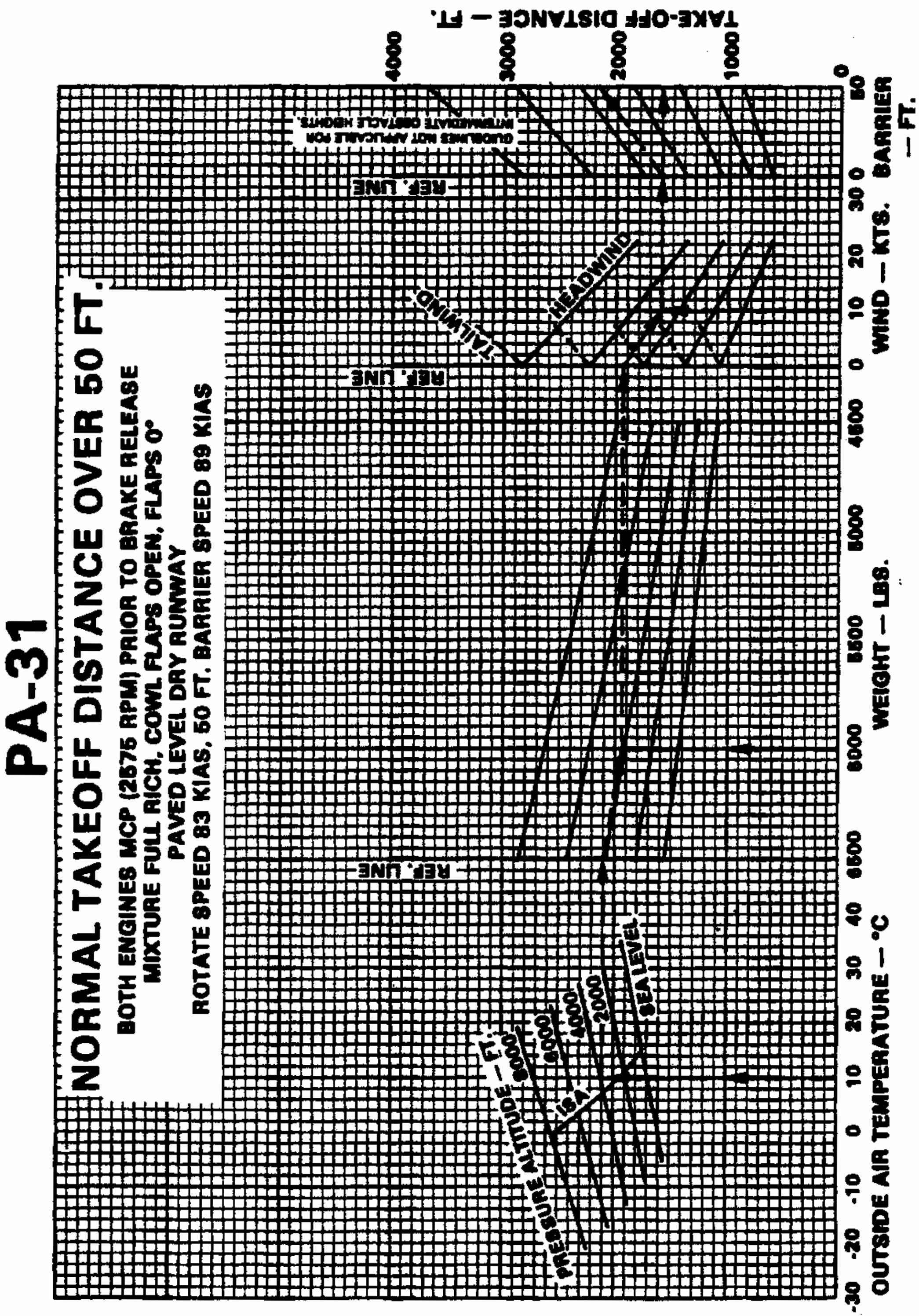


Example:

Wind velocity: 23 knots
Angle between flight path and wind: 30°

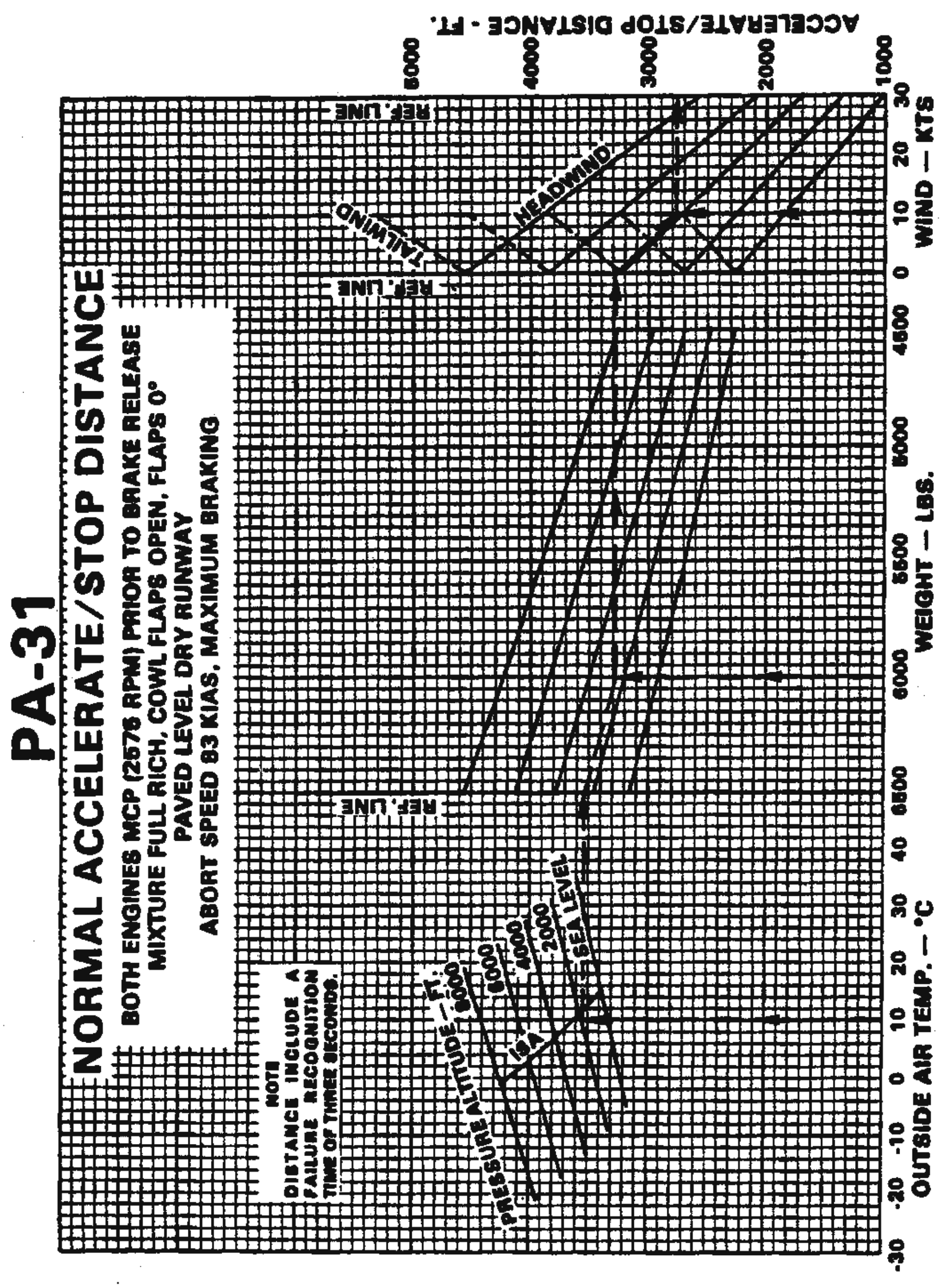
Headwind component: 20 knots
Crosswind component: 12 knots

WIND COMPONENTS
Figure 5-11



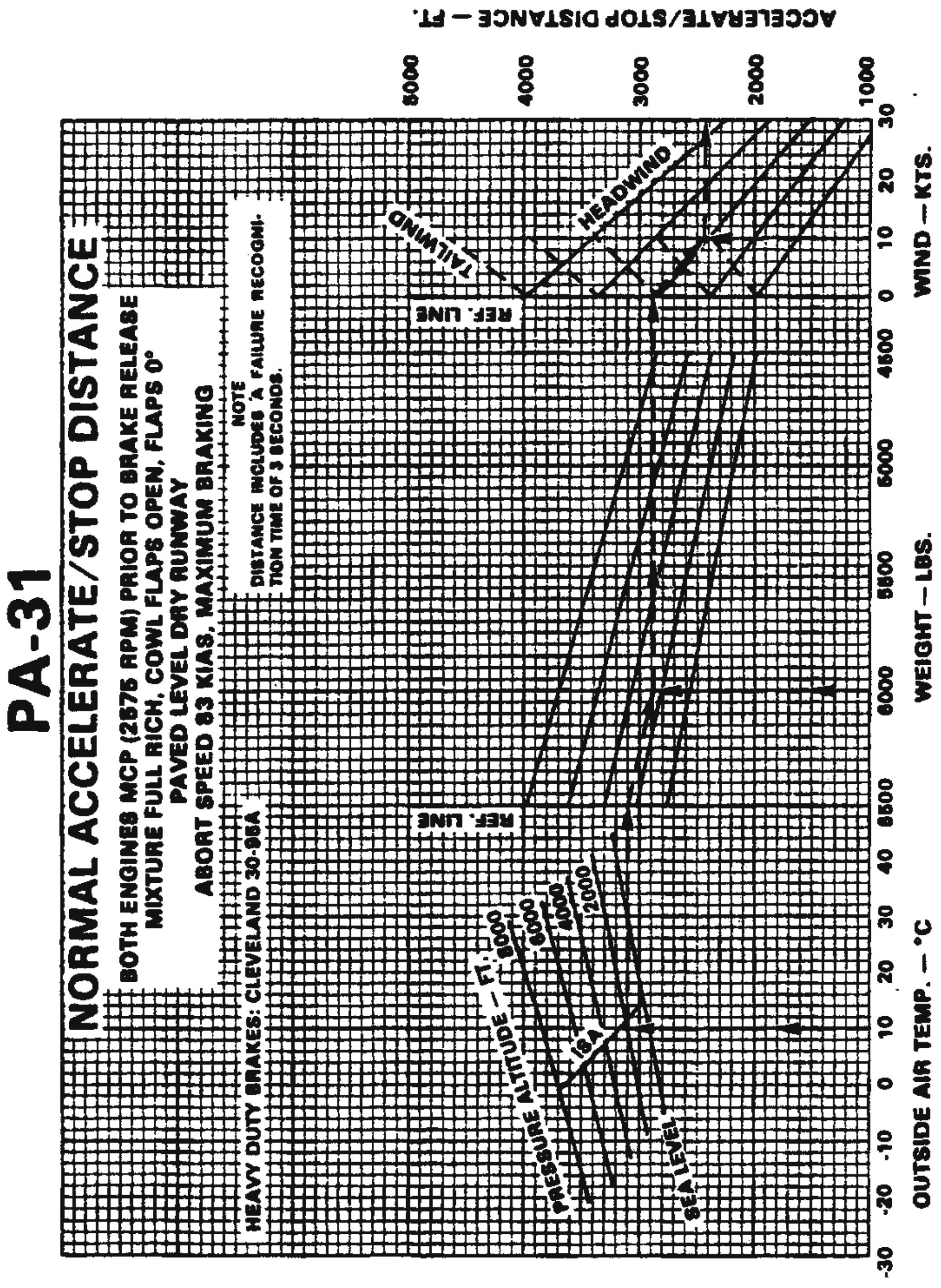
Example:
OAT: + 10°C
Pressure altitude: 4000 ft.
Weight: 6000 lbs.
Wind: 10 kts. headwind
Ground run: 1600 ft.
Take-off distance: 2160 ft.

NORMAL TAKEOFF DISTANCE OVER 50 FEET
Figure 5-13



Example:
OAT: +10°C
Pressure altitude: 2000 ft.
Weight: 6000
Wind: 10 kts headwind
Total accelerate/stop distance: 2770 ft.

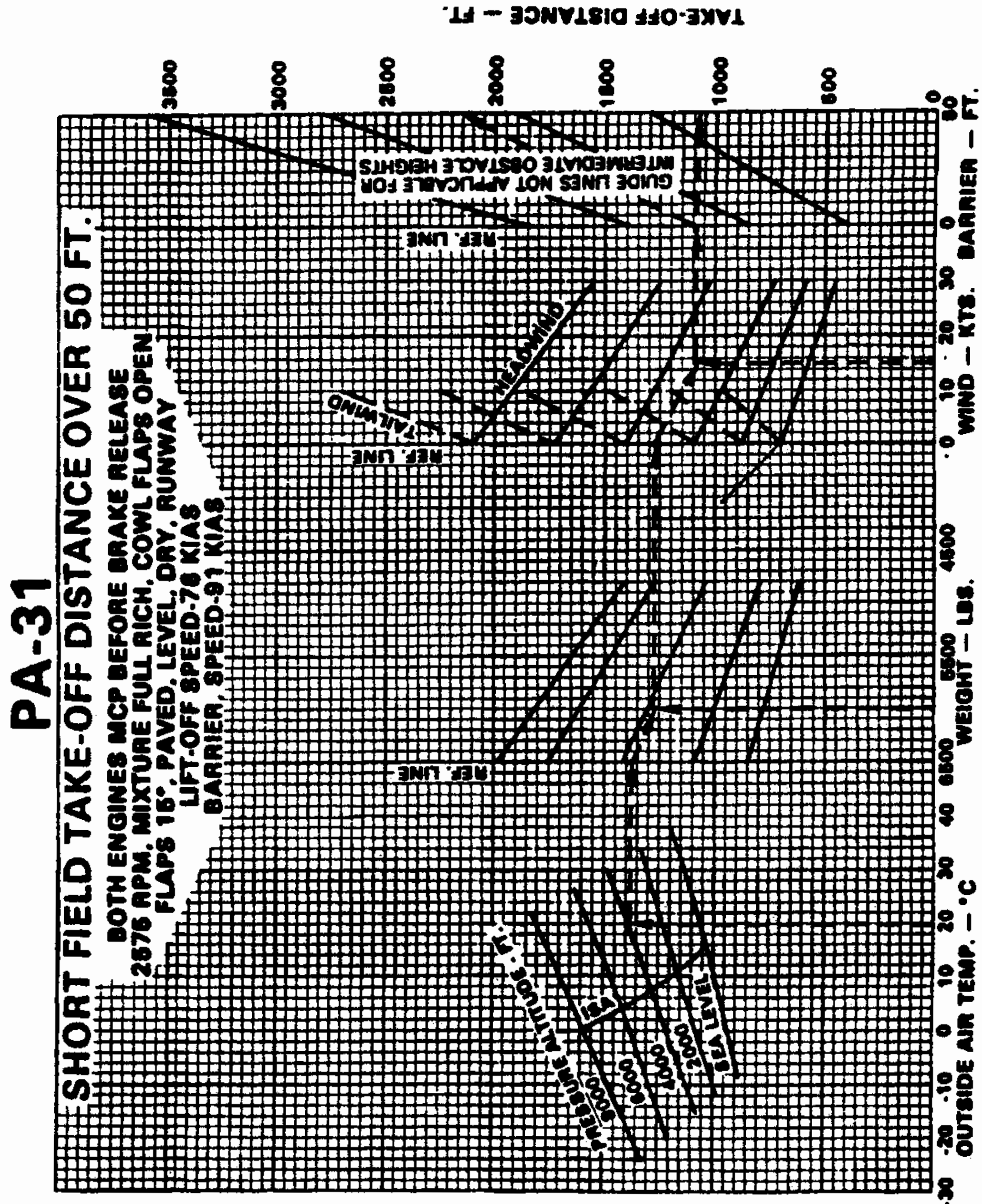
NORMAL ACCELERATE/STOP DISTANCE
Figure 5-14



Example:
OAT: +10°C
Pressure Altitude: 2000 ft.
Weight: 6000
Wind: 10 kts headwind
Total accelerate/stop distance: 2440 ft.

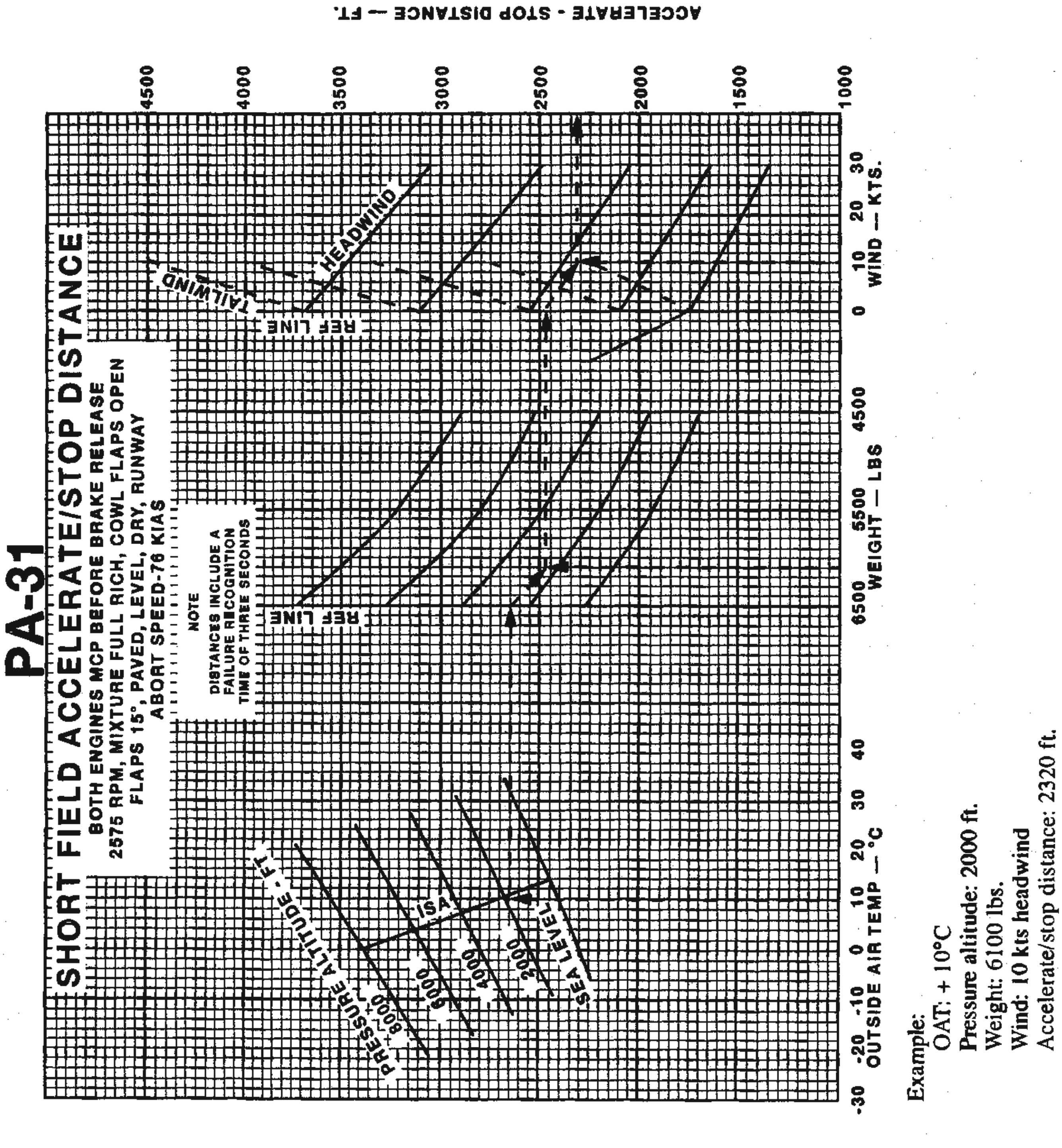
NORMAL ACCELERATE/STOP DISTANCE
(HEAVY DUTY BRAKES)
Figure 5-15

THIS PAGE INTENTIONALLY LEFT BLANK

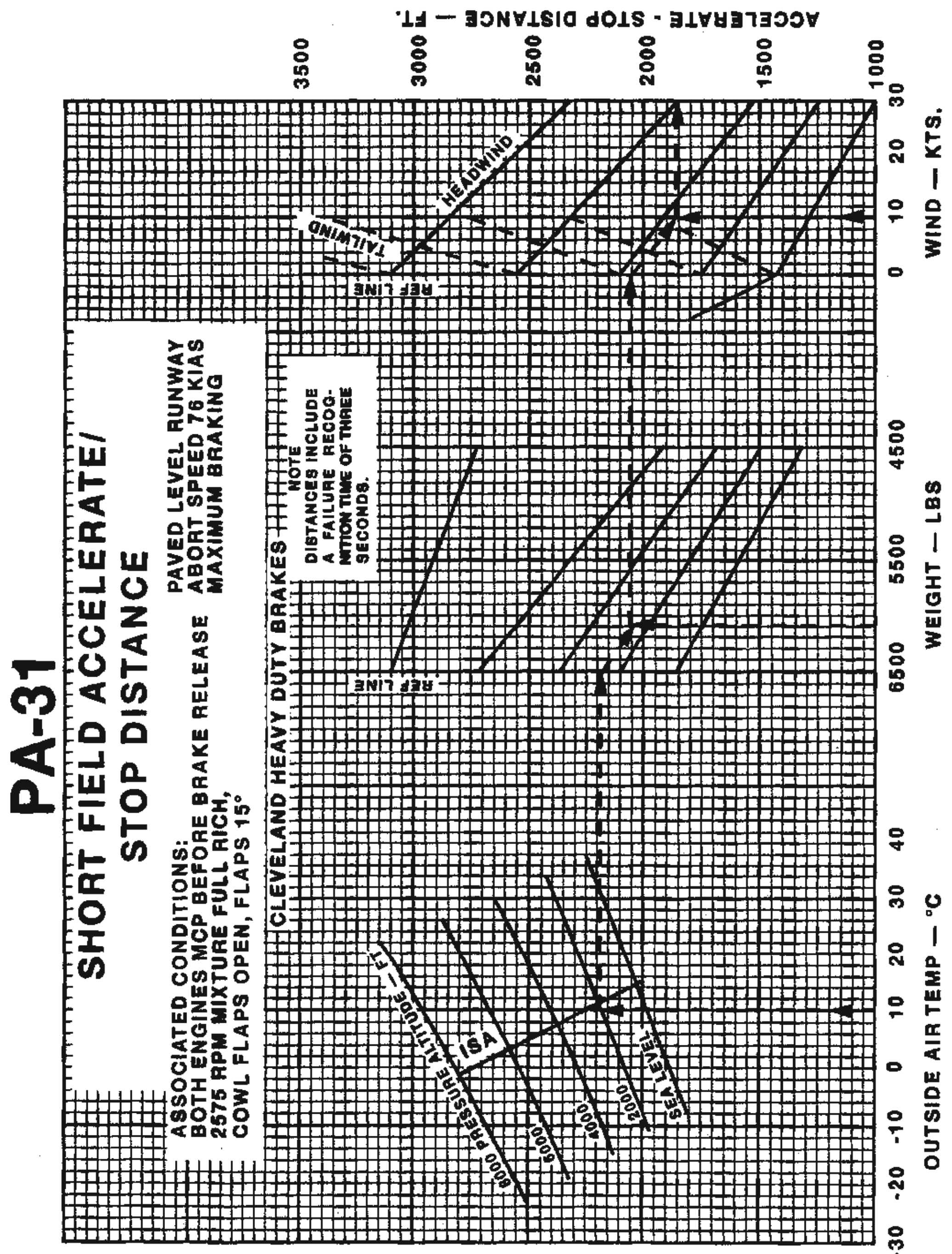


Example:
OAT: + 20°C
Pressure altitude: 4000 ft.
Weight: 6000 lbs.
Wind: 15 kts headwind
Ground run: 1080 ft.
Total takeoff distance: 2140 ft.

SHORT FIELD TAKEOFF DISTANCE OVER 50 FEET
Figure 5-16

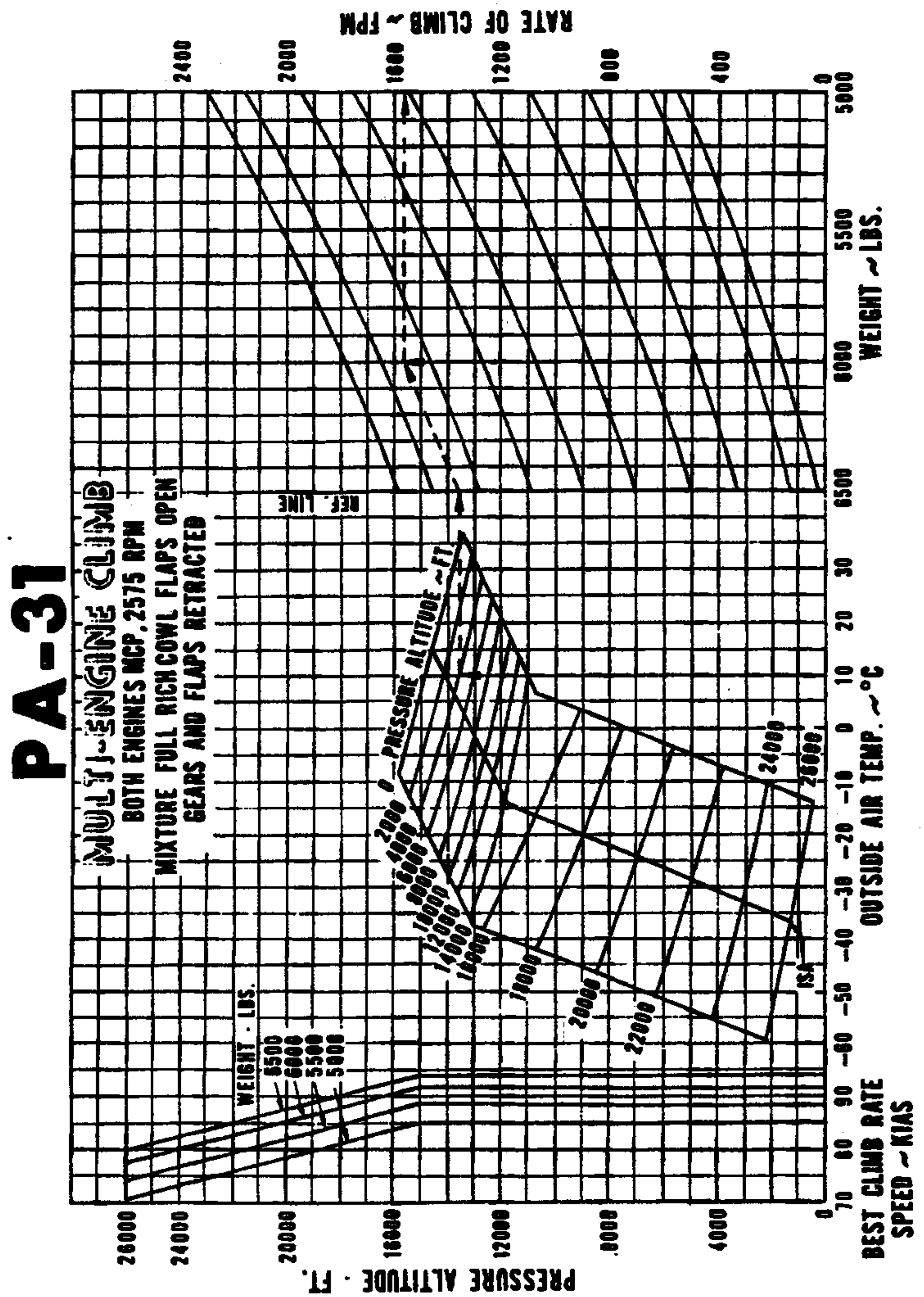


SHORT FIELD ACCELERATE/STOP DISTANCE
Figure 5-17



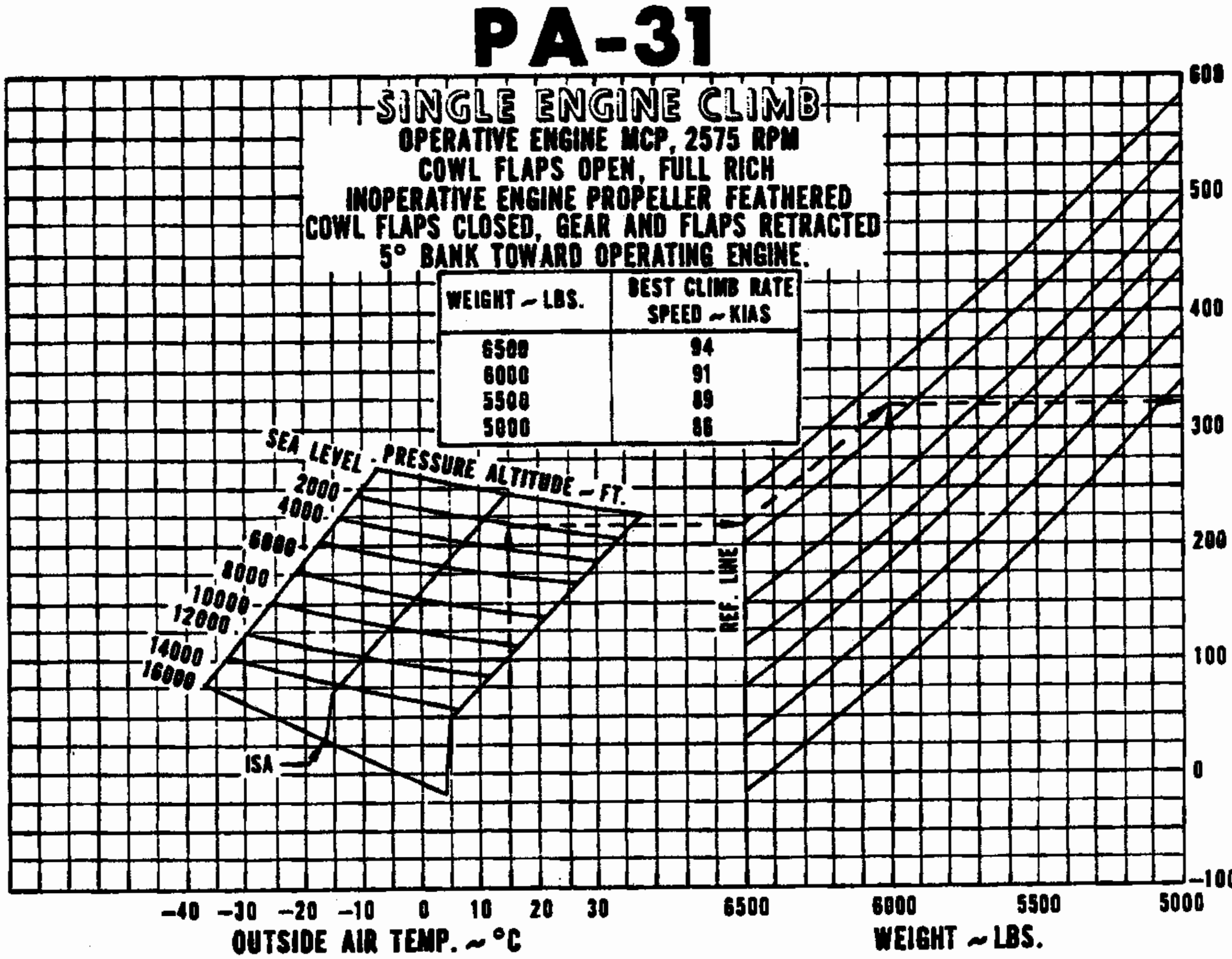
Example:
OAT: + 10°C
Pressure altitude: 2000 ft.
Weight: 6100 lbs.
Wind: 10 kts headwind
Accelerate/stop distance: 1870 ft.

SHORT FIELD ACCELERATE/STOP DISTANCE
(HEAVY DUTY BRAKES)
Figure 5-18



Example:
OAT: +10°C
Pressure altitude: 4000 ft.
Weight: 6000 lbs.
Rate of climb: 1560 FPM

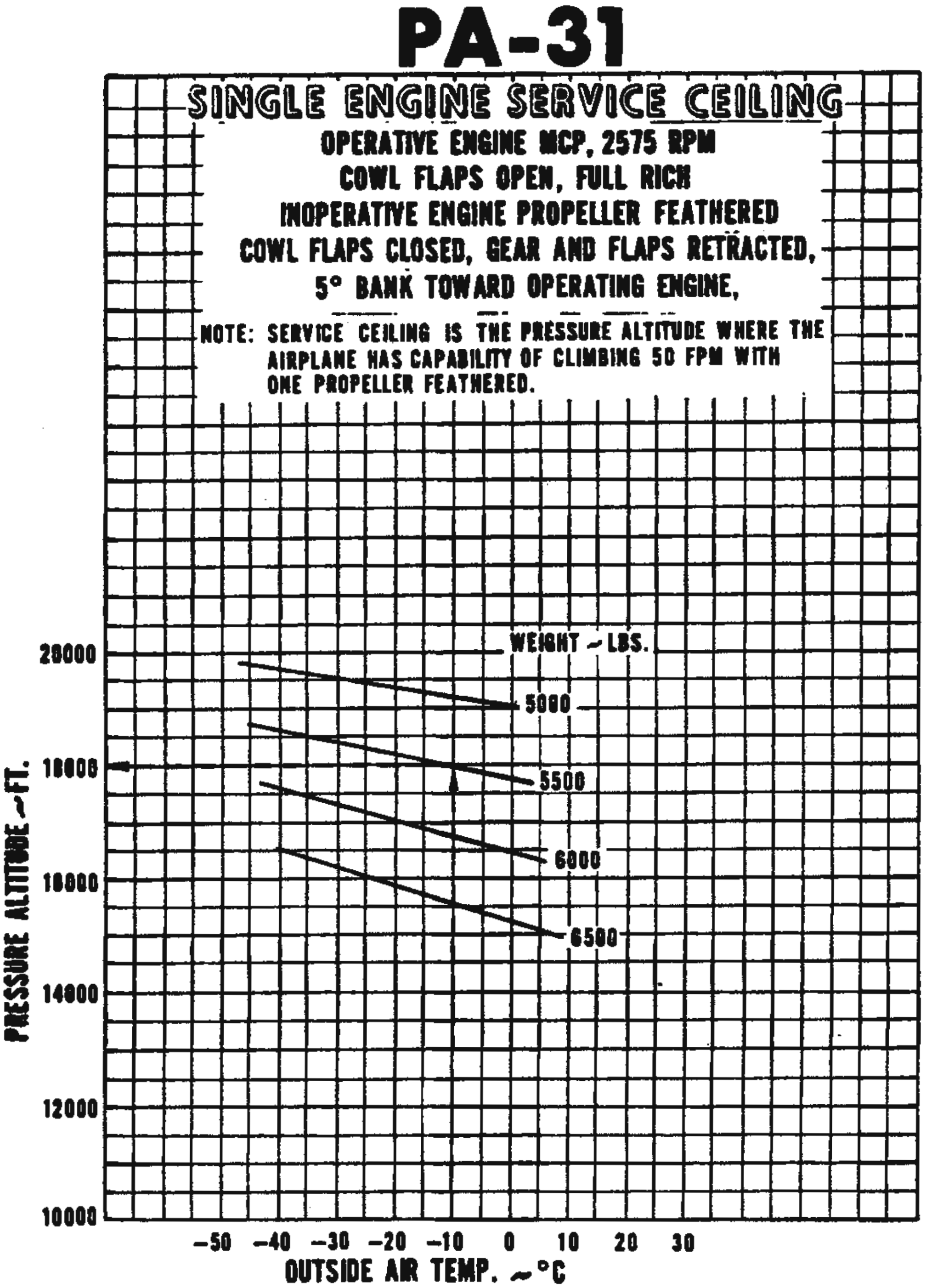
MULTI-ENGINE CLIMB
Figure 5-19



Example:

OAT: +15°C
Pressure altitude: 2000 ft.
Weight: 6000 lbs.
Rate of climb: 320 ft./min

SINGLE ENGINE CLIMB
Figure 5-21



Example:
OAT: -10°C
Weight: 5500 lbs.
S/E service ceiling: 18,000 ft. P.A.

SINGLE ENGINE SERVICE CEILING
Figure 5-23

PA-31

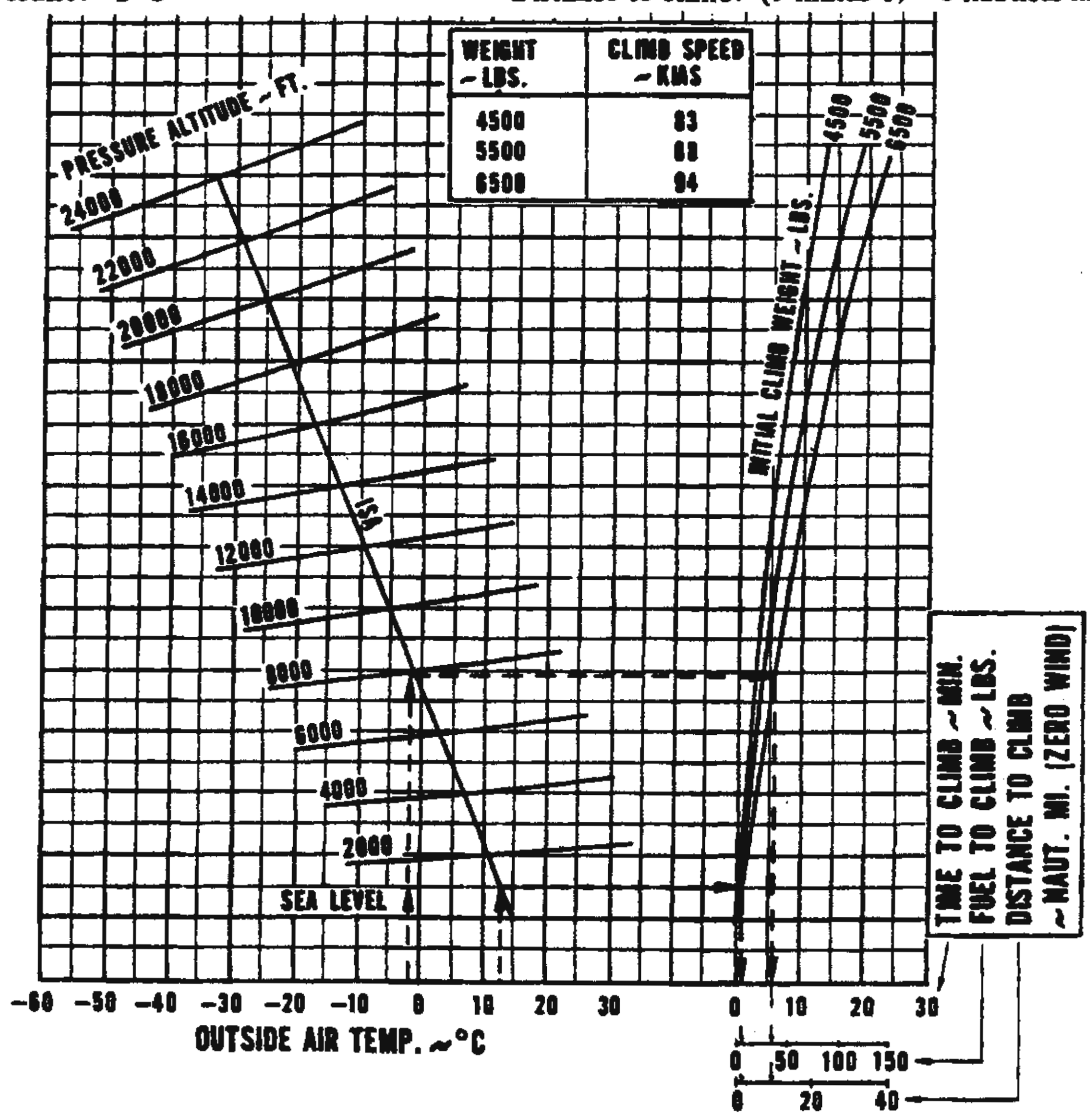
TIME, FUEL AND DISTANCE TO CLIMB

BOTH ENGINES MCP, 2575 RPM MIXTURE FULL RICH,
COWL FLAPS OPEN GEAR AND FLAPS RETRACTED

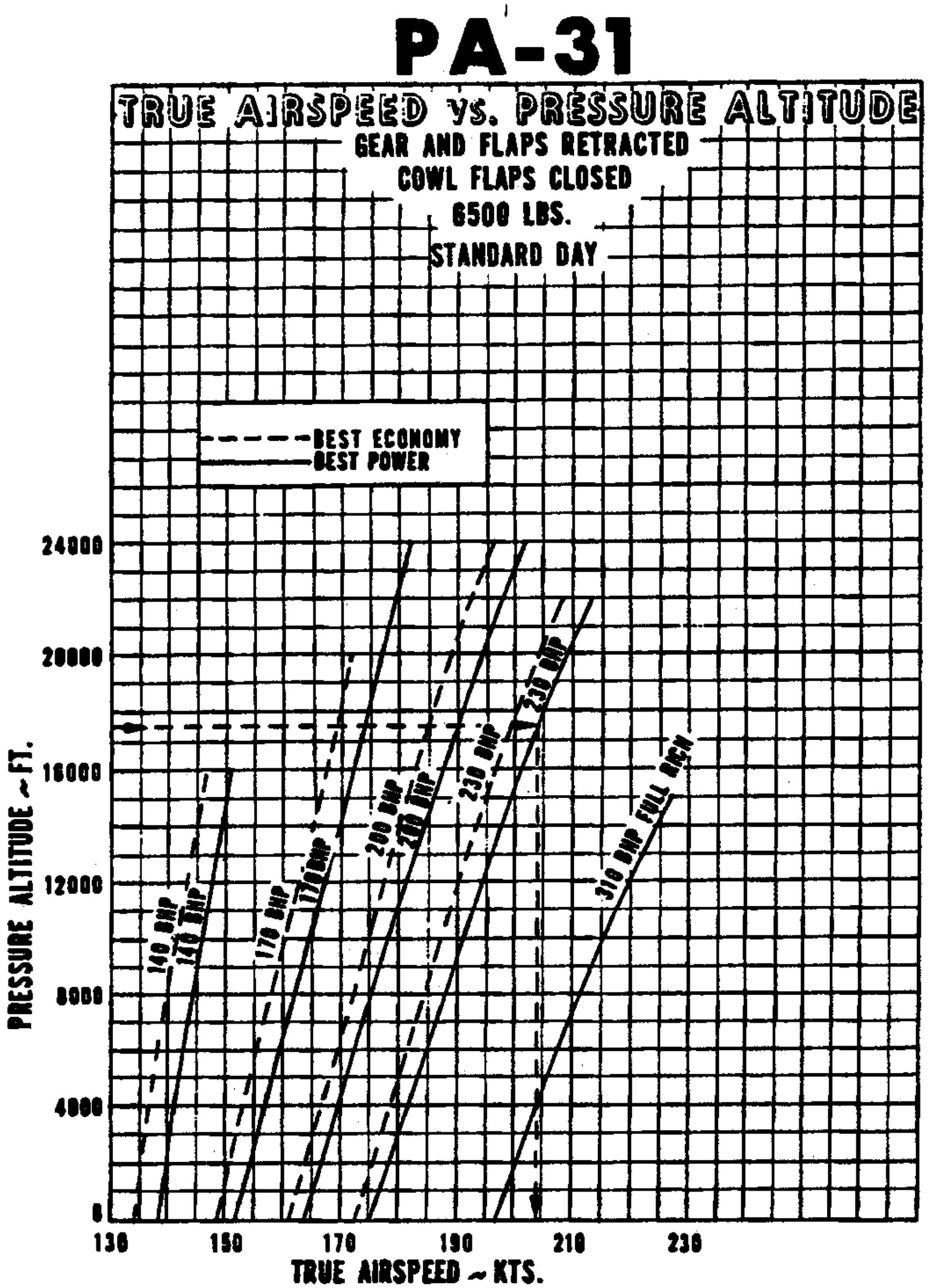
Example:

Pressure altitude at airport: 1000 ft.
OAT at airport: 13 C
Pressure altitude at cruise: 8000 ft.
OAT at cruise: -2 C

Initial climb weight: 6500 lbs.
Time to climb: (6 minus 1) = 5 min.
Fuel to climb: (35 minus 6) = 29 lbs.
Distance to climb: (9 minus 1) = 8 nautical miles



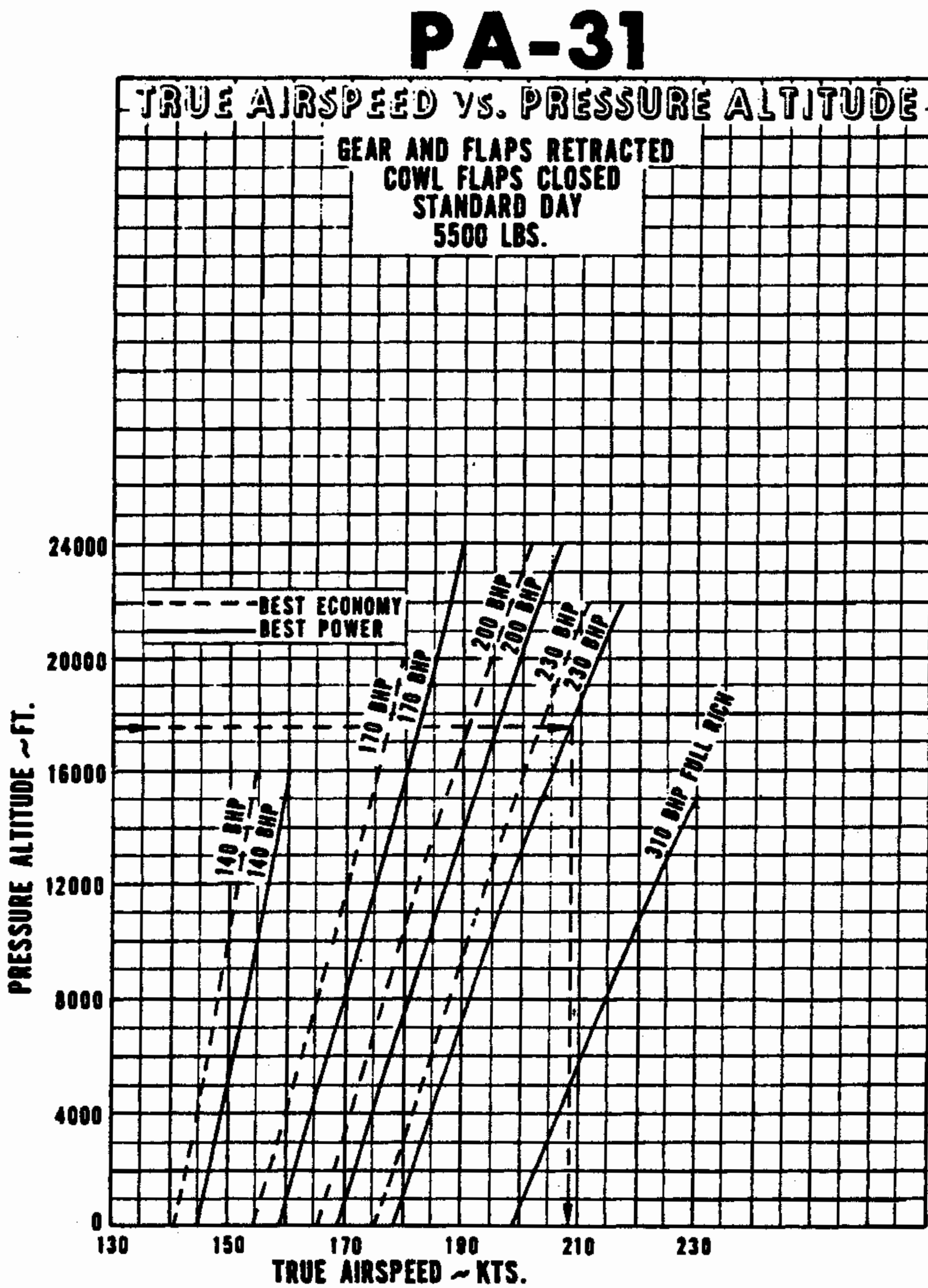
TIME, FUEL, AND DISTANCE TO CLIMB
Figure 5-25



Example:

Pressure altitude: 17,500 ft.
BHP (best power): 230
True airspeed: 204 knots

TRUE AIRSPEED VS PRESSURE ALTITUDE - 6500 LB.
Figure 5-27



Example:

Pressure altitude: 17,500 ft.
BHP (best power): 230
True airspeed: 209 knots

TRUE AIRSPEED VS PRESSURE ALTITUDE - 5500 LB.
Figure 5-29

THIS PAGE INTENTIONALLY LEFT BLANK

POWER SETTING TABLE
LYCOMING MODEL TIO-540-A SERIES, 310 HP ENGINES

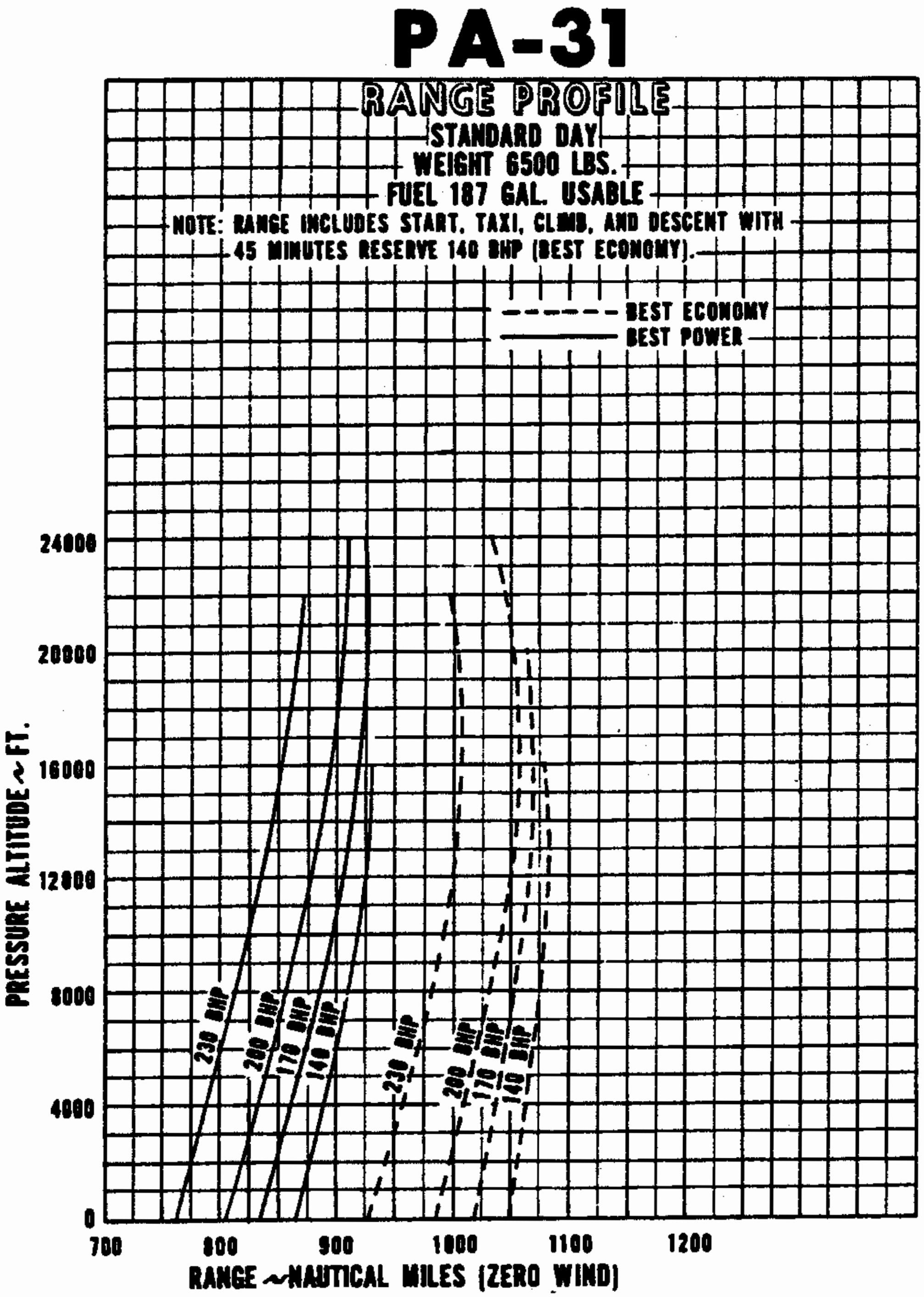
Press. Alt Feet	Std Alt Temp °F	Approx 170 BHP (55%) RPM 2200	2300	2400	Approx 200 BHP (65%) RPM 2200	2300	2400	Approx 230 BHP (75%) RPM 2300	2400	2500	Press. Alt Feet
SL	59	30.0	28.5	27.3	32.1	31.3	30.5	35.5	34.1	32.7	SL
2,000	52	28.3	26.8	25.7	31.6	30.4	29.3	34.3	33.1	31.9	2,000
4,000	45	27.4	26.0	24.9	30.9	29.3	28.0	33.2	32.1	31.1	4,000
6,000	38	26.7	24.8	23.7	30.4	28.8	27.6	32.8	31.6	30.5	6,000
8,000	31	26.2	24.4	23.3	30.2	28.7	27.4	32.8	31.5	30.3	8,000
10,000	23	26.2	24.4	23.2	30.3	28.6	27.2	33.1	31.6	30.3	10,000
12,000	16	26.4	24.7	23.2	30.8	28.9	27.3	33.3	31.8	30.4	12,000
14,000	9	26.7	24.9	23.3	31.2	29.2	27.5	33.6	32.0	30.6	14,000
16,000	2	27.2	25.1	23.4	31.9	29.6	27.6	34.2	32.4	30.9	16,000
18,000	-5	27.7	25.5	23.6	32.3	30.0	27.9	35.0	33.0	31.2	18,000
20,000	-12	28.3	26.3	24.3	33.1	30.6	28.4	F.T.	33.5	31.6	20,000

1. To maintain constant power, correct manifold pressure approximately 0.25" Hg for each 10°F variation in outside air temperature from standard altitude temperature. Add manifold pressure for air temperatures above standard; subtract for temperatures below standard.
2. Do not exceed 46" Hg up to 15,800 feet. Above 15,800 feet the following manifold limits must be observed:

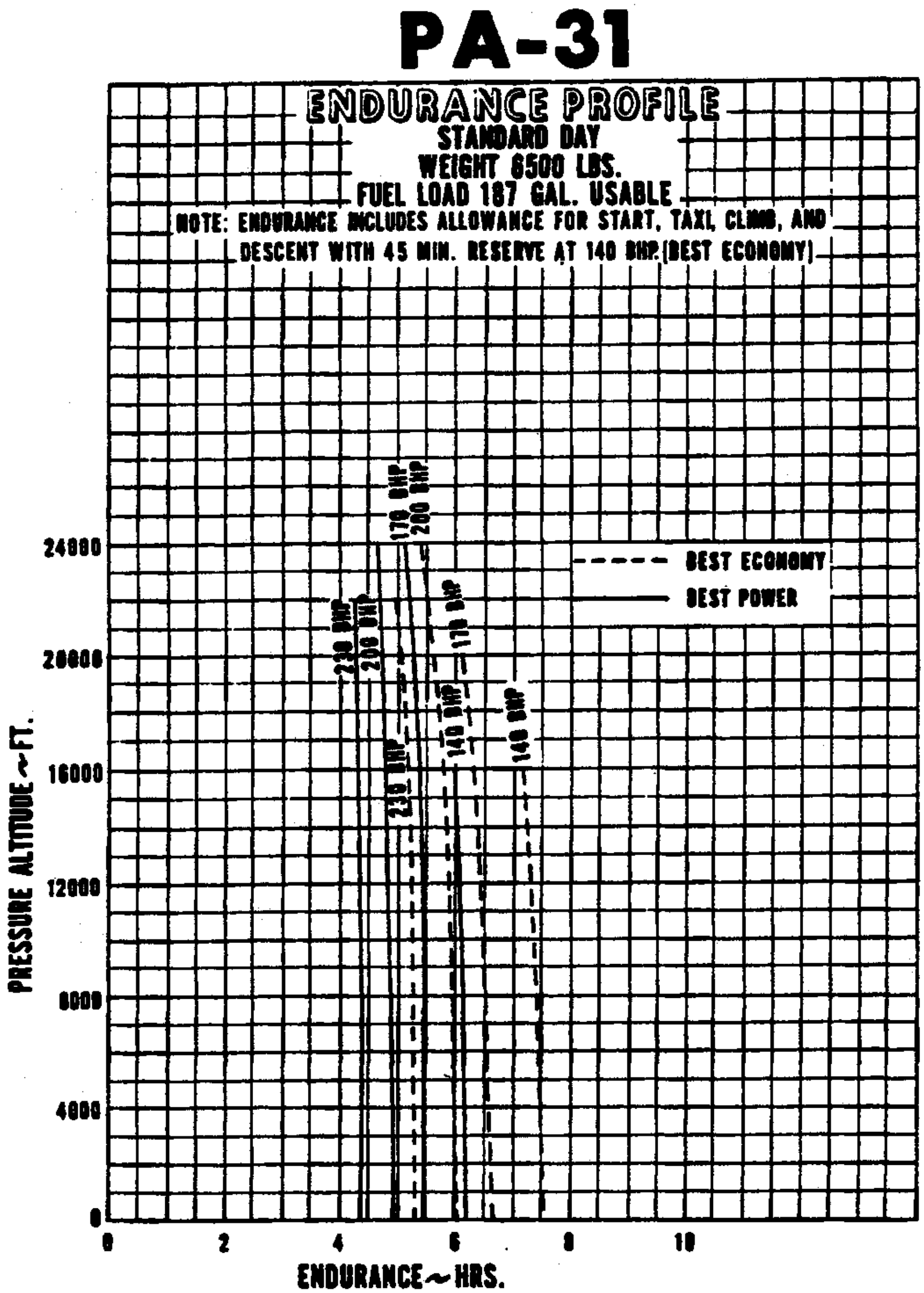
Altitude	M.P.	Altitude	M.P.
18,000 Ft	42.4"	24,000 Ft	32.7"
20,000 Ft	39.2"		
22,000 Ft	36.0"		

POWER SETTING TABLE
Figure 53-1

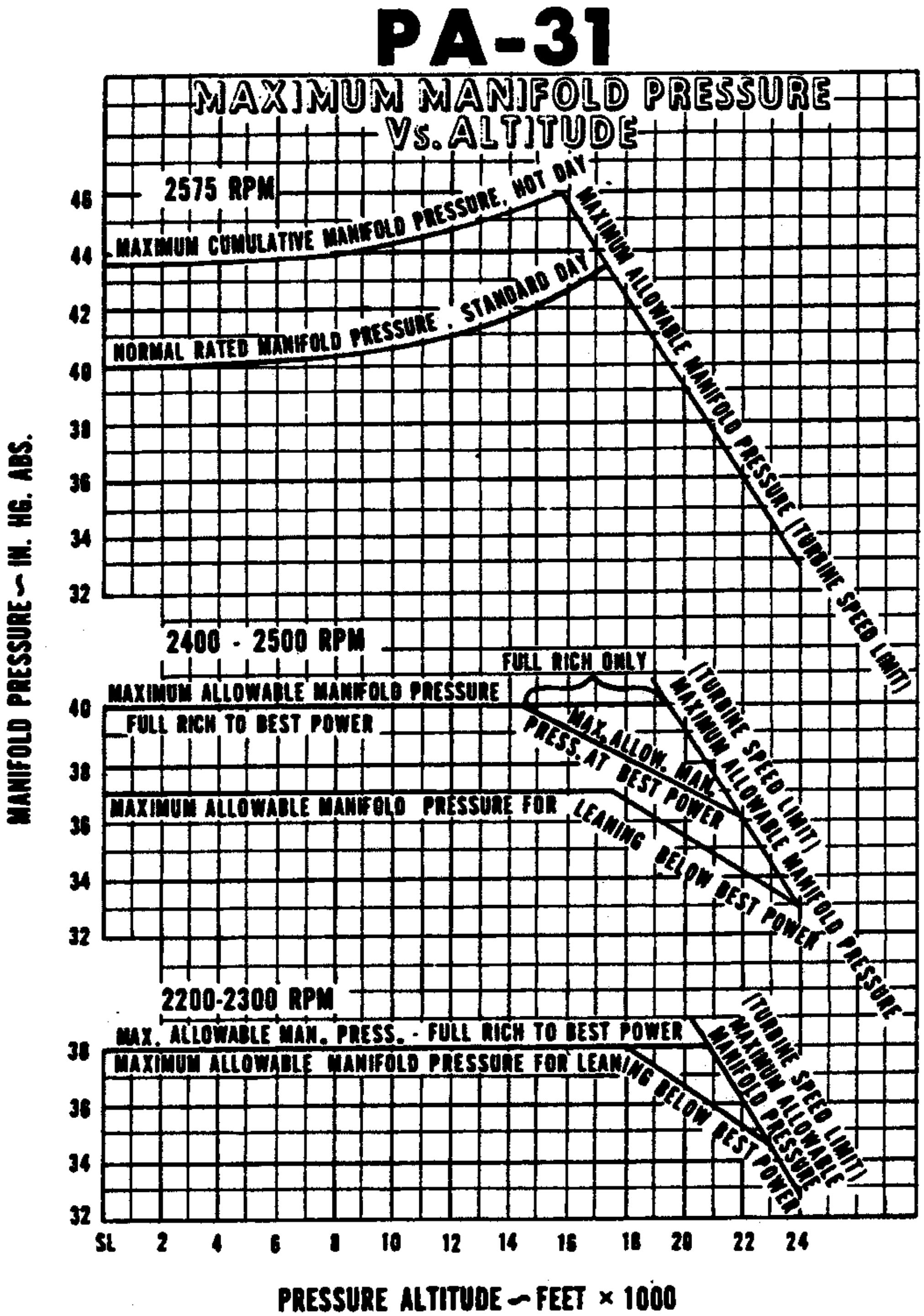
THIS PAGE INTENTIONALLY LEFT BLANK



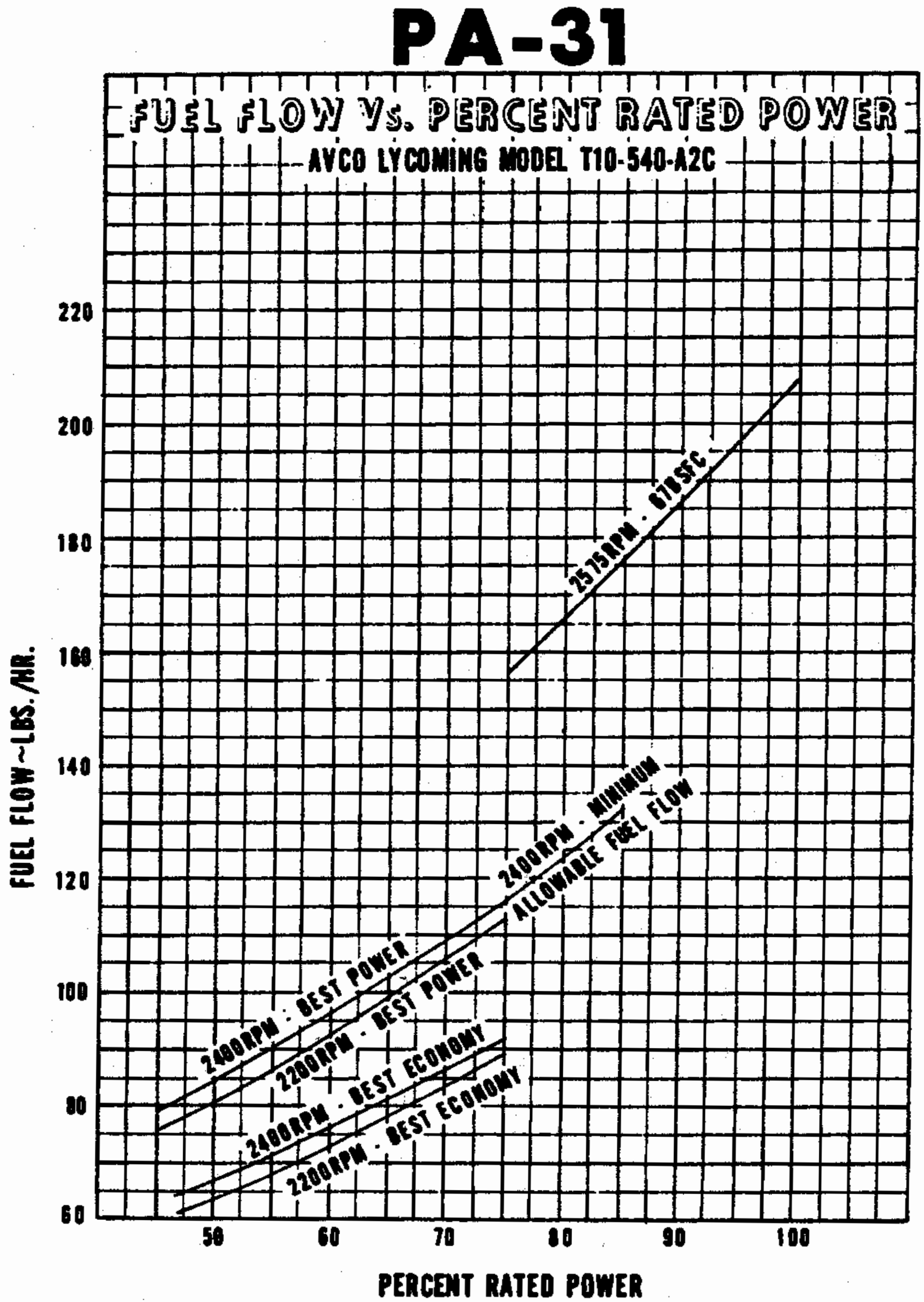
RANGE PROFILE
Figure 5-33



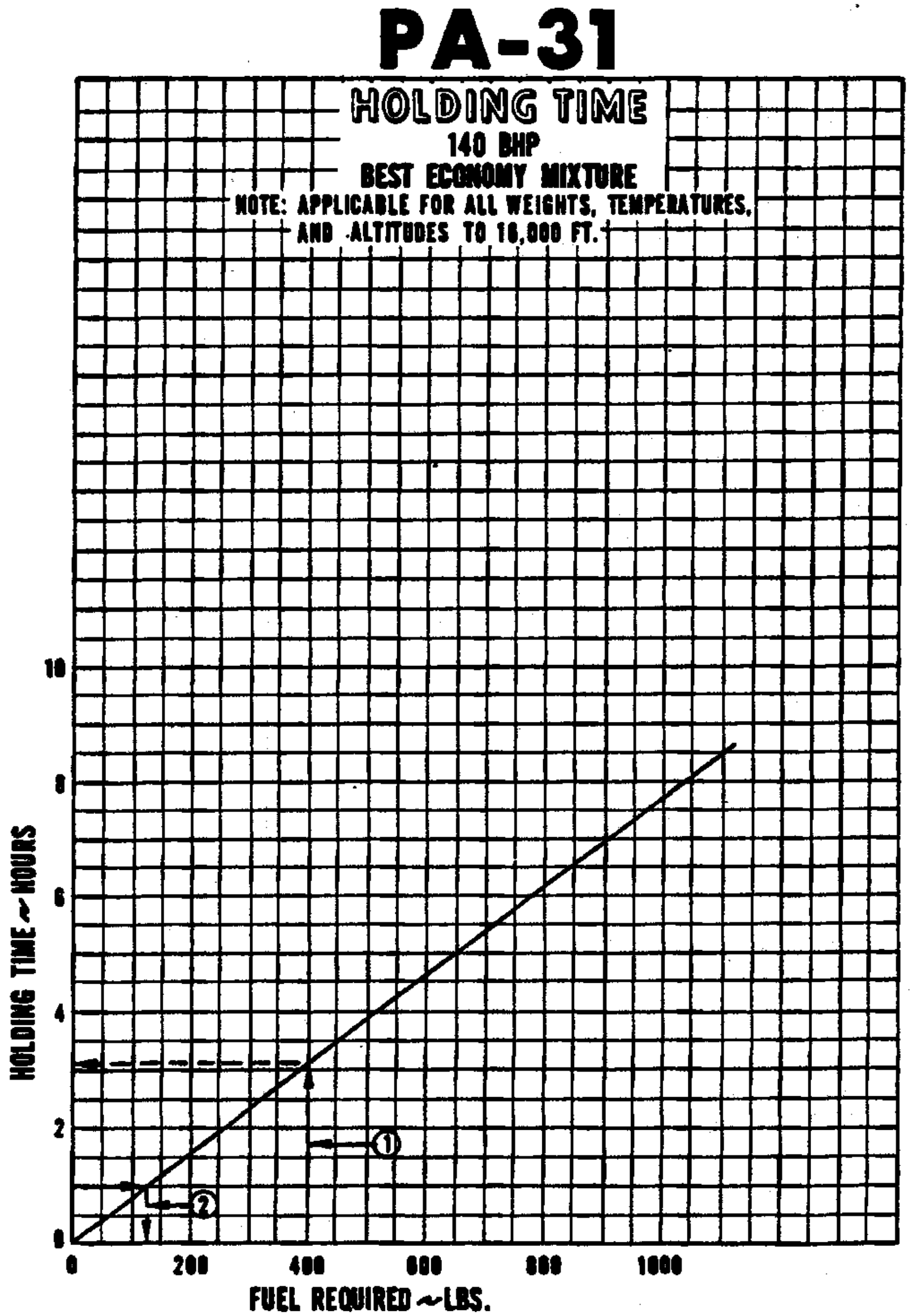
ENDURANCE PROFILE
Figure 5-35



MAXIMUM MANIFOLD PRESSURE VS ALTITUDE
Figure 5-37



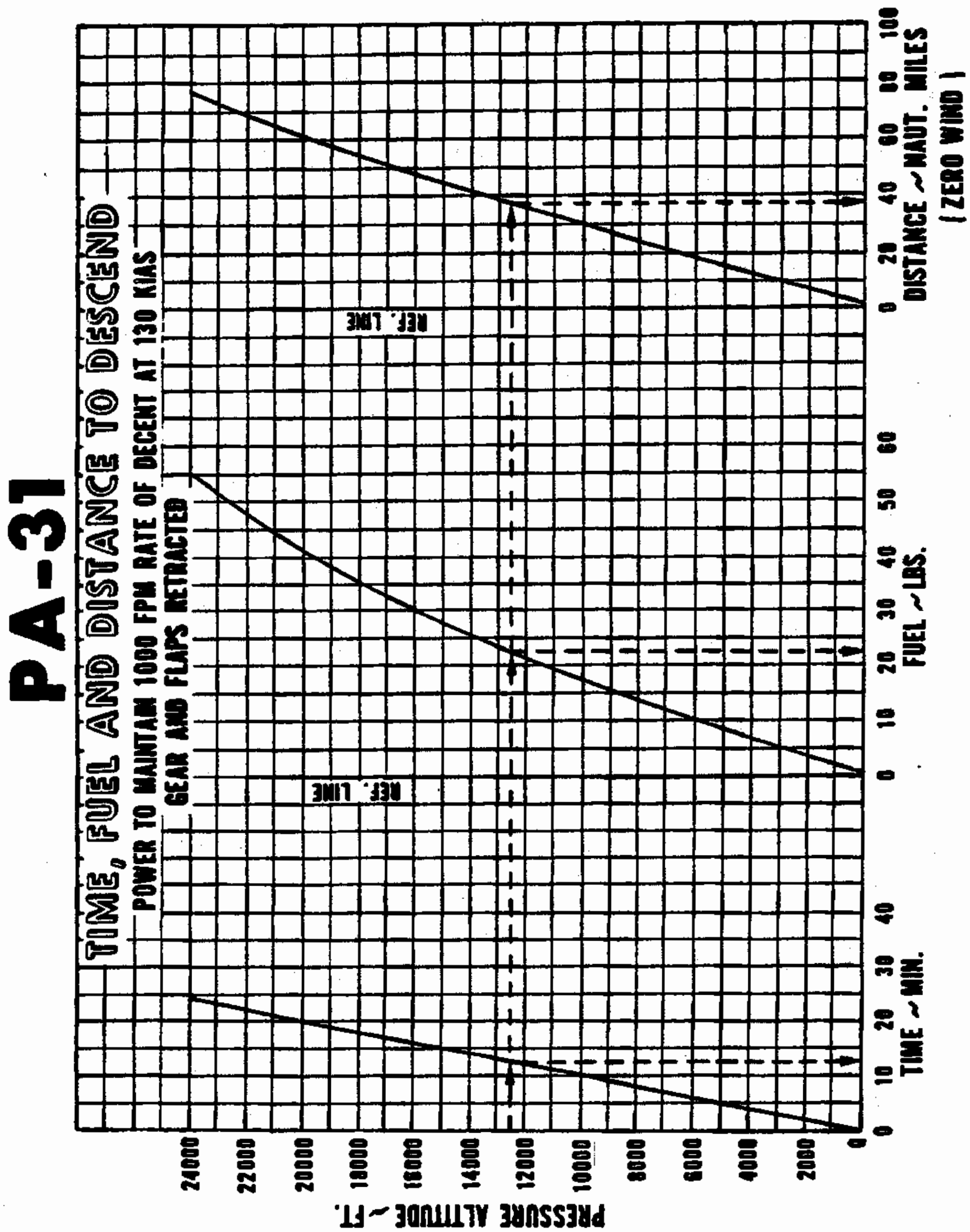
FUEL FLOW VS PERCENT RATED POWER
Figure 5-39



Examples:

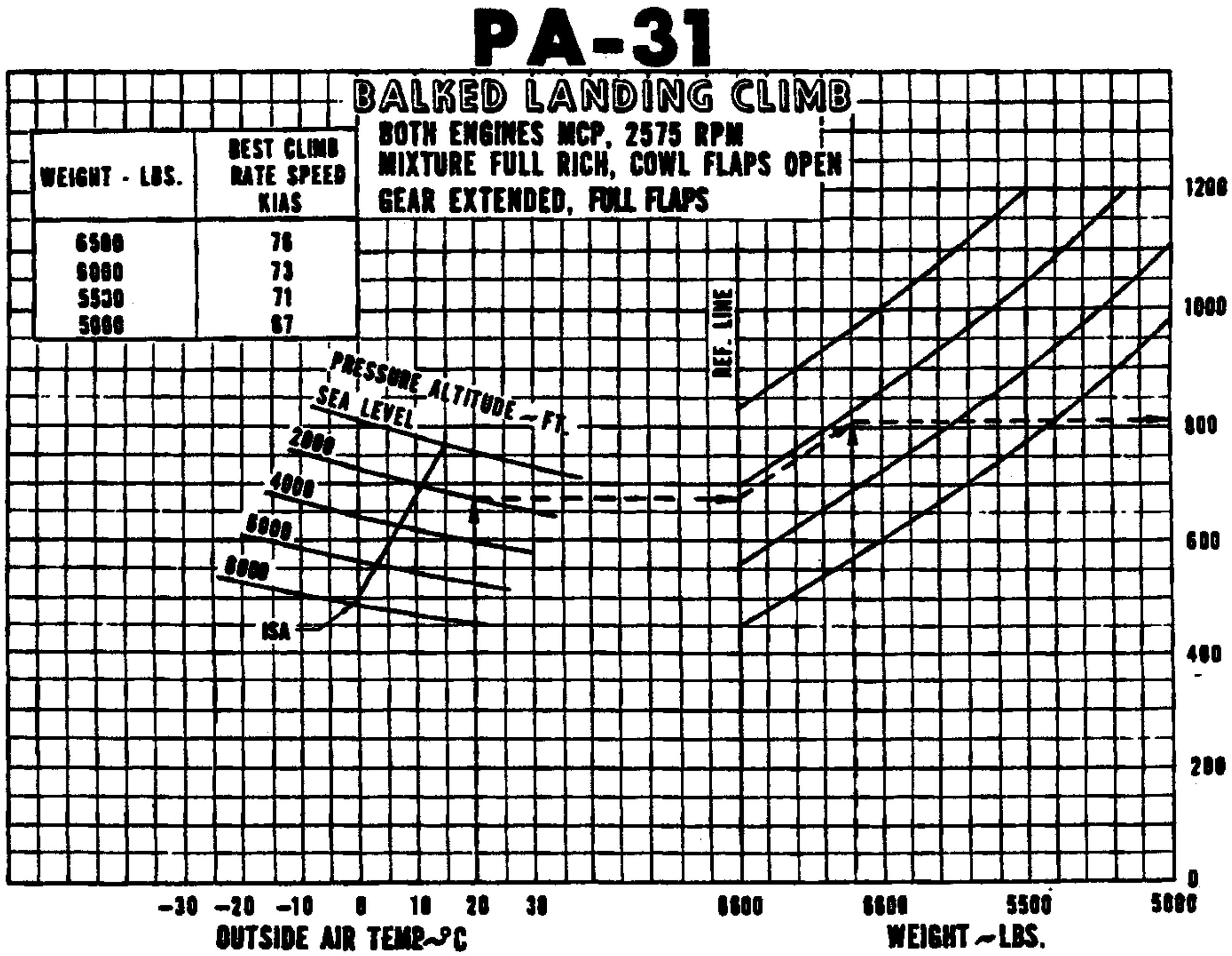
1. Fuel available for holding: 400 lbs.
   Holding time: 3:05 hrs.
2. Required holding time: 1:00 hrs.
   Fuel required: 125 lbs.

