

NAVAIR 01-85ADF-1

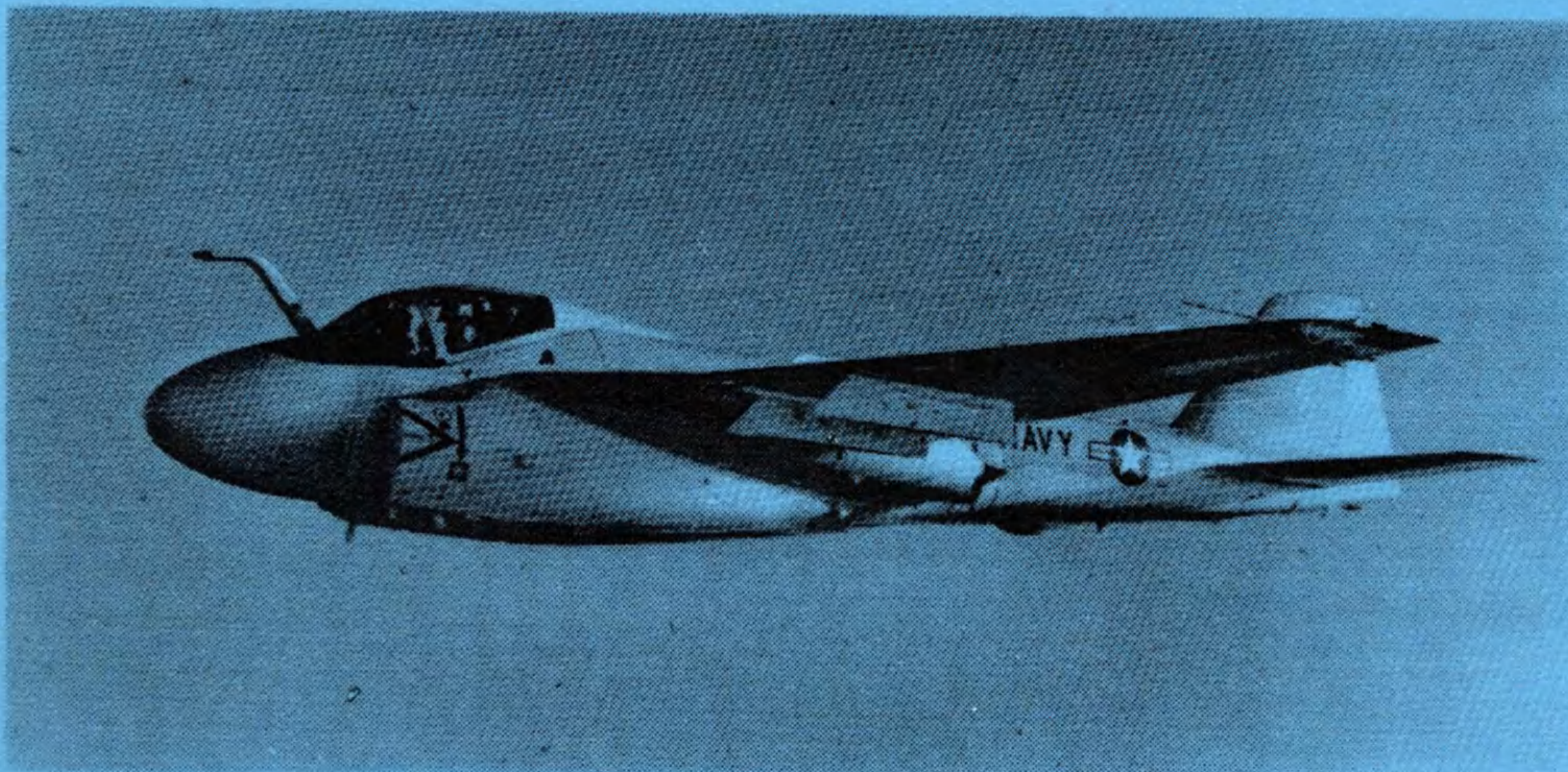


NATOPS FLIGHT MANUAL

NAVY MODEL

A-6E AIRCRAFT

This document is subject to special export controls and each transmittal to foreign governments, foreign nationals or agents thereof may be made only with the prior approval of NAVAIRSYSCOMHQ, Washington, D.C.



ISSUED BY AUTHORITY OF THE CHIEF OF NAVAL OPERATIONS AND
UNDER THE DIRECTION OF THE COMMANDER, NAVAL AIR SYSTEMS COMMAND

THE
AIRCRAFT 1

INDOCTRI-
NATION 2

NORMAL
PROCEDURES 3

FLIGHT
CHARAC 4

EMER
PROCEDURES 5

ALL-WEA
OPERATION 6

COMM
PROCEDURES 7

WEAPONS
SYSTEMS 8

FLT CREW
COORD 9

NATOPS
EVAL 10

PERFORM
DATA 11

INDEX &
FOLDOUTS 12

1 May 1973

NAVAIR 01-85ADF-1

NATOPS FLIGHT MANUAL

NAVY MODEL

A-6E

AIRCRAFT

Grumman Aerospace Corporation

N00019-68-C-0106

N00019-71-C-0444

This document is subject to special export controls and each transmittal to foreign governments, foreign nationals or agents thereof may be made only with the prior approval of NAVAIRSYSCOMHQ, Washington, D.C.

THIS MANUAL SUPERSEDES NAVAIR 01-85ADF-1
DATED 1 JULY 1971, CHANGED 15 DECEMBER 1972



ISSUED BY AUTHORITY OF THE CHIEF OF NAVAL OPERATIONS AND
UNDER THE DIRECTION OF THE COMMANDER, NAVAL AIR SYSTEMS COMMAND

THE
AIRCRAFT 1

INDOCTRI-
NATION 2

NORMAL
PROCEDURES 3

FLIGHT
CHARAC 4

EMER
PROCEDURES 5

ALL-WEA
OPERATION 6

COMM
PROCEDURES 7

WEAPONS
SYSTEMS 8

FLT CREW
COORD 9

NATOPS
EVAL 10

PERFORM
DATA 11

INDEX &
FOLDOUTS 12

1 May 1973

Reproduction for non-military use of the information or illustrations contained in this publication is not permitted. The policy for military use reproduction is established for the Army in AR 380-5, for the Navy and Marine Corps in OPNAVINST 5510.1B, and for the Air Force in Air Force Regulation 205-1.

LIST OF EFFECTIVE PAGES

Insert latest changed pages; dispose of superseded pages in accordance with applicable regulations.

NOTE: On a changed page, the portion of the text affected by the latest change is indicated by a vertical line, or other change symbol, in the outer margin of the page. Changes to illustrations are indicated by miniature pointing hands. Changes to wiring diagrams are indicated by shaded areas.

Total number of pages in this manual is 563 consisting of the following:

Page No.	# Change No.	Page No.	# Change No.
Title	0	FO-20 Blank	0
A	0	FO-21	0
Letter of Promulgation	0	FO-22 Blank	0
Flyleaf-1	0		
Flyleaf-2 Blank	0		
i - iv	0		
v Blank	0		
vi	0		
1-1 - 1-104	0		
2-1 - 2-2	0		
3-1 - 3-94	0		
4-1 - 4-24	0		
5-1 - 5-33	0		
5-34 Blank	0		
6-1 - 6-8	0		
7-1 - 7-13	0		
7-14 Blank	0		
8-1 - 8-80	0		
9-1 - 9-7	0		
9-8 Blank	0		
10-1 - 10-15	0		
10-16 Blank	0		
11-1 - 11-126	0		
Index-1 - Index-20	0		
FO-1	0		
FO-2 Blank	0		
FO-3	0		
FO-4 Blank	0		
FO-5	0		
FO-6 Blank	0		
FO-7	0		
FO-8 Blank	0		
FO-9	0		
FO-10 Blank	0		
FO-11	0		
FO-12 Blank	0		
FO-13	0		
FO-14 Blank	0		
FO-15	0		
FO-16 Blank	0		
FO-17	0		
FO-18 Blank	0		
FO-19	0		

Zero in this column indicates an original page.

INTERIM CHANGE SUMMARY

A - ODG - 2

The following Interim Changes have been cancelled or previously incorporated in this manual:

INTERIM CHANGE NUMBER(S)	REMARKS/PURPOSE
1 thru 5	Previously incorporated.

The following Interim Changes have been incorporated in this Change/Revision:

INTERIM CHANGE NUMBER	REMARKS/PURPOSE
6	Add warning concerning loss of trim button.
7	Add ECM tests to Pretaxi Procedures.
8	Add check of survival kit front lock release lever.
9	Amend gross weight limitations.
10	Revise procedures for emergency flap extension.
11	Add computer overheat procedures.

Interim Changes Outstanding - To be maintained by the custodian of this manual:

INTERIM CHANGE NUMBER	ORIGINATOR/DATE (or DATE/TIME GROUP)	PAGES AFFECTED	REMARKS/PURPOSE



DEPARTMENT OF THE NAVY
OFFICE OF THE CHIEF OF NAVAL OPERATIONS
WASHINGTON, D.C. 20350

1 May 1973

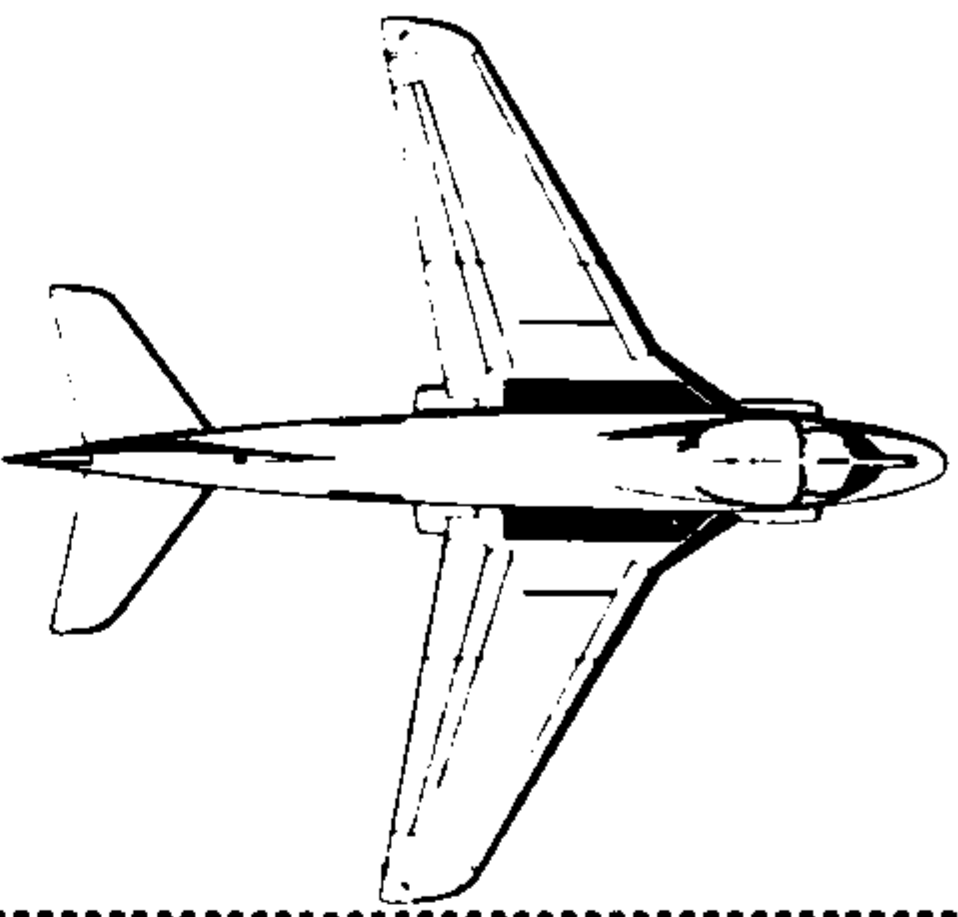
LETTER OF PROMULGATION

1. The Naval Air Training and Operating Procedures Standardization Program (NATOPS) is a positive approach toward improving combat readiness and achieving a substantial reduction in the aircraft accident rate. Standardization, based on professional knowledge and experience, provides the basis for development of an efficient and sound operational procedure. The standardization program is not planned to stifle individual initiative, but rather to aid the Commanding Officer in increasing his unit's combat potential without reducing his command prestige or responsibility.
2. This manual standardizes ground and flight procedures but does not include tactical doctrine. Compliance with the stipulated manual procedure is mandatory except as authorized herein. In order to remain effective, NATOPS must be dynamic and stimulate rather than suppress individual thinking. Since aviation is a continuing, progressive profession, it is both desirable and necessary that new ideas and new techniques be expeditiously evaluated and incorporated if proven to be sound. To this end, Commanding Officers of aviation units are authorized to modify procedures contained herein, in accordance with the waiver provisions established by OPNAVINST 3510.9 series, for the purpose of assessing new ideas prior to initiating recommendations for permanent changes. This manual is prepared and kept current by the users in order to achieve maximum readiness and safety in the most efficient and economical manner. Should conflict exist between the training and operating procedures found in this manual and those found in other publications, this manual will govern.
3. Checklists and other pertinent extracts from this publication necessary to normal operations and training should be made and may be carried in Naval Aircraft for use therein. It is forbidden to make copies of this entire publication or major portions thereof without specific authority of the Chief of Naval Operations.

A handwritten signature in cursive script, reading "W.D. Houser", is positioned above the printed name.

W.D. HOUSER
Vice Admiral, USN
Deputy Chief of Naval Operations
(Air Warfare)

TABLE OF CONTENTS



section I

AIRCRAFT..... 1-1

section II

INDOCTRINATION 2-1

section III

NORMAL PROCEDURES 3-1*

section IV

FLIGHT PROCEDURES 4-1

section V

EMERGENCY PROCEDURES 5-1

section VI

ALL WEATHER OPERATION 6-1

section VII

**COMMUNICATION EQUIPMENT
AND PROCEDURES. 7-1**

section VIII

WEAPONS SYSTEM 8-1*

section IX

**FLIGHT CREW
COORDINATION 9-1**

section X

**NATOPS
EVALUATION 10-1**

section XI

PERFORMANCE DATA 11-1

ALPHABETICAL INDEX X-1

FOLDOUT ILLUSTRATIONS FO-1

* SEE SUPPLEMENTAL TACTICAL MANUAL NAVAIR 01-85ADA-1T FOR ADDITIONAL DATA

FOREWORD

SCOPE

The NATOPS Flight Manual is issued by the authority of the Chief of Naval Operations and under the direction of Commander, Naval Air Systems Command in conjunction with the Naval Air Training and Operating Procedures Standardization (NATOPS) Program. This manual contains information on all aircraft systems, performance data, and operating procedures required for safe and effective operations. However, it is not a substitute for sound judgement. Compound emergencies, available facilities, adverse weather or terrain, or considerations affecting the lives and property of others may require modification of the procedures contained herein. Read this manual from cover to cover. It's your responsibility to have a complete knowledge of its contents.

APPLICABLE PUBLICATIONS

The following applicable publications complement this manual:

- NAVAIR 01-85ADA-1A (Supplemental NATOPS Flight Manual)
- NAVAIR 01-85ADF-1B (Checklist)
- NAVAIR 01-85ADA-1T(A-6A Tactical Manual)
- NAVAIR 01-85ADA-1T(A) (A-6A Supplemental Tactical Manual)

HOW TO GET COPIES

AUTOMATIC DISTRIBUTION

To receive future changes and revisions to this manual or any other NAVAIR aeronautical publication automatically, a unit must be established on the automatic distribution list maintained by the Naval Air Technical Services Facility (NATSF). To become established on the list or to change distribution requirements, a unit must submit a Mailing List Request for Aeronautic Technical Publications (NAVAIR Form 5605/3, Part II) to NATSF, 700 Robbins Ave., Philadelphia, Pa. 19111, listing requirements or changes thereto in accordance with the instructions contained on the request form. For additional instructions, refer to 5605.4 series and NAVSUP Publication 2002 Section VIII, Part C.

ADDITIONAL COPIES

Additional copies of this manual and changes thereto may be procured by submitting Form DD 1348 to Naval Publications and Forms Center, Philadelphia in accordance with NAVSUP Publication 2002, Section VIII, Part C.

UPDATING THE MANUAL

To ensure that the manual contains the latest procedures and information, NATOPS review conferences are held in accordance with OPNAVINST 3510.11 series.

CHANGE RECOMMENDATIONS

Recommended changes to this manual or other NATOPS publications may be submitted by anyone in accordance with OPNAVINST 3510.9 series.

Routine change recommendations are submitted directly to the Model Manager on OPNAV Form 3500-22 shown on the next page. The address of the Model Manager of this aircraft is:

Commander
Medium Attack Wing One
Naval Air Station Oceana
Virginia Beach, Virginia 23460

NEW

Change recommendations of an URGENT nature (safety of flight, etc.,) should be submitted directly to the NATOPS Advisory Group Member in the chain of command by priority message.

YOUR RESPONSIBILITY

NATOPS Flight Manuals are kept current through an active manual change program. Any corrections, additions, or constructive suggestions for improvement of its content should be submitted by routine or urgent change recommendation, as appropriate, at once.

NATOPS FLIGHT MANUAL INTERIM CHANGES

Flight Manual Interim Changes are changes or corrections to the NATOPS Flight Manuals promulgated by CNO or NAVAIRSYSCOM. Interim Changes are issued either as printed pages, or as a naval message. The Interim Change Summary page is provided as a record of all interim changes. Upon receipt of a change or revision, the custodian of the manual should check the updated interim Change Summary to ascertain that all outstanding interim changes have been either incorporated or canceled; those not incorporated shall be recorded as outstanding in the section provided.

NATOPS/TACTICAL CHANGE RECOMMENDATION
OPNAV FORM 3500/22 (5-69) 0107-722-2002

DATE

TO BE FILLED IN BY ORIGINATOR AND FORWARDED TO MODEL MANAGER

FROM (originator)		Unit			
TO (Model Manager)		Unit			
Complete Name of Manual Checklist	Revision Date	Change Date	Section/Chapter	Page	Paragraph
Recommendation (be specific)					

☐ CHECK IF CONTINUED ON BACK

Justification

Signature	Rank	Title
Address of Unit or Command		

TO BE FILLED IN BY MODEL MANAGER (Return to Originator)

FROM	DATE
TO	

REFERENCE

(a) Your Change Recommendation Dated

☐ Your change recommendation dated is acknowledged. It will be held for action of the review conference planned for to be held at

☐ Your change recommendation is reclassified URGENT and forwarded for approval to by my DTG

/S/ MODEL MANAGER AIRCRAFT

CHANGE SYMBOLS

NEW

Revised text is indicated by a black vertical line in either margin of the page, adjacent to the affected text, like the one printed next to this paragraph. The change symbol identifies the addition of new information, a changed procedure, the correction of an error, or a rephrasing of the previous material.

WARNINGS, CAUTIONS, AND NOTES

The following definitions apply to "WARNINGS", "CAUTIONS", and "NOTES" found through the manual.

WARNING

An operating procedure, practice, or condition, etc., which may result in injury or death, if not carefully observed or followed.

CAUTION

An operating procedure, practice, or condition, etc., which, if not strictly observed, may damage equipment.

Note

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

WORDING

The concept of word usage and intended meaning which has been adhered to in preparing this Manual is as follows:

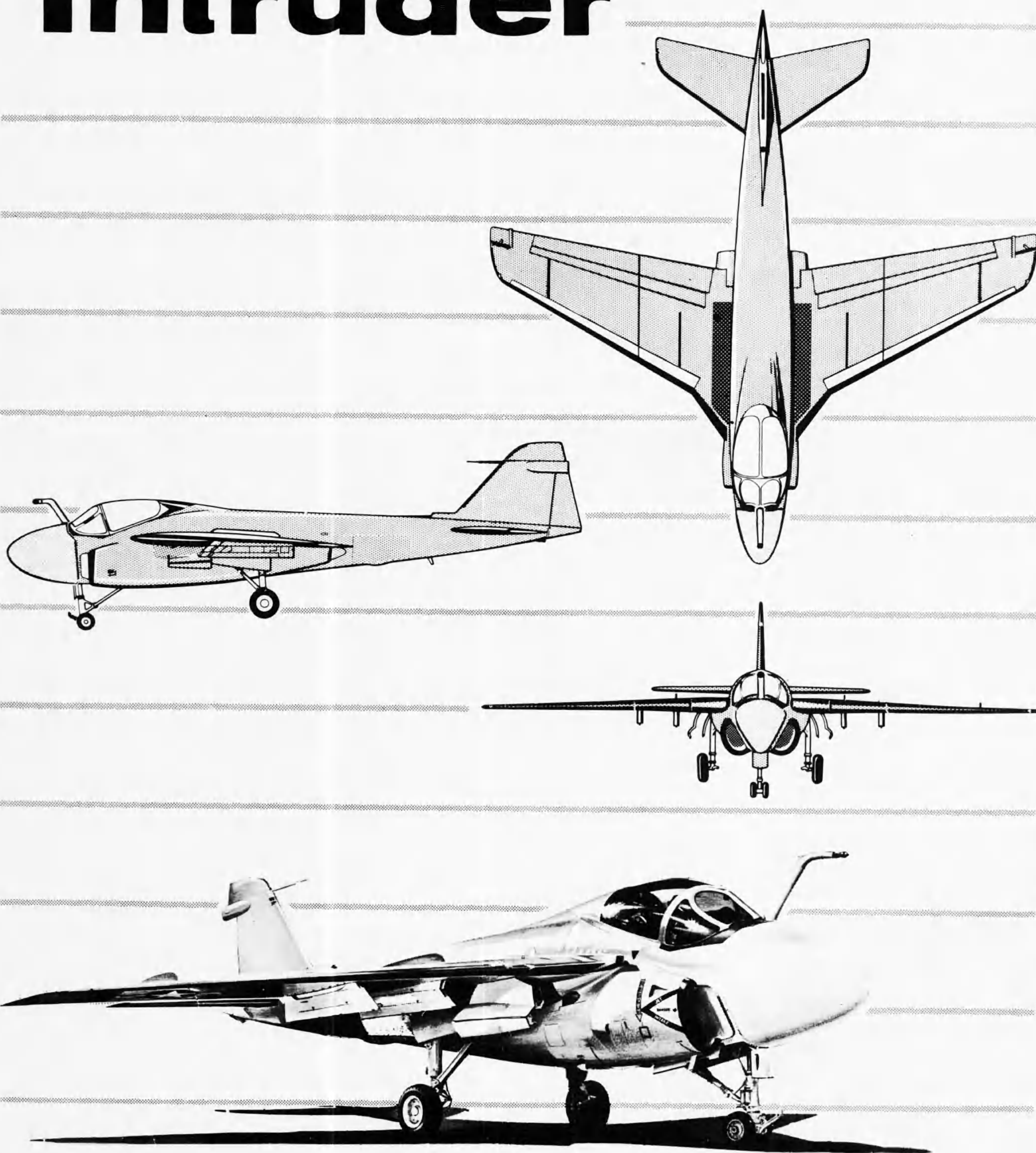
"Shall" has been used only when application of a procedure is mandatory.

"Should" has been used only when application of a procedure is recommended.

"May" and "need not" have been used only when application of a procedure is optional

"Will" has been used only to indicate futurity, never to indicate any degree of requirement for application of a procedure.

A-6E Intruder



A-ADF1-3

Figure 1-0

section I

AIRCRAFT

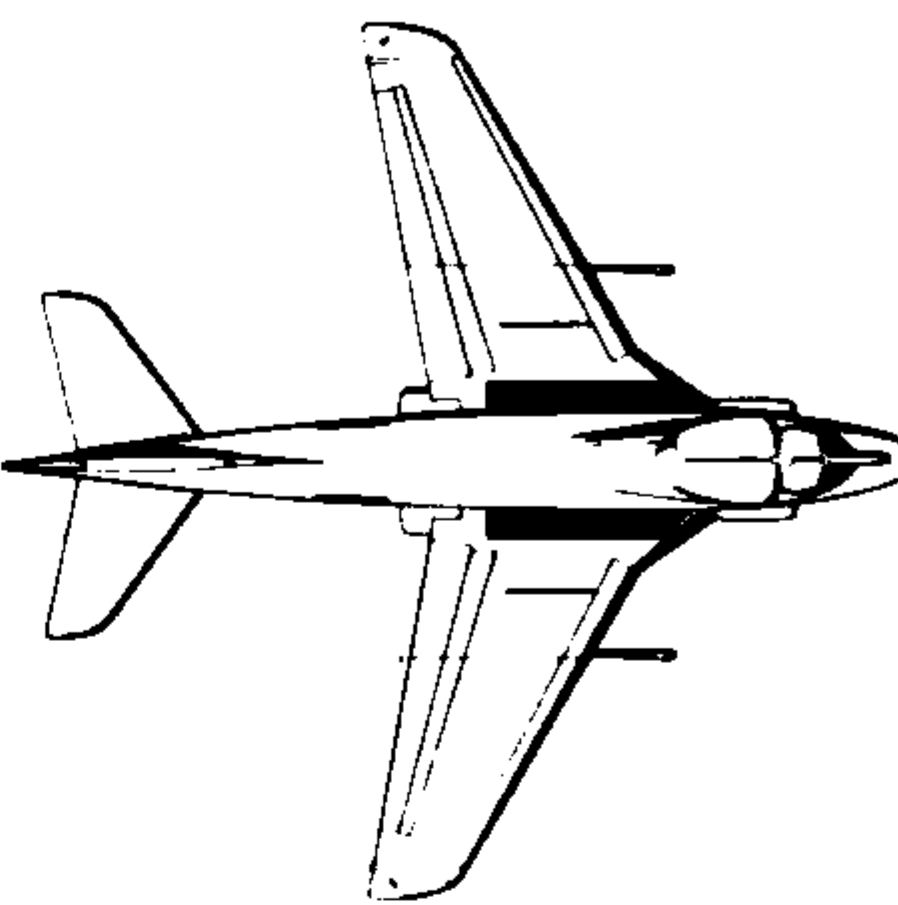


TABLE OF CONTENTS

PART 1 GENERAL DESCRIPTION	1-2	Personnel Services Disconnects	1-69
Aircraft	1-2	Seat Adjustment	1-71
Introduction	1-2	Environmental Control System	1-71
Engine	1-7	Cockpit Air -Conditioning and	
		Pressurization System	1-71
PART 2 SYSTEMS	1-8	Auxiliary Environmental Systems	1-75
Powerplant Systems	1-8	Defogging	1-76
Ignition System	1-8	Windshield Switch	1-76
Constant-Speed Drive/Starter System	1-8	Rain Removal (Anti-Ice)	1-76
Engine Oil System	1-10	Equipment Cooling	1-77
Engine Instruments	1-13	Engine Anti-Icing System	1-78
Engine Fuel Control System	1-13	Circuit Protection	1-78
Primary Aircraft Systems	1-15	Oxygen System	1-78
Aircraft Fuel Supply System	1-15	Lighting Systems	1-80
Air Refueling System	1-21	Interior Lighting	1-80
Electrical Power Supply System	1-23	Exterior Lighting	1-82
Hydraulic Power Supply System	1-30	Miscellaneous Equipment	1-83
Flight Controls	1-32	Armorplate	1-83
Wing Flaps and Slats	1-37	Flake Curtains	1-83
Auxiliary Aircraft Systems	1-39	Radiation Shields	1-84
Automatic Flight Control System	1-39	Equipment Destruct System	1-84
Automatic Carrier Landing System	1-41	Relief Tubes	1-84
Approach Power Compensator System	1-42	Stowage Containers	1-84
Speed Brakes	1-43		
Landing-Gear System	1-44	PART 3 AIRCRAFT SERVICING	1-87
Nose-Tow Catapult System	1-47	Aircraft Servicing	1-87
Wing-Fold System	1-48	Danger Areas	1-87
Wheel-Brake System	1-49	Turning Radius and Ground Clearance	1-87
Arresting-Hook System	1-51	Power Requirements	1-87
Flight Instruments and Indicator Lights	1-52	Servicing Data	1-88
Angle-of-Attack System	1-52		
Pitot-Static System	1-53	PART 4 AIRCRAFT OPERATING	
Attitude Instruments	1-54	LIMITATIONS	1-94
Compass System MA-1	1-54	Engine Limitations	1-94
Horizontal Situation Indicator	1-56	Air Starts	1-94
Radar Altimeter System (AN/APN-141V)	1-57	Airspeed Limitations	1-94
Miscellaneous Instruments	1-58	Instrument Markings	1-95
Caution, Warning, and Advisory Lights	1-59	Equipment Cooling	1-97
Canopy	1-62	Acceleration Limitations	1-97
Canopy Operation	1-62	Center of Gravity Weight Limitations	1-98
Escape System	1-65	Gross Weight Limitations	1-98
Ejection Seat	1-65	External Store Limitations	1-98
Parachute	1-66	Air Flight Refueling Store Limitations	1-99
Emergency Oxygen	1-69	Maneuvers	1-99
Survival Kit	1-69		

part 1

General Description

AIRCRAFT

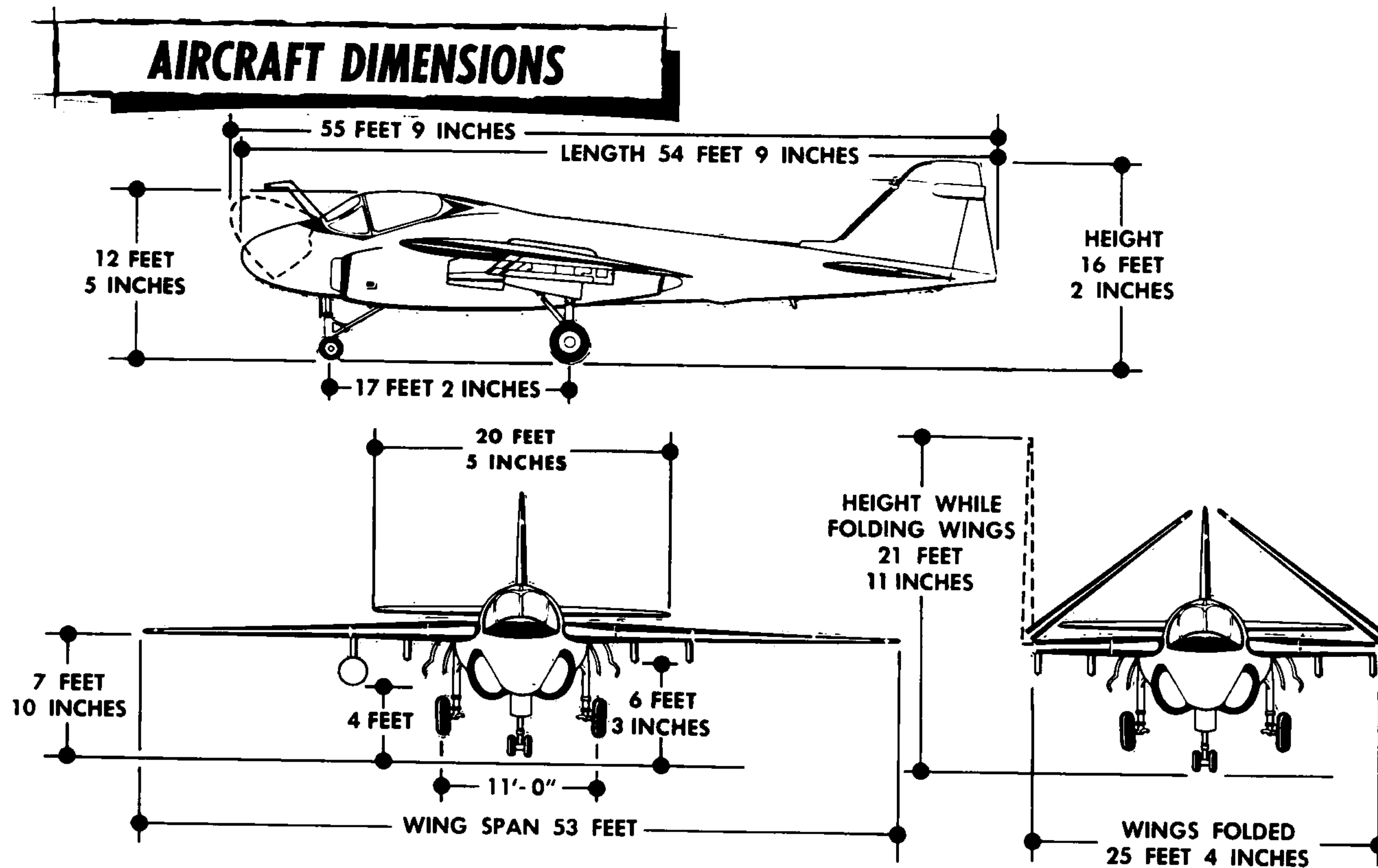
INTRODUCTION

The A-6E Intruder, an improved version of the A-6A, is a two-place, twin-engine monoplane manufactured by the Grumman Aerospace Corporation, Bethpage, Long Island, New York. The aircraft is designed for true all-weather attack and can carry a payload of 8 1/2 tons. A wide variety of weapons can be delivered without the crew ever having seen the ground or the target. The aircraft can be refueled in-flight and can also be used as a tanker. A single-point ground refueling capability shortens

turnaround time and eases the normal fueling process. Dimensions are shown in figure 1-1.

The main differences between the A-6E and A-6A are the installation in the A-6E of an improved computer that is faster and has a greater memory capacity; a search radar with track capabilities; and an improved weapon release system. The equipment cooling system has been revised to accommodate the improved avionics, and a closed circuit equipment pressurization system installed. Two 30 KVA generators supply electrical power. See figure 1-2.

NEW



ADFI-5

Figure 1-1

The aircraft is powered by two Pratt & Whitney, axial-flow, turbojet engines, and is characterized by a dumbo nose and sweptback wings. The aircraft has arrested-landing capabilities, and for a jet aircraft, has a relatively slow approach and landing speed.

The aircraft, from a flight standpoint, is essentially a hydraulic aircraft. Generally, the hydraulic systems are controlled electrically; the major departures from this being the actuation of the flight control servo-actuators, manual canopy operation, emergency landing-gear actuation and wheel brake operations. In these operations, the hydraulic selector valves and servo-actuators are directly positioned by the pilot.

The chance of complete loss of essential functions due to battle damage or system malfunction is minimized in the electrical and hydraulic systems by the use of automatic isolation of less important electrical loads, redundant hydraulic power systems, and tandem actuators.

GENERAL ARRANGEMENT

Figure FO-1 represents the general placement of the components within the aircraft.

AIRCRAFT WEIGHT

The zero fuel/zero store weight of the A-6E is approximately 28,300 pounds. Consult the applicable Handbook of Weight and Balance for exact weight of any series aircraft.

COCKPIT LAYOUT

The aircraft accommodates a two-man crew consisting of the pilot and bombardier/navigator in a

staggered side-by-side seating arrangement. The aircraft is equipped with two MK GRU-7 ejection seats. Figures FO-2 and FO-3 provide typical cockpit layout.

WEAPON CARRIAGE

The aircraft is configured with four wing pylons and a centerline store station for a total of five external store stations. The necessary electrical connections, fuel lines, and valves are housed in the pylons and the centerline store station. The wing pylons are fitted with AERO 7A ejector racks and the centerline station is fitted with an AERO 7B ejector rack. These racks are capable of being loaded with a variety of weapons, adapters, launchers, bomb racks, and ejector racks. The AERO 7A is capable of carrying weights up to 3500 pounds; the AERO 7B is capable of carrying weights up to 3600 pounds. Refer to Section VIII for a description of the weapon release system and to NAVAIR 01-85ADA-1T and -1TA, A-6 Tactical Manual and supplemental Tactical Manual, for details of the various weapons which can be carried.

AIRCRAFT DESIGNATION NUMBERS

For A-6E designation numbers with corresponding aircraft serial numbers, see figure 1-3.

TECHNICAL DIRECTIVES

Figure 1-4 is a form to be used to show those technical directives (AFC, AVC, etc.) that apply to the aircraft and that have been incorporated in this manual. As changes are made to the aircraft, those that effect aircraft operation or pilot/bombardier-navigator need-to-know information will be entered on this form.

MAIN DIFFERENCES TABLE

	A-6A	A-6B	A-6C	KA-6D	A-6E
J52 P-6 ENGINES	X	X	—	—	—
J52 P-8 ENGINES	AFC 37	AFC 37	X	X	X
20 KVA GENERATORS	X	X	X	—	—
30 KVA GENERATORS	—	MOD 1	—	X	X
MK-GRU-5 EJECTION SEATS	X	X	X	X	—
MK-GRU-7 EJECTION	AFC 119	AFC 119	AFC 119	AFC 119	X
BACK-UP HYDRAULIC SYSTEM	AFC 183	AFC 183	X	AFC 183	X
FUSELAGE SPEED BRAKES ONLY	13 THRU 25	—	—	—	—
FUSELAGE & WINGTIP SPEED BRAKES	26 THRU 309 NOT INC. AFC 178	26 THRU 309 NOT INC. AFC 178	—	—	—
WINGTIP SPEED BRAKES ONLY	AFC 178	AFC 178	X	X	X
THREE POSITION CANOPY SWITCH	AFC 185	AFC 185	AFC 185	AFC 185	X
APCS AN/ASN-54 (V)	AFC 199	—	X	AFC 199	X
ACLS AN/ASW-25	AFC 230	—	AFC 230	AFC 230	AFC 230
BALLISTICS COMPUTER AN/ASQ-61A	X	MOD 1	X	—	—
GENERAL PURPOSE COMPUTER AN/ASQ-133	—	—	—	—	X
SEARCH RADAR AN/APQ-92	X	X	X	—	—
SEARCH RADAR AN/APQ-148	—	—	—	—	X
TRACK RADAR AN/APQ-112	X	X	X	—	—
INERTIAL NAVIGATION SYSTEM AN/ASN-31	X	X	X	—	X
NAVIGATION COMPUTER AN/ASN-41	—	—	—	X	—
VIDEO TAPE RECORDER AN/USH -17 (V)	—	—	AFC 279	—	X
PROVISIONS FOR LB-31A STRIKE CAMERA	AFC 256	—	AFC 256	—	AFC 256
TIAS	—	MOD 1	—	—	—
DIRECTION FINDER AN/ASD-4	—	—	X	—	—
INFRARED DETECTING AN/AAS-28	—	—	X	—	—
TELEVISION CAMERA AN/AXD-4	—	—	X	—	—
OPTICAL SENSOR PLATFORM	—	—	X	—	—

ADF1-119

Figure 1-2

**AIRCRAFT DESIGNATION
NUMBERS**

PRODUCTION DESIGNATION NUMBERS	AIRCRAFT BUNO
1 THRU 12 13 THRU 24 25 THRU 36	158041 THRU 158052 158528 THRU 158539 158787 THRU 158798
MOD DESIGNATION NUMBERS	AIRCRAFT BUNO
M1 M2 M3 M4 M5 M6 M7 M8 M9 M10 M11 M12 M13 M14 M15 M16 M17 M18 M19	152907 149956 151592 151804 152607 149948 152905 151807 152923 152587 152584 152621 152928 152635 152640 152895 152904 152916 152933

ADF1-111

Figure 1-3

SUMMARY OF APPLICABLE TECHNICAL DIRECTIVES

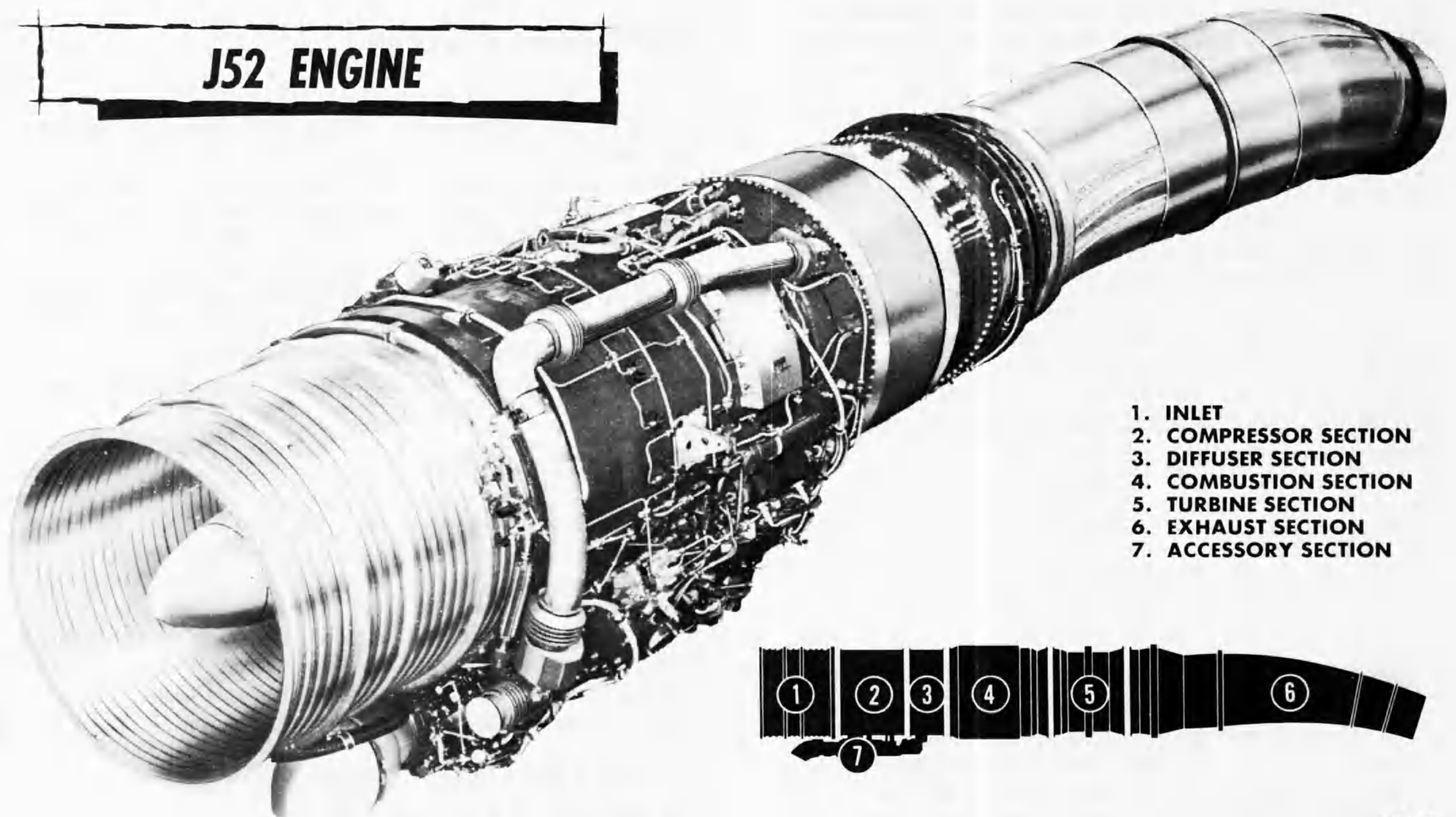
AFC NUMBER	CLASS	TITLE	INCORPORATED	VISUAL MEANS OF IDENTIFICATION
				A-ODG-3-1
230	U	Automatic Carrier Landing System	1 May 1973	ACLS Panel and Indicator
256	U	LB-31A Strike Camera Circuitry	1 May 1973	Camera Control
263	U	ECM Update	15 Dec 1972	ALR-45/50 Panel and Lights
264	U	WSHLD AIR (rain removal) Caution Light	1 July 1972	Caution Light
268	U	Bleed-Air Isolation Valves and CNI Auxiliary Blower	1 July 1972	Bleed-Air Switches
287	U	ECM Update	15 Dec 1972	New ECM Panel
AVC 1342	R	Reduction of Carrier Alignment Time	15 Dec 1972	

Figure 1-4

ENGINE**DESCRIPTION**

The aircraft is powered by two J52 P-8A/B, non-afterburning, axial-flow, turbojet engines (figure 1-5). At sea level (installed) the J52 P-8A engine develops approximately 7,700 pounds normal static thrust and 8,700 pounds military rated static thrust. The engines have a split, twelve-stage, axial-flow compressor, and a unit can-annular combustion chamber, and a split two-stage turbine. An engine bleed control system minimizes the possibility of compressor stall by automatically unloading any

unusable air conditions encountered in the compressor. The compressed air supply for the aircraft is bled from the twelfth stage of the compressor. After initial start, part of this compressor air is used to drive the constant-speed drive/starter (CSD/S) for starting the second engine. Twelfth-stage compressor bleed air is also used for CSD/S oil cooling on the ground, CSD/S generator function, air conditioning, engine vortex-removal jets, rain removal, and hydraulic tank pressurization. The rpm of the high-pressure turbine is governed by the engine fuel control. For a description of engine operation, refer to Section IV of this manual.



ADFI-7

Figure 1-5

part 2

Systems

POWER PLANT SYSTEMS

THROTTLES

The throttles on the left console in the cockpit (figure 1-6), are mechanically linked to the engine fuel control units. Throttle movement does not directly affect fuel flow, but acts as one of four inputs to the fuel control units. The throttles have three placarded positions: OFF, IDLE, and MAX POWER. The idle range is reached by moving the throttle to the first stop, then around and forward of the stop (around the horn). The MAX POWER position corresponds to military thrust, and is the forward stop position of the throttles. The OFF position cuts off fuel to the engines.

The right throttle head houses five switches. The ICS switch is the upper switch on the throttle head and is used for various interphone functions. The speed brakes switch is in the semicircular protrusion on the inboard face of the throttle head. Underneath the speed brakes switch is the mike button, which is used for radio communications. A chaff dispense button is on the forward face of the right throttle. An air-start switch is also on the aft face of both throttle heads, and is used for engine starts when airborne.

CAUTION

No provision is made in the fuel control for stabilized engine RPM in the event the throttle linkage becomes disconnected from the fuel control. If a disconnection occurs, vibration may cause the fuel control for the respective engine to assume any power setting between cut off and military power

THROTTLE FRICTION LEVER

A friction lock lever on the inboard side of the throttle quadrant is used to prevent the throttle from creeping. Moving the lever forward increases friction and moving it aft reduces friction. The full aft position is the off position.

Note

- The approach power compensator system will not engage unless the throttle friction lock lever is in the off position.
- Activation of the throttle friction lock lever with the approach power compensator system engaged will automatically disengage the APCS.

IGNITION SYSTEM

Each engine is provided with a dual ignition exciter unit for ground start, and for airborne continuous and air-start ignition. The ground start/continuous ignition exciter unit is powered by the primary 115V AC bus and provides high-energy (20-joule) ignition. When cranking an engine for starting, high-energy ignition is provided through igniter plugs in number 4 and 7 cans when the throttle is moved from OFF to IDLE. When the engine starts and accelerates to approximately 48% RPM, ignition automatically cuts out.

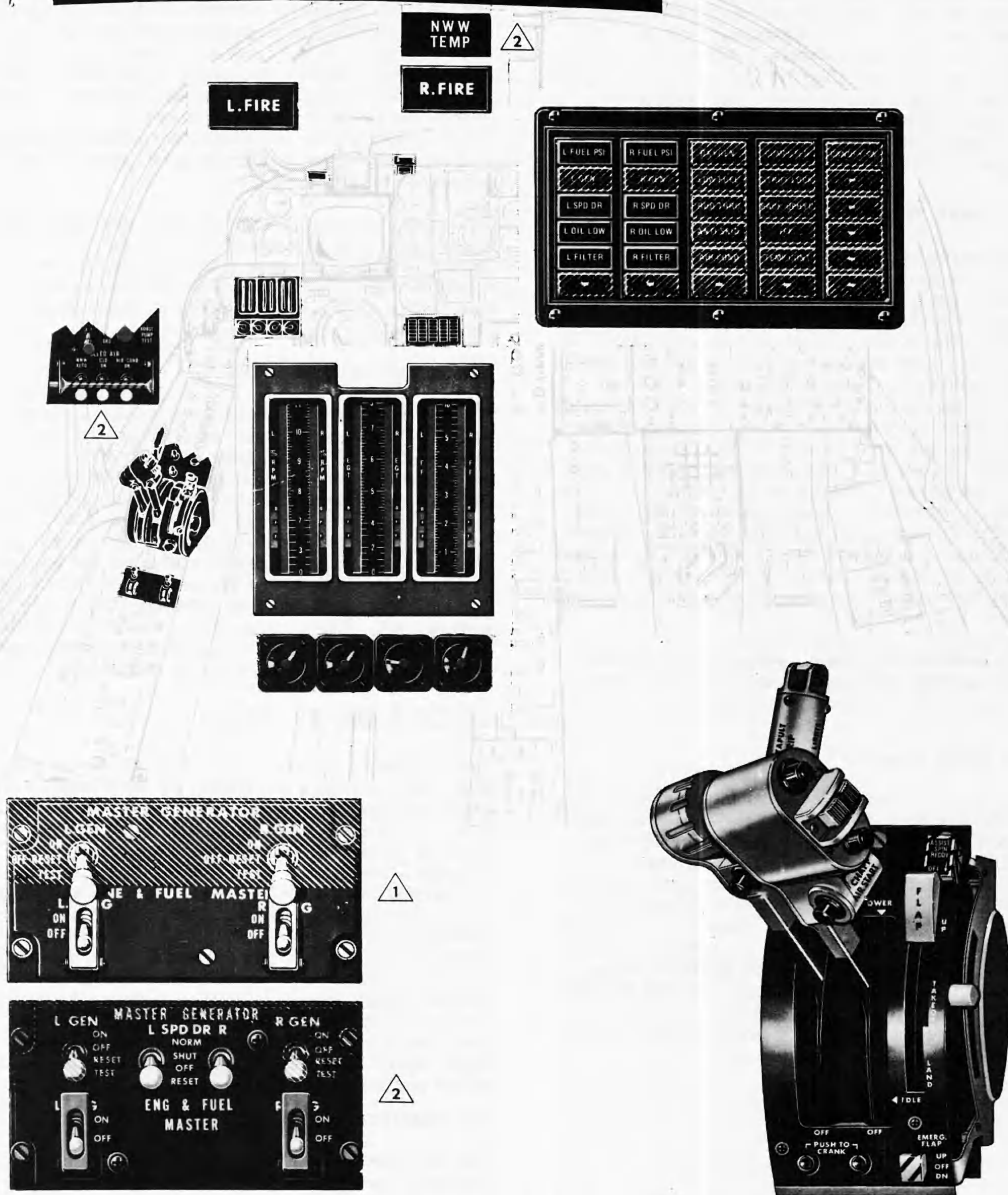
AIR - START BUTTONS

The air-start buttons on the aft face of each throttle grip (figure 1-6) provide ignition energy to the respective engine for air start. When either button is held depressed, essential 115V AC power, through the L or R EMERG IGN circuit breaker on the pilot's left circuit breaker panel, is provided to the ignition exciter unit which in turn provides ignition energy through the igniters in burner cans 4 and 7.

**CONSTANT-SPEED DRIVE/
STARTER SYSTEM**

A CSD/S (constant-speed drive/starter) provides starting torque for the engine and constant-speed drive for the generator. The CSD/S unit is mounted on the accessory section of each engine. The unit incorporates an air-driven turbine, differential transmission, and its own lubrication system. For engine start, the air turbine is driven from an external pneumatic source (or through cross bleed from an operating engine). After the engine is started, the

ENGINE CONTROLS AND INDICATORS



1 AIRCRAFT BUNO 158041 THRU 158532 NOT INCORPORATING AFC NO. 268

2 AIRCRAFT BUNO 158533 AND SUBSEQUENT AND THOSE INCORPORATING AFC NO. 268

A-ADF1-10

Figure 1-6

unit automatically goes into constant-speed drive and delivers engine torque to drive the generator. The differential transmission automatically maintains a constant generator speed with varying engine speed. To drive the generator with the engine shut down, the air turbine is driven automatically by air through cross bleed from the operating engine or from an external power source. The air turbine drives the differential transmission, which in turn drives the generator. The CSD/S is controlled by a SPEED DRIVE switch and malfunctions are indicated by lighting of a SPD DR caution light in the cockpit.

SPEED DRIVE SWITCHES

The SPEED DRIVE switches on the master generator or fuel management panel (figure 1-6 or 1-10) identified as L and R are three-position toggle switches with positions NORM, SHUTOFF, and a momentary RESET. The NORM position directs essential 28 V DC power to arm the engine crank switch and energizes a solenoid to open the pneumatic regulator shutoff valve for engine cranking. The OFF position deenergizes the solenoid, which permits the pneumatic regulator shutoff valve to close and prevents any CSD/S operation. The momentary RESET position is for ground operation of the generator without the engine operating. Positioning the switch to RESET momentarily, then to NORM, directs essential 28V DC power to bypass the engine crank switch and energize the solenoid to open the pneumatic regulator shutoff valve, which permits air pressure to be used exclusively for driving the generator.

If both generators become inoperative in flight the standby battery will keep the solenoid valve energized open and the generators engaged.

SPEED DRIVE LIGHTS

N E W The speed drive lights on the annunciator panel (figure 1-6) display L-SPD DR and R-SPD DR and are powered by the essential 28V DC bus through the CAUTION LTS circuit breaker on the main circuit breaker panel. Steady glowing of the light indicates failure, low oil pressure, or high oil temperature for the respective CSD/S unit. Flashing of the light indicates CSD/S overspeed and the respective generator will become inoperative. At altitudes above 30,000 feet a random, dim, flickering light indicates low oil pressure due to high altitude. A descent to lower altitude should be made prior to other corrective procedures.

Note

During zero-g or negative-g flight, either flashing or steady glowing of the speed drive lights may be expected. This does not necessarily indicate failure within the speed drive unless the indication persists after the aircraft has returned to positive-g conditions.

ENGINE & FUEL MASTER SWITCHES

The left and right engine and fuel master switches (figure 1-6) have two positions: ON and OFF. In the ON position, when either crank switch is depressed, the engine and fuel master switch will energize a hold-in relay. Power from the switch bypasses the crank switch, maintaining power to the speed drive switch after the crank switches are released. Other circuits in the start cycle are also energized, but since these circuits constitute automatic sequencing and cannot be controlled by the pilot, they are not discussed in this manual.

The engine and fuel master switches also open the fuel system gate valves and start the fuel boost pump. The OFF position of the switches deenergizes the engine circuits, closes the fuel system gate valves, and energizes circuits which shut down the fuel boost pump.

ENGINE CRANK BUTTONS

The engine crank buttons on the throttle quadrant (figure 1-6) are momentary pushbutton switches placarded PUSH TO CRANK. The left or right button is used to initiate the start cycle in the respective engine. With the appropriate engine fuel master switch ON and the speed drive switch in NORM, depressing a crank button completes a circuit through the gear/hook circuit breaker and opens the pressure regulator shutoff valve on the respective CSD/S unit. This allows air pressure to drive the CSD/S unit for engine start. After engine start, the crank circuit is deenergized. Both engines cannot be started simultaneously; however, either engine can be started first.

ENGINE OIL SYSTEM

Each engine is provided with a self-contained, hot-tank, high-pressure oil system for lubrication of the engine bearings and accessory drives. Oil from the tank, which has a usable capacity of 3.4 gallons, flows to the pressure pump in the accessory drive gearbox. The oil, at 45 ±5 PSI pressure, is filtered and directed to the fuel-oil cooler and the oil nozzles in the bearing compartments. Oil will bypass the fuel-oil cooler, or the filter, if either becomes blocked. Five scavenge pumps pick up the used oil and return the oil to the tank. Air in the oil tank and bearing compartments is deoiled at the centrifuge in the accessory drive gearbox, and excess internal pressure is vented overboard. Refer to Servicing Data, figure 1-37. Maximum oil consumption is .28 gallon per hour in a 10-hour period.

OIL QUANTITY INDICATING SYSTEM

The oil quantity indicating system is used to warn the aircrew of low oil which could cause engine failure due to oil starvation. The system consists of two oil-level sensor probes installed in each engine oil tank, left and right low-oil caution lights on the annunciator panel, and press-to-test buttons on the master test panel. For oil system failure procedures, refer to Section V.

Oil Low Warning Lights

During press-to-test, lighting of an OIL LOW warning light on the annunciator panel indicates oil quantity from 5 to 12 1/2 quarts $\pm$ 1 quart. If the light comes on other than during press-to-test, the usable oil quantity is less than 5 $\pm$ 1 quart.

Oil Quantity Press-To-Test Buttons

Oil quantity can be checked either airborne or during ground operations by depressing the LOX/FUEL/OIL test buttons on the master TEST panel. When the button is depressed, the OIL LOW lights on the annunciator panel come on to indicate oil quantity between 5 and 12 1/2 quarts in the respective oil tank. No light on, with the test button depressed, indicates oil quantity above 12 1/2 quarts. If the light comes on without depressing the button, there is less than 5 quarts in the indicated tank. The OIL LOW lights can be checked by depressing the FIRE/OIL test button, which applies power directly to the lights on the annunciator panel, through the amplifier, bypassing the sensors and sensor relays.

Note

- Oil quantity below 12 1/2 quarts $\pm$ 1 quart requires engine servicing and should be reported as a discrepancy and corrected before the next takeoff.
- The OIL LOW warning light is valid only after engines scavenge.

OIL-PRESSURE INDICATOR

The oil-pressure instrument is a synchro-repeater-type instrument that receives its signals from an engine-mounted oil-pressure transmitter. The instrument is marked in units from 0 to 10 with a multiplier of 10, giving a range of 0 to 100 PSI. The range between 35 and 50 is the normal oil-pressure range: 35 PSI is a minimum for ground idle conditions. Normal flight pressure is 40 to 50 PSI, and is marked by a wider band and the letter N.

Aircraft maneuvers producing positive g or negative and zero g may cause engine oil pressure to deviate above or below the accepted operating range. This should be considered a normal response provided that the oil pressure returns to normal following completion of the maneuver.

ENGINE BLEED-AIR SYSTEM

The bleed-air system (figure 1-7) supplies high-temperature, high-pressure air from the twelfth compressor stage of the engines to the environmental control system, vortex-removal system, anti-g system, canopy seal system, hydraulic reservoir pressurization system, and the fuel-cell pressurization system. The functional control of the bleed-air is initiated by the requirements of each individual system and the flow, temperature, and pressure are regulated by the system. Normally both engines

supply air for the operation of these systems, but when necessary, single-engine operation supplies sufficient air for their operation. The system ducting is insulated to protect the airframe structure from heat radiation. Check valves in the ducting prevent back flow into the nonoperating engine during starting and single-engine operation. In aircraft BUNO 158533 and subsequent and those incorporating AFC No. 268, a break in the bleed-air ducting can be isolated by dividing the system into three sectors and stopping the air supply with isolation valves, engine shutdown, or a combination of both. Temperature sensors in each sector provide warning in the event of a break.

BLEED-AIR ISOLATION VALVES

In aircraft incorporating AFC No. 268, three motor-driven butterfly bleed-air isolation valves divide the bleed-air system into three isolated sectors and an additional high-temperature sensor is included in the nose-wheel well area. Three switches to control these valves on the bottom of the fuel management control panel (figure 1-10) are supplied electrical power from the 115 VAC essential bus through the BLEED AIR circuit breaker on the B/N's circuit breaker panel.

CAUTION

Allow five seconds between actuations of the bleed-air isolation valves to permit cooling of the valve motors.

NWW Switch/Valve

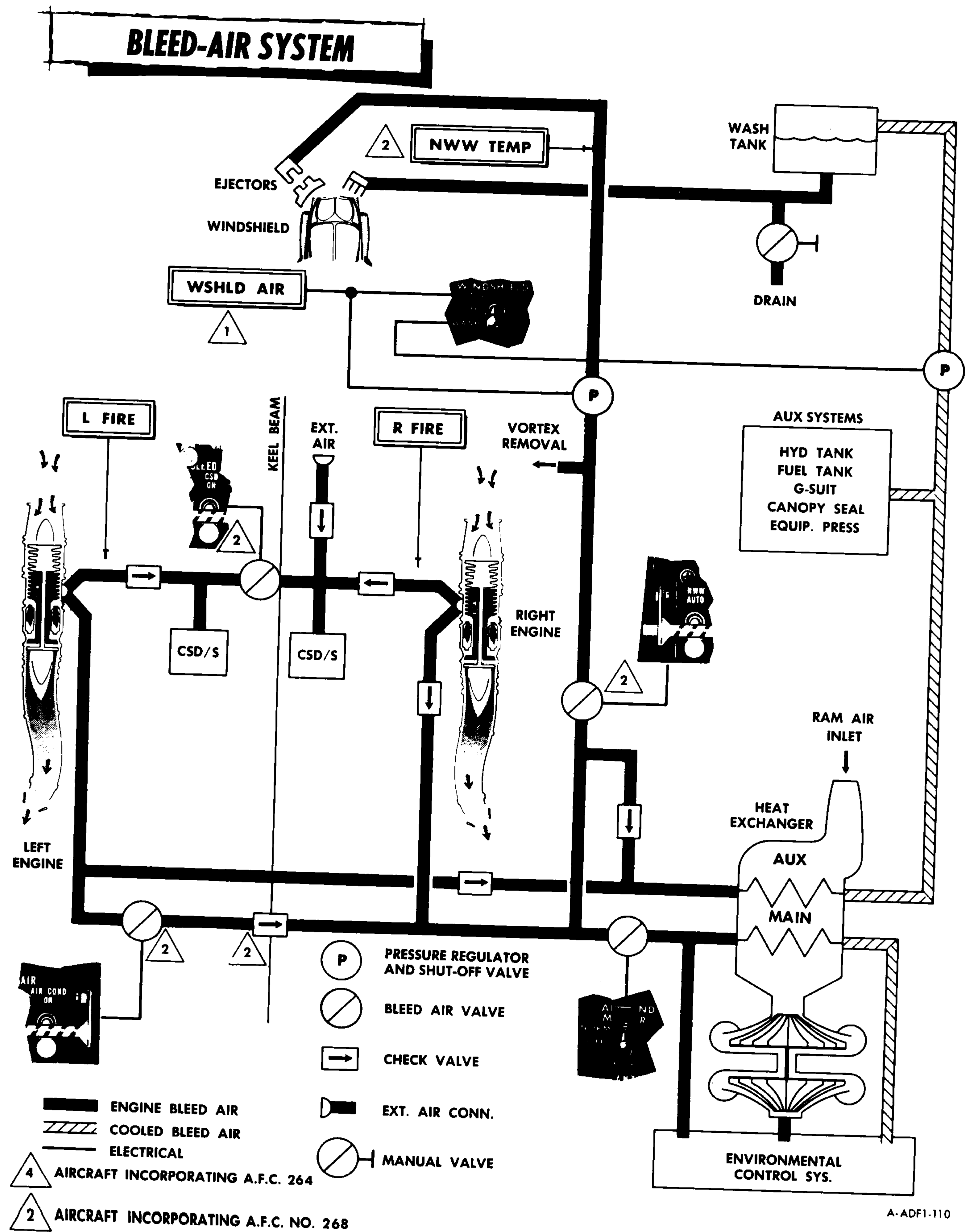
The NWW switch controls the nose-wheel well bleed-air isolation valve in the forward right engine bay. The NWW valve blocks all bleed air from the nose-wheel well in the event of a break in that area as indicated by lighting the NWW TEMP light. In the AUTO position, the valve opens with weight on the wheels to supply a vortex-removal system and any time the WINDSHIELD switch is in the AIR position to supply the rain-removal system. The OFF position overrides any other commands and closes the valve.

CSD Switch/Valve

The CSD switch controls the CSD bleed-air isolation valve on the left side of the keel beam in the cross-bleed manifold between the CSD/S's. If a break occurs in the cross-bleed manifold, it allows isolation of the two sources of bleed air so that shutdown of the affected engine will remove the supply of air to the leak.

AIR COND Switch/Valve

The AIR COND switch controls the air-conditioning bleed-air isolation valve in the left engine bay. If a break occurs in the ducting to the environmental control system, it allows isolation of the two sources of bleed air so that shutdown of the affected engine will remove the supply of air to the leak.



A-ADF1-110

ENGINE INSTRUMENTS

All the engine instruments are grouped together to the left of the horizontal display. The % RPM, EGT, and FF indicators are parallel-tape instruments. The power trim and oil-pressure instruments are circular indicators, mounted below the engine instrument group. All the instruments are marked white against black background. When cockpit lights are used, the markings appear red against a black background.

ENGINE RPM INDICATOR

A signal is developed by a tachometer generator and is compared with DC voltage from a reference potentiometer. The signal is amplified and used to drive a motor-generator, which positions a white tape on the face of RPM indicators. The indicator reads % of standard (12,052) engine RPM. The scale on the indicator is marked in 10% increments from 0% to 70%, and 1% increments, on an expanded scale, from 70% to 110%.

EXHAUST GAS TEMPERATURE INDICATOR

Exhaust gas temperature is sensed by thermocouples, which compare the generated DC signal with a reference current. The difference signal is converted to alternating current and used to drive a motor-generator. As in the % RPM indicator, the motor-generator drives a tape across the EGT scale. The indicator is marked in 50° centigrade increments from 0° to 400° and 700° to 900°, and in 10° increments from 400° to 700°.

POWER TRIM INDICATOR

The power trim indicator for each engine (figure 1-6) displays temperature-corrected pressure ratio. The face of each indicator is marked PT and accommodates a single pointer. A gray arc with the extremities marked H and L is centered at the 9-o'clock position. When the pointer indicates within the arc during the MAX POWER check prior to takeoff, the engine pressure ratio is satisfactory for takeoff. Indications beyond the arc in the H or L area indicate the engine is over- or undertrimmed. Exhaust gas pressure transmitters on each engine, the total air-temperature probe, and the air data computer provide signals through the power trim computer to the indicators. The system is powered by the monitored 28V DC bus. In flight (weight off wheels), the indicators are inoperative and the pointers out of sight behind masks.

Note

The pointer on the power trim indicator will rotate under the following conditions:

1. When engines are off and electrical power is applied to the indicator at ambient temperatures below 75° F.

2. When engines are running and RPM is

- Below 80% with ambient temperature between -40° and +10° F.
- Below 75% with ambient temperature between 20° and 30° F.
- Below 70% with ambient temperature between 40° and 50° F.
- Below 10% with ambient temperature above 70° F.

These power trim indicators are accurate in the usable range when the pointer provides a steady indication.

ENGINE FUEL CONTROL SYSTEM

The engine fuel control system (figure 1-8) is identical for both engines and schedules fuel from the engine-driven fuel pumps to the combustion chambers. The amount of fuel metered is measured at the fuel flow transmitter, which is coupled electrically to the fuel flow indicator on the pilot's instrument panel. Caution lights for each engine on the annunciator panel indicate when low fuel pressure or filter bypass conditions exist. Engine controls and indicators are shown in figure 1-6.

ENGINE FUEL CONTROL

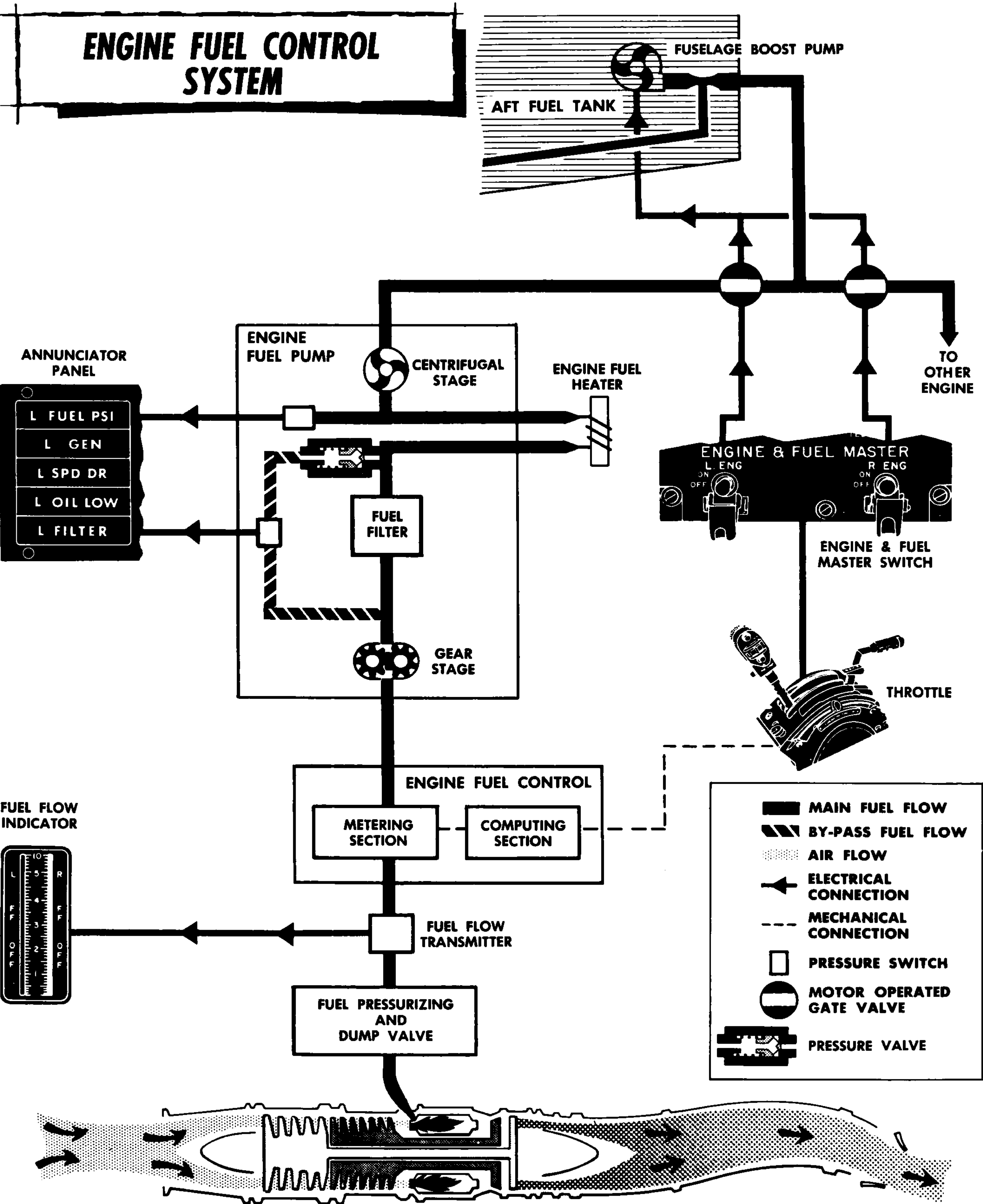
The engine fuel control can be divided into a computing and metering section. The computing section monitors throttle position, burner pressure, engine speed, and compressor inlet temperature. This is translated into a fuel demand that is relayed to the metering section, which meters the correct amount of fuel from the engine fuel pump to the fuel pressurizing-and-dump valve.

FUEL PRESSURIZING-AND-DUMP VALVE

The fuel pressurizing-and-dump valve senses fuel pressure and directs fuel to the primary and secondary fuel nozzles in the combustion chamber. Both primary and secondary fuel nozzles are used when the engine is in the operating range and fuel pressure is normal. During engine starts, low starting fuel pressure is directed to the primary fuel nozzle only. When the throttles are retarded to OFF, the pressurizing-and-dump valve stops the fuel flow from the engine fuel control and drains the primary fuel manifold overboard.

FUEL HEATER

The fuel heater is an automatically controlled unit that prevents ice from forming in the engine fuel system. This is accomplished by maintaining the minimum temperature of the fuel entering the fuel pump filter at 10°C. The fuel heater is on the bottom of the diffuser case, just forward of the pressurizing-and-dump valve and is accessible when the



ADFI-9

Figure 1-8

forward engine access door is open. The main parts of the heater are: the heat exchanger, fuel bypass valve, air regulator valve, and the override valve. Fuel leaving the impeller state of the engine-driven fuel pump flows around the heat exchanger core over the temperature-sensing elements of the air regulator and servo override valves, and reenters the fuel pump at the filter inlet. If the fuel passages around the heat exchanger core become restricted, a bypass valve in the heater housing opens to allow fuel flow to the engine.

FUEL FILTER LIGHT

The fuel filter lights on the annunciator panel (figure 1-6) display L FILTER and R FILTER and are powered by the 28V DC essential bus through the CAUTION LTS circuit breaker on the main circuit breaker panel. Lighting of either light indicates the fuel filter for the respective engine is obstructed. A pressure switch completes a circuit to the light when a minimum of 5 PSI differential pressure exists between the inlet and outlet of the fuel filter.

PRIMARY AIRCRAFT SYSTEMS

AIRCRAFT FUEL SUPPLY SYSTEM

The aircraft fuel supply system (figure FO-4) can be replenished in flight or used to refuel another aircraft. When the aircraft is used as a tanker, the centerline tank is removed and replaced with an air refueling store. For air refueling, a refueling probe is attached at the aircraft centerline forward of the windshield. See figure 1-9 for fuel tank capacities.

The fuselage tanks include forward and aft self-sealing cells and a bladder type mid cell. Manifolds integrate the fuselage cells and allow gravity fuel flow to the aft cell. The wing tanks include two outboard wet tanks, one in each outer wing panel, and an inboard wet wing tank spanning from wingfold to wingfold. Transfer from all wing tanks is simultaneous and is controlled by the tank pressurization switch on the fuel management panel.

FUEL MGMT CONTROL PANEL

The fuel management control panel on the pilot's left console (figure 1-10) provides controls for pressurization and transfer of wing and drop tank fuel, selectors for fuselage, wing and drop tank fuel quantity indications, switches for fuel dumping, ground and air refueling, and a boost pump test button.

Fuel Ready Switch

The FUEL READY switch on the fuel management panel (figure 1-10) is a three-position toggle switch with positions placarded FLT, OFF, and GRD that is used for receiving fuel in flight or for ground fueling. Placing the switch in FLT stops internal transfer of fuel by venting wing and drop tanks (and centerline store tank) to permit the aircraft to receive fuel during air refueling operations. Fuel is taken on as it is during single-point ground fueling. In OFF, the valves return to their normal configuration. The GRD position permits the aircraft to be fueled with the single-point refueling system.

Note

The normal flight position for this switch is OFF. Wing and drop-tank fuel will not transfer if the FUEL READY switch is in the FLT position or GRD position with ground refueling power switch in FUEL or DEFUEL position.

ENGINE FUEL FEED SYSTEM

The aft cell of the fuselage tanks supplies fuel through a service tank boost pump and motor-operated gate valves to the engine fuel pumps. The aft cell is divided into two compartments by a baffle and inverted flight check valves. The check valves allow fuel to flow into the bottom part of the cell, which is essentially a service tank. The boost pump that supplies fuel to the engine pumps is in the service tank, ensuring fuel supply to the engine for a limited time for any one flight maneuver. Fuel from the forward and midfuselage cells is gravity fed to the lower part of the service tank through a one-way check valve. Fuel under pressure from the wing and drop tanks is fed in turn to the forward fuselage tanks.

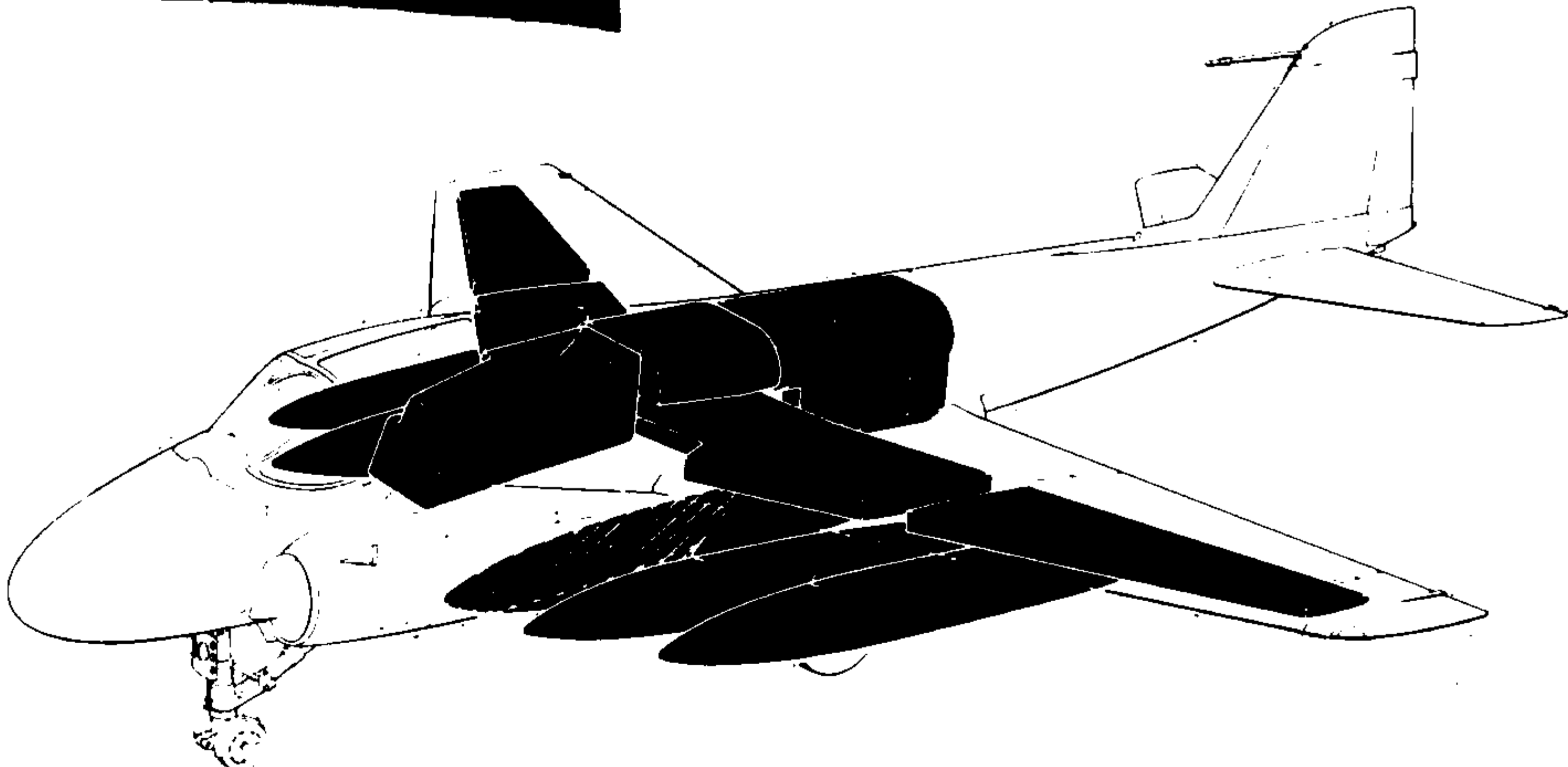
The service tank boost pump is controlled by the engine and fuel master switches on the master generator panel (figure 1-10). When either switch is placed ON, a relay deenergizes, closing a circuit to the boost pump. In this way, a relay failure in the aircraft will not affect boost pump operation. The engine and fuel master switches also control motor-operated gate valves. There is one gate valve for each engine in the manifold to the engine-driven fuel pump. The OFF position of the engine and fuel master switch electrically closes the valve; the ON position drives the valve open. If there is a power failure, the valve will remain in the last selected position.

Boost Pump Test Button

The boost pump test button on the fuel management control panel (figure 1-10) placarded BOOST PUMP TEST is for ground checking the operation of the

FUEL QUANTITY DATA TABLE

DATE: 1 MAY 1965
DATA BASIS: ESTIMATED



TANKS	TOTAL CAPACITY		APPROX. USEABLE FUEL IN LEVEL FLIGHT	
	GALLONS	POUNDS	GALLONS	POUNDS
FUSELAGE (MAIN) TANKS	1,326	9,016	1,309	8,900
INTERNAL WING TANKS	1,018	6,923	1,010	6,868
TOTAL FUSELAGE PLUS INTERNAL WING	2,344	15,939	2,319	15,768
EACH DROP TANK OR AIR REFUELING STORE	300	2,040	295.5	2,009

NOTE

TOTAL AIRCRAFT FUEL READ ON THE
FUEL QUANTITY GAGE TOTALIZER EX-
CLUDES THE AIR REFUELING STORE.

WEIGHTS ARE BASED ON 6.8 POUNDS
PER GALLON OF JP-5 FUEL, STANDARD
DAY CONDITIONS.

Figure 1-9

FUEL SYSTEM CONTROLS AND INDICATORS

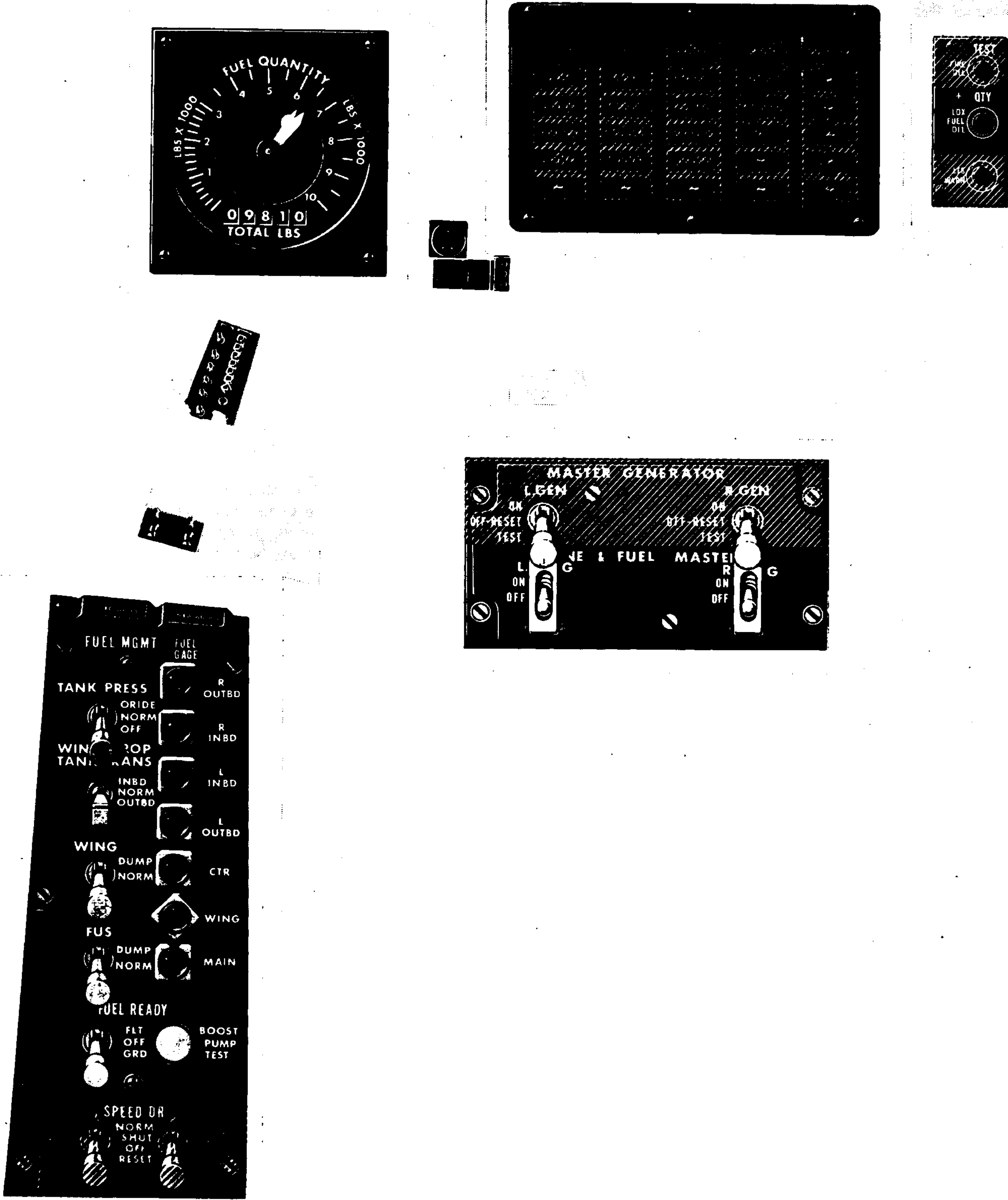


Figure 1-10

main tank boost pump and the centrifugal element of the engine-driven boost pumps. When the button is depressed, primary 115V AC power energizes a relay which opens the essential 115V AC power supply to the main tank boost pump, shutting it off. Prior to engine start, the main tank boost pump test circuit is checked by depressing the button, shutting off the electric-driven main-tank boost pump. Lighting of the L and R LOW FUEL PRESS lights indicates that the main-tank boost pump test circuit did in fact shut off the boost pump. After engines are started, the centrifugal stage of the engine-driven fuel boost pump is checked by depressing the button, shutting off the electrically driven main-tank boost pump. Lighting of either the L or R LOW FUEL PRESS lights indicates failure of the centrifugal stage of the respective engine-driven fuel boost pump by its failure to maintain fuel pressure.

Note

DO NOT DEPRESS BOOST PUMP TEST BUTTON IN FLIGHT as an engine will flame out if the centrifugal stage of an engine-driven boost pump has failed.

ENGINE FUEL PUMP

A two-stage fuel pump on the accessory drive gearbox supplies boosted fuel pressure to the engine fuel control. The pump consists of a positive-displacement gear-type pumping element and an impeller booster. If the fuel filter, located between the pumping element and the impeller, becomes blocked, fuel will be directed around the filter automatically by the filter bypass. Two pressure switches, which control the low fuel pressure and filter bypass caution lights, are also located between the pump stages.

LOW FUEL PRESSURE LIGHTS

The low fuel pressure lights on the annunciator panel (Figure 1-6) display L FUEL PSI and R FUEL PSI and are powered by the essential 28V DC bus through the CAUTION LTS circuit breaker on the main circuit breaker panel. A pressure switch downstream of the centrifugal stage of the engine-driven pump completes a circuit to the light when the pressure is below approximately 12 to 14 PSI. At lower altitudes, the centrifugal state of an engine-driven pump or the main tank boost pump alone can maintain sufficient fuel pressure for engine operation and keep the light out. At higher altitude, above approximately 20,000 feet, failure of the centrifugal stage of an engine-driven pump will turn on the light for its respective engine, and failure of the main tank boost pump will turn on the lights for both engines. A reduction in power and descent to lower altitude will turn off the light and prevent an engine flameout.

FUEL FLOW INDICATOR

A fuel flow transmitter, powered by 115V, 400-Hz current translates fuel flow into an electrical signal. The signal is fed to the transformer and stepped up to drive a motor-generator. The motor-generator in

turn drives a tape across the FF indicator. The fuel flow indicator reads pounds per hour (PPH) and is marked in 100-PPH increments up to 5,000 PPH. Above 5,000 PPH and up to 10,000 PPH, the scale is marked in 1,000-PPH increments and is compressed into a smaller linear distance.

FUEL PRESSURIZATION, TRANSFER, AND VENT SYSTEM

Under normal flight conditions, gear up and locked, the integrated pressurization transfer and vent features of the fuel supply system function automatically. Pressurization is furnished by cooled bleed air from the engines' twelfth-stage compressor. The wing tanks are pressurized to 7 PSI and the drop tanks to 25 PSI. Without pressurization, fuel cannot be transferred. Low wing-tank pressure is indicated by the wing-tank pressure caution lights on the fuel management panel. When going from unpressurized to pressurized tanks, there is a slight delay before the low wing-tank pressure caution lights go out because of the time needed to cycle the tank relief valves and pressurize the tanks. Limited control over the pressurization, transfer, and vent system is possible through the use of the tank pressurization switch, wing drop tank transfer switch, and ship tank switch.

Tank Pressurization Switch

This switch is on the fuel management panel (figure 1-10) and has three positions: ORIDE, NORM, and OFF. In ORIDE, wing pressure-relief valves will close regardless of landing-gear position and the pressure regulators will open to pressurize the tanks. With gear down, aircraft on the deck, and ORIDE selected, wing-tank pressurization is 7 PSI. With aircraft airborne, gear up or down, and ORIDE selected, wing tanks are pressurized to 12 PSI. The OFF position of the tank pressurization switch will prevent pressure buildup by holding the vent relief valve open under all flight conditions. With the switch in the NORM position and the landing gear up and locked, tank pressurization is regulated automatically. The tank pressurization switch is primarily for preflight check of fuel transfer capability.

CAUTION

During ground operation, if the tank pressure switch is actuated to ORIDE when the air-conditioning master switch is OFF, hot engine bleed air will be pumped into the wing tanks. This will damage the O-ring seals in the zero-leak check valves, permitting fuel to flow into the auxiliary heat exchanger, the hydraulic tank, vent suit, canopy seal, and electronic equipment in the nose-wheel well as well as the engine bleed air lines.

Note

With landing gear down, wing and drop tank fuel cannot be transferred or dumped unless the tank pressurization switch is set to ORIDE.

Outbd/Inbd WG PSI Lights

The wing-tank pressure lights on the fuel management panel (figure 1-10) display OUTBD WG PSI and INBD WG PSI and are powered by the essential 28V DC bus. Lighting of either or both lights indicates air pressure in the respective wing tanks is below approximately 6 PSI and fuel is not transferring, or is transferring at a reduced rate. The light circuit is completed by pressure switches in the respective wing tanks.

Wing Drop-Tank Transfer Switch

The wing drop-tank transfer switch (figure 1-10) on the fuel management panel has three positions: INBD, OUTBD, and NORM. The INBD position closes shutoff valves in the outboard drop tanks and the centerline tank and allows fuel to transfer from the inboard tanks. With the switch in the OUTBD position, the inboard and centerline shutoff valves are closed and fuel is transferred from the outboard tanks. Fuel transfers simultaneously from all the drop tanks with the switch in the NORM position.

CAUTION

Tests have indicated that possible overpressurization of the fuselage fuel tanks may occur if all four drop tanks empty simultaneously. No reported instances have occurred to date; however, the following mandatory drop-tank selection procedure must be adhered to in flight for those affected aircraft:

1. Place the wing drop-tank transfer switch on INBD until inboard drop tanks empty.
2. After the inboard drop tanks have emptied, place the switch in NORM for the remainder of the flight.
3. If configured with four or more drop tanks, and only two are fueled, then NORM should be selected since only the two will empty simultaneously.
4. Three conditions exist during which the drop-tank transfer switch is to be placed in NORM when all drop tanks contain fuel:
 - a. When fuel is being dumped.
 - b. When the aircraft is serving as a tanker and fuel is being transferred to the receiver aircraft.
 - c. Fewer than four drop tanks are installed.

FUEL QUANTITY INDICATING SYSTEM

The fuel quantity indicating system consists of fuel capacitance sensor units mounted in the fuel tanks, a fuel quantity gage, fuel quantity selector buttons, and an indicator test button. The capacitance sensor units compensate for changes in fuel density and present a signal to the gage proportional to fuel quantity in pounds. The system is powered by essential 28V DC power through the TURN/SLIP circuit breaker on the main circuit breaker panel and essential 115V AC power through the LOX/FUEL QTY circuit breaker on the pilot's left console circuit breaker panel.

Fuel Quantity Gage

The fuel quantity gage (figure 1-10) on the pilot's instrument panel displays three simultaneous indications of fuel quantity. A digital totalizer in the lower part of the instrument face provides a continuous indication of total pounds of fuel on board. Two rotating pointers indicate on a scale around the outer periphery of the gage that is graduated in increments of 200 pounds up to 3,000 pounds and 500-pound increments from 3,000 to 10,000 pounds. The large pointer indicates pounds of fuel in the main tank. The small pointer indicates pounds of fuel in the main, wing, or any of the five drop tanks as selected by buttons on the fuel management panel.

Fuel Gage Selector Buttons

Seven FUEL GAGE selector buttons on the fuel management control panel (figure 1-10) are placarded R OUTBD, R INBD, L INBD, L OUTBD, CTR, WING, and MAIN. Depressing a particular button cancels the previous selection and selects that particular tank for presentation of fuel quantity on the fuel quantity indicator by the small pointer. The depressed button rotates 45° and serves as a visual indication of the selected tank.

CAUTION

To prevent damage to the fuel quantity gage, a selector button should be selected at all times. If a selector button is not selected, the gage will continue to motorize against the zero stop and burn cut.

LOX/FUEL/OIL Test Button

The LOX/FUEL/OIL test button on the MASTER TEST panel (figure 1-10) is provided to test the operation of oxygen quantity gage, OXYGEN light and fuel quantity gage. Depressing the button causes the digital counter and the two pointers on the fuel quantity gage and the pointer on the liquid oxygen gage to move to zero and the OXYGEN light on the annunciator panel to light. Depressing this button is also a check of oil quantity. Lighting of either OIL LOW light on the annunciator indicates engine oil servicing is required.

LOW FUEL Caution Light

A separate thermal resistance bridge circuit energizes the LOW FUEL caution light on the annunciator panel. The thermal resistors are part of a liquid level sensor mounted in the aft main fuel tank. When the thermal resistors are exposed to air, a relay is deenergized, allowing electrical power to reach the LOW FUEL caution light. When the thermal resistors are immersed in fuel, the relay is energized, turning off the caution light.

The thermistor will turn on the low fuel caution light when the remaining fuel level is between 1,360 to 1,660 pounds of fuel, under the following conditions:

1. Aircraft attitude - 4° nose up
2. Fuel flow (maximum range cruise at 10,000 feet) - 1,460 lbs/hour/engine
3. Aircraft weight - 30,000 pounds

Under these conditions, 80 pounds of fuel will remain in the forward fuselage tank, and 1,380 pounds of fuel will remain in the aft tank. Since the thermistor is in the aft tank, an increase in nose-up attitude that permits all the fuselage fuel to flow to the aft tank will delay a low fuel indication until there is only 1,380 pounds of fuel remaining. This is 80 pounds below the 1,460 plus 200 minus 100 pounds desired. A decrease in the 4° nose-up attitude will result in more than 1,460 plus 200 minus 100 pounds of fuel remaining at the time the LOW FUEL caution light comes on.

FUEL DUMPING SYSTEM

Aircraft fuel can be dumped overboard simultaneously from the fuselage tanks and the wing tanks. The wing drop tanks and the centerline drop tank or the air refueling pod can be jettisoned, or if the tanks are to be retained, fuel from the wing drop tanks must be transferred to the outboard wing tanks. The centerline drop tank or the air refueling store fuel must be transferred to the fuselage tank. Drop tank transfer occurs automatically. To transfer fuel from the refueling pod, the ship tank switch must be in the FROM STORE position.

Wing fuel dumping is controlled by the wing dump switch (figure 1-10). Placing the switch in DUMP opens the wing dump valves and allows tank pressure to build to 12 PSI for quicker dumping. Optimum wing fuel dumping is achieved at cruise attitude, 4° to 4 1/2° nose up. While flying in this attitude, approximately 6,300 pounds of wing fuel can be dumped in 5 minutes. Due to drain-down time, it takes approximately 3 minutes to dump the remaining dumpable fuel, 554 pounds. The fuel leaves the aircraft through manifolds on the trailing edge of each wing-tip.

When dumping wing fuel while flying at nose-down attitudes, the dump rate becomes increasingly slower. With decreasing attitude, dumping becomes sporadic because air pressure is lost when the dump

valve inlet, located in the trailing edge, is uncovered and the amount of trapped fuel becomes increasingly larger. The amount of trapped fuel ranges from approximately 140 gallons trapped at 0° flight attitude to the total wing fuel (1,018 gallons) at 10° nose down.

Flight test has shown that the disturbance in the air-flow over the wing caused by the wing-tip speed brakes when they are extended is sufficient to significantly disrupt the pattern of fuel flowing from the wings during dump. For this reason, wing fuel should be dumped with the wing-tip speed brakes closed.

Fuselage fuel dumping is selected with the fuselage (FUS) dump switch. The transfer and dump pumps in the forward and aft cells operate to increase the dump rate. With fuselage cells full, dumpable fuel is pumped overboard in 3.5 to 4 minutes. Due to the location of the transfer and dump pump in the forward cell and the standpipe in the aft cell, a certain amount of fuel remains in the fuselage tank after dumping is completed. At cruise attitude (4 1/2° nose up or 12 1/2 units on the AOA indicator), approximately 3600 pounds remains with about 1200 pounds in the forward cell and about 2400 pounds in the aft cell. A slight dive will increase fuel remaining. A slight climb, an airspeed change, or other maneuver resulting in an increased angle of attack during dump will decrease the fuel remaining to a minimum of 2400 pounds. The fuselage fuel is dumped through a dump vent outlet at the lower aft end of the fuselage.

Purging of fuel vapor from the wing tanks is automatic. No purging is provided for the drop tanks.

Fuselage Dump Switch (FUS)

The DUMP position of the two-position fuselage switch on the fuel management panel (figure 1-10) starts the forward and aft fuel transfer pumps and opens the fuselage dump gate valve. Power to drive the forward pump comes from the monitored 115V AC bus. The rear pump is powered by 115V AC from the primary AC bus. The NORM position of the switch cuts electrical power to the transfer pumps and drives the fuselage dump gate valve closed.

CAUTION

Place the fuselage dump switch to NORM after dumping fuselage fuel to prevent the transfer pumps from overheating.

Wing-Dump Switch

The wing switch has two positions: DUMP and NORM. When DUMP is selected, power is supplied to the wing dump valves, the wing-tank gate valves, and the wing-tank pressure regulators. The regulators boost pressure to 12 PSI in the wing tanks for dumping. The wing gate valves are powered closed, preventing fuel transfer to the fuselage tanks. Leaving the

switch in DUMP will hold the wing dump valves open. The NORM position of the wing dump switch powers the wing dump valves closed, and allows the wing-tank pressure regulator to pressurize the tanks at 7 PSI with the landing gear retracted.

Note

- When refueling in flight at a low fuel state, placing the WING DUMP switch to the dump position will allow all received fuel to enter the fuselage cells and centerline tank if installed where it is immediately available to the engines.
- Return wing dump switch to NORM prior to landing to prevent dumping fuel on deck.

AIR REFUELING SYSTEM

The aircraft can receive fuel in flight from a drogue-equipped tanker, or serve as a tanker and deliver fuel in flight to a probe-equipped receiver aircraft. Air refueling procedures are found in Section IV, Part 4 of this manual, and refueling charts are available in Section XI, Part 7.

AIR REFUELING (RECEIVER)

During air refueling, fuel flows through the receiver aircraft probe nozzle under pressure and is distributed to each tank in the same manner as it is through the single-point refueling (system) receptacle. The amount of fuel flow is determined by the number of empty or partially full receiver tanks. As each tank is filled, float-operated shutoff valves stop the flow of incoming fuel.

Fuel flow rates vary in accordance with the fueling pressure at the refueling probe nozzle and the number of tanks filling. The maximum rate is approximately 325 GPM when all tanks are filling. The refueling shutoff valves are designed to withstand surge pressures which current tankers produce.

Air Refueling Probe Light

A red air refueling probe light is installed to illuminate the refueling probe for night operation. The light is located forward of the cockpit canopy and left of the aircraft centerline and is aimed at the tip of the refueling probe. Placing the TAXI/PROBE light switch on the master light control panel (figure 1-33) to ON, directs electrical power to the probe light when the landing gear are up and locked.

Refueling Valve Manual Control Handle

A refueling valve manual control handle is provided to open or close the refueling gate valve (figure FO-4) manually in the event of electrical failure. Located between the pilot and B/N, the handle is mounted in a slotted guide on the bulkhead adjacent to the right side of the main circuit breaker panel.

The handle is placarded REFUELING VALVE MANUAL CONTROL and has two detented positions marked OPEN (up) and CLOSE (down).

Note

In-flight actuation of the REFUELING VALVE MANUAL CONTROL handle in the event of complete electrical failure will permit refueling of fuselage tanks only. The wing tanks will still remain pressurized.

If operated with valve failure only (no electrical failure), all tanks will be filled.

AIR REFUELING (TANKER)

The air refueling system enables the aircraft to serve as a tanker for other aircraft. Fuel from the tanker may be directed to the air refueling store at a rate of 190 gallons per minute. All but 3,600 pounds of the tanker's fuel may be transferred to the receiver aircraft. Refueling flight procedures are found in Section IV of this manual.

AIR REFUELING STORE

The air refueling store carried on the centerline rack contains a 300-gallon fuel cell, a constant-speed ram-air turbine drive hydraulic pump, a hydraulically driven fuel pump, a hydraulically driven hose reel, and 50 feet of refueling hose with attached drogue. The store is capable of transferring fuel at a rate of approximately 180 gallons per minute at a pressure of 35 to 55 PSI. The operational envelope of the store with drogue extended is limited to 300 KIAS or 0.80 IMN, whichever is lower, at altitudes up to 35,000 feet.

Air Refueling Store Lights

At the aft end of the refueling store are two lights, AMBER (left side) and GREEN (right side). These lights are of use only to the receiver aircraft. The amber light comes on when the hose is extended indicating that the receiver aircraft may now engage the drogue. After engagement is accomplished, the receiver must move forward (3 to 6 feet), until the amber light goes out. Lighting of the green light indicates that fuel is actually flowing from the tanker to the receiver.

Drogue Light

The white drogue light is mounted on the aft fuselage to illuminate the hose and drogue. Power from the monitored 28V DC bus is applied to the drogue light when the refueling master switch on the air refueling control panel is in the ON position.

Pylon Lights

The amber pylon lights are on the trailing edge of the pylon at stations 1 and 5. Power is provided from the monitored 28V DC bus. When the refueling

master switch on the in-flight refueling control panel is at ON, power is applied to the pylon lights. The intensity of the lights is controlled by the in-flight refueling control panel light switch. The pylon lights may also be operated from the master light control panel when the exterior lights master switch on the catapult grip is on.

AIR REFUELING CONTROL PANEL

The air refueling control panel will be installed on tanker (mission) aircraft. It is normally located forward on the B/N's right console and contains all the indicators and switches to operate the system. See figure 1-11.



A-ADF1-14

Figure 1-11

Refueling Master Switch

The refueling master switch has three positions; OFF, and DUMP. When the refueling master switch is placed ON, it unlocks and unfeathers the air-driven propeller at the forward end of the refueling store. When placed to OFF, it feathers and locks the propeller. The DUMP position is inoperative.

Gallons-Delivered Counter

The gallons -delivered counter registers the gallons of fuel transferred through the hose and drogue to the receiver, in increments of 2 gallons. A reset knob is provided to reset counters to zero when desired.

Drogue Position Indicator

The drogue position indicator (figure 1-11) has three indications: RET (retract), EXT (extended), and TRA (transfer). The indication will be RET only

when the drogue is fully retracted or during drogue extension. The indication will be EXT only when the drogue is fully extended and ready for receiver engagement. TRA is indicated only when the hose and drogue has been engaged and approximately 4 feet of hose retracted onto the store reel and during hose retraction until the drogue is fully retracted.

Drogue Switch

The drogue switch on the refuel panel (figure 1-11) is a two-position toggle switch with positions placarded RET and EXT. The EXT position extends the drogue and the RET position retracts the drogue. The hose is automatically snubbed for the last several feet of extension and retraction.

Transfer Switch

The transfer switch on the refuel panel (figure 1-11) is a two-position switch with positions placarded TRANS and OFF. The TRANS position opens a control valve which permits the hydraulically driven fuel pump to operate. The TRANS position of the switch contains a holding relay and will not stay in the TRANS position unless the master switch is ON and the refueling store contains enough fuel to close a float switch. The fuel pump will not operate unless the hose is reeled in at least 2 feet. This feature stops fuel transfer prior to disengagement. The OFF position of the switch shuts off the pump.

Ship Tank Switch

The SHIP TANK switch on the lower right corner of the refuel panel (figure 1-11) is a three-position toggle switch with positions placarded TO STORE, OFF, and FROM STORE. The TO STORE position energizes the fuel transfer-and-dump pumps which pump fuel from the forward and aft fuselage cells to the refueling store or centerline drop tank. The pump in the aft fuselage cell is powered by the primary 115V AC bus, and the pump in the forward tank is powered by the monitored 115V AC bus. The OFF position closes a shutoff valve which prevents fuel flow to or from the store or drop tank. The FROM STORE position pressurizes the refueling store or centerline drop tank to 25 PSI and forces the fuel to flow to the forward fuselage cell.

WARNING

Insure SHIP TANK switch is OFF prior to engine shutdown or disconnecting electrical power to prevent backflow of fuel from fuselage to air refueling store during ground fueling operations.

Note

- Normal transfer to the tanker fuselage fuel cells from the centerline refueling store will not occur unless the ship tank switch is placed in the FROM STORE position.
- When an in-flight REFUEL control panel is installed, an air refueling pod or centerline drop tank will not accept fuel unless the SHIP TANK switch is placed to the TO STORE position.
- When in-flight refueling is completed, the FUEL READY switch must be returned to the OFF position to pressurize the wing and drop tanks for fuel transfer.

Light Switch

The light switch determines the brightness of the amber and green lights at the aft end of the refueling store and the amber lights on the aft of stations one and five pylons. The switch has two positions: BRT for daylight refueling, and DIM for night. With the switch on DIM, these lights will not normally be visible during daylight.

Hose Jettison Switch

The hose jettison switch, marked NORM and CUT, is provided to cut and crimp the store hose if a store malfunction prevents drogue retraction. It also removes all electrical power from the store controls except the ship tank switch. The hose jettison switch must be kept in the forward (NORM) position at all times unless jettisoning of the hose and drogue is required during an in-flight emergency. To move the hose jettison switch to CUT, first hold back the spring-loaded channel guard, then lift the switch from its spring-loaded safety position. Ensure that this switch is in the forward (NORM) position before electrical power is applied.

CAUTION

Once the CUT position has been selected, do not return it to the forward (NORM) position as the turbine will unfeather and cause the hose to be pulled from the guillotine crimper, spilling fuel in the store and creating a fire hazard.

DUMP Light

The DUMP light will be lit when the SHIP TANK switch is in the TO STORE or FROM STORE position and the air refueling store is other than empty.

ELECTRICAL POWER SUPPLY SYSTEM

The normal electrical power supply (figure FO-5) is provided by the two engine-driven 30-KVA 115/200V AC generators (alternators). Transformer/rectifiers convert 115V AC to 28V DC for aircraft electrical requirements. Normally each engine drives the generator by a pneumatic mechanical constant-speed drive/starter unit (CSD/S). If an engine fails, bleed air from the operating engine (RPM above 75%) will automatically be directed to the CSD/S of the inoperative engine. Each generator is controlled by a switch on the master generator panel (figure 1-12), and the CSD/S is controlled by the speed drive switch on the fuel management control panel (figure 1-10), or master generator panel (figure 1-12).

The system is protected by supervisory control panels that sense abnormal voltage conditions and automatically deenergize the affected generator. A battery is provided as an auxiliary source of DC power for the CDS/S and the assist spin recovery system. If both generators fail, an emergency electrical power system (ram-air turbine generator) is available to provide power for the operation of essential equipment. An external power receptacle is provided for starting engines or operating electrical systems by ground power.

CIRCUIT BREAKERS

Circuit breaker panels are located in the cockpit (figure 1-13) and external throughout the aircraft (figure 1-14). In the cockpit, the main and bombardier/navigator's circuit breaker panels are installed in an inverted position to facilitate reading the placards.

Pushbutton-type circuit breakers protect the electrical supply system and associated components from an overloaded circuit. The appropriate circuit breaker will pop and isolate a circuit or component that draws too much current, thus preventing equipment damage and possible fire.

The numeral on the button indicates the amperage (amp) rating. The three-phase or gang bar circuit breakers can be set so that two phases only are engaged. To prevent equipment malfunction, ensure all three phases of the gang bar are engaged.

CAUTION

Do not hold in circuit breakers that repeatedly pop out. Forcibly holding the circuit breaker in may result in irreparable damage to the equipment or possible fire.

Note

In the event of equipment malfunction, it is recommended that the applicable circuit breaker be disengaged until qualified maintenance personnel have repaired the defective equipment.

EXTERNAL POWER

External three-phase power is supplied to the AC power distribution system through a standard six-pin receptacle on the right side of the fuselage. An external power monitor protects the systems against over- and undervoltage, over- and underfrequency, and incorrect phase rotation in ground power supply. The two-position external power monitor control switch labeled RESET, NORMAL is on the external power panel.

ELECTRICAL POWER DISTRIBUTION

Electrical power is distributed to the various electrical components through a series of buses. The buses are arranged to group equipment of equivalent significance. In this way, any failure in the system can be automatically directed toward the areas of least importance. Generally, the essential buses power all the equipment necessary to fly the aircraft, the primary buses power equipment necessary to complete the mission, and the monitored bus powers the convenience circuits.

When both generators are operating, the right generator supplies the primary AC buses and, through the emergency power transfer relay supplies the essential AC buses. The left generator, through its line contactor, energizes the monitored transformer/rectifier and the 115V AC monitored bus. The transformer/rectifier, in turn, powers the 28V DC monitored buses. The right generator, through its line contactor, energizes the primary transformer/rectifier and the primary and essential AC buses.

The primary T/R supplies power to the DC primary and through the DC emergency transfer relay to the essential DC buses and the monitored T/R supplies

power to the DC monitored bus. When only one T/R is operating, the monitored bus is isolated from the system and only the essential and primary buses are energized through the transfer relay and the monitored bus is deenergized. If the right generator is inoperative, power is transferred to the essential and primary buses through the transfer relay and the monitor bus is deenergized. AC emergency power from the ram-air turbine generator supplies the AC essential buses only and the emergency DC power through a 50-ampere emergency T/R.

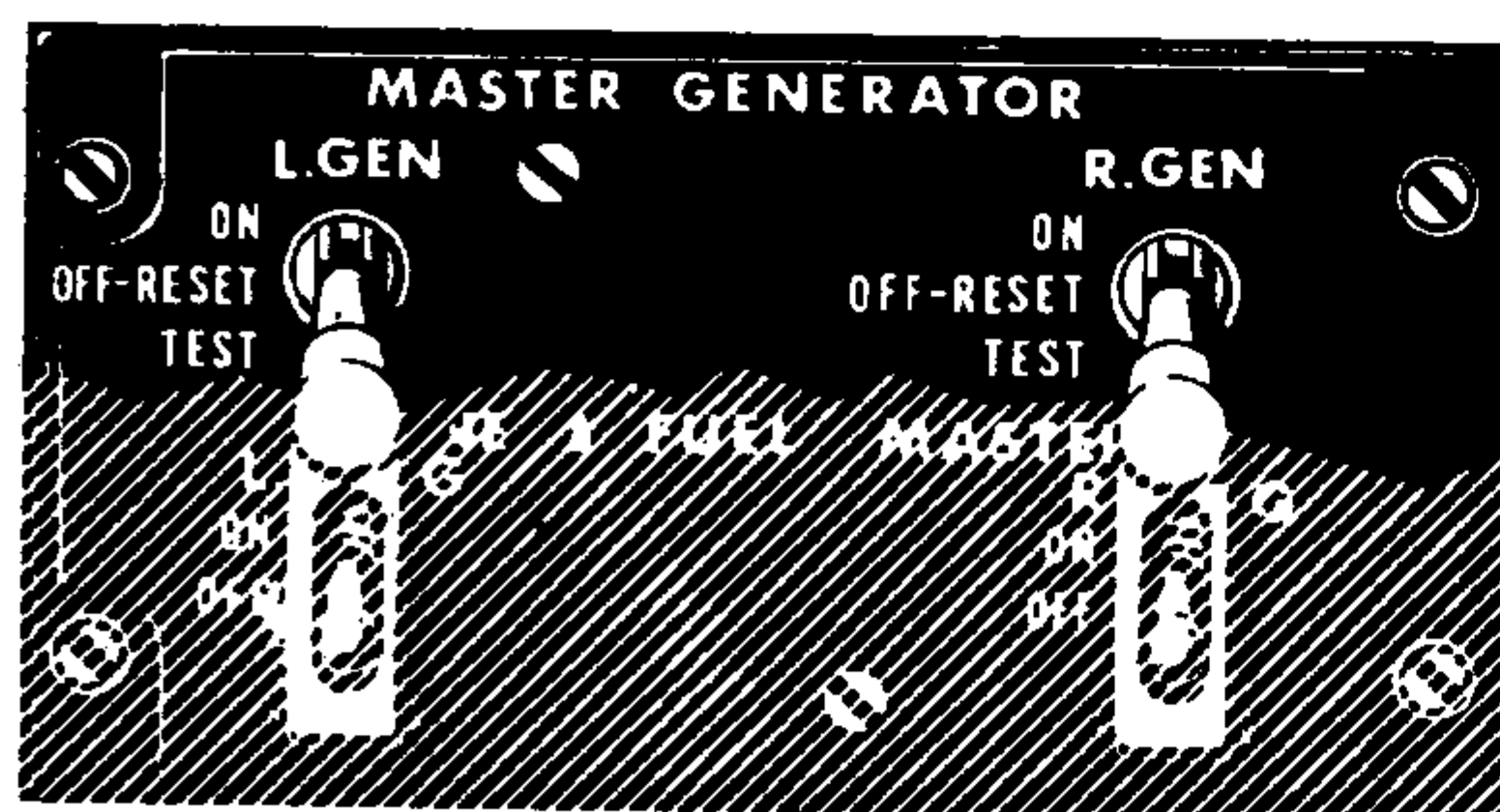
AC ELECTRICAL POWER

The AC power system supplies 115/200V, three-phase, 400-Hz, constant-frequency AC power from two nonparalleled generators.

Generator Switches

The generators are controlled by two three-position toggle switches on the master generator panel (figure 1-12) and placarded ON, OFF-RESET, and TEST. The ON position supplies 28V DC for initial generator excitation through the supervisory control panels and connects the generators to the buses after operating voltage is available. The OFF-RESET position disconnects the generator from the buses and opens the generator exciter field circuit to shut down the generator. If a generator is disconnected by over-voltage or undervoltage conditions, an attempt to reset the generator may be made by cycling the switch to OFF-RESET then ON. In the spring-loaded TEST position, the generators are energized by are not connected to the buses. The TEST position is primarily for maintenance use but can be used in flight as a troubleshooting procedure to verify generator output.

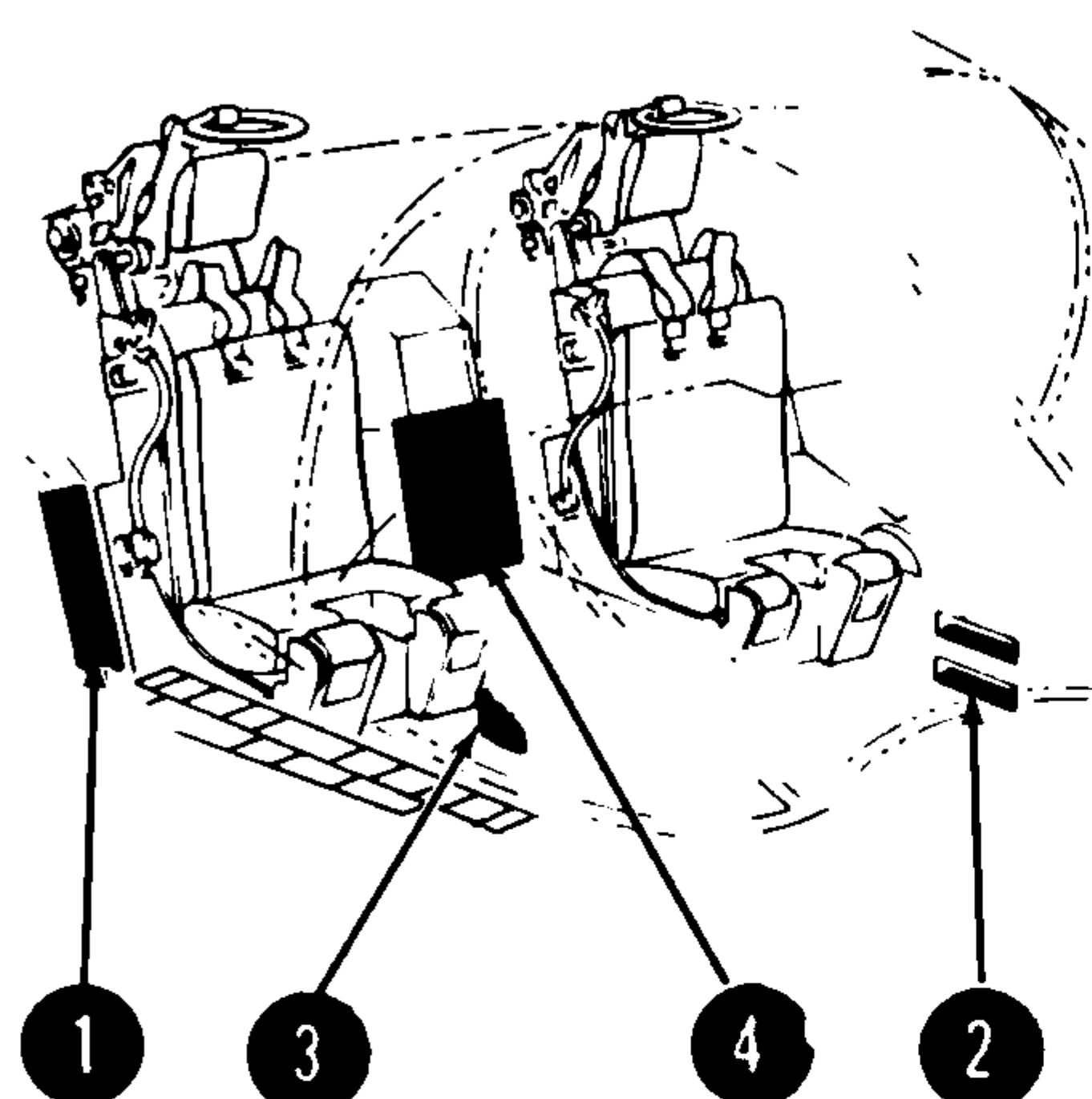
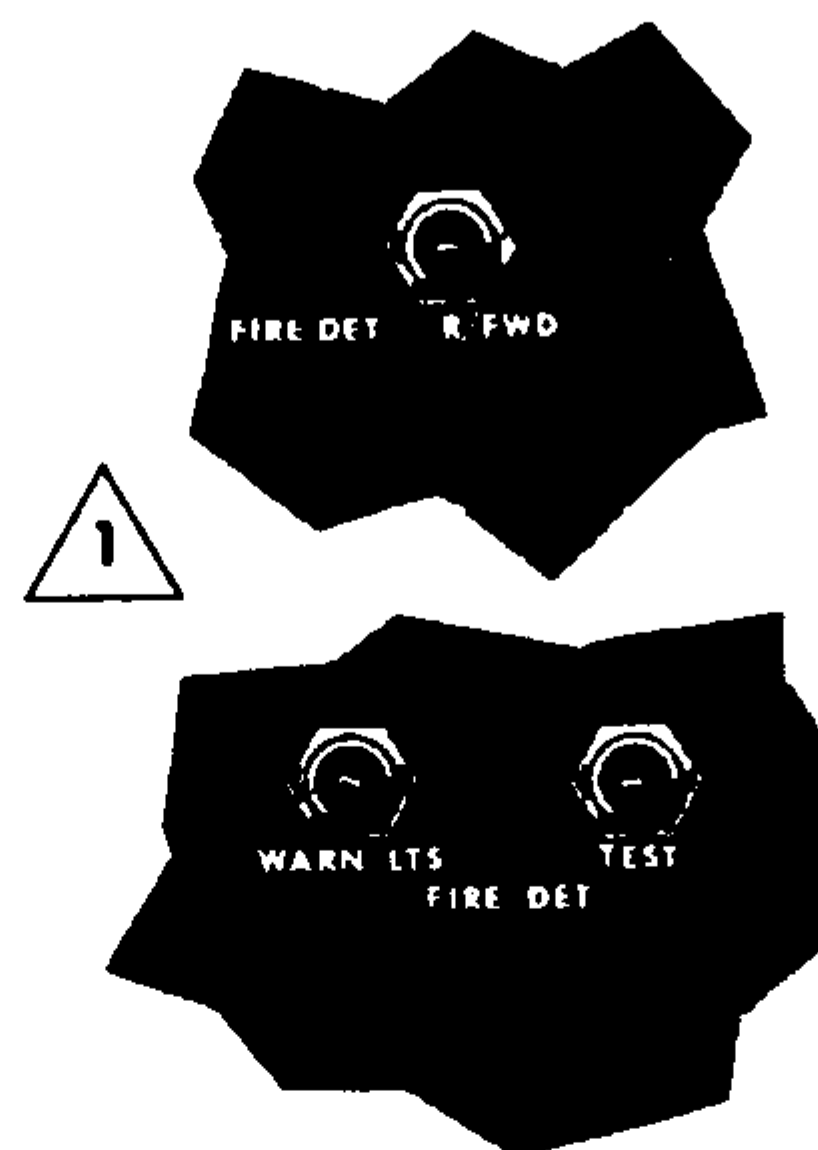
MASTER GENERATOR CONTROLS



AIRCRAFT BUNO 158041 THRU
158532 NOT INCORPORATING AFC NO. 268



AIRCRAFT BUNO 158533 AND SUBSEQUENT AND
THOSE INCORPORATING AFC NO. 268

[illegible]

AC **DC**

5 5 5

SEARCH XMTR

7 7 15

SEARCH RADAR PWR

7 7 7

TRACK RADAR

5 5 5

VERTICAL DISPLAY

5 1 5

BLEED AIR **HORZ DISPLAY**

1 1 1

PRARS ADPT
PHA PHB PHC

5 5 1

PRARS PWR **DDU ANNUN LT**

5 5 5

ELECTRIC FUZING **SEARCH XMTR**

7 7 5

3 PH MSL PWR **AUTO PILOT**

1 3 5

EQUIP COOL **BUDDY APN-141 TANK**

7 7 7

ENVIRONMENT SEATS

2 3 1 5

26V INST AFCS **ADC** **OPT SIGHT**

XFMR **OPT SIGHT**

7 7 7

CMPTR ACU **CMPTR**

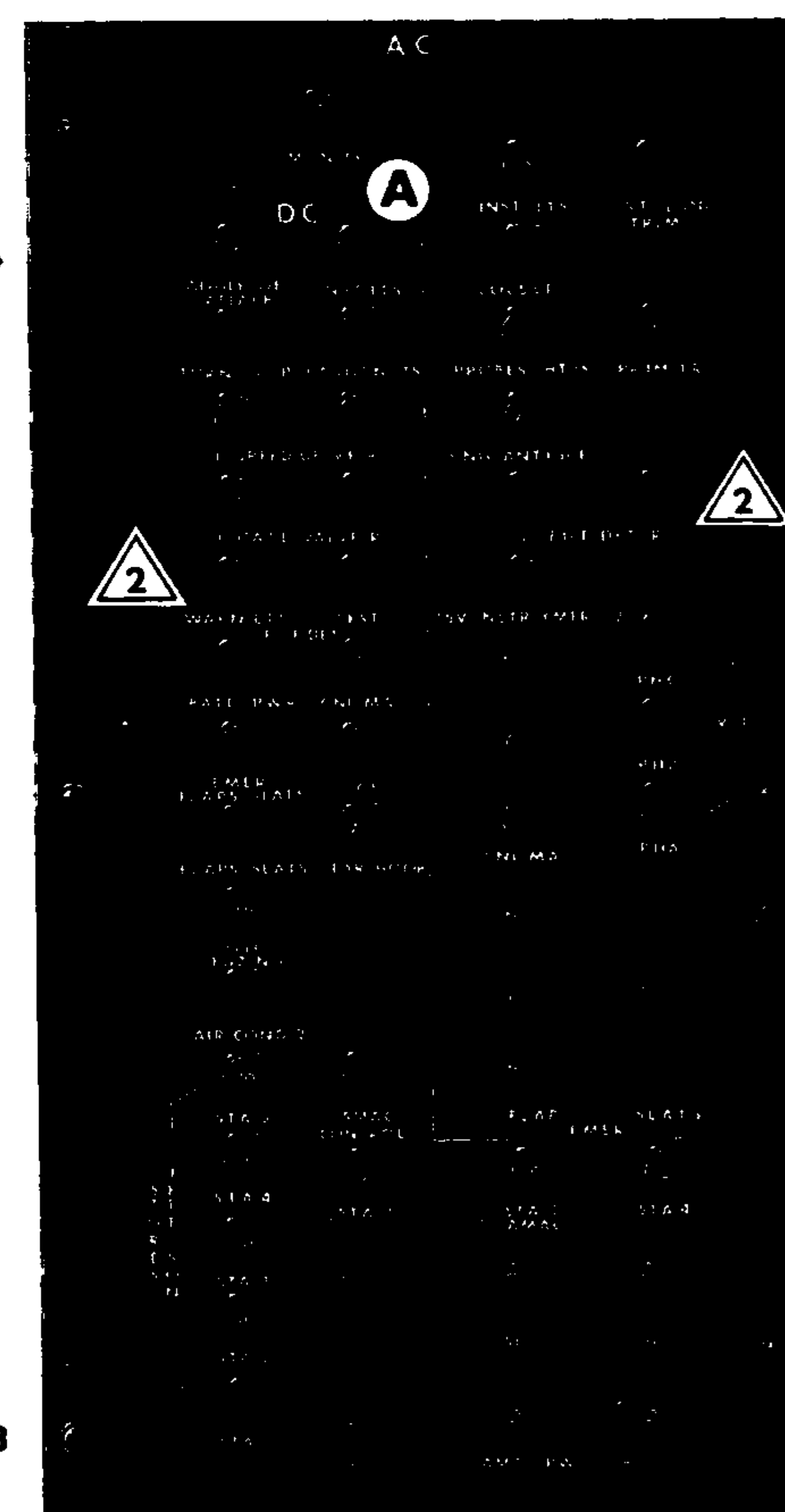
5 5 5

CNI

DC

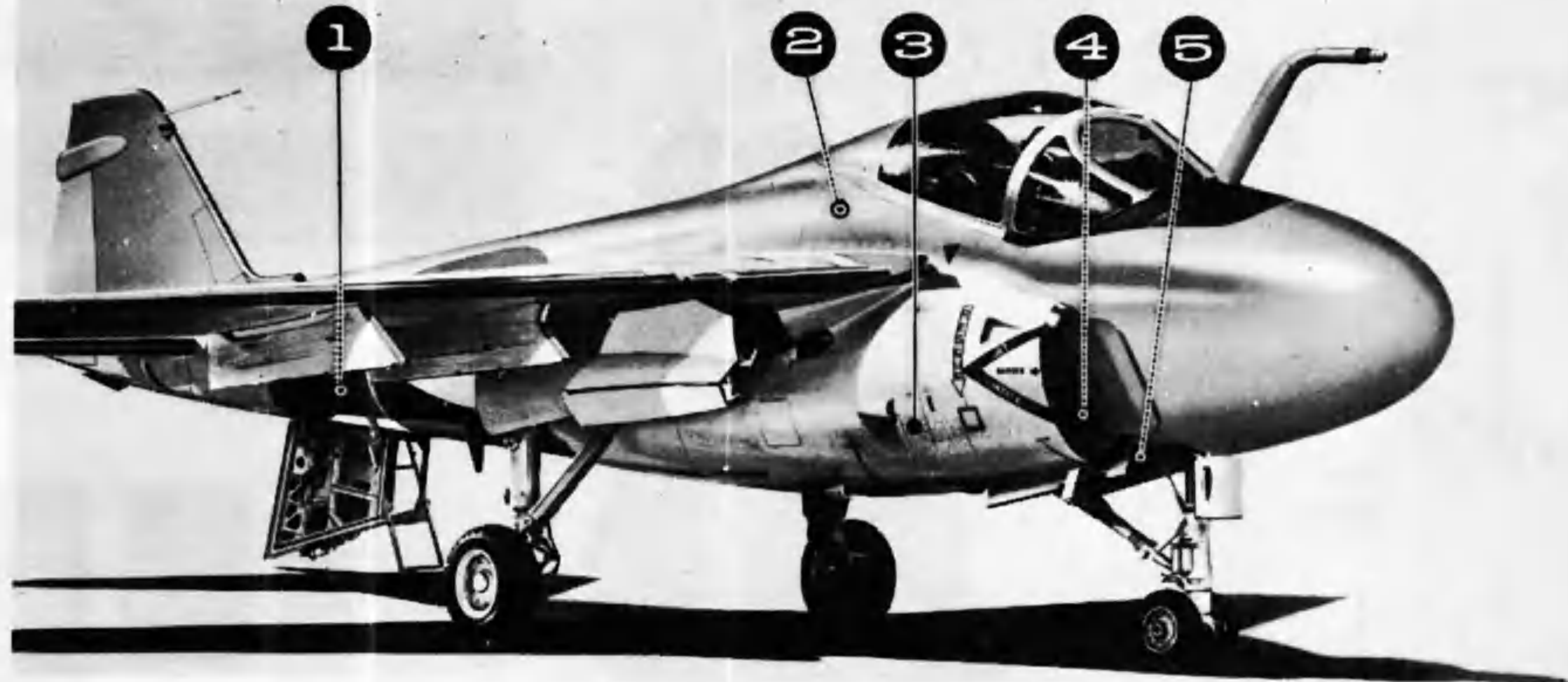
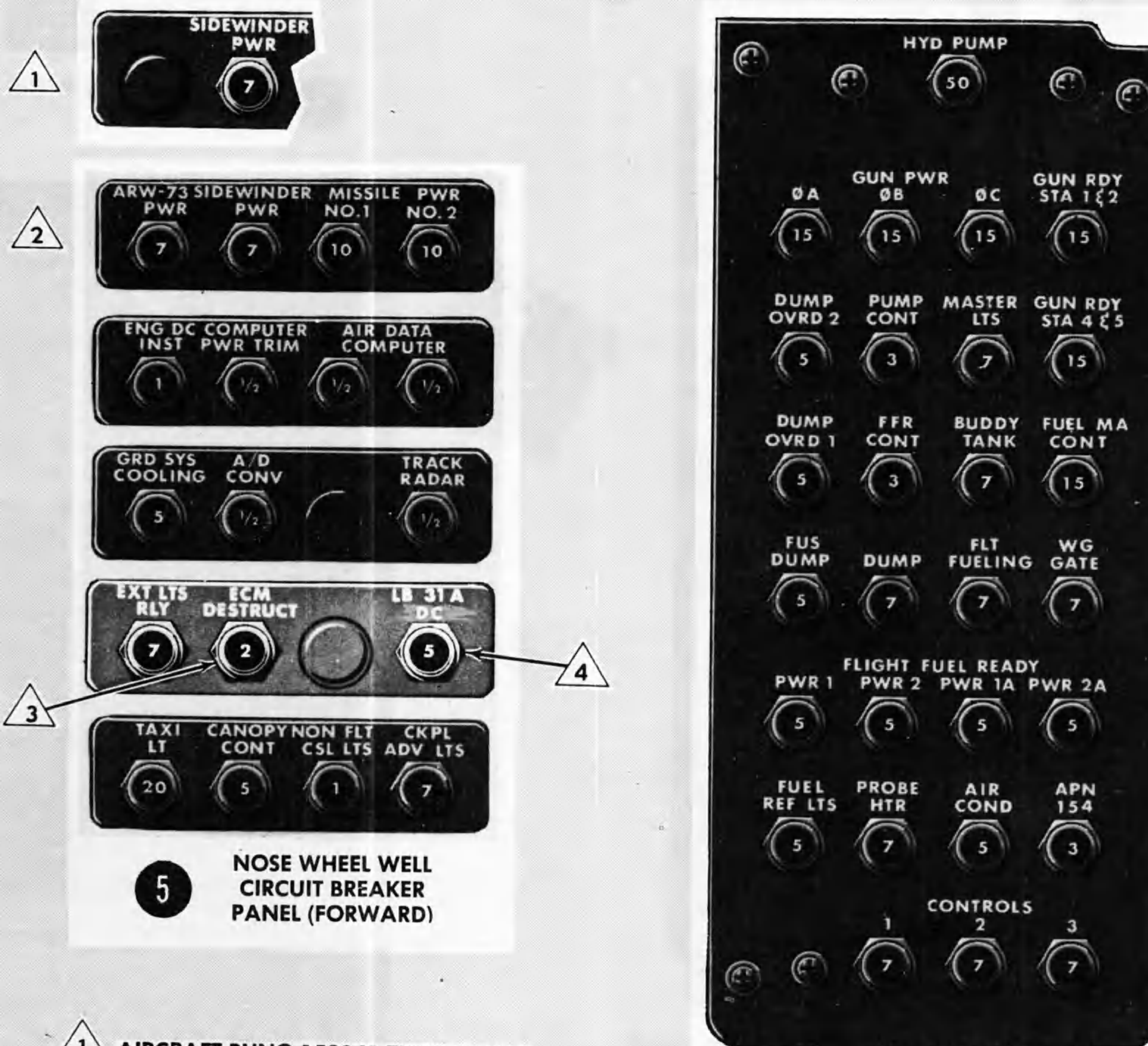
7 7 5

NOSE ARM **TAIL MASTER ARM** **MASTER ARM PWR**



- 1** AIRCRAFT BUNO 158533 AND SUBSEQUENT AND THOSE INCORPORATING AFC NO. 268
- 2** AIRCRAFT BUNO 158041 THRU 158532 NOT INCORPORATING AFC NO. 268
- 3** AIRCRAFT BUNO 158535 AND SUBSEQUENT
- 4** AIRCRAFT INCORPORATING AFC NO. 230

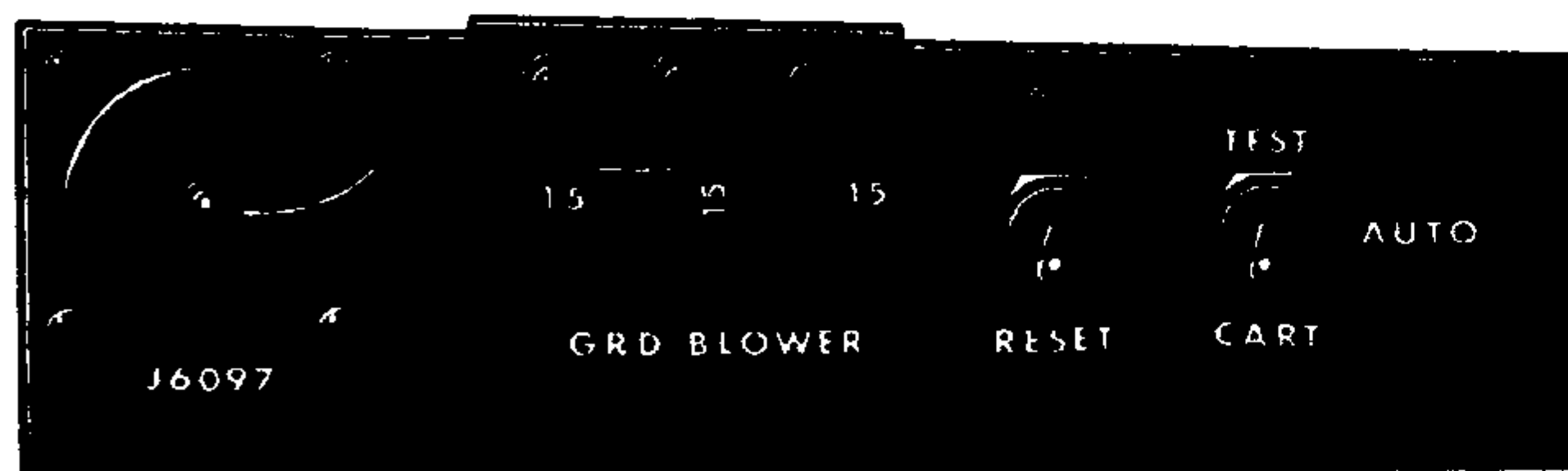
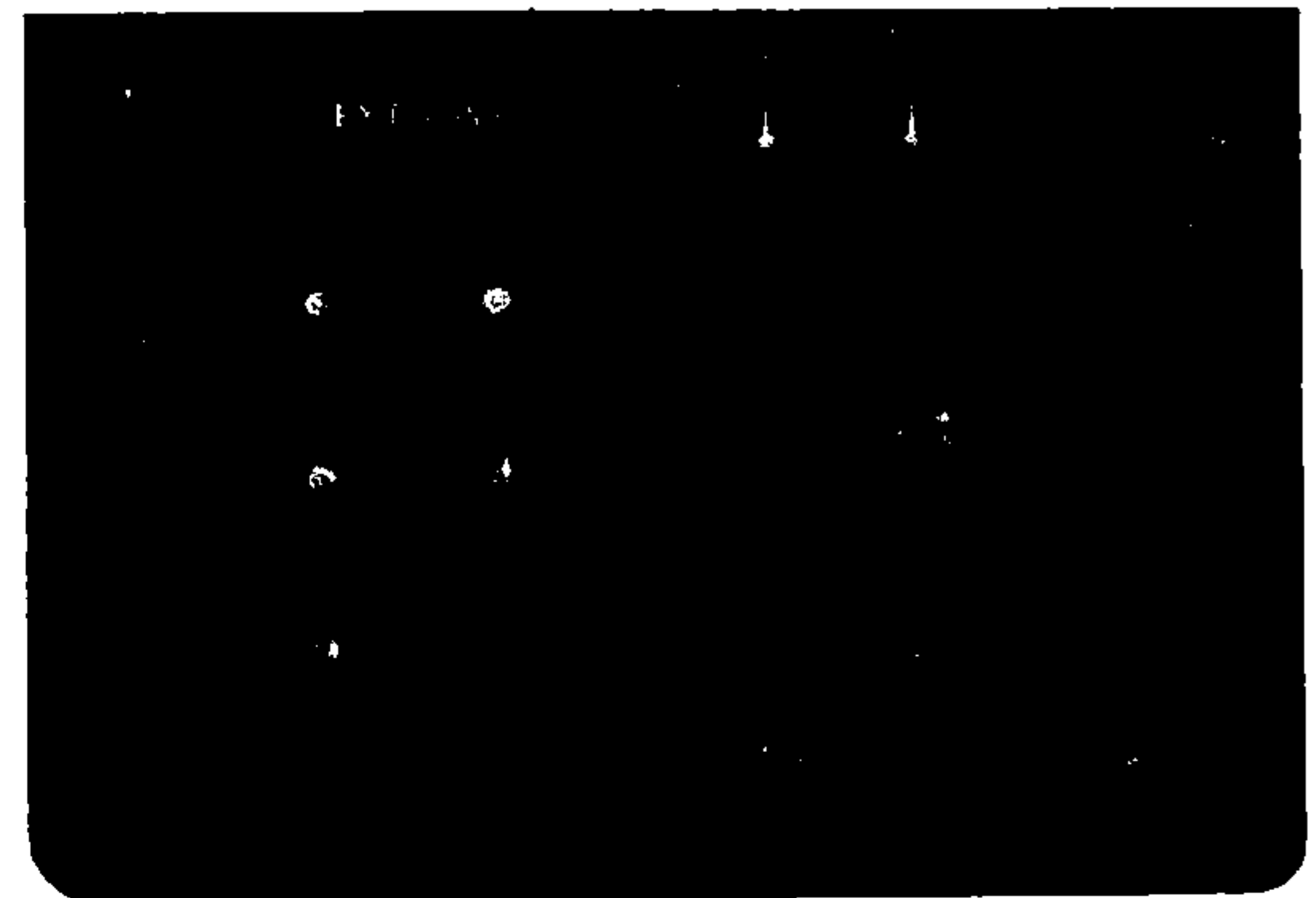
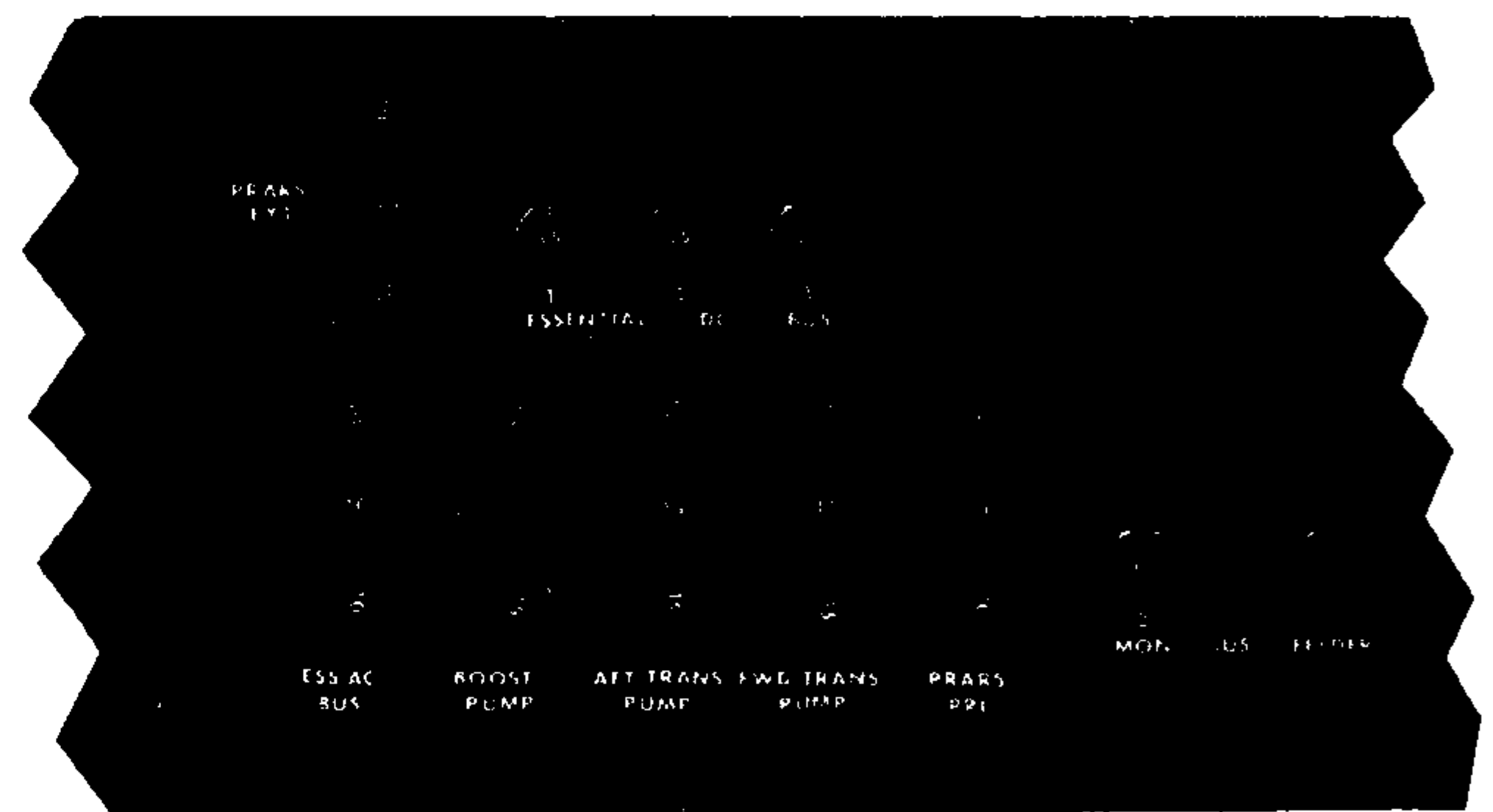
EXTERNAL CIRCUIT BREAKER PANELS



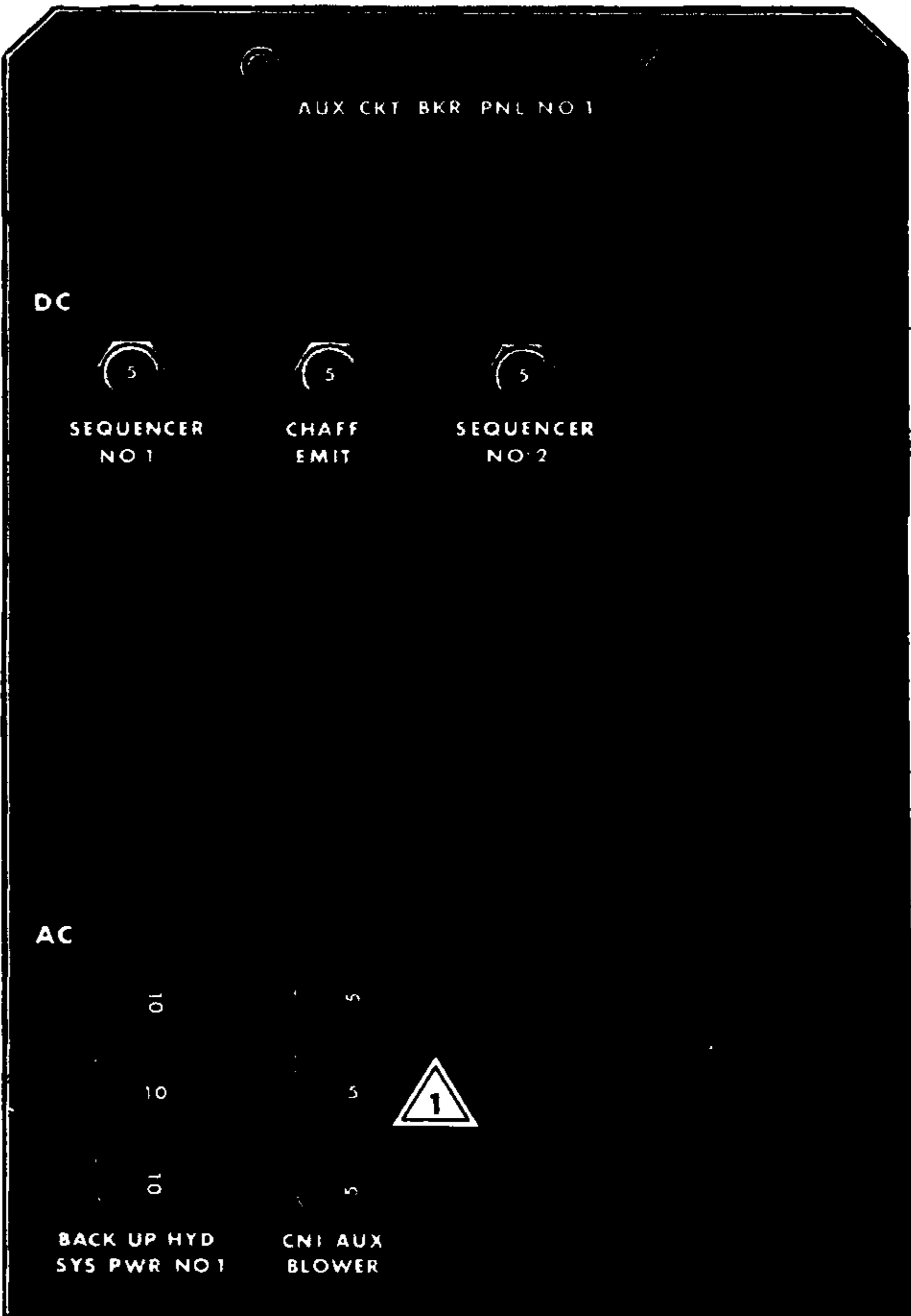
- 1 AIRCRAFT BUNO 158041 THRU 158052
- 2 AIRCRAFT BUNO 158528 AND SUBSEQUENT
- 3 AIRCRAFT BUNO 158041 THRU 158538
NOT INCORPORATING A.F.C. NO. 287
- 4 AIRCRAFT INCORPORATING A.F.C. NO. 256

C-ADF1-55-1

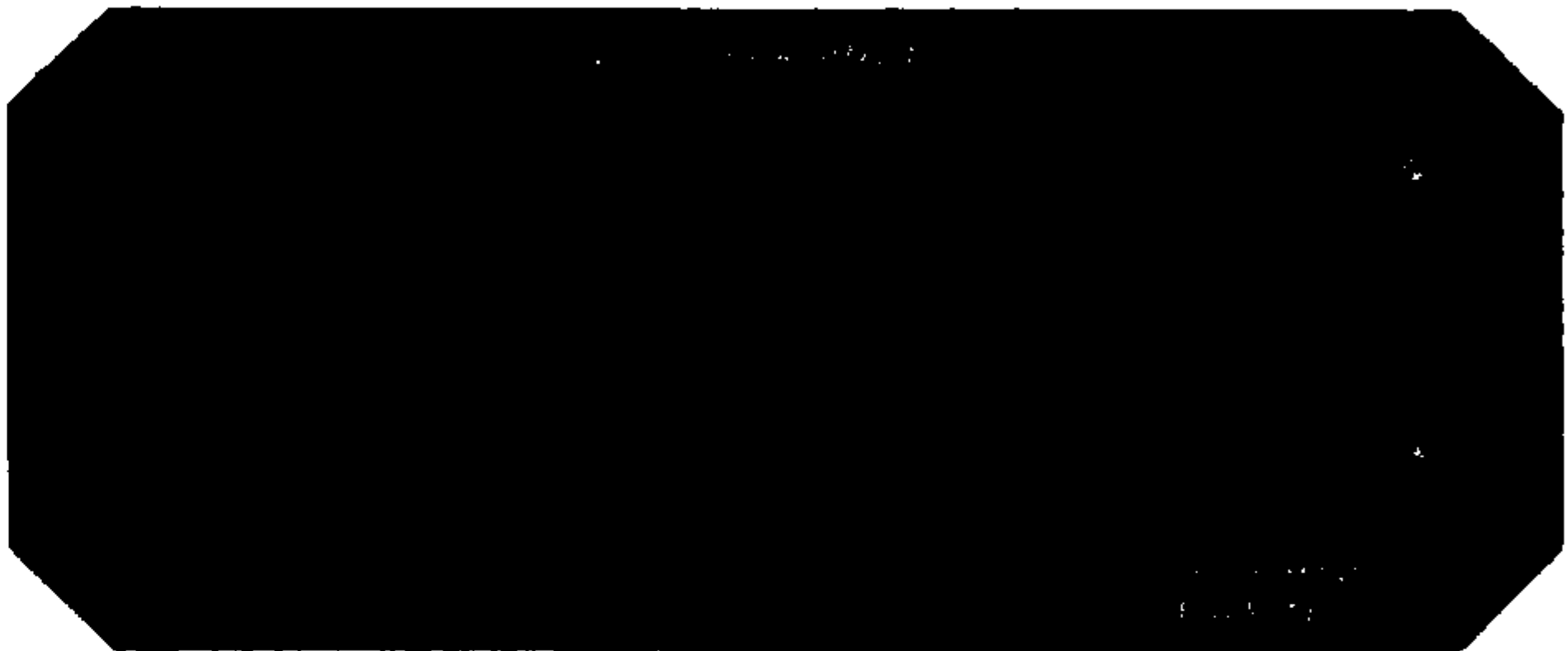
Figure 1-14 (Sheet 1)

EXTERNAL CIRCUIT BREAKERS (CONT)**4****NOSE WHEEL WELL CIRCUIT BREAKER
PANEL (AFT)****4****GROUND BLOWER PANEL****AIRCRAFT INCORPORATING A.F.C. NO. 256****3****EXTERNAL POWER PANEL****2****AC - DC POWER CIRCUIT BREAKER PANEL**

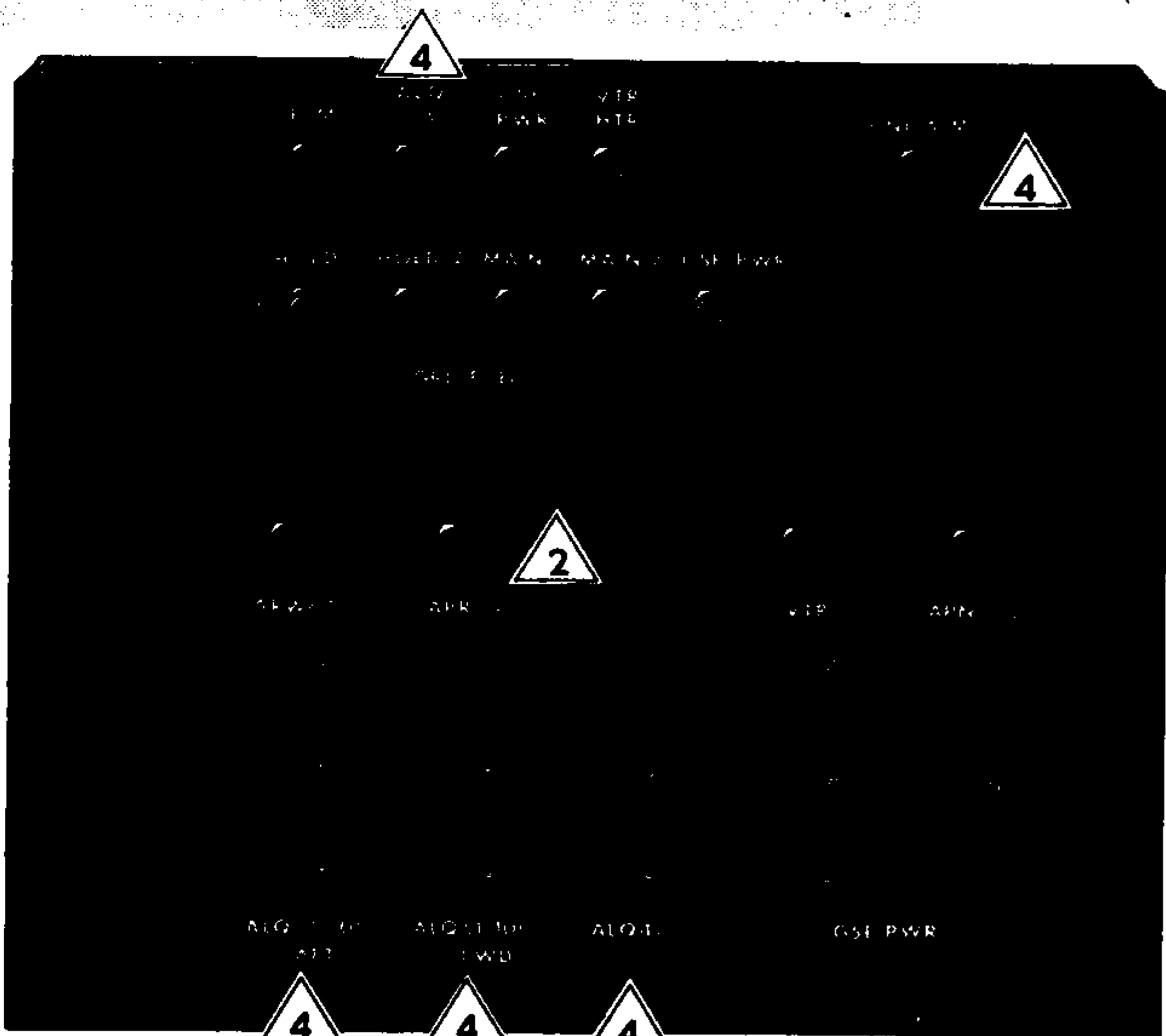
EXTERNAL CIRCUIT BREAKERS (CONT)



1 AUXILIARY AFT BAY CIRCUIT BREAKER PANEL NO. 1 (LEFT SIDE)



1 AUXILIARY AFT BAY CIRCUIT BREAKER PANEL NO. 2 (RIGHT SIDE)



1 AFT BAY CIRCUIT BREAKER PANEL

- 1** AIRCRAFT BUNO 158533 AND SUBSEQUENT AND THOSE INCORPORATING A.F.C. NO. 268
- 2** AIRCRAFT BUNO 158041 THRU 158538 NOT INCORPORATING A.F.C. NO. 263
- 3** AIRCRAFT BUNO 158539 AND SUBSEQUENT AND THOSE INCORPORATING A.F.C. NO. 263
- 4** AIRCRAFT BUNO 158041 THRU 158538 NOT INCORPORATING A.F.C. NO. 287
- 5** AIRCRAFT BUNO 158539 AND SUBSEQUENT AND THOSE INCORPORATING A.F.C. NO. 287



Figure 1-14 (Sheet 3)

KEY COCKPIT CIRCUIT BREAKERS

CIRCUIT BREAKER PLACARD	BUS	LOCATION	ITEMS ON CIRCUIT BREAKER
LAT/LONG TRIM	ESS AC	MAIN	AIR COND RAM AIR SWITCH FLAPERON AND STABILIZER TRIM
GEAR/HOOK	ESS DC #1	MAIN	SPIN ASSIST WEIGHT ON WHEELS SWITCH LANDING GEAR CONTROL
L SPEED DRIVE	ESS DC #1	MAIN	LEFT ENGINE FUEL MASTER LEFT CSD/S
R SPEED DRIVE	ESS DC #1	MAIN	RIGHT ENGINE FUEL MASTER RIGHT CSD/S
CNI/MA-1	ESS AC	MAIN	HSI MA-1 ASQ-57 POWER
CAUTION LTS	ESS DC #1	MAIN	LOW ALTITUDE WARNING LIGHT APN-141 INDICATOR WARNING LIGHTS TEST SWITCH MASTER LIGHT PANEL ANNUNCIATOR PANEL INTEGRATED POSITION INDICATOR
ANGLE OF ATTACK	ESS DC #1	MAIN	WHEELS WARNING SWITCH ANGLE OF ATTACK
TURN/SLIP	ESS DC #1	MAIN	STABILIZER TRIM GAGE RUDDER TRIM GAGE TURN AND SLIP INDICATOR
AUTOPILOT	PRIM DC	B/N	AIR DATA COMPUTER AUTOPILOT
CNI	ESS AC	B/N	ASQ-57 RECEIVER AMPLIFIER POWER ARC-75 TRANSMITTER
3 PH MSL PWR	PRIM AC	B/N	ICS JUNCTION BOX ARMAMENT PANEL (AWE)
COMPTR/ACU	PRIM AC	B/N	ASQ-133 CONTROL INDICATOR ARMAMENT PANEL (AWE)
ADC/OPT SIGHT	PRIM AC	B/N	ADC OPTICAL SIGHT CONTROL SPEED BRAKE NULL DETECTOR
PRARS ADPT PH A	PRIM AC	B/N	A/D CONVERTER INS ADAPTER

ADF1-127

Figure 1-15

Generator Warning Lights

The generator warning lights on the annunciator panel (figure 1-26), placarded L GEN and R GEN, come on indicating the respective generator is inoperative. Operating power is from the essential 28V DC bus through the CAUTION LTS circuit breaker on the main circuit breaker panel.

Note

If both generators are inoperative, the generator lights will not come on unless the RAT is extended and operating.

DC ELECTRICAL POWER

Two nonparalleled, 100-ampere transformer/rectifiers (T/R) convert AC electrical power to 28V DC electrical power for aircraft requirements. Since the DC system is dependent on the AC system, any AC system malfunction affects the DC system.

Battery

A 22.7-volt nickel cadmium 11-ampere-hour battery is located on the right side of the fuselage in the center wing section. In addition to providing power to the spin recovery and CSD/S, this battery provides power for the electric-motor-driven auxiliary hydraulic pump for ground operation (weight on wheels) of the canopy, radome, extensible equipment platform, and charging the brake accumulator. Power for generator reset is provided directly to the CSD/S through the engine fuel master switches and CSD/S battery power relay. This battery is charged from the DC monitored bus and is protected by the BAT CHARGE circuit breaker on the main circuit breaker panel.

EMERGENCY ELECTRICAL POWER (RAT)

The emergency electrical system energizes the AC and DC essential buses. The system is powered by a ram-air turbine-driven AC generator, which in turn energizes a 50-ampere transformer-rectifier for the 28V DC power. The emergency system is energized by pulling the ram-air turbine (RAT) handle (figure FO-2) on the pilot's left console. When the handle is pulled, the ram-air turbine is hydraulically positioned into the airstream above the left wing. A variable-pitch prop controls turbine speed and consequently regulates generator frequency. There is an underfrequency relay to delay power transfer to the aircraft electrical system until the ram-air turbine generator reaches approximately 90% of its normal speed. At this speed, the emergency generator will be placed on the line automatically. If either generator becomes operative, the emergency generator will be taken off the line automatically, and the corresponding generator caution light will go out. The emergency generator is retracted by pushing down the RAT handle. The minimum operating airspeed for the RAT is 110 KIAS.

Note

If the number one essential DC circuit breaker on the external port shoulder AC/DC power circuit breaker panel pops, the entire number one essential DC bus will be lost even though both main generators remain operative and power the primary and monitored buses. To restore essential DC power the RAT must be extended. If the essential bus is not energized by RAT deployment, it will then be necessary to secure both main generators to regain essential bus power.

HYDRAULIC POWER SUPPLY SYSTEM

The aircraft hydraulic system (figure FO-6) is composed of the flight and combined hydraulic systems. These systems are independent of each other even though both systems power the tandem-type flight control actuators.

Each system is powered by two 3,000 PSI engine-driven hydraulic pumps (one pump on each engine).

Each system is supplied with hydraulic fluid under 40 psi pressure from a piston type reservoir which is pressurized by engine compressor bleed air. If hydraulic power carts are attached for ground operation, the reservoirs must be pressurized from an external source.

HYDRAULIC PRESSURE GAGES

Four hydraulic pressure gages are incorporated in a single unit on the pilot's instrument panel. The upper two gages, side by side, and identified as FLT are for the two engine-driven pumps for the flight hydraulic system. The lower two gages, side by side, and identified as COMB are for the two engine-driven pumps for the combined hydraulic system. Each indicator scale is a 120° arc with increment markers 30° apart. Each increment marker represents 1,000 SPI. The 3,000 PSI marker is accentuated. Pressure transmitters sense the hydraulic pressure of each pump and transmit electric signals to position the pointers on the scale of the respective indicators.

FLIGHT HYDRAULIC SYSTEM

The flight hydraulic system powers one side of the tandem type flight control actuators and the flaperon autopilot actuator. Should the combined hydraulic system fail, the flight hydraulic system is capable of delivering sufficient power to maneuver the aircraft throughout the flight envelope except at high IMN. Hydraulic system pressure is shown on the pressure indicators (figure FO-2) on the left side of the pilot's instrument panel. The top dials indicate the pressure output of the left and right engine-driven flight system pumps.

NEW

Note

There are no hydraulic pressure warning lights in the system; however, lighting of the BACK-UP HYD caution light is indication of failure of either the flight or combined system. Lighting of both the BACK-UP HYD and the RUD THRO caution lights is indication of complete normal hydraulic failure.

FLIGHT HYDRAULIC SYSTEM POWER DISTRIBUTION

Flight controls and AFCS.

COMBINED HYDRAULIC SYSTEM

The combined hydraulic system powers the second side of the tandem-type flight control actuators and, in addition, all other hydraulic power auxiliary devices in the aircraft (figure FO-6). In order to prevent a fluid leak in any of the auxiliary devices from draining the system and thus leaving only a single system for powering flight controls, an isolation valve is added to divide the combined system into a primary circuit supplying the flight controls and a secondary circuit supplying auxiliary equipment. The hydraulic pressure indicators indicate the pressure output of the left and right engine-driven combined system pumps.

PRIMARY COMBINED HYDRAULIC SYSTEM POWER DISTRIBUTION

Flight controls, RAT accumulator and retract spin-recovery, and speed brakes.

SECONDARY COMBINED HYDRAULIC SYSTEM POWER DISTRIBUTION

Canopy, flaps, slats, landing gear, flaperon pop-up, wing-fold, antiskid, nose-wheel steering, hook (retract), strut lock, and normal wheel brakes.

Isolation Valve and Switch

The isolation valve divides the combined system into primary and secondary circuits, and is both automatically and manually controlled. Manual pilot control is by the two-position switch on the landing-gear handle (figure 1-19). In the LDG position, the combined secondary system is pressurized in addition to the primary system and all auxiliary hydraulic devices are operated. In the FLT position, only the primary flight controls, speed brakes, spin recovery, AFCS, and RAT are powered.

Note

After takeoff and when landing gear, flaps, and slats have been fully retracted, the pilot should select the FLT position on the switch.

A bar on the landing-gear handle pushes the isolating valve switch to the LDG position when the landing-gear handle is placed DN. If the pilot has not selected FLT after takeoff, and the flight hydraulic system fails, the isolation valve is spring-loaded to automatically cut off pressure to the combined secondary hydraulic system. If electrical power is lost to the valve with normal flight hydraulic pressure available, the valve will open, allowing the secondary circuit to be pressurized.

Note

A flight system failure will deenergize the isolation valve to close off the combined secondary system. It will then be necessary to use emergency landing gear, emergency flaps/slats, and auxiliary brakes to land the aircraft.

COMBINED SYSTEM AUXILIARY PUMP OPERATION

A handpump in the combined hydraulic system is available to operate the canopy, wheel brakes, the extensible equipment platform, and the radome when the engine-driven pumps are not operating. An electrically driven hydraulic pump is also provided which will power the same equipment as the handpump during ground operation.

The handpump can be operated from either the cockpit or the nose-wheel well. The electrically driven pump may be operated from the cockpit, nose-wheel well, or for canopy operation from either boarding-ladder well. Operation of the canopy from the nose-wheel well is limited to handpump operation. The handpump and the electrically driven hydraulic pump will deliver 3000 PSI at very low flow rates. The handpump will charge the brake accumulator at any time during flight or ground operation, while the electric pump is operative only with weight on the wheels. Charging rate is reduced if any additional hydraulic operation is being performed. Pressure to operate the canopy is controlled by the manual selector handle in the cockpit and nose-wheel well. The nose radome and the aft extensible equipment platform are also operated through manual selector valves in the nose-wheel well. Should the wheel brake accumulator be depleted, it must be charged before other equipment can be operated.

Note

Excessive loss of combined system hydraulic fluid will render the auxiliary hydraulic pumps inoperative. Wheel brake applications will be limited to cycles indicated on the brake cycle gage and canopy operation will then be hydraulically inoperative.

AUXILIARY HYDRAULIC PUMPS POWER DISTRIBUTION

Canopy, brake accumulator, radome, and extensible equipment platform.

BACK UP FLIGHT CONTROLS HYDRAULIC SYSTEM

The backup flight controls hydraulic system provides limited hydraulic power to the rudder and stabilizer actuators should both the flight and combined hydraulic systems fail. With a complete hydraulic failure, rudder will shift to full authority (35°). The system does not provide for flaperon operation.

The backup hydraulic pump motor package is powered by 115V AC through circuit breakers on the aft bay auxiliary circuit breaker panels.

WARNING

The backup flight control hydraulic system is provided to allow a damaged aircraft to leave the combat area. With full rudder authority (35°) available, extreme caution should be exercised in executing rudder defelections. Airspeed should be reduced to less than 0.80M, since dihedral effect begins to reverse at approximately that airspeed.

Note

Loss of the generators prevents use of the backup hydraulic system. The backup hydraulic system will not operate from the RAT.

A failure in either the flight or combined system will activate its pressure switch as the pressure drops below 800 ± 100 PSI, energizing the backup motor pump and isolating a small portion of the combined system fluid. When the motor pump pressure exceeds 1000 PSI, the BACK UP HYD caution light on the annunciator panel will come on. If, in addition, to the BACK UP HYD caution light, the RUD THRO light comes on, it indicates a complete hydraulic failure of both normal systems with flight controls then limited to rudder and stabilizer.

Note

- When operating on one hydraulic system only, rapid cycling of the controls will cause the BACK UP HYD light to blink off momentarily, indicating that the capacity of the backup pump has been exceeded. To avoid excessive demands on the backup pump, control inputs should be kept smooth.
- When operating on the backup system only, rapid control inputs exceeding pump capacity may cause some lag in surface response against opposing loads. When the pump output pressure drops below 800 PSI, the pump pressure switch opens momentarily, extinguishing the BACK UP HYD caution light. Therefore, monitoring this light while operating on the backup hydraulic system will indicate when pump capacity has been exceeded.

BACK UP HYD SYS TEST Switch

A backup hydraulic test switch is provided, on the pilot's left console. The switch enables the pilot to check the operation of the flight system pressure switch (FLT) and the combined system pressure switch (COMB) singly before starting engines and with external electrical power connected. The switch also provides checking the hydraulic backup motor pump operation. The switch is spring-loaded to the center (OFF) position.

Placing the switch in either the FLT or COMB position energizes the hydraulic backup motor pump which, in turn, turns on the BACK UP HYD caution light. While testing either system, it is possible to check rudder and stabilizer movement for several cycles.

With engine running, the switch in the OFF position and external electrical power removed, if the BACK UP HYD caution light is not on, it indicates that both pressure switches have returned to their normally open (hydraulic pressure on) position.

CAUTION

Ground operation of the backup hydraulic system should be limited only to testing of the system.

BACK UP HYD Caution Light

The BACK UP HYD caution light on the annunciator panel comes on when one hydraulic system is depressurized and the backup pump is delivering 1000 PSI. The light will go out when the backup pump output pressure goes below 800 PSI.

FLIGHT CONTROLS

The flight control surfaces consist of a slab stabilizer, a rudder, and upper wing surface spoilers called flaperons. The control stick and rudder pedals are linked directly to their corresponding surface actuators by a system of pushrods, bellcranks, and cables. In each case, control surface deflection is held in a fixed relationship to pilot control deflection by a proportional followup linkage. Each surface is powered by an irreversible actuator which is controlled by an input slide valve, and which, in turn, is positioned by the pilot's control. All control actuators are of the tandem type, and are powered by both the flight and combined primary hydraulic systems.

To provide for additional control with flaps extended, or for spin recovery, extended rudder and stabilizer travel is provided. The integrated position indicator, on the left side of the pilot's instrument panel, indicates the condition of the stabilizer and rudder throws in addition to the configuration of the flaps/slats and speed brakes, and the landing gear. Flight controls and indicators are shown in figure 1-16.

Note

Either the combined primary or the flight hydraulic system alone will power the flight controls throughout the flight envelope except at high IMN.

CAUTION

Do not actuate the assist spin recovery switch with the flaps down or lower flaps with the spin recovery system on. The spin recovery system is to be operated only with the flaps up. Operation of the system with flaps down can result in damage that will prevent reselection of cruise control throws.

ARTIFICIAL FEEL

The irreversible control actuators require that artificial feel be provided to the pilot for all three flight control systems. This feel is obtained entirely through the use of mechanical devices, and does not require mach or g sensing to be fed in by electronic equipment.

Longitudinal System

Artificial feel is provided by the following devices:

STATIC FORCE FEEL - Is provided by a double-acting bungee that produces a greater breakout force gradient near stick neutral, and a lower gradient to full deflection. Breakout forces exceed the 1 1/4 pound autopilot stick switches.

MANEUVERING FORCE - Is provided by a g-sensing bobweight at the base of the control stick, and on the control linkage aft of the pilot's seat.

DYNAMIC PITCH DAMPING - Is provided by pitch acceleration sensing bobweights, both fore and aft of the center of gravity.

STICK RATE DAMPING - Is provided by a leaf spring and eddy current damper. The eddy current damper is a magnetic-mechanical device that produces a resisting torque proportional to stick velocity. If a damper fails, a clutch can be overridden for control system operation.

Lateral System

Artificial feel is provided by the following devices:

STATIC FORCE FEEL - Is provided by a double-acting bungee similar to, but with lower force level than, the longitudinal bungee. Control preload at neutral is equal to the AFCS force cutout switch settings.

LATERAL RATE DAMPING - Is provided by an eddy-current damper identical to the longitudinal damper, except for the gear train into the system linkage.

Directional System

Artificial feel is provided by the following device:

FORCE FEEL - Is provided by a double-acting bungee of much higher preload and rate than the feel bungees in the other axis.

Three-Axis Damping

Pitch, roll, and directional oscillations are minimized through the use of the AFCS. By placing the on/off switch ON with the automatic stability augmentation switch in STAB AUG, automatic stability augmentation inputs are directed to the hydraulic power actuators in series with the pilot's command. Because the inputs to the hydraulic actuators are in series, they are not felt by the pilot.

CONTROL STICK

The control stick is the primary flight control for the aircraft's longitudinal and lateral axis. Since the flight controls are hydraulically powered, an artificial feel system is used to simulate in-flight stick loads. In manual and stability augmentation flight modes, the stick applies a mechanical input to the flaperon and stabilizer hydraulic actuators for control surface movement. Refer to the discussion on flight controls, Section IV, for more detailed information relating the stick to control surface movement, and to the discussion on lateral trim.

The control stick grip has several switches and buttons to provide maximum efficiency in mission performance (see figure 1-15). The lateral and longitudinal trim button, weapon release button, and nose-wheel steering button are easily operated by the thumb. The attack commit trigger is actuated by the forefinger and the attack button can be actuated by the fourth finger. The 1.2 ± 0.2 pound autopilot-disengage switches are located in the column. The grip moves to a slight degree independent of the control stick. When this occurs, the autopilot-disengage switches are actuated. Although the autopilot emergency disengage switch is on the lower portion of the control stick, it is within easy reach of the right hand.

Note

Refer to Section VIII Weapon Systems for description of the weapon release button, the attack commit trigger, and the attack button.

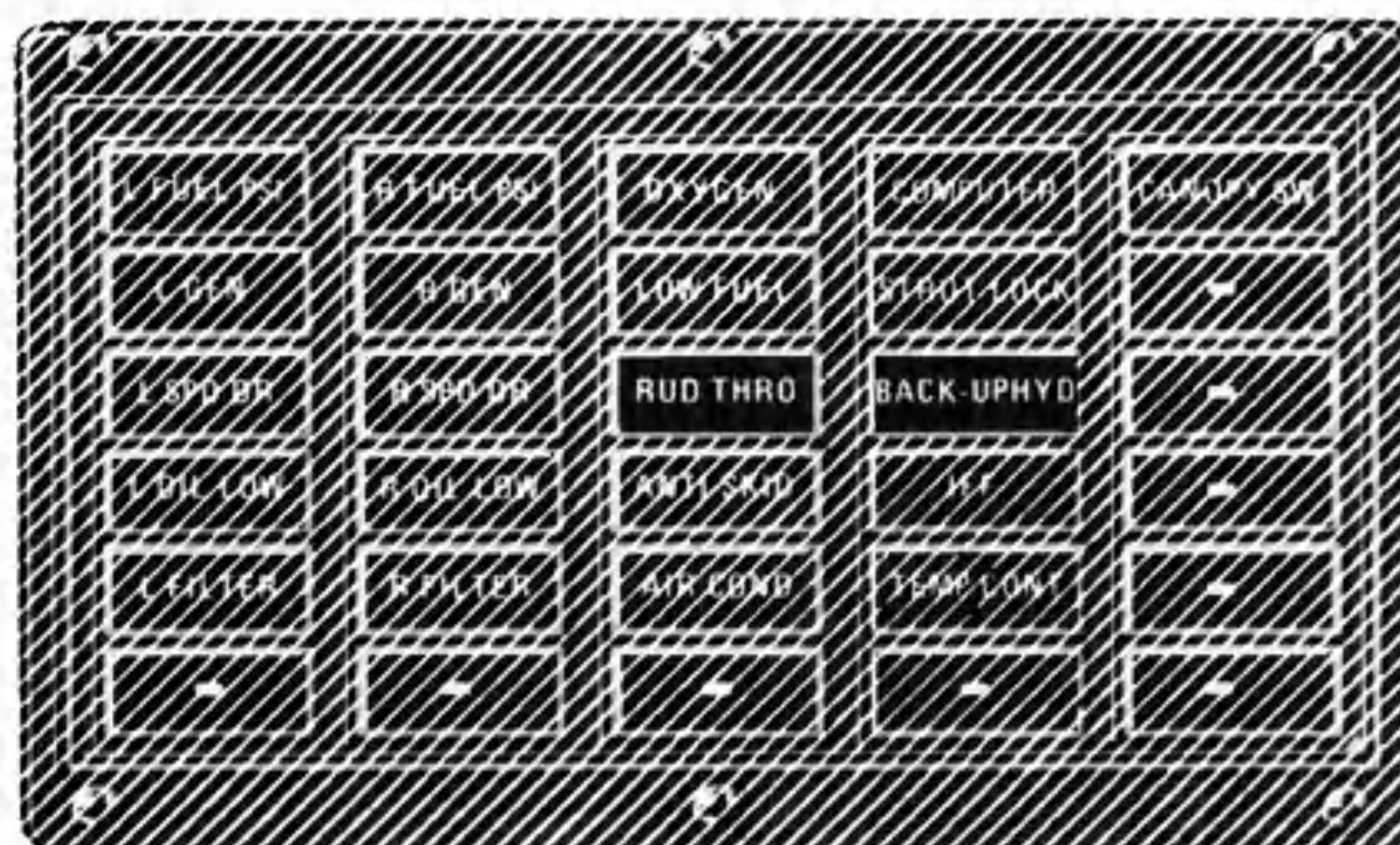
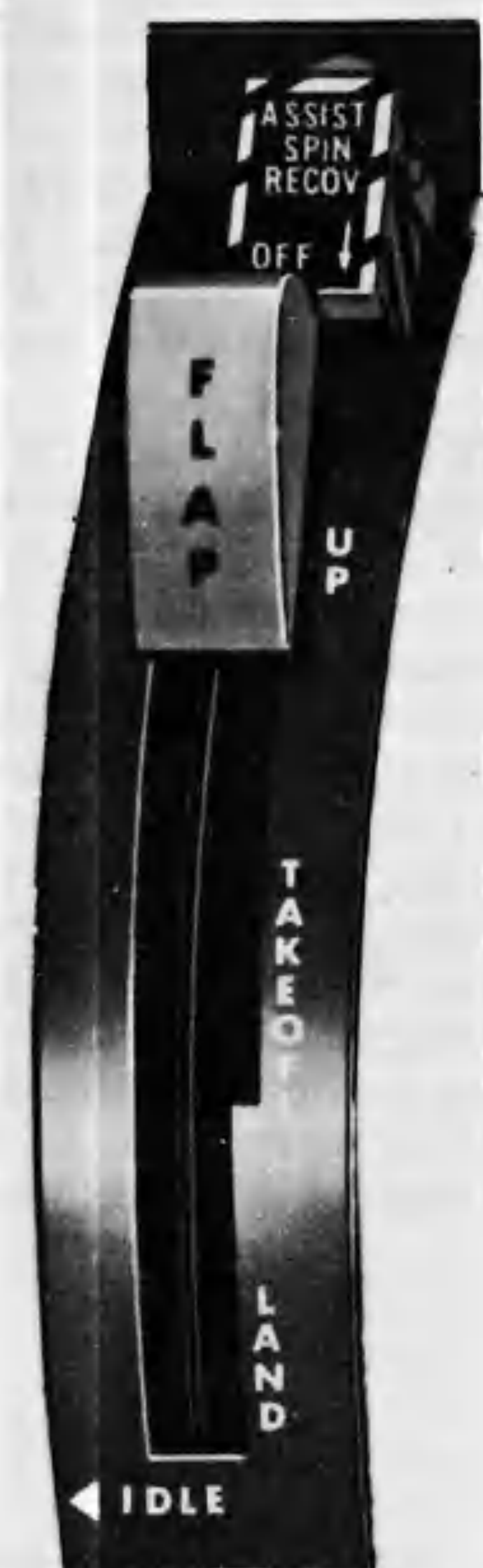
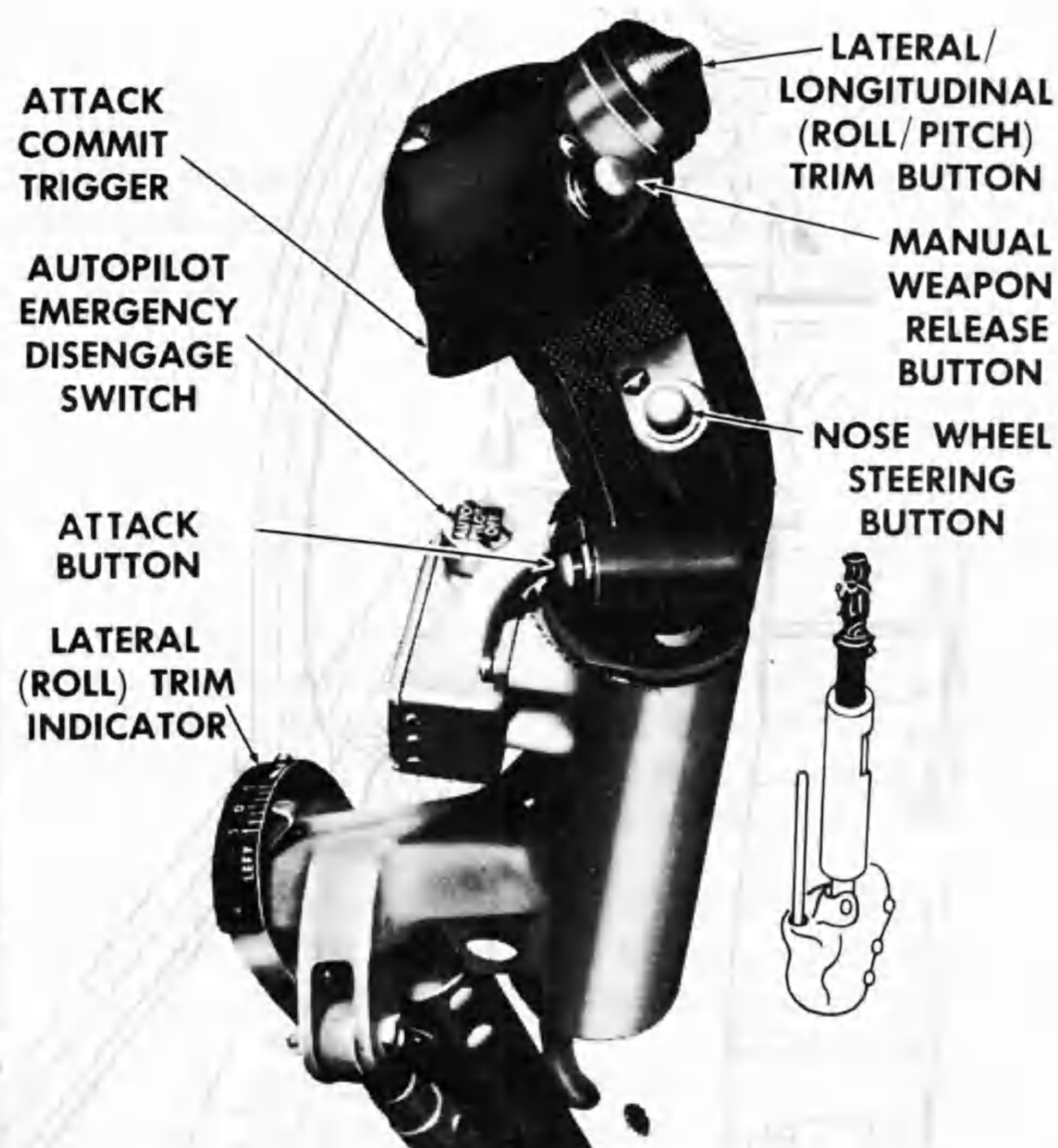


Figure 1-16

Lateral/Longitudinal (Roll/Pitch) Trim Button

The roll/pitch trim button on the stick grip (figure 1-15) is a five-position switch spring-loaded to the off (center) position. The up and down positions control pitch trim through an electromechanical actuator that repositions the stabilizer feel device (bungee) to a new no-load position. The left and right positions control roll trim through an electromechanical actuator that repositions the flaperon feel device to a new no-load position. The lateral trim indicator is on the forward base of the control stick. Total flaperon deflection, through use of the trim button, is 9° up at a rate of approximately 0.8° per second.

WARNING

If the trim button comes off, exercise extreme caution. The exposed probe will produce a severe shock.

Note

In the event of a trim button malfunction, occasional use of the AFCS AUTO MODE will assist the pilot in overcoming excessive trim requirements due to attitude, configuration and/or airspeed changes.

Autopilot Emergency Disengage Switch

This normally closed pushbutton switch (figure 1-15) provides emergency release of the AFCS. It is mounted on the junction box beneath and to the right of the pilot stick grip. The pushbutton is marked AUTOPILOT OFF and is coded with yellow and black barberpole stripes. Depressing this pushbutton disengages all AFCS control functions and returns all controller switches to their disengaged position.

Nose-Wheel Steering Button

The spring-loaded nose-wheel steering button on the pilot's control stick grip must be depressed to keep nose-wheel steering (figure 1-15). It is used to engage normal nose-wheel steering. When the nose-wheel steering circuit is energized, the nose-wheel steering selector valve is positioned to direct

combined hydraulic system pressure to the steering control valve.

Lateral (Roll) Trim Indicator

The lateral (roll) trim indicator on the forward side of the stick grip adapter (figure 1-15) indicates the trimmed position of the flaperons. The scale is calibrated in three units left and right of zero (neutral) and is mechanically operated.

FLAPERONS

Flaperons are used for lateral control. Stick movement to the left of neutral results in the left flaperon being raised with the right flaperon remaining neutral. Conversely, stick movement to the right of neutral results in the right flaperon being raised and the left flaperon remaining neutral. Maximum flaperon deflection is 51°.

The flaperons are divided on each wing at the wing fold. A mechanical interlock prevents the wing-fold system from being unlocked unless the flaperons are near neutral. Conversely, when the wing-fold handle is actuated, a mechanical stop prevents the flaperons from being actuated.

Flaperon Pop-Up Switch

A flaperon pop-up feature is available for decreasing ground-roll after landing. The flaperon will pop-up to the 39° ± 3° position. The flaperon pop-up switch on the pilot's left console (figure 1-15) is a two-position switch that provides control over flaperon pop-up. The OFF position deactivates pop-up. The ARM position electrically arms the flaperons for pop-up. In order to complete the circuit, the left weight-on-wheels switch must be actuated, the throttles retarded to idle, and the wings spread and locked.

Note

Control stick movement is limited laterally when flaperons are popped up.

Flaperon Autopilot Actuator

The flaperon autopilot actuator is a hydraulic servo unit that receives inputs from the control stick and the autopilot. The input information is converted to a mechanical movement which, in turn, actuates the flaperons.

Note

In the event of actuator malfunction, there is a ball lock detent that permits disengagement of the actuator.

HORIZONTAL STABILIZER

Longitudinal control is provided by the horizontal stabilizer. To provide maximum control and help prevent overstress under all flight conditions, actuation of the flaps results in an increase in stabilizer travel. The normal travel range of the stabilizer is 1.5° leading edge up to 9.5° leading edge down; with flaps down, the range is increased to 1.5° leading edge up to 24° leading edge down.

The backup flight controls hydraulic system permits stabilizer operation and control if both the flight and combined hydraulic systems are inoperative.

Note

Backup system control rate for stabilizer operation is approximately 10% of normal.

Stabilizer Position Indicator

The stabilizer position indicator on the integrated position indicator on the main instrument panel (figure 1-16) indicates available stabilizer travel by presenting a symbol of a stabilizer for full travel, and the word CLEAN for restricted travel. The indicator is powered by the essential 28V DC bus through the CAUTION LIGHTS circuit breaker on the right circuit breaker panel.

CAUTION

Restricted stabilizer travel at low speed could result in inadequate pitch control and full stabilizer travel at high speed could cause structural failure.

Horizontal Stabilizer Trim

The stabilizer is trimmed by actuating the trim button on the control stick grip (figure 1-16). The button controls a two-speed irreversible electromechanical actuator which varies the neutral position of the feel bungee. For manual operation, high trim speed is used, giving approximately 1° per second rate of stabilizer displacement. During autopilot operation, the slow speed is used, producing a stabilizer change at the rate of approximately $1/20^\circ$ per second. With flaps up, the trim limits are $3/4^\circ$ leading edge up to 9.5° leading edge down; flaps down $1/2^\circ$ leading edge up and 22° leading edge down.

Horizontal Stabilizer Trim Gage

The stabilizer trim gage (figure 1-16) indicates horizontal stabilizer trim position from 3 units nose down to 12 units nose up. A signal is generated by a position transmitter that drives a DC motor that positions the pointer.

Horizontal Stabilizer Hydraulic Power Actuator

The hydraulic power actuator for the horizontal stabilizer is unique in reference to the primary flight control actuators. The actuator has provisions for a parallel mode of operation in conjunction with the AFCS.

RUDDER

Directional control is provided by a single rudder. Similar to the design feature of the longitudinal controls, the lowering of the flaps mechanically provides additional rudder travel. With the flaps up, rudder travel is 4° either side of neutral; with the flaps down, rudder travel is 35° either side of neutral. The rudder is controlled by rudder pedal displacement or by AFCS input.

The rudder actuator linkage is protected from high winds when the aircraft is parked by an arrangement that permits full 35° rudder travel when the flight and combined hydraulic systems are depressurized. Full 35° rudder travel is available when both the flight and combined hydraulic systems are inoperative.

Note

Backup system control rate for the rudder is approximately 30% of normal.

Rudder Pedals

Conventional rudder pedals, with toe-action braking, are used in the aircraft. Moving the rudder pedals transmits a mechanical input to the rudder actuator. The actuator, in turn, utilizes hydraulic power to deflect the rudder.

In addition to providing manual directional control, the pedals are also used for steering the aircraft on the ground. The nose-wheel steering feature is actuated manually by depressing the nose-wheel steering button (figure 1-16) and automatically when the weight-on-wheels switches are closed and the arresting hook is down.

The rudder pedals are adjustable a total of 9 inches fore-and-aft, in 1-inch increments.

Rudder Trim Switch

The rudder trim switch on the pilot's left console controls an irreversible electromechanical actuator that varies the neutral position of the mechanical linkage for directional trim. Full trim corresponds to 4° of rudder travel either side of neutral, flaps up and 7° either side of neutral, flaps down.

Rudder Trim Gage

The rudder trim gage (figure 1-16) indicates rudder position from four units left to four units right. A signal generated by a position transmitter drives the pointer on the indicator.

ASSIST SPIN RECOVERY SWITCH

The assist spin recovery switch (ASSIST SPIN RECOVERY) enables the pilot to select extended rudder and stabilizer throw for maximum control surface deflection without lowering the flaps. The switch, which is on the forward right edge of the throttle quadrant (figure 1-16), is guarded, and has two positions. The aft (guarded) position is OFF. The forward position electrically energizes a selector valve to port hydraulic fluid to a shift cylinder. The cylinder mechanically shifts the tail control surfaces into an extended throw condition (35° rudder, 24° stabilizer). Power for the cylinder is supplied by the combined primary hydraulic system (±35° rudder, 1 1/2° to 24° stabilizer).

CAUTION

- Reselection of cruise control throws after spin recovery should be done below 300 KIAS while anticipating a nose-down pitch change.
- Do not actuate the assist spin recovery switch with the flaps down or lower flaps with the spin recovery system on. The spin recovery system is to be operated only with the flaps up. Operation of the system with flaps down can result in damage that will prevent reselection of cruise control throws.

Rudder Throw Caution Light

The RUD THRO caution light on the annunciator panel comes on whenever extended rudder travel is actuated in the clean configuration, or the assist spin recovery switch is actuated.

Lighting of both the RUD THRO caution light and the BACKUP HYD caution light indicates that both the flight and combined hydraulic systems are inoperative. Under these circumstances flight control is limited to rudder and stabilizer only.

WING FLAPS AND SLATS

The wing flaps are semi-Fowler type slotted flaps and work in conjunction with the wing slats to provide additional lift during takeoff and landing. Both the flaps and the slats are divided at wingfold and cannot be actuated hydraulically unless the wing lockpin switch is energized. No such protection exists when emergency actuation is used. Power for driving the flaps and slats in normal operation is supplied by the combined secondary hydraulic system.

There are two flap actuators for each flap panel. The actuators are mechanically linked to a central gearbox in the right wing root. The hydraulic brake of the gearbox maintains the position of the flap panel regardless of air loads. A planetary gear arrangement in the gearbox, working with the hydraulic brake, permits the flap actuators to be driven from hydraulic or electrical (emergency) power sources.

The rudder and stabilizer shift mechanisms for increasing control surface movement are also actuated through the flap gearbox. The stabilizer is shifted by a cable wound on a cable drum that is mounted on a shaft extending from the gearbox. The rudder is shifted by a cam stop mechanism that is actuated in turn by the stabilizer shift cable. The gearbox is designed to handle loads up to the breaking strength of the cables.

As in the flap system, the slat main gearbox transforms hydraulic power to mechanical power through a hydraulic motor driven by the combined hydraulic system. There is one slat actuator for the inner slat panel and two for the outer slat panel for a total of six actuators. Interconnecting pins ensure equal slat extension on both wings.

Flap Lever

A three-position flap lever to the right of the throttles (figure 1-16) controls the operation of the flaps and slats. Positioning the flaps handle to the LAND position actuates a switch, powered by the 28V DC essential bus. This completes a circuit to the solenoid-operated hydraulic selector and flap brake valves. The brake in the gearbox releases and the selector valve directs hydraulic pressure to the down side of the flap hydraulic motor. Similarly, actuation of the flap handle closes the slat switch, completing a circuit to a solenoid-operated selector and slat brake valves. The brake in the gearbox releases and the selector valve directs hydraulic pressure to the down side of the slat hydraulic motor. The flaps will extend to 40° down, and the slats will extend to 27° down (full down). Limit switches open the electrical circuits to the flap and slat selector and to the brake valve solenoids. Both brakes are spring-loaded to the locked position.

When the flap lever is moved to the TAKE-OFF position, an electric circuit is completed to the solenoid selector and to the brake valve to direct hydraulic pressure to either the extend or retract side of the flap hydraulic motor and releases the flap brake. If the flaps are down, the retract side of the hydraulic motor is energized. When the flaps reach 30°, a limit switch deenergizes the solenoid selector valve and the brake valves, stopping retraction. If the flaps are up, the extend side of the hydraulic motor is energized. The solenoid selector valve and the brake valve are deenergized by the 30° limit switch when the flaps reach 30° down. With the flaps initially full down and the flap lever moved to TAKE-OFF, the slats remain full down. If the flaps are initially UP, a circuit is completed to the slat solenoid selector valve and brake valve. The brake is

released and hydraulic pressure is directed to the extend side of the slat motor.

Positioning the flap lever to UP, with flaps and slats extended, actuates flap and slat switches which energize the respective solenoid selector valves. The selector valves then direct hydraulic pressure to the retract side of the hydraulic motors. When the flaps and slats reach full up, limit switches deenergize the selector valve solenoids and the hydraulic motors stop.

WARNING

The pilot must ensure that the flap lever is fully seated in the desired detent and aircraft flap and/or slat configuration is confirmed with the integrated position indicator. Flaps and/or slats may be positioned to the TAKEOFF or UP position without the flap lever being seated in the detent selected. Any movement of the flap lever to a position between the UP and TAKEOFF detents may cause the flaps and/or slats to assume a position not intended.

Note

- The maximum recommended airspeeds for flap and slats in the extended position are:

TAKEOFF	250 KIAS for 30° flaps
LANDING	200 KIAS for 40° flaps

- Regardless of the position of the flaps, making a selection with the emergency flap switch overrides the flap lever selection.

Emergency Flap Switch

The emergency flap switch on the throttle quadrant (figure 1-6) is a three-position, square toggle switch with positions placarded UP, OFF, and DN. The emergency flap switch provides flap and slat operation when the flight or combined hydraulic systems fail. When the switch is placed down (DN), circuits are completed to the 115V AC primary emergency flap and slat motors. As these electric motors are energized, the electric brakes are released, permitting emergency flap and slat operation. Cam-operated limit switches deenergize the emergency motors when the flaps and slats reach the fully extended position. For retracting the flaps and slats, the emergency flap switch is placed in the UP position and the electric brake locks are released, permitting emergency flaps and slat operation. The phasing of the emergency AC motors is changed, reversing the motors, and retracting the flaps and slats. The motors will be deenergized when the cam-operated upper limit switches are actuated.

CAUTION

- Emergency extension of the flaps to the terminal (LAND) position above 160 KIAS may result in a burned-out clutch in the gear box and complete loss of flap operation. It is permissible to commence flap extension by the emergency flap switch at any speed up to the structural limitation (200 KIAS for LAND position) of the flaps; however, air-speed deceleration to below 160 KIAS must be continued as the flap extension process continues toward LAND position.
- The emergency flap switch should not be used for normal flap operations. The flap and slat motors may be damaged by continuous use.
- Activation of the emergency flap/slats switch is independent of the wing-fold interlock. Operation of the switch will therefore produce damage to the flaps and slats when the wings are not fully spread and locked.
- Allow 3 minutes reset between emergency flap switch actuation. If it is necessary to cycle the emergency flap switch repeatedly, limit use to five cycles. One cycle is defined as 45 seconds extension, 3 minutes rest, 45 seconds retraction, 3 minutes rest. Abuse of motors will result in loss of emergency actuating system.
- The emergency flap/slat switch should be returned to OFF when the flaps have reached the desired position.

Note

- Insure that the position of the flap lever corresponds with the desired flap position before engaging the emergency switch. If hydraulic power should be restored, the flaps would be driven to the position selected by the flap lever.
- Emergency extension of the flaps to T/O may result in extension beyond the T/O position. An attempt to return to the T/O position will result in retraction of the slats during the period that the emergency flap switch is activated, resulting in a partially retracted slat condition.
- Regardless of the position of the flaps, making a selection with the emergency flaps switch overrides the flap lever selection.

Flap and Slat Indicators

The flap and slat indicating windows are on the integrated position indicator on the pilot's instrument

panel (figure 1-16). The flap window indicator shows that the flaps are 30° or 40° down by using position lines and a flap outline. When the flaps are in transition or when power is OFF, a barber pole will appear in the window.

Note

Above 180 KIAS (approximately), the flaps may not fully extend to the TAKE-OFF position. Above 140 KIAS (approximately),

the flaps may not fully extend to the LAND position. In either situation, the flap indicator will display a barber pole until air-speed is reduced.

The slat window displays a slat when the slats are 25° down. As in the flap window, a barber pole will appear when the slats are in transition or when power is OFF. The indications are identical for normal or emergency operations.

AUXILIARY AIRCRAFT SYSTEMS

AUTOMATIC FLIGHT CONTROL SYSTEM

The automatic flight control system (AFCS) is an electromechanical system that provides three-axis stability augmentation, three-axis attitude control, and mach hold or altitude hold, as selected by the pilot.

AUTOPILOT CONTROL PANEL

The autopilot control panel, placarded AUTOPILOT, is located on the center console (figure 1-17). The controls consist of three solenoid-held toggle switches, two solenoid-held pushbuttons, and one momentary-on pushbutton. The toggle switches are placarded ON/OFF, AUTO/STAB AUG, and CMD ON/OFF. Pushbutton switches are placarded ALT, MACH, and RETURN TO LEVEL. The RETURN TO LEVEL and CMD ON/OFF switches are currently inoperative. The other controls and their functions are discussed under the description of the various operating modes available to the pilot.

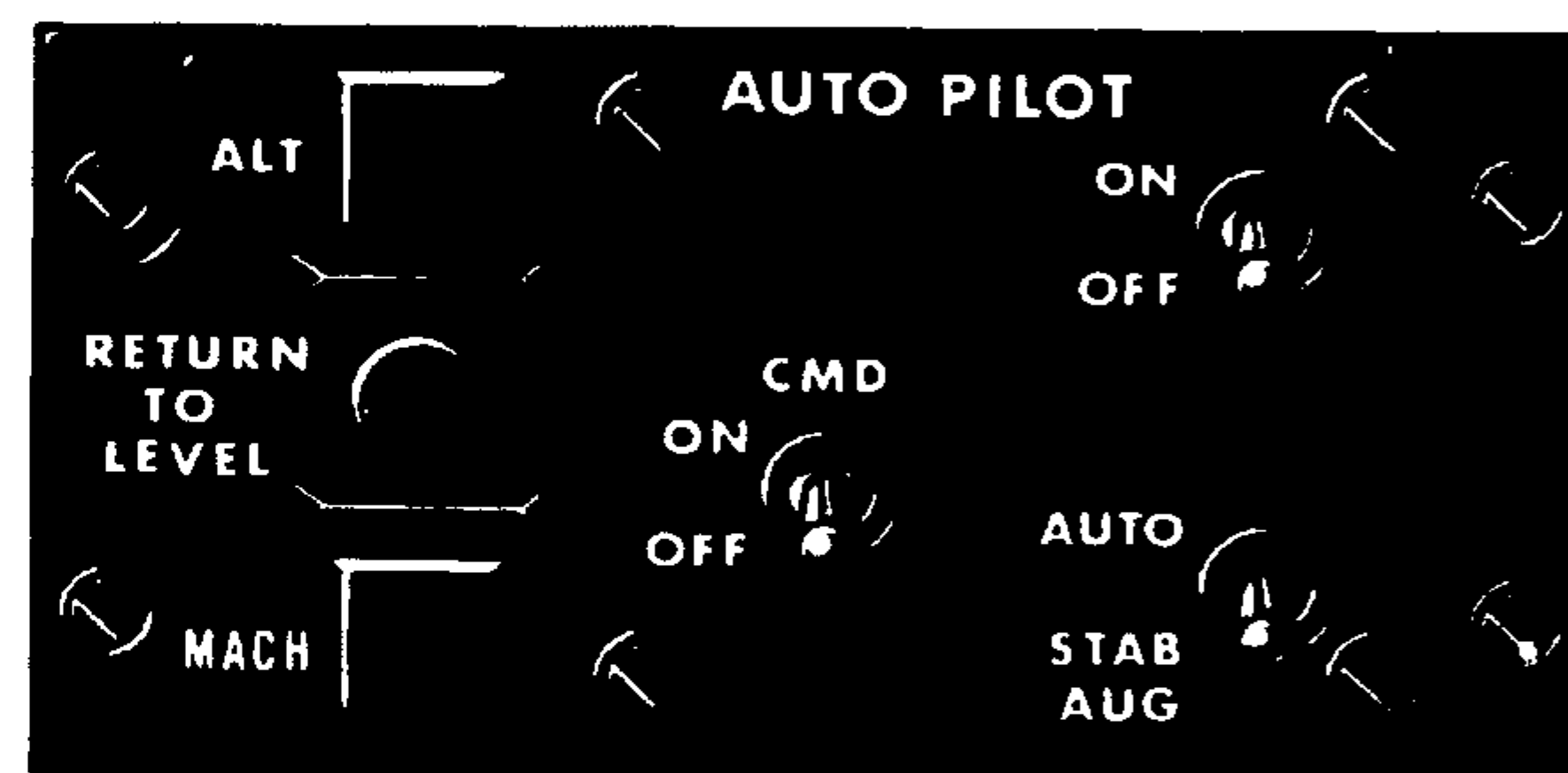
Autopilot Switch

This two-position, solenoid-held toggle switch is located on the AFCS control panel. It is interlocked with the AUTO/STAB AUG switch, which is spring-loaded to the STAB AUG position. In its normal operating position (on), the switch therefore engages the three-axis damper function of the STAB AUG mode. This switch must be engaged to permit selection of any of the automatic functions.

Note

- After positioning AUTOPILOT ON/OFF switch to ON, and thereby engaging STAB AUG mode, wait at least 30 seconds before engaging either of the AUTO mode functions, to permit the gyros to reach operating speed.
- In order to engage the AFCS with a minimum of transients, the lateral position of the pilot's control stick should be neutral when the autopilot switch is set to ON and it should be left in neutral for 3 to 6 seconds after the AFCS is engaged to permit the servo ram to engage completely.

AUTOPILOT CONTROL PANEL



ADF1-19

Figure 1-17

STABILITY AUGMENTATION MODE (STAB AUG)

The stability augmentation mode (STAB AUG) provides improved control of the aircraft by automatically damping oscillations about the pitch, roll and yaw axes. In this mode, the stabilizer, flaperons, and rudder are actuated proportionately in response to pitch, roll, and yaw rates, respectively. Movement of the control surfaces is not transmitted to the control stick or rudder pedals. The only evidence of STAB AUG action is improved aircraft stability.

STAB AUG is considered the manual mode of AFCS operation in that the pilot manually flies the aircraft with stick and rudder pressure.

AUTO/STAB AUG Switch

This two-position, solenoid-operated toggle switch on the AFCS control panel is placarded AUTO and STAB AUG. It is interlocked with the ON/OFF switch and is spring-loaded to the STAB AUG position. It can be placed in the AUTO position only when the ON/OFF switch is engaged.

AUTO MODE

The pilot relief mode (AUTO) is the basic hands-off operating mode of the AFCS. Mode selection is made by placing the AUTO/STAB AUT switch in the AUTO position. The AFCS will remain engaged only if the pitch and roll modules are properly aligned with the attitude reference selected by the ATTITUDE REF switch and the AC operating voltage of the AFCS is within limits.

Note

- The AFCS should either be secured or placed in the STAB AUG mode prior to switching into or out of MAG/VGI to prevent abrupt or unexpected attitude changes during a change in reference signals to the AFCS.
- In AUTO mode, the manual trim button on the control stick grip is deactivated and its functions are performed automatically. Manual rudder trim is available in all modes. If in the AUTO mode of operation the stick is grasped, the system reverts to STAB AUG operation during which manual trim may be accomplished. AUTO mode is resumed when the stick is released.

In the AUTO mode, the AFCS provides pitch attitude hold and heading hold. If AUTO is selected at bank angles in excess of 5°, it will hold a constant bank angle. The system will hold any bank angle between 5° and 60°. If the 60° limits are exceeded, the AFCS will automatically return the aircraft to 60°. Pitch limits are 25° nose up and 60° nose down. If these limits are exceeded, the AFCS will automatically return the aircraft to the nearest limit of the pitch range. While forces of 1.1 ±0.2 pounds are applied to the control stick, the AFCS reverts to the STAB AUG mode. When control stick pressure is released AUTO mode is reengaged and the aircraft will again hold a constant pitch attitude and a constant heading or bank, depending on bank angle existing when control stick pressure is released. If the bank angle is less than 5°, the AFCS will level the aircraft and hold a constant heading. If the bank angle is greater than 5° when stick pressure is released the AFCS will hold the existing bank angle. Additional pilot relief functions incorporated in AUTO mode are described below.

ALTITUDE HOLD MODE

When the altitude (ALT) pushbutton (figure 1-17) is depressed, the pitch attitude of the aircraft is controlled by pressure altitude signals from the air data

computer. In this mode, the AFCS retains its fully automatic features and in addition maintains the aircraft at an altitude corresponding to the barometric pressure existing at the time ALT is selected. Control stick pressure interrupts altitude hold and the system reverts to the STAB AUTO mode. When control stick pressure is released, altitude hold is reengaged and the aircraft will again maintain a constant altitude.

Note

It is recommended that the aircraft be in approximately level flight before engaging the altitude control. Using the altitude hold feature to level off from climbs or descents in excess of 1000 feet per minute will probably result in an error in the level-off altitude. Repeated use of altitude hold at high vertical speeds will result in wearing of the clutch in the altitude-hold module of the air data computer.

- Selecting ALT when the aircraft is on the deck will result in an apparent pitch trim runaway. This is a characteristic of the AFCS and does not indicate a malfunction.

MACH HOLD MODE

The mach hold function maintains the mach number existing at the time of mach hold engagement. Mach hold mode is selected by depressing the MACH pushbutton (figure 1-17) on the AFCS control panel. In this mode, a signal from the air data computer commands a pitch up or pitch down whenever the airspeed is above or below the selected mach number. Mach hold and altitude hold cannot be selected simultaneously. Selection of either mode automatically disengages the other.

Longitudinal pressure on the control stick interrupts mach hold. When pressure on the control stick is released, the AFCS returns to mach hold mode and will again hold the existing mach number.

