INTERIM SAFETY SUPPLEMENT

FLIGHT MANUAL

USAF SERIES T-38A AIRCRAFT

This publication supplements TO 1T-38A-1, dated 08 March 2016 with Change 2, dated 18 October 2017. It will remain active until rescinded or incorporated in the next change. See NOTICE TO AIRCREW below.

COMMANDERS ARE RESPONSIBLE FOR BRINGING THIS PUBLICATION TO THE ATTENTION OF ALL AFFECTED AIR FORCE PERSONNEL. MAJCOMS, SOAS, AND DRUS ARE RESPONSIBLE FOR RETRANSMITTING THIS PUBLICATION TO SUBORDINATE UNITS. IT WILL REMAIN IN EFFECT UNTIL FORMALLY PUBLISHED OR RESCINDED.

Published under authority of the Secretary of the Air Force

23 March 2018

DUAL AIRFRAME MOUNTED GEARBOX FAILURE

1. NOTICE TO AIRCREW: File this Interim Safety Supplement (ISS) in the front of the Flight Manual.

2. PURPOSE: This supplement is issued to amend the basic publication. This supplement will remain in effect until incorporated into the next change or rescinded.

3. GENERAL: The purpose of this ISS is to warn aircrew to the severity of a Dual Airframe Mounted Gearbox Failure and Dual Hydraulic Failure.

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4. INSTRUCTIONS: Printout this supplement and place pages 1 thru 4 in front of Flight Manual. Pencil write-ins are authorized to accomplish the instructions of this supplement when noted. For write-ins, cross out old verbiage and write in the change from the digital pdf on ETIMS and reference this supplement alongside the changed portion of the Flight Manual.

Another option is to print the supplemented pages from the ETIMS digital pdf Flight Manual and remove and replace as appropriate. A printable supplement will also be available on the T-38 Flight Manual SharePoint. Retain original pages until replaced by a change or revision.

When local reproduction of checklist pages is done, use the following options:

Option 1: When reproducing the pages in the pdf on synthetic paper or cardstock, remove the applicable checklist pages and insert the new supplemented pages into checklist.

Option 2: When reproducing the pages on bond paper, staple or glue the supplemented pages onto the appropriate original checklist pages.

A. In TO 1T-38A-1, Title page, write in "Reflects: 1T-38A-1SS-201" or replace page.

B. In TO 1T-38A-1, Page B, **STATUS PAGE**, replace page.

C. In TO 1T-38A-1, Page 3-1, **SECTION III EMERGENCY PROCEDURES**, replace page.

D. In TO 1T-38A-1, Page 3-11, **HYDRAULIC MALFUNCTION (CAUTION LIGHT(S) ILLUMINATED)**, Replace page.

E. In TO 1T-38A-1, Page 3-12, **EXCESSIVE HYDRAULIC PRESSURE (CAUTION LIGHT OFF) (IN FLIGHT), GEARBOX FAILURE – AIRFRAME MOUNTED**, and new **DUAL GEARBOX FAILURE – AIRFRAME MOUNTED**, Replace page.

F. In TO 1T-38A-1CL-1, Title page, write in "Reflects: 1T-38A-1SS-201" or replace page.

G. In TO 1T-38A-1CL-1, Page iii, replace page.

H. In TO 1T-38A-1CL-1, Page EC-1, **HYDRAULICS**, write-in changes and reference this supplement or replace page.

I. In TO 1T-38A-1CL-1, Page EC-4 and EC-5, **HYDRAULIC MALFUNCTION (CAUTION LIGHT(S) ILLUMINATED)**, Replace pages.

J. In TO 1T-38A-1CL-1, Pages EC-6 and EC-7, **EXCESSIVE HYDRAULIC PRESSURE (CAUTION LIGHT OFF) (IN FLIGHT),** Replace pages.

K. In TO 1T-38A-1CL-1, Pages EC-8 and EC-9, **GEARBOX FAILURE – AIRFRAME MOUNTED**, and new **DUAL GEARBOX FAILURE – AIRFRAME MOUNTED**, Replace pages.

5. STATUS INFORMATION: The data listed below is the most current for the TO 1T-38A-1, dated 8 March 2016 with change 2, dated 18 October 2017.

   A. Checklist: TO 1T-38A-1CL-1 dated 15 April 2016 with Change 2, dated 18 October 2017.

   B. Outstanding Supplements:

Number	Date	Short Title	Status	Checklist Affected?
TO 1T-38A-1SS-201	23 March 2018	DUAL GEARBOX FAILURE	Current	Yes

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7. This ISS was coordinated with HQ AETC/A3V, HQ AFMC/A3V, HQ ACC/A3TV, HQ AFGSC/A3TV and approved by the T-38 SPM.

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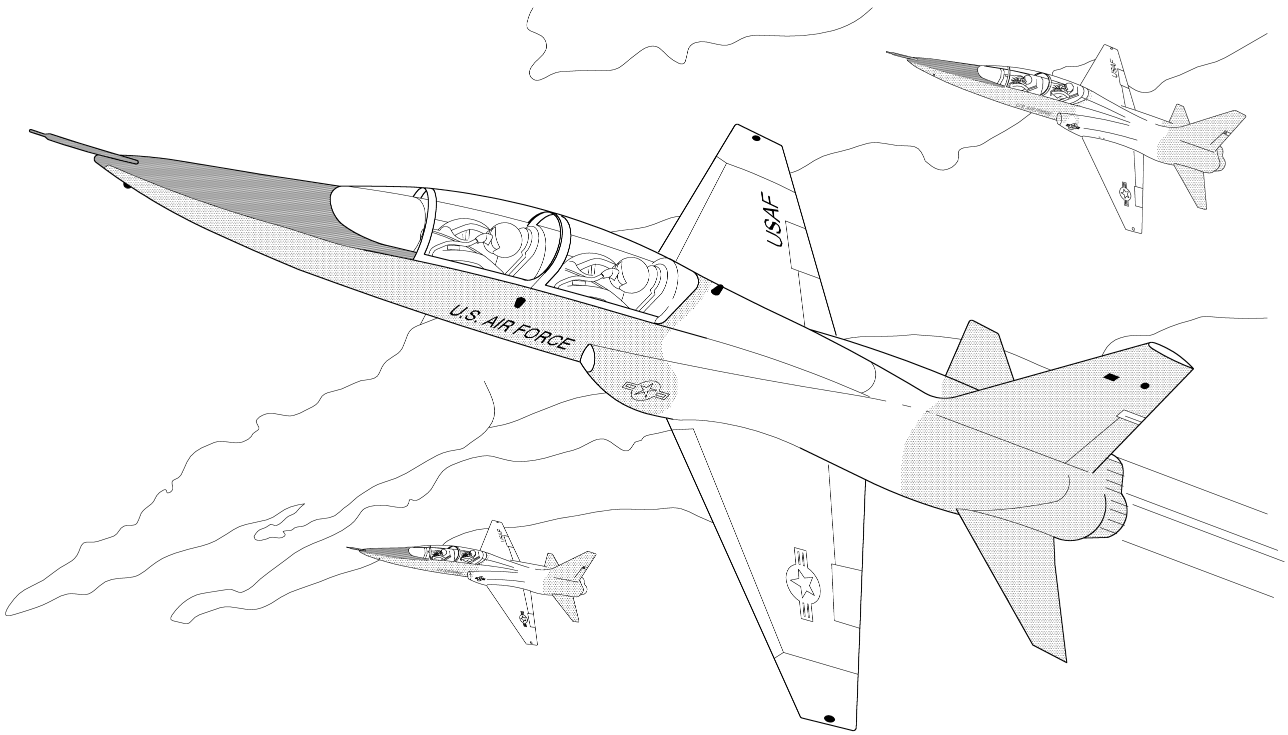
REFLECTS:
1T-38A-1SS-201

FLIGHT MANUAL

USAF SERIES T-38A AND AT-38B AIRCRAFT



(ATOS-HILL)

THIS PUBLICATION SUPERSEDES INTERIM SAFETY SUPPLEMENT TO 1T-38A-1SS-200 DATED 20 SEPTEMBER 2017.

COMMANDERS ARE RESPONSIBLE FOR BRINGING THIS PUBLICATION TO THE ATTENTION OF ALL AFFECTED PERSONNEL.

Published under authority of the Secretary of the Air Force

8 MARCH 2016 **CHANGE 2 - 18 OCTOBER 2017**

LIST OF EFFECTIVE PAGES

INSERT LATEST CHANGED PAGES. DESTROY SUPERSEDED PAGES.

NOTE: The portion of the text affected by the changes is indicated by a vertical line in the outer margins of the page. Changes to illustrations are indicated by shaded or screened areas, or by miniature pointing hands.

Dates of issue for original and changed pages are:

Original.................... 0 .... 8 March 2016
Change .... 1 .... 12 March 2017
Change .... 2 .... 18 October 2017

TOTAL NUMBER OF PAGES IN THIS MANUAL IS 348, CONSISTING OF THE FOLLOWING:

Page No.	*Change No.
Title	**2**
A - B	**2**
C Blank	0
i - iii	1
iv Blank	0
v - viii	0
1-1 - 1-18	0
1-19 - 1-20	1
1-20.1 Added	1
1-20.2 Blank	1
1-21 - 1-42	0
1-43	1
1-44 - 1-54	0
1-55 - 1-56	**2**
1-57 - 1-60	0
1-61 - 1-62	1
1-63 - 1-92	0
1-93	1
1-94 - 1-96	0
1-97	1
1-98 Blank	0
2-1	0
2-2	**2**
2-3 - 2-6	0
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2-8	0
2-9	1
2-10 - 2-11	0
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2-16	**2**
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A1-1 - A1-11	0
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A2-2 - A2-4	0
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A3-12	1
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A4-1	0
A4-2	1
A4-3 - A4-17	0
A4-18 Blank	0
A5-1 - A5-2	0
A5-3 - A5-4	1
A5-5 - A5-24	0
A6-1 - A6-4	0
A7-1 - A7-5	1
A7-6 Blank	0
A8-1 - A8-12	0
A9-1	1
A9-2	0
A9-3	1
A9-4 - A9-5	0
A9-6 Blank	0
Glossary 1 - Glossary 2 Added	1
Index 1	**2**
Index 2 - Index 6	1
Index 7 - Index 8 Deleted	1

*Zero in this column indicates an original page

STATUS PAGE

This page is published with each change package for Flight Manual Program publications. It contains a listing of the affected Flight Manual and its related Supplements and Checklists current on the date of this publication. However, formal Safety and Operational Supplements that are issued after the publication of this change, will contain a more current version of the status page. Changes or revisions that are in production are shown in parentheses.

AIRCREW FLIGHT MANUAL	DATE	CHANGE NO. AND DATE	
1T-38A-1	8 Mar 2016	2	18 Oct 2017

FLIGHT CREW CHECKLISTS	DATE	CHANGE NO. AND DATE	
1T-38A-1CL-1	15 Apr 2016	2	18 Oct 2017

SAFETY AND OPERATIONAL SUPPLEMENTS	DATE	SHORT TITLE
1T-38A-1SS-201	23 March 2018	DUAL GEARBOX FAILURE

INCORPORATED, RESCINDED, OR DELETED SUPPLEMENTS	DATE	STATUS
1T-38A-1SS-200	20 Sep 2017	Incorporated
1T-38A-1SS-199	23 Jan 2017	Incorporated
1T-38A-1SS-198	12 Oct 2016	Incorporated
1T-38A-1SS-197	24 Apr 2015	Incorporated
1T-38A-1SS-196	23 Apr 2015	Incorporated
1T-38A-1S-195	10 Oct 2014	Incorporated
1T-38A-1S-194	10 Jul 2013	Incorporated
1T-38A-1S-193	21 Feb 2013	Rescinded
1T-38A-1S-192	8 Feb 2013	Incorporated
1T-38A-1S-191	18 Nov 2011	Incorporated
1T-38A-1S-190	15 Nov 2011	Incorporated
1T-38A-1S-189	1 Jun 2011	Incorporated
1T-38A-1S-188	15 Apr 2010	Incorporated
1T-38A-1S-187	14 Jan 2009	Incorporated
1T-38A-1SS-186	24 Nov 2008	Incorporated
1T-38A-1S-185	28 Oct 2008	Incorporated
1T-38A-1S-184	18 Jul 2008	Incorporated

GRD
TO
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FLT
MISC
LND

I
II
III
IV
V
VI
VII
A
G
IN

GRD TO HYD ELE FUE OXY ENG FLT MISC LND

I II III IV V VI VII A G IN

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

GRD TO HYD ELE FUE OXY ENG FLT MISC LND

I II III IV V VI VII A G IN

LIST OF TABLES

GRD
TO
HYD
ELE
FUE
OXY
ENG
FLT
MISC
LND

I
II
III
IV
V
VI
VII
A
G
IN

INTRODUCTION

SCOPE

This manual contains information that will provide you with a general knowledge of the aircraft, and its characteristics and specific normal and emergency operating procedures. Your flying experience is recognized; therefore, basic flight principles are avoided. This manual provides you with operating instructions usable under most conditions. This does not alleviate the need for sound judgment in the operation of the aircraft. Multiple emergencies, adverse weather, terrain, etc., may require alteration of the procedure(s) presented in this manual.

PERMISSIBLE OPERATIONS

The Flight Manual takes a positive approach and normally states only what you can do. Unusual operations or configurations are prohibited unless specifically contained herein. Clearance from higher headquarters must be obtained before any questionable operation, which is not specifically permitted in this manual, is attempted.

HOW TO BE ASSURED OF HAVING LATEST DATA

Refer to the AF Enhanced Technical Information Management System (ETIMS) or the T-38 Flight Manual SharePoint https://org1.eis.af.mil/sites/hill/OOALCGH/T38FM/default.aspx for current status of Flight Manuals, Safety Supplements, Operational Supplements, and Flight Crew Checklists. Also, check the Flight Manual title page, the title block of each Safety and Operational Supplement, and the latest Status Page contained in the manual, or the latest Safety or Operational Supplement. Clear up all discrepancies before flight.

ARRANGEMENT

The manual is divided into eight independent sections to simplify for reading straight through or for using it as a reference manual. The aircraft Performance Data is located in Appendix A.

SAFETY SUPPLEMENTS

Information involving safety will be promptly forwarded to you in a Safety Supplement. Urgent information is published in interim Safety Supplements and transmitted electronically. Formal supplements are mailed. The supplement title block and status page should be checked to determine the supplement's effect on the manual and other outstanding supplements.

OPERATIONAL SUPPLEMENTS

Information involving changes to operating procedures will be forwarded to you by Operational Supplements. The procedure for handling Operational Supplements is the same as for Safety Supplements.

CHECKLISTS

The Flight Manual contains itemized procedures with necessary amplifications. The checklist contains itemized procedures. Amplifications may be included, but shall be kept to a minimum. Primary line items in the Flight Manual and checklist are identical. If a formal Safety or Operational Supplement affects your checklist, the affected checklist page will be attached to the supplement.

HOW TO GET INDIVIDUALLY ASSIGNED COPIES

Each flight crew member is entitled to receive individually assigned copies of the Flight Manual, Safety Supplements, Operational Supplements, and checklists. The required quantities should be ordered before you need them to assure their prompt receipt. Check with your publication distribution officer - it is their job to fulfill your TO requests. TO 00-5-1 gives information for properly ordering these publications.

FLIGHT MANUAL BINDERS

Loose leaf binders and sectionalized tabs are available for use with your manual and checklists. They are obtained through local purchase procedures and are listed in the General Services Administration (GSA) Supply Catalog (FSN 7510, Office Products). Check with your supply personnel for assistance in acquiring these items.

WARNINGS, CAUTIONS, AND NOTES

The following definitions apply in Warnings, Cautions, and Notes found throughout the manual:

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WARNING

Operating procedures, techniques, etc., which could result in personal injury and/or loss of life if not carefully followed.

CAUTION

Operating procedures, techniques, etc., which could result in damage to equipment if not carefully followed.

NOTE

An operating procedure, condition, etc., which it is essential to emphasize.

YOUR RESPONSIBILITY - TO LET US KNOW

Every effort is made to keep the Flight Manual current. Review conferences with operating personnel and a constant review of accident and flight test reports assure inclusion of the latest data in the manual. We cannot correct an error unless we know of its existence. In this regard, it is essential that you do your part. Comments, corrections, and questions regarding this manual or any phase of the Flight Manual program are welcome. These should be forwarded on AF Form 847 as directed by AFI 11-215.

CHANGE SYMBOLS

Changed text is indicated by a black vertical line (change bar) in either margin of the page extending the entire length of the text that has been changed or removed, as in the case of a deleted paragraph.

Example: Changed text.

The latest illustration changes will be indicated by up to three pointing hand symbols, as shown.

Four or more changes will be shown by a black vertical line (change bar) appearing in the right or left margin of the drawing.

DEFINITIONS

The word SHALL is used to express a provision that is binding. The words SHOULD and MAY are used when it is necessary to express nonmandatory provisions. WILL may be used to express a mandatory declaration of purpose or when it is necessary to express a future event.

GROUP CODING

Aircraft having different or additional systems and equipment have been block coded to avoid listing aircraft serial numbers. The Air Force serial numbers of the aircraft included in each block are as follows:

Block	Air Force Serial Numbers
20	AF59-1603 through AF59-1606
25	AF60-547 through AF60-553
30	AF60-554 through AF60-561
35	AF60-562 through AF60-596
40	AF61-804 through AF61-947
45	AF62-3609 through AF62-3752
50	AF63-8111 through AF63-8247
55	AF64-13166 through AF64-13305
60	AF65-10316 through AF65-10475
65	AF66-4320 through AF66-4389 and AF66-8349 through AF66-8404
70	AF67-14825 through AF67-14859 and AF67-14915 through AF67-14958
75	AF68-8095 through AF68-8217
80	AF69-7073 through AF69-7088
85	AF70-1549 through AF70-1591 and AF70-1949 through AF70-1956

US NAVY AIRCRAFT

The following aircraft operated by the US Navy are referred to in the manual by block numbers or by their Air Force serial numbers. These USAF serial numbers correspond to the following USN Bureau numbers:

USAF Serial Number	USN Bureau Number
65-0327	10327
68-0209	158198
68-8212	158199
68-8214	158200
68-8216	158201

AIRCRAFT CODE

Ⓐ T-38A
Ⓑ AT-38B

NOTE

- Text, illustrations, and charts applicable to all aircraft are not coded.
- When complete paragraphs are affected, the appropriate code will appear opposite the heading.
- Notes, cautions, and warnings are treated as individual paragraphs with regard to coding.

LIST OF TIME COMPLIANCE TECHNICAL ORDERS (TCTOS)

The TCTO Summary contains all current technical directives that have been incorporated in any one or all T-38A-1 series manuals. The directives are repeated in a comparable list in those manuals where the data is actually described. When a directive is rescinded or complete, the TO number will be deleted from this table and any reference to the number will be deleted from the text.

List of Time Compliance Technical Orders

TCTO Number	TCTO Title	TCTO Date
1T-38A-991	INSTALLATION OF REAR COCKPIT ULTRA HIGH FREQUENCY (UHF) RADIO, P/N RT-1168 INTO T-38A AIRCRAFT	6 Jun 2011
1T-38B-508	MODIFICATION OF FRONT COCKPIT CONSOLE PANELS AND INTERNAL WIRING TO SUPPORT ALQ-188 (V) 4 ELECTRONIC COUNTERMEASURE (ECM) PODS ON AT-38B AIRCRAFT	21 Feb 2013
1T-38A-993	MODIFICATION OF STRUCTURE AND WIRING TO INSTALL PYLON AND ELECTRONIC COUNTERMEASURE (ECM) PODS ON USAF SERIES T-38A AIRCRAFT	28 Mar 2016

EFFECTIVITY PAGE

Effectivity flags indicate the applicability of information to an aircraft modification. To indicate information that is prior to the modification, NON is added before the flag.

If the effectivity flag is placed after a paragraph title, the whole paragraph and subordinate paragraphs are effected. If the effectivity flag is placed at the beginning of a sentence, the whole sentence is effected. If the effectivity flag is placed after a word or phrase within a sentence or table, the flag only applies to the word or phrase.

Effectivity	Description
[**DUHF**]	Aircraft modified by TCTO 1T-38-991 (Dual UHF Radios)
[**ECMB**]	Aircraft modified by TCTO 1T-38B-508 (ECM Mod)
[**ECMA**]	Aircraft modified by TCTO 1T-38A-993 (Pylon/ECM Mod)

PREV COVER NEXT

GRD
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FLT
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T-38A AND AT-38B TALON
SUPERSONIC TRAINER AIRCRAFT

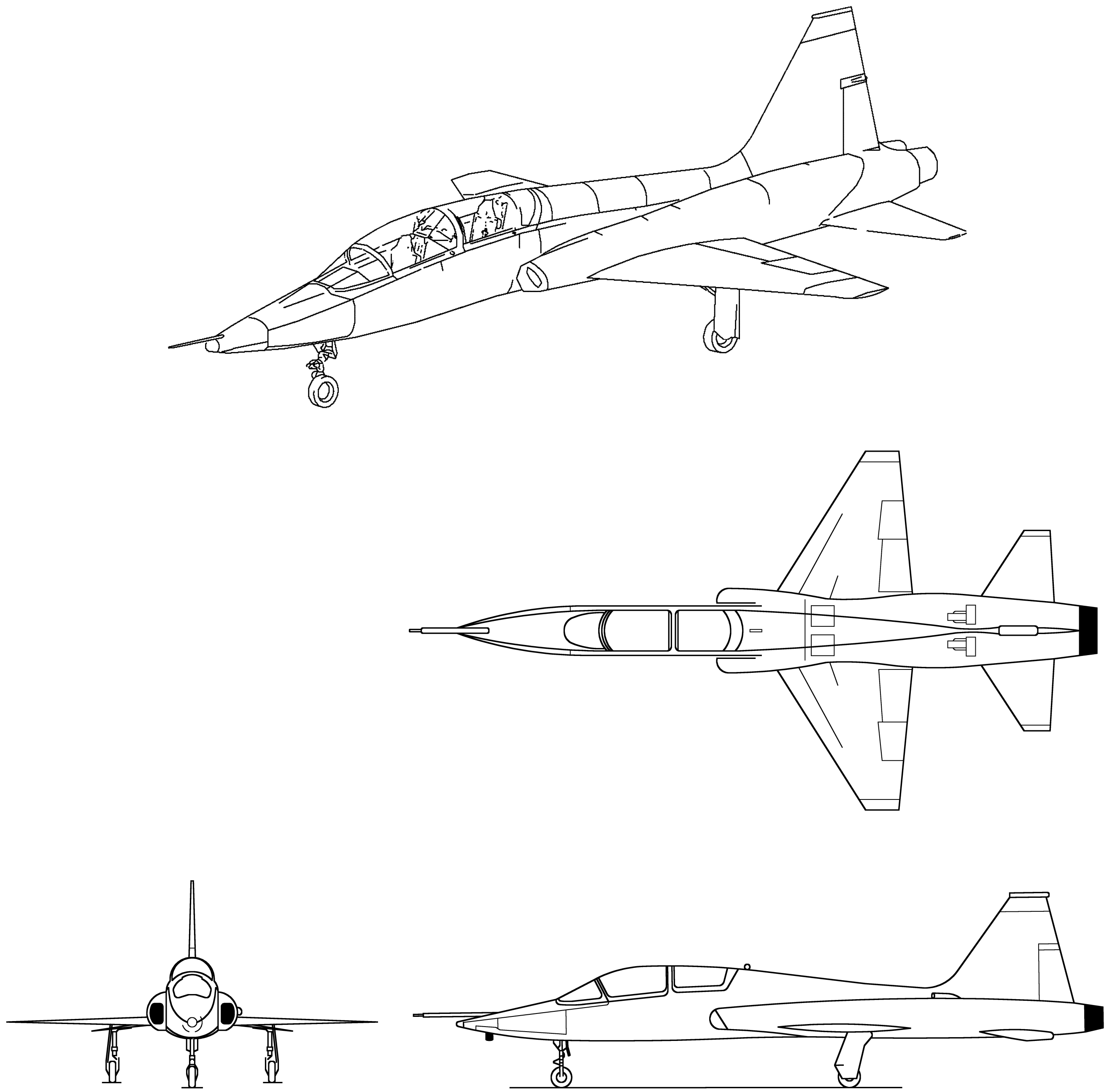

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Figure 1.

SECTION I

DESCRIPTION AND OPERATION

TABLE OF CONTENTS

GRD TO HYD ELE FUE OXY ENG FLT MISC LND
I II III IV V VI VII A G IN

GRD TO HYD ELE FUE OXY ENG FLT MISC LND

I II III IV V VI VII A G IN

DESCRIPTION

AIRCRAFT

The T38A aircraft (Figure 1-1), produced by Northrop Corporation, Aircraft Division, is a 2-place, twin-turbojet supersonic trainer. Each cockpit contains an individual jettisonable canopy and ejection seat. A cabin air-conditioning and pressurization system conditions and pressurizes the air in both cockpits. The fuselage is an area-rule (coke bottle) shape, with moderately swept-back wings and empennage. The aircraft is equipped with an all-movable horizontal tail. A speed brake is located on the lower surface of the fuselage center section. The tricycle landing gear has a steerable nosewheel. All flight control surfaces are fully powered by two independent hydraulic systems.

Some T-38A and all AT-38B Aircraft have had modifications that convert them to ECM aircraft.

- [**ECMB**] The original AT-38B aircraft that have had armament control, boresight, and gun camera systems either removed or deactivated. An ECM control panel has been installed and the pylon no longer supports external stores besides an ECM pod.
- [**ECMA**] The T-38A aircraft that have had the pylon modification and an ECM control panel installed.

AIRCRAFT DIMENSIONS

(Figure 1-2) The overall dimensions of the aircraft with normal tire and strut inflation are:

Length	46 feet 4 inches
Wingspan	25 feet 3 inches
Height	12 feet 11 inches
Tread	10 feet 9 inches
Wheelbase	19 feet 5 inches

AIRCRAFT GROSS WEIGHT

The typical takeoff gross weight of the aircraft is 12,700 pounds with a dual crew (12,500 pounds solo). Aircrew should use actual weights for computing aircraft performance. Refer to TO 1T- 38C-5 weight and balance data.

COCKPIT ARRANGEMENT

Figure 1-3 through Figure 1-10 illustrate Cockpit panels.

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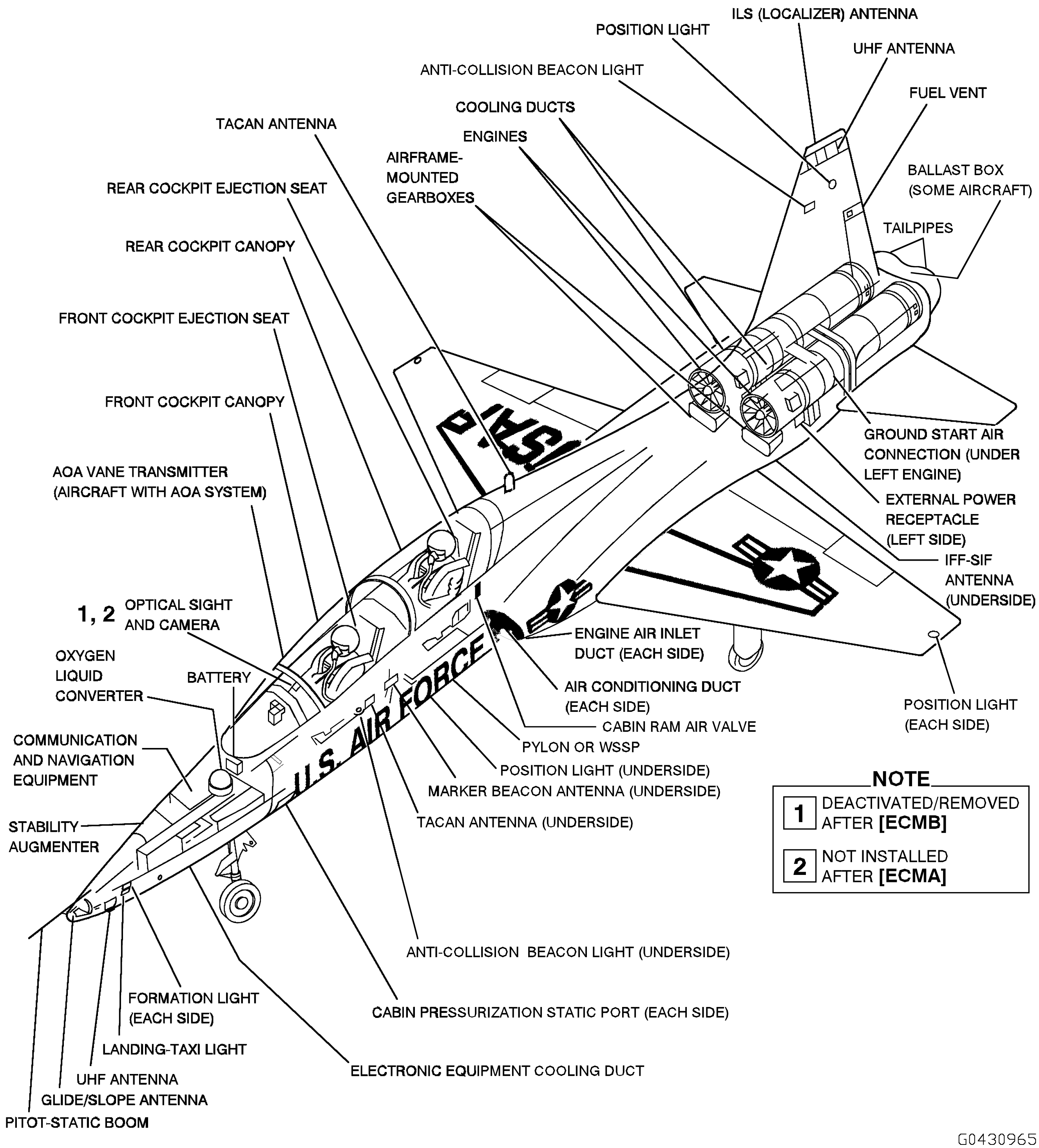

Figure 1-1. General Arrangement Diagram (Typical)

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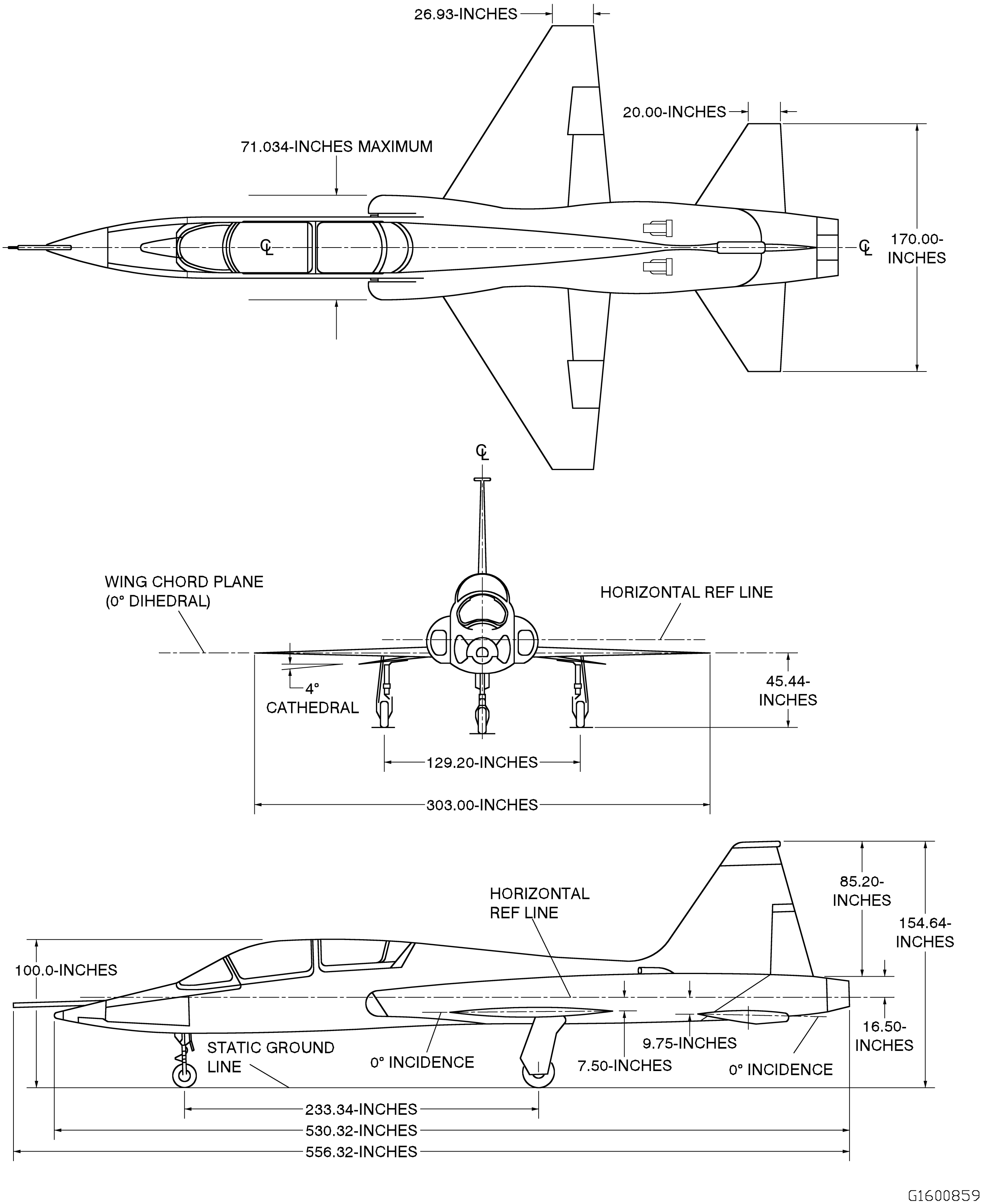

Figure 1-2. Aircraft Dimensions

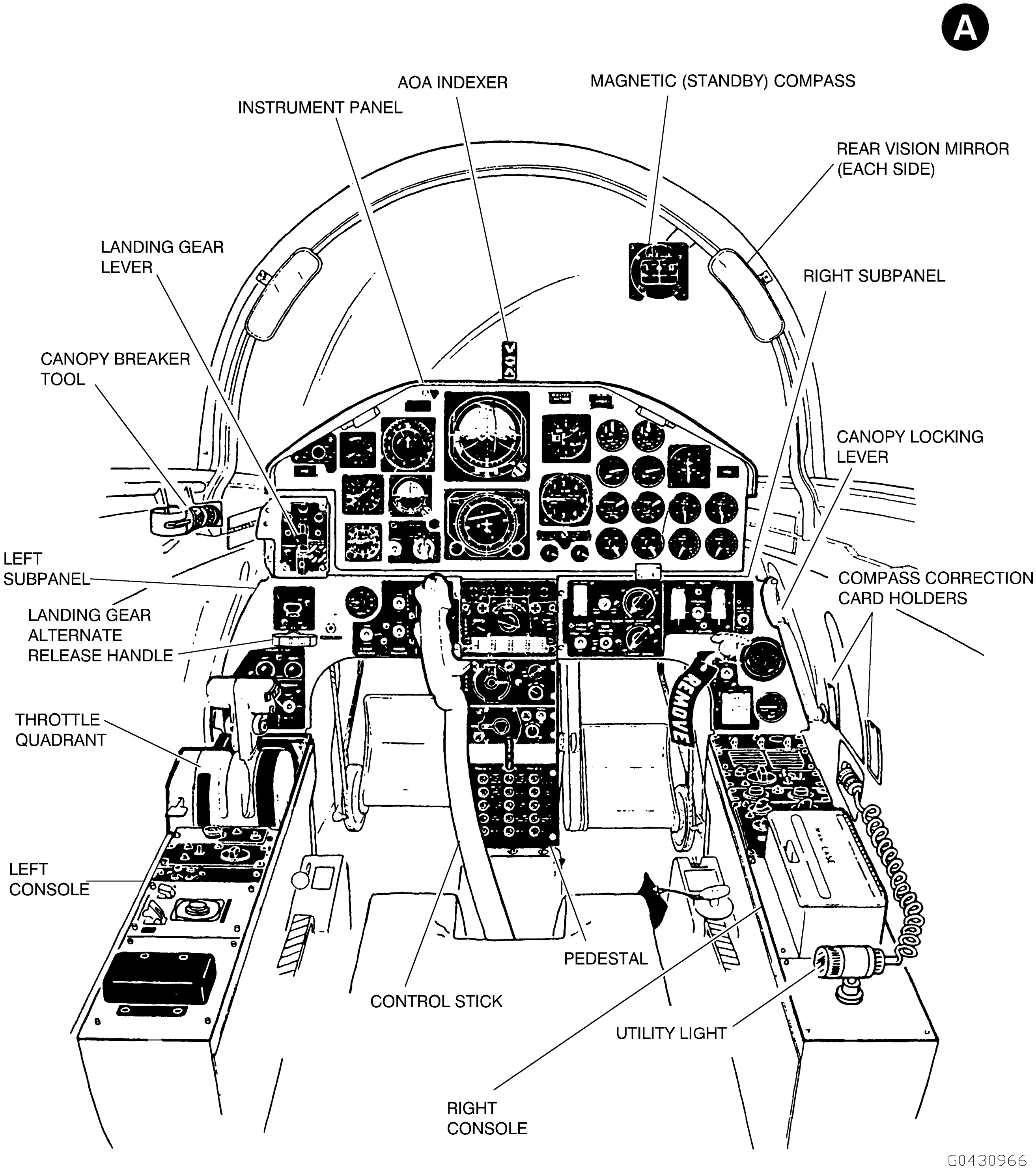

Figure 1-3. Cockpit Arrangement - Front (Typical) (Sheet 1 of 2)

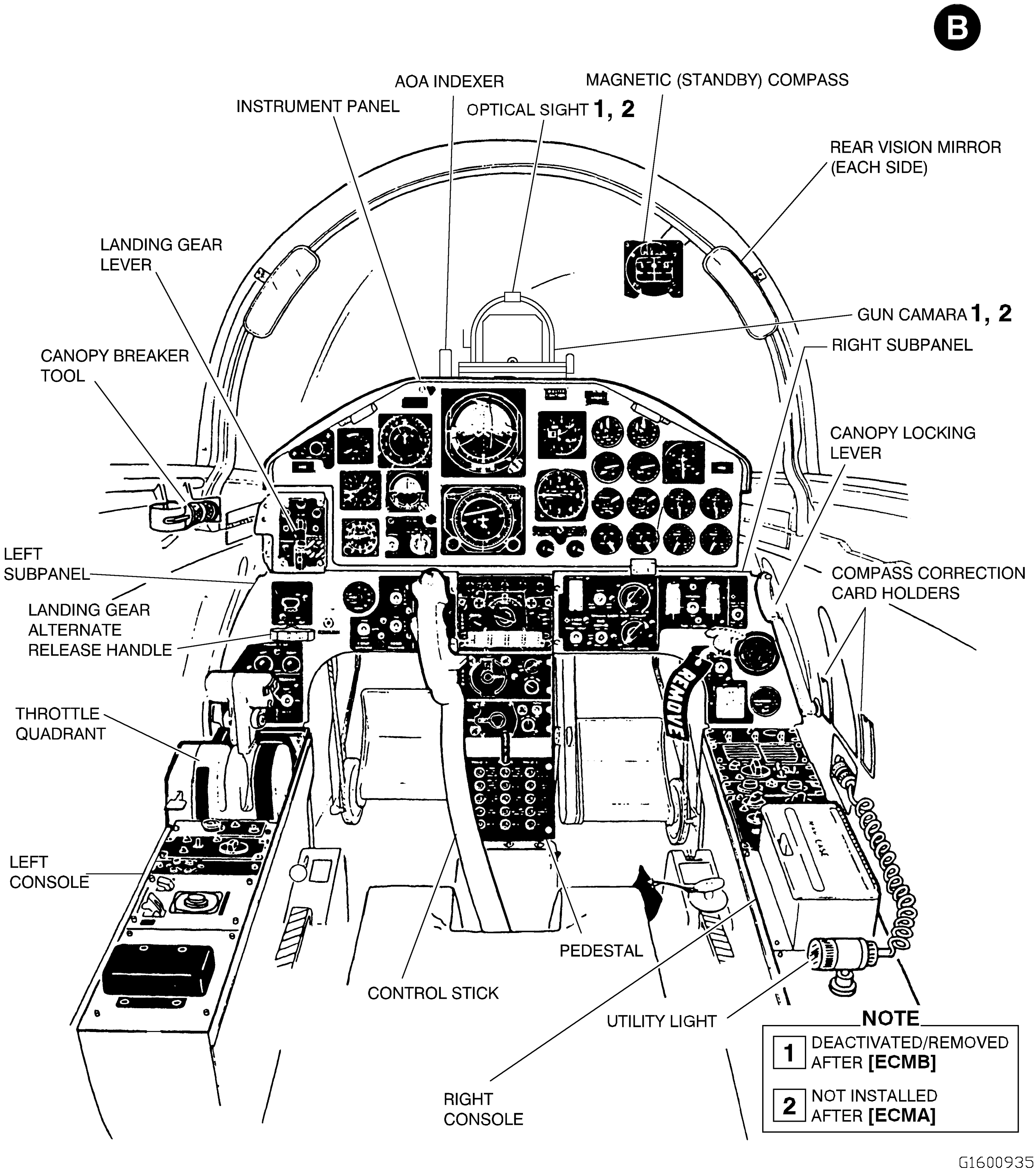

Figure 1-3. Cockpit Arrangement - Front (Typical) (Sheet 2)

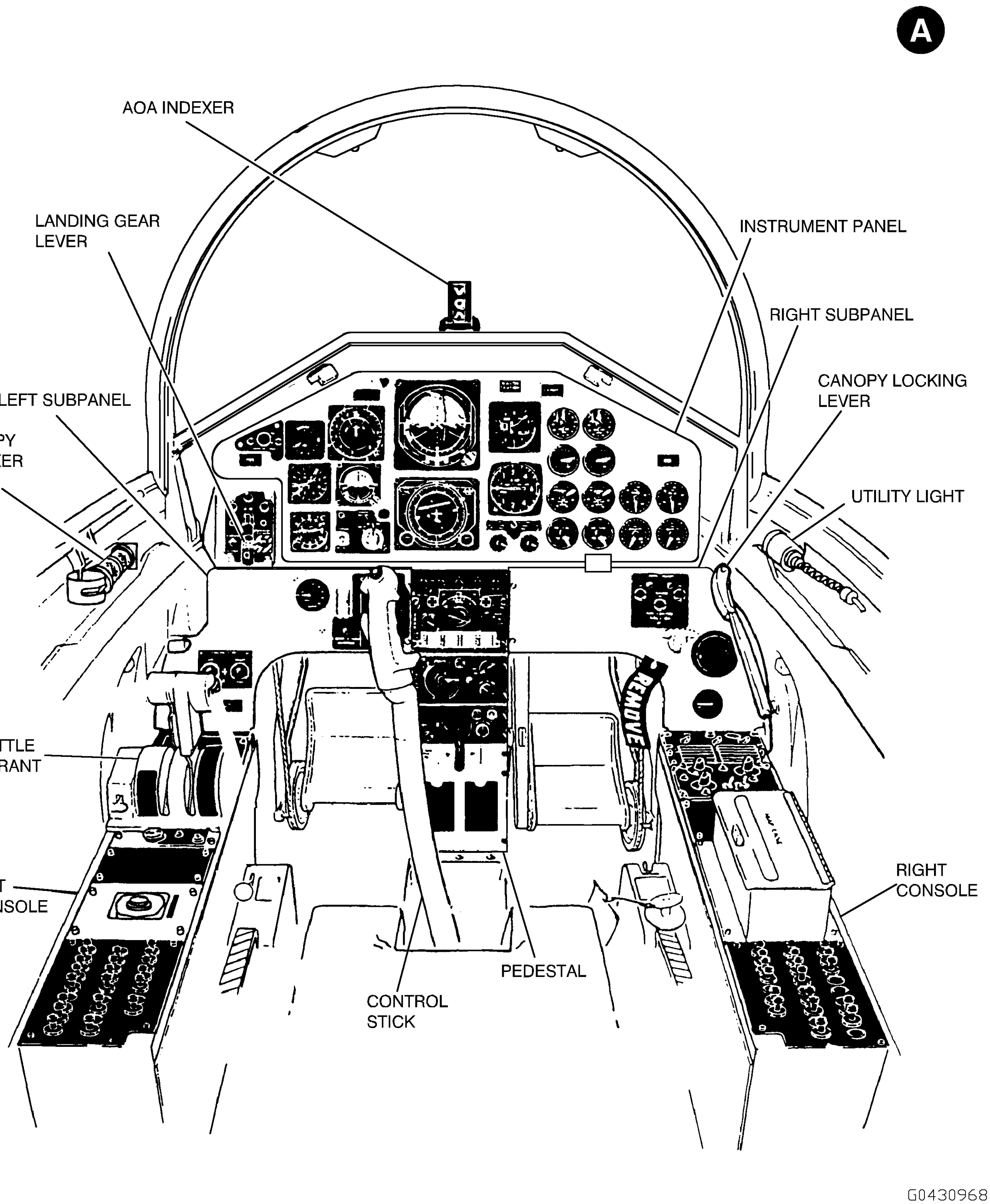

Figure 1-4. Cockpit Arrangement - Rear (Typical) (Sheet 1 of 2)

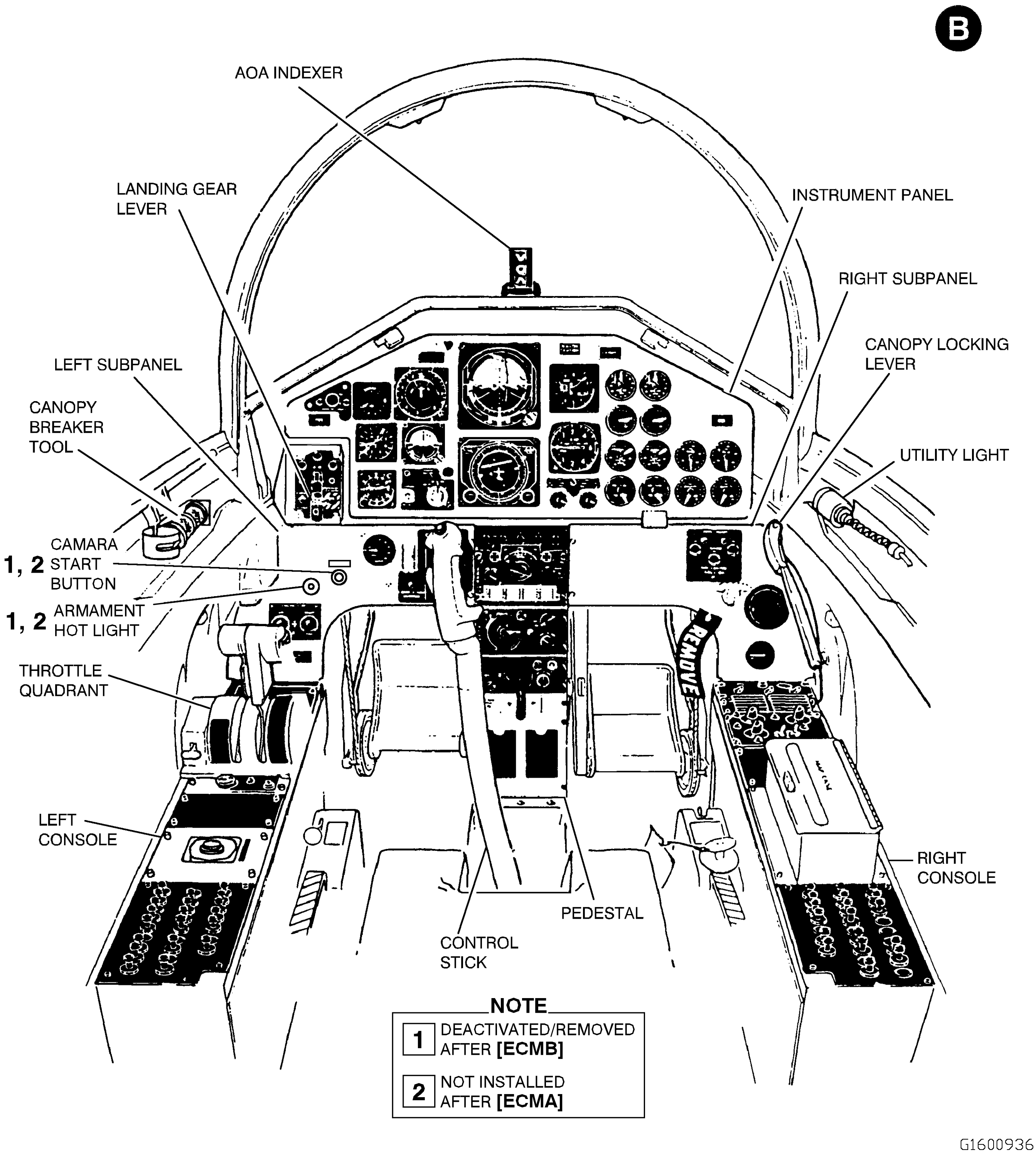

Figure 1-4. Cockpit Arrangement - Rear (Typical) (Sheet 2)

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GRD TO HYD ELE FUE OXY ENG FLT MISC LND

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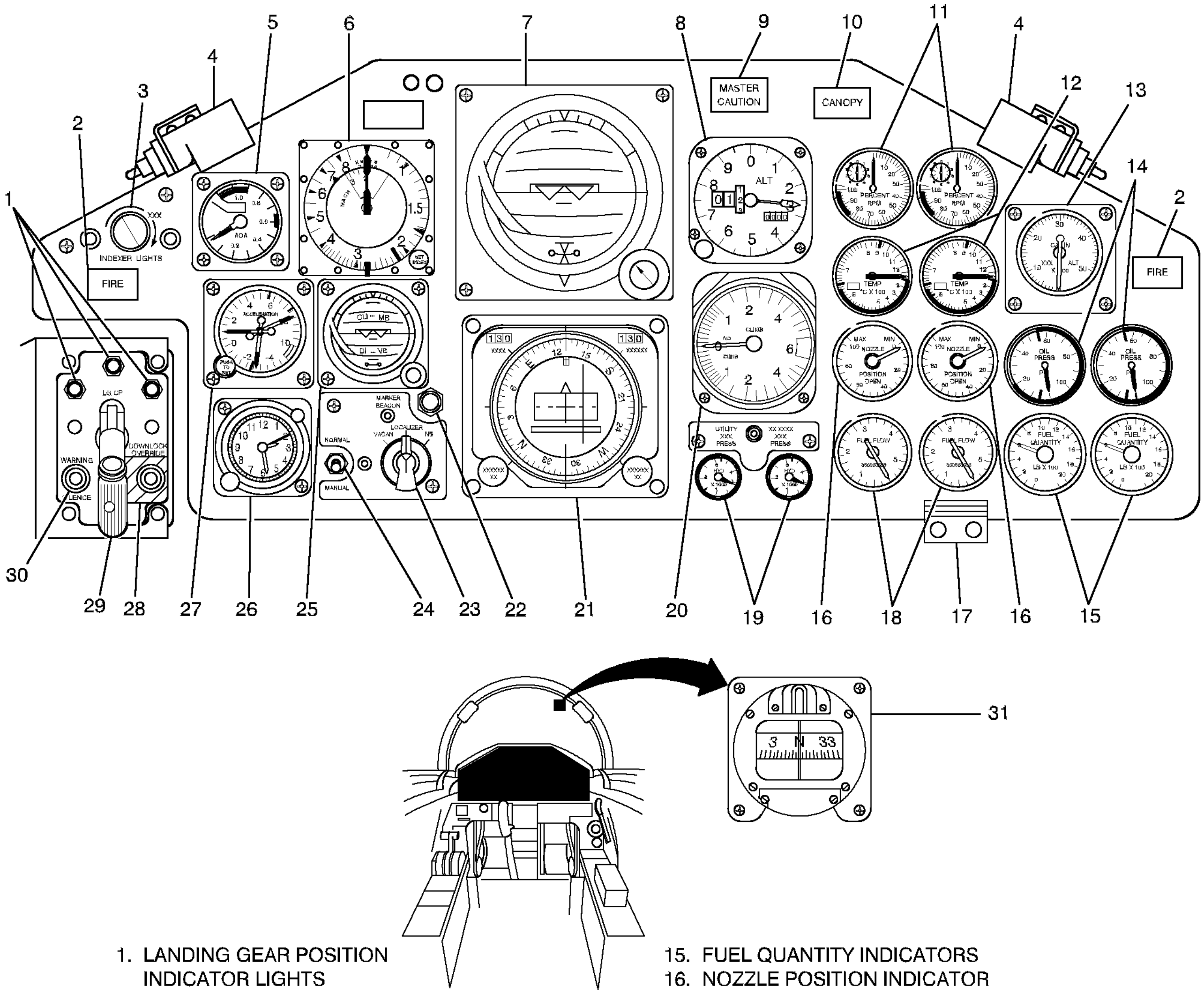

1. LANDING GEAR POSITION INDICATOR LIGHTS
2. ENGINE FIRE WARNING LIGHT
3. AOA INDEXER DIMMER
4. FLOODLIGHT
5. AOA INDICATOR
6. AIRSPEED/MACH INDICATOR
7. ATTITUDE DIRECTOR INDICATOR
8. ALTIMETER
9. MASTER CAUTION LIGHT
10. CANOPY WARNING LIGHT
11. ENGINE TACHOMETERS
12. EXHAUST GAS TEMPERATURE INDICATORS (WARNING FLAGS FRONT COCKPIT ONLY)
13. CABIN ALTIMETER (FRONT COCKPIT ONLY)
14. OIL PRESSURE INDICATORS
15. FUEL QUANTITY INDICATORS
16. NOZZLE POSITION INDICATOR
17. CARD CLIP
18. FUEL FLOW INDICATORS
19. HYDRAULIC PRESSURE INDICATORS
20. VERTICAL VELOCITY INDICATOR
21. HORIZONTAL SITUATION INDICATOR
22. MARKER BEACON LIGHT
23. NAVIGATION MODE SWITCH
24. STEERING MODE SWITCH
25. STANDBY ATTITUDE INDICATOR
26. CLOCK
27. ACCELEROMETER
28. DOWNLOCK OVERRIDE BUTTON
29. LANDING GEAR LEVER
30. LANDING GEAR WARNING SILENCE BUTTON
31. MAGNETIC COMPASS (FRONT COCKPIT ONLY)

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Figure 1-5. Instrument Panel - Both Cockpits (Typical)

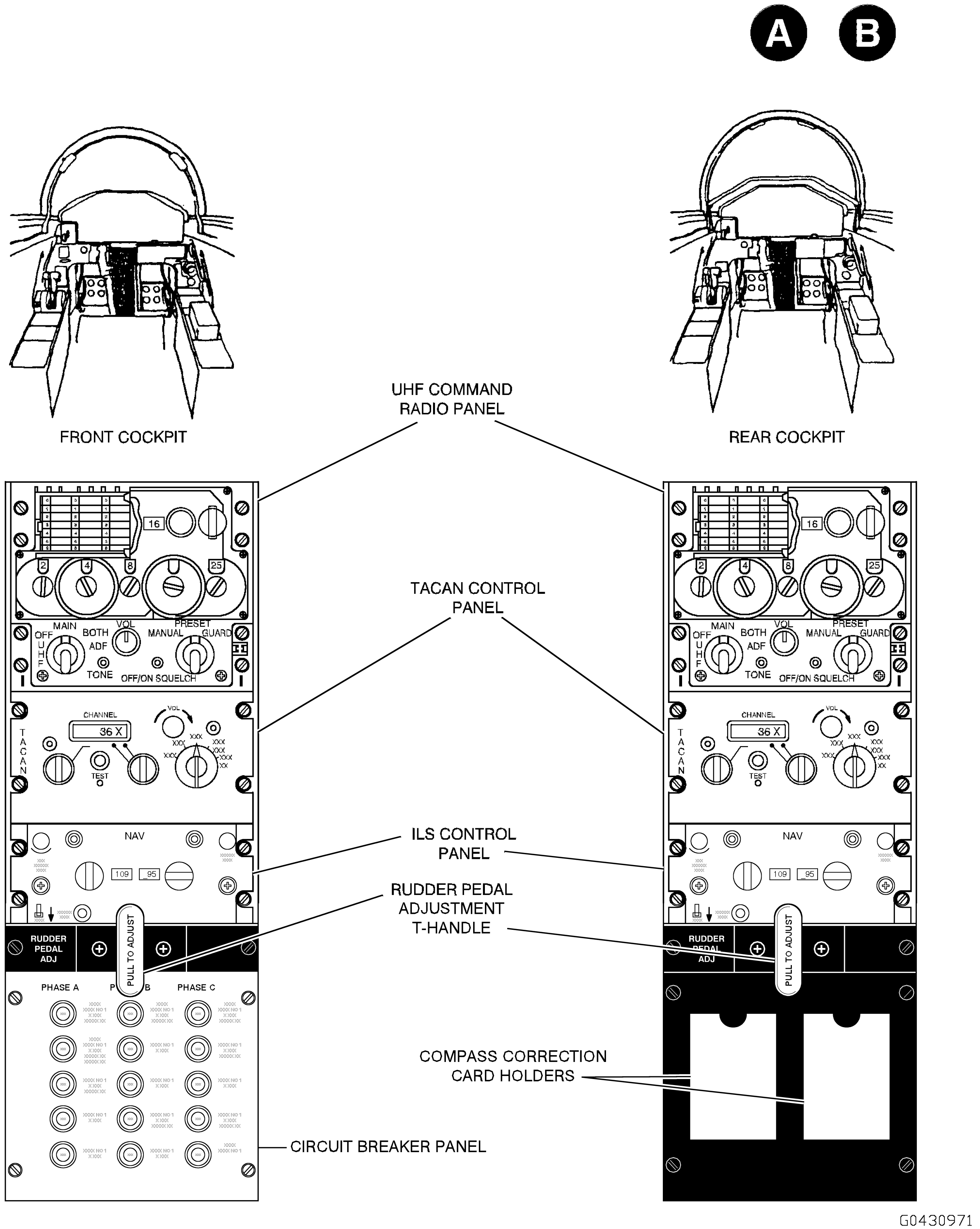

Figure 1-6. Pedestals (Typical)

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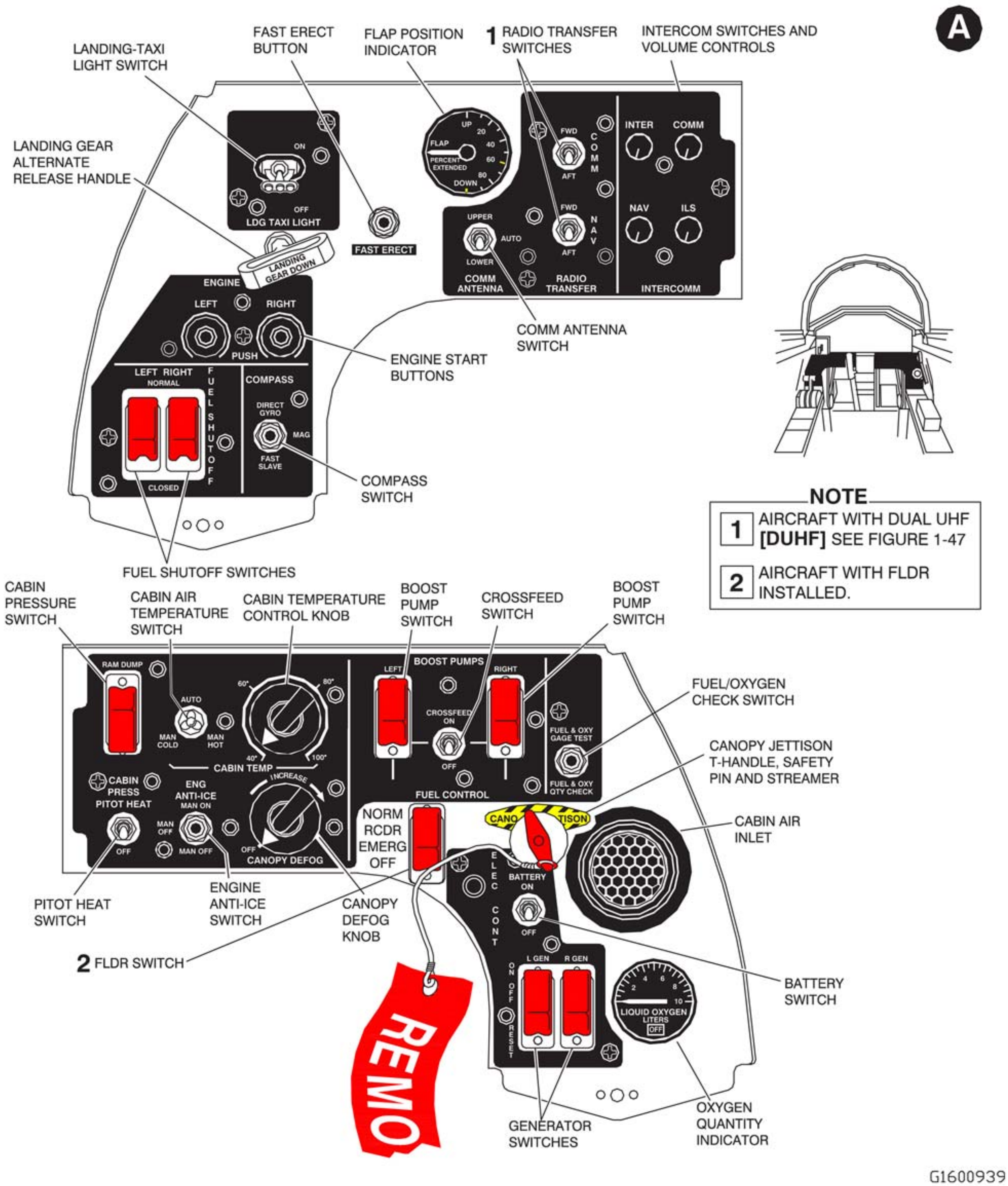

Figure 1-7. Subpanels - Front Cockpit (Typical) (Sheet 1 of 2)

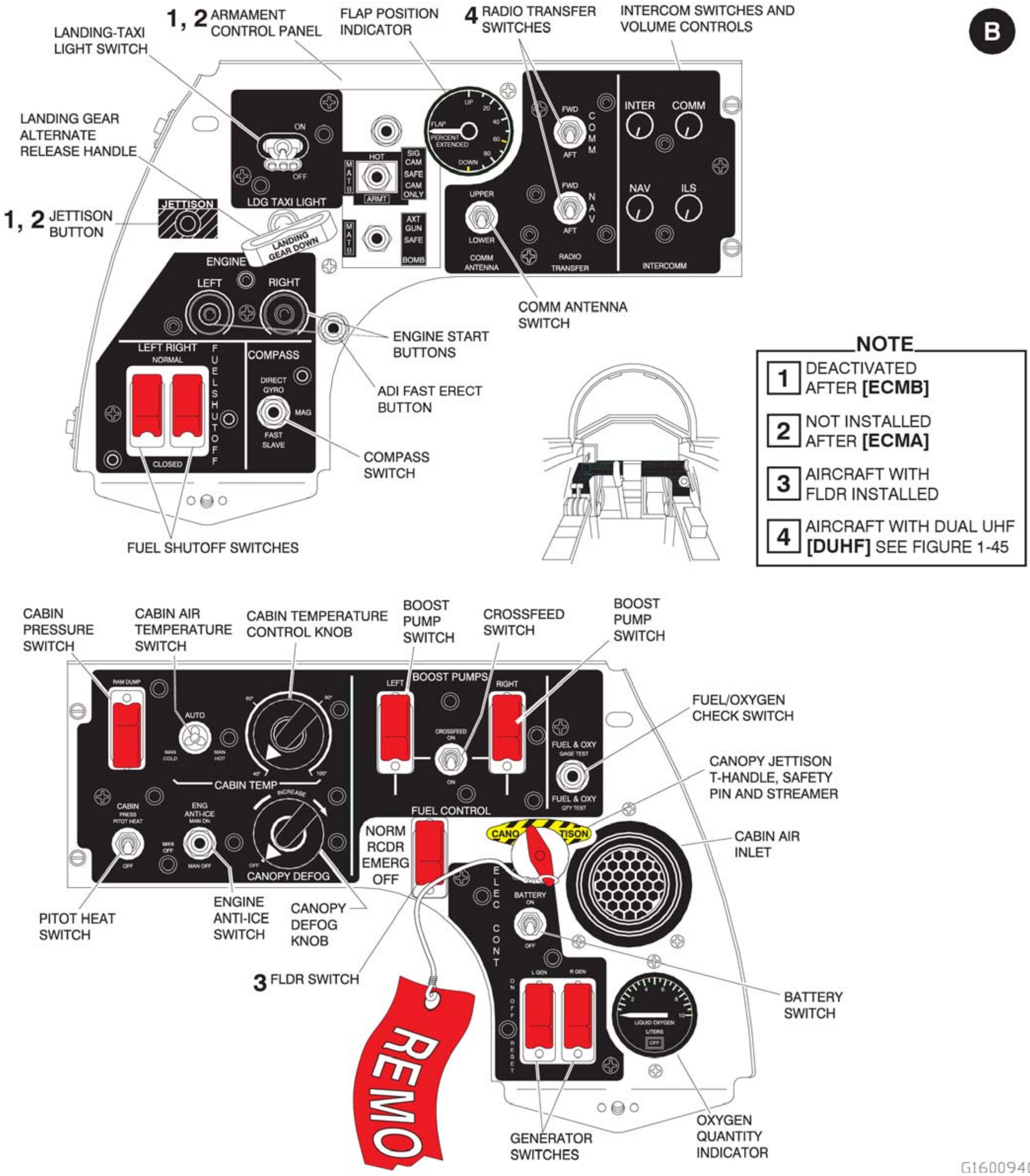

Figure 1-7. Subpanels - Front Cockpit (Typical) (Sheet 2)

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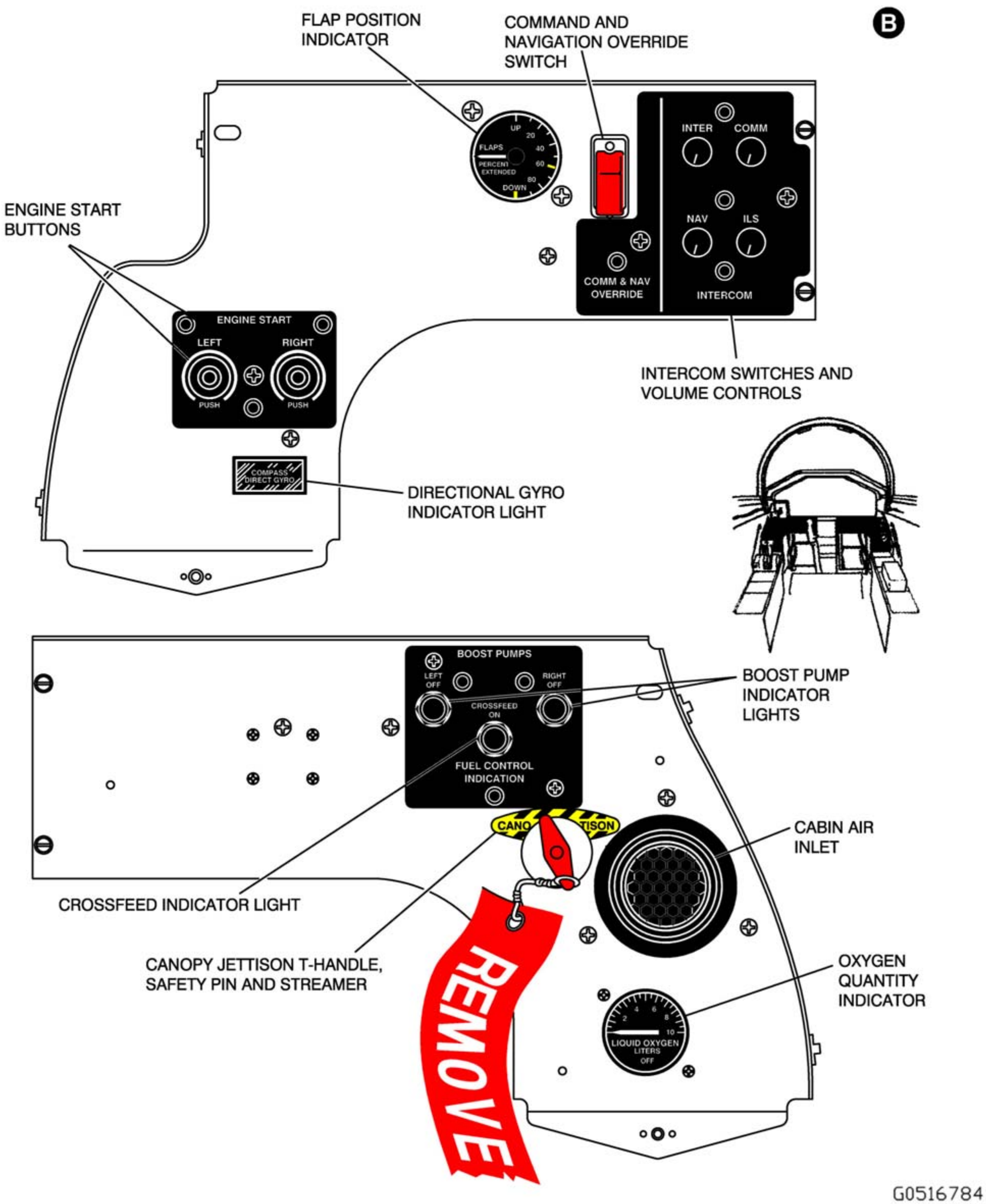

Figure 1-8. Subpanels - Rear Cockpit (Typical) (Sheet 1 of 2)

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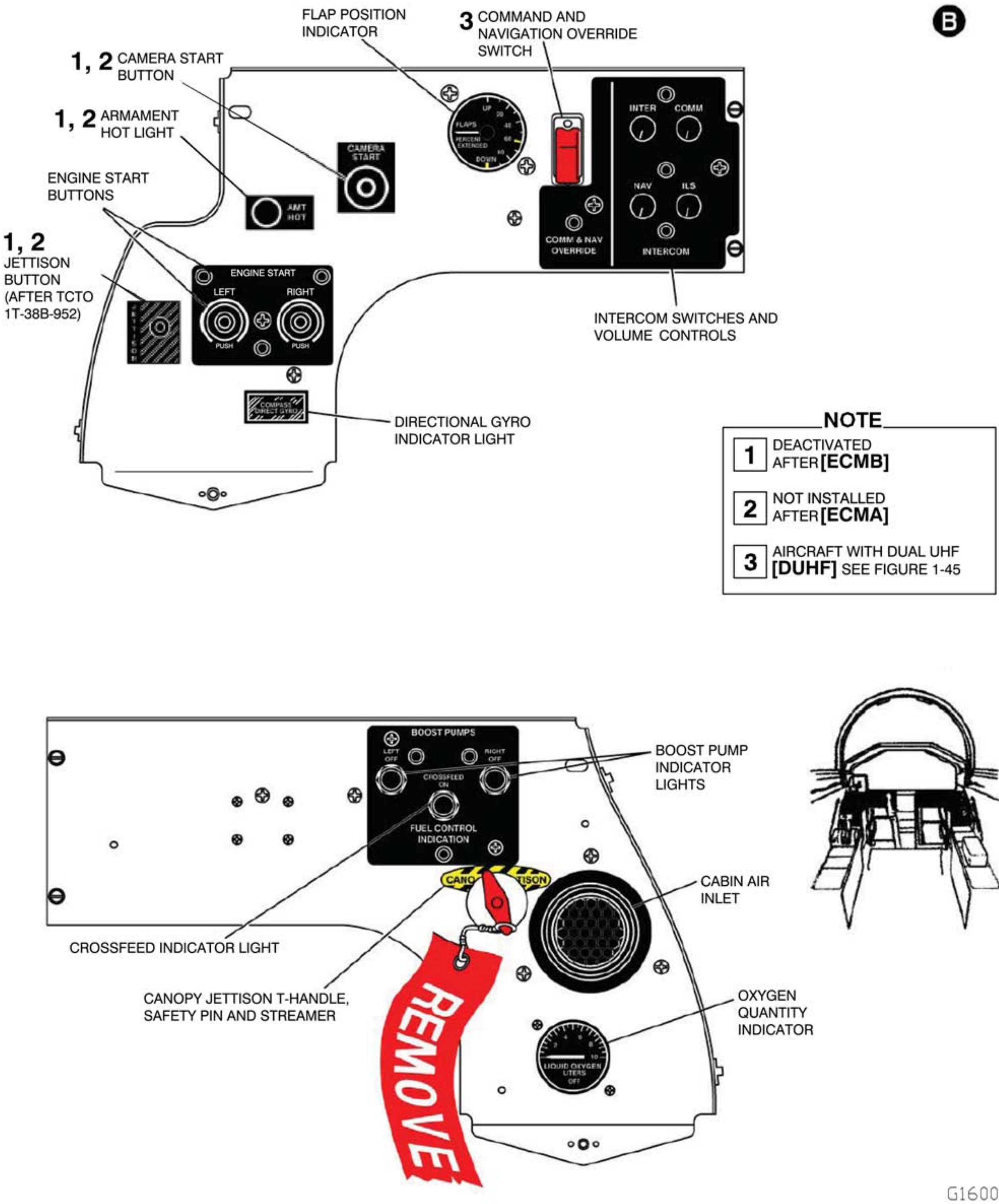

NOTE

1	DEACTIVATED AFTER **[ECMB]**
2	NOT INSTALLED AFTER **[ECMA]**
3	AIRCRAFT WITH DUAL UHF **[DUHF]** SEE FIGURE 1-45

Figure 1-8. Subpanels - Rear Cockpit (Typical) (Sheet 2)

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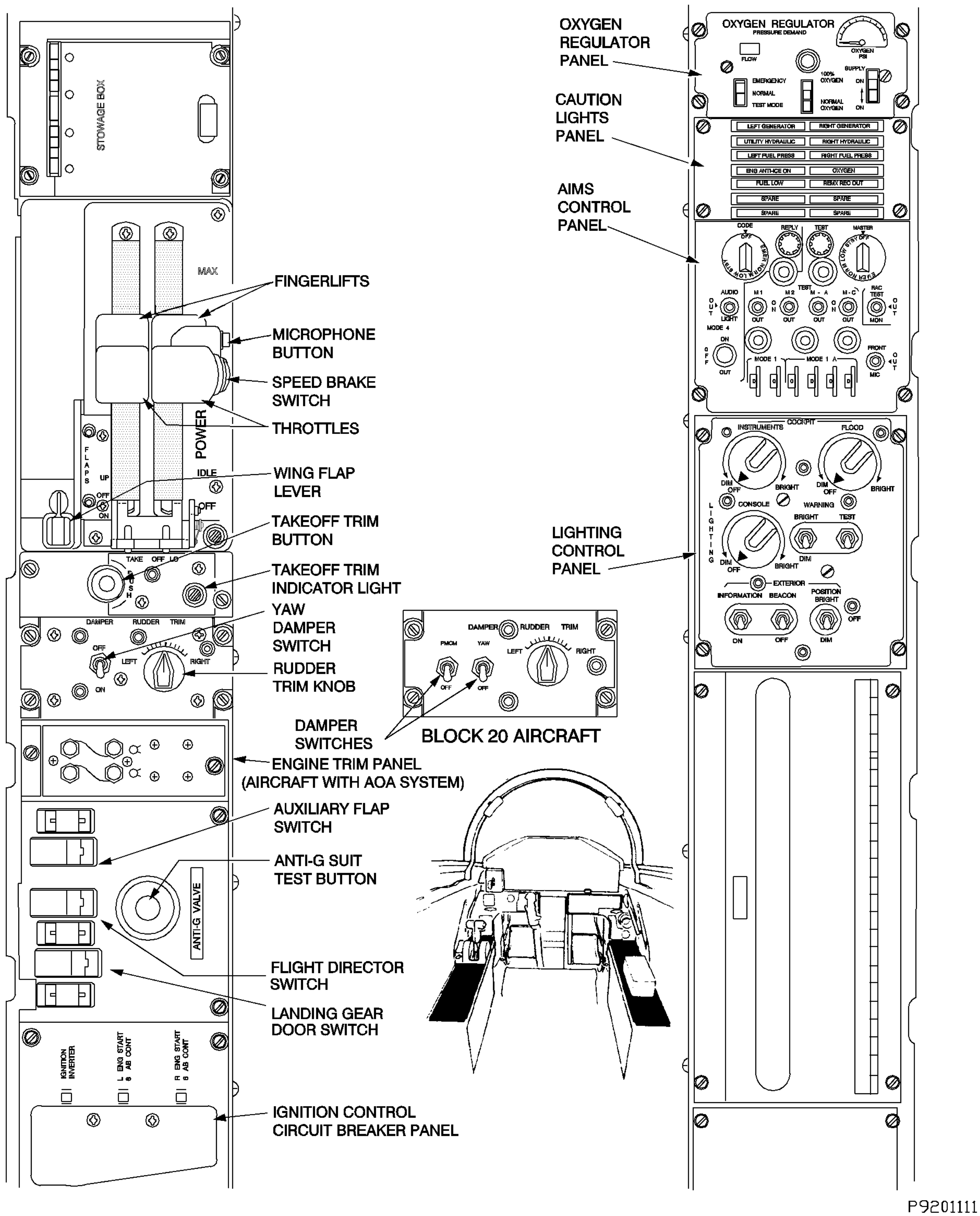

Figure 1-9. Console Panels - Front Cockpit (Typical) (Sheet 1 of 2)

[ECMB/A]

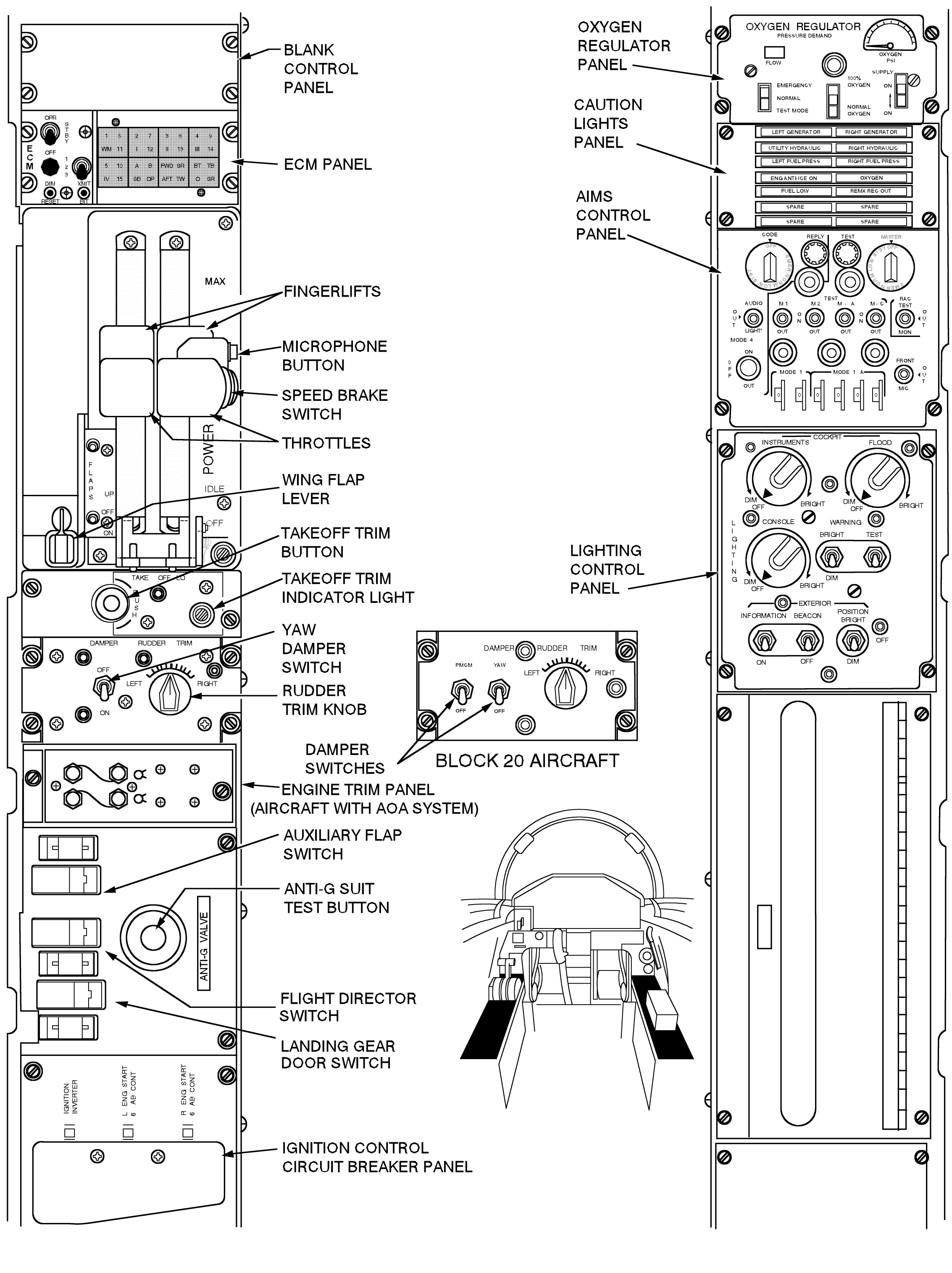

Figure 1-9. Console Panels - Front Cockpit (Typical) (Sheet 2)

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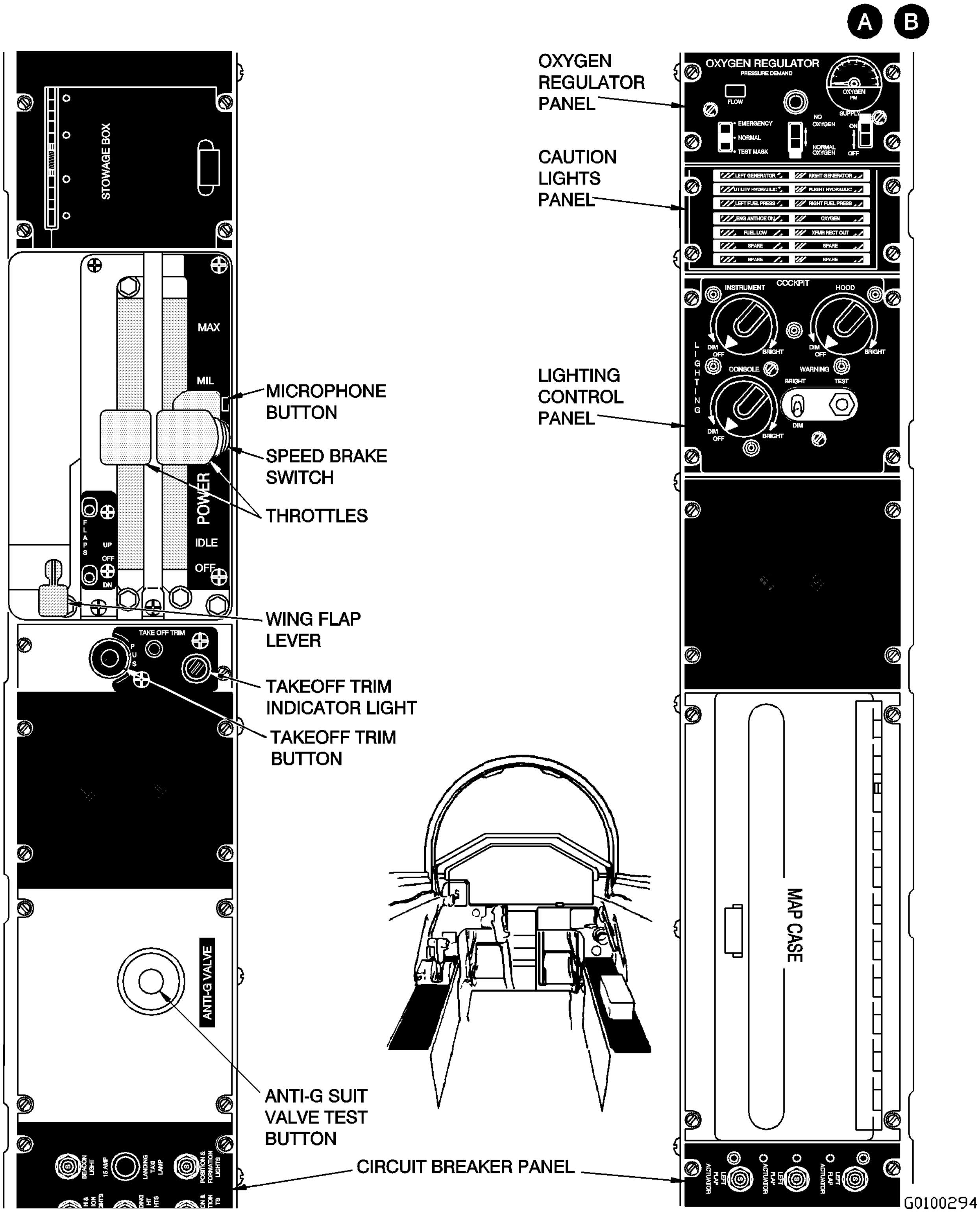

Figure 1-10. Console Panels - Rear Cockpit (Typical)

ENGINES

ENGINES OVERVIEW

The aircraft is powered by two General Electric J85-GE-5M, eight-stage, axial-flow, turbojet engines (Figure 1-11). Sea level, standard day, static thrust for an installed engine is approximately 2050 pounds at MIL power and approximately 2900 pounds at full MAX power. Air enters through the variable inlet guide vanes, which direct the flow of air into the compressor. The automatic positioning of the inlet guide vanes and air bleed valves assists in regulating compressor airflow to maintain compressor stallfree operation. Two turbine wheels and the compressor rotor stages are mounted on the same shaft. The exhaust gases are discharged through a variable area exhaust nozzle. An exhaust gas temperature (T5) sensing system varies the nozzle area to maintain exhaust gas temperature within limits at both MIL and MAX range throttle positions.

FUEL CONTROL SYSTEM

Each engine has a main fuel control system and an afterburner fuel control system (Figure 1-14). The main fuel control system consists primarily of a two-stage engine-driven pump, a main fuel control, and an overspeed governor. The afterburner control system consists primarily of an igniter plug, after-burner pilot manifold, afterburner main manifold, and afterburner fuel pump and control.

MAIN FUEL CONTROL

The main fuel control adjusts engine power on a mechanical schedule by metering fuel to the engine combustor as a function of throttle position or Power Lever Angle (PLA), engine inlet air temperature (T_2), compressor discharge pressure (CP_3) and engine speed (RPM). The control performs the following functions automatically:

a. Regulates engine speed at the selected throttle position, limits engine minimum speed at IDLE and engine maximum speed at MIL and MAX range power.

b. Limits main engine fuel flow to safe levels during starts and during rapid throttle changes providing protection from overtemperature, stalls, and flameouts.

c. Limits main engine fuel flow to a preset minimum by holding combustor fuel-air ratio at or above the proper level for low power settings and for engine restart during flight.

d. Correctly positions the compressor inlet guide vanes and air bleed valves.

VARIABLE GEOMETRY SYSTEM

(Figure 1-15) The engine is equipped with variable inlet guide vanes and variable interstage air bleed valves to regulate compressor airflow and assist in rapid engine speed transition. The system consists of inlet guide vanes keyed to an actuator ring which encircles the front frame, two actuators on the front frame, two air bleed valves mounted on the compressor casing, actuating linkage connecting the actuator pistons with the bleed valves and actuator ring, a feedback cable, a synchronizing cable, and tubing to connect the actuators with the main fuel control, which supplies fuel pressure to actuate the system.

AFTERBURNER SYSTEM

Afterburner operation is initiated by advancing throttle from the MIL detent into the MAX range. Thrust is variable within MAX range. The total rate of fuel flow at full MAX position for each engine at sea level, on a standard day, is approximately 7300 pounds per hour with the aircraft at rest and 11,400 pounds per hour at Mach 1.

AFTERBURNER FUEL CONTROL

The primary function of the afterburner fuel control is to initiate and schedule fuel flow to the afterburner main and pilot spraybars. Fuel flow is metered as a function of throttle position and compressor discharge pressure. The control also senses and regulates variable area nozzle position and automatically limits fuel flow to prevent overtemperature in case of a nozzle actuating system malfunction or during rapid throttle advances into MAX range.

VARIABLE EXHAUST NOZZLE (VEN)

(Figure 1-16) To provide thrust modulation within limits of exhaust gas temperature, the engine is equipped with a variable exhaust nozzle. The exhaust nozzle assembly has a variable nozzle opening which increases or decreases with the operation of the afterburner control unit. The nozzle assembly consists of two sections, a fixed cowl section fastened to the afterburner casing and a movable section actuated through a nozzle position actuator ring. The movable section consists of six outer leaves overlapping six inner leaves to form a circular opening. Each leaf is connected to the nozzle position actuator ring encircling the afterburner casing. The three exhaust nozzle actuators are driven by the afterburner nozzle power unit through interconnecting flexible drive shafts.

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T_5 AMPLIFIER

Each engine has a T_5 Amplifier (Figure 1-16) that primarily provides protection of engine over-temperatures and secondarily prevents stalls. The T_5 Amplifier receives input from T_2 and T_5 sensors and is powered by the engine's engine driven tachometer TAC generator. The T_5 is measured just aft of the engine turbine section. When sufficiently powered by the TAC generator (above approximately 75% RPM), the T_5 Amplifier continuously provides over-temperature protection to ensure engine operating limits are maintained. The T_5 Amplifier functions by registering T_5 at a set temperature, then overriding control of the VEN to prevent the over-temperature. It does this by opening the nozzle through an electrical signal to the T_5 Motor on the afterburner fuel control which then turns a mechanical linkage that controls the VEN. After initiation, the T_5 Amplifier controls the VEN to maintain T_5 at maximum allowable temperature as PLA increases or decreases to the limit of the T_5 Amplifier's authority. After T_5 Amplifier ends override control, the VEN returns to mechanical schedule controlled by the main fuel control.

THROTTLES

The throttles (Figure 1-12) are provided with a roller ramp-type force gradient, which must be overcome to move the throttles from MIL into MAX range or IDLE to OFF. The throttles in the front cockpit are equipped with fingerlifts, which must be raised before the throttles in either cockpit can be retarded past the IDLE roller ramp to OFF. Friction is ground adjustable only. The throttles, when placed at OFF, mechanically shut off fuel to the engine at the main control and electrically shut off fuel to the engine at the fuel shutoff valves.

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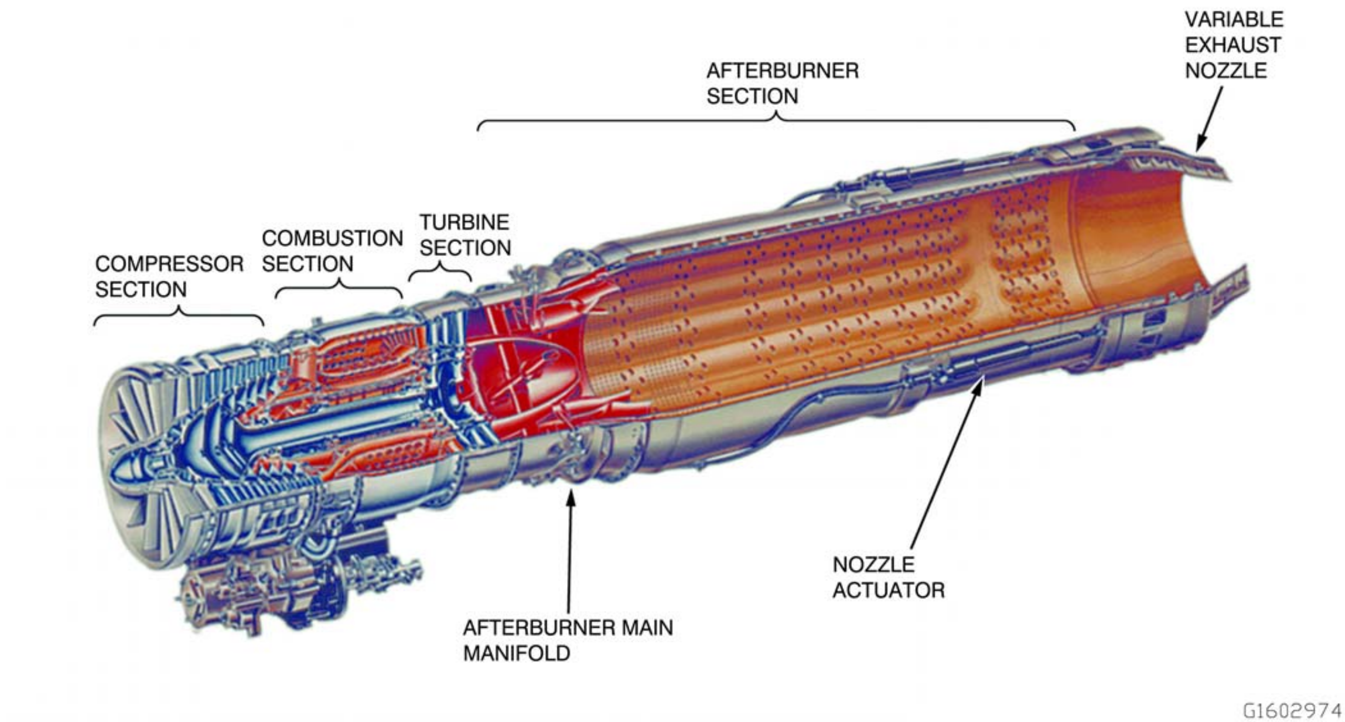

Figure 1-11. J85-GE-5 Turbojet Engine

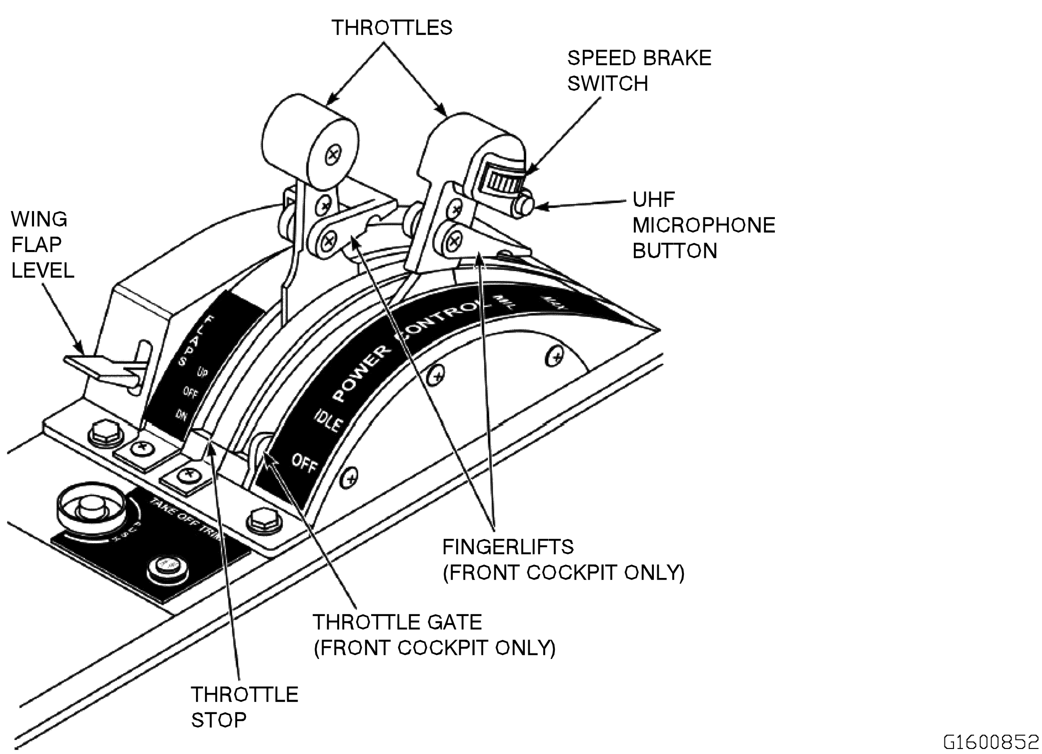

Figure 1-12. Throttles

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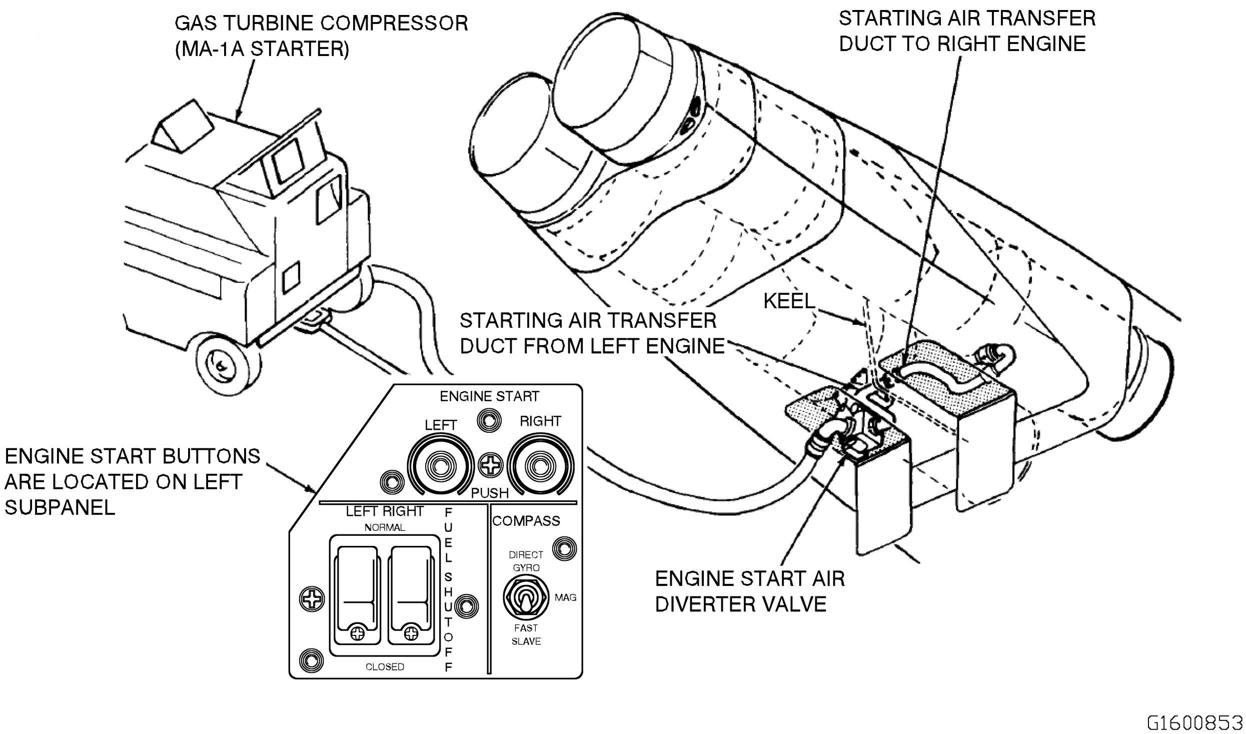

Figure 1-13. Engine Start

Some aircraft have a throttle gate installed on the front cockpit throttle quadrant. When engaged, the throttle gate prevents the throttles from being placed OFF. Rotating the throttle gate full forward and down, locks it in the engaged position. Disengage the throttle gate by pressing the finger lever inward. Spring tension automatically rotates the throttle gate aft and open. With the throttle gate disengaged, the throttles may be placed in OFF.

CAUTION

When throttle gate is disengaged, avoid fingerlift actuation to preclude inadvertent engine shutdown when retarding throttle to idle.

NOTE

Throttle movement should be conservative to help minimize blade failures. Abrupt or rapid throttle movements should be avoided. Throttle bursts (throttle movements in 1 second or less) from idle RPM to MIL should be avoided if possible. These procedures will allow the variable exhaust nozzle to keep pace and match the fuel flow and help minimize the possibility of compressor blade failures.

START AND IGNITION SYSTEM

Engine starts require compressor motoring (lowpressure air supply), DC power to energize the ignition holding relay, and AC power for ignitor firing. For ground starts, a manually operated diverter valve, mounted on the left engine, is externally positioned by the ground crew to direct the flow of air to the selected engine during the start cycle. Two engine start push buttons (Figure 1-13) are located in the left subpanel of each cockpit. Momentarily pushing the start button for the selected engine arms the ignition circuit (ignition timer and holding relay) for approximately 30 seconds. Moving the throttle to IDLE energizes the ignition exciter, firing main and afterburner igniters, and starting fuel flow to the engine. Any delay in moving the throttle to IDLE, after pushing the start button, will decrease the available ignition time from the 30-second cycle by an equal amount. Momentarily pressing the start button again during a 30-second cycle will not reset the ignition timer and start another cycle since the first actuation locks in the cycle (holding relay energized) until the timer expires. Without any start button ignition cycle operating, moving the throttle to the MAX range energizes the main and afterburner igniters for a 30-second cycle. Subsequently retarding the throttle out of MAX range at any time during the 30-second cycle will stop the igniters from firing, reset the timer (bypassing the ignition holding relay), and enable the ignition system for a new cycle. The throttle must be retarded from MAX to below MIL to reset the timer and returned to MAX to provide another 30-second cycle. However, pressing the start button within 30 seconds before or after selecting MAX will only provide ignition for the duration of the first 30-second ignition cycle selected and disables the MAX ignition reset feature until the first selected (start button or MAX) 30-second ignition cycle has expired. With the throttle at IDLE or above, the igniters may be energized at any time for longer than 30 seconds by selecting and holding the appropriate start button. AC power from a battery-operated static inverter (Figure 1-19) may be used for ground (one engine) or air starts (either engine). For battery start, the right engine should be started first, as the static inverter supplies AC power for the right engine instruments during the start cycle.

ENGINE INSTRUMENTS

A full complement of engine instruments is provided in each cockpit. The front cockpit indicators are primary. Rear cockpit EGT and fuel flow indicators repeat the pointer positions of those in the front cockpit. Hydraulic indicators represent independent reading from a single, airframe-mounted transmitter for each system. Oil pressure, nozzle, and tachometer indicators represent independent readings from a single transmitter on each engine. Tachometers are powered independently of the aircraft electrical system. Nozzle position indicators require DC power only. All other engine and quantity indicating instruments require AC power from their respective busses. The right engine instruments may also receive AC power from a battery-powered static inverter which is activated upon initiation of the engine start sequence when normal AC power is not available.

Refer to OPERATING LIMITATIONS, Section V.

NOTE

Some front cockpit indicators contain an ON or OFF flag system which operates when AC power is applied.

COMPRESSOR STALL

A compressor stall is an aerodynamic interruption of airflow through the compressor section. Factors that can increase the stall sensitivity and decrease the compressor stall margin are: Foreign object damage, high aircraft angles of attack at low airspeeds, low Compressor Inlet Temperatures (CIT), maneuvering flights, unusual flight attitudes, atmospheric variations, jet wash, temperature and pressure distortion, ice formation on inlet ducts and engine inlet guide vanes or a combination of the above. Compressor stalls can be caused by various other factors such as: Engine component malfunction, incorrect engine rigging, incorrect RPM and fuel flow trim, throttle burst to military or maximum power at high altitude and low airspeed, and by hot gas ingestion. The stall is recognized by a POP or BANG followed by an audible BUZZING sound and vibration, accompanied by a rapid RPM drop and high EGT. The stall should be cleared as soon as possible to prevent engine damage by overtemperature. This type of compressor stall can normally be recovered by rapidly retarding throttle to IDLE. Compressor stalls may lead to a flameout.

FLAMEOUT

Flameout may result from the same conditions that cause compressor stalls. During a flameout, the aerodynamic disruption causes combustion to cease (the fire goes out) and the engine will rapidly wind down to windmilling RPM. The flameout is recognized by an audible sound similar to a compressor stall; however, both RPM and EGT will rapidly decrease. Immediately pulling the throttle to idle and pushing the start button will provide a restart attempt during the wind down and may recover the engine to idle.

ENGINE PERFORMANCE DATA

Refer to Appendix A Part 2 ENGINE DATA for compressor stall and flameout avoidance.

PNEUMATIC SYSTEM

Air taken from the eighth-stage compressor is used for hydraulic reservoir and cabin pressurization, air conditioning systems, canopy defogging, engine anti-icing, canopy seal inflation, and for the anti-G system.

OIL SYSTEM

Each engine has an independent integral oil supply and lubrication system. The reservoir has a normal oil capacity of 4 quarts and an air expansion space of 1 quart. Heat from the engine oil is dissipated through a fuel-oil cooler. Oil consumption through engine operation and overboard venting caused by condensation and aerobatic flight should not exceed 1 pint per hour. See Figure 1-54 for oil specification.

AIRFRAME-MOUNTED GEARBOX

An airframe-mounted gearbox (Figure 1-1) for each engine operates a hydraulic pump and an AC generator. A shift mechanism keeps AC generator output between 320 and 480 cycles per second. Gearbox shift occurs in the 65 to 75% RPM range.

ENGINE ANTI-ICE SYSTEM

Engine anti-icing is accomplished by directing compressor eighth-stage air to the inlet guide vanes and bullet nose of the engine. A normally closed shut-off valve is controlled electrically by a three-position engine anti-ice switch (Figure 1-7) on the right subpanel of the front cockpit. The switch positions are placarded MAN ON in the up and MAN OFF in the center and down positions. Placing the switch at MAN ON allows hot air to flow to the inlet guide vanes and bullet nose of the engine and causes the ENG ANTI-ICE ON light on the caution light panel and the MASTER CAUTION light in each cockpit to illuminate. The caution light alerts the crewmember that the switch is in the MAN ON position but does not indicate that the system is operating. At engine speeds of 94 to 98% RPM,

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an increase in EGT of approximately 15°C is normal with the switch at MAN ON. The engine anti-ice system fails to the on position with a complete loss of AC electrical power. Below 65% RPM, the anti-ice valve is always open allowing hot air to flow to the inlet guide vanes and bullet nose of the engine, regardless of the position of the engine anti-ice switch. The switch should normally be at MAN OFF. A 9% loss in MIL thrust and a 6.5% loss in MAX thrust can be expected with the engine anti-ice switch on.

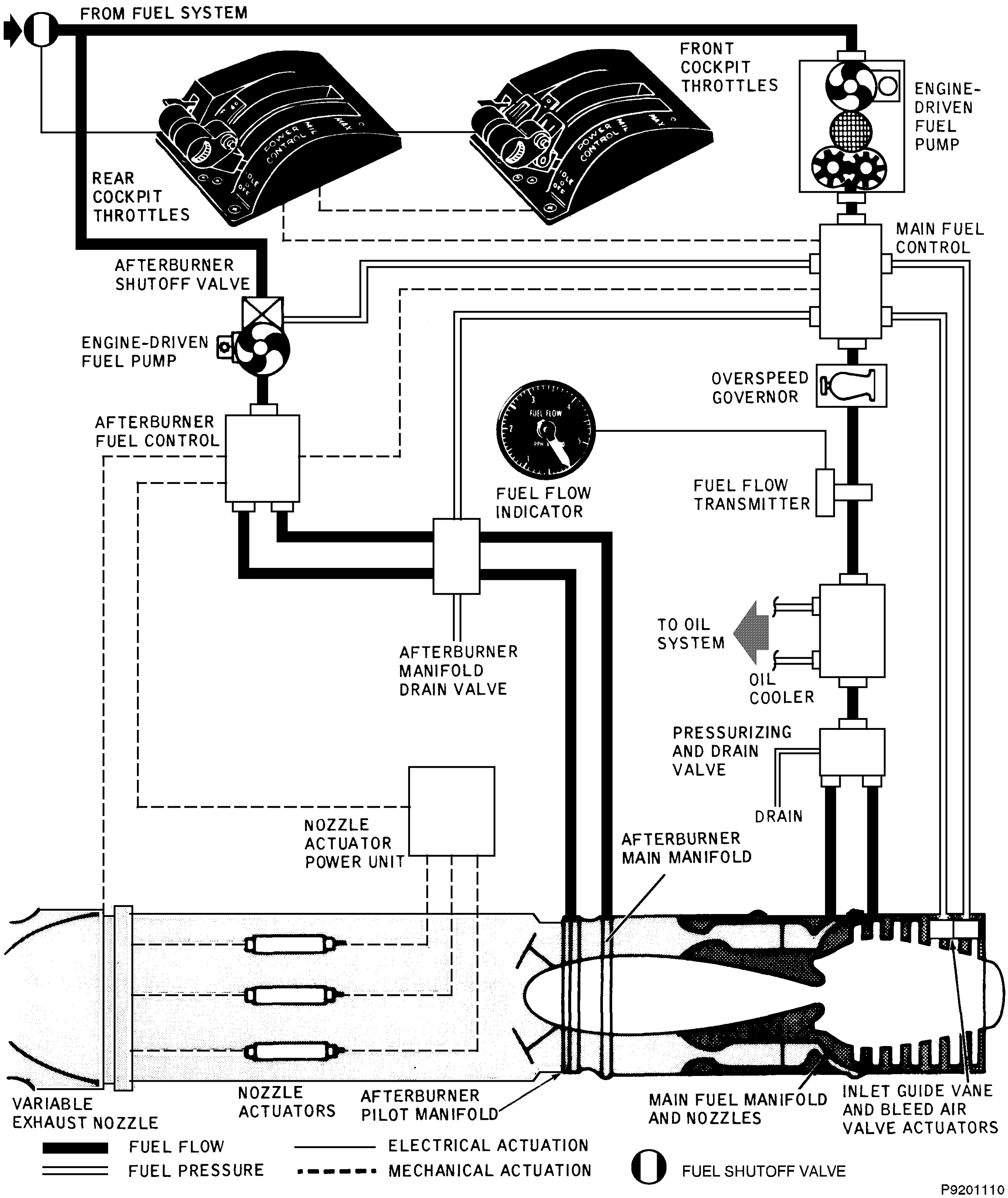

Figure 1-14. Engine Fuel Control System

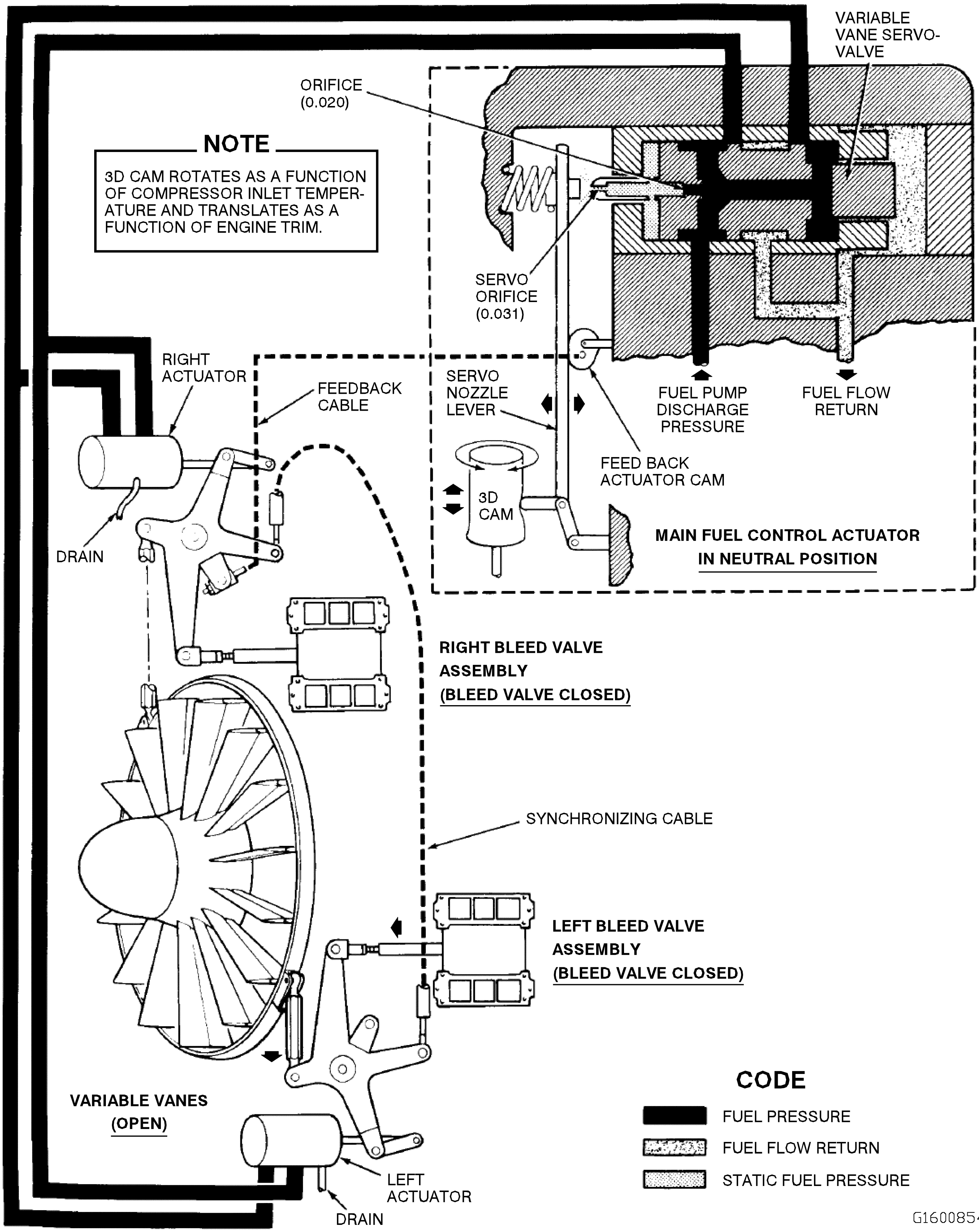

Figure 1-15. Variable Geometry System

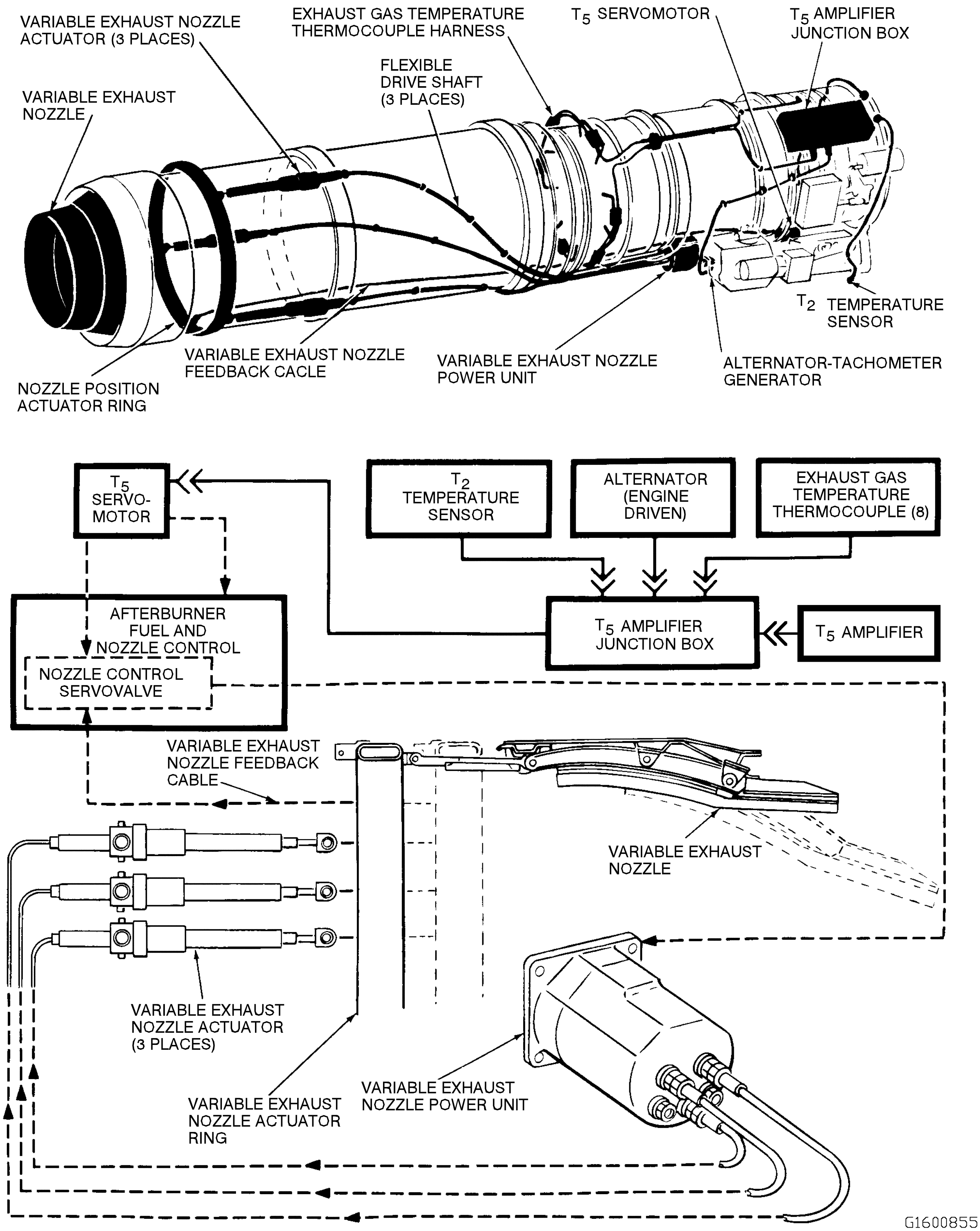

Figure 1-16. Nozzle Actuating System

FUEL SYSTEM

FUEL SYSTEM OVERVIEW

The aircraft has an independent fuel system for each engine (Figure 1-17), interconnected by a DC electrically-operated crossfeed valve. The left and right system fuel cells are in the fuselage. The left engine is supplied by the forward fuselage cell and the forward and aft dorsal cells; the right engine, by the center and aft fuselage cells. A single AC electrically-driven fuel boost pump in each system supplies fuel under pressure to the engine-driven fuel pump during normal operation. The left system boost pump is in the inverted flight compartment of the forward fuselage cell, and the right system boost pump is in the inverted flight compartment of the aft fuselage cell. Without the aid of the boost pump, each engine can be supplied with fuel by gravity flow from its respective system. Normally, sufficient fuel will flow by gravity to maintain MAX power from sea level up to approximately 25,000 feet; however, by specifications, gravity flow is guaranteed only to 6,000 feet, and flameouts have occurred as low as 15,000 feet. Through crossfeed operation, both systems may supply fuel to either engine with or without boost pump pressure (one engine off, crossfeed on, boost pumps functioning or failed). Also, one system under boost pump pressure will supply fuel to both engines. (Both engines operating, crossfeed on, one boost pump OFF.) Caution lights indicate fuel low level and low-pressure conditions. See Figure 1-54 for fuel specification and for fuel quantity data. Refer to FUEL MANAGEMENT for proper crossfeed operation.

SINGLE POINT REFUELING

Single-point pressure fueling is provided for servicing both fuel systems simultaneously. The precheck valve is used to check the operation of the primary and secondary floats of both fuel level control valves during the first few seconds of single-point refueling. After all cells are full, the fuel level control valves automatically close, causing the flow to stop. Refer to Figure 1-20.

Boost Pump Switches

Two guarded boost pump switches (Figure 1-17), one for each fuel system, are located on the right subpanel of the front cockpit. All fuel pump circuit breakers (Figure 1-20) should be closed before operating boost pumps.

Boost Pump Indicator Lights

Two boost pump indicator lights (Figure 1-17), one for each boost pump, are located on the right subpanel of the rear cockpit. An indicator light illuminates when the corresponding boost pump switch is placed at OFF.

Fuel Pressure Caution Lights

Two fuel low-pressure caution lights, placarded LEFT FUEL PRESS, RIGHT FUEL PRESS (Figure 1-19 and Figure 1-28), are on Caution Lights Panel located on the right console of each cockpit. The caution light will illuminate when the warning system detects a low-pressure condition exists. Fuel low-pressure caution lights may be used to determine if boost pumps are operating. Low-pressure lights are only valid indications of boost pump output with crossfeed OFF, the corresponding fuel shutoff switch NORMAL, and throttle out of OFF. The caution lights may blink when afterburner power is selected. Various other conditions may cause the lights to blink; this blink is not an indication of boost pump failure.

Crossfeed Switch

A crossfeed switch (Figure 1-17), operating on DC, is located on the right subpanel of the front cockpit. The switch is used to electrically open and close the crossfeed valve in the crossfeed fuel manifold that connects the two fuel systems. The switch is placed at ON to use the fuel from both systems to supply one engine or to operate both engines on fuel from one system under boost pump pressure.

WARNING

With the crossfeed switch ON, and either both boost pumps ON or both boost pumps OFF, a rapid fuel imbalance can occur.

Crossfeed Indicator Light

An amber crossfeed indicator light (Figure 1-17) is located on the right subpanel of the rear cockpit. When the crossfeed switch in the front cockpit is placed at ON, the crossfeed indicator light illuminates.

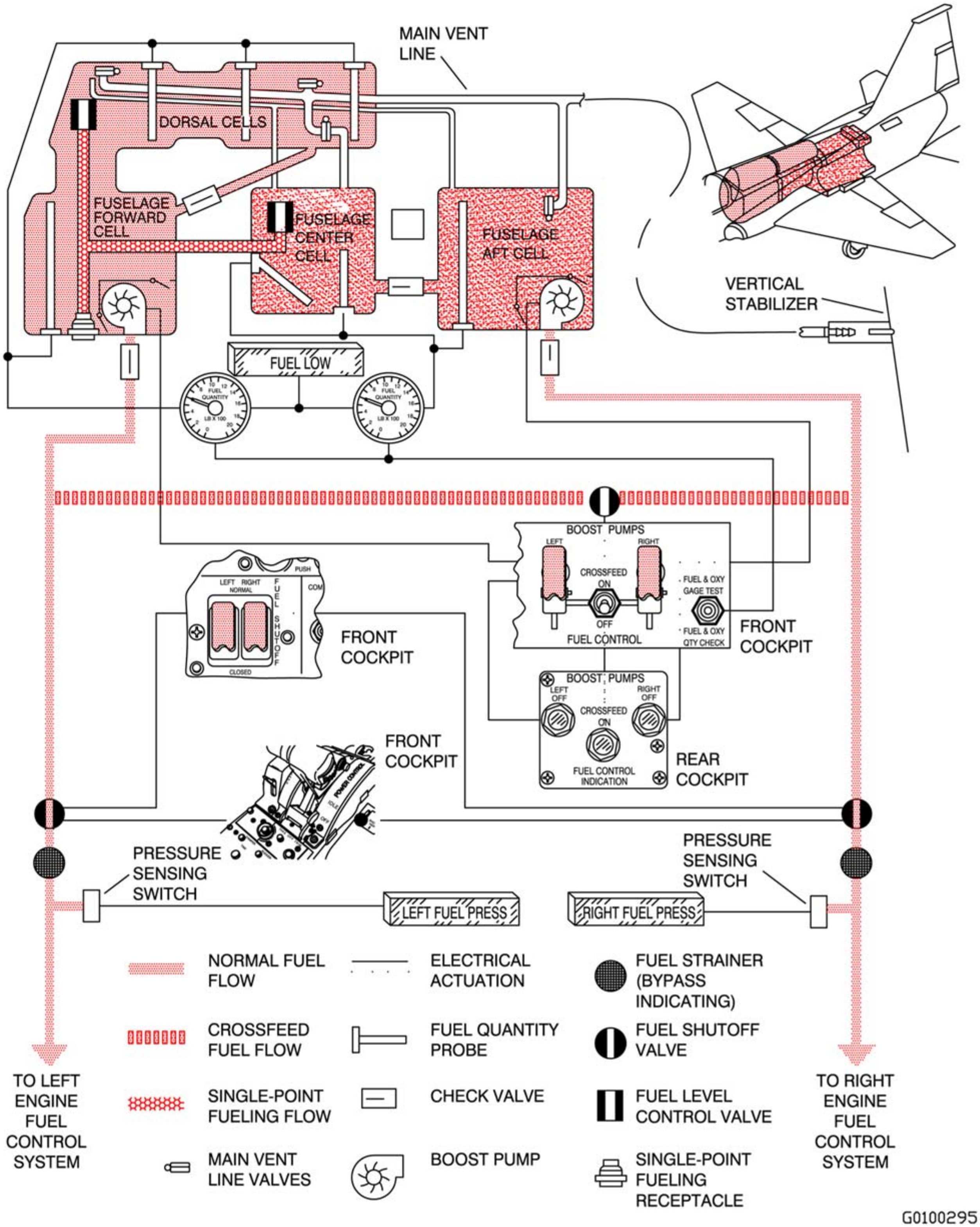

Figure 1-17. Fuel System

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Fuel Shutoff Switches

Two guarded fuel shutoff switches (Figure 1-17), one for each engine, are located on the left subpanel of the front cockpit. The fuel shutoff valves (DC operated) are normally controlled by the throttles, with the fuel shutoff switches in the NORMAL position. Placing either or both of these switches at the CLOSED position shuts off fuel flow to either or both engines in approximately 1 second without using the throttles.

CAUTION

The switches should be used only in an emergency, as damage to the engine-driven fuel pumps and main fuel control may occur.

Fuel Quantity Indicators

Two fuel quantity indicators (Figure 1-17), one for each fuel system, are located on each instrument panel. The indicators operate on AC and indicate in pounds the total usable fuel in each fuel supply system. The front cockpit indicators have an allowable error of ±47 pounds for the left system and ±32 pounds for the right system. Rear cockpit indicators repeat fuel quantity readings from the front indicators. These indicators should be within ±25 pounds of the front cockpit indicators.

Fuel Quantity Caution Light

A fuel quantity low-level caution light, placarded FUEL LOW, is located on the Caution Lights Panel on right side console of each cockpit (Figure 1-19 and Figure 1-28). The caution light will illuminate after a 7.5-second delay when a fuel quantity indicator reads below 275 to 225 pounds. The left and right system fuel quantity indicators must be checked to determine which system is low.

Fuel/Oxygen Check Switch

Fuel and oxygen quantities and indicator operation can be checked by a switch on the right subpanel of the front cockpit (Figure 1-7). The three-position switch is spring-loaded to the unmarked OFF position. With external or generator AC power, fuel and oxygen quantities are indicated when switch is at the OFF position. To check operation of fuel and oxygen quantity indicators, the switch is held at the FUEL & OXY GAGE TEST position. Indicator pointers should move counterclockwise. When the switch is released, each indicator pointer will return to indicate the fuel and oxygen quantities. With battery power only, the switch is held at the FUEL & OXY QTY CHECK position to read the fuel and oxygen quantities on board the aircraft. (The static inverter supplies AC power to the indicating circuits when the switch is actuated.)

FUEL MANAGEMENT

The fuel systems function automatically to supply fuel to the engines once the throttles have been moved from the OFF position and the fuel boost pumps turned on. The fuel quantity indicators should be monitored to maintain the two systems within 200 pounds of each other to ensure aircraft center of gravity remains within limits. This is accomplished using the fuel balancing (crossfeed) procedures in section II. Crossfeeding is not recommended during low fuel conditions or while at low altitudes, instead use differential power settings to obtain proper balance. With the fuel low caution light illuminated, a slightly nose up flight attitude should be maintained to ensure maximum usable fuel from both systems. Maintaining this attitude is necessary to preclude uncovering the fuel boost pump inlets, allowing air to enter the fuel supply lines, causing engine flameout.

NOTE

During low fuel state descents do not maintain a nose down attitude for extended periods. Occasionally, transit to a positive pitch attitude to refill the boost pump sump.

LOW FUEL OPERATION

If an internal system has less than 650 pounds of fuel, the surface of the fuel falls below the fuel boost pump upper-inlet and the boost pump output is reduced approximately 40%. During crossfeed operation, if the engines are operated at high power settings, the low pressure light may come on and engine RPM fluctuations may occur because of insufficient fuel pressure. With a low fuel state (approximately 250 pounds in either system) do not attempt to ensure fuel flow to both engines by selecting crossfeed operation with both fuel boost pumps operating. If the fuel supply in one system is depleted or is pulled away from the boost pump by G-forces and the boost pump in the other system fails, air may be supplied to the engines causing dual engine flameout. In this situation, there is no cockpit indication of boost pump failure.

LOW FUEL OPERATION (SINGLE ENGINE)

When 250 pounds of fuel remains in either system, place both boost pumps ON and crossfeed switch ON to allow the engine to be fed from both systems simultaneously.

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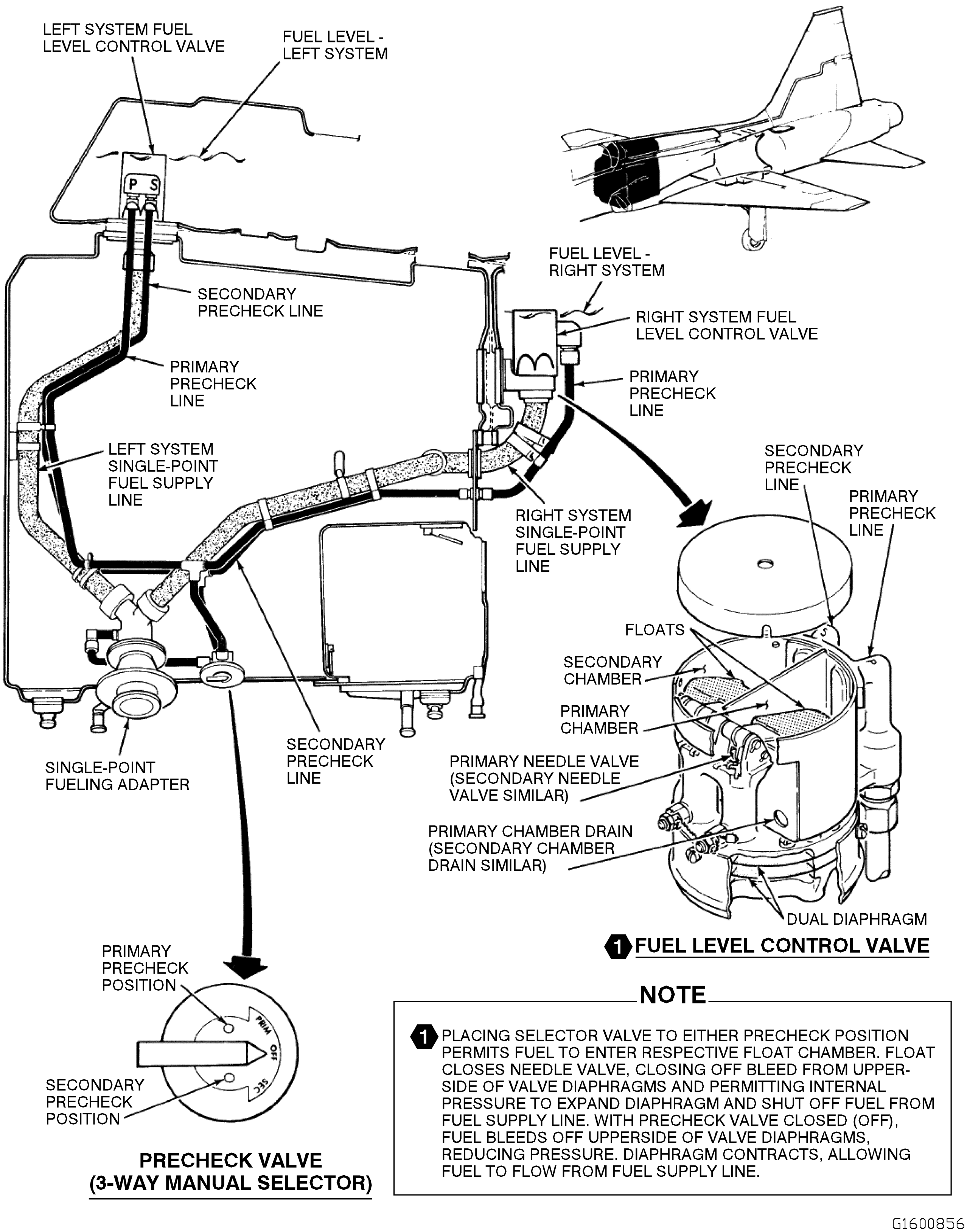

NOTE

1 PLACING SELECTOR VALVE TO EITHER PRECHECK POSITION PERMITS FUEL TO ENTER RESPECTIVE FLOAT CHAMBER. FLOAT CLOSES NEEDLE VALVE, CLOSING OFF BLEED FROM UPPERSIDE OF VALVE DIAPHRAGMS AND PERMITTING INTERNAL PRESSURE TO EXPAND DIAPHRAGM AND SHUT OFF FUEL FROM FUEL SUPPLY LINE. WITH PRECHECK VALVE CLOSED (OFF), FUEL BLEEDS OFF UPPERSIDE OF VALVE DIAPHRAGMS, REDUCING PRESSURE. DIAPHRAGM CONTRACTS, ALLOWING FUEL TO FLOW FROM FUEL SUPPLY LINE.

Figure 1-18. Single Point Refuel

ELECTRICAL SYSTEMS

ELECTRICAL SYSTEMS OVERVIEW

Two alternating current systems and one direct current system (Figure 1-14) supply electrical power to the aircraft. The 115/200 VAC power supply systems consist of two identical engine-driven AC generating systems and an external power receptacle. The DC power supply system consists of a DC bus powered either by a 24-volt battery or two 28 VDC transformer-rectifiers.

AC POWER SYSTEM

AC power is normally obtained from two engine-driven AC generators. The power distribution is divided into a right system and a left system. The generators are cut in individually when engine speed accelerates to approximately 43 to 48% RPM. If one generator should fail or is turned off, the functioning generator will automatically supply electrical power to both systems through the bus contactor relay.

Generator Switches And Caution Lights

Two guarded generator switches (Figure 1-19), one for the left and one for the right generator, are located on the right subpanel of the front cockpit. Generator caution lights, placarded LEFT GENERATOR and RIGHT GENERATOR, are located on the right console of each cockpit. A caution light will illuminate when its generator switch is placed at OFF or when a generator malfunction occurs. A switch RESET position permits resetting the generators.

DC POWER SYSTEM

DC power is normally obtained through two transformer-rectifiers which convert AC to DC power. If one transformer-rectifier fails, the other automatically supplies all DC requirements. If both transformer-rectifiers fail, the master caution light on the instrument panel and XFMR RECT OUT light on the right console will illuminate. Under this condition, the DC bus will revert to battery power.

NOTE

The XFMR RECT OUT and master caution light may blink due to the battery voltage momentarily overriding the DC bus voltage. This usually occurs when DC bus voltage drops due to a momentary heavy load, such as initiating afterburner. This is a normal condition and does not indicate a failure.

Battery Switch

A battery switch (Figure 1-19) is located on the right subpanel of the front cockpit. Placing the switch at ON connects the battery to the DC bus. Under normal flight conditions, the battery switch should remain in the ON position to permit the battery to charge. A minimum battery voltage of 18 volts is required to close the battery relay.

STATIC INVERTER

A static inverter, powered by the DC bus, converts the DC bus voltage to 115 VAC. The inverter, when activated, provides an alternate source of AC power for the following:

a. Starting first engine on the ground or during flight.

b. Operation of right engine autosyn instruments during 30 second start cycle of right engine.

c. Fuel and oxygen quantity indicators when Fuel/Oxygen check switch is in either GAGE TEST or QTY CHECK position.