HOLDING TIME
Figure 5-41



Example:
Pressure altitude: 12,500 ft.
Time to descend: 12.5 min.
Fuel to descend: 22.5 lbs.
Distance to descend: 36 nautical miles

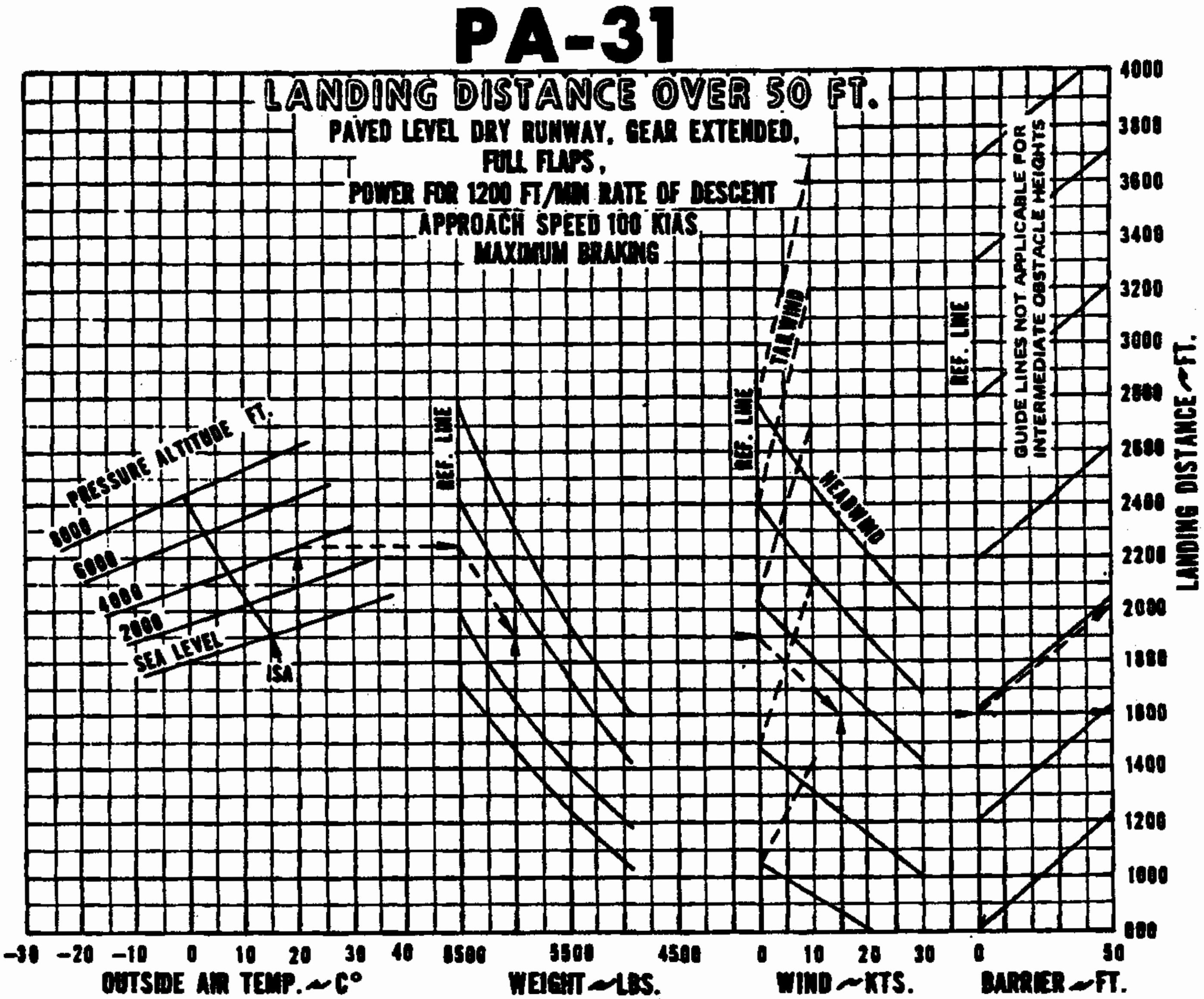
TIME, FUEL, AND DISTANCE TO DESCEND
Figure 5-43



Example:

Pressure altitude: 2000 ft.
OAT: +20°C
Weight: 6100 lbs.
Rate of climb: 810 FPM

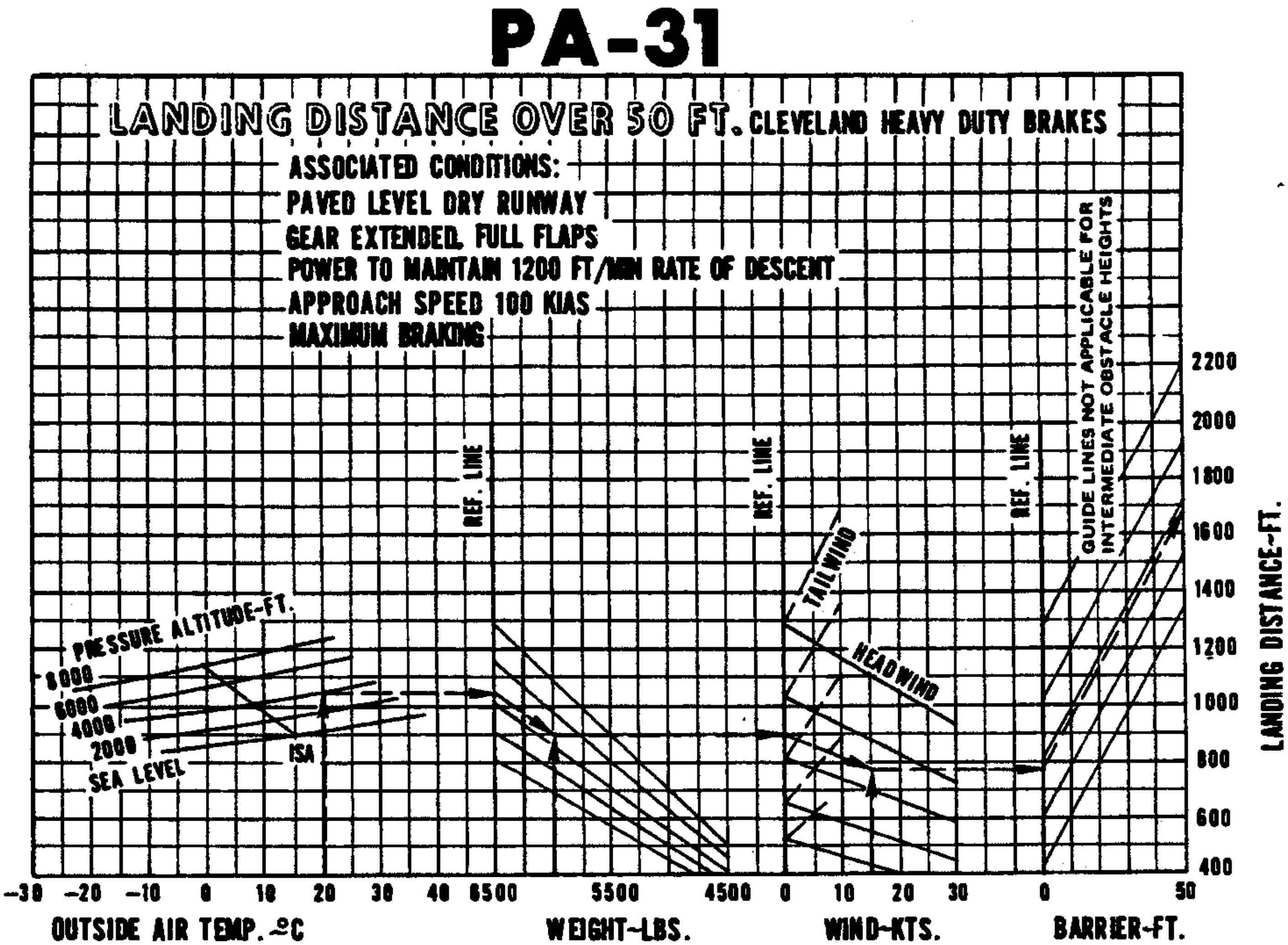
BALKED LANDING CLIMB PERFORMANCE
Figure 5-45



Example:

OAT: +20°C
Pressure altitude: 4000 ft.
Weight: 6000 lbs.
Wind: 15 knots
Ground run: 1600 ft.
Total distance: 2000 ft.

LANDING DISTANCE OVER 50 FEET
Figure 5-47



Example:
OAT: +20°C
Pressure altitude: 4000 ft.
Weight: 6000 lbs.
Wind: 15 knots
Ground run: 770 ft.
Total distance: 1680 ft.

LANDING DISTANCE OVER 50 FT. (CLEVELAND HEAVY DUTY BRAKES)
Figure 5-48

THIS PAGE INTENTIONALLY LEFT BLANK

TABLE OF CONTENTS

SECTION 6

WEIGHT AND BALANCE

SECTION 6

WEIGHT AND BALANCE

6.1 GENERAL

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

A properly loaded airplane, however, will perform as intended. Before the airplane is licensed, it is weighed, and a basic empty weight and C.G. location is computed (basic empty weight consists of the standard empty weight of the airplane plus the optional equipment). Using the basic empty weight and C.G. location, the pilot can 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.

The basic empty weight and C.G. location are recorded in the Weight and Balance Data Form (Figure 6-7) and the Weight and Balance Record (Figure 6-9). The current values should always be used. Whenever new equipment is added or any modification work is done, the mechanic responsible for the work is required to compute a new basic empty weight and C.G. position and to write these in the Aircraft Log Book and the Weight and Balance Record. The owner should make sure that it is done.

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

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

THIS PAGE INTENTIONALLY LEFT BLANK

6.3 AIRPLANE WEIGHING PROCEDURES

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 6-7.

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.

(4) Fill to full capacity with oil and operating fluids.

(5) Place pilot and copilot seats in a center position on the seat tracks. 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

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

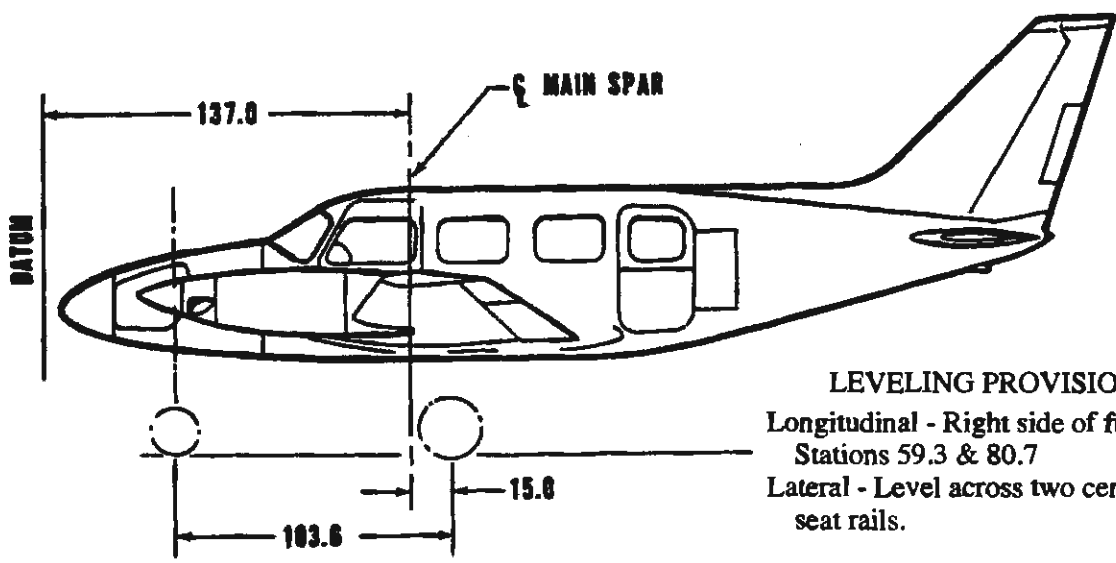
AIRPLANE AS WEIGHED
(Including full oil and operating fluids but no fuel)

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

WEIGHING FORM
Figure 6-1

(d) Center of Gravity

(1) The following geometry applies to the PA-31 airplane when it is level. Refer to Leveling paragraph 6.3 (b).



LEVELING PROVISIONS
Longitudinal - Right side of fuselage
Stations 59.3 & 80.7
Lateral - Level across two center seat rails.

LEVELING DIAGRAM
Figure 6-3

(2) C.G. Arm of airplane as weighed =

$$(137 + 15) - \frac{(103.6)\ (N)}{T} =$$

Inches Aft of Datum

(e) Basic Empty Weight

Item	Weight (Lbs)	x Arm (Inches Aft of Datum)	= Moment (In-Lbs)
Weight (as Weighed)			
Unusable Fuel (4.7 gal.)	28.2	137.0	3863
Basic Empty Weight			

BASIC EMPTY WEIGHT
Figure 6-5

6.5 WEIGHT AND BALANCE DATA AND RECORD

The Basic Empty Weight, Center of Gravity Location and Useful Load listed in Figure 6-7 are for the airplane as licensed from 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 6-9). 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 catered in the Weight and Balance Record.

MODEL PA-31 NAVAJO

Airplane Serial Number ______________________

Registration Number ______________________

Date ______________________

AIRPLANE BASIC EMPTY WEIGHT

Item	Weight (Lbs) x	Arm (Inches Aft of Datum) =	Moment (In-Lbs)
Standard Empty Weight*			
Optional Equipment (if applicable)			
Basic Empty Weight			

*The standard empty weight includes full oil capacity, full operating fluids and 4.7 gallons of unusable fuel.

AIRPLANE USEFUL LOAD - NORMAL CATEGORY OPERATION

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

(6536 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 6-7

THIS PAGE INTENTIONALLY LEFT BLANK

PA-31			Serial Number	Registration Number					Page Number		
Date	Item No.		Description of Article or Modification	Weight Change						Running Basic Empty Weight	
				Added (+)			Removed (-)				
	In	Out		Wt. (Lb.)	Arm (In.)	Moment /100	Wt. (Lb.)	Arm (In.)	Moment /100	Wt. (Lb.)	Moment /100
			As Licensed								

WEIGHT AND BALANCE RECORD

Figure 6-9

PA-31			Serial Number	Registration Number						Page Number		
Date	Item No.		Description of Article or Modification	Weight Change						Running Basic Empty Weight	
				Added (+)			Removed (-)				
	In	Out		Wt. (Lb.)	Arm (In.)	Moment /100	Wt. (Lb.)	Arm (In.)	Moment /100	Wt. (Lb.)	Moment /100

WEIGHT AND BALANCE RECORD (cont)

Figure 6-9 (cont)

6.7 GENERAL LOADING RECOMMENDATIONS

(a) When carrying 1 to 5 occupants in forward seats, rear baggage may be required to bring the loaded airplane's C.G. within allowable limits.

(b) When carrying more than 5 occupants, fuel and/or baggage may have to be reduced.

(c) When carrying 6 occupants, distribute load between front and rear baggage compartments.

(d) When carrying 7 or 8 occupants, load forward baggage compartment first and locate heaviest occupants forward.

(e) When carrying 8 occupants, forward baggage may be required to bring the loaded airplane's C.G. within allowable limits.

(f) Observe zero fuel weight limitations.

NOTE

These general loading recommendations suggest normal proper loading procedures. The charts, graphs, instructions, and plotter should be checked to assure that the airplane is within the allowable weight vs. center of gravity envelope.

CENTER OF GRAVITY RANGE (Gear Extended)

(+134.0) to (+138.0) to 6536 lb. (Max. Ramp Weight)
(+134.0) to (+138.0) to 6500 lb. (Max. Takeoff Weight)
(+128.5) to (+138.0) to 6000 lb.
(+120.0) to (+138.0) to 4800 lb. or lower
Straight line variation between points given

6.9 WEIGHT AND BALANCE DETERMINATION FOR FLIGHT

(a) Add the weight of all items to be loaded to the Basic Empty Weight.

(b) Use the Loading Chart (Figure 6-15) 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 Weight, Moment and C.G. Limits graph (Figure 6-17). If the point falls within the C.G. envelope, the loading meets the weight and balance requirements.

(f) Location of the point on the Weight, Moment, and C.G. Limits graph indicates whether the airplane is slightly nose heavy or slightly tail heavy and can assist in setting pitch trim for takeoff.

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

ITEM	WT. LBS.	ARM-IN	MOMENT
Basic Airplane	4349	128.0	556600
Revised Airplane			
Pilot's Seat	175	119.0	208
Copilot's Seat	130	119.0	155
Seat No. 3	140	166 (159 Reversed)	232
Seat No. 4	160	166 (159 Reversed)	266
Seat No. 5		198.0	
Seat No. 6		198.0	
Seat No. 7		229.0	
Seat No. 8		242.0	
Fwd. Baggage		43.0	
Rear Baggage	150	255.0	383
Rt. Nac. Baggage Forward Half	50	145.0	73
Rt. Nac. Baggage Rear Half	50	192.0	96
Lt. Nac. Baggage Forward Half	50	145.0	73
Lt. Nac. Baggage Rear Half	50	192.0	96
Inb. Fuel	600	126.8	761
Outb. Fuel	456	148.0	675
Other			
Total Wt.	6360	Total Moment	858400

C.G. Location for Takeoff **135.0** (from Figure 6-17)

SAMPLE LOADING PROBLEM
Figure 6-11

ITEM	WT. LBS.	ARM-IN	MOMENT
Basic Airplane			
Revised Airplane			
Pilot's Seat		119.0	
Copilot's Seat		119.0	
Seat No. 3		166 (159 Reversed)	
Seat No. 4		166 (159 Reversed)	
Seat No. 5		198.0	
Seat No. 6		198.0	
Seat No. 7		229.0	
Seat No. 8		242.0	
Fwd. Baggage		43.0	
Rear Baggage		255.0	
Rt. Nac. Baggage Forward Half		145.0	
Rt. Nac. Baggage Rear Half		192.0	
Lt. Nac. Baggage Forward Half		145.0	
Lt. Nac. Baggage Rear Half		192.0	
Inb. Fuel		126.8	
Outb. Fuel		148.0	
Other			
Total Wt.		Total Moment	

C.G. Location for Takeoff

WORK SHEET
Figure 6-13

OCCUPANTS

	Pilot, Copilot Arm 119	Seats 3 &4 Fwd Facing Arm 166	Seats 3 &4 Aft Facing Arm 159	Seats 5 & 6 Arm 198	Seat 7 Arm 229	Seat 8 Arm 242
Weight	Moment / 100					
120	143	199	191	238	275	290
130	155	216	207	257	298	315
140	167	232	223	277	321	339
150	179	249	239	297	344	363
160	190	266	254	317	366	387
170	202	282	270	337	389	411
180	214	299	286	356	412	436
190	226	315	302	376	435	460
200	238	332	318	396	458	484

BAGGAGE

	Fwd Baggage Arm 43	Rear Baggage Arm 255	Nacelle Baggage Fwd Half Arm 145	Nacelle Baggage Rear Half Ann 192
Weight	Moment/100			
10	4	26	15	19
20	9	51	29	38
30	13	77	44	58
40	17	102	58	77
50	22	128	73	96
60	26	153	87	115
70	30	179	102	134
80	34	204	116	154
90	39	230	131	173
100	43	255	145	192
110	47	281	160	211
120	52	306	174	230
130	56	332	189	250
140	60	357	203	269
150	65	383	218	288
160	—	408	—	—
170	—	434	—	—
180	—	459	—	—
190	—	485	—	—
200	—	510	—	—

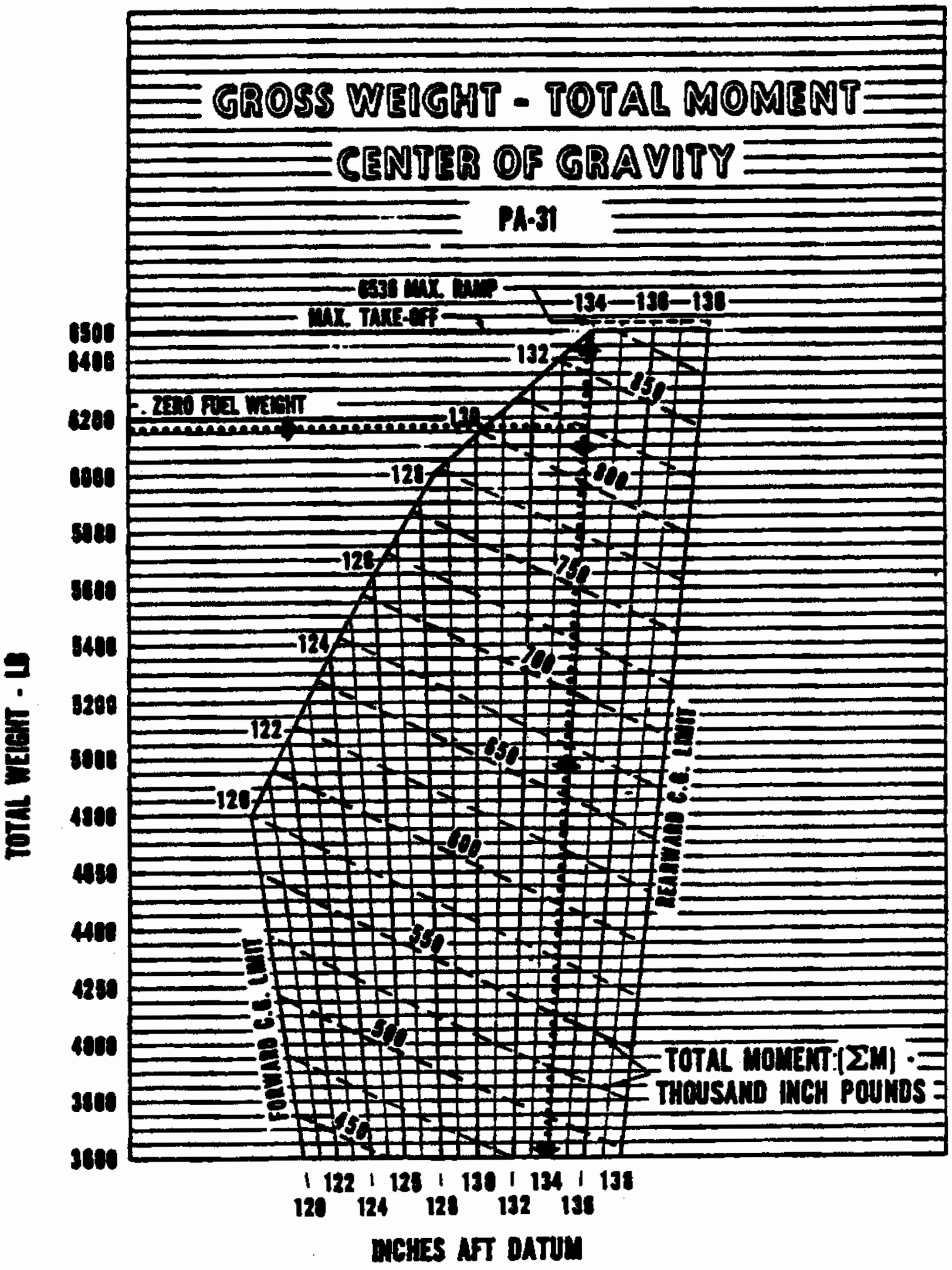
LOADING CHART
Figure 6-15

FUEL

Gallons	Weight Lbs.	Inboard Tanks Arm = 126.8	Outboard Tanks Arm = 148.0
		Moment/ 100	
5	30	38	44
10	60	76	89
15	90	114	133
20	120	152	178
25	150	190	222
30	180	228	266
35	210	266	311
40	240	304	355
45	270	342	400
50	300	380	444
55	330	418	488
60	360	456	533
65	390	495	577
70	420	533	622
75	450	571	666
77.7	466	—	690
80	480	609	—
85	510	647	—
90	540	685	—
95	570	723	—
100	600	761	—
105	630	799	—
109.6	658	834	—

1.2 gals. unusable fuel in each inboard tank and 1.15 gals. unusable fuel in each outboard tank included in basic weight (28.2 lbs., 3863 in. lbs. total)

LOADING CHART (cont)
Figure 6-15 (cont)



WEIGHT, MOMENT AND C.G. LIMITS
Figure 6-17

THIS PAGE INTENTIONALLY LEFT BLANK

6.11 WEIGHT AND BALANCE VISUAL PLOTTER

The Weight and Balance Visual Plotter furnished with this airplane is a weight and center of gravity computing device.

The face of the plotter displays the slots used for plotting and the graphic center of gravity envelope. On the back of the plotter are printed instructions for use and general loading recommendations. The center of gravity envelope on the face shows all allowable moment conditions between 3600 and 6500 pounds, with the limits outlined in red.

The "Basic Empty Weight and Center of Gravity" location is taken from the Weight and Balance Form (Figure 6-7), the Weight and Balance Record (Figure 6-9) or the latest FAA major repair or alteration form.

CAUTION

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

6.13 INSTRUCTION FOR USING PLOTTER

(a) Instructions for using the plotter are printed on the back of each plotter. To use the plotter, proceed as follows:

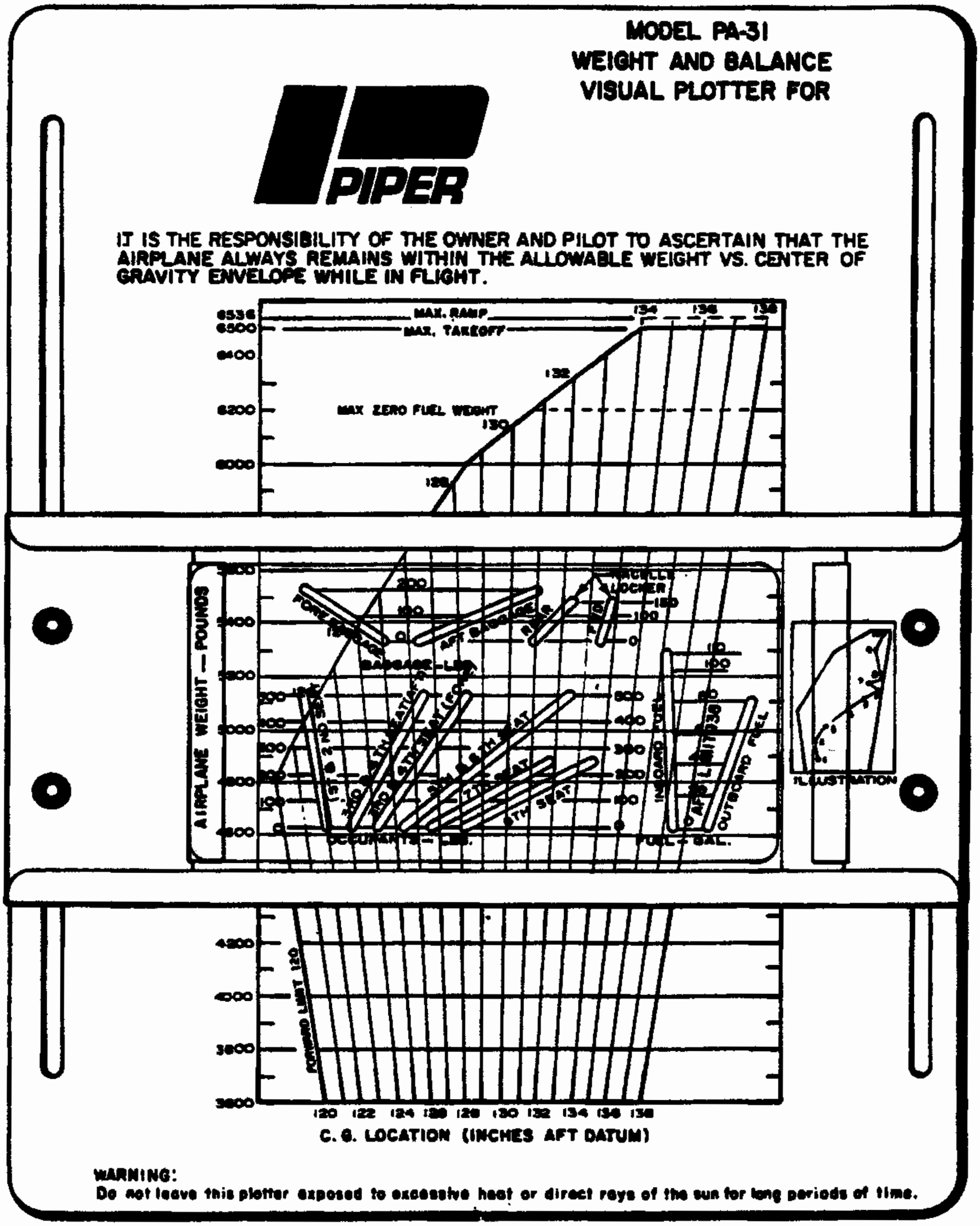
1. Locate point on plotter face corresponding to the "Basic Empty Weight" and "C.G." location.
2. "Zero" the "Occupants, 1st & 2nd" slot over the "Basic Empty Weight" point: Establish new point at weight corresponding to occupants' weight.
3. For 3rd & 4th Seats, repeat step 2 from point 2, using proper slot for aft or foward facing seats.
4. For 5th & 6th Seats, repeat step 3 from point 3.
5. For 7th Seat, repeat step 4 from point 4.
6. For 8th Seat, repeat step 5 from point 5.
7. Zero the "Front Baggage" slot over point 6: Establish new point at weight corresponding to front baggage weight.
8. For "Rear Baggage" repeat step 7 from point 7.
9. For "Nacelle Locker Baggage" zero "Nac Locker Rear" slot over point 8: Establish new point "R" corresponding to the total baggage weight in the rear half of both lockers.
   Zero "Nac Locker Fwd" slot over point "R": Establish new point "F" corresponding to the toal baggage weight in the forward half of both lockers.
10. "Zero" the "Inboard Fuel" slot over point "F": Establish new point at fuel quantity desired.
11. For "Outboard Fuel" repeat step 10 from point 10.

NOTES

Should the fuel slot leave the "C.G. Envelope" (outlined in red) between 134 and 138 inches, the fuel indicated at the exit point is maximum allowable.

Should the fuel slot leave the "C.G. Envelope" other than between 134 and 138 inches, the baggage or passenger load should be redistributed forward or aft as required, to allow a higher load, up to 6536 lbs.

(b) Refer to paragraph 6.7 for General Loading Recommendations.



WEIGHT AND BALANCE VISUAL PLOTTER
Figure 6-19

6.15 CARGO LOADING

When seats are removed for cargo stowage, the Basic Empty Weight and corresponding C.G. must be corrected prior to determination of the loading schedule. The weights and arms for these seats are:

Item	Weight	Arm	Moment/ 100
3rd & 4th Seat Fwd Facing (each)	26	166	43
3rd & 4th Seat Aft Facing (each)	26	159	41
5th & 6th Seat (each)	26	198	51
7th Seat	26.0	229	60
8th Seat	25.0	242	61

A large cargo door can be installed adjacent to the main cabin entrance door to facilitate cargo loading. The door provides an additional fuselage opening (17 inches long and 29 inches wide) which results in a total access length of over 44 inches. A quick disconnect pin is provided on the main cabin entrance door cable which permits maximum utilization of the additional opening provided by the optional cargo door.

The cargo barrier installation provides the necessary equipment to safely load the cabin area of the fuselage, establishes a protective barrier for the cockpit area, and presents instructions for cargo loading and weight limitations. This optional installation includes cargo rollers, tie down straps, cargo net, equipment container and a cargo blanket.

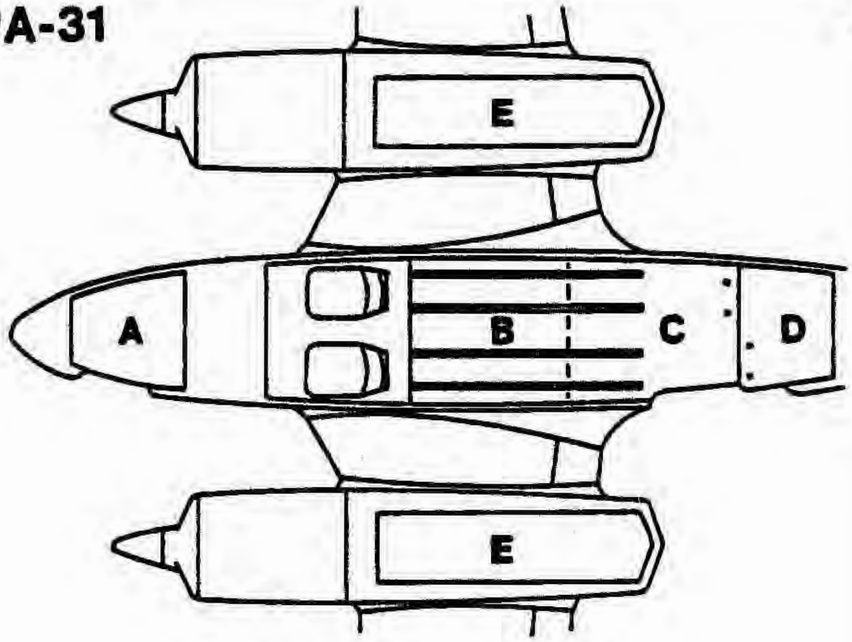
A loading placard (following page) is mounted in the rear of the aft baggage compartment and clearly defines the limitations and procedures for cargo loading. This information should be used in conjunction with the information presented in the Weight and Balance section to assure a weight and center of gravity within the limits of the airplane.

Cargo barriers and restraining equipment are limited as follows:

(a) Cargo barriers - Maximum restraining capacity of 1280 lbs. at 24 in. C.G. height of cargo.
(b) Cargo net - maximum restraining capacity of 1280 lbs. at 24 in. C.G. height of cargo.
(c) Cargo straps - maximum restraining capacity of 150 lbs. at 12 in. C.G. height of cargo.
(d) Baggage tie down rings attached to seat tracks - maximum restraining capacity of 200 lbs. each.
(e) Baggage tie down rings attached to Wedjit plates - maximum tie down capacity of 200 lbs. each.

Weight and C.G. computations of individual items should be calculated before actual loading. When loading items of identical weight with an even weight distribution, the C.G. can be determined for all the items in the center of the load. All items of unequal weight should be figured separately. Also, compute the load weight and C.G. first; then compute fuel weight and total C.G. to allow for the possibility of the C.G. moving aft of the allowable aft C.G. limit while burning off fuel.

PA-31



MAXIMUM CAPACITY

AREA	FLOOR LOAD LBS/SQ. FT.	ALLOWABLE LBS.	
A	100	150	
B	150	640	1475 TOTAL
C	150	640	
D	100	200	
E	IF WING LOCKERS ARE NOT INSTALLED THIS LINE DOES NOT APPLY		

MAXIMUM TIEDOWN CAPACITY

PER FOOT OF TRACK	200 LBS
PER TRACK	600 LBS
PER TIEDOWN RING	200 LBS

CARGO MUST BE LOADED WITHIN THE WEIGHT AND BALANCE LIMITS OF THIS AIRCRAFT

CODE NO. 582 082

CARGO LOADING PLACARD
Figure 6-21

Generally, heavier items should be loaded in section B (see cargo loading placard) and lighter items in sections C and D.

NOTE

When loading heavy items, it is recommended to install a post under the tail skid to prevent the tail from settling while loading. The parking brakes should also be set.

In most cases the forward baggage compartment must be loaded in order to utilize sections C and D. The empty weight of the airplane does not include the cargo barrier installation equipment; however, the cargo barrier equipment was included and the passengers' seats removed in the basic airplane weight and C.G. in the following loading example:

(a) Example loading:

	Weight	X	Arm	=	Moment
A/C Basic Weight	4354		127.4		554,700
Pilot	170		119.0		20,230
Load Section A	50		43.0		2,150
Load Section B	400		147.0		58,800
Load Section C	250		210.0		52,500
Load Section D	150		255.0		38,250
Load Section E	100		192.0		19,200
TOTAL	5474		136.2		745,830
Inboard Fuel 107.4 gal.	644		126.8		81,659
Outboard Fuel 63.6 gal.	382		148.0		56,536
TOTAL	6500		136.0		884,025

In the above example, the airplane falls within the limits (both C.G., weight and zero fuel gross weight) and therefore is safe to fly with the above loading.

THIS PAGE INTENTIONALLY LEFT BLANK

THIS PAGE INTENTIONALLY LEFT BLANK

6.17 EQUIPMENT LIST

The following is a list of equipment which may be installed in the PA-31. It consists of those items used for defining the configuration of an airplane when the basic empty weight is established at the time of licensing. Items marked with an "X" are those items which were installed on the airplane described below as delivered by the manufacturer.

PIPER AIRCRAFT CORPORATION PA-31, NAVAJO

SERIAL NO.__________ REGISTRATION NO.__________ DATE:__________

(a) Propeller and Propeller Accessories

Item No.	Item	Mark if Instl.	Weight (Pounds)	Arm (In.) Aft Datum	Moment (Lb-In.)
1	Two Propeller Installations Per Piper PS50071-9, Hartzell Model HC-E3YR-2ATF/ FC8468-6R Cert. Basis - TC P33EA	______	91.9 ea.	48.2	4430
3	Two Hydraulic Propeller Governors a. Per PAC Dwg. 24622-18, Hartzell Model F-6-24 b. Per PAC Dwg. 24622-24, Hartzell Model F-6-24Z Cert. Basis - TC A8EA	______	5.5 ea.	64.0	352
4	One Hydraulic Propeller Governor a. Per PAC Dwg. 24622-18, Hartzell Model F-6-24 (Left) b. Per PAC Dwg. 24622-24, Hartzell Model F-6-24Z (Left) Cert. Basis - TC A8EA	______	5.5	64.0	352
5	Two Propeller Spinners Per PAC Dwg. 43940 or -8 Cert. Basis - TC A8EA	______	3.1 ea.	46.2	143

(a) Propeller and Propeller Accessories (cont)

Item No.	Item	Mark if Instl.	Weight (Pounds)	Arm (In.) Aft Datum	Moment (Lb-In.)
7	Two Propeller Spinner Caps Per PAC Dwg. 43929-2 (3 Bld) Cert. Basis - TC A8EA	______	.6 ea.	36.0	22
9	Propeller Spinner Bulkheads Per PAC Dwg. 43933-4 or -8 Cert. Basis - TC A8EA	______	1.1 ea.	49.8	55

(b) Engine and Engine Accessories

Item No.	Item	Mark if Instl.	Weight (Pounds)	Arm (In.) Aft Datum	Moment (Lb-In.)
17	Two Engines Per PAC Dwg. 52392 Lycoming Model TIO-540-A2C Cert. Basis - TC E14EA	______	544.5 ea.	77.8	42362
19	Two Oil Coolers, Harrison Model AP16AN08-01, Part No. 8535311, Per PAC Dwg. 41635 Cert. Basis - TC A8EA	______	4.5 ea.	97.0	437
21	Fuel Pumps (Engine Driven) Lear Siegler Model RG9080-J4A or Titan Fuel Pump Equivalent Cert. Basis - TC A8EA	______	1.3 ea.	91.0	118
23	Two Emergency Fuel Pumps (Electric) Weldon Model A10014C-44, Per PAC Dwg. 42113-6 Cert. Basis - TC A8EA	______	2.8 ea.	127.2	356
25	Two Starters, 24 Volt Prestolite MHB-4013 or MHB-4018 Cert. Basis - TC A8EA	______	18.0 ea.	65.8	1184
27	Two Hydraulic Pumps Per PAC Dwg. 26802-8, Eastern Industries Model 1213-HBG Type 310 Cert. Basis - TC A8EA	______	3.6 ea.	92.0	331

(b) Engine and Engine Accessories (cont)

Item No.	Item	Mark if Instl.	Weight (Pounds)	Arm (In.) Aft Datum	Moment (Lb-In.)
29	Two Induction Air Filters, Donaldson Model P10-6590 Cert. Basis - TC A8EA	_____	1.0 ea.	88.0	88
31	Two Oil Filters, Lycomig Model 77853, AC Model 6437032 Cert. Basis - TC A8EA	_____	2.5 ea.	92.0	230
33	Two Air Pumps Per PAC Dwg. 26749-7, Airborne Model 211CC Cert. Basis - TC A8EA	_____	4.0 ea.	90.0	360

90.0

(c) Landing Gear and Brakes

Item No.	Item	Mark if Instl.	Weight (Pounds)	Arm (In.) Aft Datum	Moment (Lb-In.)
45	Two Main Wheel and Brake Assy., Cleveland Aircraft Products, Wheel No. 40-102a, Brake No. 30-68a Cert. Basis - TSO C26a	_____	18.3 ea.	152.0	2782
	Two Main Tires, 6.50 x 10, 8-Ply Rating, Type III with Regular Tubes Cert. Basis - TC A8EA	_____	13.0 ea.	152.0	1976
47	One Nose Wheel Assembly, Cleveland Aircraft Products No. 40-76B Cert. Basis - TSO C26a	_____	3.8	48.0	182
	One Nose Tire, 6.00 x 6, 6-Ply Rating, Type III with Regular Tube Cert. Basis - TC A8EA	_____	9.3	48.0	446

THIS PAGE INTENTIONALLY LEFT BLANK

(d) Electrical Equipment

Item No.	Item	Mark if Instl.	Weight (Pounds)	Arm (In.) Aft Datum	Moment (Lb-In.)
61	Two Alternators, 70 Amp ea. Prestolite No. ALU-8421 Cert. Basis - TC A8EA	_____	12.6 ea.	62.8	791
63	One Battery, 24 Volt 17 Ampere-Hour Gill No. 12-GCAB-9 Cert. Basis - TC A8EA	_____	28.0	22.0	616
65	Two Landing Lights, 28 Volt, 250-Watt GE No. 4596 Cert. Basis - TC A8EA	_____	2.0 ea	50.5	101
67	Position/Anti-Collision Lights Tail, Whelen #A460-HDM-28/ A490-HT-M-28; Left Wing, Whelen #A429-PR-D-M-28/ A490-HT-M-28; Right Wing, Whelen #A429-PG-D-M-28/ A490-HT-M-28 Cert. Basis - TC A8EA	_____	4.6	183.0	842
68	Position/Anti-Collision Lights Tail, Whelen #A500-HDM-28/ A490-HT-M-28; Left Wing, Whelen #A429-PR-D-M-28/ A490-HT-M-28; Right Wing, Whelen #A429-PG-D-M-28/ A490-HT-M-28 Cert. Basis - TC A8EA	_____	4.6	183.0	842
69	Two Low Fuel Flow Warning Lights Per PAC Dwg. 54338-2 Cert. Basis - TC A8EA	_____	Neglect Weight Change		
71	Annunciator Display Per PAC Dwg. 55930-2 Cert. Basis - TC A8EA	_____	1.0	98.0	98
73	Annunciator Control Per PAC Dwg. 49353-2 Cert. Basis - TC A8EA	_____	1.0	63.0	63

THIS PAGE INTENTIONALLY LEFT BLANK

(e) Instruments

Item No.	Item	Mark if Instl.	Weight (Pounds)	Arm (In.) Aft Datum	Moment (Lb-In.)
87	Airspeed Indicator Per PAC Dwg. 41507-18 Cert. Basis - TC A8EA	_____	.6	96.0	58
89	Magnetic Compass Per PAC Dwg. 42580 Cert. Basis - TC A8EA	_____	.7	96.0	67
91	Sensitive Altimeter Per Piper PS50008-4 or PS50008-5 Cert. Basis - TC A8EA	_____	1.3	96.0	125
93	Electric Turn and Rate Indicator Per PAC Dwg. 43220 or 32737-6 or 44378 Cert. Basis - TC A8EA	_____	2.3	96.0	221
95	Rate of Climb Per PAC Dwg. 41706 or 41706-2 Cert. Basis - TC A8EA	_____	1.0	96.0	96
97	Eight-Day Clock - Wakmann W-33-7510ET or Longines ALL-90P-ET Cert. Basis - TC A8EA	_____	.4	96.0	38
99	Outside Air Temp Per PAC Dwg. 41707 or 54507-2 or 54507-3 Cert. Basis - TC A8EA	_____	.3	103.0	31
101	Ammeter Per PAC Dwg. 41505 Cert. Basis - TC A8EA	_____	.2	96.0	19
103	Dual Manifold Pressure Gauge Per PAC Dwg. 19697-7 or -9 Cert. Basis - TC A8EA	_____	1.0	96.0	96

(e) Instruments (cont)

Item No.	Item	Mark if Instl.	Weight (Pounds)	Arm (In.) Aft Datum	Moment (Lb-In.)
104	Dual Tachometer Per Piper PS50048-13-1 Cert. Basis - TC A8EA	_____	.7	96.0	67
105	Dual Tachometer Per PAC Dwg. 25700-3 Cert. Basis - TC A8EA	_____	.7	96.0	67
106	Dual Tachometer and two Generators Per PAC Dwg. 49521-2 and 49524-2 Cert. Basis - TC A8EA	_____	3.0	105.0	315
107	Engine Hour Recorder Per PAC Dwg. 51006 Cert. Basis - TC A8EA	_____	.3	96.0	29
109	Dual Fuel Pressure Gauge Per PAC Dwg. PS50116-2 Cert. Basis - TC A8EA	_____	1.0	96.0	96
111	Two Fuel Quan. Gauges Per PAC Dwg. 43242 Cert. Basis - TC A8EA	_____	.4 ea.	96.0	38
113	Dual Fuel Flow Gauge Per PAC Dwg. 52346 or -3 Cert. Basis - TC A8EA	_____	1.1	96.0	106
115	Dual Exhaust Gas Temp Gauge Per Piper PS50101-33L Cert. Basis - TC A8EA	_____	1.2	96.0	115
117	Cowl Flap Position Indicator Per PAC Dwg. 43145 Cert. Basis - TC A8EA	_____	.2	96.0	19
118	Wing Flap Position Indicator Per PAC Dwg. 49684-2 Cert. Basis - TC A8EA	_____	.2	96.0	19
119	Wing Flap Position Indicator Per PAC Dwg. 55567-2, -3 or 4 Cert. Basis - TC A8EA	_____	.2	96.0	19

(e) Instruments (cont)

Item No.	Item	Mark If Instl.	Weight (Pounds)	Arm (In.) Aft Datum	Moment (Lb-In.)
120	Wing Flap Position Indicator Per PAC Dwg. 55991-6 Cert. Basis - TC A8EA	______	.2	96.0	19
121	Rudder Trim Position Indicator Per PAC Dwg. 41510 Cert. Basis - TC A8EA	______	.2	96.0	19
123	Elevator Trim Position Indicator Per PAC Dwg. 42507 Cert. Basis - TC A8EA	______	.2	96.0	19
125	Aileron Trim Position Indicator Per PAC Dwg. 41510 Cert. Basis - TC A8EA	______	.2	96.0	19
127	Two Combination Gauges Per PAC Dwg. 41506-2, Oil Pressure, Oil Temperature, Cylinder Head Temperature Cert. Basis - TC A8EA	______	2.4	96.0	230
129	Voltmeter Per PAC Dwg. 43816 Cert. Basis - TC A8EA	______	.2	96.0	19
131	Gyro Horizon Per PAC Dwg. 99002-2, -3, 4, -7 Cert. Basis - TC A8EA	______	2.3	96.0	220
133	Directional Gyro Per PAC Dwg. 99003-2, -3, 4, -6 Cert. Basis - TC A8EA	______	3.4	96.0	326

THIS PAGE INTENTIONALLY LEFT BLANK

(f) Miscellaneous

Item No.		Mark if Instl.	Weight (Pounds)	Arm (In.) Aft Datum	Moment (Lb-In.)
141	D.O.A. EA-1 Approved Pilot's Operating Handbook Report: 2045	_____	—	—	—
143	Cabin Heater, 24 Volt Janitrol No. B39D59 Cert. Basis - TSO C20	_____	25.5	65.0	1658
145	Cabin Exhaust Vent. Instl. Per PAC Dwg. 43827 Cert. Basis - TC A8EA	_____	3.0	252.0	756
147	Stall Warning Lift Detector, Safe Flight Instr. Corp. #C-52207-4 Cert. Basis - TC A8EA	_____	Neglect Weight Change		
149	Stall Warning Horn, Safe Flight Instr. Corp. #02054-3 Cert. Basis - TC A8EA	_____	2.0	90.0	180
151	Heated Pitot Tube AN5812-1 (24-Volt) Cert. Basis - TC A8EA	_____	1.0	64.3	64

THIS PAGE INTENTIONALLY LEFT BLANK

(g) Engine and Engine Accessories
(Optional Equipment)

Item No.	Item	Mark if Instl.	Weight (Pounds)	Arm (In.) Aft Datum	Moment (Lb-In.)
161	Two Air Pumps Per PAC Dwg. 26749-9, Airborne Model 441CC-7 Cert. Basis - TC A8EA	______	3.0 ea.	90.0	270

THIS PAGE INTENTIONALLY LEFT BLANK

(h) Propeller and Propeller Accessories
(Optional Equipment)

Item No.	Item	Mark if Instl.	Weight (Pounds)	Arm (In.) Aft Datum	Moment (Lb-In.)
170	Propeller Synchrophaser Per PAC Dwg. 49694-2 Cert. Basis - TC A8EA		8.0	75.8	606
171	Propeller Synchrophaser Per PAC Dwg. 52944-3 Cert. Basis - TC A8EA		7.7	76.7	591
174	One Hydraulic Propeller Governor Per PAC Dwg. 24622-19, Hartzell Model F-8-24 (Right) Cert. Basis - TC A8EA		5.5	64.0	352
175	One Hydraulic Propeller Governor a. Per PAC Dwg. 24622-20, Hartzell Model F-8-48 (Right) b. Per PAC Dwg. 24622-25, Hartzell Model F-8-48Z (Right) Cert. Basis - TC A8EA		5.5	64.0	352

THIS PAGE INTENTIONALLY LEFT BLANK

(i) Landing Gear and Brakes
(Optional Equipment)

Item No.	Item	Mark if Instl.	Weight (Pounds)	Arm (In.) Aft Datum	Moment (Lb-In.)
185	Dual Toe Brakes Per PAC Dwg. 42386 Cert. Basis - TC A8EA	_____	1.8	86.9	156
187	Two Main Wheel and Brake Assy., Cleveland Aircraft Products, Wheel No. 40-130, Brake No. 30-95A Cert. Basis - TSO C26a	_____	22.4 ea.	152.0	3405

THIS PAGE INTENTIONALLY LEFT BLANK

(j) Electrical Equipment
(Optional Equipment)

Item No.	Item	Mark if Instl.	Weight (Pounds)	Arm (In.) Aft Datum	Moment (Lb-In.)
211	One Battery, 24 Volt 25 Ampere-Hour Gill No. 12-GCAB-24 Cert. Basis - TC A8EA	_____	38.1	22.0	838
213	Electric Windshield Wiper Instl. Per PAC Dwg 44115 Cert. Basis - TC A8EA	_____	5.5	81.1	446
215	Electrically Heated Windshield, Per PAC Dwg. 42637 Cert. Basis - TC A8EA	_____	13.75	94.0	1293
217	Wing Ice Inspection Light Per PAC Dwg. 44404 Cert. Basis - TC A8EA	_____	.5 ea.	118.5	59
219	Electrical Propeller Anti-Icing, Per PAC Dwg. 43947 Cert. Basis - TC A8EA	_____	14.0	64.9	909
221	Emergency Locator Transmitter Per PAC Dwg. 53730-2 or 55675-2 Cert. Basis - TSO C91	_____	2.0	309.5	619
222	Emergency Locator Transmitter Per PAC Dwg. 49736-2	_____	4.2	307.9	1293
223	Two Recognition Lights Per PAC Dwg. 55802-14 Cert. Basis - TC A8EA	_____	1.3	134.0	174
225	Ground Recognition Beacon Per PAC Dwg. 49512-2 Cert. Basis - TC A8EA	_____	.7	307.7	215

THIS PAGE INTENTIONALLY LEFT BLANK

(k) Instruments
(Optional Equipment)

Item No.	Item	Mark if Instl.	Weight (Pounds)	Arm (In.) Aft Datum	Moment (Lb-In.)
233	Airspeed Indicator Per PAC Dwg. 41507-18 Cert. Basis - TC A8EA	_____	.6	96.0	58
235	Sensitive Altimeter Per Piper PS50008-4 or PS50008-5 Cert. Basis - TC A8EA	_____	1.3	96.0	125
237	Electric Turn Rate Indicator Per PAC Dwg. 43220 or 32737-6 or 44378 Cert. Basis - TC A8EA	_____	2.3	96.0	221
239	Rate of Climb Per PAC Dwg. 41706 or 41706-2 Cert. Basis - TC A8EA	_____	1.0	96.0	96
241	Eight-Day Clock - Wakmann W-33-7510ET or Longines ALL-90P-ET Cert. Basis - TC A8EA	_____	.4	96.0	38
243	Dual Gyro Pressure Gauge Per PAC Dwg. 46320 Cert. Basis - TC A8EA	_____	.5	96.0	48
245	Gyro Horizon Per PAC Dwg. 53707 (Plt./CAA) Cert. Basis - TC A8EA	_____	2.3	96.0	221
247	Gyro Horizon Per PAC Dwg. 99002-2, -3, -4, -7 (Coplt./std.) Cert. Basis - TC A8EA	_____	2.3	96.0	221
249	Gyro Horizon Per PAC Dwg. 53707 (Coplt./CAA) Cert. Basis - TC A8EA	_____	2.3	96.0	221

(k) Instruments
(Optional Equipment) (cont)

Item No.	Item	Mark if Instl.	Weight (Pounds)	Arm (In.) Aft Datum	Moment (Lb-In.)
251	Directional Gyro Per PAC Dwg. 99003-2, -3, -4, -6 (Coplt./Std.) Cert. Basis. - TC A8EA	______	3 4	96.0	326
253	Electric Directional Gyro Per PAC Dwg. 48149 (Copilot) Cert. Basis - TC A8EA	______	2.9	96.0	278
255	Electric Gyro Horizon Per PAC Dwg. 48150 (Copilot) Cert. Basis - TC A8EA	______	2.6	96.0	250
259	Altimeter, Millibar Per PAC Dwg. 42656 Cert. Basis - TC A8EA	______	1.3	96.0	125
261	Flap Position Indicator Per PAC Dwg. 55650-3 Cert. Basis - TC A8EA	______	.2	96.0	19
263	Voltmeter Per PAC Dwg. 54408-2 Cert. Basis - TC A8EA	______	.2	96.0	19
265	Attitude Gyro Per PAC Dwg 43820 Cert. Basis - TC A8EA	______	2.3	96.0	221
267	Electric Directional Gyro Per PAC Dwg. 46911 (copilot) Cert. Basis - TC A8EA	______	3.8	96.0	365
269	Electric Gyro Horizon Per PAC Dwg. 46912 (copilot) Cert. Basis - TC A8EA	______	3-4	96.0	326
271	Airspeed Indicator Per PAC Dwg. 41507-19 (Required with wing lockers) Cert. Basis -TC A20SO				
	a. Pilot	______	.6	96.0	58
	b. Copilot	______	.6	96.0	58

(l) Autopilots
(Optional Equipment)

Item No.	Item	Mark if Instl.	Weight (Pounds)	Arm (In.) Aft Datum	Moment (Lb-In.)
281	AltiMatic IIIC Autopilot (with Nav/Comm) Per PAC Dwg 54550-2 Cert. Basis - STC SA3008SW-D	_____	62.7	128.6	8063
283	AltiMatic IIIC Autopilot Per PAC Dwg. 54550-2 Cert. Basis - STC SA3008SW-D	_____	37.3	145.3	5420
285	Yaw Damper System Instl. Per PAC Dwg. 49516-2 Cert. Basis- STC SA3010SW-D	_____	5.7	590.6	3366
287	FCS-810 AP/FD Instl. Per PAC Dwg 55810-2 Cert. Basis - STC SA437SO	_____	52.4	191.1	10015
289	FCS-810 AP/FD Instl. Per PAC Dwg. 55810-3 Cert. Basis - STC SA437SO	_____	50.3	169.7	8536
291	A/P with HSI Per PAC Dwg. 55811-2 Cert. Basis - STC SA437SO	_____	48.1	182.2	8764
293	AltiMatic X Autopilot Instl. Per PAC Dwg. 49410-2 Cert. Basis - STC SA3009SW-D	_____	43.8	124.3	5444
295	AltiMatic X AP/FD Instl. Per PAC Dwg. 49411-2 and -3 Cert. Basis - STC SA3009SW-D	_____	44.8	123.7	5542
297	KFC 200 FD/AP Instl. (King) Per PAC Dwg. 71040-8 Cert. Basis - STC SA1166CE	_____	45.0	151.6	6822
299	KAP 200 A/P Instl. (King) Per PAC Dwg. 71040-2 Cert Basis - STC SA1166CE	_____	44.3	152.4	6751

(l) Autopilot's
(Optional Equipment)

Item No.	Item	Mark if Instl.	Weight (Pounds)	Arm (In.) Aft Datum	Moment (Lb.-In.)
301	KFC 200 FD/AP Instl. (King) (with yaw damper) Per PAC Dwg. 71040-11 Cert. Basis - STC SA1166CE	_____	56.7	158.9	9010
303	KAP 200 A/P Instl. (King) (with yaw damper) Per PAC Dwg. 71040-5 Cert. Basis - STC SA1166CE	_____	56.0	159.5	8932

(m) Radio Equipment
(Optional Equipment)

Item No.	Item	Mark if Instl.	Weight (Pounds)	Arm (In.) Aft Datum	Moment (Lb-In.)
321	NT-1-31 Basic Avionics Group Instl. (Includes all standard group components. Does not include standard features) Per PAC Dwg. 54439-2 Cert. Basis - TC A8EA	______	59.9	99.1	5936
323	NT-2-31 (I) Basic Avionics Group Instl. (Includes all standard group components. Does not include standard features) Per PAC Dwg. 54436-2 Cert. Basis - TC A8EA	______	84.7	115.4	9774
325	KTS-1-31 Basic Avionics Group Instl. (Includes all standard group components. Does not include standard features) Per PAC Dwg. 54315-2 Cert. Basis - TC A8EA				
	a. With Separate Sense Antenna	______	78.1	92.1	7193
	b. With Combined Sense/Loop Antenna	______	75.9	97.7	7415
327	KTS-2-31 (I) Basic Avionics Group Instl. (Includes all standard group components. Does not include standard features) Per PAC Dwg. 54650-2 Cert. Basis - TC A8EA				
	a. With Separate Sense Antenna (HF Equipment Fwd.)	______	113.7	112.0	12734
	b. With Combined Sense/Loop Antenna (HF Equipment Aft)	______	109.9	149.4	16419
329	KTG-3-31 Basic Avionics Group Instl. (Includes all standard group components. Does not include standard features) Per PAC Dwg. 54270-2 Cert. Basis - TC A8EA	______	98.5	90.4	8904

(m) Radio Equipment
(Optional Equipment) (cont)

Item No.	Item	Mark if Instl.	Weight (Pounds)	Arm (In.) Aft Datum	Moment (Lb-In.)
331	KTG-3-31 (I) Basic Avionics Group Instl. (Includes all standard group components. Does not include standard features) Per PAC Dwg. 53919-2 Cert. Basis - TC A8EA				
	a. With HF Equipment Installed Fwd.	_____	124.1	108.5	13465
	b. With HF Equipment Installed Aft	_____	123.1	141.7	17443
333	CT-1-31 Basic Avionics Group Instl. (Includes all standard group components. Does not include standard features) Per PAC Dwg. 54200-2 Cert. Basis - TC A8EA	_____	98.7	91.2	9001
335	CTM-1-31 Basic Avionics Group Instl. (Includes all standard group components. Does not include standard features) Per PAC Dwg. 55160-2 Cert. Basis - TC A8EA	_____	65.6	97.5	6396
337	NC-1-31 Basic Avionics Group Instl. (Includes all standard group components. Does not include standard features) Per PAC Dwg. 55704-2 Cert. Basis - TC A8EA	_____	85.5	95.2	8140

(m) Radio Equipment
(Optional Equipment) (cont)