Note

- Mach hold should not be engaged until mach number is stabilized.
- During extended periods of mach hold operation at a constant throttle setting, the aircraft will climb slowly due to weight loss through fuel consumption. This is normal and can be corrected by reducing thrust.

- Selecting MACH when the aircraft is on the deck will result in an apparent pitch trim runaway. This is a characteristic of the AFCS and does not indicate a malfunction.

AFCS Emergency Disconnect

The AFCS emergency disconnect switch is on a junction box immediately below and to the right of the control stick grip. The switch is marked AUTO PILOT OFF and is coded with yellow and black barber pole stripes. When the disconnect is momentarily actuated, electric power is disconnected from all AFCS circuit. Any switches or pushbuttons on the AFCS control panel that are engaged automatically return to the OFF position.

Note

In the event of any unusual vibrations or oscillations in the flight control or if a malfunction is suspected, actuate the emergency disconnect to eliminate the AFCS as a cause. Any AFCS switches or pushbuttons that do not return to the OFF positions after actuating the emergency disconnect should be positioned to OFF manually and/or the autopilot circuit breaker on the bombardier/navigator's circuit breaker panel should be pulled.

AUTOMATIC CARRIER LANDING SYSTEM

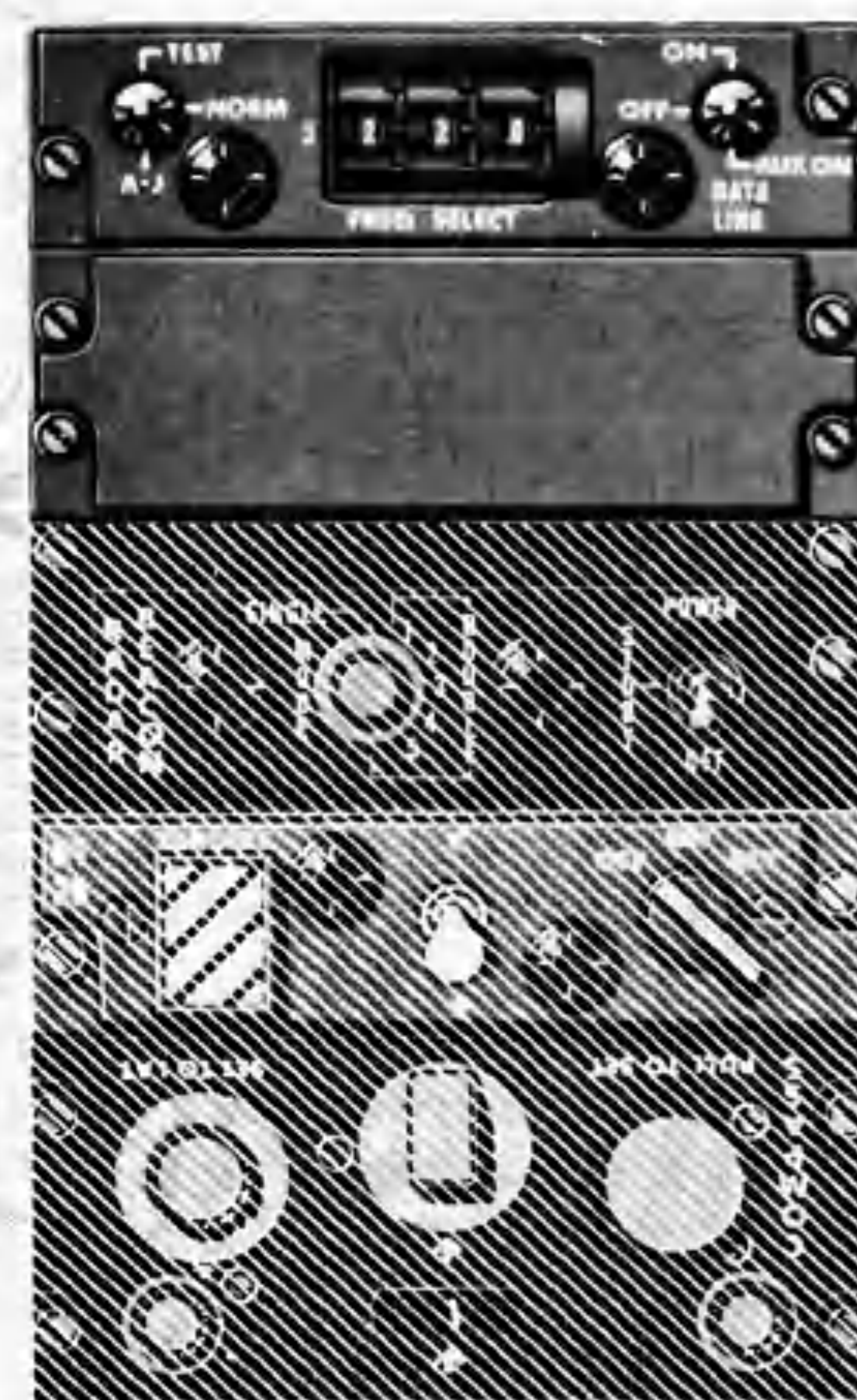
The automatic carrier landing system (ACLS) is installed on aircraft incorporating IAFC No. 230. The ACLS consists of an airborne subsystem and shipboard subsystem. The airborne system includes the AN/ASW-25 data link receiver with associated controls and indicators (figure 1-18). The shipboard system is composed of an AN/SPN-10/42 computer

interfaced with the Naval Tactical Data System (NTDS), AN/SPN-10/42 radar, and data link transmitter. A shorebased AN/SPN-42T1 is used for indoctrinating pilots in operating procedures for ACLS and is identical to the shipboard system except for ship stabilization and deck motion compensation. Guidance signals from the carrier are transmitted via data link, and glidepath/azimuth errors are displayed on the ACLS course indicator (ID-351). Additional information is displayed by discrete read-out (DRO) lights adjacent to the ACLS course indicator.

APPROACH MODES

Several ACLS approach modes are available depending on aircraft modifications. These modes are as follows:

- Mode I Approach - Automatic coupled AFCS approach from acquisition to touchdown on the carrier flight deck.
- Mode IA Approach - Automatic coupled AFCS approach from acquisition to 200 feet and 1/2 mile minimums; manual approach to touchdown.
- Mode II Approach - Uncoupled approach in which the pilot flies the aircraft in response to the ACLS course indicator pointers as in an ILS. Use of APCS is optional for a Mode II Approach.
- Mode III Approach - Manual controller talk-down approach requiring no special aircraft equipment onboard.

ACLS CONTROL PANEL AND INDICATORS

AFT BULKHEAD CONSOLE

ADF1-112

Figure 1-18

The A-6 is presently configured for Mode II (AFC 230) and Mode III approaches. A typical Mode II approach is shown in Figure 3-13.

ACLS DATA LINK CONTROL PANEL

The ACLS data link control panel on the aft bulkhead (figure 1-18) contains all the controls for ACLS operation. The ON/OFF/AUX ON toggle switch when in the ON position provides power from the essential 28V DC bus for system operation. The AUX ON position is inoperative. The TEST/NORM/A-J mode switch provides normal system operation when in the NORM position. The TEST position provides a self-test feature, which will function only in the presence of a universal test message (UTM) from a ground or carrier-based transmitter. With the proper data link frequency selected on the **FREQ SELECT** switches, the ACLS course pointers will cycle every 6 seconds from a fly up and right to a fly down and left, indicating proper data link operation. As the pointers cycle down and left the WO (wave-off) light on the discrete readout panel will come on. The A-J position is inoperative.

ACLS Course Indicator

The ACLS course indicator (ID-351) horizontal and vertical pointers present glidepath and azimuth errors (actual displacement from approach path) in relation to aircraft position represented by a miniature aircraft in the center of the instrument. The vertical and horizontal pointer OFF flags will be displayed and the needles will show a zero glide slope and centerline error whenever AN/SPN-10/42 radar is not locked on the aircraft.

Discrete Readout Panel

The discrete readout (DRO) panel (figure 1-18) contains five lights which provide the pilot with additional information during an ACLS approach. The LC (landing check) light comes on when the proper aircraft address has been inserted in the SPN-10/42 by the controller and indicates the pilot should perform the landing check. The LO light indicates the radar is locked on. At this time, the horizontal and vertical OFF flags disappear and the horizontal and vertical pointers on the ACLS course indicator present aircraft relative position from glide slope and centerline. The flashing WO (wave-off) light indicates an unsatisfactory approach path or carrier equipment failure. WO signals may also be initiated by the final controller (between lock-on and touchdown), PRI-FLY (between 9 seconds and 1.5 seconds from touchdown), and the LSO (between 1 mile and touchdown). The 10-S (10-second) light

comes on approximately 10 seconds from touchdown and indicates deck motion compensation is being added to glide path commands. The TILT (missed message) light comes on within 2 seconds after the last valid flight path command message is received. The TILT light will also be on prior to aircraft address insertion by the controller and will go out when the LC light comes on.

APPROACH POWER COMPENSATOR SYSTEM

The approach power compensator system (APC) AN/ASN-54(V) is a landing aid that maintains an airspeed that results in a constant average angle of attack. The system consists of the approach power control set, angle-of-attack transmitter, stabilizer position transducers, control switches, and a warning light. It is possible to engage the system at any airspeed in any configuration, while flying straight and level, climbing, descending, or turning.

When engaged, the APC automatically sets the throttles at the calculated thrust (regardless of the previous setting) needed to maintain the aircraft at the proper angle-of-attack. The precise throttle setting will depend upon aircraft gross weight, bank angle, flight path angle, and temperature setting selected. The APC uses acceleration measured perpendicular to the glide path, angle-of-attack error, and stabilizer position inputs to control throttle movement. If the pitch angle is changed to achieve a desired glide path, the throttles will automatically move as required to correct for the change in aircraft attitude. However, engine speed will not increase above 99% rpm or decrease below 75%. Furthermore, the system is damped to prevent excessive throttle movement when flying through heavy turbulence.

Manual throttle operation is available with the system turned off, and an emergency override feature allows the pilot to manually disengage the system by applying a forward or aft force to the throttles of 10 to 12 pounds. The system may also be disengaged by moving the throttle friction lock lever forward out of the off position, by selecting OFF or STBY with the APC power switch, or by actuating the weight-on-wheels switch. Therefore, the pilot is assured final override authority if the system malfunctions or when a missed wire (bolter) occurs during carrier landing.

Note

- After disengaging the APC, the pilot will have to manually reselect ENGAGE with the APC power switch.

- If the throttles do not come free after attempting to disengage the APC by the normal methods, a force of 35 to 55 pounds applied to the throttles manually disengages the system. This emergency procedure damages the APC actuators, which must be repaired before the system is used again.

APC POWER SWITCH

The APC power switch on the ANTI SKID/FLAPERON POF UP panel, is a three-position toggle switch placarded OFF, STBY, and ENGAGE. In the OFF position, all power to the system is removed and the throttles must be manually positioned. In the STBY position, power is supplied to the throttle computer; however, the control amplifier is not active and the throttles must be manually positioned. In the ENGAGE position, the system will automatically control the engine thrust by varying throttle position. The power switch is held in the ENGAGE position by a holding coil. If a malfunction causes a disengagement, the power switch will automatically move to STBY position and the APCS STANDBY light will come on.

WARNING

It is possible to engage the APC in any configuration. Engaging the APC at high power settings in the clean configuration will cause a rapid retardation of power to less than 75% RPM.

Note

- The APC will not engage unless the throttle friction lock lever is in the OFF position, full aft.
- STBY should be selected 60 seconds prior to ENGAGE to allow the throttle computer to adjust its output to a predicted level and thereby reduce throttle transients when ENGAGE is selected. Selecting ENGAGE without stopping at STBY is not harmful to the system; however, the pilot should anticipate increased throttle transients and a longer time before the desired thrust setting is established.

AIR TEMPERATURE SWITCH

The air temperature switch is a three-position toggle switch placarded COLD, STD, and HOT. It allows the pilot to change the computer gain as a function of outside temperature. Since thrust developed for any given throttle setting varies with outside air temperature, the correct gain should be selected before engaging the APCS. The COLD position will be used when temperature is below 40° F (+4° C) and the HOT position when the temperature is above 80° F (+26° C). When the temperature is between 40° F and 80° F (+4° C and +26° C), the STD position is used.

Note

Selecting the wrong gain may degrade APC performance; however, the system will compensate and maintain stable operation.

APCS STANDBY LIGHT

The APCS STANDBY light on the approach indexer comes on when the system is disengaged and is in the STBY position. The light can be turned off by engaging the system or by turning the system off. The primary purpose of the light is to warn the pilot that the APC has disengaged and returned to the standby position. Depressing the LTS WARN pres-to-test button on the pilot's master test panel will check for operating circuitry of the light.

SPEED BRAKES

The wing-tip speed brakes consist of a set of split trailing-edge surfaces at the tip of each wing, outboard of the flaps. When fully deflected, the brakes open to an included angle of 120° (60° per each half). The individual brake surfaces are approximately 2 ft. x 4 ft. panels making a total of 32 sq. ft. total braking area for the airplane. The lower speed brake is attached to the wing by two external fixed hinges. The upper surface is attached to the wing by two adjustable tension links at the same wing station as the lower hinges. The surfaces are interconnected at three points. This configuration has been optimized to yield symmetric deflection of the upper and lower brake surfaces. The primary consideration affecting the overall design of the speed brakes controls has been to obtain close synchronization between left and right hand wing brakes. This consideration led to the incorporation of flow regulators and electrical transmitters. Essentially the actuation is as follows:

The pilot operates a momentary switch in the cockpit which selects a position of the solenoid-controlled hydraulic slide valve. Power is then transmitted to the speed-brake surfaces by single tandem-type hydraulic cylinders located in each wing tip via the flow regulators. (This power is from the combined hydraulic system.) Consequently, primary synchronization is initially provided by the flow regulators, which control rate and position of the surfaces within 10%.

Fail-safe features have been added at several levels. If for any reason the surfaces become asymmetric by more than 8°, an electrical synchronization system will actuate to retract the surfaces. This would close the surfaces in 2 1/2 seconds from full open. Pilot operation of wing-tip speed brakes can be regained by cycling the wing-tip speed-brake control switch to retract. In the event of loss of electric or hydraulic power or both, the system will go to a closed selection. The pilot has the option of selecting closed at all times. Whenever the surfaces are in the closed position, ball locks in the speed-brake actuation cylinder hold the surfaces even with loss of hydraulic pressure.

The flow regulators in the hydraulic system have been selectively fitted to provide good control of synchronization and minimize the transients during all failure conditions. The normal speeds of operation are 5.0 seconds out and 2.5 seconds in.

SPEED-BRAKE POSITION INDICATOR

The speed-brake position indicator, part of the integrated position indicator on the pilot's instrument panel, indicates position of the speed brakes. The word IN appears when the speed brakes are stowed. Barber poles appear whenever the brakes are in transition, partially extended, or the indicator loses electrical power. Fully extended wing-tip speed brakes are indicated by black dots on a white background.

FAIL-SAFE PROVISIONS

Fail-safe provisions exist at several levels. If electrical power is lost, the system will go to a closed selection. Whenever the speed brakes are closed, ball locks in the speed-brake actuation cylinder hold the brakes closed, even if hydraulic pressure is lost.

Note

The speed brakes must be fully closed to permit engagement of the ball locks. A hydraulic failure with brakes extended will result in the brakes closing to a trail position which is not sufficiently closed for the locks to engage. It is recommended that the speed-brake selector switch be left in the retract position when not in use.

For most types of system failure, the electrical asymmetry sensors will react and retract the brakes. It is noted that there is no practical protection for either a mechanically jammed speed-brake surface or jammed hydraulic selector valve. The sizable airloads on the speed brakes will tend to close them against any but the most severe interference. Extensive experience has not produced any failure of this type.

Note

Normal operation of the stability-augmentation yaw damper will provide an increased margin of safety for yaw transients induced by asymmetric wing-brake deflections.

SPEED-BRAKE SWITCH

A three-position thumb switch with retract, neutral, and momentary extend positions is in the right throttle head, and controls actuation of the speed brakes. Positioning the switch forward retracts the speed brakes; holding it aft extends them. Momentary operation of the switch produces partial extension and will show a barber pole on the integrated position indicator. In the center (temporary hold) position, return flow of hydraulic fluid is blocked from both the extend and retract sides of the speed-brake cylinders, hydraulically locking the speed brakes.

Note

The normal position of the three-position switch is retract.

SPEED-BRAKE TEST SWITCH

The speed-brake test switch is a toggle switch on the left console placarded NORM and TEST. The switch is spring-loaded in the NORM position. The TEST position provides a check of the speed-brake null-detector system and is selected prior to takeoff.

To make the speed-brake test, proceed as follows:

1. Speed-brake switch aft to extend speed brakes.
2. Select TEST position-brakes should retract immediately.

LANDING GEAR SYSTEM

LANDING GEAR CONTROLS AND INDICATORS

The aircraft has a fully retractable tricycle landing gear. When the gear is up and locked, the wheel wells are covered flush to the aircraft with the landing-gear doors. The system is electrically controlled by the 28V DC essential bus and is powered to the extend and retract position by the secondary circuit of the combined hydraulic system. A pneumatic system powered by four air bottles charged to 2,450 PSI provide a one-shot extend cycle in the event of a hydraulic failure. A number of indicators are provided to warn of unsafe landing-gear operation.

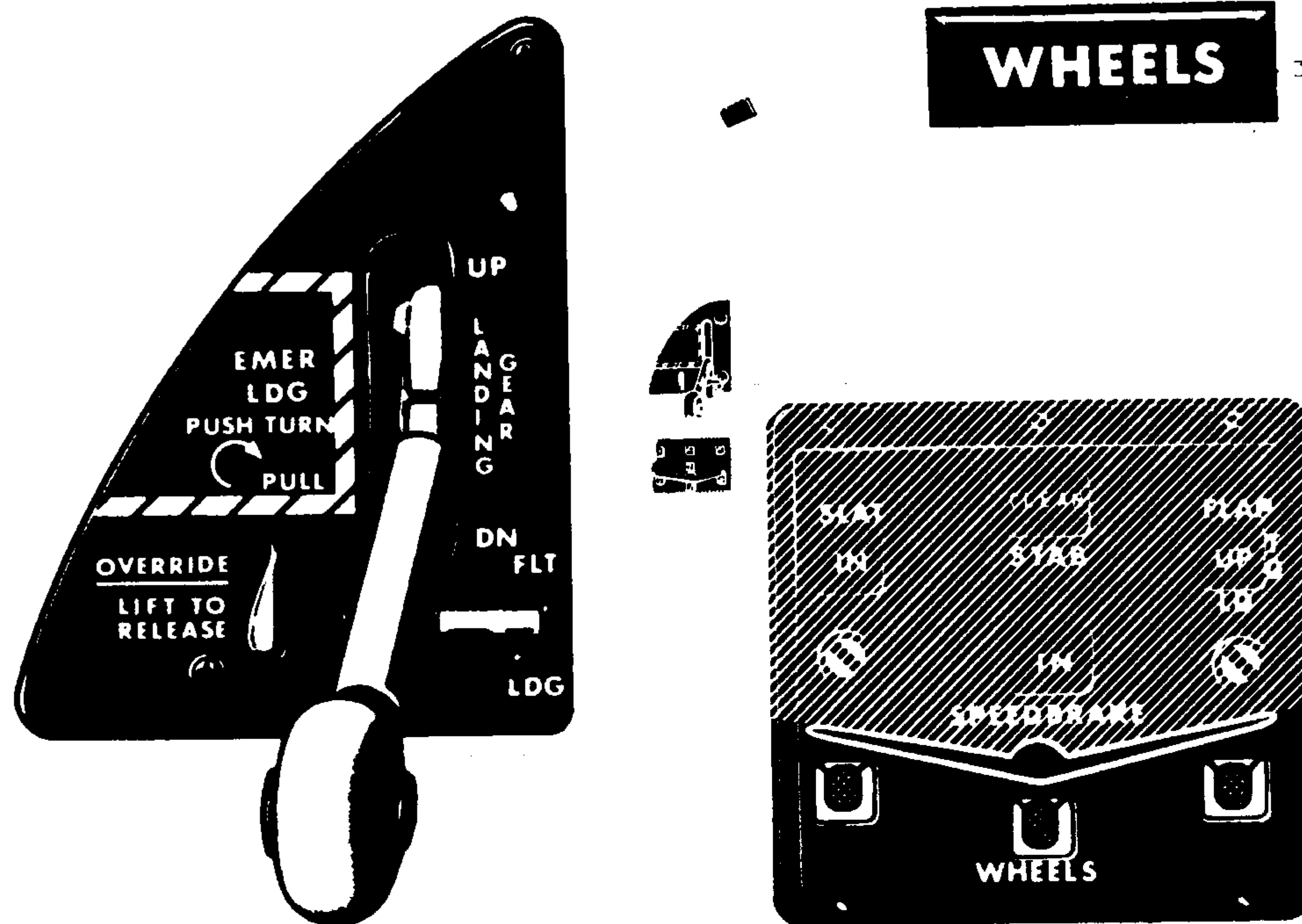
Wheels Warning Light

The wheels warning light on the windshield bow (figure 1-19) will flash any time all three landing gear are not down and locked with both throttles retarded to less than 24 1/2° above idle (approximately 82.5%) and the flaps are not retracted.

Wheels Transition Light

The wheels transition light to the right of the landing-gear handle (figure 1-19) will glow any time the landing-gear handle is first selected UP or DOWN, and will continue to glow until the position of all three gear agree with the position of the handle, and all three gear are either up or down and locked.

LANDING GEAR CONTROLS AND INDICATORS



ADF1-25

Figure 1-19

Landing Gear Position Indicator

The integrated position indicator on the left side of the pilot's instrument panel (figure 1-19) displays the position of each landing gear as follows:

GEAR UP - The word UP appears in the appropriate window when the main gear uplock switches and the forward door switches are closed; nose-gear uplock switch closed.

GEAR DOWN - A picture of a wheel appears in the appropriate window when the main gear and the nose gear are down and locked.

GEAR TRANSITION - A barber pole indication will appear in the appropriate window when the uplock or downlock switches, or the main-gear forward door switch is not closed.

Note

The landing gear is structurally capable of withstanding being extended into the slipstream up to 250 KIAS. However it will not necessarily lock down at this speed. The design of power requirements to drive the gear and doors to the down and locked position against airloads is based on the selection to down being made at 200 KIAS or less.

Note

The approach light indexer will not light until all gear are down and locked.

Landing Gear Handle

The landing gear handle (figure 1-19) is on the left side of the pilot's instrument panel. The wheel-shaped handle actuates a switch that electrically positions the landing gear selector valve to the selected position.

CAUTION

Dump cabin pressure before lowering the landing gear above 8,000 feet. Automatic pressurization begins at this altitude, and the possibility of jamming the nose-gear door exists when the gear is actuated with the aircraft pressurized.

Inadvertent gear-up selection, when the aircraft is on the deck, is prevented by the nutcracker weight-on-wheels switches, which energize a landing-gear handle lock solenoid. This solenoid throws a latch, which mechanically locks the landing-gear handle in the DN position. If the lock remains in place after takeoff, it can be mechanically repositioned by lifting the override lever to the left of the landing-gear handle.

Note

If the gear is raised by overriding the gear-handle down-lock latch, the flaperon pop-up should be disarmed to prevent its inadvertent actuation while airborne if the throttles are fully retarded. The same weight-on-wheels switch which controls the gear-handle down latch is also a series link in the flaperon pop-up arming circuit.

MAIN GEAR

Cycling of each gear from both up and down-locked positions is accomplished through hydraulic and mechanical actuation of the main-gear mechanism. When the landing-gear handle is placed in the DN position, hydraulic pressure is directed in a sequence controlled by hydraulic valves and mechanical linkage, to open the forward main-gear doors, rear doors, release uplocks, and position the down-locks. Rotation of the wheel is accomplished by a drag brace that mechanically rotates the strut cylinder and wheel as the gear is actuated. The main gear extends by gravity and is retracted hydraulically.

CAUTION

When cycling the gear, allow sufficient time (approximately 7 seconds) for the landing gear to complete a half cycle (i.e. from full up to full down) before attempting a reversal. If the direction is reversed before the door is fully opened, the gear linkage will not have completed its travel and the forward gear door may fail.

NOSE GEAR

The nose gear is hydraulically interconnected with the main gear and is actuated hydraulically to the position selected on the landing-gear handle. Motion of the nose gear during retraction is aft and up into the nose-wheel well. As the nose gear extends or retracts, mechanical linkages actuate the nose-wheel uplock, downlock, and the nose-wheel well doors.

EMERGENCY LANDING GEAR EXTENSION

Emergency air bottles furnish the power necessary to lower the landing gear in the event of a hydraulic or electrical failure. This one-shot system is powered by nitrogen pressure (2,450 PSI) stored in four compressed nitrogen bottles. Pushing in, rotating 90° clockwise, and pulling out the landing-gear control handle at least 2 to more than 3 inches to the overcenter position actuates the emergency gear-down valve (release valve) on the bottle in the nose-wheel well. Pressure from the nose-wheel well bottle, in turn, discharges the three other bottles. All bottles are manifolded on the fill side for single-point pressurizing. However, each bottle has a separate function during the extension cycle.

The nose-gear actuator is pressurized to extend, thus opening the uplock and opening the doors by a mechanical linkage. Pressure will power the nose strut to full extension where the downlock is spring-loaded to the locked position. This same air bottle

powers the aft main-gear door actuators by a separate line, and opens the main landing-gear dump valve. This dump valve vents all system actuators to prevent a hydraulic lock from opposing the gear extend sequence.

Main gear extension is accomplished by pressure from two other bottles separately opening the right and left forward doors by opening the door latch cylinders and pressurizing the door extend cylinders. Opening of the forward doors mechanically releases the aft main-gear doors to be opened by pressure from the nose-gear bottle. Opening of both aft main doors then permits pressure from the fourth bottle to release both main-gear uplocks. The aft door emergency uplock timer check valves are in series so that unless both doors are opened, neither uplock is pressurized. When unlocked, the main-gear free-falls to the down position where the downlock cylinders are spring-loaded to the lock position. Cockpit indications are the same as during normal gear extension.

Note

The landing-gear handle must be pulled out with sufficient force and extension to ensure actuation of the emergency air bottles. Extension of the gear handle may be in excess of 3 inches depending on control rigging.

NOSE-WHEEL STEERING

Directional control of the aircraft on the ground is possible through nose-wheel steering or conventional differential braking action. Shimmy damping is available in either mode of operation through the use of restrictors in the steering mechanisms. The nose-wheel steering will power the lower strut barrel up to approximately 56° and return to center. To permit tighten turns with differential braking, the lower strut will disengage a spring-loaded lockpin (tog-lock) at approximately 63° of lower strut rotation. The lower strut is now free to swivel and will remain so until the tog-lock is realigned and reengages the upper strut detent.

Nose-wheel steering is engaged when the steering button on the control stick grip is depressed and the weight-on-wheels switch on the main landing gear is closed. Steering is also engaged automatically when the arresting hook is extended and the weight-on-wheels switch is closed. When selected, steer until rotation is proportional to rudder pedal deflection, full pedal being required to obtain full 56° steering. Since full rudder travel is obtained only with flaps extended there will be rudder pedal force buildup with flaps up (steering limits are unaffected).

When the nose-wheel steering button is depressed, the nose-wheel steering selector valve is energized, allowing hydraulic fluid from the secondary circuit of the combined hydraulic system to pressurize the steering control valve and position an internal shuttle valve. The steering control valve is mechanically linked to the rudder pedals. When the rudder pedals are actuated, hydraulic fluid is directed through the control valve, around the shuttle valve, and into the appropriate side of the power chamber. The power chamber is mechanically linked to the nose wheel;

therefore, rotation of the output shaft in the power chamber turns the nose wheel. When hydraulic pressure is cut off, a centering spring on the nose-wheel strut centers the nose wheel and repositions the internal shuttle valve. Check valves provide a closed circuit between the power chamber and a restrictor in the shuttle valve. This closed hydraulic circuit effectively dampens any shimmy. It should be noted that steering unit deflection will follow pedal deflection, only so long as the steering switch is depressed. When the steering button is released, or when aircraft power is lost, the lower strut will remain at approximately the same angle since there is little centering with the weight on the wheels. When reengaging, the transient will be mild if the pedals and the steering unit are at the same rotation angle as the lower strut. If, however, the pedals have been centered, the lower strut will produce a moderate jolt when the steering switch is selected on.

When the tog-lock has been disengaged by turning past 63°, the steering switch will have no effect as long as the lower strut is free swiveling. The reengaging jolt will again be mild or severe when the tog-lock reengages the detent, depending on the relative position of the lower strut and the upper steering unit. Braking will sometimes be necessary to center the lower strut sufficiently to reengage the tog-lock. If the nose-wheel steering is deflected when the main wheels leave the ground, a centering spring will center the nose wheel, provided the tog-lock is engaged.

CAUTION

Failure of the tog-lock to reengage will result in a free swiveling nose wheel which can produce a nose-gear jam when the gear is retracted.

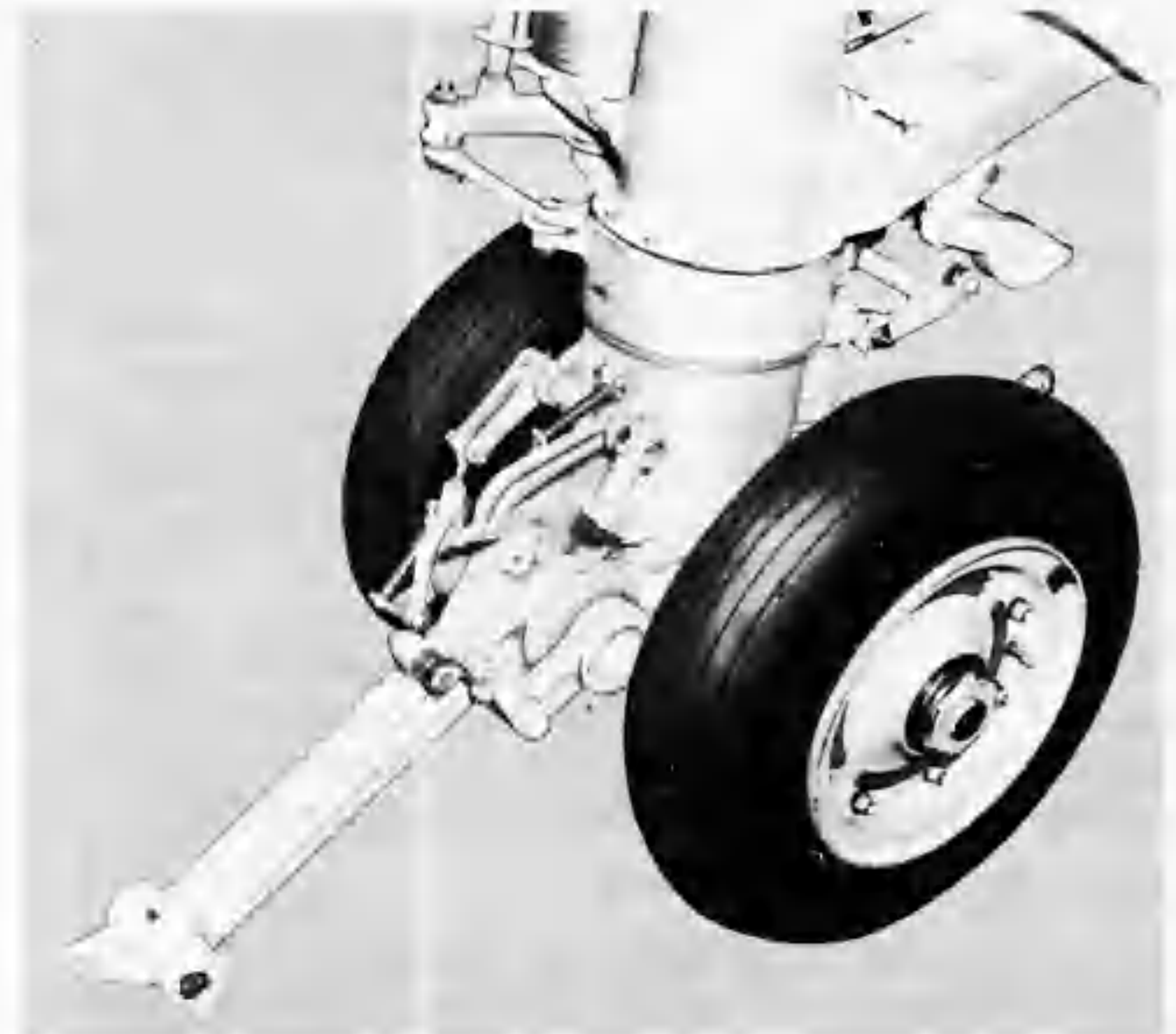
Nose-Wheel Steering Button

The spring-loaded nose-wheel steering button on the pilot's control stick grip (figure 1-16) must be depressed to keep nose-wheel steering (figure 1-40). It is used to engage normal nose-wheel steering. When the nose-wheel steering circuit is energized, the nose-wheel steering selector valve is positioned to direct combined hydraulic system pressure to the steering control valve.

NOSE-TOW CATAPULT SYSTEM

The components necessary for a catapult launch are on the nose gear. A tow link (figure 1-20) mounted forward of the nose gear, serves the dual purpose of guiding the aircraft to the shuttle from the lead-in track and attaching the aircraft to the shuttle. A bellcrank, aft of the nose-gear strut, attaches the aircraft to the catapult through an attachable trail bar and release element. The release element will fail at 53,000 pounds of tension. A lifter spring is compressed by the bellcrank as a thrust moment is exerted by the aircraft to engage the tow link and shuttle. After the release element is broken, the spring applies a force to a lifter pushrod through the

NOSE-TOW LINK



ADF1-26

Figure 1-20

holdback bellcrank, repositioning the tow link when the aircraft clears the shuttle.

To stow the tow link within the nose-wheel well after landing gear retraction, a second tow link retraction stage is needed to raise the tow link to the full up position. This is done by mechanical linkage from the nose-gear drag brace to the tow link. When the gear is extended, the linkage is moved out of the way and the tow link drops to its intermediate position.

If the tow link fails to reach its intermediate position after launch, retraction of the landing gear will move the tow link through the secondary retraction stage in a position to engage the tow link up latch.

CATAPULT GRIP

The nose-strut oleo is locked during a launch to provide clearance between large centerline stores and the deck hardware, and to minimize strut loads. This is accomplished by actuating the catapult grip (figure FO-2) forward of the throttles. With the shuttle engaged and the throttles advanced to takeoff, the catapult grip is rotated 90° to the right and pulled up. A strut lock switch is actuated by the catapult grip. This switch electrically positions the strut lock valve. Hydraulic pressure is directed to the strut, positioning the collar over the bleed holes of the shock strut. This locks the strut for launch. After launch, the catapult grip, which is spring-loaded, is released, opening the strut lock switch. The strut lock selector valve is actuated, venting the strut lock line to return. This allows the collar to uncover the bleed holes for normal strut operation.

CAUTION

The catapult grip must be utilized (pulled out and up) for all catapult shots, since proper grip position is required for nose strut stiffening. Failure to use the catapult grip will result in catapulting with a soft nose strut and may cause structural damage to the aircraft or the centerline stores.

NOSE STRUT INDICATOR

When the aircraft nose-tow link is lowered to engage the catapult, the tow link switch will arm the strut annunciator light. When the throttle is advanced past normal cruise position to full power, and the catapult grip is not positioned, the strut lock light (figure 1-26) will come on. Positioning the catapult grip will lock the strut (hard position) and turn off the strut lock warning light. When the gear is extended, the lock light will come on, through the weight-on-wheels relay, with the flaps DOWN, the throttles below approximately 82.5%, and the nose strut HARD.

NOSE-TOW LINK INDICATOR

When the aircraft is in flight (no weight-on-wheels) and the tow link is not up and latched, the nose wheel window on the integrated indicator will read TOW LINK, and the indexer and exterior approach lights will flash.

CAUTION

TOW LINK will also be indicated when the nose gear is cocked more than 8°. With a cocked nose gear, the normal tow link procedure of recycling the landing gear may result in structural damage by jamming the nose-gear wheel in the nose-wheel well.

WING-FOLD SYSTEM

The combined secondary hydraulic system supplies the power for wing folding. The flight hydraulic system must also be pressurized to hold the combined system isolation valve open.

A double locking device at the wing-fold selection control is integrated with the wing-fold handle and flight controls to prevent inadvertent damage to control surfaces spanning the wing-fold line. If the control stick is not in a neutral position, a mechanical flaperon interlock will prevent the wing-fold handle from being actuated. The wing-fold handle, in turn, must be actuated to position the mechanism on the lock cylinder to allow retraction of the hydraulically operated wing lockpins. A wing lockpin switch controls the operation of a selector valve, which directs hydraulic pressure to the lockpins. However, if the flaps and slats are extended, the electric circuit to the wing lockpin selector valve is opened, overriding the UNLOCK position of the wing lockpin switch. Conversely, the flap, slat, and flaperon pop-up circuits are opened when the wings are unlocked. When the wing-fold handle is not stowed, the control stick is restricted laterally by the wing-fold interlock.

WING-FOLD HANDLE

The wing-fold handle (figure FO-2) is mounted flush in the center console. The arm of the handle extends forward and down the right side of the console, where it is attached to a pivot point. Actuation of the wing-fold handle occurs in steps and is tied in with the wing lockpin switch.

Note

If the wing lockpin switch is in the lock position, actuation of the wing-fold handle to the down position is not possible.

WING LOCKPIN SWITCH

The wing lockpin switch is under the wing-fold handle in the center console. The switch has two positions: UNLOCK and LOCK.

WING-FOLD OPERATION

The wing-fold handle rotates the mechanical lock to a position which enables the hydraulic lockpins to be actuated, and positions the wing-lock warning flaps on each wing. The wing lockpin switch actuates a solenoid-operated hydraulic selector valve which directs combined system pressure to the four lockpin cylinders at the wing-fold joint, and opens the flap, slats, and flaperon pop-up electrical circuits. The hydraulic pressure at the lock cylinder retracts the wing lockpins. As the lockpins retract, they remove the mechanical stops of the wing-fold handle. The wing-fold handle can now be moved to the full forward position. By moving the wing-fold handle full forward, the wing-fold selector valves are positioned by mechanical linkage, directing combined hydraulic system pressure to the wing-fold actuating cylinders. The wings are folded by the two opposed actuating cylinders in each wing acting on a bellcrank at the wing-fold joint.

CAUTION

Wing-tip speed brakes, slats, and flaperons should be checked visually for retraction before folding the wings.

WING-SPREAD OPERATION

The reverse sequence of events occurs in spreading the wings. Squeeze the wing-fold handle and move it aft to the first stop, and wait for all spread motion to cease. The wing-fold selector valve directs hydraulic pressure to retract the wing-fold actuating cylinders. When the wings are fully spread and all spread motion has ceased, the wing lockpins switch should be actuated to LOCK. In the LOCK position, the wing lockpin selector valves direct flow to the wing-spread timer check valves (one in each wing). When the wings reach the fully spread position, the wing-fold timers open, pressurizing the wing lockpin cylinders. Simultaneously, the structural wing fittings release the mechanical detents that prevent lockpin extension until the lockpins and holes are aligned. When the lockpin holes are aligned, the pins extend. This locks the wings and removes the

mechanical stops of the wing-fold handle. Moving the handle flush to the console mechanically locks the hydraulic lockpin and stows the wing-fold warning flags. If any of the lockpins fail to go home the flags will remain up and the wing-fold handle cannot be stowed.

WHEEL BRAKE SYSTEM

The main wheel brakes are hydraulically powered multiple disk brakes. An artificial feel system is provided to simulate pedal forces. A brake selector handle is provided for pilot selection of normal, auxiliary, or emergency/park brake operation. The normal brakes are powered by the combined secondary hydraulic system. The auxiliary and emergency/park brakes are powered by a hydraulic brake accumulator. The accumulator is pressurized by the handpump and in aircraft incorporating it the electrically operated auxiliary hydraulic pump will also pressurize the accumulator. Accumulator pressure is displayed on a brake cycle gage in number of brake cycles remaining. An antiskid system is available only with normal brakes.

BRAKE SELECTOR HANDLE

The brake selector handle (figure 1-21) is a T-shaped handle displaying BRAKE that is used to select the mode of brake operation. The handle mechanically positions a three-way valve for the brake modes.

Normal Braking

With the brake selector handle in (full forward) and vertical, the brake selector valve ports combined

secondary hydraulic system pressure to the brake control valves. The brake control valves actuated by the pilot's feet on the toe brakes meter hydraulic pressure to the wheel brakes. The antiskid system may be employed with normal braking.

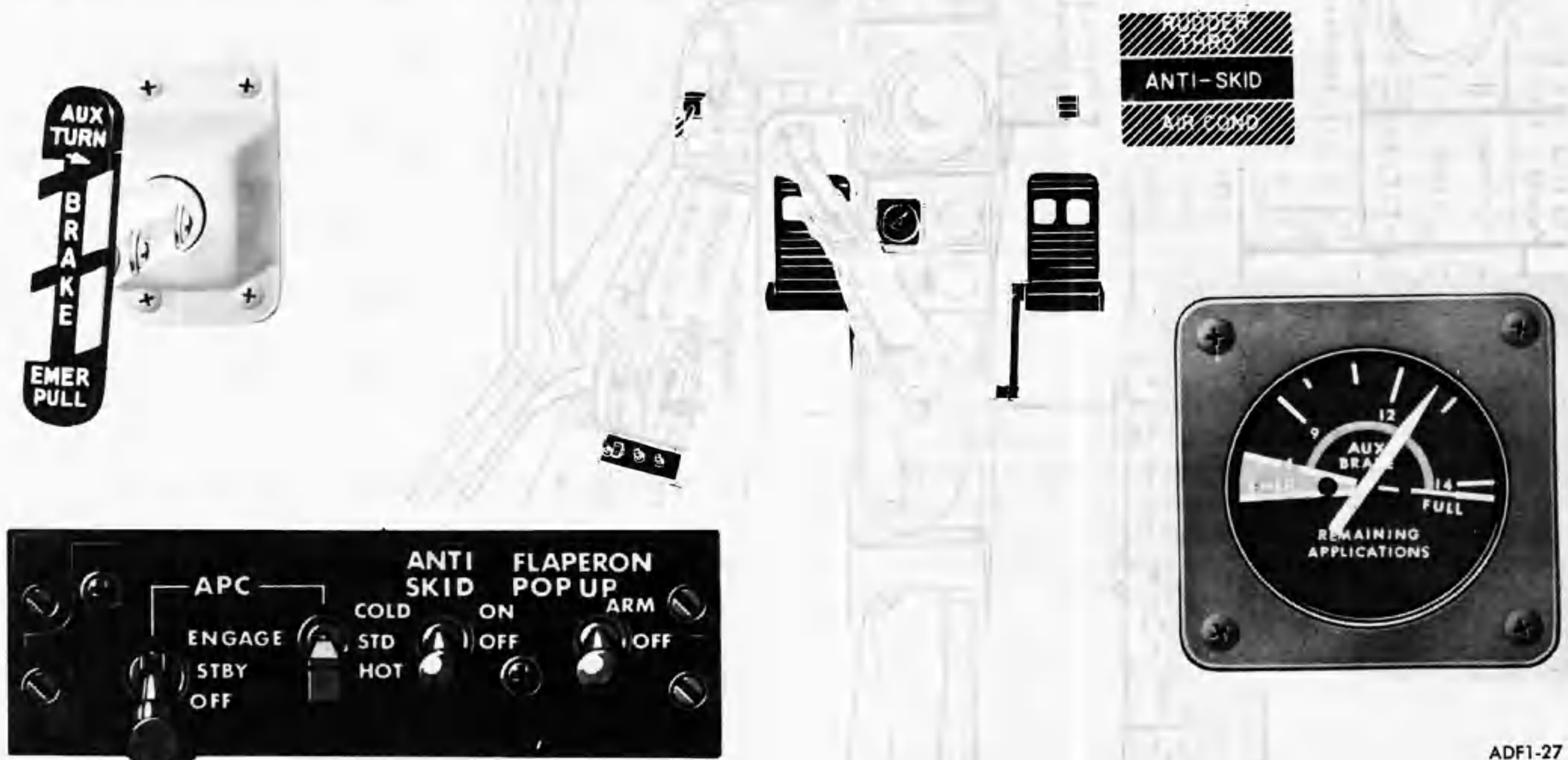
CAUTION

After heavy or repeated brake applications, such as encountered in practice landings, a 5- to 10-minute cooling period should be permitted in the air, with the gear extended between landings.

Auxiliary Braking

With the brake selector handle in (full forward) and horizontal (rotated 90° clockwise), the brake selector valve ports brake accumulator hydraulic pressure to the brake control valves. The brake control valves actuated by the pilot's feet on the toe brakes meter hydraulic pressure to the wheel brakes. The anti-skid system will be inoperative even if it is switched on. Auxiliary brake applications are limited by the capacity of the accumulator and a priority valve. A fully charged accumulator will provide approximately 15 auxiliary brake applications. The priority valve reserves the last 4 to 7 applications exclusively for emergency/park brake applications.

WHEEL BRAKE CONTROLS AND INDICATOR



ADF1-27

Figure 1-21

Emergency/Park Brakes

When the brake selector handle is out (pulled aft) in either the vertical or horizontal position, the brake selector valve ports brake accumulator hydraulic pressure directly to the wheel brakes, locking the wheels. With the selector valve in this position, if the hydraulic handpump is actuated, pressure will be applied directly to the wheel brakes.

Note

Pull the brake selector handle AFT with a clockwise motion. Pulling the handle AFT with a slight counterclockwise movement may cause the handle to bind and prevent brake actuation.

CAUTION

- If the brakes are overheated by prolonged or repeated braking, application of the emergency/park brakes may fuse the brakes and lock the wheels.
- When releasing the emergency/parking brake, ensure that the brake selector handle does not bind and remains vertical after positioning handle in by applying counterclockwise motion. Failure to do so may prevent complete relief of parking brake pressure, resulting in dragging brakes. Taxi shall not be attempted if handle binds or rotates clockwise from the vertical position.

Brake Cycles Gage

The brake cycles gage on the main instrument panel (figure 1-21) is a direct-reading pressure gage connected to the brake accumulator. The scale is calibrated in number of brake cycles (applications) remaining. The red area below 4, marked EMER, is reserved exclusively by a priority valve for emergency/park brake operation and is not available for auxiliary brake operation.

Note

The number of brake cycles indicated on the gage is an approximation. When auxiliary brakes are selected, avoid pumping brakes as each reduction in brake pressure depletes the accumulator. A smooth application of the brakes with constantly increasing pedal pressure will result in optimum braking.

ANTI SKID SYSTEM

The antiskid system used in conjunction with the normal brake system increases high-speed braking efficiency. The system, through the steering weight-on-wheels switch on the right main landing gear prevents

landing with brakes locked and permits application of full brake pedal force before touchdown for obtaining minimum stopping distances. The possibility of tire blowout is minimized and tire life and wheel balance are prolonged.

Note

Normal braking is not available with antiskid selected until the right weight-on-wheels switch is actuated.

The system is selected by a pilot-operated toggle switch and powered by the primary 28V DC bus. The major components are skid detectors in each wheel axle, and antiskid control box, and an antiskid control valve between each brake control valve and its respective wheel brake. The skid detectors sense wheel rotation speed and send proportional signals to the antiskid control box. An incipient skid is detected as a difference in wheel RPM. Under this condition, the antiskid valve for the slow turning wheel relieves hydraulic pressure permitting the wheel to rotate freely; then the pressure is reapplied over a short time interval (approximately 2 seconds). A locked wheel is detected when one wheel is not turning, and the other is turning above 150 RPM (approximately 11 knots). Under this condition, the brake pressure to the locked wheel is released, then reapplied at a slightly lower pressure. If a brake release signal exceeds 3.5 seconds, the antiskid system will become inoperative and the antiskid light in the cockpit will come on.

Antiskid Switch

The antiskid switch (figure 1-21) is a two-position toggle switch with positions placarded ON and OFF. The ON position provides primary 28V DC power to energize the system provided the brake selector handle is in the NORMAL position. The OFF position deenergizes the system. If the ANTISKID light comes on, the system may be energized again by cycling the switch to OFF, then ON.

Note

- Antiskid is available only when normal brakes are selected.
- Antiskid does not operate below 11 knots.
- Antiskid is inoperative when the ANTI-SKID light is on.
- Erratic antiskid brake operation may indicate overheated brakes and impending brake lock.
- Use antiskid for normal takeoff and landings only. For taxiing, the antiskid switch should be OFF.

Antiskid Light

The antiskid light on the annunciator panel (figure 1-21) displays ANTI-SKID and is powered by the essential 28V DC bus through the CAUTION LTS circuit breaker on the pilot's right circuit breaker panel. Glowing of the light indicates that the antiskid system is inoperative as a result of a brake release signal exceeding 3.5 seconds, the brake selector handle being out or rotated, the antiskid toggle switch being off, or a failure of the antiskid system.

ARRESTING-HOOK SYSTEM

The arresting-hook system provides carrier landing capability and arrested landing capability on runways equipped with arresting gear. It may also be utilized for aborted takeoff on suitably equipped runways. Hook release from the up position is accomplished by a cable operated up-hook release. A fail-safe feature automatically releases the hook if the release cable parts. When released, the hook is extended to the trail position by dashpot pressure assisted by gravity. The dashpot also dampens hook bounce and acts as a shock absorber during cable engagement. The system incorporated hook retraction ability and a hook transition indicator light.

Note

When the arresting hook is extended, the nose-wheel steering system is armed and will engage on landing when the main gear weight-on-wheels switches are actuated.

HOOK-RELEASE HANDLE

The hook-release handle on the pilot's instrument panel (figure FO-2) is marked ARG HOOK PULL and is shaped to be grasped by the fingers from the bottom. Pulling the handle aft pulls a cable that releases the hook uplock. (The aft position of the handle also disarms the hook lift switch circuit.) The hook is extended by dashpot pressure assisted by gravity. When the handle is released it is reset by spring action and the hook-lift switch is rearmed.

NEW There is no emergency operation of the arresting-hook system as such, but a fail-safe feature automatically releases the hook if the hook-release cable snaps. To stow the hook when the automatic release feature is actuated, pressurize the combined hydraulic system and momentarily depress the hook-lift button. By cycling the hook to the stowed position, hydraulic pressure will be maintained to the lift cylinder until the hook-release handle is pulled or power is taken off the aircraft. The hook-release handle must be in its normal flight position before the hook can be retracted. A switch in the release handle closes a circuit to the hook-lift button when the release handle is stowed. Normal operation of the indicating circuits is not affected by a failure of the release cable.

HOOK-LIFT BUTTON

The hook lift button on the pilot's instrument panel (figure FO-2) is placarded HOOK LIFT and incorporates an integral hook transition light. Pressing the button momentarily when the hook is extended energizes a solenoid valve that ports secondary hydraulic pressure to the arresting-hook lift cylinder which retracts the hook. Electric power is provided by the essential 28V DC bus through the GEAR/HOOK circuit breaker on the main circuit breaker panel. A holding relay keeps the valve energized until the uplock engages.

CAUTION

Do not depress the hook lift button while the hook is engaged in the arresting gear. Doing so may cause breakage of the hook bumper cable.

Note

A short-circuit condition in the hook-lift circuitry can result in a continuous hook-lift signal to the solenoid controlling the hook-lift cylinder. As long as the hydraulic system isolation valve switch is in the flight position, hydraulic pressure is not available to the hook-lift cylinder, and the hook will lower normally. However, when the isolation valve switch is moved to the landing position by lowering the landing gear or placing the switch to the landing position, the arresting hook will raise since hydraulic pressure is now available to the hook-lift cylinder. The arresting hook can be lowered by pulling the gear/hook circuit breaker on the center console circuit breaker panel and then pulling the hook-release handle. This procedure does not affect hydraulic pressure to the landing gear after the gear is ascertained to be down and locked. Under these conditions, the approach lights and angle-of-attack indexer will flash. Positioning the hook bypass switch to the touch-and-go position will prevent a flashing approach light and indexer.

Hook Transition Light

The hook transition light is incorporated in the hook-lift button (figure FO-2) and powered by the primary 28V DC bus through the CKPT ADV LTS circuit breaker on the nose-wheel circuit breaker panel. The light comes on during hook transition on both extension and retraction.

HOOK BYPASS SWITCH

The HOOK BYPASS switch on the pilot's left console (figure FO-2) is a three-position toggle switch with position placarded TOUCH-GO, ARREST and TEST. The TOUCH-GO position used for non-arrested landings bypasses the flashing feature of the approach

lights and indexer when the aircraft is in a landing configuration with the hook retracted. The ARREST position, used for arrested landings, arms the flashing feature of the approach lights and indexer for appropriate operation when a landing configuration is established. The flashing will continue until the hook is released. The TEST position tests the flashing circuit of the approach lights and indexer.

Dashpot Pressure Gage

The dashpot pressure gage on the left side of the aft fuselage is a direct-reading gage that indicates the pneumatic pressure in the dashpot. The gage is calibrated in 500-pound increments from 0 to 2000 pounds. The 2000-pound increment is identified by the numeral 2. The normal preflight indication should be 1000 PSI with the hook retracted.

FLIGHT INSTRUMENTS AND INDICATOR LIGHTS

ANGLE-OF-ATTACK SYSTEM

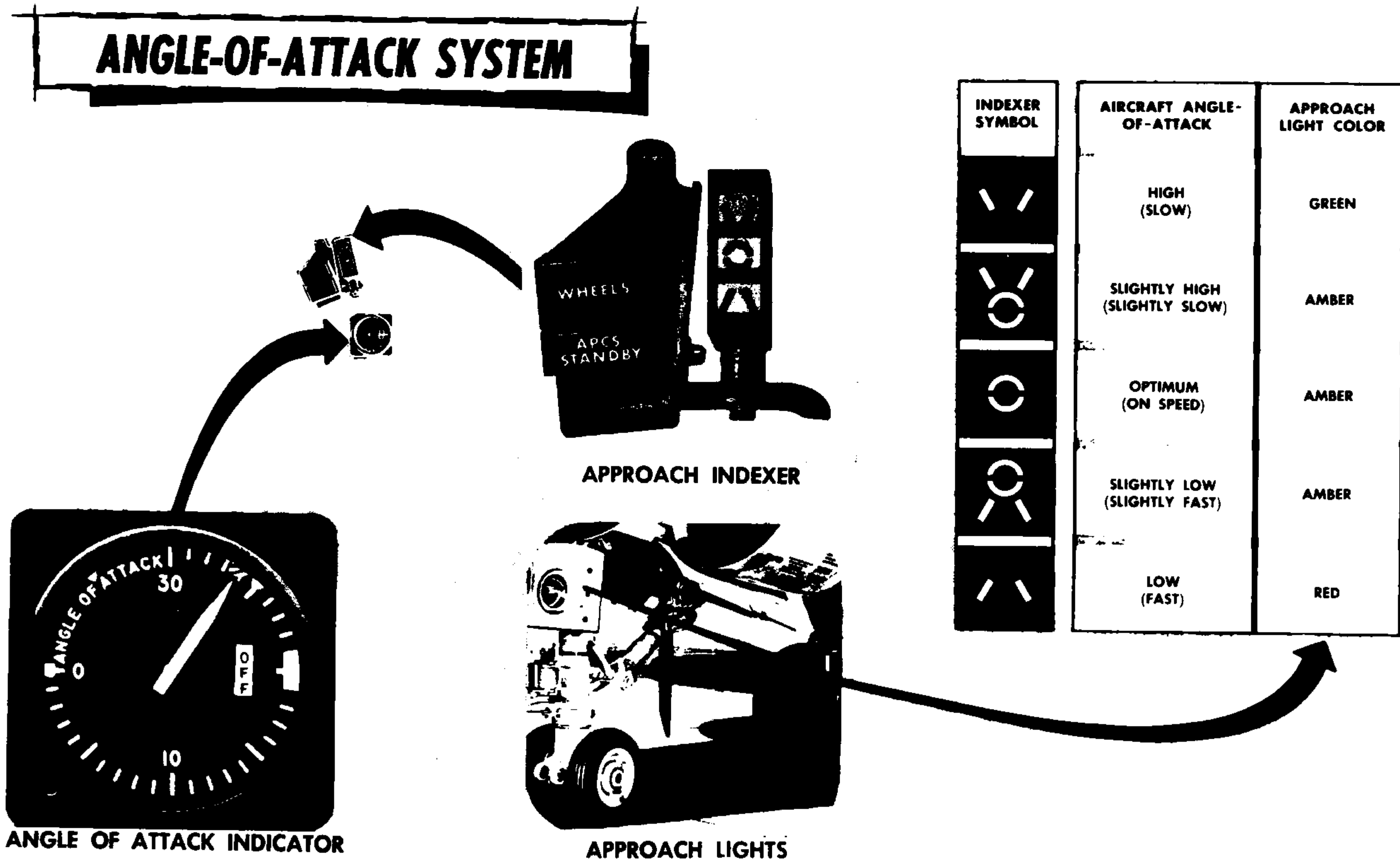
The angle-of-attack system (figure 1-22) measures the angle between the longitudinal axis of the aircraft and the relative wind. A sensor on the right side of the fuselage forward of the wings consists of a probe that lines up with the airstream, and a potentiometer pickoff that converts the position of the probe to electrical signals. The signals are compared to a rebalance potentiometer and the error signal is used to drive a servomotor in the angle-of-attack instrument. The servomotor drives the instrument pointer and rotates a series of cam-actuated switches that control the visual presentations of angle-of-attack and approach indexer to the pilot and the approach light to the LSO. Sensor heat for icing conditions is controlled by the pitot heat switch in the cockpit.

ANGLE-OF-ATTACK INDICATOR

The angle-of-attack indicator is on the upper left side of the pilot's instrument panel (figure 1-22). The pointer is driven by a servomotor and rotates over a card graduated from 0 to 30 units. Optimum angle-of-attack for landing approach is marked by a light area of the 3-o'clock position on the instrument. The units do not reflect angle-of-attack in degrees. A readout window on the instrument face will indicate OFF if there is no power to the servomotors.

APPROACH LIGHTS

The approach lights are controlled by switches actuated by the angle-of-attack indicator cam, and give qualitative information on angle-of-attack to the LSO. The lights are on the forward nose-wheel door, and



ADF1-28

Figure 1-22

are green (high angle of attack), amber (optimum angle of attack), and red (low angle of attack).

During an arrested landing, with the hook bypass switch in ARREST, the approach light will flash when the arresting hook is not in trail and the landing gear is down and locked.

APPROACH INDEXER

The cam-operated switches in the angle-of-attack indicator also control the approach indexer (figure 1-22). Three lamps glow red through apertures on the face of the indexer, giving approach information. The upper arrow is for high angle-of-attack, the lower arrow for low angle of attack, and the circle is for optimum angle of attack. When both an arrow and circle appear, an intermediate position is indicated. During an arrested landing, with the hook bypass switch in ARREST, the approach indexer will flash when the arresting hook is not in trail and the gear is extended.

Note

- The approach lights and approach indexer are disabled until all gear are down and locked.
- To ensure that the approach index lights are operating, depress the lights warning button on the master test panel. Intensity of the approach indexer lights is adjustable using the approach indexer thumbwheel on the master lights panel.

PITOT-STATIC SYSTEM

The pitot-static boom is located on the vertical stabilizer. Pitot pressure is impact air pressure developed as the result of the relative wind velocity and is measured at the opening in the forward end of the sensor. Static pressure, which is a function of altitude and temperature, is measured through a series of small openings on the side of the sensor. Pitot pressure is used in the air data computer and the mach/airspeed/command airspeed indicator. Static pressure is used in the air data computer, counter/pointer altimeter, servoed barometric altimeter, mach/airspeed/command airspeed indicator, and vertical velocity indicator. To prevent or eliminate icing, the pitot-static sensor is electrically heated.

PITOT HEAT SWITCH

The pitot heat switch, on the air-conditioning control panel (figure 1-30) is a two-position switch marked ON and OFF. Placing the switch ON allows electrical power to be supplied from the 28V DC primary bus to a conventional heater in the pitot tube. It also allows, through the left weight-on-wheels switch, heat to be provided to the angle-of-attack and total temperature probes when airborne.

SERVOED BAROMETRIC ALTIMETER

The servoed barometric altimeter on the right side of the pilot's instrument panel (FO-2) displays accurate pressure altitude in feet. The altimeter is electrically operated by a synchro signal received from the air data computer for normal operation. An integral standby mechanism, of the aneroid type, is incorporated and presents pressure altitude with normal barometric setting correction. The face of the altimeter is marked in 50-foot increments around the periphery of the dial and numerals ranging from 1 to 10 indicate the 100-foot increments. A single-dial pointer indicates correct altitude from 0 to 1000 feet in a complete revolution. A single drum-type counter, in the center of the instrument, also shows altitude in 100-foot increments. A dual digital counter to left of the 100-foot counter shows altitude in 1000-foot increments. A four digital counter placarded IN. HG. is used in conjunction with an altimeter setting selector control on the lower left side of the instrument.

A selector lever is on lower right corner of the indicator and marked RESET/STBY. Normally the selector lever will be in the center position and the altimeter will receive its electrical inputs from the air data computer. However, if this system becomes unreliable, the altimeter will receive its inputs automatically and directly from the pitot-static system. A failure warning flag marked STBY will appear on the dial face, indicating the altimeter is in mechanical or standby mode of operation. Selection of STBY or activation of the ADC failure detection circuit will result in standby mode of operation. The STBY flag will be hidden when the instrument is in normal electrical mode of operation. The electrical mode of operation may be selected by manually positioning the standby mechanism to RESET. Conversely, standby mode of operation may be selected by positioning the selector lever to STBY.

MACH/AIRSPEED/COMMAND AIRSPEED INDICATOR

The mach/airspeed/command airspeed indicator (figure FO-2) is calibrated from mach 0.5 to 2.0 and 80 to 650 knots airspeed. Indicated airspeed is read under the pointer which rotates over a nonlinear scale. The pointer is driven by the pressure differential derived from comparing pitot pressure with atmospheric (static) pressure. The mach number is read using the pointer and a rotating card calibrated with mach number. The card is rotated by static pressure from the pitot-static system. By using the rotating card in conjunction with the pointer, the necessary relationship is established between indicated airspeed and atmospheric pressure to produce a mach number.

Maximum mach number and minimum airspeed indices are controlled by the mach limit knob on the lower left side of the instrument. The minimum airspeed index is set by rotating the knob and the maximum mach is set by pushing the knob in and rotating it.

VERTICAL SPEED INDICATOR

A standard vertical velocity indicator (figure FO-2) is mounted on the right side of the pilot's instrument panel. The instrument operates on a pressure differential. Static pressure from the pitot system enters the diaphragm inside the instrument case. The instrument case itself contains static air, which passes through a restriction. Because of the restrictor, changes in altitude causes the air pressure in the diaphragm to increase or decrease more rapidly than air pressure in the instrument case. The resulting difference in pressure is converted to a vertical velocity and is displayed as feet per minute up or down on the instrument face. The needle is damped to minimize oscillation and is mechanically stopped at the extreme travel limits. The range of the instrument is from 0 to 6,000 feet per minute up or down, with the first 1,000 feet graduated in 100-foot increments and the remainder in 500-foot increments.

ATTITUDE INSTRUMENTS

TURN-AND-SLIP INDICATOR MD-1

The turn-and-slip indicator (figure FO-2) gives the pilot information on the rate of turn of the aircraft around its vertical axis and the turn coordination. The driving mechanism for the pointer is a permanent-magnet type, DC, governor-controlled, gyro motor. A needle-width deflection of the pointer will produce a 360° turn in 4 minutes. Pointer motion is damped by an air dashpot and is deflected in the direction of the turn. The inclinometer portion of the instrument contains damping fluid and a ball that moves from center in an uncoordinated turn.

VERTICAL DISPLAY INDICATOR

The vertical display indicator (VDI) (figure FO-2) on the pilot's instrument panel is the instrument of primary reference for flight attitude, vertical and horizontal steering commands, and terrain avoidance, giving the aircraft an all-weather capability during all phases of flight from takeoff to landing. Indications of attitude, vertical and horizontal drift, and steering commands are provided by means of symbols superimposed on a display of the world about the aircraft in analog form. This display, which includes a ground-stabilized horizon line, is presented in either of two modes: contact analog and terrain clearance.

The contact analog display presents all the symbols along with ground and sky texture elements which are separated by the ground-stabilized horizon line providing the attitude reference. To simplify use of the indicator as an attitude reference, a video bank angle marker with a fixed index mark and movable video pitch trim markers are provided.

The terrain clearance display provides the same symbols as contact analog except that the sky and ground textures are deleted for clarity. This mode

provides the pilot with a means of determining the position of the aircraft with respect to the terrain. The terrain is displayed in shades of gray with the lightest shade at the nearest range. The display gives a three-dimensional effect as well as a means of estimating range and is developed from search radar video processed by the radar data converter.

A more complete discussion of the VDI symbols and displays is found in Section VIII.

VERTICAL GYRO INDICATOR (VGI) MM-3

The VGI (figure FO-2) indicates to the pilot the flight attitude of the aircraft. Pitch and roll indications are displayed by a sphere in relation to a fixed miniature aircraft symbol. The sphere is light-colored above the artificial horizon bar, black below the bar, and is marked in 5° pitch increments in both directions, beginning at the horizon bar. Roll indications are given by a marker that moves around the periphery of the sphere. The marker moves across a linear scale that is graduated in 10° increments to 30° and then in 30° increments to 90°.

The sphere is positioned by servomechanisms that receive signals from a remote, independent gyro reference. A warning flag will appear whenever there is no power to the indicator, and will remain displayed for approximately 1 minute after initial power is applied. The flag does not indicate the condition of the instrument. A gyro fast-erect button (figure FO-2) to the lower left of the instrument speeds up the erection process. The flag will be visible while the button is depressed.

Rolls through 360° are possible without tumbling the gyro. The gyro will flip 180° at 90° of pitch from straight and level flight, but will return to normal after passing through the extreme pitch angles. A pitch trim knob on the lower right face of the instrument is used to adjust the horizontal bar of the sphere to the fixed miniature aircraft.

Note

The gyro fast-erect button must be held down until erection is completed.

COMPASS SYSTEM MA-1

The MA-1 compass system may be used as a directional gyro corrected for apparent drift due to the earth's rotation, or as a directional, gyro-stabilized, magnetic compass. The system is generally operated in the slaved or gyro-stabilized mode that automatically corrects inherent gyro errors of the system. The MA-1 compass system consists of a compass transmitter unit, a directional gyro assembly, an amplifier servo assembly, and a compass control panel (figure 1-23).

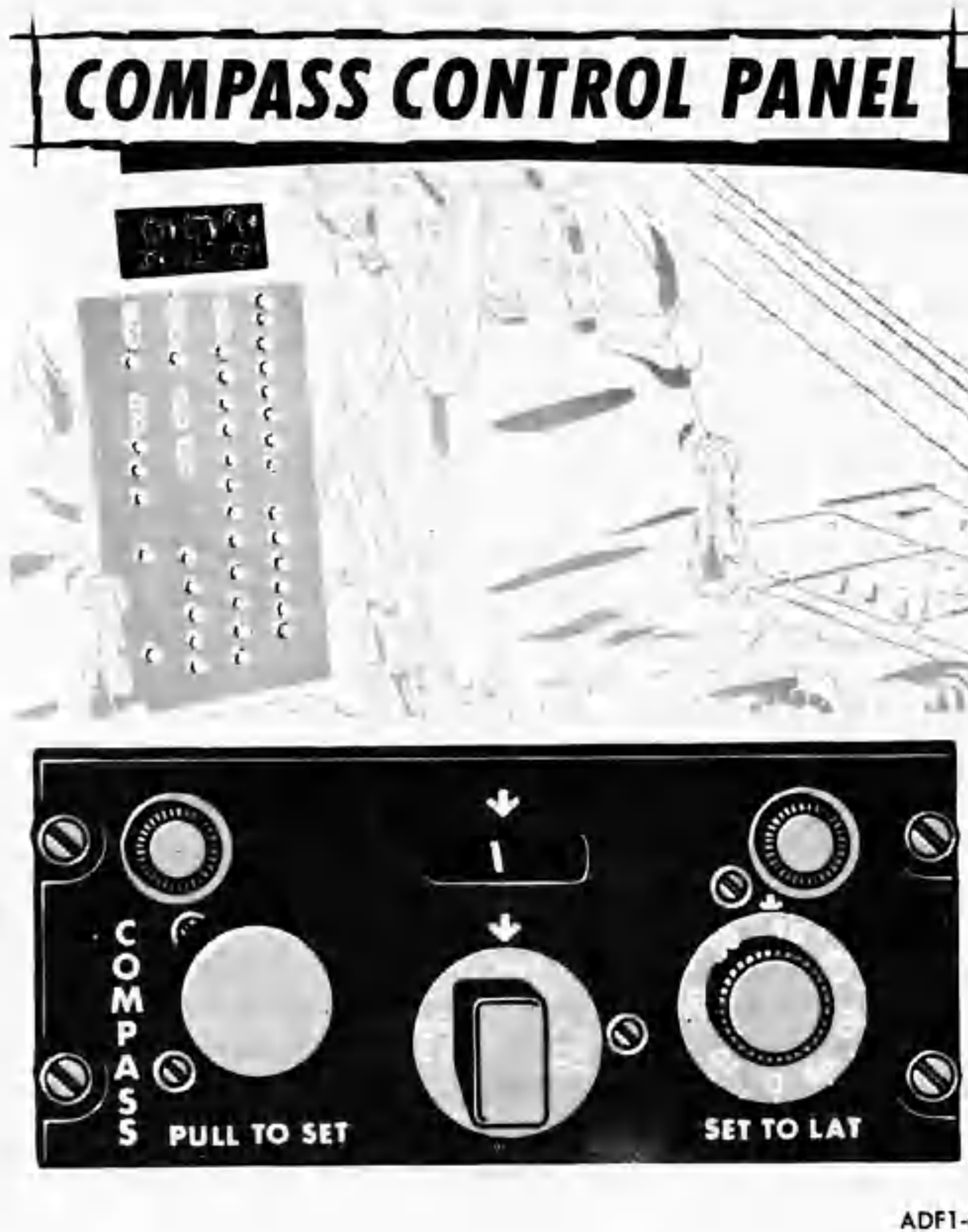


Figure 1-23

COMPASS CONTROL PANEL

The compass control panel (figure 1-23) is on the aft bulkhead, above the circuit breaker panel. The two modes of operation, magnetic slaved or directional gyro, provide accurate directional reference for all latitudes. During periods of flight in areas where the earth's fields make the readings on any magnetic compass questionable, as in the polar regions, the slaved mode should not be used since the gyro will automatically align itself with the incorrect magnetic fields generated by the earth and subsequently transmit erroneous data to the aircraft systems. Operation in these areas is best accomplished by utilizing the directional gyro operating without inputs from the compass transmitter. In this mode, the system functions as a standard directional gyro. Because of inherent system stability, this mode of operation offers reliable heading information over extended periods of operation without subsystem references. At different latitudes, apparent gyro drift varies, with the smallest amount of drift being at the equator and the greatest amount in the polar regions. In the directional gyro mode, with the proper latitude selection made on the control panel, the gyro is made to precess at a rate required to overcome gyro drift at the selected latitude.

The compass system is actuated by power being applied to the essential bus. A power failure indication or a hold indication in the form of a red flag labelled OFF is displayed in the control panel synchronizer window above the selector switch. During normal

operation, this flag will disappear 10 seconds after application of power. After a 3-minute warmup period, the selector switch should be positioned to the mode of operation required to accomplish the mission.

Compass Selector Switch

This three-position rotary switch on the compass panel (figure 1-23) has positions for FREE S LAT, SLAVED, and FREE N LAT. In the SLAVED position, the compass is supplied with inputs from the compass transmitter, relative to the earth's magnetic field. In the FREE S LAT and FREE N LAT positions, the information supplied by the compass transmitter is considered unreliable and the system operates as a directional gyro, precessing at a rate required to compensate earth's normal rotation.

Pull-To-Set Control

This control permits realignment of the radio-magnetic indicator unit. The spring-loaded control is pulled out and rotated until the desired heading appears under the indicator cursor.

Note

During reset operation, the autopilot will be automatically disconnected while this knob is pulled out, permitting normal aircraft operation when introducing heading change information.

Latitude Select Control (SET TO LAT)

The latitude selector knob (figure 1-23) on the compass control panel is used to rotate a circular dial at the base of the knob. The dial is numbered from 0° to 90° of latitude. The latitude selector control is operative in the FREE N LAT and FREE S LAT selector switch positions only, and is used to select the latitude in which the aircraft is operating.

Synchronizer Window

This indicator is on the compass control panel (figure 1-23) and affords readout indications as to system operation. During periods of system power malfunction, warmup, and shutdown, a red flag appears in the window to denote that the system is inoperative. During normal operation, the red flag is retracted and a white bar aligns itself with the fixed arrow marker above the indicator window. Positioning of the bar under the arrow indicates satisfactory system alignment only during the SLAVED mode operation.

COMPASS SYSTEM OPERATION

Gyro Operation (SLAVED)

1. Selector switch - SLAVED (required a 3-minute warmup period).
2. Pull-to-set knob - OUT
Rotate control until approximate magnetic heading of aircraft is under radio-magnetic indicator cursor.

3. Pull-to-set knob - RELEASE

When the pull-to-set knob is released, the indicator should align itself with the exact magnetic heading of the aircraft. A visual indication of system alignment is given when the white bar is below the arrow on the indicator window. Oscillation of the white bar during slaved mode is a normal condition and indicates satisfactory operation of the system.

Note

There are two null positions of the knob 180° apart. An indication of the correct null position is movement of the white bar in the same direction that the knob is turned.

Gyro Operation (UNSLAVED)

1. Selector switch - FREE N LAT or FREE S LAT as required.
2. Pull-to-set knob - OUT
Rotate control until desired heading of aircraft is set under cursor of radio-magnetic indicator.
3. Latitude selector control - ADJUST
Set this control to reflect degrees latitude at which aircraft will be flying. This affords automatic compensation for apparent drift of gyro due to earth's rotation.

Note

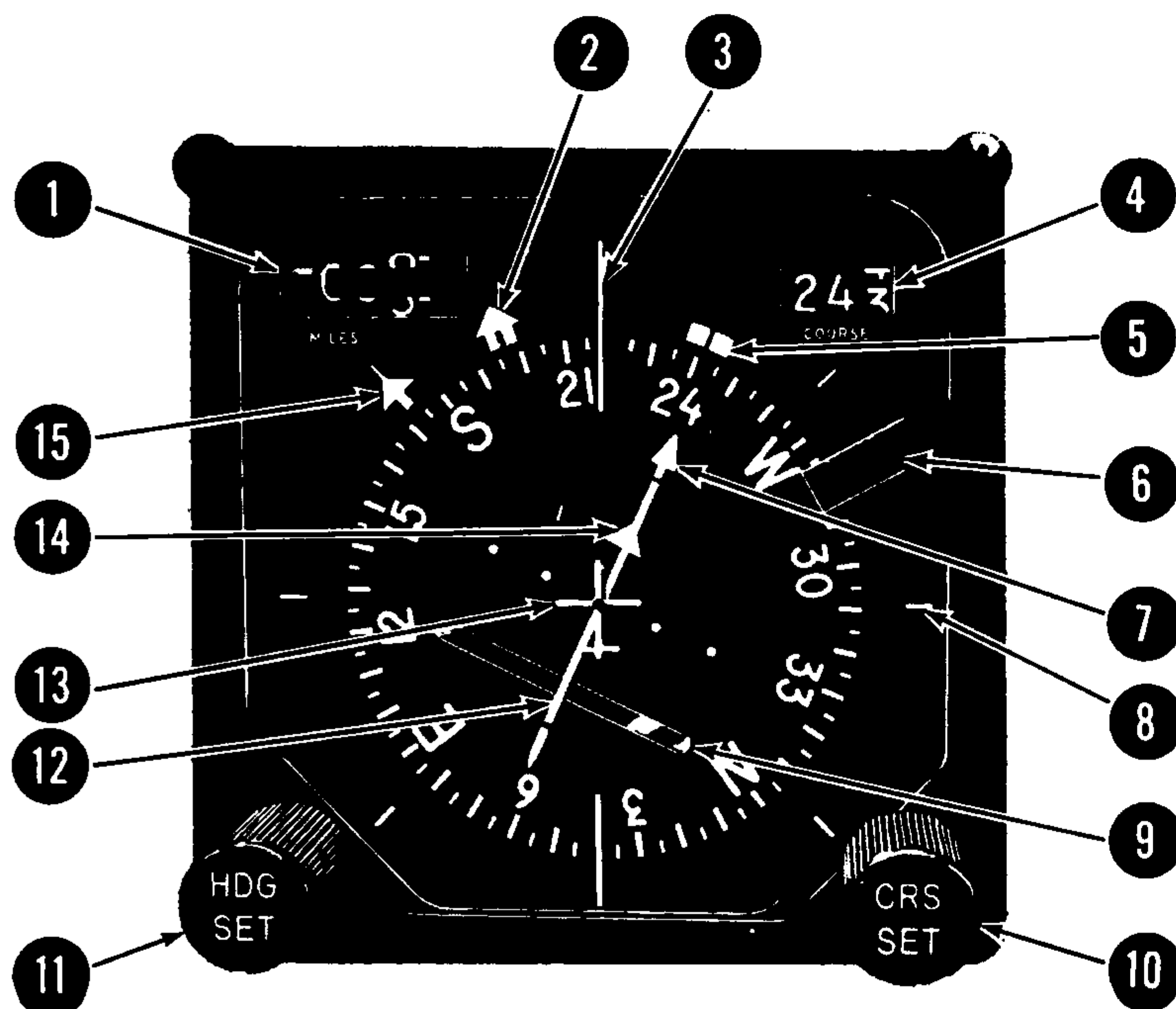
During free gyro operation, the synchronizer indicator window has no significance. If free gyro operation must be used for extended periods, reset the gyro whenever an accurate heading reference can be determined.

HORIZONTAL SITUATION INDICATOR

The horizontal situation indicator (HSI) (figure 1-24), on the pilot's instrument panel, provides range and bearing information, and course-deviation. TACAN bearing (azimuth) information is provided by the small needle head (bug) that moves around the perimeter of the compass card. The HSI needles are identified by the difference in shape: the TACAN needle is a solid triangular indicator; the UHF needle is a broken triangular indicator. When the command ratio is in the ADF mode (COMM AUX selector in the ADF/G position), the UHF indicator reflects the magnetic bearing to the selected UHF transmitter. The TACAN indicator reflects the magnetic bearing to the selected TACAN station. The displacement of the UHF or TACAN needle indicates the heading of the aircraft with respect to the individual ground installation. The course bar on the HSI shows the direction of the ground site with respect to the aircraft.

With a power loss, a red OFF flag appears in the window on the face of the instrument and a mask covers the distance counter. The distance counter is also covered when the TACAN is in REC or with a loss of DME when T/R is selected. A range display in the upper left corner shows the number of nautical miles away from the station. When the radio signal is not readable, a mask covers the numerals. An arrow will simultaneously indicate a TO or FROM direction, depending on whether the aircraft is flying toward or away from the ground station. If the power to the azimuth ceases, the

HORIZONTAL SITUATION INDICATOR



- 1 DISTANCE COUNTER
- 2 BEARING POINTER (ADF)
- 3 LUBBER LINE
- 4 SELECT COURSE COUNTER
- 5 HEADING SELECT MARKER
- 6 POWER OFF WARNING FLAG
- 7 SELECTED COURSE ARROW
- 8 FIXED INDEX
- 9 COURSE BAR SLOT
- 10 COURSE SELECT KNOB
- 11 HEADING SELECT KNOB
- 12 COURSE BAR
- 13 AIRPLANE SYMBOL
- 14 TO-FROM ARROW
- 15 BEARING POINTER (TACAN)

Figure 1-24

A-ADF1-65

TO/FROM arrow will disappear from view. The heading set knob manually adjusts the heading marker. With the course set (CRS SET) knob, the pilot can set in the desired course. Loss of 115 VAC essential or CNI/MA-1 circuit breaker will cause the red "OFF" flag to show in the indicator face.

WARNING

The UHF/ADF (APR-48) antenna is located on the under side of the starboard engine intake beneath the B/N boarding ladder. With landing gear extended, the UHF/ADF magnetic bearing indication displayed on the HSI may be up to 40° in error.

**RADAR ALTIMETER SYSTEM
AN/APN-141**

The radar altimeter is a low-altitude, pulsed, range-tracking radar that measures the surface or terrain clearance below the aircraft. Altitude information is developed by radiating a short-duration RF pulse from the transmit antenna to the earth's surface, and measuring the time interval until RF energy returns through the receiver antenna and is detected in the receiver. The altitude information is continuously presented to the pilot, in feet of altitude, on the dial of an indicator (figure 1-25).

The radar altimeter has two modes of operation. In the search mode, the system successively examines increments of range until the complete altitude range is searched for a return signal. When a return signal is detected, the system switches to the track mode and tracks the return signal, giving continuous altitude information. When the radar altimeter drops out of the track mode of operation, the OFF flag appears and the indicator will drop behind a mask at the base of the instrument. The altimeter remains inoperative until a reliable signal is received from the receiver-transmitter, at which time the altimeter will again indicate the actual altitude above the terrain.

Reliable system operation in the altitude range of 10 to 5,000 feet permits close altitude control at minimum altitudes. The system is inoperative in banks of more than 30°, inclines or dives of more than 50° and when the reflected signal is otherwise too weak. The system includes the height indicator and warning light (figure 1-25) mounted on the pilot's instrument panel, a low-altitude aural warning tone (LAWS), the radar receiver transmitter installed on the rudder actuator access door, and two antennas (transmit and receive) mounted in the rudder actuator access door and in the aircraft skin just forward of the same access door.

RADAR ALTIMETER HEIGHT INDICATOR

This indicator is on the pilot's instrument panel (figure 1-25) and contains the only operating control in the system. The indicator displays radar altitude

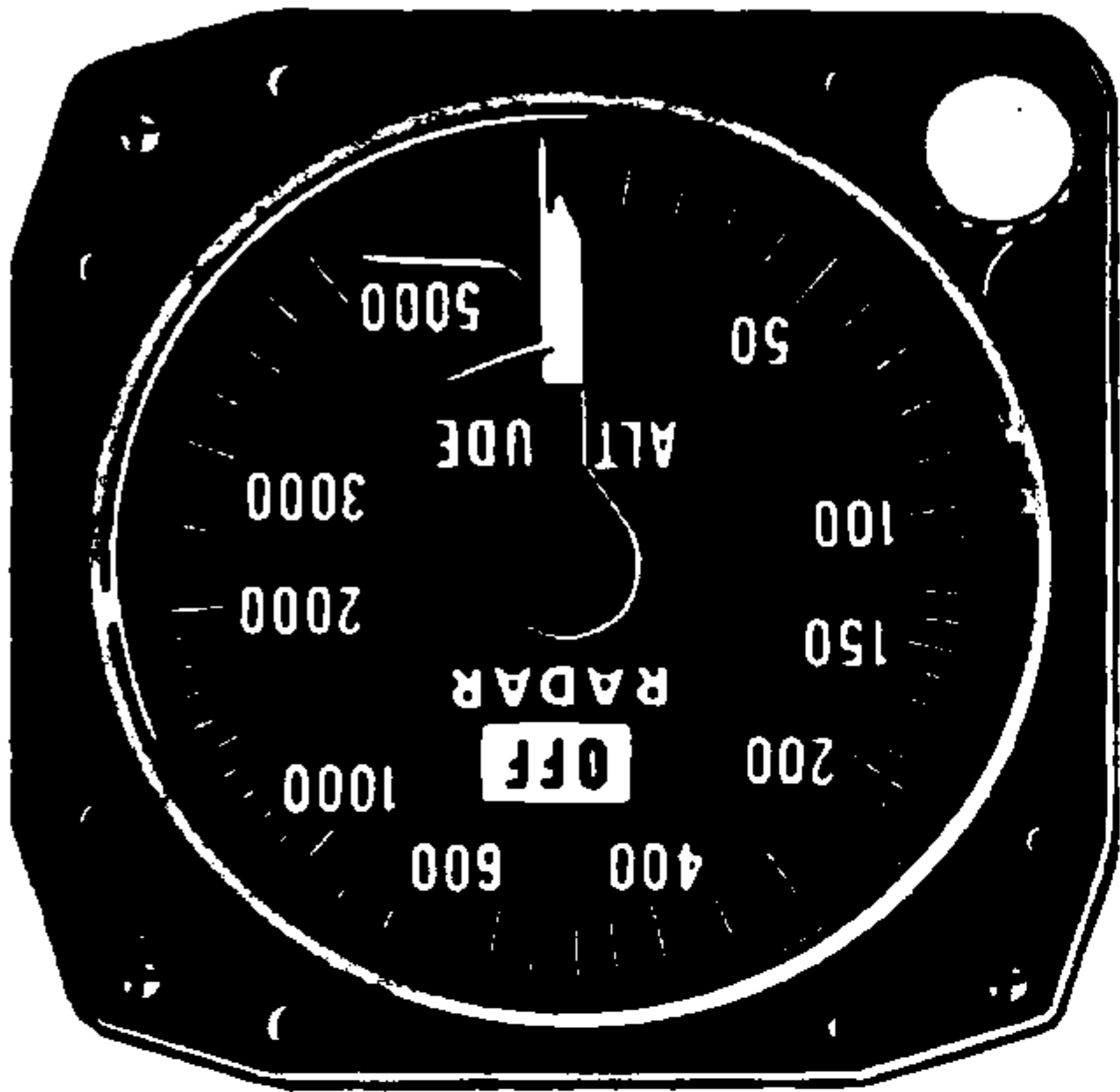


Figure 1-25

above the earth's surface on a single-turn dial that is calibrated from 0 to 5,000 feet in increasing increments. This permits greater definition at lower altitudes.

POWER/SELF-TEST/POSITIONING CONTROL

This control is located in the lower left corner of the indicator. This control is a combination power switch, self-test switch, and a positioning control for the low-altitude limit index (limit bug). The adjustable limit index outside the calibrated scale can be preset to a desired altitude and used as reference for flying at fixed altitudes. By depressing and holding the indicator control knob in flight, the self-test circuit is energized and the indicator will read 5±5 feet. Normal operation is resumed by releasing the control knob.

Off Flag

The OFF flag in the middle of the indicator is actuated either electronically or mechanically. It is energized electronically when the altitude signal becomes unreliable and exceeds a threshold voltage. Mechanical actuation of the OFF flag is accomplished when the altitude pointer rotates beyond 5,000 feet and actuated the OFF flag switch (figure 1-25).

LOW-ALTITUDE WARNING SYSTEM (LAWS)

The low-altitude warning system provides a low-altitude warning light and low-altitude aural alarm

RADAR ALTIMETER

CAUTION, WARNING, AND ADVISORY LIGHTS

The caution, warning, and advisory lights (figure 1-26) include the pilot's indicator lights and the bombardier/navigator's indicator lights. Lighting of a particular light is applicable to the system and a condition associated with it. The description and function of each light is incorporated under the applicable system.

ANNUNCIATOR PANEL

The annunciator panel (figure 1-26) on the lower center portion of the pilot's instrument panel provides caution lights for the various aircraft systems. Lighting of a particular light is advisory of a malfunction or emphasizes a particular condition of the applicable system, and will cause the master caution lights to flash. When the master caution lights are reset, the annunciator light will remain on until the discrepancy is corrected.

The lights are powered by the essential 28V DC bus through the CAUTION LTS circuit breaker on the main circuit breaker panel.

MASTER CAUTION LIGHT AND RESET BUTTON

The master caution light on the left of the optical sight (figure FO-2), and the other above the bombardier/navigator's ECM panel (figure FO-3), will give a flashing indication whenever a caution light on the annunciator panel comes on. The master caution reset button will turn the master caution light off, and rearm the circuit for any subsequent caution lights.

CAUTION

Due to the proximity of the emergency stores jettison button, care should be exercised to prevent inadvertent stores jettisoning (figure FO-2).

MASTER TEST PANEL

The master test panel (figure FO-2) is in the center of the pilot's instrument panel adjacent to the annunciator panel, and contains three press-to-test buttons. The primary purpose of the master test panel is to check the circuitry of the warning and caution lights by means of the LTS WARN and the FIRE/OIL test buttons. The LOX/FUEL/OIL test button will check the quantity gage circuitry of the oxygen, fuel and oil systems. For details of each quantity gage test, refer to the applicable system description.

FIRE/OIL Press-To-Test Button

The button placarded FIRE/OIL on the master test panel, turns on the two fire warning lights. It also turns on the low oil lights on the annunciator panel.

LOX/FUEL/OIL Press-To-Test Button

The LOX/FUEL test button is used to test electrical circuitry of the oxygen quantity gage, the oxygen warning light, and the fuel quantity gage needles. In aircraft placarded LOX/FUEL/OIL, in addition to checking oxygen and fuel quantity gages, lighting of the OIL LOW lights is a check of oil quantity.

LTS WARN Press-To-Test Button

The LTS WARN press-to-test button on the master test panel is used to check for operating circuitry of the following warning and caution lights:

ATTACK
MASTER CAUTION
COLLISION/NWW TEMP
APPROACH INDEXER
ANNUNCIATOR PANEL
ARM WEAPON
APCS STBY
BREAKAWAY
IN-RANGE

WHEELS WARNING
WHEELS TRANSITION
HOOK LIFT
OUTBD WG PSI
INBD WG PSI
RADAR ALTIMETER
TERRAIN CLEARANCE
RESELECT
COMPLETE

BOMBARDIER/NAVIGATOR'S MASTER TEST BUTTON

This test button on the bombardier/navigator's right console (figure FO-3) provides a means of checking the circuitry of the bombardier/navigator's indicator lights (figure 1-26). It also provides a circuitry check of the computer and attack lights on the pilot's VDI.

FIRE WARNING LIGHTS

Two fire warning lights, one for each engine, are on opposite sides of the optical sight (figure 1-26). The lights will come on when the heat-sensing elements, which are placed where excessive heat is likely to occur, are grounded. If a fire occurs, the semiconductor section of the sensing element heats up, decreasing resistance, and grounding the circuit. The circuit can also be grounded by the FIRE/OIL test button on the master test panel.

The system includes a short discriminator; however, if a short occurs, the light may flash on momentarily.

NWW TEMP LIGHT

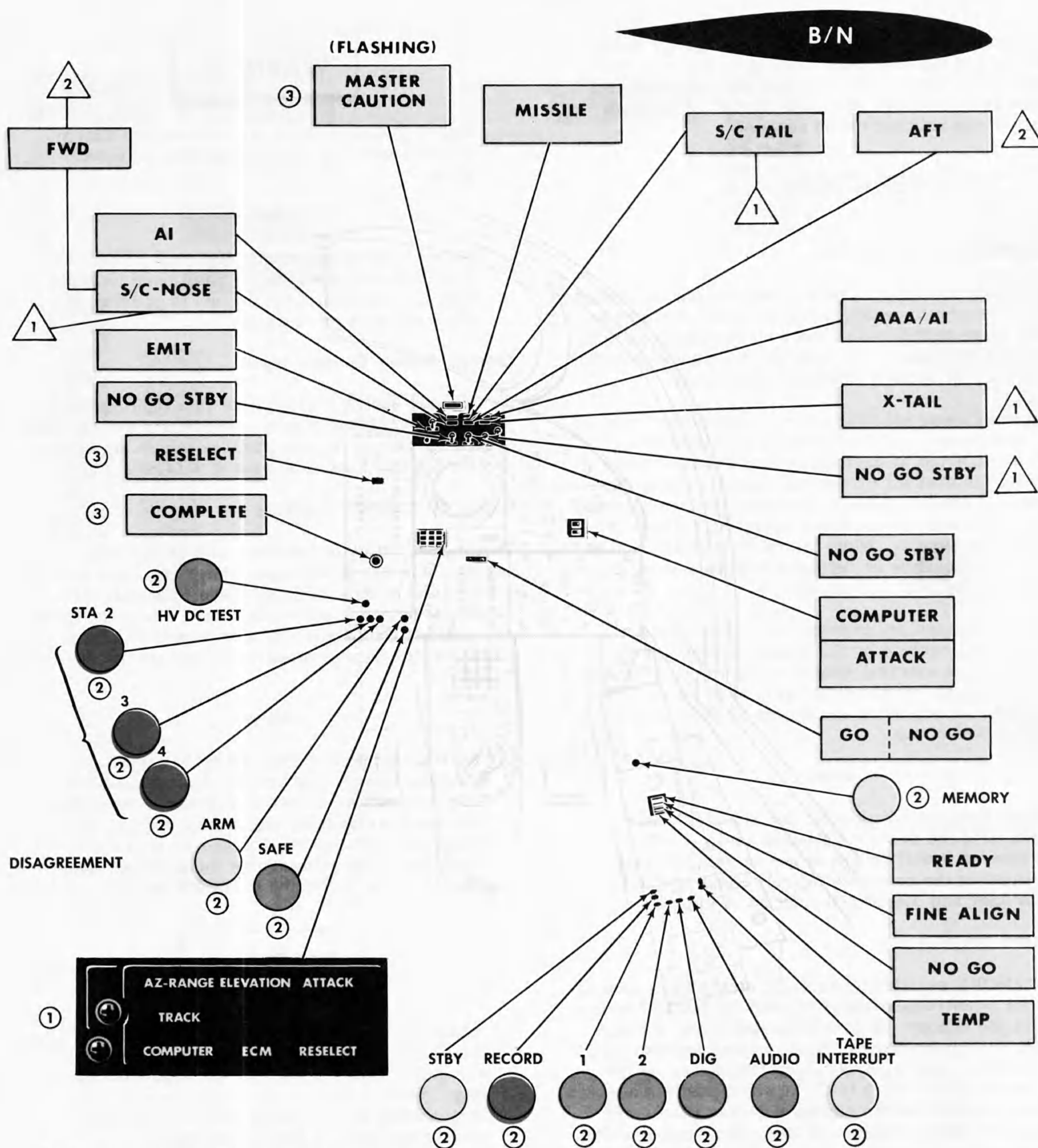
In aircraft 158533 and subsequent and those incorporating AFC No. 268, the COLLISION light is replaced by a NWW TEMP light on the lower right side of the optical sight. The light will come on when the heat-sensing element array placed near the bleed-air ducting in the nose-wheel well and radome areas senses excessive heat. The light is tested by the FIRE/OIL press-to-test button.

COLLISION LIGHT

The collision light, located on the lower right side of the optical sight, has no operational function. AFC No. 268 replaces the collision light with the NWW TEMP light.

NEW

NEW



① MAY BE TESTED BY PRESSING EITHER PILOT'S OR B/N'S MASTER TEST BUTTON

② DOES NOT ILLUMINATE WHEN B/N'S MASTER TEST BUTTON IS DEPRESSED

③ MAY ONLY BE TESTED BY DEPRESSING PILOT'S MASTER TEST BUTTON

① AIRCRAFT NOT INCORPORATING A.F.C. NO. 287

② AIRCRAFT INCORPORATING A.F.C. NO. 287

A-ADFI-29-2

Figure 1-26 (Sheet 2)

CANOPY

The aircraft canopy is operated by hydraulic pressure and can be controlled externally or from the cockpit (see figure 1-27). It can also be jettisoned or manually released from the cockpit or through external controls for crash rescue.

CANOPY OPERATION

CANOPY SELECTOR VALVE

The canopy selector valve is a three-position, spring-loaded, return-to-neutral, open-center solenoid selector valve positioned by the cockpit canopy switch, the boarding-ladder switches, or the manual selector handles in the cockpit and nose-wheel well.

When the canopy selector valve is positioned to open, hydraulic pressure from the combined system is initially directed to the canopy seal selector valve, dumping air pressure from the canopy seal so that the canopy can be opened. Pressure is then directed to the open side of the canopy actuating cylinder, opening the canopy. When the valve is positioned to close, the sequence is reversed and the canopy is closed and the seal is inflated.

When the engines are running, combined system pressure is provided by the engine-driven pumps. Otherwise, an external source of hydraulic pressure may be used, or combined system fluid can be pressurized by means of the handpump or the electric-motor-driven pump.

Note

The valve must be held in the selected position until the desired action has been completed or it will return to the neutral position, releasing the pressure to the canopy actuating cylinder and stopping the action of the canopy.

CANOPY SWITCH

The CANOPY switch (figure 1-27) on the right side of the pilot's instrument panel is used for normal operation of the canopy. It is a three-position, spring-loaded, return-to-neutral toggle switch marked OPEN and CLOSE. With aircraft electrical power on the line, moving the switch to the desired position actuates a solenoid on the canopy selector valve, permitting hydraulic pressure to move the canopy to the selected position as long as the switch is held in the desired position. To help ensure positive canopy lock, a magnetic holding device holds the CANOPY switch in the CLOSE position when selected until aircraft electrical power drops off the line or the switch is repositioned manually. A CANOPY SW light on the annunciator panel comes on when the canopy switch is not at CLOSE with aircraft electrical power on the line. Moving the switch to CLOSE turns off the light.

WARNING

Insure that personnel are clear of the canopy while connecting or disconnecting external power.

Note

Before applying aircraft electrical power, the CANOPY switch should be positioned to agree with the position of the canopy to prevent inadvertent canopy actuation.

Canopy Switch Caution Light

The canopy switch caution light is a light on the annunciator panel that comes on CANOPY SW any time aircraft primary DC electrical power is on the line and the CANOPY switch is not at CLOSE.

MANUAL CANOPY HANDLE

Two manual selector handles, one on the pilot's pedestal and one in the nose-wheel well, are used to position the canopy selector valve when aircraft electrical power is not on the line. From the cockpit, pushing the handle full in moves the valve to close and pulling the valve to full out moves the valve to open.

Note

The manual handle must be held in position until the canopy reaches the desired position. The electrically selected position of the valve can be overridden by the manual handle, but when aircraft electrical power is put on the line, the valve will assume the position electrically selected by the CANOPY switch.

WARNING

Actuating the manual canopy selector handle to the closed position after engine shutdown will close the canopy if engines are still windmilling. Serious injury can result from premature closing of the canopy prior to aircrewmen being clear of the cockpit area.

Note

If the manual canopy selector handle is actuated while operating on aircraft electrical power, the position of the cockpit electrical switch will determine the canopy position when the handle is released.

CANOPY CONTROLS AND INDICATORS

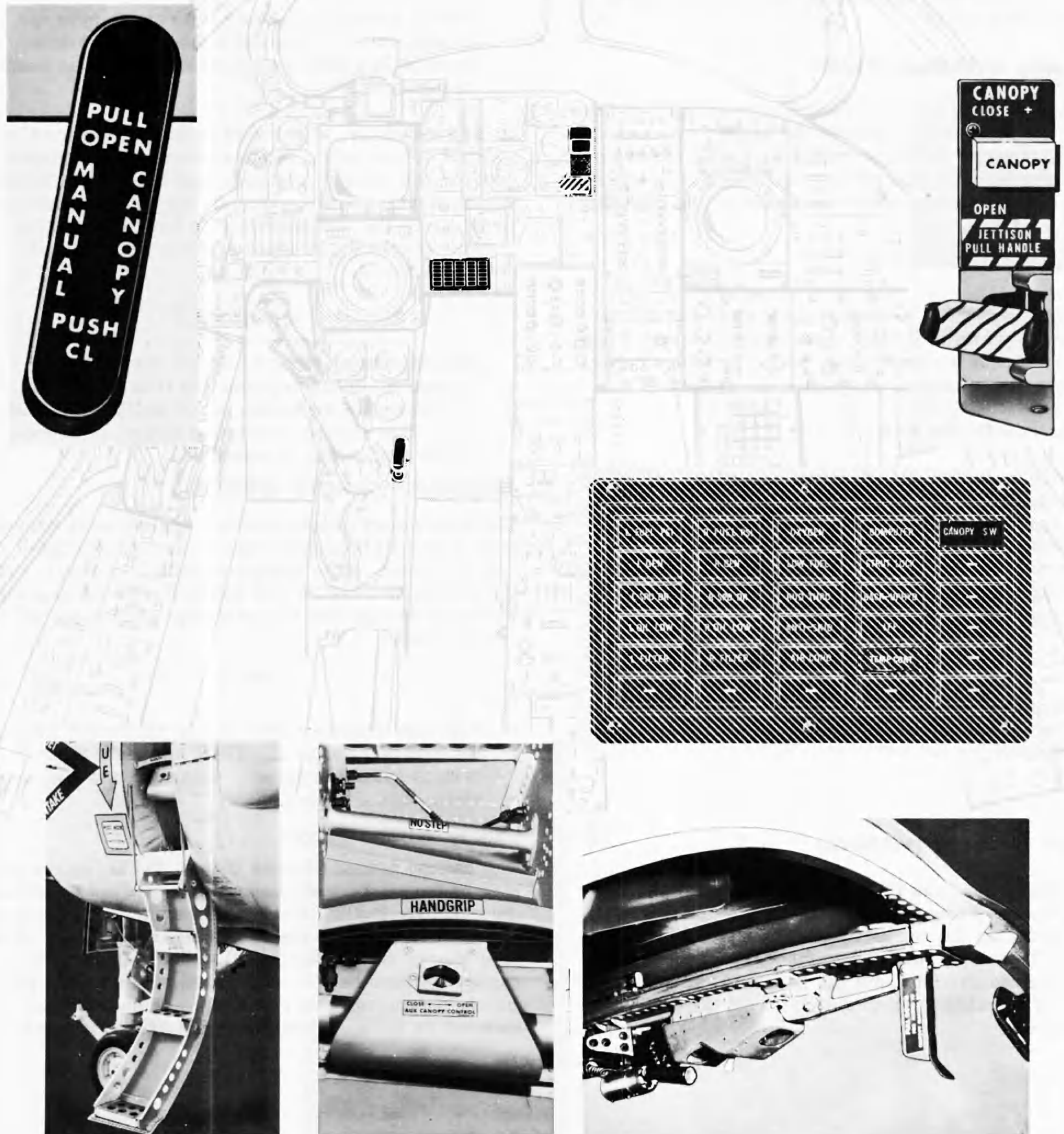


Figure 1-27

BOARDING-LADDER SWITCHES

Two three-position, spring-loaded, return-to-neutral switches, one in each boarding-ladder well, are provided for external operation of the canopy. These switches are placarded AUX CANOPY CONTROL. Holding either switch in the OPEN or CLOSE position actuates the canopy selector valve and operates the electric-motor-driven pump to move the canopy to the selected position.

AUXILIARY HYDRAULIC PUMPS

When the engines are secured, combined system fluid can be pressurized to operate the canopy by means of the handpump or the battery-powered electric-motor-driven pump. The canopy selector valve is positioned by the manual canopy selector handle or the boarding-ladder switches.

Hand Pump

Two handles, one in the nose-wheel well and one in the cockpit on the left side of the center console, are used to operate the handpump, which provides combined system pressure to operate the canopy.

Electric-Motor-Driven Pump

The electric-motor-driven pump provides combined system pressure for canopy operation on the ground and is operated by a pushbutton switch in the cockpit placarded AUX HYD PUMP MOTOR, or by the boarding-ladder switches. The pushbutton switch is on the handpump handle stop on the left side of the center console.

Note

Insure that personnel are clear of the canopy while connecting or disconnecting external power.

CANOPY REMOVAL (MANUAL)

If the canopy seal has first been deflated, the canopy can be removed manually by pulling the manual release handle on the canopy beam (figure 1-27) (or the external T-handles on the aft end of the canopy) disconnecting the canopy from the hydraulic actuating piston. The canopy can then be slid off the tracks and removed.

The canopy seal is best deflated by cracking the canopy slightly with the hydraulic handpump or the electric-motor-driven pump. This opens the canopy seal selector valve, dumping air pressure from the seal and frees the canopy for opening.

CAUTION

Do not attempt to operate the canopy hydraulically after the manual release handle has been pulled until the actuating piston has been reconnected.

In an emergency, if the seal cannot be deflated by the normal means and it is impractical or impossible to jettison the canopy, the seal may be deflated by puncturing it with a knife. Cutouts for this purpose are provided in the seal retainer on both sides of the cockpit at a location approximately even with the B/N's backrest.

CAUTION

Manual canopy removal is not intended as a normal method of egress and if used, should be entered in the yellow sheet (OPNAV FORM 3760-2) to insure corrective action or appropriate inspection is completed.

EMERGENCY CANOPY JETTISON

The emergency canopy jettison system uses pressure from a precharged air bottle to fire an explosive charge placed in the canopy actuating cylinder. When the charge is fired, a rod within the piston rod will drive the canopy and its retaining mechanism off the canopy track.

Note

Although canopies have safely separated from the aircraft above 220 KIAS, no flight test data is available on jettisoning the canopy above this airspeed.

Canopy Jettison Handle

The canopy jettison handle (figure 1-27), on the right side of the pilots instrument panel is used to jettison the canopy. Pulling the handle releases air from a precharged bottle to pneumatically activate an explosive charge in the canopy actuating cylinder. The canopy jettison handle is guarded with a safety pin which is removed prior to flight. For detail procedures on escape, see Section V of this manual.

1-64

ESCAPE SYSTEM

Safe escape from the aircraft is provided by individually controlled MK GRU-7 rocket-assisted ejection seats for each crewmember. The seats are not interlocked with the canopy and may be ejected through the canopy. The seat catapult guns are equipped with water-tight seals, permitting underwater ejection.

The seats are capable of safe ejection on the deck at zero airspeed, and in straight and level flight throughout the operational envelope of the aircraft. Capabilities of the seat are shown in Section V.

Preflight procedures and location of safety pins are shown in Section III. Ejection procedures are discussed in Section V.

EJECTION SEAT

N E W The seat (figure 1-28) consists of a main beam assembly composed of two vertical beams and three horizontal members plus the following components and assemblies: a seat-stabilizer drogue-parachute container assembly with headrest; primary firing mechanism and attached face curtain; secondary firing handle; parachute withdrawal-line guillotine; drogue gun; time-release mechanism; powered inertia-reel mechanism and attached leg garters and leg-restraint cord assemblies; ventilated parachute back pad; ventilated seat cushion; RSSK-7 survival kit containing an emergency oxygen bottle, and the seat-bucket height-adjustment actuator. Each seat contains an emergency harness-release handle, a 28-foot personnel parachute and container, and a rocket motor triggered by a gas-generating initiator.

N E W A powered retraction inertia reel triggered by a gas-generating initiator, which is actuated by the face-curtain handle or alternate firing handle, insures that the occupant is pulled back into the seat prior to ejection. Ejection of either seat sets the IFF/SIF modes 1 and 3 to emergency and actuates the equipment destruct system.

EJECTION SEAT OPERATION

N E W The ejection sequence is initiated by pulling the face-curtain firing handle or the alternate firing handle. When either firing handle is pulled, the catapult sear and inertia-reel sear are withdrawn. The powered inertia reel pulls the occupant back into the seat to an upright position. When the catapult gun fires, the expanding gases drive the catapult tubes upward and eject the seat and occupant from the aircraft. As the seat rises, the leg-restraint cords are pulled tight, holding the occupant's legs back against the leg pads. As the seat continues to rise, tension built up in the restraint cords shear rivets (securing the cords to the deck), freeing the cords from the

aircraft. The occupant's legs remain secured to the seat by snubbers wedging against the restraint cord, preventing any flailing of the occupant's legs. The occupant's legs remain secured to the seat until the time-release mechanism actuates a plunger freeing the occupant's legs prior to separation from the seat. While the set is going up the rail, the following events occur:

- The drogue-gun trip rod is pulled.
- The time-release mechanism trip rod is pulled.
- Personnel services disconnect lanyard is pulled.
- The emergency oxygen bottle is activated.
- The IFF/SIF emergency code is activated.
- The rocket-motor gas-generator lanyard is pulled.

When fully extended, the rocket-motor lanyard fires the gas generator, which fires the rocket motor under the seat.

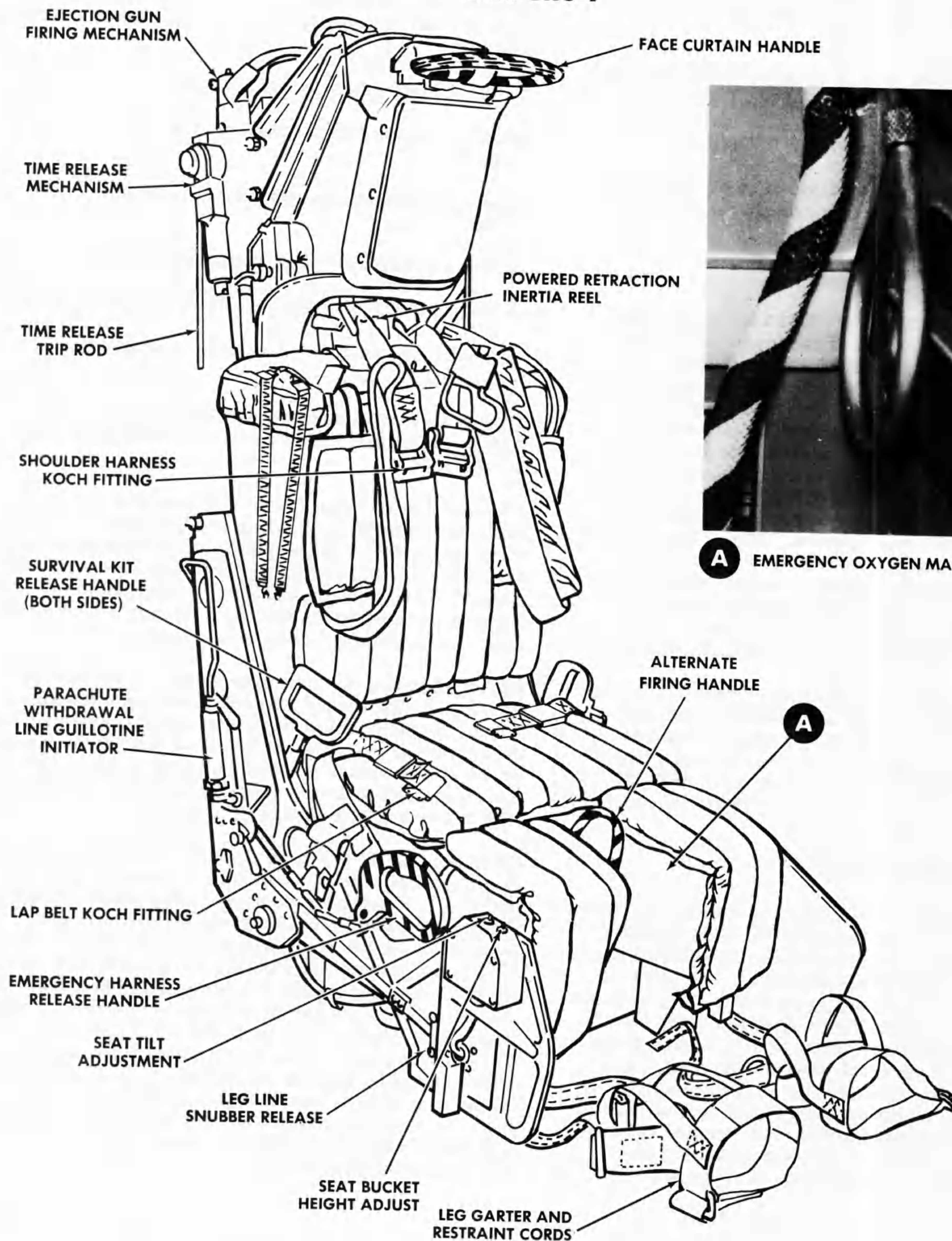
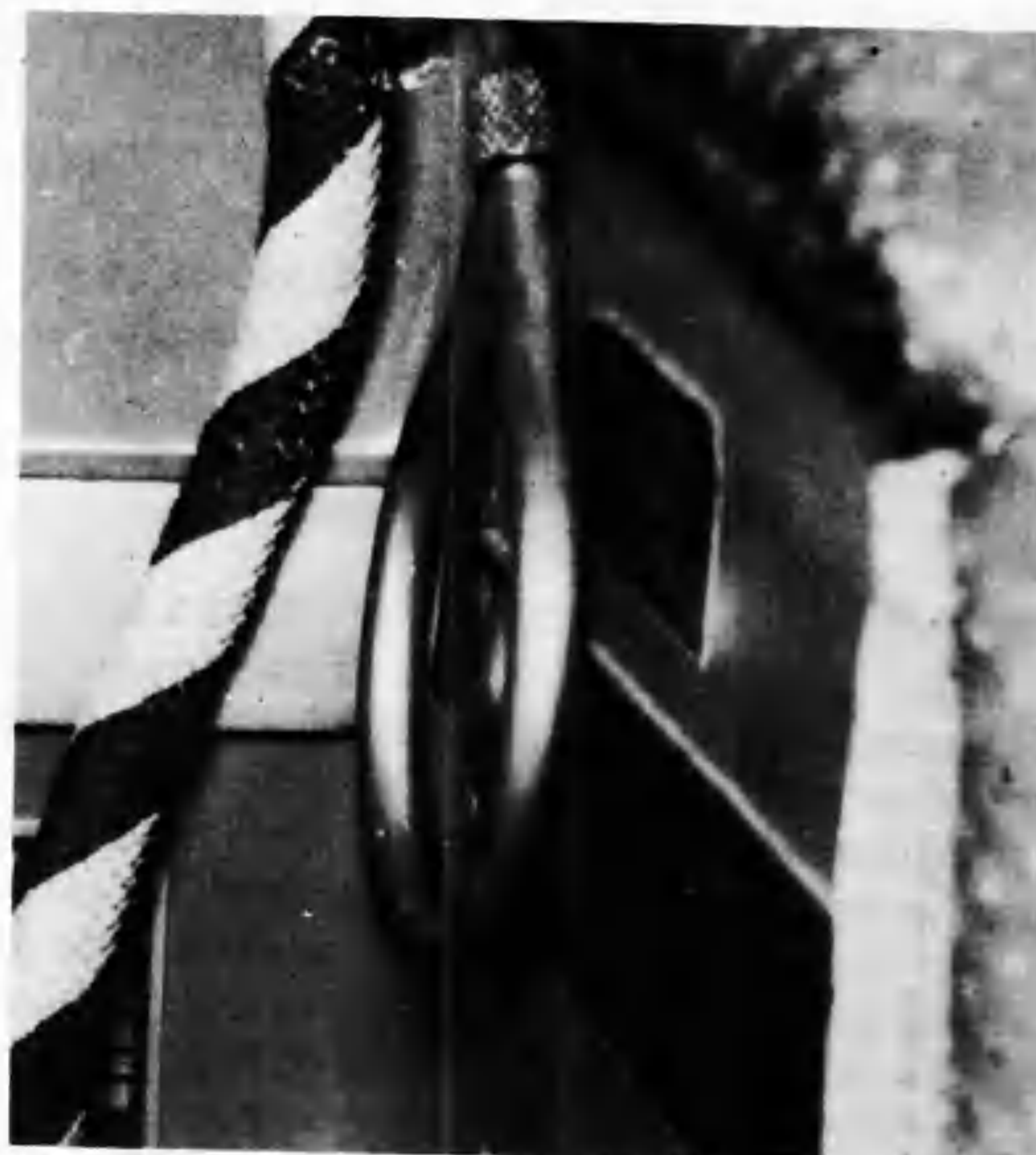
One-half second after the drogue-gun trip rod is extracted, a small controller drogue chute is drawn from the pack by a metal piston fired from the drogue gun. The controller drogue chute then tows the stabilizer chute out of its container. The stabilizer chute is secured to the seat by a scissor shackle until released by the time-release mechanism.

During ejection, the occupant is held in the seat by upper restraint straps, lap belt, and leg-restraint cords. Deployment of the personnel parachute and separation of the occupant from the seat are delayed by the time-release mechanism until the occupant has descended from the upper atmosphere or until expiration of a 2.0-second time delay.

When the seat is below an altitude of 11,500 to 14,500 feet (barostat setting), the time-release mechanism starts a 2.0-second time delay, after which the time-release mechanism releases the drogue parachute from the scissors shackle, allowing the drogue chute to pull the personnel parachute withdrawal line out of the guillotine and deploy the personnel parachute. At the same time, the shoulder harness restraints, leg restraints, survival kit, and face blind are unlocked. The occupant is then free to be pulled from the seat sticker clips by the line stretch of the main parachute as the seat rotates away. When the occupant is free from the seat, he makes a normal parachute descent with his (RSSK-7) survival kit connected to him by the integrated torso harness.

EJECTION SEAT

MK GRU 7

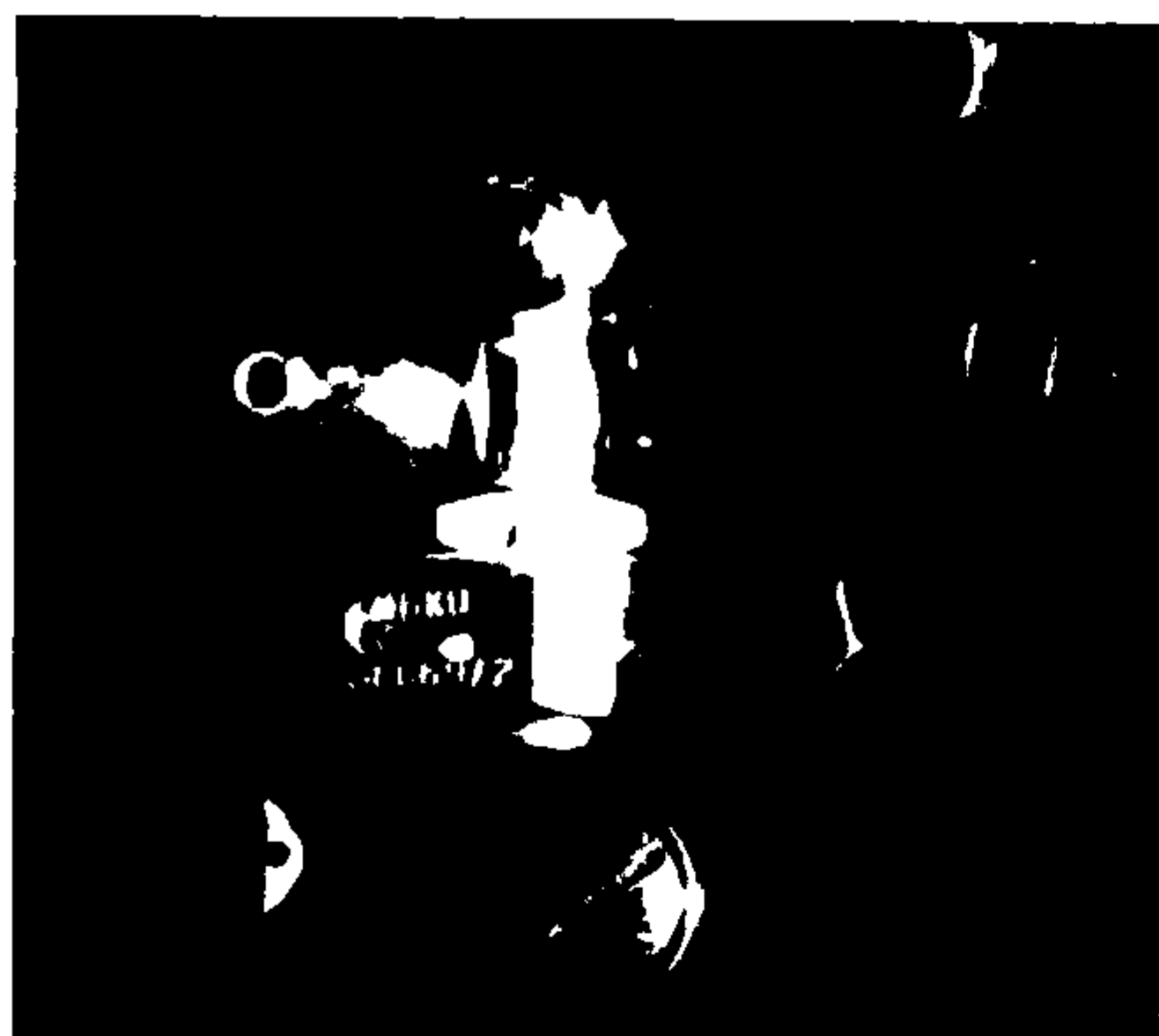


A EMERGENCY OXYGEN MANUAL RELEASE RING

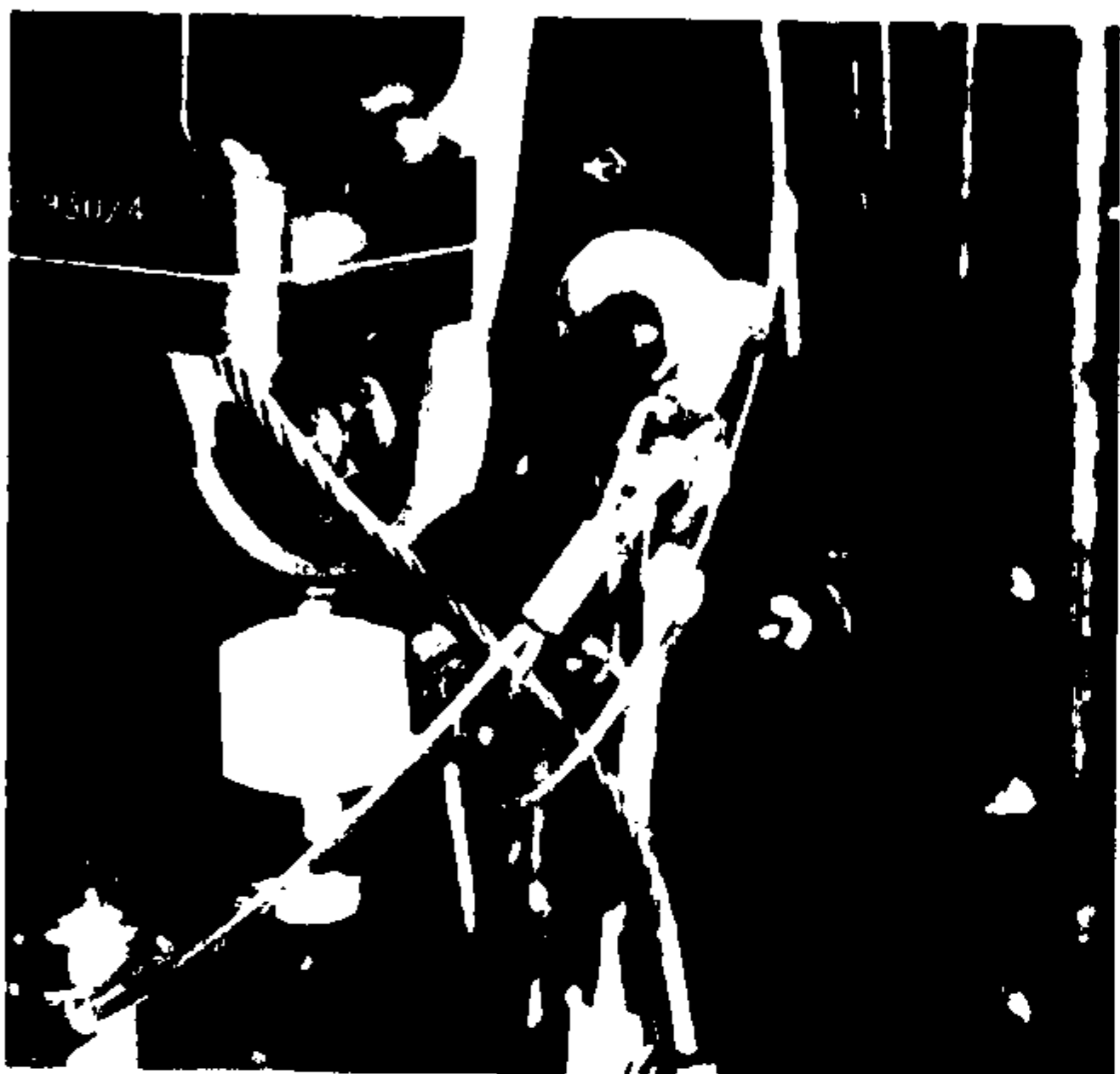
A

A-ADF1-24-1

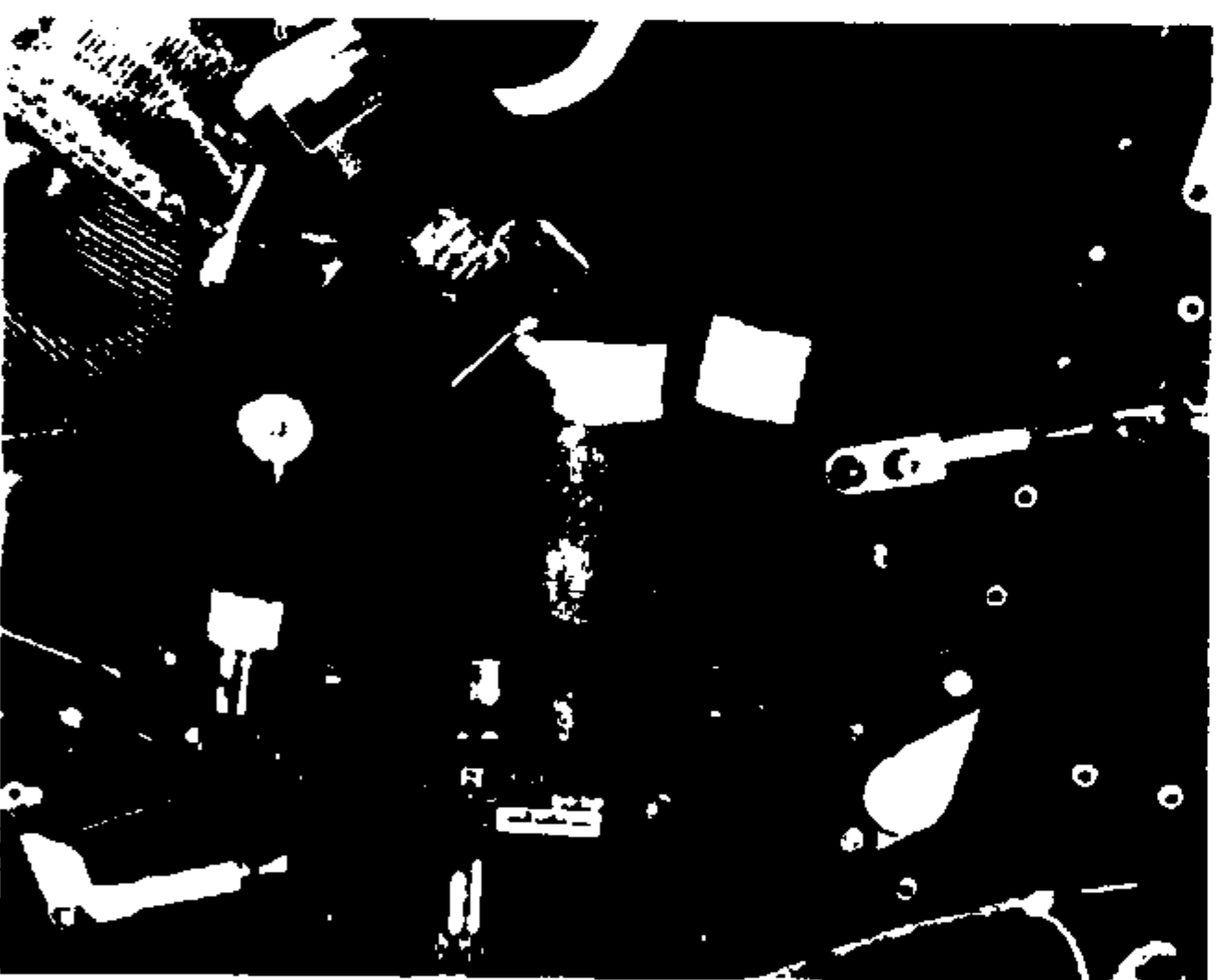
Figure 1-28 (Sheet 1)



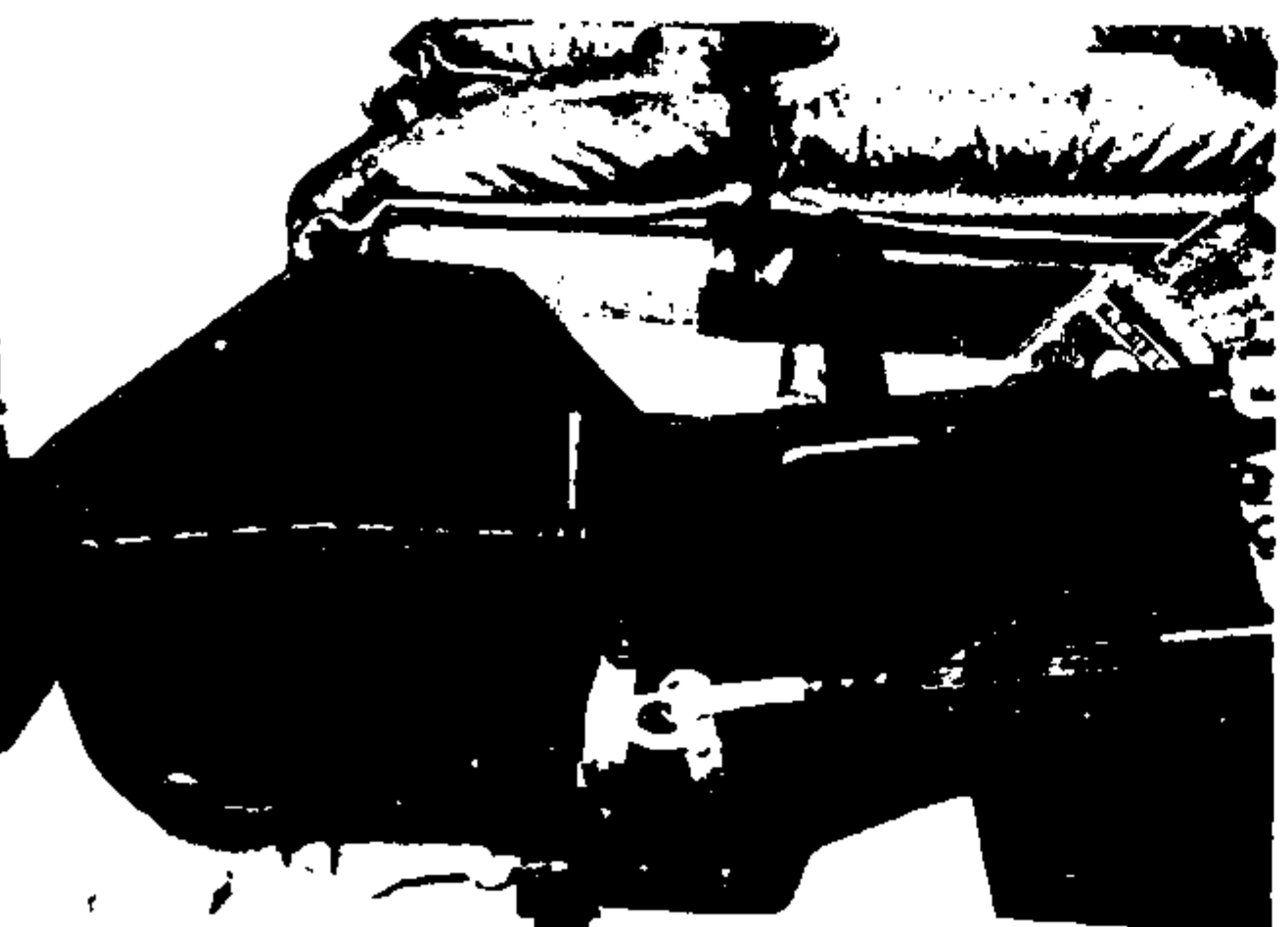
B ROCKET MOTOR INITIATOR



C ROCKET MOTOR INITIATOR
STATIC LINE



D PERSONNEL DISCONNECT LINES



E SURVIVAL KIT FRONT
LOCK RELEASE LEVER

RADIO BEACON
ACTUATING LANYARD

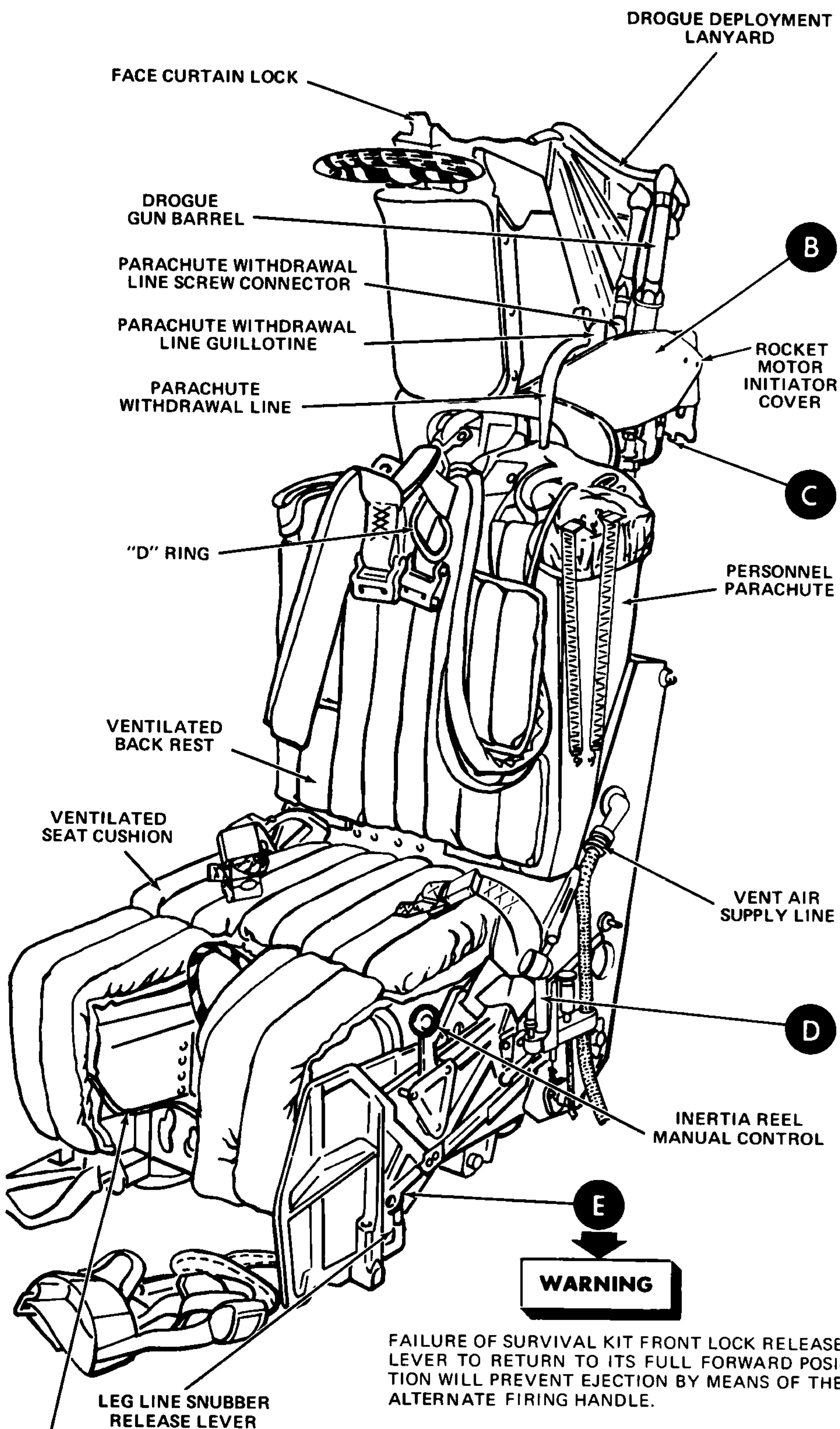


Figure 1-28 (Sheet 2)

MANUAL SEAT SEPARATION

If the time-release mechanism fails, the crewmember can manually separate from the seat by pulling up and aft on the harness emergency-release handle (front right side of seat bucket). Rotating the harness emergency-release handle fires the guillotine severing the personnel parachute withdrawal line and releasing the shoulder-harness restraint straps the lap belt, the leg-line straps, parachute container, and survival kit. The occupant must kick free of the seat and manually deploy the personnel parachute by pulling the D-ring.

WARNING

The personnel parachute must be deployed manually if the harness emergency-release handle has been pulled.

EJECTION CONTROLS

Face-Curtain Handle

The automatic ejection sequence is initiated by pulling the face-curtain handle immediately aft and above the occupant's head. When the face-curtain handle is pulled, the primary firing mechanism sear and the ballistic inertia reel sear are mechanically withdrawn and the primary cartridge is fired. As the seat rises, the drogue-gun and time-release mechanism sears are extracted by trip rods and the emergency IFF and equipment destruct are activated.

Note

The seat is fired after 7 inches of face-curtain travel.

Alternate Firing Handle

The alternate firing handle is on the front of the seat bucket, between the occupant's legs. The sequence of operation remains the same, since both the face-curtain handle and the alternate firing handle initiate seat firing by mechanically extracting the sear from the ejection-gun firing mechanism.

Note

- If the face-curtain handle does not actuate the ejection seat, the face-curtain handle should be held while the alternate firing handle is actuated, to prevent the possibility of entanglement with the drogue gun when it fires.
- The seat is fired after 2 inches of alternate firing handle travel.

PARACHUTE

The personnel parachute is contained in a rectangular back pack aft of the occupant. The parachute pack is

attached to the seat by two lock-in fittings. On ejection, the locks are automatically released by the time-release mechanism at both points. The parachute pack is attached to the occupant by two risers connected to the top Koch-fittings of the integrated torso harness.

TIME-RELEASE MECHANISM

The time-release mechanism is on the right side of the ejection-seat headrest and is armed upon ejection by a time-release mechanism trip rod, which is secured to the trip-rod bracket.

The time-release mechanism contains an altitude-sensing barostat to prevent premature deployment of the parachute at high altitudes. At approximately 13,000 ($\pm 1,500$) feet or less, the time-release mechanism releases the drogue parachute from the scissors shackle, pulling the personnel parachute withdrawal line from the guillotine and deploying the occupant's personnel parachute. At the same time, the shoulder-harness restraints, lap belt, leg restraints, parachute container survival kit, and face-curtain are unlocked.

The occupant is then free to be pulled from the seat sticker clips by the line stretch of the main parachute.

PARACHUTE WITHDRAWAL LINE

The parachute withdrawal line is connected from the personnel parachute to the seat drogue parachute with an acorn screw connector. In normal ejection, this line is pulled out by the drogue parachute after the time-release mechanism fires to deploy the personnel parachute. The line is routed through a gas-operated guillotine that severs the line for manual seat separation.

Guillotine

The guillotine on the left side of the seat is fired by the initial travel of the emergency harness-release handle. The guillotine initiator is mounted on the right aft side of the seat bucket. The guillotine severs the personnel parachute from the seat and drogue parachute; the personnel parachute must then be manually deployed by pulling the D-ring.

EMERGENCY HARNESS-RELEASE HANDLE

(EMERGENCY OVERRIDE LEVER)

This control is the black-and-yellow-striped handle forward on the right side of the seat bucket. In the forward (locked) position, the occupant and his personal equipment are secured to the seat. When the emergency harness equipment-release lever is lifted and rotated to the aft (unlocked) position, the occupant and his personal equipment are disconnected from the seat except for the sticker clips. The initial travel of this handle fires the parachute withdrawal-line guillotine, severing the personnel parachute from the seat and drogue parachute. The personnel parachute must be manually deployed by pulling the D-ring.

The emergency harness-release handle simultaneously releases the lap-belt harness locks, personal parachute-container retention straps, survival-kit attachment lugs and sticker clips, inertia-reel straps, and leg-restraint cords.

WARNING

NEW

When the emergency harness-release handle is actuated, the face-curtain handle and alternate firing handle are automatically locked and ejection cannot be accomplished. There is no provision for resetting this control in flight.

This control will normally be in the forward position. Emergencies such as ditching, over-the-side bailout, or failure of the time-release mechanism will require operation of this control. For detailed information regarding specific use of the manual override lever, refer to Section V.

POWERED INERTIA REEL

Each seat has a powered inertia reel that is fired when ejection is initiated. The initiator is fired by mechanically extracting the sear. The burn time is set to position the occupant to an upright position prior to ejection with minimum shock. The inertia-reel straps are connected to the parachute risers and the upper torso harness.

Inertia-Reel Manual Control

This control is on the left side of the seat. In the forward position, forward movement of the occupant is restricted and any slack created by rearward movement is taken up by the inertia reel. The control is locked in this position by using the detent. In the spring-loaded center position, the occupant can move forward freely, unless the reel locks owing to excessive forward velocity. Upon releasing tension on the straps following automatic lock-up, the inertia straps are released without the necessity of repositioning the manual control. Both straps feed from the same shaft and it is impossible for one to lock without the other. If the reel is locked manually, the control must be positioned full aft to the unlock position to release the straps.

LEG GARTER

NEW

The leg garter and leg-restraint cords are used to keep the occupant's legs firmly against the leg rests during ejection. The leg garter is placed around the leg above the calf and above the ankle. It should be tight enough so it does not slip down over the calf.

The leg-restraint cords are attached to the aircraft deck and routed through the snubber box seat structure. They are then passed through garter rings and snapped into the leg-line locks. The garter rings are snapped into the bayonet fitting when

strapping in. Leg-line snubbers are released by pulling the release lever on the outer side of each snubber box.

EMERGENCY OXYGEN

An emergency oxygen system in the survival kit is actuated during ejection by a cable connected from the personnel services disconnect to the automatic emergency oxygen actuator. The cable is disconnected from the survival kit after oxygen release and the oxygen flows through the occupant's personal oxygen regulator to the mask.

Note

The emergency oxygen supply will last approximately 15 minutes. The duration will depend upon altitude and breathing rate.

Emergency Oxygen Manual Control

The emergency oxygen system manual control is a green ring on the inside left thigh of the survival kit. This control is provided to actuate the emergency oxygen system if the normal system fails.

SURVIVAL KIT

The survival kit is packed in a rigid two-piece container (RSSK-7) (figure 1-29) stowed in the seat bucket under the seat pan. The following is a typical list of the contents of this kit:

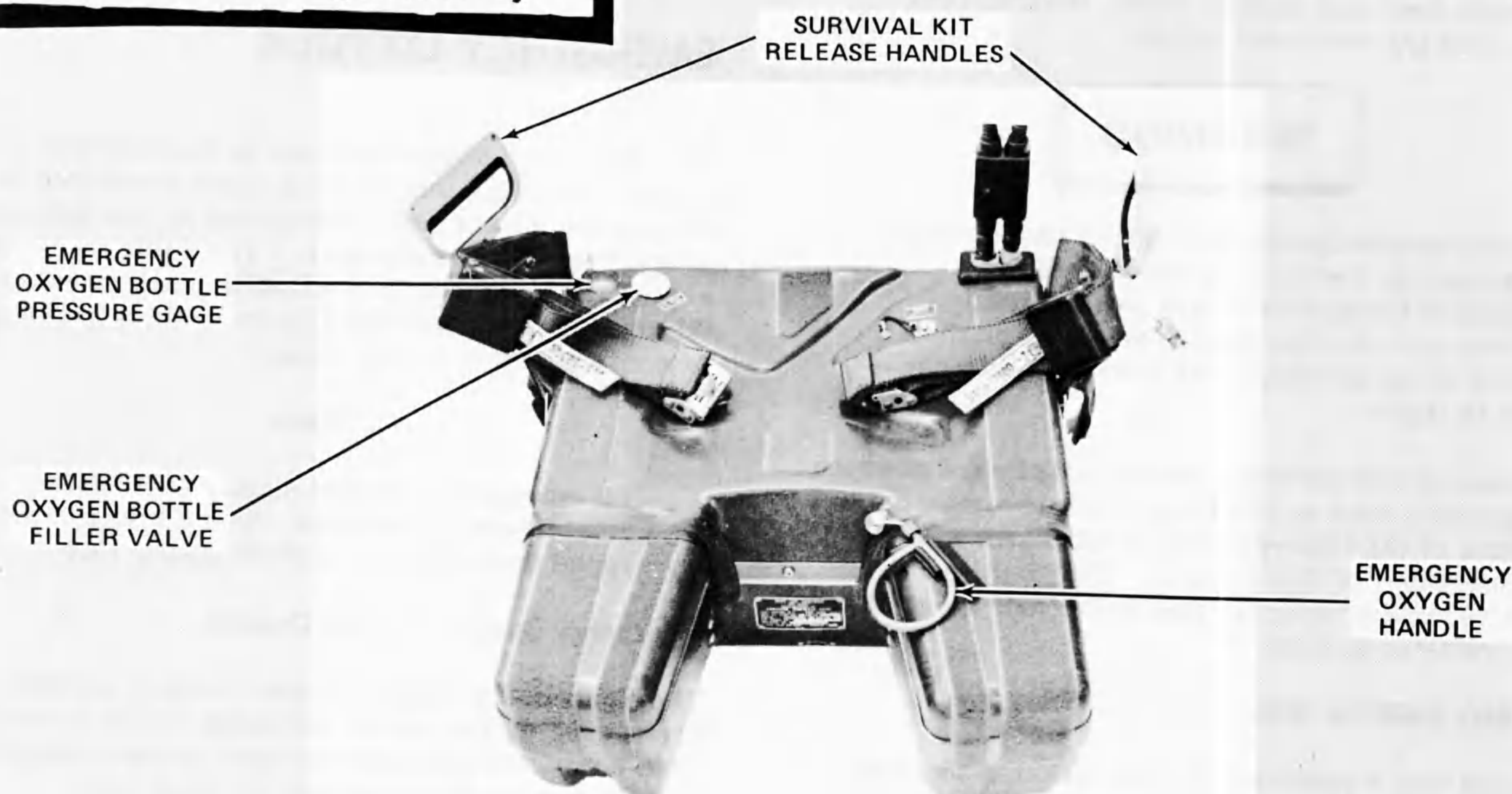
NEW

- LR-1 one-man life raft with inflation cylinder and valve
- Rations
- 2 packs shark repellent
- 50 feet nylon cord
- Desalter kit
- Water storage bag
- Bailing sponge
- Sunburn ointment
- AN/URT-33 survival radio
- MK-13 MOD 0 day/night distress signal
- 2 packs dye marker
- Signal mirror
- Ground/air emergency code card

PERSONNEL SERVICES DISCONNECTS

Supply lines from the aircraft for the oxygen, communications, anti-g, and ventilation systems terminate at the personnel services disconnect which is attached to the left side of the seat bucket by a quick-release pin. Quick-disconnect fittings connect the supply lines to the lines in the seat which serve the occupant. The oxygen and communications lines connect to a distribution point in the left rear corner of the survival kit. The emergency oxygen lanyard

SURVIVAL KIT (RSSK-7)



ADF1-120

Figure 1-29

is also attached to the personnel services disconnect. When the seat is ejected, a lanyard pulls the pin securing the personnel services disconnect to the seat. This releases the disconnect and further upward travel of the seat causes the supply lines to be disconnected at their quick-release fittings and the emergency oxygen lanyard to be pulled, actuating the emergency oxygen supply.

SEAT ADJUSTMENT

Seat adjustment is controlled by two three-position, momentary contact switches on the right side of the seat bucket. The direction of switch movement to adjust the seat is marked near the switches. Seat adjustment is limited to 5 inches of seat bucket vertical movement and 10° of tilt.

WARNING

Head and neck injury may occur during ejection if seat is not adjusted properly. Do not allow the top of the helmet to project above the level of the face curtain.

CAUTION

The seat-tilt and height-adjustment actuator motor is an intermittent-duty motor with a duty cycle of 30 seconds on and 10 minutes off.

ENVIRONMENTAL CONTROL SYSTEM

The environmental control system (figure FO-7) regulates the environment of the crew and the electronic equipment. The system provides cockpit air conditioning and pressurization, windshield and canopy defogging, electronic equipment cooling, and windshield washing, de-icing, and rain removal. In addition, pressurized air is furnished for auxiliary systems such as canopy seal inflation, operation of the anti-g suit bladders, and suit or seat cushion ventilation as well as hydraulic reservoir and fuel-tank pressurization.

High-pressure hot bleed air is taken from the twelfth stage of each engine compressor and is passed through the AIR COND bleed-air isolation valve and the main bleed-air shutoff valve to the air-cycle refrigeration unit, which cools it. Bleed-air check valves permit system operation with only one engine running. Bleed air entering the air-cycle refrigeration unit passes through the main and auxiliary heat exchangers where ram air, entering through the right-wing intake scoop, is circulated around the fins of the heat exchangers to cool the bleed air and then is dumped overboard. The cooled bleed air passes through the mass flow-control valve to drive the cooling turbine. Since energy is extracted to drive the turbine, this further cools the air. The cooling turbine drives the ram-air exhaust fan.

temperature selection is made. Correct cockpit pressure is controlled by a pressure regulator and a safety valve. All controls for operating the system are on the air-conditioning control panel (figure 1-31), except for the cabin dump switch located on the cabin dump panel.

AUTOMATIC COCKPIT AIR-CONDITIONING

In the automatic mode, the cockpit is furnished temperature-controlled air by the environmental control system. For proper temperature control, both hot engine bleed air and refrigerated, dehumidified bleed air are provided. Thus the temperature of the cockpit air is regulated by a mixture of hot and refrigerated air. This mixing is accomplished by means of a dual temperature-control valve in the hot line and in the cold line. The action of the mass flow-control valve assists in stabilizing cabin air at the temperature selected on the air-conditioning control panel (figure 1-31). For example, if the cabin temperature decreases with the dual temperature-control valve at full cold, the portion of the valve in the cold line begins to close. As this occurs, the mass flow controller, downstream of the cooling turbine, senses a pressure increase and begins to close the mass flow-control valve. This results in a decreased flow through the cooling turbine, increasing the temperature of air delivered to the dual temperature-control valve.

COCKPIT AIR-CONDITIONING AND PRESSURIZATION SYSTEM

The cockpit air-conditioning and pressurization maintains either automatically or manually system cockpit temperature and pressure within the limits of crew safety and comfort. To accomplish this, the system forces a mixture of dehumidified refrigerated bleed air and hot engine bleed air into the cockpit. In the automatic mode, a temperature-control system, consisting of temperature switches, selectors, sensors, associated valves, and an electronic controller automatically maintain the mixture temperature after

MANUAL COCKPIT AIR-CONDITIONING

The dual temperature-control valve can be operated manually by a toggle switch on the air-conditioning control panel. If the air-conditioning system fails or shuts down, ram air, ducted from the heat exchanger inlet scoop, can be selected for ventilation and limited pressurization of the cockpit.

COCKPIT PRESSURIZATION

Air from the refrigeration unit enters the cockpit under sufficient pressure to provide adequate cockpit pressurization. Cockpit pressurization, automatically initiated at 8,000 feet, is controlled by the cabin pit air-pressure regulator. The regulator controls the discharge rate of the air from the cockpit. After the aircraft reaches 8,000 feet the regulator valve maintains a cockpit altitude pressure of 8,000 feet until an aircraft altitude of 23,000 feet has been reached. Above an altitude of 23,000 feet, the regulator maintains a 5 PSI pressure differential (see figure 1-30). The regulator discharge air is used in cooling various electronic equipment in the nose compartment and nose-wheel well. If the regulator should fail, the cockpit air pressure safety valve automatically dumps when the cockpit pressure differential exceeds 5.5 PSI. The safety valve is also capable of negative pressure relief to prevent excessive negative pressure during dives, when the ambient pressure is increasing faster than cockpit pressure is increasing. The safety valve, which dumps into the atmosphere, may also be operated manually by the crew, if desired.

AIR-CONDITIONING CONTROL PANEL

Air-Conditioning Master Switch

The air-conditioning master switch is a two position, (NORM and OFF) toggle switch on the air-conditioning control panel (figure 1-31). The switch is guarded to the NORM position. Placing the switch to NORM opens the main bleed-air shutoff valves, if the engine is providing air at 8 psi or more, and causes the air-conditioning caution light (AIR COND) to go off. Hot engine bleed air is now available for operation of the various environmental systems. Placing the switch to the OFF position closes the shutoff valve, thus shutting off the supply of hot engine bleed air to the environmental system.

CAUTION

Fuel tank and anti-g suit pressurization lines bypass the main bleed-air shutoff valve. During ground operations, do not actuate either the g-valve test button or the ORIDE position of the tank pressure switch unless the air-conditioning master switch is in the NORM position. Heat damage to O-ring seals in the fuel check valves may occur. Damage to these seals will permit fuel to flow into the auxiliary heat exchanger, the hydraulic tank, vent suit, canopy seal, and electronic equipment in the nose and nose-wheel well as well as the engine bleed-air lines.

Note

The hot engine bleed-air line to the rain-removal system bypasses the main bleed-air shutoff valve. The system may still be operated with the air-conditioning master switch at OFF.

A spring-loaded guard over the air-conditioning master switch prevents inadvertent operation of the switch to OFF. Before placing the switch to OFF, the guard must be lifted.

Air-Conditioning Cockpit Switch

The cockpit switch, on the air-conditioning control panel (figure 1-30) is a three-position toggle switch marked ON, OFF, and RAM AIR. With an engine running, the air-conditioning master switch at NORM, placing the cockpit switch ON engages the air-conditioning and pressurization system by energizing the dual temperature-control valve and opening the cabin shutoff valve. Depending upon the setting on the automatic temperature-control thumbwheel, conditioned air flows into the cockpit. Placing the cockpit switch OFF closes the cabin shutoff valve, and drives the dual temperature-control valve to the full hot position. This prevents any airflow to the cockpit. The RAM AIR position closes the cabin shutoff valve and drives the dual temperature-control valve to the full hot position. When the switch is in the RAM AIR position, ram airflow is controlled manually using the manual ram-air switch.

Automatic Temperature Control

The automatic temperature-control thumbwheel, on the air-conditioning control panel (figure 1-31), enables the crew to adjust the cockpit air temperature. With the air-conditioning and pressurization controls appropriately positioned, the thumbwheel may be moved to any setting between 0 and 14. Rotating the thumbwheel automatically regulates the openings of the hot and cold sides of the dual temperature-control valve, thus varying the cockpit air temperature. The temperature may be selected within a range of 60° to 80° F (15.6° to 26.1° C).

Before leaving the chocks, the automatic temperature-control thumbwheel should be set as desired. This will allow the automatic air-conditioning controls to stabilize while taxiing.

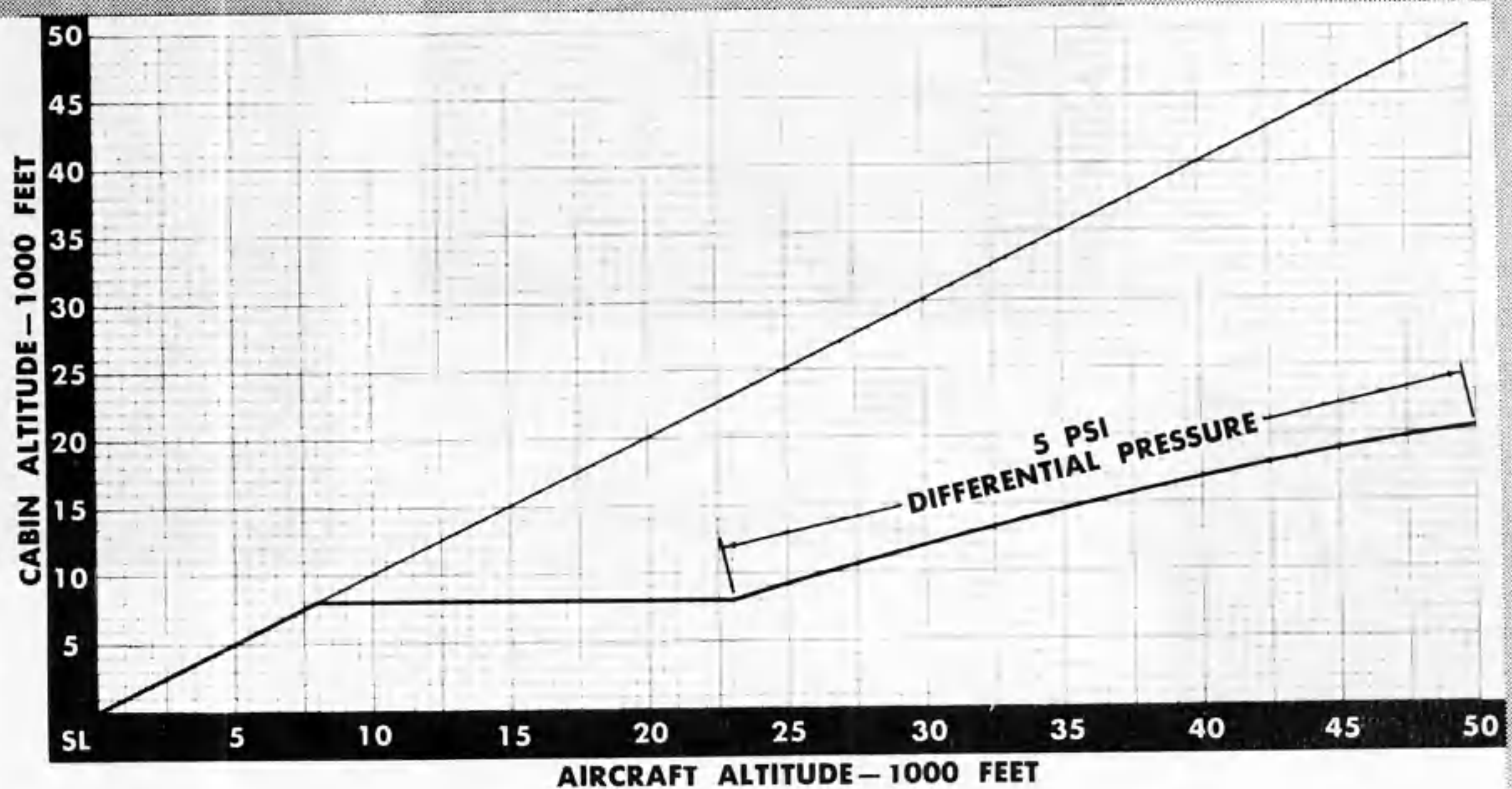
Note

In the AUTO position, temperature control should be set at the maximum cold position while the engines are at idle power.

Manual Ram-Air Switch (MAN/RAM AIR)

The manual ram-air switch on the air-conditioning control panel (figure 1-31) is a four-position toggle switch marked AUTO, HOLD, COLD, and HOT. The AUTO position is selected to place the dual temperature-control system in the automatic mode and thus allow control of the cockpit air temperature as selected by the automatic temperature-control thumbwheel. Placing the switch to HOLD removes the dual temperature-control valve from automatic control. The switch is spring-loaded to HOLD when AUTO is not selected. Momentarily holding the switch in COLD or HOT alters the positions of the hot and cold sides of the dual temperature-control valve accordingly, to change the cockpit air temperature.

CABIN PRESSURE SCHEDULE



ADF1-33

Figure 1-30

When released, the switch springs back to HOLD and the dual temperature-control valve remains fixed. The COLD and HOT positions should be toggled intermittently to avoid overshooting the desired position. With RAM AIR selected on the air-conditioning cockpit switch, airflow is controlled manually through the ram-air switch which opens and closes the ram-air valve.

AIR-CONDITIONING CAUTION LIGHT

The air-conditioning caution light on the annunciator panel indicates whether the main bleed-air shutoff valve is open or closed and the air-conditioning system engaged. The light comes on when the air-conditioning master switch is placed to OFF and the shutoff valve is closed. When the air-conditioning master switch is placed to NORM, the shutoff valve opens and the light goes off. The air-conditioning

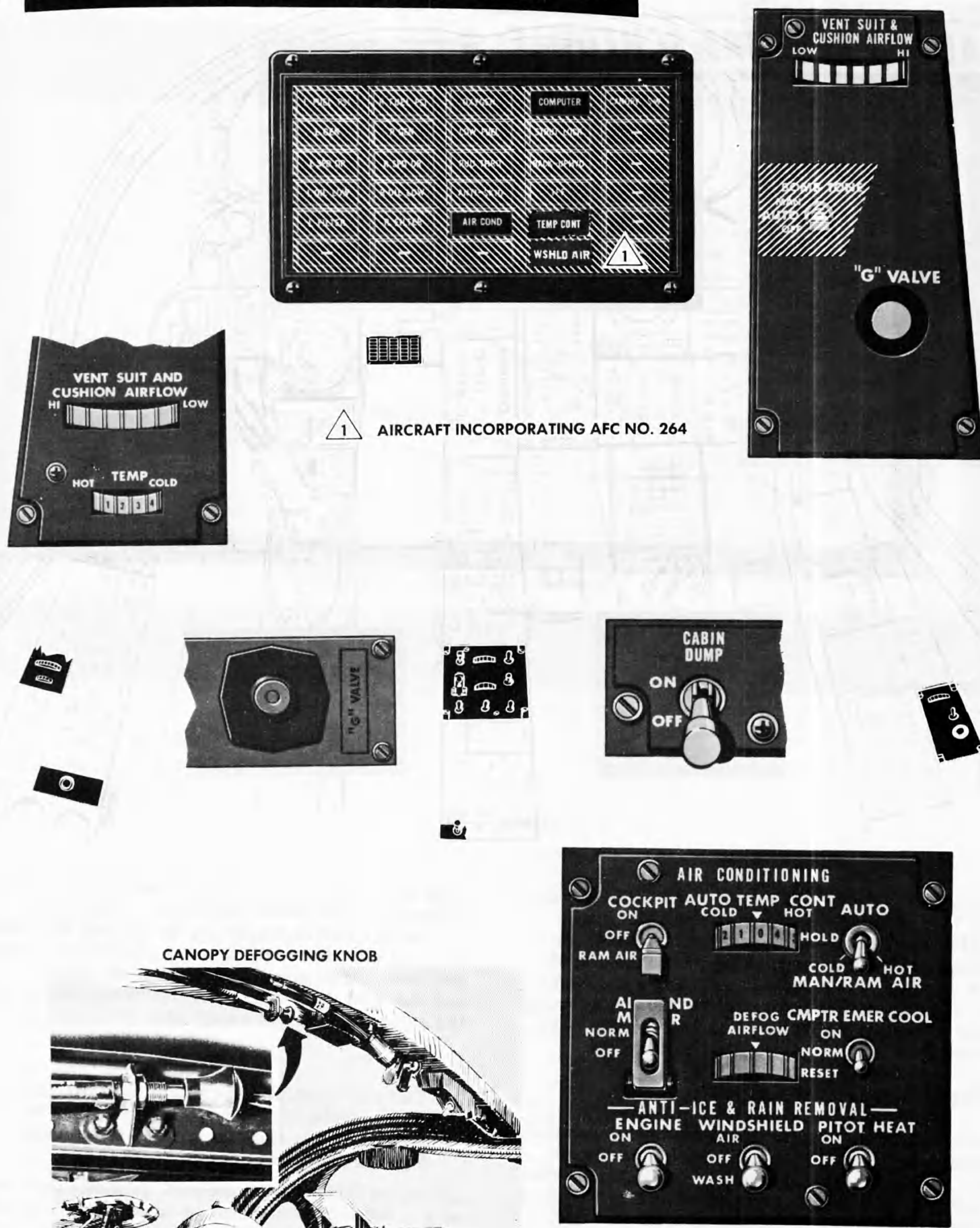
light also comes on if overpressurization occurs upstream of the water separator. When this occurs, a pressure switch located in the ducting activates the forward and aft compartment shutoff valve to the open position. After pressure is reduced, the valve closes and the light goes out. If overpressurization recurs, the same sequence is repeated.

Note

The air-conditioning caution light may come on momentarily when the throttles are advanced. This is a normal indication unless the light remains on.

During periods of high ambient humidity and temperature, the light may come on momentarily during rapid engine acceleration. Under these conditions, the light should go out within 10 seconds and not come on again.

ENVIRONMENTAL CONTROL SYSTEM CONTROLS AND INDICATORS



B-ADF1-31

Figure 1-31

CABIN DUMP SWITCH

The cabin dump switch (figure 1-31) is on the cabin dump panel on the center console and allows the crew to manually dump cabin pressure. Placing the switch ON allows electrical power to energize the cabin dump solenoid. This, in turn, causes the safety valve to open and the cockpit pressure to be dumped. With the switch OFF, the cabin dump solenoid is deenergized, the valve is closed, and normal cockpit pressurization is obtained.

NORMAL OPERATION

1. Air conditioning master switch - NORM
2. Cockpit air conditioning switch - ON
3. MAN/RAM AIR switch - AUTO
4. Automatic temperature-control thumbwheel - SET at 0

Initially set temperature controls as desired. After the system stabilizes, select desired setting.

MANUAL OPERATION

1. Air conditioning master switch - NORM
2. Cockpit air conditioning switch - ON
3. MAN/RAM AIR switch - TOGGLE AS DESIRED, then HOLD

AUXILIARY ENVIRONMENTAL SYSTEMS

The environmental control system provides hot bleed air and refrigerated, dehumidified bleed air for anti-exposure suit or seat-cushion ventilation and for anti-g suit operation. Personnel services disconnects are provided in both seats for these purposes.

ANTI-EXPOSURE SUIT AND SEAT CUSHION VENTILATION

The pilot and the bombardier/navigator receive a mixture of dehumidified refrigerated air and engine bleed air to ventilate their anti-exposure suits or seat cushions. The controls for the suit and seat cushions are on the vent suit and cushion control panel (figure 1-31). The bombardier/navigator has no temperature control; however, he will receive air at the temperature selected by the pilot. The airflow thumbwheel must be moved toward HI to receive temperature-controlled air.

Vent Suit and Cushion Airflow Control

The pilot's airflow thumbwheel on the vent suit seat cushion control panel (figure 1-31) controls the amount of airflow to the pilot's ventilated anti-exposure suit or seat cushion. With the air-conditioning master switch at NORM, rotating the

thumbwheel toward HI energizes (opens) the flow control valve and activates the temperature-control system. This allows a mixture of hot engine bleed air and air from the refrigeration unit to pass to the pilot's and bombardier/navigator's suit or cushion. The bombardier/navigator has a similar control on the right console but it has provisions only for regulating the airflow and cannot start the system operating.

Vent Suit and Cushion Temperature Control

The temperature (TEMP) thumbwheel on the vent suit and cushion panel (figure 1-31) controls the temperature of the airflow to the pilot's and bombardier/navigator's vent suits and cushions. With the air-conditioning master switch at NORM, rotating the temperature thumbwheel to HOT or COLD sets the temperature which the vent suit temperature-control system maintains.

Normal Operation of Vent Suit and Cushion

1. Air-conditioning master switch - NORM
2. Airflow thumbwheel - TOWARD HI
3. Temperature thumbwheel - AS DESIRED

ANTI-G SUITS

Cooled engine bleed air from the auxiliary heat exchanger is piped to the anti-g valves in the left and right consoles. The anti-g valves regulate pressure to the anti-g suits to a maximum of 10 psi and allow the suits to be inflated under varying pressures in proportion to the amount of g force exerted on the aircraft and occupants. As the g force decreases, the anti-g valves register a corresponding decrease in the pressure admitted to the suits. Excess pressure is exhausted into the cockpit. Air from each anti-g valve reaches its suit through personnel services disconnects in the respective seat. The suit bladders may be inflated at any time by depressing the button on top of the valve. Releasing the button allows the valve to close and the pressure in the suit to be exhausted.

G Valve Test

The g valve test buttons on the pilot's left console (figure 1-31), immediately aft of the vent suit and cushion airflow control and the bombardier/navigator's right console, aft on the outboard side (Figure FO-3) provide a means of testing the proper operation of anti-g suits. Depressing the g-valve test button provides the necessary air pressure to inflate the anti-g suit bladder. Releasing the button will automatically stop further airflow to the suit and permit the anti-g suit bladder to deflate.

WARNING

Ensure that the air-conditioning master switch is in the NORM position prior to depressing the g-valve test button. Hot engine bleed air will be pumped through the anti-g suit if the test button is depressed when the air-conditioning master switch is OFF and the aircraft is on the deck.

DEFOGGING

A mixture of engine compressor bleed air, and air cooled by the main section of the refrigeration unit heat exchanger can be directed to the inside surfaces of all transparent cockpit areas to prevent fog formation. The amount of defog air is monitored by the defog airflow thumbwheel. The temperature control valve automatically maintains the defogging air at a temperature of 115°C (240°F) within a tolerance of ±2.8°C (±5°F) for any stabilized flight conditions, and at a tolerance of ±5.6°C (±10°F) while the aircraft is experiencing varying flight conditions.

CANOPY DEFOGGING

The defog airflow is directed to the windshield and side panels any time the system is operating. To direct defog airflow to the canopy, the canopy defog knob must be moved forward (ON). Before descending after prolonged cold-soaking, the defog airflow thumbwheel should be actuated toward HI and the defog knob should be moved to full ON (figure 1-31).

Defog Airflow Thumbwheel

The defog airflow thumbwheel on the air-conditioning control panel (figure 1-31) allows the crew to engage the defogging system and regulate the pressure of the defog air to the transparent cockpit areas. With the canopy closed and the air-conditioning master switch at NORM, turning the thumbwheel to the right engages the defogging system. The defog pressure regulator shutoff valve becomes energized, opens the valve, and allows temperature-controlled air to flow through the system to the cockpit diffusers. As the thumbwheel rotation is continued, the flow of air to the transparent areas is increased. Conversely, rotating the thumbwheel to the left decreases the flow of air to these areas. The air supply to the canopy is automatically shut off when the canopy is opened.

Canopy Defog Knob

A manual canopy defog knob (figure 1-31), on the upper center structure of the canopy, permits the crew to modulate, or shut off completely, portions of total defogging flow delivered to the canopy diffusers. This is accomplished by means of a pushpull cable connected to a butterfly valve. Moving the knob aft (OFF) decreases that airflow to the canopy and increases windshield airflow.

DEFOGGING OPERATION

1. Air-conditioning master switch - NORM

2. Defog airflow thumbwheel - AS DESIRED
3. Canopy defog knob - AS DESIRED

WINDSHIELD SWITCH

The WINDSHIELD switch on the air-conditioning control panel (figure 1-31) has positions marked AIR, OFF, and WASH, and is spring-loaded from WASH to OFF (spring-loaded to OFF from either position with AFC No. 264). See figure 1-7 for a functional diagram. Electrical power for the WINDSHIELD switch comes from the 28VDC primary bus through the AIR COND circuit breaker on the nose-wheel well circuit breaker panel.

CAUTION

Allow five seconds between actuations of the WINDSHIELD switch to permit cooling of the nose-wheel well bleed-air isolation valve motor.

WINDSHIELD WASH

Placing the WINDSHIELD switch to the WASH position electrically energizes the windshield-washing regulator and dump valve. The valve allows bleed-air, cooled by the auxiliary heat exchanger, to pressurize the 1 1/2-gallon fluid tank. The 50-50 water-methanol mixture from the tank is forced through five nozzles onto the pilot's windshield as long as the switch is held to WASH. When released to OFF, the valve shuts off the bleed air and dumps the pressure in the tank.

Windshield Wash Operation

1. WINDSHIELD switch. WASH
2. WINDSHIELD switch. AIR

RAIN REMOVAL (ANTI-ICE)

Placing the WINDSHIELD switch to the AIR position electrically energizes the rain-removal pressure-regulator shutoff valve: the WSHLD AIR light (AFC No. 264) on the annunciator panel; and if AUTO is selected on the NWW switch (AFC No. 268), the nose-wheel well bleed-air isolation valve. Bleed air passes from the isolation valve through the regulator in the rain-removal valve, is mixed with ambient air by two ejectors, and then directed in a broad stream across the pilot's windshield.

Rain Removal (Anti-Ice) Operation

1. WINDSHIELD switch. WASH
2. WINDSHIELD switch. AIR

CAUTION

Operation of the rain-removal system is not recommended on a dry windshield or above 200 KIAS. Operation on the ground at high power settings may cause the windshield to crack.

EQUIPMENT COOLING

The equipment-cooling system employs ram air, refrigerated air, and a controlled mixture of refrigerated air and hot engine bleed air to cool electronic equipment located in various sections of the aircraft. With an engine running and the air-conditioning master switch at NORM, operation of the equipment-cooling system is entirely automatic. Airflow is controlled by a combination of temperature sensors and flow control valves. (See figure FO-7.)

COMPUTER EMERGENCY COOLING

If the computer inlet air temperature exceeds 150°F, the computer thermal switch will deenergize, automatically completing a circuit to the TEMP CONT caution light and computer temperature control valve. The computer temperature-control valve will then close, preventing hot bleed air from flowing and allowing cooled bleed air to be ducted to the ballistics computer.

When duct temperature drops below 150°F, the TEMP CONT caution light will go out; however, the computer temperature-control valve will remain closed. To restore automatic computer cooling, the computer emergency cooling (CMPTR EMER COOL) switch on the air-conditioning control panel (figure 1-27) must be actuated to RESET.

Computer Emergency Cooling Switch

The computer emergency cooling switch on the air-conditioning control panel (figure 1-31) is a three-position toggle switch placarded ON, NORM, and RESET. In the NORM position, automatic temperature control of computer air is provided, or in the event of temperature-control malfunction, unregulated cooled air is directed to the computer.

The RESET position is used to restore automatic computer cooling in the event of automatic temperature-control malfunction (TEMP CONT light coming on momentarily, then going off).

The ON position is used if continuous unregulated cooling airflow is desired.

Temperature Control Light

The TEMP CONT caution light is on the annunciator panel (figure 1-26). A momentary light (on and then off), indicates a shift of computer cooling from regulated to unregulated temperature control. A steady light indicates failure to temperature-control regulation and a failure of the emergency cooling system.

CAUTION

If the TEMP CONT caution light remains on, a computer temperature control valve failure is indicated. To prevent damage to the computer and possible smoke and fumes in the cockpit, the AIR COND MASTER switch should be set to OFF. The COMPUTER light may be expected to come on. The computer and any unnecessary electronic equipment should be secured to prevent damage.

Computer Light

The COMPUTER light on the annunciator panel comes on when the temperature of the computer has exceeded a safe level.

CAUTION

If the COMPUTER light comes on, the computer should be secured immediately to prevent damage.

GROUND COOLING SYSTEM

The ground cooling system automatically provides cooling air to components of the computer, radar, INS, and CNI. The ground blower operates to draw in outside air when external electrical power is applied and the search radar POWER switch, the COMPUTER switch on the DDU, or the CNI MASTER switch is set to ON. Provisions are made to connect external cooling air when ambient temperature exceeds 103°F or when the aircraft is in an enclosed, poorly ventilated area.

Equipment protection circuits are provided to warn of overheating in the computer and to shut down both the sensitive electronic equipment and the ground blower. When temperatures in the pedestal control unit exceed 176°F, or temperatures exceed 230°F in the computer or analog-to-digital converter, the COMPUTER light comes on and power to the computer, the analog-to-digital converter, the radar, and the CNI package is interrupted. The light will remain on until the equipment cools to below the overheat temperature. After sufficient cooling, power may be restored by depressing the RESET button on the ground cooling panel in the nose-wheel well.

Ground Cooling Switch

The ground cooling toggle switch on the ground cooling panel in the nose-wheel well has three positions marked TEST, AUTO, CART. The TEST position is used to test the operation of the ground blower. The CART position permits use of the ground cooling system with external cooling air. The ground blower does not operate when CART is selected. The normal AUTO position permits the system to operate in the automatic mode.

Note

The ground cooling switch automatically returns to the AUTO position when external electric power is turned off.

ENGINE ANTI-ICING SYSTEM

An independent system for preventing or removing ice at the engine inlet guide vanes is provided on each engine. Hot air, taken directly from the compressor, is ducted to the vane area when the pilot anticipates icing conditions. The engine anti-ice switch controls the engine anti-ice system. (See figure 1-31.)

ENGINE ANTI-ICE SWITCH

The engine anti-ice switch is a two-position toggle switch (ON and OFF) on the air-conditioning control panel (figure 1-31). Placing the switch ON energizes the anti-icing air shutoff valve which opens and allows hot engine bleed air to be distributed to the guide vanes.

CIRCUIT PROTECTION

Seven circuit breakers protect the components of the environmental control system. The AIR COND circuit breaker in the nose-wheel well provides 28 VDC from the primary bus while 28 VDC from the essential bus goes through the AIR COND 2 circuit breaker on the main circuit breaker panel. Power from the 115 VAC essential bus is provided through the LAT/LONG TRIM circuit breaker on the main circuit breaker panel. The ENVIRONMENT SEATS and EQUIP COOL circuit breakers on the bombardier/navigator's circuit breaker panel provides 115 VAC from the primary bus. The BLEED AIR circuit breaker on the B/N's circuit breaker panel supplies 115 VAC from the essential bus to the bleed-air isolation valves. The CNI AUX BLOWER circuit breaker on the auxiliary aft bay circuit breaker panel supplies 115 VAC from the primary bus to the CNI auxiliary cooling blower.

OXYGEN SYSTEM

The liquid oxygen system delivers gaseous oxygen to the crew to enable them to operate above 10,000 feet altitude and to maintain peak body efficiency at altitudes above 5,000 feet. The oxygen source of the system is a supply of liquid oxygen stored in a 10-liter oxygen converter in the aft equipment compartment. In addition, the converter installation has provision for the installation of a second similar converter for use during long range missions. System pressure is maintained at 70 to 100 PSI by pressure-opening and pressure-closing valves on the converter and by a system relief valve. See figure 1-32 for oxygen duration.

Liquid oxygen is converted into gaseous oxygen and is delivered through a single line to the heat exchanger and plenum assemblies on the aft sloping bulkhead of the cockpit. In the plenum, temperature-conditioned oxygen is stored before being delivered through the shutoff valves to the seat-mounted personnel services disconnects. A line from the personnel services disconnect goes to a distribution point in the left rear corner of the survival kit. The emergency oxygen supply also connects to this point. The oxygen regulators, one for each crewmember, govern the pressure and flow of gaseous oxygen to the face mask of the seat occupant.

OXYGEN QUANTITY GAGE

The oxygen quantity gage (figure FO-2) at the top right side of the pilot's instrument panel indicates the quantity of liquid oxygen in the converter. The gage reads 20 liters maximum so as to be usable when two converters are used.

OXYGEN CAUTION LIGHT

The oxygen caution light on the annunciator panel (figure 1-26) indicates that sufficient pressure is not being maintained, or that the liquid oxygen content of the converter is 2 liters or less. When the oxygen pressure drops below 50 PSI, a pressure switch, attached to one of the oxygen pressure lines, is closed. This allows electrical power to turn on the oxygen warning light.

LOX/FUEL/OIL Press-To-Test Button

Pressing the LOX/FUEL/OIL press-to-test button on the master test panel causes the oxygen quantity liter gage to drop to zero and the oxygen warning light to come on.

PERSONAL OXYGEN REGULATOR

Each crewmember is provided with a personal-issue 100% oxygen regulator which is compatible with his mask and the aircraft oxygen system.

OXYGEN SUPPLY LEVER

The oxygen levers on the pilot's left console and bombardier/navigator's right console are two-position lever switches marked ON and OFF and are used to engage the crew's oxygen system. Lifting the lever handle out against the pressure of the lever handle spring disengages the lever from its notch and allows it to be placed ON. This opens the pilot's oxygen shutoff valve, permitting oxygen under pressure to flow through the valve. Placing the lever OFF closes the valve and stops all oxygen flow through the valve.

EMERGENCY OXYGEN SUPPLY

Each survival kit is provided with a cylinder of compressed oxygen capable of supplying emergency oxygen for approximately 15 minutes. A manual control is provided to actuate the emergency supply if the aircraft system fails or is depleted.

Since the emergency oxygen supply is in the survival kit, oxygen is available during the parachute descent; however, the mask should be removed after the parachute opens to prevent suffocation after the oxygen supply is depleted.

Emergency Oxygen Manual Control

The emergency oxygen supply is actuated manually by pulling a green ring on the inside left thigh of the survival kit. When the ring is pulled, a cable opens the valve on the emergency oxygen cylinder, allowing oxygen to flow to the regulator. The ring and cable come free when the valve opens.

Note

The emergency oxygen supply is automatically actuated when the seat is ejected.

OXYGEN DURATION CHART

MAN HOURS OF OXYGEN REMAINING

CABIN ALTITUDE	LITERS 100% O ₂										LESS THAN 1
	10	9	8	7	6	5	4	3	2	1	
35,000 FEET and above	32.2	29.0	25.7	22.6	19.3	16.1	12.9	9.6	6.4	3.2	EMERGENCY DESCEND TO ALTITUDE NOT REQUIRING OXYGEN
30,000 FEET	25.5	23.0	20.4	17.9	15.3	12.8	10.2	7.6	5.1	2.5	
25,000 FEET	20.5	18.4	16.4	14.3	12.3	10.2	8.2	6.1	4.1	2.0	
20,000 FEET	16.5	14.8	13.2	11.5	9.9	8.2	6.7	4.9	3.3	1.6	
15,000 FEET	13.4	12.1	10.7	9.4	8.0	6.7	5.3	4.0	2.6	1.3	
10,000 FEET	11.0	9.9	8.8	7.7	6.6	5.5	4.4	3.3	2.2	1.1	
8,000 FEET	10.3	9.3	8.2	7.2	6.2	5.1	4.1	3.1	2.1	1.0	
5,000 FEET	9.2	8.3	7.4	6.5	5.5	4.6	3.7	2.8	1.8	.9	
SEA LEVEL	7.6	6.8	6.0	5.3	4.5	3.8	3.0	1.9	1.5	.7	

NOTE

- WHEN TWO PERSONS ARE USING OXYGEN, DIVIDE THE NUMBER OF HOURS REMAINING BY TWO.
 - DURATION DATA SHOULD BE USED AS A GUIDE ONLY SINCE OXYGEN CONSUMPTION VARIES WITH THE INDIVIDUAL.
- CONVERSION OF LIQUID O₂ TO GASEOUS O₂ IS 860 LITERS OF GASEOUS TO 1 LITER OF LIQUID O₂
 - CONSUMPTION RATES ARE BASED ON MIL 1-19326B (WEP) 1960.
 - CONSUMPTION RATES SHOWN ARE FOR 1 MAN.

Figure 1-32

LIGHTING SYSTEMS

INTERIOR LIGHTING

The interior lighting system provides maximum controlled lighting for the instrument panels and consoles, and consists of the pilot's lighting system, bombardier/navigator's lighting system, and the aft equipment bay dome light and switch.

The pilot's lighting system consists of the flight instrument lights, console lights, indexer light, floodlights, kneeboard light, utility light, and daylight floodlights. The system provides the pilot with complete control over the lighting of his instrument panel and consoles as well as the intensity of all caution and advisory lights.

The bombardier/navigator's lighting system consists of the bombardier/navigator's instrument panel lights, bombardier/navigator's console lights, and the utility light. The system provides the bombardier/navigator with complete control over the lighting of his instrument panel and console. The aft equipment bay dome light and switch system is on the top of the aft equipment bay and provides lighting of the bay for maintenance personnel. This light can be turned on only when external electrical power is supplied to the aircraft.

Electrical power for lighting of all flight instruments is supplied by the 28V DC and 115V AC essential buses, and power for lighting of all other instruments comes from the 28V DC and 115V AC monitored buses. Power for the utility light is supplied by the essential bus. All controls for operation of the pilot's internal lighting system except the kneeboard, utility, and daylight floodlights are on the master light panel, and those used for the bombardier/navigator's lighting system are on the internal lights panel.

DAYLIGHT FLOODLIGHTS

Four daylight floodlights are mounted on the canopy bow to minimize the possibility of flash blinding due to lightning or to nuclear blast (with or without the radiation shield). Two 40-watt lamps are oriented to illuminate the pilot's and the bombardier/navigator's instrument panels. Two 20-watt lamps illuminate the left and right consoles. The lights are controlled by a three-position switch on the aft side of the canopy bow. The positions of the switch are BRIGHT (forward), OFF (center) and DIM (aft).

UTILITY LIGHTS

There are three utility lights in the cockpit. Two of the lights are on either side of the cockpit on the cockpit longerons. The third light is overhead on the canopy bow. Each light has an individual ON/OFF switch, a rheostat control, and the option of red or white filter and flood or spot illumination. Alligator clips and swivel mountings allow the lights to be placed in any convenient location for maximum use.

PILOT'S KNEEBOARD LIGHT

The pilot's kneeboard light (figure 1-33) is on the canopy bow and directs a beam of light to the pilot's right knee. The light is controlled by an individual ON/OFF switch mounted on the light.

BOMBARDIER/NAVIGATOR'S MAP LIGHT

The bombardier/navigator's map light is on the lower right side of the canopy. An ON/OFF rheostat switch is used to turn on and control light intensity. **NEW**

PILOT'S INTERIOR LIGHT CONTROLS

Flight Instrument Lights Control

The pilot's flight instrument lights thumbwheel is on the master light panel (figure 1-33) and controls the illumination of the flight instruments on the pilot's instrument panel and the caution and advisory lights. Rotating the flight instrument thumbwheel to dim turns on the instruments at a low intensity, whereas with the thumbwheel at bright, they will glow with maximum intensity. Provisions are incorporated into the pilot's flight instrument lighting circuitry so that the flight instrument lights must be lit before lighting of nonflight instruments may be accomplished. This control also actuates the warning light dimming circuits.

Console Lights Control

The pilot's console lights control on the master light panel (figure 1-33), controls the illumination of the pilot's left and center consoles and the optical sight-head elevation thumbwheel. With the flight instrument thumbwheel set at either dim or bright, rotating the console thumbwheel to dim lights the instruments on the pilot's left and center consoles at a low intensity. Conversely, rotating the thumbwheel to bright lights the instruments at maximum intensity.

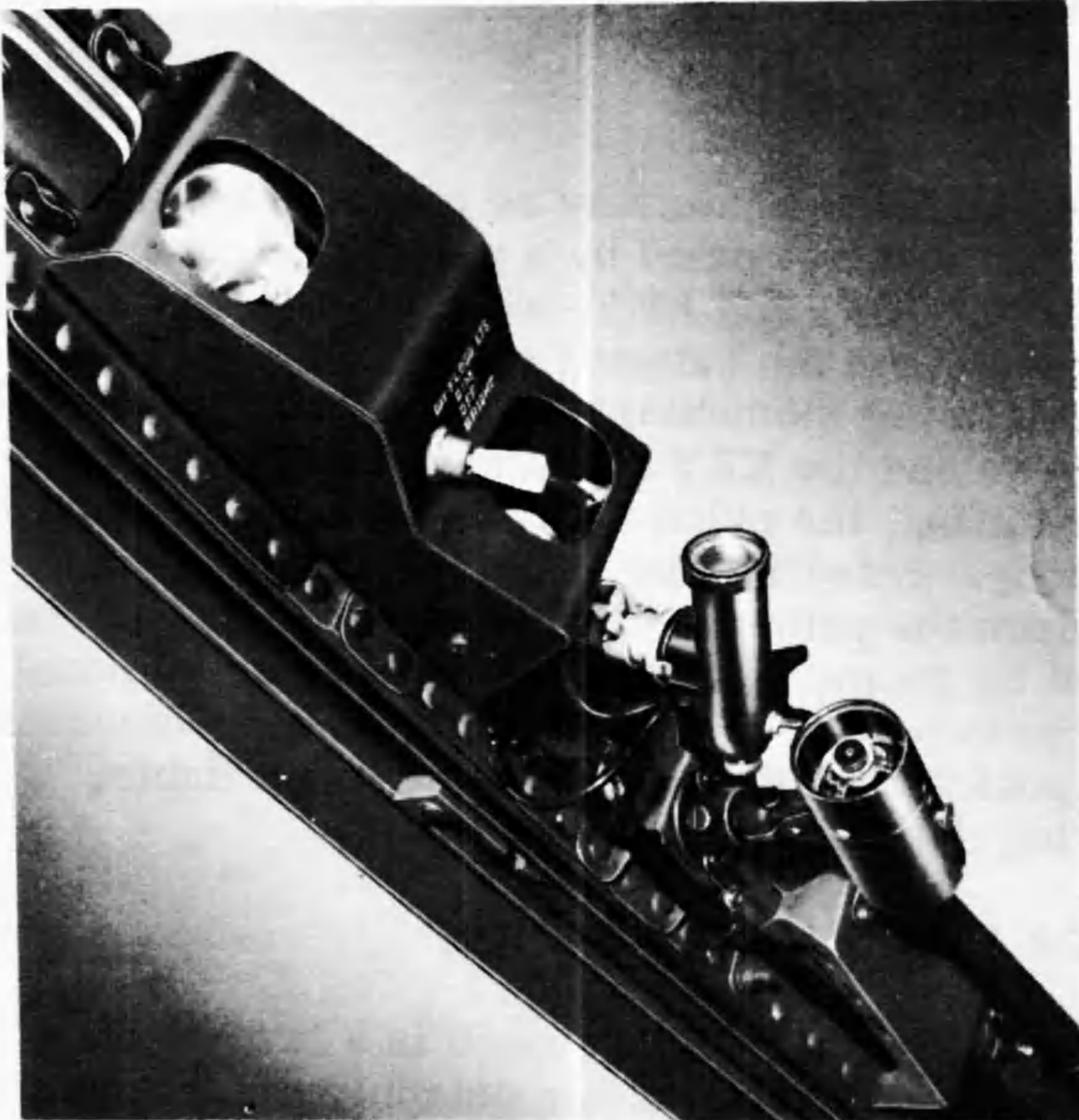
Approach Indexer Light Control

The indexer light thumbwheel on the master light panel (figure 1-33) controls the lighting of the approach light indexer. With the flight instrument thumbwheel set at either dim or bright, rotating the indexer thumbwheel to dim lights the indexer at a low intensity. Conversely, rotating the thumbwheel to bright lights the indexer at maximum intensity.

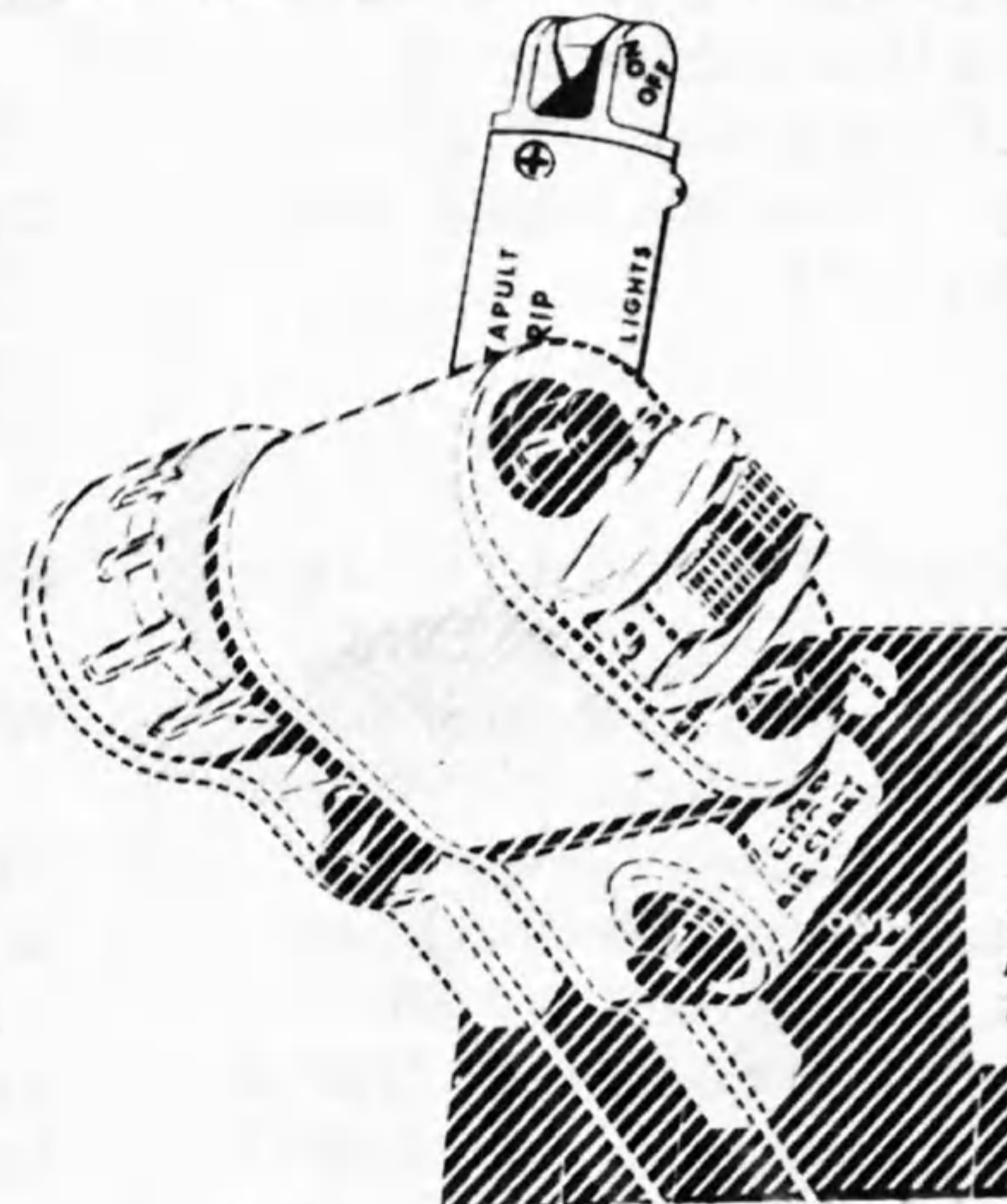
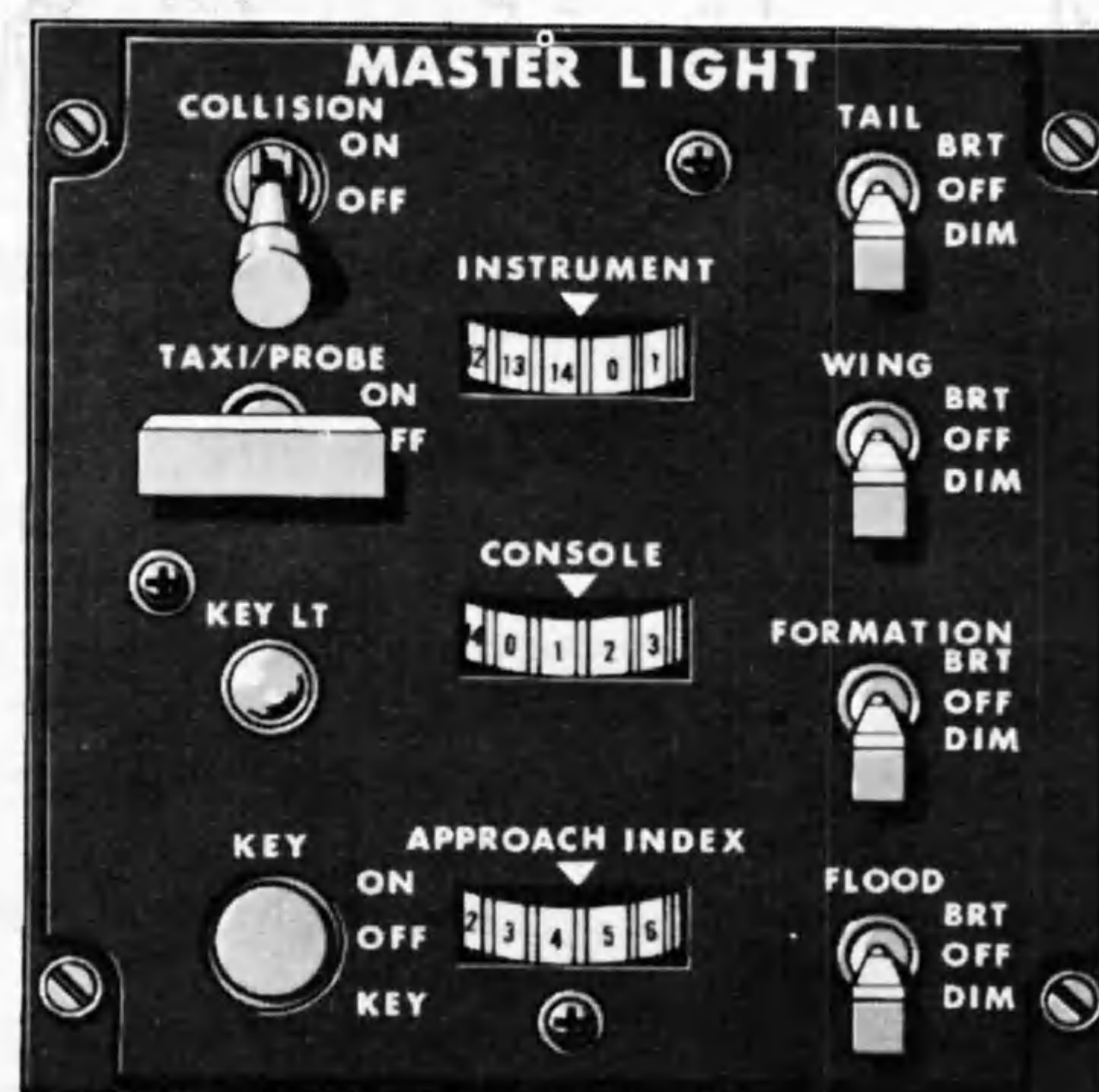
BOMBARDIER/NAVIGATOR'S INTERIOR LIGHT CONTROLS

The lighting control panel (figure 1-33) is on the bombardier/navigator's right console, immediately aft of the oxygen control panel. The function of each of the control switches is provided in the following paragraphs.

LIGHTING CONTROLS



OVERHEAD UTILITY AND FLOODLIGHTS



A-ADF1-32

Figure 1-33

Panel Light Control

The panel light control (figure 1-33) permits the bombardier/navigator to adjust the intensity of the control panel lighting. The control has an OFF and bright (BRT) position, with intermediate positions offering varying degrees of panel light intensity.

Console Light Control

The console light control (figure 1-33) permits the bombardier/navigator to adjust the right console lighting. The control has DIM and bright (BRT) positions, with intermediate positions offering varying degrees of console light intensity.

Note

Lighting of the console cannot be accomplished until the panel light control has first been rotated ON.

Floodlight Control Switch

The floodlight control switch (FLOOD) (figure 1-33) is a three-position toggle switch that controls the floodlights below the canopy sill and below the glare shield. The switch provides for three operating conditions: bright (BRT), DIM, and OFF.

Daylight Floodlight Switch

The daylight floodlight switch (DAY FLOOD LTS) (figure 1-33) is a three-position (BRT, OFF, and DIM) switch on the aft side of the canopy bow that may be actuated by the pilot or bombardier/navigator. When the switch is placed to BRT or DIM, two 40-watt lamps are oriented to illuminate the pilot's and bombardier/navigator's instrument panels and two 20-watt lamps illuminate the left and right consoles. Under normal conditions, the daylight floodlights switch will be in the OFF position and should be used only when there is need for a high-intensity source of light.

EXTERIOR LIGHTING

Position, formation, anticollision, refueling probe, and taxi lights make up the aircraft exterior lighting. The position lights are in the leading edge of the right and left wings, in the trailing edge of the pylons at stations 1 and 5, and in the tail of the aircraft. The right wing position light is green, the left wing position light is red, the pylon position lights are amber, and the tail position light is white. Provisions have been made to permit the pilot to send visual code with the pylon lights. The formation lights are a yellow light on either side of the fuselage (aft of the wing trailing edge), a red light on the left wingtip, and a green light on the right wingtip. Each of the wingtip formation lights contains two lenses: one in the upper portion of the wingtip and the other in the lower portion. Two anticollision lights, one on the vertical stabilizer and one on the nose-gear door fairing, are used on the aircraft. The nose-gear light automatically goes off when the nose gear is extended. Each

of the anticollision lights contains two rotating lamps and a red lens. (For tanker missions a green lens is substituted.) The taxi light is on the nose-gear door fairing. All controls for the exterior lights are on the master light panel (figure 1-33), except the exterior lights master switch pushbutton, which is on the catapult grip.

PYLON LIGHT CONTROLS

The pylon position lights may be operated from the master light control panel by a pylon toggle switch marked ON, OFF, and KEY, when the external lights master switch on the catapult grip is ON. Holding the switch to the momentary KEY position causes the pylon lights and the KEY LT indicator light to come on, permitting the pylon lights to be keyed to send visual code. Selecting the OFF position removes power from the pylon lights. The lights may still be operated by means of the air-refueling control panel master switch when the pylon switch is off. Selecting the ON position applies power to the pylon lights, permitting their use as position lights.

EXTERIOR LIGHTS MASTER SWITCH

The exterior lights master switch is a two-position toggle switch on the end of the catapult grip marked ON/OFF. With the exception of the anticollision lights, no external lights can be turned on until the exterior lights master switch has been set to ON.

EXTERIOR LIGHTING CONTROLS

Wing Light Switch

The wing light switch, on the master light panel (figure 1-38), controls the position lights on the right and left wings. The switch is a three-position toggle switch marked BRT, OFF, and DIM. With the exterior lights master switch pushbutton actuated to ON, placing the wing position light switch to BRT turns the wing position lights on bright, using 28V DC power from the monitored bus. Placing the switch to DIM puts a resistor in series with the lights and dims them.

Tail Light Switch

The tail light switch controls and positions light on the tail. The switch is a three-position toggle switch on the master light panel (figure 1-33) and is placarded BRT, OFF, and DIM. With the exterior lights master switch actuated to ON, placing the tail position light switch to BRT turns the tail position light on bright, using 28V DC power from the monitored bus. Placing the switch to DIM turns on the light at a lesser intensity.

Key Light and Key Pushbutton

The KEY light and KEY pushbutton on the master light panel (figure 1-33) allow the crew to signal with the pylon position lights. Depressing the key pushbutton causes the pylon position lights to come on. The key light reproduces the signal being displayed by the pylon position light. The master lights switch on the catapult grip must be on for the above operation.

Formation Light Switch

The formation light switch on the master light panel (figure 1-33) is a three-position toggle switch marked BRT, OFF, and DIM. The switch controls the formation lights on either side of the fuselage and at the left and right wingtips. With the external lights master switch pushbutton actuated to ON, placing the formation light switch to BRT connects 28V DC power from the monitored bus to all formation lights. Selecting the DIM position of the switch dims the lights by putting a resistor in series with them.

Anti Collision Light Switch

The anticollision light switch controls the anticollision lights on the vertical stabilizer and on the nose-gear door fairing. The switch is a two-position toggle switch on the master light panel (figure 1-33) and has positions marked ON and OFF. Placing the

collision light switch ON directs 115V AC power from the primary bus to the anticollision lights. When the landing gear is extended, the anticollision light relay becomes energized and the anticollision light on the nose-gear door fairing goes off.

Taxi/Probe Light Switch

The taxi/probe light switch on the master light control panel (figure 1-33) is a two-position, bar type switch placarded ON and OFF. The switch controls the taxi light on the nose-door fairing. Placing the switch ON turns on the taxi light when operating with landing gear down and locked.

The switch also controls the in-flight refueling probe light on the forward fuselage. Placing the switch ON turns on the in-flight refueling probe light when landing gear is up and locked. With the landing gear down and locked, the taxi light is lit.

MISCELLANEOUS EQUIPMENT**ARMOR PLATE**

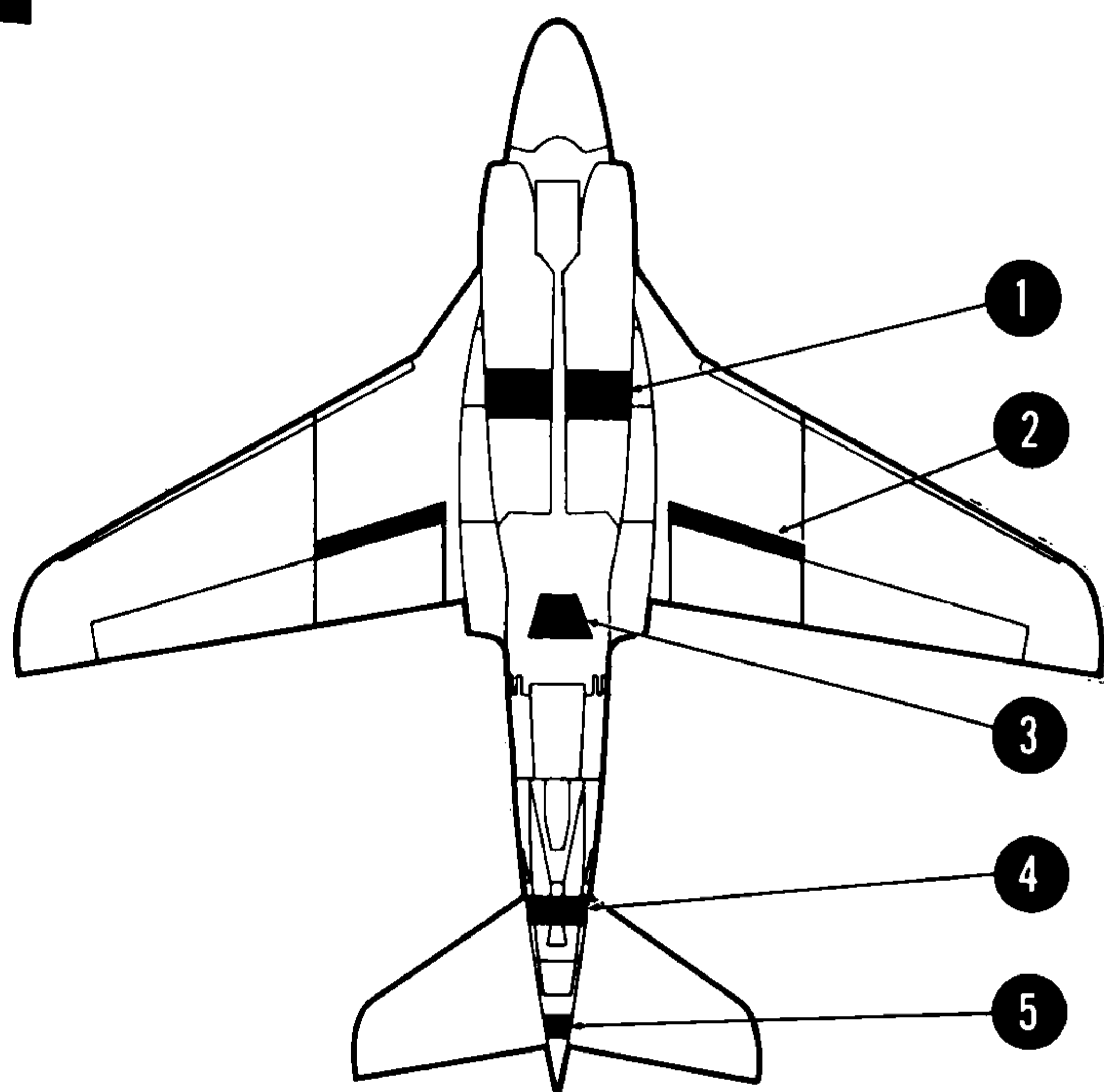
Armor plate is located on the engine access door below the engine accessory sections, below the fuel shutoff valves, below the elevator and rudder hydraulic actuators, on the wings below the flaperon actuators, and below the ECM equipment in the tail section (figure 1-34).