On the ground, with DC power only, the inverter is activated when either engine start button is pushed for engine start or when the fuel/oxygen check switch is held at FUEL & OXY GAGE TEST or FUEL & OXY QTY CHECK position. During flight, with DC power only, the inverter is activated when either engine start button is pressed or either throttle is moved into MAX range for engine restarts or when the fuel/oxygen check switch is held at FUEL & OXY GAGE TEST or FUEL & OXY QTY CHECK position. With normal AC/DC power or DC power only, an operational check of the static inverter can be accomplished by positioning the fuel/oxygen check switch to FUEL & OXY GAGE TEST and observing counterclockwise movement of fuel and oxygen quantity indicator pointers.

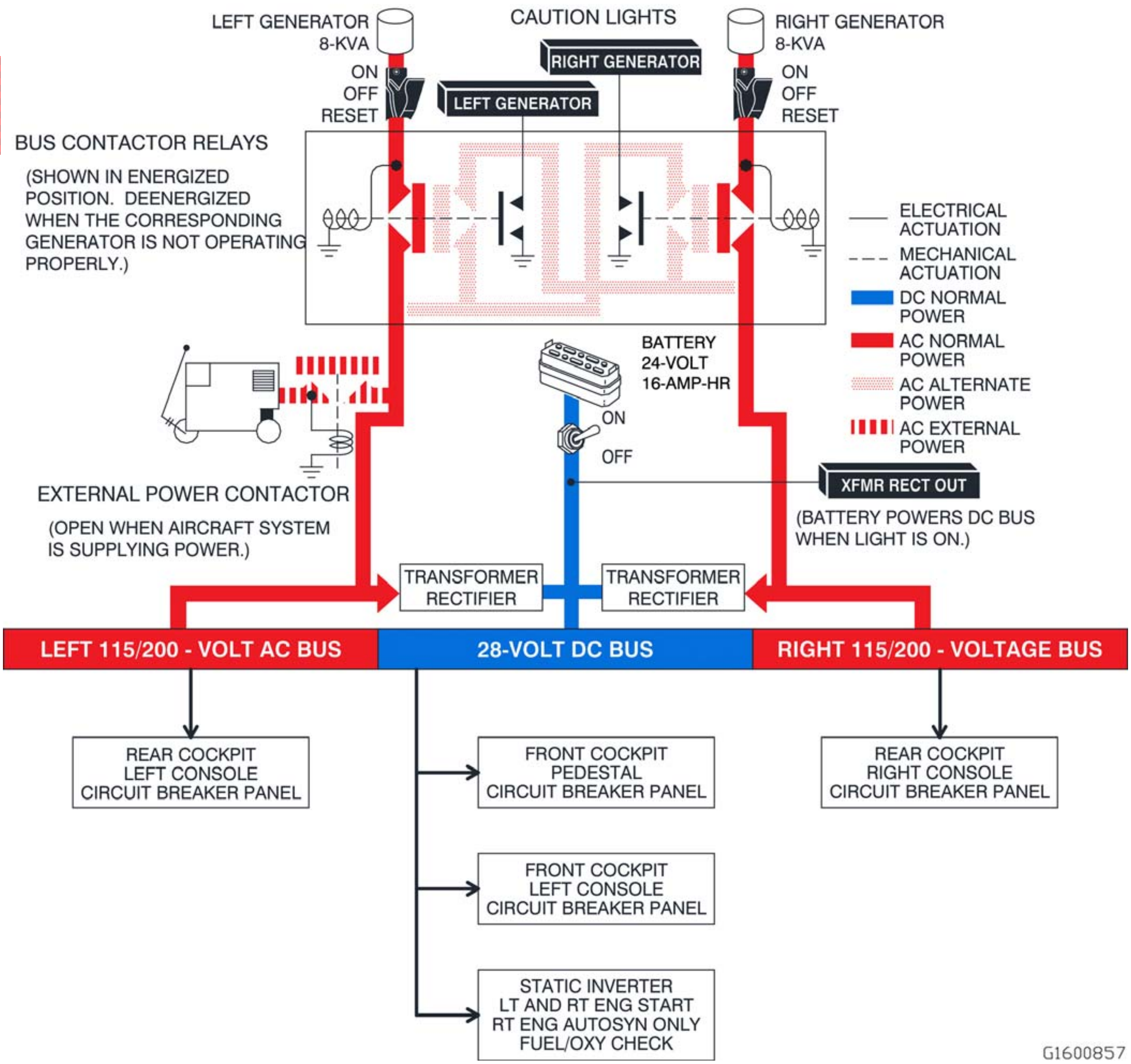

Figure 1-19. Electrical System (Sheet 1 of 2)

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LEFT 115/200V AC Bus

Flight Control
- Stability Augmenter

Fuel
- LT Fuel Boost Pump
- 2 LT Fuel Qty Indication
- LT FF Indicator

Powerplant
- 1 LT Engine Ignition
- LT Engine Autosyn
  - LT Oil Pressure Indicator
  - LT Hydraulic Pressure Indicator
  - LT EGT Indicator

Electrical
- Transformer Rectifier No. 1 and Bus Monitor
- Landing and Taxi Lamp
- Landing and Taxi Light Control (Requires DC for Extension)
- Anti-Collision Beacon Lights
- Instrument Lights
- Position Lights (6 Volts AC)
- Console Lights

Instruments
- AOA Computer
- AOA Heater

Radio, Communication, and Navigation
- AN/APX-64 AIMS Computer
- IFF-SIF

External Stores and Misc Equipment
- ECM Power (B Model)

NOTES

1 POWERED BY INVERTER WHEN ENGINE START BUTTON PRESSED AND MAX POWER WITH NO AC PWR
2 POWERED BY INVERTER BY FUEL/OXY CHECK SWITCH WITH NO AC PWR
3 ALSO REQUIRES AC
4 ALSO REQUIRES DC

28V DC Bus

Flight Control
- Flap Position Indicator
- 3 Flap Control
- Speed Brakes Control

Fuel
- Crossfeed Valve
- Fuel and Oxygen Quantity Check Switch
- LT and RT Fuel Shutoff Valves

Powerplant
- LT and RT Engine Start and Ignition Control
- LT and RT Afterburner Control
- LT and RT Fire Detection
- LT and RT Generator Control
- LT and RT Nozzle Position Indicator
- Inlet Duct Anti-Ice

Electrical
- Emergency Floodlights
- Formation Lights
- Master Caution Lights
- Caution and Warning Indicator Lights (Dim)
- Bus Monitor
- Marker Beacon Light

Landing Gear
- Landing Gear Audible Warning
- Landing Gear Control, Safety, and Nosewheel Steering
- Landing Gear Door Switch

Instruments
- Flight Director Mode Selector
- Turn Needle
- Standby Attitude Indicator
- Clocks
- AOA Indicator Lights
- Vibrator, AAU-19/A Altimeter

Radio, Communication, and Navigation
- AN/ARC-164 UHF Command Radio
- AN/ARC-164 UHF RCP Radio
- UHF Antenna Selector
- AN/ARN-118 TACAN
- 3 TACAN Antenna Selector
- AN/AIC-18 Intercom
- AN/ARN-147 ILS Reciever, Indicators, and Flags
- 3 Rate of Turn and Attitude Gyro
- AN/APX-64 AIMS Monitor

External Stores and Misc Equipment
- ECM Control (B Model)
- Flight Load Data Recorder (FLDR)

RIGHT 115/200V AC Bus

Flight Control
- 4 LT and RT Flap Actuator
- Trim Control and Light

Life Support
- 2 Oxygen Quantity and Low Level Warning
- Cabin Conditioning
- Cabin Air Valves
- Canopy Seals

Fuel
- RT Fuel Boost Pump
- RT FF Indicator
- 2 RT Fuel Qty Indication

Powerplant
- 1 RT Engine Ignition
- 1 RT Engine Autosyn
  - RT Oil Pressure Indicator
  - RT Hydraulic Pressure Indicator
  - RT EGT Indicator
- Engine Anti-Ice

Electrical
- Transformer-Rectifier No. 2 and Bus Monitor
- Normal Floodlights
- Utility Light
- Nose Equipment Compartment Cooling
- Seat Adjustment
- Caution and Warning Indicator Lights (Bright)

Instruments
- Rate Gyro
- Attitude Gyro
- Flight Director Computer
- Attitude Indicator
- Attitude Sphere
- Bearing Pointer
- Compass Card Slaving
- Pitot Heater

Radio, Communication, and Navigation
- Radio Transfer Control
- 4 AN/ARN-118 TACAN
- 4 AN/ARN-147 ILS Reciever, Indicators, and Flags

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Figure 1-19. Electrical System (Sheet 2)

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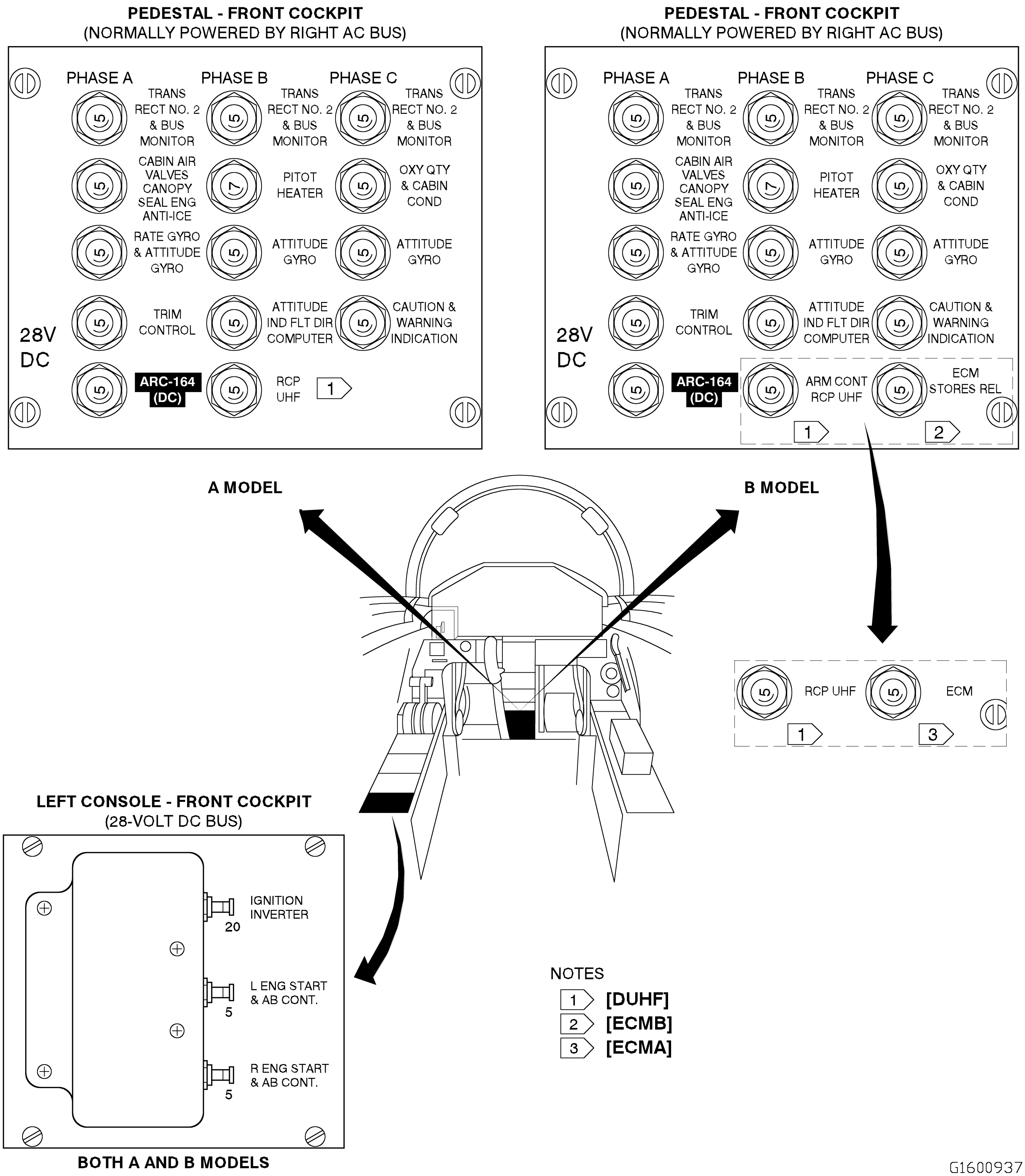

Figure 1-20. Circuit Breaker Panels (Typical) (Sheet 1 of 2)

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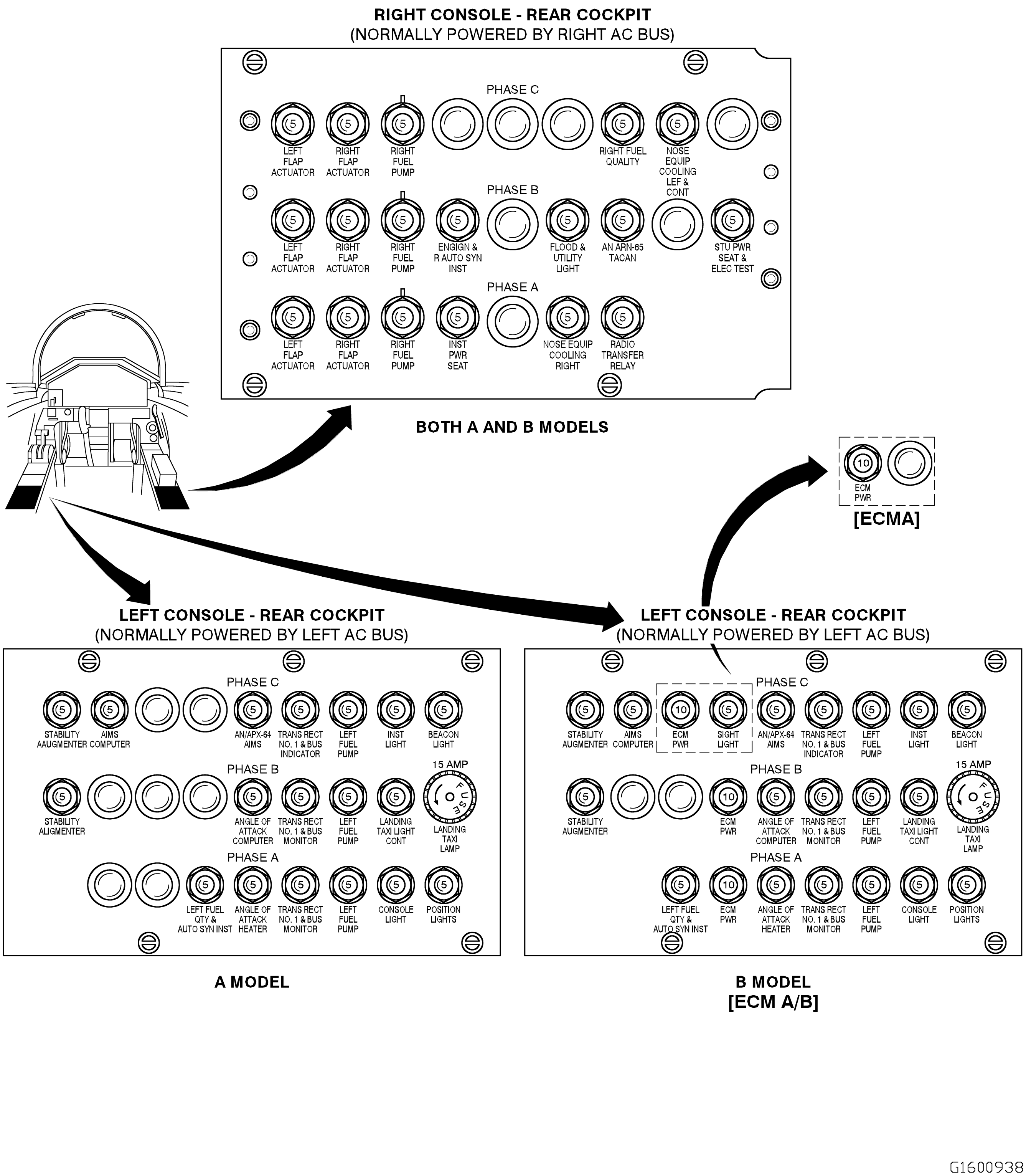

Figure 1-20. Circuit Breaker Panels (Typical) (Sheet 2)

HYDRAULIC SYSTEM

HYDRAULIC SYSTEM OVERVIEW

The aircraft hydraulic power supply systems (Figure 1-21) include the 3000 psi utility system powered by the left engine and the 3000 psi flight control system powered by the right engine. Under normal circumstances there is no interchange between systems. Separate pressure indicators and caution lights are provided for each system. Refer to Table 2-1for hydraulic fluid specification.

NOTE

On AF65-10419 and later aircraft, the ram air cooler has been deleted from the system.

HYDRAULIC PRESSURE INDICATORS

Two AC powered hydraulic pressure indicators (Figure 1-21), one for each hydraulic system, are located on the instrument panel in each cockpit.

HYDRAULIC CAUTION LIGHTS

A caution light for each hydraulic system placarded UTILITY HYDRAULIC and FLIGHT HYDRAULIC, are on the Caution Lights Panel located on the right console of each cockpit (Figure 1-21 and Figure 1-26). The lights illuminate at approximately 1500 psi to indicate a low-pressure condition. The lights go out when a pressure of approximately 1800 psi is restored. The lights will also illuminate when the hydraulic fluid has excessively high temperatures. To determine which condition has caused the lights to illuminate, the hydraulic pressure indicators must be observed.

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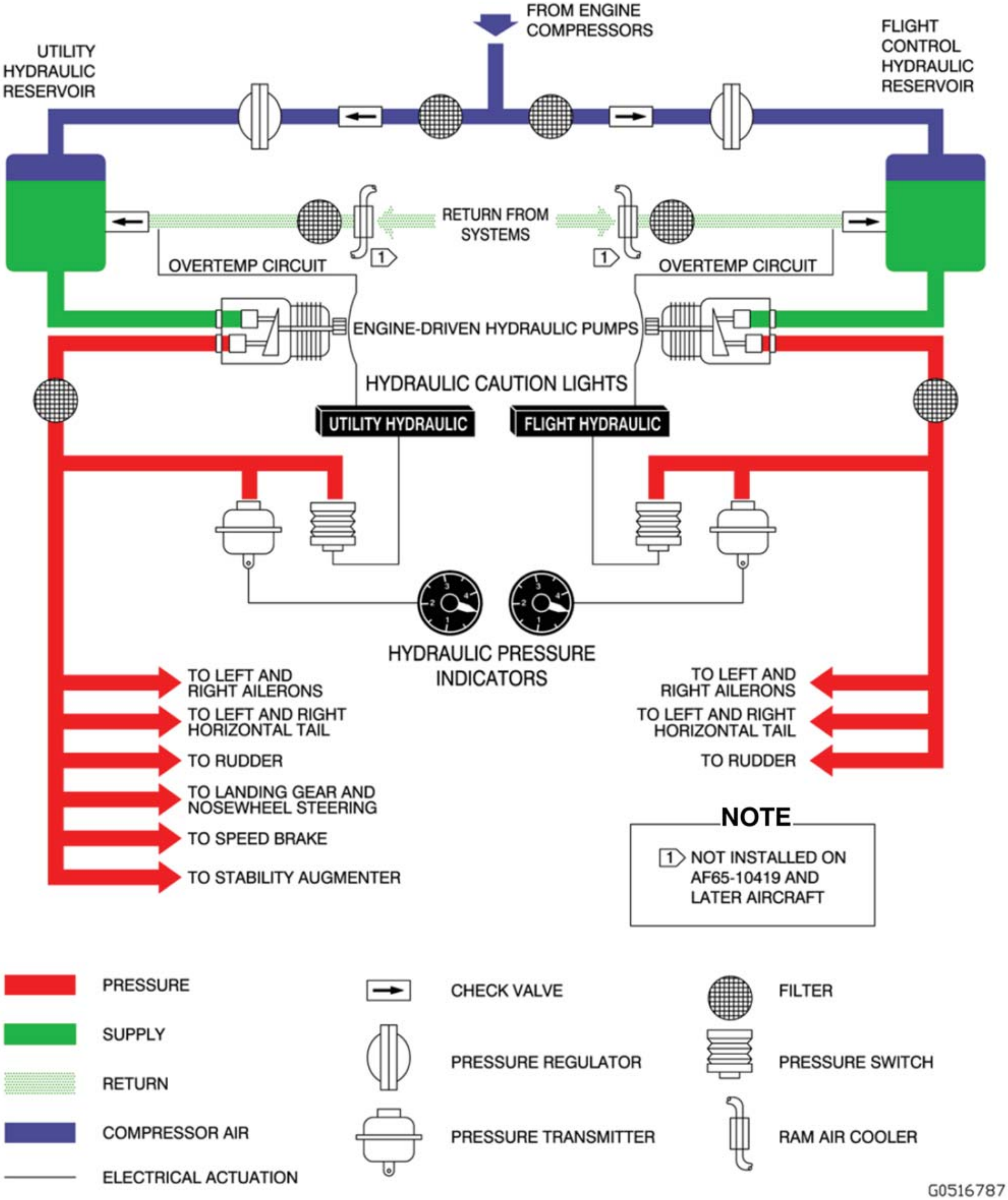

Figure 1-21. Hydraulic System

FLIGHT CONTROL SYSTEM

FLIGHT CONTROL SYSTEM OVERVIEW

A hydraulically powered, irreversible flight control system is provided (airloads on the control surfaces cannot cause control stick or surface movement). Conventional aerodynamic FEEL in the control stick is provided artificially by springs and bob weights. The springs progressively resist control stick displacement and the bob weight mechanism further resists aft stick travel during maneuvering flight. Lateral and longitudinal trim is provided by electric motors which change the neutral reference point of the feel springs and control stick position. Each control surface is moved by two hydraulic cylinders; one is powered by the UTILITY HYDRAULIC system, the other by the FLIGHT HYDRAULIC system.

CONTROL STICK

Each cockpit has a control stick with a standard stick grip (Figure 1-22), which contains a flight trim switch and a nosewheel steering button. On Block 20 aircraft, a stability augmenter pitch damper cutoff switch is located below the stick grip.

RUDDER PEDAL ADJUSTMENT T-HANDLE

A mechanical rudder pedal adjustment T-handle (Figure 1-6) is located on the pedestal of each cockpit. To adjust rudder pedals, pull T-handle out and hold until pedals are repositioned. Return the T-handle to the stowed position manually to lock the pedals in place.

CAUTION

Allowing the handle to snap back may trip or damage pedestal circuit breakers or ILS control and cause the cable to kink and wear excessively.

TAKEOFF TRIM SYSTEM

A takeoff trim system is installed to allow positioning of the horizontal tail for the optimum takeoff setting. The system uses the normal longitudinal trim system along with a push button and indicator light (Figure 1-9 and Figure 1-10) installed on the left console in both cockpits. When the button is pushed and held, the trim motor moves the control stick to the required position at which point the motor stops and a green indicator light illuminates in the left console. The aircraft has external markings to visually confirm proper takeoff trim horizontal tail position.

FLIGHT TRIM SYSTEM

A conventional aileron/elevator trim switch is located on each stick grip. Operation of the switch (Figure 1-22) causes operation of an AC motor causing appropriate movement of the control stick. Limit switches are installed in the system which limit the range of stick travel obtainable through use of the trim system. Cutout switches interrupt horizontal tail trim when stick force is exerted against the direction of trim. These two systems limit the effects of RUNAWAY TRIM since the aircraft can be flown with the control stick at either of the trim limit cutout positions; however, very heavy stick forces may be encountered.

RUDDER TRIM KNOB

An AC electrical rudder trim knob (Figure 1-9) on the left console of the front cockpit provides the means of trimming the rudder. The yaw damper switch must be turned on before the rudder will assume the selected trim position.

RUDDER LIMITER SYSTEM

Deflection of the rudder is limited by a mechanical linkage between the rudder control system and the nose gear trunnion. When the nose gear is extended 3/4 or less, rudder deflection is limited to 6 degrees from neutral in either direction. When the nose gear is more then 3/4 extended, full rudder deflection of 30 degrees from neutral in either direction is available. The rudder limiter cannot be overcome by either crew member.

STABILITY AUGMENTER SYSTEM (SAS)

The stability augmenter system uses utility hydraulic pressure to position the rudder to reduce yaw oscillations. Manual rudder trim is accomplished through the yaw damper. A yaw damper switch is located on the left console of the front cockpit (Figure 1-9). The switch is spring-loaded to OFF position and is held in the YAW position by AC power. The yaw damper is disengaged by returning the switch to OFF. The augmenter will disengage automatically in the event of AC power failure or certain system malfunctions. On Block 20 aircraft, the stability augmenter system also positions the horizontal tail to reduce pitch oscillations when the pitch damper switch next to the yaw is positioned to the PITCH position. The switch is held in the PITCH position by AC power. The pitch damper is disengaged either by returning the switch to OFF, by actuating the pitch damper cutoff switch on the control stick (Figure 1-22), or the system will automatically disengage in the event of AC power failure or certain system malfunctions.

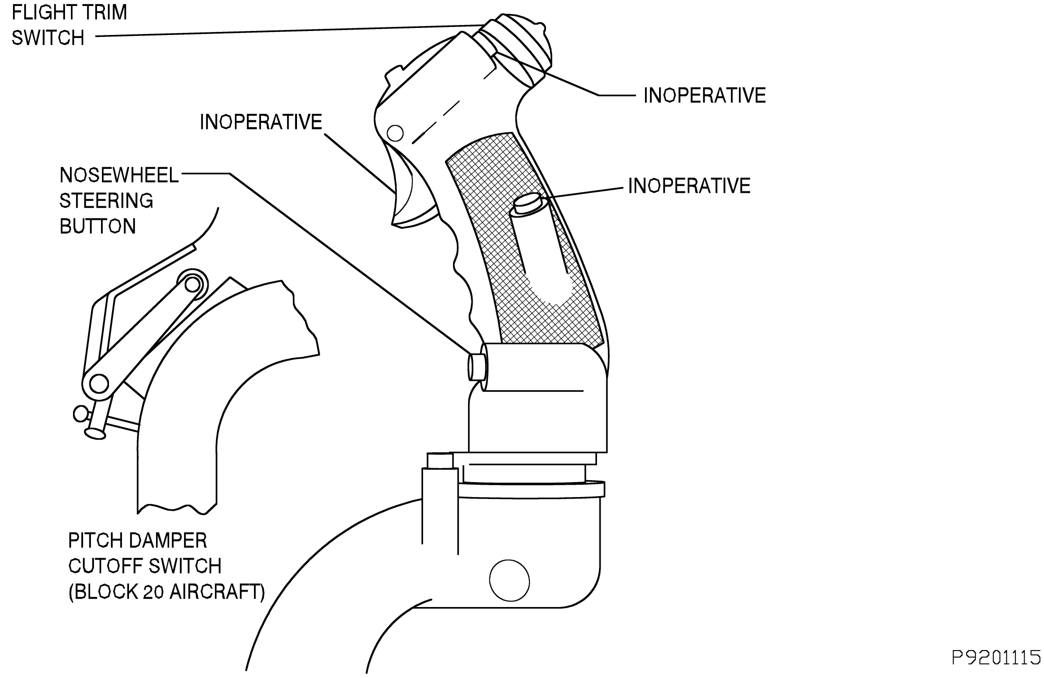

Figure 1-22. Control Stick (Typical)

LIFT AND DRAG DEVICES

WING FLAP SYSTEM

The primary purpose of the flaps is to provide increased lift for takeoff and landing. The flaps should not be used in high AOA or acrobatic maneuvering. The flaps are electrically (DC) controlled by the flap lever switch in the front cockpit. The flaps are operated by two AC electric motors and are interconnected by a rotary flexible shaft. If one flap motor fails, both flaps are actuated through the rotary shaft. Flap extension time will be much longer than normal with one motor failed.

WING FLAP-HORIZONTAL TAIL (FLAP-SLAB) INTERCONNECT SYSTEM

Flap operation changes the aerodynamic properties of the aircraft. The flap-slab interconnect system compensates for these aerodynamic changes and maintains essentially the same aircraft handling qualities, regardless of flap position.

To provide the required compensation, the flap position is mechanically transmitted to the horizontal tail operating mechanism through an interconnect cable. As the flaps are moved, the interconnect system provides the following:

a. The horizontal tail is automatically repositioned to essentially eliminate the pitch changes caused by flap movement.

b. As the flaps are extended, the interconnect system increases the amount of horizontal tail travel available in the nose down direction.

c. The interconnect system changes the pitch authority of the control stick by increasing the amount of horizontal tail deflection per inch of stick travel.

The majority of the compensation occurs in the first 35% of flap deflection.

If the interconnect system fails with flaps extended, expect the following:

a. A spring mechanism will rapidly remove all flight control compensation and reposition the horizontal tail to the zero percent flap position.

b. The aircraft will always pitch up, and moderate to heavy forward stick forces (probably beyond the forward trim limit) will be required to maintain controlled flight. Greater than normal control stick movements will be required to affect pitch response.

c. When flaps are retracted following an uncommanded pitch up, the aircraft will have a pronounced tendency to settle and a large aft stick movement will be required to maintain level flight.

d. Normal handling qualities will be obtained only when the flaps are retracted to the up position.

WING FLAP LEVER AND POSITION INDICATOR

A wing flap lever (Figure 1-12) is located on the throttle quadrant of each cockpit. The two levers are mechanically interconnected by cables; however, the lever in the front cockpit actuates the electrical switch that operates the two flap motors. Sensing switches stop the flaps at 60% when the flap lever is placed in the 60% detent. When operating in the emergency mode, the flaps can be stopped at any position by placing the flap lever in the 60% detent. When UP or DOWN is selected, flap movement is stopped by limit switches at the fully retracted or extended position. The flap position indicator, which operates on DC, is located on the left subpanel of each cockpit (Figure 1-7 and Figure 1-8). Flap extension is indicated as a percentage of full flap travel.

NOTE

If the wing flap lever is between the 0-60% position or the 60-100% position, the flaps will not extend or retract.

AUXILIARY FLAP CONTROL SWITCH

The auxiliary flap control switch is located in the front cockpit (Figure 1-9) on the left console. It is a two-position switch. In the normal position, flap positions of full up, 60% down, and full down can be selected. In the emergency position, flaps can be set at any selection from full up to full down. In this mode of operation, flap extension or retraction is stopped by moving the lever to the 60% detent, which then functions as an OFF position when flaps have reached the desired position or by limit switches when the flaps have fully extended or retracted.

SPEED BRAKE SYSTEM

A DC electrically controlled, hydraulic activated dual surface speed brake is located on the lower surface of the fuselage center section. Design of the activation system permits selection of intermediate speed brake positions other than fully extended.

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SPEED BRAKE SWITCH

A conventional, three-position (UP-OFF-DOWN) speed brake switch (DC) is installed on the right throttle in each cockpit. The switch in the front cockpit has positive detents in each position. The switch in the rear cockpit has capability to override the position selected in the front cockpit and is spring-loaded to the center OFF position. Intermediate speed brake positions can be obtained by positioning the switch to the desired direction of movement and then returning to the OFF position. Speed brake creep will occur with the switch in the OFF position. Following override, control of the speed brake system is regained in the front cockpit by moving the switch to OFF. To prevent creep following actuation from the rear cockpit, the front cockpit switch should be placed in the position selected by the rear cockpit.

LANDING GEAR

LANDING GEAR OVERVIEW

Extension and retraction of the landing gear and gear doors are powered by the utility hydraulic system and electrically controlled by the landing gear levers. Landing gear extension or retraction normally takes approximately 6 seconds. The normal landing gear cycle may be reversed at any time. The normal extension sequence is doors open, gear extends, doors close. The retraction sequence is doors open, gear retracts, doors close.

LANDING GEAR LEVER, WARNING SYSTEM, AND SYSTEM SILENCE BUTTON

A landing gear lever (Figure 1-23) is located on the instrument panel of each cockpit. The two levers are mechanically interconnected. A warning system consisting of an intermittent tone (beeper), audible through the headset of each crew member, and a red light within the wheel-shaped end of each landing gear lever will be activated if the landing gear is not down and locked and the following conditions exist:

a. The airspeed is 210 KIAS or less.

b. The altitude is 10,000 (±750) feet or below.

c. Both throttles are below 96% RPM.

NOTE

Power required under single-engine conditions may be in excess of that required to activate the landing gear warning system.

When airspeed is decreasing, the system is activated in the range of 210 to 180 KIAS. With the system activated and the aircraft accelerating, the light and tone may not go out until speed reaches approximately 240 KIAS. With the gear handle in the UP position and the system not activated, a red light in the landing gear lever indicates the landing gear doors are not up and locked. The audible warning signal is not activated by an unlocked gear door condition. A landing gear WARNING SILENCE button (Figure 1-23) is located on the instrument panel of each cockpit. Pressing either button silences the audible warning signal. Front cockpit pilot should not place the left foot outboard of the rudder pedal due to the possibility of striking the landing gear handle interconnect linkage causing uncommanded landing gear retraction.

LANDING GEAR LEVER DOWNLOCK OVERRIDE BUTTON

A landing gear lever downlock override button (Figure 1-23) on the instrument panel of each cockpit enables either crew member to raise the landing gear lever to the LG UP position if the locking solenoid fails to release the landing gear lever from the LG DOWN position. With button pressed, the landing gear lever can be raised to the LG UP position during flight or on the ground. The rear cockpit downlock override button operates electrically; the front cockpit downlock override button operates mechanically.

LANDING GEAR POSITION INDICATOR LIGHTS

Three landing gear position indicator green lights (Figure 1-23) on each instrument panel illuminate when the gear is down and locked.

CAUTION

Crossthreading of the light assembly could result in the light sticking in the press to test position, after pressure is removed, giving an erroneous green light. When pressing to test, ensure the light is spring-loaded to the out position.

NOTE

- There are separate contacts on the landing gear downlock switches for each cockpit green light indicator. A good light in either cockpit ensures that gear is safe.
- With DC failure, the rear cockpit nose gear light will not illuminate due to gear relay wiring.

LANDING GEAR ALTERNATE RELEASE HANDLE

A landing gear alternate release handle (Figure 1-7) on the left subpanel of the front cockpit permits gear extension without hydraulic pressure or electrical power. When the handle is pulled, the normal landing gear hydraulic and electrical systems are deenergized, and the gear uplocks and gear door locks are mechanically released, permitting the gear to extend by its own weight. No portion of the landing gear structure is under hydraulic pressure after extension by the alternate system. The handle must be held in the fully extended position (approximately 10 inches) until all three gears are unlocked. Extension of the main and nose landing gear will require approximately 15 seconds, but may take up to 35 seconds. If gear alternate extension was accomplished with the gear lever at LG UP, the lever must be placed at LG DOWN and then returned to LG UP to reactivate the normal system. After an alternate extension, the main gear doors will remain open and nosewheel steering will not be available until the system is reactivated. The nosewheel door assumes a spring-loaded closed position after alternate extension. A landing gear reset lever, located outboard of the left rudder pedal in the front cockpit, may be used to reset the landing gear switches.

NOTE

- During preflight, if the striker plate in the nose gear well is found in the extended position, check the reset lever in the reset (UP) position. This resets all gear switches, but will not raise the striker plate. The striker plate will remain extended until the nose gear retracts after takeoff.
- If the gear is lowered by the alternate release handle with the landing gear in the LG UP position, the red light in the landing gear lever will remain illuminated. In this situation, the illuminated red light indicates the gear door open condition normally associated with the gear retraction cycle. The landing gear green indicator lights will be illuminated and the warning signal silent, indicating a positive gear down and locked condition.

LANDING GEAR DOOR SWITCH

A guarded landing gear door switch is provided on the left console of the front cockpit (Figure 1-9). With electrical and hydraulic power available, this switch permits opening and closing the landing gear doors when the landing gear lever is at LG DOWN. If the gear is extended in flight with the gear door switch at OPEN, the gear doors will remain open until the gear is retracted or the gear door switch is placed at NORMAL.

NOSEWHEEL STEERING SYSTEM

The nosewheel steering system provides directional control and shimmy damping. Hydraulic pressure for the system is supplied by the utility hydraulic system. Nosewheel steering is controlled by rudder pedal action and may be activated only when the weight of the aircraft is on the nosewheel. If the nosewheel position does not correspond to the position of the rudder pedals when steering is activated, the nosewheel will turn to correspond to the rudder pedal position.

NOSEWHEEL STEERING BUTTON

Nosewheel steering is electrically controlled by the nosewheel steering button on the control stick (Figure 1-22) in either cockpit. Steering is available only when the button is held in the pressed position. With button pressed, nosewheel steering is deactivated when one or both throttles are advanced to MAX range and restored when both throttles are retarded below MAX range. Whenever the weight of the aircraft is not on the nose gear, the system automatically deactivates.

NOSEWHEEL CENTERING MECHANISM

A nosewheel centering cam mechanically streamlines the nosewheel whenever the nose gear strut is fully extended. Air pressure in the strut mechanism ensures the nose gear strut remains fully extended during gear retraction.

WHEEL BRAKE SYSTEM

The main gear wheel brakes (Figure 1-24) are the segmented rotor type and are powered by a separate completely self-contained hydraulic system. Three brake self-adjuster mechanisms are installed on the wheel assembly. These selfadjusters have a nut running through the middle of the cylinder.

NOTE

- The brake discs and plates are near the end of their service life when the top of the nut is less than flush with the top of the cylinder on any of the three mechanisms.
- Pilots should have maintenance personnel check the brakes for excessive wear with a gauge any time the brake self-adjuster nut is less than flush with the rim of the cylinder.

The brake pedals are the conventional toe-operated type. Each brake pedal controls a hydraulic master cylinder. Control of the brakes transfers to the crew member applying the greater pedal force.

The hydraulic brake reservoir for the independent manually operated brake system has a capacity of approximately 0.20 US gallons - On Block 25 through Block 35 and 0.10 US gallons - On Block 40 and up aircraft.

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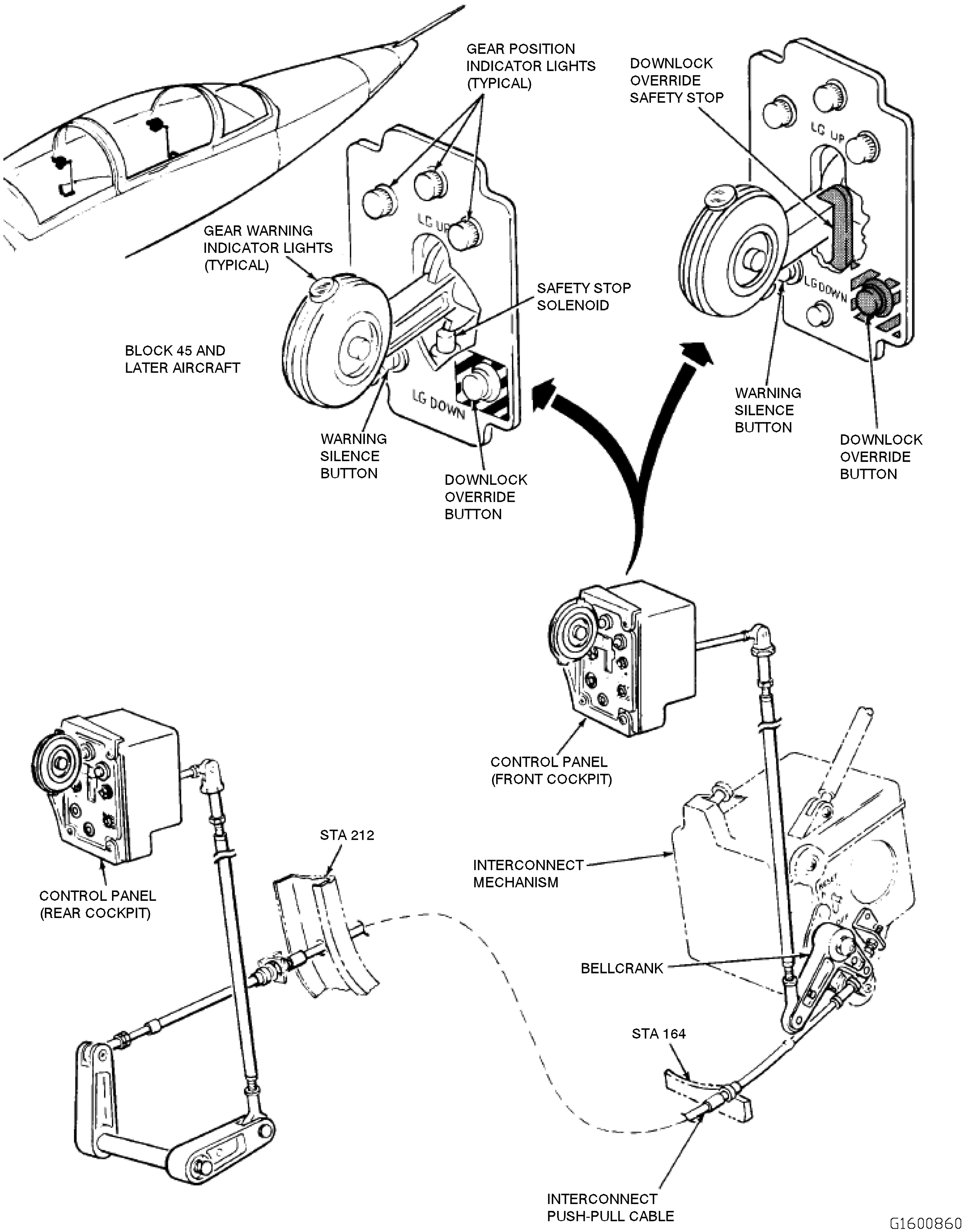

Figure 1-23. Landing Gear System (Sheet 1 of 3)

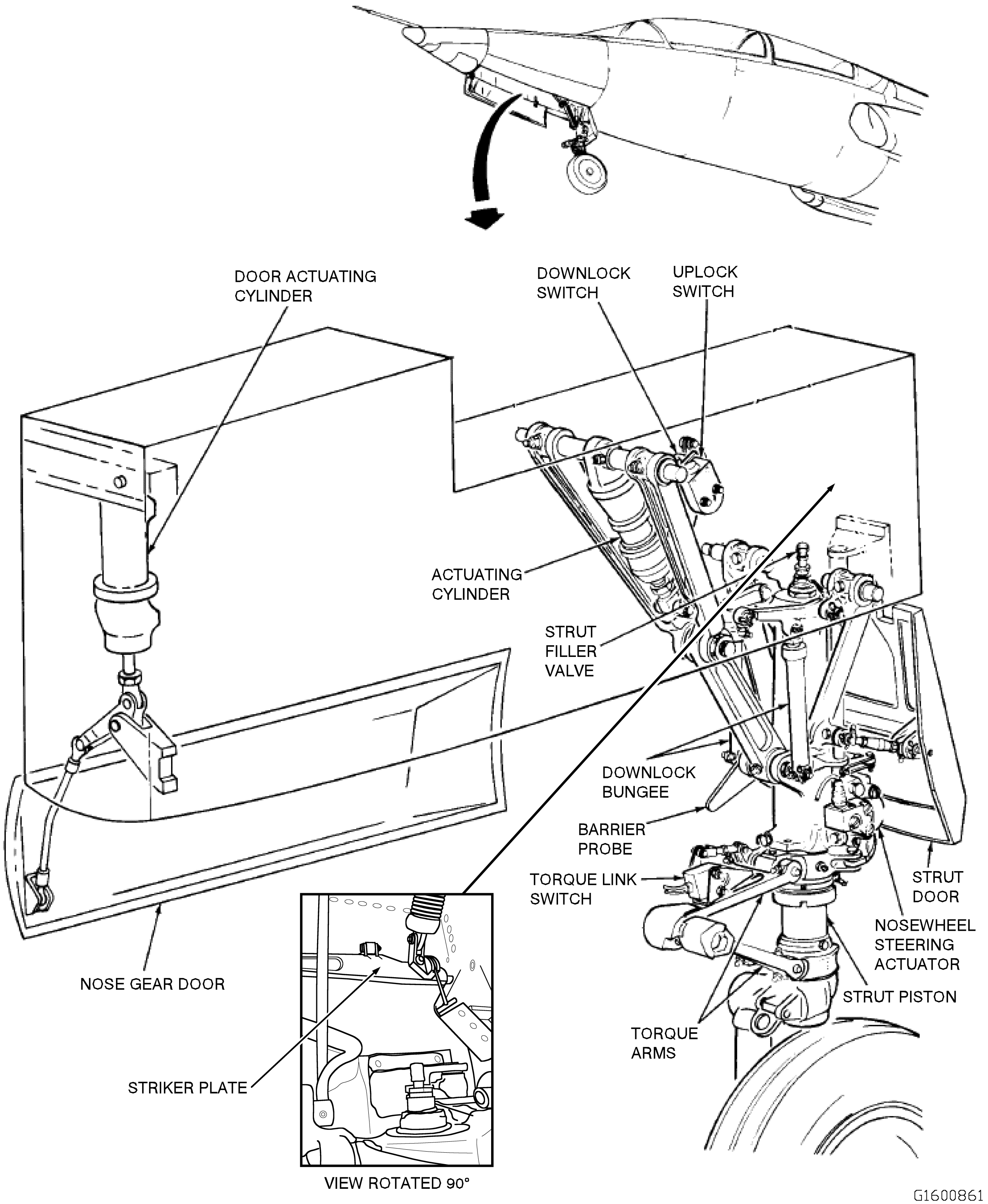

Figure 1-23. Landing Gear System (Sheet 2)

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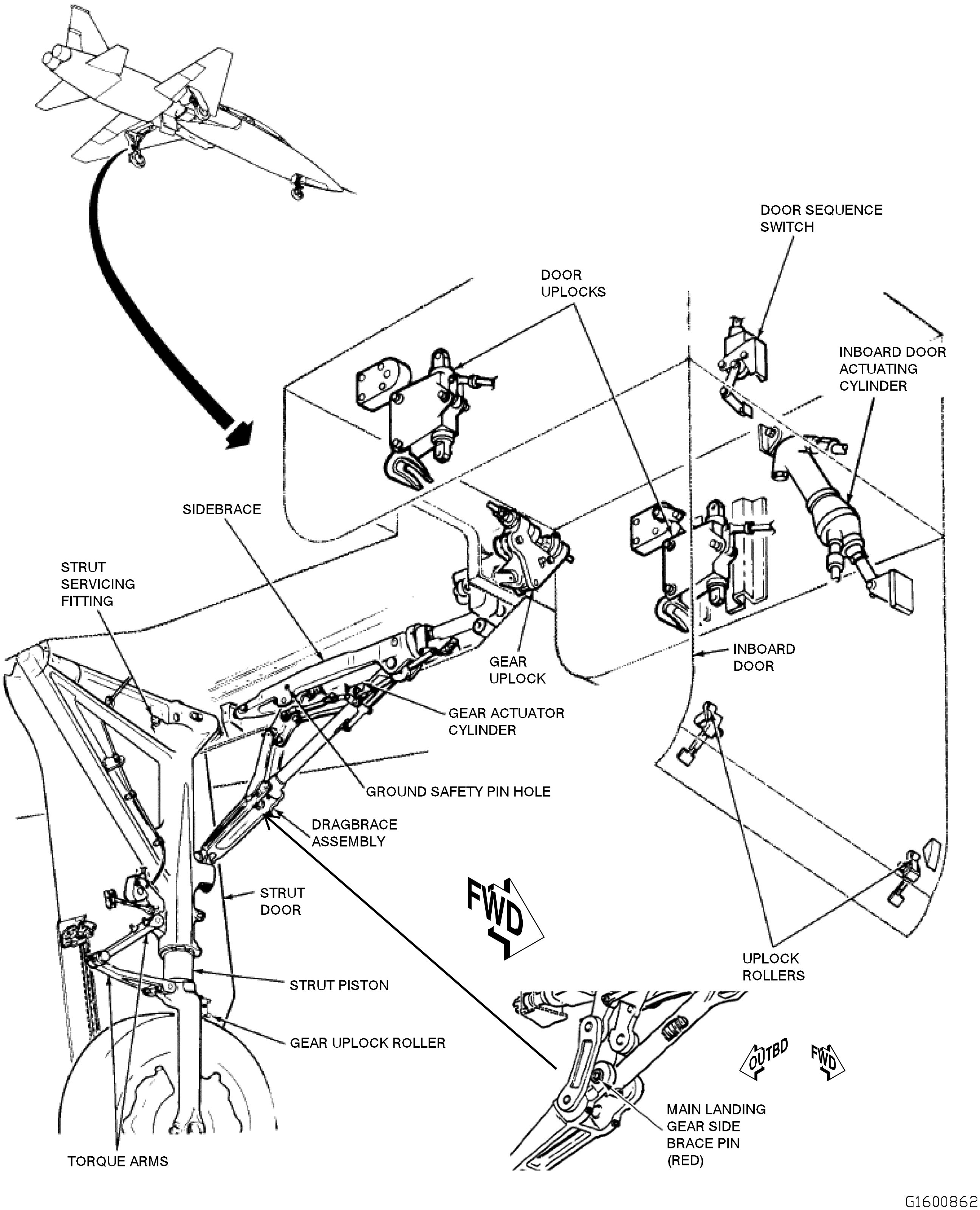
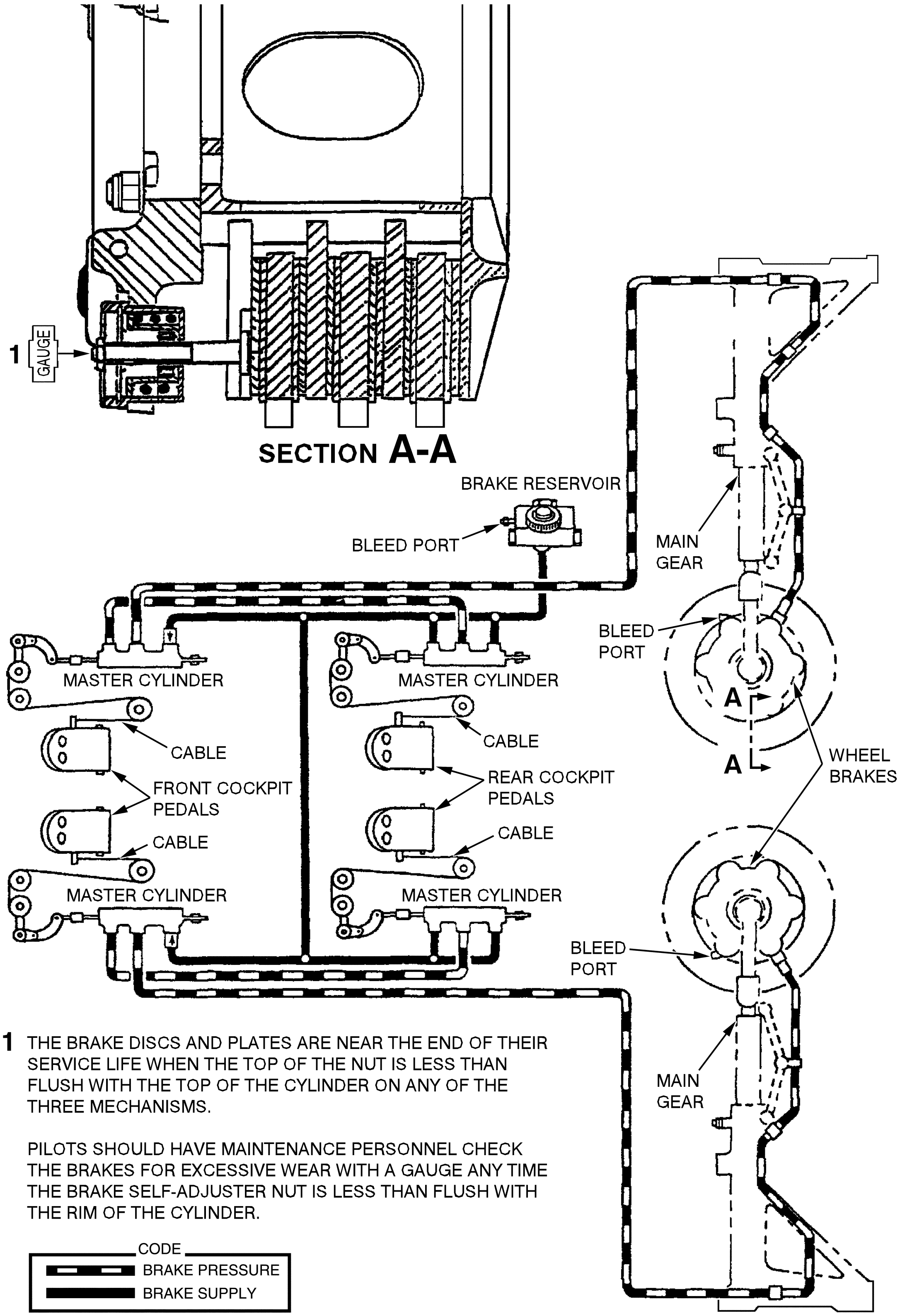


Figure 1-23. Landing Gear System (Sheet 3)



1 THE BRAKE DISCS AND PLATES ARE NEAR THE END OF THEIR SERVICE LIFE WHEN THE TOP OF THE NUT IS LESS THAN FLUSH WITH THE TOP OF THE CYLINDER ON ANY OF THE THREE MECHANISMS.

PILOTS SHOULD HAVE MAINTENANCE PERSONNEL CHECK THE BRAKES FOR EXCESSIVE WEAR WITH A GAUGE ANY TIME THE BRAKE SELF-ADJUSTER NUT IS LESS THAN FLUSH WITH THE RIM OF THE CYLINDER.

CODE
- BRAKE PRESSURE
- BRAKE SUPPLY

P0900063

Figure 1-24. Wheel Brake System

CABIN AIR CONDITIONING AND PRESSURIZATION SYSTEM

CABIN PRESSURE REGULATOR

A cabin altimeter on the instrument panel of the front cockpit (Figure 1-5) indicates the pressure altitude within the cabin. All controls in the air- conditioning and pressurization system, except the canopy defog, are electrically (AC) controlled. The canopy defog is pneumatically controlled and does not require AC power. Refer to Figure 1-25 for cabin pressurization schedule. The cabin pressure regulator maintains cabin pressure at relative zero PSI differential at altitudes below 8000 feet. Between 8000 feet and approximately 23,000 feet, the regulator maintains a cabin pressure corresponding to 8000 (±1000) feet. Above 23,000 feet, the regulator maintains a pressure differential of 5 PSI above ambient pressure.

CABIN PRESSURE SWITCH AND CABIN TEMPERATURE CONTROL KNOB

A guarded cabin pressure switch (Figure 1-26) is located on the right subpanel of the front cockpit. The switch controls cabin air conditioning and pressurization. When the switch is placed at CABIN PRESS, both the cabin air conditioning and pressurization systems are activated; the cabin temperature desired is then selected by rotating the cabin temperature control knob to the desired temperature. This is the automatic mode of operation. When the cabin pressure switch is placed at RAM DUMP, the anti-G suit, canopy defog, cabin pressurization and air conditioning systems, and canopy seal are deactivated, and ram air enters the cabin for ventilating purposes. Placing the cabin pressure switch in RAM DUMP position does not deflate the canopy seal, but prevents air flow into the seal. The seal will remain inflated for an undetermined amount of time. Normal seal deflation is provided by an AC switch activated by opening the canopy locking lever, provided AC power is available.

CAUTION

Vibrations accompanied by fumes and/or odors from the air conditioning system may indicate air conditioner turbine failure. If this condition is suspected, select oxygen - 100%, descend below FL250, and select RAM DUMP to deactivate the air conditioning system. This should stop the vibrations.

NOTE

To eliminate cabin conditioning duct HOWL with the rear cockpit cabin air inlet valve closed, adjust either the front cockpit cabin air inlet valve toward the closed position or adjust the rear cockpit cabin air inlet valve toward the open position.

CABIN AIR TEMPERATURE SWITCH

A cabin air temperature switch (Figure 1-26) is located on the right subpanel of the front cockpit. The MAN HOT and MAN COLD positions provide for manual temperature control when the automatic temperature control system fails.

NOTE

When controlling temperature manually, momentarily stop switch at the center position before going to desired position.

CANOPY DEFOG KNOB

The flow of defog air to the windshield and both canopies is controlled by the canopy defog knob in the front cockpit (Figure 1-26).

ANTI-G SUIT SYSTEM

Air pressure from the air-conditioning system is used to inflate the anti-G suit in each cockpit to offset the effects of high load factor.

ANTI-G SUIT TEST BUTTON

An anti-G suit press-to-test button in the top of each regulator (Figure 1-9 and Figure 1-10) is located on the left console of each cockpit. The button is used to manually test operation of the anti-G suit valve; the further the button is pressed, the greater is the anti-G suit pressure available.

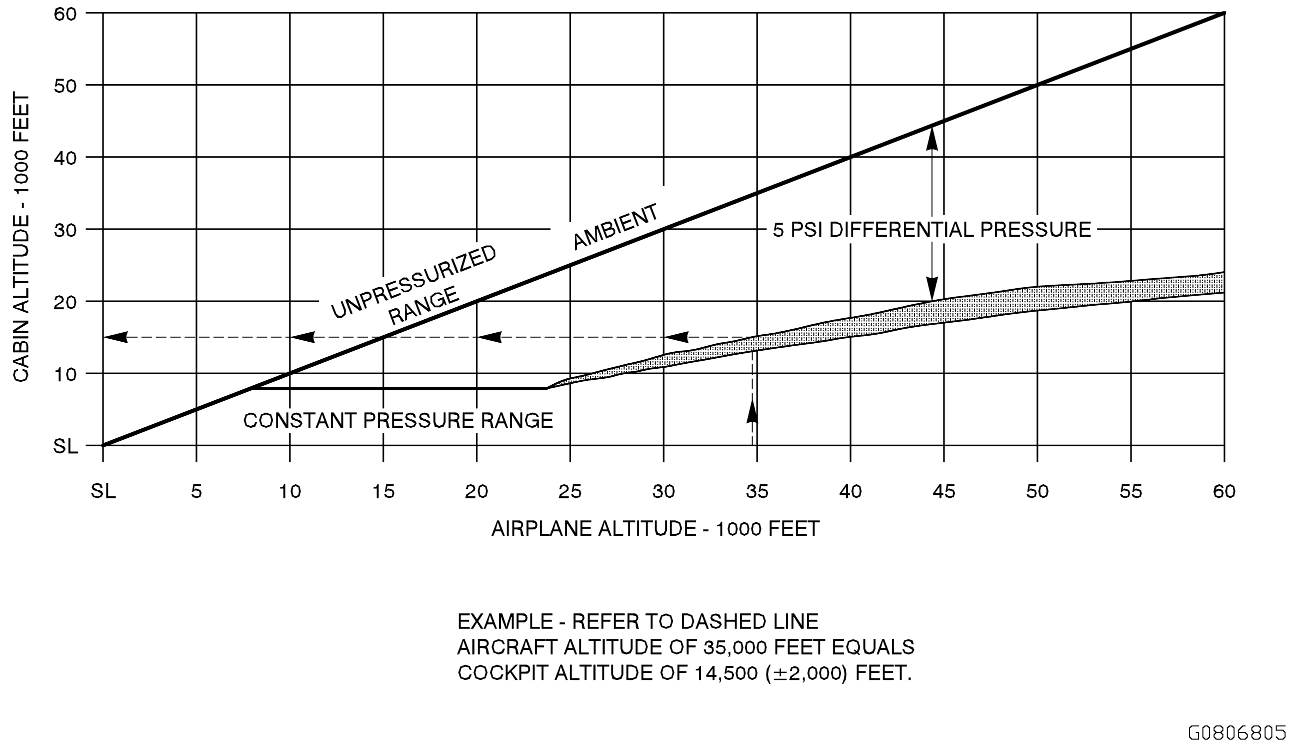


Figure 1-25. Cabin Pressurization Schedule

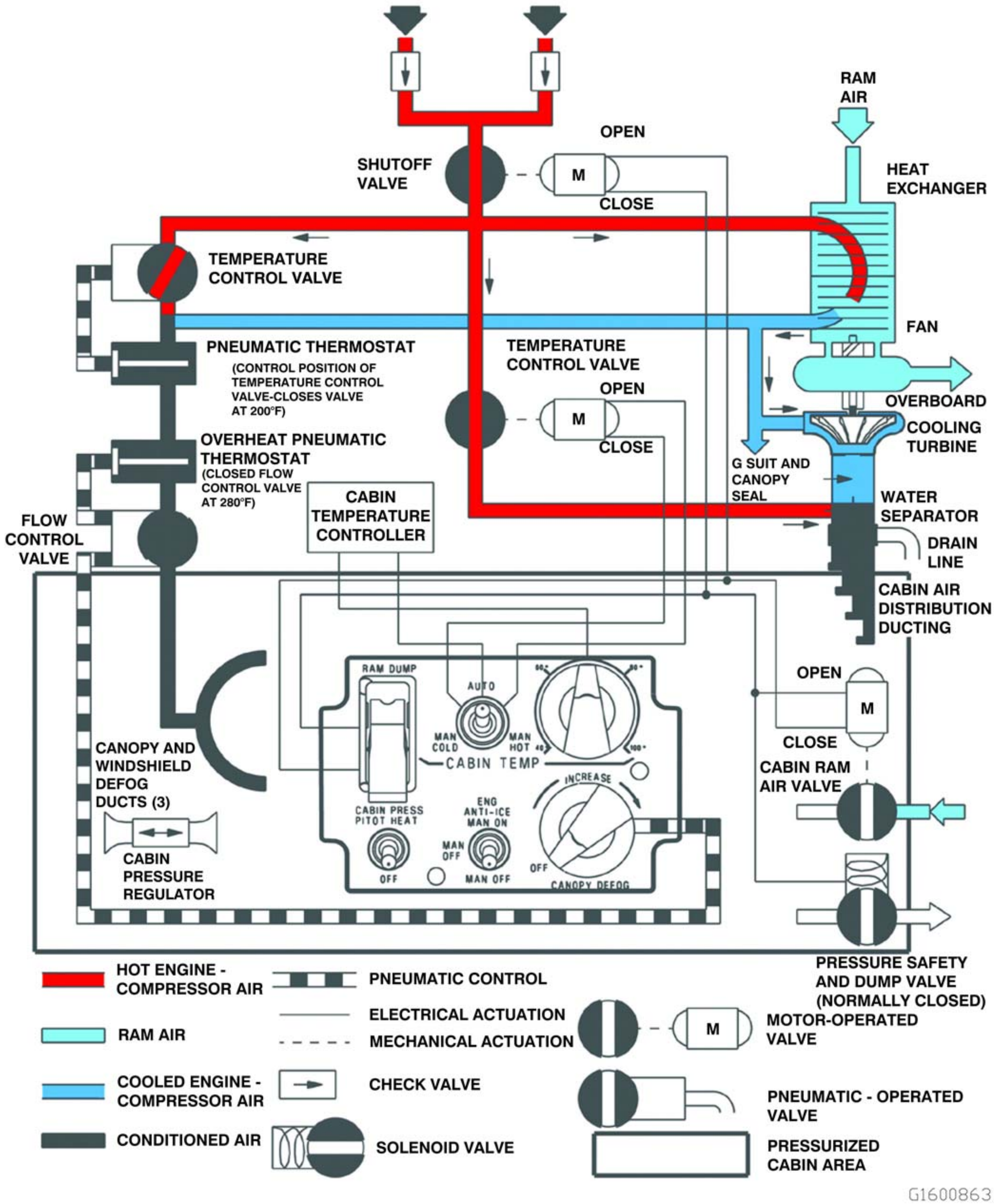


Figure 1-26. Cabin Air Conditioning and Pressurization System

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CAUTION, WARNING, AND INDICATOR LIGHT SYSTEM

CAUTION LIGHT (TELELIGHT) PANEL

A 14- or 10-capsule word caution light panel (Figure 1-27) on the right console of each cockpit is provided to alert the crew member of individual system malfunction or status change. The 14-capsule panel has four spare capsules. All capsule caution lights are yellow. Each caution light, except the ENG ANTI-ICE ON light, will remain illuminated as long as the malfunction exists or system status is unchanged. The caution lights will not go out if the master caution light is rearmed. The ENG ANTI-ICE ON light will illuminate when the engine anti-ice switch is turned on or loss of right AC bus without crossover. Refer to the description of aircraft systems for operation of the applicable caution lights.

MASTER CAUTION LIGHT

A master caution light (Figure 1-27), placards MASTER CAUTION, is located on each instrument panel. When a light illuminates on the caution light panel, the master caution light will also illuminate. When the condition is corrected, the master caution light will automatically go out, but if the condition cannot be corrected, the master caution light may be pressed, causing it to go out and rearming it to provide warning of subsequent malfunctions.

CAUTION, WARNING, AND INDICATOR LIGHT BRIGHT/DIM SWITCH

A three-position switch (Figure 1-9 and Figure 1-10) spring-loaded to neutral unmarked position is provided on the right console of each cockpit to dim all caution, warning, and indicator lights except the marker beacon, fire warning, takeoff trim indicator, and armament hot lights. With the instrument light control out of the OFF (detent) position, momentarily placing the switch in the DIM position will switch the power source from DC to AC, thus providing the DIM setting in that cockpit. Placing the switch momentarily to BRIGHT or placing the instrument light control to OFF will return the lights to bright.

CAUTION, WARNING, AND INDICATOR LIGHT TEST SWITCH

The landing gear audible warning signal, the fire detection system, the AOA indexer lights (aircraft with AOA system), and all caution, warning, and indicator lights except the takeoff trim indicator-light, armament hot light, and marker beacon light may be tested by placing the spring-loaded switch on the right console lighting control panel in each cockpit (Figure 1-9 and Figure 1-10) at the TEST position.

NOTE

If the warning test switches in both cockpits are actuated simultaneously, all fire warning lights will illuminate. The landing gear audible warning signal will not come on in either cockpit.

FIRE WARNING AND DETECTION SYSTEM

NOTE

An illuminated fire warning light may be a valid fire indication even though the test circuit may be inoperative.

The fire warning and detection system is provided to give a warning of a fire or overheat condition in either engine bay. Heat detectors are located in the forward engine bay and boattail area for each engine. The system responds to an overall average temperature or to highly localized temperatures caused by impinging flame or hot gas. Operation of the system in each engine compartment is independent of the other except when testing the system using the caution, warning, and indicator test switch. Placing either cockpit test switch at TEST checks all system detectors and fire warning light bulbs (4) in each cockpit. For test purposes only, each bulb is connected to a detector. However, any fire or overheat condition in either engine compartment will illuminate both bulbs of the respective fire warning lights in both cockpits.

ENGINE FIRE WARNING LIGHTS

Two red fire warning lights (Figure 1-5) placarded FIRE, one for each engine, on the instrument panel in each cockpit are provided to warn of an overheat or fire condition in either engine compartment. When the fire detection system senses an overheat condition or fire, the warning light for the respective engine will come on. This light will remain on until the condition is corrected and then will go out. Should the overheat condition or fire recur, the light will again come on. Each fire warning light contains two bulbs.

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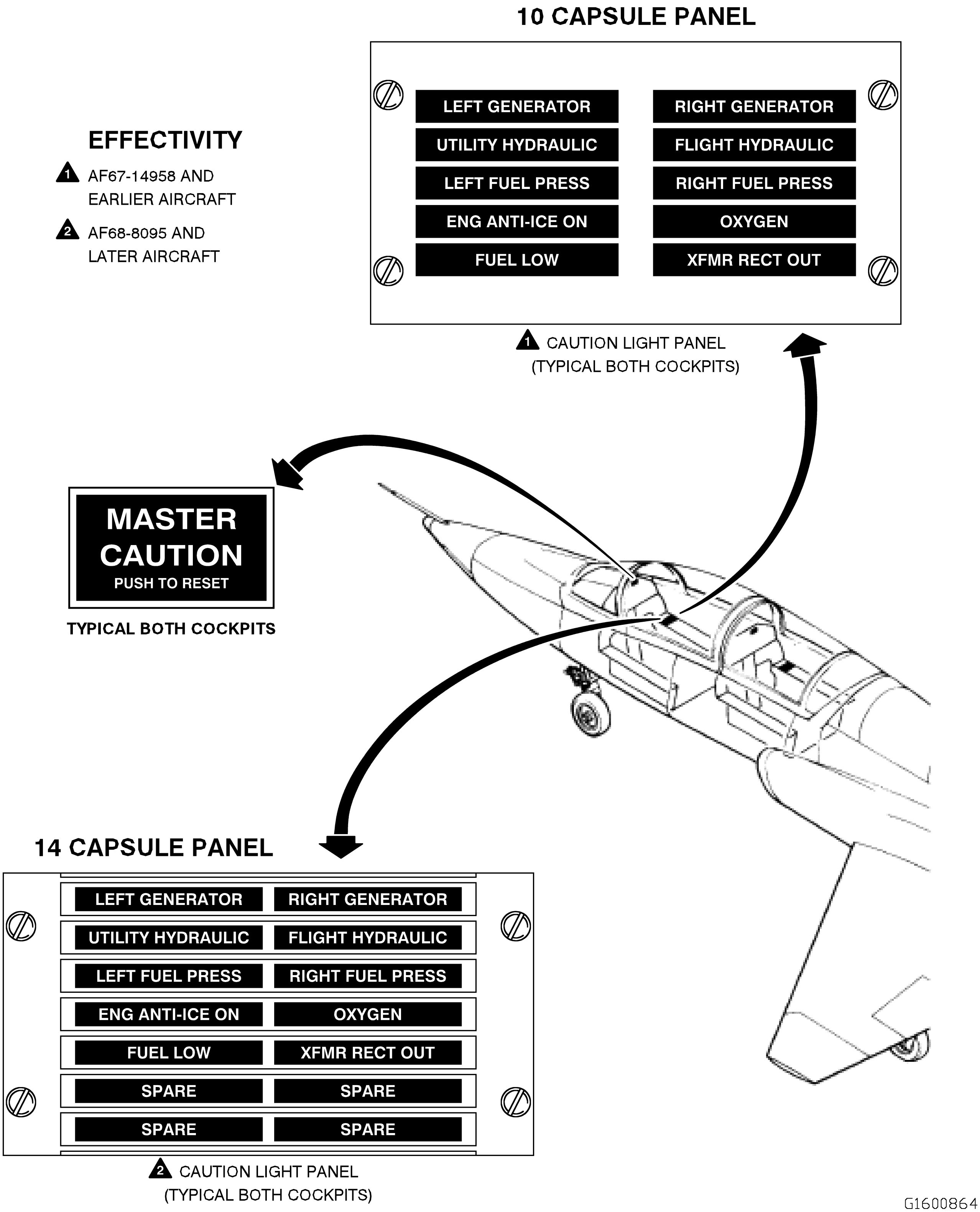

Figure 1-27. Caution Lights

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PITOT-STATIC SYSTEM

PITOT-STATIC SYSTEM

The pitot-static system supplies both impact and static air pressure to the airspeed-Mach indicator, the airspeed compensator of the stability augmenter system, and the airspeed and altitude pressure switch assembly that connects into the landing gear warning circuits. The altimeter and vertical velocity indicator receive only static pressure from the system. Refer to Figure 1-28.

PITOT BOOM ANTI-ICING

The pitot boom is deiced by an AC electrical heating system. The heater is controlled by a pitot heat switch (Figure 1-7) on the right subpanel in the front cockpit. Placing the switch to the up position (placarded PITOT HEAT) turns the pitot boom heat on.

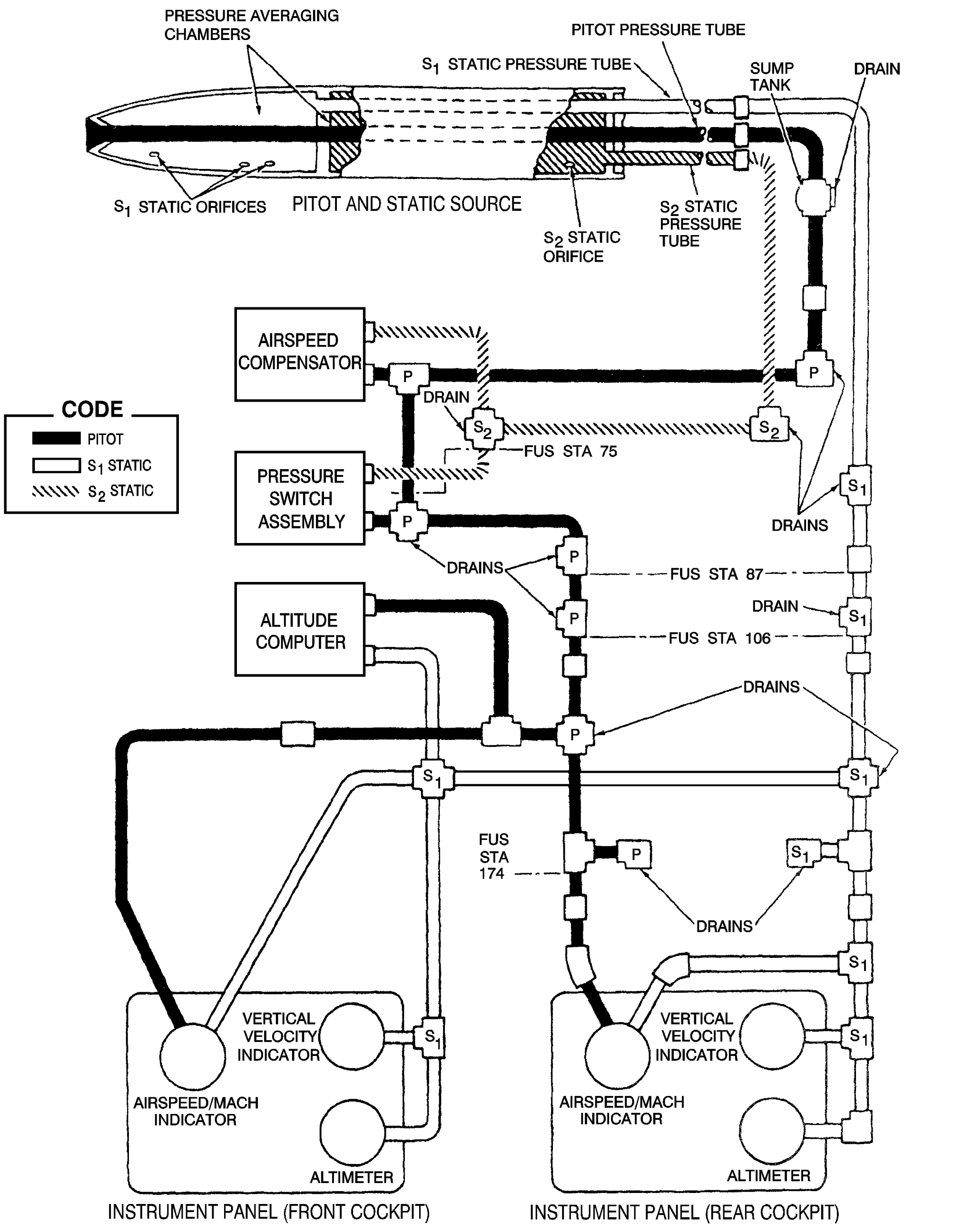

Figure 1-28. Pitot-Static System

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LIGHTING EQUIPMENT

EXTERIOR LIGHTING

ANTI-COLLISION BEACON LIGHTS AND SWITCH

One anti-collision beacon light is located near the top of the vertical stabilizer and one on the lower fuselage. The lights operate on AC and are controlled by the beacon light switch (Figure 1-10) on the right console of the front cockpit.

POSITION LIGHTS AND SWITCH

The position lights, which operate on 6-volt AC from a transformer off the left AC bus, are individually located in each wingtip, in the vertical stabilizer, and in the lower fuselage. The position lights are controlled by a bright/dim switch (Figure 1-10) on the right console of the front cockpit.

FORMATION LIGHTS AND SWITCH

Formation lights, operating on DC bus power, are individually located on each side of the forward nose section. Formation lights are controlled by a switch (Figure 1-10) on the right console of the front cockpit.

LANDING-TAXI LIGHTS

A single retractable landing-taxi light with dual filaments is installed. When the position lights are turned on, and the gear is extended, the light also extends. The landing-taxi light switch (Figure 1-9) on the left subpanel on the front cockpit controls only the filament power. When the weight of the aircraft is off the main gear and the landing-taxi light switch is at ON, both filaments are burning. When the weight of the aircraft is on the main gear, the light moves to the taxi position and one filament is extinguished. Turning off the position lights retracts the landing-taxi light in about 10 seconds.

INTERIOR LIGHTING

The instrument lights operate on AC power. A knob (Figure 1-9 and Figure 1-10) on the right console of each cockpit controls operation and intensity of the instrument lights. White floodlights, operating on AC, aid in illuminating the instrument panel, console panels, and the cockpit area. The floodlights are controlled by a knob on the right console of each cockpit. The two floodlights over each cockpit instrument panel (Figure 1-7) automatically switch from AC to DC if the AC power supply fails, provided the floodlights control knob is not at the OFF position. These floodlights serve as an alternate lighting source under this condition and cannot be dimmed when operating on DC power. The integral con-sole, subpanel, and pedestal lights operate on ac. Operation and intensity of these lights are controlled by rotating the console lights knob (Figure 1-9 and Figure 1-10) on each right console.

NOTE

If the left generator and bus transfer relay fail, instrument and console lights will not be operational. Floodlights which are powered by the right AC bus will not be automatically available, and the floodlight rheostat must be adjusted to obtain cockpit lighting.

UTILITY LIGHTS

Two removable utility lights, one in each cockpit, are normally mounted on the right console aft of the map case (Figure 1-5) in the front cockpit and on the right canopy frame (Figure 1-6) in the rear cockpit. Each light is controlled by a rheostat, which is an integral part of the light. Each light can be removed from the mounting bracket and is equipped with a spring extension cord, enabling use anywhere in the cockpit, or it can be placed in various other mounting brackets in the cockpit. The lights operate on DC power.

WARNING

Stow after use to prevent interference with ejection seat and man-seat separator system.

GRD TO HYD ELE FUE OXY ENG FLT MISC LND

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CANOPY

CANOPY

Each cockpit contains a manually operated clamshell type canopy. The canopy is locked closed or unlocked by an individual locking lever in each cockpit or by individual locking handles outside the left side of the front cockpit (Figure 1-29).

WARNING

- Make sure fingers are clear of canopy lock/unlock handle and aircraft bulkhead as they can become pinched between the handle on the canopy locking lever and the map light on the instrument panel.
- In the RCP, refrain from placing any objects on the RCP airframe bow as the front cockpit can be closed independently of the rear, creating a pinch hazard.
- It is possible to close the canopy and extinguish the canopy light but not have the canopy locking lever far enough forward. After closing the canopy, confirm lever in the full forward position and then apply upward pressure to the canopy to confirm that it has fully closed and locked.

Each canopy is counter-balanced throughout its travel limits. The canopy opening mechanism is protected against excessive loads by a hydraulic canopy dampener, which also restricts canopy opening and closing speeds. An inflatable pressurization seal installed on each canopy is inflated when both canopies are locked, the cockpit pressure switch is in the CABIN PRESS position, and an engine is operating.

WARNING

Loss of canopy and severe injury can occur if either canopy is unlocked prior to depressurizing to field elevation. The canopy could blow off its hinges and fall into the cockpit area. Any time the aircraft has been pressurized, RAM DUMP must be selected and the cabin pressure checked prior to opening the canopy.

CAUTION

After placing the Cabin Pressure switch to RAM DUMP, make sure the Cabin Pressure Indicator displays field elevation before operating the canopy. Pressure equalization can take several seconds.

The front canopy is designed to withstand the impact of a four pound bird at aircraft speeds ranging from 125 to 400 knots depending on where the impact occurs. Impacts which exceed these limitations can result in a puncture or shattered canopy.

GRD TO HYD ELE FUE OXY ENG FLT MISC LND

WARNING

- To avoid injury in the event of a bird strike, helmet visors should be down at all appropriate altitudes.
- A damaged or shattered canopy presents a significant risk of FOD ingestion into one or both engines.

CAUTION

- Canopy movement from the full open or closed and locked position must be initiated by the external or internal locking handle. Actual raising or lowering of the canopy must be done by hand pressure on the canopy frame. Do not apply pressure on the locking handle to raise or lower the canopy as damage to the mechanism may result.
- If possible, avoid opening the canopy when relative wind exceeds 30 knots (ground speed plus wind component over the nose). If canopy must be opened during this condition, use extreme caution to guard against rapid canopy fly-up (secure canopy with left hand while in transit).
- If an open canopy has been exposed to high winds or jet blast, it should be checked for normal operation; i.e., fully closed before taxi. If the canopy will not close, the aircraft should not be taxied or towed until cleared by qualified maintenance personnel. Aircraft movement may result in canopy separation.
- Damage and possible loss of canopy may occur if the hood is bunched between the drogue chute housing and canopy and the seat is raised to the near full-up position.
- If the canopy is closed with the shoulder harness on the drogue chute housing, damage to the seat or canopy may occur.

CANOPY WARNING LIGHT

A canopy warning light, placarded CANOPY (Figure 1-29), operating on DC (bright) or AC (dim), is located on the instrument panel of each cockpit. When either canopy is unlocked, both canopy warning lights illuminate.

CANOPY JETTISON SYSTEM

The canopy jettison system (Figure 1-30) permits jettisoning each canopy individually from inside the cockpit or both canopies from outside the cockpit. From inside the cockpit, the canopy of the respective cockpit may be jettisoned independent of seat ejection by pulling the T-handle on the right subpanel of each cockpit. A safety pin is provided for each canopy jettison T-handle to prevent inadvertent jettison of the canopy. A spring clip on the bottom of the T-handle must be overcome to pull the T-handle out.

To jettison the canopies from outside the cockpit, a canopy jettison D-handle (Figure 1-29) is located externally on each side of the front cockpit, pointed out by the RESCUE decal. Opening either access door and pulling the Dhandle jettisons both canopies. The front canopy jettisons first when the D-handle is pulled, followed 1 second later by jettison of the rear canopy. The canopy jettison system will function properly only with the canopy closed and locked. With the aircraft at rest, the canopy may not separate from the hinges if the canopy is in the fully open position. If the jettison system is activated with the canopy in a position other than fully open, the canopy will move to the full open position and probably separate from the aircraft.

WARNING

If the canopy jettison is activated with the canopy in other than the closed and locked position, the canopy could fall off its hinges and into the cockpit area.

CANOPY BREAKER TOOL

A canopy breaker tool (Figure 1-3 and Figure 1-4) is stowed on the left canopy frame in each cockpit. The tool is used to break the canopy glass if other methods of opening the canopy fail.

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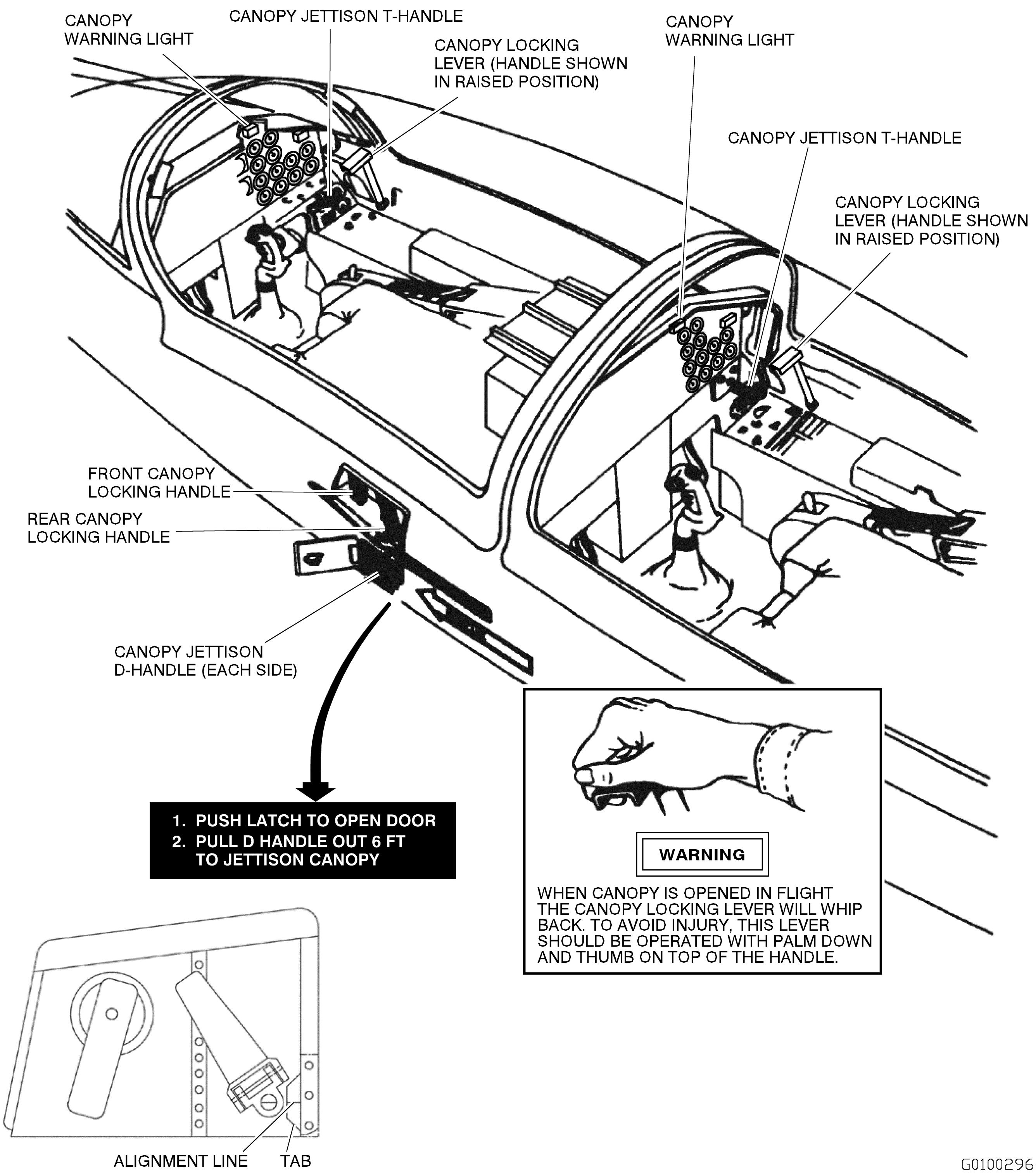

Figure 1-29. Canopy Controls

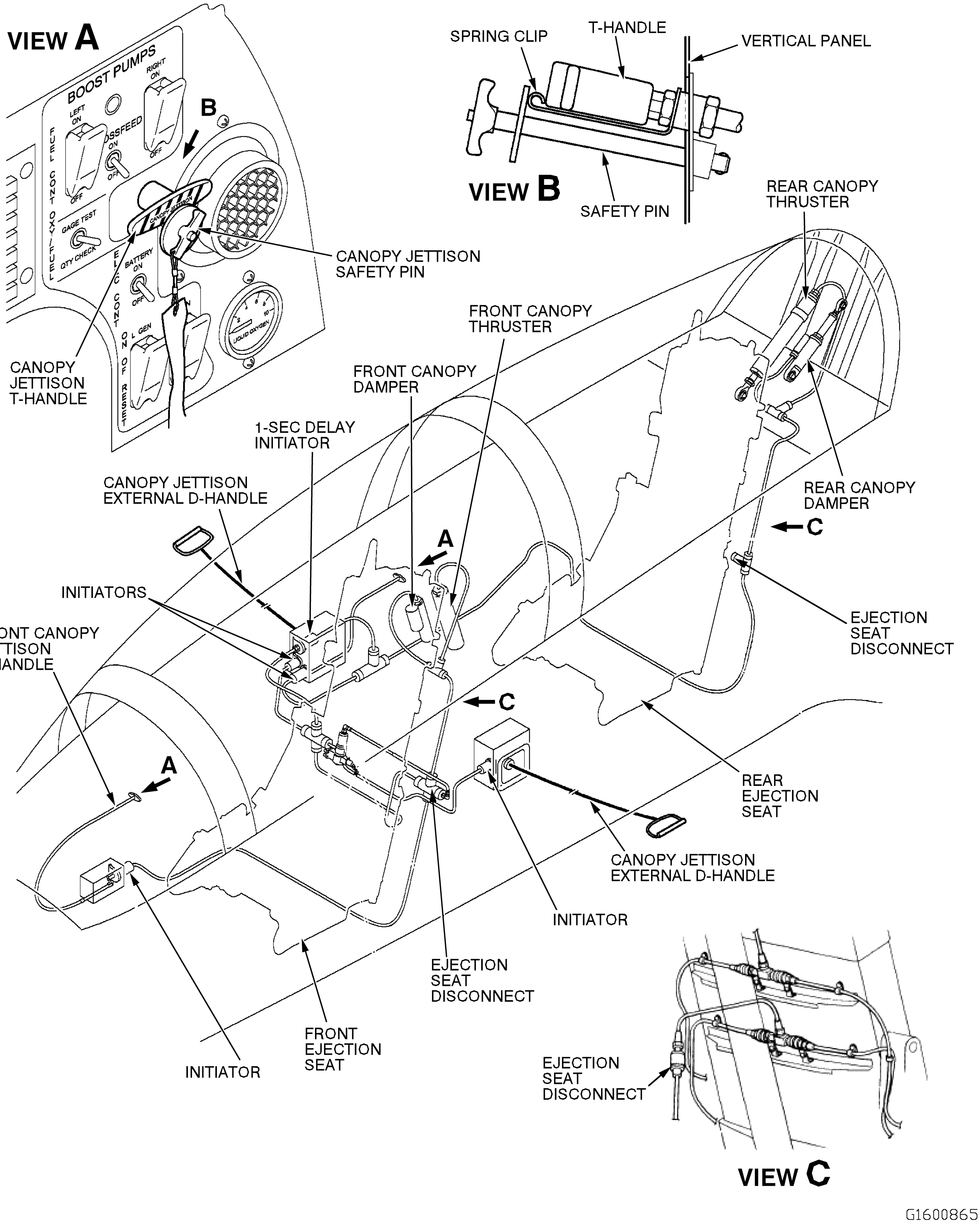

Figure 1-30. Canopy Jettison System

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EJECTION SYSTEM

EJECTION SYSTEM

The ejection system consists of an ejection seat with drogue chute and man-seat separator, an automatic opening safety belt with 0.65-second delay initiator, and an automatic opening parachute with 0.25-second delay initiator or zero delay lanyard parachute with a 1-second delay initiator.

After ejection from the aircraft, the drogue chute deploys to stabilize the seat, the safety belt opens and actuates the man-seat separator forcing the crew member from the seat. An aneroid delays parachute opening until between 15,000 and 11,500 feet pressure altitude when free falling. At or below this block altitude, parachute opening is initiated at 0.25 second (or 1 second) after seat separation. Low altitude capability (below 2000 feet AGL) is provided by the 0.25-second delay initiator or the zero delay lanyard connection. With the zero delay lanyard hooked to the parachute ripcord handle, the ripcord is pulled upon man-seat separation providing immediate parachute deployment. A stowage ring is provided on the parachute harness for the zero delay lanyard when not in use.

Refer to Figure 1-32 for proper connection of the zero delay lanyard and SECTION III for proper use of ejection equipment.

EJECTION SEAT

Each cockpit is equipped with a rocket catapult ejection seat (Figure 1-31). A calf-guard, hinge-mounted to the forward end of each seat, is pulled downward behind the crew member's legs during ejection to prevent the crew member's legs from being thrust backward beneath the seat by wind blast and to assist in man-seat separation. Controls for the ejection sequence are the handgrips. The single motion of raising either or both handgrips fires the powered inertia reel and initiates the ejection sequence. During the first part of seat ejection, initial seat movement simultaneously disconnects the oxygen, anti-G suit, and communication disconnects, pulls the calfguard down, fires the safety belt delay initiator, disconnects the seat adjuster power cable, and initiates drogue gun operation. Each seat is equipped with a canopy piercer and will eject through the canopy if canopy jettison malfunction is experienced. The front seat canopy piercer is attached to the seat and is raised and lowered with the seat. The rear seat canopy piercer is not attached to the seat and will remain in a fixed position when the seat is raised and lowered.

LEGBRACES

Two legbraces (Figure 1-31), terminating in handgrips, are attached to the ejection seat (one on each side) and are linked together mechanically so they rise simultaneously. Initial movement of either handgrip releases the downlock on both legbraces. When actuated, the legbraces are held in the raised position by an uplock and cannot be returned to the down stowed position by the crew member.

EJECTION SEAT SAFETY PIN

The safety pin, when inserted, holds the right legbrace handgrip down, preventing inadvertent seat ejection. The streamer for the ejection seat safety pin is attached to the streamer for the canopy jettison T-handle safety pin.

HANDGRIPS

The handgrips are stowed in the down position when the legbraces are down. When the handgrips are raised fully up and locked, the powered inertia reel retracts and locks and the canopy is jettisoned followed in 0.3 second by seat ejection.

SEAT ADJUSTMENT SWITCH

A seat adjustment switch, on the right leg-brace provides control of seat adjustment through a vertical range of 5 inches. The adjustment switches operate on AC power.

CAUTION

Hard items stored under the seat may puncture the cockpit floor when the seat is loweed resulting in loss of cabin pressurization.

INERTIA REEL LOCK

An inertia reel lock consisting of a powered reel and cable attachment provides mechanical locking and unlocking of the shoulder harness controlled by an inertia reel lock lever located on the left legbrace. When the handgrips are raised, the power reel is actuated causing the shoulder harness to be forcibly retracted and restrained regardless of the inertia reel lock lever position.

SEAT PACK

The seat pack may be used as a seat bucket spacer when a survival kit is not required for mission accomplishment.

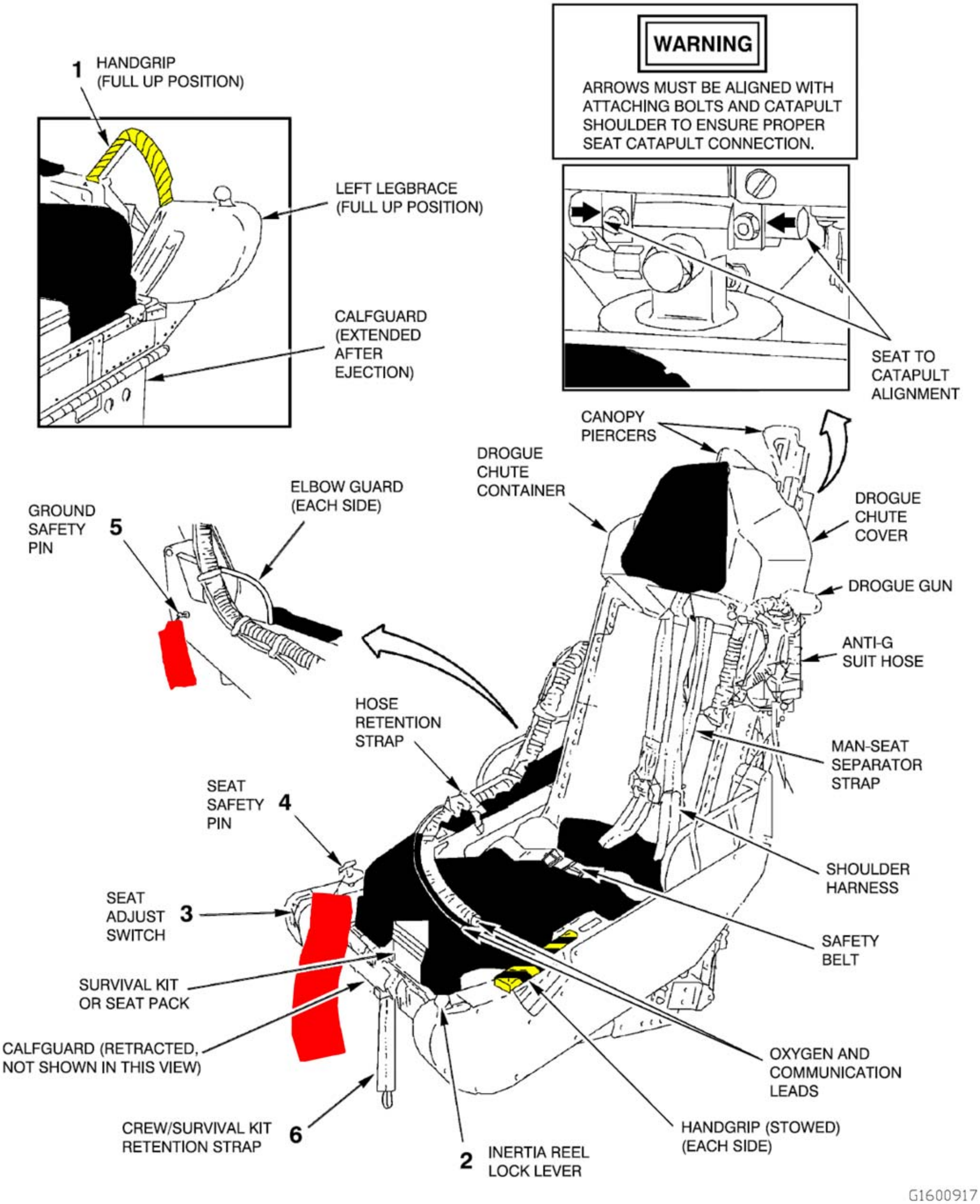

Figure 1-31. Ejection Seat (Sheet 1 of 2)

GRD TO HYD ELE FUE OXY ENG FLT MISC LND

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CONTROLS	FUNCTION	
1 Handgrips (yellow with black diagonal stripes)	Pulling either or both handgrips up to travel limits raises legbraces to the fully up and locked position, retracts and locks the shoulder harness, jettisons the canopy, and initiates seat ejection. The first 12° of travel unlocks both legbraces.	
2 Inertial reel lock lever	Lock	Lock shoulder harness.
	Auto	Unlocks shoulder harness, freeing it to reel in and out, Harness automatically locks during rapid 3-G acceleration and/or during seat ejection.
3 Seat adjust switch	Forward and Hold	Lowers seat electrically.
	Center	Spring-loaded neutral position.
	Aft and Hold	Raises seat electrically.
4 Seat safety pin	Inserted	Holds right legbraces handgrips down. The streamer is attached to the canopy jettison handle safety pin streamer.
5 Ground safety pin	Provides mechanical safing of the safety belt initiator during ground maintenance.	
6 Crew/survival kit retention strap (HBU safety belt only)	Retains crew and survival kit in position during zero and negative G maneuvers.	

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Figure 1-31. Ejection Seat (Sheet 2)

MAN-SEAT SEPARATION SYSTEM

A man-seat separation system forcibly separates the crew member from the ejection seat when the safety belt initiator fires after ejection. On ejection, man-seat separation is aided by full deployment of the drogue chute.

OXYGEN AND COMMUNICATION QUICK-DISCONNECT ASSEMBLY

The oxygen and communication quick-disconnect assembly is secured to the seat to prevent injury during ejection. The oxygen hose retention strap (Figure 1-31) effects positive hose disconnection after man-seat separation. A snap fastener on the retention strap allows individual adjustment of the oxygen hose to obtain freedom of movement without disconnecting the hose.

STRAP IN CONNECTIONS

The following connections are attached by various mechanisms and each should be adjusted and checked for security. See Figure 1-32.

- BA-22/25 Parachute
- CRU-60/P Connector
- PCU-63(V)/P UWARS
- AN/URT-33/-44 PLB
- HBU-12 Safety Belt
- Anti-G Suit Hose

BA-22/25 PARACHUTE AND HARNESS ASSEMBLY

The BA-22/25 is an automatic back-style, high speed parachute that incorporates bail out oxygen and emergency devices that are activated after man seat separation by the zero time lanyard. The harness needs to be checked for proper fit. If the parachute is not properly connected and checked there is a high probability of bodily injury during ejection.

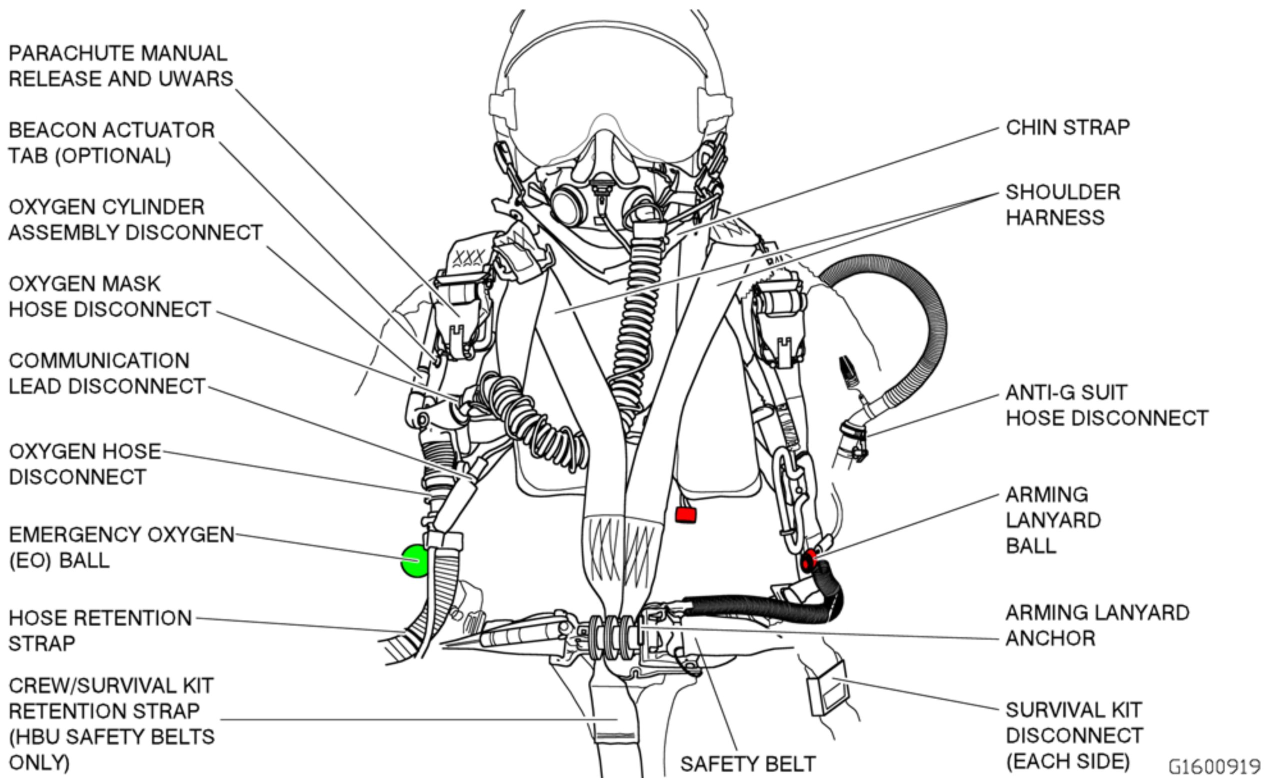
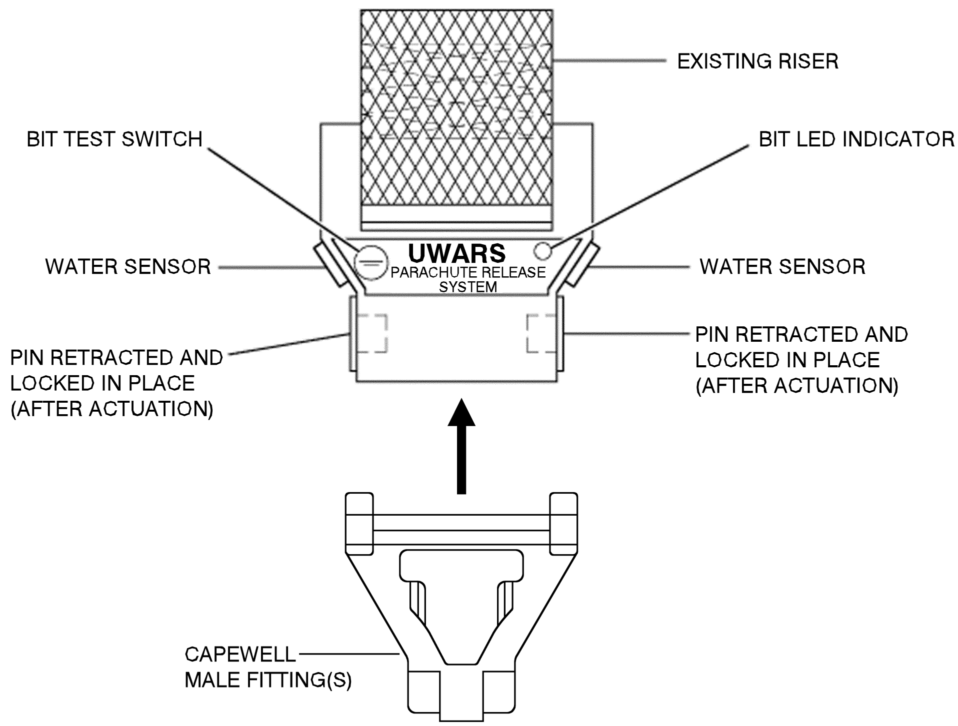


Figure 1-32. Connections (Sheet 1 of 3)

UWARS FITTINGS

USED ON PARACHUTE HARNESS FITTINGS



THE UWARS MAY BE TESTED BY PRESSING THE BIT TEST SWITCH. WITH THE TEST SWITCH DEPRESSED, THE GREEN BIT LED SHOULD FLASH A SINGLE TIME WITHIN 2 SECONDS. IF THE BIT RESULTS IN ANYTHING OTHER THAN A SINGLE FLASH WITHIN 2 SECONDS THE UWARS SHOULD BE REPLACED.

CAUTION

PERFORMING BUIT-IN-TEST (BIT) ON UWARS WHEN AMBIENT AIR TEMPERATURE IS BELOW FREEZING CAN RESULT IN A FALSE BIT FAILURE (LIGHT EMITTING DIODE (LED) FAILS TO FLASH). WHEN TEMPERATURE IS BELOW FREEZING, THE UWARS MUST BE WARMED TO ABOVE FREEZING PRIOR TO PERFORMING BIT.

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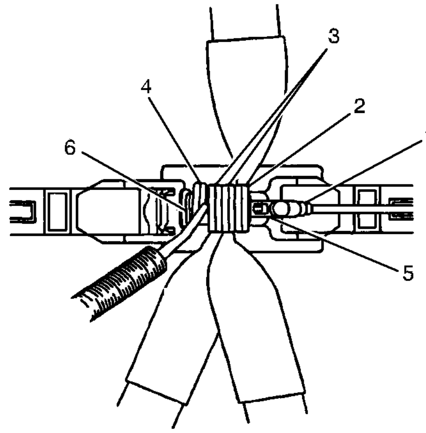
Figure 1-32. Connections (Sheet 2)

AUTOMATIC OPENING SAFETY BELT, HBU-12

LOCKED



VIEWS LOOKING DOWN
AIRCRAFT NOSE TOWARDS TOP

1. AUTOMATIC DISCONNECT LINK AND BELT LINK.
2. CREW/KIT RETENTION STRAP LOOP OVER BELT LINK BEFORE SHOULDER HARNESS LOOPS.

WARNING

FAILURE TO INSTALL CREW/KIT RETENTION STRAP LOOP ON BELT LINK MAY DELAY OR NEGATE MAN/SEAT SEPARATION DURING EJECTION.

3. RIGHT AND LEFT SHOULDER HARNESS LOOPS OVER BELT LINK.
4. ANCHOR (SILVER KEY FROM AUTOMATIC PARACHUTE ARMING LANYARD) OVER BELT LINK.

WARNING

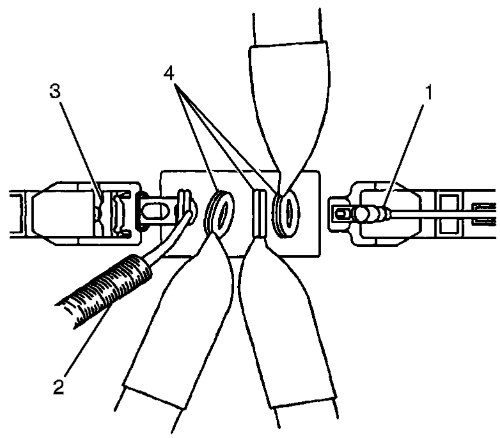
LANYARD MUST BE OUTSIDE PARACHUTE HARNESS AND NOT FOULED ON ANY EQUIPMENT TO PERMIT CLEAN SEPARATION FROM SEAT.

NOTE

ANCHOR MUST BE OVER BELT LINK LAST AND PRESSED INTO THE LATCH BASE IN ORDER TO LOCK THE LATCH.

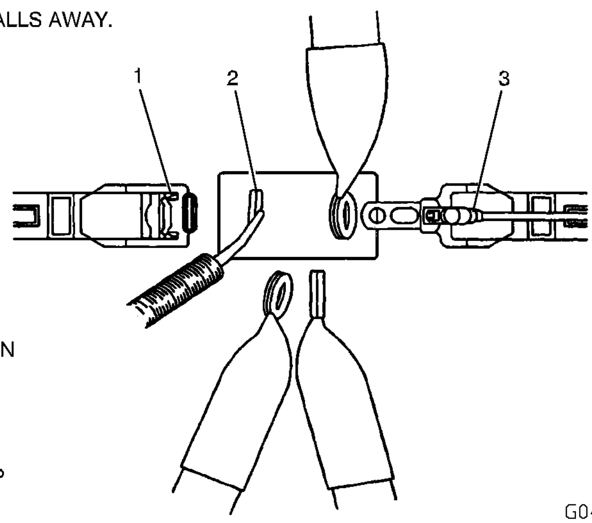
5. BELT LLINK INSERTED IN MANUAL LATCH.
6. MANUAL RELEASE LEVER LOCKED AND CHECKED.

AUTOMATICALLY OPENED



1. AUTOMATIC DISCONNECT LINK RELEASED BY GAS PRESSURE FROM INITIATOR.
2. ANCHOR RETAINED IN LATCH ON LEFT BELT AS SEAT FALLS AWAY.
3. MANUAL RELEASE LEVER DOES NOT OPEN.
4. SHOULDER HARNESS AND CREW/KIT RETENTION STRAP RELEASED FROM BELT LINK.

MANUALLY OPENED



1. OPEN MANUAL RELEASE LEVER.

WARNING

IF THE BELT IS MANUALLY OPENED DURING EJECTION, THE PARACHUTE WILL NOT OPEN AUTOMATICALLY UPON SEPARATION FROM THE SEAT.

2. ANCHOR RELEASED FROM BELT LINK.
3. SHOULDER HARNESS AND CREW/KIT RETENTION STRAP LOOPS RELEASED FROM BELT LINK.

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Figure 1-32. Connections (Sheet 3)

GRD TO HYD ELE FUE OXY ENG FLT MISC LND

CRU-60/P CONNECTOR

The CRU-60/P is essentially a three-way manifold block. It connects to the aircrew member by utilizing a male dovetailed plate that joins into a female receiving bracket that is mounted on the right parachute harness. Upon ejection or emergency egress from the aircraft, disconnection from the aircraft main oxygen supply hose connector takes place at the lower intake port. The oxygen mask delivery tube remains fixed at its distal end and is unable to flail in the wind during ejection. The connector incorporates a valve, which offers resistance to flow during inhalation unless the inlet is properly inserted into the aircraft oxygen delivery hose. This resistance is intended to warn the aircrew member that they are not properly connected to the aircraft oxygen system. When the connection to this system is separated during ejection, the resistance is not experienced as long as oxygen is supplied from the emergency oxygen cylinder assembly. The valve serves a secondary purpose of relieving excess pressure produced by the continuous flow of oxygen from the emergency cylinder assembly, particularly when the flow is not being used. This would be the case when the user exhales. When the source is depleted, the resistance to flow during inhalation returns.

NOTE

- Disconnecting the main oxygen supply hose from the CRU-60/P when emergency oxygen is activated improves breathing capability by providing pressure relief and improves anti-suffocation capability by reducing resistance.
- Avoid inadvertently disconnecting COMM cable when disconnecting main oxygen hose from CRU-60/P.

EMERGENCY OXYGEN CYLINDER

An emergency oxygen cylinder, gauge, and associated plumbing are installed inside the right side of the parachute assembly. An emergency oxygen supply hose is located on the right parachute shoulder harness which connects to the CRU-60/P. The emergency cylinder supplies oxygen for a short period of time, approximately 10 minutes. The system automatically activates when the EO handle (Green Ball) is manually pulled or during ejection.

NOTE

- When the emergency oxygen system is actuated, high-pressure air will make verbal communication with the other crewmember or ATC virtually impossible.
- Once activated, emergency oxygen cannot be shut off and will provide oxygen flow until the cylinder is depleted (approximately 10 minutes).

PCU-63(V)/P UNIVERSAL WATER ACTIVATED RELEASE SYSTEM (UWARS)

The UWARS consists of two parachute harness sensing-release units (Figure 1-32, Sheet 1), one fitted to each parachute riser. The UWARS unit is designed to operate within 2.5 seconds after being immersed in seawater. The UWARS unit will remain inactive when exposed to humidity, rain, and salt spray. The UWARS consists of two independent self-contained activation devices that attach to the parachute risers and the left and right PCU-4/P parachute canopy manual releases. The UWARS is functionally independent from the parachute manual release. It does not affect the operation of the manual release, nor does it depend on the manual release for proper operation.

AN/URT-33/44 PERSONAL LOCATOR BEACON (PLB)

A personnel locator beacon installed in the parachute harness is used in locating crew members who have ejected. The beacon transmits a signal on 243.0 MHz. The beacon will operate automatically upon parachute deployment. An (OPTIONAL) actuator tab is sometimes installed. when the actuator tab is snapped to the stud tab below the canopy release on the right-hand main lift web, the beacon will operate automatically. With the actuator tab unsnapped, the beacon will not operate automatically.

HBU-12 AUTOMATIC-OPENING SAFETY BELT

The HBU-12 safety belt is equipped with a 0.65- second delay which provides automatic belt opening during ejection, thereby reducing seat separation and parachute deployment time. This reduces the altitude required for safe ejection.

The HBU-12/B safety belt has a PUSH-PULL release mechanism that can be actuated by the fingers or palm of either hand. To open the buckle, push the Lock-out Lever to expose the Tongue Unlocking Lever which is then pulled in the opposite direction releasing the tongue of the buckle. The HBU-12/B requires the use of an automatic parachute arming lanyard (Silver Key). Refer to Figure 1-32, Sheet 3 for proper connection and operation of the belt.

WARNING

Failure to properly tighten the safety belt may result in serious injury during ejection and may adversely affect the ability to actuate cockpit controls during zero- or negative-g flight.

ANTI-G SUIT HOSE

The anti-G suite hose is located on the left side of the ejection seat next to the headrest. The hose is held in the stowed position by a flexible spring.

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SEAT SURVIVAL KIT

The seat survival kit (Figure 1-33) is designed to fit in the ejection seat and be used as a seat cushion with a back type parachute. The kit is divided into two sections, an aft section and a forward section. The aft section serves as a support for the back type parachute. The forward section contains a life raft attached to a 20-foot lanyard and a CO2 bottle to inflate the life raft. The survival kit is attached to the crew member's parachute harness by attaching straps on each side of the survival kit.

An emergency release handle is located on the right side of the survival kit forward section. Pulling the emergency release handle during descent after ejection releases and inflates the life raft. Pulling the emergency release handle while seated in the aircraft releases both attaching straps from the survival kit and the crew member will be free of the unopened survival kit.

WARNING

Seats containing a survival kit or a seat pack with a 4-inch thick cushion shall contain a cutout to prevent interference with control stick full aft movement.

AUTOMATIC/MANUAL DEPLOYMENT

The kit will be automatically released during the ejection sequence or retained for normal release, depending upon the selected position of the survival kit AUTO/MANUAL selector before ejection. During parachute deployment, the parachute shroud lines pull the kit auto-release cable. If the AUTO/MANUAL selector is at AUTO, the kit auto-release cable pull will cause an initiator cartridge to fire and after a 4-second delay, the survival kit is automatically released. If the selector is at manual, the cartridge is safetied and the kit must then be released manually by pulling the emergency release handle. When the kit is released, either automatically or manually, the quick-disconnect buckle/web assemblies separate from the kit permitting it to open and fall away from the crew member until the lanyard, attached to the parachute harness, is fully extended. The life raft, if included in the kit, will be automatically deployed and inflated.

EMERGENCY AND NORMAL EGRESS

During emergency ground egress, pulling the emergency release handle will release the survival kit from the parachute harness regardless of the position of the AUTO/MANUAL selector.

NOTE

Pilot's weight must be on survival kit to ensure the kit is bottomed in the ejection seat bucket while pulling the emergency release handle. Otherwise, the lanyard will remain attached to the parachute harness and could cause egress difficulties.

Normal egress should be accomplished by manually disconnecting both quick-disconnect buckle/web strap assemblies from the parachute harness.

NOTE

Binding of the right quick-disconnect buckle/web strap is possible while manually disconnecting from the survival kit.

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GRD TO HYD ELE FUE OXY ENG FLT MISC LND

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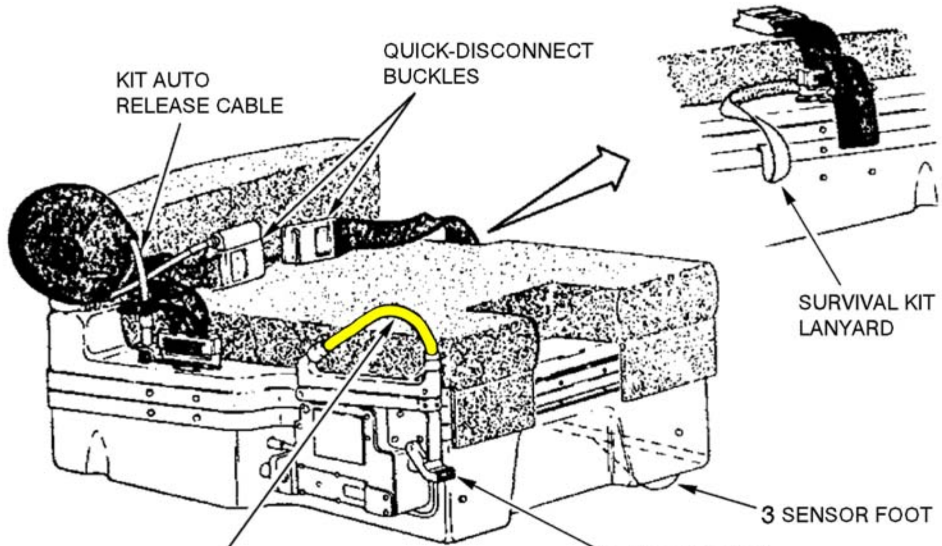

CONTROLS	FUNCTION	
1 EMERGENCY RELEASE HANDLE	PULL	A. AFTER EJECTION, WITH AUTO/MANUAL SELECTOR IN MANUAL, RELEASES KIT. B. WHILE SEATED ON SURVIVAL KIT, REGARDLESS OF THE POSITION OF THE AUTO/MANUAL SELECTOR, RELEASES BOTH QUICK DISCONNECTS FROM KIT.
2 AUTO/MANUAL SELECTOR	AUTO (UP)	PERMITS AUTOMATIC DEPLOYMENT OF SURVIVAL KIT 4 SECONDS AFTER PARACHUTE SHROUD LINES ARE FULLY STRETCHED.
	MANUAL (DOWN)	PERMITS MANUAL DEPLOYMENT OF SURVIVAL KIT WHEN EMERGENCY RELEASE HANDLE IS PULLED.
3 SENSOR FOOT		FOR EMERGENCY GROUND EGRESS, THE KIT HAS TO BE BOTTOMED IN THE SEAT BUCKET, PRESSING THE SENSOR FOOT. FOR THE LANYARD TO RELEASE.

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Figure 1-33. Seat Survival Kit

OXYGEN SYSTEM

OXYGEN SYSTEM

The aircraft uses a liquid oxygen system (Figure 1-34) to supply oxygen to the aircrew. The oxygen regulators (automatic diluter demand) control the flow and pressure of the oxygen and distribute it in the proper proportions to the masks.

OXYGEN REGULATOR PANEL

One of two types of Oxygen Regulator panels on the right console of each cockpit contains an OXYGEN SUPPLY PRESSURE gauge (Figure 5-1), a diluter lever, and a supply lever. The later type regulator differs from the earlier type regulator in that when the supply lever is OFF, the flow of oxygen and cockpit air to the oxygen mask are both cut off. On earlier type regulators, cockpit air only flows to the mask with the supply lever OFF. See Figure 1-34 for the oxygen duration chart.

OXYGEN QUANTITY INDICATOR

An oxygen quantity indicator, operating on AC and located on the right subpanel of each cockpit (Figure 1-7 and Figure 1-8), indicates converter liquid oxygen quantity in liters. The indicator is provided with an OFF flag, which appears in case of electrical power failure.

OXYGEN SUPPLY PRESSURE GAUGES

Refer to OPERATING LIMITATIONS, Section V.

OXYGEN LOW-LEVEL CAUTION LIGHT

An OXYGEN low-level caution light on the Caution Lights Panel (Figure 1-27) in each cockpit illuminates when the oxygen quantity indicator reads 1 liter or less of liquid oxygen. The light can blink, due to oxygen sloshing, if the system contains less than 3 liters.

GRD TO HYD ELE FUE OXY ENG FLT MISC LND

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	COCKPIT ALTITUDE (FEET)	CREWMEMBER DURATION IN HOURS										
ONE CREWMEMBER	40,000 AND ABOVE	56	50	45	39	33	28	22	16	11	5.6	EMERGENCY DESCEND TO ALTITUDE NOT REQUIRING OXYGEN
		56	50	45	39	33	28	22	16	11	5.6	
	35,000	56	50	45	39	33	28	22	16	11	5.6	
		56	50	45	39	33	28	22	16	11	5.6	
	30,000	40	36	32	28	24	20	16	12	8.1	4.0	
		41	37	32	29	25	20	16	12	8.3	4.1	
	25,000	31	28	25	21	18	15	12	9.4	6.2	6.1	
		39	35	31	27	23	19	15	11	7.8	3.9	
	20,000	23	21	19	16	14	11	9.5	7.1	4.7	2.3	
		44	40	35	31	26	22	17	13	8.9	4.4	
	15,000	19	17	15	13	11	9.5	7.6	5.7	3.8	1.9	
		54	48	43	37	32	27	21	16	10	5.4	
	10,000	15	13	12	10	9.2	7.6	6.1	4.6	3.0	1.5	
		54	48	43	37	32	27	21	16	10	5.4	
TWO CREWMEMBERS	40,000 AND ABOVE	28	25	22	19	16	14	11	8.4	5.6	2.8	EMERGENCY DESCEND TO ALTITUDE NOT REQUIRING OXYGEN
		28	25	22	19	16	14	11	8.4	5.6	2.8	
	35,000	28	25	22	19	16	14	11	8.4	5.6	2.8	
		28	25	22	19	16	14	11	8.4	5.6	2.8	
	30,000	20	18	16	14	12	10	8.1	6.1	4.0	2.0	
		20	18	16	14	12	10	8.3	6.2	4.1	2.0	
	25,000	15	14	12	11	9.4	7.8	6.2	4.7	3.1	1.5	
		19	17	15	13	11	9.8	7.8	5.9	3.9	1.9	
	20,000	11	10	9.5	8.3	7.1	5.9	4.7	3.5	2.3	1.1	
		22	20	17	15	13	11	8.9	6.6	4.4	2.2	
	15,000	9.5	8.6	7.6	6.6	5.7	4.7	3.8	2.8	1.9	0.9	
		27	27	21	18	16	13	10	8.1	5.4	2.7	
	10,000	7.6	6.9	6.1	5.3	4.6	3.8	3.0	2.3	1.5	0.7	
		27	24	21	18	16	13	10	8.1	5.4	2.7	
	LIQUID CONTENTS (LITERS)	10	9	8	7	6	5	4	3	2	1	BELOW 1

TOP FIGURES INDICATE DILUTER LEVER 100% OXYGEN

BOTTOM FIGURES INDICATE DILUTER LEVER NORMAL OXYGEN

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Figure 1-34. Oxygen Duration Hours

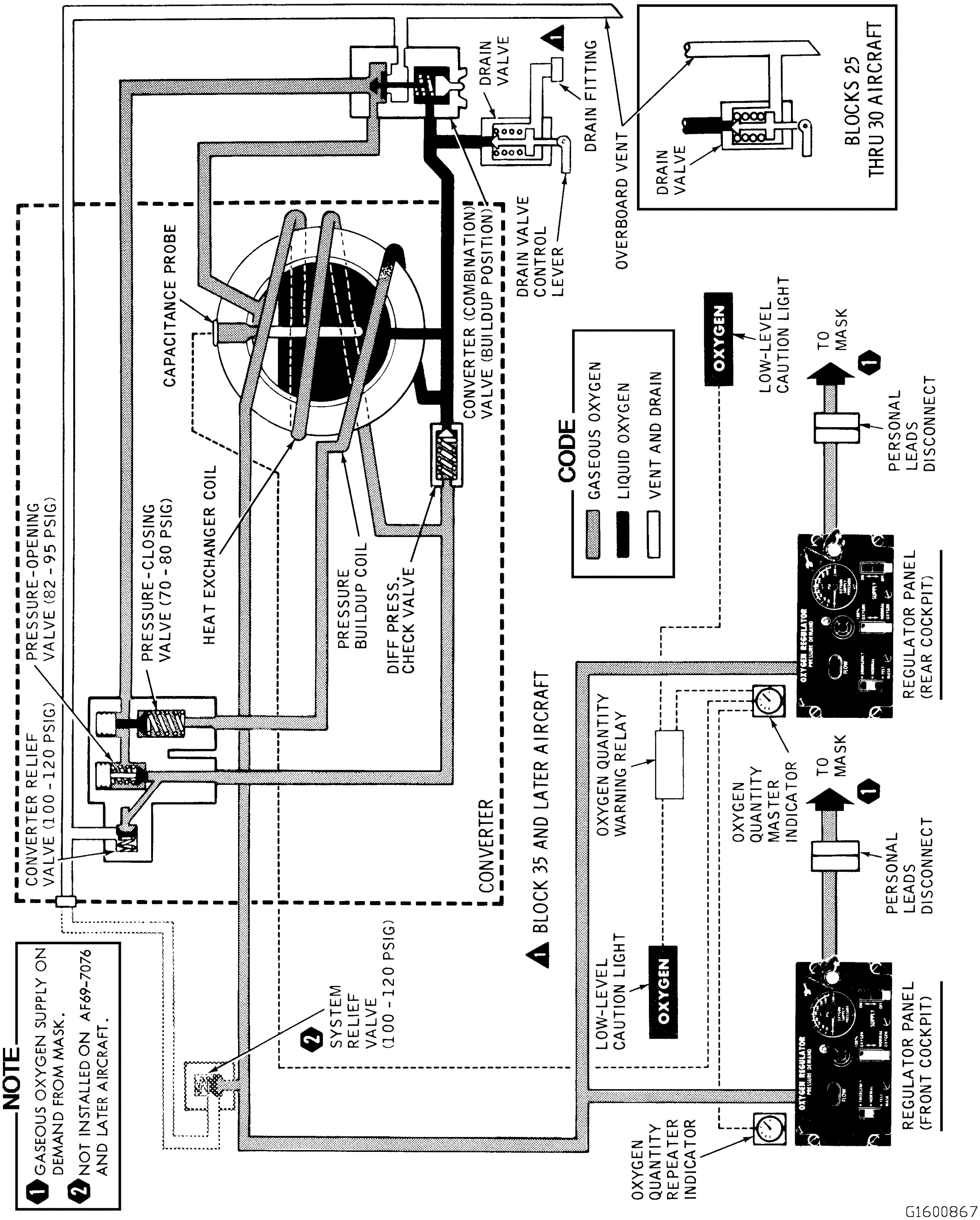

Figure 1-35. Oxygen System

FLIGHT AND NAVIGATIONAL INSTRUMENT SYSTEMS

FLIGHT AND NAVIGATIONAL INSTRUMENT SYSTEMS GENERAL DESCRIPTION

The flight and navigational instruments and instrument systems present flight attitudes, conditions and radio navigation indications for pilot information. This information is presented on instruments located generally in the center of each instrument panel. A partially integrated type flight and navigation system (the flight director system) uses a Horizontal Situation Indicator (HSI) and the Attitude Director Indicator (ADI), which incorporates the turnand- slip indicators. A standby attitude indicator is provided in each cockpit for use in case of a flight director system malfunction or loss of AC power. Flight and navigation instruments are airspeed/Mach indicator, altimeter, vertical velocity indicator, accelerometer, clock and magnetic (standby) compass. The Altitude Incoder Measurement System (AIMS) computed altitude system is installed, which uses an AAU- 19/A servoed altimeter in each cockpit. Except for the magnetic compass, the arrangement and location of the related system flight and navigation instruments are identical in each cockpit.

FLIGHT DIRECTOR SYSTEM

The flight director system consists of an attitude director indicator and horizontal situation indicator (Figure 1-36), a flight director switch (Figure 1-9), a navigation mode switch (Figure 1-7), a steering mode switch (Figure 1-7), a compass switch (Figure 1-7), a directional gyro indicator light (Figure 1-8) and an attitude gyro control assembly. The instrument presentation is always identical in the two cockpits, with mode control in the cockpit selected by the navigation transfer switch. A button for fast erection of the ADI vertical gyro is located on the left subpanel in the front cockpit.

ATTITUDE GYRO CONTROL ASSEMBLY

The attitude gyro control assembly contains two gyros, which perform functions for both the compass system and the attitude director indicator. The combination of attitude (vertical) and directional gyros, mounted in independent gimbals but jointly suspended, provides accurate attitude and heading information in all attitudes continuously.

NOTE

Gyro erection time for both ADI and HSI is approximately 3.5 minutes. Some precession can be expected during or following OVER THE TOP aerobatic maneuvers. Normally, under these circumstances, precession will not exceed 4 degrees in pitch, bank or heading.

FLIGHT DIRECTOR SWITCH

A guarded flight director switch (Figure 1-9) is located on the left console of the front cockpit. Placing the switch to the OFF position removes electrical power from the flight director system. The switch also controls power to the standby attitude indicator.

COMPASS SWITCH AND INDICATOR LIGHT

A compass switch (Figure 1-7) is located on the left subpanel of the front cockpit. When the switch is in the MAG position, the compass card will fast slave to indicate the correct magnetic heading and will remain slaved to magnetic north. In the DIRECT GYRO position, magnetic sensing is no longer available and the heading displayed is based solely on directional gyro stability. Returning the switch from DIRECT GYRO to MAG automatically fast slaves the system. Placing the switch momentarily at FAST SLAVE and returning it to MAG will also provide rapid correction of the system to magnetic north.

NOTE

A 2-minute period should be allowed between FAST SLAVE cycle attempt.

When using FAST SLAVE or returning the system to MAG from DIRECT GYRO or after AC power interruption, the aircraft should remain in level unaccelerated flight for the 30- second FAST SLAVE cycle.

NOTE

It is recommended the aircraft be stationary when the compass system is put into the FAST SLAVE cycle on the ground and the aircraft not be moved until completion of the 30-second FAST SLAVE cycle.

A directional gyro indicator light (Figure 1-8) on the left subpanel of the rear cockpit illuminates when the compass switch is placed at DIRECT GYRO.