Item No.	Item	Mark if Instl.	Weight (Pounds)	Arm (In.) Aft Datum	Moment (Lb-In.)
341	Comm 1 Instl. (Narco) Per PAC Dwg. 54034-2 or 4 Cert. Basis - TC A8EA	______	6.1	78.2	477
343	Comm 1 and 2 Instl. (King) Per PAC Dwg. 54264-2 Cert. Basis - TC A8EA	______	12.8	86.1	1102
345	Comm 1 and 2 Instl. (Collins) Per PAC Dwg. 54229-2 Cert. Basis - TC A8EA	______	14.9	87.1	1298
347	Comm 2 Instl. (Narco) Per PAC Dwg. 54035-2 Cert. Basis - TC A8EA	______	5.9	77.2	455
349	Comm 2 Instl. (Narco) Per PAC Dwg. 54035-4 Cert. Basis - TCA8EA	______	5.9	98.9	584
351	Nav/Comm 1 Instl. (King) Per PAC Dwg. 53558-2 Cert. Basis - TC A8EA	______	21.6	91.3	1972
352	Nav/Comm 2 Instl. (King) Per PAC Dwg. 53558-6 Cert. Basis - TC A8EA	______	15.8	111.2	1757
353	Nav/Comm 1 Instl. (King) Per PAC Dwg. 54690-2 Cert. Basis - TC A8EA	______	35.9	98.2	3525
355	Nav/Comm 2 Instl. (King) Per PAC Dwg. 53559-2 Cert. Basis - TC A8EA	______	17.1	92.1	1575
356	Nav/Comm 2 Instl. (King) Per PAC Dwg. 53559-5 Cert. Basis - TC A8EA	______	14.1	92.4	1303

(m) Radio Equipment
(Optional Equipment) (cont)

Item No.	Item	Mark if Instl.	Weight (Pounds)	Arm (In.) Aft Datum	Moment (Lb-In.)
357	Nav 1 Instl. (Narco) Per PAC Dwg. 54036-2 Cert. Basis - TC A8EA	______	7.1	139.7	992
359	Nav 1 and 2 Instl. (King) Per PAC Dwg. 54267-2 Cert. Basis - TC A8EA	______	20.3	102.7	2085
361	Nav 1 and 2 Instl. (King) Per PAC Dwg. 54267-4 Cert. Basis - TC A8EA	______	21.0	101.9	2140
363	Nav 1 and 2 Instl. (Collins) Per PAC Dwg. 54215-2 Cert. Basis - TC A8EA	______	20.4	102.1	2083
365	Nav 2 Instl. (Narco) Per PAC Dwg. 54038-2 Cert. Basis - TC A8EA	______	3.1	97.0	301
367	Nav 2 Instl. (Narco) Per PAC Dwg. 54039-2 Cert. Basis - TC A8EA	______	6.1	87.2	532
369	HF Comm Instl. (Sunair) Per PAC Dwg. 54077-2 Cert. Basis - TC A8EA	______	29.2	145.8	4257
370	HF Comm Instl. (Sunair) Per PAC Dwg. 49413-2 Cert. Basis - TC A8EA	______	30.8	262.8	8094
371	HF Comm Instl. (Sunair) Per PAC Dwg. 54077-6 Cert. Basis - TC A8EA	______	29.2	145.9	4260
372	HF Comm Instl. (Sunair) Per PAC Dwg. 49413-4 Cert. Basis - TC A8EA	______	32.8	261.9	8590

(m) Radio Equipment
(Optional Equipment) (cont)

Item No.	Item	Mark if Instl.	Weight (Pounds)	Arm (In.) Aft Datum	Moment (Lb-In.)
373	ADF Instl. (Narco) Per PAC Dwg. 54416-2 Cert. Basis - TC A8EA	_____	13.5	104.7	1413
374	Dual ADF Instl. (Narco) Per PAC Dwg. 54500-2 Cert. Basis - TC A8EA	_____	19.4	105.6	2049
375	ADF Instl. (King) Per PAC Dwg. 52075-10 Cert. Basis - TC A8EA				
	a. With Seperate Sense Antenna	_____	10.5	121.4	1275
	b. With Combined Sense/Loop Antenna	_____	8.7	113.3	986
376	ADF Instl. (King) Per PAC Dwg. 54269-2 Cert. Basis - TC A8EA	_____	13.5	114.3	1543
377	ADF Instl. (King) Per PAC Dwg. 54218-4 Cert. Basis - TC A8EA	_____	13.8	111.7	1541
378	Dual ADF Instl. (King) Per PAC Dwg. 53938-2 Cert. Basis - TC A8EA	_____	28.6	122.5	3504
379	ADF Antenna Instl. (King) Per PAC Dwg. 55773-2 Cert. Basis - TC A8EA	_____	3.9	202.9	791
380	Dual ADF Antenna Instl. (King) Per PAC Dwg. 55773-3 Cert. Basis - TC A8EA	_____	7.6	221.0	1680
381	ADF Antenna Instl. (King) Per PAC Dwg. 55773-4 Cert. Basis - TC A8EA	_____	3.9	202.9	791

(m) Radio Equipment
(Optional Equipment) (cont)

Item No.	Item	Mark if Instl.	Weight (Pounds)	Arm (In.) Aft Datum	Moment (Lb-In.)
382	Dual ADF Antenna Instl. (King) Per PAC Dwg. 55773-5 Cert. Basis - TC A8EA	______	7.6	221.0	1680
383	RMI (Collins) and Dual ADF (King) Instl. Per PAC Dwg. 54402-2 Cert. Basis - TC A8EA	______	31.9	109.6	3496
384	RMI Instl. (RCA) Per PAC Dwg. 54648-2 Cert. Basis - TC A8EA				
	a. With Separate Sense Antenna	______	31.6	111.0	3508
	b. With Combined Sense/Loop Antenna	______	26.3	104.7	2754
	c. With KFC 200 AP/FD	______	3.5	90.5	317
385	RMI Instl. (King KNI-581) Per PAC Dwg. 49297-2 Cert. Basis - TC A8EA	______	18.7	77.7	1453
386	RMI Instl. (King-226) Per PAC Dwg. 55441-2 Cert. Basis - TC A8EA				
	a. With AltiMatic IIIC	______	10.4	82.8	861
	b. With FCS-810 A/P or FD/AP	______	9.9	76.0	752
387	Transponder Instl. (Narco) Per PAC Dwg. 53902-2 Cert. Basis - TC A8EA	______	4.0	82.1	328
389	Transponder Instl. (King) Per PAC Dwg. 53604-2 or -9 Cert. Basis - TC A8EA	______	3.3	91.9	303
391	Transponder and DME Instl. (King) Per PAC Dwg. 54276-2 Cert. Basis - TC A8EA	______	22.9	76.7	1756
393	Transponder, DME and Audio (Collins) Per PAC Dwg. 54216-2 Cert. Basis - TC A8EA	______	28.0	77.8	2178

(m) Radio Equipment
(Optional Equipment) (cont)

Item No.	Item	Mark if Instl.	Weight (Pounds)	Arm (In.) Aft Datum	Moment (Lb-In.)
395	DME Instl. (King) Per PAC Dwg. 54777-2 Cert. Basis - TC A8EA	_____	11.2	71.7	803
396	DME Instl. (King) Per PAC Dwg. 54276-6 Cert. Basis - TC A8EA	_____	16.7	71.2	1189
397	DME Instl. (Narco) Per PAC Dwg. 54417-2 Cert. Basis - TC A8EA	_____	6.4	95.8	613
398	Transponder Antenna Instl. Per PAC Dwg. 49795-3 Cert. Basis - TC A8EA	_____	.3	33.0	10
399	Per PAC Dwg. 49795-4 Cert. Pasis - TC A8EA	_____	.5	153.4	77
400	DME Antenna Instl. Per PAC Dwg. 49795-2 Cert. Basis - TC A8EA	_____	.3	100.0	30
401	R-Nav Instl. (King) Per PAC Dwg. 54749-2 Cert. Basis - TC A8EA	_____	3.6	93.8	337
403	R-Nav Instl. (King) Per PAC Dwg. 54768-2 Cert. Basis - TC A8EA	_____	4.5	93.6	421
405	R-Nav Instl. (King) Per PAC Dwg. 54768-3 Cert. Basis - TC A8EA	_____	5.7	90.6	516
407	R-Nav Instl. (Narco) Per PaC Dwg. 54770-2 Cert. Basis - TC A8EA	_____	12.2	74.2	905

(m) Radio Equipment
(Optional Equipment) (cont)

Item No.	Item	Mark if Instl.	Weight (Pounds)	Arm (In.) Aft Datum	Moment (Lb-In.)
409	R-Nav Instl. (Narco) Per PAC Dwg. 54770-3 Cert. Basis - TC A8EA	______	8.8	72.0	634
411	Audio Panel Instl. (Narco) Per PAC Dwg. 54428-2 or -4 Cert. Basis - TC A8EA	______	7.1	92.6	657
413	Audio Amp and Marker Beacon Instl. (King) Per PAC Dwg. 53575-8 Cert. Basis - TC A8EA	______	5.5	92.3	508
415	Audio Amp Instl. (King) Per PAC Dwg. 53575-5 Cert. Basis - TC A8EA	______	5.5	92.3	508
417	Audio Amp. Instl. (King) Per PAC Dwg. 54279-2 Cert. Basis - TC A8EA	______	8.7	75.2	654
419	Radar Instl. (King) Per PAC Dwg. 54289-2 Cert. Basis - TC A8EA	______	22.4	40.3	903
420	Radar Instl. (King) Per PAC Dwg. 55716-2 Cert. Basis - TC A8EA	______	26.3	41.9	1102
421	Radar Instl. (RCA) Per PAC Dwg. 43396-3 Cert. Basis - TC A8EA	______	27.9	35.7	996
422	Radar Instl. (RCA) Per PAC Dwg. 55725-2 Cert. Basis - TC A8EA	______	28.2	36.6	1032
423	Radar Instl. (Bendix) Per PAC Dwg. 54584-2 Cert. Basis - TC A8EA	______	26.3	44.0	1157

(m) Radio Eqtiipment
(Optional Equipment) (cont)

Item No.	Item	Mark if Instl.	Weight (Pounds)	Arm (In.) Aft Datum	Moment (Lb-In.)
424	Radar Instl. (Bendix) Per PAC Dwg. 55726-2 Cert. Basis - TC A8EA	_____	18.7	45.8	856
425	Radar Instl. (Bendix) Per PAC Dwg. 54687-2 Cert. Basis - TC A8EA	_____	32.6	39.7	1294
427	Radar Instl. (Bendix) Per PAC Dwg. 55453-2 Cert. Basis - TC A8EA	_____	30.1	35.5	1069
428	Radar Altimeter (Bonzer) Per PAC Dwg. 52837-8 Cert. Basis - TC A8EA	_____	6.5	233.9	1520
429	Radar Altimeter (Bonzer) Per PAC Dwg. 52837-4 Cert. Basis - TC A8EA	_____	7.5	230.8	1731
430	Radar Altimeter (King KRA-405) Per PAC Dwg. 49356-2 Cert. Basis - TC A8EA	_____	16.7	219.0	3657
431	Encoding Altimeter (Aeromech) Per PAC Dwg. 15564-4 or -5 or -6 or -15 Cert. Basis - TC A8EA	_____	2.4	95.0	228
433	Encoding Altimeter (United) Per PAC Dwg. 15570-4 or -5 or -6 or -9 Cert. Basis - TC A8EA	_____	1.0	95.0	95
435	2nd G/S Instl. (King) Per PAC Dwg. 54476-2 Cert. Basis - TC A8EA	_____	1,8	64.1	115
436	2nd G/S Instl. (King) Per PAC Dwg. 55766-2 Cert. Basis - TCA20S0	_____	2.5	59.0	148

(m) Radio Equipment
(Optional Equipment) (cont)

Item No.	Item	Mark if Instl.	Weight (Pounds)	Arm (In.) Aft Datum	Moment (Lb-In.)
437	2nd G/S Instl. (King) Per PAC Dwg. 54730-2 Cert. Basis - TC A8EA	______	2.6	92.7	241
439	2nd G/S Instl. (Collins) Per PAC Dwg. 54690-2 Cert. Basis - TC A8EA	______	1.0	74.0	74
441	2nd G/S Instl. (Collins) Per PAC Dwg. 55180-2 Cert. Basis - TC A8EA	______	2.3	72.0	166
442	2nd G/S Instl. (Narco) Per PAC Dwg. 55706-2 Cert. Basis - TC A8EA	______	7.6	76.3	580
443	Mike and Headset Instl. - Pilot (100-T) Per PAC Dwg. 54059 Cert. Basis - TC A8EA	______	1.2	105.0	126
445	Mike and Headset Instl. - Pilot (M-700A) Per PAC Dwg. 54426-2 Cert. Basis - TC A8EA	______	1.2	96.0	115
447	Mike and Headset Instl. - Copilot (100-T) Per PAC Dwg. 54059-1 Cert. Basis - TC A8EA	______	1.2	105.0	126
449	Mike and Headset Instl. - Copilot (M-700A) Per PAC Dwg. 54422-2 Cert. Basis - TC A8EA	______	1.2	96.0	115
451	Boom Mike Instl. - Pilot Per PAC Dwg. 43369-5 Cert. Basis - TC A8EA	______	1.6	96.0	154

(m) Radio Equipment
(Optional Equipment) (cont)

Item No.	Item	Mark if Instl.	Weight (Pounds)	Arm (In.) Aft Datum	Moment (Lb-In.)
453	Boom Mike Instl. - Copilot Per PAC Dwg. 54398-2 Cert. Basis - TC A8EA	_____	2.6	109.5	285
455	Ramp Hailer Instl. Per PAC Dwg. 43006 Cert. Basis - TC A8EA	_____	3.6	40.5	146
457	Ramp Hailer Instl. Per PAC Dwg. 53591 Cert. Basis - TC A8EA	_____	5.0	50.7	254
458	Radio Telephone Instl. (King KT-96) Per PAC Dwg. 49383-2 Cert. Basis - TC A8EA	_____	9.3	134.4	1250
459	Custom Instrument Panel Instl. - Center Per PAC Dwg. 54640-2 Cert. Basis - TC A8EA	_____	Neglect	—	—
461	Custom Instrument Panel Instl. - Center Per PAC Dwg. 54669-2 Cert. Basis - TC A8EA	_____	Neglect	—	—
463	Custom Instrument Panel Instl. - Center Per PAC Dwg. 54672-2 Cert. Basis - TC A8EA	_____	Neglect	—	—
465	Custom Instrument Panel Instl. - Center Per PAC Dwg. 53920-2 Cert. Basis - TC A8EA	_____	Neglect	—	—
467	Custom Instrument Panel Instl. - Center Per PAC Dwg. 55166-2 Cert. Basis - TC A8EA	_____	Neglect	—	—

(m) Radio Equipment
(Optional Equipment) (cont)

Item No.	Item	Mark if Instl.	Weight (Pounds)	Arm (In.) Aft Datum	Moment (Lb-In.)
469	Custom Instrument Panel Instl. - Left Per PAC Dwg. 54379-2 Cert. Basis - TC A8EA	____	Neglect	—	—
471	Custom Instrument Panel Instl. - Right Per PAC Dwg. 54429-2 Cert. Basis - TC A8EA	____	Neglect	—	—
473	Gables Panel (G-4877) Cert. Basis - TC A8EA	____	11.5	95.0	1093
475	Gables Panel (G-4711) Cert. Basis - TC A8EA	____	11.5	95.0	1093
477	Gables Panel (G-4653) Cert. Basis - TC A8EA	____	11.5	95.0	1093
478	Circuit Protector Instl. Per PAC Dwg. 55971-2 Cert. Basis - TC A8EA	____	4.1	92.4	379
479	Circuit Protector Instl. Per PAC Dwg. 54298-2 or -4 or -6 or -9 Cert. Basis - TC A8EA	____	4.0	92.2	369
481	Circuit Protector Instl. Per PAC Dwg. 54298-8 Cert. Basis - TC A8EA	____	4.1	92.6	380
483	Circuit Protector Instl. Per PAC Dwg. 54298-3 Cert. Basis - TC A8EA	____	3.8	91.4	347

(m) Radio Equipment
(Optional Equipment) (cont)

Item No.	Item	Mark if Instl.	Weight (Pounds)	Arm (In.) Aft Datum	Moment (Lb-In.)
484	Circuit Protecter Instl. Per PAC Dwg. 55971-4 Cert. Basis - TC A8EA				
	a. NC-1-31	______	9.5	90.8	863
	b. KTS-1-31	______	8.4	89.1	748
	c. KTS-1-31 (I)	______	8.4	89.5	752
	d. KTG-3-31	______	8.9	90.0	801
	e. KTG-3-31 (I)	______	9.3	90.6	843
	f. CTM-1-31	______	8.7	89.8	782
485	Circuit Protector Instl. Per PAC Dwg. 54298-5 or -7 Cert. Basis - TC A8EA	______	3.9	91.8	358
486	Circuit Protector Instl., Avionics, Per PAC Dwg. 55411-2,-3,-4,-5,-6, -7 and -8 Cert. Basis - TC A8EA	______	3.8	91.7	348
487	KTG-3-31 Antenna Instl. Per PAC Dwg. 49796-2 Cert. Basis - TC A8EA	______	12.5	172.8	2160
488	KTG-3-31I Antenna Instl. Per PAC Dwg. 49796-4 Cert. Basis - TC A8EA	______	18.8	205.7	3867
489	CTM-1-31 Equipment Instl. Per PAC Dwg. 55161-2 Cert. Basis - TC A8EA	______	26.7	84.2	2248
490	CTM-1-31 Equipment Instl. Per PAC Dwg. 49452-2 Cert. Basis - TC A8EA	______	36.2	85.3	3088
491	KTG-3-31 Equipment Instl. Per PAC Dwg. 49797-2 Cert Basis - TC A8EA	______	60.5	76.8	4646

(m) Radio Equipment
(Optional Equipment) (cont)

Item No.	Item	Mark if Instl.	Weight (Pounds)	Arm (In.) Aft Datum	Moment (Lb-In.)
492	KTG-3-31 (I) Equipment Instl. Per PAC Dwg. 49798-3 Cert. Basis - TC A8EA	______	75.9	141.9	10770
493	Harness Instl. Per PAC Dwg. 55162-2 Cert. Basis - TC A8EA	______	5.1	83.2	424
494	Harness Instl. Per PAC Dwg. 49787-2 Cert. Basis - TC A8EA	______	11.0	81.9	901
495	Harness Instl. Per PAC Dwg. 49788-2 Cert. Basis - TC A8EA	______	13.6	115.3	1568
496	Master Switch Instl. Per PAC Dwg. 54677-2 Cert. Basis - TC A8EA	______	.1	100.0	10
497	Dimmer Instl. Per PAC Dwg. 54219-2 Cert. Basis - TC A8EA	______	.8	77.6	62
498	Dimmer Instl. Per PAC Dwg. 55746-2 Cert. Basis - TC A8EA	______	.7	78.9	55
499	Radio Cooling System Instl. per PAC Dwg. 54306-2 Cert. Basis - TC A8EA	______	.7	94.0	66
500	Antenna and Coax Instl. Per PAC Dwg. 55167-2 Cert. Basis - TC A8 EA	______	8.6	182.2	1567
501	Static Air - VSI Instl. Per PAC Dwg. 54701-3 Cert. Basis - TC A8EA	______	Neglect	—	—
502	Static Wicks Instl. Per PAC Dwg. 42387 Cert. Basis - TC A8EA	______	.4	240.0	96

(m) Radio Equipment
(Optional Equipment) (cont)

Item No.	Item	Mark if Instl.	Weight (Pounds)	Arm (In.) Aft Datum	Moment (Lb-In.)
503	Placard Instl. Per PAC Dwg. 80302-2 or 80304-2 Cert. Basis - TC A8EA	———	Neglect	—	—
505	Panel Mounting Rework Per PAC Dwg. 54602-2 Cert. Basis - TC A8EA	———	Neglect	—	—
507	Panel Mounting Angle Per PAC Dwg. 53563-3 Cert. Basis - TC A8EA	———	.1	98.0	10
509	Cover Plate Per PAC Dwg. 53607 Cert. Basis - TC A8EA	———	.2	99.0	20
511	Equipment Shelf Instl. Per PAC Dwg. 54106-2 Cert. Basis - TC A8EA	———	2.1	70.0	147
513	Equipment Shelf Instl. Per PAC Dwg. 54106-3 Cert. Basis - TC A8EA	———	2.1	69.0	145
515	Equipment Shelf Instl. Per PAC Dwg. 54199-2 or -3 Cert. Basis - TC A8EA	———	5.0	69.2	346
517	Equipment Shelf Instl. Per PAC Dwg. 55163-2 Cert. Basis - TC A8EA	———	4.2	69.5	292
518	Equipment Shelf Instl. Per PAC Dwg. 55747-2 or -3 Cert. Basis - TC A8EA	———	4.7	69.5	327
519	Radio Support Brackets Per PAC Dwg. 54443-2 Cert. Basis - TC A8EA	———	Neglect	—	—
520	Ground System Instl. Per PAC Dwg. 55745-2 Cert. Basis - TC A8EA	———	.2	75.8	15

(m) Radio Equipment
(Optional Equipment) (cont)

Item No.	Item	Mark if Instl.	Weight (Pounds)	Arm (In.) Aft Datum	Moment (Lb-In.)
521	Radio Support Brackets Per PAC Dwg. 54484-2 Cert. Basis - TC A8EA	———	Neglect	—	—
523	Radio Support Brackets Per PAC Dwg. 54881-2 and -3 and -4 Cert. Basis - TC A8EA	———	.3	91.0	27
525	Radio Support Brackets Per PAC Dwg. 54432-2 Cert. Basis - TC A8EA	———	.4	93.0	37
527	Radio Support Brackets Per PAC Dwg. 54204-2 Cert. Basis - TC A8EA	———	.1	99.0	10
529	Radio Support Angle Per PAC Dwg. 55168-2 Cert. Basis - TC A8EA	———	.3	95.0	29
531	Radio Support Angle Per PAC Dwg. 55169-2 Cert. Basis - TC A8EA	———	.1	98.0	10
533	Tubes Instl. Per PAC Dwg. 54310-2 Cert. Basis - TC A8EA	———	.5	90.6	45
535	Tubes Instl. Per PAC Dwg. 54275-2 Cert. Basis - TC A8EA	———	Neglect	—	—
537	Radio Support Rod Per PAC Dwg. 42215 Cert. Basis - TC A8EA	———	.2	91.0	18
539	Emergency Power Pack Per PAC Dwg. 55941-2 Cert. Basis - TC A8EA	———	12.62	74.9	946

(m) Radio Equipment
(Optional Equipment) (cont)

Item No.	Item	Mark if Instl.	Weight (Pounds)	Arm (In.) Aft Datum	Moment (Lb-In.)
540	VOR/LOC Repeater Instl. Per PAL Dwg. 55336-2 Cert. Basis - TC A8EA	______	1.8	98.0	176
541	Ground Clearance Energy Saver System Per PAC Dwg. 49817-2 Cert. Basis - TC A8EA	______	.3	100.0	30

THIS PAGE INTENTIONALLY LEFT BLANK

(n) Miscellaneous
(Optional Equipment)

Item No.	Item	Mark if Instl.	Weight (Pounds)	Arm (In.) Aft Datum	Moment (Lb-In.)
601	Pneumatic Deicing System Per PAC Dwg. 54925-2 Cert. Basis - TC A8EA	______	28.2	169.0	4766
603	Propeller Ice Shield Instl. Per PAC Dwg. 53849 Cert. Basis - TC A8EA	______	2.9	50.5	146
605	Elevator Horn Deicing Boot Per PAC Dwg. 54232-2 or -3 Cert. Basis - TC A8EA	______	.6	343.5	206
607	Second Heated Pitot Tube (AN5812-1) (24 Volt) Cert. Basis - TC A8EA	______	1.0	64.3	64
609	Oxygen System Instl. (FWD) Per PAC Dwg. 55324-2 Cert. Basis - TC A8EA	______	55.2	80.8	4460
610	Oxygen System Instl. (AFT) Per PAC Dwg. 71111-2 Cert. Basis - TCA8EA	______	55.2	280.4	15478
611	Ground Ventilation Fan Per PAC Dwg. 43642 Cert. Basis - TC A8EA	______	6.7	250.0	1675
613	Fire Extinguisher, Kidde 2-3/4 DCK-6 or Scott No. 42211-00 Cert. Basis - TC A8EA	______	5.1	137.5	701

(n) Miscellaneous
(Optional Equipment) (cont)

Item No.	Item	Mark if Instl.	Weight (Pounds)	Ann (In.) Aft Datum	Moment (LSIn.)
615	Lightning Resistant Fuel Filler Cap Instl. Per PAC Dwg. 53857 Cert. Basis - TC A8EA	______	Neglect	—	—
617	Cargo Door Per PAC Dwg. 53330-2 Cert. Basis - TC A8EA	______	19.8	245.2	4855
619	Pilot's Door Per PAC Dwg. 53448-2 Cert. Basis - TC A8EA	______	7.9	123.0	972
621	Aft Cabin Heater (24 V) Janitrol No. C39D59 Cert. Basis - TSO C20	______	29.0	279.0	8091

(n) Miscellaneous
(Optional Equipment) (cont)

Item No.	Item	Mark if Instl.	Weight (Pounds)	Arm (In.) Aft Datum	Moment (Lb-In.)
623	Cabinetry Instl. (1977 Models) Per PAC Dwg. 55570 Cert. Basis - TC A8EA				
	a. Forward Storage Divider Instl. Per PAC Dwg. 55306-2	_____	22.5	145.0	3262
	b. Forward Storage Divider Instl. Per PAC Dwg. 55306-4	_____	20.0	145.0	2900
	c. Cabinet Divider Panel Instl. Per PAC Dwg. 55346-2	_____	17.2	145.0	2494
	d. Cabinet Divider Panel Instl. Per PAC Dwg. 55310-4	_____	11.5*	146.0	1679
	e. Cabinet Divider Half Panel Instl. Per PAC Dwg. 55348-2	_____	6.0*	138.0	828
	f. Forward Storage Divider Instl. Per PAC Dwg. 55306-3	_____	19.0	145.0	2755
	g. Forward Storage Divider Instl. Per PAC Dwg. 55306-5	_____	16.5	145.0	2392
	h. Thermos Carrier Instl. Per PAC Dwg. 55308-2	_____	8.0	145.0	1160
	i. Storage Cabinet Instl. Per PAC Dwg. 55309-2	_____	7.0	145.0	1015
	j. Folding Table Instl. Per PAC Dwg. 55302-9	_____	9.0	177.5	1598
	k. Cup Holder Instl. Per PAC Dwg. 55304-2	_____	.25	as installed	—
	l. Folding Table Instl. Per PAC Dwg. 55302-4	_____	9.0	177.5	1598
	m. Aft Refreshment Cabinet Instl. Per PAC Dwg. 55307-2	_____	39.0	243.0	9477
	n. Rear Refreshment Panel Instl. Per PAC Dwg. 55305-2	_____	42.0	243.0	10206
	o. Rear Divider Panel Instl. Per PAC Dwg. 55321-2	_____	6.0	244.0	1464

*Weight included in total weight of the air conditioning system.

(n) Miscellaneous
(Optional Equipment) (cont)

Item No.	Item	Mark if Instl.	Weight (Pounds)	Arm (In.) Aft Datum	Moment (Lb-In.)
624	Cabinetry Instl. (1978 Models) Per PAC Dwg. 55570 Cert. Basis - TC A8EA				
	a. Fwd. Storage Divider Instl., Thermos Storage With Divider, Per PAC Dwg. 55306-8	____	22.5	145.0	3262
	b. Fwd. Storage Divider Instl., Thermos Storage Without Divider, Per PAC Dwg. 55306-11	____	20.0	145.0	2900
	c. Cabinet Divider Panel Instl., Plain Fwd., Per PAC Dwg. 55346-3	____	17.2	145.0	2494
	d. Fwd. Storage Divider Instl., Manual Storage With Divider, Per PAC Dwg. 55306-9	____	19.0	145.0	2755
	e. Fwd. Storage Divider Instl., Manual Storage Without Divider, Per PAC Dwg. 55306-13	____	16.5	145.0	2392
	f. Fwd. Storage Divider Instl., Manual Storage With Divider - Radio Phone (Weight of Phone Not Included) Per PAC Dwg. 55306-14	____	19.0	145.0	2755
	g. Fwd. Storage Divider Instl., Manual Storage Without Divider - Radio Phone (Weight of Phone Not Included) Per PAC Dwg. 55306-15	____	16.5	145.0	2392
	h. Storage Cabinet Instl. Per PAC Dwg. 55309-2 or -4	____	8.8 ea.	145.0	1276

(n) Miscellaneous
(Optional Equipment) (cont)

Item No.	Item	Mark if Instl.	Weightt (Pounds)	Arm (In.) Aft Datum	Moment (Lb-In.)
	i. Thermos Carrier Instl. Per PAC Dwg. 55308-2	______	8.0	145.0	1160
	j. Folding Table Instl. Per PAC Dwg. 49227-8 and -10	______	9.0	177.5	1598
	k. Folding Table Instl. Per PAC Dwg. 49227-3 and -9	______	9.0	177.5	1598
	l. Aft Refresh. Cabinet Instl., Side Facing Toilet, Per PAC Dwg. 55307-4	______	39.0	243.0	9477
	m. Rear Refresh. Panel Instl., Seventh Seat, Per PAC Dwg. 55305-4	______	42.0	243.0	10206
	n. Rear Divider Instl., Plain Panel, Per PAC Dwg. 55321-3	______	9.5	244.0	2318

(n) Miscellaneous
(Optional Equipment) (cont)

Item No.	Item	Mark if Instl.	Weight (Pounds)	Arm (In.) Aft Datum	Moment (Lb-In.)
625	Seats Instl. (1977 Models) Per PAC Dwg. 55580-2 or -3 Cert. Basis - TC A8EA				
	a. Seat Instl. Per PAC Dwg. 53275-6, -7 or -8	———	Same as standard		
	b. Third Seat Instl., Aft Facing Per PAC Dwg. 44505-2	———	25.2	159.0	4006
	c. Fourth Seat Instl., Aft Facing Per PAC Dwg. 44505-3	———	25.2	159.0	4006
	d. Passenger Seat Instl. Per PAC Dwg. 55439-8, -10, -11, -12, -14, -15, -16 or -18	———	25.2	198.0	4990
	e. Passenger Seat Instl. Per PAC Dwg. 55439-9, -10, -11, -13, -14, -15, -17 or -19	———	25.2	198.0	4990
	f. Seventh Seat Instl. Per PAC Dwg. 53505-2, -3, -4 or -5	———	24.4	229.0	5588
	g. Eighth Seat Instl. Per PAC Dwg. 53518-2 or -3	———	21.4	242.0	5179
	h. Toilet Seat Instl. Per PAC Dwg. 55628-2	———	27.0	229.0	6183
627	Nayak Nine Seat Instl. Per PAC Dwg. 44375 Cert. Basis - STC 10003V	———	51.0	240.0	12240

(n) Miscellaneous
(Optional Equipment) (cont)

Item No.	Item	Mark if Instl.	Weight (Pounds)	Arm (In.) Aft Datum	Moment (Lb-In.)
628	Seats Instl. (1978 Models) Per PAC Dwg. 55580-2 or -3 Cert. Basis - TC A8EA				
	a. Seat Instl. Per PAC Dwg. 49420-2, -4 or -5	______	Same as standard		
	b. Third Seat Instl., Aft Facing, Per PAC Dwg. 44505-4	______	24.0	159.0	3816
	c. Fourth Seat Instl., Aft Facing, Per PAC Dwg. 44505-4	______	24.0	159.0	3816
	d. Third Seat Instl., Aft Facing, Per PAC Dwg. 44505-5	______	25.2	159.0	4006
	e. Fourth Seat Instl., Aft Facing, Per PAC Dwg. 44505-5	______	25.2	159.0	4006
	f. Passenger Seat Instl. (Left), With Ashtray and Armrest, Per PAC Dwg. 49450-16	______	25.2	198.0	4990
	g. Passenger Seat Instl. (Right), With Ashtray and Armrest, Per PAC Dwg. 49450-17	______	25.2	198.0	4990
	h. Passenger Seat Instl., With Ashtray Without Armrest, Per PAC Dwg. 49450-14 or -15	______	24.2 ea.	198.0	4792
	i. Passenger Seat Instl., Without Ashtray or Armrest, Per PAC Dwg. 49450-10 or -11	______	24.0 ea.	198.0	4752

(n) Miscellaneous
(Optional Equipment) (cont)

Item No.	Item	Mark if Instl.	Weight (Pounds)	Arm (In.) Aft Datum	Moment (Lb-In.)
	j. Passenger Seat Instl. (Left), Without Ashtray With Armrest, Per PAC Dwg. 49450-12	_____	25.0	198.0	4950
	k. Passenger Seat Instl. (Right), Without Ashtray With Armrest, Per PAC Dwg. 49450-13	_____	25.0	198.0	4950
	l. Seventh Seat Instl., Without Armrest, Per PAC Dwg. 53505-6	_____	24.4	229.0	5588
	m. Seventh Seat Instl., With Armrest, Per PAC Dwg. 53505-7	_____	25.4	229.0	5517
	n. Eighth Seat Instl. Per PAC Dwg. 53518-4	_____	21.4	242.0	5179
	o. Toilet Seat Instl. Per PAC Dwg. 55628-2	_____	27.0	229.0	6183
	p. Toilet - Refreshment Unit Per PAC Dwg. 53310	_____	70.4	229.0	16122
629	Privacy Curtain Instl. Per PAC Dwg. 55426-2 or -3 Cert. Basis - TCA8EA	_____	5.8	209.8	1217
631	Nacelle Wing Lockers (2) Per PAC Dwg. 44527 Cert. Basis - TCA8EA	_____	58.4	188.6	11014

TABLE OF CONTENTS

SECTION 7

DESCRIPTION AND OPERATION OF THE AIRPLANE AND ITS SYSTEMS

TABLE OF CONTENTS (cont)

SECTION 7 (cont)

SECTION 7

DESCRIPTION AND OPERATION OF THE AIRPLANE AND ITS SYSTEMS

7.1 THE AIRPLANE

The PA-31 Navajo is a twin-engine, retractable landing gear, multi-purpose airplane. Its spacious cabin is available with a variety of optional cabin arrangements and furnishings to allow the airplane to be equipped to serve the individual needs of the owner.

Pilot and passenger comfort accessories, custom seating arrangements and flexible loading accommodations coupled with air navigational equipment, flight safety aids, speed and range, avail the PA-31 Navajo for use in a variety of operational situations.

7.3 AIRFRAME

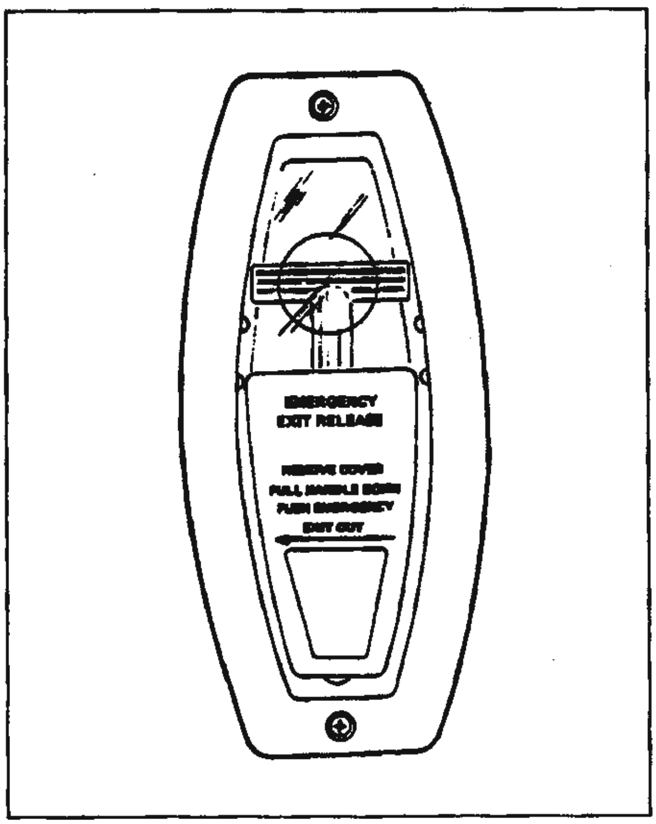
A primary structure of reinforced and stress tested metal construction provides the basis for the rugged Navajo airframe. The nose, tail cone, and other flight surface extremities are of tough fiberglass.

The fuselage is an all metal, semi-monocoque structure with riveted skin. It consists of three basic units: the nose section, the cabin section, and the tail section. Removable access plates and inspection panels are incorporated into the fuselage skin to aid in equipment inspection and repair.

Large panoramic windows, which include a two piece windshield, five side windows and pilot and copilot storm windows, furnish an unobstructed view from the cockpit or cabin areas. The four forward windows on each side of the fuselage are of double pane construction to reduce window fogging. The pilot and copilot storm windows are located in the forward lower section of each pilot's side window. To open, release the latch on the lower portion of the window and swing the storm window in and forward. The storm windows are easily removed by pulling the hinge pin. A heated pilot's windshield is offered as optional equipment to prevent windshield fogging and icing.

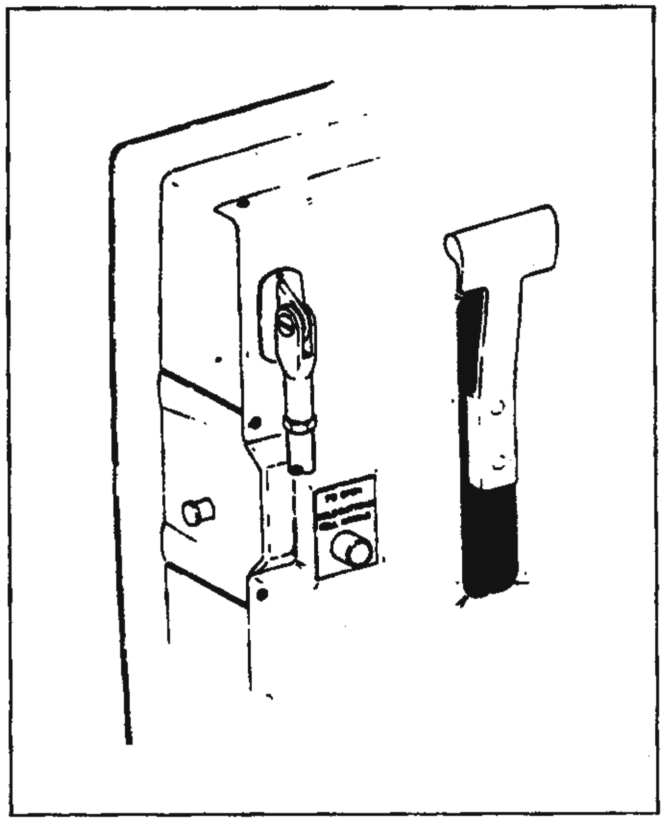
On the right side, the second side window aft of the copilot's windshield is a combination window/emergency exit. As a safety feature, the exit can be expelled by removing the plexiglas cover from the release mechanism (aft of the window), pulling the release handle down and pushing out on the exit (Figure 7-1).

For ease of entry and exit, a large, two piece cabin entrance door is provided on the left side of the fuselage, just aft of the wing. The door separates in the middle with the upper half, which incorporates the aft rectangular side window, swinging upward and the lower half, which houses the cabin entrance steps, swinging downward. To open the door from the outside, push on the upper portion of the door handle and pull upward on the lower portion of the handle. With the lock mechanism now released, lower the bottom half of the door, pull out the steps and raise the upper half of the door until it locks. The door is closed from the outside by pushing upward on the knurled cylinder on the upper door support and lowering the



EMERGENCY EXIT RELEASE

Figure 7-1



CABIN ENTRANCE DOOR LATCH

Figure 7-3

upper half of the door. Next, raise the lower half of the door, making sure the door support cords don't catch in the door frame, and push in on the door halves and the door handle until the door is securely latched. As a safety feature, a locking bolt is attached to the inside of the upper half of the entrance door. When the door is closed from within the cabin, the bolt is moved to the right across the metal strike plate attachment on the door frame. This feature provides added protection in the event the cabin door should unlatch during flight due to improper latching. To open the door from the inside, pull the bolt to the left, push in and hold the lock button (adjacent to the door handle, Figure 7-3), pull the handle and lower the bottom half of the door. Then raise the upper half to the locked position. Closing the door from the inside is performed similarly to the outside closing procedure. The door should be checked to insure proper locking by trying to pull the handle to the open position without pushing the lock button and checking that the bolt has been properly attached.

Each wing is an all metal, full cantilever type construction with a removable fiberglass tip. The wing panels incorporate an I beam main spar which extends into the center of the fuselage where the spars are joined with high strength butt fittings, making in effect, one continuous main spar. This main spar is also attached at each side of the fuselage as are the front and rear wing spars. The main landing gear are housed in wheel wells built into the lower surface of the wings and are enclosed by doors when the gear is retracted. Two flexible bladder type fuel cells in each wing house the fuel..

Ailerons are all metal and fully balanced. The right aileron incorporates a trim tab which is adjustable through a control in the cockpit.

The all metal flaps are electrically activated by an airfoil shaped control on the instrument panel. When the flap control is moved to the "UP" or "DN" position, power is transferred from an electric motor to a screw transmission through a flexible shaft. A flap indicator, mounted on the instrument panel above the flap control, is used to position the flaps to the desired setting.

The engine nacelles are an integral part of the wing. They provide a streamlined structure for the engines.

The empennage consists of a vertical stabilizer (fin), a rudder, a horizontal stabilizer and elevators. The rudder and elevators both have trim tabs which are controlled from the cockpit. The empennage group components are metal cantilever structures with removable fiberglass tips. Both the vertical and horizontal stabilizers incorporate two-channel main spars that run the length of the stabilizer and attach to the aft bulkhead assembly of the fuselage.

All structural components are completely zinc chromate primed and the exterior surfaces coated with acrylic lacquer.

7.5 ENGINES AND ACCESSORIES

The PA-31 Navajo is powered by two six-cylinder, fuel injected, turbocharged Lycoming engines rated at 310 HP at 2575 RPM. Both engines are air cooled, have top side exhaust, and incorporate oil jets for internal piston cooling.

Both engines are Lycoming TIO-540-A2C Series. They are equipped with geared starters, two magnetos (each engine), 28-volt 70 amp self rectifying alternators, shielded ignition systems, turbochargers, hydraulic pumps, oil filters, oil coolers, pneumatic pressure pumps and three bladed propellers. The alternators are belt driven by pulleys mounted on the starter ring gear.

The turbocharger (Figure 7-5) is designed to increase the power output and efficiency of the engine by supplying compressed air to the engine intake manifold. This allows the engines to operate at peak power at much higher altitudes than normally aspirated engines. Power to drive the turbocharger is extracted from energy in the exhaust gases, which are ducted through the turbine and then exhausted overboard at the bottom of the nacelles in the area of the cowl flaps.

The fuel injection system is based on the principle of measuring engine air consumption by use of a venturi tube and using the airflow forces to control fuel flow to the engines. Fuel distribution to the individual cylinders is obtained by the use of a fuel flow divider and air bleed nozzles. Idle cut-offs are incorporated in the injectors and should always be used to stop the engines. This is accomplished by pulling the mixture control levers to the rearmost position.

An automatic alternate air induction system is provided for each engine. In the event the induction air filters become obstructed by ice or other foreign particles, the induction air doors will open automatically to provide air to the engine.

Two manual alternate air controls are located to the right of the control pedestal to allow the pilot to select alternate air if the automatic feature should fail.

The cowl flaps, located on the bottom of the engine nacelles, are electrically operated by switches located on the bottom of the control pedestal. Cowl flaps should be positioned to maintain temperatures at or below maximum allowable temperature. Remote indicating gauges, located next to the switches, give the pilot a visual indication of cowl flap position.

The engines are equipped with doors on the induction housings which, in the event of a turbocharger compressor failure, automatically revert the engines to normally aspirated air. Under these conditions approximately 75% of normal rated power, or 232 HP, will be available at sea level.

Engine mounts are of steel tube construction incorporating vibration absorbing dynafocal mounts. The engine cowlings are cantilever structures constructed of a combination of fiberglass and metal attached at the fire wall. Quick release fasteners provide prompt removal of the top cowl. To remove the bottom cowl, the cowl flap must first be disconnected.

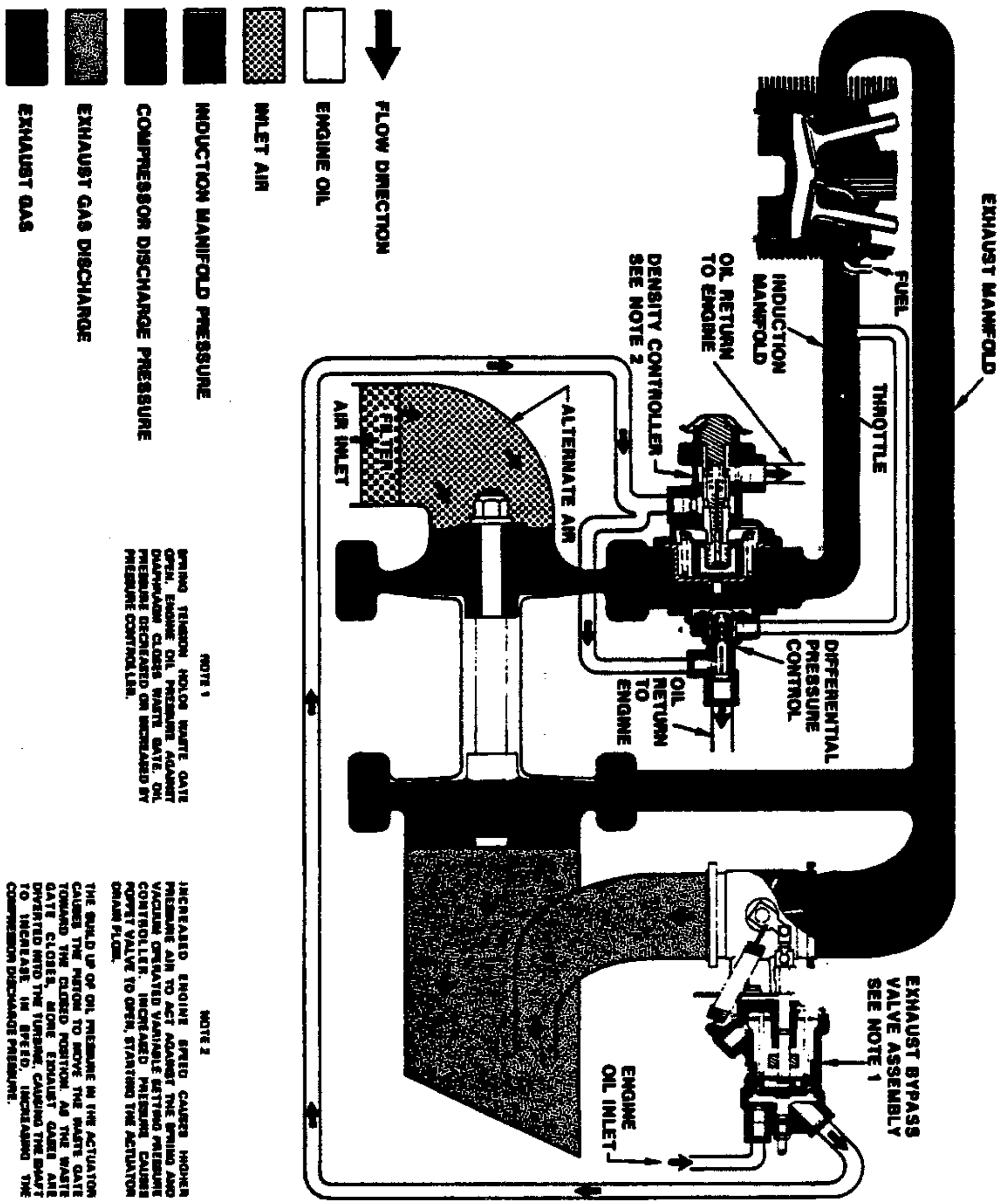
The lubrication system is of the pressure wet sump type. The oil pump, which is located in the accessory housing, draws oil from the oil suction screen located in the sump. The oil from the pump then enters the accessory housing which feeds the oil to a connection on the rear face of the accessory housing, where a flexible line leads the oil to the external oil cooler. An oil cooler is attached to the engine mounts on the lower left side below each engine. Oil under pressure from the cooler returns to a second connection on the accessory housing from which point a passage conducts the oil to the oil pressure filter. Oil flow to the oil cooler is controlled by a thermostatic valve. This valve is normally open with cold oil so that the oil will by-pass the cooler for quicker warm up. As the oil is warmed, the valve closes causing the oil to flow thru the oil cooler.

The oil filter element, located on the accessory housing, provides a means of filtering from the oil any solid particles that may have passed through the suction screen in the sump. After being filtered, the oil is fed through a passage to the oil pressure relief valve, located in the upper right side of the crankcase in front of the accessory housing. This relief valve regulates the engine oil pressure by allowing excessive oil to return to the sump, while the balance of the pressure oil is fed to the main oil gallery in the right half of the crankcase. Residual oil is returned by gravity to the sump, where after passing through a screen it is again circulated through the engine.

Engine instruments are either mounted horizontally across the top of the center instrument panel or stacked vertically at the right side of the center panel. Additional engine gauges are located in the right instrument panel.

The recommended period for engine overhaul is at 1800 hours. This time is based on Avco-Lycoming service experience. From time to time Lycoming revises the recommended overhaul period through a Service Instruction. The pilot should check with his dealer for the latest overhaul period on his engines and any additional Lycoming service information. Operation beyond the recommended overhaul period is at the discretion of the operator.

In order to obtain maximum engine efficiency and time between overhauls, the pilot should read and follow the procedures recommended by the Avco-Lycoming Operator's Manual for his engines.



TURBOCHARGER SYSTEM SCHEMATIC

Figure 7-5

THIS PAGE INTENTIONALLY LEFT BLANK

7.7 ENGINE CONTROLS

Engine controls include a throttle, a propeller control, and a mixture control for each engine (refer to Figure 7-13). These controls are located on a control pedestal in the center of the cockpit below the instrument panel, where they are accessible to both pilot and copilot.

The throttle levers, on the far left of the control pedestal, are used to adjust manifold pressure. The throttle levers adjust from fully open in the top (fore) position, through the idle position, to fully closed at the bottom (aft) of their travel. The throttle controls incorporate switches which activate a gear unsafe horn if the gear is not in the "Down-Locked" position and the power is reduced to 12 inches of manifold pressure. If the 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 prevent an inadvertent gear up landing.

The propeller controls are located in the center of the control pedestal. They are used to adjust the propeller speed from increase RPM at the top of their travel, through decrease RPM, to the feathered position at the bottom of their travel. A governor maintains a constant propeller speed once the propeller control is set.

The mixture controls at the the far right of the control pedestal adjust the air to fuel ratio. The full rich position is at the top position and the full lean to idle cut-off positions at the bottom. The mixture controls are also used to shut down the engines in the fully aft or idle cut-off position.

A friction adjustment knob on the right side of the control pedestal may be adjusted to increase or decrease the effort needed to move the control levers or to hold the controls in a selected position.

7.9 PROPELLERS

The propellers are Hartzell, three blade, constant speed, controllable pitch and full feathering. The propellers incorporate Hartzell FC8468-6R blades with HC-E3YR-2ATF hubs. Propellers are independently controlled by propeller governors, one mounted on each engine, and its corresponding propeller control lever in the center of the control quadrant on the pedestal.

A combination of nitrogen or air pressure, a spring, blade counter-weights and governor regulated oil pressure is utilized to change the pitch of the propeller blades. Nitrogen or air pressure is supplied from the precharged propeller chamber. (Refer to Section 8 - Airplane Handling, Servicing and Maintenance.) The nitrogen or air pressure, spring and blade counter-weight force is utilized to move the blades to the high pitch (decreased RPM) and feathered position and the opposing governor regulated oil pressure moves the blades to the low pitch (increased RPM) position. As the propeller control lever is moved forward, which increases the propeller RPM, a valve in the propeller governor allows increased oil pressure to enter the propeller hub and move the blades to the low pitch (increased RPM) position. Moving the propeller control lever aft decreases the propeller RPM as the propeller governor decreases the oil pressure to the hub and the nitrogen or air pressure, spring and blade counter-weights move the propeller blades to the high pitch (decreased RPM) or, if selected, the feathered position.

Feathering is accomplished by moving the propeller control lever full aft, through the low RPM detent, into the feathering position. Feathering takes place in approximately seven seconds. The low RPM detent is incorporated to prevent inadvertent feathering. To unfeather the propeller (in flight), move the propeller control lever forward, beyond the low RPM detent, to increased RPM position and engage the starter. As the engine cranks over the governor will begin to unfeather the blades and windmilling, which speeds up the process of unfeathering, will take place.

When the engines are shut down, the propeller control levers should be left in the increased RPM position. The nitrogen pressure will move the blades to the decreased RPM position by forcing most of the oil from the hub. This prevents damage to the propeller during cold weather starts. The high pitch stops will prevent the nitrogen pressure from moving the blades to the feathered position.

Full propeller feathering and unfeathering should not be practiced on the ground due to excessive vibration of the power plant installation. In flight feathering should be practiced only to familiarize the pilot with the proper procedures. In the event feathering becomes necessary during flight, the Feathering and Unfeathering procedures outlined in Section 3 - Emergency Procedures should be followed.

7.11 LANDING GEAR

The Navajo is equipped with a hydraulically actuated, fully retractable, tricycle landing gear system. The gear incorporate air-oil type oleo struts. Full travel of the strut from the fully extended to fully compressed position is 8 inches on the nose gear and 9 inches on the main, with a required extension of 3.25 inches of strut exposure under a normal static load condition. When retracted, the nose gear, which retracts aft into the nose and the main gear, which retract inboard into the wings, are fully protected by gear doors. Nose gear doors and the outboard doors on the main gear are operated by a mechanical linkage with the gear and remain in the open position when the gear is extended. The inboard main gear doors are hydraulically operated and close when the main gear is fully extended or fully retracted.

The nose gear is steerable by use of the rudder pedals. On airplanes with serial numbers 31-7712001 through 31-7812120 the total nose gear turning arc is fixed at 40°. During taxi, this 40° limit cannot be exceeded, and during towing, attempting to turn the gear beyond its 20° limit in either direction may result in damage to the nose gear and steering mechanism.

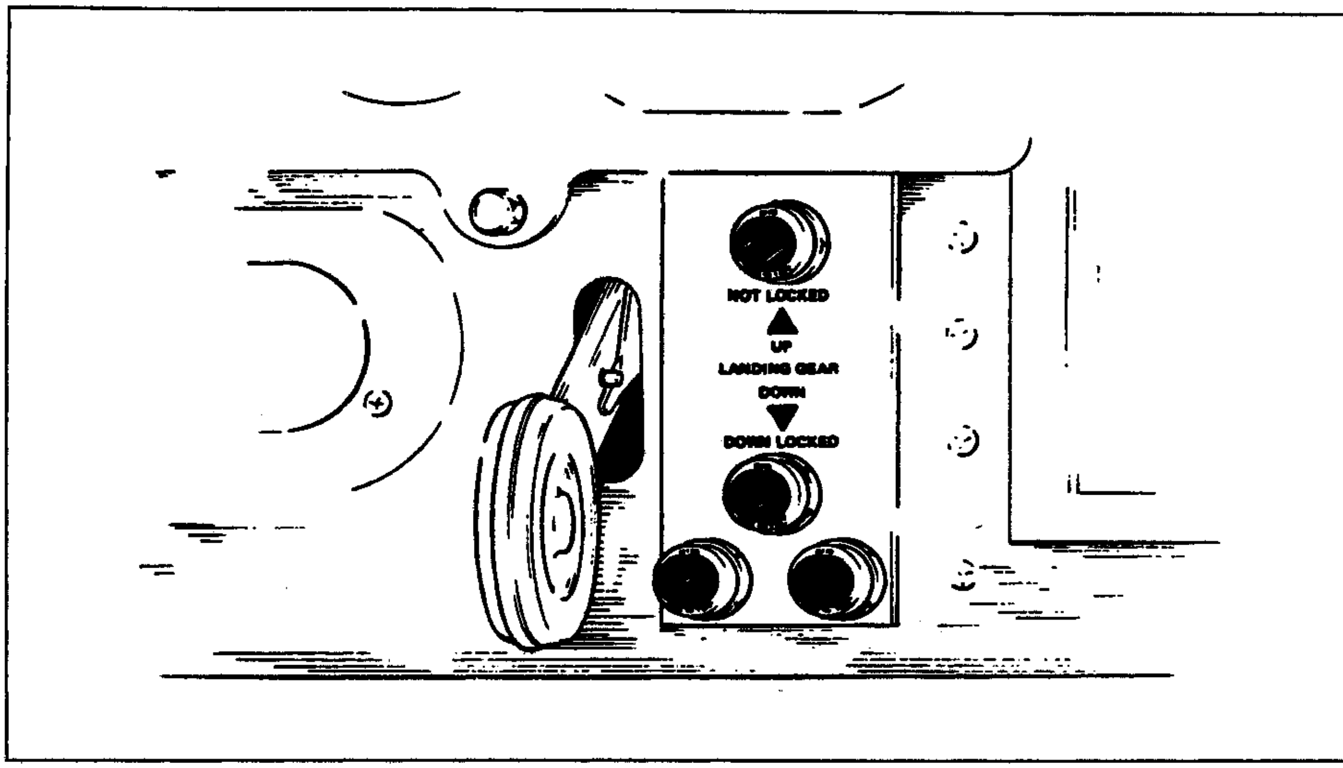
On airplanes with serial numbers 31-7812121 and up, the total nose gear turning arc when steered with the rudder pedals is normally 40°. However, these airplanes incorporate a feature which allows the nose gear to temporarily disengage from the rudder pedal steering linkage, permitting the gear to be turned an additional 20° in each direction during towing operations, thus extending the turning arc to a full 80°. A spring-loaded cam device will return the nose gear to within the center 40° arc, where it automatically reengages with the steering linkage. Although this device is intended for use during towing, while taxiing through tight turns with differential engine power and braking, the nose gear can disengage itself, permitting a shorter turning radius. Should this occur, the rudder pedal force changes and accompanying noise in the nose gear is normal and should not be interpreted as a malfunction.

NOTE

Avoid unnecessary sharp turns as excessive wear will result.

The nose gear is also equipped with a shimmy dampening device mounted to the bottom of the outer housing. As the nose gear retracts, the steering linkage separates from the nose gear to reduce the inflight rudder pedal forces.

The landing gear selector (Figure 7-7) is located on the instrument panel to the right of the pilot's control wheel and is provided with a wheel-shaped knob to differentiate it from the flap control, which has an airfoil shape. To guard against inadvertent gear retraction on the ground, a solenoid latch is incorporated in the landing gear selector control. An anti-retraction (squat) switch on the left main gear must actuate this solenoid latch before the landing gear selector can be moved to the "UP" position. When the selector is moved to either the "UP" or "DOWN" position, the handle will remain locked in this position until the gear has fully extended or retracted. At this time the selector handle will return to the neutral position. To raise or lower the gear in flight the handle must first be pulled aft.



LANDING GEAR SELECTOR
Figure 7-7

On the instrument panel to the right of the landing gear selector, are one red and three green indicator lights with "Press to Test" features. An illuminated red light indicates when the gear is in transit between the up-locked and down-locked positions. A red light indication will also occur during flight if the inboard gear doors remain open when the gear is retracted or extended. The green lights illuminate to indicate when each gear is down and locked. The indicator lights can be dimmed by turning each light. There is no light indication when the gear is up and locked. For added protection, a gear unsafe horn will sound if the power in one or both of the engines is reduced below 12 inches of manifold pressure while the landing gear is not in the "Down-Locked" position. If the gear selector has been forced into the up or up neutral position while on the ground, the gear unsafe horn will sound when the master switch is on.

NOTE

In the event of an electrical failure, or with the master switch "OFF," there will not be an indication of the down and locked position of the gear.

The main wheels are 6.50 x 10 Cleveland Aircraft Products units with disc type brakes and are fitted with 6.50 x 10 eight-ply rated tires. The nose wheel is a Cleveland 6.00 x 6 model with a 6.00 x 6 six-ply rated tire. Proper tire pressure is printed on the wheels.

7.13 BRAKE SYSTEM

The brakes are hydraulically operated by individual master cylinders mounted on the left set of rudder pedals. They are actuated by applying toe pressure against the top of the rudder pedals. There are provisions for an optional dual brake installation with brake cylinders attached to the copilots rudder pedals.

A hydraulic brake fluid reservoir, which is separate from the main hydraulic system, supplies fluid to each master cylinder. The reservoir is accessible through an access door atop the fuselage nose section.

Hydraulic fluid is routed from the master cylinders through lines and hoses to a parking brake valve, located on the left aft side of the forward cabin bulkhead then through the cabin and wings to the brake assembly on each main landing gear. The parking brake handle is located on the lower left face of the instrument panel below the pilot's control wheel. To set the parking brake, first depress and hold the toe brake pedals and then pull out the parking brake handle. To release the parking brake first depress and hold the toe brake pedals and then push in on the parking brake handle.

WARNING

Braking may not occur if parking brake handle is pulled and held prior to brake pedal application.

The brakes are Cleveland Aircraft Products, single disc, single housing triple-piston assemblies. They are self adjusting and utilize bonded linings for maximum strength and durability.

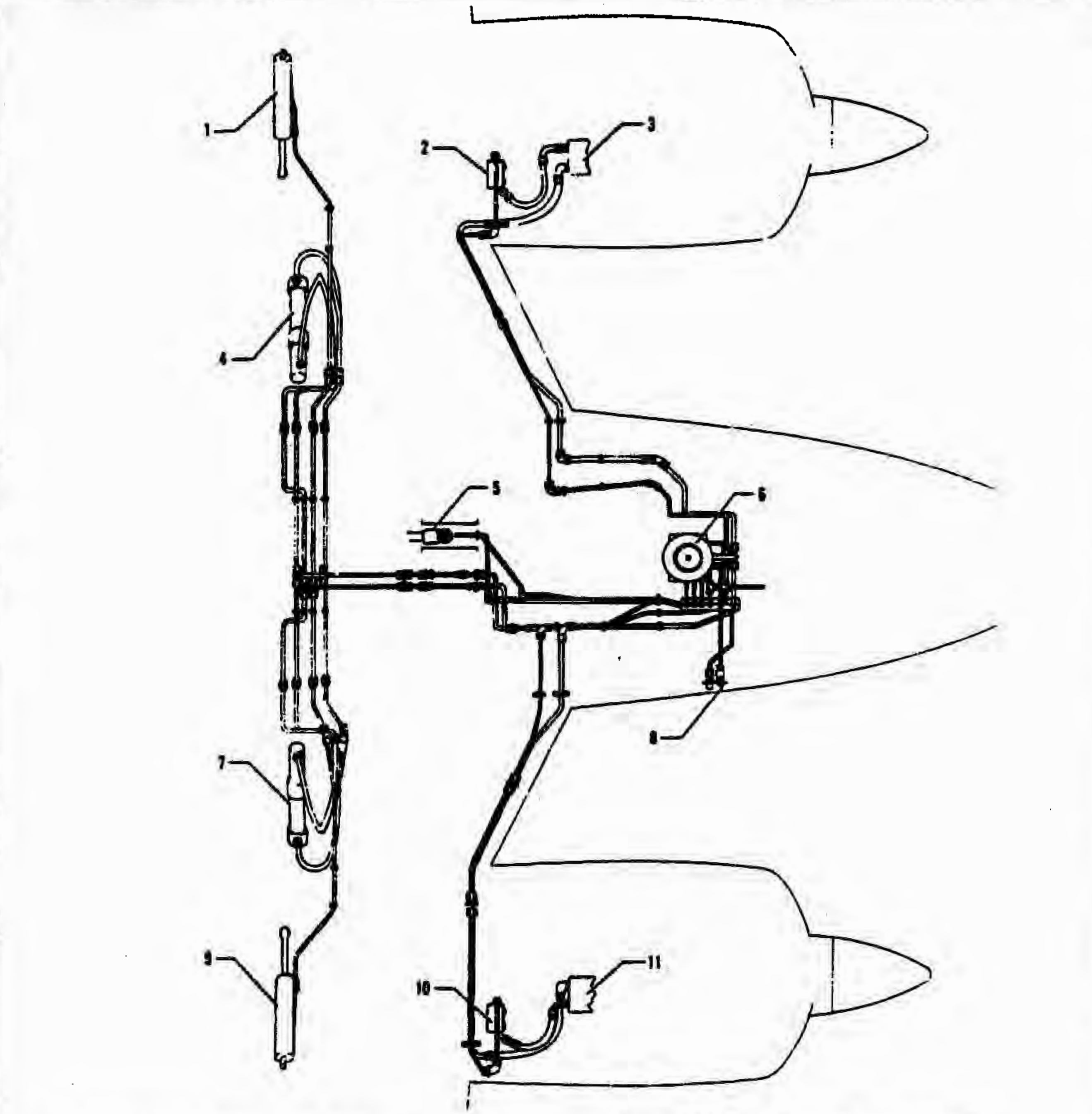
7.15 HYDRAULIC SYSTEM

A hydraulic system, consisting of two hydraulic pumps, a power pack, an emergency hand pump, actuating cylinder and filters, supplies pressure for the smooth extension and retraction of the landing gear. (Refer to Figure 7-9.)

The hydraulic pumps, which develop pressure for the system, are engine driven and mounted on the rear of each engine. The hydraulic power pack, located in the fuselage nose section just aft of the nose baggage compartment, is the central control unit for the hydraulic system. It contains the valves, manifold, fluid reservoir and necessary controls which work in conjunction with various electrical switches and solenoid valves to perform the desired sequences of operation as selected by the cockpit control lever. Access to the power pack may be gained through the nose baggage compartment door or an access panel just aft of the baggage door.

Fluid is drawn from the power pack reservoir by the engine driven pumps and pumped through the system filters and check valves back to the pressure port of the power pack. Fluid within the power pack is then directed to the appropriate actuator, depending upon the sequence and selector position.

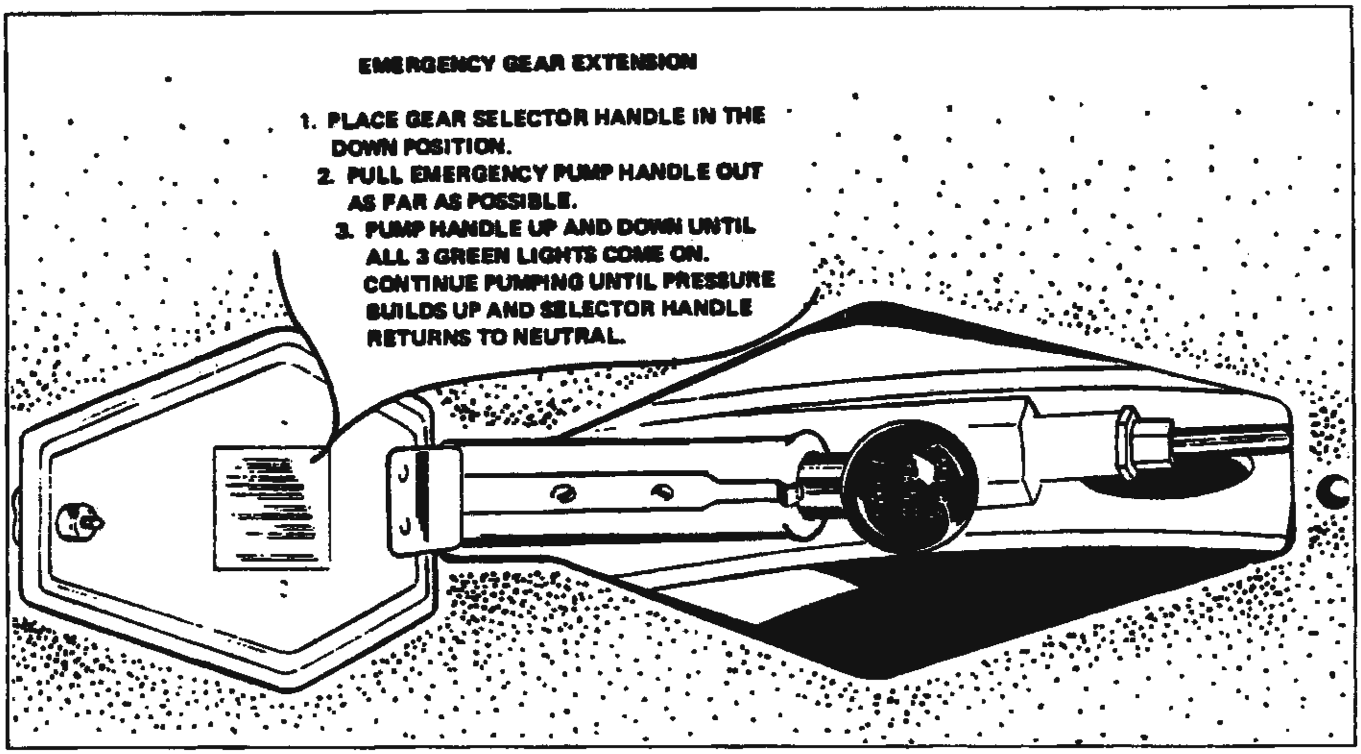
As a safety precaution, the reservoir contains a standpipe, which in the event of severe leakage of fluid, retains a sufficient quantity of fluid for gear extension by means of the emergency hand pump. The engine driven pumps are supplied with fluid through the standpipe; so if a severe system leak would develop, the continued operation of the engine driven pumps would drop the fluid level below the top of the standpipe and the system would be denied operational fluid from the reservoir. If this occurs, operation would be limited to pressure obtained through the use of the emergency hand pump and fluid retained in the standpipe.