FLAK CURTAINS

The aircraft has provisions for installation to flak curtains or small arms shields. Canopy curtains are installed in the lower left and right sides of the sliding canopy. A slide fastener along the top forward edge may be zippered open and the curtain folded down to improve visibility (figure 1-35).

**INSTALLATION OF ARMOR PLATE FOR
VULNERABLE FLIGHT CONTROL AREAS**

- 1. FUEL CONTROLS**
(External plates over engine access doors)
- 2. FLAPERON ACTUATORS**
(External plates below each wing)
- 3. FUEL VALVES**
(Internal plates wishbone area)
- 4. ECM EQUIPMENT**
(Internal plates)
- 5. ELEVATOR and RUDDER ACTUATORS**
(External plates)

**VIEW LOOKING UP**

ADFI-35

Figure 1-34

Additional protection is installed against the fuselage above the pilot's and bombardier/navigator's consoles. A flak shield is also available for installation on the pilot's left rudder scuff plate (figure 1-35).

RADIATION SHIELDS

The aircraft may be equipped with manually operated radiation shields (figure 1-35) to completely shield off the glass-enclosed portions of the cockpit. The shields present an opaque surface from which light and heat are reflected, providing flight crew protection from flash blindness and heat during special weapons deliveries. The radiation shields may be closed or opened at will during flight.

The canopy radiation shield consists of two fixed and two movable panels of molded fiber glass at each side of the canopy, inside the enclosed area. The two sliding panels are suspended on a system of tracks and rollers between the canopy spine and a fixed side panel. When stowed, both movable panels telescope inside a fixed aft panel. When the shields are in use, they extend forward to the canopy bow, completely blanking out the canopy. The shield assemblies in each side of the canopy move independently of each other and must be manually unlocked and positioned by the pilot and bombardier/navigator. The forward movable panel automatically locks when moved to the full open, half open, or full closed (canopy arch) position.

The windshield radiation shield is an aluminized fiber glass cloth that is attached to the glare shield mounted on top of the instrument panel underneath the windshield. A zipper assembly attached along the entire inner surface of the windshield bow permits the curtain to be drawn up to this position when zippered up by the bombardier/navigator and by the pilot. When closed, it completely shields off the windshields.

EQUIPMENT DESTRUCT SYSTEM

The aircraft contains provisions for automatically destroying certain communications and electronic countermeasures equipment. The destruction system operates automatically when the ejection seats are fired, when the aircraft is subjected to 60 to 80 g's laterally, or when the aircraft is immersed in salt water.

A guarded two-position ECM maintenance safe toggle switch marked ARM and SAFE is in the left boarding-ladder well. When the boarding ladder is down, the switch may be set to SAFE for maintenance. Stowing the boarding ladder moves the switch to ARM.

RELIEF TUBES

The pilot and bombardier/navigator are provided with individual relief tubes. The relief tubes are stowed on the right side of the crewmembers' seats.

NEW

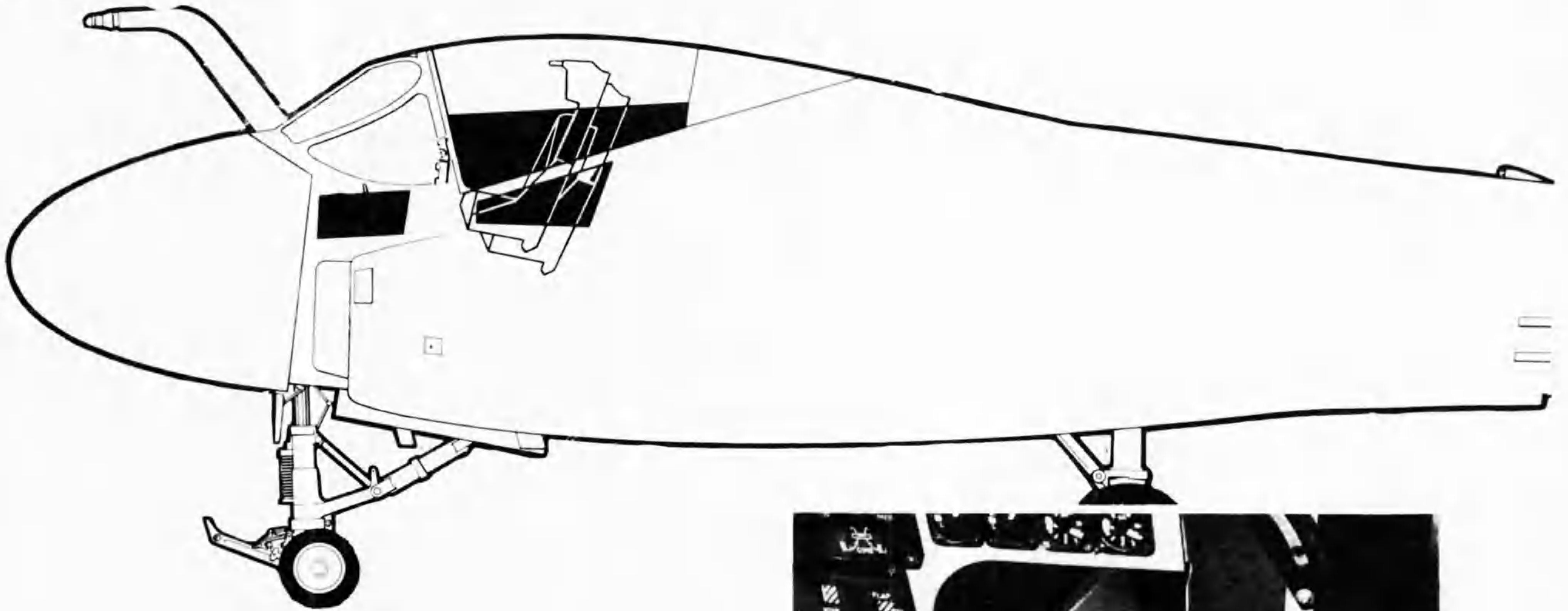
STOWAGE CONTAINERS

Covered rations and data storage containers are on the pilot's left console aft of the optical sight control panel and on the bombardier/navigator's right console. The containers have hinged covers and locking wingnuts.

Ground safety locks and pins are stowed in a compartment in the pilot's boarding-ladder well.

FLAK CURTAINS AND RADIATION SHIELD

FLAK CURTAINS

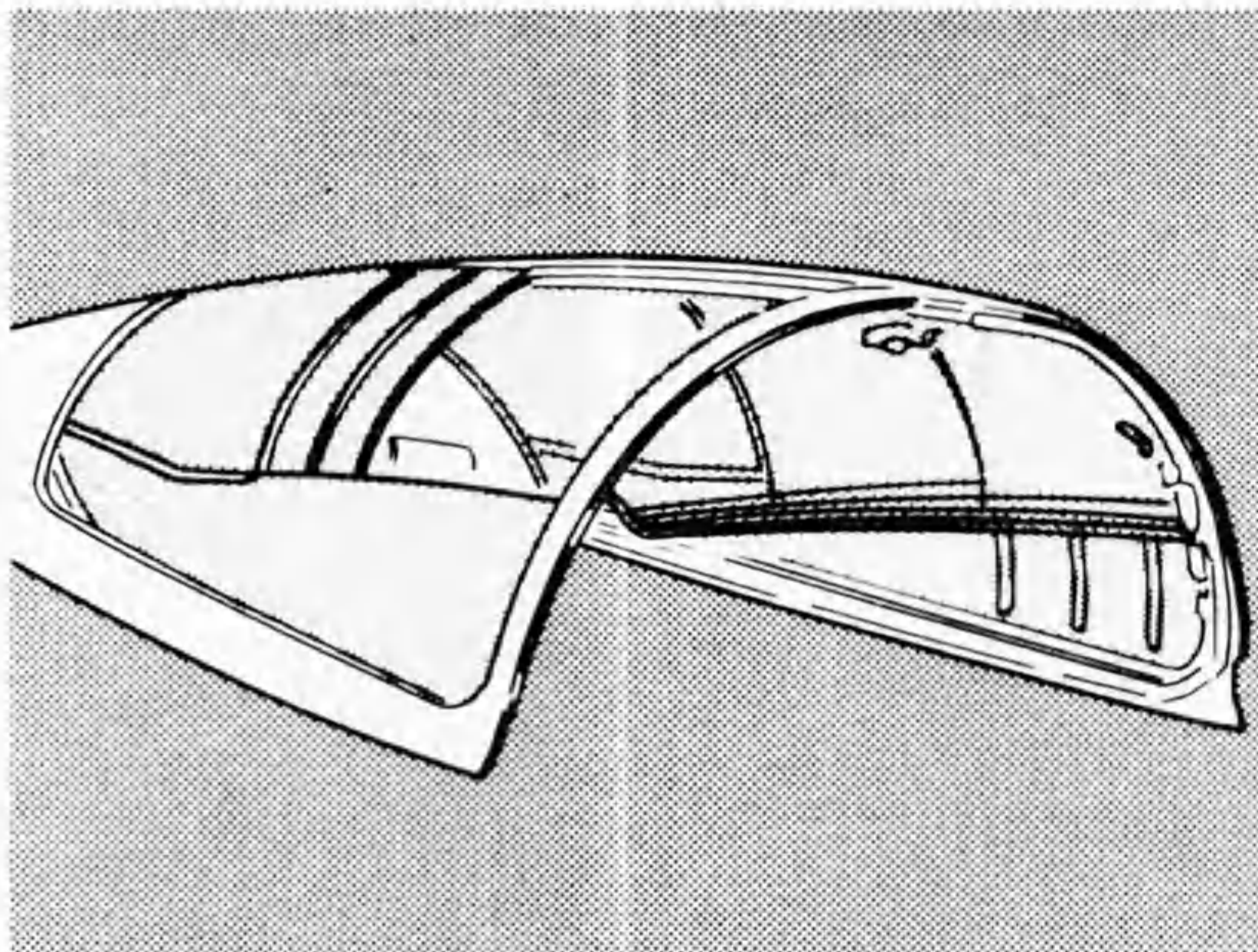


CANOPY FLAK CURTAIN (TYPICAL)

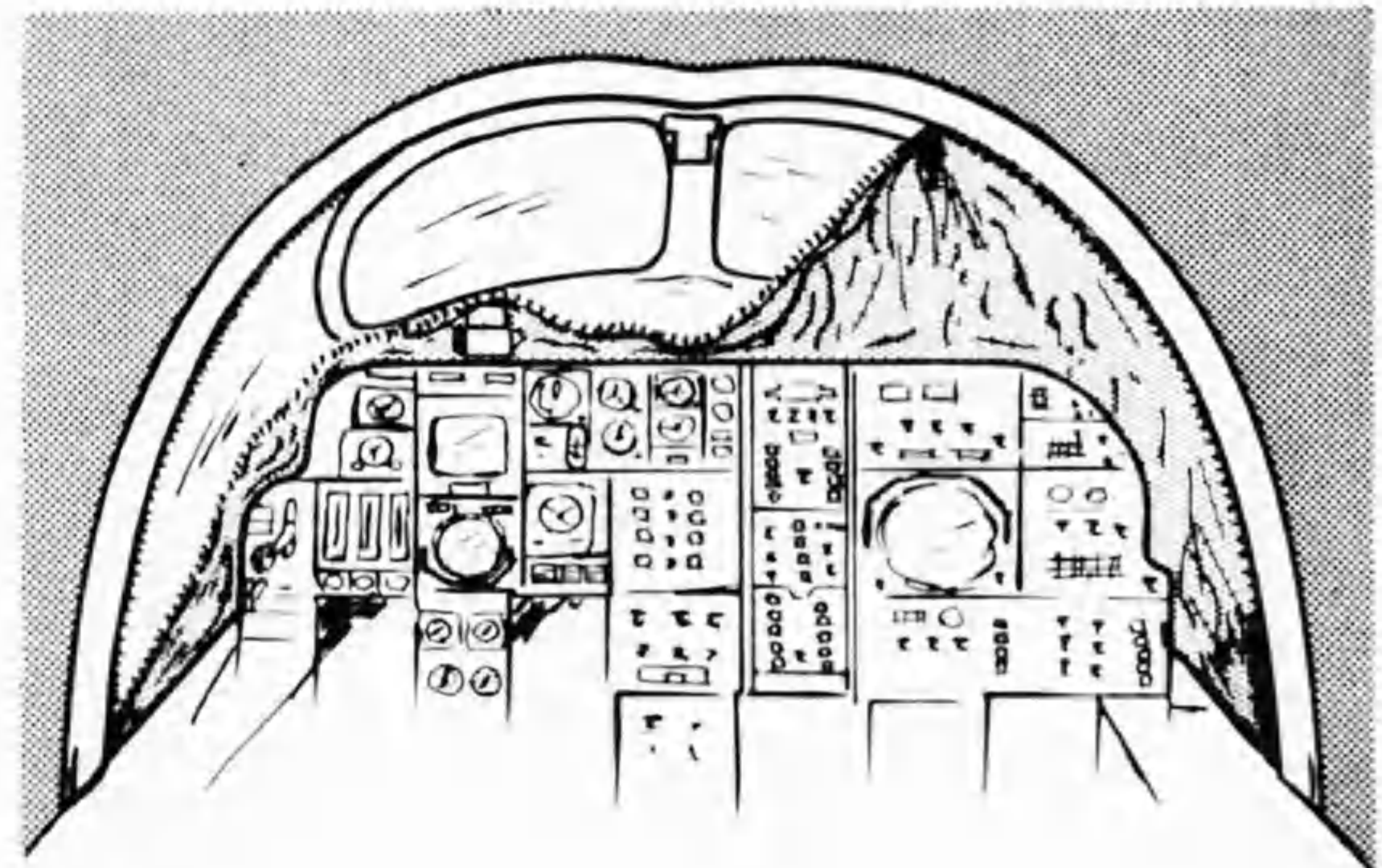


LEFT RUDDER SKUFF PLATE SHIELD

RADIATION SHIELDS



EXTEND TELESCOPING SECTIONS



ZIP-UP FORWARD LINING

A-ADFI-36

Figure 1-35

part 3

Aircraft Servicing

AIRCRAFT SERVICING

The following servicing data is provided to lend assistance if the aircraft lands at a strange field or the maintenance crews are unfamiliar with the aircraft. See figure 1-37 for servicing diagram.

Note

When operating in and out of military airfields, consult the current DOD IFR Supplement for compatible servicing units, fuel, etc.

AIRCRAFT FUELING

The aircraft can be fueled and defueled on the ground through a single-point pressure adapter (figure 1-37). The ground fueling and defueling operation is controlled at the fueling station control panel (figure 1-37). The switches on the fueling station control panel operate shutoff valves in the aircraft fuel system, thereby controlling fuel flow into or out of the internal fuel cells of the fuselage, integral wing tanks, and air refueling store. The aircraft can be fueled with wings folded or spread; however, in order to empty the outboard wing tanks, the wings must be spread during defueling operations.

PNEUMATIC PRESSURES

- 1. Ram-air turbine accumulator 500 PSI
- 2. Combined hydraulic accumulator . . . 2,000 PSI
- 3. Flight hydraulic accumulator 2,000 PSI
- 4. Wheel brake accumulator 800 ± 50 PSI
- 5. Canopy jettison pressure 2,400 ± 50 PSI bottle
- 6. Arresting-hook dashpot pressure. . . 1,000 PSI (dry nitrogen)
- 7. Emergency landing gear bottles . . . 2,450 PSI (dry nitrogen)

- 8. Landing gear strut pressures
 - a. Nose gear 350 PSI (dry nitrogen)
 - b. Main gear see strut nameplates
- 9. Pneumatic starting 100 LBS at 50 PSI compressor

DANGER AREAS

See figures 1-38 and 1-39.

TURNING RADIUS AND GROUND CLEARANCE

See figures 1-40 and 1-41.

POWER REQUIREMENTS

Power requirements for ship-board and shore-based operations are as follows:

- 1. Pneumatic starting and electrical power - 23 KVA
- 2. BACE (all black boxes) - 21 KVA
- 3. Air Force power units providing 28V DC require the use of an adapter.

POWER UNITS				
	PNEUMATIC STARTING	ELECTRICAL POWER	COMBINATION UNITS	AIR CONDITIONING
SHORE BASED	GTC-85-28 GTC-85-72 MA - 1, MA - 1A MA - 2	NC-12, NC-10 MD - 3 MD - 3A	MA - 1MP MA - 2MP MA - 3MP	NR-3, NR-4 NR - 10
SHIPBOARD	GTC-85-28 GTC-85-72	DECK EDGE POWER NC-10		NR-3, NR-5
AGE REQUIREMENTS	40-50 PSI AT 90 TO 91 LBS. PER MIN., 100° TO 425°F.	115/200V 400 CPS. AC 23 KVA.		3 PSI, 45 LBS PER MIN., 35 TO 50 F.

ADF1-68

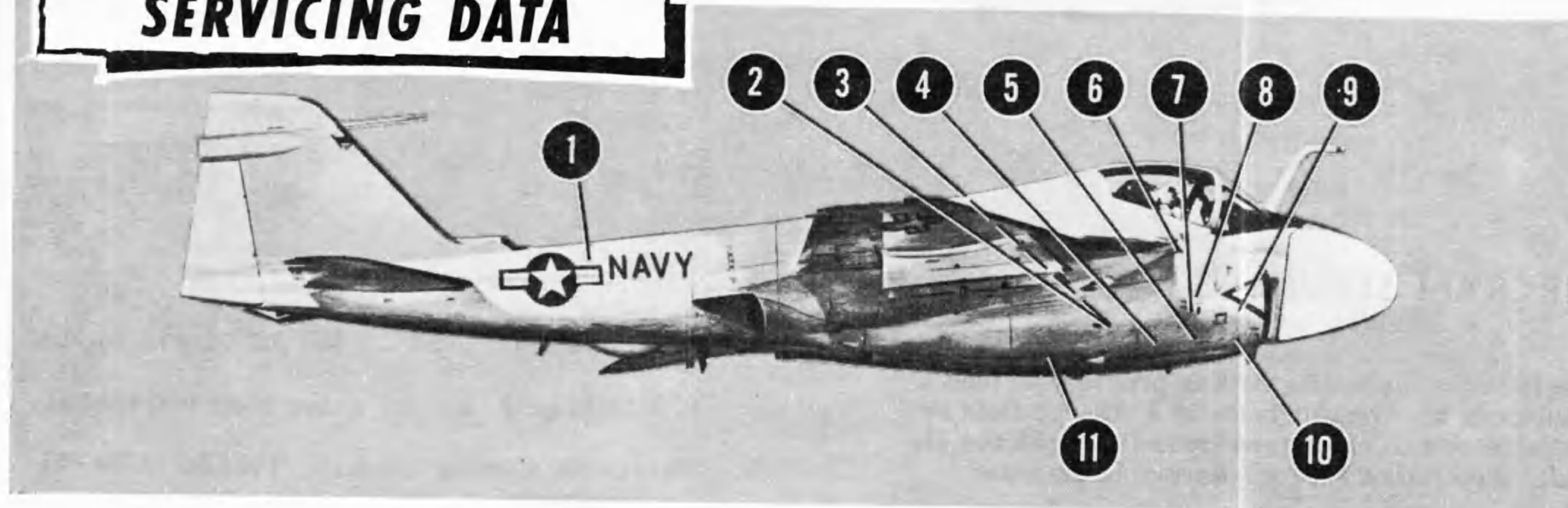
Figure 1-36

RESERVOIR CAPACITIES

Reservoir capacities are as follows:

- 1. Flight hydraulic system reservoir - 0.74 gallons.
- 2. Combined hydraulic system reservoir - 3.34 gallons.

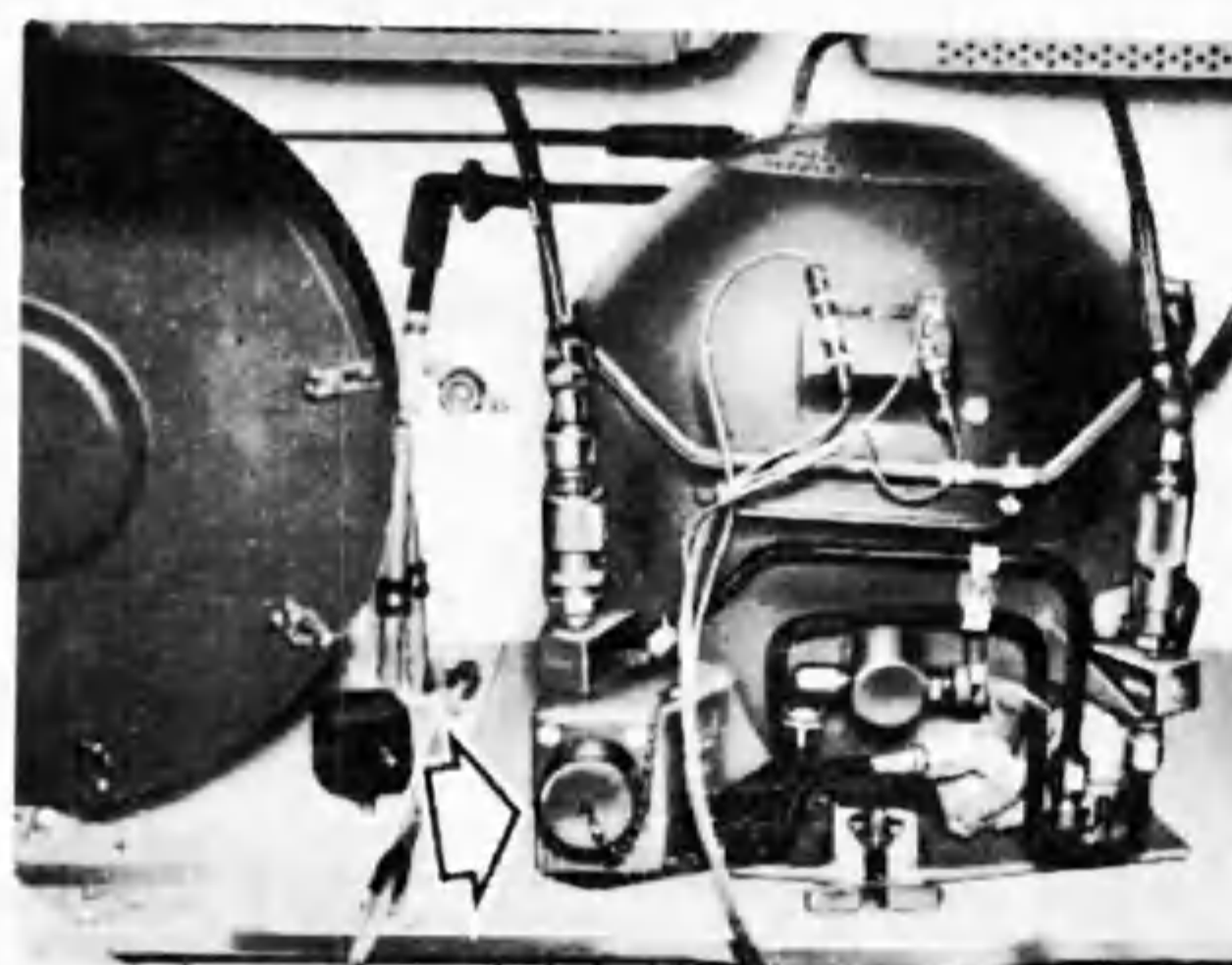
SERVICING DATA



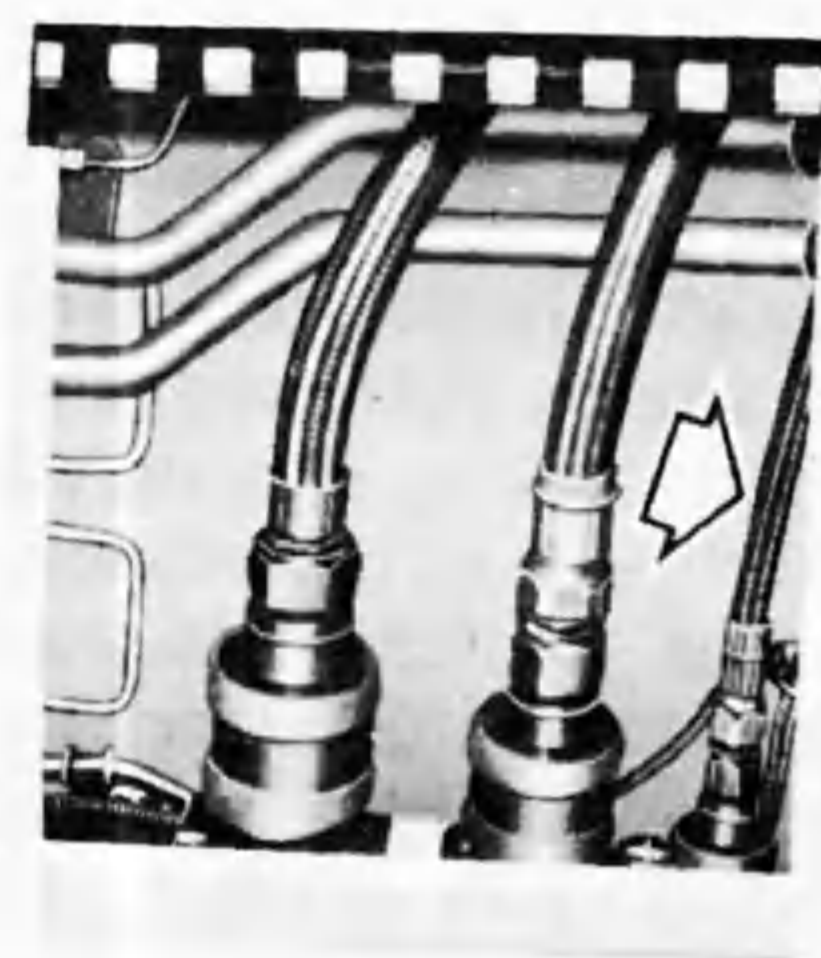
* FUEL GRADE SELECTOR ON ENGINE FUEL CONTROL MUST BE SET FOR GRADE OF FUEL USED

** OIL MIL-L-7808 SHOULD BE USED WHEN GROUND TEMPERATURES ARE - 40°C (- 40°F) AND BELOW IN WHICH COLD STARTING CAN BECOME A PROBLEM

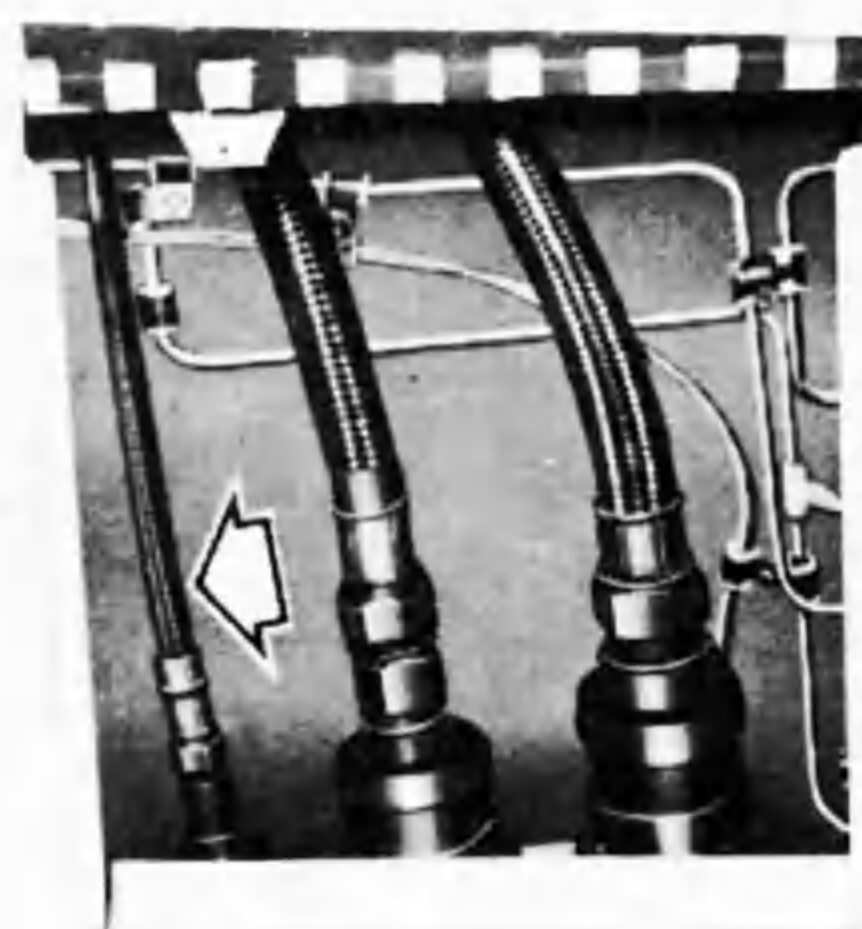
* FUEL	MIL-J-5624 (JP-5 OR JP-4)
HYDRAULIC FLUID	MIL-H-5606
LIQUID OXYGEN	MIL-O-27210 (TYPE II)
OIL	MIL-L-23699 ** MIL-L-7808
WINDSHIELD WASH METHANOL	MIL-O-M-232D



1 LIQUID OXYGEN FILLER VALVE



2 FLIGHT HYDRAULIC SYSTEM FILLER LINE (RIGHT SIDE)



3 COMBINED HYDRAULIC SYSTEM FILLER LINE (LEFT SIDE)



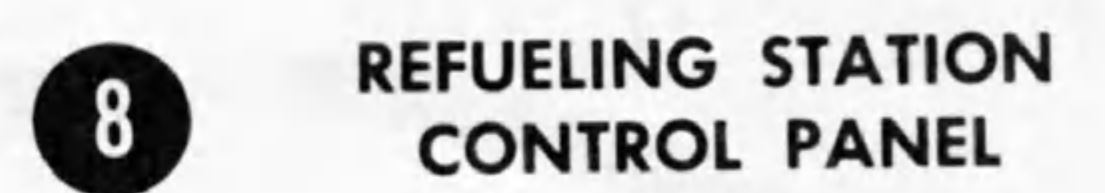
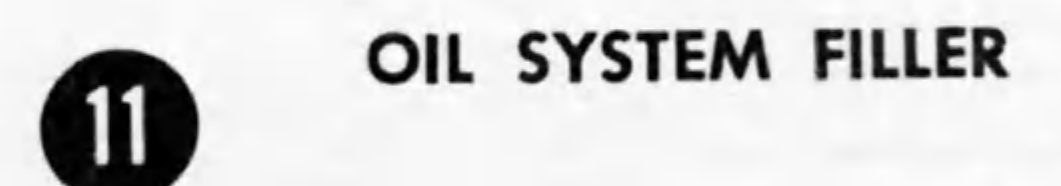
4 ENGINE STARTING RECEPTACLE



5 CSD/S FILLER

ADFI-40-1

Figure 1-37 (Sheet 1)



3. Oxygen converter - 10 liters
4. Auxiliary oxygen converter - 10 liters

TIRES

Tires sizes for the aircraft are:

- Mains - 36x11-24 P.R. Type VII
- Nose - 20x5.5-12 P.R. Type VII or
20x5.5-14 P.R.

Note

Do not mix 12 P.R. and 14 P.R. 20x5.5 tires on nose wheel.

Minimum Tire Inflation Pressures

- Mains - 230 PSI (carrier) - As shown in figure 1-37 (land)
- Nose - 290 PSI (carrier) - 175 PSI (land)

NEW

NEW

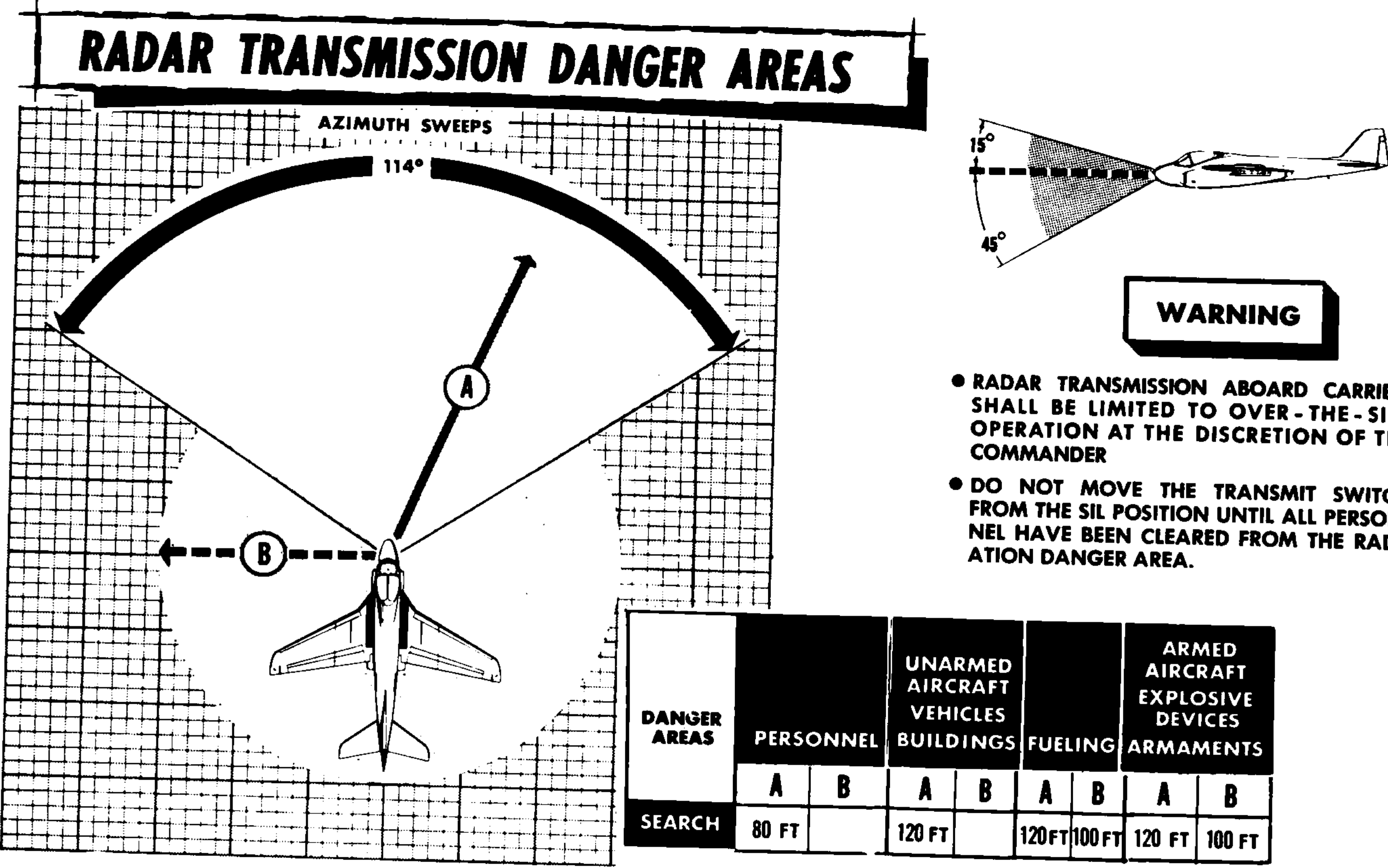


Figure 1-38

ADF1-57

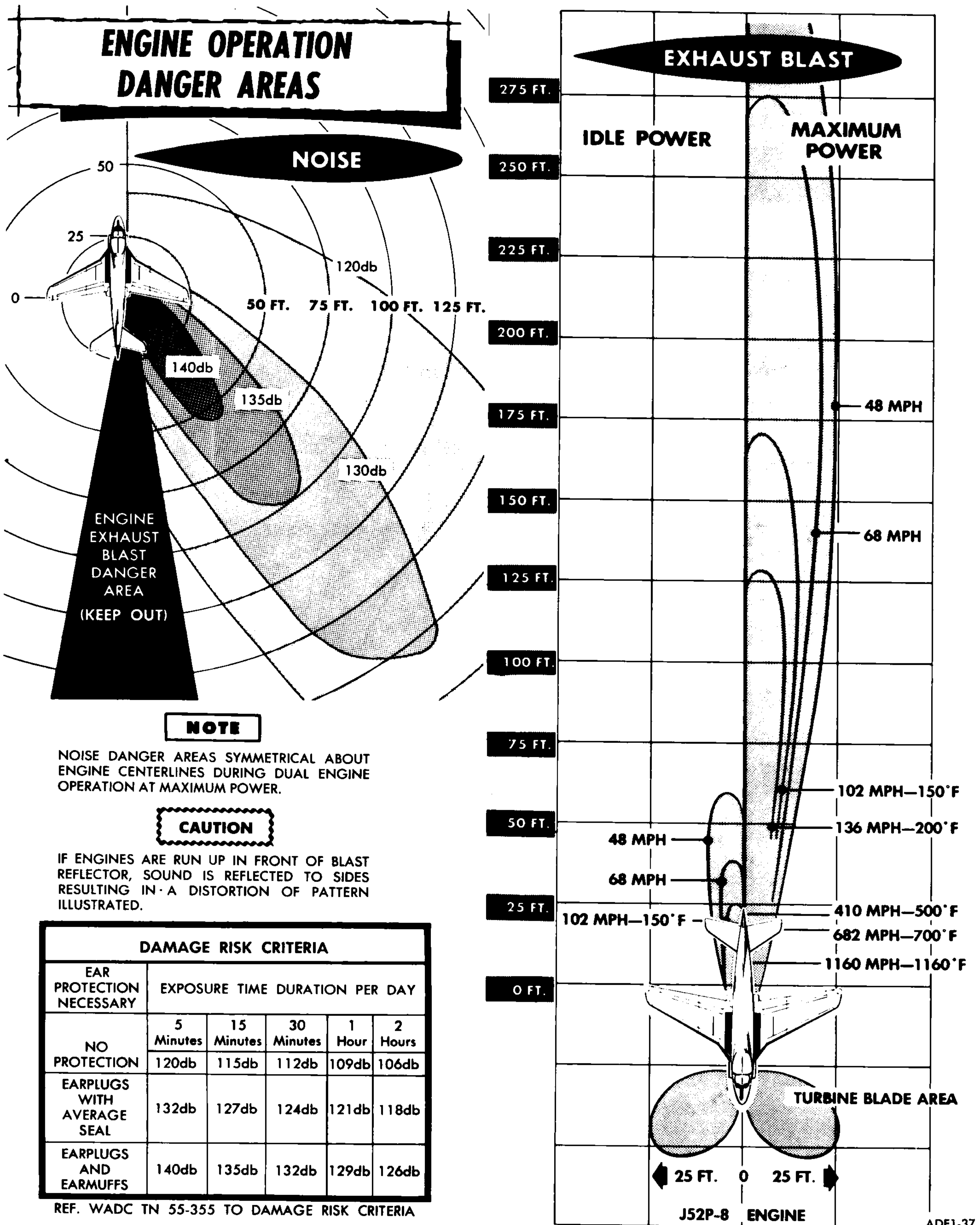
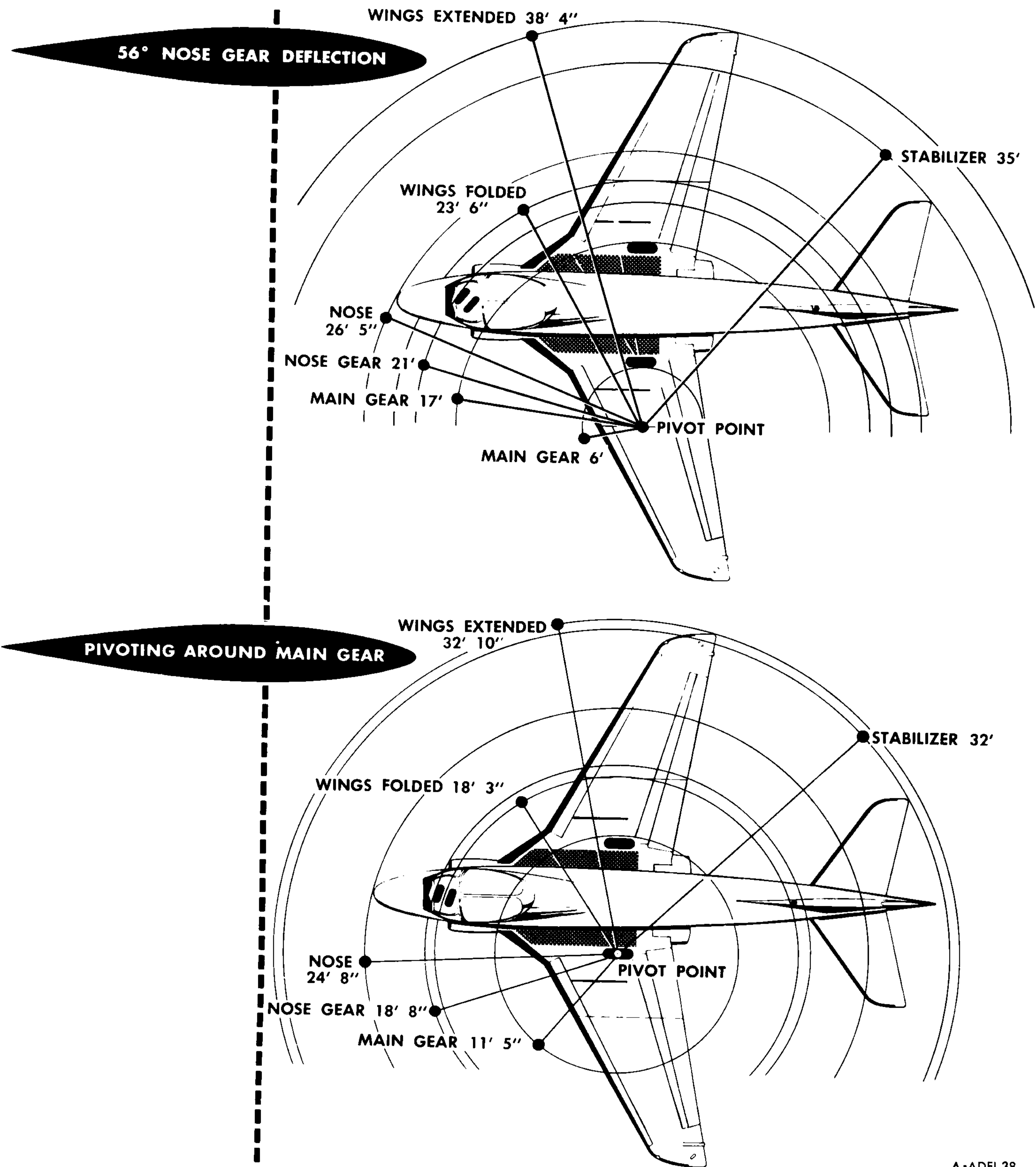


Figure 1-39

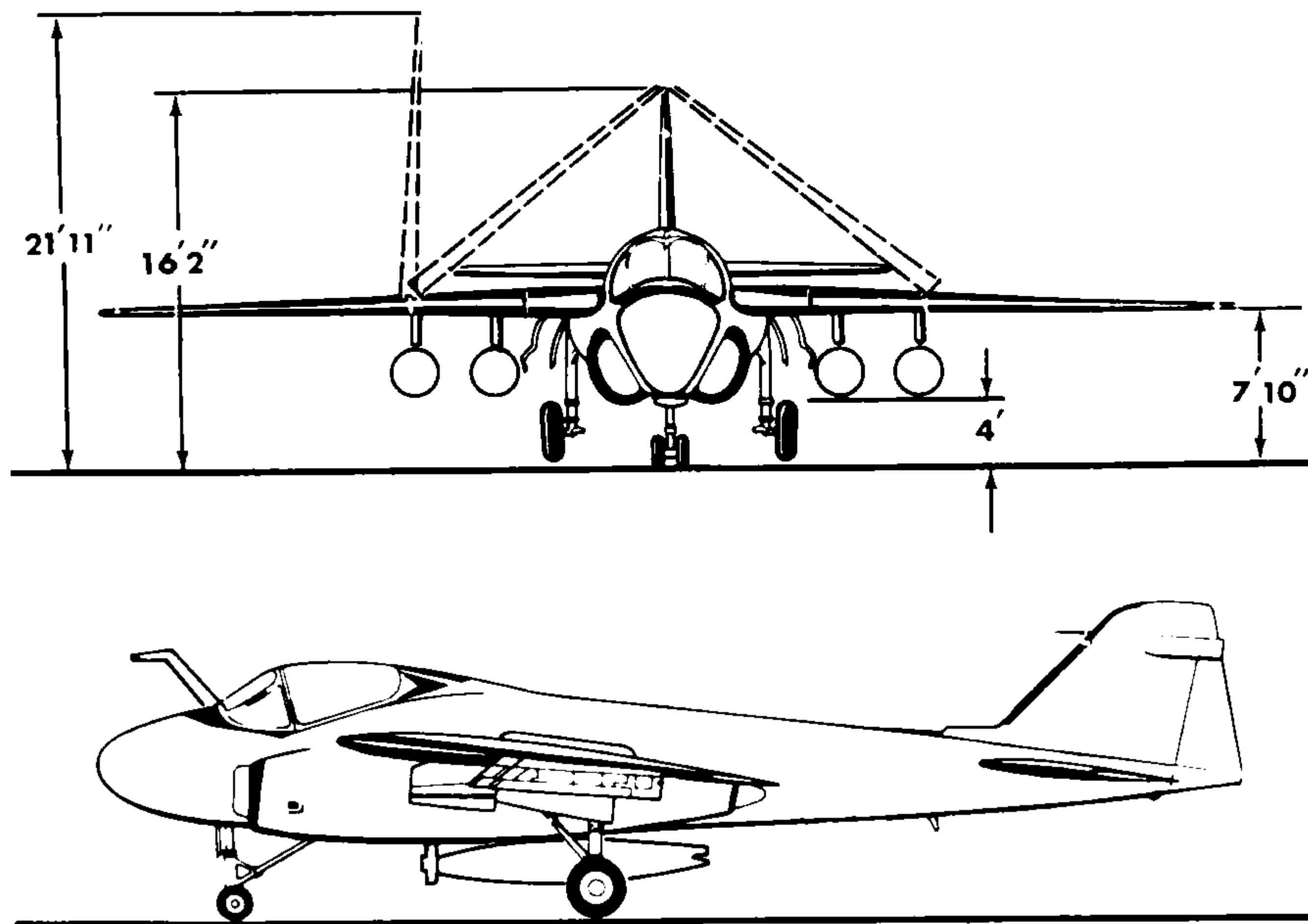
TURNING RADIUS



A-ADFI-38

Figure 1-40

GROUND CLEARANCE



CENTER LINE CLEARANCES

D-704 REFUELING STORE

CATAPULTING (59,000 LB.)

AERO 7A : 9 INCHES

AERO 7B : 11 INCHES

LANDING

AERO 7A : 9 1/4 INCHES

AERO 7B : 11 1/2 INCHES

STATIC (53,000 LB.)

AERO 7A : 13 1/4 INCHES

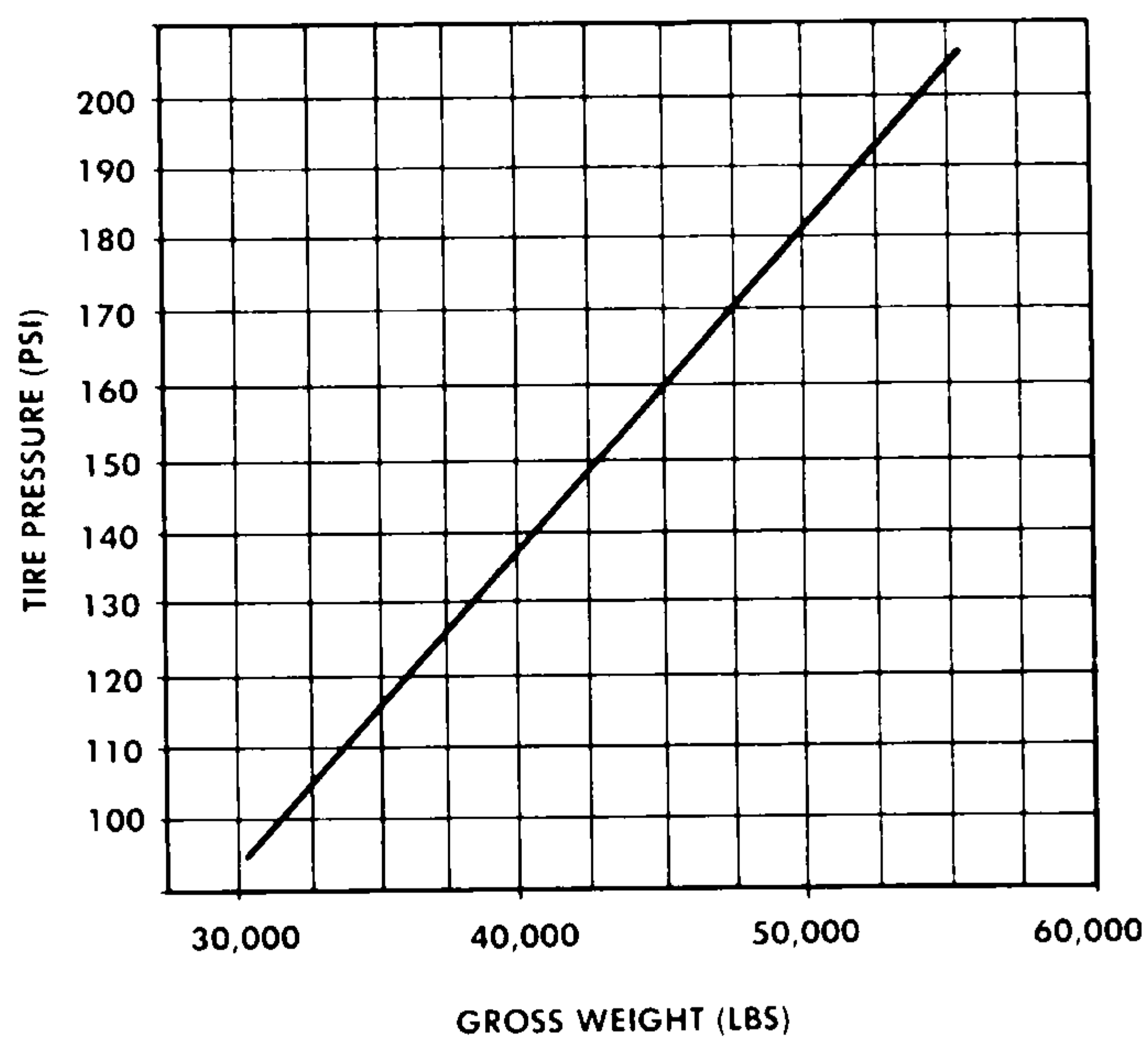
AERO 7B : 15 1/2 INCHES

A ADF1-39

Figure 1-41

TIRE PRESSURE CHART

LAND OPERATION—MAIN WHEELS



ADF1-43

Figure 1-42

part 4

Aircraft Operating Limitations

INTRODUCTION

This section includes the aircraft and engine limitations that must be observed during normal operation. Instrument markings giving various operation limitations are shown in figure 1-43. Some markings that are self-evident are not discussed in the text.

ENGINE LIMITATIONS

Engine limitations are shown in figure 1-44. Additional information is given in the following paragraphs.

ENGINE OVERSPEED

Should the engine overspeed limit of 102.5% on the J52-P-8 engine be exceeded, the engine must be inspected for damage. Log condition on the yellow sheet (OP-NAV Form 3760-2) to insure inspection. Should the maximum permissible engine overspeed limit of 102.9% rated rpm be exceeded on the J52-P-8 engine, the engine must be changed.

ENGINE IDLE

CAUTION

- A minimum speed of 65% should be maintained during idle letdown to insure that the generators will continue to produce required output while under high electrical loads. This may require advancement of the throttle(s) off the IDLE stop.
- A minimum engine speed of 75% should be maintained during glide/reduced power bombing runs and during high-g or high-speed maneuvers to minimize the possibility of hung accelerations/burner can blowout.

ENGINE OIL PRESSURE

Normal oil pressure is 40 to 50 PSI with a minimum of 35 PSI at idle. Oil pressures between 35 and 40 PSI are undesirable and should be tolerated only for the completion of the flight, preferably at a reduced throttle setting. Oil pressures below normal should be reported as an engine discrepancy and should be

corrected before the next flight. Oil pressures below 35 PSI are unsafe and require that either the engine be shut down or a landing be made as soon as possible, using the minimum thrust required for safe flight.

ENGINE EXHAUST GAS TEMPERATURE

The engine exhaust gas temperatures (EGT) are given in figure 1-44 for starting and acceleration conditions. They are time-limited to momentary for starting and 8 minutes for acceleration. Momentary is considered a period not to exceed 15 seconds.

AIR STARTS

Refer to Air Start Envelope, Section V.

AIRSPEED LIMITATIONS

MAXIMUM AIRSPEEDS

The maximum permissible indicated airspeed in smooth or moderately turbulent air for the aircraft in the basic configuration is the maximum attainable; i.e., the aircraft is drag limited.

Note

Basic configuration is landing gear and flaps retracted, and canopy closed.

Landing Gear

Extended	250 KIAS
Extending	250 KIAS
Retracting	200 KIAS

Flaps/Slats

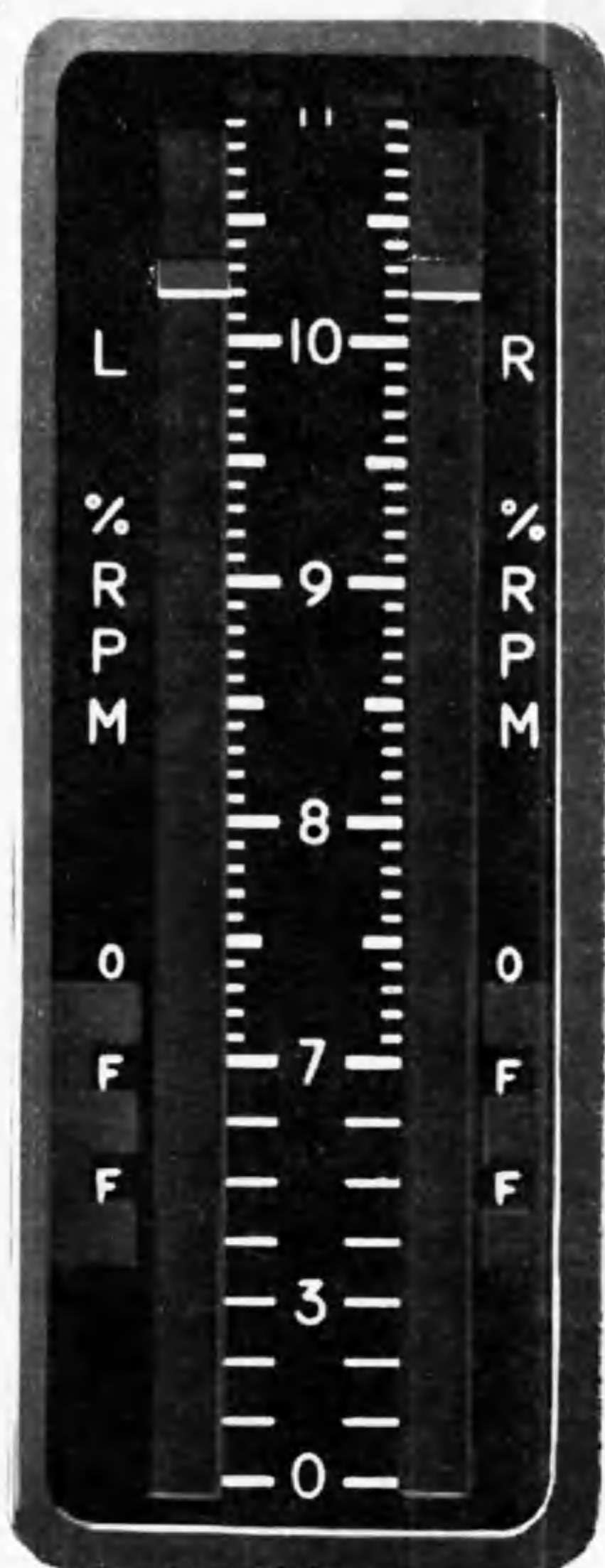
Takeoff position or less	250 KIAS
Land position.	200 KIAS

NEW

INSTRUMENT MARKINGS

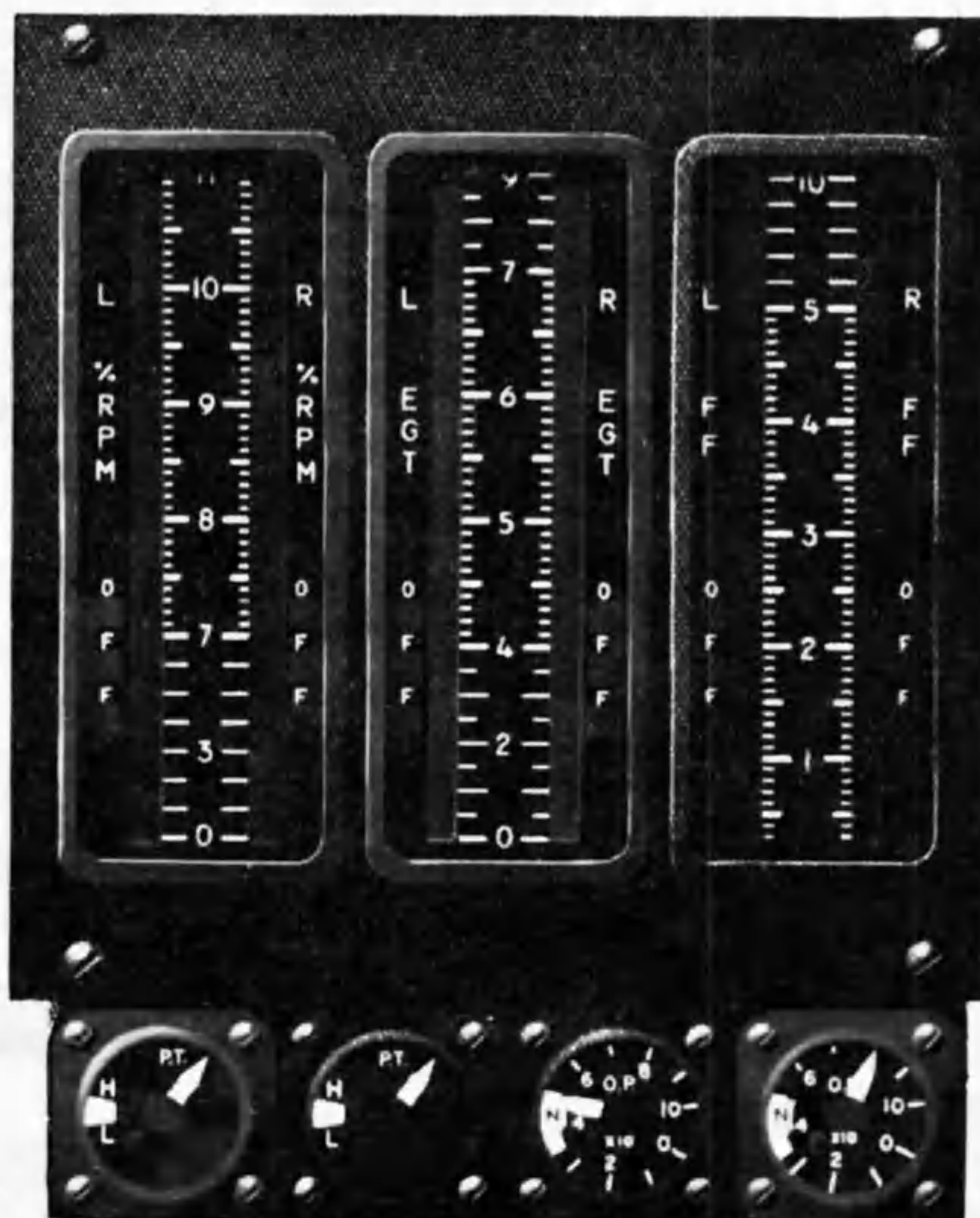
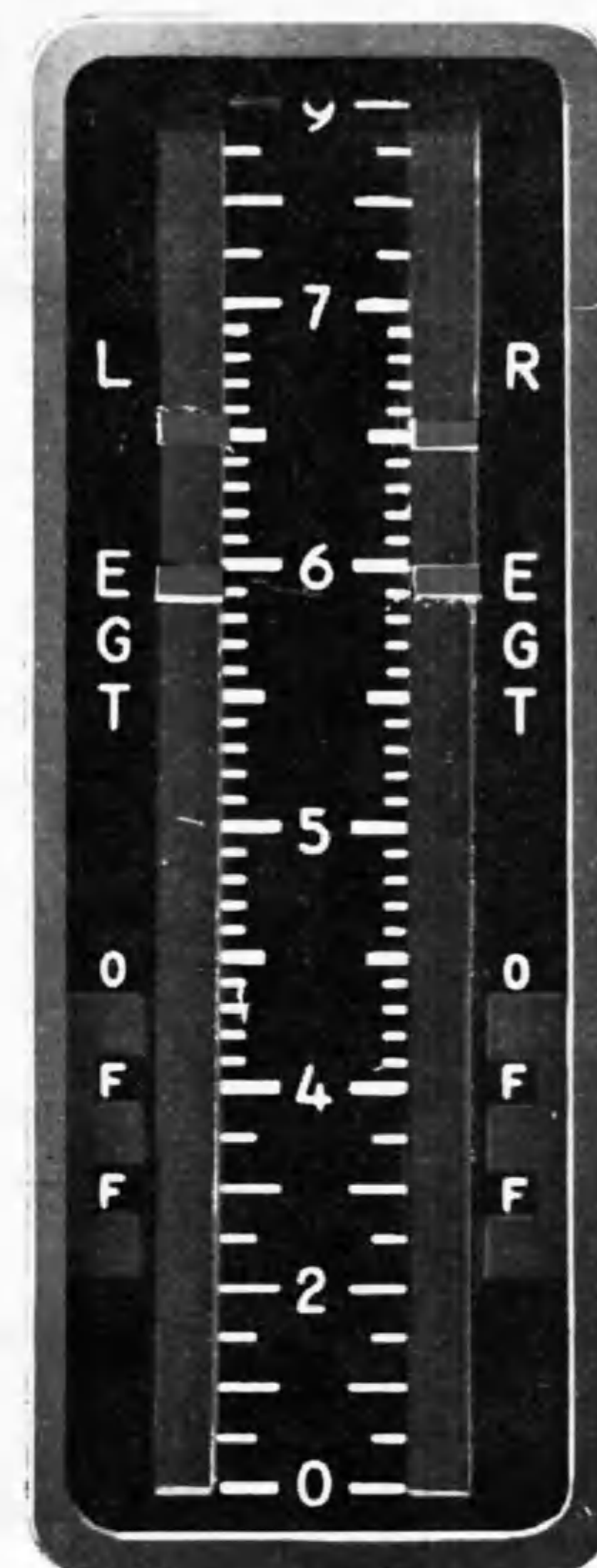
ENGINE J52-P-8A/B

BASED ON JP-5 FUEL



TACHOMETER

102.9% MAXIMUM OVERSPEED



EXHAUST TEMPERATURE

650°C MILITARY POWER
594°C NORMAL RATED



POWER TRIM

NORMAL RANGE



OIL PRESSURE

35 PSI MINIMUM (GROUND IDLE)
35-40 PSI CAUTION
40-50 PSI CONTINUOUS
50 PSI MAXIMUM

ADF1-41

Figure 1-43

ENGINE OPERATING LIMITS

J-52 P-8 ENGINES

OIL: MIL-L-23699

FUEL: MIL-J5624D
GRADE: JP-5 or JP-4

EGT LIMITS	ANY EGT LIMITS EXCEEDED SHOULD BE REPORTED AS A DISCREPANCY AND MAXIMUM TEMPERATURES REACHED AND LENGTH OF TIME NOTED.	
THRUST SETTING	MAXIMUM OBSERVED EGT (°C)	TIME LIMIT (MINUTES)
ACCELERATION	677°	8 MINUTES
MILITARY	650°	30 MINUTES (ACCELERATION TIME INCLUDED)
NORMAL RATED	594°	CONTINUOUS
90% NORMAL RATED (CRUISE)		
75% NORMAL RATED		
IDLE		
STARTING	455°	MOMENTARY

RPM LIMITS ANY OVERSPEED LIMIT EXCEEDED SHOULD BE REPORTED AS A DISCREPANCY AND MAXIMUM RPM NOTED.	OIL PRESSURE LIMITS MIL-L-23699
52 to 60% RPM - IDLE 102.5% RPM - OVERSPEED, Engine inspection required. 102.9% RPM - OVERSPEED, Engine change required.	35 PSI - MINIMUM AT GROUND IDLE RPM 40 PSI - MINIMUM 50 PSI - MAXIMUM

NOTES
(1) NORMAL OIL PRESSURE IS 40 TO 50 PSI. EXCEPT AT IDLE, OIL PRESSURES BETWEEN 35 AND 40 PSI ARE UNDESIRABLE AND SHOULD BE TOLERATED ONLY FOR THE COMPLETION OF THE FLIGHT, PREFERABLY AT A REDUCED THROTTLE SETTING. OIL PRESSURES BELOW NORMAL SHOULD BE REPORTED AS AN ENGINE DISCREPANCY AND SHOULD BE CORRECTED BEFORE THE NEXT TAKE-OFF. OIL PRESSURES BELOW 35 PSI ARE UNSAFE AND REQUIRE THAT EITHER THE ENGINE BE SHUT DOWN OR A LANDING BE MADE AS SOON AS POSSIBLE, USING THE MINIMUM THRUST REQUIRED FOR SAFE FLIGHT.
(2) (OIL MIL-L-7808 SHALL BE USED WHEN CONTINUOUS GROUND COLD SOAK TEMPERATURES BELOW -40°F. ARE ANTICIPATED).

Figure 1-44

WARNING

- Extreme caution should be exercised during flap retraction under heavy gross weight conditions. To avoid aircraft stall or settling due to flap retraction, do not retract the flaps below 170 KIAS for weights up to 50,000 pounds and not below 185 KIAS for weights above 50,000 pounds. At the heavier weights and under high ambient temperature conditions, acceleration and climb performance are marginal and it may be impossible to reach 185 KIAS. If 185 KIAS cannot be reached, it is recommended that external store weight be reduced in order to permit acceleration to 185 KIAS prior to flap retraction.
- If a barber pole indication on slat/flap retraction should occur after takeoff, power must be maintained at military and airspeed controlled within limits (170 KIAS or 185 KIAS as applicable) by adjusting aircraft attitude. Power reduction or diversion of attention must not be attempted until reaching safe operating altitudes.

CAUTION

If a wave-off is initiated with flaps in the LAND position (40°), insure that they are retracted to the TAKE-OFF position (30°) prior to reaching 200 KIAS in order to prevent structural failure to the flap actuating mechanism. The flap drive system does not provide a blowback feature.

Flaps/Slats Emergency (40° LAND)

CAUTION

Emergency extension of the flaps to the terminal (LAND) position above 160 KIAS will result in a burned-out clutch in the gear box and complete loss of flap operation.

Canopy

Opened	250 KIAS
Opening	200 KIAS
Closing	150 KIAS
Jettisoning (maximum recommended)	220 KIAS

Note

Although canopies have safely separated from the aircraft above 200 KIAS, no flight test data are available on jettisoning the canopy above this airspeed.

Ram-Air Turbine

Extension	Maximum Airspeeds
Retraction	475 KIAS

Note

The minimum recommended airspeed to ensure full electrical output is 110 KIAS.

Speed Brakes

Partial or Full Extension Maximum Airspeeds

Rain-Removal System

Operating 200 KIAS

Air Refueling

Drogue Extension.	300 KIAS
Drogue Retraction	250 KIAS
Drogue Unfeathering	300 KIAS
Refueling Store Jettison.	300 KIAS

EQUIPMENT COOLING

CAUTION

- Operation without cooling of any electronic equipment requiring forced cooling should be limited to 5 minutes to prevent failure from overheating. Without engines running or ground cooling applied, ground blower operation is automatic when external electrical power is applied and the search radar, computer, or CNI systems are turned on.
- Electronic equipment should not be operated without aircraft air conditioning on or external cooling air applied when ambient air temperature exceeds 103° F or when the aircraft is located in an enclosed, poorly ventilated area.
- The CNI equipment, which is normally force-cooled, is provided with an auxiliary cooling blower in aircraft incorporating AFC No. 268. The blower operates any time cooling air from the environmental system is not available.

ACCELERATION LIMITATIONS

Except that moderate and heavy buffeting shall be avoided, the maximum permissible accelerations for flight with wing-tip speed brakes retracted are (figures 1-46 and 1-47):

Symmetrical flight	-2.4 to +6.5g
Asymmetrical flight	-1.0 to +5.2g

With wing-tip speed brakes extended, the maximum permissible accelerations are (figures 1-48 and 1-49):

Symmetrical	-2.4 to +6.0g
Asymmetrical	-1.0 to +4.8g

Whenever a MER or MBR installed on any aircraft wing station has stores loaded asymmetrically fore and aft, observe the following carriage limits:

RACK ASYMMETRY (LB)	ACCELERATION (G)
600 to 1,200	-1.0 to +4.5
1,300 to 1,800	-1.0 to +3.5
1,800 or greater	-1.0 to +2.5

As gross weights are increased above 37,000 pounds (figure 1-46), the permissible accelerations are decreased in order to maintain a constant $g \times G.W.$ product. To approximate the maximum permissible accelerations at these higher gross weight conditions, reduce load factor by 0.15 g for every 1,000 pounds above 37,000 pounds.

When flying in conditions of moderate turbulence, it is essential that accelerations due to deliberate maneuvers be limited to 5.0 g in order to minimize the possibility of overstressing the aircraft as a result of the combined effects of gusts and maneuvering loads.

LANDING CONFIGURATION

Zero g to +2.0 g is permitted in the landing configuration.

CENTER OF GRAVITY LIMITATIONS

MAXIMUM FORWARD C.G.

Gear Up	20.5% MAC
Gear Down (Landing)	20.5% MAC
Gear Down (Takeoff)	23.0% MAC

MAXIMUM AFT C.G.

Gear Up	28.7% MAC
Gear Down (Landing & Takeoff).	29.0% MAC

GROSS WEIGHT LIMITATIONS

The maximum recommended gross weights are as follows:

Field takeoff	60,400 pounds
Field landing (minimum rate of descent)	45,000 pounds
Field landing (other than minimum rate of descent), FMLP, and field arrestments	36,000 pounds
Catapulting.	58,600 pounds
Carrier landing and carrier arrestments	36,000 pounds
Barricade engagement	33,000 pounds
Field arrestment	See Section V

CAUTION

Landings other than field landings (minimum rate of descent) are not permitted if the total weight of external stores (excluding pylons with Aero-7 but including racks), on stations 1, 2, 4, and 5 exceeds 4,000 pounds or if the sum of the weight of stores on aircraft stations 1 and 2 or on stations 4 and 5 exceeds 2,000 pounds. For asymmetric external store loadings, the static moment shall not exceed 21,150 foot-pounds.

Note

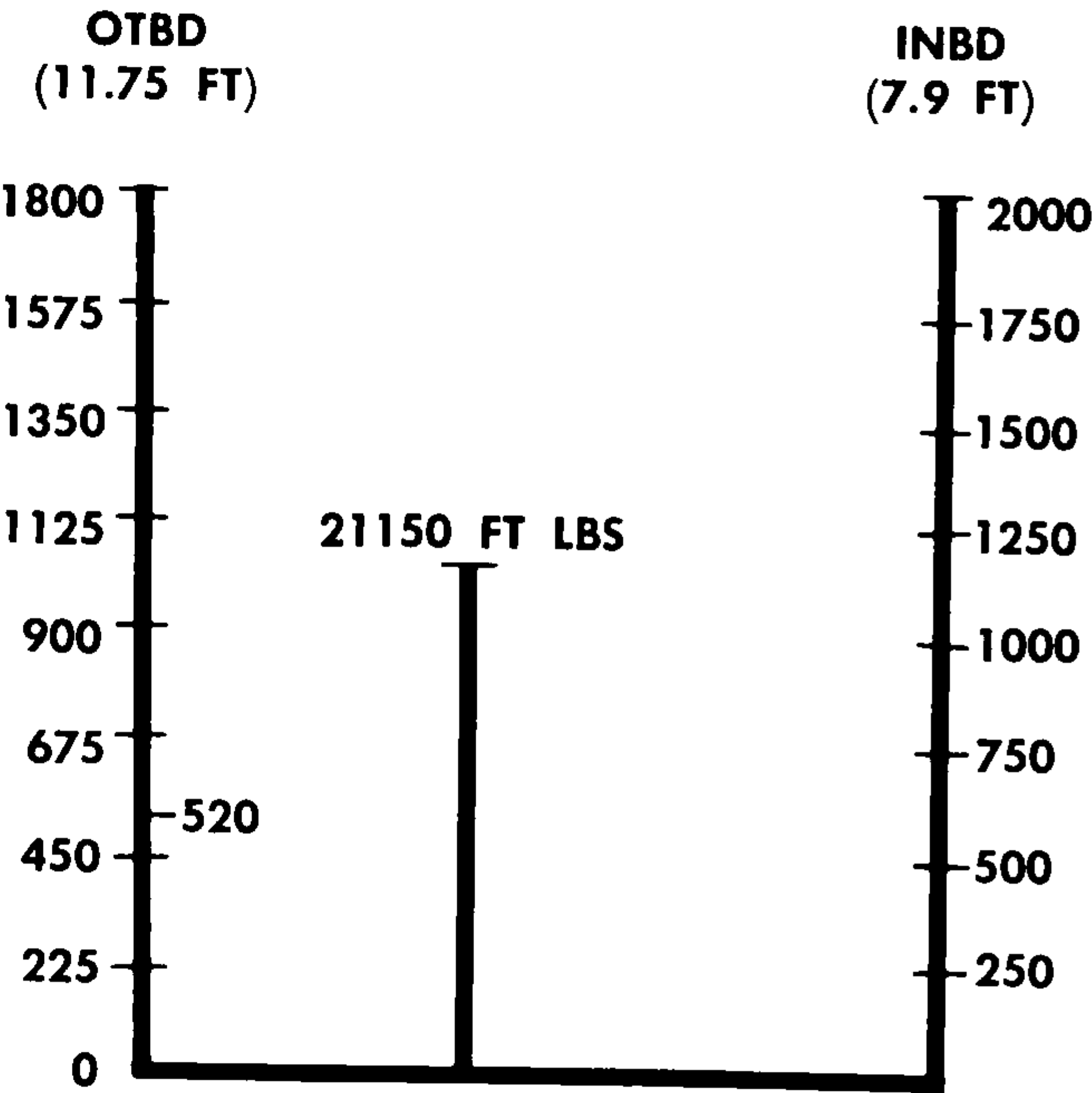
If the total weight of external stores (excluding pylons with Aero-7, but including racks), loaded symmetrically or asymmetrically, exceeds 800 pounds on either aircraft station 1 or 5, landings other than field landings (minimum rate of descent) should be made at a gross landing weight of 33,500 pounds or less if operational requirements permit. This will decrease the moment of inertia in roll and thereby increase the safety margin in case of high rate-of-sink, one wing low, or hard carrier landings.

CARRIER LIMITATIONS

- 1. CATAPULTING WITH PARTIALLY FULL INTERNAL INBOARD WING TANKS, OUTBOARD WING PANEL TANKS, OR EXTERNAL TANKS IS NOT PERMITTED.
- 2. CATAPULT LAUNCH AND ARRESTED LANDINGS ARE NOT PERMITTED WITH ASYMMETRIC EXTERNAL STORE LOADING IN EXCESS OF 21,150 FOOT-POUNDS OF STATIC MOMENT. THE ASYMMETRIC LOAD AT THE OUTBOARD WING STATIONS (1 OR 5) X 11.75 PLUS THE ASYMMETRIC LOAD AT THE INBOARD WING STATIONS (2 OR 4) X 7.9 SHALL NOT EXCEED 21,150 FOOT-POUNDS.

WING MOMENT
NOMOGRAM

(CATAPULT & ARREST)



- 3. ARRESTED LANDINGS WITH FUEL IN THE EXTERNAL FUEL TANKS IS NOT PERMITTED EXCEPT IN AN EMERGENCY.

NOTE

FOR ADDITIONAL LIMITATIONS, REFER TO THE CURRENT A-6 LAUNCH AND RECOVERY BULLETINS.

ADF1-121

Figure 1-45

EXTERNAL STORE LIMITATIONS

Only the external stores listed in the A-6 Tactical Manual NAVAIR 01-85ADA-1T may be carried and released, singly or in combination, to the limits shown. Operating limitations for flight, catapulting, and arrested landings with external stores are the same as the basic aircraft unless otherwise noted.

AIR REFUELING STORE LIMITATIONS

Refer to Section IV, Part 4.

MANEUVERS**RUDDER MANEUVERS****Clean Configuration (Gear and Flaps Retracted /4° Rudder)**

Full pedal sideslips are permitted to the limits of the flight envelope.

Extended Rudder Throw (35° Rudder)

Extended rudder throw can be obtained in the following modes of operation:

- Gear and flaps extended
- Assist spin recovery switch ON
- Flight and combined hydraulic systems depressurized (backup flight controls hydraulic system activated)

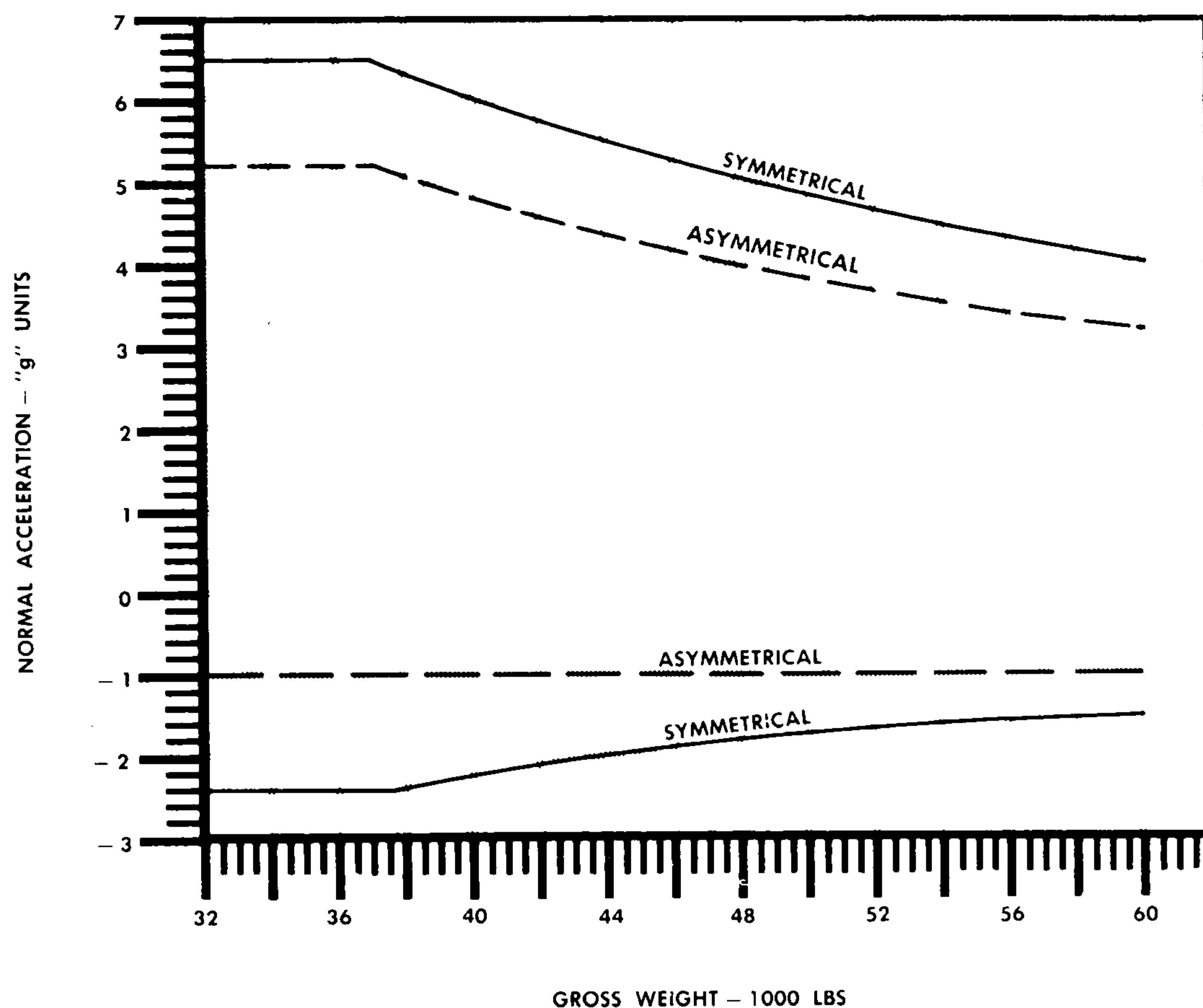
ACCELERATION LIMITATIONS**WING TIP SPEED BRAKES RETRACTED**AIRCRAFT CONFIGURATION
WING TIP SPEED BRAKES
RETRACTEDDATE 1 FEB 1972
DATA BASIS: FLIGHT TESTREMARKS
ENGINE(S): (2) J52-P8FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB GAL

Figure 1-46

A-ADF1-402

OPERATING FLIGHT STRENGTH DIAGRAM

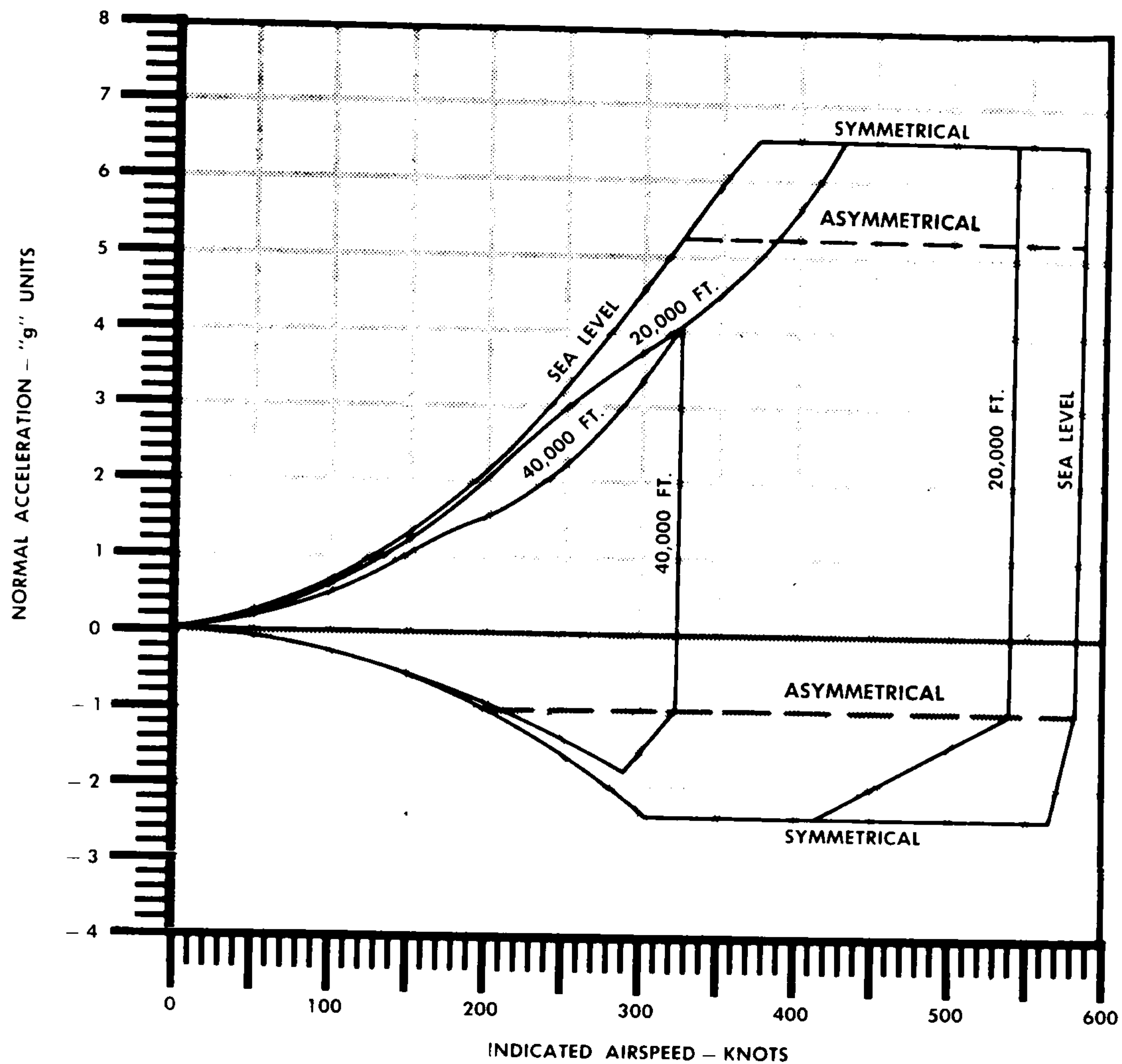
WING TIP SPEED BRAKES RETRACTED

AIRCRAFT CONFIGURATION
FOR GROSS WEIGHTS
OR 37,000 LB. OR LESS

DATE 1 FEB 1972
DATA BASIS: FLIGHT TEST

REMARKS
ENGINE(S): (2) J52-P8

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



A-ADF1-403

Figure 1-47

ACCELERATION LIMITATIONS

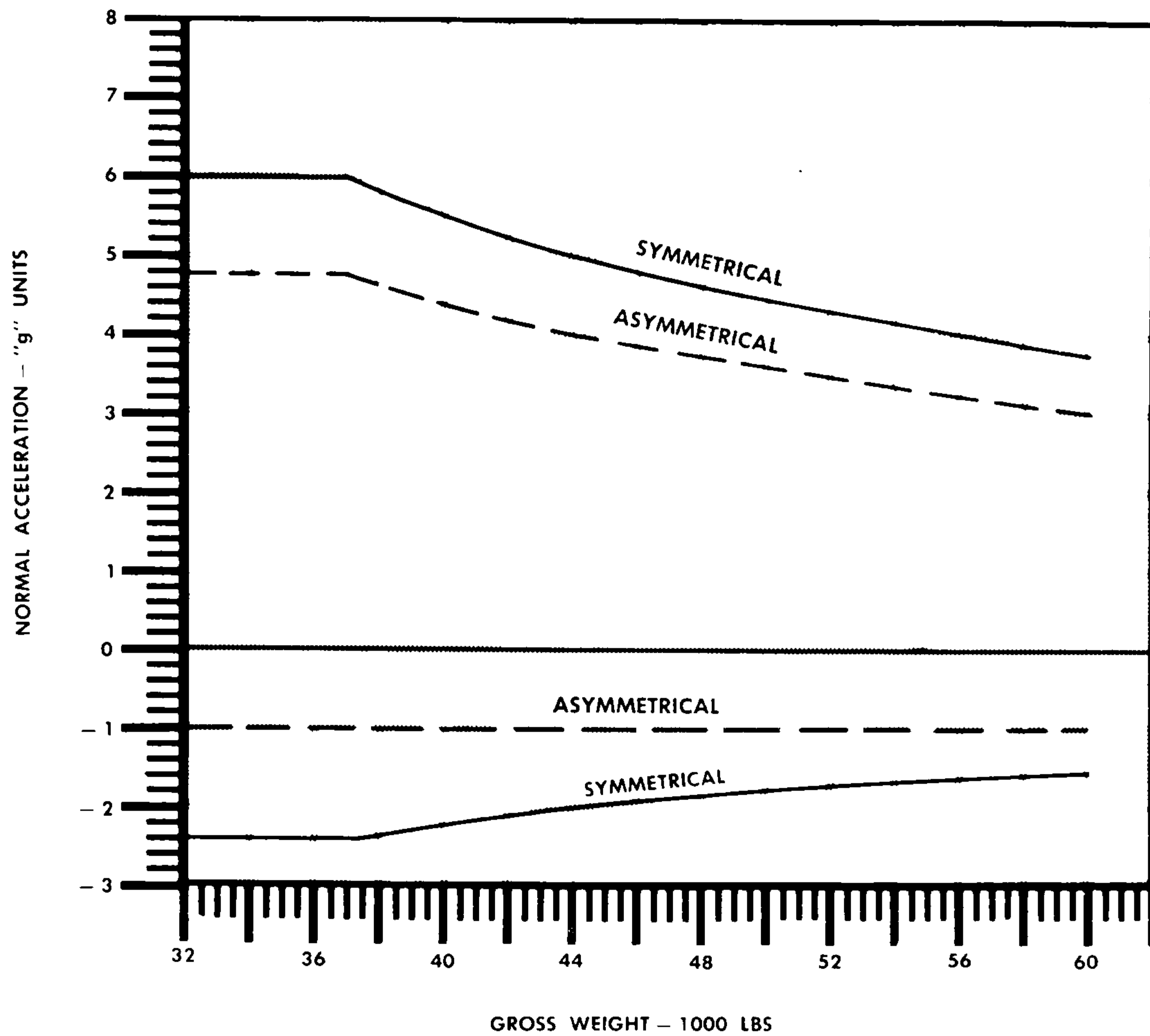
WING TIP SPEED BRAKES EXTENDED

AIRCRAFT CONFIGURATION
WING TIP SPEED BRAKES
EXTENDED

DATE 1 FEB 1972
DATA BASIS: FLIGHT TEST/ANALYSIS

REMARKS
ENGINE(S): (2) J52-P8

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



A-ADF1-404

Figure 1-48

OPERATING FLIGHT STRENGTH DIAGRAM

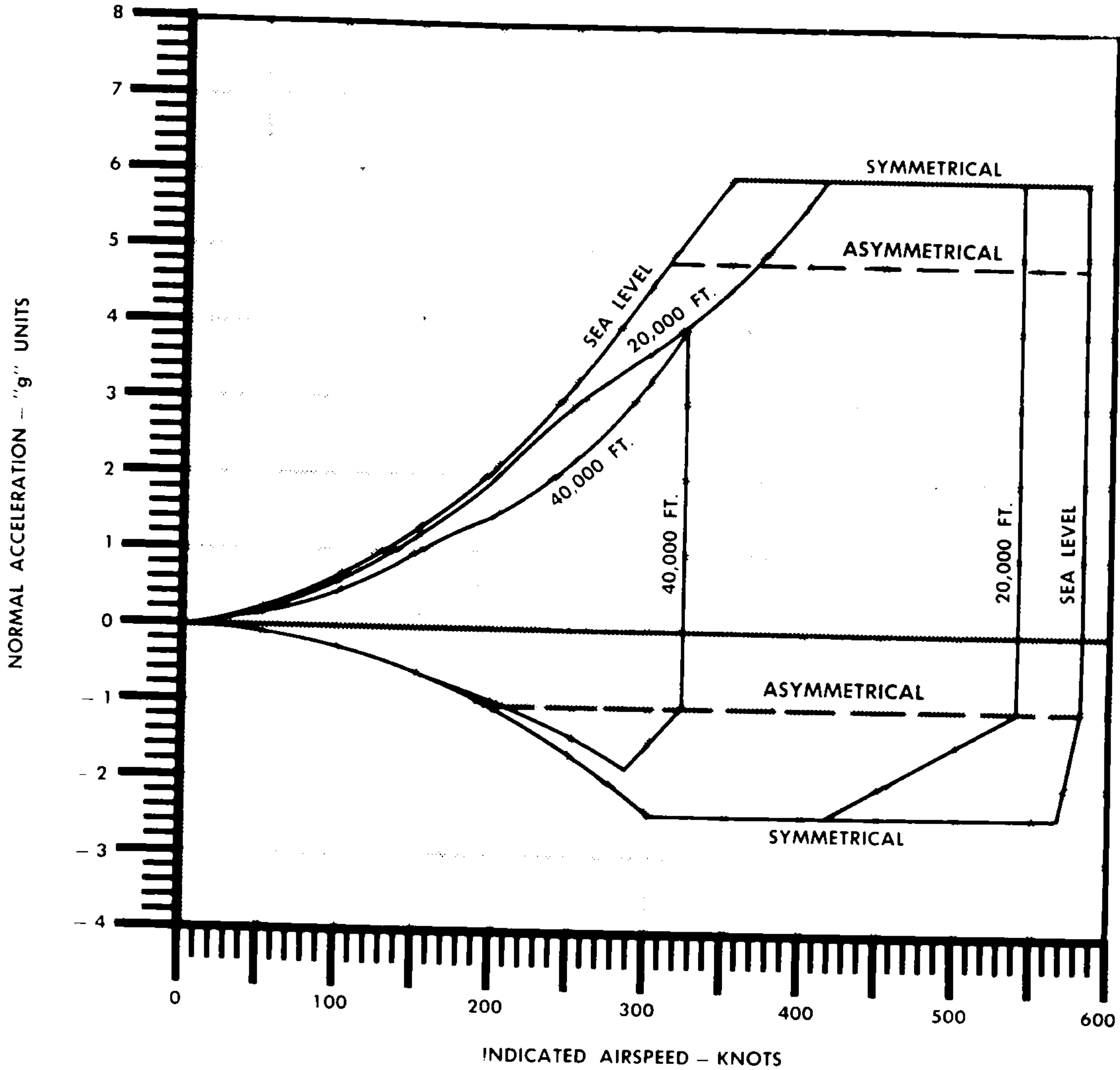
WING TIP SPEED BRAKES EXTENDED

AIRCRAFT CONFIGURATION
FOR GROSS WEIGHTS
OR 37,000 LB. OR LESS

DATE: 1 FEB 1972
DATA BASIS: FLIGHT TEST

REMARKS
ENGINE(S): (2) J52-P8

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



A-ADF1-405

Figure 1-49

Restrictions applicable to these configurations are outlined in the following paragraphs:

Gear and Flaps Extended

Full pedal sideslips are permitted to 250 KIAS with flaps at TAKEOFF (30°) and to 200 KIAS with flaps at LAND (40°).

BACKUP FLIGHT CONTROLS HYDRAULIC SYSTEM ACTIVATED

Rudder maneuvers are permitted to the limits presented in figure 1-50.

ASSIST SPIN RECOVERY SWITCH ON

CAUTION

- The assist spin recovery switch should be actuated only to effect recovery from a spin. Operation of the switch may impose an additional acceleration which during an accelerated maneuver may overstress the aircraft or when operating at minimum airspeeds may pitch the aircraft up into a stall or heavy buffet.
- After spin recovery is accomplished, the limitations presented in figure 1-50 must be observed until the assist spin recovery switch is moved to OFF.
- Positioning the switch to OFF after spin recovery should be done below 300 KIAS while anticipating a sharp nose-down trim change.

ROLLING MANEUVERS

Gear and Flaps Extended

Full stick 60° banks are permitted up to 250 KIAS with flaps at TAKEOFF (30°) and to 200 KIAS with flaps at LAND (40°).

Gear and Flaps Retracted

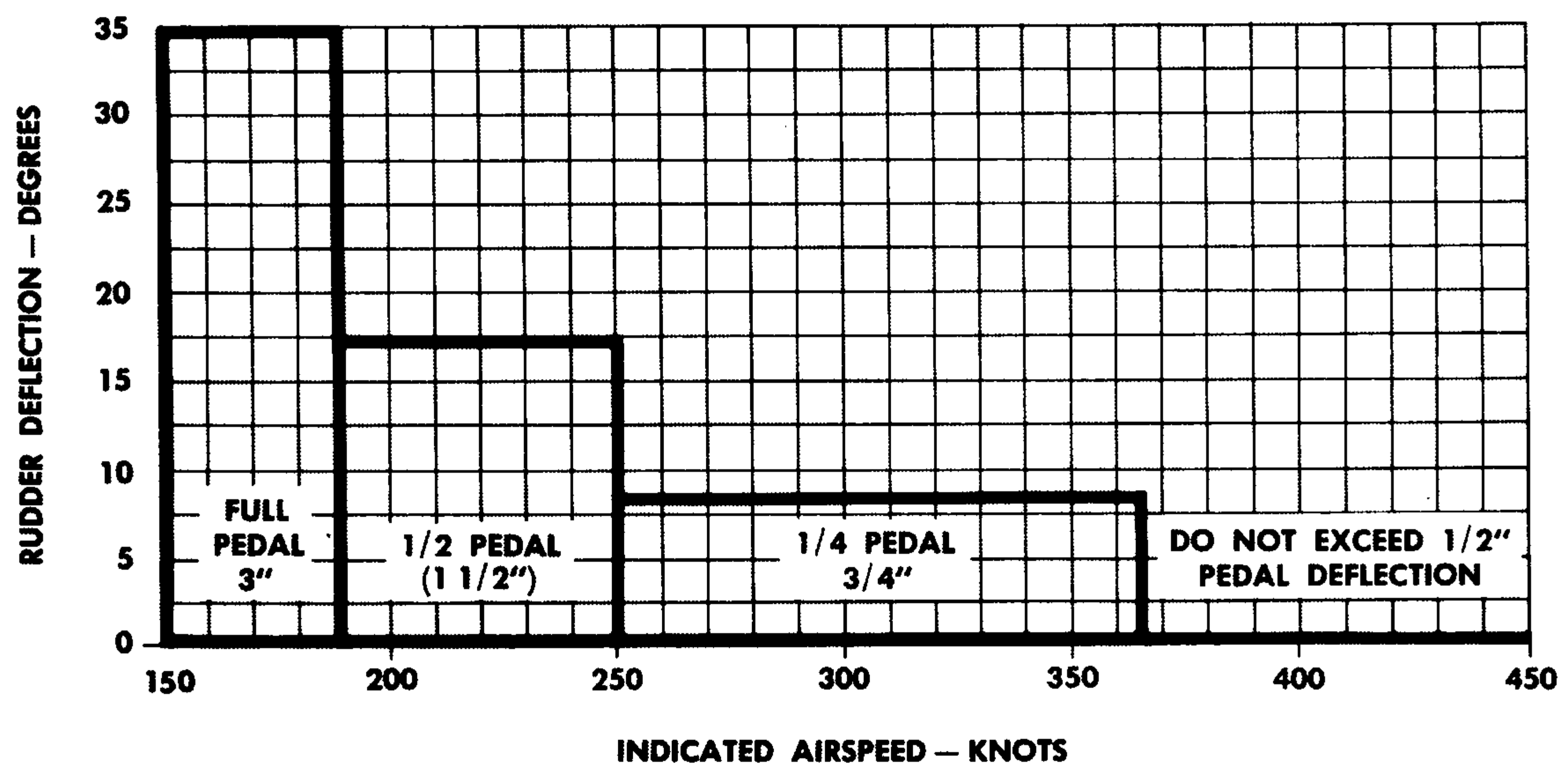
Full abrupt flaperon rolls and rolling pullouts are permitted up to the acceleration limits shown in figures 1-46 and 1-48 and to the maximum speed attainable and with the following additional restrictions:

- Not to exceed 360°.
- With more than 1,500 pounds of fuel in an external fuel tank at stations 1 and/or 5, and/or with a full or partially full D-704 air refueling store at station 3, lateral control motion is limited to 1/2 deflection at airspeeds in excess of 450 KIAS.
- With the A/37B-1 MBR, A/A37B-5 TER, or A/A37B-6 MER loaded with more than 1,500 pounds of bombs at station 1 and/or 5, lateral control motion is limited to 1/2 full deflection at airspeeds in excess of 350 KIAS or 0.65 IMN, whichever is less.

RUDDER LIMITS

EXTENDED RUDDER THROW ENGAGED

DATE: 1 SEPTEMBER 1969
DATA BASIS: FLIGHT TEST



ADF1-406

Figure 1-50

- d. When a MER or MBR installed on an aircraft wing station is asymmetrically loaded with stores, additional rolling limitations are imposed. A rack asymmetrical loading condition exists:
- When the total weight of stores loaded forward does not equal the total weight of stores loaded aft, or
- When the total weight loaded on rack stations 3 and 4 does not equal the total weight loaded on stations 5 and 6.

When either of the above asymmetrical loading conditions occurs, observe the lateral control motion limits shown in figure 1-51.

CAUTION

Exercise caution when deflecting the flaperons as an increase in normal acceleration will result.

PROHIBITED MANEUVERS

1. Large abrupt control reversals
2. Intentional spins
3. Negative g flight in excess of 30 seconds
4. Zero g flight in excess of 10 seconds
5. Delivery of ordnance from MBR racks by curvilinear tracking runs (commonly called pippet on target tracking) is prohibited.

**ASYMMETRICAL LOADING,
ROLL LIMITS**

RACK ASYMMETRY (LB)		MAX STICK DEFLECTION
A/C STATION 2 OR 4	A/C STATION 1 OR 5	
600 TO 1,200	400 TO 600	
1,200 OR GREATER	600 TO 1,200	1/2 THROW ABOVE 350 KIAS/ .50 IMN
	1,200 OR GREATER	COORDINATED TURNS ONLY.

ADF1-44

Figure 1-51

section II

INDOCTRINATION

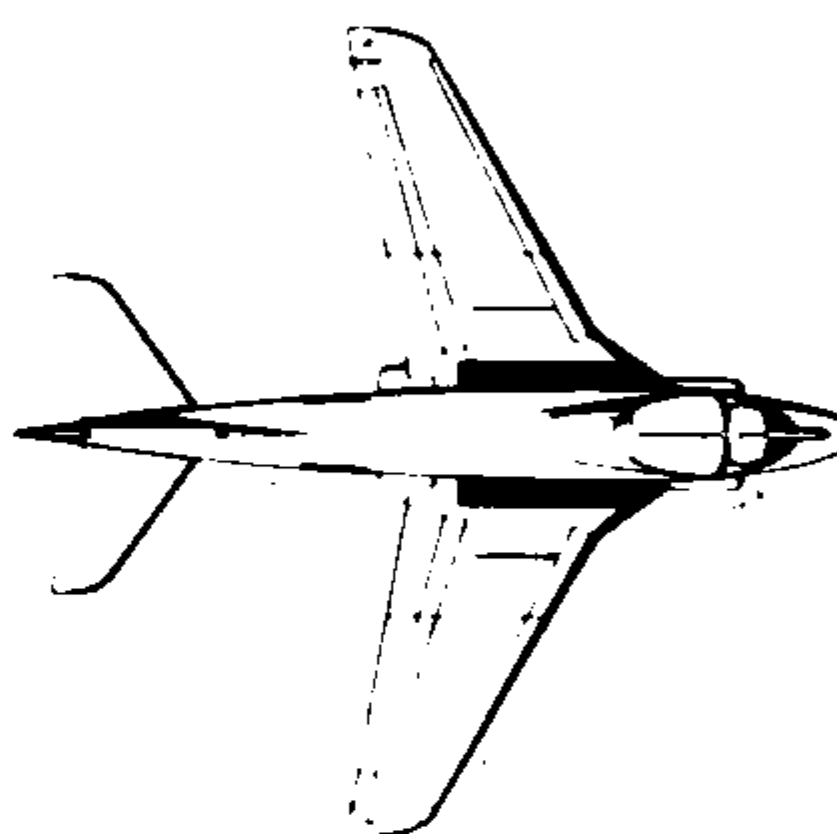


TABLE OF CONTENTS

Ground Training Syllabus.	2-1	Requirements for Various Flight Phases	2-2
Flight Training Syllabus	2-1	Requirements for Night/Instrument Flight	2-2
Ceiling/Visibility Requirements	2-1	Carrier-Landing Qualifications.	2-2
Initial Qualification and Currency Requirements	2-2	Minimum Crew Requirements.	2-2
		VIP/Orientation Flights.	2-2
		Personal Flying Equipment	2-2

GROUND TRAINING SYLLABUS

MINIMUM GROUND TRAINING

The ground training syllabus sets forth the minimum ground training which must be satisfactorily completed prior to operating the A-6E. The ground training syllabus for each activity will vary according to local conditions, field facilities, requirements from higher authority, and the immediate Unit Commander's estimate of the squadron's readiness. The minimum ground training syllabus for the pilot and bombardier/navigator is set forth below.

Minimum Ground Training Requirements

The minimum ground training requirements for the A-6E pilot and bombardier/navigator shall be successfully completed prior to flight as follows:

1. NAMTD A-6A Flight crew familiarization course or equivalent
2. Preflight check of the aircraft
3. Cockpit check and familiarization
4. Bailout, ditching procedure, safety, and survival equipment checkout
5. Weapons System Trainer A-6E Flight Syllabus (if available)
6. Locally prepared written examination covering appropriate emergency procedures.

The minimum ground training requirements for the A-6E observer shall be successfully completed prior to flight as follows:

1. Flight physiology training required by OPNAVINST 3710.7.
2. Bailout, ditching procedures, safety, and survival equipment checkout.
3. Lookout responsibilities and procedures.
4. Emergencies evaluation and use of emergency procedures checklist.
5. Hand signals (ground and flight).

FLIGHT TRAINING SYLLABUS

The flight training syllabus is designated to effect the orderly and expeditious qualification of pilots and bombardier/navigators in flying the A-6E as an aircraft and as a weapons system from both carrier- and shore-based installations.

CEILING/VISIBILITY REQUIREMENTS

In general, the following pilot ceiling/visibility minimums for time-in-model apply.

Time-in-Model (hr)	Ceiling/Visibility (ft) (mi)
0 to 10	VFR (remain clear of clouds)
10 to 20	800/2; 900/1-1/2; 1,000/1
20 to 45	700/1; 600/2; 500/3
45 and above	OPNAV minimums

Where adherence to these minimums unduly hampers pilot training, Commanding Officers may waive time-in-model requirements for actual instrument flight, provided pilots meet the following criteria:

1. Have a minimum of 10 hours in model.
2. Completed two simulated instrument sorties.
3. Completed two actual or simulated TACAN penetrations to field minimums.

INITIAL QUALIFICATION AND CURRENCY REQUIREMENTS

Initial flight qualification shall be obtained by satisfactory completion of the required course of instruction at a formal USN/USMC A-6 replacement training squadron training syllabus. Minimum requirements to maintain currency after initial qualification shall be established by the unit commanding officer but will involve as a minimum 10 hours of first pilot time and 2 takeoffs and landings in A-6 aircraft in the previous 90 days for pilots and annual NATOPS evaluation with the grade of at least conditionally qualified for pilots and B/N's. Requalification of those crewmembers whose currency has lapsed shall include appropriate ground training followed by a familiarization flight phase to include NATOPS requalification.

REQUIREMENTS FOR VARIOUS FLIGHT PHASES

Solo Flight

Solo flight is prohibited.

Night

Not less than 10 hours in model.

Cross-Country

1. Have a minimum of 25 hours in model.
2. Have a valid instrument card.
3. Have completed at least one night familiarization flight.
4. Have completed a locally prescribed aircraft servicing checkout.
5. Must be current in model.

Ferry

Ferry requirements are contained in OPNAVINST 3710.6 series.

For members of ferry squadrons, training requirements, check out procedures, evaluation procedures and weather minima shall be governed by the provisions contained in OPNAVINST 3710.6 (series).

REQUIREMENTS FOR NIGHT/INSTRUMENT FLIGHT

Aircraft instrumentation requirements for night and instrument flight are specified in OPNAV 3710.7 series instructions. In addition, a vertical display indicator, radar altimeter and aligned inertial platform are required for night and instrument flight. The VDI and the inertial platform are the primary attitude reference.

CARRIER LANDING QUALIFICATIONS

Carrier landing qualifications will be in accordance with LSO NATOPS manual.

MINIMUM CREW REQUIREMENTS

The minimum crew requirements for flights in the A-6 shall consist of a qualified pilot and NFO. A qualified observer, when authorized by competent authority, may occupy the B/N seat during nonsystem flights.

VIP/ORIENTATION FLIGHTS

VIP/orientation flight requirements are contained in OPNAVINST 3710.7.

PERSONAL FLYING EQUIPMENT

The equipment indicated below will be worn or carried on all flights in A-6E aircraft.

1. Flame retardant flight suit.
2. Identification tags.
3. Flight gloves.
4. Flight safety boots.
5. Protective helmet.
6. Life preserver.
7. Knife.
8. Personal survival kit.
9. Oxygen mask.
10. Antiexposure suit.
11. Signal devices.
12. Flashlight.
13. Anti-g suit.
14. Navigation packet.
15. Pocket checklist.

The latest available flight safety and survival equipment as authorized by Aviation Crew Systems Manual, Volume 7 (Aircrew Personal Protective Equipment), NAVAIR 13-1-6.7, shall be used by crewmen for flight in A-6E aircraft.

section III

NORMAL PROCEDURES

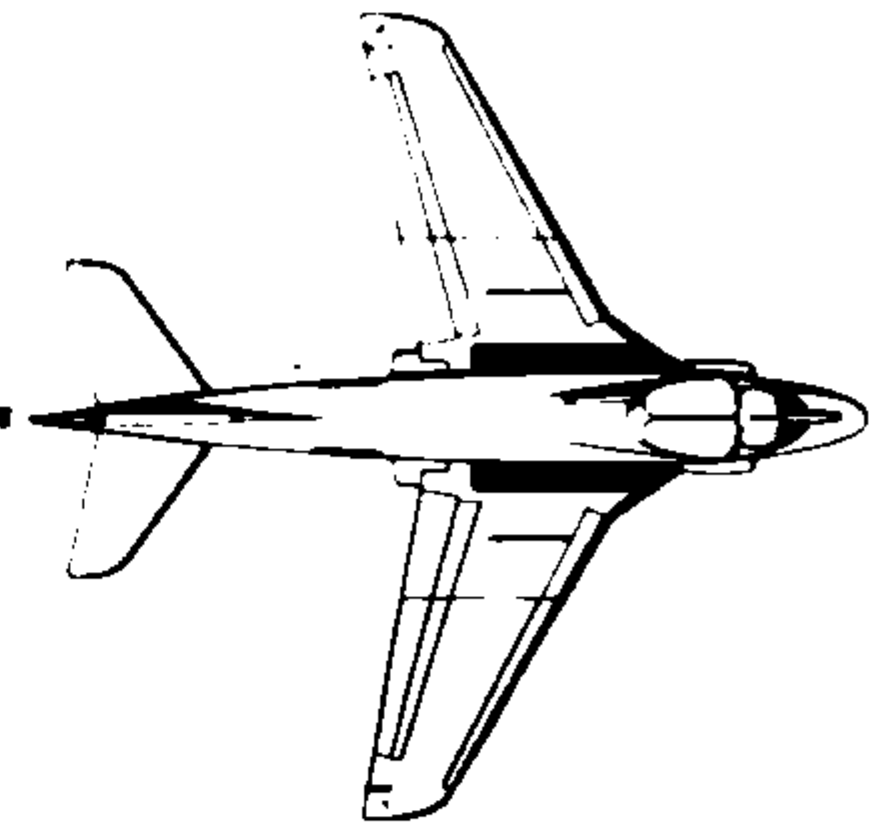


TABLE OF CONTENTS

PART 1 BRIEFING/DEBRIEFING	3-2	In-Flight Alignment	3-56
Briefing/Debriefing Responsibilities	3-2	Target Tracking Procedures	3-58
Briefing Officer	3-2	Velocity Correct Procedures	3-60
Pilot In Command	3-2	Computer Optical Positioning (COP) Check	3-61
Operational Briefing	3-2	Attack Procedures	3-61
Preoperational Briefing	3-2	Air Refueling (Refueling Store)	3-68
Preflight Briefing	3-2	Descent	3-69
Operating Area Briefing	3-4	Before Landing	3-69
PART 2 MISSION PLANNING	3-5	After Landing	3-69
Mission Planning	3-5	In Chocks	3-70
Nuclear Weapons	3-5	PART 4 CARRIER-BASED PROCEDURES	3-71
Conventional Weapons	3-5	Pilot's Procedures	3-71
PART 3 SHORE-BASED PROCEDURES	3-6	Field Mirror Landing Practice	3-71
Pilot's Procedures	3-6	Preflight Inspection	3-71
Preparations for Flight	3-6	Pattern Entry	3-71
Preflight Check	3-8	Pattern	3-71
Ejection Seat Check	3-12	Night Pattern	3-71
Prestart Procedures External		Carrier-Based Procedures	3-72
Power On	3-17	Preflight	3-72
Starting Engines	3-21	Post Start	3-72
Post Start	3-22	Taxi	3-72
Ordnance	3-23	Launch Procedures	3-72
Before Taxiing	3-24	Catapult Launch	3-73
Wing Spread	3-24	Recovery	3-74
Control Checks	3-24	Pattern (VFR)	3-74
Before Takeoff	3-25	Approach	3-74
Takeoff (Ashore)	3-26	Wave-Off/Bolter Pattern	3-74
After Takeoff Climb	3-27	Arrested Landing and Exit	
Cruise	3-29	from Landing Area	3-74
Flight Characteristics	3-29	Carrier-Controlled Approach	3-77
Descent	3-29	Automatic Carrier Landing System	3-77
Before Landing	3-29	Bombardier/Navigator's Procedures	3-80
Landing	3-30	Carrier Alignment (Automatic)	3-80
Wave-Off	3-31	Carrier Alignment (Manual)	3-80
After Landing	3-32	PART 5 SATS PROCEDURES	3-83
Wing Fold	3-32	Sats Limitations	3-83
Hot Refueling	3-33	Preflight	3-83
Engine Shutdown	3-33	Taxi	3-83
Bombardier/Navigator's Procedures	3-34	Launch Procedures	3-83
Preparations for Flight	3-34	Catapult Emergencies	3-84
Preflight Check	3-35	Recovery	3-84
Exterior Inspection	3-37	Wave Off/Bolter	3-84
Ejection Seat Check	3-40	PART 6 FUNCTIONAL CHECKFLIGHT	
Interior Inspection - Power On	3-41	PROCEDURES	3-85
Pretaxi Procedures	3-54	Functional Checkflight Requirements	3-85
Taxi Procedures	3-55	Pretakeoff	3-85
Pretakeoff Procedures	3-56	In-Flight	3-89
Takeoff Procedures	3-56	Landing	3-94
After Takeoff Procedures	3-56		

part 1

Briefing/ Debriefing

BRIEFING/DEBRIEFING RESPONSIBILITIES

The Commanding Officer shall ensure that every flight crew is properly and adequately briefed on all facets of the assigned mission. Through the Operations Officer, he shall assign the appropriate personnel to brief each flight, according to the mission and anticipated conditions.

BRIEFING OFFICER

The Briefing Officer assigned on the Flight Schedule shall have the overall responsibility for coordinating and conducting a proper and adequate briefing of the flight. This responsibility will be assumed by the flight leader if a Briefing Officer has not been assigned.

PILOT IN COMMAND

Each Pilot-in-Command shall ensure that an adequate briefing has been obtained, and that his crew is fully prepared for the scheduled mission.

OPERATIONAL BRIEFING

Flight crews shall be given complete, comprehensive briefings on all operations. The briefing officer shall work in conjunction with the operations officer, Air Intelligence Officer, and other officers concerned, in preparing the necessary information. He shall make optimum use of all graphic presentation devices, maps, charts, etc., that are available.

PREOPERATIONAL BRIEFING

Immediately prior to all operations of appreciable complexity and duration, a general information brief shall be given to familiarize personnel with the overall nature of the operation. The following topics shall be included:

1. The mission and objectives of the operation, and the part the squadron will play in carrying them out
2. A brief chronological breakdown of how the operation will be conducted
3. The geographical area in which the operations will be conducted
4. The forces involved, both friendly and enemy, and how they will be deployed

5. The rules of engagement set down by the governing operation order
6. Search and rescue, EMCOM, and other special communications procedures which will be used, including explanation of shackles and authenticators
7. A discussion by the Briefing Officer of the principal attack tactics to be employed

PRE-FLIGHT BRIEFING

These briefs are presented immediately before the launching of scheduled flights, and therefore must be carried out in the most expeditious manner. It is imperative that all pilots and bombardier/navigators be in flight gear and otherwise ready for the briefing at the designated time. The brief shall include, but not be limited to the following:

Note

Information marked with an asterisk (*) shall be displayed on a status board in the briefing or ready room, and should be copied by pilots before the briefing.

1. General.
 - a. Aircraft assigned, call signs, and event number. *
 - b. Fuel load, stores, and aircraft gross weight.
 - c. Engine start, taxi, and takeoff times.
 - d. Line and taxi procedures.
 - e. Takeoff distance and speed, rendezvous instructions, and visual signals.
2. Mission.
 - a. Primary.
 - b. Secondary.
 - c. Operating area.
 - d. Time on station or over target.
 - e. IP (Radar/Visual).
 - f. Review of target and procedures.

3. Communications.
 - a. Channels and frequencies. *
 - b. Controlling agencies.
 - c. Navigational aids. *
 - d. Radio procedures and discipline.
 - e. Reports required.
 - f. Authenticators, IFF/SIF procedures.
 - g. ADIZ procedures.
 - h. EMCON conditions.
4. Participating units.
 - a. Voice calls and side numbers. *
 - b. Disposition.
 - c. Utilization.
 - d. Friendly subs and surface units.
5. Navigation and flight planning.
 - a. Duty runway/predicted foxtrot corpen for launch and recovery.
 - b. Takeoff.
 - c. Climb out.
 - d. Mission route including planned use of all navigation systems, check point (radar/visual) restricted or danger areas.
 - e. Fuel/oxygen management including bingo fuel.
 - f. Marshall holding.
 - g. Penetration procedures.
 - h. GCA or CCA procedures.
 - i. Recovery time and recovery order. *
6. Operations.
 - a. Instructions for coordinating other units.
7. Weapons.
 - a. Type/quantity. *
 - b. Preflight.
 - c. Special routes with ordnance aboard.
 - d. Pattern including airspeeds and altitudes.
 - e. Restrictions on use.
 - f. Armament switches/armoring.
 - g. Minimum release/pullout altitudes.
 - h. Duds, hung ordnance, dearming and jettison procedures.
 - i. Safety.
8. Weather - base, enroute, and target.
 - a. Wind: direction and velocity at surface and at applicable altitudes (jet streams and contrails). *
 - b. Cloud coverage: present and forecast. *
 - c. Visibility. *
 - d. Sea state.
 - e. Water and air temperature (cold weather). *
 - f. Target weather.
 - g. Divert weather.
9. Emergencies.
 - a. Takeoff.
 - b. Radio failure.
 - c. Loss of NAV aids/system.
 - d. Loss of visual contact with flight.
 - e. SAR procedures.
 - f. System failure.
10. Air intelligence and special instructions.
 - a. Friendly/enemy force disposition.
 - b. Current situation.
 - c. Targets.
 - d. Safety precautions.
 - e. Reports and authentication.
 - f. Escape and evasion.
11. Miscellaneous.
 - a. Other units in the area.
 - b. Current NOTAMS, bulletins, and safety-of-flight information.
 - c. SAR - participating units and procedures.

OPERATING AREA BRIEFING

Prior to operating in a new area, a mandatory briefing covering (but not limited to) the following items shall be given:

A. BINGO FIELDS

Instrument approach facilities.

Runway length and arresting gear.

Local terrain and obstructions.

B. EMERGENCY FIELDS

Fields suitable for landing but without required support equipment.

Instrument approach facilities.

Runway length and arresting gear.

Terrain and obstructions.

C. SAR FACILITIES.

Type.

Frequencies.

Locations.

part 2**Mission Planning****MISSION PLANNING**

Detailed preflight planning is essential for the success of any attack mission, consistent with the time available and the nature of the assignment.

NUCLEAR WEAPONS

Mission planning for nuclear weapons delivery shall be in accordance with NAVAIR 01-85ADA-1T (A), Supplemental A-6 Tactical Manual.

CONVENTIONAL WEAPONS

Conventional weapons deliveries fall generally into two types:

1. Preplanned strikes on specific targets.
2. Close air support, call fire, or armed reconnaissance.

A description of conventional weapons and deliveries may be found in A-6 Tactical Manual NAVAIR 01-85ADA-1T.

Preplanned Strikes

Preplanned strikes on specific targets shall be planned in the same manner as nuclear weapons deliveries.

Close Air Support, Call Fire, and Armed Reconnaissance Strikes

Due to the tactical nature of these missions, detailed preplanning is unrealistic. Preplanning shall concentrate primarily on target area familiarization and review of weapons check lists and fuel planning aids.

part 3

Shore Based Procedures

PILOT'S PROCEDURES

PREPARATIONS FOR FLIGHT

When both crewmembers are present, it is recommended that a thorough briefing be conducted concerning normal and emergency procedures, crew coordination, and cooperation through the planned mission.

FLIGHT RESTRICTIONS

Refer to Section I, Part 4, Aircraft Operating Limitations, and Section XI, Performance Data.

FLIGHT PLANNING

Refer to Section XI, Performance Data, to determine fuel consumption, airspeeds, power settings, and altitude required for the intended flight mission.

ACCEPTANCE OF AIRCRAFT

Review current OPNAV form 3760-2 (yellow sheet) for status and servicing of aircraft.

WEIGHT AND BALANCE

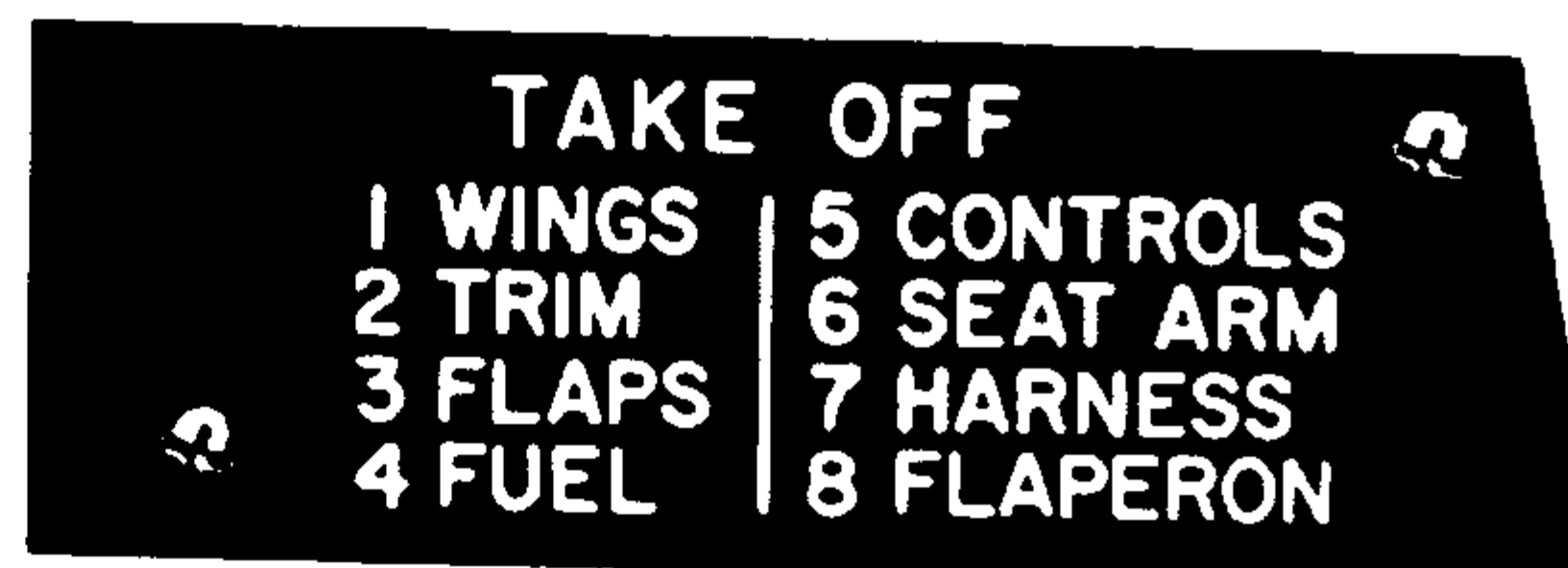
Refer to Section I, Part 4, for Aircraft Operating Limitations.

For loading information, refer to the Handbook of Weight and Balance Data, AN01-1B-40.

CHECKLISTS

The placarded takeoff and landing checklists (figure 3-1) in the aircraft cockpit serve as reminders for the orderly check of certain essential aircraft functions. The pilot is responsible for the completion of the checklist and acknowledgement by the crewmember is mandatory prior to takeoff or landing.

PILOTS' CHECK LISTS



ADF1-70

Figure 3-1

ACCESS TO COCKPIT

See figure 3-2 for normal entry into the cockpit.

ACCESS TO COCKPIT**MANUAL CANOPY ACTUATION—NOSE WHEEL WELL**

CONNECT HAND PUMP HANDLE
TO HAND PUMP (45 CYCLES TO
FULLY OPEN CANOPY)

- 1 CANOPY SELECTOR GROUND
OPERATION "PUSH UP" TO
OPEN — "PULL DOWN" TO
CLOSE.

NOTE

CANOPY SELECTOR HANDLE
MUST BE HELD IN DESIRED
POSITION TO OPERATE
CANOPY.

- 2 HAND PUMP AND HANDLE

ELECTRICAL CANOPY ACTUATION—BOARDING LADDER SWITCHES

TYPICAL BOTH SIDES OF AIRCRAFT

Figure 3-2

PREFLIGHT CHECK

BEFORE EXTERIOR INSPECTION

CAUTION

Prior to ground power being applied, it is mandatory that either qualified maintenance personnel or a crew-member insure that steps 1 through 3 have been completed.

- 1. Fire Extinguishing AVAILABLE
- 2. Cockpit canopy switch and manual selector handle NEUTRAL
- 3. Cockpit Check
 - a. Landing-gear handle DOWN
 - b. Armament panel OFF
 - c. CNI master OFF
 - d. Wing and fuselage dump switch OFF
 - e. Fuel ready switch OFF
 - f. Emergency flap switch OFF
 - g. Pitot heat switch OFF
 - h. Trim button SECURED

WARNING

Should the trim button become dislodged, human contact with the exposed probe with electrical power on, can result in incapacitation/unconsciousness.

- 4. External power CONNECTED
- 5. Platform STBY
- 6. Annunciator panel RUD THRO light LIT

WARNING

If the RUD THRO light is not lit prior to start, a rudder linkage failure may have occurred.

- 7. Oxygen quantity CHECK

CONTINUED ON NEXT PAGE

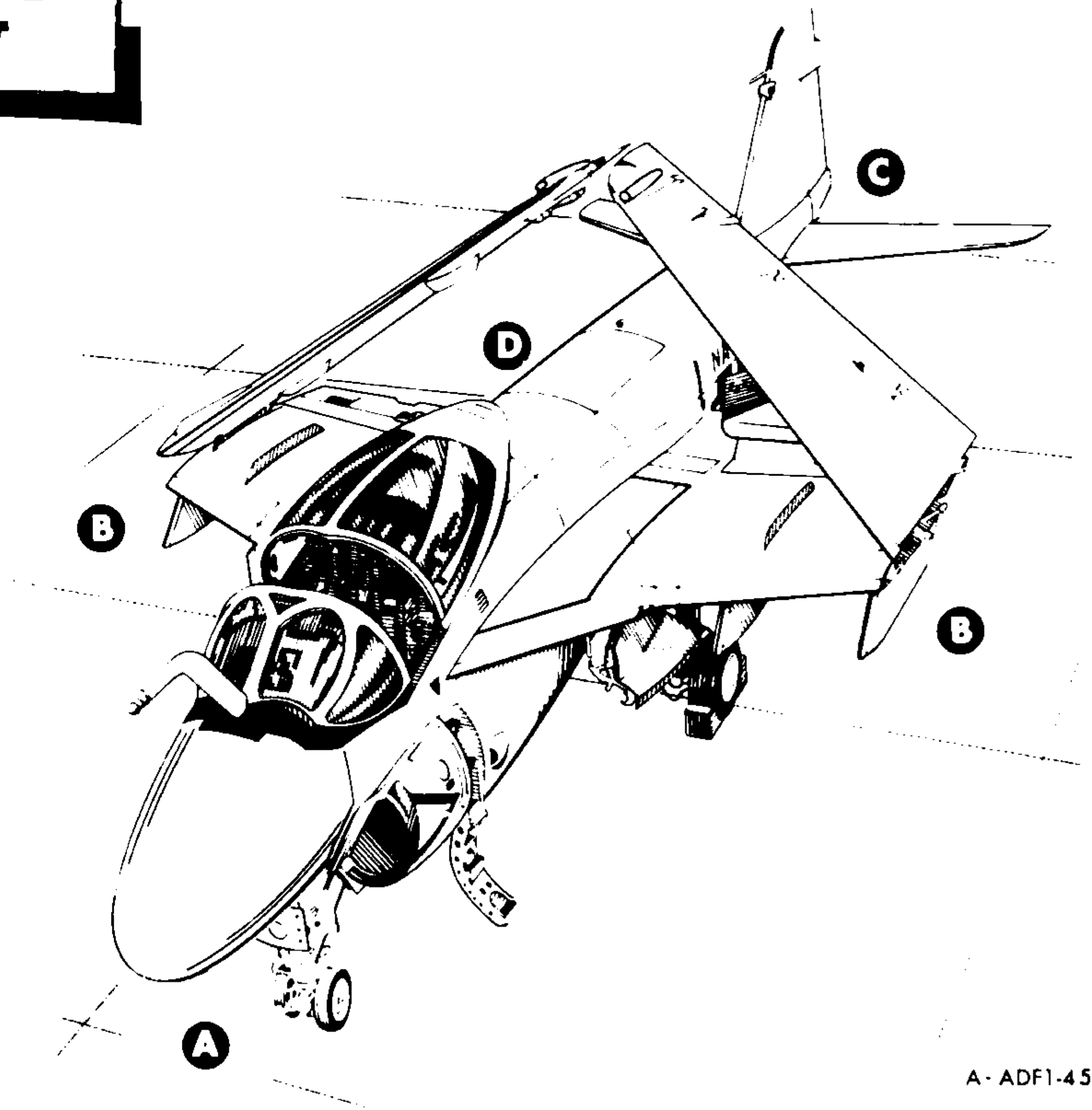
EXTERIOR INSPECTION-PILOT

GENERAL CHECKS

THE FOLLOWING GENERAL CHECKS SHOULD BE PERFORMED THROUGHOUT THE EXTERIOR INSPECTION: CRACKS, DISTORTIONS, LOOSE FASTENERS; COVERS REMOVED; FUEL, OIL, HYDRAULIC LEAKS; ACCESS DOORS AND PANELS SECURELY FASTENED; AND EXTERNAL STORES SECURE.

NOTE

THE EXTERIOR INSPECTION BEGINS AT THE PILOT'S COCKPIT BOARDING LADDER AND PROGRESSES IN A CLOCKWISE DIRECTION AROUND THE AIRCRAFT. AFTER COMPLETION OF THE "AFT FUSELAGE AREA" CHECKS. REPEAT THE "CENTER FUSELAGE AND WING AREA" CHECKS FOR THE LEFT SIDE INSPECTION.



A-ADF1-45

Figure 3-3

PREFLIGHT CHECK-CONTINUED

EXTERIOR INSPECTION

Perform exterior inspection as outlined below: (refer to figure 3-3)

(A) NOSE AREA

1. Canopy air bottle 2450 PSI $\pm$ 100 PSI
2. Canopy jettison bleeder valve plunger DEPRESS
If air escapes, a leak in one of the canopy jettison bottles is indicated. This could result in unintentional jettison of the canopy.
3. Total-temperature probe CHECK
4. Intake duct area CHECK
5. Radome SECURE
6. Armament safety override switch OFF
7. Air refueling probe CHECK VISUALLY FOR DAMAGE

NEW

NEW

CONTINUED ON NEXT PAGE

PREFLIGHT CHECK-CONTINUED

8. Nose gear CHECK
- a. Approach, anticollision, and taxi lights CHECK
- b. Tires and shockstrut PROPERLY INFLATED
- c. Nose-gear ground safety lock INSTALLED
- d. Nose-gear shimmy damper CHECK
- e. Nose-gear steering linkage CHECK
- f. Nose-gear door linkage CHECK
- g. Nose-gear tie down CHECK AS REQUIRED
- h. Nose-wheel cotter pins INSTALLED
9. Nose-gear wheel well CHECK
- a. Landing-gear emergency air gage 2450 PSI
- b. Auxiliary brakes 800 PSI MINIMUM
- c. Circuit breakers IN
- d. Handpump handle SECURE
- e. Splash curtains SECURE
- f. Manual canopy handle UP (OPEN)
- g. Equipment pressure 600-2800 PSI
10. Intake duct area CHECK
11. Outside air-temperature probe CHECK
12. Angle-of-attack probe CHECK
13. Ground refueling panel CHECKED
- a. Power switch OFF
14. Air-conditioning inlet CLEAR

Ⓑ CENTER FUSELAGE AND WING AREA

1. Main-gear wheel well CHECK
2. Main gear CHECK
- a. Tire & shock strut PROPERLY INFLATED
- b. Main-gear ground safety lock INSTALLED
- c. Main-gear tie down CHECK AS REQUIRED
- d. Jack pads STOWED
3. Center pylon SECURE

CONTINUED ON NEXT PAGE

PREFLIGHT CHECK-CONTINUED

- | | |
|--|---------------------|
| 4. Wing pylon | SECURE |
| 5. Wing slat | SECURE |
| 6. Fuel ram-air inlet | CLEAR |
| 7. Wing-tip speed brakes
Ensure speed brake ground safety lock removed. | CLOSED |
| 8. Position and formation lights | CHECK |
| 9. Wing fuel dump-vent line | CLEAR |
| 10. Wing flap & flaperon | SECURE |
| 11. Forward engine access doors | FLUSH WITH FUSELAGE |
| a. Latch handles (6) | STOWED AND LOCKED |
| b. Locking pins (8)
Check through visual inspection ports. | FULLY SEATED |
| 12. Exhaust area | CLEAR |

© AFT FUSELAGE AREA

- | | |
|--|---------|
| 1. Rudder and stabilizer | CHECK |
| 2. Fuselage fuel dump-vent line | CLEAR |
| 3. Arresting hook | SECURE |
| 4. Arresting-hook ground safety lock | REMOVED |
| 5. Extensible equipment platform | SECURE |

WARNING

Aircrews will ensure that items stowed in the aft equipment bay are properly secured to prevent damage or interference with critical components.

- | | |
|---------------------------------|---|
| 6. Dashpot pressure | (HOOK DOWN) 500 PSI
(HOOK UP) 1000 PSI |
| 7. Liquid oxygen vent | CLEAR |
| 8. Doppler radome | SECURE |

© TOP FUSELAGE WING, TAIL AREA

- | | |
|--|---------------|
| 1. Fuel ram-air inlet | CLEAR |
| 2. Aft compartment air inlet | CHECK |
| 3. Anticollision light | CHECK |
| 4. Ram-air turbine | CHECK |
| 5. Pitot tube | COVER REMOVED |

CONTINUED ON NEXT PAGE

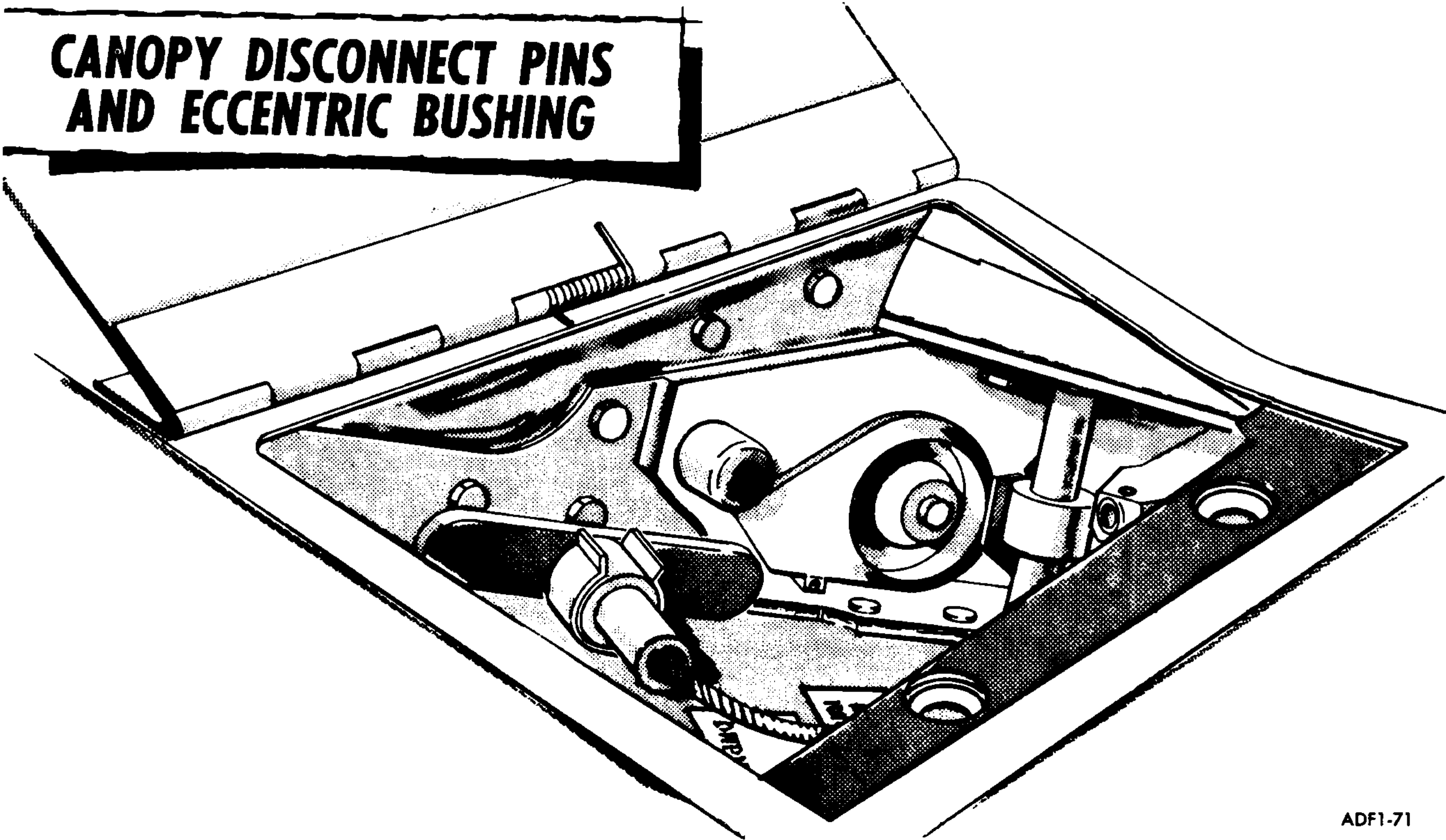
PREFLIGHT CHECK-CONTINUED

6. Canopy manual disconnect pin and eccentric bushing CHECK
Check that eccentric bushing is in horizontal position with pins inserted and locked
and T-handles stowed in clips provided. See figure 3-4.

WARNING

If pin is difficult to remove, it may indicate the bottle has discharged and the canopy will be jettisoned unless the pressure is bled off.

7. Canopy jettison air bottle pin CHECK REMOVED



ADF1-71

Figure 3-4.

EJECTION SEAT CHECK

1. Ejection-seat ground safety pins (6) (7 in seats with ACC 271) IN
2. Face-curtain lock and alternate firing-handle guard UP (LOCKED POSITION)
3. Drogue rigging COVERED

CONTINUED ON NEXT PAGE

4.	Ejection-gun firing linkage	CONNECTED
	Check through the windows that the face curtain handles are connected to the firing linkage.	
5.	Top latch mechanism	LOCKED
	Check that top latch mechanism plunger and indicator dowel are both flush with or slightly recessed from end of top latch mechanism housing.	
6.	Drogue-gun trip rod	SECURED
	Check that the drogue-gun trip rod is secured to the fixed ejection-gun bracket with the red painted portion covered by the trip-rod outer barrel.	
7.	Rocket-motor initiator sear extraction lanyard	ATTACHED
	Check that the rocket-motor initiator sear extraction lanyard is attached to the sear actuating link and the drogue-gun trip rod.	
8.	Drogue gun	LOCKWIRED AND SEALED
9.	Inertia-reel actuating link	CONNECTED
	Check that the actuating link is connected to the powered inertia-reel gas-generator sear.	
10.	Parachute withdrawal line	ROUTED THROUGH GUILLOTINE
11.	Parachute withdrawal-line screw connector	FINGER-TIGHT

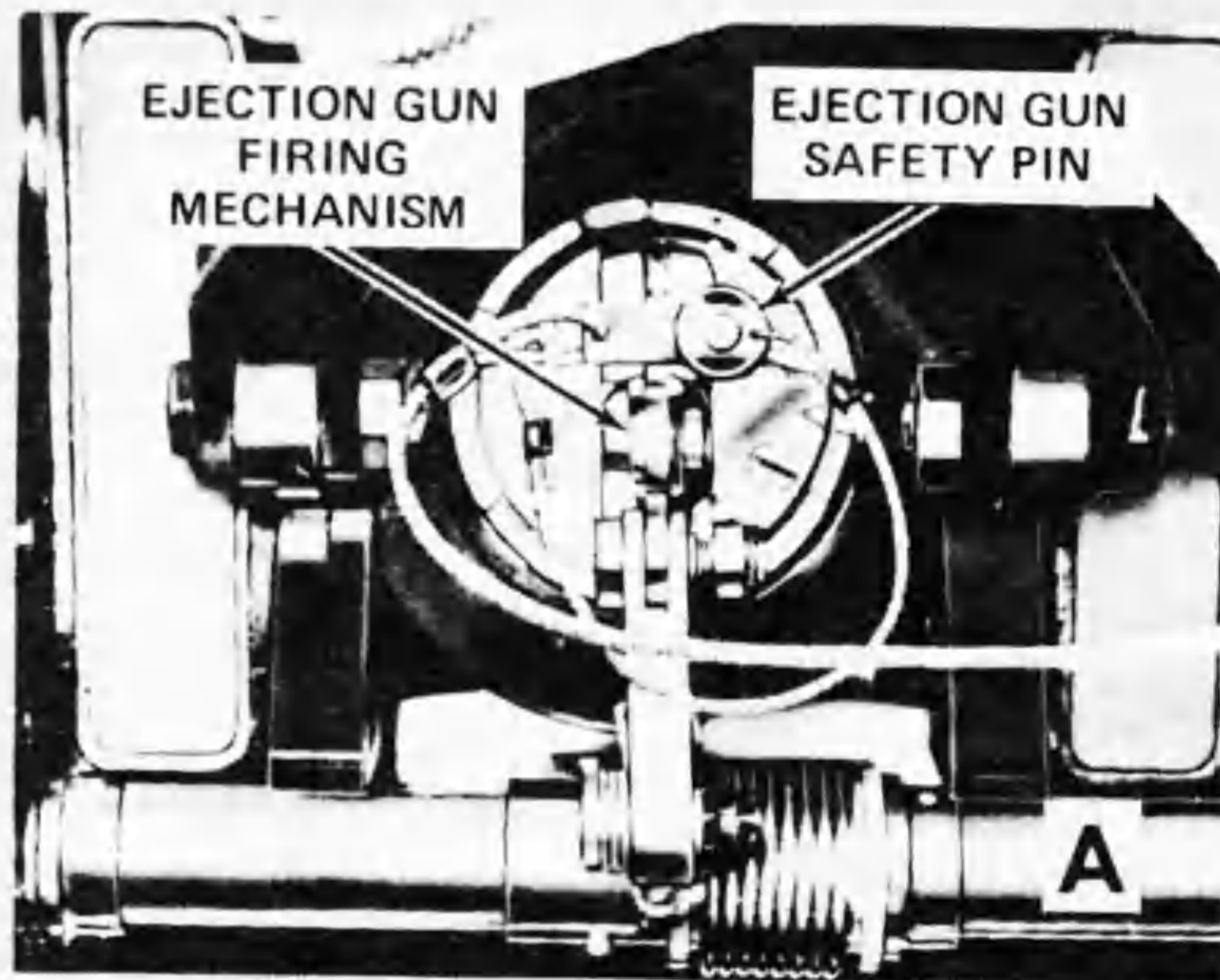
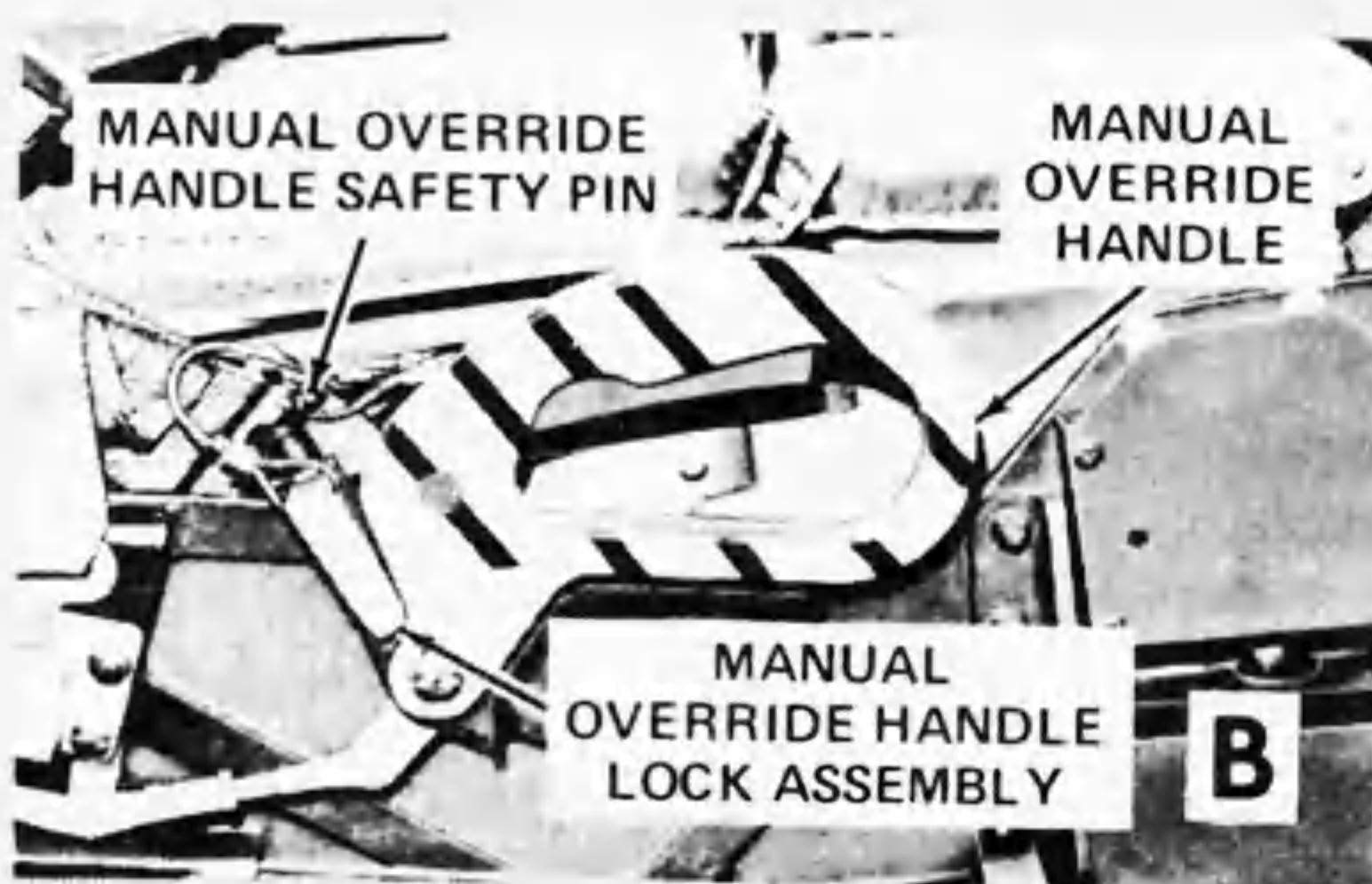
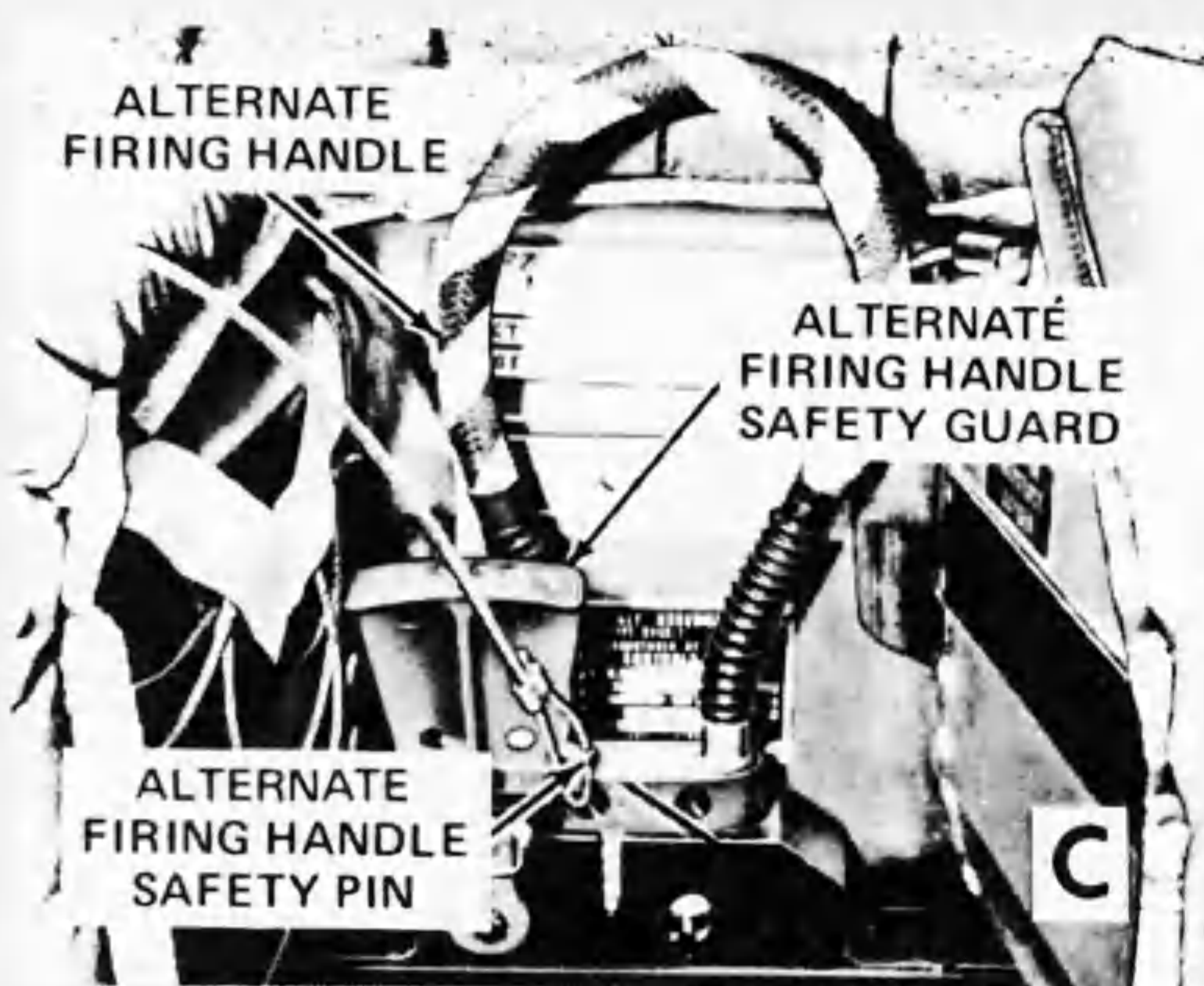
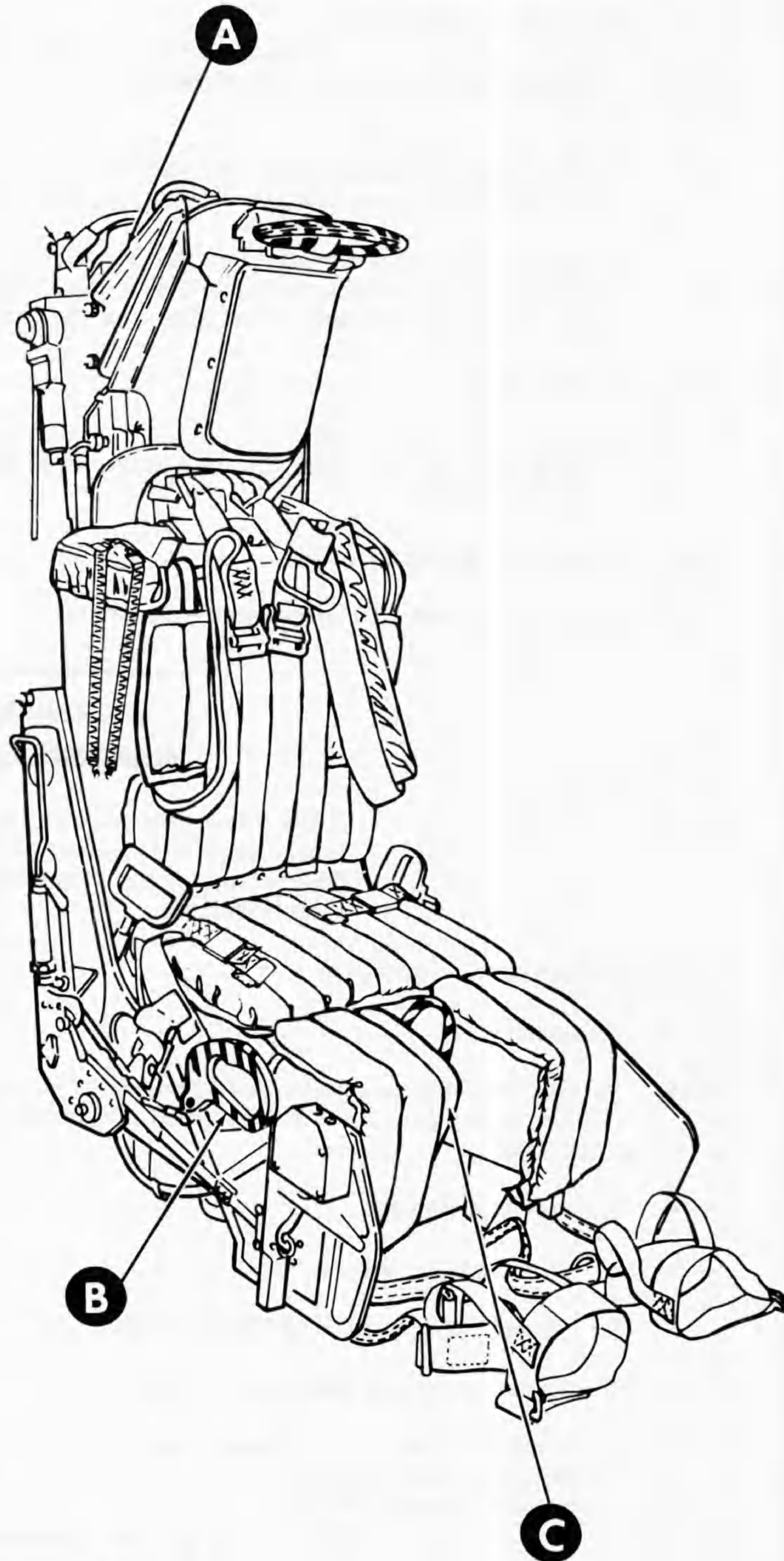
If the personnel parachute withdrawal line is not securely connected, automatic deployment of the parachute will not occur after ejection.

- | | | |
|-----|--|----------------------|
| 12. | Rocket-motor initiator | LOCKWIRED AND SEALED |
| 13. | Parachute | ATTACHED SECURELY |
| 14. | Inertia reel straps and leg-restraint cords
Determine security of inertia reel straps and leg restraint cords by means of a
hard pull. | SECURE |
| 15. | Emergency oxygen | |
| | a. Emergency oxygen bottle | 1,800 PSI |
| | b. Emergency oxygen system actuator | PROPERLY STOWED |
| 16. | Personnel services disconnect lanyard | SECURED TO DECK |
| 17. | Survival kit front lock release lever
Check that survival kit front lock release lever peg is full forward against
leg-line release linkage. | FULL FORWARD |

Failure of survival kit front lock release lever to return to its full forward position will prevent ejection by means of the alternate firing handle

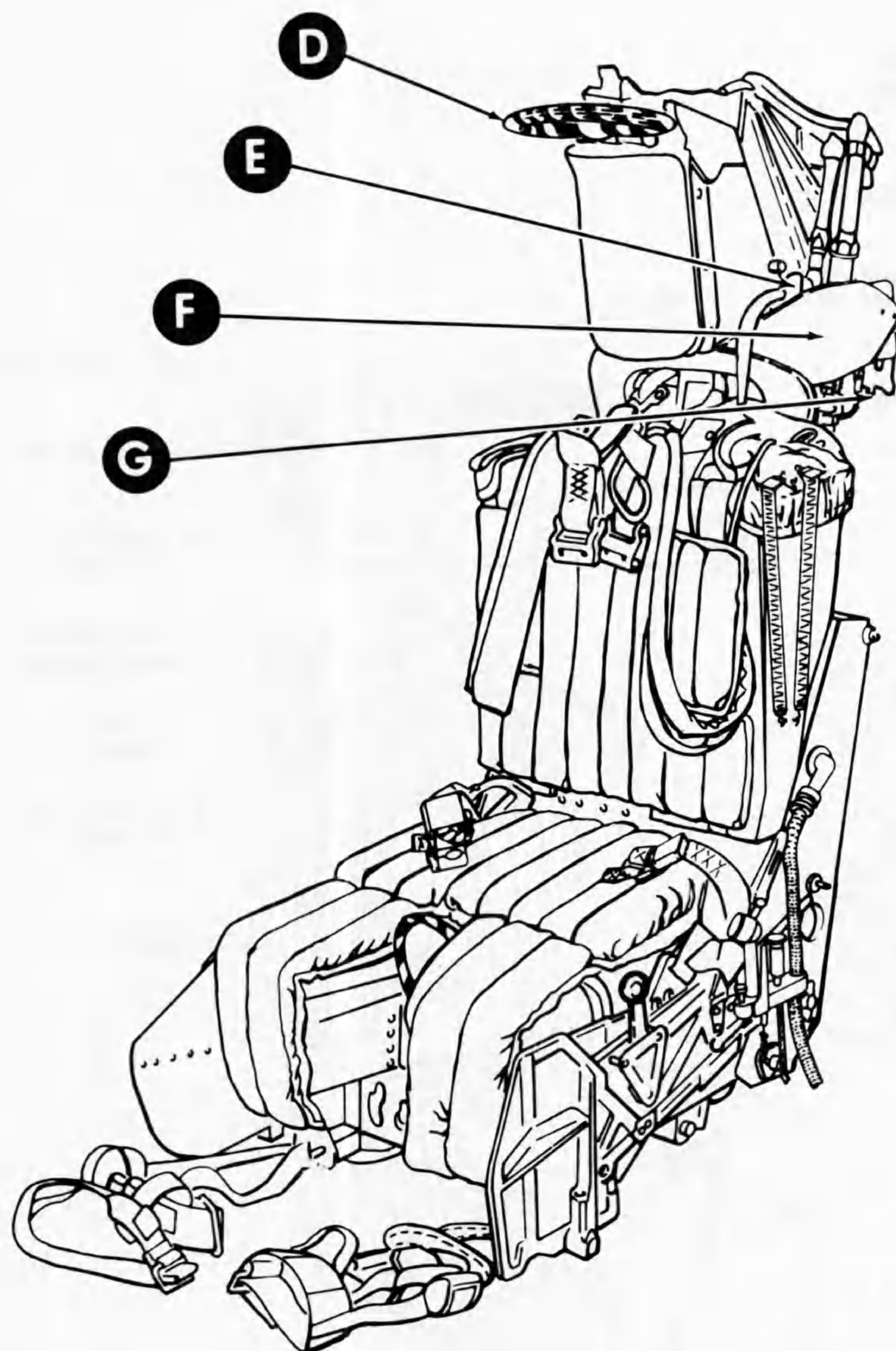
EJECTION SEAT SAFETY PINS

MK GRU-7

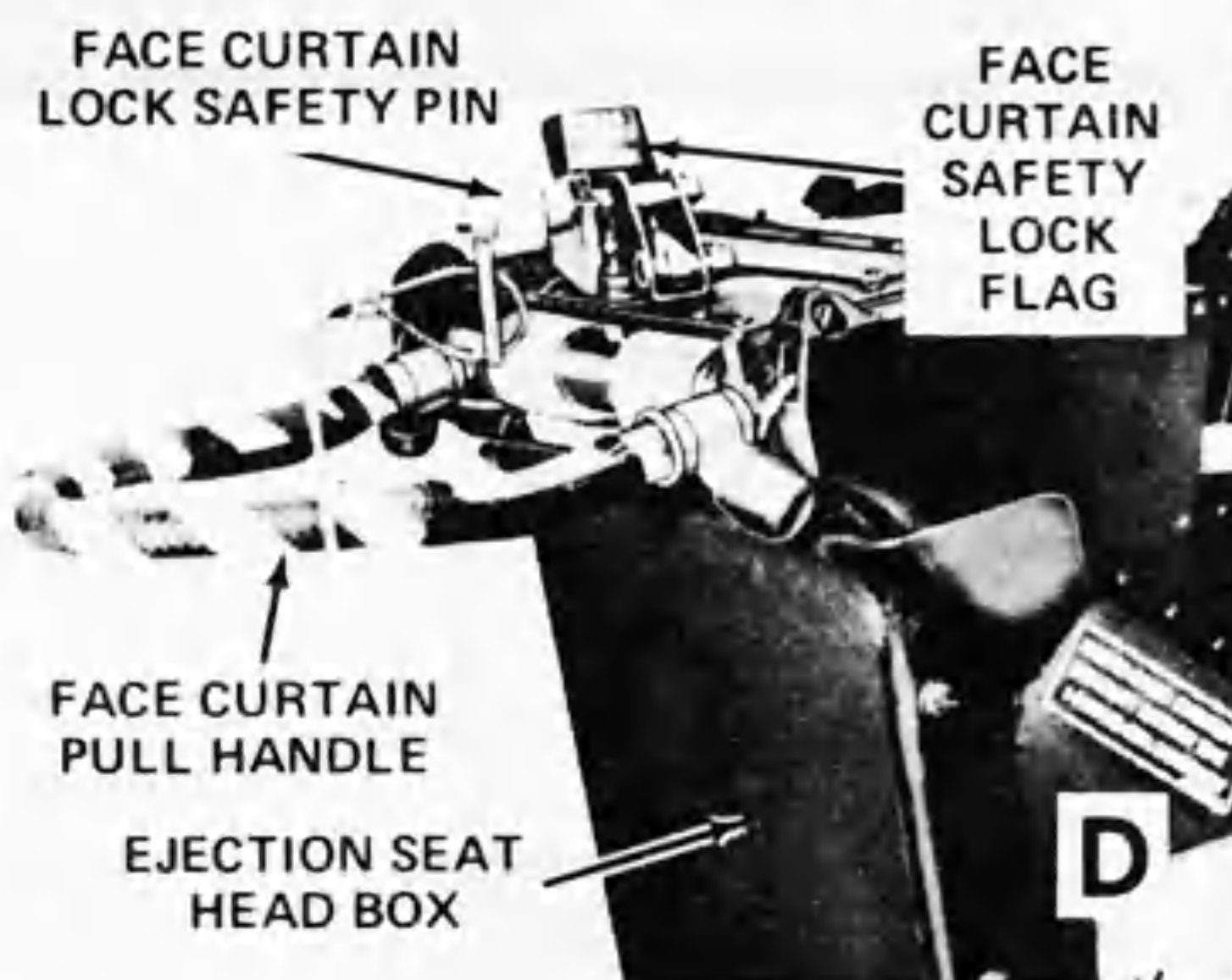
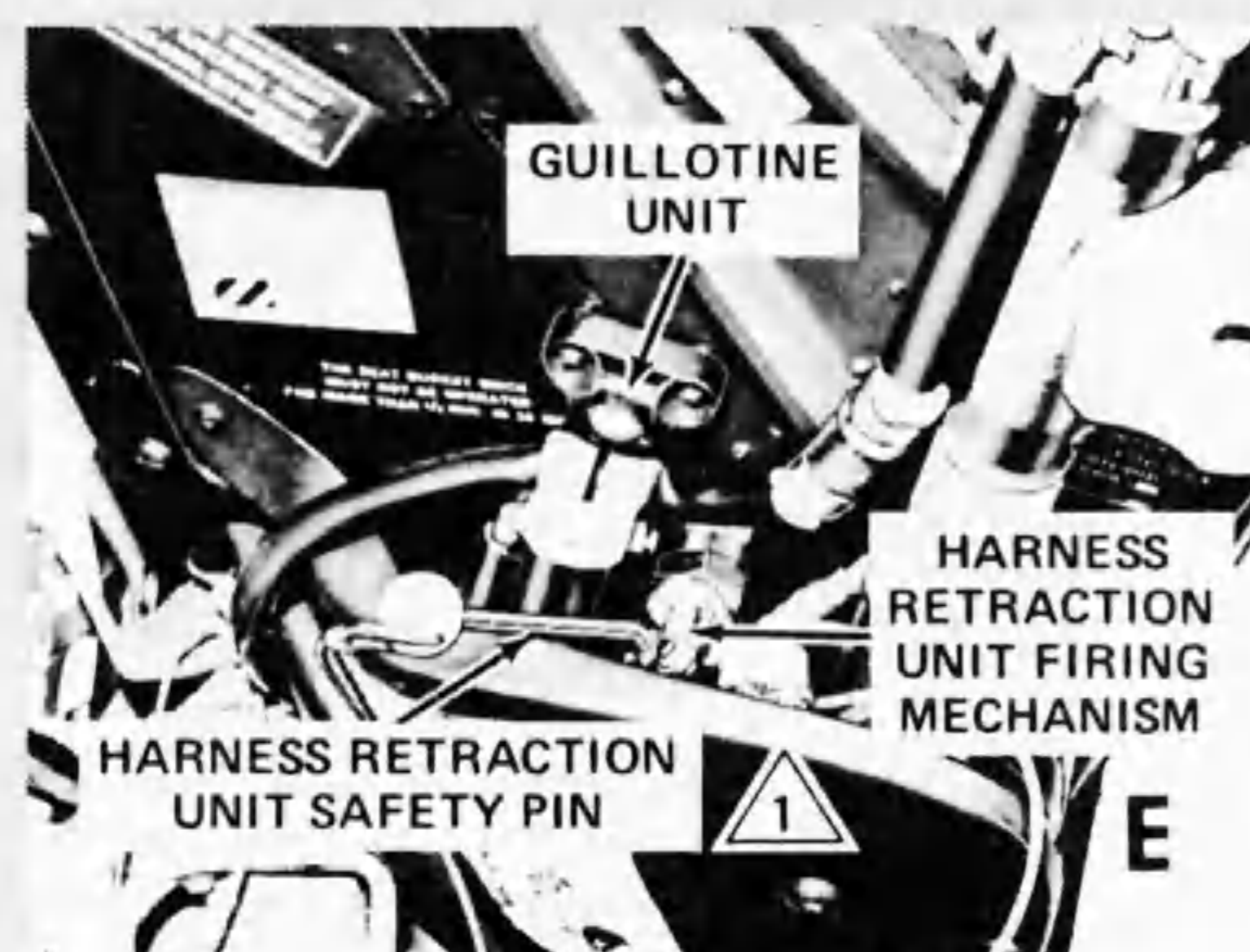
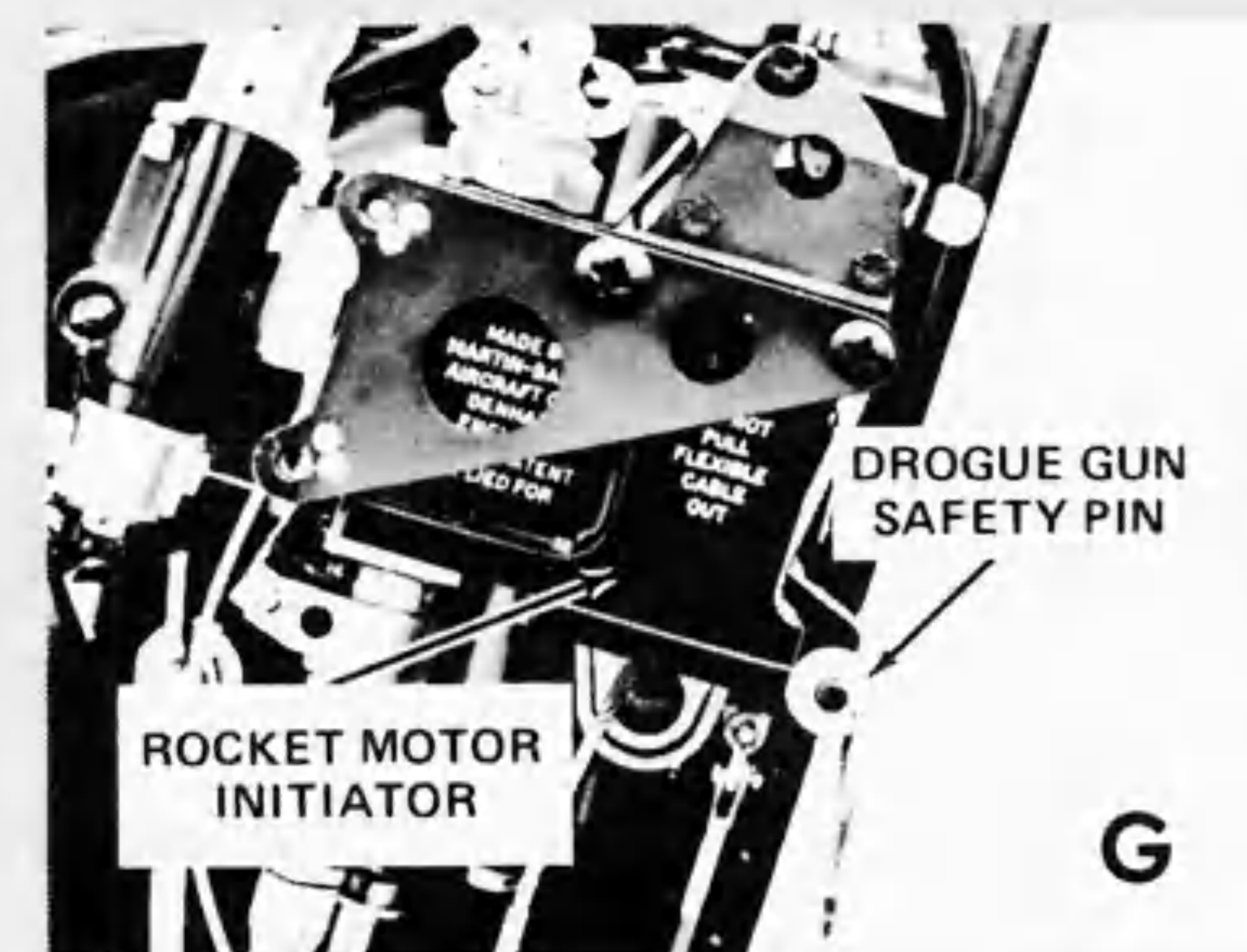


A-ADF1-20-1

Figure 3-5 (Sheet 1)

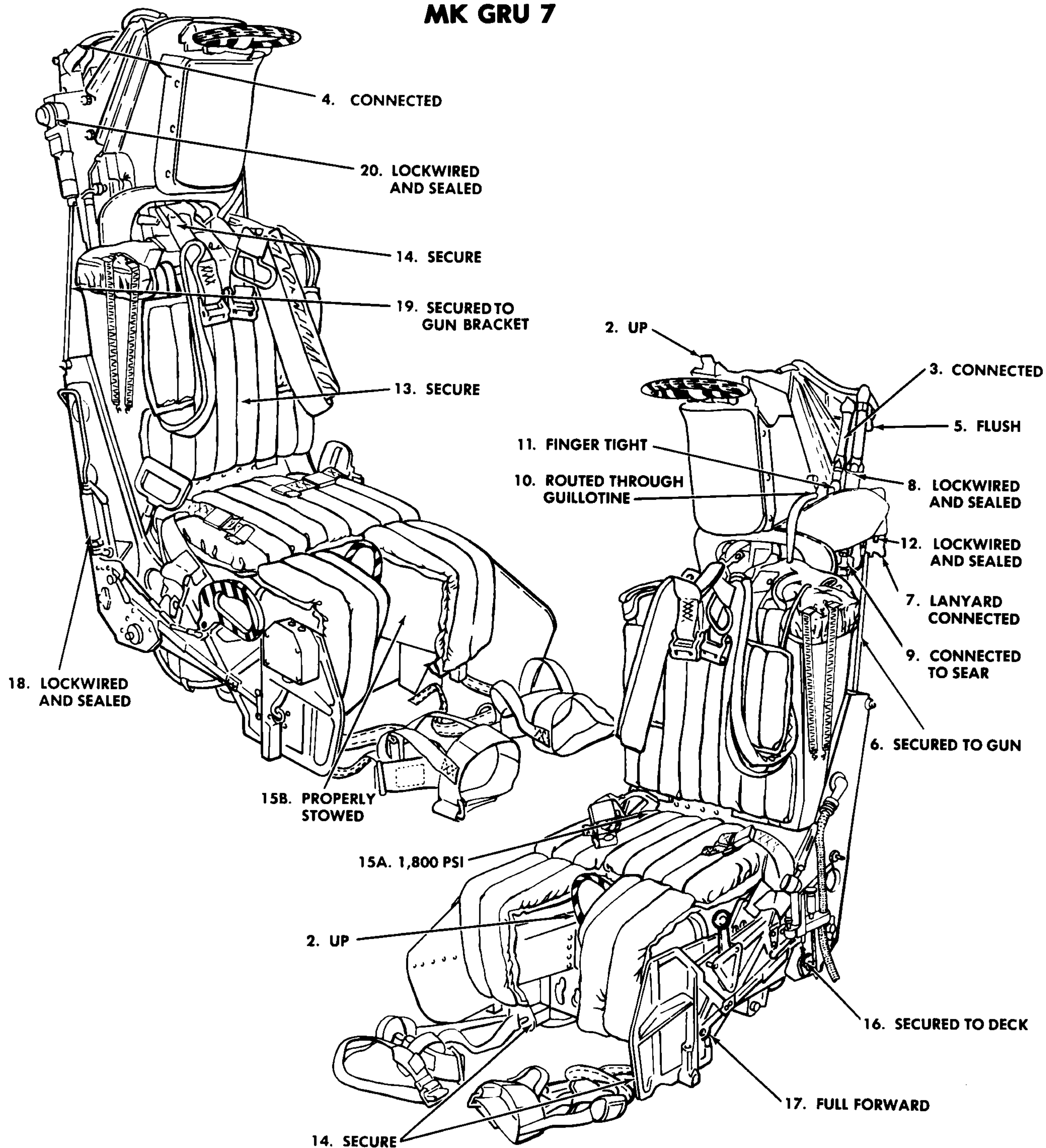


1 SEATS INCORPORATING ACC 271



EJECTION SEAT PREFLIGHT

MK GRU 7



A-ADF1-21

Figure 3-6

EJECTION SEAT CHECK-CONTINUED

Note

It may be necessary to raise the seat to see the lever.

- | | | |
|-----|--|----------------------|
| 18. | Guillotine initiator | LOCKWIRED AND SEALED |
| 19. | Time-release mechanism trip rod | SECURED |
| | Check that the time-release mechanism trip rod is secured to the fixed ejection-gun bracket with the red painted portion covered by the trip-rod outer barrel. | |
| 20. | Time-release mechanism | LOCKWIRED AND SEALED |
| 21. | Ejection seat ground safety pins (6) (7 in seats with ACC 271) | REMOVED AND STOWED |

PRESTART PROCEDURES EXTERNAL POWER ON

UPON ENTERING COCKPIT

- | | | |
|----|--|-----------|
| 1. | Canopy safety pins | REMOVED |
| 2. | Harnessing | FASTEN |
| 3. | Helmet | ON |
| 4. | Attach oxygen mask/communication connections and anti g-suit/anti-exposure suit | CONNECTED |
| 5. | Seat | ADJUST |
| a. | Assume ejection position, sit erect, buttocks against backrest, head firmly against headrest, spine straight, thighs against seat pan. | |
| b. | With left hand, reach up and touch face-curtain handle. | |
| c. | Adjust seat height and tilt so that top of helmet just clears underside of face-curtain handle. | |

Note

Above procedure ensures proper positioning for ejection and optimum vision over the nose of the aircraft and inside the cockpit.

- | | | |
|-----|---|-----------------------|
| 6. | Rudder pedals | ADJUST |
| 7. | Backup flight control hydraulic system | TEST |
| | Place the backup hydraulic test switch to the TEST position. The BACKUP HYD light will go on. Cycle the rudder and stabilizer (response indicated by plane captain's signals). Repeat for COMBINED position of switch. This test verifies operation of the pressure-sensing switches in the flight and combined hydraulic systems and the operation of the backup hydraulic motor/pump. | |
| 8. | RAT handle | MATCHING RAT POSITION |
| 9. | Interior and exterior lighting | AS DESIRED |
| 10. | Anticollision switch | ON |
| 11. | Aux receiver | SET AS DESIRED |

CONTINUED ON NEXT PAGE

PRESTART PROCEDURES EXTERNAL POWER ON-CONTINUED

12. ICS AS DESIRED
13. Vent suit and cushion air flow AS DESIRED
14. Optical sight unit switches AUTO/MAN

CAUTION

Do not leave AUTO/OFF/MAN switch OFF
during taxi or flight operation.

15. Oxygen CHECK
(with mask away from face, depress ICS)
16. Rudder trim SET TO ZERO
17. Hook bypass switch AS DESIRED
18. Engine/fuel master switches ON
(low fuel-pressure caution lights out)
19. Boost pump test button DEPRESS
Check that LOW FUEL PRESSURE lights come on.
20. Right engine/fuel master switch OFF
21. Generator switches OFF
22. Speed drive switches NORMAL
23. Approach power compensator OFF
(when installed)
24. Antiskid switch OFF
25. Flapron pop-up switch OFF
26. Speed brake test switch NORMAL
27. Emergency flap switch OFF
28. Throttles OFF AND FRICTION ADJUSTED
29. Flap lever UP
30. Assist-spin recovery switch OFF AND GUARDED
31. Bleed-air isolation valves (AFC-268)
 - a. NWW AUTO
 - b. CSD OFF
 - c. Air cond. ON
32. Fuel quantity CHECK
33. Fuel ready switch OFF
34. Fuselage dump switch OFF

CONTINUED ON NEXT PAGE

PRESTART PROCEDURES EXTERNAL POWER ON-CONTINUED

- | | | |
|-----|--------------------------------|--------------------------------|
| 35. | Wing dump switch | OFF |
| 36. | Wing drop-tank transfer switch | NORM/OUTBD |
| 37. | Tank pressurization switch | NORMAL |
| 38. | Brake selector handle | OUT AND VERTICAL |
| 39. | Landing-gear handle | DN |
| 40. | Integrated position indicator | CHECK FOR
PROPER INDICATION |
| 41. | Radar altimeter | OFF |
| 42. | Auxiliary brakes cycle gage | 15 CYCLES |
| 43. | Pressure altimeter | CHECK AND SET |

Note

Do not set altimeter while computer
ORT is in progress.

- | | | |
|-----|--|-----------------|
| 44. | Airspeed indicator | CHECK AND ZERO |
| 45. | VGI | SET TO HORIZON |
| 46. | Clock | SET |
| 47. | VSI | CHECK AT ZERO |
| 48. | Canopy switch | OPEN OR NEUTRAL |
| 49. | Fire/oil warning system | TEST |
| | Depress fire/oil test button and check lighting of left and right fire warning lights, and left and right oil low warning lights, and NWW TEMP light (AFC 268) | |
| 50. | Lox/fuel/oil button | TEST |
| | Depress lox/fuel/oil button. Check that oxygen quantity gage drops to zero and the oxygen warning light comes on at approximately 2 liters, pointer on fuel quantity gage moves toward zero, which is a functional test of the fuel quantity indicating system. This is not a test of low-fuel warning light. Low-oil warning light check is valid only after engine oil scavenging. | |
| 51. | Lights warnings | TEST |
| | Check following lights: Landing gear transition, wheels warning, hook transition, annunciator panel and angle-of-attack indexer, reselect and complete (ACU). | |
| 52. | Manual canopy selector handle | PULL UP |

WARNING

In aircraft that do not incorporate the AUX
HYD PUMP button on the center console, if
the canopy selector handle valve is in the
closed position, the canopy will close when
hydraulic pressure is applied to the system.

CONTINUED ON NEXT PAGE

PRESTART PROCEDURES EXTERNAL POWER ON-CONTINUED

53.	VDI	STANDBY FOR 5 MINUTES
54.	Station selector switches (5)	OFF AND LOCKED
55.	Master armament switch	OFF AND LOCKED
56.	Mechanical and electrical fuzing switches	OFF
57.	Selective jettison button	OUT AND GUARDED
58.	Nuclear selector buttons (3)	OFF AND LOCKED
59.	Autopilot switch	OFF
60.	UHF	ON (T/R & G)
61.	TACAN	ON T-R
62.	IFF	STANDBY
63.	SIF	AS REQUIRED
64.	Air-conditioning cockpit switch	ON
65.	Temperature control wheel	SET AT ZERO
66.	MAN/RAM air switch	AUTO
67.	Computer emergency cooling switch	NORM
68.	DEFOG air-flow thumb wheel	OFF
69.	Air conditioning master	NORM
70.	Engine anti-ice switch	OFF
71.	Windshield rain-removal switch	OFF
72.	Pitot heat switch	OFF
73.	Wing-fold handle	MATCHING WINGS
74.	Radio mixer control box	SET-UP AS DESIRED
75.	ECM tone	COUNTER CLOCKWISE
76.	Cabin dump	OFF
77.	Antenna select switches	AS DESIRED
78.	CNI master	OFF
79.	Circuit breakers (inc. C/B under pilot's left console)	IN
80.	MA-1 compass	CHECK SYNC AND SLAVED
81.	Speech security equipment	OFF
82.	Radar beacon	STANDBY (AS REQ)
83.	ACLS (where installed)	PROPER FREQ AND OFF

CONTINUED ON NEXT PAGE

STARTING ENGINES

The engines cannot be started simultaneously; however, either engine can be started first. This procedure establishes starting the left engine (No. 1) first to allow checking the operation of all three bleed-air isolation valves.

CAUTION

If any of the following indications occur during an attempted engine start, a malfunction is indicated and immediate action on the part of the pilot is required:

- Abnormal engine noise or sound
- Wet start (no light-off within 10 seconds after placing throttle to idle)
- Hot start (EGT exceeds 455°C)
- Hung start (RPM will not accelerate to idle)
- Oil pressure fails to rise to 35 PSI within 30 seconds of operation
- Fire warning light comes on, or other indication of fire
- Speed-drive caution light remains ON above 40% RPM

1. Ground turbine compressor (GTC) ON
2. GTC start air AVAILABLE
50 PSI indicated available from ground crew
3. Left crank switch (Aircraft incorporating AFC No. 268 only.) DEPRESS, THEN RELEASE
No rotation should be obtained, indicating that the CSD bleed-air isolation valve is actually closed.
4. CSD bleed-air isolation valve (Aircraft incorporating AFC No. 268 only.) ON
5. Left crank switch DEPRESS, THEN RELEASE
Rotation should now begin, indicating that the CSD bleed-air isolation valve has opened. Steps 3 through 5 provide a functional check of the CSD bleed-air isolation valve.

CAUTION

If the wings are folded, grasp the wing-fold handle and insure that the mechanical lock is unlocked, and maintain positive forward pressure on the wing-fold handle until flight and combined systems indicate normal pressure.

6. At 18% RPM, throttle IDLE
7. Fuel flow 700 TO 800 POUNDS PER HOUR
8. Exhaust temperature UNDER 455°

CAUTION

A hot start can be anticipated by observing a greater than normal starting fuel flow and exhaust temperature increase. Normally, the EGT tape will ride evenly with or slightly below the RPM tape during a start. Whenever the EGT exceeds the RPM a hot start can be anticipated. It is essential that the engine be shut down immediately.

CONTINUED ON NEXT PAGE

STARTING ENGINES-CONTINUED

9. Oil pressure 35 to 50 PSI
10. Idle RPM STABILIZED
Check idle RPM stabilized at approximately 52% to 60% RPM depending upon ambient conditions.
11. Hydraulic pressure NORMAL
12. External compressed-air source DISCONNECT
13. Hook RAISE
Hook will be down on first flight of day.
14. RAT RETRACT (IF EXTENDED)
15. AIR COND bleed-air isolation valve (Aircraft incorporating AFC No. 268 only.) CHECK
Check the AIR COND bleed-air isolation valve and note that the cabin air flow stops, indicating that the valve actually closed. Reopen the valve.
16. Landing gear and drop-tank ground safety locks REMOVE
Check visually with ground crewman.
17. Right engine and fuel master switch ON
18. Left throttle ADVANCE TO 76% RPM TO SUPPLY STARTING AIR
19. Start right engine as per items 5 through 11.
20. Left throttle IDLE (AFTER RIGHT ENGINE AT IDLE SPEED)
21. Right generator ON (CHECK CAUTION LIGHT OUT)
22. Left generator ON (CHECK CAUTION LIGHT OUT)
23. External electrical power DISCONNECT

POST START

1. Engine-driven fuel pump CHECK
Depress the boost pump test button and check that L or R FUEL PSI caution lights do not come on. If either light comes on, an engine-drive fuel pump has failed and the engine should be shut down.

CAUTION

To preclude an engine fire, if an engine flames out during this test, the appropriate engine fuel master which should be positioned to OFF before releasing the fuel boost pump test button.

2. VDI ON AND ADJUST

Note

Elevation calibration of the horizon line can be checked by going to the TEST position. When in TEST, the horizon line should match the fiducial markers.

3. Boarding ladder(s) STOWED

CAUTION

Pilot and bombardier/navigator should visually check their respective boarding ladders up to avoid damage in flight.

CONTINUED ON NEXT PAGE

POST START-CONTINUED

- | | | |
|--|-------|---------------|
| 4. Oxygen switch | | ON |
| 5. Oxygen mask | | ATTACHED |
| 6. Anti-g valve | | PRESS TO TEST |
| 7. Rain removal (aircraft not incorporating AFC No. 268) | | CHECK |

CAUTION

The rain-removal system shall be checked by actuating the windshield switch to the AIR position on a wet windscreen (use WASH as necessary) by holding your hand over the top of the windscreen to feel the hot air. Turn the windshield air off as soon as possible to prevent cracking the windshield. If unable to turn off the hot air, secure the engines as soon as possible (after gear pins are installed).

- | | | |
|---|-------|-------|
| 8. NWW bleed-air isolation valve (Aircraft incorporating AFC No. 268 only.) | | CHECK |
| Place the windshield switch to the AIR position on a wet windscreen (use WASH as necessary). Check for hot air by holding your hand over the top of the windscreen, and for WSHLD AIR light (AFC No. 264) on. Close the NWW bleed-air isolation valve and note that hot air stops. Return the NWW switch to AUTO and note that hot air is reapplied; return windshield switch to OFF and note that hot air stops. | | |

- | | | |
|-----------|-------|--------|
| 9. Canopy | | CLOSED |
|-----------|-------|--------|

WARNING

Prior to actuating canopy switch to the closed position, ensure that both boarding ladders are clear, that no one is on the aircraft, and that B/N is aware that canopy will be closed.

- | | | |
|------------------------------------|-------|------------------------|
| 10. Air conditioning master switch | | OFF AND BACK TO NORMAL |
|------------------------------------|-------|------------------------|

Note

Ducted air to cabin ceases and air conditioning light comes on.

- | | | |
|---------------------|-------|----------------|
| 11. Radar altimeter | | ON AND SET |
| 12. Platform | | VERIFY OPERATE |

ORDNANCE

When carrying ordnance, refer to and complete the appropriate NAVAIR checklist for type of ordnance carried. Capability and type of ordnance carried on the A-6 series aircraft can be found in NAVAIR 01-85ADA-1T.

BEFORE TAXIING

1. Chocks REMOVE
2. Brake selector handle CHECKED, IN AND VERTICAL
Push brake handle in to release parking brakes. Check handle for freedom of push/pull movement and with handle in vertical position by applying counterclockwise rotation.

CAUTION

If handle binds or does not remain in vertical position when pushed in (brake released), taxi shall not be attempted.

3. Brakes TEST
After initial roll, apply normal brakes and test operation.
4. Nose-wheel steering ENGAGE
Engage nose-wheel steering to minimize brake wear.

WING SPREAD

1. Wing-fold handle AFT, TO FIRST STOP
(Wait for all spread motion to cease.)
2. Wing lockpin switch LOCK
3. Wing-fold handle STOW
Move wing-fold handle aft and down flush with center console smartly with palm of hand.
4. Wing-fold warning flags RETRACTED
Check retraction of wings-fold warning flags after wing-fold handle is stowed.

CONTROL CHECKS

1. Flight controls CYCLE SMOOTHLY AND CHECK FOR NORMAL THROW AND DIRECTION

CAUTION

To prevent damage to the hydraulic pumps from cavitation, do not permit hydraulic pressure to go below 2000 PSI during control checks.

2. Wing fuel pressure ORIDE AND CHECK LIGHTS OUT

CAUTION

Insure that the air-conditioning master switch is in the NORM position. Hot engine bleed air will be pumped into the wing tank if the tank pressure switch is actuated to ORIDE when the air-conditioning master switch is OFF.

3. Speed brakes OPEN
4. Flaps and slats TAKE OFF
While flaps/slats are in transit observe flaperon for pop-up. Return the flaps to TAKEOFF position.

WARNING

If flaperon pop-up occurs during slat operation a pop-up valve failure is indicated and takeoff should not be attempted.

5. Autopilot CHECK
6. Speed brakes RETRACT

CONTINUED ON NEXT PAGE

CONTROL CHECKS—CONTINUED

Note

If wing-tip speed brakes do not retract using the speed brake test switch, DO NOT extend speed brakes in flight.

- | | | | |
|-----|---|-------|--|
| 7. | Wing fuel pressure | | NORMAL |
| 8. | Flight controls | | CYCLE AND CHECK FOR EXTENDED THROW AND DIRECTION |
| | During control stick cycling, hold the stick in the full aft and full forward positions. | | |
| | If the stabilizer does not achieve full travel, secure the engines and investigate. | | |
| 9. | Trim | | CYCLE AND SET FOR TAKE-OFF |
| | Adjust pitch trim so that the stabilizer leading edge aligns with the takeoff trim reference mark painted on the aft fuselage. Note pitch trim position indicator reading for future reference. | | |
| 10. | Flight instruments | | CHECK |

BEFORE TAKEOFF

Before takeoff, the takeoff check list (figure 3-1) must be completed.

- | | | | |
|----|-------------------------|-------|-------------------|
| 1. | Wings | | SPREAD AND LOCKED |
| 2. | Trim | | CHECKED |
| | a. Rudder | | 0° |
| | b. Flaperon | | 0° |
| | c. Stabilizer | | 6 UNITS NOSE UP |
| 3. | Flaps | | TAKE-OFF |
| | a. Slats | | DOWN |
| | b. Stabilizer | | SHIFTED |
| | c. Speed brakes | | IN |
| 4. | Fuel | | |
| | a. Quantity | | CHECKED |
| | b. Tank pressure switch | | NORMAL |
| | c. Wing pressure lights | | LIT |
| | d. Fuel ready switch | | OFF |
| 5. | Controls | | UNRESTRICTED |

CONTINUED ON NEXT PAGE

BEFORE TAKEOFF-CONTINUED

- 6. Seats ADJUSTED AND ARMED
 - a. Seat face-curtain guard DOWN (UNLOCKED)
 - b. Secondary firing-handle guard ROTATE CLEAR (UNLOCKED)
- 7. Harness LOCKED
- 8. Flaperon pop-up ARM

Note

Check that the flaperons go down when each throttle is moved out of the IDLE position

- 9. Antiskid switch ON
- 10. Auxiliary brakes RECHECK 15 CYCLES
- 11. Boarding ladders STOWED

TAKEOFF (ASHORE)

After taxiing to the runup area, allow the aircraft to roll straight ahead to insure nose alignment. Apply brakes and complete the following checks:

- 1. Pitot heat switch AS REQUIRED
Set pitot heat switch as required for existing weather conditions.
- 2. Engine anti-ice switch AS REQUIRED
Set engine anti-ice switch as required for existing weather conditions.
- 3. RAT DEPLOYED FOR WET RUNWAY TAKEOFF

CAUTION

Ingestion of significant amount of water into the generator cooling scoop may result in the loss of the generator(s). Deployment of the RAT will preclude the loss of electrical power above 110 KIAS.

- 4. IFF/SIF AS REQUIRED
- 5. AFCS OFF UNTIL SAFELY AIRBORNE
- 6. ICS HOT
- 7. Engines CHECK
Advance throttle to MAX POWER, flaperons in normal configuration, allow engine RPM to stabilize; observe that EGT, fuel flow, oil pressure, and hydraulic pressure gages are within operating limits. Check cockpit power trim indicators to insure engines are developing proper takeoff thrust.

Note

Engine thrust is a critical factor in heavy gross weight takeoffs under high ambient air-temperature conditions. Under these conditions, if the power trim indicators show less than the desired engine power outputs, the decision to elect takeoff must be carefully weighed against such critical factors as runway available, density altitude, critical field length, and other indications of engine performance.

- 8. Controls CYCLED
Controls shall be cycled rapidly while the engines are operating at sufficient RPM to preclude hydraulic pump cavitation (above 75%). If any unusual airframe vibrations are experienced takeoff shall not be attempted.

CONTINUED ON NEXT PAGE

TAKEOFF (ASHORE) – CONTINUED

WARNING

Takeoff shall not be attempted if stabilizer shift indicator flickers/barber poles when the controls are rapidly cycled. The BACK-UP HYD light may flicker showing normal operation of the backup hydraulic system.

- 9. Nose-wheel steering ENGAGE
- 10. All caution and warning lights OFF
- 11. Bombardier/navigator CHECK READY FOR TAKEOFF
- 12. Brakes RELEASED
- 13. Nose-wheel CENTERED
Use nose-wheel steering for directional control until rudder effective at approximately 80 knots.

TAKEOFF TECHNIQUE

Refer to Section XI, for rotation speeds at various gross weights. A positive climb attitude at a moderate rate of climb (1,000 to 1,500 FPM) must be established before the landing gear is retracted. Flaps/slats are raised prior to 250 KIAS. Maintain a moderate climb attitude until scheduled climb speed is attained. Refer to Section XI, for recommended maximum rate of climb. Minimum run takeoff is the same as for normal takeoff, except that the nose is

raised at speeds recommended for minimum takeoff ground run; airspeed is then held constant.

CROSSWIND TAKEOFF

The use of the nose-wheel steering and normal flight control are adequate for crosswind takeoffs up to a crosswind component of 90° and 20 knots. See Section XI for chart.

AFTER TAKEOFF – CLIMB

When the aircraft is definitely airborne:

- 1. Landing gear UP (BELOW 200 KIAS)
Check that wheels transition light comes on and then goes out. Check that OUT'BD WING TK PRESS and INBD WING TK PRESS caution lights are out.

CAUTION

The landing gear should be completely up and locked before exceeding 200 KIAS.

- 2. Flaps UP
Retract flaps before reaching 250 KIAS. Check integrated position indicator for flap UP and slat IN, and stabilizer shaft indications.

AFTER TAKEOFF—CLIMB—CONTINUED

WARNING

- Extreme caution should be exercised during flap retraction under heavy gross weight conditions. To avoid aircraft stall or settling due to flap retraction, do not retract the flaps below 170 KIAS for weights up to 50,000 pounds and not below 185 KIAS for weights above 50,000 pounds. At the heavier weights and under high ambient temperature conditions, acceleration and climb performance are marginal and it may be impossible to reach 185 KIAS. If 185 KIAS cannot be reached, it is recommended that external store weight be reduced in order to permit acceleration to 185 KIAS before flap retraction.
- If a barberpole indication on slat/flap retraction should occur after takeoff, power must be maintained at military and airspeed controlled within limits (maximum of 250 KIAS and minimum of 170 KIAS or 185 KIAS as applicable) by adjusting aircraft attitude. Power reduction or diversion of attention must not be attempted until reaching safe operating altitudes.

Note

Remedial action for barberpoled slats may include any or all of the following at speeds above the minimum for slat retraction and up to a maximum of 250 KIAS.

- (1.) With the flap lever in the retracted position, apply a slight negative g.
- (2.) Momentarily actuate the flap lever to the takeoff position and as the slats begin to extend, immediately return the lever to the up position.
- (3.) Momentarily actuate the emergency flap switch to DOWN and as the slats begin to extend, immediately set the switch to UP and then OFF.
- (4.) While maintaining airspeed above minimum retraction speed, extend the flaps/slats partially and then retract. As the slats approach the fully closed position, momentarily apply slight negative g.

3. Isolation valve switch FLT
After landing gear, flaps, and slats have been fully retracted, place isolation valve switch to FLT position.
4. Accelerate to best climb speed.
5. Trim for climb.

CRUISE

Cruise control data for various weights and configurations are contained in Section XI.

WARNING

Monitor fuselage fuel quantity to insure proper fuel transfer.

FLIGHT CHARACTERISTICS

See Section IV, for information on the flight characteristics of this aircraft.

DESCENT

Before descent, and after prolonged cold-soaking at high altitudes, the cockpit temperature should be increased and the defogging control turned ON. Normal penetration (letdown), as reflected in the descent charts is in Section XI, and is normally accomplished with approximately 80% RPM at a descent speed of 250 KIAS. Speed brakes are extended and descent speed is maintained by adjusting the rate of descent.

For maximum-range glide see Section V, Emergency Procedures. The descent speed is maintained without the use of speed brakes. Prior to all descents, the following checks should be performed:

- 1. Defog ON
- 2. Fuel CHECK

Note

Inform the bombardier/navigator when dumping fuel.

- 3. Weather CHECK
- 4. Pressure altimeter CHECK AND SET
- 5. Radar altimeter . . ON AND CHECKED BELOW 5,000 FEET AGL

CAUTION

Do not actuate landing gear above 8,000 feet unless the cabin is depressurized.

- 6. Refile AS REQUIRED
- 7. Anti-ice pitot heat AS REQUIRED

BEFORE LANDING

The landing checklist must be completed before landing:

- 1. Harness LOCKED
- 2. Armament ALL SWITCHES OFF
- 3. Flaperon-Pop-Up ARM
- 4. Antiskid ON
- 5. Hook AS REQUIRED
(Isolation switch to LAND)
- 6. Wheels DOWN

BEFORE LANDING-CONTINUED

7. Flaps TAKEOFF DETENT
(Check stabilizer shifted, slats extended and speed brakes extended.)

WARNING

The pilot must ensure that the flap lever is fully seated in the desired detent and aircraft flap and/or slat configuration is confirmed with the integrated position indicator.

Note

Approximately 180 KIAS and above, the flaps may not fully extend to TAKEOFF position (30°). Above 140 KIAS (approximately), the flaps may not fully extend to the LAND position. In either case, the flap indicator will display a barber pole until the airspeed is reduced.

8. Fuel CHECK
Check quantity, compute correct approach airspeeds, and check fuel dump NORM,
Wing PSI lights on.
9. Autopilot OFF or STAB AUG (AS DESIRED)
10. ICS HOT
11. AUX BRAKES CHECKED FULL CYCLES

LANDING

Upon touchdown

1. Throttles IDLE
2. Nose-wheel steering ENGAGE AS NECESSARY
(below 80 KIAS)
3. Brakes APPLY AS REQUIRED

NORMAL LANDING

For a normal landing, enter the traffic pattern at pattern altitude and airspeed, adjust the throttles as necessary. In the break, reduce power to 75%, extend the speed brakes, lower the landing gear and extend the flaps and slats below 250 KIAS. Check that the integrated position indicator shows landing gear down and locked, flaps and slats extended, speed brakes extended and stabilizer extended throw.

The additional throw of the control surfaces provided by rudder and stabilizer in the power approach configuration offers positive aircraft control throughout the landing.

Complete landing checklist by the abeam position. Reduce speed to appropriate airspeed and check for donut angle of attack, and roll into approach turn on speed with moderate rate of descent.

Note

- Check donut indication against airspeed on the downwind leg. If a discrepancy exists between the two indications, fly the instrument showing lower airspeed indication.
- A donut indication will be 107 KIAS plus 2 knots airspeed for each 1000 pounds over 28,000 gross weight. If external stores are carried, add 2 additional knots.

Use the angle-of-attack indexer and maintain the on-speed indication. Maintaining final approach power of approximately 87% at sea level RPM, and a 3 to 3 1/2° glide-slope angle will provide a normal rate of descent (approximately 700 FPM).

Upon touchdown, retard throttles to idle for flaperon pop-up operation to hold aircraft firmly on the runway. For minimum rollout distance, drop the nose and use antiskid braking. Use the rudder and nose-wheel steering for directional control of the aircraft on the landing roll. Rudder control is effective on landing roll down to speeds of 50 KIAS. Aerodynamic braking may be employed to minimize brake wear.

CAUTION

If heavy braking is used during landing or taxi, do not use the parking brakes until the brake disks have cooled. Avoid prolonged brake applications to prevent the brake disks fusing.

CROSSWIND LANDING

When the crosswind component is greater than 10 knots, take a longer interval and land on the upwind side of the runway. If the crab technique is used, line the aircraft up with the runway just prior to touchdown. The crabbing technique may produce lateral drift or skid, the amount varying with the pilot's ability to line the aircraft up at touchdown. Retard the throttles to IDLE. Rudder control is effective down to 50 knots. Do not use aerodynamic braking. Aerodynamic braking may cause the loss of directional control in a crosswind. The flaperon pop-up will hold the aircraft firmly on the runway. Nose-wheel steering can be used after the right weight-on-wheels switch has actuated.

Note

Neutralize rudder pedals prior to engaging nose-wheel steering.

REDUCING BRAKING REQUIREMENTS

If it is suspected that heavy or repeated braking will result in overheated brakes, residual thrust during taxi back to the chocks can be reduced by securing the left engine using the following procedures:

1. Left CSD switch OFF
2. Left throttle IDLE-CUT-OFF
3. Left engine and fuel master switch OFF

Note

The output from the monitored buses will be lost when either engine is shut down. This will generally make the above procedures undesirable during night operations.

HEAVY GROSS WEIGHT LANDINGS

As landing gross weight increases, the landing pattern should be expanded, and the approach and touchdown speeds will be increased as necessary to maintain donut on-speed indication. For gross weights above 36,000 pounds, the final approach speed should be planned for a minimum sink-rate landing.

WET RUNWAY LANDING

The procedure to be followed when landing on a wet runway is essentially the same as that for a normal landing. However, if standing water is evident or suspected, and the crosswind is not greater than 10 knots, aerodynamic braking should be employed.

WAVE-OFF

The decision to wave off should be made as early as possible. If decision to wave off is made, proceed as follows:

1. Throttles MAX POWER Speed brakes RETRACTED
(Establish a positive rate of climb.)

CAUTION

If a wave-off is initiated with flaps in the LANDING position, ensure that they are retracted before reaching 200 KIAS to prevent structural failure of the flap-actuating mechanism. The flap drive system does not have a blowback feature.

AFTER LANDING

After aircraft has slowed to taxi speed:

1. IFF/SIF OFF
2. Alternate firing-handle guard UP (LOCKED POSITION)
3. Seat face-curtain guard UP (LOCKED POSITION)
4. Pitot heat switch OFF
(windshield air)
5. Engine anti-ice switch OFF
6. Flaps UP
7. Wing-tip speed brakes CLOSED
8. Antiskid switch OFF

Note

The antiskid switch should be turned OFF
for any taxiing maneuvers.

9. Flaperon pop-up switch OFF
10. Wing fold AS REQUIRED
11. Radar altimeter OFF
12. VDI STDBY/OFF
13. LOX OFF

WING FOLD

1. Wing flaps/slats/flaperon/wing-tip speed brakes RETRACTED/CHECKED VISUALLY
2. Control stick NEUTRAL
3. Wing-fold handle FORWARD TO FIRST DETENT
Check wing-fold warning flags extended at wing fold.
4. Wing lockpin switch UNLOCK
5. Wing-fold handle FULL FORWARD

HOT REFUELING**WARNING**

Do not refuel following in-flight refueling operations until positive check has been made to ascertain that the in-flight refueling probe has not been damaged.

1. Wings SPREAD
2. Fire extinguisher equipment AVAILABLE
3. All emitters OFF
4. Canopy CLOSED
5. Shoulder harness, lap belt, leg restraints UNFASTEN
6. Air-conditioning master switch CHECK ON
7. Tank pressure override switch NORM
8. Fuel-ready switch GROUND
9. Monitor appropriate frequency.

ENGINE SHUTDOWN

1. Wheels CHOCKED
(Get signal from ground crew that wheels are chocked.)
2. CNI master switch OFF
3. Canopy OPEN
4. Landing-gear ground safety locks INSTALLED
5. Oil level CHECK

CAUTION

Do not shut down engines until landing-gear ground safety locks are installed as the gear may inadvertently retract.

6. Throttles IDLE, 3 to 5 minutes
(Idle RPM stabilizes engine temperature)

CONTINUED ON NEXT PAGE

ENGINE SHUTDOWN-CONTINUED

7. Throttles 75% RPM for 30 seconds
(75% RPM for 30 seconds scavenges oil)
8. LOX/FUEL/OIL button TEST
Depress LOX/FUEL/OIL test button. Check that oxygen quantity gage drops to zero and the oxygen warning light comes on at approximately 2 liters. Pointer on fuel quantity gage moves towards zero, which is a functional test of the fuel quantity indicating system. This is not a test of low-fuel warning light. Lighting of either and/or both oil-low lights on the annunciator panel indicates oil quantity from 5 to 12 1/2 quarts ±1 quart.
9. Transfer relay and left generator phase CHECK
Check proper operation of the transfer relay and correct phase of the left generator as follows:
- a. Right generator switch OFF

Note

Left generator assumes electrical load, VGI provides proper indications, and seat adjustment operates correctly.

- b. Right generator switch ON
(CHECK CAUTION LIGHT OUT)
10. Throttles OFF
11. Engine fuel master switches OFF

CAUTION

Ensure engine fuel master switches are turned off immediately after securing throttles to ensure fuel system gate valves close before generators fall off the line.