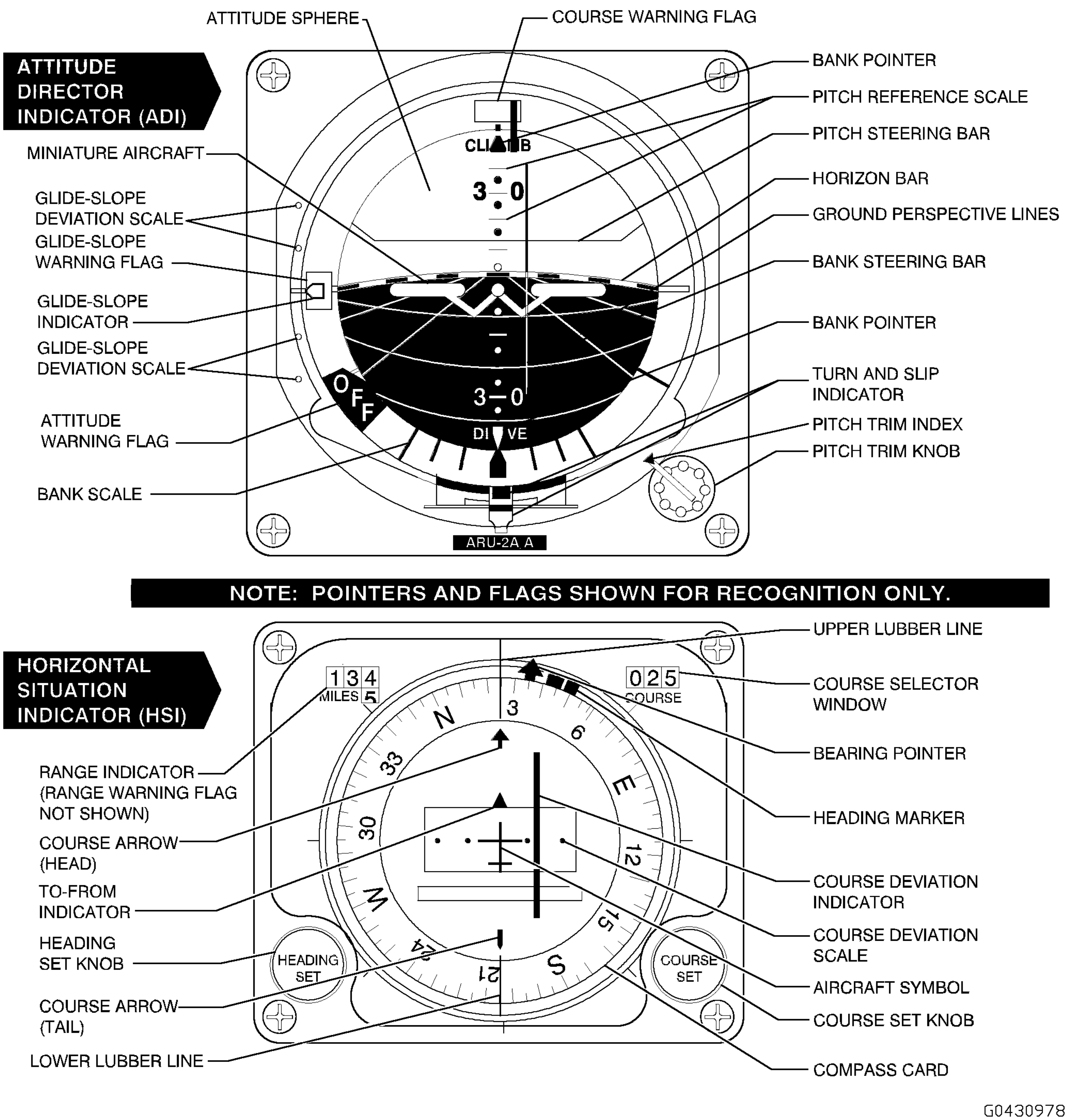

Figure 1-36. Flight Director Display

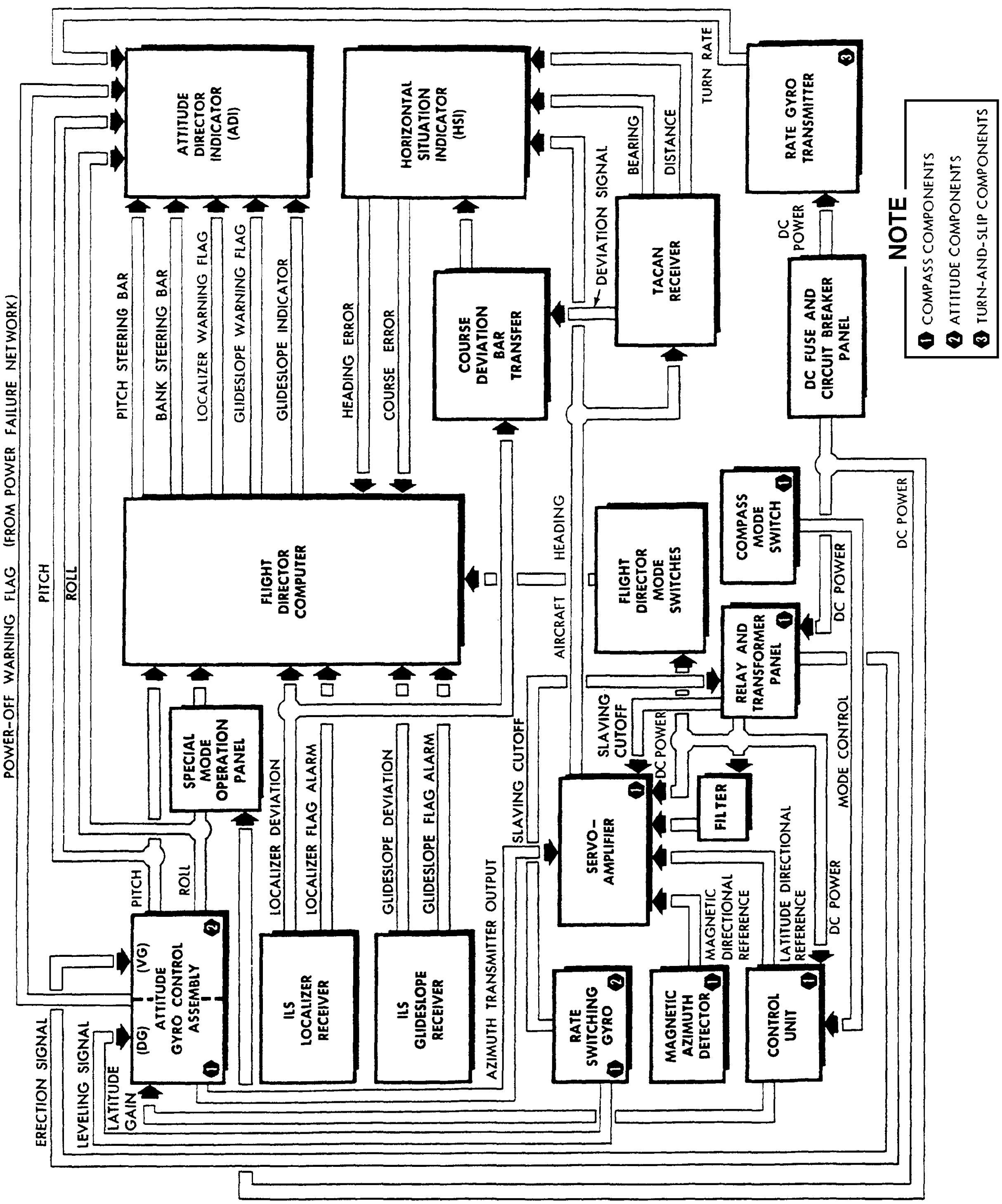

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Figure 1-37. Flight Director System Block Diagram

NAVIGATION MODE SWITCH		TACAN		LOCALIZER		ILS	
STEERING MODE SWITCH		NORMAL	MANUAL	NORMAL	MANUAL	NORMAL	MANUAL
ATTITUDE DIRECTOR INDICATOR (ADI)	BANK STEERING BAR	OUT OF VIEW	COMMAND HEADING AND ROLL	ROLL, COMMAND COURSE AND LOCALIZER DEVIATION	COMMAND HEADING AND ROLL	ROLL, LOCALIZER DEVIATION AND LOCALIZER RATE	COMMAND HEADING AND ROLL
	PITCH STEERING BAR	OUT OF VIEW	OUT OF VIEW	OUT OF VIEW	OUT OF VIEW	PITCH AND GLIDESLOPE DEVIATION	OUT OF VIEW
	GLIDESLOPE INDICATOR	OUT OF VIEW	OUT OF VIEW	GLIDESLOPE DEVIATION	GLIDESLOPE DEVIATION	GLIDESLOPE DEVIATION	GLIDESLOPE DEVIATION
	COURSE WARNING FLAG	OUT OF VIEW	OUT OF VIEW	OUT OF VIEW WHILE LOCALIZER DEVIATION IS RELIABLE	OUT OF VIEW WHILE LOCALIZER DEVIATION IS RELIABLE	OUT OF VIEW WHILE LOCALIZER DEVIATION IS RELIABLE	OUT OF VIEW WHILE LOCALIZER DEVIATION IS RELIABLE
	GLIDESLOPE WARNING FLAG	OUT OF VIEW	OUT OF VIEW	OUT OF VIEW WHILE GLIDESLOPE DEVIATION IS RELIABLE	OUT OF VIEW WHILE GLIDESLOPE DEVIATION IS RELIABLE	OUT OF VIEW WHILE GLIDESLOPE DEVIATION IS RELIABLE	OUT OF VIEW WHILE GLIDESLOPE DEVIATION IS RELIABLE
	ATTITUDE WARNING FLAG	OUT OF VIEW WHILE ATTITUDE INDICATION IS RELIABLE	OUT OF VIEW WHILE ATTITUDE INDICATION IS RELIABLE	OUT OF VIEW WHILE ATTITUDE INDICATION IS RELIABLE	OUT OF VIEW WHILE ATTITUDE INDICATION IS RELIABLE	OUT OF VIEW WHILE ATTITUDE INDICATION IS RELIABLE	OUT OF VIEW WHILE ATTITUDE INDICATION IS RELIABLE
HORIZONTAL SITUATION INDICATOR (HSI)	COURSE ARROW AND COURSE SELECTOR WINDOW	MANUALLY SET TO TACAN COURSE	MANUALLY SET TO TACAN COURSE	MANUALLY SET TO LOCALIZER COURSE	MANUALLY SET TO LOCALIZER COURSE	MANUALLY SET TO LOCALIZER COURSE	MANUALLY SET TO LOCALIZER COURSE
	COURSE DEVIATION INDICATOR	TACAN COURSE DEVIATION	TACAN COURSE DEVIATION	LOCALIZER COURSE DEVIATION	LOCALIZER COURSE DEVIATION	LOCALIZER COURSE DEVIATION	LOCALIZER COURSE DEVIATION
	BEARING POINTER	BEARING TO TACAN STATION	BEARING TO TACAN STATION	BEARING TO TACAN STATION	BEARING TO TACAN STATION	BEARING TO TACAN STATION	BEARING TO TACAN STATION
	RANGE INDICATOR	DISTANCE FROM TACAN STATION (MILES)	DISTANCE FROM TACAN STATION (MILES)	DISTANCE FROM TACAN STATION (MILES)	DISTANCE FROM TACAN STATION (MILES)	DISTANCE FROM TACAN STATION (MILES)	DISTANCE FROM TACAN STATION (MILES)
	TO-FROM INDICATOR	COURSE SET TO OR FROM TACAN STATION	COURSE SET TO OR FROM TACAN STATION	COURSE SET TO OR FROM TACAN STATION	COURSE SET TO OR FROM TACAN STATION	COURSE SET TO OR FROM TACAN STATION	COURSE SET TO OR FROM TACAN STATION
	HEADING MARKER	MANUALLY SET TO COMMAND HEADING	MANUALLY SET TO COMMAND HEADING	MANUALLY SET TO COMMAND HEADING	MANUALLY SET TO COMMAND HEADING	MANUALLY SET TO COMMAND HEADING	MANUALLY SET TO COMMAND HEADING

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Figure 1-38. Flight Director System Operation Chart

GRD TO HYD ELE FUE OXY ENG FLT MISC LND

FAST ERECT BUTTON (ADI GYRO)

A button for rapidly erecting the vertical gyro (Figure 1-7) is located on the left subpanel in the front cockpit. Pressing and holding the push button erects the vertical gyro at a minimum rate of 15 degrees per minute.

NOTE

- Maintain level, unaccelerated flight while actuating the button.
- The attitude warning flag will be visible during actuation of the button.

HORIZONTAL SITUATION INDICATOR (HSI)

An HSI (Figure 1-36) on each instrument panel provides a view of the navigation situation as if the pilot were above the aircraft looking down.

HEADING INFORMATION

When the compass switch is at MAG, the magnetic heading of the aircraft is displayed under the upper lubber line and the reciprocal heading is displayed under the lower lubber line. When the compass switch is in the DIRECT GYRO position, the heading displayed will be a random heading. If DIRECT GYRO is selected with the correct magnetic heading displayed at the time of selection, the heading will probably remain close to the correct magnetic heading, as the gyro has a very slow random drift rate. If DIRECT GYRO is selected when the compass card is not properly slaved to magnetic north, the compass card will be stabilized but will not indicate proper magnetic heading. In this case, the magnetic compass must be used for correct magnetic heading.

HEADING MARKER AND HEADING SET KNOB

The heading marker may be positioned about the compass card by use of the heading set knob. Once positioned, the marker remains fixed relative to the card. Use of the heading marker is discussed under steering mode switch and navigation mode switch.

COURSE ARROW, COURSE SET KNOB, COURSE SELECTOR WINDOW, AND COURSE DEVIATION INDICATOR

The course arrow may be positioned about the compass card by use of the course set knob. The course set knob simultaneously positions the course arrow and course selector window so they will always read the same course. Once positioned, the course arrow remains fixed relative to the compass card. When the course arrow is set, it will remain aligned (parallel) with the radial or localizer course selected, providing the compass card is slaved to magnetic north. The course deviation indicator, which consists of the center section of the course arrow, indicates lateral and angular displacement from the selected TACAN or localizer course. After tuning in a TACAN station and receiving a reliable signal, center the Course Deviation Indicator (CDI) by rotating the course set knob, and check the reading of the course selector window. Rotate the course set knob until the CDI is at the outer dot, and check the course selector window for a change of 10 (±1.5) degrees. Radar, if available, should be used for any suspected HSI malfunction.

BEARING POINTER

The bearing pointer indicates correct magnetic bearing to a selected TACAN station when the compass card is functioning in the MAG mode. If the compass card is not aligned with magnetic north, which is possible when in the DIRECT GYRO mode the bearing pointer will still indicate magnetic bearing to a selected TACAN station. The bearing pointer will not indicate proper relative bearing if the compass card is not slaved to magnetic north. With bearing pointer or compass malfunctions, the CDI may be used to find magnetic headings to a TACAN station by centering the CDI with a TO indication, and flying the course in the course set window, using the standby compass.

WARNING

With bearing pointer or compass malfunction, using the CDI to determine the magnetic course to a TACAN station should be attempted only as a last resort if unable to confirm position by radar.

TO/FROM INDICATOR

The TO/FROM indicator functions only for TACAN. If the course deviation indicator is centered when the TO/FROM reading is taken, it will immediately indicate whether the course selected, if intercepted and flown, will lead TO or FROM the station. A TO indication is presented when the TO/FROM indicator appears on the same side of the instrument as the HEAD of the course arrow and conversely a FROM indication is presented when the indicator appears on the same side of the instrument as the TAIL of the course arrow.

AIRCRAFT SYMBOL

The aircraft symbol is presented at the center of the HSI and is fixed relative to the instrument. Comparison of the aircraft symbol with the compass card, course arrow, course deviation indicator, and heading marker will give a pictorial view of the angular relationship between the aircraft and the selected information.

RANGE INDICATOR

The range indicator reads slant range in nautical miles to the selected TACAN station.

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ATTITUDE DIRECTOR INDICATOR (ADI)

An ADI (Figure 1-7) is located on each instrument panel. For modes of operation of the ADI, refer to the steering mode switch and navigation mode switch discussion in this section.

ATTITUDE SPHERE, PITCH TRIM KNOB, AND MINIATURE AIRCRAFT

The attitude sphere upper half is painted gray and the lower half is black. The gray area represents the sky and the black area, with etched perspective lines, represents the ground. At the junction of the gray and black is the horizon bar. General pitch attitude near level flight may be obtained by referencing the miniature aircraft against the sphere color. Specific pitch attitude may be obtained by referencing the miniature aircraft against the attitude sphere pitch markings. There are dots each 5 degrees of pitch, lines each 10 degrees of pitch, and numbered lines each 30 degrees of pitch. The pitch trim knob allows the attitude sphere to be adjusted to provide the desired pitch presentation relative to the miniature aircraft.

BANK POINTERS

A bank pointer is provided at the top and bottom of the instrument. The top pointer is without scale, but the bottom pointer is provided with a bank scale which is graduated in 10-degree increments up to 30 degrees and in 30-degree increments up to 90 degrees of bank. General bank information may be obtained by noting the angle between the miniature aircraft and numbered pitch lines. When the aircraft is erect, the legends on the attitude sphere will appear right side up.

NOTE

Since two bank pointers are provided, they cannot be used as a SKY POINTER.

ATTITUDE WARNING FLAG

The attitude warning flag (OFF) will appear whenever electrical power to the system has failed or is interrupted. The flag will also appear during initial application of electrical power for approximately 1 minute. The instrument is unreliable until the flag disappears.

WARNING

- There is no warning of attitude sphere malfunctions other than power failure.
- The attitude warning flag will not appear with a slight electrical power reduction or failure of other components within the system. Failure of certain components can result in erroneous or complete loss of pitch and bank presentations without a visible flag. It is imperative the attitude indicator be cross-checked with other flight instruments when under actual or simulated instrument conditions.

TURN AND SLIP INDICATOR

One needle width deflection provides a 2-minute 360-degree turn.

GLIDE-SLOPE INDICATOR AND GLIDE-SLOPE WARNING FLAG

The glide-slope indicator indicates aircraft position relative to an ILS glide-slope. The glide-slope warning flag retracts from view if the glide-slope signal strength is sufficient for satisfactory glide-slope information.

COURSE WARNING FLAG

The course warning flag retracts from view if the localizer signal strength is sufficient for satisfactory localizer information. The course warning flag is at the top of the ADI, but serves as warning for localizer information displayed on the HSI course deviation indicator.

BANK STEERING BAR

The bank steering bar may be used in two ways. First, in the MANUAL mode, if the aircraft is flown in such a manner as to keep the bank steering bar centered, it will cause the aircraft to turn to a heading selected by the heading knob and displayed by the heading marker. Second, in the NORMAL mode, if the aircraft is flown in such a manner as to keep the bank steering bar centered, it will cause the aircraft to turn to and intercept a selected localizer beam in the direction of the approach course. In both of the above cases, the correct amount of bank is maintained during roll-in, turn, and roll-out by keeping the bank steering bar centered.

PITCH STEERING BAR

The pitch steering bar functions only to intercept and maintain a glide-slope. If the aircraft is flown so as to keep the pitch steering bar centered, the aircraft will fly to and maintain a glide-slope. The bar will center when:

a. The pitch angle is correct to return to the glide-slope.

b. The pitch angle is correct for leveling out on the glide-slope.

c. The pitch angle is correct for remaining on the glide-slope.

GRD TO HYD ELE FUE OXY ENG FLT MISC LND

NOTE

Although the course and glide-slope warning flags are positioned on the ADI near the pitch and bank steering bars, they do not warn of pitch and bank steering malfunctions. If the pitch and bank steering bars are being used for an ILS approach, the warning flags must be out of view. The steering bars may malfunction without warning, so the glide-slope indicator and the course deviation indicator must be monitored during an ILS approach to ensure desired aircraft positioning is being obtained using the steering bars.

STEERING MODE SWITCH AND NAVIGATION MODE SWITCH

A steering mode switch and a navigation mode switch (Figure 1-7) are located on each instrument panel. The following discussion assumes that desired navigation facilities are turned on.

STEERING MODE SWITCH

The steering mode switch has two positions, (1) MANUAL and (2) NORMAL. In the MANUAL position, the bank steering bar is displayed on the ADI. If the aircraft is flown in such a manner as to center the bank steering bar, the aircraft will roll in, turn to, roll out, and maintain the heading selected by the heading set knob and displayed by the heading marker. This is the sole function of the MANUAL position and it will operate in this manner regardless of the position of the navigation mode switch. Operation of the system with the switch in the NORMAL position will be discussed under Navigation Mode Switch.

NAVIGATION MODE SWITCH

The navigation mode switch has three positions: (1) TACAN, (2) LOCALIZER, and (3) INSTRUMENT LANDING SYSTEM (ILS). The following discussion of switch selections assumes the steering mode switch is in the NORMAL position.

TACAN SELECTED

When TACAN is selected, the bearing pointer indicates magnetic bearing to the TACAN station. The course arrow and course window, which are set simultaneously with the course set knob, indicate the TACAN course selected. The course deviation indicator indicates the aircraft position relative to the selected TACAN course, and the range indicator indicates range to the TACAN station in nautical miles. The TO/FROM indicator indicates whether the course selected, if intercepted and flown, will lead the aircraft TO or FROM the station. No steering bars are in view.

LOCALIZER SELECTED

When LOCALIZER is selected, the course arrow and course window should be set with the published localizer front course. The course deviation indicator will then show aircraft position relative to the localizer course. If within the area of the glide-slope reception, the glideslope indicator will provide indications of the aircraft position relative to the glide-slope. The bank steering bar will be in view.

ILS SELECTED

When ILS is selected, the operation is the same as in LOCALIZER, except that the bank required to center the bank steering bar is reduced from a maximum of 35 to 15 degrees. The pitch steering bar is in view to provide pitch steering relative to the glide-slope. Crosswind correction is also provided in this mode.

AAU-19/A COUNTER-DRUM-POINTER ALTIMETER

A servo/pneumatic counter-drum-pointer altimeter (AAU-19/A) on the instrument panel in each cockpit (Figure 1-41) consists of a precision pressure altimeter combined with a servomechanism. The altimeter has two modes of operation; primary (servoed) mode and standby (pneumatic) mode. In the primary mode of operation, the altimeter is controlled by signal inputs from the altitude computer. Direct readout of the altitude is accomplished by the numbers on the 10,000-foot counter, 1000-foot counter, and the 100-foot drum on the face of the instrument. A single pointer indicates hundreds of feet around the fixed circular scale. The 100-foot pointer serves as a precise readout of values less than 100 feet. Below an altitude of 10,000 feet, a diagonal warning symbol will appear on the 10,000-foot counter. A barometric pressure set knob is provided to insert the desired altimeter setting in inches of Hg. Rapid rotation of the barometric pressure set knob or use of abnormal force to overcome binding of the knob may cause internal gear disengagement or gear failure, resulting in excessive altitude indication errors in both the primary and standby modes. In case of an electrical power interruption longer than 3 seconds or a system failure in the altimeter or altitude computer, a warning flag placarded STBY (standby) will appear in the upper left portion of the instrument face, indicating the altimeter has automatically reverted to standby mode of operation (pressure altimeter) and uncorrected altitude is displayed. Simultaneously, a DC operated vibration is activated in the altimeter. A function switch, placarded STBY (standby) and RESET, is a spring-loaded self-centering switch used to select the primary or standby mode of operation. To select the primary mode of operation, momentarily place the function switch to RESET after AC electrical power is available. The standby mode of operation may be selected while the altimeter is in the primary mode of operation by momentarily placing the function switch to STBY. Each altimeter can be operated independent of the other in the primary mode or in the standby mode.

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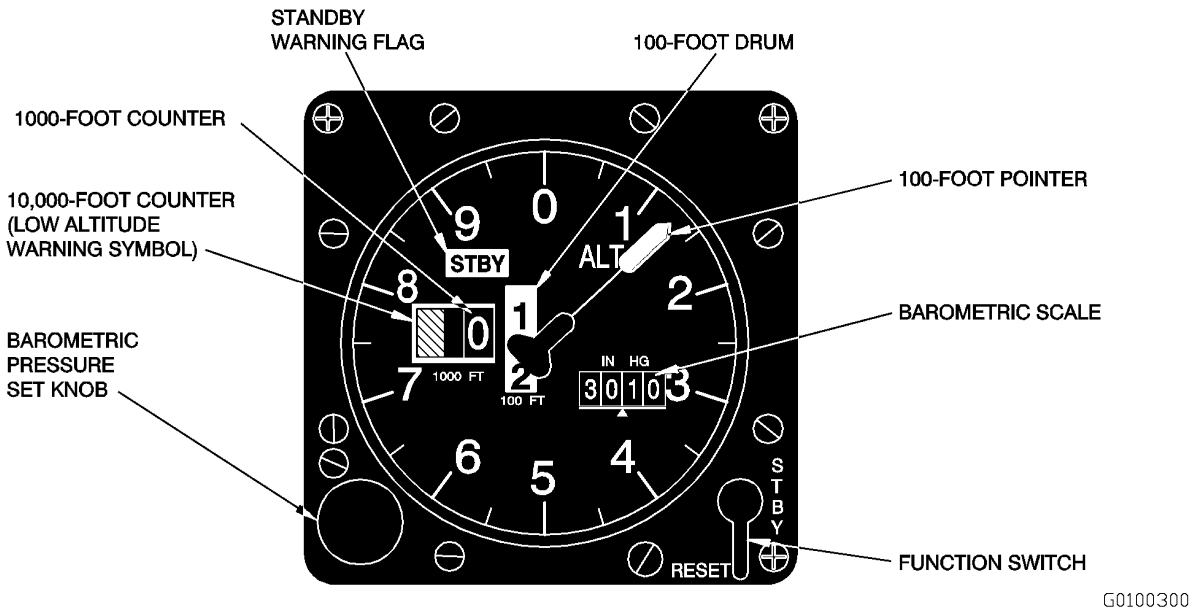

Figure 1-39. Altimeter

PRIMARY (SERVOED) MODE OF OPERATION

In the primary mode of operation, corrected pressure altitude (installation error correction) synchro signals are sent from the altitude computer to the receiver-transmitter and to a servomechanism in the altimeter. These signals are computed only for a barometric pressure of 29.92 inches of Hg. To correct the altimeter indicated altitude for other than 29.92 inches of Hg, set the current altimeter setting in the altimeter barometric scale. When the system is interrogated for altitude reporting (mode C), the receiver-transmitter will automatically report the aircraft altitude to the nearest 100 feet for a barometric pressure of 29.92 inches of Hg, regardless of the setting in the altimeter barometric scale.

STANDBY (PNEUMATIC) MODE OF OPERATION

In the standby mode of operation, the altimeter receives static air pressure directly from the pitot static system and operates in exactly the same manner as the standard pressure altimeter (AAU-7). Altimeter installation error corrections from the appendix must be used to correct the aircraft altitude. Mode C altitude reporting is available if the standby mode of operation has been selected by the crewmember and is not the result of the system automatically reverting to standby operation due to an altitude computer failure. In the standby mode of operation, the vibrator is automatically energized to remove the friction from the counter-drum-pointer mechanism, decreasing the lag in the altimeter indications.

WARNING

If the AAU-19/A altimeter internal vibrator is inoperative, due either to internal failure or DC power failure, the 100-foot pointer may momentarily hang up when passing through 0 (12-o'clock position). If the vibrator has failed, the 100-foot pointer HANGUP can be minimized by tapping the case of the altimeter.

ALTIMETER ERROR CROSS-CHECK

Operational checks of the altimeter should be performed routinely as prescribed in section II and any time a malfunction is suspected. When changing from RESET to STBY to RESET positions, a change in readings will be observed due to the difference between corrected altitude (RESET position) and uncorrected altitude (STBY position). At sea level static conditions, the change may be up to 75 feet. At airspeeds up to 0.9 Mach, below 10,000 feet, the indicated change may be as much as 150 feet and above 10,000 feet, as great as 250 feet. This difference may be observed between the modes of one altimeter or the modes of both front and rear altimeters (front in RESET, rear in STBY, etc.). The allowable difference between the primary mode (RESET) readings of both altimeters is 75 feet during preflight and at all altitudes and airspeeds throughout the operating range.

NOTE

If the difference in indicated altitude between RESET and STBY modes of one altimeter or between altimeters exceeds allowable limits, continue the mission in the STBY mode(s).

ARU-42/A2 STANDBY ATTITUDE INDICATOR

The ARU-42/A2 attitude indicator (Figure 1-40) is self-contained and provides a visual indication of the bank and pitch of the aircraft. The instrument limits are: 92 degrees climb, 78 degrees dive with full 360 degrees roll capability. The pitch trim knob is used to adjust the miniature aircraft and to cage the indicator. Rotating the knob while it adjusts the miniature aircraft. Pulling the knob out to the fully extended position cages (erects) the indicator. With the knob fully extended, rotating the knob fully clockwise locks the indicator in the cage position until released. Approximately 3 minutes are required to erect to true vertical after power is applied to the system. The indicator should be uncaged and set after applying electrical power and left uncaged during flight. It should be caged prior to removing electrical power after the flight. When power is interrupted or the indicator is caged, the OFF warning flag appears on the face of the indicator. It will provide a minimum of 9 minutes of useful attitude information after power failure (accurate to within 6 degrees). Power is supplied by the DC bus.

WARNING

The indicator may precess following sustained acceleration or deceleration periods and may tumble during maneuvering flight near the vertical.

CAUTION

For solo flight, rear cockpit gyro should be uncaged. There is a high risk of damage during flight in the caged and locked condition. Avoid snap releasing the pitch trim knob after uncaging to prevent damage to the indicator.

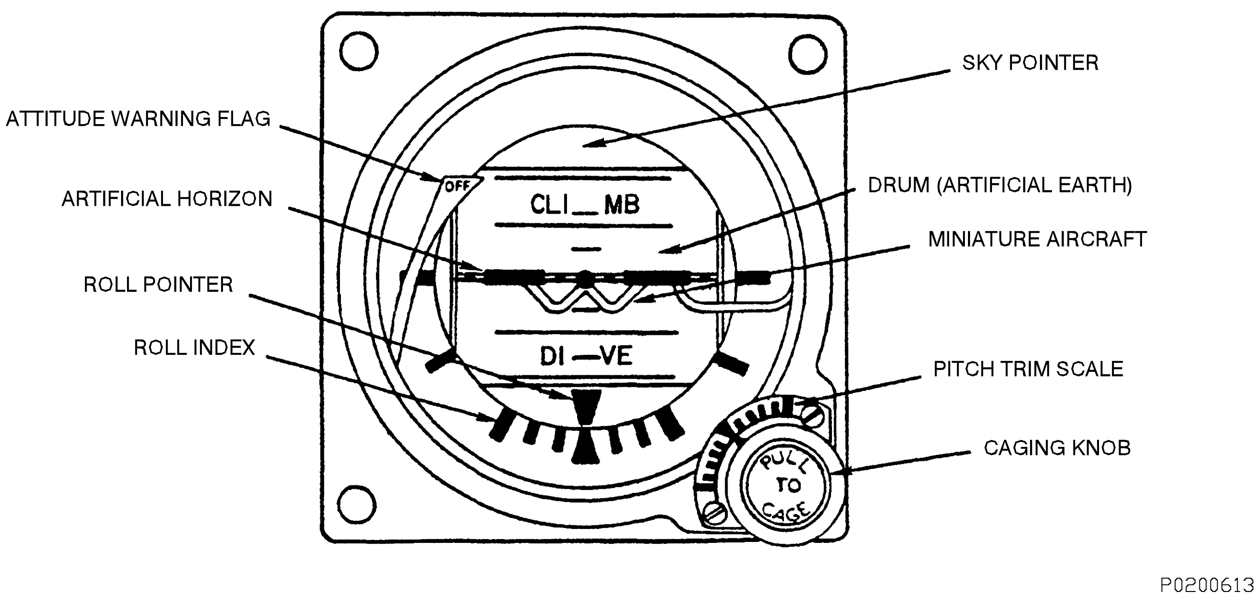

Figure 1-40. Standby Attitude Indicator

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ATTITUDE WARNING FLAG

The attitude warning flag (OFF) will appear whenever electrical power to the system has failed or is interrupted. The flag will also appear during initial application of electrical power for approximately 1 minute. The instrument is unreliable until the flag disappears.

WARNING

- There is no warning of attitude sphere malfunctions other than power failure.
- The attitude warning flag will not appear with a slight electrical power reduction or failure of other components within the system. Failure of certain components can result in erroneous or complete loss of pitch and bank presentations without a visible flag. It is imperative that the attitude indicator be cross-checked with other flight instruments when under actual or simulated instrument conditions.

NOTE

During high G maneuvering, the warning flag may appear without system malfunction.

ACCELEROMETER

The accelerometer (Figure 1-41) indicates loads and stresses imposed on the aircraft during flight in terms of Gravitation (G-units). The Type B-6 accelerometer consists of one main and two auxiliary pointers connected to a mechanically restricted weight, which moves up and down in response to acceleration and deceleration loads. The pointers move over a dial calibrated in Gunits, reading from +1.0 to +10 and from +1.0 to -5.0. The main pointer continuously indicates +1.0 when the aircraft is in level flight. The auxiliary pointers may be reset to +1.0 position by a reset knob on the lower left corner of the instrument. A maximum difference of 0.64G indication is allowed between the front and rear cockpit accelerometers.

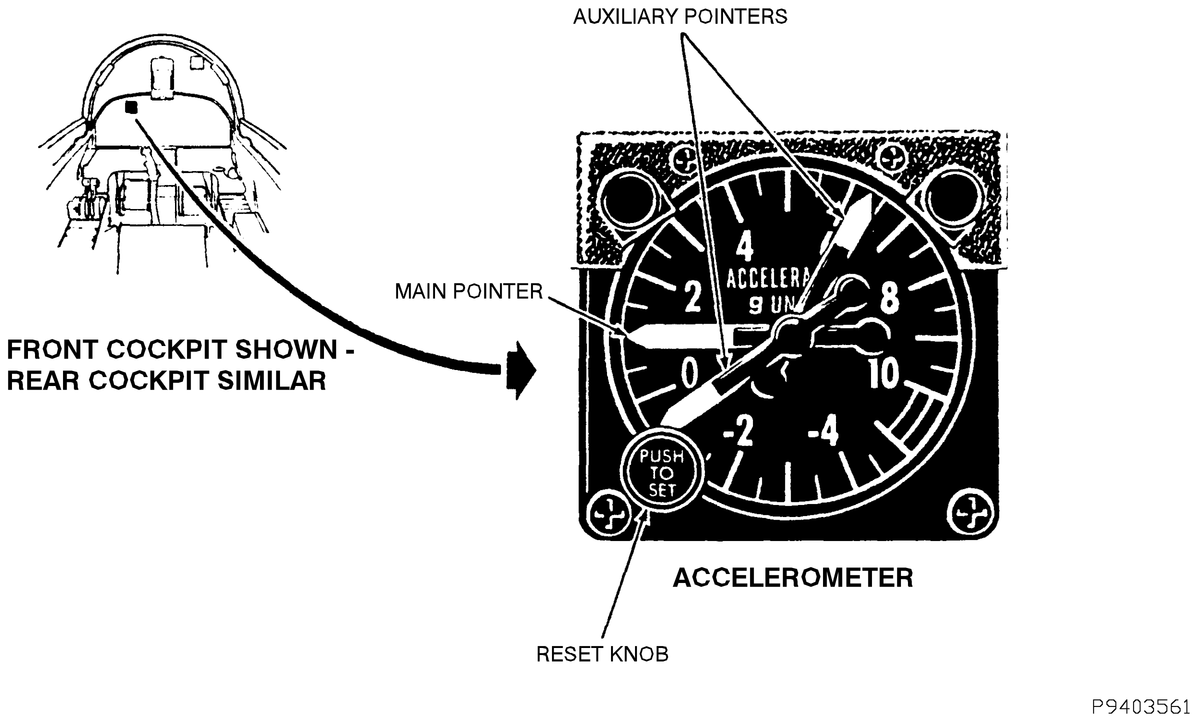

Figure 1-41. Accelerometer

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AIRSPEED/MACH INDICATOR

The airspeed/Mach indicator (Figure 1-42) is a combined instrument used to present Mach number, indicated airspeed and maximum allowable airspeed. Airspeed is indicated on a fixed dial calibrated in knots from 0.8 to 8.5 (X100). Mach number is indicated on a rotating dial calibrated from 0.5 to 2.2 Mach. Airspeed and Mach number are indicated by the airspeed and Mach number pointer mask on the face of the instrument. An index marker at the outer edge of the airspeed dial is set by the knob placarded SET INDEX in the lower right corner. The index marker can be set at any desired point over the operating range of the instrument. The indicator is designed to operate between -1,000 and 80,000-feet altitudes.

VERTICAL VELOCITY INDICATOR (VVI)

The vertical velocity indicator (Figure 1-43), indicates the rate of climb or dive of the aircraft in feet per minute. A single pointer moves over a fixed dial, clockwise for up and counterclockwise for down. Zero indication is at the 9 o'clock position of the dial. The pointer operates through 175 degrees in indicating 0 to 6,000-feet per minute. The top half of the dial is calibrated from 0 to 6,000-feet per minute in a clockwise direction to indicate ascent; the bottom half of the dial is calibrated from 0 to 6,000-feet per minute in a counterclockwise direction to indicate descent.

MAGNETIC (STANDBY) COMPASS

The standby compass (Figure 1-44) is used as an emergency compass if the flight director compass system should fail. The standby compass is mounted on a bracket attached to the front cockpit windshield frame.

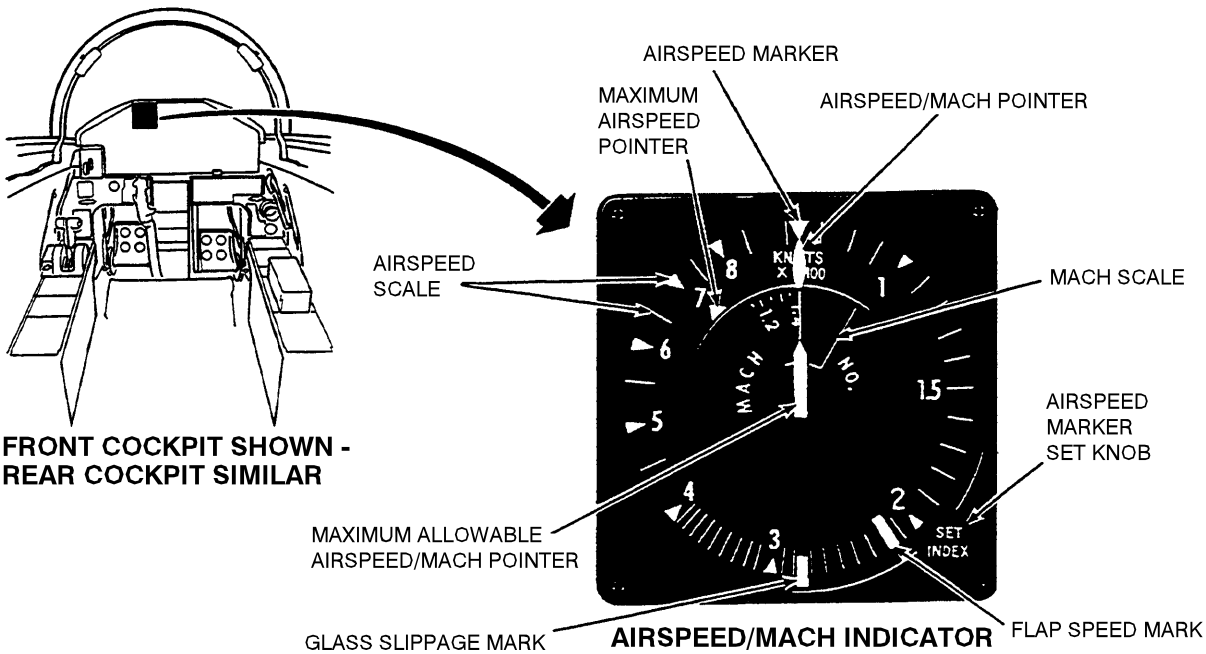

Figure 1-42. Airspeed/Mach Indicator

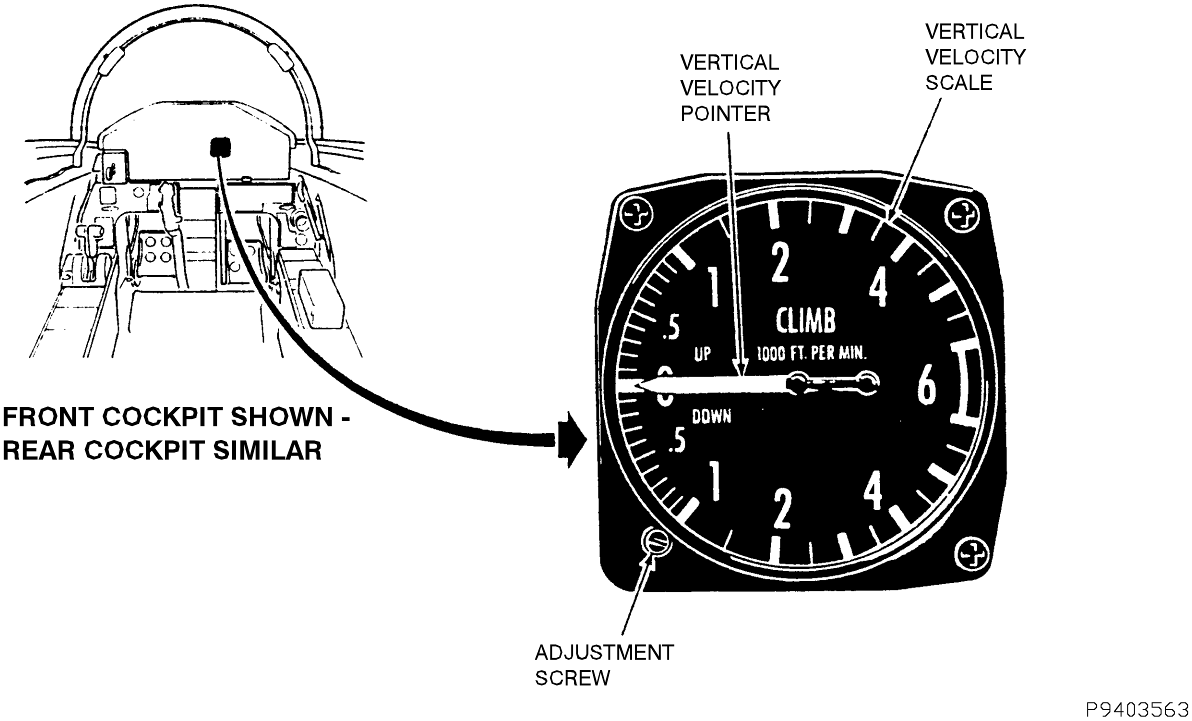

Figure 1-43. Vertical Velocity Indicator

CLOCK

The mechanical clock (Figure 1-45) is an 8-day, stem-wound, stem-set type, incorporating an elapsed time mechanism. The clock is wound by rotating the winding knob on the lower left of the clock case clockwise until the clock is fully wound. The hour and minute hands are set by pulling out the winding knob and rotating the knob right or left until the clock indicates the desired time. The elapsed time mechanism, using a sweep-second hand and minute totalizer pointer rotating over the face of the clock, will indicate total elapsed time up to 60 minutes. Elapsed time is measured in seconds by the sweep-second hand, and the number of revolutions is counted by the minute totalizer pointer up to 60 revolutions (minutes). The elapsed time mechanism is started, stopped, and reset by successively pressing the push button on the upper right of the clock case.

The digital clock (Figure 1-45) indicates the time of day and the elapse time on an aircraft. This clock offers a six-digit liquid crystal display, which indicates the time of day in a 24-hour format. The clock displays hours, minutes and seconds in a digital mode. An analog sweep second indicator on this clock allows the pilot to easily track time by seconds.

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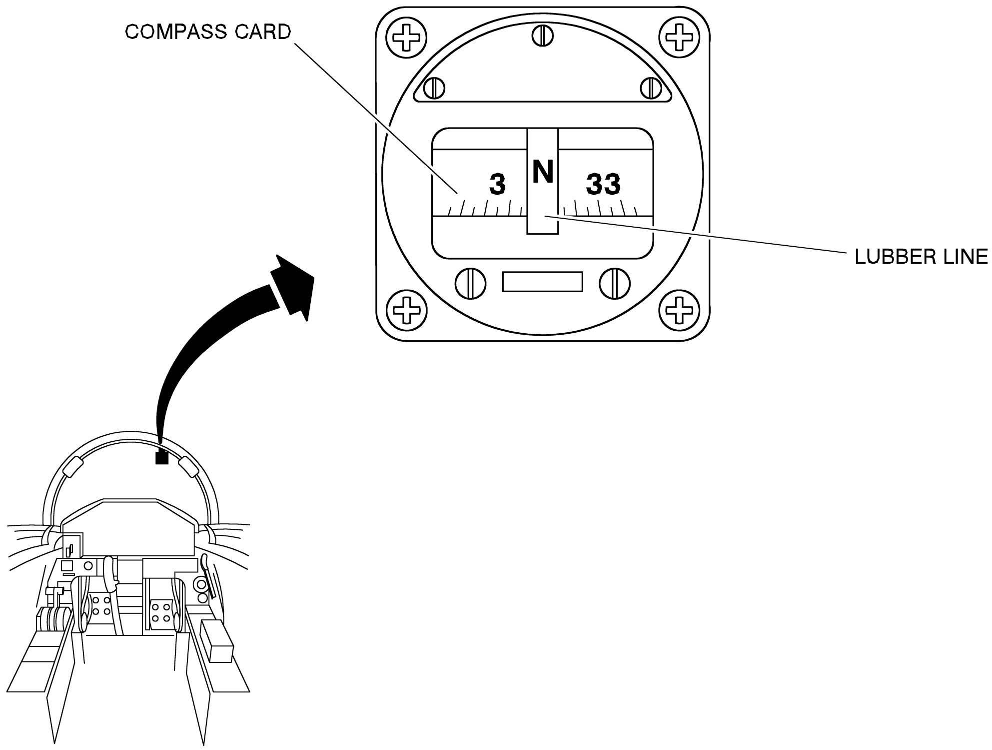

Figure 1-44. Standby Compass

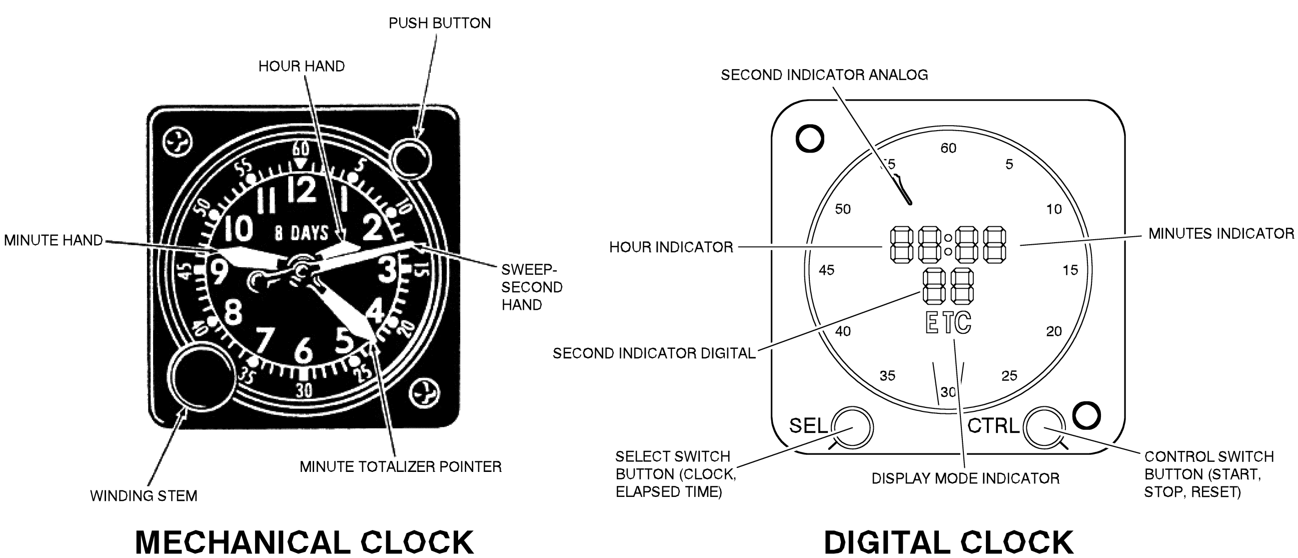

Figure 1-45. Clock

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COMMUNICATION AND NAVIGATIONAL EQUIPMENT

Communication and navigation equipment installed in the aircraft is listed in Figure 1-47. Refer to Figure 1-19 for electrical power requirements to operate the communication and navigation equipment and the associated controls.

COCKPIT CONTROL TRANSFER SYSTEM

The cockpit control transfer system enables the pilot in the front cockpit to transfer control of the navigation and command radio systems from one cockpit to the other and enables the pilot in the rear cockpit to take control of the navigation and command radio systems, overriding the selection made in the front cockpit. Components comprising the system are the command radio transfer switch and the navigation radio transfer switch in the front cockpit, the command and navigation override switch in the rear cockpit, and the radio interconnecting box installed forward of the front cockpit instrument panel. The flight director system relay panel, installed forward of the front cockpit instrument panel, is included in the cockpit control transfer system.

NOTE

> [**DUHF**] For aircraft equipped with (Dual Radio), the UHF command radio control transfer system is inoperable.

COMMAND RADIO AND NAVIGATION TRANSFER SWITCH (FRONT COCKPIT)

A command radio transfer switch and a navigation transfer switch are located on the left subpanel of the front cockpit, placarded RADIO TRANSFER (Figure 1-7). The switches enable the front cockpit crewmember to transfer control of command radio and navigation equipment to either cockpit. The cockpit selected by the command radio transfer switch and the navigation transfer switch has control of the respective system for both cockpits.

COMM ANTENNA SWITCH

The aircraft is equipped with an upper and a lower UHF antenna. An antenna selector switch is located on the left subpanel of the front cockpit, placarded COMM ANTENNA (Figure 1-7). Placing the switch at UPPER or LOWER, permits reception and transmission through the antenna manually selected. The AUTO position now selects the lower antenna.

UHF OVERRIDE

A UHF override switch is installed on the rear cockpit left console. This spring-loaded switch will permit momentary reduction (approximately 50%) in the volume of UHF radio reception without affecting the intercom volume.

DUAL UHF RADIO [DUHF]

(See Figure 1-46) The AN/ARC-164(V) UHF Command Radio replaces the rear cockpit control head. The rear cockpit radio antenna is located in the vertical stabilizer. The front cockpit radio will operate off of the lower antenna. The pilot in the front cockpit can transmit on the rear cockpit UHF Frequency by using the COM XMIT select switch on the COMM/NAV panel. The pilot in the rear cockpit will always receive UHF audios and will not receive the ILS localizer audio tone. Volume of the rear UHF audio in the rear cockpit is controlled through the knob labeled COMM 2. The pilot in the front cockpit will always receive the selected frequency from the front UHF radio and has the ability to receive the selected frequency in the rear UHF radio. Selection is made by using the RECV AUDIO switch on the COMM/NAV panel in the front cockpit. Volume is controlled through the knob labeled ILS/COMM 2. The command override function of the Command and Navigation Override Switch is not functional. The switch is placarded NAV OVERIDE. Power is supplied by 28 VDC through the ARC-164 circuit breaker on the front cockpit circuit breaker panel.

AN/AIC-18 INTERCOM SYSTEM

The AN/AIC-18 intercom system provides communication between the pilots and is the central control for all aural communication and navigation signal reception and transmission. Audio signals are provided to the intercom system from the UHF command and navigation systems, as well as the interphone line and the landing gear warning system. The intercom system also provides control for keying the UHF command transmitter.

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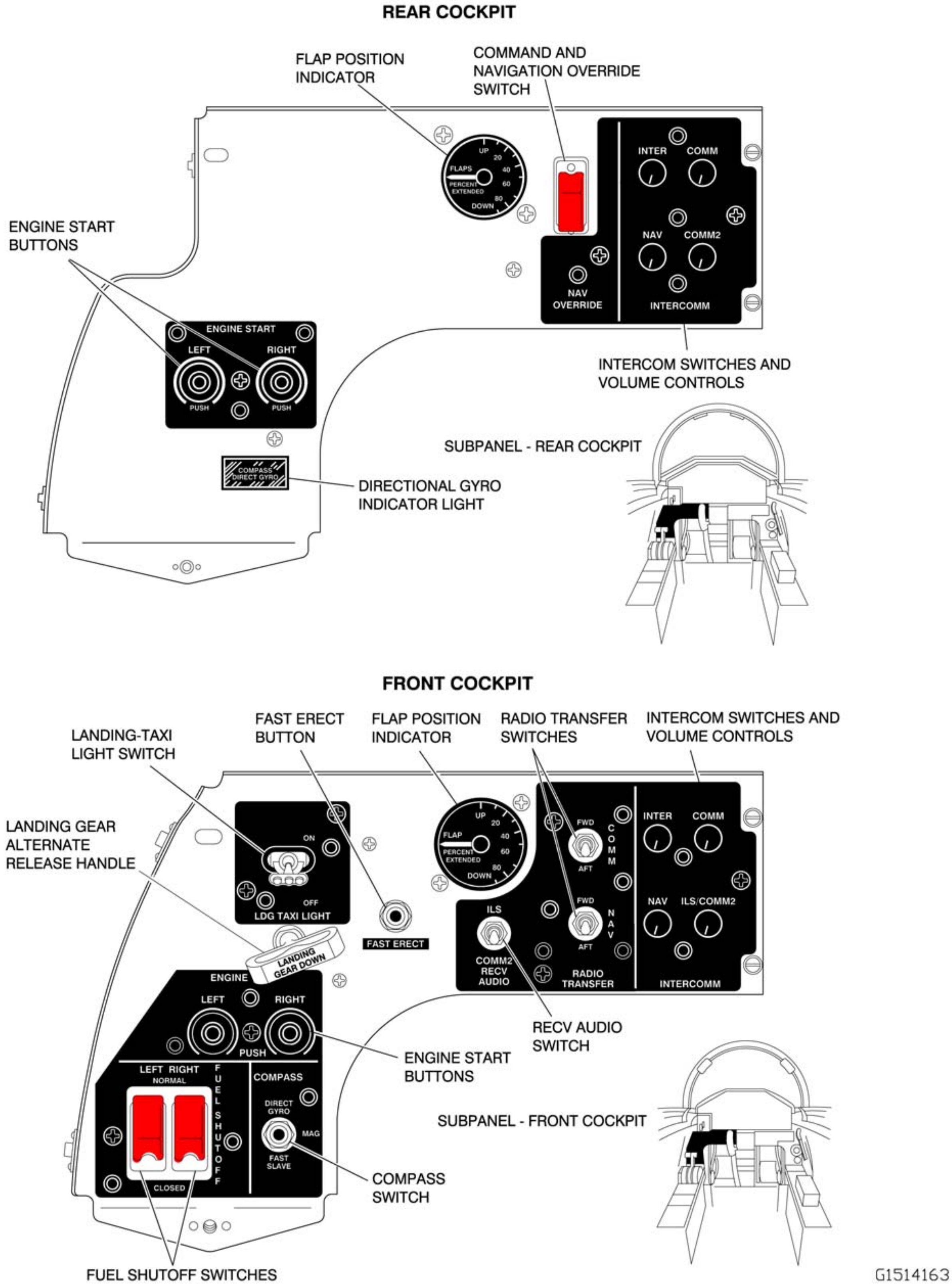

Figure 1-46. Dual UHF Radio Control

TYPE	DESIGNATION	USE	OPERATOR	RANGE	CONTROL LOCATION
INTERPHONE	AN/AIC-18	Crew intercommunication; flight crew and ground personnel intercommunication when aircraft is parked.	Both crewmembers.	Either cockpit and exterior when ground receptacle is used.	Left subpanel - both cockpits.
UHF COMMAND RADIO	AN/ARC-164	Air-to-air and air-to-ground communication.	Both crewmembers.	Line of sight.	Pedestal and left subpanel - both cockpits.
TACAN	AN/ARN-118	Bearing and range information. Reception of coded identification signals.	Both crewmembers.	Line of sight.	Pedestal, left subpanel, and instrument panel - both cockpits.
ILS (LOCALIZER, GLIDE SLOPE, MARKER BEACON)	AN/ARN-147	Reception of marker beacon signals and vertical and horizontal guidance during approach.	Both crewmembers.	Localizer - 85 miles. Glide slope - 35 miles. Marker Beacon - vertical.	Pedestal, left subpanel, and instrument panel - both cockpits.
IFF/SIF	AN/APX-64	Automatic coded replies to ground interrogation for aircraft identification, altitude reporting, and air traffic control.	Front cockpit crewmember.	Line of sight.	Right console, front cockpit.

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Figure 1-47. Comm/Nav Equipment

AN/ARC-164(V) UHF COMMAND RADIO

The AN/ARC-164(V) UHF Command Radio set provides line-of-sight voice and tone transmission and reception. The control panel (Figure 1-48) is located on the pedestal in each cockpit. A four-position function control switch (1) selects OFF, MAIN, BOTH, and ADF (inactive). The MAIN position of the switch permits normal operation on the selected main frequency. The BOTH position permits normal operation on the selected main frequency and simultaneous reception on guard channel. The ADF position is inoperative. A three-position mode control switch (2) selects MANUAL PRESET and GUARD. The MANUAL position of the switch permits selection of any desired frequency within the range of the set to be manually selected by the manual frequency selector knobs (3). PRESET position permits selection of any of the 20 preset frequencies by use of the channel selector knob (4). GUARD position selects the fixed guard frequency (243.0) for the main receiver and transmitter. A button marked TONE (5) is adjacent to the function control switch and is used to provide a Continuous Wave (CW) for homing operations.

The volume control knob (6) is inoperative. A PRESET button (7) is located under the channel frequency card (8). New frequencies are preset by selecting PRESET on the mode control switch, placing the channel selector knob on the desired channel, setting the desired frequency with the manual frequency selector knobs, and depressing the PRESET button under the channel frequency card. The 20 preset frequencies are normally standardized and set by communications personnel. The set is powered by the 28 VDC bus. It can operate on as little as 18 volts and will operate on battery power in the event of electrical failure. In the event of AC electrical failure, the front cockpit radio is in control. The rear cockpit occupant can transmit and receive only as deter-mined by front cockpit control settings.

NOTE

Reception of weak signals may be aided by turning the squelch switch OFF.

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AN/ARN-118(V) TACAN

The TACAN system (Figure 1-49) provides range and bearing navigation information for air-to-air operation with a suitably equipped cooperating aircraft. A suitably equipped cooperating aircraft is defined as an aircraft equipped with TACAN bearing and/or distance transmitting equipment using prearranged 63-channel separation. The AN/ARN-118(V) will act as a distance transmitter but will not transmit bearing information. It reduces 40-degree lockon error and long search cycles. In case of cochannel interference in T/R mode, the interfering identifier is garbled. A warning flag appears when the desired station signal is invalid. When a temporary loss of signal occurs, memories keep range and bearing indications tracking for 15 seconds and 3 seconds respectively until the signal is regained. It automatically self-tests after any temporary signal loss and displays its status on the control head. Operational range is up to 390 NM depending on aircraft altitude. The set requires AC and DC power.

TACAN CONTROLS

Function Selector Switch (3)

a. OFF – Turns TACAN equipment off.

b. REC – Receives only. Indicators display bearing to ground station; no distance is displayed.

c. T/R Indicators display bearing and distance to ground station. This is the normal position.

d. A/A REC – Indicators display bearing to other suitably equipped aircraft. No distance is displayed.

e. A/A T/R – Indicators display bearing and distance to other cooperating suitably equipped aircraft.

Channel Selector Switches (5)

The Channel Selector Switches select TACAN channels 1 through 126.

Channel Mode Selector Switch (4)

The Channel Mode Selector Switch selects either X or Y modes making a total of 252 TACAN channels available.

Volume Control Knob (VOL) (2)

Not operational.

Press-to-Test Button/Test Indicator Light (6 And 7)

TEST – Self-test is initiated by pressing the button. The test indicator light will flash to confirm lamp operation. If the test indicator light illuminates at a subsequent time, a receiver-transmitter fault has been detected. For maximum test capability, allow 2 minutes of operation before initiation. The function selector switch should be set to T/R or A/A T/R for selftest. A test cycle may be terminated at any time by rotating either a channel or mode selector switch. Only receiver-transmitter faults are displayed by the test indicator light.

AN/ARN-147 INSTRUMENT LANDING SYSTEM (ILS)

The ILS provides glideslope, marker beacon and localizer functions during landing operations. The system consists of an ILS receiver, an ILS control panel on the pedestal in each cockpit, a marker beacon light on the instrument panel in each cockpit, a marker beacon antenna, a glideslope antenna and a VHF (localizer) antenna.

ILS CONTROL PANEL

The ILS control panel (Figure 1-6) contains a switch placarded TEST/PWR/OFF, a frequency control knob, a localizer-frequency window and a volume control. Placing the power switch at POWER places the ILS receiver in operation. The power switches on both control panels are connected in parallel. Therefore, the system is turned on from either cockpit and turned off only when the system is turned off in both cockpits. The ARINC 2/5 switching method is used for frequency selection. The frequency is selected by rotating the frequency control knob until the correct localizer frequency appears in the localizer-frequency window. The properly paired glideslope frequency is automatically obtained when the desired localizer frequency is set. Forty odd-tenths MHZ can be set up through the frequency range of 108.1 to 111.9 MHZ. Volume control is not used. Front or rear cockpit control of the ILS depends upon the selection of the navigation radio transfer switch or the command and navigation override switch.

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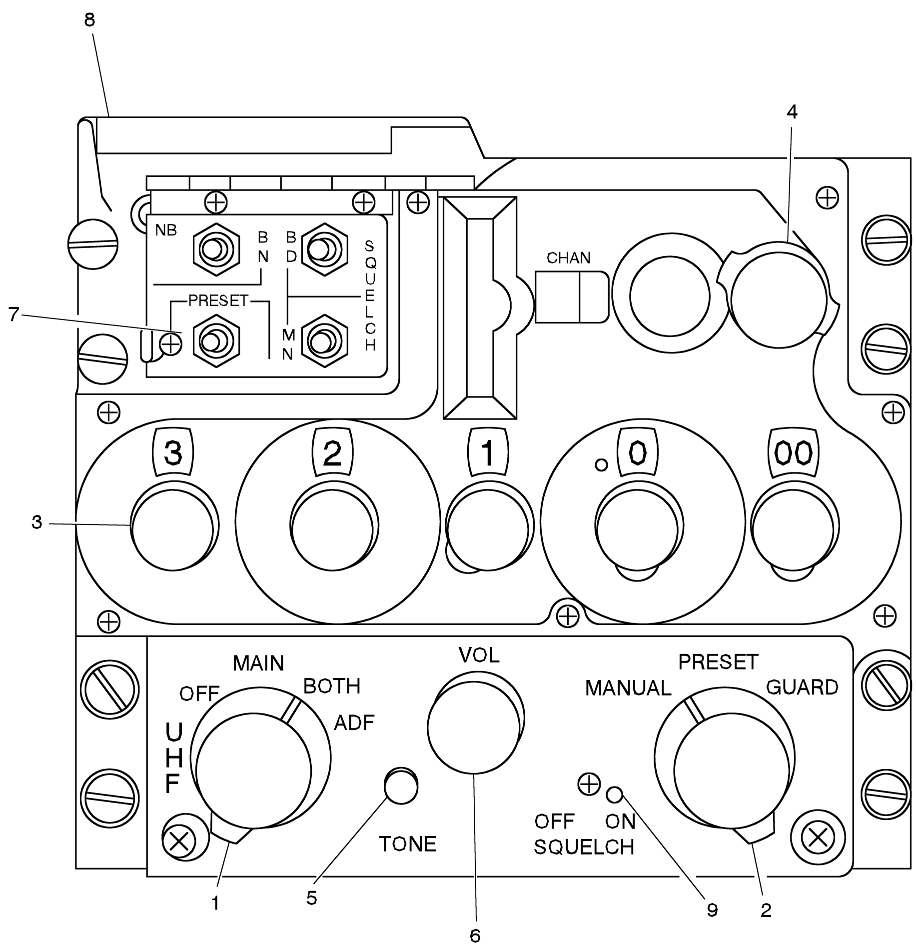

1. FUNCTION CONTROL SWITCH
2. MODE CONTROL SWITCH
3. MANUAL FREQUENCY SELECTOR KNOBS
4. CHANNEL SELECTOR KNOB
5. TONE BUTTON
6. VOLUME CONTROL KNOB
7. PRESET BUTTON
8. CHANNEL FREQUENCY CARD
9. SQUELCH SWITCH

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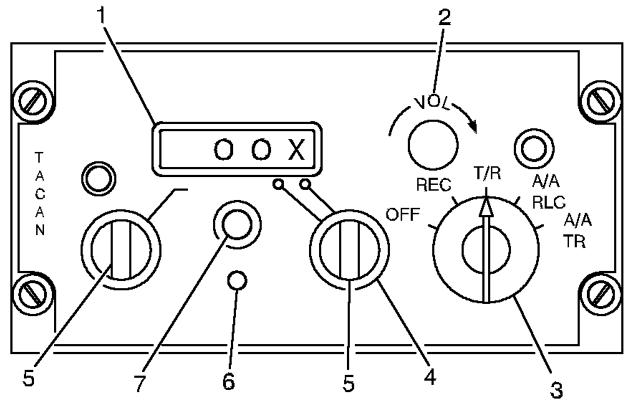
Figure 1-48. UHF Radio Control Panel



1. CHANNEL DIGITAL DISPLAY
2. VOLUME CONTROL KNOB
3. FUNCTION SELECTOR SWITCH
4. CHANNEL MODE SELECTOR SWITCH (X,Y)
5. CHANNEL SELECTOR SWITCHES
6. PRESS-TO-TEST BUTTON
7. TEST INDICATOR LIGHT

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Figure 1-49. TACAN Control Panel

AN/APX-64 ALTITUDE INCODER MEASUREMENT (AIM) SYSTEM

The AIM system provides for Identification Friend or Foe/Selective Identification Feature (IFF/SIF), altitude reporting and a corrected display of the aircraft altitude on an AAU-19/A counter-drum-pointer altimeter. The IFF/SIF function and altitude reporting are accomplished through the receiver-transmitter (AN/APX-64), which enables the aircraft to identify itself automatically and report the aircraft altitude when challenged by surface or airborne radar equipment capable of interrogation. The set can also identify the aircraft in which it is installed as a friendly aircraft within a group of specific friendly aircraft.

The modes of operation have the following significance:

- Mode 1 - Friend Identity
- Mode 2 - Personal Identity
- Mode 3/A - Air Traffic Control
- Mode 4 - Not Used
- Mode C - Altitude Reporting

The receiver is sensitive to all interrogation signals within operating frequency; however, only those signals meeting the complete predetermined requirements of the mode being used will be recognized and answered. Mode 2 code settings are set into the receiver-transmitter on the ground and thus are fixed for any one flight. Mode 1 and 3/A codes are set up at the control panel and all modes can be turned on or off. The corrected altitude function is accomplished by an altitude computer and the counter-drum-pointer altimeters. The altitude computer (CPU-46/A) provides digital altitude information, corrected for static pressure effect, to the receiver-transmitter, and as an electrical input to the counter-drum-pointer altimeters (AAU-19/A). An airborne test set is a component of the system to self-interrogate or monitor the replies to external interrogation. When the test set is not installed, all selfinterrogation and external checks are inoperative. The system is powered by the left AC bus except for the test set and AAU-19/A altimeter vibrator, which are powered by the 28- VDC bus.

AIM SYSTEM CONTROL PANEL

The AIM system control panel (Figure 1-50) is located on the right console of the front cockpit.

MASTER CONTROL KNOB

The master control knob has five positions, placarded OFF, STBY, LOW, NORM, and EMER. When the master control knob is positioned to STBY (standby), the system is inoperative but ready for use after the initial 3-minute warmup period. In the LOW position, the system operates at reduced sensitivity and replies only in the area of strong interrogations. In the NORM (normal) position, the system operates at full sensitivity, which provides maximum performance. To select the EMER (emergency) position, the master control knob must be pulled out and rotated. When

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the knob is positioned at EMER, Modes 1, 2, and 3A are automatically enabled regardless of the position of the mode select switch or code selector wheel. Mode 3 code 7700 is transmitted each time the set is interrogated by ground radar. On some control units, the STBY position has a detent stop; when returning from any selected position to OFF, the master control knob must be pulled out and rotated to return to the OFF position.

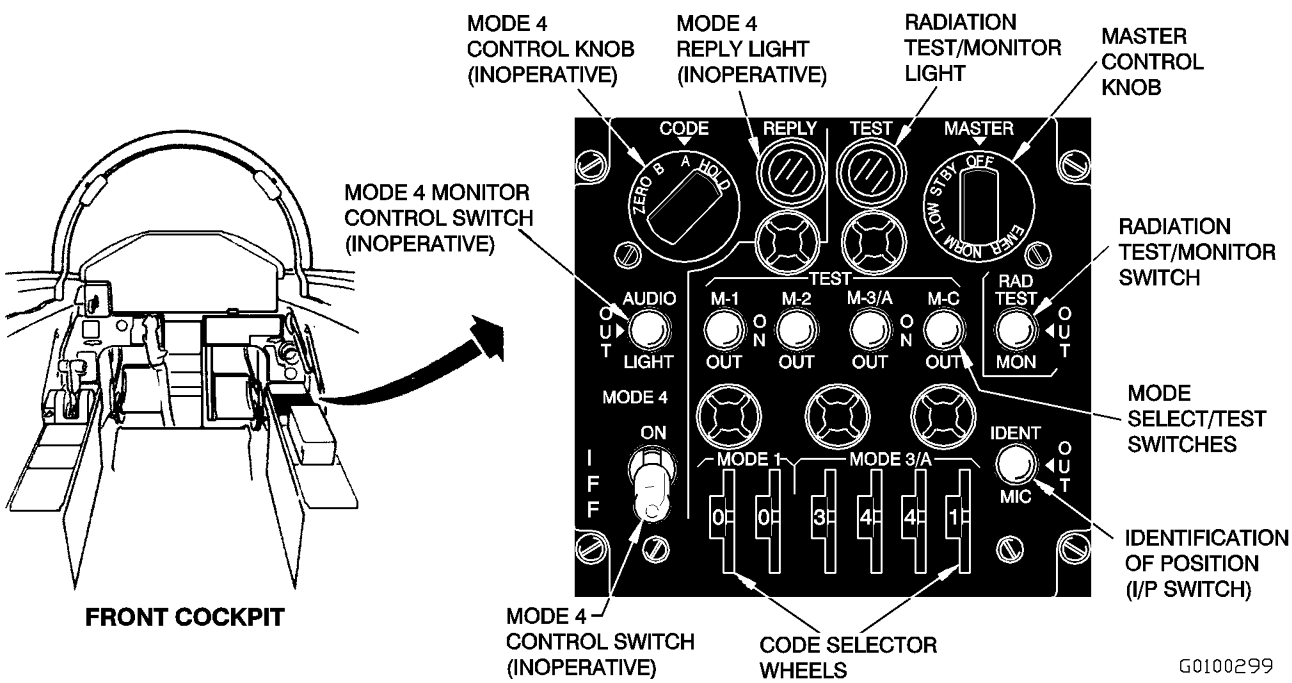

Figure 1-50. AIM System Control Panel

RADIATION TEST/MONITOR SWITCH

The radiation test/monitor switch has three positions, placarded RAD TEST, OUT and MON. The switch is spring-loaded for momentary contact in the RAD TEST (radiation test) position and will return to the OUT position when released. The RAD TEST positions are used by the ground crew to preflight the system. With the switch at the MON (monitor) position, illumination of the TEST light indicates a normal operating condition for the signal response to external interrogations for the mode switches that are ON. With the radiation test/monitor switch in the OUT position, the TEST light will not illuminate in response to external interrogations. The MON position is inoperative when the airborne test set is not installed.

MODE SELECT/TEST SWITCH

Four mode select/test switches are placarded TEST, ON, and OUT. The switches grouped under the TEST heading are labeled M-1, M-2, M-3/A, and M-C. The OUT position for each switch deactivates the mode selected. If more than one switch is placed at ON, the receiver-transmitter will reply to interrogations for all modes selected. With the M-C mode switch at ON, the aircraft altitude is reported in increments of 100 feet referenced to a barometric pressure of 29.92 inches of Hg to an altitude of 80,000 feet when interrogated. The switches are spring-loaded to the ON position from the TEST position. With the radiation test/monitor switch at the OUT position and a mode select switch held in the TEST position, the selected mode can be self- interrogated; illumination of the TEST light indicates a normal operating condition. The TEST function is inoperative when the airborne test set is not installed.

MODE 4 OPERATION

Mode 4 is not used and all controls and lights are inoperable.

CODE SELECTOR WHEELS

Two sets of code selector wheels are provided to set Mode 1 and Mode 3/A. A set of two wheels placarded Mode 1 will select 32 difference codes. A set of four wheels placarded Mode 3/A will select 4096 codes. Each wheel is placarded with digits 0 through 7, which can be seen through the recessed window on the face of the control panel.

IDENTIFICATION OF POSITION (I/P) SWITCH

The Identification of Position (I/P) switch has three positions, placarded IDENT, OUT, and MIC. When the switch

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is momentarily held in the spring-loaded IDENT (identification) position, the I/P timer is energized for approximately 15 to 30 seconds. The receivertransmitter will transmit an identification-ofposition pulse group during the period if a Mode 1, 2, or 3/A interrogation is recognized. When the switch is placed in the MIC (microphone) position, the system will function in an identical manner as it did in the IDENT position except the system will not be activated until the microphone button on the right throttle in either cockpit is pressed. Placing the switch to the OUT position prevents transmission of identification-of-position pulse groups.

MODE 4 OPERATION

Mode 4 is not used and all controls and lights are inoperable.

ANGLE OF ATTACK SYSTEM

AOA SYSTEM OVERVIEW

The Angle-Of-Attack (AOA) system (Figure 1-52) senses aircraft angle-of-attack and displays this information to both crewmembers. The AOA system consists of an AOA vane transmitter, AOA CPU-115/A computer, and in each cockpit, an AOA indicator, AOA indexer, and indexer lights dimmer control. The system provides compensation for various wing flap and landing gear configurations. The AOA system presents the following displays in each cockpit:

a. Optimum AOA for final approach.

b. AOA when buffet and stall will occur.

c. Approximate AOA maximum range and maximum endurance. The vane of the AOA transmitter is located on the forward right side of the fuselage. The vane is electrically heated for anti-ice and is activated when the pitot heat switch is turned on. The AOA computer, which is powered by the left AC bus, receives signals from the AOA vane transmitter, wing flap position synchrotransmitter, and nose gear downlock indicating system. The computer automatically computes and sends the appropriate signals to the AOA indicator and AOA indexer in each cockpit.

AOA VANE ANTI-ICING

The vane of the AOA transmitter is decided by an electric heating element powered by the left AC bus and activated when the pitot heat switch is turned on.

AOA INDICATOR

The ARU-26/A AOA dial indicator on the instrument panel operates during all phases of flight and indicates AOA information. The indicator presents AOA as a percentage of maximum lift AOA. The dial is calibrated in units of 0.1 counterclockwise from 0 to 1.1. Each unit represents approximately 10% of aircraft lift, from 0% at 0 indication to 100% at 1.0 indication. Three preset fixed indices and two colored arcs on the dial indicate the following:

- 0.18 White Index - Maximum Range (1- G flight) Optimized for Flight above 35,000 feet.
- 0.3 White Index - Maximum Endurance (1-G flight)
- 0.6 White Index - Optimum Final Approach at 3-o'clock Position (1-G flight)
- 0.9 to 1.0 Yellow Arc - Buffet Warning
- to 1.1 Red Arc - Stall Warning

NOTE

- The red OFF flag will appear on the face of the dial when electrical power is removed from the AOA system or when the system has failed. The AOA indicator is powered by the left AC bus.
- The airspeed indicator should be cross-checked frequently when using AOA information; some system malfunctions may not necessarily trigger the OFF flag or be repeated in the other cockpit.

AOA INDEXER

The ARU-27/A AOA indexer above the instrument panel is controlled by the AOA computer and provides an illuminated heads-up display of the AOA information in the form of low-speed, on speed, and high-speed indexer lights. (See Figure 1-52). The three indexer lights are powered by the DC bus. The lights are operative in the landing configuration with the wing flaps up or down, or when the landing gear is up and the wing flaps are extended 5% or more. With the landing gear and wing flaps up, the high-speed indexer light is inoperative to eliminate continuous illumination during cruise flight conditions. See Figure 1-51 for allowable On-Speed Band for AOA indexer. AOA system failure is indicated when all three symbols of the indexer are illuminated. The three indexer lights can be tested by placing the warning test switch on the right console at TEST.

AOA INDEXER LIGHTS DIMMER

The AOA indexer lights dimmer control knob to the left of the AOA indicator, controls the light intensity of the three indexer lights from dim to bright.

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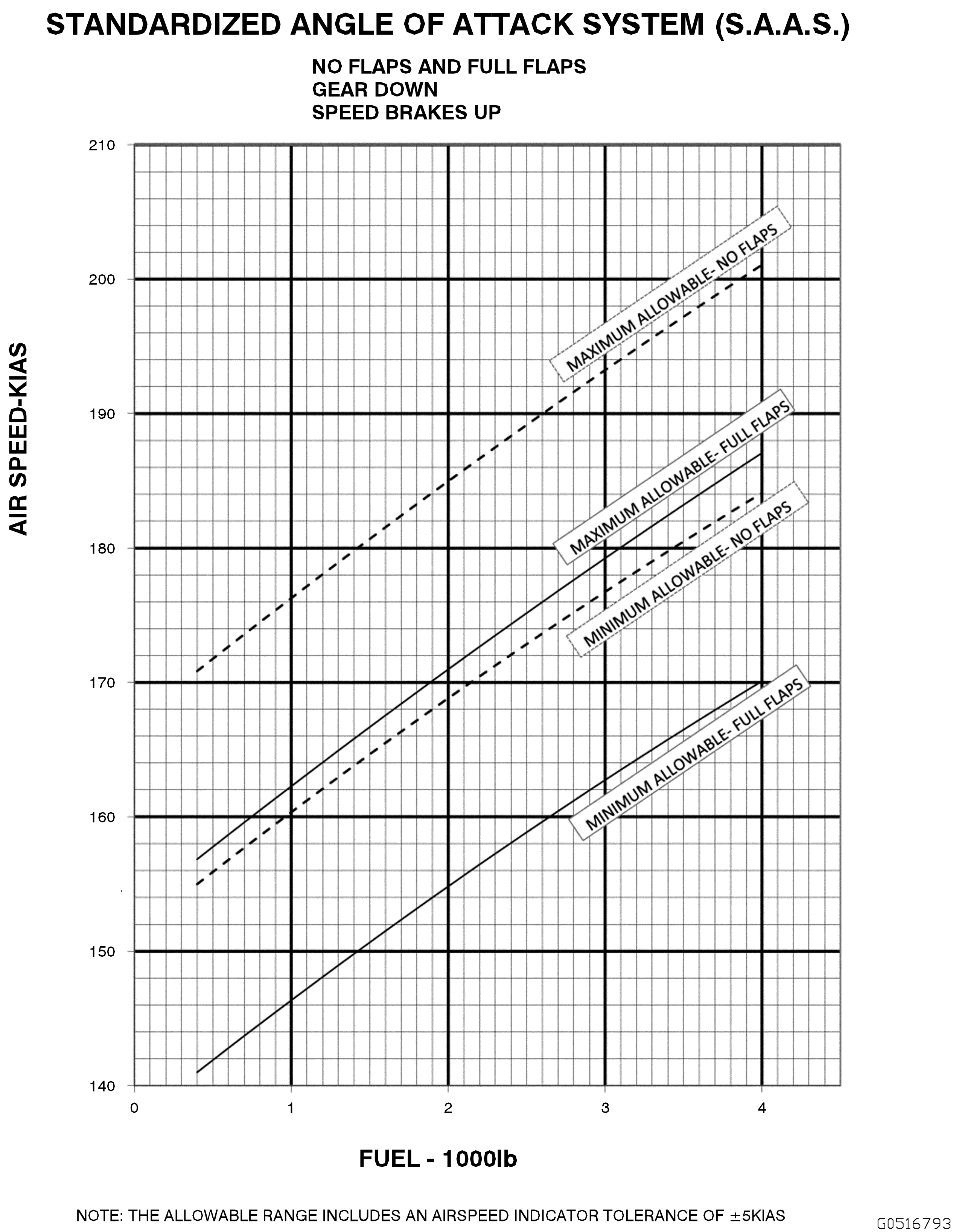

Figure 1-51. Allowable On-Speed Band Chart

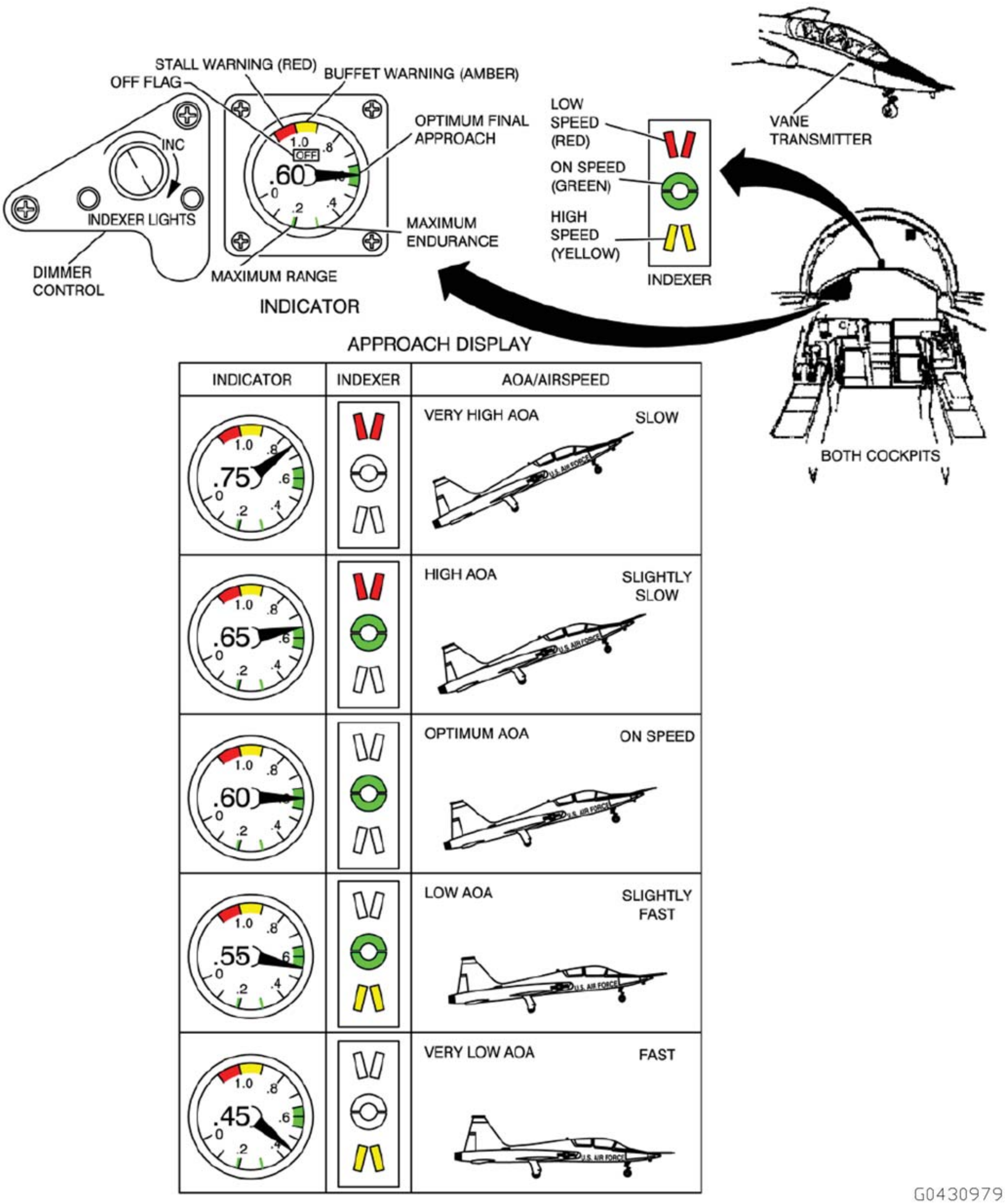

Figure 1-52. AOA System Display

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EXTERNAL STORES AND MISCELLANEOUS EQUIPMENT

WEAPONS SYSTEM SUPPORT POD (WSSP)

Some T-38A aircraft are equipped to carry a WSSP which mounts under the center section of the fuselage. The nose section of the pod is attached to a tray which slides out for loading and, when stowed, is secured in place by a metal overcenter latch type strap on each side. Each latch strap is covered by a streamlined fairing which is secured by a wing nut dzus-type fastener. The pod is approximately 84 inches long, 24 inches wide, and 16 inches deep. The nose and tail sections are faired. Normal load capacity is approximately 140 pounds. Refer to Section V for external stores limitation.

CENTER LINE PYLON

All AT-38B and some T-38A aircraft are fitted with a centerline pylon containing an MA-4 bomb rack. The rack can carry stores weighing up to 1000 pounds with 14 inch suspension. The pylon is bolted to aircraft and is not jettisonable. The pylon can carry either a MXU-648 or ECM pod. All other stores capabilities are nonexistent due to wiring modifications.

MXU-648 AIRCRAFT BAGGAGE/CARGO POD

The MXU-648 baggage/cargo pod, used with the centerline pylon, is a modification of a fire bomb container. Each pod has a hinged access door on the left side. Some pods have a removable tail cone for loading a variety of cargo in size and length. The cargo compartment contains a metal floor and a cargo tie-down system which consists of straps and/or netting secured to permanent hooks installed in the floor. Refer to section V for external stores limitation.

ELECTRONIC COUNTERMEASURES/ELECTRONIC ATTACK (ECM/EA) POD

The ECM/EA Pod, used with the centerline pylon, is a programmable system that generates Radio Frequency (RF) noise, repeater, and transponder jamming signals to replicate known threats or simulate observed and postulated threats for aircrew training and weapon system development. The pod is suspended from the centerline pylon and commanded using a removable control panel located on the left console of the forward cockpit. Refer to Section V for external stores limitation.

ECM/EA CONTROL PANEL

The ECM/EA Control Panel (Figure 1-53) is located on the left console in the forward cockpit and is installed only when the pod is installed on the aircraft. This panel controls the pod's operation using the POWER switch, XMIT switch, and eight push button controls. The POWER switch when in the OFF position removes power from the pod but when the POWER switch is set to either STBY or OPR mode, the pod will either be in standby mode or operational. The BIT button checks the lamps and the basic function of the pod. The brightness of the push button lamps is controlled by the DIM switch.

WARNING

- Potential RF radiation hazards exist to personnel, fuel, and equipment when the ECM pod is operated while on the ground.
- Personnel, fuel, and equipment should be positioned outside the radiation hazard zones prior to operating the ECM pod on the ground.

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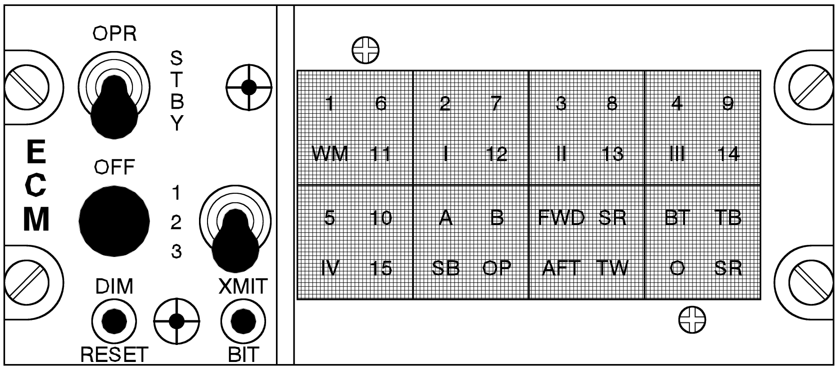

Figure 1-53. ECM/EA Control Panel

MISCELLANEOUS EQUIPMENT

Additional items provided include:

a. Instrument hood

b. Rearview mirrors

c. Map data case

d. Elastic Tie-Down Cords - The optional elastic tie-down cords are to secure the rear cockpit seat packs/survival kit in the seat bucket during solo flights for pilot/ passenger pickup or delivery missions. They are to be attached in a criss-cross fashion by attaching the rear cord hooks to the safety belt attachment clevis pins near the back of the seat bucket on one side and the other hook attached under the opposite forward corner of the seat bucket. See Figure 2-3.

e. Flight Load Data Recorder (FLDR) – Some aircraft have been modified with an FLDR to assist in Aircraft Structural Integrity Program (ASIP) engineering assessments. The system (If Installed) should remain on for all flights. The system is operated by a guarded switch placard RCDR on the fwd cockpit RH subpanel (Figure 1-7). The switch has a NORM and EMER OFF position.

SERVICING DIAGRAM

The aircraft servicing diagram is shown in Figure 1-54.

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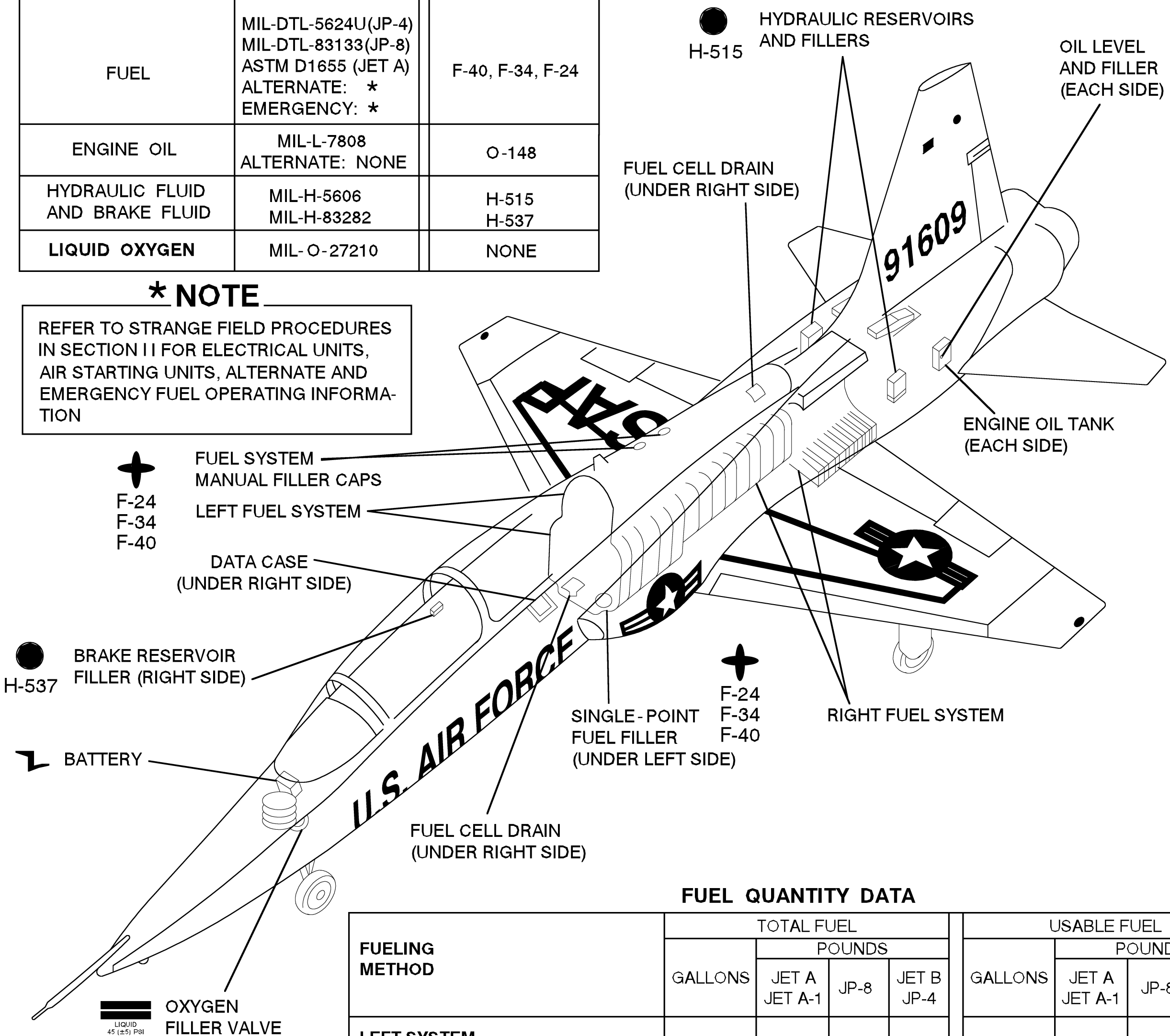
FLUID SPECIFICATIONS

	USAF	NATO SYMBOL
FUEL	MIL-DTL-5624U(JP-4) MIL-DTL-83133(JP-8) ASTM D1655 (JET A) ALTERNATE: * EMERGENCY: *	F-40, F-34, F-24
ENGINE OIL	MIL-L-7808 ALTERNATE: NONE	O-148
HYDRAULIC FLUID AND BRAKE FLUID	MIL-H-5606 MIL-H-83282	H-515 H-537
LIQUID OXYGEN	MIL-O-27210	NONE

*** NOTE**

REFER TO STRANGE FIELD PROCEDURES IN SECTION II FOR ELECTRICAL UNITS, AIR STARTING UNITS, ALTERNATE AND EMERGENCY FUEL OPERATING INFORMATION



FUEL QUANTITY DATA

FUELING METHOD	TOTAL FUEL GALLONS	TOTAL FUEL POUNDS JET A JET A-1	TOTAL FUEL POUNDS JP-8	TOTAL FUEL POUNDS JET B JP-4	USABLE FUEL GALLONS	USABLE FUEL POUNDS JET A JET A-1	USABLE FUEL POUNDS JP-8	USABLE FUEL POUNDS JET B JP-4
LEFT SYSTEM								
SINGLE POINT	293	1992	1963	1875	286	1945	1916	1830
MANUAL	290	1972	1943	1856	283	1924	1896	1811
RIGHT SYSTEM								
SINGLE POINT	305	2074	2044	1952	297	2020	1990	1901
MANUAL	302	2054	2023	1933	294	1999	1970	1882
TOTAL CAPACITY BOTH SYSTEMS								
SINGLE POINT	598	4066	4007	3827	583	3964	3906	3731
MANUAL	592	4026	3966	3789	577	3924	3866	3693

NOTE

CAPACITIES ARE BASED ON STANDARD DAY (15°C/59°F) FOR FUEL DENSITIES OF 6.8 (JET A/JET A-1), 6.7 (JP-8), 6.4 (JET B/JP-4) - POUNDS PER GALLON. REFERENCE TO 42B1-1-14.

A ± 50-POUNDS DIFFERENCE BETWEEN THE FUEL QUANTITY INDICATING SYSTEM AND THE KNOWN FUEL ONBOARD IS PERMITTED.

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Figure 1-54. Servicing Diagram

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SECTION II

NORMAL PROCEDURES

TABLE OF CONTENTS

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PREFLIGHT CHECK

BEFORE EXTERIOR INSPECTION (WITH/WITHOUT EXTERNAL POWER)

For cockpit entry, see Figure 2-1. Items identified with an asterisk (*) shall be checked/confirmed in both cockpits, as applicable.

1. Pylon Safety Pin — INSTALLED and SAFETIED (if Applicable)

2. AFTO Form 781 — CHECK (For aircraft status and proper servicing)

*3. Seat and Canopy Safety Pins — INSTALLED

NOTE

If safety pins other than seat and canopy pins are installed, do not remove until the status of the ejection system has been checked with maintenance personnel.

4. (DUAL) Rear Seat Pack/Survival Kit Elastic Tiedown Cords — REMOVED and STORED (As Required)

5. Seat Pack Tiedown Straps — SECURITY and CONDITION (if applicable) (See Figure 2-3)

*6. Oxygen Hose Retention Strap — CHECK SECURITY(and Adjust)

7. Seat Attach Bolts — CHECK

WARNING

The two attach bolts must be aligned with the arrows and reference line (or shoulder) of catapult head. (See Figure 1-31)

NOTE

Due to lighting conditions, the two bolts and alignment arrows may only be visible with the use of a flashlight or with the seat in the full-down position.

8. Drogue Chute Cover — CHECK (Check that left cover fits closely and conforms to the contour of the drogue chute container. The forward edge of the cover should fit inside or below edge of container. The right cover is fixed in place.)

WARNING

If the drogue chute cover is forced above the edges of the container, the chute is improperly installed and shall be replaced. If the drogue chute cover is not flush with the drogue chute container and if the canopy is lost or jettisoned in flight, wind blast effect could separate the drogue chute cover from the container and cause inadvertent drogue chute deployment. Chute deployment could cause an immediate out-of-control condition.

9. Publications — CHECK (For required navigational publications)

*10. Standby Attitude Indicator — CAGED and LOCKED

11. Fuel and Oxygen Quantity — CHECK

12. Oxygen Pressure — CHECK (if greater than 120 psi refer to OVER-PRESSURE OF OXYGEN SYSTEM (GROUND) Section III)

*13. Wing Flap Lever — MATCH FLAP POSITION

14. Landing Gear Lever — LG DOWN (Physically check full down)

15. Radio Transfer Switches — FWD

16. Pitot Heat — OFF

17. FLDR Power Switch — NORM (If Installed)

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CAUTION

CANOPY SHOULD NOT BE OPENED IF PRESENT OR FORECAST WINDS ARE ABOVE 30-KNOTS, AS CANOPY SEPARATION OR SYSTEM DAMAGE MAY OCCUR.

CAUTION

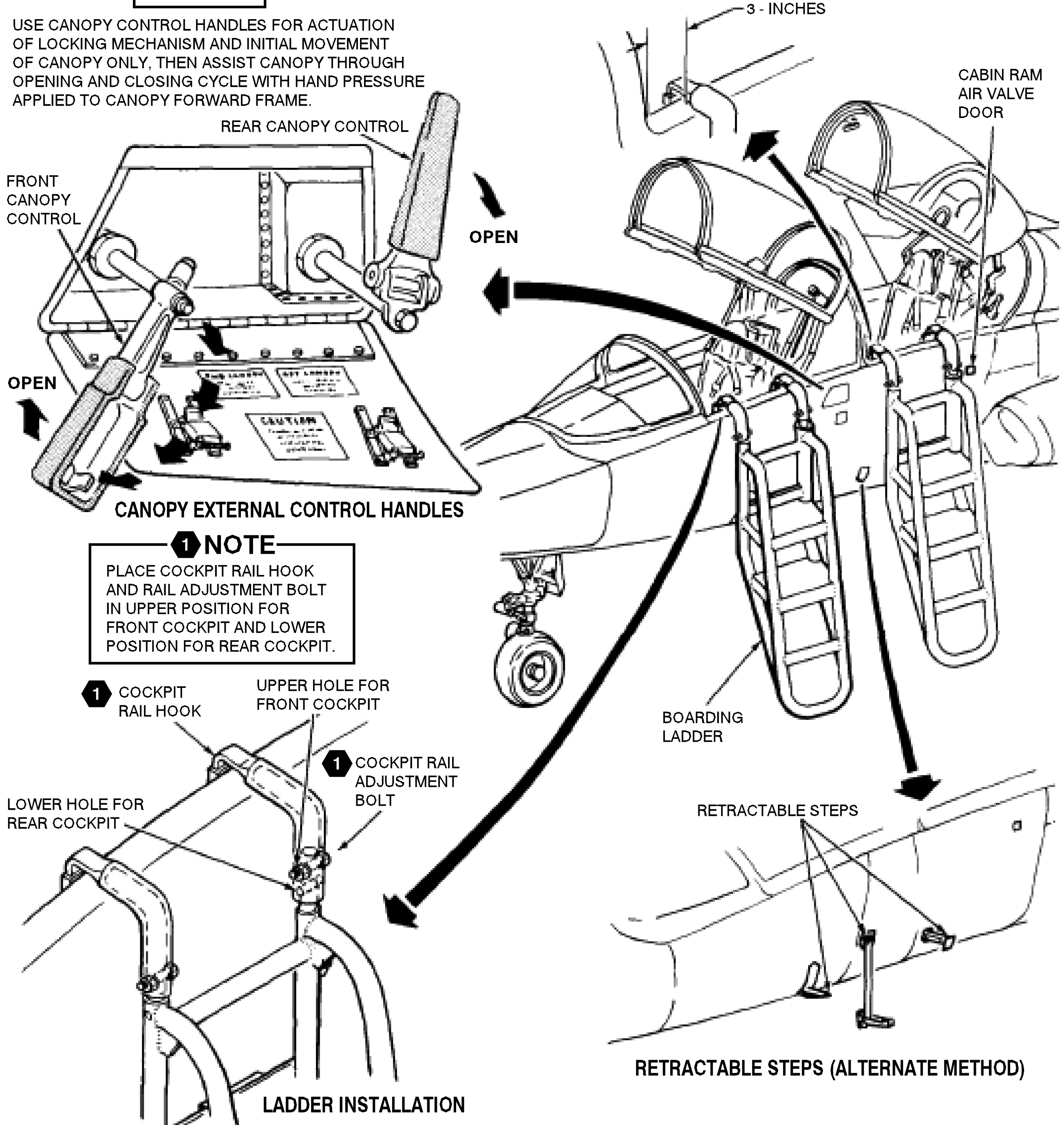
USE CANOPY CONTROL HANDLES FOR ACTUATION OF LOCKING MECHANISM AND INITIAL MOVEMENT OF CANOPY ONLY, THEN ASSIST CANOPY THROUGH OPENING AND CLOSING CYCLE WITH HAND PRESSURE APPLIED TO CANOPY FORWARD FRAME.

CAUTION

POSITION LADDER APPROXIMATELY 3-INCHES AFT OF REAR COCKPIT WINDSHIELD TO CLEAR CABIN RAM AIR VALVE DOOR.

CAUTION

MAKE SURE BLIND FLYING HOOD AND SHOULDER HARNESS ARE CLEAR OF THE DROGUE CHUTE COMPARTMENT PRIOR TO OPENING OR CLOSING THE REAR CANOPY.



1 NOTE

PLACE COCKPIT RAIL HOOK AND RAIL ADJUSTMENT BOLT IN UPPER POSITION FOR FRONT COCKPIT AND LOWER POSITION FOR REAR COCKPIT.

Figure 2-1. Cockpit Access

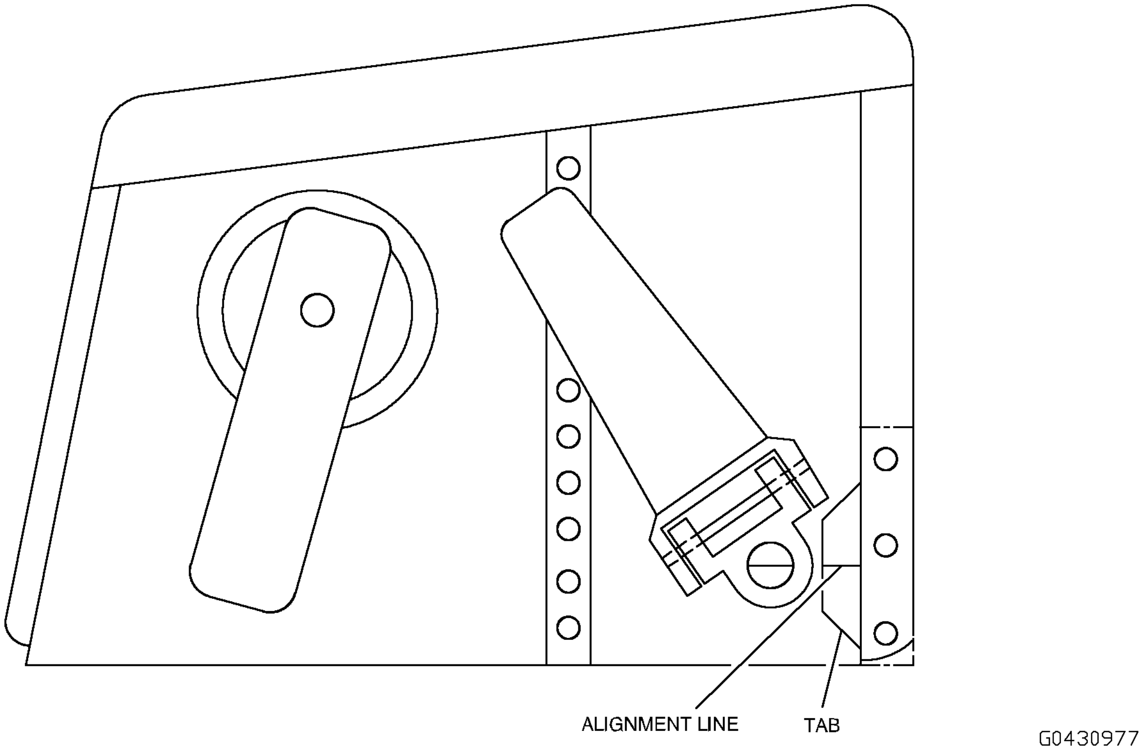


Figure 2-2. RCP Canopy Locking Handle Alignment

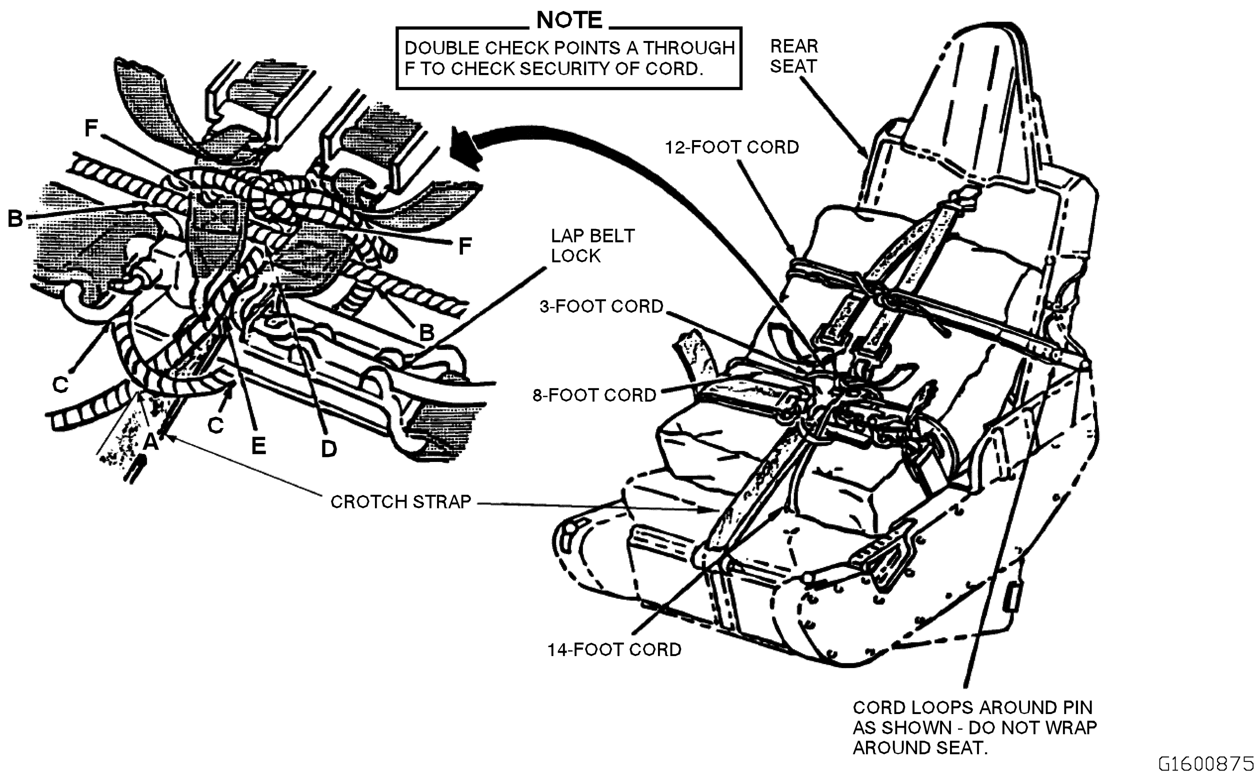


Figure 2-3. Seat Pack Installation

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REAR COCKPIT (SOLO FLIGHTS)

1. Seat and Canopy Safety Pins — CHECK (Installed and Streamers Fastened Together)

2. Seat Attach Bolts — CHECK

WARNING

The two attach bolts must be aligned with the arrows and reference line (or shoulder) of catapult head. (See Figure 1-31).

NOTE

Due to lighting conditions, the two bolts and alignment arrows may only be visible with the use of a flashlight or with the seat in the full-down position.

3. Seat Survival Kit — AS REQUIRED

NOTE

- The survival kit/seat pack shall be removed for solo flights unless required for pilot/passenger pickup missions.

- For aircrew/passenger pickup flights where transportation of a parachute is required, secure the parachute as follows (see Figure 2-3): set parachute in seat facing forward, leave Parachute Spacer Kit (PSK) (if applicable) attached to parachute harness D-rings. If possible, place survival vest (if used) inside seat pack. If not possible, place survival vest inside parachute harness. Fasten parachute leg and chest straps.

4. Safety belt, shoulder harness, crew/survival kit retention strap, oxygen hose, man-seat separator straps — SECURE

   a. Unlock inertial reel, wrap shoulder harness around parachute riser (if applicable) and through survival vest (if applicable).

   b. Fasten shoulder harness and crew/survival kit retention strap to lap belt with silver key (attached to aircraft oxygen supply hose).

   c. Lock inertial reel. Cinch the lap belt, shoulder harness, and crew/survival kit retention strap tight. Tie ends of excess lap belt webbing and excess shoulder harness straps together.

WARNING

If these items are not secured, they may become entangled with the control stick.

5. Drogue Chute Cover — CHECK (Check that left cover fits closely and conforms to the contour of the drogue chute container. The forward edge of the cover should fit inside or below edge of container. The right cover is fixed in place.)

WARNING

If the drogue chute cover is forced above the edges of the container, the chute is improperly installed and shall be replaced. If the drogue chute cover is not flush with the drogue chute container and if the canopy is lost or jettisoned in flight, wind blast effect could separate the drogue chute cover from the container and cause inadvertent drogue chute deployment. Chute deployment could cause an immediate out-of-control condition.

6. Stowage Box Cover — CLOSED and SECURED

7. Standby Attitude Indicator — UNCAGE

CAUTION

- Avoid snap releasing the pull to cage/pitch trim knob after uncaging the standby ADI to prevent damage to the indicator.

- For solo flight, the RCP standby ADI should be uncaged. There is a risk of damage during flight in the caged and locked position.

8. Communication and Navigation Equipment — CHECK

   a. Command Radio: [**NON DUHF**]

      (1) Function Switch — BOTH

      (2) MANUAL/PRESET/GUARD Switch — GUARD

   b. Frequency — SET [**DUHF**]

GRD TO HYD ELE FUE OXY ENG FLT MISC LND

c. TACAN:

(1) Function Switch — T/R

(2) Channel Selector Knobs — DESIRED CHANNEL

d. ILS:

(1) Steering Mode switch — NORMAL

(2) Navigation Mode Switch — LOCALIZER

(3) Power Switch — POWER

(4) Channel Selector — DESIRED CHANNEL

9. Command and Override Switch — OFF [**NON DUHF**]

10. Nav Override Switch — OFF [**DUHF**]

11. Loose Equipment — CHECK (Securely Stowed)

12. Circuit Breakers — CHECK

13. Lights — OFF

14. Oxygen — NORMAL - 100% - ON

15. Map Case — CHECK (Closed and Secured; All unnecessary mission items Removed)

16. Instrument Hood — REMOVE and SECURE (Check all bungee cords connected)

17. Canopy — CLOSED and LOCKED (Check visual lines for horizontal alignment of handle and indicator tab. See Figure 2-2.)

CAUTION

- Make sure the rear canopy is closed and locked. To check for a locked condition, push up on the canopy and visually check the markings on the rear canopy locking handle bolt head and nearby tab. Any indication of these marks other than aligned may imply the canopy is not fully closed and locked.

- In the event of a canopy malfunction (difficulty in closing, opening, binding of the canopy or canopy handle during transit, or if the canopy unlocked light remains illuminated with canopy fully closed), do not move the aircraft or attempt further movement of the canopy without having the system checked by qualified maintenance personnel, unless a greater emergency exists as determined by the pilot in command. Efforts to close the canopy or vibrations set up by aircraft movement could result in canopy separation.

- While stowing the outside handle, do not apply clockwise pressure after the canopy is locked.

EXTERIOR INSPECTION

During the exterior inspection, Figure 2-4, the aircraft should be checked for general condition, wheels chocked, access doors, panels, and filler caps secured, and ground wires removed. Check for hydraulic fluid, oil, and fuel leaks. Check to make sure all screws and fasteners forward of the engine intakes are properly installed, or those missing are appropriately annotated in the aircraft forms. Check tires for allowable wear. Additionally, the following specific items will be checked:

CAUTION

Do not apply excessive force to any aircraft honeycomb assemblies. Significant structural damage may occur.

EXTERNAL STORES CHECK

1. WSSP (If Installed) — CHECK

a. Attach bolts — INSTALLED (Safetied)

b. Cargo (140 lbs max) — SECURE

NOTE

Cargo shall be arranged to keep pod CG within limits specified in TO 1T-38C-5.

c. Toggle latch hinged fairing — CLOSED, SECURE

2. Pylon (If Installed) — CHECK

a. Pylon Safety Pin — INSTALLED (Safetied)

b. Bomb Rack — COCKED (Check that container release lever locking arm engages locking pin (minimum 50 percent engagement) (See Figure 2-5.)

c. Swaybrace Bolts — TIGHT

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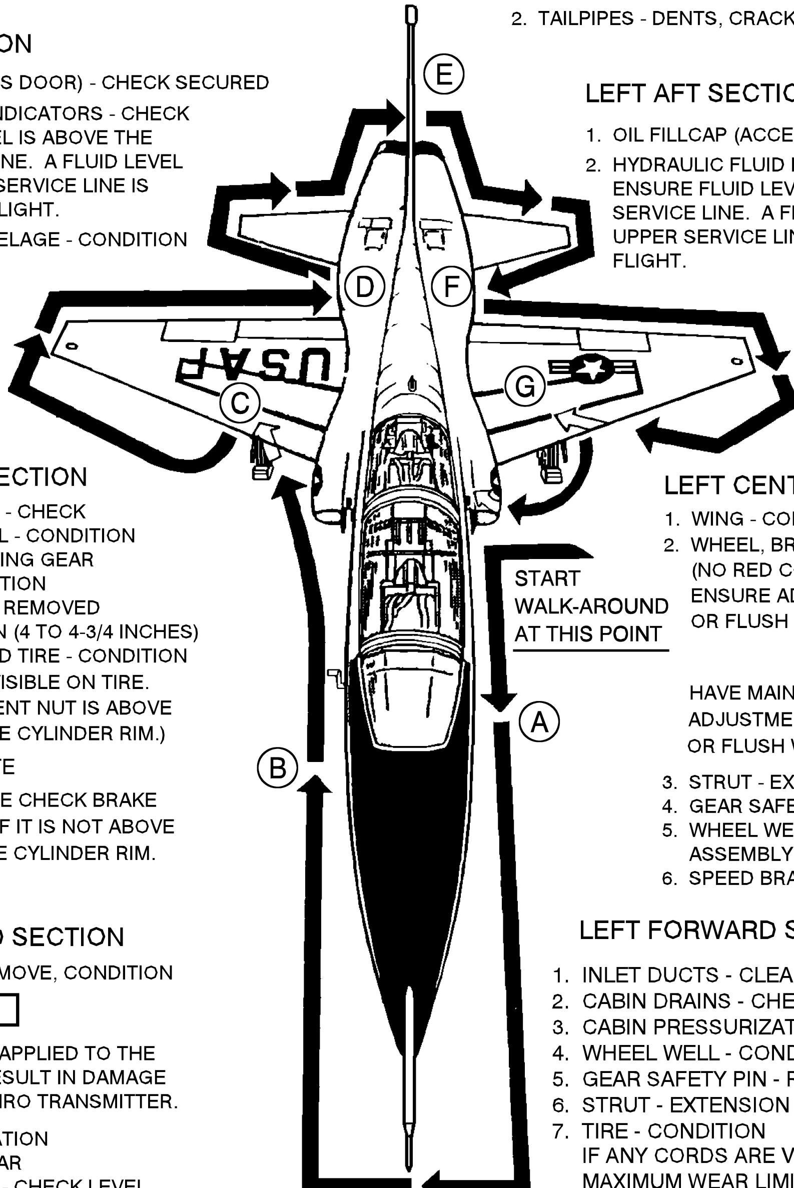
DURING THE EXTERIOR INSPECTION, THE AIRCRAFT SHOULD BE CHECKED FOR GENERAL CONDITION, WHEELS CHOCKED, ACCESS DOORS, PANELS AND FILLER CAPS SECURED, GROUND WIRES REMOVED FOR HYDRAULIC, OIL AND FUEL LEAKS. CHECK ALL SCREWS/FASTENERS FORWARD OF THE ENGINE INTAKES ARE PROPERLY INSTALLED OR THOSE MISSING ARE APPROPRIATELY ANNOTATED IN THE AFTO 781. ADDITIONALLY, THE FOLLOWING SPECIFIC ITEMS WILL BE CHECKED:



TAIL SECTION

1. EMPENNAGE - CONDITION.
2. TAILPIPES - DENTS, CRACKS, FUEL

RIGHT AFT SECTION

1. OIL FILLCAP (ACCESS DOOR) - CHECK SECURED
2. HYDRAULIC FLUID INDICATORS - CHECK ENSURE FLUID LEVEL IS ABOVE THE BOTTOM SERVICE LINE. A FLUID LEVEL ABOVE THE UPPER SERVICE LINE IS ACCEPTABLE FOR FLIGHT.
3. UNDERSIDE OF FUSELAGE - CONDITION

LEFT AFT SECTION

1. OIL FILLCAP (ACCESS DOOR) - CHECK SECURED
2. HYDRAULIC FLUID INDICATORS - CHECK ENSURE FLUID LEVEL IS ABOVE THE BOTTOM SERVICE LINE. A FLUID LEVEL ABOVE THE UPPER SERVICE LINE IS ACCEPTABLE FOR FLIGHT.

RIGHT CENTER SECTION

1. EXTERNAL STORES - CHECK
2. SPEED BRAKE WELL - CONDITION
3. WHEEL WELL/LANDING GEAR ASSEMBLY - CONDITION
4. GEAR SAFETY PIN - REMOVED
5. STRUT - EXTENSION (4 TO 4-3/4 INCHES)
6. WHEEL, BRAKE, AND TIRE - CONDITION (NO RED CORD IS VISIBLE ON TIRE. ENSURE ADJUSTMENT NUT IS ABOVE OR FLUSH WITH THE CYLINDER RIM.)

NOTE

HAVE MAINTENANCE CHECK BRAKE ADJUSTMENT NUT IF IT IS NOT ABOVE OR FLUSH WITH THE CYLINDER RIM.

7. WING - CONDITION

LEFT CENTER SECTION

1. WING - CONDITION
2. WHEEL, BRAKE, AND TIRE - CONDITION (NO RED CORD IS VISIBLE ON TIRE. ENSURE ADJUSTMENT NUT IS ABOVE OR FLUSH WITH THE CYLINDER RIM.)

NOTE

HAVE MAINTENANCE CHECK BRAKE ADJUSTMENT NUT IF IT IS NOT ABOVE OR FLUSH WITH THE CYLINDER RIM.

3. STRUT - EXTENSION (4 TO 4-3/4 INCHES)
4. GEAR SAFETY PIN - REMOVED
5. WHEEL WELL/LANDING GEAR ASSEMBLY - CONDITION
6. SPEED BRAKE WELL - CONDITION

RIGHT FORWARD SECTION

1. AOA VANE - PIN REMOVE, CONDITION

CAUTION

EXCESSIVE FORCE APPLIED TO THE AOA STOPS MAY RESULT IN DAMAGE TO THE AOA SYNCHRO TRANSMITTER.

2. CABIN PRESSURIZATION STATIC PORT - CLEAR
3. BRAKE RESERVOIR - CHECK LEVEL (60-0596 AND BELOW - FLUID VISIBLE IN SIGHT GAGE. 61-0804 AND ABOVE - FLUID TO FULL MARK.)
4. INLET DUCTS - CLEAR, CONDITION
5. STICK WELL AND CABIN DRAINS - CHECK IF APPLICABLE

LEFT FORWARD SECTION

1. INLET DUCTS - CLEAR, CONDITION
2. CABIN DRAINS - CHECK IF APPLICABLE
3. CABIN PRESSURIZATION STATIC PORT - CLEAR
4. WHEEL WELL - CONDITION
5. GEAR SAFETY PIN - REMOVED
6. STRUT - EXTENSION (5-3/4 TO 6-1/8 INCHES)
7. TIRE - CONDITION
   IF ANY CORDS ARE VISIBLE, CHECK THE MAXIMUM WEAR LIMIT LISTED ON THE TIRE SIDEWALL.
   WEAR LIMITS VARY BY MANUFACTURER. NO CORDS MAY BE VISIBLE ON THE NOSE TIRE SIDEWALLS.
8. PITOT TUBE AND STATIC PORTS - CLEAR

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Figure 2-4. Exterior Inspection

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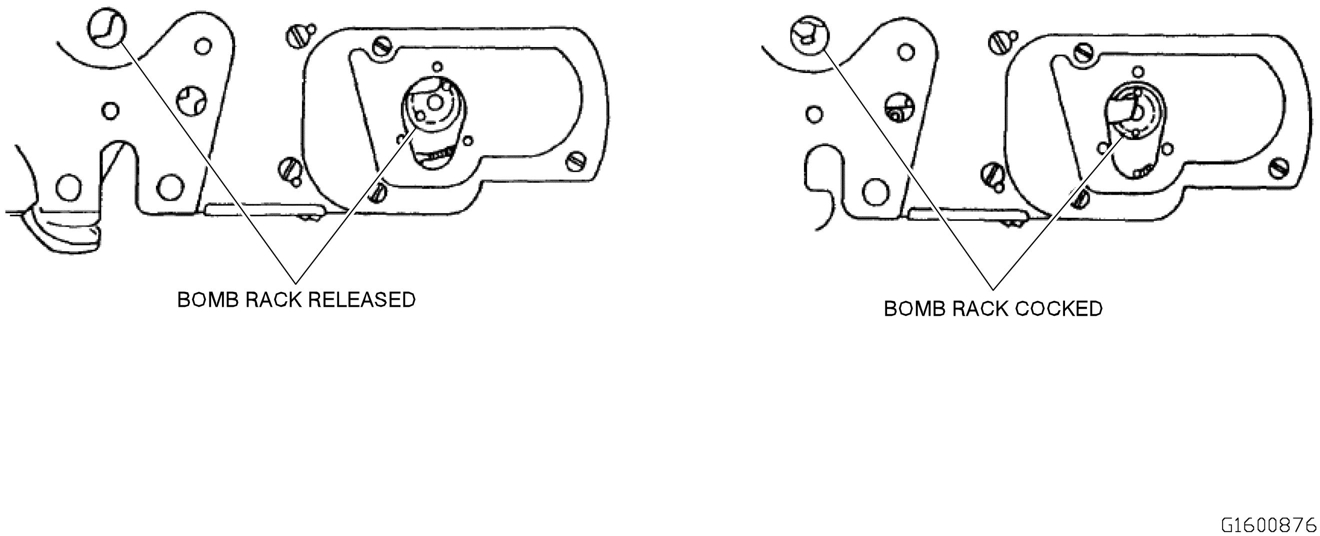

Figure 2-5. Bomb Rack Inspection

3. MXU-648 Cargo Pod (If Installed) — CHECK

   a. Stenciled Arrow — POINTING FORWARD

   b. Cargo (300 lbs max) — SECURE

NOTE

Cargo shall be arranged to keep pod CG within limits specified in TO 1T-38C-5.

   c. Door — CLOSED, FASTENERS FLUSH

CAUTION

Only one fastener may be missing or broken on the top portion of the door and none may be missing or broken on the corners of doors secured by nine fasteners. For pods with three finger latches and two camlocks, all five security devices must be serviceable.

4. ECM/EA Pod (If Installed) — CONDITION, SECURE

INTERIOR INSPECTION

COCKPIT (ALL FLIGHTS)

On dual flights, all items marked with an asterisk (*) should also be checked in the rear cockpit.

1. Battery/External Electrical Power — AS REQUIRED

CAUTION

If external power is connected, the battery should be turned off to prevent battery damage.

NOTE

If the aircraft will not accept external AC power and the Ground Support Equipment (GSE) checks good, cycling the battery switch ON then OFF may actuate necessary relays to allow the aircraft to accept external AC power.

*2. Intercom Switches — AS REQUIRED

GRD TO HYD ELE FUE OXY ENG FLT MISC LND

3. Crew Retractable Steps — Ensure STOWED (if Required) (If steps are used, ensure they are stowed to prevent flight with the steps extended)

*4. Survival Kit — ATTACHED and ADJUSTED (if Applicable)

WARNING

- Survival kit must be connected to the parachute harness prior to fastening lap belt. Failure to properly tighten these straps could result in injury or seat-main chute entanglement during ejection sequence. Loose straps can result in the kit moving forward and up out of the seat bucket during zero or negative-G maneuvers and restrict or prohibit aft control stick movement in both cockpits.

- Ensure survival kit straps are routed under the safety belt to prevent interference and possible man-seat entanglement during ejection sequence.

*5. Personal Equipment, Safety Belt, Shoulder Harness, Crew/Survival Kit Retention Strap, Parachute Arming Lanyard Anchor, Zero- Delay Lanyard Hook, Beacon Actuator Tab, Oxygen Connectors, Hose Retention Strap, Anti-G Suit Hose, and Helmet Chin Strap — CONNECT, FASTEN, ADJUST

WARNING

- Failure to attach personal equipment correctly may prevent separation from seat after ejection. Refer to Figure 1-32 and Figure 2-6.

- Ensure hose retention strap is adjusted to preclude hose separation from oxygen disconnect on parachute harness.

- Do not route the anti-G suit hose under the safety belt or in any manner which would interfere with disconnecting the hose, if required.

- The oxygen hose from the mask to the disconnect should be routed under the right shoulder harness strap before connecting to the disconnect. This helps keep the shoulder harness clear of the connector and prevents the harness from being snagged between the connector and its mounting plate during seat separation.

- The seat pack can rise up and move forward during zero or negative-G maneuvers even though the seat safety belt and shoulder harness are tightly adjusted.

NOTE

UWARS BIT Check recommended prior to overwater flights (See Figure 1-32, Sheet 2).

*6. Ejection Seat Handgrips — PUSH (to ensure fully down)

*7. Oxygen System — CHECK (PRICE)

a. P - Pressure — The pressure gage should read 50 to 120 psi (Figure 5-1) and should agree with the pressure gage in the other cockpit.

b. R - Regulator — Check regulator supply lever in ON position. Hook up mask and perform a pressure check. Place the emergency flow lever in EMERGENCY position, take a deep breath and hold it. If mask leaks, readjust mask and check pressure. The oxygen should stop flowing if the mask is properly fitted; if the oxygen continues to flow, the regulator, the hose, or the valve is not holding pressure, and the cause of the leak should be corrected. Return the emergency lever to NORMAL position. If you cannot exhale, the valve has malfunctioned and the discrepancy should be corrected.

WARNING

It is possible for the supply lever to stop in an intermediate position between OFF and ON. Care should be taken to push the supply lever full ON and visually check the flow indicator blinker for proper functioning.

c. I - Indicator — With the SUPPLY lever ON, switch the diluter lever from NORMAL to 100% and check the blinker for proper operation. There should be a distinct difference in the sound of the flow when 100% oxygen is selected. If not, suspect oxygen diluter valve failure.

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AUTOMATIC OPENING SAFETY BELT, HBU-12

LOCKED

1. AUTOMATIC DISCONNECT LINK AND BELT LINK
2. CREW/KIT RETENTION STRAP LOOP OVER BELT LINK BEFORE SHOULDER HARNESS LOOPS.

WARNING

FAILURE TO INSTALL CREW/KIT RETENTION STRAP LOOP ON BELT LINK MAY DELAY OR NEGATE MAN/ SEAT SEPARATION DURING EJECTION.

3. RIGHT AND LEFT SHOULDER HARNESS LOOPS OVER BELT LINK.
4. ANCHOR (SILVER KEY FROM AUTOMATIC PARACHUTE ARMING LANYARD) OVER BELT LINK.

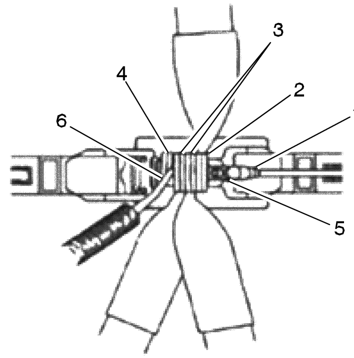
WARNING

LANYARD MUST BE OUTSIDE PARACHUTE HARNESS AND NOT FOULED ON ANY EQUIPMENT TO PERMIT CLEAN SEPARATION FROM SEAT.

NOTE

ANCHOR MUST BE OVER BELT LINK LAST AND PRESSED INTO THE LATCH BASE IN ORDER TO LOCK THE LATCH.

5. BELT LINK INSERTED IN MANUAL LATCH.
6. MANUAL RELEASE LEVER LOCKED AND CHECKED.



VIEWS LOOKING DOWN
AIRCRAFT NOSE TOWARDS TOP

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Figure 2-6. Safety Belt Connections

d. C - Connections — Check connection secure at the seat quick disconnect. Check supply hose for kinks, cuts or cover fraying. Check that the male part of the CRU-60/P is not warped and rubber gasket is in place. A 12- to 20-pound pull should be required to separate the supply hose from CRU- 60/P. Check mask hose properly installed to CRU-60/P connector.

e. E - Emergency — Check emergency oxygen cylinder is properly connected to CRU-60/P and a minimum pressure of 1800 psi. (Pressure gage must be checked during parachute preflight.)

*8. Circuit Breakers — CHECK

9. Gear Door Switch — NORMAL

10. Flight Director Switch — ON

11. Aux Flap Switch — NORMAL

12. Rudder Trim Knob — CENTERED

*13. Throttles — OFF

14. Speed Brake Switch — DN (Open)

15. ECM Power Switch — OFF (If Installed)

WARNING

The ECM pod does not have a Weight-On-Wheels (WOW) switch to prevent transmission on the ground. Ensure the ECM power switch is off prior to applying ground power to prevent radiating ground personnel.

16. Compass Switch — MAG

17. Fuel Shutoff Switches — NORMAL (guarded position)

18. Landing Gear Alternate Release Handle — IN

19. Landing-Taxi Light Switch — OFF

*20. Landing Gear Lever — LG DOWN

*21. Airspeed-Mach Indicator — CHECK

*22. Standby Attitude Indicator — UNCAGE and ADJUST

*23. Accelerometer — CHECK

*24. Clock — SET

*25. Steering Mode Switch — AS REQUIRED

*26. Navigation Mode Switch — AS REQUIRED

*27. Marker Beacon Light — TEST

*28. Radio Transfer Switches — AS REQUIRED

a. Comm Antenna Switch — AUTO [**NON DUHF**]

b. RECV AUDIO Switch — AS REQUIRED [**DUHF**]

*29. UHF, TACAN, ILS — ON

30. Magnetic Compass — CHECK

*31. Altimeter — SET

*32. Vertical Velocity Indicator — CHECK

33. Cabin Altimeter — CHECK

34. Cabin Pressure Switch — CABIN PRESS

35. Cabin Air Temperature Switch — AUTO

36. Pitot Heat Switch — OFF

37. Engine Anti-Ice Switch — AS REQUIRED

38. Fuel Boost Pump Switches — ON

39. Crossfeed Switch — OFF

40. Generator Switches — ON

41. IFF/SIF — STBY

*42. Warning Test Switch — TEST (Without AC power on Block 30 and earlier aircraft, no landing gear audible warning signal.)

NOTE

- When the test switches in both cockpits are actuated simultaneously, all FIRE warning lights will illuminate. The landing gear audible warning signal will not come on in either cockpit.
- All four FIRE warning light bulbs in both cockpits must illuminate during test. Failure of any bulb to illuminate may indicate an inoperative fire detector.

*43. Interior Lights — AS REQUIRED

44. Formation Lights — AS REQUIRED

45. Anti-Collision BEACON — ON

46. Position Lights — AS REQUIRED

*47. Forms/Publications/Loose Items — STOWED

STARTING ENGINES

NOTE

- Start the right engine first when external electrical power is not available.
- If left engine is started first with external power, make sure diverter valve is repositioned by ground personnel to the No. 1 position following right engine start.
- If the LEFT/RIGHT FUEL PRESS lights are not illuminated and the LEFT/RIGHT FUEL PRESS lights test good, this is normal due to residual pressure in system.

RIGHT ENGINE

1. Danger Areas — CLEAR (Fore, aft, and under the aircraft. See Figure 2-7.)

2. External Air — APPLY

3. Engine Start Button — PRESS at Approximately 14% RPM (Minimum required is 12% RPM)

4. Throttle — Advance to IDLE

CAUTION

- Prior to moving either throttle to IDLE, ensure the respective EGT indicator OFF flag is out of view or the ON flag is in view as applicable (front cockpit only); otherwise, an engine start cannot be properly monitored.
- If ignition does not occur before fuel flow reaches 360 lbs./hr., retard throttle to OFF. Maintain airflow to permit fuel and vapors to be purged from engine. Wait at least 2 minutes to permit fuel to drain before attempting another start.
- If EGT does not begin to rise within 12 seconds after the first indication of fuel flow, abort the start. If engine light is normal but RPMs do not reach generator cut-in speed before termination of the start cycle, push the engine start button to ensure aircraft electrical power is available to monitor the start.

5. Engine Instruments — CHECK

6. Hydraulic Pressure — CHECK

7. Caution Light Panel — CHECK

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LEFT ENGINE

1. Left Engine — START (Start Same As Right Engine)
2. Throttle Gate — ENGAGE
3. External Air/Electric Power — DISCONNECT (Signal ground crew to disconnect external power and/or air supply.)
4. Circuit Breakers — CHECK
5. Battery Switch — CHECK ON

BEFORE TAXIING

CAUTION

Allow 3-1/2 minutes to elapse after power has been applied to the attitude gyro control assembly before taxiing.

1. Canopy Defog, Cabin Temp, and Pitot Heat — CHECK

WARNING

For night or anticipated weather operation with conditions of high humidity and narrow temperature dew-point spread, the canopies should be closed and the cabin temperature increased to the 100° AUTO position to preheat all flight instruments and canopy surfaces. Return temperature control to a comfortable inflight setting after completion of the line-up check.

2. Anti-G Suit Test — TEST (Zippers Closed, Press To Test)
3. Yaw Damper Switch — YAW
4. Flight Trim System — CHECK (Verify proper operation of fore and aft trim including the fore and aft cutout switches. Press takeoff trim button until indicator light illuminates.)
5. Aileron Trim — NEUTRAL (Check Visually).
6. Flight Controls — CHECK (Visually confirm free and proper movement of flight control surfaces, and that the rudder and ailerons return to neutral at completion of flight control checks.)

WARNING

Due to the artificial feel assembly, some flight control failure modes will allow a flight control surface (rudder and ailerons) to remain displaced with no warning to the crew when the controls are returned to neutral.

NOTE

- If hydraulic pressure is high, cycling the flight controls will circulate the hydraulic fluid back through the reservoir eliminating air in the lines. This action may cause the pressure to return to normal.
- With normal movement, hydraulic pressure should not drop below 1500 psi.
- During any ground flight control checks limit intentional stick movements as follows:
  - Without hydraulic pressure limit movement to the max extent possible.
  - With hydraulic pressure limit the rate of movement to less than 1 inch per 0.1 seconds. This equates to full stick deflection from center in approximately 0.6 seconds or stop-to-stop deflection in approximately 1.2 seconds.

7. Speed Brake Switch — UP (Closed)

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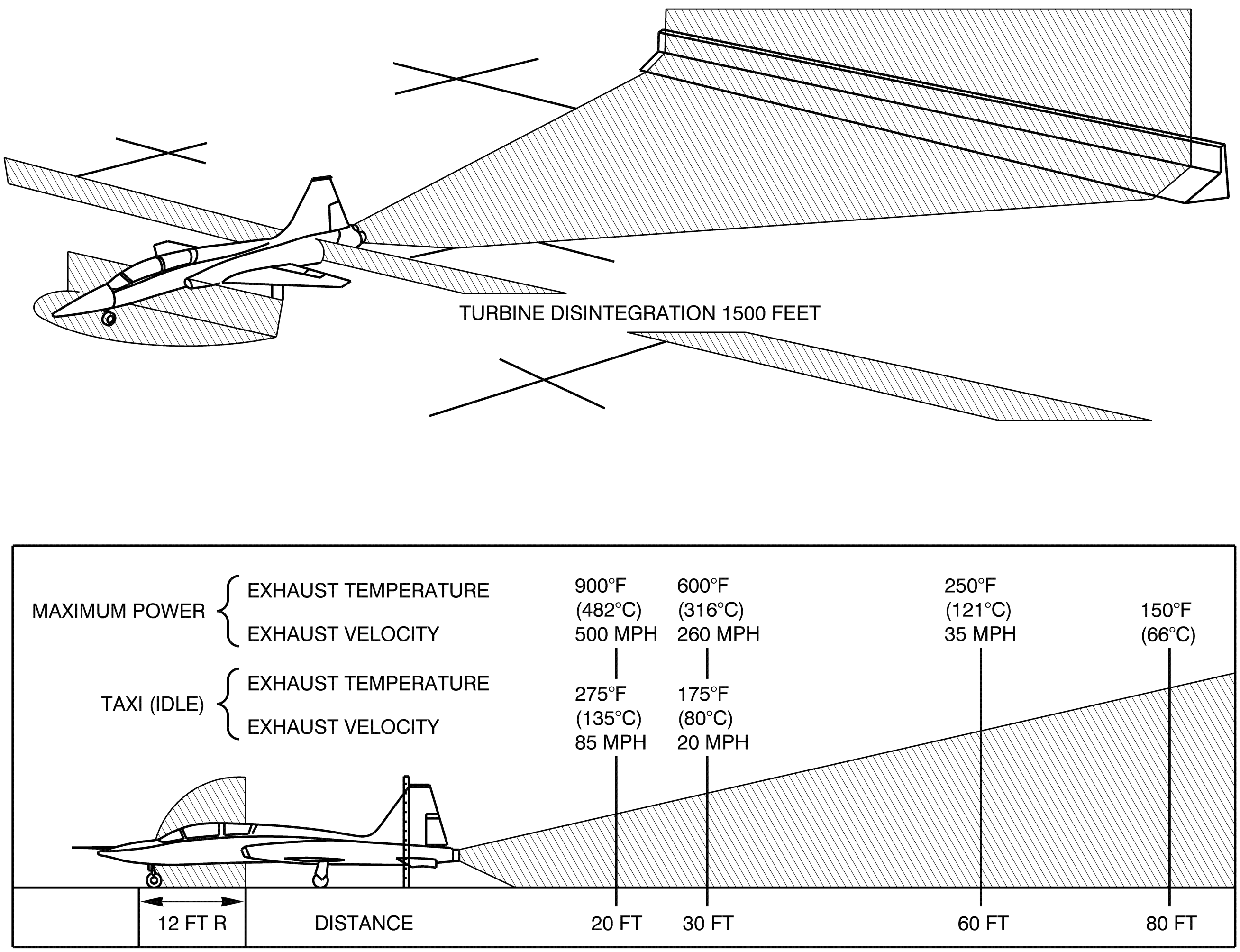

Figure 2-7. Danger Area

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8. Wing Flap and Flap-Slab Interconnect System — CHECK (Wing flaps down to 60%, full down, then retract to 60%. The flap position indicator should be checked at 60(±5)% when flaps are lowered or retracted. Operation of the flap-slab interconnect system must be checked. Visually note the trailing edge of the slab moves down continuously as the flaps are lowered. Also note the trailing edge of the slab moves up as the flaps are raised.)