1. LEFT MAIN GEAR ACTUATING CYLINDER
2. LEFT HYDRAULIC PUMP FILTER
3. LEFT HYDRAULIC PUMP
4. LEFT GEAR DOOR ACTUATING CYLINDER
5. EMERGENCY HAND PUMP
6. POWER PACK ASSEMBLY
7. RIGHT GEAR DOOR ACTUATING CYLINDER
8. CHECK VALVES
9. RIGHT MAIN GEAR ACTUATING CYLINDER
10. RIGHT HYDRAULIC PUMP FILTER
11. RIGHT HYDRAULIC PUMP

HYDRAULIC SYSTEM SCHEMATIC

Figure 7-9



EMERGENCY LANDING GEAR HAND PUMP
Figure 7-11

A door solenoid valve, mounted in the power pack, is electrically operated and spring loaded to the door open position. Should an electrical failure occur, the solenoid valve will move to the door open position to allow the gear to be lowered normally or with the hand pump.

A system pressure port/check valve and a suction, fill and drain valve are located on the right side of the fuselage nose section, accessible through an access panel. (Refer to Section 8 - Airplane Handling, Servicing and Maintenance.)

To operate the gear, pull out the wheel shaped gear selector mounted on the instrument panel to the right of the pilot's control wheel and move it from the neutral position to the "UP" landing gear or "DOWN" landing gear position. When the desired position of the gear is obtained, the handle is forced back to the neutral position by hydraulic pressure in the selector valve. The hydraulic fluid then circulates freely between the pump and control unit. Gear retraction or extension will occur normally in approximately 6 seconds.

NOTE

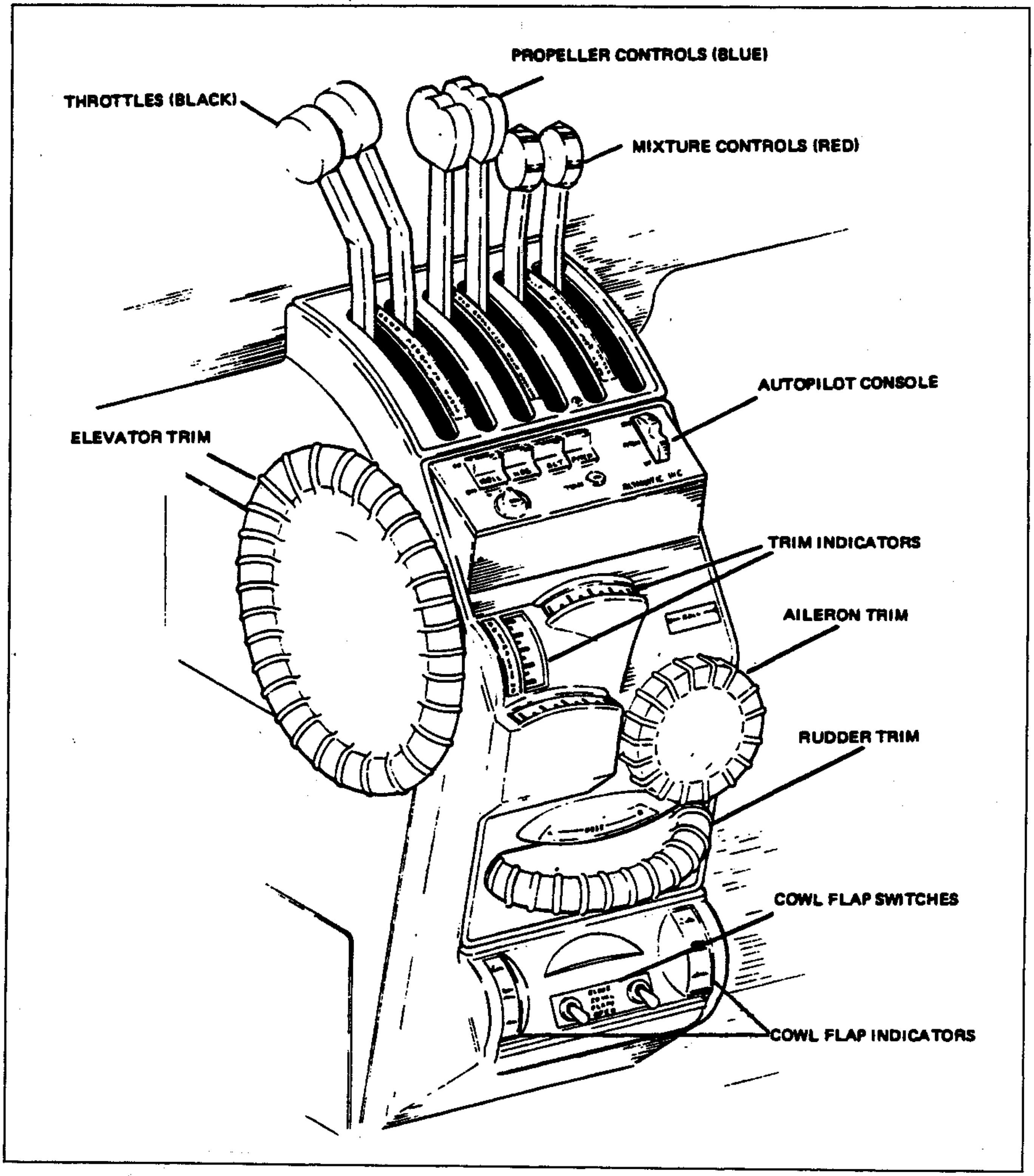
In the event of electrical failure or when the master switch is OFF, the selector handle will not return to neutral and the gear doors will not close.

When the selector handle returns to neutral, it relieves all pressure in the system. The gear is held in position by mechanical locks. Return of the control handle to the neutral position is an indication that the components have reached full extension or retraction; however the landing gear position lights should be used as primary indications.

CAUTION

When retracting the Landing gear, be sure that the gear unsafe light is out before exceeding the maximum gear operating speed.

The emergency hydraulic hand pump (Figure 7-11) is used to obtain hydraulic pressure in the event of failure of the engine driven hydraulic pumps. This hand pump is located between the pilot's and copilot's seats. An access cover marked "Emergency Gear Extension" must be lifted to gain access to the pump handle. Follow instructions on the underside of the access plate to lower the gear. The hand pump should not be used to retract the gear in flight.



CONTROL PEDESTAL
Figure 7-13

7.17 FLIGHT CONTROL SYSTEM

The primary flight controls are operated by dual control wheels and rudder pedals assuring complete operational control by the pilot or copilot. The control wheel operates the ailerons and the elevators; the rudder pedals operate the rudder, the nose wheel steering and the toe brakes. The toe brakes, which are an integral part of the pedals, operate the wheel brakes. The ailerons and rudder are interconnected through a cable-spring system to provide coordination in normal turns.

Secondary control is provided by the aileron, elevator, and rudder trim tabs. Trim is operated by knobs or wheels on the control pedestal (Figure 7-13) which turn cable-wrapped drums located inside the pedestal. With rotation of the drums, screws are moved forward or aft to position the trim tabs. The aileron trim wheel, for right wing down or left wing down (roll) correction, is located below the power controls. The rudder trim wheel, for nose left or nose right correction, is located below the aileron trim wheel. The elevator trim wheel, for nose up or nose down correction, is located on the left side of the pedestal. To show the position of the trim tab, and indicator is mounted next to each trim control on the control pedestal.

AIRPLANE SERIAL NUMBERS 31-7712001 THROUGH 31-7812129

The wing flaps are controlled by an airfoil shaped selector switch mounted on the instrument panel to the right of the control pedestal. The switch activates an electric motor under the center floor panel of the cabin. The motor is connected at each end to flexible drive shafts which are in turn connected to screw transmission at each flap. Up and down flap travel is limited by micro switches located in the left wing only. The flap position indicator, located immediately above the flap selector switch, is controlled by a rheostat also located in the left wing. On airplanes with serial numbers 31-7712001 through 31-7712103, flaps may be extended to 15° at airspeeds below 164 KIAS. On airplanes with serial numbers 31-7812001 through 31-7812129, 15° of flaps may be extended at airspeeds below 174 KIAS. On all Navajo's, full flap extension is limited to airspeeds below 140 KIAS.

The flap system has a device known as a "time-delay relay." The time-delay relay is located adjacent to the flap motor and shuts the flap system down should the left flap fail to move within one second (about 9 degrees) of right flap travel. Should the time delay system function, the flap selector switch will become inoperative. The selector switch will remain inoperative until the time-delay relay is reset. The time-delay relay may be reset by pulling the flap control circuit breaker and resetting it.

CAUTION

DO NOT reset the flap time-delay relay system while the aircraft is in flight. Resetting the system will allow an additional one second of flap travel and can cause the flap asymmetry to become more severe. Reset the flap system only after the aircraft has landed.

The time-delay relay does not affect the system if a failure occurs at any point after the left flap has left either the up or down limit switch. If a failure occurs in either flap system when the left flap is not in contact with a limit switch, use the flap selector switch to bring the operable flap to a symmetrical configuration with the inoperable flap.

An electrical brake in the flap motor prevents the flaps from "coasting" when intermediate flap settings are selected.

To preclude the possibility of encountering large asymmetric ("split") flap angles due to a failure in the flap actuating system, the following procedures should be followed for flap extensions and retractions:

(a) Actuate the flaps only while the airplane is under manual control, not while the autopilot is engaged. The autopilot will mask the high control forces created by an asymmetric flap condition.

(b) Extend or retract the flaps in a minimum of five steps of approximately one half second activation each. Do not initiate the successive extension/retraction step until a symmetric position is verified by a negligible change in aileron/rudder cockpit control positions to hold straight flight.

(c) Do not extend the flaps beyond 15° if the flap motor circuit breaker has a history of popping. A popped circuit breaker is indicative of excessive actuation loads on one or both flaps; such loads are most likely at flap angles in excess of 15°. The airplane should not be flown until the cause of the high loads is determined and repairs effected.

AIRPLANE SERIAL NUMBERS 31-7912001 AND UP

Wing flap position is controlled by a selector switch mounted on the instrument panel immediately to the right of the control pedestal. The flap position indicator is located to the right of the selector switch. The position indicator 40° arc is segmented at the 15° flap range and in increments of 5° between the 15° and 40° arcs. An OFF position is also provided to indicate zero (0) voltage to the system. The selector switch provides for variable wing flap positioning in as little as 2° increments from 0° to 40°. Detent positions are provided at the most commonly used positions of 0°, 15°, and 40°. A wing flap position change is made by moving the selector handle to any desired position (marked on the switch selector guard). The flaps will automatically move to the selected position and indicator will display the actual flap position. The flaps may be extended to 25° at airspeeds below 174 KIAS. 40° flap extension is limited to airspeeds below 140 KIAS. The entire system is electronically monitored for system component failures and will prevent an asymmetric flap position greater than 5° differential.

The basic electronic control system consists of an amplifier, three rheostats, two power solenoids, and one motor. The motor is of a D. C. permanent magnet type and extends or retracts the flaps through a pair of flexible shafts attached to jackscrew, transmission assemblies located on each wing flap.

The amplifier is the heart of the control system. It provides a regulated voltage supply for the three external rheostats, circuit logic to analyze the system condition and position; provides commands to the power solenoids to actuate the motor for extensions and retractions and contains its own monitoring system to ascertain the condition of critical components.

The three rheostats feed back to the amplifier the signals necessary to operate the system. One rheostat is located in the flap position selector and one each is located so as to sense the positions of the right and left flaps independently. The selector rheostat tells the amplifier where it wants the flaps to be. The left flap rheostat controls flap position in relation to the selector rheostat position and provides information to the amplifier to drive the position indicator. The right flap rheostat must agree with the left flap rheostat within 5° at all times or the system will shut down and cannot be reactivated until the inbalance and/or the cause has been corrected.

The system also incorporates an annuncaitor light that will illuminate when an imbalance exists between the right and left wing flap rheostats or a critical component of the amplifier has failed.

The operation of the flaps may be checked with a test switch before takeoff. This switch is located adjacent to the position indicator.

7.19 FUEL SYSTEM

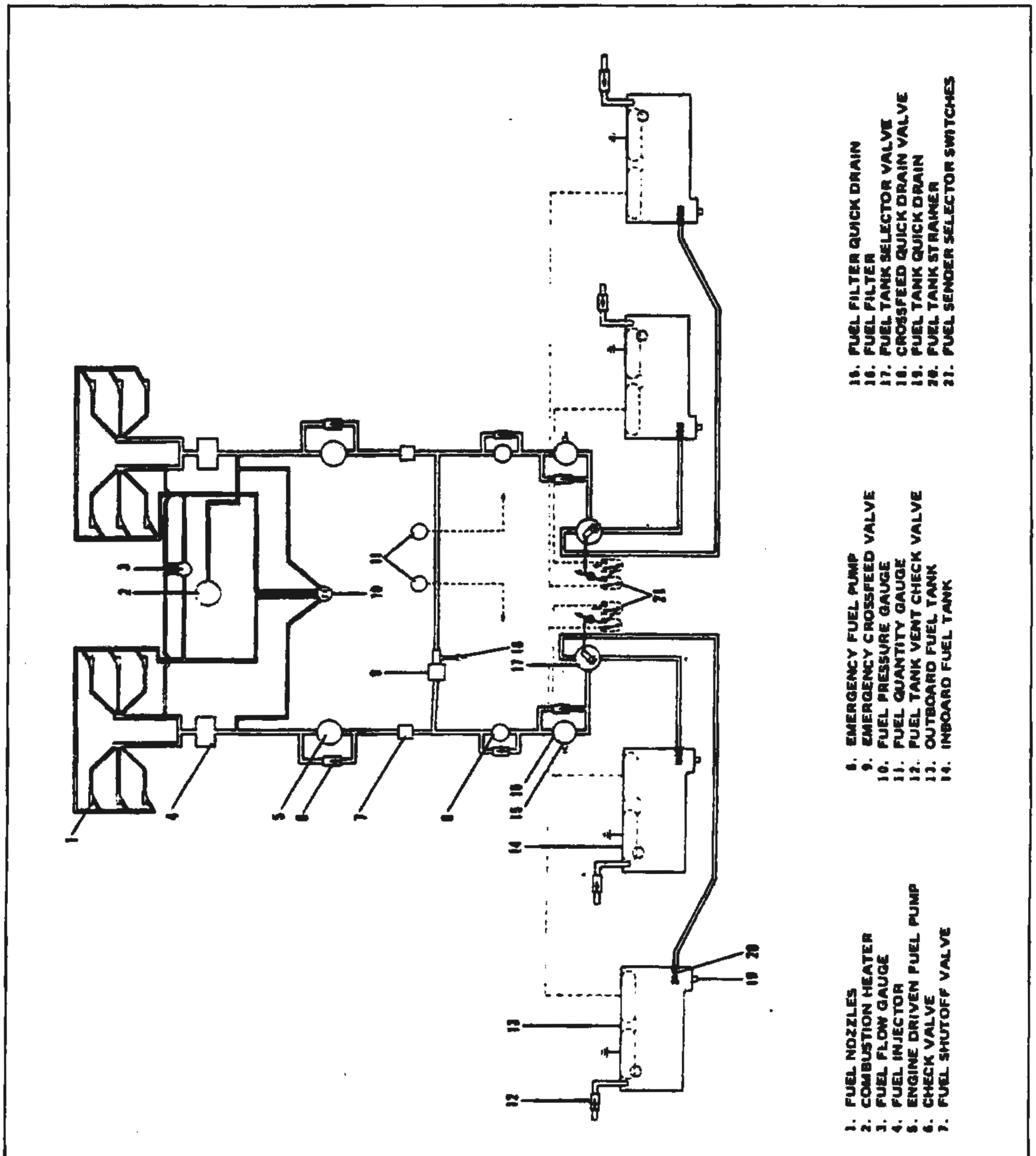
The fuel system consists of fuel cells, engine driven fuel pumps, emergency fuel pumps, fuel injectors, control valves, fuel filters, fuel pressure and flow gauges, fuel drains, non-icing NACA fuel tank vents and a fuel selector panel. (Refer to Figure 7-15.)

Fuel is stored in four flexible fuel cells, two in each wing. The outboard fuel cells have a capacity of 40 U.S. gallons each and the inboard cells have a capacity of 56 U.S. gallons each, providing a total fuel capacity of 192 gallons, 187.3 of which are usable. Each individual fuel cell incorporates its own fuel senders, screened outlet, sump drain valve, vent line check valves and filler assemblies available with optional lightning shielded caps.

The four fuel sump drains for the fuel tanks are located along the bottom of the wings: one just outboard of each wheel well and one on the inboard of each wing near the wing root fillet plate assemblies. On the fuel filter assemblies, attached to the inboard wing ribs, are fuel filter drains, accessible through a door on the bottom of the wing root fillet plate. A crossfeed drain is located on the left wing root fillet plate inboard of the tank drain. All of the fuel drains incorporate quick drain valves to provide speedy fuel contamination checks. (Refer to Section 8 - Airplane Handling, Servicing and Maintenance.)

The right and left wing fuel systems are independent of each other and are connected only when the crossfeed system is activated. Under normal operation, fuel is routed from the fuel cells, through the selector valve to the fuel filter. Fuel from the fuel filter travels through the emergency fuel pump, the fire wall shutoff valve and the engine driven fuel pump to the fuel injector and then to the cylinders.

Emergency fuel pumps are installed to provide fuel pressure in the event an engine driven pump fails. The emergency fuel pumps are also used under normal conditions for takeoff, landing, and priming the engines. It may also be necessary to turn on the emergency fuel pumps during climb or cruise to stabilize fuel pressure. Under high ambient temperature conditions the emergency fuel pumps may be turned on while taxiing to stabilize fuel pressure provided there is no indication of an engine driven fuel pump malfunction. Left and right emergency fuel pump switches are located on the overhead panel to the right of the fuel gauges.



FUEL SYSTEM SCHEMATIC
Figure 7-15

Two electric fuel quantity gauges are mounted in the overhead switch panel. The right fuel quantity gauge indicates the quantity of fuel in the selected right fuel system tank (right inboard or right outboard), and the left fuel quantity gauge indicates the quantity of fuel in the selected left fuel system tank (left inboard or left outboard). The fuel gauges are connected electrically to micro switches mounted in the fuel selector console. The fuel senders are also connected electrically to the micro switches. When a fuel tank is selected, its corresponding micro switch is actuated, completing the circuit between the fuel senders and the fuel quantity gauge, providing a visual reading of the fuel quantity in the selected tank. The gauges are illuminated, and the lights are controlled by a rheostat switch on the left side of the overhead switch panel.

Fuel flow and fuel pressure for the left and right engine fuel systems are monitored by a dual fuel flow gauge and a dual fuel pressure gauge. The fuel flow gauge, mounted on the instrument panel above and to the right of the control pedestal, measures both the right and left engine fuel system fuel flow in U.S. gallons per hour. The fuel pressure gauge, mounted on the instrument panel above and to the right of the copilot's control column, measures the fuel pressure in pounds per square inch for both the left and right engine fuel systems.

Right and left fuel flow warning lights illuminate to warn the pilot of an impending fuel flow interruption. The lights are activated by a sensing probe mounted near each inboard fuel tank outlet. In the event the fuel level near the tank outlet drops to a point where a fuel flow interruption and power loss could occur, the sensing probe will illuminate its corresponding warning light. The warning light will be on for a minimum of 10 seconds and will remain on if the cause is not corrected.

In airplanes with serial numbers 31-7712001 through 7712103, the warning lights are mounted at the base of the windshield divider post. The lights are provided with a "press-to-test" feature. To test, depress the button mounted between the lights for 3 seconds; the lights should illuminate and remain on for 10 seconds.

In airplanes with serial numbers 31-7812001 and up, the warning lights are incorporated in the annunciator panel. For press-to-test procedures in these later models, refer to Paragraph 7.24.

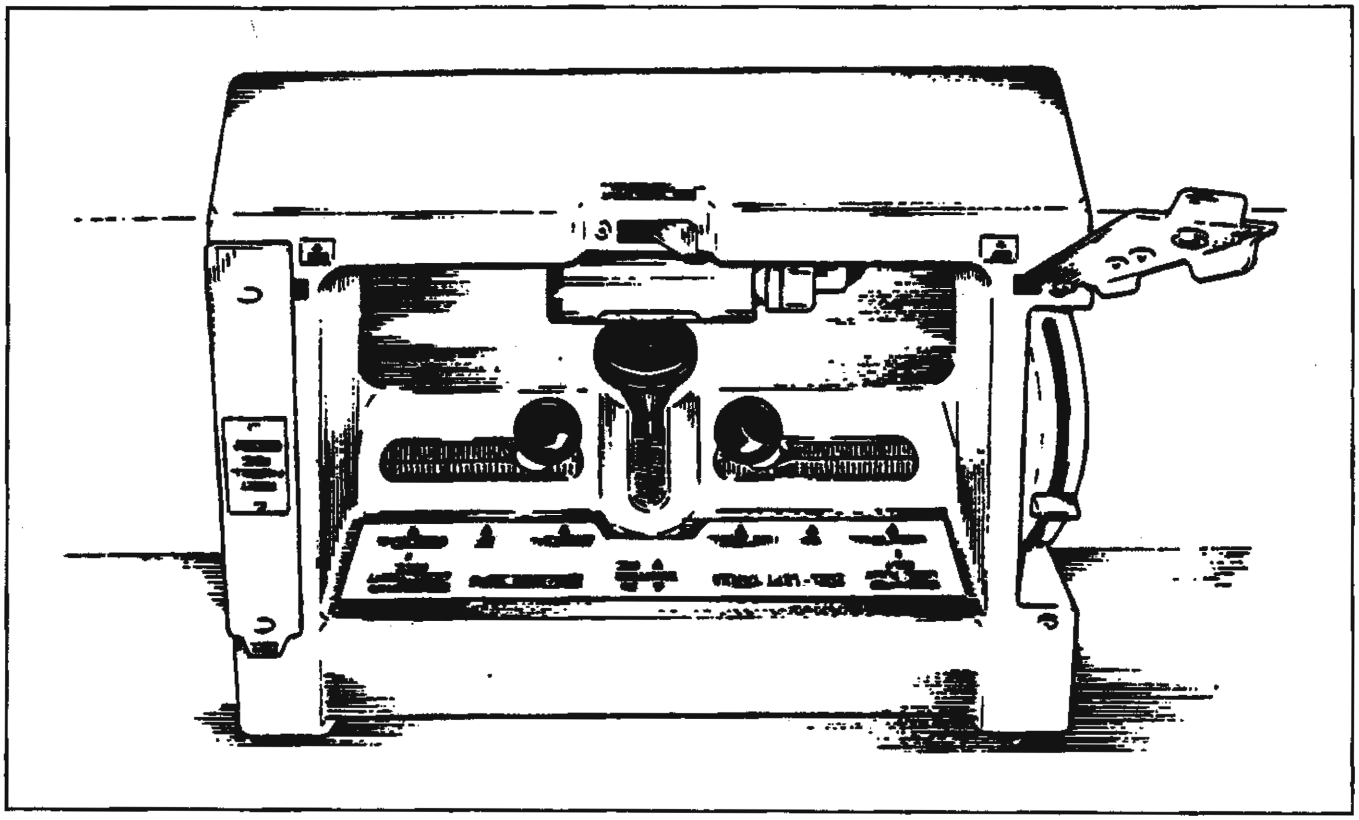
The fuel management (Figure 7-17) controls are located in the fuel system control panel mounted between the front seats on the forward edge of the wing spar carry-through cover. Located on the fuel control panel are the fuel tank selectors, fire wall fuel shutoffs and the crossfeed controls. A fuel control panel light and switch are mounted at the top of the panel.

During normal operation of the fuel system, each engine is supplied with fuel from its respective fuel supply. Selection of the controls on the right side of the control panel provides fuel from the right inboard or outboard fuel cells to the right engine and left fuel control selection provides fuel from the left inboard or outboard fuel cells to the left engine.

For emergencies, fuel from one system can supply the opposite engine through the use of the crossfeed system. The crossfeed valve is located at the inboard rib assembly of the left wing butt area and is intended for emergency use only. The crossfeed is controlled by a knob in the center of the fuel control panel, and under all normal conditions should be in the off (aft) position.

NOTE

> The crossfeed system is not intended for normal operation. When the crossfeed valve is on, be certain the fuel selector valve on the tank not in use is off, and the procedures outlined in Section 3 - Emergency Procedures are followed.



FUEL SYSTEM CONTROL PANEL
Figure 7-17

Emergency fire wall fuel shutoff valves are installed in both the right and left engine fuel systems. The valves are actuated by controls on the left and right sides of the fuel system control panel. Since the fire wall shutoff valves are intended for emergency use only, they are provided with covers which must be lifted before the valves can be turned off. The covers are designed to prevent them from being closed when the fire wall shutoff valve controls are in the off position, preventing inadvertent activation and insuring a normal valve-open position with the cover closed. The valves are open when the lever is down.

Fuel to supply the combustion heater is provided by the right engine fuel system. (Refer to paragraph 7.37 in this section.)

7.21 ELECTRICAL SYSTEM

Electrical power is supplied by a 28-volt, direct current, negative ground electrical system. Standard electrical supply equipment includes alternators, starters, voltage regulators, an ammeter, a battery, an external power receptacle, circuit breakers, warning lights, switches and solenoids.

The electrical system is controlled by switches located in the overhead panel (Figure 7-23) and the circuit breaker control panel (Figure 7-21). The circuit breaker control panel, located on the side panel of the cockpit, provides circuit protection and control for a complement of standard and optional electrical equipment and accessories. All switches and circuit breakers are marked to their individual functions. Switches are mainly of the toggle or rocker type and circuit breakers are of the push to reset or circuit breaker switch type. If a circuit breaker pops, automatically opening the overloaded circuit, it is recommended that the breaker be allowed to cool before resetting. The circuit breakers can be manually tripped by pulling out on the reset button.

CAUTION

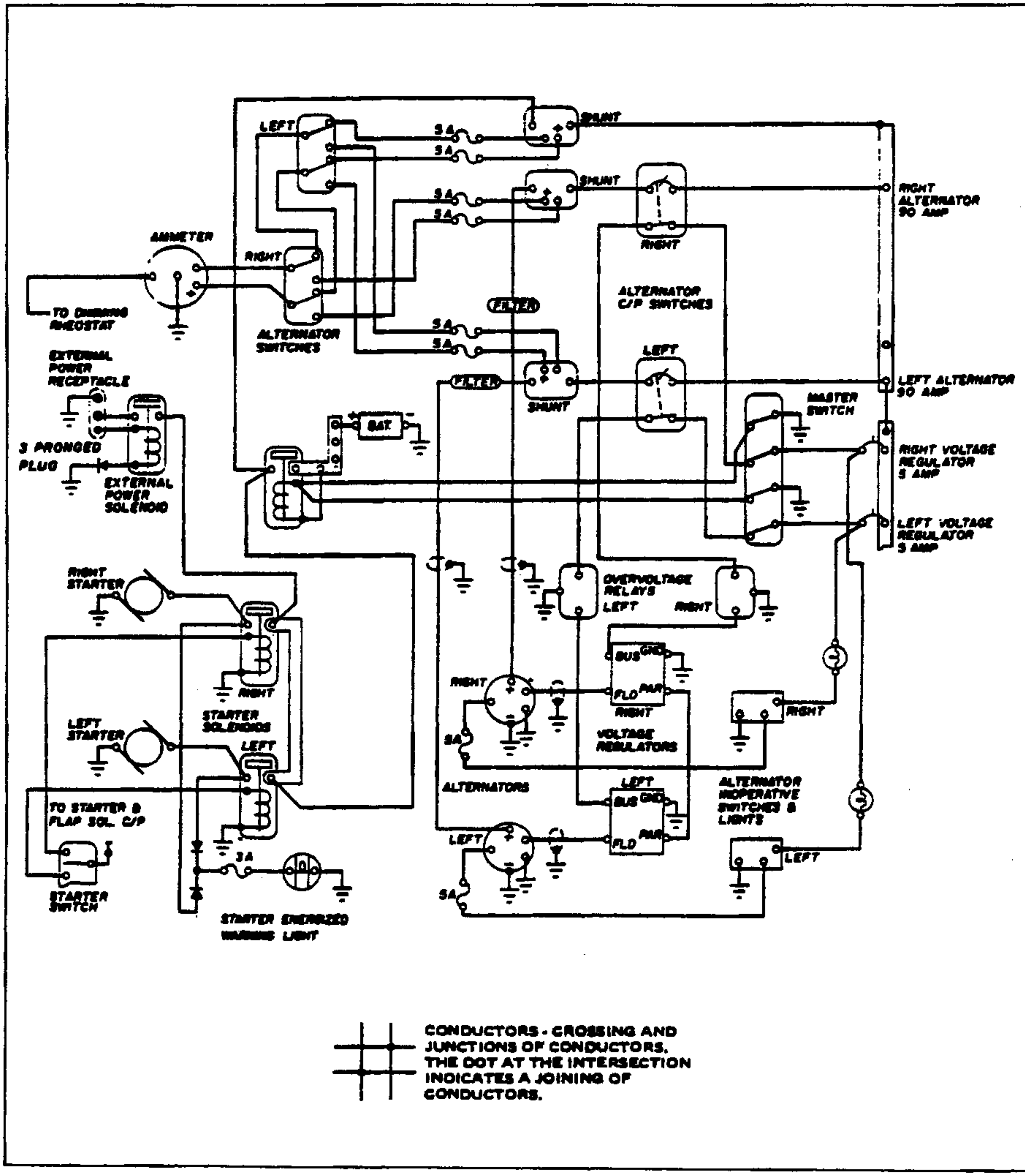
The alternator output circuit breaker switches (black), located on the lower left portion of the circuit breaker panel, should not be opened manually when the alternators are functioning normally.

The starters are energized by a rocker type switch labeled "ENGINE STARTER" located on the overhead switch panel between the left and right magneto switches. To activate, push on the side of the switch which corresponds to the engine to be started and hold until the selected engine has started. When released, the switch should return to the off position. A warning light (optional), mounted on the overhead switch panel below the starter switch, illuminates when either starter is energized.

NOTE

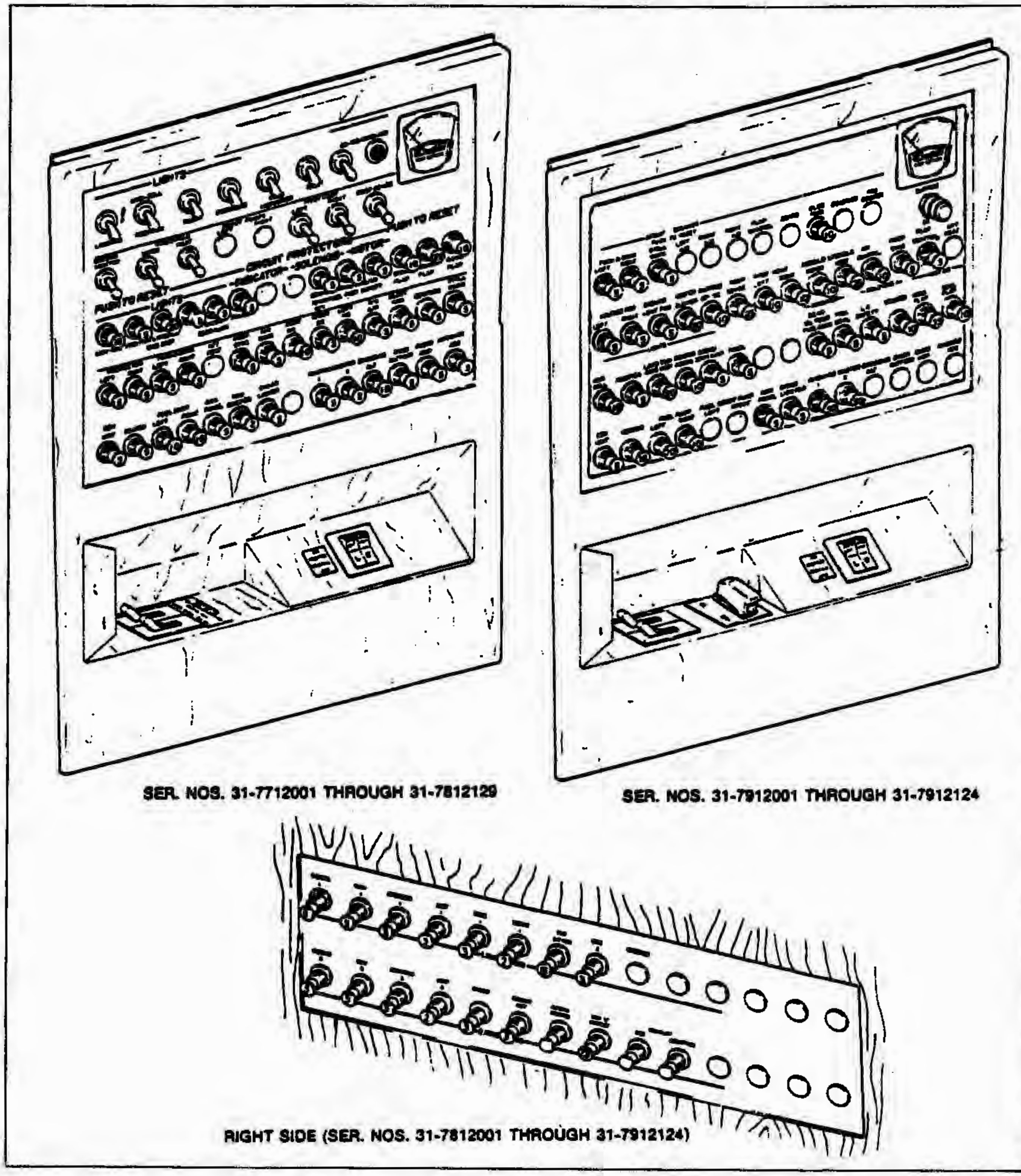
Starter should not be energized for more than 30 seconds of continuous cranking. Allow to cool between starting attempts.

The primary electrical sources are two 28-volt 70 ampere alternators. The alternators are controlled independently by two voltage regulators which are interconnected electrically to provide parallel outputs at normal engine operating speeds. Alternator circuit protection is supplied by left and right alternator circuit breaker switches on the bottom left of the circuit breaker control panel and alternator inoperative lights on the top left of the instrument panel. When an alternator fails to provide voltage, its respective alternator inoperative light will illuminate. The lights can be checked by turning on the master switch with the engines shut down (serial numbers 31-7712001 through 7712103) or by using the annunciator press-to-test procedure (serial numbers 31-7812001 and up). If a light fails to illuminate, the bulb should be replaced. Whenever the engines are operating at a high differential RPM, the alternator inoperative light for the slower engine may illuminate.



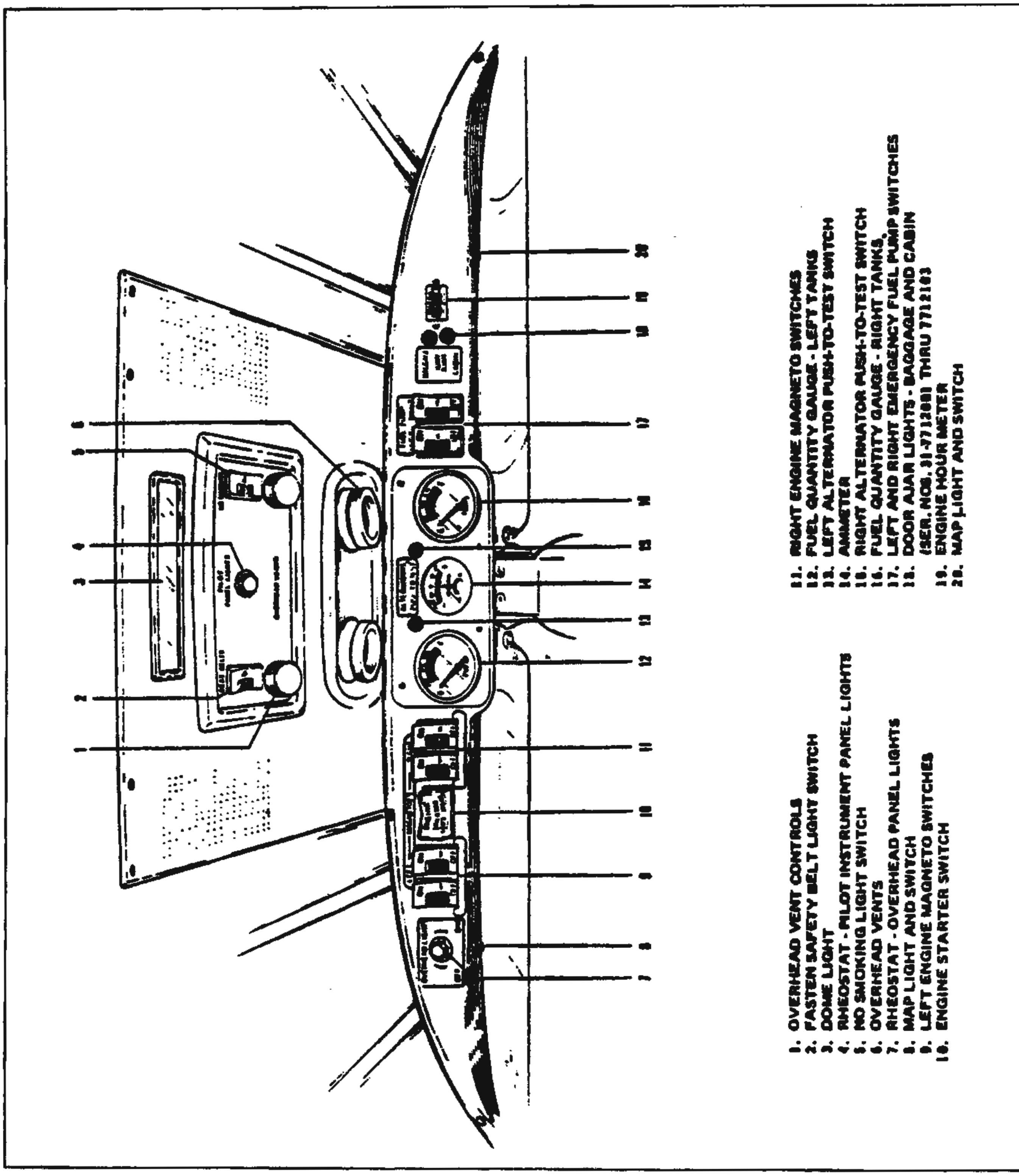
ALTERNATOR AND STARTER SCHEMATIC

Figure 7-19

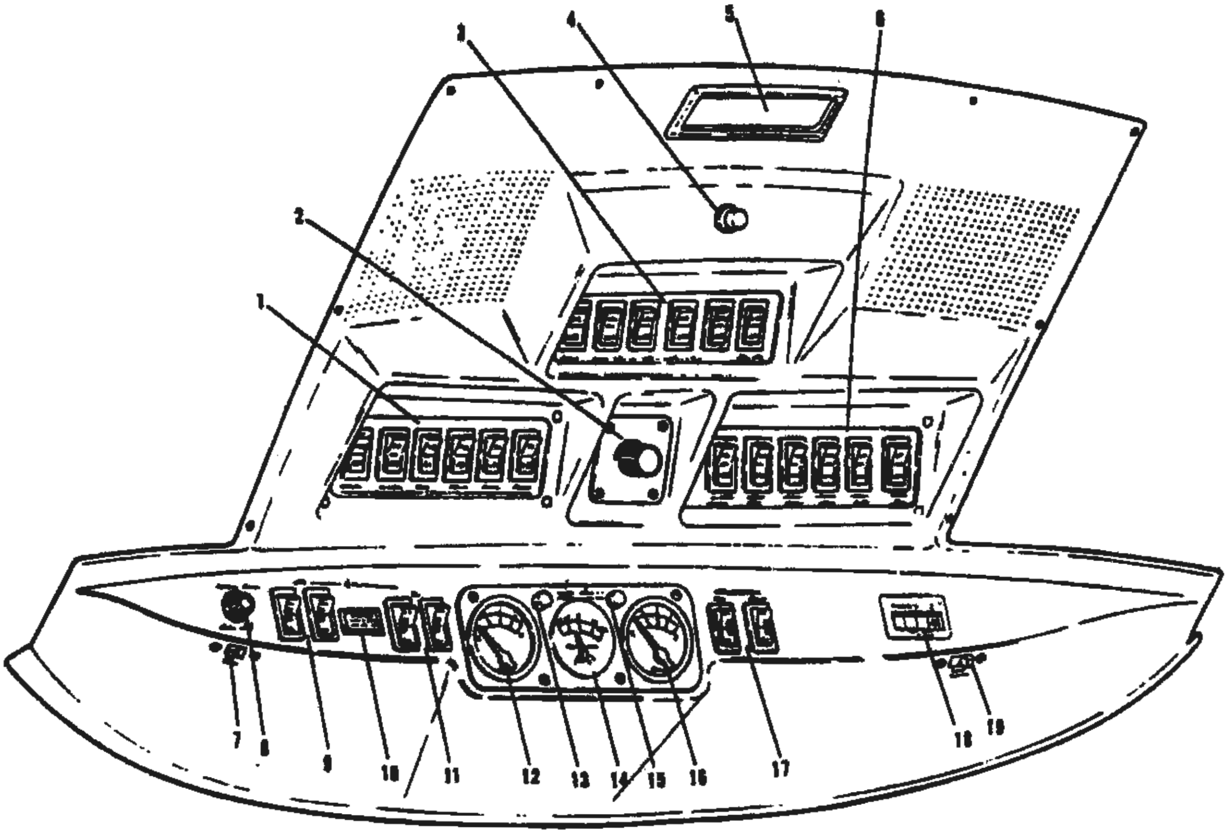


TYPICAL CIRCUIT BREAKER CONTROL PANEL

Figure 7-21



OVERHEAD SWITCH PANEL (SER. NOS. 31-7712001 THROUGH 31-7812129)
Figure 7-23



1. LIGHT SWITCH PANEL
2. PANEL LIGHT RHEOSTAT SWITCH
3. ELECTRICAL SWITCHES
4. DOME LIGHT SWITCH
5. DOME LIGHT
6. VARIOUS DEICING SYSTEM SWITCHES
7. LEFT MAP LIGHT SWITCH
8. OVERHEAD PANEL RHEOSTAT SWITCH
9. LEFT ENGINE MAGNETO SWITCHES
10. STARTER SWITCH
11. RIGHT ENGINE MAGNETO SWITCHES
12. LEFT FUEL GAUGE
13. LEFT ALTERNATOR PRESS-TO-TEST SWITCH
14. AMMETER
15. RIGHT ALTERNATOR PRESS-TO-TEST SWITCH
16. RIGHT FUEL GAUGE
17. FUEL PUMP SWITCHES
18. ENGINE HOUR METER
19. RIGHT MAP LIGHT SWITCH

OVERHEAD SWITCH PANEL (SER. NOS. 31-7912001 AND UP)
Figure 7-23a

THIS PAGE INTENTIONALLY LEFT BLANK

NOTE

In the event of an alternator inoperative indication, refer to Section 3 - Emergency Procedures.

The ammeter, located in the center of the overhead switch panel, monitors the battery charging current. When the needle pointer indicates left of center, the battery is discharging, and when the needle pointer indicates right of center, the battery is charging.

Two test switches, located on the overhead switch panel above the ammeter, are provided to check the output of each alternator. The right switch, when depressed, will cause the ammeter to indicate the output of the right alternator, and the left switch, when depressed, will cause the ammeter to indicate the left alternator output. The switches are momentary on type and must be depressed when reading the ammeter. (Refer to Section 4 - Normal Procedures for preflight alternator check procedure.)

The "MASTER SWITCH" is located on the bottom left of the circuit breaker control panel. It is a split rocker type switch to avail the pilot with a separate control over the field of each alternator.

Secondary electrical power is supplied by a 24-volt 17 ampere hour battery. The battery is enclosed in a stainless steel box accessible through the nose baggage compartment. A 24-volt 25 ampere hour battery is offered as optional equipment.

NOTE

The airplane battery must be removed before recharging.

An external power source receptacle is installed in the lower left side of the fuselage nose section. It is designed to utilize a 24-volt DC external power source when the aircraft battery is low or during cold weather to prevent heavy battery discharge due to extended starting procedures. It can also be used to save the battery when ground checking the airplane systems. (Refer to Section 4 - Normal Procedures for external power starting procedures.)

Position/anti-collision light assemblies are installed in each wing tip. The right wing tip incorporates a green position light and a white anti-collision strobe light and the left wing tip, a red position light and a white anti-collision strobe light. A white position and a white anti-collision strobe light are also installed on the tail cone of the airplane. The position lights and the anti-collision lights are controlled by a switch on the luminescent panel at the top of the circuit breaker control panel.

CAUTION

Strobe lights should not be operating when flying through overcast and clouds, since reflected light can produce spacial disorientation. Do not operate strobe lights when taxing in the vicinity of other aircraft.

A landing and a taxi light, also controlled by switches on the luminescent portion of the circuit breaker control panel, are mounted on the nose gear strut housing. Both lights retract with the nose gear and will automatically turn out if the switches are left on. Nevertheless, the pilot should turn the lights off before or soon after retracting the gear.

Cabin and cockpit lighting consists of forward and center dome lights, map lights, reading lights - mounted above each passenger seat, a cabin exit light, instrument panel lighting and various indicator lights. For added courtesy and convenience, the center dome light and the cabin exit light may be illuminated by a switch just inside the cabin door, or by a switch located in the circuit breaker control panel.

The master switch does not have to be on to use the baggage compartment, exit and cockpit dome lights. Make sure they are off when leaving the aircraft. Leaving the lights on for an extended period of time could cause depletion of the battery.

As a safety feature, the baggage door and the cabin entrance door are equipped with a door ajar warning system. Switches at the doors activate respective lights warning the pilot that the baggage door or the cabin entrance door has not been secured.

Other standard and optional electrical accessories include pitot heat, wing ice detection light, heated pilot's windshield, a gear warning horn, a stall warning horn, a rheostat switch to control instrument panel lighting and other assorted systems, controls and lights.

7.23 INSTRUMENT PANEL

An instrument panel designed to accommodate a full complement of instrumentation is a standard for the PA-31 Navajo. The instrument panel (Figure 7-25) is divided into three segments: the left segment – pilot, the center segment, and the right segment – copilot.

Flight instruments are installed on the left segment of the panel for direct pilot reference. The flight group is shock mounted in a removable sub-panel. Duplicate flight instrumentation is available on the copilot's side as optional equipment. The directional gyro and the attitude gyro in the flight group are operated by a pressure system incorporating pneumatic pumps. An electrically operated turn and bank indicator is also a standard in the flight group. Pitot and static pressure for operation of the airspeed indicator is provided by a pitot/static system utilizing a pitot head and dual static pads for pressure pickups. Static pressure is also provided to the rate of climb indicator and the altimeter. An alternate static source control is mounted beneath the extreme left side of the instrument panel. Airspeed and altimeter indicator calibrations may be made with the use of charts provided in Section 5 - Performance.

An eight day clock, installed in the upper left corner of the panel, is equipped with dummy hands for time settings and calculations. An optional clock is available on the right panel segment.

Alternator inoperative lights provide a visual indication of inadequate output from the respective alternator. The lights are mounted at the top left corner of the instrument panel.

The left side of the instrument panel has provisions for installing a variety of optional extras.

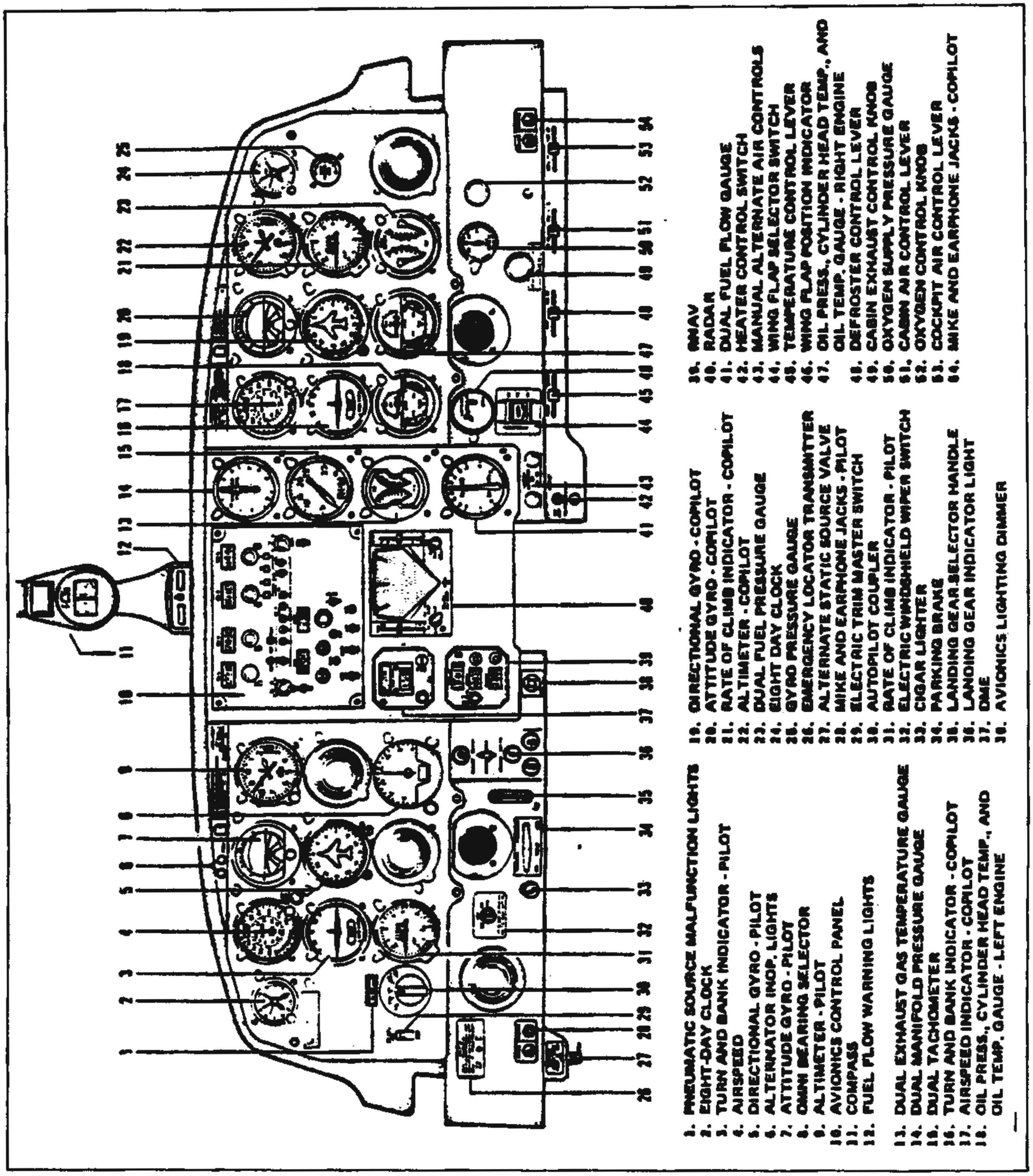
Engine monitoring gauges are either mounted horizontally across the top of the center instrument panel or stacked vertically at the right edge of the center instrument panel. There are four engine gauges in the group: a manifold pressure gauge, a tachometer, an exhaust gas temperature gauge and a fuel flow gauge.

The center segment offers space for an arrangement of navigation and communications equipment including weather radar.

The upper portion of the right instrument panel segment accommodates the optional copilot's flight instruments, a gyro pressure gauge (standard) and the remainder of the engine monitoring gauges (standard). The gyro pressure gauge is on the far right of the right segment. This pressure should remain constant in flight. The additional engine monitoring gauges are mounted in a row above the copilot's control wheel. They consist of two combination oil pressure-cylinder head temperature-oil temperature gauges and a fuel pressure gauge.

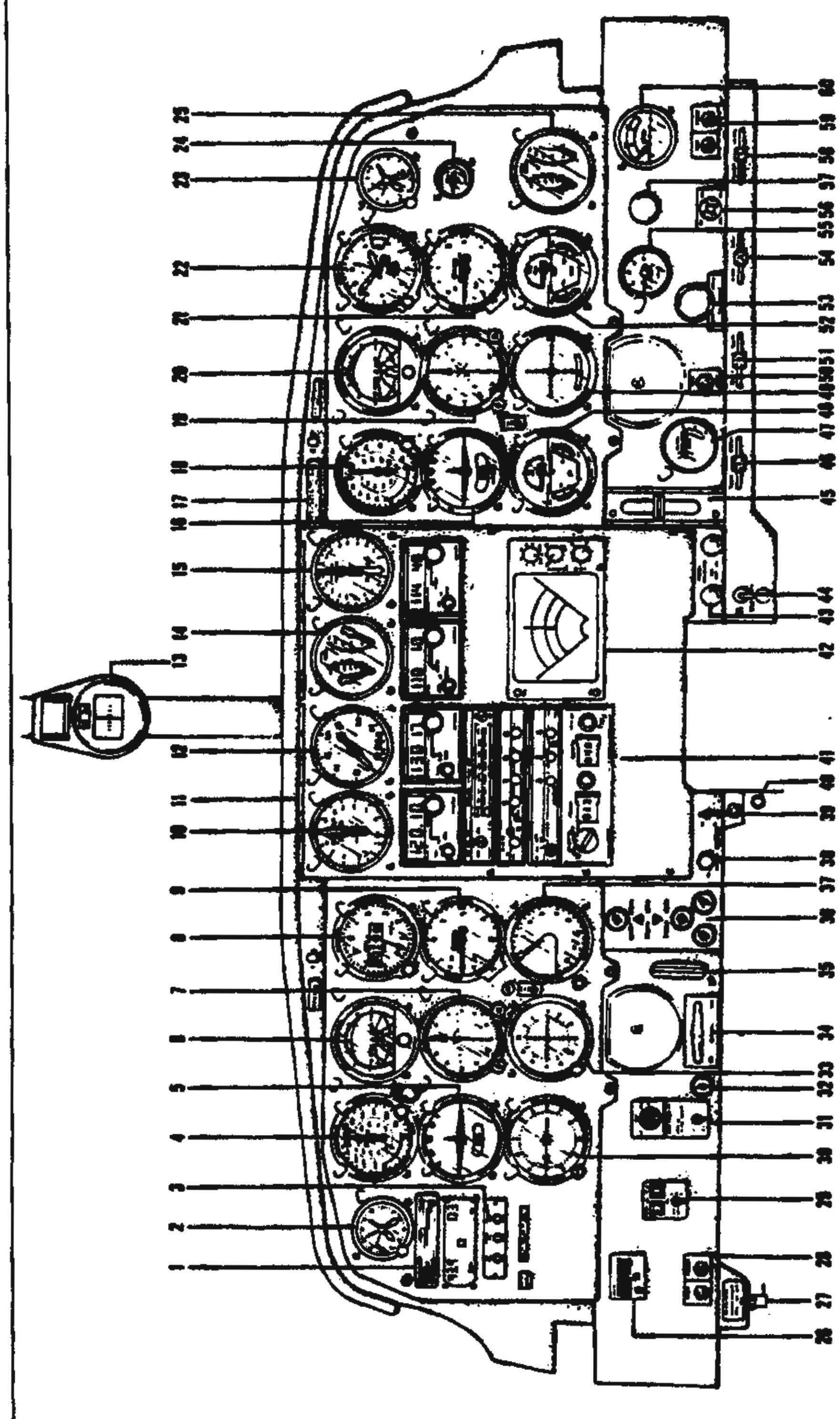
Pilot and copilot microphone and headphone jacks are mounted at the bottom of the left and right panel segments near the sidewalls. Autopilot controls and indicators are mounted below the control quadrant on the pedestal and on the left instrument panel segment.

Instrument lighting is provided by individual post lamps mounted adjacent to each instrument. These lights are controlled by a rheostat switch on the overhead panel. The lights illuminate by the first movement of the knob and intensity increases with further rotation. When copilot flight instruments are installed, a separate rheostat switch is mounted near the bottom of the right panel segment.



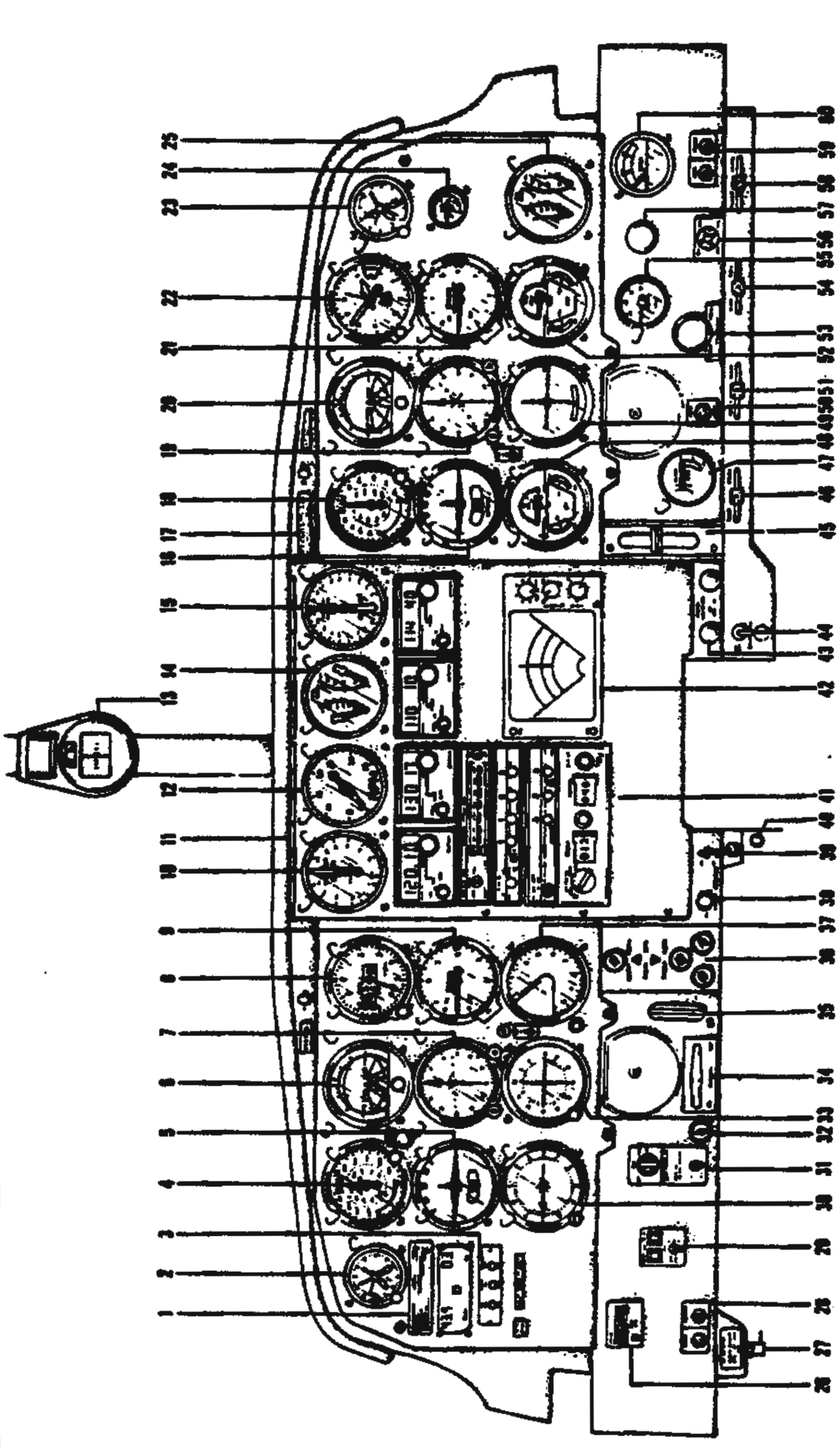
TYPICAL DUAL INSTRUMENT PANEL (SERIAL NUMBERS 31-7712001 THROUGH 7712103)

Figure 7-25



TYPICAL DUAL INSTRUMENT PANEL (SERIAL NUMBERS 31-7812001 THROUGH 31-7812129)

Figure 7-26



1. AIRSPEED PLACARD
2. CLOCK
3. DME
4. AIRSPEED INDICATOR
5. TURN AND BANK INDICATOR
6. ATTITUDE GYRO
7. DIRECTIONAL GYRO
8. ALTIMETER
9. RATE OF CLIMB INDICATOR
10. DUAL MANIFOLD PRESSURE GAUGE
11. ANNUNCIATOR PANEL
12. DUAL TACHOMETER
13. COMPASS
14. DUAL EGT GAUGE
15. DUAL FUEL FLOW GAUGE
16. TURN AND BANK INDICATOR - COPILOT
17. CATEGORY PLACARD
18. AIRSPEED INDICATOR - COPILOT
19. DIRECTIONAL GYRO - COPILOT
20. ATTITUDE GYRO - COPILOT
21. RATE OF CLIMB INDICATOR - COPILOT
22. ALTIMETER - COPILOT
23. CLOCK
24. GYRO PRESSURE GAUGE
25. DUAL FUEL PRESSURE GAUGE
26. EMERGENCY LOCATOR TRANSMITTER
27. ALTERNATE STATIC SOURCE VALVE
28. MIKE AND EARPHONE JACKS - PILOT
29. AUTOPILOT CONTROLS
30. ADF
31. WINDSHIELD WIPER CONTROL/ EMERGENCY BATTERY PACK
32. CIGAR LIGHTER
33. NAV 2
34. PARKING BRAKE
35. GEAR SELECTOR
36. GEAR INDICATOR LIGHTS
37. RADAR ALTIMETER
38. RADIO LIGHT SWITCH
39. AVIONICS MASTER SWITCH
40. PA VOLUME CONTROL/ON-OFF KNOB
41. AVIONICS
42. RADAR
43. MANUAL ALTERNATE AIR CONTROLS
44. HEATER CONTROL SWITCH
45. WING FLAP SELECTOR SWITCH
46. CABIN TEMP. CONTROL
47. WING FLAP POSITION INDICATOR
48. OIL PRESS., CYL. HEAD TEMP., AND OIL TEMP. - LEFT ENGINE
49. NAV 2 - COPILOT
50. FLAP TEST SWITCH
51. DEFROSTER CONTROL
52. OIL PRESS., CYL. HEAD TEMP., AND OIL TEMP. - RIGHT ENGINE
53. CABIN EXHAUST CONTROL KNOB
54. CABIN AIR CONTROL LEVER
55. OXYGEN SUPPLY PRESSURE GAUGE
56. PANEL LIGHTS SWITCH
57. OXYGEN CONTROL KNOB
58. COCKPIT AIR CONTROL LEVER
59. MIKE AND EARPHONE JACKS COPILOT
60. VOLTMETER

TYPICAL DUAL INSTRUMENT PANEL (SERIAL NUMBERS 31-7912001 AND UP)

Figure 7-26a

Pilot and copilot map lights are installed in the overhead switch panel and on the instrument panel to provide reference lighting during night operation. Two white map lights are mounted in the horizontal surface on the bottom side of the overhead switch panel. Separate on-off control switches are mounted above each light. A red (pilot) and a white (copilot) map light are mounted below the instrument panel eyebrow in the center of the right and left segments. A control switch is mounted on top of the panel eyebrow above each light.

An engine hour meter installed on the overhead switch panel records and presents the total hours of engine operation. A magnetic compass is mounted above the instrument panel on the windshield center post panel.

Various other standard and optional operational controls, switches and indicators for windshield wiper, parking brake, landing gear, manual alternate air, wing flaps, heating, ventilating, defrost and synchrophaser are mounted on the instrument panel.

Deviations in the location of certain instruments and gauges may result from the installation of optional avionics and radio packages.

7.24 ANNUNCIATOR PANEL (SERIAL NUMBERS 31-7812001 AND UP)

In Navajos with serial numbers 31-7812001 and up, warning lights are grouped together in an annunciator panel which extends across the upper center of the instrument panel. Monitored functions include the pneumatic system, low fuel flow, flap condition, alternator operation, and cabin and baggage door security. There are also provisions in the annunciator panel for the addition of warning lights for various optional systems.

To the left of the annunciator display is a press-to-test switch. When this switch is depressed while the master switch is ON, all lights on the annunciator panel should illuminate. Failure of a light to illuminate is an indication of a burnt out bulb or other annunciator system abnormality. The switch should be held for at least 3 seconds, as the low fuel warning light will take a few seconds longer than the others to illuminate and will remain lit for as long as 10 seconds after the others have extinguished. To the right of the annunciator display is a dimmer switch which raises or lowers the intensity of the lights in the display. During the press to-test procedure, the lights will test either bright or dim, depending upon the position of the dimmer switch. During daylight operations, the annunciator lights should be in the bright mode.

7.25 RADIO OPERATION

Electrical power for avionics equipment is controlled by a master switch located in the center of the instrument panel below the radios The audio control panel allows the pilot to select radio audio individually. This allows pre-setting of frequencies or volume and also provides the option of listening with either the speaker or the headphones.

On airplanes with serial numbers 31-7812002 and up, an Emergency Avionics Bus Power circuit breaker switch is located below the left circuit breaker panel. The switch is protected from inadvertent activation by a red switch guard.

In normal conditions, the switch is in the OFF position and the guard is closed. The ON position is for emergency use only and causes power from the primary bus to go directly to the number 1 avionics bus. In this configuration, number 1 avionics bus power is independent of the avionics master circuit breaker number 1.

NOTE

To avoid chatter in the speaker with the Emergency Avionics Bus Power ON, pull the avionics master number 1 circuit breaker before turning the Emergency Avionics Bus Power ON.

A PA volume control knob is mounted on the left side of the pedestal, below and forward of the propeller synchrophaser switch. The control is a rheostat providing variable volume control through the rear speaker system.

If operation with oxygen masks is required and the airplane is equipped with Collins radios and Scott Duo-Seal oxygen masks, communications between the pilot and copilot are possible through the headphones by selecting the PA mode and turning down the rear speaker volume. This will allow the pilot and copilot to communicate and still receive incoming communications.

A ground clearance energy saver system is available to provide direct power to Comm #1 without turning on the master switch. An internally lit pushbutton switch, located on the instrument panel, provides annunciation for engagement of the system. When the button is engaged direct aircraft battery power is applied to Comm #1 and audio amplifier (speaker). The system is reset to the OFF position by activating the aircraft master switch.

7.27 PITOT/STATIC SYSTEM

Dynamic and static air pressure for operation of the airspeed indicator is supplied by the pitot static system (Figure 7-27). The system also supplies static air pressure to the altimeter and the vertical speed indicator.

A heated pitot head is mounted under the nose section, forward of the nose gear doors. Total pressure is extracted by the pitot head and routed directly to the airspeed indicator. Provisions have been made for installation of an additional pitot head if dual instruments are desired. The second pitot head is mounted to the right of the existing head under the nose.