BOMBARDIER/NAVIGATOR'S PROCEDURES

PREPARATIONS FOR FLIGHT

coordination, and individual responsibility and cooperation through the planned flight.

Accomplishing the preflight inspection of the bombing and navigation systems will be the prime responsibility of the bombardier/navigator before each mission. This inspection will include a review of the current OPNAV Form 3760-2 (yellow sheet) for status of weapon system, ground crew and armament personnel actions regarding the weapons system, inspection of all weapon installations, and operational check of the integrated attack-navigation equipment. A thorough crew briefing will be conducted before accomplishing this inspection. This briefing will familiarize the crew with the type of mission being conducted, emergency procedures, crew

Note

All procedures contained in the following pages pertain primarily to the responsibilities of the bombardier/navigator. Cockpit preflight inspection should be conducted by the pilot and the bombardier/navigator simultaneously to ensure that all steps are successfully completed, and to satisfy individual crew requirements.

PREFLIGHT CHECK**BEFORE EXTERIOR INSPECTION**

1. Fire Extinguishers AVAILABLE **NEW**

CAUTION

Before ground power is applied, it is mandatory that either qualified maintenance personnel or a crewmember insure that steps 1 through 26 have been completed.

2. Cockpit canopy switch and manual selector handle NEUTRAL **NEW**

Upon Entering the Cockpit, Make the Following Safety Checks:

3. Landing-gear handle DOWN
4. Pilot's left console
- a. Wing and fuselage dump switch OFF
- b. FUEL READY switch OFF
- c. Emergency flap switch OFF
- d. ENGINE & FUEL MASTER Switches OFF AND LOCKED
5. MASTER ARMT Switch OFF
6. STATION selector switches OFF AND LOCKED
7. MECH ARM Switch SAFE
8. GUN switch SAFE
9. Missile switches OFF
10. AWW-4 FUNCTION switch SAFE
11. Nuclear selector button OFF/GUARD LOCKED
12. PHD power switch OFF
13. VDI selector button OFF
14. ALR-45/50 power switch OFF **NEW**
15. ECM panel
- a. Chaff emit switch OFF
- b. Nose and tail switches STBY
- c. Power switch OFF
16. Computer power switch OFF
17. Search radar power switch OFF

CONTINUED ON NEXT PAGE

PREFLIGHT CHECK-CONTINUED

18. Refueling panel (if installed)
- a. Refueling master switch OFF
 - b. Drogue position switch RET
 - c. Hose jettison switch OFF/GUARDED
 - d. SHIP TANK switch OFF
19. Doppler power switch OFF
20. Platform selector button OFF
21. BOMB TONE switch OFF
22. Mission recorder power switch OFF
23. GCBS ENGAGE switch OFF
24. Cockpit circuit breakers IN
25. CNI MASTER switch OFF
26. ICS AMPL SEL switch NORM
27. External power ON
28. Interior lights AS DESIRED
29. Platform selector button STBY (5 minutes minimum)
30. VDI selector button STBY (5 minutes minimum)
31. ATTITUDE REF switch COMP IN OR COMP OUT
32. CNI MASTER switch (AFC 269 incorporated) MA-1 ONLY
33. MA-1 compass selector switch SLAVED (3 minutes minimum)
34. Doppler power switch STBY
35. ALIGN switch OFF
36. AUTO/MAN switch MAN
37. Erection controller windows SET
Set proper values in erection controller windows using the function switch and slew switch
- a. Latitude window SET LOCAL LATITUDE
 - b. Carrier speed window SET 0
 - c. Carrier heading window SET AIRCRAFT MAGNETIC HEADING
 - d. Longitude window SET LOCAL LONGITUDE
38. DDU MAG VAR switch SET LOCAL MAG VAR
39. MA-1 compass SYNCHRONIZE
Using pull-to-set knob, set aircraft magnetic heading on HSI.

CONTINUED ON NEXT PAGE

PREFLIGHT CHECK-CONTINUED

40. VDI selector button CONT ANALOG

If Normal Ground Alignment Is To Be Performed:

41. Platform selector button ALIGN (START ELAPSED-TIME CLOCK)
Alignment progress can be monitored on the VDI.

Note

- To insure normal alignment operation of the inertial navigation system, a minimum of 5 minutes warmup is required in the STBY position. For cold weather, allow 10 minutes for warmup.
- The fine align light should go on approximately 1 minute after selecting ALIGN. If alignment was started with altitude reference switch at COMP OUT, select COMP IN or MAG/VGI before gyro compassing begins. This will usually shorten the time required for alignment; however, the attitude reference switch should be kept at COMP OUT when gusty winds or buffeting of the aircraft occurs.

If Preset Alignment Is To Be Performed:

Note

A preset alignment can be performed if the previous good alignment has not been disturbed by selecting MAG/VGI or moving the aircraft since the platform was last turned off.

42. Platform selector button PRESET ALIGN (START ELAPSED-TIME CLOCK)

Note

The fine align light should go on approximately 1 minute after commencing preset alignment.

EXTERIOR INSPECTION

Perform exterior inspection as outlined below: (see figure 3-7).

(A) NOSE AREA

1. Radome SECURE
2. Nose-gear wheel-well circuit breakers IN

CONTINUED ON NEXT PAGE

EXTERIOR INSPECTION-CONTINUED

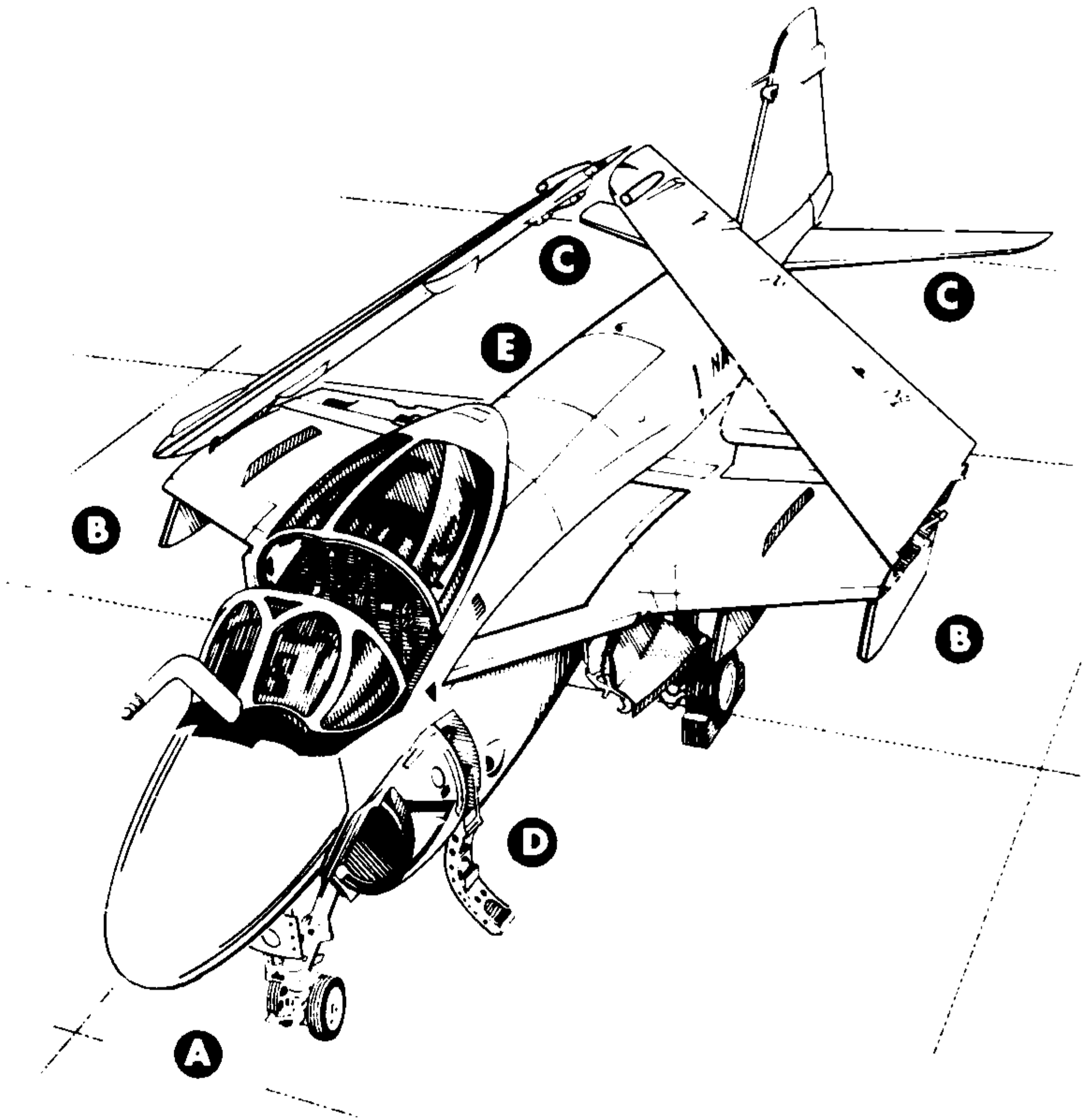
EXTERIOR INSPECTION-B/N

GENERAL CHECKS

THE FOLLOWING GENERAL CHECKS SHOULD BE PERFORMED THROUGHOUT THE EXTERIOR INSPECTION: CRACKS, DISTORTIONS, LOOSE FASTENERS AND FITTINGS; COVERS REMOVED SHOULD BE SECURED, FUEL, OIL AND HYDRAULIC LEAKS; ACCESS DOORS AND PANELS SECURELY FASTENED.

NOTE

THE EXTERIOR INSPECTION BEGINS AT THE NOSE OF THE AIRCRAFT AND PROGRESSES IN A CLOCKWISE DIRECTION AROUND THE AIRCRAFT.



A-ADF1-46

Figure 3-7

- 3. Ground blower power switch AUTO
- 4. Ground blower inlet screen CLEAR
- 5. Equipment pressure 600 TO 2800 PSI

(B) WEAPONS STATIONS

General Checks - Aero 7A/Aero 7B

- 1. Sear indicator CHECK POSITION
- 2. Sway braces SECURE
- 3. Ejector foot SET
- 4. Arming wires CHECK
- 5. Electrical connectors INSTALLED AND SECURE
- 6. Breech chamber LOADED AND SECURE
- 7. Pylon door SECURE
- 8. Ejector-rack safety pin INSTALLED

CONTINUED ON NEXT PAGE

EXTERIOR INSPECTION-CONTINUED

General Checks - Aero 5A-1

- 1. Electrical disconnect receptacle CHECK AND SECURE
- 2. Shear pin CHECK PROPER TYPE
- 3. Forward umbilical receptacle CHECK
- 4. Aft umbilical receptacle (solid motor only) CHECK

General Checks - Lau - 7/A

- 1. Aft fairing assembly CHECK NITROGEN CYLINDER
- 2. Pressure gauge ABOVE 2200 POUNDS
- 3. Safety pin INSTALLED

AIR REFUELING STORE

- 1. Store propeller CHECK
- 2. Hydraulic oil level CHECK
- 3. Pod fuel quantity CHECK
- 4. Drogue CHECK
- 5. Electrical hookup CHECK

Ⓒ CENTER FUSELAGE

- 1. Extensible equipment platform CLOSED AND SECURE

CAUTION

Aircrews will ensure that items stowed in the aft equipment bay are properly secured to prevent damage or interference with critical components.

Ⓓ LEFT NACELLE AREA

- 1. Ballistic control panel AS BRIEFED

Ⓔ UPPER RIGHT FUSELAGE AND WING

- 1. Canopy manual disconnect pin and eccentric bushing CHECK
Check that eccentric bushing is in horizontal position with pins inserted and locked and T-handles stowed in clips provided. See figure 3-4.
- 2. Canopy jettison air bottle pin CHECK REMOVED

WARNING

If pin is difficult to remove, it may indicate the bottle has discharged and the canopy will be jettisoned unless the pressure is bled off.

NEW
NEW
NEW

NEW
NEW
NEW
NEW

EJECTION SEAT CHECK

- NEW
1. Ejection seat ground safety pins (6) (7 in seats with ACC 271) IN
2. Face curtain lock and alternate firing-handle guard UP (LOCKED POSITION)
3. Drogue rigging CONNECTED AND COVERED
4. Ejection gun firing linkage CONNECTED
Check through the windows that the face curtain handles are connected
to the firing linkage.
5. Top latch mechanism LOCKED
Check that top latch mechanism plunger and indicator dowel are both flush with or
slightly recessed from end of top latch mechanism housing.
6. Drogue-gun trip rod SECURED
Check that the drogue-gun trip rod is secured to the fixed ejection-gun bracket with the
red painted portion covered by the trip-rod outer barrel.
7. Rocket-motor initiator-sear extraction lanyard ATTACHED
Check that the rocket-motor initiator-sear extraction lanyard is attached to the sear
actuating link and the drogue-gun trip rod.
8. Drogue gun LOCKWIRED AND SEALED
9. Inertia-reel actuating link CONNECTED
Check that the actuating link is connected to the powered inertia-reel gas-generator
sear.
10. Parachute withdrawal line ROUTED THROUGH GUILLOTINE
11. Parachute withdrawal-line screw connector FINGER-TIGHT

WARNING

If the personnel parachute withdrawal line is not
securely connected, automatic deployment of the
parachute will not occur after ejection.

- NEW
12. Rocket-motor initiator LOCKWIRED AND SEALED
13. Parachute ATTACHED SECURELY
14. Inertia-reel straps and leg restraint cords SECURE
Determine security of inertia-reel straps and leg restraint cords by means
of a hard pull.
15. Emergency oxygen
- a. Emergency oxygen bottle 1,800 PSI
- b. Emergency oxygen system actuator PROPERLY STOWED
16. Personnel services disconnect lanyard SECURED TO DECK
- NEW

EJECTION SEAT CHECK-CONTINUED

17. Survival kit front lock release lever. FULL FORWARD
Check that survival kit front lock release lever peg is full forward
against leg-line release linkage.

WARNING

Failure of survival kit front lock release lever
to return to its full forward position will prevent
ejection by means of the alternate firing handle.

Note

It may be necessary to raise the seat to see the
lever.

18. Guillotine initiator LOCKWIRED AND SEALED
19. Time-release mechanism trip rod SECURED
Check that the time-release mechanism trip rod is secured to the fixed ejection-gun
bracket with the red painted portion covered by the trip-rod outer barrel.
20. Time-release mechanism LOCKWIRED AND SEALED
21. Ejection seat ground safety pins (6) (7 in seats with ACC 271) REMOVED AND STOWED

INTERIOR INSPECTION - POWER ON**WHEN SEATED IN COCKPIT**

1. Harnessing FASTEN
2. Helmet ON
3. Oxygen/communications, anti-g suit, anti-exposure suit CONNECTED
4. Seat ADJUST
- a. Assume ejection position, sit erect, buttocks against backrest, head firmly
against headrest, spine straight, thighs against seat pan.
- b. With left hand, reach up and touch face-curtain handle.
- c. Adjust seat height and tilt so that top of helmet just clears underside
of face-curtain handle.
5. Oxygen CHECK
With mask away from face, depress ICS
6. Inertia reel CHECK
7. Vent suit/cushion airflow AS DESIRED

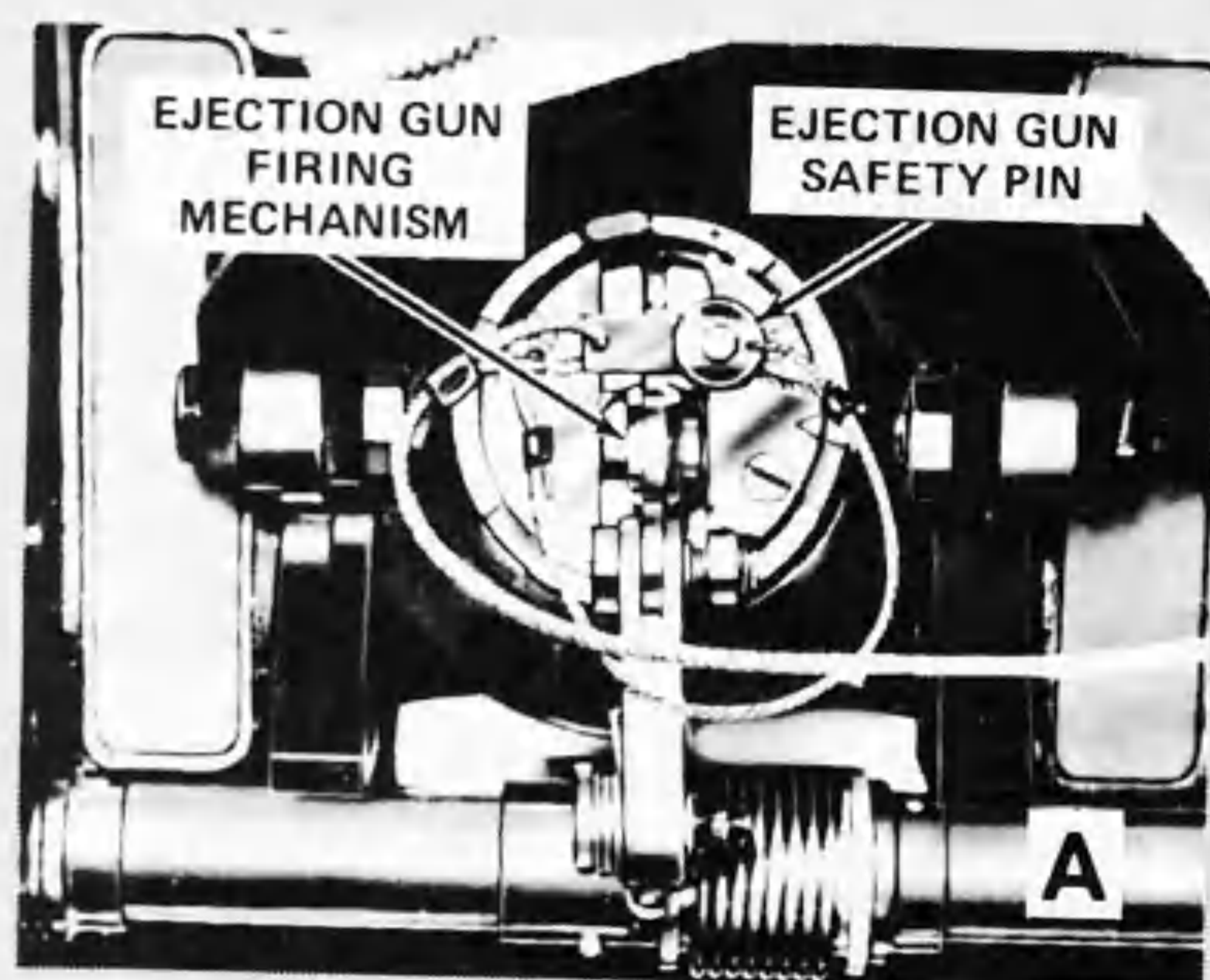
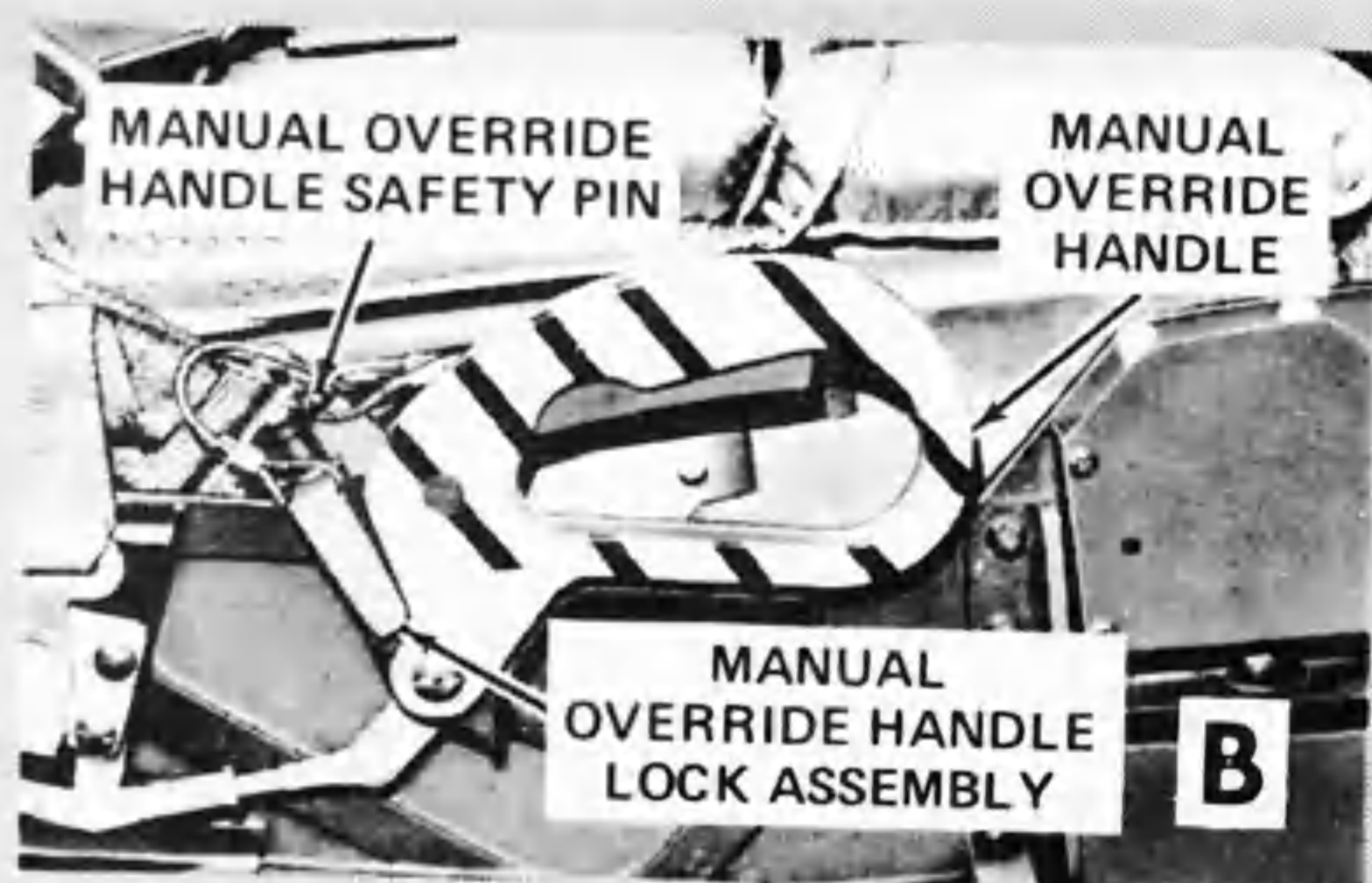
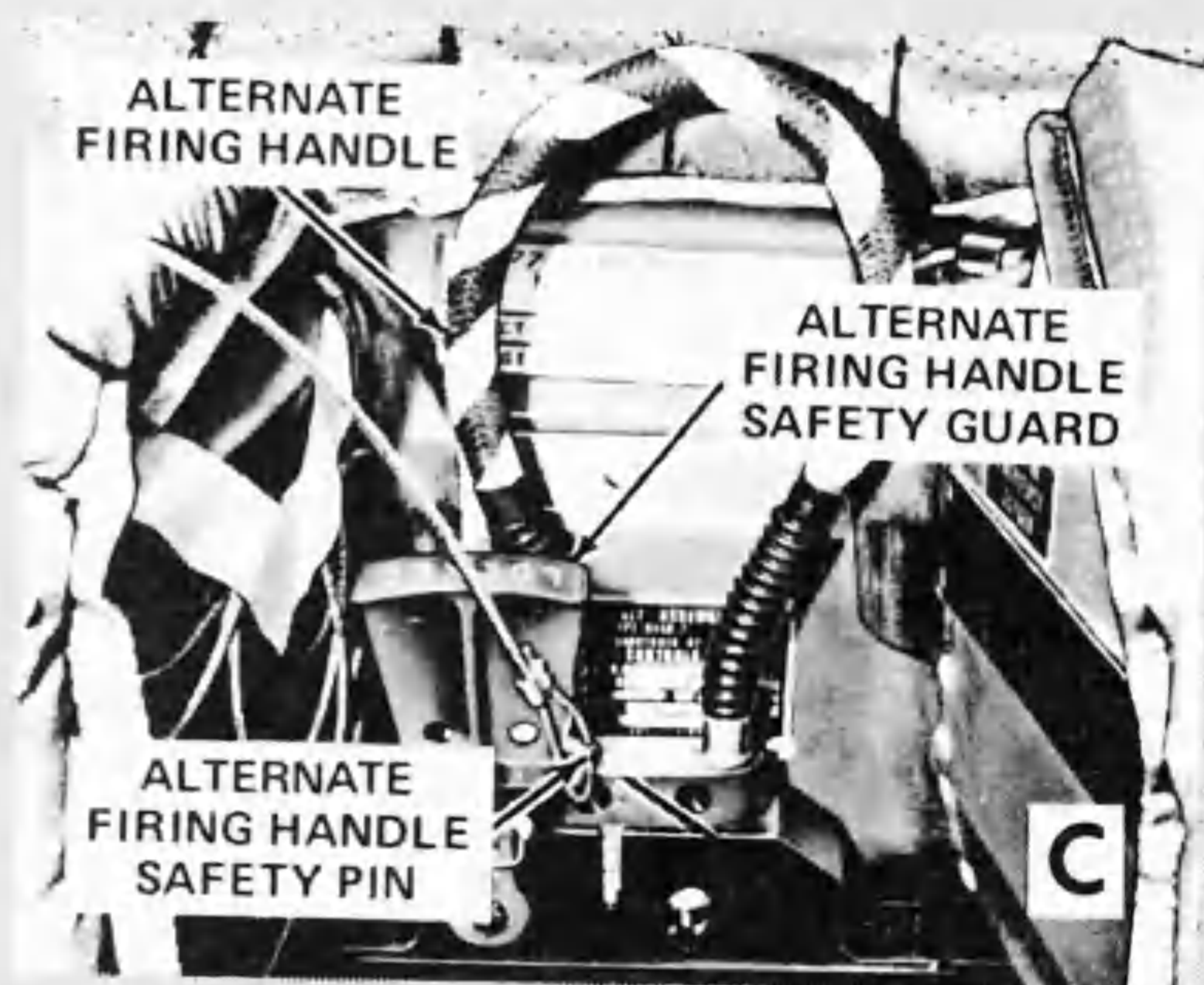
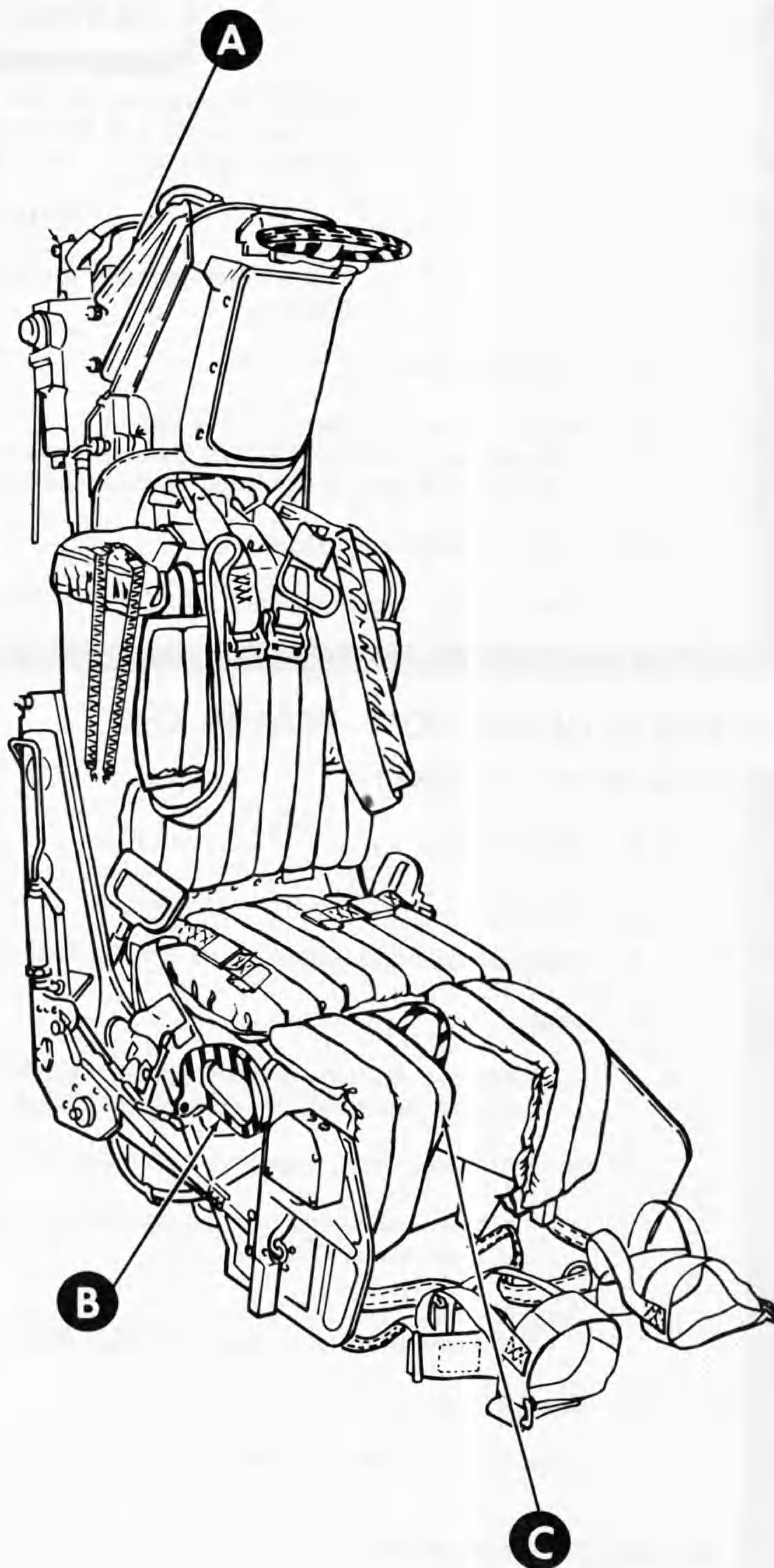
PRE-TURN-ON PROCEDURES**Bombardier/Navigator's Right Console**

1. B/N circuit breaker panel ALL CIRCUIT BREAKERS IN

CONTINUED ON NEXT PAGE

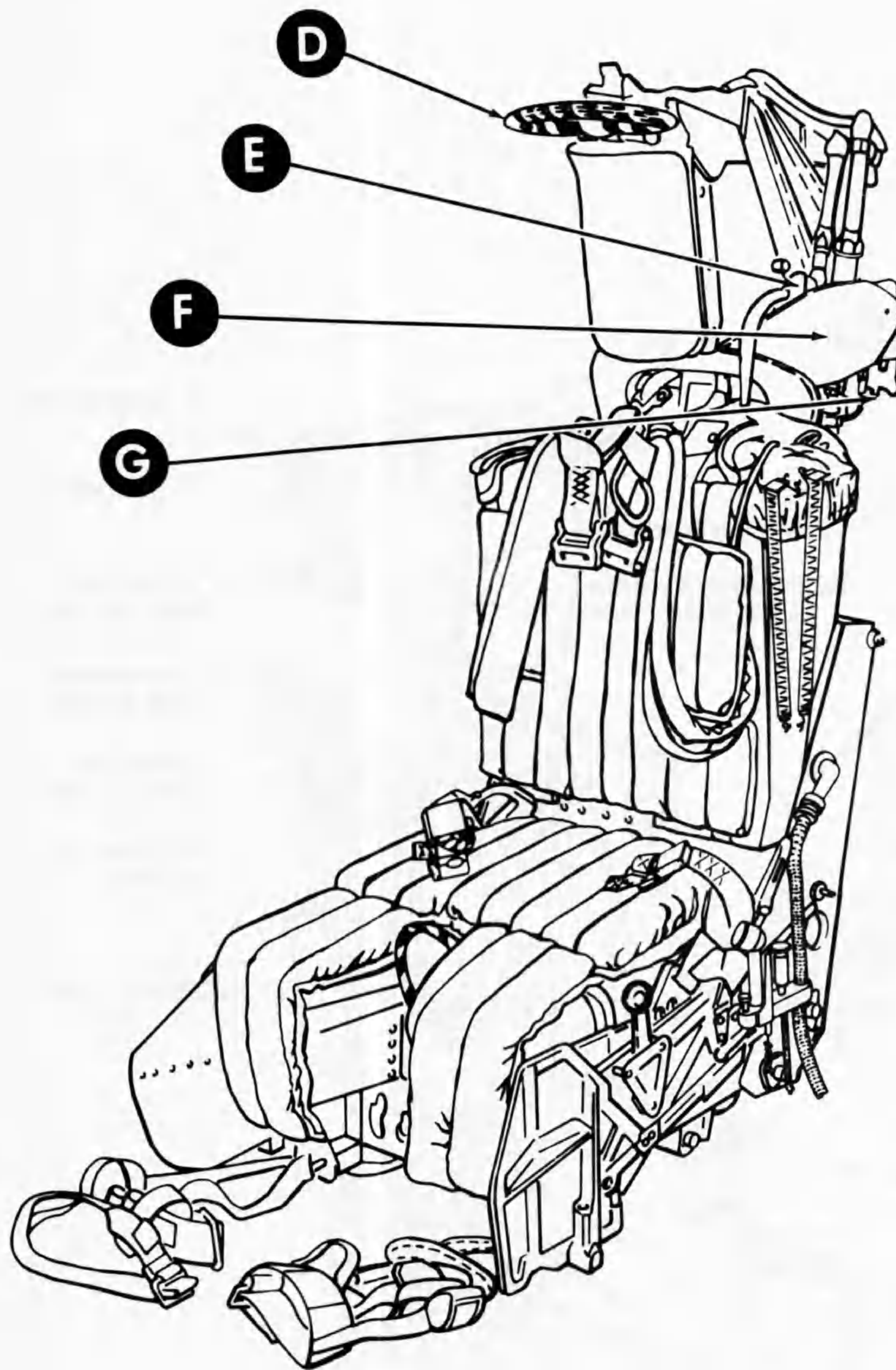
EJECTION SEAT SAFETY PINS

MK GRU-7

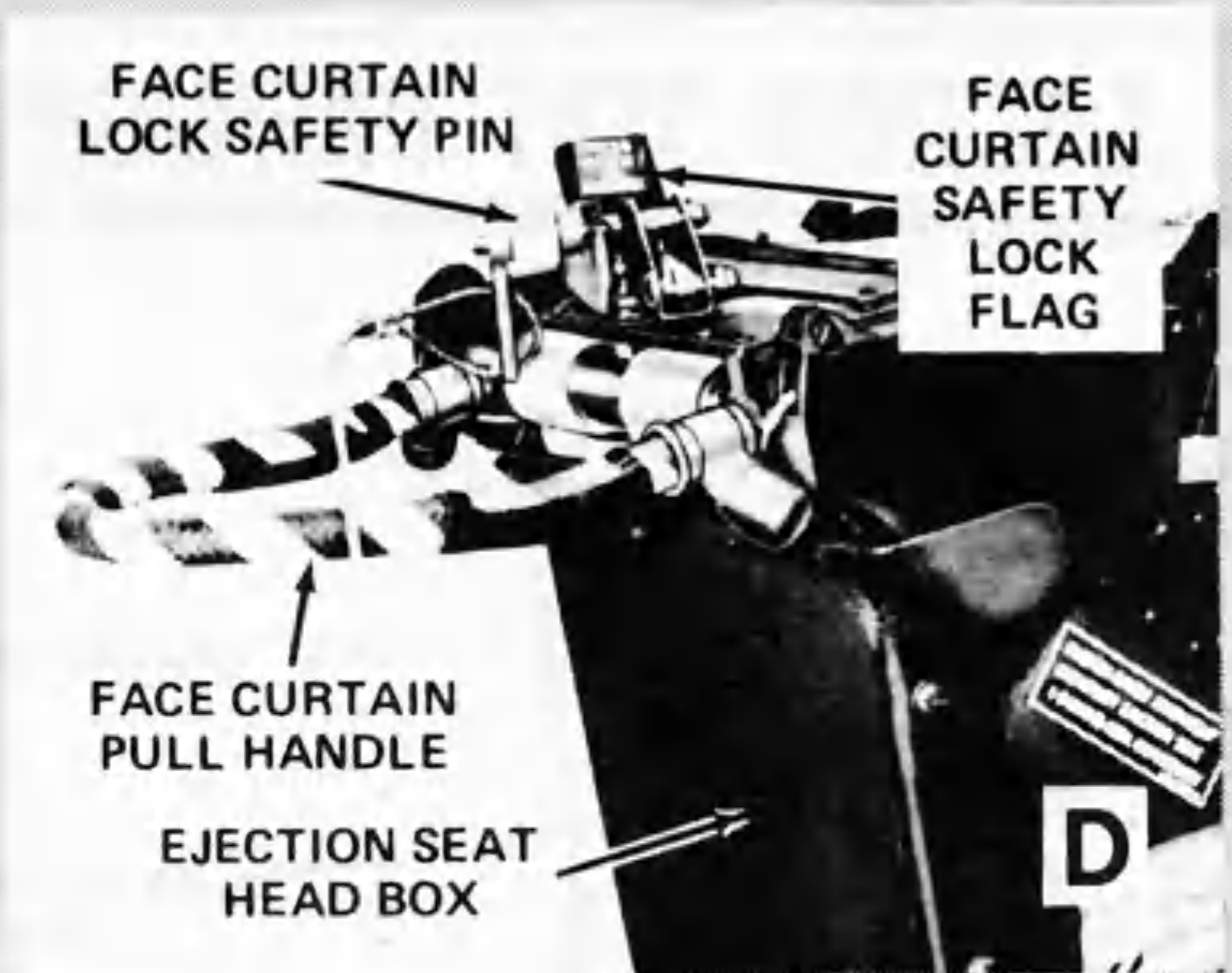
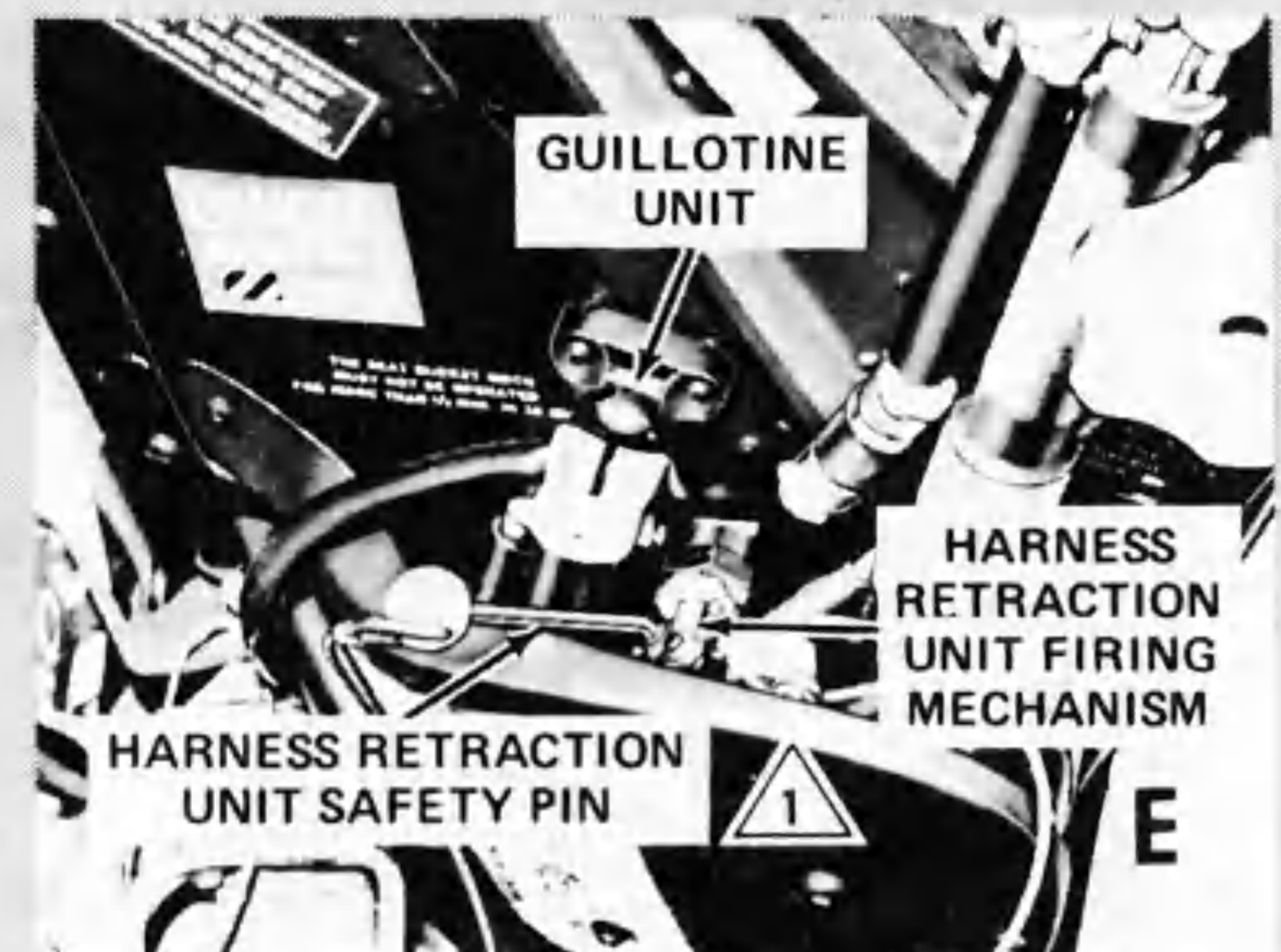
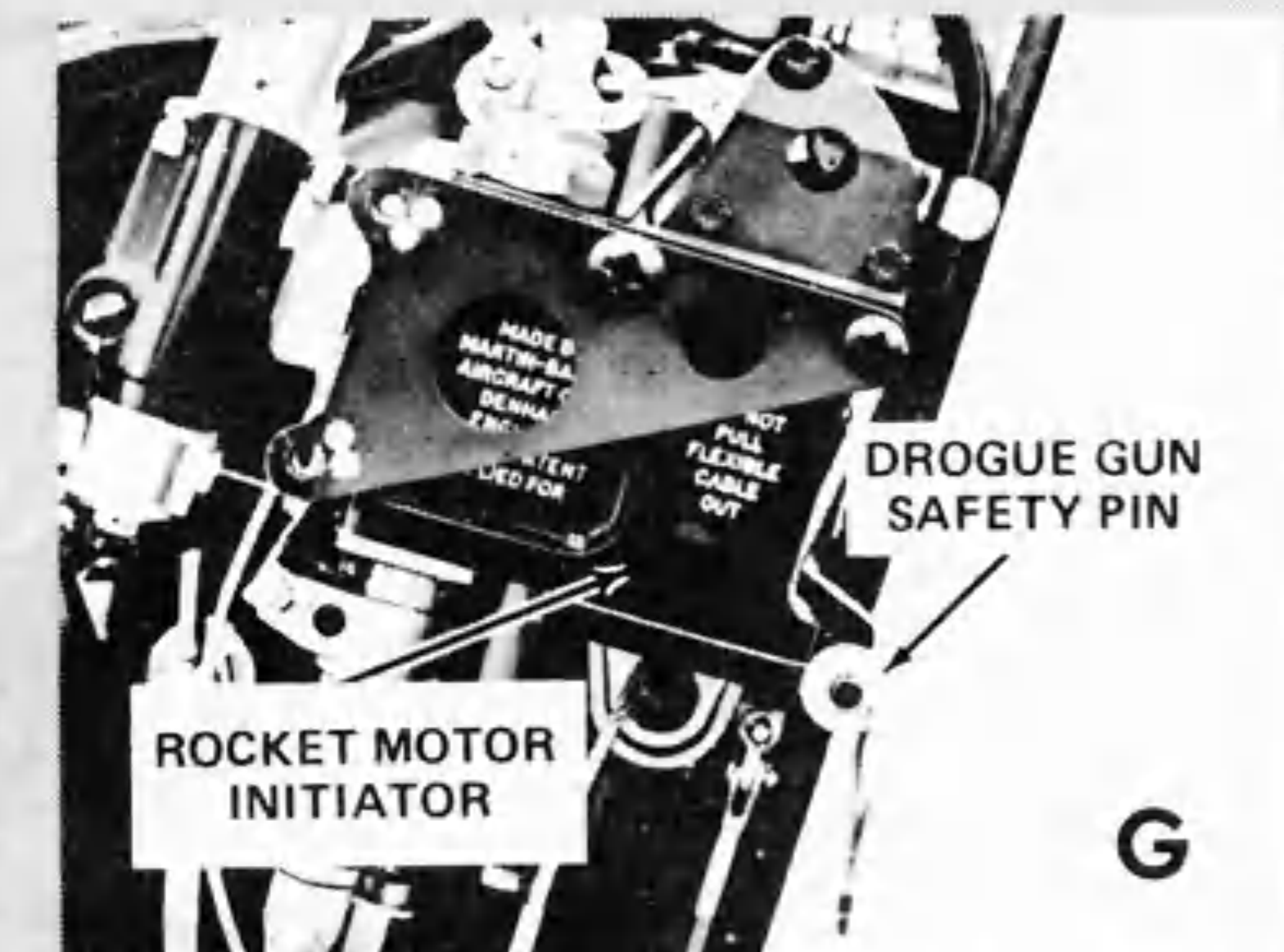


A-ADF1-20-1

Figure 3-8 (Sheet 1)



1 SEATS INCORPORATING ACC 271

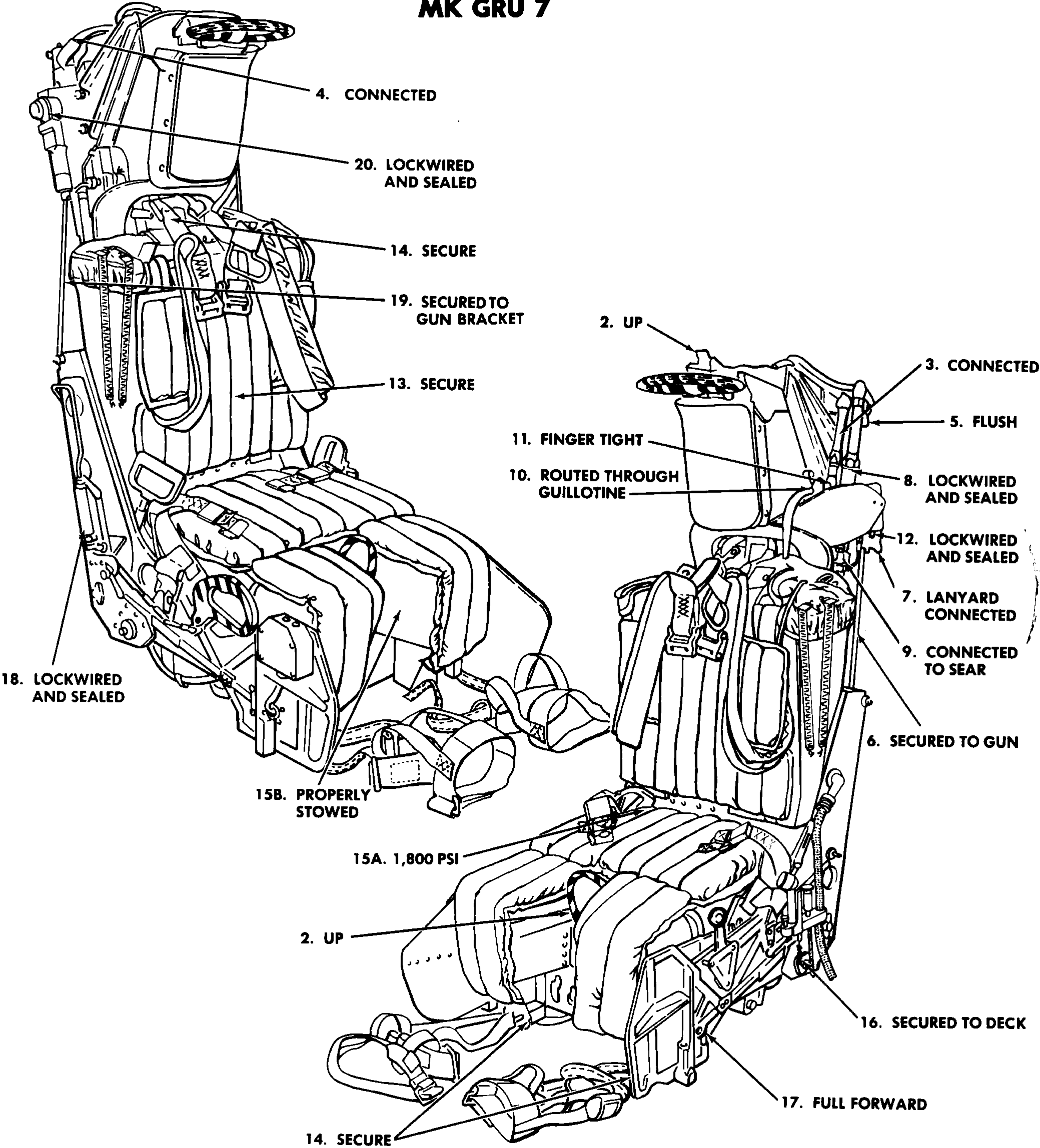


ADF1-20-2

Figure 3-8 (Sheet 2)

EJECTION SEAT PREFLIGHT

MK GRU 7



A-ADF1-21

Figure 3-9

INTERIOR INSPECTION - POWER ON-CONTINUED

2. Chaff programmer panel AS DESIRED
3. RADIO control panel AS DESIRED
4. BOMB TONE switch AS DESIRED
5. Mission recorder
 - a. Function switch STBY
 - b. Channel switch RDR
 - c. Test switch OFF
 - d. PWR switch OFF
6. Interior lights AS DESIRED
7. Advisory lights TEST
Test all advisory lights except those on the ARMAMENT panel and DDU by depressing the B/N MASTER TEST BUTTON.
8. B/N's auxiliary circuit breaker panel ALL CIRCUIT BREAKERS IN

Platform Panel

If Normal Ground Alignment is Being Performed:

1. Align progress meter CHECK FOR INDICATOR MOVEMENT
The align progress meter indicator should show movement in approximately 2 minutes with the ATTITUDE REF switch at COMP IN or 5 minutes at COMP OUT.

If Preset Alignment is Being Performed:

1. READY Light ON
The ready light should come on approximately 3 minutes after commencing preset alignment.
2. Platform selector button OPER

Note

Remaining in preset alignment after the READY light comes on will not improve alignment accuracy.

Bombardier/Navigator's Control Panel**Note**

Before turning the search radar POWER switch to STBY, ensure that the nose-wheel well area is clear.

1. TRANSMIT switch SIL
2. Search radar POWER switch STBY

Note

The search radar requires 4 to 7 minutes warmup in STBY.

CONTINUED ON NEXT PAGE

INTERIOR INSPECTION - POWER ON-CONTINUED

3. BRT control CW UNTIL SWEEP
4. CONTRAST control CW
5. VIDEO/DIF gain control CCW
6. RCVR gain control CW
7. DISPLAY PPI (APPROXIMATELY 27.5 MILES)
8. RNG MKR/AZ MKR controls CW TO DESIRED SETTING
Check for two 10-mile range marks.
9. STC SLOP/DEPTH controls SET CCW
10. SCAN RATE control SLOW SCAN
11. AMTI control OFF
12. SCAN STAB switch ADL
13. SCAN ANGLE control SET AS DESIRED
14. BEACON control OFF
15. FREQ AGILITY switch OFF
16. ELEV TRKG switch OFF
17. RCVR TUNE control MAN
18. Cursor control switch MAN
19. MAN RANGE setting 30,770
20. METER toggle switch RIGHT
21. FAULT ISLN switch OFF (CENTER)
22. TEST MODE toggle switch OFF (CENTER)
23. TEST MODE button BIT
24. TRACK POWER switch OFF
25. MODE switch TRACK

Note

Manual test procedures step 26 through 37 may be accomplished prior to engine start and computer ORT.

26. TEST MODE toggle LEFT
Note GO light.
27. Test mode - SRCH ADJUST FOR VIDEO
Note GO light.
28. Display ARE 30

CONTINUED ON NEXT PAGE

INTERIOR INSPECTION-POWER ON-CONTINUED

29. MAN RNG ADJUST TO VIDEO
Note Range 30,775 $\pm$ 100
30. TEST MODE toggle RIGHT
31. Test mode ELEV TRACK
Note GO light.
32. Test mode TWS
Adjust MAN RNG for GO light 30,775 $\pm$ 100
33. TEST MODE toggle LEFT
34. Test mode SRCH
35. COMPT/MAN COMPT
36. RCVR Tune AFC

Note

The following check may be made only if current hazards of electronic radiation to Ordnance (HERO) and EMCON conditions permit.

37. Radar Power ON
 - a. DISPLAY PPI
 - b. MAG CUR8
 - c. All PRF's CHECK
 - d. XTAL CUR ABOUT .6
 - e. All PRF's CHECK
 - f. MAG FREQ5
 - g. ANT PATT NEAR
 - h. Check XMTR PWR4 to .8
 - i. Check RCVR SENS at .5 to .8 with full RCVR Gain
 - j. METER toggle-right ANT PATT
 - k. Display ARE 30

Digital Display Unit

1. Navigation mode select switch INRL
2. Navigation data switch DATA
3. DATA SELECT switch A

Armament Control Unit

1. STA readouts (STA 1-5) AS DESIRED
2. RELEASE mode select button AS DESIRED

CONTINUED ON NEXT PAGE

INTERIOR INSPECTION-POWER ON-CONTINUED

3. ATTACK mode select button AS DESIRED
4. TIME thumbwheel. AS DESIRED
5. QUANTITY thumbwheel AS DESIRED
6. INTERVAL thumbwheel AS DESIRED

Pilot's Control Panel

1. VDI BRT/CONTRAST controls CCW
2. PITCH TRIM control CCW
3. OFFSET IMP PT/PATH BRT controls CCW
4. PHD BRT/CONTRAST controls CCW
5. PHD power switch STBY
6. RNG MKR/AZ MKR controls CCW

Center Console

1. UHF COMM/AUX switch ON (T/R+G)
2. TCN function selector switch ON (T/R)
3. IFF MASTER switch STBY
4. SIF codes AS REQUIRED
5. AIR CONDITIONING COCKPIT switch ON
6. MAN/RAM AIR switch AUTO
7. AUTO TEMP CONT thumbwheel AS DESIRED
8. AIR COND MASTER switch NORM
9. CMPTR EMER COOL switch NORM
10. DEFOG AIRFLOW thumbwheel AS DESIRED
11. Engine anti-ice switch OFF
12. Windshield rain removal switch OFF
13. PITOT HEAT switch OFF
14. WING FOLD handle MATCHING WINGS
15. Wing lockpin switch FORWARD (WITH WINGS FOLDED)
16. B/N ICS AS DESIRED
17. CABIN DUMP switch. OFF
18. ANT SEL switches AS DESIRED

CONTINUED ON NEXT PAGE

INTERIOR INSPECTION – POWER ON – CONTINUED

Aft Console

1. Main circuit breaker panel. ALL CIRCUIT BREAKERS IN
2. MA-1 compass CHECK SYNC AND SLAVED
3. Speech security equipment AS DESIRED

CAUTION

During preflight operations, the bombardier/navigator will ensure that the radiation danger area is clear of personnel, equipment, and other aircraft before moving the TRANSMIT switch from SIL.

Note

All radar transmissions shall conform to current Hazards of Electromagnetic Radiation to Ordnance (HERO) restrictions.

COMPUTER TURN-ON/TEST PROCEDURES

CAUTION

The AAU-19 altimeter should remain in STBY until the A/D converter tests have been completed.

Note

Turning on the right generator with the computer on may cause the computer to revert to the initial power-up test sequence.

1. COMPUTER switch. ON
 - a. COMPT ERROR light: lit 4 seconds
 - ATTACK light: lit 4 seconds
 - DDU windows: all 0's
 - TEMPORARY STORAGE window: all dashes
 - b. CLEAR button DEPRESS
 - All windows: 3's
 - c. CLEAR button DEPRESS
 - G/S/LONG window: S77777
 - WIND SPEED/LAT window: S7777
 - TEMPORARY STORAGE window: S777777
 - All other windows: 7's

Note

Operational requirements may dictate that the flight program be entered at this point; however, it is recommended that the ORT be completed through the A/D converter checks on internal power. The complete computer check will be accomplished by maintenance personnel during daily checks.

INTERIOR INSPECTION - POWER ON - CONTINUED

Note

Before commencing the A/D converter checks, ensure that the VDI is in CONT ANALOG.

- d. CLEAR button DEPRESS
Depressing the clear button starts the analog to digital (A/D) converter test.

G/S/LONG window first reads: 012000
then 011900
then 010600

If no failures are present between 011900 and 010600:

then decreases by 100's 3400
then reads 111111

- ATTACK light lit: ADC out of tolerance/failed.
- COMPT ERROR light lit: normal accelerometer failure.

Note

- The A/D converter test is completely automatic and requires approximately 3 minutes to complete.
- Any failure during the A/D converter test stops the test and the readout in the G/S/LONG window indicates which test was failed. Depressing the CLEAR button permits the rest of the tests to be completed unless readout 120, 119, 118, 117, 064 or 063. Refer to A/D Converter Tests in Section VIII for mission impact of test failures.

2. COMPT MODE switch ENTER
3. ADDRESS key. PRES LOC
Enter present position data:
- a. Latitude and longitude of departure using POS ACTION key.
- b. Pressure altitude of departure using ALT ACTION key.
4. Navigation mode select switch DR
5. Velocity correct switch OFF ERASE, THEN OFF SAVE
6. RELEASE bar. DEPRESS
7. ADDRESS key. UNSTAB
Enter desired cursor initialization range in miles.
8. RELEASE bar. DEPRESS
9. COMPT MODE switch STEER

Digital Display Unit

10. Navigation data select switch PRES POS
Read correct present position entries of latitude, longitude and altitude to conform keyboard entries.
11. Navigation data select switch ON CALL
Depress UNSTAB key and read correct cursor initialization range to confirm keyboard entry.

CONTINUED ON NEXT PAGE

INTERIOR INSPECTION - POWER ON - CONTINUED**Note**

The inertial platform may be placed in OPER at any time during the ORT if necessary. However, a complete evaluation of alignment accuracy requires that the computer be operating in the flight program.

RADAR TEST PROCEDURES**Note**

The following tests are to be accomplished after computer flight program has been entered.

1. CMPT MODE STEER AND UNSTAB
2. AZ/RNG switch DISLODGE
3. Position range line on video with slew stick 30,775 $\pm$ 100
4. BEACON ON
Just out of detent, adjust range line to video and note. (MAN tune RCVR for video)
 - a. RCVR gain CCW
Test video disappears.
 - b. BEACON FULL CW
Readjust range line to video note approximately 150 feet difference.
 - c. BEACON OFF
 - d. RCVR gain CW
Test video reappears.
 - e. RCVR tune AFC
5. ELEV TRK ON
6. CMPT steer OPT TGT
Position range line on video with slew stick 30,775 $\pm$ 100. ELEVATION light ON.
7. Azimuth-range switch ENABLE (FORWARD)
Note RNG 30,775 $\pm$ 100. AZ-RANGE/ELEVATION lights ON, check slew inhibited.

Note

Range accuracy data obtained by ranging on the BIT video is considered accurate enough to preclude ground transmission.

8. Azimuth-range switch DISLODGE (AFT)
9. Test mode AMTI
GO light, AMTI CW/then OFF. Note video dropout just out of detent, then fills in as control is rotated CW.
10. PCB TC
Observe antenna pattern goes to FAR.
11. Test mode TC
GO light, check TC fail light on VDI OFF

CONTINUED ON NEXT PAGE

INTERIOR INSPECTION – POWER ON – CONTINUED

- 12. RCVR tune MAN THEN AFC
Observe TC fail light on then OFF.
- 13. PCB TEST
Observe proper display. Select RNG 2.
- 14. PCB TC CAL
Observe proper display with RNG 2 and 1.5 coded.
- 15. PCB CONT/ANALOG
- 16. POWER switch STBY
- 17. Test mode OFF
- 18. CMPT steer UNSTAB
- 19. DISPLAY PPI

Note

All fault isolation operations must be conducted in accordance with appropriate maintenance publications and are not flight crew procedures.

Video Tape Recorder

- 1. Function STBY
- 2. Power ON
- 3. Test LAMP
- 4. Test BIT
Wait at least 1 minute prior to checking for any failure lights.
- 5. Power OFF

OPTICAL SIGHT CHECK PROCEDURES

Sight Unit Control Panel

- 1. AUTO/OFF/MAN switch AUTO
- 2. Fixed and moving reticles ON
- 3. In range and breakaway displays TEST

Computer Control Unit Keyboard Panel

- 4. COMPT MODE switch STEER
- 5. UNSTAB key DEPRESS
Observe that fixed and moving reticles are superimposed (within 1 1/2 to 2 mils).

COMPUTER ENTRY PROCEDURES

Computer Control Unit Keyboard Panel

- 1. COMPT MODE switch ENTER

INTERIOR INSPECTION—POWER ON—CONTINUED

2. ADDRESS key TGT 1
Enter data for first target as follows:

- a. Latitude and longitude, using POS ACTION key.
b. MSL altitude of target, using ALT ACTION key.

3. ADDRESS key OAP 1
Enter data for Target 1 Offset aimpoint 1 as follows:

- a. True bearing from target to aimpoint, using BRG ACTION key.
b. Distance from target to aimpoint in feet, using DIST ACTION key.

Note

The OAP 1 offset distances for TGT 1 through 4 and the OAP 2 offset distances for TGT 1 through 3 are entered in feet. The OAP 2 offset distance for TGT 4 is entered in X and Y coordinates in meters.

- c. Altitude difference in feet from target to aimpoint, using ALT ACTION key.

4. ADDRESS key OAP 2
Enter data for target 1 offset aimpoint 2 in the same manner as OAP 1.

5. Release bar DEPRESS

6. Data for targets 2, 3, and 4 ENTER
Enter data for additional targets and offset aimpoints in the same manner as target 1, except that offset distances (X and Y) must be entered in meters for target 4, OAP 2.

7. Release bar DEPRESS

8. ADDRESS key NAV XPT
Enter data for the navigation checkpoint as follows:

- a. Latitude and longitude of checkpoint using POS ACTION key.
b. MSL altitude of checkpoint, using ALT ACTION key.

9. RELEASE bar DEPRESS

10. ADDRESS key GRD TRK
Enter blast clearance altitude for ordnance carried using ALT ACTION key. If ground track bombing is to be used, enter ground track using BRG ACTION key.

11. RELEASE bar DEPRESS

12. ADDRESS key MAN
Enter temperature in degrees F using TEMP ACTION key.

Note

Temp displayed will be corrected so will not necessarily be the number entered.

13. RELEASE bar DEPRESS

14. ADDRESS key REL ADV
Enter desired release advance distance or zeros using DIST ACTION key.

CONTINUED ON NEXT PAGE

INTERIOR INSPECTION- POWER ON-CONTINUED

15. COMPT MODE switch STEER

Digital Display Unit

16. Navigation data select switch ON CALL

Computer Control Unit Keyboard Panel

17. ADDRESS keys DEPRESS
Depress each address key for which data was entered one at a time and read correct entries in windows in lower section of DDU.

Note

Entries for the address key depressed on the lowest row of the CCU keyboard panel will be displayed.

18. ADDRESS key UNSTAB

Digital Display Unit

19. Navigation data select switch DATA

PRE-TAXI PROCEDURES

1. Doppler drift angle SET 20° LEFT OR RIGHT
2. Doppler groundspeed SET 305 KNOTS

Note

A minimum of 5 minutes warmup in STBY is required before selecting TEST.

3. Doppler mode selector TEST
4. MEMORY light OFF
5. Doppler drift angle 0° ±2°
6. Doppler groundspeed 121 ±5 KNOTS

Note

- Test values should be displayed within 35 seconds maximum.
- Doppler drift angle and groundspeed are also displayed in DDU windows B2 and B3.

7. Doppler mode selector STBY
8. READY light ON
The READY light should come on 7 to 14 minutes after commencing a compass-in-alignment and 10 to 20 minutes for a compass-out-alignment. Note alignment time.
9. Align progress meter NULLED (±1 DIVISION)
Additional time will be required for optimum alignment if the needle is not at or near null.

CONTINUED ON NEXT PAGE

PRE-TAXI PROCEDURES—CONTINUED

10. Platform selector button OPER

Note

Moving the aircraft, checking nose-wheel steering or lowering the arresting hook before the OPER button is depressed may seriously degrade platform alignment.

11. SAC key DEPRESS
Observe computer error lights out.
12. Chaff emit switch OFF
13. S/C-NOSE, S/C-TAIL, X-TAIL or FWD and AFT switches STBY
14. ECM POWER switch ON

CAUTION

Prior to turning on ECM POWER switch, ensure GEAR/HOOK circuit breaker is properly seated and there is no indication of weight-on-wheels switch failure (angle-of-attack indexer and approach lights on).

15. APR-25 or ALR-45/50 power switch ON
16. APR-27 DECM switch (aircraft without AFC 263). ON
17. ALQ-100 or ALQ-126 TEST
After warmup, place ALQ-100 S/C-NOSE and S/C-TAIL switches or the ALQ-126 FWD and AFT switches to REC. Hold the ECM POWER switch in TEST for at least 40 seconds. If the NO GO STBY lights do not come on, the system is operational.
18. APR-25 or ALR-45/50 TEST
Turn APR-25 S, C, X, (or ALR-45 LO, MID, HI) and AAA band switches on and adjust audio control as desired. Place TEST switch to each position and push. Check audio, azimuth display, and threat indicator lights for correct response.
19. APR-27 (aircraft without AFC 263) TEST

Note

Whenever APR-27 self-test is conducted, ensure that the ALQ-100's are in STBY.

Place DECM switch in TEST position and check audio and MISSILE light flashing.

20. OXYGEN switch ON
21. Oxygen mask DON

TAXI PROCEDURES

1. Monitor inertial heading on DVRI and ground speed and vertical velocity on DDU.
Groundspeed should approximate taxi speed; vertical velocity should be 2 ft/sec or less.
2. Navigation data select switch PRES POS
Monitor present position and altitude (± 32 feet).
3. MAN key. DEPRESS
Observe that sensor usage readout is b111011.

PRETAKEOFF PROCEDURES

1. Complete TAKEOFF checklist with pilot using challenge and reply.
2. Check INS heading and MA-1 heading.

When ready for takeoff:

3. Navigation data select switch. DATA
4. Check groundspeed zero to 3 knots or carrier speed +3 knots (maximum).
5. Steering mode UNSTAB
6. Report to pilot READY FOR TAKEOFF

TAKEOFF PROCEDURES

1. Monitor pilot's instruments.
2. Monitor inertial velocities.

AFTER TAKEOFF PROCEDURES

1. Observe sensor usage readout. Should be b111111.
2. Search radar POWER switch ON
3. Radar TRANSMIT switch NORM/SHORT
4. Adjust search radar for optimum PPI display.
5. Steering mode AS DESIRED
6. Doppler power switch ON LAND/ON SEA
Monitor Doppler groundspeed and drift angle on Doppler panel and DDU. If not acceptable,
set Doppler mode selector switch to STBY.

IN-FLIGHT ALIGNMENT

IN-FLIGHT ALIGNMENT (FULL TERM, COMPUTER ON)

1. Computer is navigating correctly with Doppler or velocity-correct inputs (Doppler preferred).
2. Platform button STBY
3. Auto pilot STAB AUG OR OFF
4. ATTITUDE REF switch MAG/VGI
5. MA-1 compass SYNC
6. Erection controller MAN/AUTO switch MAN
7. MAG VAR LOCAL VARIATION SET
8. ALIGN switch OFF
9. Autopilot. AUTO

CONTINUED ON NEXT PAGE

IN-FLIGHT ALIGNMENT-CONTINUED

10. Erection controller panel UPDATE LAT, LONG, CARR HEAD AND SPEED ($\div 10$)
Carrier heading is aircraft true heading, speed is aircraft groundspeed in 10-knot increments.
11. Navigation mode selector EMER DOP OR DR
12. Platform button ALIGN (START ELAPSED-TIME CLOCK)
Observe fine align light after 55 seconds. Observe the align progress meter to null shortly thereafter, indicating that the platform heading is slewed to the MA-1 compass. Observe Doppler and inertial velocities to converge after approximately 5 minutes.
13. Erection controller panel UPDATE LAT & LONG
14. Autopilot STAB AUG OR OFF
15. ATTITUDE REF switch COMP IN
16. Navigation select switch INERL
Check VDI for proper attitude display and DVRI compass rose for approximate true heading; monitor velocities in digital display unit readout dials (data position).
17. Autopilot AUTO
18. ALIGN switch GYROCOMP
Fine align and ready light will go out. Alignment will be indicated after approximately 20 minutes by a null indication on the align progress meter, stable inertial velocities, proper VDI attitude, and DVRI compass rose approximating true heading.

Note

Platform azimuth alignment is suspended (SA) when the aircraft turns at a rate of 30° /minute or when the Doppler is on and in memory. SA causes the align progress meter to null.

19. Computer present position UPDATE
20. Platform selector switch OPER

IN-FLIGHT ALIGNMENT (SHORT TERM, COMPUTER ON)

For a short-term, computer-on inflight alignment, perform steps 1 through 16 of the procedure for full-term alignment and the following two steps:

21. Update computer present position
22. Platform selector button OPER

Note

- Platform level should be accurate and the velocities and heading information will only be as accurate as the MA-1 compass and the MAGVAR setting.
- A computer-off alignment is accomplished by following the same procedures as those listed above for a computer-on alignment.
- A computer-off alignment will provide attitude reference only.
- Before selecting OPER, the VDI should be monitored to check the progress of the platform leveling.

TARGET TRACKING PROCEDURES

CURSOR INTERSECTION TRACKING

- 1. MODE switch TRACK
- 2. ELEV TRKG switch OFF
- 3. Azimuth-range switch DISLODGE (FORWARD)
- 4. FREQ AGILITY switch AS DESIRED
- 5. Locate fixed/moving target in PPI and proceed as follows:
 - a. DISPLAYS button PPI OR ARE
 - b. PPI RANGE switch APPROXIMATELY 20 NMI
 - c. Antenna pattern ADJUST FOR MAXIMUM RETURN
 - d. SCAN ANGLE control NARROW ($\pm 10^\circ$)
 - e. SCAN RATE switch SLOW
 - f. STC SLOPE/DEPTH controls ADJUST
 - g. AMTI control (for moving target) ON, CANCELLATION AS REQUIRED
 - h. RCVR gain control ADJUST
 - j. VIDEO gain control ADJUST FOR OPTIMUM DISPLAY
- 6. Cursors SLEW OVER TARGET
- 7. DISPLAY button ARE 60 OR ARE 30
- 8. Velocity correct (manual) AS REQUIRED

ELEVATION TRACKING

- 1. MODE switch TRACK
- 2. ELEV TRKG switch ON
- 3. Azimuth-range switch DISLODGE (FORWARD)
- 4. FREQ AGILITY switch AS DESIRED
- 5. Locate fixed/moving target in PPI.
If moving targets are to be tracked, proceed as follows:
 - a. DISPLAY button PPI OR ARE
 - b. PPI RANGE switch APPROXIMATELY 20 NMI
 - c. Antenna pattern ADJUST FOR MAXIMUM RETURN
 - d. SCAN ANGLE control NARROW ($\pm 10^\circ$)
 - e. SCAN RATE switch SLOW
 - f. STC SLOPE/DEPTH controls ADJUST
 - g. AMTI control ON, CANCELLATION AS REQUIRED

CONTINUED ON NEXT PAGE

TARGET TRACKING PROCEDURES-CONTINUED

- h. RCVR gain control ADJUST
- j. VIDEO gain control ADJUST FOR OPTIMUM DISPLAY
- 6. Cursors SLEW OVER TARGET
- 7. DISPLAYS button ARE 60 OR ARE 30 (IF DESIRED)
- 8. ELEVATION light (under 60,800 feet maximum) ON
- 9. Velocity correct (manual) AS REQUIRED

AZIMUTH RANGE TRACKING

- 1. MODE switch TRACK
- 2. ELEV TRKG switch OFF
- 3. Azimuth-range switch DISLODGE (FORWARD)
- 4. FREQ AGILITY switch AS DESIRED
- 5. Locate fixed/moving target in PPI and proceed as follows:
 - a. DISPLAYS button PPI OR ARE
 - b. PPI RANGE switch APPROXIMATELY 20 NMI
 - c. Antenna pattern ADJUST FOR MAXIMUM RETURN
 - d. SCAN ANGLE control NARROW ($\pm 10^\circ$)
 - e. SCAN RATE switch SLOW
 - f. STC SLOPE/DEPTH controls ADJUST
 - g. AMTI control (for moving target) ON, CANCELLATION AS REQUIRED
 - h. RCVR gain control ADJUST
 - j. VIDEO gain control ADJUST FOR OPTIMUM DISPLAY
- 6. DISPLAYS button ARE 60 OR ARE 30
- 7. Cursors SLEW OVER TARGET
- 8. Azimuth-range switch ENABLE (AFT)
- 9. AZ-RANGE light ON
Slewing is inhibited. Cursors automatically track the target.
- 10. Velocity correct (AUTO) AS REQUIRED
If cursors track the target, set the velocity vorrect switch to MEM PT. If cursors
unstable, proceed with steps 11 and 12.

To Break Lock:

- 11. Velocity correct switch OFF ERASE, THEN OFF SAVE
- 12. Azimuth-range switch DISLODGE (FORWARD)

CONTINUED ON NEXT PAGE

TARGET TRACKING PROCEDURES-CONTINUED

TRACK-WHILE-SCAN TRACKING

Note

The azimuth-range switch should be left in the forward position until an azimuth-range lock-on is desired.

- 1. MODE switch. TRACK
 - 2. Locate fixed/moving target in PPI/ARE and proceed as follows:
 - a. DISPLAY button PPI OR ARE
 - b. PPI-RANGE switch APPROXIMATELY 20 NMI
 - c. Antenna pattern ADJUST FOR MAXIMUM RETURN
 - d. SCAN ANGLE control NARROW ($\pm 10^\circ$)
 - e. SCAN RATE switch SLOW
 - f. STC SLOPE/DEPTH control ADJUST
 - g. AMTI control (for moving target) ON, CANCELLATION AS REQUIRED
 - h. RCVR gain control ADJUST
 - j. VIDEO gain control ADJUST FOR OPTIMUM DISPLAY
 - 3. FREQ AGILITY switch AS REQUIRED
 - 4. Cursors SLEW OVER TARGET
 - 5. DISPLAYS button ARE 60 OR ARE 30 (IF DESIRED)
 - 6. Azimuth-range switch ENABLE (AFT)
 - 7. AZ-RANGE light ON
Slewing is inhibited. Cursors automatically track the target.
 - 8. ELEV TRKG switch ON
 - 9. ELEVATION light. ON
 - 10. Velocity correct switch MEMORY POINT
- To Break Lock:
- 11. Velocity correct switch (if velocity good) OFF SAVE
 - 12. Velocity correct switch (if velocity bad). OFF ERASE
 - 13. Azimuth-range switch. DISLODGE (FORWARD)

VELOCITY CORRECT PROCEDURES

AUTOMATIC VELOCITY CORRECT

Automatic velocity correct is performed when the VELOCITY CORRECT switch is at MEMORY POINT and an azimuth-range or track-while-scan lock-on exists. Corrected velocity will stabilize in 12 to 18 seconds.

CONTINUED ON NEXT PAGE

MANUAL VELOCITY CORRECT (CURSOR INTERSECTION OR ELEVATION TRACKING)

1. Position cursors with the azimuth cursor centered on the target and the range cursor just touching the leading edge of the target.
2. Observe cursors for drift off target (10 seconds minimum).
3. VELOCITY CORRECT switch MEMORY POINT
4. Cursors REPOSITION OVER TARGET
Slew the cursors to their original position and observe for drift. Repeat as necessary to cancel drift.
5. VELOCITY CORRECT switch OFF SAVE

COMPUTER OPTICAL POSITIONING (COP) CHECK

1. B/N - Position radar cursors on a visually recognizeable target in desired tracking mode.
2. Pilot - Depress attack commit trigger to first detent and observe position of optical sight moving reticle in relation to the target.

Note

- The aircraft should be in a stable dive attitude of 10° to 12° when a COP check is performed for optimum results.
- If a COP check is performed on the ground, only azimuth indications are valid.

ATTACK PROCEDURES

Note

- The attack procedures below are only those required to execute the attack selected, and must be used in conjunction with the procedures for the release of weapons from multiple ejector racks and triple ejector racks.
- The MASTER ARMT switch should be set to OFF before making any changes to switch selection on the armament control unit.

ROCKET ATTACK PROCEDURES

At any point en route to the target, the following settings may be made:

1. ATTACK mode button ROCKET
2. Station select switches ROCKETS/MISSILES (DOWN)
3. RELEASE mode button ROCKET SALVO

CONTINUED ON NEXT PAGE

ATTACK PROCEDURES-CONTINUED

4. INTERVAL/QUANTITY/TIME wheels AS DESIRED
5. MASTER ARMT switch ON (UP)
6. BOMB TONE switch AS DESIRED
7. Attack button DEPRESS
Depressing the attack button on the slew grip places the computer in attack mode.
8. RESELECT light OFF
Check that RESELECT light is off. If light goes on, it indicates that no attack solution can be generated because of some incompatible setting of armament switches.
9. ATTACK light ON
If ATTACK light remains off, it indicates that computer has not entered attack mode.
10. In-range lights ON AT MAXIMUM RANGE
11. Zero steering both horizontally and vertically.

Note

Release is obtained by the pull-through or line-up techniques.

12. Attack commit trigger COMMIT (SECOND DETENT) AND HOLD
When pilot depresses attack commit trigger on his control stick, the computer is directed to fire if within in-range limits and within ± 4 mils vertically of the electronic center of the VDI. The bomb tone comes on at commit and goes off when the COMPLETE light comes on.

Note

- It is possible to commit out of range.
- For the release of empty rocket launchers or CBU's from MER/TER, set the station select switch to BOMBS/GUNS, and release the units as if they were bombs.

HI LOFT ATTACK PROCEDURES

At any point en route to the target, the following settings may be made:

1. ATTACK mode button HI LOFT
2. Station select switches UP AS DESIRED
3. Fuzing/arming AS BRIEFED
4. RELEASE mode button BOMB SALVO OR BOMB TRAIN
5. INTERVAL/QUANTITY/TIME wheels SET
6. MASTER ARMT switch ON (UP)
7. BOMB TONE switch AS DESIRED

ATTACK PROCEDURES—CONTINUED

After steps 1 through 7 have been accomplished and the aircraft is within 32 nautical miles of the target, the following procedures must be accomplished:

8. Attack button DEPRESS
Depressing attack button on slew grip places computer in attack mode.
9. RESELECT light OFF
Check that RESELECT light is off. If light goes on, it indicates that no attack solution can be generated because of some incompatible setting of armament switches.
10. ATTACK light ON
If ATTACK light remains off, it indicates that computer has not entered attack mode.
11. In-range lights ON AT MAXIMUM RANGE - HI LOFT PULLUP POINT
12. Attack commit trigger COMMIT (SECOND DETENT) AND HOLD
13. Bomb tone COMES ON WHEN ATTACK COMMIT TRIGGER IS DEPRESSED
AND GOES OFF WHEN COMPLETE LIGHT COMES ON

STRAIGHT PATH ATTACK PROCEDURES

At any point en route to the target, the following settings may be made:

1. ATTACK mode button STRAIGHT
2. Station select switches UP AS DESIRED
3. Fuzing/arming AS BRIEFED
4. RELEASE mode button BOMB SALVO OR BOMB TRAIN
5. INTERVAL/QUANTITY/TIME wheels SET (AS DESIRED)
6. REL ADV key DEPRESS (AS DESIRED)
7. MASTER ARMT switch ON (UP)
8. BOMB TONE switch AS DESIRED

After steps 1 through 8 have been accomplished and the aircraft is within 32 nautical miles of the target, the following procedures must be accomplished:

9. Attack button DEPRESS
Depressing attack button on slew grip places computer in attack mode.
10. RESELECT light OFF
Check that RESELECT light is off. If light goes on, it indicates that no attack solution can be generated because of some incompatible setting of armament switches.
11. ATTACK light ON
If ATTACK light remains off, it indicates that computer has not entered attack mode.
12. In range lights SHOULD LIGHT BEFORE RELEASE
13. Attack commit trigger COMMIT (SECOND DETENT) AND HOLD
14. Bomb tone COMES ON WHEN ATTACK COMMIT TRIGGER IS DEPRESSED
AND GOES OFF WHEN COMPLETE LIGHT COMES ON

CONTINUED ON NEXT PAGE

ATTACK PROCEDURES-CONTINUED

GENERAL ATTACK PROCEDURES

1. ATTACK mode button GENERAL
2. Station select switches UP AS DESIRED
3. Fuzing/arming AS BRIEFED
4. RELEASE mode button BOMB SALVO OR BOMB TRAIN
5. INTERVAL/QUANTITY/TIME wheels SET (AS DESIRED)
6. REL ADV key ENGAGED (AS DESIRED)
7. MASTER ARMT switch ON (UP)
8. BOMB TONE switch AS DESIRED

After steps 1 through 8 have been accomplished and the aircraft is within 32 nautical miles of the target, the following procedures must be accomplished:

9. Attack button DEPRESS
Depressing attack button on slew grip places computer in attack mode.
10. RESELECT light OFF
Check that RESELECT light is off. If light goes on, it indicates that no attack solution will be generated because of some incompatible setting of armament switches.
11. ATTACK light ON
If ATTACK light remains off, it indicates that computer has not entered attack mode.
12. In-range lights COME ON AT MAXIMUM RANGE LOFT PULLUP POINT
13. Attack commit trigger COMMIT (SECOND DETENT) AND HOLD
14. Bomb tone COMES ON WHEN ATTACK COMMIT TRIGGER IS DEPRESSED
AND GOES OFF WHEN COMPLETE LIGHT COMES ON

Note

- With convential stores, the computer solves a low-loft release with a forced commit at 8°.
- With special weapons, the computer solves a low-loft and high-loft in that order.
- If pull-up steering commands are not followed, the computer solves for and provides a level release.

BORESIGHT TARGET ACQUISITION AND ATTACK

If possible velocity correct within 10 minutes of making a boresight attack.

1. COMPT MODE switch STEER
2. ADDRESS key AS DESIRED
Select any steering mode. Do not use UNSTAB.
3. Optical sight switch AUTO
4. MODE switch BORESIGHT

CONTINUED ON NEXT PAGE

ATTACK PROCEDURES—CONTINUED

5. ATTACK mode button GENERAL OR STRAIGHT OR HI LOFT
When BORESIGHT is selected, the computer uses a general attack regardless of the
ATTACK button depressed.
6. Station select switches UP AS DESIRED
7. Fuzing/arming AS BRIEFED
8. RELEASE mode button BOMB SALVO OR BOMB TRAIN
9. INTERVAL/QUANTITY/TIME wheels SET (AS DESIRED)
10. MASTER ARMT switch ON (UP)
11. BOMB TONE switch AS DESIRED
12. Attack button DEPRESS
Depressing the attack button on slew grip places computer in attack mode.
13. RESELECT light OFF
Check that RESELECT light is out. If light goes on it indicates that no attack solution
will be generated because of some incompatible setting of armament switches.
14. ATTACK light ON
If ATTACK light remains off, it indicates that computer has not entered attack mode.
15. Dislodge switch FORWARD
16. ELEV TRKG ON
Elevation track lock-on should occur when the validity parameter of $\pm 53^\circ$ bank angle
and 2° /second pitch rate are met. The attack may be completed on baro-inertial
information if elevation track lock-on is not acquired.
17. In-range lights FLASHING
Flashing of the in-range lights indicates that the computer is using elevation
tracking data.
18. Moving reticle PLACE ON TARGET
Pilot maneuvers the aircraft into a dive, positioning the moving reticle on the target.
The moving reticle represents the aircraft inertial velocity vector and is 20 mils
below the ADL.

Note

Initial reticle alignment should be maintained for a
minimum of 1/8 second before designating. Subse-
quent designates require 1/2 second of reticle
alignment.

19. Attack commit trigger DESIGNATE (FIRST DETENT)
To designate a second time, release the trigger, and re-actuate.
20. Attack commit trigger COMMIT (SECOND DETENT)
21. Azimuth and elevation steering NULL
22. Bomb tone COMES ON AT COMMIT AND GOES OFF
WHEN COMPLETE LIGHT COMES ON

Note

Flashing of the breakaway lights is the only visual
cue provided to the pilot when terrain avoidance
pullup is indicated in a visual attack.

CONTINUED ON NEXT PAGE

ATTACK PROCEDURES—CONTINUED

LAB IP ATTACK PROCEDURES

At any point en route to the initial point (IP), the following settings may be made:

1. ATTACK mode button LAB IP
2. Station select switches UP AS DESIRED
3. Fuzing/arming AS BRIEFED
4. RELEASE mode button BOMB SALVO OR BOMB TRAIN
5. INTERVAL/QUANTITY/TIMER wheels SET
6. MASTER ARMT switch ON (UP)
7. BOMB TONE switch AUTO

When the aircraft is over the initial point (IP), perform the following procedures:

8. Attack commit trigger COMMIT (SECOND DETENT) AND HOLD
Pilot depress and hold attack commit trigger. Bomb warning tone comes on for 1/2 second 2 seconds before time countback reaches 0. When time reaches 0, bomb tone comes on, pilot starts 4-g pullup. The stores are automatically released at the pre-set release angle and the station release indicators set. When release is complete, the COMPLETE light comes on and the bomb tone goes off. The COMPLETE light goes off when the pilot releases the attack commit trigger.

LAB TGT ATTACK PROCEDURES

At any point en route to the target, the following settings may be made:

1. ATTACK mode button LAB TGT
2. Station select switches UP AS DESIRED
3. Fuzing/arming AS DESIRED
4. RELEASE mode button BOMB SALVO OR BOMB TRAIN
5. INTERVAL/QUANTITY/TIME wheels SET
6. MASTER ARMT switch ON (UP)
7. BOMB TONE switch AUTO

When aircraft is over the target, perform the following procedures:

8. Attack commit trigger COMMIT (SECOND DETENT) AND HOLD
Pilot begins a 4-g pullup when bomb tone comes on. The stores are automatically released at the preset release angle and the station release indicators set. When release is complete, the COMPLETE light comes on and stays on until the pilot releases the attack commit trigger.

Note

- Bomb warning tones comes on for 1/2 second 2 seconds before time countback reaches 0 if INTERVAL is set to 02.0 or greater. If INTERVAL is set between 02.0 and 01.5, warning tone duration depends on INTERVAL setting. If less than 01.5 is set, there is no warning tone.
- Bomb tone comes on when time countback reaches 0 and goes off when the COMPLETE light comes on.

CONTINUED ON NEXT PAGE

ATTACK PROCEDURES—CONTINUED**DELAY BOMBING PROCEDURES**

At any point en route to the target, the following settings may be made:

1. ATTACK button DELAY
2. Station select switches UP AS DESIRED
3. FUZING AS BRIEFED
4. RELEASE button BOMB SALVO OR BOMB TRAIN
5. INTERVAL/QUANTITY/TIME wheels SET (AS DESIRED)
6. MASTER ARMT switch ON (UP)
7. BOMB TONE switch AUTO

After steps 1 through 7 have been accomplished and the aircraft is at the selected commit point, the following procedures must be accomplished:

8. Attack commit trigger COMMIT (SECOND DETENT) AND HOLD
Depressing the commit trigger starts the ACU timer.
9. Bomb tone COMES ON WHEN ATTACK COMMIT TRIGGER IS DEPRESSED
AND GOES OFF WHEN COMPLETE LIGHT COMES ON
The weapon is automatically released at the end of the selected delay.

GUNNERY ATTACK PROCEDURES

At any point enroute to the target the following settings may be made:

1. RELEASE mode button GUNS
2. GUN switch READY
Placing the switch to ready charges all the guns.
3. Optical sight AUTO/OFF/MAN switch MAN
4. Optical sight movable reticle switch OFF

When ready to begin the attack:

5. Station select switches BOMBS/GUNS (UP)
6. MASTER ARMT switch ON (UP)
7. Attack commit trigger DEPRESS (SECOND DETENT)
When lined up on the target, depress the attack commit trigger to fire the guns.

Note

Firing the guns will produce a release indication on the stations selected.

Just before landing or when ready to secure the guns (weight must be off wheels):

7. MASTER ARMT switch OFF
8. Gun switch CLEAR, (DOWN) then SAFE

CONTINUED ON NEXT PAGE

ATTACK PROCEDURES—CONTINUED

CAUTION

Moving the gun pod switch to the momentary CLEAR position renders the guns inoperative for the remainder of the flight. Do not select READY after selecting CLEAR as this will result in a jam of the ammunition belt links.

MINING PROCEDURES

1. ATTACK mode button STRAIGHT
2. Station select switches BOMBS/GUNS (UP)
3. RELEASE mode button BOMB TRAIN
4. INTERVAL/QUANTITY/TIME wheels AS DESIRED
5. MASTER ARMT switch ON (UP)
6. BOMB TONE switch AS DESIRED
7. Steering SELECT TARGET AND GRD TRK
8. Attack commit trigger COMMIT (SECOND DETENT) AND HOLD
9. Bomb tone COMES ON AT COMMIT AND GOES OFF
WHEN COMPLETE LIGHT COMES ON

AIR REFUELING (REFUELING STORE)

BEFORE TAKEOFF

1. SHIP TANK switch OFF
2. DROGUE POSITION switch RET
3. Refueling master switch OFF
4. Fuel transfer switch OFF
5. LIGHT switch (DAY) BRT
..... (NIGHT) DIM
6. Gallons delivered 000

DROGUE EXTENSION

1. REFUELING MASTER switch ON
2. Airspeed (MAX) 300 KIAS (.80 IMN)
..... (MIN) 190 KIAS
3. Drogue position switch EXT
Drogue indicator will read EXT when drogue reaches full trail position.
4. SHIP TANK switch TO STORE

CONTINUED ON NEXT PAGE

AIR REFUELING (REFUELING STORE) – CONTINUED**REFUELING**

1. DROGUE POSITION indicator TRA
2. Fuel Transfer switch TRANS
When refueling is complete the DROGUE POSITION indicator shows EXT.

DROGUE RETRACTION

1. DROGUE POSITION indicator EXT
2. Fuel Transfer switch OFF
3. Airspeed 250 KIAS OR LESS
4. Drogue switch RET

Note

If the drogue cannot be fully retracted at about 250 KIAS, reducing airspeed to 230 KIAS or less should permit full retraction.

5. DROGUE POSITION indicator RET
6. Refueling master switch OFF

CAUTION

Landing with the drogue extended is not recommended.
Guillotine over clear or uninhabited area.

TRANSFER FROM STORE TO TANKER

1. SHIP TANK switch FROM STORE
When transferring fuel from store to tanker, monitor dump light. When dump light goes out, fuel transfer is complete. This condition should be confirmed with the selectable needle on the fuel quantity indicator.

DESCENT

1. Complete DESCENT checklist with pilot using challenge and reply.

BEFORE LANDING

1. Complete LANDING checklist with pilot using challenge and reply.
2. Search radar POWER switch STBY
3. TRANSMIT switch SIL
4. Doppler power switch STBY
5. Search radar SCAN ANGLE control CCW
6. Search radar SCAN RATE control FAST
7. Steering key UNSTAB
8. ECM nose and tail control switches STBY

AFTER LANDING

1. Complete AFTER LANDING checklist with pilot using challenge and reply.

IN CHOCKS

- NEW
NEW
NEW
1. Copy data

a. Vertical velocity (A3)

b. Present position

c. Groundspeed (after selecting OFF ERASE)

d. Erection controller latitude and longitude.
2. Pilot's horizontal display power switch

OFF
3. Search radar POWER switch

OFF
4. Inertial platform selector button

OFF
5. Doppler power switch

OFF
6. COMPUTER switch

OFF
7. Panel/console lights

OFF
8. ECM power switches

OFF

part 4**Carrier Based Procedures****PILOT'S PROCEDURES****FIELD MIRROR LANDING PRACTICE****PREFLIGHT INSPECTION**

NEW A normal preflight inspection (figure 3-3) will be conducted with specific attention being given to the struts and tire condition. Check that the hook bypass switch is in the touch-and-go position.

PATTERN ENTRY

NEW Call "Paddles" prior to pattern entry to confirm Charlie time. Enter the break at 250 KIAS, at 800 feet above the terrain. When cleared to break and the proper interval of the aircraft ahead is assured, roll into a 60° banked turn, extend wing-tip speed brakes, reduce power to a minimum of 75%, slow to 250 KIAS, extend gear, place flaps to TAKE OFF (below 250 KIAS), and maintain 800 feet until intercepting the downwind leg. On the downwind leg, descend to 600 feet above the terrain. Slow to appropriate airspeed for gross weight and check airspeed against the angle-of-attack indicator to ensure proper calibration of the indicator and the indexer. At the 180° position, the angle-of-attack indicator should indicate "on speed." Aircraft in formation will take a 10-second break interval. Complete the landing check list prior to reaching the 180° position.

PATTERN**180° Position**

NEW Begin approach by turning 15 seconds past the abeam position in order to have a 1 1/2 mile wings-level groove. Commence a slight descending turn to final, maintaining optimum angle of attack.

90° Position

NEW Maintain optimum angle of attack at approximately 450 feet. Final adjustment to longitudinal trim should be made.

Final

At approximately 1 1/4 miles, the meatball will appear in the center of the mirror. Reduce power as

NEW necessary to maintain a rate of descent that will keep the meatball centered. Glide slope corrections should be made early by smooth changes in power and stick position as required to maintain a centered meatball and optimum angle of attack. Control altitude with the throttle and angle of attack (airspeed) with the stick. Once established on the glide slope, keep the scan going, cross-checking meatball, line-up, and angle of attack, and make positive corrections, immediately but smoothly.

Landing

Keep the aircraft on the glide slope and centerline all the way down. Do not flare. When touchdown is made, add full power, retract speed brakes and use the bolter technique described under Wave-Off/Bolter Pattern. Climb straight ahead until reaching 300 feet. Turn downwind for the next pass when the aircraft ahead is approximately in the 10-o'clock position on the downwind leg.

Wave-Off

The pilot must initiate a wave-off whenever he believes his aircraft to be in an unsafe position. Anytime a wave-off is received, either by the wave-off lights or by radio, it is mandatory and will be answered with FULL MILITARY POWER, speed brakes, and a transition to climbing attitude to prevent further loss of altitude.

Bingo Fuel

Recovery at home field will be with no less than 1,450 pounds of fuel remaining.

Note

With the landing gear down, wing and drop tank fuel cannot be transferred or dumped unless the tank pressurization switch is set to ORIDE.

NIGHT PATTERN

The night pattern and approach technique are generally the same as the day pattern with the following exceptions:

1. The pattern will be flown on instruments until visual acquisition of the meatball is made.

- NEW
2. A straight-in CCA type approach at 600 feet above the terrain will be made by extending the downwind leg 30 to 45 seconds past the normal abeam position used in the day pattern.
 3. For ACLS, the pattern is flown at 1200 feet or as assigned. A level turn to final is commenced 3 miles past the abeam position until a positive lock-up is achieved, then radar controlled approach to landing.

CARRIER BASED PROCEDURES

The CVA/CVS NATOPS manual and LSO NATOPS manual are the governing sources for carrier-based procedures.

PREFLIGHT

Day

A normal preflight inspection should be accomplished with particular attention given to the landing gear, tires, hook, and underside of the fuselage for possible damage.

Occasionally, the aircraft assigned will be manned on the hangar deck. Unless the aircraft is already spotted on the elevator, it will be towed or pushed for access to the flight deck. The signal to stop a plane that is being moved by other than its own power is a whistle blast. Leave the hardhat off. Any whistle blast signifies an immediate stop. If the plane director is lost from view, stop. The aircraft will be raised to the flight deck level and either re-spotted or started on the elevator.

Note

Brake cycles remaining should be kept at 12 or higher by use of the auxiliary hydraulic pumps.

Night

External preflight will be made using a flashlight. In addition to normal cockpit preflight, ensure that external light switches are positioned to dim for post start light check. The master exterior lights, anti-collision, and taxi light switches should always be in the OFF position before start. Set the cockpit and approach indexer lights as desired.

POST START

Day

Engines will normally be started 20 minutes before launch, and the customary functional checks will be performed. Do not let the plane directors hurry these checks. When ready, signal the plane director with a thumbs up. Chocks and tiedowns will be removed upon signal by the plane director. Hold foot-brakes regardless of parking brake position when tiedowns are removed.

Night

After normal system checks are completed, perform exterior lights check. When ready, signal the plane director with a vertical motion of the flashlight, meaning checks are completed and the aircraft is up. If the aircraft is down, make a horizontal motion with the flashlight.

TAXI

Day

Only emergency stop signals are used. Any signal from the plane director given from above the waist is intended for the pilot. Any signal given from below the waist is intended for deck-handling personnel. While taxiing, careful attention must be given to the director and his signals shall be followed explicitly. Nose-wheel steering permits the use of minimum power while taxiing. Taxi speed shall be slow at all times, especially on wet decks and approaching the catapult area. Be prepared to use the emergency brake should normal braking fail.

Night

During night carrier-deck operations, the tempo of operations, both in volume and speed, is considerably reduced from day operations. Slow and careful handling of aircraft by both plane directors and pilots is mandatory. If the pilot has any doubt as to the plane director's signals, stop.

LAUNCH PROCEDURES

Day

Proper positioning on the catapult is easily accomplished if the entry is made with only enough power to maintain forward motion and the plane director's signals are followed explicitly. All functional checks will be performed prior to taxiing into the shuttle. After the tow link is dropped to the deck and the trail bar has been attached to the aircraft and checked by squadron maintenance personnel, the aircraft shall be taxied up to the mouth of the lead-in track. The catapult director will then direct the pilot to approach the catapult track, using nose gear steering and brakes. Release nose-wheel steering upon signal in the track, and as the aircraft rolls forward, the tow bar will drop into the shuttle and the aircraft will stop in position for shuttle tension-up.

Night

Maneuvering the aircraft for catapult hookup at night is identical to that used in day operations; however, it is difficult to determine your speed or motion over the deck. The pilot must rely upon, and follow closely, the plane director's signals.

CATAPULT LAUNCH**Day**

Ensure that the takeoff checklist is completed before entering the nose-tow approach ramp. Aircraft trim should be set to recommended setting for expected excess end airspeed. Refer to current Aircraft Launching Bulletins for A-6 aircraft.

Upon receipt of the "tension up and release brakes" signal, advance the throttles to full military power, engage throttle friction and engage the strut lock. Check all engine and flight instruments for normal indications and operation, check the STRUT LOCK light extinguished, and perform a smooth, but rapid cycle of flight controls. Ensure B/N is ready, place head firmly against the headrest, chin down; and render an exaggerated hand salute to the Catapult Officer. There will be a two to four second delay prior to catapult firing due to sequence by the catapult crew.

CAUTION

The catapult grip must be used (rotated in-board and pulled up) for all catapult launches, since proper positioning is necessary for nose-strut stiffening. Maximum centerline store clearance is attained when the engines are operating at maximum thrust, brakes released, and catapult grip moved to the strut-lock position. Air crews should monitor the annunciator panel for STRUT LOCK warning light out before catapult launch. Failure to use the catapult grip will result in catapulting with a soft nose strut and may cause structural damage to the aircraft or centerline stores.

Catapult launches should be planned for a 10- to 15-knot excess end airspeed. Excess end airspeed is an arbitrary safety factor added to the minimum airspeed required to effect a safe but not optimum catapult launch. The minimum airspeed was determined during shipboard carrier suitability trials and is applicable for specific gross weight and ambient temperature/wind conditions. Recommended elevator trim settings for variations in end airspeed will result in optimum climb attitude off the catapult. Launch bulletins recommend a "lightly held control stick" catapult technique be used.

After leaving the catapult, allow the aircraft to rotate to the pitch attitude (10° to 12°) resulting from the elevator trim setting. The resulting climbing attitude is the optimum for aircraft weight and, once attained, should be maintained with stick positioning and trim. The angle of attack (AOA) indicator should indicate approximately 3 o'clock. Initial climbing attitude information is also available on the VDI. After launch, maintain optimum AOA and pitch angle and monitor the airspeed and altimeter for increasing values. Retract the landing gear after becoming airborne. Retract the flaps at the recommended flaps-up airspeed for launch gross weight.

Note

The right flaperon will raise due to a reaction to the catapult's acceleration and will result in a slight right clearing turn off the catapult stroke. This may be prevented by the pilot with lateral stick input during the catapult stroke.

CAUTION

Extreme caution should be exercised during flap retraction under heavy gross weight conditions. To avoid aircraft stall or setting due to flap retraction, do not retract the flaps below 170 KIAS for weights up to 50,000 pounds and not below 185 KIAS for weights above 50,000 pounds. At the heavier weights and under high ambient temperature conditions, acceleration and climb performance are marginal and it may be impossible to reach 185 KIAS. If 185 KIAS cannot be reached, it is recommended that external store weight be reduced in order to permit acceleration to 185 KIAS before flap retraction.

Throttle friction should be tight enough to prevent aft throttle movement. Instrument scan after launch should include all flight instruments. Initial pitch attitude is immediately indicated on the VDI, VGI, and AOA. Wing position is displayed on VDI, VGI, and by the HSI if turning. Airspeed information is available and can be monitored during the catapult stroke. Vertical speed lags slightly but may be used after leaving the catapult. The altimeter, like the VSI, lags and accurate information is not immediately available. The radar altimeter is available for use immediately after launch. It must be emphasized that the most important requirement after catapult launch is the necessity to climb.

CAUTION

Use of the vertical gyro instrument (VGI) as a primary attitude reference following catapult launches is not recommended. Due to the inherent inaccuracies and possibility of failure of the VGI, this instrument should be used for backup/emergency situations only.

Night

The procedures for catapult launch at night are basically the same as for day launches. When ready to launch, signal the Catapult Officer by placing the external light master switch to ON. The launch technique discussed under the DAY procedures is applicable. The bombardier/navigator should monitor the flight instruments until climbing through 2,500 feet.

AIRCRAFT OR CATAPULT MALFUNCTION

If it is determined that the aircraft is down after establishing military power, signal the catapult officer by shaking the head from side to side. Transmit to Pri-Fly, "Suspend (catapult number)." Never raise a hand into the catapult officer's view to give a thumbs down signal for it may be misinterpreted as a salute and the catapult fired. At night, do not turn the master light switch on. The catapult officer will relay a no-go situation to the deck edge catapult operator by crossing his forearms over his head. He will then give the release tension signal and walk in front of the wing to give the throttle back signal. Then, and only then, reduce the throttle from military power to idle and remove the head from head-rest. The same signals will be used to signify a catapult malfunction.

CAUTION

Leave the throttle at military power until the catapult officer walks in front of the wing and signals for power to be reduced to idle.

RECOVERY

Procedures for arrival, marshal, and approach shall be in accordance with the CVA/ CVS NATOPS Manual.

PATTERN (VFR)

Pattern entry shall be in accordance with the CVA/ CVS NATOPS Manual. At the break, the leader shall break smartly to 60° of bank, extend wing-tip speed brakes, reduce power to a minimum of 75%, slow to 250 KIAS, extend the landing gear, flaps to TAKE OFF below 250 KIAS, and maintain 800 feet until intercepting the downwind leg. Then descend to 600 feet and slow to the appropriate airspeed for gross weight and compare airspeed and angle-of-attack indicators for proper indications. At the 180° position, at 1 mile abeam, the angle-of-attack should be on-speed. Subsequent aircraft in the flight shall break at 17-second intervals. Complete the landing check list prior to the 180° position (Flaperon pop-up, and antiskid switches OFF).

APPROACH

Begin the approach by turning at the 180° position in order to have an approximate 35-second groove. Establish a 25° to 35° bank and descend to no lower than 450 feet. Meatball acquisition at 450 feet will occur near the 45° position; reduce power as necessary to maintain a rate of descent that will keep the meatball centered.

Glide slope corrections should be made early by smooth changes in power and stick position as required to maintain a centered meatball and normal

angle of attack. Twenty-one units may be set when operating on larger class carriers to enhance visibility during the approach. Control altitude with the throttle and angle of attack (airspeed), with the stick. Once established on the glide slope, keep the scan going, cross-checking meatball, line-up and angle of attack, and make positive corrections, immediately but smoothly. During the approach, cross-check meatball, angle of attack, and line-up down to touchdown. Add full power and retract speed brakes immediately upon touchdown in anticipation of a bolter.

WAVE-OFF/BOLTER PATTERN

Day

Wave-offs will be straight up the angle deck when given close in. Pilots must bear in mind that a late wave-off is critical in that the chance of an in-flight engagement is great. Therefore, the pilot will, upon receiving a wave-off signal either by radio or the wave-off lights, immediately add full military power, retract speed brakes, and transition to a climbing attitude to prevent any further loss of altitude.

A wave-off to the right will be made only when overshooting the landing line to the extreme, or for other safety considerations.

Climb straight ahead on a wave-off or a bolter, then turn to parallel the ship's recovery course on the port side. Do not cross the bow while flying upwind. Be alert for other aircraft launching or entering the pattern from the break. The aircraft ahead will have priority for the turn downwind.

Night

On a wave-off or bolter, climb straight ahead on final bearing. The downwind turn will be at 1,200 feet or as assigned by CCA, not exceeding 30° bank. The night pattern should be flown entirely on instruments until in a position to acquire the meatball visually. However, it is prudent to remain alert to the transmission of other aircraft and to make a brief visual check when it becomes apparent another aircraft is in close proximity.

ARRESTED LANDING AND EXIT FROM LANDING AREA

Day

Upon touchdown, advance the throttles to full military power and retract speed brakes. As soon as arrested, place the throttles to idle and raise the flaps. Allow the aircraft to roll back to disengage the arresting gear, then raise the hook.

CARRIER APPROACH SUMMARY

		APPROACH AIRSPEED, KCAS			HOOK-TO-EYE DISTANCE, FT	
CONFIGURATION	OPTIMUM AOA	36,000 LB GROSS WT	33,500 LB GROSS WT	28,000 LB GROSS WT	OPTIMUM AOA	OPTIMUM AOA PLUS 1 UNIT
NORMAL (T.O. FLAPS)	22	120	115	105	15.4	15.9
T.O. FLAPS/NO. SLATS	19	126	121	111	13.7	14.2
LANDING FLAPS/NO SLATS	19	122	117	107	13.7	14.2
NO FLAPS/SLATS EXTENDED	22	148	142	130	15.4	15.9
NO FLAPS/NO SLATS	21	152	146	133	14.8	15.3
SINGLE ENGINE (T.O. FLAPS)	21	123	118	108	14.8	15.3

DATA IN THIS CHART IS THE RESULT OF CARRIER SUITABILITY FLIGHT TEST EVALUATION CONDUCTED BY THE NAVAL AIR TEST CENTER, PATUXENT RIVER, MARYLAND.

A-ADF1-73

Figure 3-10

NEW
On CVA's with a long roll-out, any holding of brakes or application of military power longer than that which is absolutely necessary to ensure safety will result in the aircraft being hung in the gear. The hook must be in the lowered position during the subsequent pull-back. Additionally, during pull-back the pilot must stay off the brakes and be alert to the taxi director's signal to raise the hook.

CAUTION

Do not depress the HOOK LIFT button while the hook is engaged in the arresting gear. Doing so may cause breakage of the hook bumper cable.

CAUTION

Before folding the wings, ensure that the flaps, slats, and speed brakes have been retracted.

Prior to shutdown, the aircraft should be cleaned up. Keep the engines running until the director signals "chocks are in place", and "cut engine". Landing gear safety pins should be installed prior to shutdown.

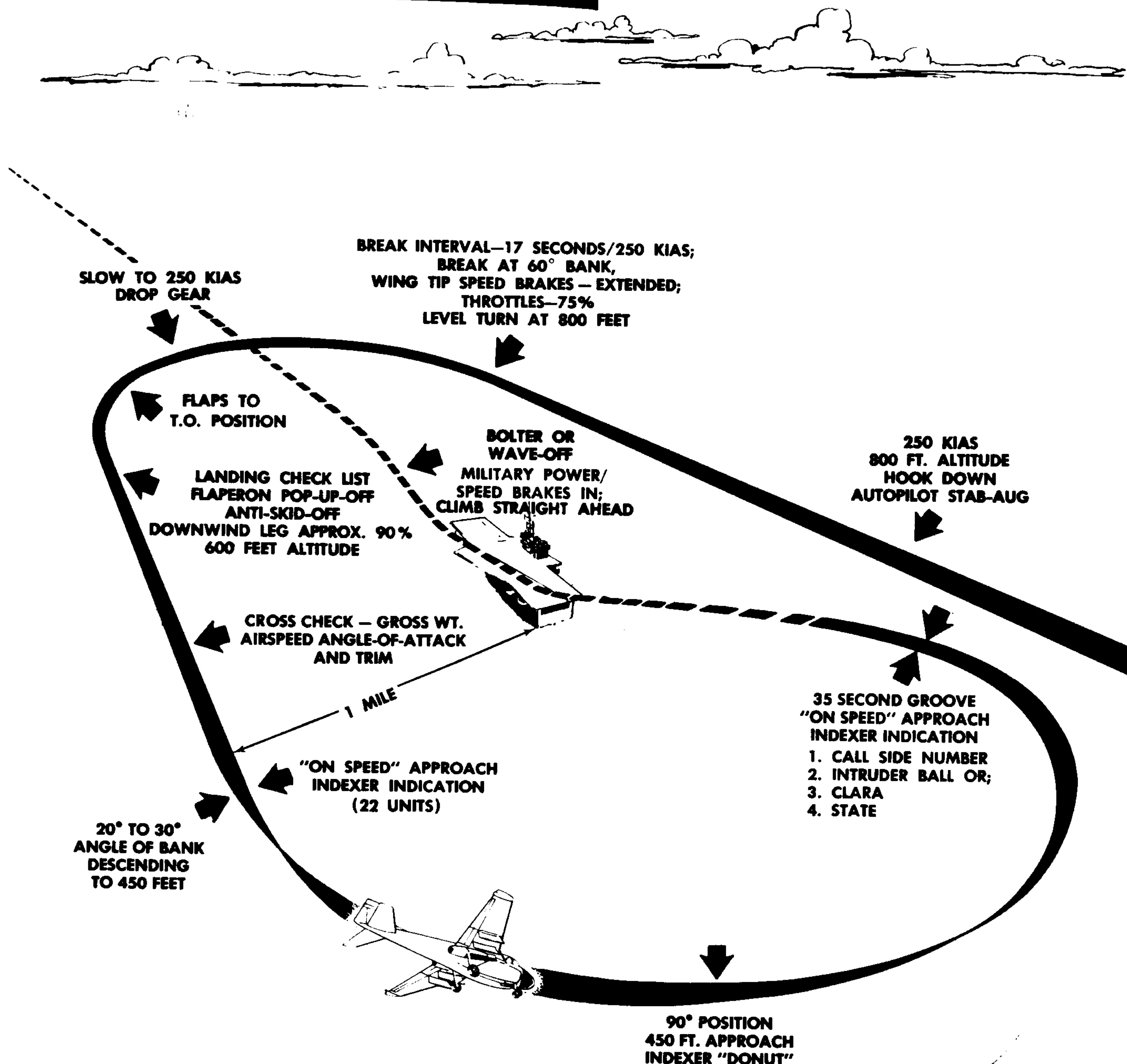
Be prepared to use the auxiliary or emergency braking if necessary.

If the aircraft is struck below to the hangar deck, keep the canopy closed and the oxygen mask on until dropped from the flight deck and signalled to shut the engines down. Open the canopy prior to securing the engines. After the engines are cut, normal braking will lose effectiveness and the auxiliary braking systems must be used. Remove the hardhat and follow the aircraft director's signal. Aircraft handling personnel will move the aircraft from this point. Engine rundown noise will make it very difficult to hear whistle signals; consequently, the pilot must be alert for both hand and whistle signals. Keep rolling speed slow and under control by use of brakes, keeping the cycles at 12 with auxiliary hydraulic pumps. Whenever the plane director is not in sight, stop.

Night

The same procedures for day operations should be utilized at night, except that immediately following arrestment, place the master exterior light switch to OFF. Taxi out to the landing area slowly. Do not stare fixedly at the plane director's wands, but use them as the center of the scan pattern.

CARRIER LANDING PATTERN



A-ADF1-47

Figure 3-11

CARRIER-CONTROLLED APPROACH

Carrier-controlled approaches shall be conducted in accordance with the CVA/CSV NATOPS Manual. A typical approach is illustrated in figure 3-12.

Holding

Aircraft will normally hold individually at 230 KIAS with the arresting hook down. Five minutes prior to penetration, the defog should be turned on and maximum comfortable cabin temperature should be maintained to prevent possible fogging on the windscreen and canopy.

Penetration

The aircraft will depart holding allowing approximately 700 pounds of fuel for the penetration and approach. Penetration will be accomplished as follows:

- 1. Throttles RETARD
- 2. Nose over to establish a 4,000 foot per minute rate of descent.
- 3. Airspeed. ACCELERATE TO 250 KIAS
- 4. Speed brakes OUT, ADJUST THROTTLES
- 5. Call PLATFORM at 5,000 feet and reduce rate of descent to 2,000 feet per minute.

At level-off altitude:

- 6. Speed brakes IN
- 7. Throttles . . . ADJUST POWER TO MAINTAIN 250 KIAS

Final Approach

The pilot will continue to fly on instruments until the meatball is intercepted. The bombardier/navigator will normally maintain a visual lookout and will call meatball to the pilot on the ICS.

AUTOMATIC CARRIER LANDING SYSTEM

Automatic carrier landing system (ACLS) approaches apply to properly modified ASW-25 data link equipped aircraft using carrier- or shore-based SPN-10, SPN-42 or MPN-T1 ACLS facilities. Four modes of approach are available; however, use of specific modes is dependent on aircraft modifications. In mode 1 approaches, data-link-transmitted ACLS control signals are coupled to the autopilot after ACLS radar lock-on and control the aircraft until touchdown. Mode 1A approaches differ from mode 1 approaches in that data link/ACLS control signals are uncoupled 1/2 mile (approximately 200 feet altitude) from touchdown. Mode 2 approaches are pilot-controlled approaches using the data link/ACLS signals to present the pilot with the aircraft's glide slope and final bearing situation on a cockpit course indicator. Mode 3 approaches are simply a controller talk-down approach and require no special aircraft equipment onboard.

ACLS MODE 2 APPROACHES

An ACLS mode 2 approach is illustrated in figure 3-13. In a mode 2 approach, the ACLS indicator (ID-351) pitch-and-bank steering bars present

vertical and lateral glide-slope errors respectively in relation to the aircraft. The pilot flies the aircraft toward the steering bars as in an ILS approach. Discrete readout (DRO) panel light lighting and going out are noted in the following procedural steps.

- 1. Position the following controls as indicated to prepare the aircraft for data link/ACLS signals:
 - a. Data link power switch ON
 - b. Message selector switch NORM
 - c. Frequency-select dials AS BRIEFED

When the controls are selected, the DRO will indicate missed message (TILT).

- 2. Before or while in marshal, check the data link system for correct operation by the universal test message (UTM) check. The UTM is selected by holding the TEST/NORM/AJ switch in TEST. Observe the following ACLS indicator commands:

	Sequence 1	Sequence 2
Pitch Bar	Down	Up
Bank Bar	Left	Right
DRO	Wave-off	Blank

- 3. Perform a normal CCA and at the 10-mile gate, level at 1200 feet (or as assigned), and change to landing configuration. The DRO will continue to indicate missed message (TILT).
- 4. Engage APCS (optional) while heading inbound level at 1200 feet (or as assigned) and stabilize approach speed.
- 5. At approximately 6 miles, the controller will insert the aircraft data link address and the DRO will indicate landing check (LC). The missed-message signal will simultaneously go out. Complete the landing checklist.
- 6. At ACLS radar lock-on, the DRO will indicate ACL ready (LO). Observe a fly-up signal and final bearing on the ACLS indicator. Then report side number and needles.

Note

- The pitch steering bar indicates erroneous information if level at 1200 feet and further than 3 miles aft of the carrier.
- Hold altitude as the pitch steering bar moves down from the top of the ACLS indicator. As the pitch steering bar approaches the center of the indicator, ease the nose over to intercept glide slope. Fly on glide slope and centerline by keeping the indicator needles centered.
- 7. At 1/2 mile astern or sooner (pilot's discretion), transfer to the standard visual approach and make the ball call.
- 8. If the console operator does not unlock the radar, the 10 second will light 10 seconds prior to touchdown.
- 9. If the aircraft exceeds ACLS limits or experiences a system malfunction, the flashing wave-off (WO) light on the DRO will alert the pilot.

CARRIER CONTROLLED APPROACH (TYPICAL)

VOICE REPORTS

1. AT MARSHAL
2. DEPT MARSHAL
3. PLATFORM
4. 10 MILE GATE
5. 6 MILE GATE WITH FUEL STATE
6. MEATBALL—SIDE NO, A6, STATE
7. ABEAM—SIDE NO—STATE

MARSHALL POINT 1 MILE PER 1000 FT. OF ALTITUDE
+ 15 MILES HOLD AS ASSIGNED

LETDOWN 4000
FPM, 250 KNOTS

PLATFORM (PASSING 5000 FT.)
REDUCE TO 2000 FPM

10 MILE GATE
(LEVEL AT 1200 FT.)
LANDING CHECK LIST

6 MILE GATE
(MAINTAIN 1200 FT.)

AT 2 1/4 MILES
INTERCEPT GLIDE PATH
COMMENCE DESCENT

3 MILES 1200 FT (PAR)
600 FT (ASR)

1 MILE—500 FEET
3/4 MILE—400 FEET
1/2 MILE—300 FEET

FINAL BEARING

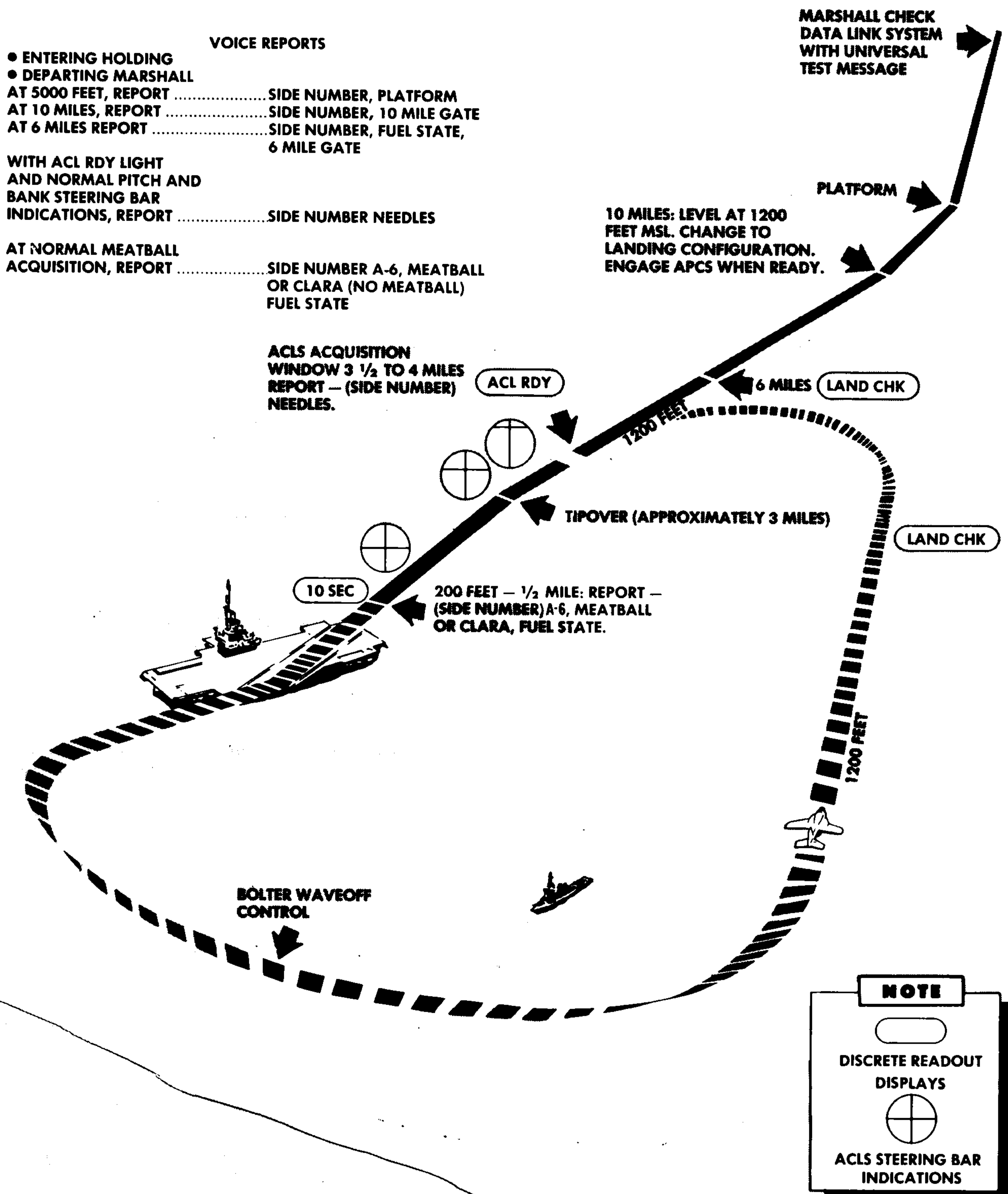
WAVE OFF/BOLTER
BEARING CLIMB STRAIGHT
AHEAD TO 1200 FT.

TURN TO DOWNWIND
HEADING WHEN DIRECTED.
25° BANK LEVEL TURN

MISSED APPROACH PATTERN

A-ADF1-74

Figure 3-12

ACLS MODE 2 APPROACH (TYPICAL)

ADF1-126

Figure 3-13

BOMBARDIER/NAVIGATOR'S PROCEDURES

CARRIER ALIGNMENT (AUTOMATIC)

1. Electrical power on the aircraft and SINS cable connected.
2. ALIGN switch SINS ICS
3. Platform selector button STBY (allow 5 minutes for warmup)
4. ATTITUDE REF switch COMP OUT
5. MAG VAR SET
Set magnetic variation to angle between aircraft and carrier true heading. If aircraft heading is to the left of carrier heading, set in a west reading. If aircraft heading is to the right of the carrier heading, set in an east reading.

Note

The time required to complete the alignment is dependent upon an accurate spotting angle being inserted in the MAG VAR window prior to starting alignment.

6. AUTO/MAN switch AUTO
7. Latitude Switch SET LOCAL LATITUDE
8. Platform button ALIGN
9. Observe the CARR SPEED AND CARR HDG readouts correspond to carrier's speed and heading.
10. Observe that LATITUDE window is updated to carrier's latitude as the alignment progresses.
11. Fine align light GOES ON APPROXIMATELY 1 MINUTE AFTER GOING TO ALIGN
12. Ready light GOES ON BETWEEN 10 and 20 MINUTES (9 to 14 Minutes with AVC No. 1342) AFTER GOING TO ALIGN
13. Align progress meter CHECK THAT INDICATOR IS AT A NULL $\pm$ ONE DIVISION FOR 30 SECONDS

Note

The ready light in item 12 above is not required provided the following criteria have been met:

- The align progress meter indicates a null $\pm$ 1 unit for at least 55 seconds prior to going to operate.
- At least 15 minutes (10 minutes with AVC No. 1342) have been spent in align.
- Actual carrier velocities (within 3 knots) are read out in the DDU after going to operate and no velocity drift is observed.

Additional time will be required for optimum alignment if needle is not at or near a null.

14. Platform selector button OPER

CONTINUED ON NEXT PAGE

CARRIER ALIGNMENT (AUTOMATIC)- CONTINUED**Note**

Accurate present position latitude must be inserted into the computer for proper inertial operation.

15. ATTITUDE REF switch COMP IN

Note

A better alignment can be obtained by aligning the inertial platform sufficiently early in order to be in OPER prior to the ship maneuvering into position before launch.

16. MAG VAR SET TO LOCAL MAGNETIC VARIATION
Local magnetic variation may be set at anytime after FINE ALIGN light is lit.

CARRIER ALIGNMENT (MANUAL)

1. Electrical power CONNECT
2. ALIGN switch SINS ICS
3. Platform selector button STBY (allow 5 minutes for warmup)
4. ATTITUDE REF switch COMP OUT
5. MAG VAR SET
Set magnetic variation to angle between aircraft and carrier true heading. If aircraft heading is to the left of carrier heading, set in a west reading. If aircraft heading is to the right of the carrier heading, set in an east heading.

Note

The time required to complete the alignment is dependent upon an accurate spotting angle being inserted in the MAG VAR window prior to starting alignment.

6. AUTO/MAN switch MAN
7. Latitude Switch SET LOCAL LATITUDE
8. Platform button ALIGN
9. Manually set in carrier speed and heading.

Note

- Continuous updating of carrier speed and heading is necessary for an accurate alignment. SINS information is preferred.
- Turns of the carrier that are 30°/minute or more will suspend the alignment and cause the align progress meter to indicate a null.

10. Fine align light GOES ON APPROXIMATELY 1 MINUTE AFTER GOING TO ALIGN

CONTINUED ON NEXT PAGE

CARRIER ALIGNMENT (MANUAL) - CONTINUED

11. Ready light GOES ON BETWEEN 10 and 20 MINUTES
(9 to 14 Minutes with AVC No. 1342)
AFTER GOING TO ALIGN
12. Align progress meter CHECK THAT INDICATOR IS AT A NULL $\pm$ ONE
DIVISION FOR 30 SECONDS

Note

The ready light in item 12 above is not required provided the following criteria have been met:

- The align progress meter indicates a null ± 1 unit for at least 55 seconds with positive indication that a suspend align condition is not existing prior to going to operate.
- At least 15 minutes (10 minutes with AVC No. 1342) have been spent in align exclusive of suspend align time.
- Actual carrier velocities (within 3 knots) are read out in the DDU after going to operate and no velocity drift is observed.

Additional time will be required for optimum alignment if needle is not at or near a null.

13. Platform selector button OPER

Note

Accurate present position latitude must be inserted into the computer for proper inertial operation.

14. ATTITUDE REF switch COMP IN

Note

A better alignment can be obtained by aligning the inertial platform sufficiently early in order to be in OPER prior to the ship maneuvering into position before launch.

15. MAG VAR SET TO LOCAL MAGNETIC VARIATION
Local magnetic variation may be set at anytime after FINE ALIGN light is lit.

part 5**Sats Procedures****SATS LIMITATIONS**

In addition to the aircraft limitations given in Section I, part 4 of this manual, the following restrictions are applicable for A-6E SATS catapult launches:

1. CG limits: 23% MAC to 29% MAC
2. Gross weight: 30,000 lb to 54,000 lb
3. The D-704 refueling store may not be carried on the fuselage station.
4. No fuselage stores may be carried on multiple stores racks
5. Density altitude between -2320 to +3000 feet
6. Crosswind not to exceed 15 kts

WARNING

Failure to adhere to the above restrictions will result in damage to the catapult, aircraft or both.

PREFLIGHT**Day**

A normal preflight inspection should be made with particular attention given to the landing gear, tires, hook, and underside of the fuselage for previous damage. The aircraft's gross weight and drag count should be determined and written (grease pencil, etc.) in a place visible to the catapult crew.

CAUTION

SATS launch end airspeeds are functions of aircraft gross weight and drag count. These parameters must be known if a safe launch is to be accomplished.

Night

In addition to the normal cockpit preflight, ensure that external light switches are positioned to dim, the taxi light is definitely off, and that interior lights are prepositioned as desired.

TAXI

Taxiing on duty SATS matting is analagous to taxiing on any dry, hard surface area with the exception that the matting will give slightly under heavy loads. Taxiing into or out of revetted areas presents no difficulties except that particular attention to plane director's signals is required due to the small clearances provided.

Taxiing on wet or oily SATS matting is hazardous at best due to a greatly reduced coefficient of friction. Keep speed under control at all times by judicious use of the brakes. At light gross weights, it may be advisable to use only one engine, starting the other just before positioning for takeoff.

LAUNCH PROCEDURES

Proper positioning on the SATS catapult requires particular attention to the plane director's signals. All functional checks must be performed before taxiing into the catapult. Assure that the following is done:

FLAPS:	TAKE-OFF
TRIM:	RUDDER: O
AILERON:	O
LONGITUDINAL:	4 units aircraft nose-up

Use nose-wheel steering for initial positioning as required. Approximately 80% to 90% RPM will be required to taxi over the arrester ropes and up the dolly ramp. Once the ground handling crew has lowered the launch bar and it is engaged in the lead-in track, release the nose-gear steering and refrain from differential braking. Taxi forward slowly to avoid engaging the launch bar retract mechanism and overstressing the tension bar.

Before launch verify that the takeoff checklist has been completed. Upon receipt of the "tension-up and release brakes" signal, release brakes and watch the catapult officer for two-finger turn-up signal. When this signal is received, advance power to military, grasp and extend the catapult grip, check flight and engine instruments, and when satisfied that the aircraft is ready, give an exaggerated salute to the catapult officer.

CAUTION

If the catapult grip is not extended throughout the launch cycle, the nose strut will not be stiffened and unsatisfactory aircraft pitch oscillations may develop during the launch.

After the salute and prior to launch, ensure that the head is back against the headrest and that the control stick is held in a neutral position. Normally, there will be a 2 to 6 second delay before the catapult actually fires. During the actual launch, observe the green cut-off light changes to amber. Upon perceiving the amber light, initiate normal aft stick movement and rotate the aircraft to a takeoff attitude.

The front section of the launch dolly will pitch up during the power stroke, causing the aircraft to assume a nose-up attitude. At the end of the programmed launch sequence, as the tow force decays, the front section of the dolly will drop back onto the matting and the aircraft nose-up attitude will decrease. The dolly will be first on the deck and the launch bar will separate from the dolly at approximately the same time the cut-off light changes to amber.

WARNING

Do not apply brakes during launch. Do not use nose-wheel steering during launch.

The aircraft will leave the catapult at or near the optimum airspeed for flight. Avoid overrotation but establish a positive rate of climb at 6° to 10° nose-up, cross reference with AOA, vertical speed, and indicated airspeed. Retract the landing gear when safely airborne and, flaps below 250 KIAS.

WARNING

Extreme caution should be exercised during flap retraction at heavy gross weights. Do not retract the flaps below 170 KIAS for weights up to 50,000 lb. At heavy gross weights under high ambient temperature conditions, acceleration and climb performance are marginal and it may be impossible to reach 185 KIAS. If 185 KIAS cannot be obtained, reduce external store weight in order to accelerate to 185 KIAS before flap retraction.

NIGHT

Taxi onto the catapult with external lights off. When ready to launch, place the external light master switch on. As in daytime launches, closely monitor AOA, airspeed, vertical speed, and nose and wing position after launch.

CATAPULT EMERGENCIES

If the launch bar separates from the dolly prematurely, the pilot will feel a sudden loss of acceleration but the dolly will continue to accelerate and move ahead of the aircraft. As soon as the dolly can be seen in front of the aircraft, the pilot should maneuver to the side of the matting to avoid contacting the rebounding dolly. If abort or takeoff is not possible and speed of 100 KIAS has been attained, EJECT.

A cold shot can result from a catapult malfunction. If the dolly moves ahead of the airplane, maneuver to the side of the matting so as to avoid contact with the rebounding dolly. If abort or takeoff is not possible and a speed of 100 KIAS has been attained, EJECT.

RECOVERY

SATS traffic and landing approach patterns are generally in accordance with the procedures outlined for normal landings in section III, Part 3 of this manual. Maximum arrested landing weight is 36,000 lbs. Begin the approach by turning approximately 5 to 8 seconds past the arresting-gear position in order to have a 1-mile wings-level groove. Report the 180° position with side number and fuel state, and hung ordnance as appropriate.

At approximately the 90° position, 450 feet of altitude, the meatball will appear in the center of the lens: correct the rate of descent as required to keep the meatball centered. Glide slope corrections should be made smoothly with combined power and attitude changes so as to maintain optimum approach AOA and a centered meatball. Pay particular attention to line-up, correcting for cross-winds, as required so as to land in the center of the runway.

Upon landing, apply full military power and retract the speed brakes. As soon as arrested, place the throttle to idle and raise the flaps. Allow the airplane to roll back to disengage the arresting gear, then raise the hook when signalled to do so.

CAUTION

Do not raise the tailhook while engaged so to prevent damage to the hook bumper cable.

WAVE-OFF/BOLTER

Wave-offs and bolters are readily accomplished by application of full military power, retraction of speed brakes, and rotation to a fly-away attitude. To preclude any possibility of engaging the terminal and dolly arrested ropes, retract the tailhook immediately after becoming airborne or safely stopping the rate of descent.

WARNING

Inadvertent engagement of the dolly arrester ropes will result in extensive damage to the aircraft and catapult.

part 6**Functional Check Flight Procedures****FUNCTIONAL CHECKFLIGHT REQUIREMENTS**

Checkflights will be performed when directed by, and in accordance with, OPNAVINST 4790.2 series and the directions of NAVAIRSYSCOM Type Commanders, or other appropriate authority. Functional checkflight requirements and applicable minimums are described below. Functional checkflight checklists are promulgated separately.

CONDITIONS REQUIRING CHECKFLIGHTS

Checkflights are required under the following conditions (after the necessary ground check and prior to release of the aircraft for operational use):

- A. At the completion of aircraft rework and calendar inspections (all checkflight items required are prefixed A).
- B. After the installation of an engine, propeller, or engine fuel control, or any components which cannot be checked in ground operation (minimum required are prefixed B).
- C. When fixed or movable flight surfaces or flight control system components have been installed or reinstalled, adjusted, or rerigged, and improper adjustment or replacement of such components could cause an unsafe operating condition (minimum required are prefixed C).

CHECKFLIGHT PROCEDURES

The items which follow provide detailed descriptions of the functional checks, sequenced in the order in which they should be performed. In order to complete the required checks in the most efficient and logical order, a flight profile has been established for each checkflight condition and identified by the letter corresponding to the purpose for which the checkflight is being flown; i.e., A, B, or C, as shown above. The applicable letter identifying the profile prefixes each check both in the following text and in the Functional Checkflight Checklist. Checkflight personnel will familiarize themselves with these requirements prior to each flight. NATOPS procedures will apply during the entire checkflight unless specific deviation is required by the functional check to record data or ensure proper operation within the approved aircraft envelope. A daily inspection is required before each checkflight.

PRETAKEOFF**TAXI CHECKS****Before Taxi****PROFILE**

AC

1. Wing-Fold System - SPREAD WINGS.

Check that WING FOLD control handle is locked out when control stick is not in neutral. Control stick is laterally restricted when WING FOLD handle is not stowed (except when autopilot is engaged). Flaps, slats, and flaperon pop-up circuits are open with wings unlocked. Wings cannot be cycled with flaps and slats extended and control stick out of neutral. Wings spread smoothly in approximately 20 seconds.

AC

2. Flight Controls - CHECKED.

- a. Flaperons: Check for smooth lateral control stick movement and flaperon operation. Check mutual lock-out of flaperon and wing-fold mechanism. Position FLAPERON POP UP switch to ARM; flaperons should pop up. Check for limited lateral control stick movement. Return FLAPERON POP UP switch to OFF; flaperons should return to normal; check trim operation three units left and right. Full travel in 11 1/4 seconds.
- b. Horizontal Stabilizer: Check for smooth operation with flaps up. STAB position indicator should show CLEAN indicating normal stabilizer throw. Lower flaps and recheck. Position indicator will show a symbol of a stabilizer indicating that extended throw is available. Check full travel of trim operation (3 units nose down to 12 units nose up).

CONTINUED ON NEXT PAGE

PRETAKEOFF-CONTINUED

PROFILE

- c. Rudder: With flaps down, check for smooth rudder pedal movement. Extended rudder throw should be available. Raise flaps and recheck; rudder throw available should return to normal (4° either side of neutral). Check full travel of trim operation (4 units left and right).
- d. Assist-Spin Recovery: Activate assist-spin recovery system. RUD THRO caution light should light and extended rudder and horizontal stabilizer throw should be available. Return ASSIST SPIN RECOV switch to OFF; controls should revert to normal throw and caution light should go out.
- e. Wing Flaps and Slats: Select LAND; flaps extend to 40° down and slats to full down 27.5°. Select UP; flaps return to full up and slats return to full up. Select TAKEOFF; flaps extend to 30° down and slats to full down. Cycle times, flaps 10 to 12 seconds, and slats 6 to 8 seconds.
- f. Wing Flap and Slat Indications: FLAP window indicates UP position; displays 30° and 40° flap positions, barber pole when flaps are in transition or power is OFF, SLAT window displays slat when slats fully extended and IN when slats are retracted; barber pole when slats are in transition or power is OFF.
- g. Emergency Operation of Flaps and Slats: Emergency switch in desired position, electric operation shall have priority over hydraulic operation. Electric emergency switch shall be actuated only with wings spread and locked.
- h. Wing-Tip Speed Brakes: Operate smoothly during fully closed to fully open (120°) operation and incremental partial extension.

AC

3. Automatic Flight Control System - CHECKED.
Check for engagement in all modes and for positive disengagement. With AUTOPILOT switch OFF, deflect control stick through full lateral throws.

AB

4. Air Conditioning - CHECKED.
Check air conditioning maintains constant temperature and air flow. Check HOT and COLD switch positions - (Auto and Manual). Check for proper equipment cooling, no warning lights.

AB

5. Vent Suit or Cushion Airflow - CHECKED.
Check for constant temperature and airflow, and controllability.

AB

6. Anti-G System - CHECKED.
Press g-suit test button. Pressurization shall commence immediately.

AB

7. Windshield-Washing System - CHECKED.
Check that spray is even on windshield.

AB

8. Rain-Removal (Anti-Ice) System - CHECK BRIEFLY.
Reach over top of windshield; check temperature and airflow.

A

9. Lighting Systems - CHECKED.
Satisfactory illumination control on all lighting systems.

A

10. Oxygen System - CHECKED.
Check quantity gage; oxygen for flight in accordance with NATOPS Flight Manual for altitude and duration of flight. Check LOX/FUEL/OIL press-to-test and proper operation including caution light. Supply satisfactory.

A

11. Integrated Electronic Control (IEC) System (with CNI master switch at ON) - CHECKED.

- a. Intercommunications Set (ICS): Operates satisfactorily in all modes. COLD position of MIC SEL switch allows transmission only when ICS switch is depressed. HOT position allows transmission at any time.

CONTINUED ON NEXT PAGE

PRETAKEOFF-CONTINUED

PROFILE

A

- b. UHF: Operates satisfactorily; channel and frequency-select all functions smoothly.
 - c. AUX UHF: Operates satisfactorily; large needle on HSI indicates magnetic bearing ($\pm 10^\circ$) to station unless UHF - ADF is selected.
 - d. TACAN: Controls operate satisfactorily. With SEL switch in REC position, bearing displayed. With SEL switch in T/R, both bearing and range are indicated. Identification signal is heard in headsets when selected and volume is controllable. Range and bearing displayed on HSI with no undesirable excursions. With antenna select switch in AUTO position, lock-on occurs within 30 seconds of station selected.
 - e. Bomb Tone: Check satisfactory tone quality. Place TRAN SEL switch to U, TONE switch to BOMB, and BOMB TONE switch to MAN.
 - f. ECM Warning Tone - CHECKED.
 - g. IFF/SIF: Proper response to interrogation signal in each mode. I/P provides identification transmission when switch is actuated plus an additional 15 to 30 seconds after switch release. MIC same as I/P switch but answers interrogation when microphone button is depressed.
12. Vertical Display Indicator - CHECKED.
- a. Contrast/Brightness: Acceptable variable control.
 - b. Impact Point: Approximately circular and located near or at center of scope (minimum drift and angle of attack). Bright shading and thick black line on right edge of symbol.
 - c. Target Symbol: Solid white 1/4 inch square.
 - d. Steering Symbol: Hollow white 5/8 inch square.
 - e. Pullup Marker: Black line extending from left outline of path to middle of path when visible.
 - f. Release Marker: Horizontal black bar ended by short vertical bar extending to right side of display. Left edge of symbol shall be right of center of display. Horizontal member, located at vertical display center in test, is visible only when IN RANGE light is on or in test.
 - g. Flight Path: Perspective black vertical lines converging at a point on indicator.
 - h. Horizon: Interface between ground shading and sky shading. Dark shading at horizon becoming lighter at bottom of raster.
 - i. -30° Pitch Line: Line parallel to horizon and extending across display approximately midway between horizon and bottom of raster; black shading.
 - j. $+30^\circ$ Pitch Line: Line parallel to display horizon and extending across display above horizon; black shading.
 - k. $+60^\circ$ Pitch Line: Line parallel to display horizon and extending across display above $+30^\circ$ pitch line; black shading. Line is approximately twice thickness of -30° and $+30^\circ$ pitch lines.
 - l. $+90^\circ$ Pitch Line: Dashed line (3 to 6 dashes) parallel to display horizon and extending across display above $+60^\circ$ pitch line; black shading. Line is same thickness as $+60^\circ$ pitch line.
 - m. Clouds: Semiflattened, irregularly curved outline, and black lines on right edges. Bright shading against medium light sky.

CONTINUED ON NEXT PAGE

PRETAKEOFF-CONTINUED

PROFILE

- n. Ground Texture: Rows of ellipses emanating from horizon line constant in size and rate of movement. Dark shading on background.
- o. Electronic Roll Marker: White line extending approximately 3/4 inch down from top of screen perpendicular to horizon line; bright shading.
- p. Pitch Trim Markers: Two movable vertical lines extending in approximately 3/4 inches from sides of display and parallel to horizon line; bright shading.
- q. Command Heading Lines: Three black lines minimum, four maximum. Apparent convergence point shall be approximately 3/8 inch above path apex. Apparent point of convergence shall be centered horizontally within 3/16 inch of path apex point.
- r. Roll Index: Centered on roll pointer $\pm 2^\circ$.

A

13. Pilot's Horizontal Display - CHECKED.

- a. Command Steering Bug: Functions smoothly and is positioned dead ahead $\pm 0.5^\circ$ in UNSTAB/NO STEER and agrees with electronic azimuth cursor within $\pm 2^\circ$.
- b. Tape Dials: Windows show range and bearing to cursor intersection.
- c. Variable Filter Installation: Satisfactory day/night control.
- d. Controls: Satisfactory brightness, contrast, persist, and marker control. Persist shall be capable of holding through two full scans on all search displays. Adjustment for blooming may be necessary to obtain usable display.

A

14. Optical Sight - CHECKED.

- a. Accuracy: Align moving reticle to fixed reticle. Elevation wheel must be within +3 mils of zero. Fixed and moving reticle lines must not be displaced by more than one line width.
- b. Controls: In-range and breakaway brightness control operate satisfactorily. FIL 1 and FIL 2 control operate satisfactorily in fixed and moving reticles.
- c. Test: In-range and breakaway displays are present.
- d. Elevation Thumbwheel: Functions satisfactorily.
- e. Displays: Fixed reticle has satisfactory display with manual control of masking. Moving reticle has satisfactory display of steering information.
- f. Parallel: Maximum allowable at 0.0 lead angle is ± 3 mils.

During Taxi

A

15. Brakes - CHECKED.

Check wheel brakes for smooth operation and no pulling tendencies.

A

16. Nose-Wheel Steering - CHECKED.

Check steering just after leaving chocks, for smooth operation and satisfactory shimmy damping.

A

17. Antiskid - CHECKED.

Check antiskid system for proper functioning. ANTI-SKID caution light shall light if a brake release signal exceeds 3.5 seconds.

A

18. Auxiliary Brake System - CHECKED.

Auxiliary brake cycle gage shall indicate and hold 14 cycles.

CONTINUED ON NEXT PAGE

PRETAKEOFF-CONTINUED

PROFILE

A

19. INS - CHECKED.

- a. Taxi speed in window A1 approximates aircraft speed.
- b. Altitude holds steady (+32 feet) during taxi run.
- c. Velocities go to zero to 3 knots when aircraft comes to a stop.
- d. Note heading, velocity and altitude.

IN-FLIGHT

TAKEOFF CHECKS

Before Takeoff

PROFILE

A

20. Compass System - CHECKED.

- a. Standby compass shall be accurate to $\pm 5^\circ$ MAG HEAD when compared to corrected true heading from DVRI.
- b. MA-1 compass shall be accurate to $\pm 2^\circ$ when compared to corrected true heading from DVRI.

ABC

21. Complete Before Takeoff Checklist.

AB

22. Throttle stagger 1/2 inch maximum mismatch with engines in sync at MAX POWER; 1/4 inch maximum mismatch at 86% RPM.

AB

23. Engine P-8A, P-8B

RPM%	98.5 $\pm$ 1.5
EGT	640° to 660°C
Fuel Flow	6.500 to 8.500 pph
Oil Pressure	40 to 50 psi
Power Trim	(In Band)
Hydraulic Pressure	(In Band)

After Takeoff

AB

24. Monitor engine RPM and EGT.

A

25. Counter-pointer/servo barometric altimeter: Operates smoothly; 0 to 500 feet (± 50 feet), 500 to 1,000 feet (± 75 feet), and 1,000 to 5,000 feet (± 150 feet).

AC

26. Check for proper retraction of main gear, nose gear, flaps, slats, and stabilizer (including transition lights, warning lights, and integrated position indicators).

A

27. Radar Altimeter: Compare radar altimeter with corrected barometric altimeter at 500 feet and 300 knots. Maximum difference allowed is 85 feet. Attitude limits determined over flat terrain are: roll $\pm 30^\circ$ and pitch $\pm 50^\circ$.

CONTINUED ON NEXT PAGE

IN-FLIGHT - CONTINUED

10,000-FOOT CHECKS (LEVEL CRUISE)

PROFILE

A

28. Flight Indicators - CHECKED.

- a. Angle-of-Attack Indicator: Operating smoothly; OFF indication when no power to indicator. Calibration - read 9.5 to 10 units with clean aircraft at 350 knots.
- b. Mach/Airspeed Indicator: Operating smoothly; 10,000 feet, 0.63 IMN at 340 to 360 KIAS.
- c. Rate of Climb Indicator: Operates smoothly and indicates in zero band in level flight.
- d. MD-1 Turn-and-Bank Indicator: Operates smoothly; needle width deflection produces 360° of turn in 4 minutes.
- e. B-6 Accelerometer: Operates smoothly; the two telltale pointers shall remain at maximum readings until reset ($\pm 10\%$ tolerance).
- f. G-Meter: Operates smoothly ($\pm 10\%$ tolerance).
- g. Horizontal Situation Indicator: Operates smoothly with no excessive excursions.

A

29. IFF/SIF (all modes) - Proper response to interrogation in each mode. I/P provides identification transmission when switch is actuated plus an additional 15 to 30 seconds after switch release. MIC same as I/P switch but answers interrogation when microphone button is depressed.

AB

30. Pressurization - Check at minimum RPM at which level flight can be maintained and with defog OFF. Cabin pressure should be 8,000 $\pm$ 750 feet.

AB

31. Air Conditioning - Auto air conditioning operates smoothly, manual maintains selected position.

A

32. Doppler Radar - Checked.

- a. Memory: Memory light goes out when Doppler is within $\pm 10\%$ of inertial ground-speed. Out of memory within 2 minutes in flight.
- b. Attitude Limits: Roll - remains out of memory up to +33°. Pitch - remains out of memory up to 20° (NU) minimum and -24° (ND) minimum.
- c. Accuracy: Groundspeed and windspeed agree to within ± 7 knots of known good inertial velocities. Wind direction agrees within $\pm 5^\circ$ of known good inertial wind direction provided windspeed is greater than 15 KTS.
- d. Doppler control panel readings agree with windows B2 and B3.

A

33. Computer - CHECKED.

- a. Steering Presentation: Steering presentation shall be free of perturbations on all displays. Moving reticle, steering symbol, and PHD shall all display compatible steering to preselected targets.
- b. Computer Errors: No error codes or lights observed in navigation or attack.

A

34. Search Radar - CHECKED.

- a. All Displays: All modes must be operationally functional.
- b. One Scan: While in silent display, one scan of video on next left-to-right sweep.
- c. Erase: Momentary display similar to no-persist.

CONTINUED ON NEXT PAGE

IN-FLIGHT - CONTINUED

40,000-FOOT CHECKS (LEVEL CRUISE)

PROFILE

- | | |
|----|---|
| AB | 35. Pressurization - Check at minimum RPM at which level flight can be maintained and with defog OFF. Cabin pressure should be 15,850 to 17,690 feet. |
| AB | 36. Defogging System - Check proper operation. |
| AB | 37. Engines - CHECKED. <ul style="list-style-type: none"> a. Full Power: <ul style="list-style-type: none"> (1) RPM: 94% to 98% rpm for J52 P-8A and P-8B engines. (2) EGT: 630° to 660°C maximum for J52 P-8A and P-8B engines after 8 minutes at full power. (3) Fuel Flow: 2,300 to 2,700 pph for J52 P-8A and P-8B engines. b. Low engine speed (for engines with PPC 185): <ul style="list-style-type: none"> (1) RPM: 75% for J52 P-8A and J52 P-8B engines. (2) EGT: 208° to 238°C for J52 P-8A and J52-P-8B engines. (3) Fuel Flow: 750 to 850 pph for J52 P-8A and J52 P-8B engines. |
| A | 38. Mach Airspeed Indicator - CHECKED.
Operates smoothly; 40,000 feet, 0.84 IMN at 255 to 265 KIAS. |
| A | 39. Search Radar MAX RNG - NOTE. |

20,000-FOOT CHECKS (LEVEL CRUISE)

- | | |
|----|--|
| A | 40. AUX UHF - CHECKED.
Operates satisfactorily; large needle on HSI indicates magnetic bearing ($\pm 10^\circ$) to station unless UHF-ADF is selected. |
| A | 41. TACAN - CHECKED.
Controls operate satisfactorily with SEL switch in REC position, bearing data is displayed. With SEL switch in T/R, both bearing and range are indicated. Identification signal is heard in headsets when selected and volume is controllable. Range and bearing displayed on HSI with no undesirable excursions. With antenna select switch in the AUTO position, lock-on occurs within 30 seconds of station selected. |
| AC | 42. Automatic Flight Control System - CHECKED. <ul style="list-style-type: none"> a. Stability Augmentation (300 KIAS): Check for proper operation. Engage and disengage trim shifts not to exceed $\pm 6^\circ/\text{sec}$ in pitch or roll. Rate damping satisfactory about all axes. Engage transient shall be nonobjectionable in nature. b. Roll Attitude-Hold: Tolerance $\pm 1^\circ$ limited by readability. Effective from 3° to 7° to $60^\circ + 3^\circ$, -6° from left and right bank. If engaged beyond $60^\circ + 3^\circ$, -6° limit, the aircraft will return to $60^\circ + 3^\circ$, -6°. Control stick disconnect-automatic reengage after release of lateral stick commands. c. Pitch Attitude Hold: Tolerance $\pm 1^\circ$ limited by readability. Effective from $-61^\circ + 6^\circ$, -1° to $+25^\circ + 1^\circ$, -4°. Out-of-limit engagements will return aircraft to stated limits. Control stick disconnect-automatic reengage after release of longitudinal stick commands. |

CONTINUED ON NEXT PAGE

IN-FLIGHT - CONTINUED

PROFILE

- d. Heading Hold: Automatic whenever roll attitude is less than 3° to 7° . Tolerance $\pm 1/2^{\circ}$ limited by readability. Control stick disconnect-automatic reengage after release of lateral stick commands.
- e. Altitude Hold: Altitude hold shall not be engaged with climb or dive rates in excess of 1,000 feet/min. Tolerance for bank angles less than 30° , ± 45 feet. With 5% RPM change, note that altitude hold conforms to the above tolerance. Period of oscillation shall not be greater than 30 seconds. Control stick disconnect-automatic reengage after release of longitudinal stick commands.
- f. Mach Hold: Stable flight engage - hold aircraft within ± 0.02 mach of that mach which existed at engagement (for bank angles less than 30°). Flight check - from cruise to idle descent from 20,000 feet. The change in mach number shall be ± 0.02 mach and stable in descent. Control stick disconnect - automatic reengage after release of longitudinal stick commands.

A

- 43. Mach/Airspeed Indicator - CHECKED.
Operates smoothly; 20,000 feet, 0.54 IMN at 245 to 255 KIAS.

AB

- 44. Anti-G - CHECKED.
Automatic inflation of g-suit for test; suit begins at 2.2 g's.

5,000-FOOT CHECKS (LEVEL CRUISE)

A

- 45. Fuel System - CHECKED.
 - a. Totalizer: Reads ± 300 lb $\pm 2\%$ of actual fuel except that totalizer shall never read less than zero. The preceding criteria apply only when selectable needle is set on a station that has a fuel tank attached. When selectable needle is set to an external station that does not have a fuel tank attached, the following criteria will apply: (± 600 lb $\pm 4\%$ of the actual fuel), except that totalizer should never read less than zero.
 - b. Fuel Quantity Gage: Large pointer reads quantity in main tanks. Small needle indicates quantity of fuel in tanks selected on fuel management panel.
 - c. Transfer: Capable of transfer of all wing fuel. When main tank drops below 6,500 to 7,500 lb, automatic transfer begins raising the quantity in main tank between 7,000 lb and 8,000 lb. Uneven transfer rates will be allowed to maximum of one mark wing heaviness.
 - d. Fuel Dump: Briefly check wing dump and fuselage dump.

AB

- 46. Ram-Air Turbine (RAT) - CHECKED.
A maximum force of 70 lb is acceptable for operation of the ram-air turbine control.

AC

- 47. TRIM - CHECKED.
Tolerance from TRIM indicator zero reference - lateral $\pm 1/2$ unit and rudder $\pm 1/8$ unit.

A

- 48. Angle-of-Attack Indicator - CHECKED.
Operates smoothly - reads to $\pm 1/2$ units. In a (power approach) landing configuration (takeoff flaps), 28,000 lb aircraft, AOA reads 22 units at 107 KIAS. For every 1,000 lbs of fuel add 2 knots. Add 2 knots if external stores are carried.

A

- 49. Search Radar - CHECKED.
 - a. STC SLOPE/DEPTH: Reduces gain of close-in targets and allows display optimization.

CONTINUED ON NEXT PAGE

IN-FLIGHT - CONTINUED

PROFILE

A

50. Computer - CHECKED.

- a. Attacks: Check for satisfactory performance, including COP check.
- b. Bomb tone in manual.
- c. Radar PPI 30.
- d. Radar ARE 60, 30.
- e. Lock-ons.

A

51. AMTI: MAX range check and tracking.

500-FOOT AGL CHECKS

A

52. SRTC - CHECKED.

- a. Ten shades of grey.
- b. Ten range contours.
- c. Clearance accuracy.
- d. Selectable range coding.

A

53. Low Altitude Warning System (LAWS) - CHECKED.

Whenever aircraft radar altitude penetrates the low limit index (set on radar altimeter) a 2 + 1.0, -.25 second tone alternating at 1.5 to 2.5 cps between approximately 700 and 1,700 cps will be heard.

AB

54. Approach Power Compensator System (APCS) - CHECKED.

- a. System Engagement: Place aircraft in approach configuration. Place throttle friction lever to OFF. Set engines to approach speed. Place temperature switch in appropriate position for ambient temperature (HOT - temperatures greater than 80°F/26.7°C; STANDARD - temperatures between 80°F/26.7°C and 40°F/4.4°C; COLD - temperatures less than 40°F/4.4°C). Set control switch to STBY. Note that APCS STBY light is lit. Allow 60 seconds for warm-up. Engage system. Upon release of control switch, switch shall remain in the ENGAGE position and APCS STBY light should be out. Engagement of system can be checked by making pitch changes and noting throttle movement. (A micro-switch on friction lever shall cut out APCS when friction lever is advanced in increase friction direction.)
- b. System Disengage: Place control switch to STBY. Throttles shall be free for manual use and APCS STBY light shall come on.
- c. Override Check: Manually override system by opening each throttle individually. Control switch shall drop to STBY and STBY light shall come on. Manual override forces should be 8 to 12 lb.
- d. Off Speed Engagement: Engage system at 5 knots indicated air speed above and below referenced AOA (22 units) airspeed. Temperature switch to appropriate outside air temperature. Airspeed shall return to within 2.0 KIAS of approach speed within 4 seconds after engagement.
- e. Limit Checks: Perform pullups to hold AOA greater than 22 units. Throttles shall drive to maximum stop 96 to 100° RPM. Perform pushover to hold AOA less than 22 units. Throttles shall drive to minimum stop 71 to 79° RPM.
- f. Approach: Observe APCS capability to maintain reference AOA 22 units during FCLP approach. Observe disengagement at touchdown.

CONTINUED ON NEXT PAGE

IN-FLIGHT - CONTINUED

PROFILE

A

55. INS NAV accuracy, note the following:

- a. INS VEL
- b. MVC VEL
- c. AVC VEL
- d. DOPPLER VEL

A

56. Present Position Update - CHECKED.

LANDING

LANDING CHECKS

PROFILE

AC

57. Landing Gear - CHECKED.

- a. Warning Lights: WHEELS warning light flashes when all three gears are not down and locked and both throttles are less than 85% and flaps are extended. Wheels transition light shall light during all gear transitions until all landing gears are locked.
- b. Position Indicator: UP in window when all gears are up and locked and doors closed. Picture of wheel appears when all gears down and locked. Barber pole when gear is not locked or door is not closed. Nose-gear indication will indicate TOW LINK if tow link is down or nose gear is cocked (indexer will flash).
- c. Arresting Gear: Hook transition warning light shall be on when hook is cycling between stow and trail or trail and stow positions. Approach lights and approach light indexer will flash until hook is released to trail position with landing gear down and hook bypass switch in ARREST.
- d. Flaperon Pop-Up - CHECKED.
- e. Wing Flaps and Slats - CHECKED.
- f. Wing-Tip Speed Brakes - CHECKED.
- g. Antiskid - CHECKED.

A

58. Landing Mode - CHECKED.

- a. Steering: Check that accurate vertical and horizontal steering commands are provided.
- b. OAP: Check steering with OAP selected.

PRIOR TO SHUTDOWN

A

59. INS - CHECKED.

- a. Altitude: Checks stable during taxi run.
- b. Velocities: Note when aircraft comes to a stop, after OFF ERASE selected.

section IV

FLIGHT PROCEDURES

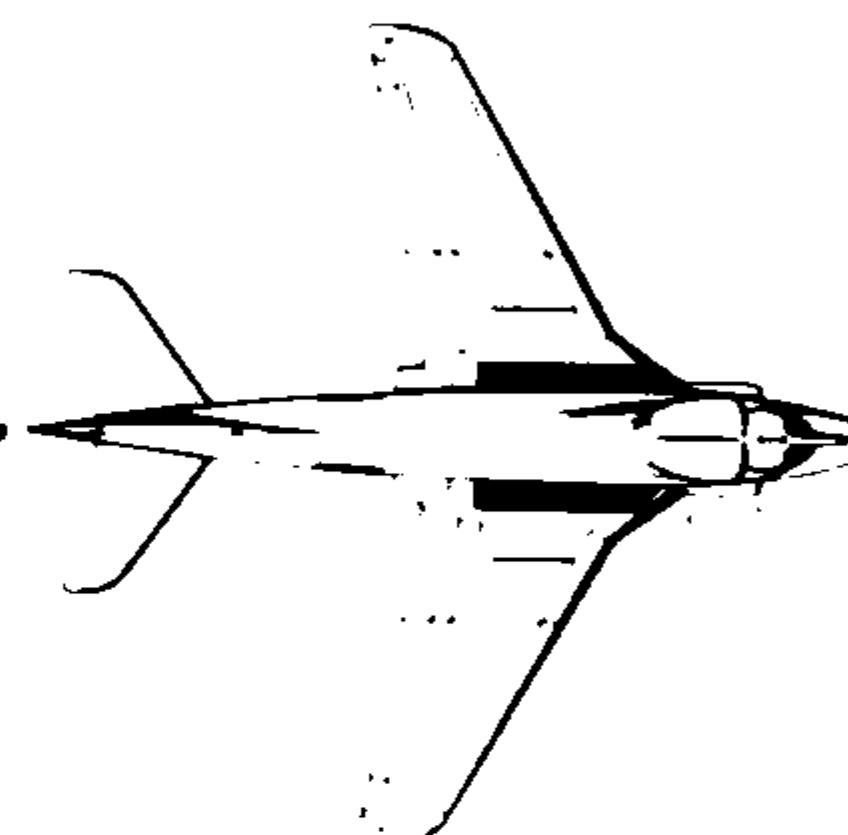


TABLE OF CONTENTS

PART 1 OPERATING TECHNIQUES.	4-1	Single-Engine Flight Characteristics	4-15
Familiarization and Transition	4-1	Single-Engine Flight Performance	4-15
Engine Operation	4-1	Flight With External Loads	4-15
Compressor Stalls	4-1	Backup Flight Controls Hydraulic System	4-15
Engine Ratings	4-3	PART 3 FORMATION AND TACTICS	4-17
Exhaust Gas Temperature	4-3	Formation Takeoff	4-17
Flameout	4-3	Rendezvous	4-17
Cooling Before Shutdown	4-3	Turning Rendezvous	4-17
Burner Can Blowout	4-3	Circling Rendezvous	4-17
Smoke After Shutdown	4-4	TACAN Circling Rendezvous	4-19
Fuel Management	4-4	Running Rendezvous	4-19
Wing-Tank Purging System	4-4	ADF Running Rendezvous	4-19
Aerodynamic Braking	4-4	ADF Circling Rendezvous	4-19
Approach Power Compensator Technique	4-4	Low-Visibility Rendezvous/Rendezvous on	4-19
PART 2 FLIGHT CHARACTERISTICS.	4-5	Different Model Aircraft	4-19
Climb Characteristics	4-5	Safety Rules for Rendezvous	4-19
Normal Stalls	4-5	Formation	4-20
Deep Stall Penetration	4-5	Free Cruise Formation (4 Aircraft Division)	4-20
Accelerated Stalls	4-5	Parade Formation	4-20
Post Stall Gyration	4-7	Formation Instrument Approach	4-20
Spins	4-7	PART 4 AIR REFUELING (TANKER)	4-22
Erect Spins	4-7	Air Refueling (Tanker)	4-22
Spin Characteristics	4-7	Before Takeoff	4-22
Erect Spin Recovery	4-8	Drogue Extension	4-22
Inverted Spins	4-8	Receiver Hookup and Refueling	4-22
Inverted Spin Recovery	4-9	Drogue Retraction	4-22
Spin Recovery on Instruments	4-9	Transfer From Store to Tanker	4-22
Flight Controls	4-10	Before Landing	4-22
Level Flight	4-10	Jettisoning Refueling Store	4-22
Pilot-Induced Lateral Oscillation	4-10	Tanker Safety Precautions	4-23
Dives	4-10	Air Refueling Store Limitations	4-23
Speed-Brake Restrictions	4-15	Air Refueling Receiver Technique	4-23
Speed-Brake Blowback	4-15	Night Refueling	4-24
Single-Engine Operation	4-15		

part 1

Operating Techniques

INTRODUCTION

The information for this section was supplied by flight observations of test pilots. As an overall assessment of the flight characteristics of aircraft, the aircraft is fully controllable in all normal speeds and maneuvers. The stall warnings are generally characteristic of slower, conventional aircraft, and landing speed is relatively slow. The A-6E is adequately powered, which is reflected in its takeoff and climb acceleration, and in its ability to carry a substantial store load safely.

FAMILIARIZATION AND TRANSITION

Procedures for the accomplishment of transition and familiarization training are promulgated by the Unit Commander through the Operations Officer. The amount of time required to complete transition and familiarization will vary, depending upon the experience level within each crew category. The training of each crew and each squadron should be directed toward improving crew coordination in the complete weapons system.

The training syllabus will be in accordance with the outline in Section II.

ENGINE OPERATION

COMPRESSOR STALLS

Compressor stalls result when one or all of the compressor blades are operating at too high an angle of attack. Normally, the compressor blades are kept in a desirable angle of attack by maintaining air velocity in proportion with engine RPM. Hence, anything that would affect inlet air velocity or engine RPM will either increase or decrease the possibility of compressor stall. In the J-52 P-8A/B engine, compressor stalls are minimized automatically by the compressor bleed system and the fuel control system, but pilot technique can also directly affect the possibility of a compressor stall.

Stall Warnings

Compressor stall warnings vary greatly in degree and intensity. Pulsations through the airframe and retorts from the engine are the most obvious warnings. The noises from the engine can vary from low-intensity pops to loud bangs. The most subtle

indication is the inability of the engine to respond to forward throttle movement.

Minimizing Compressor Stalls

The engine bleed control system is used to maintain a desirable angle of attack on the compressor blades by maintaining a proper relationship between inlet air velocity and engine RPM.

When the bleed control senses an unstable pressure ratio, twelfth-stage compressor bleed air pressure is transmitted to a series of 15 intercompressor bleed valves, opening the bleed valves. Air from the low compressor discharge section is then dumped into the engine compartment, tending to restore the air inlet velocity/RPM relationship. The bleed override control automatically locks out any signal from the pressure ratio bleed control below approximately 0.5 IMN, allowing the compressor bleed valves to remain closed. Another automatically operated safeguard against a compressor stall is contained in the engine fuel control system. Since the engine is more susceptible to compressor stalls at low inlet-air temperature and at certain RPM's, it is necessary to limit acceleration fuel flow schedules to avoid a stall. If fuel is introduced at a rate that will increase pressure before an inlet pressure, air flow, and RPM increase, the burner pressure will increase to a point where airflow is blocked through the engine, causing the compressor to stall. The engine fuel control senses the condition of RPM and inlet temperature and schedules a correct amount of fuel.

It would seem that these automatic functions for preventing a compressor stall would be enough to eliminate a stall. However, the engine was set up only for normal operation. One variable not covered by engine adjustments is pilot technique. When operating in conditions marginal for compressor stalls, the responsibility remains with the pilot to aid the automatic functions rather than to rely on them. The flight conditions which can cause a compressor stall must be kept in mind and erratic or abrupt throttle movements must be avoided. An in-flight refueling hookup is a good example where throttle technique could be overlooked. During flight attitudes which affect air inlet flow, throttle technique is even more important due to the added factor of distortion at the air inlet. If poor throttle technique, marginal flight attitudes, and uncoordinated flight are combined, the conditions are ideal for a compressor stall.

Lessening the Stall Effect

Several techniques can be employed to reduce a compressor stall effect. If a rising EGT accompanies an RPM drop, this is an indication of a stall. Retard the throttle to prevent engine damage. If the stall is eliminated, then slowly advance the throttle to the desired thrust level. Avoid erratic throttle movements. If the stall resulted from excessive distortion of airflow at the air inlet, and a drop in RPM without a rising EGT is observed, increasing the thrust setting to about 90%, or increasing the airspeed by decreasing rate of climb, or by dropping the nose will usually eliminate the stall. Be especially careful to maintain coordinated flight. If the stall is uncontrollable, shut down the engine. Although a compressor stall is not normally dangerous, if the stall continues, it could cause engine damage.

ENGINE RATINGS

Engine ratings were not set up as limits which, if exceeded, would result in the engine falling apart. Overall engine life for a particular installation is first determined. This life is broken down into percentages which reflect the time used at different thrust settings. With this information, allowable limits are set. In normal engine life, when engine time is used up, the engine is ready for overhaul. The overhaul times are used to plan logistical support of the aircraft. If premature breakdowns occur, this can seriously affect squadron strength by causing shortages of necessary items. A better understanding of engine ratings will prevent a pilot from inadvertently exceeding engine limits and will bring into focus the real reason engine limits are set.

EXHAUST GAS TEMPERATURE

Excessive temperature causes deformation of sheet metal parts and, if allowed to persist, will result in sagging and subsequent structural failure. Consequently, exhaust gas temperature (EGT) is the most important factor in engine durability. This does not mean that EGT is to be used as a limit in place of a time at maximum thrust settings. However, always reduce a thrust setting to maintain an EGT limit.

In its normal function, the exhaust gas temperature conveys information on how well the engine is performing at a desired thrust setting. Normally, EGT will be kept within limits by the fuel control. If temperatures still increase or stabilize at too high a temperature, retard the throttle. Whenever the EGT becomes uncontrollable, shut down the engine. Excessive temperatures should be noted for maximum reached and for the length of time at the overtemperature. The temperature should be reported as a discrepancy for appropriate maintenance action.

CAUTION

The J52 P-8A/B engine fuel control will not maintain EGT within limits above 35,000 feet at military power. It is therefore necessary that pilots monitor EGT carefully under these conditions and maintain EGT within limits by retarding the throttle.

Exhaust Gas Temperature and Inlet Icing

Exhaust gas temperature will begin to increase in an icing condition usually as a result of decreased airflow through the engine. The decreased airflow is sensed by the fuel control, resulting in an increased fuel flow to the combustion chamber. This causes the EGT to rise. Since a rise in EGT follows the buildup of ice, EGT is a reliable indication of the beginning of ice formation at the air inlet.

FLAMEOUT

A single-engine flameout is not normally a dangerous situation. Nevertheless, the cause of the flameout should be ascertained to prevent a similar occurrence at critical altitudes and airspeeds. A flameout usually occurs if the fuel-air-ratio is either too rich, or too lean to maintain combustion. The fuel control unit automatically responds to varying conditions; however, severe changes in normal flight conditions, such as those which result in compressor stalls, heavy moisture ingestion, or excessive throttle movements at altitude, can exceed the fuel control's ability to react, and will probably result in a flameout.

Indications of a flameout are a loss of thrust, dropping EGT, and dropping RPM; an air start should be initiated as soon as possible while engine RPM is still high. Attempt to avoid the conditions that set up the flameout initially. If the flameout occurs during an icing condition, or during moisture ingestion, use the air start switches and anti-icing for the duration of the condition. However, the starting ignition should not be used indiscriminately, because premature breakdown of the igniter plugs will result. If it is determined that the flameout resulted from an engine malfunction, shut down the engine.

BURNER CAN BLOWOUT

Burner can blowout is an engine condition where one or more nozzles of the four-nozzle cluster have been blown out and failed to relight. One or more burner cans may be affected.

This condition may occur in aircraft with PPC No. 185 incorporated. During idle power, slow speed descents (below 250 KIAS) or idle power, constant altitude aircraft decelerations, the burner can blowout condition is characterized by an idle droop. This may result in engine hangups of up to 10 seconds duration during subsequent engine acceleration.

COOLING BEFORE SHUTDOWN

Before shutdown (except for emergency or operational necessity), the engines should be operated at

IDLE for 3 to 5 minutes to allow engine temperature to stabilize, and then at 75% RPM for 30 seconds to permit oil scavenging.

Note

If operating conditions preclude oil scavenging at 75%, no damage will result; however, the possibility of oil overflow from the accessory gear box exists.

SMOKE AFTER SHUTDOWN

If smoke is emitted from the engine after shutdown, determine the cause. White vapor indicates fuel vaporization. This does not harm the engine, but is potentially dangerous because of the fire hazard in the immediate area. If heavy black smoke is emitted, this is indicative of burning oil or fuel. If the GTC is available, crank the affected engine. If the smoke persists, use firefighting equipment to extinguish the fire.

FUEL MANAGEMENT

Since fuel transfer occurs as the result of differential air pressure within the fuel tanks and gravity flow, fuel management is directly related to pressure regulation. Overall fuel management is handled automatically when the wing drop-tank transfer switch is in the normal position. It has been found however, that by controlling fuel from the drop tanks, the range of the aircraft can be increased.

By using fuel from two drop tanks at a time, and then jettisoning the empty tanks, the aircraft reaches a cleaner configuration in the shortest time. The wing drop-tank transfer switch (WING DROP TANK TRANS) selects the transfer from the wing drop tanks. Fuel can be selectively transferred from either the outboard or inboard tanks, or all drop tanks simultaneously.

CAUTION

Tests have indicated that possible overpressurization may occur if all four drop tanks empty simultaneously.

Throughout all fuel transfer, pressure at 25 PSI is maintained on the drop tanks. Therefore, selective fuel transfer is accomplished by allowing fuel flow from selected tanks only. In selecting transfer from the outboard tanks, move the wing drop-tank transfer switch to outboard (OUTBD). The shutoff valves from the inboard tanks and centerline drop-tank prevent fuel transfer from these tanks. By selecting the inboard (INBD) position, the opposite sequence will occur with the centerline drop-tank remaining closed. In the NORM position, the drop-tank shutoff valves are opened, allowing automatic simultaneous fuel transfer from the tanks. In the event of an electrical failure, the shutoff valves will open, allowing normal automatic transfer.

When the air refueling pod is attached, the ship-to-tank switch must be used to transfer fuel from the centerline store position. The centerline shutoff valve, used in centerline drop-tank transfer, is not

controlled by the ship-to-tank switch. When placed in the FROM STORE position, the centerline store shutoff valve opens. Pressure, regulated to 25 PSI, then forces the fuel out of the air refueling pod to the forward fuselage tank. The center position of the switch corresponds to OFF.

Through the use of the tank pressure switch on the fuel management panel, the wing and drop tanks can be pressurized on the ground or transfer can be stopped in flight. The switch positions and their functions are covered in Section I.

WING-TANK PURGING SYSTEM

Wing tanks may be purged by placing the wing dump switch to DUMP. Purging will continue as long as the wing switch remains in DUMP.

Spring-loaded, zero-leak check valves are used for purging. The valves are set to open at 0.5 PSI pressure differential. When air is sensed in the wing-tank shutoff valves, a signal is sent to the wing-tank pressure regulator, shutting off pressure to the wing tanks. When the check valves sense the preset pressure differential, the valves open, purging the tanks. The fuel vapors are evacuated through the wing dump valves, which are electrically opened when the wing dump switch is actuated.

AERODYNAMIC BRAKING

After touchdown and flaperon pop-up activation, raise the nose to 21 units angle of attack and allow the aircraft to decelerate. As indicated airspeed approaches 80 knots, smoothly lower the nose to the runway and commence normal braking as necessary to slow aircraft to taxi speed.

**APPROACH POWER
COMPENSATOR TECHNIQUE**

The technique required for an APC approach differs from a manual approach in that all glide slope corrections are made by changing airplane attitude. Since this technique violates the basic rule that altitude is primarily controlled by throttle, practice is required to develop the proper control habits necessary to use APC. For the APC to perform satisfactorily, smooth attitude control is essential. Large abrupt attitude changes result in excessive thrust changes. Close-in corrections are very critical. A large attitude correction for a high-in-close condition will produce an excessive power reduction and can easily result in a hard landing. If a high-in-close situation develops, the recommended procedure is to stop meatball motion and not attempt to recenter it. A low-in-close condition is difficult to correct with APC and usually results in an over-the-top bolter. It may be necessary to manually override APC in order to safely recover from a low-in-close condition. Throughout the approach the pilot should keep his hand on the throttles in the event it is necessary to manually override the APC.

part 2**Flight Characteristics****CLIMB CHARACTERISTICS**

A typical climb schedule for the basic aircraft is 340 KIAS to .72 IMN. For best fuel consumption, military power should be maintained during a climb. Longitudinal stability is positive throughout the climb regime.

STALLS**NORMAL STALLS**

The following stall description is applicable to normal 1-g stalls approached at a deceleration rate of approximately 1 to 2 knots per second. At greater deceleration rates, pilot perceptibility of stall warning buffet as well as the time available for reaction to prevent the stall is reduced and stall penetration tends to be deeper. Stall characteristics do not appreciably change with the addition of wing and/or fuselage stores or as a result of asymmetrical power, speed brake position, or STAB AUG engagement.

Stall warning in flaps/slats down configurations (takeoff, wave-off, power approach, and land) occurs 10 to 15 knots prior to stall and is characterized by light buffet at onset, increasing to moderate buffet as stall is approached. Flaperon effectiveness decreases as stall is approached; however, sufficient control authority is available to maintain wings-level flight up to the stall. Rudder is effective for roll control during the approach to the stall and at stall. The use of the flaperons alone to maintain wings-level flight during the approach to the stall may induce a lateral oscillation due to high roll inertia and decreasing lateral control effectiveness. This characteristic is particularly noticeable when carrying wing stores. Stall in the flaps/slats down configuration is defined by a loss of longitudinal control characterized by the aircraft breaking in and out of stall while holding aft stick. In the takeoff and wave-off configurations with military power, a mild longitudinal pitch-up is experienced at stall; however, this phenomenon is only momentary and does not create a dangerous situation.

Stall warning in flaps/slats up configurations (power, cruise, and glide) is characterized by wing rock and a gradual loss of lateral control effectiveness beginning approximately 20 to 35 knots prior to stall followed by light buffet at 7 to 10 knots prior to stall. Stall in the flaps/slats up configurations is defined by a complete loss of lateral control with the aircraft in a sideslip and roll maneuver. Stall recovery in

either the flaps/slats up or down configuration is immediate and is achieved by applying forward stick to reduce angle of attack and increase airspeed. No excessive altitude loss is encountered during recovery except in the high gross weight/high drag loadings where slow aircraft acceleration increases the time and altitude required to effect a safe recovery.

WARNING

During NATC flight testing under controlled conditions and using optimum recovery technique, up to 2,000 feet of altitude was required for recovery from configuration land stalls in the heavy gross weight/high drag loadings.

DEEP STALL PENETRATION

Three factors combine to make the aircraft highly susceptible to deep stall penetration and progressive stalls during the recovery:

- a. With power reduction or nose-up attitude change, rapid deceleration occurs at heavy gross weight/high drag loadings. In addition to the rapid deceleration, the stall speed increases approximately 12 knots with power reduction from military to idle RPM.
- b. Good longitudinal control effectiveness (pitch response with longitudinal control stick movement). This is particularly evident with extended control travel.
- c. At stall, light longitudinal stick forces induce a tendency to overcontrol aircraft attitude prior to attaining sufficient airspeed for recovery.

Note

To prevent entering a progressive stall, the angle-of-attack indicator should be used as the primary stall recovery instrument.

Stall airspeeds for various configurations are plotted as a function of gross weight in figure 4-1.

ACCELERATED STALLS

Accelerated stalls are preceded by light airframe buffet 30 to 40 knots prior to stall, increasing progressively to moderate buffet at stall. Lateral instability in the form of wing rocking is coincident

STALL SPEEDS

P-8 ENGINE

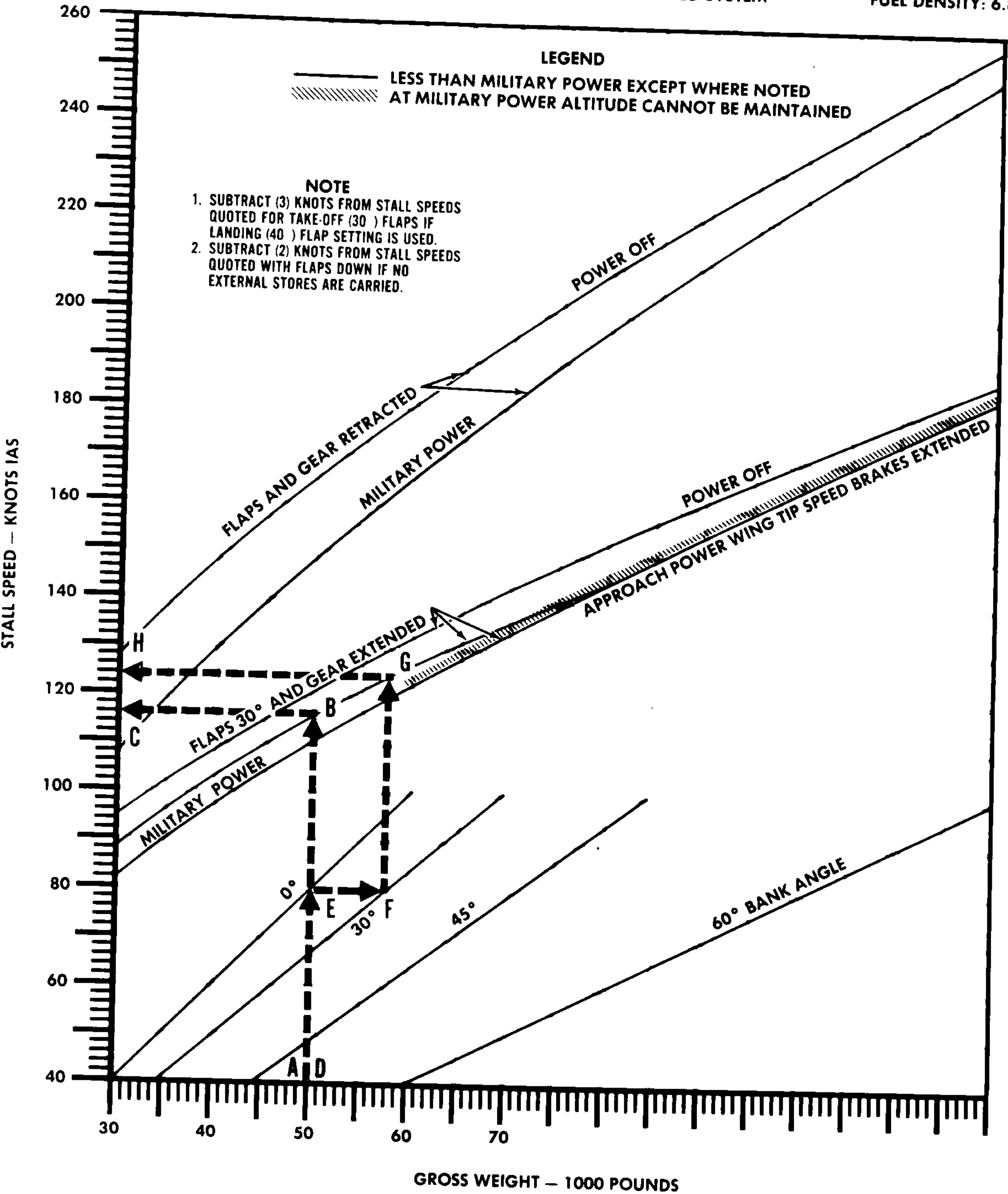
SEA LEVEL

AIRCRAFT CONFIGURATION
ALL EXTERNAL STORES

DATE 15 FEBRUARY 1971
DATA BASIS: ESTIMATED

REMARKS
ICAO STANDARD DAY
STALL SPEEDS CORRESPOND TO FIN BOOM AIRSPEED SYSTEM

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



ADF1-407

Figure 4-1

with airframe buffet but remains at a low level and is correctable with flaperons. In a gradual approach to a 2-g accelerated stall, a decrease in lateral control effectiveness beginning approximately with onset of stall warning buffet provides additional warning of a near-stall condition. However, during high-g high angle-of-attack maneuvering, later control loss will most likely not be noticed and normal prestall airframe buffet will be the primary warning of an impending accelerated stall. If stall warning is not recognized or normal acceleration is not reduced, the aircraft will enter an accelerated stall characterized by a yawing and rolling maneuver. Increase the rate of aft stick displacement will increase the magnitude and rate of yaw at the stall. Stall recovery is instantaneous and is achieved by applying forward stick to reduce aircraft angle-of-attack and increase airspeed.

POST STALL GYRATIONS

The aircraft exhibits excellent stall recovery characteristics, and post stall gyrations commonly experienced in other swept wing aircraft are not displayed. However, following either a normal 1-g stall or an accelerated stall, if angle of attack is not reduced by releasing back stick pressure, the longitudinal and lateral oscillations will increase in amplitude and the aircraft will roll and pitch to a 50° to 60° dive angle. Pitching then decreases but the lateral oscillations increase varying from gentle rolls to snap rolls as the airspeed builds up. These lateral oscillations will continue as long as the stick is held aft.

Note

The aircraft does not exhibit any tendency to spin from a normal 1-g stall or an accelerated stall. However, application of spin recovery technique during post stall gyrations will induce a spin.

Post stall gyrations entered from vertical stalls are preceeded by wing rocking and a back slide. As the aircraft stalls, it pitches down to a 70° to 80° dive angle with the airspeed increasing rapidly. When the aircraft is stalled with a vertical flight path angle less than 90°, it pitches nose down erect and when the flight path angle is greater than 90°, it pitches down inverted. The negative load factor in the inverted maneuver causes the CSD/S warning lights (L or R SPD DR) on the annunciator panel to come on. These lights will go out when the load factor becomes positive. The aircraft exhibits the same post stall characteristics as those experienced in normal 1-g stalls and accelerated stalls with the stick held full aft.

Note

The aircraft will not spin from a vertical stall unless pro-spin controls (full aft stick, full rudder, and neutral flaperons) with extended throws are applied.

SPINS

The aircraft is not prone to enter unintentional spins. To attain a spin, the controls must be intentionally held in the pro-spin positions (full aft stick, full rudder, and neutral flaperons). During spin testing at NATC, erect spins induced with cruise control throws were achieved only on 12.5% of the attempts. These spins were all from normal 1-g stall entries. Erect spins could not be induced from vertical, inverted, or accelerated stall entries with cruise control throws. Erect spins were induced on 95% of the spin attempts using extended control throws in vertical and 1-g entries.

ERECT SPINS

The erect spin requires approximately 1 1/2 turns to become fully developed. The initial 1 1/2 turns comprising the incipient spin phase (or post stall gyration) are more disorienting than the fully developed spin due to the rolling, pitching, and yawing motions in conjunction with a rapidly changing load factor. This gyration is what will be experienced in most instances rather than a spin and is the same whether or not a spin develops and regardless of the control throws (cruise or extended) used. Recovery is normally effected by neutralizing or releasing all controls, but in some cases lateral stick deflection is necessary to stop rolling motion.

SPIN CHARACTERISTICS

The fully developed erect spin is a low-speed, high angle-of-attack, autorotative spin characterized by the airspeed indication fluctuating around 100 KIAS, the turn needle indicating a steady full needle deflection turn in the direction of the spin, and the accelerometer showing 0 to +0.3 g.

Note

Aircraft oscillatory motion in the spin is sufficient to cause the ball in the turn-and-slip indicator to slide back and forth and to be of no use to the pilot. The turn needle should be used as the primary instrument to determine the direction of the spin.

Airframe buffet level in the spin is very low and the predominant aircraft motion apparent to the pilot is yaw. The spin rotation rate is 3.5 to 4.0 sec/turn, the angle-of-attack is 60° to 65°, and the pitch attitude oscillates from 30° to 50° nose down once during each turn. The forces exerted on the pilot are mild and an erect spin with the shoulder-harness inertia reel unlocked presents no problems. All cockpit switches can be easily reached and full cockpit control throws can be accomplished.

During the fully developed spin, engine compressor stalls at the rate of approximately 10 per second are audible, and EGT will increase rapidly to over 700°C if engine RPM is greater than 88% to 90%. The engine RPM will drop to below flight idle resulting in loss of the aircraft electrical system if engine RPM

is less than 80%. The ram-air turbine will not operate in an erect spin. The automatic flight control system, speed-brake position, or aircraft CG location do not noticeably affect the spin characteristics. However, asymmetrical power assists in inducing erect spins. The approximate 6° cant of the exhaust nozzles out from the fuselage centerline results in an addition to the spin moment when the engine on the inside of the spin is developing more thrust than the one on the outside. Erect spins, with the exception of asymmetrical power spins, are recoverable with cruise control throws but may require up to three turns to effect.

WARNING

The aircraft will not recover from an erect spin with asymmetrical power using cruise control throws for recovery.

An assist-spin recovery switch has been provided to permit the attainment of the landing configuration control throws (+35° rudder and 24° stabilizer leading edge down) while in the clean configuration. Use of extended control throws provide a recovery in 1 to 1 1/2 turns from all spins.

CAUTION

- Operation of the assist-spin recovery switch may impose an additional acceleration which, during an accelerated maneuver, may overstress the aircraft, or when operating at minimum airspeeds may pitch the aircraft up into stall or heavy buffet conditions.
- Reselection of cruise control throws after spin recovery should be done below 300 KIAS while anticipating a nose-down pitch change.
- The assist-spin recovery switch should not be activated with the flaps down. Activation can cause damage to the extended throw mechanism.

The altitude lost in the fully developed erect spin is 1,300 to 1,500 feet per turn. The altitude lost from the initiation of recovery to level flight is approximately 9,000 feet with 2.5 to 3.0 g roundout.

ERECT SPIN RECOVERY

The first step in recovery from all spins is to determine if the aircraft is in a spin. Since post stall gyration can be extremely disorienting, it is relatively easy to assume the aircraft is in a spin when in fact it is not. Application of spin recovery technique during post stall gyration may force the aircraft into a spin. Upon entering a post stall gyration, controls should be neutralized to effect recovery. If it is determined that the aircraft is in a spin, determine the direction of the spin by reference to the turn needle; then initiate recovery according to the following sequence:

1. Apply full rudder pedal deflection in direction opposite to spin (rudder opposite direction that turn needle is indicating).

2. Hold control stick full aft and neutral laterally.
3. Simultaneously with application of spin recovery controls, or as soon as possible, select extended control throws with assist spin recovery switch.
4. Adjust throttles to provide 80% to 85% RPM. Adjusting throttles to a point where they are parallel to pilot's vertical axis results in desired power setting without requirements to monitor RPM indicator.
5. When rotation ceases, immediately neutralize rudder and move control stick forward to at least neutral position. Failure to neutralize controls as soon as spin rotation has ceased will result in violent lateral snaps, causing the aircraft to assume a steeper nose-down position and require more altitude for recovery to level flight.
6. Return assist spin recovery switch to cruise control throw position after return to level flight and at or below 300 KIAS.

Recovery will occur in 1 to 1 1/2 turns at a 70° or greater nose-down attitude. If turn reversals are encountered while neutralizing the controls, release the controls and the aircraft will fly itself out. The flaperons are not effective during erect spins.

WARNING

Wind tunnel tests on spin characteristics of swept wing aircraft have shown that asymmetrical loads on the order of 10,000 to 12,000 foot-pounds or higher produce an undesirable flattening of the spin. A-6 spin characteristics with asymmetrical stores have not been tested. If a spin occurs with asymmetrical stores, use the emergency jettison button to jettison all stores.

INVERTED SPINS

Inverted spins have been unobtainable (contractor demonstration and NATC tests) with the normal cruise control throws, but have been induced by using the extended control throws. The inverted spin requires 1 to 1 1/2 turns to become fully developed. Recovery from the initial 1 to 1 1/2 turns, the incipient spin phase, is effected by neutralizing or releasing the controls, but in some cases lateral stick deflection is necessary to stop the rolling motion.

The fully developed inverted spin is a low-speed high negative angle-of-attack, autorotative spin characterized by the airspeed indication fluctuating from less than 80 KIAS up to 100 KIAS, the turn needle indicating a steady full needle deflection turn in the direction of the spin, the ball remaining in the side of the cage opposite to the direction indicated by

the turn needle, and the accelerometer indicating a steady -1.0 g. In the fully developed inverted spin, airplane pitch attitude oscillates from 0° to 35° below the horizon once every turn, the spin rotation rate is 3.5 to 4.0 sec/turn, the aircraft angle-of-attack in a steady -55° , and airframe buffet is non-existent. The main force felt by the pilot is the negative load factor. If the seat belt is not tight and/or the seat is raised, difficulty may be experienced in reaching and actuating the assist spin recovery switch. With the seat belt properly secured, all cockpit switches can be reached and full cockpit control throws accomplished. Yaw, pitch, and roll rates are relatively steady, resulting in a physically comfortable spin. Determination of spin direction by observing the terrain traverse in the windscreen is difficult due to disorientation. However, spin direction can be immediately determined by referring to the turn needle. Engine compressor stalls occur as described for erect spins. The ram-air turbine will operate satisfactorily in inverted spins. All inverted spins are recoverable with cruise control throws but may require up to $3\frac{1}{2}$ turns. Use of extended control throws provides recovery in $\frac{1}{2}$ to 1 turn. The altitude lost during a fully developed inverted spin is 1,000 to 1,300 feet per turn. The altitude lost from the initiation of recovery to level flight is approximately 9,000 feet with a 2.5 to 3.0 g roundout.

INVERTED SPIN RECOVERY

Determine the spin direction by reference to the turn needle, then take the following steps:

1. Apply full rudder pedal deflection in direction opposite to spin.
2. Hold control stick full forward and neutral laterally.
3. Simultaneously with application of spin recovery controls, or as soon as possible, select extended control throws with assist-spin recovery switch.
4. Adjust throttles to 80% to 85% RPM.
5. Neutralize controls as soon as spin rotation ceases.
6. Return assist spin recover switch to cruise control throw position after return to level flight and at or below 300 KIAS.

Recovery will occur in about one turn in a 70° to 90° nose-down attitude. Turn reversals have not been encountered during forward stick recoveries from inverted spins. The flaperons are not effective during inverted spins. The CSD/S warning lights on the annunciator panel will go on during the spin but will go out following spin recovery without corrective action being taken.

SPIN RECOVERY ON INSTRUMENTS

Recovery on instruments from erect and inverted spins can be effected using the following technique:

1. Determine direction of spin by reference to turn needle. Determine if spin is inverted or erect by reference to the angle of attack. If the angle of attack is pegged upward, the spin is erect. If the angle of attack is pegged downward (low angle of attack), the spin is inverted.
2. Apply full rudder pedal deflection in direction opposite to turn needle.
3. Apply full aft stick for recovery from an erect spin and full forward stick for recovery from an inverted spin.
4. Simultaneously with application of recovery controls, or as soon as possible, select extended control throws.
5. Adjust throttles to 80% to 85% RPM.
6. Hold spin recovery controls for a count of 3, or 3 seconds; then release controls to neutral. Monitor airspeed, turn needle, accelerometer, and gyro horizon for indication of spin recovery.
7. Return to level flight using gyro horizon and turn needle for attitude reference.
8. Select cruise control throws after return to level flight and at or below 300 KIAS.

Recovery from all inverted spins will normally occur when the controls are released to neutral. The recovery from all erect spins will occur within one turn after release of the controls to neutral.

After activating the assist spin recovery switch, the flight controls must be held in the spin recovery position for a count of 3, or 3 seconds, and then released to neutral because the inherent lag in the turn-and-slip indicator is too great for it to be used to determine when spin rotation has ceased. Holding the spin recovery controls for 3 seconds provides about one spin recovery turn which is enough to cause the spin recovery to progress to a point where the aircraft will recover hands-off within an additional one-half turn. Waiting until the turn needle begins to move toward the centered position before neutralizing the controls results in a series of reversals and the aircraft will not recover due to the late neutralization of the flight controls.

A momentary loss of electrical power will not adversely affect the performance of the gyro horizon or the turn-and-slip indicator. The turn needle will continue to indicate the correct direction of turn for 9 seconds after electrical power failure.

FLIGHT CONTROLS

A movable slab stabilizer, flaperon wing spoiler, and a conventional rudder provide effective control over the operational range of the aircraft. The control surfaces are positioned by irreversible hydraulic actuators linked to the stick and rudder pedals by a proportional followup linkage. Control force feel is provided entirely by mechanical devices such as bungees and bobweights, and requires no mach or "q" compensation. Control trim is accomplished electrically by shifting the feel system neutral position in each system.

WARNING

If the trim button comes off, exercise extreme caution. The exposed probe will produce a severe shock.

The stabilizer travel is increased for flaps-down flight in a programmed manner so that trim change with flap deflection is minimized. Stabilizer shift is accomplished by a cable drive from the flap motor and is designed to remain at either full flaps down or flaps up gearing, should the shift cable fail. Stabilizer travel is 1.5° leading edge up, to 9.6° leading edge down in the flaps-up configuration, and 1.5° leading edge up to 24° leading edge down for flaps-down operation, with full stick travel. Selection of the assist spin recovery drives the same shift mechanism.

CAUTION

Operation of the assist spin recovery switch may impose additional acceleration, which during an accelerated maneuver may overstress the aircraft, or when operating at minimum airspeeds may pitch the aircraft up into a stall or heavy buffet condition. Reselection of cruise control throws after spin recovery should be done below 300 KIAS, while anticipating a nose-down pitch change.

Rudder travel is increased for flaps-down flight by withdrawing stops in the rudder control linkage. Rudder travel is reduced to 4° with flaps up, and increases to 35° flaps down, or with the assist spin recovery selected. Rudder travel is proportional to rudder pedal deflection in each case.

The rudder stops shift to full open if the cable fails. Selection of the assist spin recovery switch accomplishes the stop withdrawal by the same mechanism as (full) flap extension.

After landing, the flaperon pop-up feature, as well as the flaps and slats, act together to effectively kill lift and increase drag to decrease landing roll.

LEVEL FLIGHT

No unusual characteristics will be noted in level flight. Control response is excellent. Longitudinal stability is positive up to .84 IMN where a reverse stability regime is gradually entered. This transonic trim change of tuck-under is common to swept wing jets of this type and is considered mild and completely controllable. Positive stability is regained at .92 IMN and above.

Loss of either engine will not compromise control or stability. Engine thrust lines pass close to aircraft e.g., and minimum single-engine control speeds are within 3 to 5 knots of the normal two-engine stall speeds. Single-engine control speed is limited by prestall buffet, slight lateral and longitudinal oscillations, and close to full lateral and directional control deflections. With the application of power to the operating engine, the aircraft has a tendency to turn into and roll toward the operating engine, instead of into the dead engine. This condition results from the deflected thrust by the fuselage speed brakes.

Note

When operating under single-engine conditions, ensure that the speed brakes have been retracted.

CAUTION

Restricted stabilizer travel at low speed could result in inadequate pitch control and full stabilizer travel at high speed could cause structural failure.

PILOT INDUCED LATERAL OSCILLATION

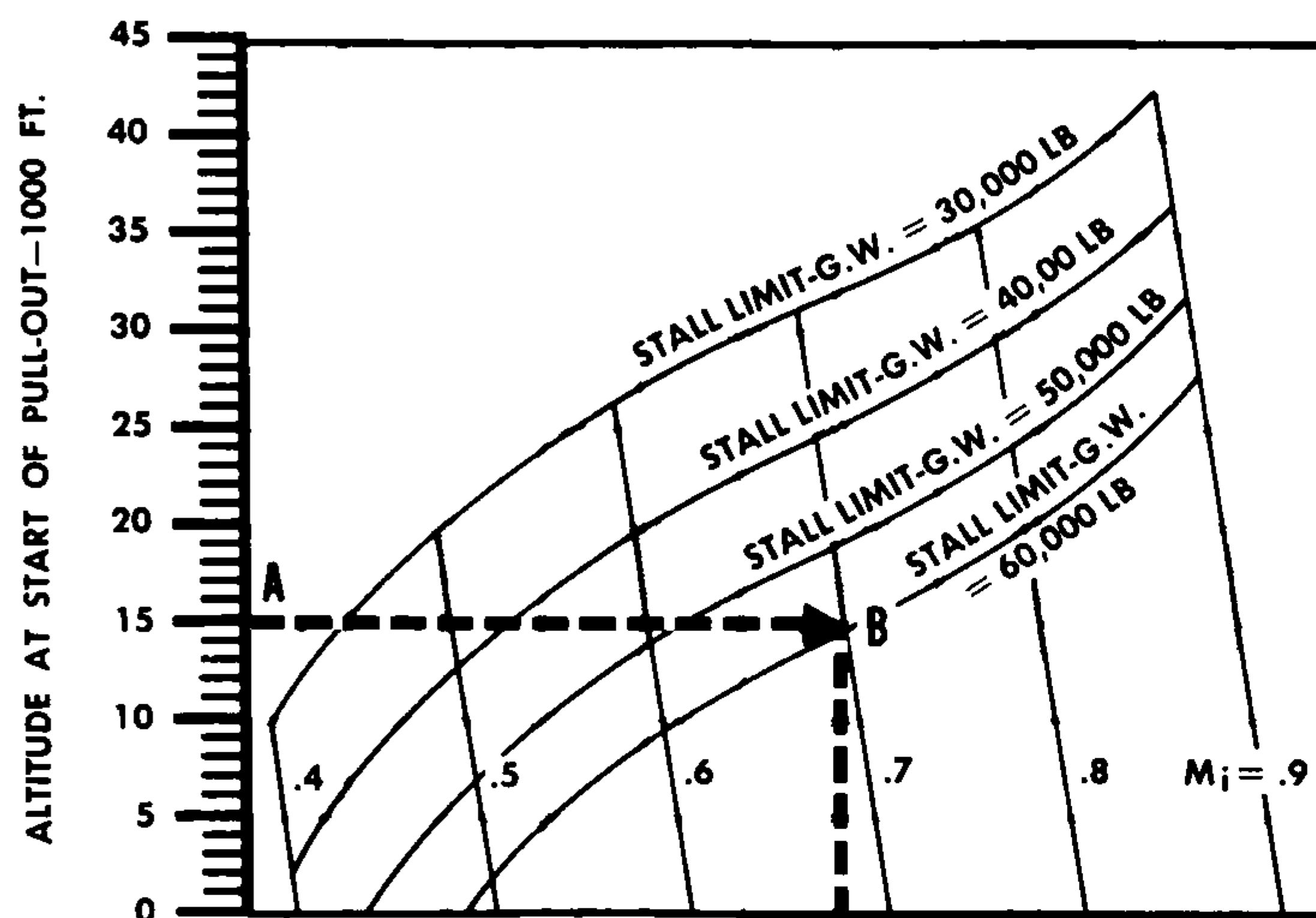
With the AFCS operating in STAB/AUG at airspeeds in excess of 450 KIAS, moderately abrupt lateral stick displacement or reversal may induce an oscillation in roll of 20° to 30° per second. This oscillation is sustained by the pilot displacing the stick and may be stopped immediately by neutralizing the stick. The lateral oscillation increases in intensity from 450 KIAS to limit speed but is not divergent or destructive throughout the flight envelope. The oscillation will not normally be experienced in maneuvering flight.

DIVES

Dive entries may be either pushovers or split-s type. In either case, transition through the transonic trim changes will be rapid. At about .90 IMN, reduced lateral control effectiveness and slightly negative dihedral effect will be encountered. The latter phenomenon will not be noted unless rudder deflections are made. The basic airframe is not restricted in dive angle or maximum speeds but certain store configurations may require limits. Dive recoveries may be made either clean or with speed brakes. Trim changes with speed brakes are slight, but it should be remembered that as speed is reduced, trim changes and/or gusts may add to the existing g's during pullouts at the bottom of the dives. See figures 4-2 through 4-5.