WARNING

Do not attempt flight if proper operation of the Flap-Slab Interconnect System has not been verified. The leading edge of the horizontal tail must be aligned with the upper index mark on the fuselage at the 60% flap setting. The visual alignment portion of the interconnect system check must be performed by ground personnel.

9. Communication and Navigation Equipment — CHECK

10. IFF/SIF — TEST (Self-Test Modes 3A and C)

11. Altimeter — CHECK (As Required)

CAUTION

Do not rotate the barometric set knob at a rapid rate or exert force to overcome momentary binding. If binding should occur, the required setting may be established by rotating the barometric set knob a full turn in the opposite direction and then approaching the desired setting carefully.

12. FUEL/OXY Check Switch — GAGE TEST

13. Crossover Relay Check — CHECK (Right Generator Switch OFF then ON (when external electrical power used for start, also check Left Generator OFF then ON))

14. ECM BIT Check — AS REQUIRED (If Installed)

    a. ECM Power Switch — STBY

    b. BIT Test Button — PRESS (All push button lamps on for 10 to 30 sec. then all lamps out except for WM and SB. After 30 to 45 sec, WM, SB, and BT lights on. If pass BT and WM go out and SB and FWD lights come on for 3 to 5 minutes.)

    c. ECM Power Switch — AS REQUIRED

15. Survival Kit (AUTO-MANUAL) — AS REQUIRED

16. Seat Height — ADJUST (Adjust seat height to ensure ability to assume ejection position)

WARNING

Ensure all equipment is stowed and clear of the handgrips to prevent inadvertent handgrip movement during seat adjustment. Whenever practical during ground operations, adjust the seat with the seat safety pin installed.

17. Ejection Seat/Canopy Safety Pins — REMOVE (Stow As Required)

CAUTION

Care should be taken to prevent inadvertent pulling of the canopy jettison T-handle when removing the safety pin.

18. Brakes — CHECK (Check Pedal Pressure)

19. Chocks — REMOVE

GRD TO HYD ELE FUE OXY ENG FLT MISC LND

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TAXIING

WARNING

If carbon monoxide contamination is suspected during ground operation, use 100% oxygen.

CAUTION

- Low-frequency vibration, buzzing or chatter felt through the rudder pedal may indicate present or pending stability augmentation system malfunction.
- If brake drag is encountered or suspected, the aircraft should be aborted.
- Simultaneous use of wheel brakes and nose wheel steering to effect turns, results in excessive nosewheel tire wear. Nosewheel tires are severely damaged when maximum deflection turns are attempted at speeds in excess of 10 knots.
- A low nose gear strut indicates insufficient strut pressure and may result in a cocked nosewheel and/or damage to the nosewheel well during retraction. Do not fly the aircraft if the nose gear strut is deflated or if the strut bottoms during taxiing.
- To prevent possible damage to the canopy downlock mechanism, taxi with both canopies open or both closed and pressurized whenever practical.
- Close and lock both canopies when taxiing directly behind another aircraft with engines running. Failure to do so can damage the canopy mechanism, possibly resulting in an inadvertent opening of either of the canopies.

1. Landing-Taxi Light — AS REQUIRED
2. Flight Instruments — CHECK (As Required)

If canopies are opened from the closed and locked position:

3. Cabin Pressure Switch — RAM DUMP

WARNING

Loss of canopy and severe injury may occur if either canopy is unlocked prior to depressurizing the cockpit to field elevation. The canopy could blow off its hinges and fall into the cockpit area. Anytime the aircraft has been pressurized, RAM DUMP must be selected to ensure the cabin altimeter displays field elevation prior to opening the canopy. Pressure equalization may take several seconds.

4. Canopy — UNLOCKED
5. Cabin Pressure Switch — CABIN PRESS

BEFORE TAKEOFF

1. Takeoff Data — UPDATE/REVIEW
2. Battery Switch — CHECK ON
3. Canopy Defog, Cabin Temp — AS REQUIRED
4. Engine Anti-Ice Switch — OFF
5. Cockpit Loose Items — CHECK SECURE
6. Helmet Visors — AS REQUIRED
7. Flight Control Surfaces — CHECK (Visually confirm free and proper movement of flight control surfaces, and that the rudder and ailerons return to neutral at completion of flight control checks.)

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WARNING

- Due to the artificial feel assembly, some flight control failure modes will allow a flight control surface (rudder and ailerons) to remain displaced with no warning to the crew when the controls are returned to neutral.
- Ensure rudder pedals do not feel loose and center normally. Abnormal indications may be the result of a rudder force producer spring failure. In-flight failure of the spring may cause the rudder to jam, resulting in a possible loss of aircraft control.

NOTE

- During any ground flight control checks, lateral stick movement should be smooth and controlled to prevent undue strain on the aileron control mechanisms.
- Accomplish this task as close as possible to takeoff.

8. Takeoff Trim Button — PRESS (Check indicator light illuminates.)
9. Ejection Seat and Canopy Pins — CONFIRM REMOVED and STOWED
10. Canopy — CLOSED, LOCKED (Warning light out)

WARNING

- It is possible to close the canopy and extinguish the canopy light but not have the canopy locking lever far enough forward. After closing the canopy, confirm lever in the full forward position and then apply upward pressure to the canopy to confirm that it has fully closed and locked.
- In the RCP, refrain from placing any objects on the RCP airframe bow as the front cockpit can be closed independently of the rear, creating a pinch hazard.
- Make sure fingers are clear of canopy lock/unlock handle and aircraft bulkhead as they can become pinched between the handle on the canopy locking lever and the map light on the instrument panel.

CAUTION

- Before lowering the canopy, extend the instrument hood forward, as necessary, to ensure the hood is not bunched between the ejection seat drogue chute housing and the canopy or damage may occur to the seat or canopy.
- Should the canopy be difficult to close and lock or if binding is encountered in transit, have the system checked by qualified maintenance personnel before flight.
- Should the canopy jam in the fully open position, the aircraft should not be taxied or towed until cleared by qualified maintenance personnel. Efforts to close the canopy or vibrations set up by aircraft movement could result in canopy separation.
- Do not store objects or personal equipment on top of or behind the backseat ejection seat or damage to canopy mechanism or inadvertent canopy opening may occur.

LINEUP CHECK

1. Pitot Heat Switch — ON
2. IFF/SIF — AS REQUIRED
3. Speed Brake Switch (FCP) — OFF (Centered), then UP (Closed)

NOTE

Unintentional operation of the rear cockpit speedbrake switch could cause speedbrake creep before takeoff.

4. Nosewheel Steering — CHECK DISENGAGED
5. Throttles — MIL
6. Master Caution Light — OUT
7. Engine Instruments — CHECK
8. Hydraulic Pressure — CHECK

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TAKEOFF

The following takeoff procedure and that given in Figure 2-8 forms the basis of the performance predictions in Appendix A. Part 3 Conditions such as weight, wind, single engine performance considerations, etc., may make it prudent to delay rotation and liftoff above the speeds shown in the figure. However, tire limit speeds in Section V should be observed.

WARNING

- Avoid wake turbulence. Allow a minimum of 2 minutes before takeoff behind any large type aircraft or helicopter and a minimum of 4 minutes behind heavy type aircraft. With effective crosswind of over 5 knots, the interval may be reduced. Attempt to remain above and upwind of the preceding aircraft's flight path. See Section VI.

- Due to the potential of an out-of-control situation, ensure the nosewheel steering button is not depressed during takeoff roll. Unintentional nosewheel steering activation, especially during an abort, may place the aircraft in an unrecoverable skid.

1. Brakes — RELEASE
2. Throttles — MAX
3. Instruments — CHECK

CAUTION

The takeoff should be aborted if either afterburner fails to light within 5 seconds or if the light off is abnormal.

NOTE

- The acceleration check speed is the only means by which actual aircraft (engine) performance can be referenced to the computed values. Less than predicted acceleration will invalidate all computed speeds and associated distances.

- During rotation, nose wheel vibration may be experienced when the nose wheel loses contact with the runway. Vibration is caused by a slightly unbalanced nose wheel, and should not be confused with an aircraft malfunction.

CROSSWIND TAKEOFF

Aileron into the wind will aid in directional control and help in preventing compression of the downwind strut. The aircraft should be allowed to crab into the wind as rotation occurs.

AFTER TAKEOFF

1. Landing Gear Lever — LG UP (When definitely airborne)

CAUTION

Check the red light in the gear handle out prior to 240 KIAS.

2. Wing Flap Lever — UP

CLIMB

1. Oxygen System — CHECK
2. Fuel Quantity/Balance — CHECK
3. Cabin Pressure — CHECK
4. Canopy Defog and Cabin Temp — AS REQUIRED

LEVEL-OFF AND CRUISE

1. Oxygen System — CHECK
2. Fuel Quantity/Balance — CHECK
3. Cabin Pressure — CHECK
4. Altimeter — RESET AS REQUIRED (Check STBY and return to RESET)

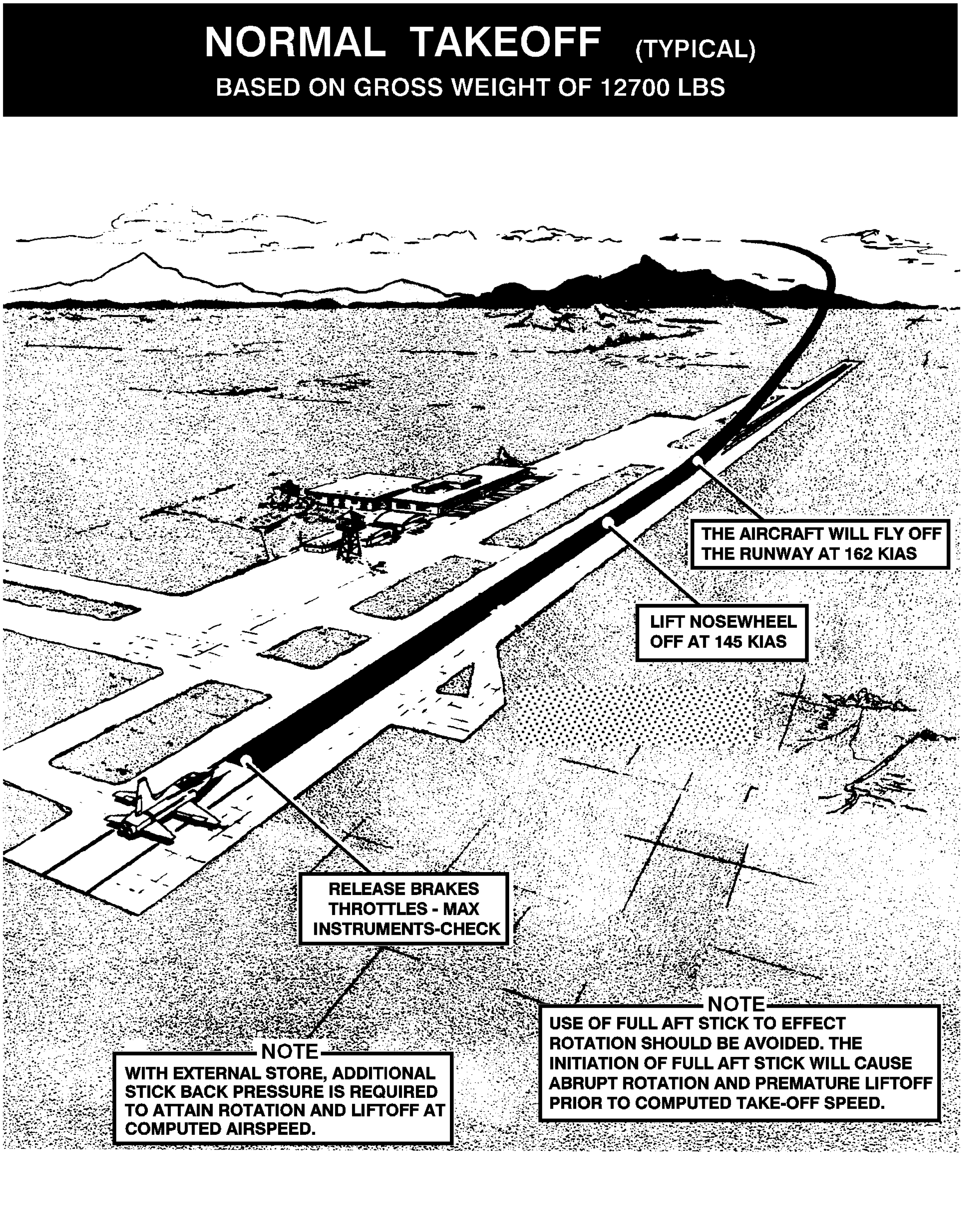

Figure 2-8. Normal Takeoff (Typical)

CAUTION

The altimeter may malfunction without reverting to standby mode. If any altimeter malfunction is suspected, check STBY position and return to RESET. If during any check the difference between primary and standby mode exceeds 150 feet below 10,000 feet or 250 feet above 10,000 feet, continue the mission in standby mode.

NOTE

If the AAU-19/A altimeter reverts to standby operation at any time during flight, attempt to return to the servoed mode of operation by placing the altimeter function switch momentarily to the RESET position. If the altimeter will not reset or reverts to standby after a few seconds, continue mission in the standby mode.

DESCENT

1. Helmet Visor(s) — AS REQUIRED
2. Heading and Attitude Systems — CHECK
3. Altimeter – RESET AS REQUIRED — (Check STBY and return to RESET)

CAUTION

The altimeter may malfunction without reverting to standby mode. If any altimeter malfunction is suspected, check STBY position and return to RESET. If during any check the difference between primary and standby mode exceeds 150 feet below 10,000 feet or 250 feet above 10,000 feet, continue the mission in standby mode.

NOTE

If the AAU-19/A altimeter reverts to standby operation at any time during flight, attempt to return to the servoed mode of operation by placing the altimeter function switch momentarily to the RESET position. If the altimeter will not reset or reverts to standby after a few seconds, continue mission in the standby mode.

4. Fuel Quantity/Balance — CHECK
5. Crossfeed Switch — OFF
6. Canopy Defog, Cabin Temp — AS REQUIRED
7. Engine Anti-Ice Switch — AS REQUIRED
8. Landing-Taxi Light Switch — ON

BEFORE LANDING

See Figure 2-9 for pattern speeds:

1. Pattern Airspeeds — COMPUTE
2. Landing Gear Lever — LG DOWN (Check Down) (Physically press the front cockpit lever full down.)

CAUTION

Failure of the landing gear lever interconnect cable while the landing gear is being lowered from the rear cockpit may result in normal gear extension without full down travel of the front landing gear lever, leading to possible uncommanded gear retraction on landing. To preclude this, the front landing gear lever shall be physically checked full down any time the gear is lowered from the rear cockpit.

3. Hydraulic Pressures — CHECK
4. Flaps — AS REQUIRED

LANDING

WARNING

- Avoid wake turbulence. Allow a minimum of 2 minutes before landing behind any large type aircraft or helicopter and a minimum of 4 minutes behind heavy aircraft. With effective crosswinds of over 5 knots, the interval may be reduced. Attempt to remain above and upwind of the preceding aircraft's flight path. See Section VI.
- Due to the potential of an out-of-control situation, ensure the nosewheel steering button is not depressed during landing. Unintentional nosewheel steering activation as the nosewheel is lowered to the runway may place the aircraft in an unrecoverable skid.

NORMAL LANDING

Normal landings are performed using flaps at 60% or full down. See Figure 2-9 for recommended landing and go-around pattern. After touchdown, continue to increase back pressure on the stick to obtain the highest possible nose high attitude without flying the aircraft off the runway.

The Landing Distance chart assumes the pilot will maintain a nose high pitch attitude down to the aerobrake speed and lower the nosewheel to the runway. Refer to Appendix A, Part 8. After nosewheel touchdown the pilot will gradually apply wheel brakes so that the desired braking is reached in two seconds. Wheel braking is limited to cautious braking from 130 KIAS to 100 KIAS, with optimum braking below 100 KIAS.

CAUTION

- Extreme CAUTION must be exercised when applying wheel brakes above 120 KIAS, as locked wheels or tire skids are difficult to recognize. If tire skids are detected, immediately release both brakes and cautiously reapply.
- Attempting to aerobrake using full back stick until the nose can no longer be held up will produce a hard nosewheel impact at approximately 100 KIAS.
- Extreme nose high aerobraking when crossing raised arresting cables may result in damage to the afterburner ejectors.
- Gusty winds may cause the aircraft's nose to raise high enough during aggressive aerobraking that may result in damage to the exhaust nozzles.
- Rubber deposits on the last 2000 feet of wet runways make directional control difficult even at very low speeds. Braking should be started in sufficient time so as not to require excessive braking on the last portion of the runway.

MINIMUM ROLL LANDING

Decrease airspeed 10 knots below normal landing final approach airspeed to ensure touchdowns at speeds noted in the landing distance chart in Part 7 of Appendix A. The landing distance chart shows data for landing at computed touchdown speed at approximately 12 degrees nose high attitude. Just prior to loss of elevator authority, lower the nosewheel to the runway and apply optimum wheel braking. For wet runways, a firm touchdown will tend to reduce the effects of hydroplaning.

CROSSWIND LANDING

Approach and Touchdown

On final approach, counteract drift by crabbing into the wind, maintaining flight path alignment with the runway. The crab should be held through touchdown. When the crosswind component exceeds 15 knots, touchdown should be planned for the upwind side of the runway. Maintain precise airspeed control throughout the final approach; in gusty conditions, increase the indicated airspeed by one-half of the gust increment above the wind velocity. Refer to section V for landing rate of descent.

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CAUTION

- When the crosswind component exceeds 15 knots, limit touch and go landing due to increased tire wear and the risk of blown tires.
- Drift after touchdown increases the probability of tire damage.

After Touchdown

Do not commence a normal aerobrake; however, the landing attitude should be maintained by increasing back pressure on the stick. The ground run distance may increase as much as 50% due to the decreased aerodynamic braking and less than optimum wheel braking. Aileron into the wind will aid in directional control, will help in preventing compression of the downwind strut, and will prevent the upwind wing from becoming airborne. Maintain directional control of the aircraft with the rudder. A too rapid increase in the back stick pressure may cause the aircraft to become airborne and drift across the runway. Just prior to loss of elevator authority, lower the nosewheel to the runway.

CAUTION

Attempting to aerobrake using full back stick until the nose can no longer be held up will produce a hard nosewheel impact at approximately 100 KIAS.

USE OF WHEEL BRAKES

Wheel Brake Operation

To minimize brake wear, the brakes should be used as little and as lightly as possible.

NOTE

If the first application of brakes do not provide adequate pressure or if the brakes feel spongy, normal pressure might be regained by pumping the brake pedals. The pedals should be allowed to return to the full up position between strokes.

Failure of certain brake components within a cockpit may result in complete failure of one or both brakes. Should this occur, braking might be gained by operating the brakes in the other cockpit. Full advantage of the length of runway should be taken during landing or aborted takeoff. Minimize use of brakes during turns and avoid dragging the brakes during taxiing. When there is considerable lift on the wings, such as immediately after touchdown, heavy brake pressure will lock the wheel more easily than when the same pressure is applied after the full weight of the aircraft is on the tires. Once a wheel is locked, it may be necessary to completely release brake pressure to allow wheel rotation.

Optimum Braking Action

The physical limitations of the tire and brake system make it extremely difficult to consistently achieve optimum braking action, particularly at high speeds (above 120 KIAS), where the weight component is reduced due to lift. A single, smooth application, increasing as airspeed decreases, offers the best braking opportunity. Great caution should be used when braking at speeds above 100 KIAS. Locked brakes are difficult to diagnose until well after the fact. Braking should be discontinued at the first indication of directional problems and then cautiously reapplied. At speeds below 100 KIAS, the chances of approaching optimum braking action are greatly increased.

WARNING

- Braking required for high speed, heavy gross weight abort may result in extremely hot brakes or brake failure and the possibility of tire fire should be anticipated.
- If hot brakes are suspected, the aircraft should not be taxied into a congested area. Ensure all personnel remain clear of the main wheels until they have cooled.

NOTE

All stopping distances computed from the appendix are based on optimum braking. Optimum braking is difficult to achieve. Variables such as brake and tire condition, pilot technique, etc., may increase computed distances.

LANDING AND GO-AROUND PATTERN

(TYPICAL)

FLAPS FULL DOWN

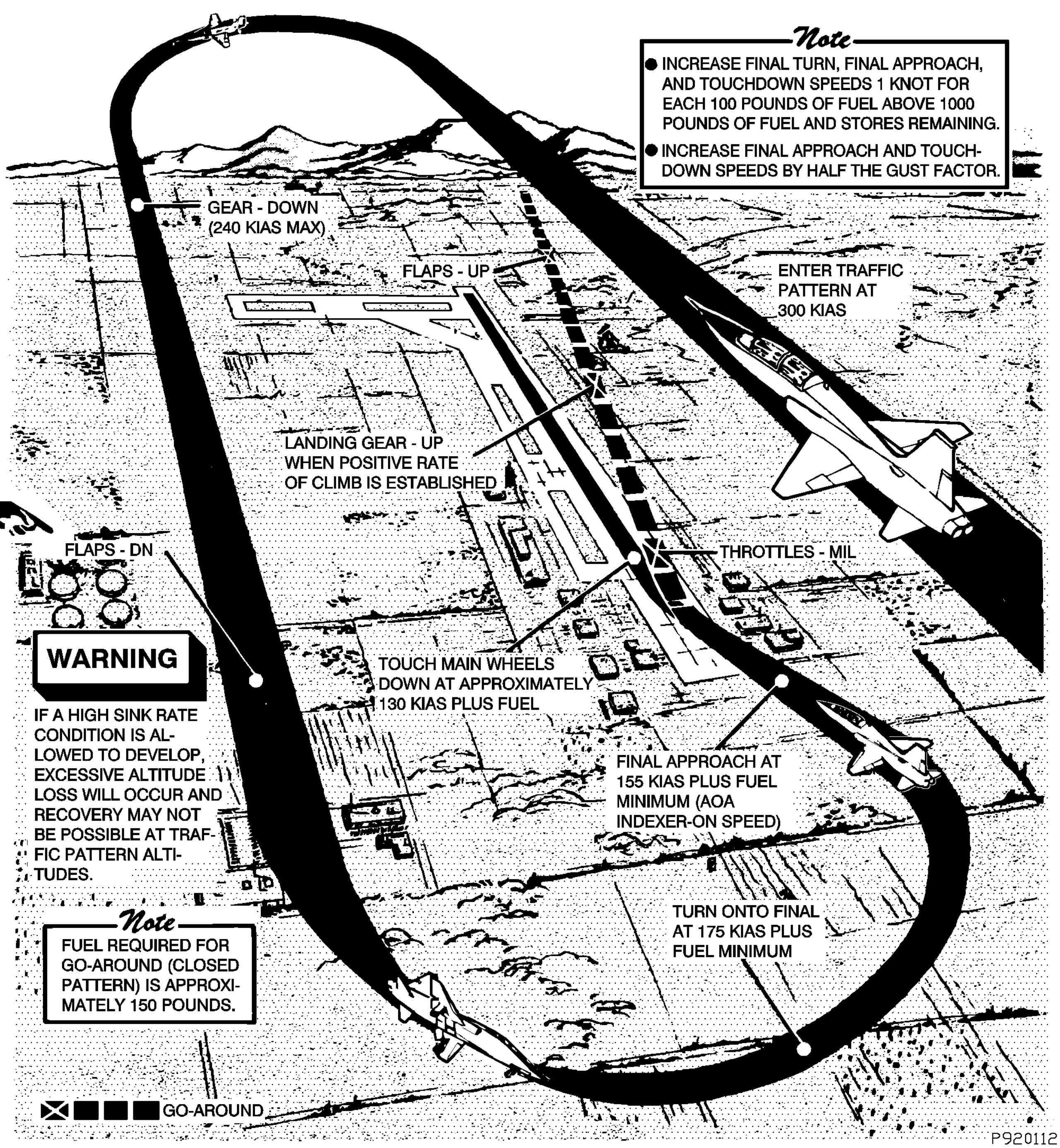

Figure 2-9. Landing and Go-Around Pattern

GO-AROUND

Make the decision to go-around as early as possible. Military power is normally sufficient for go-around, but do not hesitate to use maximum power if necessary.

WARNING

If conditions do not permit an aerial go-around, do not try to hold the aircraft off the runway; continue to fly the aircraft to touchdown and follow the go-around procedure.

1. Throttles — MIL (MAX if necessary)
2. Landing Gear Lever — LG UP (When definitely airborne)
3. Wing Flap Lever — UP

NOTE

If touchdown is made, lower the nose slightly to accelerate. Establish takeoff attitude to allow the aircraft to fly off the runway at takeoff speed.

TOUCH-AND-GO LANDINGS

To make a touch-and-go landing, perform the desired approach and landing. After touchdown, follow the normal go-around procedure.

WARNING

Touch-and-go landings encompass all aspects of the landing and takeoff procedures in a relatively short time span. Be constantly alert for possible aircraft malfunctions and/or unsafe operator technique during these two critical phases of flight.

AFTER LANDING

1. Seat and Canopy Safety Pins — INSTALL
2. Pitot Heat Switch — OFF
3. Loose Items — CHECK SECURE (Before opening canopy)
4. Cabin Altimeter — CHECK (If reading is below field elevation, write up the failure in the AFTO Form 781)
5. Cabin Pressure Switch — RAM DUMP

WARNING

Loss of canopy and severe injury may occur if either canopy is unlocked prior to depressurizing the cockpit to field elevation. The canopy could blow off its hinges and fall into the cockpit area. Anytime the aircraft has been pressurized, RAM DUMP must be selected to ensure the cabin altimeter displays field elevation prior to opening the canopy. Pressure equalization may take several seconds.

6. Canopy — UNLOCK

CAUTION

- To prevent possible damage to the canopy downlock mechanism, taxi with both canopies open or both closed and pressurized whenever practical.
- Close and lock both canopies when taxiing directly behind another aircraft with engines running. Failure to do so can damage the canopy mechanism, possibly resulting in an inadvertent opening of either of the canopies.

7. Gear Door Switch — OPEN
8. Takeoff Trim Button — PRESS (Check indicator light illuminates)
9. Wing Flaps — UP
10. Speed Brake Switch — DN (Open)
11. ECM Power Switch — OFF (If Installed)

WARNING

The ECM pod does not have a Weight-On-Wheels (WOW) switch to prevent transmission on the ground. Ensure the ECM power switch is off prior to applying ground power to prevent radiating ground personnel.

12. Landing-Taxi Light Switch — AS REQUIRED
13. TACAN, ILS, IFF/SIF — OFF
14. Cabin Pressure Switch — CABIN PRESS

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ENGINE SHUTDOWN

NOTE

- Operate engines at 70% RPM or below for a minimum of 1 minute.
- Allow 10 seconds for landing-taxi light retraction and/or closure of ram dump door prior to engine shutdown.

1. Seat Height — ADJUST (Full Up)
2. Position Lights Switch — OFF
3. Formation Lights — OFF
4. Oxygen — 100%
5. Wheels — CHOCKED
6. Throttle Gate — DISENGAGE
7. Throttles — OFF
8. Anti-Collision BEACON — OFF
9. Standby Attitude Indicator — CAGE and LOCK
10. All Unguarded Switches — OFF
11. Gold/Silver Key — SECURE
12. Battery Switch — OFF
13. Flight Director Switch — OFF
14. Personal Equipment, Safety Belt, Shoulder Harness, Crew/Survival Kit Retention Strap, Parachute Arming Lanyard Anchor, Zero-Delay Lanyard Hook, Beacon Actuator Tab, Oxygen/Comm Connectors, Hose Retention Strap, Anti-G Suit Hose — DISCONNECT, SECURE

WARNING

Ensure seat safety pin is installed and all equipment is properly secured to prevent entanglement with the ejection seat handgrips and possible handgrip movement during egress.

CAUTION

Do not allow disconnected personal equipment to fall and damage aircraft equipment when standing up.

15. Postflight Exterior Inspection — ACCOMPLISH (Look for any abnormalities, such as missing panels, damaged tires, leaking fluids, scrapes, dents or evidence of bird strikes and notify maintenance personnel.)

INSTRUMENT FLIGHT PROCEDURES

INSTRUMENT TAKEOFF

For an instrument takeoff, perform all normal pre-takeoff checks, and turn on pitot heat and engine anti-ice system if necessary. Allow for increased takeoff roll if engine anti-ice is used. Check the horizontal situation indicator for proper heading, and align the index marker on the pitch trim knob with the reference index marker on the pitch trim knob with the reference index on the ADI case. On a level surface with proper strut inflation, this should give approximately a 3-degree noise low indication. This setting will give an approximate level flight indication for intermediate altitude level offs during departure and at normal cruise conditions. Manual bank steering may be used to aid in maintaining directional control, but steering bar indications should be cross-checked with the compass card. Whenever visibility permits, runway features and lights should be used as an aid to maintain proper headings. Adjust back stick pressure to attain the takeoff attitude and allow the aircraft to fly off the runway. When vertical velocity indicator and altimeter indicate a definite climb, retract the landing gear. Raise the wing flaps immediately after the landing gear lever has been placed at LG UP.

INSTRUMENT CLIMB

Approaching 300 KIAS in a 5-degree climb indication, retard throttles to MIL thrust. Maintain a 2- to 5-degree climb indication and at least a 1000-fpm climb until reaching recommended climb schedule. A slow airspeed and/or low rate of climb may be required to comply with departure procedures. For this type climb, reduce power below MIL As Required. Power settings between 90 and 95% RPM will provide comfortable climb rates at 300 KIAS for intermediate altitude level-offs. MAX thrust instrument climbs require extremely high pitch angles and are not normally used for instrument departures. If conditions require a MAX thrust climb, maintain a 2- to 5-degree climb indication until approaching recommended climb MACH, then rotate to approximately a 20- to 25-degree initial climb indication.

HOLDING PATTERNS

Hold at 250 to 265 KIAS at all altitudes. To descend in holding patterns, reduce power and maintain holding airspeed in descent. The speed brake may be used for holding pattern descents, but higher descent rates must be anticipated.

PENETRATION DESCENTS

Prior to penetration descent, the canopy defog system should be operated at the highest flow possible (consistent with crew members' comfort) during high altitude flight to prevent the formation of frost or fog during descent. To enter a penetration descent, reduce power and lower the nose approximately 10 degrees on the attitude sphere. Open speed brakes (if required) at 300 KIAS and maintain by adjusting pitch As Required. Initiate the level-off from a penetration descent 1000 feet or more above the desired altitude by decreasing the pitch attitude approximately one half. Use normal lead point for level-off at the desired altitude. The speed brakes may be left OPEN or CLOSED as required to obtain the desired airspeed at the final approach fix.

NOTE

For engine anti-ice operation, 80% RPM or above is recommended.

INSTRUMENT APPROACHES

Figure 2-10 shows a typical TACAN penetration and approach. Normally, a maximum of 300 KIAS will be maintained during approach maneuvering prior to extending the gear. Recommended final approach airspeed will depend upon the type of approach being made. AOA indexer will show a fast indication during final approach maneuvering and on speed indication after final approach fix. For a straightin approach, maintain 155 KIAS plus fuel minimum (AOA indexer on speed). Full flaps should be used for landing.

NOTE

Increase final approach and touchdown speeds by half the gust factor.

RADAR APPROACHES

See Figure 2-11 for aircraft configuration.

INSTRUMENT LANDING APPROACHES

Refer to Figure 2-12 for aircraft configuration.

ILS APPROACH

1. ILS Receiver — TUNE, IDENTIFY, and MONITOR
2. Course Arrow and Course Window — SET localizer front course
3. Navigation Mode Switch — LOCALIZER

NOTE

With the localizer front course selected, the aircraft symbol is always directional in relation to the Course Deviation Indicator (CDI).

4. Steering Mode Switch — NORMAL
5. Bank Steering Bar — CENTERED (The bank steering bar may be used when the aircraft heading is within 90 degrees of the localizer front course. The flight director directs an intercept angle up to 45 degrees to the localizer. A maximum bank angle of 35 degrees is required to center the bank steering bar.)

WARNING

- The bank steering bar may be used only for a front course approach.
- If the published front course has not been set in the course selector window, the bank steering bar will be unreliable.

6. Navigation Mode Switch — ILS when on the localizer (Keeping the bank steering bar centered will maintain the aircraft on or correct it to the localizer course. Wind drift corrections are accomplished automatically.)

NOTE

The bank steering bar will command excessive or erroneous steering indications if the aircraft is not on or near the localizer course when ILS is selected.

7. Pitch Steering Bar — CENTERED (As the Glide-Slope Indicator (GSI) approaches midscale, adjust the pitch to center the pitch steering bar. Keeping the pitch steering bar centered will maintain the aircraft on or correct it to the glide-slope.)
8. CDI and GSI — CROSS CHECK throughout the approach (The navigation mode switch must be at LOCALIZER or ILS to obtain localizer or glide-slope indications from the CDI and GSI. The course and glide-slope warning flags function only in LOCALIZER and ILS and are out of view in TACAN. TACAN bearing and range are available in the LOCALIZER or ILS positions.)

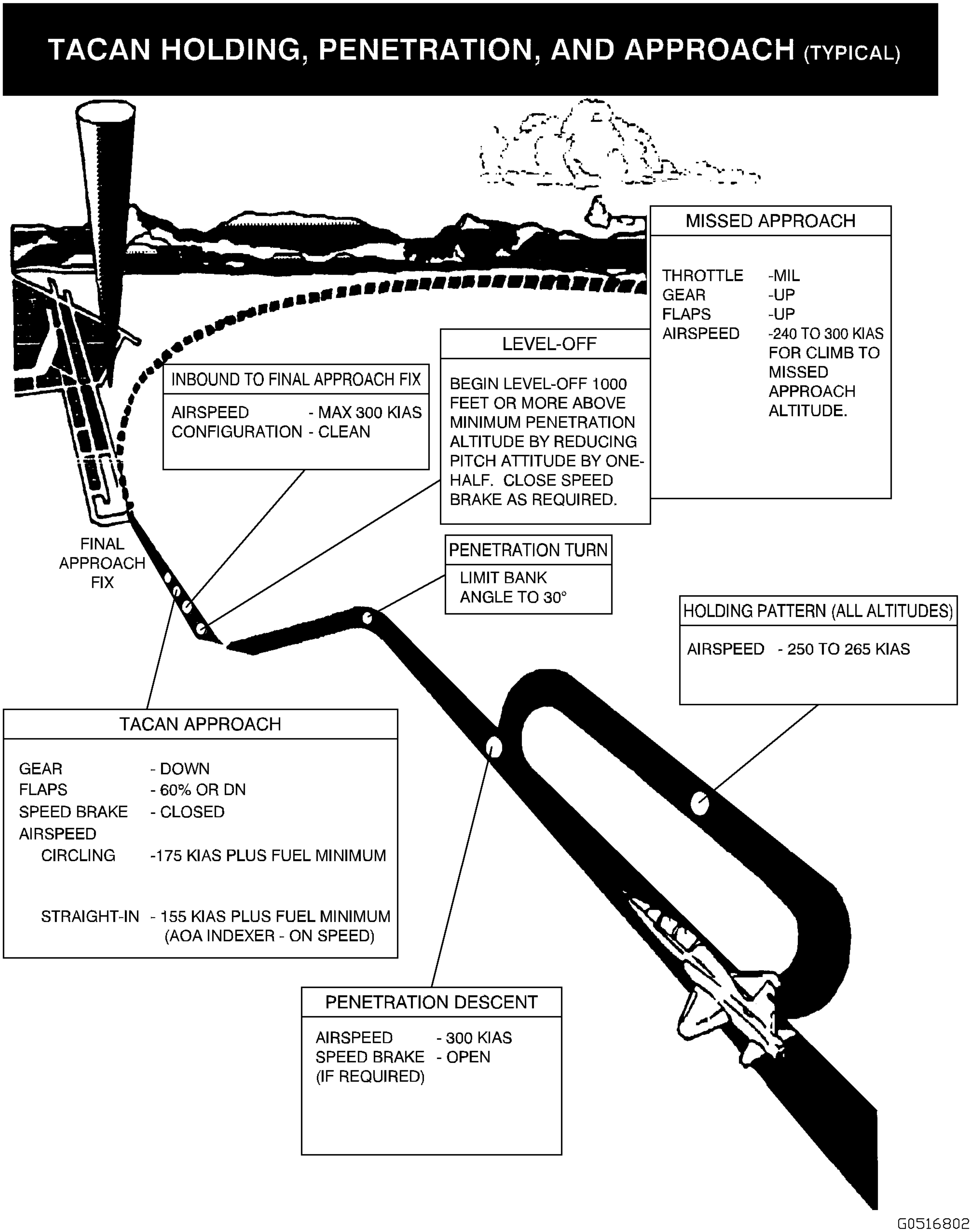

Figure 2-10. TACAN Holding, Penetration, and Approach (Typical)

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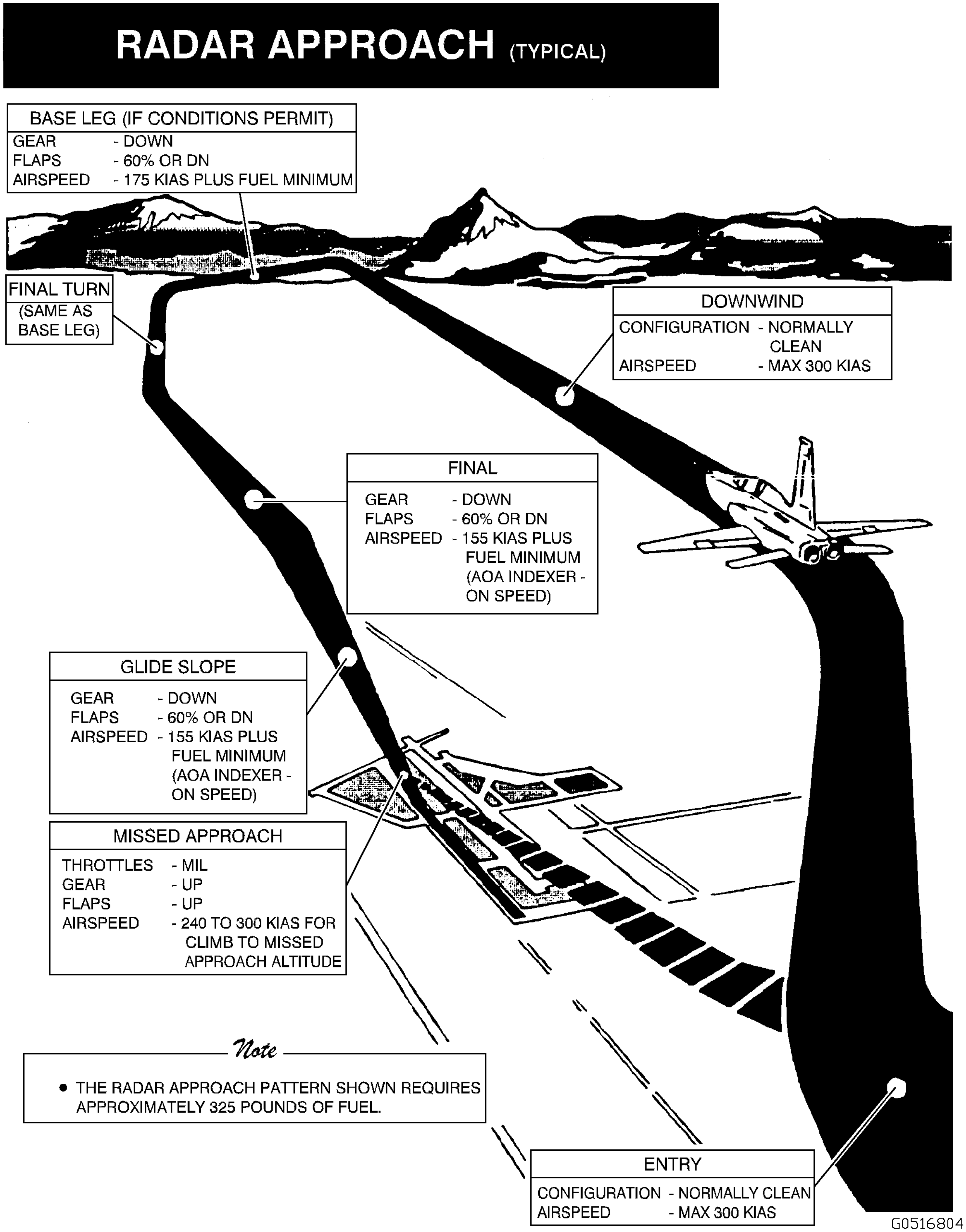

Figure 2-11. RADAR Approach (Typical)

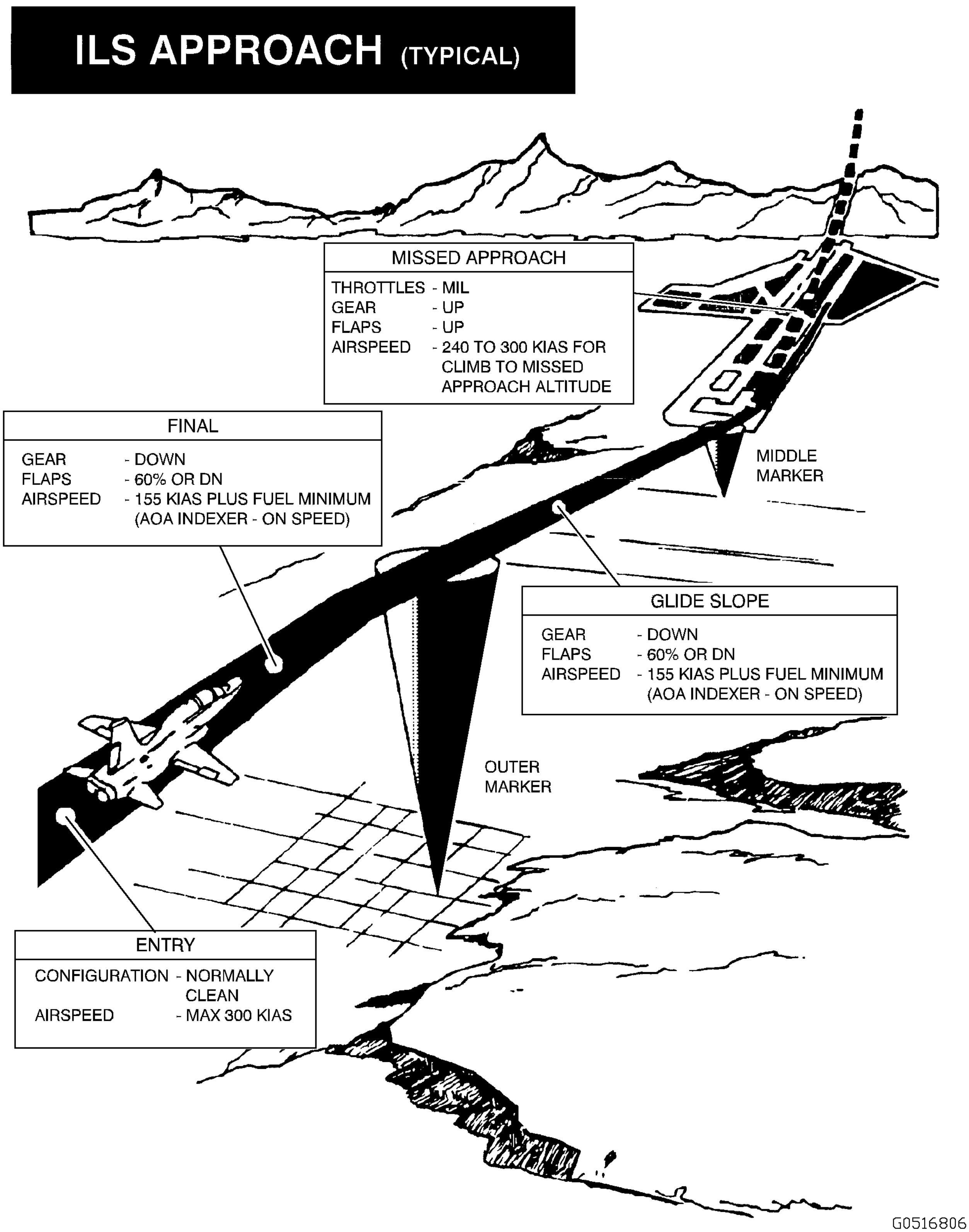

Figure 2-12. ILS Approach (Typical)

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CIRCLING APPROACHES

A circling approach is a visual maneuver flown at a lower altitude than normal VFR overhead traffic pattern. The pilots shallower look angle to the runway causes a tendency to fly a downwind and/or a base leg that is too close to the runway, thus increasing the possibility of an overshoot or steeper than normal final approach. Ensure sufficient downwind and/or base leg displacement prior to initiating the turn to final approach. As the circling maneuver may initially be a level turn, aircraft configuration will require higher power settings than those used in an overhead traffic pattern. Bank angles in excess of 45 degrees may make a level turn impossible under some conditions of heavy gross weights, high temperatures, and pressure altitudes. Maintain 175 KIAS plus fuel minimum and 60% flaps until transitioning to a normal final. AOA indications will vary depending on airspeed, bank angle, and back pressure applied during the circling maneuver. Refer to AFMAN 11-217, Volume 1, for illustrations of circling approach maneuvers.

MISSED APPROACH PROCEDURE

To accomplish a missed approach, advance throttles to MIL, close speed brake (if open) as power is applied, and rotate the aircraft to normal instrument takeoff attitude. Retract landing gear and flaps as in an instrument takeoff and accelerate to 240 to 300 KIAS. Climb at 240 to 300 KIAS to missed approach altitude. Power may be reduced to 90 to 95% to provide a more controllable rate of climb.

FUEL BALANCING (CROSSFEED)

Crossfeeding is recommended when fuel differences exceed 200 pounds. Attempt to enter the traffic pattern in a fuel-balanced condition. Differential power settings should be used to balance fuel to avoid use of the crossfeed operation during low fuel conditions.

1. Fuel Quantity Gauge — TEST (If a malfunctioning fuel gauge is indicated, do not crossfeed.)
2. Crossfeed Switch — ON
3. Boost Pump Switch (on side with the lower fuel quantity) — OFF

WARNING

- With the crossfeed switch ON and either/both boost pumps ON or both boost pumps OFF, a rapid fuel imbalance can occur.
- If crossfeed operation is continued until the active system runs dry, dual engine flameout will occur.

4. Boost Pump Switches — BOTH ON
5. Crossfeed Switch — OFF

FLIGHT DIRECTOR OPERATION

MANUAL HEADING MODE

1. Navigation Mode Switch — TACAN
2. Steering Mode Switch — MANUAL
3. Heading Marker — Set to desired heading
4. Bank Steering Bar — CENTERED

NOTE

The maximum bank angle commanded by the bank steering bar in the manual mode is 35 degrees.

TACAN COURSE INTERCEPTIONS

Select TACAN on navigation mode switch when making TACAN course interceptions.

AN/ARN-118(V) TACAN OPERATION PREFLIGHT CHECK

1. Function Selector Switch — T/R
2. HSI Course — Set to 180 degrees

NOTE

Allow 90-second warm-up.

3. Press-to-Test Button — PRESS and release Observe HSI and test indicator light:
   a. Test indicator light flashes momentarily.
   b. DME warning flag comes into view.
   c. Bearing pointer may slew to 270 degrees for approximately 7 seconds.

NOTE

The following indications last approximately 15 seconds.

   d. DME warning flags go out of view.
   e. Range Indication: 000.0 (±0.5) NM.
   f. Bearing Indication: 180 (±3) degrees.
   g. CDI: Centered (±1/2) dot
   h. To-From arrow: To

I II III IV V VI VII A G IN

GRD TO HYD ELE FUE OXY ENG FLT MISC LND

i. DME warning flag comes into view until a signal is received. Normal operation for Air-to-Ground Navigation.

NOTE

Allow 90-second warm-up.

4. Function Selector Switch — T/R

5. Channel Mode and Selector Switches — SET frequency, ADJUST volume and IDENTIFY station.

6. HSI — CHECK (DME, CDI, To-From arrow, and bearing pointer information displayed)

7. HSI Course Set — ADJUST to proper course (Fly normal intercept procedures. Normal operation for Air-to-Air Navigation)

NOTE

- For A/A operation, use preassigned channels or contact a cooperating aircraft. The channel of the receiving aircraft must be either 63 channels above or below the cooperating aircraft and within the 1 through 126 channel X or Y range. Y mode is preferred to preclude interference since few Y mode ground stations are presently operating. Interference shows mainly as reduced bearing and distance lock- on range. To avoid interference, do not use a Y mode ground station channel within 200 NM of the ground station.
- To prevent IFF/TACAN interference, avoid channels 1 through 11, 58 through 74, and 121 through 126.
- As many as five aircraft can lockon to a PARENT aircraft in A/A T/R mode. The radius of operation for all aircraft involved will be limited to a distance equal to four times the distance between the PARENT aircraft and the nearest other aircraft unless the system is otherwise set by ground maintenance personnel. If system is otherwise set, bearing information received from a PARENT aircraft may be erratic due to resultant noise pickup when an automatic gain control is disabled.

8. Function Selector Switch — A/A T/R

9. Channel Mode and Selector Switches — SET to desired frequency (If the cooperating aircraft is equipped to transmit bearing signals, CDI, distance, to-from, and bearing information will be displayed. If not, DME only will be displaced.)

NOTE

- Automatic Self-Test. If the TACAN signal is lost, an automatic self-test is initiated. This is indicated by the bearing pointer slewing to 270 degrees for about 7 seconds. If the test indicator light illuminates, a system malfunction has occurred and a press-to-test should be accomplished. Changing channel or mode will not initiate a self-test.
- Press-to-Test. If the test indicator light illuminates during flight, perform a preflight test. If the light remains on, repeat the test in REC or A/A REC function. If the light goes out, the malfunction is probably in the transmitter and bearing information is valid. If the light is illuminated in both T/R and REC functions, all information is considered invalid.

SETTING THE DIGITAL CLOCK TIME

To set the time, use the following steps:

1. Enter Time Set Mode: press SEL & CTRL switch buttons simultaneously during clock mode C. The hour digits will flash. Depress CTRL button, hours digit will increment.

2. Depress SEL button, minutes digits will flash. Depress CTRL button, minutes digits will increment.

3. Depress SEL button, seconds digits will flash. Depress CTRL button, seconds digits will increment. Depress SEL button, returns to normal clock.

I II III IV V VI VII A G IN

GRD TO HYD ELE FUE OXY ENG FLT MISC LND

I II III IV V VI VII A G IN

STRANGE FIELD PROCEDURES

The following information provides guidance for operation at fields that do not normally support the aircraft. A Cross servicing guide; TO 1T-38A-2-1-1 is available to ground personnel for normal turnaround under the NATO cross servicing program.

1. Oil: Use Specification MIL-PRF-7808 (NATO 0-148)

   a. Alternate: None.

Oil consumption through engine operation and overboard venting caused by condensation and aerobatic should not exceed 6 ounces per hour. The FULL line on the dipstick under the oil fill cap equates to 8 pints of oil. Each ADD line on the dipstick is equivalent to 1 pint of oil consumption, 6 ounces is equivalent to 0.375 pints. It is very difficult to determine when 6 ounces of oil have been consumed on the dipstick. Use the following oil consumption chart to determine the maximum allowed oil consumption rate when the pilot is responsible for checking engine oil levels within 15 mins of engine shutdown.

Flight Hours	Engine Hours (Assumes 15 mins from engine start to takeoff plus 5 mins taxi time after landing)	Max Oil Consumption (6 ounces per hour limit multiplied by total engine hours) 0.375 pint per hour	Max Oil Consumption (When checking the oil fill cap dipstick within 15 mins of engine shutdown)
0.7	1	0.375	1/2 Pint
0.8	1.1	0.4125	1/2 Pint
0.9	1.2	0.45	1/2 Pint
1	1.3	0.4875	1/2 Pint
1.1	1.4	0.525	3/4 Pint
1.2	1.5	0.5625	3/4 Pint
1.3	1.6	0.6	3/4 Pint
1.4	1.7	0.6375	3/4 Pint
1.5	1.8	0.675	3/4 Pint
1.6	1.9	0.7125	3/4 Pint
1.7	2	0.75	3/4 Pint

2. Fueling: See Table 2-1 FUEL SPECIFICATIONS for approved grades.

   a. Single-point: Use a 45 to 55 PSI system no flow pressure. After fuel flow starts, expect a drop in pressure. Do not increase fuel flow pressure during refueling. Start fuel flowing and then move the precheck valve handle, located next to the single-point fueling adapter, to the PRIM (primary) position. Fuel flow should stop within 10 seconds. Stoppage is indicated by fuel flow not greater than 10 gallons per minute at fuel truck meter. Return precheck valve handle to OFF. Allow fuel flow to continue for a short duration and then place precheck valve handle in the SEC (secondary) position. Fuel flow should stop within 10 seconds. Return precheck valve handle to OFF position and continue refueling. If fuel flow fails to stop in both check positions, do not use single-point refueling.

   b. Manual: Service left system first or aircraft may settle on tail.

3. Oxygen: Use Specification MIL-PRF-27210.

4. Hydraulic fluid and brake fluid: Use Specification MIL-PRF-5606 (NATO H-515) or Specification MIL-PRF-83282 (NATO H-537).

5. Tire pressure: Main - 265 PSI. Nose - 75 PSI

6. Loose fasteners: Use Torq-set bit.

7. Air Starting Units:

   a. Air Force - MA-1, MA-1A, MA-1MP, MA-2, MA-2MP, M32A-60, MA-3MP, A/M 32A-95, and 502-70

   b. Navy - GTC-85, MA-1E, WELLS AIR START SYSTEM, and RCPP/RCPT/NCPP-105

NOTE

If at a location with no USAF/NAVY ground support equipment available, the minimum Start Air requirement is 49 PSI/338 KPA, 340 DEG F/207 DEG C, 60 lb/Min/0.45 KG/S.

8. Electrical Units: (115/200 volts, 3-phase, 400-cycle required).

GRD TO HYD ELE FUE OXY ENG FLT MISC LND

ALTERNATE FUELS

Alternate fuels can be used continuously with a possible loss of efficiency. The use of these fuels might result in increased maintenance. The use of JP-5 is limited to three consecutive flights after which fuel density adjustments must be accomplished for continued use. Any fuel used as an alternate fuel must contain an anti-icing inhibitor. If it does not, it must be used only in an emergency.

EMERGENCY FUELS

Emergency fuels may cause significant damage to the engine or other systems. Examples of conditions that might warrant use of emergency fuels are an accomplishment of an important mission and emergency evacuation flights (see Table 2-1).

1. Use of emergency fuels is restricted to a one-time subsonic flight with minimum maneuvers and power changes. Engine RPM and EGT must be closely monitored to prevent exceeding operating limits during throttle movement. Rapid throttle movements and afterburner lights in flight are allowed only under emergency conditions.

2. Idle speed (minimum thrust) may be increased, acceleration may be faster causing the engine to stall, maximum RPM and EGT may be exceeded, and afterburner fuel flow may be high and cause the engine to stall.

3. When using fuel without an anti-icing inhibitor, flight is restricted to altitudes below the freezing level.

I II III IV V VI VII A G IN

GRD TO HYD ELE FUE OXY ENG FLT MISC LND

I II III IV V VI VII A G IN

Table 2-1. Fuel Specifications

Grade Designation	Specification	NATO Symbol	Freeze Point °C
PRIMARY FUEL			
JET A (Note 1, 5)	ASTM D1655	F-24	-40
JET A +100 (Note 1, 3, 5)	ASTM D1655	F-27	-40
JET A-1 (Note 1, 5)	ASTM D1655	F-34	-47
JP-8	MIL-DTL-83133	F-34	-47
JP-8 BLEND (Note 6)	MIL-DTL-83133	F-34	-47
JP-8 +100 (Note 3)	MIL-DTL-83133	F-37	-47
JP-4	MIL-DTL-5624	F-40	-58
JET B (Note 1, 5)	ASTM D6615	F-40	-58
ALTERNATE FUEL			
JET A+ (Note 5)	ASTM D1655	None	-40
JET A-1+ (Note 5)	ASTM D1655	None	-47
JP-5 (Note 2)	MIL-DTL-5624	F-44	-46
EMERGENCY FUEL			
JET A (Note 5)	ASTM D1655	None	0
JET A-1 (Note 5)	ASTM D1655	None	0
AVGAS 100LL (Note 4)	DEF STAN 91-90	F-18	-58

GENERAL NOTES

* An entry in the AFTO 781 is required when an alternate or emergency fuel is used.
* If possible, the aircraft should be refueled immediately after flight to minimize water condensation in fuel cells.
* JP-4, JP-8, JP-8+100, JP-8 BLEND may be combined to form a mixture containing any quantity of these fuels. Temperature restrictions for JP-8 shall be observed.

SPECIFIC GRADE NOTES

1. Commercial grades (JET A, A-1, and B) for military use have FSII (Fuel System Icing Inhibitor (except JET B)), CI/LI (Corrosion Inhibitor/ Lubricity Improvement), and SDA (Static Dissipator Additive) additives and a NATO symbol.
2. The use of JP-5 is limited to three consecutive flights after which fuel density adjustments must be accomplished for continued use.
3. The +100 thermal additive was discontinued by the USAF in May 2014.
4. When aviation gasoline is used, a 3% lubricating oil, Specification SAE J1899, Type II, must be added to improve its lubricity.
5. Non military commercial grades JET A (US), JET A-1 (EUROPE), JET B (CANADA) Restrictions.
   a. With FSII and CI/LI additives (JET A/A-1++) - No Restrictions.
   b. With FSII and no CI/LI additives (JET A/A-1+) - Engine operation is limited to 10 consecutive hours.
   c. Without FSII - Ensure the temperature is maintained above 0°C (32°F).
   d. JET B does not contain FSII additive due to already low freeze point.
6. JP-8 BLEND is a mixture of JP-8 and up to 50% of Synthetic Paraffinic Kerosene (SPK) or Hydro-treated Renewable Jet (HRJ) IAW MIL-DTL-83133.

GRD
TO
HYD
ELE
FUE
OXY
ENG
FLT
MISC
LND

I
II
III
IV
V
VI
VII
A
G
IN

SECTION III

EMERGENCY PROCEDURES

TABLE OF CONTENTS

GRD
TO
HYD
ELE
FUE
OXY
ENG
FLT
MISC
LND

I
II
III
IV
V
VI
VII
A
G
IN

GRD TO HYD ELE FUE OXY ENG FLT MISC LND

I II III IV V VI VII A G IN

EMERGENCY PROCEDURES

NOTE

- A Critical Procedure is an emergency is an emergency procedure that must be performed immediately without reference to printed checklist and that must be committed to memory. These critical procedures appear in **BOLDFACE** capital letters. Noncritical Procedures are all other steps wherein there is time available to consult the checklist.
- In the event of multiple emergencies, exercise sound judgement as to the appropriate action. A thorough knowledge of the correct procedures and aircraft systems is essential to analyze the situation correctly and determine the best course of action.
- To assist when an emergency occurs, three basic rules are established which apply to most emergencies occurring while airborne. They should be remembered by each aircrew member.

1. Maintain aircraft control.
2. Analyze the situation and take proper action.
3. Land as soon as conditions permit.

LAND AS SOON AS POSSIBLE

An emergency will be declared. A landing should be accomplished at the nearest suitable airfield considering the severity of the emergency, weather conditions, airfield facilities, lighting, aircraft gross weight, and command guidance.

LAND AS SOON AS PRACTICAL (MISSION ABORT)

Emergency conditions are less urgent and, although the mission is to be terminated, the degree of the emergency is such that an immediate landing at the nearest suitable airfield may not be necessary.

WARNING, CAUTION INDICATOR LIGHTS

Warning/Caution Indicator Lights are listed in Table 3-1, together with their cause(s) and corrective action(s) or references. They are listed under two major headings:

a. RED Warning Lights

b. YELLOW Caution Lights

Each display is listed alphabetically under its major heading; however, if the display starts with a single letter (or left or right), that letter (word) is not used to place the display alphabetically.

Do not use Table 3-1 as the sole source for deciding a course of action in the event a warning or caution appears. Review other aircraft and instrument indications before responding.

Table 3-1. Warning/Caution Indicator Lights

Indicator	Cause/Remarks	Corrective Action
RED WARNING LIGHTS		
FIRE	Engine fire detected	Refer to FIRE WARNING DURING FLIGHT (Affected Engine) and ENGINE FIRE DURING START, this section.
GEAR	• Landing gear not down and locked with: • The airspeed is 210 KIAS or less. • The altitude is 10,000 (±750) feet or below. • Both throttles are below 96% RPM.	Increase airspeed (above 210 KIAS), altitude or throttle setting; or lower landing gear (if appropriate).
	• Landing gear handle up and doors not closed. • Landing gear handle down and gear not down and locked.	Refer to LANDING GEAR RETRACTION FAILURE, this section. Refer to LANDING GEAR ALTERNATE EXTENSION, this section.

GRD TO HYD ELE FUE OXY ENG FLT MISC LND

I II III IV V VI VII A G IN

Table 3-1. Warning/Caution Indicator Lights - Continued

Indicator	Cause/Remarks	Corrective Action
CANOPY	Canopy not fully closed and locked	**Ground -** Close and lock canopy. **In Flight -** Land as soon as practical.
	YELLOW CAUTION LIGHTS	
ENG ANTI-ICE ON	ENG ANTI-ICE Switch is in MAN ON position	Information
LEFT FUEL PRESS; RIGHT FUEL PRESS	• Low fuel pressure • Loss of boost pump **NOTE** Reset boost pump circuit breaker only one time. • Fuel leak • Fuel line leak • Generator phase failure • Surging of engine driven pump	Refer to LOW FUEL PRESS LIGHT ILLUMINATED/FUEL LEAK, this section.
FUEL LOW	Either fuel quantity indicator reads below 275 to 225 pounds.	Check left and right fuel quantity indicators to determine which system is low.
LEFT GENERATOR; RIGHT GENERATOR	• Designated generator offline • Either generator can support the total aircraft electrical load	Refer to GENERATOR FAILURE (In Flight), GENERATOR FAILURE (No AC Crossover), GENERATOR FAILURE – PARTIAL, GEARBOX FAILURE TO SHIFT, this section.
FLIGHT HYDRAULIC; UTILITY HYDRAULIC	Hydraulic system • Fluid over temperature • Low pressure	Refer to HYDRAULIC MALFUNCTION (CAUTION LIGHT(S) ILLUMINATED), this section.
OXYGEN	• Oxygen indicator reads 1 liter or less of liquid oxygen • Light may blink due to oxygen sloshing if system contains less than 3 liters	Information
XMFR RECT OUT	• Failure of both transformer-rectifiers • DC-powered systems supplied by aircraft battery	Refer to TRANSFORMER-RECTIFIER FAILURE, this section.
CAUTION	MASTER CAUTION light is on	Correct problem causing MASTER CAUTION light illumination.

GRD
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FUE
OXY
ENG
FLT
MISC
LND

GROUND-OPERATION EMERGENCIES

ENGINE FIRE DURING START

If a fire light illuminates or if there is other indication of a fire, proceed as follows:

1. Throttles — OFF
2. Battery — OFF

NOTE

Time and conditions permitting, alert the ground controlling agency and the other crewmember of egress intentions prior to shutting the BATTERY off.

Refer to EMERGENCY GROUND EGRESS to abandon the aircraft.

EXCESSIVE HYDRAULIC PRESSURE (CAUTION LIGHT NOT ILLUMINATED) ON GROUND

NOTE

Cycling the flight controls once, may reduce indicated hydraulic pressure indication if air has been introduced into the respective hydraulic system during servicing.

1. Throttle Gate — DISENGAGE
2. Affected Engine — SHUT DOWN

DEPARTING PREPARED SURFACE

Any time the aircraft departs a hard surface (taxiway or runway), immediately shut down both engines. Refer to EMERGENCY GROUND EGRESS to abandon the aircraft.

SMOKE, FUMES OR ODORS IN COCKPIT (GROUND)

All odors not identifiable shall be considered toxic. If smoke, fumes or odors are encountered in the cockpit, proceed as follows:

1. Abort

NOTE

Do not take off if smoke, fumes or unidentified odors are detected.

If canopies are closed -

2. Oxygen — 100%

NOTE

If odors persist, consider use of emergency oxygen bottle. If the emergency oxygen supply is activated, disconnect from the normal aircraft oxygen system.

3. Check for Fire
4. Cabin Pressure Switch — RAM DUMP

NOTE

Vibrations accompanied by fumes and/ or odors from the air conditioning system may indicate air conditioner turbine failure. If this condition is suspected, select oxygen - 100% and select RAM DUMP to deactivate the air conditioning system. This should stop the vibrations.

5. Canopy — OPEN

NOTE

If aircraft is not stopped, ensure safe operating speed is attained prior to initiating canopy operation.

6. If Fire or Smoke, Fumes Becomes Severe — EMERGENCY GROUND EGRESS

EMERGENCY GROUND EGRESS

Emergency egress on the ground as follows:

1. Throttle Gate — DISENGAGE
2. Throttles — OFF

CAUTION

The canopy seals will remain inflated if engines are shut down with both canopies locked making the canopies more difficult to open.

3. Notify crewmember of decision to ground egress — AS REQUIRED
4. Battery Switch — OFF
5. Seat Safety Pin — INSTALL

I
II
III
IV
V
VI
VII
A
G
IN

WARNING

Ensure the seat safety pin is installed and all equipment is properly secured to prevent entanglement with the ejection seat handgrips and possible handgrip movement during egress.

6. Survival Kit Emergency Release Handle — PULL

WARNING

- Inadvertently raising the ejection seat handgrip rather than the survival kit emergency release handle will cause ejection.
- To avoid kit deployment and possible pilot-survival kit entanglement during emergency exit, the survival kit must be seated firmly in position before the survival kit emergency release handle is pulled.

7. Personal Leads — DISCONNECT
8. Safety Belt — DISCONNECT
9. Visor(s) — DOWN (As Required)
10. Canopy — OPEN (NORMAL/JETTISON)(As Required)
11. Cockpit — EXIT

USE OF CANOPY BREAKER TOOL

1. To break the canopy, grasp the canopy breaker tool with both hands and use your body weight behind an arm swinging thrust. Aim the point of the tool to strike perpendicular to the canopy surface. The blade alignment will determine the direction of the cracks. No set pattern of blows is necessary on the front canopy. Several minutes of chopping may be required to open an adequate hole in the rear canopy (see Figure 3-1).

WARNING

To preclude personal injury, the curved edge of the blade must be towards you. This will allow glancing blows against the canopy to deflect away from you.

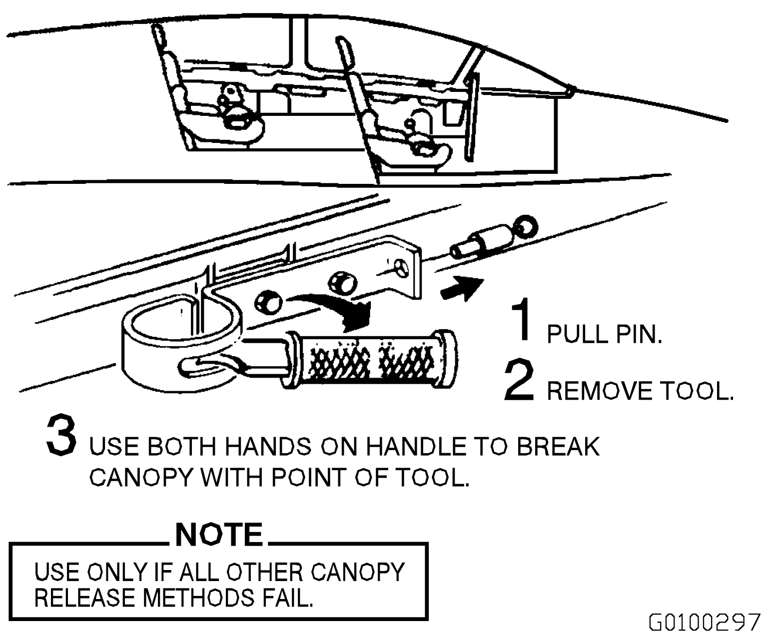

Figure 3-1. Canopy Breaker Tool

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OVER-PRESSURE OF OXYGEN SYSTEM (GROUND)

A pressure of greater than 120 psi indicated on the oxygen regulator pressure gage could indicate a potential relief valve failure, and immediate action is required. Perform the following actions to help relieve pressure until maintenance can be performed.

1. Oxygen supply hose(s) — hang over the side of aircraft

CAUTION

Pure oxygen is heavier than air. When attempting to allow oxygen to free-flow from the regulators, oxygen hoses must be hung over the side of the cockpit to prohibit the buildup of high-purity oxygen within the cockpit. Failure to do so increases risk of fire leading to significant damage to the aircraft and injury to personnel.

2. Oxygen pressure regulator(s) — EMERGENCY-100%-ON

WARNING

A pressure indication of greater than 450 psi may indicate a potentially more hazardous situation in that explosion of the LOX Converter may be imminent. Quickly perform steps, then evacuate area immediately and maintain a safe distance away from the aircraft.

3. Note oxygen pressure and notify ground personnel.

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TAKEOFF EMERGENCIES

ABORT

If the decision is made to abort during takeoff or a touch-and-go-landing, variables such as gross weight, pressure altitude, runway condition (i.e., dry, wet, icy), and runway length must be evaluated.

The braking energy required during a high speed, heavy gross weight abort may result in brake failure, a significant decrease in braking effectiveness, hot brakes or tire failure/fire. An aborted takeoff with a tire failure presents a greater problem than landing with a failed tire. The effects of tire failure are most pronounced at heavy gross weights and speeds below 100 KIAS. Directional control is more difficult and braking effectiveness is greatly reduced at higher gross weights.

Below 130 KIAS, maximum deceleration can be obtained by optimum braking in three-point attitude, but tests have demonstrated that optimum braking is difficult to achieve and should not be attempted at airspeeds above 100 KIAS.

Aerodynamic braking is more effective than cautious wheel braking above 100 KIAS and it avoids the potential for skidding, blown tires, brake failure, etc. Therefore, use aerodynamic braking to the maximum extent possible during any abort above 100 KIAS. Once the nose wheel returns to the runway, initiate smooth-brake application with the stick full aft, increases brake pressure as the airspeed decreases. Unless brake failure occurs, avoid pumping the brakes. During heavy gross weight aborts, the nose will lower at approximately 120 KIAS. When the nosewheel is lowered to the runway, immediately commence moderate braking while maintaining full aft stick. Optimum braking should not be attempted in excess of 100 KIAS. Aerodynamic braking performed with less than full flaps or 12-degree pitch attitude becomes progressively less effective. Aerobraking is recommended even if it is not possible to obtain this optimum configuration and pitch attitude. If runway length is insufficient to completely stop the aircraft, decelerate as much as possible and prepare to engage the barrier or depart the hard surface.

WARNING

Due to the potential of an out-of-control situation, ensure the nosewheel steering button is not depressed during takeoff roll. Unintentional nosewheel steering activation during an abort may place the aircraft in an unrecoverable skid.

CAUTION

During high speed abort situations, it is essential maximum aerodynamic braking be attained. Once established in an aerobrake, lowering flaps will further reduce the stopping distance. Flaps should not be repositioned until the full aft stick pitch attitude is attained. The aircraft may become airborne if flaps are lowered above the computed full flap touchdown speed.

1. **THROTTLES — IDLE**

CAUTION

Certain failures of the main fuel control may result in an engine remaining at the power setting selected at the time of failure despite additional throttle movements. With an engine stuck at a high power setting consider shutting down the engine to preclude excessively fast abort speeds which may result in extremely hot brakes and possible barrier engagement/runway departure. If the engine cannot be shut down with the throttle, close the affected fuel shutoff switch.

NOTE

If the abort was made as a result of an engine fire, place the throttle of the affected engine to OFF once the aircraft is under control. If the fire is confirmed, accomplish the EMERGENCY GROUND EGRESS procedures once the aircraft is stopped.

2. **WHEEL BRAKES — AS REQUIRED**

WARNING

- Braking required for high speed, heavy gross weight abort may result in extremely hot brakes or brake failure and possibility of tire fire should be anticipated.
- If hot brakes are suspected, the aircraft should not be taxied into congested area. Ensure all personnel remain clear of the main wheels until they have cooled. Comply with local hot brakes procedures/directive.

CAUTION

- Heavy braking above 100 KIAS may cause skidding, tire failure, and loss of directional control.
- Extreme caution must be exercised when applying wheel brakes above 120 KIAS as locked wheels or tire skids are difficult to recognize. If tire skid is detected, immediately release both brakes and cautiously reapply.
- An aborted takeoff with tire failure will present a greater problem than landing with a failed tire. The effects of a tire failure are most pronounced at heavy gross weights and speeds below 100 KIAS. Directional control is more difficult and braking effectiveness is greatly reduced at higher Gross Weight.

BARRIER ENGAGEMENT

Barrier engagement may be necessary either during an aborted takeoff or after landing with an aircraft malfunction affecting stopping distance or capabilities. Approach the barrier perpendicularly, in 3-point attitude, and, if possible, in the center. Prior to engagement, the brakes should be released and then reapplied after passing the barrier. After barrier engagement, actuation of the flight controls or changing the aircraft configuration may cause damage to the aircraft.

NOTE

MA-1, MA-1A, and BAK-15 (61QSII) are the only suitable barriers.

For MA-1/MA-1A barriers, the minimum engagement speed is approximately 60 knots. Expect nose or main gear failure above 120 knots if aborting while heavy weight. The designed dynamic limit for the MA-1/MA-1A is 150 knots for all aircraft. Barrier failure can occur during attempted engagements above this speed. Engagement may not be successful so pilots must reapply brakes after engagement attempt. Aircraft with centerline pylon or external stores, or with the speed brakes open, may not successfully engage an MA-1/MA-1A barrier.

The BAK-15 is large web-type barrier that fighter-type aircraft have successfully engaged at speeds up to 200 knots. Successful engagement is completely independent of aircraft configuration. Pilots should be aware of the actual barrier position before arrival or departure. It is designed to be activated by tower personnel on command from the pilot and should be in the raised position within 5 to 7 seconds or it may be left in the raised position continuously.

1. Shoulder Harness — LOCK
2. Speed Brake — CONFIRM CLOSED

Prior to BARRIER ENGAGEMENT

3. Brakes — DISENGAGE (IMMEDIATELY PRIOR TO BARRIER ENGAGEMENT)
4. Barrier — ENGAGE IN A THREEPOINT ATTITUDE

WARNING

To minimize damage to aircraft and loss of life, steer so as to engage perpendicular to and preferably in the center of the barrier/net. Discontinue braking just prior to engagement and continue again after barrier/net is engaged.

CAUTION

- Discontinue braking just prior to engagement and continue again after barrier is engaged.
- BAK-15 engagements may result in canopy entanglement. In this case do not attempt canopy jettison. Consider use of the canopy breaker tool if egress is required. Opening the canopy prior to engagement may result in serious injury.
- MA-1, MA-1A barrier engagement is unlikely with center line pylon or external stores installed or speed brake open.

5. Brakes — REAPPLY

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ENGINE FAILURE/FIRE WARNING DURING TAKEOFF, TAKEOFF CONTINUED

If an engine fails on takeoff prior to reaching decision speed, use the procedure in this section titled ABORT or BARRIER ENGAGEMENT. If an engine fails on takeoff above the computed decision speed, it is possible to continue the takeoff. Limited excess thrust is available for takeoff, acceleration, and climb-out when operating on a single engine. The available runway should be used to accelerate the aircraft above Single-Engine Takeoff Speed (SETOS). The computed SETOS is the minimum speed at which the aircraft will take off and be able to fly out of ground effect with a minimum of 100 FPM rate of climb.

Thrust predictions of the takeoff factor can be verified only by an accurate acceleration speed check. A significant relationship exists between airspeed and initial climb performance: between SETOS and SETOS + 10 KIAS; single-engine climb performance increases approximately 35 feet per minute for each knot of airspeed above SETOS. Best acceleration occurs with the aircraft in a 3-point attitude, with the stick at or slightly aft of the takeoff trim setting. The nosewheel should not be allowed to DIG-IN, nor should it be permitted to lift off. This attitude must be maintained until the airspeed reaches a minimum of SETOS. Initial pitch attitude is shallower than normal. Climb should be restricted to only that required to avoid obstacles until the airspeed reaches 200 KIAS and flaps are retracted. The gear should be retracted as soon as the aircraft is airborne above SETOS + 10 KIAS. Gear door drag is not a factor during retraction above SETOS + 10 KIAS. The flaps should be raised after gear retraction and above 200 KIAS.

Due to the critical nature of airspeed and altitude and the ejection envelope, the decision made by the pilot may vary.

1. **THROTTLES — MAX**

WARNING

Continuing a takeoff on a single engine should be attempted only at maximum thrust.

NOTE

Depending on airspeed and altitude, it may be necessary to leave the throttle of the affected engine at a high power setting until reaching a safe airspeed and/or altitude for ejection.

2. **FLAPS — 60%**

WARNING

With other than 60% flaps, single-engine capability is impaired to such an extent that the combination of temperature, pressure altitude, and gross weight may make takeoff impossible.

NOTE

After flaps are set at 60%, the flap indicator should be checked to make sure flaps are within 60% range (55 to 65%).

3. **AIRSPEED — ATTAIN SETOS MINIMUM**

WARNING

If engine failure occurs after rotation, it will probably be necessary to lower the nose to attain speed above SETOS. If engine failure occurs after takeoff, it may be necessary to allow the aircraft to settle back to the runway.

CAUTION

The nosewheel tire limit may be exceeded prior to reaching SETOS + 10 KIAS.

4. Gear — UP (when airborne above SETOS + 10 KIAS)

NOTE

- If the left engine is inoperative but windmilling, generally, gear retraction may be accomplished but will require an extended time period; however, gear doors may not completely close. Gear retraction, when initiated between SETOS plus 10 knots and 200 KIAS, may require up to 1 minute.
- If unable to retract the landing gear, best level flight/climb capability is obtained at 200 KIAS with 60% flaps or at 220 KIAS with the flaps up.

5. Flaps — UP (as required above 200 KIAS)

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NOTE

At high gross weight, with the landing gear extended, flap retraction should not be initiated prior to 220 KIAS.

TIRE FAILURE DURING TAKEOFF, TAKEOFF CONTINUED

A takeoff abort with tire failure will present a greater problem than landing with a failed tire. The effects of a tire failure are most pronounced at heavy gross weights and speeds below 100 KIAS. Directional control is more difficult and braking effectiveness is greatly reduced at higher gross weights.

1. **GEAR — DO NOT RETRACT**

If possible, reduce fuel weight prior to landing. Land on side of runway away from blown tire and make maximum use of rudder and wheel braking to maintain directional control. Nosewheel steering is engaged as a final attempt to maintain or regain directional control. Make sure rudder pedals are neutralized prior to engaging nosewheel steering. Once aircraft is stopped, Do not clear the runway, change configuration or activate flight controls.

LANDING GEAR RETRACTION FAILURE

If both throttles are below 96%, altitude is below 10,000 feet (±750), and airspeed has not increased above 210 KIAS, the landing gear light and landing gear warning horn may remain on. Move one throttle above 96% while remaining below 240 KIAS.

It may be necessary to reduce fuel weight to obtain a safe landing distance. As a guide, landing distance will be approximately (fuel weight plus 2500) past the touchdown point (with full flaps).

If the landing gear lever warning light remains illuminated after the lever has been moved to the LG UP position -

1. Airspeed — MAINTAIN BELOW 240 KIAS

2. Landing Gear Lever — LG DOWN

NOTE

After placing the landing gear lever down and a safe gear down indication is obtained, Do not retract or recycle the gear unless a greater emergency exists.

3. Land as soon as practical.

If unable to raise the landing gear, aircraft will consume approximately 10 – 15 pounds of fuel per nautical mile. When configured with gear down and full flaps, the aircraft will burn approximately 60 pounds/minute at low altitudes and airspeeds below 220 KIAS.

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HYDRAULIC EMERGENCIES

HYDRAULIC SYSTEMS MALFUNCTIONS

Three different types of hydraulic system malfunctions may be encountered: hydraulic fluid overtemperature, low pressure, and high pressure. The UTILITY HYDRAULIC or FLIGHT HYDRAULIC caution light will illuminate for either a fluid overtemperature or a low pressure condition. To determine the cause of a hydraulic caution light, check indicators. Readings below 1500 PSI indicate a low pressure situation. Momentary drops in pressure sufficient to cause illumination of the hydraulic caution light may be an indication of an unpressurized system. Normal or excessive pressure readings indicate a fluid overtemperature condition. The hydraulic indicators provide the only warning of high hydraulic pressure, a situation that can cause a hydraulic overtemperature condition. Although fluid overtemperature and high pressure usually occur together, it is possible to have one without the other. The corresponding engine should be shut down immediately whenever an overtemperature condition exists. If the right engine is to be shut down, check crossover. If crossover is bad, consider lowering 60% flaps to reduce landing distance and trim the aircraft to final approach airspeed (fuel permitting). If crossover is good, leave generator OFF. If the pressure is high, but not accompanied by a caution light or sluggish controls, land as soon as possible. Be alert for the indications of overtemperature. If a leak is suspected, consider an emergency ground egress.

HYDRAULIC MALFUNCTION (CAUTION LIGHT(S) ILLUMINATED)

NOTE

- When a flight hydraulic system fails, utility hydraulic system will operate flight controls.
- When a utility hydraulic system fails, the stability augmenter, nosewheel steering, normal landing gear extension, and speed brake are inoperative.

If the UTILITY/FLIGHT HYDRAULIC caution lights illuminate, use the following procedure:

1. Hydraulic pressure indicators — CHECK

WARNING

With dual hydraulic failure (both gages read zero), eject. Do not delay ejection in futile attempts to adjust aircraft parameters. Aircraft control is impossible despite feedback provided by artificial feel assembly.

If hydraulic pressure is low –

2. Both hydraulic systems — MONITOR (AVOID ZERO AND NEGATIVE-G FLIGHT.)

WARNING

If one system reads zero, hydraulic system transfer may occur. In this case, flight time could be limited to only 35 minutes.

3. Land as soon as possible.

CAUTION

If utility hydraulic pressure is depleted, stop straight ahead and have gear pins installed prior to clearing runway.

If hydraulic pressure is normal or high (fluid overtemperature) –

4. Throttle Gate — DISENGAGE
5. Affected engine — SHUTDOWN

WARNING

Hydraulic pressure provided solely by a windmilling engine is insufficient to control the aircraft for landing.

NOTE

- If the hydraulic caution light goes out, the engine may be restarted if necessary. However, the engine should be left shut down as long as possible to permit maximum cooling of hydraulic fluid.
- If the right engine is to be shut down, check crossover. If crossover is bad, consider lowering 60% flaps to reduce landing distance and trim the aircraft to final approach airspeed (fuel permitting). If crossover is good, leave generator OFF.

6. Land as soon as possible.

CAUTION

If utility hydraulic pressure is depleted, stop straight ahead and have gear pins installed prior to clearing runway.

Refer to:

- LANDING GEAR ALTERNATE EXTENSION (if applicable)
- ENGINE FAILURE/SHUTDOWN DURING FLIGHT

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EXCESSIVE HYDRAULIC PRESSURE (CAUTION LIGHT(S) NOT ILLUMINATED) (IN FLIGHT)

A steady-state hydraulic pressure higher than 3200 PSI in either system must be considered a system malfunction.

1. Affected engine — SHUT DOWN (IF ACCOMPANIED BY SLUGGISH FLIGHT CONTROLS)

WARNING

- Hydraulic pressure provided solely by a windmilling engine is insufficient to control the aircraft for landing.
- If an engine is shut down and a dual hydraulic failure occurs (both gauges read zero), eject. Do not delay ejection in futile attempts to adjust aircraft parameters. Aircraft control is impossible despite feedback provided by artificial feel assembly.

NOTE

- Sluggish flight controls are indicated by slow or erratic response to normal control inputs. If the actuator seals continue to expand to the point of binding, the flight controls will not respond to stick inputs. In case of binding flight controls, consideration should be given to ejecting.
- If the right engine is to be shut down, check crossover. If crossover is good, leave generator OFF. If crossover is bad, consider lowering 60% flaps to reduce landing distance and trim the aircraft to final approach airspeed (fuel permitting).

2. Land as soon as possible.

CAUTION

If utility hydraulic pressure is depleted, stop straight ahead and have gear pins installed prior to clearing runway.

3. After landing and clear of runway, shut down the affected engine (if not already accomplished).

Refer to ENGINE FAILURE/SHUTDOWN DURING FLIGHT

GEARBOX FAILURE - AIRFRAME MOUNTED

A complete gearbox failure is indicated by simultaneous illumination of the LEFT/RIGHT GENERATOR and FLIGHT/UTILITY HYDRAULIC caution lights for the same engine. Additionally, with complete gearbox failure, the applicable hydraulic gauge will indicate zero pressure. Since cockpit indications of a seized engine closely resemble the indications of a gearbox failure, prior to confirming gearbox failure, all engine instruments must be analyzed to confirm that the engine is still operating normally.

If the gearbox shaft fails at its designed failure point, with no associated vibration, the engine can continue to be operated normally.

If the gearbox itself fails (gears,bearings,etc.) excessive vibrations will normally result and the engine should be shut down.

If gearbox fails completely and excessive vibration exists:

1. Throttle Gate — DISENGAGE
2. Throttle (Affected Engine) — OFF

Refer to:

- ENGINE FAILURE/SHUTDOWN DURING FLIGHT
- HYDRAULIC MALFUNCTION (CAUTION LIGHT(S) ILLUMINATED)
- GENERATOR FAILURE (IN FLIGHT)

DUAL GEARBOX FAILURE — AIRFRAME MOUNTED

NOTE

Dual gearbox failure will result in total loss of hydraulics and AC electrical power.

1. If dual gearbox failure occurs — EJECT

WARNING

With dual hydraulic failure (both gages read zero), eject. Do not delay ejection in futile attempts to adjust aircraft parameters. Aircraft control is impossible despite feedback provided by artificial feel assembly.

Refer to: EJECTION PROCEDURE

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ELECTRICAL EMERGENCIES

BOTH GENERATORS INOPERATIVE (Battery Operative)
LEFT AND RIGHT AC BUSSES OFFLINE

OPERATIVE EQUIPMENT

FLIGHT CONTROL
- Flap position indicator
- Flap control (L/R) (no operation)
- Speed brake

FUEL
- Crossfeed valve
- Fuel and oxygen quantity test
- Firewall valves

POWERPLANT
- Engine start (L/R)
- Afterburner control (L/R)
- Ignition inverter
- Fire detection (L/R)
- Generator control (L/R)
- Nozzle position indicator (L/R)

ELECTRICAL
- Emergency floodlights
- Formation lights
- Cockpit warning lights (Front/Rear)
- Bus monitor (L/R)

LANDING GEAR
- Landing gear warning
- Landing gear control, safety, and steering

INSTRUMENTS
- Transmitter and Clocks
- Standby Attitude Indicator

RADIO, COMMUNICATION, AND NAVIGATION
- AN/ARC-164 UHF command radio
- AN/AIC-18 Intercom
- AN/ARN-147 ILS
- Rate of Turn and Attitude Gyro
- AIMS Monitor

INOPERATIVE EQUIPMENT

FLIGHT CONTROL
- Stability Augmenter
- Flap Actuator (L/R)
- Trim Control

PNEUDRAULIC
- Oxygen quantity indicator [1]
- Cabin conditioning
- Cabin air valves
- Canopy seals

FUEL
- Fuel pump (L/R)
- Fuel flow indicator (L/R [1])
- Fuel quantity (L/R [1])

POWERPLANT
- Oil pressure indicator (L/R [1])
- Hydraulic pressure indicator (L/R [1])
- Exhaust gas temperature indicator (L/R [1])
- Engine ignition
- Engine anti-ice operation

ELECTRICAL
- Transformer rectifier (L/R)
- Landing and taxi lamp and control
- Beacon and position lights
- Console and instrument lights
- Flood and utility lights
- Nose equipment cooling (L/R) and control
- Power seats (Front/Rear)
- Caution and warning indication
- Electronic test receptacle

INSTRUMENTS
- Angle of attack computer and heater
- Rate of turn gyro
- Attitude gyro and indicator
- Pitot heater
- Flight director computer

RADIO, COMMUNICATION, AND NAVIGATION
- AN/APX-64 AIMS
- AN/ARN-118 TACAN
- Radio transfer relays

[1] Available via static inverter (oxygen/fuel quantity check switch or L/R engine start cycle)

Figure 3-2. Emergency Power Distribution (Sheet 1 of 5)

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DUAL TRANSFORMER RECTIFIER FAILURE
Both Generators Operative (Battery Operative)

OPERATIVE EQUIPMENT

FLIGHT CONTROL

- Stability Augmenter
- Flap Position Indicator
- Flap control (L/R)
- Flap Actuator (L/R)
- Speed Brake
- Trim Control

PNEUDRAULIC

- Oxygen quantity indicator
- Cabin conditioning
- Cabin air valves
- Canopy seals

FUEL SYSTEMS

- Crossfeed valve
- Fuel and oxygen quantity test
- Firewall Valves
- Fuel pump (L/R)
- Fuel flow indicator (L/R)
- Fuel quantity (L/R)

POWERPLANT

- Engine start (L/R)
- Afterburner control (L/R)
- Ignition inverter
- Fire detection (L/R)
- Generator control (L/R)
- Nozzle position indicator (L/R)
- Inlet duct anti-ice control
- Oil pressure indicator (L/R)
- Hydraulic pressure indicator (L/R)
- Exhaust gas temperature indicator (L/R)
- Engine ignition
- Engine anti-ice operation

ELECTRICAL

- Emergency floodlights
- Formation lights
- Cockpit warning lights (Front/Rear)
- Bus monitor (L/R)
- Transformer rectifier (L/R)
- Landing and taxi lamp and control
- Beacon and position lights
- Console and instrument lights
- Flood and utility lights
- Nose equipment cooling (L/R) and control
- Power seats (Front/Rear)
- Caution and warning indication
- Electronic test receptacle

LANDING GEAR

- Landing gear warning
- Landing gear control, safety, and steering

INSTRUMENTS

- Transmitter
- Standby Attitude Indicator
- Clocks
- Angle of attack computer and heater
- Rate of turn gyro
- Attitude gyro and indicator
- Pitot heater
- Flight director computer

RADIO, COMMUNICATION, AND NAVIGATION

- AN/APX-64 AIMS
- AN/ARN-118 TACAN
- Radio transfer relays
- AN/ARC-164 UHF command radio
- AN/AIC-18 Intercom
- AN/ARN-147 ILS
- Rate of Turn and Attitude Gyro

INOPERATIVE EQUIPMENT

Figure 3-2. Emergency Power Distribution (Sheet 2)

DUAL TRANSFORMER RECTIFIER FAILURE Both Generators Operative (Battery Dead)	
OPERATIVE EQUIPMENT	
FLIGHT CONTROL	**ELECTRICAL**
Stability Augmenter System	Landing-Taxi Light
Flight Trim System	Anti-Collision Beacon Lights
PNEUDRAULIC	Position Lights
Oxygen Quantity Indicator	Console and Instrument Lights
Cabin Air Conditioning	Floodlights (Normal)
Canopy Seals	Nose Equipment Bay Cooling
FUEL SYSTEMS	Seat Adjustment (Front/Rear)
Fuel Boost Pumps (L/R)	Caution, Warning, and Indicator Lights (Dim)
Fuel Flow Indicators (L/R)	**INSTRUMENTS**
Fuel Quantity Indicators (L/R)	Angle of Attack Computer and Indicator
POWERPLANT	Angle of Attack Vane Anti-Icing
Oil Pressure Indicators (L/R)	Attitude Director Indicator (ADI) (Attitude Sphere)
Hydraulic Pressure Indicators (L/R)	Pitot Heat
Exhaust Gas Temperature Indicators (L/R)	**RADIO, COMMUNICATION, AND NAVIGATION**
Engine Anti-Ice	Cockpit Control Transfer System
INOPERATIVE EQUIPMENT	
FLIGHT CONTROL	**LANDING GEAR**
Flaps	Landing Gear Audible Warning
Flap Position Indicator	Landing Gear Control and Safety Circuits
Speed Brake	Nosewheel Steering
FUEL SYSTEMS	RCP Nose Landing Gear Light
Crossfeed Valve	**INSTRUMENTS**
Fuel/Oxygen Check Switch	Altimeter Vibrator (Standby)
Fuel Shutoff Valves (L/R)	Standby Attitude Indicator
POWER PLANT	Clocks
Engine Start (L/R)	AOA Indexer
Afterburner Ignition (L/R)	Flight Director System
Fire Warning and Detection (L/R)	**RADIO, COMMUNICATION, AND NAVIGATION**
Nozzle Position Indicators (L/R)	AN/APX-64 AIMS
Static Inverter	AN/ARN-118 TACAN
ELECTRICAL	AN/ARC-164 UHF radio
Floodlights (Emergency)	AN/AIC-18 Intercom
Formation Lights	AN/ARN-147 ILS
Utility Lights	ADI Bank and Pitch Steering Bars
Caution, Warning, and Indicator Lights (Bright)	

Figure 3-2. Emergency Power Distribution (Sheet 3)

LEFT GENERATOR INOPERATIVE (No AC Crossover)

OPERATIVE EQUIPMENT

FLIGHT CONTROL

- Flap Position Indicator
- Flap control (L/R)
- Flap Actuator (L/R)
- Speed Brake and Trim Control

PNEUDRAULIC

- Oxygen quantity indicator
- Cabin conditioning
- Cabin air valves and Canopy seals

FUEL SYSTEMS

- Crossfeed and Firewall valves
- Fuel and oxygen quantity test
- Fuel pump (L/R)
- Fuel flow indicator (L/R)
- Fuel quantity (L/R)

POWERPLANT

- Engine start (L/R)
- Afterburner control (L/R)
- Ignition inverter and Engine ignition
- Fire detection (L/R)
- Generator control (L/R)
- Nozzle position indicator (L/R)
- Inlet duct anti-ice control
- Oil pressure indicator (L/R)
- Hydraulic pressure indicator (L/R)
- Exhaust gas temperature indicator (L/R)
- Engine anti-ice operation

ELECTRICAL

- Emergency floodlights
- Formation lights
- Cockpit warning lights (Front/Rear)
- Bus monitor (L/R)
- Transformer rectifier (L/R)
- Flood and utility lights
- Nose equipment cooling (L/R) and control
- Power seats (Front/Rear)
- Caution and warning indication
- Electronic test receptacle

LANDING GEAR

- Landing gear warning
- Landing gear control, safety, and steering

INSTRUMENTS

- Transmitter
- Standby Attitude Indicator
- Clocks and Pitot heater
- Rate of turn gyro
- Attitude gyro and indicator
- Flight director computer

RADIO, COMMUNICATION, AND NAVIGATION

- AN/ARN-118 TACAN
- Radio transfer relays
- AN/ARC-164 UHF command radio
- AN/AIC-18 Intercom
- AN/ARN-147 ILS
- Rate of Turn and Attitude Gyro

INOPERATIVE EQUIPMENT

FLIGHT CONTROL

- Stability Augmenter

PNEUDRAULIC

- Oxygen quantity indicator
- Cabin conditioning
- Cabin air valves and Canopy seals

FUEL SYSTEMS

- Fuel pump and Fuel quantity (L)
- Fuel flow indicator (L)

POWERPLANT

- Oil pressure indicator (L)
- Hydraulic pressure indicator (L)
- Exhaust gas temperature indicator (L)

ELECTRICAL

- Bus monitor (L)
- Transformer rectifier (L)
- Landing and taxi lamp and control
- Beacon and position lights
- Console and instrument lights

INSTRUMENTS

- Angle of attack computer and heater

RADIO, COMMUNICATION, AND NAVIGATION

- AN/APX-64 AIMS

Figure 3-2. Emergency Power Distribution (Sheet 4)

RIGHT GENERATORS INOPERATIVE (No AC Crossover)

OPERATIVE EQUIPMENT

FLIGHT CONTROL

- Stability Augmenter
- Flap position indicator
- Speed brake

FUEL SYSTEMS

- Crossfeed valve
- Fuel and oxygen quantity test
- Firewall valves
- Fuel pump (L)
- Fuel flow indicator (L)
- Fuel quantity (L)

POWERPLANT

- Engine start (L/R)
- Afterburner control (L/R)
- Ignition inverter
- Fire detection (L/R)
- Generator control (L/R)
- Nozzle position indicator (L/R)
- Inlet duct anti-ice control (no operation)
- Oil pressure indicator (L)
- Hydraulic pressure indicator (L)
- Exhaust gas temperature indicator (L)
- Engine ignition

ELECTRICAL

- Emergency floodlights
- Formation lights
- Cockpit warning lights (Front/Rear)
- Bus monitor (L/R)
- Transformer rectifier (L)
- Landing and taxi lamp and control
- Beacon and position lights
- Console and instrument lights

LANDING GEAR

- Landing gear warning
- Landing gear control, safety, and steering

INSTRUMENTS

- Transmitter and Clocks
- Standby Attitude Indicator
- Angle of attack computer and heater

RADIO, COMMUNICATION, AND NAVIGATION

- AN/APX-64 AIMS
- AN/ARC-164 UHF command radio
- AN/AIC-18 Intercom
- AN/ARN-147 ILS
- Rate of Turn and Attitude Gyro

INOPERATIVE EQUIPMENT

FLIGHT CONTROL

- Flap Actuator (L/R)
- Trim Control

PNEUDRAULIC

- Oxygen quantity indicator [1]
- Cabin conditioning
- Cabin air valves and Canopy seals

FUEL SYSTEMS

- Fuel pump (R)
- Fuel flow indicator (R [1])
- Fuel quantity (R [1])

POWERPLANT

- Engine start (R)
- Oil pressure indicator (R [1])
- Hydraulic pressure indicator (R [1])
- Exhaust gas temperature indicator (R [1])
- Engine anti-ice operation (default on)

ELECTRICAL

- Bus monitor (R)
- Transformer rectifier (L/R)
- Flood and utility lights
- Nose equipment cooling (L/R) and control
- Power seats (Front/Rear)
- Caution and warning indication
- Electronic test receptacle

INSTRUMENTS

- Rate of turn gyro
- Attitude gyro and indicator
- Pitot heater
- Flight director computer

RADIO, COMMUNICATION, AND NAVIGATION

- AN/ARN-118 TACAN
- Radio transfer relays

[1] Available via static inverter (oxygen/fuel quantity check switch or L/R engine start cycle)

Figure 3-2. Emergency Power Distribution (Sheet 5)

GRD TO HYD ELE FUE OXY ENG FLT MISC LND

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GENERATOR FAILURE (IN FLIGHT)

NOTE

A complete gearbox failure is indicated by simultaneous illumination of the LEFT/RIGHT GENERATOR and FLIGHT/UTILITY HYDRAULIC caution lights for the same engine, refer to GEARBOX FAILURE - AIRFRAME MOUNTED.

If LEFT/RIGHT GENERATOR caution light illuminates, proceed as follows:

1. Affected Generator Switch — RESET, then ON

If generator fails to reset –

2. Engine RPM (Affected Engine) — ADJUST (Adjust RPM of engine with the failed generator to opposite side of shift range (65 to 75%)
3. Affected Generator Switch — RESET, then ON

CAUTION

If a successful reset is not observed, refrain from future attempts due to the danger of the generator burning.

NOTE

If a generator fails, resets successfully, then fails later, re-accomplish checklist.

If gearbox failure to shift is suspected – refer to GEARBOX FAILURE TO SHIFT

If LEFT/RIGHT GENERATOR caution light continues to illuminate:

4. Affected Generator Switch — OFF
5. Land as soon as practical.
6. After landing, engine with failed generator will be shut down after clearing the runway.

GENERATOR FAILURE (NO CROSSOVER)

Left Generator No Cross INDICATIONS

- Off flags on Altimeter
- AOA off flag and all AOA indexer lights on.
- Utility hydraulic gauge freezes. Left engine autosyn gauges freeze.
- MASTER CAUTION, LEFT GENERATOR, LEFT FUEL PRESS lights illuminate.
- All exterior lights, interior instrument lights except CAUTION, and console lights are inoperative.

Main Inoperative Components

IFF/SIF, SAS, AOA, left boost pump, left fuel QTY

Right Generator No Cross INDICATIONS

- Main ADI and HSI will freeze with ADI off Flags/ steering bars in view on main ADI.
- Flight hydraulic gauge freezes. Right engine autosync gauges freeze.
- MASTER CAUTION, RIGHT GENERATOR, RIGHT FUEL PRESS, and ENG ANTI-ICE ON lights illuminate.
- At night, when Caution and Warning lights are set to DIM, Caution, Warning, and Indicator lights go to bright.

Main Inoperative Components

Main ADI, HSI, flaps, TACAN, ILS, trim, right boost pump, right fuel Qty, pitot heat, communications (revert to FCP)

If LEFT/RIGHT GENERATOR caution light illuminates, proceed as follows:

1. Affected Generator Switch — RESET, then ON

If generator fails to reset –

2. Engine RPM (Affected Engine) — ADJUST (Adjust RPM of engine with failed generator to opposite side of shift range (65 to 75%).
3. Affected Generator Switch — RESET, then ON

CAUTION

If a successful reset is not observed, refrain from future attempts due to the danger of the generator burning.

NOTE

If a generator fails, resets successfully, then fails later, re-accomplish checklist.

If LEFT/RIGHT GENERATOR light is extinguished, proceed to Step 7.

If LEFT/RIGHT GENERATOR caution light continues to illuminate, proceed as follows:

4. Affected Generator Switch — OFF
5. Descend below 25,000 feet if practical.

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6. Fuel Quantity — CHECK (Check fuel with FUEL/OXY QTY check switch)

NOTE

With right AC failure, right engine instruments may be checked by activating the static inverter.

7. Land as soon as practical.

CAUTION

If the generator does not reset (right generator affected), consider burning down fuel if no flap landing distance is critical.

8. After landing, engine with failed generator will be shut down after clearing runway.

If RIGHT GENERATOR fails with no crossover, refer to NO FLAP LANDING and EMERGENCY POWER DISTRIBUTION for inoperative and operative equipment, this section.

GENERATOR FAILURE – PARTIAL

The loss of certain electrical components without illumination of the LEFT/RIGHT GENERATOR caution light may indicate the loss of one or two phases of an AC generator.

Three phase items on the A/C bus include:

- Boost pump: fuel pressure light may illuminate
- ADI: sluggish/inoperative
- Transformer/Rectifier: XFMR RECT OUT light may be illuminated
- Flaps: slow flap actuation

If conditions permit, use the following procedures:

1. Identify the affected generator by reference to the circuit breaker diagram Figure 1-22.

2. Affected Generator Switch — OFF

If gearbox failure to shift suspected - Refer to GEARBOX FAILURE TO SHIFT

3. Land as soon as practical.

4. After landing, shut down engine with failed generator after clearing runway.

If malfunction not corrected:

5. Affected Generator Switch — ON

6. Land as soon as practical.

GEARBOX FAILS TO SHIFT

LEFT/RIGHT GENERATOR caution light illuminates when the engine is passing through the shift range of 65 to 75%.

1. RPM (Affected Engine) — ADJUST (Return to range where generator operation can be maintained.)

2. Affected Generator Switch — RESET then ON (if necessary).

3. RPM (Affected Engine) — MAINTAIN (Leave in range of successful generator operation until on final approach; then use, as necessary, to complete landing.)

4. Land as soon as practical.

Refer to:

- GENERATOR FAILURE (IN FLIGHT)
- GENERATOR FAILURE (NO CROSSOVER)

TRANSFORMER-RECTIFIER FAILURE

When the XFMR RECT OUT caution light illuminates, it indicates a possible failure of both transformer-rectifiers. If both transformerrectifiers have failed, the systems requiring DC power will be supplied by the battery. Battery life depends on many factors and cannot be accurately predicted.

NOTE

- The XFMR RECT out and Master CAUTION light may blink due to surge current developed by a high battery voltage overriding the DC bus voltage. This is a normal condition and does not indicate a failure.
- The FLDR power switch should be set to EMERG (OFF), If installed.

MAIN INOPERATIVE COMPONENTS (IF BATTERY FAILS) Refer to Figure 3-2:

AOA, Crossfeed, Engine restart, Fire detection, Flaps, Radios, Nav aids, Fuel shutoff valves, Interphone, Landing Gear, Speed Brake and standby AI.

Proceed as follows:

1. Transformer-Rectifier Circuit Breakers — IN

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GRD TO HYD ELE FUE OXY ENG FLT MISC LND

NOTE

Transformer-Rectifier circuit breakers are located on the FCP center pedestal and the RCP left console.

If battery fails -

2. Cockpit Instruments Rheostat — OUT OF OFF POSITION

3. Caution, Warning, and Indicator Lights Bright/Dim Switch — DIM

NOTE

XFMR RECT OUT light will extinguish when the battery is dead. Battery life is approximately 10 to 20 minutes.

4. Land as soon as practical

CAUTION

If complete DC failure occurs with the landing gear extended, downside hydraulic pressure will be lost. The gear should be pinned prior to taxiing clear of the runway.

Refer to:

- NO FLAP LANDING
- LANDING GEAR ALTERNATE EXTENSION

ELECTRICAL FIRE

1. Oxygen — 100%

2. Cabin Pressure Switch — RAM DUMP (Below 25,000 feet, if possible)

3. Battery and Generators — OFF

NOTE

With boost pumps inoperative, engine flameout may occur if above 25,000 feet.

4. All Electrical Equipment — OFF

NOTE

- Refer to appropriate items on AFTER LANDING and ENGINE SHUTDOWN checklists to ensure all electrical equipment is off.

- FLDR Power Switch should be set to EMERG (OFF), if installed.

5. Battery, Generator(s), Electrical Equipment — ON (as necessary, for flight and landing).

NOTE

- Turn on the battery first. This will allow DC power until the battery is dead. Turn on equipment only as needed for safe flight. If smoke reappears, turn off the last switch that was turned on.

- If AC power is necessary, turn on either generator. If the battery was left off intentionally, pull the TRANS RECT circuit breakers (No. 1 RCP LEFT CONSOLE/ No. 2 FCP PEDESTAL) before turning on the generator. Again, turn on equipment only as needed for safe flight. Be ready to turn off if smoke reappears.

Refer to:

- OXYGEN SYSTEM EMERGENCY OPERATION
- ELECTRICAL FAILURE COMPLETE
- CABIN PRESSURE LOSS

ELECTRICAL FAILURE – COMPLETE

With complete electrical failure, all warning systems, engine instruments (except engine tachometers), flight director, flight trim, communication and navigation systems, speed brake, flaps, landing gear normal extension, landing gear indicators, nosewheel steering, fuel boost pumps, and engine ignition system are inoperative; and each engine anti-ice valve opens. Use the following procedures:

If electrical systems fail completely:

1. Battery Switch — CHECK ON

2. Generator Switches — RESET then ON

If generators fail to reset:

3. Generator Switches — OFF

4. Descend to the lowest practical altitude below 25,000 feet. Attempt to maintain VMC.

5. Land as soon as practical.

NOTE

A no-flap landing will be required. The landing gear must be extended using the alternate system.

Refer to:

- NO FLAP LANDING
- LANDING GEAR ALTERNATE EXTENSION

I II III IV V VI VII A G IN

GRD TO HYD ELE FUE OXY ENG FLT MISC LND

FUEL EMERGENCIES

Normally sufficient fuel will flow by gravity to maintain MAX power from sea level up to approximately 25,000 feet. However, by specification, gravity flow is guaranteed to 6,000 feet; flameouts have occurred as low as 15,000 feet.

To prevent fuel starvation and engine flameout, Do not:

1. Perform MAX thrust drives with less than 650 pounds of fuel in either system.

2. Perform MAX thrust power in zero G flight or at negative load factors exceeding 10 seconds at 10,000 feet or 30 seconds at 30,000 feet. With less than 650 pounds of fuel in either supply system, time for successful engine operation is further reduced.

During low-fuel state (approximately 250 pounds in either system), do not maintain a nose down attitude for extended periods. Occasionally transit to a positive pitch attitude to refill the boost pump sump.

Crossfeeding is not recommended when:

- Boost pump inoperative
- Fuel quantity failure
- Leak in the fuel system
- Low altitude
- Low fuel (Dual Engine)

FUEL QUANTITY INDICATOR AND LOW-LEVEL CAUTION LIGHT SYSTEM MALFUNCTION

When fuel quantity indicator failure is experienced, the fuel low-level caution light is unreliable. Failure of the fuel low-level caution system is indicated when either fuel quantity indicator reads less than 250 (±25) pounds and the FUEL LOW caution light does not illuminate. If fuel quantity indicator failure or low-level caution system failure proceed as follows:

1. Fuel quantity — MONITOR

WARNING

Do not attempt crossfeed operation with a fuel quantity indicator inoperative, as it will be impossible to monitor the fuel balance.

2. Land as soon as practical.

LOW FUEL PRESSURE LIGHT ILLUMINATED/FUEL LEAK

Momentary blinking of the LEFT/RIGHT FUEL PRESS light(s) can be due to a fuel requirements surge, such as initiating afterburner. This is not a malfunction. Monitor systems for fuel imbalance.

Turning crossfeed ON should cause the LEFT/RIGHT FUEL PRESS light(s) to go out. If not, the possibility of a fuel leak must be considered.

The possibility of fire is normally of prime concern with any fuel leak. With a fuel leak, consider shutting down the affected engine because of the fire possibility. However, with a massive leak, the fuel loss itself must be dealt with promptly and correctly to make sure that sufficient fuel remains to return to base.

Monitor systems for fuel imbalance. If generator phase failure is suspected, refer to GENERATOR FAILURE – PARTIAL, this section.

Indicated by the LT/RT FUEL PRESS caution light illuminated.

1. Crossfeed switch — ON

If LT/RT FUEL PRESS light stays illuminated; indicating possible leak or pressure sensor malfunction:

2. Crossfeed switch — OFF

3. Monitor fuel status to determine if leak exists.

WARNING

An internal leak could cause a fire or explosion and requires immediate recovery. An external fuel leak is indicated by excessive fuel drop, vapor trail, and/or verification by other aircraft.

If a fuel leak exists:

4. Throttle Gate — DISENGAGE

5. Throttle (affected engine) — OFF

6. Boost Pump (affected engine) — OFF

7. Land as soon as possible.

Refer to ENGINE FAILURE/SHUTDOWN DURING FLIGHT.

SOLO FLIGHT - IF LT/RT FUEL PRESS light goes off indicating a boost pump failure, proceed to step 13.

I II III IV V VI VII A G IN

GRD TO HYD ELE FUE OXY ENG FLT MISC LND

DUAL FLIGHT - IF LT/RT FUEL PRESS light goes off indicating a boost pump failure, reset boost pump circuit breakers (LT/RT RCP circuit breaker panels) as follows:

8. Boost Pump (affected engine) — OFF

NOTE

Failure of certain electrical components, such as the boost pumps, without a generator light, can indicate the loss of one or two phases of AC generator. Refer to GENERATOR FAILURE - PARTIAL.

If boost pump circuit breakers are POPPED:

9. Boost pump circuit breakers (affected engine) — RESET (Reset a boost pump circuit breaker one time only)
10. Go to step 12.

If boost pump circuit breakers are NOT POPPED:

11. Boost pump circuit breakers (affected engine) — PULL AND RESET (Reset a boost pump circuit breaker one time only)
12. Boost Pump (affected engine) — ON

To reduce possibility of engine fuel starvation:

13. Descend below 25,000 feet MSL.
14. Power — REDUCE

NOTE

- If a reduced power setting at high altitude is impractical the crossfeed switch should remain ON to minimize the possibility of fuel flow interruption. Monitor the fuel balance and descend as soon as practical.
- With crossfeed on, full throttle is available for recovery if needed when there is no fuel leak.

15. Crossfeed Switch — OFF

If LT/RT FUEL PRESS light re-illuminates indicating probable boost pump failure, refer to FUEL EMERGENCIES.

16. Land as soon as practical.

NOTE

If solo and landing with a fuel imbalance with the right (aft) fuel system quantity more than twice the left (forward) fuel system quantity, causing an AFT CG condition, consider having ground personnel install tail stand prior to egress.

I II III IV V VI VII A G IN

GRD TO HYD ELE FUE OXY ENG FLT MISC LND

OXYGEN EMERGENCIES

SMOKE, FUMES OR ODORS IN COCKPIT (IN FLIGHT)

All odors not identifiable shall be considered toxic.

If smoke, fumes or odors are encountered in the cockpit -

1. Oxygen — 100%

NOTE

- If odors persist, use of emergency oxygen bottle should be considered.
- If the emergency oxygen supply is activated, disconnect from normal aircraft oxygen system.

2. Check for Fire
3. Cabin Pressure Switch — RAM DUMP (Below 25,000 Feet, if possible)
4. If Smoke Becomes Severe — JETTISON CANOPY (Below 300 KIAS, if possible)

CAUTION

Vibrations accompanied by fumes and/ or odors from the air conditioning system may indicate air conditioner turbine failure. If this condition is suspected, select oxygen - 100%, descend below FL 250, and select RAM DUMP to deactivate the air conditioning system. This should stop the vibrations.

Refer to:

- CABIN PRESSURE LOSS
- ELECTRICAL FIRE
- OXYGEN SYSTEM EMERGENCY OPERATION

CABIN PRESSURE LOSS

1. Oxygen System — 100% and EMERGENCY (Below 25,000 feet Oxygen System operation may be returned to normal.)
2. Descend Immediately — MAINTAIN AIRCRAFT AT OR BELOW 25,000 FEET (Below 18,000 feet desired).
3. Land as soon as practical.

Refer to OXYGEN SYSTEM EMERGENCY OPERATION.

OXYGEN SYSTEM EMERGENCY OPERATION

Plan on using approximately 1 liter/hour.

The OXYGEN low-level caution light illuminates when the oxygen indicator reads 1 liter or less of liquid oxygen. The light may blink (due to sloshing) if the system contains less than 3 liters.

Should either pilot detect symptoms of hypoxia or hyper-ventilation, proceed as follows:

1. Supply Lever — CHECK ON
2. Diluter Lever — 100% OXYGEN
3. Emergency Lever — EMERGENCY
4. Connections — CHECK SECURITY

WARNING

If positive pressure is not felt after completing step 4 or oxygen system contamination is suspected, use of the emergency oxygen cylinder should be considered. If oxygen system contamination is suspected, further consideration should be given to disconnecting the aircraft oxygen hose after activating the emergency oxygen cylinder.

5. Breath at a rate and depth slightly less than normal until symptoms disappear.
6. Descend below 10,000 feet MSL (cabin pressure) and land as soon as practical.

I II III IV V VI VII A G IN

GRD TO HYD ELE FUE OXY ENG FLT MISC LND

ENGINE EMERGENCIES

SINGLE-ENGINE FLIGHT CHARACTERISTICS

Single-engine directional control can normally be maintained at all speeds above the stall. Very little rudder is required because of the close proximity of the thrust lines to the centerline of the aircraft. In high-drag, highthrust, low-airspeed conditions, rudder must be used to coordinate flight to obtain optimum aircraft performance.

There are conditions under which the aircraft will not maintain altitude in takeoff configuration or landing configuration with one engine operating at either MIL or MAX thrust. For fully fueled takeoffs, single-engine takeoff speed should be attained to ensure excess thrust is available. At other fuel weights, final approach speed will ensure excess thrust is available for go-around. Single-engine performance in a landing configuration with 60% flaps is shown in the Thrust Required and Available chart and the Effect of Bank Angle on Vertical Velocity charts in Part 7 of Appendix A.

Minimum single-engine flying speed for any condition occurs where the thrust available and thrust required lines cross. If the airspeed is less than the minimum speed, altitude must be sacrificed to attain this minimum and/or the configuration must be changed to reduce the drag. Every effort should be made to immediately attain a speed that will give excess thrust. It is imperative that the speed brake be closed during all single-engine flight to obtain the performance stated in the single-engine charts. The single-engine service ceiling can be attained by following the climb schedule shown in the Single-Engine Service Ceiling chart in Part 3 of Appendix A.

THROTTLE BINDING

If a binding or stuck throttle is experienced in flight, Do not attempt further movement of the affected throttle. Attempt to minimize use of the unaffected throttle and recover using single-engine procedures. Land as soon as possible.

If both throttles are stuck and altitude and airspeed permit, attempt to break one throttle free. Consider using zero or negative-Gs to dislodge any foreign objects. If able, attain a power setting suitable for landing approach. If neither throttle can be freed, consider using the fuel shutoff switch to shut down one engine. Aircraft weight, available runway length, and barrier capabilities should be taken into consideration if landing will be attempted with one or both throttles stuck at high-power settings.

1. Stuck/binding throttle — Do not MOVE

CAUTION

Due to the close proximity of the throttle linkages and potential for foreign object interference, attempts to dislodge a stuck throttle may cause inadvertent shutdown of either engine.

2. Unaffected throttle — MINIMIZE MOVEMENT

If both throttles are stuck and altitude and airspeed permit, attempt to break one throttle free.

3. Land as soon as possible.

FIRE WARNING DURING FLIGHT (AFFECTED ENGINE)

Any time the fire lights illuminate, verify the condition by other indications before abandoning the aircraft. It is possible that the warning system may have malfunctioned and given an erroneous indication. Fire is usually accompanied by one or more of the following indications: excessive EGT, erratic or vibrating engine operation, fluctuating fuel flow, smoke trailing the aircraft, and/or smoke in the cockpit.

If a fire light illuminates, use the following procedure:

1. **THROTTLE — IDLE**

WARNING

When a fire light is preceded or accompanied by a pop, bang or thump, it usually indicates a serious malfunction and/or fire. Consideration should be given to shutting down the engine. If engine has seized, place the throttle to OFF even if the fire light has gone out.

CAUTION

If the fire light goes out, test the fire circuit with the warning test switch. If one or both bulbs of the affected fire light does not illuminate, shut the engine down.

2. **THROTTLE — OFF, IF FIRE LIGHT REMAINS ON**

I II III IV V VI VII A G IN

GRD TO HYD ELE FUE OXY ENG FLT MISC LND

WARNING

- Do not delay placing the throttle to OFF due to possible rapid loss of flight control system from fire damage.
- If engine cannot be shut down with the throttle, the fuel shutoff switch (affected engine) should be closed.

CAUTION

Do not attempt to restart the affected engine if the fire is extinguished. Make a single-engine landing.

3. **IF FIRE IS CONFIRMED — EJECT**
4. Land as soon as possible.

Refer to ENGINE FAILURE/SHUTDOWN DURING FLIGHT.

ENGINE RPM EXCEEDANCE

If engine RPM limits is exceeded, immediately retard throttle to the setting at which the RPM of the affected engine decreases and remains within limits.

1. Throttle (Affected Engine) — RETARD (Maintain RPM within limits).
2. Land as soon as practical.

Refer to ENGINE FAILURE/SHUTDOWN DURING FLIGHT.

ENGINE OVERTEMPERATURE

If excessive exhaust gas temperature occurs, immediately retard throttle to the setting at which the exhaust gas temperature of the affected engine decreases and remains within limits.

1. Throttle (Affected Engine) — RETARD (Maintain EGT within limits).
2. Land as soon as practical.

Refer to ENGINE FAILURE/SHUTDOWN DURING FLIGHT.

OIL SYSTEM MALFUNCTION

Abnormal engine oil pressure indications frequently are an early indication of some engine trouble. The engine oil pressure indicators display engine oil pressure on the ground and in the air.

During cold weather starts, oil pressure may exceed limitations. This is a normal indication as long as the oil pressure continues to decrease as engine oil warms. If oil pressure does not continue to decrease, shut down the engine. Refer to COLD WEATHER OPERATION, Section VII.

If engine oil pressure is not within the operating limits or a sudden change in 10 psi or more occurs at any stabilized RPM, proceed as follows:

1. Throttle (Affected Engine) — ADJUST (to maintain pressure within limits).

If 5 to 55 psi pressure cannot be maintained or if engine seizure appears imminent:

2. Throttle Gate — DISENGAGE
3. Throttle (Affected Engine) — OFF

NOTE

- Simultaneous failure of the engine RPM indications and oil pump (oil pressure indicates zero) may be an indication of a sheared oil pump shaft. In this case, the T-5 system will be lost.
- If the operating engine requires shutdown, the engine previously shut down for oil system malfunction may be restarted.
- If the right engine is to be shut down, check crossover. If crossover is bad, consider lowering 60% flaps to reduce landing distance and trim the aircraft to final approach airspeed (fuel permitting). If crossover is good, leave generator OFF.

Refer to ENGINE FAILURE/SHUTDOWN DURING FLIGHT.

NOZZLE FAILURE

If nozzle failure occurs in closed range, excessive EGT is possible. If this condition occurs, follow the ENGINE OVERTEMPERATURE procedure.

If the nozzle is closed, EGT may increase above 645°C during landing rollout or taxi. If this occurs, the engine should be shut down.

If a nozzle fails in the open position, low EGT will result. The affected engine will operate from idle to MIL, but with a much lower thrust output. Afterburner may not be available.

Depending on the severity of either condition, consideration should be given to recovering the aircraft in accordance with single-engine landing procedures.

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NOZZLE STUCK CLOSED (At or near zero)

1. Throttle (Affected Engine) — RETARD (Maintain EGT within limits).

2. Land as soon as practical.

MALFUNCTION INDICATION - Nozzle position closed (approximately 0%) and excessive EGT with high power settings. The following considerations apply:

- Engine may be used if EGT is kept within limits.
- MAX power probably will not be available on engine with the stuck nozzle.
- Due to reduced airflow, use caution for engine overtemperature.
- Consider using Single Engine procedures for approach and landing.
- Fly a straight-in approach.

NOZZLE STUCK OPEN (In the open range 20% to 100%)

1. Abort mission.

2. Land as soon as practical.

MALFUNCTION INDICATION - Nozzle position (20 - 85%), dependent on throttle setting at the time of failure (MIL or MAX) and low EGT for respective throttle settings. The following considerations apply:

- Expect thrust output to be decreased.
- MAX power probably will not be available on engine with the stuck nozzle.

FLUCTUATING NOZZLE

1. Throttle (Affected Engine) — RETARD UNTIL NOZZLE STABILIZES

2. Land as soon as practical.

MALFUNCTION INDICATION - Nozzle position fluctuations greater than +3% (MIL or MAX) with none allowed in IDLE on the ground. The following considerations apply:

- Possible T5 failure.
- EGT may fluctuate with the nozzle.
- Cross check fuel flow to prevent misinterpreting a fluctuating nozzle as a fuel control problem.
- Fly a straight-in approach using single-engine procedures.

Refer to SINGLE-ENGINE LANDING

ENGINE FAILURE/SHUTDOWN DURING FLIGHT

If an engine operates abnormally or fails during flight, reduce drag to a minimum and maintain airspeed and directional control while investigating to determine the cause. Failure of the left engine may deactivate speed brake, normal landing gear extension and retraction, nosewheel steering, and the stability augmenter system. However, left engine windmilling RPM under this condition may supply sufficient hydraulic pressure to operate these systems.

Use the following procedure for shutting down an engine in flight:

1. Safe Single-Engine Airspeed — MAINTAIN

2. Throttle Gate — DISENGAGE

3. Throttle (Inoperative Engine) — OFF (For 10 Seconds Before Attempting a Start If Conditions Permit.)

WARNING

Do not attempt a restart if the engine was shutdown due to FOD, Fire or if the engine is seized.

NOTE

- If the right engine is to be shut down, check crossover. If crossover is bad, consider lowering 60% flaps to reduce landing distance and trim the aircraft to final approach airspeed (fuel permitting). If crossover is good, leave generator OFF.

- Certain failures of the main fuel control may result in an engine remaining at the power setting selected at the time of failure despite additional throttle movements. With an engine stuck at a high-power setting, consideration should be given to shutting down the engine to preclude excessively fast landing speeds which may result in extremely hot brakes and possible barrier engagement/runway departure. If the engine cannot be shut down with the throttle, close the affected fuel shutoff switch.

4. Crossfeed — AS NECESSARY

GRD TO HYD ELE FUE OXY ENG FLT MISC LND

WARNING

With the crossfeed ON and either both boost pumps ON or both boost pumps OFF, a rapid fuel imbalance can occur.

With fuel less than 250 pounds in either system:

5. Fuel Boost Pump Switches (LEFT and RIGHT) — ON
6. CROSSFEED Switch — ON

NOTE

Under single-engine low fuel conditions with two operating boost pumps, placing the crossfeed ON and BOTH boost pumps ON will provide the maximum usable fuel.

7. Land as soon as possible.

Refer to Single-Engine Diversion Range Summary Table in Part 4 of Appendix A.

Refer to

- RESTART DURING FLIGHT
- LANDING GEAR ALTERNATE EXTENSION
- SINGLE-ENGINE LANDING
- SINGLE-ENGINE GO-AROUND
- EJECTION PROCEDURE
- CROSSFEED

RESTART DURING FLIGHT

Airstarts can be expected over the range of operating conditions shown in Figure 3-3. The engine airstart requirements are based on engine windmill speed and pressure altitude and are independent of ambient temperature. Lines of constant indicated airspeed have been superimposed on the basic engine requirements. These are the indicated airspeeds required to achieve corresponding windmill speeds. A minimum of 12 to 14% RPM is required to achieve any engine fuel flow; 18 to 20% engine RPM is the heart of the airstart envelope at all altitudes. Airstart attempts in the area above the upper left-hand corner of the envelope will normally result in a hung start. If airspeed is increased and/or altitude decreased with an engine in a hung start, it may accelerate up to operating speed. Airstart attempts at engine windmill speeds higher than the upper limit will normally fail because of a lean mixture (low fuel/air ratio). Combustion may be established by decreasing airspeed and/or decreasing altitude. Since the ignition circuitry is engaged for about 30 seconds after pushing the start button, it may be necessary to press the start button again. Use the following procedure:

WARNING

Do not attempt a restart if the engine was shut down due to FOD, Fire or if the engine is seized.

1. Throttle Gate — DISENGAGE
2. Throttle (Inoperative Engine) — OFF (10 Seconds, If Conditions Permit)
3. Altitude — BELOW 25,000 FEET
4. Engine RPM — WITHIN AIRSTART ENVELOPE, 12% MINIMUM
5. Battery Switch — CHECK ON
6. Boost Pump Switches — CHECK ON
7. Engine Start and Ignition Circuit Breakers — IN (LEFT CONSOLE IN THE FCP)
8. Engine Start Button — PRESS
9. Throttle — ADVANCE to IDLE

NOTE

- Leave throttle at IDLE for 30 seconds before aborting a start.
- If dual engine flameout occurs, right engine start should be attempted first as right engine instruments will operate normally as soon as engine start button is pushed.

If restart attempt fails:

10. Throttle (Inoperative Engine) — OFF (For Approximately 10 Seconds)
11. Crossfeed Switch — ON
12. Affected Engine — START

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NOTE

- The RPM may hang up during restart after combustion occurs at low airspeeds. RPM hangup during an airstart may be eliminated by increasing airspeed.
- If it appears that a boost pump has failed, remain below 25,000 feet. Turn crossfeed OFF to avoid having to use an abnormal fuel balancing procedure.
- If it appears that a boost pump has failed and flight below 25,000 feet is impractical, engine operation above 25,000 feet with gravity fuel flow is possible at reduced power settings. If a reduced power setting is also impractical, use crossfeed operation to ensure boost pump pressure and minimize the possibility of fuel flow interruption. Monitor the fuel balance and descend as soon as practical. Flight at lowest practical altitude and reduced power setting will minimize probability of fuel flow interruption.

Refer to ENGINE FAILURE/SHUTDOWN DURING FLIGHT.

DUAL ENGINE FAILURE AT LOW ALTITUDE

If both engines fail during flight at low altitude and with sufficient airspeed, the aircraft should be zoomed (approximately 20 degrees nose up attitude) to exchange airspeed for altitude and to allow additional time to accomplish subsequent emergency procedures. ALTERNATE AIRSTART/LOSS OF THRUST (LOW ALTITUDE) should be attempted immediately upon detection of dual engine flameout. If the decision is made to eject, ejection should be accomplished during the zoom while the aircraft is in a nose high positive rate of climb. It is imperative that the ejection sequence be initiated prior to reaching a stall or rate of sink.

ALTERNATE AIRSTART/LOSS OF THRUST (LOW ALTITUDE)

The alternate airstart is primarily designed for use at low altitude when thrust requirements are critical. An airstart may be accomplished by advancing the throttle(s) to MAX range. This energizes normal and afterburner ignition for approximately 30 seconds. If throttle(s) remains in MAX but the engine(s) does not start after 30 seconds, additional starts may be attempted by retarding the throttle(s) out of MAX range to reset the circuit and again advancing the throttle(s) into MAX range to reactivate the ignition cycle.

After engine start, the throttle(s) may be left in MAX range if afterburner operation is desired.

WARNING

Do not delay ejection by attempting airstarts at low altitude if below the optimum airstart airspeed and below 2000 feet AGL.

If alternate airstart is required, proceed as follows:

1. **THROTTLE(S) — MAX**

WARNING

- If throttle is already in MAX, recycle throttle MIL to MAX.
- With dual engine failure, battery switch must be at ON to provide ignition.

NOTE

If the throttle is in the MAX range, pushing the start button will also provide ignition; however, only for that period of time which the button is held.

2. **SPEED BRAKE — CONFIRM CLOSED**

WARNING

Ensure the speed brake is not unintentionally extended from either cockpit when the throttle is advanced. The close proximity of the speed brake switch to the pilot's knee makes unintentional activation likely.

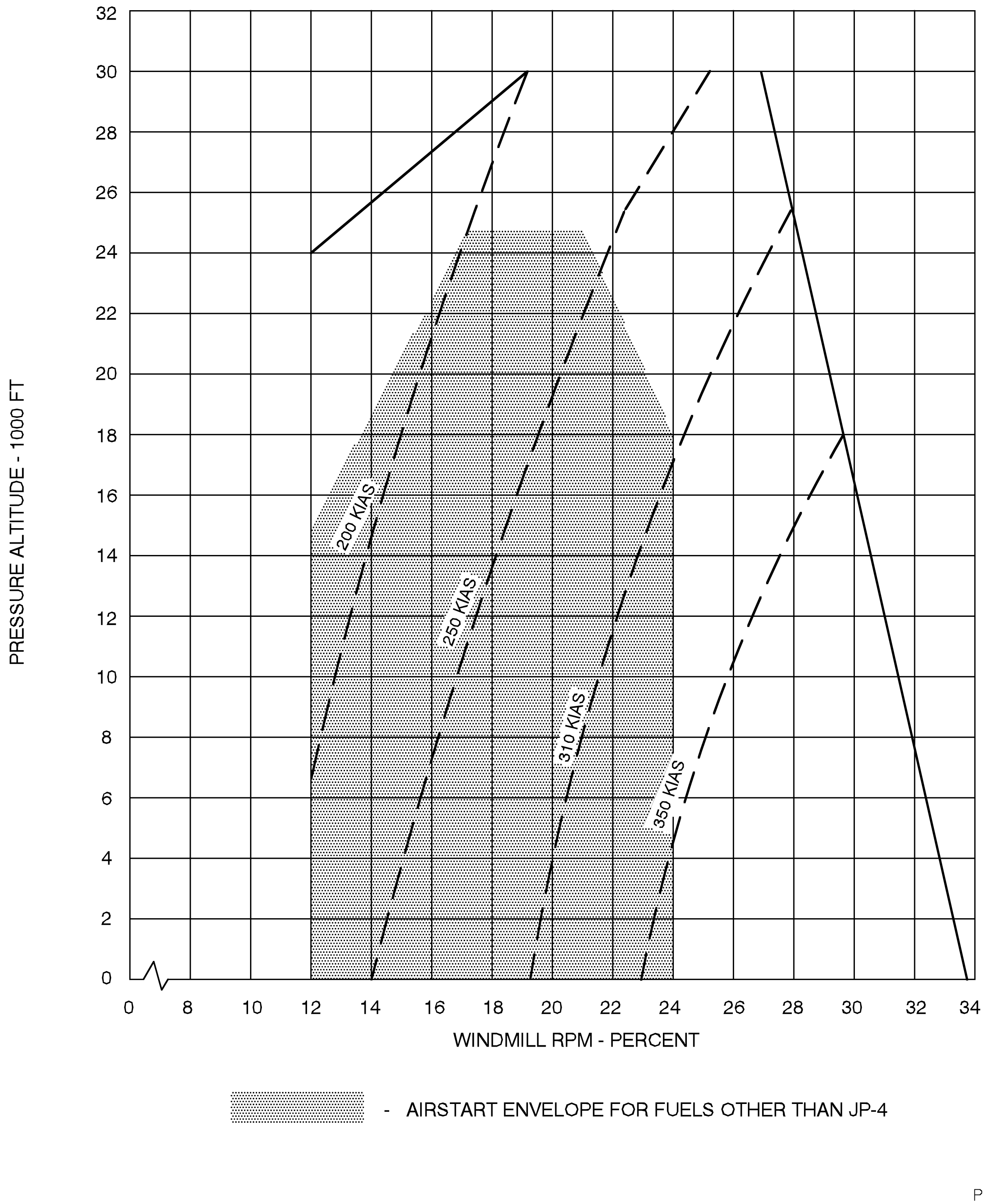

Figure 3-3. Airstart Envelope

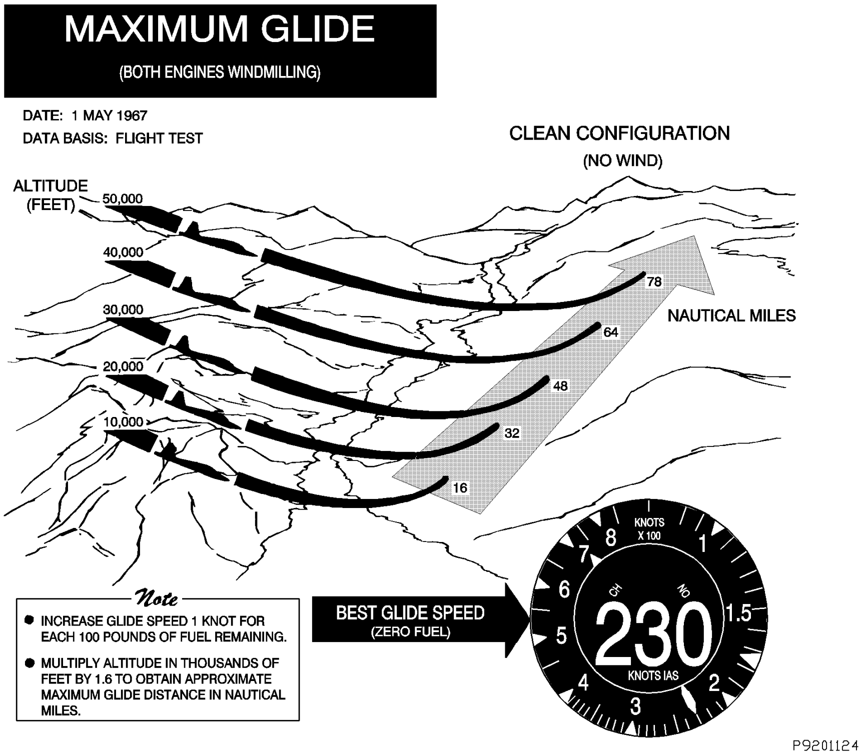

Figure 3-4. Maximum Glide

COMPRESSOR STALL

If an engine compressor stalls, proceed as follows:

1. Throttle (Affected Engine) — IDLE
2. Engine Start Button — PRESS

NOTE

Rapidly retarding the throttle to IDLE and immediately pushing the engine start button may permit the engine to recover and prevent complete flameout.