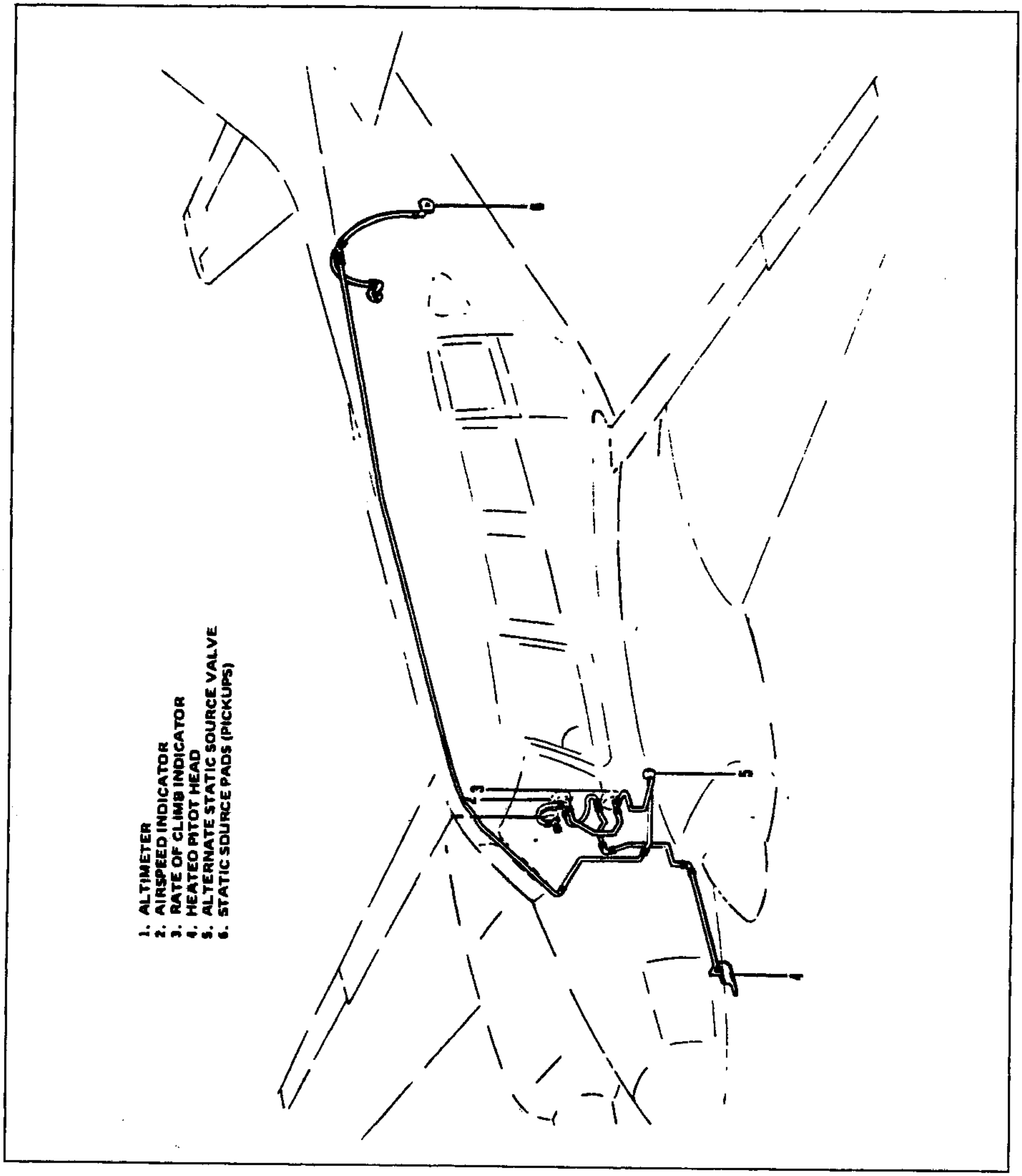
Static source pads (pickups) are located on both sides of the fuselage forward of the horizontal tail. They connect to a single line leading to the instruments. Dual pickups are provided to reduce side slip effects on the airspeed indicator.

An alternate static source valve is mounted below the left segment of the instrument panel near the pilot's left knee. To actuate, push the lever up and to the left, locking the valve in the open position. When the alternate static source is selected, the pilot's airspeed indicator, altimeter and rate of climb indicator utilize cabin air for static pressure. Under these conditions the altimeter and airspeed indicator readings will be higher than normal (refer to Section 5 - Performance for correction chart).

Pitot heat is provided to prevent ice accumulations from blocking the pitot head pressure inlet and restricting pressure to the airspeed indicator. Switches for the pitot heat are located in the circuit breaker control panel to the left of the pilot. Pitot covers are provided with each pitot head and should be installed when the airplane is parked to prevent bugs and rain from entering the pitot head. A partially or completely blocked pitot system will cause erratic or zero readings on the airspeed indicator.

NOTE

Before each flight, insure that pitot covers have been removed.



PITOT/STATIC SYSTEM

THIS PAGE INTENTIONALLY LEFT BLANK

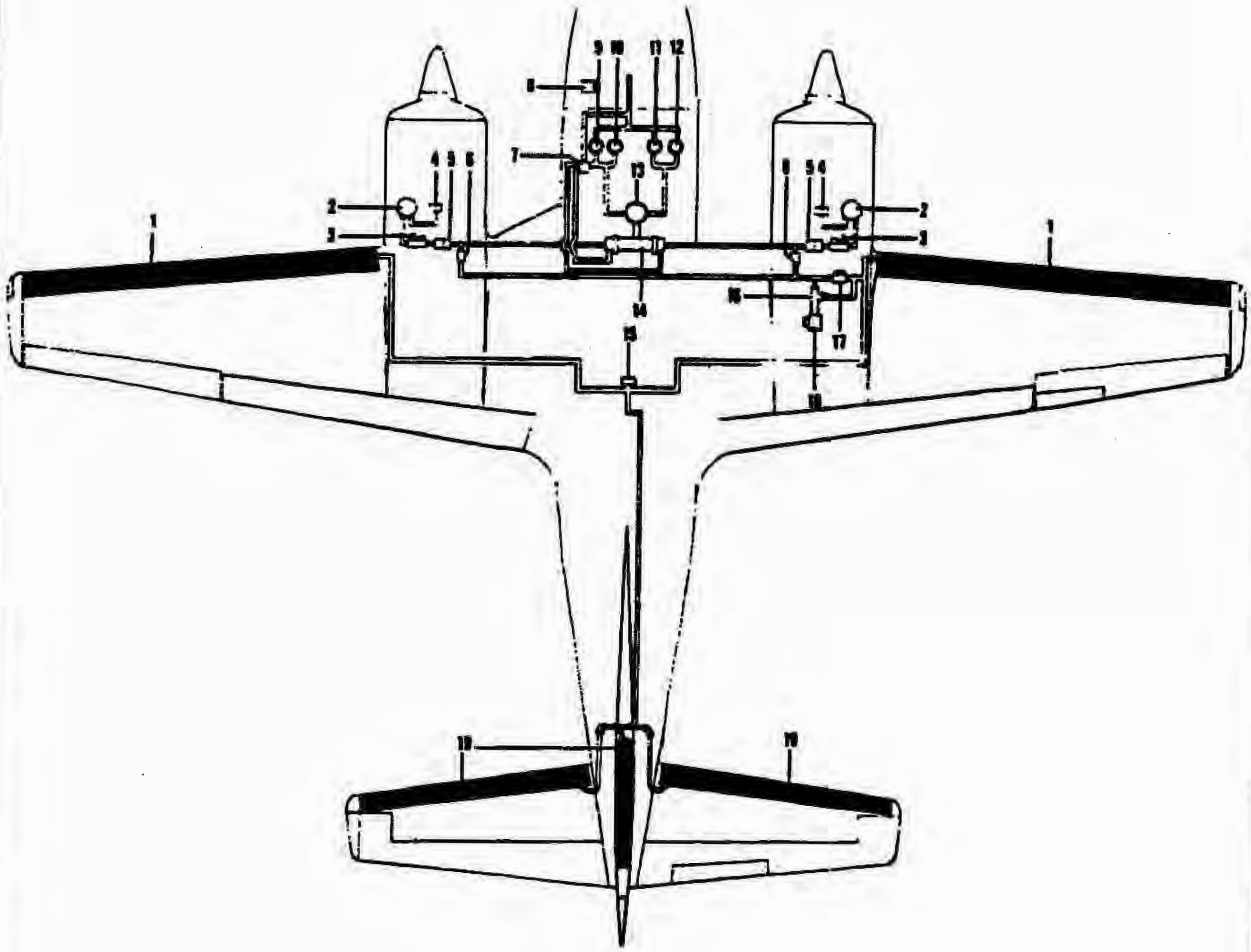
7.29 PNEUMATIC SYSTEM

The pneumatic system (Figure 7-29) supplies air pressure to operate the air driven gyros. Pressure is also supplied to the surface deicing boots when the wing and empennage deicing system (optional) is installed.

Basically, the pneumatic system is divided into two independently operated pressure supply systems: the left engine supply and the right engine supply. Both systems utilize a common manifold check valve and pressure gauge. Each side of the pneumatic system incorporates its own inlet, inlet filter, engine driven pneumatic pump, regulator and inline filter. Recessed inlets, just aft of the fire wall on the bottom-outboard side of the engine nacelle, extract constant supplies of outside air, which are passed through inlet filters and directed to the left and right engine driven pneumatic pumps. Air pressure from each pump is then routed to its respective pressure regulator. Each pressure regulator has its own adjustment to provide a means of setting the pump outlet pressure. Any airflow supplied by the pumps in excess of the adjusted setting is expelled from the system at the regulators. Regulated air pressure is then passed through a .3 micron inline filter for further protection against contaminated air reaching the instruments. Once filtered, pressure from the left engine supply and pressure from the right engine supply are united in a manifold check valve, common to both sides of the system. The manifold check valve supplies a single outlet line to the gyros. In the event one of the engine driven pneumatic pumps fail, the other side of the system can still supply air pressure to the gyros and/or deicers. Air pressure supplied by the system is utilized to operate the attitude gyro and the directional gyro and exhausted through a bulkhead forward of the instrument panel.

Each pressure pump is capable of operating the air driven gyros and the pneumatic deicers up to single engine service ceiling and with both pumps operating normally, up to the maximum approved altitude of the airplane.

A gyro pressure gauge, mounted in the right segment of the instrument panel, indicates system pressure in inches of mercury. A graduated green arc on the face of the gauge indicates pressure readings within normal operating limits. Two indicator lights, mounted in the left segment of the instrument panel, provide a visual warning to the pilot that either the right or left pneumatic source is inoperative. The lights are placarded, "RIGHT PNEU. SOURCE MALFUNCTION" and "LEFT PNEU. SOURCE MALFUNCTION."



1. WING DEICING BOOT
2. PNEUMATIC PUMP
3. DUAL REGULATOR
4. INLET AIR FILTER
5. INLINE FILTER
6. CHECK VALVE
7. PRESSURE GAUGE
8. DEICER CYCLE TIMER
9. DIRECTIONAL GYRO - PILOT
10. ATTITUDE GYRO - PILOT
11. DIRECTIONAL GYRO - COPILOT
12. ATTITUDE GYRO - COPILOT
13. PNEUMATIC PRESSURE REGULATOR (RELAY VALVE)
14. MANIFOLD CHECK VALVE
15. PRESSURE SWITCH
16. EJECTOR
17. CONTROL VALVE
18. DEICER DUMP VALVE
19. EMPENNAGE DEICING BOOT

PNEUMATIC/WING AND EMPENNAGE DEICING

7.31 WING AND EMPENNAGE DEICING*

Pneumatic wing and empennage boots are installed on the leading edges of the wings, the vertical stabilizer (fin) and the horizontal stabilizer. A constant suction is applied to all of the surface deicer boots by an ejector to provide smooth streamlined leading edges during normal operation with the deicing system off. The ejector assembly utilizes air pressure supplied by the pneumatic system in conjunction with a venturi to obtain vacuum suction to hold the boots in the flat, deflated condition.

The deicing system is controlled by a "momentary on" type control switch located in the circuit breaker control panel to the left of the pilot's seat. When this "WING DE-ICE" switch is actuated, the boots perform one complete inflation cycle. The switch must be actuated for each additional inflation cycle. This allows the pilot to manually select boot inflation in any desired time interval, should icing conditions require. After each inflation cycle, the timer automatically resets to allow the inflation cycle to begin when the switch is actuated.

Actuation of the switch activates a system cycle timer which energizes the pneumatic pressure control valves to control the pneumatic pump pressure to boot pressure for approximately six seconds. The boot solenoid valves are activated, suppressing the suction, and boot system pressure is released to the boots, inflating all pneumatic deicers on the airplane.

A blue indicator light, with press-to-test and dimming features, illuminates when the surface deicer boots innate to a predetermined pressure. Illumination of the indicator light is controlled by a pressure sensitive switch connected to the deicer pressure lines.

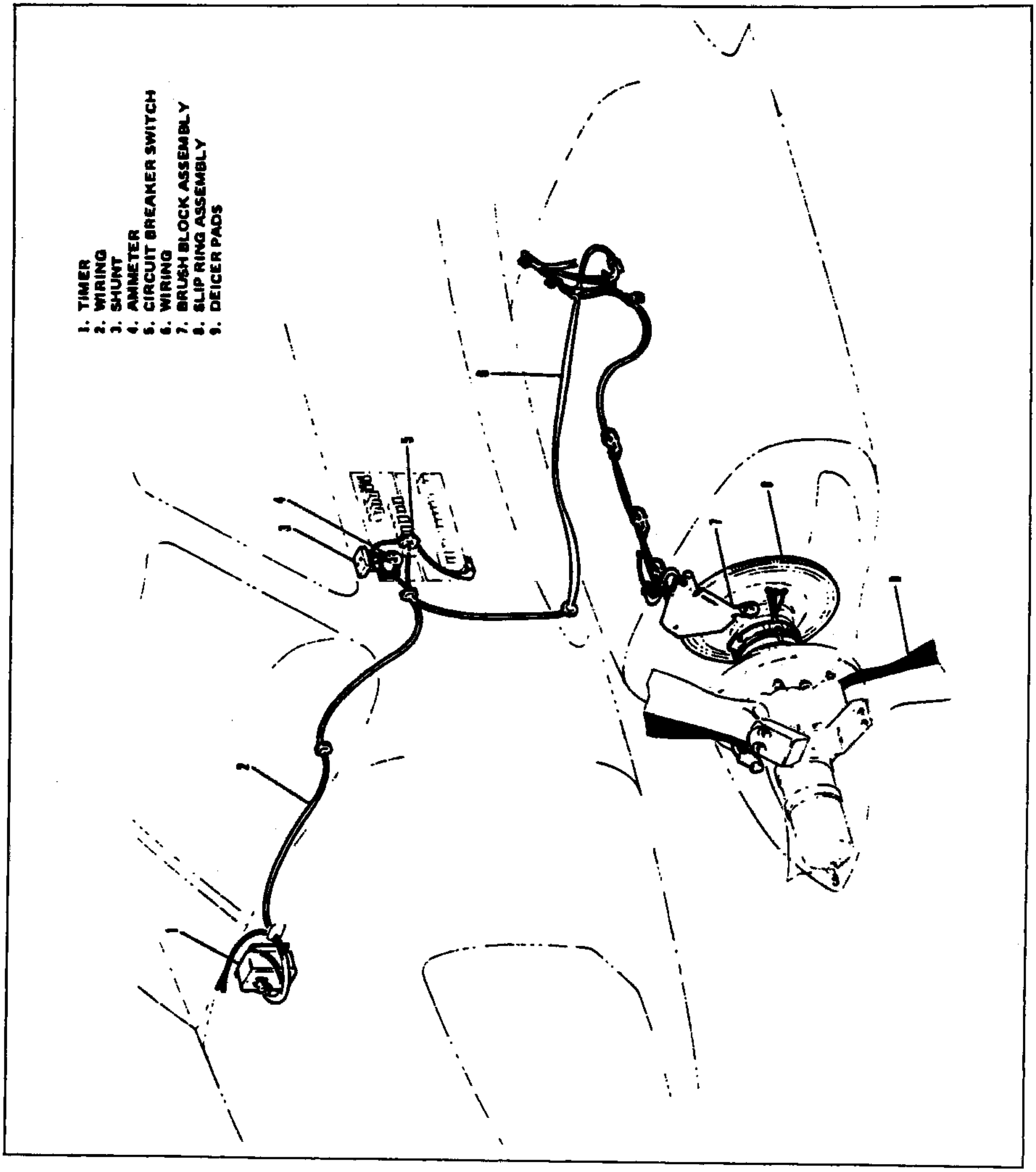
When the inflation cycle is complete, the deicer solenoid valves permit overboard exhaustion of the pressurized boots. Suction is then reapplied to the deicer boots to hold them close to the airfoil surface.

A pneumatic pressure regulator, installed with the deicing system, is connected to the outlet line from the manifold check valve in the pneumatic system. This valve automatically stops the airflow to the copilot gyros when the deicing system is activated. After the deicing system inflation cycle is complete, air pressure is returned to the copilot gyros. Pilot and copilot gyro pressure adjustments are also provided by this pneumatic pressure regulator. If copilot gyros are not installed, this feature of the regulator is not used. The airflow to the copilot's gyros is interrupted during deicer boot performance during single engine operation.

7.33 ICE DETECTION LIGHTS*

Wing ice may be detected during night flight with the use of an ice detection light installed in the outboard side of the left engine nacelle. The light is controlled by a "WING INSPECTION" switch mounted in the circuit breaker panel to the left of the pilot. Circuit protection for the ice detection light system is provided in the panel by a push-to-reset circuit breaker.

*Optional equipment



ELECTRIC PROPELLER DEICING SYSTEM

Figure 7-31

7.35 ELECTRIC PROPELLER DEICERS*

Electrothermal propeller deicer pads are bonded to the leading edges of the propeller blades. Each deicer pad has two separate heaters, one for the outboard and one for the inboard half. (Refer to Figure 7-31.)

The system is controlled by an on-off type "PROP DE-ICE" circuit breaker switch in the circuit breaker control panel. When the switch is actuated, power is supplied to the system timer. The "PROP DE-ICER" ammeter is connected in series between the switch and the timer to monitor the current through the propeller deicing system. With the propeller deicing system "ON," the ammeter needle should be within the green arc on the face of the ammeter for a normal reading.

Power from the timer is cycled to brush assemblies which distribute power to modified starter ring gears incorporating slip rings. The current is then supplied through the slip rings directly to the electrothermal propeller deicer pads.

Deicing is accomplished by heating the outboard and then the inboard half of the deicer pads in a sequence controlled by the timer. The heating sequence of the deicer pads is according to the following cycle:

a. Outboard halves of the propeller deicer pads on the right engine. (30 seconds)
b. Inboard halves of the propeller deicer pads on the right engine. (30 seconds)
c. Outboard halves of the propeller deicer pads on the left engine. (30 seconds)
d. Inboard halves of the propeller deicer pads on the left engine. (30 seconds)

When the system is turned on, heating may begin on any one of the above steps, depending upon the positioning of the timer switch when the system was turned off from previous use. Once begun, cycling will proceed in the above sequence and will continue until the system is turned off.

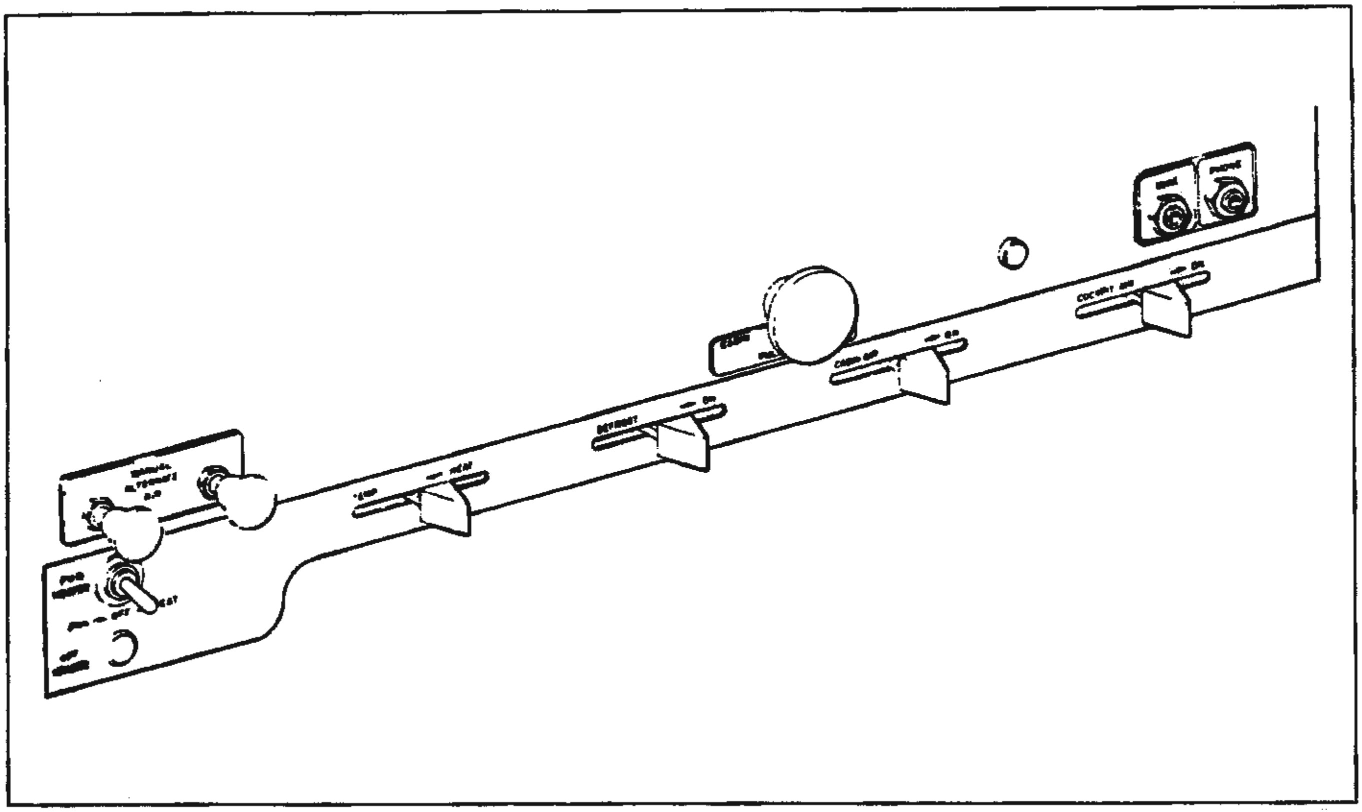
A preflight check of the propeller deicers can be performed by turning the "PROP DE-ICE" switch on and feeling the deicer pads for proper heating sequence. The deicer pads should be warm to the touch. A less vigorous test can be made by turning the switch on and off four times and noting that the ammeter needle goes to the green arc each time.

The heat provided by the deicer pads reduces the adhesion between the ice and the propeller so that centrifugal force and the blast of airstream cause the ice to be thrown off the propeller blades in very small pieces. This ice can produce minor damage to the fuselage if ice shields* have not been installed.

CAUTIONS

When conducting the above described ground test, do not operate system longer than two complete cycles.

If the ammeter reading is less than in the green arc this indicates that one or more of the pads is not functioning. If propeller deice is used under this condition the pilot can expect an uneven build up of ice with consequent undesirable vibration.



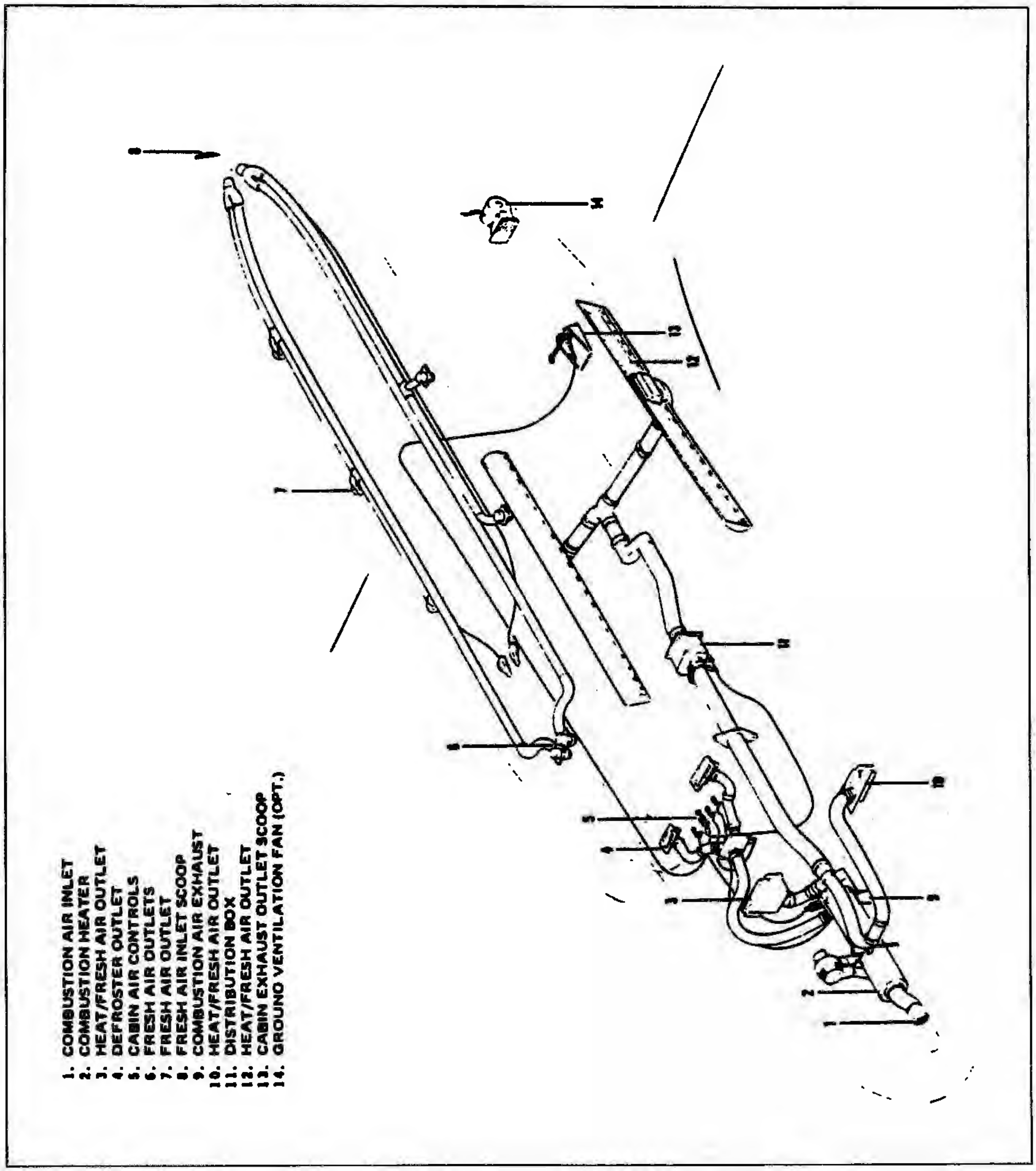
CABIN AIR CONTROL PANEL
Figure 7-33

7.37 HEATING, VENTILATING AND DEFROSTING

Controls to regulate cabin air temperature and provide fresh air ventilation and heated air for defrosting are mounted in the cabin air control panel below the right segment of the instrument panel (Figure 7-33). They include a three position forward heater switch and temperature, defroster, cabin air and cockpit air control levers. A cabin exhaust control is mounted directly above the cabin air control panel. Provisions for mounting an aft heater (optional) switch have also been made on the panel.

The heating system (Figure 7-35) is designed to provide maximum comfort for the occupants during winter and cool weather flights. A 35,000 B.T.U. Janitrol combustion heater furnishes the hot air source for cabin heating and windshield defrosting. The heater is mounted in the nose section and is accessible through a removable panel on the right side.

Operation of the heater is controlled by the "FWD HEATER" switch. The forward heater switch has three positions: "FAN," "OFF," "HEAT." Selection of the "HEAT" position activates the heater regulator/shutoff valve, allowing fuel to flow from the selected right fuel cell to the combustion heater, and simultaneously ignites the heater.



HEATING, VENTILATING, AND DEFROSTING

Figure 7-35

A recessed inlet in the bottom right side of the nose section supplies a constant source of outside air for operation of the combustion heater. Air from the inlet passes through the combustion heater to a distribution box and then to the heater outlets and/or the defroster outlets, depending upon the positions selected on the control panel. Heat outlets are mounted in the cockpit and cabin areas, furnishing a complete interior heat flow. Cockpit heater outlets are forward and below the instrument panel and cabin heater outlets are along the floor on the left and right sides of the fuselage. Two defroster outlets are mounted in the cover atop the instrument panel to allow an even airflow to each windshield. Interior hot air regulation is controlled by the "TEMP" control lever mounted in the cabin air control panel. To increase the cockpit and cabin air temperature, move the lever to the right. Defroster air is turned on by moving the "DEFROST" lever in the cabin air control panel to the right. Air from the distribution box is ducted directly to the defroster outlets; thus, the defroster control should be turned on full (far right) until the windshield is defrosted and then moved toward the off (far left) position until just enough air is flowing to keep the windshield defrosted.

Windshield defrosting can be regulated by various settings of the defroster lever. In severe windshield fogging or icing conditions it may be necessary to restrict the heater air, since this will drive more air through the defroster outlets.

Since the combustion heater utilizes fuel extracted from either right fuel cell, it will not operate with the right engine secured and the fire wall shutoff valve off. To operate the heater with the right engine shut down, select a left tank, turn the crossfeed on, move the right engine mixture control to idle cut-off, open the right fuel shutoff valve (down), turn the left emergency fuel pump on and the right fuel tank selector off.

CAUTION

The fuel crossfeed should not be used to operate the heater with the right engine shut down if the engine was shut down due to an emergency situation such as a fuel leak or fire.

Heat may be supplied to warm the cabin before engine start by turning on the master switch, moving the mixture control to idle cut-off, turning on the right emergency fuel pump and starting the heater. This operation should not be performed in such a manner as to deplete the battery.

A circulating fan is attached to the inlet end of the combustion heater. This fan is partially controlled by a landing gear safety (squat) switch during ground operation. When the three position heater switch is turned to "HEAT," the circulating fan automatically draws outside air from the inlet for heater operation (ground operation only). Selection of the "FAN" position will also operate the heater circulating fan. This position allows air circulation through the heater ducts and windshield defogging on the ground when heat is not desired. The "FAN" position of the heater switch is also used for heater cooling to prevent the heater duct limit switch from tripping after use on the ground. When the combustion heater is turned off after use on the ground, the switch should be turned to the "FAN" position for a few minutes to cool the heater before the master switch is turned off. When the heater is turned off during flight it is not necessary to select the "FAN" position due to the automatic heater cooling provided by inlet air.

The heater is protected from overheating by a heat limit switch. If the heater temperature reaches a predetermined setting, the limit switch opens and the heater becomes inoperative. The switch is provided with a manual reset button. To reset, remove the access panel on the right side of the nose. The reset button is red and is located on the top rear of the heater. Push the button to reset. If after resetting the button, the heater does not operate, have the heater system checked by a mechanic.

Cabin temperature and air circulation can be maintained by using various combinations of control settings to suit individual desires. To minimize the feeling of drafts, a low airflow-high heat combination should be used.

"CABIN AIR" and "COCKPIT AIR" control levers mounted in the cabin air control panel allow independent selection of cooling air to the cabin and cockpit areas. Movement of either lever to the right increases the amount of fresh air to the cabin or cockpit during flight or on the ground. When cooling air is desired on the ground, the "FAN" position of the heater switch must be selected and the control levers moved toward the on position (far right). During flight, the heater air inlet provides a constant supply of ram air to the distribution box. By selecting the "OFF" position of the heater switch and moving the "COCKPIT AIR" and/or "CABIN AIR" levers to the right, fresh air is distributed through the heater ducts for cockpit and cabin cooling.

Individual fresh air outlets are provided by the overhead ventilating system to provide maximum in-flight cabin and cockpit ventilation. An air scoop, mounted on the tail fin fairing, extracts outside air which is passed through lines under the headliner and released at the outlets. Left and right master controls for overhead ventilation are mounted on the pilot's speaker-light panel. Each of the individual outlets, located above the seats, are adjustable to the desired airflow setting.

A cabin exhaust is located in the raised floor panel in the aft cabin area to aid air distribution within the cabin. A retractable exhaust outlet is located in the lower aft section of the fuselage just aft of the main cabin door. Retraction or extension of the outlet is controlled by the "CABIN EXHAUST" push-pull knob mounted above the cabin air control panel on the instrument panel. To extend the outlet, allowing cabin air exhaustion, pull out on the control knob. The outlet should be open when the heater is operating and, if desired, to facilitate cabin ventilation. A ground ventilation fan is available for installation into the cabin exhaust system as optional equipment.

7.39 GROUND VENTILATION FAN*

To aid in cabin ventilation during ground operation, a ground ventilation fan is installed aft of the cabin exhaust in the raised floor panel in the aft cabin area. An on-off control switch labeled "GROUND VENT FAN" is mounted in the circuit breaker control panel. The fan extracts air from beneath the cabin floorboards and expells it into the cabin through the ventilating grill.

*Optional equipment

7.41 AFT CABIN HEATER*

In addition to the standard combustion heater mounted in the nose section, an aft cabin heater can be installed at the aft cabin bulkhead as optional equipment to provide an even hot air distribution through the cabin.

The 35,000 B.T.U. Janitrol combustion heater utilizes an electric fuel pump, independent from the standard fuel system, to extract fuel through a tee fitting in the fuel line from the right fuel cells. If the fuel supply in the right cells is exhausted the aft cabin heater will not operate.

Operation of the heater is controlled by a three position "AFT HEATER" switch mounted in the cabin air control panel directly below the "FWD HEATER" switch. The three positions are "FAN," "OFF" and "HEAT." Selection of the "FAN" position activates the ventilating fan within the heater inlet. This position should be used to cool the heater after use to prevent the heat limit switch from tripping. Also, the "FAN" position can be used to recirculate cabin air when heat is not desired. Air is extracted from the cabin in the rear baggage compartment through an inlet on the right side, passed through the heater and released into the cabin at an adjustable outlet on the opposite side of the baggage compartment. Outside air, for heater operation within the combustion chamber, is drawn through an inlet on the bottom of the fuselage by the heater blower (separate from the heater ventilating fan). The air is used for heater combustion and expelled overboard through a heater exhaust outlet to the left of the inlet.

Selection of the "HEAT" position automatically activates the heater fuel pump and ignition occurs instantly. The off position automatically shuts off the fuel to the heater. Since the aft heater does not incorporate a temperature control, the pilot must manually regulate the amount of heat through the use of the three position switch.

Circuit protection for the aft cabin heater system is provided by a push-to-reset type circuit breaker mounted in the circuit breaker control panel labeled "AFT HEATER."

CAUTION

Do not hang heat sensitive materials on clothes rack during rear heater operation (see placard in rear baggage compartment).

*Optional equipment

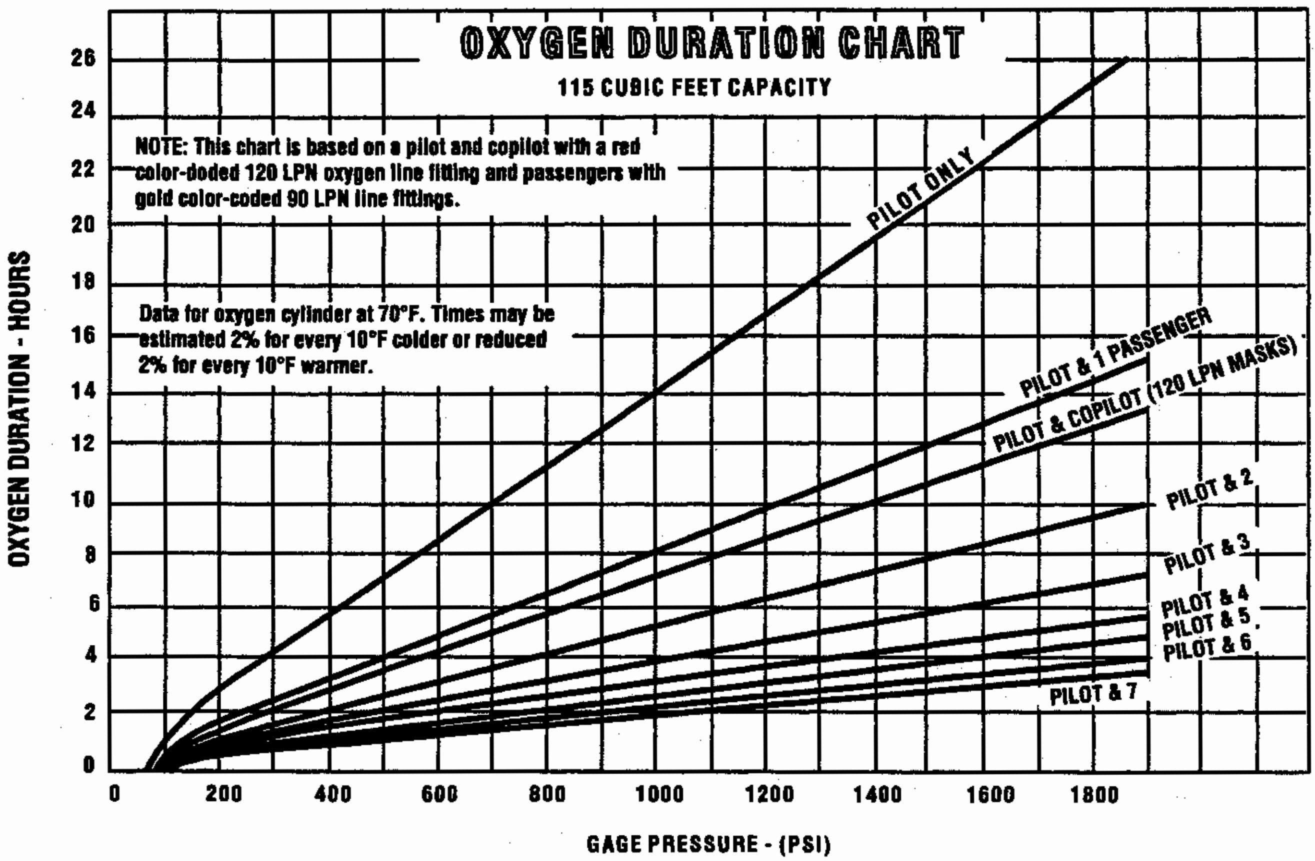
7.43 OXYGEN SYSTEMS*

An oxygen system designed to provide supplementary oxygen for the crew and passengers during high altitude flights (above 10,000 ft.) is available as optional equipment on the PA-31 Navajo. All components are light weight and compactly installed throughout to provide a completely built-in system with maximum efficiency and safety. The major components of the Scott oxygen system (Figure 7-39) consist of a 115 cubic foot oxygen cylinder, an oxygen supply gauge, a flow control knob, a pressure regulator and eight plug-in receptacles.

All of the oxygen plug-in receptacles, conveniently incorporated into the headliner panels, are also on-off valves. The oxygen cylinder is mounted aft of the forward baggage compartment or aft of the aft baggage compartment. When fully charged, the cylinder contains oxygen at a pressure of 1850 pounds per square inch at 70° F. The pressure regulator is mounted directly to the oxygen cylinder. A constant indication of the total cylinder pressure is presented by the oxygen supply gauge mounted on the lower right side of the instrument panel. The oxygen flow control knob labeled, "PULL-ON" is mounted to the right of the supply gauge on the instrument panel.

Before taking off for high altitude flying, determine that the oxygen supply is adequate for the proposed flight and that passengers are briefed (refer to Figure 7-37). When oxygen is required, pull the control knob aft (ON position), allowing oxygen to flow from the cylinder through the connecting tubing and into the receptacles. To use the oxygen supplied to the receptacles, connect a constant flow mask fitting into the receptacle and don the mask. When the fitting is connected, the on-off valve feature of the receptacle automatically releases an oxygen flow to the mask. A flow indicator in the hose of the mask shows oxygen flow to the mask by the absence of the red pellet, which is forced toward the mask. The pilot's, copilot's and the passengers' masks are stowed under their respective seats. A mask for the eighth seat is stowed behind the seat.

*Optional equipment



OXYGEN DURATION CHART

Figure 7-37

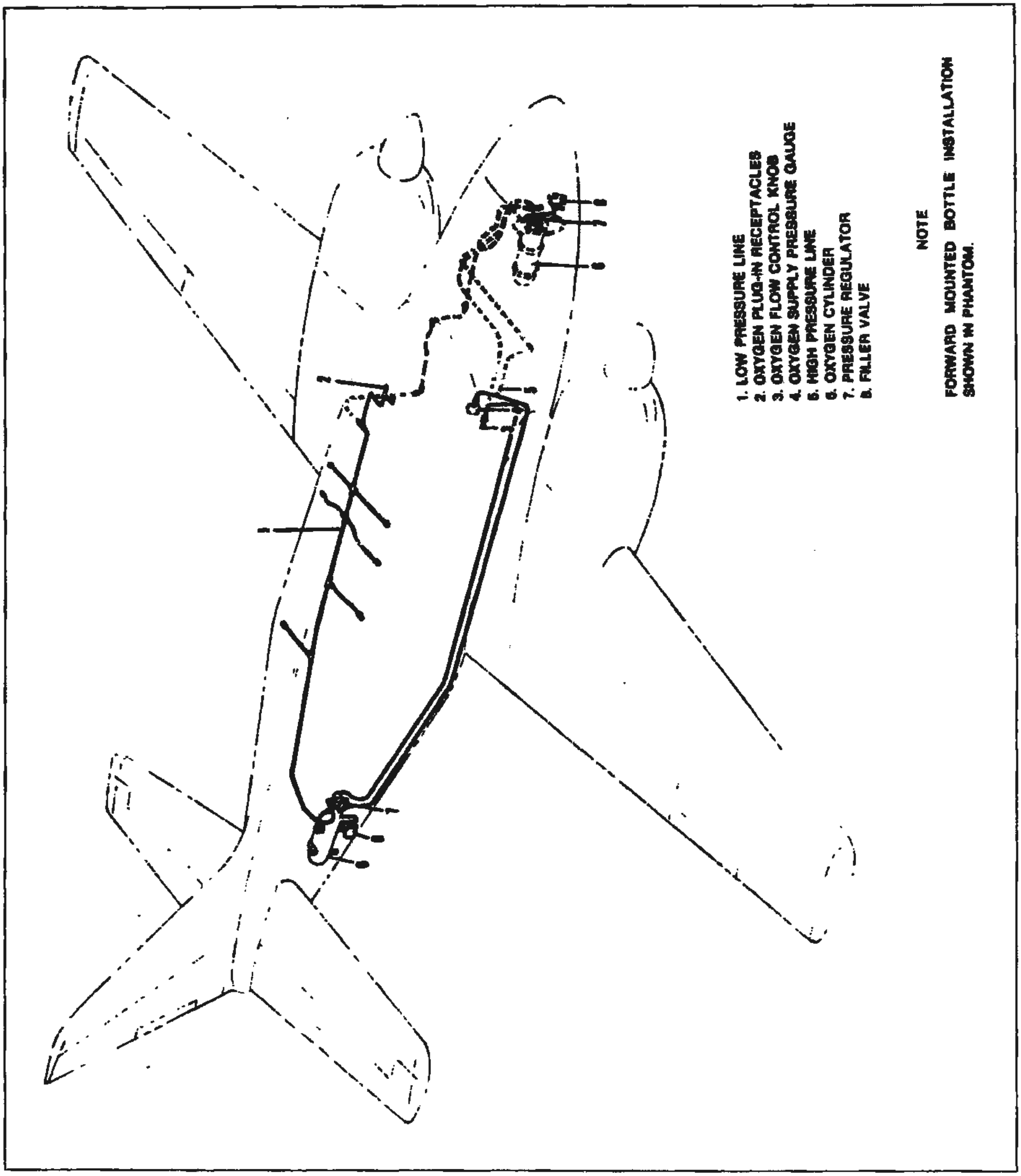
Always remove fittings from the receptacles and stow the masks when not in use. Oxygen will flow through the mask whenever the fitting is in the receptacle, and the control knob is pulled out (ON position). Masks may become damaged if not properly cleaned and stowed after use.

The pilot's mask (identified by a red band on the supply hose) supplies 120 liters of oxygen per hour and the passengers masks (identified by a gold band on the supply hose) supply 90 liters of oxygen per hour. (Refer to Section 9 - Supplements for oxygen requirements and procedures.)

CAUTION

Postively NO SMOKING while oxygen is being used by anyone in the airplane.

To avoid fire keep oil, grease, hydraulic fluid, paint, and other inflammable materials away from oxygen equipment.



OXYGEN SYSTEM

7.45 CABIN FEATURES

The cabin interior has been designed for multi-purpose use. Standard seating includes two pilot seats and reclining, adjustable passenger seats, each equipped with adjustable headrests and two armrests. All passenger seats have folding armrests on the aisle side and a continuous armrest along the wall of the cabin. Ash trays, individual reading lights, ventilation controls, pilot and copilot map lights and cigar lighter are also standard cabin features.

CAUTION

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

Two additional passenger seats can be installed for increased passenger capacity. The standard seats are track mounted to allow movement fore and aft and are easily removed for cargo loading or reversed (refer to Section 2 - Limitations for requirements on certain seating arrangements). Pilot and copilot seats are adjustable fore and aft, up and down and to a reclining position. The hand lever nearest the floor allows the seat to move fore and aft; the center handle controls the movement up and down, and the smaller top handle allows the seat to be reclined. To adjust the seat fore or aft, pull up on the handle and move the seat to the desired position; then release the handle. Move the seat slightly to insure that the locking pin is engaged in the seat track or until the pin engages into the track. To raise the seat, relieve some of the weight on the seat, pull the handle and the seat will rise. Raise the handle and apply weight to the seat to lower it to the desired position. Make sure the locking pin engages the vertical track when the handle is released after adjustment. Adjusting the seat to a reclining position is accomplished by pulling on the handle, applying pressure to the back of the seat and releasing the handle. To erect, pull forward on the seat back.

All seats are equipped with safety belts. Optional shoulder harnesses are also available for the crew seats. To use, the shoulder harness should be routed over the shoulder nearest the window and latched when the safety belt is latched. Self adjusting inertia reels are standard with the shoulder harnesses. The inertia reels allow the shoulder harness to expand or retract during normal movement; the strap locks securely in place under a sharp forward force. This locking feature prevents the harness from extending and holds the user in place. Operation of the inertia reel can be checked by pulling sharply on the shoulder strap. This test should lock the reel in place and prevent the harness from being extended. Shoulder harnesses should be routinely worn during takeoffs, landings and emergency situations.

For passengers' convenience utility pockets are attached to the backs of the passengers' seats. A flashlight is clipped to the oxygen mask container beneath the pilot's seat.

Additional cabin features include sun visors, storm windows in both the pilot's and copilot's side windows, and pilot and copilot ash trays. "NO SMOKING" and "FASTEN SEAT BELT" lighted signs, installed overhead in the cabin, are controlled by switches in the cockpit.

Optional features include choice of interior, front and rear cabin dividers, toilet, fire extinguisher, folding table, refreshment center, tinted windows, cargo net, clothes hanger support bars, curtains and individual oxygen masks.

For added pilot convenience, a map clip can be attached to the pilot's control wheel as optional equipment.

The interior is available in a choice of fabric vinyls or leather in a variety of colors. Scotchguard fabrics are used throughout, and with the blend of vinyls or leather, gives long wear and comfort.

7.47 BAGGAGE AREA

There are two large baggage compartments: one in the nose section, and one aft of the main cabin door. The spacious cabin can be quickly converted into a complete cargo area.

The forward baggage compartment in the nose section has a loading capacity of 150 lbs and a volume of 14 cubic feet. Access to the spacious compartment is gained through a large hinged door on the left side of the nose. A placard on the inner side of the door clearly indicates the maximum allowable baggage weight. To open, unlock, push in on the forward end of the door handle, pull out on the aft end and raise the door until it latches in the up position, to lower, the latch (placarded "PUSH TO RELEASE") must be pushed in, the door lowered and the handle pushed in and locked. The nose compartment is equipped with a courtesy light for night loading. This light will illuminate even if the master switch is off.

Access to the aft baggage compartment is gained through the main cabin entrance door or, if installed, a cargo doors* mounted aft of the main cabin door. The compartment has a volume of 22 cubic feet and will accommodate up to 200 lbs of cargo. The complete area is finished to match the cabin interior, including carpeting, fabric and leather or vinyl upholstering. A placard attached to the walnut panel in the rear of the compartment indicates the maximum loading capacity of the aft compartment. The compartment is conveniently accessible from the cabin even in flight.

Baggage tie down straps should be used in all baggage areas for safe and secure stowage of baggage.

When the cargo barriers* is installed, an additional placard is located in the aft baggage compartment which completely defines the cargo loading for the airplane. This optional installation includes cargo rollers, tie down straps, cargo net, equipment container and a cargo blanket.

NOTE

It is the pilot's responsibility to insure that the airplane is properly loaded and that the airplane C.G. falls within the allowable C.G. range (refer to Section 6 - Weight and Balance).

*Optional equipment

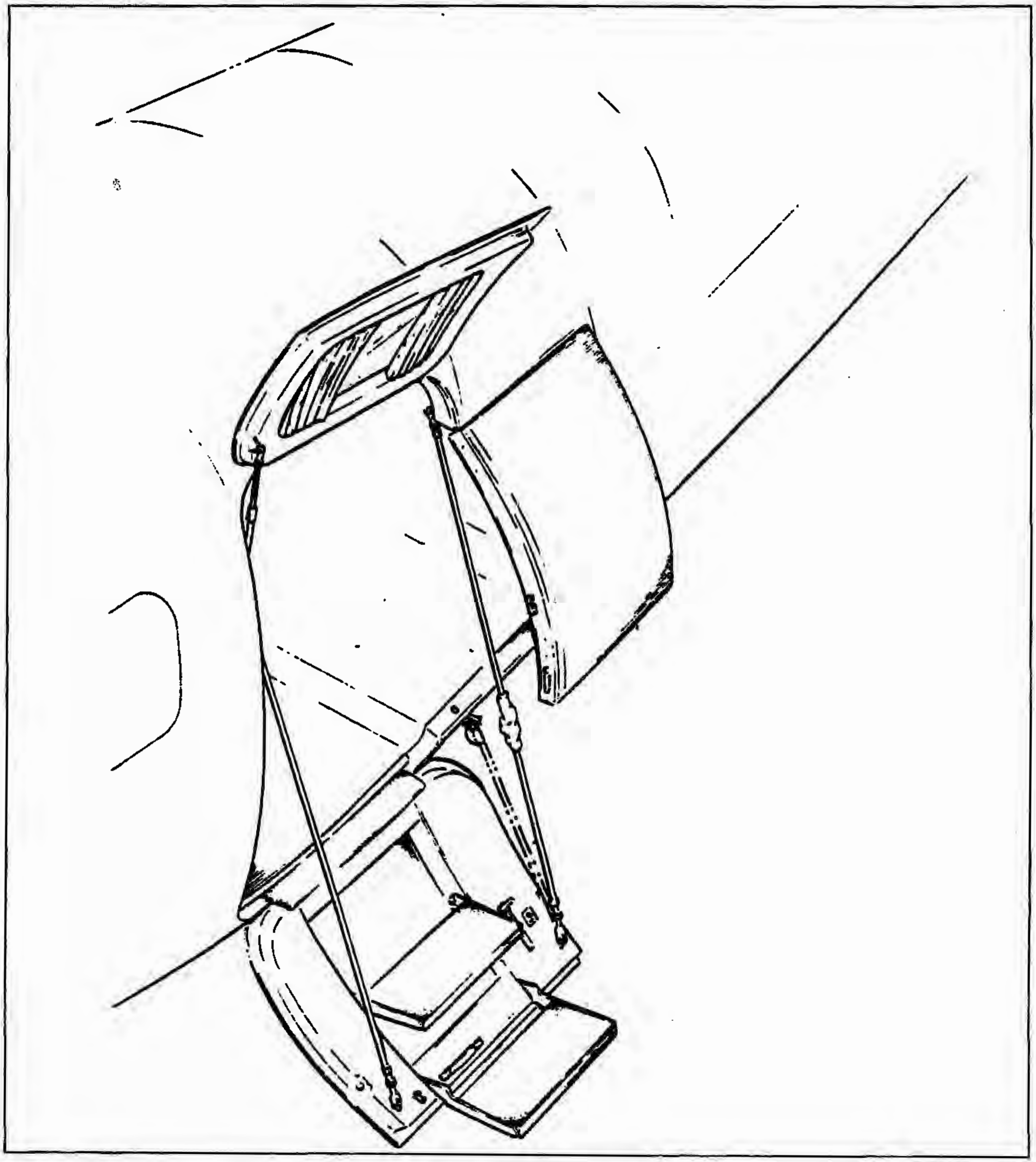
7.49 CARGO DOORS*

A large cargo door can be installed adjacent to the main cabin entrance door to facilitate loading of the aft baggage compartment (refer to Figure 7-41). The door latch handle, mounted in the forward side of the door, is revealed by opening the cabin entrance door. To open the cargo door, pull down on the top of the handle and raise the door until it latches in the up position. The additional width and height of the fuselage opening will allow convenient unhindered loading of bulky items. To lower the door, push up on the knurled knob on the door support arm, lower the door and push in on the bottom of the door handle until it latches securely to the fuselage.

The aft main cabin entrance door support cable is provided with fitting which enables it to be detached in the center. After the cable is separated the lower portion of the cable can be attached to the eye bolt fitting on the fuselage. This feature provides an unobstructed fuselage opening for loading cargo.

When the optional cargo door is installed, the standard, triangular shaped aft window in the left side of the fuselage is deleted. The interior of the cargo door is deeply upholstered to match the interior styling of the cabin.

*Optional equipment



CABIN ENTRANCE DOOR AND CARGO DOOR
Figure 7-41

7.51 PILOT'S DOORS*

The pilot door installation provides direct access to the pilot compartment from the left side of the fuselage. This feature permits convenient pilot entry when the cabin area is loaded with cargo.

The door incorporates the pilot's side window and storm window. A door handle, theft lock and latching mechanism are provided on the inside of the pilot's door to maintain a secure theft-proof cockpit (Figure 7-43). To open the door from within the cockpit, release the latch on the bottom edge of the door and move the door handle to the "OPEN" position (aft). This will allow the door to be pushed out and forward until it latches in place. The door is held in place by a support arm which must be released before the door can be closed. This is accomplished by pushing upward on the adjustment knob attached to the support arm.

The theft lock is an integral part of the main latching mechanism. This locking device is intended for ground purposes only, and should be unlocked prior to flight to allow the door to be opened from the outside in the event of an emergency landing.

To open the pilot's door from outside the airplane, turn the door handle counterclockwise and pull out on the door. If the theft lock is pushed, or the door was previously locked from the outside, the key provided with the airplane must be used to unlock the door before opening.

7.53 FINISH

All aluminum sheet components of the PA-31 Navajo are carefully finished inside and out to insure maximum service life. Both sides of all pieces are alodine treated and sprayed with zinc chromate primer to prevent corrosion of all structural and non-structural parts. The exterior surface of the airplane is coated with durable acrylic lacquer in a variety of tasteful colors and color combinations to fulfill the desires of each individual owner. To keep the new look, economy sized "Touch-Up" spray cans of matching colors are available from Piper dealers.

7.55 NUMBER PLATES

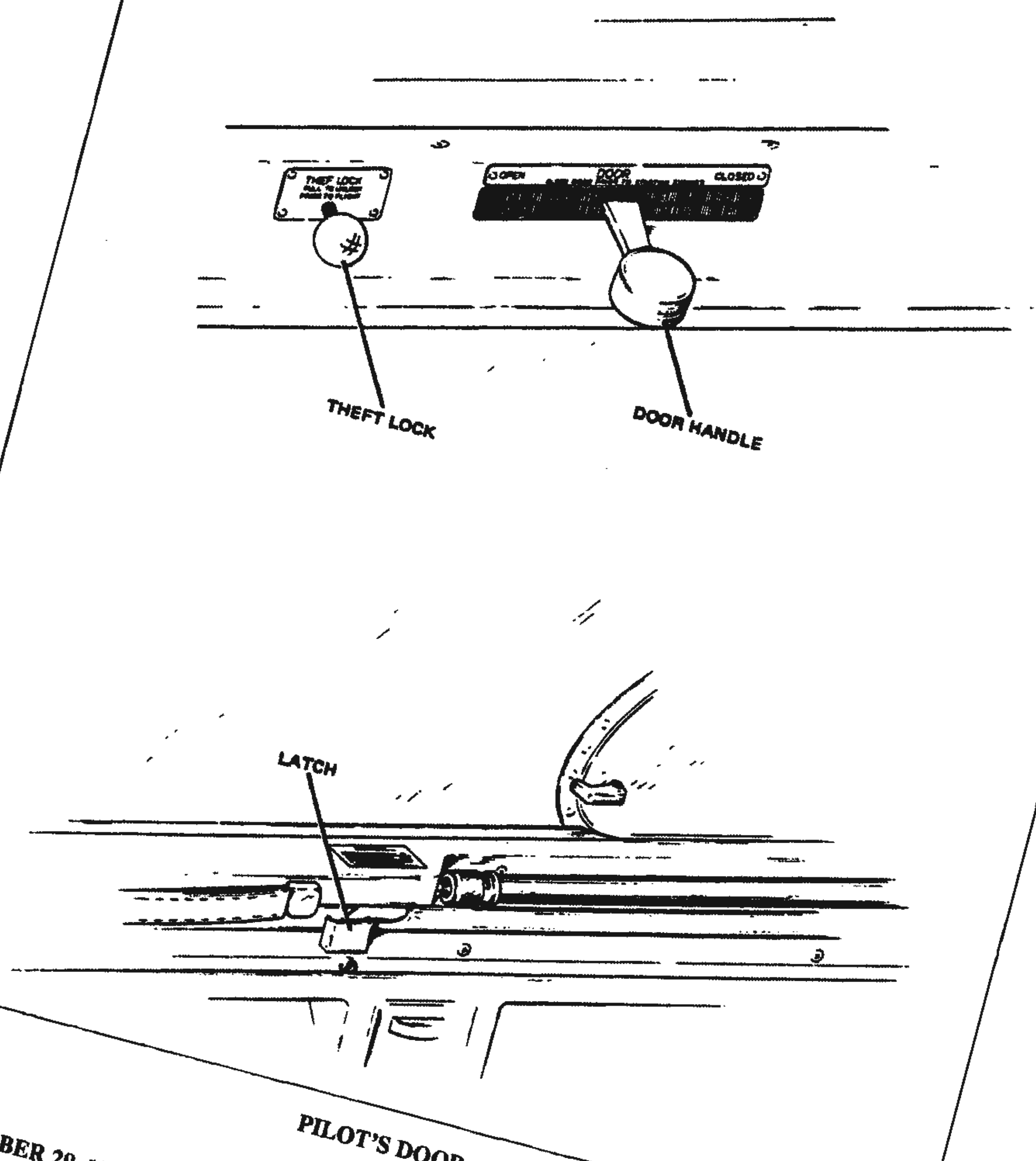
The manufacturer's identification plate is attached to the underside of the fuselage skin even with the forward edge of the main cabin entrance door. A plate identifying only the serial number is attached to the fuselage to the left of the tail skid. The serial number should always be used in referring to the airplane in service or warranty matters.

7.56 STALL WARNING

An approaching stall is indicated by the sounding of a stall warning horn. This warning is activated by a sensing vane on the leading edge of the right wing. Stall warning is given at about 4 to 10 knots before an actual stall would occur. The stall warning system may be checked during preflight by lifting the sensing vane while the airplane master switch is ON. The horn should activate.

Stall speed information is presented in graphs in Section 5 - Performance.

*Optional equipment



PILOT'S DOOR

7.57 PROPELLER SYNCHROPHASER* (HARTZELL)

The propeller synchrophaser eliminates slight manual propeller adjustments to reduce the "beat" effect of the propellers and minimizes vibration.

A two position "PROPELLER SYNCHRO" control switch is mounted on the lower portion of the instrument panel to the left of the control pedestal. The switch positions are "MANUAL" and "SYNC."

With the switch in the "MANUAL" position, the engines and propellers are operated and controlled in the conventional manner. The synchrophaser automatically maintains selected rpm after the pilot manually sets the desired propeller speed and selects the "SYNC" position of the control switch. This rpm will be maintained by the synchrophaser until the pilot readjusts the propeller speed.

The major components of the system are a pulse generator, a strobe sensor, a computer and an electrical control solenoid. The pulse generator, connected to master (left) engine, supplies timing information to the strobe sensor on the slave (right) engine. The resultant error signal, generated by the strobe sensor, is fed to the computer which drives the servo amplifiers (within the computer). Outputs from the servo amplifiers control the electrical solenoid on the slave engine governor, keeping the slave engine in phase with the rotation of the master engine.

Circuit protection is provided by a push-to-reset type circuit breaker in the circuit breaker control panel to the left of the pilot's seat on the sidewall. The breaker is labeled "PROP SYNC."

For Taxiing:
Set the synchrophaser switch to "MAN."

For Takeoff and Landing:
Set the synchrophaser switch to "MAN."

For Cruise:
Synchronize the propellers as close as possible manually; then set the synchrophaser switch in the "Prop Sync." position.

NOTE

Normally, propeller synchrophasing is achieved in a few seconds but occasionally it may take a full minute to achieve full propeller synchrophasing.

If a change in power setting is desired, set the synchrophaser switch to "MAN." position; wait 30 seconds. Adjust the power setting; then set the synchrophaser switch in the "Prop Sync." position.

*Optional equipment

Propeller "Phase" is preset at the factory. For further information on Phase control and the Propeller Synchrophasing System, consult the aircraft service manual.

NOTES

Should it be necessary to completely deactivate the Prop Sync. system the circuit breaker must be pulled.

Each time a propeller RPM differential greater than 50 RPM occurs, it will be necessary to recycle the system to "MAN." for 30 to 40 seconds. Manually resynchronize propellers; then turn switch to "Prop Sync." position.

In the event of an electrical system failure or if the master switch is off, the slave engine will return to the controlled selected RPM plus approximately 25 RPM regardless of the position of the synchrophaser switch (out of synchronization).

7.59 EMERGENCY LOCATOR TRANSMITTER*

The Emergency Locator Transmitter (ELT), when installed, is enclosed under the removable dorsal fin forward of the vertical tail attachment to the fuselage. The unit meets the requirements of FAR 91.52. The transmitter operates on a self-contained battery.

A battery replacement date is marked on the transmitter lable. To comply with FAA regulations, the battery must be replaced on or before this date. The battery must also be replaced if the transmitter had 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.

When installed in the airplane, the ELT transmits through the antenna mounted on the fuselage. The unit is also equipped with an integral portable antenna to allow the locator to be removed from the airplane in an emergency and used as a portable signal transmitter. Should it become necessary to remove the ELT from the airplane, be sure that the switch on the unit is in the "OFF" position before the transmitter is disconnected from the fuselage antenna. After the portable antenna is attached, the unit may be turned "ON" as desired.

The locator should be checked during the preflight ground check to make sure that it has not been accidentally activated. Check by turning a radio receiver to 121.5 MHz. If there is an oscillating sound, the locator may have been activated and should be turned off immediately. Rearm the unit and then recheck.

NOTE

If for any season 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.

*Optional equipment

GARRETT 627810-1 OPERATION

On the unit itself is a three position selector switch placarded "OFF," "ARM" and "ON." The "ARM" position is provided to set the unit to the automatic position so that it will transmit only after impact and will continue to transmit until the battery is drained to depletion or until the switch is manually moved to the "OFF" position. The "ARM" position should be selected whenever the unit is in the airplane.

The "ON" position is provided so the unit can be used as a portable transmitter or in the event the automatic feature was not triggered by impact or to periodically test the function of the transmitter.

Select the "OFF" position when changing the battery, when rearming the unit if it has been activated for any reason, or to discontinue transmission.

NOTE

If the switch has been placed in the "ON" position for any reason, the "OFF" position has to be selected before selecting "ARM." If "ARM" is selected directly from the "ON" position, the unit will continue to transmit in the "ARM" position.

A pilot's remote switch, located on the lower left instrument panel allows the transmitter to be controlled from inside the cabin. The pilot's remote switch is placarded "ON (RESET)," "ARM." The "ARM" position should be selected for all normal flight operations. If activation occurs with the remote switch in the "ARM" position, the transmitter must be reset by selecting the "ON (RESET)" position for one second and returning the switch to "ARM."

CCC CIR 11 OPERATION

On the unit itself is a three position selector switch placarded "OFF," "ARM" and "ON." The "ARM" position is provided to set the unit to the automatic position so that it will retransmit only after impact and will continue to transmit until the battery is drained to depletion or until the switch is manually moved to the "OFF" position. The "ARM" position should be selected whenever the unit is in the airplane. The "ON" position is provided so the unit can be used as a portable transmitter or in the event the automatic feature was not triggered by impact or to periodically test the function of the transmitter.

Select the "OFF" position when changing the battery, when rearming the unit if it has been activated for any reason, or to discontinue transmission.

NOTE

If the switch has been placed in the "ON" position for any reason, the "OFF" position has to be selected before selecting "ARM." If "ARM" is selected directly from the "ON" position, the unit will continue to transmit in the "ARM" position.

A pilot's remote switch, located on the lower left instrument panel allows the transmitter to be controlled from inside the cabin. The pilot's remote switch is placarded "ON," "ARM" (Normal Flight Position), "RESET." If the pilot's remote switch has been placed in the "ON" position for any reason, the momentary "RESET" position must be selected for 3 seconds before allowing it to return to the "ARM" position. If for any reason the impact switch becomes inadvertently activated, it may be reset by selecting the momentary "RESET" position for 3 seconds before allowing it to return to the "ARM" position.

NARCO ELT 10 OPERATION

On the unit is a switch placarded "ON," "OFF," and "ARM." The "ARM" position allows the unit to be set to the automatic mode so that it will transmit only after activation by impact and will continue to transmit until the battery is drained to depletion or until the switch is manually moved to the "OFF" position. The "ARM" position should be selected whenever the unit is in the airplane. The "ON" position is provided so the unit can be used as a portable transmitter or in the event the automatic feature was not triggered by impact or to periodically test the function of the transmitter. The "OFF" position should be selected while changing the battery or to discontinue transmission after the unit has been activated.

A pilot's remote switch, located on the lower left instrument panel allows the transmitter to be controlled from inside the cabin. The pilot's remote switch is placarded "ON," "ARM." The "ARM" position should be selected for all normal flight operations. If activation occurs with the remote switch in the "ARM" position, the transmitter must be reset. A button tabled "RESET" is located above the selector switch. To rearm the unit after it has been turned off or after it has been activated, the "RESET" button should be pressed in after the selector switch has been placed in the "ARM" position. This will end transmission and rearm the unit.

7.61 RADARS*

A weather avoidance radar system can be installed in the PA-31 Navajo. The basic components of this installation are an antenna, a transmitter/receiver, and a cockpit indicator. The function of the weather radar system is to detect weather conditions along the flight path and to visually display a continuous weather outline on the cockpit indicator mounted in the center segment of the instrument panel. Through interpretation of the advance warning given on the display, the pilot can make an early decision on the most desirable weather avoidance course.

In addition to its primary purpose, weather mapping, the system can be used for navigation. A ground mapping feature allows the pilot to identify coastlines, water masses, islands, high ground, etc. This provides the pilot with a guidance feature which may be useful in adverse weather conditions or over areas where ground-based navigational aids are limited.

NOTE

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

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

NOTE - RADAR PERMANENTLY REMOVED IAW A.E.A EO9061/1 ISSUE 2.
REFERENCE REGULATORY REQUIREMENTS AND OPERATIONAL LIMITATIONS
BEFORE INTENDED FLIGHT.

*Optional equipment

WARNING

Heating and radiation effects of radar can cause serious damage to the eyes and organs of the body. Personnel should not be allowed within fifteen feet of the area being scanned by the antenna while the system is transmitting. Do not operate the radar during refueling or in the vicinity of trucks or containers accommodating explosives or flammables. Flashbulbs can be exploded by radar energy. Before operating, direct the nose of the airplane away from buildings, large metal structures or other aircraft within a distance of 100 yards to prevent the return of reflected energy to the system. Do not operate the radar while the airplane is in a hangar or other enclosure.

7.63 ELECTRIC HEATED WINDSHIELDS*

An electrically heated pilot's windshield can be installed on the PA-31 Navajo as optional equipment.

The electric windshield, used to prevent and/or remove icing and fogging, is controlled by a "WINDSHIELD HEAT" circuit breaker switch mounted in the circuit breaker control panel. With the engines running, a preflight check can be made by activating the control switch. The windshield is operating properly if it feels warm to the touch.

Ground operation should be kept to a minimum to prevent overheating of the windshield. Distorted vision or small bubbles in the pastic of the windshield may indicate an overheat condition.

The exterior surface of the windshield has a Nesa coating to prevent static discharge. Use care when cleaning (refer to Section 8 - Airplane Handling, Servicing and Maintenance).

7.65 ELECTRIC WINDSHIELD WIPER*

An electrically operated windshield wiper can be installed in conjunction with the electric windshield on the pilot's side.

The system is controlled by an on-off circuit breaker switch located in the circuit breaker control panel and a speed adjustment knob mounted on the instrument panel. The speed adjustment knob has four positions: "PARK," "OFF," "LOW" and "HIGH." To operate the wiper, activate the circuit breaker switch and select the desired speed position.

CAUTION

Do not operate the windshield wiper at airplane speeds above 129 KIAS or on a dry windshield.

When operation of the wiper is no longer required, turn the speed adjustment knob to "OFF," then to "PARK," and deactivate the circuit breaker switch. The "PARK" position resets the wiper blade and will automatically return the knob to the "OFF" position when released.

*Optional equipment

7.67 PORTABLE CABIN FIRE EXTINGUISHER*

A two and three-quarter pound portable fire extinguisher can be mounted to the seat frame beneath the pilot's seat.

The extinguisher is a dry powder type suitable for liquid or electrical fires. It is operated by aiming the nozzle at the base of the fire and squeezing the trigger grip. Releasing the trigger automatically stops further discharge of the extinguishing powder.