DIVE RECOVERY CHART - 3g

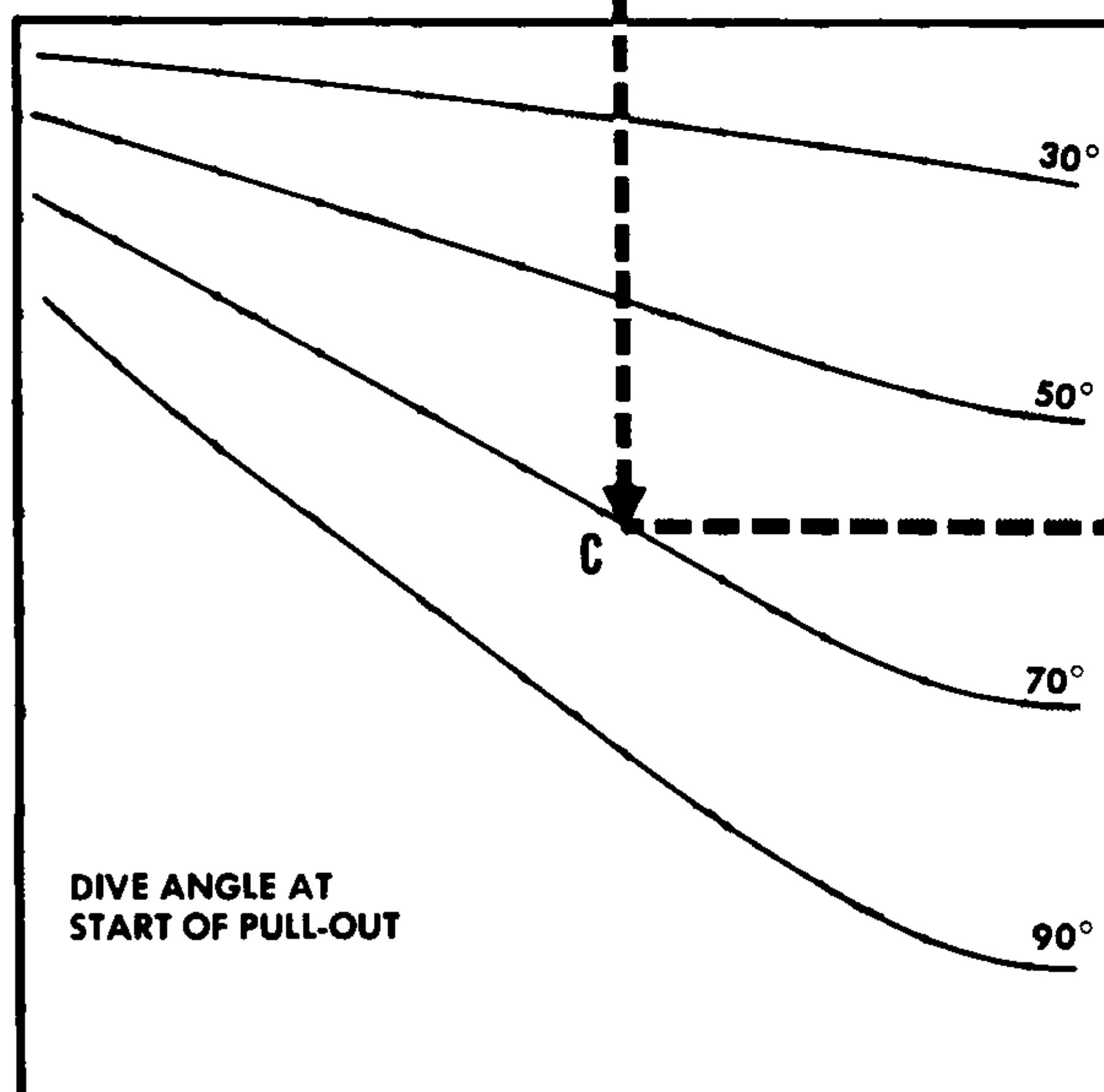
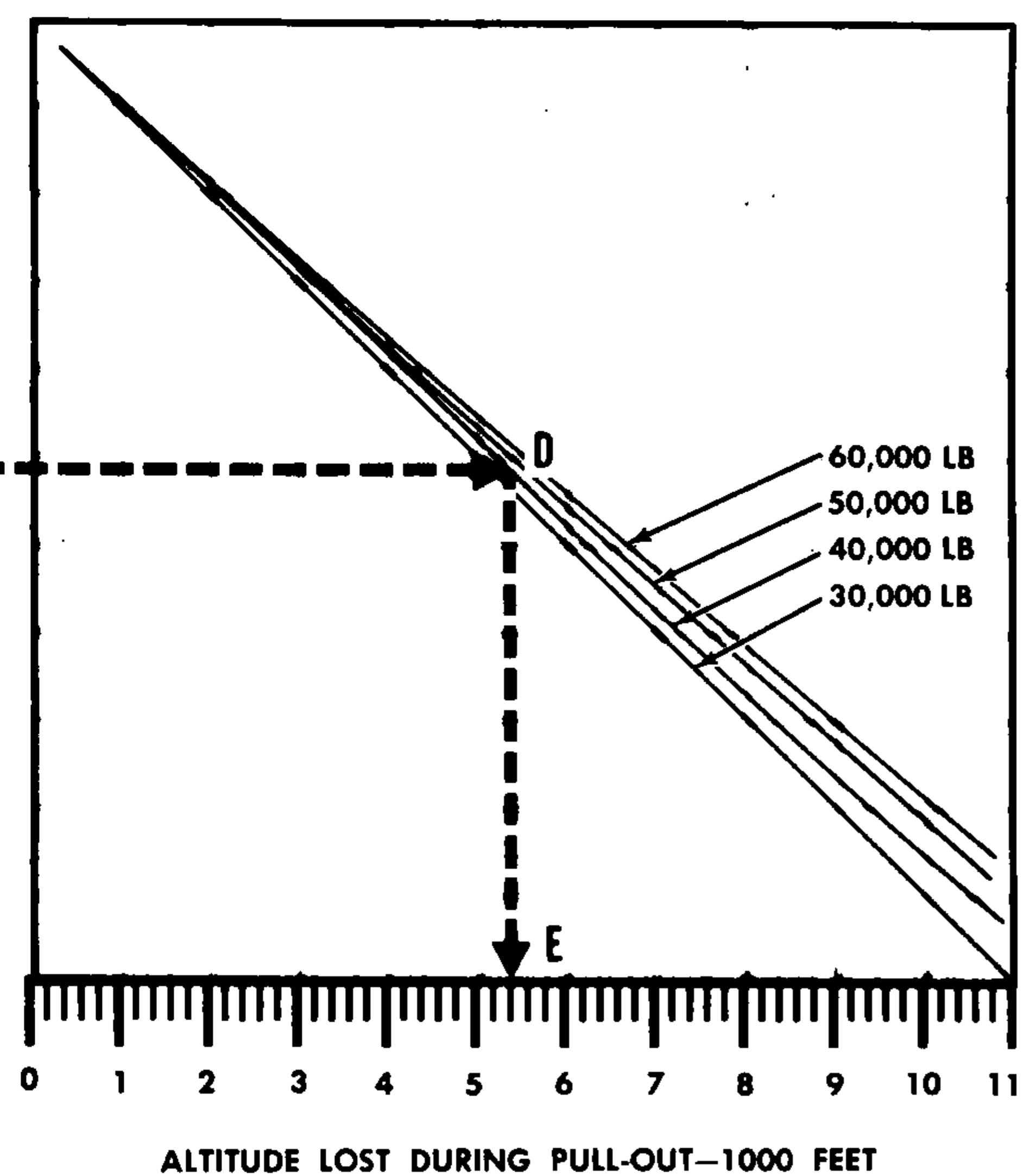
CONFIGURATION: NO EXTERNAL STORES

DATE: 1 DECEMBER 1972
DATA BASIS: ESTIMATEDREMARKS
WING TIP SPEED BRAKES EXTENDED
80% RPM
ENGINE (S) : (2) J52-P-8FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

NOTE
STALL LIMIT IS THE MACH NO. AT START OF PULL-OUT AT WHICH THE AIRCRAFT WILL ENTER AN ACCELERATED STALL BEFORE ATTAINING LEVEL FLIGHT WHILE PULLING 3g's AT THE GROSS WEIGHT INDICATED

SAMPLE PROBLEM:

- ENTER CHART AT ALTITUDE AT START OF PULL-OUT (15,000 FT)
- PROCEED HORIZONTALLY TO MACH NUMBER AT WHICH PULL-OUT STARTED ($M_i = .70$)
- DESCEND TO DIVE ANGLE AT WHICH DIVE WAS STARTED (70°)
- PROCEED HORIZONTALLY TO GROSS WEIGHT (40,000 LB)
- DESCEND TO ALTITUDE LOST DURING CONSTANT 3g PULL-OUT (5,400 FT)



A-ADF1-408

Figure 4-2

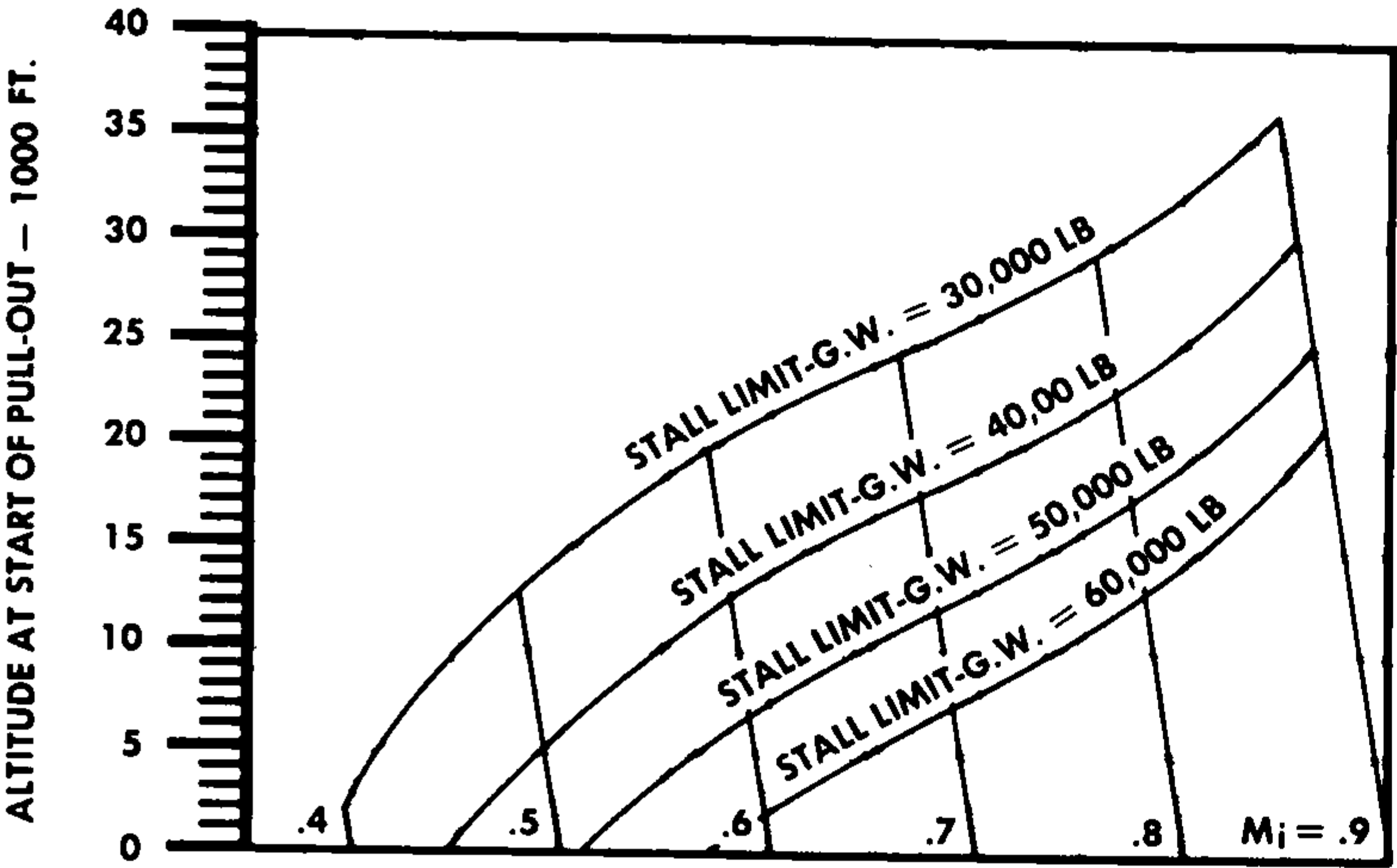
DIVE RECOVERY CHART - 4 g

CONFIGURATION: NO EXTERNAL STORES

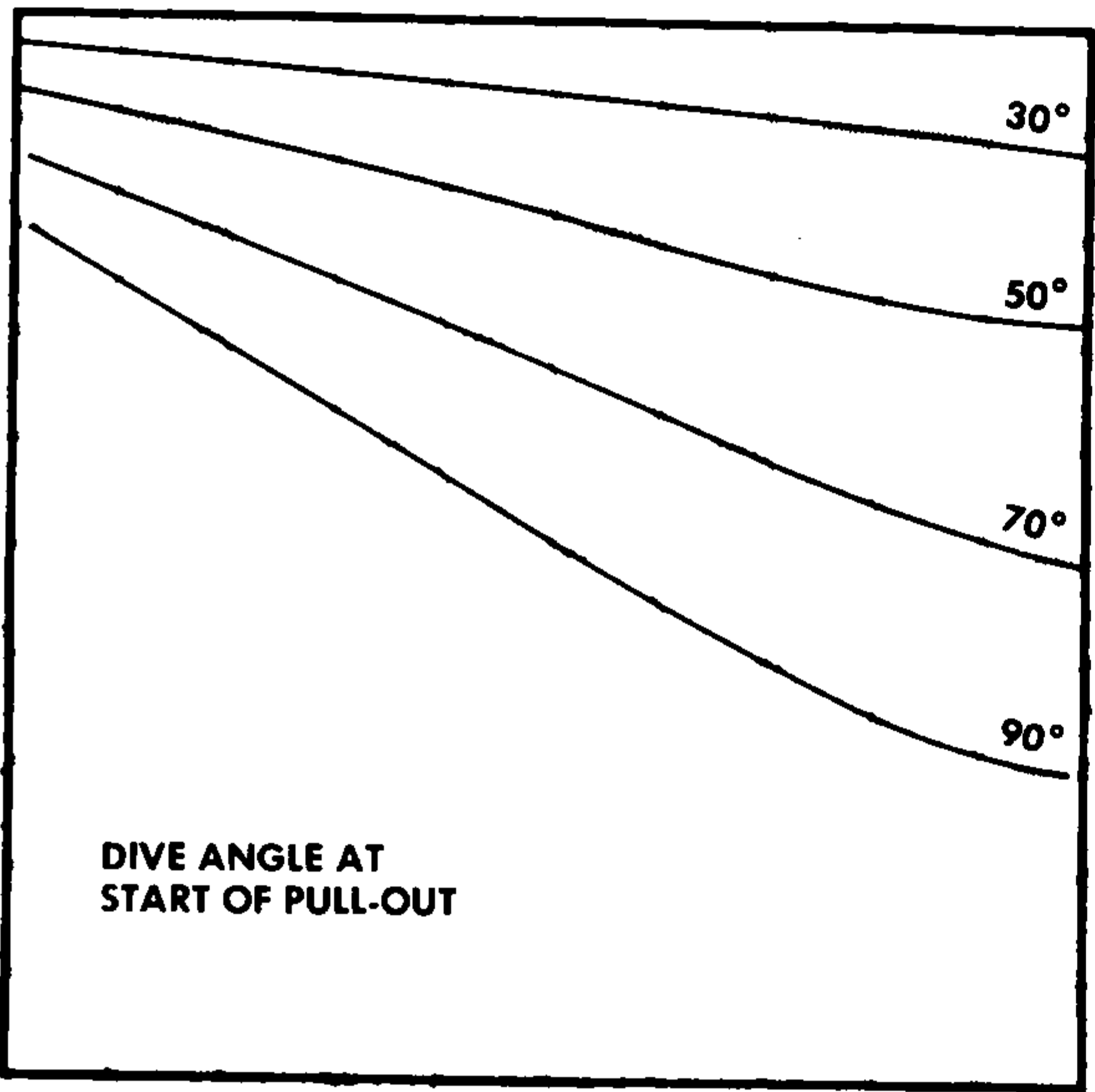
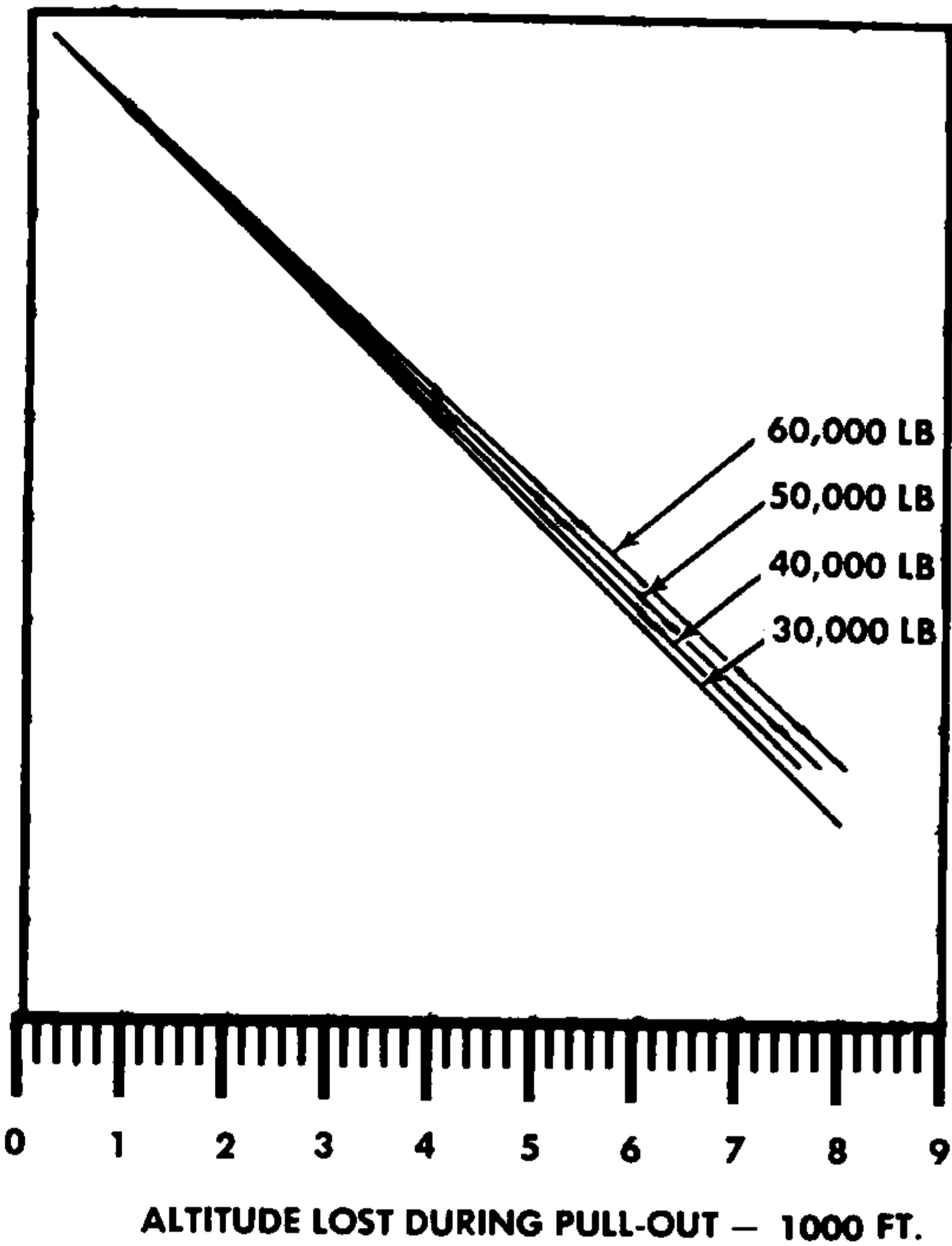
REMARKS
WING TIP SPEED BRAKES EXTENDED
80% RPM
ENGINE (S) : (2) J52-P-8

DATE: 1 DECEMBER 1972
DATA BASIS: ESTIMATED

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



NOTE
STALL LIMIT IS THE MACH NO. AT
START OF PULL-OUT AT WHICH THE
AIRCRAFT WILL ENTER AN ACCELERATED
STALL BEFORE ATTAINING LEVEL FLIGHT
WHILE PULLING 4 g's AT THE
GROSS WEIGHT INDICATED.



A-ADF1-409

Figure 4-3

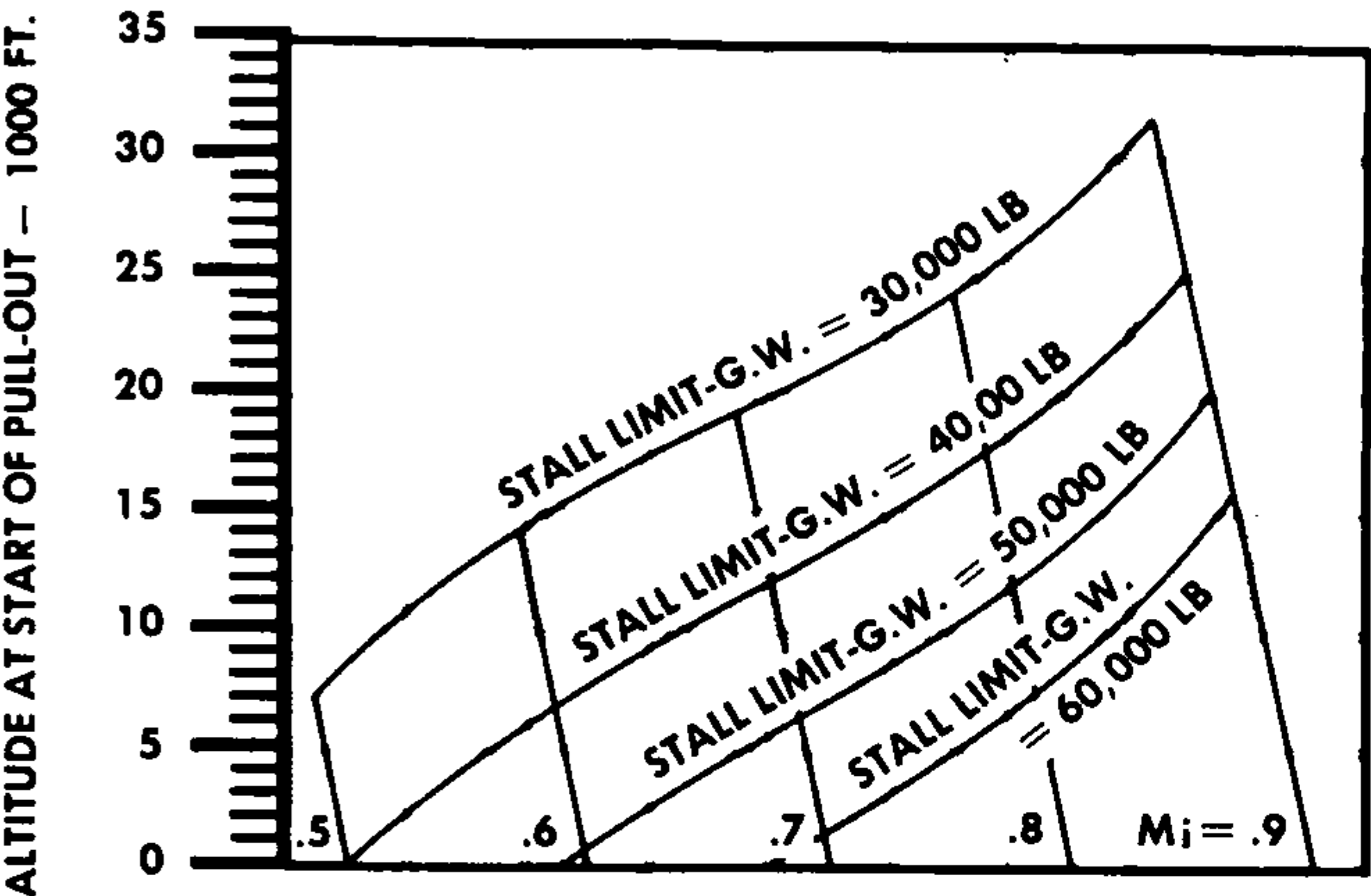
DIVE RECOVERY CHART - 5g

CONFIGURATION: NO EXTERNAL STORES

DATE: 1 DECEMBER 1972
DATA BASIS: ESTIMATED

REMARKS
WING TIP SPEED BRAKES EXTENDED
80% RPM
ENGINE (S) : (2) J52-P-8

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



NOTE
STALL LIMIT IS THE MACH NO. AT
START OF PULL-OUT AT WHICH THE
AIRCRAFT WILL ENTER AN ACCELERATED
STALL BEFORE ATTAINING LEVEL FLIGHT
WHILE PULLING 5 g's AT THE
GROSS WEIGHT INDICATED.

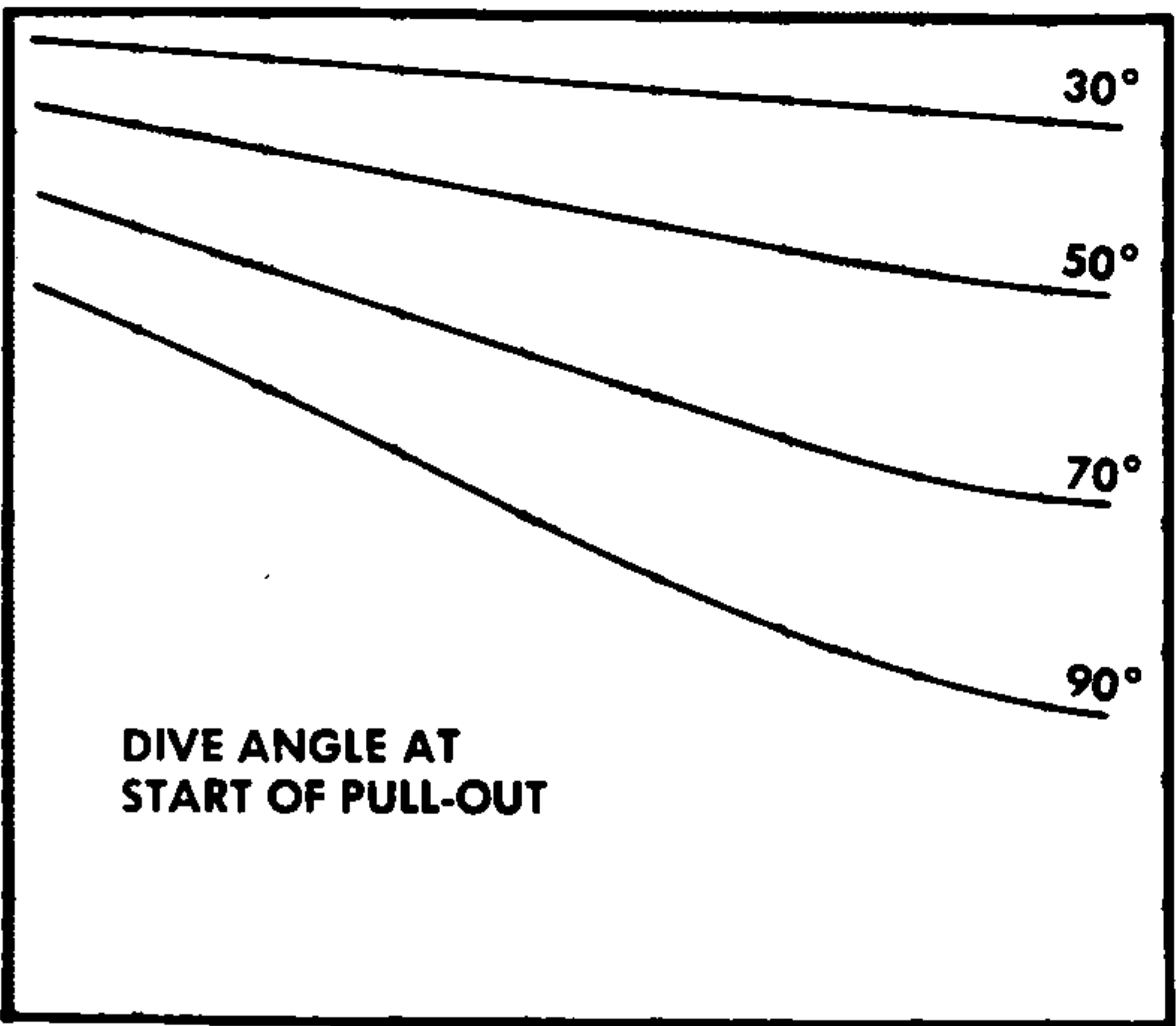
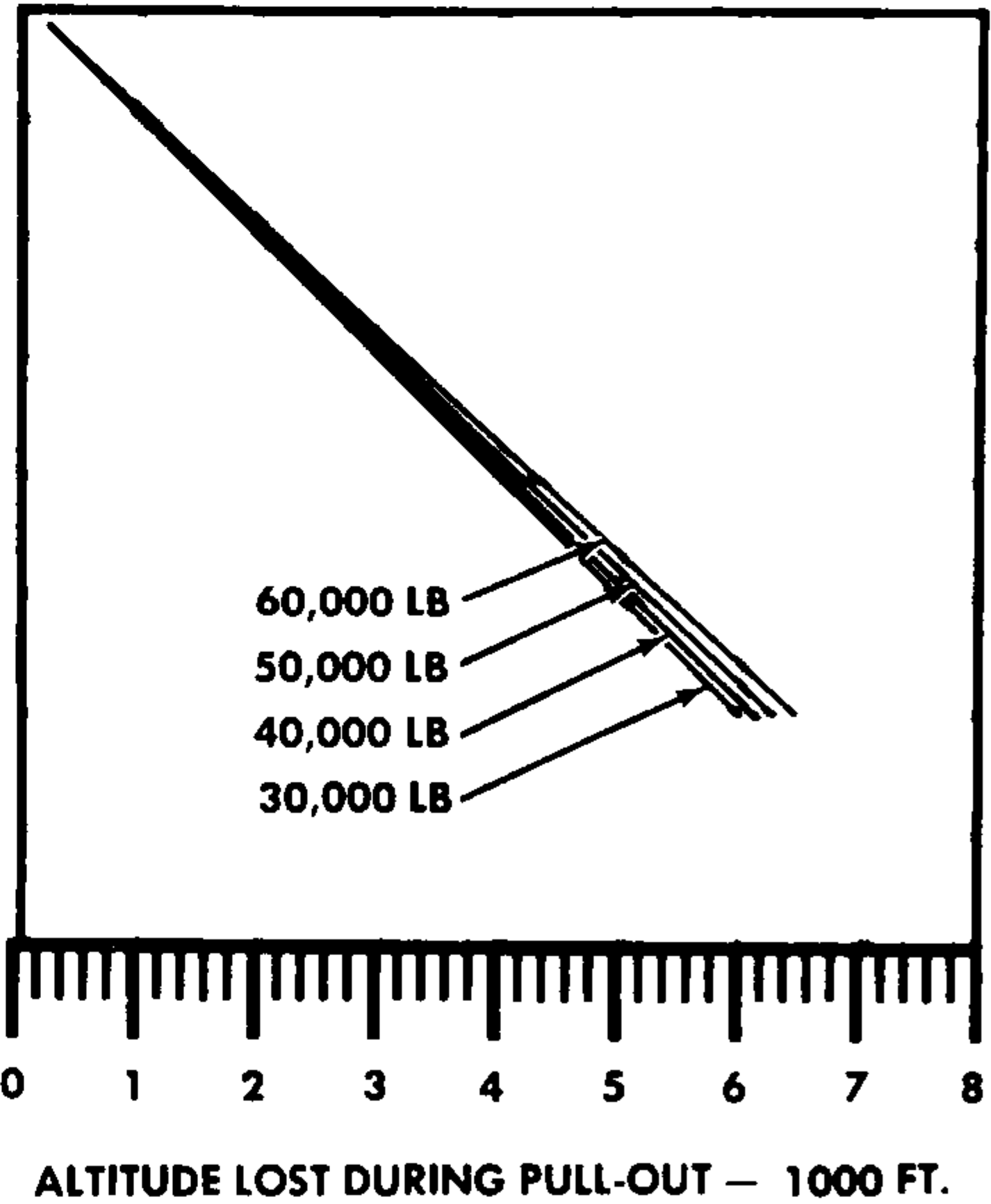


Figure 4-4

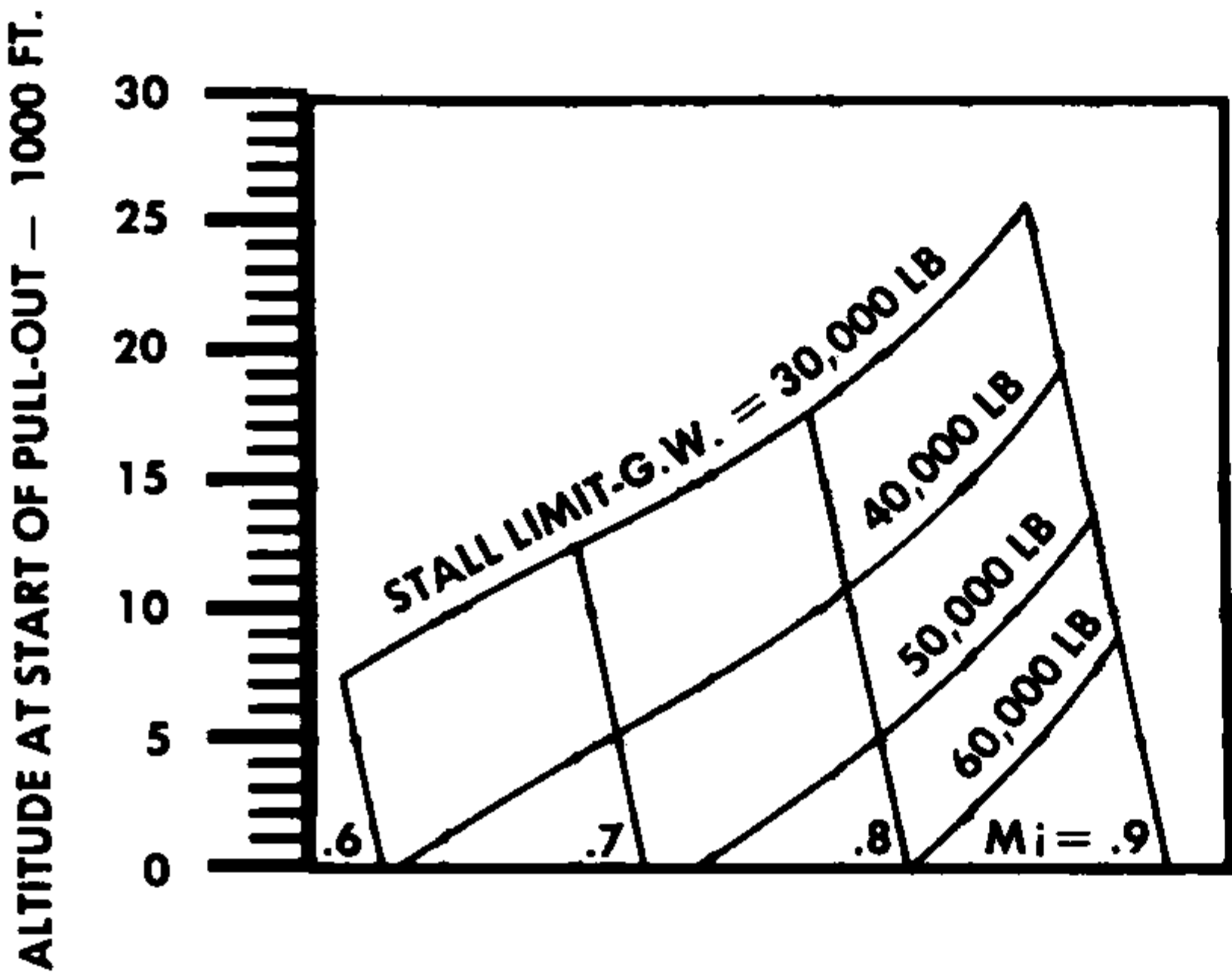
DIVE RECOVERY CHART - 6.5g

CONFIGURATION: NO EXTERNAL STORES

DATE: 1 DECEMBER 1972
DATA BASIS: ESTIMATED

REMARKS
WING TIP SPEED BRAKES EXTENDED
80% RPM
ENGINE (S) : (2) J52-P-8

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



NOTE
STALL LIMIT IS THE MACH NO. AT
START OF PULL-OUT AT WHICH THE
AIRCRAFT WILL ENTER AN ACCELERATED
STALL BEFORE ATTAINING LEVEL FLIGHT
WHILE PULLING 6.5 g's AT THE
GROSS WEIGHT INDICATED.

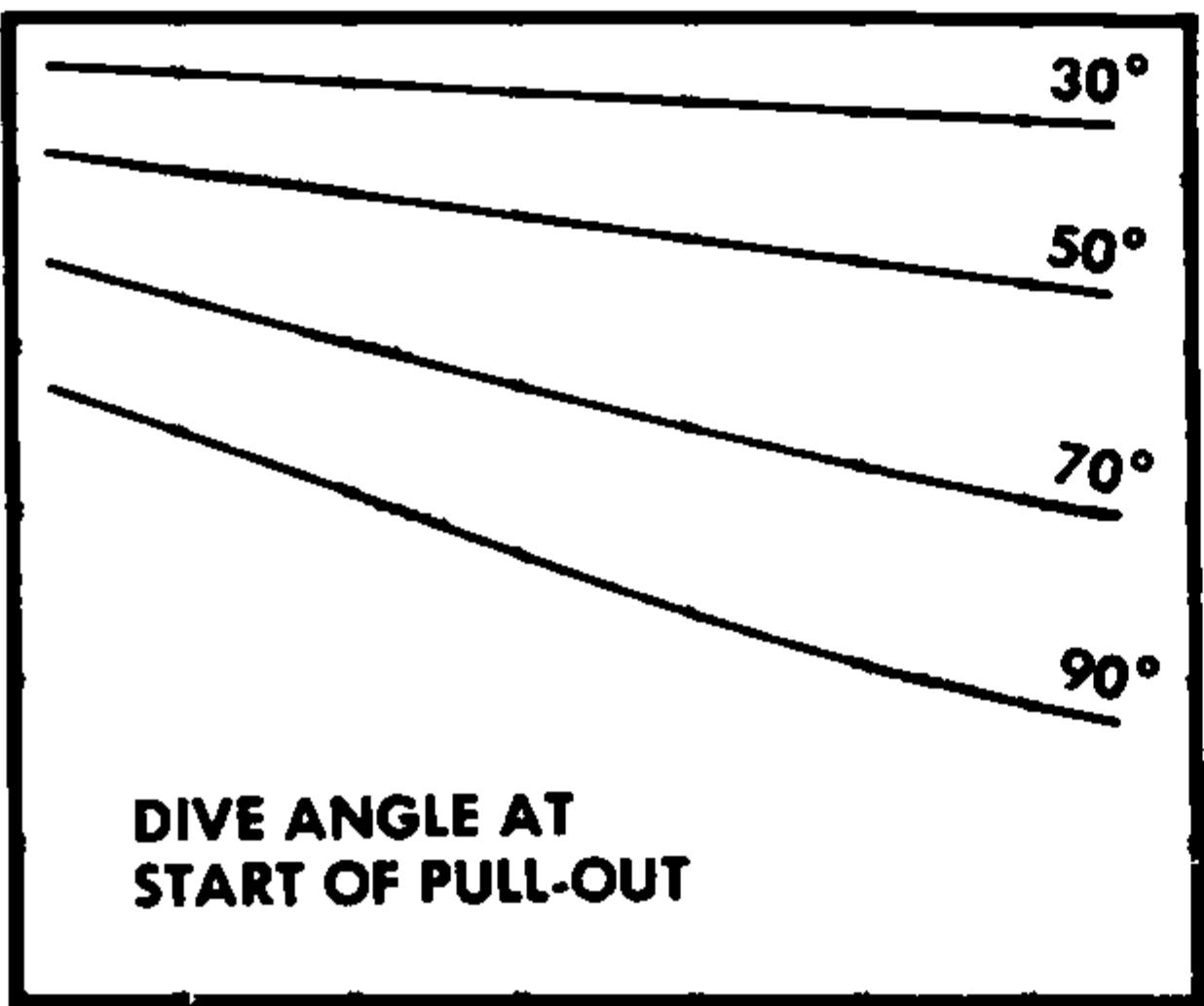
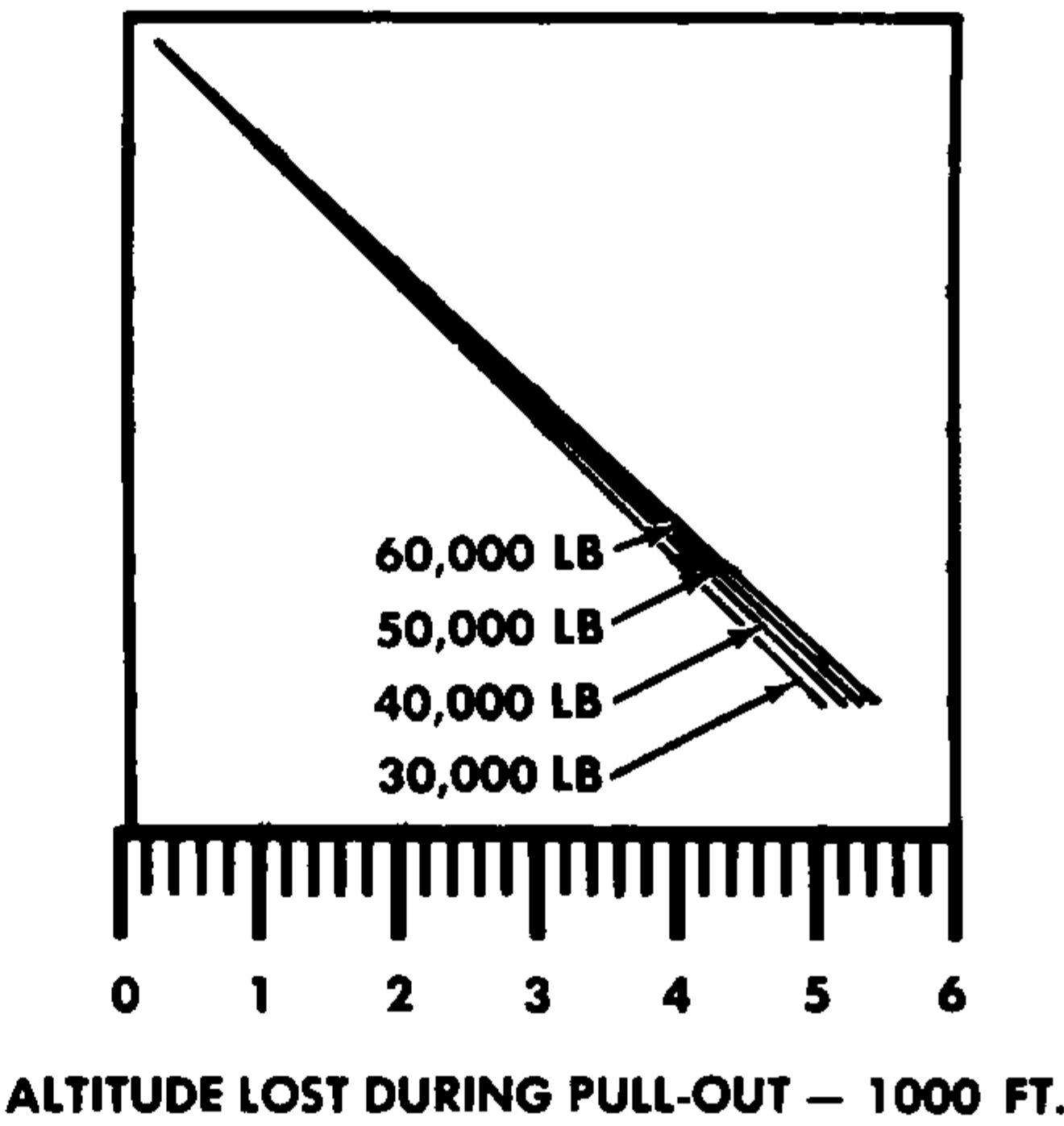


Figure 4-5

SPEED BRAKE RESTRICTIONS

Note

When operating under single-engine conditions, ensure that speed brakes have been retracted.

SPEED BRAKE BLOWBACK

The speed-brake system is so designed that the speed brakes will blowback when the speed-brake actuator load is equal to 20,300 pounds. This is equal to the 3,400 psi cracking pressure of the relief valve, or 3,560 psi at full flow, with the speed brakes positioned at 55°. The wing-tip speed brakes will blowback at .80 IMN, level flight.

SINGLE ENGINE OPERATION

SINGLE-ENGINE FLIGHT CHARACTERISTICS

For normal flight conditions, there is ample lateral and directional control for maximum asymmetric engine thrust operation. Minimum single-engine control speed, with flaps retracted, is obtained at approximately the onset of prestall buffet at 5 to 10 knots before stall, and is characterized by an increasing wing heaviness which requires full lateral control at minimum speed. Minimum single-engine control speed with flaps extended (either TAKE-OFF or LANDING) is approximately 105 KIAS at sea level, at normal landing gross weights. Minimum speed is characterized by an increasing wing heaviness toward the dead engine, which requires nearly full lateral and rudder control to correct.

Extending the flaps will withdraw the 4° rudder limit stops, allowing the rudder to deflect up to 35°. This increase or decrease of the directional control range should be anticipated when flaps are extended or retracted during single-engine operations.

CAUTION

- Do not use the assist spin recovery switch to obtain increased control throws.
- Extension of the speed brakes drastically reduces performance.
- In single-engine operation, ensure that the speed brakes have been retracted.

SINGLE ENGINE FLIGHT PERFORMANCE

Refer to Section XI, for qualitative single-engine performance information.

WARNING

An engine failure will produce a rate of descent in excess of 700 FPM in takeoff configuration at maximum operational takeoff weight: 60,400 pounds sea level. Upon failure of an engine, the pilot should immediately jettison all external stores to reduce gross weight and drag sufficiently for positive rate of climb. The landing gear and flaps can be retracted and excess fuel dumped if desired. Refer to Section XI.

Note

External stores cannot be jettisoned until 70% of the aircraft weight is off the wheels.

FLIGHT WITH EXTERNAL LOADS

Handling qualities of the aircraft with stores loaded vary with their weight, shape, and distribution. Spanwise loading increases roll inertia noticeably, with accompanying reduction in roll acceleration. For all store configurations, lateral control is still satisfactory. Longitudinal control and stability is least affected by addition of stores.

Stores with large diameters, such as fuel tanks and the air refueling pod, cause added airframe buffet during flight above normal cruise speeds, and during increased g loads.

BACKUP FLIGHT CONTROLS HYDRAULIC SYSTEM

Upon complete hydraulic failure, a backup flight control system is activated which provides horizontal stabilizer control through longitudinal stick movement and rudder control through pedal movement. Flaperon control is not provided.

The backup flight controls hydraulic system provides the capability of recovery from unusual attitudes, basic navigation, and, under optimum conditions, field landings. Refer to Section V for recommended flight procedures using the backup flight control system.

Flight on the backup flight controls hydraulic system may be simulated by using only rudder for roll control with STAB AUG at OFF. Training should include cruising flight, recovery from unusual attitudes, and no-flap landings, all without the use of flaperons.

Training flights using the extended rudder throw available with the assist spin recovery switch are prohibited except for no-flaps landing practice.

LONGITUDINAL CONTROL RATE LIMITING

In the cruise configuration, aircraft pitch response is high, requiring surface rates well below the actuator saturation limit. Aircraft pitch response to longitudinal stick inputs is identical to normal flight control response.

In the power approach configuration, as the speed decreases, the pitch response is reduced requiring large stabilizer rates to obtain a given g per unit time. Aft stick surface rate limiting occurs first and is more critical and noticeable to a pilot who, during the landing approach, is attempting to recover from a rapidly induced pitch-over. Longitudinal stick rate limiting becomes apparent at about 150 kts and increases in severity as the speed decreases. This condition is not hazardous if rate limiting is anticipated and moderate, unexcessive longitudinal control inputs are effected.

TRIM CHANGES

Gear extension or retraction produces no appreciable trim change and can be easily controlled. Flap extension can result in a significant roll-off in either direction. This is a result of assymetric floating of the flaperons due to flap extension. The degree of assymetry is unpredicable; therefore, it is recommended that the flaps not be extended when controlling the aircraft with the backup system only.

DIHEDRAL EFFECT

Attempts to yaw the airplane with rudder will produce roll in the same direction as yaw. This dihedral effect becomes more pronounced at high angles of attack. The use of rudder inputs to produce yaw and in turn generate roll, will provide the highest attainable roll rates at high angles of attack. The rudder must be used judiciously, however, since excessive rudder inputs will induce excessive yaw.

part 3**Formation and Tactics****FORMATION TAKEOFF**

All aspects of the takeoff must be prebriefed by the flight leader such as use of nose-wheel steering, power changes, power settings, and signals for landing gear and flaps.

Section takeoff will not be performed with dissimilar type aircraft, nor with a crosswind component in excess of 10 knots. The section leader will position his aircraft on the port side of the runway. Aircraft will line up on a parade bearing with enough lateral clearance to provide separation between aircraft in case the leader experiences a blown tire, or is required to abort the takeoff. When the section is in position, the B/N of the lead aircraft will give a two-finger turn-up signal at the command of the flight leader. Next, both pilots will turn up to military power and make all final checks from the check list. The lead B/N will carefully check the second for leaks, trim settings, flap settings, and flaperon position, at which time the second aircraft pilot will make the same checks of the lead aircraft. After airframe and instrument requirements are met by both aircraft, the lead B/N and wingman will show a raised hand to indicate they are both ready for takeoff. At the command of the lead pilot, the lead B/N will drop his hand smartly out of view to signal brake release and commencement of takeoff roll. The lead pilot will reduce his power approximately 2% on each engine before giving the brake release command. The wingman will adjust his power to maintain relative position through the takeoff roll. Normal takeoff techniques will be utilized with respect to the nose-wheel steering and lift-off speed.

When the section is comfortably airborne and has established a positive rate of climb, the lead B/N at the command of the lead pilot will signal for the landing gear to be raised. When the section has attained safe altitude and airspeed, the lead B/N will give the appropriate signal and the flaps will be raised, again (at the command of the lead pilot).

Turns into the wingman will not be made at altitudes of less than 500 feet AGL. The first section must be airborne before the second section commences its takeoff roll. See visual communication procedures in Section VII.

CAUTION

- In the event of an aborted takeoff, the aircraft aborting must immediately notify the other aircraft. The aircraft not aborting should add maximum power and accelerate ahead and out of the way of the aborting aircraft. This will allow the aborting aircraft to steer to the center of the runway and engage the arresting gear.

- It is imperative that the wingman always be alert for an overrunning situation and take timely steps to preclude such an occurrence. Should an overrunning/overshooting situation develop after becoming airborne, the wingman should immediately move laterally away from the lead and, if feasible, reduce power in order to maintain wing position. Safe flight of both aircraft must not be jeopardized in an attempt to maintain formation. The leader should detach the wingman if he is experiencing loss of thrust and flying speed. The wingman should detach and add power if unable to maintain a safe wing position on the lead.

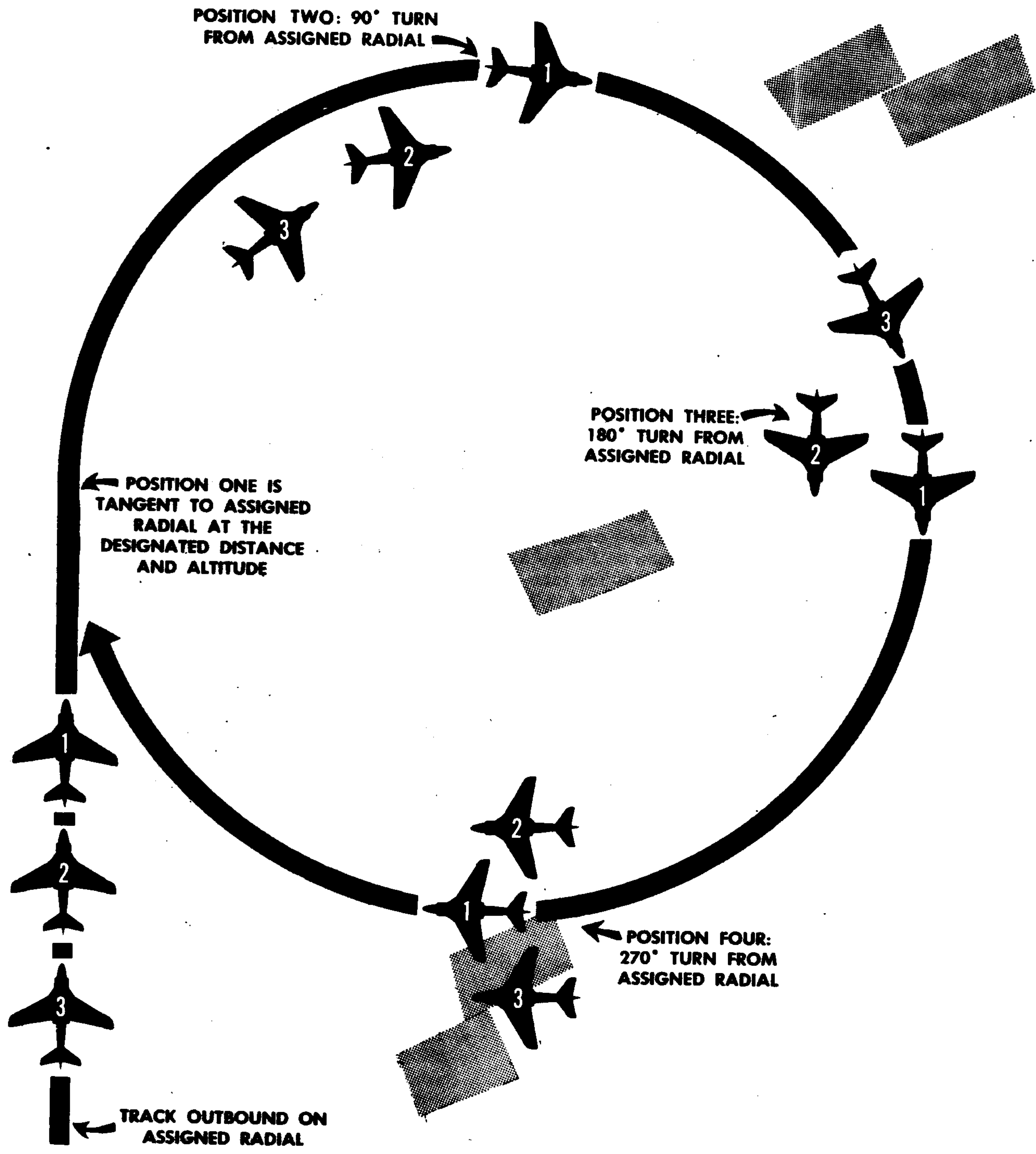
RENDEZVOUS**TURNING RENDEZVOUS**

The turning rendezvous is made at 300 KIAS (unless otherwise briefed). After all aircraft are in a loose-trail position, the leader commences a 180° turn, using 30° of bank. Each member of the flight waits until the aircraft ahead passes through a 30° bearing from his 12-o'clock position, and then rolls into a 45° banked turn to the inside of the leader's turn. When the leader bears 40° relative to the joining aircraft, wingmen ease turn as necessary to maintain the 45° bearing until joined either on the preceding aircraft or the flight. Wingmen may add power to gain no greater than a 10-knot speed advantage over the leader, to avoid overshooting. As the aircraft approach the leader, the closure rate is adjusted so as to join on the man ahead or on the inside of the leader's turn. After joining on the inside of the leader, a crossunder is made to the outside, assuming normal wing positions.

CIRCLING RENDEZVOUS

A circling rendezvous is used when aircraft are separated by extended or indefinite distances or time intervals. The pattern is normally a starboard orbit, using 30° of bank around a geographic fix. Altitude must be specified and airspeed will be 300 KIAS (unless otherwise briefed). Upon arrival, each aircraft flies directly over the fix, slightly below the rendezvous altitude, to provide altitude separation upon entry into the pattern. The first aircraft to arrive should establish the orbit. Subsequent aircraft should be able to sight other aircraft in the circle from directly over the fix. When sighted, a hard turn in the direction of the orbit turn should be made to establish a 45° bearing relative to the joining aircraft. Vary the bank as necessary to maintain the bearing until joined. Do not use an airspeed advantage in excess of 15 knots. As the leader is closed, check closure rate so as to stop on the inside of the turn; then cross under to a normal wing position on the outside (figure 4-6).

TACAN CIRCLING RENDEZVOUS



ADF1-75

Figure 4-6

TACAN CIRCLING RENDEZVOUS

A TACAN circling rendezvous is used when aircraft are separated by extended or indefinite distances or time intervals and it is not possible to use a geographic fix (at sea or above an overcast). The pattern will be a starboard orbit tangent to the designated TACAN radial, at a specified distance and altitude. Normally, each pilot flies outbound on the assigned radial, maintaining the briefed climb schedule or rendezvous speed. Upon reaching the join-up circle, each pilot commences a starboard orbit, using 30° of bank (or more) until visual contact is made with the flight leader. If necessary, request for the leader's position. The leader will state his position around the orbit, using figures 1, 2, 3, or 4, corresponding to 000°, 090°, 180° and 270°, respectively, relative to the designated radial, as shown in figure 4-6. Each pilot then plans his turn to cut across the orbit for rendezvous. ARA-25 may be used to assist in picking up the leader.

RUNNING RENDEZVOUS

A running rendezvous is effected by closing from the rear on a prebriefed heading or radial. This rendezvous should be accomplished with the leader climbing at 300 KIAS and 95% (unless otherwise briefed). If it is to be made level, the leader should normally be at 300 KIAS at the designated altitude.

ADF RUNNING RENDEZVOUS

The ARA-25 rendezvous is useful for joining aircraft under all conditions, and particularly during a straight course running rendezvous. The procedure to be used for the latter is as follows:

1. Trailing aircraft select ADF position on UHF control.
2. The flight leader will transmit a short count every minute, and when climbing, include passing altitude.
3. Trailing aircraft will position themselves so that as leader transmits short counts, No. 1 needle points 5° left or right of nose position. The No. 2 aircraft will hold leader to his left, No. 3 to his right, etc.
4. As trailing aircraft approach flight leader, they will turn to keep him 5° (left or right respectively) off nose position. The amount of turn required to maintain leader in this position will increase as separation is reduced. Continue until visual sighting is obtained.

ADF CIRCLING RENDEZVOUS

If a circling rendezvous is to be made, the flight leader will maintain prebriefed airspeed, 30° of bank, a specified altitude, and broadcast a short count and heading every minute. The trailing aircraft will correct heading to keep the No. 1 needle on the nose when the leader transmits. From the change in azimuth of the No. 1 needle between short

counts, approaching aircraft will be able to determine their proximity to the lead aircraft. Approaching the flight leader, the needle will change more degrees in azimuth between counts, requiring larger corrections to keep the leader on the nose. At this time, the leader can probably be detected visually and a standard rendezvous completed.

LOW VISIBILITY RENDEZVOUS/RENDEZVOUS ON DIFFERENT MODEL AIRCRAFT

This type of rendezvous should be performed in emergency situations only when directed by higher authority or when the urgency of the mission dictates. The rendezvous aircraft should be flown at a safe maneuvering airspeed. The initial procedures will be as previously described for standard rendezvous. However, the latter stages should be modified as outlined below.

1. Establish radio contact, if possible, and determine indicated airspeed and intended flight path of aircraft to be joined.
2. Place all lights on BRIGHT (if applicable).
3. Rendezvous about 1,000 feet out, slightly aft of abeam (4 or 8 o'clock) lead aircraft.
4. Cautiously close, while assuring constant nose-to-tail clearance. Maintain a constant relative bearing. Changes in relative bearing will cause foreshortening or lengthening of aircraft fuselage and make determination of closure rate difficult.
5. A rendezvous on a different model aircraft and or in low-visibility conditions is extremely conducive to vertigo. A high degree of caution and good judgment must be exercised throughout the rendezvous. At no time should a rapid-closing situation be allowed to develop.

SAFETY RULES FOR RENDEZVOUS

1. During all rendezvous, safety shall be the prime consideration.
2. Keep all aircraft ahead constantly in view and join in order.
3. During rendezvous, only enough step-down should be used to ensure vertical clearance on aircraft ahead.
4. When necessary, a wingman should abort rendezvous by leveling his wings, sighting all aircraft ahead, and flying underneath them to outside of formation. He should then remain on outside until all other aircraft have joined.
5. To avoid overshooting, all relative motions should be stopped when joining on an inside wing position. A crossunder to outside may then be made.

6. During a running rendezvous, use caution in the final stage of join-up, as relative motion is difficult to discern when approaching from astern.

FORMATION

FREE CRUISE FORMATION (4 AIRCRAFT DIVISION)

This formation (figure 4-7) will normally be employed for all operations away from home base, unless another formation is signaled. Within each section, the wingman's position is 45° aft the section leader's beam, with sufficient distance abeam to clear the wingtips, and sufficient distance astern to clear the tail of the lead aircraft.

The vertical stepdown of the wingman will be sufficient to clear the leader's aircraft and jet wash. The second section leader's position is approximately 45° abaft the division leader's beam and slightly stepped down. The second section leader must maintain a distance out on the assigned bearing line which will provide clearance with the lead section wingman and which will also permit visual communications between division and section leader. During steep turns or hard maneuvering, the second section and wingmen within each section are free to slide as necessary to avoid large power changes.

PARADE FORMATION

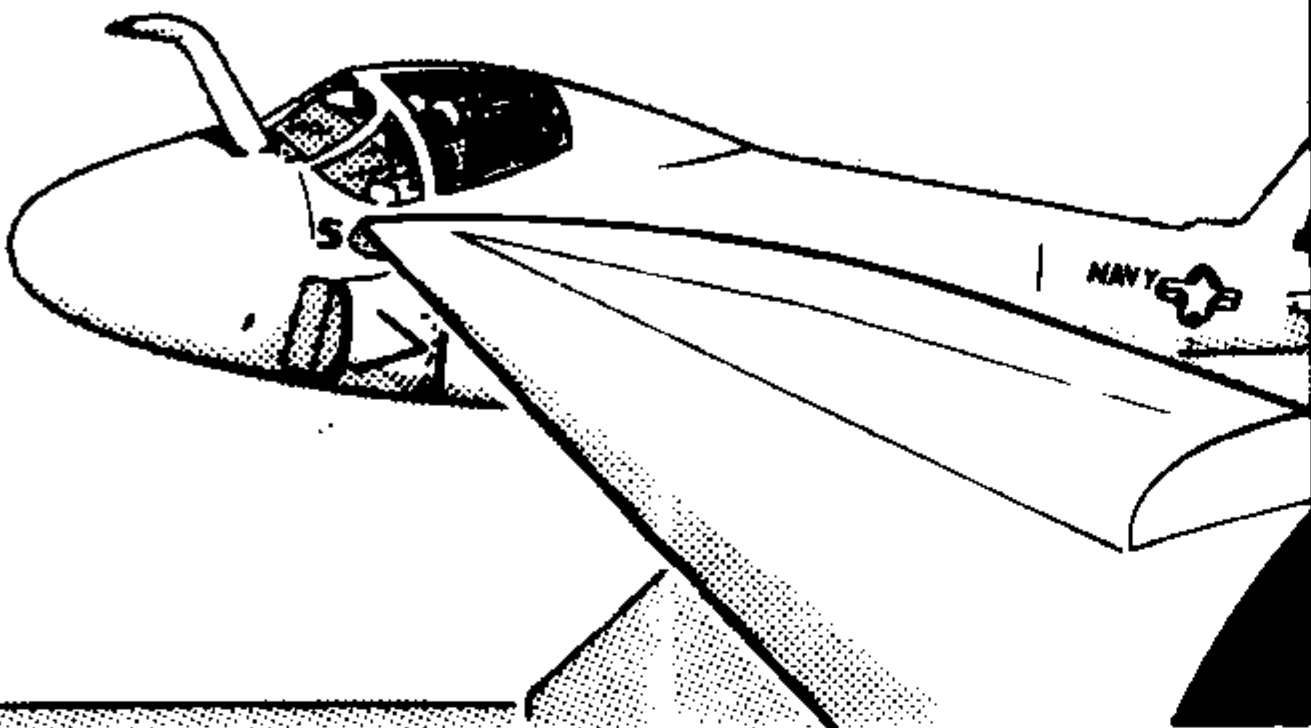
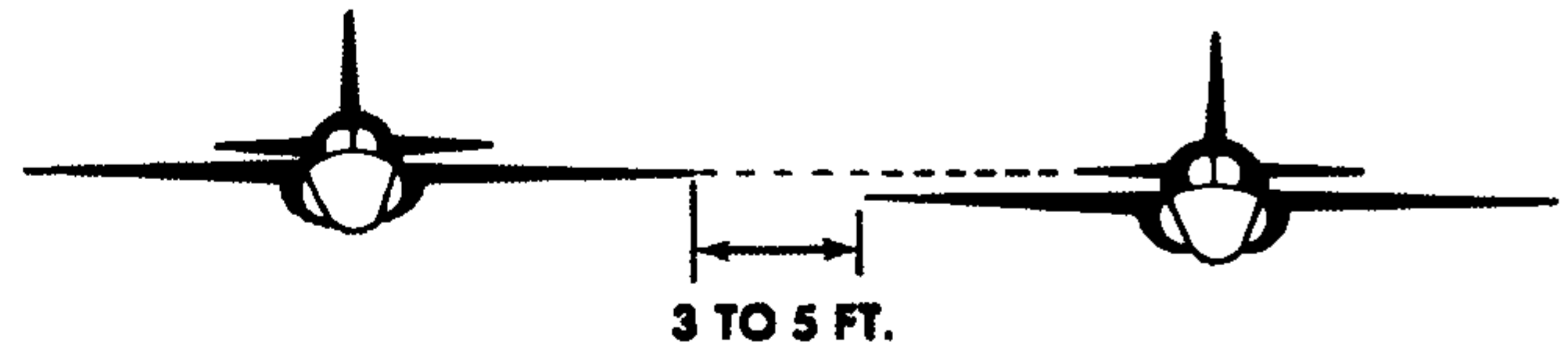
This formation (figure 4-7) will normally be employed when the flight is operating in the vicinity of home base and in conditions of low visibility. The parade formation position is obtained by the wingmen and sections leader maintaining a position slightly stepped down with 3 to 5 feet of lateral clearance between wingtips on a bearing matching the sweep back of the wing leading edge. Sliding during turns is not permitted.

FORMATION INSTRUMENT APPROACH

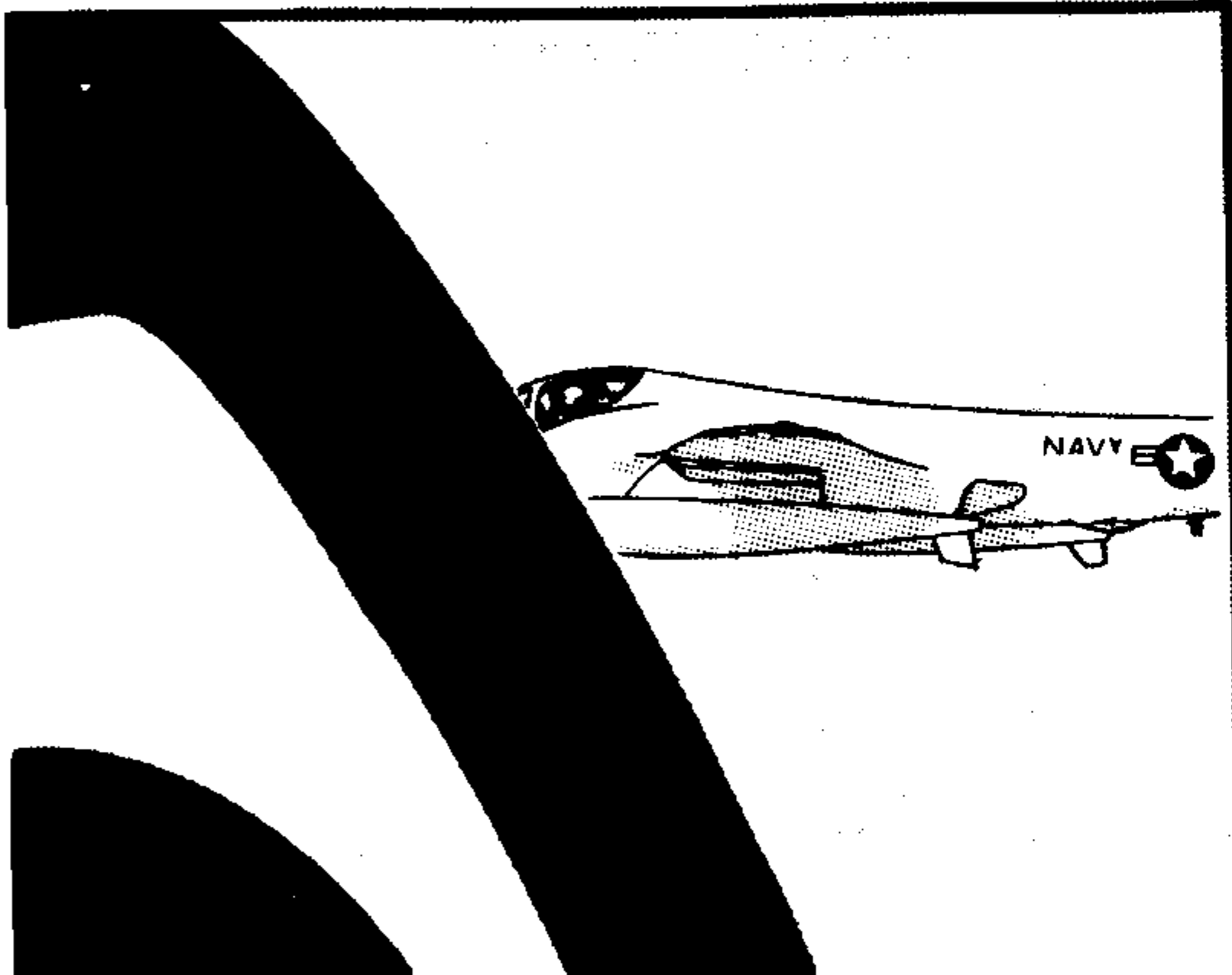
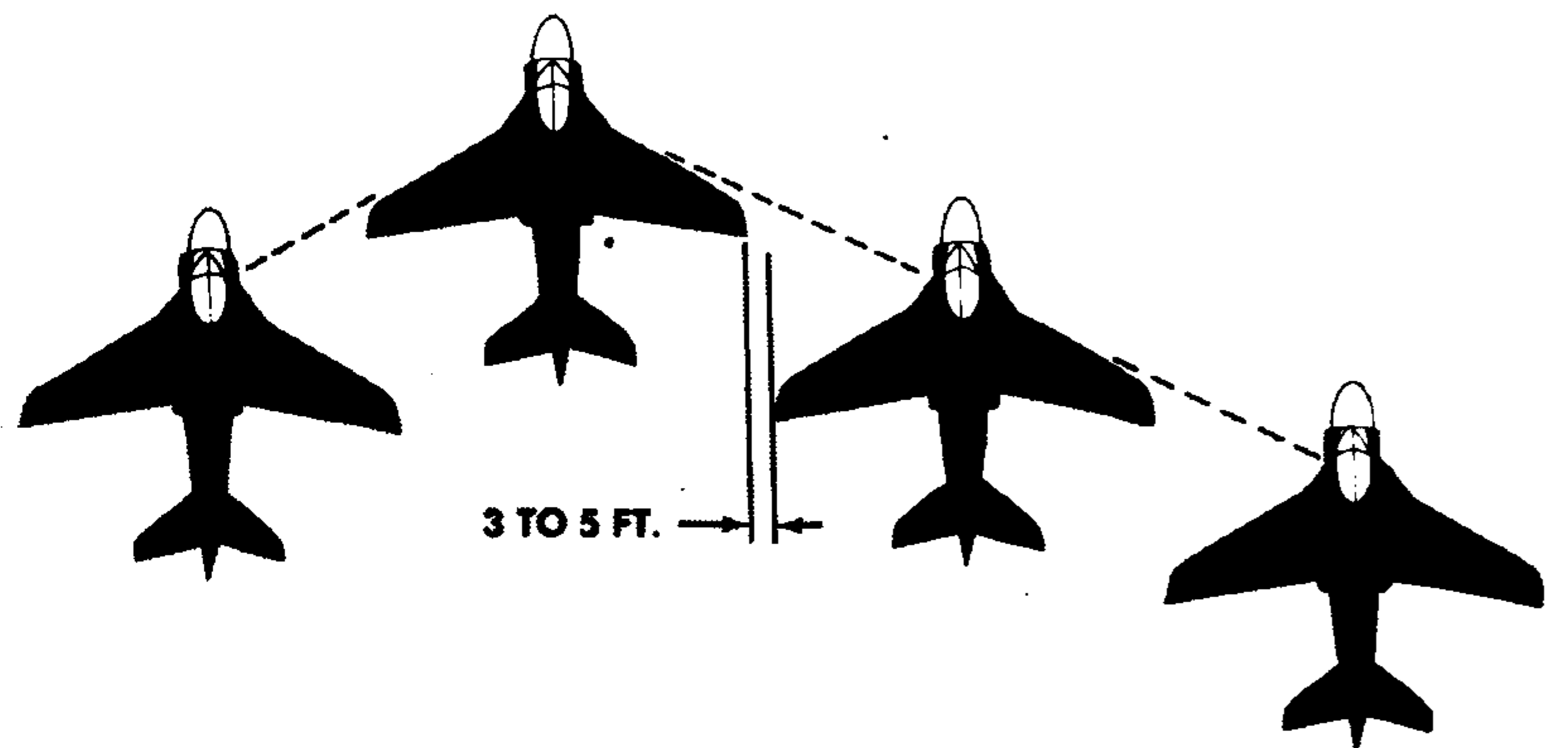
1. Wingman follows all configuration changes of the leader.
2. When runway OLS is sighted, leader signals lead change to wingman. When wingman considers he can safely continue approach unaided, he accepts lead.
3. After passing lead, the leader turns away from wingman, and then back to final approach heading and observes wingman's progress.
4. In case of a wave-off or bolter, and a VFR pattern is not feasible, the wingman rejoins leader for another approach.

FORMATIONS

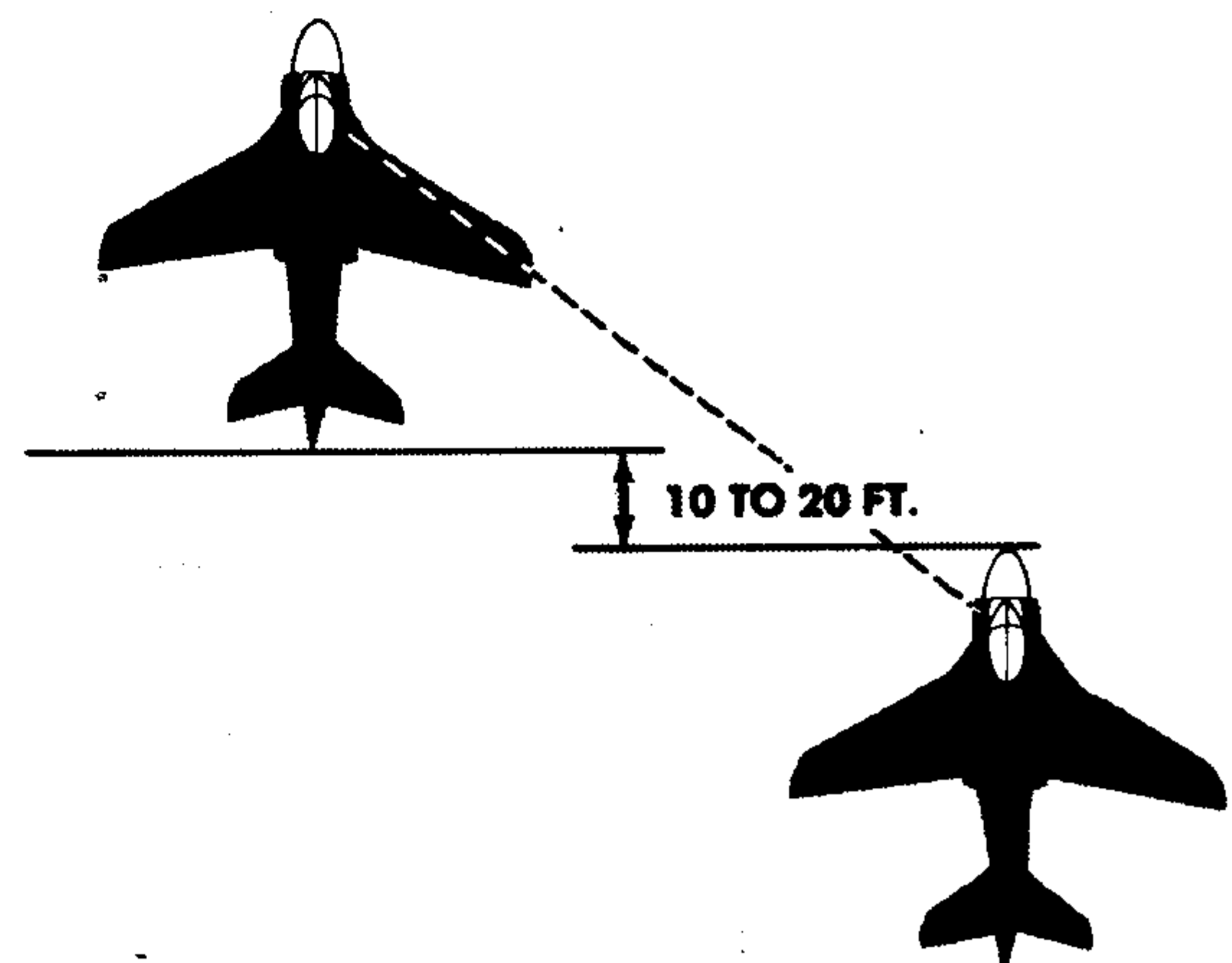
PARADE



BALANCED PARADE



CRUISE FORMATION



ADF1-123

Figure 4-7

part 4

Air Refueling

AIR REFUELING (TANKER)

BEFORE TAKEOFF

1. Ship tank switch OFF
2. Drogue position switch RET
3. Refueling master switch OFF
4. Fuel transfer switch OFF
5. Light switch (Day) BRT
(Night) DIM
6. Gallons delivered 000.
7. Hose jettison switch OFF

DROGUE EXTENSION

1. Refueling master switch ON
2. Airspeed 300 KIAS or less
3. Drogue switch EXT
Drogue indicator will read EXT when drogue reaches full trail position.
4. Ship tank switch TO STORE

RECEIVER HOOKUP AND REFUELING

After the receiver aircraft engages and moves forward in relation to the tanker enough to turn off the amber light on the store, the drogue position indicator will read TRA. The bombardier/navigator then places the fuel transfer switch to TRANS to start the flow of fuel.

Stopping Fuel Transfer

Fuel transfer may be stopped at any time by placing the fuel transfer switch to OFF. Refueling will stop if the receiver aircraft backs off enough for the amber light to come on or if the probe disengages. In either case, the drogue position indicator window will change from TRA to EXT.

CAUTION

Refueling cannot be stopped by placing the refueling master switch in the OFF position. Lack of hydraulic pressure will cause whiplash to occur in the refueling hose.

To stop transfer to the store, turn the ship tank switch to OFF.

If hose tensioning or reel-in features are inoperative, the hookup should be discontinued immediately and the cause determined. If the hose does not reel in properly, a recycling of the hose by the tanker may remedy the malfunction.

DROGUE RETRACTION

1. Fuel transfer switch OFF
2. Airspeed 250 KIAS OR LESS

WARNING

Field or carrier landing with drogue extended is not recommended. Guillotine drogue in clear or uninhabited area.

3. Drogue switch RET

Note

If the drogue cannot be fully retracted at about 250 KIAS, reducing airspeed to 230 KIAS or less should permit full retraction.

4. When drogue position indicator reads RET, place refueling master switch to OFF.

TRANSFER FROM STORE TO TANKER

If it is desired to transfer fuel from the refueling store to the tanker, place the ship tank switch to FROM STORE.

BEFORE LANDING

1. Ship tank OFF
2. Drogue switch RET
3. Drogue position indicator RET
4. Refueling master switch OFF
5. Fuel transfer switch OFF

JETTISONING REFUELING STORE

The air refueling store may be jettisoned electrically in the same manner as other external stores.

TANKER SAFETY PRECAUTIONS

Note

Do not jettison refueling stores above 300 KIAS.

WARNING

- Do not start the turbine or extend or retract the drogue when over populated areas or when other aircraft are close abeam or behind.
- Do not extend the drogue when a store hydraulic leak has been observed.
- Do not actuate the speed brakes during any part of the refueling operation.
- Once the hose jettison switch is actuated, do not return it to the OFF position. Inadvertent cycling of this switch will cause a dangerous condition in the store.

IN-FLIGHT REFUELING STORE LIMITATIONS

1. Maximum speed for unfeathering is 300 KIAS. For extension of drogue and refueling, maximum speed is 300 KIAS or 0.80 IMN.
2. Maximum speed for drogue retraction is 250 KIAS.
3. The air refueling store must be empty for catapult launches if it is suspended from the AERO 7A rack. Catapult launches with a full store are permissible if the AERO 7B rack is used.
4. Maximum gross catapult weight with an air refueling store on the AERO 7A rack is 52,500 pounds due to possible trail bar slap.
5. The air refueling store must be empty for arrested landings.

WARNING

- When the ship tank switch is placed to FROM STORE to empty the air refueling store prior to carrier arrestment, do not select landing gear down until the SHIP TANK switch is placed from FROM STORE to OFF. When the landing gear is lowered, the air refueling store depressurizes and, if FROM STORE is selected, the shutoff valve remains open, allowing reverse flow back into the air refueling store. Fuel flow to store will be accelerated if FUSELAGE DUMP is also selected.
- When receiving fuel from a KC 135, the drop tanks may be filled but the maximum internal fuel shall not exceed 14,000 pounds of JP-4 or 15,000 pounds of JP-5. The A6 has no surge relief provisions between the probe and the refueling

gate valve; therefore, the receiver aircraft must discontinue fueling by disengaging from the refueling drogue.

AIR REFUELING RECEIVER TECHNIQUE

Air refueling can be accomplished within a wide range of altitude and airspeed. Successful engagements have been made between sea level and 35,000 feet at airspeeds between 190 and 300 KIAS. The optimum airspeed for engagement is approximately 230 KIAS. Use of optimum airspeed will assist the receiver in escaping heavy buffeting caused by the tanker slipstream and jet exhaust. Prior to engaging the drogue of a tanker aircraft, the FUEL READY switch on the fuel management panel must be positioned to FLT to depressurize wing and drop tanks.

CAUTION

Closure speeds in excess of 5 knots and off-center engagements may cause the refueling probe valve assembly to become distorted and prevent successful fuel transfer.

Thermal turbulence from the deck may be annoying when hooking up at very low altitudes due to oscillatory drogue motion.

Normally the air refueling operation is conducted without the use of radio transmissions. For proper hand signals see Section VII.

1. The receiver pilot should move into a position 20 feet behind and below the drogue, on a plane with the trailing drogue, to minimize turbulence from the tanker's wake. Call "Lining Up" before sliding into position behind the tanker. Observe amber light on tanker store indicating store may be engaged. If light is not on, use caution during engagement, as hose tensioning and reel-in may be inoperative. The most likely cause however, is a burned out bulb. Trim the aircraft slightly nose-down to remove any slop or break-out force from the horizontal stabilizer control system, and move forward and up until the tip of the probe is approximately 5 to 10 feet behind and 2 to 3 feet below the drogue. Pause here long enough to get stabilized, then add enough power to close and engage the probe at a closure speed of about 3 knots. The probe and drogue are primary visual references. Closure speeds in excess of 5 knots may cause hose whip with ensuing damage. Misalignment at high closure speeds may cause damage to radome or canopy. If the drogue is missed, stay below the drogue and back straight out until the drogue is in sight.

Note

When refueling from KC-130 tanker aircraft, at other than high gross weight conditions, takeoff flaps may be used to maintain position with the drogue. Under high gross weights or high drag counts, use of flaps is not recommended because it will reduce power available to establish sufficient closure speed.

2. After engaging the drogue and the amber light goes out, the receiver calls "Contact". The last 20 feet of hose to unreel from the store has a white stripe every 2 feet. At least two stripes must be pushed into the store before transfer will occur. Do not fly so close that no stripes are visible. Maintain a position so that if some opening between the tanker and the receiver occurs, the transfer will not be interrupted. This position should also be along the general reference of the hose before plug-in and will keep the hose centered slightly above the lip of the aft end of the store.

3. Disengagement is accomplished by the receiver reducing power in order to open from the tanker at about 3 knots. Back straight away and down, following the flight path of the tanker.

When the receiver aircraft is clear of the area behind the hose and drogue, call "Clear".

CAUTION

All disengagements must be made straight back, parallel to the tanker flight path and descending along the natural trail angle of the hose. Disengagements from below the natural trail position of the drogue may cause the refueling probe valve assembly to become distorted and prevent successful fuel transfer.

NIGHT REFUELING

Night refueling is performed in the same manner as during the day. The tanker should have all exterior lights DIM and the anticollision lights off. The centerline store lights should be on DIM. The amber lights on the outboard pylons of the tanker aircraft are used for reference during night refueling. A white light in the under side of the tanker fuselage will illuminate the refueling hose.

Prior to assuming position for approach to the drogue, receiver aircraft may turn on the probe light. Take up an initial position on the tanker and use the same procedures described in this section for day refueling. When in position aft of the drogue, correct altitude can be determined by referring to the amber pylon lights. The receiver aircraft lights should be on BRIGHT and the anticollision light ON.

The tendency in night in-flight refueling is to start the approach too far aft. This makes it very difficult to judge relative motion and usually results in a high closure rate.

Note

Do not engage the AUTO mode of the AFCS while in-flight refueling.

section V

EMERGENCY PROCEDURES

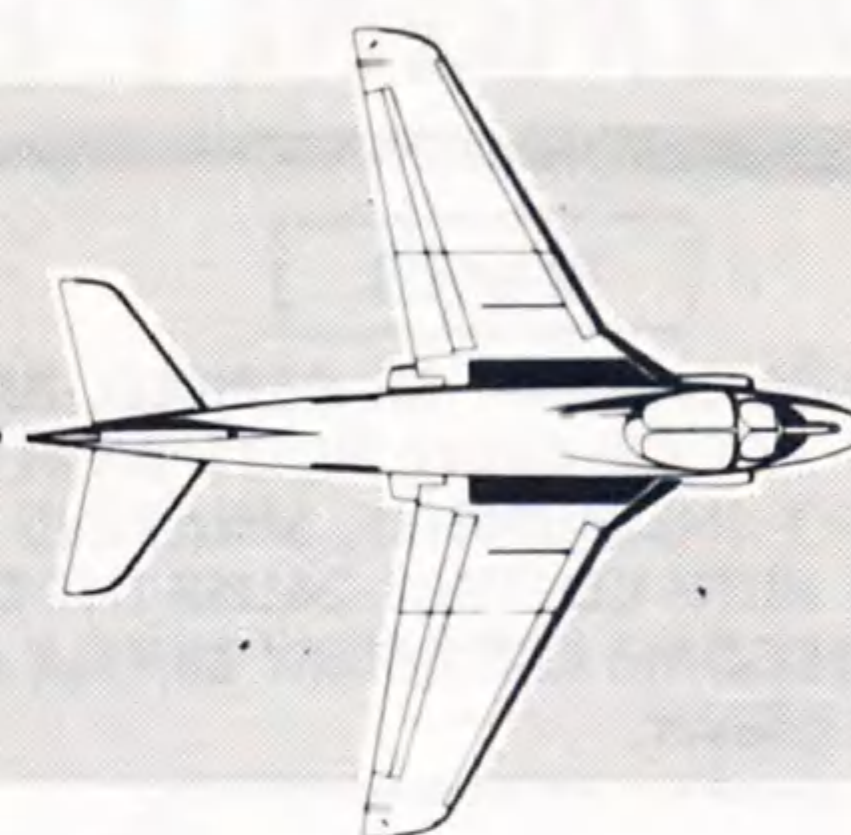


TABLE OF CONTENTS

GROUND EMERGENCIES	5-2	Flaps/Slats Fail To Retract	5-21
Engine Starting Malfunctions	5-2	Flaperon Pop-Up Failure	5-21
Emergency Entrance	5-2	Landing-Gear Handle Cannot Be	
Emergency Engine Shutdown	5-2	Raised	5-22
TAKEOFF EMERGENCIES	5-3	Landing-Gear Handle Up,	
Engine Failure Or Fire/Takeoff		Indicates Unsafe	5-22
Aborted	5-3	Weight-On-Wheels Switch Failure	5-22
Engine Failure/Takeoff Continued	5-3	Damaged Aircraft	5-22
Fire Warning Light/Takeoff		Airspeed Indicator Failure	5-23
Continued	5-3	LANDING EMERGENCIES	5-23
Strut Lock Light	5-4	Single-Engine Landing	5-23
Tow Link/Nose Gear Cocked	5-4	Flaps or Slats Fail to Extend Normally	
IN-FLIGHT EMERGENCIES	5-4	(Failure Other Than Hydraulic)	5-26
Engine Failure	5-4	No Flaps/No Slats Landing	5-26
Air Starts	5-6	Flaps Take-Off/No Slats Landing	5-26
Fire	5-6	No Flaps/Slats Down Landing	5-27
Ejection	5-9	Landing-Gear Down, with Unsafe	
Manual Bailout	5-14	Indications	5-27
Emergency Jettisoning	5-14	Field Arresting Gear	5-28
Emergency Fuel Dumping	5-15	Barricade Arrestment	5-31
Oil System Failures	5-15	Forced Landing	5-31
Engine Fuel System Failure	5-15	Blown Tire	5-31
Electrical System Failure	5-16	Arresting-Hook Malfunction	5-32
Hydraulic System Failure	5-19	Wheel-Brake System Failure	5-32
Speed-Brake System Failure	5-21	Ditching	5-32

INTRODUCTION

Knowledge of the aircraft and emergency procedures must be reviewed on a regular basis to insure that the crew will take the correct course of action when faced with difficulties. The initial training should be thorough in this respect. Above all, the crew must recognize and admit the emergency situation, then take positive steps in accordance with recommended procedures and good airmanship. Due to the many situations that can arise concerning emergencies, it is impossible to set an absolute policy. The crew must weigh all the factors of a given situation and

then take appropriate action for the particular situation. This manual discusses and preplans some likely courses of action and the recommended way of handling certain emergencies. The emergency procedure section should be referred to on a continuing basis. Reference to emergency procedures promulgated in NWP-41 is also required.

Note

As soon as possible, the pilot should notify the bombardier/navigator of the emergency and the intended action.

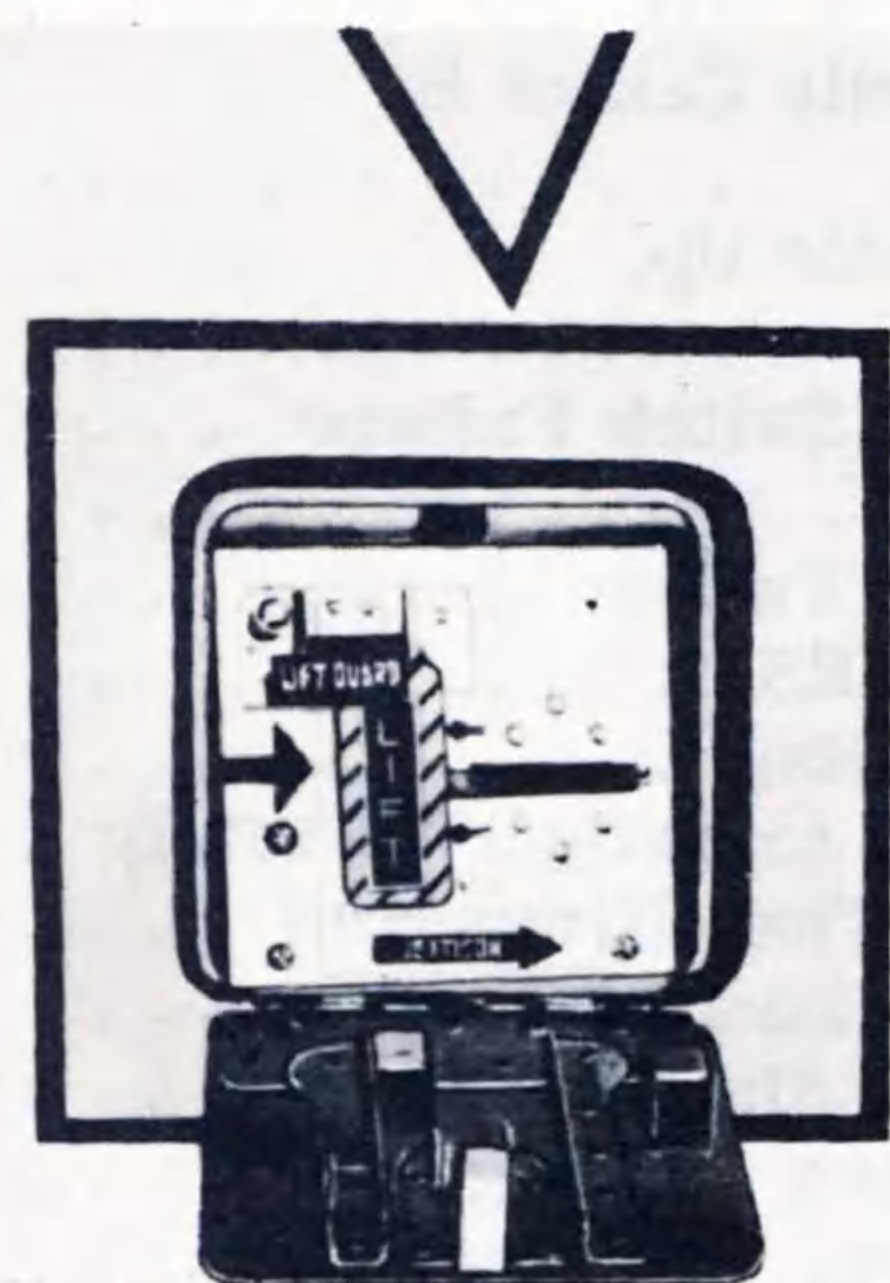
EMERGENCY ENTRANCE

NOTE

IF CANOPY CANNOT BE OPENED, BREAK CANOPY AFT OF CREW SEATS WITH AXE OR HEAVY INSTRUMENT. SPRAYING THE CANOPY WITH CO₂ WILL CAUSE THE CANOPY TO BECOME EXTREMELY BRITTLE AND EASY TO BREAK.

WARNING

WHEN REMOVING CREW FROM AIRCRAFT, DO NOT PULL THE FACE CURTAIN HANDLE OR ALTERNATE FIRING HANDLE. ACTUATING THE HANDLES WILL EJECT THE SEAT FROM THE AIRCRAFT.



LOCATED ON BOTH SIDES OF FUSELAGE-COCKPIT AREA



OPEN DOOR

RAISE HANDLE GUARD
PULL HANDLE

ADF1-76

Figure 5-1

GROUND EMERGENCIES

For emergency entrance to aircraft see figure 5-1.

ENGINE STARTING MALFUNCTIONS

If any of the following indications occur during an engine start, a malfunction exists and immediate action is required.

- Wet start (no light-off within 10 seconds of placing throttle to IDLE)
- Hot start (EGT exceeds 455° C)
- Hung start (RPM fails to accelerate to IDLE)
- Fire warning light, or other indications of fire

Proceed as Follows:

1. Throttle OFF (affected engine)
2. Allow engine to continue cranking for 30 seconds if starter mode is still engaged. The CSD starter mode automatically disengages at 48% to 50% RPM

3. Engine and fuel master switches OFF

Note

Attempt restart only if cause is determined to be other than an engine malfunction and the maximum start temperature has NOT been exceeded.

EMERGENCY ENGINE SHUT DOWN

In an extreme emergency, where continued engine operation is undesirable, the engines can be shut down most expeditiously as follows:

1. Throttles OFF
2. Engine/fuel master switches OFF

TAKEOFF EMERGENCIES

The takeoff phase of flight is critical in that it affords the pilot a very short period of time in which to decide whether to continue or abort the takeoff. The pilot must have fixed firmly in mind the best course of action to be taken in any given situation. Before each flight the pilot should know:

1. Lift-off airspeed and takeoff ground roll
2. Refusal speed and distance, or line check speed and distance
3. Single-engine performance (refer to Section XI)
4. Availability and location of arresting abort gear
5. Surrounding terrain and obstructions

Note

During any takeoff emergency where a safe abort cannot be accomplished and takeoff is impossible, ground-level ejection is possible at any speed.

ENGINE FAILURE OR FIRE/TAKEOFF ABORTED

If either engine fails or a fire warning light comes on during the takeoff run, abort immediately if sufficient runway is available.

1. Throttles/speed brakes IDLE/EXTEND
2. Bleed-air isolation valves (aircraft incorporating AFC No. 268)
 - a. NWW
 - b. CSD
 - c. AIR COND
 GANG-BAR OFF
3. Throttle (affected engine) OFF

Note

Use caution when securing the right engine to prevent inadvertent shutdown of both engines. If both engines are secured, antiskid, nose-wheel steering, flaperon pop-up, and normal braking will be lost.

4. Engine and fuel master switch (affected engine) OFF
5. Brakes APPLY
6. Nose-wheel steering ENGAGE

If an Arrested Rollout is To Be Made :

7. Arresting hook DOWN
8. Steer for center of runway
9. Canopy OPEN AFTER ARRESTMENT

ENGINE FAILURE/TAKEOFF CONTINUED

The pilot's reaction and his ability to maintain directional control, altitude, or climb depends upon

the gross weight of the aircraft, air density, ambient temperature, and the thrust of the good engine. Prior to each flight it is essential that the pilot know the single-engine climb speed for his aircraft configuration. If this speed has not been attained, the following steps are considered optimum to continue safe flight:

1. Operating engine MAX THRUST
2. External stores JETTISON
3. Landing gear UP, AFTER AIRBORNE
4. Establish single-engine climb . . 22 units AOA
5. Wing and fuselage fuel DUMP
6. Fly straight ahead. Attempt no turns until safe airspeed and altitude are attained (terrain permitting).
7. Failure other than mechanical ATTEMPT AN AIR START
8. Flaps UP (after safe airspeed is attained)

For Obvious Mechanical Failure:

9. Throttle (failed engine) OFF
10. Engine and fuel master switch (failed engine) OFF
11. Climb to safe altitude; land as soon as practicable.

Note

Landing should not be attempted until fuel has been dumped or burned down.

FIRE WARNING LIGHT/TAKEOFF CONTINUED

If a warning light comes on immediately after takeoff, without other visual or audible confirmation, the pilot's first concern is to maintain safe flight.

The fire warning light is reliable.

Before each flight it is essential that the pilot know the single-engine climb speed for his configuration.

If this speed has not been attained, the following steps are considered optimum for continuing safe flight.

1. Engines MAX. THRUST
2. External stores JETTISON
3. LANDING GEAR. UP, AFTER AIRBORNE
4. Bleed-air isolation valves (aircraft incorporating AFC No. 268)
 - a. NWW
 - b. CSD
 - c. AIR COND
 GANG-BAR OFF
5. Establish single-engine climb. . (22 units AOA)
6. Throttle (affected engine) OFF

7. Wing and fuselage fuel DUMP
8. Continue flight straight ahead. Attempt no turns until a safe airspeed and altitude are attained (terrain permitting).
9. Flaps UP
(after safe airspeed is attained) See Takeoff and Climb Charts, Section XI, Part 3.
10. Engine and fuel master switch (affected engine) OFF
11. Climb to safe altitude: DO NOT ATTEMPT restart on affected engine.
12. If fire indications are positive EJECT
Some positive indications might be explosion, vibration, abnormal engine instrument readings, smoke or fumes in the cockpit, burning odor in oxygen mask, trailing smoke, or verification from another aircraft or control tower.
13. If fire indications are not positive
. LAND AS SOON AS POSSIBLE

STRUT LOCK LIGHT

If the STRUT LOCK light comes on with the landing gear down, this indicates that the nose strut is still locked. A field landing is preferred.

TOW LINK/NOSE GEAR COCKED

- Tow link in nose-gear window
 - Flashing indexer
1. Obtain a visual check.

If Nose Wheel Cocked:

2. Make a normal landing, use aerodynamic braking and then place nose firmly on deck.

If Tow Link is Down and Nose Wheel is Straight:

3. Gear handle RECYCLE

IN-FLIGHT EMERGENCIES

ENGINE FAILURE

See figure 5-2 for velocity required for maximum glide.

SINGLE-ENGINE FLIGHT CHARACTERISTICS

WARNING

At certain gross weights and ambient temperatures, the aircraft will NOT fly on one engine in the takeoff or landing phase of flight. The applicable single-engine graphs should be referred to before each flight.

Because of the location of the engines relative to the centerline of the aircraft, only a slight rudder deflection is required to prevent a yaw toward the failed engine at normal speeds. Minimum single-engine control speed varies with gross weight, flap setting, and the landing gear position. The aircraft is designed so that no one system (hydraulic, pneumatic, electrical, etc.) is dependent on a specific engine. Therefore, loss of an engine will not result in a loss of any complete system. Refer to Section XI for single-engine performance data.

SINGLE-ENGINE FAILURE DURING FLIGHT

It is possible to shut down (secure) an engine due to the malfunction of the fuel control system or to incorrect technique used during certain critical flight conditions. If engine failure can be attributed to some obvious nonmechanical failure, proceed as follows:

1. Speed brakes CLOSED
2. Positively determine failed engine

3. Attempt air start if feasible. (See Air Start procedure.)

If No Relight:

4. Throttle and engine/fuel master switches OFF
5. Land as soon as practicable (See Single-Engine Landing procedure)

DOUBLE-ENGINE FAILURE DURING FLIGHT

The possibility of a double-engine failure during flight is very remote; however, if such a situation should occur, proceed as follows:

Pull RAT handle, check EMERG IGN circuit breakers IN, FUEL READY switch OFF, and attempt air start.

If repeated relight attempts are not successful between 20,000 and 10,000 feet, eject by 10,000 feet AGL.

If still on first or second relight attempt when passing through 10,000 feet AGL and it appears that a relight is likely, air start attempt may be continued to a minimum of 5000 feet AGL.

If both engines are still flamed out below 10,000 feet AGL, zoom to convert excess airspeed to altitude. Attempt a normal air start as time permits. If the peak altitude is 5000 feet AGL and the air start attempt is not successful, eject no lower than 5000 feet AGL. If the peak altitude is below 5000 feet AGL and an air start attempt is made during the zoom and there is no evidence of a relight, eject at the peak altitude. If no air start attempt is made, eject at the peak altitude.

If the decision to eject is made at high altitude, it is recommended that the aircrew eject at a minimum of 10,000 feet AGL.

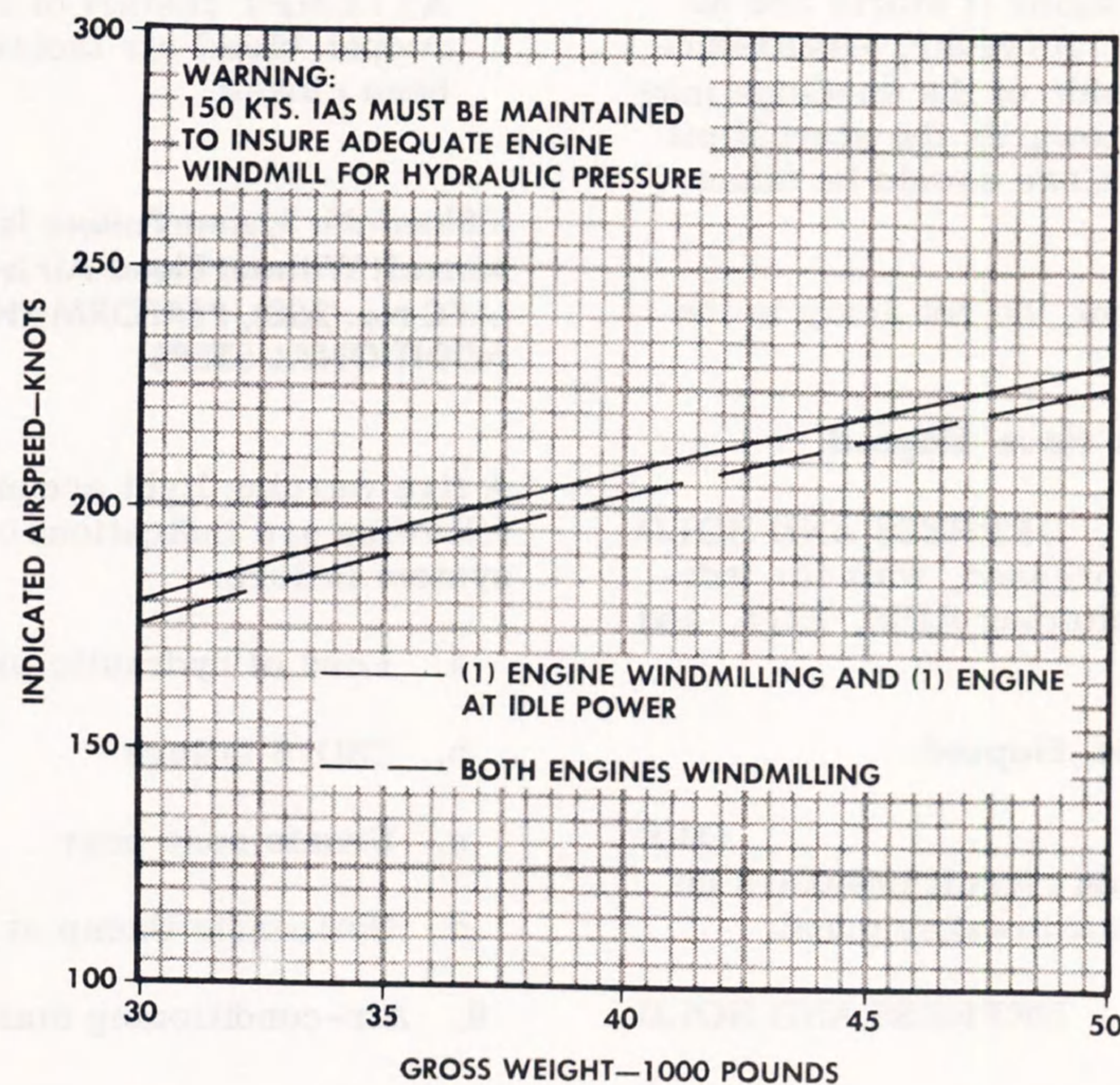
VELOCITY REQUIRED FOR MAXIMUM GLIDE

AIRCRAFT CONFIGURATION
(1) MK-28 STORE PLUS
(4) 300 GALLON DROP TANKS

DATE: 15 FEBRUARY 1971
DATA BASIS: ESTIMATED

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

NOTE
GLIDE RATIO WITH BOTH ENGINES WINDMILLING — 12:1
GLIDE RATIO WITH ONE ENGINE WINDMILLING AND ONE ENGINE AT IDLE POWER — 13:1



ADF1-416

Figure 5-2

DOUBLE-ENGINE FAILURE DURING FLIGHT (LOW ALTITUDE LOWAIRSPEED)

1. Fuel READY switch CHECK OFF
2. Convert excess airspeed to altitude.
3. RAT handle PULL
4. Air start button DEPRESS AND HOLD
With air start button depressed, wait for indication of a start by monitoring RPM, EGT, and fuel flow.

WARNING

If both engines fail below 1,500 feet AGL and 250 KIAS EJECT

AIR STARTS

In general, air start capability is increased by higher airspeeds and lower altitudes. Refer to figure 5-3. No damage will occur to the engine if starts are attempted outside the envelope. However, unsatisfactory starts on the low-speed side of the envelope may result in an increase in EGT towards the start limit (455°C) due to a hung start. Care should be taken not to exceed this limit.

If one or both engines flame out, do not delay in the air start.

If Not More Than 10 Seconds Have Elapsed:

1. Air start button DEPRESS AND HOLD
With air start button depressed, wait for indication of a start by monitoring RPM, EGT, and fuel flow.

If More Than 10 Seconds Have Elapsed:

2. Throttle (failed engine) OFF
Check emergency ignition circuit breakers on pilot's left console circuit breaker panel.
3. Air start button DEPRESS AND HOLD
4. Throttle (failed engine) IDLE
Go around the horn with air start button depressed, wait 60 seconds for indication of a start monitoring RPM, EGT, and fuel flow.
5. Throttle (after start) ADJUST AS REQUIRED

FIRE

FIRE WARNING LIGHT LIT

1. Bleed-air isolation valves (aircraft incorporating AFC No. 268)

- a. NWW
- b. CSD
- c. AIR COND

GANG-BAR OFF

2. Throttle (affected engine) OFF
3. Engine and fuel master switch
(affected engine) OFF
4. If fire indications are positive EJECT
Some positive indications might be explosion, vibration, abnormal engine instrument readings, smoke or fumes in the cockpit, burning odor in oxygen mask, trailing smoke, or verification from another aircraft or control tower.
5. If fire indications are not positive
. LAND AS SOON AS POSSIBLE

CAUTION

If the fire warning light goes out, DO NOT ATTEMPT restart of affected engine or reopen bleed-air isolation valves that have been closed.

If Bleed-Air System Failure Is Suspected In Aircraft Without Bleed-Air Isolation Valves (AFC No. 268), PERFORM THE FOLLOWING ADDITIONAL STEPS:

A fire warning light accompanied by any or all of the following are indications of a probable bleed-air system failure:

- a. Loss of hydraulic pressure indications
 - b. CSD/S failure
 - c. Unsafe nose gear
 - d. Noticeable thump at time of failure
6. Air-conditioning master switch OFF

Note

If the fire warning light is turned off by securing the air-conditioning system, the fire indication may have been caused by a bleed-air leak from the environmental system into the starboard engine bay only.

7. Land as soon as possible with single-engine landing procedure.

NEW

WARNING

- Substantial loss of thrust from the remaining engine will result in marginal or no wave-off capability. A barricade is required for shipboard recovery.
- A wave-off is extremely hazardous due to minimum rate of climb available and increased possibility of fire damage.

In aircraft with bleed-air isolation valves (AFC No. 268), if the fire warning light goes out and flight is continued for a significant length of time, consideration should be given to the systems lost and additional steps required as a result. WITH THE RIGHT ENGINE SHUT DOWN, the right generator, air conditioning and rain removal have been lost. Going to RAM AIR may alleviate crew discomfort but will not affect equipment cooling. No equipment cooling will soon cause overheating of all electronic equipment, except the CNI equipment, which is provided with an alternate cooling blower. Therefore, unless absolutely needed for flight, all electronic equipment except the CNI equipment should be turned off. WITH THE LEFT ENGINE SHUT DOWN, air conditioning and pressurization are normal. Only the left generator and rain removal have been lost.

WARNING

In the event of unsafe gear indications, perform emergency landing-gear extension procedures on final approach and land on the first pass regardless of landing-gear indication.

NWW TEMP LIGHT LIT

Lighting of the NWW TEMP light indicates a leak in the bleed-air ducting in the nose-wheel well or radome areas. Therefore, damage to electrical or electronic components in those areas should be suspected, even if the NWW isolation valve was closed promptly. With the NWW isolation valve closed, the rain-removal and vortex-removal systems have been lost.

1. NWW bleed-air isolation valve OFF
2. Windshield rain removal OFF
3. If NWW TEMP light goes out
LAND AS SOON AS POSSIBLE

If NWW TEMP Light Remains On:

4. Bleed-air isolation valves gang-bar . . . OFF
5. Right throttle OFF

6. Right engine and fuel master switch . . . OFF
7. If NWW TEMP light goes out
LAND AS SOON AS POSSIBLE

**If NWW TEMP Light Remains On
Complete Steps 4. through 11. Under
Fire Procedure****TEMP CONT LIGHT REMAINS ON**

If the TEMP CONT light remains on steady, a computer temperature control valve failure is indicated.

1. Check computer pedestal area for hot air flow around pedestal base or excessive heating of pedestal area.

If Excessive Heat is Detected:

2. COMPUTER switch OFF
3. AIR COND MASTER switch OFF

Note

Operation of avionics systems (radar, etc.) requires air conditioning. Operating with air conditioning off for periods in excess of 5 minutes may damage equipment.

4. Land as soon as practicable.

ELECTRICAL FIRE OR SMOKE IN COCKPIT

Circuit breakers protect most circuits and can be used to isolate most electrical failures. Due to the electrical complexity of the aircraft, however, electrical fires may occur and immediate action is required. Some electrical fires may be isolated visually, and the affected circuit deenergized.

If the cause of the malfunction cannot be immediately determined, further steps may be necessary. These will depend on the intensity of the smoke and the circumstances under which the aircraft is operating. Should symptoms of an electrical fire occur, and the cause cannot be determined, proceed as follows:

1. Oxygen ON
2. All electrical switches OFF
Ensure that following switches have been positioned to OFF: computer, search radar, VDI, and PHD.
3. Air-conditioning master switch OFF
The possibility exists that smoke and fumes symptomatic of an electrical fire may have originated in the air-conditioning system.

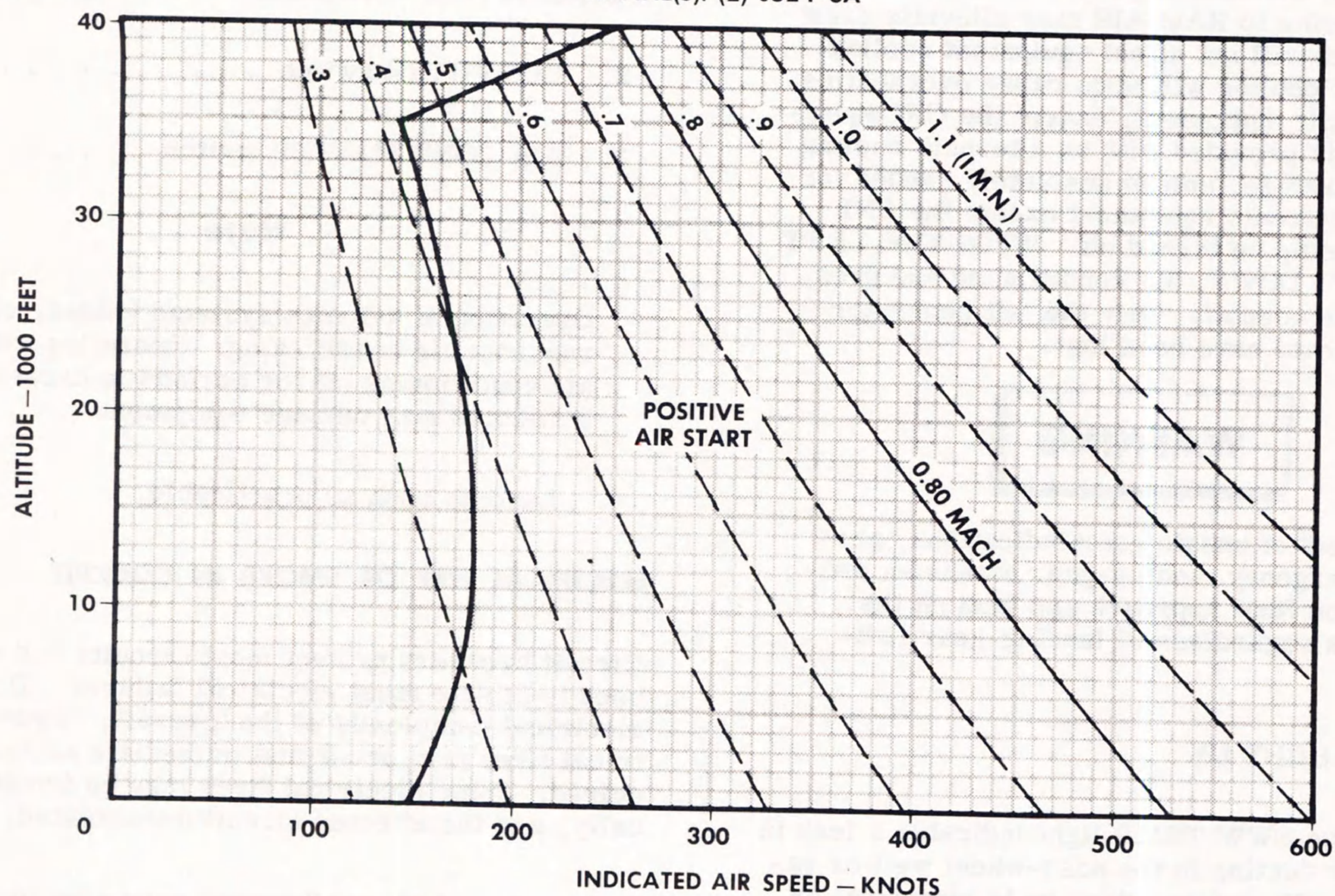
AIR START ENVELOPE

AIRCRAFT CONFIGURATION
ALL CONFIGURATIONS

FUEL DENSITY: 6.8 LB/GAL
FUEL GRADE: JP-5

DATE: 1 JANUARY 1967
DATA BASIS: FLIGHT TEST

REMARKS
ENGINE(S): (2) J52-P-8A



ADF1-419

Figure 5-3

If Symptoms of Fire Persist:

4. RAT Handle PULL
5. Generators OFF
The possibility exists that the RAT may be in-operative, and may not assume the electrical load of the essential bus. The best indication of this is failure of the generator caution light to come on.
6. Air-conditioning master switch ON
7. Necessary electrical equipment ON
8. Circuit breaker
(affected equipment) . . . PULL IF AVAILABLE

CAUTION

Do not attempt to actuate the affected equipment circuit breaker until the cause of the fire has been determined and corrected by qualified maintenance personnel.

9. Land as soon as practicable.

ELIMINATION OF SMOKE AND FUMES

To eliminate smoke and fumes from the cockpit, proceed as follows:

1. Air-conditioning cockpit switch . . . RAM AIR
2. MAN/RAM AIR switch COLD
3. Descent to below 25,000 feet.
4. Cabin dump switch ON

AIR-CONDITIONING FULL HOT

If cabin temperature goes full hot, perform the following immediately:

1. ENVIRONMENT/SEATS circuit breaker . . . IN
2. MAN/RAM AIR switch FULL COLD

If Temperature Remains Hot:

3. AIR CONDITIONING COCKPIT
switch RAM AIR
4. AIR COND MASTER switch OFF

If Temperature Remains Hot:

In aircraft incorporating AFC No. 268:

- 5.A. Bleed air SECURE
 - a. AIR COND bleed-air switch. OFF
 - b. Right throttle OFF

In aircraft without AFC No. 268:

- 5.B. CABIN DUMP switch ON
6. Canopy OPEN OR JETTISON
(AS NECESSARY)

WARNING

The canopy must be fully closed or jettisoned before ejection.

7. Foot heat control CLOSED
8. All unnecessary electrical equipment . . . OFF
9. Land as soon as possible.

Note

Ram air will provide sufficient cooling for wing-tank pressurization system in flight.

EJECTION

Escape from the aircraft in flight should be made with the ejection seat. The ejection capabilities of the ejection seat are presented in figure 5-4, the ejection procedure in figure 5-5, and the ejection seat sequence of operation in figure 5-6.

WARNING

If the first crewman ejects through the canopy, the other crewmember should also eject through the canopy. Any attempt to jettison the canopy after one crewmember has ejected may either catch the crewmember as he is penetrating the canopy or arrest the canopy on the telescoped ejection gun of the ejected seat. Either event would result in severe personal injury and/or significantly alter the ejection trajectory, adversely affecting system performance.

EJECTION CAPABILITY CHART

The chart in figure 5-4 presents the capability of the MK GRU-7 ejection seat for level flight, level dives, various bank angles, and high sink rates. The curves do not include any reaction time and provide the minimum altitudes at which ejection must have been initiated for the various conditions presented.

To determine minimum ejection altitude for a level dive, enter the upper right plot at the selected dive angle, proceed vertically to the selected airspeed reflector line, and project horizontally to the minimum altitude.

To find minimum ejection altitude for conditions of high sink rate, enter the lower left plot at the selected sink rate, proceed vertically to the selected airspeed reflector line, and project horizontally to the minimum altitude.

To find minimum altitude for high bank angles, enter the lower right hand plot at the selected angle of bank, proceed vertically to the selected airspeed reflector line, and project horizontally to the minimum altitude.

LOW-ALTITUDE EJECTION

Ejection at low altitudes is accomplished by pulling the nose of the aircraft above the horizon ("zoom up" maneuver). This maneuver affects the trajectory of the ejection seat and provides a greater increase in altitude than if ejection is performed in a level flight altitude. If the aircraft is in a

EJECTION CAPABILITY

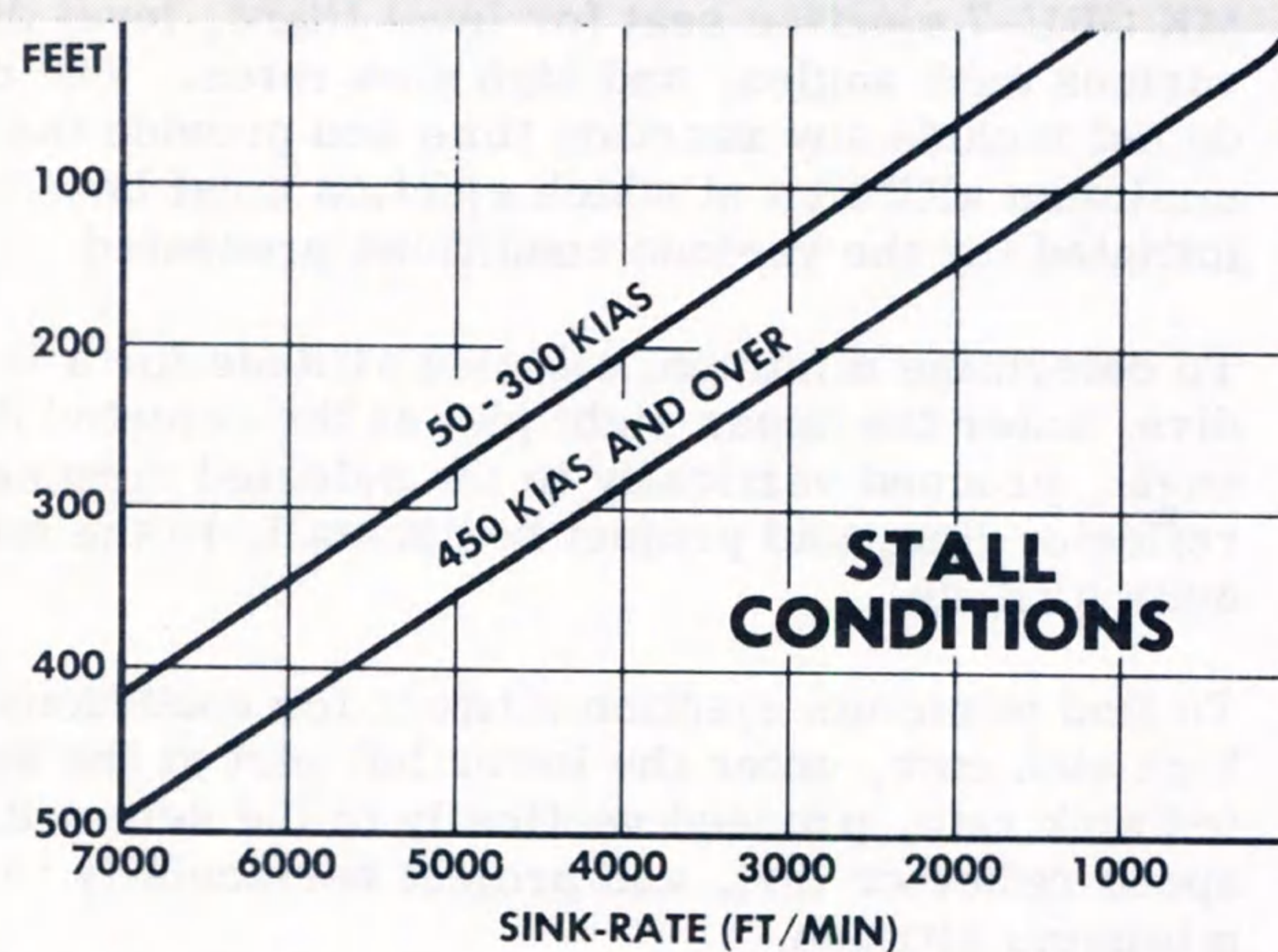
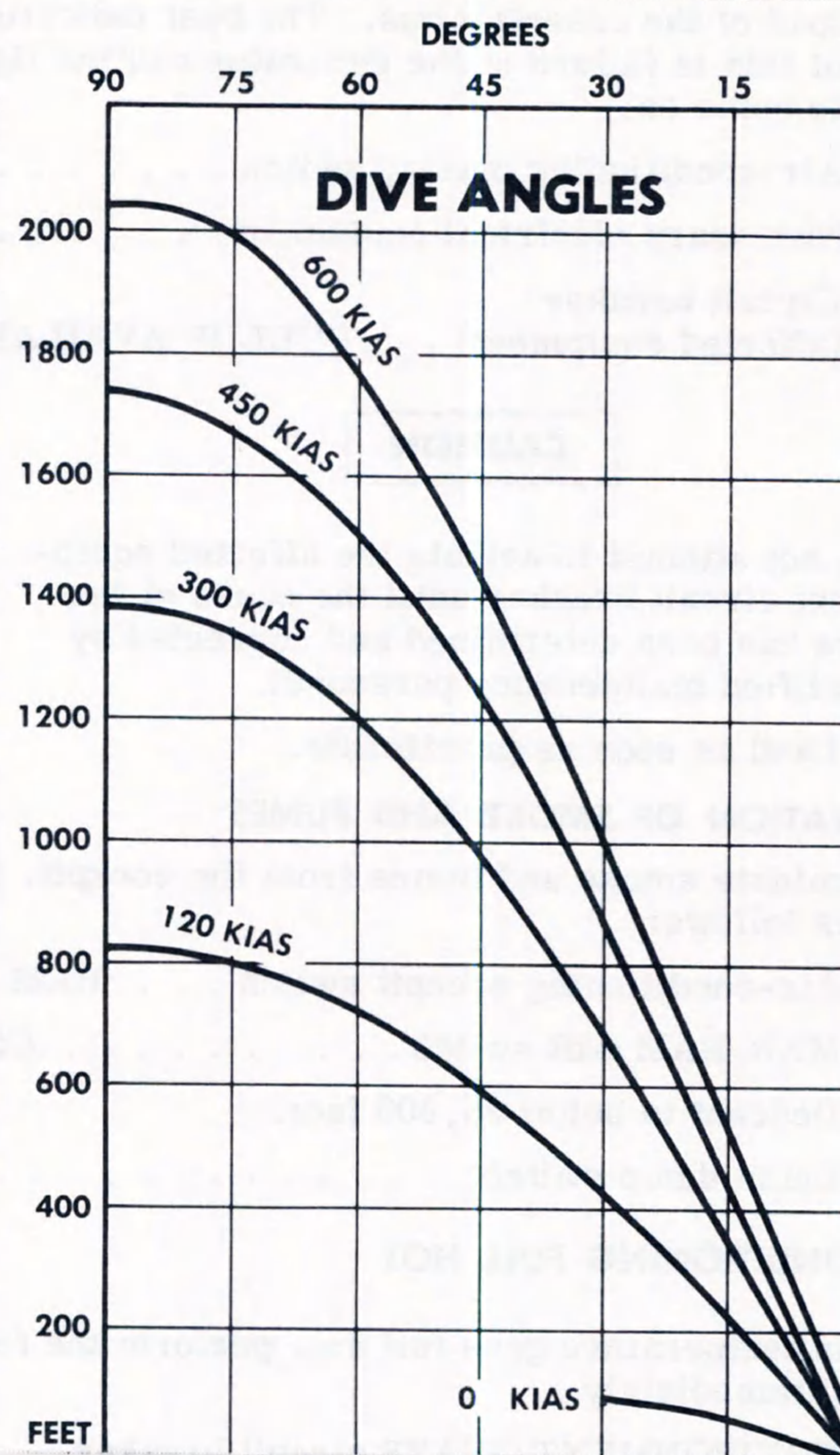
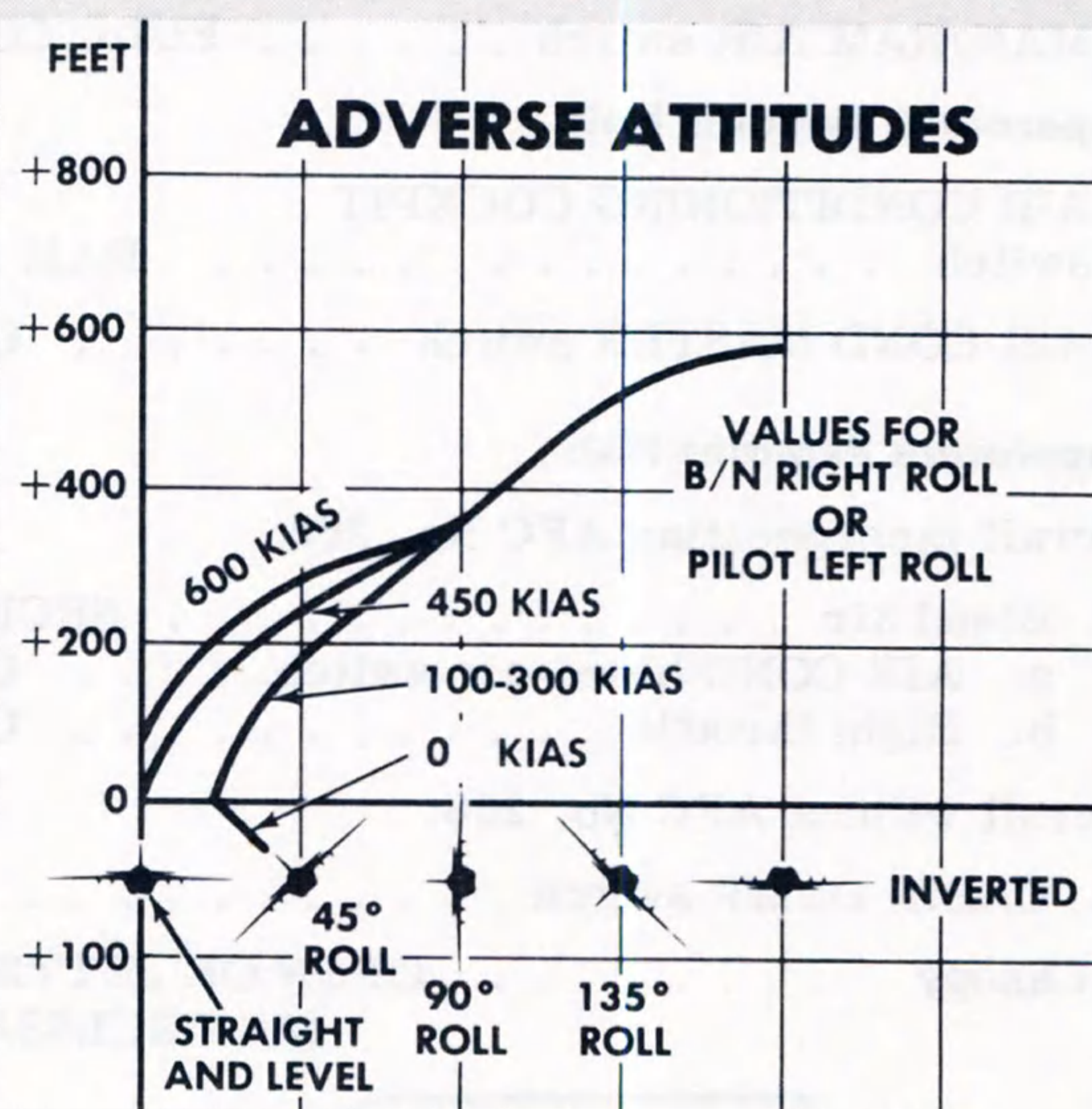
MARTIN BAKER MK GRU-7 EJECTION SEAT

MAX EJECTION WT. = 475 LBS.

CREW MEMBERS
UNCLOTHED WT. = 205 LBS.

NOTE

THESE CURVES INCLUDE THE EFFECTS OF ROCKET MOTOR DIVERGENCE AND THE ABSOLUTE MINIMUM ALTITUDES AT WHICH EJECTIONS MUST BE INITIATED. THESE CURVES DO NOT INCLUDE REACTION TIME. ZERO SPEED CURVES DO NOT ACCOUNT FOR THE AFFECTS OF GROUND WIND.



A-ADF1-59

Figure 5-4

EJECTION

BEFORE EJECTION

ALERT CREW MEMBER.

WHENEVER EJECTION IS CONTEMPLATED, REGARDLESS OF THE SITUATION, THE PILOT WILL NOTIFY THE CREW MEMBER, EITHER BY ICS OR BY VISUAL SIGNALS IF THE ICS FAILS.

TIME PERMITTING, ACCOMPLISH THE FOLLOWING.

1. AIRSPEED — REDUCE TO 220 KIAS OR LESS, MAINTAIN FLYING SPEED
2. TRANSMIT — MAYDAY (POSITION, SITUATION AND INTENTION)
3. IFF — SQUAWK EMERGENCY

4. HELMET, CHIN STRAPS — TIGHT, VISOR — DOWN
5. OXYGEN MASK — TIGHT
6. HARNESS PROPERLY ADJUSTED AND TIGHT
7. CABIN DUMP SWITCH — ON (ABOVE 30,000 FT.)
8. ASSUME EJECTION POSITION
SIT ERECT, BUTTOCKS AGAINST BACKREST, HEAD FIRMLY AGAINST HEADREST, SPINE STRAIGHT, THIGHS AGAINST SEAT PAN.

WARNING

POSITIONING THE LEGS AFT PRIOR TO EJECTION WILL CAUSE THE SPINE TO FLEX AND WILL INCREASE THE POSSIBILITY OF SPINAL INJURY.

9. CANOPY — JETTISON
CANOPY MUST BE FULLY CLOSED OR JETTISONED PRIOR TO EJECTION. EJECTION MAY BE ACCOMPLISHED THROUGH THE CANOPY.

WARNING

WITH THE CANOPY IN THE OPEN POSITION THE CANOPY BULKHEAD IS ALMOST DIRECTLY OVER BOTH EJECTION SEATS, THUS PREVENTING A SUCCESSFUL EJECTION.
SEAT TILT HAS NO EFFECT ON EJECTION.

EJECTION PROCEDURE

1. ORDER CREW MEMBER TO EJECT.

THE ORDER WILL BE SIGNALLED VISUALLY BY RAISING THE ARMS ABOVE THE HEAD IN AN EXAGGERATED ACT OF GRASPING THE FACE CURTAIN HANDLE. THIS WILL BE REPEATED TWICE, AND EVERY EFFORT SHOULD BE MADE TO ENSURE IT IS UNDERSTOOD. IMMEDIATE COMPLIANCE IS SUFFICIENT ACKNOWLEDGMENT. THE CREW MEMBER SHOULD EJECT FIRST; THE PILOT SHOULD EJECT IMMEDIATELY AFTER.

EJECTION MAY BE DIFFICULT ONCE THE CANOPY IS BROKEN DUE TO WIND BLAST, AND THE PILOT SHOULD MINIMIZE THIS DIFFICULTY BY GRASPING THE FACE CURTAIN HANDLE PRIOR TO THE CREW MEMBER'S EJECTION.

WARNING

DO NOT EJECT SIMULTANEOUSLY. THE SEATS EJECT PARALLEL TO EACH OTHER, AND PARACHUTE ENTANGLEMENT COULD RESULT.

2. EJECT

GRASP FACE CURTAIN HANDLE WITH BOTH HANDS (PALMS DOWN) ELBOWS TOGETHER, AND PULL OUT AND DOWN SMARTLY SO THAT CURTAIN COVERS FACE.



IF SEAT FAILS TO EJECT:

CONTINUE TO HOLD FACE CURTAIN HANDLE WITH LEFT HAND AND GRASP ALTERNATE FIRING HANDLE WITH RIGHT HAND AND PULL UP SMARTLY.



IF SEAT STILL FAILS TO EJECT: USE MANUAL BAILOUT PROCEDURE.

IF UNABLE TO REACH FACE CURTAIN HANDLE:

GRASP ALTERNATE FIRING HANDLE WITH ONE HAND AND GRASP WRIST WITH OTHER HAND AND PULL UP SMARTLY.



A-ADF1-23-1

Figure 5-5 (Sheet 1)

AFTER EJECTION**IF SEAT FAILS TO SEPARATE:**

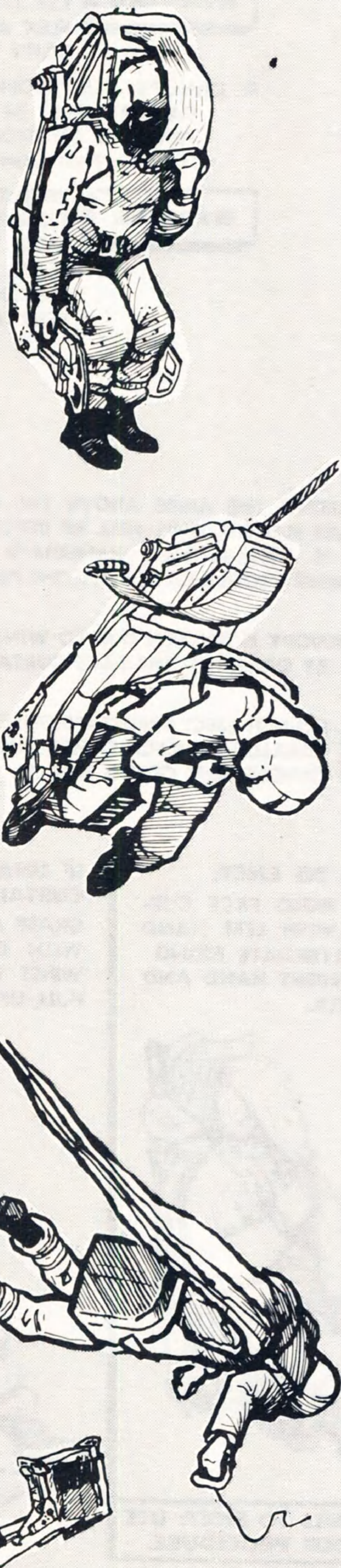
1. RIGHT HAND: GRASP EMERGENCY HARNESS RELEASE HANDLE - PULL UP AND AFT.

2. THROW FACE CURTAIN UPWARD AND REARWARD.

3. PLACE HANDS ON SIDE OF SEAT BUCKET AND PITCH FORWARD AND DOWNWARD OUT OF SEAT, KICKING SEAT CLEAR IF NECESSARY.

4. RIGHT HAND: GRASP PARACHUTE D-RING — PULL DOWNWARD AND TO RIGHT SIDE OF BODY.

5. MAKE A NORMAL PARACHUTE DESCENT.

**NORMAL PARACHUTE DESCENT**

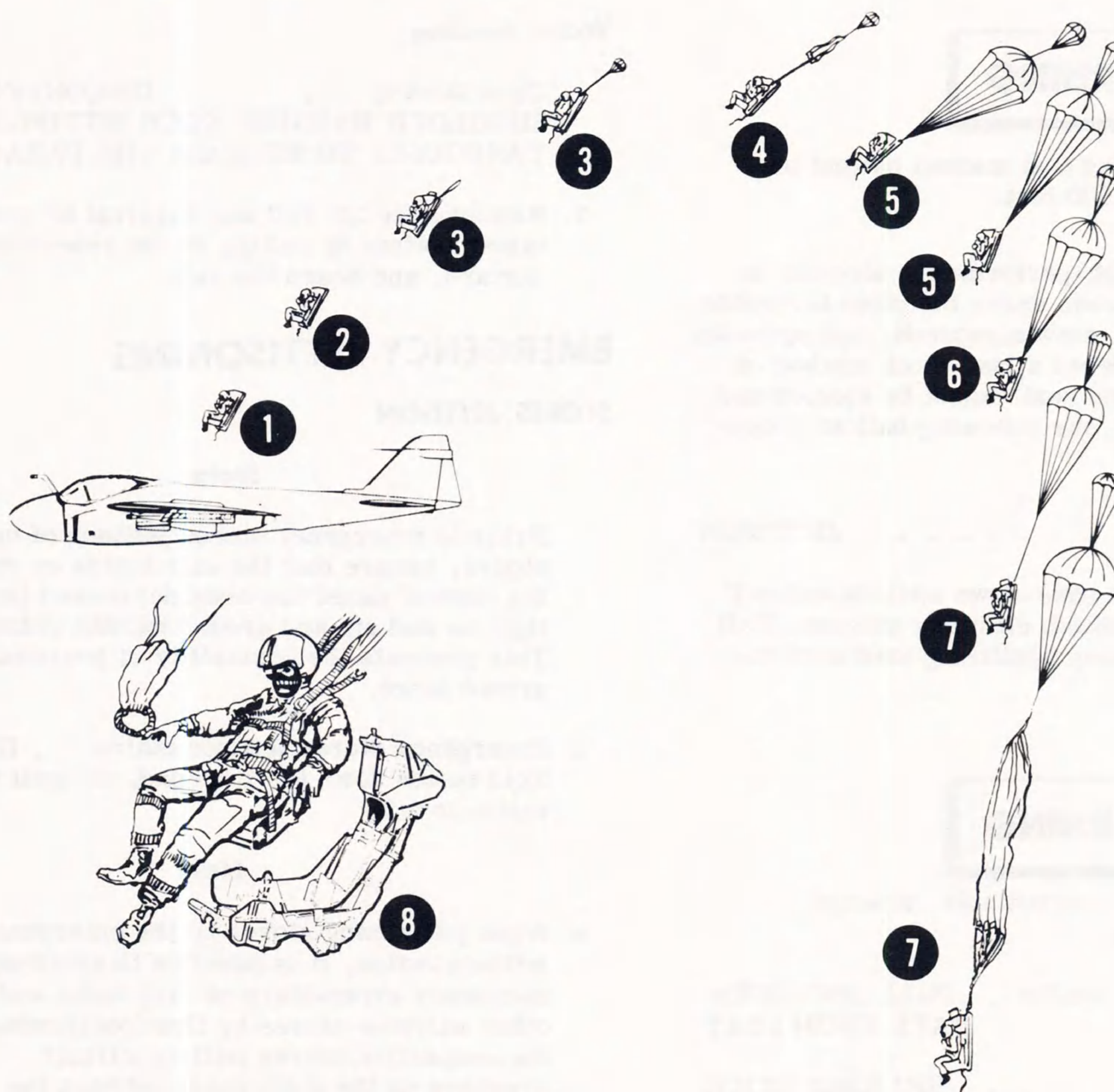
1. OXYGEN MASK — REMOVE AFTER PARACHUTE IS OPEN
2. DEPLOY SURVIVAL KIT AND INFLATE RAFT BY PULLING RELEASE HANDLE ON EITHER SIDE OF KIT
3. INFLATE LIFE PRESERVER (IF WATER LANDING ANTICIPATED)
4. DISCONNECT KOCH FITTINGS AFTER LANDING

A-ADF1-23-2

Figure 5-5 (Sheet 2)

EJECTION SEQUENCE

- 1** INITIAL EJECTION: EMERGENCY OXYGEN RELEASED, IFF, EQUIPMENT DESTRUCT SWITCH ACTUATED, SHOULDER HARNESS RETRACTED AND LOCKED, LEG RESTRAINTS WITHDRAWN AND LOCKED AND TIME RELEASE AND DROGUE GUN MECHANISMS ARE TRIPPED AND PERSONNEL SERVICES AND ROCKET MOTOR LANYARDS ARE PULLED AS SEAT LIFTS OUT OF COCKPIT.
- 2** ROCKET MOTOR INITIATOR SEAR WITHDRAWN BY EXTENDED LANYARD, GAS DRIVES ROCKET MOTOR FIRING MECHANISM, IGNITING MOTOR.
- 3** DROGUE GUN FIRES ONE HALF SECOND AFTER EJECTION; DROGUE PISTON WITHDRAWS CONTROLLER DROGUE PARACHUTE.
- 4** CONTROLLER DROGUE DEPLOYS AND WITHDRAWS STABILIZER DROGUE.
- 5** STABILIZER DROGUE DEPLOYS, STABILIZING AND DECELERATING SEAT AND OCCUPANT.
- 6** ABOVE 14,500 FEET: BAROSTAT SECURES TIME RELEASE ESCAPEMENT MECHANISM UNTIL COMPLETION OF DESCENT TO LOWER ALTITUDE, DROGUE PARACHUTE RETENTION SHACKLE REMAINS LOCKED TO SEAT BY RESTRAINT SCISSOR AND SEAT AND OCCUPANT DESCEND THROUGH HIGHER ALTITUDES ON DROGUE PARACHUTES ONLY.
- 7** BELOW APPROXIMATELY 11,500 FEET: BAROSTAT FREES TIME RELEASE ESCAPEMENT MECHANISM. TIME RELEASE MECHANISM SUBSEQUENTLY RELEASES DROGUE GUN SHACKLE RESTRAINT SCISSOR, OCCUPANT'S SHOULDER HARNESS RESTRAINTS, LAP BELT LEG RESTRAINTS, PARACHUTE CONTAINER AND SURVIVAL KIT. RELEASE OF SHACKLE PERMITS CONTINUED PULL OF DROGUE PARACHUTES ON LINK LINES TO RELEASE FACE CURTAIN RESTRAINT AND MAIN PERSONNEL PARACHUTE. OCCUPANT REMAINS ATTACHED TO SEAT BY STICKER CLIP RETENTION OF LOWER RESTRAINT HARNESS ON SEAT BUCKET.
- 8** LINE STRETCH OF MAIN PARACHUTE PULLS OCCUPANT, SURVIVAL KIT AND LOWER RESTRAINT HARNESS FREE OF STICKER CLIPS. SEAT FALLS FREE. OCCUPANT DISCARDS FACE CURTAIN AND CONTINUES NORMAL PARACHUTE DESCENT.



A-ADF1-17

Figure 5-6

descending attitude and cannot be pulled out, ejection should not be delayed. When circumstances permit, slow the aircraft prior to ejection to reduce the forces exerted on the body. See figure 5-4 for ejection capabilities.

HIGH-ALTITUDE EJECTION

For a high altitude ejection the basic ejection procedure (figure 5-5) is applicable. The zoom up maneuver is still useful to slow the aircraft to a safer ejection speed, or to provide more time and more distance, as long as an immediate ejection is not mandatory.

If normal seat separation and personnel parachute deployment does not occur between 11,500 and 14,500 feet, actuate the manual-release handle, push away from the seat, and pull the personnel parachute D ring.

MANUAL BAILOUT

WARNING

It is not recommended that manual bailout be considered below 2,000 feet.

Manual bailout from high-performance aircraft is extremely hazardous, even under the most favorable conditions (level flight, slow airspeeds, and optimum altitude), and is considered a last-ditch method of escape. However, if the seat cannot be ejected and ditching is not feasible, the following bailout procedures are suggested:

- 1. Canopy JETTISON
- 2. Trim aircraft for nose-down attitude and pull stick back to establish climbing attitude. Roll inverted maintaining positive g load until inverted.

WARNING

If the aircraft is not controllable, attempt bailout over the side.

- 3. Harness-release handle . . .PULL AND SEPARATE FROM SEAT
- 4. Once inverted RELEASE STICK

When Clear of the Aircraft and Below 10,000 Feet:

- 5. Parachute D-ring PULL

WARNING

If bailout is essential over 15,000 feet, a free fall should be made until an altitude below 15,000 feet is reached, since parachute opening shock increases with altitude. As a rule of thumb, 3 to 4 seconds are required to free fall 1,000 feet.

NORMAL PARACHUTE DESCENT

After Parachute Deployment

- 1. Deploy the survival kit and inflate the raft by grasping and pulling one of the kit release handles on either side of the kit. This releases the bottom of the kit container and the raft which hang from a lanyard secured to the top part of the kit, and inflates the raft.
- 2. Life preserver (if water landing anticipated) INFLATE
- 3. Upon landing DISCONNECT BOTH SHOULDER HARNESS KOCH FITTINGS SIMULTANEOUSLY TO RELEASE THE PARACHUTE.

Water Landing

- 1. Upon landing DISCONNECT BOTH SHOULDER HARNESS KOCH FITTINGS SIMULTANEOUSLY TO RELEASE THE PARACHUTE.
- 2. Retrieve the lift raft and survival kit container bottom by pulling on the retention lanyard, and board the raft.

EMERGENCY JETTISONING

STORES JETTISON

Note

Prior to emergency stores jettison of nuclear stores, ensure that the safe button on the fuzing control panel has been depressed (safe light on and air and ground buttons unlocked). This prevents the possibility of jettisoning an armed store.

- 1. Emergency stores jettison button . . .DEPRESS Hold button down for 1 second, or until separation is felt.

Note

- When jettisoning stores by the emergency jettison button, it is possible to avoid unnecessary expenditure of drop tanks and other salvable stores by first positioning the respective stores jettison circuit breakers on the main panel between the crewmembers.
- 70% of the weight must be off the wheels for emergency jettisoning of external stores.

NEW

If Step 1 Fails, Proceed With Selective Jettisoning as Follows:

2. Fuzing SAFE
3. Appropriate station
select switches BOMBS/GUNS
4. SEL JETT button DEPRESS
5. Master ARMT switch ON
6. Manual weapons release button . . . DEPRESS

Note

The landing gear must be up and locked before stores will be released using the SEL JETT button.

EMERGENCY FUEL DUMPING (RAT OPERATING)

If the situation necessitates fuel dumping with double generator failure and the ram-air turbine is operating, it is possible to dump only from the outboard wing panels. An operating RAT energizes the essential buses and normal outboard wing fuel dumping is controlled by the wing dump switch.

Wing drop tanks and the centerline drop tank or air refueling pod can be jettisoned. Fuselage and inboard wing fuel dumping is not possible with a double generator failure and any weight reduction of fuselage fuel must be through burn down.

OIL SYSTEM FAILURES

An oil system failure is recognized by a decrease of, or a complete loss of oil pressure. If an oil system malfunction has caused prolonged oil starvation of engine bearings, the result will be a progressive bearing failure and subsequent engine seizure. This progression of bearing failure starts slowly and will normally continue at a slow rate up to a certain point at which the progression failure accelerates rapidly to complete bearing failure. The time interval from the moment of oil starvation to complete failure depends on such factors as condition of bearings prior to the starvation, operating temperatures of bearings, and bearing loads. Bearing failure due to oil starvation is generally characterized by a rapidly increasing vibration. When the vibration becomes moderate to heavy, complete seizure will occur in seconds. In order to minimize engine damage and conserve remaining operating time for possible emergencies, the affected engine should be shut down upon first recognition of an oil system failure. Upon first recognition of sustained oil system failure (above or below oil pressure limits), perform the following:

LOSS OF OIL PRESSURE

1. Throttle OFF
2. Engine/fuel master OFF
3. Land as soon as practicable.

LOW OIL WARNING LIGHTS

1. Land as soon as practicable.

CAUTION

Consideration should be given to securing the engine. If the engine is allowed to run until oil pressure starts to fall, severe engine bearing damage will result. The engine may be relit for critical flight evolutions, i.e., carrier landing, etc.

2. If normal pressure
cannot be maintained THROTTLE OFF
3. Engine/fuel master OFF

HIGH OIL PRESSURE

1. Reduce power on affected engine
2. If unable to maintain oil
pressure within limits THROTTLE OFF
3. Engine/fuel master OFF

Note

If the engine is secured for oil-pressure malfunctions, it may be desirable to relight the engine for use during critical flight evolutions, i.e., carrier landings.

ENGINE FUEL SYSTEM FAILURE

ENGINE FUEL PUMP FAILURE

Failure of the entire two-stage engine fuel pump will result in engine flameout due to fuel starvation. Gear stage (high-pressure pump) failure will result in a flameout; failure of the centrifugal stage (low-pressure engine boost pump) alone will have little or no effect on performance, and will not be evident to the pilot since the fuselage boost pump will continue to supply adequate pressure to the inlet side of the high-pressure pump except at higher altitudes (above 20,000 feet). Should either FUEL PSI light come on, either power reduction on the affected engine or descent to a lower altitude is indicated.

CAUTION

DO NOT DEPRESS BOOST PUMP TEST BUTTON IN FLIGHT, as an engine will flame out if the centrifugal stage of an engine-driven fuel pump has failed.

FUSELAGE BOOST PUMP FAILURE

If the electrically driven fuselage boost pump fails, fuel will still be supplied to the engine fuel pump by suction feed (below 20,000 feet). If the fuel flow demands of the engines cannot be met by suction feed, loss of thrust may result when above 20,000 feet. Insufficient pressure will be indicated by the L and R FUEL PSI lights coming on. Power reduction or descent is indicated to restore engine performance.

TRANSFER PUMP FAILURE

Failure of one transfer pump will result in a 50% reduction of fuel flow for either fuselage fuel transfer to the in-flight refueling pod or fuselage fuel dumping. If both transfer pumps fail, fuselage dumping and fuselage fuel transfer to the air in-flight refueling pod cannot be accomplished.

FUEL FILTER LIGHT LIT

Lighting of the left or right fuel FILTER light indicates that the fuel filter for the respective engine is contaminated. Proceed as follows:

- 1. Throttle (affected engine) RETARD
Retard throttle of affected engine to reduce fuel flow.
- 2. Avoid large or unnecessary throttle movements.
- 3. Land as soon as practicable.

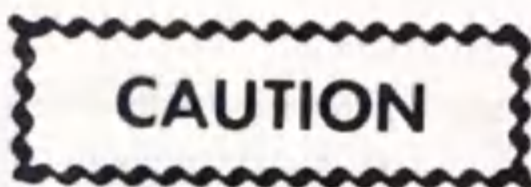
THROTTLE LINKAGE FAILURE

No provisions are incorporated for automatic positioning of the fuel control in the event of throttle linkage failure. The affected engine may stabilize at any RPM between cutoff and military power. If this should occur proceed as follows:

- 1. Land as soon as practicable.

Note

The APCS electromechanical actuators are located on the engines, and the throttle linkage failure may have occurred between an electromechanical actuator and the throttle. If so, the APCS switch may be held in the ENGAGE position and the desired throttle position obtained by varying AOA and releasing the APCS switch when set. Desired throttle positions may be set in this manner throughout the flight for all portions of the profile. The APCS should also be available for a normal landing approach.



During a wave-off or bolter, the APCS will be disengaged and a rapid power change on the affected engine may occur.

Prior to Entering Landing Pattern:

- 2. Dump/burn down to single-engine approach gross weight.
- 3. Make a normal or single-engine approach as necessary (depending on engine power available).

Note

Engine RPM may change with any change in fuel control vibration. If necessary, due to fluctuating or excessively high power, shut the affected engine down prior to the approach.

After Landing:

- 4. Throttle (affected engine) OFF
- 5. Engine and fuel master switch OFF

ELECTRICAL SYSTEM FAILURE

See figure 5-7 for emergency power distribution.

SINGLE GENERATOR FAILURE

Failure of one generator will be noted by lighting of either the L-GEN or R-GEN caution light on the annunciator panel. The light will indicate which generator has failed. Failure of either generator will result in loss of the monitor bus power. If a generator fails, proceed as follows:

- 1. Affected generator switch . .RESET, THEN ON
- 2. Check generator caution light OUT

Repeated attempts may be made to reset generator.

If Generator Caution Light Remains Lit:

Note

In flight at a reduced power setting, resetting the CSD/S may enable the resetting of the failed generator.

- 3. Affected generator switch OFF
- 4. Land as soon as practicable.
- 5. For instrument or night approach,
RAT handle PULL
The extended RAT ensures the reliability of electric power supply to the essential buses.

DOUBLE GENERATOR FAILURE

When both generators fail, both generator caution light will be out and all AC power will be lost. All DC power, except battery power for generator reset, and assist spin recovery will also be lost. Upon the loss of both generators, immediately perform the following:

- 1. RAT handle PULL
- 2. Check caution lights on

3. Generator switches RESET, THEN ON

If Generator Caution Lights Remain On:

4. Land as soon as practicable.

Note

Minimum airspeed to maintain RAT power is 110 KIAS.

LOSS OF ESSENTIAL DC BUS

If the external number one essential DC bus circuit breaker pops, the entire number one essential DC bus will be lost even though both main generators remain operative and power the primary and monitor buses. Major items lost include: speed brakes, normal and emergency flaps/slats, normal gear operation, AOA, integrated position indicator, CNI package including ICS, UHF, TACAN and IFF, MA-1 compass system, weapon release, normal and emergency stores jettison, approach indexer, cabin dump, emergency brakes, flight instrument lights, turn and slip, and master caution and warning lights. If it is suspected that the number one essential DC bus circuit breaker is disengaged, extend the RAT. If power is not restored to essential flight instruments and equipment by this action, it will be necessary to secure both main generators to energize the essential bus. Action taken should be predicated on which equipment is most essential at the time.

Note

- Unless absolutely necessary, do not secure main generators if not in VFR conditions. If the RAT is inoperative, securing both main generators will result in loss of all altitude and navigation systems.
- Minimum airspeed to maintain RAT power is 110 KIAS.

COMPLETE ELECTRICAL FAILURE

If both generators fail, and electrical power to the essential bus is not restored when the RAT is deployed, proceed as follows:

Night/IFR

Maintain control flight if possible, or attempt to gain and maintain outside visual reference. If unable to maintain controlled flight EJECT

Note

Instruments remaining are the vertical speed indicator (VSI), airspeed indicator, pressure altimeter, standby compass, and auxiliary brake gage.

VFR

Attempt to join another aircraft, and use HEFOE signals to indicate extent of problems. Use PRC emergency radio if available.

Note

- Landing gear must be lowered by emergency method (visual check by LSO/TOWER/WINGMAN is very desirable).
- Fuel state must be estimated using power setting, airspeed, altitude, and time (fuel quantity gage pointers will freeze at the last fuel indications before power loss).
- Flaps/slats, antiskid, flaperon pop-up, trim, and nose-wheel steering will not be available. Normal wheel brakes will be available.
- If available, plan to make midfield arrested landing. Battery-powered spin assist may be selected before landing, to gain extended rudder throw for additional directional control.

SPD DR LIGHT ON

Lighting of the L or R-SPD DR light on the annunciator panel indicates a failure of the constant speed drive/starter (CSD/S). A steady light indicates high oil temperature, low oil pressure, or CSD/S failure. A bright flashing light (2 to 3 second interval) indicates CSD/S overspeed. A random, dim, flickering light at altitudes above 30,000 feet indicates low oil pressure due to altitude. If the constant-speed drive/starter fails, perform the following:

1. SPD DR light flashing REDUCE RPM - RESET SPEED DRIVE

If SPD DR Light Continues to Flash:

2. Speed drive switch (affected CSD/S) . . . OFF

If SPD DR Light is ON Steady:

3. Speed drive switch (affected CSD/S) . . . OFF

At High Altitude:

4. SPD DR light flashes brightly after reset REDUCE RPM (BOTH ENGINES) TO 75% RESET SPEED DRIVE

If light continues to flash, descent to lower altitude. If light continues to flash, switch affected CSD/S OFF.

5. If speed drive light flickers dimly, descend to lower altitude.

Note

If the SPD DR light is allowed to continue flickering, loss of CSD control and generators may ensue.

EMERGENCY POWER DISTRIBUTION

SINGLE GENERATOR FAILURE
(LOSS OF MONITORED BUS)
EQUIPMENT LOST

INSTRUMENTS	AVIONICS	INTERIOR LIGHTS	EXTERIOR LIGHTS
OUTSIDE AIR TEMP ACCELEROMETER SYSTEM "G" METER POWER TRIM	ALL ECM CAPABILITY EXCEPT CHAFF DISPENSER RADAR RECORDER GROUND CONTROL BOMBING	ALL, EXCEPT FOLLOWING: FLIGHT INSTRUMENT CAUTION LIGHTS FLOOD LIGHTS UTILITY LIGHTS MAP LIGHT PILOT'S SPOT LIGHT WARNING LIGHTS B/N INSTRUMENT	ALL, EXCEPT FOLLOWING: APPROACH LIGHT ANTI-COLLISION LIGHT
FUEL & OIL	HYDRAULIC		
FWD. TRANS. PUMP (SLOWER FUSELAGE DUMPING RATE)	AUX HYD PUMP		

DOUBLE GENERATOR FAILURE - RAT EXTENDED
(ESSENTIAL BUS ONLY)
EQUIPMENT REMAINING

ENGINE INSTRUMENTS	MISC	ENGINE CONTROL	AIR COND. HEAT & VENT.
FUEL QUANTITY FUEL FLOW EGT OIL PRESSURE % R.P.M.	NON-ANTI SKID BRAKES LIQUID OXYGEN INDICATOR LOX/FUEL/OIL TEST WING LOCK & UNLOCK SWITCH CNI-AIMS/ECM DESTRUCT	AIR START CSDS (BATTERY)	RAM AIR CABIN DUMP VALVE BLEED-AIR ISOL. VALVES
FLIGHT INSTRUMENTS	FLIGHT CONTROLS	FUEL & OIL	LIGHTS
AAU/19 ALTIMETER HSI MA-1 COMPASS VERTICAL GYRO ANGLE OF ATTACK INTEGRATED POSITION INDICATOR APPROACH INDEXER TURN & SLIP AIRSPEED INDICATOR	LATERAL TRIM LONG. TRIM RUDDER TRIM FLAPS/SLATS (NORMAL) FLAPERON POP-UP SPIN ASSIST (BATTERY)	NO LOSS OF CAPABILITY EXCEPT FUSELAGE DUMP & ELECTRICAL OPERATION OF IN FLIGHT REFUELING.	FIRE WARNING & TEST FLIGHT INSTRUMENT ANNUNCIATOR PANEL APPROACH LIGHTS FLOOD LIGHTS UTILITY LIGHTS MAP LIGHT PILOT'S SPOTLIGHT B/N INSTRUMENT MASTER CAUTION ESSENTIAL ENGINE INSTRUMENTS CAUTION DIMMING WHEELS WARNING WHEELS TRANSITION
LANDING AND ARRESTING GEAR	RADIO	ARMAMENT	
LANDING GEAR ARRESTING HOOK	INTERCOM AIC-14 CNI (AN/ASQ-57) UHF, ADF TACAN, IFF	MECHANICAL FUZING STORES JETTISON T-375 WEAPONS MONITOR AND CONTROL ESSENTIAL ARMAMENT FEEDER MANUAL WEAPON RELEASE GUN CLEAR	

B-ADFI-61

Figure 5-7

NEW
NEW
NEW
NEW**LOSS OF TRIM BUTTON**

1. LAT/LONG TRIM circuit breaker PULL

Note

Pulling LAT/LONG TRIM circuit breaker deenergizes the ram air switch. Should ram air be desired, reset the LAT/LONG TRIM circuit breaker long enough to select RAM AIR.

HYDRAULIC SYSTEM FAILURE**SINGLE HYDRAULIC PUMP FAILURE**

The loss of any one hydraulic pump will be indicated on the hydraulic pressure indicator and will not present any flight control problems.

CAUTION

Failure of one pump may result in failure of the other pump in the same system.

1. Land as soon as practicable.

FLIGHT OR COMBINED HYDRAULIC SYSTEM FAILURE

Loss of either the flight or combined hydraulic system allows the one operating system to assume full demand of the stabilizer, rudder, and flaperons.

Note

Either the combined primary or the flight hydraulic system alone will power the flight controls throughout the flight envelope except at high IMN.

With a failure of either hydraulic system, hydraulic operation of the following systems will not be available:

*Canopy
*Wing Slats
*Wing Flaps
Flaperon Pop-Up
Wing Fold
Strut Lock

*Landing Gear
Nose-Wheel Steering
Antiskid
*Normal Brakes
Arresting Hook
(retraction)

*Alternate means of actuation available

With a flight hydraulic system failure, the AFCS will also be inoperative.

With a combined hydraulic system failure, the following will also be inoperative.

Speed Brakes
Assist Spin Recovery
RAT Retraction

If Either the Flight or Combined Hydraulic System Fails, Proceed as Follows:

1. Land as soon as practicable.

Just Prior to Landing:

2. Wing and fuselage fuel DUMP TO 3600 POUNDS

Note

If arrested landing is planned, dump to maximum arrested landing gross weight.

3. Slow to 180 KIAS
4. Flap lever LAND
5. Emergency flap switch DN

CAUTION

Emergency extension of the flaps to the terminal (LAND) position above 160 KIAS will result in a burned-out clutch in the gear box and complete loss of flap operation.

6. Slow to 150 KIAS
7. Landing gear EXTEND BY EMERGENCY SYSTEM

If Gear Fails To Indicate Down and Locked:

8. Select flaps UP, accelerate to maximum of 250 KIAS and apply positive and negative g, yaw aircraft.
9. Repeat steps 3, 4, and 5 if necessary.
10. Have visual gear-position check made by tower on a fly-by, or by another aircraft.
11. Brake selector handle TURN 90° CW
12. Auxiliary brake gage . CHECK AT 15 CYCLES

Note

Except with complete loss of combined hydraulic system fluid, the brake accumulator can be recharged. Availability of fluid may readily be determined by operating the hand-pump and noting an increase on the brake pressure gage or back pressure on the pump handle. The bombardier/navigator shall assist the pilot in this operation.

13. Make a normal landing approach.

Note

Advise tower of intentions prior to landing.

14. A short field arrestment is recommended.

After Landing (No Arrestment):

15. If there is less than a 10-knot crosswind, use aerodynamic braking to decelerate.
16. Use minimum number of brake applications. (Bombardier/navigator actuate auxiliary hydraulic pump to replenish brake accumulator.)
17. Clear runway, DO NOT attempt to taxi.
18. Insert landing gear pins.
19. Shut down engines.

LOSS OF FLIGHT AND COMBINED HYDRAULIC SYSTEM

Failure of either flight or combined hydraulic system will light the BACK-UP HYD caution light. If the RUD THRO caution light also lights, this indicates loss of normal hydraulic system pressure in both systems with flight controls limited to rudder and stabilizer using the backup flight control system. This provides rudder control through rudder pedal movement and horizontal stabilizer control through longitudinal stick movement. Flaperon control is not provided.

In cruising flight, nose attitude is easily maintained by normal stick control. Straight flight and gentle turns can be performed by the use of smooth rudder input.

In Recovery From Unusual Nose-High Attitudes:

1. Maintain angle of attack below 20 units.
2. Gently roll the aircraft upright using only as much rudder as necessary.

WARNING

Full rudder authority (35°) is provided automatically upon loss of flight and combined hydraulic system pressure. Use of excessive rudder at low speeds and high angles of attack may induce a spin.

In Recovery From Unusual Nose-Low Attitudes:

1. Reduce power to idle.
2. Use rudder gently to roll the aircraft upright.

3. As soon as bank angle is less than 90° , apply aft stick to raise nose to horizon. Continue to roll airplane to wings-level attitude.

WARNING

Full rudder authority (35°) is provided automatically upon loss of flight and combined hydraulic system pressure. Use of excessive rudder deflection above 190 KIAS should be avoided because resulting loads on the vertical stabilizer may exceed available strength. If rudder is used at speeds above 200 KIAS, observe the following limits to prevent possible catastrophic failure:

Full pedal to 190 KIAS
One half pedal ($1\frac{1}{2}$ inch) to 250 KIAS
One quarter pedal ($\frac{3}{4}$ inch) to 365 KIAS
One eighth pedal ($\frac{3}{8}$ inch) above 365 KIAS

In addition, apparent dihedral effect (the ability to roll the aircraft with rudder) is sharply reduced to zero above .84 MACH. If airspeed exceeds .84 MACH, lateral control by use of the backup flight control system or by asymmetrical thrust is not possible.

Under optimum conditions, field landings are possible using the backup flight control system.

If a Field Landing is to be Attempted:

1. Lower landing gear at safe altitude using emergency method.
2. Leave flaps and slats retracted.

WARNING

Asymmetrical flaperon float exists when the flaps are lowered in flight following complete hydraulic failure. Asymmetry may cause uncontrollable rolling movement in either direction.

3. Conduct slow flight at safe altitude using 18 units angle of attack, 150 KIAS, or minimum controllable speed, whichever is higher.
4. Plan for a straight-in approach using speed determined in step 3.
5. If fuel permits, one or more low approaches may be made prior to final landing.
6. For go-around, avoid rapid large longitudinal control inputs. The bombardier/navigator should monitor the BACK-UP HYD light and alert the pilot if the light goes out, indicating pump capacity has been exceeded.

NEW

NEW

Note

Longitudinal control rate limiting (decreased pitch response) may occur in the power approach configuration while using the backup hydraulic system.

7. Plan arrested landing since flaperon pop-up and antiskid braking will not be available.
8. Use smooth control movements; do not attempt to damp the aircraft dutch roll.

SPEED BRAKES SYSTEM FAILURE

If an electrical system failure occurs with the speed brakes extended, they will be automatically retracted by combined hydraulic system pressure. If a combined hydraulic system failure occurs, the speed brakes will be retracted by air loads when the speed-brakes switch is moved forward. When the electrical and combined hydraulic systems both fail, the speed brakes will retract by air loads.

FLAPS/SLATS FAIL TO RETRACT

If a Barberpole Indication Should Occur on the Flaps/Slats Indicator:

1. Climb to a safe operating altitude (do not exceed flap extensions limit of 250 KIAS).
2. Maintain a safe airspeed/angle of attack and a high thrust setting.

WARNING

Extreme caution should be exercised during flap retraction under heavy gross weight conditions. To avoid aircraft stall or settling due to flap retraction, do not retract the flaps below 170 KIAS for weights up to 50,000 pounds and not below 185 KIAS for weights above 50,000 pounds. At the heavier weights and under high ambient temperature conditions, acceleration and climb performance are marginal and it may be impossible to reach 185 KIAS. If 185 KIAS cannot be reached, it is recommended that external store weight be reduced in order to permit acceleration to 185 KIAS prior to flap retraction.

Note

Remedial action for barberpoled slats may include any or all of the following steps at speeds above the minimum for slat retraction and up to a maximum of 250 KIAS.

3. Place flap lever to the TAKEOFF position. After slats/flaps have extended, place flap lever UP
4. If the indicator barberpoles, apply 0 g momentarily.

5. If it still barberpoles, momentarily actuate the flap lever to TAKEOFF. As the slats begin to extend, immediately return the lever to UP.
6. If it still barberpoles, momentarily actuate the emergency flap switch to DN. As the slats begin to extend, immediately set the switch to UP and then OFF.
7. If it still barberpoles, maintain airspeed above the minimum retraction speed and extend the flaps/slats partially and then retract. As the slats approach the fully closed position, momentarily apply slight negative g.
8. If it still barberpoles, return to base and land.

FLAPERON POP-UP FAILURE

If the Flaperons Pop-Up in Flight:

1. Apply full power
2. Flaperon pop-up switch OFF

Note

If the flaperons pop up at the start of flap/slat transit (from up or down) return the flap handle to its original position.

3. External stores . . JETTISON IF NECESSARY

If flaperons do not retract with application of power; (caused by failure of a hydraulic check valve, which ports fluid to the pop-up valve any time the slats are in transit (up or down)):

4. While maintaining a safe altitude, electrically extend the flaps/slats as follows:
 - a. Flaperon pop-up OFF

Note

Turn flaperon pop-up OFF to preclude pop-up if the failure is due to a weight-on-wheels switch failure. If pop-up is required for crosswind or short field landing, it may be armed shortly after touchdown.

CAUTION

Leave flap handle up. Ensure that the slat actuating cylinder is not hydraulically actuated to either up or down when the isolation valve switch is moved to LDG by actuation of the gear handle down.

- b. Gear handle DOWN
- c. Slow to 180 KIAS.
- d. Emergency flap switch . . . DN POSITION

Note

Leave emergency flap switch at DN.



Emergency extension of the flaps to the terminal (LAND) position above 160 KIAS will result in a burned-out clutch in the gear box and complete loss of flap operation.

LANDING GEAR HANDLE CANNOT BE RAISED

Note

If the landing-gear handle cannot be raised, it may be due to failure of the landing-gear handle lock solenoid or the left weight-on-wheels switch.

- 1. Flaperon pop-up OFF

To raise the landing gear:

- 2. Landing-gear OVERRIDE lever LIFT
- 3. Landing-gear handle UP

LANDING GEAR HANDLE UP, INDICATES UNSAFE

With the landing-gear handle in the UP position, if the wheels transition light comes on, and/or the integrated position indicator displays a barber pole for any of the three landing gear, proceed as follows:

- 1. If both flight and combined hydraulic system pressure is available, isolation valve switch - LDG.
- 2. If either flight or combined hydraulic system pressure is not available, or gear continues to indicate unsafe with the isolation valve in the LDG position - Observe gear extension speed limit (250 KIAS).

An unsafe indication may be due to a failure in the landing-gear position indicating system. Such a failure will normally be observed first when the landing gear is raised immediately after takeoff and cycling the gear may correct the problem. Repeated cyclings are not recommended.



When cycling the gear from the up position, allow sufficient time (approximately 7 seconds) for the landing gear to complete a half cycle (i.e. from full up to full down) before attempting a reversal. If the direction is reversed before the door is fully opened, the gear linkage will not have completed its travel and the forward gear door may fail.

Note

Do not attempt to cycle the landing gear for an unsafe indication until a safe altitude has been reached. Select takeoff flaps and maintain less than 200 KIAS while cycling the gear.

WEIGHT-ON-WHEELS SWITCH FAILURE

LEFT WEIGHT-ON-WHEELS SWITCH

Failure of the left weight-on-wheels switch to actuate to the in-flight position is indicated in the cockpit by the power trim indicators remaining unmasked and the radar altimeter indicating a constant value between 0 and 10 feet. In addition, the following effects will occur:

- Gun charging and clearing disabled
- Emergency jettison disabled
- Landing-gear handle lock engaged
- Refueling store hose jettison disabled
- Flaperon pop-up enabled
- AOA system disabled
- Tow-link and strut-lock indications disabled
- ALE-29 sequencer disabled
- Electric fuzing disabled
- Wing-tank pressurization disabled
- Approach power compensator disabled
- SHRIKE guidance disabled
- In-flight alignment disabled

The landing-gear handle lock can be released by lifting the OVERRIDE lever.

The wing tanks can be pressurized to 7 PSI by setting the wing-tank pressurization switch to ORIDE.

RIGHT WEIGHT-ON-WHEELS SWITCH

Nose-wheel steering and antiskid braking operate through the right weight-on-wheels switch. Failure of this switch to actuate to the in-flight position will cause no in-flight losses.

DAMAGED AIRCRAFT

Loss of structural integrity may result from a midair collision, exceeding structural limits, bird strikes, canopy losses, or battle damage. The following procedure generally applies:

- 1. Determine whether adequate control of the aircraft is available; if not EJECT.
- 2. If at low altitude, ZOOM to convert airspeed to altitude. Maintain airspeed as required.
- 3. If FOD damage is suspected:
 - a. TO ONE ENGINE - Secure the engine.
 - b. TO BOTH ENGINES - Reduce power to minimum required for maintaining level flight or a slow climb.

4. If practicable, climb to at least 10,000 feet and proceed to an uninhabited area in the vicinity of intended landing.
5. When possible, obtain a visual inspection by another aircraft to assist in evaluating the damage.
6. Cabin pressurization DUMP (above 8,000 feet)
7. Landing gear handle DOWN
8. Flap handle TAKEOFF DETENT
9. Perform slow flight to determine minimum safe airspeed to be used during landing approach. If insufficient lateral control is available, flaps and slats DOWN or if flaps or slats fail to extend fully, make a flaps/slats UP landing. (Refer to NO FLAPS/NO SLATS LANDING Procedure.)
10. Approach speed should be the minimum speed obtained on slow flight check plus 10 knots.

AIRSPEED INDICATOR FAILURE

Figure 5-9 presents angle of attack for various flight conditions for use in the event of airspeed indicator failure.

LANDING EMERGENCIES

If the situation necessitates an approach speed above normal, or affects slowing or control of the aircraft after landing, an arrested landing shall be considered. Satisfactory field and carrier approaches can be made in abnormal approach configurations. For optimum angles of attack for various approach configurations, see figure 5-8.

SINGLE-ENGINE LANDING

A single-engine landing is basically the same as a normal landing, except that the pattern is expanded slightly to avoid steep turns. Performance at high gross weights and high ambient temperatures is critical. Single-engine landing, wave-off, or bolter may be accomplished safely up to gross weight and temperature limits as shown in figure 5-10.

During wave-off, the optimum technique is to select MILITARY THRUST, rotate to 23 units AOA. After wave-off, decrease AOA to 18 units to provide adequate excess thrust margin for maneuvering flight. Bolter techniques consist of selecting military thrust, rotating to 20 units AOA. During acceleration decrease AOA to 18 units. External fuel tanks have a negligible affect on thrust required and need be dropped only if necessary for gross weight considerations. For single-engine landing, proceed as follows:

1. Wing and fuselage fuel DUMP

Note

Fuel dumping will automatically stop at approximately 3600.

2. External stores JETTISON (AS NECESSARY)

WARNING

High weight/drag stores will considerably reduce wave-off and bolter capability.

EMERGENCY APPROACH CONFIGURATION AOA/ AIRSPEED		
CONFIGURATION	OPTIMUM AOA (UNITS)	OPTIMUM APPROACH SPEEDS GROSS WEIGHT = 28,000 KIAS
FLAPS UP SLATS OUT	22	130
FLAPS 30° SLATS IN	19	111
FLAPS UP SLATS IN	21	133
SINGLE ENGINE FLAPS 30° SLATS OUT	21	108
NOTES 1. FOR EACH 1000 LBS ADDED TO ABOVE GROSS WEIGHTS, ADD 2 KIAS TO OPTIMUM APPROACH SPEED. 2. DATA IN ABOVE CHART IS THE RESULT OF CARRIER SUITABILITY FLIGHT TEST EVALUATION CONDUCTED BY THE NAVAL AIR TEST CENTER, PATUXENT RIVER, MARYLAND.		

A-ADF1-77

Figure 5-8

3. Wing-tip speed brakes RETRACT
4. Landing gear DOWN
5. Flaps TAKEOFF

AIRSPEED INDICATOR FAILURE

FLIGHT CONDITION	ANGLE OF ATTACK (UNITS)
CATAPULT	
TRANSITION FROM CATAPULT (30° FLAPS, GEAR DOWN) -----	22
L/D _{MAX} DIRTY	
30° FLAPS DRAG INDEX = 0 -----	19
30° FLAPS DRAG INDEX = 100 -----	21
L/D _{MAX} CLEAN	
DRAG INDEX = 0 -----	15
DRAG INDEX = 100 -----	16
MILITARY POWER CLIMB	
30° FLAPS, GEAR UP -----	17
FLAPS AND GEAR UP	
DRAG INDEX = 0 . . . SEA LEVEL -----	10
COMBAT CEILING -----	14
DRAG INDEX = 100 . . . SEA LEVEL -----	13
COMBAT CEILING -----	16
MAX RANGE CRUISE AT ALTITUDES BELOW 20,000 FT. (ALL GROSS WEIGHTS)	
DRAG INDEX = 0 -----	12
DRAG INDEX = 100 -----	14
MAX RANGE CRUISE AT OPTIMUM CRUISE ALTITUDE	
DRAG INDEX = 0 -----	12
DRAG INDEX = 100 -----	13
ENDURANCE AT OPTIMUM ENDURANCE ALTITUDE	
DRAG INDEX = 0 -----	15
DRAG INDEX = 100 -----	16
DESCENTS (LOW TO MEDIUM GROSS WEIGHTS)	
MAX. RANGE DESCENT (IDLE POWER) -----	18
NORMAL DESCENT (80% RPM. WING TIP SPEED BRAKES OPEN) -----	14
GEAR AND FLAP EXTENSION	
SAFE GEAR EXTENSION (WITH FLAPS UP) -----	15
SAFE 30° FLAP EXTENSION (WITH FLAPS UP) -----	15
STALL WARNING	
FLAPS UP -----	21
FLAPS 30° -----	26
STALL	
FLAPS UP, GEAR UP -----	25
FLAPS 30°, GEAR DOWN -----	28
APPROACH (FINAL ON SPEED APPROACH)	
GEAR DOWN, FLAPS 30°, WING TIP SPEED BRAKES OPEN -----	22
GEAR DOWN, FLAPS UP -----	19
<p align="center">NOTE</p> <ul style="list-style-type: none"> • DUE TO THE BASIC INACCURACY OF SETTING UP FLIGHT CONDITIONS (OTHER THAN LANDING APPROACH) BY REFERENCE TO THE ANGLE OF ATTACK INDICATOR, THE INFORMATION INCLUDED IN THIS TABLE SHOULD BE USED ONLY IN AN EMERGENCY SITUATION. • THE ANGLES SHOWN FOR ANGLE OF ATTACK VERSUS DRAG INDEX, WHILE NOT ENTIRELY LINEAR, MAY BE INTERPOLATED LINEARLY FOR PRACTICAL PURPOSES. 	

ADF1-122

Figure 5-9

SINGLE ENGINE CARRIER LANDING

GROSS WEIGHT VS TEMPERATURE

DATE: 15 MARCH 1969
DATA BASIS: ESTIMATED

REMARKS
SINGLE ENGINE OPERATION
INOPERATIVE ENGINE WINDMILLING

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

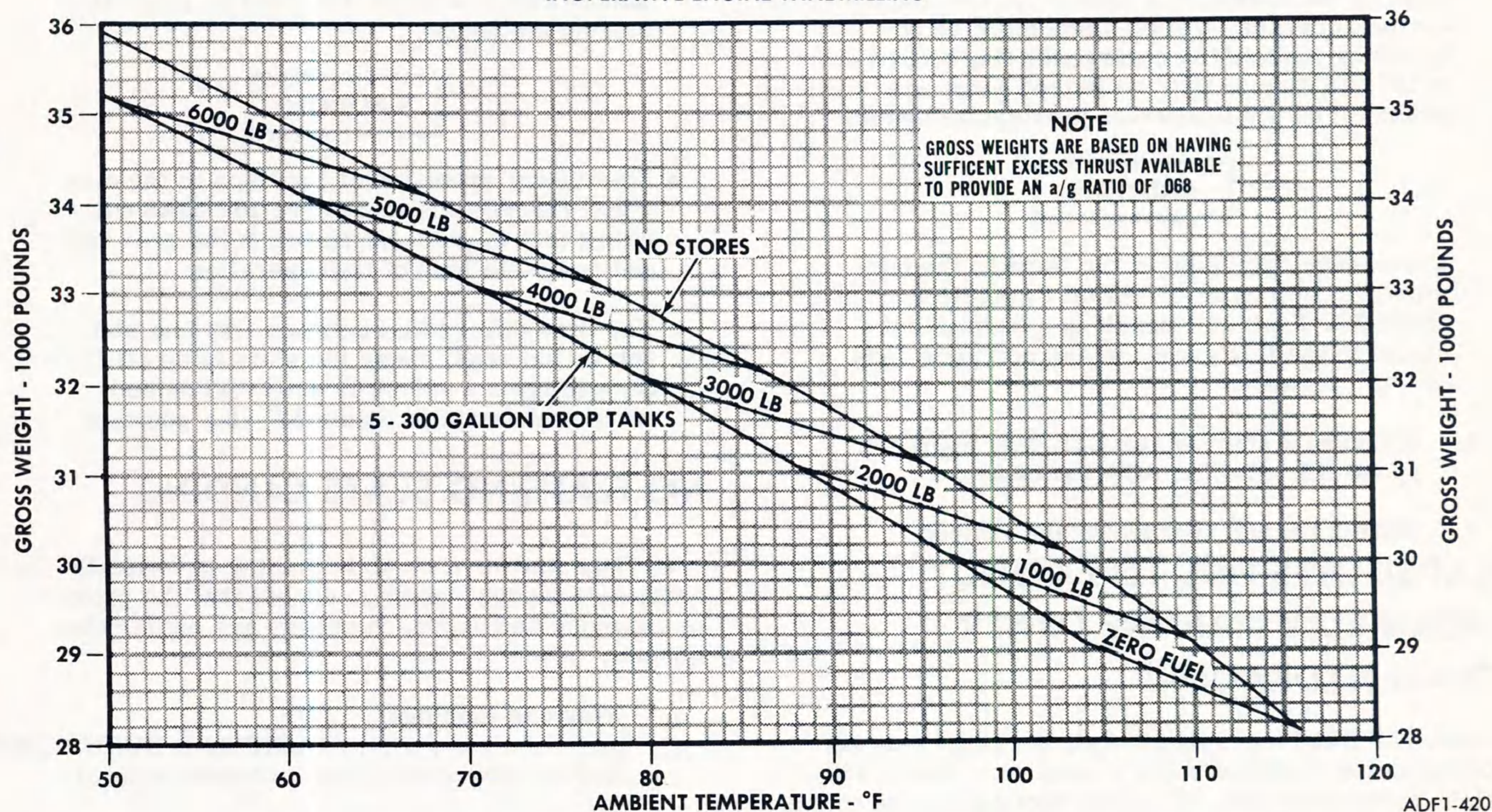


Figure 5-10

WARNING

- Do not use LAND flaps for single-engine landing.
- In the event a single-engine approach is compounded by a hydraulic failure, or the necessity otherwise arises to extend the flaps/slats by the emergency means for the single-engine approach, takeoff flaps must be obtained by placing the emergency flap switch to DN and then to OFF as takeoff flaps are indicated on the integrated position indicator.

CAUTION

Emergency extension of the flaps to the terminal (in this case, TAKEOFF) position above 160 KIAS will result in a burned-out clutch in the flap gear box and complete loss of flap operation.

6. Maintain a shallow, slightly fast approach speed (21 units) on AOA indicator.
7. Make a normal touchdown and rollout.

FLAPS/SLATS FAIL TO EXTEND NORMALLY (FAILURE OTHER THAN HYDRAULIC)

Above 180 KIAS (approximately), the flaps may not extend to the TAKEOFF (30°) position. Above 140 KIAS (approximately), the flaps may not extend to the full down or LAND position. In either situation, the flap indicator may indicate a barberpole situation until the airspeed is reduced.

Note

Flaps and slats may fail to extend normally as a result of hydraulic or electric malfunctions. If the cause is determined to be hydraulic, follow procedures as outlined for flight or combined hydraulic system failure. If the malfunction is not hydraulic, proceed as follows:

1. FLAP/SLAT circuit breaker PULL
2. Airspeed 180 KIAS
3. Emergency flap switch EXTEND FLAPS
ELECTRICALLY TO
TAKEOFF POSITION, RETURN
EMERGENCY FLAP SWITCH TO OFF.

Pulling the flap/slat circuit breaker isolates the normal flap/slat position switches, allowing any flap position to be selected electrically. If the circuit breaker is not pulled, TAKEOFF flaps cannot be

selected electrically, since the flaps may return to the up position hydraulically as soon as the emergency flap switch is repositioned to OFF.

Note

After landing, and the flaps and slats have been raised, the FLAP/SLAT circuit breaker must be reset, the flaps/slats visually checked up, and the normal flap handle checked in the UP position prior to folding the wings.

CAUTION

- Emergency extension of the flaps to the terminal (LAND) position above 160 KIAS will result in a burned-out clutch in the gear box and complete loss of flap operation.
- The time differential between flap and slat retraction could cause the slats to be off if the emergency switch is activated on and off in an attempt to obtain 30° flap position.

NO FLAPS/NO SLATS LANDING

A no flaps and/or a no slats landing is basically the same as a normal landing, except that the pattern is expanded and approach speeds are higher than normal.

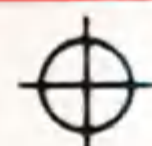
1. Wing and fuselage fuel DUMP AND BURN DOWN
Reduce fuel to minimum acceptance level.
2. Fly traffic pattern slightly wider than normal.
3. Flap lever UP
4. Maintain 21 units AOA.

FLAPS TAKE-OFF/NO SLATS LANDING

1. Wing and fuselage fuel DUMP
2. Fly traffic pattern slightly wider than normal.
3. Flap lever TAKEOFF

Note

- Extension of the flaps will produce a characteristic of strong alternate wing-dropping and abrupt pitch-up prior to stall.
- Extension of either flaps or slats will reduce stall speed approximately 10 knots below the clean stall speed.
- 4. Fly slightly faster approach. Maintain 19 units AOA.

**WARNING**

- Do not attempt to flare the landing. This may result in a severe pitch-up.
- During wave-off or bolters in this configuration, overrotation must be avoided due to pitch-up occurring at 21 to 22 units AOA.

NO FLAPS/SLATS DOWN LANDING

Slats only landing is basically the same as a normal landing, except the approach speed will be faster.

1. Wing and fuselage fuel DUMP
2. Fly pattern slightly wider than normal.
3. Flap lever TAKEOFF
4. Maintain 22 units AOA.

If the stabilizer does not shift upon flap/slat actuation for landing (full back stick throw may be less than required for control), proceed as follows:

1. Flap lever UP
2. Make no flaps/slats landing.

CAUTION

Structural damage will result if spin assist is activated with flaps selected down. Damage to the stabilizer shift mechanism does not have a derogatory effect on landing configuration flight characteristics. If engagement speed or runway length dictate, a normally configured landing is warranted.

LANDING GEAR DOWN WITH UNSAFE INDICATIONS

Gear extension failures may be due to electrical, hydraulic, mechanical, or cabin pressurization malfunctions. The gear will not extend normally if combined secondary hydraulic system pressure or 28V DC essential bus electrical power is not available. Without 28V DC power, the wheel transition light will be inoperative and the wheel position indicator will show a barberpole unsafe condition. Whenever the landing gear handle is selected down and all the wheels do not extend and indicate positively down and locked, accomplish the following as necessary:

1. Gear/hook circuit breaker CHECK IN
2. Cabin dump switch ON
3. Reduce airspeed to 200 KIAS.
4. Landing gear . . . CYCLE AS NECESSARY TO OBTAIN DOWN INDICATION
Leave gear handle DOWN after completion of landing gear cycling.

CAUTION

When cycling the gear allow sufficient time (approximately 7 seconds) for the landing gear to complete a half cycle (i.e. from full up to full down) before attempting a reversal. If the direction is reversed before the door is fully opened, the gear linkage will not have completed its travel and the forward gear door may fail.

5. With flaps up, accelerate to a maximum of 250 KIAS and apply positive and negative g.
6. Flap lever TAKEOFF DETENT

LANDING GEAR EMERGENCY

FINAL CONFIGURATION	CARRIER LANDING APPLICABLE NOTES	FIELD LANDING APPLICABLE NOTES
ALL GEAR UP	3, 4, 5, 6, 8, 9, 10, 16, 17, 18, 19	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 14, 17, 19
NOSE GEAR UP	3, 4, 5, 6, 7, 8, 9, 10, 17, 18, 19	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 17, 19
ONE MAIN UP	3, 4, 5, 6, 7, 8, 9, 10, 17, 18	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 13, 15, 17
BOTH MAINS UP	3, 4, 5, 6, 7, 8, 9, 10, 17, 18	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 14, 17
ONE MAIN UP & NOSE GEAR UP	3, 4, 5, 6, 7, 8, 9, 10, 17, 18, 19	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 15, 17, 19

NOTES

1. Request Foam on Runway.
2. Utilize Midfield Arresting Gear and LSO, If Available.
3. Lighten Aircraft by Dumping and Burning Off Excess Fuel to Approximately 1500 Pounds Remaining.
4. Retain External Tanks, If Empty.
5. Jettison Other External Stores. If the Gear Has Been Lowered. The Emergency Jettison System Must Be Used to Jettison Stores. Pull Appropriate Emergency Stores Jettison Circuit Breakers to Retain Empty Drop Tanks.
6. Flaps Down, If Available.
7. Arresting Hook Down.
8. Canopy Closed.
9. Wingtip Speedbrakes Out, If Available.
10. Flaperon Popup Off.
11. Fly Reduced Rate of Descent Utilizing LSO If Available. Do Not Let The Nose Fall Through.
12. Touch-Down Short of the Midfield Arresting Gear on Runway Centerline with Power On. Maintain 90 KIAS Nose High Attitude with Aft Stick Until Arresting Gear is Engaged.
13. If Arresting Gear Is Not Available, Land on Side of Runway Opposite the Failed or Unsafe Main Gear.
14. Touch-Down Just Short of the Midfield Arresting Gear on Runway Centerline.
15. Touch-Down Just Short of Midfield Arresting Gear on Runway Centerline with Power On. Maintain Flying Speed (105-115 KIAS) Until Arresting Gear Is Engaged. Be Prepared to Go Around If Arresting Gear Is Missed.
16. Hook Up Landing Is Recommended to Prevent Possible Crew Injuries As the Result of Excessive Nose Slapdown Loads.
17. Throttles and Engine Master Switches Off (After Engaging Arresting Gear, or After Touchdown, If No Arresting Gear Is Available).
18. Barricade Required.
19. Tank Pressurization Switch OFF

A-ADF1-78

Figure 5-11

CAUTION

The aircraft is limited to 2 positive and 0 negative g in the landing configuration. Accelerating to 250 KIAS with the flaps down and applying positive and negative g will exceed these limits resulting in possible flap failure. A better procedure is to leave the flaps up, accelerate to 250 KIAS and apply positive and negative g, subsequently lowering the flaps/slats for landing.

7. Have a visual gear position check made by the tower on a fly-by or by another aircraft.
8. If one or more gears still indicate unsafe, steps 4, 5, 6, and 7 may be repeated.
9. Reduce airspeed to 150 KIAS.

Note

- The alternative of landing aboard ship with one or more gears not down, vice proceeding to a suitable divert airfield, must be considered prior to attempting gear extension by the emergency means, since the possibility exists that the offending gear may remain not down after such action is taken, and any feasible divert fields attainable in a clean configuration may then be beyond range.
 - The landing gear, once extended by the emergency means, cannot be retracted while airborne.
10. With the gear handle down (any configuration), push handle in, rotate 90° clockwise, then pull out.

Note

The landing gear handle must be pulled out with sufficient force and extension to ensure actuation of the emergency air bottles. Extension of the gear handle may be in excess of 3 inches depending on control rigging.

11. If necessary, steps 5, 6, and 7 may be repeated.

Note

- If a landing gear is down and indicates unsafe and is visually checked down after the above procedure, a short field arrested landing is recommended. An unsafe gear indication may not necessarily constitute an emergency; the

unsafe indication could be a malfunction of the indicating system. When it is necessary to lower the landing gear by the emergency extension system (for other than a hydraulic failure/malfunction) there is no loss of the full operation of normal braking, antiskid, flaperon pop-up, or nose-wheel steering. In the event an unsafe gear indication remains, a visual check by another aircraft or by tower personnel should be accomplished to determine actual condition. When landing with any gear up, or the gear is confirmed unsafe, figure 5-11 provides recommended courses of action.

These recommendations are based upon available information and experience to date. They are subject to operational and pilot/crew considerations existing at the time.

- After actuation of the emergency landing gear extension system, and the nose gear remains unsafe, consideration should be given to making a touch and go in an effort to obtain a down indication.

FIELD ARRESTING GEAR

There are several types of field arresting gear. These types include the anchor chain cable, water squeezer, and Morest-type equipment. All of these types require engagement of the arresting hook in a cable pendant rigged across the runway. Location of the pendant in relation to the runway will classify the gear as follows:

1. Midfield gear. - Located near the halfway point of the runway. Usually requires prior notification in order to rig for arrestment in the direction desired.
2. Abort gear. - Located 1500 to 2500 feet short of the upwind end of the duty runway and usually will be rigged for immediate use.
3. Overrun gear. - Located shortly past the upwind end of the duty runway. Usually will be rigged for immediate use.

Some fields will have all of these types of gear, others none. For this reason, it is imperative that all pilots be aware of the type, location, and compatibility of the gear in use with the aircraft, and the policy of the local air station with regard to which gear is rigged for use and when.

The approximate maximum permissible engaging speed, gross weight, and off-center engagement distance for field arrestment of aircraft are listed in figure 5-12.

WARNING

- Under no circumstances should a pilot's decision to abort a takeoff be delayed because of knowledge that an emergency arresting gear is available at the end of the runway. Decision to abort should be based on the usual parameters of remaining runway and distance required for stopping, using wheel brakes. The arresting gear will then serve as an assist to stop the aircraft from rolling off the runway onto unprepared surfaces.
- If off center, just before engaging the arresting gear, do not attempt to go for the center of the runway. Continue straight ahead parallel to the centerline.

As various modifications to the basic types of arresting gear are used, exact speeds will vary accordingly. Certain aircraft service changes may also affect engaging speed and weight limitations. Severe damage to the aircraft is usually sustained if an engagement into the chain gear is made in the wrong direction.

The following recommendations are made; however, depending upon the existing emergency condition, runway conditions, weather, time, fuel remaining, and other considerations, it may be impractical or impossible to adhere strictly to the following general recommendations.

In an emergency situation, first determine the extent of the emergency by whatever means are possible (instruments, other aircraft, LSO, RDO, tower, or other ground personnel). Next, determine the most advantageous arresting gear available and the type of arrestment to be made under the conditions which prevail. Whenever deliberate field arrestment is intended, notify control tower personnel as much in advance as possible and state estimated landing time in minutes. If gear is not rigged, it will probably require 10 to 20 minutes to prepare it for use. If foaming of the runway or area of arrestment is required or desired, it should be requested by the pilot at this time.

In general, the arresting gear is engaged on the centerline at as slow a speed as possible. Burn down to 6500 pounds of fuel/stores or less. While burning down, make practice passes to accurately locate the arresting gear. Engagement should be made with feet off the brakes, shoulder harness locked, and with the aircraft in a 3-point attitude. If the nose is held firmly on the deck (either by brake pressure or by forward stick) and when at a relatively high airspeed, the hook point can be off the ground. At low gross weight and in the 100 KIAS speed range, the tail hook may lift from the runway; this can be corrected by a slight amount of back pressure on the stick. Use caution when applying either forward or aft stick pressure just prior to engagement to prevent raising the hook or flying over the arresting gear. On runways with centerline

lights, the aircraft should be lined up slightly off centerline to prevent hook skip. The centerline lights can cause the hook point to bounce over the arresting gear. After engaging the gear, good common sense and existing conditions now dictate whether to keep the engines running or to shut it down and abandon the aircraft.

SHORT-FIELD ARRESTMENTS

If at any time prior to landing, it is known that a directional control problem exists or a minimum rollout is desired, a short field arrestment should be made and the assistance of an LSO requested. He should be stationed near the touchdown point and equipped with a radio. Inform the LSO of the desired touchdown point. A constant glide slope approach to touchdown is permitted (mirror or Fresnel Lens Landing Aid utilized) with touchdown on centerline at or just prior to the arresting wire with the hook extended. The hook should be lowered while airborne and a positive hook-down check should be made, if possible. If midfield gear or Morest type is available, it should be used. If neither are available, use abort gear. Use an approach speed commensurate with the emergency experienced. Landing approach power will be maintained until arrestment is assured or a waveoff is taken. Be prepared for a waveoff if the gear is missed. After engaging the gear, retard the throttle to IDLE or secure engine and abandon aircraft, depending on existing conditions.

LONG-FIELD ARRESTMENTS

The long field arrestment is used when a stopping problem exists with insufficient runway remaining (i.e., aborted takeoffs, icy or wet runways, loss of brakes after touchdown, etc.). Lower the hook, allowing sufficient time for it to extend fully prior to engagement. Do not lower the hook too early and weaken the hook point. Line up the aircraft on the runway centerline. On runways with centerline lights, the aircraft should be lined up slightly off centerline to prevent hook skip. The centerline lights can cause the hook point to bounce over the arresting gear. Inform the control tower of your intentions to engage the arresting gear, so that aircraft landing behind you may be waved off. If no directional control problem exists (crosswind, brakes out, etc.), secure the engine.

ABORTED TAKEOFF ARRESTMENTS

Where an aircraft takeoff must be aborted, a roll-in type engagement of all arresting gear is recommended to prevent overrun. The aircraft is cleared up to the maximum takeoff gross weight specified in the Aborted Takeoff column of figure 5-12. Additionally, the data provided in the Long Field Landing column may be used for light weight aborted takeoff, where applicable.

Note

The taxi light may be of use in locating arresting/abort gear at night.

FIELD ARRESTMENT DATA

TYPE OF ARRESTING GEAR	MAXIMUM SPEED KNOTS (a)													MAXIMUM OFF CENTER ENGAGEMENT FEET
	GROSS WEIGHT X 1000 POUNDS													
	SHORT FIELD LANDING (c,d)				LONG FIELD LANDING (e)				ABORTED TAKEOFF (g)					
	30	32	34	36	38	40	43	45	48	51	54	56.5	60.4	
M-2	109	106	103	100	99	96	94	92	89	86	85	83	81	20
E-14-1	160	160	160	160	160	160	159	157	156	156	144	139	132	50
E-27	157	155	153	150	149	147	144	142	139	135	132	130	125	35
E-15 200' SPAN	160	160	160	160	160	160	160	160	158	157	157	156	156	35
E-15 300' SPAN	160	160	160	160	160	160	160	160	160	160	160	160	160	50
M-21	150	150	150	150	150	150	150	125	115	115	115	115	115	10
E-28	160	160	160	160	160	160	160	160	157	156	155	154	153	40
E-5 STD CHAIN	150	150	150	150	150	150	146	144	140	137	134	132	128	(f)
E-5-1 STD CHAIN	161 (b)	163	159	156	153	150	146	144	140	137	134	132	128	(f)
E-5 HEAVY CHAIN	150	150	150	150	150	150	150	150	150	150	150	150	150	(f)
E-5-1 HEAVY CHAIN	161 (b)	161	161	161 (b)	165	165	165	165	165	165	163	161	156	(f)
BAK-6	160	160	160	156	154	153	150	149	147	145	142	139	135	15
BAK-9	160	160	160	160	160	160	160	160	160	160	150	145	136	30
BAK-12	160	160	160	160	160	160	160	160	160	160	160	160	156	50

(a) Except where noted, all engaging speeds limited by arresting gear capacity.

(b) Maximum engaging speed limited by landing gear strength.

(c) Maximum of 3.0 degree glide slope.

(d) Consult appropriate section for recommended approach speed.

(e) Flared or minimum rate of descent landing.

(f) Off-center engagement may not exceed 25% of the runway span.

(g) Data provided in the aborted take-off columns may be used for emergency high gross weight arrestments.

NOTE

At low gross weight and in the 100 KIAS speed range the tail hook may lift from the runway; this can be corrected by a slight amount of back pressure on the stick.

A-ADF1-79

Figure 5-12

BARRICADE ARRESTMENT

If a barricade arrestment is required, the following procedures are recommended:

1. Jettison stores if possible. Stores will not hamper successful barricade engagement, but may possibly be torn loose and present a hazard to flight-deck personnel.
2. Normally, the tailhook should be lowered, if possible, to permit engagement of a cross-deck pendant which will minimize barricade engagement speed and damage to the aircraft, and also help to keep the aircraft on the deck at barricade entry.
3. Fly a normal pattern and approach; on speed, centerline, and meatball.
4. Barricade entry must be with three wheels on deck to ensure that the refueling probe passes under the upper load straps.
5. Anticipate loss of meatball for a short period of time during the approach. Barricade stanchions may obscure meatball.
6. Keep the canopy closed.

FORCED LANDING

It is not recommended that a landing on unprepared surfaces be attempted with this aircraft. The crew should EJECT.

WARNING

It is recommended that forced landings be made with the landing gear extended, regardless of the terrain. A greater injury hazard is present whenever emergency landings are made with the landing gear retracted. Increased airspeed or nose-high angle of impact during landings with the landing gear retracted contributes greatly to crew injuries and aircraft damage. The nose-high attitude causes the aircraft to slap the ground, which subjects the crew to possible spinal injuries. Less injury and less aircraft damage will result with the gear extended.

If a Forced Landing is Unavoidable, Proceed as Follows:

1. RAT handle PULL IF REQUIRED
2. If time and conditions permit, dump and burn down to 800 pounds fuel.
3. Emergency calls COMPLETED
4. IFF EMERGENCY
5. External stores JETTISON
6. Landing gear DOWN AND LOCKED
7. Flaps EXTEND
Use emergency flaps/slats if necessary.

CAUTION

Do not extend the flaps electrically beyond TAKE-OFF (30°) in EMERGENCY above 160 KIAS.

8. Helmet visor . .DOWN, CHIN STRAP TIGHTEN
9. Lap belts TIGHTEN
10. Shoulder harness LOCKED
11. Make shallow approach.
12. Canopy JETTISON
Jettison canopy prior to touchdown.

Upon Touchdown:

13. Throttles OFF
14. Engine and fuel master switches OFF
15. Abandon aircraft.

BLOWN TIRE

A situation may occur when the pilot must land with a blown tire, or the tire may rupture during ground roll. A blown tire at high speed will require immediate control action to keep the aircraft aligned with the runway. The following procedures are applicable:

1. Use field arresting gear if available.

If Arresting Gear is Not Available:

1. Antiskid OFF
2. Flaperon pop-up OFF
3. Make normal final approach.
4. Land on side of runway opposite blown tire.
5. Lower nose gear to runway and use nose gear steering for directional control.
6. Use light opposite braking to slow aircraft.

If Fire Equipment is Available:

7. Engines SHUT DOWN

If possible, do not shut down engines until adequate firefighting equipment is available.

CAUTION

The damaged wheel may be either on fire or very hot, and fuel drained overboard after engine shutdown could contact the hot wheel, causing fire.

ARRESTING-HOOK MALFUNCTION

In the event that the hook does not extend by the normal method or the hook retracts when the combined hydraulic system is pressurized:

1. Ensure that landing gear is down and locked.
2. GEAR/HOOK circuit breaker PULL
3. Hook-release handle PULL

Note

To prevent a flashing approach light and indexer, place the hook bypass switch in the TOUCH-GO position.

WHEEL BRAKE SYSTEM FAILURE**WHEEL BRAKE ANTI-SKID SYSTEM FAILURE**

If erratic braking is experienced, or the antiskid annunciator light is lit, proceed as follows:

1. Antiskid switch OFF

CAUTION

The brakes should be released before the antiskid system is disengaged to prevent the possibility of skidding.

Note

Loss of antiskid braking may be due to an over-serviced strut which prevents the steering weight-on-wheels switch from closing. Such a loss would be accompanied by a loss of nose-wheel steering. Braking can be restored in this case by turning antiskid off, but steering must be accomplished by means of differential braking.

BRAKE SYSTEM EMERGENCY OPERATION

If braking action is lost, the aircraft can be stopped by using auxiliary to emergency braking.

1. Brake selector handle. TURN 90° CLOCKWISE
Check that auxiliary brakes cycles gage indicates approximately 15 cycles. If gage indication is considerably less than 15 cycles, manually pump with handpump or on aircraft incorporating the electric-motor-driven pump, depress AUX HYD button. The electric-motor-driven pump is not operative until 70% of aircraft weight is on the wheels.

Note

The antiskid feature of the aircraft will be inoperative when the brake selector handle is turned 90° clockwise. Avoid pumping brakes. Each application of brakes will deplete brake accumulator pressure.

2. Allow aircraft to decelerate, using aerodynamic braking. Delay using wheel brakes as long as safety will permit, thus allowing the aircraft to decelerate as much as possible; then apply brakes evenly, increasing brake pressure gradually.

If The Auxiliary Brake Applications are Exhausted:

3. Use abort gear if available:

If Arrestment is Unsuccessful:

4. Brake selector handle PULL OUT
Modulation of brake selector handle will provide approximately 2 brake applications after brake selector handle is pulled out.

Note

- Pull the brake selector handle AFT with a clockwise motion. Pulling the handle AFT with a slight counterclockwise movement may cause the handle to bind and prevent brake actuation.
- When combined hydraulic system fluid is available, it is possible to recharge the brake accumulator during rollout. Recharging can be accomplished by means of the auxiliary hydraulic pump motor or by operating the handpump. On earlier aircraft only the handpump is available for recharging.

HOT BRAKES

If heavy braking is used during the landing or taxiing, overheated brakes may result. Avoid prolonged brake applications to prevent brake disk fusing. Do not use the parking brakes until the brake disks have cooled. To prevent overheated brakes, braking requirements can be reduced by securing the left engine as follows:

1. Left CSD/S switch OFF
2. Left throttle IDLE CUT-OFF
3. Left engine and fuel master switch . . . OFF

Note

Lights powered by the monitored buses will be lost when either engine is cut. This will generally make the above procedures undesirable during night operations.

WARNING

Do not secure an engine after suspected hot brakes. Fuel from the primary fuel manifold is dumped near the wheel area when the throttle is shut off, creating a fire hazard.

DITCHING

Ditching the aircraft should be the pilot's last choice. All survival equipment is carried by the crewmember and ejection is therefore advisable. However, if altitude and situation demand ditching, the procedures set forth on the ditching chart (figure 5-13) are the fastest and safest way of evacuating the cockpit.