3. Airspeed — INCREASE/DECREASE (As necessary)

NOTE

If engine damage is suspected, advance throttle above idle only if required.

4. EGT/RPM (Affected Engine) — MONITOR
5. Land as soon as practical.

If engine will not recover:

1. Throttle Gate — DISENGAGE
2. Throttle (Affected Engine) — OFF

NOTE

- After experiencing a compressor stall, the engine may not recover to the full range of operation. If normal instrument indications can be achieved for a given power setting, the engine should not be shut down unless other circumstances dictate.
- If the engine is shut down, an airstart may be attempted as applicable.

Refer to ENGINE FAILURE/SHUTDOWN DURING FLIGHT.

FLIGHT CONTROL EMERGENCIES

WING FLAP HORIZONTAL TAIL LINKAGE MALFUNCTIONS

ABRUPT AND UNCOMMANDED AIRCRAFT PITCH-UP, FLAPS EXTENDED

If the interconnect system fails with flaps lowered any amount, the horizontal tail will instantly reposition to the zero flap setting and all flight control compensation is removed. This will always result in an abrupt and uncommanded aircraft pitch-up. The severity of the pitch-up is directly dependent on the airspeed and flap setting at the moment of failure. The stick must be positioned forward (to within 1 inch of the forward stop) to obtain controlled level flight. Furthermore, the available nose down slab deflection is greatly reduced and the stick must be positioned full forward to arrest the initial pitch-up rate caused by the interconnect failure. These forward stick forces cannot be trimmed out. When a safe airspeed and altitude are obtained, positioning the flaps up will return flight control and handling characteristics to normal. Flight tests have verified that at speeds as low as touchdown airspeeds, this type of failure is recoverable and that a controlled go-around is possible. However, the recovery procedure requires immediate pilot response and must be precisely applied within 3 seconds to ensure recovery without a loss of altitude. Recovery from an interconnect failure during the final approach or touchdown phase requires the use of full afterburners and the immediate retraction of flaps to 60% to eliminate the excess drag caused by full flaps.

WARNING

If takeoff is made with interconnect system failure, a lighter than normal stick force and reduced amount of stick travel will be required for rotation. Until the flaps are retracted, significant forward stick pressure will be required to keep the pitch attitude from increasing.

1. Control Stick — FULL FORWARD TO ARREST PITCH RATE

WARNING

If interconnect cable failure with flaps down 60% or more, full forward stick will be necessary to arrest the rate of pitch-up and corrective action must be taken within 3 seconds to ensure recovery without a loss of altitude.

2. Throttles — MAX
3. Flaps — 60%

WARNING

If failure occurs while flying at final approach airspeed, initially repositioning the flaps to 60% will reduce stick forces and will provide the best chance of recovery. Do not retract the flaps to the no-flap position until the aircraft accelerates above no-flap flying airspeed.

4. Landing Gear — LG UP (when continued flight is assured)
5. Flaps — UP (when the aircraft accelerates above no-flap flying airspeed. Be prepared to relax forward stick force as flaps are retracted.)

NOTE

- Interconnect failure can occur even after flaps have stabilized in a given position.
- The amount of horizontal tail authority will be that available with zero flaps regardless of the actual flap setting.
- With the flaps set at 60% or more, the required stick position will be beyond the forward trim cutout limit.
- Moderate to heavy stick forces will be present until the flaps are retracted.

6. Land with wing flaps retracted.

A no-flap landing is preferred. However, if landing conditions require the use of some flaps to reduce touchdown speeds and landing distance, a flap setting between 30 to 45% will provide limited but adequate nose down control authority and manageable stick forces. Fly AOA on-speed indications on final and use caution to avoid over-rotation in the flare as forward stick pressure is relaxed.

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UNCOMMANDED SMOOTH PITCH-UP DURING FLAP EXTENSION

If the interconnect system fails with the flaps retracted, the aircraft will have these characteristics: As flaps are lowered, a smooth but definite pitch-up will occur. This pitch-up can be controlled. As flaps approach 60%, the control stick must be positioned very close to the forward stop to maintain controlled flight. Heavy forward stick forces will be required which cannot be completely trimmed out, as the stick will be forward of the trim cut out limit. Although the aircraft may be flown in level flight in this configuration, very little nose down control authority is available to maneuver the aircraft. If such a condition is encountered, retract the flaps and make a no-flap landing whenever possible.

1. Flaps — REPOSITION TO UP

NOTE

It is easy to confuse trim failure with flap-slab interconnect failure. Careful analysis of configuration and control movements at the time of occurrence are essential.

2. Throttles — AS REQUIRED TO MAINTAIN ABOVE NO FLAP FLYING AIRSPEED

3. Land with flaps retracted.

A no-flap landing is preferred. However, if landing conditions require the use of some flaps to reduce touchdown speeds and landing distance, a flap setting between 30 to 45% will provide limited but adequate nose down control authority and manageable stick forces. Fly AOA on-speed indications on final and use caution to avoid over-rotation in the flare as forward stick pressure is relaxed.

Refer to NO FLAP LANDING (if applicable)

WING FLAP ASYMMETRY

WARNING

High speed flap deflection can result in an instantaneous failure of one or both flaps. If one flap fails, the sudden asymmetric condition will result in a severe coupled roll and yaw possibly associated with high negative Gs. Immediately return the flap lever to the UP position to ensure recovery.

NOTE

Detection of unintentional flap deployment at high speed is critical to avoiding a flap failure. Upon flap deflection, there will be an uncommanded pitch down associated with a noise of rushing air and possible buffet. If this condition occurs, immediately return the flap lever to the UP position.

If lateral rolling and yawing is experienced during operation of the wing flaps or while the flaps are extended, an asymmetric wing flap condition probably exists. Asymmetry may occur from physical binding or only one flap tracking when the flaps area actuated resulting in a gradually increasing uncommanded roll and yaw as the flap extends or retracts. This is readily detected and can be corrected by reversing the direction of flap movement.

If a flap setting less than 60% is used, fly AOA on speed indications on final. Greater than 60%, use normal pattern airspeeds.

A more serious control situation arises when the asymmetry occurs following an instantaneous failure within the flap system. The severity is dependent on airspeed and flap position (in transit or fully extended) at the moment of failure. The situation is characterized by an immediate uncommanded yaw and rapid roll. Sufficient control authority is available to counteract the yaw and roll at pattern airspeeds. If either condition occurs, use the following procedure:

1. Throttles — MAX

2. Wing Flap lever — ACTUATE (to eliminate or minimize the wing flap asymmetric condition.)

3. Airspeed — ABOVE 180 KIAS

4. Aux Flap Switch — EMER

NOTE

In the EMER position flap settings can be set to any intermediate position to eliminate the asymmetrical condition.

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If Asymmetry Persists:

5. Airspeed — MAINTAIN (Maintain airspeed 20 KIAS above final approach and touchdown speeds. Do not touchdown below 160 KIAS)

NOTE

If the asymmetric condition cannot be corrected and conditions permit, land from a straight-in approach.

TRIM MALFUNCTION

If an aircraft trim malfunction results in either full nose up or full nose down trim, stick force needed to position the horizontal stabilizer may be several times greater than expected. Runaway trim effects may be minimized by immediately attempting to trim opposite the undesired stick forces in order to stop or reverse the horizontal tail trim movement. If the trim malfunction results in excessive nose down trim loads, increasing airspeed may reduce required stick forces to maintain level flight. If the trim malfunction results in excessive nose up trim loads, decreasing airspeed may reduce required stick forces to maintain level flight.

NOTE

- The takeoff trim system is independent and, depending on trim position, may help relieve some stick pressure near approach airspeeds.
- Once the trim has been returned to a neutral stick force position, pulling the TRIM CONTROL circuit breaker (FCP Pedestal) may prevent further runaway trim problems.

In case of runaway or uncontrollable trim -

1. Trim button — Hold in opposite direction of trim movement.
2. TRIM CONTROL circuit breaker — PULL

STABILITY AUGMENTER MALFUNCTION

The stability augmenter yaw system can fail with a resulting:

- Rudder deflection of 4 degrees. This deflection will cause a yaw and resulting moderate rudder roll.
- Possible chattering rudder pedals.
- At high speed/high AOA, the roll rate is greater and the yaw is less noticeable. Opposite rudder will immediately neutralize the yaw and roll.

1. AOA — REDUCE (if able)
2. Apply opposite rudder and aileron (as required to control yaw and roll).
3. Yaw Damper Switch — OFF

NOTE

- If yaw oscillations are induced by the stability augmenter, the Yaw Damper switch should be placed to OFF -
- If the yaw damper switch is found in the OFF position during the flight, the mission may be continued. Do not reengage the damper switch.
- If you disengage the yaw damper switch and correct the malfunction, you may continue the mission.

4. Stability Augmenter Circuit Breakers — PULL (RCP LEFT PANEL, if malfunction continues).

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NOTE

If unable to pull the STABILITY AUGMENTER circuit breakers (solo) and landing is questionable due to oscillations, turn off both generators. This will shut off electrical power.

RUDDER SYSTEM FAILURE

WARNING

- A flight control malfunction can result in an unrecoverable loss of aircraft control immediately after liftoff. If a flight control malfunction is suspected during takeoff roll, consider a highspeed abort or ejection.
- Do not confuse other flight control malfunctions with a hard-over rudder. If a hard-over rudder malfunction is suspected, but aircraft roll can be controlled with opposite aileron and/or rudder input, suspect an aileron or flap system malfunction instead.
- Available rudder authority with the landing gear down is sufficient to create a loss of roll stability resulting in rapid roll acceleration. Excessive rudder inputs will increase the time and altitude required to recover.

If rudder system failure is experienced, the failure mode may be a full 30 degrees hardover rudder. Indications of this type failure will be a smooth, increasing, uncontrollable yaw and a resulting roll. Opposite rudder inputs will have no effect on the yaw. As the yaw angle increases, the engines will probably stall, stagnate or flameout. Immediate aileron inputs may control the roll at first but as the rudder approaches full deflection, the rudder roll authority will overcome the ailerons and the aircraft will depart control flight. Aircraft control cannot be regained. Eject as soon as practical after confirming that full opposite rudder input cannot control the yaw/roll.

An additional rudder failure mode may result in a full, 30 degrees hard-over rudder. The aircraft motion will vary greatly dependent on airspeed.

WARNING

- If a hard-over rudder is confirmed, Do not delay the decision to eject.
- At low speeds, the indication may be a smooth increasing yaw and roll motion that is initially controllable with aileron control input. Immediate aileron inputs and reduction of AOA may control the yaw at first, but aircraft control is not possible at normal angles of attack due to increased rudder roll authority.
- At high speeds, the aircraft motion may be violent and immediately uncontrollable with potentially incapacitating cockpit forces. Ultimately, the aircraft is uncontrollable with all hard-over rudder malfunctions regardless of input.

CONTROLLABILITY CHECK/STRUCTURAL DAMAGE

If structural damage or a flight control malfunction occurs or is suspected in flight, a decision must be made whether to abandon the aircraft or attempt a landing. The purpose of this check is to determine if the aircraft is landable and, if so, to determine what configuration is best for landing. Normally, the aircraft would be configured with gear and full flaps and slowed to a minimum controllable airspeed or normal touchdown speed, whichever is higher. If unable to achieve a normal configuration and airspeed, then configuration and airspeed should be adjusted in order to accomplish a landing. Proceed as follows:

1. Notify appropriate ground agency of intentions.
2. Climb to at least 15,000 feet AGL (if practical) at a controlled airspeed.
3. Simulate a landing approach.

CAUTION

Consider using the auxiliary flap control switch to reposition the flaps. If damage to the flaps or flap actuating mechanism (other than flap-slab interconnect) is known or suspected, Do not reposition flaps.

4. Determine airspeed at which aircraft becomes difficult to control.

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NOTE

Slow to minimum controllable airspeed or touchdown speed, whichever occurs first. As a guide, if you have to deflect the stick more than 3/4- stick travel to maintain level unaccelerated flight, you have reached your minimum controllable airspeed. Touchdown speed is generally plus or minus 5 knots of level flight stall speed. In no case allow airspeed to decrease below touchdown speed.

5. Do not change aircraft configuration.
6. Maintain at least 20 KIAS above minimum controllable airspeed during descent and landing approach.
7. Fly a power-on straight-in approach requiring minimum flare. Plan to touch down at 10 knots above either normal touchdown speed or minimum control speed, whichever is higher.

WARNING

Touchdowns as high as 200 knots are possible. High-speed touchdown initially limits the effectiveness of aerodynamic and/or wheel braking.

If a touchdown speed greater than 200 knots is computed, another controllability check at a lower fuel weight should be considered. Touchdowns greater than 200 knots should not be attempted as the nose gear will touch down first increasing the possibility of a high speed PIO.

Once a touchdown speed is computed, Do not change the speed due to fuel weight lost enroute to the airfield.

With any structural damage, Do not aerobrake. Hold the landing attitude until the loss of slab authority and then cautiously apply the wheel brakes. No aerobraking could increase normal landing distance by as much as 50%.

Refer to EJECTION PROCEDURES.

LANDING EMERGENCIES

SINGLE-ENGINE LANDING

CONSIDERATIONS:

- Under certain conditions; level, configured, single-engine flight may be impossible. Consider delaying configuration until just prior to the glideslope.
- Operating with one engine may cause yaw - especially in MAX. This can usually be controlled with use of rudder.
- If left engine has failed, have landing gear pinned prior to taxiing clear of runway (conditions permitting).

A straight-in approach should be flown. See Figure 3-5 through Figure 3-8 or Appendix A for single-engine approaches. The following procedure should be accomplished before landing:

1. Gear — DOWN

NOTE

- Power required under single-engine conditions may be in excess of that required to activate the landing gear warning system.
- If left engine is inoperative, normal windmilling rpm will provide adequate utility hydraulic pressure for a landing gear normal extension in a slightly longer extension time. If utility hydraulic system pressure is depleted, use the landing gear alternate extension system to extend the gear and allow additional time for gear extension.

2. Wing Flaps — 60% (Set on Final Prior to Descent)
3. Wing Flaps — DOWN (when landing is ensured (optional))

WARNING

Use maximum power, if necessary, to maintain landing pattern airspeeds. Refer to Section VI and Part 7 of the Appendix A for the effect of bank angle on vertical velocity.

CAUTION

- At high density altitudes and/or high gross weights, limited excess thrust is available to offset full flap drag. If full flaps are selected in the flare, an immediate touchdown and premature landing may occur.
- Aerodynamic braking with less than 100% flaps is less effective and longer landing distances should be anticipated.

SINGLE-ENGINE GO-AROUND

The available altitude and/or runway should be used to accelerate. The aircraft should be rotated at final approach speed or as required to become air borne prior to the end of the runway, whichever comes first. Allow the aircraft to accelerate straight ahead, climbing only as necessary, until reaching 200 KIAS.

If, during the go-around, a touchdown occurs and take off appears questionable, an abort may be warranted.

If go-around is continued:

1. **THROTTLE(S) — MAX**

WARNING

- A single-engine go-around should be attempted only at maximum power.
- Ensure the speed brake is not unintentionally extended from either cockpit when the throttle is advanced. The close proximity of the speed brake switch to the pilot's knee makes unintentional activation likely.

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2. **FLAPS — 60%**

WARNING

- With other than 60% flaps, single engine capability is impaired to such an extent that the combination of temperature, pressure altitude, and gross weight may make go-around impossible.
- It may be necessary to lower the nose to sacrifice altitude and perhaps allow the aircraft to settle to the runway to attain final approach speed for 60% flaps. If the aircraft settles to the runway, lower the nose to facilitate acceleration.

NOTE

After flaps are set at 60%, the flap indicator should be checked to ensure flaps are within 60% range.

3. **AIRSPEED — ATTAIN FINAL APPROACH SPEED MINIMUM**

Attaining final approach airspeed will ensure excess thrust for single-engine flight.

4. Gear — UP (As required above final approach speed)
5. Flaps — UP (As required above 200 KIAS)

NOTE

- If the left engine is inoperative but windmilling, generally gear retraction may be accomplished, but will require an extended time period; however, gear doors may not completely close. Gear retraction, when initiated between final approach speed and 200 KIAS, may require up to 1 minute.
- If unable to retract the landing gear, best level flight/climb capability is obtained at 200 KIAS with 60% flaps or at 220 KIAS with the flaps up. At high gross weight, with the landing gear extended, flap retraction should not be initiated prior to 220 KIAS.

NO-FLAP LANDING

As a guide, the no-flap landing distance is approximately 2X (2500 + fuel weight) past the touchdown point. Consider burning down fuel to reduce landing roll.

If a landing is to be made with the wing flaps retracted, use the normal landing procedure modified as follows:

1. Downwind Leg — EXTEND
2. Increase the final turn, final approach, and touchdown airspeeds by 15 KIAS.

CAUTION

Extreme caution must be exercised when applying wheel brakes above 120 KIAS as locked wheels or tire skids are difficult to recognize. If a tire skid is detected, immediately release brakes and cautiously reapply.

NOTE

A no-flap full stop landing using aerobraking to just prior to loss of elevator authority and optimum braking thereafter may double the normal landing distance.

Refer to BARRIER ENGAGEMENT

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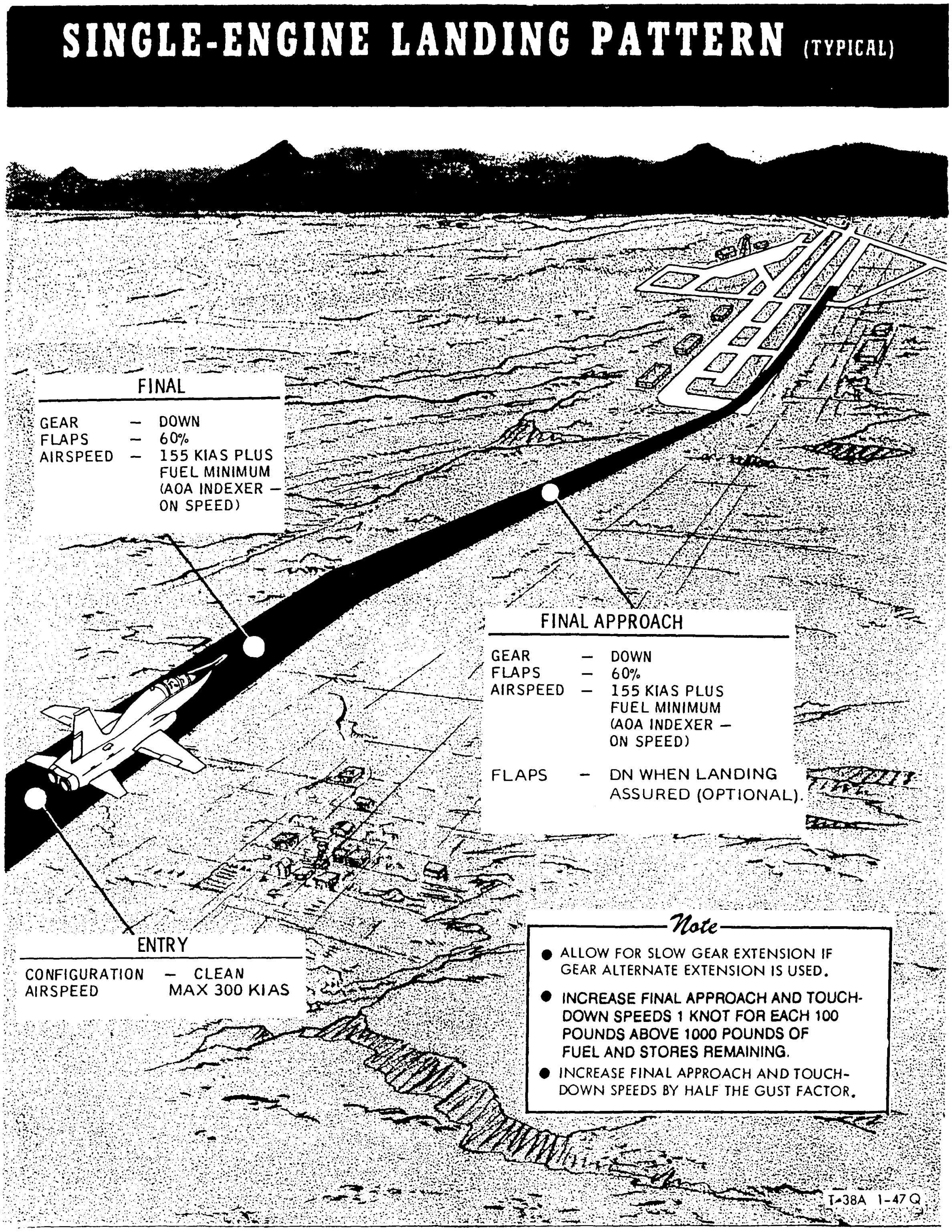

Figure 3-5. Single-Engine Landing Pattern

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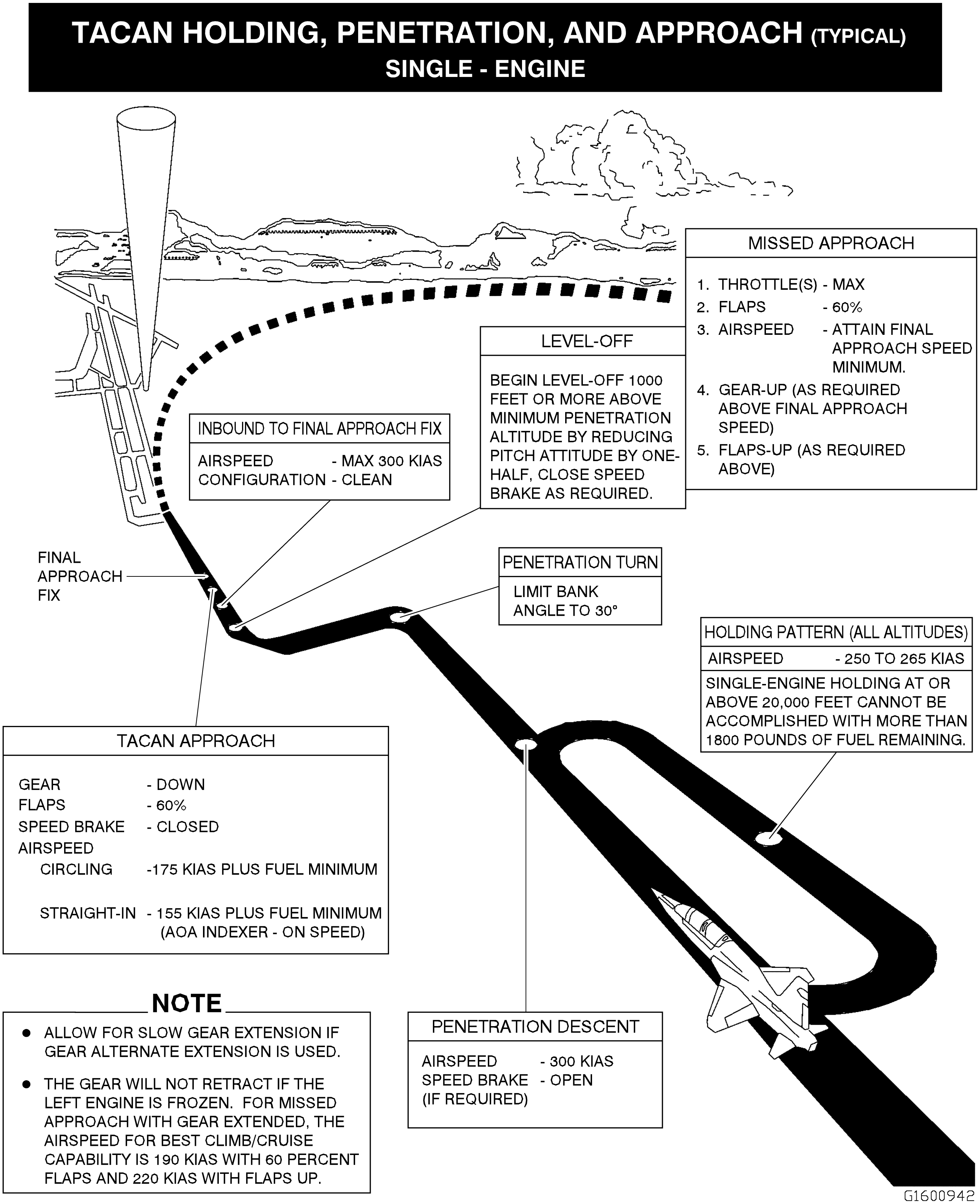

Figure 3-6. TACAN Holding, Penetration, and Approach (Typical) (Single-Engine)

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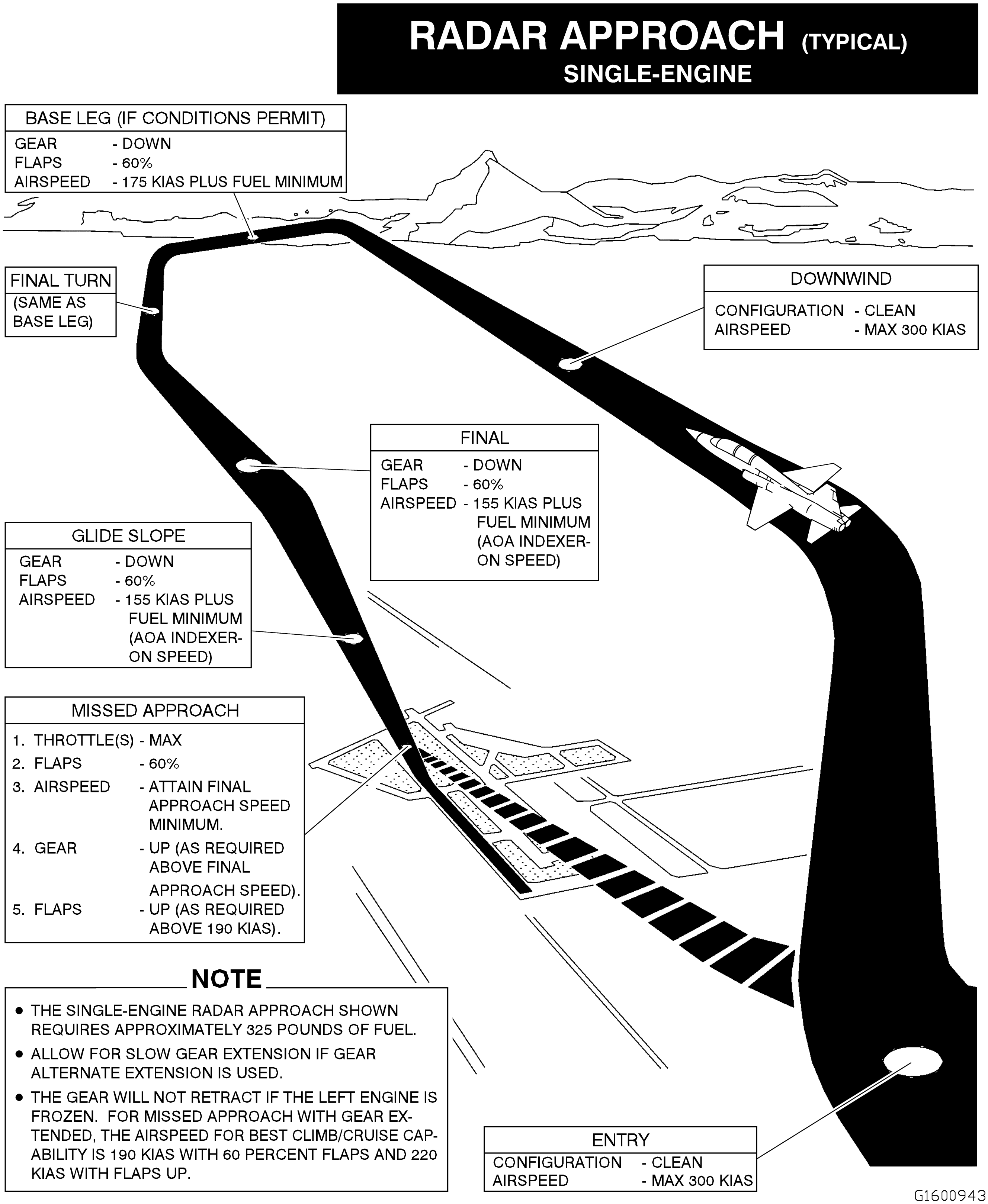

Figure 3-7. RADAR Approach (Typical) (Single-Engine)

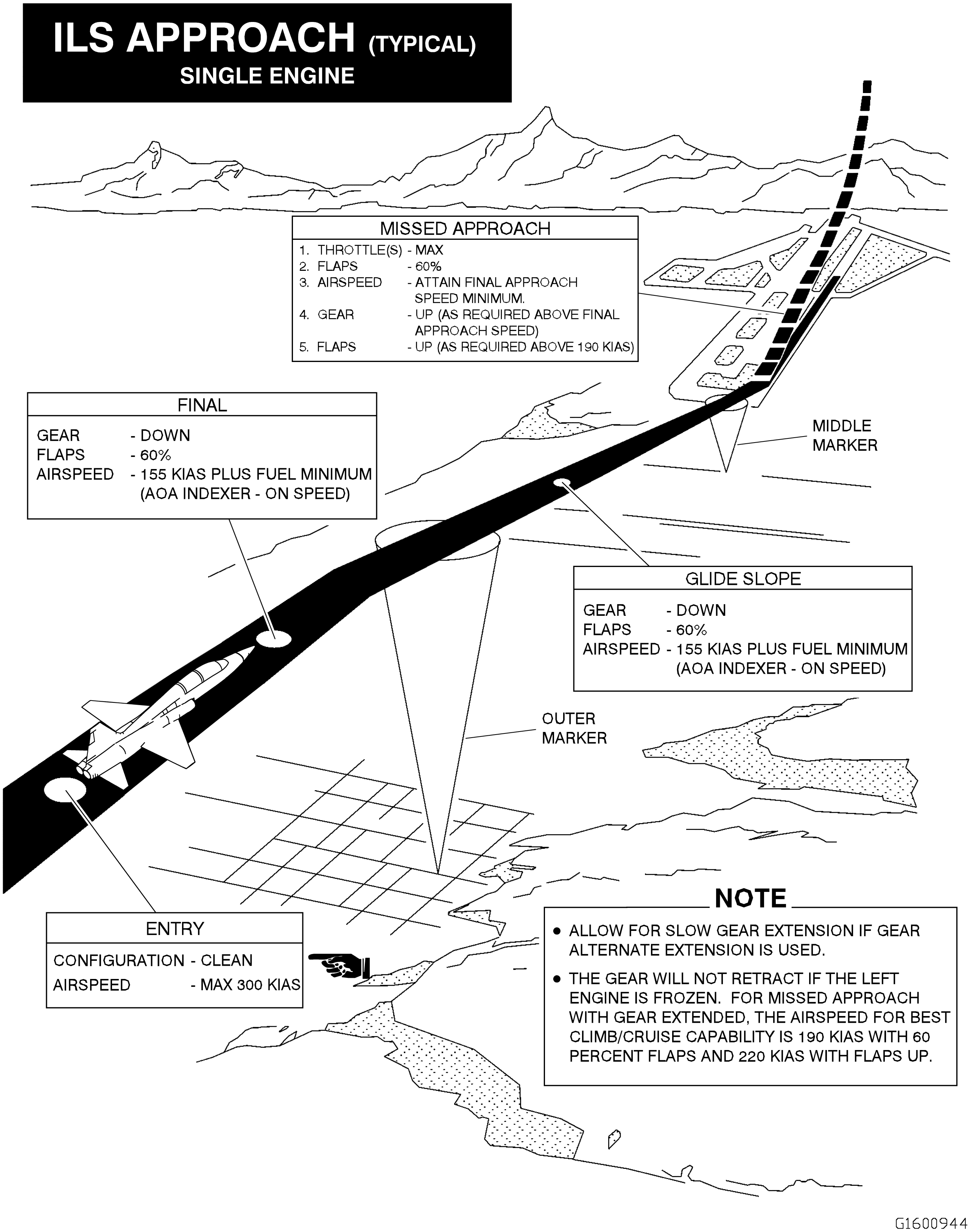

Figure 3-8. ILS Approach (Typical) (Single-Engine)

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LANDING GEAR EXTENSION FAILURE

Unsafe cockpit gear indications should not be the only factor in the determination of an unsafe gear condition. Gear position should be determined by chase aircraft, if available or other visual means. In the absence of visual confirmation of gear position, any gear that indicates down in one or both cockpits is down and locked based upon the independent warning systems for each cockpit green light indicator. Press to test any unlit bulbs. Burned out bulbs can be replaced with the trim light, boost pump lights (rear cockpit). If all gear are fully down (verified by chase or other visual means) but one or more are indicating unsafe, stop straight ahead on the runway and have the gear safety pins installed.

Before attempting a landing with gear up, carefully consider whether to attempt a landing or to eject. Use the following chart as a guide in determining whether a landing is feasible. Disregard gear door position when determining landing feasibility.

Gear Condition [1]		Recommended
Nose	**Main**	**Action**
UP	BOTH DOWN	LAND
UP	BOTH UP	LAND
UP	ONE DOWN	EJECT
DOWN	BOTH UP	
DOWN	ONE DOWN	

[1]Actual landing gear position (not indication).

WARNING

- Landing in lieu of ejection for gear conditions recommending ejection is considered more hazardous.
- Do not attempt to land on a main landing gear that is missing its wheel assembly.
- Do not attempt landing with all landing gear UP unless in a clean (no external store) configuration, or loaded with a non-flammable external store. Do not attempt landing if configured pylon only.

The landing surface should be smooth and hard, i.e., no lips or joints between asphalt and concrete that could snag the pylon. Approach end arrestment cables should be removed. The aircraft should be configured with speed brakes down and full flaps.

Use normal approach speeds for all configurations. Use normal touchdown speeds for all configurations except when landing with all gear up. Minimize rate-of-sink at touchdown but maintain a normal landing attitude to avoid excessive SLAM-DOWN. The procedures to be used for landing with gear extension failure are contained in the following paragraphs.

LANDING GEAR ALTERNATE EXTENSION

Landing gear alternate extension will take approximately 15 to 35 seconds.

If the landing gear normal extension procedure fails to extend the gear to a down and locked position, leave the landing gear lever at LG DOWN and use the landing gear alternate extension system to extend the gear by using the following procedure:

1. Airspeed — 240 KIAS or less
2. Flaps — AS REQUIRED
3. Gear Door Switch — OPEN
4. Landing Gear Lever — LG DOWN
5. Landing Gear Alternate Release Handle — PULL (approximately 10 inches), and HOLD (until gear unlocks), then STOW Handle
6. Gear Position — CHECK (If down and locked, proceed to Step 25.)

NOTE

- Once the three landing gear position indicators indicate that all three gears are down and locked, Do not further activate landing gear controls.
- After lowering the landing gear with the alternate release handle, do not attempt to reset the switches by cycling the landing gear lever. Cycling the landing gear lever may lead to further complications, particularly if the alternate release handle is not fully stowed.
- If the main gear fails to extend fully, yawing the aircraft and applying negative or positive-G forces may aid in extension.

If unsafe gear indication remains with UTILITY hydraulics available -

If the gear alternate extension system does not provide a safe gear indication and utility hydraulic pressure is available, use the following procedure to return utility hydraulic pressure to the landing gear system and possibly provide a safe gear indication.

7. Landing Gear Lever — LG UP (momentarily), then LG DOWN (If down and locked, proceed to Step 25.)

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If unsafe gear indication remains -

If the landing gear still fails to extend, the following steps may extend the landing gear. The decision to land with the nose gear up or unsafe, all gear up, eject or continue with attempts to extend the landing gear should be carefully considered based on fuel remaining and the risk involved with these options. If a gear-up configuration is obtained and fuel is not critical, continued attempts to obtain a more favorable gear-down configuration may be warranted.

8. Landing Gear Alternate Extension — REPEAT (Repeat the alternate extension procedure step 5. and 6. if unsafe gear indication remains and the main landing gear side brace is in place.)

WARNING

If a main landing gear fails to extend to the locked position due to the main landing gear side brace pin (Figure 3-9) backing out (verified by chase aircraft), repeated gear extension attempts may cause the pin to fall out of the side brace bellcrank. This can cause the gear to fail to retract or extend fully, resulting in an unlandable configuration.

9. Landing Gear — RECYCLE (Recycle the gear step 7. If the nose gear remains up and the main gear are down and locked, continued gear extension attempts may extend the nose gear.)

If fuel is critical, refer to LANDING WITH NOSE GEAR UP/UNSAFE.

NOTE

Repeated attempts of steps 8. and 9. have resulted in successful gear extensions. Alternate extending gear while yawing the aircraft and applying negative- or positive-G forces may aid in extension.

If unsafe gear indication remains -

If the landing gear still fails to extend, the following steps may extend the landing gear by removing electrical power to landing gear control circuits.

10. Generators — OFF

11. Battery Switch — OFF

12. Landing Gear Alternate Release Handle — PULL (approximately 10 inches), and HOLD (until gear unlocks), then STOW Handle.

13. Battery Switch — ON

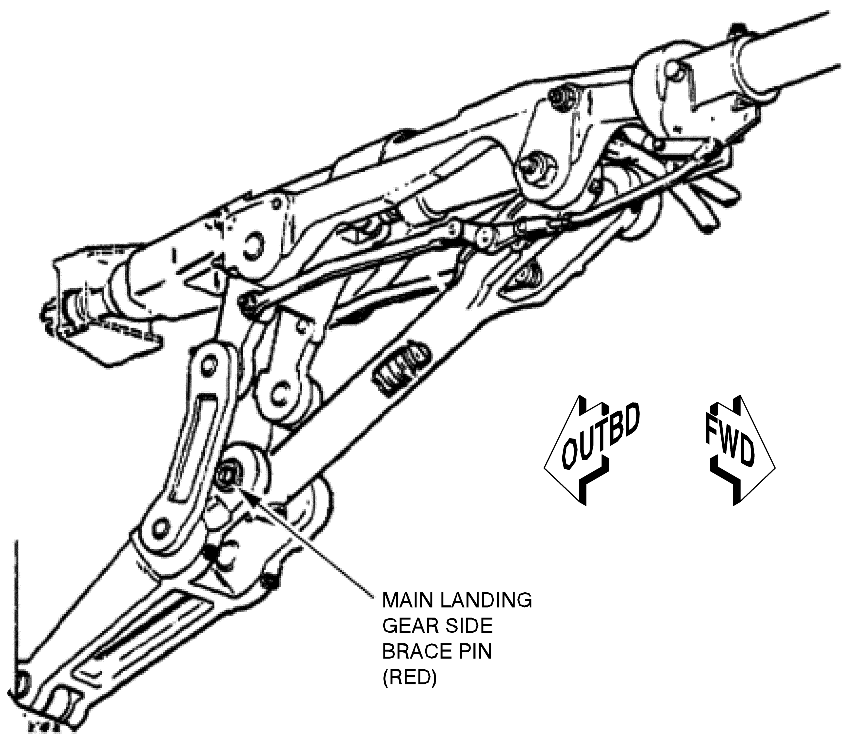

Figure 3-9. Landing Gear Side Brace Pin

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14. Generators — ON
15. Gear Position — CHECK (If down and locked, proceed to Step 25.)

NOTE

- Once the three landing gear position indicators indicate that all three gears are down and locked, Do not further activate landing gear controls.
- After lowering the landing gear with the alternate release handle, do not attempt to reset the switches by cycling the landing gear lever. Cycling the landing gear lever may lead to further complications, particularly if the alternate release handle is not fully stowed.
- If the main gear fails to extend fully, yawing the aircraft and applying negative or positive-G forces may aid in extension.

If the gear have remained up and locked throughout the normal and emergency lowering attempts, proceed as follows:

If all gear remain up and locked after using both normal and emergency lowering procedures, accomplish steps 16 through 25. This procedure is only effective if all the landing gear have remained up and locked after using both normal and emergency lowering procedures. If fuel is critical, refer to LANDING WITH ALL GEAR UP procedure.

If the landing gear still fails to extend, the following steps may extend the landing gear by removing hydraulic pressure to the system.

16. Gear Door Switch — CHECK OPEN
17. Throttle Gate — DISENGAGE
18. Throttle (Left Engine) — OFF
19. Control Stick — CYCLE (Use rapid lateral stick movements to deplete utility hydraulic pressure.)
20. Landing Gear Lever — LG DOWN
21. Landing Gear Alternate Release Handle — PULL (approximately 10 inches), and HOLD (until gear unlocks), then STOW Handle
22. Gear Position — CHECK

NOTE

- Once the three landing gear position indicators indicate that all three gears are down and locked, Do not further activate landing gear controls.
- After lowering the landing gear with the alternate release handle, do not attempt to reset the switches by cycling the landing gear lever. Cycling the landing gear lever may lead to further complications, particularly if the alternate release handle is not fully stowed.
- If the main gear fails to extend fully, yawing the aircraft and applying negative or positive-G forces may aid in extension.

23. Left Engine — RESTART
24. Throttle Gate — ENGAGE
25. Land as soon as practical.

CAUTION

Stop straight ahead on the runway and have the Landing Gear safety pins installed prior to clearing runway.

NOTE

If the landing gear has been extended by use of the landing gear alternate release handle, nosewheel steering will not be available for taxiing.

If fuel is critical and unsafe condition remains, refer to one of the following procedures:

- LANDING WITH ALL GEAR UP
- LANDING WITH NOSE GEAR UP/UNSAFE
- EJECTION PROCEDURES

LANDING WITH ALL GEAR UP

This procedure should be used only under favorable conditions of the runway environment. Burn down excess fuel prior to landing.

CAUTION

Do not attempt landing with all landing gear UP unless in a clean (no external store) configuration, or loaded with a non-flammable external store. Do not attempt landing if configured pylon only.

1. Gear — UP

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NOTE

With damage to the landing gear, the gear doors may not close, but they will either wear down, collapse, or break off upon gear-up landing.

2. CABIN PRESSURE Switch — RAM DUMP
3. Shoulder Harness — LOCK
4. Speed Brake — OPEN

NOTE

After landing, the speed brake may grind down beyond the actuator attach point. When this occurs, expect the nose to drop suddenly accompanied by increased noise, vibration, and deceleration.

5. Flaps — FULL DOWN (Fly a power-on approach requiring minimum flare.)

CAUTION

Consider using the auxiliary flap control switch to reposition the flaps. If damage to the flaps or flap mechanism is known or suspected, Do not reposition the flaps.

6. Throttle Gate — DISENGAGE
7. Landing Pattern — NORMAL (Plan to touch down at 10 knots above normal touchdown speed.)
8. Throttles — OFF AT TOUCHDOWN
9. Battery Switch — OFF

LANDING WITH NOSE GEAR UP/UNSAFE

1. CABIN PRESSURE Switch — RAM DUMP
2. Shoulder Harness — LOCK
3. Flaps — FULL DOWN
4. Throttle Gate — DISENGAGE
5. Landing Pattern — NORMAL
6. Throttles — IDLE AT TOUCHDOWN
7. Nose — GENTLY LOWER TO RUNWAY

If nose gear is up -

8. Throttles — OFF (when nose touches the runway)
9. Wheel Brakes — AS REQUIRED
10. Battery Switch — OFF

If nose gear is down (UNSAFE) –

If the nose gear remains down (UNSAFE) leave the left engine running until gear is pinned - utility hydraulic pressure may keep the gear from collapsing.

11. Wheel Brakes — AS REQUIRED

CAUTION

When the nose gear is down but indicating unsafe, Do not use brakes if a safe stop can be made without them.

LANDING WITH BLOWN TIRE, LOCKED BRAKE OR DIRECTIONAL CONTROL DIFFICULTY

WARNING

If one brake system fails or failure is suspected, with no other directional control problems such as a blown tire or locked brake, plan to land in the center of the runway. Stop the aircraft by using aerodynamic braking followed by a combination of wheel brake and nosewheel steering. Rudder pedals should be neutralized prior to engaging the nosewheel steering to prevent violent swerving and possible loss of directional control.

The aircraft may be safely landed with a blown tire, locked brake or similar directional control difficulty. Plan to land at minimum gross weight unless landing sooner is necessitated. Go-around after touchdown on a blown tire or locked brake should be avoided as rubber or other debris may be ingested by the engines. When it has been determined that a main gear tire has blown or a brake is locked, land on the side of the runway away from the malfunction. Make maximum use of rudder and wheel braking to maintain directional control. Nosewheel steering should be engaged only as a final attempt to maintain or regain directional control.

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MISCELLANEOUS EMERGENCIES

BRAKE SYSTEM MALFUNCTION (FLUID VENTING)

Failure of certain components of the wheel brake master cylinders or brake lines located within the pressurized area of the cockpit may cause brake fluid (red) present/visible on the right side of aircraft below/aft of the RCP canopy rail to vent overboard through the brake fluid reservoir. If allowed to continue, all brake fluid could be forced overboard. With no other known malfunction, plan to land in the center of the runway.

If brake fluid venting is suspected or detected –

1. Descend to 25,000 feet or below, if practical.
2. CABIN PRESS switch — RAM DUMP, BELOW 25,000 FEET
3. Land at lowest practical gross weight.

WARNING

If brake failure is encountered on landing roll, braking action may be regained by repeatedly pumping the brakes. The pedals should be released to the full up position between strokes.

CAUTION

Do not pump the brakes in flight as this action could introduce air into the brake system which could result in complete brake failure.

Refer to:

- CABIN PRESSURE LOSS
- BARRIER ENGAGEMENT

EJECTION VS FORCED LANDING

Ejection is preferable to landing on an unprepared surface. Do not land the aircraft with both engines flamed out.

DITCHING

Ejection is to be accomplished in preference to ditching the aircraft.

EJECTION PROCEDURE

Escape from the aircraft should be made with the ejection seat using the sequence shown in Figure 3-14. After ejection, the safety belt automatically opens and a man-seat separation system forcibly separates the crew member from the ejection seat. A rapid deployment escape system is provided to improve lowaltitude escape capability. The zero-delay lanyard, if present on the parachute, may be disconnected for completely controlled ejections if time and altitude permit. If the zerodelay lanyard is present, it should be connected in accordance with present directives. However, if the crew member knows he is going to eject at more than 2000 feet AGL in a controlled condition disconnect the zero-delay lanyard to reduce chances of seat/chute pilot involvement. There is no evidence to indicate that one should attempt to connect the zerodelay lanyard after deciding to eject. The time lost in connection is greater than any advantages which may be gained.

WARNING

- Do not delay ejection below 2000 feet above the terrain in futile attempts to start the engines or for other reasons that may commit you to an unsafe ejection or a dangerous flameout landing. Accident statistics emphatically show a progressive decrease in successful ejections as altitude decreases below 2000 feet above the AGL.
- Under uncontrollable conditions, eject at least 15,000 feet AGL.

During any low-altitude ejection, the chances for successful ejection can be greatly increased by pulling up to exchange airspeed for altitude if airspeed permits. Ejection should be accomplished while in a positive rate of climb with the aircraft approximately 20 degrees nose-up and before the start of any sink rate.

Ejection while the nose of the aircraft is above the horizon and in a positive rate of climb will result in a more nearly vertical trajectory for the seat, thus providing more altitude and time for seat separation and parachute deployment. See Figure 3-12 for safe minimum ejection altitude versus sink rate and Figure 3-13 for ejection altitude versus bank/dive angle. If rate of climb cannot be accomplished, level flight ejection should be accomplished immediately to avoid ejection with a sink rate. The automatic safety belt must not be opened before ejection, regardless of altitude. If the safety belt is opened manually, the automatic feature of the parachute is eliminated.

The following information is based on numerous rocket-sled tests using the ballistic rocket ejection catapult. No safety factor is provided for equipment malfunction. Since survival from an extremely low altitude ejection depends primarily on the aircraft attitude and altitude, the decision to eject must be left to the discretion of the pilot. Factors such as G-loads, high sink rates, and aircraft attitudes other than level or slightly nose high will decrease chances for survival. Aircraft rolling, pitching, and yawing moments, such as those found in a loss of control, increase the chance

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of seat-man contact and para-chute entanglement regardless of ejection altitude. The emergency minimum ejection conditions (ground level and 50 KIAS) are provided only to show that zero altitude ejection can be accomplished in case of an emergency which would require immediate ejection. It must not be used as a basis for delaying ejection when above 2000 feet.

The emergency MINIMUM ejection conditions, based on a level attitude, with no sink rate are as follows:

BA-22 or BA-25 parachutes with 0.25 sec. delay opening	
Or	Ground Level at 50 KIAS
BA-22 parachute with zero delay lanyard ATTACHED	
BA-22 parachute with zero-delay lanyard NOT ATTACHED (1-second delay opening)	100 feet AGL

The emergency MAXIMUM ejection airspeeds sea level through 14,000 feet are as follows:

BA-22 or BA-25 parachutes with 0.25 sec. delay opening	500 KIAS
BA-22 parachute - zero delay lanyard ATTACHED	400 KIAS
BA-22 parachute - zero delay lanyard NOT ATTACHED (1-second delay opening)	550 KIAS

BEFORE EJECTION

If time and conditions permit...

1. Notify crew member of decision to eject
2. IFF/SIF — EMER (If not in radio contact with appropriate agencies, turn radio to GUARD and transmit MAYDAY.)
3. Turn aircraft toward uninhabited area.
4. All Loose Equipment — STOWED
5. Survival Kit (AUTO/MANUAL) — AS REQUIRED
6. Emergency Oxygen Cylinder (Green Ball) — PULL to Actuate (At high altitude)
7. Oxygen and G-suit hose — DISCONNECT
8. Personal Equipment — CHECK (Tighten oxygen mask and chin strap securely (well beyond comfortable range), and lower and lock visor(s).

If under controlled conditions above 2000 feet AGL -

9. Zero-delay lanyard — DISCONNECT AND STOW (If applicable)
10. Proper Altitude, Attitude, and Airspeed — ATTAIN

WARNING

If the aircraft is not controllable, ejection must be accomplished at whatever speed exists, as this offers the only opportunity for survival. At sea level, wind blasts and deceleration will exert medium forces on the body up to approximately 450 KIAS (0.7 Mach), severe forces causing flailing and skin injuries between 450 (0.7 Mach) and 600 KIAS (0.9 Mach), and excessive forces above 600 KIAS (0.9 Mach). As altitude increases, the speed ranges of the injury-producing forces will be a function of the Mach number.

11. Proper Ejection Position — ASSUME

Refer to WARNINGS in Figure 3-10.

EJECTION

1. **HANDGRIPS — RAISE**

AFTER EJECTION

Immediately after ejection the following procedures apply:

1. Safety Belt — ATTEMPT TO OPEN MANUALLY (Attempt to manually open the safety belt as a precaution against the belt failing to open automatically.)
2. Safety Belt Released — ATTEMPT TO SEPARATE FROM SEAT (A determined effort must be made to separate from the seat to obtain full parachute deployment at maximum terrain clearance. This is extremely important for low altitude ejections.)

If safety belt opened manually –

3. Parachute Arming Lanyard (Red Ball) — PULL IMMEDIATELY

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GRD TO HYD ELE FUE OXY ENG FLT MISC LND

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NOTE

If flying over high terrain, consideration should be given to pulling the ripcord handle even if above automatic parachute opening altitude.

4. Survival Kit — DEPLOY AFTER PARACHUTE OPENING

WARNING

ASSUME PROPER POSITION

SIT ERECT, HEAD FIRMLY AGAINST HEADREST, FEET HELD BACK AGAINST THE SEAT.

POSITION ELBOWS CLOSE TO BODY WITHIN ELBOW GUARDS, TO PROTECT ELBOWS WHEN LEG BRACES ARE RAISED, AND DURING EJECTION.

THE CREW MEMBER IN REAR COCKPIT SHOULD EJECT FIRST IF ALTITUDE PERMITS. THIS WILL PREVENT POSSIBLE INJURY FROM FRONT SEAT ROCKET BLAST.

MAINTAINING AIRCRAFT CONTROL MAY REQUIRE USE OF ONE HAND TO INITIATE THE EJECTION SEQUENCE.

THE EJECTION SEAT IS CURRENTLY QUALIFIED AND CERTIFIED FOR AIRCREW MEMBER WEIGHING IN THE RANGE OF 140 - 211 POUNDS. AIRCREWS OUTSIDE THIS WEIGHT RANGE HAVE AN INCREASED PROBABILITY OF INJURY DURING THE EJECTION PROCESS.

1 HANDGRIPS - RAISE

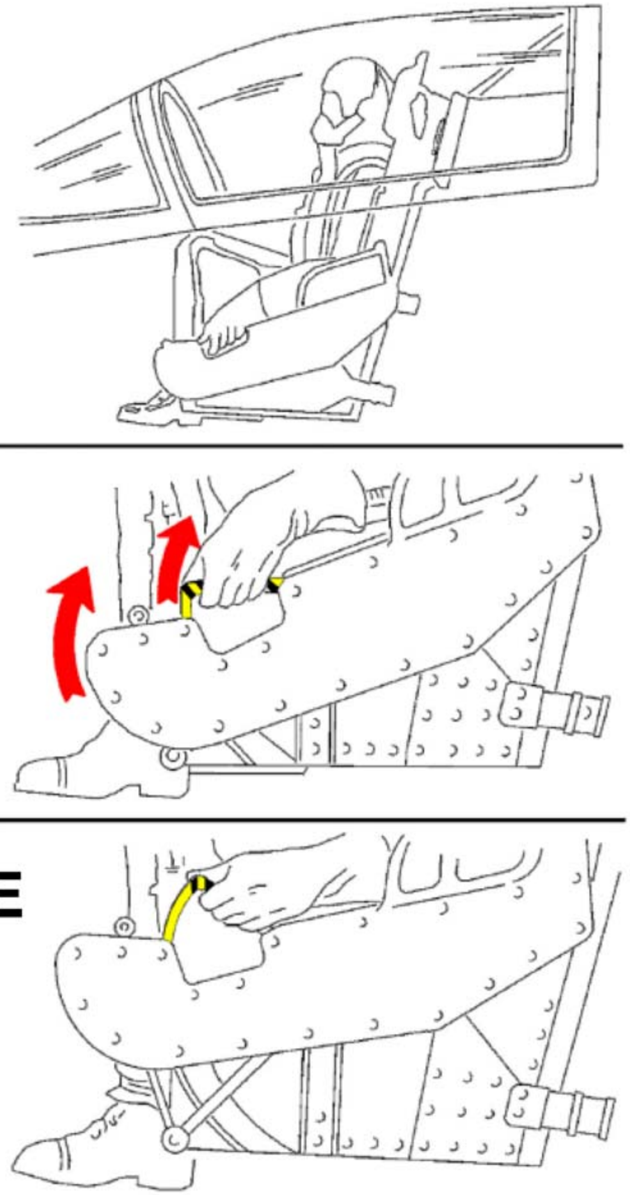

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Figure 3-10. Ejection

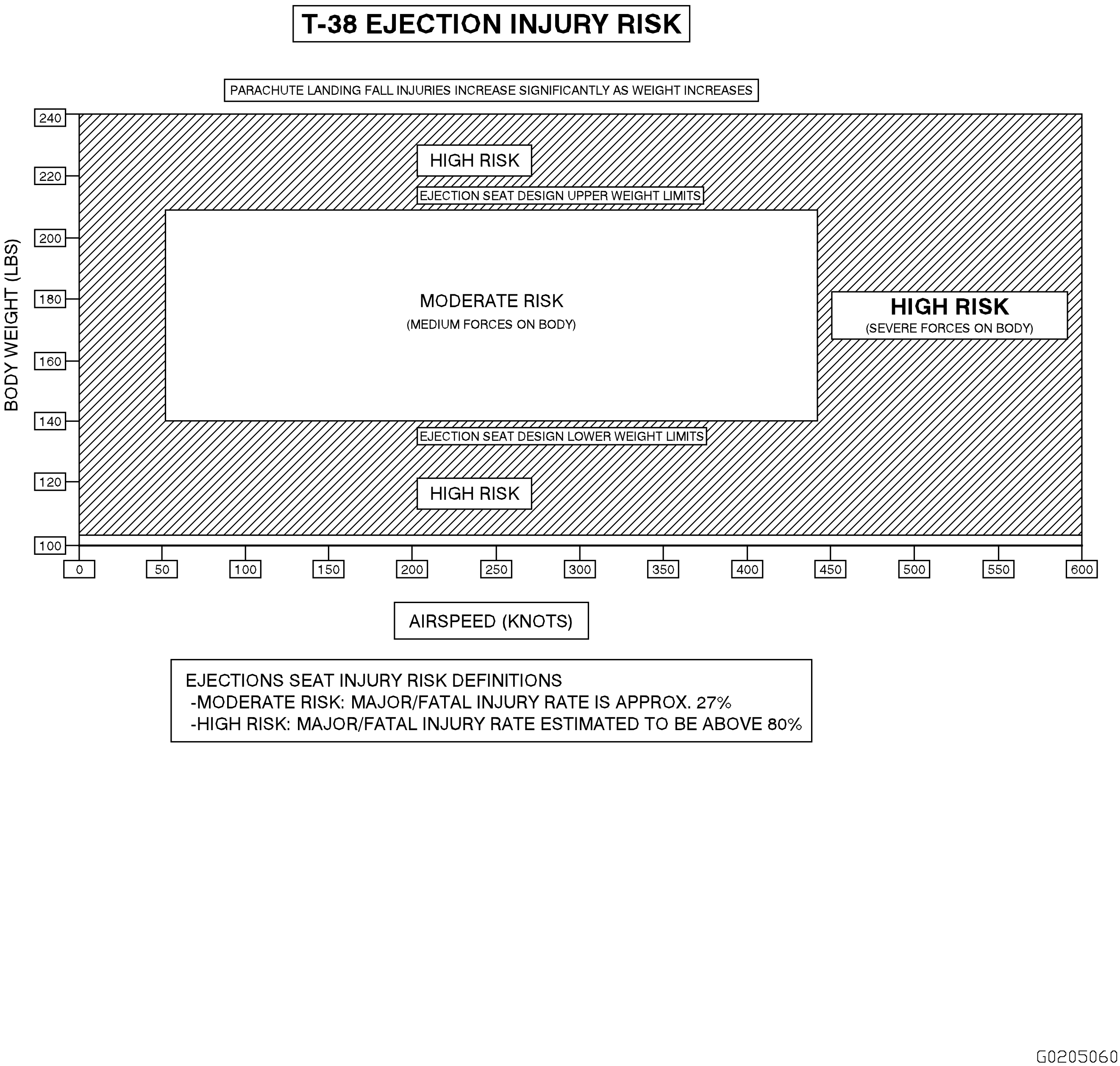


Figure 3-11. Ejection Injury Risk Chart

EJECTION ALTITUDE VS SINK RATE

0.25 SECOND DELAY OPENING PARACHUTE OR ZERO DELAY LANYARD ATTACHED

NOTE

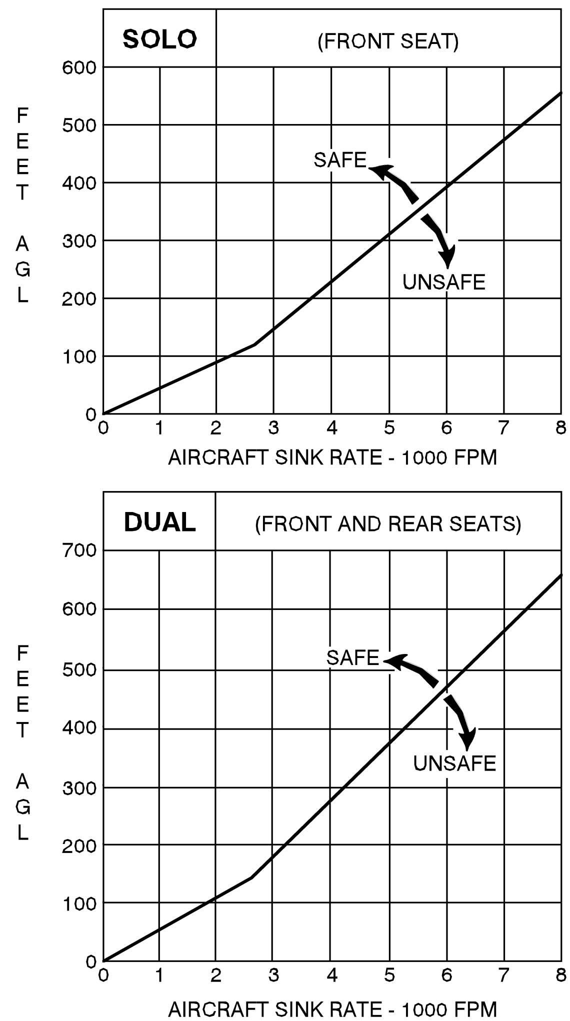
- ASSUMED REAR SEAT EJECTS FIRST, FOLLOWED IN 0.75 SECOND BY FRONT SEAT.
- IF THE WINGS ARE NOT LEVEL, BANK ANGLE EFFECTS (FIGURE 3-6) MUST BE ADDED.
- BOTH EJECTION SEATS HAVE THE SAME EJECTION CAPABILITY.

WARNING

- THE MINIMUM EJECTION ALTITUDES SHOW SEAT CAPABILITY (WITH 2-SECOND REACTION TIME) AS AFFECTED BY AIRCRAFT SINK RATE. THE MINIMUM ALTITUDES DO NOT PROVIDE ANY SAFETY FACTOR FOR EQUIPMENT MALFUNCTION, DELAY IN SEPARATING FROM THE SEAT, AND AIRCRAFT DIVE AND BANK ANGLES ABOVE 2000 FEET TERRAIN CLEARANCE.
- THE MINIMUM EJECTION ALTITUDES SHALL NOT BE USED AS THE BASIS FOR DELAYING EJECTION WHEN ABOVE 2000 FEET TERRAIN CLEARANCE.

CONDITIONS

AIRSPEED AT EJECTION - 150 KIAS
WINGS LEVEL - SLIGHT NOSE-UP ATTITUDE
2-SECOND REACTION TIME



SINK RATE

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Figure 3-12. Ejection Altitude vs. Sink Rate

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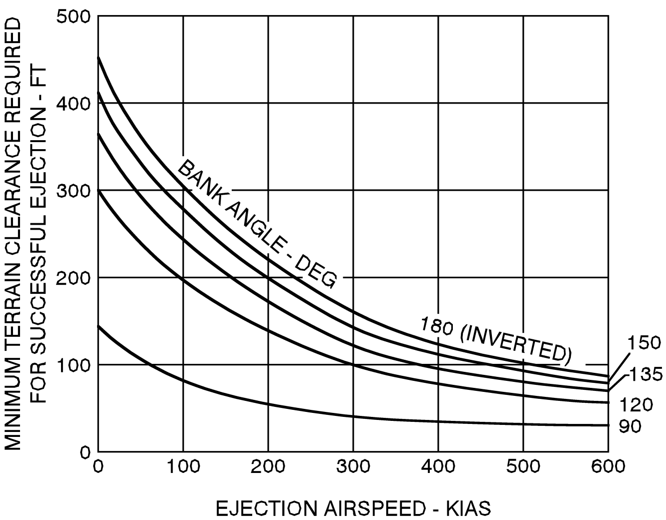
WARNING

- EJECTIONS ABOVE EACH TIME REACTION, DIVE ANGLE, OR BANK ANGLE LINE ARE SAFE FOR GIVEN CONDITIONS.
- EJECTIONS BELOW EACH LINE ARE UNSAFE.

BANK ANGLE

CONDITION

CONSTANT ALTITUDE



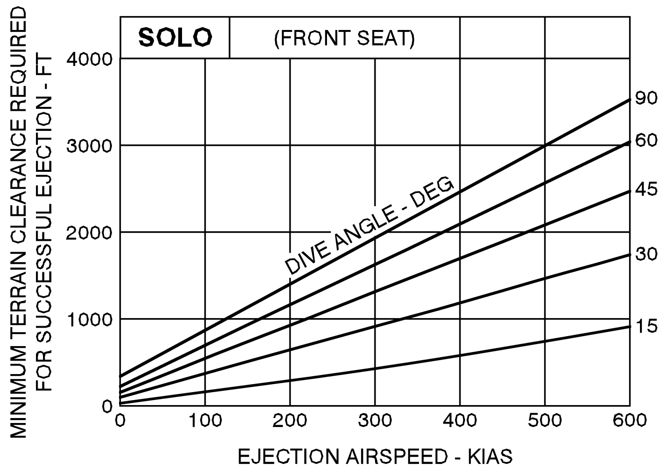
NOTE

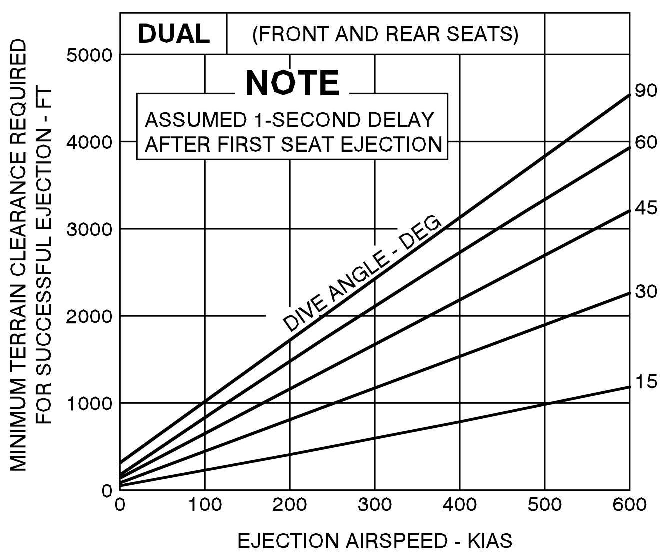
BANK ANGLES UP TO 60° ARE SAFE FOR LEVEL FLIGHT AT ALL AIRSPEEDS UP TO 500 KIAS WITH 0.25 SECOND DELAY OPENING PARACHUTE OR 400 KIAS WITH ZERO DELAY LANYARD ATTACHED.

DIVE ANGLE

CONDITIONS

WINGS LEVEL
2-SECOND REACTION TIME





NOTE

IF THE WINGS ARE NOT LEVEL, BANK ANGLE EFFECTS MUST BE ADDED.

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Figure 3-13. Ejection Altitude vs. Bank/Dive Angle

EJECTION SEQUENCE

NOTE

- TIME FROM RAISING HANDGRIPS TO FULL 0.25 SECOND DELAY PARACHUTE DEPLOYMENT IS 3.42 SECONDS (APPROX) AT AN EJECTION AIRSPEED OF 150 KNOTS. VARIABLES SUCH AS LOWER AIRSPEEDS AND THE ATTITUDE OF THE PILOT AT TIME OF PACK OPENING CAN INCREASE PARACHUTE DEPLOYMENT TIME.
- TIME TO FULL PARACHUTE DEPLOYMENT IS THE SAME FOR BOTH SEATS.

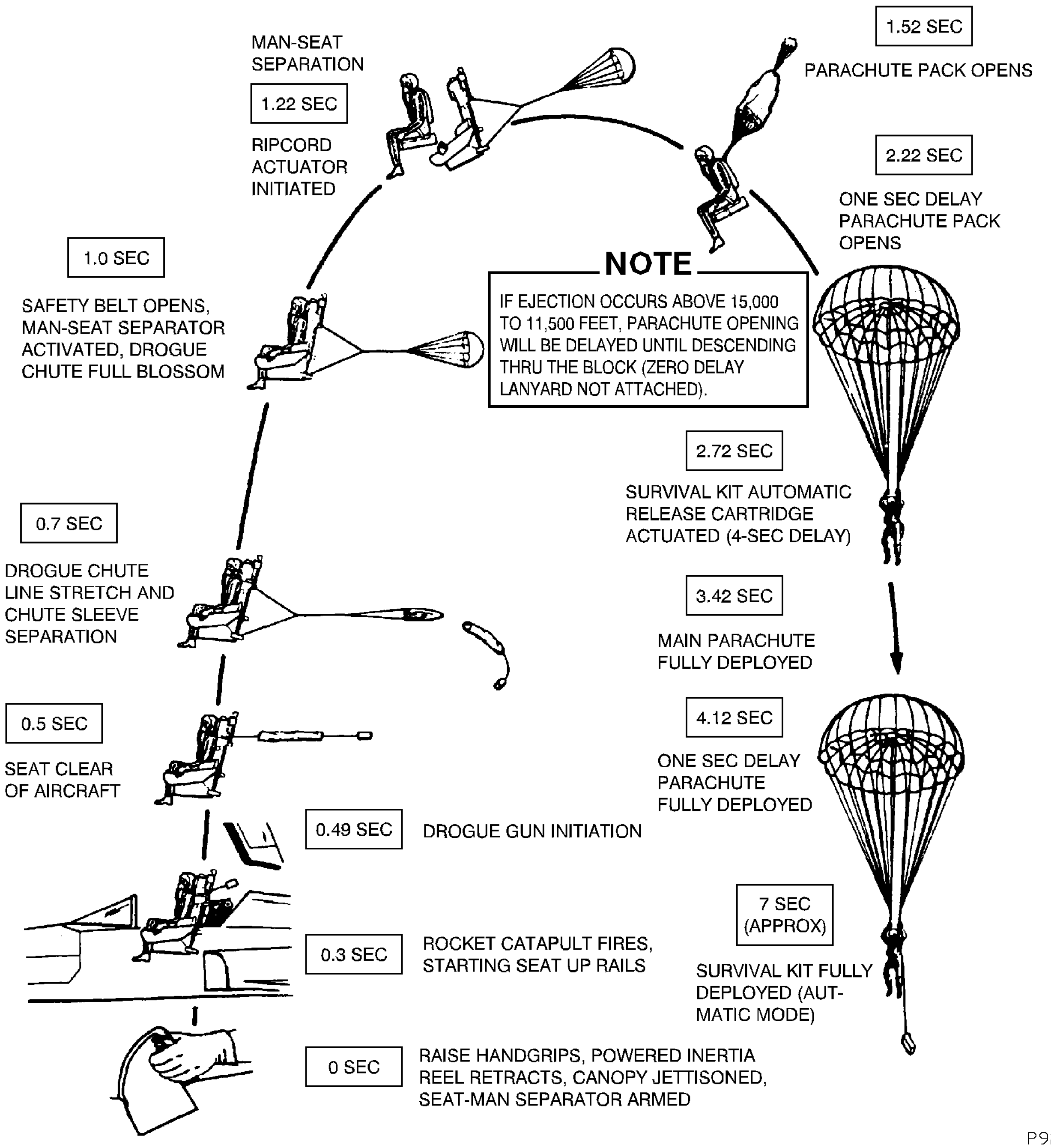

Figure 3-14. Ejection Sequence

LOSS OF CANOPY

WARNING

- With a lost or damaged canopy, it is imperative to confirm the speed brakes are retracted. The combination of canopy and speed brake drag may require afterburner to sustain level flight.
- After the canopy is lost or jettisoned, inadvertent drogue chute deployment is possible. Chute deployment could cause an immediate out-of-control condition.

NOTE

The drag due to a lost front canopy is equal to approximately one-half the drag of a fully extended speed brake.

If either or both canopies are lost:

1. Airspeed — Immediately slow to below 300 KIAS.

NOTE

Minimum drag occurs at approximately 225 KIAS.

2. Reestablish intercockpit communications.
3. Land as soon as practical.

Refer to CABIN PRESSURE LOSS.

ERECT SPIN RECOVERY

The primary anti-spin control is the aileron, and it is imperative that full aileron deflection be held during recovery.

WARNING

Ejection from either an erect or inverted spin is to be accomplished if a spin recovery is not completed by 15000 feet above the terrain or if transverse G-loads preclude maintaining anti-spin controls, whichever occurs first.

Immediately upon recognition of the direction of rotation, use the following procedure:

1. Control stick — FULL AILERON (Using both hands, in direction of spin (turn needle) and as much aft stick as possible without sacrificing aileron.)

WARNING

If full aileron deflection in the direction of the spin is not maintained throughout the recovery, spin recovery may be prolonged or prevented.

2. Rudder — FULL OPPOSITE (Opposite turn needle.)
3. Gear, flaps, and speed brake positions - DO NOT CHANGE (during recovery).
4. Neutralize controls after recovery.

NOTE

Recovery from the spin is normally abrupt and may be followed by some spiraling during the resultant dive.

INVERTED SPIN RECOVERY

Immediately upon experiencing an inverted spin, use the following procedure:

1. All Flight Controls — NEUTRALIZE

WARNING

- Maintain controls in neutral position throughout the spin recovery. Any aileron or rudder deflection can induce a transition to an erect spin.
- Ejection from either an erect or inverted spin is to be accomplished if a spin recovery is not completed by 15000 feet above the terrain or if transverse G-loads preclude maintaining anti-spin controls, whichever occurs first.

EMERGENCY ENTRANCE

Refer to Figure 3-15 when assisting in rescue of aircrew on the ground.

GRD TO HYD ELE FUE OXY ENG FLT MISC LND

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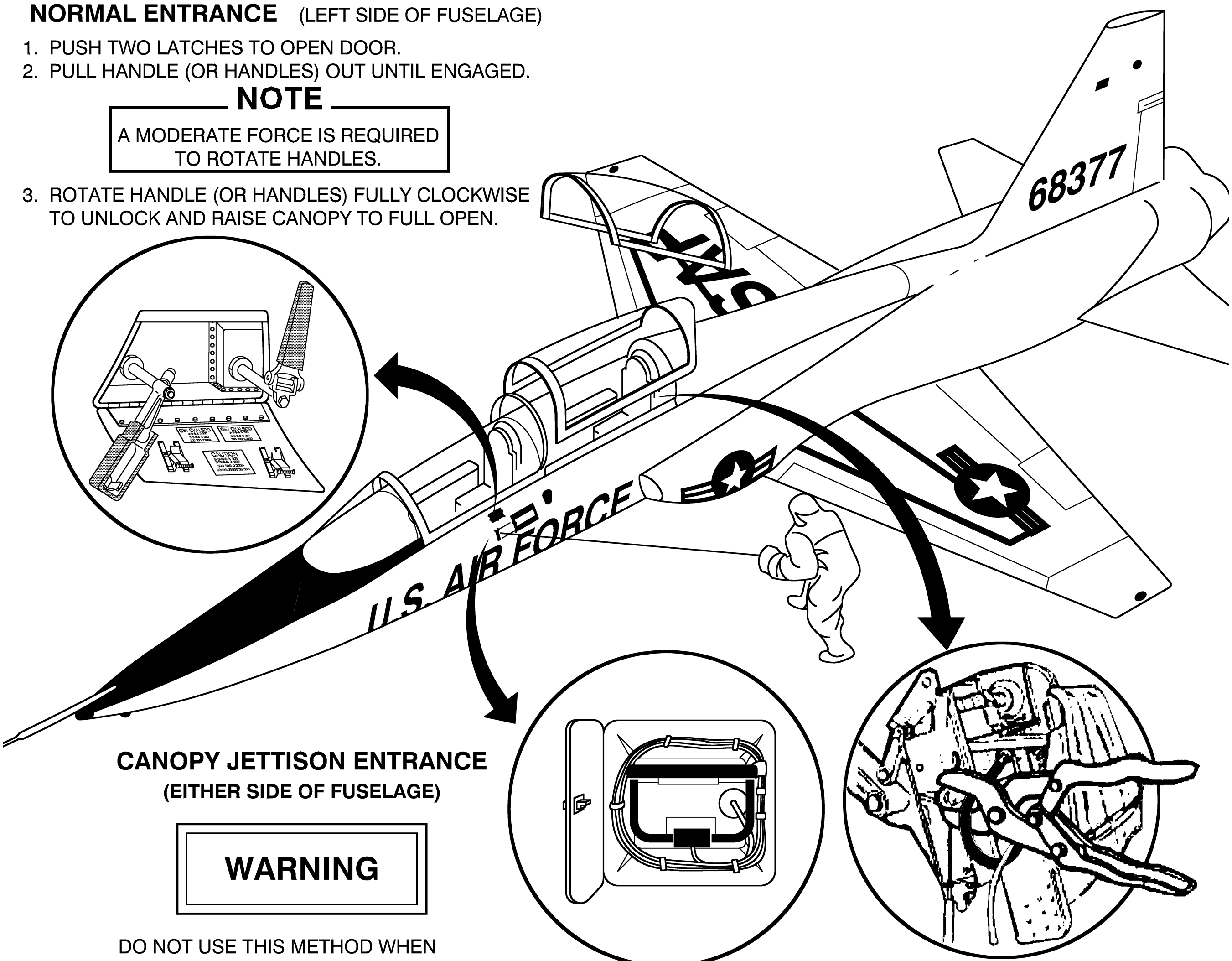
NORMAL ENTRANCE (LEFT SIDE OF FUSELAGE)

1. PUSH TWO LATCHES TO OPEN DOOR.
2. PULL HANDLE (OR HANDLES) OUT UNTIL ENGAGED.

NOTE

A MODERATE FORCE IS REQUIRED TO ROTATE HANDLES.

3. ROTATE HANDLE (OR HANDLES) FULLY CLOCKWISE TO UNLOCK AND RAISE CANOPY TO FULL OPEN.



CANOPY JETTISON ENTRANCE
(EITHER SIDE OF FUSELAGE)

WARNING

DO NOT USE THIS METHOD WHEN RESIDUAL FUEL IS AROUND COCKPIT AREA.

1. PUSH LATCH TO OPEN DOOR.
2. PULL D-HANDLE OUT TO FULL LENGTH (APPROXIMATELY 6 FEET).

NOTE

BOTH CANOPIES ARE JETTISONED WHEN EMERGENCY D-HANDLE IS PULLED.

IF UNABLE TO OPEN CANOPY

BREAK CANOPY BEHIND PILOT/AIRCREW WITH AX OR SIMILAR IMPLEMENT.

NOTE

SPRAYING CANOPY WITH CO_2 WILL CAUSE THE GLASS TO BECOME BRITTLE AND EASY TO BREAK.

AFTER ACCESS TO COCKPIT IS GAINED

WARNING

INADVERTENT SEAT JETTISON IS POSSIBLE IF HANDGRIPS ARE RAISED.
CUT CATAPULT HOSE AND DROGUE GUN INITIATOR HOSE, USING WISS BULLDOG SHEARS NO. 6 OR BOLT CUTTER.

NOTE

IF HANDGRIPS HAVE NOT BEEN RAISED, INSERT SAFETY PIN IN RIGHT EJECTION SEAT LEGBRACE TO PREVENT INADVERTENT EJECTION.

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Figure 3-15. Emergency Entrance

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SECTION IV

CREW DUTIES

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SECTION V

OPERATING LIMITATIONS

TABLE OF CONTENTS

GRD TO HYD ELE FUE OXY ENG FLT MISC LND

INTRODUCTION

Cognizance must be taken of instrument markings in Figure 5-1, since they represent limitations that are not necessarily repeated in the text.

MINIMUM CREW REQUIREMENT

The minimum crew requirement for this aircraft is one pilot. Solo flights must be made with the pilot flying the aircraft from the front cockpit.

THROTTLE SETTING THRUST DEFINITIONS

NORMAL THRUST

Normal (maximum continuous) thrust is the thrust obtained at 98.5% RPM or 630°C EGT, whichever occurs first.

MILITARY THRUST

MIL (military) thrust is the thrust obtained at 100% RPM without afterburner operation.

MAXIMUM THRUST

MAX (maximum) thrust is the thrust obtained at 100% RPM with the afterburner operating. After burner range extends from minimum afterburner of approximately 5% augmentation above MIL thrust to maximum afterburner, which is approximately 40% augmentation above MIL thrust.

AIRSPEED LIMITATIONS

WING FLAPS

Do not exceed the following airspeeds for the wing flap deflections:

1 to 45%	300 KIAS
46 to 60%	240 KIAS
Over 60%	220 KIAS

LANDING GEAR

Do not exceed 240 KIAS with the landing gear extended and/or landing gear doors open.

CAUTION

Extension/retraction of landing gear at bank angles greater than 45 degrees or at load factors greater than 1.5 Gs can result in overstress failure of the main landing gear sidebrace trunnion.

NOSEWHEEL STEERING

Do not exceed 65 KIAS with nosewheel steering engaged.

WARNING

Due to the potential of an out-of-control situation, ensure the nosewheel steering button is not depressed during takeoff roll. Unintentional nosewheel steering activation, especially during an abort may place aircraft in an unrecoverable skid.

CANOPY

Do not exceed 50 KIAS while taxiing with a canopy open.

If possible, avoid taxi operations with an open canopy with a relative wind greater than 30 knots (relative wind is defined as ground speed plus wind component over the nose).

LOAD FACTOR LIMITATIONS

Do not exceed the following (See Figure 5-3 and Figure 5-4):

SYMMETRICAL FLIGHT

Load Factor (Gs)	Weight of Fuel Remaining (lbs)
-2.3 to +5.7	3500
-2.4 to +5.9	3000
-2.6 to +6.5	2000
-2.9 to +7.2	1000

UNSYMMETRICAL FLIGHT

Load Factor (Gs)	Weight of Fuel Remaining (lbs)
0 to +4.1	3500
0 to +4.3	3000
0 to +4.7	2000
0 to +5.0	1000

SPECIAL FLIGHT LIMITATIONS

Functional Check Flights (FCF) and one-time ferry flight authorizations may require limitations or operation different from standard. Prior to flying an aircraft for these missions, a briefing should be received from appropriate maintenance (QC) and/or operations personnel. T.O. 1T-38A-3 contains requirements for one-time ferry flights and other special instructions. Certain conditions could exist which may allow continuous operation with restrictions. These conditions and restrictions will be noted and flight approval from the using command will be required. These aircraft will be identified by a placard on the cover of the AFTO 781 and cockpit placards.

PROHIBITED MANEUVERS

VERTICAL STALLS

Vertical stalls are prohibited.

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GRD TO HYD ELE FUE OXY ENG FLT MISC LND

SPINS

Intentional spins are prohibited. Refer to SECTION III for spin recovery procedure in case an inadvertent spin is experienced.

ROLLS

Continuous aileron rolls at any load factor other than 1.0 G are prohibited. Continuous aileron rolls exceeding three-quarter stick travel are prohibited.

NOTE

Single aileron rolls may be accomplished at any load factor or stick deflection if asymmetric G limits are observed.

MISCELLANEOUS LIMITATIONS

FUEL SYSTEM

To prevent fuel starvation and subsequent engine flameout, do not exceed the following:

1. Maximum thrust dives with less than 650 pounds of fuel in either fuel supply system.
2. Maximum thrust power in zero G flight or at negative load factors exceeding 10 seconds at 10,000 feet or 30 seconds at 30,000 feet. With less than 650 pounds of fuel in either supply system, time for successful engine operation is further reduced.

NOTE

Lower power settings will result in proportionally longer operating times; however, do not exceed engine oil system supply limitations.

ENGINE OIL SYSTEM

Due to engine oil supply and pressure requirements, zero-G flight is restricted to 10 seconds and negative-G flight (any attitude) to 30 seconds. A momentary drop or loss of oil pressure may be experienced during negative-G or inverted flight. Engine oil venting overboard and/or low oil pressure may occur until positive-G loads are applied.

CAUTION

If oil pressure does not recover within approximately 10 seconds, return to normal flight conditions. Do not attempt zero-G or negative-G maneuvers again until oil pressure registers at a normal value for at least 30 seconds.

WHEEL BRAKES AND TIRES

If the following minimum time intervals between full stop landings cannot be complied with, brakes, wheels, and tires should be allowed to cool with the aircraft parked in an uncongested area and the condition reported in Form 781.

	Minimum Time Interval Between Full Stop Landings
Gear retracted in flight	45 minutes
Gear extended in flight	15 minutes

NOSEWHEEL TIRE

The nosewheel tire is rated to 174 knots.

MAIN WHEEL TIRE

The main wheel tire is rated to 221 knots (14 ply) groundspeed.

LANDING RATE OF DESCENT

Landing should be made with as low a sink rate as practicable. Do not exceed the following sink rates at touchdown:

1. 590 feet per minute normal landing, 395 feet per minute crab landing, with less than 1700 pounds of fuel.
2. 340 feet per minute normal landing, 200 feet per minute crab landing, with full fuel.

WEIGHT AND CENTER OF GRAVITY LIMITATIONS

The weight and balance limitations cannot be exceeded by normal operating or loading conditions; however, it is possible to attain an aft center of gravity when the right fuel system contains more fuel than the left fuel system. To avoid exceeding the aft CG limit during solo flight, do not allow the right (aft) fuel system quantity to equal more than twice the left (forward) fuel system quantity. If this should occur, longitudinal static stability may be reduced and caution should be exercised to prevent over-controlling during high-speed subsonic flight or landings. Refer to TO 1T-38C-5.

HYDRAULIC PRESSURE

Hydraulic pressure readings outside the normal range with no demand on the respective system are indicative of a malfunction within the system. High pressures pose the greater danger because of possible fluid overtemperatures. However, operating hydraulically powered equipment (e.g., making rapid flight control movements) will cause pressure fluctuations well outside the static limit. These fluctuations are not considered a malfunction.

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PREV COVER NEXT

GRD TO HYD ELE FUE OXY ENG FLT MISC LND

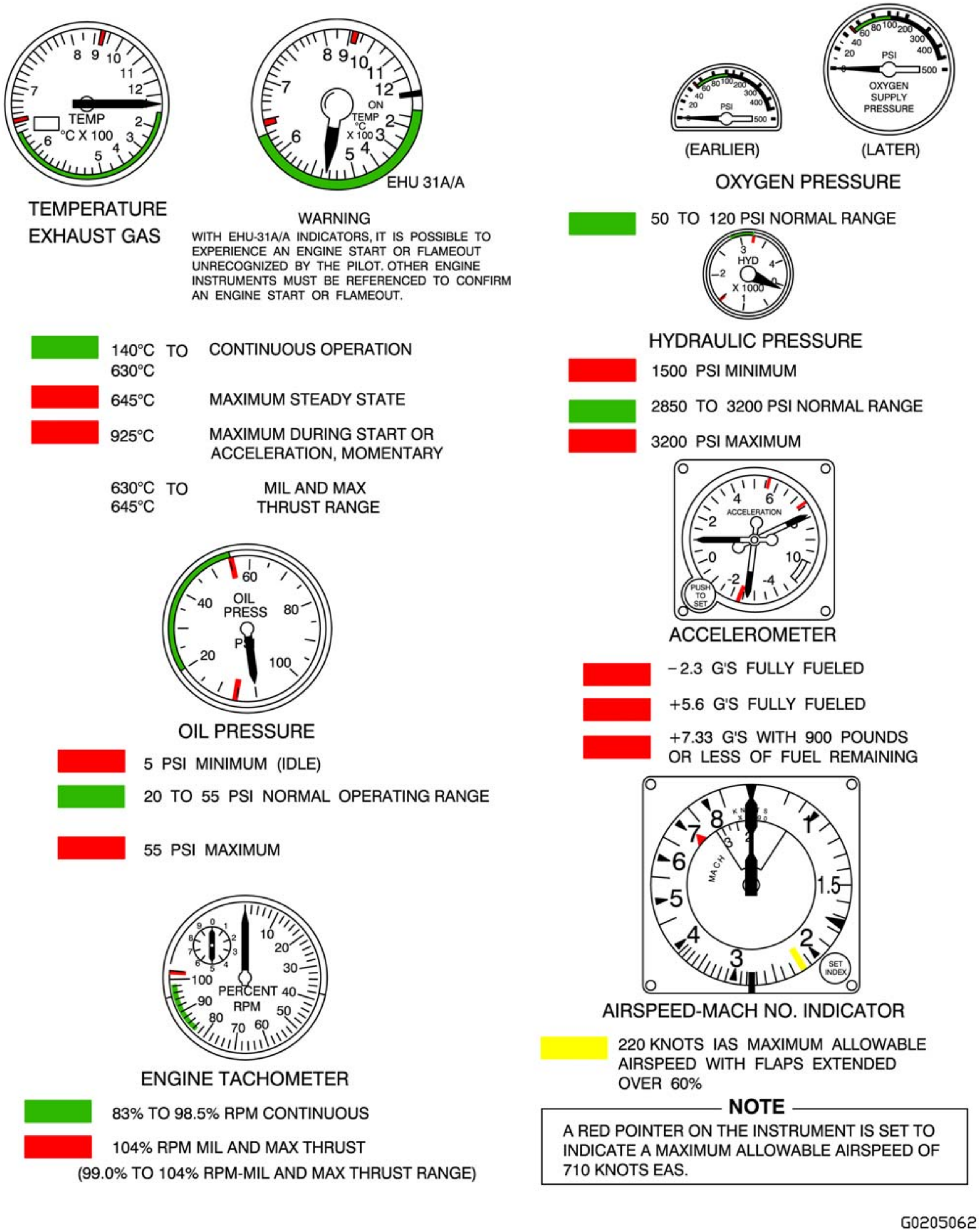

Figure 5-1. Instrument Markings

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GRD TO HYD ELE FUE OXY ENG FLT MISC LND

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CONDITION	EGT °C	RPM %	NOZZLE POSITION %	FUEL FLOW LB/HR	OIL PRESSURE PSI	TIME DURATION (MINUTES)
GROUND STEADY STATE						
START	925 (MAX) *845	– – –	– – –	360 (MAX)	– – –	– – –
IDLE	– – –	46.5-49.5	77-92	400-600 (STD DAY)	5-20	– – –
MILITARY	630-645	99.0-100.5	0-20	2100-2500 (SEA LEVEL)	20-55	30
(MAX) AFTERBURNER	630-645	99.0-100.5	50-85	– – –	20-55	5
FLIGHT STEADY STATE						
START	925 (MAX) *845	– – –	– – –	360 (MAX)	– – –	– – –
IDLE	– – –	– – –	– – –	200 (MIN) (STD DAY)	5 (MIN)	– – –
MILITARY	630-645	99.0-104	0-20	– – –	20-55	30
(MAX) AFTERBURNER	630-645	99.0-104	50-85	– – –	20-55	15
FLUCTUATION LIMITS	**WITHIN STEADY STATE LIMITS**					
IDLE (GROUND)	– – –	46.5-49.5	NONE ALLOWED	±25	±2	– – –
MILITARY AND AB (GROUND)	* *	99.0-100.5	±3	±50	±2	– – –
MILITARY AND AB (FLIGHT)	* *	±1	±3	±50	±2	– – –

OTHER LIMITATIONS

EGT:

* 1. ABORT START IF EGT REACHED 845°C TO PRECLUDE EXCEEDING TEMPERATURE LIMITS.
2. ABORT AIRCRAFT DURING GROUND START IF EGT EXCEEDS 925°C MOMENTARILY.

** 3. TOTAL FLUCTUATIONS IN EGT OF 15°C (±7.5°C) ARE ACCEPTABLE IF THE AVERAGE EGT IS BETWEEN 630°C AND 645°C.
4. AT LOW COMPRESSOR INLET TEMPERATURES, MILITARY AND AFTERBURNER EGT AND RPM MAY BE BELOW NORMAL OPERATING LIMITS. (SEE SECTION VII.)

RPM:

1. MAXIMUM ALLOWABLE TRANSIENT RPM IS 107%.

NOZZLE POSITION:

1. FOLLOWING RAPID THROTTLE MOVEMENTS, NOZZLE POSITION SHOULD STABILIZE WITHIN PERMISSIBLE FLUCTUATION RANGE WITHIN 10 SECONDS.
2. NOZZLE POSITION MAY BE LESS THAN 50% WHEN OPERATING THE AFTERBURNER AT LESS THAN MAX AB.

OIL PRESSURE:

1. DURING COLD WEATHER STARTS, OIL PRESSURE MAY EXCEED LIMITATIONS. THIS IS A NORMAL INDICATION AS LONG AS THE OIL PRESSURE CONTINUES TO DECREASE AS ENGINE OIL WARMS. DO NOT EXCEED 5 MINUTES IN MILITARY POWER WITH OIL PRESSURE ABOVE 55 PSI. REFER TO COLD WEATHER OPERATION, SECTION VII.
2. IF A SUDDEN CHANGE OF 10 PSI OR GREATER IN OIL PRESSURE INDICATION OCCURS AT ANY STABILIZED RPM, FOLLOW ENGINE OIL SYSTEM MALFUNCTION PROCEDURES IN SECTION III.

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Figure 5-2. Engine Operating Limitations

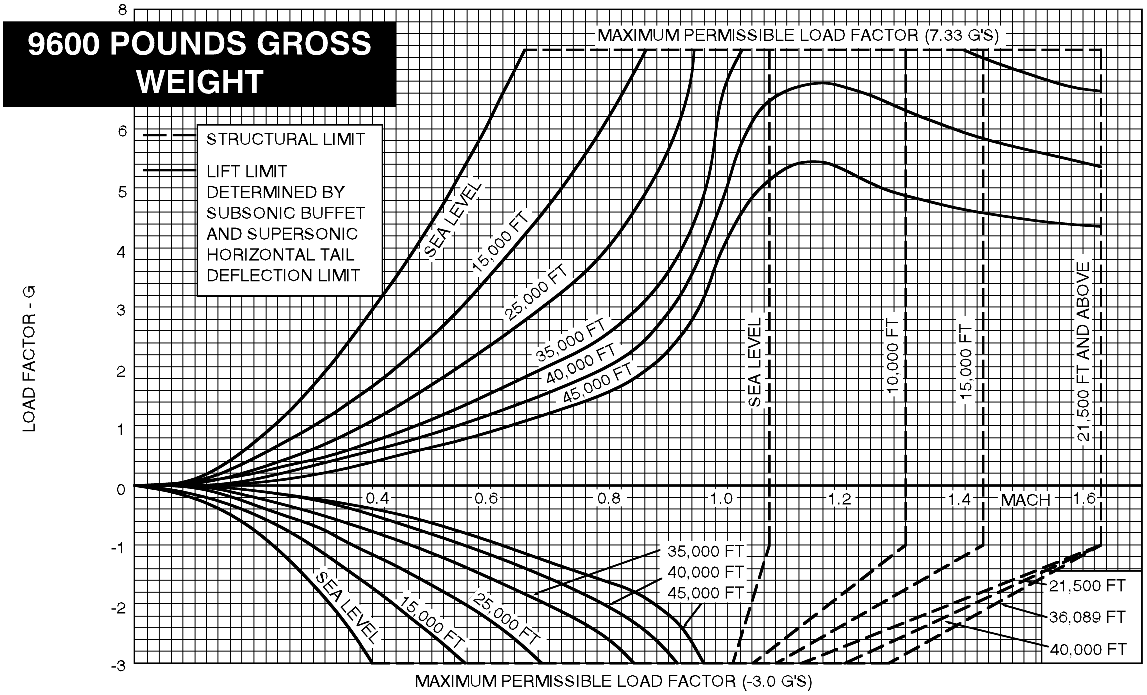
GRD TO HYD ELE FUE OXY ENG FLT MISC LND

I II III IV V VI VII A G IN

OPERATING FLIGHT STRENGTH

SYMMETRICAL FLIGHT

DATE: 1 MARCH 1970
DATA BASIS: FLIGHT TEST



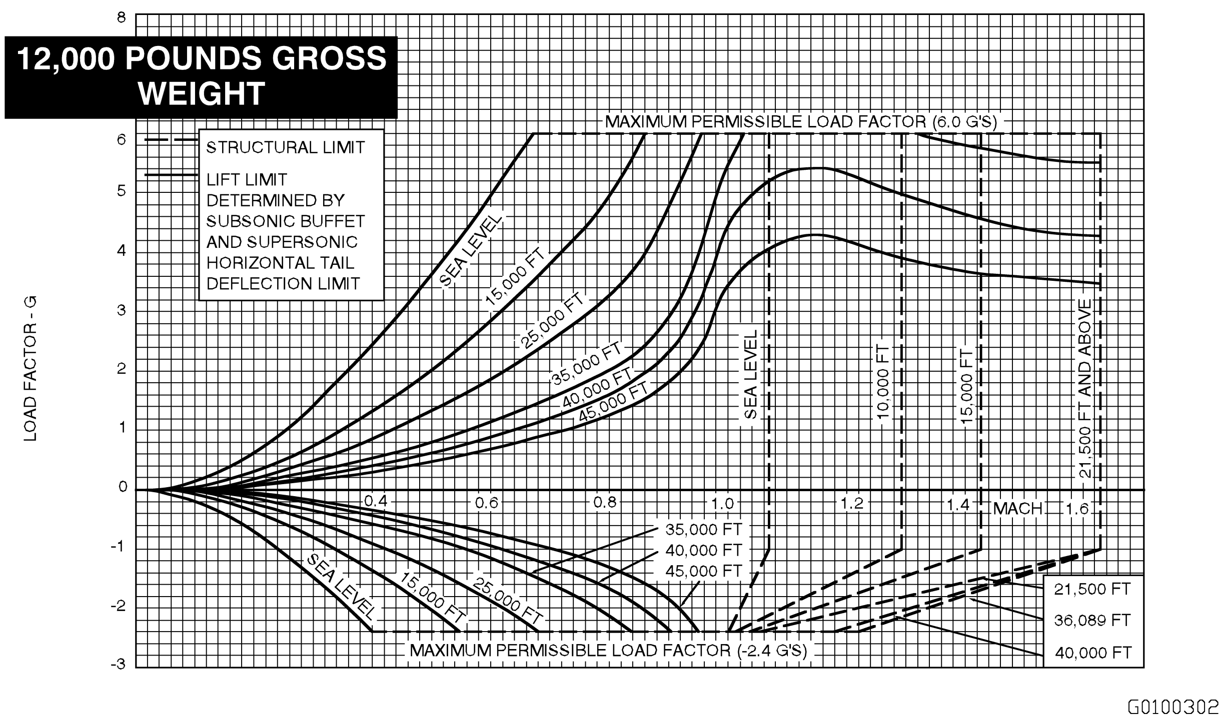


Figure 5-3. Operating Flight Strength

MAXIMUM PERMISSIBLE LOAD FACTOR

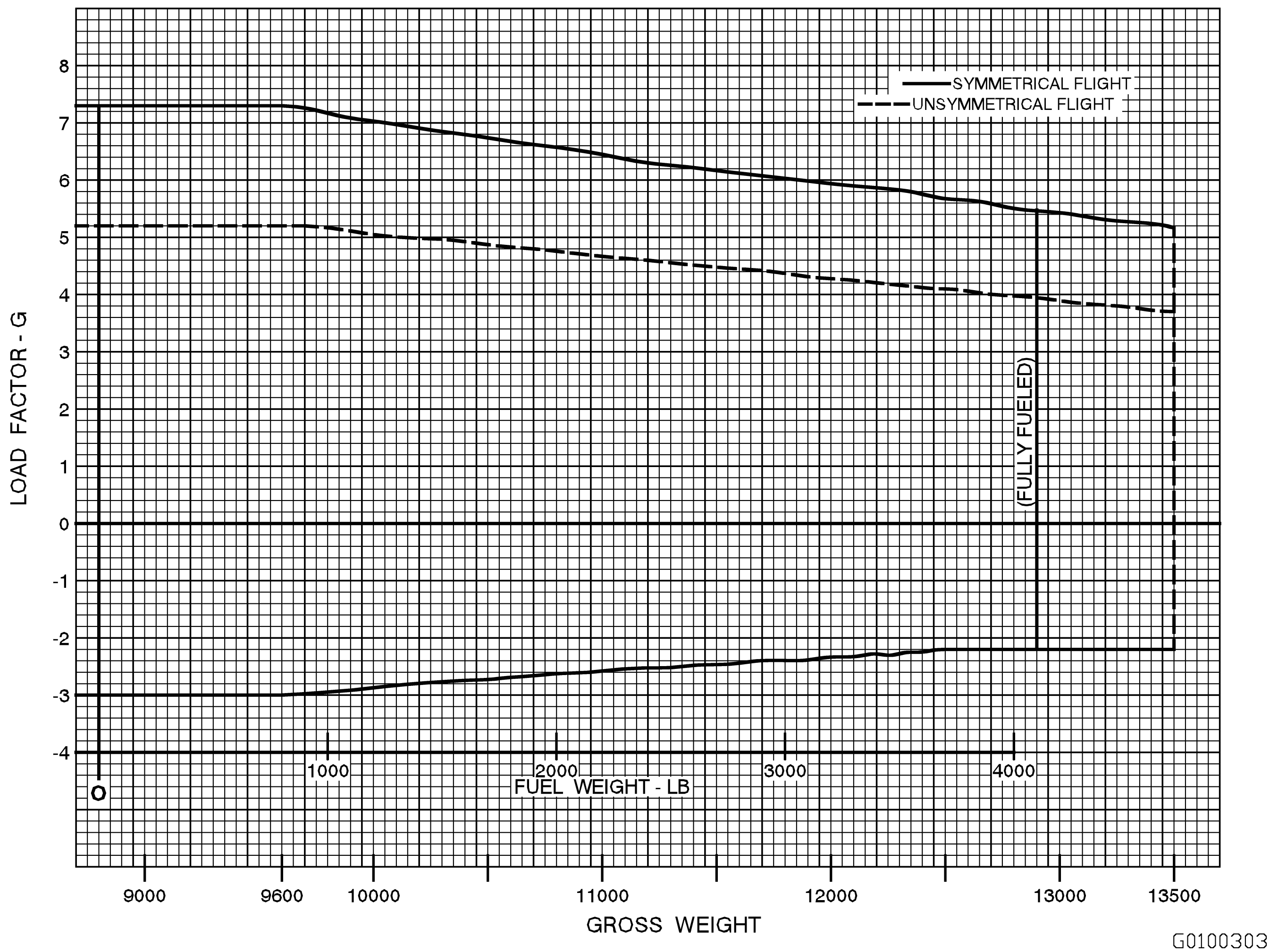


Figure 5-4. Maximum Permissible Load Factor

AUTHORIZED STORES

[ECM] STORE
AN/ALQ-188(V)4 ECM POD AN/ALQ-188A(V)-17 ECM POD AN/ALQ-188A(V)-18 ECM POD MXU-648/A, A/A, B/A, C/A, D/A BAGGAGE/CARGO POD

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Figure 5-5. Authorized Stores

AIRCRAFT LIMITATIONS WITH EXTERNAL STORES

STORE	AIRSPEED LIMITATIONS			ACCELERATION - G				MAX DIVE FOR DEL	STORES CONFIGURATION WEIGHT LBS.	TOTAL DRAG INDEX	REMARKS
	CARRIAGE	EMPLOY-MENT	JETTISON	CARRIAGE		EMPLOY-MENT	JETTISON				
				SYM	UNSYM						
PYLON	600 1.2	NA	NA	BAL	BAL	NA	NA	NA	29	5	
MXU-648/A, A/A, B/A, C/A, D/A [ECM]	500 1.0	NA	NA	+5.0 -1.0	+3.0 0.0	NA	NA	NA	REMOV-ABLE TAIL E130 F430 FIXED TAIL E98 F398	25 **	MAX CARGO LOAD - 300 LBS DO NOT EXCEED 120 DEGREES/ SECOND ROLL RATE
WSSP	400 ****	NA	NA	+4.0 0.0	+3.0 0.0	NA	NA	NA	E110 F250	25 **	NORMAL LOAD CAPACITY - 140 LBS
AN/ALQ-188 (V)4, -17, -18 ECM POD [ECM]	500 0.9	NA	NA	+5.0 - 1.0	+3.0 0.0	NA	NA	NA	F 364 (V)4 F 323 (-18) F 311 (-17)	60 **	

NA - NOT APPLICABLE/NOT AUTHORIZED
* WHICHEVER IS LESS
** STORE DRAG INCLUDES PYLON
*** IF GROSS WEIGHT EXCEEDS 11,700 LBS; REDUCE THE SYMMETRIC POSITIVE G LIMIT ACCORDING TO FIGURE 5-4.
**** 350 KIAS IN SEVERE TURBULENCE OR SPEED BRAKES OPEN. AVOID ABRUPT CONTROL MOVEMENTS OVER 240 KIAS.
BAL - BASIC AIRCRAFT LIMITS

WARNING

- POTENTIAL RF RADIATION HAZARDS EXIST TO PERSONNEL, FUEL, AND EQUIPMENT WHEN THE ECM POD IS OPERATED WHILE ON THE GROUND.
- PERSONNEL, FUEL, AND EQUIPMENT SHOULD BE POSITIONED OUTSIDE THE RADIATION HAZARD ZONES PRIOR TO OPERATING THE ECM POD ON THE GROUND.

NOTE

AIRCRAFT MODIFIED TO CARRY AN ECM POD ARE AUTHORIZED TO CARRY EITHER THE MXU-648/A CARGO POD OR THE ECM POD. NO OTHER EXTERNAL STORES ARE AUTHORIZED DUE TO WIRING MODIFICATIONS.

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Figure 5-6. Aircraft Limitations With External Stores

SECTION VI

FLIGHT CHARACTERISTICS

TABLE OF CONTENTS

GRD TO HYD ELE FUE OXY ENG FLT MISC LND

FLIGHT CONTROLS

STABILITY AUGMENTATION

The stability augmenter system positions the rudder control surfaces to automatically damp out yaw short period oscillations. On Block 20 aircraft, the stability augmenter system additionally damps out pitch oscillations. The aircraft may be flown safely throughout the flight envelope without the stability augmenter system engaged.

G-OVERSHOOT

The horizontal tail control system incorporates a bob-weight to increase stick forces under G-loads. Since the pilot does not feel the effect of the bob- weight until the aircraft responds to the stick movement, G-overshoots may occur if the stick is deflected too abruptly.

CAUTION

Abrupt forward or aft deflection or PULSING of the stick in the mach range from 0.80 to 0.95 may result in overshoot of the limit load factor.

LATERAL CONTROL

Aileron deflection does not increase proportionally with stick travel. The first 4-1/2 inches of stick travel provide one-half aileron deflection, while the remaining 1-1/2 inches of stick travel provide full aileron deflection.

PILOT INDUCED OSCILLATIONS

The relationship between pilot response and aircraft pitch response in high subsonic low altitude flight is such that overcontrolling may lead to severe pilot induced oscillations. This oscillation is characterized by a sudden and violent divergence in pitch attitude resulting in very large positive and negative load factors, which are actually made larger by attempting to control the oscillation. Because the basic aircraft is stable, immediately release the stick so that the aircraft can damp itself or if at very low altitude or close to another aircraft, attempt to apply and rigidly hold back-pressure on the stick. In addition to the above, a reduction in airspeed will aid in recovery. It should be noted that if the pilot is not securely strapped into his seat, the above recovery procedures may be difficult to accomplish.

ROLLS

Roll rates obtainable in this aircraft with, full aileron deflection are extremely high and could cause disorientation. Caution should be exercised when using rudder in conjunction with aileron application during rapid roll or turn entry. Rapid input of both rudder and half (or more) aileron, can cause large load factor excursions during the maneuver.

UNSYMMETRICAL-G

Unsymmetrical-G forces occur anytime the aircraft has a roll rate. A phenomenon known as roll coupling can also superimpose an additional G increment during rolling maneuvers. In steady state banked coordinated flight (roll rate = 0), G forces are symmetrical. When evaluating G-limit over-shoots as a result of a wingtip vortex or wake turbulence encounter, the unsymmetrical acceleration limit applies.

WAKE TURBULENCE

Avoid wake turbulence. The aircraft, because of the short wingspan, is particularly susceptible to wake turbulence upset. The vortex-produced rolling moment can exceed aileron authority in the takeoff and/or landing configuration. The rapid changes in lift can result in a stall without sufficient altitude to recover.

EXTERNAL STORE CHARACTERISTICS

The addition of an external store shifts the center- of-gravity forward. This results in increased rotation and liftoff speeds, reduced trim authority, higher aft stick forces, increased deceleration during flare for landing, and reduced aerobraking capability.

HIGH-SPEED DIVE RECOVERY

To recover from a high speed dive, simultaneously retard throttles to IDLE, open the speed brake, level the wings, and pull out with sufficient G-forces for a safe recovery.

MANEUVERING FLIGHT

NOTE

Maneuvering and handling qualities are degraded at lower airspeeds; therefore, a minimum of 300 KIAS should be maintained until configuring for instrument approaches or performing maximum range descents, landings, and tactical maneuvering. The objective for establishing a minimum airspeed is to maintain a satisfactory energy state (i.e. G available that will provide desired recovery response if an undesirable flight parameter is encountered below 15,000 feet AGL).

STICK FORCES

Minimum stick forces per G occur at approximately mach 0.9. Be careful not to overcontrol when maneuvering near this airspeed so that the allowable load factor is not exceeded.

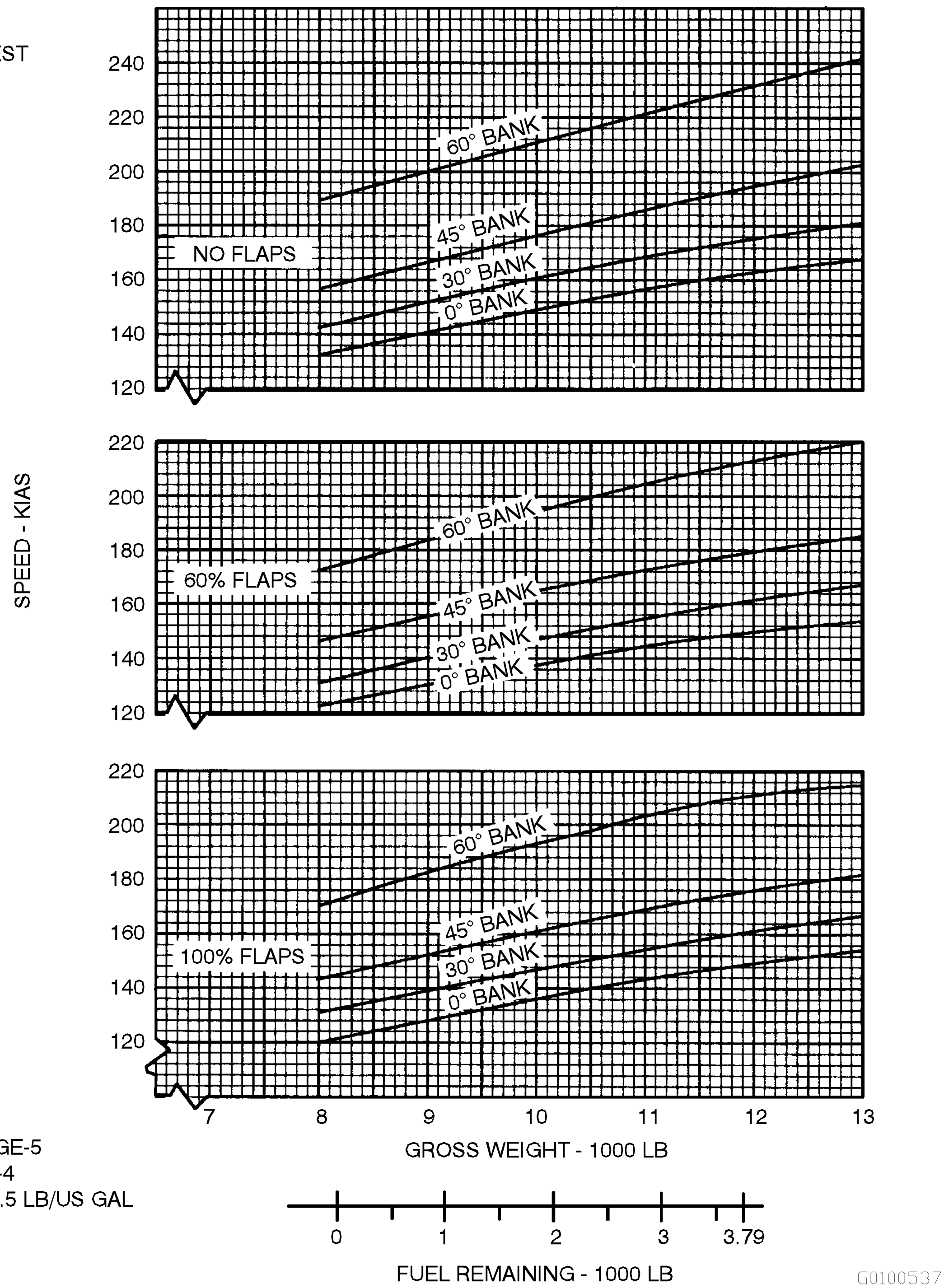
I II III IV V VI VII A G IN

STALL SPEED CHART

POWER-OFF (IDLE THRUST)

LANDING GEAR UP OR DOWN **SEA LEVEL TO TO 5,000 FT**

MODEL: T-38A
DATE: 1 AUGUST 1965
DATA BASIS: FLIGHT TEST



ENGINE: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

Figure 6-1. Stall Speed Chart

EFFECT OF BANK ANGLE ON VERTICAL VELOCITY

SEA LEVEL STANDARD DAY

60% FLAPS AND GEAR DOWN

DATE: 1 APRIL 1969
DATA BASIS: FLIGHT TEST

Note

CHART VALID ONLY FOR RECOMMENDED APPROACH TURN SPEED.

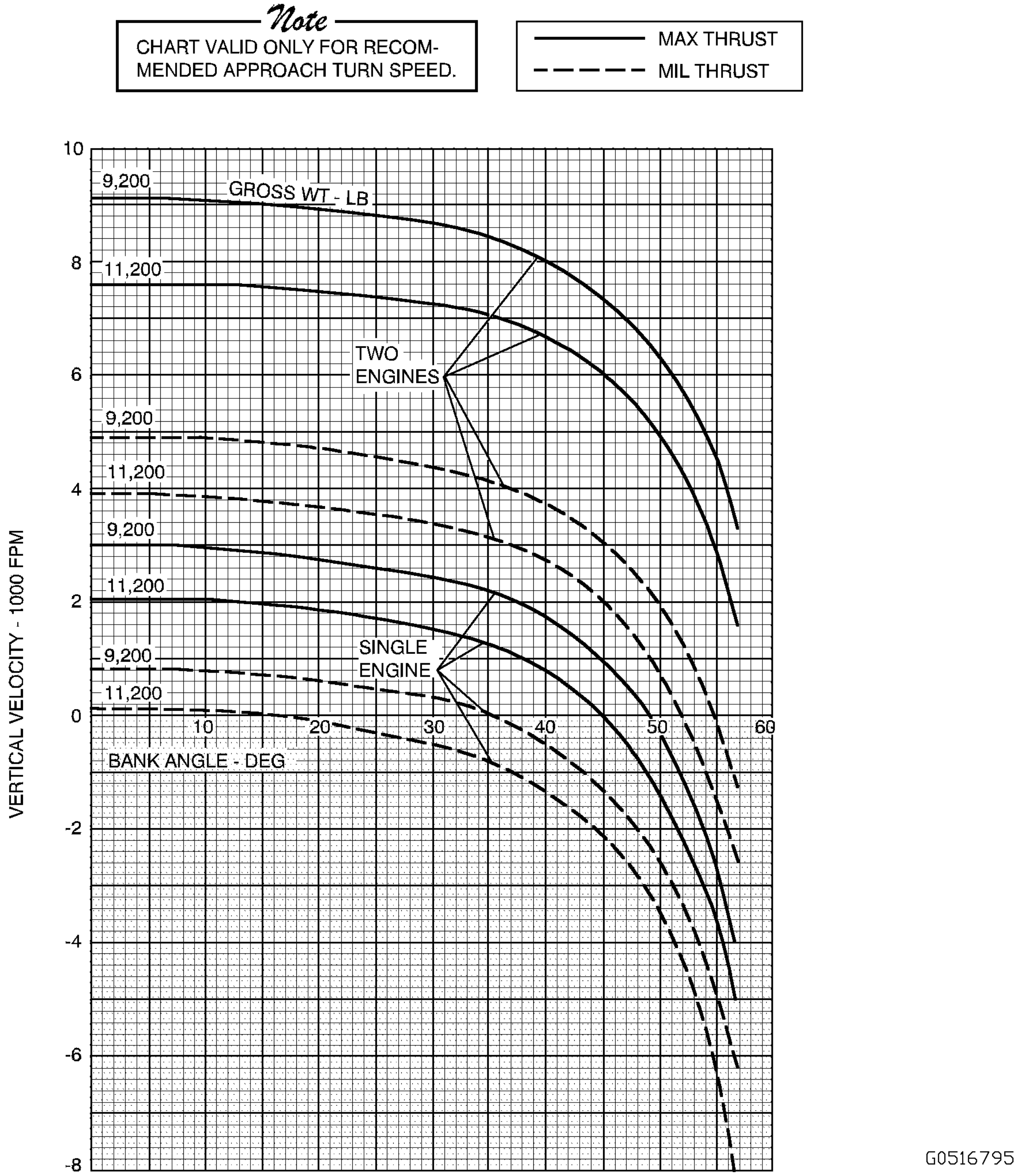


Figure 6-2. Effect of Bank Angle on Vertical Velocity

AREA OF POSSIBLE SPIN ENTRY

CONFIGURATION: CLEAN
GROSS WEIGHT: 10,000 POUNDS

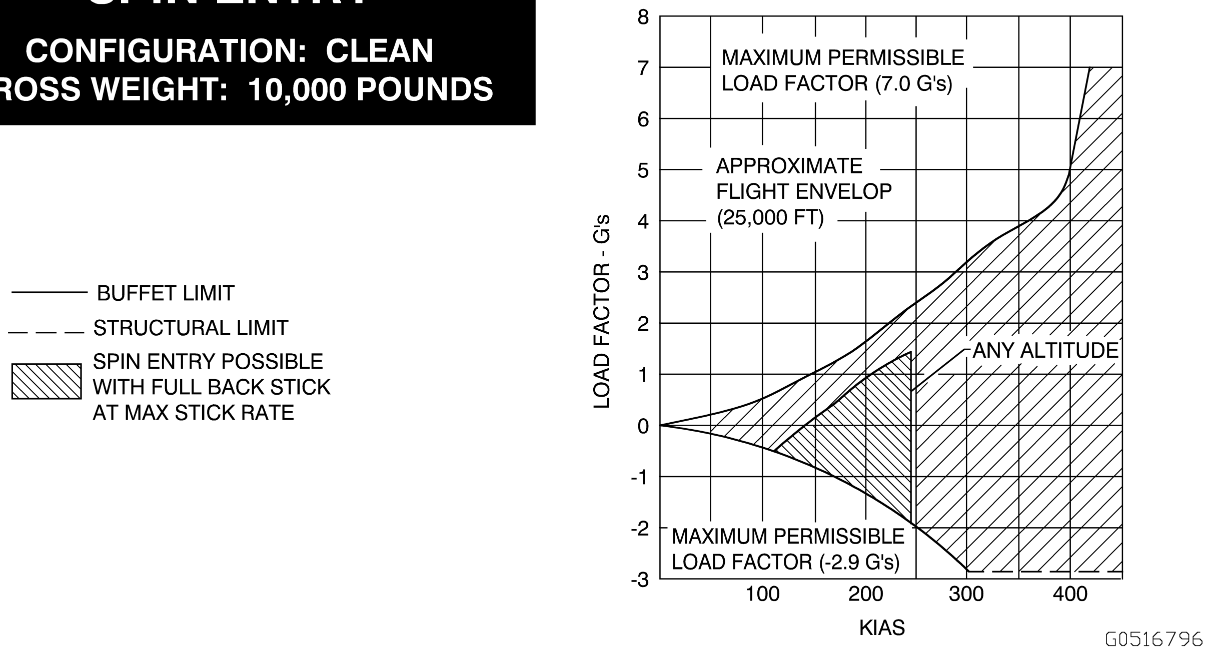


Figure 6-3. Area of Possible Spin Entry

FLIGHT ENVELOPE
STANDARD DAY

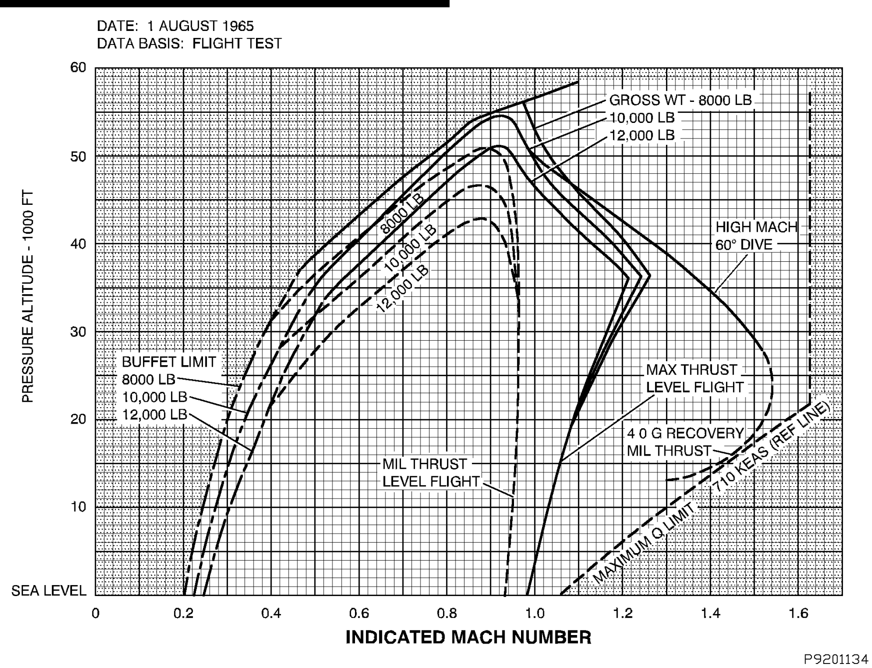


Figure 6-4. Flight Envelope

STALLS

The stall is characterized by airframe buffet and a high sink rate rather than by a clean nose-down pitch motion. As angle of attack is increased, there is a corresponding increase in buffet intensity. The buffet is most severe with flaps fully extended. The stall condition is immediately preceded by heavy low-speed buffet and moderate wing rock. The wing rock can be controlled with rudder. The actual stall is normally not accompanied by any abrupt aircraft motion, but is indicated only by the very high sink rate.

WARNING

If the stall condition is aggravated by abrupt control inputs, unusual aircraft attitudes may result.

STALL RECOVERIES

Stalls can be terminated by relaxing back stick pressure, rolling wings level, and moving throttles to MAX simultaneously. If in the landing configuration, raise gear and speed brake allowing flaps to remain extended until stall recovery has been accomplished. While it is normally not necessary to allow the nose to pitch down, relaxation of back pressure is critical in breaking the stall and allowing the aircraft to accelerate, reducing the buffet, eliminating wing rock, and maintaining adequate aileron control. Reducing the bank angle will lower the stall speed and decrease the sink rate (see Figure 6-1 and Figure 6-2, and the Effect of Bank Angle on Vertical Velocity charts in part 7 of appendix). Since timely identification of an actual stall is difficult, stall recovery should be initiated at the first indication of increasing buffet or rate of sink. Recovery from a stalled condition can be accomplished with a minimum loss of altitude using the above stall recovery technique.

WARNING

If a high sink rate condition is allowed to develop, excessive altitude loss will occur and recovery may not be possible at traffic pattern altitudes.

NOTE

See section VII for engine operating instructions during stall.

SUBSONIC ACCELERATED STALLS

Accelerated stalls are similar to 1-G stalls.

POST STALL GYRATIONS

Gyrations can be experienced during 1-G stalls, inverted stalls (negative-G, negative angle-of-attack and stick held forward), accelerated stalls and cross control stalls. These gyrations will not result in a spin (abrupt full aft stick movement at near maximum rate is required or spin entry). The corrective procedure for all unrecgnizable gyrations is to smoothly neutralize controls until the aircraft settles into a recognizable maneuver or recovers. Expect a short period of erratic motion and/or nega tive load factors after controls are neutralized.

EFFECT OF BANK ANGLE ON VERTICAL VELOCITY

Steep bank angles during turn to final approach can cause a very rapid descent rate from which it may be impossible to recover. This is especially true for single-engine approaches to landing. Figure 6-2 shows the effects of bank angle on velocity for sea level standard day conditions for light and heavy aircraft gross weights at the recommended final turn speed. Single-engine landing patterns should be planned so that steep bank angles are not required. A complete set of charts showing the effects of bank angle on vertical velocity for various conditions can be found in part 7 of the Appendix.

SPINS

The aircraft exhibits a high degree of resistance to spin entry; abrupt application of aft stick at close to maximum possible rates within the envelope shown in Figure 6-3 is required to enter a spin. Entry will occur without use of rudder. Normal flight maneuvers, if properly flown, will not cause a spin. During unusual maneuvers (e.g., collision avoidance), be aware of airspeed and control inputs relative to those required for a spin entry.

WARNING

Abruptly applying spin recovery controls when the aircraft is not in an actual spin may cause a spin or extremely disorientating aircraft gyrations. Do not apply spin recovery controls unless a spin has been definitely diagnosed.

ERECT SPIN

The primary anti-spin control is the aileron, and it is imperative that full aileron deflection be held during recovery. Refer to SECTION III for erect spin recovery.

INVERTED SPIN

An inverted spin is very oscillatory about all axes and is easily recoverable. Refer to SECTION III for inverted spin recovery.

GRD TO HYD ELE FUE OXY ENG FLT MISC LND

I II III IV V VI VII A G IN

HIGH MACH 60° DIVE

STANDARD DAY GROSS WEIGHT 10,000 LB

DATE: 15 JANUARY 1965
DATA BASIS: FLIGHT TEST

1. BEGIN 1.5 G'S MAX THRUST. ENTRY.
2. ATTAIN 60° DIVE ANGLE.
3. REDUCE THRUST TO MIL AND BEGIN 4-G DIVE RECOVERY:
   AT 26,400 FT FOR ENTRY AT 45,000 FT.
   AT 27,800 FT FOR ENTRY AT 50,000 FT.
4. END DIVE RECOVERY AT LEVEL FLIGHT ATTITUDE.

Note

ALTITUDE LOSS SHOWN INCLUDES A 4-SECOND TIME ALLOWANCE FOR LOAD FACTOR TO BUILD UP TO 4 G'S.

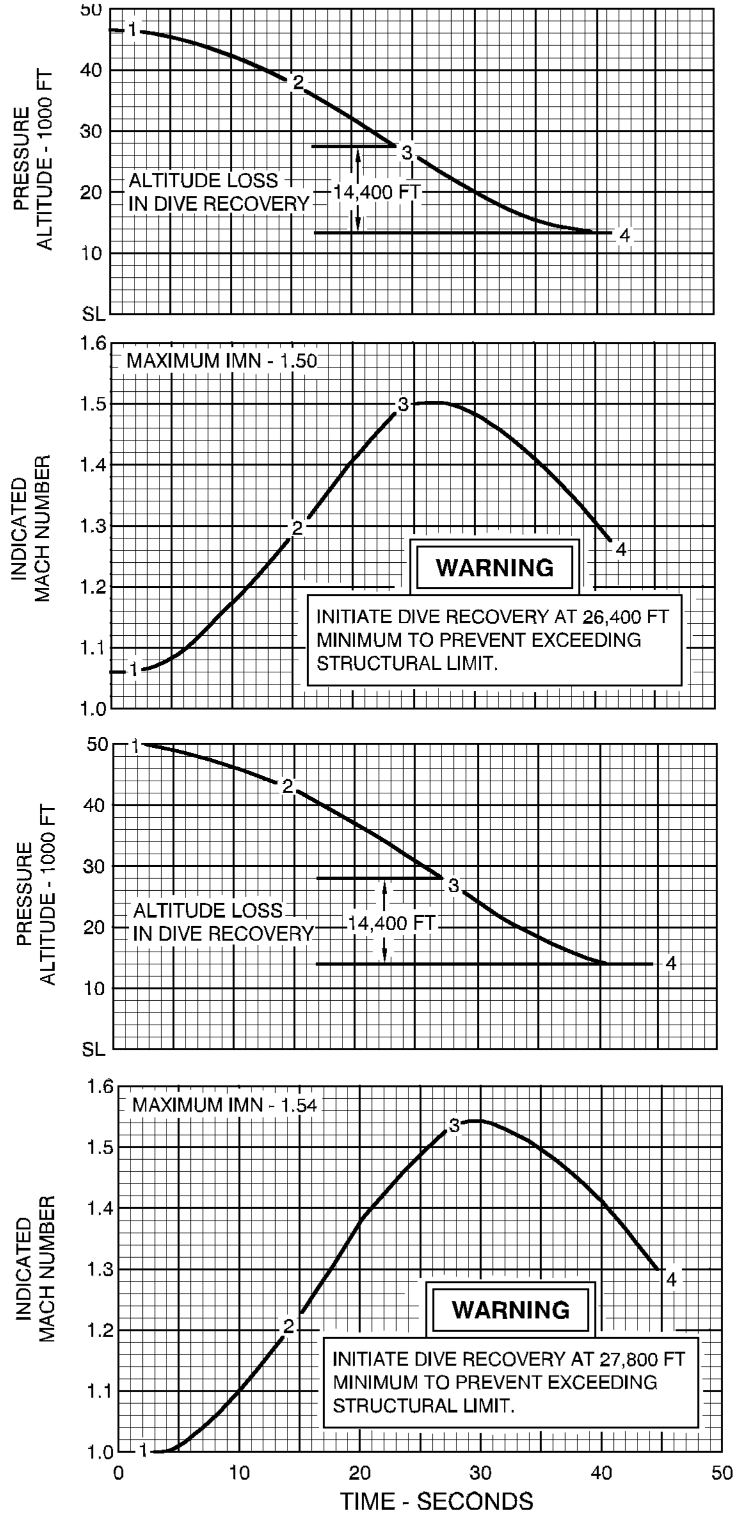


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Figure 6-5. High Mach 60° Dive

GRD TO HYD ELE FUE OXY ENG FLT MISC LND

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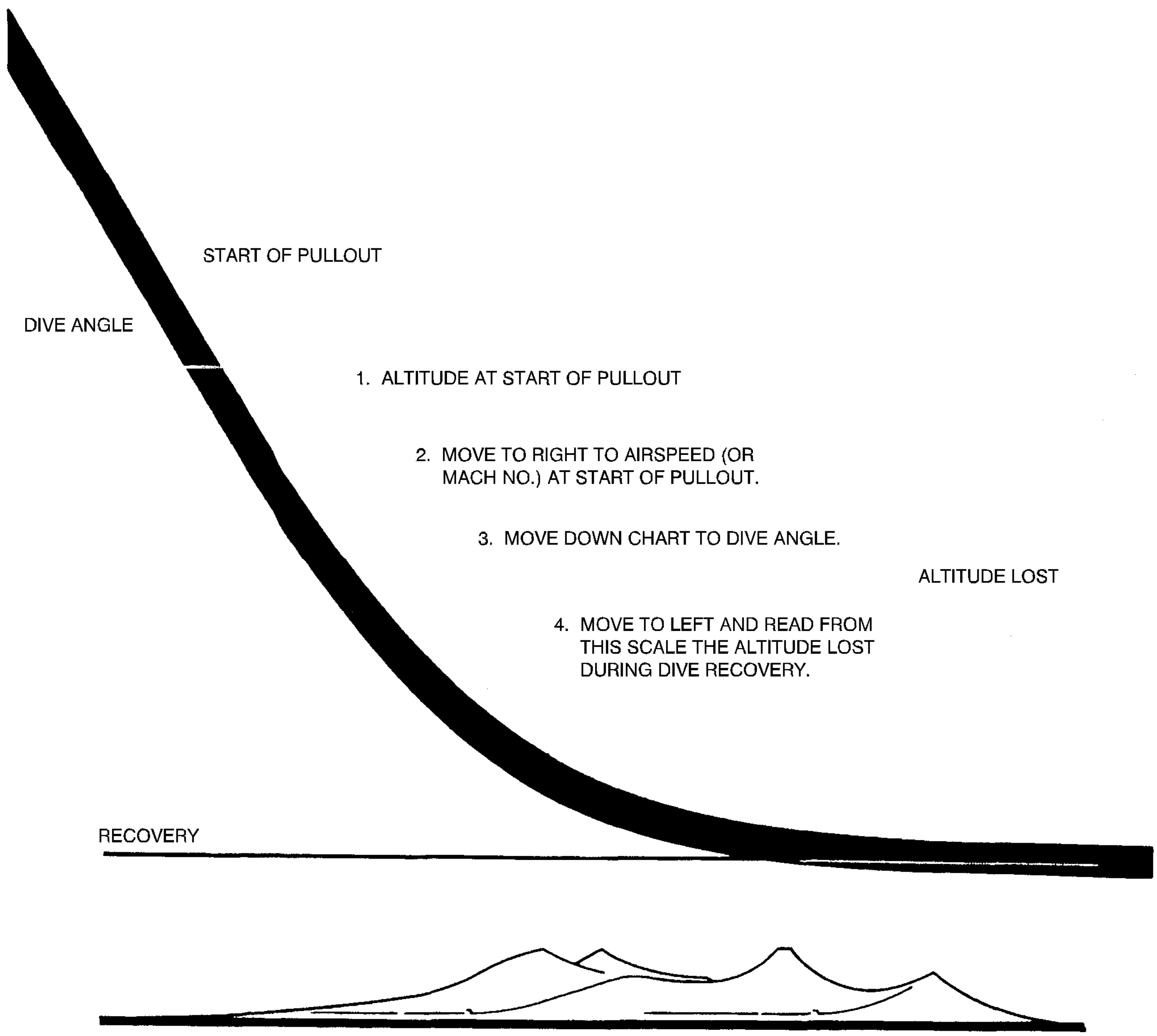
HOW TO READ DIVE RECOVERY CHARTS . . . .