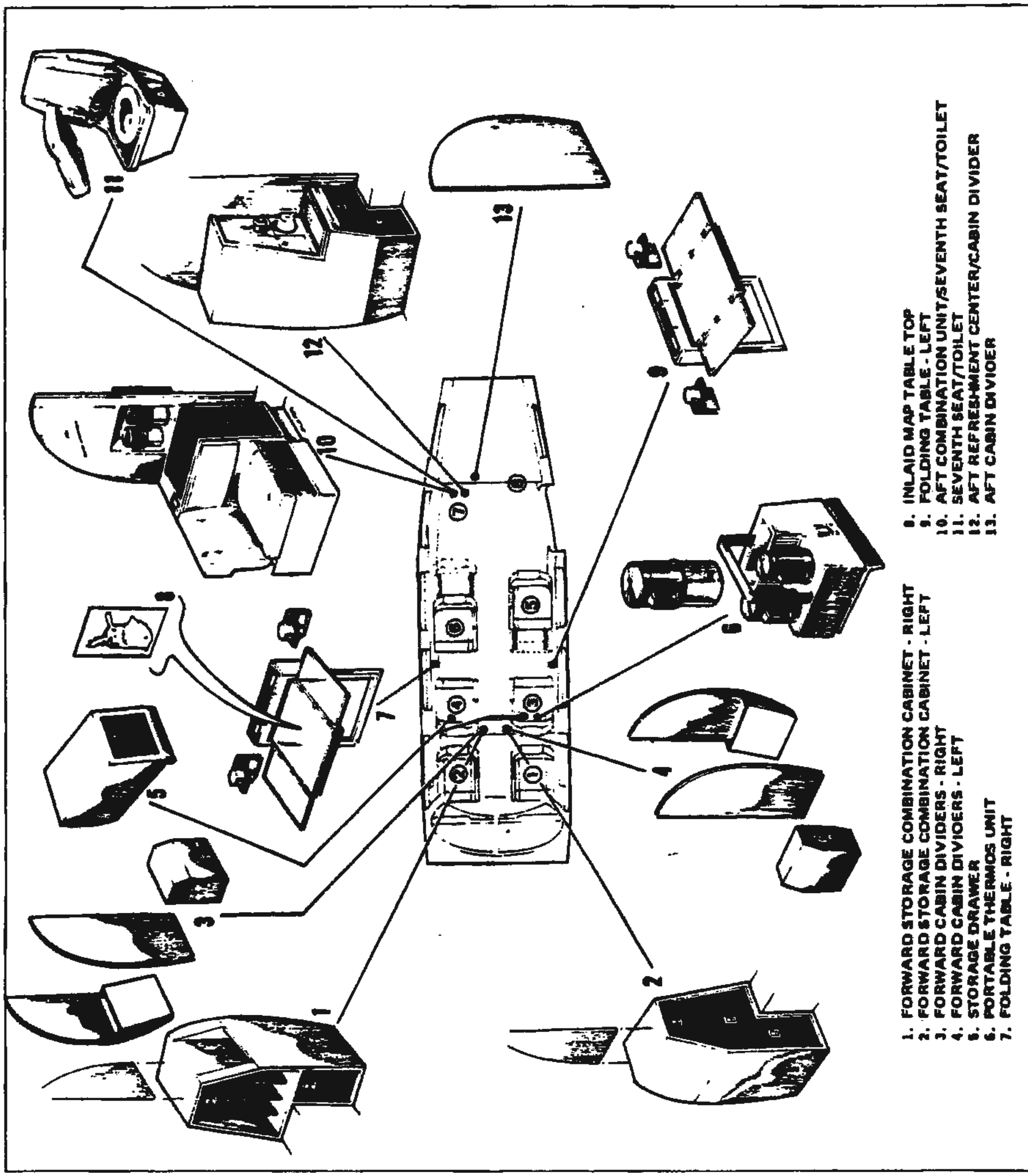
7.69 CABINETRY*

Among the optional interior appointments available in the Navajo is a variety of cabinet installations (Figure 7-45).

Storage cabinets or a combination storage cabinet and refreshment unit may be installed aft of the crew seats, between the cockpit and the main cabin areas. The storage cabinet units include slots for map, chart, or manual storage and several slide-out drawers. The refreshment unit may include storage drawers and two one quart thermos pitchers with or without a portable carrying case. The area between the cabinets and the cabin ceiling may be closed off with cabin dividers, and the walkway between the cabinet units equipped with a draw curtain to allow the cockpit area to be completely separated from the main cabin.

Cabinetry available for the aft cabin area includes storage cabinets, vanity, and refreshment units which may be installed in the aft cabin area forward of the rear baggage area. Among the optional vanity and refreshment facilities available with rear cabinetry installations are a mirror, an ice chest, a beverage container, thermos pitchers, a half-gallon electrically heated liquid unit, an ash tray, a pull-out work surface, and storage drawers. The aft cabinets are mounted on vertical dividers extending the height of the cabin, and several are available with privacy curtains or folding doors to allow the aft cabin to be closed off from the passenger area.

*Optional equipment



CABINETRY OPTIONS

Figure 7-45

7.71 FOLDING TABLES*

Folding tables (Figure 7-45) can be installed on either or both sides of the cabin between the second and third windows. A table can be used only when the first seat in the passenger area is installed facing aft, conference style. The drop-leaf table pulls up from its wall rack and folds down into position. The table installation includes ash trays, glass holders, and recesses for holding small items.

7.73 TOILET INSTALLATION*

A self-contained toilet can be installed in the aft section of the cabin (Figure 7-45). In either the side-facing or the forward-facing seventh seat position, the unit may be used as a passenger seat. The seat cushion conceals the toilet. Either a folding door or a draw curtain may be installed forward of the toilet to close off the aft cabin, assuring the occupant of privacy.

Plastic disposable bags which are available from Piper dealers should be placed in the toilet receptacle. After use, remove the plastic bag, close it with a wire tie, and, after landing, dispose of it in the proper field facilities. Do not attempt to flush the bag in a toilet.

A relief tube is exposed when the toilet seat is raised. The relief tube also serves as a vent for the toilet; therefore, be sure that the tube system is not blocked or obstructed.

7.75 ANTI-STATIC WICKS*

Anti-static wicks can be installed on the trailing edges of the wing panels and the tail surfaces to aid in clearing the airplane of surface static electricity which may disrupt LF reception, cause a loss of ADF indication or cause VHF interference. A total of ten wicks are attached to the airplane: three on each wing, one on the outboard end of each elevator and two on the rudder.

7.77 RAMP HAILER*

The ramp hailer is controlled by a transmitter selector switch on the radio master control panel mounted on the center segment of the instrument panel. An external speaker mounted beneath the floor of the nose baggage compartment allows the pilot to speak to ground personnel. To operate, turn ON the airplane master switch and the radio master switch, select EXT on the transmitter selector switch on the radio control panel and key the microphone. The ramp hailer works best when the engines are idling or shut down.

7.79 EMERGENCY ELECTRICAL POWER PACK*

An optional emergency electrical power supply installation is available for the Navajo. This installation includes a 28 volt nickle-cadmium battery which will provide a short-term electrical source to power nav 2, comm 2 and glide slope 2.

This installation is to be used only in an emergency situation and only after all emergency procedures for electrical failure outlined in Section 3 have been completed and no power from either alternator or from the airplane's battery is available to the avionics bus.

*Optional equipment

The switch for the emergency power supply is located on the pilot's instrument panel. When the emergency mode is selected, nav 2, comm 2 and glide slope 2 are removed from the primary electrical system and are transferred to the emergency power supply.

The emergency power supply battery has a 3.8 amp hour life when fully charged. Limited operation (equipment turned OFF when not in actual use) of the nav 2, comm 2 and glide slope 2 is required to extend the life of the emergency battery. The pilot must become familiar with the current consumption of these avionics installations to allow budgeting of emergency electrical power to insure arrival at a landing site. Current consumption information is available in the manuals provided by the manufacturer of the avionics equipment.

For a complete description of the system, its operation and maintenance, refer to the appropriate operating and service manuals supplied by the system manufacturer.

NOTE

Under IFR conditions, an approach and landing should be made at the nearest suitable airport no more than 45 minutes after activation of the Emergency Power Switch. The 45 minute limitation assumes a fully charged emergency battery.

THIS PAGE INTENTIONALLY LEFT BLANK

TABLE OF CONTENTS

SECTION 8

AIRPLANE HANDLING, SERVICING AND MAINTENANCE

SECTION 8

AIRPLANE HANDLING, SERVICING, AND MAINTENANCE

8.1 GENERAL

This section provides general guidelines relating to the handling, servicing, and maintenance of the Navajo. For complete maintenance instructions, refer to the PA-31 Service Manual.

Every owner should stay in close contact with an authorized Piper Service Center or Piper's Customer Services 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 airplane 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.

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

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

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

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

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

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

8.3 AIRPLANE INSPECTION PERIODS

Piper Aircraft Corporation has developed inspection items and required inspection intervals for the PA-31 (see PA-31 Service and Inspection Manuals). The PA-31 Service Manual contains appropriate forms, and all inspection procedures should be complied with by a properly trained, knowledgeable, and qualified mechanic at an authorized Piper Service Center or a reputable repair shop. Piper Aircraft Corporation cannot accept responsibility for the continued airworthiness of any aircraft not maintained to these standards, and/or not brought into compliance with applicable Service Bulletins issued by Piper Aircraft Corporation, instructions issued by the engine, propeller, or accessory manufacturers, or Airworthiness Directives issued by the FAA.

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

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

A 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 airplane should be accomplished by appropriately licensed personnel.

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

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

8.7 AIRPLANE ALTERATIONS

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

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

(a) To be displayed in the aircraft at all times:
  (1) Aircraft Airworthiness Certificate Form FAA-1362B.
  (2) Aircraft Registration Certificate Form FAA-500A.
  (3) Aircraft Radio Station License Form FCC-404A, if transmitters are installed.

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

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

8.9 GROUND HANDLING

(a) Towing

The airplane may be towed by use of the nose wheel tow bar stowed in the baggage area or with power equipment that will not damage or excessively strain the nose gear steering assembly.

CAUTION

When towing with power equipment, do not turn the nose gear beyond its turning radius in either direction, as this may result in damage to the nose gear and steering mechanism. Turn limits are marked on a placard on the nose gear strut assembly.

CAUTION

Do not tow the airplane when the controls are secured. Do not push or pull on the propeller or the control surfaces when handling the airplane on the ground.

(b) Taxiing

Before attempting to taxi the airplane, ground personnel should be instructed and approved by a qualified person authorized by the owner. Engine starting and shut-down procedures and taxiing 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 procedures should be followed:

(1) Taxi with the propeller in the low pitch, high RPM setting.
(2) When taxiing on uneven ground, avoid holes and ruts.
(3) Observe wing clearances when taxiing near buildings or other stationery objects. If possible, station an observer outside to guide the airplane.
(4) Do not operate the engines at high RPM when running up or taxiing over ground containing loose stones, gravel, or any loose material that might cause damage to the propeller blades.
(5) Be sure that alternate air is not being used.
(6) After taxiing forward a few feet, apply the brakes to determine their effectiveness.
(7) While taxiing, make slight turns to ascertain the effectiveness of the steering.

(c) Parking

When parking the airplane, be sure that it is sufficiently protected against 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) When parking the airplane, head it into the wind if possible.
(2) Set the parking brake by first depressing and holding the toe brake pedals and then pull out the parking brake handle. To release the parking brake, first depress and hold the toe brake pedals and then push in on the parking brake handle.

WARNING

Braking may not occur if parking brake handle is pulled and held prior to brake pedal application.

THIS PAGE INTENTIONALLY LEFT BLANK

CAUTION

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

(3) Aileron and elevator controls may be secured with the front seat belts. Wheels should be blocked if chocks are available.

(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 elevator by looping the seat belt through the control wheel and pulling it snug.
(4) Chock the wheels.
(5) Secure tie-down ropes to the wing tie-down rings and 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.

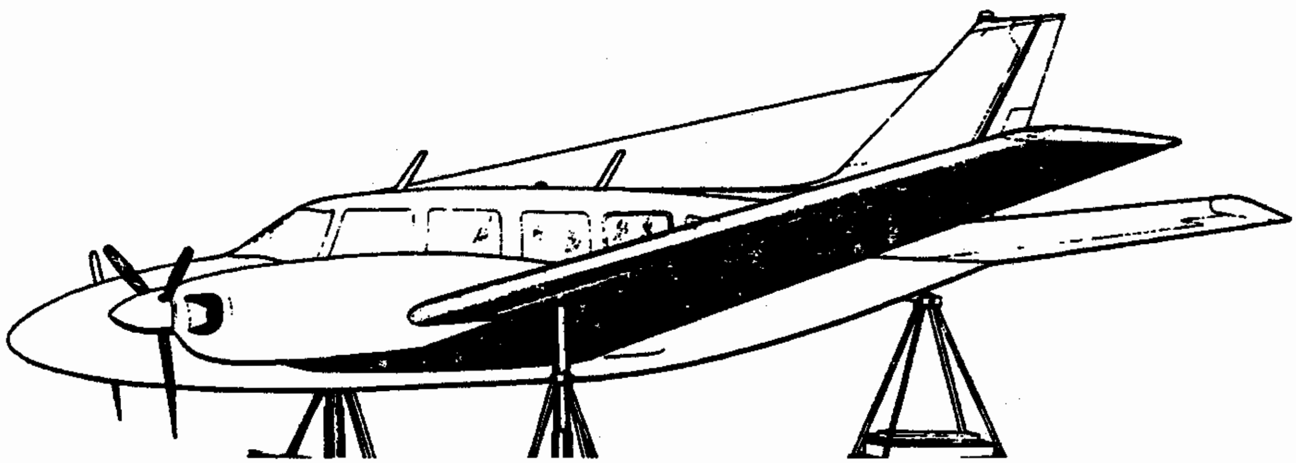
(6) Install pitot head cover(s) if available. Be sure to remove the pitot head cover(s) before flight.
(7) Cabin and baggage doors should be locked when the airplane is unattended.

(e) Jacking

When it is necessary to place the airplane on jacks for landing gear servicing or other servicing operations, be sure that the jack pads (located on the underside of the front wing spars outboard of the engine nacelles) are used (Figure 8-1). A tail support will be necessary and should be attached to the tail skid and weighted with approximately 500 pounds of ballast. For complete jacking instructions refer to the Service Manual.

CAUTION

Be sure to apply sufficient tail support ballast or the airplane will tip forward. Should it be necessary to raise the nose gear while the main gear remain on the ground, use the seat belts to hold the control wheel aft, raising the elevators to neutral or higher. If the elevators are down, the tabs will contact the ground before the skid and could be damaged.



AIRPLANE JACKING ARRANGEMENT
Figure 8-1

8.11 SERVICING AIR FILTERS

Induction air filters should be cleaned and examined at least once every fifty hours. Filters should be replaced if the paper filter material is torn or ruptured, if the housing is damaged, or if the filter is excessively dirty. The usable life of an air filter should be restricted to one year or 500 hours, whichever comes first. Depending on the conditions in which the airplane is operated, filters may have to be cleaned or replaced at shorter intervals.

(a) Remove the screws (3) from the securing brackets on the sides of the filter box and remove the filter.
(b) Check the filter. If it is damaged or excessively dirty, replace it immediately.
(c) Clean the filter by one of the two following methods:
    (1) Keeping the air nozzles at least one inch from the filter, direct a jet of air not exceeding 100 psi up and down the pleats on the clean air side of the filter. This method will remove grit, dust, and sand from the filter.
    (2) If carbon, soot, or oil remain on the filter after completing the above procedure, soak the filter for 15 minutes in a good non-sudsing detergent; then swish it gently in the solution for about two minutes. Rinse the filter with a stream of water not exceeding 40 psi until the rinse water is clear. Dry the filter thoroughly before reinstalling, but do not use light bulbs or extreme heat for drying.
(d) Recheck the filter for damage, and if it is found to be clean and sound, reinstall the filter.
(e) Before reinstalling the filter, examine the filter gasket. It should have no tears and should be securely in place.

8.13 BRAKE SERVICE

The brake system is filled with MIL-H-5606 (petroleum base, red) hydraulic fluid. This should be checked at every 50 hour inspection and replenished when necessary.

Do not use vegetable base brake fluids (blue) when refilling the system. The brake fluid reservoir is filled by opening the access door, which is located above the forward access panel on the right side of the fuselage, and removing the filler cap. Then add fluid to the reservoir to the required level.

If it is necessary to bleed the brake system to get air out of the lines, fluid should be added under pressure at the bleeder attachment on the brake unit.

No adjustment of brake clearances is necessary. If, after extended service, braking action requires too much movement of the toe pedal or the brakes are spongy, check the Service Manual for corrective action.

8.15 HYDRAULIC SYSTEM SERVICE

The fluid level of the hydraulic reservoir should be checked every 50 hours by placing the airplane in a level position and viewing the fluid level through the sight glass located in the forward surface of the reservoir dome. Access to the reservoir is through the forward baggage compartment door. The reservoir is mounted directly aft of the radio shelf.

If fluid is not visible, filtered hydraulic fluid MIL-H-5606 should be added. Fluid may be added by utilizing the filler line located at the upper forward corner of the access panel on the right side of the nose section. See Service Manual for filling instructions.

8.17 LANDING GEAR SERVICE

The operation of the landing gear oleos is standard for the air-oil type. Hydraulic fluid passing through an orifice serves as the major shock absorber, while air compressed statically acts as a taxiing spring. The piston tube has a total travel of 8 inches on the nose and 9 inches on the main. About 3.25 inches of tube should be exposed under normal static loads.

All of the oleos are inflated through readily accessible valves on the top of the unit. All major attachments and actuating bearings are equipped with grease fittings for lubrication of the bearing surfaces, and should be lubricated periodically. (Refer to the Lubrication Chart in the Service Manual.)

In the event the oleo strut slowly loses pressure and extension, the most probable source of trouble is the air valve attachment to the leg or the core of the air valve. These parts should be checked first to determine whether or not air leaks are occurring. If hydraulic fluid is evident on the exposed chrome plated oleo strut, the O-rings on the piston tube bearing units may need to be replaced. If the landing gear is washed with a degreaser (refer to paragraph 8.43) the strut tube must be lubricated or the O-ring will fail.

To add air to the oleo struts, a strut pump is attached at the air valve and the oleo pumped up until 3.25 inches of piston tube is exposed with normal static weight on the gears. To add oil, first place the airplane on jacks; then release all the air through the valves, allowing the oleo to extend fully. Next, remove the air valve and fill the unit through this opening. Compress the oleo again to within 1/4 inch of full compression, allowing excess oil to overflow and working out trapped air. Then reinsert the valve core and pump up the strut.

The steering arms from the rudder pedals to the nose wheel steering torque shaft arm are adjusted at the rudder pedals or at the torque shaft rollers by turning in or out the threaded rod end bearings. Adjustment is normally accomplished at the forward end of the rods. Adjustment should be made in such a way that the nose wheel is in line with the fore and aft axis of the airplane 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 airplane follows a perfectly straight line.

In adjusting the steering arm stops, care should be taken to see that the nose wheel reaches its full travel just after the rudder hits its stops. This guarantees that the rudder will be allowed to move through its full travel.

The turning arc of the nose wheel is 20 degrees in either direction and is factory adjusted at stops on the bottom of the forging. The turning radius is approximately 25 feet.

Adjustable rod end bearings on each hydraulic cylinder actuate the landing gear struts. These rod ends should be set so that the cylinders move the landing gear retracting links just far enough to engage the spring-loaded downlocks and make contact at the stops. Too much extension of the adjusting screws will overload the links, and too little extension will prevent the links from traveling to the required past-center position.

Incorporated with each gear assembly is a micro switch which closes after full downward movement of the gear. The down switches are connected individually to green indicator lights on the instrument panel. The up switches are in series and make contact after each gear door is closed. The red light will show an indication when the gear is not locked in either the up or down position or when the gear is up and the main gear doors are ajar. Within the control pedestal are two micro switches that operate a warning horn when power from one or both engines is reduced below 12 inches of manifold pressure. Operation of the red gear in transit light is independent of the throttle micro switches.

8.19 TIRE SERVICE

For maximum service from the tires, keep them inflated to the proper pressure of 42 psi for the nose wheel and 60 psi for the main wheels. When inflating the tires, visually inspect them for cracks and breaks. If necessary, reverse the tires on the wheels or interchange them for even wear. All tires and wheels are balanced before original installation, and the relationship of tire, wheel, and tube should be maintained upon reinstallation. If new components are installed, it may be necessary to rebalance the wheels with the tires mounted. Out-of-balance wheels can cause extreme vibration during takeoff and landing.

8.21 PROPELLER SERVICE

Since propellers will pick up loose pieces of rock or debris from the ramp and runway, the blades should be checked periodically for damage. Minor nicks in the leading edge of blades should be filed out and all edges rounded, since cracks sometimes start from such defects. Use fine emery cloth for finishing the depressions. Refer to FAA Advisory Circular 43.13-1 for blade repair recommendations and repair limitations. The daily inspection should include examination of blades and spinner for visible damage or cracks and inspection for grease or oil leakage.

Remove spinner cap and check air pressure or, if necessary, charge the cylinder with dry air or nitrogen gas to the prescribed pressure. Refer to the placard in the spinner cap or Table below for an exact pressure for the existing temperature. It is most important that an accurate air charge be maintained.

NOTE

Do not check pressure or charge with propeller in feathered position.

CHAMBER PRESSURE REQUIREMENTS
WITH TEMPERATURE

Temperature °F	Pressure (PSI)
70 to 100	41 ± 1 lb.
40 to 70	38 ± 1 lb.
0 to 40	36 ± 1 lb.
-30 to 0	33 ± 1 lb.

8.23 OIL REQUIREMENTS

The oil capacity of the Lycoming TIO-540-A2C engines is 12 quarts. The minimum safe quantity of oil in the sump is 2-3/4 quarts. It is recommended that the engine oil and oil filter element be changed after the first 25 hours of flying time on new, remanufactured and newly overhauled engines. It is recommended that engine oil be drained and renewed every 50 hours. The oil filter element should be changed every 50 hours of operation. The interval between oil and oil filter changes should not exceed a total of four (4) months. Under unfavorable dusty conditions, the oil and oil filter should be changed more frequently.

It is recommended that single or multi viscosity aviation grade oils in accordance with latest issue of Textron Lycoming Service Instruction 1014 be used. The following seasonal aviation oil grades and seasonal ambient temperature ranges are recommended.

LUBRICATING OIL RECOMMENDATIONS
USE AVIATION ENGINE OIL FOR PISTON ENGINES

Average Ambient Temperature	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
0°F to 90°F	20W-50	20W-50 or 15W-50
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 Textron Lycoming Service Instruction 1014 (Lubricating Oil Recommendations) for further information.

NOTE

When checking oil level, read right engine side of dipstick for right engine, and left engine side of dipstick for left engine.

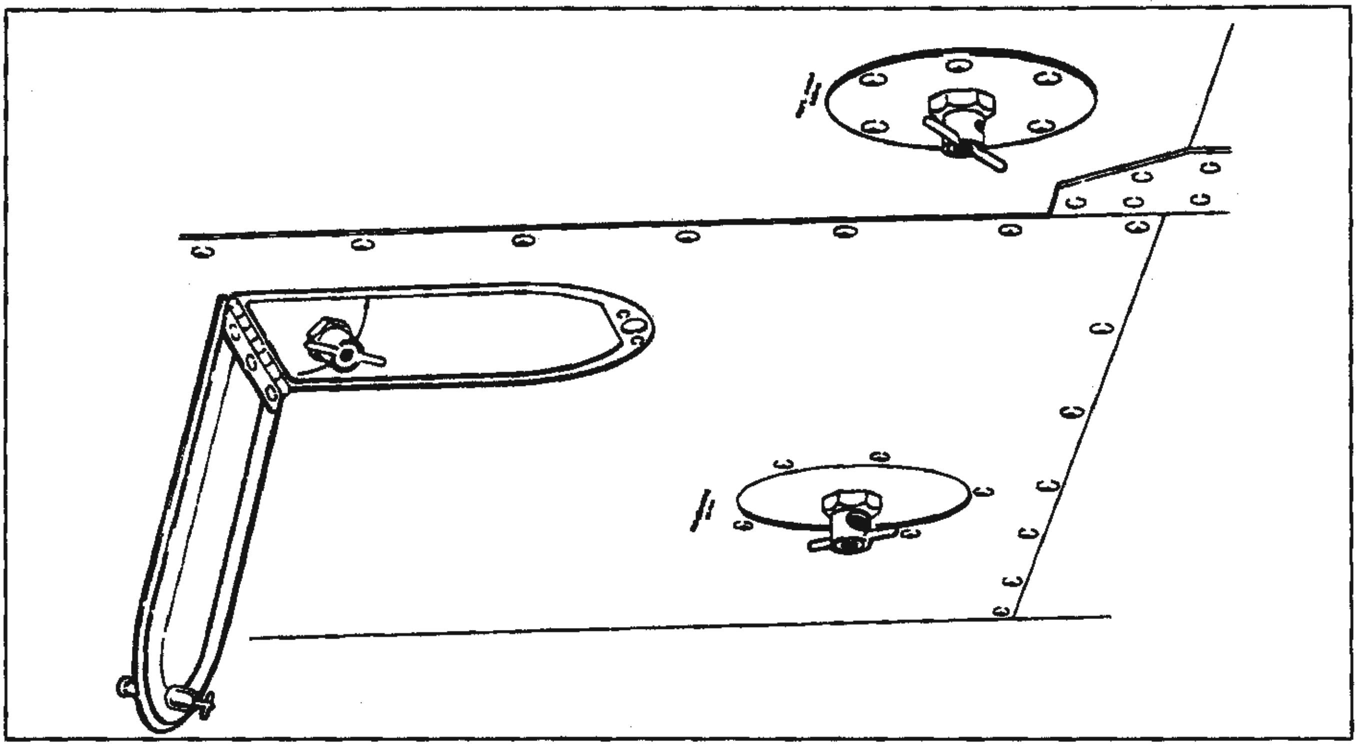
8.25 DUEL SYSTEM

(a) Fuel Requirements (AVGAS ONLY)

Aviation grade 100/130 (minimum) octane should be used in the Navajo. The use of lower grades of fuel can cause serious damage in a very short period of time, and is considered of such importance that the engine warranty is invalidated by such use. Refer to Paragraph 1.7, Fuel.

(b) Inspection

At every 50 hour inspection or every 90 days screens and bowls in the fuel filter units should be cleaned.



FUEL FILTER DRAIN AND LINE DRAINS
Figure 8-3

(c) Filling Fuel Cells

The fuel supply is carried in two 56 gallon main cells and two 40 gallon auxiliary cells. A filler neck is provided in the upper center section of each wing for servicing the main cells, while another filler neck in the upper outboard section of each wing is provided for servicing the auxiliary cells. Observe all safety precautions required when handling gasoline.

When refueling the Navajo, ground the refueling hose before beginning the transfer of fuel. Secure the filler cap immediately after servicing each cell.

NOTE

Never leave the fuel cells completely dry, or the cell inner liners may dry out and crack, permitting fuel to diffuse through the walls of the cell after refueling. If the cell is to be left empty for a week or more, spray the inner liner with a light coat of engine oil.

(d) Fuel Draining

Condensed water vapor can be drained from the main or auxiliary cells by the quick-drain fittings on the wing panel lower surface (Figure 8-3).

The fuel filter drain and inboard fuel cell fuel line drain valves are located inboard of the main wheel wells, and the outboard fuel cell fuel drain valves are outboard of the main wheel wells. They are fitted with quick drains and should be drained regularly. In order to check the fuel system for possible moisture content, the inboard fuel cell line quick drain valve should be opened and drained and the quick drain valve on the fuel filter should be opened and drained. This procedure should be repeated at the quick drain valves located outboard of the main wheel well. Fuel screens are provided at the cell outlets, in the injectors, and in the fuel filter bowls.

A crossfeed line drain valve is located to the rear of the left fuel filter drain valve. This valve should be opened occasionally, with the crossfeed on, the left emergency fuel pump on, and then the right emergency fuel pump on to allow any water that might accumulate at that point to be drained out.

CAUTION

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

8.27 BATTERY SERVICE

Access to the battery is through the forward baggage compartment opening. The stainless steel battery box has a plastic drain tube, located on the bottom right rear comer, which is equipped with a shut-off clamp to be opened at least every 30 days to drain off any electrolyte that may have overflowed into the box.

Corrosion on the battery terminals and connections may be neutralized by applying a solution of baking soda and water mixed to the consistency of thin cream. Do not allow any of this soda solution to enter the battery. Repeat this application until all bubbling action has ceased before washing battery and box with clean water. Dry battery and box and close drain tube clamp.

Whenever checking the battery, ascertain that all connections are clean and tight and the fluid level is above the baffle plates. If it is necessary to add fluid, use distilled water.

A hydrometer check should be performed to determine the percentage of charge present in the battery.

Hydrometer Readings	Percent of Charge
1280	100
1250	75
1220	50
1190	25
1160	Very little useful capacity
1130 or below	Discharged

The battery should be removed for recharging. Starting recharge current should be 2 amperes. Finishing current should be 1 ampere.

8.29 PRESSURE GYRO SYSTEM

The Navajo pressure gyro system operates at a pressure of 4.3 to 6.1 inches of mercury. The system obtains the regulated pressure from the engine driven pressure pumps. The filters on the pumps should be inspected regularly and changed every 100 hours. The setting of the pressure regulators should be performed by an experienced mechanic.

8.31 HEATING SYSTEM

A preflight check should be made of the air inlet scoop, combustion air inlet scoop, exhaust outlet, and fuel drain for possible obstructions. Make sure that all of the openings are clear of any restrictions and that no damage has occurred to the exhaust outlet or combustion air inlet.

An operational check can be performed by moving the airplane master switch to the ON position and the heater control toggle switch to the HEAT position. The ventilating air blower and combustion air blower should operate.

To proceed with the operational check, move the right tank fuel control and the right emergency fuel pump to "ON." This will start the fuel and ignite the burner simultaneously; heat should be felt within a few minutes.

8.33 OXYGEN SYSTEM SERVICE*

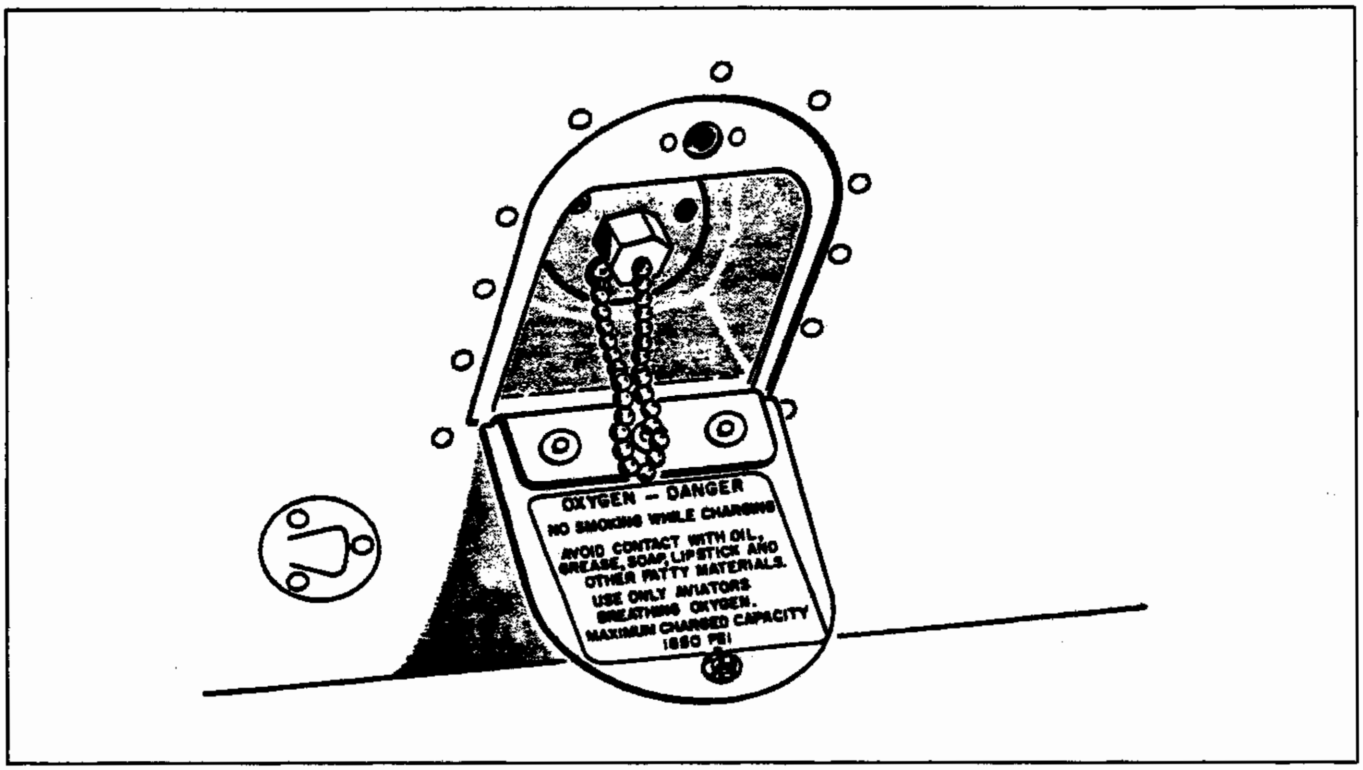
The filler valve for the oxygen cylinder is serviced by opening the access panel on the lower left nose section just aft of the forward baggage compartment door. To charge the oxygen system, remove the protective cap from the filler valve and attach the fitting from an oxygen cart. Refer to Figure 8-5.

WARNING

Inspect the filler connection for cleanliness before attaching it to the filler valve. Be sure your hands, tools and clothing are very clean and free from grease and oil since these contaminants will ignite when in contact with pure oxygen under pressure.

Open the cylinder supply valve on the airplane and fill the system slowly by adjusting the recharge rate with the pressure regulating valve on the cart. When the pressure gauge on the cylinder reads 1800 to 1850 psi, close the pressure regulating valve and replace the protective cap on the filler valve.

*Optional equipment



OXYGEN FILLER VALVE
Figure 8-5

8.35 PROPELLER DEICING*

Lock brakes and operate engines at near takeoff power. Turn deicer system switch ON and observe deicer ammeter for at least 2 minutes. Ammeter needle must stay within the shaded band except for a "flicker," approximately each 30 seconds, as the step switch of the timer operates.

With engines stopped, turn deicer switch ON and feel deicers on propellers for proper sequence of heater operation. The starting point is not important but sequence is vital and must be: RIGHT OUTBOARD, RIGHT INBOARD, LEFT OUTBOARD and LEFT INBOARD heaters, in that order. Temperature rise should be noticeable and each heater should warm for about 30 seconds. Local hot spots indicate surface damage of deicer heaters.

CAUTION

When conducting above static test, do not operate system longer than two complete cycles.

*Optional equipment

8.37 NUMBER PLATES

The manufacturer's name plate is located on the fuselage underside even with the forward edge of the cabin door. A second plate containing only the serial number is located to the left of the tail skid. The serial number should always be used in referring to the airplane in service or warranty matters.

8.39 LUBRICATION

For lubricating instructions, a chart showing lubrication points and types of lubricants to be used, and lubrication methods, refer to the PA-31 Service Manual.

8.41 CLEANING

(a) Cleaning Engine Compartment

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

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

CAUTION

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

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

CAUTION

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

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

*Optional equipment

(b) Cleaning Landing Gear

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

(1) Place a pan under the gear to catch waste.
(2) Spray or brush the gear with solvent or a mixture of solvent and degreaser. To remove especially heavy dirt and grease deposits, it may be necessary to brush areas that were sprayed.
(3) Allow the solvent to remain on the gear from five to ten minutes. Then rinse the gear with additional solvent and allow it to dry.
(4) Remove the protective cover and the catch pan.
(5) Lubricate the gear in accordance with the Lubrication Chart in the Service Manual.

CAUTION

Do not brush the micro switches.

(c) Cleaning Exterior Surfaces

The airplane should be washed with a mild soap and water solution. Harsh abrasives or alkaline soaps or detergents could scratch painted or plastic surfaces or corrode metal. Cover areas where a cleaning solution could cause damage. To wash the airplane, use the following procedure:

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

(d) Cleaning Windshield and Windows

CAUTION

Use only water and mild soap when cleaning the heated windshield. Use of ANY other cleaning agent or material may cause distortion or damage to windshield coatings.

(1) Remove dirt, mud, and other loose particles from exterior surfaces with clean water.
(2) Wash interior and exterior window surfaces 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 dampened with kerosene.

CAUTION

Do not use gasoline, alcohol, benzene, carbon tetrachloride, thinner, acetone, other strong solvents, or window cleaning sprays. Do not use plastic cleaner on heated glass windshields.

(4) A severe scratch or mar in plastic can be removed by rubbing out the scratch with jeweler's rouge.

(5) When windows are clean, apply a thin coat of hard polishing wax. Rub lightly with a soft cloth. Do not use a circular motion. Do not apply wax on the optional heated windshield.

(e) Cleaning Interior

(1) Headliners and other vinyl interior surfaces may be cleaned with a damp cloth and mild soap and water solution.

(2) Window curtains may be dry cleaned but it is not recommended that they be laundered.

(3) Leather may be cleaned with a mild hand soap and water solution or with saddle soap. Follow the precautions which apply to the cleaning of any fine leather product. Avoid saturation and never use detergents or harsh cleaning solutions on leather.

(4) Wood surfaces may be cleaned with any good household liquid or spray cleaner/polish manufactured for this purpose.

(5) All upholstery fabrics are "Scotchgard" treated and may be cleaned as follows:

Spilled oily and watery liquids will generally bead up on the fabric and can be blotted away leaving little or no stain. Blot spills up as quickly as possible with an absorbent cloth, tissue or sponge. If the material is a solid or semi-solid, such as butter, remove the excess by gentle scraping with a table knife. Often, blotting will remove all traces of stain but if the staining agent is not completely removed by blotting, the following techniques are suggested:

a. Water-based stains such as ketchup, milk, ice cream, coffee:

Wipe the stain with a cloth wet with water containing a detergent or ammonia (1/2 cup ammonia to a gallon of water). Repeat if necessary.

b. Oil based stains such as salad dressing, butter, mayonnaise removed by either of the following procedures:

Apply "Texize K-2R Spot Remover" by spraying or rubbing into the fabric, and let dry. Vacuum off the residual powder. Repeat if necessary.

or

Wet a cloth with a solvent type spot cleaner such as "Energine" or "Renuzit" and wipe or gently rub the stained area. Turn cloth and rewet with solvent often. Repeat until stain disappears.

Fabrics treated with "Scotchgard" Fabric Protector with Extra Soil Defense offer remarkable oil resistance. This means that dirt will sit on the fabric surface and can be readily vacuumed off. Frequent vacuuming of loose dirt will prevent its being worked into the fabric.

Fabrics which have accumulated significant overall soil must be vacuumed thoroughly. A foam cleaner recommended by the manufacturer should then be applied. The following cleaners have been found to be suitable: "Fiber Fresh Concentrate," "Bissell Foam Upholstery Cleaner," "Glamorene," and "Ivory Flakes" or any other similar product. Carefully follow the manufacturer's instructions.

NOTE

It is best to test the cleaner on an inconspicuous portion of the fabric to test for discoloration. Also, avoid soaking or harsh rubbing.

To remove residual detergent left on the fabric, wipe the entire fabric surface with a cloth dampened with water. The cloth should be rinsed in clean water several times. This procedure will ensure that the treatment will continue to function.

CAUTION

Solvent cleaners require adequate ventilation.

(f) Cleaning Carpets

Use a small whisk broom or vacuum cleaner to remove dirt. For soiled spots, use a noninflammable dry cleaning fluid. Floor carpets may be removed and cleaned like any household carpet.

(g) Cleaning Toilets*

(1) To dispose of the sanitary bag, pull the top of the bag from the pail and close with a wire tie. Remove it from the airplane in the covered pail and dispose of according to field facilities. Do not attempt to flush the bag in a toilet.
(2) To clean and deodorize the airplane's toilet, mix a solution of disinfectant type cleaner. Using a soft bristled brush, rag and solution, wash the toilet pail and seat. The toilet may be removed for cleaning by disconnecting the two fasteners at the inside forward end of the unit. Slide it back and lift from the floor.
(3) When offensive odor remains, use a stronger solution and reclean.
(4) Rinse with fresh water and dry.
(5) To install a new sanitary bag, place it over the top edge of the pail and push it into the bottom of the pail.

(h) Cleaning Surface Deicing Equipment*

The deicers should be cleaned when the aircraft is washed using a mild soap and water solution.

In cold weather, wash the boots with the airplane inside a warm hangar if possible. If the cleaning is to be done outdoors, heat the soap and water solution before taking it out to the airplane. If difficulty is encountered with the water freezing on boots, direct a blast of warm air along the region being cleaned, using a portable type ground heater.

As an alternate cleaning solvent, use benzol or nonleaded gasoline. Moisten the cleaning cloth in the solvent, scrub lightly, and then, with a clean, dry cloth, wipe dry so that the cleaner does not have time to soak into the rubber. Petroleum products such as these are injurious to rubber, and therefore should be used sparingly if at all.

When the deicers are clean, a coating of B.F. Goodrich Icex should be applied. Icex is compounded to lower the strength of adhesion between ice and the rubber surface of the deicer boots.

*Optional equipment

TABLE OF CONTENTS

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 it is equipped with one or more of the various optional systems and equipment not approved with the standard airplane.

All of the supplements provided in 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.

THIS PAGE INTENTIONALLY LEFT BLANK

SUPPLEMENT 1

OXYGEN SYSTEM INSTALLATION

SECTION 1 - GENERAL

This supplement supplies information necessary for the efficient operation of the airplane when the optional oxygen system is installed. The information in 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 the handbook at all times when the optional oxygen system is installed.

SECTION 2 - LIMITATIONS

No smoking while the oxygen is in use.

SECTION 3 - EMERGENCY PROCEDURES

In the event that during operation the red indicator appears in any of the flow indicators, check for oxygen quantity and assure proper engagement of the oxygen mask in the receptacle. If oxygen cannot be supplied, the aircraft should be lowered to a safe altitude immediately.

SECTION 4 - NORMAL PROCEDURES

PREFLIGHT

(a) The pilot's and copilot's masks are stowed under their respective seats. Both masks (identified with a Red band on the supply hose) supply 120 liters per hour or a 5000 foot level supply of oxygen to 20,000 feet.
(b) The passengers' masks are stowed under their respective seats. The passengers' masks (identified with a Gold band on the supply hose) supply 90 liters per hour or a 10,000 foot level supply of oxygen to 20,000 feet.
(c) Insure an adequate supply of both pilot and passenger masks.
(d) Check the oxygen pressure. The supply gauge should read 1850 psi when full.
(e) Using pilot's mask, check for operation by momentarily opening the control knob and noticing that flow indicator in tube of mask shows flow. Oxygen pressure to the mask is indicated by the absence of the red pellet, which is forced toward the mask.
(f) Brief passengers:
  (1) Need for oxygen above 10,000 feet
  (2) How to determine flow
  (3) Recognizing anoxia
  (4) No smoking, no oil near oxygen.

(g) Always remove fitting from receptacle and stow mask when not in use. Oxygen will flow through mask whenever fitting is in receptacle, with control knob "ON." Mask may be damaged if not stowed.
(h) Oxygen masks should be cleaned and checked frequently. Defective masks should be replaced.

IN-FLIGHT

(a) Oxygen - "ON" (Pull control knob out, this allows the flow of oxygen to all receptacles.)
(b) Insert fitting into receptacle. (This allows flow of oxygen through mask.)
(c) Don mask. (Check oxygen flow indicator frequently.)
(d) Oxygen pressure - monitor to determine supply.
(e) If the oxygen tank has a pressure of 1850 psi when the use of oxygen is begun, oxygen will be available as shown below:

Crew	Passengers	Oxygen Supply Range in Hours
1		25.76
1	1	14.72
1	2	10.30
1	3	7.93
1	4	6.44
1	5	5.42
1	6	4.68
1	7	4.12

With 2 Pilot's Masks		Oxygen Supply Range in Hours
2		12.88
2	1	9.37
2	2	7.36
2	3	6.07
2	4	5.15
2	5	4.48
2	6	3.96

SECTION 5 - PERFORMANCE

Installation of the oxygen system does not affect the basic performance information presented in Section 5 of this Pilot's Operating Handbook.

SUPPLEMENT 2

ICING EQUIPMENT INSTALLATION

SECTION 1 - GENERAL

This supplement supplies information necessary for the efficient operation of the airplane when the optional Icing Equipment 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 Icing Equipment is installed.

SECTION 2 - LIMITATIONS

(a) The following items of equipment must be installed and operable to effectively cope with light to moderate icing conditions:
  (1) Heated pitot heads
  (2) Electrically heated windshield
  (3) Electric propeller deicers
  (4) Wing and empennage pneumatic deicers
  (5) Wing ice detection light
  (6) NACA anti-icing outboard fuel tank vents
  (7) Static wicks
  (8) Shielded antennas
  (9) Elevator horn deicing boots

(b) The following limitations must be observed for operation of pneumatic deicers:
  (1) The deicer boots may not maintain optimum effectiveness above the altitudes listed below for the specified conditions.

No. of Eng. Pumps	Engine Speed RPM	Max. Altitude For Optimum Boot Effectiveness
2	2200	20,000 Ft.
2	2400	24,000 Ft.
1	2575	15,000 Ft.

  (2) Maximum speed for boot inflation is Vne.
  (3) Do not take off or land with deicer boots inflated.
  (4) Not approved for operation below -40°C.
  (5) Operation of surface deice boots is prohibited with wing flap settings in excess of 15°.

SECTION 3 - EMERGENCY PROCEDURES

(a) Deicer electronic timer malfunction
   (1) Reset circuit breaker.
   (2) Activate boots by pressing surface deice switch to ON.

(b) Single-engine operation or pneumatic pump failure
   (1) System will adjust automatically to function on remaining pump.
   (2) Observe altitude limitations given in Section 2, item (b)(1) above for optimum effectiveness.

(c) In the event any of the required icing equipment malfunctions, immediate action must be taken to avoid icing conditions.

SECTION 4 - NORMAL PROCEDURES

(a) Heated pitot heads
   (1) Circuit breaker switches (left and right pitot heat) are located on the left side panel.
   (2) Pitot heat should not be used during extended ground operation.

(b) Electrically heated windshield
   (1) Circuit breaker switch is located on the left side panel.
   (2) The electrically heated windshield should not be operated for extended periods of ground operation unless windshield ice is present to prevent overheating.

(c) Electric propeller deicers
   (1) Circuit breaker switch is located on the left side panel.
   (2) Ammeter is located on the left side panel. (Normal reading in green arc - deflects momentarily each 30 seconds when operating.)
   (3) May be operated continuously in flight.
   (4) Do not operate when propellers are static (except maximum of 2 complete cycles when checking operation - see Section 7.35).

(d) Wing and empennage pneumatic deicers
   (1) Momentary on switch is located on the left side panel.
   (2) Pneumatic pressure indicators are located on the instrument panel.
   (3) Deicer operation indicator light with press-to-test feature is located on the left side panel. Light illuminates during inflation.
   (4) When the switch is activated, wing and empennage boots inflate simultaneously for 6 seconds, then deflate.
   (5) Switch must be manually activated for each inflation cycle.
   (6) Most effective surface deicing is obtained if a thickness of 1/4 to 1/2 inch of ice is allowed to accumulate before the deicers are activated.
   (7) Preflight check
      a. Press to test deice indicator light.
      b. Check indicators for pneumatic source malfunction.
      c. At approximatley 2000 RPM, turn surface deice ON. In approximately 3 seconds, deice light will illuminate for 6 seconds then extinguish. Visually check boots for inflation.

d. During inflation, check pneumatic indicators. When pneumatic deicers are turned ON, note a momentary drop in pressure, then a gradual increase toward upper limit, then a momentary drop toward lower limit. When the cycle is complete, note a gradual increase to approximately 4 inches of mercury.

e. A continued drop in pneumatic pressure at the end of the cycle or a time between boot actuation and indicator light illumination exceeding 4 seconds indicates a possible malfunction and a need for investigation.

NOTE

Some of the deicing equipment draws considerable current. The electrical load should be monitored carefully, especially during single-engine operation.

SECTION 5 - PERFORMANCE

Installation of Icing Equipment does not affect the basic performance information presented in Section 5 of this Pilot's Operating Handbook.

THIS PAGE INTENTIONALLY LEFT BLANK

SUPPLEMENT 3

FCS-810 AFCS WITH FLIGHT DIRECTOR INSTALLATION

SECTION 1 - GENERAL

This supplement supplies information necessary for the efficient operation of the airplane when the optional FCS-810 with the FC-823F Flight Controller is installed. The information contained within this supplement is to be used in conjunction with the complete handbook.

This supplement has been "DOA Approved" as a permanent part of this handbook based on Bendix STC No. SA437SO and must remain in this handbook at all times when the optional FCS-810 AFCS with Flight Director is installed.

SECTION 2 - LIMITATIONS

NOTE

The maximum altitude for operation of the autopilot has not been determined. The maximum altitude demonstrated during flight test was 24,000 ft.

(a) Autopilot OFF during takeoff and landing.
(b) Do not engage autopilot if airplane is out of trim.
(c) Maximum airspeed for autopilot operation is 230 KIAS.
(d) During autopilot operation, the pilot must be in his seat with the safety belt fastened.
(e) Do not manually override autopilot to produce or prevent pitch attitude changes or to increase bank angle.
(f) As the autopilot may mask high control forces necessary to counter an asymmetric ("split") flap condition, actuate the flaps only while the airplane is under manual control - not while the autopilot is engaged. Autopilot operation not authorized with greater than 15° of flaps extended.
(g) Do not engage the altitude hold mode with vertical speeds in excess of 1500 feet per minute.

SECTION 3 - EMERGENCY PROCEDURES

(a) Autopilot

(1) In the event a malfunction in the autopilot performance is detected, the pilot must immediately disengage the autopilot by momentarily pressing the TRIM/AUTOPILOT DISCONNECT SWITCH. This switch is on the left side of the pilot's control wheel.

(2) Maximum altitude loss during malfunction tests in the following flight configuration.

a.	Cruise, Climb, Descent	150 feet
b.	ILS Approach (with all engines operating)	100 feet
c.	ILS Approach (with one engine inoperative)	100 feet

(b) Single-Engine Operation

(1) Autopilot performance has been satisfactorily demonstrated during simulated failure of one engine. In the event that the pilot elects to continue single-engine operation with autopilot, disengage the autopilot; re-trim the aircraft for single-engine operation; and re-engage the autopilot.

(2) Do not initiate single-engine go-around in coupled GA mode. After aircraft is stabilized and trimmed out in single-engine climb, autopilot may be engaged.

(c) Pitch Trim

(1) If trim warning light illuminates in flight, or if electric trim runs at any time without actuating the trim switch, an overpower force up to 20 lbs. at the control wheel will be experienced at time of disengagement (3-second delay for recognition time). Turn trim ON-OFF switch OFF, pull the pitch trim circuit breaker, and have system inspected prior to operation.

(2) If the trim circuit breaker releases, or the trim follow-up becomes inoperative during autopilot operation, disengage the autopilot and pull the trim circuit breaker.

SECTION 4 - NORMAL OPERATING PROCEDURES

(a) Manual Electric Trim

Manual electric trim is provided as standard equipment with the autopilot installation. The manual electric trim system is powered through the aircraft master switch, and a trim ON-OFF switch, located on the left side of the pilot's control wheel, both of which must be on for electric trim operation. A circuit breaker, located on the circuit breaker panel, provides circuit protection. Electric trim is obtained by actuating the electric trim switch on the pilot's control wheel in the desired direction.

PRE-FLIGHT

(a) Flight Director - Autopilot
  (1) FD/AP MASTER SWITCH - Turn FD/AP Master Switch to ON.
  (2) The Flight Director incorporates a Director Horizon in lieu of the conventional Artificial Horizon. In addition to supplying attitude information to the computer the Director Horizon displays commands which receive information from the computer. By maneuvering the aircraft to satisfy the commands, the pilot is acting in the same manner as the autopilot servos.
  (3) Adjust pitch command or depress pitch SYNC button to align the commands with the fixed reference of the Director Horizon.
  (4) BEFORE TAKEOFF - Engage the autopilot, apply a force to the controls (on one axis at a time) to determine if the autopilot may be overpowered.
    a. Press HDG, NAV, APPR, ALT, GS PUSH MAN, and REV buttons one at a time, and check respective lights on the Flight Controller for operation.

(b) Manual Electric Trim
  (1) Trim Warning Light - OUT
  (2) Actuate electric trim switch and observe proper direction of movement of manual trim wheel - CHECK
  (3) Manual Trim Wheel Freedom of Movement - CHECK
  (4) Press the press-to-test button in the area of trim warning light. Light should light while being pressed and trim should not run. If trim runs, or if light does not illuminate, turn trim ON-OFF switch OFF, pull trim circuit breaker, and do not reset until the problem has been corrected.
  (5) Turn trim ON-OFF switch to OFF. Push trim switch to UP or DN. Trim should not run.
  (6) Turn TRIM ON-OFF switch ON.
  (7) Recheck aircraft pitch trim prior to takeoff.

IN-FLIGHT

NOTE

When engaging the autopilot, the pitch synchronizer will automatically stabilize the aircraft in the pitch attitude existing at the time of engagement.

(a) Engagement
  (1) Manually adjust aircraft trim in WINGS-LEVEL attitude prior to engaging autopilot. Press the AP ENGAGE BUTTON which will light upon engagement. To climb, actuate the pitch rocker switch to UP. To descend, actuate the pitch rocker switch to DN.
  (2) PITCH SYNC BUTTON - Pressing and holding the PITCH SYNC button, located on the pilot's wheel, disengages the pitch axis to allow the pilot to manually change the aircraft pitch attitude. The pitch trim indicator, when centered, indicates to the pilot that the autopilot has synchronized to the aircraft pitch attitude. While the PITCH SYNC button is depressed, manual electric trim may be actuated without disengaging the autopilot. When the PITCH SYNC button is released, the pitch axis will again engage, synchronized to the new pitch attitude. SYNC will cancel GS, ALT, or GA modes.

(b) Automatic Pitch Trim

Automatic pitch trim is provided whenever the autopilot is engaged. Any attempt to overpower the autopilot pitch axis will cause the pitch trim to oppose the applied force, resulting in an out-of-trim condition.

(c) Manual Electric Trim/AP Disengage

During normal AP operations, actuation of the trim switch in either direction disconnects AP and electric trim is immediately available. The electric trim system design is such that a single fault, other than a stuck switch will not cause a runaway trim. Other faults will be indicated by the trim warning light or by a preflight check. Illumination of the trim warning light indicates that a single fault has occurred, but trim will not run away. (See Emergency Pitch Trim Procedures.)

(d) Altitude Hold

The ALT button may be depressed at any time the vertical speed is less than 1500 feet per minute. Aircraft pressure altitude will be held when the autopilot altitude hold is engaged. Momentarily actuating the pitch rocker switch in either direction, engagement of the glide slope, or pressing the PITCH SYNC switch disengages the altitude hold function.

NOTE

The altitude controller attempts to maintain the aircraft at the selected altitude by changing the pitch attitude of the aircraft. The human pilot must then maintain power settings to assure a safe airspeed. In level flight, the autopilot should hold altitude within 20 feet of the pre-selected altitude; however, during turns there may be altitude excursions greater than 20 feet, but in no instance should the excursions be greater than 100 feet.

NOTE

If for any reason the selected altitude is deviated from by approximately 300 feet, the altitude controller will recycle to the new altitude.

(e) Heading Mode

The heading knob on the Horizontal Situation Display (HSD) may be used to select a heading prior to pushing the HDG button. When the HDG button is pressed, the button will light and the aircraft will turn to the selected heading in the direction which is less than 180°, and at a bank angle of no more than 25°.

(f) En Route Navigation

NOTE

There are two methods of intercepting a VOR radial.

(1) Variable Intercept Angle - With this method, the pilot may preselect any intercept angle desired.

a. After identifying desired omni station, select desired omni course by rotating the CRS knob on the HSD until the course select pointer aligns with the desired omni course.

b. Position the heading bug to select the desired intercept angle by rotating the HDG knob on the HSD. The number of degrees between the course select pointer and the heading bug is the intercept angle. The pilot should not select an intercept angle less than 20°, or more than 90°.

c. Simultaneously press HDG and NAV buttons on the controller. HDG and NAV buttons will light. The aircraft will turn toward the heading selected until the lateral deviation needle moves approximately one dot away from full deflection. At this time, the HDG button light on the controller will go out and the aircraft will assume a normal 45° intercept angle.

(2) Fixed Intercept Angle

a. After identifying the desired omni station, select desired omni course on the HSD by rotating the CRS knob until the course select pointer aligns with the desired omni course.

b. Press the NAV button. Button light comes on. Aircraft will turn left or right, depending upon the relation of the aircraft heading to that of the selected omni bearing. If the omni bearing selected is less than 120° from the aircraft heading when the NAV mode is selected, the aircraft will turn toward the selected omni course. At angles of 120° or greater, the aircraft will turn away from the selected omni course and continue to turn through the larger angle until a proper intercept angle is established. In either case, the aircraft will assume an intercept course which will be no greater than 45° to the selected omni course.

(g) Automatic Approach Coupler

NOTE

There are two methods of intercepting the localizer.

(1) Variable Intercept Angle - This method is recommended when being vectored toward the localizer, by approach control, with the HDG and APPR modes engaged.

a. Align course arrow with the published inbound course by rotating the CRS knob on the HSD.

b. Position the heading bug to select the desired intercept angle by rotating the HDG knob on the HSD.

c. Simultaneously press HDG and APPR buttons on the controller. HDG and APPR buttons will light. Aircraft will turn toward the heading selected until the lateral deviation needle moves approximately one dot away from full deflection. At this time, the HDG button light on the controller will go out and the aircraft will assume a normal 45° intercept angle.

(2) Fixed Intercept Angle

a. Align the course select pointer with the published inbound course by rotating the CRS knob on the HSD.

b. Press the APPR button on the controller. The APPR button will light and aircraft will turn left or right, depending upon the relation of the aircraft heading to that of the localizer inbound heading. Aircraft will automatically assume an intercept course of no more than 45° to the localizer. For the reason explained in Paragraph (f) (2) b., do not select APPR until the aircraft heading is less than 120° from the localizer inbound heading.

(3) Glide Slope

a. Automatic Engage

Glide slope is automatically armed and the aircraft will bracket the glide slope and begin a rate of descent commensurate with the glide slope angle. The pilot must maintain airspeed with power, providing the following conditions are met:

1. The APPR button is pressed.
2. The aircraft must approach the glide path from below.
3. Aircraft is established on localizer beam at least 20 seconds prior to glide slope interception.
4. The glide slope pointer is centered.

b. Manual Engage

If desired, glide slope may be captured manually by actuating glide slope button when glide slope pointer centers, provided the aircraft is in approach mode.

c. Glide Slope Mode

1. When the aircraft couples to the glide slope signal, the GS PUSH MAN light on the controller will light, and ALT light extinghishes.
2. Glide slope may be disengaged while flying the localizer by pressing ALT, HDG or NAV button on the controller; actuating pitch rocker switch; depressing the GA button; or pitch SYNC button.

d. Back Course Localizer

For a back course localizer approach, select the localizer front course inbound heading. Press REV button on controller. Both APPR and REV button lights will light, indicating to the pilot that he is in both the localizer and reverse modes.

e. Go-Around

Go-around switch may be pressed any time the pilot decides not to continue the approach to landing. Pressing the GA switch will cause the aircraft to automatically assume a pitch attitude of approximately seven degrees nose-up. (Pilot must adjust power settings to maintain airspeed.) Aircraft will continue to track localize. GA light on controller will light. If a missed approach heading is selected and HDG button pressed, aircraft will turn to the selected heading, and remain in a pitch-up attitude of approximately seven degrees. Movement of the pitch rocker switch, pressing the pitch SYNC button, or ALT button will disengage the GA mode.

f. AP Release Switch

If the approach is carried to completion, the Trim/Autopilot Disconnect switch must be momentarily pressed prior to landing, thus disconnecting the automatic pilot and returning the aircraft to manual control for completion of the landing.

SECTION 5 - PERFORMANCE

Installation of the FCS-810 AFCS does not effect the basic Performance information presented by Section 5 of this handbook.

SUPPLEMENT 4

FCS-810 AFCS WITHOUT FLIGHT DIRECTOR INSTALLATION

SECTION 1 - GENERAL

This supplement supplies information necessary for the efficient operation of the airplane when the optional FCS-810 with the FC-823E Flight Controller is installed. The information contained within this supplement is to be used in conjunction with the complete handbook.

This supplement has been "DOA Approved" as a permanent part of this handbook based on Bendix STC No. SA437SO and must remain in this handbook at all times when the optional FCS-810 AFCS without Flight Director is installed.

SECTION 2 - LIMITATIONS

NOTE

The maximum altitude for operation of the autopilot has not been determined. The maximum altitude demonstrated during flight tests was 24,000 feet.

(a) Autopilot OFF during takeoff and landing.
(b) Do not engage autopilot if airplane is out of trim.
(c) Maximum airspeed for autopilot operation is 230 KIAS.
(d) During autopilot operation, the pilot must be in his seat with the safety belt fastened.
(e) Do not manually override autopilot to produce or prevent pitch attitude changes or to increase bank angle.
(f) As the autopilot may mask the high control forces necessary to counter an asymmetric ("split") flap condition, actuate the flaps only while the airplane is under manual control - not while the autopilot is engaged. Autopilot operation not authorized with greater than 15° of flaps extended
(g) Do not engage the altitude hold mode with vertical speeds in excess of 1500 feet per minute.

SECTION 3 - EMERGENCY PROCEDURES

(a) Autopilot
(1) In the event a malfunction in the autopilot performance is detected, the pilot must immediately disengage the autopilot by momentarily pressing the TRIM/AUTOPILOT DISCONNECT SWITCH. This switch is on the left side of the pilot's control wheel.
(2) Maximum altitude loss during malfunction tests in the following flight configuration.

a.	Cruise, Climb, Descent	150 feet
b.	ILS Approach (with all engines operating)	100 feet
c.	ILS Approach (with one engine inoperative)	100 feet

(b) Single-Engine Operation
  (1) Autopilot performance has been satisfactorily demonstrated during simulated failure of one engine. In the event that the pilot elects to continue single-engine operation with autopilot, disengage the autopilot; re-trim the aircraft for single-engine operation; and re-engage the autopilot.
  (2) Do not initiate single-engine go-around in coupled GA mode. After aircraft is stabilized and trimmed out in single-engine climb, autopilot may be engaged.

(c) Pitch Trim
  (1) If trim warning light illuminates in flight, or if electric trim runs at any time without actuating the trim switch, an overpower force up to 20 lbs. at the control wheel will be experienced at time of disengagement (3-second delay for recognition time). Turn trim ON-OFF switch OFF, pull the pitch trim circuit breaker, and have system inspected prior to operation.
  (2) If the trim circuit breaker releases, or the trim follow-up becomes inoperative during autopilot operation, disengage the autopilot and pull the trim circuit breaker.

SECTION 4 - NORMAL OPERATING PROCEDURES

(a) Manual Electric Trim

Manual electric trim is provided as standard equipment with the autopilot installation. The manual electric trim system is powered through the aircraft master switch, and a trim ON-OFF switch, located on the left side of the pilot's control wheel, both of which must be on for electric trim operation. A circuit breaker, located on the circuit breaker panel, provides circuit protection. Electric trim is obtained by actuating the electric trim switch on the pilot's control wheel in the desired direction.

PRE-FLIGHT

(a) Autopilot
  (1) Turn the autopilot master switch to "ON."
  (2) Check attitude gyro for proper erection. Set the directional gyro, if manual slaving type.
  (3) Depress the Pitch SYNC Button to center trim indicator.
  (4) Engage the autopilot; apply a force to the controls (one axis at a time) to determine if the autopilot may be overpowered.
  (5) Press HDG, NAV, APPR, ALT, GS PUSH MAN, and REV buttons, one at a time, and check respective lights on flight controller for proper operations.

(b) Manual Electric Trim
  (1) Trim Warning Light - OUT
  (2) Actuate electric trim switch and observe proper direction of movement of manual trim wheel - CHECK
  (3) Manual Trim Wheel Freedom of Movement - CHECK
  (4) Press the press-to-test button in the area of trim warning light. Light should light while being pressed and trim should not run. If trim runs, or if light does not illuminate, turn trim ON-OFF switch OFF, pull trim circuit breaker, and do not reset until the problem has been corrected.
  (5) Turn trim ON-OFF switch to OFF. Push trim switch to UP or DN. Trim should not run.
  (6) Turn TRIM ON-OFF switch ON.
  (7) Recheck aircraft pitch trim prior to takeoff.

IN-FLIGHT

NOTE

When engaging the autopilot, the pitch synchronizer will automatically stabilize the aircraft in the pitch attitude existing at the time of engagement.

(a) Engagement

(1) Manually adjust aircraft trim in WINGS-LEVEL attitude prior to engaging autopilot. Press the AP ENGAGE BUTTON which will light upon engagement. To climb, actuate the pitch rocker switch to UP. To descend, actuate the pitch rocker switch to DN.

(2) PITCH SYNC BUTTON - Pressing and holding the PITCH SYNC button, located on the pilot's wheel, disengages the pitch axis to allow the pilot to manually change the aircraft pitch attitude. The pitch trim indicator, when centered, indicates to the pilot that the autopilot has synchronized to the aircraft pitch attitude. While the PITCH SYNC button is depressed, manual electric trim may be actuated without disengaging the autopilot. When the PITCH SYNC button is released, the pitch axis will again engage, synchronized to the new pitch attitude. SYNC will cancel GS, ALT, or GA modes.

(b) Automatic Pitch Trim

Automatic pitch trim is provided whenever the autopilot is engaged. Any attempt to overpower the autopilot pitch axis will cause the pitch trim to oppose the applied force, resulting in an out-of-trim condition.

(c) Manual Electric Trim/AP Disengage

During normal AP operations, actuation of the trim switch in either direction disconnects AP and electric trim is immediately available. The electric trim system design is such that a single fault, other than a stuck switch will not cause a runaway trim. Other faults will be indicated by the trim warning light or by a preflight check. Illumination of the trim warning light indicates that a single fault has occurred, but trim will not run away. (See Emergency Pitch Trim Procedures.)

(d) Altitude Hold

The ALT button may be depressed at any time the vertical speed is less than 1500 feet per minute. Aircraft pressure altitude will be held when the autopilot altitude hold is engaged. Momentarily actuating the pitch rocker switch in either direction, engagement of the glide slope, or pressing the PITCH SYNC switch disengages the altitude hold function.

NOTE

The altitude controller attempts to maintain the aircraft at the selected altitude by changing the pitch attitude of the aircraft. The human pilot must then maintain power settings to assure a safe airspeed. In level flight, the autopilot should hold altitude within 20 feet of the pre-selected altitude; however, during turns there may be altitude excursions greater than 20 feet, but in no instance should the excursions be greater than 100 feet.

NOTE

If for any reason the selected altitude is deviated from by approximately 300 feet, the altitude controller will recycle to the new altitude.

(e) Heading Mode
The heading knob on the Horizontal Situation Display (HSD) or DG may be used to select a heading prior to pushing the HDG button. When the HDG button is pressed, the button will light and the aircraft will turn to the selected heading in the direction which is less than 180°, and at a bank angle of no more than 25°.

(f) En Route Navigation

NOTE

There are two methods of intercepting a VOR radial.

(1) Variable Intercept Angle - With this method, the pilot may preselect any intercept angle desired.
   a. After identifying desired omni station, select desired omni course by rotating the CRS knob on the HSD or NAV indicator until the course select pointer aligns with the desired omni course.
   b. Position the heading bug to select the desired intercept angle by rotating the HDG knob on the HSD or DG. The number of degrees between the course select pointer and the heading bug is the intercept angle. The pilot should not select an intercept angle less than 20°, or more than 90°.
   c. Simultaneously press HDG and NAV buttons on the controller. HDG and NAV buttons will light. The aircraft will turn toward the heading selected until the lateral deviation needle moves approximately one dot away from full deflection. At this time, the HDG button light on the controller will go out and the aircraft will assume a normal 45° intercept angle.

NOTE

If the NAV indicator is not equipped with a course datum synchro, the heading bug must be reset to the same heading as the course select pointer when the HDG light goes out.