DITCHING CHART

CREW MEMBER	DUTIES BEFORE IMPACT	DUTIES AFTER IMPACT (CANOPY OUT OF WATER)	DUTIES AFTER IMPACT (AIRCRAFT SINKING WITH CANOPY UNDER WATER) PILOT AND B/N
PILOT	<ol style="list-style-type: none"> 1. B/N—ALERT. 2. External stores—JETTISON. 3. Landing Gear—UP. 4. Flap lever—LAND. 5. Arresting hook—DOWN. 6. Helmet visor—DOWN. 7. Oxygen mask—TIGHTEN. 8. Shoulder harness—LOCKED. 9. Lap belt—TIGHTEN. 10. Canopy—JETTISON. 11. Fly parallel to swell pattern. 12. Attempt touchdown along wave crest. 13. When arresting hook contacts water—SHUT DOWN ENGINES. 	<ol style="list-style-type: none"> 1. Emergency Oxygen—Actuate (if breathing difficult) 2. Canopy—Jettison (if not jettisoned before impact). 3. Emergency harness release handle—Pull up and aft. 4. Reach over shoulder with one hand and hold parachute close to back. 5. Lean forward and stand up. If parachute hinders egress release parachute harness Koch fittings. 6. See that B/N is clear of aircraft. 7. Abandon aircraft and swim clear—Inflate life preserver. 8. Actuate survival kit release handle. 9. Inflate life raft and enter. 10. Tie rafts together. 	<ol style="list-style-type: none"> 1. Emergency Oxygen—Actuate if breathing difficult. 2. Oxygen Mask—Tighten as much as possible. <p>NOTE</p> <p>Underwater breathing is possible if chest mounted 100% oxygen regulator is near mask level. Exhaling is difficult when regulator is lower than mask. Conversely, inhalation is difficult when regulator is above mask. Water incursion between mask and face will also occur when regulator is above mask.</p> <ol style="list-style-type: none"> 3. Jettison canopy if canopy prevents egress. <p>NOTE</p> <p>Canopy glass will implode approximately 15 feet under water if cockpit remains watertight.</p> <ol style="list-style-type: none"> 4. Egress Cockpit as detailed in (Canopy out of water) procedure.
B/N	<ol style="list-style-type: none"> 1. Acknowledge pilot's ditching order. 2. Make radio distress call. 3. IFF—EMERGENCY. 4. B/N work table—STOW. 5. Helmet visor—DOWN. 6. Oxygen mask—TIGHTEN. 7. Shoulder harness—LOCKED. 8. Lap belt—TIGHTEN. 9. Seat recline—FULL AFT. 	<ol style="list-style-type: none"> 1. Emergency Oxygen—Actuate (if breathing difficult) 2. Canopy—Jettison (if not jettisoned before impact). 3. Emergency harness release handle—Pull up and aft. 4. Reach over shoulder with one hand and hold parachute close to back. 5. Lean forward and stand up. If parachute hinders egress release parachute harness Koch fittings. 6. See that pilot is clear of aircraft. 7. Abandon aircraft and swim clear—Inflate life preserver. 8. Actuate survival kit release handle. 9. Inflate life raft and enter. 10. Tie rafts together. 	<p>UNDER WATER EJECTION PILOT AND B/N</p> <p>Underwater ejection should be attempted only if no other means exist.</p> <ol style="list-style-type: none"> 1. Body Position—Move out-board (laterally) in seat as water incursion will push seat and occupant into center canopy beam. 2. Eject with face curtain handle assembly. 3. Immediately after ejection Pull up and aft on Emergency harness release handle.

Figure 5-13

DITCHING CHART

NAV AIR 11-55AD-1

EMERGENCY PROCEDURES

1. Emergency Oxygen—Activate if breathing difficult. 2. Oxygen Mask—Tighten as much as possible. NOTE Underwater breathing is possible if chest mounted 100% oxygen regulator is near mask level. Exhaling is difficult when regulator is lower than mask. Con- versely, inhalation is diffi- cult when regulator is above mask. Water in- sion between mask and face will also occur when regulator is above mask. 3. Jettison canopy if canopy prevents egress. NOTE Canopy glass will implode approximately 15 feet under water if cockpit remains watertight. 4. Egress Cockpit as detailed in (Canopy out of water) procedure.	1. Emergency Oxygen—Activate (if breathing difficult) 2. Canopy—Jettison (if not jettisoned before impact) 3. Emergency harness release handle—Pull up and off. 4. Reach over shoulder with one hand and hold para- chute close to back. 5. Lean forward and stand up. 6. If parachute hinders egress release parachute harness Koch fittings. 7. See that B/N is clear of aircraft. 8. Abandon aircraft and swim clear—inflate life preserver. 9. Activate survival kit release handle. 10. Inflate life raft and enter. 11. Tie rafts together.	1. B/N—ALERT 2. External noise—JETTISON 3. Landing Gear—UP 4. Flap lever—LAND 5. Arresting hook—DOWN 6. Helmet vision—DOWN 7. Oxygen mask—TIGHTEN 8. Shoulder harness—LOCKED 9. Lap belt—TIGHTEN 10. Canopy—JETTISON 11. Fly parallel to swell pattern 12. Attempt touchdown along wave crest. 13. When sighting hook contacts water—SHUT DOWN ENGINES
Underwater ejection should be attempted only if no other means exist. 1. Body Position—Move out board (laterally) in seat as water intrusion will push seat and occupant into center canopy beam. 2. Eject with face curtain handle assembly. 3. Immediately after ejection pull up and off on emergency harness release handle.	1. Emergency Oxygen—Activate (if breathing difficult) 2. Canopy—Jettison (if not jettisoned before impact) 3. Emergency harness release handle—Pull up and off. 4. Reach over shoulder with one hand and hold para- chute close to back. 5. Lean forward and stand up. 6. If parachute hinders egress release parachute harness Koch fittings. 7. See that pilot is clear of aircraft. 8. Abandon aircraft and swim clear—inflate life preserver. 9. Activate survival kit release handle. 10. Inflate life raft and enter. 11. Tie rafts together.	1. Acknowledge pilot's ditching order. 2. Make radio distress call. 3. IFF—EMERGENCY. 4. B/N work table—STOW. 5. Helmet vision—DOWN. 6. Oxygen mask—TIGHTEN. 7. Shoulder harness—LOCKED. 8. Lap belt—TIGHTEN. 9. Seat recline—FULL ALT.

Figure 5-13

section VI

ALL WEATHER OPERATION

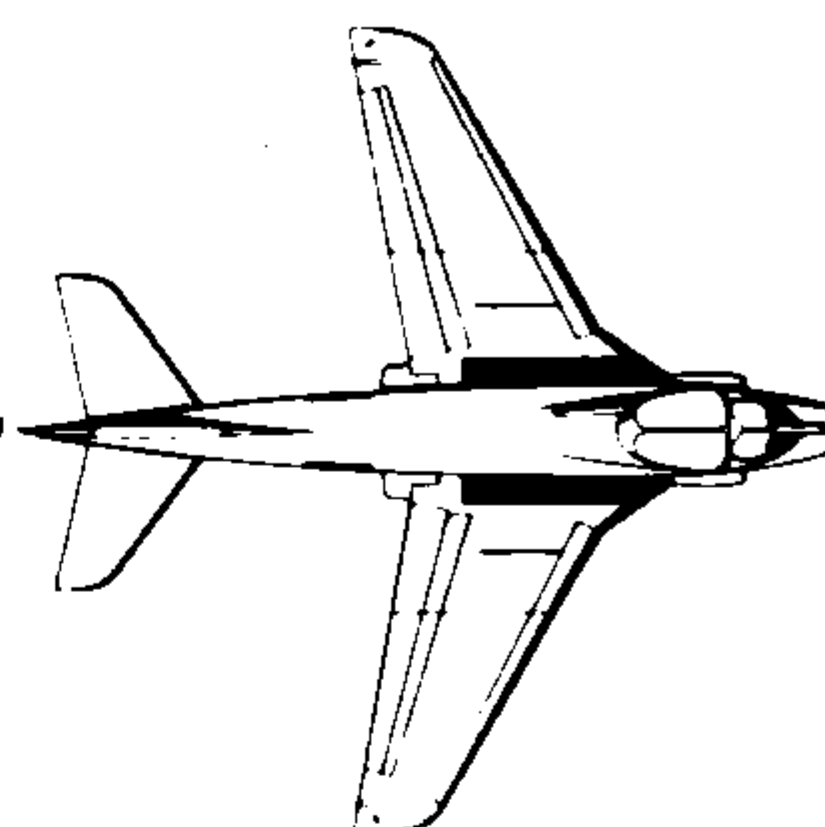


TABLE OF CONTENTS

Instrument Flight Procedures	6-1	Turbulence and Thunderstorms	6-6
Instrument Approaches	6-2	Cold Weather Procedures	6-7
Ice and Rain	6-4	Hot Weather and Desert Procedures	6-8

INSTRUMENT FLIGHT PROCEDURES

NEW In accordance with the OPNAV instruction 3710.7 series, the A-6E is considered a multipiloted aircraft for instrument flight, provided both seats are occupied by currently qualified A-6E flight crewmembers.

The following procedures are general approach techniques which are modified to reflect the specific techniques used for this aircraft. Standard navigational aids include TACAN and UHF-ADF. IFF and SIF are used for radar identification. An automatic flight control system can be used to alleviate pilot fatigue.

FLIGHT PLANNING

Clearance delays, prolonged operation at low altitudes and low airspeeds, and holding and stacking, demand a more critical approach to flight planning than would be necessary to VFR conditions. Particular attention should be paid to flight information publication and NOTAMS, and you should be thoroughly familiar with the weather and its possible changes at your destination and alternates.

Before entering the aircraft, a thorough preflight should be performed emphasizing any particular procedures needed for the existing weather conditions. If in icing conditions or if icing is anticipated, turn pitot heat and engine anti-icing on. Icing can occur in haze conditions. Engine anti-icing causes a negligible loss of engine thrust.

INSTRUMENT TAKEOFF

Before Taxi

1. Determine that UHF communications channels are preset for tower control, departure control, FAA frequencies, etc.
2. Check UHF navigation for proper channel operation.

Before Instrument Takeoff

Steps 1 and 2 are performed if climb-out through precipitation or clouds is anticipated.

1. Engine anti-ice switch - ON
2. Pitot heat switch - ON
3. Rain-removal system - CHECK

Note

The rain removal may be checked by actuating the windshield switch to the AIR position on a wet windscreen (use WASH as necessary) or by holding your hand over the top of the windscreen to feel the hot air. Turn the windshield air off as soon as possible to prevent cracking the windshield. If unable to turn off hot air, secure the engines as soon as possible (after gear pins installed and spin recovery assist switch is ON) if appropriate.

4. Attitude references - ADJUST
5. Proper checkpoints are inserted in computer
6. HSI heading set and course set - AS REQUIRED
7. Takeoff check list - COMPLETE

Instrument Takeoff and Transition

1. Align aircraft with runway and check VDI and HSI
2. Computer - AS DESIRED
3. Use nose-wheel steering until 70 KIAS.
4. At lift-off speed, rotate aircraft approximately 8° to 10° nose up.

5. Establish a positive rate of climb and raise landing gear.
6. Maintain positive rate of climb as flaps are raised (above 170 KIAS).
7. Upon flaps/slats retraction, rotate to 8° to 12° nose-up attitude.

Note

If possible, turns should be avoided until 250 KIAS, or 1,000 feet is reached. All turns should be limited to 30° of bank.

INSTRUMENT CLIMB

Depending on FAA, and other operating restrictions, a simplified climb schedule as outlined below may be used. However, for accurate climb schedules versus gross weight and aircraft configuration, refer to the climb charts in Section XI, Performance Data.

1. Maintain 8° to 12° nose-up attitude until reaching 340 KIAS.
2. Vary pitch attitude as necessary to maintain 340 KIAS until reaching cruise Mach.
3. Vary pitch attitude as necessary to maintain cruise Mach to cruise altitude.

For best fuel economy, military power should be used throughout the climb. Mach number should be closely monitored to preclude the necessity for adverse pitch changes due to mach effect (.84 to .92 IMN).

When in the clear, or on top:

4. Engine anti-ice switch - OFF
5. Pitot heat switch - OFF

INSTRUMENT CRUISING FLIGHT

After leveling off from climb:

1. Establish cruise mach number.
2. Adjust power.
3. Adjust VDI pitch trim markers for level flight.

Turns

Instrument turns should be limited to 30° of bank. Store loading will effect the response characteristic of the aircraft in turns; however, awareness of this characteristic is sufficient to eliminate any over-controlling. Half-standard rate turns, (approximately 30° angle of bank), are recommended above 19,000 feet.

Steep turns should be avoided if possible. If a steep turn is necessary, anticipation of the aircraft reaction becomes most important to retaining precise control. Bear in mind that the attitude indication will precess in steep turns and that airspeed and pitch should be closely monitored throughout.

HOLDING

Holding patterns may be flown at most altitudes at approximately 230 KIAS. For more accurate holding speeds, refer to the maximum endurance charts in Section XI. Turns should be limited to 30° bank (one needle width) in the pattern.

INSTRUMENT DESCENT

1. Destination WX CHECK
2. Altimeter CHECK AND RECORD
3. Refile. AS NECESSARY
4. Penetration check list
 - a. Defog (5 min prior to descent) ON
 - b. Engine anti-ice/
pitot heat ON (AS NECESSARY)
 - c. Fuel DUMP AS NECESSARY
 - d. Altimeter SET PASSING FL 180

INSTRUMENT APPROACHES

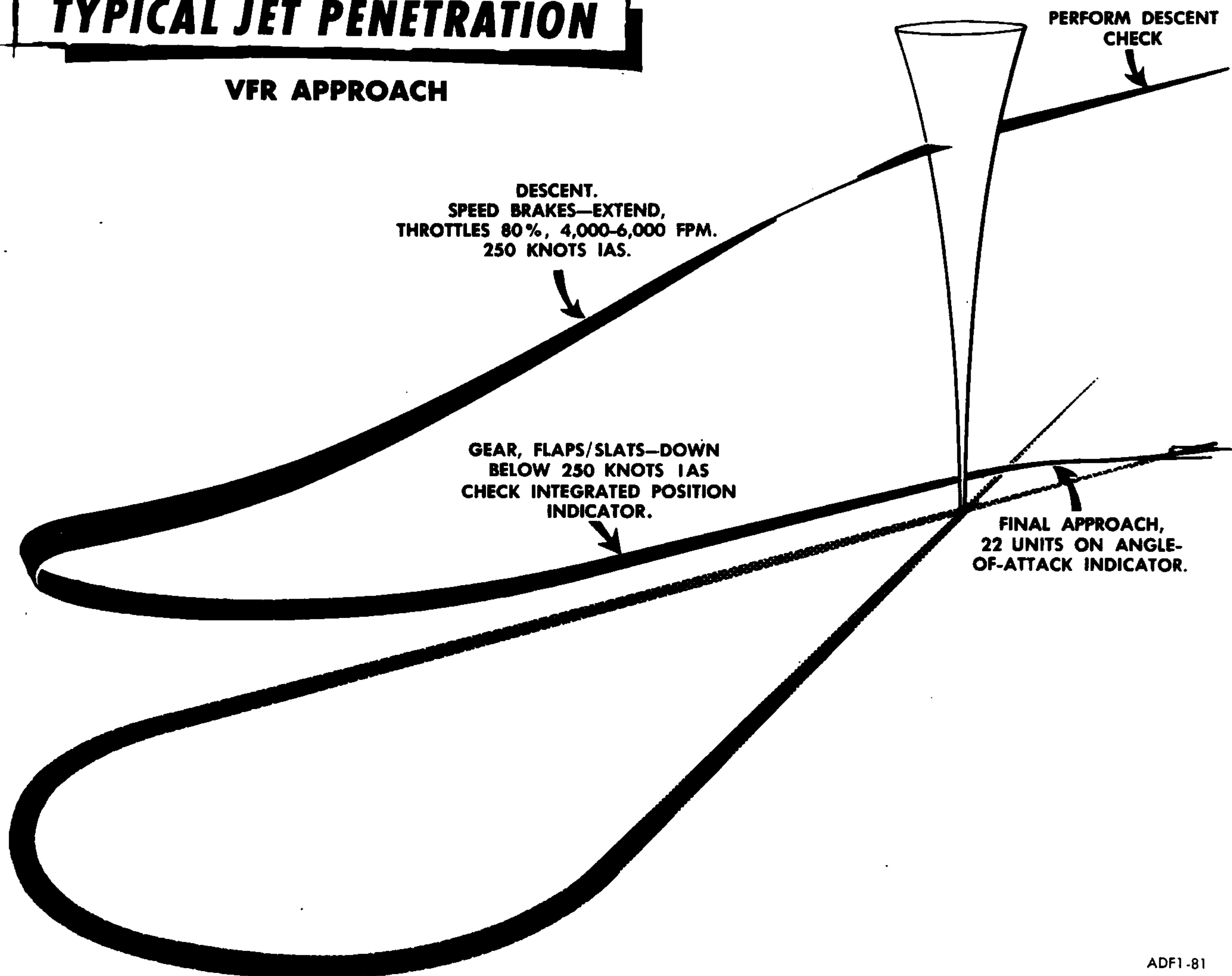
Typical patterns on instrument approaches appear in figures 6-1 through 6-5. Adjust final approach speeds as necessary for a safe approach. Airspeed and configuration should be set up prior to descent on final. Do not begin lowering the gear or the flaps/slats above 250 KIAS. Lower the gear first, followed by the flaps/slats, allowing the airspeed to drop off to 150 KIAS after flaps/slats extension. If it becomes necessary to use engine anti-ice during the approach, allow for the slight reduction of power, which results because of tapping compressor bleed air for the anti-ice system. The aircraft handles well through all speeds in the approach with adequate stall warning if a stall condition should arise. In the event of a missed approach, apply military thrust, retract the speedbrakes and retract the gear as soon as level-off is achieved. When the airspeed reaches 170 knots, retract the flaps. Continue the missed approach as directed, being careful not to exceed the missed approach altitude or to build up excessive airspeed. Establish a climb at 250 KIAS and limit turns to 30° of bank.

GCA APPROACHES

1. Descend to GCA pickup altitude and maintain 250 KIAS. With gear and flaps down, fly pattern at 18 units angle of attack (3:30 position on indicator).

TYPICAL JET PENETRATION

VFR APPROACH



ADF1-81

Figure 6-1

2. Execute all turns at full standard rate (not to exceed 30° angle of bank) except when on final, then do not exceed 15° angle of bank.
3. Maintain 22 units angle of attack or donut air-speed (as computed for aircraft gross weight) on final approach. Approaching glide path, reduce power and adjust speedbrakes as necessary to maintain 500 to 700 FPM rate of descent.

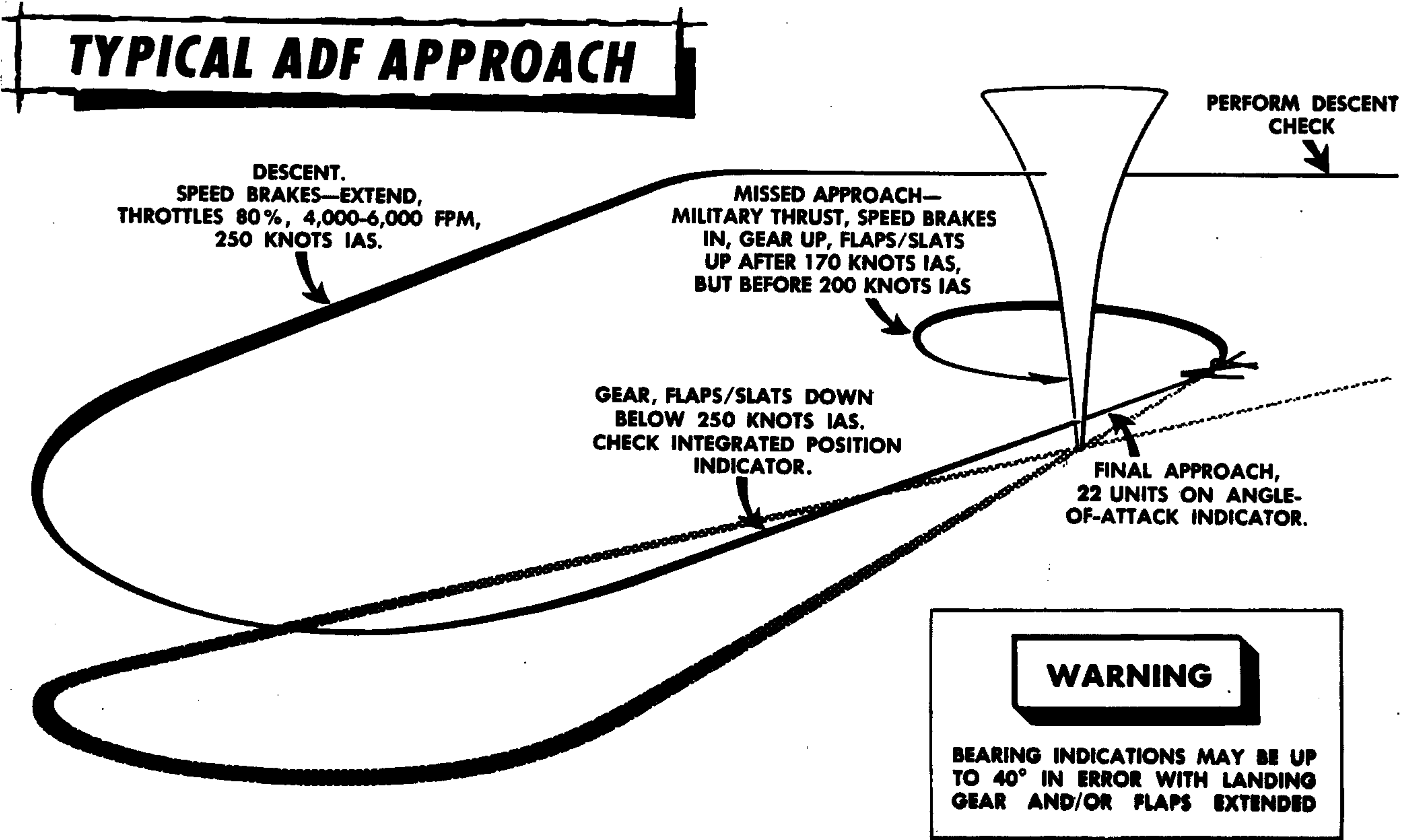
LANDING MODE APPROACHES (TYPICAL RADAR RECOVERY)

1. The optimum starting point for a landing mode approach is at 1500 feet above field elevation 4 NM from touchdown. This effects a $3\frac{1}{2}^\circ$ glide slope. Arrival at the 4-mile point can be varied to suit terrain and/or circumstances, but the pilot must have completed the transition

to a landing configuration and the B/N should have acquired a lock-on prior to this point.

2. Maintain a donut on angle-of-attack indicator.
3. Fly the aircraft to the desired point in space by following the VDI.
4. When VDI pathway is the proper width, retard power to establish a rate of descent to keep the aircraft on the glide scope.
5. Adjust power as necessary to fly the VDI presentation.

A straight-in radar or TACAN penetration followed by a CGA or LANDING mode approach will require approximately 700 pounds of fuel. A missed approach, followed by a second final approach requires approximately 800 pounds of fuel. Refer to figure 6-4 for typical radar recovery.



ADF1-82

Figure 6-2

NIGHT FLYING

The following checks and information are in addition to those given for normal instrument flight.

On entering aircraft:

- 1. Interior lighting - ADJUST

Note

For night catapult launches, place instrument panel emergency floodlights to DIM to provide instrument panel lighting if normal instrument lights fail.

- 2. Emergency floodlights - CHECK
- 3. Navigation and exterior lights - CHECK
- 4. Flashlight - CHECK

VFR CONDITIONS

- 1. Exterior lights - BRIGHT
- 2. Anticollision lights - ON

During formation flights, set lights as desired.

IFR CONDITIONS

During night instrument conditions, the anticollision lights should be turned OFF due to vertigo effect of flashing light reflections from surrounding clouds.

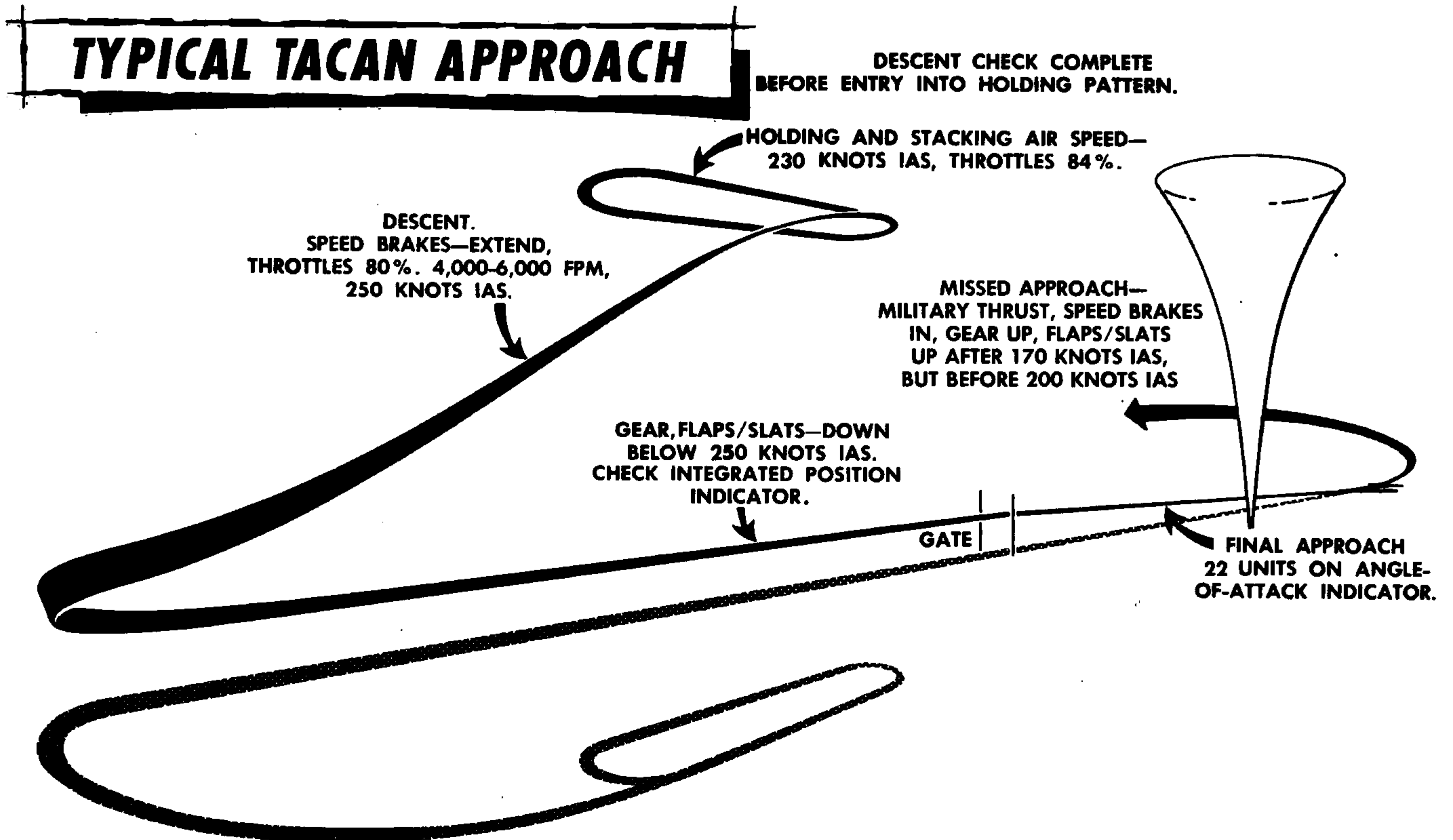
ICE AND RAIN

ICING

Icing conditions should be avoided whenever possible. Before flight, check freezing levels and areas of probable icing from weather service. If ice starts to form on the windshield or wing leading edge, proceed as follows:

- 1. Pitot heat switch ON
- 2. Engine anti-ice switch. ON
- 3. Defog switch ON
- 4. Altitude CHANGE AS REQUIRED

Climb or descend to an altitude where icing does not exist.



ADF1-83

Figure 6-3

Note

When a descent through severe icing conditions becomes necessary, the descent should be accomplished with the aircraft held at mach 0.80 and the throttles adjusted to 90% or greater (engine anti-ice on).

5. Engine instruments. . MONITOR FREQUENTLY

Carefully monitor tachometer and exhaust temperature indicator, as a reduction of RPM or an increase in exhaust temperature accompanied by a loss of thrust is an indication of engine icing.

Note

If exhaust temperature increases with loss of thrust, the throttle should be retarded as a low airspeed and high engine speed are conducive to engine icing.

A low approach into an area of icing should be considered an emergency approach. If there is any ice accumulation on the aircraft, an effort should be made to eliminate the ice before descending. Remember that using the engine anti-ice system results in a slight power loss due to a compressor bleed tap which furnishes air for the system. An approach flown with an ice accumulation plus a slight power

loss becomes doubly critical. You should be aware of these factors affecting flight.

Note

Engine anti-ice should be used whenever operating in conditions of visible moisture in the outside air.

RAIN

Whenever rain is encountered and icing is possible, use engine and pitot anti-ice as necessary.

WINDSHIELD RAIN REMOVAL**CAUTION**

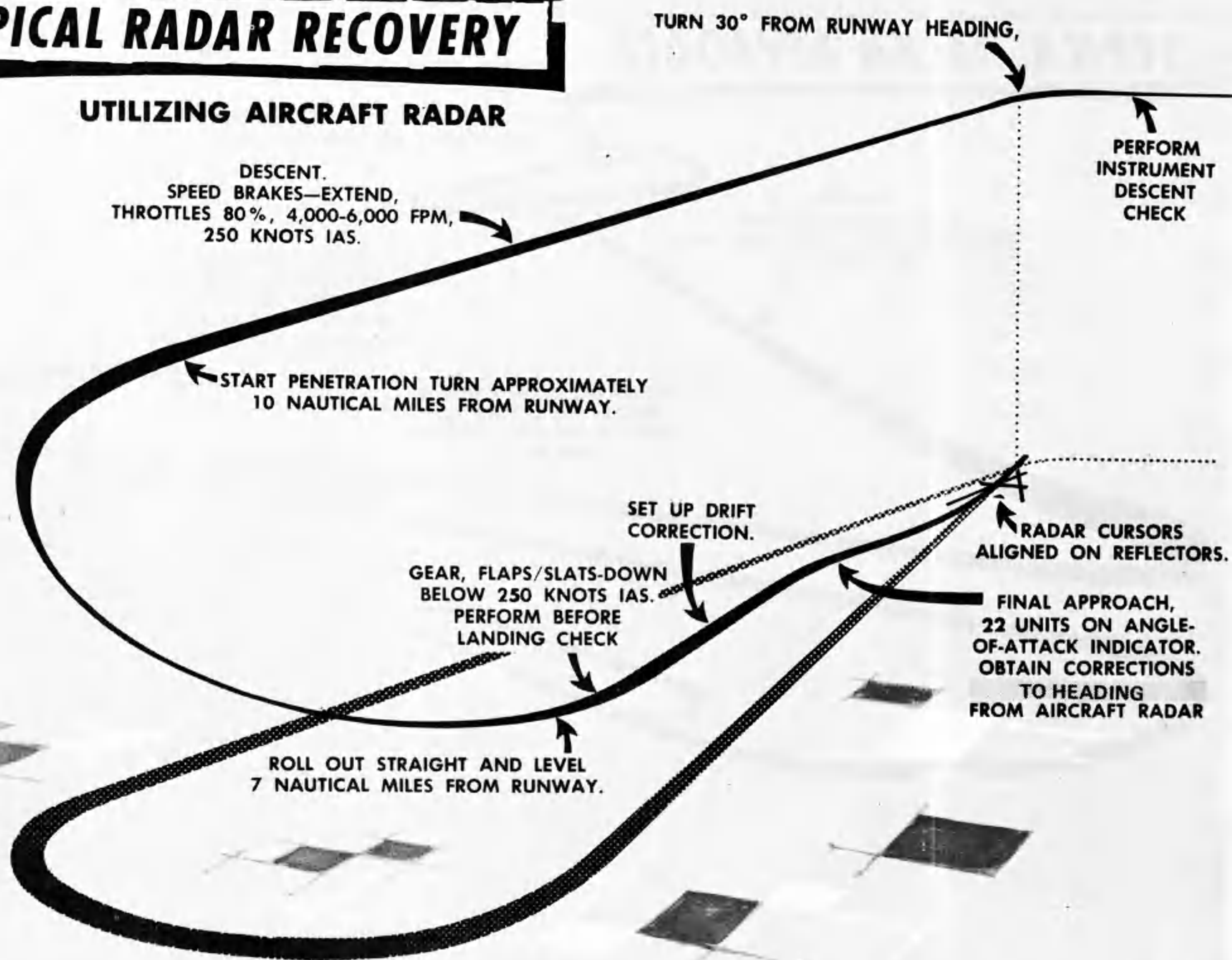
Operation of the rain-removal system is not recommended on a dry windshield. Use of the system on a dry windshield could result in:

1. Foreign materials being baked on the glass.
2. Above 200 KIAS, windshield distortion and failure.

Windshield rain removal has been found to be marginal when flying through moderate to heavy

TYPICAL RADAR RECOVERY

UTILIZING AIRCRAFT RADAR



A-ADF1-84

Figure 6-4

precipitation. Rain removal during ground taxiing operations is satisfactory. The windshield rain-removal system is somewhat effective in deicing the windshield.

FLAMEOUTS

Flights through heavy rains have not resulted in flameouts. However, if a flameout should occur, commence air start procedures and attempt to get out of the rain area. In the event of compressor stalls due to ice ingestion or ice buildup, adjust throttles to 85%-90% and turn on engine anti-ice.

LANDING IN RAIN

The AIR position of the windshield switch controls a blast of air that blows rain off the windshield. Be aware of the possibility of a flameout in a heavy rain and of reduced braking action due to a wet runway. Refer to Section III, Wet Runway Landing Procedures.

TURBULANCE AND THUNDER STORMS

Intentional flight through thunderstorms should be avoided, unless the urgency of the mission precludes a deviation from course, due to the high probability of damage to the airframe and components by impact of ice, hail, and lightning. Flameouts, due to water ingestion, or compressor stalls due to rapidly changing flight attitudes, could also occur. The radar provides a means of navigation between or around storm cells. If circumnavigating the storm is impossible, penetrate the thunderstorm in the lower third of the storm cell, away from the leading edge of the storm cloud if possible. It is recommended that the STAB AUG mode of the AFCS be used. The AUTO mode should not be used. Damage to the controls could result with the automatic functions operating.

If necessary to penetrate a thunderstorm, proceed as follows:

1. Slow to between 230 to 280 KIAS.
2. Pitot heat switch ON

TYPICAL PAR PATTERN

PRECISION APPROACH RADAR

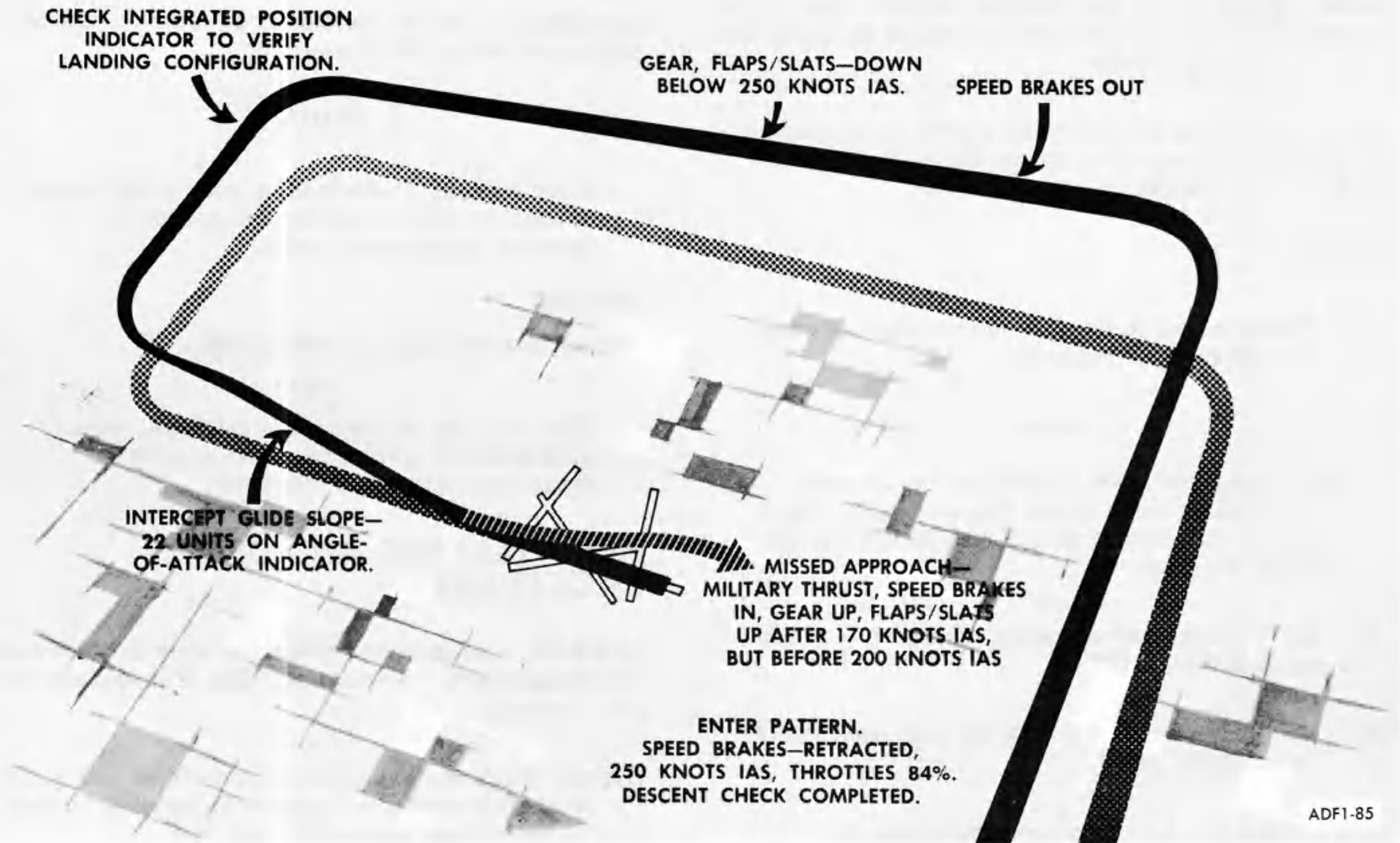


Figure 6-5

3. Engine anti-ice switch ON
4. Loose equipment SECURED
5. Tighten lap belts and lock shoulder harness.
6. Cockpit lights ON BRIGHT
7. Fly attitude and heading indicators primarily while in extreme turbulence, because altimeter and airspeed will fluctuate.

Note

During severe icing conditions, the pilot can expect to lose airspeed indications even with the pitot heat on. GCI stations, if available, can aid the pilot with tracking assistance through thunderstorm areas.

Severe turbulent air at high altitudes may cause the inlet airflow distribution to exceed acceptable limits of the engine, thereby inducing compressor stalls. To avoid compressor stalls during flight to turbulent air, maintain 230 to 280 KIAS at all altitudes.

Severe compressor stalls can result in engine flame-out. If severe stalls are encountered, proceed as follows:

1. Throttles IDLE
2. Airspeed. . . . INCREASE BY LOWERING NOSE

Compressor stalls are generally accompanied by increased exhaust gas temperature. If temperature exceeds allowable limits, perform shutdown procedure and accomplish an air start as soon as practical.

COLD WEATHER PROCEDURES

A careful preflight will eliminate many potential hazards found in cold weather operations. Inspect engine intakes for accumulation of ice and snow. If possible, preheat the engine, for easier engine starts. When removing ice and snow from the aircraft surfaces, be careful not to damage the aircraft. Also, use precautions not to step on any no-step surfaces which could be covered with ice or snow. Check the pitot-static tube for ice as well as the fuel pressurization ram/air intakes, and yaw, pitch, and angle-of-attack transducers.

Moisture in the fuel system greatly increases operational problems in cold weather. At lower temperatures, the water-dissolving capacity of fuel is greatly reduced and will result in considerably more water accumulation (as much as several gallons of water to 1,000 gallons of fuel). If the water separation occurs at below freezing temperatures, the water will crystallize on fuel drains and internal valves. Any water accumulation will settle to the bottom of the tanks and freeze up the fuel drains.

Normal operating procedures as outlined in Section III, Normal Procedures, should be adhered to with the following additions and exceptions:

PREFLIGHT

1. Check entire aircraft to ensure that all snow, ice, or frost is removed.

Note

Snow, ice, and frost collections on the aircraft surface are a major flight hazard. The result of this condition is a loss of lift and increased stall speeds.

2. Shock struts and actuating cylinders - FREE OF ICE AND DIRT
3. Fuel drain cocks - FREE OF ICE AND DRAIN CONDENSATION
4. Pitot tube, fuel pressurization ram air intakes - ICE AND DIRT REMOVED
5. Exterior protective covers - REMOVED

WARMUP AND GROUND CHECK

Be sure that the aircraft is adequately chocked before engine start. Normal starting procedures will start the engines in cold weather.

In severely cold weather, allow a short time for warmup before increasing RPM out of the idle range. If oil pressure is low or fails to come up in a reasonable length of time, shut down. Attempt another start after heating the engines.

CAUTION

If abnormal sounds or noises are present during starting, discontinue starting and apply intake duct preheating for 10 to 15 minutes.

TAXIING

1. Avoid taxiing in deep or rutted snow since frozen brakes will likely result.

2. Increase spacing between aircraft while taxiing at subfreezing temperatures to ensure safe stopping distance, and to prevent icing of aircraft surfaces by melted snow and ice being blown by jet blast of a preceding aircraft.

TAKEOFF

Acceleration will be noticeably greater in cold temperatures during the takeoff run.

CAUTION

After takeoff, cycle landing gear a few times to free the gear from the possibility of freezing in the wheel wells.

LANDING

Use antiskid during the landing roll.

Note

Hard braking on ice or wet runways, even with antiskid system on, could result in dangerous skidding conditions.

HOT WEATHER AND DESERT PROCEDURES

Check for accumulation of sand or dust in the intakes and transducers. Normal starting procedures will be employed.

Normal operation procedures as outlined in Section III, Normal Procedures, should be adhered to with the following additions and exceptions:

1. Expect higher temperatures than normally obtained in operating ranges.
2. Engine ground operation should be minimized as much as possible.

CAUTION

Do not attempt takeoff or engine operation in a sand storm or dust storm, if avoidable. Park aircraft crosswind to prevent sand or dirt from blowing into the intake and exhaust ducts, and subsequently causing engine damage.

TAKEOFF

The takeoff distances are increased as ambient temperature increases. Check required takeoff distance charts in Section XI.

LANDING

Anticipate a slightly longer landing distance and the possibility of turbulence due to thermal action of the air close to the ground. Use the defogger, if necessary, in warm, humid weather.

section VII

COMMUNICATION EQUIPMENT
AND PROCEDURES

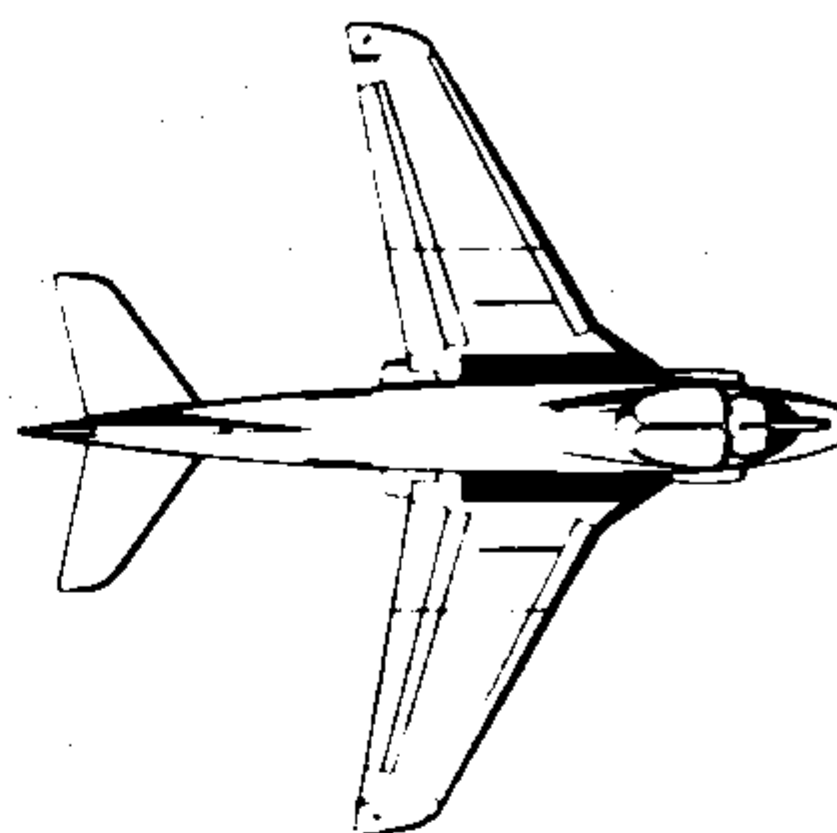


TABLE OF CONTENTS

Communication Navigation and Identification (CNI) System	7-1	Speech Security Equipment	7-7
Intercommunications Set (ICS)	7-1	Tactical Air Navigation (TACAN)	7-8
UHF Communication Radio	7-6	Identification Radar AN/APX-64	7-9
Auxiliary Receiver (UHF)	7-7	Ground Handling Signals	7-10
		In-Flight Visual Communications	7-10

COMMUNICATION, NAVIGATION, AND IDENTIFICATION (CNI) SYSTEM

The communication, navigation, and identification system provides the overall communication, navigation, and identification functions of the aircraft. Communications equipments include the UHF receiver-transmitter, and an auxiliary UHF receiver unit operating in conjunction with the intercommunications set (ICS). Communications security is provided by means of the KY-28. Navigation information is provided by the tactical air navigation system (TACAN), and by the automatic direction finding equipment (ADF). Identification and control information is provided by the IFF/SIF equipment. See figure 7-1 for communications and associated electronic equipment. The CNI master switch on the center console (figure 7-2) must be placed to ON before communication/navigation/identification equipments can be operated.

NEW Operating power is supplied from the 28V DC essential bus, the 28V DC primary bus, the 115V AC essential bus, and the 115 VAC primary bus.

CAUTION

The CNI equipment is normally force-cooled and must not be operated without cooling longer than 5 minutes or equipment damage may result. Aircraft with AFC No. 268 incorporate a CNI auxiliary blower that operates to supply cooling air any time it is not available from the environmental system. On the ground without engines running or ground cooling applied, ground blower operation is automatic when external electrical power is applied and the CNI equipment is turned on.

INTERCOMMUNICATION SET AN/AIC-14

Intercommunication Set AN/AIC-14 (ICS) is a two-station transistorized system which provides amplification of microphone signals for intercommunication and radio transmission, and amplification of selected audio signals from the radios, ECM

equipment, and the attack-navigation system. Operating power is provided from the 28V DC essential bus through the ICS circuit breaker on the main circuit breaker panel.

Control of voice communications with the SINS (Ships Inertial Navigation System) center is provided through the ALIGN switch on the bombardier/navigator's right console. With the aircraft on the carrier deck, the CARRIER ALIGNMENT plug inserted and the CNI master switch on, placing the ALIGN switch to SINS ICS permits two-way communication with the SINS center. Placing the switch to OFF or GYRO COMP removes the aircraft ICS from the SINS circuit.

The ICS is operated from the pilot's and B/N's control stations. Each control station includes an interphone amplifier, an isolation amplifier, a voice-operated (VOX) relay module, a sidetone attenuation circuit, and the various controls on the front panel.

The pilot and B/N may select from among the audio signals available to each of them by means of controls on their radio control panels.

During normal operation, at each ICS station, incoming audio is amplified at the isolation amplifier and is then routed to the headset. Outgoing audio is amplified at the interphone amplifier, and is sent to the other ICS station or to the UHF transmitter, depending on whether the MIC or ICS button is depressed, through the VOX relay module. If hot microphone operation has been selected, audio will be transmitted to the other ICS station without depressing the ICS button.

If an amplifier at either ICS station fails, alternate operation of that station may be selected. During alternate operation, both incoming and outgoing

**COMMUNICATIONS AND ASSOCIATED
ELECTRONIC EQUIPMENT**

TYPE AND DESIGNATION		FUNCTION	RANGE	OPERATION	LOCATION OF CONTROLS
INTERPHONE AN/AIC-14		Voice communications in cockpit or cockpit to ground crew personnel. Miscellaneous warning tones from weapons, ECM, and obstacle avoidance systems.	Within the aircraft and ground crew personnel.	Pilot, B/N, Ground Crew Personnel	Pilot's left console, Center console, B/N right console, and the external power panel on the right nacelle.
INTEGRATED ELECTRONIC CENTRAL (IEC) AN/ASQ-57	UHF COMMUNICATIONS RADIO	Radio communications between aircraft and ship, aircraft and shore, or between aircraft.	Line of sight up to 350 miles air to air depending upon altitude.	Pilot, B/N	Center console.
	SPEECH SECURITY EQUIPMENT	Permits Secure UHF Voice Communications	—	Pilot, B/N	Aft Console
	AUXILIARY UHF RECEIVER	Auxiliary UHF receiver.	Line of sight up to 350 miles air to air depending upon altitude.	Pilot, B/N	Pilot's left console
	DIRECTION FINDER GROUP (ADF)	Indicates bearing of, and homes on UHF signal sources. WARNING Bearing indication may be up to 40° in error with landing gear and/or flaps extended	Line of sight up to 350 miles air to air depending upon altitude.	Pilot, B/N	Center console.
	IFF	Identifies aircraft as friend or foe.	Line of sight up to 200 miles.	Pilot, B/N	Center console.
	SIF	Provides specific identification of separate aircraft or of a single aircraft within a group. Provides automatic altitude reports. Transmits coded signals in reply to coded interrogations.	Line of sight up to 200 miles.	Pilot, B/N	Center console.
	TACAN	Indicates distance and bearing of suitably equipped ground stations. Determines identity of beacon and indicates dependability of beacon.	Line of sight distances up to 196 miles depending upon altitude.	Pilot, B/N	Center console.
RADAR ALTIMETER AN/APN-141		Indicates distance in feet from aircraft to ground.	0-5000 feet	Pilot	Pilot's instrument panel.
RADAR BEACON AN/APN-154		Replies to coded interrogations	Line of sight range variable	Pilot, B/N	Aft console

A-ADF1-48

Figure 7-1

PILOT'S RADIO AND ICS CONTROLS

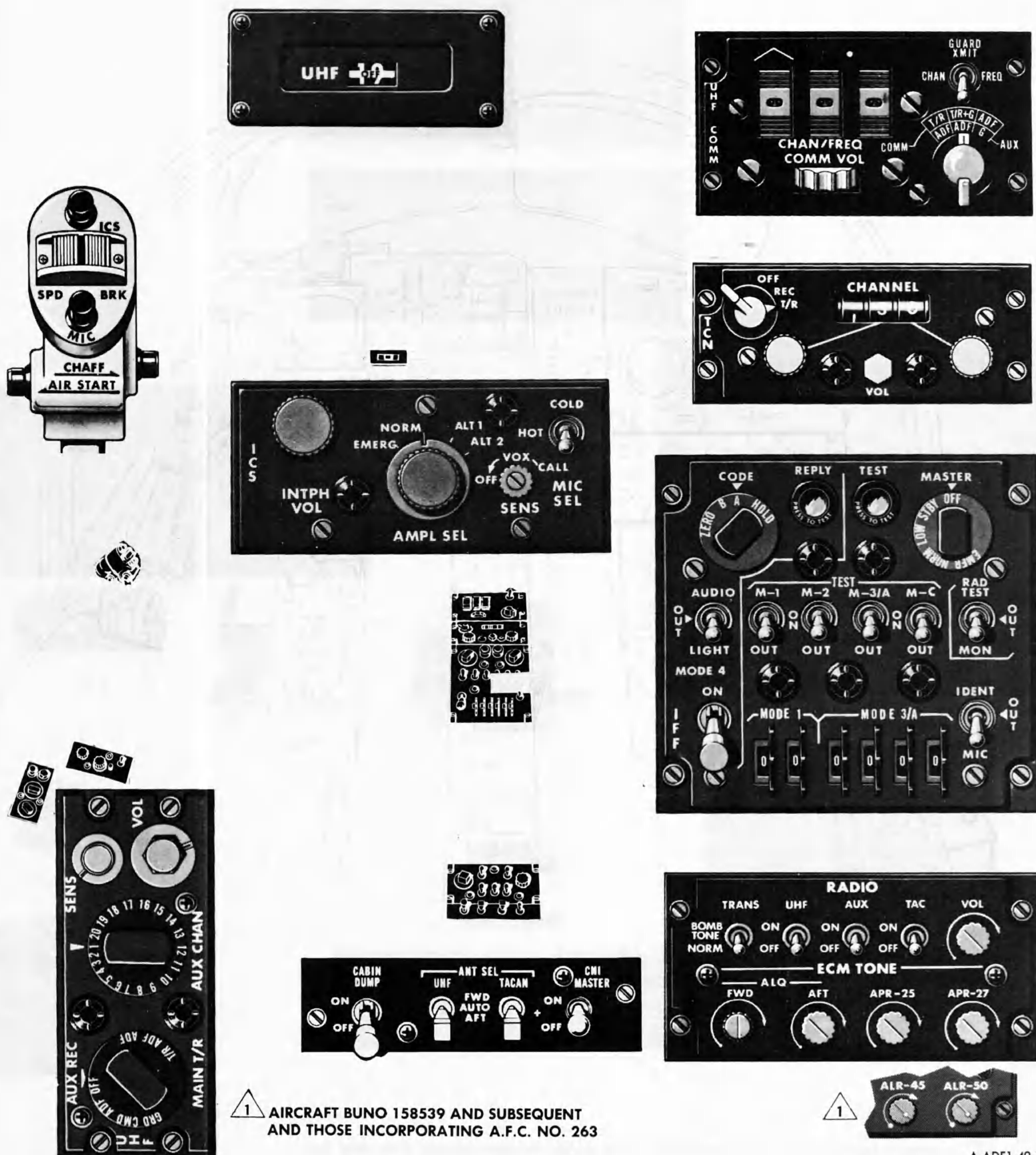
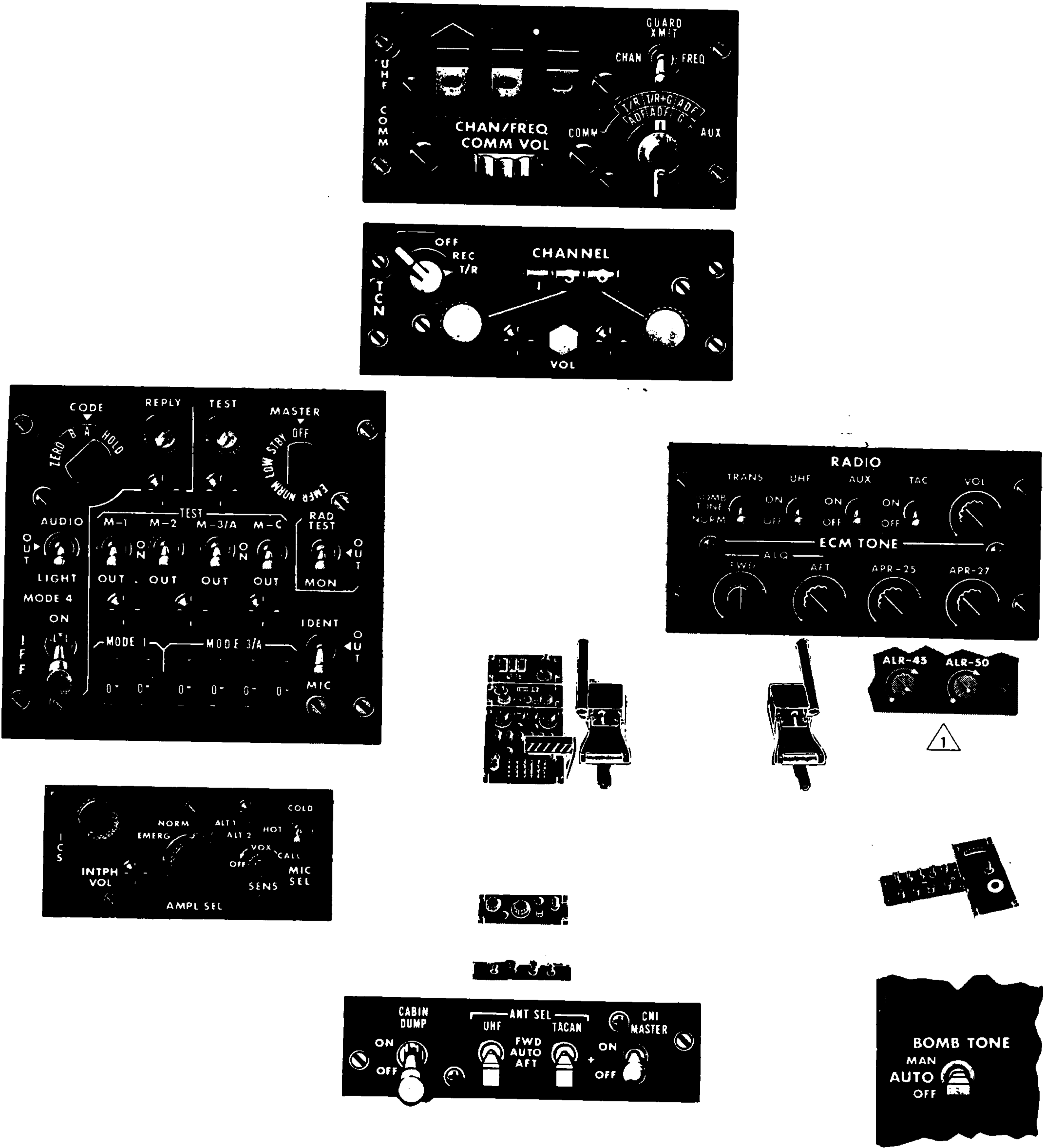


Figure 7-2 (Sheet 1)

B/N RADIO AND ICS CONTROLS



1 AIRCRAFT BUNO 158539 AND SUBSEQUENT AND THOSE INCORPORATING A.F.C. NO. 263

Figure 7-2 (Sheet 2)

audio is amplified at the amplifier selected and is routed to the headset at that station and to the other ICS station or to the UHF transmitter through the VOX relay module. The sidetone level at the transmitting station increases when that station uses alternate operation, and the incoming interphone level at the receiving station also increases. When the transmitting station is in normal operation and the receiving station is in alternate operation, the sidetone level at the transmitting station is decreased.

To ensure that the interphone audio overrides any selected audio, when the ICS system is keyed, the level of incoming interphone audio is increased and the level of the selected audio is decreased.

Either crewmember may listen to audio from the UHF receiver, the auxiliary UHF receiver, TACAN, and the ECM receivers. In addition, a bomb tone and missile tones are available to the pilot.

By selecting alternate operation, either crewmember can route the audio he has selected to the other crewmember.

Note

Should both crewmembers select alternate operation a cross-feed arrangement is set up and there is a possibility of feedback occurring. This feedback can be reduced or eliminated by reducing the interphone volume level.

ICS CONTROL PANEL

Two identical ICS control panels (figure 7-2) are provided. The pilot's control is on the pilot's left console; the B/N's is on the center console.

Interphone Volume Control

The interphone volume control marked **INTPH VOL** provides control over the audio level of incoming interphone signals and sidetones. Full clockwise rotation provides maximum volume; full counterclockwise rotation provides minimum volume. The volume of the selected audio is not affected by this control.

Amplifier Selector Switch

The amplifier selector (**AMPL SEL**) is a four-position rotary switch marked **EMERG**, **NORM**, **ALT 1**, and **ALT 2**. In the **NORM** position, received interphone and selected audio signals are routed to the headset through the isolation amplifier, and outgoing signals are routed through the interphone amplifier. In the **ALT 1** position, both incoming and outgoing signals are routed through the isolation amplifier. In the **ALT 2** position, both incoming and outgoing signals are routed through the interphone amplifier. In the **EMERG** position, there is no interphone signal available; the only audio available is sent unamplified directly from the UHF receivers, the TACAN receiver, and the UHF transmission sidetone. The crewmembers can communicate by UHF sidetone.

VOX Sensitivity Control

The VOX sensitivity control (**VOX SENS**) provides control over the voice operated relay. Full counterclockwise rotation to the **OFF** detent removes the VOX relay from the circuit. Clockwise rotation from **OFF** increases the sensitivity of the VOX relay so that it keys at a lower audio level.

Note

The operation of the VOX relay is independent of the mode of microphone operation. The **VOX SENS** control should be kept at **OFF** unless **HOT** microphone operation is selected.

Microphone Mode Selector Switch

The microphone mode selector (**MIC SEL**) switch is a three-position toggle switch marked **COLD**, **HOT** and **CALL**, which controls the mode of operation of the microphone for interphone transmission only. UHF transmission is not affected. When the switch is at **COLD**, the ICS press-to-transmit switch must be depressed to transmit on interphone. Selecting **HOT** permits the user to transmit over interphone without using the press-to-transmit switch. The **CALL** position does not function.

PRESS-TO-TRANSMIT SWITCHES

Two press-to-transmit switches (figure 7-2) are provided for each crewmember. The pilot's switches, marked **ICS** and **MIC**, are on the inboard face of the right throttle. The **ICS** switch is above the speed-brake switch and the **MIC** switch is below it. The B/N is provided with foot switches. The left switch is marked **UHF**, the right switch is marked **ICS**. When the **MIC SEL** switch is at **COLD**, pressing the **ICS** switch permits ICS transmission. Pressing the **MIC** or **UHF** switch permits UHF transmission.

RADIO CONTROL PANEL

Each crewmember is provided with a **RADIO** control panel (figure 7-2), which permits him to select which of the available audio signals he will monitor, and to control their volume.

TRANS Switch

The **TRANS** switch is a two-position toggle switch marked **BOMB TONE** and **NORM**, which is active on the pilot's **RADIO** panel only. Selecting **BOMB TONE** permits the bomb tone to be transmitted over UHF. With the switch at **NORM**, the tone cannot be transmitted outside the aircraft.

Audio Selector Switches

The three audio selector switches marked **UHF**, **AUX**, and **TAC** are two-position **ON**, **OFF** toggles permitting the crewmember to select audio from the main UHF receiver, the auxiliary UHF receiver, or the TACAN receiver to be monitored in addition to the interphone audio. He may select any, all, or none of these signals.

VOL Control

The VOL knob is a rotary control providing adjustment of the volume level of the selected receiver audio signals. Full clockwise rotation provides maximum volume.

ECM TONE Controls

The tones generated by the ECM equipment are routed to the headsets of both crewmembers without selection whenever these tones are present. The four ECM TONE knobs permit the volume of these tones to be adjusted by each crewmember. Full clockwise rotation provides maximum volume; full counterclockwise rotation reduces the volume so that the tone cannot be heard.

MISSILE TONES

Certain missiles generate tones which are routed to the pilot's headset whenever they are present. Control of missile tone volume is provided by a knob on the armament control unit. Refer to Section VIII for a description of this control.

BOMB TONE

A bomb tone is provided to the pilot to assist in weapon delivery. The tone is routed to the pilot's headset without selection whenever the tone is present. Control of the bomb tone may be manual or automatic depending on the position of the bomb tone mode selector switch, and the tone may be transmitted over the UHF radio.

Note

In order to hear and/or transmit the bomb tone, the MASTER ARMT switch on the armament control unit must be at ON or PRAC.

BOMB TONE Mode Selector Switch

The BOMB TONE mode selector switch (figure 7-2) on the B/N's right console is a three-position toggle marked MAN, AUTO, and OFF. When the switch is at OFF, no bomb tone is available. With the switch at AUTO and the MASTER ARMT switch at ON or PRAC, the bomb tone goes on and off automatically according to the attack mode selected. The switch is spring-loaded from MAN to AUTO, and when held at MAN, with the MASTER ARMT switch at ON or PRAC, a continuous tone is produced.

UHF COMMUNICATIONS RADIO

The UHF communications radio provides two-way voice communication in the frequency range of 225.0 to 399.9 megahertz between aircraft and ground station or between aircraft. It also performs ADF (automatic direction finding) for visual presentation of bearing information. Complete operation can be maintained by the pilot through the UHF communications control panel on the center console and the

UHF auxiliary control panel on the left console. The control provides operation on any one of 1,1750 frequencies between 225.0 and 399.9 megahertz. Twenty of these frequencies are preset as channels. In addition to the preset frequencies, a manual means of frequency channel selection is available.

UHF COMMUNICATIONS CONTROL PANEL

Channel Frequency Switches

Three touch-tuning slewing switches (figure 7-2) marked CHAN/FREQ on the UHF communications control panel, are used to manually adjust the operating frequency of the receiver-transmitter. Pressing on the forward portion of the rocker causes the UHF communications frequency to increase and the indicator to increase to the desired frequency. Releasing the touch-tuning slewing switch stops the slewing action. Pressing the switch or switches on the aft portion decreases the UHF communication frequency and the indication. The switch on the right selects the tenths-of-megahertz, and the middle switch selects the megahertz to be used and displayed on the frequency channel indicator. The switch on the left controls the tens and hundreds of megahertz or the channel number, depending upon the position of the masking mode switch.

Masking Mode Switch

The masking mode (GUARD XMIT) switch (figure 7-2) is a three-position toggle switch on the forward right corner of the UHF communications control panel. When in the channel (CHAN) position, the frequency channel indicator displays the two digit (tenths and units masked) channel number selected by the touch-tuning slewing switches. In the GUARD position, the frequency channel indicator displays a guard transmit mask over the digits, labeled GUARD. In the FREQ position, the frequency channel indicator displays one of 1,750 possible UHF communications frequencies, between 225.0 and 399.0 megahertz. To enter a selected channel (20 for example), position the masking mode switch to CHAN and press forward on the left slewing switch until 20 is read on the UHF frequency indicator on the pilot's instrument panel. To manually set any frequency between 225.0 and 399.9 mc, place the guard transmit switch to FREQ and press the touch-tuning switches until the UHF frequency indicator shows the desired frequency.

Command Auxiliary Selector Switch

The command auxiliary selector switch, placarded COMM AUX (figure 7-2), is a three position, double-row selector that selects the combination of functions to be performed by the main UHF communications receiver-transmitter and auxiliary receivers. The top row of positions indicates the function performed by the UHF communications receiver-transmitter, while the bottom row indicates the functions of the auxiliary receiver. In the first position, T/R-ADF, the main UHF communications receiver is in the usual transmit-receive function, while the auxiliary receiver is operating as an ADF receiver. In the T/R-G-ADF position, the main UHF communications

receiver-transmitter is operating normally with the additional operation of a guard receiver, and the auxiliary receiver is performing the ADF function. With the COMM AUX selector in the ADF/G position, the main UHF communications receiver is performing the ADF function while the auxiliary receiver is serving as a guard receiver.

AUXILIARY RECEIVER (UHF)

An auxiliary receiver, which supplies DC power to the CNI system and operates in conjunction with the main receiver-transmitter under normal conditions, also operates as an emergency receiver if a failure occurs in the main receiver-transmitter. The auxiliary receiver is used as an ADF receiver in the frequency range of 265.0 to 284.9 megahertz. The operating channels from 1 to 20 are selected on the UHF communications control panel, on the pilot's left console.

Note

The auxiliary channel (AUX CHAN) selector and the volume (VOL) control are the only operative controls on the UHF control panel. The function selector and the sensitivity (SENS) controls are inoperative.

AUXILIARY RECEIVER (UHF) CONTROL PANEL

The auxiliary UHF receiver control panel (figure 7-2) is located on the pilot's left console outboard of the MASTER LIGHT control panel.

The rotary knob placarded VOL, controls the volume of the auxiliary receiver. The rotary channel selector switch placarded AUX CHAN controls selection of 20 operating channels for the auxiliary receiver. Channel selection is made by matching the desired channel number with the triangular indexer.

ANTENNA SELECTOR SWITCH

Two antenna selector switches marked ANT SEL, are on the cabin dump panel (figure 7-2). These switches provide selection of either the forward UHF blade antenna or aft UHF/TACAN blade antenna and either the forward TACAN blade antenna or the aft UHF/TACAN blade antenna during UHF reception and transmission. Each antenna selector switch operates a coaxial switch for selection of the desired antenna. There are three modes of operation:

1. Forward antenna - FWD
2. Aft Antenna - AFT
3. Automatic - AUTO

In the FWD position, the pilot manually overrides the automatic mode and selects the forward blade antenna.

In the AFT position, the pilot manually selects the aft blade antenna. In the AUTO mode, the forward and aft antennas are time-shared until lock-on. During the lock-on, the antenna producing the strongest signal is used. A memory function in the automatic antenna selector causes transmission on the antenna last used for reception.

Note

IAFC 300 removes automatic selection and uses only one antenna in fin cap for UHF and one antenna on nose wheel fairing door for TACAN.

SPEECH SECURITY EQUIPMENT (KY-28)

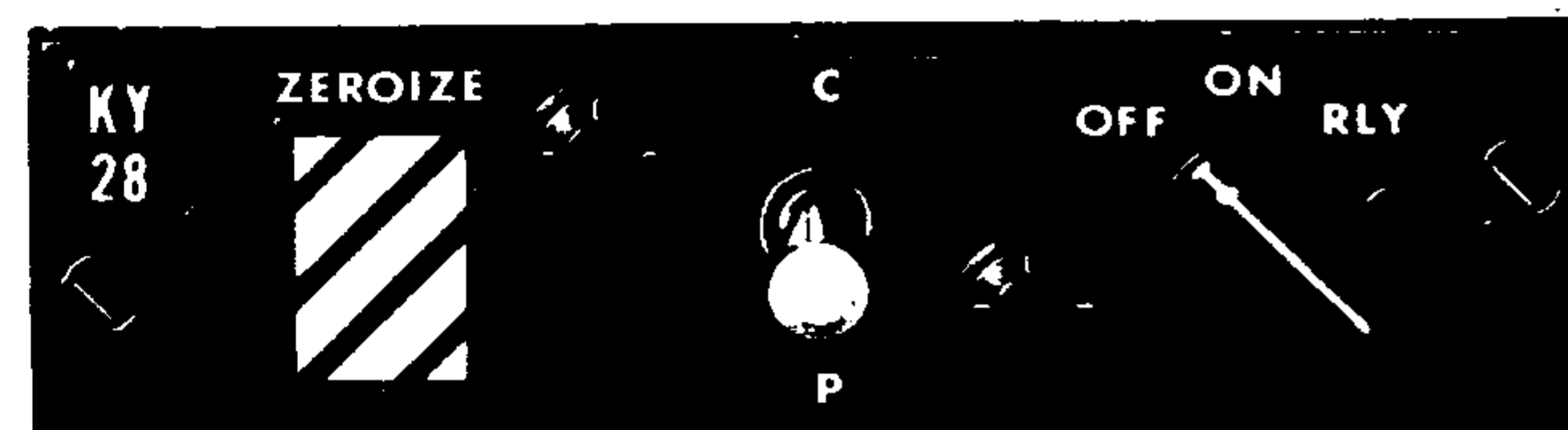
The aircraft is provided with TSEC/KY-28 speech security equipment for cipher and plain-language operation for the UHF radio. With KY-28 installed, preset codes are set by qualified personnel to enable the cipher mode. A jumper is provided to enable the UHF radio when the KY-28 is removed.

TSEC/KY-28 speech security equipment theory of operation, function, and tactical operation are found in the applicable operation manual KAO-124B/TSEC.

KY-28 CONTROL PANEL

The KY-28 control panel (figure 7-3) on the aft console provides the cockpit controls for operating the UHF receiver/transmitter in cipher or plain-language modes.

KY-28 CONTROL PANEL



ADF1-86

Figure 7-3.

Power Switch

The power switch is a three-position rotary selector placarded OFF, ON, and RLY. The RLY (relay) position is not used. OFF removes power from the system and prevents use of the UHF radio. ON applies operating voltage to the KY-28 system.

Cipher-Plain Switch

The cipher-plain switch is a two-position toggle switch placarded C and P. In the P position, the UHF radio is used as a plain-language receiver/transmitter. The C position is used to transmit and receive voice secure communications over the UHF radio in accordance with the preset codes.

Zeroize Switch

The zeroize switch is a guarded two-position spring-loaded toggle switch. When placed to the ZEROIZE (up) position the preset codes are erased, and must be reset by qualified personnel before being used in the cipher (C) mode.

KY-28 OPERATION**Pre-Launch**

1. Determine that the proper code has been set by qualified personnel in KY-28 equipment on the extensible equipment platform.
2. UHF radio and CNI master switch ON.
3. Power switch - ON.
4. Cipher/plain switch to P
5. If a ground test of the equipment is desired, after a 2-minute warmup period, establish two-way plain-text UHF radio communications with a suitable ground station and request an equipment check.
6. Cipher/plain switch to C
 - a. Listen for a steady, unbroken tone in the headset, followed by
 - b. A double-pitched broken tone.
7. Depress MIC button, hold for approximately 2 seconds, and release. Double-pitched broken tone will cease and no sound will be heard.
8. Depress MIC button and hold. A single beep tone will be heard in approximately 1 1/2 seconds. When this tone is heard, equipment is ready to cipher transmission.

9. After beep tone is heard, establish two-way cipher UHF communications with cooperating ground station and check for readability and signal strength.
10. Set cipher/plain switch in accordance with tactical situation.

Note

If a ground check is not practical, the above procedures may be used to perform an in-flight check of the equipment.

Post Launch

The speech security equipment will be operated as directed by appropriate authority.

After Landing

1. ZEROIZE switch - ZEROIZE (AS BRIEFED) Zeroize code as directed by appropriate authority.
2. Power switch - OFF.

TACTICAL AIR NAVIGATION (TACAN)

The TACAN equipment of the CNI system consists of a short-range navigation radio that converts radio signals into visual displays of azimuth and range. The azimuth and range signals are displayed on the horizontal situation indicator (HSI) on the pilot's instrument panel. The receiver-transmitter is used in conjunction with a receiver-transmitter located at a ground site or aboard ship. The signals used for azimuth measurement originate at the surface beacon, are radiated by a rotating antenna, and are displayed on the HSI. A pulse signal from the TACAN transmitter in the aircraft triggers a responding pulse from the ground station; the time lapse between the initial pulse and response pulse is translated into distance and displayed in nautical miles on the HSI. The maximum range of TACAN is approximately 195 nautical miles; however, bearing information is accurate beyond this range under most conditions. All controls for the equipment are on the TACAN control panel (figure 7-2).

TACAN CONTROL PANEL**Function Selector Knob**

The function selector knob has three positions: OFF, REC(receive), and T/R (transmit-receive). In the OFF position, there is no power applied to the TACAN equipment. In the REC position, pulse signals are not transmitted and no range information is received. Only bearing data is received and displayed. Both range and bearing are received and displayed when the switch is positioned to T/R.

Volume Knob

This control adjusts the volume of the station identification signal heard in the pilot's and bombardier/navigator's headsets. The signal is transmitted in international Morse code, with a three-letter designation representing the station's call letters.

Channel Selector Knobs

The desired operating TACAN channel is selected by two selector knobs. The left knob selects the first two digits of the desired channel, and the right knob selects the last digit. All digits are displayed through the channel digit display window.

IDENTIFICATION RADAR AN/APX-64

The IFF/SIF radar identification system provides automatic selective identification of the aircraft when properly challenged by surface or airborne radar sets. The system also provides momentary identification of position and transmits emergency modes when selected. In operation, the radar identification system receives interrogation signals, and automatically transmits coded response signals to the source of the challenge, where this response is displayed together with associated radar information (such as aircraft, etc.,) on ground or airborne radar scopes. The proper reply identifies the target as friendly.

The radar identification control panel marked IFF is on the center console. The control panel contains the system master switch, mode switches, code selector switches, and an identification (IDENT-MIC) switch.

The APX-64 IFF/SIF transponder incorporates the capability to transmit automatic altitude reporting (AIMS). Altitude is obtained from the AAU-19 servoed barometric altimeter.

IFF CONTROL PANEL

The IFF control panel is on the center console (figure 7-2) and can be operated by the pilot or bombardier navigator.

MASTER Control Switch

The master control switch is a five-position rotary switch placarded OFF, STBY, LOW, NORM, and EMER. In the STBY position, power is applied to the IFF coder, but interrogations are blocked. In the LOW position, the IFF coder is operational, but the receiver sensitivity is reduced. In the NORM position the IFF coder is fully operational at normal receiver sensitivity. In the EMER position, the IFF coder transmits emergency replies to interrogations in any mode. To select the EMER position, the control must be pulled outward.

Note

The emergency mode is automatically selected when either crewmember ejects. However if the IFF is off, it will take 80 seconds to warm up and reply.

IDENT/MIC/OUT Switch

The IDENT/MIC/OUT switch is a three-position toggle switch. Momentarily actuated (the switch has spring-loaded return) to the IDENT position, the IFF coder responds in SIF with coded replies for 15 to 30 seconds. In the MIC position, the coder responds with coded replies whenever the microphone switch is actuated. In the OUT position, the IDENT reply is disabled.

MODE 1-3/A Code Selectors

Six code-selector switches are provided for selection of mode 1 and mode 3 codes. Mode 1 has two thumb-wheel selectors which allow selection of 32 different codes. Mode 3 has four thumbwheel selectors which provide the capacity of selecting 4,096 codes.

Mode C Operation

The APX-64 (KY533A/ASQ) IFF/SIF transponder has the capability of transmitting altitude information in reply to a ground station's interrogation, when the air data computer (ADC) is installed.

Pitot-static information is provided to the ADC and to the AAU-19 servoed altimeter. The ADC converts this information to an altitude, including static defect corrections. The altitude, in the form of a digital signal, is sent to the KY533A for transmission when interrogated and to the AAU-19 altimeter in the form of a synchro signal. Thus, the altitude read on the AAU-19 represents the same altitude being transmitted via the KY533A. In the AAU-19, the barometric altitude is compared to the input from the ADC and, if the error is excessive, the altimeter will revert to the backup mode. (A flag on the AAU-19 indicates that it is in the backup mode.) In the ADC, an error signal monitoring circuit will interrupt the altitude signal being sent to the KY533A should the power fail, or the errors become excessive.

Mode-Selector/Test Switches and Light

Four mode-selector/test-selector switches labeled M-1, M-2, M-3A, and M-C have TEST, ON, and OUT positions. In the momentary TEST position of the M-2 and M-3/A switches only, lighting of the TEST light indicates proper operation of the mode selected. The OUT position for each switch disables its respective mode. The ON position for each switch enables the transponder to reply to interrogations for the mode selected. In aircraft equipped with the AIMS reporting system, the M-C switch provides automatic coded altitude reporting for air-traffic control identification.

RAD TEST/MON Switch

The RAD TEST/MON switch is a three-position toggle switch spring-loaded to the OUT (center) position. This switch is operational only when a transponder test set is included in the IFF system, which permits a check of the transponder by supplying locally generated interrogations that turn on the TEST light.

Mode 4 Controls/Reply Light

The mode 4 controls and indicator light are grouped on the left side of the control panel. The MASTER rotary switch controls transponder operation in mode 4 as well as in the other modes of operation. Mode 4 will operate normally, when selected, in either the NORM or EMER positions, and at reduced receiver sensitivity in LOW position. The mode 4 function will be inoperative in either STBY or OFF positions.

With the transponder functioning, mode 4 operation is selected by placing the mode 4 ON-OUT toggle switch to ON. Placing the switch to OUT disables mode 4 operation. The Mode 4 CODE control selects either of the two (A or B) Mode 4 codes. It has two additional positions, HOLD and ZERO. The switch is spring-loaded to return from HOLD to the A position. At a designated daily time and/or prior to the day's mission, maintenance or operations personnel mechanically set in the Mode 4 code for the present code period in position A, and the code for the succeeding code period in position B, with a single insertion of the KIK-18/TSEC Code Changer Key. Both code settings will be zeroized when power is turned off after the aircraft has landed. The code settings can be retained by activating the HOLD function. This will normally be done after the aircraft has landed, (landing gear must be down and locked) and before power is removed from the transponder. Place the Mode 4 CODE control to HOLD, and release. Allow transponder power to remain on for at least 15 seconds, and then turn off. The code setting is now mechanically latched and will be retained when aircraft power is turned off.

Note

If power is removed from the transponder less than 15 seconds after selecting HOLD either by turning the transponder off or by turning off aircraft electrical power, the code setting may not be mechanically latched and will zeroize.

With aircraft power on and the C-6280 MASTER rotary switch in any position except OFF, both code settings can be zeroized at any time by placing the CODE switch to the ZERO position. Both code settings will also be zeroized, if the HOLD function has not been properly actuated before the MASTER switch is turned to OFF. (Inadvertent selection of OFF is prevented by switch design which requires that the rotary knob be pulled out before it can be turned to OFF.) When the CODE switch is placed in the A position, the aircraft transponder will respond to Mode 4 interrogations from an interrogator using the same code setting as that set into the aircraft's

Code A position. In the B position, interrogations from an interrogator using the same code setting as that set into the aircraft's code B position will be answered. The change-over time from Code A to Code B use is operationally directed.

The Mode 4 AUDIO-LIGHT switch selects the aircraft indication for Mode 4 replies. In the LIGHT position, the Mode 4 REPLY light (green) will illuminate when Mode 4 replies are transmitted. In the AUDIO Position, an audio signal in the pilot's headset indicates Mode 4 interrogations are being received and illuminations of the Mode 4 REPLY light indicate when replies are transmitted. Mode 4 audio volume can be adjusted by the appropriate aircraft intercom audio volume control. In the OUT position, both light and audio indications are inoperative.

IFF CAUTION LIGHT

An IFF caution light on the annunciator panel lights whenever the IFF caution light circuitry detects an inoperative mode 4 capability, provided that: the KIT-1A/TSEC computer is installed, aircraft power is on, and the IFF MASTER switch is not OFF. Specific discrepancies monitored by the IFF caution light circuitry are: (1) Mode 4 codes zeroized, (2) Transponder failure to reply to proper interrogation, or (3) Automatic self-test function of the computer reveals a faulty computer. Lighting of the caution light indicates the equipment will not respond to mode 4 interrogations, and that operation in a known mode 4 interrogating environment should be avoided or, if already in one, take appropriate corrective or emergency action. To attempt correction place the IFF MASTER control switch to NORM (if in STBY or LOW), check to see that the mode 4 ON-OUT toggle switch is ON, and that the proper A or B code has been selected for the current code time period. If the caution light remains lit, employ the applicable flight procedures that are operationally directed for an inoperative mode 4 condition.

Note

Since power for the caution light is routed through the KIT-1A/TSEC Transponder Computer, this unit must be installed in the aircraft to render the caution light operative.

GROUND HANDLING SIGNALS

Communications between the aircraft and ground crew personnel are visual whenever practicable, if operations permit. The visual signals illustrated in figure 7-4 should be reviewed and practiced by all pilots and bombardier/navigators.

INFLIGHT VISUAL COMMUNICATIONS

Communications between aircraft are visual whenever practicable, if operations permit. Flight leaders shall ensure that all pilots in the formation receive and acknowledge signals when given. The visual communications section of NWP-41 must be reviewed and practiced by all pilots and bombardier/navigators. For ease of reference, common visual signals applicable to flight operations are contained in figure 7-5.

DECK/GROUND HANDLING SIGNALS

1 FINGER GTC START

2 FINGERS AIR PRESSURE AVAILABLE TO AIRCRAFT
CLEAR TO START EITHER ENGINE

3 FINGERS CUT GTC - DISCONNECT

.....

RESPONSE 3 FINGERS CLEAR TO START
OTHER ENGINE



START ENGINES



LEFT INDEX FINGER TO THE NOSE,
RIGHT HAND PALM OUT IN A
"STOP" MOTION.



ENTERING "Y"
(STOP NOSE GEAR STEERING)



TOW BAR IS LOWERED.



TOW BAR LOWERED



LEFT ARM PULLED UP/DOWN
ALONG LEFT SIDE.



RAM AIR TURBINE

CARRIER FLIGHT DECK PERSONNEL COLOR CODING

- RED SHIRTS** ORDNANCE, AND CRASH CREW
- PURPLE SHIRTS** FUEL HANDLING
- YELLOW SHIRTS** PRI FLY, PLANE DIRECTORS, CATAPULT OFFICER AND ARRESTMENT OFFICER
- BLUE SHIRTS** PLANE HANDLERS (PUSHERS CHOCK MEN, ETC.)
- GREEN SHIRTS** AIRCRAFT MAINTENANCE, CATAPULT CREW, ARRESTMENT CREW
- BROWN SHIRTS** PLANE CAPTAINS
- WHITE SHIRTS** MEDICAL

Figure 7-4

IN-FLIGHT VISUAL COMMUNICATIONS

GENERAL CONVERSATION

MEANING	SIGNAL	RESPONSE
Affirmative (I understand).	Thumb up, or nod of head.	
Negative (I do not know).	Thumb down, or turn of head from side to side.	
Question (repeat). Used in conjunction with another signal, this gesture indicates that the signal is interrogatory.	Hand cupped behind ear as if listening.	As appropriate.
Wait.	Hand held up with palm outward.	
Ignore last signal.	Hand waved in an erasing motion in front of face, with palm turned forward.	
Perfect, well done.	Hand held up, with thumb and forefinger forming an O and remaining three fingers extended.	
Numerals, as indicated.	With forearm in vertical position, employ fingers to indicate desired numerals 1 through 5. With forearm and fingers horizontal, indicate number which, added to 5, gives desired number from 6 through 9. A clenched fist indicates zero.	A nod of the head (I understand). To verify numerals, addressee repeats. If originator nods, interpretation is correct. If originator repeats numerals, addressee should continue to verify them until they are understood.
Take over communications.	Tap earphones, point to plane, and hold up one finger.	Execute.

CONFIGURATION CHANGES

MEANING	SIGNAL	RESPONSE
Lower landing gear.	Rotary movement of hand in cockpit, as if cranking wheels.	Execute.
Lower arresting gear hook.	Leader lowers hook.	Wingman lowers arresting gear hook. Leader indicates wingman's hook is down with thumb up signal.
Extend or retract flaps or speed brakes as appropriate.	Open and close four fingers and thumb.	

FUEL AND ARMAMENT

MEANING	SIGNAL	RESPONSE
How much fuel have you?	Raise fist with thumb extended in a drinking position.	Indicate fuel in tens of gallons or hundreds of pounds by finger numbers.
Arm or safety ordnance.	Pistol cocking motion with either hand.	Execute and return signal.
1—Arm or safety tanks as applicable; 2—how many tanks do I have? 3—I am unable to drop.	1 — Shaking fist; 2 — followed by question signal; 3 — followed by nose-held signal.	1—Execute and return signal; 2—indicate with appropriate finger numerals; 3—nod head (I understand).

ADF1-87 -1

Figure 7-5 (Sheet 1)

FORMATION

MEANING	SIGNAL	RESPONSE
1—I have completed my take-off Check-off and am, in all respects ready for take-off; 2—I have completed my take-off check list and am, in all respects, ready for a section take-off; 3—take-off path is clear, I am commencing take-off.	1—Section take-off leader raises arm (either) over head; 2—wingman raises arm over head; 3—leader lowers arm.	1—Stands by for reply from wingman, holding arm over head until answered; 2—wingman lowers arm and stands by for immediate section take-off; 3—executes section take-off.
Leader shifting lead to wingman.	Leader pats self on head points to wingman. At night, leader A/C switches lights to bright, and turn anti-collision light on. In the event of an external light failure, leader shines flashlight on hard hat, then shines light on wingman.	Wingman pats head and assumes lead. At night, wingman puts lights on dim, and turns grimes light off when he accepts the lead. In the event of an external light failure, wingman shines flashlight at leader, then on his hard hat. Turns external lights to dim and assumes lead.
Leader shifting lead to division designated by numerals.	Leader pats self on head points to wingman and holds up two or more fingers.	Wingman relays signal; division leader designated assumes lead.
Take cruising formation.	Thumb waved backward over the shoulder.	Execute.
I am leaving formation.	Any pilot blows kiss.	Nod (I understand).
Aircraft pointed out leave formation.	Leader blows kiss and points to aircraft.	Execute.
Directs plane to investigate object or vessel.	Leader beckons wing plane, then points to eye, then to vessel or object.	Wingman indicated blows kiss and executes.
Refers to landing of aircraft, generally used in conjunction with another signal; 1—I am landing; 2—directs indicated aircraft to land.	Landing motion with open hand; 1—followed by patting head; 2—followed by pointing to another aircraft.	1—Execute; 2—execute.
a. Join up or break up, as appropriate. b. On GCA/CCA final: Leader has runway/ship in sight.	Flashing external lights.	a. Comply. b. Wingman repeats, indicating runway/ship in sight. Ship: Leader waves-off wingman lands. Field: When runway conditions preclude a safe section landing leader will wave-off.
I am going to dump fuel.	Make hand into cup shape and make repeated pouring motions.	Wingman nods moves clear of fuel dump vents and gives "thumbs up" when dumping commences.
I have stopped dumping fuel.	Slashing motion of index finger across throat.	Wingman gives "thumbs up" when dumping stops.

AIR REFUELING

MEANING	SIGNAL	RESPONSE
Extend Drogue.	Form cone-shape with hand, and move hand aft.	Tanker execute.
Retract Drogue.	Form cone-shape with hand, and move hand forward.	Tanker execute.
Secure Turbine.	One finger turn-up signal followed by cut signal.	Tanker execute.

FORMATION SIGNALS**MADE BY AIRCRAFT MANEUVER**COMBAT OR
FREE CRUISE

MEANING	SIGNAL	RESPONSE
Single aircraft cross under in direction of wing dip.	Single wing dip.	Execute.
Section cross under.	Double wing dip.	Execute.
Close up.	Series of small zooms.	Execute.
Join up; join up on me.	Series of pronounced zooms.	Expedite join-up.

ADF1-87-2

Figure 7-5 (Sheet 2)

MOI 24204

[illegible]

2004년 3월 23일 위촉

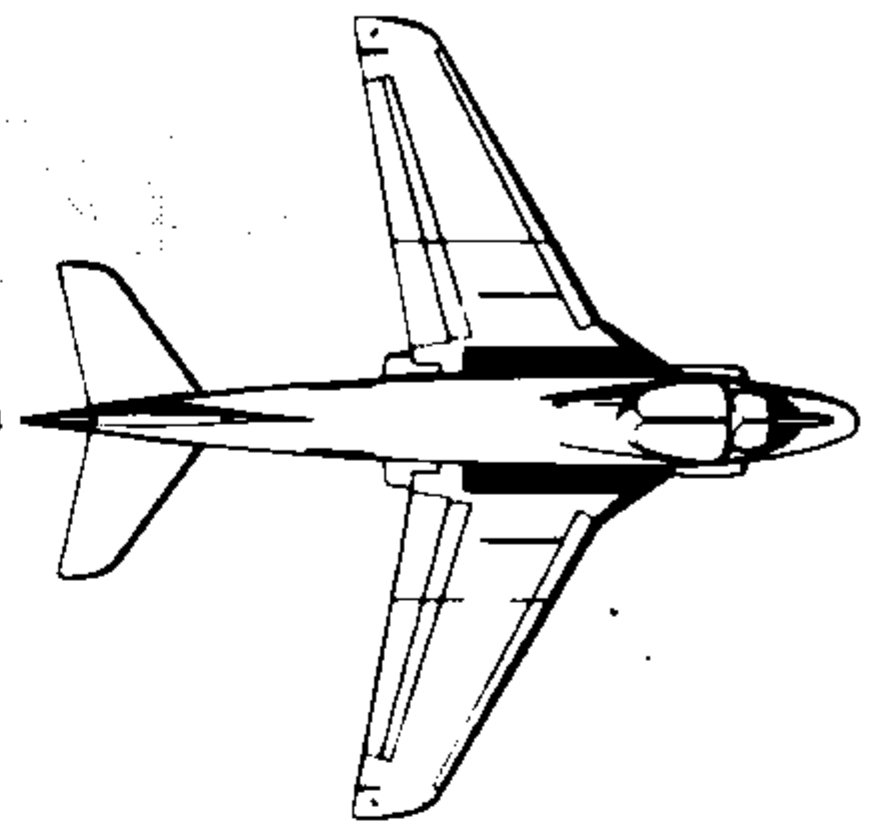
Signal	Meaning	Signal	Meaning
Extend Signal	From down-slope with head and arms back off	Down Tumble	One finger down-slope signal followed by cut signal
First Signal	From down-slope with head and arms back forward		
Topper Signal	From down-slope with head and arms		

INFORMATION SIGNALS

MADE BY AIRCRAFT MANEUVER

Time	Signal	Response
10:00 am	Signal of emergency	Response: 10:05 am
10:10 am	Signal of emergency	Response: 10:15 am
10:20 am	Signal of emergency	Response: 10:25 am
10:30 am	Signal of emergency	Response: 10:35 am

section VIII

WEAPON SYSTEMS**TABLE OF CONTENTS**

PART 1 ATTACK/NAVIGATION SYSTEM	8-2	Velocity Correct	8-35
Sensors	8-2	Computer Operational Readiness	
Aircraft Data Sensors	8-2	Test (ORT)	8-36
Search Radar AN/APQ-148	8-4	System Advisory Codes	8-37
Radar Operating Modes	8-4	Computer Controls	8-38
Radar Display Modes	8-6	System Displays	8-52
Radar Cursors	8-7	Direct View Radar Indicator	8-52
Radar Tracking Modes	8-8	Pilot's Horizontal Display	8-52
Built-In-Test (BIT)	8-9	Vertical Display Indicator	8-53
Search Radar Controls	8-11	Optical Sight	8-63
Track Radar Controls	8-14	Weapons Release System	8-67
Video Tape Recorder AN/USH-17(V)	8-15	Armament Control Unit	8-67
Doppler Navigation Radar	8-17	ACU Control Panel	8-69
Doppler Operating Characteristics	8-17	Fuze Function Control Panel	8-73
Doppler Radar Control Panel	8-17	Nuclear Panel	8-73
Inertial Navigation System		Ballistic Control Panel	8-74
AN/ASN-31	8-18	Manual Release Button	8-75
Inertial Platform Orientation	8-18	Reselect Logic	8-75
Alignment	8-18	Stores Jettison	8-77
Alternate Heading and Attitude		Weapon Mounting	8-77
References	8-23	Ground Control Bombing	
Digital Computer AN/ASQ-133	8-24	System (GCBS)	8-77
Computer Program	8-24	Strike Camera System LB-31A	8-78
Navigation Options	8-25	Radar Beacon AN/APN-154(V)	8-79
Computer Steering Selections	8-27		
Attack Modes	8-33	PART 2 ELECTRONIC COUNTERMEASURES . .	8-80

INTRODUCTION

The weapons system, which provides the crew with an all-weather attack capability, is composed of the airframe and flight-related systems which are described in Section I, the communications systems

which are described in Section VII, and the mission-related systems which are described in this section.

The mission-related systems include the attack/navigation system and the defensive electronic countermeasures system.

part 1

Attack/Navigation System

To solve the navigation problem the attack/navigation system (figure FO-8) integrates data from various on-board sensors by means of a general-purpose digital computer. The computer receives automatic inputs from the sensors and navigation aids and manual inputs from the crew, evaluates the inputs based on programmed logic and integrates the data which is valid. Position and correction signals are then sent to the sensors and navigation aids as required, and the

crew is provided with displays of steering commands and other data necessary to navigate to a target and deliver ordnance accurately without visual reference to the surface. When an attack is being executed, the computer performs certain additional calculations related to the attack profile and weapons selected by the crew and provides attack steering commands to the crew and if an automatic release has been selected, weapon release signals to the armament control unit.

SENSORS

As shown in figure FO-8, the following sensors provide data which is processed in the computer:

- Search Radar AN/APQ-148
- Inertial Navigation System AN/ASN-31
- Magnetic Compass MA-1 (Backup)
- Vertical Gyro Indicator MM-3 (Backup)
- Doppler Navigation System AN/APN-153
- Air Data Computer
- Normal Accelerometer
- Air Temperature Probe
- Angle of Attack Probe

Those equipments which are primarily flight-related are described in Section I. Therefore only their inputs to the attack/navigation system will be discussed in this section.

AIRCRAFT DATA SENSORS

Data from the angle of attack probe, the temperature probe, the normal accelerometer and the air data computer, which will be discussed under the general heading of aircraft data, are provided to the digital computer for use in the attack/navigation system.

Aircraft angle of attack as measured by the angle of attack probe with respect to the ADL is received by the computer and is used in the Doppler or DR navigation options to calculate aircraft true angle of attack

with respect to the airspeed vector. In the inertial and doppler/inertial navigation options, angle of attack is calculated using INS elevation angle, vertical velocity, and true airspeed.

Impact air temperature from the total temperature probe is Mach corrected in the computer and is used in calculations of airspeed and altitude to correct for non-standard conditions.

Acceleration or load factor normal (perpendicular) to the ADL is measured by the normal accelerometer and is used in the computer in the calculation of rates of change of aircraft angular position with respect to the air mass and the earth.

The air data computer provides Mach number which is used to calculate true airspeed, and static pressure which is used in computing altitude.

The inertial platform provides attitude and horizontal and vertical velocities.

EVALUATION AND REPLACEMENT OF AIRCRAFT DATA

The failure of an aircraft data sensor or an unreliable input from one of those sensors could degrade the operational capability of the weapons system. To keep possible degradation to a minimum, logic has been included in the computer program by which the reliability of the aircraft data sensors and the accuracy of their inputs are evaluated. If the computer determines that angle of attack, temperature, Mach or normal acceleration are bad, these values are automatically replaced by values derived from backup calculations. The B/N must initiate the replacement of bad value of static pressure or inertial platform vertical velocity himself. He also has the

option of initiating the replacement of data from the Mach sensor.

The replacement for a bad angle of attack from the probe is from a back-up computation using the aircraft elevation angle and the rate of change of pressure altitude. This replacement is necessary only in the doppler and DR navigation options since data from the angle of attack probe is not used in the inertial or Doppler/inertial navigation options. If temperature is bad, a standard day ambient air temperature is calculated, using static pressure. An option is available to the B/N whenever calculated standard day temperature is in use. He may bring the solution closer to actual conditions by entering known temperature, in degrees Fahrenheit, at the target, or if this is not known, the existing temperature at departure. The standard day temperature is then adjusted by the difference between the entered temperature and standard.

Note

- It is good practice to make the backup temperature entry whenever bringing the computer on the line, so that it will be available if needed during the mission.
- Any time Mach number is set bad, temperature is also set bad.

A calculated value of normal load factor derived from inputs of aircraft angular rates from the inertial platform replaces bad inputs from the normal accelerometer.

The B/N evaluation of Mach number and static pressure is based on the credibility of the read-outs of true airspeed and static pressure displayed in the digital display unit (DDU) and the readings on the altimeter and airspeed indicator. If an error is large enough, system advisory codes (SAC's) displayed in the DDU will assist in the evaluation. SAC 010 is displayed if true airspeed - total inertial velocity exceeds $180 + .0055 \times \text{pressure altitude}$, that is, an excessive airspeed/groundspeed differential. If this code is the result of a large wind derivation, selecting OFF ERASE on the velocity correct switch may allow the code to be cleared. If not, it may be necessary to change navigation options or replace the Mach input. The 011 SAC is the result of a vertical loop altitude difference of more than 640 feet. Three probable causes are:

- If an improper or unstable static pressure is continuously provided. This can be determined by checking window B1 on the DDU in the non-attack condition.
- If the vertical velocity is bad (window A3). By changing navigation options it can be determined whether static pressure or inertial vertical velocity is suspect and the bad value replaced.

- Failure to initialize present position altitude, or trying to initialize it within 40 seconds of completing the converter portion of the ORT (before the air data computer has time to return to ambient conditions). Re-entering present position altitude should remove the cause of this type of code.

When the computer receives an indication from the B/N that Mach number from the air data computer is not accurate, replacement is made in one of two ways depending on the navigation option selected. If the inertial, Doppler/inertial or doppler options have been selected, true airspeed is determined by applying the current value of wind to total inertial velocity. True airspeed is then converted to Mach number. If the dead reckoning option has been selected, the keyboard entry of true airspeed is converted to Mach number.

Note

With the air data computer Mach number bad and D.R. selected, the aircraft should be flown as closely as possible to the selected airspeed.

System altitude is reset to the current value of temperature-corrected pressure altitude when present position correct is selected with the radar cursors stabilized (UNSTAB not selected). System altitude is also reset when the INS is placed into a nonoperate mode or inertial velocity is set bad.

If the B/N determines that the input of vertical velocity from the inertial platform is not valid he may cause it to be replaced by a back-up value calculated from true airspeed and angle of attack.

When the entry is made indicating invalid pressure, the computer suspends operation of the baro-inertial vertical loop. Present position altitude should be re-initialized at this point using the keyboard entry. System altitude will then be derived by means of continuous integration of system vertical velocity. If the inertial or doppler/inertial navigation option is in use, the vertical accelerometer feed-back loop is modified to use INS elevation angle, true airspeed and probe input of angle of attack instead of pressure to provide accelerometer corrections. If using DR or Doppler navigation options with static pressure set bad, level flight at the keyboard entered altitude is required.

The option of replacement or elimination of bad Mach number, static pressure, or inertial vertical velocity is initiated by manual entries. With the MAN key depressed and the COMPT MODE switch at ENTER, entering with the ALT ACTION key:

N11111 sets Mach and static pressure sensors and inertial vertical velocity USED

N101111 sets Mach sensor NOT USED; static pressure sensor and inertial vertical velocity USED

N111101 sets and static pressure NOT USED; Mach sensor and inertial vertical velocity USED

N101101 sets both Mach and static pressure sensors NOT USED, inertial vertical velocity USED.

N111110 sets Mach and static pressure sensors USED, inertial vertical velocity NOT USED.

Appropriate velocity and/or present position altitude entries should be made. The desired true airspeed is entered in knots through MAN/VEL. In a similar manner, a bad value of inertial platform vertical velocity is replaced in the solution by entering N111110 MAN/ALT.

DISPLAY OF SENSOR USAGE

An advisory display of system sensor usage status is available in the computer pedestal temporary storage indicator. This display is selected by depressing the MAN key with the computer mode switch

SEARCH RADAR AN/APQ-148

The search radar is a multiple mode system which provides the capabilities of search, target tracking, moving target identification, beacon interrogation, and terrain clearance. Indicators are provided for both the bombardier/navigator and the pilot. The controls for operating the radar are located principally on the bombardier/navigator's control panel, while display controls and adjustments are on the bombardier/navigator's control panel and the pilot's control panel. See figure 8-1.

In this discussion, the operation of the radar has been divided into general classifications of operating modes, display modes and target tracking modes. These classifications are for descriptive purposes only.

RADAR OPERATING MODES

The operating modes include search, which is the basic mode, and beacon, airborne moving target identification (AMTI) and terrain clearance which are additional capabilities that may be selected.

SEARCH OPERATION

The radar is in the search mode when it is on and operating and none of the additional capabilities have been selected. In this mode, reflected radar energy is displayed on the bombardier/navigator's and pilot's indicators in either a depressed center PPI or B-scan format. Range and azimuth cursors and fixed range marks are also displayed. The antenna scan and display are centered about either the aircraft ADL or the relative bearing of the azimuth cursor. Scan rate, pulse width, and PRF are determined by the requirements of the range selected.

BEACON OPERATION

The beacon mode provides the capability of detecting and locating the return from a ground-based beacon.

at STEER. The temporary storage indicator displays a blank followed by a series of six ones or zeros with one indicating sensor usage and zero indicating data substitution. Sensor status is displayed from the most significant digit (MSD) to the least significant digit (LSD) as follows:

- MSD- BLANK
- 2MSD- Normal load factor (Set automatically)
- 3MSD- Mach number (Set manually and/or automatically)
- 4MSD- Angle of attack (Set automatically)
- 5MSD- Temperature (Set automatically)
- 6MSD- Static pressure (Set manually)
- LSD- INS vertical velocity (Set manually)

This mode is available only in high PRF, is compatible with all of the target tracking modes, and may be used simultaneously with terrain clearance.

In the beacon mode, the radar interrogates the beacon, and the return is processed in the search receiver. Normal ground return video is processed in the beacon ground map receiver so that background video can be displayed along with the beacon signal. The beacon return, which is a coded pulse train is displayed on the DVRI and the PHD at the range and bearing of the transponder's actual geographic position. This is the true position, corrected in the radar for beacon delay. The BEACON control on the B/N's control panel permits the B/N to vary the amount of ground return mixed with the beacon returns.

Note

When using the beacon for bombing, an offset with a nonzero distance entry must be used or the computer will not step into attack.

AMTI OPERATION

In AMTI operation, search radar video is processed to emphasize moving ground targets. The return from a moving target characteristically fluctuates in amplitude with respect to returns from fixed targets. During AMTI operation, a portion of each pulse of reflected radar energy is sent to a delay line to be compared in amplitude with the next pulse. Pulse-to-pulse amplitude fluctuations are detected in the AMTI unit and converted to moving target video for display on the DVRI and PHD. Those returns whose amplitude remains constant from pulse to pulse are treated as fixed returns, and are canceled. The AMTI control on the B/N's control panel permits the B/N to vary the amount of fixed target background to be added to the AMTI display.

RADAR CONTROLS AND INDICATORS

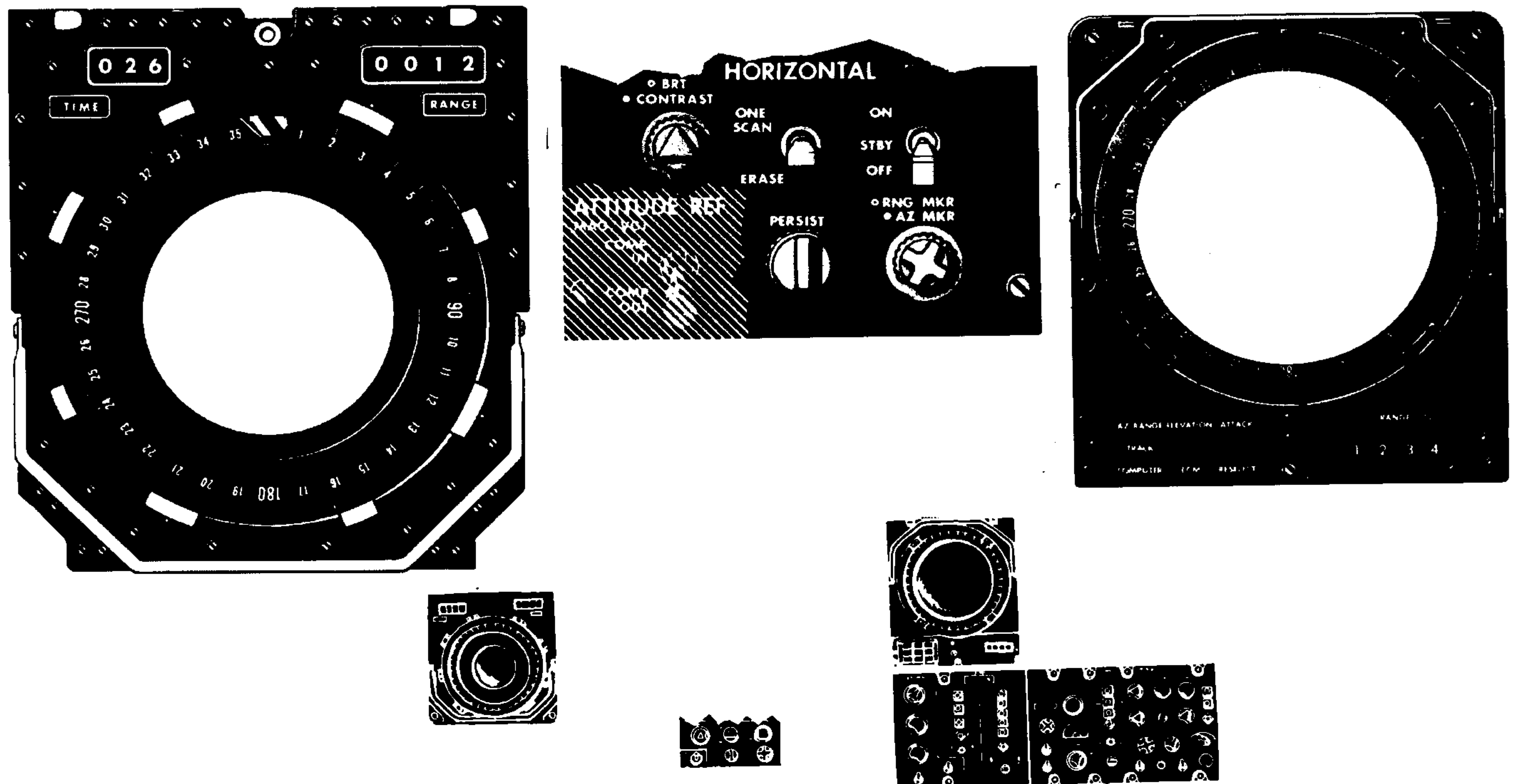


Figure 8-1

The timing pulses produced by the AMTI unit trigger radar operation during the AMTI mode to assure that transmitter and receiver operation are timed to match the pulse period required for fixed target cancellation.

The amplitude fluctuations caused by a moving target are detectable for only the range component of target movement. For this reason, a target that is moving on a line perpendicular to the aircraft heading will not be detected as a moving target. The detection range of a given moving target increases as the aircraft approach heading approximates the fore-and-aft axis of the target movement (head-on or tail-on approach). The relative approach angle (angle off) between aircraft and target becomes most critical with slow moving targets. For example, a 10 mile per hour pickup truck and 4 mile per hour road grader, traveling the same road, could both be detected at the same range on a zero degree angle-off run, but the detection range for the road grader would be half that of the truck on a 10-degree angle-off run.

The AMTI mode is compatible with all the target tracking modes, and may be used simultaneously with terrain clearance. Since AMTI operation requires normal pulse width and high PRF only short ranges may be selected with either the PPI or ARE display modes:

With 5-75 selected, range less than 27.5 miles

With ARE-30 selected, range less than 22 miles

With ARE-60 selected, range less than 18 miles

If an incompatibility exists, selecting AMTI will have no effect.

TERRAIN CLEARANCE OPERATION

In the terrain clearance mode, terrain elevation data out to a range of 10 miles is provided to the radar data converter which uses it to generate the terrain clearance display on the VDI. This mode of operation may be selected simultaneously with beacon and AMTI and is compatible with all the target tracking modes. Terrain clearance requires a normal pulse width and high PRF. Selection of a display mode which is incompatible with these requirements results in a PPI display with a 27.5-mile sweep length.

Note

If BORESIGHT has been selected, the radar will not enter the terrain clearance mode.

Normal transmitting circuits and system timing are used for terrain clearance but the reflected energy is received by a special dual channel antenna array. The phase of the returns received by the bottom row of antenna ports is compared to that of the returns received by the upper row. The difference of phase is a function of the elevation of the terrain from

which the returns are received. This elevation data is provided to the pilot as a display on the VDI. For more details on the terrain clearance display, refer to System Displays in this section.

RADAR DISPLAY MODES

Radar data may be displayed on the DVRI and the PHD in either a depressed center plan position indicator (PPI) format with sweep length of 150 miles or variable 5-75 miles, or in a B-scan format. The B-scan displays are available with the computer on, and provide automatic range expansion (ARE) whereby the sweep length is automatically varied to keep the cursor intersection in the center of the display. PRF and pulse width are automatically changed in accordance with the sweep length in use.

Fixed range marks are provided in both display formats. In the PPI format, with radar range less than 27.5 miles, range marks are displayed every 10 miles, and with radar range 27.5 miles or more, they are displayed every 25 miles. In the B-scan format, two range marks are displayed: one at 1 mile beyond the range cursor, and one at 5 miles beyond the range cursor. All range marks are displayed with the middle 50% blanked.

PPI 150 DISPLAY MODE

In the PPI 150 mode a depressed center PPI display with a fixed range of 150 miles is provided. The azimuth sector scanned is continuously variable from 20° to 110°. The radar operates at a low PRF and wide pulse width. Range and azimuth cursors are displayed and may be computer- or manually-controlled. The PPI 150 mode is incompatible with beacon, AMTI and terrain clearance, but may be used with search and all the target tracking modes.

Note

If the pilot selects terrain clearance while PPI 150 is selected, the radar switches to high PRF and narrow pulse width with maximum displayed range at 27.5. The minimum scan angle will be $\pm 30^\circ$.

PPI 5-75 DISPLAY MODE

In the PPI 5-75 display mode, a depressed center PPI display with a range which is variable from 5 to 75 miles is provided. The azimuth sector scanned is continuously variable from 20° to 110°. With the ranges between 27.5 and 75 miles selected the radar operates with a medium PRF and pulse width. Selection of a displayed range of 27.5 miles or less results in the radar operating at a high PRF and narrow pulse width. At ranges of 27.5 miles and below, the PPI 5-75 mode is compatible with beacon, AMTI, and terrain clearance. It may be used at all ranges with search and with all target tracking modes.

Note

If the pilot selects terrain clearance when the displayed range selected is greater than 27.5 miles, the radar will switch to high PRF and narrow pulse width and the displayed range will be reduced to 27.5 miles. The minimum scan angle will be $\pm 30^\circ$.

ARE-60 DISPLAY MODE

The ARE 60 (automatic range expansion - 60°) display mode is presented in a B-scan format with the cursors at the center of the display. The horizontal sweep scaling is set such that a 60° scan angle completely fills the display. The vertical sweep is controlled so as to keep the range cursor in the center of the sweep. The sweep starts at $0.5 R_{SI}$ (one-half the slant range distance to the cursor intersection) and sweep length is set at $1.0 R_{SI}$. As the range cursor is moved, the sweep start and sweep length are changed to keep the range cursor at the center of the display while the targets appear to move behind it. This relationship is maintained until the range reaches 1.5 miles which is the minimum sweep length for the DVRI. At this point, range expansion stops and the sweep now starts at 0.75 mile before the range cursor. With continued decrease of range, the sweep start continues to approach the point at which pulse transmission begins (main bang) until R_{SI} is 0.75. At this point, sweep start is at the same time as the main bang. Further decrease of range will cause the range cursor to move up the sweep toward the display center. If ARE 60 is selected when R_{SI} is greater than 18 miles, a PPI display corresponding to the selection on the PPI range control will result, until the range is reduced to less than 18 miles.

The actual azimuth angle scanned may be varied by the B/N from 10° either side of the azimuth cursor (20° scan angle) to 55° either side of the azimuth cursor (110° scan angle). If a scan angle of less than 60° is selected, only the returns in the selected area will be displayed. If a scan angle greater than 60° is selected an over-scan results where the antenna scans beyond the display limits.

Since the outer scan limit of the antenna is 55° either side of the ADL, a symmetrical picture will be displayed only so long as the combination of the selected scan angle and the relative bearing of the azimuth cursor does not exceed 55° . For example, if a scan angle of 60° (30° either side of the azimuth cursor) is selected the picture will no longer be symmetrical when the relative bearing of the azimuth cursor is greater than 25° .

ARE 60 is a short range display mode. If R_{SI} exceeds 18 miles the display format will change to

PPI with displayed range as selected on the PPI range switch until the range cursor is returned to within display limits.

Note

If the pilot selects terrain clearance when the range cursor is beyond 18 miles, the radar will switch to high PRF and narrow pulse width and the display will be PPI with maximum displayed range of 27.5 miles. Expanded displays are still available at short ranges. The minimum scan angle will be $\pm 30^\circ$.

ARE-30 DISPLAY MODE

The ARE 30 (automatic range expansion - 30°) display mode is presented in a B-scan format with the azimuth cursor at the center of the display. The horizontal sweep scaling is set such that a 30° scan angle completely fills the display. The vertical sweep is controlled so as to keep the range cursor at the center of the sweep. The sweep starts at $0.75 R_{SI}$ (three-fourths the slant range distance to the cursor intersection) and sweep length is set at $0.5 R_{SI}$. As the range cursor is moved, sweep start and sweep length are changed to keep the range cursor at the center of the display while the targets appear to move behind it. This relationship is maintained until the range is decreased to 3.0 miles which results in a sweep length of 1.5 miles, the minimum for the DVRI. At this point range expansion stops and sweep now starts at 0.75 mile before the range cursor. With continued decrease of range, the sweep start continues to approach the point at which pulse transmission begins (main bang) until R_{SI} is 0.75. At this point sweep start is at the same time as the main bang. Further decrease of range will cause the range cursor to move down the sweep toward the sweep start.

If R_{SI} is less than 22 miles, the radar operates at high PRF and pulse width is normal, if R_{SI} is greater than 22 miles but less than 56 miles, a medium PRF and medium pulse width are used. If R_{SI} is greater than 56 miles, the format will change to PPI.

Note

If the pilot selects terrain clearance while the range cursor is beyond 22 miles the display format will change to PPI with a maximum displayed range of 27.5 miles. Expanded displays are still available at short ranges. The minimum scan angle will be $\pm 30^\circ$.

RADAR CURSORS

Two cursors are displayed on the DVRI and PHD, one representing the precision range line and one

representing the azimuth line. These cursors are generated in the radar and controlled either manually or by the computer.

During computer control of the cursors, range and relative bearing to the target are provided by the computer. Precision range line position is sent from the cursor control unit to the computer which computes a range (R_{SL}) corresponding to this position. This range is converted to time in the signal converter unit and is displayed as intensity modulation on the range sweep as the antenna scans, forming the range cursor. The computer provides relative bearing to the DVRI and the antenna/receiver. If REL BRG is selected on the SCAN STAB switch the antenna receiver left and right limits of antenna scan are adjusted so as to center the scan about the relative bearing signal. Antenna scan is then compared to target relative bearing in the DVRI where coincidence produces a null. The null is used in the SCU to generate an azimuth line pulse which is mixed with search video and displayed as the azimuth cursor.

During manual control, the cursor position is based on inputs from the MAN RANGE and AZ CURSOR controls on the bombardier/navigator's control panel.

RADAR TRACKING MODES

The search radar provides four tracking modes in an ascending order of capability. These modes include cursor intersection, elevation track, azimuth range tracking and track-while-scan. To select any of the tracking modes, the MODE switch must be at TRACK and the cursor control switch at COMPT in addition to the switch positions required to select the individual tracking modes.

Note

No radar lock-ons are permitted if the computer steering selection is UNSTAB.

CURSOR INTERSECTION TRACKING

The cursor intersection mode is a manually aided means of target tracking. The bombardier/navigator positions the cursors on the target with the slew grip and they are repositioned by the computer based on system velocities to track the target. System velocities may be improved by manual velocity correct. Cursor intersection is compatible with all operating and display modes.

ELEVATION TRACKING

When elevation tracking has been selected by setting the ELEV TRKG switch to ON, measurement of the

depression angle to a ground position defined by the intersection of the range and azimuth cursors (to a maximum range of 10 miles) is provided to the computer. The computer performs tests to validate the inputs and if they are valid, turns on the ELEVATION light on the DVRI. The radar provides the elevation angle of the target defined by the cursor intersection. Elevation track lock-ons are broken during pushovers, however the light will come back on as soon as the aircraft stabilizes. Valid inputs are used to calculate depression angle to the aimpoint, altitude above the aimpoint, angle and closing rates, and to update target and cursor position. The cursors are initially positioned with the slew grip and the computer repositions them to track the target based on system velocities and radar inputs. Manual velocity correct may be used to improve system velocities. Slewing breaks an elevation lock, however it is re-acquired as soon as slewing is stopped.

Elevation track lock is inhibited when the aircraft is past the target.

Elevation tracking requires high PRF operation. It is compatible with terrain clearance, beacon, AMTI, and the short range display modes.

AZIMUTH-RANGE TRACKING

Azimuth-range tracking is selected by moving the slew grip dislodge switch aft. It may be used to track targets out to a maximum range depending on video strength. In this mode, range is measured by using computer range cursor position to control an early-late gate measurement loop which provides range error to the computer. Azimuth is determined in a similar manner. The radar incorporates a beam splitter and uses a left-right measurement technique, providing azimuth error to the computer. The computer performs tests to validate the inputs, and if the data is valid turns on the AZ-RANGE light on the DVRI. Valid inputs are used to calculate slant range and relative bearing to the aimpoint, angle and closing rates and to update target and cursor positions. The cursors are initially positioned with the slew grip and a lock-on is initiated by moving the dislodge switch aft. When the AZ-RANGE light comes on, the radar tracks the target in range and azimuth, further slewing is inhibited and the computer repositions the cursors to track the target based on system velocities and radar inputs. Azimuth range tracking at short ranges, is compatible with terrain clearance, beacon, AMTI and the short range display modes.

TRACK-WHILE-SCAN TRACKING

Track-while-scan (TWS), the full-capability mode, providing three-axis tracking to a maximum range of 10 miles, is selected by setting the ELEV TRKG switch to ON and the dislodge switch aft. Measurement of the depression angle to a position defined by the intersection of the range and azimuth cursors is provided to the computer. Range is measured

NEW

NEW

NEW

by using computer range cursor position to control an early-late gate measurement loop which provides range error to the computer. Azimuth is determined in a similar manner. The radar incorporates a beam-splitter and uses a left-right measurement technique, providing azimuth error to the computer. The computer performs tests to validate the radar inputs and if the data is valid, turns on the ELEVATION and AZ-RANGE lights on the DVRI. Valid inputs are used to calculate depression angle to the aimpoint, altitude above the aimpoint, slant range and ground range to the aimpoint, relative bearing to the aimpoint and to update target and cursor positions. At aircraft pitch angles greater than 53° , memory target tracking is used.

TWS tracking requires high PRF operation. It is compatible with terrain clearance, beacon, AMTI and the short range display modes.

BUILT-IN-TEST (BIT)

By means of the built-in test capability an end-to-end check (except for the antenna) of the radar can be performed on the ground or in-flight without transmitting radar energy. The radar indicators and all major functions of the radar including search, AMTI, terrain clearance, elevation tracking, and track while scan are checked in this manner. (See figure 8-2). In addition, the proper functioning of the test circuitry may be checked by a self-test feature which lights a GO or NO GO light.

If a fault is found during the test procedure it may be isolated to one of 10 aircraft replaceable assemblies (ARA's) by use of a fault isolation feature which lights a GO or NO GO light for the selected ARA.

SEARCH BIT

When BIT is selected in search or any of the other test positions a test signal is processed through the search radar circuits and displayed on the DVRI. If all circuits are functioning properly, target video will be displayed at a range of 30,775 feet ± 100 feet centered in azimuth about the ADL. The fixed target will be displayed over approximately a 2° sector.

Note

If the search radar POWER switch is on, BIT video will also be displayed on the PHD.

AMTI BIT

When AMTI BIT is selected, a test signal is processed through both the search radar and AMTI channels before being displayed. When the AMTI control is switched on, simulated moving targets will appear to the left and right of the area where the fixed target appeared during the search BIT. The area occupied by the search radar test target will be void of video. As the AMTI control is adjusted clockwise, hard target video will appear between the two simulated moving targets and will increase in amplitude until

one continuous line is painted in azimuth at 30,775 feet ± 100 feet throughout the selected scan angle.

TERRAIN CLEARANCE BIT

When terrain clearance BIT is selected, signals pertinent to TC are monitored in the antenna/receiver, SCU, low voltage power supply, and the B/N's control box. If all signals are proper, the resulting output level drives the TC failure light on the VDI and the GO-NO GO indicators on the bombardier/navigator's control panel. Since the normal terrain clearance mode of operation is vital to the safety of the aircraft, it is monitored continuously in-flight and on the ground and the pilot is alerted to a failure by the TC failure light going on, when terrain clearance is selected.

When TC BIT is selected, the test target again appears on the DVRI and PHD.

During ground check of the terrain clearance mode with the TRANSMIT switch at SIL, the TC light will remain on.

Note

Since BIT disables the normal terrain clearance mode, BIT should not be selected if the terrain clearance mode is being flown.

ELEVATION TRACKING BIT

When elevation tracking BIT is selected, the same fixed target displayed during search BIT is displayed at 30,755 feet ± 100 feet on the DVRI and PHD, at the same time, a boresight test signal is processed through the TC receiver. When the B/N positions the cursors over the target using the manual controls, the SCU elevation angle computer examines the resulting boresight phase signal from the TC receiver. If the calculated boresight angle is correct, the GO light on the B/N's control panel will go on. As the B/N moves the cursors off the displayed target, this light goes off and the NO GO light goes on. A NO GO light indicates that the computed boresight test target is not within specifications.

TRACK-WHILE-SCAN BIT

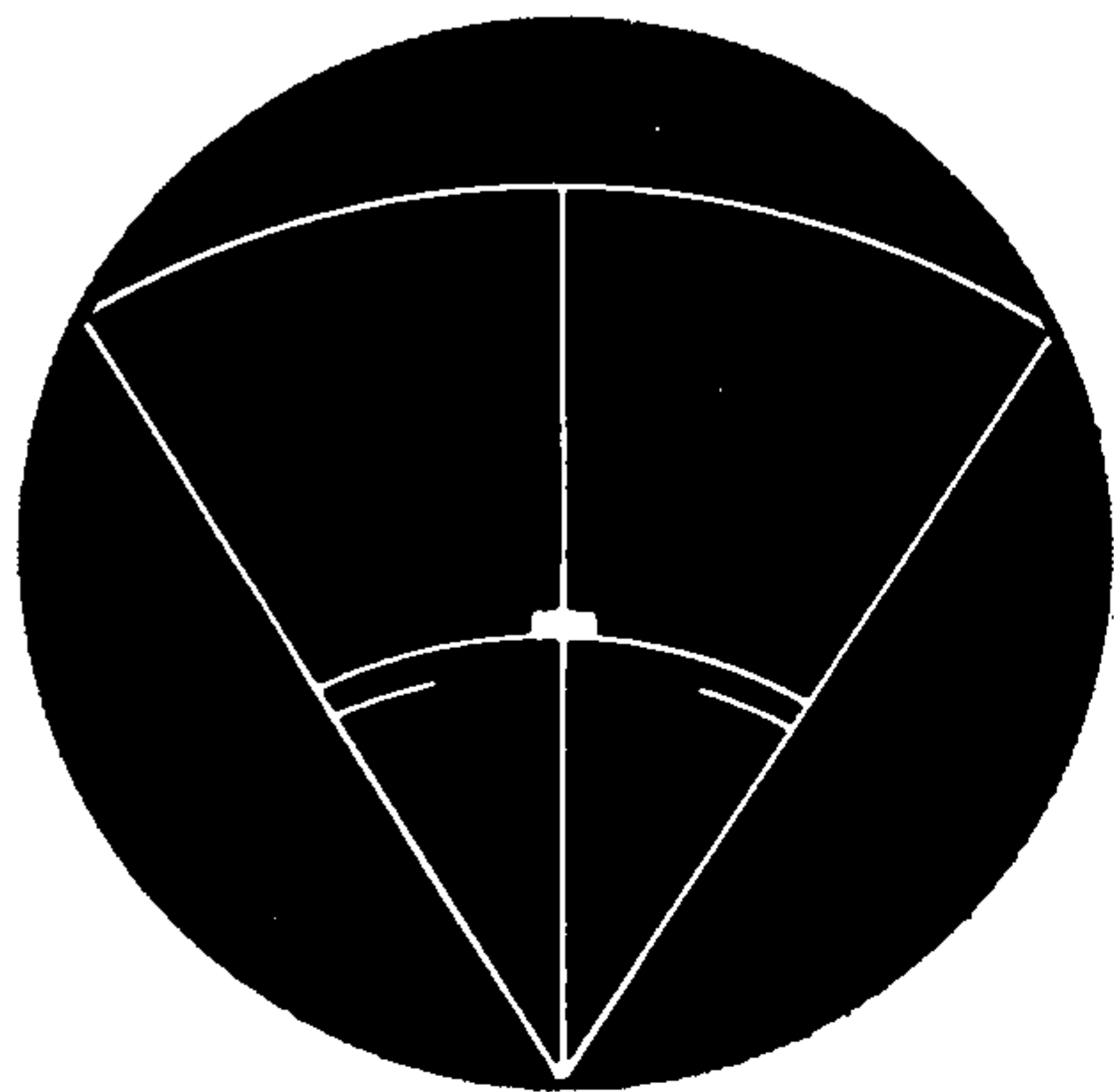
When TWS BIT is selected, a test signal is processed through the search radar circuits and displayed on the DVRI. The B/N manually slews the manual range line to the displayed target. When the cursors are at the target in range and azimuth, the GO light on the B/N's control panel will go on, indicating that the radar has locked on to the target in range and azimuth. As the cursors are moved off the target, the GO light goes off and the NO GO light goes on.

ATF BIT

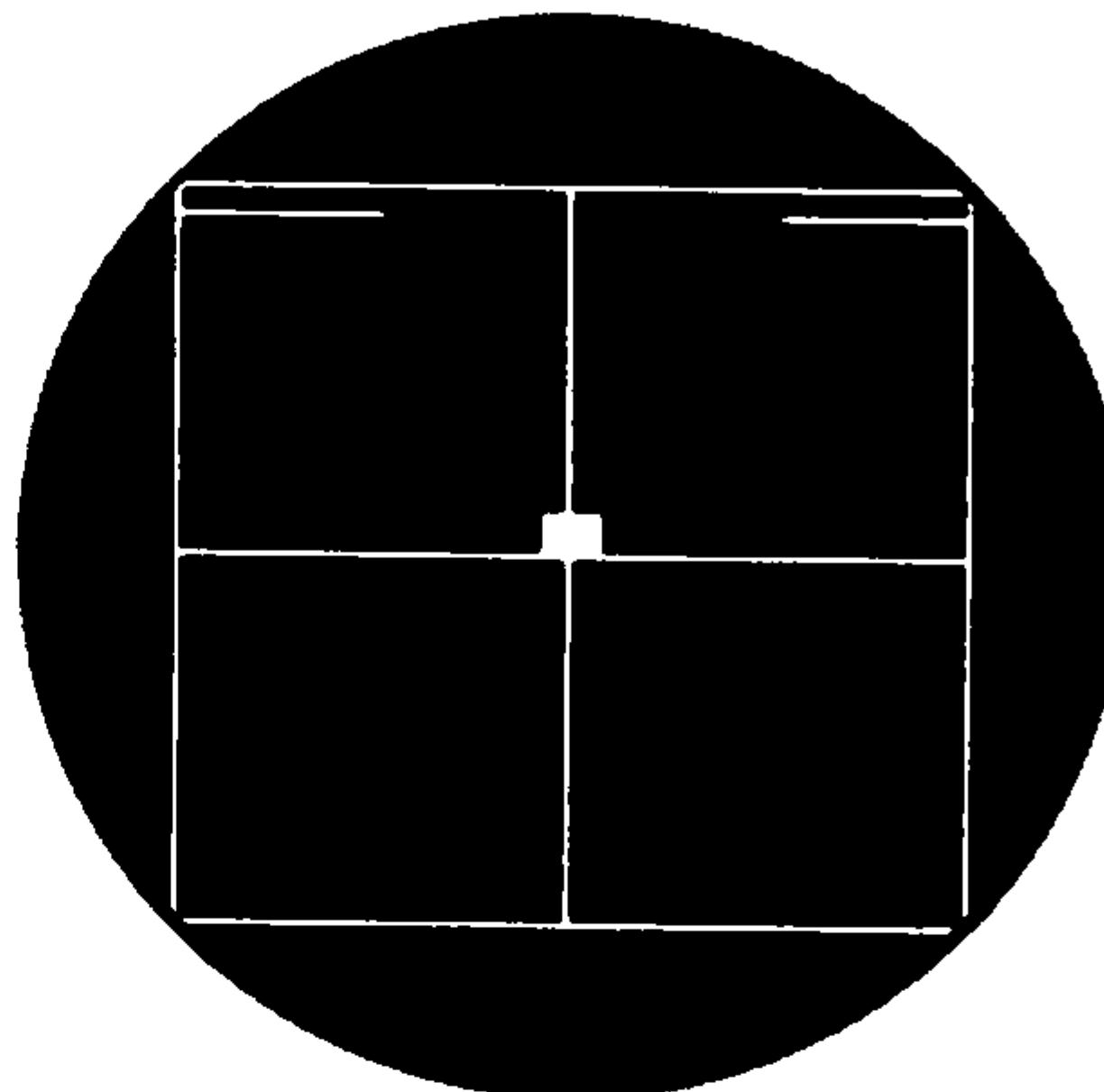
The ATF BIT is presently inoperative.

RADAR BIT DISPLAYS

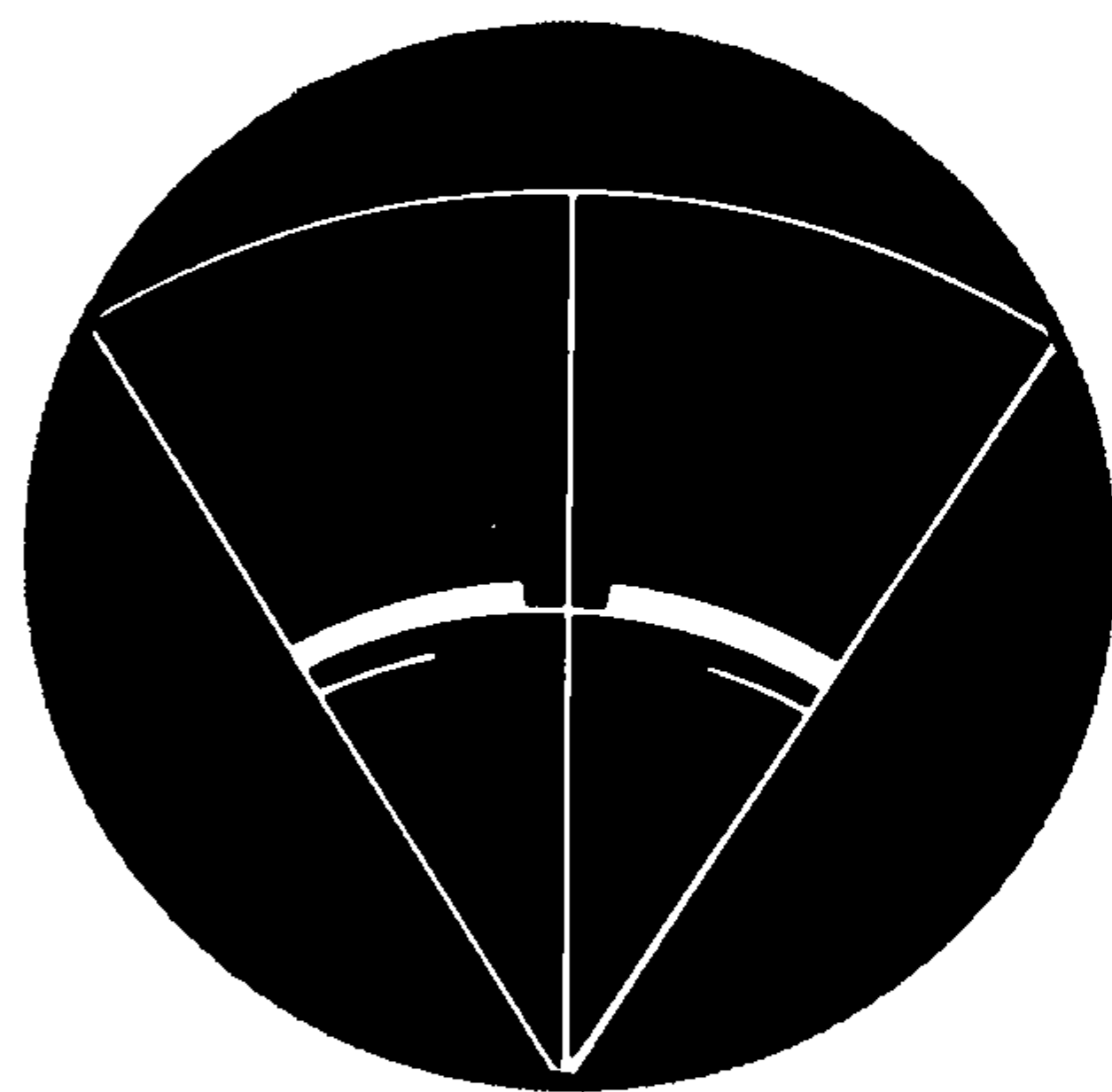
1 SEARCH BIT PPI RANGE 10 MILES



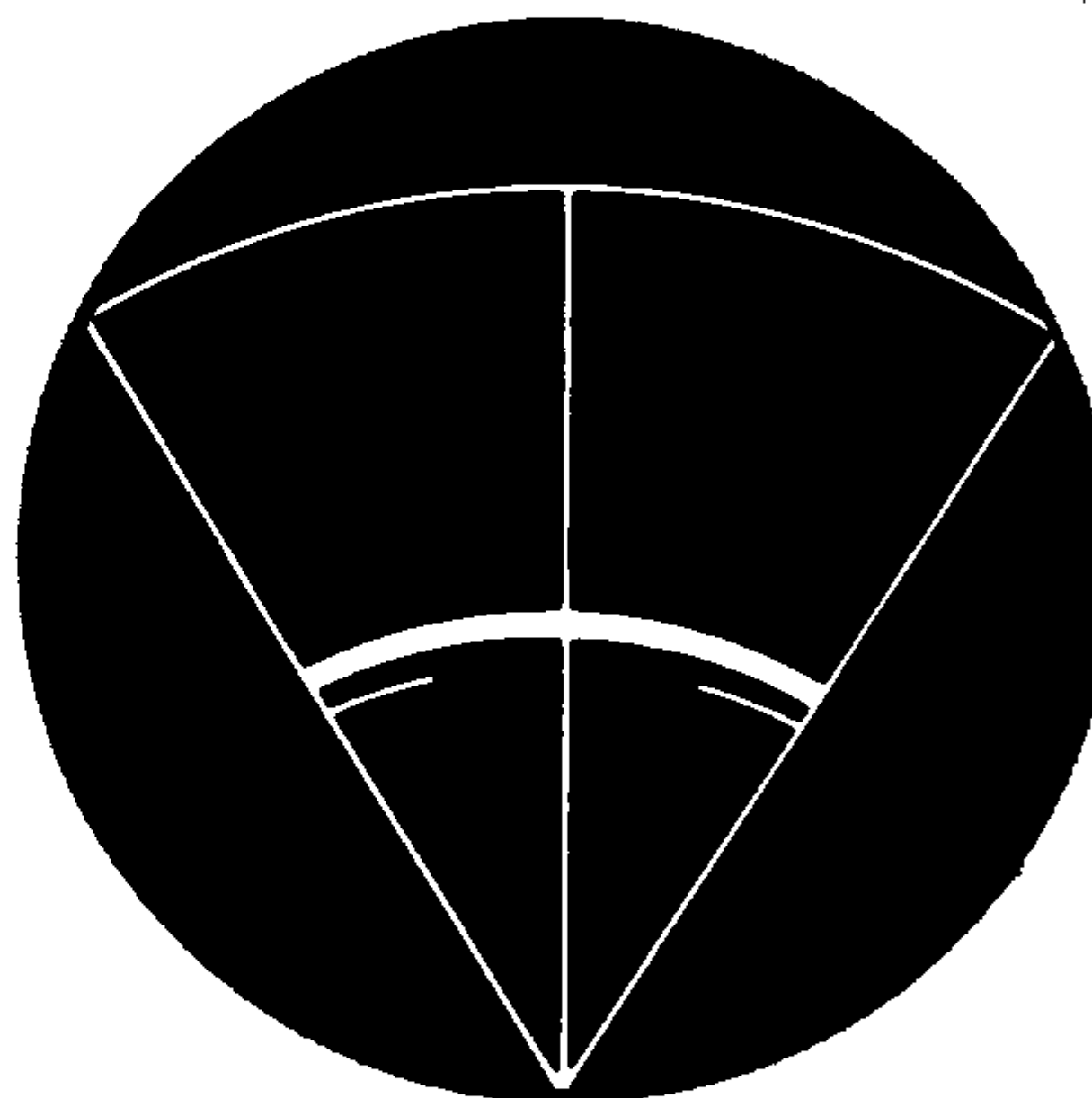
2 SEARCH BIT ARE-30



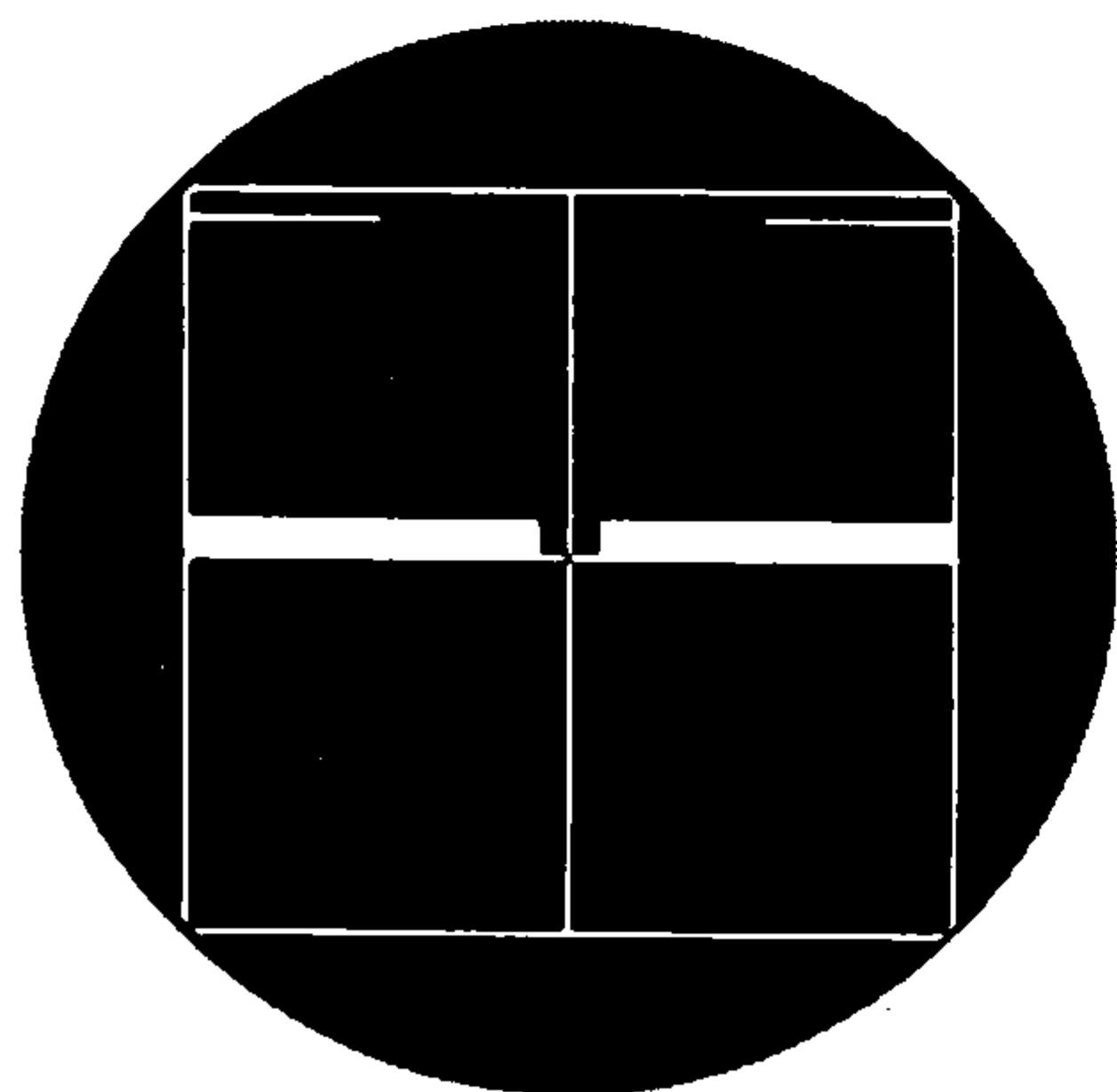
3 AMTI BIT PPI RANGE 10 MILES
MAXIMUM CANCELLATION



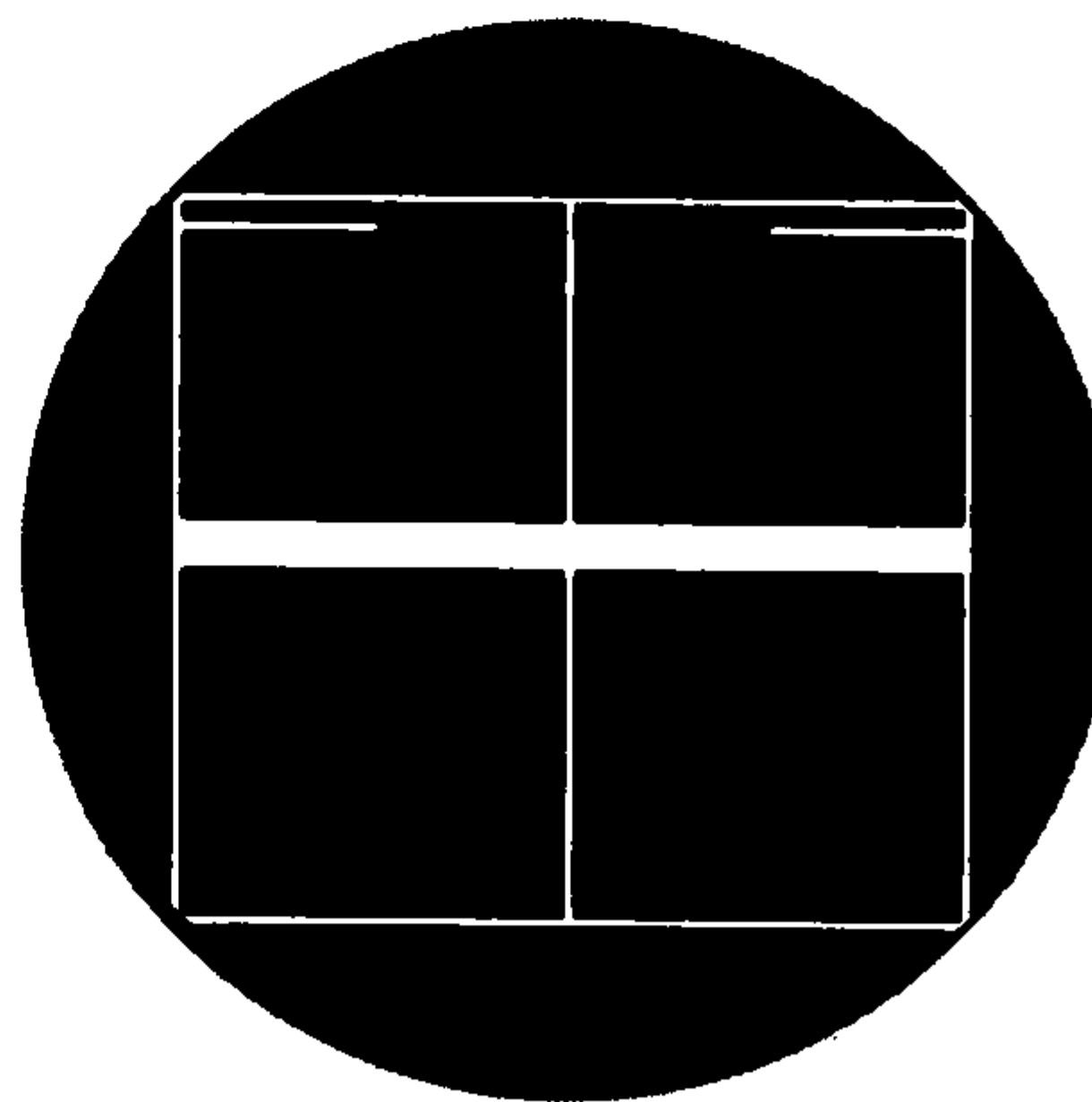
4 AMTI BIT PPI RANGE 10 MILES
MINIMUM CANCELLATION



5 AMTI BIT ARE-30
MAXIMUM CANCELLATION



6 AMTI BIT ARE-30
MINIMUM CANCELLATION



ADF1-118

Figure 8-2

SEARCH RADAR CONTROLS

BOMBARDIER/NAVIGATOR'S CONTROL PANEL

The bombardier/navigator's control panel (figure 8-1) contains the principal operating controls for the search radar, the BIT controls, the DVRI display controls and controls for the track radar.

POWER Switch

The POWER switch is a three-position lever-lock toggle switch marked OFF, STBY and ON, which controls the application of aircraft power to the search radar. The search radar receives 3 phase AC power from the primary 115 VAC bus and DC power from the 28 VDC bus through circuit breakers on the B/N's circuit breaker panel.

With OFF selected no power is applied to the radar and the raster does not appear on the DVRI.

Positioning the switch to STBY provides low voltage only to all units and to tube filaments. The raster, fixed range marks and cursors appear. When the receiver tune control is at MAN, sector spoking will be present.

When ON is selected, high voltage is applied to the transmitter magnetron making the radar completely operational.

Note

There is a 5-minute time delay, starting from the time the switch is set to STBY from OFF before high voltage is available to the magnetron.

The display consists of the raster, markers and target video with ON selected. Video will not be displayed if the TRANSMIT switch is in SIL.

CAUTION

To prevent damage to the antenna, the POWER switch should be at a position other than OFF prior to taxi or flight.

TRANSMIT Switch

The TRANSMIT switch is a three-position toggle switch marked SIL, NORM and SHORT which permits selection of dummy load or either of two pulse widths.

When the switch is at SIL, transmission of the search radar is into a dummy load and no target video is displayed. Selection of SIL enables the pilot's horizontal display ONE SCAN/ERASE switch on the pilot's control panel.

When NORM is selected, the radar transmits normally and pulse width is determined by the PRF at which the radar is operating.

During high PRF operation only, i. e. at short ranges, selecting SHORT reduces the pulse width by half for greater range resolution thus making it easier to distinguish between targets closely spaced in range.

Receiver Tune Control

The receiver tune control is a stacked combination rotary selector switch and tuning control which permits automatic or manual control of the frequency of the local oscillator. The control is top-coded with a clover leaf.

The outer portion of the control marked RCVR, is a rotary selector switch having two detented positions, AFC and MAN. When the switch is at AFC, the frequency of the local oscillator is automatically controlled to maintain a 30 Mhz difference from the transmitter frequency. When the switch is at MAN the local oscillator frequency is manually controlled.

The inner portion of the control marked TUNE is a 5 turn rotary control permitting manual tuning of the local oscillator during manual operation.

BRT/CONTRAST Control

The BRT/CONTRAST control is a stacked rotary control top-coded with a triangle. The outer control marked BRT adjusts the over-all brightness of the DVRI raster. The inner control marked CONTRAST varies the DVRI video gain to adjust the contrast ratio of targets relative to the background on the DVRI.

RNG MKR/AZ MKR Control

The RNG MKR/AZ MKR control is a stacked rotary control top-coded with a triangle. The outer control marked RNG MKR varies the brightness of the fixed range markers and the range cursor on the DVRI, and the inner control marked AZ MKR varies the brightness of the azimuth marker on the DVRI.

SCAN STAB/SCAN ANGLE Control

The SCAN STAB/SCAN ANGLE control is a stacked combination rotary selector switch and control top-coded with a triangle.

The outer portion of the control marked SCAN STAB is a rotary selector switch with positions marked ADL and REL BRG. When the switch is at ADL the search radar antenna scan is stabilized about the aircraft ADL. When the switch is set to REL BRG, the search radar antenna scan is stabilized about the relative bearing of the azimuth cursor.

Note

- If terrain clearance is selected when the SCAN STAB switch is at REL BRG, antenna scan stabilization automatically switches to the aircraft ADL and the display may not be centered about the azimuth cursor.
- If relative bearing exceeds $\pm 55^\circ$, antenna scan stabilization automatically switches to ADL.

The inner portion of the control marked SCAN ANGLE is a rotary control permitting continuous adjustment of the search antenna scan angle from an angle of $\pm 10^\circ$ to $\pm 55^\circ$ about the selected scan stabilization reference.

Note

If terrain clearance is selected, the minimum antenna scan angle is automatically set to $\pm 30^\circ$ about the ADL.

SCAN RATE/AMTI Control

The SCAN RATE/AMTI control is a stacked combination rotary selector switch and control top-coded with a cross.

The outer portion, marked SCAN RATE is a rotary selector switch with detented positions marked OFF, SLOW and FAST. When the switch is at the push locked OFF position, the antenna is held at the selected scan reference. If the SCAN STAB switch is at REL BRG the antenna will be positioned to the input relative bearing. When the switch is at SLOW or FAST the antenna scans at rates depending on the PRF. At medium or high PRF scan rates of $100^\circ/\text{second}$ or $50^\circ/\text{second}$ may be selected. At low PRF the scan rates are $50^\circ/\text{second}$ or $25^\circ/\text{second}$.

Note

When terrain clearance is selected antenna scan rate is set to $100^\circ/\text{second}$ regardless of the position of the SCAN RATE switch.

The inner portion of the control, marked AMTI, is a rotary control with a detented OFF position. When the control is rotated out of the OFF detent, the AMTI mode is selected and maximum fixed target cancellation is provided. As the control is rotated clockwise a mix of fixed targets is added to the display of moving target video.

DISPLAYS Pushbuttons

The three DISPLAYS pushbutton switches select the display mode on the DVRI and PHD. The buttons are interlocked so that only one may be selected at a time and the selected button rotates 45° when depressed. PPI, ARE 30, or ARE 60 may be selected.

Note

If the TC mode is selected, the displays revert to a high PRF mode.

PPI RANGE Switch

The PPI RANGE switch is a rotary selector switch top-coded with a bar, having positions marked 150,

75, and 5, used to select the maximum displayed range on the DVRI and PHD in the PPI display modes. Selecting a range automatically selects the correct PRF and corresponding transmitted pulse width. When the switch is at 150 the displayed range on the DVRI and PHD is 150 miles, the PRF is low and the transmitted pulse width is long.

The area between 75 and 5 is marked with an arc to indicate continuous adjustment of the maximum displayed range on the DVRI and PHD between 75 miles and 5 miles. Between 27.5 miles and 75 miles, the PRF is medium and the transmitted pulse width is medium. Between 5 and 27.5 miles the PRF is high and the transmitted pulse width is normal or short as selected.

ANT PATT Switch

The ANT PATT switch is a three-position toggle switch spring-loaded to the center (off) position, and marked FAR and NEAR. The switch permits adjustment of the peak position of the antenna beam pattern from -2° to approximately -12° .

When the switch is held to the FAR position, the antenna dish is driven upward with respect to the feed horn, altering the beam pattern to enhance distant targets. Holding the switch to NEAR tilts the beam down.

Note

When terrain clearance is selected the antenna pattern is automatically set to FAR, but it may then be overridden if desired.

STC SLOPE/DEPTH Control

The STC (sensitivity time control) control is a stacked rotary control top-coded with a triangle. Used in conjunction with the RCVR gain control, the STC controls provide adjustment of target intensities to produce even over-all intensity and prevent blooming of close-in strong targets on the DVRI and PHD.

The inner control is marked STC DEPTH and adjusts the initial level of receiver gain reduction applied to the affected video.

The outer control marked STC SLOPE adjusts the recovery or receiver gain reduction as a function of range; decreasing the amount of gain applied to closer targets relative to those farther out.

Full counterclockwise rotation of the STC controls allows target video to be displayed as received by the radar.

RCVR Gain Control

The RCVR gain control adjusts the amount of gain applied to received target video. Rotating the control clockwise increases the gain, permitting weaker targets to be displayed and increasing the intensity of all targets and the ground return. Counterclockwise rotation decreases gain and removes weaker returns and the ground return from the displays.

VIDEO/DIF Gain Control

The VIDEO/DIF gain control is a stacked rotary control providing adjustment of displayed target video on the DVRI and PHD.

The outer control marked VIDEO adjusts the amount of gain applied to displayed target video. Clockwise rotation increases the intensity of hard target video while decreasing low level background video; counter-clockwise rotation reduces gain decreasing the intensity of hard target video while increasing low level background video.

The inner control marked DIF permits differentiation of individual targets in a complex return. When the control is at the AREA position, target information is presented as received. Rotating the control clockwise suppresses more and more of the target returns until at the DET (detail) position only the leading edges of targets are displayed.

BEACON Control

The BEACON control is a rotary control with a detented OFF position that permits selection of the beacon mode of operation. When the control is at OFF, the beacon mode is de-energized. Clockwise rotation from OFF permits beacon signals to be displayed. The intensity of the beacon target is controlled by the RCVR gain, VIDEO gain, FTC, and STC controls. As clockwise rotation is continued, the amount of ground mapping displayed is increased until at the full clockwise position full ground mapping video is displayed along with the beacon target.

ELEV TRKG Switch

The ELEV TRKG switch is a two-position toggle switch marked ON and OFF permitting selection of the elevation mode of target tracking.

FREQ AGILITY Switch

The FREQ AGILITY switch is a two-position toggle switch marked ON and OFF. When the switch is ON, clutter and scintillation effects on target returns are reduced, providing a cleaner display. This switch has effect only during high PRF operation, is overridden by selection of AMTI, SIL or STBY and when the receiver is being manually tuned.

Cursor Control Switch

The cursor control switch is a two-position toggle switch marked COMPT and MAN. When the switch is at COMPT, the position of the range and azimuth cursors is controlled by the computer. Selecting MAN permits manual positioning of the cursors with the MAN RANGE and AZ CURSOR controls.

AZ CURSOR Control

The AZ CURSOR control is a continuously adjustable rotary control, top-coded with a cross. When the cursor control switch is at MAN, clockwise rotation of the control moves the azimuth cursor to the right. The cursor may be set to any angle from +55° to -55° with respect to the ADL. The compass rose on the

DVRI will display the relative bearing of the azimuth cursor (relative bearing bug). The relative bearing bug may be rotated through 360° by use of the AZ CURSOR control even though the azimuth cursor only appears from +55° to -55° of the ADL.

MAN RANGE Control and RANGE Indicator

The MAN RANGE control is a multi-turn rotary control used to position the range cursor when the cursor control switch is at MAN. A six digit RANGE readout indicator displays the setting of the control to the nearest 10 feet (the last digit is fixed at zero). Rotational stops on the control are located at 0 and 200,000 feet.

METER Select and Slew Switch (METER INCR/DECR)

The METER select consists of 4 dual function push-buttons and a three-position toggle switch permitting selection of the function to be displayed on the meter. When the toggle switch is at OFF, no meter readings are displayed.

With the toggle switch to the right the following functions may be monitored:

ANT PATT - The meter indicates the relative position of the peak of the transmitted beam pattern. A reading at the low end of the scale indicates that the peak is at its upper limit of 2° below the horizon (FAR pattern) while a reading at the high end indicates that the peak is at its low limit approximately 12° below the horizon (NEAR pattern).

XTAL CUR - The meter indicates the search radar mixer crystal current. When the RCVR TUNE control is in the MAN position, the inner knob of the control adjusts the XTAL CUR meter reading.

MAG CUR - The meter indicates the search radar magnetron current. This value may be adjusted using the METER slew switch. With a normal pulse, this should be set to 0.8.

MAG FREQ - The meter indicates search radar magnetron operating frequency. A reading at the high end of the scale indicates that the radar is operating at the high end of its transmitter frequency range, a low reading indicates the low end. The frequency can be adjusted with the METER slew switch.

When the toggle switch is to the left the following may be monitored:

RCVR SENS - The meter indicates receiver sensitivity, i.e. its ability to detect signals just above the noise level. The reading should be taken with RCVR gain at maximum. The meter reading is determined the position of the RCVR gain control.

XMTR PWR - The meter indicates transmitter power output. This meter reading is not adjustable.

TRACK XTAL CUR - This position is inoperative.

TRACK MAG CUR - The position is inoperative.

The METER slew switch is a three-position toggle switch spring-loaded to the center (off) position. Holding the switch to the INCR or DECR position permits adjustment of search radar magnetron current (power) or frequency.

MODE Switch

The MODE switch is a two-position toggle switch marked BORESIGHT and TRACK on the TRACK portion of the B/N's control panel. Setting the switch to TRACK permits normal operation of the search radar tracking modes. Selecting BORESIGHT puts the azimuth cursor at the ADL, and puts the computer in the boresight mode. The DVRI and PHD displays revert to high PRF.

With the computer in the boresight mode, and attack selected, the azimuth cursor goes to the velocity vector, and range goes to 48,000 feet or impact point slant range, depending on aircraft pitch angle.

With the ACU panel set for a Shrike delivery, setting the MODE switch to BORESIGHT enables Shrike ranging.

TEST Controls and Indicators

The TEST control and indicators permit selection and monitoring of the built-in test and fault isolation functions.

The MODE buttons permit selection of one of seven test modes. With the toggle switch below the buttons set to the left the following functions may be tested:

- BIT - The test circuits are self-tested.
- SRCH - The search radar circuits are tested.
- AMTI - The search and AMTI channels are checked.
- TC - The terrain clearance mode is tested.

Note

Since the BIT mode disables normal terrain clearance, BIT should not be selected if the clearance mode is being flown.

When the toggle switch is set to the right the following functions may be tested.

ELEV TRKG - The operation of the elevation tracking mode is checked.

TWS - The operation of the azimuth-range tracking mode is checked.

ATF - Provisions are made for future incorporation of automatic terrain following.

If a fault is detected during one of the BIT modes it may be isolated to one of 10 aircraft replaceable assemblies by use of the FAULT ISLN select buttons and toggle switch.

The GO and NO GO indicators assist in monitoring test results.

When the two associated three-position toggle switches are at OFF, the test modes are disabled.

PILOT'S CONTROL PANEL

The lower portion of the pilot's control panel (figure 8-1) marked HORIZONTAL contains controls for the search radar displayed on the pilot's horizontal display.

Power Switch

The power switch is a three-position toggle switch marked OFF, STBY and ON, which controls power to the pilot's horizontal display (PHD). The OFF position de-energizes the PHD; the compass rose and command heading bug; the STBY position provides power to the compass nose and command heading bug; and the ON position provides operating voltage to light the PHD storage tube.

Note

The search radar POWER switch on the B/N's control panel provides low voltage power and blower power to the PHD.

RNG MKR/AZ MKR Control

The RNG MKR/AZ MKR control is a stacked rotary control top-coded with a cross. The outer control marked RNG MKR, varies the brightness of the range cursor and the fixed range marks on the PHD and the inner control marked AZ MKR, varies the brightness of the azimuth marker on the PHD.

PERSIST Control

The PERSIST control is a rotary control top-coded with a bar which varies the persistence time of the PHD phosphor. Full clockwise rotation provides maximum persistence.

ONE SCAN/ERASE Switch

The ONE SCAN/ERASE switch is a three position toggle switch spring-loaded to the center (off) position that controls operation of the radar when the TRANSMIT switch is at SIL. Selecting ONE SCAN causes the radar to operate for one left to right scan of the antenna. Video will be displayed on the DVRI and on the PHD long persistence phosphor. Setting the switch to ERASE removes the display stored on the PHD screen.

BRT/CONTRAST Control

The BRT/CONTRAST control is a stacked rotary control top-coded with a triangle. The outer control, marked BRT, adjusts the over-all brightness of the PHD raster. The inner control, marked CONTRAST, adjusts the contrast ratio of targets relative to the background on the PHD.

TRACK RADAR CONTROLS

Track radar controls are provided on the bombardier/navigator's control panel (figure 8-1) to permit operation should a track radar be installed.

POWER Switch

The POWER switch is presently inoperative.

Note

The position of the track radar POWER switch is considered in computer validity tests of search radar tracking modes. The switch should be left at OFF when a track radar is not installed.

MAG CUR Control

The MAG CUR control is presently inoperative.

Receiver Tune Control

The receiver tune control is presently inoperative.

TARGET/TONE Control

The TARGET/TONE control is presently inoperative.

**VIDEO TAPE RECORDER
AN/USH-17(V)**

Provisions have been made for the installation of the AN/USH-17(V) airborne video tape recorder on the extensible equipment platform. When the recorder is installed, the control panel marked MISSION RECORDER (figure 8-3) is on the B/N's right console.

The video tape recorder (VTR) is a dual-channel solid state recorder which provides 46 minutes of recording time for single-channel and 23 minutes for dual channel operation.

In addition to the video signals being displayed on the DVRI, the VTR records the audio at the B/N's headset and digital outputs from the computer. The computer provides a continuous output of the following data:

- Present position latitude and longitude
- True heading
- Ground track direction
- Groundspeed
- Altitude
- Relative bearing to cursor intersection
- Slant range to cursor intersection
- True heading to destination
- Ground range to destination
- Time to go to destination

At the time of weapon release, the computer freezes and provides the following data to the VTR:

- True heading
- Wind direction and velocity

- Steering error
- Aircraft angle-of-attack
- Ground track velocity
- Corrected true airspeed
- Vertical loop error term
- Target altitude (MSL)
- Vertical separation
- Range to target
- Computed ballistic range
- Normal acceleration
- Time of Fall
- Release advance and/or 1/2 stick length
- Moving target velocity/velocity correct

The VTR receives 115 VAC for operation from the AC monitored bus and 28 VDC for heater power from DC monitored bus #1 through circuit breakers on the aft bay circuit breaker panel.

MISSION RECORDER PANEL

ADF1-115

Figure 8-3

MISSION RECORDER PANEL

The MISSION RECORDER panel on the B/N's right console (figure 8-3) contains all the controls and indicators for operating the video tape recorder.

PWR Switch

The power switch is a two-position toggle switch marked OFF and ON. When the switch is at OFF, no power is applied. Selecting ON provides 115 VAC for operation and 28 VDC for the heaters. The recorder should be at operating temperature within three minutes from the time power is applied. In extremely cold weather 5 minutes may be required.

Note

To reduce wear on the head-wheel bearings, the PWR switch should be OFF for launch.

TAPE Time Indicator and RESET Control

The TAPE time indicator provides a 4-digit readout of elapsed recording time in minutes and seconds. The readout may be returned to zero by depressing the RESET control.

Channel Select Switch

The CHN switch is a three-position rotary switch marked EOS, RDR and DUAL. When the switch is at RDR the recorder will operate at 7.5 inches/second and record the radar video channel. When the switch is at DUAL, the recorder will operate at 15 inches/second and will record one radar video channel and one other video channel. The EOS (electro-optical sensor) position is provided for recording a future video channel.

Note

The channel select switch should be kept at RDR. Since there is presently only one video channel to record, selecting DUAL will only reduce the recording time available. Selecting EOS will result in no video on the tape.

FAULT Light

The FAULT light goes on whenever a condition exists which would prevent normal operation. The conditions are: broken tape, incorrect temperature in the tape transport unit, incorrect reel and/or capstan speeds, or incorrect head-wheel motor speed. When the FAULT light comes on, the recorder is placed in the standby mode.

Test Switch and Lights

The test switch is a three-position toggle switch marked LAMP, OFF and BIT, spring-loaded to the OFF position. Holding the switch to LAMP tests the indicator lights on the panel. When the switch is held to BIT, the recorder goes into self-test. An internally generated signal is recorded and played back. During playback the recording is compared with the reference. Any failure lights the EOS or RDR lights, the DGTL (digital) light, or the AUD light.

Mode Selector Switch

The mode selector switch is a 5-position rotary selector switch marked RCD, STBY, PLAY, RVS and FWD which controls the mode of recorder operation. This switch must be at STBY before actuating the PWR switch to either ON or OFF.

Setting the switch to RCD places the recorder in operation and lights the RCD light. When the VTR is recording, it records the selected video, the digital data, the ICS audio, and it automatically erases any data which may have been on the tape previously.

Selecting STBY turns the STBY light on and applies power to the recording head motors and the VTR is ready to record.

Note

When power is on and the function switch is at STBY, stepping the computer into attack automatically starts the recorder and lights the RCD light. A stop signal is automatically sent after transmission of freeze data at release.

The PLAY position is operational, however there is no provision made to display play-back of recorded data in this installation.

Selecting RVS re-winds the tape at 100 inches/second without disturbing the recorded information.

Selecting FWD winds the tape at 100 inches/second without disturbing the recorded information.

DOPPLER NAVIGATION RADAR

Doppler Navigation Radar AN/APN-153 is a self-contained airborne system that automatically computes aircraft groundspeed and drift angle, completely independent of ground situations and wind estimates. The only auxiliary input this system required is pitch and roll from the aircraft attitude reference system.

Doppler - derived ground speed and drift angle are provided to the computer where they are translated into North/South and East/West components of velocity and smoothed wind. Doppler inputs are used in deriving system velocities, depending on the navigation mode selected. Doppler-derived velocities may be removed from the computer memory by setting the velocity correct switch on the computer control unit to OFF ERASE.

The Doppler navigation radar consists of three major functional units: a control panel, a receiver-transmitter and an antenna assembly. The set uses a four-beam pulsed transmission. It beams signals to the ground, receives echoes, and measures the frequency shift produced by the relative motion between the aircraft and the earth. The frequency shift drives the antenna in azimuth until the antenna is aligned with the aircraft's track. The drift angle indication is the resultant angle between the antenna axis and the aircraft axis. Once the antenna is aligned with the ground track of the aircraft, the measured frequency shift is used to derive groundspeed. When the Doppler radar is energized, it is in either a normal mode, or in a memory mode. In the normal mode, groundspeed and drift angle are measured automatically and simultaneously. In the memory mode, the MEMORY light is on and the last derived groundspeed and drift angle are retained until the radar can again acquire a usable signal, or the equipment is turned to OFF.

Note

Whenever the Doppler radar is in memory mode, the computer considers Doppler inputs invalid and they are not used.

DOPPLER OPERATING CHARACTERISTICS

The Doppler radar receives AØ 115 VAC from the PRARS bus through the APN-153 5-ampere CB in the aft bay, and 26 VAC from the primary bus through the APN-153 1/2-ampere CB on the nose wheel well (aft) circuit breaker panel. All other voltages (DC and AC) are generated in the APN-153 internal power supply.

Operating characteristics of the Doppler are:

Minimum altitude:	40 feet above terrain
Maximum altitude:	50,000 feet
Groundspeed:	80 to 800 knots
Drift angle:	25° left or right
Pitch stabilization:	17° nose up to 25° nose down
Roll stabilization:	±30°
Transmitter frequency:	13,325 MHz ±50 MHz

Pulse repetition frequency:

75 kHz nominal, modulated from 60 kHz to 50 kHz at 30 Hertz

Note

The computer rejects Doppler signals as invalid when aircraft pitch attitude exceeds 17° nose up or down.

DOPPLER RADAR CONTROL PANEL

The Doppler radar control panel on the right console (figure 8-4) contains all of the operating controls, the groundspeed and drift indicators, and the controls for self-test.

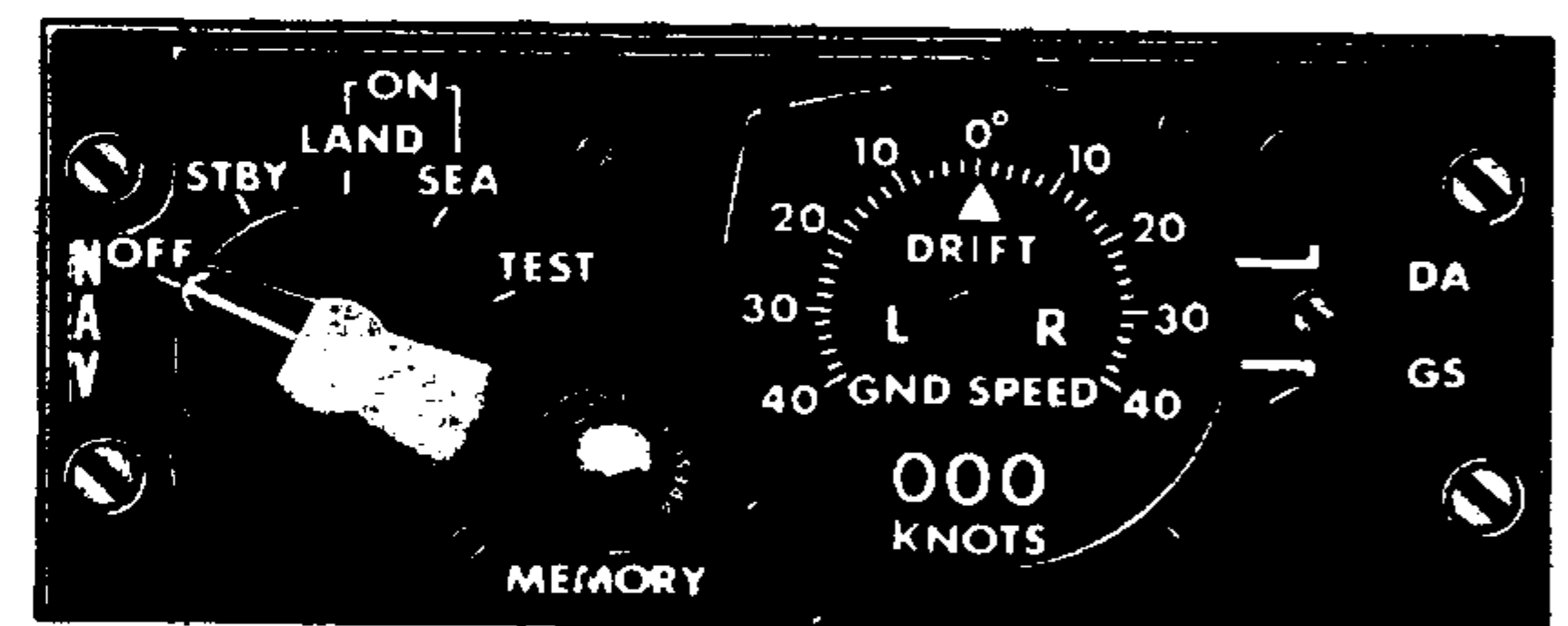


Figure 8-4

Mode Switch

The mode switch is a five-position rotary switch placarded OFF, STBY, ON LAND, ON SEA, and TEST. When the switch is in the OFF position, all power is removed from the radar navigation set. Placing the switch to STBY applies all power except magnetron high voltage. The ON LAND and ON SEA positions place the equipment in operation for the type of surface below the aircraft. SEA applies a constant (k) factor to correct for the dispersion of radar energy by water. The TEST position is used for self-test purposes and inserts a simulated Doppler signal of 121 knots and 0° drift angle.

ADF1-114

CAUTION

To provide stabilization to the antenna and to prevent damage to the equipment, the Doppler should be in STBY during taxi, takeoff, or landing.

Memory Indicator Light

The MEMORY indicator light is an amber press-to-test light which comes on when the mode selector is in the STBY position or when the system is operating in memory. A memory signal is also supplied to the computer.

The MEMORY light will come on under the following conditions:

1. Before a signal has been acquired on initial turn-on.
2. Operation over extremely rough terrain.
3. Operation over glassy smooth water.
4. When the signal is lost due to the aircraft maneuvering beyond the pitch and roll limits of the Doppler Antenna.
5. When a cooler or power failure has occurred.
6. When the APN-153 circuit breaker on the aft bay circuit breaker panel pops or is pulled.

Ground Speed/Drift Angle Indicator

The ground speed/drift angle indicator consists of a needle placarded DRIFT L and R marked in 2° increments to 40°, and a window placarded GND SPEED - KNOTS. Aircraft ground speed and drift angle are read directly.

Note

Due to the antenna installation, the maximum drift reading is limited to $\pm 25^\circ$.

Ground Speed/Drift Angle Knobs

The ground speed (GS) and drift angle (DA) manual control knobs are used to manually set in values used in self-test of the equipment. The knobs must be depressed in order to change the values on the indicator. Values can only be changed when the set is in memory, standby, or off.

Note

Since Doppler information is rejected by the computer whenever the Doppler is in the memory mode, test, or OFF, manual insertion of ground speed and drift is useful only when performing self-test.

INERTIAL NAVIGATION SYSTEM AN/ASN-31

The inertial navigation system (INS) is an automatic aid to navigation which is independent of outside reference. The system is the primary source of aircraft heading, attitude, and horizontal and vertical velocities. This data is derived from accelerometers mounted along three axes on a gyro-stabilized platform. Information from the INS may be combined by the computer with information from other sources for greater accuracy.

The accelerometers mounted along the three axes sense any variation in aircraft acceleration and generate acceleration signals which are converted to velocities by the platform computer and are sent to the digital computer. The velocities are used by the computer to update latitude, longitude and altitude. By updating these values, the computer generates earth rate correction signals to be sent to the INS to keep it level with respect to the local gravity vector and oriented to true north. Attitude and azimuth signals are generated by synchros mounted on the platform gimbals. These signals are sent to the platform adapter to provide pitch, roll, and true heading to the other aircraft systems.

INERTIAL PLATFORM ORIENTATION

The orientation of the gyro-stabilized inertial platform is maintained with respect to three mutually perpendicular axes referred to as the X, Y, and Z axes, and it is about these axes that the accelerometers measure aircraft accelerations.

ORIENTATION AXES

The Z-axis is coincident with the local vertical and the direction toward the center of the earth is considered to be positive. The X-axis is perpendicular to the Z-axis and lies in the plane of the local meridian. The positive direction of the X-axis, defines north. The Y-axis is mutually perpendicular to the X- and Z-axis, and is positive toward the east.

ALIGNMENT

In order to establish the inertial navigation system as a valid reference, the platform must be initially leveled with respect to the local vertical and oriented to true north. This process is known as alignment and is accomplished in two phases: rough alignment and fine alignment.

Alignment of the gyro-stabilized platform may be accomplished ashore, on a carrier deck or in-flight. Shore-based or carrier alignments can be accomplished with the computer either on or off. In-flight alignments are normally performed with the aid of the computer. However, it is possible to rough align the INS in flight for use as an attitude reference with the computer turned off.

During the rough alignment phase which lasts 50 seconds, the gyros are brought up to speed and the platform is leveled with respect to the elevation and roll axes of the aircraft by means of error signals transmitted to the platform gimbal motors from pitch and roll resolvers contained in the system. The platform is also oriented to within a few degrees of a true north reference provided from an outside source. The heading reference is used as a positioning signal and is sent to the azimuth gimbal motors.

Fine alignment, which begins automatically at the end of the 50-second rough alignment consists of accurately leveling the gyro-stabilized platform and accurately orienting it to true north and requires approximately 9 to 20 minutes (9 to 14 minutes with AVC No. 1342) depending on the alignment mode selected. The accelerometers sense any displacement of the platform orientation with respect to local gravity and generate error signals which are applied to the platform gimbal motors which level the platform. Gyrocompassing, which commences during the latter portion of fine leveling, is the method by which the platform is oriented precisely to true north.

If the X-axis is not properly aligned, a portion of the acceleration due to the earth's angular velocity proportional to the alignment error is felt about the Y-axis. This acceleration is transmitted as an error signal to the azimuth gimbal motors which turns the azimuth gimbal until no error exists.

The bombardier/navigator can monitor the alignment by means of the indicator lights, the align progress meter on the platform control panel, the inertial velocities on the digital display unit and on the VDI.

SHORE-BASED ALIGNMENT

The inputs to the inertial navigation system required to perform a shore-based alignment are latitude and a true heading reference. The true heading reference is derived from MA-1 compass heading $\pm$ local magnetic variation when the ATTITUDE REF switch is set to COMP IN or MAG/VGI, or the heading set in the CARR HDG window when the ATTITUDE REF switch is set to COMP OUT. Latitude is provided by means of the erection controller panel. These inputs are required for the 50-second rough alignment phase. Fine alignment normally takes 9 to 11 minutes with the COMPASS switch set to IN and 11 to 20 minutes (11 to 14 minutes with AVC No. 1342) with the switch set to OUT.

PRE-SET ALIGNMENT

Preset alignment is predicated upon three conditions; first, that the aircraft had a good alignment when the system was last turned off, secondly, that the aircraft has not been moved, and third, that MAG/VGI has not been selected. Given these conditions, a preset alignment can be made in approximately three minutes after the five minute warm-up period by depressing the PRE-SET ALIGN button on the platform control panel. As in a normal ground alignment, rough alignment and fine alignment occur, but unlike other alignments, no gyrocompassing takes place. The true heading shaft of the platform adapter is locked in place until OPER is selected on the platform control panel. The READY light will illuminate approximately three minutes after selecting PRE-SET ALIGN, indicating that the level detection circuit in the platform computer has fired, and OPER may be selected. A preset alignment will result in an alignment no more accurate than the alignment that had been attained prior to the previous shut down. Remaining in PRE-SET ALIGN will not improve the alignment accuracy inasmuch as no gyrocompassing takes place.

CARRIER ALIGNMENT

When the aircraft is on the deck of a moving carrier, the inertial navigation system requires initial inputs of latitude, a true heading reference and carrier velocity as initial conditions for rough alignment which takes 50 seconds. The true heading reference is derived from carrier true heading (ATTITUDE REF switch must be at COMP OUT) and aircraft spotting angle, i. e., the difference between aircraft heading and the heading of the carrier. Aircraft spotting angle is manually set in the MAG VAR window. Spotting angles to the right of carrier heading are set as east variation; angles to the left of carrier heading are set as west variation. The inputs of carrier heading and carrier speed, may be set manually on the erection controller panel, or may be available automatically from the ship's inertial navigation system (SINS) through the receptacle on the external power panel on the right side of the fuselage. Latitude initially must be inserted manually but is automatically updated by the erection controller. Longitude is not required. The CARRIER ALIGNMENT receptacle also provides a two-way communications link with the SINS center. The ALIGN switch must be set to SINS ICS for communications with the SINS center. The relative velocity computer modifies carrier velocity inputs to the INS as necessary, depending upon the aircraft location with respect to the SINS. A turn rate detector in the aircraft suspends alignment and nulls the align progress meter if carrier heading changes at a rate of 30° per minute or greater unless automatic inputs are being provided and a relative velocity computer is being used. Fine heading alignment is accomplished by gyro-compassing. A full alignment requires 20 minutes (14 minutes with AVC No. 1342) to complete.

IN-FLIGHT ALIGNMENT (FULL TERM)

In-flight alignment requires initial inputs to the INS of true heading, aircraft velocity and the latitude of

the alignment starting point. As in shore-based alignment, the source of the heading reference for rough alignment depends on the position of the ATTITUDE REF switch and may be MA-1 heading $\pm$ local variation as set on the lower portion of the DDU or the heading set on the erection controller panel. Latitude is manually set on the erection controller panel. Aircraft velocity data can be derived from the computer and by making use of doppler velocities or velocity correct.

Note

If the computer is not operating, the inertial platform may be partially aligned in flight so as to provide altitude information only.

Fine alignment of attitude and velocity begins automatically after the approximately 50-second rough alignment period and requires approximately 8 minutes (6 minutes with AVC No. 1342). If the bombardier/navigator moves the ALIGN switch from OFF to GYROCOMP at this time, fine heading alignment (gyrocompassing), which requires about 20 minutes, commences.

IN-FLIGHT ALIGNMENT (SHORT TERM)

A short term alignment can be made in flight that eliminates gyrocompassing. Alignment of the inertial platform may be less than optimum due to the limitation of heading information being derived from the MA-1 compass. Aircraft velocity inputs continue to be used during fine alignment. A turn rate detector suspends alignment during turns of 30° per minute or greater. A normal short term alignment following the procedures found in Section III of this manual will provide relatively accurate results, provided a fully operational system (i. e., Doppler radar, computer, MA-1 compass, VGI, and search radar) is available.

The navigation capability after a short term in-flight alignment will depend upon the quality of the heading information that the platform has aligned to and the velocity outputs of the system. Heading information from the MA-1 using correct magnetic variation should be within $\pm 2^\circ$. Using this value, cross track navigation errors will be close to 3% of distance. Along track navigation for the Doppler/inertial mode will depend upon the quality of the Doppler. Typical values are 1%.

PLATFORM CONTROLS AND INDICATORS

The platform operating controls and indicators are principally located on the PLATFORM panel on the right console (figure 8-5). The ATTITUDE REF switch on the pilot's control panel (figure 8-5) selects the heading reference for rough alignment. Other alignment controls are on the ERECTION CONTROLLER panel (figure 8-5).

ATTITUDE REF Switch

The attitude reference switch on the pilot's control panel is a three-position toggle switch labeled

COMP OUT, COMP IN and MAG/VGI. The switch is used during platform alignments to select the source of azimuth information for the initial coarse alignment. After the platform has been aligned, the ATTITUDE REF switch serves as a selector switch for determining whether heading and attitude reference is to be provided by the INS or the MA-1 compass and the VGI.

Platform Selector Buttons

The five platform selector pushbuttons select a phase or condition of system operation. When set from OFF to STBY (standby), power is applied to the platform temperature controls to bring the platform to proper temperature. When the selector is set to ALIGN or PRESET ALIGN, power is applied to the power supply, providing operating voltages to the platform units. The normal operating condition of the inertial navigation system is with the OPER (operate) position depressed, and all platform indicator lights out.

Note

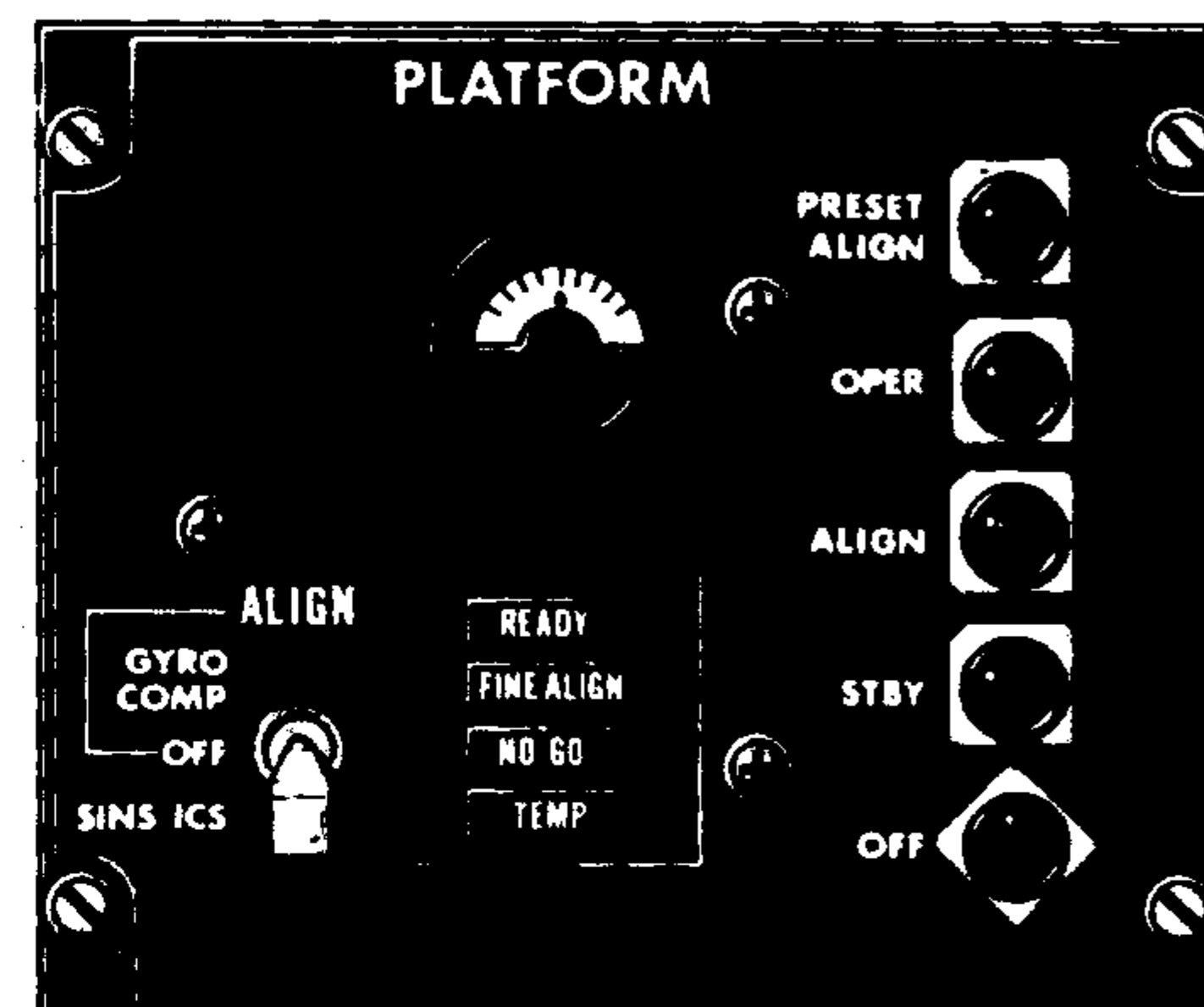
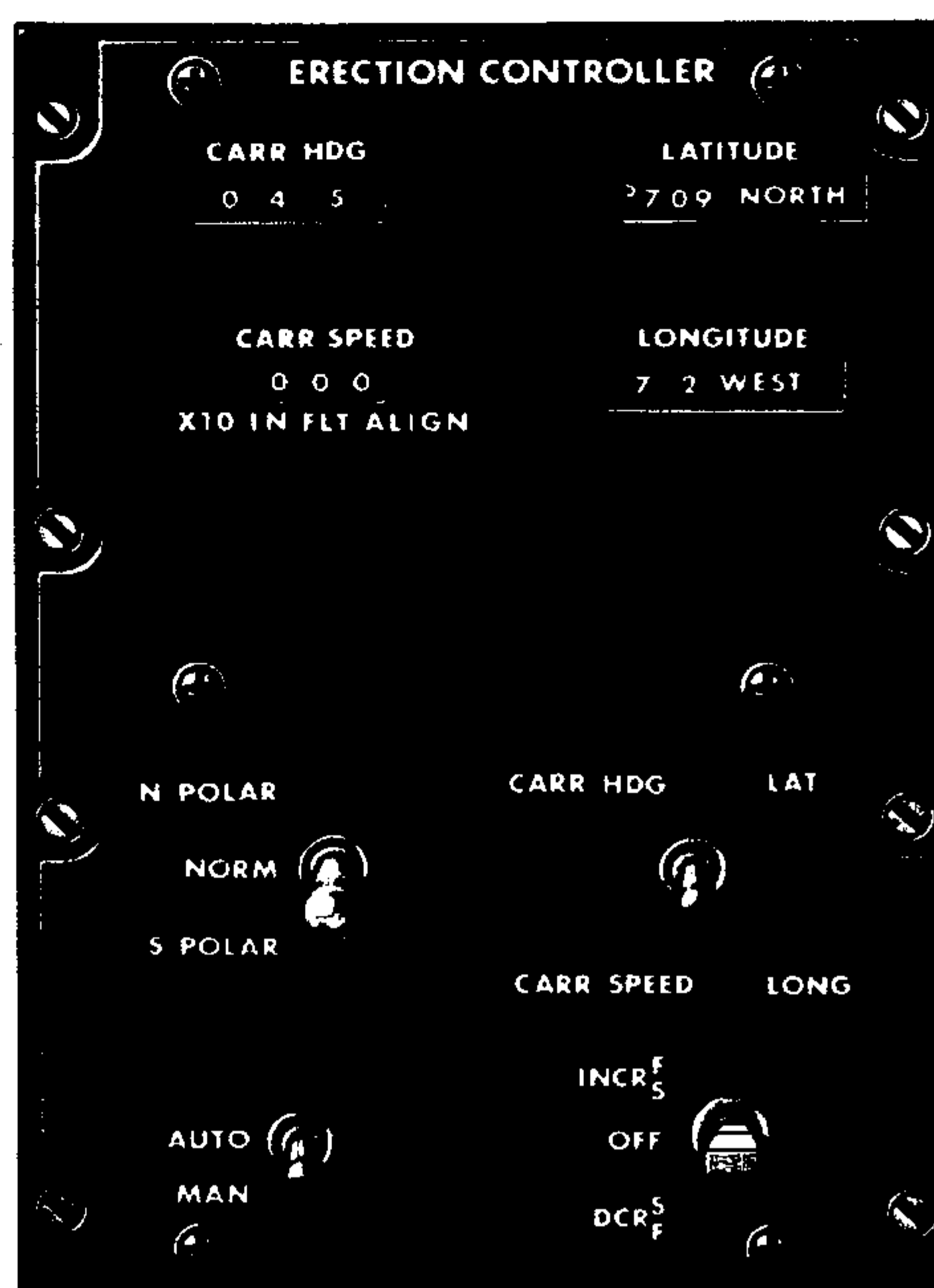
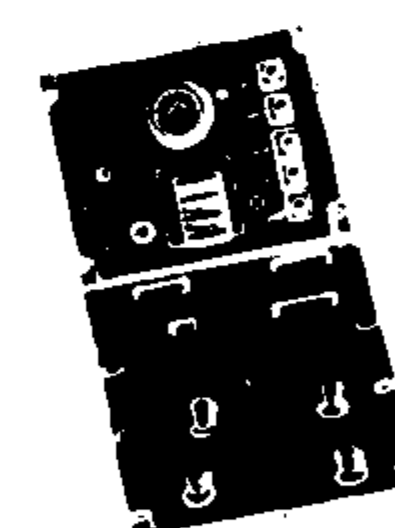
The STBY button must be depressed to set information in the erection controlled panel prior to alignment.

Align Progress Indicator

The align progress indicator is used in conjunction with the READY light during platform alignments. While the READY light will go on after a level detection circuit has sensed that a level condition has existed for 55 seconds (2 minutes with AVC No. 1342), a nulled align progress indicator (± 1 unit) is the only true indication that the platform is ready to be switched to OPER. Any oscillations of the needle indicate that the inertial system has not finished gyrocompassing.

Note

- When making an automatic carrier alignment a READY light is not required, provided following criteria have been met: the align progress meter indicates a null ($\pm$ one unit) for at least 55 seconds prior to going to operate; at least 15 minutes have been spent in align; and actual carrier velocities are read out in the digital display unit (within 3 knots) after going to operate and no velocity drift is observed.
- When making a manual carrier alignment, turns of the carrier which are 30 degrees/minute or more will suspend the alignment and cause the align progress meter to indicate a null. The same condition may occur during an automatic carrier alignment if the relative velocity computer is not used.
- When making a manual carrier alignment, the same criteria as for automatic carrier alignments apply with the additional requirements that the 15-minute alignment time must be exclusive of suspend align time, and there must be positive indication that a suspend align is not existing during the 55-second meter null.

[illegible]

ALIGN Switch

The ALIGN switch is a three-position toggle switch marked SINS ICS, OFF and GYRO COMP.

During a carrier alignment, with the carrier alignment plug inserted in the CARR ALIGN receptacle on the external power panel, setting the ALIGN switch to SINS ICS permits two-way interphone communications between the aircraft and the ship's inertial navigation system (SINS) center.

When the aircraft is in flight with the ALIGN button depressed and the FINE ALIGN light on, setting the ALIGN switch to GYRO COMP begins the period of fine heading alignment. The GYRO COMP position has no effect when weight is on wheels.

When the switch is at OFF, SINS ICS communication is disabled and gyrocompassing is inhibited during an in-flight alignment. Gyrocompassing is automatically initiated during shore - or carrier - based alignment.

Indicator Lights

The following platform indicator lights are provided on the platform control panel:

NO GO	Indicates a system malfunction. (Platform is unreliable.)
READY	Indicates operational readiness and alignment of inertial navigation system.
FINE ALIGN	Indicates completion of rough alignment, and that fine alignment period has been started.
TEMP	Indicates an abnormally high platform temperature, insufficient warmup time during the first minute of alignment, or loss of power to the platform. During the first 5 minutes of operation in STBY, on a cold system, the light may come on for up to 2 minutes.

ERECTION CONTROLLER PANEL

The erection controller panel (figure 8-5) provides erection and alignment information to the inertial navigation system for shore, carrier deck, or in-flight alignment and digital computer OFF operation.

Information for the initial alignment can be set automatically in the display windows or inserted manually by the bombardier/navigator.

Mode Selector Switch

The mode selector switch is a two-position toggle switch marked AUTO and MAN. Setting the switch to AUTO permits automatic inputs of carrier heading and carrier speed to the erection controller panel from the ship's inertial navigation system through the carrier alignment plug on the external power panel on the right side of the fuselage. Setting the switch to MAN permits manual slewing of the counters on the erection controller panel.

Note

The initial latitude must be manually set in the erection controller.

Function Selector Switch

The function selector switch is a four-position toggle switch marked CARR HDG, LAT, LONG and CARR SPEED. Selection of one of the positions enables slewing of the value in the respective window on the erection controller panel.

Increase/Decrease Slew Switch

The increase/decrease slew switch is a five-position toggle switch marked INCR F, INCR S, OFF, DCR F, and DCR S. Use of the switch increases or decreases the values in the windows marked CARR HDG (carrier heading), LATITUDE, LONGITUDE and CARR SPEED (carrier speed) as determined by the position of the function selector switch. Slewing can be accomplished at the fast rate, 30 units per second, or the slow rate, 3 units per second.

Polar Mode Switch

The Polar mode switch is inoperative and should be left in NORM. This three-position lever-lock toggle switch is marked N POLAR, NORM (normal), or S POLAR.

INS FAILURE/UNRELIABLE INDICATIONS

Figure 8-6 illustrates the indications of failure or unreliability in the INS along with possible corrective actions for each of the various conditions.

INS FAILURE/UNRELIABLE INDICATIONS

INDICATION	CAUSE	CORRECTIVE ACTION
1. NO GO LIGHT ON (STEADY) 2. VDI PLATFORM LIGHT ON (FLASH)	IN OPER, NO GO CONDITION	REALIGN INS, OR SELECT MAG/VGI AND INS OFF ¹
VDI PLATFORM LIGHT ON (STEADY)	NOT IN OPER, ATTITUDE REF SW. AT COMP IN OR COMP OUT	SELECT OPER IF READY LIGHT IS ON OR SELECT MAG/VGI
TEMP LIGHT ON (STEADY)	OVER TEMPERATURE (MORE THAN 3 MIN. IN ALIGN) (MORE THAN 1 MIN. IN OPER)	SELECT MAG/VGI AND INS OFF FOR DURATION OF FLIGHT INCLUDING LANDING
TEMP LIGHT ON (STEADY)	LOSS OF POWER IN STBY	1. CHECK CIRCUIT BREAKERS 2. REALIGN INS OR SELECT MAG/VGI AND INS OFF ¹
TEMP LIGHT ON (STEADY) NO GO LIGHT ON (STEADY)	LOSS OF POWER IN ALIGN	1. CHECK CIRCUIT BREAKERS 2. REALIGN INS OR SELECT MAG/VGI AND INS OFF ¹
1. NO GO LIGHT ON (STEADY) 2. TEMP LIGHT ON (STEADY) 3. VDI PLATFORM LIGHT ON (FLASH)	LOSS OF POWER IN OPER	1. CHECK CIRCUIT BREAKERS 2. REALIGN INS OR SELECT MAG/VGI AND INS OFF ¹
LOSS OF VDI PICTURE	LOSS OF ADAPTER 28V OR ADAPTER FILTERED 28V	1. CHECK THE ADAPTER CIRCUIT BREAKER 2. CONTINUE USE OF INS OR USE MA-1 AND VGI FOR HEADING AND ATTITUDE REFERENCE



TO PROVIDE PROTECTION TO THE PLATFORM, THE INS SHOULD BE IN OPERATE OR ALIGN FOR ALL TAKEOFFS AND LANDINGS.

A-ADF1-69

Figure 8-6

ALTERNATE HEADING AND ATTITUDE REFERENCES

The MA-1 compass and the vertical gyro indicator (VGI) provide alternate sources of heading and attitude to the computer, AFCS, search radar, doppler radar and system displays. Control of the selection of the source of heading and attitude information is provided by the ATTITUDE REF switch (figure 8-5) on the pilot's control panel. The MA-1 compass and the VGI are described in Section I of this manual.

ATTITUDE REF Switch

The ATTITUDE REF switch is a three-position toggle switch in the lower left of the pilot's control panel marked MAG/VGI, COMP IN and COMP OUT.

During inertial platform alignment, the ATTITUDE REF switch selects the source of true heading. When COMP IN or MAG/VGI is selected, MA-1 magnetic heading modified by the MAG VAR setting on the DDU is used. When the switch is at COMP OUT, the CARR HDG window on the erection controller panel provides the source of alignment heading reference.

When the OPER button is DEPRESSED, the ATTITUDE REF switch selects the source of heading and attitude information provided to the system and to the HSI.

In the COMP OUT position, platform heading and attitude information is supplied to the computer, VDI,

HSI, AFCS, Doppler, search radar and other system components. The MAG VAR must reflect the correct variation for the HSI to read magnetic headings and bearings.

In the COMP IN position, the platform provides heading and attitude to all system components except the HSI. MA-1 compass heading is displayed on the HSI.

The MAG/VGI position provides an alternate source of heading and attitude information. In the MAG/VGI position, all heading information is derived from the MA-1 compass (modified by MAG VAR) and all attitude information supplied to the computer and related systems is derived from the VGI. It is necessary to continuously update the MAG VAR on the DDU in order to maintain a true heading reference.

DIGITAL COMPUTER AN/ASQ-133

The digital computer AN/ASQ-133 is a solid-state general-purpose airborne computer powered by primary 3-phase 115 VAC and primary 28 VDC through the CMPTR/ACU and CMPTR circuit breakers on the B/N's circuit breaker panel. The chief operating characteristics of the computer are:

Operating altitude. . .	Sea level to 50,000 feet
Operating temperature. . .	In-flight: 2°C to 27°C (36°F to 85°F)
	Ground: -54°C to 49°C (-65°F to 120°F)

The computer subsystem consists of the following units:

- Computer unit
- Pedestal control unit, including the computer control unit, the interface electronics assembly, and the slew control.
- Digital display unit
- Analog-to-digital converter

Based on programmed instructions, the computer performs the operations necessary for navigation and weapon delivery, provides the crew with required steering commands and, if selected by the crew, initiates automatic weapon release.

COMPUTER PROGRAM

The computer program is the set of instructions permanently stored in the main storage unit under which the computer functions. The computer is periodically re-programmed with a new set of instructions to reflect aircraft changes, new weapons, etc., however this is not a flight crew procedure.

The program includes a set of instructions for hardware check-out and a set of instructions for the solution of the navigation, ranging and attack problem. The navigation/ranging/attack instructions are called the flight program and are repeated 8 times per second. A repetition of these instructions is commonly referred to as an iteration. Figure FO-9 provides a general diagram of the functions performed each iteration. The instructions for hardware check-out are called the operational readiness test (ORT).

Throughout this manual, programs are identified by the letter E followed by a number which indicates the particular program's position in the order of development. Thus E1.0 would be an earlier program

than E5.0. Revisions to a program are identified by a decimal point and a number. For example E 1.5 would be the fifth revision of the first program. Window C 1 on the DDU displays the program identifier number. The read-out for program E 1.4 is 014 and for program E2 it is 020. The current program designation is E 1.5.

COMPUTER OPERATION AT TURN-ON

On the ground, when the computer is turned on, a 001 system advisory code (SAC) is displayed, the computer error lights come on, the ATTACK lights flash and the computer remains inactive until the COMPT MODE switch is placed to TEST. This enters the computer into the operational readiness test (ORT) and sends a digital computer off signal to the INS. When the ORT is completed or is terminated by the B/N, the computer may be entered into the flight program by selecting ENTER. At this time the computer error lights come on, the 001 SAC is displayed and data may be entered into the computer.

If the computer is turned on in flight, it is the B/N's option whether or not to perform the ORT. If TEST is selected the ORT begins. If ENTER or STEER is selected the computer is placed into the flight program, the 001 SAC is displayed, and the computer error lights come on.

Note

Present position data must be entered before depressing the SAC key to turn off the error lights or the error lights will stay on and a 002 SAC will be displayed.

COMPUTER NON-ATTACK OPERATION

The computer continuously derives aircraft present position along three axis using inputs from the various sensors on board the aircraft according to the navigation mode selected. The validity of aircraft data is determined and this data is either used or replaced. Corrections are provided to the inertial platform, the validity of radar tracking data is checked, cursor positioning is updated and steering commands are provided. The computer makes digital readouts available to inform the crew of present status, and to provide a means of monitoring computer functions.

Once the aircraft armament system has been activated (MASTER ARMT switch at ON or PRAC) the computer also checks that no weapon-incompatible switch selections have been made. In the event an improper selection has been made, a reselect condition is established and the RESELECT light is turned on. With either a computer error light on or a RESELECT light on, the program inhibits entry into the attack modes.

COMPUTER OPERATION IN ATTACK

When the computer has been stepped into attack, it will perform all non-attack functions and in addition, it performs the functions related to weapon delivery. Aircraft and bomb travel distances are generated for the selected weapon and attack profile. Point of weapon release is calculated and steering to the point of weapon release is provided. Validity of the release solution is checked, release pulse spacing for train releases is computed and at the proper time, weapon release is initiated.

COMPUTER OPERATION ON THE GROUND

When the computer is operating in the flight program on the ground or the carrier deck, it performs in the same manner as in flight with the following differences of interest to the B/N:

- Mach sensor input usage is controlled by keyboard selection where:
 - 0 = B/N control of true airspeed
 - 1 = System control of true airspeed
- Temperature sensor status is always 0, and keyboarded temperature entry is displayed immediately.
- With Mach sensor status set at 0, the INS at OPERATE and the inertial navigation option selected, inertial vertical velocity is displayed in window A3 of the digital display unit.
- System altitude is updated by inertial vertical velocity if its status is at 1 and the vertical velocity is not greater than 2 feet per second.

NAVIGATION OPTIONS

In using the computer to solve the navigation problem, the bombardier/navigator may select one of four

computer navigation options which determine the sensors that are used. The navigation options provide an increasing level of capability as shown in figure 8-7.

DEAD RECKONING

The dead reckoning navigation option is selected by setting the navigation mode selector switch to DR. The computer derives aircraft horizontal velocity from air data computer Mach converted to true airspeed, and wind from existing system winds memorized when DR was selected, keyboard inputs or velocity correct. With the INS at OPERATE and inertial vertical velocity set good, the computer uses inertial vertical velocity. If the INS is not at OPERATE or inertial vertical velocity is set bad, vertical velocity comes from the vertical component of true airspeed. Platform leveling corrections are provided by the computer and the INS may be used as a source of heading and attitude by setting the ATTITUDE REF switch to COMP IN or COMP OUT. If the INS attitude is invalid, the MA-1 compass may be used for heading and the VGI for attitude reference by setting the ATTITUDE REF switch to MAG/VGI. All other system inputs are available to the computer. The DR option is the least accurate and should only be used when both the Doppler and the INS are providing bad velocities.

DOPPLER

If the Doppler is providing valid inputs of drift and ground speed, the Doppler navigation option may be selected by setting the navigation mode selector switch to EMER DOP. All system inputs are available to the computer except INS horizontal velocities and velocity correct. Platform leveling corrections are provided to the INS and it may be used as a source of heading and attitude reference if this data appears valid. System horizontal velocities are based on Doppler values of drift and groundspeed and air data computer Mach converted to true airspeed. With the INS at OPERATE and inertial vertical velocity set good, the computer uses inertial vertical velocity. If the INS is not at operator inertial vertical velocity is set bad, vertical velocity comes from the vertical component of true airspeed.

INERTIAL

When the inertial platform is operating properly and the Doppler inputs of drift and groundspeed are not valid, the inertial navigation option may be selected by setting the navigation mode selector switch to INERL and the Doppler power switch to STBY or OFF.