NOTE

IF AIRCRAFT CONFIGURATION OR POWER SETTINGS ARE SUCH AS TO CAUSE DECELERATION DURING DIVE RECOVERY, THE ALTITUDE LOST WILL BE LESS THAN THAT SHOWN ON THE CHARTS.

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Figure 6-6. How To Read Dive Recovery Charts (Sheet 1 of 4)

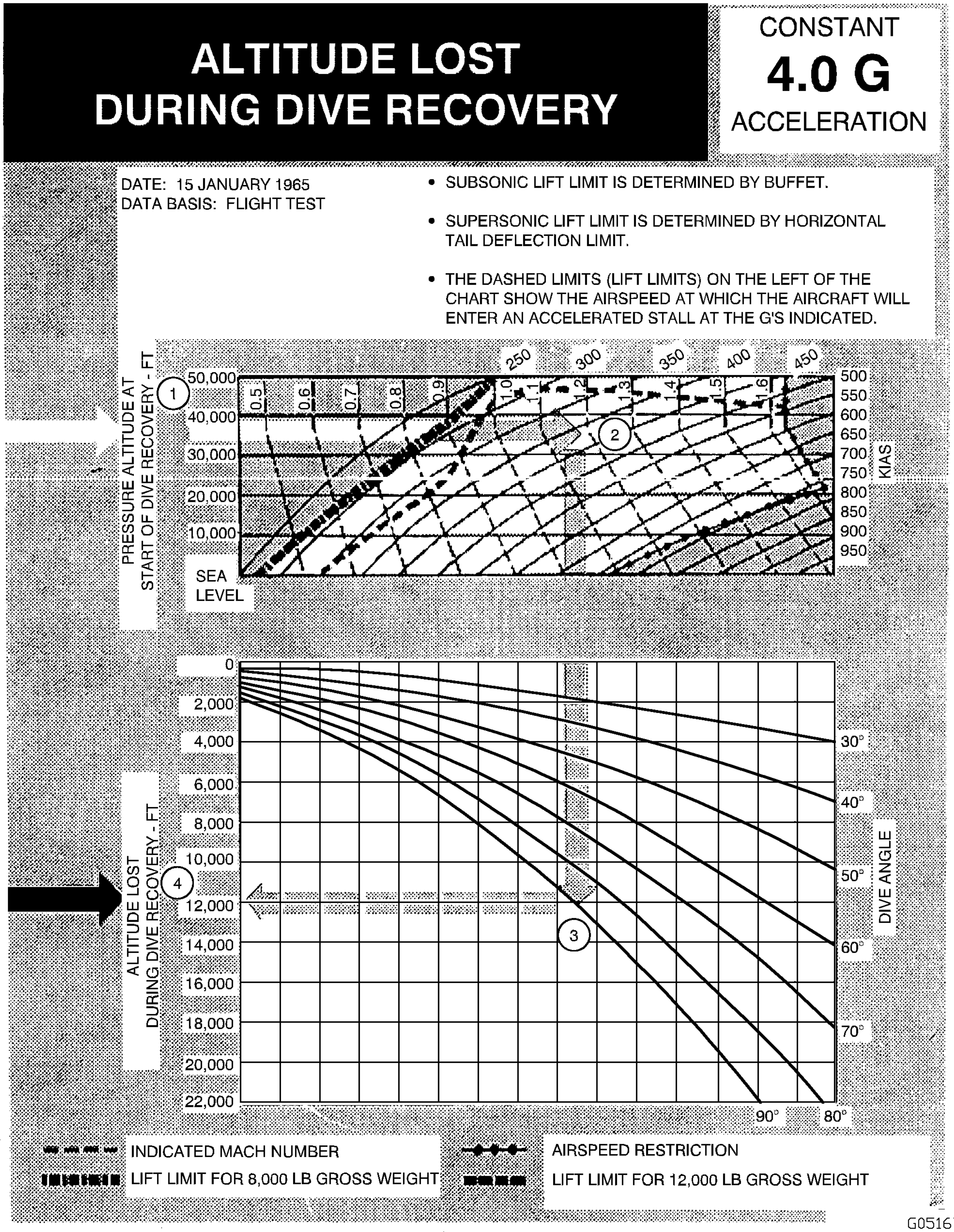

Figure 6-6. How To Read Dive Recovery Charts (Sheet 2)

ALTITUDE LOST DURING DIVE RECOVERY

CONSTANT
6.0 G
ACCELERATION

DATE: 15 JANUARY 1965
DATA BASIS: FLIGHT TEST

- SUBSONIC LIFT LIMIT IS DETERMINED BY BUFFET.
- SUPERSONIC LIFT LIMIT IS DETERMINED BY HORIZONTAL TAIL DEFLECTION LIMIT.
- THE DASHED LIMITS (LIFT LIMITS) ON THE LEFT OF THE CHART SHOW THE AIRSPEED AT WHICH THE AIRCRAFT WILL ENTER AN ACCELERATED STALL AT THE G'S INDICATED.

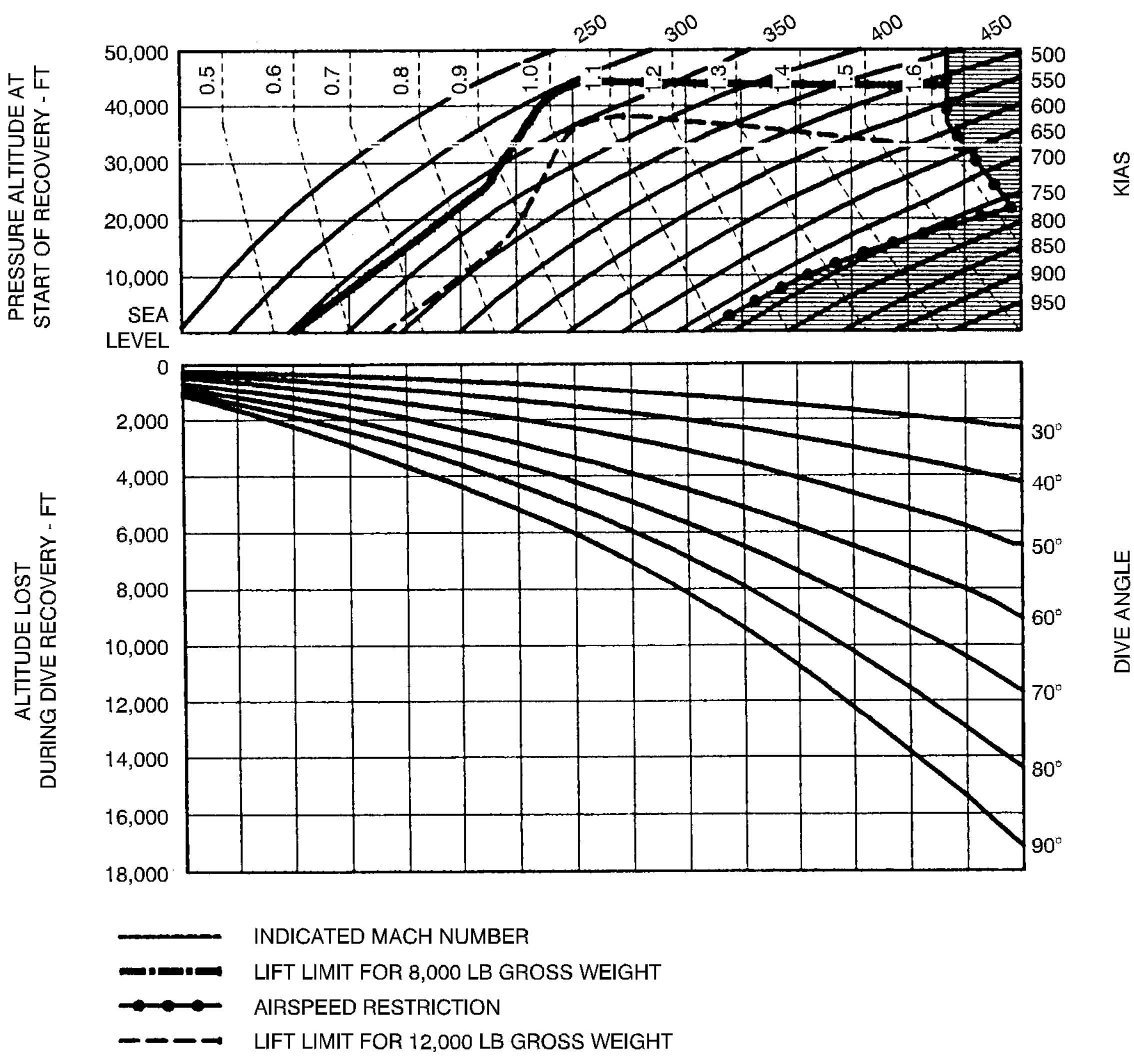

Figure 6-6. How To Read Dive Recovery Charts (Sheet 3)

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MISC
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ALTITUDE LOST DURING DIVE RECOVERY

CONSTANT **7.33 G** ACCELERATION

DATE: 15 JANUARY 1965
DATA BASIS: FLIGHT TEST

- SUBSONIC LIFT LIMIT IS DETERMINED BY BUFFET.
- SUPERSONIC LIFT LIMIT IS DETERMINED BY HORIZONTAL TAIL DEFLECTION LIMIT.
- THE DASHED LINES (LIFT LIMITS) ON THE LEFT OF THE CHART SHOW THE AIRSPEED AT WHICH THE AIRCRAFT WILL ENTER AN ACCELERATED STALL AT THE G'S INDICATED.

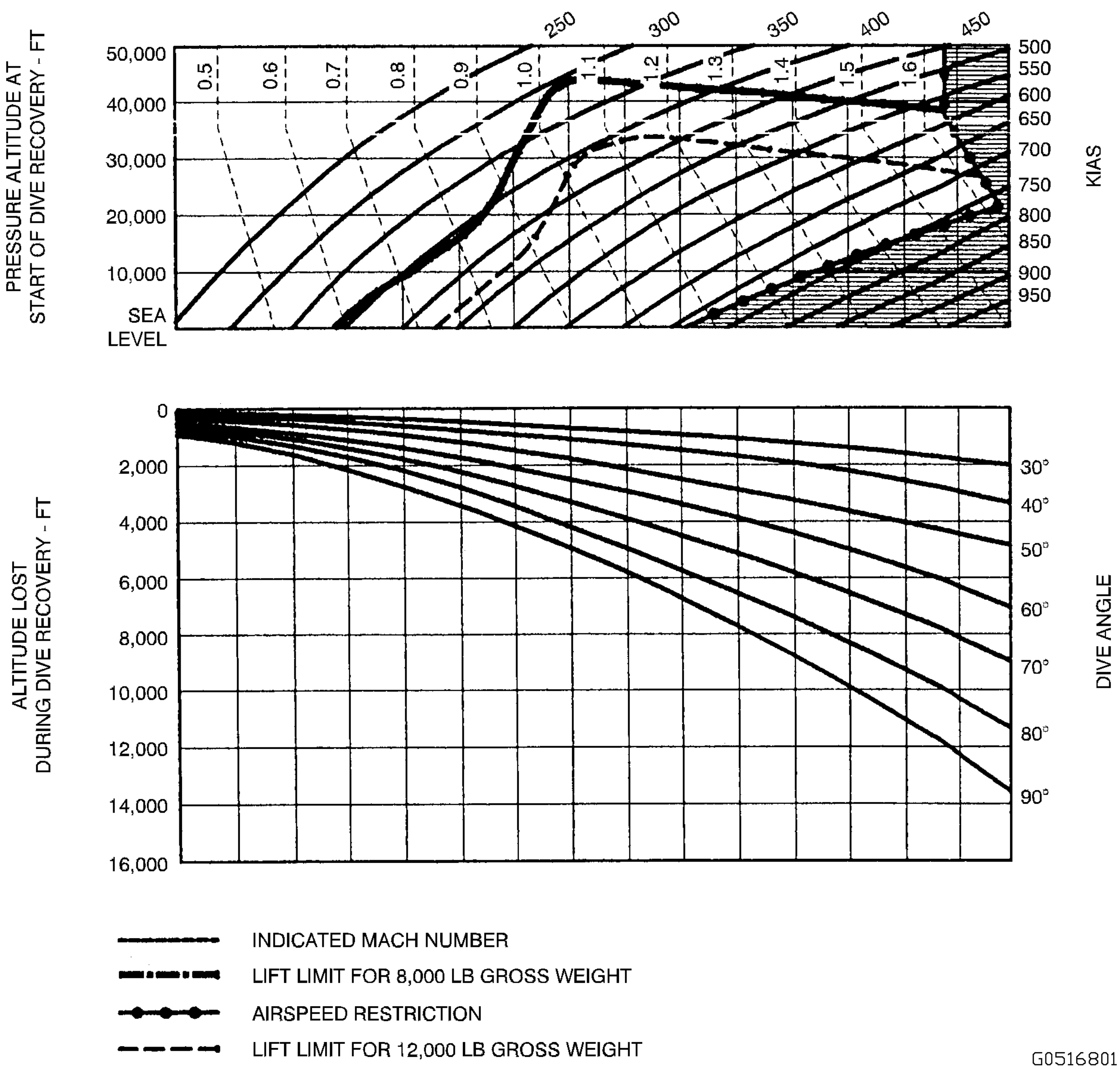

Figure 6-6. How To Read Dive Recovery Charts (Sheet 4)

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OXY
ENG
FLT
MISC
LND

I
II
III
IV
V
VI
VII
A
G
IN

SECTION VII

ADVERSE-WEATHER OPERATION

TABLE OF CONTENTS

ICE AND RAIN

TAKEOFF

Monitor engine performance closely during takeoff on runways with large amounts of puddled water. Engine flameouts have occurred as a result of water thrown up by the nosewheel. In the event of dual engine flameout, loss of horizontal slab authority and nosewheel steering may affect abort distance and directional control.

ICING

Anti-icing equipment for the wings, empennage, and inlet ducts is not provided. The aircraft is provided with engine anti-ice, pitot heat, and canopy defog heat, which also provides windshield heat for adverse weather operation. Icing conditions which may be encountered are trace, light, moder ate, and severe. Moderate and severe icing, particu larly, can cause rapid buildup of ice on the aircraft surface and greatly affect performance.

WARNING

The aircraft should not be flown in icing conditions. If icing is inadvertently encountered, leave the area of icing conditions as soon as possible.

When icing conditions are unavoidable, the pitot heat switch should be placed at PITOT HEAT and the canopy defog knob turned to full increase. The aircraft is not equipped with a windshield anti-icing or rain removal equipment. Instrument approaches in heavy rain are possible, but forward visibility through the windshield may be marginal. Forward visibility in icing conditions is further reduced and may be completely obscured through the windshield.

ICE INGESTION

Engine damage may occur if as little as 1/4 inch of ice accumulates on engine inlet duct lips. Ingestion of accumulated ice into an engine may be evidenced by a jar or noise in the engine and may result in damage to inlet guide vanes and first-stage compressor blades. Engine instrument indications may remain normal, even though engine damage from ice ingestion has been experienced.

CAUTION

- After ice ingestion, the affected engine should be operated at the lowest possi ble RPM necessary to make a safe landing, avoiding abrupt or rapid throttle movements.
- If flight in icing conditions results in ice accumulations on the aircraft, enter this information on Form 781, as the engines must be inspected for ice ingestion damage when this occurs.

ENGINE ICING

Engine inlet duct and/or guide vane icing may occur when the ambient temperature is at or slightly above freezing and either the humidity is high or when operating in visible moisture. Under these conditions, and when icing conditions are unavoidable, the engine anti-ice switch should immediately be placed at MAN ON, ensuring continuous anti- icing action.

NOTE

To ensure effective anti-icing, maintain a minimum of 80% RPM when the engine anti-icing system is turned ON.

RAIN

CAUTION

Flight in moderate precipitation may damage the nose cone or vertical stabilizer. Nose cone damage may result in inflight engine FOD. If flight in moderate precipitation is unavoidable, slow to the minimum practical airspeed to negate or lessen damage.

TURBULENCE AND THUNDERSTORMS

WARNING

Intentional flight in thunderstorms should be avoided.

The recommended best penetration airspeed if turbulence and thunderstorms are experienced is 280 KIAS.

NIGHT FLYING

When flying away from concentrations of ground lights, caution should be exercised to prevent spatial disorientation.

COLD WEATHER OPERATION

Most cold weather operating difficulties are encountered on the ground. The following instructions are to be used in conjunction with the normal procedures given in section II when cold weather aircraft operation is necessary.

GRD TO HYD ELE FUE OXY ENG FLT MISC LND

I II III IV V VI VII A G IN

BEFORE ENTERING AIRCRAFT

Remove all protective covers and duct plugs; check to see that all surfaces, ducts, struts, drains, canopy rails, and vents are free of snow, ice, and frost. Brush off light snow and frost. Remove ice and encrusted snow either by a direct flow of air from a portable ground heater or by using deicing fluid.

WARNING

- All ice and snow must be removed from the aircraft before flight is attempted. Remove all frost from wing and tail surfaces. Takeoff distance and climbout performance can be adversely affected by ice and snow accumulations. The roughness and distribution of these accumulations can vary stall speeds and alter flight characteristics to a degree extremely hazardous to safe flight.
- Ensure water does not accumulate in control hinge areas or other critical areas where refreezing may cause damage or binding.

CAUTION

To avoid damage to aircraft surfaces, do not permit ice to be chipped or scraped away.

Check the fuel system vents on the vertical stabilizer for freedom from ice. Remove all dirt and ice from landing gear shock struts, actuating cylinder pistons, and limit switches. Wipe exposed parts of shock struts and pistons with a rag soaked in hydraulic fluid. Inspect aircraft carefully for fuel and hydraulic leaks caused by contraction of fittings or by shrinkage of packages. Inspect area behind aircraft to ensure water or snow will not be blown onto personnel and equipment during engine start.

ON ENTERING AIRCRAFT

Use external power for starting to conserve the battery. No preheat or special starting procedures are required; however, at temperatures below -30°F (-34°C), allow the engines to idle 2 minutes before accelerating. Turn on cockpit heat and canopy defog system, as required, immediately after engine start. Check flight controls, speed brake, and aileron trim for proper operation. Cycle flight controls four to six times. Check hydraulic pressure and control reaction, and operation of all instruments.

ENGINE OIL PRESSURE INDICATIONS

Oil pressure indications may exceed 55 PSI. As the oil warms up, oil pressure should continue to decrease and return to normal operating limits. Allow adequate time for the oil to warm up to operating temperature before determining there is an engine malfunction; however, do not delay shutting down the engine if oil pressure does not continue to decrease as the oil warms. To reduce time for oil pressure to return to normal, the engine may be operated above idle up to military power until oil pressure is within limits. Do not exceed 5 minutes in military power with oil pressure above 55 PSI. Operating the engine between 70 and 75% RPM will significantly reduce the time required to warm the oil. An engine with oil pressure within idle power limitations may not subsequently be within military power limits during engine runup and may require additional warmup time. Do not take off it oil pressure does not return to operating limits.

ENGINE IDLE RPM

Low engine idle RPM can be expected after engine start when the engines are cold and the ground ambient temperature is below -16°F (-26°C). Monitor EGT and increase engine RPM as necessary to cut in the ac generators. If engine RPM will not increase when the throttle is advanced, shut down engine and determine cause. Engine idle RPM should be within operating limits after the engine has warmed up and the oil pressure has decreased to the normal operating range.

TAXIING

Nosewheel steering effectiveness is reduced when taxiing on ice and hard packed snow. A combination of nosewheel steering and wheel braking should be used for directional control. The nosewheel will skid sideways easily, increasing the possibility of tire damage. Reduce taxi speeds and exercise caution at all times while operating on these surfaces. Increase the normal interval between aircraft both to ensure a safe stopping distance and to prevent icing of the aircraft from melted snow and ice caused by the jet blast of the preceding aircraft. Minimize taxi time to conserve fuel and reduce the amount of ice fog generated by the engines. If bare spots exist through the snow, skidding onto them should be avoided. Check for sluggish instruments while taxiing.

TAKEOFF

Do not advance throttles into MAX range until the aircraft is rolling straight down the runway.

WARNING

Do not take off on slush covered runway; the nosewheel may sling slush into the inlet ducts, causing engine flameout and/or damage.

LANDING

Use landing techniques given in section II. When landing on runways that have patches of dry surface, avoid locking the wheels. If the aircraft starts to skid, release brakes until recovery from skid is accomplished.

GRD TO HYD ELE FUE OXY ENG FLT MISC LND

ENGINE SHUTDOWN

Use normal engine shutdown procedure.

HOT WEATHER AND DESERT OPERATION

Operation of the aircraft in hot weather and in the desert requires precautions be taken to protect the aircraft from damage caused by high temperatures, dust, and sand. Care must be taken to prevent the entrance of sand into aircraft parts and systems such as the engines, fuel system, pitot-static system, etc. All filters should be checked more frequently than under normal conditions. Plastic and rubber segments of the aircraft should be protected both from high temperatures and blowing sand. Canopy covers should be left off to prevent sand from accumulating between the cover and the canopy and acting as an abrasive on the plastic canopy. With a canopy closed, cockpit damage may result when ambient temperature is in excess of 110°F. Desert and hot weather operation require that in addition to normal procedures, the following precautions be observed.

TAKEOFF

1. Monitor pitch attitude closely to ensure a positive rate of climb during gear and flap retraction and to prevent an excessive angle of attack.

2. Be alert for gusts and wind shifts near the ground.

APPROACH AND LANDING

1. Monitor airspeed closely to ensure recommended approach and touchdown airspeeds are maintained; high ambient temperatures cause speed relative to the ground to be higher than normal.

2. Anticipate a long landing roll due to higher ground speed at touchdown.

3. Utilize effective aerodynamic braking and all available runway for stopping the aircraft without overheating the wheel brakes.

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PREV COVER NEXT

GRD TO HYD ELE FUE OXY ENG FLT MISC LND

I II III IV V VI VII A G IN

APPENDIX A
PERFORMANCE DATA

The appendix is divided into nine parts. These parts are presented in proper sequence for preflight planning. Discussions and sample problems are given in each part.

TABLE OF CONTENTS

GRD
TO
HYD
ELE
FUE
OXY
ENG
FLT
MISC
LND

I
II
III
IV
V
VI
VII
A
G
IN

GRD TO HYD ELE FUE OXY ENG FLT MISC LND
I II III IV V VI VII A G IN

PART 1
INTRODUCTION

TABLE OF CONTENTS

GRD TO HYD ELE FUE OXY ENG FLT MISC LND

INTRODUCTION

The flight performance charts provide flight test data for basic flight planning purposes. All charts are based on standard day conditions except when necessary, as in the takeoff and landing charts, to include temperature corrections for nonstandard days. These corrections are based on maintaining the recommended indicated mach number or indicated airspeed. Instrument error is assumed to be zero in all performance charts of this appendix.

DESCRIPTION OF DRAG INDEX SYSTEM

The drag index system permits the presentation of performance for a number of external store loadings on one chart and greatly reduces the number of charts required in flight planning work. In the drag index system, each item of the external store configuration, such as a bomb or pylon, is assigned a drag number whose value depends on the size and shape of the item and its location on the aircraft. These numbers are not drag coefficients. The summation of the store drag numbers for a particular loading defines a drag index for that configuration. This drag index, when used in the performance charts, determines the aircraft performance for that exter nal store configuration. The T-38A, with no external store capability, has a drag index of zero.

ALTIMETER AND AIRSPEED INSTALLATION ERROR CORRECTION

Static pressure, which affects both airspeed and altimeter indications, is not always accurately measured because of the location of the static ports. This pressure error is a function of both airspeed and altitude. KCAS is obtained from KIAS by correcting for the installation error in static pressure (airspeed installation error). Knowing indicated airspeed and pressure altitude, both airspeed and altimeter installation corrections may be read from Figure A1-1.

USE OF ALTIMETER CORRECTION CHART

Consider the aircraft flying at 280 KIAS at 40,000 feet (FL 400). Read up the 280 KIAS line to intersect the 40,000-foot correction curve, and from this point, draw a horizontal line to the left margin of the chart. Read the correction, which is 60 feet. Since indicated altitude is pressure altitude plus correction, the proper indicated altitude is 40,060 feet.

MACH NUMBER CORRECTION

To convert true mach number to indicated mach number, use mach number correction chart Figure A1-2.

COMPRESSIBILITY CORRECTION TO CALIBRATED AIRSPEED

The compressibility correction chart (Figure A1-3) provides the necessary airspeed correction to convert KCAS to KEAS (KEAS = KCAS - ΔV_c).

AIRSPEED CONVERSION

The chart in Figure A1-4 is used to convert between KCAS, true mach number, and KTAS. If KCAS is known, enter the chart at that value and move upward to the known pressure altitude. At that point, true mach number is read on the left-hand scale and KTAS for standard atmosphere conditions is interpolated between the sloping speed lines whose scale is located at the sea level pressure altitude line. To correct KTAS for nonstandard temperatures, move horizontally from the intersection of KCAS and the known altitude to the sea level pressure altitude line, then vertically downward to the known ambient air temperature, and read the corrected KTAS on the scale at the right.

STANDARD ALTITUDE TABLE

Significant properties of the ICAO standard atmosphere are tabulated at 1,000-foot increments between -2,000 and 65,000 feet altitude in Figure A1-5. Sea level values of the properties are listed in the top of the chart for use with the ratio shown in the table. As an example of the use of the table, find the equivalent airspeed in knots in standard atmosphere corresponding to 0.85 mach number at 30,000 feet pressure altitude. In Figure A1-5, at 30,000 feet read

a/a_o = 0.8909, read $1/\sqrt{\sigma}$ = 1.6349, and at the top of the table read a_o = 661.7 knots.

Then: a = a_o x a/a_o = 661.7 x 0.8909 = 589.5 knots.

KTAS = Mach x a = 0.85 x 589.5 501.1 knots.

KEAS = KTAS ÷ $1/\sqrt{\sigma}$ = 501.1 ÷ 1.6349 = 306.5 knots.

DENSITY ALTITUDE

Figure A1-6 presents the variation of density altitude with ambient temperature for constant values of pressure altitude. Values of $1/\sqrt{\sigma}$ are tabulated at the right of the chart as a function of the density altitude scale on the left side. ICAO standard atmosphere conditions are defined by the line which slopes to the left and upward through the chart. As an example of the use of the chart, find the value of $1/\sqrt{\sigma}$ at 8000 feet pressure altitude and 19° centigrade temperature Move vertically upward to the 8000 feet pressure altitude line, then move horizontally right to the scale and read $1/\sqrt{\sigma}$ = 1.16 The equivalent density altitude, if required, is 10,000 feet. Note that these conditions do not correspond to those of the standard atmosphere, since the true temperature at 8000 feet pressure altitude in standard atmosphere is approximately 0° and $1/\sqrt{\sigma}$ =- 1.12

I II III IV V VI VII A G IN

STANDARD CONVERSION TABLE

Linear scales for converting units of temperature, distance, and speed from one measurement system to another are provided in Figure A1-7. Additional conversion factors for volume, pressure, and weight are listed at the bottom of the table.

FUEL

Aircraft performance when using JET A and JP-8 fuel is the same as when using JP-4 fuel.

Table A1-1. Abbreviation and Definitions

KBAS	Basic Airspeed (knots). Indicated airspeed corrected for instrument error.
KIAS	Indicated Airspeed (knots). Airspeed indication uncorrected for instrument error.
KCAS	Calibrated Airspeed (knots). Indicated airspeed corrected for instrument error and installation error (pitot-static system error and errors induced by aircraft attitude).
KEAS	Equivalent Airspeed (knots). Calibrated airspeed corrected for compressibility.
KTAS	True Airspeed (knots). Calibrated airspeed corrected for density and compressibility.
GS	Groundspeed (knots). Speed over the ground equal to true airspeed corrected for headwind (subtract) or tailwind (add).
Mach	A number expressing the ratio of the true airspeed of a moving body with the speed of sound in the air surrounding it.
IMN	Indicated Mach Number. Indicated mach reading uncorrected for instrument error.
TMN	True Mach Number. Indicated mach reading corrected for installation error.
ICAO	International Civil Aviation Organization.
inHg	Inches of mercury.
H_i	Indicated pressure altitude. Altimeter indicated pressure altitude with respect to the reference level set on barometric scale of the instrument. Standard pressure altitude is read by setting barometric scale at 29.92 inches of mercury.
H_p	True pressure altitude. Altimeter reading corrected for installation error ($H_p = H_i - \Delta H_p$).
ΔH_p	Altimeter installation error correction.
ΔV_p	Airspeed installation error correction.
ΔV_c	Airspeed compressibility correction.
ΔV_M	Increase in takeoff speed above normal for military thrust.
ΔV_{SE}	Increase in takeoff speed above normal for single-engine maximum thrust.
%RPM	Engine speed expressed as a percentage of maximum engine speed (16,500 RPM 100%).
ΔTEMP	Temperature correction.
a	Speed of sound at altitude.
a_o	Speed of sound at sea level.
P	Static pressure at altitude.
P_o	Static pressure at sea level.
δ	Pressure ratio, P/P_o
p	Ambient air density.
p_o	Air density at sea level.
σ	Relative air density, p/p_o.
MAC	Mean aerodynamic chord.
CG	Center-of-gravity.
KN	Knot.
FPM	Feet-per-minute.
NMI	Nautical miles.
NMI/LB	Nautical miles per pound.

Table A1-1. Abbreviation and Definitions - Continued

LB/MIN	Pounds per minute.
LB/HR/ENG	Pounds per hour per engine.
RCR	Runway Condition Reading.
SL	Sea Level.
ALT	Altitude.
AMB TEMP	Ambient air temperature.
TEMP	Temperature.
STD	Standard.
G	Load factor or G-loading.
Q	Dynamic pressure.
PRESS	Pressure.

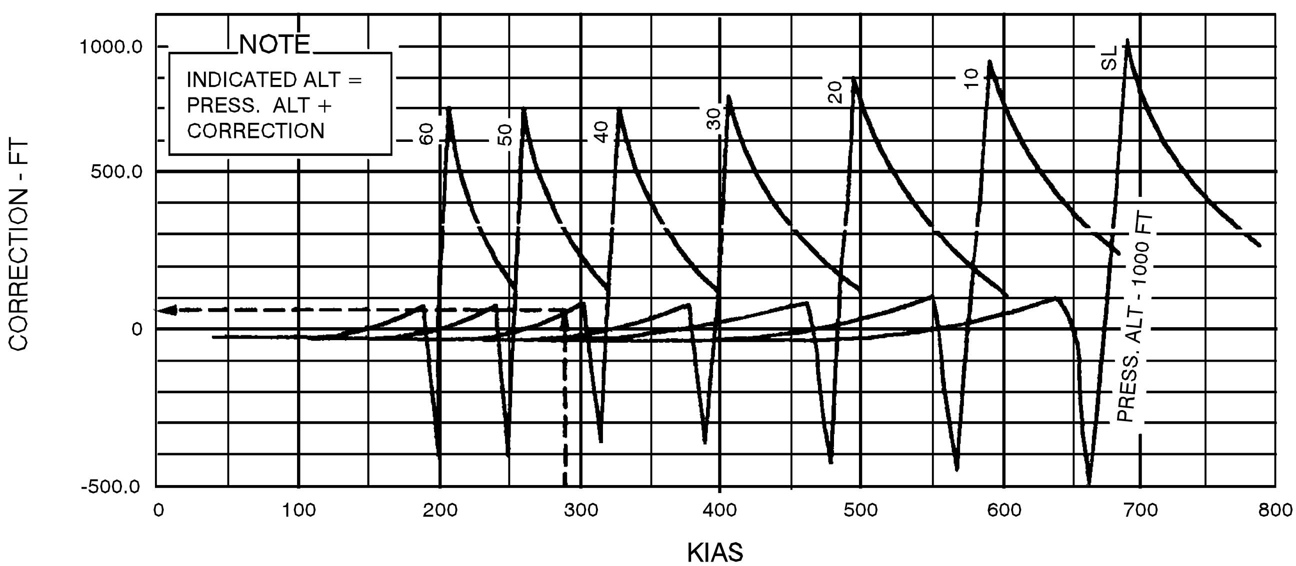
ALTIMETER AND AIRSPEED INSTALLATION ERROR CORRECTIONS

CLEAN CONFIGURATION

MODEL: T-38A
DATE: 1 AUGUST 1965
DATA BASIS: FLIGHT TEST

ENGINE: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

ALTIMETER CORRECTION



AIRSPEED CORRECTION

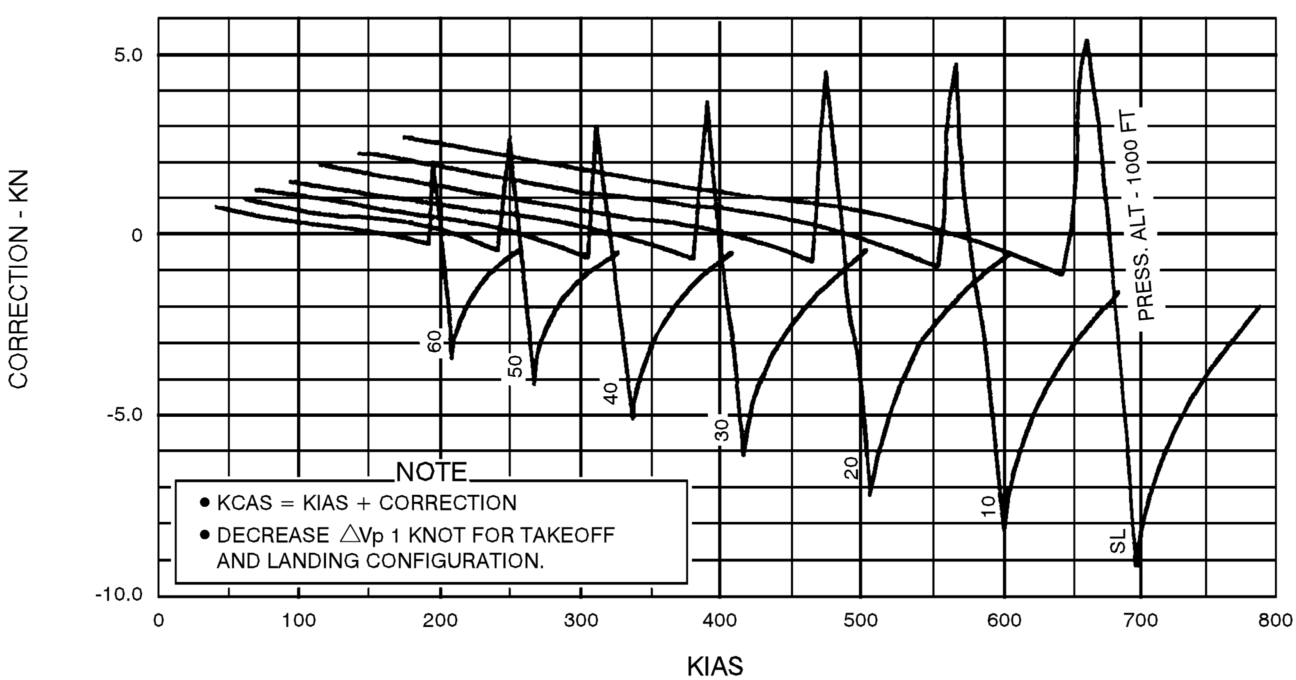


Figure A1-1. Altimeter and Airspeed Installation Error Corrections

GRD TO HYD ELE FUE OXY ENG FLT MISC LND

I II III IV V VI VII A G IN

MACH NUMBER CORRECTION

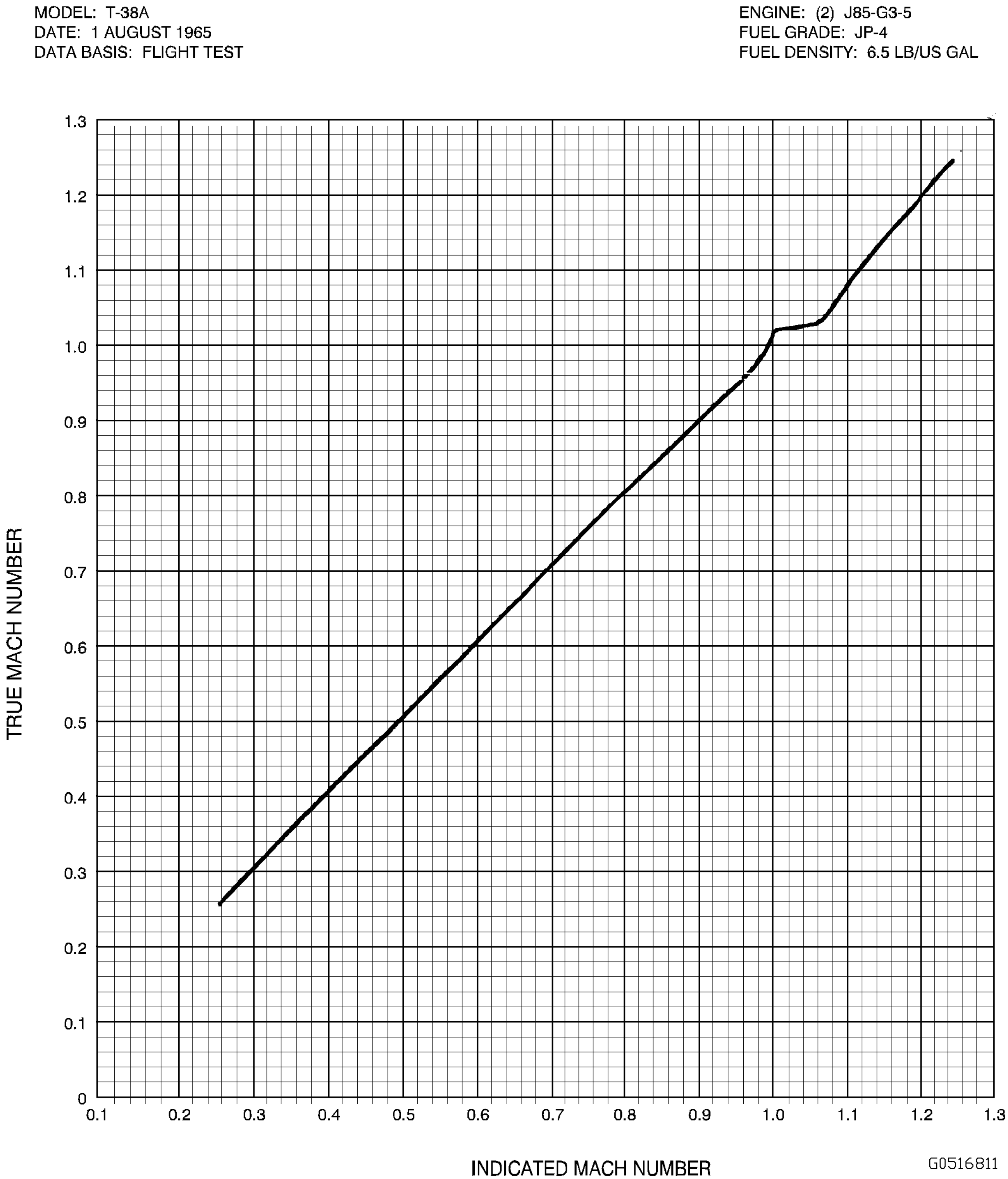


Figure A1-2. Mach Number Correction

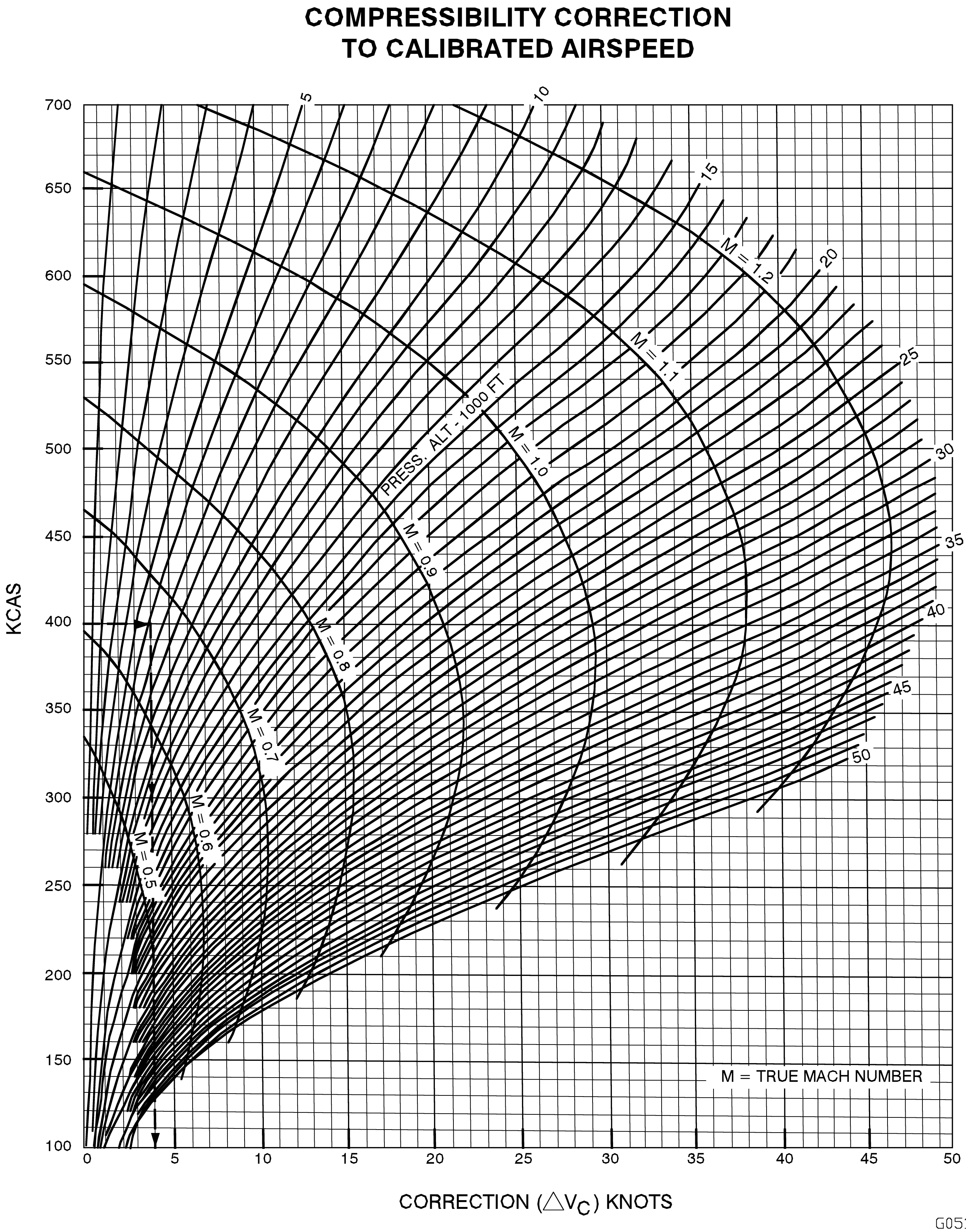


Figure A1-3. Compressibility Correction to Calibrated Airspeed

EXAMPLE:
KCAS = 440
PRESS. ALT = 15,000 FT
TMN = 0.85
KTAS (STD DAY) = 530
KTAS (AT 20° C) = 565

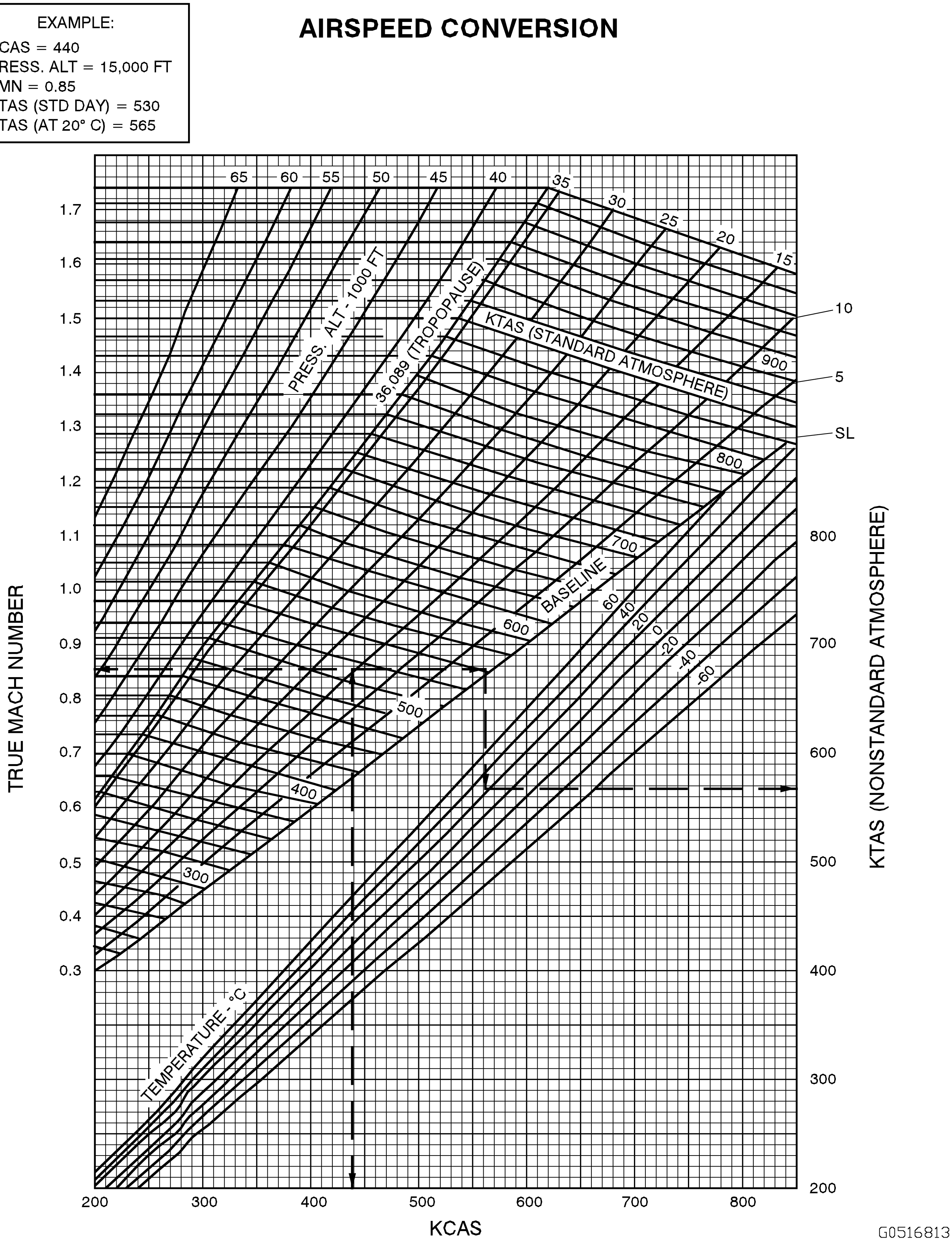


Figure A1-4. Airspeed Conversion

STANDARD ALTITUDE TABLE

STANDARD SEA LEVEL AIR:
T = 59°F (15°C)
P = 29.921 IN. OF HG

W = 0.076475 LB/CU FT ρ_0 = 0.0023769 SLUGS/CU FT
1" OF HG = 70.732 LB/SQ FT = 0.4912 LB/SQ IN.
a_0 = 1116.89 FT/SEC = 661.7 KN

STANDARD ATMOSPHERE (NACA TECHNICAL REPORT NO. 1235)

ALTITUDE FEET	DENSITY RATIO $\rho/\rho_0 = \sigma$	$1/\sqrt{\sigma}$	TEMPERATURE DEG. F	TEMPERATURE DEG. C	SPEED OF SOUND RATIO a/a_0	PRESSURE IN. OF HG	PRESSURE RATIO $p/p_0 = \delta$
-2.000	1.0598	0.9714	66.132	18.962	1.0064	32.15	1.0294
-1.000	1.0296	0.9855	62.566	16.981	1.0030	31.02	1.0147
0	1.0000	1.0000	59.000	15.000	1.0000	29.92	1.0000
1.000	0.9711	1.0148	55.434	13.019	0.9966	28.86	0.9644
2.000	0.9428	1.0299	51.868	11.038	0.9931	27.82	0.9298
3.000	0.9151	1.0454	48.302	9.057	0.9896	26.82	0.8962
4.000	0.8881	1.0611	44.735	7.075	0.9862	25.84	0.8637
5.000	0.8617	1.0773	41.169	5.094	0.9827	24.90	0.8320
6.000	0.8359	1.0938	37.603	3.113	0.9792	23.98	0.8014
7.000	0.8106	1.1107	34.037	1.132	0.9756	23.09	0.7716
8.000	0.7860	1.1279	30.471	-0.849	0.9721	22.22	0.7428
9.000	0.7620	1.1456	26.905	-2.831	0.9686	21.39	0.7148
10.000	0.7385	1.1637	23.338	-4.812	0.9650	20.58	0.6877
11.000	0.7156	1.1822	19.772	-6.793	0.9614	19.79	0.6614
12.000	0.6932	1.2011	16.206	-8.774	0.9579	19.03	0.6360
13.000	0.6713	1.2205	12.640	-10.756	0.9543	18.29	0.6113
14.000	0.6500	1.2403	9.074	-12.737	0.9507	17.58	0.5875
15.000	0.6292	1.2606	5.508	-14.718	0.9470	16.89	0.5643
16.000	0.6090	1.2815	1.941	-16.699	0.9434	16.22	0.5420
17.000	0.5892	1.3028	-1.625	-18.681	0.9397	15.57	0.5203
18.000	0.5699	1.3246	-5.191	-20.662	0.9361	14.94	0.4994
19.000	0.5511	1.3470	-8.757	-22.643	0.9324	14.34	0.4791
20.000	0.5328	1.3700	-12.323	-24.624	0.9287	13.75	0.4595
21.000	0.5150	1.3935	-15.889	-26.605	0.9250	13.18	0.4406
22.000	0.4976	1.4176	-19.456	-28.587	0.9213	12.64	0.4223
23.000	0.4807	1.4424	-23.022	-30.568	0.9175	12.11	0.4046
24.000	0.4642	1.4678	-26.588	-32.549	0.9138	11.60	0.3876
25.000	0.4481	1.4938	-30.154	-34.530	0.9100	11.10	0.3711
26.000	0.4325	1.5206	-33.720	-36.511	0.9062	10.63	0.3552
27.000	0.4173	1.5480	-37.286	-38.492	0.9024	10.17	0.3398
28.000	0.4025	1.5762	-40.852	-40.473	0.8986	9.725	0.3250
29.000	0.3881	1.6052	-44.419	-42.455	0.8948	9.297	0.3107
30.000	0.3741	1.6349	-47.985	-44.436	0.8909	8.885	0.2970
31.000	0.3605	1.6654	-51.551	-46.417	0.8871	8.488	0.2837
32.000	0.3473	1.6968	-55.117	-48.398	0.8832	8.106	0.2709
33.000	0.3345	1.7291	-58.683	-50.379	0.8793	7.737	0.2586
34.000	0.3220	1.7623	-62.249	-52.361	0.8754	7.382	0.2467
35.000	0.3099	1.7964	-65.816	-54.342	0.8714	7.041	0.2353
36.000	0.2981	1.8315	-69.382	-56.323	0.8675	6.712	0.2243
37.000	0.2844	1.8753	-69.700	-56.500	0.8671	6.397	0.2138
38.000	0.2710	1.9209	-69.700	-56.500	0.8671	6.097	0.2038
39.000	0.2583	1.9677	-69.700	-56.500	0.8671	5.811	0.1942
40.000	0.2462	2.0155	-69.700	-56.500	0.8671	5.538	0.1851
41.000	0.2346	2.0645	-69.700	-56.500	0.8671	5.278	0.1764
42.000	0.2236	2.1148	-69.700	-56.500	0.8671	5.030	0.1681
43.000	0.2131	2.1662	-69.700	-56.500	0.8671	4.794	0.1602
44.000	0.2031	2.2189	-69.700	-56.500	0.8671	4.569	0.1527
45.000	0.1936	2.2728	-69.700	-56.500	0.8671	4.355	0.1455
46.000	0.1845	2.3281	-69.700	-56.500	0.8671	4.151	0.1387
47.000	0.1758	2.3848	-69.700	-56.500	0.8671	3.956	0.1322
48.000	0.1676	2.4428	-69.700	-56.500	0.8671	3.770	0.1260
49.000	0.1597	2.5022	-69.700	-56.500	0.8671	3.593	0.1201
50.000	0.1522	2.5630	-69.700	-56.500	0.8671	3.425	0.1145
51.000	0.1451	2.6254	-69.700	-56.500	0.8671	3.264	0.1091
52.000	0.1383	2.6892	-69.700	-56.500	0.8671	3.111	0.1040
53.000	0.1318	2.7546	-69.700	-56.500	0.8671	2.965	0.09909
54.000	0.1256	2.8216	-69.700	-56.500	0.8671	2.826	0.09444
55.000	0.1197	2.8903	-69.700	-56.500	0.8671	2.693	0.09001
56.000	0.1141	2.9606	-69.700	-56.500	0.8671	2.567	0.08578
57.000	0.1087	3.0326	-69.700	-56.500	0.8671	2.446	0.08176
58.000	0.1036	3.1063	-69.700	-56.500	0.8671	2.331	0.07792
59.000	0.09877	3.1819	-69.700	-56.500	0.8671	2.222	0.07426
60.000	0.09414	3.2593	-69.700	-56.500	0.8671	2.118	0.07078
61.000	0.08972	3.3386	-69.700	-56.500	0.8671	2.018	0.06746
62.000	0.08551	3.4198	-69.700	-56.500	0.8671	1.924	0.06429
63.000	0.08150	3.5029	-69.700	-56.500	0.8671	1.833	0.06127
64.000	0.07767	3.5881	-69.700	-56.500	0.8671	1.747	0.05840
65.000	0.07403	3.6754	-69.700	-56.500	0.8671	1.665	0.05566

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Figure A1-5. Standard Altitude Table

DENSITY ALTITUDE

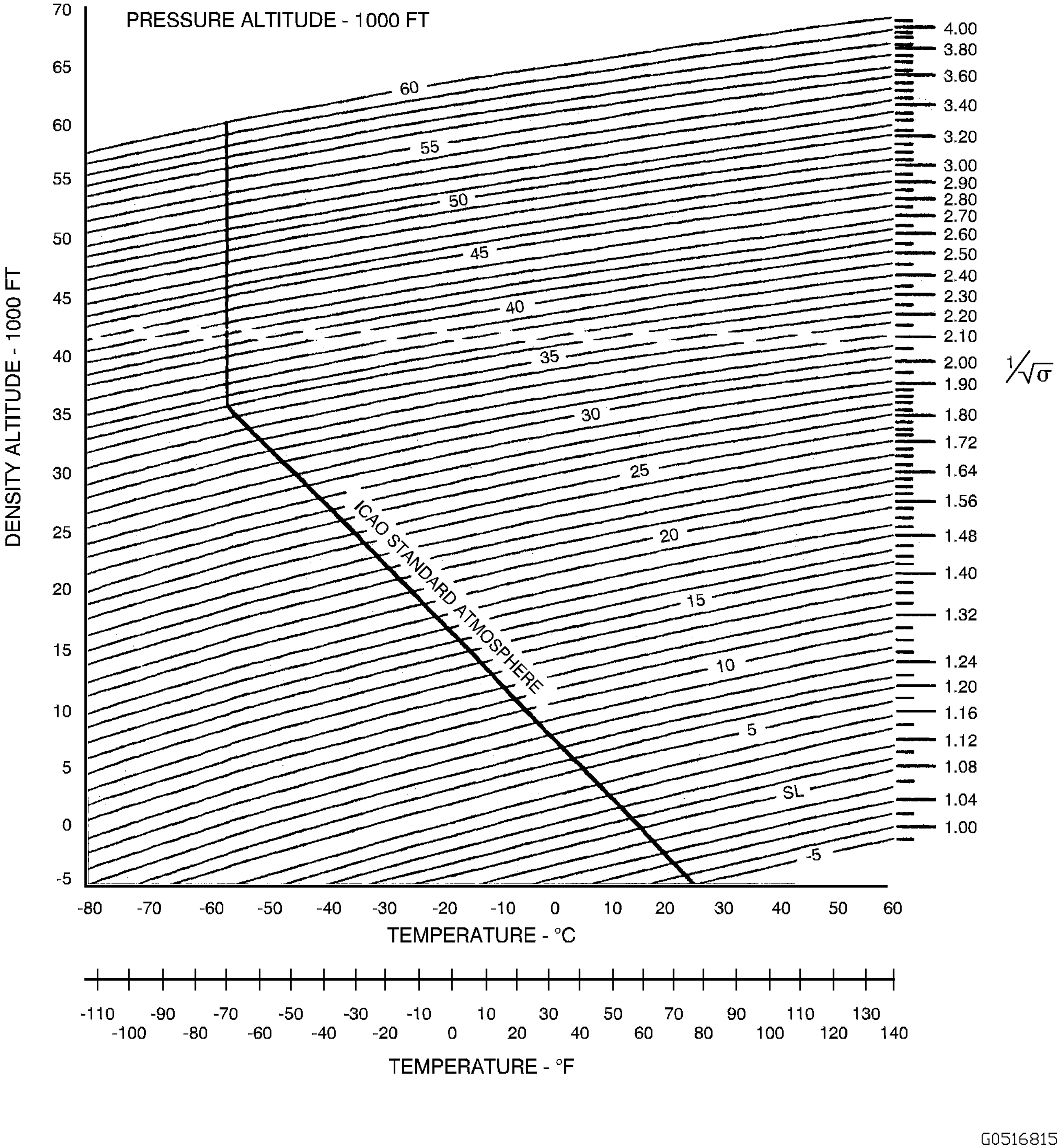
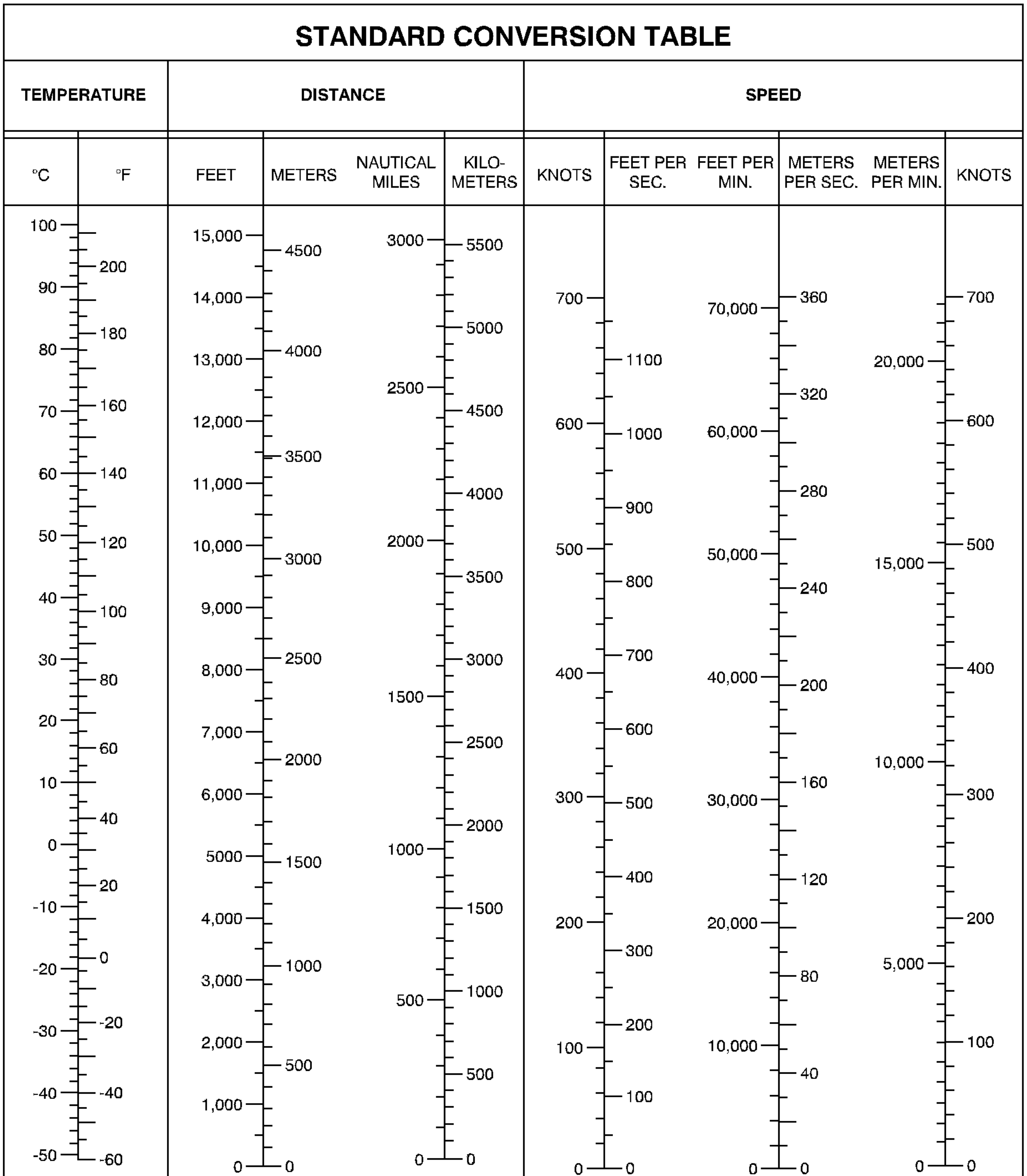


Figure A1-6. Density Altitude



Note

- TO OBTAIN US GALLONS MULTIPLY LITERS BY 0.264
- TO OBTAIN IMPERIAL GALLONS MULTIPLY LITERS BY 0.220
- TO OBTAIN INCHES OF MERCURY MULTIPLY MILLIBARS BY 0.0295
- TO OBTAIN POUNDS MULTIPLY KILOGRAMS BY 2.20

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Figure A1-7. Standard Conversion Table

PART 2
ENGINE DATA

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

ENGINE PERFORMANCE VS. RPM CHART

Familiarity with this chart will help pilots understand the aircrafts sensitivity to throttle setting and fuel flow, particularly in high drag configurations or emergency situations (gear down, speed brake extended, flaps extended, canopy loss, etc.).

The chart in Figure A2-1 shows the thrust and fuel flow per engine, as a function of engine speed (% RPM) and throttle position (deg). The relationship between engine speed and thrust is not linear. For example a 15% reduction in engine speed from MIL to 85% decreases thrust over 60%.

Relationship between thrust and fuel flow: The thrust and fuel flow curves at military power and below have a similar trend, however, once afterburner is initiated fuel flow increases faster than thrust output.

Consequently moving the throttle from MIL to MAX power increases thrust almost 50% and fuel flow by over 300%.

ENGINE COMPRESSOR STALL/FLAMEOUT SUSCEPTIBILITY AREAS CHART

Figure A2-2 depicts the stall/flameout prone areas for the installed J85-5 engine. The chart is presented in terms of pressure altitude versus indicated Mach number for standard day conditions with considerations for temperature deviation of ±10°C from standard. The chart illustrates the operating airspace at higher altitudes where colder temperatures and less dense air may cause the engine to stall or flameout. This operating restriction is further expanded as temperatures colder than standard are encountered. Conversely, the opposite is true as temperatures warmer than standard are encountered. These regions of flight require operator attention and have been portrayed on the chart as the black striped and shaded areas. Flight is not prohibited in these areas but merely requires the operator to acknowledge the engine susceptibility as indicated on the chart.

THROTTLE MOVEMENT

The engine stall margin and operating parameters decrease with increasing altitude where the air is less dense and colder. As a result, throttle movement must be more carefully controlled in the black striped and shaded areas shown in Figure A2-2. Abrupt throttle movements, which are acceptable to the engine at low altitude, are not recommended in these areas and can result in a stall or flameout.

AFTERBURNER INITIATION (HIGH ALTITUDE)

Afterburner initiation attempts in the black striped area as indicated in Figure A2-2 are not recommended. Afterburner light-off is not guaranteed and, even if successful, may drive the engine RPM down (rollback) and possibly cause engine flameout.

MANEUVERING

Maximum performance maneuvering involves high AOA, low airspeed, unusual attitudes, high yaw, roll and pitch rates and throttle manipulation, which increase the engine susceptibility to compressor stall and flameout. Maneuvering above approximately 28,000 feet and below 0.6 IMN (Figure A2-2, shaded area) has proven to increase susceptibility to stall/flameout due to reduced/distorted ram air flow to the engine, caused by lower air density coupled with reduced effective intake duct area. Throttle manipulation demanding more engine air increases the possibility of stall/flameout. The area below approximately 30,000 feet and above 0.6 IMN has not been a stall/flameout prone area because ram air in the higher speed range is sufficient to satisfy engine requirements. However, excessive heavy maneuvering and throttle movements broaden the susceptible area indicated on the chart.

HIGH MACH DIVE

CAUTION

Avoid afterburner operation as indicated in the solid black area of Figure A2-2. Engine stall or damage to the variable exhaust nozzles may occur.

EFFECT OF COMPRESSOR INLET TEMPERATURE (T2 CUTBACK)

The T2 sensor in the main fuel control automatically reduces the physical RPM and EGT T2 cutback) to prevent overpressurization and high corrected speed conditions of the compressor at low CIT. At any normal operating condition, CIT is higher than the Outside Air Temperature (OAT) and varies with airspeed for a given OAT. Increasing airspeed will increase CIT. At low indicated airspeeds and low OAT conditions, the engine RPM and EGT indications may be below the normal operating limits at MIL and MAX power. When the aircraft is flown in the striped black area of the engine envelope, Figure A2-2, T2 cutback may be observed. In maneuvering flight, the CIT of each engine will vary depending on flight attitude. As a result, the engine sensing the lower CIT will have a decreased stall margin and increased probability of compressor stall if a throttle transient is made. If T2 cutback observed, the airspeed should be increased by exchanging altitude for airspeed to increase CIT prior to making a throttle movement.

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EGT DROOP AT HIGH-Q/MIL POWER

At low altitude and high speed (500 KIAS), EGT droop may occur with engine at military power when accompanied by 3% or less nozzle indication.

EFFECT OF HIGH ALTITUDE AND LOW AIRSPEED ON ENGINE RPM

During 1.0 G stalls at or above 20,000 feet, with throttles at IDLE detent and airspeed 200 KIAS or below, the inflight idle RPM can decay to less than normal ground idle speed (46.5 to 49.5% RPM) and the generator caution lights will illuminate. Under these flight conditions, an engine on which RPM has dropped below normal idle speed will not accelerate when the throttle is advanced. To avoid this condition, maintain engine RPM at 80% or above when airspeeds of less than 200 KIAS above 20,000 feet are anticipated. Corrective action for idle decay is to retard the throttle of the affected engine(s) to idle and increase airspeed to above 200 KIAS by lowering the nose of the aircraft. As airspeed increases, throttle advances may be attempted; however, the throttle should be returned to IDLE detent if the engine does not accelerate.

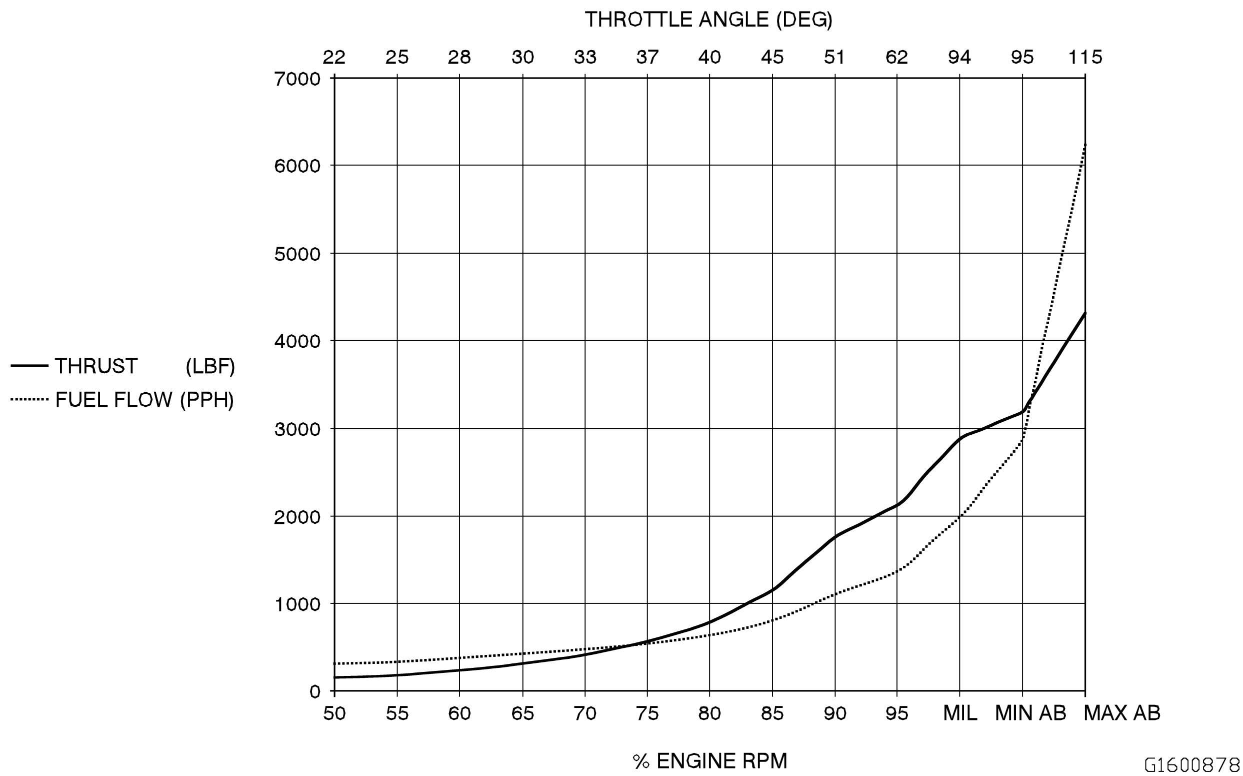

Figure A2-1. Engine Performance vs. RPM

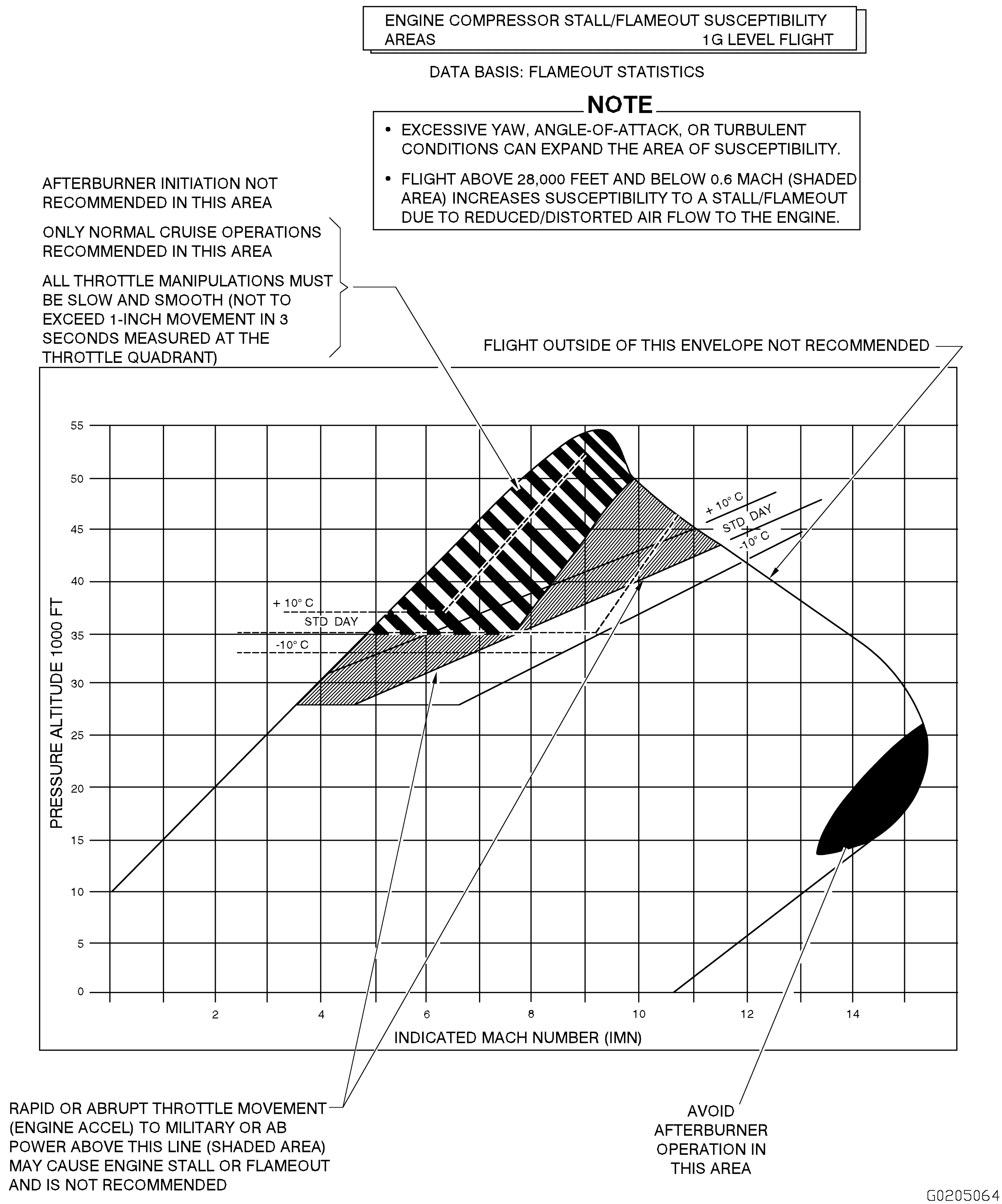

Figure A2-2. Engine Compressor Stall/Flameout Susceptibility Areas

PART 3
TAKEOFF

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

GRD TO HYD ELE FUE OXY ENG FLT MISC LND

I II III IV V VI VII A G IN

WIND COMPONENTS

A Takeoff and Landing Wind components chart is provided to enable the pilot to convert surface winds to headwind and crosswind components. Enter the chart with steady wind velocity to determine headwind component; use the maximum gust velocity to determine crosswind component. Maximum recommended 90° crosswind component for dry runways is 30 knots, for wet runways, 20 knots, and for icy runways and those containing Standing Water (SW), 10 knots.

USE OF TAKEOFF AND LANDING WIND COMPONENTS CHART

Enter the chart, Figure A3-1, with the wind direction and velocity (35° off runway heading at 41 knots). Move horizontally left to find the headwind component (34 knots) and vertically down to find the crosswind component (24 knots).

ROTATION SPEED/TAKEOFF SPEED/50-FOOT OBSTACLE SPEED

The Rotation, Takeoff, and Obstacle Clearance Speed chart is used to determine rotation speed, anticipated takeoff speed and expected speed while climbing through a height of 50 feet above the runaway. Rotation speed is the speed at which aft stick is initiated and takeoff speed is the speed at which the main gear lifts off the runway. A 7.5° pitch attitude is held through an altitude of 50 feet.

USE OF ROTATION SPEED/TAKEOFF SPEED/50-FOOT OBSTACLE SPEED CHART

The chase thru lines on Figure A3-2, Rotation, Takeoff, Obstacle Clearance Speed chart, show the rotation and normal takeoff speeds for an aircraft with a gross weight of 12,700 pounds are 134 KIAS and 162 KIAS respectively. The expected speed when climbing through a height of 50 feet above the runway is 194 KIAS.

TAKEOFF DISTANCE

Takeoff Distance is the distance in feet from brake release to main gear lift off. Takeoff distance to clear a 50-foot obstacle is the distance in feet to main gear lift off plus the air distance to clear a 50-feet obstacle. The Takeoff Distance chart shows ground run distance and total distance to clear a 50-foot obstacle as a function of ambient temperature, pressure altitude, gross weight, wind velocity, and runway slope. The chart shows data for normal takeoff at MAX thrust using the normal takeoff procedures defined on the chart. Takeoff distance and total distance to clear a 50-foot obstacle are increased with a WSSP loaded on the aircraft.

USE OF TAKEOFF DISTANCE CHART

Enter chart, Figure A2-3, Takeoff Distance Chart, with a temperature of 32°C, a pressure altitude of 1000 feet, a takeoff gross weight of 12,700 pounds, and a headwind component of 10 knots, to compute a takeoff distance of 3100 feet. To compute the distance to clear a 50-foot obstacle, continue down to a gross weight of 12,700 pounds, then left to the headwind baseline. Parallel the headwind guideline to 10 knots of headwind, then left to a Total Distance to Clear 50-foot Obstacle of 4000 feet.

CRITICAL FIELD LENGTH (CFL)

Critical Field Length is the total runway length required to accelerate with both engines operating to the critical engine failure speed, experience an engine failure, then either continue to accelerate to Single-Engine Takeoff Speed (SETOS) and takeoff (approximately 350 feet from start of rotation at SETOS) or stop in the same distance (see Refusal Speed section).

USE OF CRITICAL FIELD LENGTH CHART

Enter chart Figure A3-4, Critical Field Length, with a temperature of 32°C, a pressure altitude of 1000 feet, a gross weight of 12,700 pounds and a 10-knot headwind. The Critical Field Length for an RCR of 12 is 9000 feet. Corrections to CFL due to runway slope are shown in the notes.

REFUSAL SPEED (RS-BEO)

Refusal Speed (RS) is the maximum speed to which the aircraft is able to accelerate with both engines operating in MAX, and either: Abort with Both Engines Operating (BEO) or abort with an Engine Failure (EF). In both situations, a 3-second delay is allowed to recognize and react to an event. During this 3-second reaction time, under the Both Engines Operating scenario, both engines are producing MAX thrust; in the Engine Failure scenario, one engine is producing MAX thrust while the other engine is windmilling. At the end of this period, throttles are pulled to idle and the aircraft begins to decelerate as the engine thrust decays. If the aircraft is in a three-point attitude and the airspeed is below 130 KIAS, wheel brakes are gradually applied such that desired braking is reached in 2 seconds. Wheel braking is limited to cautious braking from 130 KIAS to 100 KIAS, and optimum braking below 100 KIAS. If the aircraft has rotated at abort initiation, the pitch attitude is held in the rotated position of 7.5° for aerobraking until 120 KIAS. Wheel braking is not used while aerobraking. At 120 KIAS, the nose settles to the runway, and at nose wheel touchdown, wheel brakes are gradually applied such that desired braking is reached in 2 seconds. While decelerating, under the BEO scenario, both engines are producing idle thrust; under the EF scenario, one engine is producing idle thrust and the other engine is windmilling.

GRD TO HYD ELE FUE OXY ENG FLT MISC LND

USE OF REFUSAL SPEED CHARTS

The chase through lines in Figure A3-5, Refusal Speed/Both Engines Operating, show that for an abort not associated with an engine failure entering the chart with a temperature of 32°C, a pressure altitude of 1000 feet, an 8000-foot runway length, at any gross weight, the refusal speed is 106 KIAS.

To illustrate Refusal Speed/Both Engines Operating once rotation has occurred, at a temperature of 32°C, pressure altitude at 1000 feet, for a runway length of 12,000 feet and a gross weight of 12,700 pounds, the intersection falls on or to the right of the aerobraking region line and the aircraft is traveling fast enough to aerobrake. In this case, continue down to the aerobraking block to the 12,000-foot runway length and then horizontally to read the aerobraking refusal speed of 136 KIAS.

The chase through lines in Figure A3-6, Refusal Speed, Engine Failure show that for an abort associated with engine failure, entering with a temperature of 32°C, a pressure altitude of 1000 feet, an 8000-foot runway length, the refusal speed is 125 KIAS. To illustrate Refusal Speed-Engine Failure once rotation has occurred, at the same ambient conditions, for a runway length of 12,000 feet at a gross weight of 12,700 pounds, the intersection falls to the right of the aerobraking region line and the aircraft is traveling fast enough to aerobrake. In this case, continue down to the aerobraking block to the 12,000-foot runway length, and then horizontally to read the aerobraking refusal speed of 146 KIAS.

USE OF REFUSAL SPEED/CORRECTED FOR RCR

Enter Figure A3-7, Refusal Speed/Corrected for RCR chart, with a refusal speed of 115 KIAS from Figure A3-5 and Figure A3-6. Follow the guideline and proceed vertically to the required RCR of 12, then down read an adjusted Refusal Speed/Corrected for RCR of 99 KIAS.

SINGLE ENGINE TAKEOFF SPEED (SETOS)

SETOS is the speed at which the aircraft is able to climb, once clear of ground effect, at a minimum of 100 feet per minute with gear down, Flaps - 60%. Rotation is initiated at SETOS during a single engine takeoff. The minimum SETOS is two engine takeoff speed.

USE OF SINGLE ENGINE TAKEOFF SPEED CHART

Enter Figure A3-8, Single/Engine Takeoff Speed, with a temperature of 32°C, move up vertically to a pressure altitude of 1000 feet, then horizontally to the right to a gross weight of 12,700 pounds. Proceed down to a SETOS of 178 KIAS. The chart is also used to compute expected Single Engine Rate of Climb for an increased airspeed. Continue to project down to the line for the aircraft weight of 12,700 pounds. From this point, project left to the baseline (corresponding to 100 feet per minute) in the Single Engine Rate of Climb plot and draw a line parallel to the guidelines. In the lower right hand plot, increase the speed the desired amount (10 KIAS) in the example and project down to the same 12,700 pound line, then left to intersect the constructed guideline. Read the Single-Engine Rate of Climb of 450 ft per minute at the intersection.

CRITICAL ENGINE FAILURE SPEED (CEFS)

Critical Engine Failure Speed is the speed to which the aircraft accelerates with both engines, experience an engine failure, and permit either acceleration to (SETOS) (see Decison Speed section) and takeoff (approximately 350 feet from start of rotation at SETOS) or decelerate to a stop (see Refusal Speed section) in the same distance.

USE OF CRITICAL ENGINE FAILURE SPEED CHART

Enter Figure A3-9, Critical Engine Failure Speed, with a temperature of 32°C, move up vertically to a pressure altitude of 1000 feet, and horizontally to the right to a gross weight of 12,700 pounds. Then move down using a 10-knot headwind component. Continue down to the RCR baseline, parallel the guideline to an RCR of 12 and then straight down to a critical engine failure speed of 121 KIAS.

DECISION SPEED (DS)

Decision speed is the minimum speed at which the aircraft is able to experience an instantaneous engine failure and still accelerate to SETOS and takeoff (approximately 350 feet from start of rotation at SETOS) in the remaining runway. At decision speed, a 3-second delay is allowed to recognize and react to the engine failure, during which time acceleration continues with one engine in MAX thrust and the other engine windmilling. If the aircraft reaches rotation speed before or during this period, the aircraft begins a rotation to the takoff attitude. At the end of the 3-second reaction time, the aircraft maintains or is returned to a three- point attitude and accelerated to SETOS with neutral stick.

USE OF DECISION SPEED CHART

Enter Figure A3-10 (Sheet 1 of 2) Decision Speed, with a temperature of 32°C, move vertically up to a pressure altitude of 1000 feet, then horizontally to the right to a gross weight of 12,700 pounds. Drop down to a runway length of 9000 feet, then move to the left to the baseline and follow the curve to a 10-knot headwind component line, then move left to show a decision speed of 127 KIAS.

I II III IV V VI VII A G IN

VELOCITY DURING TAKEOFF GROUND RUN

The velocity during takeoff charts show the relationship between airspeed and distance traveled during take-off. The two engine velocity during takeoff chart, Figure A3-12, is used to check acceleration performance. The chart provides the Normal Acceleration Check Speed (NACS) and must be adjusted to Minimum Accelertion Check Speed (MACS) using the note on the chart. MACS is the minimum acceptable speed at the check distance with which takeoff should be continued. MACS is computed to allow for variations in engine performance due to engine trim, throttle setting (e.g. formation takeoff), and pilot technique. Compute NACS using an acceleration check distance to any usable value up to 2000 feet from brake release that results in a speed equal to or less than CEFS. The Velocity During Takeoff Ground Run, Single Engine chart, Figure A3-13, is used to evaluate single-engine takeoff acceleration performance and is used to calculate takeoff distance from any engine failure speed to SETOS and takeoff (approximately 350 feet from start of rotation at SETOS).

USE OF VELOCITY DURING TAKEOFF GROUND RUN CHART/BOTH ENGINES OPERATING

Enter Figure A3-2, Rotation/Takeoff/Obstacle Speed, with a takeoff weight of 12,700 pounds, giving a normal takeoff speed of 162 KIAS. Enter Figure A3-3, Takeoff Distance, with a temperature of 32°C, a pressure altitude of 1000 feet, a takeoff weight of 12,700 pounds, and with no wind. Takeoff distance is 3500 feet.

Enter Figure A3-11, Velocity During Takeoff Ground Run Chart, Both Engines Operating, with these two parameters, 162 KIAS and 3500 feet. From the point of intersection of these lines, draw a line parallel to the guideline until it meets a distance of 1000 feet. Where these two lines meet, move left to read 92 KIAS, which is the velocity at a point 1000 feet from brake release. To find the speed for a 10-knot headwind, move horizontally to the right, follow a guideline to 10-knot headwind and then horizontally to 100 KIAS. If the acceleration check speed was greater than or equal to CEFS, the chart is reentered at a shorter ground run distance (such as 500 feet) to find a revised acceleration check speed.

USE OF VELOCITY DURING TAKEOFF GROUND RUN CHART/SINGLE ENGINE OPERATING CHART

Enter Figure A3-12, Velocity During Takeoff Chart, Single Engine Operating at the runway temperature 32C, and project vertically up to the pressure altitude of 1000 feet, then right horizontally to the aircraft gross weight 12,700 pounds, and project down vertically to the wind chart. Parallel the headwind guidelines to 10 knots and project vertically down to the baseline. Draw a line through this point that parallels the guidelines downward to the SETOS speed of 178 KIAS. Note the ground run distances at the intersections with SETOS (178 KIAS from Figure A3-8), 10,000 feet, and 140 KIAS, 5200 feet. Subtract the distance at the 140 KIAS failure speed from the distance at SETOS (10,000 - 5,200). The result (4800 feet) is the distance to accelerate with a single engine in a 3-point attitude from 140 KIAS to SETOS. Add the noted 350 feet for rotation to determine the distance for 140 KIAS to takeoff to 5150 feet.

MODEL: T-38A AND C (NON-PMP)
ENGINE(S): (2) J85-GE-5
DATE: 1 DECEMBER 2005
DATA BASIS: FLIGHT TEST

NOTE

ENTER CHART WITH STEADY WIND TO DETERMINE HEADWIND COMPONENT AND WITH MAXIMUM GUST VELOCITY TO DETERMINE CROSSWIND COMPONENT.

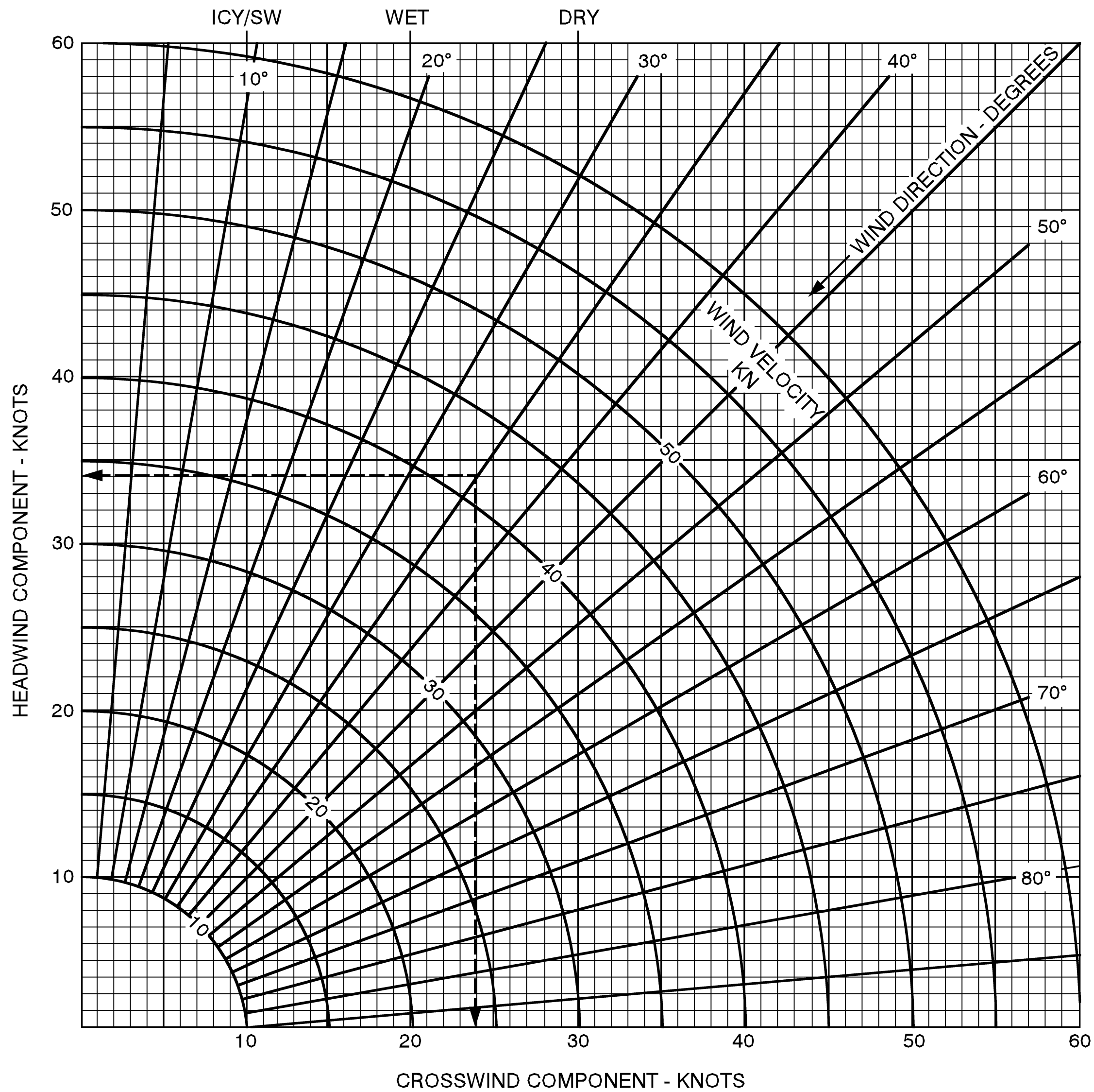

Figure A3-1. Takeoff and Landing Wind Components

MODEL: T-38A AND C (NON-PMP)
ENGINE(S): (2) J85-GE-5
DATE: 1 DECEMBER 2005
DATA BASIS: FLIGHT TEST

MAX THRUST
FLAPS - 60%
GEAR - DOWN

NOTE

AFT STICK APPLIED AT THE ROTATION SPEED SHOWN BELOW AND 7.5° PITCH ATTITUDE HELD AFTER ROTATION THROUGH 50 FT AGL

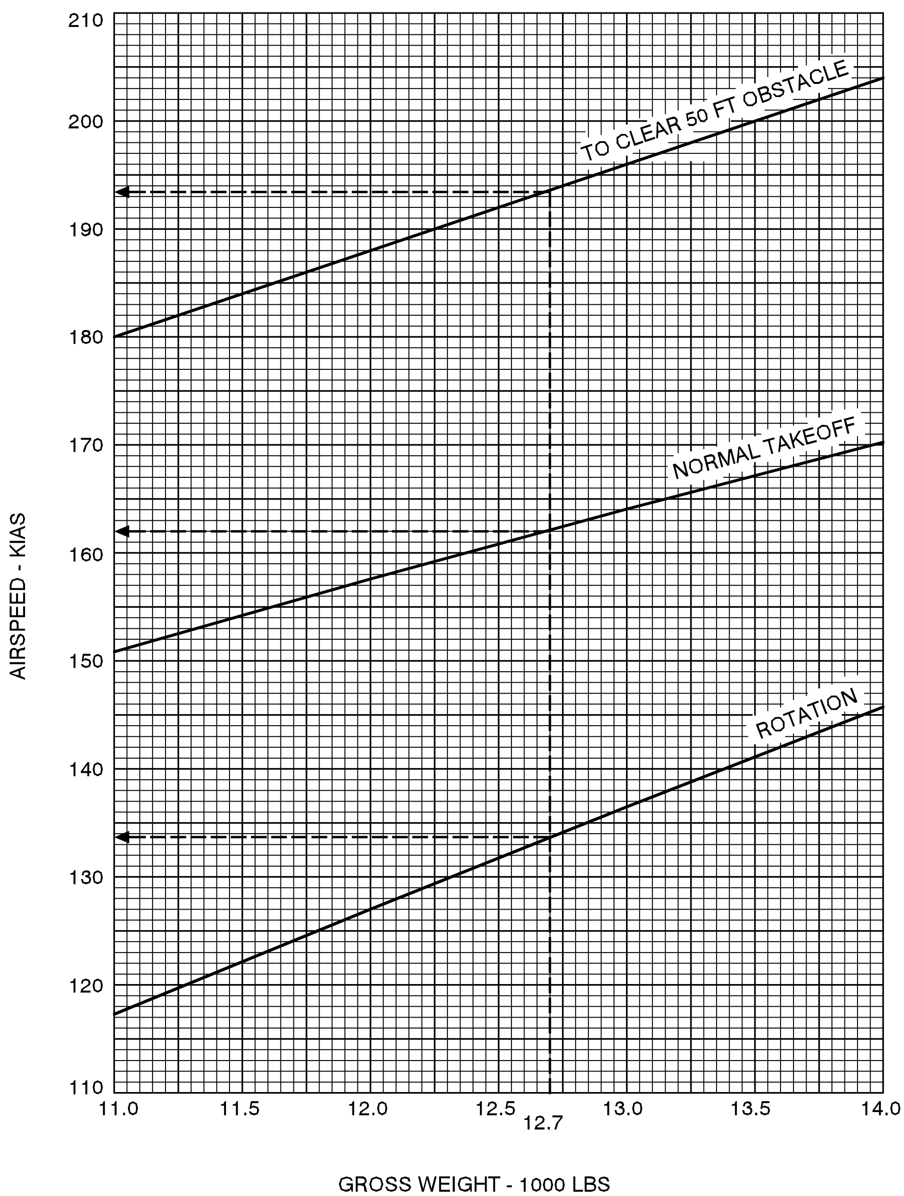

Figure A3-2. Rotation Speed/Takeoff Speed/50 Ft Obstacle Speed

MODEL: T-38A AND C (NON-PMP)
ENGINE(S): (2) J85-GE-5
DATE: 1 DECEMBER 2005
DATA BASIS: FLIGHT TEST

MAX THRUST
FLAPS - 60%
GEAR - DOWN

NOTES

- DATA BASED ON NORMAL TAKEOFF PROCEDURES.
  AFT STICK APPLIED AT THE ROTATION SPEED SHOWN IN FIGURE A3-2 AND 7.5 DEG PITCH ATTITUDE HELD AFTER ROTATION.
- INCREASE TAKEOFF DISTANCE 5% FOR EACH PERCENT OF UPHILL RUNWAY SLOPE. INCREASE TOTAL DISTANCE TO CLEAR 50 FT OBSTACLE 16% FOR EACH PERCENT OF UPHILL RUNWAY SLOPE
- WITH AUTHORIZED EXTERNAL STORES INSTALLED, ADD EXTERNAL STORES WEIGHT TO AIRCRAFT WEIGHT TO DETERMINE TAKEOFF DISTANCE AND TOTAL DISTANCE TO CLEAR A 50-FOOT OBSTACLE, THEN INCREASE BOTH DISTANCES BY 1%

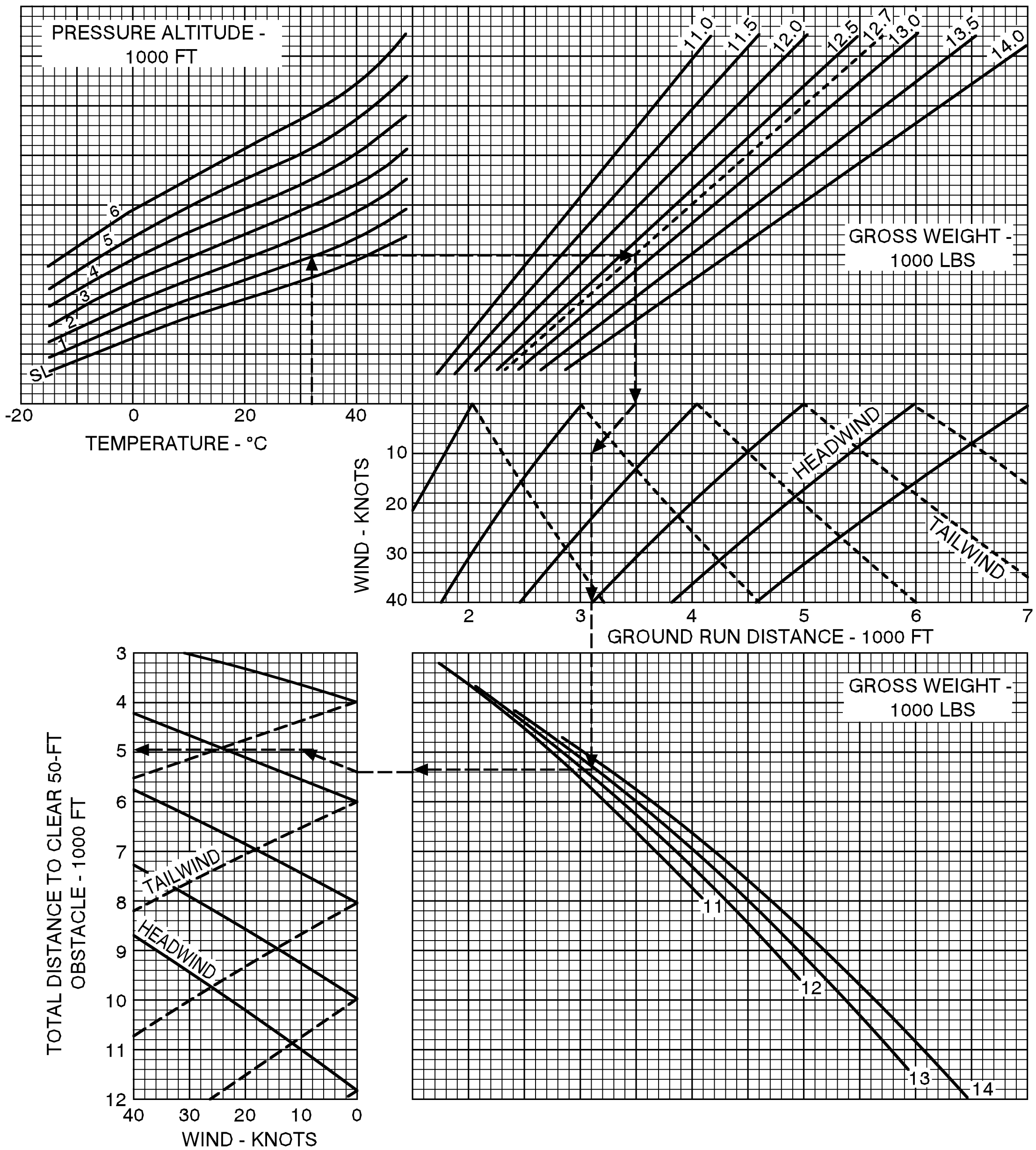

Figure A3-3. Takeoff Distance

MODEL: T-38A AND C (NON-PMP)
ENGINE(S): (2) J85-GE-5
DATE: 1 DECEMBER 2005
DATA BASIS: FLIGHT TEST

MAX THRUST
FLAPS - 60%
GEAR - DOWN

IF RCR IS NOT AVAILABLE USE THE FOLLOWING:

RUNWAY CONDITION	RCR
DRY	23
WET	12
ICY	5

NOTES

- CFL VALID UP TO SETOS
- AERO-BRAKE IF POSSIBLE. THESE DATA ASSUME NO AERO-BRAKING.
- INCREASE CFL 4% FOR EACH PERCENT OF UPHILL RUNWAY SLOPE OR DECREASE CFL 3% FOR EACH PERCENT OF DOWNHILL RUNWAY SLOPE.
- WITH AUTHORIZED EXTERNAL STORES INSTALLED, ADD EXTERNAL STORES WEIGHT TO AIRCRAFT WEIGHT AND COMPUTE CFL.

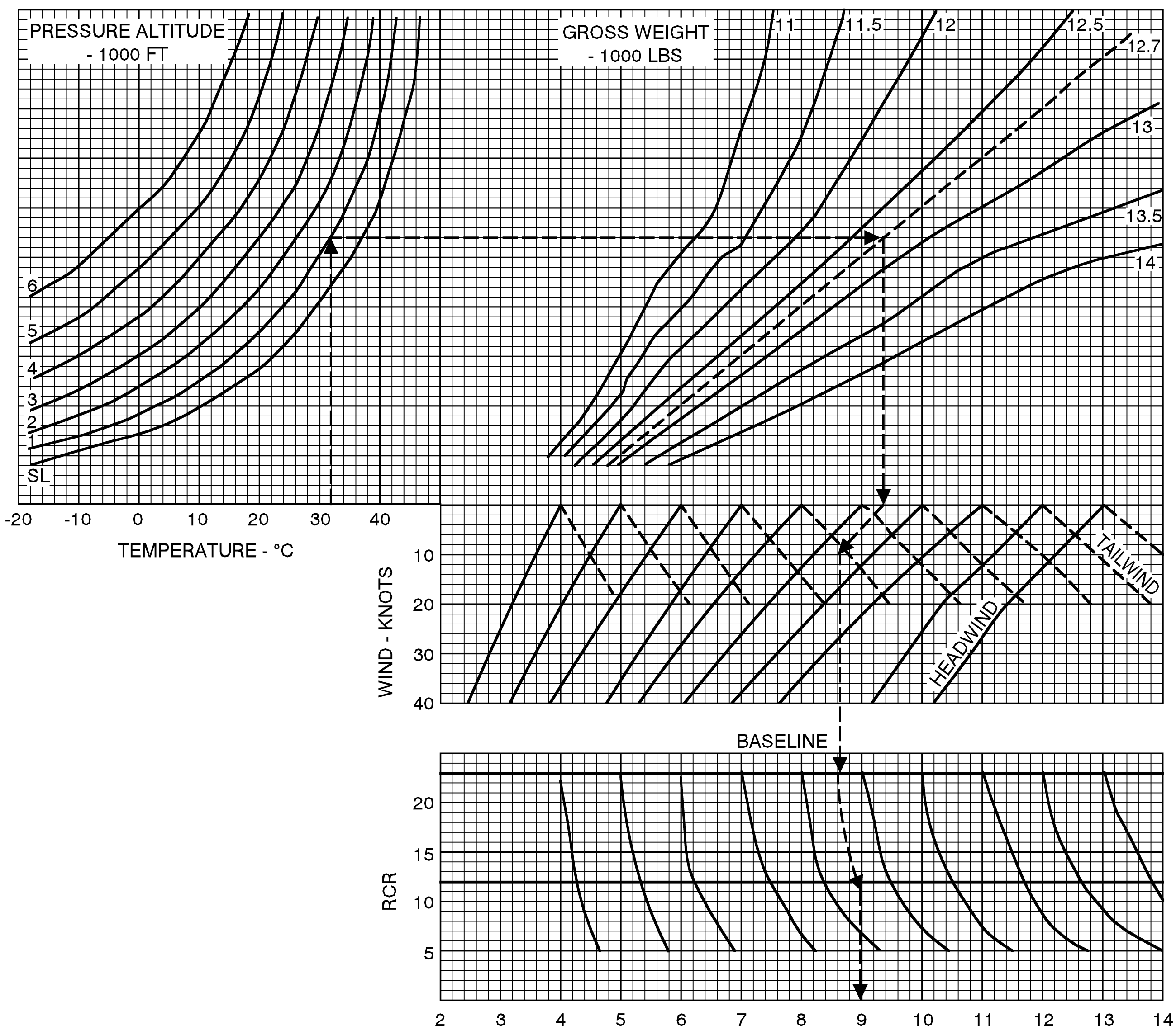

Figure A3-4. Critical Field Length (CFL)

MODEL: T-38A AND C (NON-PMP)
ENGINE(S): (2) J85-GE-5
DATE: 14 JULY 2006
DATA BASIS: FLIGHT TEST

MAX THRUST
FLAPS - 60%
GEAR - DOWN

NOTES

- THESE DATA ASSUME NON-ENGINE FAILURE
- REFUSAL SPEEDS VALID UP TO SETOS
- ADD 50% OF THE HEADWIND TO REFUSAL SPEED OR SUBTRACT 70% OF THE TAILWIND FROM NO AERO-BRAKING REFUSAL SPEED.
- FOR AERO-BRAKING:
  AFT STICK APPLIED AT THE ROTATION SPEED AND 7.5° PITCH ATTITUDE HELD FROM ROTATION TO 120 KIAS.

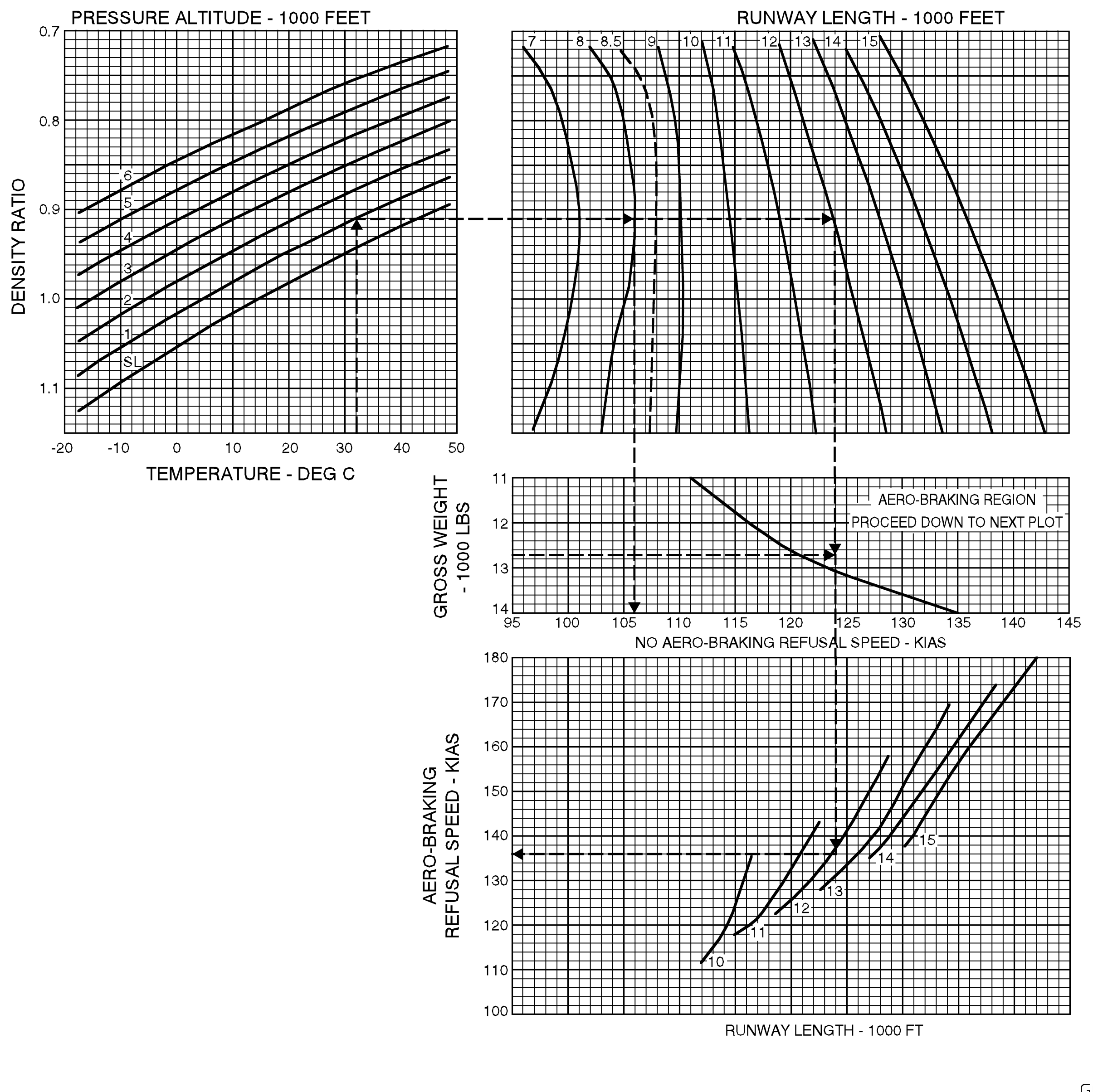

Figure A3-5. Refusal Speed/Both Engines Operation (RS-BEO)

MODEL: T-38A AND C (NON-PMP)
ENGINE(S): (2) J85-GE-5
DATE: 25 APRIL 2007
DATA BASIS: FLIGHT TEST

MAX THRUST
FLAPS - 60%
GEAR - DOWN

NOTES

- THESE DATA ASSUME ENGINE FAILURE
- REFUSAL SPEEDS VALID UP TO SETOS
- ADD 50% OF THE HEADWIND TO REFUSAL SPEED OR SUBTRACT 70% OF THE TAILWIND FROM NO AERO-BRAKING REFUSAL SPEED.
- ON THIS CHART, ADD 3 KTS TO KIAS TO CONVERT TO KCAS
- FOR AERO-BRAKING:
  AFT STICK APPLIED AT THE ROTATION SPEED AND 7.5 DEG PITCH ATTITUDE HELD FROM ROTATION TO 120 KIAS

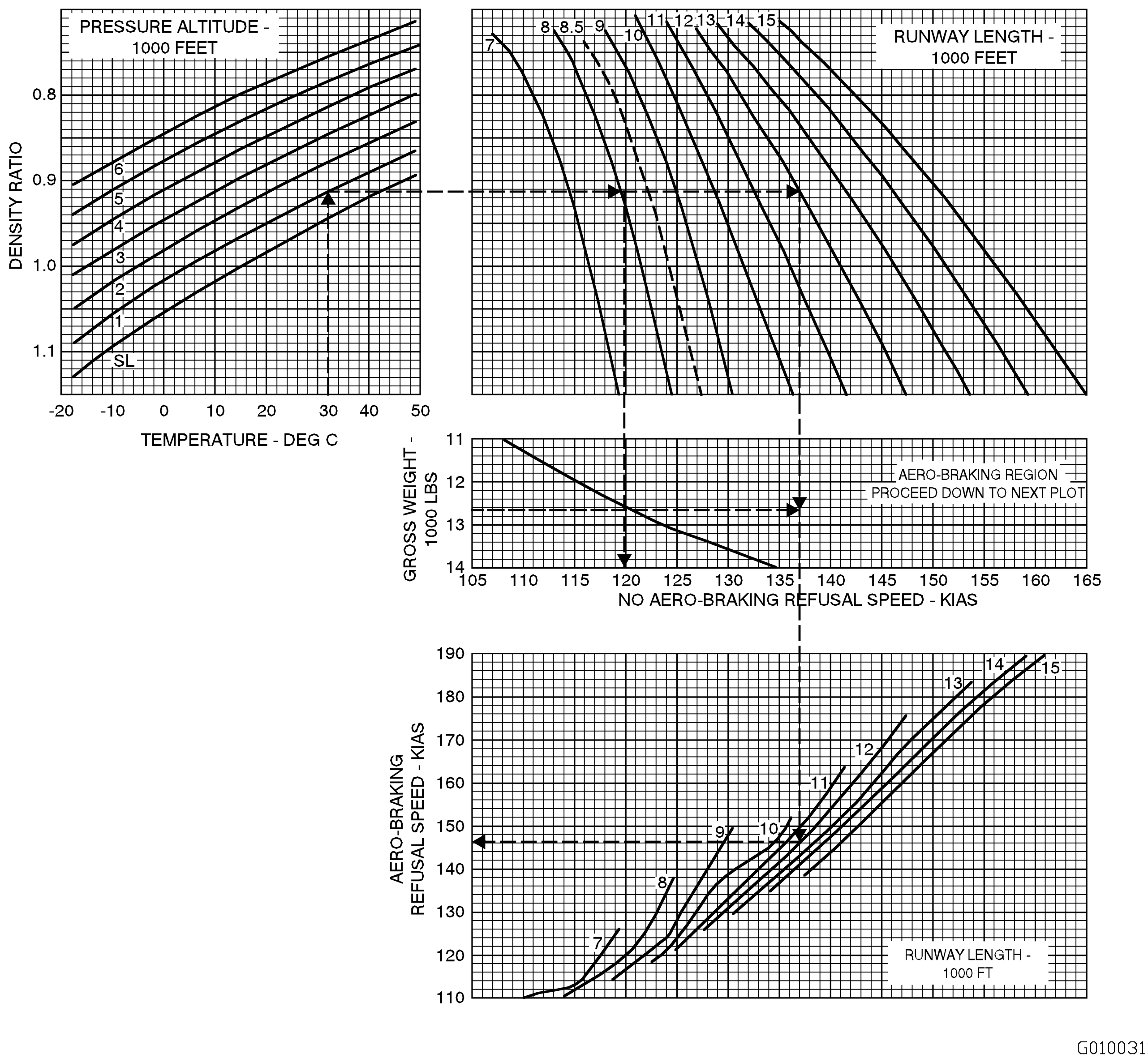

Figure A3-6. Refusal Speed/Engine Failure (RS-EF)

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MODEL: T-38A AND C (NON-PMP)
ENGINE(S): (2) J85-GE-5
DATE: 1 DECEMBER 2005
DATA BASIS: FLIGHT TEST

MAX THRUST
FLAPS - 60%
GEAR - DOWN

NOTES

- AERO-BRAKE IF POSSIBLE. DATA ASSUMES NO AERO-BRAKING
- APPLICABLE FOR ENGINE FAILURE AND NON-ENGINE FAILURE REFUSALS
- IF RCR IS NOT AVAILABLE, USE THE FOLLOWING:

RUNWAY CONDITION	RCR
DRY	23
WET	12
ICY	5

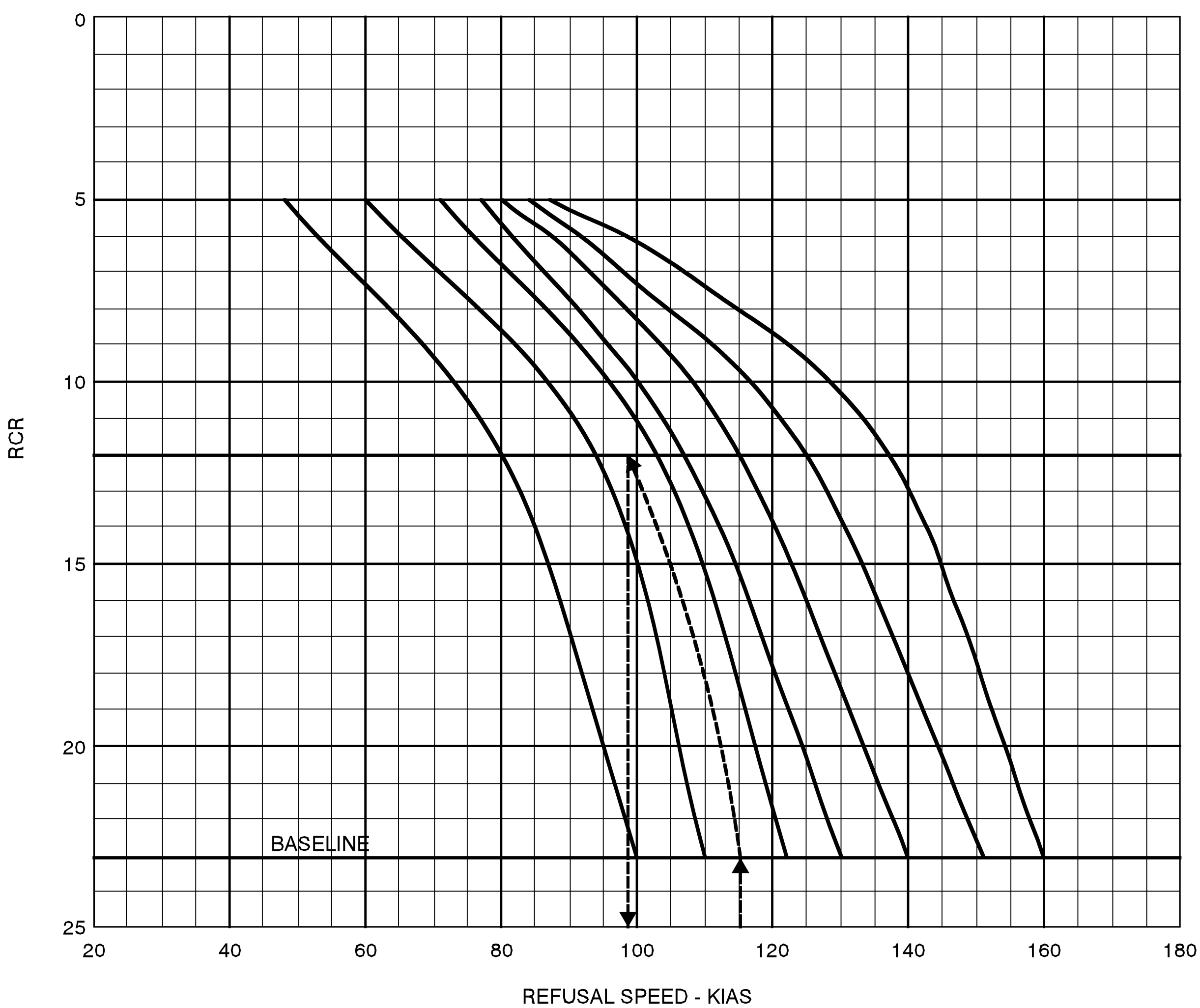

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Figure A3-7. Refusal Speed/Corrected for RCR

MODEL: T-38A AND C (NON-PMP)
ENGINE(S): (2) J85-GE-5
DATE: 30 JAN 07
DATA BASIS: FLIGHT TEST

MAX THRUST
FLAPS - 60%
GEAR - DOWN

NOTE

- SETOS IS THE GREATER OF:
  - (a) TWO-ENGINE TAKEOFF SPEED (DEPICTED BY VERTICAL LINES IN THE TOP RIGHT HAND PLOT. SINGLE ENGINE RATE OF CLIMB IS GREATER THAN 100 FPM)
  - (b) SPEED FOR 100 FPM SINGLE ENGINE RATE OF CLIMB OUT OF GROUND EFFECT, 60% FLAPS, GEAR DOWN.
- ACCELERATE TO SETOS IN A 3-POINT ATTITUDE. ROTATE NO EARLIER THAN SETOS.
- DELAYING ROTATION TO HIGHER SPEEDS IMPROVES PERFORMANCE. CONSIDER RUNWAY REMAINING AND TIRE SPEED LIMITS.
- BEST RATE-OF-CLIMB SPEED WITH GEAR AND FLAPS EXTENDED IS 208 KIAS AT 12,700 LBS GW. FOR BEST RATE-OF-CLIMB SPEED OTHER THAN 12,700 LBS, ADD OR SUBTRACT 8 KTS FOR EVERY 1000 LBS HEAVIER OR LIGHTER THAN 12,700 LBS.
- WITH AUTHORIZED EXTERNAL STORES INSTALLED, ADD EXTERNAL STORES WEIGHT TO AIRCRAFT WEIGHT AND ADD 2 KNOTS TO COMPUTED SETOS.

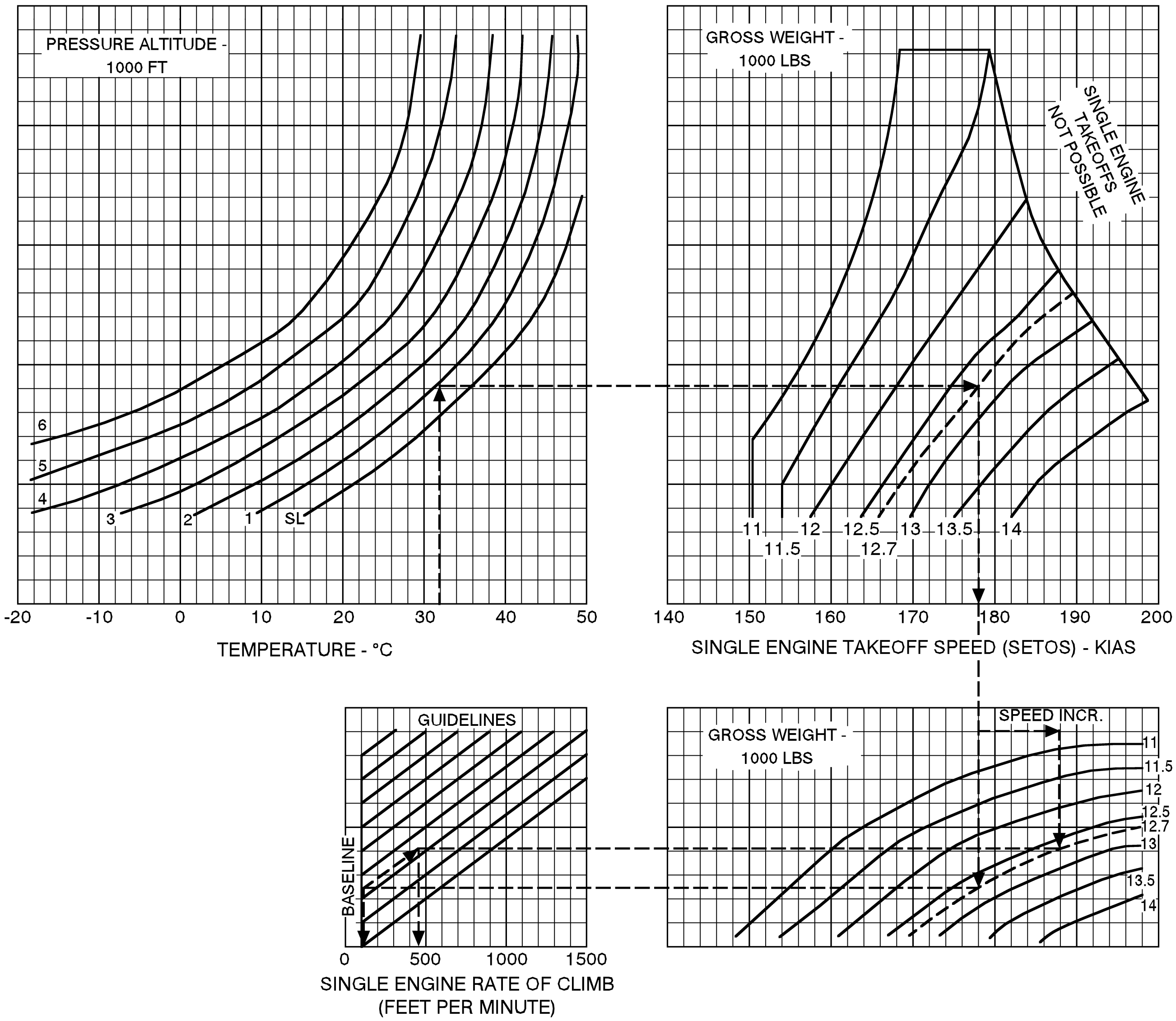

Figure A3-8. Single Engine Takeoff Speed (SETOS)

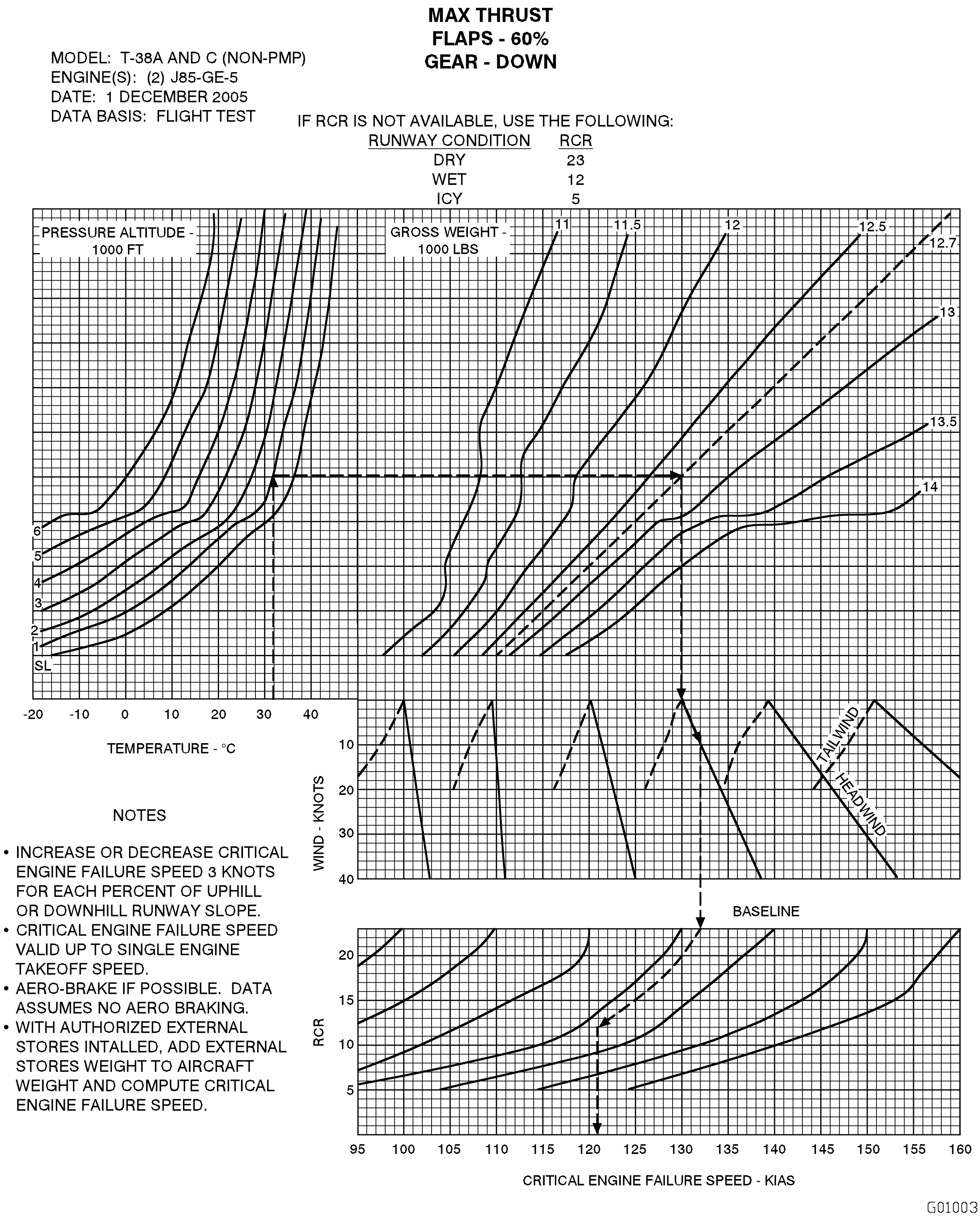

Figure A3-9. Critical Engine Failure Speed (CEFS)

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MODEL: T-38A AND C (NON-PMP)
ENGINE(S): (2) J85-GE-5
DATE: 1 DECEMBER 2005
DATA BASIS: FLIGHT TEST

MAX THRUST
GEAR - DOWN
FLAPS - 60%
RUNWAY LENGTHS BETWEEN 7,000 - 10,000 FEET

NOTES

- FOLLOWING ENGINE FAILURE, MAXIMUM AFTERBURNER IS SELECTED ON THE OPERATING ENGINE.
- ACCELERATE IN 3-POINT ATTITUDE TO SETOS.
- SMOOTH ROTATION STARTING AT SETOS UNTIL TAKEOFF OCCURS.

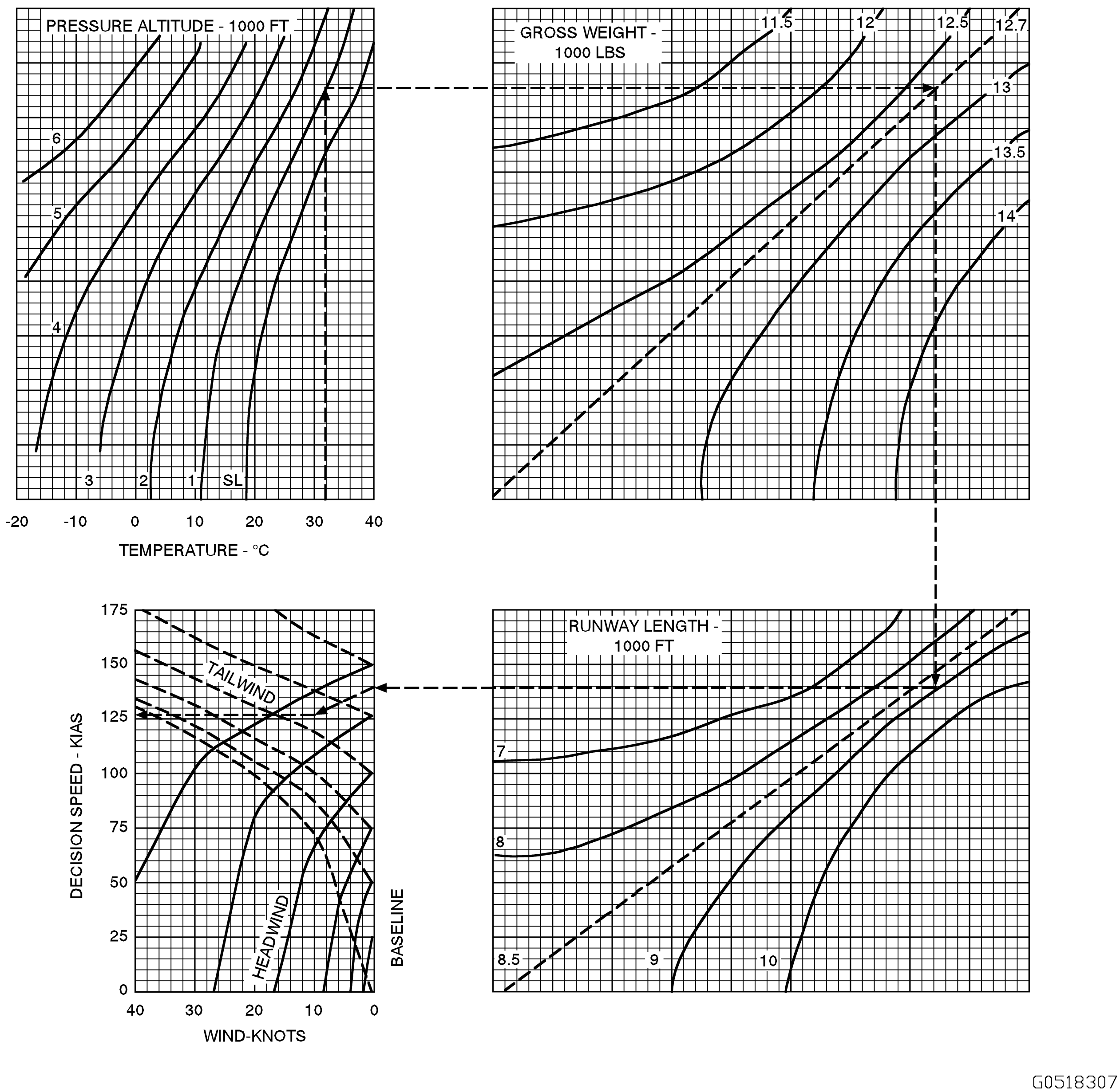

Figure A3-10. Decision Speed (DS) (Sheet 1 of 4)

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MODEL: T-38A AND C (NON-PMP)
ENGINE(S): (2) J85-GE-5
DATE: 1 DECEMBER 2005
DATA BASIS: FLIGHT TEST

MAX THRUST
FLAPS - 60%
GEAR - DOWN
RUNWAY LENGTHS BETWEEN
10,000 - 14,000 FEET

NOTES

- FOLLOWING ENGINE FAILURE, MAXIMUM AFTERBURNER IS SELECTED ON THE OPERATING ENGINE.
- ACCELERATE IN A 3-POINT ATTITUDE TO SETOS.
- ROTATE SMOOTHLY AT SETOS UNTIL TAKEOFF OCCURS.

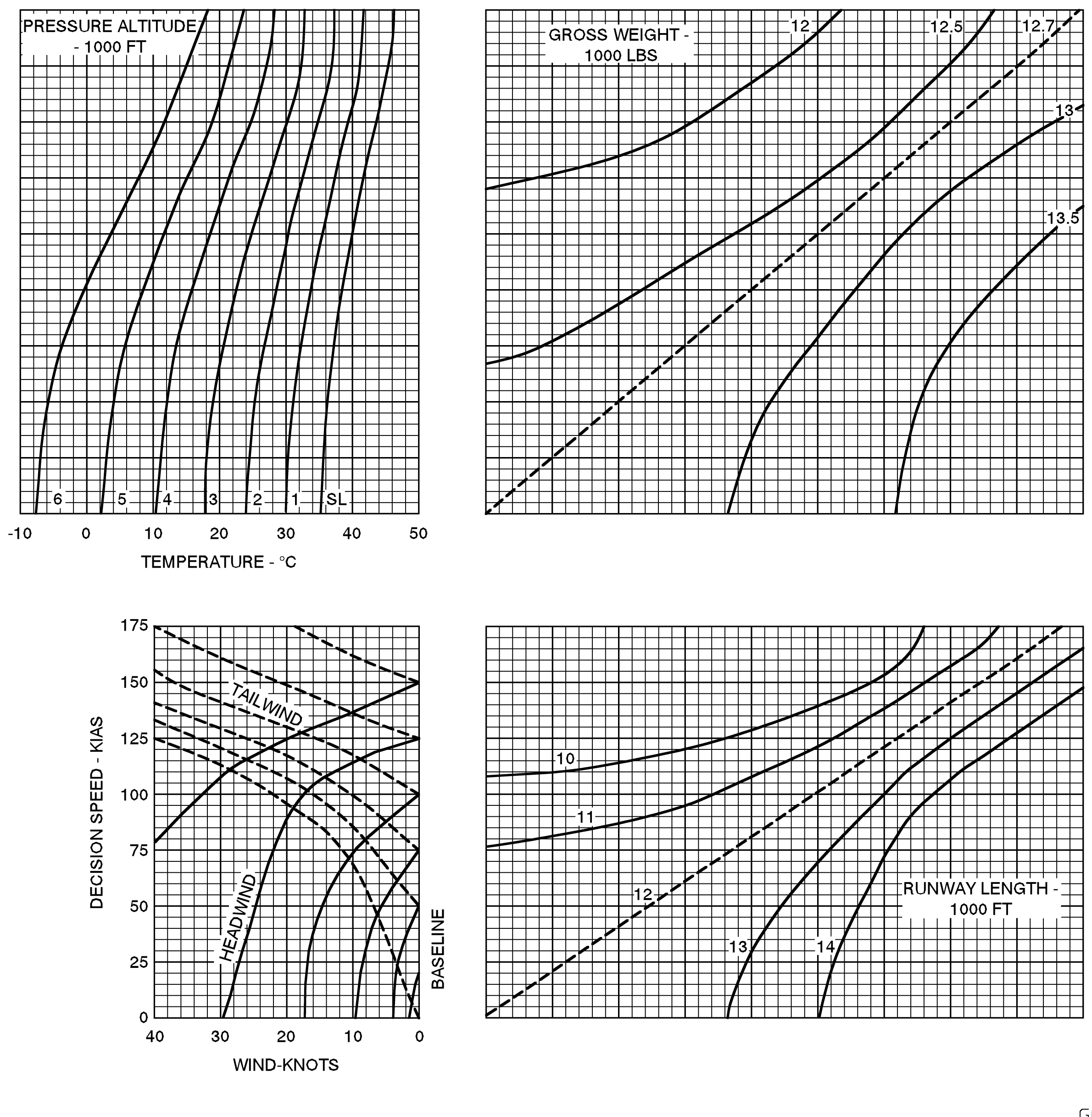

Figure A3-10. Decision Speed (DS) (Sheet 2)

MODEL: T-38A AND C (NON-PMP)
ENGINE(S): (2) J85-GE-5
DATE: 17 JULY 2006
DATA BASIS: FLIGHT TEST

MAX THRUST
FLAPS - 60%
GEAR - DOWN
RUNWAY LENGTH BETWEEN 13 - 16,000 FT

NOTES

- FOLLOWING ENGINE FAILURE, MAXIMUM AFTERBURNER SELECTED ON THE OPERATING ENGINE.
- ACCELERATE IN A 3-POINT ATTITUDE TO SETOS.
- ROTATE SMOOTHLY AT SETOS UNTIL TAKEOFF OCCURS.