(2) Fixed Intercept Angle
   a. After identifying the desired omni station, select desired omni course on the HSD or NAV indicator by rotating the CRS knob until the course select pointer aligns with the desired omni course.

b. Press the NAV button. Button light comes on. Aircraft will turn left or right, depending upon the relation of the aircraft heading to that of the selected omni bearing. If the omni bearing selected is less than 120° from the aircraft heading when the NAV mode is selected, the aircraft will turn toward the selected omni course. At angles of 120° or greater, the aircraft will turn away from the selected omni course and continue to turn through the larger angle until a proper intercept angle is established. In either case, the aircraft will assume an intercept course which will be no greater than 45° to the selected omni course.

NOTE

If the NAV indicator is not equipped with a course datum synchro, the heading bug must be set to the same heading as the course select pointer.

(g) Automatic Approach Coupler

NOTE

There are two methods of intercepting the localizer.

(1) Variable Intercept Angle - This method is recommended when being vectored toward the localizer, by approach control, with the HDG and APPR modes engaged.
   a. Align course arrow with the-published inbound course by rotating the CRS knob on the HSD or NAV indicator.
   b. Position the heading bug to select the desired intercept angle by rotating the HDG knob on the HSD or DG.
   c. Simultaneously press HDG and APPR buttons on the controller. HDG and APPR buttons will light. Aircraft will turn toward the heading selected until the lateral deviation needle moves approximately one dot away from full deflection. At this time, the HDG button light on the controller will go out and the aircraft will assume a normal 45° intercept angle.

NOTE

If the NAV indicator is not equipped with a course datum synchro, the heading bug must be reset to the same heading as the course select pointer when the HDG light goes out.

(2) Fixed Intercept Angle
   a. Align the course select pointer with the published inbound course by rotating the CRS knob on the HSD or NAV indicator.
   b. Press the APPR button on the controller. The APPR button will light and aircraft will turn left or right, depending upon the relation of the aircraft heading to that of the localizer inbound heading. Aircraft will automatically assume an intercept course of no more than 45° to the localizer. For the reason explained in Paragraph (f) (2) b., do not select APPR until the aircraft heading is less than 120° from the localizer inbound heading.

NOTE

If the NAV indicator is not equipped with a course datum synchro, the heading bug must be set to the same heading as the course select pointer.

(3) Glide Slope

a. Automatic Engage

Glide slope is automatically armed and the aircraft will bracket the glide slope and begin a rate of descent commensurate with the glide slope angle. The pilot must maintain airspeed with power, providing the following conditions are met:

1. The APPR button is pressed.
2. The aircraft must approach the glide path from below.
3. Aircraft is established on localizer beam at least 20 seconds prior to glide slope interception.
4. The glide slope pointer is centered.

b. Manual Engage

If desired, glide slope may be captured manually by actuating glide slope button when glide slope pointer centers, provided the aircraft is in approach mode.

c. Glide Slope Mode

1. When the aircraft couples to the glide slope signal, the GS PUSH MAN light on the controller will light, and ALT light extinghishes.
2. Glide slope may be disengaged while flying the localizer by pressing ALT. HDG or NAV button on the controller; actuating pitch rocker switch; depressing the GA button; or pitch SYNC button.

d. Back Course Localizer

For a back course localizer approach, select the localizer front course inbound heading. Press REV button on controller. Both APPR and REV button lights will light, indicating to the pilot that he is in both the localizer and reverse modes.

e. Go-Around

Go-around switch may be pressed any time the pilot decides not to continue the approach to landing. Pressing the GA switch will cause the aircraft to automatically assume a pitch attitude of approximately seven degrees nose-up. (Pilot must adjust power settings to maintain airspeed.) Aircraft will continue to track localized GA light on controller will light. If a missed approach heading is selected and HDG button pressed, aircraft will turn to the selected heading, and remain in a pitch-up attitude of approximately seven degrees. Movement of the pitch rocker switch, pressing the pitch SYNC button, or ALT button will disengage the GA mode.

f. AP Release Switch

If the approach is carried to completion, the Trim/Autopilot Disconnect switch must be momentarily pressed prior to landing, thus disconnecting the automatic pilot and returning the aircraft to manual control for completion of the landing.

SECTION 5 - PERFORMANCE

Installation of the FCS-810 AFCS does not effect the basic Performance information presented by Section 5 of this handbook.

SUPPLEMENT 5

ALTIMATIC IIIC INSTALLATION
(Includes Roll, Pitch and Pitch Trim)

SECTION 1 - GENERAL

This supplement supplies information necessary for the efficient operation of the airplane when the optional AltiMatic IIIC 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 AltiMatic IIIC is installed.

SECTION 2 - LIMITATIONS

(a) The maximum speed for autopilot operation is 218 KIAS. (Autopilot Vmo)
(b) As the autopilot may mask high control forces necessary to counter an asymmetric ("split") flap condition, actuate the flaps only while the airplane is under manual control — not while the autopilot is engaged. Autopilot operation not authorized with greater than 15° of flaps extended.
(c) Autopilot "OFF" for takeoff and landing.
(d) Placard, "Conduct Trim Check Prior to Flight (See POH)" to be installed in clear view of pilot.
(e) During autopilot operation, the pilot must be in his seat with the safety belt fastened.

SECTION 3 - EMERGENCY PROCEDURES

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

NOTE

During examination of this supplement, the pilot is advised to locate and identify the Autopilot controls, the Trim Master Switch and the Circuit Breakers for both systems.

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

CAUTION

Do not overpower Autopilot pitch axis for periods longer than 3 seconds because the Autotrim System will operate in a direction to oppose the pilot and will, thereby, cause an increase in the pitch overpower forces.

  (2) Disconnected by depressing the Master Disc/Inter Switch.
  (3) Disconnected by depressing the Trim Switch "A/P OFF" bar.
  (4) Disconnected by pushing the Roll rocker switch "OFF."

(b) In the event of a Trim malfunction:
  (1) Depress and hold the Master Trim Interrupt Switch.
  (2) Trim Master Switch - OFF. Retrim aircraft as necessary using manual trim system.
  (3) Release Master Trim Interrupt Switch - be alert for possible trim action.
  (4) Trim Circuit Breaker - Pull. Do not operate trim until problem is corrected.

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

(d) Altitude Loss During Malfunction:
  (1) An Autopilot malfunction during climb or cruise with a 3 second delay in recovery initiation could result in as much as 50° of bank and a 400 foot altitude loss.
  (2) Altitude loss - high altitude descent - 3 second delay in recovery could result in a 30° bank and a 800 foot altitude loss.
  (3) An Autopilot malfunction during an approach with a 1 second delay in recovery initiation could result in as much as 15° of bank and a 100 foot altitude loss. Maximum altitude loss measured in approach configuration gear down and operating either coupled or uncoupled, single or multi-engine.

(e) Single Engine Operations:
  (1) Engine failure during an Autopilot approach operation: Disengage Autopilot conduct remainder of approach manually.
  (2) Engine failure during Go-Around: Disengage Autopilot, retrim aircraft, perform normal aircraft engine out procedures then re-engage Autopilot.
  (3) Engine failure during normal climb, cruise, descent: Retrim aircraft, perform normal aircraft engine out procedures.
  (4) Maintain aircraft yaw trim throughout all single engine operations.

EMERGENCY OPERATION WITH OPTIONAL HSI
(Slaved and/or Non-Slaved)

(a) Appearance of HDG Flag:
  (1) Check air supply gauge (vac or pressure) for adequate air supply (4 in. Hg min.).
  (2) Check compass circuit breaker.
  (3) Observe display for proper operation.
(b) To disable heading card - pull circuit breaker and use magnetic compass for directional data. Note: If heading card is not operational, autopilot should not be used.
(c) With card disabled - VOR and Glide Slope displays are still functional; use card set to rotate card to aircraft heading for correct picture.
(d) Localizer - left-right information still usable. Flag information is disabled - compare needle with #2 indicator for valid left-right needle operation.
(e) Slaving Failure - (i.e. failure to self-correct for gyro drift):
  (1) Check gyro slaving switch is set to No. 1 position.
  (2) Check for HDG Flag.
  (3) Check compass circuit breaker.
  (4) Reset heading card while observing slaving meter.
  (5) Select slaving amplifier #2 (gyro slaving switch is set to No. 2 position).
  (6) Reset heading card while checking slaving meter.
  (7) Switch to free gyro and periodically set card as unslaved gyro.

SECTION 4 - NORMAL PROCEDURES

PREFLIGHT

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

(b) Pitch Section
  (1) Engage "Roll" rocker switch.
  (2) Center pitch command disc and engage "Pitch" rocker switch.
  (3) Rotate pitch command disc full DOWN and full UP and check control wheel describes a corresponding fore and aft movement. Check to see that servo can be overridden by hand at control wheel.

NOTE

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

(4) Hold control wheel and disengage Autopilot by pressing Master A/P Disconnect/Trim Interrupt switch button. Check Roil and Pitch controls to assure autopilot has disconnected.

(c) Trim Section (General)

This aircraft is equipped with a Command Trim System designed to withstand any type of single malfunction, either mechanical or electrical, without uncontrolled operation resulting. The preflight check procedure is designed to uncover hidden failures that might otherwise go undetected. Proper operation of the electric elevator trim system is predicated on conducting the following preflight check before each flight. If the trim system fails any portion of the procedure, pull the trim circuit breaker out until the system is repaired. Substitution of any trim system component for another model is not authorized. For emergency interrupt information, refer to Section 3 - Emergency Procedures of this supplement.

The Command Electric Trim Switch on the left hand portion of the pilot's control wheel has two functions:

(1) When the top bar (A/P off) is pressed, it disconnects the Autopilot.
(2) When the top bar is pressed and the rocker is moved forward, nose down trim will occur - when moved aft, nose up trim will occur.

PREFLIGHT: Command Trim - Before Each Flight

(1) Check trim circuit breaker - IN.
(2) Trim Master Switch - ON.
(3) A/P OFF - Check normal trim operation - UP. Grasp trim wheel and check override capability. Check nose DOWN operation. Recheck override.
(4) Press center bar only - trim should not operate.
(5) Without pressing center bar, move rocker fore and aft - trim should not operate.

AUTOTRIM: Before Each Flight

(1) A/P ON - (Roll and Pitch Sections) Check automatic operation by activating A/P Pitch Command Disc UP, then DN. Observe trim operation follows Pitch Command Direction.

NOTE

In Autopilot Mode, there will be approximately a 3 second delay between operation of Pitch Command and operation of trim.

(2) Press center bar (A/P OFF) - release - check autopilot disengagement.
(3) Rotate trim wheel to check manual trim operation. Reset to takeoff position prior to takeoff.

IN-FLIGHT

(a) Trim airplane (ball centered).

(b) Check air pressure or vacuum to ascertain that the Directional Gyro and Attitude Gyro are receiving sufficient air.

(c) Roll Section
   (1) To engage, center Roll Command Knob, push Roll rocker switch to the "ON" position. To turn, rotate Roll Command Knob in desired direction. (Maximum angle of bank should not exceed 30°.)
   (2) For heading mode, set Directional Gyro with Magnetic Compass. Push directional gyro HDG knob in, rotate to select desired heading. Push HDG rocker switch to the "ON" position. (Maximum angle of bank will be 20° with heading lock engaged.)

(d) Pitch Section - (Roll Section must be engaged prior to engaging Pitch Section.)
   (1) Center pitch trim indicator with the Pitch Command Disc.
   (2) Engage pitch rocker switch. To change attitude, rotate Pitch Command Disc in the desired direction.

(e) Altitude Hold

Upon reaching desired or cruising altitude, engage ALT Hold Mode rocker switch. As long as ALT Hold Mode rocker switch is engaged, aircraft will maintain selected altitude. For Maximum Passenger comfort, rate of climb or descent should be reduced to approximately 500 FPM prior to Altitude Hold engagement. For accurate Altitude Holding below 95 KIAS, disengage the autopilot, lower flaps to takeoff position, retrim and re-engage the autopilot.

NOTE

Prior to disengaging Altitude Hold Mode, rotate Pitch Command Disc to center.

(f) Radio Coupling VOR/ILS with H.S.I. (Horizontal Situation Indicator) Type Instrument Display. (Optional)

VOR Navigation
   (1) Tune and identify VOR Station. Select desired course by rotating CRS knob of H.S.I.
   (2) Select OMNI mode on Radio Coupler.
   (3) Engage HDG mode on autopilot console to engage coupler. Aircraft will turn to a 45° intercept angle to intercept the selected VOR course. Intercept angle magnitude depends on radio needle off-course magnitude, 100% needle deflection will result in 45° intercept angle, diminishing as the needle off-set diminishes.
   (4) NAV mode - NAV mode provides reduced VOR sensitivity for tracking weak, or noisey, VOR signals. NAV mode should be selected after the aircraft is established on course.

ILS/LOC Front Course
   (1) Set inbound, front, localizer course on H.S.I.
   (2) Select LOC/NORM mode on Radio Coupler to intercept and track inbound on the localizer. Select LOC/REV to intercept and track the localizer course outbound to the procedure turn area.
   (3) Engage HDG mode on autopilot console to engage coupler.

ILS/Back Course
(1) Set inbound, front, localizer course on H.S.I.
(2) Select LOC/REV on Radio Coupler to intercept and track inbound on the back localizer course. Select LOC/NORM to intercept and track outbound on the back course to the procedure turn area.
(3) Engage HDG mode on autopilot console to engage coupler.

(g) Radio Coupling VOR/ILS with Standard Directional Gyro

NOTE

Radio Coupler operation in conjunction with a standard Directional Gyro and VOR/LOC display differs from operation with an integrated display (H.S.I.) only in one respect. The Heading Bug is used as the radio course datum and therefore must be set to match the desired VOR/ILS course as selected on the O.B.S.

(1) For VOR Intercepts and Tracking: Select the desired VOR course and set the Heading Bug to the same heading. Select OMNI mode on the coupler and engage the HDG mode on the autopilot console.
(2) For ILS Front Course Intercepts and Tracking: Tune the localizer frequency and place the Heading Bug on the inbound, front course heading. Select LOC/NORM mode on the coupler and engage HDG mode on the autopilot console.
(3) For LOC Back Course Intercepts and Tracking: Tune the localizer frequency and place the Heading Bug on the inbound course heading to the airport. Select LOC/REV mode on the coupler and engage HDG mode on the autopilot console.

COUPLED APPROACH OPERATIONS

(a) VOR or LOC
(1) After arrival at the VOR Station, track outbound to the procedure turn area as described in In-Flight item (f) or (g), as appropriate, and slow to 105-120 KIAS. Disengage the autopilot, lower flaps to takeoff position (15° extension), retrim and re-engage the autopilot.
(2) Use HDG mode and Pitch or ALT Hold modes as appropriate during procedure turn.
(3) At the F.A.F. inbound, return to pitch mode for control of descent and lower landing gear.
(4) At the M.D.A. engage ALT Hold mode and add power for level fight. Monitor Altimeter to assure accurate altitude control is being provided by the autopilot.
(5) Go-Around. For missed approach, select desired pitch attitude with Pitch Command Disc and disengage ALT Hold mode. This will initiate the pitch up attitude change. Immediately add takeoff power and monitor Altimeter and rate of climb for positive climb indication. After climb is established, retract landing gear, disengage the autopilot, raise the flaps, readjust trim and re-engage the autopilot. Adjust attitude as necessary for desired airspeed and use HDG mode for turn from the VOR final approach course.

(b) ILS - Front Course Approach with Glide Slope Capture (Optional)
   (1) Track inbound to L.O.M. as described in In-Flight item (f) or (g), with ALT Hold mode engaged.
   (2) inbound to L.O.M. slow to 105-120 KIAS. Disengage the autopilot. lower flaps to the 15° position, retrim and re-engage the autopilot.
   (3) Automatic Glide Slope capture will occur at Glide Slope Intercept if the following conditions are met:
      a. Radio Coupler in LOC/NORM Mode.
      b. Altitude Hold Mode engaged (ALT rocker switch on console).
      c. Under Glide Slope for more than 20 seconds.
      d. Localizer radio frequency selected on NAV receiver.
   (4) At Glide Slope Intercept immediately lower landing gear and reduce power to maintain 105-120 KIAS on final approach. Glide Slope capture is indicated by lighting of the green Glide Slope engage Annunciator Lamp and by a slight pitch down of the aircraft.
   (5) Monitor localizer and Glide Slope raw data through out approach. Adjust power as necessary to maintain correct final approach airspeed. All power changes should be of small magnitude and smoothly applied for best tracking performance. Do not change aircraft configuration during approach while autopilot is engaged.
   (6) Conduct missed approach maneuver as described in Coupled Approach Operations, item (a)(5).

NOTE

Glide Slope Coupler will not automatically decouple from Glide Slope. Decoupling may be accomplished by any of the following means:

a. Disengage ALT Hold mode.
b. Switch Radio Coupler to HDG mode.
c. Disengage Autopilot.

SECTION 5 - PERFORMANCE

Installation of the AltiMatic IIIC does not affect the basic Performance information presented by Section 5 of this handbook.

THIS PAGE INTENTIONALLY LEFT BLANK

SUPPLEMENT 6

PIPER YAW DAMPER SYSTEM INSTALLATION

SECTION 1 - GENERAL

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

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

SECTION 2 - LIMITATIONS

Yaw Damper use not authorized above 236 KIAS. (Vne)

SECTION 3 - EMERGENCY PROCEDURES

(a) In the event of a Yaw Damper Malfunction:
  (1) Override Yaw Damper with rudder pedals initially.
  (2) Depress control wheel disengage switch, or
  (3) Yaw Damper Engage Switch - Push OFF.
  (4) Pull Yaw Damper Circuit Breaker until trouble is corrected.
  (5) A Yaw Damper runaway in climb, cruise or descent with a 3 second delay in recovery initiation could result in 25° bank and/or 14° yaw and approximately a 220 foot altitude loss. (Maximum altitude loss during descent at Vne)
  (6) A Yaw Damper runaway in approach operations will result in slight yaw angle and increased rudder forces.

SECTION 4 - NORMAL PROCEDURES

PREFLIGHT CHECK

(a) Engage Yaw Damper - Depress rudder pedals to check override.
(b) During straight taxi Yaw Damper should tend to oppose taxiing turns.
(c) Control wheel disengage switch - Depress - check disengagement.

NOTE

If aircraft is equipped with an Autopilot System, the Yaw Damper Quick Disengage feature will be connected to the Master Control Wheel Disengage Switch.

IN-FLIGHT

(a) Engage Yaw Damper as desired.

APPROACH/LANDING

(a) During approach operations small magnitude rudder feedback may be expected. For small rudder induced heading changes expect increased rudder forces. Pilot may elect to disengage Yaw Damper during approach if feedback or force increase is objectionable.
(b) Disengage Yaw Damper before landing.

SECTION 5 - PERFORMANCE

Installation of the Piper Yaw Damper System does not affect the basic Performance information presented by Section 5 of this handbook.

SUPPLEMENT 7

ALTIMATIC X AUTOPILOT OR FLIGHT DIRECTOR AUTOPILOT INSTALLATION

SECTION 1 - GENERAL

This supplement must be used in conjunction with the FAA Approved Pilot's Operating Handbook, dated 10-29-76 when Piper Altimatic X Autopilot Model AK685 or Altimatic X Flight Director Autopilot Model AK685FD is installed in accordance with STC SA3210SW-D. The information contained herein supplements the information of the basic Pilot's Operating Handbook; for limitations, procedures and performance information not contained in this supplement, consult the basic Pilot's Operating 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 Altimatic X Autopilot or Flight Director Autopilot is installed.

SECTION 2 - LIMITATIONS

(a) The maximum speed for autopilot operation is 217 KIAS (Autopilot Vmo).
(b) As the autopilot may mask high forces necessary to counter an asymmetric ("split") flap condition, actuate the flaps only while the airplane is under manual control — not while the autopilot is engaged. Autopilot operation not authorized with greater than 15° of flaps extended.
(c) Autopilot OFF for takeoff and landing.
(d) Placard, "Conduct trim check prior to flight (See POH)", to be installed in clear view of pilot.

SECTION 3 - EMERGENCY PROCEDURES

3.1 AUTOPILOT

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

NOTE

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

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

CAUTION

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

   (2) Disconnected by depressing the master disconnect/interrupt switch.
   (3) Disconnected by depressing the trim switch "AP OFF" bar.
   (4) Disconnected by pushing the AP ON-OFF annunciator switch on the autopilot programmer.

(b) ALTITUDE LOSS DURING MALFUNCTION
   (1) An autopilot malfunction during cruise with a 3 second delay in recovery initiation could result in as much as 50° of bank and 400' of altitude loss.
   (2) An autopilot malfunction during a high altitude descent at Vmo with a 3 second delay in recovery initiation could result in as much as 30° bank and 800' altitude loss.
   (3) An autopilot malfunction during an approach with a 1 second delay in recovery initiation could result in as much as 15° bank and 100' altitude loss. Maximum altitude loss measured in approach configuration gear down and operating either coupled or uncoupled, single or multi-engine.

(c) SINGLE ENGINE OPERATIONS - AUTOPILOT MODE
   (1) Engine failure during an autopilot approach operation: Disengage autopilot conduct remainder of approach manually.
   (2) Engine failure during go around: Disengage autopilot, retrim aircraft, perform normal aircraft engine out procedures then re-engage autopilot.
   (3) Engine failure during normal climb, cruise, descent: Retrim aircraft, perform normal aircraft engine out procedures.
   (4) Maintain aircraft yaw trim throughout all single engine operations.

NOTE

Proper autopilot performance requires that the aircraft trim be maintained.

3.2 TRIM SYSTEM

(a) In the event of a trim malfunction:
   (1) Depress and hold the master disconnect/interrupt switch.
   (2) Trim master switch - OFF. Retrim aircraft as necessary using manual trim system.
   (3) Release master interrupt switch - be alert for possible trim action.
   (4) Trim circuit breaker - Pull. Do not operate trim until problem is corrected.

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

3.3 COMPASS SYSTEM

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

NSD 360A

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

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

NOTE

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

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

(4) Slaving Failure - (i.e. failure to self correct for gyro drift):
   a. Check gyro slaving switch is set to No. 1 position. (If equipped with Slave No. 1 - No. 2 switch.)
   b. Check for HDG Flag.
   c. Check compass circuit breaker.
   d. Reset heading card while observing slaving meter.

NOTE

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

   e. Select slaving amplifier No. 2 (gyro slaving switch is set to No. 2 position).
   f. Reset heading card while checking slaving meter.
   g. Switch to free gyro mode and periodically set card as with an unslaved gyro.

NOTE

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

SECTION 4 - NORMAL PROCEDURES

4.1 SYSTEM DESCRIPTION

The Altimatic X Autopilot utilizes three axis sensing with two surface control to provide roll and pitch axis stabilization. The autopilot system also provides lateral and vertical radio coupling and command or automatic elevator pitch trim. A yaw damper providing rudder surface control is optional as an independent sub-system.

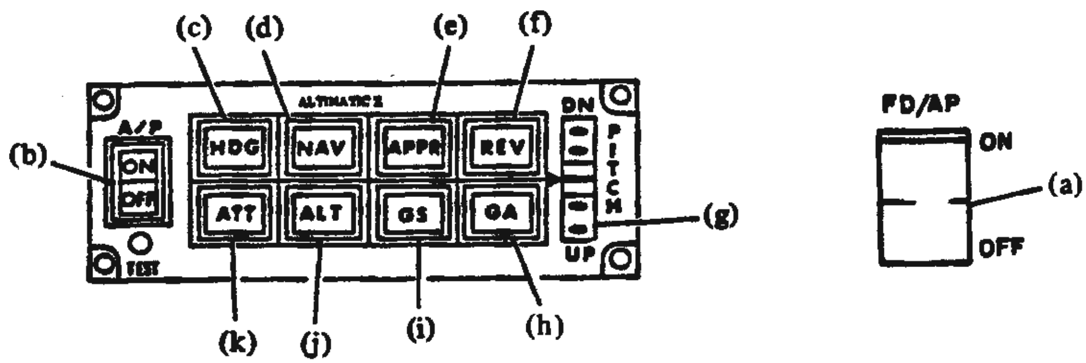
The Altimatic X is available as an integrated flight director and autopilot system by the use of one of the two optional Attitude Direction Indicators (A.D.I.) offered.

The system utilizes a separate master ON-OFF switch for autopilot and flight director power control. Mode selection is made by pushing the desired mode switch on the mode programmer. All mode annunciators are lighted on the programmer with the operating (selected) modes lighted to a higher brilliance than the others.

During night operation, the programmer annunciator light level is controlled by the pilot's instrument lamp control and light brilliance will track the light level selected for the flight instruments.

The electric trim system is powered through a separate system master switch that must be "ON" during autopilot operation.

4.2 COCKPIT CONTROL AND FUNCTIONS



(a) System Master Switch - Master power switch which must be "ON" for flight director and/or autopilot operation.

(b) Autopilot ON-OFF Switch - Pedestal mounted push ON - push OFF switch to engage or disengage autopilot (servos).

NOTE

Altimatic X systems without the optional Attitude Director Instrument (A.D.I.) will always return to HDG and ATT modes when the autopilot is engaged or disengaged. System with A.D.I. will not change modes during autopilot engage-disengage when flight director display is "ON." When the autopilot is engaged there will be approximately a 1 second lag during synchronization cycle.

(c) HDG (Heading) Mode Selector - provides turn control through use of the heading indice (bug) on the H.S.I. heading instrument.

(d) NAV (Navigation) Mode Selector - provides automatic 45° VOR intercept; tracking and crosswind correction for cross country VOR tracking. Utilizes information from H.S.I. VOR course indicator and left-right needle. (HDG bug is disabled during operation in NAV - APPR - REV modes.) Select desired course on H.S.I. Omni Bearing Selector (O.B.S.) and then select NAV mode.

(e) APPR (Approach) Mode Selector - provides automatic 45° VOR/LOC intercept angle, tracking and crosswind correction for use during instrument approach maneuver. Select desired course on H.S.I. Omni Bearing Selector (OBS) and then select APPR mode.

(f) REV (Reverse) Mode Selector - For use in tracking LOC Front course outbound or LOC Back course inbound to airfield. Always set inbound front course bearing on O.B.S. when using REV mode.

(g) Pitch Command Disc - Controls aircraft climb and dive attitude when operating in ATT mode. System limits maximum angle to 15°, or less. When the autopilot is engaged in ATT mode, automatic pitch synchronization will be provided to match autopilot command position to aircraft attitude.

(h) GA (Go Around) Mode Selector - provides a pre-selected pitch up attitude which will provide approximate single-engine best rate of climb speed during single-engine operation. During multi-engine operation this attitude will provide a comfortable go-around angle and cruise climb airspeed. GA mode may be operated remotely from the left engine throttle switch located in the throttle knob.

(i) GS (Glide Slope) Mode Selector - GS mode will arm (illuminate) automatically during ILS approaches when the aircraft is under the GS center line and the system is in APPR and ALT modes. When GS center line is reached the ALT annunciator will extinguish, indicating GS capture. When operating above the GS center line, within 80% of full scale, manual GS arming and engaging may be obtained by selecting GS from any pitch mode.

NOTE

When over 80% full scale, selection of GS will automatically cause engagement of ALT mode. In addition, any time a GS offset of 80%, or more, above the GS occurs, the system will automatically revert to ALT mode to preclude diving to the GS.

(j) ALT (Altitude Hold) Mode Selector - Selection of ALT mode will cause the autopilot to maintain the pressure level (altitude) at the point of engagement. For maximum passenger comfort the rate of climb or descent should be reduced to approximately 500 FPM with the pitch disc prior to ALT hold engagement.

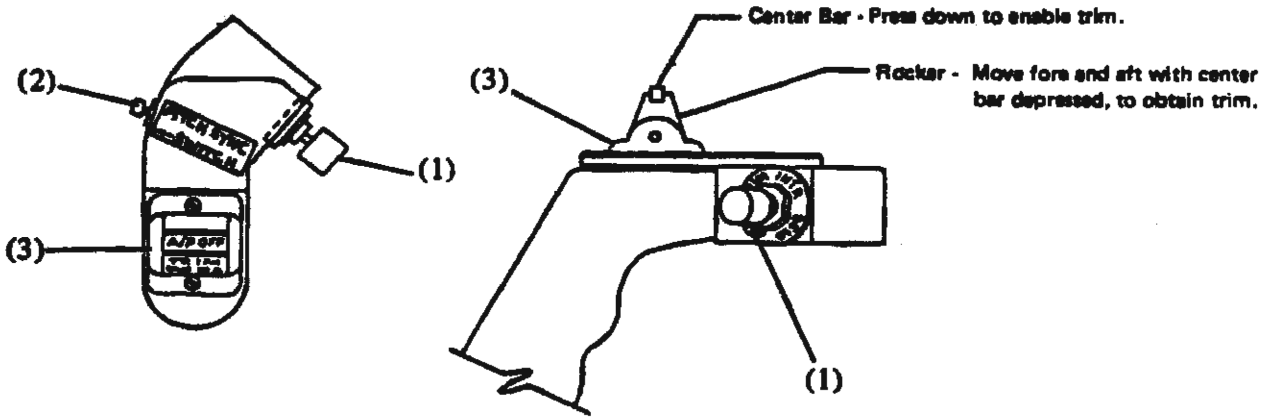
(k) ATT (Attitude) Mode Selector - provides attitude control through pitch command disc (item No. 7). Automatic synchronization is provided when autopilot is engaged in ATT mode. For autopilot (only) system, roll and pitch modes will revert to HDG and ATT any time the autopilot is disengaged and pitch synch will be provided any time the autopilot is engaged.

(l) SPECIAL MODES OR OPERATIONS

(1) Selected angle intercepts may be obtained during VOR or ILS intercept situations, i.e. radar vectors to final approach, by selecting HDG and APPR mode simultaneously when the VOR-LOC needle is displaced 60% full scale or more. In this condition, the system will follow the HDG indice (bug) until within 60% of "on course" at which time the system will shift from HDG to APPR automatically. Selected angle intercepts of over 60° are not recommended.

(2) Pitch Synch Mode - The system is provided with a pitch synch switch on the left horn of the pilot's control wheel. When depressed, momentarily, the system will revert to ATT and automatic synchronization will occur before servo re-engagement. When depressed and held, the system will revert to ATT and the roll and pitch servos will be disengaged to allow maneuvering. When released, the servos will re-engage. The lateral (roll) modes will not be disturbed during pitch synch operation.

(m) CONTROL WHEEL SWITCHES

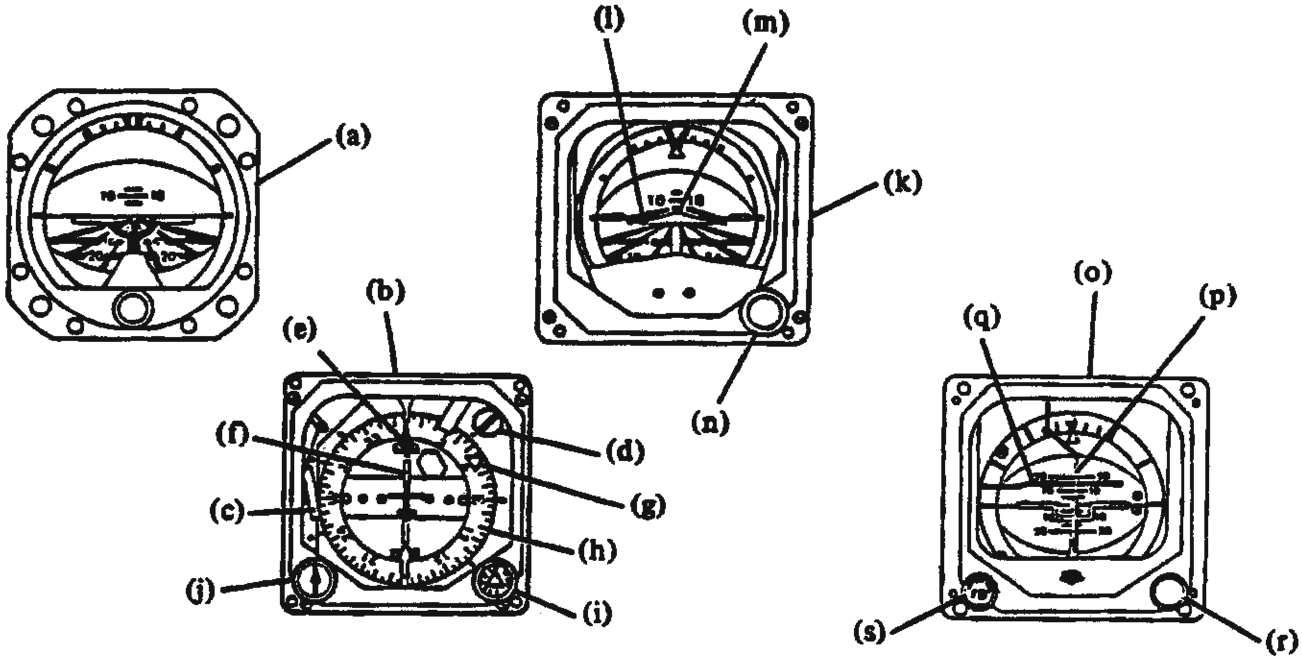


(1) Emergency Interrupt/Disconnect Switch - This switch will disconnect the autopilot and yaw damper when depressed. When depressed and held it will interrupt all electric elevator trim operations.

(2) Pitch Synch Switch - See explanation above.

(3) Command Trim Switch - Split action type trim switch requiring the top bar to be depressed and the switch rocked fore or aft for trim operation. Depressing the top bar will disconnect the autopilot (will not disconnect the yaw damper).

4.3 INSTRUMENTS



(a) Standard 3" Air Driven Attitude Indicator Gyro
(b) NSD 360A Compass System (shown) - For details of any other compass system, refer to manufacturer's information.
(c) G/S Indicator with Flag Alarm.
(d) Slaving Meter - Oscillation of needle indicates that compass is slaved to magnetic flux detector. Needle maintained in either extreme position for more than 2 - 3 minutes indicates system failure.

NOTE

NSD 360A System includes a slaving selector switch allowing the selection of free gyro mode. Refer to emergency procedures for failure instructions.

(e) VOR-LOC Bearing Selector Course Needle and Omni Bearing Indicator
(f) Left-right portion of VOR-LOC Course Needle
(g) HDG indice (bug) for autopilot or flight director HDG control.
(h) Compass card
(i) HDG Control Knob - push in to cage instrument for initial compass setting. (NSD 360A)
(j) VOR Course Needle Set Knob (O.B.S.)
(k) Optional flight director instrument (A.D.I.) providing single cue type steering display.
(l) Steering Command Bar - Raises and lowers for pitch commands and tilts to indicate bank direction and amount.
(m) Miniature Airplane (Delta Symbol) - Operate aircraft controls to cause aircraft to pitch or bank as necessary to position  inside steering bars  in order to satisfy computed steering commands.
(n) Miniature airplane elevation knob.

(o) Optional flight director instrument (A.D.I.) providing two-cue steering display.
(p) Vertical steering bar providing roll steering. To satisfy command, maneuver aircraft to keep vertical bar centered.
(q) Horizontal steering bar providing pitch steering. To satisfy command, maneuver aircraft to keep horizontal bar centered.
(r) Miniature aircraft elevation adjust.
(s) Flight director OFF switch to remove steering presentation from view during autopilot operation, if desired.

4.4 PRE-FLIGHT PROCEDURES

NOTE

During system functional check the system must be provided adequate D.C. voltage (24.0 VDC min.) and instrument air (4.2 in. Hg. min.). It is recommended that one engine be operated (minimum) to provide the necessary power and that the aircraft be positioned in a level attitude, during the functional check.

(a) FLIGHT DIRECTOR
  (1) Check power - ON.
  (2) Programmer lights - press to test
  (3) Flight director switch on A.D.I. - ON. (Two-cue only)
  (4) Pitch disc DN - UP - check pitch steering indicator moves appropriately.
  (5) HDG indice RT - LT - check roll steering indicator moves appropriately.

(b) COMPASS SYSTEM (NSD 360A)
  (1) Check slaving switch in slave or slave 1 or 2 position, as appropriate. (Slaving systems with R.M.I. output provide only slave and free gyro positions.)
  (2) Rotate card to center slaving meter - check HDG displayed with magnetic compass HDG.
  (3) Perform standard VOR receiver check.
  (4) NAV - APPR - Engage NAV or APPR mode switch and observe steering bar indicates turn toward the VOR needle.

NOTE

If the Omni Bearing Selector is more than 45° from the aircraft heading, the flight director steering bar will only indicate a turn toward the omni bearing.

(c) AUTOPILOT
  (1) Engage autopilot.
  (2) Repeat flight director roll and pitch response check. Control wheel movement should correspond to HDG or pitch command input.

NOTE

Autopilot might not be able to raise aircraft elevator on the ground without assistance from the pilot.

(3) Grasp control wheel and override roll and pitch servo actuators to assure override capability.
(4) Hold control yoke and disengage autopilot by activating the control wheel emergency disconnect/interrupt switch.
(5) Check controls through full travel in roll and pitch to assure complete autopilot disengagement.
(6) Retrim aircraft for takeoff.

(d) TRIM SYSTEM

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

The command electric trim switch on the left portion of the pilot's control wheel has two functions:

(1) When the top bar (AP OFF) is pressed, it disconnects the autopilot.
(2) When the top bar is pressed AND the rocker is moved forward, nose down trim will occur; when moved aft, nose up trim will occur.
(3) PRE-FLIGHT

Command Trim - Before Each Flight

a. Check trim circuit breaker - IN.
b. Trim master switch - ON.
c. AP OFF - Check normal trim operation - UP. Grasp trim wheel and check override capability. Check nose down operation. Recheck override. With trim operating, depress emergency interrupt/disconnect switch - trim operation should stop.
d. Activate center bar only - Push rocker fore and aft - only. Trim should not operate with either separate action.

Autotrim - Before Each Flight

a. AP ON - Check automatic operation by activating autopilot pitch command disc UP then DN. Observe trim operation follows pitch command direction.

NOTE

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

b. Press center bar (AP OFF) - release - check autopilot disengagement.
c. Rotate trim wheel to check manual trim operation.
d. Recheck aircraft pitch trim to correct takeoff position after autopilot and trim system check.

4.5 IN-FLIGHT PROCEDURE - FLIGHT DIRECTOR

(a) Altimatic X master switch - ON. Flight director switch on A.D.I. - ON, if appropriate.
(b) Adjust HDG indice to aircraft heading and select desired pitch attitude by movement of pitch command disc or by activation of pitch synch switch.
(c) Maneuver aircraft manually to satisfy the commands presented. Select other modes as desired, refer to Section 4.0 for mode description.

4.6 IN-FLIGHT PROCEDURE - AUTOPILOT/FLIGHT DIRECTOR AUTOPILOT

(a) Altimatic X master switch - ON. Flight director switch on A.D.I. - ON, if desired and equipped.
(b) Trim aircraft for existing flight condition (all axes). Engage autopilot.
(c) During maneuvering flight - control aircraft through use of the HDG indice and the pitch disc. (HDG-ATT modes)
(d) For navigation operations select modes as required by the operation being conducted and in accordance with the mode description provided in Section 4.0. For specific instructions relating to coupled instrument approach operations, refer to Special Operations and Information Section, 4.7.

4.7 SPECIAL OPERATIONS AND INFORMATION

ALTITUDE HOLD OPERATION

For best results, reduce rate of climb or descent to 500 FPM before engaging altitude hold mode.

INSTRUMENT APPROACH OPERATIONS

Initial and/or intermediate approach segments should be conducted between 105-120 KIAS with the flaps extended to the takeoff position. Upon intercepting the glide path or when passing the final approach fix (FAF) immediately lower the landing gear and reduce the power for approximately 105-115 KIAS on the final approach segment. Adjust power as necessary during remainder of approach to maintain correct airspeed. Monitor course guidance information (raw data) throughout the approach. All power changes should be of small magnitude and smoothly applied for best tracking performance. Do not change aircraft configuration during approach while autopilot is engaged. For approaches without glide path coupling, adjust pitch command disc in conjunction with power to maintain desired airspeed and descent rate.

NOTES

1. Automatic G/S disengagement will occur if a deviation above the G/S center line of 80%, or more, occurs after G/S capture. Automatic G/S disengagement will revert the autopilot to altitude hold mode.
2. Flight director or autopilot will not decouple from the G/S or Localizer in the event of radio failure. Monitor course guidance raw data during approach to assure signal quality.

INSTRUMENT APPROACH GO AROUND MANEUVER

At the decision height (DH) or missed approach point (MAP) perform the go-around as follows:

(a) Select G/A mode at the programmer or push the remote G/A switch, if installed.
(b) Add takeoff power, or power as desired.
(c) Check the correct attitude and that a positive rate of climb is indicated, then raise the gear. Disengage the autopilot, raise the flaps, retrim and re-engage the autopilot.
(d) Set desired HDG and select HDG mode for lateral maneuvering.

SECTION 5 - PERFORMANCE

Installation of the Altimatic X Autopilot or Flight Director Autopilot does not effect the basic Performance information presented by Section 5 of this handbook.

THIS PAGE INTENTIONALLY LEFT BLANK

SUPPLEMENT 8

NACELLE WING LOCKER INSTALLATION

SECTION 1 – GENERAL

This supplement supplies information necessary for efficient operation of the airplane when optional Nacelle Wing Lockers are installed per PAC Dwg. 44527. 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 the handbook at all times when the optional Nacelle Wing Lockers are installed. When nacelle wing lockers are installed and an inconsistency exists between the information contained within this supplement and that presented in the basic portion of this handbook, the supplement shall apply.

SECTION 2 – LIMITATIONS

2.5 AIRSPEED INDICATOR MARKINGS

MARKING	KIAS
Green Arc (Normal Operating Range)	76 to 188
Yellow Arc (Caution Range - Smooth Air)	188 to 236
White Arc (Flaps Extended Range)	70 to 140
Radial Red Line (Never Exceed - Smooth Air)	236
Radial Red Line (Minimum Control Speed - Single Engine)	76
Radial Blue Line (Best Rate of Climb Speed - Single Engine)	98

2.15 WEIGHT LIMITS

Maximum Weight in Nacelle Lockers — 150 lbs. each
Do not exceed 100 lbs differential between lockers

2.29 PLACARDS

On inside of NACELLE locker Doors:

BAGGAGE CAPACITY
150 MAX.
SEE LOADING SCHEDULE
DO NOT EXCEED
10 LBS./SQ. FT. FLOOR LOADING
OR 100 LBS. DIFF. BETWEEN LOCKERS

SECTION 3 – EMERGENCY PROCEDURES

SPEEDS

Minimum Single Engine Control .... 76 KIAS
Safe Single Engine .... 90 KIAS
Best Single Engine Angle of Climb .... 95 KIAS
Best Single Engine Rate of Climb .... 98 KIAS
Maneuvering .... 159 KIAS
Never Exceed .... 236 KIAS

ENGINE INOPERATIVE PROCEDURES

ENGINE SECURING PROCEDURE
(FEATHERING PROCEDURE)

Throttle .... close
Propeller .... FEATHER (1000 RPM min.)
Mixture .... IDLE CUT-OFF
Cowl flaps .... close
Magneto switch .... OFF
Emergency fuel pump .... OFF
Fuel Selector .... OFF (detent)
Alternator CB switch .... OFF
Prop Sync .... OFF
Electrical load .... reduced
Crossfeed .... considered

ENGINE FAILURE DURING
NORMAL TAKEOFF (BELOW 83 KIAS)

If sufficient runway remains for a safe stop:
Throttles .... CLOSE immediately
Brakes .... as required
Stop straight ahead
If insufficient runway remains for a safe stop:
Throttles .... close immediately
Brakes .... as required
Mixture .... retard fully aft
Master switch .... OFF
Fuel selectors .... OFF
Magneto switches .... OFF

NOTE

Maintain directional control and maneuver to avoid obstacles.

ENGINE FAILURE DURING
NORMAL TAKEOFF (83 KIAS or above)

Directional control .... Maintain
Power (operating engine) .... Max. continuous
Propeller control
(inoperative engine) .... Feather
Landing gear
(in level or climbing flight) .... Retract
Bank .... 5° into operating engine
Airspeed .... 89 KIAS to 50 ft. then accelerate to 95 KIAS
Cowl flaps
(inoperative engine) .... close
Airspeed .... 98 KIAS, after all obstacles have been cleared
Engine securing procedures .... Complete

NOTE

Land as soon as practical at the nearest suitable airport.

ENGINE FAILURE DURING SHORT FIELD
TAKEOFF (91 KIAS or below)

If sufficient runway remains for a safe stop:
Throttles .... immediately close
Land (if airborne) .... on remaining runway
Brakes .... as required

If insufficient runway remains for a safe stop:
Throttles .... immediately close
Mixtures .... IDLE CUT-OFF
Master switch .... OFF
Fuel selectors .... OFF
Magneto switches .... OFF
Land (if airborne) avoiding obstacles

ENGINE FAILURE DURING SHORT FIELD
TAKEOFF (Above 91 KIAS)

If sufficient runway remains for a safe stop:
Throttles .... immediately close
Land .... on remaining runway
Brakes .... as required

If insufficient runway remains and the decision is made to abort the takeoff:
Throttles .... immediately close
Landing gear .... extend

NOTE

Depending on terrain, it may be advisable to land with the gear retracted.

Flaps....................extend
Airspeed....................89 KIAS min.
Mixtures....................IDLE CUT-OFF
Master switch....................OFF
Fuel selectors....................OFF
Magneto switches....................OFF
Land avoiding obstacles

If insufficient runway remains, the terrain ahead is unsuitable for a safe landing and the decision is made to continue the takeoff:

Directional control....................maintain
Power (operating engine)....................max. continuous
Propeller control (inoperative engine)....................FEATHER
Landing gear (in level or climbing flight)....................retract
Bank....................5° into operating engine
Flaps....................retract in increments
Airspeed....................accelerate to 95 KIAS until all obstacles have been cleared then accelerate to 98 KIAS
Engine Securing Procedures....................accomplish

WARNINGS

Negative climb performance may result from an engine failure occurring after lift-off and before the gear and flaps have been retracted, the failed engine propeller has been feathered, the cowl flap on the failed engine is closed and a speed of 98 KIAS has been attained. Refer to "Single Engine Climb" chart, Figure 5-21 of this supplement, for clean configuration positve climb performance.

Certain combinations of aircraft weight, configuration, ambient conditions and airspeeds will result in negative climb performance. (Refer to specific chart in Performance Section.)

ENGINE FAILURE DURING CLIMB

Airspeed....................maintain 98 KIAS
Directional control....................maintain
Inop. engine....................identify and verify
Inop. engine....................complete Engine Securing Procedure
Land as soon as practical at nearest suitable airport.

THIS PAGE INTENTIONALLY LEFT BLANK

ENGINE FAILURE DURING FLIGHT
(Below 76 KIAS)

Rudder....................apply towards operative engine
Throttles (both engines)....................retard to stop turn
Pitch attitude....................lower nose to accelerate above 76 KIAS
Operative eng....................increase power as airspeed increases above 76 KIAS

If altitude permits, a restart may be attempted.

If restart fails or altitude does not permit:
Inop. Eng. Prop....................FEATHER
Bank....................adjust 5° toward operative eng.
Inop. eng....................complete Engine Securing Procedure
Cowl flap (operative eng.)....................as required

ENGINE FAILURE DURING FLIGHT
(Above 76 KIAS)

Inop. eng....................identify
Operative eng....................adjust as required

Before securing inop. engine:
Fuel flow....................check (if deficient-emergency fuel pump ON)
Fuel quantity....................check
Fuel selector (inop. eng.)....................switch to other tank containing fuel
Oil pressure and temp....................check
Magneto switches....................check

If engine does not start, complete Engine Securing Procedure.

Power (operative eng.)....................as required
Mixture (operative eng.)....................adjust for power
Fuel quantity (operative eng. tank)....................sufficient
Emergency fuel pump (operative eng.)....................as required
Cowl flap (operative eng.)....................as required
Bank....................adjust 5° toward operative eng.
Electrical load....................decrease to min. required

Land as soon as practical at nearest suitable airport.

SINGLE ENGINE LANDING

Inop. engine....................Engine Securing Procedure complete
Hydraulic pump....................check
Seat belts/harnesses....................secure
Heater....................FAN position
Emergency fuel pump (operative eng.)....................ON
Fuel selector on operative engine side....................ON INBOARD tank
Crossfeed....................OFF
Cowl flap (operative eng.)....................as required
Airspeed....................maintain 104 KIAS min. until landing is assured
Altitude....................higher than normal until landing is assured

When landing is assured:
Gear....................DOWN
Flaps....................DOWN
Power....................retard slowly and flare airplane
Trim....................as power is reduced (airplane will yaw in direction of operative engine)

SINGLE ENGINE GO-AROUND

(Not possible from a full flap position unless sufficient altitude is available to raise flaps in a descent.)

Avoid if possible, if necessary:
Airspeed....................hold 98 KIAS
Power....................max. on operating engine
Flaps....................retract
Landing gear....................retract
Cowl flaps....................as required
Trim....................as required

3.7 ENGINE INOPERATIVE PROCEDURES

ENGINE SECURING PROCEDURE (FEATHERING PROCEDURE)

The engine securing procedure should always be accomplished in a sequential order according to the nature of the engine failure (ie., practice, engine failure during takeoff, engine failure during climb, etc.).

Begin the securing procedure by closing the throttle of the inoperative engine and moving its propeller control to "FEATHER" (fully aft) before the propeller speed drops below 1000 rpm. The inoperative engine mixture control should be moved fully aft to the "IDLE CUT-OFF" position. "CLOSE" its cowl flaps to reduce drag. Turn "OFF" the magneto switch, the emergency fuel pump switch and the fuel selector. Turn "OFF" the alternator circuit breaker switch of the inoperative engine. The propeller synchrophaser (if installed) should be OFF. Complete the procedure by reducing the electrical load and considering the use of the fuel crossfeed if the fuel quantity dictates.

ENGINE FAILURE DURING NORMAL TAKEOFF (Below 83 KIAS)

A preflight determination of runway length and computation of accelerate/stop distance will aid in determining the best course of action in the event of an engine failure during takeoff. If engine failure occurs while sufficient runway remains for a deceleration and a safe stop, cut power immediately and stop straight ahead.

If an engine failure occurs before an airspeed of 83 KIAS is attained, and there is not adequate runway remaining for deceleration and a stop, immediately retard the throttle and mixture levers fully aft. Turn "OFF" the master switch, the fuel selectors, and the magneto switches. During these procedures, maintain directional control and maneuver to avoid obstacles if necessary.

ENGINE FAILURE DURING NORMAL TAKEOFF (83 KIAS or above)

If an engine fails during takeoff at an airspeed of 83 KIAS or above the pilot must decide whether to abort, following the preceding procedures, or to continue the takeoff and climb on a single engine. The pilot's decision must be based on a personal judgment, taking into consideration such factors as remaining runway, obstacles, the type of terrain beyond the runway, density altitude, weight and loading, weather, airplane condition, and the pilot's own proficiency and capability.

WARNING

Certain combinations of aircraft weight, configuration, ambient conditions and airspeeds will result in negative climb performance.

If takeoff is continued the airplane will tend to turn in the direction of the inoperative engine, since one engine will be inoperative and the other at maximum power. Rudder pedal force on the side of the operating engine will be necessary to maintain directional control. If rotation for takeoff has begun or the aircraft is just airborne, maintain the takeoff attitude. The aircraft may skip along the runway or settle back to the runway if airborne. Do not force the aircraft off the ground or raise the gear, but continue to maintain maximum power on the operating engine and the aircraft directionally aligned with the runway. Once the faulty engine is identified and its power loss verified, feather its propeller. The drag reduction resulting from feathering the windmilling propeller will provide a rate of climb increment which will allow the aircraft to accelerate to and remain airborne at the 50 foot barrier airspeed (89 KIAS) if the aircraft will maintain level flight or a positive rate of climb, retract the landing gear. Maintain 89 KIAS to the 50 foot barrier, then accelerate of 95 KIAS (best single engine angle of climb speed) until clear of obstacles and close the cowl flap on the inoperative engine. When above all obstacles accelerate to the best single engine rate of climb speed (98 KIAS), trim as necessary and CLOSE the cowl flaps on the operating engine as much as possible without exceeding engine temperature limits. After a climb has been established, complete the "Engine Securing Procedure" on the inoperative engine.

ENGINE FAILURE DURING SHORT FIELD TAKEOFF (Below 91 KIAS)

Should an engine failure occur prior to reaching the barrier speed (91 KIAS), the takeoff should be aborted. If the failure occurs while the aircraft is still on the ground and sufficient runway or suitable overrun remains, retard the throttles and apply braking as necessary. If insufficient runway or suitable overrun exists, retard the throttles, apply braking as required, pull the mixtures to idle cut-off, turn the master switch, fuel selectors, magneto switches off and steer the aircraft to avoid obstacles.

Should the engine failure occur after the aircraft is airborne, lower the nose to maintain airspeed, retard the throttles and land on the remaining runway, the runway overrun or the most suitable area straight ahead avoiding obstacles. If the landing cannot be accomplished on the remaining runway or overrun prior to touchdown, pull mixtures to idle cut-off, turn the master switch, fuel selectors and magneto switches to the off position.

ENGINE FAILURE DURING SHORT FIELD TAKEOFF (Above 91 KIAS)

Should an engine failure occur above the barrier speed (91 KIAS), the decision to abort or continue the takeoff will be based on several factors including altitude, aircraft weight, suitable landing areas, pilot proficiency and ambient conditions. The two most important considerations, however, are the altitude gained prior to the engine failure and the availability of suitable landing areas ahead of the aircraft at the time of the failure.

Should a suitable landing area (remaining runway, overrun or an area relatively free of obstructions) be accessible from the point where the engine failure occurs, the takeoff should be immediately aborted and a power-off landing should be accomplished within that area.

If a suitable landing area is not available and sufficient altitude has been obtained, the pilot may elect to continue the takeoff. Should the decision be made to continue the takeoff, it is of the utmost importance to realize that the aircraft will have negative single engine climb performance until the gear and flaps have been retracted and an airspeed of 95 KIAS has been reached. As altitude may be lost during gear and flap retraction and the subsequent transition to 95 KIAS, the decision to continue the takeoff should primarily be based on the altitude gained prior to the failure. Flight tests have indicated that as much as 100 feet may be lost during gear and flap retraction and the transition to the best single engine angle of climb speed (95 KIAS). The altitude loss is a difficult variable to quantify and is primarily predicted on pilot proficiency; however aircraft weight and ambient conditions may also be considered. Prior to takeoff, the pilot should always review the performance section to determine that adequate single engine climb performance exists for the takeoff weight and associated ambient conditions.

Should the decision be made to abort the takeoff, the throttles should be closed, the landing gear extended (terrain permitting), the flaps extended and a minimum airspeed of 89 KIAS should be maintained. If possible, plan to land in an area free of obstructions. Prior to touchdown, position the mixture controls to idle cutoff and turn the master switch, fuel selectors and magneto switches off.

Should the decision be made to continue the takeoff, maintain directional control, identify and then feather the inoperative engine. In level or climbing flight, retract the landing gear. Apply 5° of bank into the operating engine. As the aircraft starts to accelerate, retract the flaps incrementally (recommend 3-5° increments). After attaining 95 KIAS, maintain 95 KIAS until all obstacles have been cleared and then accelerate to 98 KIAS. Complete the engine securing procedures and land at the nearest suitable airport.

WARNING

Negative climb performance may result from an engine failure occurring after lift off and before the gear and flaps have been retracted, the failed engine propeller has been feathered, the cowl flap on the failed engine is closed and a speed of 98 KIAS has been attained. Refer to "Single Engine Climb" chart, Figure 5-21 of this supplement, for clean configuration positive climb performance.

ENGINE FAILURE DURING CLIMB

If engine failure occurs during climb, a minimum airspeed of 98 KIAS should be maintained. Since one engine will be inoperative and the other will be at maximum power, the airplane will want to turn in the direction of the inoperative engine. Rudder pedal force on the side of the operating engine will be necessary to maintain directional control. After the faulty engine has been identified and power loss verified, complete the "Engine Securing Procedures." Continue a straight ahead climb until sufficient altitude (minimum of 1000 feet above ground elevation) is reached to execute the normal "Single Engine Landing" procedure at the nearest suitable airport.

During climbs, the best single-engine rate of climb speed of 98 KIAS is recommended; however, in high ambient temperature, airspeed may be increased to 103 KIAS if necessary for improved cooling. Normally, cylinder head temperatures can be maintained within limits through cowl flap adjustments. Climb rate will be reduced by approximately 50 FPM.

ENGINE FAILURE DURING FLIGHT (Below 76 KIAS)

Should an engine fail during flight at an airspeed below 76 KIAS, apply rudder towards the operative engine to maintain directional control. The throttles should be retarded to stop the yaw force produced by the inoperative engine. Lower the nose of the aircraft to accelerate above 76 KIAS and increase the power on the operative engine as the airspeed exceeds 76 KIAS.

After an airspeed above 76 KIAS has been established, an engine restart attempt may be made if altitude permits. If the restart has failed, or altitude does not permit, the engine should be secured. Move the propeller control of the inoperative engine to FEATHER and complete the "Engine Securing Procedure." Adjust the trim to 5° bank toward the operating engine. The cowl flap on the operative engine should be adjusted as required to maintain engine temperature within allowable limits.

ENGINE FAILURE DURING FLIGHT (Above 76 KIAS)

If an engine fails at an airspeed above 76 KIAS during flight, begin corrective response by identifying the inoperative engine. The operative engine should be adjusted as required after the loss of power has been verified. Once the inoperative engine has been identified and the operating engine adjusted properly, an engine restart may be attempted if altitude permits.

Prior to securing the inoperative engine, check to make sure the fuel flow to the engine is sufficient. If the fuel flow is deficient, turn ON the emergency fuel pump. Check the fuel quantity on the inoperative engine side and switch the fuel selector to the other tank if a sufficient supply is indicated. Check the oil pressure and oil temperature and insure that the magneto switches are ON.

If the engine fails to start it should be secured using the "Engine Securing Procedure."

After the inoperative engine has been secured, The operative engine can be adjusted. Power should be maintained as required and the mixture control should be adjusted for power. Check the fuel supply and turn ON the emergency fuel pump if necessary. The cowl flaps on the operative engine should be adjusted as required to maintain engine temperatures within allowable limits. Trim 5° bank toward the operating engine. The electrical load should be decreased to a required minimum. Land as soon as practical at the nearest suitable airport.

SINGLE ENGINE LANDING

If a single-engine landing is necessary, a check should be performed to determine whether or not the hydraulic pump is functioning for normal gear extension. This check is accomplished by placing the landing gear control in the "UP" position with the gear retracted. If the hydraulic pump is functioning, pressure will return the control to the neutral position. This check should be performed before entering the traffic pattern so that there will be time to pump the gear down with the hand pump if necessary.

The "Engine Securing Procedure" should be complete on the inoperative engine. Fasten the seat belts and shoulder harnesses and select the "FAN" position of the heater switch. The operative engine electric fuel pump should be ON and the mixture RICH. Advance the propeller control (operative engine) full forward. Check to ensure that the fuel selector is ON the main (inboard) tank on the same side as the operating engine. The fuel crossfeed valve should be OFF. The cowl flap on the operative engine should be adjusted as required.

Maintain an airspeed of 104 KIAS or above and an altitude higher than normal until a landing is assured. When a landing is assured, extend the gear and flaps. Slowly retard the power on the operative engine and flare out the airplane for a normal landing. Trim as necessary as power is reduced. The airplane will tend to yaw toward the operative engine.

SINGLE ENGINE GO-AROUND

A single engine go-around should be avoided if at all possible. A go-around from a full flap position is not possible unless sufficient altitude is available to raise flaps in a descent. A final approach speed above 94 KIAS will place the airplane in the best configuration should a go-around be necessary.

To execute a single engine go-around, advance mixture, throttle, and propeller controls fully forward for maximum power on the operating engine. Retract flaps and landing gear. Maintain the airspeed at or above 94 KIAS. Set the trim and cowl flaps as required.

WARNING

A go-around should not be attempted after the airspeed is decreased below the best single engine angle of climb speed (95 KIAS).

During climbs, the best single-engine rate of climb speed of 98 KIAS is recommended; however, in high ambient temperatures, airspeed may be increased to 103 KIAS if necessary for improved cooling. Normally, cylinder head temperatures can be maintained within limits through cowl flap adjustments. Climb rate will be reduced by approximately 50 FPM.

SECTION 4 – NORMAL PROCEDURES

4.5 NORMAL PROCEDURES CHECKLIST

SHORT FIELD TAKEOFF

Brakes .... hold
Throttles .... full forward
Manifold pressure .... checked
Prop speed .... 2575 RPM
Brakes .... release
Rotate .... 76 KIAS
Accelerate to .... Barrier speed — 85 KIAS

After the barrier has been cleared:
Gear .... retract
Flaps .... retract
Accelerate to .... Best Single Engine Rate of Climb Speed (98 KIAS)

4.23 TAKEOFF

SHORT FIELD

The initial segment of the short field takeoff procedure is identical to the normal procedure except that the brakes shall be held until it has been determined that each engine is operating normally at maximum continuous power. After it has been determined that each engine is operating normally at maximum continuous power, release the brakes, neutralize the elevator control and initiate the take-off roll. Maintain directional control with the nose wheel steering system only. Avoid making steering inputs with the brakes as this may result in increasing the takeoff ground roll distance.

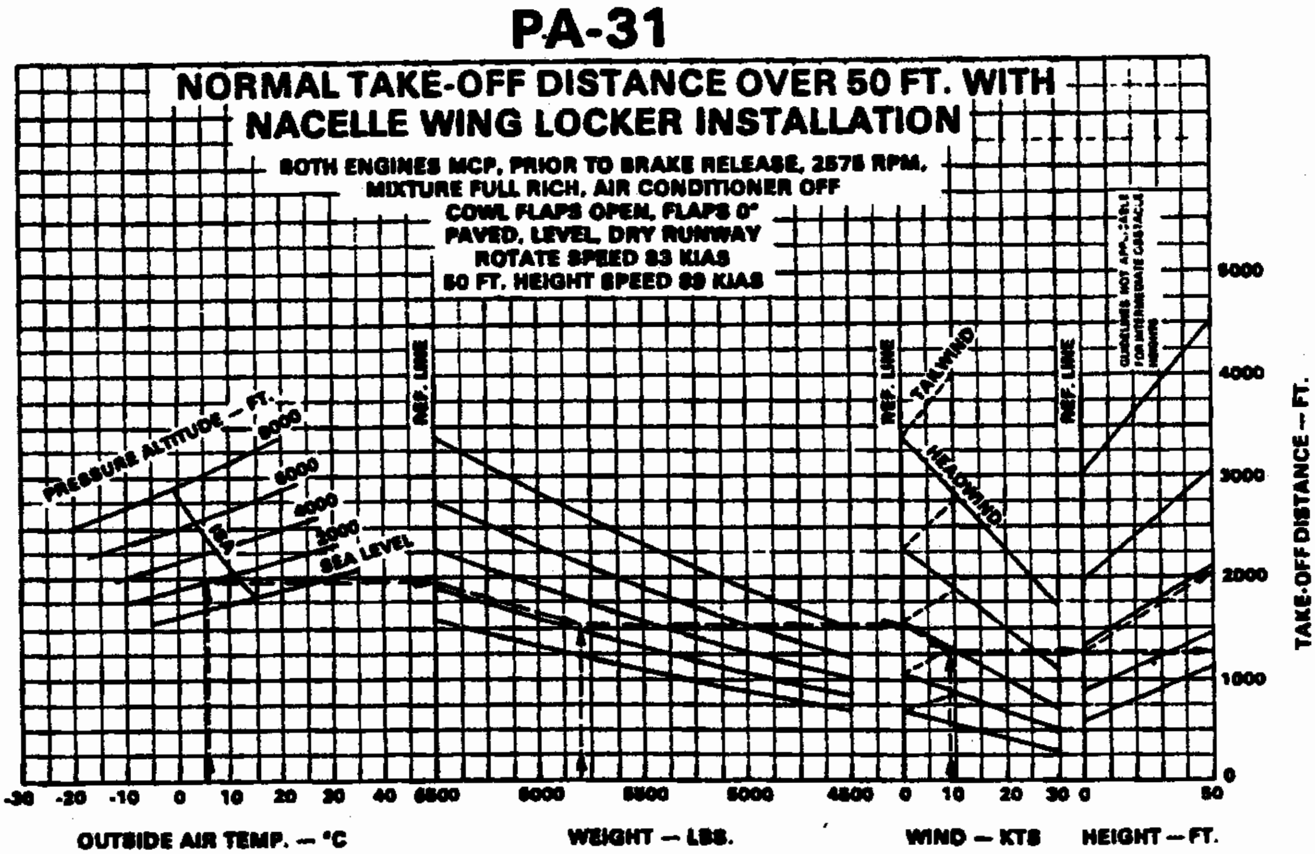
At 76 KIAS, rotate the aircraft to achieve an altitude that will result in an initial climb airspeed of 85 KIAS. Maintain 85 KIAS until the barrier has been cleared. After the barrier has been cleared, retract the landing gear, the flaps and accelerate to 98 KIAS (best single engine rate of climb).

SECTION 5 – PERFORMANCE

5.1 GENERAL

The performance in this supplement supersedes the information presented in Section 5 of the complete handbook when the optional Nacelle Wing Lockers are installed.

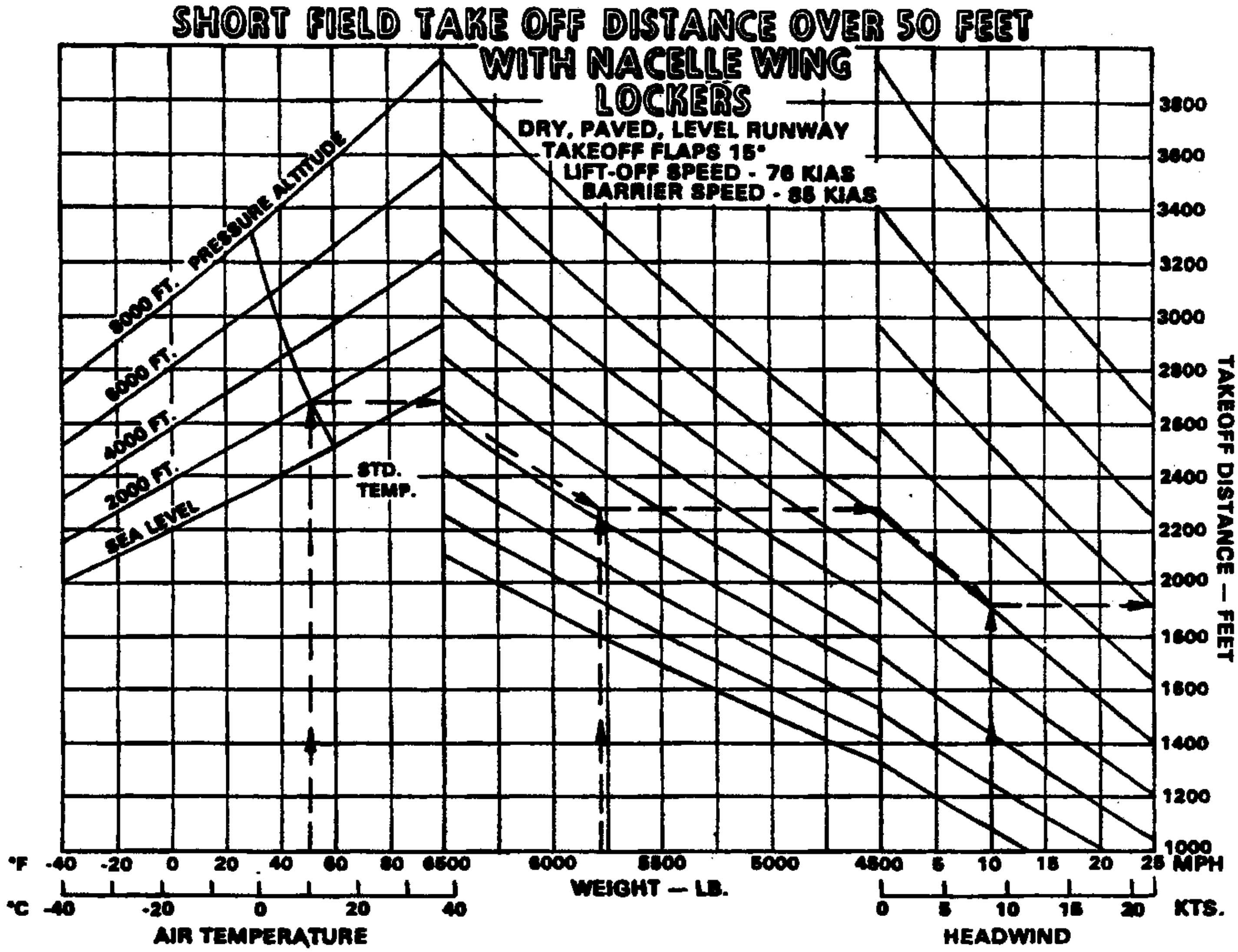
LIST OF FIGURES



Example:
OAT: +6°C
Pressure Altitude: 2000 ft.
Weight: 5800 lbs.
Wind: +9 kts.
Ground Run: 1280
Total Distance: 2040

NORMAL TAKEOFF DISTANCE OVER 50 FEET

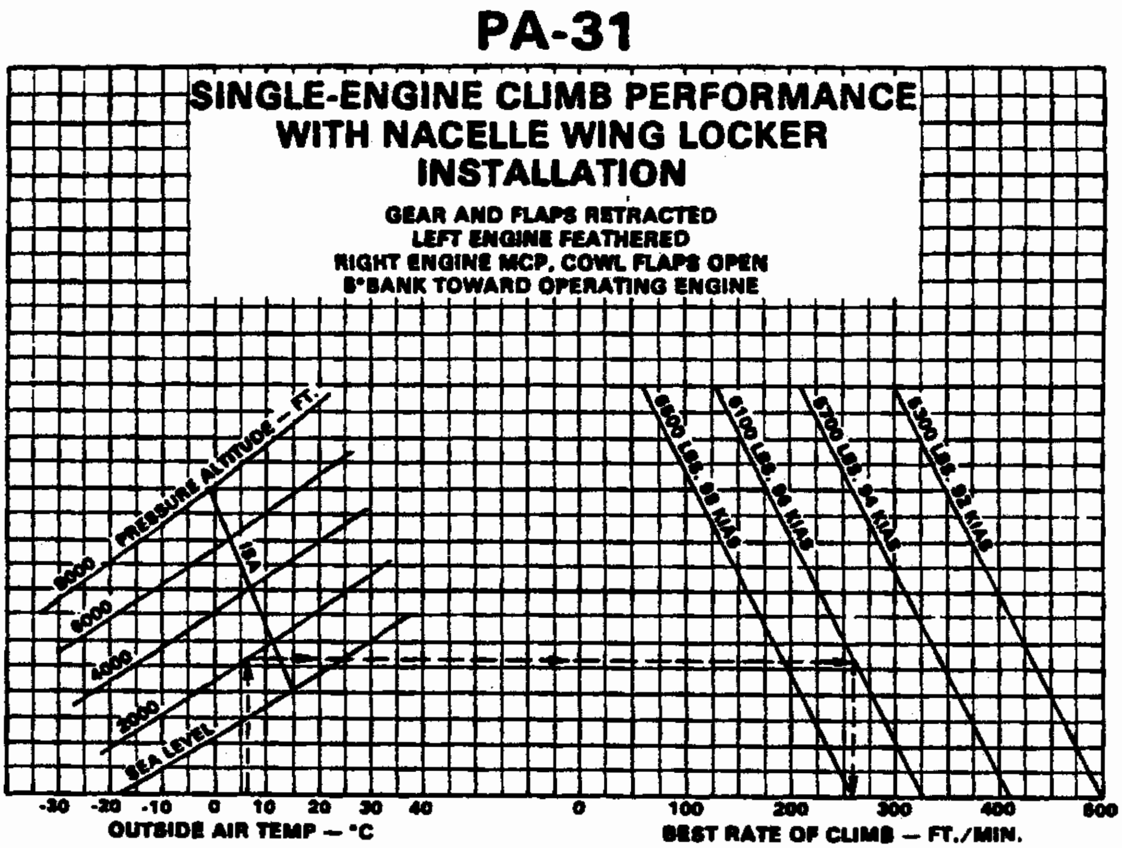
Figure 5-13



Example:
OAT: +50°C
Pressure Altitude: 2000 ft.
Weight: 5800 lbs.
Wind: +12 kts.
Total Distance: 1920 ft.