COMPUTER NAVIGATION OPTIONS

OPTION	NAV MODE SWITCH	DOPPLER MODE	ATTITUDE REF SWITCH	PLATFORM MODE	NAVIGATION INFORMATION FLOW	SUMMARY
DEAD RECKONING	DR	N/A	MAG/VGI	OPER	1. TH FROM MA-1 → MAG VAR VIA INS PLATFORM ADAPTER 2. ATTITUDE FROM VGI VIA INS PLATFORM ADAPTER. 3. ALTITUDE, TAS FROM ADC OR DATA REPLACEMENT 4. WIND FROM VELOCITY COR- RECT OR KEYBOARD INPUT.	1. MINIMUM CAPABILITY DOPPLER NOT USED; INS OUTPUTS NOT USED; ADC USED. 2. USE WHEN DOPPLER BAD AND INS VELOCITIES AND ATTITUDE BAD.
	DR	N/A	COMP IN OR COMP OUT	OPER	1. TH, ATTITUDE FROM INS. 2. ALTITUDE AND TAS FROM ADC OR DATA REPLACEMENT. 3. WIND FROM VELOCITY CORRECT OR KEYBOARD INPUT.	1. LIMITED USE OF INS; DOPPLER NOT USED; ADC USED. 2. USE WHEN DOPPLER BAD, INS VELOCITIES BAD.
DOPPLER	EMER DOP	ON LAND OR ON SEA	MAG/VGI	OPER	1. TH FROM MA-1 → MAG VAR VIA INS PLATFORM ADAPTER 2. ATTITUDE FOR NAVIGATION AND DOPPLER STABILIZATION FROM VGI VIA INS PLATFORM ADAPTER. 3. ALTITUDE AND TAS FROM ADC OR DATA REPLACEMENT. 4. WIND FROM DOPPLER AND TAS, OR FROM KEYBOARD INPUT WHEN ADC MACH NO. INPUT NOT IN USE.	1. FULL USE OF DOPPLER; INS OUTPUTS NOT USED, ADC USED. 2. USE WHEN DOPPLER GOOD INS ATTITUDE AND VELOCITY BAD.
	EMER DOP	ON LAND OR ON SEA	COMP IN OR COMP OUT	OPER	1. TH, ATTITUDE FOR NAVIGATION AND DOPPLER STABILIZATION FROM INS. 2. ALTITUDE AND TAS FROM ADC OR DATA REPLACEMENT 3. WIND FROM DOPPLER AND TAS, OR FROM KEYBOARD INPUT WHEN ADC MACH NO. INPUT NOT IN USE.	1. FULL USE OF DOPPLER; LIMITED USE OF INS; ADC USED. 2. USE WHEN DOPPLER GOOD, INS VELOCITIES BAD.
INERTIAL	INERL	STBY OR OFF	COMP IN OR COMP OUT	OPER	1. TH, ATTITUDE FROM INS. 2. HORIZONTAL/VERTICAL VELOCITIES FROM INS 3. ALTITUDE AND TAS FROM ADC OR DATA REPLACEMENT. 4. WIND FROM VELOCITY CORRECT, INS HORIZONTAL VELOCITIES AND TAS OR KEYBOARD INPUT WHEN ADC MACH NOT IN USE.	1. FULL USE OF INS; DOPPLER NOT USED; ADC USED. 2. SYSTEM HORIZONTAL VELOCITIES DERIVED FROM INS AND VELOCITY CORRECT. 3. SYSTEM VERTICAL VEL- OCITIES DERIVED FROM BARO-INERTIAL VERTICAL LOOP 4. USE WHEN DOPPLER BAD, INS GOOD.
DOPPLER — INERTIAL	INERL	ON LAND OR ON SEA	COMP IN OR COMP OUT	OPER	1. TH, ATTITUDE FOR NAVIGATION AND DOPPLER STABILIZATION FROM DOPPLER DAMPED INS. 2. HORIZONTAL/VERTICAL VELOCITIES FROM DOPPLER DAMPED INS. 3. ALTITUDE AND TAS FROM ADC OR DATA REPLACEMENT. 4. WIND FROM VELOCITY CORRECT, INS HORIZONTAL VELOCITIES AND TAS OR KEYBOARD INPUT WHEN ADC MACH NOT IN USE.	1. FULL USE OF INS AND DOPPLER 2. SYSTEM HORIZONTAL VEL- OCITIES DERIVED FROM DOPPLER DAMPED INS AND VELOCITY CORRECT. 3. SYSTEM VERTICAL VELOCITIES DERIVED FROM BARO-INERTIAL VERTICAL LOOP.

NOTE

- INS VERTICAL VELOCITY IS USED IN DR, INERTIAL OR DOPPLER-INERTIAL MODES UNLESS SET BAD BY B/N. PLATFORM OR IS NOT IN OPERATE. THEREFORE IT IS POSSIBLE TO HAVE ANY COMBINATION OF INERTIAL OR ADC DERIVED HORIZONTAL AND VERTICAL VELOCITIES.
- DR MODE IS ARE USED IF INERTIAL SELECTED WHEN THE PLATFORM IS NOT IN OPERATE.

B-ADF1-90

Figure 8-7

Note

Doppler inputs are automatically eliminated by the computer when one or more of the following conditions occur:

- Doppler OFF or STBY
- Doppler in TEST
- MEMORY light on
- Roll exceeds $\pm 25^\circ$
- Pitch exceeds $\pm 17^\circ$
- The difference between raw Doppler ground-speed and system groundspeed exceeds 76 knots.

The computer derives horizontal velocities from inputs from the inertial platform and velocity correct. Vertical velocity comes from the baro-inertial vertical loop. All other system inputs are available to the computer. The computer provides inertial platform leveling signals.

DOPPLER-INERTIAL

The Doppler-inertial option which makes full use of all the navigation equipment available is selected by setting the navigation mode selector switch to INER and the Doppler power switch to ON LAND or ON SEA. The computer determines horizontal velocities from the inertial platform damped by Doppler-derived velocities and from velocity correct. Doppler damping of inertial velocities reduces the long term Schuler frequency oscillations inherent in inertial platforms. Vertical velocity comes from the baro-inertial vertical loop. The computer provides inertial platform leveling signals.

COMPUTER STEERING SELECTIONS

The computer provides steering to a selected target by presenting commands and displays on the DVRI, PHD optical sight and VDI. See figures 8-8, 8-9, and 8-10. Opportunity target steering or unstabilized cursors may also be selected. Drift corrected and roll-summed steering indications are provided.

Pilot steering remains as last selected when the COMPT MODE switch is set to ENTER regardless of the keys selected while in ENTER. The keyboard should be returned to the original configuration to avoid inadvertent disruption of pilot steering indications.

DRIFT CORRECTED STEERING

Drift corrected steering is heading information which permits the pilot to fly the aircraft from its present

position on a direct course to a specific point. A steering error exists when the aircraft is making a ground track which would not take it from its present position on a straight line, (the commanded ground track), to the selected point. This steering error is conveyed to the pilot at all times through the VDI pathway vanishing point, and the PHD steering indicator; and in non-attack through the optical sight moving reticle. The steering information has been corrected to account for any wind conditions that may cause the aircraft to drift off course while enroute to the point. When the present ground track matches the commanded ground track, the movable reticle will be centered in azimuth, the pathway vanishing point will be in the center of the VDI and the PHD steering indicator will be located under the fixed marker (see figure 8-8).

ROLL-SUMMED STEERING

Roll-summed steering is a computer-generated steering command which provides the pilot with an indication of the bank angle required to null out the drift corrected steering error to the selected target or release point, within 5 seconds during non-attack operation or 2 seconds in attack. This information is always displayed by the VDI steering symbol (figure 8-20); in attack it is also displayed by the optical sight moving reticle and the VDI pathway command heading lines (figure 8-20). Since all the indications of roll-summed steering commands are similar, only the operation of the VDI steering symbol will be discussed.

The maximum command bank angle is $\approx 30^\circ$. Full left or right deflection of the VDI steering symbol indicates that $\approx 30^\circ$ bank is being commanded. Maximum bank angle will be commanded for a steering error of greater than 2.8° in attack and 1.1° in non-attack. As the steering error decreases, command bank angle is reduced so that the aircraft will roll out on the proper track. See figure 8-9.

COMMAND PULLUP INDICATIONS

Terrain avoidance pullup command and the terrain avoidance function are operational whenever airspeed exceeds 181 knots at dive angles below 3° and landing mode is not selected. The commands are provided on the optical sight and the VDI and are based on aircraft total velocity, dive angle, and aircraft slant range to the computer-defined surface. It is therefore suggested that when flying cross-country, the altitude of the highest terrain remaining be entered temporarily as the altitude of the selected target and then an update made as soon as the high point is passed. Here, in the absence of a radar lockon, it is possible that premature (and not unsafe) pullup commands will be generated. However, if radar elevation tracking is not in use and target altitude is not continuously updated to terrain altitude, the computer should not be relied upon to provide a timely (safe) terrain avoidance pullup command.

DRIFT CORRECTED STEERING

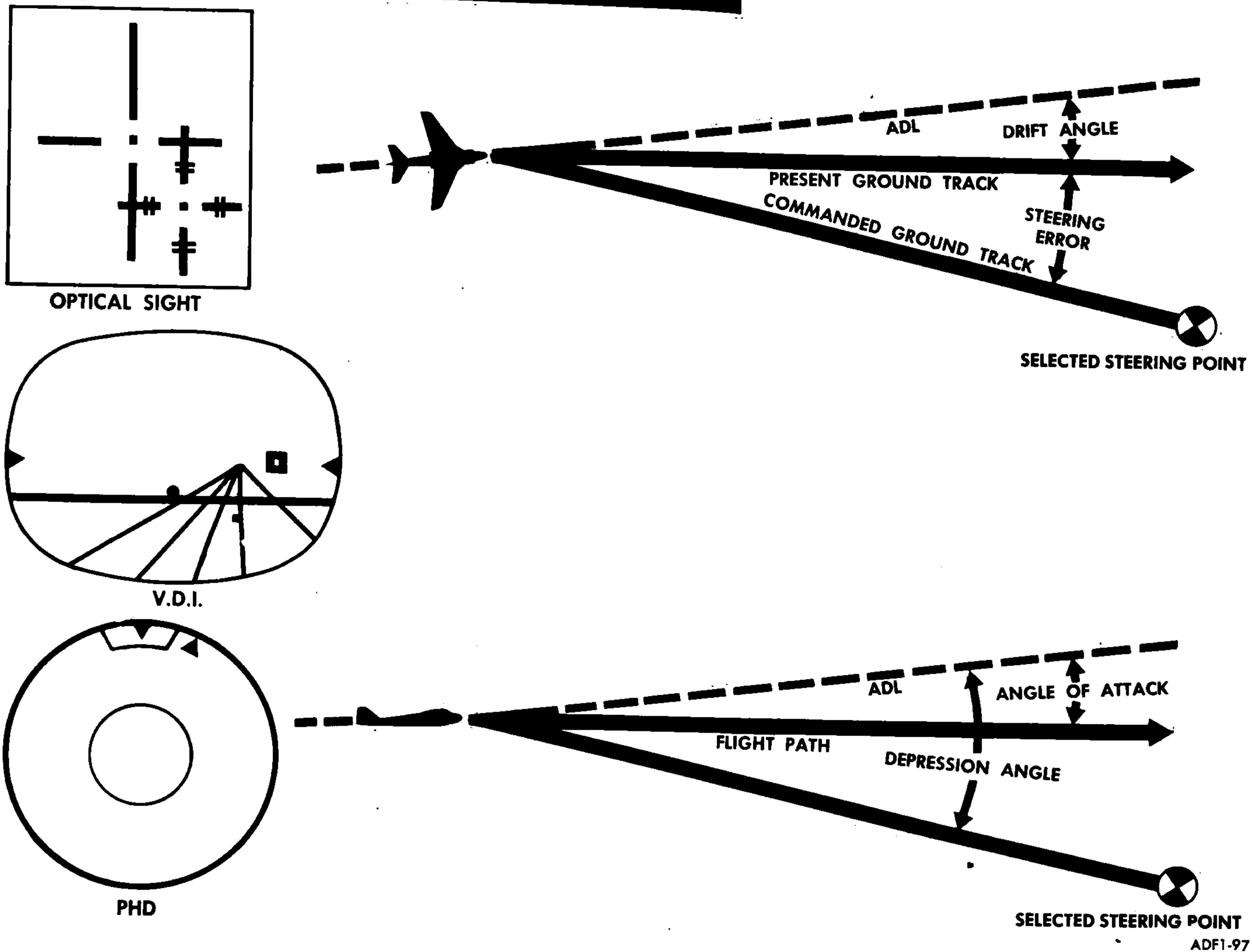


Figure 8-8

ADF1-97

This pullup command is in addition to pullup requirements for a selected attack mode.

Command pullup is indicated when the breakaway lights flash, the pullup marker goes to the bottom of the VDI display and pathway pitchup-up (blossoming) occurs. The steering symbol and optical sight moving reticle jump vertically to indicate command g based on 4g's. With BORE-SIGHT selected, optical sight moving reticle jump is deleted.

When the MASTER ARMT switch is in ON or PRAC, a special pitchup command is provided to:

- In attack, prevent the aircraft from descending below the keyboard selected blast clearance altitude,
- In attack or nonattack, force the aircraft to climb if inadequate safe time is available for non-conventional weapons,

- In attack, force the aircraft to climb if current geometry is incompatible with an attainable weapon release.

This special pitchup command is indicated when the steering symbol and moving reticle command in the upward direction without the other associated pullup indications.

TARGET STEERING

When one of the 4 target steering keys is depressed, computer steering is provided to the stored coordinates of the selected target. When the computer is not in attack, DVRI, PHD and VDI steering indications are as shown in figure 8-10, and the PHD time-to-go readout is estimated time to the selected target in minutes. The optical sight moving reticle provides drift corrected steering error to the selected target. If an offset aimpoint is selected, the pilot's indications are to the OAP.

NEW
NEW
NEW

ROLL-SUMMED STEERING

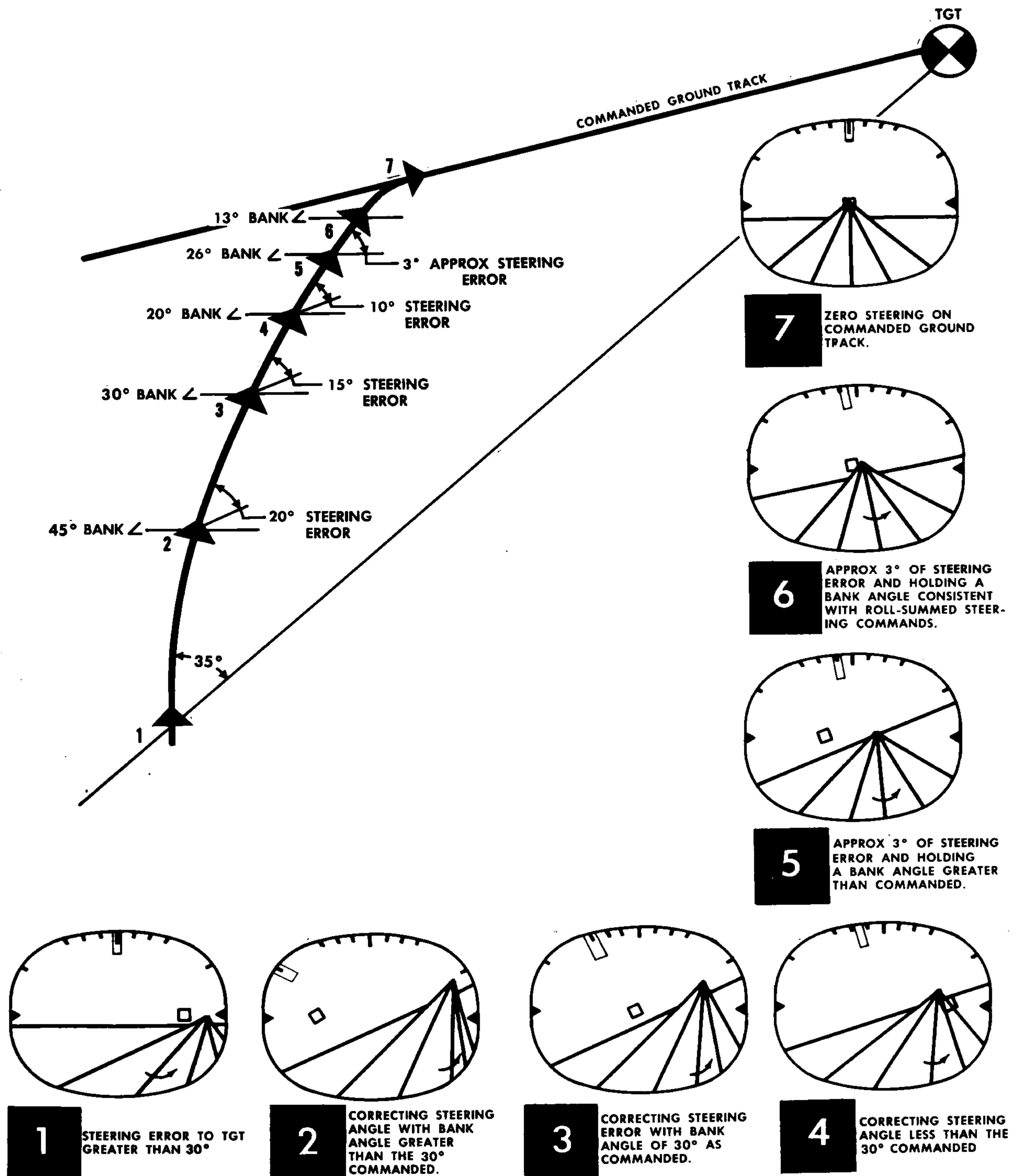


Figure 8-9

COMPUTER NON-ATTACK STEERING SELECTIONS

STEERING SELECTED	PHD RANGE READOUT	PHD BUG POINTS TO	RADAR CURSORS POSITION TO	DVRI BUG POINTS TO	DVRI RANGE READOUT ①	VDI/OPT SIGHT STEERING TO	REMARKS
TARGETS 1-4	GROUND RANGE TO SELECTED TARGET	DRIFT COR- RECTED HEADING TO SELECTED TARGET	COORDINATES OF SELECTED TARGET	TRUE BEARING TO SELECTED TARGET	TO SELECTED TARGET	COORDINATES OF SELECTED TARGET	RADAR CURSORS ARE POSITIONED BY THE COMPUTER BUT MAY BE SLEWED BY THE B/N
OAP'S 1-2			SELECTED OAP FOR SELECTED TARGET	TRUE BEARING TO SELECTED OAP FOR SELECTED TARGET	TO SELECTED OAP FOR SELECTED TARGET		
UN STAB ②	GROUND RANGE TO CURSOR INTERSECTION	TRUE HEADING	DEAD AHEAD AT KEYBOARD SELECTED RANGE	TRUE HEADING	TO CURSOR INTER- SECTION	NO STEERING ORIENTATION	
NAV XPT ②	GROUND RANGE TO CHECKPOINT	DRIFT CORREC- TED HEADING TO CHECKPOINT	COORDINATES OF CHECKPOINT	TRUE BEARING TO CHECKPOINT	TO CHECK POINT	COORDINATES OF CHECKPOINT	B/N MAY UPDATE PRESENT POSITION WITHOUT DISTURBING PILOT'S COMMAND STEERING
NAV X PT AND TARGET ④							
TARGET AND NAV XPT ④	GROUND RANGE TO TARGET	DRIFT COR- RECTED HEADING TO TARGET				COORDINATES OF TARGET	
OPT TARGET ③	GROUND RANGE TO CURSOR INTERSECTION	DRIFT CORRECTED HEADING TO CURSOR INTERSECTION	POSITIONED BY SLEW CONTROL AND GROUND STABILIZED	ALIGNED WITH AZIMUTH CURSOR	CURSOR INTER- SECTION	CURSOR INTERSECTION	RADAR CURSORS BY THE COMPUTER BUT MAY BE SLEWED BY THE B/N
GRD TRK ②	GROUND RANGE TO SELECTED TARGET	DRIFT COR- RECTED HEADING TO SELECTED TARGET	COORDINATES OF SELECTED TARGET/OAP	TRUE BEARING TO SELECTED TARGET/OAP	TO SELECTED TARGET/OAP	SELECTED GROUND TRACK HEADING	RADAR CURSORS ARE POSITIONED BY THE COMPUTER BUT MAY BE SLEWED BY THE B/N
LDG ②							

NOTE

1. UNDER 16 MILES: SLANT RANGE TO CURSOR INTERSECTION FEET/10.
OVER 16 MILES: GROUND RANGE TO CURSOR INTERSECTION IN MILES
2. MAY BE SELECTED ALONG WITH OTHER STEERING
3. NO STEERING SELECTED
4. SEQUENCE DEPENDENT

Figure 8-10

When the computer is in attack, steering indications are as before except that the optical sight moving reticle provides roll-summed steering, and all horizontal steering commands provided to the pilot are to the weapon release point rather than the target. Pilot steering commands are based on steering being nulled within 2 seconds. The PHD time to go readout is in seconds.

UNSTABILIZED STEERING

In the non-attack condition when unstabilized steering is selected, the radar cursors initially go to dead ahead at the range selected on the keyboard, and no steering is provided. The PHD range readout is not updated by slewing. If unstabilized steering is selected along with target steering under the non-attack condition, pilot steering is provided to the selected target.

If the computer is in attack with only UNSTAB and no other steering selected, both pilot and B/N get opportunity target steering. If one of the target steering keys is depressed, the pilot's steering is to the selected target; while the B/N's indications are the same as for opportunity target.

Note

Radar lock-ons are not available with UNSTAB selected.

OPPORTUNITY TARGET STEERING

Opportunity target steering is presented when no other steering selection is made, that is when no target steering keys are depressed.

When the computer is not in attack, steering indications are shown in figure 8-10. The PHD time to go readout is estimated time to the cursor intersection in minutes and the optical sight moving reticle provides drift corrected steering to the cursor intersection.

In attack, steering indications are as before except that the optical sight moving reticle provides roll-summed steering and all horizontal steering commands to the pilot are to the weapon release point rather than cursor intersection ground position. Pilot steering commands are based on steering being nulled within 2 seconds. The PHD time to go readout is in seconds.

GROUND TRACK BOMBING

When the computer is not in attack, and ground track bombing is selected, steering is provided to intercept and maintain the keyboard selected ground track heading. If target steering has also been selected, the selected track passes through the target. If opportunity target steering has been selected, the selected ground track passes through the cursor intersection ground position. See figure 8-10. The PHD time to go readout is estimated time in minutes to the selected target. The optical sight moving reticle provides drift corrected steering, and the VDI, roll-summed steering, to the selected ground track

heading through the target. The pilot is directed in a curving path until within 30° of the selected heading.

In attack, steering indications are as before except that vertical steering is presented on the optical sight and VDI according to the attack mode selected and the optical sight moving reticle presents roll-summed steering. All horizontal steering is vectored so that all weapons released will impact along the selected ground track across the target. The PHD time to go readout is in seconds.

LANDING MODE

When LDG (landing) is selected, the computer provides horizontal and vertical steering indications for an instrument landing. Vertical steering is provided on the optical sight and VDI when the aircraft is within 30° of runway heading. Runway direction is entered by the keyboard and the B/N may enter the latitude, longitude and altitude of the point of intended landing as a target, and if the point is not radar significant, he may use an offset aimpoint. Opportunity target steering may also be selected. Glide slope angle is fixed at 3.5°.

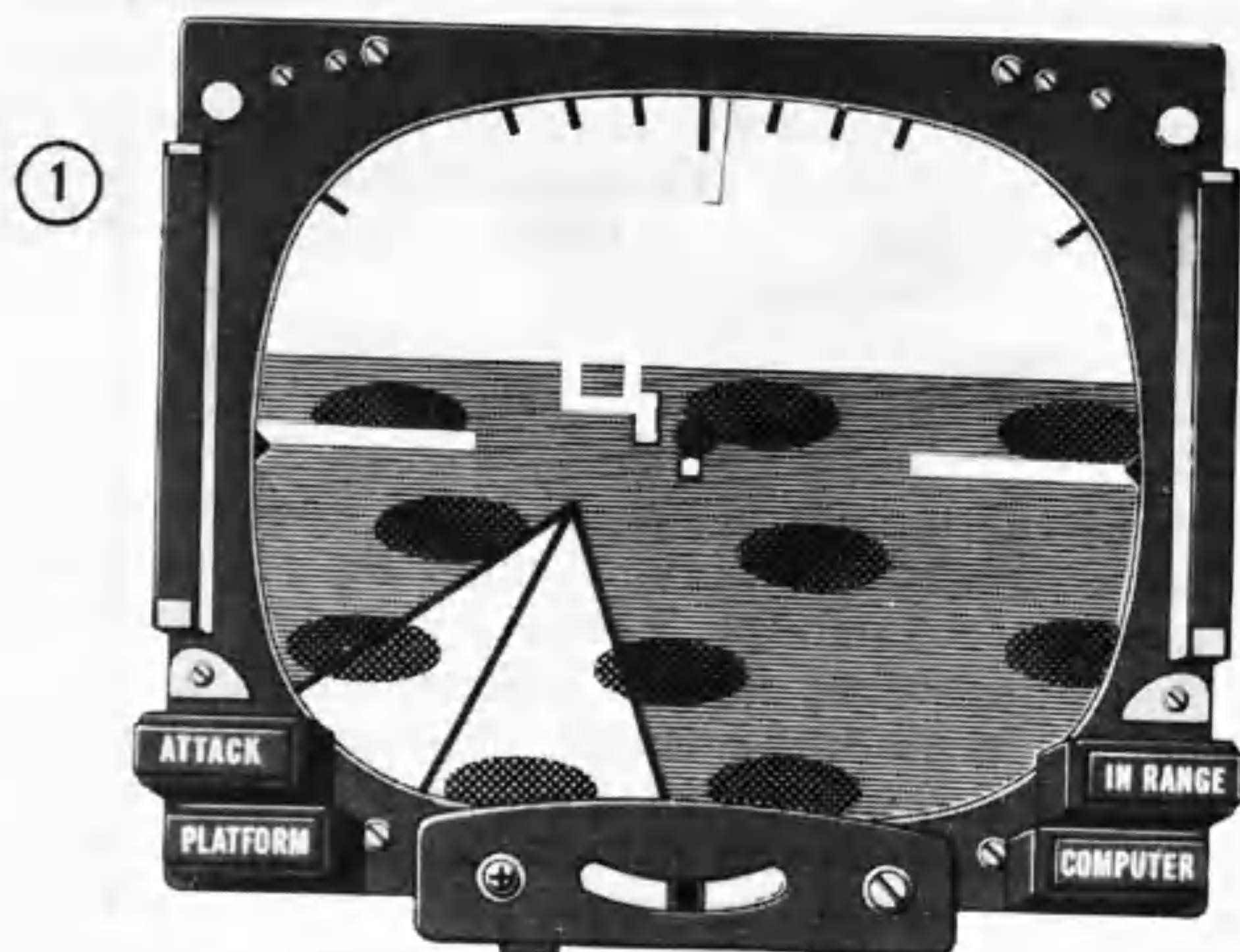
The command altitude change indication provided to the pilot is in the form of vertical display variable pathway width. Within 1 NM of touchdown, a full narrow pathway (figure 8-11) indicate that the aircraft is 150 feet or more above the desired glide slope. At a range greater than 1 NM, this same indication represents 1.5° or more above desired glide slope. The full width pathway (figure 8-11) indicates that the aircraft is 150 feet or more below desired glide path slope. At ranges of greater than 1 NM, the same indication represents 1.5° or more below the flight path.

Glide Path Bearing

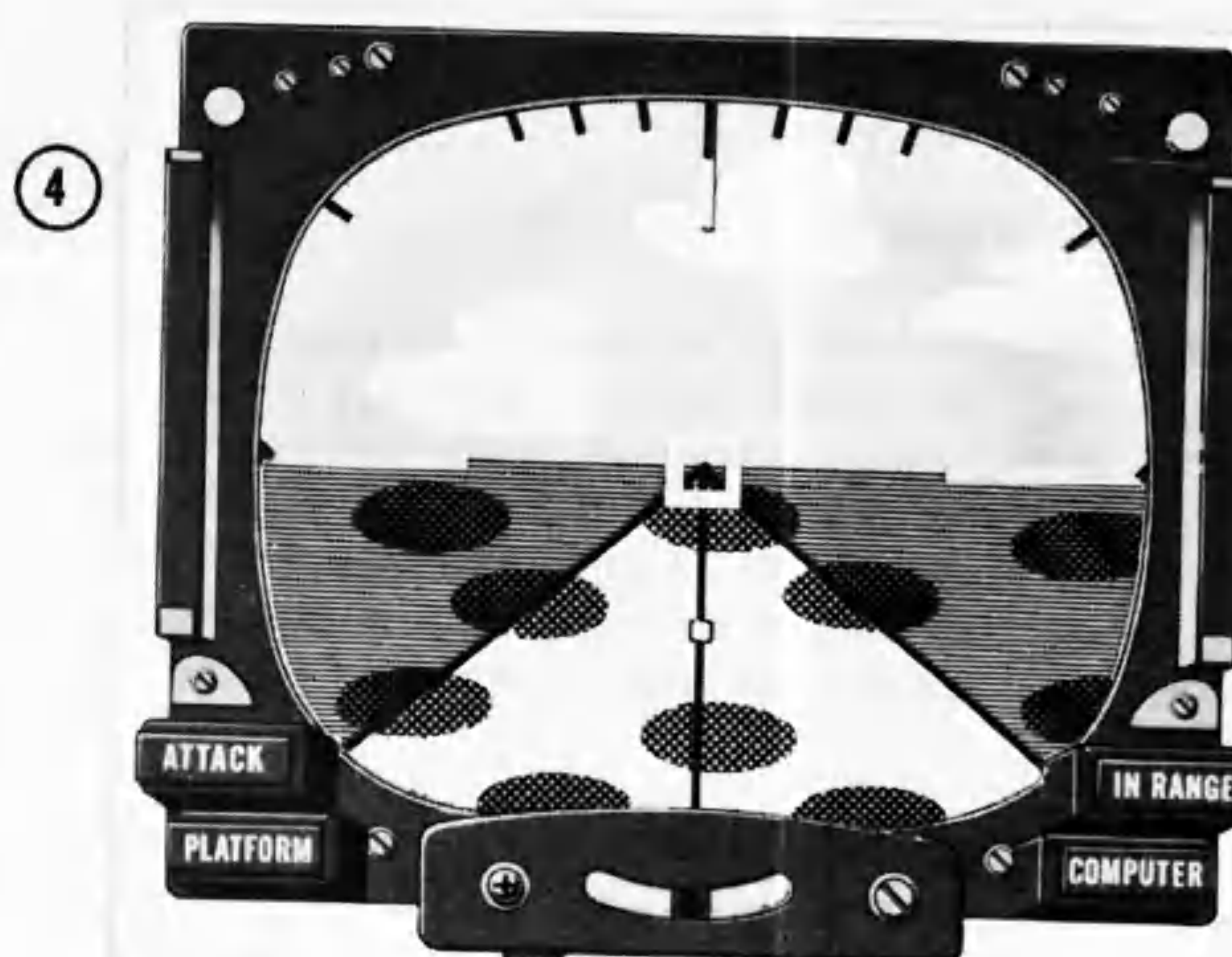
The bombardier/navigator selects cursor position or radar lock-on in combination with appropriate keyboard data so as to describe the intended point of landing. Coupled with a keyboard input of glide path bearing (true heading in degrees and minutes), this information is used to establish the glide path horizontal position, or extension of the landing runway. Differences between radar-measured bearing to intended point of landing and desired glide path bearing is used to position the VDI display near end (horizontal position) at ranges of 2 NM or more. At closer ranges, the near end is positioned by the computed distance from the glide path center line.

With the aircraft centered on the selected glide path, the near end of the vertical display pathway centerline appears to pass directly below the aircraft (figure 8-11). In wings-level flight, the near-point is therefore directly below display center. At ranges less than 2 NM, full right or left displacement of the near-point (figure 8-11) indicates that the aircraft is 301 feet or more left or right of the intended glide path. At ranges greater than 2 NM, this same indication represents about 1.25° or more left or right of intended glide path. A well-defined and unique radar target is required for optimum glide slope information.

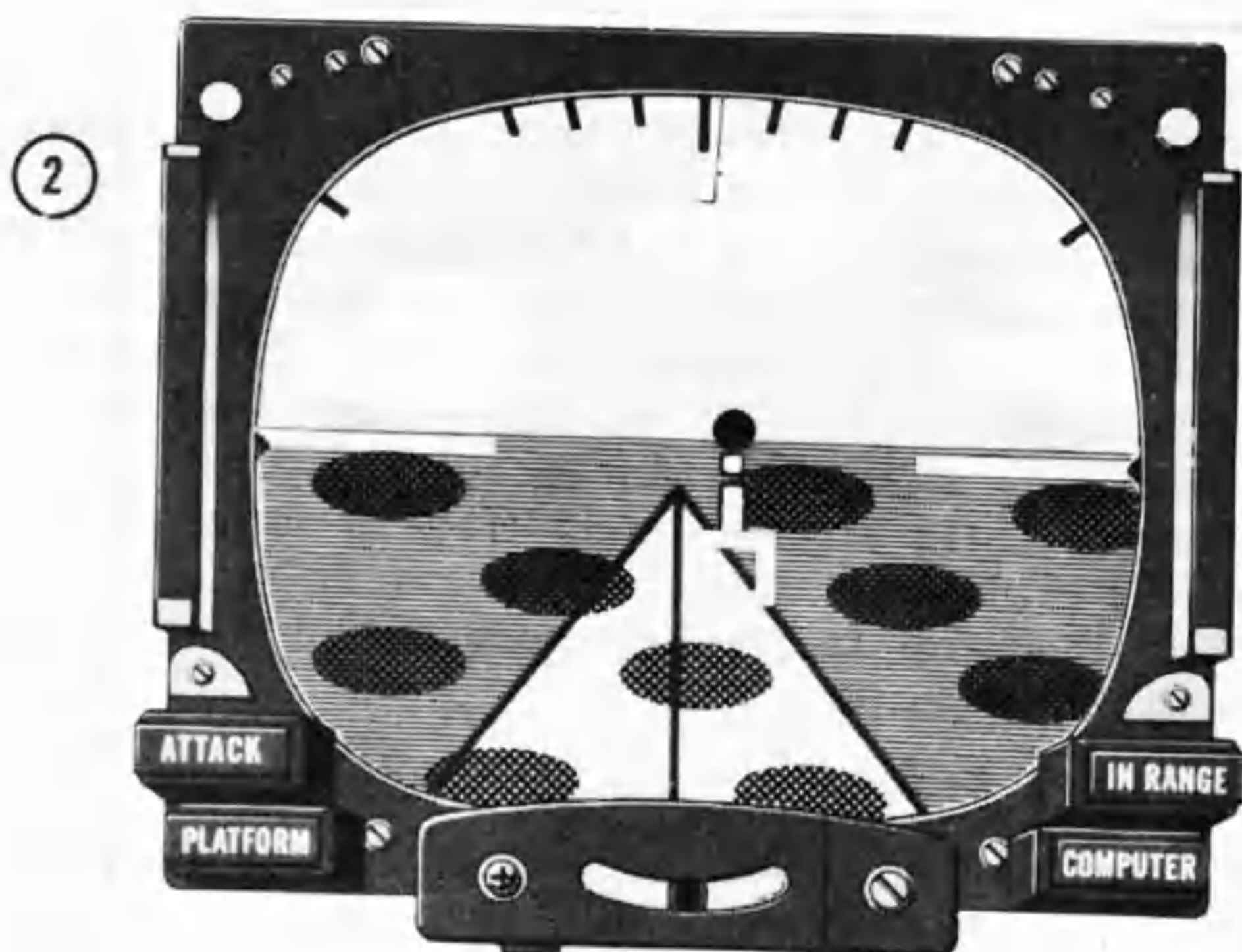
LANDING MODE



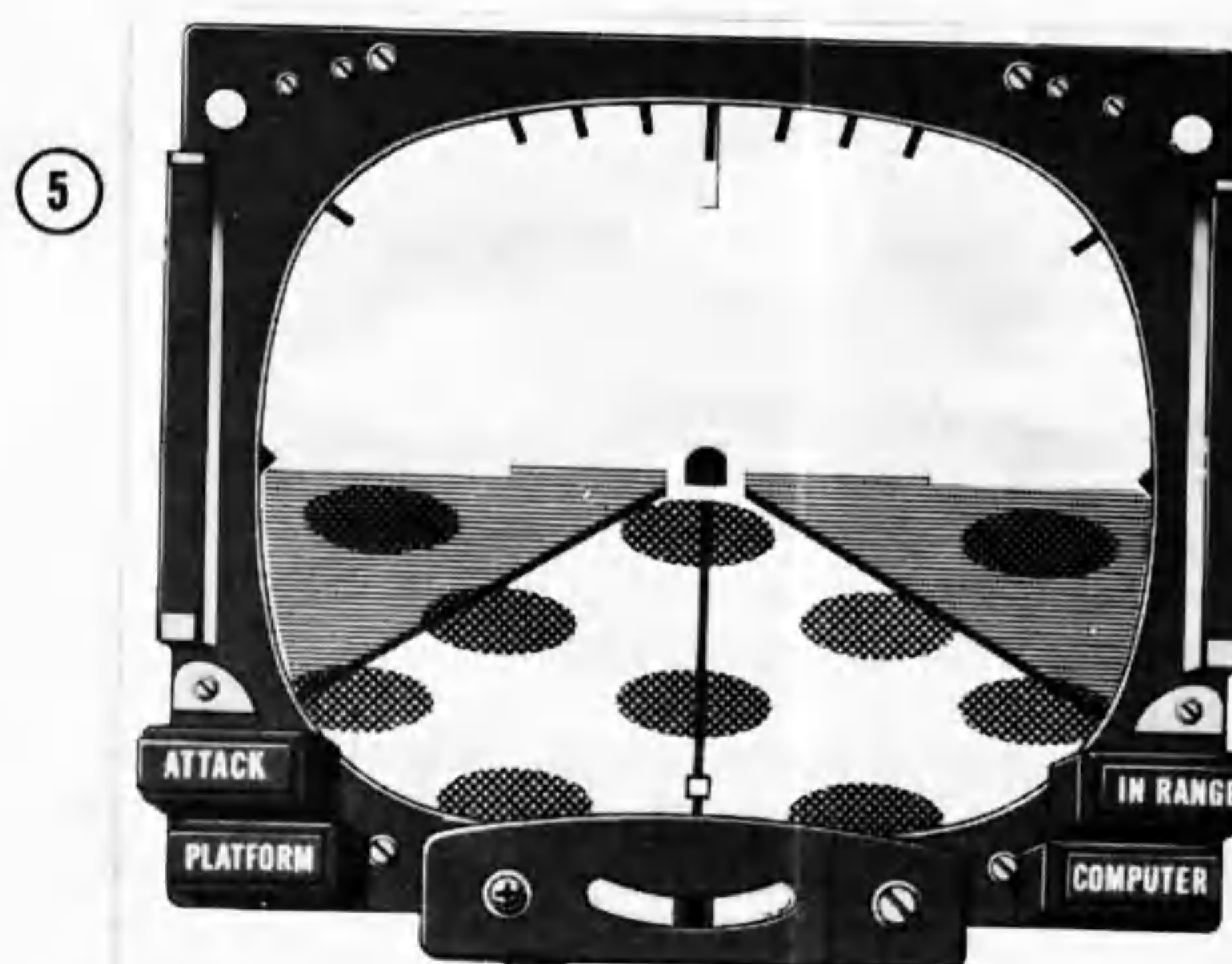
RIGHT OF RUNWAY AT 10 NM ABOVE GLIDE SLOPE



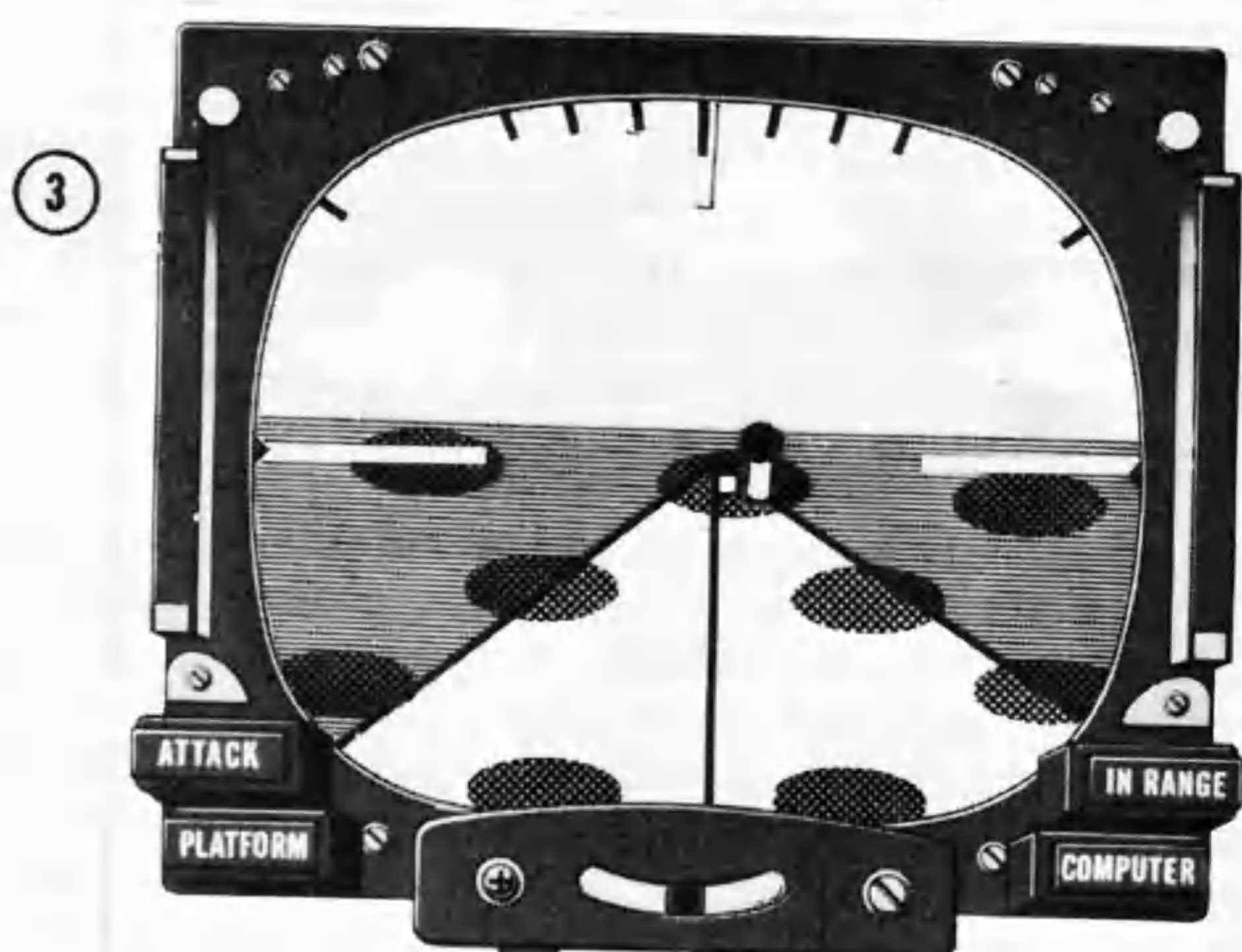
ON GLIDE PATH AT 4 NM



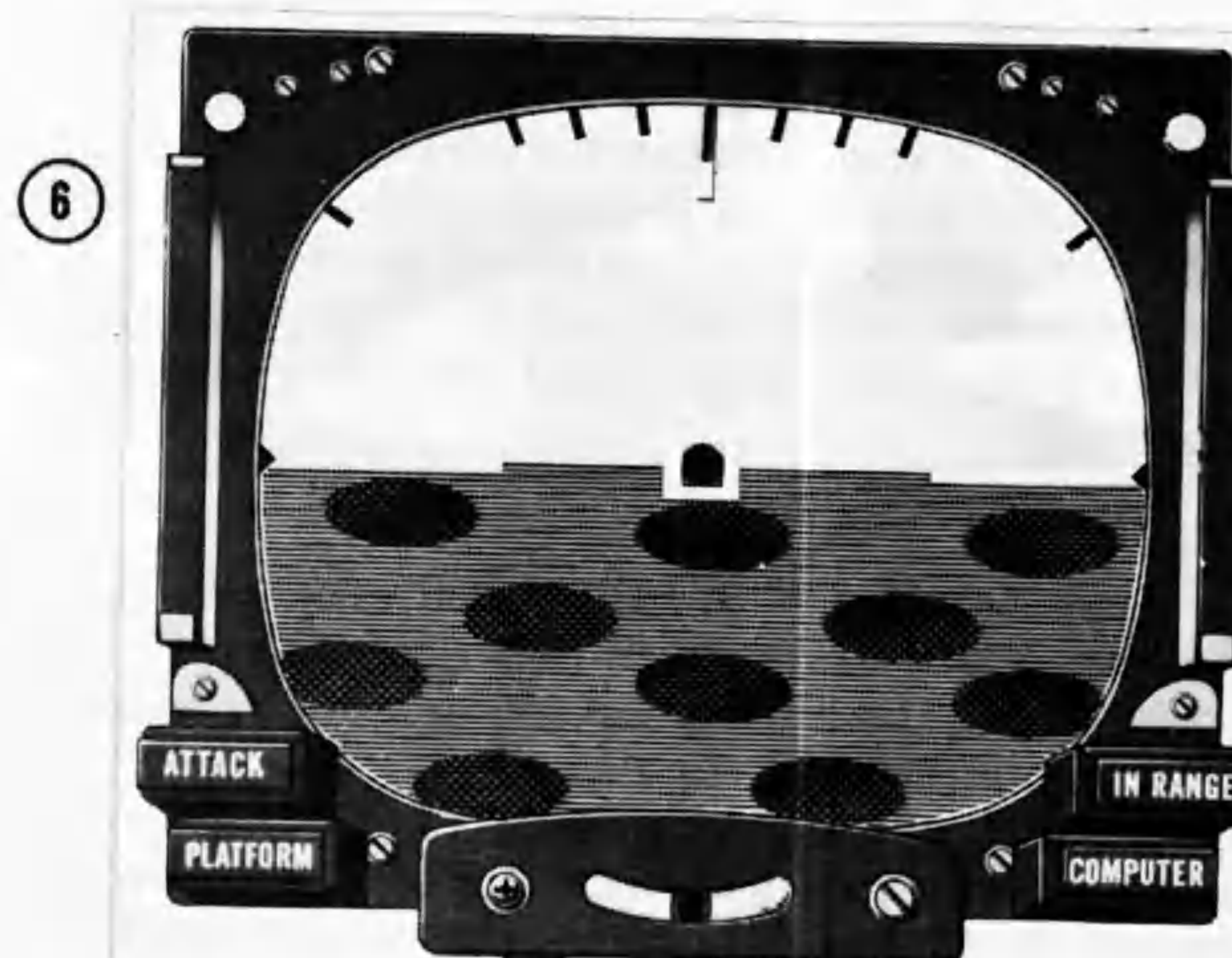
SLIGHTLY HIGH, ON COURSE AT 9 NM



SLIGHTLY LOW JUST BEFORE MINIMUM ALTITUDE



SLIGHTLY LOW ON GLIDE PATH AT 10 NM



ON GLIDE PATH, MINIMUM ALTITUDE

A-ADF1-101

Figure 8-11

Note

- Glide slope command and near end position are particularly sensitive to small corrections in cursor repositioning if TWS or AZ RNG lock-on is not available. Therefore, care should be used in selecting prominent radar targets for use in landing mode.
- Use of elevation tracking while making carrier approaches using landing mode is not recommended. The low grazing angle coupled with the large radar return may cause erroneous target altitude computations resulting in incorrect vertical separation and consequently incorrect and erratic glide slope information.
- The accuracy of landing mode glide slope displacement in offset or opportunity target modes is predicated on prior knowledge of exact bearing and altitude relationships between radar targets and the intended point of landing.

Pathway Vanishing Point Horizontal Position

The keyboard input of glide path bearing is compared with computed aircraft ground track and target bearing to determine steering error, which positions the pathway vanishing point along a line through the display center and parallel with the display horizon. Twenty-seven degrees or more of difference causes full right or left displacement of the vanishing point.

USE OF LANDING MODE

Command steering and command glide angle are displayed by steering symbol position and circling orientation to the runway extension is automatically provided. Command altitude change is based on range to the point of intended landing and glide slope angle and is available when target bearing is within 30° of runway heading. Command glide angle required to zero altitude error is displayed by the steering symbol vertical position. Thus with the steering symbol centered vertically, the aircraft will intercept the glide slope. The amount of altitude error is indicated by pathway width.

Horizontal roll-summed steering command is displayed by the horizontal position of the steering symbol. Steering commands are programmed so that centering the steering symbol horizontally orients the airplane position with respect to the runway centerline extension and allows transition to glide path intercept. Steering error is displayed by the horizontal position of the pathway vanishing point, and aircraft displacement from the extension of the runway centerline by the pathway near end horizontal position.

Maximum steering symbol commands are limited to 30° bank, 4° climb and 6° descent. Due to these limits, the optimum range for selection of landing

mode is from 4 to 10 nautical miles. Selection in this area will allow glide slope interception without overshooting and will keep orientation time to a minimum. A circling orientation is based on the smallest angle (the shortest way around) either left or right. Steering commands during orientation are programmed so that a constant radius turn centered on the point of intended landing is flown until the aircraft is within 30° of the keyboard runway heading. With the steering symbol centered, a smooth transition from orientation to glide path command is made so as to cause the aircraft ground track to match the runway heading.

The PHD bug and optical sight moving reticle provide the same steering information as the pathway vanishing point.

Minimums for landing mode are indicated by pathway disappearance. The minimum as incorporated in the computer program is 200 feet AGL. The minimum altitude with a TWS or elevation tracking lock-on is radar derived and with azimuth-range or no lock-on is the computed difference between present position altitude and target keyboard altitude.

The ground range at which the pathway disappears for minimum altitude is approximately 3/4 mile.

ATTACK MODES

The weapons system has the capability of 4 computer controlled full system attack modes, 2 LABS modes and a delay mode.

PRIMARY ATTACK MODES

The primary system attack modes include general, straight path, high loft and rocket and are selected by depressing the desired ATTACK selector button on the armament control unit (ACU). The computer is stepped into the attack condition by depressing the attack button on the slew grip or the pilot's attack button on the stick grip. The computer cannot be stepped into attack when the computer error or RESELECT lights are on. The ATTACK light should come on indicating that the computer has entered the attack mode. The computer then continuously calculates a weapon release point based on the ballistics of the selected weapon and the attack mode, and provides horizontal steering commands to that point until weapon release. Vertical steering is also provided based on blast clearance altitude entered, the type of weapon selected, the attack mode selected and terrain avoidance considerations. Armament control unit and ballistic panel switch settings are tested for incompatibilities and if any are found, the RESELECT lights are turned on and the computer is stepped out of attack, turning off the ATTACK lights. The computer also checks for valid data failures. If a serious failure (i. e., system altitude or velocity breakdown)

which would prevent automatic release is found in four successive iterations, the following occurs:

- The COMPUTER lights on the DVRI and the VDI and the COMPT ERROR light on the DDU are turned on when release is inhibited.
- The applicable system advisory code (SAC) is displayed in window A5 of the DDU.

A less serious valid data failure (i.e., unexpectedly noisy inputs) will not cause an error light, but will be evidenced by the appropriate SAC on the DDU. If there is a valid data failure of any kind automatic release is inhibited and the VDI pathway is turned off. If a nuclear weapon is selected, valid data failure will not inhibit a system release. Release remains inhibited and the pathway remains off until the valid data failure disappears.

The general attack is a low loft delivery mode which may be used for free fall or retarded weapons and is suitable for the delivery of conventional or nuclear weapons. The general attack is the most suitable mode for use with visual boresight target acquisition or an automatic Shrike delivery.

The straight path attack is a non-accelerated delivery mode which may be used with free fall or retarded conventional weapons and with nuclear weapons. This attack may be used from a level or diving condition and it is particularly well suited for use with ground track bombing and for mining.

The high loft attack may be used with free fall or retarded conventional weapons and with nuclear weapons.

The rocket attack mode is designed specifically for the delivery of rockets and may not be used with any other type of weapon.

A complete description of each of the primary attack modes may be found in the A-6 Tactical Manual NAVAIR 01-85ADA-1T.

LAB IP AND LAB TARGET ATTACK MODES

The LAB IP and LAB TGT attack modes are non-computer controlled back-up loft delivery modes which may be used with free fall or retarded conventional weapons, Shrike missiles or nuclear weapons.

Automatic release of ordnance is provided at release angles preset in the inertial platform adapter. For a LAB IP release angles between 0° and 90° are available and for LAB TGT between 90° and 135° may be used. The release angles must be set before launch by ground personnel and can not be changed in flight. The angles to be used for nuclear weapons and for Shrike missiles may be found in the A-6 Tactical Manual NAVAIR 01-85ADA-1T.

The LAB IP or LAB TGT mode is selected by depressing the applicable ATTACK button on the ACU.

If the computer is on, it may not be stepped into attack and no attack steering is provided, however reselect logic protection is available. With the computer off, there is no reselect logic available. A description of the LAB IP and LAB TGT modes may be found in the A-6 Tactical Manual NAVAIR 01-85ADA-1T.

DELAY MODE

The DELAY mode, a non-computer controlled delivery which provides automatic release of ordnance at the end of a selected delay is selected by depressing the DELAY attack mode button on the ACU. This mode may be used with free fall or retarded conventional weapons or with nuclear weapons. If the computer is on, it may not be stepped into attack when DELAY is selected, however reselect logic protection is available. With the computer off there is no reselect logic available.

BORESIGHT TARGET ACQUISITION AND TRACKING MODE

The boresight target acquisition mode permits a system attack on a visual target. To use this mode, target steering or opportunity target or UNSTAB steering may be selected. After the cursors are initially positioned in the target area, the MODE switch on the B/N's control panel is set to BORESIGHT. Selecting BORESIGHT and attack aligns the optical sight moving reticle to the aircraft velocity vector in azimuth and 20 mils below the ADL in elevation, inhibits B/N cursor slewing, activates the computer boresight ranging mode and sets the DVRI cursors. In azimuth, the cursor reflects aircraft drift angle. In range the cursor is positioned to 48,000 feet in climbs or level flight, and in dives, to velocity vector line of sight to the surface. The pilot maneuvers the aircraft so as to place the optical sight moving reticle on the target, and when he is satisfied that the reticle is properly placed, depresses the attack commit trigger to the first detent (COP). This designates the target to the computer.

Note

The computer must be in attack prior to COP for a designate to be recognized. The pilot may re-designate a target at any time without cycling the attack button. Computer target position will be re-defined based upon the most recent designate.

The computer determines target position at designate based on velocity vector direction and system altitude. Target position is then updated continuously using system velocities. After the first designate, the designate position must be held for 1/2 second to be considered valid by the computer.

The system-derived target altitude data used at initial designate to compute line of sight range to the selected target is also used in the ballistic solution. Subsequent designations reset system target altitude as required.

Note

If there is no designation of the target before the pilot commits (i. e. depresses the attack commit trigger to the second detent) the computer regards the commit as a simultaneous designate and commit, and derives target position based upon the status of the moving reticle at commit.

The commit trigger should be released when the moving reticle is off the target and reselected when lined up. If the computer is stepped out of attack after designation, memory steering is provided to the designated target until attack is re-initiated.

With BORESIGHT selected, selection of STRAIGHT or HI LOFT on the ACU will automatically result in computer selection of a general attack, permitting a straight path maneuver after target designation without requiring 1 g unaccelerated flight at the release point.

SHRIKE TARGET ACQUISITION AND TRACKING MODE

Shrike target acquisition is enabled by selecting BORESIGHT, setting RKT/MSL on a Shrike-loaded weapon station and then setting the MASTER ARMT switch to ON.

Note

All missile deliveries require a 60 ms or longer setting on the ACU TIME thumb-wheel.

Depending upon aircraft altitude, the Shrike seeker head is capable of detecting targets at long ranges.

Once a suitable ground based radar target has been acquired, Shrike antenna azimuth and elevation angles are presented on the VDI as horizontal and vertical deflection of the steering symbol. Shrike target position is defined in range in the computer by a single point elevation boresight technique which determines slant range as a function of altitude and elevation angle. Azimuth is determined by aircraft heading at the time the target was boresighted. A second boresighting of the target permits a more precise fix of target azimuth position by triangulation.

When the Shrike missile acquires a target, the pilot maneuvers the aircraft to center the steering symbol on the VDI and when lined up satisfactorily, he depresses the attack commit trigger to the first detent, completing the single point boresight. Successive elevation ranges may be acquired by successive designates. A second boresight is acquired by slowly turning the aircraft away from the target to a relative bearing of 20° -30°. When the aircraft has flown long enough on the new heading, the in-range lights will flash and the target may again be boresighted when the attack commit trigger is depressed with the steering symbol centered on the VDI.

The impact point flashes to indicate that the computer is using the two-point azimuth solution.

To aid in centering the steering symbol, the target symbol is driven to the VDI centerpoint whenever the attack commit trigger is depressed to the first detent. The commit trigger should not be released until the steering and target symbols are superimposed.

Note

With BORESIGHT selected, the in-range lights do not flash at ballistic in-range in a Shrike attack. The release marker appears at ballistic in-range, however, providing a visual cue.

The Shrike defined target position is used to position the cursors on the DVRI.

After the cursors are initially placed by Shrike ranging, they revert to normal program control permitting radar tracking of the target when available without having to cycle steering.

Note

Shrike may be delivered without using the Shrike target acquisition mode by leaving the MODE switch at TRACK. When BORESIGHT is not selected, the in-range lights operate at ballistic in-range and steering remains normal.

VELOCITY CORRECT

When the system is operating in other than the doppler navigation option, the horizontal velocity values used by the computer to determine aircraft position and generate steering commands may be corrected from radar data either automatically or manually. If the search radar is in the track-while scan (TWS) mode or azimuth-range tracking mode, an automatic velocity correct may be performed. If none of these conditions exists, a manual velocity correct may be performed. Manual velocity correct calculations are based on a period of at least 10 seconds. If necessary more than one velocity correct may be accomplished.

The corrected velocities retained when the velocity correct switch is set to OFF SAVE are used by the system as follows:

- With the INS operating, in the DR, inertial, and Doppler-inertial navigation modes velocity correct is used to improve present position and cursor tracking and system closing velocity determination.
- During INS inflight alignment, in the DR navigation mode velocity is used to calculate accelerometer correction and gyro-torquing signals as well as for system velocity calculations and for improving present position and cursor position.

With a moving target lock-on and OFF SAVE selected, moving target velocities are calculated and displayed in the DDU but the retained velocity correct is used for navigation. Selecting OFF ERASE will erase both velocity correct and moving target velocities. Cycling the AMTI control will erase the moving target velocities. With AMTI on and a valid TWS or azimuth range lock, moving target velocities are automatically used without the necessity of selecting MEMORY POINT.

AUTOMATIC VELOCITY CORRECT

With the search radar providing valid TWS or azimuth range data or with a valid track radar discrete lock-on, setting the velocity correct switch on the B/N's pedestal to MEMORY POINT initiates an automatic velocity correct. While the automatic velocity correct is selected, the computer calculates a smoothed velocity correction for each scan based on the radar derived rate of change of target position.

MANUAL VELOCITY CORRECT

When a manual velocity correct is performed, the computer calculates a smoothed velocity correction based on radar-derived rate of change of DVRI cursor position with respect to a radar significant target on the DVRI. The cursor drift is introduced into the computer as follows:

1. In any ground stabilized steering mode, place the radar cursors on a persistent point target with the slew grip.
2. Allow the cursors to drift off the target for at least 10 seconds and set the VELOCITY CORRECT switch to MEMORY POINT.

Note

Manual velocity correct calculations are based on MEMORY POINT being selected for a period of at least 10 seconds but not longer than 128 seconds.

3. Replace the cursors on the original point, and note any additional cursor drift. If additional drift is observed, replace the cursors and continue the process until no further drift is observed.
4. When there is no further drift observed, set the VELOCITY CORRECT switch to OFF SAVE.

Setting the VELOCITY CORRECT switch to MEMORY POINT enables velocity correct calculations. Depressing one or both of the slew rate switches starts velocity correct timing in the computer, and target rate of change is calculated based on the amount of slew stick input.

For manual moving target tracking (cursor intersection or elevation tracking), a manual velocity correct is required to stabilize the cursors on a moving

target. The computer adjusts system velocities to compensate for target motion. At the completion of the run, these velocities should be erased by selecting OFF ERASE on the velocity correct switch, and a new velocity correct should be performed.

COMPUTER OPERATIONAL READINESS TEST (ORT)

In addition to the tactical flight program, the computer is provided with an additional program for self-test. Comprehensive built-in self-test features have been incorporated to detect, and aid in the isolation of system malfunctions. Fault isolation to a defective ARA is accomplished within approximately ten minutes. Both hardware and software type features are employed for this purpose.

The ORT is initialized at turn-on by placing the COMP MODE Switch in the TEST position and then turning on the computer. The computer may be placed into the test program from the flight program by depressing one of the OAP keys and setting the COMP MODE Switch to TEST. The basic ORT flow is described below.

Note

- To perform the ORT, the INS must be in OPER or ALIGN.
- The AAU-19 altimeter should be at STBY.
- To pass the ORT, the search radar power switch must be at STBY or ON.
- The VDI must be in CONT ANALOG

Immediately following ORT initialization, the COMPT ERROR light on the DDU will go on for a period of approximately 4 seconds, during which time the automatic computer self-test is performed to determine computer GO-NO-GO status.

As soon as the COMPT ERROR light goes out, the ATTACK light will go on for a period of approximately 4 seconds, during which time an automatic GO-NO-GO check of the majority of the interface electronic assembly (IEA) is performed.

With both lights (COMPT ERROR and ATTACK) now out, a portion of the indicators and indicator logic is automatically tested by commanding them to read 0's and dashes (-).

By depressing the CCU CLEAR button, the computer is stepped into a further check of the CCU and DDU indicators, and associated IEA logic. In a "GO" system the operator must observe 3's on all subsystem indicators.

Depressing the CLEAR button once again rotates the directional indicator (CCU, LATITUDE, and LONGITUDE) to the quantity S77777. Remaining indicators will be 7's. This test comprises a check of all CCU and DDU indicators, and IEA indicator logic.

Depressing the CLEAR button once again activates the discrete tests. This group of tests is concerned with exercising the strobed and unique discrete logic in the IEA which interfaces with CCU, slew control, DDU, and other aircraft equipments. These tests are basically manual in nature and are employed to test both computer subsystem discretes and all other aircraft/computer discrete interfaces.

Depressing CLEAR button again activates the analog/digital converter built-in test (BIT) modes as follows:

- The first BIT mode provides the performance of the central converter. Upon command, internally generated, fixed analog voltages are converted to digital form and the results are applied to the computer for evaluation. Different voltages are converted depending upon which two addresses are applied to the A/D converter.
- The second BIT mode is a test of the synchro input channels. Tests are accomplished when the computer commands a conversion using the channel under test. The results of this conversion are stored in the computer and the same analog input is then converted using the test channel. The computer evaluates the performance of the A/D converter by comparing the results.
- The third BIT mode serves to check the digital to analog conversion circuitry. The test of a particular channel is initiated by the computer transmitting an address and a predetermined digital word. The analog output resulting from the conversion is evaluated by an analog comparator in the A/D converter. A NO-GO indication is given to the computer if the resultant analog voltage is out of tolerance.

A failure during the A/D converter test stops the test and the readout in the G/S/LONG window indicates which test was failed. Depressing the CLEAR button permits the rest of the tests to be completed except for certain critical failures. See figure 8-12.

This completely automatic check-out of the A/D converter is completed in about three minutes. During this time, the BIT circuits of the air data computer (ADC) and the normal accelerometer are also activated.

The indications during these test modes are as follows:

- G/S/LONG reads 012000, then 011900, then 10600, if there are no failures between 011900 and 010600.
- G/S/LONG reading then decreases by 100's to 003400.
- G/S/LONG then reads 111111. A failure of the A/D converter test results in a readout other than 111111.

- ATTACK light on means air data computer out of tolerance/failure.
- COMPT ERROR light on means normal accelerometer failure.

Finally, by depressing the CLEAR button again the slew control synchro test is initiated. This test checks the maximum and intermediate positions of the slew stick in all four quadrants by displaying direction and angle quantities in the LATITUDE and LONGITUDE windows on the DDU as a function of a slew stick position. Selecting ENTER re-establishes the computer in the flight program and displays a power-up 001 system advisory code (SAC).

SYSTEM ADVISORY CODES

During each iteration of the computer program, tests are performed to evaluate system performance, and a failure causes a system advisory code (SAC) to be displayed in window A5 of the DDU. These tests and their resulting SAC's are categorized as either serious system deficiencies or minor difficulties which are temporary and correctable. The serious deficiencies are assigned a high display priority and the minor difficulties a low priority. If both a high priority failure and a low priority failure are detected simultaneously, the displayed SAC will be that for the high priority failure. Figure 8-15 lists the SAC's and the failures they indicate.

HIGH PRIORITY SAC'S

The high priority SAC's (figure 8-15) are those which have a zero in the left digit and indicate a failure of a serious nature. The computer error lights are turned on when a serious failure is present. These tests are monitored at all times in and out of attack.

In a non-attack condition, a failure must occur in four successive iterations to cause a SAC to be displayed and the computer error lights to be turned on. The SAC and error lights can be removed only by depressing the SAC ACTION key on the keyboard. The computer cannot be stepped into attack when the error lights are on.

In attack, a failure in only one iteration is necessary to cause a SAC to be displayed and the computer error light to be turned on. If the condition causing the failure disappears, and the valid data test is satisfied, the SAC will be erased and the lights turned off automatically.

LOW PRIORITY SAC'S

The low priority SAC's (figure 8-15) are those which have other than zero in the left digit and indicate difficulties of a minor nature. These tests are monitored only in attack after in-range. The computer error lights do not come on for failures of this nature and the SAC is erased automatically when the failure disappears.

A/D CONVERTER TESTS

G/S LONG READOUT	TEST FAILED	MISSION IMPACT	G/S LONG READOUT	TEST FAILED	MISSION IMPACT
012000	START TEST	CANNOT BYPASS SYSTEM NOT AVAILABLE	009300	S/R ELEVATION TRACK RATE	DEGRADED ELEVATION TRACKING
011900	CONVERTER CIRCUITRY		009200	COMMAND AFCS	NOT USED
011800	CONV. REF VOLT A		009100		
011700	CONV. REF VOLT B		009000	VDI PATHWAY	PATHWAY PRESENTATION INVALID
011600	S/R ANTENNA ELEV ANGLE	ELEVATION TRACKING INVALID	008900		
011500	ROLL	DEGRADED NAVIGATION/ATTACK ACCURACIES	008800	STEERING SYMBOL	HORIZONTAL POSITION INVALID
011400	TRUE HEADING		008700	IMPACT POINT	
011300	PITCH		008600	TARGET SYMBOL	
011200	DOPPLER GS	DOPPLER INVALID	008500	RELEASE MARKER	INDICATIONS INVALID
011100	DOPPLER DRIFT		008400	CMD HDG LINES	
011000	TEMPERATURE PROBE	TRUE AIRSPEED INVALID	008300	PATHWAY APEX	
010900	SLEW RANGE RATE	DEGRADED SLEW CAPABILITY	008200	LAND MODE ALT.	
010800	SLEW AZ RATE		008100	PULL-UP MARKER	
010700	STATIC PRESSURE	SYSTEM ALTITUDE INVALID	008000	PATH PULL-UP	DISTORTED PATHWAY
010600	MACH	TAS INVALID	007900	RELEASE MARKER	DISTORTED SIZE
010500	ENABLE AIR DATA COMP TEST	AIR DATA COMP TEST INVALID	007800	SPARE	NONE
010400	INERTIAL	INS VELOCITIES INVALID	007700		
010300	INERTIAL	INS VELOCITIES INVALID; MAY RESULT IN LOSS OF PRIMARY ATTITUDE REFERENCE	007600	NOT APPLICABLE	NONE
010200			007500	INERTIAL	INS VELOCITIES INVALID
010100			007400	STEERING SYMBOL	VERTICAL POSITION INVALID
010000	OPTICAL SIGHT MOVING RETICLE	MOVING RETICLE INVALID	007300	TARGET SYMBOL	
009900			007200	IMPACT POINT	
009800	DVRI REL BRNG	DVRI REL BRNG UNRELIABLE	007100	INERTIAL	INS VELOCITIES INVALID; MAY RESULT IN LOSS OF PRIMARY ATTITUDE REFERENCE
009700	PHD CMD HDG	PHD BUG UNRELIABLE	007000		
009600	INERTIAL	INS ALTITUDE INVALID	006900		
009500		INS VELOCITIES INVALID	006800	INERTIAL	INS VELOCITIES INVALID
009400	INFLIGHT ALIGN	DEGRADED INFLIGHT ALIGN CAPABILITY	006700	INERTIAL	INS VELOCITIES INVALID; MAY RESULT IN LOSS OF PRIMARY ATTITUDE REFERENCE
			006600		
			006500		
			006400	CONVERTER RESET	CANNOT BYPASS SYSTEM NOT AVAILABLE
			006300	TIME OUT CIRC CK	
			006200	RESET COMPUTER DISCRETE SIGNALS	WEAPON SYSTEM ADVISORY LIGHTS INVALID

Figure 8-12 (Sheet 1)

NOTE • 006100 THROUGH 003400 ARE CHECKS OF COCKPIT INDICATORS AND COMPUTER DISCRETE OUTPUTS ONLY AND ARE NOT SYSTEM DEGRADING WITH THE FOLLOWING EXCEPTIONS:

G/S LONG READOUT	TEST FAILED	MISSION IMPACT
005700	BORESIGHT ON	BORESIGHT MODE INOPERATIVE
005600	ELEVATION TRACK ON	ELEVATION TRACKING INOPERATIVE
005100	AZIMUTH RANGE ON	AZIMUTH RANGE TRACKING INOPERATIVE
004200	VIDEO TAPE RECORDER ON	NO AUTOMATIC TURN-ON OF VTR

NOTE • AT THE COMPLETION OF THE A/D CONVERTER TESTS THE FOLLOWING INDICATIONS APPLY:

G/S LONG READOUT	TEST FAILED	MISSION IMPACT
111111	NONE	A/D CONVERTER TESTS COMPLETE NO FAILURES
111111	ATTACK	AIR DATA COMPUTER SELF TEST FAILURE/OUT OF TOLERANCE
111111	COMPT ERROR	NORMAL ACCELEROMETER FAILURE

NOTE

- IF A FAILURE INDICATION IS OBSERVED, THE A/D CONVERTER TEST SHOULD BE RE-RUN SEVERAL TIMES TO ESTABLISH THAT THE PROBLEM IS CONSISTENT AND VALID.

SYSTEM FAILURES IN ATTACK

Any existing SAC will cause the VDI pathway to be turned off and will cause weapon release to be inhibited while the SAC is present. If a release is inhibited due to the presence of a SAC, the computer error lights will come on, and the appropriate SAC will remain on display after the program steps out of attack.

COMPUTER CONTROLS

Controls for operating the computer are on the digital display unit (DDU) and the computer control unit (pedestal), (figure 8-13).

DIGITAL DISPLAY UNIT CONTROLS

COMPUTER Switch

The COMPUTER switch is a two-position level lock toggle switch marked ON and OFF, that controls power application to the computer. When the switch is at OFF no power is applied. Selecting ON supplies 3 phase 400 Hz 115 volts AC and 28-volt-DC from the primary buses.

DATA SELECT Switch

The DATA SELECT switch is a 3-position toggle switch with positions marked A, B, and C. This switch controls which data is displayed in the 5 FLT DATA windows. Figure 8-15 represents the data displayed for each of the switch positions for the attack condition and the non-attack condition.

Flight Data Windows

The 5 FLT DATA windows numbered 1 through 5, present 3-digit readouts of computer data as selected with the DATA SELECT switch. See figure 8-15.

Navigation Data Switch

The navigation data switch is a 3-position toggle switch marked DATA, PRES POS and ON CALL that controls which readouts are to be displayed in the 3 navigation data windows. Figure 8-15 shows the readouts displayed for each of the switch positions for the non-attack condition and for the attack condition.

Note

The ON CALL readouts for TGT 1-4 or NAV XPT are updated to agree with cursor position when it is slewed by the B/N, however the computer retains the actual coordinates of the position for present position correct.

Navigation Data Windows

The 3 navigation data windows are marked WIND SPEED/LAT, G/S/LONG, and WIND DIR/ALT. These windows display readouts as selected with the navigation data switch (figure 8-15).

CORRECT POS Button

The CORRECT POS button is a pushbutton switch permitting system present position to be updated using radar information. With the COMPT MODE switch at STEER and any of the 4 target keys, or the NAV XPT key depressed, the latitude and longitude of system present position may be updated by placing the radar cursors on the selected target and depressing the CORRECT POS button. If UNSTAB is not selected, system altitude is also updated to temperature-corrected pressure altitude. This function is available either in the attack or non-attack condition.

Navigation Mode Selector Switch

The navigation mode selector switch is a 3-position toggle switch marked EMER DOP INERL, and DR which permits selection of the computer navigation option. See figure 8-7. When the switch is at EMER DOP, the Doppler navigation option is selected. When the switch is at INERL with no valid Doppler signal present, the inertial option is selected. With the switch at INERL, and a valid Doppler signal present, the Doppler inertial option is selected. When the switch is at DR, the dead reckoning option is selected.

COMPT ERROR Light

The computer error (COMPT ERROR) light is a flush-mounted amber advisory light which comes on when one or more errors or valid data failures exist in the computer. There are 2 repeaters of this light both marked COMPUTER, one on the DVRI light panel and one on the lower right corner of the VDI. The light on the DDU and the repeater on the DVRI light panel are tested by depressing the B/N MASTER TEST button. The pilot's repeater on the VDI may be tested by depressing the LTS WARN button.

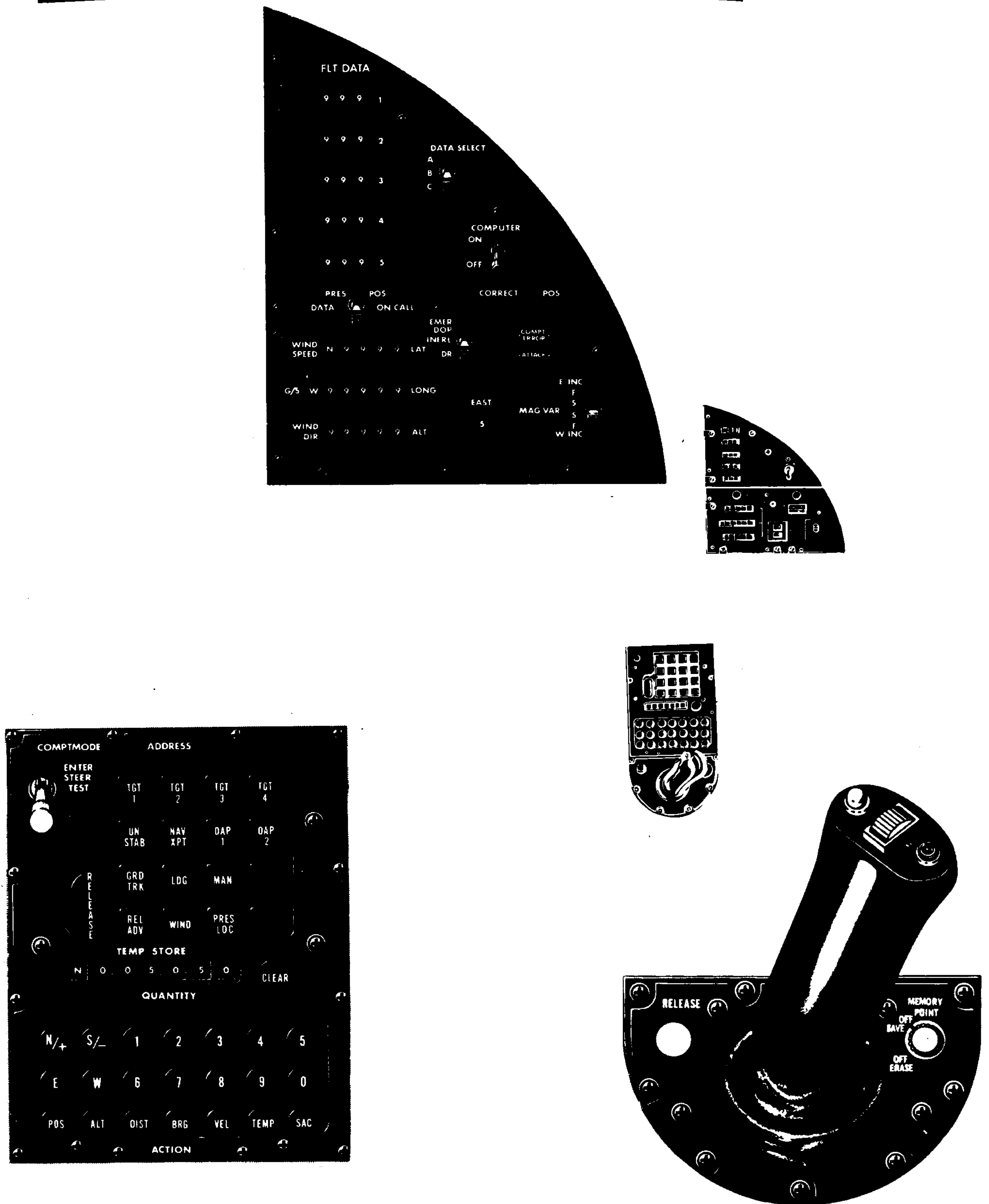
ATTACK Light

The ATTACK light is a flush-mounted white advisory light which goes on when the computer is stepped into the attack condition. Repeater of this light are on the DVRI light panel and on the lower left corner of the VDI. The bombardier/navigator's lights may be tested by depressing the B/N MASTER TEST button and the pilot's repeater may be tested by depressing the LTS WARN button. If the light goes out during an attack, it indicates that a valid solution is no longer possible and the attack will have to be re-initialized. The ATTACK light has a special use during ORT which is explained in the description of the ORT.

MAG VAR Switch and Indicator

Magnetic variation for use in the system is inserted by use of a 5-position slew switch spring-loaded to the neutral (off) position. The switch is marked E INC and W INC and its 2 extreme positions are marked F while the 2 intermediate positions are marked S. Holding the switch to one of the F positions increases magnetic variation in the selected direction at a slower rate. The value and direction of the variation in use are displayed in a 2-window indicator next to the MAG VAR switch.

COMPUTER CONTROLS AND INDICATORS



A-ADF1-105

Figure 8-13

DIGITAL DISPLAY UNIT READOUTS

The digital display unit presents readouts to permit evaluation of system operation, analysis of malfunctions, and reconstruction of release conditions so that weapon impact errors can be analyzed. See figure 8-15. The readouts displayed may differ depending on whether the computer is or is not in attack. Three sets of readouts are available for display in the flight data windows in the upper portion of the DDU controlled by the DATA SELECT switch, and three sets of readouts, controlled by the navigation data switch, are available for display in the navigation data windows in the lower portion of the DDU. In discussion, the flight data window readouts are identified by the DATA SELECT switch position and window number and the navigation data readouts by the navigation data switch position and the window label.

Note

- Flight data windows 3, 4, and 5 and the WIND DIR/ALT navigation data window show a minus (-) in the first dial when displayed readout is negative. All other readouts are positive or absolute values.
- The display readouts are not updated during keyboard entry while the QUANTITY keys are depressed.

Flight Data Non-Attack Readouts

A1

True airspeed is derived from air data computer Mach number corrected for angle of attack and temperature and is displayed in knots.

A2

Ground track heading is the computer-calculated direction of the aircraft ground track measured clockwise from true north and displayed in degrees.

A3

Vertical velocity is the system-derived aircraft vertical velocity from the baro-inertial vertical loop and absolute value (ignoring sign) is displayed in feet per second.

A4

Velocity correction or moving target velocity magnitude is displayed in knots. See figure 8-14.

A5

The highest priority system advisory code is displayed. Depressing the SAC key erases the displayed SAC, and permits the next priority SAC to be displayed if the cause of the first SAC has been corrected.

B1

Static pressure from the air data computer is displayed in tenths of an inch of mercury.

B2

Ground speed from the Doppler is displayed in knots.

B3

Drift angle from the Doppler is displayed in degrees.

B4

Ambient air temperature from the temperature probe or system computation is displayed in degrees F. For a positive value, no sign is displayed, for a negative value a minus sign and two digits is displayed. Sensor value is not displayed until Mach exceeds .15 (101 knots at sea level).

B5

Aircraft roll angle from the INS is displayed in degrees. A positive readout indicates right wing down; a negative readout indicates left wing down.

C1

This readout displays the program identification number.

C2

The absolute value (ignoring the sign) of search radar depression angle input is displayed in tenths of a degree. During memory tracking, the last useful angle input remains displayed.

VC/MTV DISPLAY LOGIC

VELOCITY CORRECT SWITCH	AMTI SWITCH	DISPLAYED QUANTITY
NOT MEMORY PT	OFF	VELOCITY CORRECT (IF ANY EXISTING)
NOT MEMORY PT	ON	TARGET VELOCITY IN USE BY SYSTEM
MEMORY PT	OFF	VELOCITY CORRECT
MEMORY PT	ON	SYSTEM CLOSING ERROR* (TARGET AND CORRECTION VELOCITIES)

*MOVING TARGET SOLUTION HAS PRIORITY

ADF1-108

Figure 8-14

C3

NEW System depressing angle to the target is displayed in degrees. A negative value indicates that the target is lower than the aircraft.

C4

NEW Aircraft true angle of attack derived from the angle of attack probe or system computation is displayed in tenths of a degree. The readout is always positive when the ADL is above the airspeed vector and negative when the ADL is below the airspeed vector.

C5

Zeroes are displayed when not in attack.

Flight Data Attack Readouts

A1

This readout is the same as for non-attack.

A2

This readout is the same as for non-attack.

A3

This readout is the same as for non-attack.

A4

This readout is the same as for non-attack.

A5

NEW This readout is the same as for non-attack.

B1

System-defined total aircraft velocity relative to the earth is displayed in knots.

B2

Aircraft true heading from the INS is displayed in degrees.

B3

The system value of corrected aircraft elevation angle measured from the horizontal to the ADL is displayed in degrees. The readout is positive for ADL above the horizontal and negative for ADL below the horizontal.

B4

System calculated weapon ballistic time of fall is displayed in seconds times 0.1.

B5

Computed azimuth steering error to destination. A positive readout is an error to the left, a negative readout is an error to the right.

C1

This readout displays a code identifying the source of target tracking data. See figure 8-15.

C2

The acceleration (load factor) normal (perpendicular) to the aircraft ADL measured by the normal accelerometer or system back-up computation is displayed in tenths of a g.

C3

Weapon release angle (figure 8-15) is displayed in degrees.

C4

Search radar depression angle input measured from the horizontal to the target line of sight is displayed in degrees. A negative readout indicates that the target is lower than the aircraft.

DIGITAL DISPLAY UNIT READOUTS

FLIGHT DATA WINDOWS

WINDOW	NON - ATTACK						ATTACK					
	DATA SELECT POSITION						DATA SELECT POSITION					
	A		B		C		A		B		C	
	UNITS	ADD	UNITS	ADD	UNITS	ADD	UNITS	ADD	UNITS	ADD	UNITS	ADD
1 [X][X][X]	KNOTS	-	IN /10	-	-	-	KNOTS	-	KNOTS	-	-	-
	TRUE AIRSPEED		STATIC PRESSURE		PROGRAM IDENTIFIER		TRUE AIRSPEED		TOTAL AIRCRAFT VELOCITY		TRACKING CODE 3	
2 [X][X][X]	DEG	-	KNOTS	-	DEG/10	-	DEG	-	DEG	-	G/10	-
	GROUND TRACK HEADING		DOPPLER VELOCITY		INPUT DEPRESSION ANGLE		GROUND TRACK HEADING		INS TRUE HEADING		NORMAL LOAD FACTOR	
3 [*][X][X]	FPS	0	DEG	-	DEG	-	FPS	0	DEG	-	DEG	-
	SYSTEM VERTICAL VELOCITY		DOPPLER DRIFT ANGLE		DEPRESSION ANGLE TO TARGET		SYSTEM VERTICAL VELOCITY		ELEVATION ANGLE (PITCH)		RELEASE ANGLE 4	
4 [*][X][X]	KNOTS	-	DEG F.	-	DEG/10	-	KNOTS	-	SEC/10	-	DEG	-
	VELOCITY CORRECT OR MOVING TARGET VELOCITY		AMBIENT AIR TEMPERATURE		ANGLE OF ATTACK		VELOCITY CORRECT OR MOVING TARGET VELOCITY		TIME OF FALL		SEARCH RADAR DEPRESSION ANGLE INPUT	
5 [*][X][X]	-	-	DEG	-	FEET	00	-	-	MILS	-	FEET	00
	SYSTEM ADVISORY CODES 1		INS ROLL ANGLE		RELEASE ADVANCE 2		SYSTEM ADVISORY CODES 1		STEERING ERROR		RELEASE ADVANCE 2	

X DIGITS AVAILABLE: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9
* DIGITS AVAILABLE: 0, 1, 2, 3, 4, 5, 6, 7, -, BLANK

NAVIGATION DATA WINDOWS

NAVIGATION DATA SWITCH - DATA

WINDOW	ATTACK	NON-ATTACK
WIND SPEED/LAT [*][X][X][X]	WIND VELOCITY (KNOTS)	WIND VELOCITY (KNOTS)
G/S /LONG [*][X][X][X][X]	GROUND TRACK VELOCITY (KNOTS)	GROUND TRACK VELOCITY (KNOTS)
WIND DIR/ALT [*][X][X][X]	WIND DIRECTION (DEGREES)	WIND DIRECTION (DEGREES)

NAVIGATION DATA SWITCH - PRES POS

WINDOW	ATTACK	NON-ATTACK
WIND SPEED/LAT [*][X][X][X]	WEAPON CODE 5	PRESENT POSITION LATITUDE (DEGREES, MINUTES)
G/S /LONG [*][X][X][X][X]	VERTICAL SEPARATION (FEET)	PRESENT POSITION LONGITUDE (DEGREES, MINUTES)
WIND DIR/ALT [*][X][X][X]	SYSTEM ALTITUDE - MSL (FEET)	SYSTEM ALTITUDE - MSL (FEET)

NAVIGATION DATA SWITCH - ON CALL

WINDOW	ATTACK	NON-ATTACK
WIND SPEED/LAT [*][X][X][X]	COMPUTED BALLISTIC RANGE (FEET) ** 6	BASED ON STEERING KEY SELECTION 7
G/S /LONG [*][X][X][X][X]	GROUND RANGE TO TARGET (FEET)	BASED ON STEERING KEY SELECTION 7
WIND DIR/ALT [*][X][X][X]	COMPUTED TARGET ALTITUDE (FEET)	BASED ON STEERING KEY SELECTION 7

* DIGITS AVAILABLE: WINDSPEED/LAT } N, S, E, W, 0, 1, 2, 3, 4, 5
G/S /LONG }
WIND DIR/ALT 0, 1, 2, 3, 4, 5, 6, 7, 8, -
X DIGITS AVAILABLE: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9

**DISPLAYED IN FEET X 10 WHEN RANGE EXCEEDS 60,000 FEET.

Figure 8-15 (Sheet 1)

DIGITAL DISPLAY UNIT READOUTS—CONT:**NOTE****1 SYSTEM ADVISORY CODES (SAC's):**

SAC REASON

001 COMPUTER POWER UP SEQUENCE INDICATOR

002 FAILURE TO ENTER PRES POS LATITUDE AT TURN ON

009 INCOMPLETE ITERATION. PERFORM ORT.

010 TAS - GS ERROR. CHECK VELOCITY INPUTS.

011 VERTICAL LOOP ERROR. CHECK STATIC PRESSURE AND VERTICAL VELOCITY INPUTS. RE-ENTER PRES POS ALTITUDE

013 CYCLING STEERING IN MEMORY POINT

110 PILOT FAILED TO COMMIT

111 EXCESSIVE STEERING ERROR

112 EXCESSIVE BALLISTIC RANGE ERROR*

113 NORMAL ACCELEROMETER-SYSTEM VELOCITY INCONSISTENCY. CHECK THESE INPUTS.

114 FAILURE TO RELEASE DUE TO NOISY COMPUTER INPUT

*NOT DUE TO ANY SINGLE OPERATOR OR SYSTEM ERROR

2 INCLUDES ONE-HALF STICK LENGTH FOR TRAIN RELEASES AND/OR RELEASE ADVANCE**5 WEAPON CODES:****3 TRACKING CODES:**

CODE SOURCE

000 CURSOR INTERSECTION

001 MEMORY AZ-RANGE

010 MEMORY ELEVATION ANGLE

011 MEMORY TWS

101 AZ-RANGE

110 ELEVATION ANGLE

111 TWS

4 RELEASE ANGLES:

FREE FALL LOFT — RELEASE ANGLE IN DEGREES

FREE FALL STRAIGHT PATH — AIRCRAFT VELOCITY VECTOR IN DEGREES

RETARD BOMBS — ANGLE TO GO TO RELEASE

ROCKETS — LAUNCH ANGLE IN DEGREES

ACU TAPE LEGEND	WEAPON	RACK/ CAR- TRIDGE	ARM/FUZE		CODE	ACU TAPE LEGEND	WEAPON	RACK/ CAR- TRIDGE	ARM/FUZE		CODE
			MECH	ELEC					MECH	ELEC	
FFB-A	SPARE FREE FALL BOMB				1	F76	FREE FALL MK-76 PB	MER / MK2	2	3	07606
FFB-B	SPARE FREE FALL BOMB				1	F61	FREE FALL MK-61 NUCLEAR	AERO-7A / MK51			06101
FFB-C	FREE FALL MK-76 PB	X4D			S7646	F57	FREE FALL MK-57 NUCLEAR	AERO-7A / MK51			05701
F117	FREE FALL M-117 DEMO	MER / MK2	X		1	F43	FREE FALL MK-43 NUCLEAR	AERO-7A / MK1, 2			04301
F116	FREE FALL MK-116 WETEYE	MER / MK2			11606	F28	FREE FALL MK-28 NUCLEAR	AERO-7A / MK1, 2			02801
F94	FREE FALL MK-94 CHEMICAL	MER / MK2			09406	R43	RETARDED MK-43 NUCLEAR	AERO-7A / MK1, 2			04351
F84A	FREE FALL MK-84 GP	AERO-7A / MK1, 2			08401	R57	RETARDED MK-57 NUCLEAR	AERO-7A / MK51			05751
F83A-E	FREE FALL MK-83 GP	AERO-7A / MK1, 2		X	1	R61	RETARDED MK-61 NUCLEAR	AERO-7A / MK51			06151
F83T-E	FREE FALL MK-83 GP	TER / MK2		X	1	RET-A	SPARE RETARDED BOMB				1
F83A-M	FREE FALL MK-83 GP	AERO-7A / MK1, 2		X	1	R40	RETARDED MK-40 DESTRUCTOR	MER / MK2			04052
F83T-M	FREE FALL MK-83 GP	TER / MK2	X		08303	R81	RETARDED MK-81 SNAKEYE	MER / MK2			08156
F82-E	FREE FALL MK-82 GP	MER / MK2		X	1	R82	RETARDED MK-82 SNAKEYE	MER / MK2			08256
F82-M	FREE FALL MK-82 GP	MER / MK2	X		08206	R106	RETARDED MK-106 PB	MER / MK2	2		10656
F82SN	FREE FALL MK-82 SNAKEYE	MER / MK2	X		08216	R20	RETARDED MK-20 ROCKEYE	MER / MK2			02056
F81SN	FREE FALL MK-81 SNAKEYE	MER / MK2	X		08106	CBU-24	RETARDED CBU-24 CLUSTER	MER / MK2			32053
F77	FREE FALL MK-77 FIRE	MER / MK2			07702	R-CL-A	SPARE RETARDED CLUSTER				1

DIGITAL DISPLAY UNIT READOUTS—CONT: NOTE

ACU TAPE LEGEND	WEAPON	RACK/ CAR- TRIDGE	ARM/FUZE		CODE	ACU TAPE LEGEND	WEAPON	RACK/ CAR- TRIDGE	ARM/FUZE		CODE
			MECH	ELEC					MECH	ELEC	
FLARES	MK6 OR 24 PARAFLARE	AERO-7A			1	CBU-1, 2	RETARDED CBU-1 OR CBU-2				1
R36	RETARDED MK-36 MINE	AERO-7A			1	RKT-A	SPARE ROCKET				1
R50	RETARDED MK-50 MINE	AERO-7A			1	RKT-B	SPARE ROCKET				1
R52	RETARDED MK-52 MINE	AERO-7A			1	RKT-C	SPARE ROCKET				1
R56	RETARDED MK-56 MINE	AERO-7A			1	RKT-D	SPARE ROCKET				1
MINE-A	SPARE MINE				1	275H151	2.75 FFAR, MK-151 HEAD	AERO-7A, TER			27515
MINE-B	SPARE MINE				1	275	2.75 FFAR, MK 5 HEAD	AERO-7A, TER			27500
MINE-C	SPARE MINE				1	ZUNI	5-INCH ZUNI FFAR	AERO-7A, TER			05555
MK4 GUN	MK-4 GUN POD	AERO-7A			1	SHRIKE	AGM-45A SHRIKE MISSILE	AERO-5A			03902
POD-A	SPARE GUNS OR NON-WEAPON				4	MSL-A	SPARE MISSILE				1
POD-B	SPARE GUNS OR NON-WEAPON				4	MSL-B	SPARE MISSILE				1
POD-C	SPARE GUNS OR NON-WEAPON				4	SWDR	AIM-9D SIDEWINDER MISSILE	LAU-7/A			1
POD-D	SPARE GUNS OR NON-WEAPON				4	BULLPUP	AGM-12C BULLPUP MISSILE	AERO-7A			1
T300	AERO-1D DROP OR D-704 BUDDY				4	WALL I	WALLEYE MISSILE	AERO-7A			1
T450	450 GAL FUEL TANK				4	CONDOR	CONDOR MISSILE	AERO-7A			1
T-SPARE	SPARE TANK				4	STD ARM	AGM-78A STD ARM MISSILE	ELA			1

- 1 NO BALLISTIC DATA IS PROGRAMMED. SOLID RESELECT LIGHT INHIBITS AUTOMATIC RELEASE IF SELECTED.
- 2 STORED TIME DELAY ASSUMES F76/R106 CARRIAGE ON MER/TER. USE OF X4D INCREASES DELAY TIME BY .040 SEC, CAUSING LONG IMPACT.
- 3 F76 TREATED AS NUCLEAR WITH T-375 AT AIR OR GRD; NON-NUCLEAR WITH T-375 AT OFF OR SAFE. FOR NON-NUCLEAR, RESELECT LOGIC REQUIRES USE OF EITHER MECHANICAL ARMING OR ELECTRIC FUZING.
- 4 NO MANUAL OR AUTOMATIC RELEASE PERMITTED. JETTISON ONLY.

6 BALLISTIC RANGE:
STRAIGHT PATH — CALCULATED DISTANCE TO TARGET
RETARDED LOFT — CALCULATED DISTANCE TO TARGET
FREE FALL GENERAL AND LOFT — COMPUTED BALLISTIC RANGE
ROCKET — WEAPON TRAVEL AT RELEASE (LIMITED TO 13,500 FEET)

7 NON-ATTACK ON CALL READOUTS:

KEY SELECTED (LOWEST ROW)	WIND SPEED/LAT WINDOW	G/S /LONG WINDOW	WIND DIR/ALT WINDOW
TGT 1-4, UNSTAB, OR OP TGT (NO KEY DEPRESSED)	LAT. CURSOR INTERSECTION (DEGREES, MINUTES)	LONG. CURSOR INTERSECTION (DEGREES, MINUTES)	COMPUTED TARGET ALTITUDE (FEET) <div></div>
GRD TRK	KEYBOARD BLAST CLEARANCE ALTITUDE ABOVE TGT (FEET)	KEYBOARD GROUND TRACK HEADING (DEGREES)	
LDG	0 0 0 0 0	KEYBOARD RUNWAY TRUE HEADING (DEGREES)	
NAV XPT	KEYBOARD CHECKPOINT LAT. (DEGREES, MINUTES)	KEYBOARD CHECKPOINT LONG. (DEGREES, MINUTES)	
OAP1, TGT 1-4 OR OAP2, TGT 1-3	KEYBOARD TGT — OAP RANGE (FEET)	KEYBOARD TGT — OAP TRUE BEARING (DEGREES)	
OAP2, TGT 4	KEYBOARD TGT 4 — OAP2 N/S RANGE COMPONENT (METERS)	KEYBOARD TGT 4 — OAP2 E/W RANGE COMPONENT (METERS)	

ADF1-91-3

Figure 8-15 (Sheet 3)

C5

Selecting TEST initializes the ORT program.

When release advance (range offset) and/or train bombing is being used, the total ground distance from first impact to target is displayed to the lowest 100 feet. Values less than 100 feet read zero. A negative readout indicates impact beyond the target, a positive readout indicates impact short of the target. Zeroes are displayed when release advance is not in use.

Navigation Data Readouts

Figure 8-15 presents the readouts available in the three navigation data windows in the attack and non-attack condition for the DATA, PRES POS, and ON CALL positions of the navigation data switch.

Data Freeze at Weapon Release

Six seconds after weapon release, all readouts for all positions of the DATA SELECT switch and the navigation data switch stop updating and the values at the time of release are displayed. The displayed values will change as the position of these switches is changed but they will not update until an ACTION key is depressed.

COMPUTER CONTROL UNIT CONTROLS

The computer control unit (CCU) (figure 8-13) contains the controls for manual entry of data into the computer memory unit steering selection, and replacement of invalid aircraft data. The controls consist of a mode selector switch, a keyboard and a temporary storage window. The keyboard is composed of 16 ADDRESS keys and a RELEASE key, 14 QUANTITY keys, and 7 ACTION keys.

COMPT MODE Switch

The computer mode (COMPT MODE) switch is a 3-position lever-lock toggle switch marked ENTER, STEER and TEST. With the COMPUTER switch at ON, the COMPT MODE switch is used to select the function of the keyboard or to select the ORT program. When the switch is at ENTER, the keyboard is used for the manual entry of data into the computer memory. In the ENTER mode, the procedure for manual entry of data is to select an address, enter the appropriate data into the TEMP STORE indicator in right justified 1-letter, 6-digit format using the appropriate QUANTITY keys, and then depress the appropriate ACTION key.

When the switch is at STEER, the ADDRESS keys are used to select the desired computer steering.

Note

Program logic requires that the computer be placed in the ORT program on turn-on on the ground.

ADDRESS Keys

The 16 ADDRESS keys are arranged in 4 rows of 4 keys. In the third and fourth rows, the fourth key is an unmarked spare reserved for future use. Each row of keys has a mechanical interlock to prevent depressing more than one key in that row at a time. The computer sequences through the ADDRESS keys from bottom row to top row.

When the COMPT MODE switch is at ENTER, the ADDRESS keys are used to identify to the computer the address at which manual entries of data by means of the QUANTITY and ACTION keys are to be stored.

When the COMPT MODE switch is at STEER, the ADDRESS keys are used to select the mode of steering to be provided by the computer.

TGT KEYS - The keys in the top row are marked TGT 1, TGT 2, TGT 3 and TGT 4. When the COMPT MODE switch is at ENTER, depressing one of the TGT keys permits a geographical position and altitude to be entered for that address. Latitude and longitude are entered in degrees minutes and tenths using the POS ACTION key. Altitude (MSL) is entered in feet using the ALT action key. When the COMPT MODE switch is at STEER, depressing a TGT key selects the stored geographical position to which the computer will provide steering.

UNSTAB KEY - With the COMPT MODE switch at ENTER, depressing the UN STAB key permits entry of the range to which the radar cursors initially move when unstabilized steering is selected. Range is entered in miles using the DIST ACTION key. When the COMPT MODE switch is at STEER, depressing the UN STAB key alone selects unstabilized steering on the VDI, PHD and DVRI. If any TGT key is selected jointly with UNSTAB, continuous steering to that target will be displayed on the VDI and PHD while the DVRI cursors remain unstabilized. UNSTAB steering will automatically revert to opportunity target stabilized steering whenever the computer is stepped into attack.

NAV XPT KEY - When COMPT MODE switch is at ENTER depressing the NAV XPT key permits

latitude, longitude and altitude to be entered for a navigation checkpoint. Latitude and longitude are entered in degrees, minutes, and tenths using the POS ACTION key and altitude (MSL) is entered in feet using the ALT ACTION key. With STEER selected, depressing NAV XPT alone selects the stored geographical position to which the computer will provide steering. If NAV XPT is selected jointly with a target key, and the target key was selected first, memory steering to that target will be displayed on the VDI and PHD while the DVRI cursors will be positioned at the checkpoint, thus permitting the bombardier/navigator to check or update the computer present position without disturbing any other selected steering provided to the pilot. See figure 8-10. When the computer is stepped into attack, VDI and PHD steering and the DVRI cursors all will reflect the NAV XPT selection.

OAP KEYS - There are two OAP keys marked OAP 1 and OAP 2. These keys must be used in conjunction with one of the TGT keys. When the COMP MODE switch is at ENTER, the location of 2 offset aimpoints for each of the 4 target locations can be entered. With any of the TGT keys and OAP 1 depressed, or with TGT 1 through 3 and OAP 2 depressed, the true bearing from the selected target to the selected aimpoint, the range from target to aimpoint and the MSL altitude differential from target to aimpoint may be entered. Bearing is entered in degrees, minutes and tenths using the BRG ACTION key. Range is entered in feet using the DIST ACTION key and differential altitude is entered in feet using the ALT ACTION key. With TGT 4 and OAP 2 depressed, the N/S and E/W components of target to aimpoint range and the differential MSL altitude between target and aimpoint may be entered. Range components are entered in meters using the DIST ACTION key and the differential altitude is entered in feet using the ALT ACTION key.

When the CMPTR MODE switch is at STEER, depressing one of OAP keys selects an offset aimpoint associated with the target identified by the depressed TGT key. The cursors and DVRI range and bearing indications are to the offset aimpoint and VDI and PHD steering is provided to the selected target.

Note

Selection of an OAP key without an associated target will result in an error code which is displayed in the temporary storage indicator.

GRD TRK KEY - With the CMPT MODE switch at ENTER, depressing the GRD TRK key permits the true bearing of a command ground track for bombing to be entered in degrees, minutes and tenths using the BRG ACTION key. The minimum altitude for

blast clearance may be entered in feet using the ALT ACTION key. With the COMPT MODE switch at STEER, depressing GRD TRK selects ground track steering.

LDG KEY - With the COMPT MODE at ENTER depressing LDG permits the true bearing in degrees, minutes and tenths of the intended landing runway to be entered using the BRG ACTION key and the altitude of the touchdown point to be entered using the ALT ACTION key. With STEER selected, depressing the LDG key selects the landing mode.

MAN KEY - With ENTER set on the COMPT MODE switch, depressing MAN permits entry of temperature in degrees F using the TEMP ACTION key and true airspeed in knots using the VEL ACTION key. These entries are made for use as back-up values. Manual entries of sensor status may be made using the ALT ACTION key where 1 indicates sensor USED and 0 indicates sensor NOT USED. When STEER is selected, depressing MAN displays the status of aircraft sensor usage in the TEMPORARY STORAGE window. The first digit in the window is blank. Sensor usage status is indicated by 1's or 0's in the other digits, with 1 indicating in use and 0 indicating not in use, as follows:

- Normal load factor (Set automatically)
- Mach number (Set manually and/or automatically)
- Angle of attack (Set automatically)
- Temperature (Set automatically)
- Static pressure (Set manually)
- Inertial platform vertical velocity vector (Set manually)

REL ADV KEY - With the COMPT MODE switch at ENTER, depressing the REL ADV key permits entry of the release distance in feet using the DIST ACTION key. A positive value is early release; a negative value is a delayed release. When the COMPT mode switch is at STEER depressing REL ADV introduces the stored release advance value into the weapon release solution. When release advance is in use it is displayed in window C5 of the DDU.

WIND KEY - When the COMPT MODE switch is at ENTER, depressing the WIND key permits entry of

wind true direction in degrees, minutes and tenths, using the BRG ACTION key and wind velocity in knots using the VEL ACTION key. Depressing the WIND key with the COMPT MODE switch at STEER provides the computer with the manual wind entry. The wind entry will only be used in the DR option or, with Mach bad, in the Doppler or Doppler/inertial options, therefore the required navigation option selection should be made before entering wind.

N E W PRES LOC KEY - Depressing PRES LOC when the COMPT MODE switch is at ENTER permits a geographical position and altitude to be entered for the present position of the aircraft. Latitude and longitude are entered in degrees minutes and tenths using the POS ACTION key and altitude is entered in feet using the ALT ACTION key.

OPPORTUNITY-TARGET - With the COMPT MODE switch at ENTER, when no keys are depressed, the altitude to be used with opportunity target steering may be entered in feet using the ALT ACTION key.

N E W With STEER selected and none of the upper 8 keys depressed, opportunity target steering is activated.

RELEASE KEY - The RELEASE key is a momentary action key which mechanically releases any depressed ADDRESS key.

TEMP STOR Window

N E W The TEMP STORE window is a 7-digit indicator which displays the values being entered with the QUANTITY keys when the COMPT MODE switch is at ENTER. When the COMPT MODE switch is at STEER and the MAN button depressed the TEMP STORE window displays sensor usage status. When the COMPT MODE switch is at TEST, many of the ORT results are displayed in the TEMP STORE window.

CLEAR Button

The CLEAR button is momentary action pushbutton. When the COMPT MODE switch is at ENTER, depressing the CLEAR button removes any value in the TEMP STORE window without entering it into the computer. When the COMPT MODE switch is at STEER, depressing CLEAR removes the sensor status display. When TEST is selected, depressing CLEAR steps the computer to the next test in the ORT program.

QUANTITY Keys

The 14 QUANTITY keys are momentary action push-buttons marked N/+, S/-, 1 through 5, E, W, 6

through 9, and 0. The N/+ and S/- keys are used to indicate either hemisphere for latitude entries or sign for numerical values. Latitude entries may be north or south; release advance, temperature, and altitude entries may be positive or negative. All other numbers must be entered as positive. The E and W keys are used to indicate hemisphere for longitude entries and compass direction for TGT 4 - OAP 2 distance entries.

ACTION Keys

The 7 ACTION keys are momentary action push-buttons marked POS, ALT, DIST, BRG, VEL, and SAC. They are used when the COMPT MODE switch is at ENTER to identify to the computer the type of data being entered and to complete the data entry by blanking the TEMP STORE window. The POS key is used with entries of latitude and longitude to identify the values as position data. The ALT key is used to identify entries of altitude data. DIST is used to identify values of range such as offset distance and release advance. The BRG key identifies bearing data such as ground track and landing mode heading, offset bearing, and wind direction. VEL is used to identify entries of wind velocity and backup true airspeed. TEMP is used when entering target temperature.

The seventh key marked SAC has a special purpose. It is a momentary action pushbutton used to erase computer error light and the system advisory code being displayed in the DDU window A5.

SLEW CONTROL PANEL

The slew control panel (figure 8-13) on the aft end of the bombardier/navigator's pedestal contains the slew grip, the slew grip stow release button and the velocity correct switch.

Slew Grip

The slew grip provides operator control of computer positioning of the radar cursors.

The grip is designed for left-hand operation. By pressing down on the head of the grip, it can be stowed within the computer pedestal. To release the grip for use, the RELEASE button on the left of the slew control panel is depressed allowing the spring-loaded grip to pop up to the operating position.

CAUTION

To prevent damage, hold pressure on the slew grip when depressing the RELEASE button.

With the cursor control switch at COMPT, one or both of the slew rate switches depressed, and the radar POWER switch at ON or STBY, moving the slew grip forward or aft moves the range cursor, moving the slew grip left or right moves the azimuth cursor. Releasing the grip returns it to the spring-loaded neutral position.

Note

- Once an azimuth-range or TWS lock-on is established, range and azimuth slewing is inhibited.
- When in attack, slewing is inhibited after release enable occurs about 2 seconds prior to release. As soon as the computer is stepped out of attack, or, with a TRAIN release selected, after the first weapon has been released, slew is functional.
- Slewing is inhibited when in the boresight mode.
- Slewing interrupts elevation tracking; however elevation tracking resumes as soon as slewing is stopped.

When both slew rate switches are depressed and the slew grip is displaced to its limit, maximum slew speed is achieved.

Slew Rate Switches

The slew rate switches are two spring-loaded push-buttons on the forward face of the slew grip which select the maximum slew speed available when held depressed. Depressing the lower button provides a range slew rate of 1024 feet/second and an azimuth slew rate of 1 degree/second. Depressing the upper button provides a range slew rate of 6,100 feet/second and an azimuth rate of 5 degrees/second. When both buttons are depressed, the range rate is 38,400 feet/second and the azimuth rate is 32 degrees/second.

Elevation Slew Switch

The elevation slew switch is presently inoperative.

Azimuth-Range Switch

The azimuth-range switch is a two-position toggle switch on the top of the slew grip which provides control of automatic azimuth-range tracking. When the switch is in the forward position, azimuth-range tracking by the search radar is inhibited. When the switch is aft, automatic azimuth-range tracking is enabled.

Attack Button

The attack button is an alternate action momentary pushbutton switch on top of the slew grip used to step the computer into or out of attack. When the computer is not in attack, depressing the attack button steps the computer into attack (provided the MASTER ARMT switch is at ON or PRAC and the RESELECT or computer error lights are out) and depressing it a second time returns the computer to the non-attack condition.

Velocity Correct Switch

The velocity correct switch is a three-position rotary switch on the slew control panel marked OFF, ERASE, OFF SAVE, and MEMORY POINT and is used to select the various velocity correct options.

Selecting MEMORY POINT enables velocity correct. When a TWS or azimuth-range lock-on has been established, selecting MEMORY POINT provides automatic velocity correct (AVC). If neither of these lock-ons exist, selecting MEMORY POINT permits a manual velocity correct (MVC) to be accomplished by use of the slew grip.

Selecting OFF SAVE retains the velocity correction for use by the computer. When the switch is held at the momentary OFF ERASE position the existing velocity correction is erased from the computer memory.

PILOT'S COMPUTER CONTROLS

The pilot's computer controls, consisting of the attack commit trigger on the stick grip (figure 8-16) and the COMMIT button on the canopy bow, give the pilot control over automatic weapon release and permit him to step the computer into attack and to designate the target in the visual boresight attack and the Shrike attack.

PILOTS COMPUTER AND WEAPONS RELEASE CONTROLS

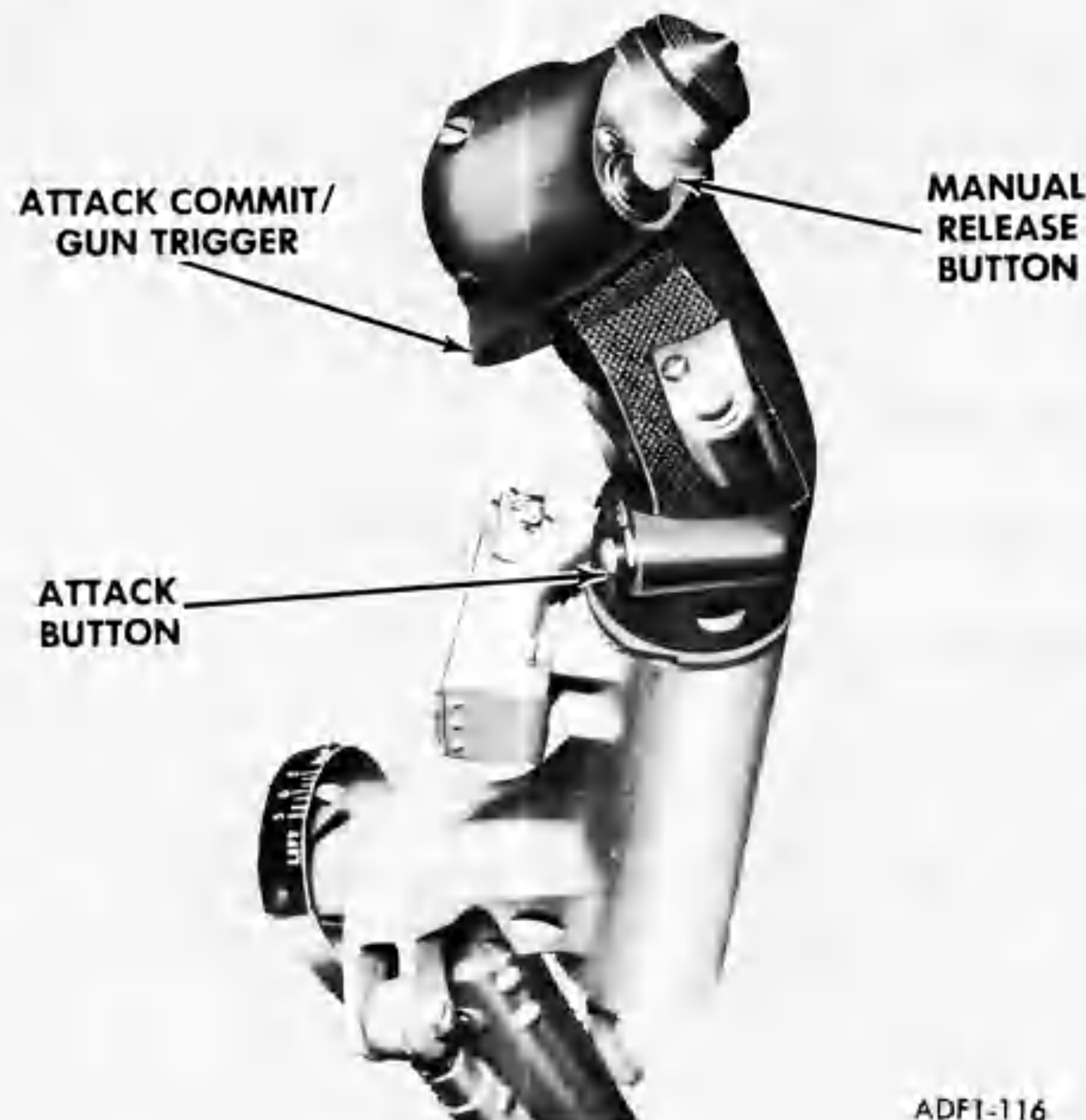


Figure 8-16

ADF1-116

Attack Commit Trigger

The attack commit trigger is a 3-position spring-loaded pushbutton switch on the control stick grip which can be actuated by the forefinger. There is a detented intermediate position between the un-actuated position and the fully depressed position. The computer samples the position of the attack commit trigger during each iteration and the position of the attack commit trigger affects computer operation.

When the tracking MODE switch is at TRACK and the optical sight mode switch is at AUTO, depressing the attack commit trigger to the intermediate position aligns the optical sight moving reticle with the radar cursors for a computer optical positioning (COP) check. When the attack commit trigger is depressed to the COP position, the TIME window on the PHD displays true airspeed in knots. The value existing when the trigger is initially depressed is displayed instantaneously and is updated every 8 seconds while the trigger is held. An immediate update can be obtained by releasing the trigger and then depressing it again.

When the computer is in attack and the tracking MODE switch is at BORESIGHT, holding the attack commit trigger to the intermediate position designates the position defined by the optical sight moving reticle to the computer as the target.

When a Shrike delivery has been selected, holding the attack commit trigger to the intermediate

position for at least 0.8 second with the VDI steering symbol centered designates the Shrike-defined target to the computer. As soon as the computer recognizes a Shrike designate, the VDI target symbol will be positioned to indicate the display center. The attack commit trigger should be held depressed until the steering and target symbols can be superimposed.

When one of the 4 full system attack modes is selected and the computer is in attack, holding the attack commit trigger in the fully depressed position enables the computer to solve for and provide an automatic weapon release. The attack commit trigger must be held in the commit position for an automatic release to be provided.

Note

Failure to commit in a straight path attack, results in the computer stepping out of attack 2 seconds after the computer release point. In a general or high loft attack, the computer program provides a forced commit when the last possible commit point is near to give the pilot a visual cue if he has not yet committed, however a manual commit is still required to release stores.

When the LAB IP, LAB TGT or DELAY attack is selected, holding the attack commit trigger to the fully depressed position starts the armament control unit (ACU) time countdown and enables automatic weapon release.

When a gunnery attack is selected, fully depressing the attack commit trigger fires the guns.

Attack Button

The attack button on the pilot's stick grip is an alternate action pushbutton which permits the pilot to step the computer into or out of attack. When the computer is not in attack, depressing the attack button steps the computer into attack (provided the MASTER ARMT switch is at ON or PRAC and the RESELECT or computer error lights are not on) and depressing it a second time returns the computer to the non-attack condition.

COMMIT Button

A button marked COMMIT mounted on a bracket on the left side of the canopy bow is provided for the pilot's convenience. This button is a spring-loaded pushbutton switch, which when held depressed has the same effect as holding the attack commit trigger to the fully depressed commit position.

SYSTEM DISPLAYS

The system displays include the B/N's direct view radar indicator, the pilot's horizontal display, the pilot's vertical display indicator, and the pilot's optical sight. In addition there are digital display unit and computer control unit readouts which are discussed along with the digital computer AN/ASQ-133.

DIRECT VIEW RADAR INDICATOR

The bombardier/navigator's direct view radar indicator (DVRI) (figure 8-1) in the center of the bombardier/navigator's instrument panel consists of a circular 7-inch cathode ray tube centered in a rotating azimuth ring. The azimuth ring provides a true heading reference and a movable pointer or bug provides true bearing data. Advisory lights and a RANGE readout are mounted on the indicator face plate.

The 7-inch cathode ray tube presents the radar displays selected by the bombardier/navigator along with fixed range marks and the range and azimuth cursors. A hood is provided to ease daylight viewing and prevent glare in the cockpit at night.

DVRI AZIMUTH RING AND BEARING POINTER

The lighted azimuth ring consists of a servo-driven rotating compass card that indicates true heading read against a fixed reference at the top of the indicator. The heading reference is provided by the INS when the ATTITUDE REF switch is at COMP IN or COMP OUT or by the MA-1 compass heading modified by magnetic variation set on the DDU when the ATTITUDE REF switch is at MAG/VGI. The movable pointer or bug rotates within the azimuth ring to indicate drift corrected true bearing to the cursor intersection in non-attack and to the required release path vector in attack.

DVRI LIGHT PANEL

Seven advisory lights are flush-mounted on the DVRI light panel in the lower left corner of the indicator face plate located so that they may be seen by the bombardier/navigator when under the hood. These lights may be tested by depressing the B/N MASTER TEST button.

AZ-RANGE Light

The AZ-RANGE light comes on when a valid azimuth-range lock-on as determined by computer logic has been acquired. A valid TWS lock-on is indicated by lighting of both the AZ-RANGE and the ELEVATION lights. As soon as a lock-on is lost, the appropriate light will go out.

ELEVATION Light

The ELEVATION light comes on when a valid elevation track lock-on as determined by computer logic has been acquired.

ATTACK Light

The ATTACK light comes on when the computer is stepped into the attack condition; it comes on with the ATTACK light on the DDU. If the light goes out during an attack, it indicates that a valid solution is no longer possible and the attack will have to be re-initiated. The ATTACK light has a special function during ORT which is explained in the description of ORT.

TRACK Light

The TRACK light presently has no function.

COMPUTER Light

The COMPUTER light comes on when one or more errors or valid data failures exist in the computer; it comes on with the COMPT ERROR light on the DDU. The computer cannot be stepped into attack with the COMPUTER light on.

ECM Light

The ECM light comes on when one or more of the warning indicators on the ECM panel is on.

RESELECT Light

The RESELECT light comes on when, according to computer logic, an incompatible combination of weapon selection, release mode, attack mode and arming/fuzing exists; it comes on with the RESELECT light on the armament control unit (ACU). While the light is on there can be no automatic weapon release, and computer logic causes the computer to step out of attack.

RANGE WINDOW

The RANGE window displays a 4-digit computer-derived readout as shown in figure 8-10. When the ground range to the cursor intersection is less than 16 miles, the RANGE readout is slant range to cursor intersection in feet/10. When the ground range to the cursor intersection is greater than 16 miles the RANGE readout is ground range to the cursor intersection in miles.

PILOT'S HORIZONTAL DISPLAY

The pilot's horizontal display (PHD) (figure 8-1) permits the pilot to view the radar display selected by the bombardier/navigator. The PHD is a circular daylight viewing storage tube centered in a rotating azimuth ring. Windows above the indicator display values of time and range.

The persistence of the indicator is variable with a control on the pilot's control panel. When the radar TRANSMIT switch is at SIL, the PHD will display one left to right scan when the ONE SCAN/ERASE switch is actuated to ONE SCAN. The display will remain on the scope depending on the persistence setting. Actuating the ONE SCAN/ERASE switch to ERASE removes the stored picture from the PHD.

PHD AZIMUTH RING AND COMMAND HEADING INDICATOR

The lighted azimuth ring is a servo-driven rotating compass card that indicates true heading read against a fixed reference at the top of the indicator. The heading reference is provided by the INS when the ATTITUDE REF switch is at COMP IN or COMP OUT or by the MA-1 compass heading modified by magnetic variation set on the DDU when the ATTITUDE REF switch is at MAG/VGI.

The command heading indicator (steering bug) rotates independently around the azimuth ring. The indicator provides drift corrected steering to the selected target or cursor intersection if no target is selected.

PHD TIME AND RANGE WINDOWS

Two windows above the indicator, marked TIME and RANGE are provided. The RANGE window provides a readout of computer ground range to the target in

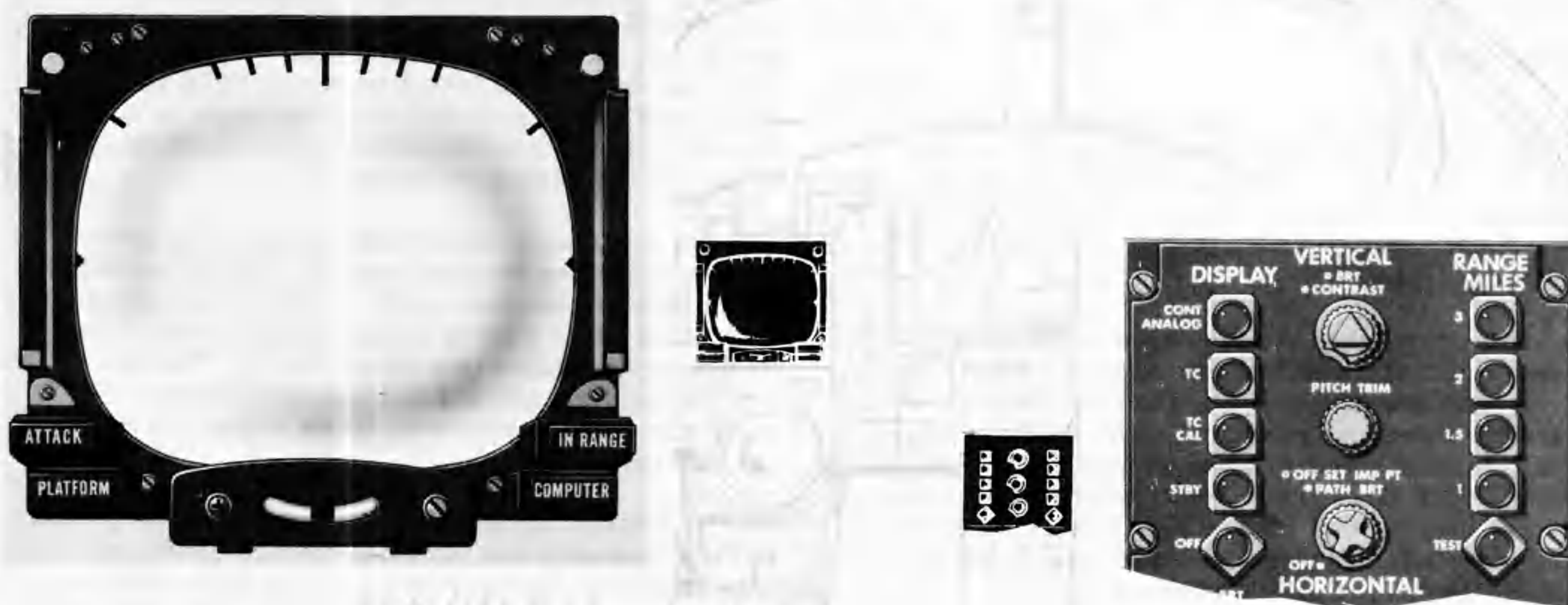
nautical miles. When the computer is in attack, the TIME window provides a readout of estimated time in seconds to the selected target. When the computer is not in attack, the TIME readout is estimated time in minutes to the selected target for a straight path attack and to pullup for an accelerated attack. The TIME readout is to the cursor intersection if no target is selected. When a computer optical positioning (COP) check is in progress, true airspeed in knots is displayed in the PHD TIME window.

VERTICAL DISPLAY INDICATOR

The vertical display indicator (VDI) (figure 8-17) on the pilot's instrument panel is the instrument of primary reference for flight attitude, vertical and horizontal steering commands, and terrain avoidance, giving the aircraft an all-weather capability during all phases of flight from takeoff to landing. Indications of attitude, vertical and horizontal drift, and steering commands are provided by means of symbols superimposed on a display of the world about the aircraft in analog form. This display, which includes a ground stabilized horizon line, is presented in either of two modes: contact analog and terrain clearance.

Fixed bank angle indices are marked on the glass at the top of the scope and two triangular fiducial marks at the sides of the scope mark the vertical center. Advisory lights are arranged around the viewing screen.

VERTICAL DISPLAY INDICATOR AND CONTROLS



ADF1-107

Figure 8-17

VDI ADVISORY LIGHTS

A vertical light bar on each side of the VDI viewing screen and 4 rectangular legend lights provide the pilot with indications of system status and a break-away command. The lights may be tested by depressing the LTS WARN button.

COMPUTER Light

The COMPUTER light is the bottom legend light on the right side of the VDI. It comes on when one or more errors or valid data failures exist in the computer. The computer cannot be stepped into attack when the COMPUTER light is on.

IN RANGE Light

The IN RANGE light is the upper legend light on the right side of the VDI. It is a repeater of the in-range display on the optical sight. When flashing, this light indicates that the aircraft is within weapon release range of the selected target, as computed by the computer or that a release point has been selected by the computer in a straight path attack. In the boresight and Shrike modes the IN RANGE light has special functions. In the boresight mode, flashing of the in-range lights indicates that a valid elevation track lock-on has been acquired. During Shrike ranging, it indicates that the minimum requirements for valid azimuth ranging have been met.

PLATFORM Light

The PLATFORM light is the lower legend light on the left side of the VDI. When the light is on it indicates that the inertial platform is not operating or has malfunctioned and is providing unreliable attitude information. The light does not go on if the ATTITUDE REF switch is in MAG/VGI. Failure of the VDI roll stabilization or loss of power to the INS will cause the platform light to flash.

ATTACK Light

The ATTACK light is the upper legend light on the left side of the VDI. When the light is on, it indicates that the computer is operating in the attack condition.

Breakaway Lights

The breakaway lights are displayed by flashing red on the upper half of a vertical bar on each side of the VDI. These breakaway lights are repeaters of the breakaway lights on the optical sight, providing target data terrain avoidance and weapon release pullup warning. The circuitry of the breakaway lights may be tested by selecting BREAKAWAY on the test switch on the optical sight control panel or with the LTS WARN button on the pilot's instrument panel.

Radar Altimeter Failure Light

A radar altimeter failure light illuminates RA in black letters on a red background in the lower half of the vertical bar on the right side of the VDI. When

the output of the radar altimeter is less than 1 volt (20 feet) or greater than 26.5 volts (5000 feet) the light will be on.

Terrain Clearance Failure Light

A terrain clearance failure light illuminates TC in black letters on a red background on the lower half of the vertical bar on the left side of the VDI. Built-in-test circuits continuously evaluate the terrain clearance mode of the search radar. Failure of the TC built-in-test turns on the TC light.

Note

Setting the TRANSMIT switch to SIL or the RCVR TUNE switch to MAN will also turn on the TC light.

CONTACT ANALOG DISPLAY

The basic contact analog display (figure 8-18) consists of a horizon line, pitch lines, pitch trim markers, video bank angle markers, ground texture elements, and cloud texture elements. The physical center of the scope represents the armament datum line (ADL) of the aircraft. The horizon line is presented as a ground-stabilized element and indicates the attitude of the aircraft. The principle is similar to the standard attitude gyro.

To indicate pitch angles for all the flight conditions, the display is provided with a series of pitch lines which are parallel to the horizon line. These lines are relative to the horizon line and when positioned in the center of the VDI, they represent aircraft pitch angles of 30° nose up or down, 60° nose up or 90° nose up (figures 8-19, 8-22). In addition, two pitch trim markers are provided to assist the pilot in maintaining a selected pitch attitude in flight. These are short, bright markers which emanate from the sides of the scope and can be varied in elevation by the control located on the pilot's control panel (figure 8-17), placarded PITCH TRIM. These markers will stay with the horizon line during rolls and constant bank angles provided the pitch angle is maintained. The pitch trim markers are also displayed in the terrain clearance mode.

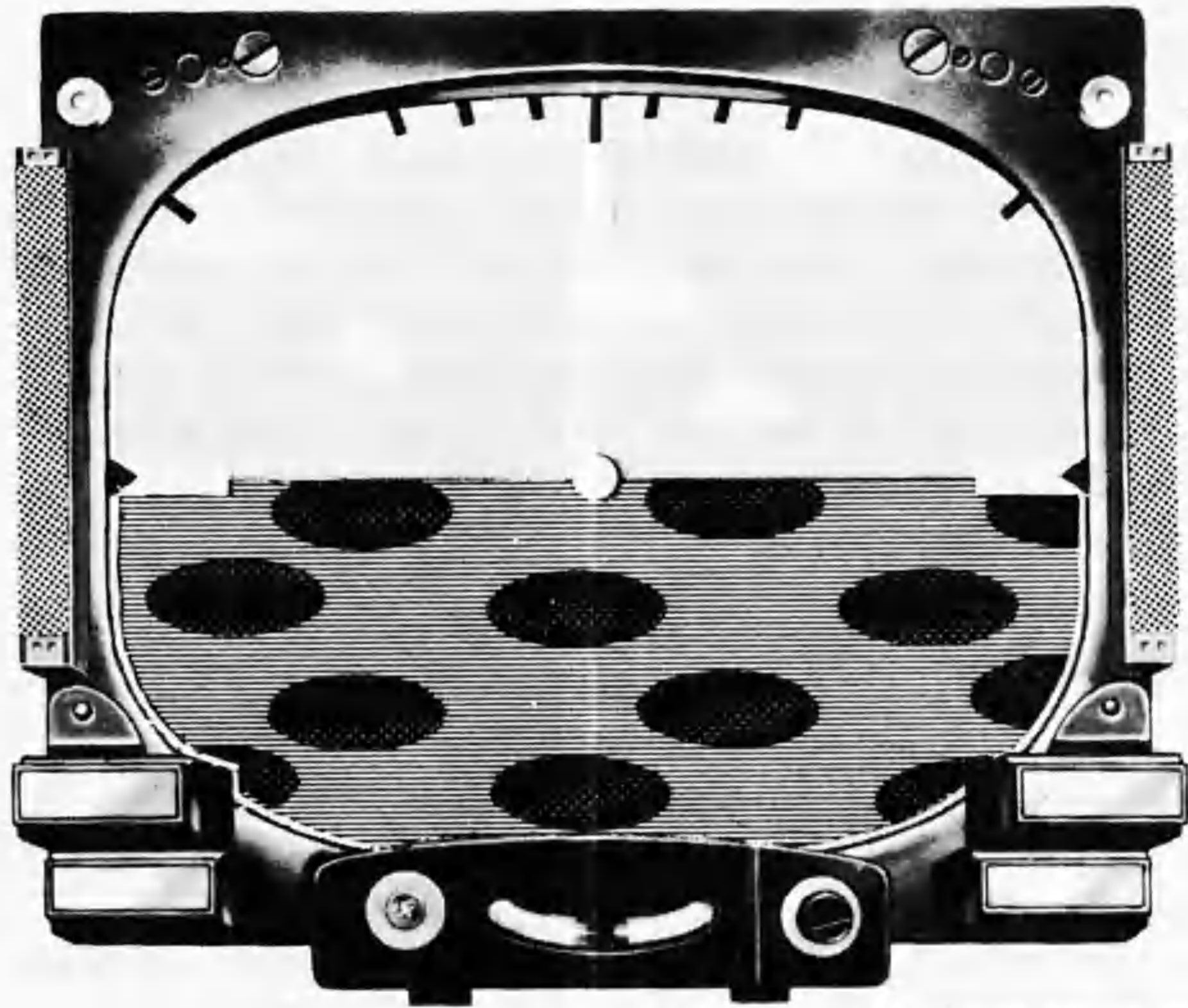
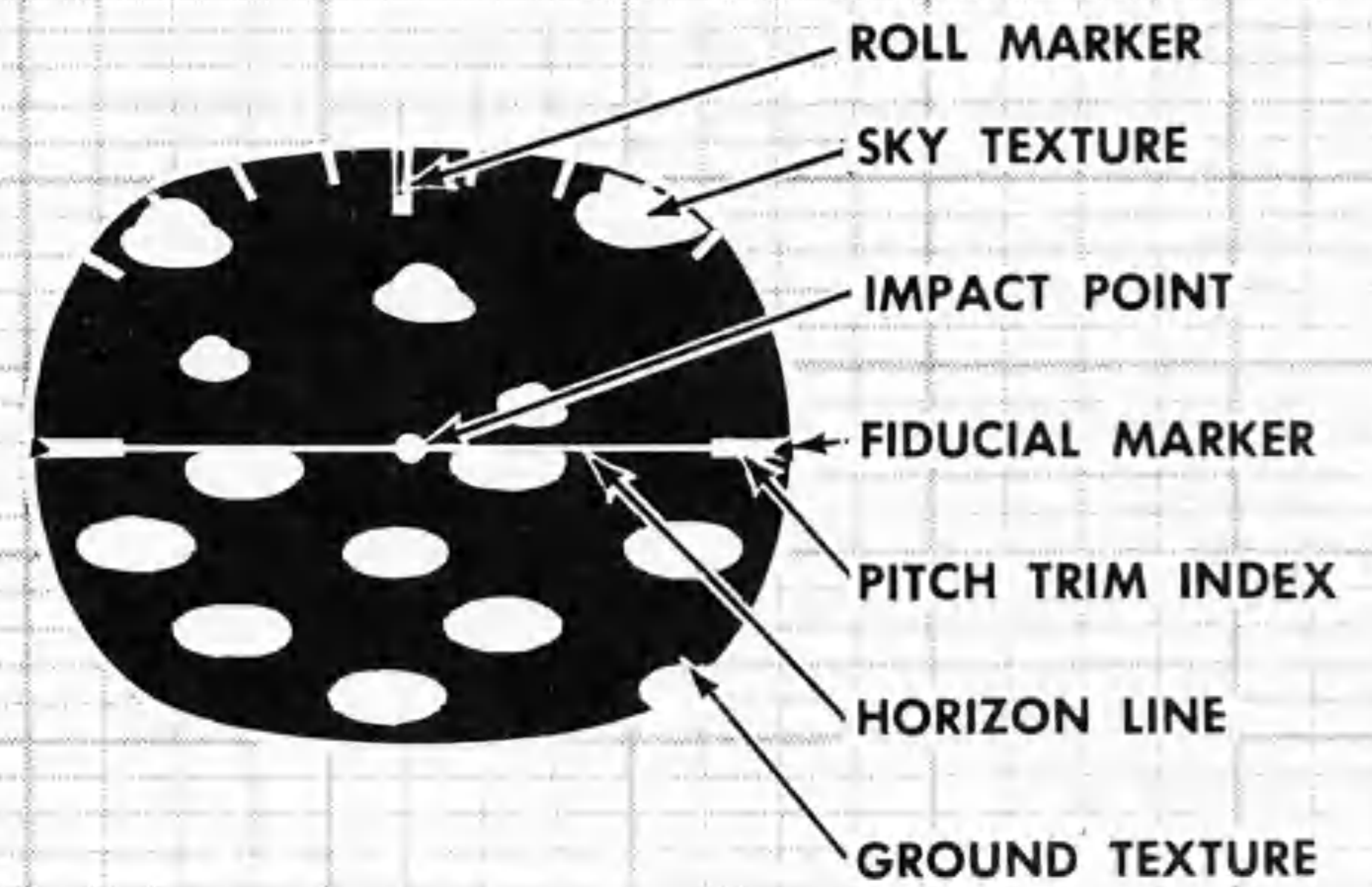
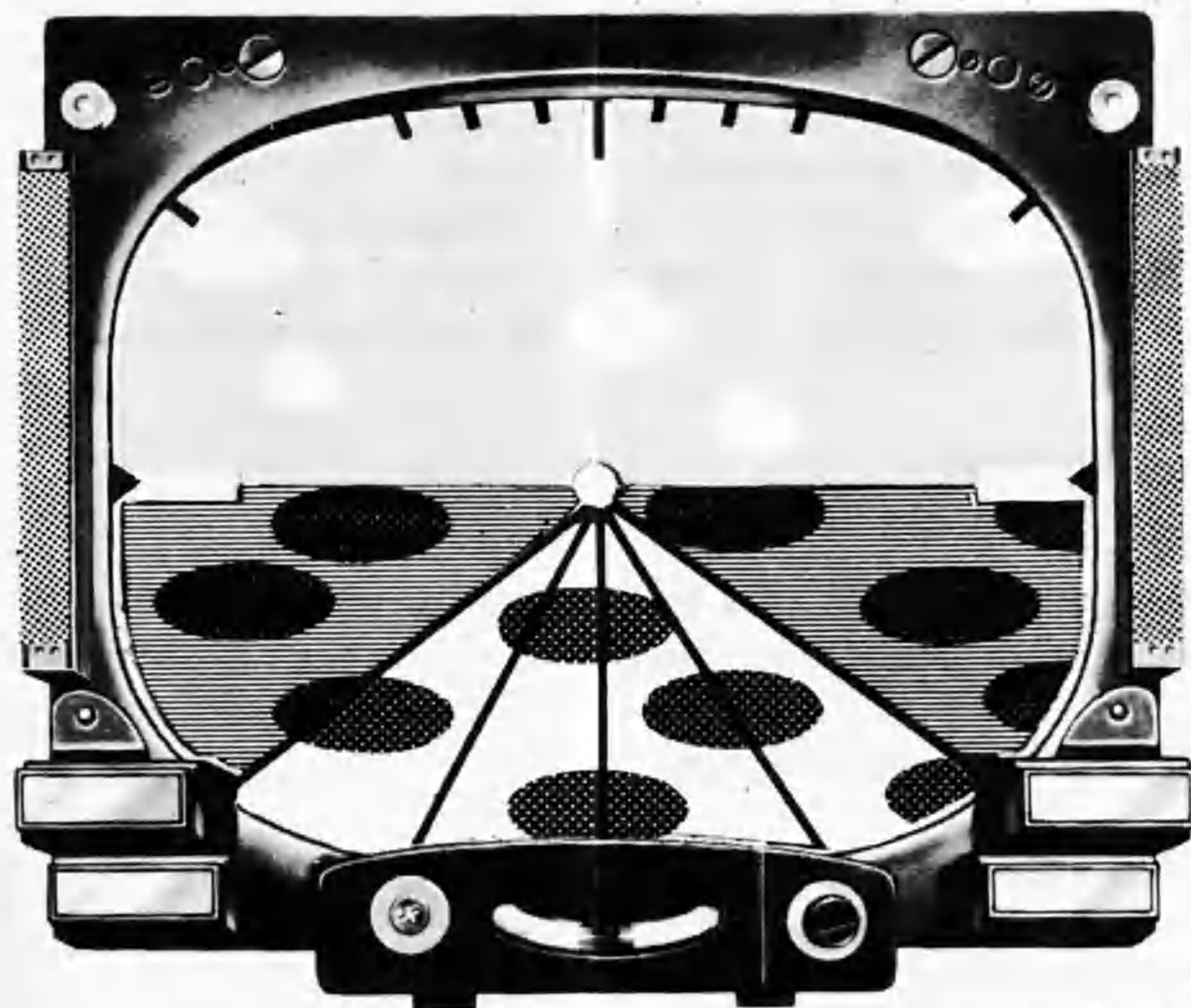
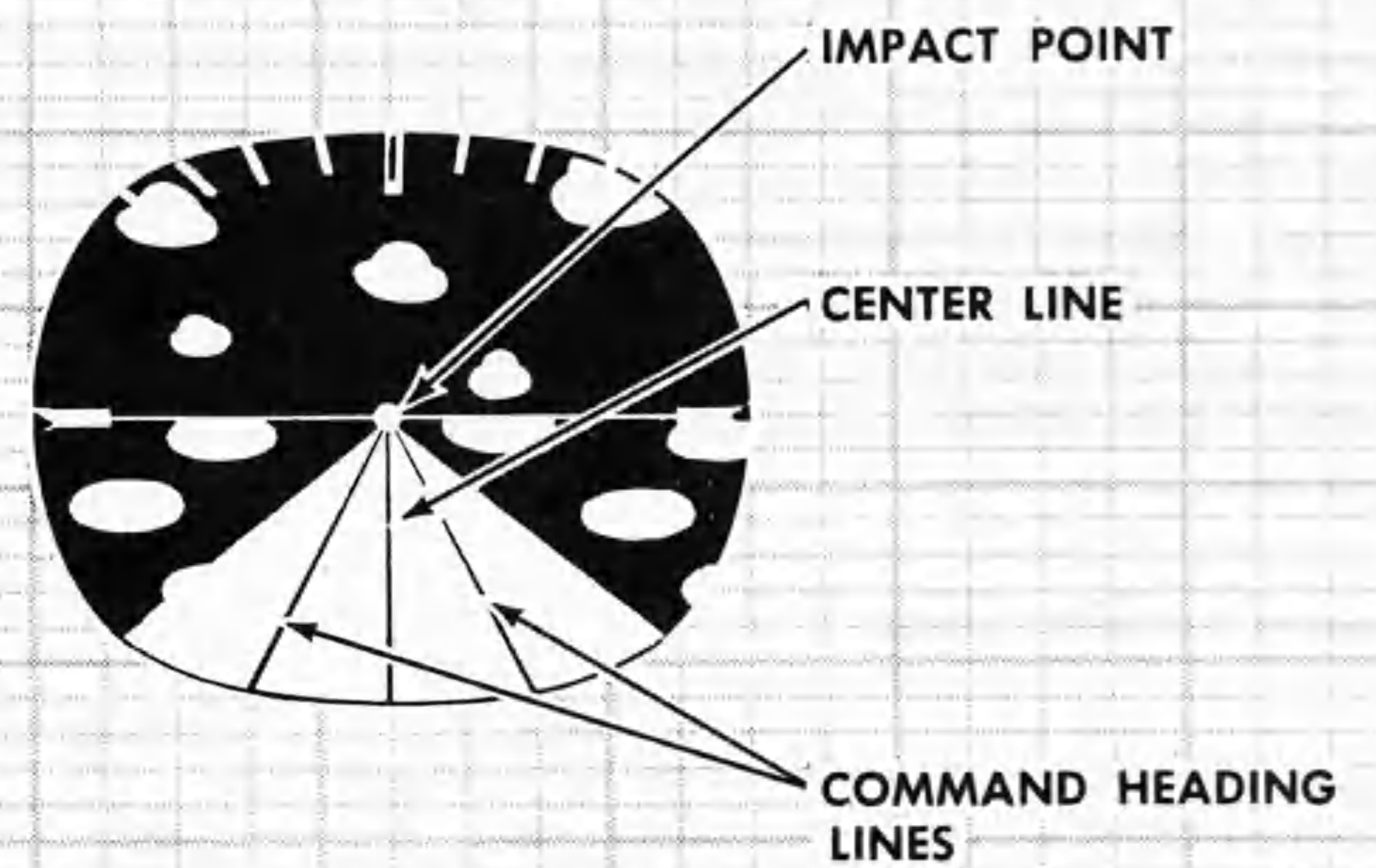
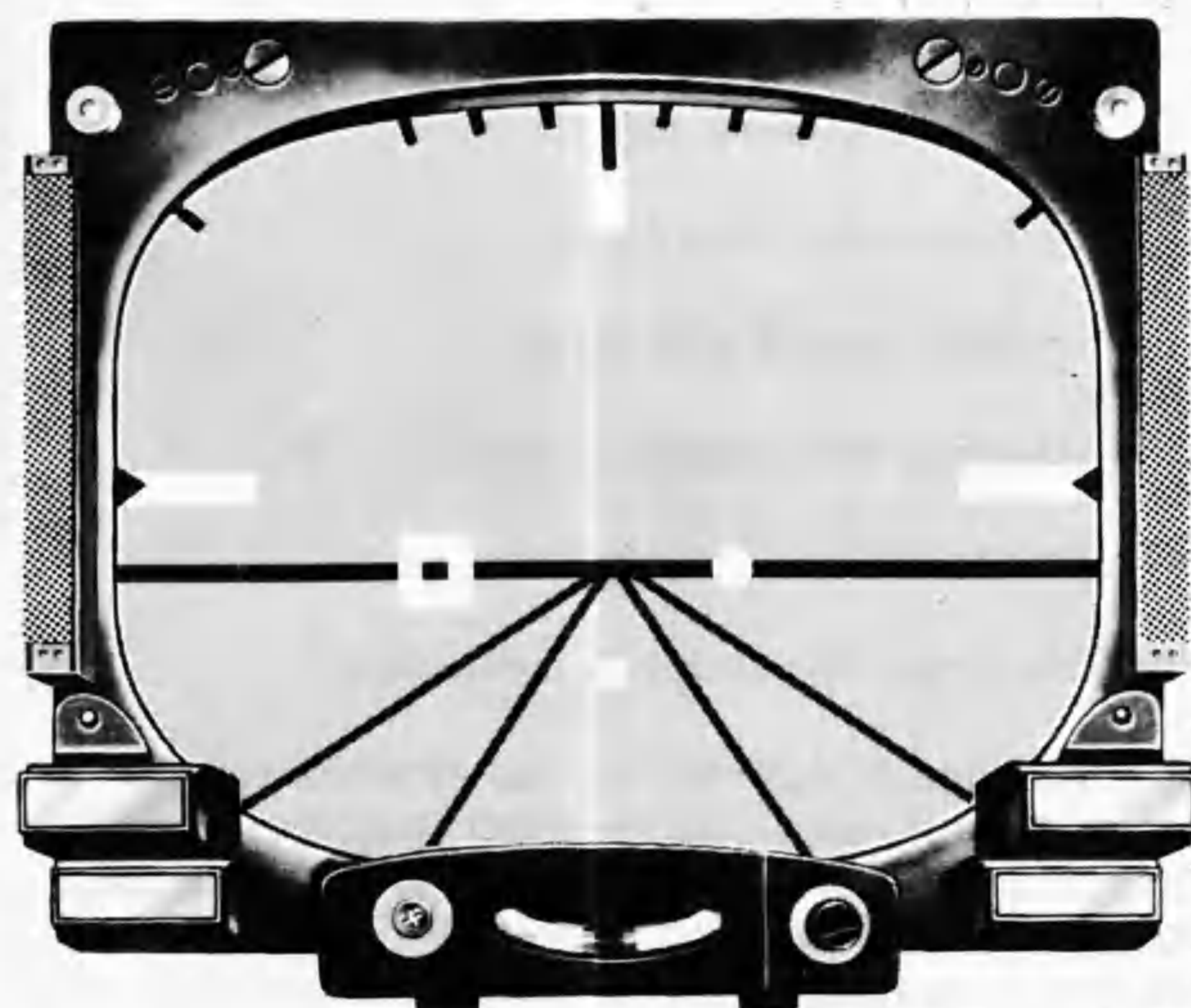
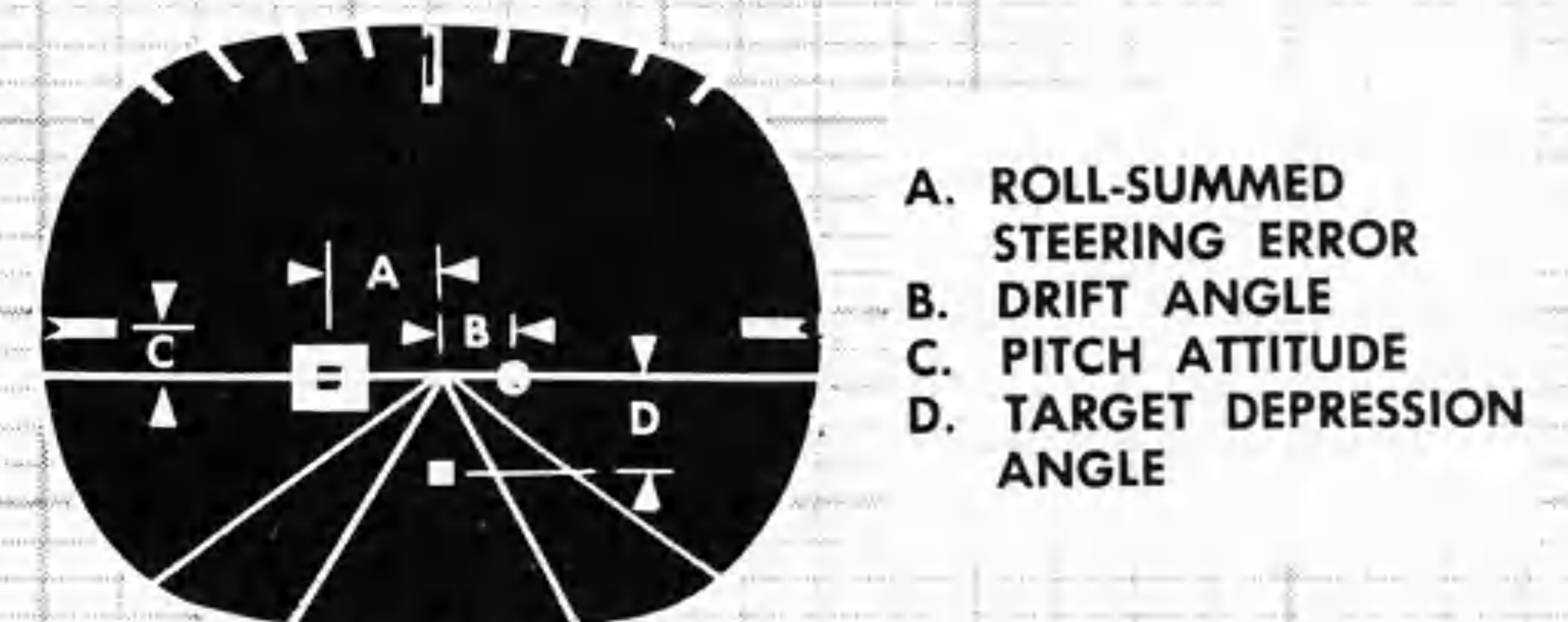
Further assistance is provided to establish a consistent reference for bank angles. The scope is provided with a video bank angle marker and a series of fixed bank angle indices along the upper half of the scope display frame (see figure 8-17). The relationship of the marker and indices provides the pilot with a ready reference to the angle of bank of the aircraft.

On the display, the horizon line separates the ground texture elements and the cloud texture elements. The ground is represented by a grey background with dark grey tapered egg-shaped texture elements. The texture elements move from the horizon toward the bottom of the display to simulate aircraft motion. Above the horizon, the sky is lighter than the ground and has white cloud texture elements. Cloud texture elements provide additional real-world reference.

NEW

NEW

NEW

BASIC CONTACT ANALOG DISPLAYS

A-ADF1-100

Figure 8-18

The clouds move when the aircraft attitude is changed in pitch or heading, and remain fixed when a constant attitude is maintained.

SYMBOLS AND MARKERS

To provide a means of displaying attack-navigation system information, various symbols and markers are added to the basic contact analog display (figure 8-19). These include the basic flight path, command heading lines, impact point, target symbol, pullup marker, release marker, steering symbol, and centerline. All components of the display are represented in true perspective to afford the optimum degree of realism in the final presentation. To this end, the basic components have been shadowed to provide greater definition in the overall presentation. In addition, calibration markers, an offset impact bar, and a radar altitude curtain are display for TC mode of operation.

Basic Flight Path

The basic flight path is formed by two perspective vertical lines converging on an imaginary line that passes through the ADL parallel to the horizon line. The path apex will always appear on this imaginary line and indicate steering error, except in a pullup situation. When 27° or more of steering error is present, the path apex will be at full azimuth deflection. The pilot may vary the path brightness by using the control placarded PATH BRT on the pilot's control panel.

Command Heading Lines

Command heading lines are parallel lines in perspective emanating from the path apex. These lines will appear to move left or right when a steering error exists. The command heading lines will not move in non-attack or with BORESIGHT selected. In attack, the command heading lines will attain the maximum rate of motion at about 4° of steering error. They are not visible during the landing mode of operation.

Impact Point

The impact point is a solid white circle that represents an extension of the velocity vector of the aircraft. This corresponds to a projection of the aircraft flight path with reference to all immediate aircraft data. Displacement of the impact point from the ADL indicates drift and yaw in azimuth and angle-of-attack and drift in elevation.

Target Symbol

The target symbol is a solid white square that represents the actual position of the target from the aircraft. Displacement of the symbol from the ADL will show depression angle of the target in elevation and true bearing in azimuth to approximately $\pm 23^\circ$.

Note

After commit, the target symbol is positioned at the electronic center of the VDI.

Pullup Marker

The pullup marker is used to indicate a command pullup given in the event of terrain avoidance command, or during a general or hi-loft attack sequence. The marker moves down the left side of the flight path. When the marker reaches the bottom of the display, the pilot is advised that the necessary 4g command pullup must be executed to achieve the desired results.

Release Marker

The release marker is used to indicate attack progress and in-range in all attack situations. In general and hi-loft attacks, it indicates angle-to-go to release. In rocket attack however, the release marker indicates a rocket firing zone and is not related to actual release of the weapon if weapon release is accomplished by means of the firing zone. If rocket firing is accomplished by the pull-through technique, release marker operation is normal. The marker moves down the right side of the display denoting anticipation of release. When the marker reaches the bottom of the display, it indicates weapon release.

Steering Symbol

The steering symbol is a hollow white square that serves four distinct functions:

1. Roll summed steering
2. Elevation steering:
command pitch indication for:
 - a. nuclear safe escape
 - b. blast clearance safety
 - c. occurrence of in-range
 - d. rocket launch condition
 - e. landing mode glide slope
3. G-command
4. Shrike target directional indication

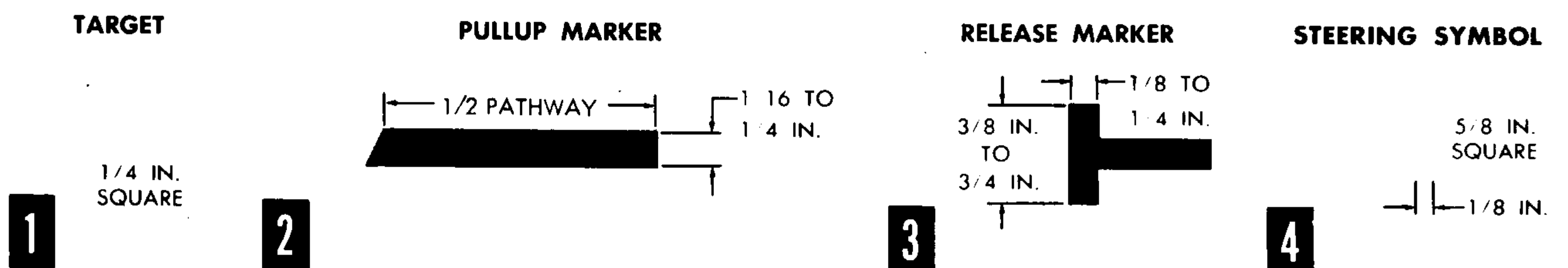
During all modes of operation, the symbol acts to give the pilot roll-summed steering commands. The symbol will move horizontally between the fiducial markers with the symbol base parallel to the horizon line. During hi-loft and general attacks, the symbol provides g commands in addition to roll-summed steering. The symbol will then move horizontally to indicate azimuth errors, and vertically to indicate g requirements.

NEW

NEW
NEW
NEW
NEW
NEW

VERTICAL DISPLAY SYMBOLS AND MARKERS

SYMBOL DESIGNATION	DESCRIPTION	GRAYSCALE	MAX. DIM.	MIN. DIM.	MAX. DISPLAY ANGULAR RANGE	
					HOR.	VER.
HORIZON LINE	A GROUND STABILIZED LINE WHICH SEPARATES GROUND AND CLOUD TEXTURE	BLACK				
±30° PITCHLINE	THESE LINES DENOTE EITHER +30° OR -30° ELEVATION ANGLES WHEN IN DISPLAY CENTER.	BLACK	1/8" WIDE FIXED			15°
+60° PITCH LINE	A LINE DENOTING 60° ELEVATION ANGLE WHEN IN DISPLAY CENTER	BLACK	1/4" WIDE FIXED			15°
+90° PITCH LINE	A DASHED LINE WITH SIX SEGMENTS DENOTES 90° ELEVATION ANGLE IN DISPLAY CENTER	BLACK	1/4" WIDE FIXED			15°
PITCH TRIM MARKERS	PITCH ANGLE REFERENCE TO THE HORIZON	BRIGHT	1/4" WIDE	1/8" WIDE		15°
BANK ANGLE MARKER	SINGLE REFERENCE LINE USED TO DENOTE DEGREE OF AIRCRAFT BANK	BRIGHT	1/4" WIDE	1/8" WIDE		
GROUND TEXTURE ELEMENTS	ELLIPTICAL ELEMENTS THAT EMANATE FROM THE HORIZON AND MOVE IN ACCORDANCE WITH A QUASI RANDOM GROUND PLANE	DARK GRAY	MAJOR AXIS 1-1/2"	MAJOR AXIS 1/2"		±20°
CLOUD TEXTURE ELEMENTS	ANALOG OF CUMULUS CLOUDS; STATIONARY FOR FIXED A/C ATTITUDE AND MOVE WITH ATTITUDE CHANGE	LT. GRAY	MAJOR AXIS 1-1/2"	MAJOR AXIS 1/2"		±20°
BASIC FLIGHT PATH	PERSPECTIVE VERTICAL LINES CONVERGING AT THE IMAGINARY LINE WHICH PASSES THROUGH THE ADL	BLACK	30° REAL WORLD	25° REAL WORLD	±35°	±15°
COMMAND HEADING LINES	THREE LINES THAT RADIATE FROM THE PATH APEX AND ROTATE WITH HEADING ERROR	DARK GRAY	1/16" WIDE FIXED			
IMPACT POINT	A SOLID WHITE CIRCLE REPRESENTING AN EXTENSION OF THE FLIGHT PATH	BRIGHT	CIRCLE 5/32" DIA.		±27°	±27°
TERRAIN CLEARANCE OFFSET IMPACT BAR	HORIZONTAL BAR THAT IS A REFERENCE FOR TERRAIN CLEARANCE, ADJUSTABLE 1 1/2 INCHES ABOVE TO 4 INCHES BELOW IMPACT POINT AT ZERO ANGLE OF ATTACK	BLACK, BRIGHT TIPS	3" WIDE			
1 TARGET SYMBOL	A SOLID WHITE SQUARE THAT INDICATES THE POSITION OF THE TARGET IN THE GROUND PLANE	BRIGHT	1/4" SQUARE FIXED		±35°	15°
2 PULL UP MARKER	A HORIZONTAL BAR THAT MOVES DOWN THE PATH LEFT SIDE IN PERSPECTIVE AND DENOTES PULL UP WHEN AT THE BOTTOM OF THE DISPLAY	BLACK	1/4" WIDE	1/16" WIDE		
3 RELEASE MARKER	A HORIZONTAL BAR ENDED BY A SHORT VERTICAL BAR MOVES DOWN THE RIGHT SIDE OF THE PATH	BLACK				+67°
4 STEERING SYMBOL	A HOLLOW WHITE SQUARE THAT DENOTES ROLL SUMMED STEERING AND ELEVATION STEERING	BRIGHT	5/8" SQUARE 1/8" LINE WIDTH FIXED		±36°	±34°
CENTER LINE	A LINE WHICH IN PERSPECTIVE BISECTS THE TAKE OFF AND LANDING PATHWAY	BLACK				



A-ADF1-102

Figure 8-19

Note

No steering commands are provided on the steering symbol when BORESIGHT is selected.

In the rocket attack mode, the symbol again provides roll-summed steering, combined with vertical steering, or angle-to-go to launch.

Note

To realize optimum system accuracy during all aircraft maneuvers, it is mandatory that the pilot fly the aircraft so that the steering symbol is centered in the VDI at all times.

In the straight path attack, roll-summed steering is combined with pitch commands. Vertical steering is provided to prevent under-diving the target.

In attack, the steering symbol commands a climb if the aircraft goes below selected blast clearance altitude.

If a nuclear weapon is selected in any attack mode, the steering symbol will command a climb if current time-of-fall is insufficient to meet the ballistics panel safe time requirement.

In the landing mode, the steering symbol will provide a pitch command to make good a $3\frac{1}{2}^\circ$ glide slope.

In Shrike missile attacks, the missile direction-finding signals will position the symbol.

Note

With the optical sight control switch in the AUTO position, the optical sight moving reticle displays roll-summed steering in attack and may be used as a backup for VDI and PHD steering.

Centerline

The centerline is a dark line that bisects the basic flight path. It will remain in the perspective center of the pathway, regardless of path motion. The centerline will be available only when the computer is in the landing mode of operation.

TERRAIN CLEARANCE DISPLAY

The terrain clearance display provided on the vertical display indicator affords a means of maintaining terrain clearance along the projected flight path of the aircraft. A 53° by 26° window of the terrain about the aircraft ADL is displayed on the VDI with the attack and navigation steering functions.

The display consists of a perspective plot of range and elevation angle vertically, and azimuth horizontally shown on the VDI (figure 8-20). Terrain clearance information is sensed by a dual channel horn mounted on the search radar antenna receiver. This array receives ground returns from search radar transmissions (pulse-for-pulse with the search radar).

The search radar antenna receiver derives range information from search radar timing, azimuth information from antenna position, and terrain elevation information from phase variations.

The display presentation provides 10 shaded contours starting with the lightest shade in the near range at the base of the display, and progressing to darker gray tones toward the horizon, or far ranges. These shades of gray each represent a specific range contour ahead of the aircraft. All symbols and markers are available on this display except for the ground and cloud texture elements. These are removed to avoid unnecessary scope clutter. Phase video and terrain clearance amplitude video are processed through the terrain clearance processor. The radar data converter accepts the processed video and converts the signals to a television format acceptable to the VDI.

A continuous built-in-test of the terrain clearance circuits is performed. The pilot is informed of a no-go condition in the terrain clearance mode by the lighting of the TC light.

A radar altitude curtain is displayed. This black curtain presents an analog of aircraft altitude AGL and is positioned by signals from the radar altimeter.

The curtain, like the radar altimeter, operates between the altitudes of 20 feet and 5,000 feet. The position of the curtain between the horizon and the bottom of the scope varies with aircraft altitude, attitude and the altitude scale factors which are displayed below.

Altitude	Displacement Below Horizon Line
0 to 20 feet	0 inches
20 to 400 feet	175 feet/inch
400 to 5,000 feet	1340 feet/inch

Range Coding

Sets of 4 vertical code bars permanently mark the first range contour. At the option of the pilot, one of the 3rd, 4th, 5th, or 6th ranges can also be coded with vertical bars as an aid to interpretation and to provide a pre-determined reference point for flying the display of terrain. The 7th contour is permanently coded with 4 times the normal number of bars to distinguish it from the 4 selectable contours. The 10 range contours present specific range information as shown in figure 8-21.

Offset Impact Bar

The offset impact bar, displayed in the TC mode only, permits terrain following with selectable terrain clearance altitudes. For ease of identification the offset impact bar is a black bar with white tips and easily distinguishable in any background (coded ranges). The offset impact bar is adjustable vertically from 1 to 4 inches below the impact point at zero angle of attack.

Calibration Markers

Whenever TC CAL mode is selected, two black horizontal calibration markers are displayed on the right side of the viewing tube, space 1.4 ± 0.25 inches apart (0° and 6°). The position and thickness of the markers are measures of the calibration of the TC display.

Radar Altitude Curtain

A black curtain indicating the radar altitude below the aircraft is superimposed on the display between 5000 feet and 20 feet AGL. The height of the curtain between the TC horizon and the bottom of the scope is dependent on the aircraft altitude, attitude, and curtain scale factor.

TC Scaling

When the VDI is in contact analog (CA), the horizon and all symbols are computer scaled to $\pm 30^\circ$. With terrain clearance (TC) selected, the horizon and terrain are scaled in the radar data converter, while the VDI symbols are still computer-derived and scaled to $\pm 30^\circ$. Terrain clearance video is scaled to approximately 27° ($\pm 13.5^\circ$) vertically, and 52° ($\pm 26^\circ$) horizontally.

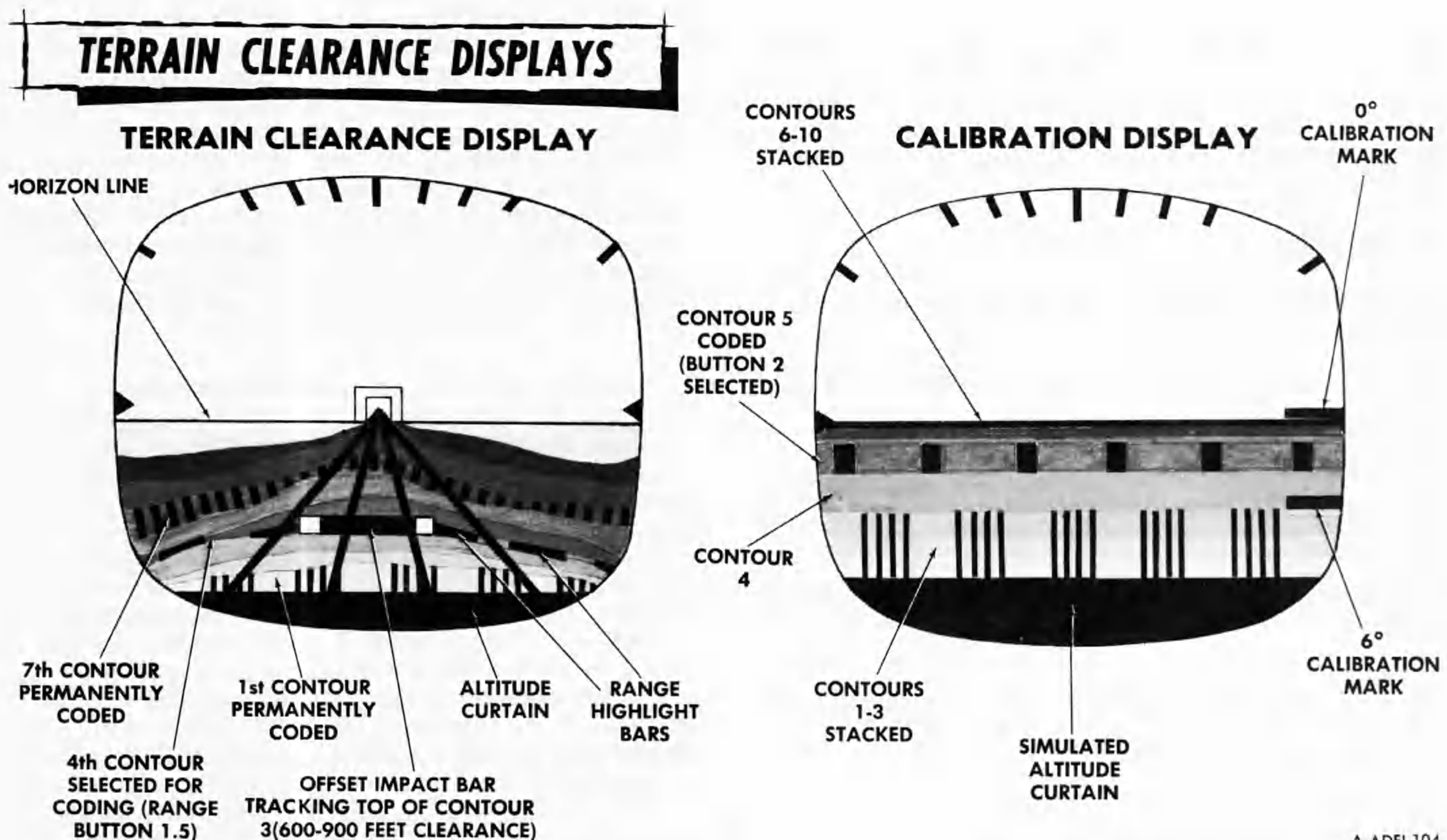
The TC horizon is scaled to 30° in a climb (or pullup) and 15° in a dive. The change in scale occurs when the horizon is at the VDI vertical center. In most normal flight attitudes or on the ground, there should be no change in the horizon position when selecting TC from contact analog. Tracking circuits provide for correct positioning of terrain for all attitudes within the pitch ($\pm 30^\circ$) and roll (60°) limits of the antenna.

Note

When in the TC mode, if the roll or pitch limits are exceeded, the VDI display will automatically switch to contact analog.

TC Test

With TC selected, depressing the TEST button on the pilot's control panel causes a self-test signal to be generated in the radar data converter. This signal results in a flat earth type presentation on the VDI, permitting identification of all 10 range contours. The altitude curtain is displayed at an artificial level, thus permitting the first contour to be seen. The horizon line and the top of the 7th (permanently coded) contour coincide at the fiducial marks. If one of the selectable range contours is selected for coding, this coding is properly displayed. See figure 8-22.



A-ADFI-104

Figure 8-20

TC Calibration

Terrain clearance calibration may be checked on the ground or in flight by depressing the TC CAL button on the pilot's control panel. When the calibration display (figure 8-20) is selected, the horizon line is positioned at the fiducial marks and the search radar and radar data converter process -6° and 0° calibration levels for display across the full azimuth window of the VDI. Range contours 1, 2, and 3 are stacked at the -6° calibrate level and range contours 6 through 10 are stacked at the 0° (horizon) level. Range contours 4 and 5 may occur at -6° or 0° or anywhere in between.

At the right edge of the display, 2 black calibration markers are displayed coincident with the -6° and 0° calibrate levels. The upper marker should at least touch the horizon line at scan update. Any offset indicates an overall elevation bias error. The spacing between the two bars is a measure of the elevation scaling of the display, so they should be 1.4 ± 0.25 inches apart.

The thickness of each calibration mark is a measure of how well each contour stacks at its calibration level. These marks will be at least 2 TV raster lines thick, however they should not exceed $1/4$ inch. If for example, the -6° marker exceeds $1/4$ inch in thickness this indicates that one or two of range contours 1 through 3 is displaced from its calibration level by more than 1° .

The altitude curtain is displayed at an artificial level permitting the first range contour with its coding to be seen. Since all the other range contours except 4 and 5 are stacked, the only time any other coding should be visible is when either the 1.5 or 2 RANGE MILES button is depressed.

TC Operation

The following conditions MUST be met to use TC properly.

1. The search radar must be ON and transmitting.
2. TC must be selected on the pilot's control panel.
3. BORESIGHT must not be selected.

The following limitations will be imposed when TC is selected.

1. The only search radar display available will be PPI 5-75 or ARE display with cursor range less than 27.5 miles.
2. Antenna scan angle to a minimum of $\pm 30^\circ$ with scan stabilized about the ADL.
3. Fast scan only.
4. Antenna pattern to FAR initially, but it may be depressed if desired.

Terrain Clearance Flight Technique

The basic technique for flying the airplane in response to the terrain displayed on the VDI is by matching the offset impact bar (1.50 in. from horizon) with a selected coded range.

The rules that apply to this technique are:

1. The range selected for reference must be at or beyond the $1/2$ to $3/4$ NM range line (bottom of the first selectable coding). Do not track the first range line.
2. The range contour selected for tracking must be kept at or below the offset impact bar.
3. Do not attempt to push over rapidly and directly to a range line off the bottom of the display.
4. Do not push over rapidly in an attempt to track a range contour that is descending rapidly toward the bottom of the display.

The airplane should be flown so as to maintain the entire offset impact bar at the selected position (top or bottom) on the desired range contour. What we are doing with this technique is maintaining a fixed angle with the terrain at the range contour being tracked. The range contour selected for tracking will be dependent on the desired resultant clearance above the terrain. Figure 8-21 shows the recommended range contour to be tracked for various conditions of terrain severity. For initial training in TC flying, it is recommended that one of the further out range contours (e.g. $1-1/2$ to 2) be tracked with the resultant high terrain clearance. As pilot confidence and proficiency increase with the flying technique, a closer range contour can be tracked with lower resultant terrain clearance.

A situation that can occur using the technique of matching the offset impact bar with a selected range contour, is a premature pushover prior to hill crest clearance. This condition occurs when tracking a close-in range line ($1/2$ to $3/4$ NM range line - bottom of first selectable coding). The cause of this phenomenon is that the actual (and displayed) elevation angle to the hill crest decreases rapidly as the range to the hill crest decreases. The display of this event shows the tracked range contour rapidly falling to the bottom of the scope, and a pushover to track this dropping range contour is potentially dangerous. If the desired range contour to be tracked is dropping rapidly toward the bottom of the display or is off the bottom of the display do not push over in an attempt to find it or track it. Maintain airplane altitude or track a further out range contour until the radar altimeter has peaked low and started up again or the radar altitude curtain has peaked high and started down indicating the crest has been cleared. Then sequentially push over and step down in range contours until reaching the desired range line.

TERRAIN CLEARANCE OPERATING PARAMETERS

RANGE CONTOUR	RANGE MILES BUTTON	RANGE CONTOUR REPRESENTED	TERRAIN FEATURES	TRACKING POSITION OF OFFSET IMPACT BAR	RESULTANT CLEARANCE (FEET)
1		$\frac{1}{4}$ to $\frac{1}{2}$ (PERM. CODED)			
2	1	$\frac{1}{2}$ to $\frac{3}{4}$	FLAT PLAINS	BOTTOM OF FIRST SELECTABLE CONTOUR	400 to 600
3	1	$\frac{3}{4}$ to 1	ROLLING PLAINS	TOP OF FIRST SELECTABLE CONTOUR	600 to 900
4	1.5	1 to $1\frac{1}{2}$	HILLS	TOP OF SECOND SELECTABLE CONTOUR	900 to 1050
5	2	$1\frac{1}{2}$ to 2	HILLS	TOP OF THIRD SELECTABLE CONTOUR	1050 to 1600
6	3	2 to $2\frac{1}{2}$	HILLS	BOTTOM OF FOURTH SELECTABLE CONTOUR	1600 to 2000
7		$2\frac{1}{2}$ to 3 (PERM. CODED)	HILLS	BOTTOM OF CODED CONTOUR	GREATER THAN 2000
8		3 to 4			
9		4 to 6			
10		6 to $8\frac{1}{2}$			

NOTE

1. The offset impact bar is measured downward from the center of the VDI.
2. Hills are defined as terrain having a differential altitude of approximately 700 feet.
3. Increasing severity of terrain features will decrease the resultant clearance when using listed tracking positions.

A significant fact in using any combinations of coded ranges and the offset impact bar is that as long as the coded range is not masked, i.e. there is coding always displayed, there are no known possible impact situations and the technique (but not necessarily the display) is foolproof. The result of using the wrong airspeed and coded range combination for a particular terrain is crest overshoot (ballooning or excessive g but not impact). If undesirable ballooning occurs or uncomfortable g levels are encountered, the use of a further range contour, or slower air-speed is indicated.

VERTICAL DISPLAY CONTROLS

The controls for the VDI are grouped on the upper section of the pilot's control panel (figure 8-17).

DISPLAY Selector Buttons

The DISPLAY selector buttons allow a choice of contact analog, (CONT ANALOG), and search radar terrain clearance (TC) displays. The standby button (STBY) keeps the vertical display in readiness for a mode selection. The TC CAL button selects the terrain clearance calibration display. With the OFF position selected, no power is supplied to the vertical display system.

RANGE MILES Buttons

The range miles buttons provide a choice of range contour coding (1, 1.5, 2 and 3), for use with the terrain clearance function.

TEST Button

With CONT ANALOG selected, all symbols and markers except the command heading line may be displayed on the VDI simultaneously (see figure 8-22) by depressing the TEST button on the pilot's control panel. With TC selected, depressing TEST selects the TC test display (figure 8-22).

BRT/CONTRAST Control

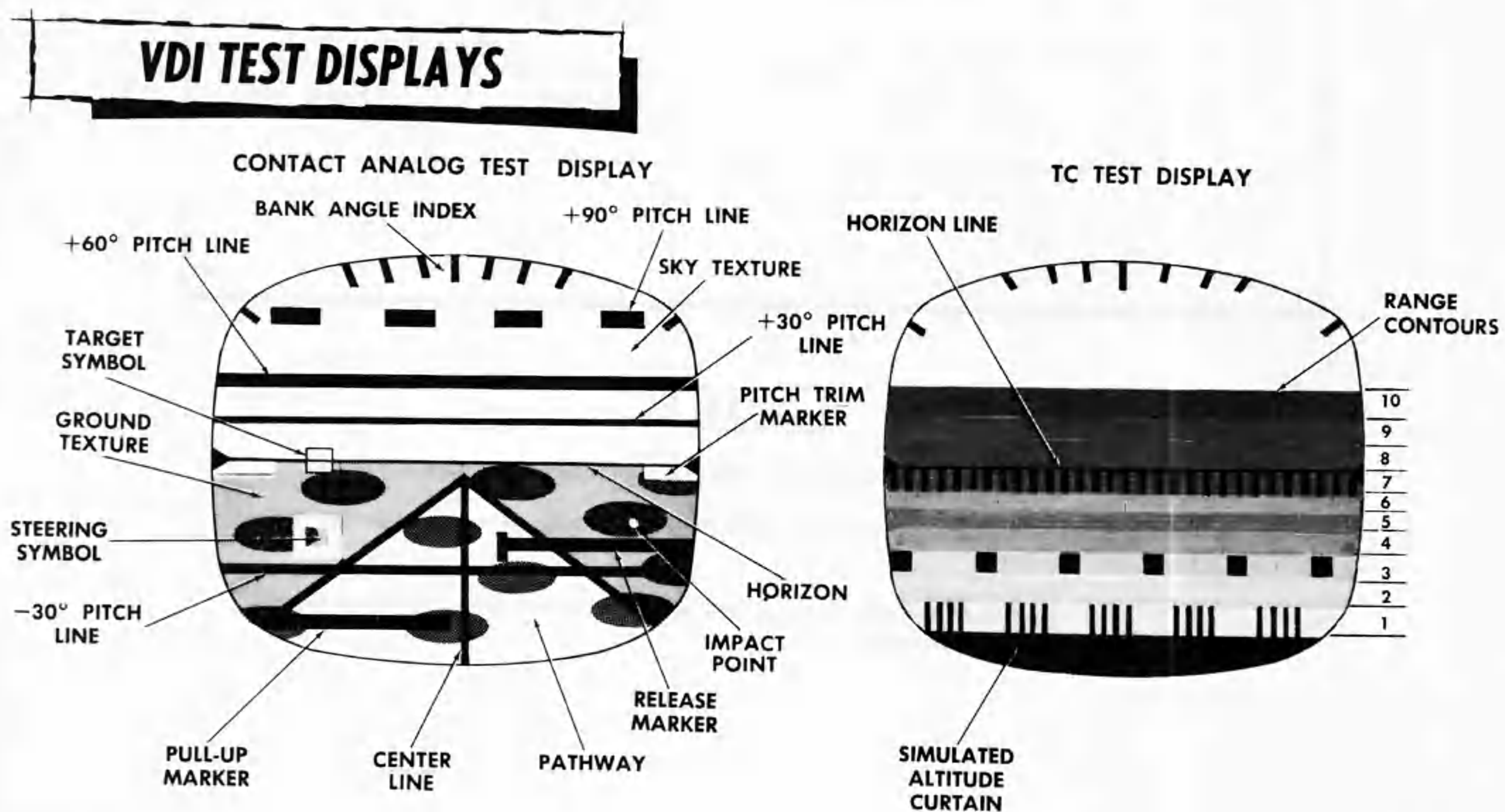
The BRT/CONTRAST control is a dual stacked control top-coded with a triangle. The outer portion marked BRT varies the brightness of the overall display and the inner portion adjust the contrast ratio of the symbols and the display background.

PITCH TRIM Control

The PITCH TRIM control permits the pilot to adjust the vertical position of the pitch trim markers with respect to the center of the VDI.

OFFSET IMP PT/PATH BRT Control

The OFFSET IMP PT/PATH BRT control is a stacked rotary control top-coded with a cross. The outer control marked OFFSET IMP PT adjusts the vertical position of the offset impact bar on the VDI in the TC mode. The inner portion of the control, marked PATH BRT, adjusts the brightness of the VDI pathway; rotating the control fully counterclockwise to the OFF position removes the pathway from the display.



A-ADFI-99

Figure 8-22

OPTICAL SIGHT

The lead-computing optical sight (figure 8-23) is above the pilot's instrument panel and is positioned parallel with the aircraft armament datum line. The optical sight provides the pilot with accurate information regarding target lead angle, and in-range and breakaway indications which will enable him to release a weapon at the precise time and heading that will result in destruction of the selected target. The primary function of the optical sight is accomplished by projecting four optical displays onto a reflector in the pilot's field of vision (figures 8-23 and 8-24). These displays include a fixed and a movable reticle and in-range and breakaway projections. The various functions available to the sighthead are adjusted by controls on the optical sight control panel on the pilot's left console.

RETICLE DISPLAYS

The reticle displays are illustrated in figure 8-24.

Fixed Reticle

The fixed reticle display is permanently aligned with the armament datum line (ADL) of the aircraft and reflected into the pilot's field of view. The reticle forming this display consists of a cross with a center dot and two dashed, concentric semi-circular arcs spaced 50 mils apart. Additional dots, spaced at 10-mil increments, are located directly between and beneath the semi-circular arcs. With masking, the fixed image reticle appears as the cross and dot without dashed semi-circular arcs and dots. With the mask removed, the fixed image reverts to the cross and dot configuration complete with semi-circular arcs and dots. When operating in the manual (MAN) mode, the mask may be removed so that the arcs and dots can be used for lead angle calculations. When using mil lead, set movable reticle in the manual mode; the fixed reticle should be turned off. In the boresight mode, the fixed reticle is not displayed until commit.

Movable Reticle

When the optical sight is operated in the AUTO mode, positioning of the movable reticle is controlled by the digital computer. In this mode, the movable reticle provides the following command or status conditions:

1. Azimuth steering commands. In attack, the horizontal displacement reflects roll-summed steering; in non-attack, angular steering error is displayed.
2. Boresight target acquisition. In attack with BORESIGHT selected on the B/N control panel MODE switch and prior to commit, the horizontal and vertical displacements reflect the aircraft aiming vector which must be lined up on the target at designate.
3. G-command. Except in the boresight mode, vertical displacement reflects g-to-go when the breakaway display is on.

4. Command pitch. Vertical displacement provides a command pitch indication under the following conditions:
 - a. Nuclear safe escape criteria unsatisfied (climb)
 - b. Insufficient altitude for blast clearance (climb)
 - c. Aircraft under-diving target in a STRAIGHT path attack
 - d. Angle-to-go to release in ROCKET attack.
 - e. Angle-to-go to 3 1/2° glide slope in landing mode.

The image reflected to the pilot's field of vision consists of a dashed cross and dot with short arcs at 25 and 50 mils. To release a weapon at the proper heading, the pilot must maintain an aircraft heading such that the movable reticle is superimposed in azimuth upon the fixed reticle. The position of the movable reticle in elevation is relative to the aircraft ADL for the function being displayed.

In-Range Display

The in-range optical display (figure 8-25) is a reflection of flashing white light. This display is generated by six small lamps within the sighthead and forms an arc reticle impression. When flashing, this light indicates that the aircraft is within weapon release range of the selected target, as computed by the computer or that a release point has been selected by the computer in straight path attack. In the boresight mode, flashing of the in-range lights indicates that a valid elevation track lock has been acquired.

Breakaway Display

The breakaway optical display (figure 8-25) provides the pilot with two distinct operational functions, involving immediate alteration of aircraft altitude. The display consists of two parallel lines of flashing red lights reflected on the port and starboard edges of the sighthead reflector and the movable reticle indicates pullup based on selected g. When this display is seen, the pilot is advised that:

1. The computer has developed a dead ahead terrain avoidance pullup based on computer present position altitude and velocity vector direction.
2. A pullup maneuver is required for a particular weapon release.

COMPUTER OPTICAL POSITIONING (COP) CHECK

The tracking accuracy of the system may be evaluated visually with the optical sight by use of the computer optical positioning (COP) check. With the radar in the desired tracking mode, the bombardier/navigator positions the cursors on a visually recognizable radar target. With the optical sight AUTO/

NEW
NEW

OFF/MAN switch at AUTO, depressing and holding the attack commit trigger to the intermediate detent aligns the optical sight moving reticle, with the radar cursors. The position of the moving reticle with respect to the target may be observed and the magnitude and direction of any tracking error may be determined. The PHD TIME window displays true airspeed in knots when the attack commit trigger is depressed to the COP position. This value is updated every 8 seconds as long as COP is held. An instantaneous update can be acquired by deselecting, then reselecting COP.

Note

If a COP check is performed on the ground, only azimuth indications are valid.

SIGHTHEAD OPERATING CONTROLS

The mask control and elevation thumbwheel are the only controls on the sighthead that are used in normal flight operation. All remaining operational controls are on the sight unit control panel (figure 8-23) on the pilot's left console.

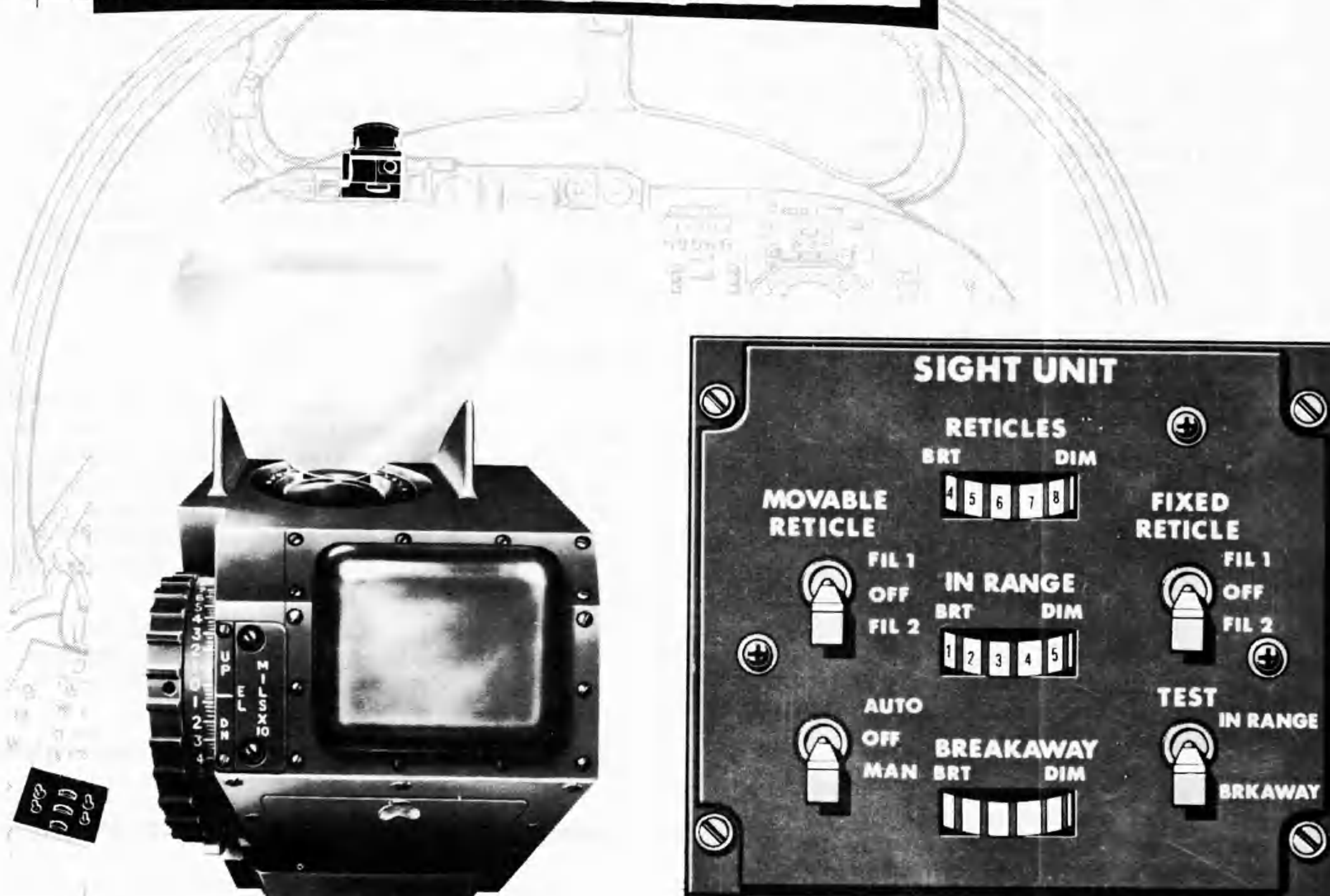
Mask Control

This control is a lever that is mechanically coupled to a hinged mask that covers the concentric arcs on the lower portion of the fixed reticle. This mask controls the image exposure content generated by the fixed reticle and subsequently presented to the pilot's view. When the mask control is placed in the OUT position, the fixed reticle concentric arcs are projected in the pilot's view to enable him to determine lead angle while in the MAN mode of operation, or when no lead angle information is available from the ballistics computer. When the mask control is in the IN position, the mask effectively covers all the fixed reticle except the cross and dot center.

Elevation Thumbwheel

The elevation thumbwheel is a calibrated control mechanically coupled to a synchro transmitter. Operation of the thumbwheel controls the position of the movable reticle in elevation when the optical sight is in the MAN mode of operation. The dial of

OPTICAL SIGHT AND CONTROL PANEL



ADF1-92

Figure 8-23

the thumbwheel is calibrated in 350 mils of elevation down (approximately 20°) and 88 mils up (approximately 5°), and numbered in divisions of mils x 10. The dial and identification plate are edge-lighted to facilitate reading and locating the control. The intensity of dial illumination is controlled by the aircraft console lights dimmer control.

SIGHT UNIT CONTROL PANEL

Reticle Control

This thumbwheel control is marked BRT and DIM. Positioning of this control adjusts the intensity of the sighthead reticle illumination to the level desired by the pilot.

In-Range Control

This thumbwheel control is marked BRT and DIM. Positioning of the control adjusts the intensity of the sighthead in-range illumination to the level desired by the pilot.

Breakaway Control

This thumbwheel control is marked BRT and DIM. Positioning of this control adjusts the intensity of the sighthead breakaway illumination to the level desired by the pilot.

Movable Reticle Switch

This three-position switch, marked FIL 1, OFF, and FIL 2, provides filament power to the movable reticle lamp. In the OFF position, no power is supplied to the lamp and no movable reticle image is presented. In FIL 1 position, power is supplied to filament number one of the movable reticle lamp and the image is reflected to the sighthead. The FIL 2 position of the switch provides for a second filament circuit in the movable reticle lamp in the event of damage to the FIL 1 circuit. This provides a secondary means of illuminating the moving reticle.

OPTICAL SIGHT DISPLAY MODES



ADF1-93

Figure 8-24

Fixed Reticle Switch

This three-position switch, marked FIL 1, OFF, and FIL 2, provides filament power to the fixed reticle lamp. In the OFF position, no power is supplied to the lamp and no fixed reticle image is presented. In FIL 1 position, power is supplied to filament number one of the fixed reticle lamp and the image is reflected. The FIL 2 position of the switch, power is supplied to the second filament circuit in the fixed reticle lamp in the event of damage to the FIL 1 circuit. This provides a secondary means of illuminating the fixed reticle.

Automatic/Off/Manual Switch

This three-position switch, marked AUTO, OFF, and MAN, controls input power and permits selection of the desired mode of operation of the sighthead. In the OFF position, no electrical power is supplied to the sighthead. When the control is moved to the MAN

position, the fixed reticle and movable reticle are illuminated, and the position of the movable image is adjustable with the elevation thumbwheel. The fixed reticle image coincides with the ADL of the aircraft. When the switch is positioned to the AUTO detent, all movable reticle inputs are initiated by the digital computer. When this switch is positioned to either AUTO or MAN the appropriate reticle image will be reflected indicating sighthead operating condition.

NEW
NEW

Sight Unit Test Switch

This three-position, provides a means of testing the in-range and breakaway reflections. The switch is spring-loaded to the neutral position and when momentarily held in either position, presents to the pilot the appropriate sighthead reticle indication. The sight unit test switch can also be used to test the in-range and breakaway lights on the VDI.

OPTICAL SIGHT ADVISORY DISPLAYS



IN-RANGE
(FLASHING WHITE)



BREAKAWAY
(RED)

ADF1-94

Figure 8-25

OPERATION OF OPTICAL SIGHT**Note**

Before engaging the optical sight AUTO-OFF-MAN switch, ensure that optical sight primary 28 VDC OPT-SIGHT circuit breaker and ADC/OPT SIGHT 115V/400 Hz circuit breaker on the bombardier/navigator circuit breaker panel are engaged.

1. Position AUTO/OFF/MAN switch as desired. The sight is now ready for automatic or manual operation within limits described in this section.

CAUTION

Do not leave AUTO/OFF/MAN switch OFF during taxi or flight operation.

2. Adjust reticle controls for optimum illumination.
3. Operate test control for in-range and break-away lights.

WEAPONS RELEASE SYSTEM

NEW The aircraft weapons release system is capable of transporting and delivering a variety of conventional and nuclear weapons against air and surface targets. The system consists of the armament control unit (ACU), fuze function control set, the aircraft monitor and control system, cockpit controls and indicators, mounting facilities at five external store stations, and associated electrical wiring. The cockpit controls and indicators are located on the ACU control panel labeled ARMAMENT, the AWW-4 fuze function control panel and the NUCLEAR control panel. (See figure FO-3.)

in either the step or train mode of release is fixed at 1, 5, 2, 4, 3 and stations not selected are bypassed. When all five stations are selected in the step or train mode, after releasing the store from the fuselage centerline station (station 3), the station select logic resets back to station 1. If all stations are not selected, the station select logic resets back to the highest priority station selected after the store has been released from the lowest priority station selected. This automatic reset action continues until the quantity of release pulses as set on the ACU QUANTITY select thumbwheels has been completed.

ARMAMENT CONTROL UNIT

The ACU allows the crew to control, arm and release various weapons, fire guns, rockets, and missiles, and to jettison weapons selectively or simultaneously. Bombs, rockets and missiles are released in either an automatic or manual mode of operation. Guns are only fired in a manual mode. The ACU provides releases as follows:

- Firing of rockets in the step, train or salvo mode from four of the five external store stations. (1, 2, 4 and 5).

Note

The ACU has the capability to interface with seven external store stations. The two additional ACU stations labeled L OUT BD and R OUT BD, provide for future growth.

- Step, train or salvo release of bombs from all five external store stations.
- Step or train firing of missiles from four of the five external store stations (1, 2, 4 and 5).
- Salvo firing of gun pods from four of the five external store stations (1, 2, 4 and 5).

Weapons are carried on the five external store stations: left wing outboard (1), left wing inboard (2), fuselage centerline (3), right wing inboard (4) and right wing outboard (5). The station firing priority

MANUAL WEAPON RELEASES

Manual release of weapons in the step, train or salvo release mode is accomplished at any time by the pilot depressing the manual release button on either the pilot's control stick or the left canopy bow. The release button must be depressed until the preselected number of releases has been completed.

Train

The manual release signal in the train release mode starts the intervalometer and the spacing and number of sequential releases from the selected stations is controlled by the TIME and QUANTITY select thumbwheels. The multiple release counter counts the number of release pulses generated and when the preselected quantity is reached, the intervalometer turns off, the station select logic resets to the highest priority station selected, and the COMPLETE light comes on. If the release button is released before the preselected number of releases has been completed, the intervalometer stops generating output pulses and weapon release ceases, the station select logic is not reset and the COMPLETE light is not lit. The next time the manual release button is depressed, the intervalometer starts generating output pulses and the station select logic picks up from where it left off and starts releasing weapons from the next priority station. Upon completion of the original preselected quantity or a new selected quantity, the intervalometer will turn off, the station select logic will reset, and the COMPLETE light comes on.

Step

In the step release mode, the manual release signal, generated by the manual release button, by-passes the intervalometer and drives the station select logic directly. The weapons are released from the selected stations sequentially at a manual rate. The number of releases is controlled by the number of manual release signals generated by the manual release button. The multiple release counter operates but does not inhibit release pulses in this mode.

Salvo

The salvo release mode when activated by a manual release signal operates in a similar fashion to the train release except that the weapons are released simultaneously from the selected stations and the number of release pulses generated is controlled by the QUANTITY select thumbwheel and the number of stations selected.

The spacing in time between simultaneous releases is controlled by the TIME select thumbwheel. The multiple release counter counts the number of release pulses generated and when the preselected quantity is reached the intervalometer is turned off, and the COMPLETE light is turned on.

If the release button is released before the preselected number of releases have been completed, the intervalometer stops generating release pulses, weapon release ceases, and the COMPLETE light is not turned on. The next time the release button is depressed, the intervalometer starts generating release pulses and weapons are released from the selected stations. Upon completion of the original preselected quantity or a new selected quantity, the intervalometer is turned off, and the COMPLETE light is turned on.

A multiple weapon BOMB SALVO release with only one station selected appears identical to a TRAIN release.

AUTOMATIC WEAPON RELEASES

Automatic weapon releases are activated by the following systems:

- Digital computer (GENERAL, HI LOFT, STRAIGHT, ROCKET)
- Inertial navigation system (INS) (LAB TGT, LAB IP)
- Ground controlled bombing system (GCB)
- Armament control unit (ACU) (DELAY)

In order to release a store in the train or salvo release mode using one of the four automatic types, the attack commit trigger on the pilot's control stick or the left canopy bow must be depressed prior to receiving the automatic release signal and until the preselected number of releases has been completed.

Non-Computer Releases

Three of the automatic release types (those activated by the INS, GCBS, and ACU) use the intervalometer to drive the station select logic. The intervalometer is started by the automatic release signal in the train or salvo release mode and operates in the same manner as when started by the manual release signal.

If the attack commit trigger is released before one of these three automatic release signals is received, automatic release does not occur.

If the attack commit trigger is released after the automatic release signal is received but before the preselected number of release signals is completed, the intervalometer stops and operation is the same as if the manual release signal was stopped.

Computer Releases

In the fourth type of automatic release, the computer drives the station select logic in the train or salvo release mode. Two computer signals are required to activate this type of release. The first is the fire ready signal and the second is the automatic release signal.

If the attack commit trigger is released before the computer supplies pulses to the station select logic, weapon release does not occur.

If the commit trigger is released after the computer starts supplying pulses to the station select logic but before the preselected number of releases has been completed, the computer pulses are kept from the station select logic and weapon release ceases. In the train release mode the station select logic does not reset and the COMPLETE light is not turned on. Upon the reapplication of computer signals, or application of output pulses from the intervalometer, or STEP release pulses, the station select logic will pick up from where it left off and start releasing weapons from the next priority station. The multiple release counter counts the number of release pulses generated and upon completion of the original preselected quantity the station select logic is reset, and the COMPLETE light is turned on.

When the salvo release mode is interrupted, the COMPLETE light is not turned on. Upon reapplication of computer signals or application of output pulses from the intervalometer, weapons are released from the selected stations. The multiple release counter will count the number of release pulses generated and upon completion of the original preselected quantity or a new selected quantity, the COMPLETE light is turned on.

ARMING AND FUZING

The fuze function control set and the aircraft monitor and control (AMAC) system operate in conjunction with the ACU and provide control over electrically fuzed and nuclear weapons respectively by means of controls on the AN/AWW-4 panel and the NUCLEAR panel.

ACU CONTROL PANEL

The armament control unit (ACU) is a 7-station device with solid-state logic and relay switching which provides control of arming and release of conventional weapons. Controls for the operation of the ACU are provided on the ARMAMENT control panel on the left side of the bombardier/navigator's instrument panel (Figure FO-3).

EXTERNAL STORE STATION CONTROLS

The external store station controls consist of 7 armament tape assemblies, release indicators, and station select switches. The controls for the left and right outboard stations are provided for growth only. These outboard station controls may be used, singly or in combination, for practice. However, selection of the L OUT BD or R OUT BD station with any of the numbered stations will cause a reselect condition. See figure 8-27.

Note

It is strongly recommended that only the L OUT BD and/or R OUT BD station(s) be used for practice attacks.

Armament Tape Assemblies

Each external store station is provided with an armament tape assembly which is a self-contained device consisting of an armament tape, readout window, thumbwheel control, gun switch, and an armament digital readout which indicates to the computer the store selected on the armament tape.

The armament tape is a continuous loop capable of displaying 64 separate legends (figure 8-15). The tape is positioned by use of a thumbwheel control adjacent to a readout window marked for the station it represents. The store displayed in the readout window is identified to the computer by the armament digital readout as the store actually loaded on the external store station. The readout windows should be checked before takeoff to insure that they agree with the weapons loaded on the station. When the armament tape is set to MK 4 GUN, one of the pods, or one of the tanks, the gun switch operates to prevent inadvertent manual or automatic release. These stores may be jettisoned only. There is a release indicator above each readout window which shows black when reset (the station is loaded). When a release pulse is directed to a station, its release indicator rotates changing its displayed color to black and white.

Station Select Switches

Three-position lever-lock station select toggle switches are used to select the station from which weapons are to be released and the type of weapons (bombs/guns or rockets/missiles) to be released. The three station select positions are BOMBS/GUNS (up), OFF (center) and ROCKETS/MISSILES (down).

Note

Reselect logic inhibits release if the position of the station select switch is incompatible with the armament tape setting.

A locking assembly, located on each of the switches and which can be safety-wired in the off position, prevents inadvertent operation of any of the station select switches. Before placing any of the switches to the BOMBS/GUNS position, the locking assembly must be pulled out and rotated to the collar slot up position. The station select switch is now free to be placed in either the BOMBS/GUNS or OFF position. Before placing any of the switches to the ROCKETS/MISSILES position, the locking assembly must be pulled out and rotated to the collar slot down position. The station select switch is now free to be placed in either the ROCKETS/MISSILES or OFF position.

MASTER ARMT SWITCH

The three position, lever-lock MASTER ARMT toggle switch controls the power necessary for release and selective jettison. The switch positions are ON (up), OFF (center) and PRAC (down).

With the switch OFF, no electrical power is available to the release circuitry.

With the landing gear up and locked, placing the switch ON allows electrical power to be supplied to the store release circuitry. The MASTER ARMT switch must be in the ON position before release or selective jettison of weapons can be accomplished.

The third switch position is PRAC, and is used to simulate actual operation during practice missions. When the switch is positioned to PRAC, the release pulses generated by the ACU are restricted from the pylons, and weapons are not released. Selective jettison, gun fire, gun ready, and Shrike fire ready are also inhibited. All other operations and functions will perform as during an actual release. On the ground, PRAC prevents store release but permits power to be applied to the ACU.

A locking assembly, which can be safety-wired in the OFF position, prevents inadvertent operation of the MASTER ARMT switch. Before placing the switch to ON, the locking assembly must be pulled out and rotated to the collar slot up position. The MASTER ARMT switch is now free to be placed in either the ON or OFF position. To place the switch in the PRAC position, the locking assembly must be pulled out and rotated to the collar slot down position. The MASTER ARMT is now free to be placed in either the PRAC or the OFF position.

RELEASE MODE SELECT BUTTONS

The RELEASE mode buttons permit selection of any one of 8 release modes. The buttons are interlocked so that only one may be depressed at a time. The following paragraphs describe the release modes. Reselect logic inhibits release if the RELEASE mode selected is incompatible with the armament tape selection.

STEP

The STEP position allows for the sequential release of bombs, rockets, and missiles, based upon a manual rate of release signals generated by the manual release button.

BOMB TRAIN

In the BOMB TRAIN position, the stores are sequentially released from the selected stations. One store is released each time a release signal is directed to the station select logic. The spacing between these sequential releases is based upon the predetermined setting on the TIME thumbwheel except when using an automatic computer release mode. In the GENERAL, STRAIGHT or HI LOFT attack mode the sequential spacing is based upon the INTERVAL thumbwheel setting if minimum safe time is satisfied.

Train releases are inhibited at pitch angles greater than 85°.

Note

Cycling the MASTER ARMT switch causes the station select logic to reset to the highest priority station selected in the 1, 5, 2, 4, 3 sequence.

BOMB SALVO

In the BOMB SALVO position the stores are released simultaneously from all of the selected stations. One store is released from each selected station each time a release signal is directed to the station select logic. The spacing between these simultaneous releases (a train of salvos) is generated in the same manner as it is in the bomb train position.

ROCKET TRAIN

The ROCKET TRAIN position allows for the sequential firing of rockets from the selected stations. One station is fired each time a release signal is directed to the station select logic. The spacing between the sequential firing is based upon the predetermined setting on the TIME thumbwheel except when using the ROCKET attack mode. In the ROCKET attack mode the sequential spacing is based upon the INTERVAL thumbwheel setting if minimum safe time is satisfied.

ROCKET SALVO

The ROCKET SALVO position allows for the simultaneous firing of rockets from all of the stations selected. All selected stations are fired each time a release signal is directed to the station select logic. The spacing between these simultaneous firings (a train of salvos) is generated in the same manner as the rocket train position.

MISSILE

The MISSILE position allows for the sequential release of a single missile from each of the selected

stations. The spacing between these sequential releases is based upon the predetermined setting on the TIME thumbwheel.

GUNS

The GUNS position allows for the simultaneous firing of the gun pods on the stations selected.

SEL JETT

The selective jettison position allows for the simultaneous jettison of the stores from all of the stations selected. This position is protected from inadvertent operation by a clear plastic guard. In order to activate this position, the guard must be held back and the pushbutton depressed.

MECH ARM SWITCH

The MECH ARM switch is a three-position, lever-lock toggle switch that controls the nose and tail arming of conventional weapons. In the NOSE/TAIL position (up), the fuzes in both the nose and tail of the weapon are set. With the switch placed to TAIL (down), only the tail fuze is set. Placing the switch to SAFE (center) prohibits all mechanical arming for safe weapons release.