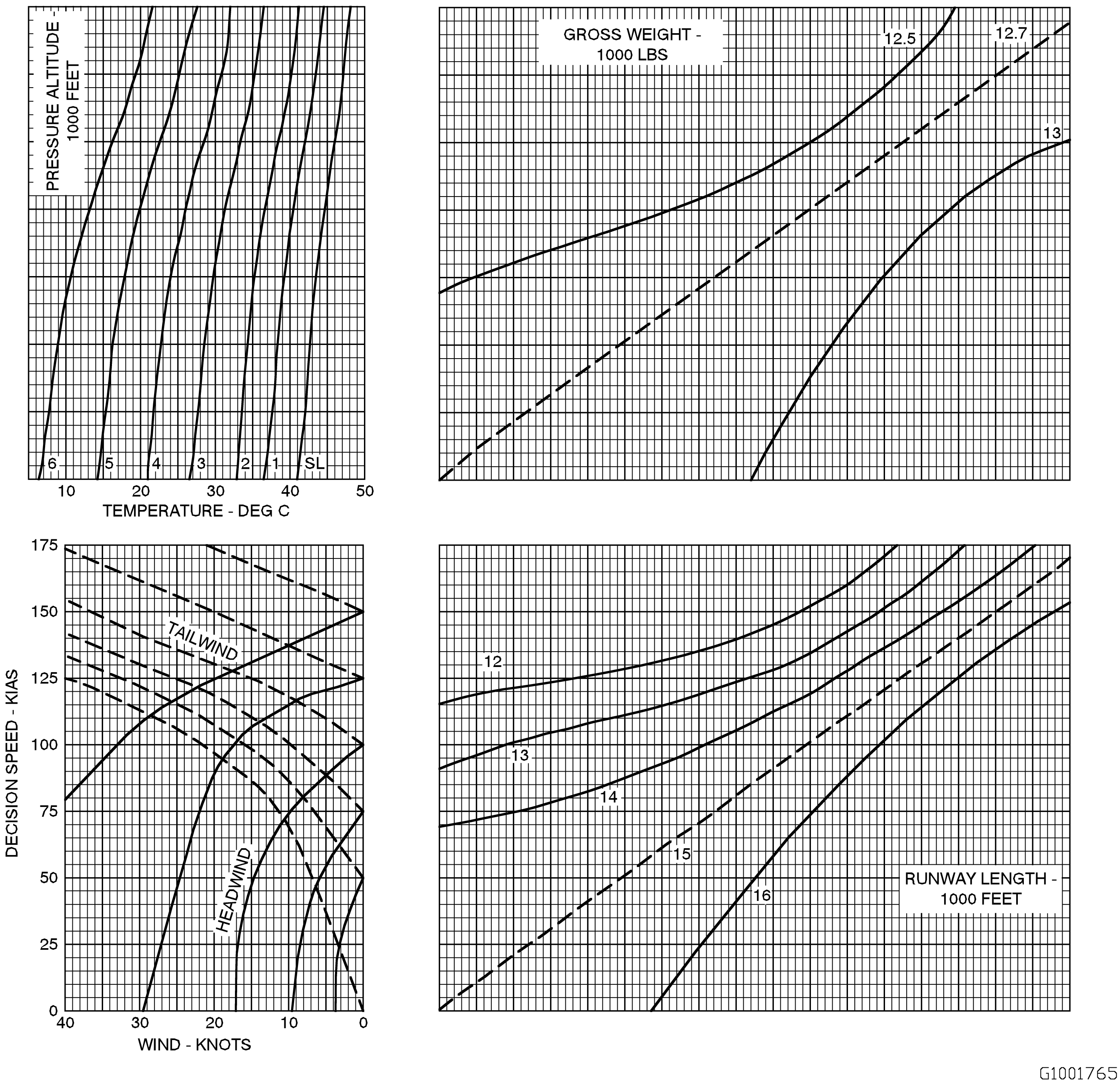

Figure A3-10. Decision Speed (DS) (Sheet 3)

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MODEL: T-38A AND C (NON-PMP)
ENGINE(S): (2) J85-GE-5
DATE: 20 JULY 2006
DATA BASIS: FLIGHT TEST

MAX THRUST
FLAPS - 60%
GEAR - DOWN
RUNWAY LENGTH BETWEEN 13 - 16,000 FT

NOTES

- FOLLOWING ENGINE FAILURE, MAXIMUM AFTERBURNER SELECTED ON THE OPERATING ENGINE.
- ACCELERATE IN A 3-POINT ATTITUDE TO SETOS.
- ROTATE SMOOTHLY AT SETOS UNTIL TAKEOFF OCCURS.

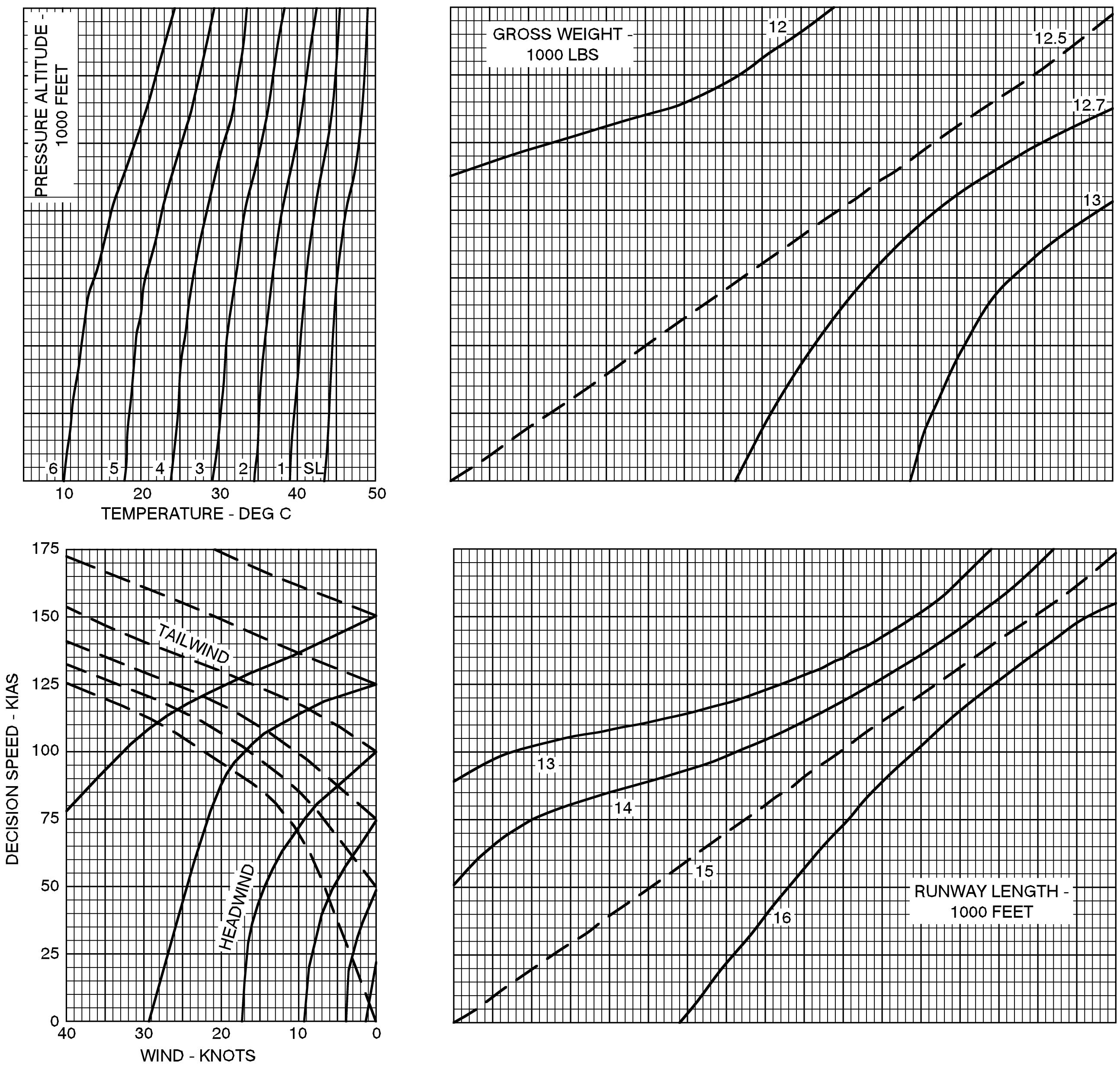

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Figure A3-10. Decision Speed (DS) (Sheet 4)

MODEL: T-38A AND C (NON-PMP)
ENGINE(S): (2) J85-GE-5
DATE: 1 DECEMBER 2005
DATA BASIS: FLIGHT TEXT

BOTH ENGINES OPERATING
MAX THRUST
FLAPS - 60%
GEAR - DOWN

NOTE

TO COMPUTE MACS, SUBTRACT 3 KNOTS FOR EACH 1000 FEET OF RUNWAY IN EXCESS OF CRITICAL FIELD LENGTH, NOT TO EXCEED 10 KNOTS

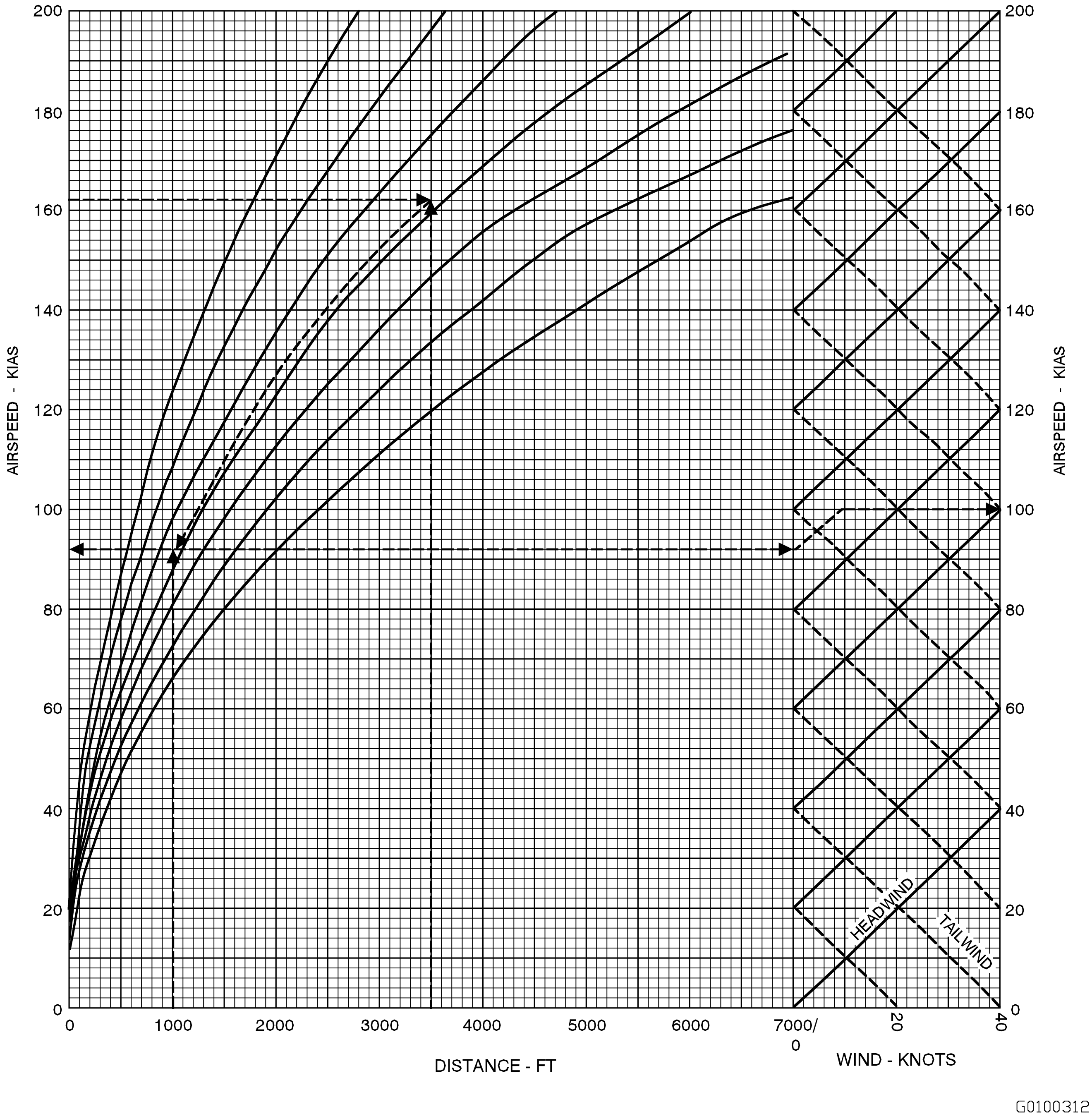

Figure A3-11. Velocity During Takeoff Ground Run (Both Engines Operating)

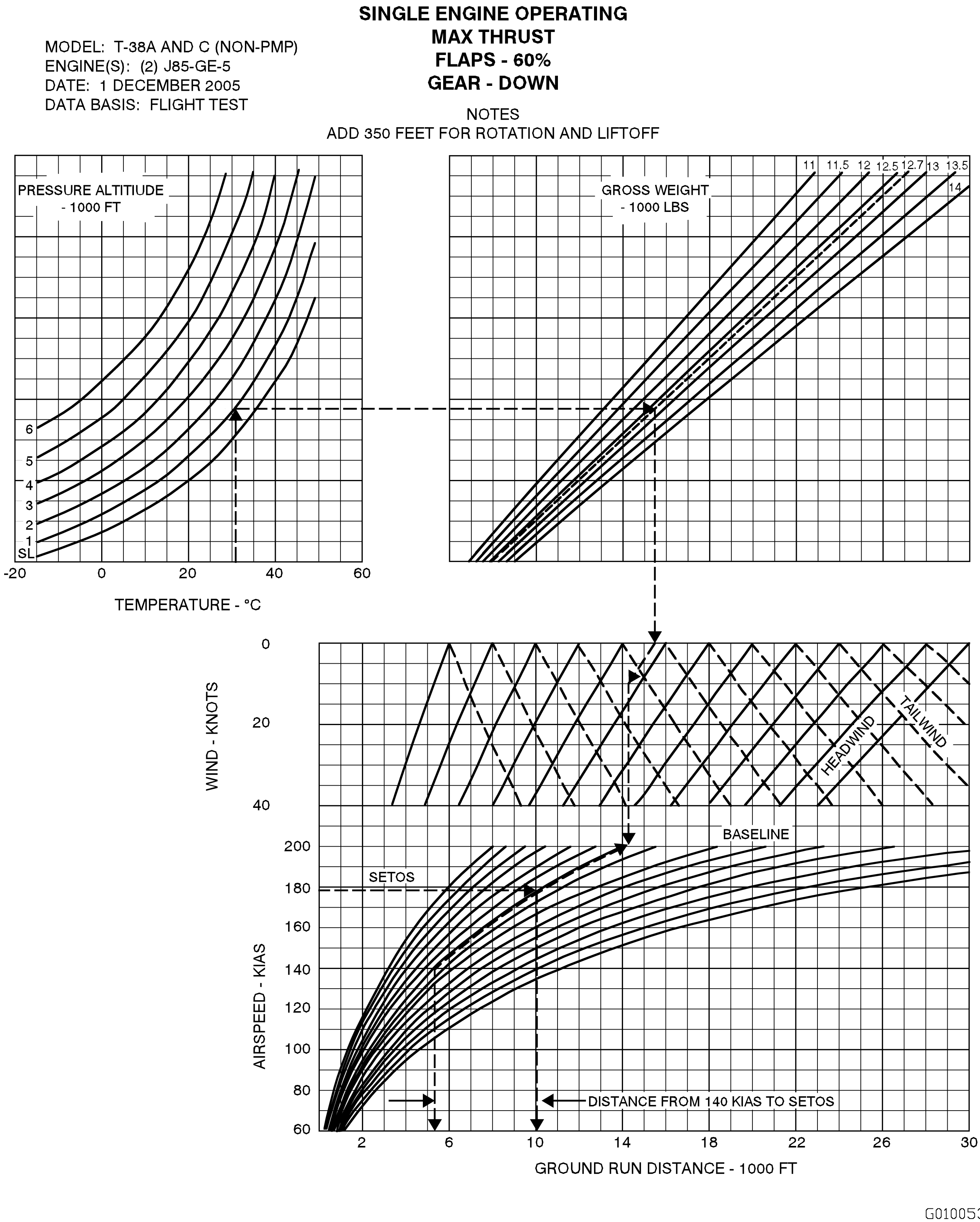

Figure A3-12. Velocity During Takeoff Ground Run (Single Engine Operating)

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PART 4
CLIMB

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

PURPOSE OF CHARTS

The charts provide a means of determining the aircraft climb performance. Included are ceilings to which the aircraft may climb in the performance of missions.

The climb charts (Figure A4-1, Figure A4-2, Figure A4-3, Figure A4-4, and Figure A4-5) show the climb performance for MIL thrust for both two engines and single-engine and MAX thrust for two engines. Two-engine MIL and MAX thrust climb charts are included for both restricted and unrestricted climb schedules. The restricted climb charts (Figure A4-1 and Figure A4-3) show performance data which reflects a MIL thrust climb at 300 KIAS to 10,000 feet followed by a level acceleration to unrestricted climb speed and continuation of climb. The restricted climb charts should be used for all climbs not performed in a military climb corridor. The unrestricted climb charts MIL and MAX THRUST CLIMB (Figure A4-2 and Figure A4-4) are used when a military climb corridor is available. All of the charts show climb performance in terms of gross weight versus fuel used, time, and distance. Climb speed schedules and allowances prior to climb are provided on each chart. The charts require successive approximations when climbing from an altitude other than sea level. The fuel, air distance, and time shown include the effects of kinetic energy change and weight reduction during climb. The fuel allowance for taxi, takeoff, and acceleration to climb speed is noted and should be subtracted from gross weight before entering the chart when climb follows a takeoff.

USE OF CLIMB CHARTS

The chase-thru lines on the MIL thrust restricted climb chart (Figure A4-1) show 565 pounds of fuel used in climb from sea level to 35,000 feet pressure altitude at an initial gross weight of 11,500 pounds and a temperature 10°C hotter than standard day. The corresponding time and air distance are 8.3 minutes and 67 nautical miles, respectively. Had the initial altitude been 15,000 feet and the gross weight 11,270 pounds, by using successive approximations, the sea level gross weight would be 11,500 pounds (same as above). From sea level to 15,000 feet, the fuel used, time, and distance are 290 pounds, 3.0 minutes, and 23 miles, respectively. Then from 15,000 to 35,000 feet, the fuel used is 275 pounds (565 - 290), 5.3 minutes (8.3 - 3.0), and the distance is 44 nautical miles (67 -23). The MIL thrust climb charts (Figure A4-2) show that 480 pounds of fuel are required in climb from sea level to 35,000 feet and, correspondingly, it takes 7.3 minutes and 62 nautical miles. This climb is started at 11,400 pounds; however, since 95 more pounds of fuel are required for acceleration to climb speed, the MIL thrust restricted climb and the MIL thrust climb from 15,000 feet to 35,000 feet are identical.

OPTIMUM CRUISE-CLIMB ALTITUDE

The optimum cruise-climb altitude chart (Figure A4-6) shows this altitude versus gross weight for two-engine and single-engine operation. Normal thrust cruise ceilings are included and show the limitations of the optimum cruise-climb altitude.

USE OF OPTIMUM CRUISE-CLIMB ALTITUDE CHART

Assume two-engine operation and a gross weight of 10,500 pounds at end of climb. The chase-thru lines show optimum cruise-climb altitude from Figure A4-6 is 41,200. The optimum cruise-climb altitude will increase as the fuel is used in cruise. This altitude is not limited by the normal thrust cruise ceiling.

SINGLE-ENGINE SERVICE CEILING

The single-engine service ceiling chart (Figure A4-7) shows the service ceiling that can be attained by flying with MAX or MIL thrust at the climb schedules shown.

USE OF SINGLE-ENGINE SERVICE CEILING CHART

The chase-thru lines in Figure A4-7 show a single-engine service ceiling of 24,500 feet for MIL thrust and a gross weight of 10,500 pounds.

CLIMB SPEEDS FOR 200 FT/NMI SINGLE-ENGINE CLIMB GRADIENT

The climb speed and distance chart (Figure A4-8) meets a Federal Aviation Administration requirement to show the ability of a dual-engine aircraft to meet a 200 Ft/NMi minimum climb gradient on a single engine. The chart shows the climb speed necessary to achieve a 200 Ft/NMi climb gradient and the distance required to accelerate to that climb speed from brake release.

NOTE

Windmilling drag exceeds seized engine drag at these climb speeds.

Calculations are based on the worst-case scenario of a windmilling left engine with the landing gear extended. The chart assumes that a normal takeoff is attempted with both engines at maximum thrust when an engine failure occurs at the critical engine failure speed. The aircraft rotates at single-engine takeoff speed and climbs out of ground effect before it levels off and continues to accelerate, with 60% flaps and the landing gear down, to the climb speed that allows it to achieve a 200 Ft/NMi climb gradient. The gray areas on the chart represent the conditions where it is not possible to achieve a 200 Ft/NMi rate of climb in this configuration.

The assumption of the gear remaining down was made due to the extended time necessary to retract the gear with the left engine windmilling. If the right engine were windmilling instead of the left, maintaining normal hydraulic pressure, the gear could be retracted without a noticeable increase in retraction time. With the landing gear retracted, all else being equal, the aircraft exceeds a 200 Ft/NMi climb gradient on a single engine at any speed above SETOS.

USE OF CLIMB SPEEDS FOR 200 FT/NMI SINGLE-ENGINE CLIMB GRADIENT CHART

Conditions: 15°C (59°F) at 2000 feet pressure altitude with a 12,500-pound aircraft.

Enter the chart in the column of the applicable takeoff gross weight (12,500 pounds). Proceed down to the section of the given temperature (15°C or 59°F). Then find the row for the appropriate pressure altitude (2000 feet) and read the values for climb speed (V_C) and distance.

Climb Speed: 183 KIAS

Distance: 2.9 NMi

Note the gray areas on the chart represent the conditions where it is not possible to achieve a 200 Ft/NMi climb gradient in this configuration.

SINGLE-ENGINE CLIMB GRADIENT

The Single-Engine Climb Gradient and Distance to 190 KIAS chart (Figure A4-8) is used to determine the single-engine climb gradient attainable at the best climb angle speed of 190 KIAS and the distance required to accelerate to this speed from brake release.

NOTE

Windmilling drag exceeds seized engine drag at these climb speeds.

Calculations are based on the worst-case scenario of a windmilling left engine with the landing gear extended. The chart assumes that a normal takeoff is attempted with both engines at maximum thrust when an engine failure occurs at the critical engine failure speed. The aircraft rotates at single-engine takeoff speed and climbs out of ground effect before it levels off and continues to accelerate, with 60% flaps and the landing gear down, to the climb speed of 190 KIAS. The gray areas on the chart represent the conditions where either the climb capability at 190 KIAS is inadequate or takeoff is not possible.

The assumption of the gear remaining down was made due to the extended time necessary to retract the gear with the left engine windmilling. The best climb angle speed of 190 KIAS is based on the gear being extended and the flaps set at 60%.

USE OF SINGLE-ENGINE CLIMB GRADIENT CHART

Conditions: 15°C (59°F) at 2000 feet pressure altitude with a 12,500-pound aircraft.

Enter the chart in the column of the applicable takeoff gross weight (12,500 pounds). Proceed down to the section of the given temperature (15°C or 59°F). Then find the row for the appropriate pressure altitude (2000 feet) and read the values for climb gradient and distance.

Climb Gradient: 260 Ft/NMi

Distance: 3.5 NMi

Note the gray areas on the chart represent the conditions where either the climb capability at 190 KIAS is inadequate or takeoff is not possible.

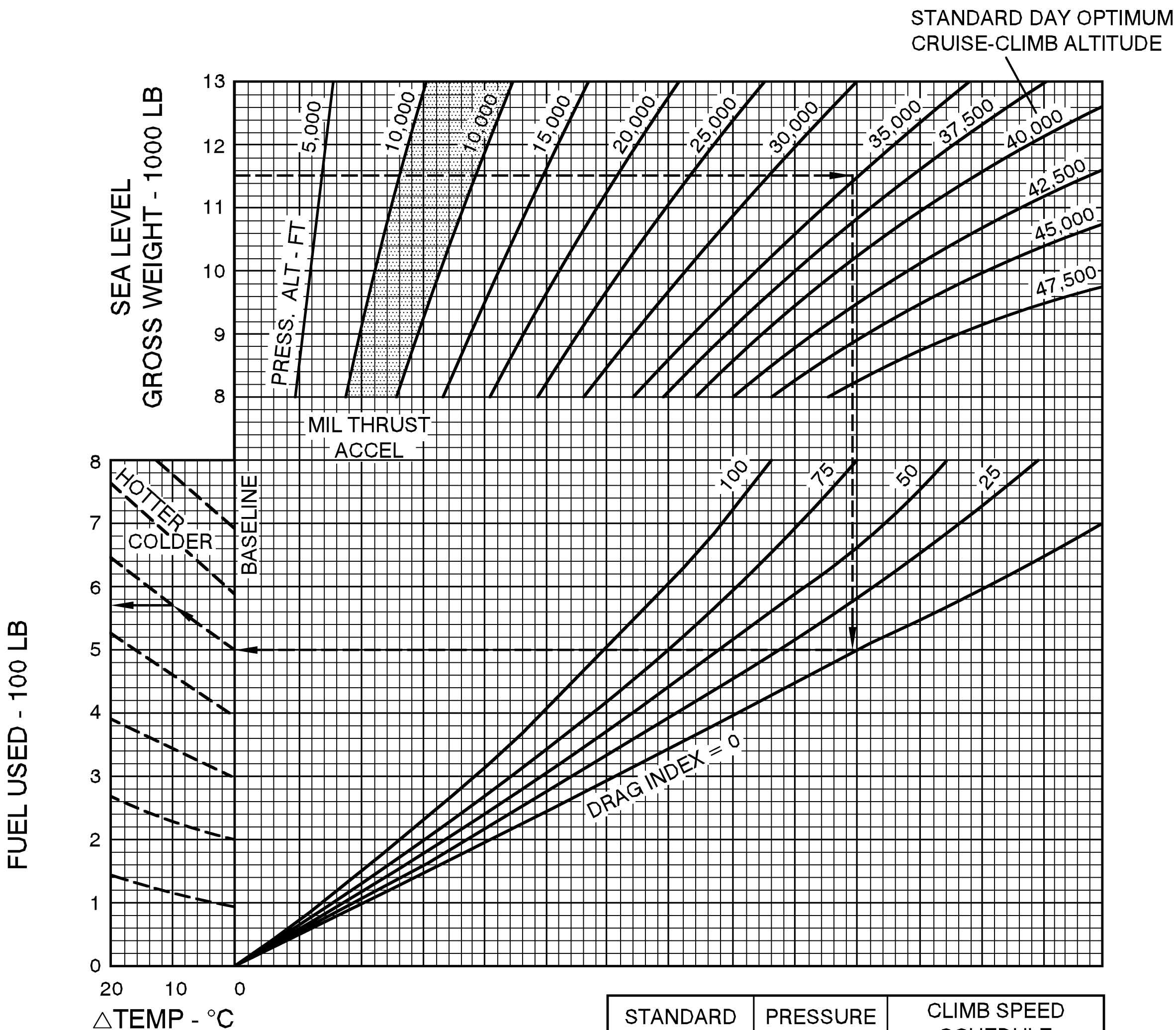
MIL THRUST CLIMB

RESTRICTED CLIMB SCHEDULE

FUEL USED

MODEL: T-38A
DATE: 1 OCTOBER 1976
DATA BASIS: ESTIMATED DATA

ENGINE: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL



STANDARD DAY TEMP - °C	PRESSURE ALTITUDE (FEET)	CLIMB SPEED SCHEDULE KCAS	TMN
15.0	SL	300	0.45
5.1	5,000	300	0.50
-4.8	10,000	300	0.55
-4.8	10,000	435	0.78
-14.7	15,000	406	0.79
-24.6	20,000	377	0.81
-34.5	25,000	349	0.83
-44.4	30,000	322	0.84
-54.3	35,000	295	0.86
-56.5 AT 37,000 FT & ABOVE	40,000	264	0.87
	45,000	236	0.87
	50,000	210	0.87

FUEL, TIME, AND DISTANCE ALLOWANCE PRIOR TO CLIMB	
GROUND TAXI: 18 LB/MIN	
FROM BRAKE RELEASE TO BEGIN CLIMB USING MAXIMUM THRUST	
FUEL (LB)	190
TIME (MN)	0.6
DISTANCE (NMI)	2.0

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Figure A4-1. MIL Thrust Climb (Restricted Climb Schedule) Fuel Used (Sheet 1 of 2)

GRD TO HYD ELE FUE OXY ENG FLT MISC LND

I II III IV V VI VII A G IN

MIL THRUST CLIMB

RESTRICTED CLIMB SCHEDULE

MODEL: T-38A
DATE: 1 OCTOBER 1976
DATA BASIS: ESTIMATED DATA

TIME TO CLIMB AND DISTANCE TRAVELED

ENGINES: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

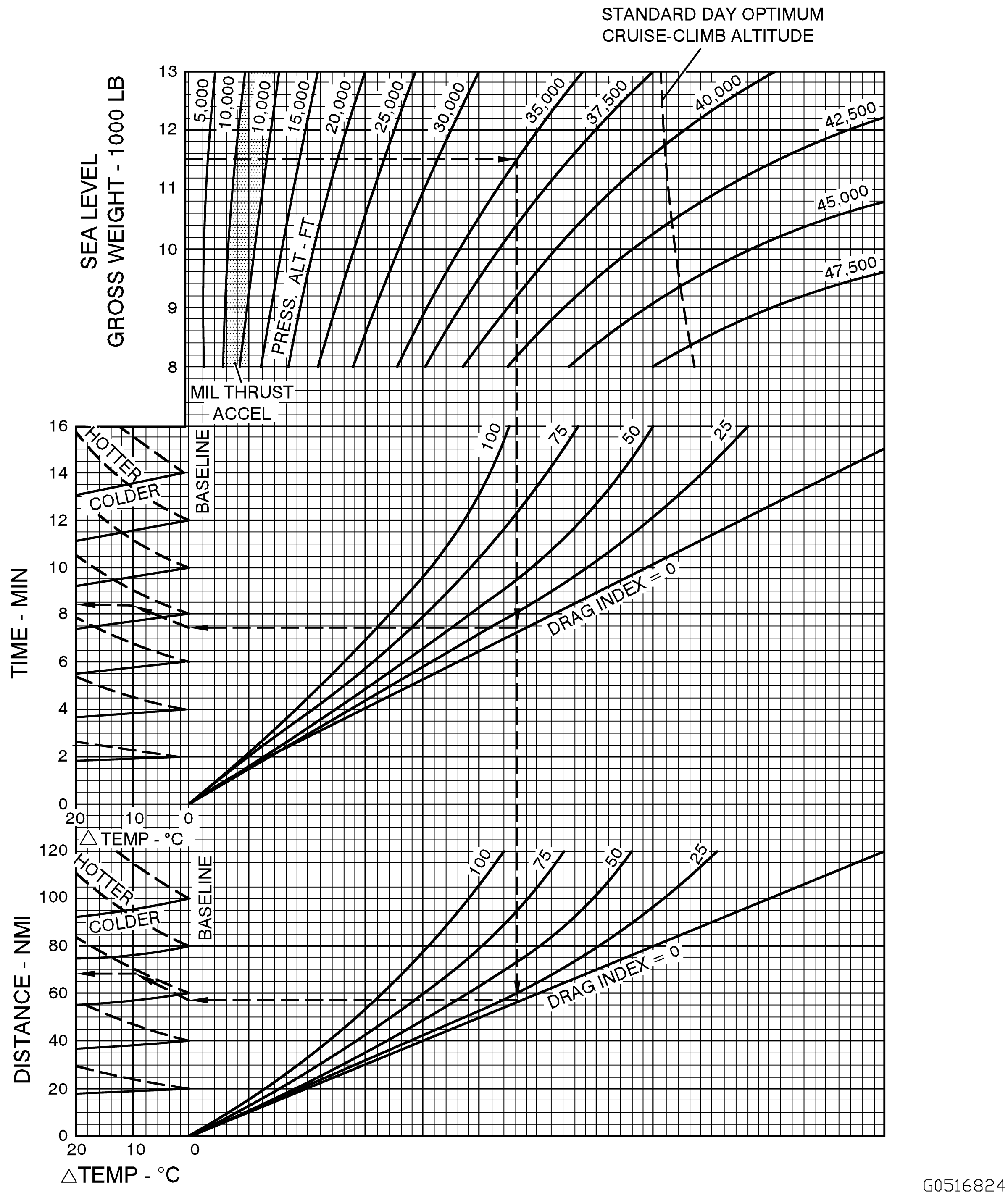


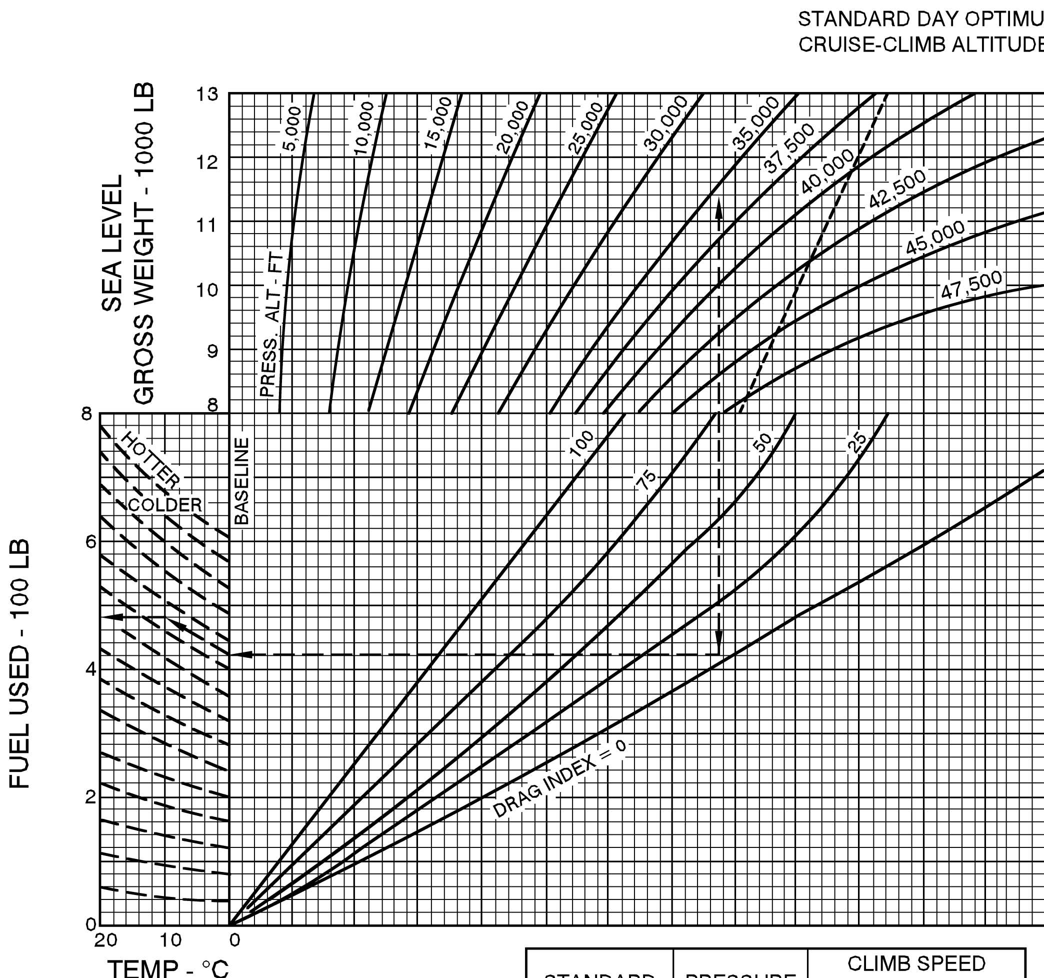
Figure A4-1. MIL Thrust Climb (Restricted Climb Schedule) Fuel Used (Sheet 2)

MIL THRUST CLIMB

FUEL USED

MODEL: T-38A
DATE: 1 OCTOBER 1976
DATA BASIS: ESTIMATED DATA

ENGINE: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL



STANDARD DAY TEMP - °C	PRESSURE ALTITUDE (FEET)	CLIMB SPEED SCHEDULE KCAS	TRUE MACH NO.
15.0	SEA LEVEL	496	0.75
5.1	5,000	466	0.76
-4.8	10,000	435	0.78
-14.7	15,000	406	0.79
-24.6	20,000	377	0.81
-34.5	25,000	349	0.83
-44.4	30,000	322	0.84
-54.3	35,000	295	0.86
-56.5 AT	40,000	264	0.87
37,000 FT	45,000	236	0.87
& ABOVE	50,000	210	0.87

FUEL, TIME, AND DISTANCE ALLOWANCE PRIOR TO CLIMB	
GROUND TAXI: 18 LB/MIN	
FROM BRAKE RELEASE TO BEGIN CLIMB USING MAXIMUM THRUST	
FUEL (LB)	285
TIME (MIN)	1.0
DISTANCE (NMI)	4.0

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Figure A4-2. MIL Thrust Climb (Sheet 1 of 2)

GRD
TO
HYD
ELE
FUE
OXY
ENG
FLT
MISC
LND

I
II
III
IV
V
VI
VII
A
G
IN

MIL THRUST CLIMB

TIME TO CLIMB AND DISTANCE TRAVELED

MODEL: T-38A
DATE: 1 OCTOBER 1976
DATA BASIS: ESTIMATED DATA

ENGINE: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

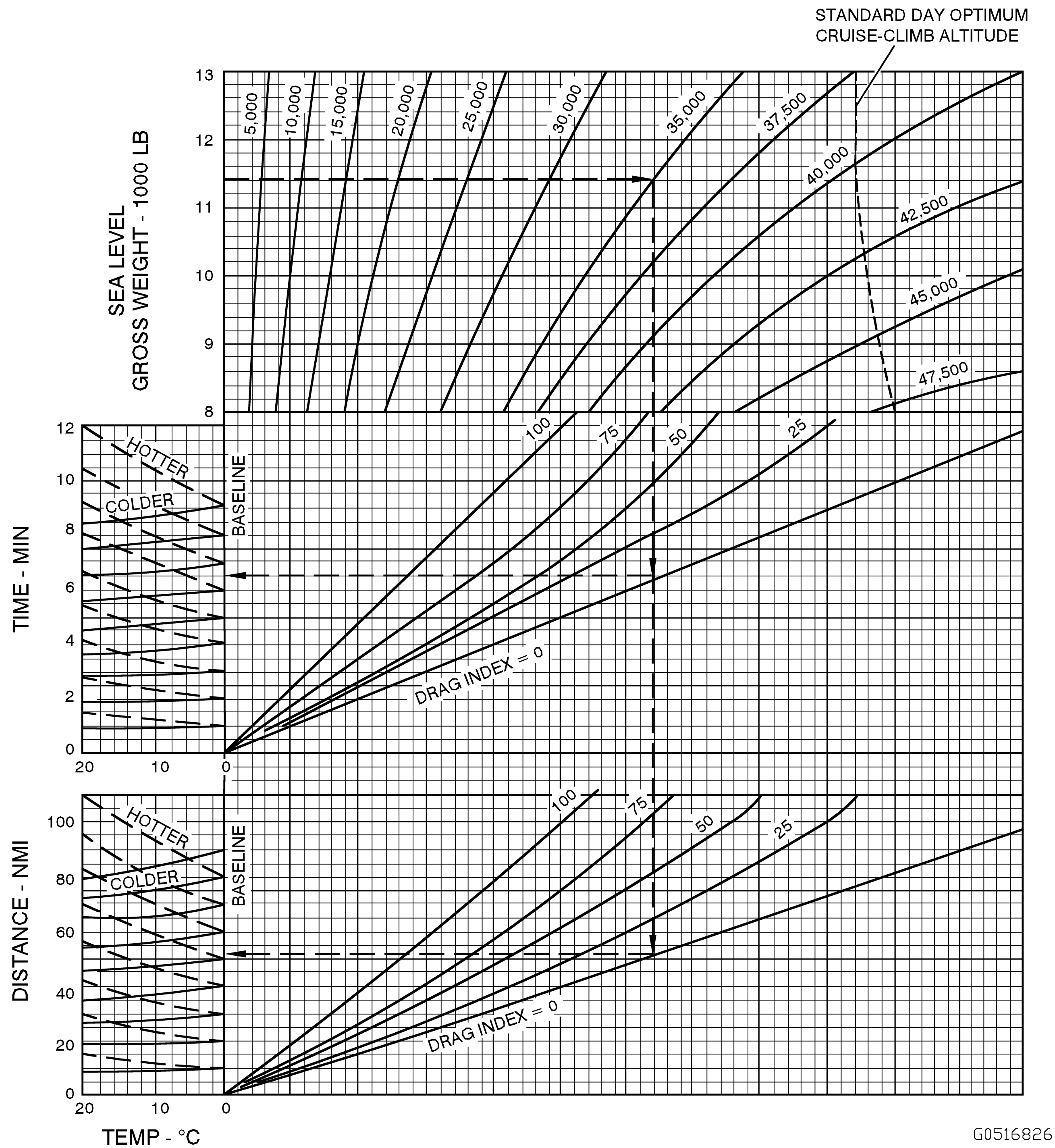


Figure A4-2. MIL Thrust Climb (Sheet 2)

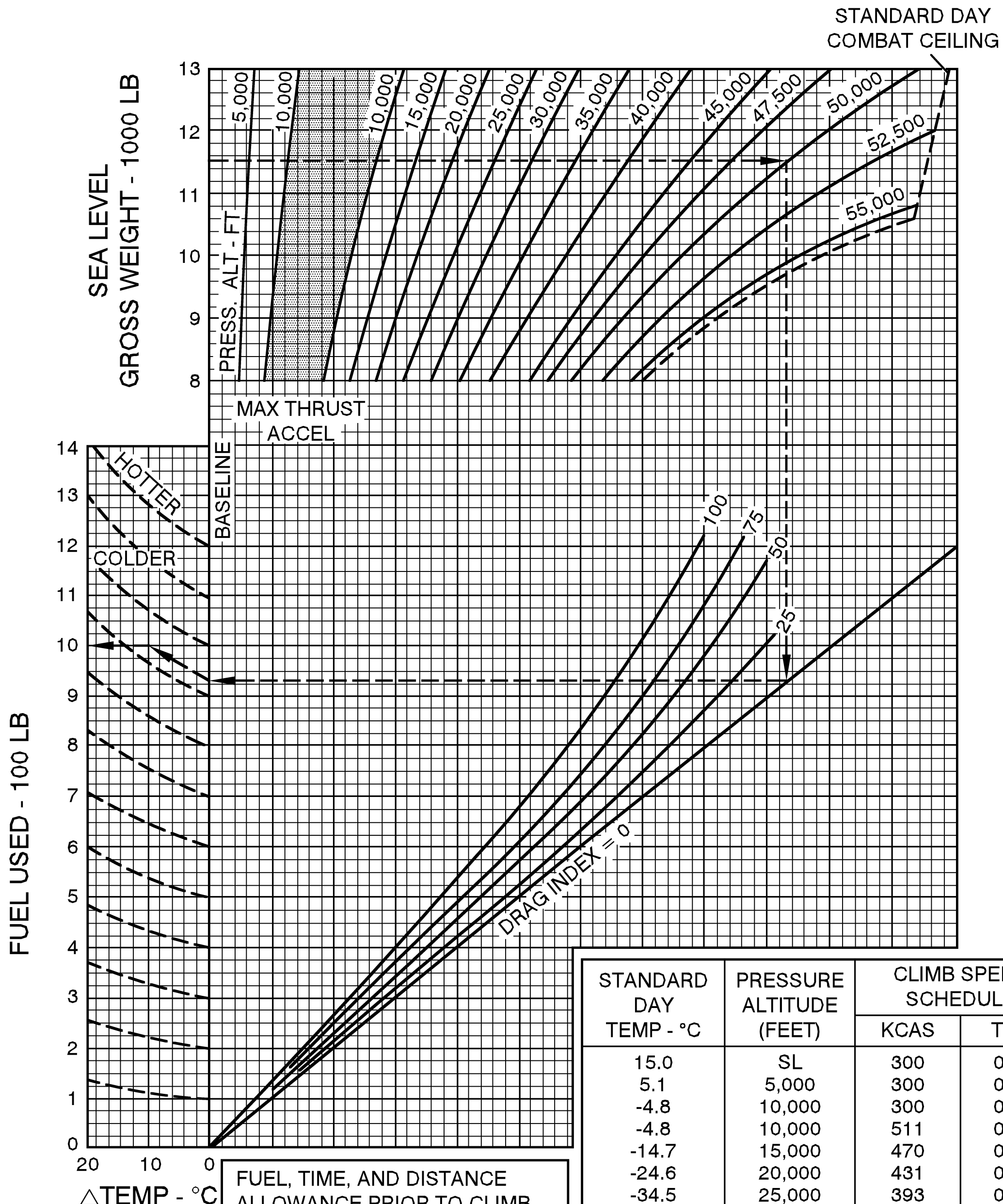
MAX THRUST CLIMB

MODEL: T-38A
DATE: 1 OCTOBER 1976
DATA BASIS: ESTIMATED DATA

RESTRICTED CLIMB SCHEDULE

FUEL USED

ENGINES: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL



STANDARD DAY TEMP - °C	PRESSURE ALTITUDE (FEET)	CLIMB SPEED SCHEDULE	
		KCAS	TMN
15.0	SL	300	0.45
5.1	5,000	300	0.50
-4.8	10,000	300	0.55
-4.8	10,000	511	0.91
-14.7	15,000	470	0.91
-24.6	20,000	431	0.92
-34.5	25,000	393	0.92
-44.4	30,000	357	0.93
-54.3	35,000	322	0.93
-56.5 AT 37,000 FT & ABOVE	40,000	287	0.93
	45,000	256	0.93
	50,000	228	0.93
	55,000	203	0.93

FUEL, TIME, AND DISTANCE ALLOWANCE PRIOR TO CLIMB	
GROUND TAXI: 18 LB/MIN	
FROM BRAKE RELEASE TO BEGIN CLIMB USING MAXIMUM THRUST	
FUEL (LB)	190
TIME (MN)	0.6
DISTANCE (NMI)	2.0

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Figure A4-3. Max Thrust Climb (Restricted Climb Schedule) Fuel Used (Sheet 1 of 2)

MAX THRUST CLIMB

RESTRICTED CLIMB SCHEDULE

TIME TO CLIMB AND DISTANCE TRAVELED

MODEL: T-38A
DATE: 1 OCTOBER 1976
DATA BASIS: ESTIMATED DATA

ENGINES: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

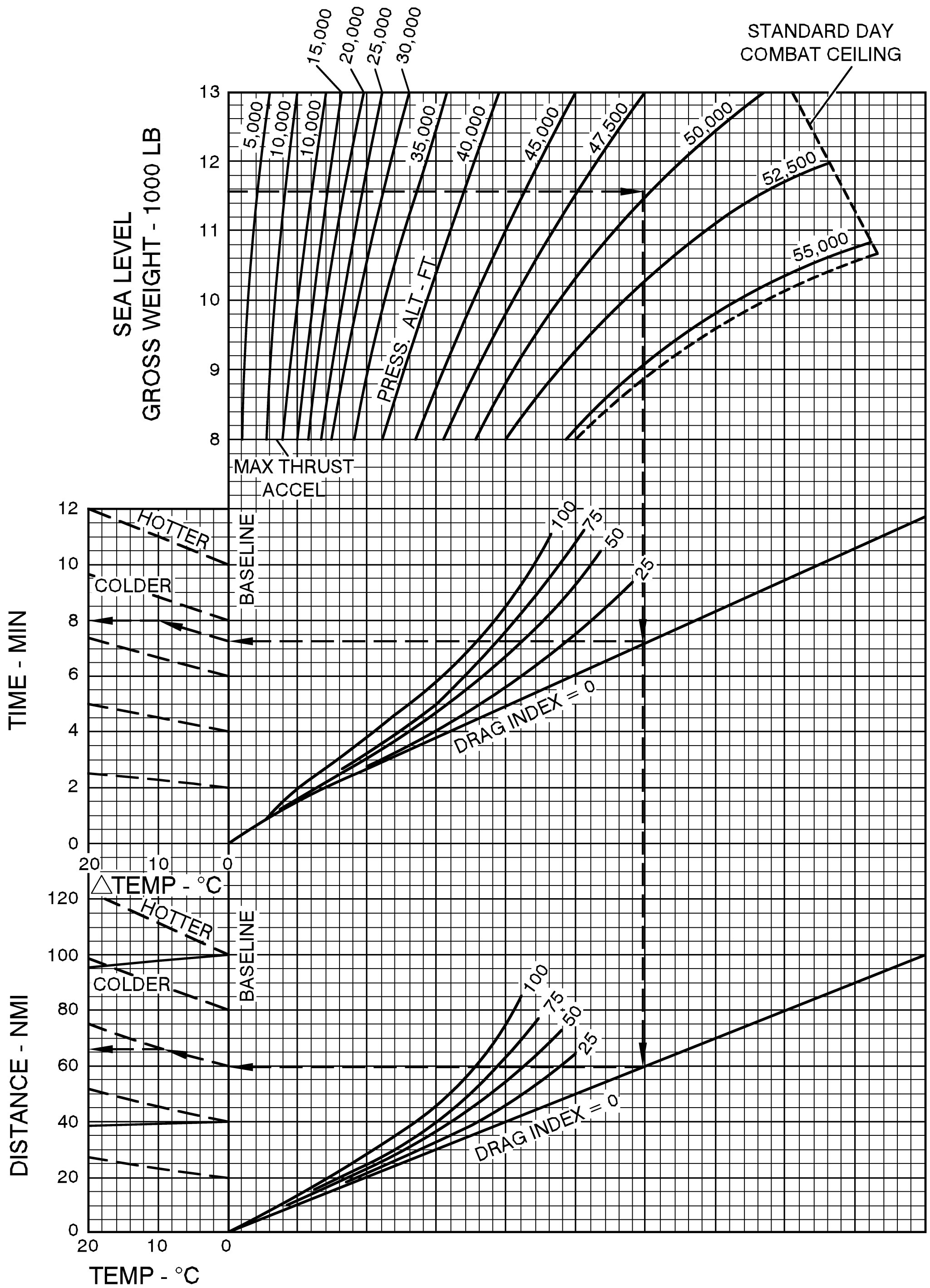


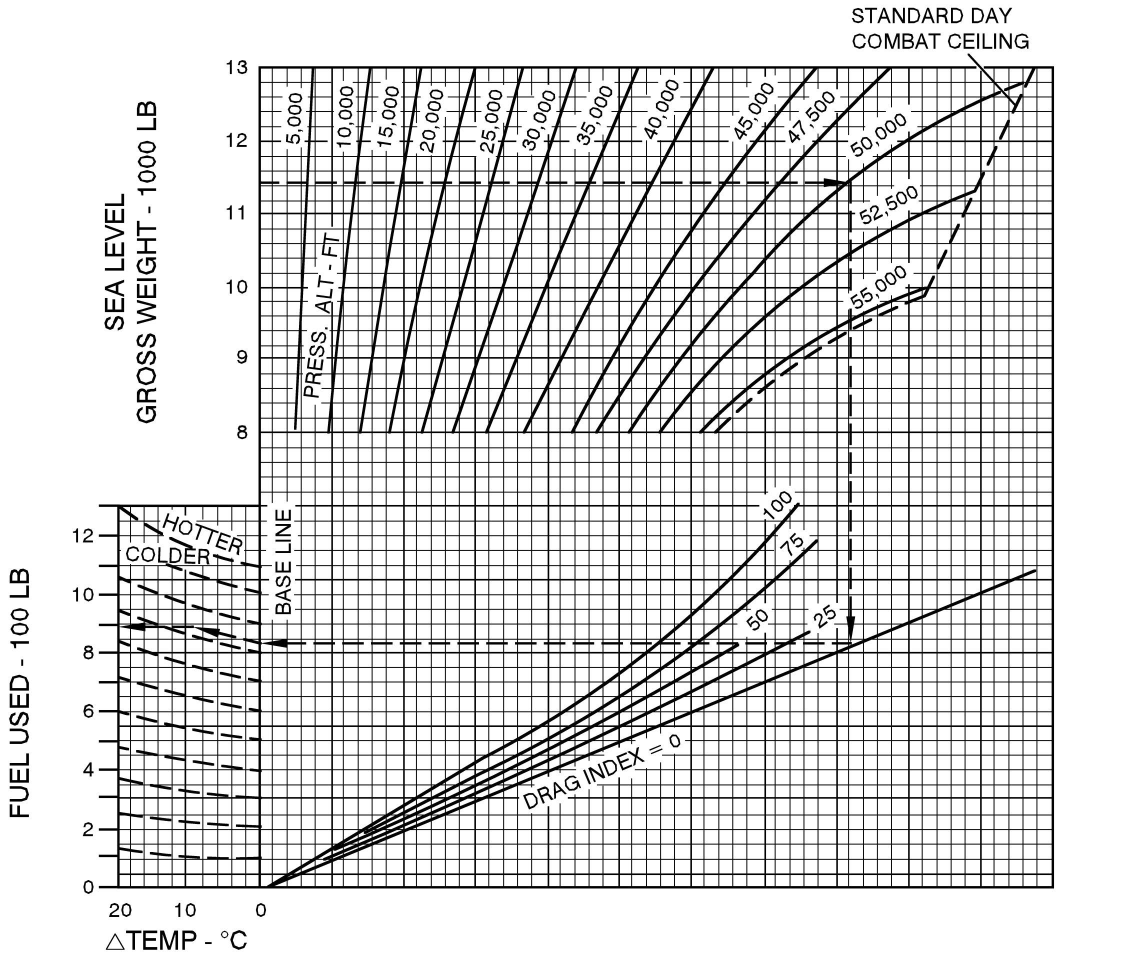
Figure A4-3. Max Thrust Climb (Restricted Climb Schedule) Fuel Used (Sheet 2)

MAX THRUST CLIMB

FUEL USED

MODEL: T-38A
DATE: 1 OCTOBER 1976
DATA BASIS: ESTIMATED DATA

ENGINE: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL



FUEL, TIME, AND DISTANCE ALLOWANCE PRIOR TO CLIMB	
GROUND TAXI: 18 LB/MIN	
FROM BRAKE RELEASE TO BEGIN CLIMB USING MAXIMUM THRUST	
FUEL (LB)	315
TIME (MIN)	1.2
DISTANCE (NMI)	6.0

STANDARD DAY TEMP - °C	PRESSURE ALTITUDE (FEET)	CLIMB SPEED SCHEDULE	
		KCAS	TRUE MACH NO.
15.0	SEA LEVEL	596	0.90
5.1	5,000	553	0.90
-4.8	10,000	511	0.91
-14.7	15,000	470	0.91
-24.6	20,000	431	0.92
-34.5	25,000	393	0.92
-44.4	30,000	357	0.93
-54.3	35,000	322	0.93
-56.5 AT	40,000	287	0.93
37,000 FT	45,000	256	0.93
AND ABOVE	50,000	228	0.93
	55,000	203	0.93

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Figure A4-4. Max Thrust Climb (Sheet 1 of 2)

GRD
TO
HYD
ELE
FUE
OXY
ENG
FLT
MISC
LND

I
II
III
IV
V
VI
VII
A
G
IN

MAX THRUST CLIMB

TIME TO CLIMB AND DISTANCE TRAVELED

MODEL: T-38A
DATE: 1 OCTOBER 1976
DATA BASIS: ESTIMATED DATA

ENGINE: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

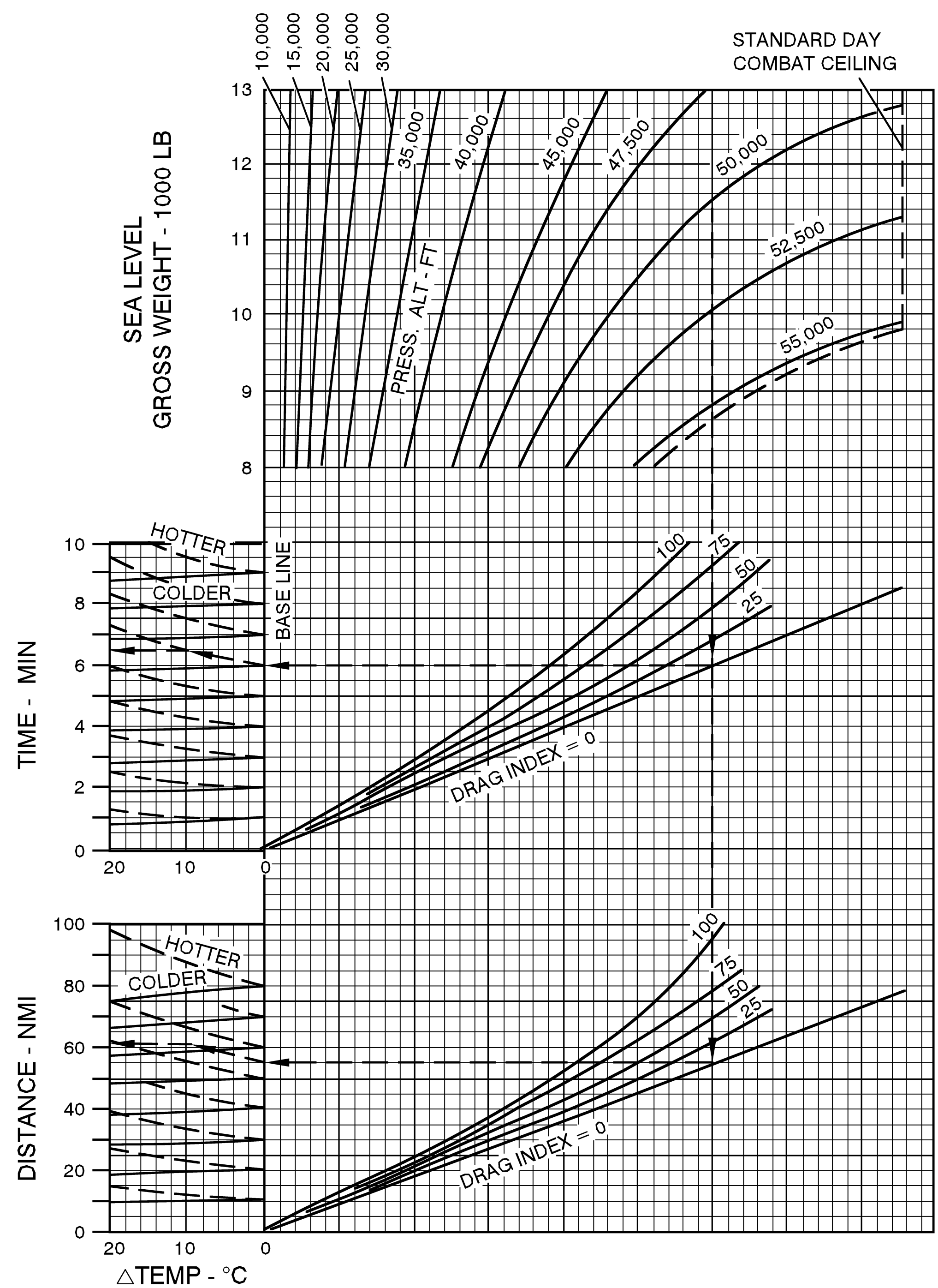

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Figure A4-4. Max Thrust Climb (Sheet 2)

GRD TO HYD ELE FUE OXY ENG FLT MISC LND
I II III IV V VI VII A G IN

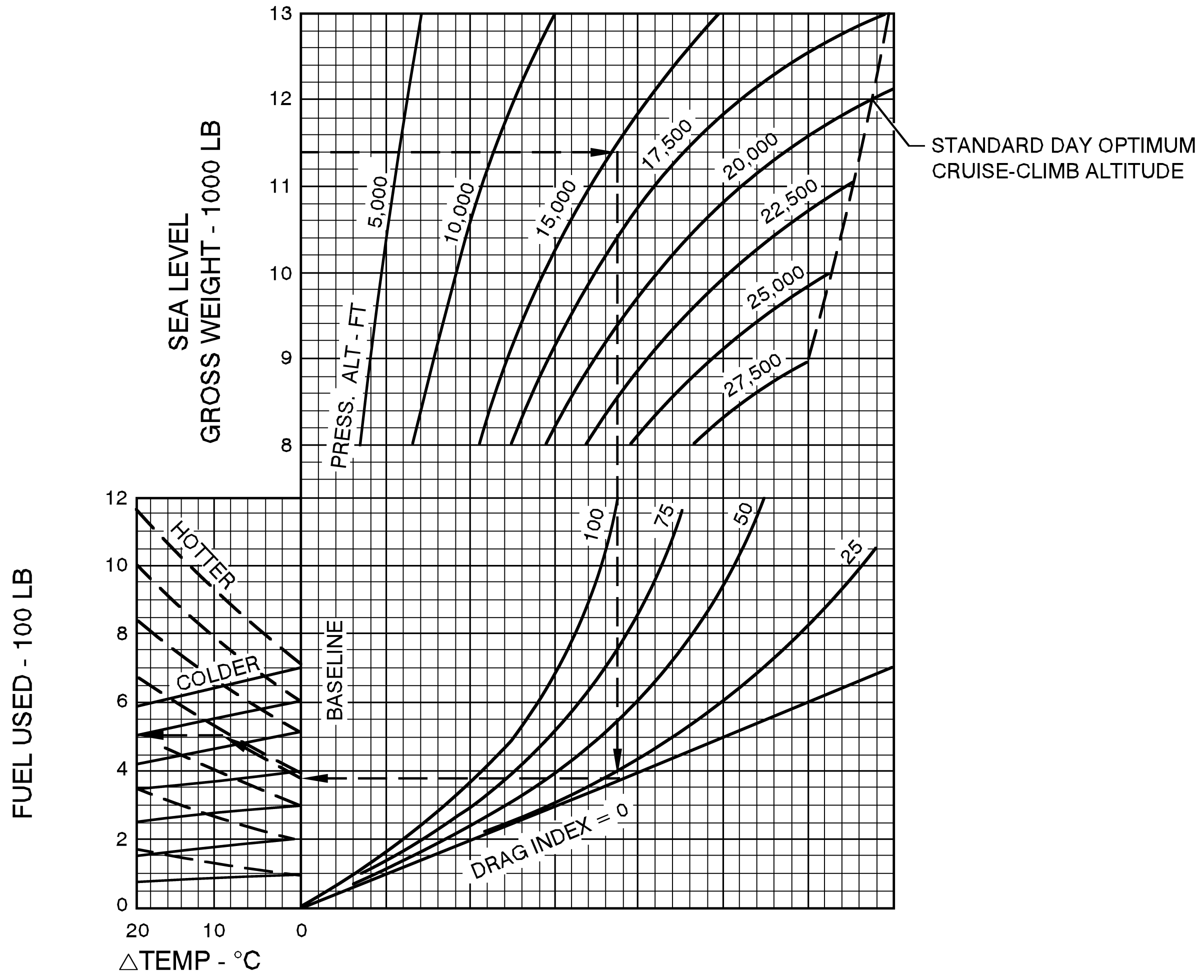
MIL THRUST CLIMB

FUEL USED

MODEL: T-38A
DATE: 1 OCTOBER 1976
DATA BASIS: ESTIMATED DATA

SINGLE ENGINE

ENGINE: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL



STANDARD DAY TEMP - °C	PRESSURE ALTITUDE (FEET)	CLIMB SPEED SCHEDULE	
		KCAS	TRUE MACH NO.
15.0	SL	281	0.43
5.1	5,000	278	0.46
-4.8	10,000	271	0.49
-14.7	15,000	264	0.52
-24.6	20,000	256	0.56
-34.5	25,000	246	0.59
-44.4	30,000	227	0.61

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Figure A4-5. MIL Thrust Climb (Single Engine) Fuel Used (Sheet 1 of 2)

MIL THRUST CLIMB

TIME TO CLIMB AND DISTANCE TRAVELED

SINGLE ENGINE

MODEL: T-38A
DATE: 1 OCTOBER 1978
DATA BASIS: ESTIMATED DATA

ENGINE: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

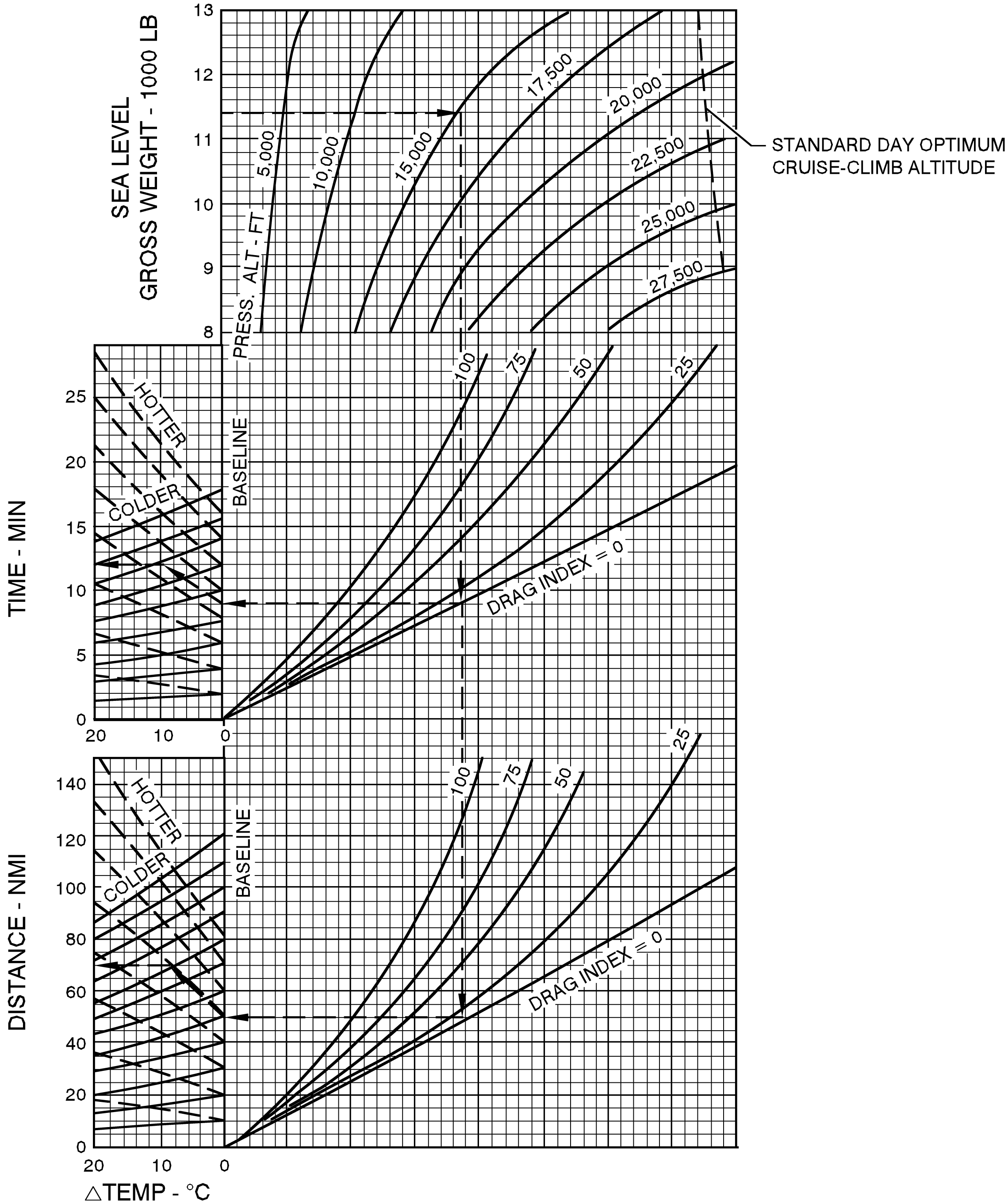


Figure A4-5. MIL Thrust Climb (Single Engine) Fuel Used (Sheet 2)

OPTIMUM CRUISE-CLIMB ALTITUDE

DRAG INDEX = 0

MODEL: T-38A
DATE: 1 AUGUST 1965
DATA BASIS: FLIGHT TEST

ENGINE: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

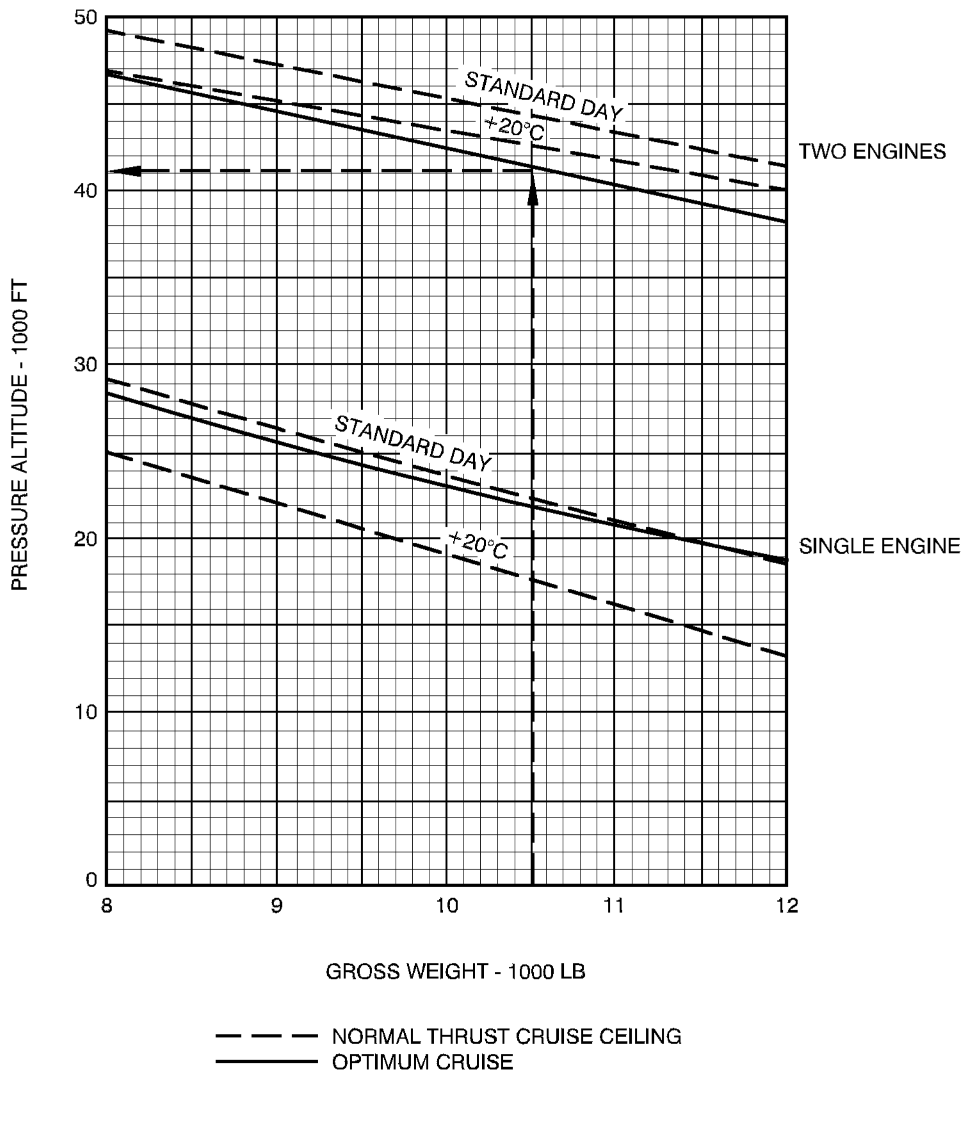


Figure A4-6. Optimum Cruise-Climb Altitude

GRD TO HYD ELE FUE OXY ENG FLT MISC LND

I II III IV V VI VII A G IN

SINGLE ENGINE SERVICE CEILING

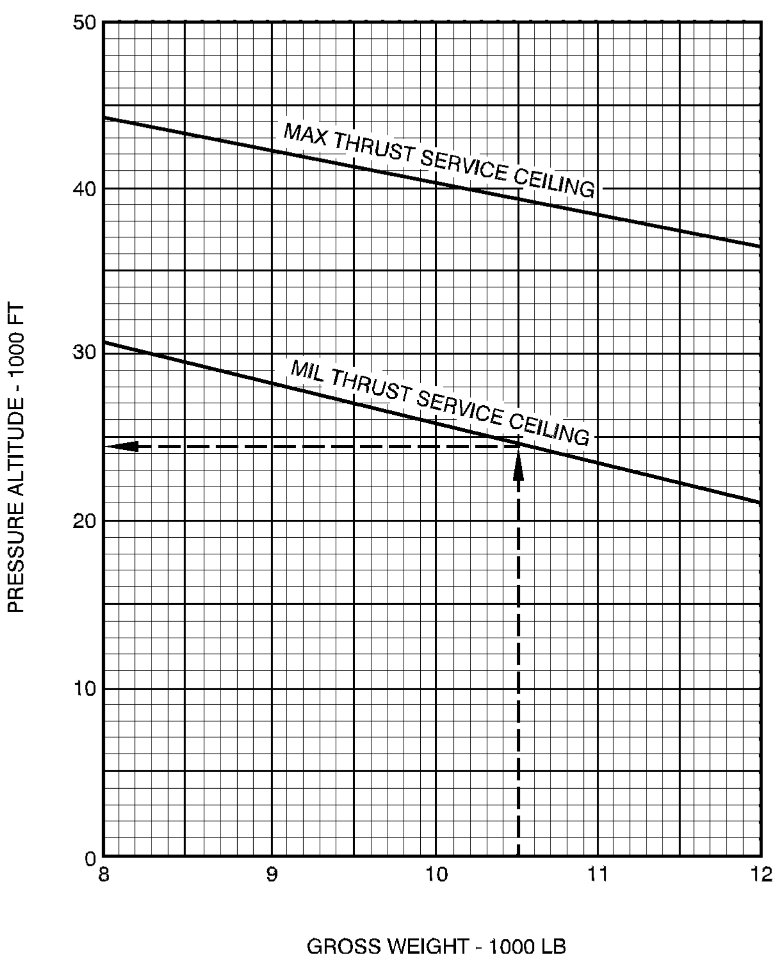
STANDARD DAY
DRAG INDEX = 0

MODEL: T-38A
DATE: 1 AUGUST 1965
DATA BASIS: FLIGHT TEST

ENGINE: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

Note

FOR EACH 10°C RISE IN AIR TEMPERATURE ABOVE STANDARD DAY CONDITIONS, DECREASE SERVICE CEILING 2600 FEET.



ALT 1000 FT	CLIMB SCHEDULE			
	MIL THRUST		MAX THRUST	
	KCAS	MACH NO.	KCAS	MACH NO.
45	——	——	216	0.80
40	——	——	242	0.80
35	——	——	270	0.80
30	277	0.61	295	0.78
25	246	0.59	313	0.75
20	256	0.56	331	0.72
15	264	0.52	349	0.69
10	272	0.49	365	0.65
5	278	0.46	377	0.62
SL	281	0.43	394	0.60

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Figure A4-7. Single Engine Service Ceiling

GRD TO HYD ELE FUE OXY ENG FLT MISC LND

I II III IV V VI VII A G IN

CLIMB SPEED (KIAS) AND DISTANCE (NMI) FROM BRAKE RELEASE TO CLIMB SPEED

FOR 200 FT/NMI CLIMB WITH
LEFT ENGINE FAILURE AT CRITICAL ENGINE FAILURE SPEED
SINGLE ENGINE
MAX THRUST
LEFT ENGINE WINDMILLING
FLAPS = 60%
GEAR - DOWN

MODEL: T-38A
DATE: 25 APRIL 2000
DATA BASIS: ESTIMATED DATA

ENGINES: (2) J85-GE-5
FUEL GRADE: JP-8
FUEL DENSITY: 6.8 LB/US GAL

			TAKEOFF GROSS WEIGHT (LB) 11000		12000		12500		13000		13500	
TEMP °C	°F	PA FT	V_C KIAS	DIST NMI	V_C KIAS	DIST NMI	V_C KIAS	DIST NMI	V_C KIAS	DIST NMI	V_C KIAS	DIST NMI
-10	14	0	151	1.0	164	1.6	170	2.0	177	2.1	184	2.4
-10	14	1000	152	1.1	166	2.0	173	2.1	179	2.3	188	2.6
-10	14	2000	154	1.3	169	2.1	175	2.3	184	2.6	191	2.9
-10	14	3000	156	1.6	171	2.2	179	2.5	187	2.9	197	3.5
-10	14	4000	159	2.1	175	2.5	182	2.8	192	3.4		
-10	14	5000	161	2.1	178	2.8	187	3.3				
-10	14	6000	165	2.4	181	3.2	194	4.2				
-5	23	0	151	1.1	165	1.8	172	2.1	178	2.2	185	2.4
-5	23	1000	153	1.2	167	2.1	174	2.2	181	2.4	189	2.7
-5	23	2000	155	1.5	170	2.2	176	2.3	185	2.7	193	3.2
-5	23	3000	157	1.8	172	2.3	180	2.7	188	3.0	199	3.8
-5	23	4000	159	2.1	175	2.6	184	3.0	193	3.6		
-5	23	5000	163	2.3	179	2.9	188	3.5				
-5	23	6000	165	2.4	183	3.4						
0	32	0	152	1.1	166	2.0	173	2.1	179	2.3	188	2.6
0	32	1000	154	1.3	168	2.1	175	2.3	182	2.5	191	2.9
0	32	2000	156	1.6	170	2.2	178	2.5	187	2.9	195	3.4
0	32	3000	158	2.0	173	2.4	181	2.8	190	3.3	203	4.3
0	32	4000	160	2.1	176	2.7	185	3.1	195	3.9		
0	32	5000	164	2.3	180	3.1	190	3.7				
0	32	6000	166	2.5	185	3.6						
5	41	0	153	1.2	167	2.1	174	2.2	181	2.4	190	2.8
5	41	1000	155	1.5	169	2.2	176	2.3	184	2.7	193	3.1
5	41	2000	157	1.8	171	2.3	179	2.6	188	3.0	197	3.6
5	41	3000	159	2.1	175	2.5	182	2.9	192	3.5		
5	41	4000	161	2.2	178	2.8	186	3.3	202	4.6		
5	41	5000	164	2.4	181	3.2	192	4.0				
5	41	6000	167	2.6	186	3.8						
10	50	0	154	1.3	168	2.1	175	2.2	183	2.6	191	2.9
10	50	1000	156	1.6	170	2.2	178	2.5	186	2.9	195	3.4
10	50	2000	158	1.9	172	2.4	181	2.8	190	3.2	201	4.1
10	50	3000	160	2.1	175	2.6	184	3.1	194	3.7		
10	50	4000	163	2.3	178	2.9	188	3.6				
10	50	5000	165	2.5	183	3.4	197	4.7				
10	50	6000	168	2.7	188	4.1						
15	59	0	155	1.4	169	2.2	176	2.3	185	2.7	193	3.2
15	59	1000	157	1.7	171	2.3	179	2.6	188	3.0	197	3.6
15	59	2000	158	2.1	174	2.5	182	2.9	192	3.5		
15	59	3000	160	2.2	177	2.8	186	3.3	198	4.2		
15	59	4000	164	2.4	180	3.1	190	3.8				
15	59	5000	166	2.5	183	3.5						
15	59	6000	169	2.8	192	4.6						

			TAKEOFF GROSS WEIGHT (LB) 11000		12000		12500		13000		13500	
TEMP °C	°F	PA FT	V_C KIAS	DIST NMI	V_C KIAS	DIST NMI	V_C KIAS	DIST NMI	V_C KIAS	DIST NMI	V_C KIAS	DIST NMI
20	68	0	157	1.8	172	2.3	181	2.6	189	3.1	200	3.8
20	68	1000	159	2.0	175	2.5	184	2.9	193	3.5		
20	68	2000	161	2.1	178	2.8	186	3.3				
20	68	3000	164	2.3	180	3.1	190	3.8				
20	68	4000	166	2.5	184	3.5						
20	68	5000	168	2.7	189	4.2						
20	68	6000	172	3.1								
25	77	0	160	2.0	176	2.5	184	2.9	195	3.6		
25	77	1000	161	2.1	178	2.7	188	3.3				
25	77	2000	164	2.3	181	3.0	193	3.9				
25	77	3000	166	2.4	185	3.5						
25	77	4000	168	2.7	193	4.5						
25	77	5000	171	3.0								
25	77	6000	175	3.5								
30	86	0	162	2.1	179	2.7	190	3.4				
30	86	1000	165	2.3	183	3.1						
30	86	2000	166	2.4	187	3.6						
30	86	3000	169	2.7								
30	86	4000	172	2.9								
30	86	5000	175	3.4								
30	86	6000	179	4.0								
35	95	0	166	2.2	185	3.2						
35	95	1000	168	2.5	192	4.0						
35	95	2000	171	2.7								
35	95	3000	173	3.0								
35	95	4000	176	3.4								
35	95	5000	179	3.9								
35	95	6000										
40	104	0	170	2.5								
40	104	1000	172	2.7								
40	104	2000	174	3.0								
40	104	3000	178	3.5								
40	104	4000										
40	104	5000										
40	104	6000										

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Figure A4-8. Climb and Distance (Sheet 1 of 2)

CLIMB GRADIENT (FT/NMI) AND DISTANCE (NMI) FROM BRAKE RELEASE TO 190 KIAS

SINGLE ENGINE
WITH LEFT ENGINE FAILURE AT CRITICAL ENGINE FAILURE SPEED
MAX THRUST
LEFT ENGINE WINDMILLING
FLAPS = 60%
GEAR - DOWN
190 KIAS

MODEL: T-38A
DATE: 25 APRIL 2000
DATA BASIS: ESTIMATED DATA

ENGINES: (2) J85-GE-5
FUEL GRADE: JP-8
FUEL DENSITY: 6.8 LB/US GAL

			TAKEOFF GROSS WEIGHT (LB)									
			11000		12000		12500		13000		13500	
TEMP °C	°F	PA FT	CLMB GRAD FT/NMI	DIST NMI	CLMB GRAD FT/NMI	DIST NMI	CLMB GRAD FT/NMI	DIST NMI	CLMB GRAD FT/NMI	DIST NMI	CLMB GRAD FT/NMI	DIST NMI
-10	14	0	633	2.1	493	2.6	422	2.9	342	2.8	262	2.8
-10	14	1000	588	2.3	452	3.1	383	3.0	304	2.9	226	2.9
-10	14	2000	541	2.6	409	3.2	341	3.1	264	3.1	187	2.9
-10	14	3000	494	3.0	368	3.3	302	3.3	226	3.2	151	3.0
-10	14	4000	448	3.4	326	3.4	262	3.5	188	3.4	114	3.1
-10	14	5000	402	3.6	283	3.7	220	3.6	150	3.5	77	2.5
-10	14	6000	358	3.8	243	3.9	183	3.9	112	3.3		
-5	23	0	610	2.2	473	2.8	402	3.0	323	2.9	244	2.8
-5	23	1000	567	2.4	433	3.1	365	3.1	287	3.0	209	2.9
-5	23	2000	522	2.7	392	3.2	325	3.2	248	3.2	172	3.0
-5	23	3000	477	3.2	353	3.4	287	3.4	212	3.3	137	3.0
-5	23	4000	434	3.5	313	3.5	249	3.6	176	3.4	103	3.0
-5	23	5000	390	3.7	271	3.8	209	3.7	139	3.6		
-5	23	6000	347	3.9	233	4.0	173	4.0	102	3.2		
0	32	0	588	2.3	452	3.1	382	3.0	304	3.0	226	2.9
0	32	1000	546	2.6	414	3.2	346	3.1	269	3.1	193	2.9
0	32	2000	504	2.9	375	3.3	309	3.3	233	3.2	157	3.0
0	32	3000	461	3.4	337	3.4	273	3.5	198	3.4	124	3.1
0	32	4000	419	3.6	300	3.7	237	3.6	164	3.5	91	2.8
0	32	5000	378	3.8	260	3.9	199	3.8	129	3.5		
0	32	6000	335	4.0	223	4.1	163	4.1	93	3.2		
5	41	0	565	2.4	431	3.1	363	3.1	285	3.0	207	2.9
5	41	1000	526	2.7	395	3.2	328	3.2	252	3.2	176	3.0
5	41	2000	485	3.1	358	3.4	292	3.4	217	3.3	142	3.0
5	41	3000	444	3.5	322	3.5	258	3.5	184	3.4	111	3.1
5	41	4000	405	3.7	287	3.8	224	3.7	152	3.6	79	2.6
5	41	5000	366	3.9	249	4.0	188	3.9	119	3.5		
5	41	6000	324	4.1	212	4.3	153	4.1	83	3.0		
10	50	0	542	2.6	411	3.2	343	3.1	266	3.1	189	2.9
10	50	1000	505	2.9	377	3.3	310	3.3	235	3.2	159	3.0
10	50	2000	466	3.3	341	3.4	276	3.5	201	3.3	127	3.1
10	50	3000	428	3.6	307	3.6	244	3.6	171	3.5	97	2.9
10	50	4000	391	3.7	274	3.8	212	3.8	140	3.7		
10	50	5000	354	3.9	238	4.1	177	4.1	109	3.4		
10	50	6000	313	4.2	202	4.4	143	4.1	74	2.9		
15	59	0	520	2.7	390	3.2	323	3.2	247	3.2	171	3.0
15	59	1000	484	3.1	358	3.4	292	3.4	217	3.3	143	3.0
15	59	2000	448	3.5	324	3.5	260	3.5	186	3.4	112	3.1
15	59	3000	411	3.7	292	3.7	229	3.7	157	3.6	84	2.7
15	59	4000	376	3.8	261	3.9	199	3.9	128	3.6		
15	59	5000	342	4.0	227	4.2	167	4.2	99	3.3		
15	59	6000	301	4.4	192	4.5	133	4.1	64	2.8		

			TAKEOFF GROSS WEIGHT (LB)									
			11000		12000		12500		13000		13500	
TEMP °C	°F	PA FT	CLMB GRAD FT/NMI	DIST NMI	CLMB GRAD FT/NMI	DIST NMI	CLMB GRAD FT/NMI	DIST NMI	CLMB GRAD FT/NMI	DIST NMI	CLMB GRAD FT/NMI	DIST NMI
20	68	0	472	3.1	346	3.3	281	3.3	206	3.2	132	2.9
20	68	1000	439	3.4	316	3.5	253	3.5	179	3.3	106	2.9
20	68	2000	405	3.6	285	3.7	223	3.6	150	3.5	78	2.5
20	68	3000	372	3.8	256	3.9	195	3.8	123	3.4		
20	68	4000	339	4.0	227	4.1	167	4.1	96	3.2		
20	68	5000	307	4.2	196	4.4	136	4.0	70	2.7		
20	68	6000	269	4.6	162	4.6	105	3.8				
25	77	0	424	3.4	302	3.4	239	3.4	166	3.3	93	2.6
25	77	1000	394	3.5	275	3.6	213	3.6	141	3.4		
25	77	2000	363	3.7	247	3.8	185	3.8	114	3.2		
25	77	3000	332	3.9	220	4.0	160	3.9	90	3.0		
25	77	4000	302	4.2	193	4.3	134	3.8				
25	77	5000	272	4.5	164	4.5	106	3.7				
25	77	6000	237	4.8	133	4.5	76	3.0				
30	86	0	376	3.5	258	3.5	197	3.5	126	3.1		
30	86	1000	349	3.6	234	3.8	174	3.7	103	2.9		
30	86	2000	321	3.9	208	4.0	148	3.7	79	2.7		
30	86	3000	292	4.1	183	4.3	125	3.6				
30	86	4000	265	4.4	159	4.4	101	3.5				
30	86	5000	238	4.7	132	4.4	76	2.8				
30	86	6000	204	5.1	103	4.4						
35	95	0	328	3.6	215	3.7	155	3.5	85	2.6		
35	95	1000	304	3.8	193	4.0	134	3.5				
35	95	2000	278	4.1	169	4.1	111	3.4				
35	95	3000	253	4.3	147	4.2	90	3.2				
35	95	4000	228	4.6	125	4.2						
35	95	5000	204	5.0	101	4.3						
35	95	6000	172	5.5								
40	104	0	280	3.8	171	3.8	113	3.2				
40	104	1000	259	4.0	151	3.9	94	3.0				
40	104	2000	236	4.3	130	3.9						
40	104	3000	213	4.6	111	4.0						
40	104	4000	191	5.0	91	3.6						
40	104	5000	169	5.3								
40	104	6000	139	5.6								

G0100315

Figure A4-8. Climb and Distance (Sheet 2)

GRD
TO
HYD
ELE
FUE
OXY
ENG
FLT
MISC
LND

I
II
III
IV
V
VI
VII
A
G
IN

PART 5
CRUISE

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

PURPOSE OF CHARTS

The cruise charts provide cruise and loiter data which can be used to determine the subsonic cruise and loiter portions of any type of flight plan. Charts for constant altitude cruise and optimum cruise altitude for short range missions are included. Diversion range summary tables are provided in tabular form for two-engine and single-engine operation.

CRUISE CHARTS

The cruise charts (Figure A5-1 and Figure A5-2) are for two-engine and single-engine operation. They provide cruise and loiter data throughout the speed range from maximum endurance to military thrust. Each chart is composed of three pages whose parameters are weight, altitude, mach number, ambient temperature, true airspeed, fuel flow, drag number, and nautical miles per pound of fuel. The average gross weight used in the charts is the average of the gross weights at the beginning and the end of the cruise or cruise interval. This average gross weight is equal to the gross weight at the beginning of cruise less one half of the fuel necessary for cruise. An ICAO standard day temperature table is included on sheet 3 of each chart.

USE OF CRUISE CHART

Assume a constant altitude cruise at 0.8 mach number and pressure altitude of 20,000 feet when the temperature is -20°C and the average gross weight is 10,400 pounds. The chase-thru lines on sheet 1 of Figure A5-1 show the maximum range mach number of 0.702. Then, by following the guidelines from the intersection with the baseline (maximum range) to the assumed mach number (0.8), the basic reference number is 2.75. The chase-thru lines on sheet 3 show 0.225 nautical mile per pound of fuel for the assumed mach number and the basic reference number determined on sheet 1 and 2. Entering sheet 4 with the assumed mach number and the nautical miles per pound from sheet 3 the chase-thru lines show a true air-speed of 495 knots and fuel flow of 1100 pounds per hour per engine. If the fuel available is 1000 pounds, the cruise distance is 225 nautical miles (0.225 x 1000) and the time is 27 minutes (1000 x 60 ÷ 1100 x 2). When the distance is known instead of the fuel available, the fuel required is computed by the reverse process (225 ÷ 0.225 = 1000) and the average gross weight is obtained by successive approximations, knowing the gross weight at the start of the cruise.

CONSTANT ALTITUDE CRUISE CHARTS

The constant altitude cruise charts (Figure A5-3 and Figure A5-4) are for two-engine and single- engine operation. The charts are used to determine cruise performance at a particular pressure altitude, temperature, wind velocity, and average gross weight. The charts provide data for air and ground speeds, time, nautical miles per pound of fuel, fuel flow, and fuel required. When the fuel required is unknown, the average gross weight is obtained by successive approximations.

USE OF CONSTANT ALTITUDE CRUISE CHARTS

The chase-thru lines on Figure A5-3 are for an average gross weight of 10,020 pounds, a constant altitude cruise of 35,000 feet, a temperature of -46°C, a headwind of 50 knots, and a distance of 400 nautical miles. On sheet 1, the chase-thru lines show a mach number of 0.83, a true airspeed (airspeed reflector) and groundspeed of 485 knots and 435 knots, respectively, and a time of 55 minutes. Using the airspeed of 485 knots and the time of 55 minutes, the chase-thru lines on sheet 2 show 0.338 nautical mile per pound of fuel, a fuel flow of 720 pounds per hour per engine, and 1320 pounds of fuel. Since 1320 pounds of fuel is required, the gross weight at the start of the cruise is 10,680 pounds (10,020 + 1/2 x 1320).

OPTIMIUM CRUISE ALTITUDE FOR SHORT RANGE MISSIONS

For short-range flights, it is not economical to climb to the same optimum cruise altitude as used for long range missions. Figure A5-5 presents the optimum constant altitude cruise for short-range missions and also indicates when the mission is in the short-range category; that is, below the optimum cruise-climb altitude.

USE OF OPTIMUM CRUISE ALTITUDE FOR SHORT RANGE MISSIONS CHART

For a short-range mission 100 nautical miles from base and a start climb gross weight of 11,400 pounds, the chase-thru lines show the optimum cruise at constant altitude (Figure A5-5) is 28,000 feet. Had the distance been 150 nautical miles, the optimum cruise-climb altitude would be the most economical.

DIVERSION RANGE SUMMARY TABLES

Diversion range summary tables are presented in Figure A5-6, Figure A5-7, Figure A5-8, Figure A5-9, Figure A5-10, Figure A5-11, Figure A5-12, and Figure A5-13 for two-engine and single-engine operation. These tables show, in quick reference form, the range available and the time required to return to base with 600, 800, 1000 or 1400 pounds of fuel available. The range is based on having 300 pounds of fuel remaining for the approach and landing after the descent is completed. The 300 pounds of fuel is ample for one missed approach. Range and time data are shown in the tables for three optional return profiles, together with the optimum altitudes for cruise. The optimum altitude is the constant cruise altitude which provides the maximum range for the particular type of flight profile. Climb is made to the cruise altitude, using military thrust.

NOTE

The Mil Thrust Climb Speed Schedule at the bottom of each table must be used to obtain the maximum ranges in the table.

The three types of flight profiles are:

1. a. Cruise at initial altitude to base.

b. Descend to sea level with idle thrust and speed brake closed after arrival over base.

2. a. Climb on course to optimum cruise altitude.

b. Cruise at optimum altitude to base.

c. Descend to sea level with idle thrust and speed brake open after arrival over base.

3. a. Climb on course to optimum cruise altitude.

b. Cruise at optimum altitude.

c. Descend on course to sea level with idle thrust and speed brake closed.

USE OF DIVERSION RANGE SUMMARY TABLES

Assume the following conditions prevail: Single-engine operation, fuel remaining is 1240 pounds, and the aircraft is 200 nmi from the base at 15,000 feet altitude. Drag Index = 0.

Determine which flight profiles in Figure A5-10 provide necessary range in return to base.

1. In Figure A5-10, enter the chart at the top of the column marked 15,000 feet initial altitude.

2. Proceed downward to the section of the chart for 1000 pounds of fuel shown at the left side of the page.

3. The ranges available with the three profile options are as follows:

First option	168 nmi.
Section option	179 nmi.
Third option	211 nmi.

4. As the required range is 200 nmi, the flight profile for the third option must be used.

5. Climb with MIL thrust from 15,000 at mach number 0.52 (footnote number 5) to 25,000 at mach number 0.59. At 25,000 feet, cruise at 0.62 mach; engine fuel flow will be approximately 1275 lb/hr. At 40 nmi from the base, descend on course at 240 KIAS, idle thrust, with the speed brake closed.

6. The time required with no wind is 36 minutes for 211 nmi, and the fuel used is 1000 pounds by the time the landing is completed. As the fuel available was 1240 pounds, 240 pounds of this amount would be available for headwind conditions.

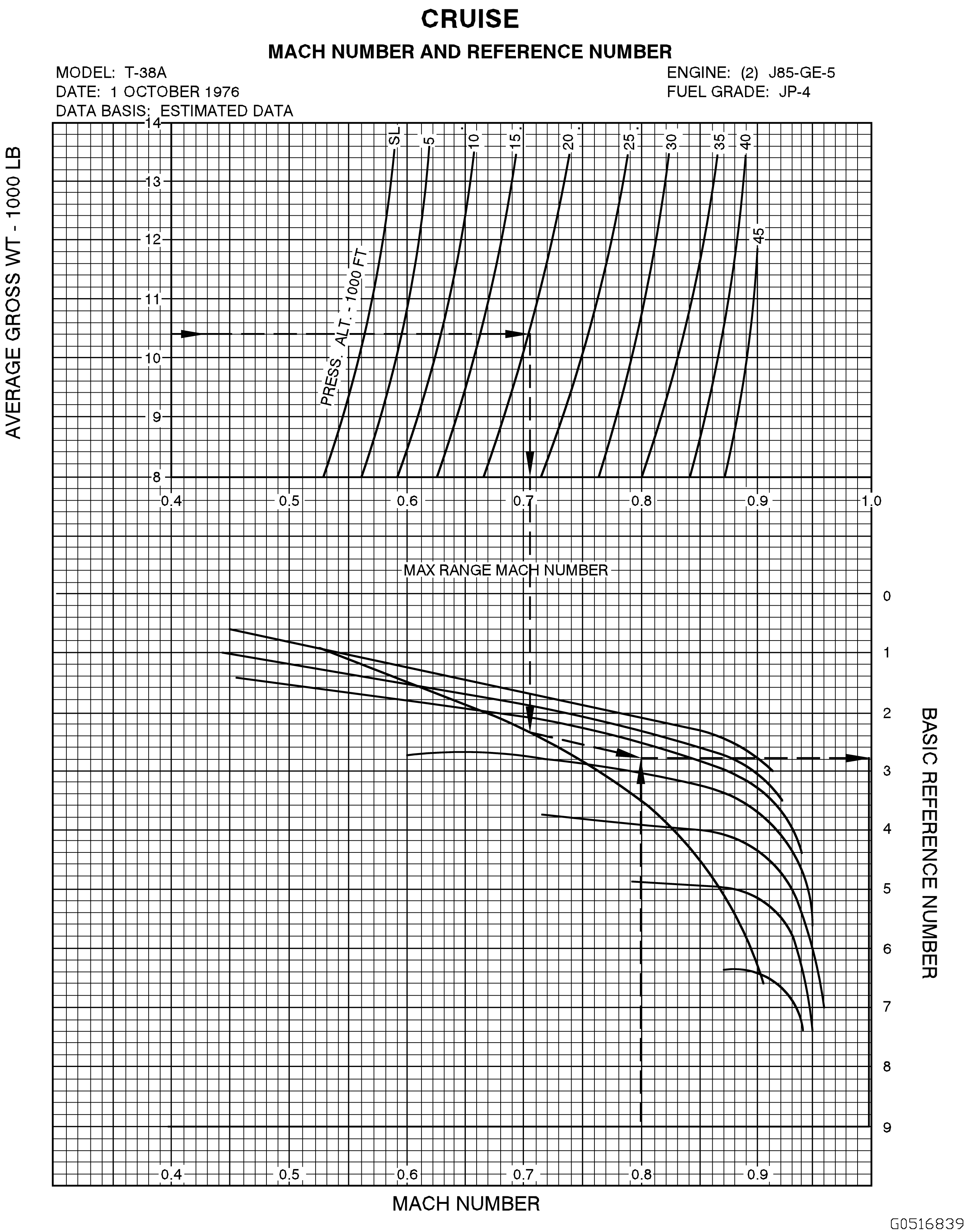


Figure A5-1. Cruise (Sheet 1 of 4)

CRUISE
CORRECTED REFERENCE NUMBER FOR EXTERNAL STORES

MODEL: T-38A
DATE: 1 OCTOBER 1976
DATA BASIS: ESTIMATED DATA

ENGINE: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

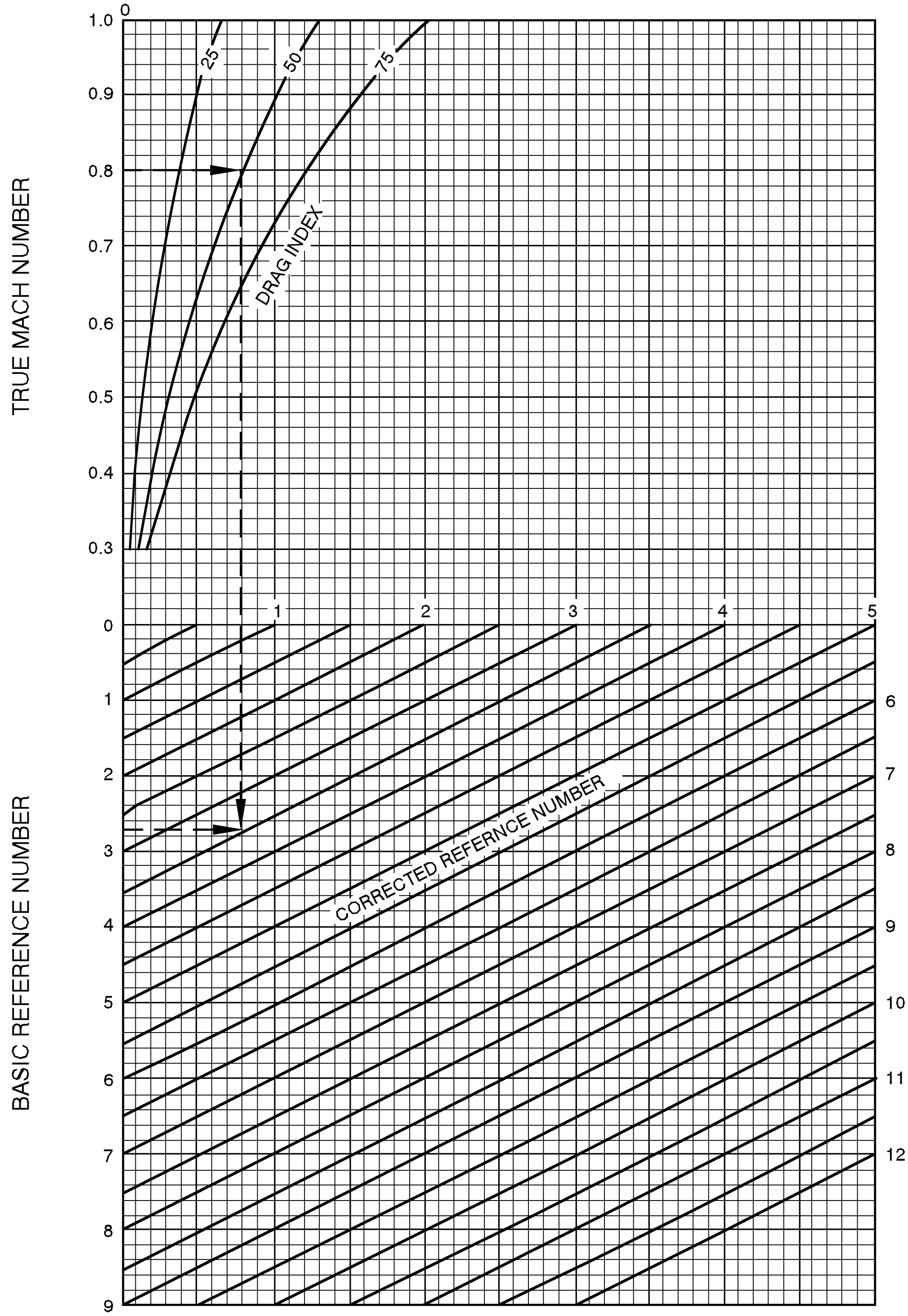


Figure A5-1. Cruise (Sheet 2)

CRUISE
NAUTICAL MILES PER POUND

MODEL: T-38A
DATE: 1 OCTOBER 1976
DATA BASIS: ESTIMATED DATA

ENGINE: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

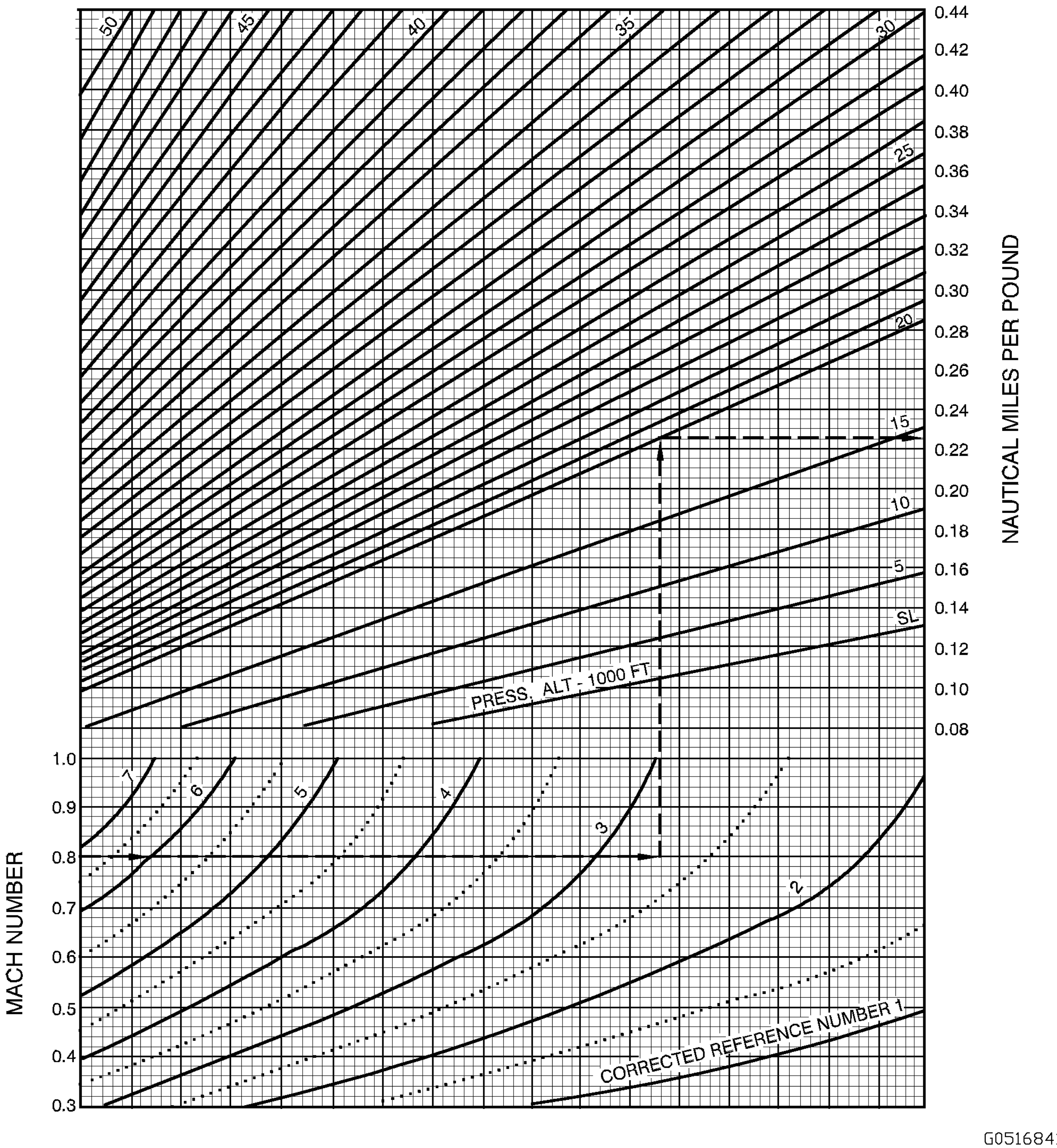


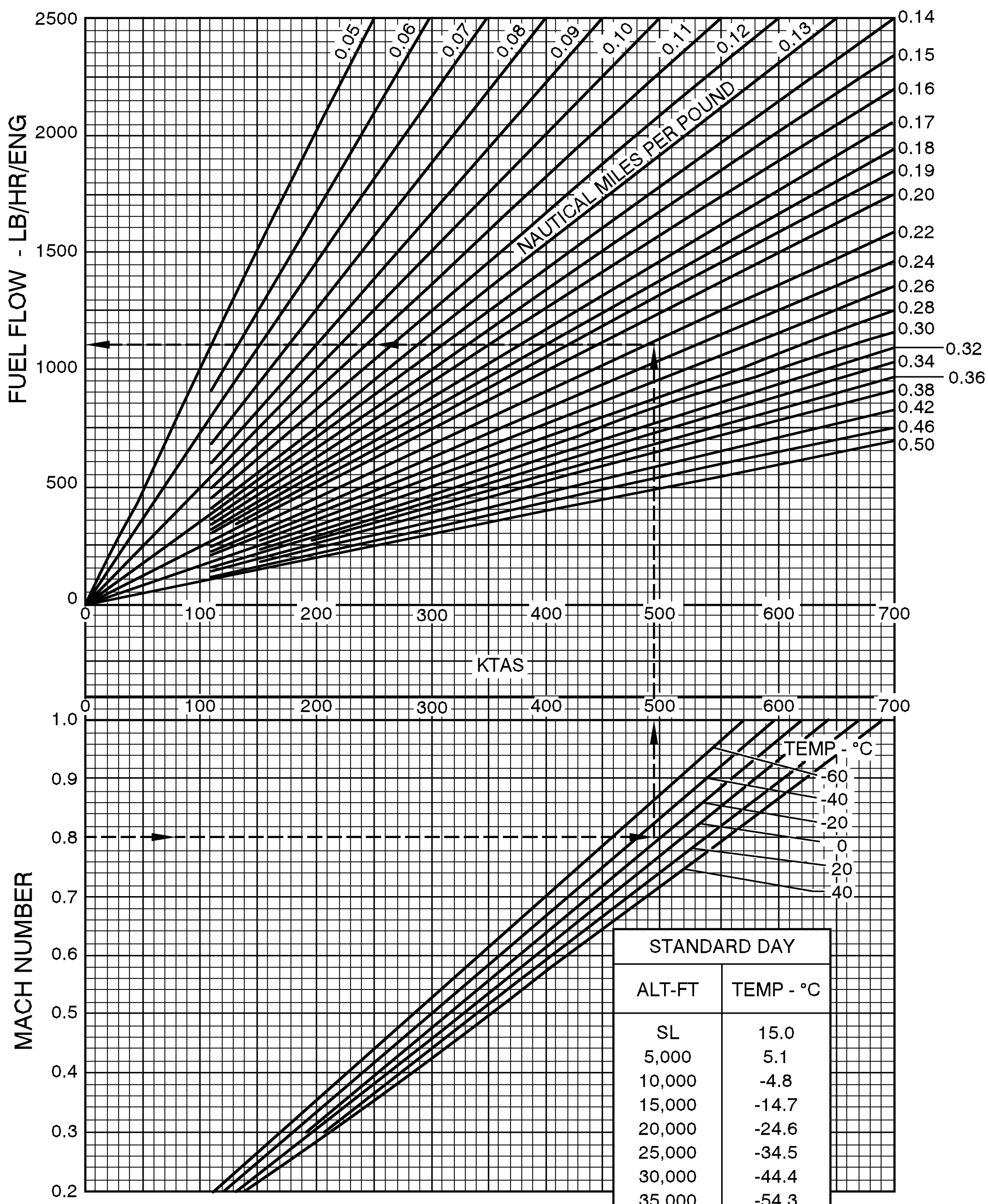
Figure A5-1. Cruise (Sheet 3)

CRUISE

FUEL FLOW AND TRUE AIRSPEED

MODEL: T-38A
DATE: 1 OCTOBER 1976
DATA BASIS: ESTIMATED DATA

ENGINE: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL



STANDARD DAY	
ALT-FT	TEMP - °C
SL	15.0
5,000	5.1
10,000	-4.8
15,000	-14.7
20,000	-24.6
25,000	-34.5
30,000	-44.4
35,000	-54.3
37,000 AND ABOVE	-56.5

Figure A5-1. Cruise (Sheet 4)

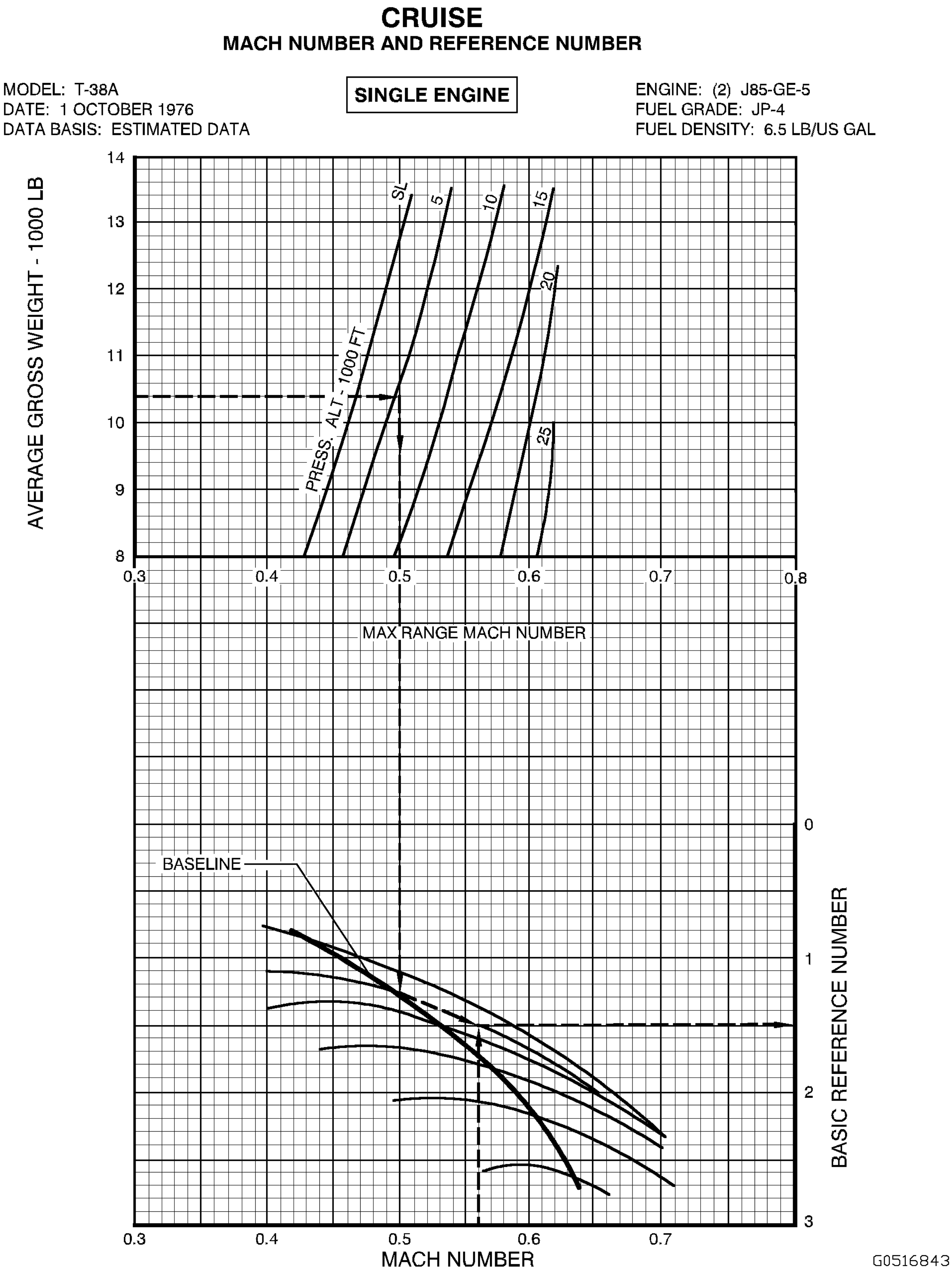


Figure A5-2. Cruise (Single Engine) (Sheet 1 of 4)

GRD TO HYD ELE FUE OXY ENG FLT MISC LND
I II III IV V VI VII A G IN

CRUISE

CORRECTED REFERENCE NUMBER
FOR EXTERNAL STORES

MODEL: T-38A
DATE: 1 OCTOBER 1976
DATA BASIS: FLIGHT TEST

ENGINE: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

SINGLE ENGINE

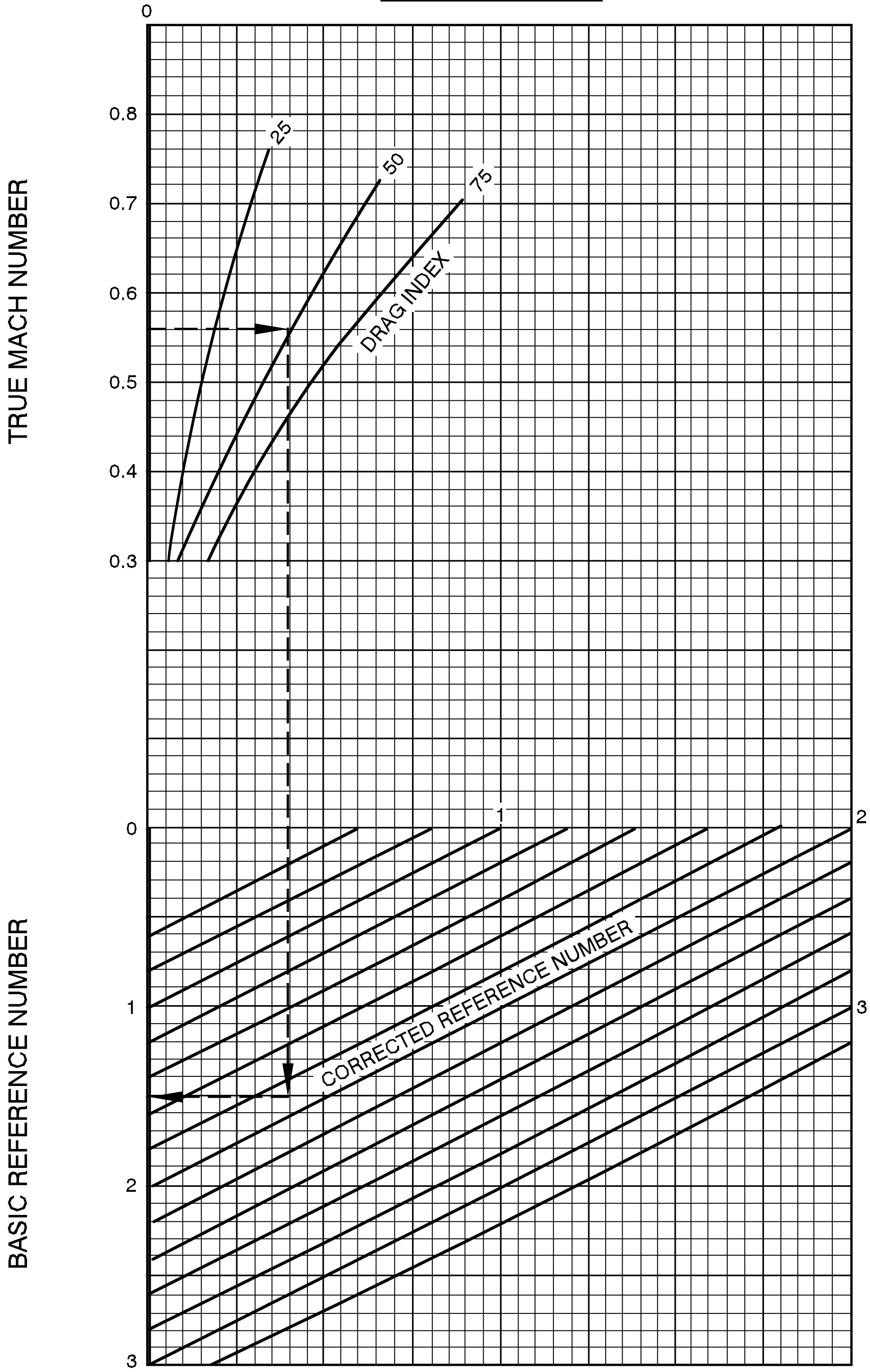


Figure A5-2. Cruise (Single Engine) (Sheet 2)

CRUISE

NAUTICAL MILES PER POUND

MODEL: T-38A
DATE: 1 OCTOBER 1976
DATA BASIS: ESTIMATED DATA

ENGINE: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

SINGLE ENGINE

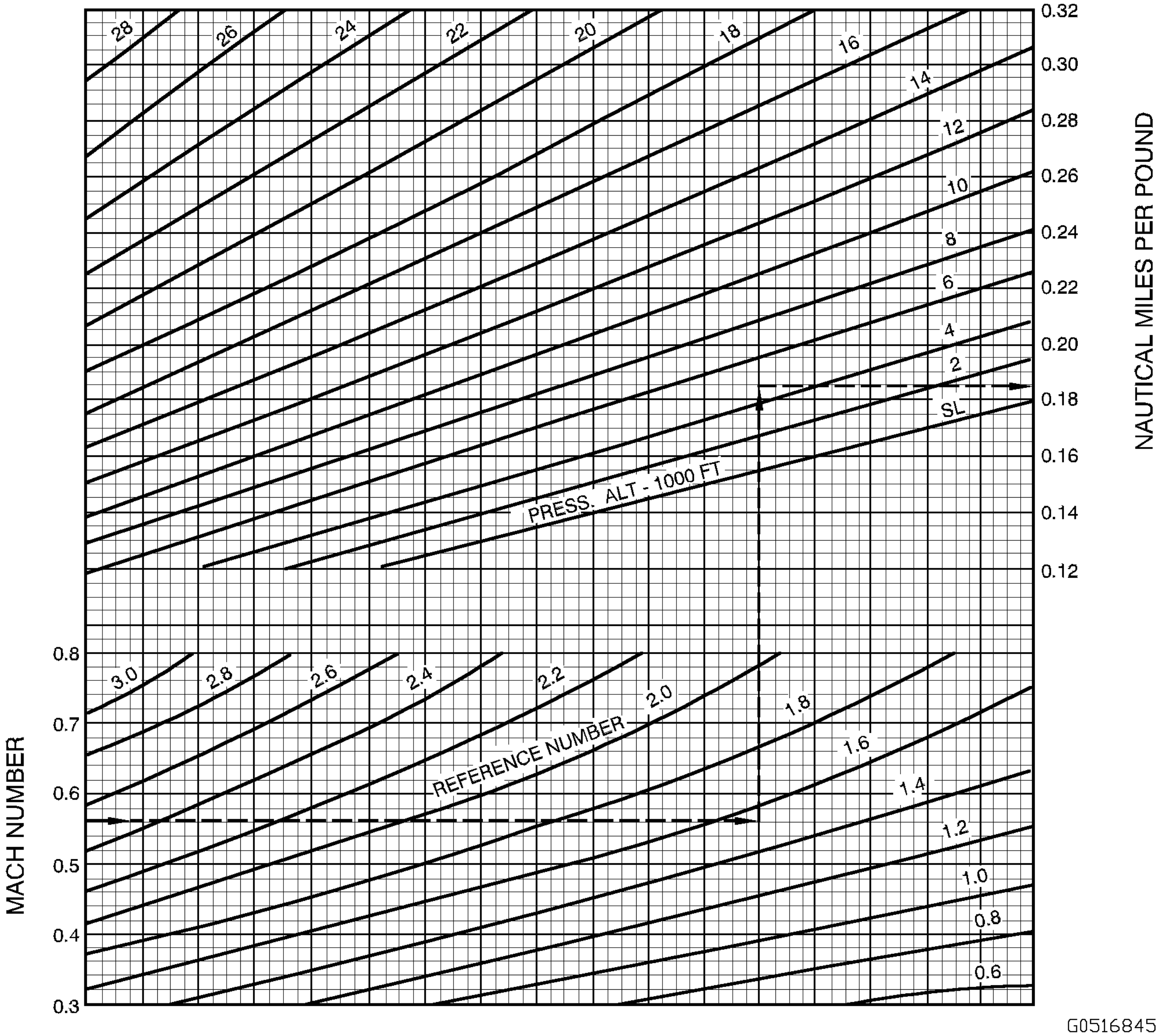


Figure A5-2. Cruise (Single Engine) (Sheet 3)

GRD TO HYD ELE FUE OXY ENG FLT MISC LND

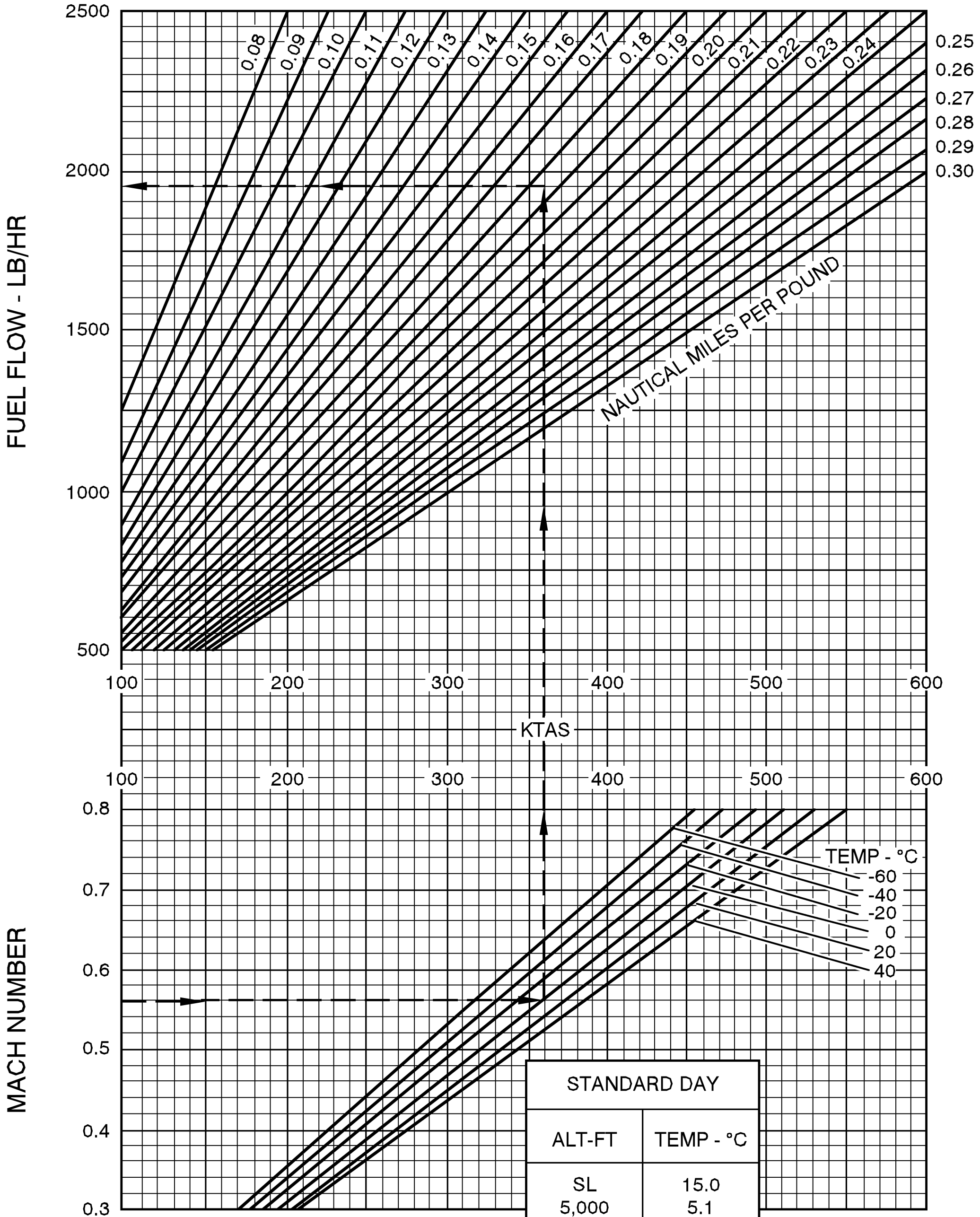
I II III IV V VI VII A G IN

CRUISE
FUEL FLOW AND TRUE AIRSPEED

SINGLE ENGINE

MODEL: T-38A
DATE: 1 OCTOBER 1976
DATA BASIS: ESTIMATED DATA

ENGINE: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL



STANDARD DAY	
ALT-FT	TEMP - °C
SL	15.0
5,000	5.1
10,000	-4.8
15,000	-14.7
20,000	-24.6
25,000	-34.5
30,000	-44.4

Figure A5-2. Cruise (Single Engine) (Sheet 4)

GRD TO HYD ELE FUE OXY ENG FLT MISC LND

I II III IV V VI VII A G IN

CONSTANT ALTITUDE CRUISE
TIME AND AIRSPEED

MODEL: T-38A
DATE: 1 OCTOBER 1976
DATA BASIS: ESTIMATED DATA

ENGINE: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

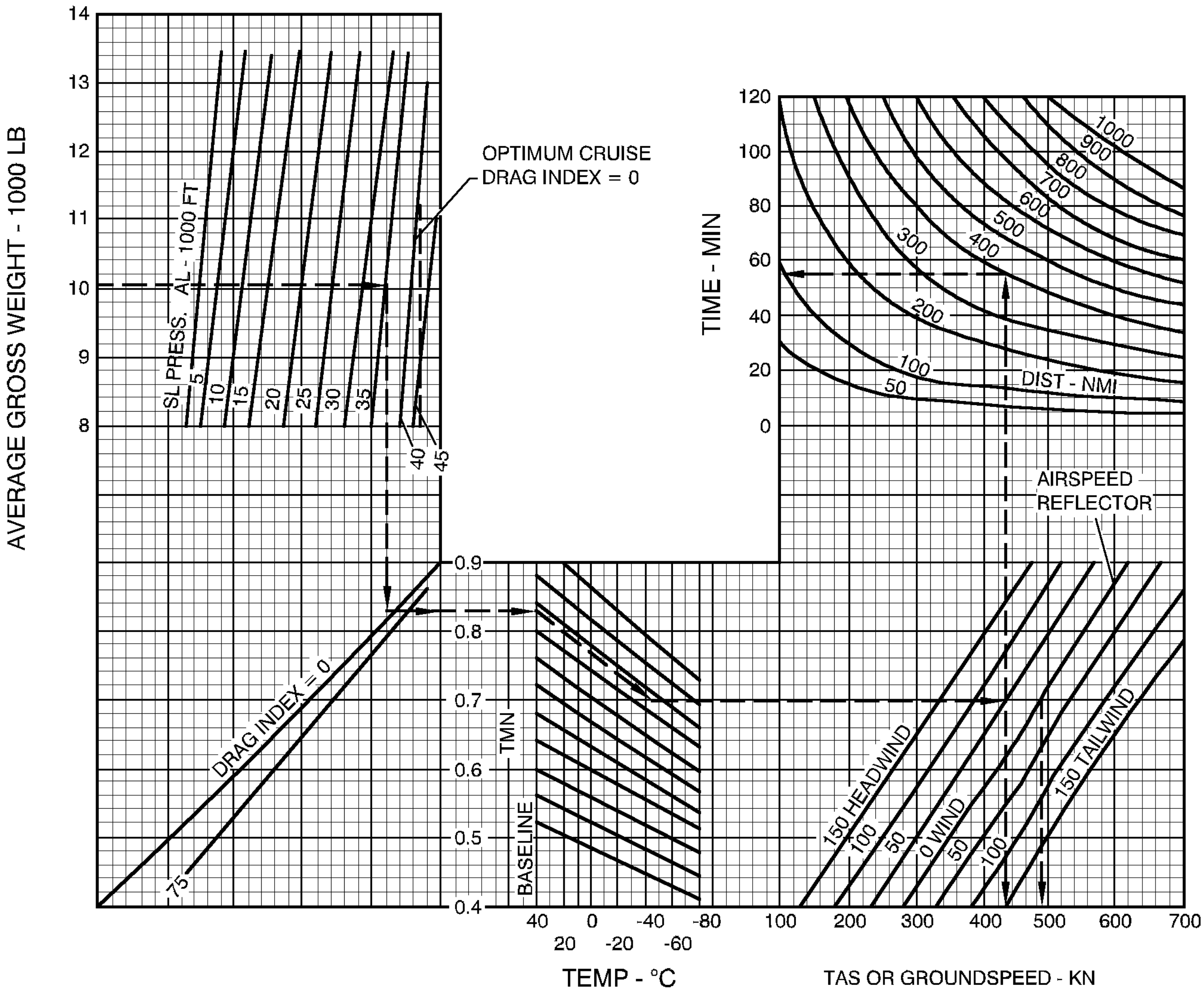


Figure A5-3. Constant Altitude Cruise (Sheet 1 of 2)

CONSTANT ALTITUDE CRUISE
FUEL FLOW AND FUEL REQUIRED

MODEL: T-38A
DATE: 1 OCTOBER 1976
DATA BASIS: ESTIMATED DATA

ENGINE: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

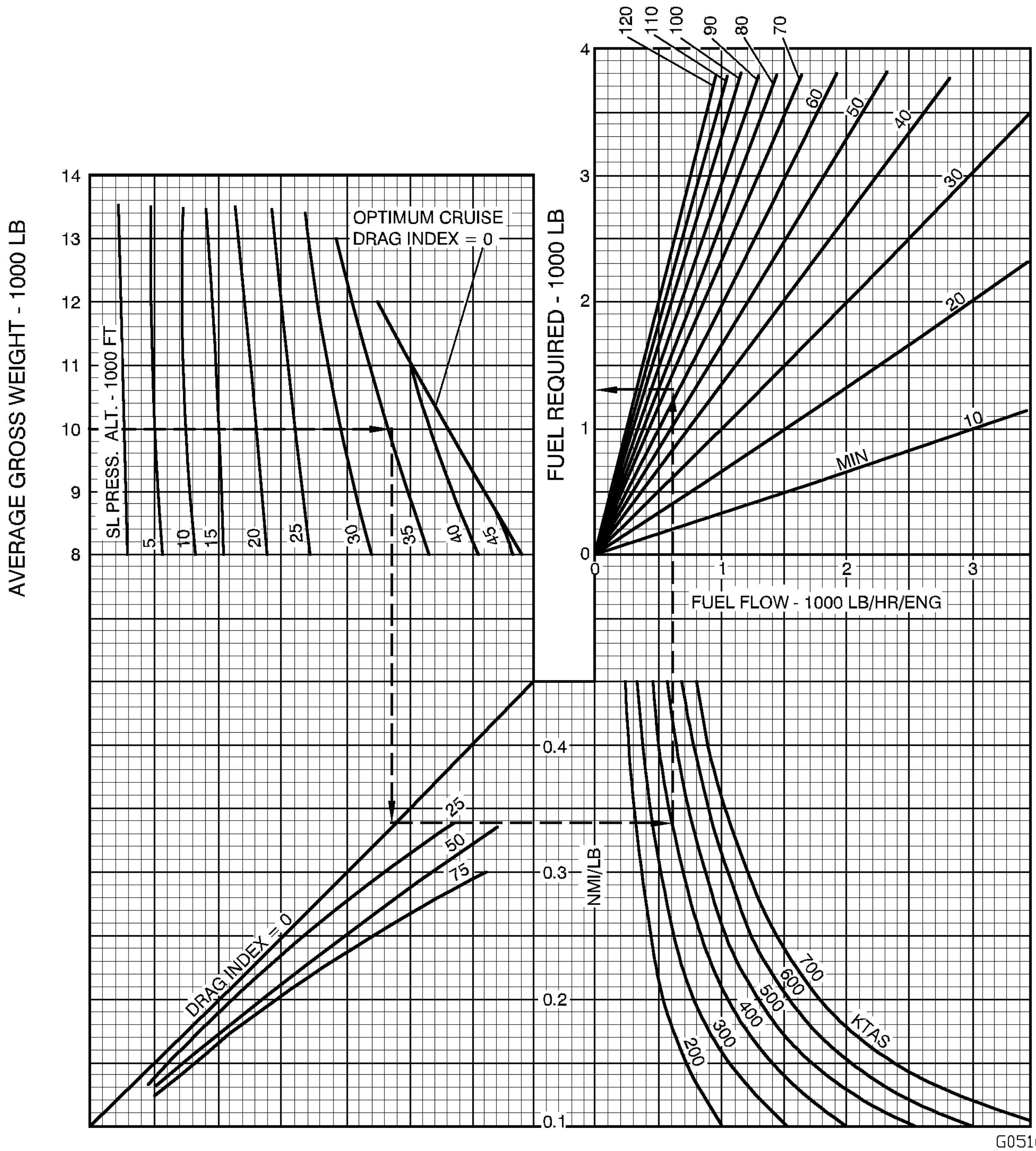


Figure A5-3. Constant Altitude Cruise (Sheet 2)

CONSTANT ALTITUDE CRUISE
TIME AND AIRSPEED

SINGLE ENGINE

MODEL: T-38A
DATE: 1 OCTOBER 1976
DATA BASIS: ESTIMATED DATA

ENGINE: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

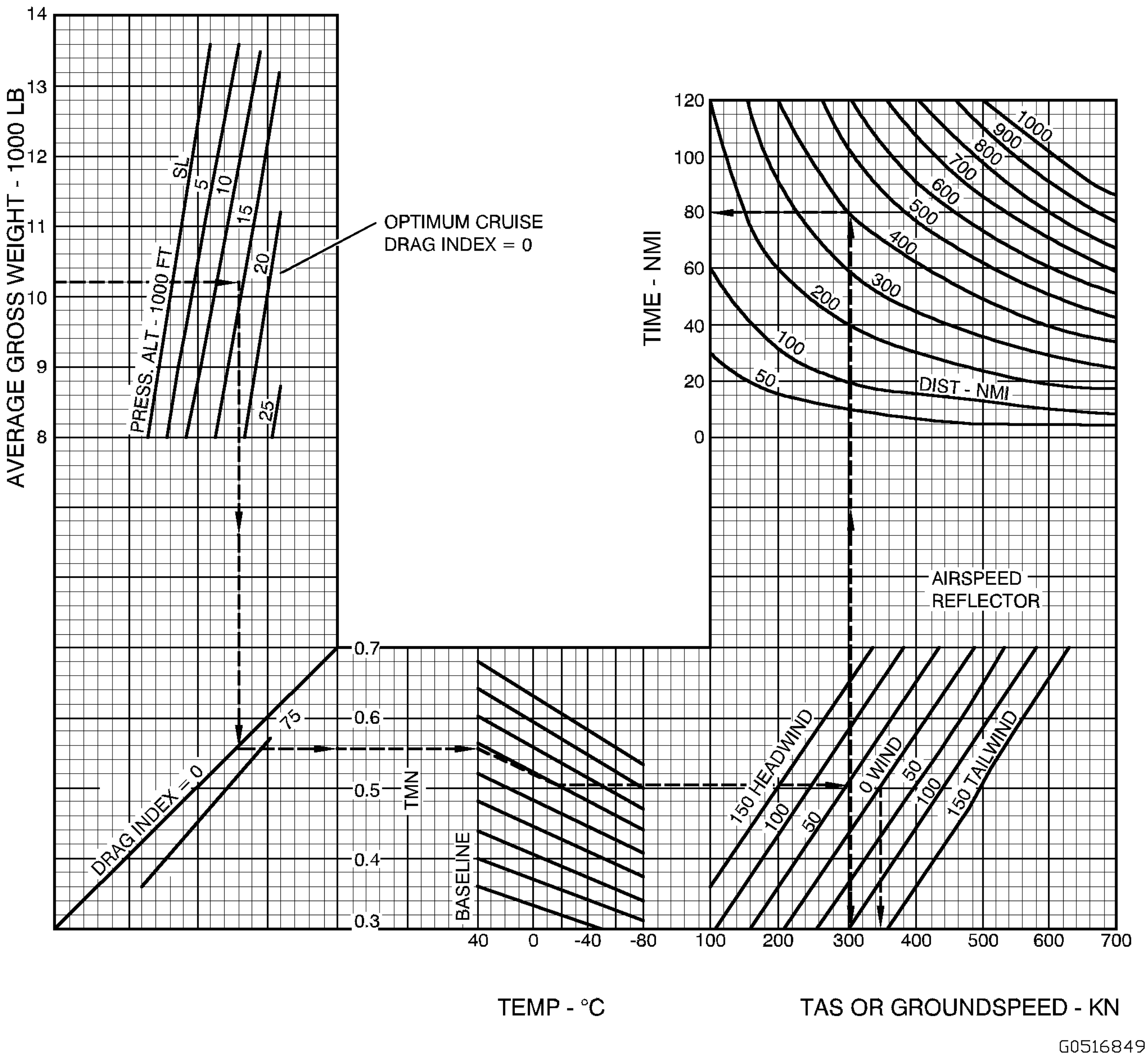


Figure A5-4. Constant Altitude Cruise (Single Engine) (Sheet 1 of 2)

CONSTANT ALTITUDE CRUISE

FUEL FLOW AND FUEL REQUIRED

MODEL: T-38A
DATE: 1 OCTOBER 1976
DATA BASIS: ESTIMATED DATA

SINGLE ENGINE

ENGINE: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

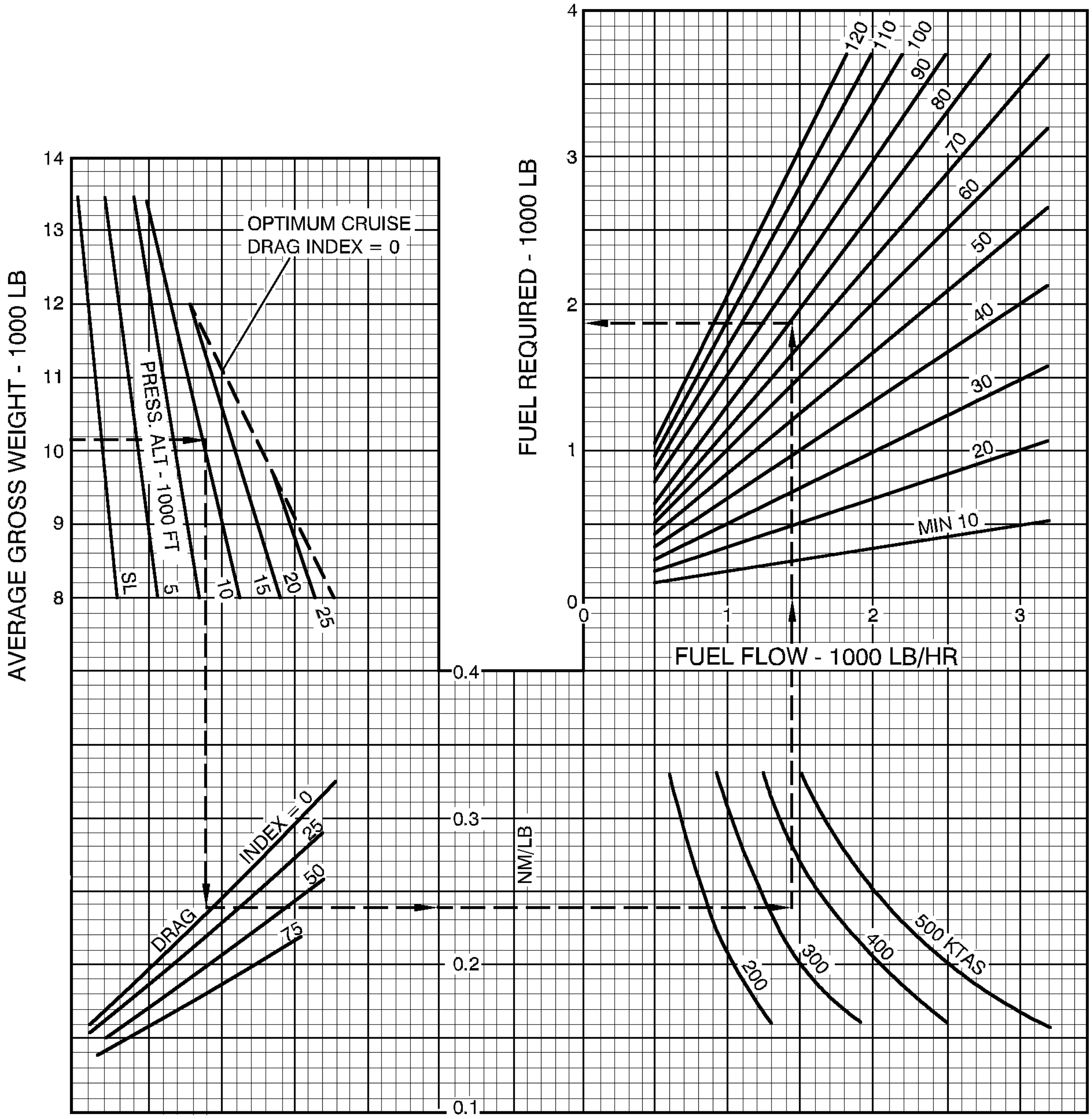
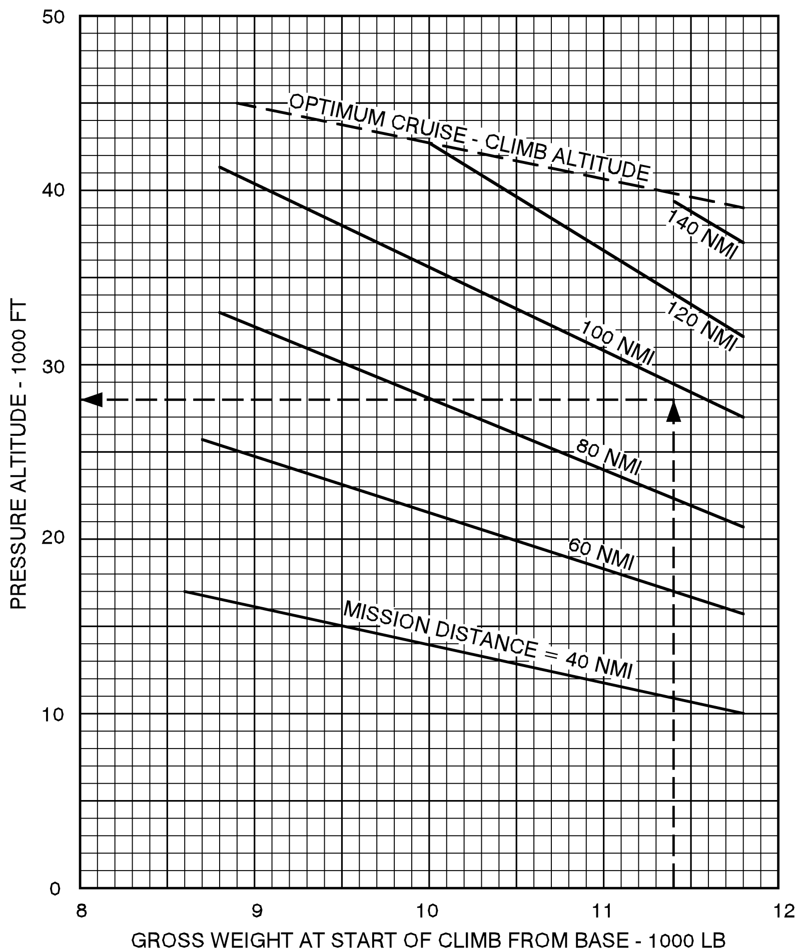


Figure A5-4. Constant Altitude Cruise (Single Engine) (Sheet 2)

OPTIMUM CRUISE ALTITUDE FOR SHORT RANGE MISSIONS
CONSTANT ALTITUDE CRUISE
DRAG INDEX = 0

MODEL: T-38A
DATE: 1 AUGUST 1965
DATA BASIS: FLIGHT TEST

ENGINES: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL



NOTE

MIL THRUST CLIMB ON COURSE INCLUDED IN MISSION DISTANCE.