SHORT FIELD TAKEOFF DISTANCE OVER 50 FEET

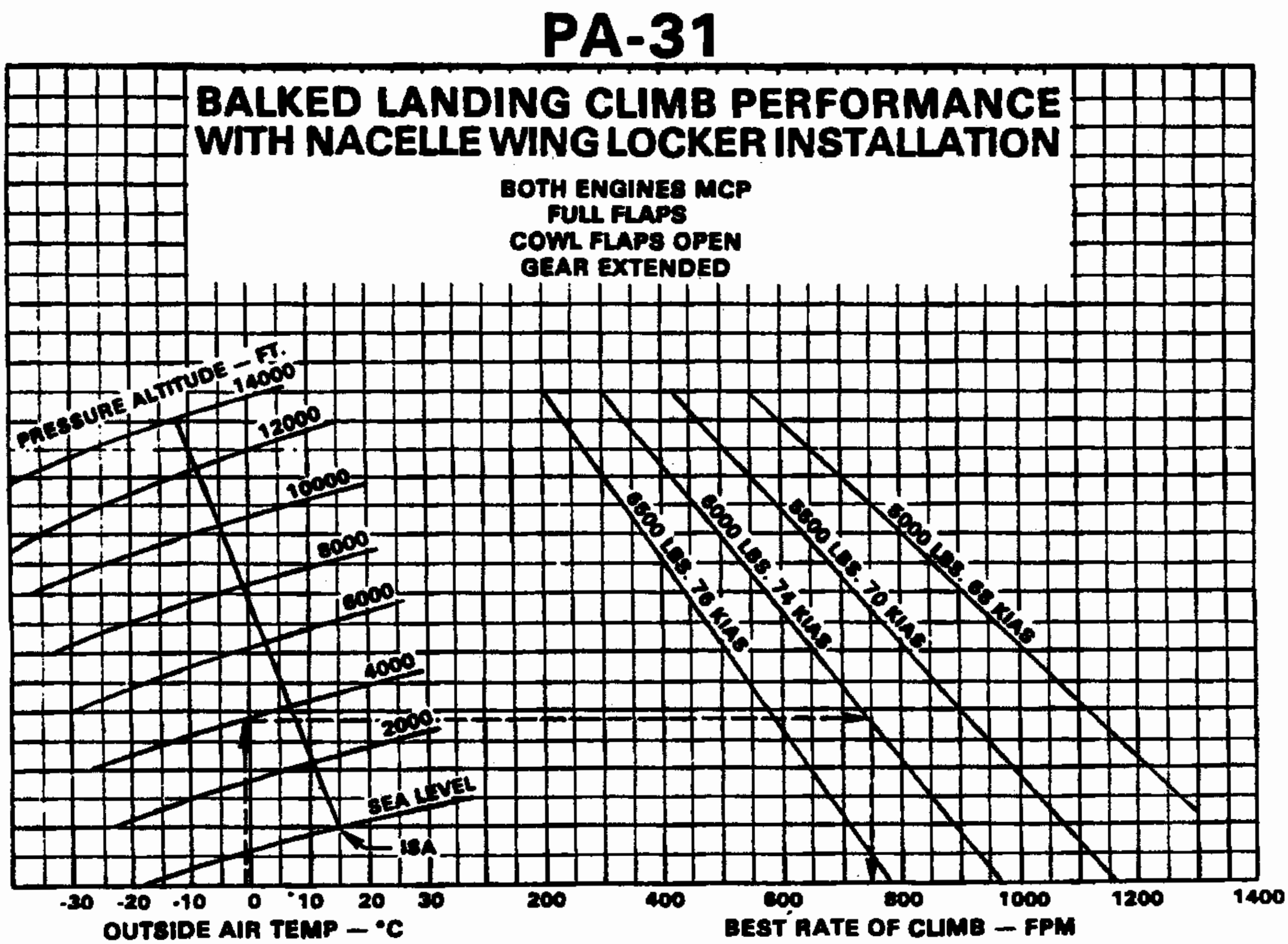
Figure 5-16



Example:
OAT: +6°C
Pressure Altitude: 2000 ft.
Weight: 6100 lbs.
Rate of Climb: 260 fpm
Climb Speed: 96 KIAS

SINGLE ENGINE CLIMB PERFORMANCE

Figure 5-21

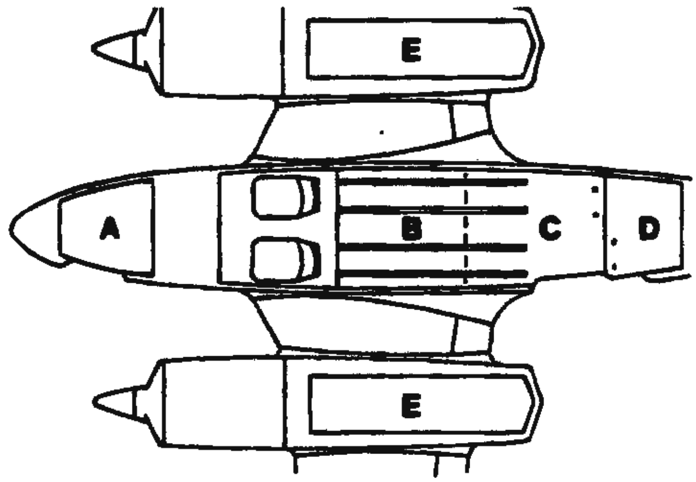


Example:
OAT: - 1°C
Pressure Altitude: 4000 ft.
Weight: 6000 lbs.
Rate of Climb: 750 FPM
Climb Speed: 74 KIAS

BALKED LANDING CLIMB PERFORMANCE

Figure 5-45

SECTION 6 – WEIGHT AND BALANCE



MAXIMUM CAPACITY

AREA	FLOOR LOAD LBS/SQ. FT.	ALLOWABLE LBS.	
A	100	150	
B	150	640	1475 TOTAL
C	150	640	
D	100	200	
E	10	150 EACH. DO NOT EXCEED 100 DIFF BETWEEN LOCKERS	

MAXIMUM TIEDOWN CAPACITY

PER FOOT OF TRACK	200 LBS
PER TRACK	600 LBS
PER TIEDOWN RING	200 LBS

CARGO MUST BE LOADED WITHIN THE WEIGHT AND BALANCE LIMITS OF THIS AIRCRAFT

CODE NO. 582 082

CARGO LOADING PLACARD

Figure 6-21

Refer to Section 6 - Weight and Balance, in the basic portion of this Handbook for additional Weight and Balance information.

THIS PAGE INTENTIONALLY LEFT BLANK

SUPPLEMENT 9

KFC 200 AUTOMATIC FLIGHT CONTROL SYSTEM (WITH FLIGHT DIRECTOR INSTALLATION)

SECTION 1 - GENERAL

This supplement is to acquaint the pilot with the operation of the KFC 200 Automatic Flight Control System with Flight Director as installed in the PA-31, Navajo. The airplane must be operated within the limitations herein specified.

This supplement has been "FAA Approved" as a permanent part of this handbook based on King STC No. SA1166CE and must remain in this handbook at all times when the optional King KFC 200 Automatic Flight Control System is installed.

The KFC 200 System with Flight Director may be operated as a Flight Director alone with the pilot steering the airplane to satisfy the Flight Director command presentation or the autopilot may be engaged to automatically steer the airplane to satisfy the Flight Director commands.

The KFC 200 System autopilot is certified in this airplane with two-axis control - pitch and roll- or three-axis control if optional Yaw Axis is installed. The optional third axis (Yaw) when installed gives three-axis damping and control whenever the autopilot mode is engaged. With the installation of an optional KC 291 Yaw Damper Mode Controller; Yaw Damping and turn coordination is available with or without the basic autopilot mode being engaged. Both the two-axis and three-axis version of the system are described in this supplement.

The airplane is equipped with an electric pitch trim system which is also used to accomplish automatic trimming to unload the autopilot elevator servo so that autopilot disengagement does not result in transient airplane motion. An autotrim/manual electric pitch trim monitor is provided in the autopilot. Autotrim and/or manual electric pitch trim faults are visually annunciated on the Mode Annunciator and accompanied by an audible warning.

This airplane is equipped with a manual electric pitch trim system designed to withstand any type in-flight single malfunction provided that the system is fully functional during the preflight operational check.

ABBREVIATIONS

AFCS	Automatic Flight Control System
ALT	Altitude or Altitude Hold
AP	Autopilot
APPR	Approach
ARM	System Arm for Capture
BC	Back Course
CDI	Course Deviation Indicator or Control
CPLD	Coupled
CWS	Control Wheel Steering
DISC	Disconnect
FDI	Flight Director Indicator
FCS	Flight Control System
FD	Flight Director System
GA	Go-Around
GS	Glideslope
HDG	Heading Select
NAV	Navigation
PAH	Pitch Attitude Hold
PNI	Pictorial Navigation Indicator
YD	Yaw Damper

SECTION 2 - LIMITATIONS

(a) During autopilot operation, pilot must be seated at the controls with seat belt fastened. Operation is limited to the left-side pilot position.
(b) Maximum speed for autopilot operation is 211 KIAS.
(c) As the autopilot may mask high control forces necessary to counter an asymmetric ("split") flap condition, actuate the flaps only while the airplane is under manual control - not while the autopilot is engaged. Autopilot operation not authorized with greater than 15° of flap extension.
(d) The autopilot must be disengaged during takeoff and landing.
(e) System approved for Category I operation only (APPR or BC selected).
(f) Autopilot attitude command limits:

Pitch	±15°
Roll	±25°
Yaw	NA

(g) The maximum altitude for operation of the autopilot has not been determined. The maximum altitude demonstrated during flight test was 24,000 feet.
(h) Placards:

Location - Pilot's control wheel, left horn:

AP DISC　　TRIM INTERRUPT

- Pilot's control wheel, left horn:

CWS

- Pilot's control wheel, left horn:

TRIM UP/DN

- Left throttle lever:

GO AROUND

Immediately adjacent to KA 285 Annunciator or KC 290 Mode Controller Panels:

CONDUCT AFCS PREFLIGHT CHECK PRIOR TO FLIGHT IN ACCORDANCE WITH FLIGHT MANUAL:

Immediately adjacent to KC 290 (if equipped with a third axis without KC 291).

3 AXIS AP CONTROL

SECTION 3 - EMERGENCY PROCEDURES

(a) AUTOPILOT/YAW DAMPER DISENGAGEMENT
Disengage the Autopilot/Yaw Damper and/or prevent engagement by:
(1) Pilot's AP DISC switch.
(2) AP engage lever on Mode Controller and Yaw engage switch on Yaw Controller (on airplanes equipped with optional KC 291).
(3) Pulling the AUTOPILOT circuit breaker.
(4) Turning master switch OFF.
(5) Turning avionics master switch OFF.

(b) AUTOMATIC AUTOPILOT DISENGAGEMENT
Any of the following will cause the autopilot to automatically disengage:
(1) External power failure.
(2) Actuating manual electric trim.
(3) Internal Flight Control System failure.
(4) With KCS 55A system a loss of compass valid (displaying HDG flag) disengages the AP and FD when a mode using heading information is engaged. With compass flag present only FD and vertical modes can be selected.

(c) MANUAL ELECTRIC PITCH TRIM
Manual electric pitch trim can be disengaged by pressing AP DISC/TRIM INTERRUPT switch and holding down until recovery can be made. Then turn off AVIONICS MASTER switch and manually retrim the airplane using the manual trim control wheel. After the airplane is trimmed out, pull the (PITCH TRIM) breaker and turn the AVIONICS MASTER switch back on.

(d) MAXIMUM ALTITUDE LOSSES DUE TO AUTOPILOT MALFUNCTION

(1) Cruise, Climb, Descent	400 feet
(2) Maneuvering	60 feet
(3) APPR	60 feet
(4) SE APPR	60 feet

CAUTION

OVERPOWERING THE AUTOPILOT IN THE PITCH AXIS FOR PERIODS OF THREE SECONDS OR MORE WILL RESULT IN THE AUTOTRIM SYSTEM OPERATING IN THE DIRECTION TO OPPOSE THE PILOT AND WILL, THEREFORE, CAUSE AN INCREASE IN THE PITCH OVERPOWER FORCES AND, IF AUTOPILOT DISENGAGED, WOULD RESULT IN A PITCH TRANSIENT CONTROL FORCE.

(e) ENGINE FAILURE (Coupled)
   (1) Disengage AP
   (2) Follow basic Airplane Flight Manual single-engine procedures.
   (3) Airplane rudder and aileron axes must be manually trimmed prior to engaging autopilot for single-engine operations.

CAUTION

IF RUDDER AND AILERON CANNOT BE MAINTAINED WHEN POWER IS CHANGED DURING A SINGLE-ENGINE COUPLED APPROACH OR GO-AROUND, DISENGAGE AUTOPILOT AND CONTINUE APPROACH/GO-AROUND MANUALLY.

SECTION 4 - NORMAL OPERATING PROCEDURES

(a) The airplane MASTER SWITCH function is unchanged and can be used in an emergency to shut off all electrical power while the problem is isolated.
(b) The AVIONICS MASTER switch supplies power to the avionics bus bar of the radio circuit breakers, AUTOPILOT and PITCH TRIM circuit breakers.
(c) The KFC 200 is controlled by the following circuit breakers:

AUTOPILOT - This supplies power to the FCS KC 295 Computer, KC 290 Mode Controller, KA 285 Annunciator Panel, KI 256 FDI if used, and AP Pitch and Roll Servos. When optional yaw damper system is installed, this breaker also supplies power to the KC 296 Yaw Computer, the Yaw Servo, and the optional KC 291.

AVIONICS MASTER - This in conjunction with the AVIONICS MASTER Switch supplies power to the avionics bus.

COMPASS SYSTEM - This supplies power to the KCS 55/55A Compass System.

PITCH TRIM - This supplies power to the FCS autotrim and manual electric pitch trim systems.

(d) PILOT'S CONTROL WHEEL SWITCH FUNCTIONS

AP DISC/TRIM INTERRUPT - This emergency disconnect switch will disengage the AP and/or YD, interrupt the power to the electric system. To resume AP control, the AP lever on the Mode Controller must be re-engaged. in the event of electric trim or autotrim failure, the switch can be held depressed, which removes all power from the trim system to allow the pilot time to turn off the AVIONICS MASTER switch and pull the (PITCH TRIM) circuit breaker.

CWS - This switch when depressed and held will allow the pilot to manually fly the airplane in pitch and roll without disengaging the AP. When the switch is released the AP will resume control, (within the pitch and roll attitude limits). The CWS switch will resync the FD in PAH, or ALT hold mode and will transfer the GA mode to PAH. When the CWS is held depressed, manual electric pitch trim may be operated without disengaging the AP.

TRIM UP/DN - Manual electric pitch trim is activated by a dual-action type switch that requires both halves be moved simultaneously for actuating up or down trim commands. Operation of the manual electric pitch trim switch will disengage the AP. (Except when CWS switch is held depressed as previously noted.) The third axis will not disengage with operation of manual trim switch if the airplane is equipped with a KC 291.

GA - The GA switch is located on the throttle and the operation of the switch will indicate a fixed angle of climb of 6 on the FDI. Selection of the GA Mode when in the APPR or NAV CPLD Mode will disengage the mode and revert to the FD Mode (wings level) for lateral steering. The AP, if engaged, will disengage. The AP, however, can be engaged or re-engaged with GA mode selected and will follow the pitch command to climb at the fixed angle.

(e) FCS WARNINGS FLAGS AND ANNUNCIATORS DESIGNATION AND OPERATION

FD - This warning flag, mounted in the Flight Director Indicator, will be in view whenever any of the following conditions are not met: KC 295 internal power valid, Vertical Gyro excitation valid, adapter board valid, or a FD mode not selected. (The KI 256 Flight Director Indicator does not have a warning flag. However, the command bars will be biased out of view whenever the system is invalid or a FD mode is not engaged.)

HDG/PWR* - This warning flag, mounted in the Pictorial Navigation Indicator, will be in view whenever the Directional Gyro information is invalid. If a HDG invalid occurs with either NAV, APPR, or HDG modes selected, the AP and/or FD is disengaged. Basic FD mode may then be re-engaged along with any vertical mode and the AP re-engaged. This flag is labeled HDG in the KCS 55A Compass System. *This warning flag is labled PWR in the KCS 55 Compass System. All modes may be selected and will function with or without a PWR warning present.

TRIM - The TRIM warning light, located in the lower right corner of the annunciator panel, will flash and be accompanied by an audible warning whenever the following autotrim and/or manual electric pitch trim failures occur: Trim servo motor running without a command. The trim servo motor not running when commanded to run and the trim servo motor running in the wrong direction are monitored on autotrim only. The TRIM warning light flashes four times and the audible warning sounds when the test switch on the Mode Controller is depressed.

GS - The Glideslope valid (GS pointer being in view on PNI) has to be present before GS may couple. If, after GS CPLD, the valid is lost the system will flash the GS Annunciator and revert from GS CPLD to PAH with the FDI pitch steering bar providing pitch attitude steering information. If the GS valid returns the system will revert back to GS CPLD.

NAV - The NAV or APPR Modes (ARM OR CPLD) may be selected and will function with or without a NAV warning flag present. The FDI bank steering will continue to provide steering information with or without a valid NAV signal.

(f) BEFORE ENGAGING FLIGHT CONTROL SYSTEM
- (1) Verify that all circuit breakers for the system are in.
- (2) Allow sufficient time for the gyros to come up to speed and for the system to warm up (3-4 minutes).

(g) PREFLIGHT CHECK (Must be performed prior to each flight)
- (1) With no modes engaged and all valid flags retracted, depress the Test Button on the Mode Controller. The Yaw Damp ON light will illuminate and all annunciators will illuminate on the annunciator panel, including the three marker lights. Also, the red TRIM failure light will flash. At least four or more flashes must be observed to indicate proper operation of the autotrim/manual electric pitch trim feature and an audible warning should sound.
- (2) With the AP disengaged, run the following manual electric pitch trim checks.
  - a. Verify that the PITCH TRIM circuit breaker is in.
  - b. Actuate the left - side switch to the fore and aft positions. The trim solenoid should engage, but the trim should not run.
    Actuate the right - side switch to the fore and aft positions. The trim solenoid should not engage and the trim should not run.
  - c. Run the trim from stop to stop. The time required is 61 ±6 seconds.
  - d. Grasping the manual trim wheel, run the trim both up and down and check the overpower capability. (Check that the trim indicator moves with the wheel.)
  - e. Press the AP DISC/TRIM INTERRUPT switch down and hold. The manual electric pitch trim will not operate either up or down.
- (3) Engage the FD. Then engage the AP, depress the CWS switch, center the flight controls and then release the CWS switch. Apply force to the controls to determine if the AP can be overpowered.
- (4) Check the operation of the pilot's control wheel switch functions.
- (5) Engage the FD and AP and put in a pitch (UP) command using the vertical trim switch on the Mode Controller. Hold the control column to keep it from moving and observe the autotrim run in the nose up direction after approximately three seconds delay. Use the vertical trim switch and put in a pitch (DN) command. Hold the control column and observe the autotrim run in the nose down direction after approximately three seconds.
- (6) Engage the HDG mode and the AP. Set the HDG bug to command a right turn. The control wheel will rotate clockwise. Set the HDG bug to command a left turn. The control wheel will rotate counterclockwise.

CAUTION

DISENGAGE THE AP AND CHECK THAT THE AIRPLANE MANUAL PITCH TRIM IS IN THE TAKE OFF POSITION PRIOR TO TAKE OFF.

CAUTION

IF THE AUTOPILOT CIRCUIT BREAKER IS PULLED, THE RED "TRIM" FAILURE LIGHT ON THE ANNUNCIATOR PANEL WILL BE DISABLED AND THE AUDIBLE WARNING WILL CONTINUOUSLY SOUND INDICATING THAT THE FAILURE LIGHT IS DISABLED. IN THIS EVENT THE "PITCH TRIM" CIRCUIT BREAKER SHOULD BE PULLED AND IN-FLIGHT TRIM ACCOMPLISHED BY USING THE MANUAL PITCH TRIM WHEEL.

(h) IN-FLIGHT OPERATION

(1) Engage Procedure:
After takeoff, clean up airplane and establish climb. Engage the FD mode first, monitor flight controls and engage AP. The pitch attitude will lock on any attitude up to 15°.

Engaging and holding the CWS switch allows the pilot to momentarily revert to manual control while retaining his previous modes, except GA, and conveniently resuming that profile at his discretion.

(2) Disengage Procedure:
Check the airplane trim by monitoring the command bars before engaging the AP. While monitoring the flight controls, disengage the system by one of the following methods: depressing the pilot's AP DISC/TRIM INTERRUPT switch, operating the manual electric pitch trim switch, or by operating the AP engage lever on the Mode Controller. The AP light on the annunciator panel will flash at least four times and remain off to indicate that the AP is disengaged. to deactivate the flight director system, depress the FD switch on the Mode Controller or press the AP DISC/TRIM INTERRUPT switch on the pilot's control wheel.

NOTE

IF THE AIRPLANE IS EQUIPPED WITH AN OPTIONAL KC 291, THE OPTIONAL YAW DAMPER MODE WILL DISENGAGE WITH THE USE OF THE PILOT'S CONTROL WHEEL "AP DISC" SWITCH, BUT WILL NOT DISENGAGE AUTOMATICALLY WHEN THE MODE CONTROLLER "AP" SWITCH IS DISENGAGED OR WHEN THE MANUAL ELECTRIC PITCH TRIM IS OPERATED. THE YAW DAMPER CAN BE ENGAGED OR DISENGAGED AT ANY TIME BY DEPRESSING THE YAW CONTROLLER "YAW DAMP" SWITCH.

(3) Flight Director Mode (FD):
The FD mode must be engaged before the AP can be engaged. The FD alone indicates PAH and wings level. The pilot may choose to fly the FDI commands manually, without the AP engaged, by depressing the FD mode switch on the Mode Controller and selecting any of the other modes he wishes to follow. When the AP is engaged, the airplane will automatically follow the FDI commands. The FD may be disengaged by depressing the FD mode switch on the Mode Controller at any time the AP is not engaged or by pressing the AP DISC/TRIM INTERRUPT switch on the pilot's control wheel with or without the AP engaged. FD mode engagement is displayed on the annunciator.

1 SPACE

NOTE

THE "VERTICAL TRIM" SWITCH, LOCATED ON THE MODE CONTROLLER, MAY BE USED TO TRIM THE COMMAND PITCH ATTITUDE AT A RATE OF ONE DEGREE PER SECOND (THE PITCH ATTITUDE DEGREES LEGEND ON THE AIRPLANE ATTITUDE INDICATOR WILL NOT SERVE TO INDICATE ACCURATE FDI PITCH STEERING BAR PITCH ATTITUDES IN DEGREES).

(4) Altitude Hold Mode (ALT):
When the ALT switch on the Mode Controller is pressed, the FDI will provide commands for maintaining the pressure altitude existing at the time the switch is depressed. For smooth operation, engage the ALT at no greater than 500 feet per minute climb or descent. The ALT will automatically disengage when glideslope couples or the GA switch is depressed. ALT hold may be turned off at any time by depressing the ALT switch. ALT engagement is displayed on the annunciator panel.

NOTE

THE "VERTICAL TRIM" SWITCH, LOCATED ON THE MODE CONTROLLER, MAY BE USED TO CHANGE OR TRIM THE COMMAND ALTITUDE UP OR DOWN AT 500 TO 700 FPM WITHOUT DISENGAGING THE MODE. THE NEW PRESSURE ALTITUDE THAT EXISTS WHEN THE SWITCH IS RELEASED WILL THEN BE HELD.

(5) Heading Mode (HDG):
Set the heading bug to the desired heading on the PNI, depress the HDG switch on the Mode Controller and HDG will be displayed on the annunciator panel. The airplane FDI and/or AP will command a turn to the heading selected and hold. The pilot may then choose any new heading by merely setting the bug on a new heading. The airplane FDI and/or AP will automatically command a turn in the direction of the new setting. To disengage the HDG Mode, depress the HDG switch on the Mode Controller and observe the HDG light go out on the annunciator. The HDG mode will automatically disengage when APPR or NAV CPLD is achieved.

(6) Navigation Mode (NAV):
The Navigation mode may be selected by tuning the NAV receiver to the desired frequency, setting the CDI to the desired radial and depressing the NAV switch on the Mode Controller. The annunciator will indicate NAV ARM until intercepting the selected course, unless the NAV switch is engaged with wings level and a centered needle on the CDI. Then the mode will go directly to NAV CPLD as displayed on the annunciator panel. The system can intercept at any angle up to 90° and will always turn toward the course pointer. If a condition requiring a capture exists at mode engagement, the pilot is required to set up an intercept angle using either HDG or FD mode. NAV may be disengaged by depressing the NAV switch or by engaging HDG when in NAV CPLD or APPR when in NAV CPLD/ARM.

CAUTION

THE "NAV" MODE OF OPERATION WILL CONTINUE TO PROVIDE AIRPLANE COMMAND AND/OR CONTROL WITHOUT A VALID VOR/LOC SIGNAL (NAV FLAG IN VIEW).

(7) Approach Mode (APPR):
The Approach mode may be selected by tuning the NAV receiver to the desired VOR or LOC frequency, setting the CDI to the desired radial or front course and depressing the APPR switch on the Mode Controller. The annunciator will indicate APPR ARM until the course is intercepted unless the APPR switch is engaged with the wings level and there is a centered needle on the CDI. In that situation, the mode will go directly to APPR CPLD as displayed on the annunciator panel. The system can intercept at any angle up to 90° and will always turn toward the course pointer. See approach procedure for more detail. APPR mode can be disengaged by depressing the APPR switch on the Mode Controller; by depressing the GA switch on the left engine throttle control; or by engaging HDG or NAV when in APPR CPLD. The annunciator panel indicates the status of the approach mode.

CAUTION

THE "APPR" MODE OF OPERATION WILL CONTINUE TO PROVIDE AIRPLANE COMMANDS AND/OR CONTROL WITHOUT A VALID VOR/LOC SIGNAL (NAV FLAG IN VIEW).

(8) Back Course Mode (BC):
For BC operation proceed as for normal approach mode, but engage BC after selecting APPR. The BC switch reverses the signals in the computer and cannot be engaged without a LOC frequency selected. BC status is indicated on the annunciator panel. BC mode can be disengaged by depressing either the BC, APPR or GA switches, or by selecting other than a LOC frequency on the NAV receiver.

(9) Vertical Mode Switch (Trim Up/Dn):
Operation of the vertical trim switch on the Mode Controller provides a convenient means of adjusting the ALT hold or PAH angle function without disengaging the mode.

(10) Go-Around Mode (GA):
The GA mode may be engaged by depressing the GA switch on the left engine throttle. GA will illuminate on the annunciator panel indicating mode status. The GA mode provides a fixed pitch up angle that will command the best rate of climb-out for single-engine performance. The AP, if engaged, will disengage. GA will cancel all other vertical modes as well as APPR or NAV CPLD.

(11) Yaw Damper Mode (YAW DAMPER):
The optional Yaw Damper mode engages automatically when the AP is engaged or may be engaged or disengaged separately by the use of the YAW DAMP switch on the Yaw Controller. The Yaw Damper provides lateral damping plus turn coordination as a third axis with AP engaged or as a stand alone system with only the YAW DAMP on. The Yaw Damper will disengage with AP disengagement if there is no KC 291.

(i) VOR PROCEDURES
(1) Tune NAV receiver to the appropriate frequency.
(2) Set the desired heading with the HDG bug to intercept the radial and engage HDG and AP (Maximum recommended intercept angle is 90°).
(3) Select the desired radial and engage NAV. The FCS will remain on HDG as indicated on the annunciator panel and in ARM on the NAV mode. When the airplane intercepts the beam, the system will automatically couple and track in NAV mode and indicate CPLD on the annunciator panel.
(4) A new course may be selected over the VOR station when operating in the NAV mode, by selecting a new radial when the To-From indication changes.
(5) For VOR approach, see approach procedure.

(j) APPROACH PROCEDURES
(1) Tune ILS or VOR.
(2) Set CDI to front course.
(3) Set Heading Bug and engage HDG to intercept beam at any angle. (Maximum recommended intercept angle is 90).
(4) Engage APPR and Note APPR ARM on the annunciator panels.
(5) When the airplane approaches the beam; APPR will couple; HDG will decouple; the FDI and/or AP will give commands to track LOC or VOR; and CPLD will illuminate on the annunciator panel.
(6) When the glideslope beam is intercepted, the glideslope will couple automatically and indicate GS on the annunciator panel. If ALT was engaged prior to intercepting the glideslope, it will automatically disengage when GS couples. Airplane FDI and/or AP will now provide command to track LOC and GS. Adjust throttles to control speed on descent. Set HDG bug for missed approach but do not engage HDG.
(7) When middle marker signal is received, system will automatically switch to a more stable track mode.

(8) Landing or missed approach.
  a. Disengage AP and land.
  b. Go-Around by depressing GO AROUND switch on left engine throttle and applying full power. The autopilot, if engaged, will disengage. Manually fly the airplane and retrim as required to establish the GA attitude as displayed on the Flight Director Indicator. After the GA attitude has been established and the airplane has been retrimmed, the autopilot may be re-engaged. APPR may be engaged for a straight away missed approach or HDG may be engaged to turn to the missed approach heading.

CAUTION

AT AIRSPEEDS BELOW 101 KIAS, RAPID POWER APPLICATION FOR GO AROUND MAY CAUSE A PRONOUNCED PITCH-UP ATTITUDE CHANGE.

(k) BACK COURSE PROCEDURE
Same as front course except that BC is engaged after APPR is engaged and the airplane must be set for descent manually by holding the vertical trim switch DN on the MODE CONTROLLER if in ALT HOLD or by establishing the desired pitch angle using the CWS interrupt switch or Vertical Trim Switch if in PAH.

SECTION 5 - PERFORMANCE

Installation of the King KFC 200 Flight Control System does not affect the basic performance information presented by Section 5 of this handbook.

THIS PAGE INTENTIONALLY LEFT BLANK

SUPPLEMENT 10

KAP 200 AUTOMATIC FLIGHT CONTROL SYSTEM (WITHOUT FLIGHT DIRECTOR INSTALLATION)

SECTION 1 - GENERAL

This supplement is to acquaint the pilot with the operation of the KAP 200 Automatic Flight Control System as installed in the PA-31, Navajo. The airplane must be operated within the limitations herein specified.

This supplement has been "FAA Approved" as a permanent part of this handbook based on King STC No. SA1166CE, and must remain in this handbook at all times when the optional King KAP 200 Automatic Flight Control System is installed.

The KAP 200 System autopilot is certified in this airplane with two axis control, pitch and roll or three axis control if optional Yaw Axis is installed. The optional third axis (Yaw) when installed gives three axis damping and control whenever the autopilot mode is engaged. With the installation of an optional KC 291 Yaw Damper Mode Controller, Yaw Damping and turn coordination is available with or without the basic autopilot mode being engaged. Both the two axis and three axis version of the system are described in this manual.

The airplane is equipped with an electric pitch trim system which is also used to accomplish automatic trimming to unload the autopilot elevator servo so that autopilot disengagement does not result in transient airplane motion. An autotrim/manual electric pitch trim monitor is provided in the autopilot. Autotrim and/or manual electric pitch trim faults are visually annunciated on the Mode Annunciator and accompanied by an audible warning.

This airplane is equipped with a manual electric pitch trim system designed to withstand any type in-flight single malfunction provided that the system is fully functional during the preflight operational check.

ABBREVIATIONS

AFCS	Automatic Flight Control System
ALT	Altitude or Altitude Hold
AP	Autopilot
APPR	Approach
ARM	System Arm for Capture
BC	Back Course
CDI	Course Deviation Indicator or Control
CPLD	Coupled
CWS	Control Wheel Steering
DISC	Disconnect
FCS	Flight Control System
FD	Flight Director System
GA	Go Around
GS	Glideslope
HDG	Heading Select
NAV	Navigation
PAH	Pitch Attitude Hold
PNI	Pictorial Navigation Indicator
YD	Yaw Damper

SECTION 2 - LIMITATIONS

(a) During autopilot operation, pilot must be seated at the controls with seat belt fastened. Operation is limited to the left-side pilot position.
(b) Maximum speed for autopilot operation is 211 KIAS.
(c) As the autopilot may mask high control forces necessary to counter an asymmetric ("split") flap condition, actuate the flaps only while the airplane is under manual control - not while the autopilot is engaged. Autopilot operation not authorized with greater than 15° of flap extension.
(d) The autopilot must be disengaged during takeoff and landing
(e) System approved for Category I operation only (APPR or BC selected).
(f) Autopilot attitude command limits:

Pitch	±15°
Roll	±25°
Yaw	NA

(g) The maximum altitude for operation of the autopilot has not been determined. The maximum altitude demonstrated during flight tests was 24,000 feet.
(h) Placards:

Location - Pilot's control wheel, left horn:

AP DISC	TRIM INTERRUPT

- Pilot's control wheel, left horn:

CWS

- Pilot's control wheel, left horn:

TRIM UP/DN

Immediately adjacent to KA 285 Annunciator or KC 292 Mode Controller Panels:

CONDUCT AFCS PREFLIGHT CHECK PRIOR TO FLIGHT IN ACCORDANCE WITH FLIGHT MANUAL:

Immediately adjacent to KC 292 (if equipped with a third axis without KC 291).

3 AXIS AP CONTROL

SECTION 3 - EMERGENCY PROCEDURES

(a) AUTOPILOT/YAW DAMPER DISENGAGEMENT
Disengage Autopilot/Yaw Damper and/or prevent engagement by:
(1) Pilot's AP DISC switch detent.
(2) AP engage lever on Mode Controller and Yaw engage switch on Yaw Controller (on airplanes equipped with KC 291).
(3) Pulling the AUTOPILOT circuit breaker.
(4) Turning master switch OFF.
(5) Turning avionics master switch OFF.

(b) AUTOMATIC AUTOPILOT DISENGAGEMENT
Any of the following will cause the autopilot to automatically disengage:
(1) External power failure.
(2) Actuating manual electric trim.
(3) Internal Flight Control System failure.
(4) With KCS 55A system, a loss of compass valid, (displaying HDG flag) disengages the AP when a mode using heading information is engaged. With compass flag present only AP and vertical modes can be selected.

(c) MANUAL ELECTRIC PITCH TRIM
The manual electric pitch trim can be disengaged by pressing the AP DISC/TRIM INTERRUPT switch and holding it down until recovery can be made. Then turn off AVIONICS MASTER switch and manually retrim the airplane using the manual trim control wheel. After the airplane is trimmed out, pull the (PITCH TRIM) breaker and turn the AVIONICS MASTER switch back on.

(d) MAXIMUM ALTITUDE LOSSES DUE TO AUTOPILOT MALFUNCTION

(1)	Cruise, Climb, Descent	400 feet
(2)	Maneuvering	60 feet
(3)	APPR	60 feet
(4)	SE APPR	60 feet

CAUTION

OVERPOWERING THE AUTOPILOT IN THE PITCH AXIS FOR PERIODS OF THREE SECONDS OR MORE WILL RESULT IN THE AUTOTRIM SYSTEM OPERATING IN THE DIRECTION TO OPPOSE THE PILOT AND WILL, THEREFORE, CAUSE AN INCREASE IN THE PITCH OVERPOWER FORCES AND, IF AUTOPILOT DISENGAGED, WOULD RESULT IN A PITCH TRANSIENT CONTROL FORCE.

(e) ENGINE FAILURE (Coupled)
(1) Disengage AP
(2) Follow basic Airplane Flight Manual single-engine procedures.
(3) Airplane rudder and aileron axes must be manually trimmed prior to engaging autopilot for single-engine operations.

CAUTION

IF RUDDER AND AILERON CANNOT BE MAINTAINED WHEN POWER IS CHANGED DURING A SINGLE-ENGINE COUPLED APPROACH OR GO-AROUND, DISENGAGE AUTOPILOT AND CONTINUE APPROACH/GO-AROUND MANUALLY.

SECTION 4 - NORMAL OPERATING PROCEDURES

(a) The airplane MASTER SWITCH function is unchanged and can be used in an emergency to shut off all electrical power while the problem is isolated.
(b) The AVIONICS MASTER switch supplies power to the avionics bus bar of the radio circuit breakers AUTOPILOT and PITCH TRIM circuit breakers.
(c) The KAP 200 is controlled by the following circuit breakers:

AUTOPILOT - This supplies power to the FCS KC 295 Computer, KC 292 Mode Controller, KA 285 Annunciator Panel and AP Pitch and Roll Servos. When optional yaw damper system is installed, this breaker also supplies power to the KC 296 Yaw Computer, the Yaw Servo, and the optional KC 291 if so equipped.

AVIONICS MASTER - This in conjunction with the AVIONICS MASTER Switch supplies power to the avionics bus.

COMPASS SYSTEM - This supplies power to the KCS 55/55A Compass System.

PITCH TRIM - This supplies power to the FCS autotrim and manual electric pitch trim systems.

(d) PILOT'S CONTROL WHEEL SWITCH FUNCTIONS

AP DISC/TRIM INTERRUPT - This emergency disconnect switch will disengage the AP and/or YD and interrupt the power to the electric trim system. To resume AP control, the AP lever on the Mode Controller must be re-engaged. In the event of electric trim or autotrim failure, the switch can be held depressed which removes all power from the system to allow the pilot time to turn off the AVIONICS MASTER switch and pull the (PITCH TRIM) circuit breaker.

CWS - This switch when depressed and held will allow the pilot to manually fly the airplane in pitch and roll without disengageing the AP. When the switch is released the AP will resume control, (within the pitch and roll attitude limits). The CWS switch will resync PAH, or ALT hold mode. When the CWS is held depressed, manual electric pitch trim may be operated without disengaging the AP.

TRIM UP/DN - Manual electric pitch trim is activated by a dual-action type switch that requires both halves be moved simultaneously for actuating up or down trim commands. Operation of the manual electric pitch trim switch will disengage the AP. (Except when CWS switch is held depressed as previously noted.) The third axis will not disengage with operation of manual trim switch if the airplane is equipped with a KC 291.

(e) FCS WARNINGS FLAGS AND ANNUNCIATORS DESIGNATION AND OPERATION

HDG/PWR* - This warning flag, mounted in the Pictorial Navigation Indicator, will be in view whenever the Directional Gyro information is invalid. If a HDG invalid occurs with either NAV, APPR, or HDG modes selected, the AP is disengaged. Basic AP mode may then be reengaged along with any vertical mode. This flag is labeled HDG in the KCS 55A Compass System.
*This warning flag is labeled PWR in the KCS 55 Compass System. All modes may be selected and will function with or without a PWR warning flag present.

TRIM - The TRIM warning light, located in the lower right corner of the annunciator panel, will flash and be accompanied by an audible warning whenever the following autotrim and/or manual electric pitch trim failures occur: Trim servo motor running without a command. The trim servo motor not running when commanded to run and the trim servo motor running in the wrong direction are monitored on autotrim only. The TRIM warning light flashes four times and the audible warning sounds when the test switch on the Mode Controller is depressed.

GS - The Glideslope valid (GS pointer being in view on PNI) has to be present before GS may couple. If, after GS CPLD, the valid is lost the system will flash the GS Annunciator and revert from GS CPLD to PAH. If the GS valid returns the system will revert back to GS CPLD.

NAV - The NAV or APPR Modes (ARM OR CPLD) may be selected and will function with or without a NAV warning flag present.

(f) BEFORE ENGAGING FLIGHT CONTROL SYSTEM
   (1) Verify that all circuit breakers for the system are in.
   (2) Allow sufficient time for the gyros to come up to speed and for the system to warm up (3-4 minutes).

(g) PREFLIGHT CHECK (must be performed prior to each flight)
   (1) With no modes engaged and all valid flags retracted, depress the Test Button on the Mode Controller. The Yaw Damp ON light will illuminate and all annunciators will illuminate on the annunciator panel, including the three marker lights except FD and GA. Also, the red TRIM failure light will flash. At least four or more flashes must be observed to indicate proper operation of the autotrim/manual electric pitch trim feature and an audible warning should sound.
   (2) With the AP disengaged, run the following manual electric pitch trim checks.
      a. Verify that the PITCH TRIM circuit breaker is in.
      b. Actuate the left - side switch to the fore and aft positions. The trim solenoid should engage, but the trim should not run.
         Acutate the right - side switch to the fore and aft positions The trim solenoid should not engage and the trim should not run.
      c. Run trim from stop to stop. the time required is 61 ±6 seconds.
      d. Grasping the manual trim wheel, run the trim both up and down and check the overpower capability. (Check that the trim indicator moves with the wheel.)
      e. Press the AP DISC/TRIM INTERRUPT switch down and hold. The manual electric pitch trim will not operate either up or down.
   (3) Engage the AP, depress the CWS switch, center the flight controls and then release the CWS switch. Apply force to the controls to determine if the AP can be overpowered.
   (4) Check the operation of the pilot's control wheel switch functions.
   (5) Engage the AP and put in a pitch (UP) command using the vertical trim switch on the Mode Controller. Hold the control column to keep it from moving and observe the autotrim run in the nose up direction after approximately three seconds delay. Use the vertical trim switch and put in a pitch (DN) command. Hold the control column and observe the autotrim run in the nose down direction after approximately three seconds.
   (6) Engage the AP and HDG. Set the HDG bug to command a right turn. The control wheel will rotate clockwise. Set the HDG bug to command a left turn. The control wheel will rotate counterclockwise.

CAUTION

DISENGAGE THE AP AND CHECK THAT THE AIRPLANE'S MANUAL PITCH TRIM IS IN TAKEOFF POSITION PRIOR TO TAKEOFF.

CAUTION

IF THE AUTOPILOT CIRCUIT BREAKER IS PULLED, THE RED "TRIM" FAILURE LIGHT ON THE ANNUNCIATOR PANEL WILL BE DISABLED AND THE AUDIBLE WARNING WILL CONTINUOUSLY SOUND INDICATING THAT THE FAILURE LIGHT IS DISABLED. IN THIS EVENT THE "PITCH TRIM" CIRCUIT BREAKER SHOULD BE PULLED AND IN-FLIGHT TRIM ACCOMPLISHED BY USING THE MANUAL PITCH TRIM WHEEL.

(h) IN-FLIGHT OPERATION

(1) Engage Procedure:
After takeoff, clean up airplane and establish climb. Monitor flight controls and engage the AP. The pitch attitude will lock on any attitude up to 15°.

Engaging and holding the CWS switch allows the pilot to momentarily revert to manual control while retaining his previous modes and conveniently resuming that profile at his discretion.

(2) Disengage Procedure:
While monitoring the flight controls, disengage the system by one of the following methods: depressing the pilot's AP DISC switch, operating the manual electric pitch trim switch, or by operating the AP engage lever on the Mode Controller. The AP light on the annunciator panel will flash at least four times and remain off to indicate that the AP is disengaged. All other modes will also disengage.

NOTE

IF THE AIRPLANE IS EQUIPPED WITH A KC 291, THE OPTIONAL YAW DAMPER MODE WILL DISENGAGE WITH THE USE OF THE PILOT'S CONTROL WHEEL "AP DISC" SWITCH, BUT WILL NOT DISENGAGE AUTOMATICALLY WHEN THE MODE CONTROLLER "AP" SWITCH IS DISENGAGED OR WHEN THE MANUAL ELECTRIC PITCH TRIM IS OPERATED. THE YAW DAMPER CAN BE DISENGAGED OR ENGAGED AT ANY TIME BY DEPRESSING THE YAW CONTROLLER "YAW DAMP" SWITCH.

(3) AP Mode:
The AP must be engaged before any other mode can be engaged. The AP alone indicates PAH and wings level. The AP will automatically follow any other modes engaged. Disengaging the AP disengages all other modes.

NOTE

THE "VERTICAL TRIM" SWITCH, LOCATED ON THE MODE CONTROLLER, MAY BE USED TO TRIM THE COMMAND PITCH ATTITUDE AT A RATE OF ONE DEGREE PER SECOND.

(4) Altitude Hold Mode (ALT):
When the AP is engaged and the ALT switch on the Mode Controller is pressed, the AP will provide commands for maintaining the pressure altitude existing at the time the switch is depressed. For smooth operation, engage the ALT at no greater than 500 feet per minute climb or descent. The ALT will automatically disengage when glideslope couples. ALT hold may be turned off at any time by depressing the ALT switch. ALT engagement is displayed on the annunciator panel.

NOTE

THE "VERTICAL TRIM" SWITCH, LOCATED ON THE MODE CONTROLLER, MAY BE USED TO CHANGE OR TRIM THE COMMAND ALTITUDE UP OR DOWN AT 500 TO 700 FPM WITHOUT DISENGAGING THE MODE. THE NEW PRESSURE ALTITUDE THAT EXISTS WHEN THE SWITCH IS RELEASED WILL THEN BE HELD.

(5) Heading Mode (HDG):
Set the heading bug to the desired heading on PNI, engage AP and depress the HDG switch on the Mode Controller and HDG will be displayed on the annunciator panel. The AP will command a turn to the heading selected and hold. The pilot may then choose any new heading by merely setting the bug on the new heading. The AP will automatically command a turn in the direction of the new setting. To disengage the HDG Mode, depress the HDG switch on the Mode Controller and observe the HDG light go out on the annunciator. The HDG mode will automatically disengage when APPR or NAV CPLD is achieved.

(6) Navigation Mode (NAV):
The Navigation mode may be selected by tuning the NAV receiver to the desired frequency. setting the CDI to the desired radial and with the AP engaged depressing the NAV switch on the Mode Controller. The annunciator will indicate NAV ARM until intercepting the selected course, unless the NAV switch is engaged with wings level and a centered needle on the CDI. Then the mode will go directly to NAV CPLD as displayed on the annunciator panel. The system can intercept at any angle up to 90 and will always turn toward the course pointer. If a condition requiring a capture exists at mode engagement, the pilot is required to set up an intercept angle using either HDG or AP mode. NAV may be disengaged by depressing the NAV switch or by engaging HDG when in NAV CPLD or APPR when in NAV CPLD/ARM.

CAUTION

THE "NAV" MODE OF OPERATION WILL CONTINUE TO PROVIDE AIRPLANE COMMAND AND/OR CONTROL WITHOUT A VALID VOR/LOC SIGNAL (NAV FLAG IN VIEW).

(7) Approach Mode (APPR):
The Approach mode may be selected by tuning the NAV receiver to the desired VOR or LOC frequency, setting the CDI to the desired radial or front course and with the AP engaged depressing the APPR switch on the Mode Controller. The annunciator will indicate APPR ARM until the course is intercepted unless the APPR switch is engaged with the wings level and there is a centered needle on the CDI. In that situation, the mode will go directly to APPR CPLD as displayed on the annunciator panel. The system can intercept at any angle up to 90° and will always turn toward the course pointer. See approach procedure for more detail. APPR mode can be disengaged by depressing the APPR switch on the Mode Controller; or by engaging HDG or NAV when in APPR CPLD. The annunciator panel indicates the status of the approach mode.

CAUTION

THE "APPR" MODE OF OPERATION WILL CONTINUE TO PROVIDE AIRPLANE COMMANDS AND/OR CONTROL WITHOUT A VALID VOR/LOC SIGNAL (NAV FLAG IN VIEW).

(8) Back Course Mode (BC):
For BC operation proceed as for normal approach mode, but engage BC after selecting APPR. The BC switch reverses the signals in the computer and cannot be engaged without a LOC frequency selected. BC status is indicated on the annunciator panel. BC mode can be disengaged by depressing either the BC or APPR switches, or by selecting other than a LOC frequency on the NAV receiver.

(9) Vertical Mode Switch (Trim Up/Dn):
Operation of the vertical trim switch on the Mode Controller provides a convenient means of adjusting the ALT hold or PAH angle function without disengaging the mode.

(10) The optional third axis engages automatically when the AP is is engaged or may be engaged or disengaged separately by the use of the YAW DAMP switch on the Yaw Controller if so equipped. The third axis provides lateral damping plus turn coordination with AP engaged or as a stand alone system with only the YAW DAMP on. The Yaw Damper mode will disengage with the use of the pilot's control wheel AP DISC switch, but will not disengage automatically when the Mode Controller AP is desengaged or when the manual electric pitch trim is operated. The Yaw Damper can be disengaged at any time by depressing the Yaw Controller Yaw Damp switch. The Yaw Damper will disengage with AP disengagement if there is no KC 291.

(i) VOR PROCEDURES
(1) Tune NAV receiver to the appropriate frequency.
(2) Set the desired heading with the HDG bug to intercept the radial and engage HDG and AP (Maximum recommended intercept angle is 90°).
(3) Select the desired radial and engage NAV. the FCS will remain on HDG as indicated on the annunciator panel and in ARM on the NAV mode. When the airplane intercepts the beam, the system will automatically couple and track in NAV mode and indicate CPLD on the annunciator panel.
(4) A new course may be selected over the VOR station when operating in the NAV mode, by selecting a new radial when the To-From indication changes.
(5) For VOR approach, see approach procedure.

(j) APPROACH PROCEDURES
   (1) Tune ILS or VOR.
   (2) Set CDI to front course.
   (3) Set Heading Bug and engage AP and HDG to intercept beam at any angle. (Maximum recommended intercept angle is 90°).
   (4) Engage APPR and note APPR ARM on the annunciator panel.
   (5) When the airplane approaches the beam; APPR will couple; HDG will decouple; the AP will give commands to track LOC or VOR; and CPLD will illuminate on the annunciator panel.
   (6) When the glideslope beam is intercepted, the glideslope will couple automatically and indicate GS on the annunciator panel. If ALT was engaged prior to intercepting the glideslope, it will automatically disengage when GS couples. The AP will now provide command to track LOC andGS. Adjust throttles to control speed on descent. Set HDG bug for missed approach but do not engage HDG.
   (7) When middle marker signal is received, system will automatically switch to a more stable track mode.
   (8) For landing or missed approach, disengage AP.

(k) BACK COURSE PROCEDURE
Same as front course except that BC is engaged after APPR is engaged and the airplane must be set for descent manually by holding the vertical trim switch DN on the MODE CONTROLLER if in ALT HOLD or by establishing the desired pitch angle using the CWS INTERRUPT switch or Vertical Trim Switch if in PAH.

SECTION 5 - PERFORMANCE

Installation of the King KAP 200 Flight Control System does not affect the basic performance information presented by Section 5 of this handbook.

Piper Aircraft Corporation
3000 Medulla Road
Lakeland, Florida 33803

FAA APPROVED
"PILOT'S OPERATING HANDBOOK AND FAA APPROVED AIRPLANE FLIGHT MANUAL" SUPPLEMENT FOR FLAP CONTROL SYSTEM

MODEL PA-31

REG. NO. ______

SER. NO. ______

This Supplement must be attached to the "Pilot's Operating Handbook and FAA Approved Airplane Flight Manual" PAC Report 2045, dated October 29, 1976, when the Wing Flap System with a 40:1 Flap Transmission is installed on PA-31 airplane with serial numbers 31-7712001 through 31-7812129, in accordance with PAC Drawing 73259 (S.L. 959). The information contained herein supplements or supersedes the information of the basic handbook 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.O.A. No. SO-2
Piper Aircraft Corporation
Lakeland, Florida

Date: May 24, 1983

SECTION 1 - GENERAL

This supplement supplies information necessary for the safe operation of the airplane when equipped with a Flap System with a 40:1 flap transmission.

SECTION 2 - LIMITATION

2.3 AIRSPEED LIMITATIONS

SPEED	KCAS	KIAS
Maximum Flaps Extended Speed (V_{FE}) - Do not exceed this speed with a given flap setting.		
Flaps extended speeds		
15° flap (serial numbers 31-7712001 through 7712106)	152	164
25° flap (serial numbers 31-7812001 and up)	160	174
40° flap	130	140

2.27 PLACARDS

On pilot's window side moulding (serial numbers 31-7712001 through 31-7812129):

DISENGAGE THE AIRCRAFT AUTOPILOT PRIOR TO OPERATING FLAPS. OPERATE FLAPL CONTROL IN SMALL INCREMENTS TO ASSURE FLAP SYMMETRY.

SECTION 3 - EMERGENCY PROCEDURES

3.3 EMERGENCY CHECKLIST

ASYMMETRIC FLAP CONDITION (Serial numbers 31-7712001 through 31-7812129)

DURING FLAP OPERATION

Flap switch .... OFF
Aileron .... maintain wings level
Flap switch .... ACTUATE, in increments (to obtain flap symmetry, 0.5 sec. max.)

If symmetry obtained, stays the same, or worsens
Flap switch .... OFF
Flap control CB .... PULL

AFTER FLAPS HAVE BEEN POSITIONED

Autopilot....disengage
Aileron....maintain wings level
Flap switch....ACTUATE, in increments (to obtain flap symmetry, 0.5 sec. max.)

If symmetry obtained, stays the same, or worsens
Flap switch....OFF
Flap control CB....PULL

LANDING WITH ASYMMETRIC FLAPS

Approach speed....106 KIAS min.
Power....as required for 500-800 ft/min rate of descent. Slowly reduce during landing flare.

WARNING

Flight with maximum flap asymmetry (0° and 25°) will require an aileron detraction of approximately 85% of the total available travel to maintain wings level. Considering the decreased lateral control maneuvering capability (in the direction of the maximum deflected flap), minimize bank angles and roll rate while maneuvering.

With asymmetric flaps in excess of 25° differential, control of the airplane cannot be maintained.

3.5 AMPLIFIED EMERGENCY PROCEDURES

3.39 ASYMMETRIC FLAP CONDITION (Serial numbers 31-7712001 through 31-7812129)

An asymmetric flap condition occurs when the wing flaps become unsynchronized and each flap assumes a different deflection angle.

Should this condition occur, the aircraft will exhibit a tendency to roll towards the flap with the lesser deflection.

An asymmetric flap condition may occur during flap operation or after the flaps have been positioned. If, while operating the flaps, the aircraft exhibits an uncommanded roll tendency, immediately position the flap switch to the OFF position. Maintain wings level using the aileron control. Briefly activate the flap switch and then return to the OFF position (assuring that the switch does not remain in the UP or DOWN position longer than 0.5 seconds) to determine if the rolling tendency moderates. If the roll tendency moderates, continue the same incremental retraction until symmetry is obtained, and upon achieving symmetry, position the flap switch to the OFF position and pull the flap control circuit breaker.

If the rolling tendency does not moderate, or worsens, immediately position the flap control to the OFF position and pull the flap control circuit breaker.

Should the aircraft exhibit an uncommanded rolling tendency alter the flaps have been positioned, immediately disengage the autopilot (if engaged) and utilize the aileron control to maintain wings level. If the rolling tendency persists, utilize the previously mentioned incremental retraction technique to obtain flap symmetry. If flap symmetry cannot be obtained, position the flap control to the OFF position and pull the flap control circuit breaker.

Aircraft lateral control with asymmetric flaps (0° and 25°) can be maintained by utilizing approximately 85% of the total aileron travel in the direction of the flap with the higher deflection angle. Aileron deflection does not vary appreciably with airspeed; however, the aileron force decreases proportionately with airspeed. The affects of power (symmetrical) have a small proportional affect on control deflection and force.

WARNING

With asymmetric flaps in excess of 25° differential, control of the airplane cannot be maintained.

The landing approach should be planned to provide a higher and wider pattern than normal considering the aircraft's reduced lateral control capability. After turning final approach, configure the aircraft for landing. Set the power for a 500-800 ft. rate of descent and establish a final approach airspeed of 106 KIAS. During the landing flare, gradually reduce power. Touchdown in a level flight attitude.

WARNING

Considering the aircraft's reduced roll control capability, always select a landing runway which will minimize the crosswind component. Should a landing become necessary in a crosswind condition, maintain a wings level attitude while varying the aircraft's heading for runway alignment until the aircraft has been touched down.

SECTION 4 - NORMAL PROCEDURES

4.3 AIRSPEEDS FOR SAFE OPERATION

(d) Maximum Flaps Extended Speeds

0° to 15° Flaps (serial numbers 31-7712001 through 7712106)	164 KIAS
25° Flaps (serial numbers 31-7812001 and up)	174 KIAS
40° Flaps	140 KIAS

4.5 NORMAL PROCEDURES CHECKLIST

BEFORE LANDING

Wing flaps..as required - down in steps

(164 KIAS max. 15° S/N 31-7712001 thru 7712106)
(174 KIAS max. 25° S/N 31-7812001 and up)
(140 KIAS max. 40° flaps)

4.7 AMPLIFIED NORMAL PROCEDURES

4.29 BEFORE LANDING

The maximum speed for 15° flap extension is 164 KIAS (serial numbers 31-7712001 through 7712106). In airplanes with serial numbers 31-7812001 and up, up to 25° of flaps may be extended at airspeed below 174 KIAS. The maximum speed for full flap extension is 140 KIAS.

SECTION 5 - PERFORMANCE

No change

Piper Aircraft Corporation
3000 Medulla Road
Lakeland, Florida 33803

SECTION 6 - WEIGHT AND BALANCE

No change.

SECTION 7 - DESCRIPTION AND OPERATION

No change.

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 Navajo.

10.3 OPERATING TIPS

(a) Before starting the engine, check that an radio switches, light switches, and the pitot heat switch are in the off position so as not to create an electrical overload when the starter is engaged.

(b) To aid cold weather start use a normal starting procedure but leave the mixture full rich and crank the engine with a fuel flow indication of 6 GPH. Use a preheater if available, to reduce engine wear, at very low temperatures.

(c) 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.

(d) The shape of the wing fuel tanks is such that in certain maneuvers the fuel may move away from the tank outlet. If the outlet is uncovered, the fuel flow will be interrupted and a temporary loss of power may result. Pilots can prevent inadvertent uncovering of the outlet by having adequate fuel in the tank selected and avoiding maneuvers which could result in uncovering the outlet.

Normal and running turning takeoffs are not to be made when the inboard tanks are less than one-quarter full as fuel flow interruption may occur. Only the inboard tanks may be used for takeoff. Outboard tanks are for coordinated level flight only and may never be used for takeoff.

Prolonged slips or skids of 30 seconds or more, in any pitch attitude or other unusual or abrupt maneuvers which could cause uncovering of the fuel outlet must be avoided when outboard tanks are being used or when inboard tanks are less than one-quarter full.

(e) Always determine landing gear position by checking the gear position lights.

(f) Do not use fuel crossfeed to compensate for an inoperative emergency fuel pump.

(g) The engines are equipped with a dynamic counterweight system and must be operated accordingly. Use a smooth, steady movement (avoid rapid opening and closing) of the throttle.

(h) All fuel pumps should be on for takeoffs and landings.

(i) A high indication on the fuel flow indicator is a possible sign of restricted fuel nozzles.

(j) When an open circuit breaker is discovered, reset the breaker. If the breaker pops again, allow a two to five minute cooling off period before attempting to reset again.

(k) For a smooth comfortable ride for your passengers a 2400 RPM or lower engine speed is recommended for cruise.

(l) In extreme turbulence reduce power settings to obtain design maneuvering speed. (See Section 2 - Limitations for correct speeds.)

(m) Strobe lights should not be operated when flying through heavy haze or clouds, since reflected light can produce spacial disorientation. Show courtesy for other pilots by not operating strobe lights while taxiing in the vicinity of other aircraft.

(n) Pilots who fly above 10,000 feet should be aware of the need for special physiological training Appropriate training is available at approximately twenty-three Air Force Bases throughout the United States for a small fee. The training is free at the NASA Center in Housten and at the FAA Aeronautical Center in Oklahoma.

Forms to be completed (Physiological Training Application and Agreement) for application for the training course may be obtained by writing to the following address:

Chief of Physiological Training, AAC-143
FAA Aeronautical Center
P.O. Box 25082
Oklahoma City, Oklahoma 73125

It is recommended that all pilots who plan to fly above 10,000 feet take this training before flying this high and then take refresher training every two or three years.

(o) To reduce flap operating loads, it is desirable to have the airplane at a speed slower than the maximum allowable before extending the flaps.

(p) If a single engine landing is necessary, a check should be performed to determine whether or not the hydraulic pump is functioning for normal gear extension. This check is accomplished by placing the landing gear control in the "UP" position with the gear retracted. If the hydraulic pump is functioning, pressure will return the handle to the neutral position. This test should be performed before entering the traffic pattern so that there will be time to pump the gear down with the hand pump if the hydraulic pump is inoperable.

(q) 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.

(r) To reduce flap operating loads, it is desirable to have the airplane at a speed slower than the maximum allowable before extending the flaps. The flaps should be extended or retracted in small increments to guard against the possibility of encountering an asymmetric "split" flap condition (refer to Section 7, Description of Flight Control System).

(s) Experience has shown that the training advantage gained by pulling a mixture control or turning off the fuel to simulate engine failure at low altitude is not worth the risk assumed. Therefore, it is recommended that instead of using either of these procedures to simulate loss of power at low altitude the throttle be retarded slowly to idle position. Fast reduction of power may be harmful to the engine.

CASA AUSTRALIA

APPROVED SUPPLEMENT

PA-31 (WITHOUT LOCKERS)
VH-LJI
FEBRUARY, 1997

PA-31 WITHOUT WING LOCKERS

FLIGHT MANUAL SUPPLEMENT

with

'BOUNDARY LAYER RESEARCH,Inc' VORTEX GENERATOR INST.

CASA APPROVED

This Supplement is required to be inserted into the Aircraft Flight Manual when 'Boundary Layer Research, Inc' vortex generators have been installed in accordance with FAA STC SA00047SE and Engineering Order HSJ 1440.

With this installation the aircraft may be operated as per the FAA approved Flight Manual Supplement supplied with the STC.

The information contained herein supplements the information of the Basic Flight Manual. For limitations, procedures and performance data not contained in this Supplement, consult the Basic Flight Manual.

This and the following CASA pages are to be attached to the front of the FAA approved Supplement before insertion into the Aircraft Flight Manual.

APPROVED: P. Larcey (P. LARCEY) DATE: 26.2.97
for the CIVIL AVIATION SAFETY AUTHORITY, AUSTRALIA.
CAR 138

CIVIL AVIATION SAFETY AUTHORITY AUSTRALIA 26.2.97

HSJ AVIATION Pty Ltd

CASA AUSTRALIA

APPROVED SUPPLEMENT

PA-31 (WITHOUT LOCKERS)
VH-LJI
FEBRUARY, 1997

'BOUNDARY LAYER' V.G. INSTALLATION

LOG OF PAGES

REVISION No	DATE	PAGES
Initial Issue	3/2/97	1 to 5 (Aust.Cover Sheets)
A	Jan 21,1994	(i) to 14 FAA FMS Document No AFMS-NAV-7

CIVIL AVIATION ★ AUSTRALIA ★ SAFETY AUTHORITY 26.2.97

APPROVED P. Larcey (P. LARCEY) DATE 26.2.97
for the CIVIL AVIATION SAFETY AUTHORITY, AUSTRALIA

'BOUNDARY LAYER' V.G. INSTALLATION

GENERAL STATEMENT

This Supplement specifies the limitations and procedures for operations with vortex generators installed as per FAA STC SA 00047 SE and Engineering Order HSJ 1440.

With this installation the aircraft must be operated in accordance with this Supplement and the 'Boundary Layer Research, Inc' Supplement Document No AFMS-NAV-7.

In the FAA approved Supplement some measurements are expressed in imperial units.

Metrication of data is no longer a mandatory requirement for CASA approved Flight Manuals, however for ease of interpreting such data, conversion charts (imperial/metric) are incorporated into this Supplement.

SECTION 2 : LIMITATIONS

Eighty-two (82) vortex generators constitute the minimum requirement. If less than eighty-six (86) vortex generators are in place, the aircraft must be operated in accordance with the Basic Flight Manual.

For other limitations refer to the 'Boundary Layer Research, Inc' Flight Manual Supplement Document No AFMS-NAV-7.

SECTION 3 : EMERGENCY PROCEDURES

Refer to the 'Boundary Layer Research, Inc' Flight Manual Supplement Document No AFMS-NAV-7.

SECTION 4 : NORMAL PROCEDURES

The Pilot-in-Command shall, on the first flight of the day, walk around the aircraft and during the pre-flight inspection perform a visual inspection of the vortex generators.

Inspect for loose or missing vortex generators. As a guide, a red line is painted around the base of the end vortex generator of each row.

'BOUNDARY LAYER' V.G. INSTALLATION

SECTION 5 : PERFORMANCE

The performance data presented in the FAA approved Supplement is not factored.

Take-off distance and landing distance performance charts in Australian approved Flight Manuals present data that has been factored as per CAO 20.7.4 and CAO 101.22 Appendix I requirements.

Factoring of this data is mandatory for aircraft engaged in Regular Public Transport (RPT) operations (20.7.2).

a) Take-Off Distance
For RPT Operations, the calculated take-off distance determined from page 5 of the FAA approved Supplement must be multiplied by 1.23. The actual available or declared take-off distance of the runway must not be less than this *factored* length.

b) Landing Distance
Unchanged
Refer to the Basic Flight Manual.

SECTION 6 : WEIGHT AND BALANCE

The vortex generator installation permits an increase in the Maximum Take-off Weight.

The pilot must refer to the revised weight and balance data, in the Basic Flight Manual, that has been raised to reflect this installation.

Refer also to the 'Boundary Layer Research, Inc' Flight Manual Supplement Document No AFMS-NAV-7.