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Figure A5-5. Optimum Cruise Altitude for Short Range Missions

GRD TO HYD ELE FUE OXY ENG FLT MISC LND

I II III IV V VI VII A G IN

DIVERSION RANGE SUMMARY TABLE

CONSTANT ALTITUDE CRUISE
STANDARD DAY ZERO WIND

MODEL: T-38A
DATE: 1 JULY 1978
DATA BASIS: ESTIMATED DATA

TWO ENGINE

DRAG INDEX = 0

ENGINES: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

RANGE AND TIME REMAINING WITH 300-LB RESERVES AT SEA LEVEL												
FUEL	1000 FT	INITIAL ALTITUDE SL	5	10	15	20	25	30	35	40	45	PROCEDURE
600 LB	NMI MIN	39 7	46 10	51 12	56 13	60 16	65 17	70 18	73 20	76 21	73 23	CRUISE AT INITIAL ALTITUDE TO BASE ①
	1000 FT	10/20	10/25	16/30	20/35	25/36	30/40	30/40	35/45	40/45	30/45	OPTIMUM ALTITUDE
	NMI MIN	43 8	48 9	64 10	60 12	66 13	74 14	82 15	87 17	94 18	95 18	USE OPTIMUM ALTITUDE UNTIL OVER BASE ②
	NMI MIN	64 11	74 12	84 13	95 16	106 17	117 18	128 19	138 21	148 22	154 23	USE OPTIMUM ALTITUDE AND DESCEND ON COURSE ③
800 LB	NMI MIN	65 11	76 15	86 18	96 20	106 22	118 24	130 26	139 29	148 30	147 32	CRUSE AT INITIAL ALTITUDE TO BASE ①
	1000 FT	25/35	30/40	30/40	30/40	35/45	40/45	40/45	40/45	40/45	45	OPTIMUM ALTITUDE
	NMI MIN	84 15	95 17	106 18	116 20	126 22	137 23	148 24	157 25	166 26	168 27	USE OPTIMUM ALTITUDE UNTIL OVER BASE ②
	NMI MIN	124 19	139 20	152 22	166 24	179 26	191 27	203 29	213 30	222 31	228 31	USE OPTIMUM ALTITUDE AND DESCEND ON COURSE ③
1000 LB	NMI MIN	90 15	100 20	121 23	137 26	152 29	170 31	189 34	201 37	219 39	220 40	CRUSE AT INITIAL ALTITUDE TO BASE ①
	1000 FT	35/45	40/45	40/45	40/45	40/45	40/45	40/45	40/45	40/45	45	OPTIMUM ALTITUDE
	NMI MIN	143 24	167 25	171 27	185 29	197 30	208 32	219 33	229 34	237 35	240 35	USE OPTIMUM ALTITUDE UNTIL OVER BASE ②
	NMI MIN	196 28	212 30	226 32	240 33	252 34	264 36	276 37	286 38	295 39	301 40	USE OPTIMUM ALTITUDE AND DESCEND ON COURSE ③
1400 LB	NMI MIN	142 24	166 29	192 34	217 318	244 42	273 45	306 50	352 54	360 56	360 56	CRUSE AT INITIAL ALTITUDE TO BASE ①
	1000 FT	40/45	40/45	40/45	40/45	40/45	40/45	40/45	40/45	40/45	45	OPTIMUM ALTITUDE
	NMI MIN	282 41	297 43	311 44	324 46	337 47	348 49	359 50	369 51	378 62	381 53	USE OPIMUM ALTITUDE UNTIL OVER BASE ②
	NMI MIN	339 45	352 47	369 48	382 50	395 51	406 53	418 54	428 55	437 56	441 56	USE OPTIMUM ALTITUDE AND DESCEND ON COURSE ③
CRUSE ALT		SL	5	10	15	20	25	30	35	40	45	
CRUSE MECH NO.		0.54	0.56	0.59	0.64	0.68	0.73	0.77	0.81	0.85	0.89	
APPROX FUEL FLOW LB/HR/ENG		1325	1200	1050	975	900	825	750	700	575	650	
DESCEND 240 KCAS IDLE ④	NMI REMAINING		8	16	24	32	40	49	59	70	81	
	NMI REMAINING		2	4	5	7	8	9	11	12	14	
	FUEL REMAINING		312	328	340	352	362	375	386	397	407	

Note

WITH MORE THAN 1400 POUNDS FUEL, CRUISE AT 0.90 MACH, PRESSURE ALTITUDE 43,000 FEET.

① FUEL AND TIME INCLUDED FOR DESCENT AT DESTINATION WITHOUT DISTANCE CREDIT. SPEED BRAKE CLOSED.
② TIME AND FUEL INCLUDED FOR CLIMB TO OPTIMIM ALTITUDE AND DESCENT AT DESTINATION; NO DISTANCE CREDIT FOR DESCENT TO SEA LEVEL DESTINATION. SPEED BRAKE OPEN.
③ TIME AND FUEL INCLUDED FOR CLIMB TO OPTIMUM ALTITUDE AND DESCENT AT DESTINATION, RANGE INCLUDES DISTANCE FOR ON-COURSE DESCENT TO SEA LEVEL DESTINATION, SPEED BRAKE CLOSED.
④ DESCENT DATA TABULATED FOR SPEED BRAKE CLOSED; WITH SPEED BRAKE OPEN, USE ONE-HALF OF THE VALUES.
5. CLIMB USING FOLLOWING MIL THRUST CLIMB SPEED SCHEDULE:
6. TIME DISTANCE AND FUEL (APPROX 120 POUND) FOR ACCELERATION TO CLIMB SPEED NOT INCLUDED.

PRESS. ALT (1000 FT)	SL	5	10	15	20	25	30	35	40	45
TRUE MACH	0.75	0.76	0.78	0.79	0.81	0.83	0.84	0.86	0.87	0.87
KCAS	496	466	435	406	377	349	322	295	264	236

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Figure A5-6. Diversion Range Summary Table (Drag Index = 0)

GRD
TO
HYD
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FUE
OXY
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FLT
MISC
LND

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II
III
IV
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VI
VII
A
G
IN

DIVERSION RANGE SUMMARY TABLE
CONSTANT ALTITUDE CRUISE
STANDARD DAY ZERO WIND

MODEL: T-38A
DATE: 1 JULY 1978
DATA BASIS: ESTIMATED DATA

TWO ENGINE

DRAG INDEX = 25

ENGINES: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

RANGE AND TIME REMAINING WITH 300-LB RESERVES AT SEA LEVEL

FUEL	1000 FT	SL	5	10	15	20	25	30	35	40	45	PROCEDURE
		INITIAL ALTITUDE										
600 LB	NMI MIN	37 7	43 9	48 11	53 13	54 14	62 16	68 18	71 19	75 20	75 21	CRUISE AT INITIAL ALTITUDE TO BASE ①
	1000 FT	5/16	10/20	10/25	15/30	20/35	25/40	30/40	35/40	40/45	45	OPTIMUM ALTITUDE
	NMI MIN	39 7	44 8	50 10	56 11	63 12	70 13	77 15	82 16	89 16	89 17	USE OPTIMUM ALTITUDE UNTIL OVER BASE ②
	NMI MIN	54 10	66 11	74 12	87 14	98 16	108 17	119 18	128 19	138 20	142 21	USE OPTIMUM ALTITUDE AND DESCEND ON COURSE ③
800 LB	NMI MIN	61 11	72 14	81 16	91 19	101 21	111 23	124 26	132 27	141 28	141 29	CRUSE AT INITIAL ALTITUDE TO BASE ①
	1000 FT	20/35	25/35	30/40	30/40	35/40	40/45	40/45	40/45	40/45	45	OPTIMUM ALTITUDE
	NMI MIN	75 14	85 15	96 17	107 19	116 20	126 21	137 22	147 24	155 25	157 25	USE OPTIMUM ALTITUDE UNTIL OVER BASE ②
	NMI MIN	108 17	123 19	137 20	151 22	163 23	175 25	187 26	197 27	207 28	210 29	USE OPTIMUM ALTITUDE AND DESCEND ON COURSE ③
1000 LB	NMI MIN	86 15	100 19	114 22	129 25	144 27	160 30	179 33	192 35	207 36	208 36	CRUSE AT INITIAL ALTITUDE TO BASE ①
	1000 FT	30/40	35/45	40/45	40/45	40/45	40/45	40/45	40/45	45	45	OPTIMUM ALTITUDE
	NMI MIN	126 21	140 23	154 25	168 26	180 28	191 29	203 30	212 32	222 32	224 32	USE OPTIMUM ALTITUDE UNTIL OVER BASE ②
	NMI MIN	171 25	188 27	204 28	218 30	231 31	243 33	255 34	265 35	275 36	277 36	USE OPTIMUM ALTITUDE AND DESCEND ON COURSE ③
1400 LB	NMI MIN	134 24	156 29	180 32	204 35	230 40	257 43	280 48	310 50	336 52	– –	CRUSE AT INITIAL ALTITUDE TO BASE ①
	1000 FT	40/45	45	45	45	45	45	45	45	45	45	OPTIMUM ALTITUDE
	NMI MIN	251 36	268 38	284 40	298 42	312 43	326 45	339 46	341 48	350 49	355 49	USE OPIMUM ALTITUDE UNTIL OVER BASE ②
	NMI MIN	304 40	321 42	337 44	352 46	365 47	378 49	392 51	395 51	398 52	400 53	USE OPTIMUM ALTITUDE AND DESCEND ON COURSE ③
CRUSE ALT		SL	5	10	15	20	25	30	35	40	45	
CRUSE MECH NO.		0.50	0.54	0.58	0.63	0.67	0.71	0.76	0.80	0.85	0.89	
APPROX FUEL FLOW LB/HR/ENG		1350	1225	1100	1025	960	875	800	750	725	725	
DESCEND 240 KCAS IDLE ④	NMI REMAINING		7	15	22	30	38	45	53	62	69	
	NMI REMAINING		2	3	5	5	7	9	10	11	12	
	FUEL REMAINING		312	325	337	347	356	365	373	382	390	

Note

WITH MORE THAN 1400 POUNDS FUEL, CRUISE AT 0.88 MACH, PRESSURE ALTITUDE 42,000 FEET.

① FUEL AND TIME INCLUDED FOR DESCENT AT DESTINATION WITHOUT DISTANCE CREDIT. SPEED BRAKE CLOSED.
② TIME AND FUEL INCLUDED FOR CLIMB TO OPTIMIM ALTITUDE AND DESCENT AT DESTINATION; NO DISTANCE CREDIT FOR DESCENT TO SEA LEVEL DESTINATION. SPEED BRAKE OPEN.
③ TIME AND FUEL INCLUDED FOR CLIMB TO OPTIMUM ALTITUDE AND DESCENT AT DESTINATION, RANGE INCLUDES DISTANCE FOR ON-COURSE DESCENT TO SEA LEVEL DESTINATION, SPEED BRAKE CLOSED.
④ DESCENT DATA TABULATED FOR SPEED BRAKE CLOSED; WITH SPEED BRAKE OPEN, USE ONE-HALF OF THE VALUES.
5. CLIMB USING FOLLOWING MIL THRUST CLIMB SPEED SCHEDULE:
6. TIME DISTANCE AND FUEL (APPROX 120 POUND) FOR ACCELERATION TO CLIMB SPEED NOT INCLUDED.

PRESS. ALT (1000 FT)	SL	5	10	15	20	25	30	35	40	45
TRUE MACH	0.75	0.76	0.78	0.79	0.81	0.83	0.84	0.86	0.87	0.87
KCAS	496	466	435	406	377	349	322	295	264	236

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Figure A5-7. Diversion Range Summary Table (Drag Index = 25)

DIVERSION RANGE SUMMARY TABLE

CONSTANT ALTITUDE CRUISE
STANDARD DAY ZERO WIND

MODEL: T-38A
DATE: 1 JULY 1978
DATA BASIS: ESTIMATED DATA

TWO ENGINE

DRAG INDEX = 50

ENGINES: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

RANGE AND TIME REMAINING WITH 300-LB RESERVES AT SEA LEVEL												
FUEL	1000 FT	INITIAL ALTITUDE										PROCEDURE
		SL	5	10	15	20	25	30	35	40	45	
600 LB	NMI MIN	35 7	48 8	45 11	50 12	55 14	59 16	65 17	68 18	71 19	– –	CRUISE AT INITIAL ALTITUDE TO BASE ①
	1000 FT	5/15	5/20	10/25	15/30	20/30	25/35	30/40	35/40	40	40	OPTIMUM ALTITUDE
	NMI MIN	36 6	42 8	47 10	53 10	59 12	66 13	73 14	77 15	82 15	83 15	USE OPTIMUM ALTITUDE UNTIL OVER BASE ②
	NMI MIN	48 8	59 10	69 12	80 13	89 14	99 15	110 17	120 18	128 19	131 19	USE OPTIMUM ALTITUDE AND DESCEND ON COURSE ③
800 LB	NMI MIN	58 11	68 13	77 16	86 18	96 21	106 22	117 24	124 25	132 26	– –	CRUSE AT INITIAL ALTITUDE TO BASE ①
	1000 FT	15/30	20/30	25/35	30/40	30/40	35/40	40	40	40	40	OPTIMUM ALTITUDE
	NMI MIN	67 12	77 14	87 15	98 17	107 18	116 20	126 21	135 22	143 23	144 23	USE OPTIMUM ALTITUDE UNTIL OVER BASE ②
	NMI MIN	94 15	108 17	122 18	136 20	148 21	160 23	171 24	181 25	189 26	192 27	USE OPTIMUM ALTITUDE AND DESCEND ON COURSE ③
1000 LB	NMI MIN	81 16	95 18	108 21	122 23	137 27	151 29	169 31	180 33	192 34	– –	CRUSE AT INITIAL ALTITUDE TO BASE ①
	1000 FT	30/40	30/40	25/40	40	40	40	40	40	40	40	OPTIMUM ALTITUDE
	NMI MIN	110 19	125 21	138 22	151 24	163 25	175 27	186 28	198 29	204 30	204 31	USE OPTIMUM ALTITUDE UNTIL OVER BASE ②
	NMI MIN	148 21	166 24	182 25	196 27	208 29	220 30	232 32	241 33	249 34	252 35	USE OPTIMUM ALTITUDE AND DESCEND ON COURSE ③
1400 LB	NMI MIN	127 24	148 27	170 32	193 34	218 39	242 41	271 45	289 47	311 49	– –	CRUSE AT INITIAL ALTITUDE TO BASE ①
	1000 FT	40	40	40	40	40	40	40	40	40	40	OPTIMUM ALTITUDE
	NMI MIN	221 32	239 25	255 37	269 38	282 40	294 41	305 43	314 44	322 45	323 45	USE OPIMUM ALTITUDE UNTIL OVER BASE ②
	NMI MIN	226 36	284 38	300 40	314 42	327 44	339 45	350 46	360 48	368 49	370 49	USE OPTIMUM ALTITUDE AND DESCEND ON COURSE ③
CRUSE ALT		SL	5	10	15	20	25	30	35	40	45	
CRUSE MECH NO.		0.47	0.52	0.56	0.61	0.65	0.70	0.75	0.79	0.84	DESCEND TO 40,000 FT	
APPROX FUEL FLOW LB/HR/ENG		1350	1250	1125	1075	1000	900	850	775	775		
DESCEND 240 KCAS IDLE ④	NMI REMAINING	7	14	20	27	34	42	49	57	64		
	NMI REMAINING	1	3	4	6	7	8	9	10	11		
	FUEL REMAINING	310	323	332	342	352	360	368	375	382		

Note

WITH MORE THAN 1400 POUNDS FUEL, CRUISE AT 0.86 MACH, PRESSURE ALTITUDE 41,000 FEET.

1. FUEL AND TIME INCLUDED FOR DESCENT AT DESTINATION WITHOUT DISTANCE CREDIT. SPEED BRAKE CLOSED.
2. TIME AND FUEL INCLUDED FOR CLIMB TO OPTIMIM ALTITUDE AND DESCENT AT DESTINATION; NO DISTANCE CREDIT FOR DESCENT TO SEA LEVEL DESTINATION. SPEED BRAKE OPEN.
3. TIME AND FUEL INCLUDED FOR CLIMB TO OPTIMUM ALTITUDE AND DESCENT AT DESTINATION, RANGE INCLUDES DISTANCE FOR ON-COURSE DESCENT TO SEA LEVEL DESTINATION, SPEED BRAKE CLOSED.
4. DESCENT DATA TABULATED FOR SPEED BRAKE CLOSED; WITH SPEED BRAKE OPEN, USE ONE-HALF OF THE VALUES.
5. CLIMB USING FOLLOWING MIL THRUST CLIMB SPEED SCHEDULE:
6. TIME DISTANCE AND FUEL (APPROX 120 POUND) FOR ACCELERATION TO CLIMB SPEED NOT INCLUDED.

PRESS. ALT (1000 FT)	SL	5	10	15	20	25	30	35	40	45
TRUE MACH	0.75	0.76	0.78	0.79	0.81	0.83	0.84	0.86	0.87	0.87
KCAS	496	466	435	406	377	349	322	295	264	236

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Figure A5-8. Diversion Range Summary Table (Drag Index = 50)

GRD TO HYD ELE FUE OXY ENG FLT MISC LND

I II III IV V VI VII A G IN

DIVERSION RANGE SUMMARY TABLE
CONSTANT ALTITUDE CRUISE
STANDARD DAY ZERO WIND

MODEL: T-38A
DATE: 1 JULY 1978
DATA BASIS: ESTIMATED DATA

TWO ENGINE

DRAG INDEX = 75

ENGINES: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

RANGE AND TIME REMAINING WITH 300-LB RESERVES AT SEA LEVEL												
FUEL	**1000 FT**	**INITIAL ALTITUDE** SL	5	10	15	20	25	30	35	40	45	**PROCEDURE**
600 LB	NMI MIN	33 6	39 8	44 10	48 12	52 13	57 14	62 16	64 17	67 17	– –	CRUISE AT INITIAL ALTITUDE TO BASE ①
	1000 FT	0/10	5/15	10/20	15/25	20/30	25/30	30/35	35/40	40	40	OPTIMUM ALTITUDE
	NMI MIN	33 6	39 8	45 9	50 10	56 11	62 12	69 13	73 14	77 14	77 14	USE OPTIMUM ALTITUDE UNTIL OVER BASE ②
	NMI MIN	42 7	52 9	62 10	72 11	83 13	92 14	101 15	112 16	120 17	123 18	USE OPTIMUM ALTITUDE AND DESCEND ON COURSE ③
800 LB	NMI MIN	55 11	64 13	73 15	82 17	91 19	100 20	110 22	117 24	123 25	– –	CRUSE AT INITIAL ALTITUDE TO BASE ①
	1000 FT	10/25	15/30	20/30	25/35	30/40	30/40	30/40	35/40	40	40	OPTIMUM ALTITUDE
	NMI MIN	60 11	69 13	79 14	88 15	99 17	108 18	117 20	125 21	133 21	134 22	USE OPTIMUM ALTITUDE UNTIL OVER BASE ②
	NMI MIN	80 12	95 14	109 16	121 18	105 19	147 21	159 22	168 23	176 25	179 26	USE OPTIMUM ALTITUDE AND DESCEND ON COURSE ③
1000 LB	NMI MIN	77 15	90 17	103 20	116 23	129 24	143 27	159 29	169 32	179 32	– –	CRUSE AT INITIAL ALTITUDE TO BASE ①
	1000 FT	25/30	30/35	20/40	30/40	35/40	40	40	40	40	40	OPTIMUM ALTITUDE
	NMI MIN	96 16	110 18	125 20	137 22	149 23	160 24	172 26	181 27	189 28	189 29	USE OPTIMUM ALTITUDE UNTIL OVER BASE ②
	NMI MIN	126 18	144 21	162 22	177 24	191 26	203 28	215 29	224 30	232 32	234 32	USE OPTIMUM ALTITUDE AND DESCEND ON COURSE ③
1400 LB	NMI MIN	121 23	141 27	162 30	183 33	205 36	228 39	254 42	272 44	289 45	– –	CRUSE AT INITIAL ALTITUDE TO BASE ①
	1000 FT	40	40	40	40	40	40	40	40	40	40	OPTIMUM ALTITUDE
	NMI MIN	191 28	211 31	229 33	244 35	258 37	270 38	282 40	291 41	299 42	301 43	USE OPIMUM ALTITUDE UNTIL OVER BASE ②
	NMI MIN	234 31	254 34	272 36	287 38	301 40	313 41	325 43	334 44	342 45	346 46	USE OPTIMUM ALTITUDE AND DESCEND ON COURSE ③
CRUSE ALT		SL	5	10	15	20	25	30	35	40	45	
CRUSE MECH NO.		0.47	0.52	0.56	0.61	0.65	0.70	0.75	0.79	0.84	DEDCEND TO 40,000 FT	**Note** WITH MORE THAN 1400 POUNDS FUEL, CRUISE AT 0.86 MACH, PRESSURE ALTITUDE 41,000 FEET.
APPROX FUEL FLOW LB/HR/ENG		1400	1300	1200	1125	1050	975	900	850	825		
DESCEND 240 KCAS IDLE ④	NMI REMAINING		6	13	19	25	32	39	45	53		
	NMI REMAINING		1	3	4	5	6	7	8	9		
	FUEL REMAINING		310	320	330	339	348	356	363	370		

① FUEL AND TIME INCLUDED FOR DESCENT AT DESTINATION WITHOUT DISTANCE CREDIT. SPEED BRAKE CLOSED.
② TIME AND FUEL INCLUDED FOR CLIMB TO OPTIMIM ALTITUDE AND DESCENT AT DESTINATION; NO DISTANCE CREDIT FOR DESCENT TO SEA LEVEL DESTINATION. SPEED BRAKE OPEN.
③ TIME AND FUEL INCLUDED FOR CLIMB TO OPTIMUM ALTITUDE AND DESCENT AT DESTINATION, RANGE INCLUDES DISTANCE FOR ON-COURSE DESCENT TO SEA LEVEL DESTINATION, SPEED BRAKE CLOSED.
④ DESCENT DATA TABULATED FOR SPEED BRAKE CLOSED; WITH SPEED BRAKE OPEN, USE ONE-HALF OF THE VALUES.
5. CLIMB USING FOLLOWING MIL THRUST CLIMB SPEED SCHEDULE:
6. TIME DISTANCE AND FUEL (APPROX 120 POUND) FOR ACCELERATION TO CLIMB SPEED NOT INCLUDED.

PRESS. ALT (1000 FT)	SL	5	10	15	20	25	30	35	40	45
TRUE MACH	0.75	0.76	0.78	0.79	0.81	0.83	0.84	0.86	0.87	0.87
KCAS	496	466	435	406	377	349	322	295	264	236

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Figure A5-9. Diversion Range Summary Table (Drag Index = 75)

GRD
TO
HYD
ELE
FUE
OXY
ENG
FLT
MISC
LND

I
II
III
IV
V
VI
VII
A
G
IN

DIVERSION RANGE SUMMARY TABLE
CONSTANT ALTITUDE CRUISE
STANDARD DAY ZERO WIND

MODEL: T-38A
DATE: 1 JULY 1978
DATA BASIS: ESTIMATED DATA

SINGLE ENGINE
DRAG INDEX = 0

ENGINES: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

RANGE AND TIME REMAINING WITH 300-LB RESERVES AT SEA LEVEL												
FUEL	1000 FT	INITIAL ALTITUDE SL	5	10	15	20	25	30	35	40	45	PROCEDURE
600 LB	NMI MIN	53 11	50 14	65 16	71 18	75 20	78 21	– –	– –	– –	– –	CRUISE AT INITIAL ALTITUDE TO BASE (1)
	1000 FT	5/15	10/20	10/20	15/20	20/25	25	25	25	25	25	OPTIMUM ALTITUDE
	NMI MIN	55 12	60 14	67 15	73 16	80 17	83 17	86 18	97 20	106 20	116 22	USE OPTIMUM ALTITUDE UNTIL OVER BASE (2)
	NMI MIN	70 14	80 16	91 17	100 19	110 20	118 21	124 21	132 23	142 24	151 25	USE OPTIMUM ALTITUDE AND DESCEND ON COURSE (3)
800 LB	NMI MIN	87 18	99 22	110 25	119 26	131 29	134 30	– –	– –	– –	– –	CRUSE AT INITIAL ALTITUDE TO BASE (1)
	1000 FT	10/20	15/25	20/25	20/25	20/25	25	20/25	20/25	20/25	20/25	OPTIMUM ALTITUDE
	NMI MIN	97 21	106 22	116 24	126 25	134 26	139 26	146 27	155 29	164 30	174 32	USE OPTIMUM ALTITUDE UNTIL OVER BASE (2)
	NMI MIN	134 34	134 25	145 26	156 28	156 29	174 30	180 30	188 32	198 33	208 34	USE OPTIMUM ALTITUDE AND DESCEND ON COURSE (3)
1000 LB	NMI MIN	122 25	158 29	151 33	153 35	135 38	152 38	– –	– –	– –	– –	CRUSE AT INITIAL ALTITUDE TO BASE (1)
	1000 FT	10/25	20/25	20/25	20/25	20/25	25	20/25	20/25	20/25	20/25	OPTIMUM ALTITUDE
	NMI MIN	148 29	159 31	169 33	179 34	188 35	194 35	200 36	209 38	218 39	228 41	USE OPTIMUM ALTITUDE UNTIL OVER BASE (2)
	NMI MIN	176 32	190 35	201 35	211 36	221 38	229 38	235 39	244 41	253 42	263 43	USE OPTIMUM ALTITUDE AND DESCEND ON COURSE (3)
1400 LB	NMI MIN	189 39	214 44	239 49	261 51	288 55	294 55	– –	– –	– –	– –	CRUSE AT INITIAL ALTITUDE TO BASE (1)
	1000 FT	20/25	20/25	20/25	20/25	20/25	25	25	25	25	25	OPTIMUM ALTITUDE
	NMI MIN	250 47	261 48	272 50	282 5	291 53	299 52	304 53	313 54	322 55	332 57	USE OPIMUM ALTITUDE UNTIL OVER BASE (2)
	NMI MIN	282 49	294 51	305 52	316 53	325 55	334 55	339 53	348 58	358 58	367 60	USE OPTIMUM ALTITUDE AND DESCEND ON COURSE (3)

		SL	5	10	15	20	25	
CRUSE ALT		SL	5	10	15	20	25	DESCEND TO 20,000 OR 25,000 FT.
CRUSE MECH NO.		0.44	0.47	0.50	0.54	0.58	0.62	USE IDLE THRUST AND 240 KCAS WITH SPEED BRAKE CLOSED.
APPROX FUEL FLOW LB/HR/ENG		1650	1550	1400	1350	1300	1275	
DESCEND 240 KCAS IDLE (4)	NMI REMAINING	8	15	24	32	40		
	NMI REMAINING	2	4	5	7	8		
	FUEL REMAINING	306	314	320	326	332		

Note

WITH MORE THAN 1400 POUNDS FUEL, CRUISE AT 0.62 MACH, PRESSURE ALTITUDE 23,000 FEET.

1. FUEL AND TIME INCLUDED FOR DESCENT AT DESTINATION WITHOUT DISTANCE CREDIT. SPEED BRAKE CLOSED.
2. TIME AND FUEL INCLUDED FOR CLIMB TO OPTIMIM ALTITUDE AND DESCENT AT DESTINATION; NO DISTANCE CREDIT FOR DESCENT TO SEA LEVEL DESTINATION. SPEED BRAKE OPEN.
3. TIME AND FUEL INCLUDED FOR CLIMB TO OPTIMUM ALTITUDE AND DESCENT AT DESTINATION, RANGE INCLUDES DISTANCE FOR ON-COURSE DESCENT TO SEA LEVEL DESTINATION, SPEED BRAKE CLOSED.
4. DESCENT DATA TABULATED FOR SPEED BRAKE CLOSED; WITH SPEED BRAKE OPEN, USE ONE-HALF OF THE VALUES.
5. CLIMB USING FOLLOWING MIL THRUST CLIMB SPEED SCHEDULE:
6. TIME DISTANCE AND FUEL (APPROX 120 POUND) FOR ACCELERATION TO CLIMB SPEED NOT INCLUDED.

PRESS. ALT (1000 FT)	SL	5	10	15	20	25
TRUE MACH	0.43	0.46	0.49	0.52	0.56	0.59
KCAS	281	273	271	264	256	246

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Figure A5-10. Diversion Range Summary Table - Single Engine (Drag Index = 0)

DIVERSION RANGE SUMMARY TABLE
CONSTANT ALTITUDE CRUISE
STANDARD DAY ZERO WIND
SINGLE ENGINE
DRAG INDEX = 25

MODEL: T-38A
DATE: 1 JULY 1978
DATA BASIS: ESTIMATED DATA

ENGINES: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

RANGE AND TIME REMAINING WITH 300-LB RESERVES AT SEA LEVEL												
FUEL	1000 FT	INITIAL ALTITUDE: SL	5	10	15	20	25	30	35	40	45	PROCEDURE
600 LB	NMI MIN	49 11	55 13	61 15	65 17	71 18	– –	– –	– –	– –	– –	CRUISE AT INITIAL ALTITUDE TO BASE (1)
	1000 FT	5/15	5/15	10/20	15/20	20	20	20	20	20	20	OPTIMUM ALTITUDE
	NMI MIN	50 11	56 12	62 13	67 15	74 16	76 16	85 18	92 19	100 20	106 21	USE OPTIMUM ALTITUDE UNTIL OVER BASE (2)
	NMI MIN	63 13	72 14	84 15	93 17	101 18	107 19	112 21	119 21	127 22	133 23	USE OPTIMUM ALTITUDE AND DESCEND ON COURSE (3)
800 LB	NMI MIN	81 18	92 21	102 23	110 25	120 27	– –	– –	– –	– –	– –	CRUSE AT INITIAL ALTITUDE TO BASE (1)
	1000 FT	10/20	15/20	20	20	20/25	20	20	20	20	20	OPTIMUM ALTITUDE
	NMI MIN	89 19	97 20	106 22	116 23	123 24	126 25	135 27	142 27	150 28	156 29	USE OPTIMUM ALTITUDE UNTIL OVER BASE (2)
	NMI MIN	111 21	123 23	133 24	143 26	153 26	156 27	162 29	169 30	177 31	103 32	USE OPTIMUM ALTITUDE AND DESCEND ON COURSE (3)
1000 LB	NMI MIN	113 25	128 28	142 30	151 33	169 35	– –	– –	– –	– –	– –	CRUSE AT INITIAL ALTITUDE TO BASE (1)
	1000 FT	20	20/25	20/25	20/25	20	20	20	20	20	20	OPTIMUM ALTITUDE
	NMI MIN	133 27	144 29	155 30	165 31	172 33	174 33	183 35	190 36	198 37	204 37	USE OPTIMUM ALTITUDE UNTIL OVER BASE (2)
	NMI MIN	160 29	171 31	185 32	194 33	199 35	205 36	210 37	217 38	225 39	231 40	USE OPTIMUM ALTITUDE AND DESCEND ON COURSE (3)
1400 LB	NMI MIN	175 39	198 43	221 45	240 48	262 51	– –	– –	– –	– –	– –	CRUSE AT INITIAL ALTITUDE TO BASE (1)
	1000 FT	20	20	20	20	20	20	20	20	20	20	OPTIMUM ALTITUDE
	NMI MIN	226 43	237 45	248 46	257 47	265 48	267 49	276 51	283 52	291 53	297 53	USE OPIMUM ALTITUDE UNTIL OVER BASE (2)
	NMI MIN	253 45	264 47	275 49	284 50	292 51	297 52	303 53	310 54	318 55	324 56	USE OPTIMUM ALTITUDE AND DESCEND ON COURSE (3)

		SL	5	10	15	20	25		
CRUSE ALT		SL	5	10	15	20	25	DESCEND TO 20,000 FT	*Note* WITH MORE THAN 1400 POUNDS FUEL, CRUISE AT 0.60 MACH, PRESSURE ALTITUDE 20,000 FEET.
CRUSE MECH NO.		0.41	0.45	0.49	0.53	0.57	0.62	USE IDLE THRUST AND 240 KCAS WITH SPEED BRAKE CLOSED.	
APPROX FUEL FLOW LB/HR/ENG		1650	1575	1500	1450	1375	1400		
DESCEND 240 KCAS IDLE (4)	NMI REMAINING		7	15	22	30	38		
	NMI REMAINING		2	3	5	6	7		
	FUEL REMAINING		305	313	319	325	330		

1. FUEL AND TIME INCLUDED FOR DESCENT AT DESTINATION WITHOUT DISTANCE CREDIT. SPEED BRAKE CLOSED.
2. TIME AND FUEL INCLUDED FOR CLIMB TO OPTIMIM ALTITUDE AND DESCENT AT DESTINATION; NO DISTANCE CREDIT FOR DESCENT TO SEA LEVEL DESTINATION. SPEED BRAKE OPEN.
3. TIME AND FUEL INCLUDED FOR CLIMB TO OPTIMUM ALTITUDE AND DESCENT AT DESTINATION, RANGE INCLUDES DISTANCE FOR ON-COURSE DESCENT TO SEA LEVEL DESTINATION, SPEED BRAKE CLOSED.
4. DESCENT DATA TABULATED FOR SPEED BRAKE CLOSED; WITH SPEED BRAKE OPEN, USE ONE-HALF OF THE VALUES.
5. CLIMB USING FOLLOWING MIL THRUST CLIMB SPEED SCHEDULE:
6. TIME DISTANCE AND FUEL (APPROX 120 POUND) FOR ACCELERATION TO CLIMB SPEED NOT INCLUDED.

PRESS. ALT (1000 FT)	SL	5	10	15	20	25
TRUE MACH	0.43	0.46	0.49	0.52	0.56	0.59
KCAS	281	273	271	264	256	246

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Figure A5-11. Diversion Range Summary Table - Single Engine (Drag Index = 25)

DIVERSION RANGE SUMMARY TABLE
CONSTANT ALTITUDE CRUISE
STANDARD DAY ZERO WIND

MODEL: T-38A
DATE: 1 JULY 1978
DATA BASIS: ESTIMATED DATA

SINGLE ENGINE

DRAG INDEX = 50

ENGINES: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

RANGE AND TIME REMAINING WITH 300-LB RESERVES AT SEA LEVEL

FUEL	1000 FT	INITIAL ALTITUDE SL	5	10	15	20	25	30	35	40	45	PROCEDURE
600 LB	NMI MIN	46 10	52 12	56 14	60 15	64 17	– –	– –	– –	– –	– –	CRUISE AT INITIAL ALTITUDE TO BASE ①
	1000 FT	5/10	5/15	10/15	15/20	20	20	20	20	20	20	OPTIMUM ALTITUDE
	NMI MIN	47 10	52 11	58 13	62 14	67 15	69 15	79 16	85 17	92 18	98 19	USE OPTIMUM ALTITUDE UNTIL OVER BASE ②
	NMI MIN	57 12	66 13	74 14	85 16	91 17	96 18	103 19	109 20	117 21	123 22	USE OPTIMUM ALTITUDE AND DESCEND ON COURSE ③
800 LB	NMI MIN	77 17	86 19	95 22	102 23	109 25	– –	– –	– –	– –	– –	CRUSE AT INITIAL ALTITUDE TO BASE ①
	1000 FT	10/15	10/20	15/20	20	20	20	20	20	20	20	OPTIMUM ALTITUDE
	NMI MIN	82 18	89 19	97 20	105 22	111 23	113 23	123 24	130 25	137 26	143 27	USE OPTIMUM ALTITUDE UNTIL OVER BASE ②
	NMI MIN	98 19	111 21	121 23	130 24	136 25	141 26	148 27	154 25	161 29	168 29	USE OPTIMUM ALTITUDE AND DESCEND ON COURSE ③
1000 LB	NMI MIN	107 24	120 26	133 29	143 31	153 33	– –	– –	– –	– –	– –	CRUSE AT INITIAL ALTITUDE TO BASE ①
	1000 FT	15/20	20	20	20	20	20	20	20	20	20	OPTIMUM ALTITUDE
	NMI MIN	121 25	130 27	140 28	149 30	155 31	157 31	167 32	174 33	181 34	187 35	USE OPTIMUM ALTITUDE UNTIL OVER BASE ②
	NMI MIN	145 28	155 27	165 31	174 32	180 33	185 34	192 35	195 36	205 36	212 37	USE OPTIMUM ALTITUDE AND DESCEND ON COURSE ③
1400 LB	NMI MIN	165 37	185 40	206 43	221 46	236 48	– –	– –	– –	– –	– –	CRUSE AT INITIAL ALTITUDE TO BASE ①
	1000 FT	20	20	20	20	20	20	20	20	20	20	OPTIMUM ALTITUDE
	NMI MIN	204 40	215 42	225 43	233 44	239 45	241 46	151 47	257 48	265 49	271 50	USE OPIMUM ALTITUDE UNTIL OVER BASE ②
	NMI MIN	229 43	239 44	249 46	258 47	263 48	259 49	276 50	282 50	289 51	295 52	USE OPTIMUM ALTITUDE AND DESCEND ON COURSE ③

CRUSE ALT		SL	5	10	15	20	25
CRUSE MECH NO.		0.41	0.45	0.49	0.53	0.57	
APPROX FUEL FLOW LB/HR/ENG		1850	1700	1625	1575	1525	
DESCEND 240 KCAS IDLE ④	NMI REMAINING		7	14	20	27	
	NMI REMAINING		1	3	4	6	
	FUEL REMAINING		305	312	317	321	

DESCEND TO 20,000 FT

USE IDLE THRUST AND 240 KCAS WITH SPEED BRAKE CLOSED.

Note

WITH MORE THAN 1400 POUNDS FUEL, CRUISE AT 0.58 MACH, PRESSURE ALTITUDE 20,000 FEET.

① FUEL AND TIME INCLUDED FOR DESCENT AT DESTINATION WITHOUT DISTANCE CREDIT. SPEED BRAKE CLOSED.
② TIME AND FUEL INCLUDED FOR CLIMB TO OPTIMIM ALTITUDE AND DESCENT AT DESTINATION; NO DISTANCE CREDIT FOR DESCENT TO SEA LEVEL DESTINATION. SPEED BRAKE OPEN.
③ TIME AND FUEL INCLUDED FOR CLIMB TO OPTIMUM ALTITUDE AND DESCENT AT DESTINATION, RANGE INCLUDES DISTANCE FOR ON-COURSE DESCENT TO SEA LEVEL DESTINATION, SPEED BRAKE CLOSED.
④ DESCENT DATA TABULATED FOR SPEED BRAKE CLOSED; WITH SPEED BRAKE OPEN, USE ONE-HALF OF THE VALUES.
5. CLIMB USING FOLLOWING MIL THRUST CLIMB SPEED SCHEDULE:
6. TIME DISTANCE AND FUEL (APPROX 120 POUND) FOR ACCELERATION TO CLIMB SPEED NOT INCLUDED.

PRESS. ALT (1000 FT)	SL	5	10	15	20	25
TRUE MACH	0.43	0.46	0.49	0.52	0.56	0.59
KCAS	281	273	271	264	256	246

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Figure A5-12. Diversion Range Summary Table - Single Engine (Drag Index = 50)

DIVERSION RANGE SUMMARY TABLE

CONSTANT ALTITUDE CRUISE
STANDARD DAY ZERO WIND

MODEL: T-38A
DATE: 1 JULY 1978
DATA BASIS: ESTIMATED DATA

SINGLE ENGINE

DRAG INDEX = 75

ENGINES: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

RANGE AND TIME REMAINING WITH 300-LB RESERVES AT SEA LEVEL

FUEL	1000 FT	SL	5	10	15	20	25	30	35	40	45	PROCEDURE
600 LB	NMI MIN	44 10	48 11	53 13	56 15	59 16	– –	– –	– –	– –	– –	CRUISE AT INITIAL ALTITUDE TO BASE ①
	1000 FT	5/10	5/10	10/15	15	20	20	20	20	20	20	OPTIMUM ALTITUDE
	NMI MIN	44 10	49 11	54 12	58 13	61 13	63 14	73 15	78 16	85 17	91 18	USE OPTIMUM ALTITUDE UNTIL OVER BASE ②
	NMI MIN	53 11	60 12	69 13	75 15	84 16	89 16	96 17	101 18	108 19	113 20	USE OPTIMUM ALTITUDE AND DESCEND ON COURSE ③
800 LB	NMI MIN	72 16	82 18	89 20	95 22	100 23	– –	– –	– –	– –	– –	CRUSE AT INITIAL ALTITUDE TO BASE ①
	1000 FT	10/15	10/15	15	20	20	20	20	20	20	20	OPTIMUM ALTITUDE
	NMI MIN	76 17	83 18	90 19	97 20	102 21	104 21	114 22	119 23	126 24	132 25	USE OPTIMUM ALTITUDE UNTIL OVER BASE ②
	NMI MIN	91 18	100 19	108 21	120 22	125 23	130 24	136 24	142 25	149 26	154 27	USE OPTIMUM ALTITUDE AND DESCEND ON COURSE ③
1000 LB	NMI MIN	101 23	113 25	124 27	133 29	131 28	– –	– –	– –	– –	– –	CRUSE AT INITIAL ALTITUDE TO BASE ①
	1000 FT	10/15	15/20	20	20	20	20	20	20	20	20	OPTIMUM ALTITUDE
	NMI MIN	111 23	120 25	129 26	128 27	140 27	144 28	154 30	159 30	155 31	172 32	USE OPTIMUM ALTITUDE UNTIL OVER BASE ②
	NMI MIN	129 25	142 27	152 28	161 29	156 28	170 32	177 32	182 33	189 33	195 34	USE OPTIMUM ALTITUDE AND DESCEND ON COURSE ③
1400 LB	NMI MIN	156 35	174 38	192 41	206 43	210 44	– –	– –	– –	– –	– –	CRUSE AT INITIAL ALTITUDE TO BASE ①
	1000 FT	20	20	20	20	20	20	20	20	20	20	OPTIMUM ALTITUDE
	NMI MIN	187 37	197 38	208 40	217 41	220 41	224 42	229 43	234 44	237 45	242 46	USE OPIMUM ALTITUDE UNTIL OVER BASE ②
	NMI MIN	210 39	220 40	231 42	236 43	240 43	244 44	250 45	254 46	261 47	265 48	USE OPTIMUM ALTITUDE AND DESCEND ON COURSE ③

CRUSE ALT		SL	5	10	15	20	25
CRUSE MECH NO.		0.40	0.44	0.48	0.51	0.55	
APPROX FUEL FLOW LB/HR/ENG		1825	1750	1700	1525	1600	
DESCEND 240 KCAS IDLE ④	NMI REMAINING		6	13	19	25	
	NMI REMAINING		1	3	4	5	
	FUEL REMAINING		305	310	315	320	

DESCEND TO 20,000 FT

USE IDLE THRUST AND 240 KCAS WITH SPEED BRAKE CLOSED.

Note

WITH MORE THAN 1400 POUNDS FUEL, CRUISE AT 0.56 MACH, PRESSURE ALTITUDE 18,000 FEET.

① FUEL AND TIME INCLUDED FOR DESCENT AT DESTINATION WITHOUT DISTANCE CREDIT. SPEED BRAKE CLOSED.
② TIME AND FUEL INCLUDED FOR CLIMB TO OPTIMIM ALTITUDE AND DESCENT AT DESTINATION; NO DISTANCE CREDIT FOR DESCENT TO SEA LEVEL DESTINATION. SPEED BRAKE OPEN.
③ TIME AND FUEL INCLUDED FOR CLIMB TO OPTIMUM ALTITUDE AND DESCENT AT DESTINATION, RANGE INCLUDES DISTANCE FOR ON-COURSE DESCENT TO SEA LEVEL DESTINATION, SPEED BRAKE CLOSED.
④ DESCENT DATA TABULATED FOR SPEED BRAKE CLOSED; WITH SPEED BRAKE OPEN, USE ONE-HALF OF THE VALUES.
5. CLIMB USING FOLLOWING MIL THRUST CLIMB SPEED SCHEDULE:
6. TIME DISTANCE AND FUEL (APPROX 120 POUND) FOR ACCELERATION TO CLIMB SPEED NOT INCLUDED.

PRESS. ALT (1000 FT)	SL	5	10	15	20	25
TRUE MACH	0.43	0.46	0.49	0.52	0.56	0.59
KCAS	281	273	271	264	256	246

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Figure A5-13. Diversion Range Summary Table - Single Engine (Drag Index = 75)

PART 6
ENDURANCE

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

PURPOSE OF CHARTS

Endurance charts determine the optimum mach number and fuel required to loiter at a given altitude for a specific period of time. A correction grid to gross weight for bank angle and a temperature correction grid (hotter-than-standard conditions) to fuel flow are provided for optional use.

NOTE

> The effects of temperature for colder- than standard day conditions are considered negligible. Use standard day (base-line) for temperatures below standard day.

The altitude for maximum loiter time is defined in the charts by the drag index curves titled OPTIMUM MAXIMUM ENDURANCE ALTITUDE contained in the gross weight grid. The endurance chart for two-engine operation provides data for drag indices of 0 through 75. The single-engine endurance chart provides data for drag indices of 0 through 75.

USE OF MAXIMUM ENDURANCE CHARTS

Enter the appropriate two-engine or single-engine chart (Figure A6-1 or Figure A6-2) with gross weight. If the loiter period requires turning flight, gross weight should be corrected for bank angle. To use the bank angle correction grid, enter with gross weight and contour the nearest guideline to the right while simultaneously entering the bank angle scale with desired degree of bank angle and projecting up. At the point of intersection of the two projections, proceed left and read gross weight corrected for bank angle.

Gross weight (corrected for bank angle, if required) is then projected right from the gross weight scale of the chart to the pressure altitude. If maximum loiter time is desired, stop momentarily at the optimum maximum endurance altitude drag index curve (interpolate, if necessary). Mark this position location on the chart for further use.

From the point of intersection with pressure altitude, proceed up to the configuration drag index in the upper left grid of the chart, then left to read the indicated mach number for loiter. Return to the plotted point intersection of the gross weight and pressure altitude and proceed down to the drag index at the lower left portion of the chart, then right to the gross weight curve. From this point, proceed up to the baseline of the temperature correction grid (standard day). For hotter-than-standard day condition, contour the guidelines to the temperature increase. (If no increase is required, proceed directly through.) Fuel flow can be read while proceeding up to the desired loiter time. Project right to read fuel required for loiter.

If loiter is already known, project left from the fuel required scale and simultaneously intersect the vertical plot projected from the temperature grid to read loiter time.

The chase-thru lines on Figure A6-1 represent an average gross weight of 10,500 pounds, bank angle of 20°, drag index of 50, loiter time of 30 minutes, and a temperature deviation of 10°C hotter than standard. These lines show corrected gross weight of 11,200, an optimum maximum endurance altitude for a drag index of 50 of 32,000 feet, a loiter speed of 0.71 mach, a fuel flow of 1800 lbs/hr, and 900 pounds of fuel required. For loiter times of long duration greater accuracy requires use of average gross weight during loiter to calculate the fuel required. To obtain average loiter weight, the fuel required to loiter must first be determined based on gross weight at start or end of loiter and then is recalculated based on start or end gross weight, decreased or increased, respectively, by half the calculated loiter fuel.

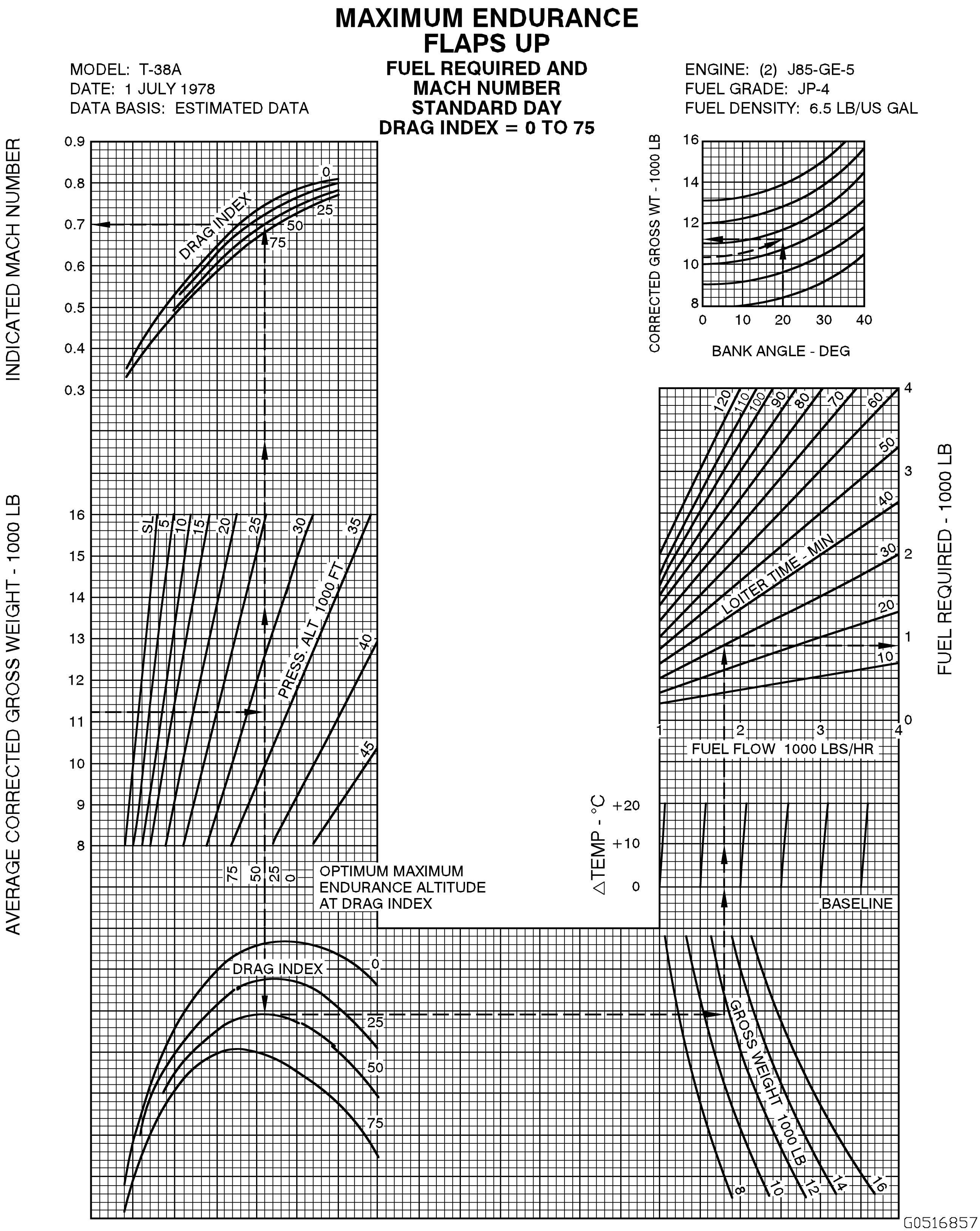

Figure A6-1. Maximum Endurance Flaps Up

GRD
TO
HYD
ELE
FUE
OXY
ENG
FLT
MISC
LND

I
II
III
IV
V
VI
VII
A
G
IN

MAXIMUM ENDURANCE FLAPS UP

MODEL: T-38A
DATE: 1 OCTOBER 1976
DATA BASIS: ESTIMATED DATA

FUEL REQUIRED AND MACH NUMBER

STANDARD DAY
DRAG INDEX = 0 TO 75

SINGLE ENGINE

ENGINE: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

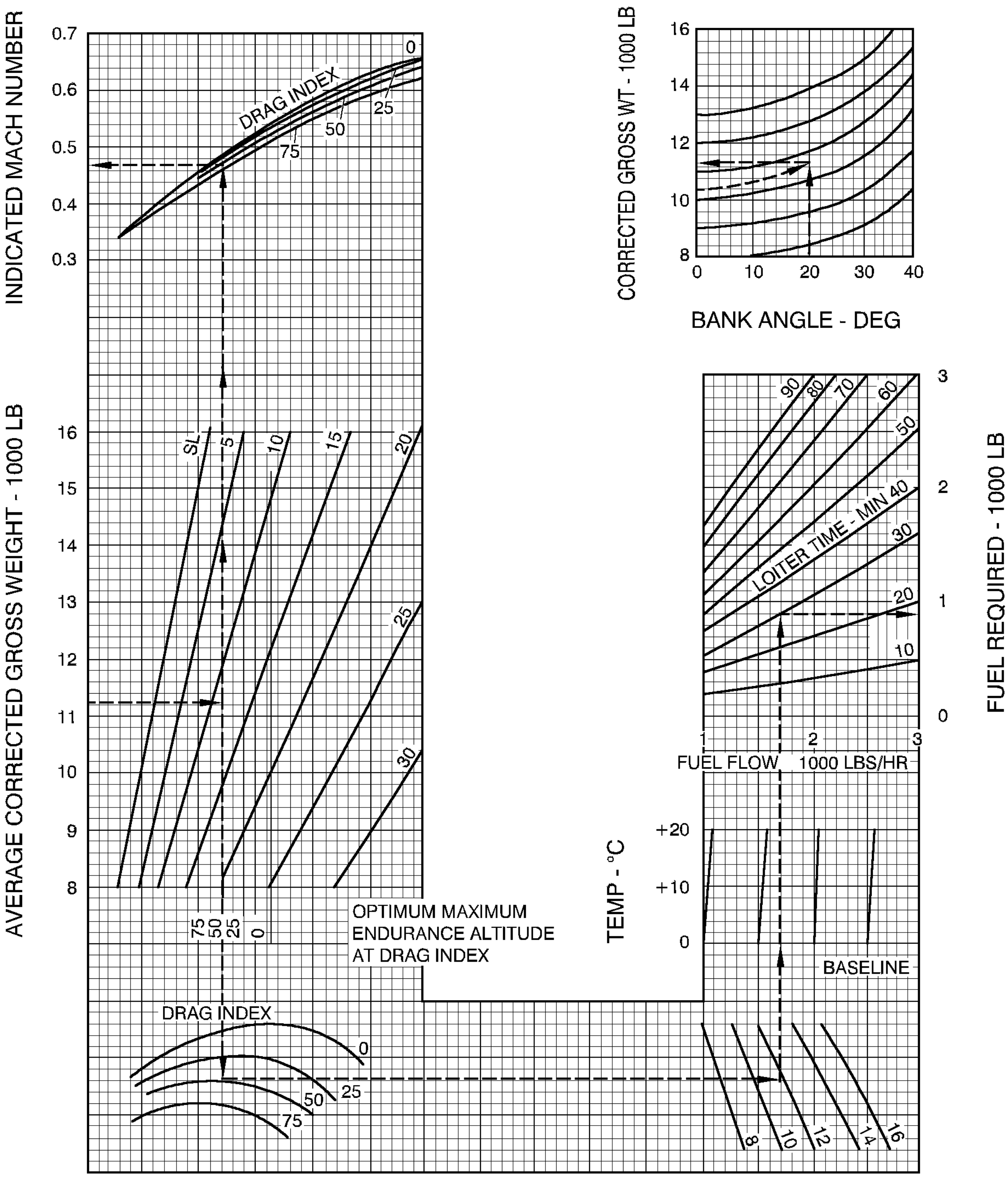

Figure A6-2. Maximum Endurance Flaps Up - Single Engine

GRD TO HYD ELE FUE OXY ENG FLT MISC LND
I II III IV V VI VII A G IN

PART 7
DESCENT

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

GRD
TO
HYD
ELE
FUE
OXY
ENG
FLT
MISC
LND

PURPOSE OF CHARTS

The descent charts provide a means of determining the fuel, time, and distance required to descend from altitude with speed brake closed or open.

DESCENT CHARTS

The maximum range descent chart (Figure A8-1) shows the performance for maximum range. This range is obtained by using idle thrust and maintaining an airspeed of 240 KIAS. Figure A8-2 and Figure A8-3 give the performance for penetration descent. This chart requires 80% RPM and an airspeed of 300 KIAS. The descent charts may be used for descending from one altitude to another by reading the incremental values between the initial and final altitudes.

USE OF DESCENT CHARTS

Assume that maximum range descent is desired from a pressure altitude of 40,000 feet to 10,000 feet. From Figure A8-1, the chase-thru lines show the fuel to descend is 70 pounds (98 - 28), the time is 9 minutes (12.5 - 3.5), and the distance is 54 nautical miles (70 - 16).

I
II
III
IV
V
VI
VII
A
G
IN

GRD TO HYD ELE FUE OXY ENG FLT MISC LND

I II III IV V VI VII A G IN

MAXIMUM RANGE DESCENT

IDLE THRUST 240 KIAS

MODEL: T-38A
DATE: 1 OCTOBER 1976
DATA BASIS: ESTIMATED DATA

STANDARD DAY
DRAG INDEX 0 TO 75
ALL GROSS WEIGHTS
SPEED BRAKE IN

ENGINE: (2) J85-GE-5
FUEL GRADE: JP-4

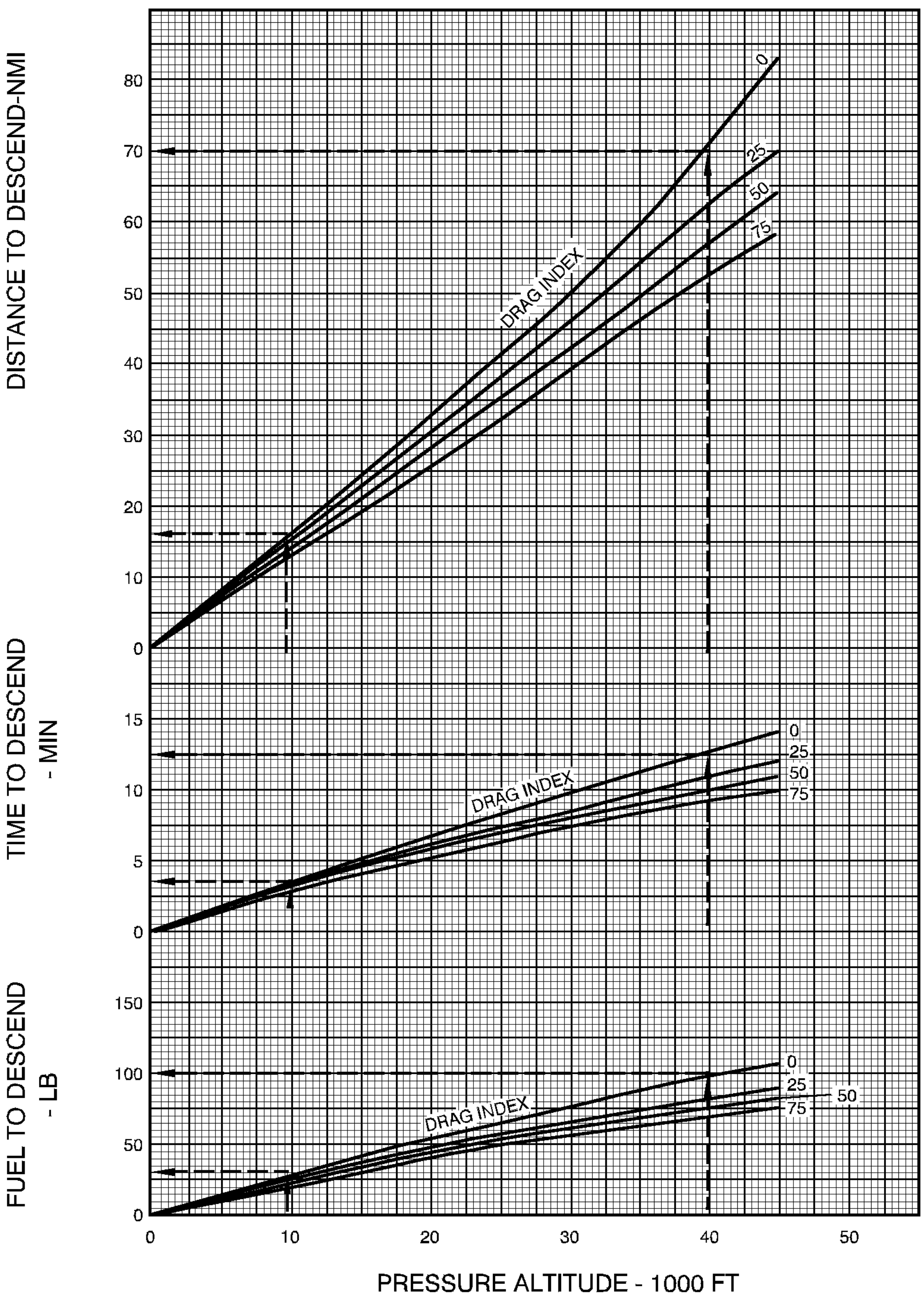

Figure A7-1. Maximum Range Descent

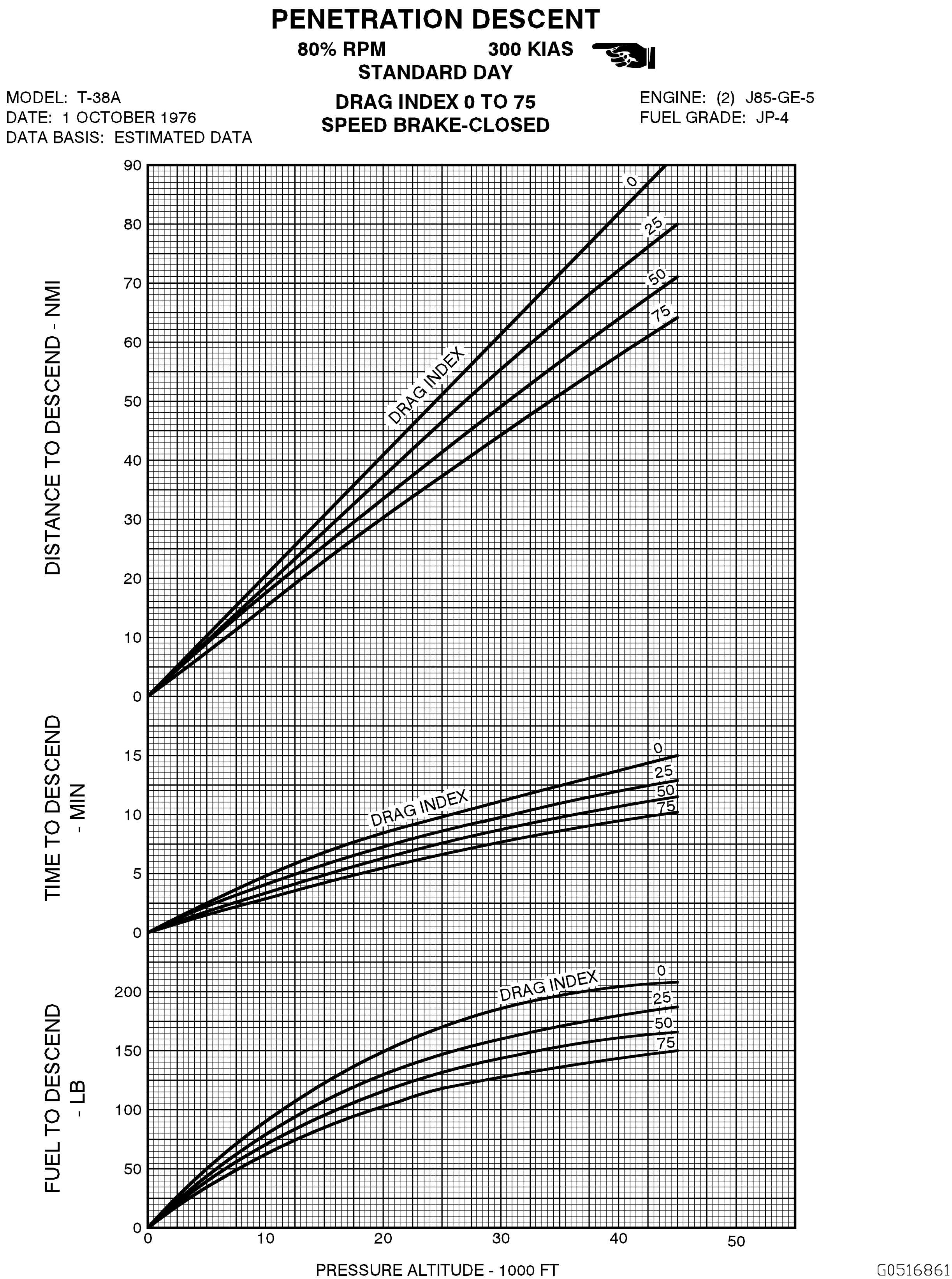

Figure A7-2. Penetration Descent Speed Brake Closed

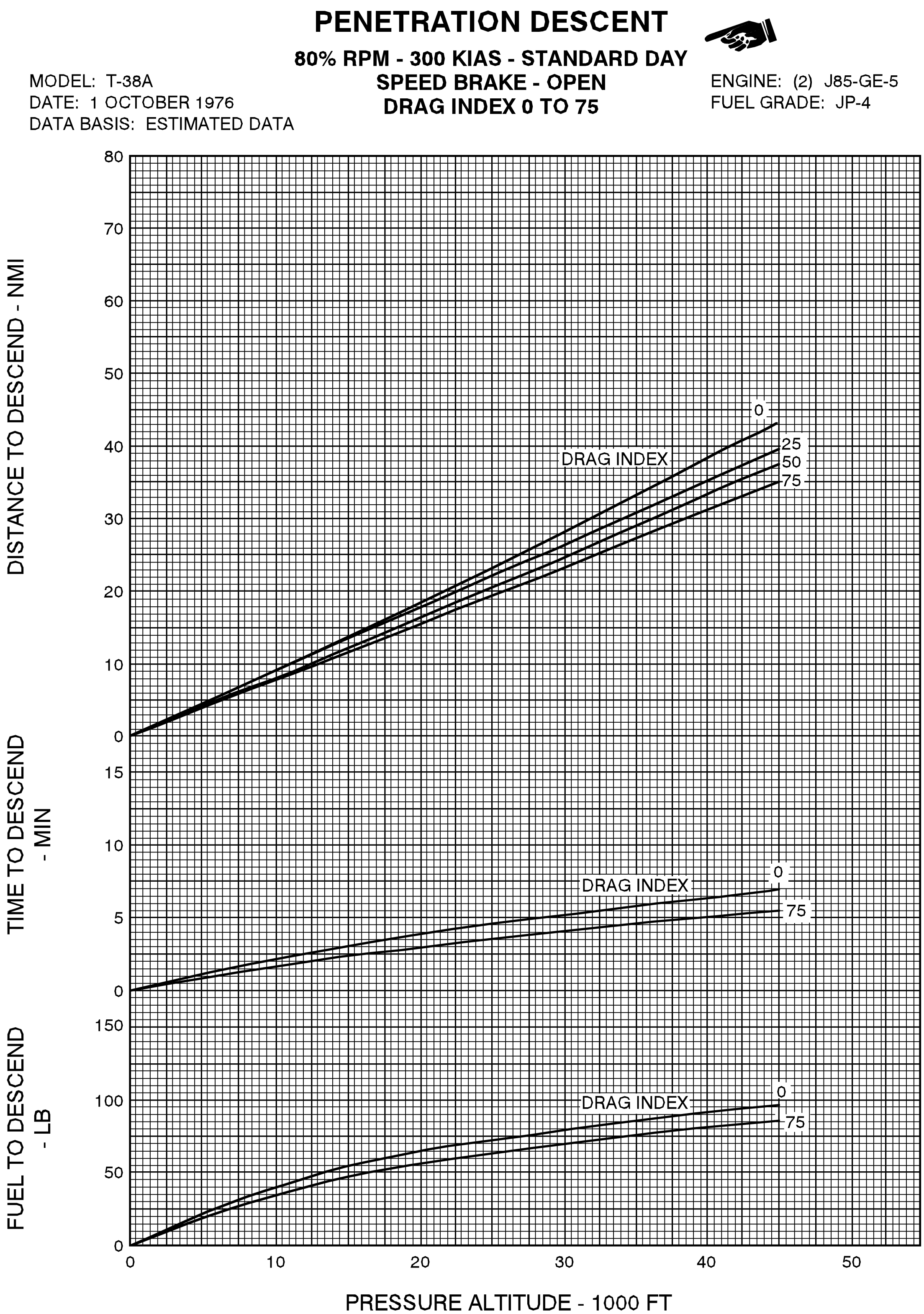

Figure A7-3. Penetration Descent Speed Brake Open

GRD
TO
HYD
ELE
FUE
OXY
ENG
FLT
MISC
LND

I
II
III
IV
V
VI
VII
A
G
IN

PART 8
APPROACH AND LANDING

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

GRD TO HYD ELE FUE OXY ENG FLT MISC LND

LANDING DISTANCE

The landing distance chart (Figure A8-1) shows ground distance and associated landing speeds. The ground roll distance is based on full flaps. The chart shows data for landing at the appropriate chart landing speeds, maintaining a 12-degree nose high attitude until just prior to loss of elevator authority, then lowering the nosewheel to the runway and applying optimum braking. If the landing technique differs, landing distances will vary from those given in the charts. A 5% variation in touchdown speed causes approximately a 10% variation in landing distance. Insufficient aerodynamic or wheel braking could further increase the ground roll distance by as much as 50%.

LANDING SPEED

The landing speed chart (Figure A8-1) shows the normal landing final approach speed, minimum roll landing final approach speed, and touchdown speed. The landing speeds in the normal landing distance chart (Figure A8-1) are compatible with the normal landing pattern speed rule in section II, which indicates that final turn, final approach, and touchdown speeds be increased 1 knot for each 100 pounds of fuel above 1000 pounds of fuel remaining.

USE OF LANDING DISTANCE CHART

The chase-thru lines in the landing distance chart (Figure A8-1) show a landing with two engines operating, with a runway air temperature of 15°C at 2000 feet pressure altitude, a gross weight of 9000 pounds, and a 20-knot headwind.

EFFECT OF RUNWAY CONDITION (RCR) ON GROUND ROLL DISTANCE

Figure A8-2 provides the means of correcting the landing ground roll distance for the effect of various runway surface conditions. The corrections are shown as a function of Runway Condition Readings (RCR), which is a number indicating the degree of braking effectiveness available during the ground roll. RCR values vary from 23 to 5 for dry to icy runways. RCR of 12 is provided for a wet runway but for conditions of heavy rain or standing water, lower RCR values should be selected to determine the approximate stopping distance. When wet conditions prevail, the runway will be reported as wet (no RCR provided).

CAUTION

RCR values provide an approximation of the required stopping distance. RCR is only valid for dry or icy runways. Selection of an RCR for a wet runway does not ensure a safe landing and stopping distance. If hydroplaning occurs, it is not possible to predict the actual stopping distance.

USE OF THE CORRECTION CHART FOR RUNWAY SURFACE CONDITIONS

Using the ground roll distance of 2700 feet for a dry, hard surfaced runway and an RCR of 12, the chase-thru lines in Figure A8-2 show 3600 feet required for this runway condition.

SINGLE-ENGINE THRUST REQUIRED AND AVAILABLE

The single-engine thrust required and available charts (Figure A8-3, Figure A8-4, and Figure A8-5) show thrust required and available versus airspeed for go-around configuration with 0, 60, and 100% flaps with gear down. These charts are for several weights and temperatures from sea level to 6,000 feet and include both single-engine MAX and MIL thrusts.

USE OF SINGLE-ENGINE THRUST REQUIRED AND AVAILABLE CHART

Assume an airspeed of 160 KIAS, a weight of 11,000 pounds, and an ambient temperature of 30°C with MAX thrust. The chase-thru lines in Figure A8-3 show the thrust required is 2230 pounds for all altitudes, and the thrust available is 2810 pounds at sea level. When the pressure altitude is 2000 feet, the thrust available is 2625 pounds.

EFFECT OF BANK ANGLE ON VERTICAL VELOCITY

The effect of bank angle on vertical velocity charts show the climb capability of the aircraft as a function of ambient temperature, gross weight (fuel remaining), bank angle, and thrust setting. Figure A8-6 shows two and single engine performance for MIL thrust settings and Figure A8-7 shows two and single-engine performance for MAX thrust settings. All of the charts are for landing gear extended and 60% flaps, which is the recommended flap setting for single-engine approaches. The two-engine charts are for comparison purposes and are based on a 60% flap setting. The rate-of-climb determined from the charts is valid only for the recommended approach turn speed, which may be computed from the curve in the upper left corner of each chart.

I II III IV V VI VII A G IN

USE OF EFFECT OF BANK ANGLE ON VERTICAL VELOCITY CHARTS

Assume a pattern altitude at 2000 feet, ambient temperature of 25°C and 1000 pounds of fuel remaining. Entering the MIL thrust, single-engine chart, Figure A8-6 (sheet 2), the chase-thru lines show an approach turn speed of 175 KIAS. Reentering the chart at an ambient temperature of 25°C the chase-thru lines show a climb capability of 300 fpm with a 0° bank angle. If a 30° bank angle were used in turn, the chase-thru lines show a negative climb capability of -300 fpm in the gray area. In the MAX thrust, single-engine chart Figure A8-7 (sheet 2), for the same conditions, the chase-thru lines show a 2300 fpm climb capability at 0° bank angle and 1700 fpm climb capability at a 30° bank angle.

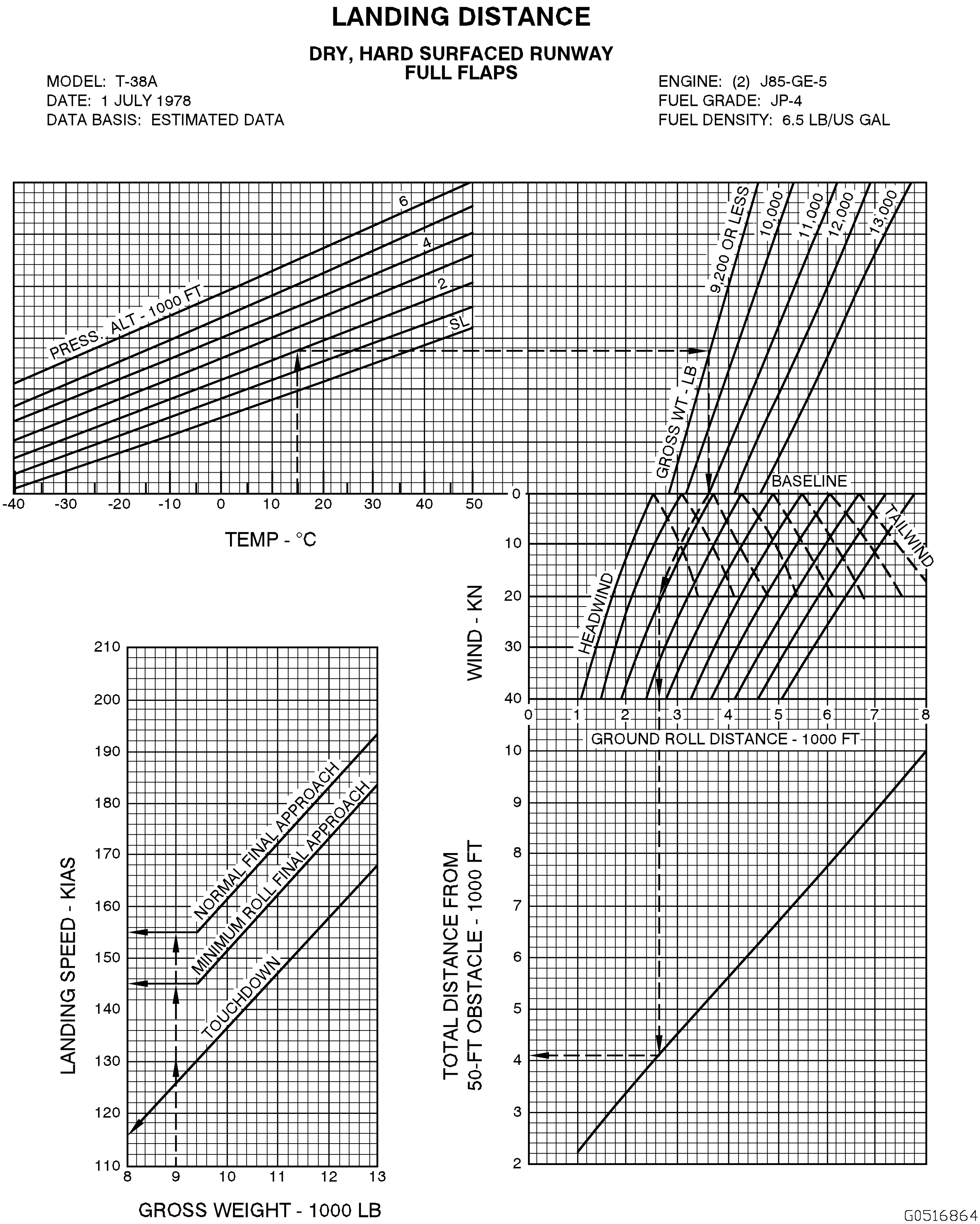

Figure A8-1. Landing Distance

GRD TO HYD ELE FUE OXY ENG FLT MISC LND

I II III IV V VI VII A G IN

EFFECT OF RUNWAY CONDITION (RCR) ON GROUND ROLL DISTANCE FULL FLAPS

MODEL: T-38A
DATE: 1 AUGUST 1965
DATA BASIS: FLIGHT TEST

ENGINES: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

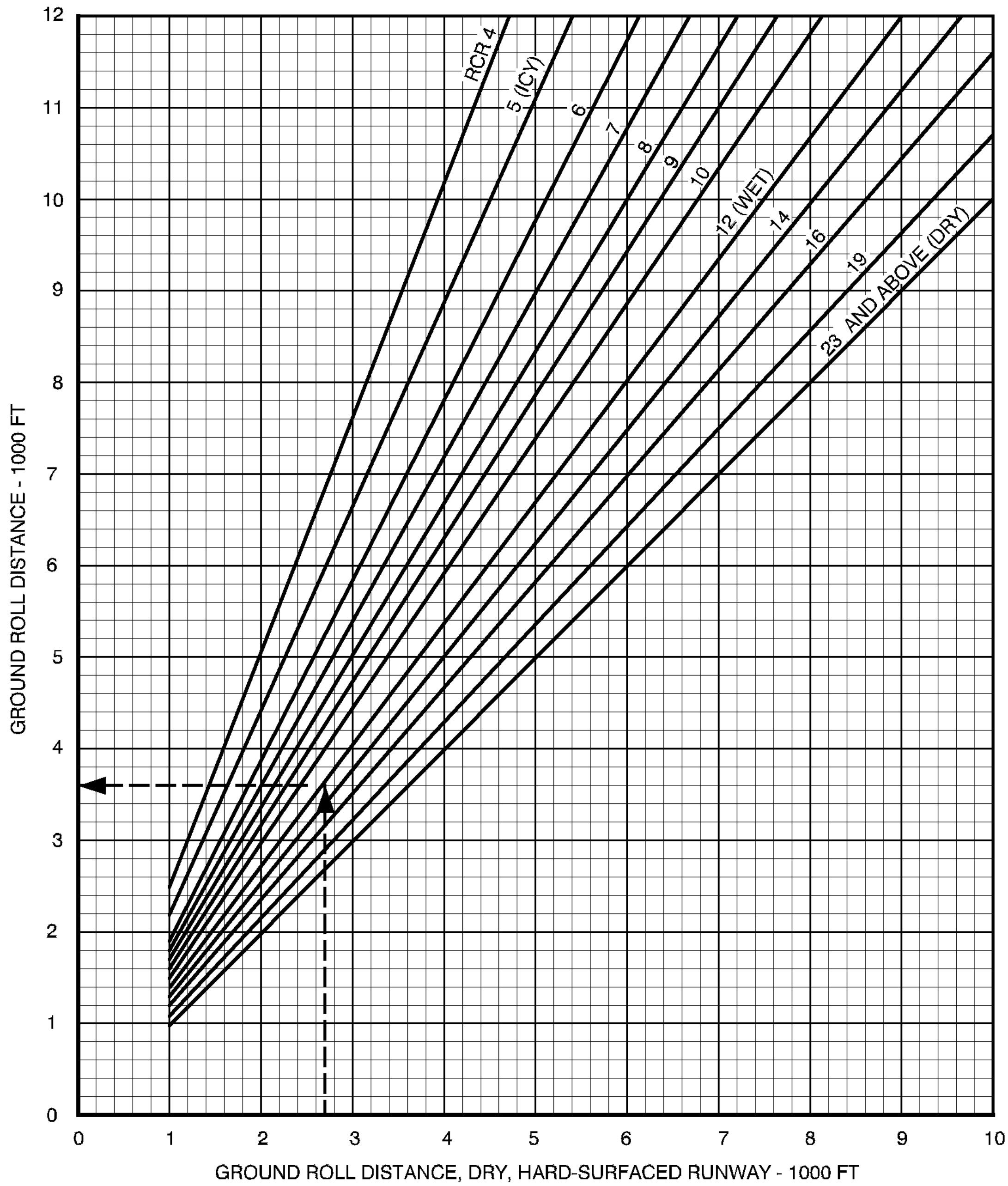

Figure A8-2. Effect of Runway Condition (RCR)

SINGLE-ENGINE THRUST REQUIRED AND AVAILABLE

WITH 60% FLAPS AND GEAR DOWN
SEA LEVEL TO 6000 FEET

MODEL: T-38A
DATE: 1 JULY 1978
DATA BASIS: ESTIMATED DATA

ENGINE: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

Note

DECREASE SEA LEVEL THRUST AVAILABLE BY 3.3% FOR EACH 1000 FEET INCREASE IN PRESSURE ALTITUDE.

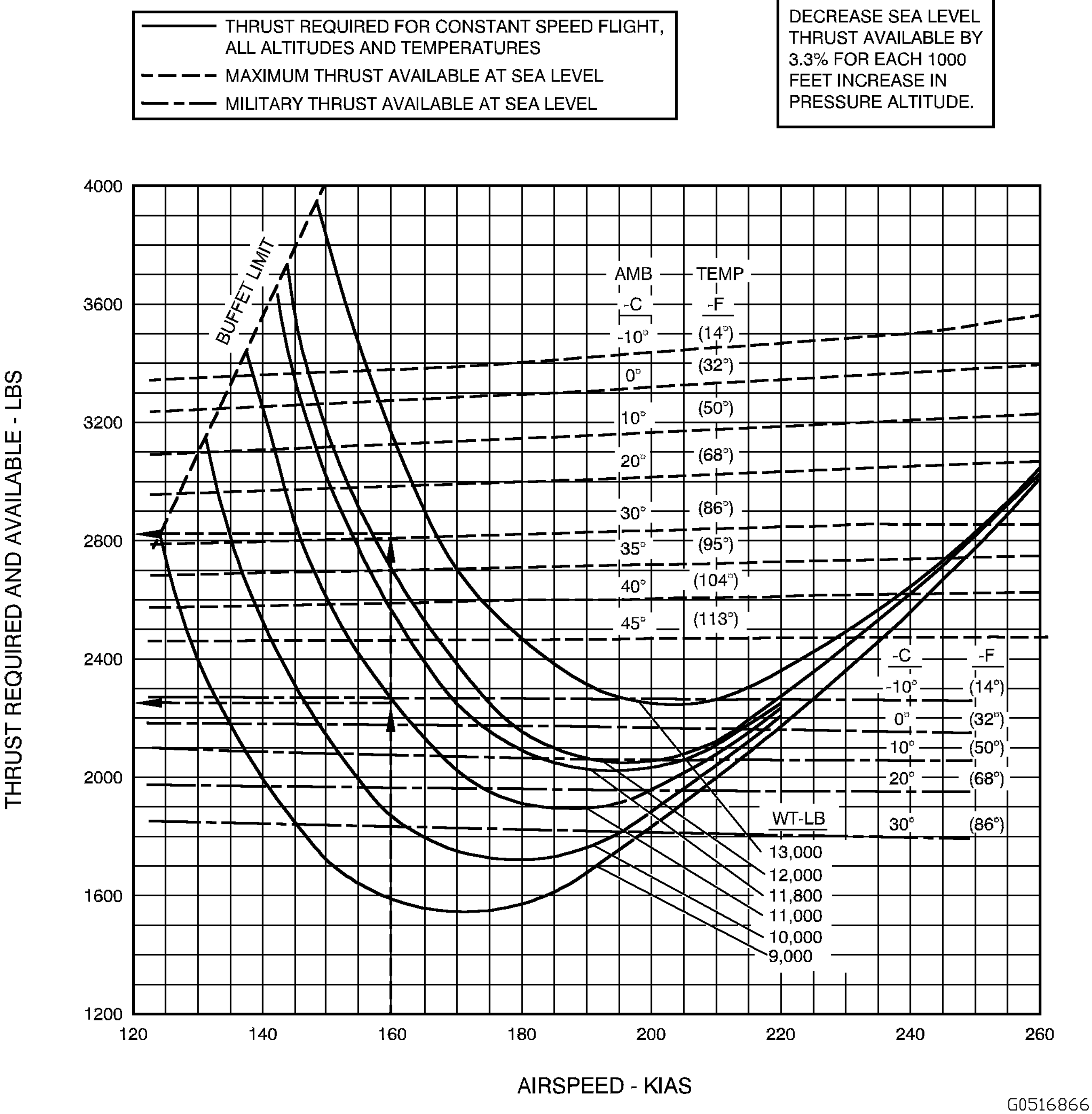

Figure A8-3. Single-Engine Thrust Required and Available (60% Flaps)

GRD TO HYD ELE FUE OXY ENG FLT MISC LND
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SINGLE-ENGINE THRUST REQUIRED AND AVAILABLE

0% FLAPS, GEAR DOWN
SEA LEVEL TO 6000 FEET

MODEL: T-38A
DATE: 1 JULY 1978
DATA BASIS: ESTIMATED DATA

ENGINE: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

Note

DECREASE SEA LEVEL THRUST AVAILABLE BY 3.3% FOR EACH 1000 FEET INCREASE IN PRESSURE ALTITUDE.

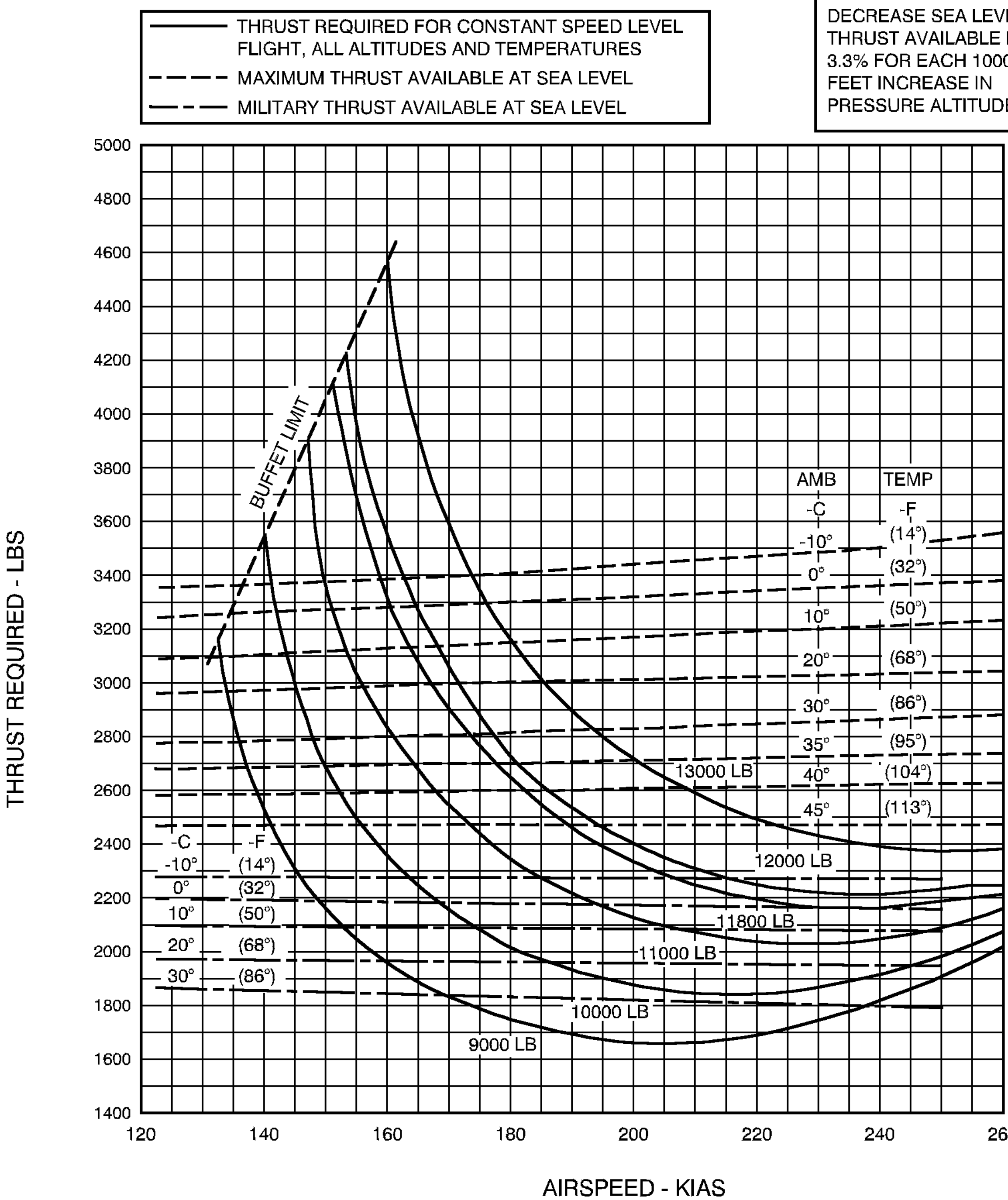

Figure A8-4. Single-Engine Thrust Required and Available (0% Flaps)

SINGLE-ENGINE THRUST REQUIRED AND AVAILABLE

100% FLAPS, GEAR DOWN
SEA LEVEL TO 6000 FEET

MODEL: T-38A
DATE: 1 JULY 1978
DATA BASIS: ESTIMATED DATA

ENGINE: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

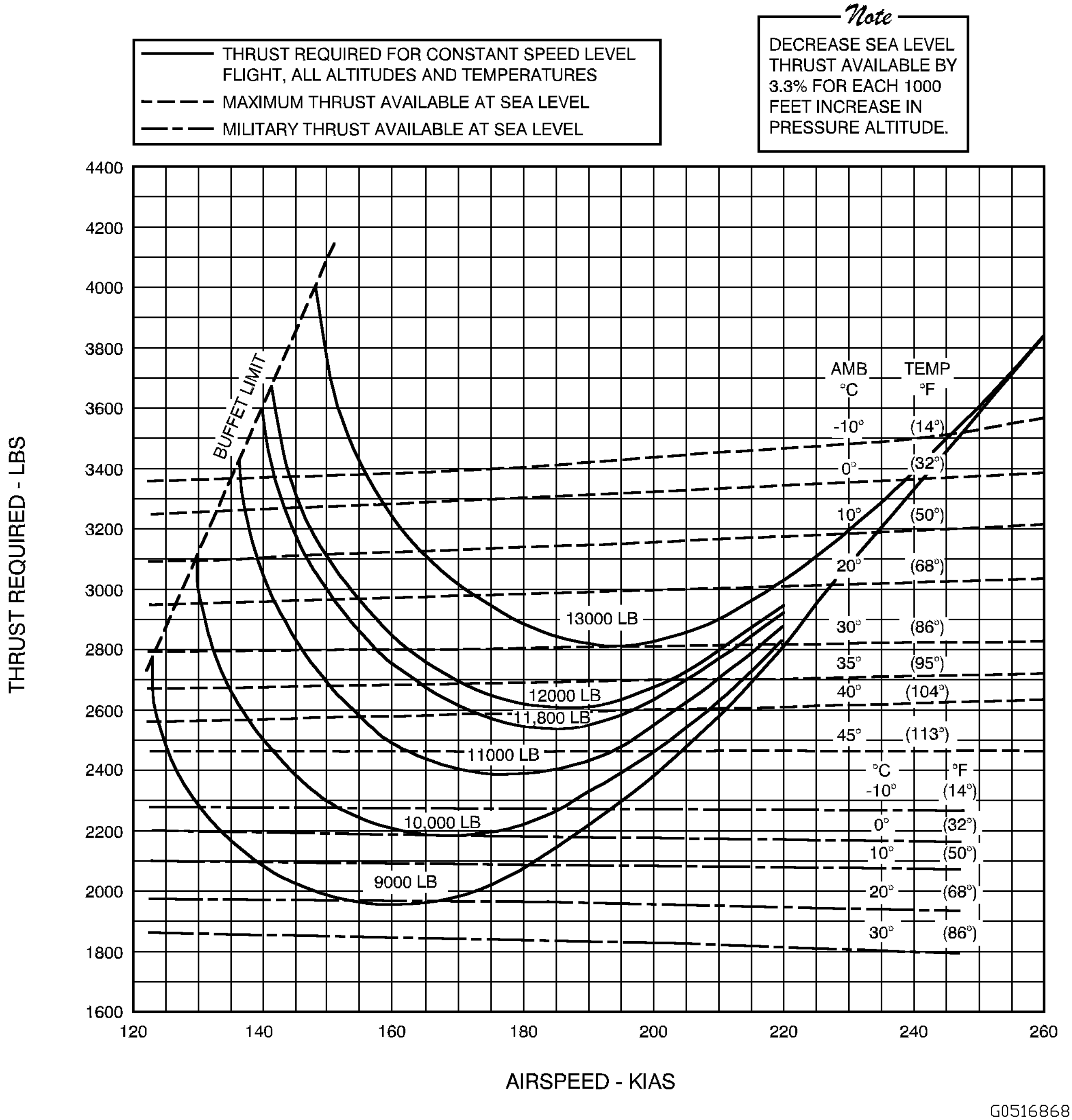

Figure A8-5. Single-Engine Thrust Required and Available (100% Flaps)

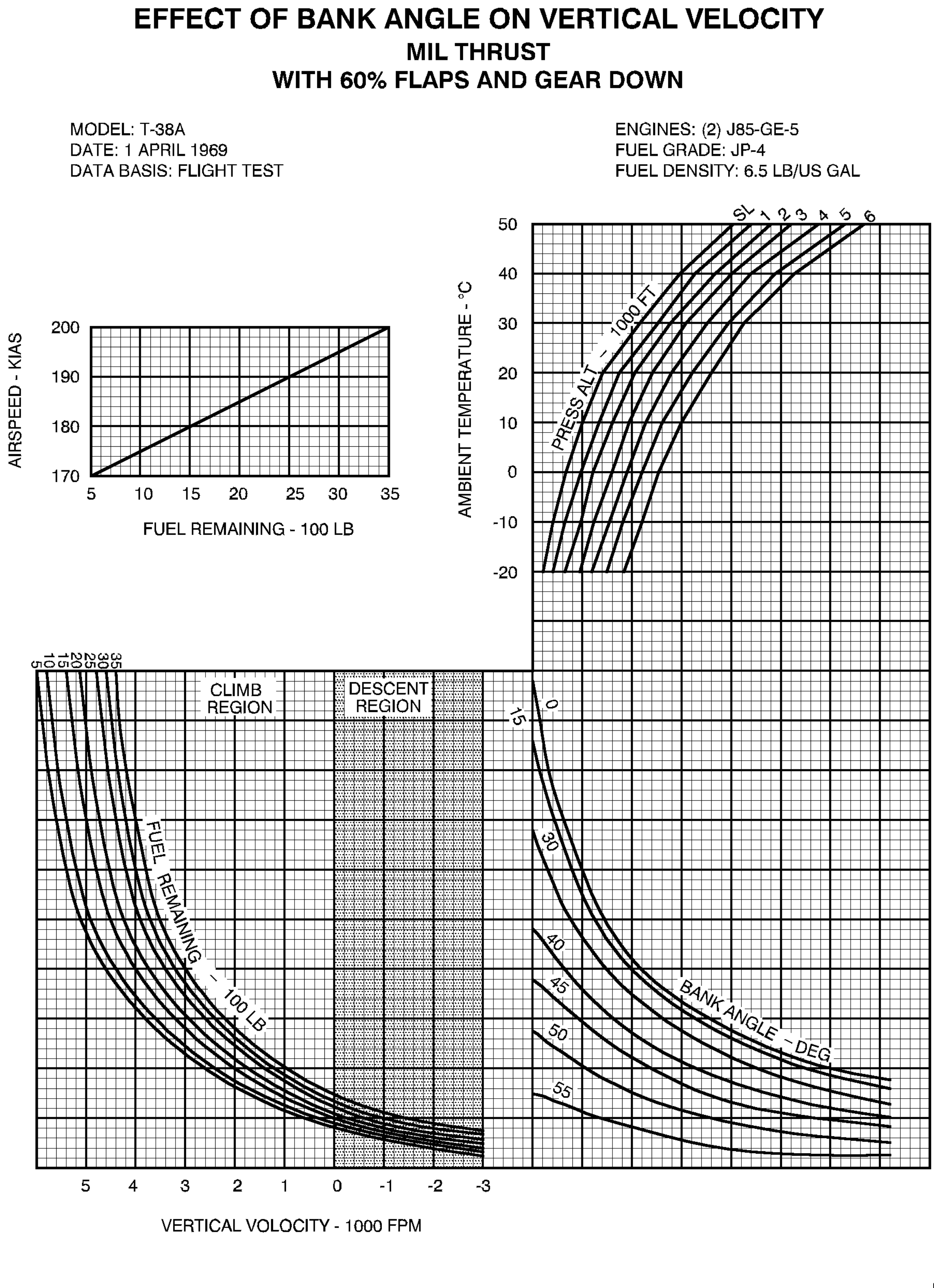

Figure A8-6. Effect of Bank Angle on Vertical Velocity

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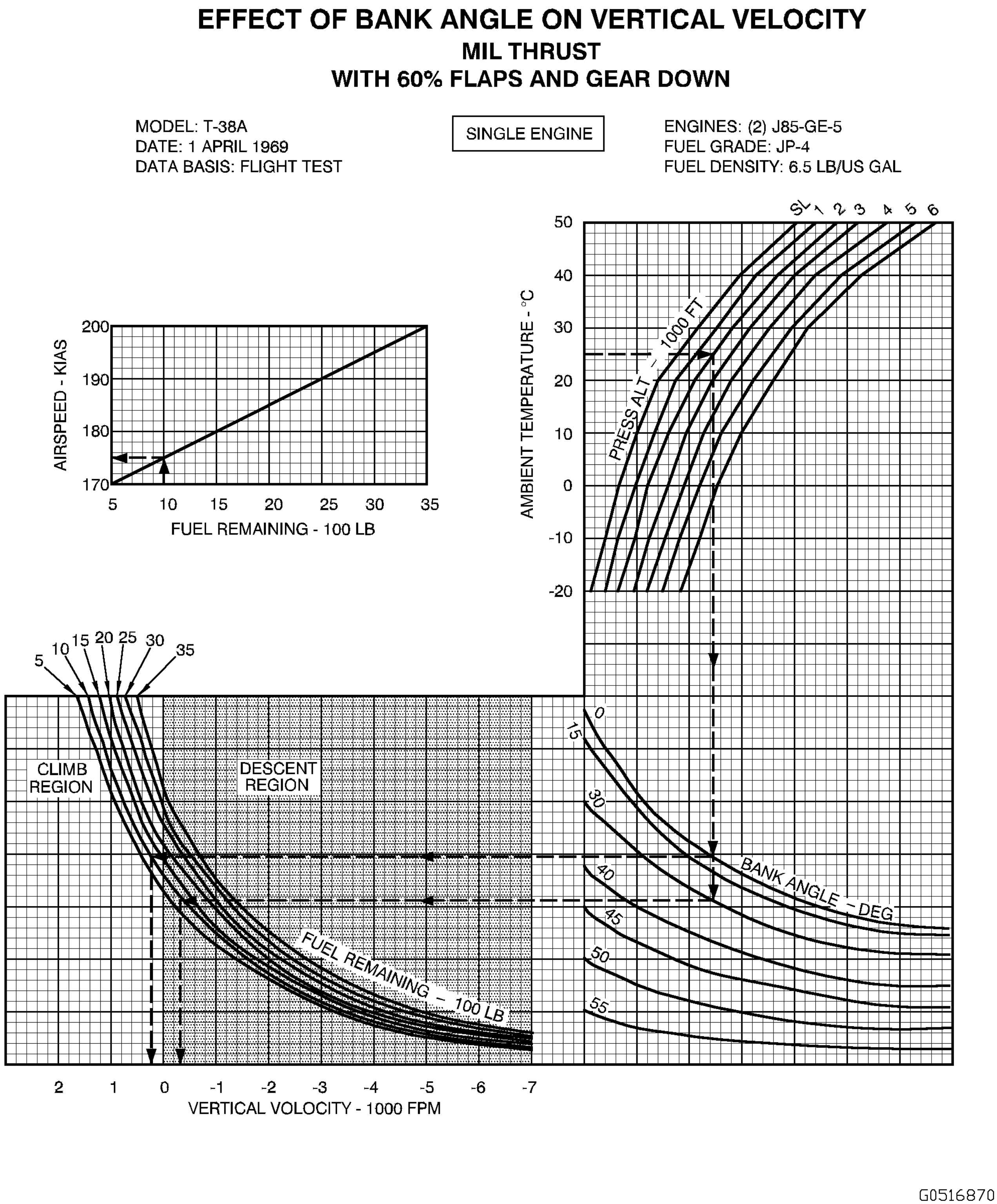

Figure A8-7. Effect of Bank Angle on Vertical Velocity - Single Engine

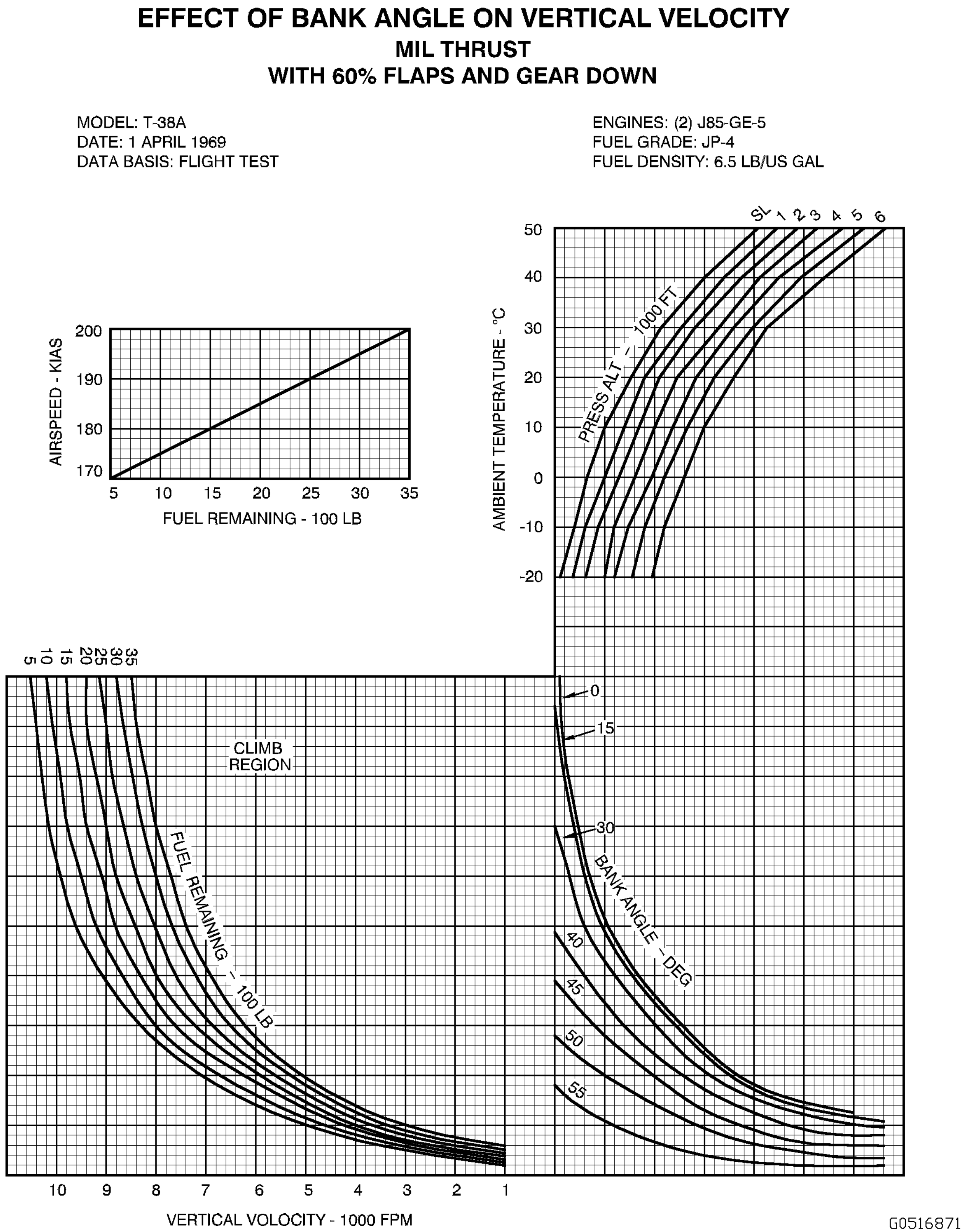

Figure A8-8. Effect of Bank Angle on Vertical Velocity

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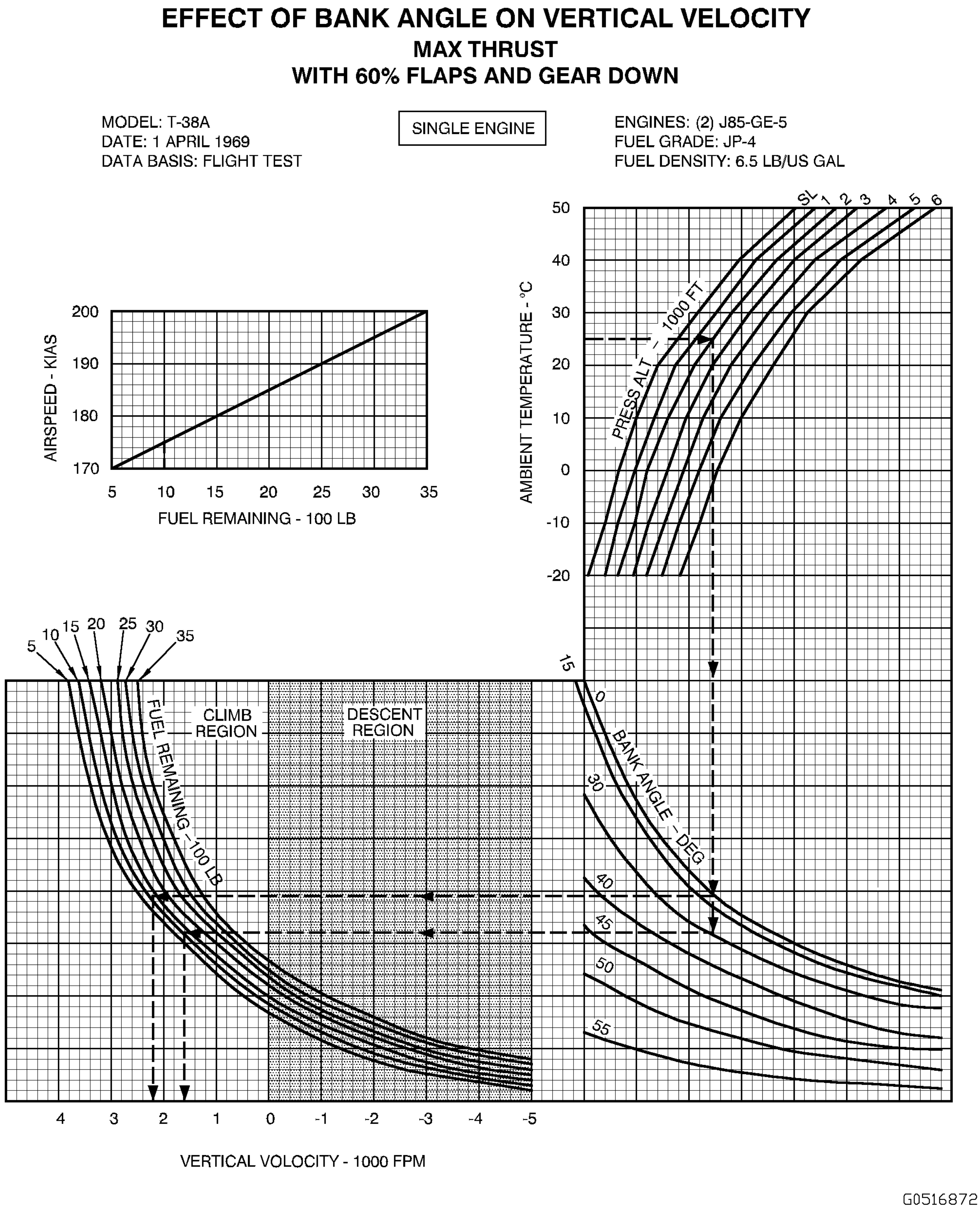

Figure A8-9. Effect of Bank Angle on Vertical Velocity - Single Engine

PART 9
MISSION PLANNING

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

PURPOSE OF MISSION PLANNING

Mission planning can be termed preflight planning. The purpose of preflight planning is to obtain optimum performance from the aircraft for any specific mission. Optimum performance will vary, for example, from maximum time on station to maximum radius with no time on station. Exact requirements will vary, depending upon the types of missions to be flown.

MISSION PLANNING SAMPLE PROBLEM

The following problem is an exercise in the use of the performance charts. It is not intended to reflect actual or proposed missions employing this aircraft on a typical cross country flight.

FLIGHT PLAN DATA

A mission profile is to be flown, assuming the following conditions:

1. Takeoff data.
   a. Takeoff weight (solo): 11,800 lb
   b. Wind: 10-knot headwind
   c. Runway temperature: 15°D
   d. Pressure altitude: 4000 ft
   e. Runway: 7000 ft
   f. RCR: 12
2. Climb Data to 35,000 ft
   a. Temperature deviation from standard +10°C
   b. Wind: 15-knot headwind
3. 35,000 ft cruise data
   a. Temperature: -46°C
   b. Wind: 15-knot headwind
   c. Speed: Optimum
4. Descent data to 3000 ft
   a. Temperature deviation from standard: Zero
   b. Wind: 15-knot tailwind
5. Enter pattern 1000 ft above terrain with 1000 lb fuel reserve
6. Landing data
   a. Landing weight: 9000 lb
   b. Wind: 20-knot headwind
   c. Temperature: 15°C
   d. Pressure altitude: 2000 ft
   e. Runway length: 7000 ft
   f. RCR: 12

TAKEOFF

1. MAX thrust takeoff factor (Figure A3-2): 3.45
2. Takeoff speed (Figure A3-3): 154 KIAS
3. Takeoff distance (Figure A3-4 and Figure A3-5): 3050 ft
4. Critical field length (Figure A3-6)
   a. RCR = 23: 5800 ft
   b. RCR = 12: 6500 ft
5. Critical engine failure speed (Figure A3-7)
   a. RCR = 23: 132 KIAS
   b. RCR = 12: 112 KIAS
6. Acceleration check speed at 1500 ft from brake release.
   a. Normal (Figure A3-10): 110 KIAS
   b. Minimum (7000 - 65000) = 500,

   $110 - \frac{500}{1000} \times 3)$ 108 KIAS

7. Single-engine takeoff speed (Figure A3-3) (154 + 8): 162 KIAS
8. Refusal speed (Figure A3-7)
   a. RCR = 23: 143 KIAS
   b. RCR = 12: 116 KIAS

INITIAL CLIMB FROM 4000 FT TO FLIGHT LEVEL 350

(Using MIL Thrust Climb Chart Figure A4-1)

1. Aircraft weight at start of climb is 11,800 lb minus the allowance for taxi, takeoff, and acceleration to climb speed (11,800 - 3): 11,500 lb
2. Obtain time to climb, fuel to climb, and climb range

Time (8.2 - 06)	7.5 min
Fuel (565 - 55)	510 lb
Range (67 - 3)	64 nmi

GRD TO HYD ELE FUE OXY ENG FLT MISC LND

3. Compute distance lost due to headwind (15 x 7.6/60): 2 nmi

4. Adjusted climb range (64 - 2): 62 nmi

5. Weight at level-off (11,500 - 510): 10,990 lb

PENETRATION DESCENT TO 3000 FT, SPEED BRAKE OPENED (300 KIAS. 80% RPM)

1. Obtain time, fuel, and no wind range from Figure A7-3

Fuel (85 - 15)	70 lb
Time (5.6 - 06)	5.0 min
Range (32 - 2)	30 nmi

2. Compute distance gained due to tailwind (15 x 5.0/60): 1 nmi

3. Compute ground range (30 + 1): 31 nmi

4. Weight at end of descent (8010 + 1000): 9010 lb

AVERAGE GROSS WEIGHT

1. Weight at beginning of cruise: 10,990 lb

2. Weight at end of cruise (9010 + 70): 9080 lb

3. Compute fuel for cruise (10,990 - 9080): 1910 lb

4. Average weight (10,990 - 1/2 x 1910): 10,035 lb

CRUISE AT FLIGHT LEVEL 350
(Using cruise chart Figure A5-1)

1. Maximum range mach number: 0.83

2. Basic reference number: 4

3. Nautical miles per pound: 0.338

4. True airspeed: 485 kn

5. Fuel flow lb/hr/eng: 715

6. Groundspeed (485 - 50): 435 kn

7. Time

$$\frac{(1980 \times 60)}{715 \times 2} \quad 83 \text{ min}$$

8. Ground distance

$$\frac{(83 \times 435)}{60} \quad 602 \text{ nmi}$$

CRUISE AT FLIGHT LEVEL 350
(Using Constant Altitude Cruise Chart Figure A5-3)

1. True mach number: 0.83

2. True airspeed: 485 kn

3. True ground speed: 435 kn

4. Fuel flow lb/hr/eng: 715

5. Time

$$\frac{(1980 \times 60)}{715 \times 2} \quad 83 \text{ min}$$

6. Ground distance

$$\frac{(83 \times 435)}{60} \quad 602 \text{ nmi}$$

LANDING
(Using Normal Landing Distance Chart Figure A8-1)

1. Final turn speed: 175 KIAS

2. Normal landing final approach speed: 155 KIAS

3. Minimum roll landing final approach speed: 145 KIAS

4. Touchdown speed: 125 KIAS

5. Ground roll distance

   a. RCR = 23: 2700 ft

   b. RCR = 12 (Figure A8-2)

MISSION SUMMARY

1. Total time: 95.6 min

2. Total range: 695 nmi

TAKEOFF AND LANDING DATA CARD

The takeoff and landing data card is included in the Flight Crew Checklist normal procedures. The takeoff and landing data was computed during mission planning from part 2 and part 7, respectively. The landing weight for immediately after takeoff is the takeoff gross weight less an average fuel allowance of 300 lb for takeoff and go-around. Landing immediately after takeoff for the conditions stated in the mission planning takeoff data is computed as follows:

LANDING (IMMEDIATELY AFTER TAKEOFF)

1. Landing gross weight: 11,500 lb

2. Final turn speed: 198 KIAS

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3. Normal landing final approach speed (Figure A8-1): 178 KIAS

4. Touchdown speed (Figure A8-1): 153 KIAS

5. Ground roll distance:

a. RCR = 23 (Figure A8-1): 5100 ft

b. RCR = 12 (Figure A8-2): 6800 ft

The takeoff and landing information for mission planning is entered on the data card as a ready reference for review prior to takeoff and landing as shown in Figure A9-1.

TO HYD ELE FUE OXY ENG FLT MISC LND

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TAKEOFF & LANDING DATA CARD

CONDITIONS

RUNWAY LENGTH	7000	FT
WIND COMPONENT	10 HW	KN
RUNWAY TEMPERATURE	15	°C
PRESSURE ALTITUDE	4000	FT

TAKEOFF

ACCELERATION CHECK	108	KIAS	1500	FT
CRITICAL ENGINE FAILURE SPEED			112	KIAS
REFUSAL SPEED			116	KIAS
SINGLE-ENGINE TAKEOFF SPEED			162	KIAS
TAKEOFF DISTANCE			3050	FT

LANDING

		IMMEDIATELY AFTER TAKEOFF		FINAL	
FINAL TURN SPEED		198	KIAS	175	KIAS
FINAL APPROACH SPEED		178	KIAS	155	KIAS
TOUCHDOWN SPEED		153	KIAS	125	KIAS
GROUND ROLL:	DRY	5100	FT	2700	FT
	WET	6800	FT	3600	FT

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Figure A9-1. Takeoff & Landing Data Card

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GLOSSARY

A

A/A or AA	Air to Air
A/B or AB	Afterburner
AC	Alternating Current
ADF	Automatic Direction Finder
ADI	Attitude Direction Indicator
AIMS	Altitude Encoder Measurement System
AMAD	Aircraft Mounted Accessory Drive
AOA	Angle of Attack
ARINC	Aircraft Radio Incorporated
ASDA	Accelerate and Stop Distance Available
ASIP	Aircraft Structural Integrity Program
ATC	Air Traffic Control

B

BEO	Both Engines Operating
BIT	Built In Test

C

C	Celsius
CEFS	Critical Engine Failure Speed
CDI	Course Direction Indicator
CFL	Critical Field Length
CG	Center of Gravity
CIT	Compressor Inlet Temperature
COMM	Communication
CTRL	Control
CW	Complied With or Continuous Wave

D

DC	Direct Current
DEG	Degree
DME	Distance Measuring Equipment
DN	Down
DS	Decision Speed

E

EA	Electronic Attack
ECM	Electronic Counter Measures
EF	Engine Failure
EGT	Exhaust Gas Temperature
EO	Emergency Oxygen
EPR	Engine Pressure Ratio
ETIMS	Enhanced Technical Information Management System
EXT	External

F

F	Fahrenheit
FF	Fuel Flow
FL	Flight Level
FLDR	Flight Load Data Recorder
FLDR or FD	Flight Director
FM	Flight Manual
FMM	Flight Manual Manager
FMP	Flight Manual Program
FPI	Forward Preface Introduction
FSII	Fuel System Icing Inhibitor
FWD	Forward

G

G or g	Load Factor or G-Loading
GSE	Ground Support Equipment

H

HEFOE	Hydraulics/Electrical/Fuels/Oxygen/Engines
HSI	Horizontal Situation Indicator
HYD	Hydraulic

I

I/P	Identification of Position
ICAO	International Civil Aviation Organization
IDENT	Identification
IFF	Identify Friend or Foe
IFR	Instrument Flight Rules
IGV	Inlet Guide Vane
ILS	Instrument Landing System
IMN	Indicated Mach Number

J

JMPS	Joint Mission Panning System

K

KBAS	Knots Basic Airspeed
KCAS	Knots Calibrated Airspeed
KEAS	Knots Equivalent Airspeed
KG/S	Kilo Grams per Second
KIAS	Knots Indicated Airspeed

KPA	Kilo Pascals
KTAS	Knots True Airspeed

L

lbs or LB	Pounds
LG or LDG	Landing Gear
LDA	Landing Distance Available
LEP	List of Effective Pages
LOI	List of Illustrations
LOX	Liquid Oxygen
LRU	Line Repairable Unit
LT	Left

M

MAC	Mean Aerodynamic Chord
MAG	Magnetic
MAN	Manual
MHZ	Mega Hertz
MIC	Microphone
MSL	Mean Sea Level

N

NAV	Navigation
NWS	Nose Wheel Steering

O

OPR	Operate
OSG	Over Speed Governor

P

PIC	Pilot in Charge
PIO	Pilot Induced Oscillation
PLA	Power Lever Angle
PPH	Pounds Per Hour
PRF	Performance
PSI	Pounds per Square Inch
PWR	Power

R

RAD	Radiation
RADAR	Radio Detection And Ranging
RCDR	Recorder
RCP	Rear Cockpit
RCR	Runway Condition Reading
RECV	Receiver
RPM	Revolutions Per Minute
RS	Refusal Speed
RSA	Runway Safety Area
RSC	Runway Surface Covering
RT	Right

S

SAS	Stability Augmentation System
SEL	Select
SETOS	Single Engine TakeOff Speed
SGML	Standard Generalized Markup Language
SIF	Selective Identification Feature
SL	Sea Level
SPK	Parachute Spacer Kit
SSK	Seat Survival Kit
STBY	Standby
STD	Standard

T

T/R	Transmit/Receive
TACAN	Tactical Air Control And Navigation
TBD	To Be Determined
TCTO	Time Change Technical Order
TEMP	Temperature
TO	Technical Order
TOLD	Takeoff And Landing Data
TORA	Take-Off Run Available
TRU	Transformer Rectifier Unit

U

UHF	Ultra-High Frequency
UWARS	Universal Water Activated Release System

V

VAC	Volts, Alternating Current
VDC	Volts, Direct Current
VEN	Variable Exhaust Nozzle
VFR	Visual Flight Rules
VHF	Very High Frequency
VMC	Visual Meteorological Conditions
VOR	VHF Omnidirectional Range
VVI	Vertical Velocity Indicator

W

WOW	Weight On Wheels
WSSP	Weapon System Support Pod

X

XMIT	Transmit

INDEX

GRD TO HYD ELE FUE OXY ENG FLT MISC LND

I II III IV V VI VII A G IN

GRD TO HYD ELE FUE OXY ENG FLT MISC LND

I II III IV V VI VII A G IN

GRD TO HYD ELE FUE OXY ENG FLT MISC LND

I II III IV V VI VII A G IN