Note

Reselect logic requires that either the MECH ARM switch or the electric fuzing FUNCTION switch be in a position other than SAFE.

ROCKET SWITCH

The ROCKET switch is a two-position toggle switch marked RIPPLE and SINGLE, whose only function is to permit selection of stick centering for BOMB SALVO or BOMB TRAIN releases. When the switch is at RIPPLE, release timing is adjusted to place the first bomb on the target, and when SINGLE is selected the middle bomb will be on the target.

GUNS CHARGING SWITCH

The GUNS charging switch is a three-position lever-lock toggle switch. This switch controls the charging and clearing of guns in the gun pod. In the READY position (up) the guns on the selected station are simultaneously charged and made ready for firing. Placing the switch in the CLEAR position (down) empties the gun chamber of live rounds and renders the gun inoperative. With the switch in the SAFE position (center), no electrical power is available for firing. Operation of the guns switch is such that a locking assembly prevents inadvertent operation. Before placing the switch to READY, the locking assembly must be pulled out and rotated to the collar slot up position. To place the switch in the CLEAR position, the locking assembly must be pulled out and rotated to the collar slot down position.

ATTACK MODE SELECT BUTTONS

The ATTACK mode buttons permit selection of any one of 8 attack modes. The buttons are interlocked

so that only one may be depressed at a time. The following paragraphs describe the manner in which each ATTACK mode affects the weapons release. Reselect logic inhibits release if the selected ATTACK mode is incompatible with the armament tape selection.

GENERAL STRAIGHT, HI LOFT and ROCKET

These four attack modes are activated by the digital computer. When the computer is stepped into attack, it will supply a fire ready signal and release pulses to the ACU to drive the station select logic. In this mode, the ACU intervalometer is by-passed and the digital computer controls the spacing between releases from the selected stations to obtain the desired ground spacing distance. If an even number of releases has been selected and the ROCKET switch is at SINGLE, the impacts are spaced to straddle the target. The digital computer determines the correct ground spacing as follows:

1. When the MASTER ARMT switch is ON, the computer converts the ground spacing distance in feet set in the ACU INTERVAL thumbwheel to time between releases.
2. Next, the computer compares the time obtained in 1. above to the time set in the ACU TIME thumbwheel. If the time obtained in 1. above is less than the time set in the TIME thumbwheel, the computer flashes the ACU RESELECT light and releases are inhibited.

When the computer is stepped into the attack mode, the ACU RESELECT light stops flashing and automatic releases will occur at the safe station to station time set on the TIME thumbwheel. If the time is equal to or greater than safe time, normal release will occur at the ground spacing distance set on the INTERVAL thumbwheel. The total number of release pulses from the computer is set by the ACU QUANTITY select thumbwheel. If the digital computer is not put into the attack mode, automatic release will not occur and a manual release must be used.

DELAY

This attack mode is activated by the ACU. During this mode, the pilot's attack commit trigger activates the ACU timer which in turn activates the ACU intervalometer when the timer countback reaches zero. The length of the countdown is determined by the setting on the INTERVAL thumbwheel. The spacing and number of releases are controlled by the TIME and QUANTITY select thumbwheels. The multiple release counter counts the number of release pulses generated and when the preselected quantity is reached, it will turn the intervalometer off and the COMPLETE light will be turned on.

LAB IP and LAB TGT

These two attack modes are activated by the INS. During these attack modes, the pilot's attack commit trigger activates the ACU timer which is used to countdown from the pre-selected time set on the

INTERVAL thumbwheel. When the countdown is completed, the pilot begins a 4-g pull-up maneuver and the INS sends a release signal to the ACU when the aircraft reaches a set pitch angle. This automatic release signal activates the ACU intervalometer and stores are released with the spacing and number as set on the TIME and QUANTITY select thumbwheels. The multiple release counter counts the number of release pulses generated and when the preselected quantity is reached, it turns the intervalometer off, the station select logic is reset and the COMPLETE light is turned on.

GCB

This attack mode is activated by the ground controlled bombing system. During this mode the ground controlled bombing system supplies an automatic release signal after the pilot's attack commit trigger is depressed. This automatic release signal activates the ACU intervalometer and stores are released with the spacing and number as set on the TIME and QUANTITY select thumbwheels. The multiple release counter counts the number or release pulses generated and when the preselected quantity is reached, it turns the intervalometer off, the station select logic is reset and the COMPLETE light is turned on.

RESELECT LIGHT

The RESELECT light is activated by the reselect relay internal to the ACU. The light may be tested by depressing the pilot's TEST button. The reselect relay is energized by a signal from the digital computer when there is an incompatibility in the ACU switch settings. The light goes out when the correct setting is made. The reselect relay, when energized, inhibits intervalometer and computer release pulses from the station select logic but not the manual STEP pulses. Since the RESELECT light is driven by computer logic, the RESELECT light is inoperative and reselect protection is not available when the computer is OFF or not in the aircraft.

COMPLETE LIGHT

The COMPLETE light is controlled by the multiple release counter circuitry. When the ACU has generated the required number of released pulses as set on the QUANTITY select thumbwheel, the COMPLETE light is turned on to indicate that the desired number of stores have been released. The COMPLETE light goes out when either the attack commit trigger or manual release button is released.

INTERVAL THUMBWHEEL

The three digit INTERVAL thumbwheel performs two functions. In the LAB IP, LAB TGT and DELAY attack modes, it is used to set the ACU timer so that the correct count back is obtained in real time. For this function, the thumbwheel has a range from 99.9 seconds to 00.0 seconds and it is variable in 00.1 second discrete steps. In the GENERAL, STRAIGHT, HI LOFT and ROCKET attack modes, the thumbwheel is used to control the digital computer release pulses

to the ACU so that the correct ground spacing distance in feet is obtained. For this function, the thumbwheel has a range from 999 to 001 and it is variable in 001 discrete steps. (9990 feet to 10 feet in 10 feet discrete steps.)

Note

- Reselect logic does not permit release if INTERVAL is set to 0 and quantity is greater than 1.
- A setting on the INTERVAL thumbwheel which is less than the minimum safe time as set on the TIME thumbwheel will cause the RESELECT light to flash. Increasing the interval or stepping into attack will eliminate the flashing reselect light. If the B/N steps into attack with a flashing RESELECT light, the computer provides releases at the setting on the TIME thumbwheel.

TIME THUMBWHEEL

The three digit TIME thumbwheel performs two functions. In the manual and three of the automatic (LAB IP/TGT, GCB and DELAY) releases, the thumbwheel is used to set the ACU intervalometer so that the correct station-to-station release spacing is obtained in real time. For this function, the switch has a range from 9.99 seconds to 0.00 seconds and it is variable in 0.01 second discrete steps. In the GENERAL, STRAIGHT, HI LOFT and ROCKET attack modes, the thumbwheel is used to control the digital computer release pulses to the ACU so that the weapon is not released from the aircraft below the minimum safe time. For this mode, the range is from 9.99 to 0.00 seconds in 0.01 second discrete steps.

Note

For computer releases, a minimum setting of 0.06 is required to satisfy reselect logic.

WARNING

When the digital computer is off or not installed, and a TIME of less than 0.06 is selected, stores could be released at intervals as low as 0.01 seconds and weapon-to-weapon collisions could occur. This condition could also result in hung stores.

QUANTITY THUMBWHEEL

The two digit QUANTITY select thumbwheel performs two functions. In the manual and three of the automatic (LAB IP/TGT, GCB and DELAY) releases the thumbwheel is used to control, via the multiple release counter, the number of pulses to be generated by the ACU intervalometer. For this function, the switch has a range from 99 to 00 and it is variable in 01 discrete steps. In the GENERAL, STRAIGHT, HI LOFT and ROCKET attack modes, the thumbwheel is

used to control the number of automatic release pulses generated by the digital computer. For this function, the range is the same as above.

The quantity input for train releases is the desired number of bombs to be released. For salvo, the number of weapons released will be a multiple of the stations selected. If the quantity set is not a multiple of the stations selected, the number of bombs released will be equal to the next higher multiple. For example.

- Weapons loaded: 22 Mk-82 on stations 1, 2, 4, 5
- Stations selected: 1, 2, 4, 5
- QUANTITY setting: 18

In this case, 20 bombs would be released, because multiples of 4 are 8, 12, 16, 20.

MISSILE CONTROLS

Missile CONTROL Switch

The missile CONTROL switch is a 2 position toggle switch marked ON and OFF. This switch is provided to control application of electrical power for a future missile capability.

Missile PWR/TONE Control

The missile PWR/TONE control is a dual stacked control marked PWR and TONE. The inner control, marked TONE permits adjustment of the audio level of missile tones. Full clockwise rotation provides maximum volume; full counterclockwise rotation reduces tone volume to a minimum. The outer control, marked PWR is a 3-position rotary selector switch with positions marked OFF, STBY and ON. When the switch is at OFF, no electrical power is available to the missiles. Setting the switch to STBY provides power for the heaters on all missiles carried. When the switch is at ON, electrical power is available to the missile guidance systems on the selected stations.

Note

The MASTER ARMT switch must be at ON or PRAC to apply power to the missile heater or guidance circuits.

Missile COOLING Switch

The missile COOLING switch is a 3-position toggle switch marked ON, OFF and TEST. When the switch is at OFF no power is available to the Sidewinder cooling circuits or the Shrike guidance circuits. When the ON position is selected power is applied to the Sidewinder missile cooling system. When TEST is selected, electrical power is available to the Shrike guidance system for ground test.

Note

The MASTER ARMT switch must be at ON or PRAC to apply power to the Shrike guidance circuits.

FUZE FUNCTION CONTROL PANEL

The fuze function control set AN/AWW-4 provides several DC voltage combinations for charging and arming electric bomb and missile fuzes. The electrical signal selected on the panel is supplied to the bomb through interconnecting cabling during the first few inches of bomb fall. The operating controls are on the fuze function control panel below the ARMA-MENT panel (figure FO-3).

FUNCTION SWITCH

The FUNCTION switch is a 5-position rotary selector switch marked SAFE, VT, INST DLY1 and DLY2. When the switch is set to SAFE no power is applied to the AWW-4. This switch permits selection of the following fuzing voltages.

SAFE	-	All power disconnected from the system
VT	-	+ 300 VDC
INST	-	+ 195 VDC
DLY 1	-	- 195 VDC
DLY 2	-	- 300 VDC

It is not necessary that the MASTER ARMT switch be ON to energize the high voltage circuitry in the AWW-4 power supply. However, the MASTER ARMT switch must be ON and a release signal supplied in order to supply fuze charging power to the bomb racks. No warm-up time is required.

HVDC TEST BUTTON

The HVDC TEST button is a spring-return push button used to test the AWW-4 power supply when the aircraft is on the deck. When weight is on the wheels and the FUNCTION switch is at a position other than SAFE, depressing the button energizes the high-voltage circuits of the AWW-4 power supply. Voltage is not supplied to the racks unless the manual release button is also depressed. In flight with the system operating properly, the HVDC TEST button serves no purpose.

HVDC LIGHT

The HVDC light is a press-to-test light which comes on whenever the high voltage circuits of the AWW-4 power supply have been energized. It does not indicate that voltage has been supplied to the racks.

In flight, with the system operating properly the HVDC light will come on when the FUNCTION switch is set to a position other than SAFE. The light must not come on when SAFE is selected.

The press-to-test features does not operate when the FUNCTION switch is at SAFE. The light contains a standard intensity control. Rotate the receptacle counter-clockwise for full intensity.

If the HVDC light fails to come on with the FUNCTION switch at any position other than SAFE.

1. Press the light to test for bulb failure.
2. Depress the HVDC TEST button. If the light comes on, the weight-on-wheels interlock circuitry is faulty. Successful release can be made by selecting the desired fuzing option and depressing the HVDC TEST button during release.
3. If the light does not come on when the HVDC TEST button is depressed, and the bulb tested good, the AWW-4 power supply has not been energized. Under this condition, electric fuzes will not be properly charged. If the bulb is bad, there is no assurance that the power supply has been energized.

PREFLIGHT CHECK

A preflight check of the system should be performed after engine start as follows:

1. DO NOT energize MASTER ARMT or station select switches.
2. Set FUNCTION switch to anticipated delivery option (VT, INST, DLY 1 or DLY 2). HVDC lamp must remain OFF.
3. Check condition of HVDC light bulb by depressing press-to-test feature.
4. Press HVDC TEST button. HVDC light must go ON.
5. Release HVDC TEST button. HVDC light must go OFF.
6. Set FUNCTION switch to SAFE.

NUCLEAR PANEL

The NUCLEAR panel contains the controls and indicators for the operation of the T-375 aircraft weapon monitor and control system (AMAC) (figure FO-3).

NUCLEAR SELECT BUTTONS

Four pushbuttons, OFF, SAFE, GRD, and AIR control arming and safing of the nuclear weapons and allow for selection of either a ground (GRD) or AIR burst.

Depressing the SAFE button releases the OFF button and directs 28 volt DC electrical power to the special weapon fuzing circuits. The normal off condition of corresponding station disagreement lights indicates that all weapons are safe to carry or return, or are ready to be armed.

CAUTION

Never go directly from OFF to AIR or GRD.
The safe button must first be depressed.

A locking assembly over the GRD and AIR buttons serves as a safety device and prevents inadvertent arming of the nuclear weapons. To arm the stores, the locking pins must first be compressed, and the guard over the pushbuttons lifted. The special weapons being carried may now be armed by depressing either the GRD or AIR button, depending upon the desired type of burst.

Note

Do not depress the AIR or GRD buttons under any circumstances when the aircraft is on the ground and special weapons are loaded on the aircraft.

When the AIR or GRD buttons are depressed, all special weapons being carried on the aircraft will assume an armed condition.

When the SAFE button is again depressed, following arming of the weapons, the GRD or AIR button is automatically released; the guard over these buttons must be returned to its former position and locked.

Note

The nuclear selector OFF button must be depressed before and during take-off. Before landing, the OFF button must be depressed.

The computer program provides a capability for a practice nuclear delivery with the MK-76 practice bomb. When the armament tape for the selected station is set to F76, depressing the GND or AIR button selects a practice nuclear delivery. Depressing OFF or SAFE with the ACU MECH ARM set to NOSE/TAIL or TAIL selects a conventional weapon delivery.

SAFE LIGHT

A press-to-test SAFE indicating light monitors the T-375 system circuits. The light comes on when the SAFE button is depressed to indicate that the relay assembly in the aircraft is in the safe position. When the OFF, GND, or AIR button is depressed, the SAFE light is off.

Note

When the SAFE button is depressed, following arming of the weapons, the ARM light will remain illuminated momentarily. This is normal. The ARM light will go off at completion of the safing operation.

The press-to-test feature of the light checks the indicator for continuity by supplying 28 volt DC electrical power from the essential bus.

ARM LIGHT

A press-to-test ARM indicating light monitors the T-375 system circuits. The light comes on when the GND or AIR button is depressed indicating that the relay assembly in the T-375 relay module has reached the armed position. With either the OFF or SAFE buttons depressed, the ARM light is off.

The press-to-test feature of the ARM light checks it for illumination by supplying 28 volt DC electrical power from the essential bus to the light.

Station Disagreement Lights

The red press-to-test station disagreement lights monitor the store and T-375 system circuits. The numerals 2, 3, and 4 above the lights refer to the respective store locations: left inboard wing, centerline, and right inboard wing station. The disagreement lights are designed on the light-off principle. Thus, the normal condition of the weapon for any setting of the nuclear selector is indicated by the disagreement lights remaining off. If a light illuminates, it indicates that the fuze setting of the corresponding weapon does not agree with the AIR or GND selection of the nuclear selector, or that a malfunction exists. The press-to-test feature of the lights checks them for illumination and monitors proper aircraft/weapon connections.

Note

Depressing the nuclear selector buttons may cause the station disagreement lights to flash momentarily. This is normal.

BALLISTIC CONTROL PANEL

The ballistic control panel (figure 8-26) on the left engine inlet duct contains controls for setting aircraft safe escape time in seconds and altitude fuzing in hundreds of feet for free fall nuclear and retard nuclear and cluster weapons loaded on stations 2, 3, and 4. These values are used by the computer to establish the following function for the type weapon selected:

1. Nuclear weapons - Safe escape time and burst altitude above surface, provided AIR is selected on the NUCLEAR panel.
2. Retard cluster weapons - Time from release to dispersal of bomblets if burst altitude is not equal to zero. If burst altitude is set to zero, bomblet dispersal time is assumed to be a pre-programmed constant for the weapon selected.

BALLISTIC CONTROL PANEL

ADF1-95

Figure 8-26

Note

- For nuclear weapons, the time and altitude settings on the ballistic control panel must correspond to the settings on the weapons itself.
- For cluster retard weapons, the time setting on the ballistic control panel must agree with the setting on the weapon. If the burst altitude is set to zero, however, the time set on the weapon must be the same as the programmed constant. In the latter case, the computer uses the constant and does not use the value set on the ballistic control panel.
- When a cluster weapon is loaded on one of the outboard stations (1 or 5) the time setting on the weapon must agree with the programmed constant time for that weapon since no variable time entry option is available for the outboard stations.

If more than one weapon is selected, and the settings on the ballistic control panel are not compatible with each other the RESELECT light comes on and release is inhibited.

The ballistics control panel also contains the armament safety override switch and two test receptacles for maintenance purposes. The settings on the ballistic control panel are sampled by the computer when the MASTER ARMT is set to ON.

MANUAL RELEASE BUTTON

There are two manual release buttons, one on the stick grip (figure 8-16) and one on the left canopy bow.

Each manual release button is a spring-return push-button. Depressing and holding the manual release button with the MASTER ARMT switch ON activates the ACU to provide releases according to the RELEASE mode selected and the settings on the INTERVAL, QUANTITY and TIME thumbwheels.

Note

Except with SEL JETT selected, when the armament tape for the selected station is set to MK4 GUN or one of the pods or tanks depressing either manual release button has no effect.

When the computer is on, reselect logic prevents manual train or salvo release when incompatible selections have been made.

RESELECT LOGIC

Whenever the computer is on and not in TEST, the position of the armament system switches is sampled during each iteration. If the position of any ACU switch is found to be incompatible or improper, the RESELECT light is turned on and release is inhibited. Reselect logic (figure 8-27) requires that the condition of the following be checked:

- Selected station select switches and armament tapes
- Selective jettison switch
- Mechanical arming switch
- RELEASE mode buttons
- ATTACK mode buttons
- INTERVAL, QUANTITY and TIME thumbwheels
- AWW-4 panel
- NUCLEAR panel
- Ballistic control panel

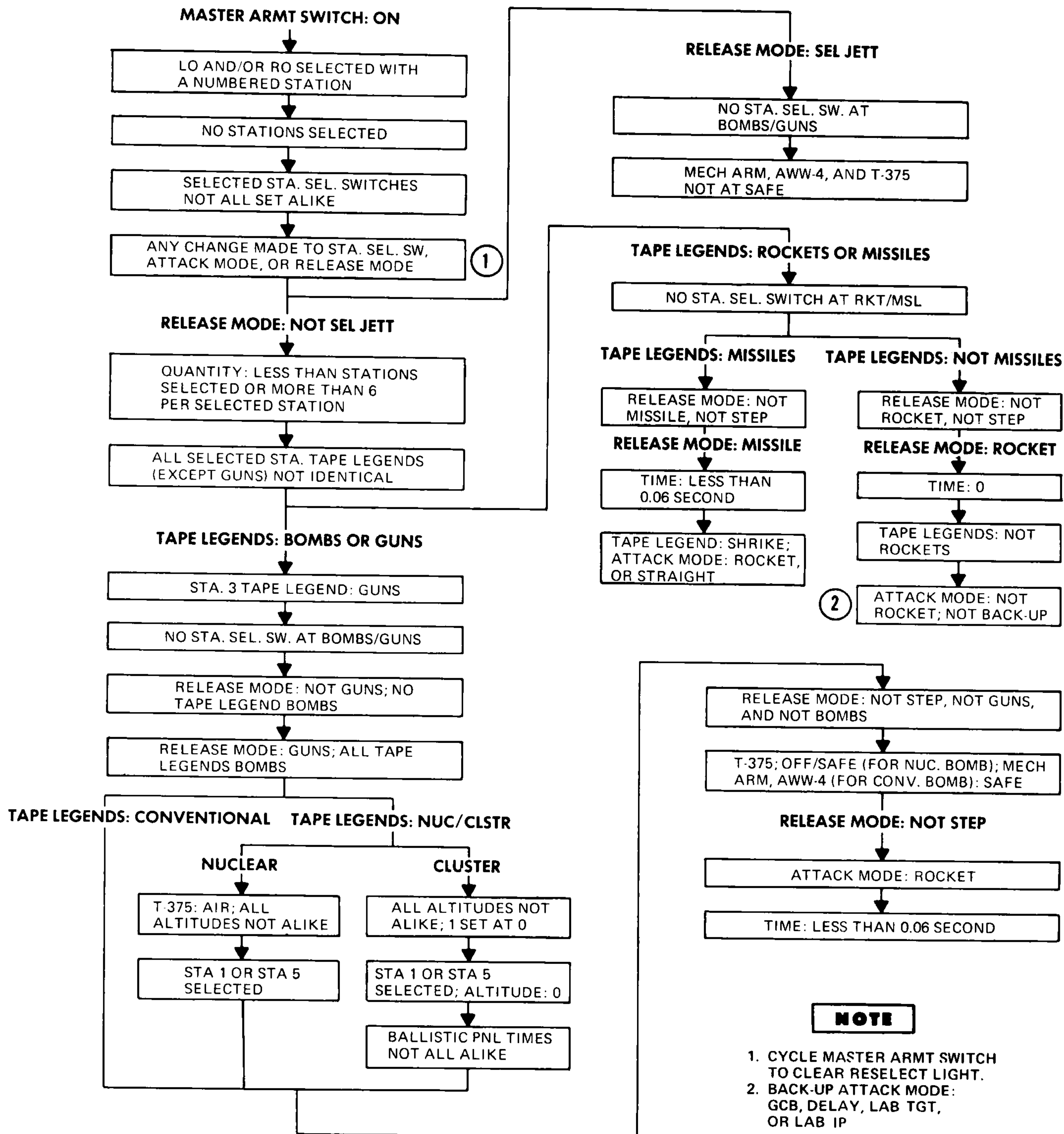
Note

If the RESELECT light is on steady, only manual STEP releases are possible.

RESELECT LOGIC

THE CONDITION DESCRIBED IN EACH BOX CAUSES A STEADY RESELECT LIGHT.

COMPUTER ON



ADF1-117

Figure 8-27

To clear a reselect condition, the MASTER ARMT switch must be set to OFF, the incompatible switch setting corrected and then the MASTER ARMT switch returned to ON. If the computer is in attack, a reselect condition causes it to step out of attack and the attack must be re-initiated after the reselect condition is cleared.

Note

The MASTER ARMT switch must be re-cycled any time the status of the RELEASE mode, ATTACK mode, or station select switches is changed. The RESELECT light will remain on until the MASTER ARMT switch is re-cycled.

STORES JETTISON

EMERGENCY STORES JETTISON BUTTON

An emergency stores jettison (EMER STORES JETTISON) button on the upper left corner of the pilot's instrument panel provides for emergency, simultaneous jettisoning of all stores. With 70% of the aircraft weight off the wheels, (left weight-on-wheels switch closed), depressing the emergency stores jettison button allows electrical power to be supplied to the five ejector racks and releases all stores simultaneously.

Note

Prior to emergency stores jettison of nuclear weapon, ensure that the safe button on the fuzing control panel has been depressed (safe light illuminated and air ground buttons locked). This prevents the possibility of jettisoning an armed weapon.

SELECTIVE STORES JETTISON BUTTON

N E W The SEL JETT button on the ARMAMENT panel permits simultaneous jettison of stores from selected stations. With the left main gear door closed, the MASTER ARMT switch at ON, and a station select switch set to BOMBS/GUNS, depressing the SEL JETT button permits safe release of the store with the manual release button.

Note

- The clear plastic guard must be lifted to press the SEL JETT button.
- Reselect logic will light the RESELECT light if the MECH ARM switch, AWW-4 FUNCTION switch and nuclear select button are not all at SAFE; however, this will not inhibit selective jettison of stores.

WEAPON MOUNTING

The Aero 7A ejector rack provides suspension and release capabilities for conventional weapons and nuclear weapons. The rack is a cartridge-actuated,

electrically triggered assembly and may be attached to all five stations. The attachments, accessible by opening two access doors on each pylon or on the centerline fairing, make the ejector rack readily removable. Either of two sets of tandem hooks on the rack suspend the weapon. In addition to electrical release, the rack hooks may be opened manually for loading or other ground operation by rotating the nut above the forward hook counterclockwise. As a safety device, a safety pin is provided to prevent accidental electrical ground release.

The Aero 7B ejector rack is installed on the centerline station. The principal difference between this rack and the Aero 7A is that the height of the Aero 7B is about 2-1/2 inches less than the height of the Aero 7A.

GROUND CONTROL BOMBING SYSTEM (GCBS)

The ground-controlled bombing system (airborne system) operates in conjunction with the TPQ-10 remote bombing system (ground station) and provides ground-controlled steering and weapon release for close-support bombing attacks. The system components in the aircraft include the ground-control bombing system control panel on the bombardier/navigator's right console, the address panel on the pilot's instrument panel, and the necessary receiver and antenna assemblies located throughout the aircraft. The ground station tracks the aircraft relative to the target coordinates; computes altitude, velocity and heading error; and transmits coded signals to the airborne system.

Note

The GCB ATTACK button on the ARMAMENT panel must be depressed to permit a ground-controlled release.

GCBS CONTROL PANEL

This control panel is on the bombardier/navigator's right console (figure FO-3), aft of the chaff control panel, and controls the mode selector and channel selector capabilities of the system. It also contains the necessary controls to initiate operation of the ground-controlled bombing system equipment.

Channel Selector Switch

This control provides for selection of the four operating channels, and initiates system operation. This switch is rotated to reflect selection of the particular command-coded channel of the TPQ-10 equipment.

The channel selector control is placarded OFF, 1, 2, 3, and 4. The numbered positions represent available channel selections of the ground station equipment.

Engage Switch

This two-position toggle switch is used to engage the TPQ-10 ground system to the automatic flight control

NEW system of the aircraft. When this switch is actuated, the commands from the ground station are automatically initiated by the automatic flight control system without the aid of the pilot or bombardier/navigator.

Code Selector Switch

This control permits selection of any one of four coded signals generated by the TPQ-10 ground equipment. The code selector switch is placarded 1, 2, 3, and 4, and is rotated to select the desired signal.

ADDRESS PANEL

NEW The GCBS address panel (figure FO-3) is on the center console, forward. The panel contains an indicator light, placarded ARM WEAPON. When the system is commanded by a ground signal, the arm weapon indicator is illuminated, advising the bombardier/navigator to arm or fuze the weapon prior to its release.

STRIKE CAMERA SYSTEM LB-31A

NEW Aircraft incorporating AFC No. 256 have provisions for carrying the LB-31A strike camera system. The system consists of the LB-31A camera pod suspended on the No. 1 or No. 3 external store stations, installed on either the AERO 7 rack or on the A/A37 MER. The camera pod contains a KB-18B panoramic camera and a KB-19A forward-looking motion picture camera. The panoramic camera provides continuous film documentation of the strike area throughout an air-to-ground armament delivery. The forward-looking camera provides motion picture coverage of the area forward of the aircraft along the boresight line during an air-to-ground armament delivery. Both cameras operate simultaneously when energized by automatic or manual control circuits. The system receives power from the 28V DC monitored bus through the LB-31A DC circuit breaker on the AC-DC power circuit breaker panel. The two heated camera windows are supplied power from the 115V AC monitored bus through the LB-31A circuit breaker on the AC-DC power circuit breaker panel.

KB-18B CAMERA

NEW The KB-18B camera components contained in the pod are the camera body with an accessory magazine LB-29A, and a camera control LB-17A. The camera has a 3-inch focal length f/2.8 lens. The shutter speeds range from approximately 1/100 sec to 1/4000 sec depending on limits established by a cycle rate switch and an aerial exposure index (AEI) switch. The accessory magazine accommodates 250 feet of film (300 exposures) and produces photographs with a format size of 2.25 by 9.40 inches. Panoramic photography is accomplished by rotating a double dove prism in front of the lens while the film is advanced across a narrow slit at the focal plane of the camera. Film advance is synchronized with prism rotation, projecting the panoramic image of the strike area on the film as the prism scans 180° fore and aft. Side coverage is 20° either side of the

aircraft vertical axis. The automatic exposure control senses variations in the light source and initiates compensatory aperture adjustments. The camera control contains switches for ground testing the camera and preselecting camera operating functions required for the mission. The controls include the ground test switch, cycle rate switch, overrun dial, and the AEI switch.

Overrun Dial

The overrun dial setting determines the amount of time the camera will run (automatic mode only) after the attack commit trigger or manual weapon release button is released. Dial settings are calibrated in 2-second increments from 0 to 20 seconds plus an additional setting of 32 seconds.

Cycle Rate Switch

The cycle rate switch permits selection of 1, 2, or 4 frames per second during camera operation. The switch is set in accordance with the planned mission altitude/airspeed combination.

AEI Switch

The AEI switch is set as determined by the type of film in the camera. Film speeds (exposure sensitivity) of 40, 64, 80, or 200 are selectable.

KB-19A CAMERA

The KB-19A camera mounted in the forward fairing of the pod, provides 16mm motion picture coverage of the area forward of the aircraft along the bore-sight line. The film magazine attached to the camera contains 100 feet of film. An automatic exposure control (AEC) controls the shutter sector opening to ensure proper exposure.

Overrun Switch

The overrun switch controls the time the camera continues to operate after attack commit trigger or manual weapon button release and provides the following overrun selections: 0, 5, 10, or 15 seconds. An overrun indicator light marks the film at the release of the trigger or weapon release button and continues marking until completion of the overrun period.

Test Switch

The test switch on the rear of the camera is used by the ground crew to test operation of the camera.

STRIKE CAMERA CONTROL PANEL

NEW The strike camera control panel on the bombardier navigator's right console (figure FO-3), controls the operating modes of the strike camera system. The panel labeled LB-31A POD contains a mode switch and press-to-test OPERATE light. In the AUTO position, the cameras operate when the proper station armament switches are energized and the pilot actuates the attack commit trigger or manual weapon

NEW
NEW
NEW
NEW
NEW

release button. When the attack commit trigger or manual weapon release button is released, the cameras continue to operate for the preselected overrun time. The MANUAL position is a momentary position and the cameras operate as long as the switch is held in MANUAL. The manual mode is independent of the armament system and enables film coverage of specific terrain without armament delivery. The OPERATE light comes on whenever the cameras are operating.

RADAR BEACON AN/APN-154(V)

The radar beacon is used with the TPQ-10 ground-based control radar to extend the radar range of the ground station and to assist in determining the range and location of the aircraft. Basically, the ground-based radar transmits a coded interrogating signal; the radar beacon receives the interrogation, decodes the signal, and transmits replies to the ground-based radar.

RADAR BEACON CONTROL PANEL

The radar beacon control panel, which is on the rear center console (figure FO-3), controls the operation of the radar beacon.

POWER/STDBY/OFF Switch

This three-position switch provides power for radar beacon operation. The STDBY position places the equipment in a standby condition but does not permit

the transponder to reply to interrogation. The POWER position places the beacon in full operation. The OFF position turns off all power to the equipment.

Mode Selector Switch

This six-position rotary switch selects the function to be performed by the transponder. If the radar beacon is to respond to a single-pulse interrogation, place the MODE selector switch on the SINGLE position. If it is to respond to double-pulse interrogation, place the MODE selector switch on 1, 2, 3, 4, or 5 of the DOUBLE bracket. The double-pulse code response desired determines the position of the switch.

RADAR BEACON OPERATION

1. POWER-STDBY-OFF switch - STBY
For optimum performance, allow 5 minutes for warm-up.
2. POWER-STDBY-OFF switch - POWER.
3. MODE selector switch - AS BRIEFED.

Note

The radar beacon will warm-up with the switch in either STDBY or POWER position. To prohibit response to a premature or unintentional interrogation, warm-up should be accomplished in the STDBY position.

part 2

Electronic Countermeasures

Electronic countermeasure (ECM) equipment is provided for aircraft self-protection and includes both passive warning equipment and active devices. The theory of operation, functions, and tactical operation of the equipment are described in the applicable

Advance Evaluation Note (AEN) published by Air Test and Evaluation Squadron Five (VX-5); Supplemental NATOPS Flight Manual for A-6 Aircraft, NAVAIR 01-85ADA-1A; or the Supplemental A-6 Tactical Manual, NAVAIR 01-85ADA-1TA.

section IX

FLIGHT CREW COORDINATION

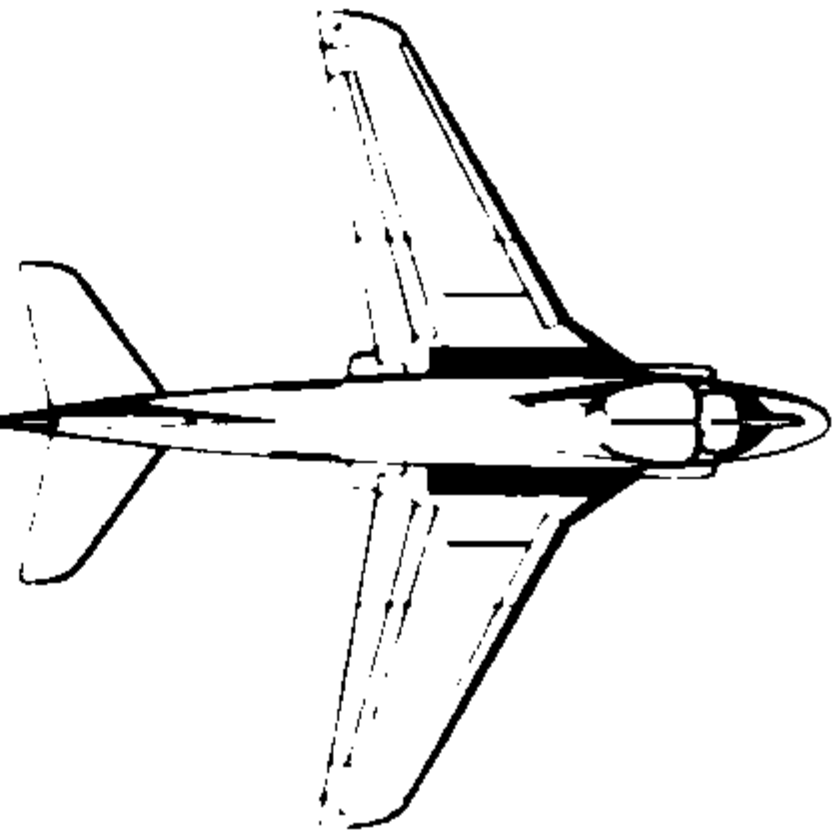


TABLE OF CONTENTS

Pilot-Bombardier/Navigator		Pretakeoff	9-3
Responsibilities	9-1	Takeoff/Departure	9-4
General	9-1	Rendezvous	9-4
Specific Responsibilities	9-2	Cruise and Mission	9-4
Flight Planning	9-2	Instrument Flight	9-5
Briefing	9-2	Air Refueling	9-5
Preflight	9-2	Air Combat Maneuvering	9-5
Prestart	9-2	Descent/Approach	9-5
Starting	9-3	Landing	9-6
Post Start	9-3	Post Flight	9-7
Taxi	9-3	Debriefing	9-7

PILOT-BOMBARDIER/NAVIGATOR RESPONSIBILITIES

GENERAL

The most successful A-6 crews are those who work together continuously and know each other's reactions, weaknesses, and strengths. The mission commander bears responsibility for mission success, sharing safety of flight responsibilities whether he be the pilot or bombardier/navigator. The pilot is the aircraft commander and is responsible for the safe control of the aircraft throughout its entire mission. The bombardier/navigator should assist the pilot in every way possible, anticipating rather than awaiting, developments. The duties of the pilot-bombardier/navigator team are necessarily integrated, and each must support and contribute to the performance of the other. Each crewmember must share the responsibility of every evolution encountered. In other words, the crew concept is a system of checks and balances and, as such, it is a dual obligation equally shared. The interruption of routine functions is usually caused by an emergency; however, routine habit patterns may be broken through complacency. The assistance of the bombardier/navigator in these instances is of the utmost value, challenging the pilot with the appropriate emergency checklist and monitoring flight performance of the aircraft.

The crew responsibilities are written with the premise that the bombardier/navigator will handle UHF communications throughout the flight; however, it is recommended that prior to takeoff the pilot initiate at least one transmission to check out his communications.

The importance of each crewmember being completely aware of all his responsibilities has to be continuously stressed. Both crewmembers must realize that successful mission accomplishment and safety depends on flight crew coordination.

Note

It is stressed that the crew coordination functions, duties, and responsibilities listed in this section are not meant to be utilized as in-flight checklists.

While frequent reference is made to checklists, and certain important procedures are highlighted, the contents of this section are designed to be utilized as a basis for squadron and unit ground training syllabi. So utilized, this section will enhance the successful and safe completion of each unit's mission through intelligent and proper compliance with all NATOPS procedures and other applicable aviation directives.

To further the strengthening of aircrew integrity, it is imperative that the team concept be employed as early in the training evolution as is practicable. The best balance of talent and experience, divided into permanent pilot-bombardier/navigator teams, will develop the coordination required of a truly professional combat team.

SPECIFIC RESPONSIBILITIES

FLIGHT PLANNING

Mission Commander

1. Responsible for all phases of the assigned mission and for effectiveness of the flight.

Flight Leader

1. Assist the mission commander in preparing required charts, flight logs, and navigation computations, including fuel planning, checking weather, and NOTAMS, and in completing required flight plans.

Pilot

1. Assist the mission commander/flight leader in preparing required charts, flight logs, and navigation computations, including fuel planning, checking weather, and NOTAMS, and in completing required flight plans.
2. Be prepared to assume flight lead; thus have a thorough understanding of the conduct of the flight.

Bombardier/Navigator

1. Assist the mission commander/flight leader/pilot in preparing required charts, flight logs, and navigation computations, including fuel planning, checking weather, and NOTAMS, and in completing required flight plans.
2. Be prepared to assist the pilot in assuming flight lead; thus have a thorough understanding of the conduct of the flight.

BRIEFING

Mission Commander

1. Responsible for ensuring all crewmembers are briefed on all aspects of the operation and conduct of the flight.
2. Ensure that a briefing guide as outlined in Section III of this manual is utilized.

Flight Leader—Pilot—Bombardier/Navigator

1. Assist the mission commander in preparing required flight or briefing forms and if directed, brief all flight crewmembers on all aspects of the operation and conduct of the flight.
2. When directed, in addition to using the briefing guide as outlined in Section III, brief the following:
 - a. Crew coordination in each flight evolution
 - b. Command/control of aircraft

- c. Utilization of each weapons system
- d. System degradation

PREFLIGHT

Pilot

1. Check yellow sheet for flight status, configuration, armament loading and servicing.
2. Review at least the ten previous B sections for discrepancies noted and corrective actions taken.
3. Responsible for accepting the aircraft assigned.
4. Responsible for preflighting the aircraft assigned IAW this manual, the A-6E NATOPS Pocket Checklist and the A-6 Tactical Manual.
5. Note any preflight discrepancies and ensure they are logged on yellow sheet.
6. Calculate gross weight of aircraft for catapult launch and compare with B/N's figures.

Bombardier/Navigator

1. Check yellow sheet for flight status, configuration, armament loading and servicing.
2. Review at least the ten previous B sections for discrepancies noted and corrective action taken.
3. Conduct a thorough individual preflight of entire aircraft IAW this manual, the A-6E NATOPS Pocket Checklist and the A-6 Tactical Manual.
4. Check weapon configuration and security.
5. Note any preflight discrepancies and ensure they are logged on yellow sheet.
6. Calculate gross weight of aircraft for catapult launch and compare with pilot's figures.

PRESTART

Pilot

1. Execute prestart checks IAW this manual and the A-6E NATOPS Pocket Checklist.
2. Receive a clear to start signal from plane captain ensuring security of aircraft and adjacent area.
3. Inform B/N "Prestart checks complete, ready to start."

Bombardier/Navigator

1. Execute prestart checks IAW this manual and the A-6E NATOPS Pocket Checklist.
2. Ensure starboard engine areas are clear.

3. Acknowledge pilot's "Prestart check" with "Ready to start".

4. Assist the pilot as necessary.

STARTING

Pilot

1. Start engines IAW this manual and the A-6E NATOPS Pocket Checklist.
2. Remain alert for any emergency signals from ground crew or B/N.

Bombardier/Navigator

1. Notify pilot of any emergency signals noted from ground crew or any unusual occurrences observed.
2. Report any circuit breakers that do not remain seated.
3. Observe wings, reporting any movement to pilot.
4. Alert pilot of possibility of any foreign object which might be drawn into the compressor.
5. Report any movement of aircraft to the pilot.

POST START

Pilot

1. Complete all before taxi checks IAW this manual and the A-6E NATOPS Pocket Checklist.
2. Prior to closing canopy ensure canopy rail area clear and inform B/N "Canopy coming closed."
3. Inform B/N when "Ready to Taxi".

Bombardier/Navigator

1. Complete all before taxi checks IAW this manual and the A-6E NATOPS Pocket Checklist.
2. Inform pilot when INS is aligned and in OPERATE.
3. Inform pilot on status of all systems.
4. Check UHF and navigation equipment and report any malfunctions to pilot.
5. Scan instruments and circuit breakers, reporting any discrepancies.
6. Advise pilot when "Ready for taxi."
7. Call clearance delivery and ground control when directed by pilot.

TAXI

Pilot

1. After aircraft has started rolling, check brakes, and report to B/N.
2. Remain watchful for obstructions and taxi signals and inform B/N.
3. Check wing clearance.
4. Be alert for calls from ground/tower control concerning taxi information.

Bombardier/Navigator

1. Challenge pilot on brake check.
2. Monitor taxi speed.
3. Remain watchful for obstructions and taxi signals, relaying to pilot.
4. Check wing clearance.
5. Be alert for calls from ground/tower control concerning taxi information.
6. Complete weapons system checks.

PRETAKEOFF

Pilot

1. Complete pretakeoff checks IAW this manual and the A-6E NATOPS Pocket Checklist.
2. Use challenge and reply system when going over takeoff checklist.
3. Inform B/N of acknowledged aircraft gross weight for catapult launch.
4. Complete takeoff checklist prior to crossing shuttle aboard ship.
5. ICS- Hot Mike. Challenge B/N.
6. Inform B/N when ready for takeoff.

Bombardier/Navigator

1. Complete pretakeoff checks IAW this manual and the A-6E NATOPS Pocket Checklist.
2. Use challenge and reply system when going over takeoff checklist.
3. Inform pilot of acknowledged aircraft gross weight for carrier launch.
4. Report visual check of the wing lock indicator pins.
5. Complete takeoff checklist prior to crossing shuttle aboard ship.

6. ICS Hot Mike. Challenge pilot.
7. Maintain hands below canopy sill while on catapult.
8. Report "Ready for Takeoff."

TAKEOFF/DEPARTURE**Pilot**

1. Relay engine instrument readings to B/N.
2. Report rolling, saluting, or lights as appropriate, to B/N.
3. Advise B/N of any unusual occurrences.
4. Report "Gear Up" and "Flaps Up" to B/N.
5. Inform B/N when going from gages to visual or vice versa.
6. Inform B/N prior to engaging autopilot.
7. Inform B/N when changing Radio/TACAN/IFF.
8. Confirm headings and altitudes with B/N.
9. Maintain a lookout doctrine.

Bombardier/Navigator

1. Copy and acknowledge all clearances.
2. Challenge pilot for engine operation after throttles are advanced to takeoff power. Record engine instrument readings reported by pilot.
3. During section takeoff check wingman's airplane/position.
4. Monitor airspeed and runway remaining.
5. Challenge pilot on after takeoff checklist.
6. Monitor instruments, maintain a diligent lookout doctrine.
7. Monitor the published or clearance departure procedures and challenge the pilot on any deviations from prescribed heading or altitude.
8. During IFR departure, inform pilot when not monitoring gages.

RENDEZVOUS**Pilot**

1. Maintain a good lookout doctrine.
2. Ensure B/N established radio contact, as briefed.
3. Advise B/N of any signals received from other aircraft or signals to be passed to other aircraft.

Bombardier/Navigator

1. Maintain a good lookout doctrine.
2. Monitor airspeed, angle of bank, altitude.
3. Establish radio contact, as briefed.
4. Confirm all lights BRIGHT/FLASH (if applicable).
5. Monitor closure rate, relative bearing, altitude separation.
6. Advise pilot of any signals received from other aircraft.
7. Be prepared to give hand signals to other aircraft.

CRUISE AND MISSION**Pilot**

1. Maintain a good lookout doctrine.
2. Report fuel switchology, transfer and fuel state to B/N periodically.
3. Inform B/N when going from gages to visual or vice versa.
4. Inform B/N when changing radio/TACAN/IFF.
5. Advise B/N when engaging AFCS.
6. Be constantly aware of geographical position.
7. Maintain fuel computations, flight log, and frequencies assigned.

Bombardier/Navigator

1. Maintain a good lookout doctrine.
2. Maintain a scan pattern.
3. Challenge pilot on fuel switchology, transfer, and state periodically.
4. During IFR conditions, inform pilot when going from gages to visual or vice versa.
5. Be constantly aware of geographical position and bingo distance for alternate/emergency airfields along route of flight. Be prepared to give immediate steer to home base.
6. Know winds at operating and bingo profile altitude.
7. Copy all clearances, heading/altitude changes.
8. Maintain fuel computations, flight log, and frequencies assigned.

INSTRUMENT FLIGHT**Pilot**

1. Transitioning from VFR to IFR conditions, the pilot should shift completely to the gages prior to entering IFR flight and so inform the B/N.
2. Remain on instruments any time the aircraft is climbing or descending through layers or when in and out of IFR conditions at low altitudes.
3. If experiencing vertigo/disorientation, notify B/N immediately, stay on gages, and refrain from making any UHF or IFF changes.
4. Inform B/N any time scan is broken to change an IFF squawk, TACAN channel, radio frequency, or light configuration.
5. Inform B/N any time a change in heading or altitude will be made.

Bombardier/Navigator

1. Assume all lookout responsibilities any time the pilot is flying instruments, monitor the flight instruments and advise the pilot in VFR conditions.
2. If pilot experiences vertigo/disorientation, carefully monitor gages, informing pilot of attitude, altitude, and airspeed. Be prepared to advise pilot how to maneuver the aircraft back to a wings-level attitude.
3. Inform pilot when going off the gages or experiencing vertigo/disorientation.
4. Inform pilot any time prior to changing radio frequencies or TACAN channel.
5. Challenge pilot if not at assigned altitude or heading.
6. Be particularly aware of attitude, altitude, airspeed, and geographical position at all times.
7. Advise the pilot of bank angle and changes in altitude, airspeed, or heading when flying formation.
8. Utilize radar as appropriate and ensure weapons system is functioning properly.

AIR REFUELING**Pilot**

1. Maintain good lookout doctrine.
2. Complete air refueling checklist with B/N.
3. Report to B/N when fuel transfer is complete.
4. After disengagement, stay behind the drogue until all members of the flight are sighted.

5. Complete the post refueling checklist with B/N.
6. Report fuel received, fuel remaining, and fuel switchology to the B/N.

Bombardier/Navigator

1. Acquire tanker visually.
2. Keep pilot informed of azimuth, range, and overtake during joinup.
3. Maintain good lookout doctrine.
4. Complete the air refueling checklist with the pilot.
5. Insure amber light visible prior to commencing approach.
6. Monitor closure rate on and coach pilot into the drogue if requested.
7. Make required voice reports as briefed.
8. Maintain sharp lookout doctrine while engaged.
9. Monitor heading, airspeed, altitude, reporting variances to pilot while engaged.
10. Advise pilot of unusual fuel spillage or unsafe probe/drogue conditions.
11. Complete the post refueling checklist with pilot.
12. Challenge pilot on fuel received, fuel remaining, and fuel switchology.

AIR COMBAT MANEUVERING**Pilot-Bombardier/Navigator**

Delineating the entire realm of aircrew responsibility during ACM is beyond the scope of this manual. Careful preplanning and briefing are necessary to ensure adequate crew coordination prior to any ACM mission. As a minimum, each crewmember must have a constant awareness of the rules of engagement, flight safety, fuel state (including bingo), attitude, and minimum prebriefed base altitude and carry on a continuous supportive commentary.

DESCENT/APPROACH**Pilot**

1. Select the type approach to be made with respect to existing weather.
2. Complete the descent/instrument penetration checklist with B/N.
3. Challenge B/N on approach plate availability and bingo profile.

4. Monitor UHF communication conducted by the B/N and copy all clearances.
5. When executing a CCA, conform to procedures contained in this manual, CVA/CVA NATOPS manual, and augmenting ship's instructions.
6. Inform B/N when going from gages to visual or vice versa.
7. Inform B/N when changing IFF/UHF/TACAN.
8. Confirm headings and altitudes with B/N.
9. Cross check pressure altimeter and radar altimeter with B/N below 5000 feet.
10. Advise B/N if fuel dump switch has been activated/deactivated.
11. Advise B/N if experiencing vertigo/disorientation.

Bombardier/Navigator

1. Assist the pilot in his decision to commence the approach with existing weather and the selection of the type approach to be made.
2. Prior to penetration complete the descent/instrument penetration checklist with the pilot.
3. Update computer prior to commencing an approach.
4. Conduct UHF communications, being prepared to request, copy, and read back clearance and provide the pilot with any required information.
5. Aid in planning holding/marshall entry and pattern timing.
6. Monitor altitude, attitude, airspeed during holding, penetration, and approach.
7. Monitor appropriate approach plate advising pilot of heading changes and altitudes prescribed on the approach plate.
8. When executing a CCA, monitor the procedures of this manual, CVA/CSV NATOPS Manual, and augmenting ship's instructions.
9. Utilize radar and computer during CCA prior to landing.
10. When not monitoring the gages inform the pilot.
11. Challenge pilot on deviations from published/assigned course or altitude.
12. Know ship's/field position relative to bingo field.

13. Report to pilot during penetration and/or descents (VFR or IFR) as the aircraft descends through each 5000 feet of altitude above 5000 feet and each 1000 feet below 5000 feet, until reaching desired altitude.
14. Challenge pilot on cross checking pressure altimeter and radar altimeter passing 5000 feet.
15. Monitor the fuel dump.
16. Advise the pilot if experiencing vertigo/disorientation.
17. If pilot experiences vertigo/disorientation, inform him of attitude, altitude, and airspeed.
18. Be prepared to talk down pilot through distance/altitude check points when executing a CCA utilizing radar, TACAN, and computer.
19. Inform pilot when going contact or achieving a "ball" when on GCA/CCA.

LANDING

Pilot

1. Complete landing checklist with B/N.
2. Double-check pressure altimeter with radar altimeter and inform B/N.
3. Report indexer lights to B/N. (Secondary gear check)

Bombardier/Navigator

1. Monitor traffic pattern entry, altitude, airspeed as prescribed by local course rules or CVA/CSV NATOPS Manual while maintaining a good lookout doctrine and assisting pilot in determining interval.
2. Complete landing checklist with pilot.
3. Challenge pilot on pressure versus radar altimeter.
4. Attempt to check gear handle down, hook handle, indexer lights, no flashing wheels light, and speed brakes out.
5. Make UHF transmissions as directed by pilot.
6. Be alert for and report conflicting traffic to the pilot.
7. Call for "power-speed brakes" to pilot on touchdown aboard ship.
8. On rollout, be prepared to advise of arresting gear location.
9. Report to pilot airspeed in conjunction with runway remaining.

POST FLIGHT**Pilot**

1. Perform post flight checklist with B/N.
2. Report to B/N when wing fold is actuated.

Bombardier/Navigator

1. Perform post flight checklist with the pilot.
2. When informed wing fold is actuated, report to pilot wing position.
3. Advise pilot of clearances when taxiing.
4. Complete weapons system checks remaining.
5. Advise pilot when ready for shutdown.

DEBRIEFING**Mission Commander**

1. Review the entire flight from takeoff to landing.

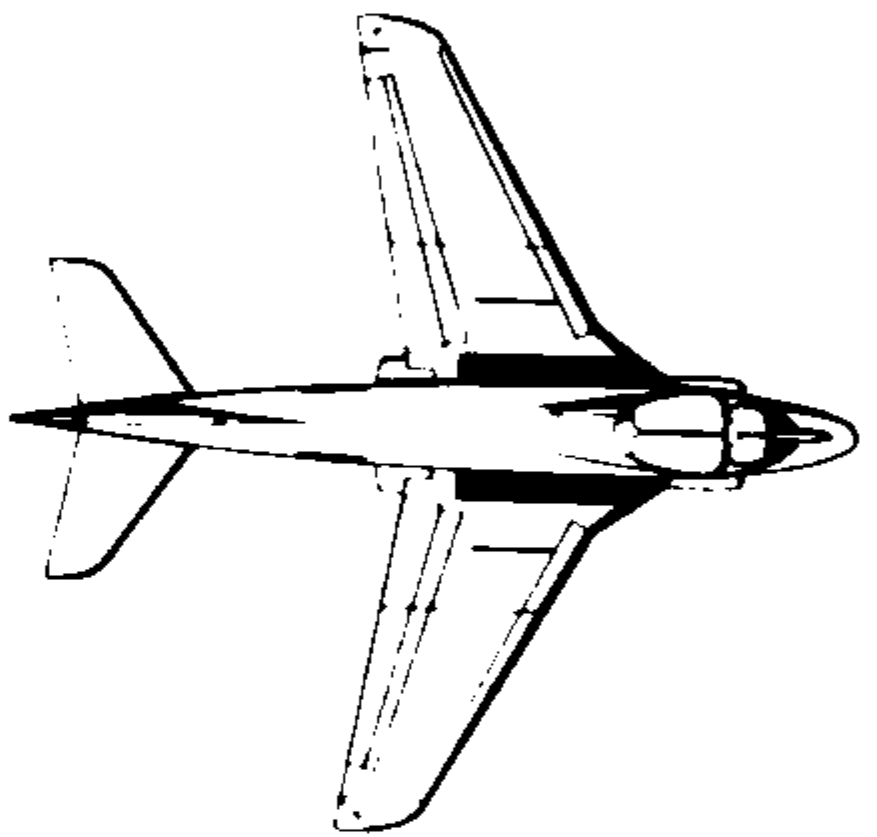
2. Specifically comment on errors and techniques and review procedures for correcting/improving them.

Flight Leader—Pilot—Bombardier/Navigator

1. Assist the mission commander when requested and if directed, debrief all crewmembers on all aspects of the flight from takeoff to landing.
2. When directed, comment on errors and techniques and review procedures for correcting/improving them.
3. When directed, cover completely any deviations from standard operating procedures.
4. Complete yellow sheet and all required debriefing forms.
5. Utilize Anymouse reporting to pass the word on unusual flight occurrences, if applicable.

Section X

NATOPS EVALUATION



Concept	10-1
Definitions	10-1
Implementation	10-2
Ground Evaluation	10-2
Flight Evaluation	10-3

Final Grade Determination	10-4
Records and Reports	10-4
NATOPS Evaluation Forms	10-4
NATOPS Evaluation Question Bank	10-9

CONCEPT

The standard operating procedures prescribed in this manual represent the optimum method of operating this aircraft. The NATOPS Evaluation Program is intended to evaluate compliance with NATOPS procedures by observing and grading individuals and units. This evaluation is tailored for compatibility with the various operational commitments and missions of both Navy and Marine Corps units. The prime objective of the NATOPS Evaluation Program is to assist the unit Commanding Officer in improving unit readiness and safety. Maximum benefit from the NATOPS Evaluation Program is achieved only through the vigorous support of the program by commanding officers as well as flight crewmembers.

DEFINITIONS

The following terms, which are used throughout this section, are defined as to their specific meaning within the NATOPS program.

NATOPS EVALUATION

A periodic evaluation of individual flight crewmember standardization consisting of an open-book examination, a closed-book examination, and an oral examination. A flight evaluation is required on initial qualification and on requalification after lapse of currency. Annual NATOPS currency may be maintained by satisfactory completion of the open-book, closed-book, and oral examination in conjunction with a flight evaluation or (at the unit Commanding Officer's discretion) a WST evaluation.

NATOPS REEVALUATION

A partial NATOPS evaluation administered to a flight crewmember who has been placed in an Unqualified status by receiving an Unqualified grade for any of his ground examinations or the evaluation flight. Only those areas in which an unsatisfactory level was noted need to be observed during a reevaluation.

QUALIFIED

That degree of standardization demonstrated by a very reliable flight crewmember who has a good knowledge of standard operating procedures and a thorough understanding of aircraft capabilities and limitations.

CONDITIONALLY QUALIFIED

That degree of standardization demonstrated by a flight crewmember who meets the minimum acceptable standards. He is considered safe enough to fly as a pilot-in-command or to perform normal duties without supervision, but more practice is needed to become Qualified.

UNQUALIFIED

That degree of standardization demonstrated by flight crewmember who fails to meet minimum acceptable criteria. He should receive supervised instruction until he has achieved a grade of Qualified or Conditionally Qualified.

AREA

A routine of preflight, flight, or postflight.

SUBAREA

A performance subdivision within an area, which is observed and evaluated during an evaluation flight.

CRITICAL AREA

Any area or sub area which covers items of significant importance to the overall mission requirements, the marginal performance of which would jeopardize safe conduct of the flight.

EMERGENCY

An aircraft component, system failure, or condition that requires instantaneous recognition, analysis, and proper action.

MALFUNCTION

An aircraft component, system failure, or condition that requires recognition and analysis, but which permits more deliberate action than is required for an emergency.

IMPLEMENTATION

The NATOPS Evaluation Program shall be carried out in every unit operating Naval aircraft. Flight crewmembers desiring to attain/retain qualification in the aircraft shall be evaluated initially in accordance with OPNAV Instruction 3510.9 series, and at least once during the 12 months following initial and subsequent evaluations. Individual and unit NATOPS Evaluations will be conducted annually; however, instruction in, and adherence to NATOPS procedures must be on a daily basis within each unit to obtain maximum benefits from the program. The NATOPS Coordinators, Evaluators, and Instructors shall administer the program as outlined in OPNAV Instruction 3510.9 series. Those who receive a grade of Unqualified on a ground or flight evaluation shall be allowed 30 days in which to complete a reevaluation. A maximum of 60 days may elapse between the day the initial ground evaluation was commenced and the date the flight evaluation is satisfactorily completed.

GROUND EVALUATION

Before commencing the flight evaluation, an evaluatee must achieve a minimum grade of Qualified on the open-book and closed-book examinations, and an OFT/WST procedures evaluation.

The oral examination is also part of the ground evaluation but may be conducted as part of the flight evaluation. To assure a degree of standardization between units, the NATOPS Instructors may use the bank of questions contained in this section in preparing portions of the written examinations. (Refer to NATOPS Evaluation Question Bank paragraph.) Due to the close coordination required between pilot and bombardier/navigator in the aircraft, both crewmembers should have completed knowledge of all aircraft systems and procedures. For this reason, the question bank is not categorized as to crewmember. Individual Instructors may emphasize particular categories

on pilot and bombardier/navigator examinations, but all categories must be covered on both.

OPEN-BOOK EXAMINATION

Questions in this category may be based on tables, graphs, charts, figures, and other information not conducive to memorization.

Up to 50% of the questions used may be taken from the question bank. The number of questions on the examination shall not exceed 50 or be less than 25. The purpose of the open-book examination portion of the written examination is to evaluate the knowledge of appropriate publications and the aircraft. The maximum time for this examination shall not exceed 8 hours.

CLOSED-BOOK EXAMINATION

Up to 50% of the closed-book examination may be taken from the question bank and shall include questions concerning normal procedures and aircraft limitations. The number of questions on the examination shall not exceed 100 or be less than 40. In addition, at least 20 questions on emergency procedures must be included. Questions designated critical will be so marked. An incorrect answer to any critical question will result in a grade of Unqualified being assigned to the examination. Maximum time for this examination shall not exceed 2 hours.

ORAL EXAMINATION

This examination is designed to evaluate the examinee's overall knowledge of the aircraft systems and components, and his ability to recognize malfunctions. Questions may be taken from this or other appropriate manuals, and drawn from the experience of the Instructor/Evaluator. Such questions should be direct and positive and should in no way be opinionated.

OFT/WST PROCEDURES EVALUATION

The OFT/WST (if available) will be used to evaluate the pilot's and bombardier/navigator's efficiency in the execution of normal procedures, and their reaction to simulated emergencies and malfunctions. In areas where WST is not available, this portion may be conducted orally either in the cockpit of the aircraft, or on deck.

GRADING INSTRUCTIONS

Examination grades shall be computed on a 4.0 scale and converted to an adjective grade of Qualified or Unqualified.

Open-Book Examination

To obtain a grade of Qualified, an evaluatee must obtain a minimum score of 3.5.

Closed-Book Examination

To obtain a grade of Qualified, an evaluatee must obtain a minimum score of 3.3.

Oral Examination and OFT/WST Procedures Evaluation

A grade of Qualified or Unqualified shall be assigned by the NATOPS Instructor/Evaluator on the basis of the following criteria:

Normal Procedures

1. **QUALIFIED** - Demonstrates adequate knowledge of procedures and systems with only minor deviations or omissions.
2. **UNQUALIFIED** - Exhibits obvious lack of knowledge of procedures and systems which result in serious or numerous oversights affecting safety or mission completion.

Emergency Procedures and Malfunctions

1. **QUALIFIED** - Recognizes emergencies promptly, analyzes them properly, and takes the proper corrective action. Slow reaction in situations that cannot be realistically simulated will justify failure of this section.
2. **UNQUALIFIED** - Demonstrates improper or unsafe cockpit procedures. Fails to recognize emergencies, overlooks probable or possible causes, or takes improper corrective action. Slow to act in obvious situations that require immediate action until the condition is no longer remediable.

FLIGHT EVALUATION

The flight evaluation is intended to measure the degree of standardization demonstrated by the pilot or bombardier/navigator being evaluated. It is not intended to measure technique beyond a point necessary to ensure safe completion of the mission. Within reasonable limits, any individual evaluated should be able to attain a grade of Qualified, based on demonstrated knowledge without regard to special proficiency or technique.

All phases of the ground evaluation must be completed prior to commencement of the flight evaluation.

The flight evaluation may be completed on any flight which will permit the evaluatee to demonstrate standard procedures in the preparation for and execution of a representative type of mission for the model aircraft concerned. With the concurrence of the Evaluator/Instructor, the unit concerned may select the mission which is best suited to aircraft configuration, training phase, target facilities, etc. Only those areas which are required by the particular mission and which can be actually observed by the Evaluator/Instructor will be graded.

Due to difficulty of grading in the A-6 type aircraft, the Bombardier/Navigator Flight Evaluation may be flown in the WST, when available.

The number of flights required to complete the flight evaluation should be kept to a minimum; normally one

flight. The areas and subareas to be observed and graded on an evaluation flight are outlined in the grading criteria with critical areas marked by an asterisk (*). Subarea grades will be assigned in accordance with the grading criteria. These subareas shall be combined to arrive at the overall grade for the flight. Area grades, if desired, shall also be determined in this manner.

SAFETY CONSIDERATIONS DURING EVALUATION FLIGHTS

Due to the broad significance of safety, it is impractical to list all contingencies that may fall under the general category of grading criteria in safety. Generally, mission success is subject to compromise when there are any safety infractions, omissions, or deviations beginning with mission planning and ending with the postflight debriefing. The following provide additional guidance in these areas:

1. Violations of pertinent directives or procedures that have a direct bearing on the safe completion of the mission or negligence in following any procedure or directive that jeopardizes the safety of the pilot of aircraft, will constitute an overall grade of Unqualified. The degree of jeopardy involved, in the absence of specific directive, must be determined by the Instructor/Evaluator, based on good judgment and experience.
2. The latitude given the examiner in grading safety items must be exercised with care. The examiner must observe a discrepancy which directly contributes to an unsafe condition to justify an overall grade of Unqualified for safety reasons.
3. When an in-flight safety discrepancy is imminent, and the pilot appears unaware of the condition, or has not taken the appropriate action, the examiner will correct the situation by directing that action be taken. Safety of flight cannot and must not be compromised due to the reluctance on the part of the examiner to correct any discrepancy.
4. If a grade of Unqualified is given for safety reasons, the examiner will include a written statement, describing the deficiency on the NATOPS Evaluation Report. The statement should be clearly titled "Safety Discrepancy".

FLIGHT EVALUATION GRADING CRITERIA

The grading criteria establishes the standard for grading pilot performance, but does not relieve the Evaluator/Instructor from using good judgment based on experience. In those items where a pilot fails to meet the minimums set forth in the grading criteria the examiner, through past experience and judgement, knows that the discrepancy could have been caused by other factors, such as weather, turbulence, or partial malfunction of aircraft or weapons systems, may assign a grade of Qualified. A note to this effect will be included in the NATOPS Evaluation Report.

EXAMPLE: (Add subarea numerical equivalents)

$$\frac{4+2+4+2+4}{5} = \frac{16}{5} = 3.20 \text{ Qualified}$$

FINAL GRADE DETERMINATION

The following procedure shall be used in determining the flight evaluation grade. A grade of Unqualified in any critical area will result in an overall grade of Unqualified for the flight. Otherwise, flight evaluation (or area) grades shall be determined by assigning the following numerical equivalents to the adjective grade for each sub-area.

RECORDS AND REPORTS

A NATOPS Evaluation Report (OPNAV Form 3510-8) (Figure 10-2) shall be completed for each evaluation and forwarded to the evaluatee's commanding officer. This report shall be filed in the individual flight training record and retained therein for 18 months. In addition, an entry shall be made in the PILOT/NFO flight logbook under "Qualification and Achievements" (see Figure 10-1).

NATOPS EVALUATION FORMS

In addition to the NATOPS Evaluation Report, a NATOPS Flight Evaluation Worksheet, OPNAV FORMS 3510 (Figure 10-2) is provided for use by the Evaluator/Instructor during the flight evaluation. All of the flight areas and subareas are listed on the worksheet with space allowed for related notes.

QUALIFICATION			DATE	SIGNATURE	
NATOPS EVALUATION	(Aircraft Model)	(Crew Position)	(Date)	(Authenticating Signature)	(Unit Which Admini- stered Evaluation)

10-4

NATOPS EVALUATION REPORT			GRADE		SERVICE NUMBER
OPNAV FORM 3510-9 (8-85) 0107-723-0000					
NAME (Last, first initial)			AIRCRAFT MODEL		CREW POSITION
SQUADRON/UNIT			TOTAL HOURS IN MODEL		DATE OF LAST EVALUATION
TOTAL PILOT/FLIGHT HOURS					
NATOPS EVALUATION			GRADE		
REQUIREMENT	DATE COMPLETED	Q	CQ	U	
OPEN BOOK EXAMINATION					
CLOSED BOOK EXAMINATION					
ORAL EXAMINATION					
*EVALUATION FLIGHT					
FLIGHT DURATION	AIRCRAFT BUNO	OVERALL FINAL GRADE			
REMARKS OR EVALUATOR/INSTRUCTOR					

☐ CHECK IF CONTINUED ON REVERSE SIDE

GRADE, NAME OF EVALUATOR/INSTRUCTOR	SIGNATURE	DATE
GRADE, NAME OF EVALUEE	SIGNATURE	DATE
REMARKS OF UNIT COMMANDER		

RANK, NAME OF UNIT COMMANDER	SIGNATURE	DATE
------------------------------	-----------	------

*WST, OFT, COT, or cockpit check in accordance with OPNAVINST 3510.9 (effective edition).

ODG-5

Figure 10-2

A-6E PILOT FLIGHT EVALUATION GRADING FORM

NAME:	SQDN:	DATE:
AREA/SUBAREA	SUBAREA GRADE	AREA GRADE
1. PLANNING		
A. FLIGHT PLANNING		
B. BRIEFING		
C. PERSONAL FLYING EQUIPMENT		
D. AIRCRAFT TAKE-OFF DATA		
2. PRE-FLIGHT		
A. YELLOW SHEETS		
B. AIRCRAFT INSPECTION		
3. PRE-TAKE-OFF		
A. START/POST-START PROCEDURES		
B. TAXI		
C. ARMING		
D. CLEARANCE/COMMUNICATIONS		
*4. TAKE-OFF		
A. ENGINE RUN-UP		
B. DIRECTIONAL CONTROL		
C. LIFT-OFF		
D. TRANSITION		
5. DEPARTURE		
A. IFR/VFR PROCEDURES		
B. RENDEZVOUS		

ADF1-124-1

Figure 10-3 (Sheet 1)

A-6E PILOT FLIGHT EVALUATION GRADING FORM (CONTINUED)

6. ENROUTE		
A. IFR/VFR PROCEDURES		
B. WEAPONS/TARGET PROCEDURES		
C. AIR REFUELING		
D. FORMATION		
7. ARRIVAL		
A. VFR FIELD ENTRY		
B. IFR HOLDING		
C. PENETRATION		
D. GCA/LOW APPROACH		
E. MISSED APPROACH		
*8. LANDING		
*9. EMERGENCY PROCEDURES		
10. POST-FLIGHT		
A. DE-ARMING		
B. SHUTDOWN		
C. YELLOW SHEET		
D. DEBRIEFING		
11. MISCELLANEOUS		
A. COMMUNICATIONS		
B. VISUAL SIGNALS		
C. IFF/SIF		
NUMERICAL AVERAGE		

ADF1-124-2

A-6E BOMBARDIER/NAVIGATOR FLIGHT EVALUATION GRADING FORM

NAME:		SQDN:	DATE:
AREA/SUBAREA	SUBAREA GRADE	AREA GRADE	
1. PLANNING			
A. ROUTE PLANNING			
B. WEAPONS SYSTEM PLANNING			
C. TARGET BRIEF			
D. PERSONAL FLYING EQUIPMENT			
2. PRE-FLIGHT PROCEDURES			
A. AIRCRAFT INSPECTION			
B. WEAPONS SYSTEM TURN-ON AND CHECKS			
3. ENROUTE PROCEDURES			
*A. WEAPONS SYSTEM OPERATION			
*B. RADAR INTERPRETATION			
4. ATTACK PROCEDURES			
*A. SYSTEM DELIVERY			
B. DEGRADED SYSTEM OPERATION			
5. APPROACH PROCEDURES			
A. INTRUDER APPROACH			
B. INSTRUMENT APPROACH			
6. POST-FLIGHT PROCEDURES			
7. DEBRIEFING			
NUMERICAL AVERAGE			

ADF1-125

Figure 10-4

NATOPS QUESTION BANK

The following bank of questions is intended to assist the unit NATOPS Instructor/Evaluator in the preparation of ground examinations and to provide an abbreviated study guide. These questions cover material presented in this manual as well as material covered in A-6 indoctrination courses. The questions from the bank should be combined with locally originated questions as well as questions obtained from the Model Manager in the preparation of ground examinations.

1. Failure of one generator will result in the loss of which electrical bus?
2. What are the two restrictions for using the windshield rain removal system?
3. Aircraft battery power is available to what items in the A-6?
4. Zero-g flight is limited to how many seconds? Why?
5. When will the low-level fuel caution light come on?
6. An A-6 at 30,000 feet with both engines windmilling and RAT extended can glide approximately how many miles?
7. The isolation valve position is controlled by the cockpit switch and/or fluid from which hydraulic system?
8. What is the result of an engine fuel pump failure in flight?
9. The emergency gear extension system should be actuated with the gear handle in what position if both main gear will not extend?
10. Which fuselage fuel cell supplies fuel to the engine fuel controls?
11. Above what altitude is there a possibility of jamming the nose-gear door when the landing gear is activated with the cockpit pressurized?
12. Which bus supplies power for fuel dump control?

- NEW
13. With a double generator failure, RAT extended, what indications will the pilot have of a complete hydraulic failure? Of a failure of only one hydraulic system?
- NEW
14. What is the indication of a CSD/S overspeed?
- NEW
15. What will be the result on the handpump system if excessive loss of combined system hydraulic fluid occurs?
- NEW
16. What is the time limit for negative-g flight?
- NEW
17. What is the maximum speed for retracting the ram-air turbine?
- NEW
18. Is the position of the hydraulic isolation valve of any consequence when checking the hook up for a field landing?
- NEW
19. What is the maximum recommended gross weight for a carrier arrestment?
- NEW
20. With the air-conditioning master switch off, what danger exists with respect to fuel tank pressurization and g-suit inflation?
- NEW
21. What are the normal engine oil-pressure limits?
- NEW
22. What is the maximum airspeed for flaps in the takeoff position?
- NEW
23. If a double-engine failure occurs, what is the minimum indicated airspeed that will ensure adequate engine windmill RPM for hydraulic pressure?
- NEW
24. What associated problems may be indicated if it is necessary to raise the landing-gear handle by actuating the override latch lever?
- NEW
25. Why is use of the catapult grip mandatory for all catapult shots?
- NEW
26. In spin recovery, what altitude is required for successful recovery to level flight using a 2.5 to 3.0 g round out?
- NEW
27. What is the normal position of the generator switches during engine start?

28. After in-flight refueling of the aircraft, wing and drop-tank fuel will not transfer. What is the probable cause?
29. What is maximum continuous EGT?
30. What indication will the pilot receive with a fuselage boost pump failure in flight?
31. On the Martin-Baker ejection seat, what conditions must be satisfied for the time-release mechanism to actuate?
32. Illumination of the wheels warning light is predicated on what three conditions?
33. Can drop-tank fuel be transferred to the fuselage if a complete electrical failure should occur?
34. What is indicated by a lighted hook light?
35. What configuration is used for a single-engine landing in the A-6?
36. What systems are operated from the primary side of the combined hydraulic system?
37. Describe the procedure in the event of a hot start.
38. After a start, the starboard CSD/S light comes on and remains on. What procedure should be followed?
39. What is indicated by illumination of both RUD THRO and BACK-UP HYD caution lights?
40. What items are powered by the back up hydraulic system?
41. What does a low fuel pressure light on the annunciator panel indicate?
42. Where are the canopy seal cutouts located? What is their purpose?
43. What effect does seat tilt have on ejection?

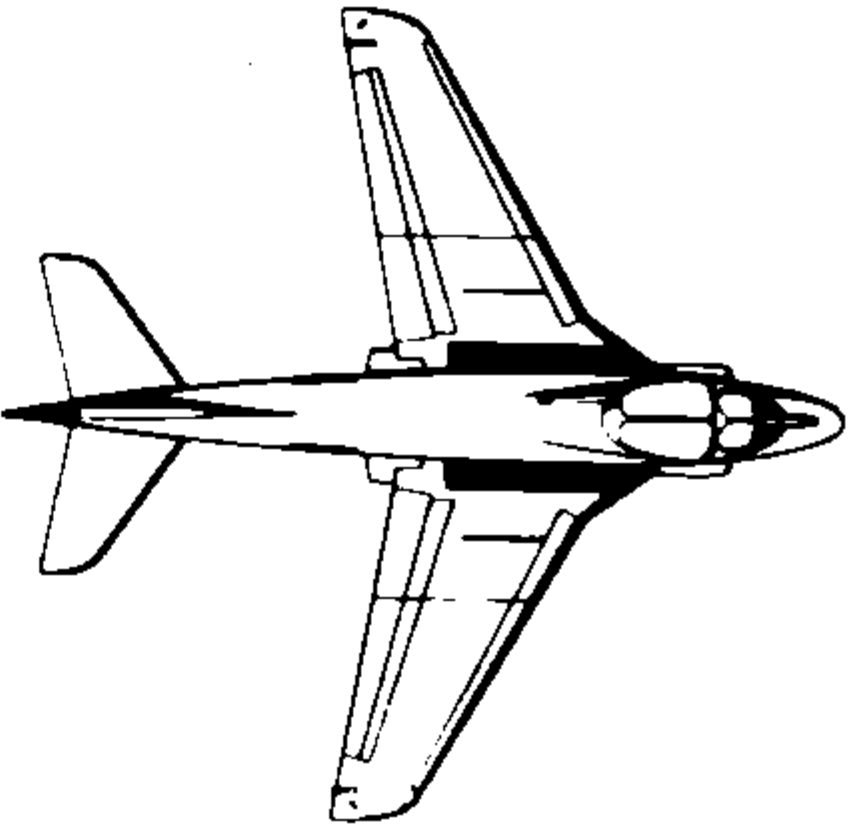
- 10-12

60. What is roll-summed steering?
61. What are the various methods the computer uses to obtain vertical separation?
62. How can the crew isolate the ADC from the system?
63. What is the significance of "in range" lights in the various attack modes?
64. What is blast clearance? How is it entered? Where is it displayed? When?
65. If the pilot commits, but does not pull-up in a general loft attack, what occurs?
66. How are the angles-to-go-to-release displayed in general and high loft attack modes?
67. What is the function of the platform adapter? What effect will its loss have on system attacks? On navigation?
68. What is data replacement? How is it accomplished? Which data is automatically replaced if bad? Which may be replaced manually?
69. Discuss navigation and attack options with the various data sensors replaced.
70. Is the position of the release indicator "fish eye" a part of reselect logic?
71. What is the function of the ACU INTERVAL thumbwheel in secondary attack modes?
72. The correct weapon loaded readout tape must be selected or the computer cannot be stepped into attack. True/False
73. Will selecting mechanical fuzing satisfy reselect logic if electrical fuzed weapons are loaded?
74. During the rough align phase of the INS where does the initial heading information come from in compass-in mode? In compass-out mode?

- 10-14

90. How is OP TGT selected?
91. How are system attacks affected by the loss of one generator?
92. What does a 011 SAC indicate? How may the erroneous sensor be determined?
93. In boresight mode, how is the intended target designated to the computer?
94. What information is provided to the pilot by the gunsight moving reticle in the AUTO mode?
95. What are the automatic modes of weapon release?
96. What is the function of the ACU?
97. What are the parameters of the landing mode display outside of 1 NM? Inside 1 NM? At what point will the pathway disappear?
98. In what mode of operation should the AAU-19 altimeter be when conducting the computer operational readiness test?

section XI

PERFORMANCE DATA**TABLE OF CONTENTS**

PART 1 STANDARD DATA	11-2	Maximum Rate of Climb	11-73
Introduction	11-2	Maximum Climb Speed	11-73
Airspeed Conversion	11-2	Combat Ceiling	11-73
Airspeed Position Error Correction	11-2	Service Ceiling	11-73
Altimeter Position Error Correction	11-2		
Takeoff and Landing Crosswind Chart	11-3	PART 5 RANGE	11-96
Aircraft Configuration Store Drag		Maximum Range Cruise at Constant	
Count Chart	11-3	Altitude (Time and Speed)	11-96
		Maximum Range Cruise at Constant	
PART 2 MISSION PLANNING	11-14	Altitude (Fuel Required)	11-96
Cruise Performance	11-14		
Best Cruise Altitude	11-15	PART 6 ENDURANCE	11-101
Optimum Endurance Altitude	11-15	Maximum Endurance (Speed)	11-101
Combat Allowance	11-15	Maximum Endurance (Fuel Required)	11-101
Military Power Acceleration	11-15		
Maximum Turn Performance	11-16	PART 7 AIR REFUELING	11-106
		Fuel Consumption During Air	
PART 3 TAKEOFF	11-58	Refueling	11-106
Maximum Refusal Speed	11-58	Acceleration to Climb Speed	11-106
Takeoff Distance Charts	11-58	Air Refueling	11-107
Velocity During Takeoff Ground Run	11-59		
Critical Field Length	11-59	PART 8 DESCENT	11-113
Climb Performance After Takeoff		Normal Descent	11-113
(Single Engine)	11-59	Maximum Range Descent	11-113
PART 4 CLIMB	11-72	PART 9 LANDING	11-123
Military Power Climb	11-72	Landing Approach Speeds	11-123
Maximum Climb-Out Angle	11-72	Landing Distance	11-123



Standard Data

INTRODUCTION

Section XI is divided into nine parts to present performance data in proper sequence for preflight planning. Two concepts of data presentation are used to show drag effects on aircraft performance; i.e., specific configuration charts and drag count charts. The drag count concept is used to present military power climb, best cruise altitude, optimum endurance altitude, combat ceiling, service ceiling, cruise performance, maximum range cruise, maximum endurance speed, maximum endurance fuel, and maximum range descent. All other data are presented as a specific configuration per chart. All performance data are based on flight tests or the contractor's estimate, IACO standard day conditions except those used for takeoff and landing where temperature corrections for nonstandard atmosphere are included, and J52-P-8A engines, and JP-5 fuel.

Note

The fuel quantity indicator presents the readings of actual fuel weight remaining. This is accomplished by means of compensator readings regardless of changes in the specific density due to temperature changes. Therefore, adjustment for various fuel densities is not necessary.

AIRSPEED CONVERSION

The airspeed conversion charts (figures 11-3 and 11-4) provide a means of converting calibrated airspeed to true mach number and true airspeed.

INDICATED AIRSPEED

Indicated airspeed (IAS) is the uncorrected airspeed read directly from the cockpit indicator when the ADC is inoperative.

CALIBRATED AIRSPEED

Calibrated airspeed (CAS) is indicated airspeed corrected for static source error.

EQUIVALENT AIRSPEED

Equivalent airspeed (EAS) is calibrated airspeed corrected for compressibility effect.

TRUE AIRSPEED

True airspeed (TAS) is equivalent airspeed corrected for atmospheric density. Refer to airspeed conversion, figures 11-3 and 11-4.

AIRSPEED POSITION ERROR CORRECTION

These charts (figures 11-5 and 11-6) provide a direct-reading conversion from indicated airspeed to airspeed position error and from indicated mach number to mach number position error correction.

Aircraft Configuration: Clean

- A. Indicated Airspeed 120 kts
- B. Gross Weight 50,000 lb
- C. Airspeed Correction (to be added to correct instrument reading) -3 kts

Aircraft Configuration: All Configurations, All Gross Weights

- A. Indicated Mach Number 0.82
- B. Reflector Line
- C. Mach Number Correction (to be added to correct instrument reading) 0.015

ALTIMETER POSITION ERROR CORRECTION

These charts (figures 11-7 and 11-8) provide ΔH corrections for various indicated airspeed and indicated mach number gross weight combinations.

Aircraft Configuration: Gear and Flaps Down

- A. Indicated Airspeed 140 kts
- B. Gross weight 55,000 lb
- C. Altitude Correction (To be added to correct instrument reading.) -20 ft

AIRCRAFT CONFIGURATION: ALL CONFIGURATIONS, ALL GROSS WEIGHTS

- A. Indicated mach number 0.84M NEW
- B. Altitude Line Sea Level
- C. Altitude Correction (To be added to correct instrument reading.) +500 ft

TAKEOFF AND LANDING CROSSWIND CHART

The takeoff and landing crosswind chart (figure 11-9) presents minimum recommended takeoff and touchdown speeds for crosswind conditions. The line between recommended and not recommended is based on the maximum sideslip angle of the aircraft using maximum rudder deflection. The chart may also be used to determine the headwind and crosswind component.

USE

Determine the wind angle relative to the runway heading, and enter the plot at the lower left along the applicable relative wind angle line to the reported wind velocity arc. To find the headwind component, project a line horizontally to the left and read the headwind in knots; for crosswind component drop vertically to the baseline. To find minimum takeoff or touchdown speeds, from the intersection of the relative wind angle line and the velocity arc, project a line upward vertically to the computed takeoff or touchdown speed. If this point is not in the recommended area, continue vertically until the line between the recommended and not recommended areas is reached, and project horizontally to the right to read the minimum recommended speed.

The effect of increased speed on takeoff or landing criteria should be considered because under conditions of high gross weights, large crosswind components and short runways, it might dictate down-loading, dumping, or selection of a different runway.

Sample Problem

GIVEN:

Wind Angle	- 70°
Windspeed	- 37 kts
Computed takeoff speed	- 125 kts

SOLUTION:

Headwind Component	- 12.5 kts
Crosswind Component	- 35 kts
Minimum Takeoff Speed	- 127 kts

AIRCRAFT CONFIGURATION STORE DRAG COUNT

The aircraft configuration store drag count table (figure FO-10) presents various combinations of external stores that are symmetrically carried on the aircraft. A drag count has been assigned to each external store or combination of stores for the particular store station. The drag count for a given configuration is the sum of the store drag count of the centerline stations, and the stores drag count of the wing stations.

Note

- Drag count values for wing stations are based on the assumption that all wing stations are loaded. For minimum drag, if only 2 wing stations are to be loaded stations 1 and 5 should be used because of the following relationships:

- Stations 1 and 5 only = 70% of tabulated drag count
- Stations 2 and 4 only = 110% of tabulated drag count

Centerline station drag count is not affected by the presence of wing stores.

- Drag count values for expended rocket pods are equivalent to the values for pods with the nose fairing off.
- Drag count values for empty ejector racks on any station are:

TER= 5
MER=8

- Caution should be exercised when carrying high drag count combinations (over 50 counts/station). Most of the store loadings listed have not been quantitatively flight tested and their influence on wing lift are unknown. Therefore these high drag count loadings may have a significant effect on catapulting, takeoff, and stall speed performance.

USE

To determine the drag count of the aircraft, enter the table at the store loaded and pick out the tabulated drag count for the loading used on each station and add these values.

Sample Problem

AIRCRAFT CONFIGURATIONS:

Centerline - Empty

Inboard - LAU-10A Rocket (Full)	= 16
Outboard - LAU-10A Rocket (Full)	= 16

Total drag count 32

STORES WEIGHTS

Figure 11-10 provides a listing of the weights of various stores carried.

STANDARD ALTITUDE TABLE

STANDARD SEA LEVEL AIR:
T = 15° C.
P = 29.921 IN. OF Hg.

W = .07648 LB/CU. FT. $\rho_0 = .0023769$ SLUGS/CU. FT.
1" OF Hg. = 70.727 LB/SQ. FT. = 0.4912 LB/SQ. IN.
A₀ = 1117 FT./SEC. (661.7 KNOTS) (A₀)
 σ = DENSITY RATIO

THIS TABLE IS BASED ON ICAO STANDARD ATMOSPHERE FROM NACA TN NO. 3182

ALTITUDE FEET	DENSITY RATIO ρ/ρ_0	$\sqrt{\sigma}$	TEMPERATURE		SPEED OF SOUND		PRESSURE	
			DEG. C	DEG. F	RATIO A/A ₀	KNOTS	IN. OF Hg	RATIO P/P ₀
0	1.0000	1.000	15.0	59.0	1.000	661.7	29.92	1.0000
1000	.9711	1.015	13.0	55.4	.997	659.5	28.86	.9644
2000	.9428	1.030	11.0	51.9	.993	657.2	27.82	.9298
3000	.9151	1.045	9.0	48.3	.990	654.9	26.82	.8962
4000	.8881	1.061	7.1	44.7	.986	652.6	25.84	.8637
5000	.8617	1.077	5.1	41.2	.983	650.3	24.90	.8320
6000	.8359	1.094	3.1	37.6	.979	647.9	23.98	.8014
7000	.8107	1.111	1.1	34.0	.976	645.6	23.09	.7716
8000	.7860	1.128	-0.8	30.5	.972	643.3	22.23	.7428
9000	.7620	1.146	-2.8	26.9	.969	640.9	21.39	.7148
10000	.7385	1.164	-4.8	23.3	.965	638.6	20.58	.6877
11000	.7156	1.182	-6.8	19.8	.961	636.2	19.79	.6614
12000	.6932	1.201	-8.8	16.2	.958	633.9	19.03	.6360
13000	.6713	1.221	-10.8	12.6	.954	631.5	18.29	.6113
14000	.6500	1.240	-12.7	9.1	.951	629.1	17.58	.5875
15000	.6292	1.261	-14.7	5.5	.947	626.7	16.89	.5643
16000	.6090	1.282	-16.7	2.0	.943	624.3	16.22	.5420
17000	.5892	1.303	-18.7	-1.6	.940	621.9	15.57	.5203
18000	.5699	1.325	-20.7	-5.2	.936	619.4	14.94	.4994
19000	.5511	1.347	-22.6	-8.8	.933	617.0	14.34	.4791
20000	.5328	1.370	-24.6	-12.3	.929	614.6	13.75	.4595
21000	.5150	1.394	-26.6	-15.9	.925	612.1	13.18	.4406
22000	.4976	1.418	-28.6	-19.5	.921	609.6	12.64	.4223
23000	.4807	1.442	-30.6	-23.0	.918	607.2	12.11	.4046
24000	.4642	1.468	-32.5	-26.6	.914	604.7	11.60	.3876
25000	.4481	1.494	-34.5	-30.1	.910	602.2	11.11	.3711
26000	.4325	1.521	-36.5	-33.7	.906	599.7	10.63	.3552
27000	.4173	1.548	-38.5	-37.3	.903	597.2	10.17	.3398
28000	.4025	1.576	-40.5	-40.9	.899	594.6	9.725	.3250
29000	.3881	1.605	-42.5	-44.4	.895	592.1	9.297	.3107
30000	.3741	1.635	-44.4	-48.0	.891	589.6	8.885	.2970
31000	.3605	1.665	-46.4	-51.6	.887	587.0	8.488	.2837
32000	.3473	1.697	-48.4	-55.1	.883	584.4	8.106	.2709
33000	.3345	1.729	-50.4	-58.7	.879	581.9	7.737	.2586
34000	.3220	1.762	-52.4	-62.2	.876	579.3	7.382	.2467
35000	.3099	1.796	-54.3	-65.8	.872	576.7	7.041	.2353
36000	.2981	1.832	-56.2	-69.4	.868	574.0	6.712	.2243
37000	.2844	1.875	-56.5	-69.7	.867	573.8	6.397	.2138
38000	.2710	1.921	-56.5	-69.7	.867	573.8	6.097	.2038
39000	.2583	1.968	-56.5	-69.7	.867	573.8	5.811	.1942
40000	.2462	2.016	-56.5	-69.7	.867	573.8	5.538	.1851
41000	.2346	2.065	-56.5	-69.7	.867	573.8	5.278	.1764
42000	.2236	2.115	-56.5	-69.7	.867	573.8	5.030	.1681
43000	.2131	2.166	-56.5	-69.7	.867	573.8	4.794	.1602
44000	.2031	2.219	-56.5	-69.7	.867	573.8	4.569	.1527
45000	.1936	2.273	-56.5	-69.7	.867	573.8	4.355	.1455
46000	.1845	2.328	-56.5	-69.7	.867	573.8	4.151	.1387
47000	.1758	2.385	-56.5	-69.7	.867	573.8	3.956	.1322
48000	.1676	2.443	-56.5	-69.7	.867	573.8	3.770	.1260
49000	.1597	2.502	-56.5	-69.7	.867	573.8	3.593	.1201
50000	.1522	2.563	-56.5	-69.7	.867	573.8	3.425	.1145
51000	.1451	2.625	-56.5	-69.7	.867	573.8	3.264	.1091
52000	.1383	2.689	-56.5	-69.7	.867	573.8	3.111	.1040
53000	.1318	2.755	-56.5	-69.7	.867	573.8	2.965	.0991
54000	.1256	2.822	-56.5	-69.7	.867	573.8	2.826	.0944
55000	.1197	2.890	-56.5	-69.7	.867	573.8	2.693	.0900

Figure 11-1

STANDARD UNITS CONVERSION CHART

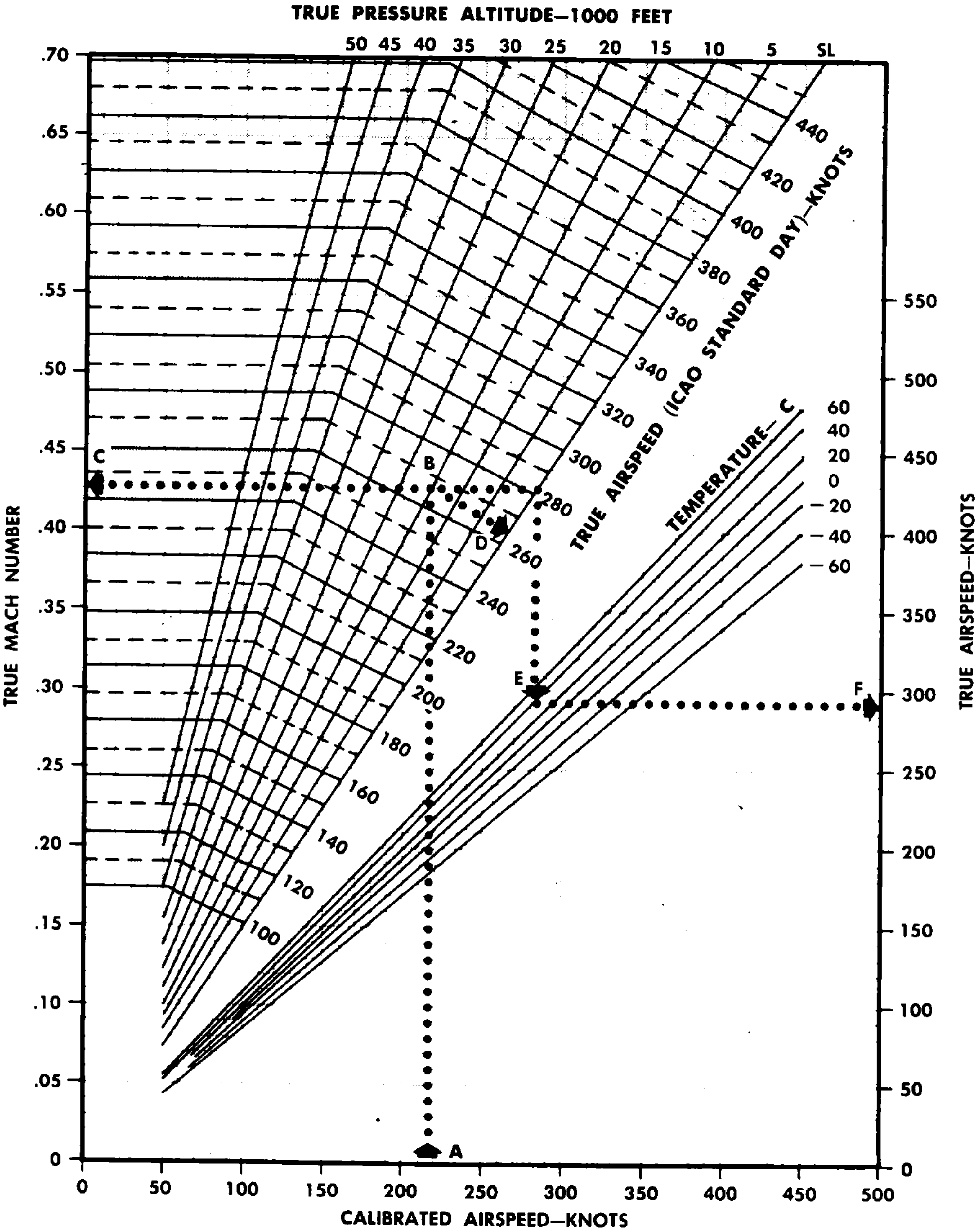
TEMPERATURE		DISTANCE				SPEED					
°C	°F	FEET	METERS	NAUTICAL MILES	KILO-METERS	KNOTS	FEET PER SEC	FEET PER MIN	METERS PER SEC	METERS PER MIN	KNOTS
100	200	15,000	4500	3000	5500						
90	180	14,000			5000	700		70,000	360		700
80	160	13,000	4000				1100			20,000	
70	140	12,000		2500	4500	600	1000	60,000	320		600
60	120	11,000	3500		4000		900		280		
50	100	10,000	3000	2000	3500	500	800	50,000	240	15,000	500
40	80	9,000			3000		700		200		
30	60	8,000	2500		2500	400	600	40,000	160	10,000	400
20	40	7,000	2000	1500	2000		500	30,000	120	5,000	300
10	20	6,000	1500		1500	300	400	20,000	80		200
0	0	5,000	1000	1000	1000	200	300	10,000	40		100
-10	-20	4,000	500		500	100	200				
-20	-40	3,000					100				
-30	-60	2,000									
-40		1,000									
-50		0									

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

Figure 11-2

AIRSPEED CONVERSION



SAMPLE PROBLEM

A. CALIBRATED AIRSPEED	=	215 KNOTS
B. PRESSURE ALTITUDE	=	15,000 FEET
C. TRUE MACH NUMBER	=	.428
D. TRUE AIRSPEED (ICAO STANDARD DAY)	=	268 KNOTS
E. AMBIENT TEMPERATURE	=	30°C
F. TRUE AIRSPEED	=	290 KNOTS

Figure 11-3

AIRSPEED CONVERSION

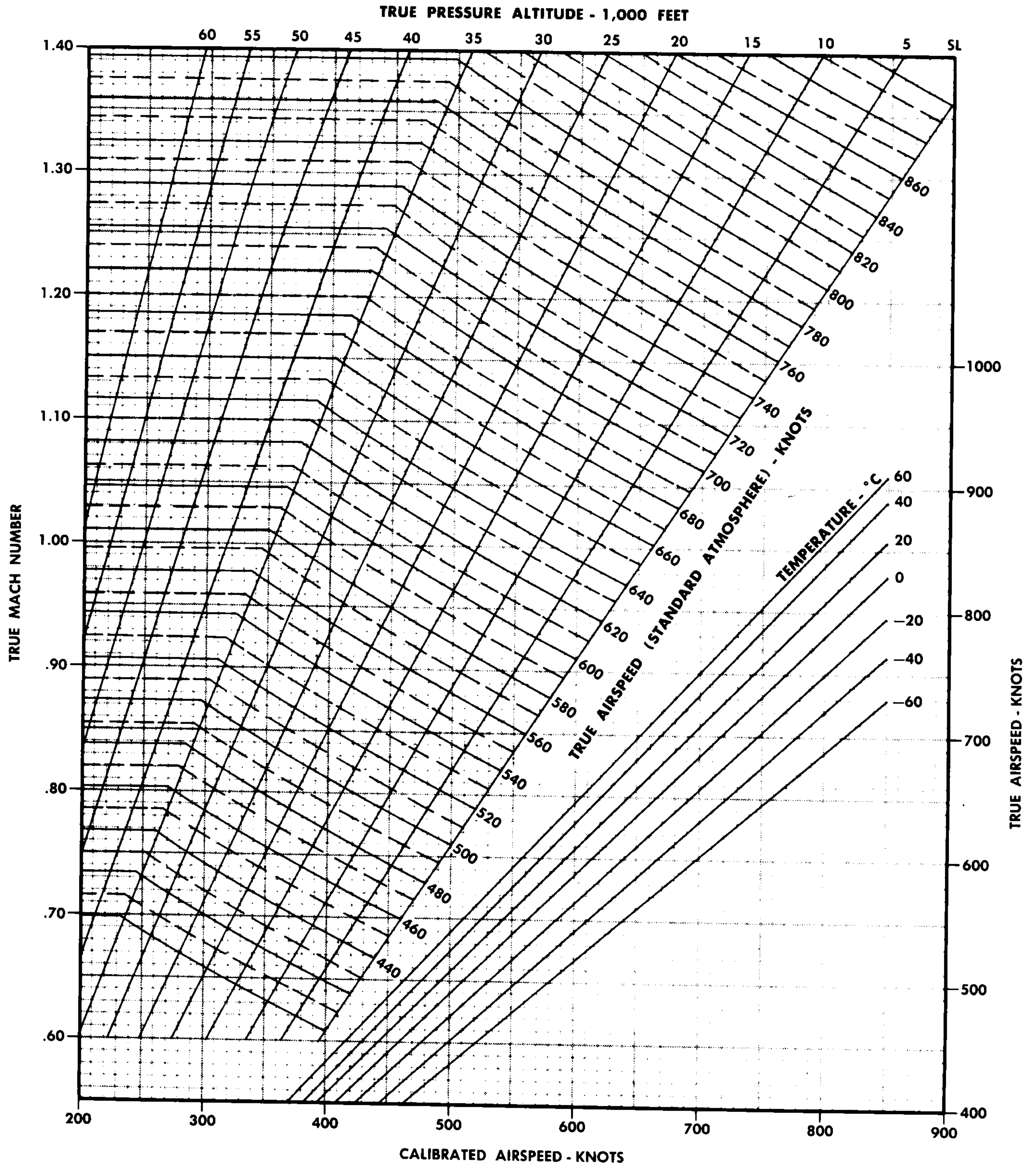


Figure 11-4

ADF1-301

AIRSPEED POSITION ERROR CORRECTION

P-8 ENGINE

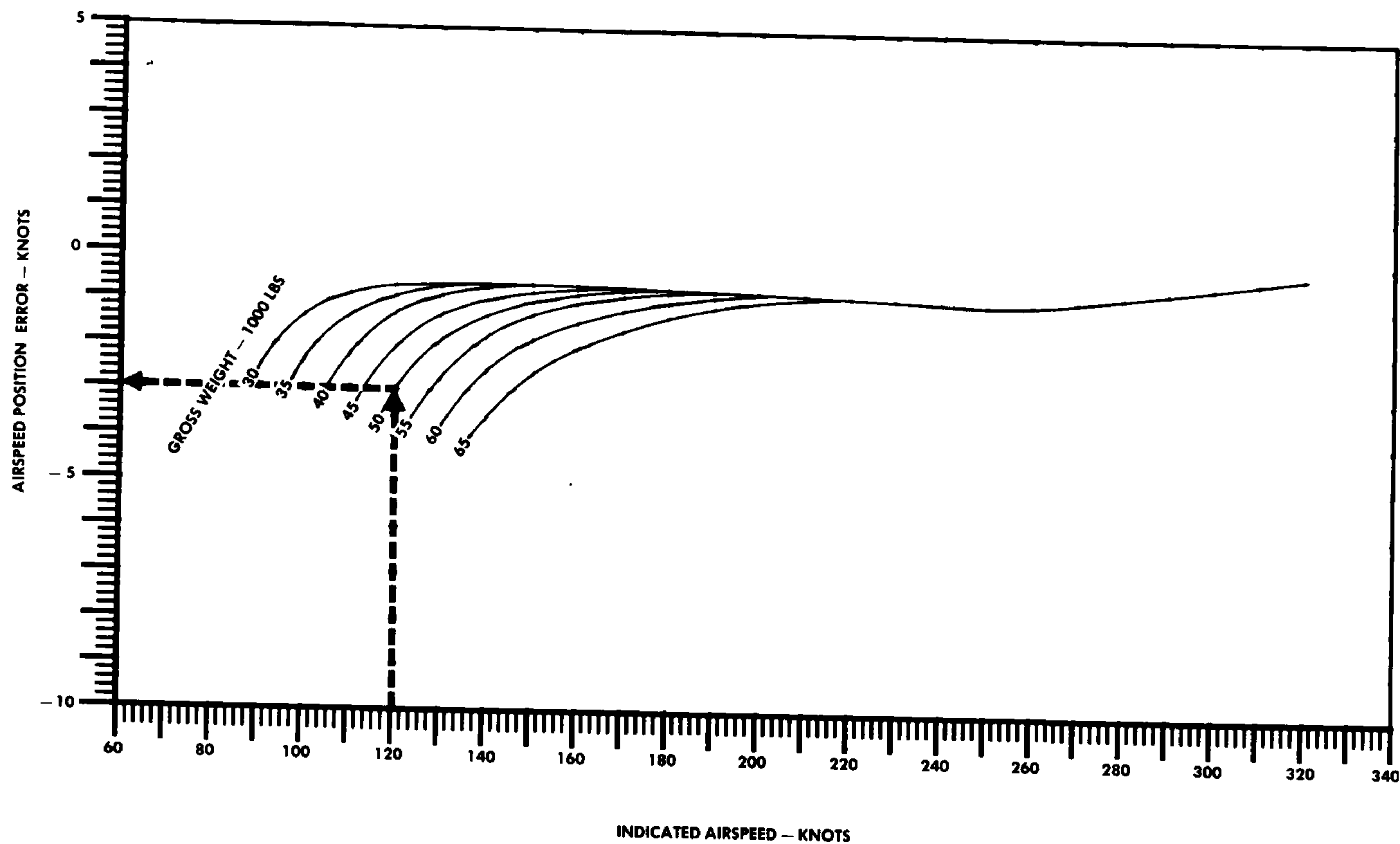
FINBOOM AIR SPEED SYSTEM

AIRCRAFT CONFIGURATION
ALL CONFIGURATIONS
ALL GROSS WEIGHTS

DATE: 10 MARCH 1970
DATA BASIS: FLIGHT TEST

REMARKS
ADD CORRECTION TO CORRECT
INSTRUMENT READING

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



ADF1-306

Figure 11-5

AIRSPEED POSITION ERROR CORRECTION

P-8 ENGINE

FINBOOM AIR SPEED SYSTEM

AIRCRAFT CONFIGURATION
ALL CONFIGURATIONS
ALL GROSS WEIGHTS

DATE: 10 MARCH 1970
DATA BASIS: FLIGHT TEST

REMARKS
ADD CORRECTION TO CORRECT
INSTRUMENT READING

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

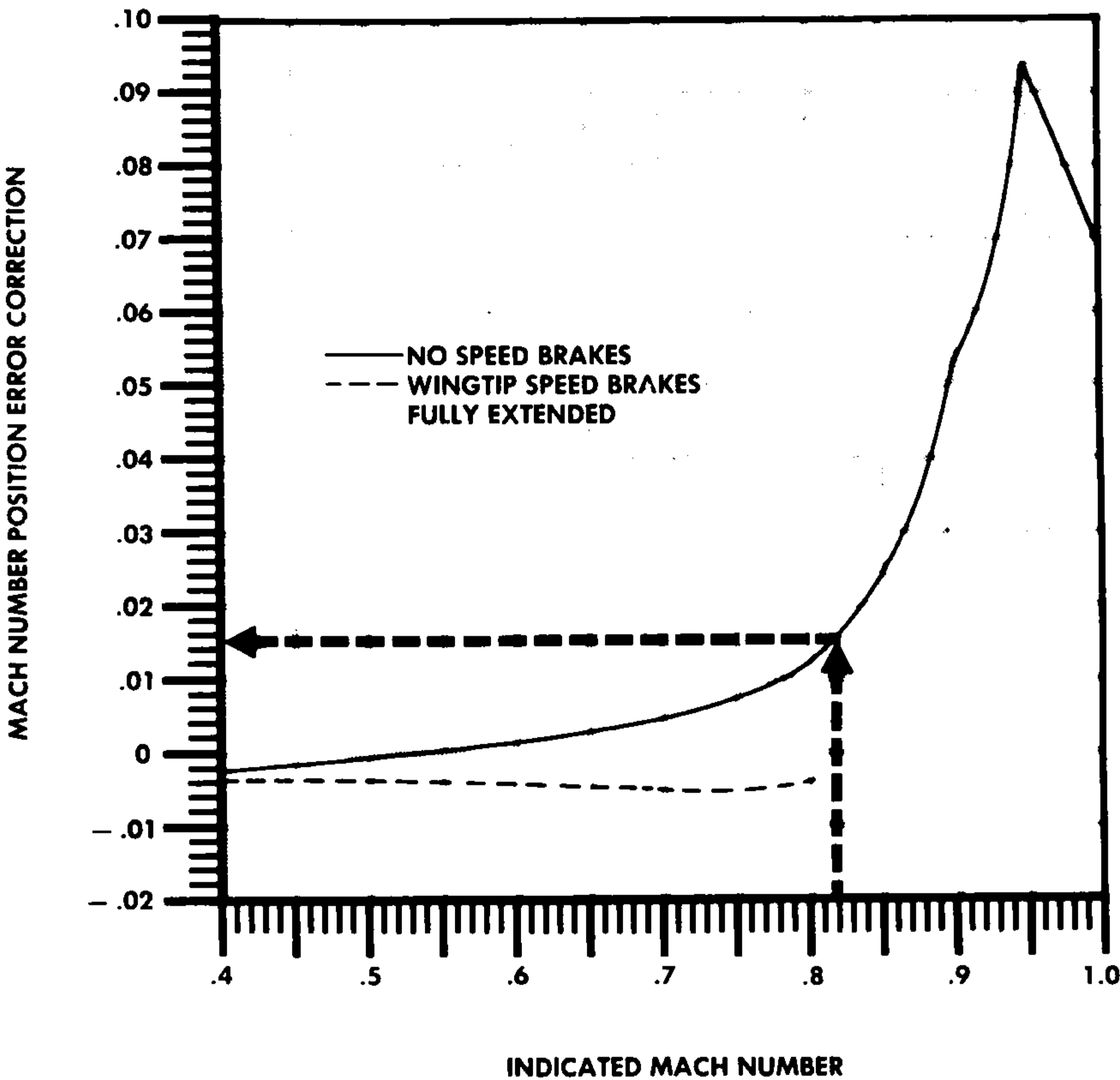


Figure 11-6

ALTIMETER POSITION ERROR CORRECTION

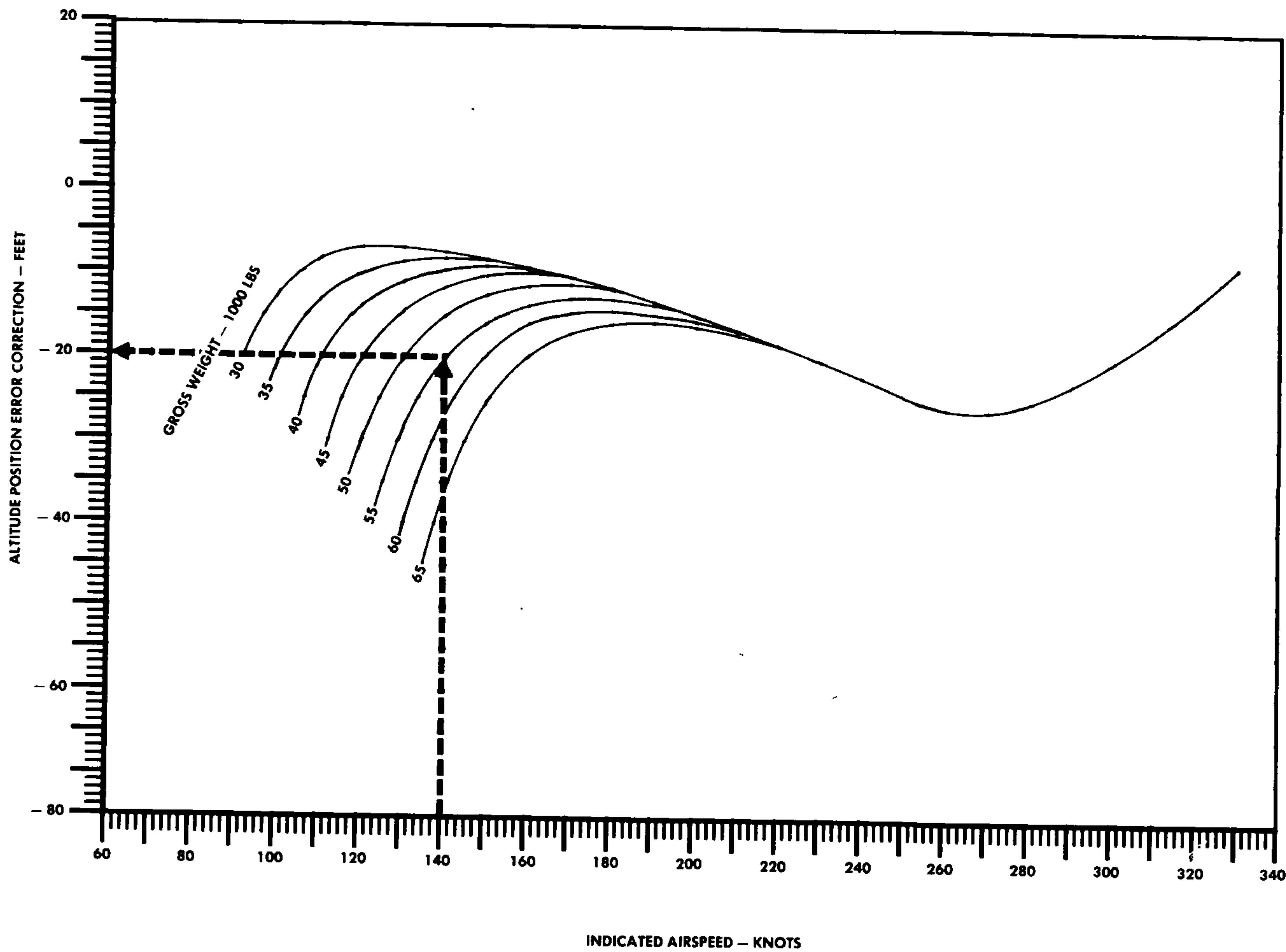
P-8 ENGINE

FINBOOM AIR SPEED SYSTEM

AIRCRAFT CONFIGURATION
ALL CONFIGURATIONS
ALL GROSS WEIGHTS

DATE: 10 MARCH 1970
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



ADF1-307

Figure 11-7

ALTIMETER POSITION ERROR CORRECTION

P-8 ENGINE

FINBOOM AIR SPEED SYSTEM

AIRCRAFT CONFIGURATION
ALL CONFIGURATIONS
ALL GROSS WEIGHTS

DATE: 10 MARCH 1970
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

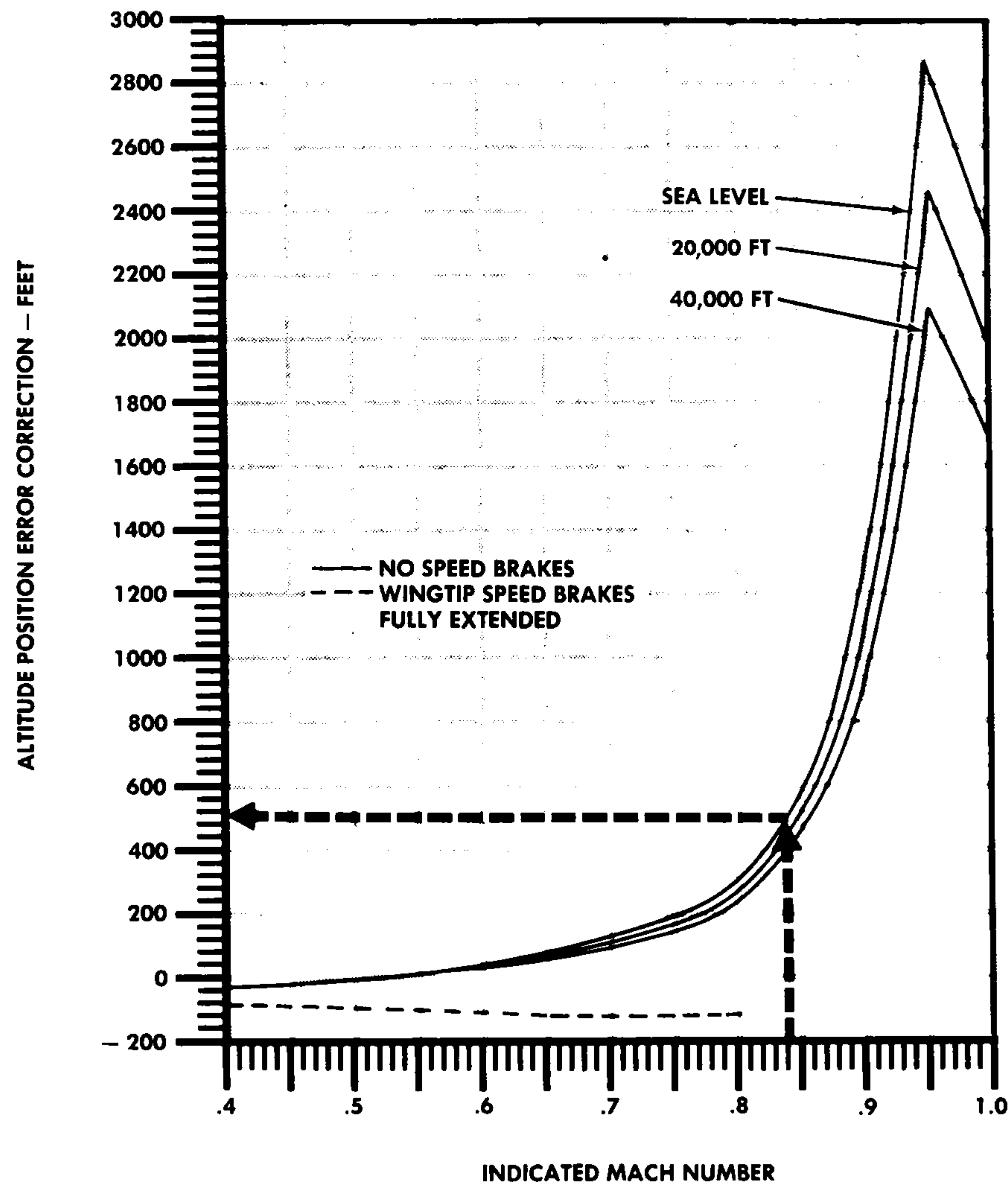


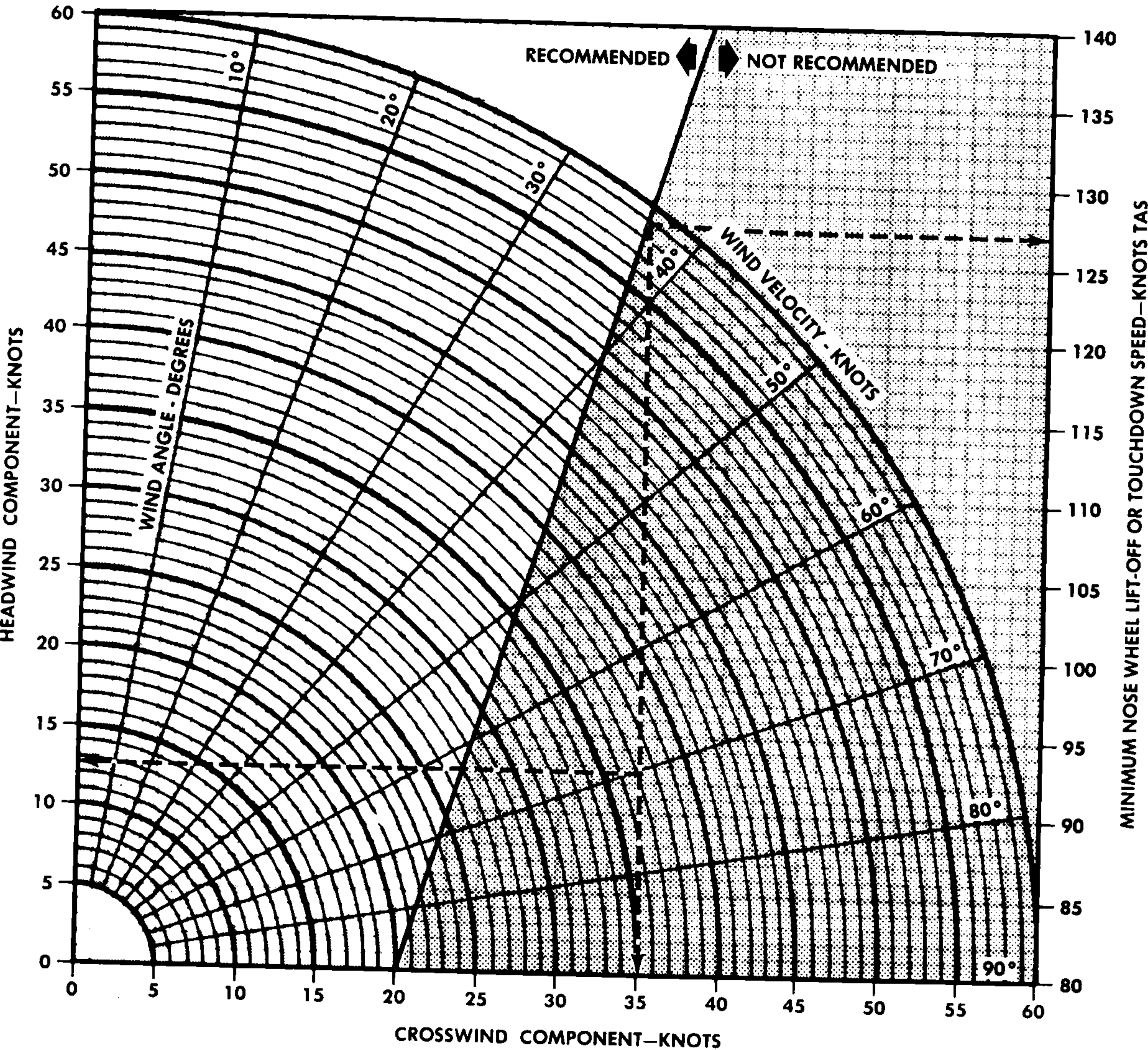
Figure 11-8

TAKE-OFF/LANDING CROSSWIND CHART

STANDARD DAY

DATE: 1 SEPTEMBER 1968
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



NOTE
CORRECT IAS FOR TEMPERATURE AND PRESSURE TO OBTAIN TAS.

Figure 11-9

STORES WEIGHTS

BOMBS		WT. LB.	MISSILES		WT. LB.
MK-81 LDGP			AGM-45A (SHRIKE)		400
CONICAL TAILS		260	AIM-9D/G/H (SIDEWINDER) . . .		195
SNAKEYE TAILS		295	AGM-78A (STANDARD ARM		
MK-82 LDGP			MOD-0) A-6B ONLY		1375
CONICAL TAILS		531	ROCKET LAUNCHERS		WT. LB. FULL/EMPTY
SNAKEYE TAILS		572	LAU-32A/A (2.75 FFAR) . . .		167/43
MK-82 LGB		650	LAU-32B/A (2.75 FFAR) . . .		174/49
MK-83 LDGP		985	LAU-3A/A (2.75 FFAR) . . .		416/79
MK-83LGB		985	LAU-60/A (2.75 FFAR) . . .		473/79
MK-84 LDGP		1970	LAU-61/A (2.75 FFAR) . . .		540/133
MK-84 LGB		2052	LAU-69/A (2.75 FFAR) . . .		507/98
M117A1		806	LAU-56/A (2.75 FFAR) . . .		168/43
M117 DEMO		799	LAU-68/A (2.75 FFAR) . . .		218/67
M-77 MOD 2, 4 FIRE		520	LAU-10/A, 10A/A (ZUNI) . .		533/105
CBU-24/B, B(MOD), A/B, C/B . .		830	TRAINING AND PYROTECHNICS		WT. LB.
CBU-29/B, B(MOD), A/B, C/B . .		830	MK-86 WSF/WF PB		217/141
CBU-49/B, B(MOD), A/B, C/B . .		830	MK-87 WSF/WF PB		333/221
MK-20 (ROCKEYE II)		470	MK-88 WSF/WF PB		783/458
MK-36 DESTRUCTOR MOD 2 & 3			MK-76 MOD 4, 5 PB		25
CONICAL TAIL		531	MK-106 MOD 3, 4 PB		5
SNAKEYE TAIL		572	MK-124 PB		525
MK-40 DESTRUCTOR		1057	MK-24 PARAFLARE		27
NUCLEAR WEAPONS, SHAPES, AND MINES		WT. LB.	MK-45 PARAFLARE		27
B-28		2040	SUU-40/A OR 44/A FLARE		
B-43		2120	CONTAINER (MK 24 MOD 4		
B-57		500	PARAFLARES WITH TRAYS) . .		350
B-61		715	MK 33 MOD 1		
MK-104		2100	FLARE		45.9 W/O MOTOR
BDU-6E		2100	102.4 W/MOTOR		
BDU-8/B		1970	MK 58 MARINE MARKER		13
BDU-11E		500	EJECTOR RACKS AND LAUNCHERS		WT. LB.
BDU-12/B		500	AERO-7A EJECTOR RACK		53
BDU-20/C		515	AERO-7B EJECTOR RACK		50
BDU-36			A/A37B-3 PMBR		87
MK-25 MINE		2015	A/A37B-5 TER		96
MK-25 DRILL MINE		2132	A/A37B-6 MER		214
MK-36 MINE		1130	LAU-7/A MISSILE LAUNCHER . .		87
MK-36 DRILL MINE		1258	AERO-5 MISSILE LAUNCHER . .		90
MK-50 MINE		580	ADU 299E		20
MK-52 MINE		1200	AERO 1A ADAPTER		10
MK-52 DRILL MINE		1325	GAEC ADAPTER		20
MK-53 MINE		385	LAU-77A/A ELA		181
MK-55 MINE		2128	NOTE		
MK-55 DRILL MINE		2128	THE FOLLOWING STORES WEIGHTS ARE FOR INFORMATION		
MK-56 MINE		2200	ONLY AND ARE NOT AUTHORITY FOR AIRCRAFT LOADING.		
MK-56 DRILL MINE		2200	FOR AIRCRAFT STORES LIMITATIONS REFER TO NAVAIR		
TANKS/PODS AND SENSORS		WT. LB. FULL/EMPTY	01-85ADA-1T.		
AERO 1D DROPTANK		2238/198			
D-704 REFUELING					
STORE		2774/700			
SARGENT FLETCHER MODEL					
31-300 REFUELING					
STORE		2720/680			
MK 4 GUN POD		1390/787			
CNU 188/A EXTERNAL BAGGAGE					
CONTAINER					
ONE FIN		MAX 645/212			
TWO FIN		MAX 649/216			
CTU-1A DELIVERY					
CONTAINER		750/230			
GTC-85-72/-73					
STARTER UNIT POD		575			
ADSID I		23			
ADSID III (FOLDING FIN)		39			
GSQ-117/LS		44			
GSQ-141		32			
SUU-53A					

Figure 11-10



Mission Planning

CRUISE PERFORMANCE

The cruise performance is presented in four phases, figures 11-11 through 11-14. Phase I is the determination of the clean aircraft transfer number and the appropriate cruise mach number for a known aircraft gross weight, altitude and drag count. The clean transfer number may also be determined for any desired mach number at any altitude, as well as the best cruise altitude for the aircraft. Phase II gives a final aircraft reference number by adding the clean aircraft transfer number to the drag count transfer number. Phase III yields the value of pounds of fuel per nautical mile for the cruise mach number found, or chosen, in phase I and the reference number obtained in phase II. Phase IV is simply a conversion from pounds of fuel per nautical mile to fuel flow for various outside air temperatures in degrees centigrade. Pounds of fuel per nautical mile and corresponding fuel flow can be determined for any possible aircraft configuration, gross weight, altitude, and air temperature.

USE

Phase I. Enter the bottom chart of figure 11-11 at the appropriate gross weight and proceed to the desired altitude. If it is desired to cruise at the best altitude, then proceed instead to the appropriate drag count. Proceed vertically upward to intersect the dotted line for a drag count of zero (0). If it is desired to cruise at the mach number recommended for maximum range, then parallel the nearest guide line (solid line) to intersect the appropriate drag count (broken line). From this point, proceed vertically downward to read the recommended mach number for maximum range and horizontally to the right to obtain the clean aircraft transfer scale. If it is desired to fly at some other predetermined mach number, then parallel the nearest guide line from the zero drag count line to intersect a vertical line projected up from the desired mach number. Proceed horizontally to the right to obtain the clean aircraft transfer scale.

Phase II. Enter the bottom chart of figure 11-12 at the mach number determined in phase I and proceed to the right to intersect the appropriate drag count line. Project vertically upward from this point. Enter the top chart at the transfer scale determined in phase I and proceed to the right intersecting the line projected vertically from the bottom chart. The intersecting of these lines determines the aircraft reference number. If no external stores are carried, phase II may be ignored. In this case, the reference number is equal to the transfer scale number determined in phase I.

Phase III. Enter the bottom chart of figure 11-13 at the previously determined mach number and proceed to the right to the reference number found in phase II. Proceed vertically upward to intersect the proper altitude line and then directly to the left to obtain the correct value of pounds of fuel per nautical mile.

Phase IV. Enter the bottom chart of figure 11-14 at the correct mach number and proceed to the right until the correct temperature line is reached. From this point proceed vertically upward until the value of pounds of fuel per nautical mile found in phase III is reached, and then horizontally to the left to read the correct value of fuel flow.

Sample Problem

Aircraft Configuration:

- (1) MK-28 store plus (4) 300 gallon tanks.

Phase I

A. Gross Weight	45, 000 lbs
B. Altitude	Best Cruise at a drag count of 47
C. Zero Drag Count Line	0
D. Drag Count	47
E. Recommended Mach Number	. 695 M
F. Clean Aircraft Transfer Scale	13. 5

Phase II

E. Recommended Mach Number	. 695 M
D. Drag Count	47
F. Transfer Scale	13. 5
G. Reference Number	15. 0

Phase III

E. Recommended Mach Number	. 695 M
G. Reference Number	15. 0
B. Altitude at drag count 30 (Corresponds to Best Cruise Altitude)	34, 000 ft
H. Pounds of Fuel Per Nautical Mile	9. 20 lb/NMI

Phase IV

E. Mach Number	.695 M
I. Temperature (OAT) (Degrees Centigrade)	-40° C
H. Pounds of Fuel Per Nautical Mile	9.20 lb/NMI
J. Fuel Flow	3900 lb/hr

BEST CRUISE ALTITUDE

The best cruise altitude graph is presented in the upper portion of figure 11-19. Pressure altitude for best cruise vs weight is plotted for a drag count range of 0 to 250.

USE

Enter chart at aircraft gross weight and proceed vertically to appropriate drag count reflector line. From this point proceed horizontally to left scale of graph to read best cruise altitude.

Sample Problem

Aircraft Configuration:

(1) MK-28 plus (4) 300-gallon tanks.

A. Gross Weight	45,000 lb
B. Drag Count	47
C. Best Cruise Altitude	34,000 ft

OPTIMUM ENDURANCE ALTITUDE

The optimum endurance altitude, presented on the lower half of figure 11-19, is a plot of pressure altitude vs gross weight for a drag count range of 0 to 250.

USE

Enter chart at aircraft gross weight and proceed vertically to the appropriate drag count reflector line. From this point proceed horizontally to left scale of graph to read optimum endurance altitude.

Sample Problem

Aircraft Configuration:

(1) MK-28 plus (4) 300-gallon tanks.

A. Gross Weight	45,000 lb
B. Drag Count	47
C. Optimum Endurance Altitude	29,000 ft

COMBAT ALLOWANCE

With a constant combat power setting, these charts (figures 11-21 and 11-22) present the relationship at an initial gross weight between time and fuel, at various altitudes and drag counts.

USE

Enter the base of the altitude chart at the initial gross weight and ascend vertically to intersect the combat altitude. Proceed horizontally to intersect the drag count line. Descend vertically to intersect a fuel line and then continue horizontally to read time in minutes.

Sample Problem

Aircraft Configuration:

(1) MK-28 store plus (4) 300-gallon drop tanks.

A. Initial Gross Weight	45,000 lb
B. Combat Altitude	30,000 ft
C. Drag Count	50
D. Fuel Used	2,000 lb
E. Total Time	15.1 min

MILITARY POWER ACCELERATION

These charts (figures 11-23 through 11-33) show the relationship between time, fuel, and distance at various altitudes, gross weights, and configuration during military power operation. Lines of constant mach number from loiter speed to V_{max} provide a means of determining the time, fuel, and distance required for level flight accelerations within the speed envelope of the aircraft.

USE

To determine time, fuel, and distance required for acceleration, select the applicable chart (altitude and configuration) and enter the chart with gross weight. Proceed vertically to initial mach number. Note time, and project horizontally and note difference. From initial mach number, parallel a guide curve until it intersects the desired mach number at the end of the acceleration period and note time. Project horizontally and note distance. Project vertically and note gross weight. Subtract time, distance, and gross weight values to determine time, distance, and fuel for acceleration.

Sample Problem

Aircraft Configuration:

(1) MK-28 store plus (4) 300-gallon drop tanks.

Altitude 15,000 feet

A. Gross Weight	45,000 lb
B. Initial Mach Number	.70 M
C. Time Corresponding to IMN	1.16 min
D. Distance	7.0 NMI
E. Parallel Guide Curve	
F. Desired Mach Number	.822 M (MAX)
G. Time Corresponding to Desired Mach Number	2.75 min
H. Distance	20.0 NMI
I. Gross Weight	44,700 lb
J. Time Required for Acceleration (G-C)	1.59 min
K. Distance Required for Acceleration (H-D)	13.0 NMI
L. Fuel Required for Acceleration (A-I)	300 lb

MAXIMUM TURN PERFORMANCE

The turn performance charts (figures 11-34 through 11-42) present the maximum load factor and bank angle, maximum rate of turn, and minimum radius of turn at various constant airspeeds, altitudes, and configurations. Performance limitation is determined by either the buffet onset or military power available.

USE

For a particular weight and configuration enter the charts with mach number and proceed vertically to the desired altitude. Read load factor and bank angle, rate of turn, and radius of turn.

Sample Problem

Aircraft Configuration:

(1) MK-28 store plus (4) 300-gallon drop tanks.

A. Mach Number	.70
B. Altitude	15,000 ft
C. Bank Angle	77.0°
D. Load Factor	4.5 g
E. Rate of Turn (degrees/second)	10.8°
F. Radius of Turn	.61 NMI

CRUISE PERFORMANCE

P-8 ENGINE

PHASE I – CLEAN AIRCRAFT TRANSFER SCALE

DATE 15 MARCH 1971
DATA BASIS: ESTIMATED

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB./GAL.

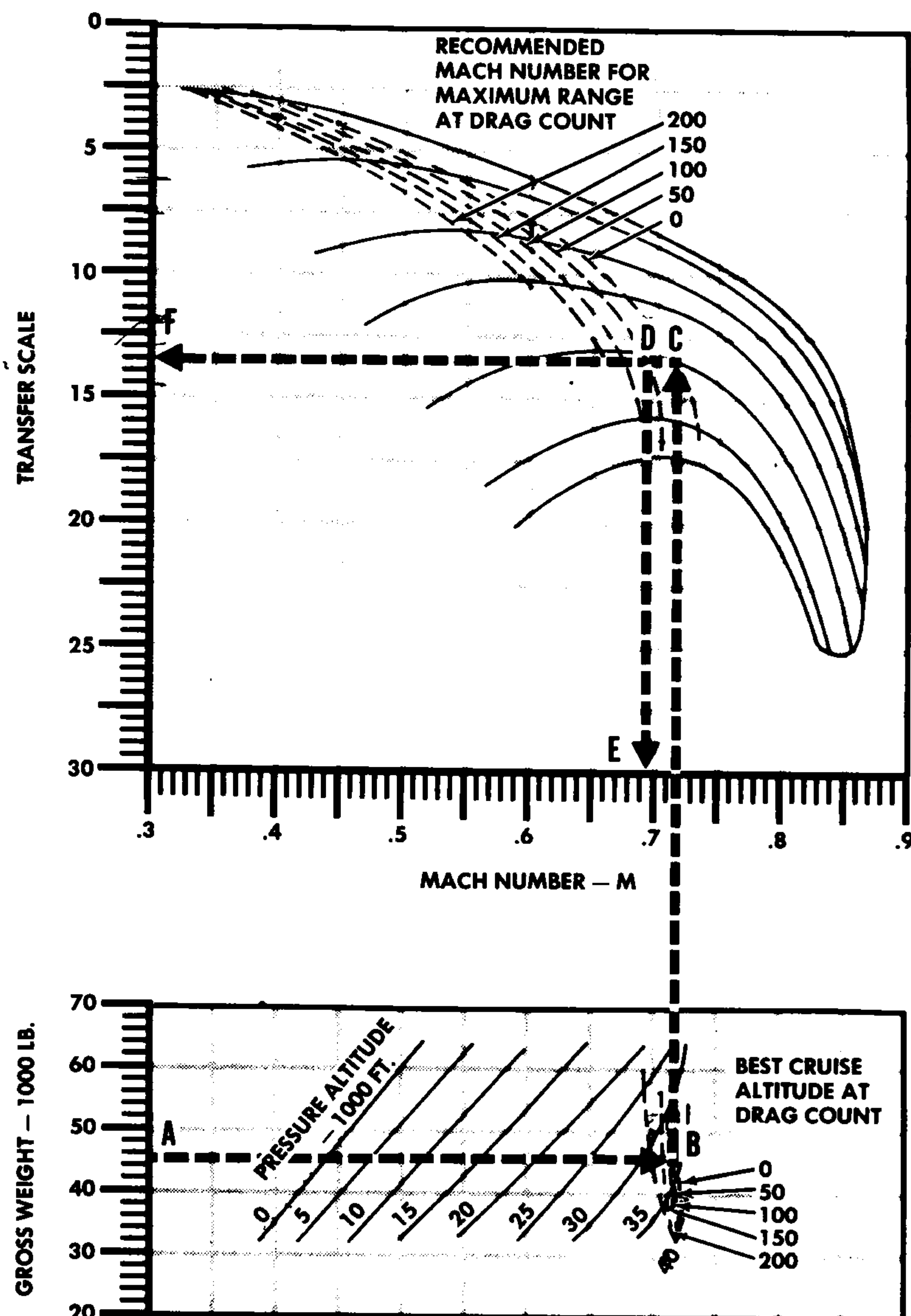


Figure 11-11

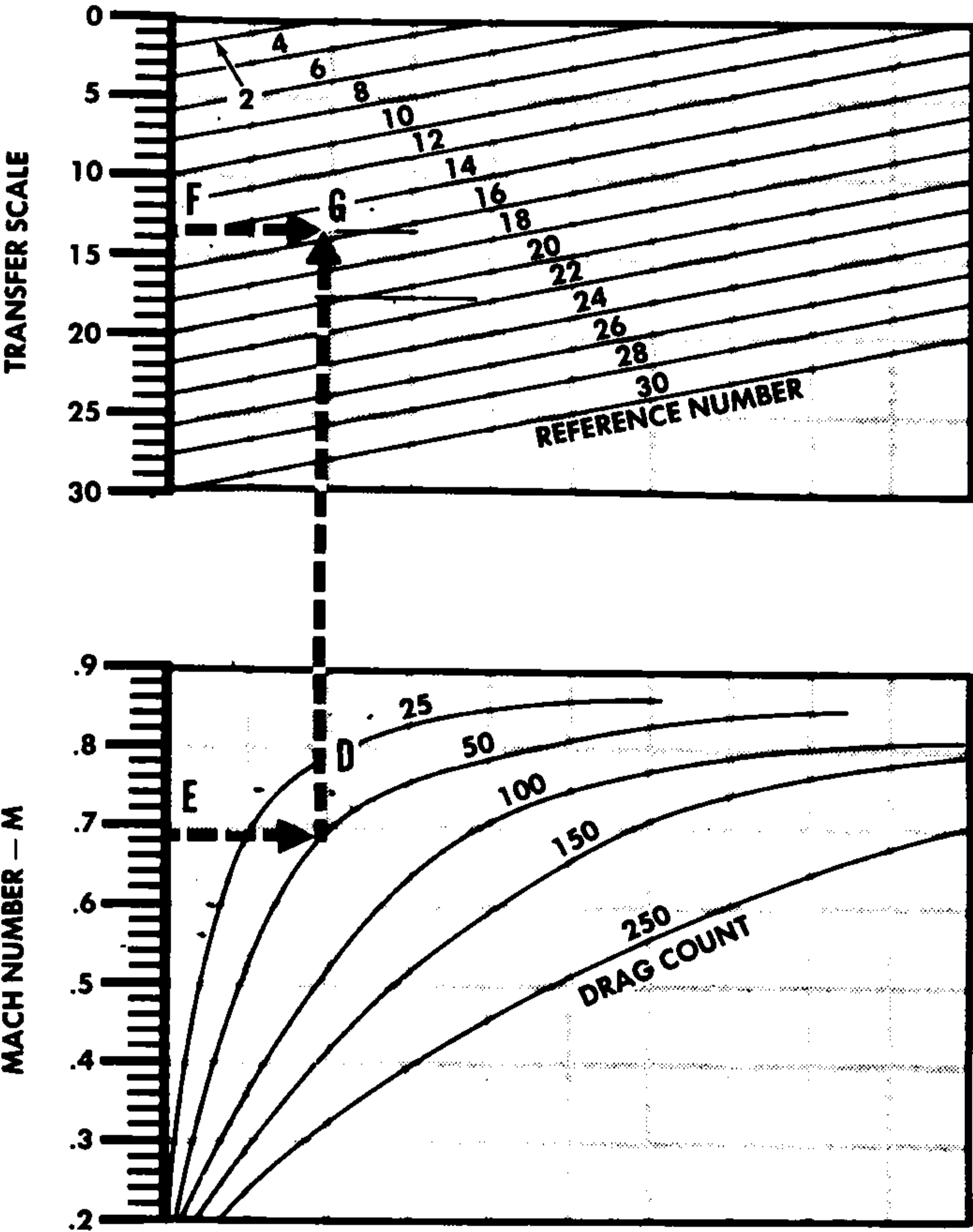
CRUISE PERFORMANCE

P-8 ENGINE

PHASE II – AIRCRAFT REFERENCE NUMBER

DATE 15 MARCH 1971
DATA BASIS: ESTIMATED

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB./GAL.



ADF1-312

Figure 11-12

CRUISE PERFORMANCE

P-8 ENGINE

PHASE III – POUNDS OF FUEL PER NAUTICAL MILE

DATE 15 MARCH 1971
DATA BASIS: ESTIMATED

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB./GAL.

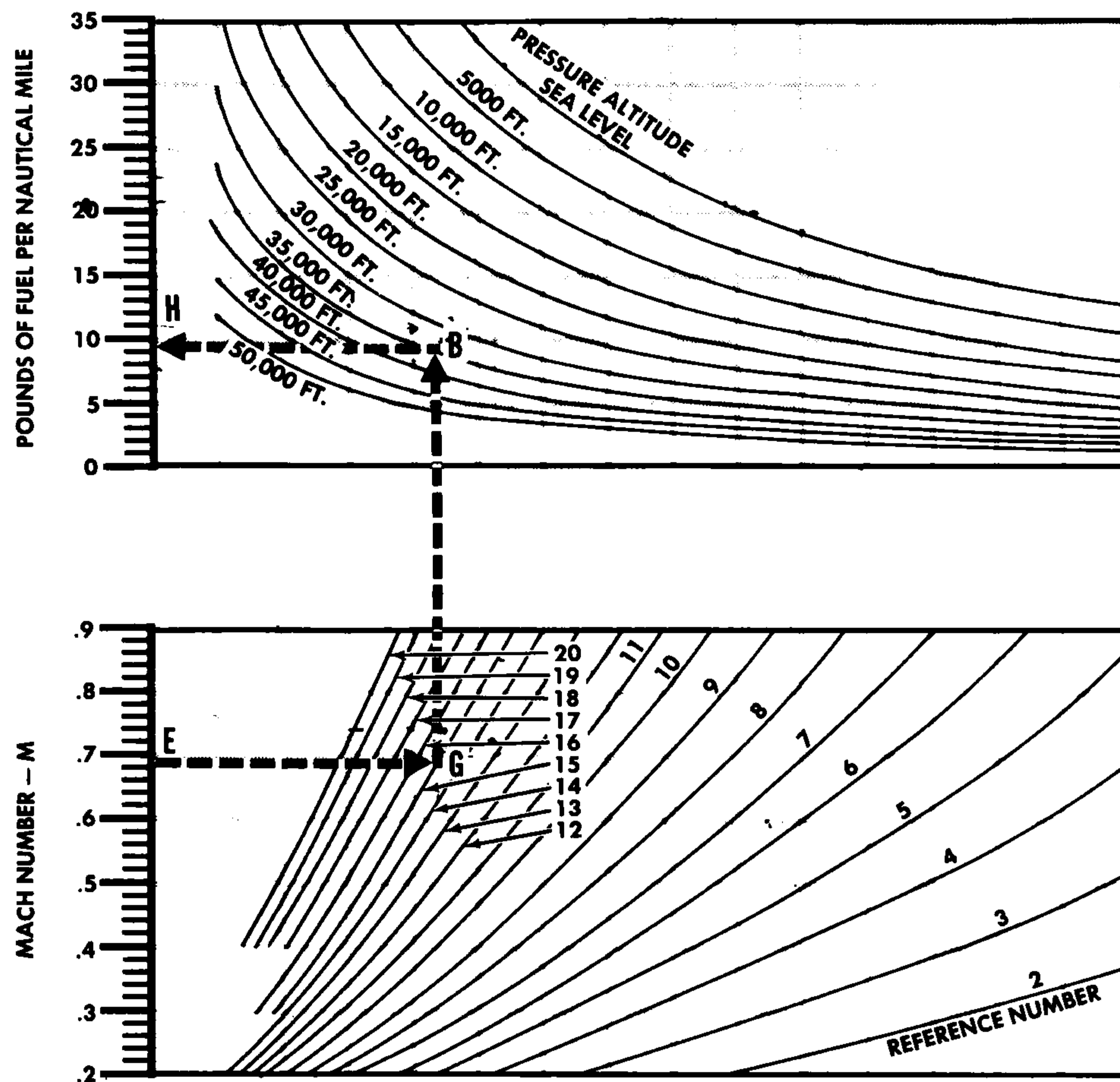


Figure 11-13

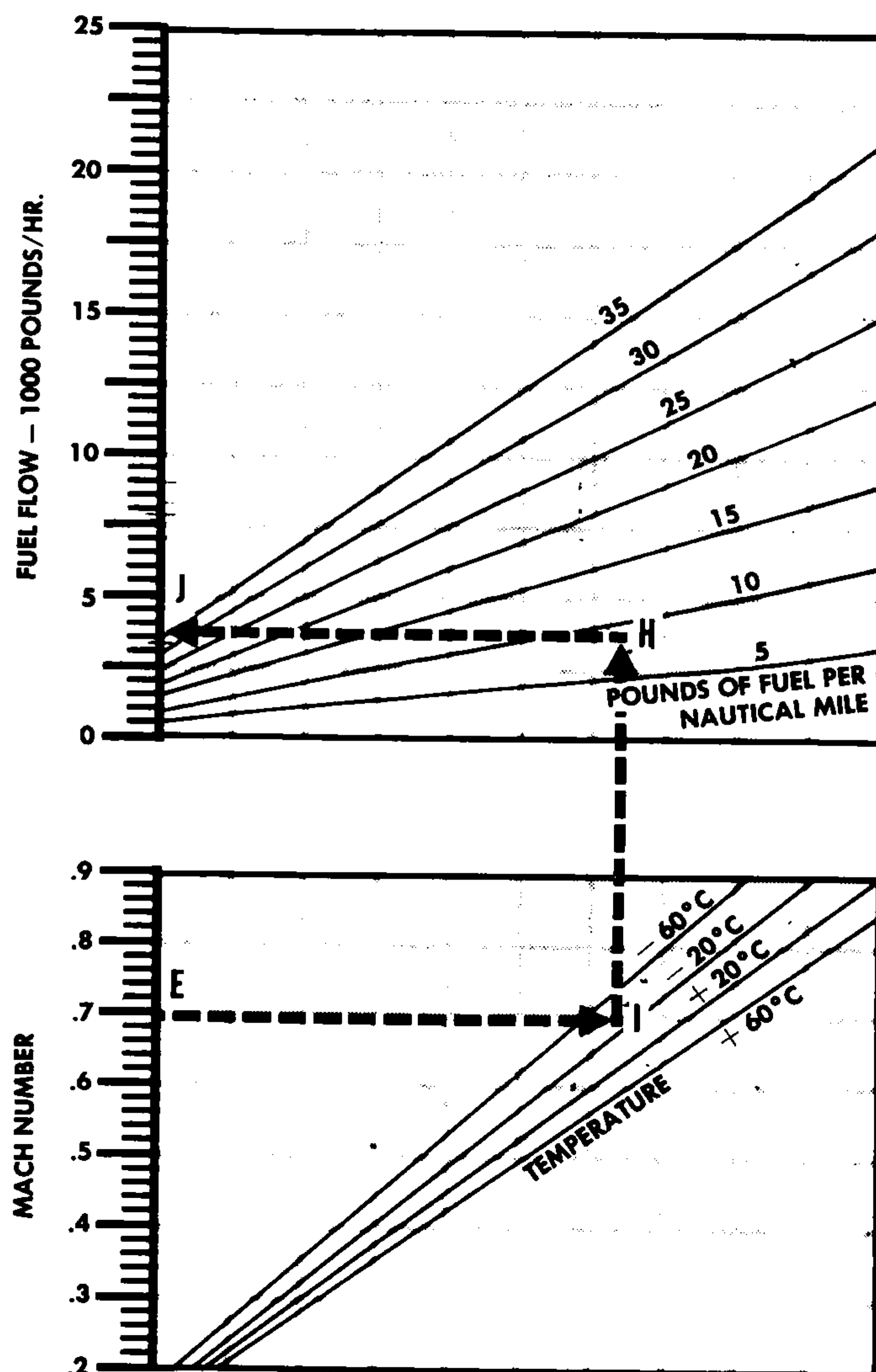
CRUISE PERFORMANCE

P-8 ENGINE

PHASE IV - FUEL FLOW

DATE 15 MARCH 1971
DATA BASIS: ESTIMATED

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB./GAL.



ADF1-314

Figure 11-14

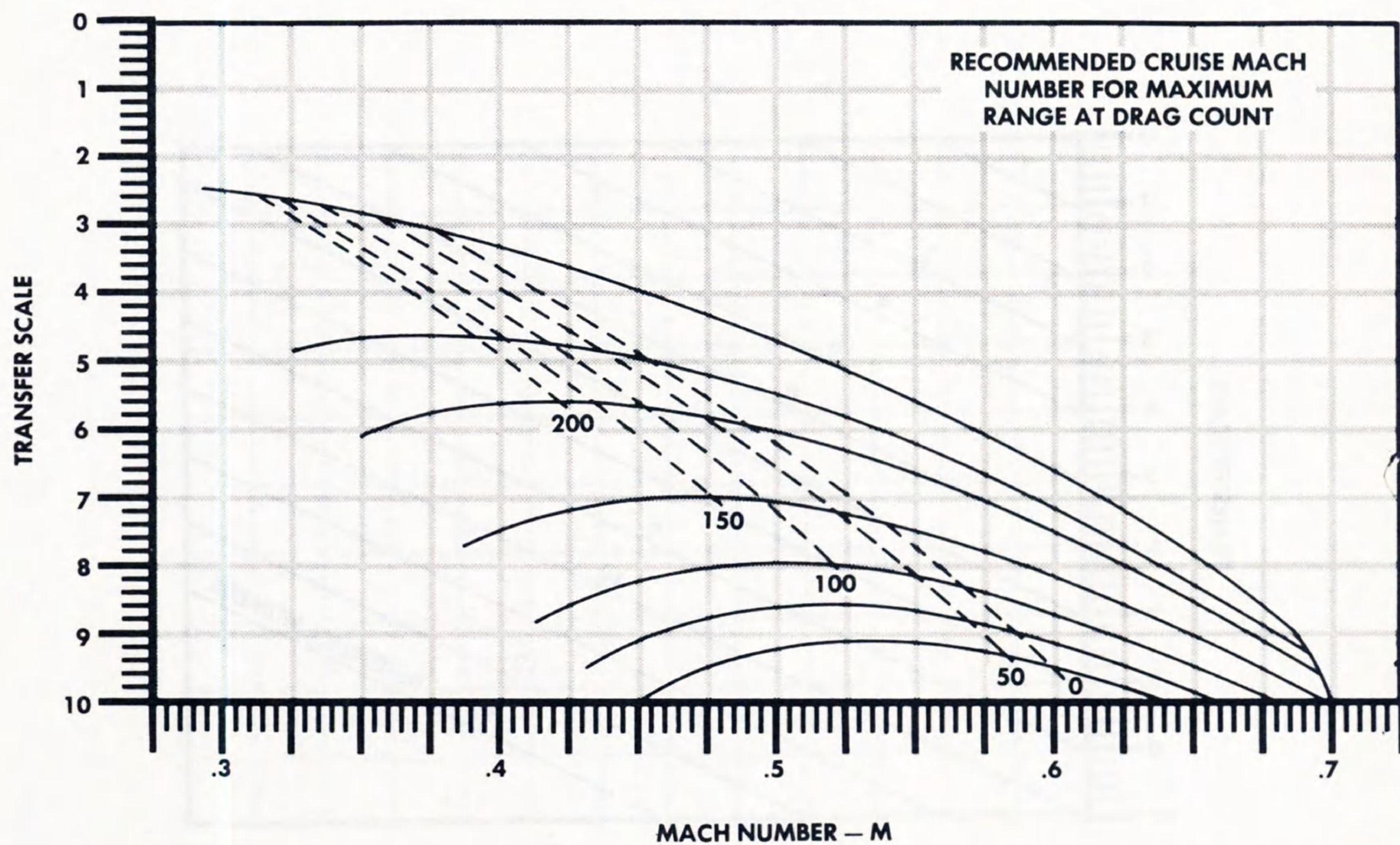
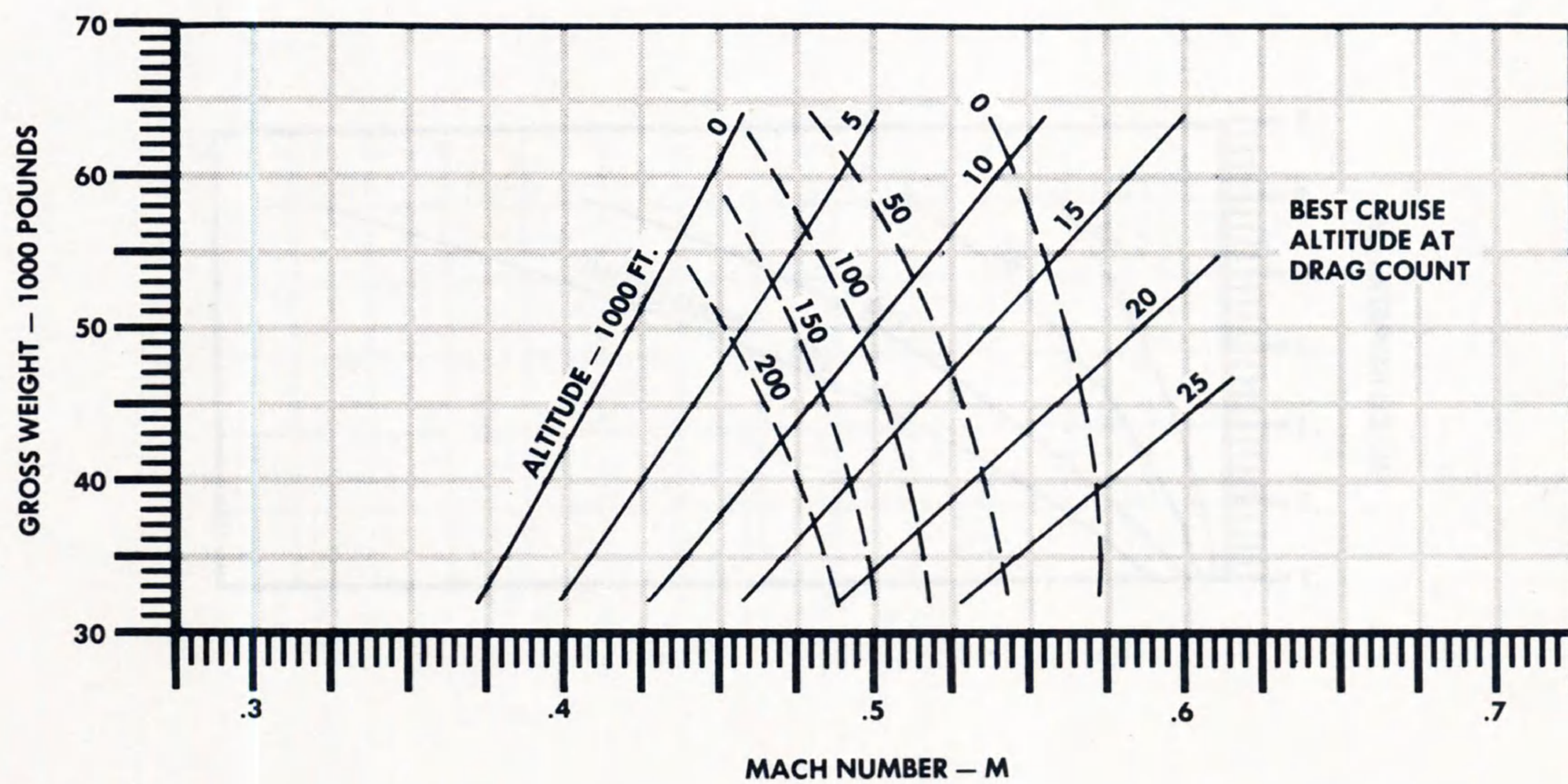
CRUISE PERFORMANCE (single engine)

P-8 ENGINE

PHASE I – CLEAN AIRCRAFT TRANSFER SCALE

DATE 15 MARCH 1971
DATA BASIS: ESTIMATED

REMARKS
INOPERATIVE ENGINE WINDMILLING
ICAO STANDARD DAY

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB./GAL.


ADF1-315

Figure 11-15

CRUISE PERFORMANCE (single engine)

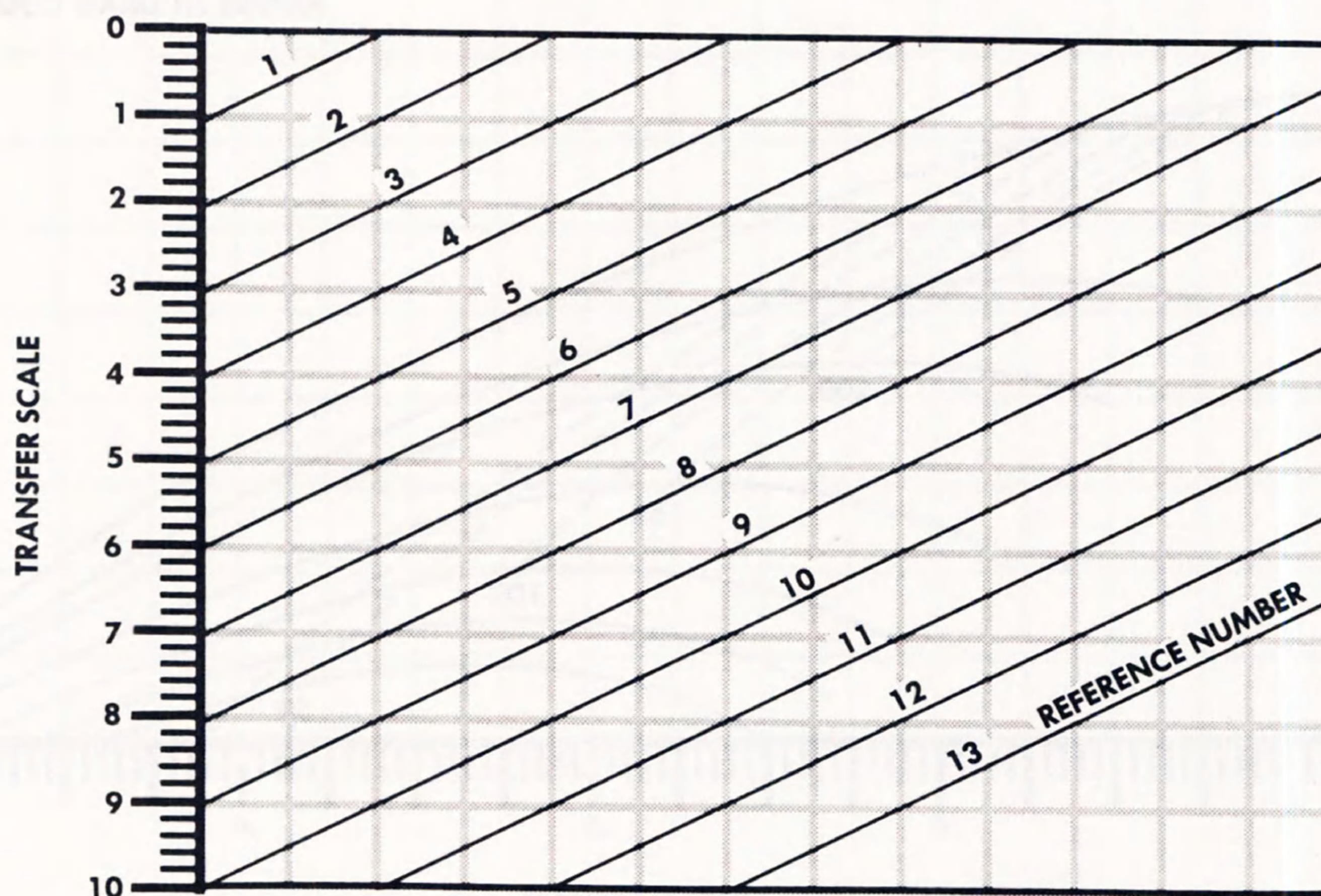
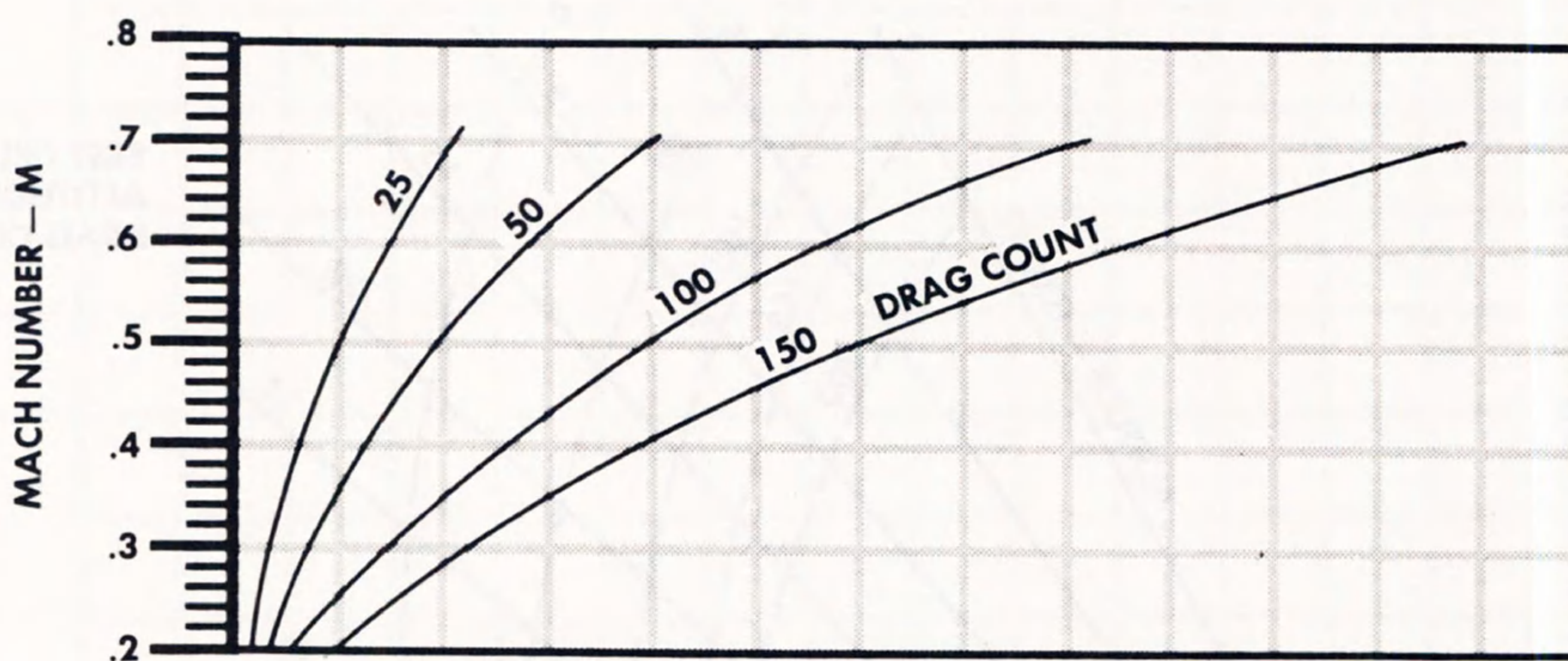
P-8 ENGINE

PHASE II — AIRCRAFT REFERENCE NUMBER

DATE 15 MARCH 1971
DATA BASIS: ESTIMATED

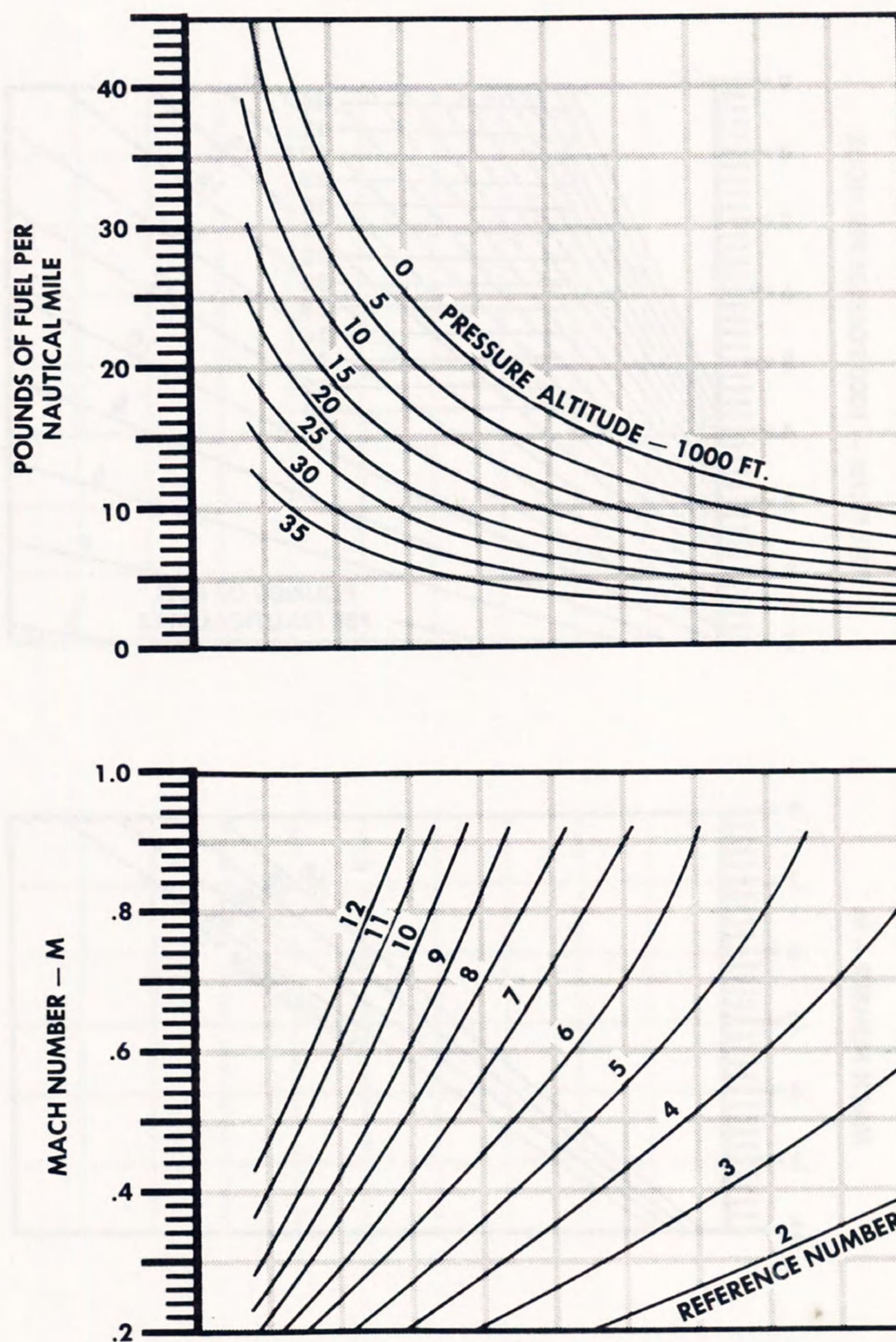
REMARKS
INOPERATIVE ENGINE WINDMILLING
ICAO STANDARD DAY

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB./GAL.



ADF1-316

Figure 11-16

CRUISE PERFORMANCE (single engine)**P-8 ENGINE****PHASE III — POUNDS OF FUEL PER NAUTICAL MILE**DATE 15 MARCH 1971
DATA BASIS: ESTIMATEDREMARKS
INOPERATIVE ENGINE WINDMILLING
ICAO STANDARD DAYFUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB./GAL.

ADF1-317

Figure 11-17

CRUISE PERFORMANCE (single engine)

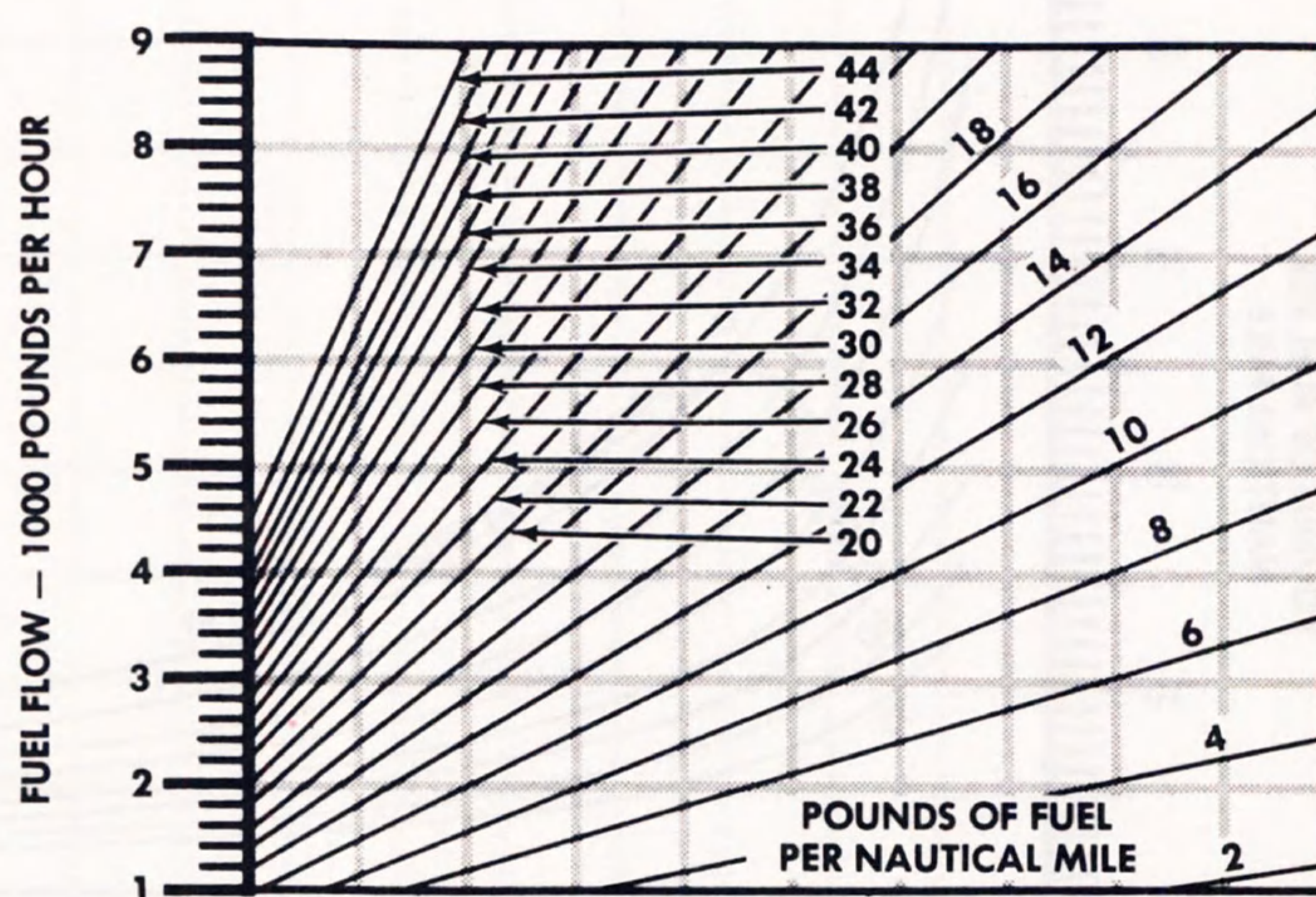
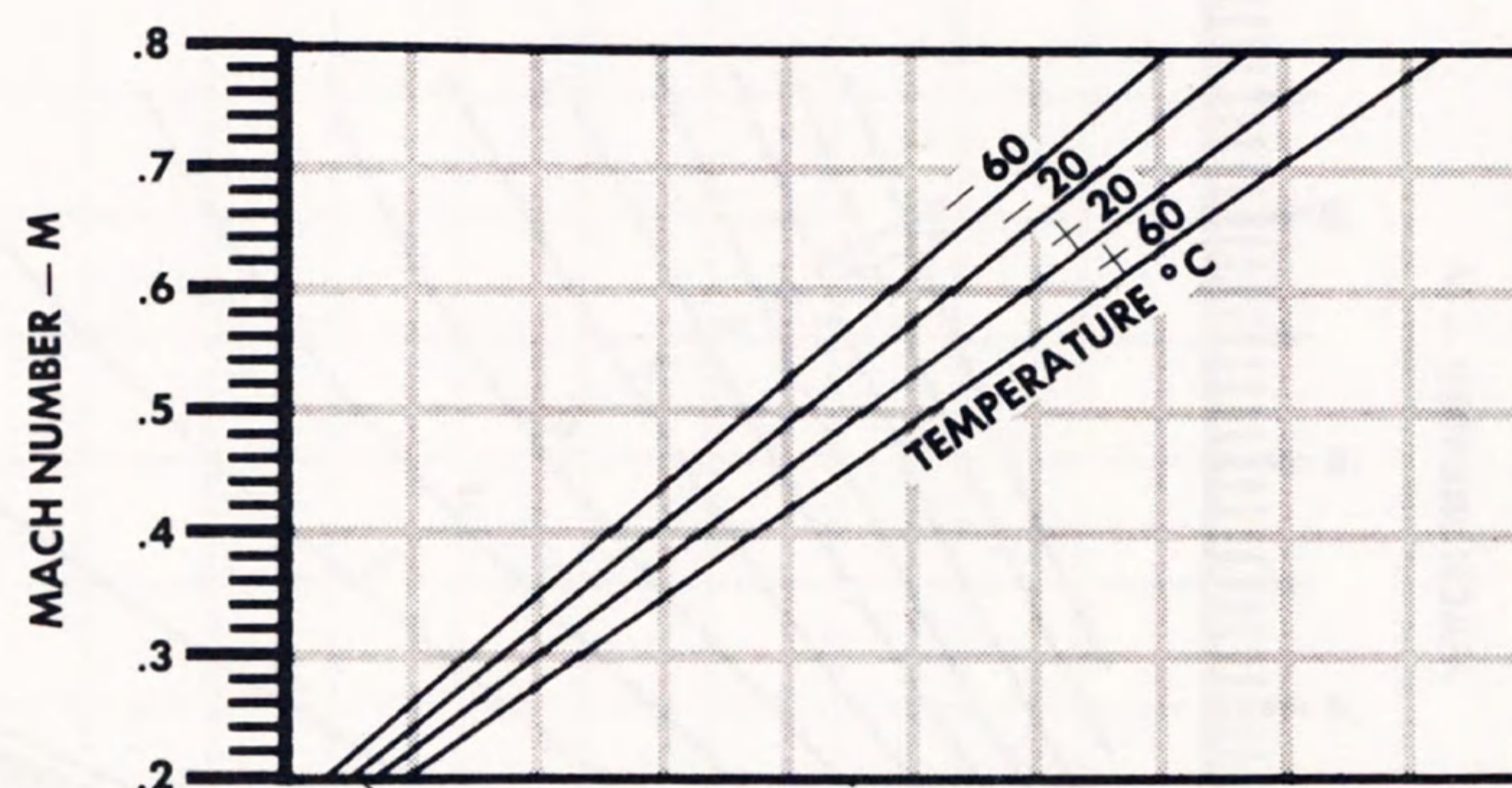
P-8 ENGINE

PHASE IV - FUEL FLOW

DATE 15 MARCH 1971
DATA BASIS: ESTIMATED

REMARKS
INOPERATIVE ENGINE WINDMILLING
ICAO STANDARD DAY

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB./GAL.



ADF1-318

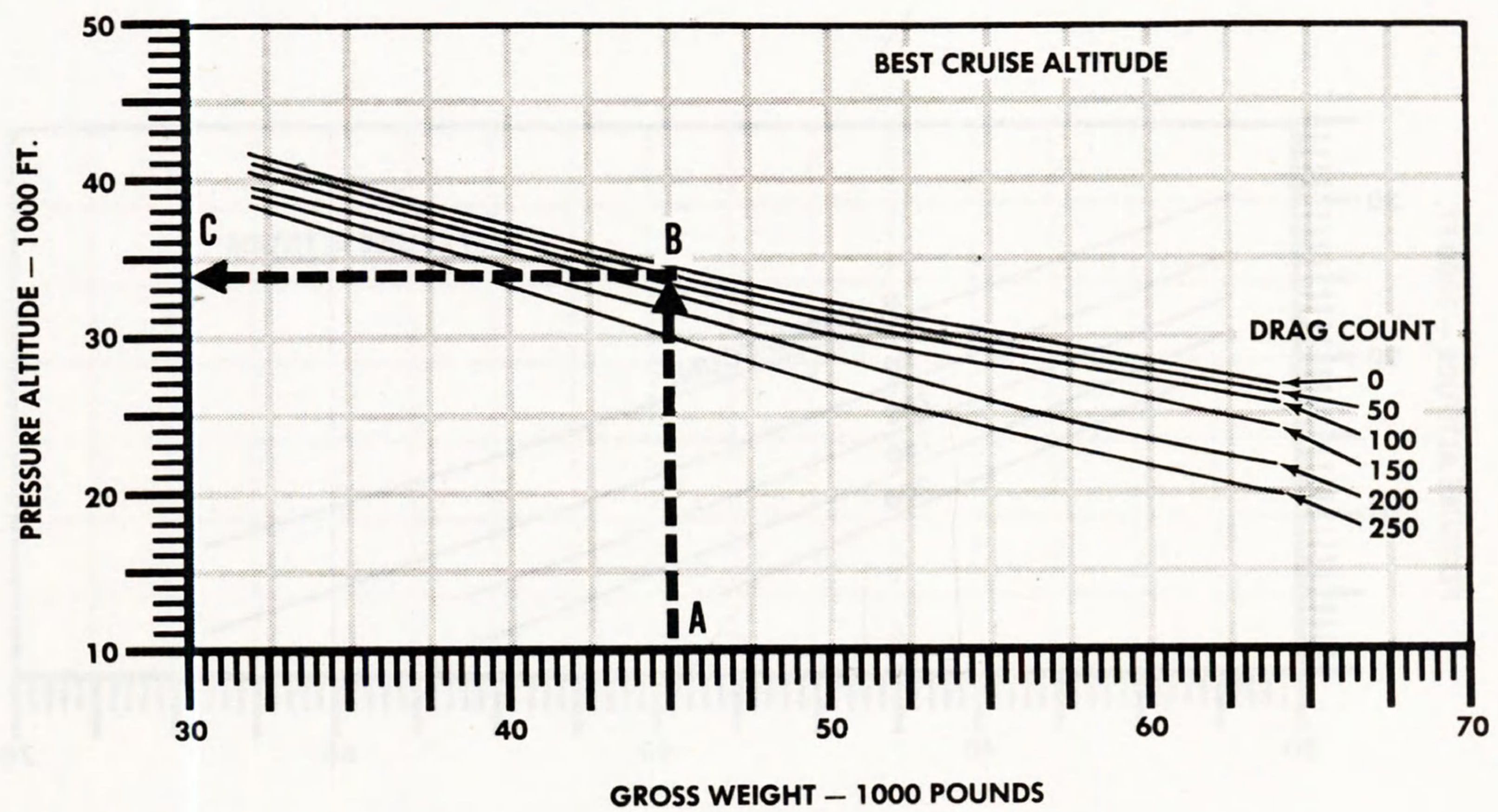
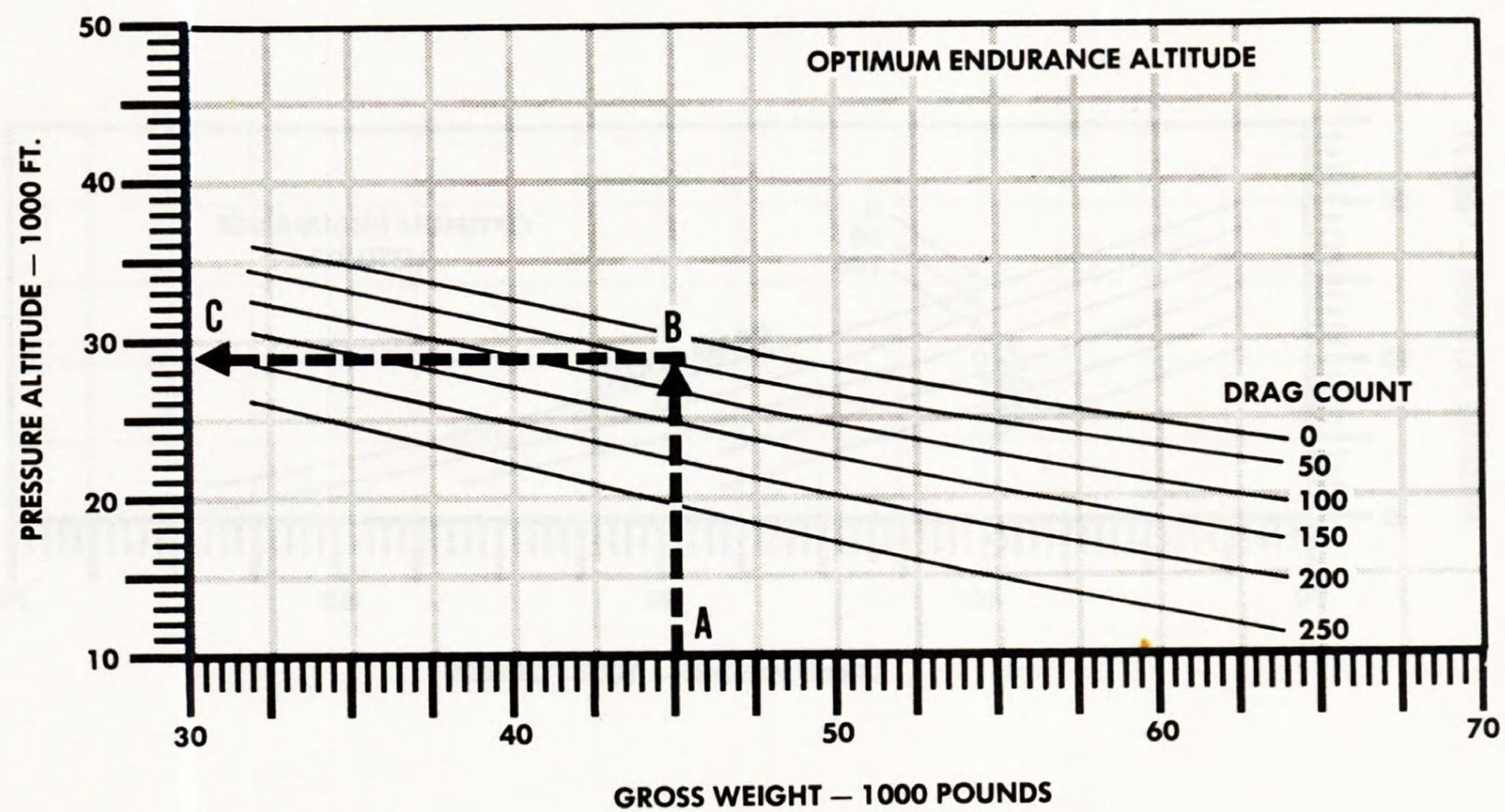
Figure 11-18

BEST CRUISE ALTITUDE AND OPTIMUM ENDURANCE ALTITUDE

P-8 ENGINE

DATE 15 MARCH 1971
DATA BASIS: ESTIMATED

REMARKS
ENGINES: (2) J52-P-8
ICAO STANDARD DAY

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB./GAL.


ADF1-319

Figure 11-19

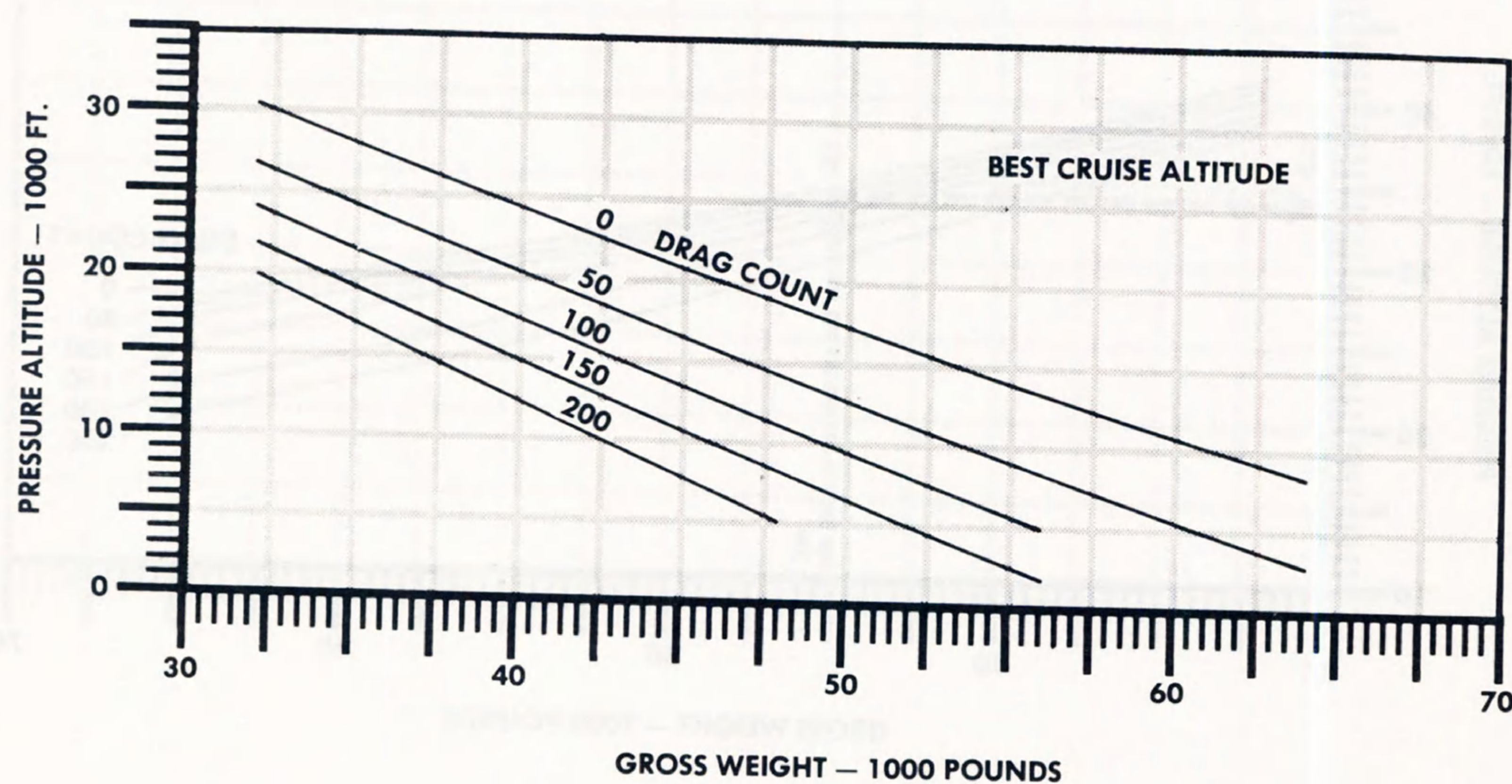
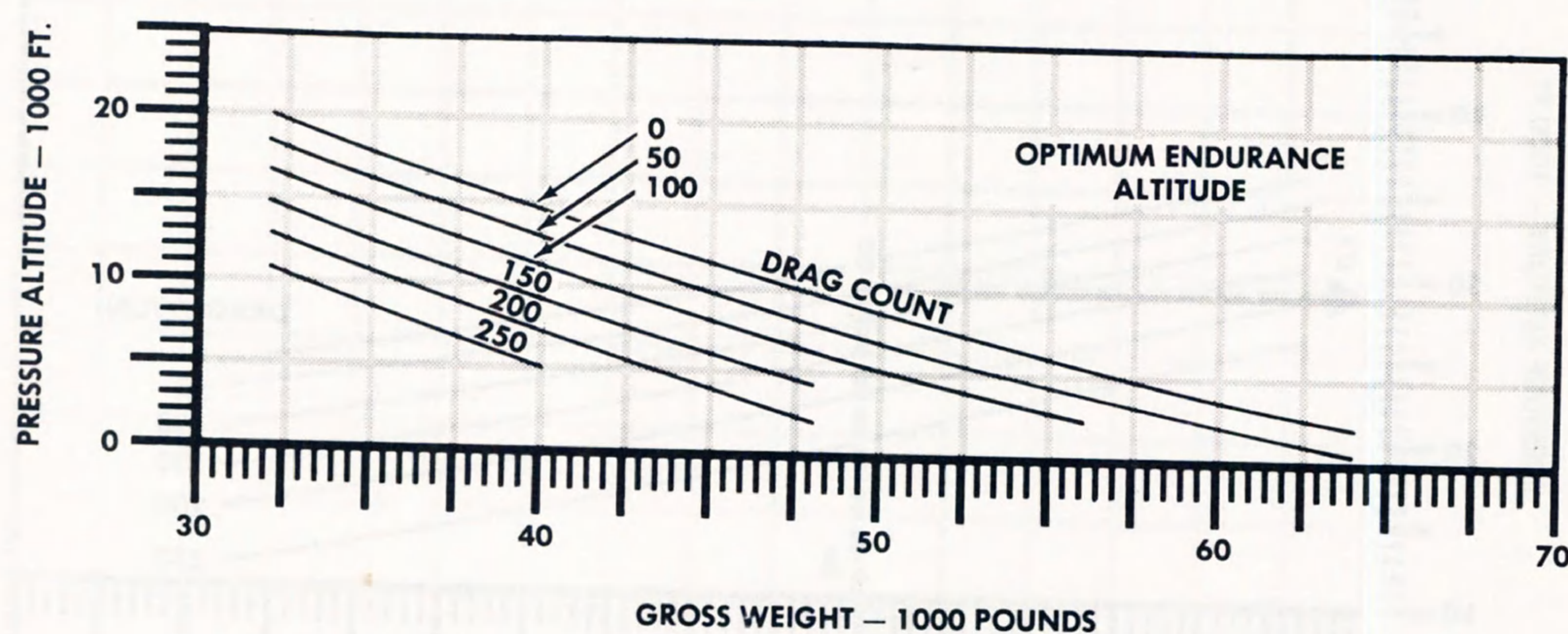
BEST CRUISE ALTITUDE AND OPTIMUM ENDURANCE ALTITUDE (single engine)

P-8 ENGINE

DATE 15 MARCH 1971
DATA BASIS: ESTIMATED

REMARKS
INOPERATIVE ENGINE WINDMILLING
ICAO STANDARD DAY

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB./GAL.



ADF1-320

Figure 11-20

COMBAT ALLOWANCE

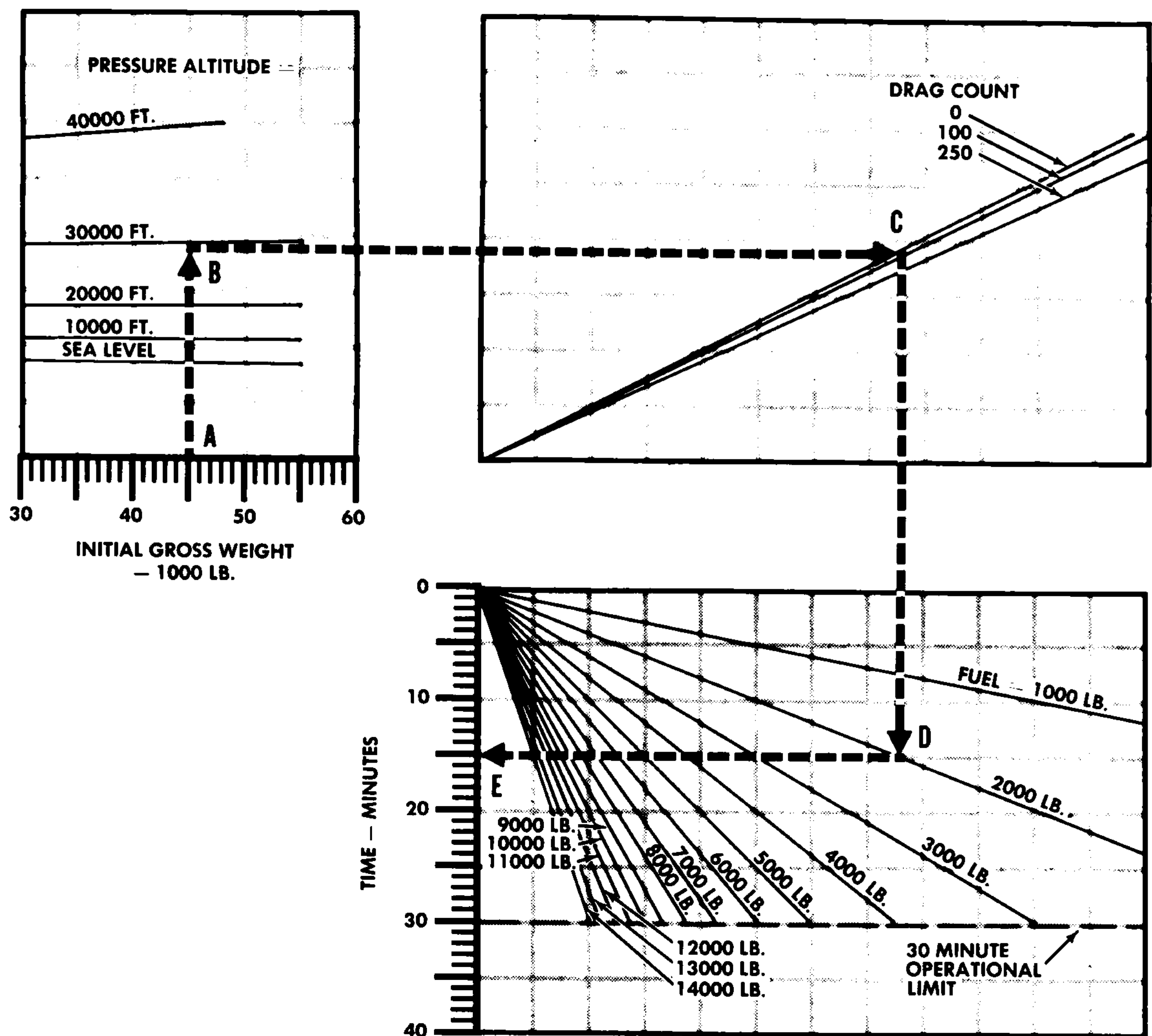
P-8 ENGINE

MILITARY POWER LIMIT EGT 650°C

DATE 15 FEBRUARY 1971
DATA BASIS: ESTIMATED

REMARKS
ICAO STANDARD DAY

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



ADF1-321

Figure 11-21

COMBAT ALLOWANCE

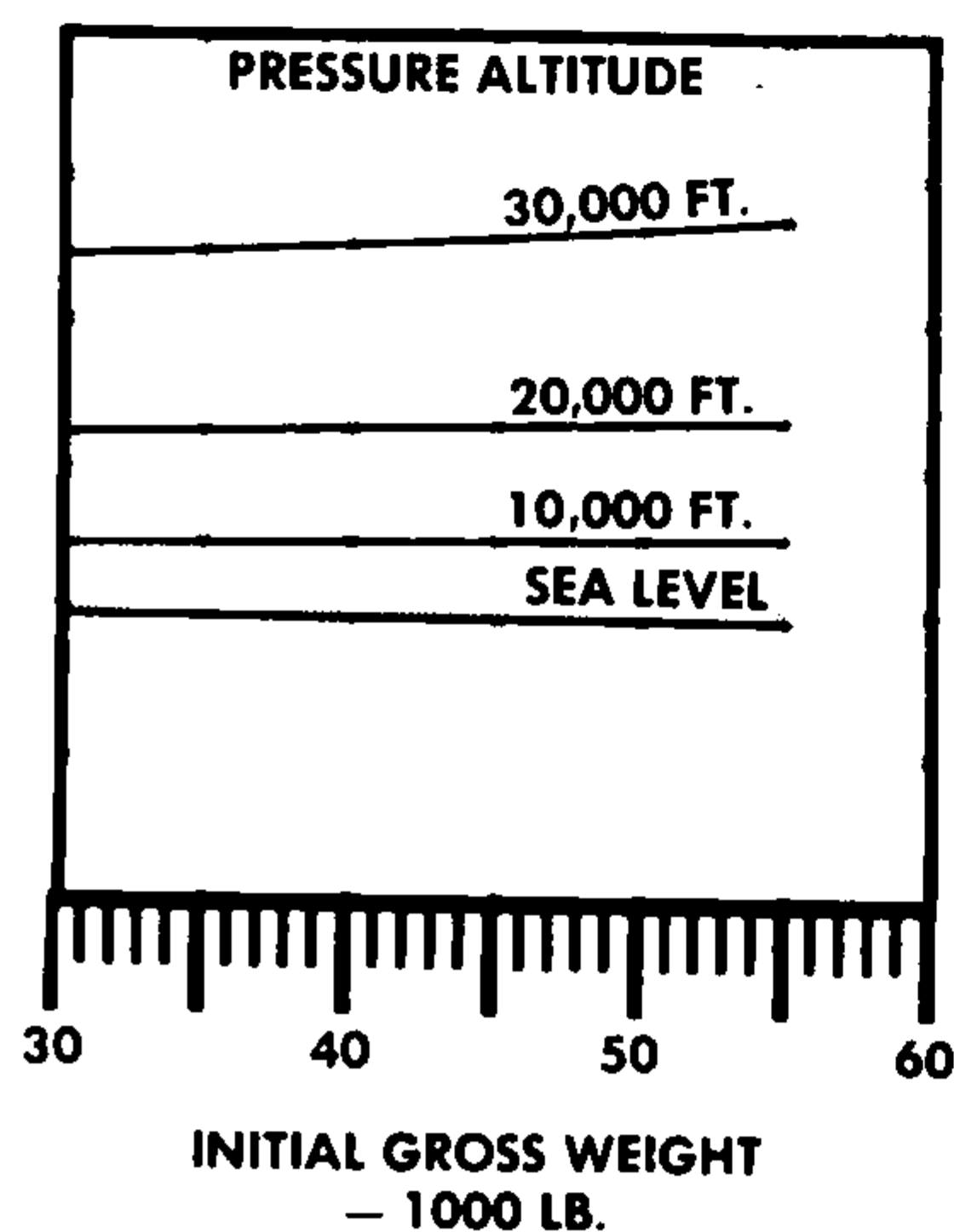
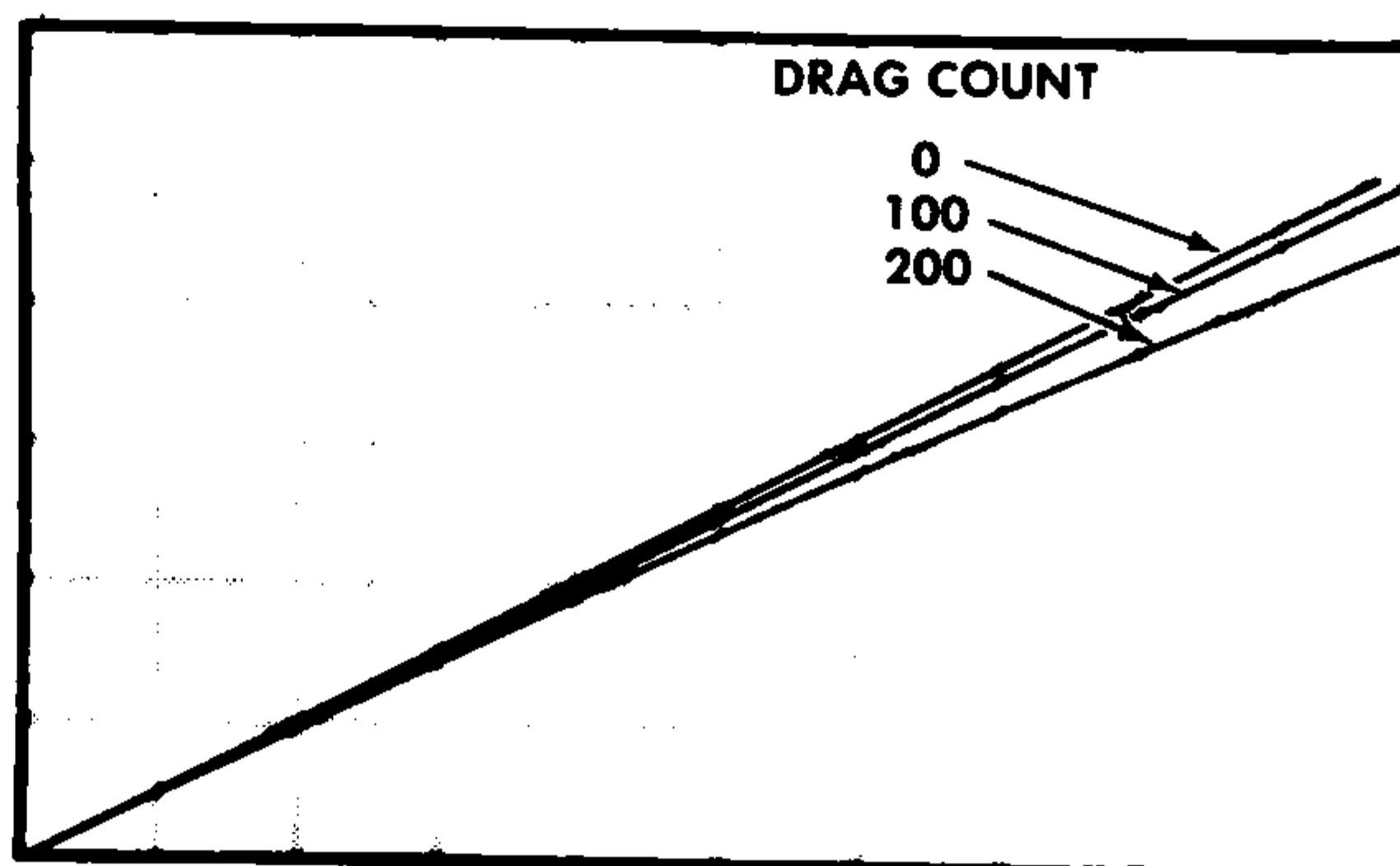
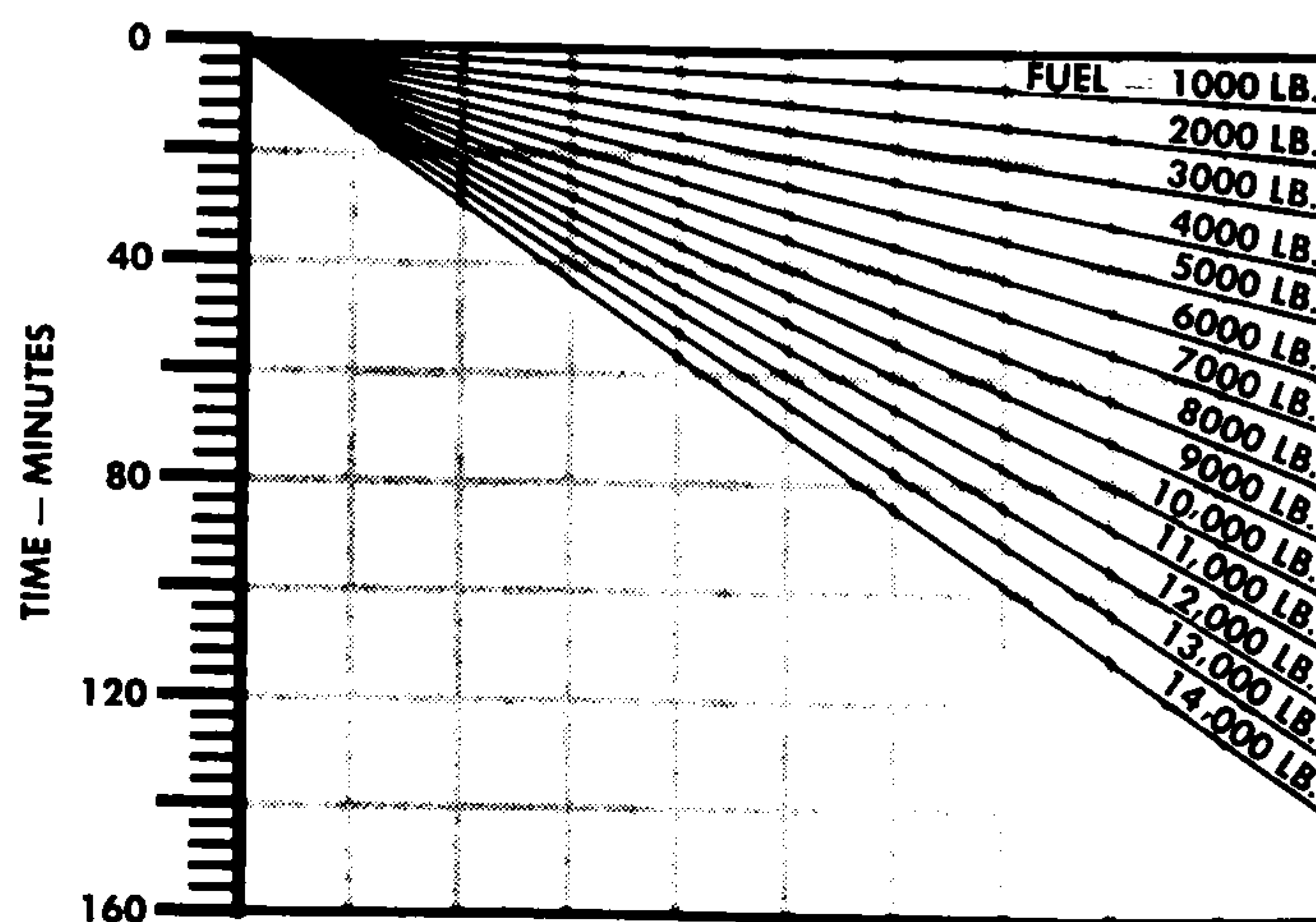
P-8 ENGINE

NORMAL POWER (MAXIMUM CONTINUOUS POWER) LIMIT EGT 594°C

DATE 15 FEBRUARY 1971
DATA BASIS: ESTIMATED

REMARKS
ICAO STANDARD DAY

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



ADF1-322

Figure 11-22

MILITARY POWER ACCELERATION

P-8 ENGINE

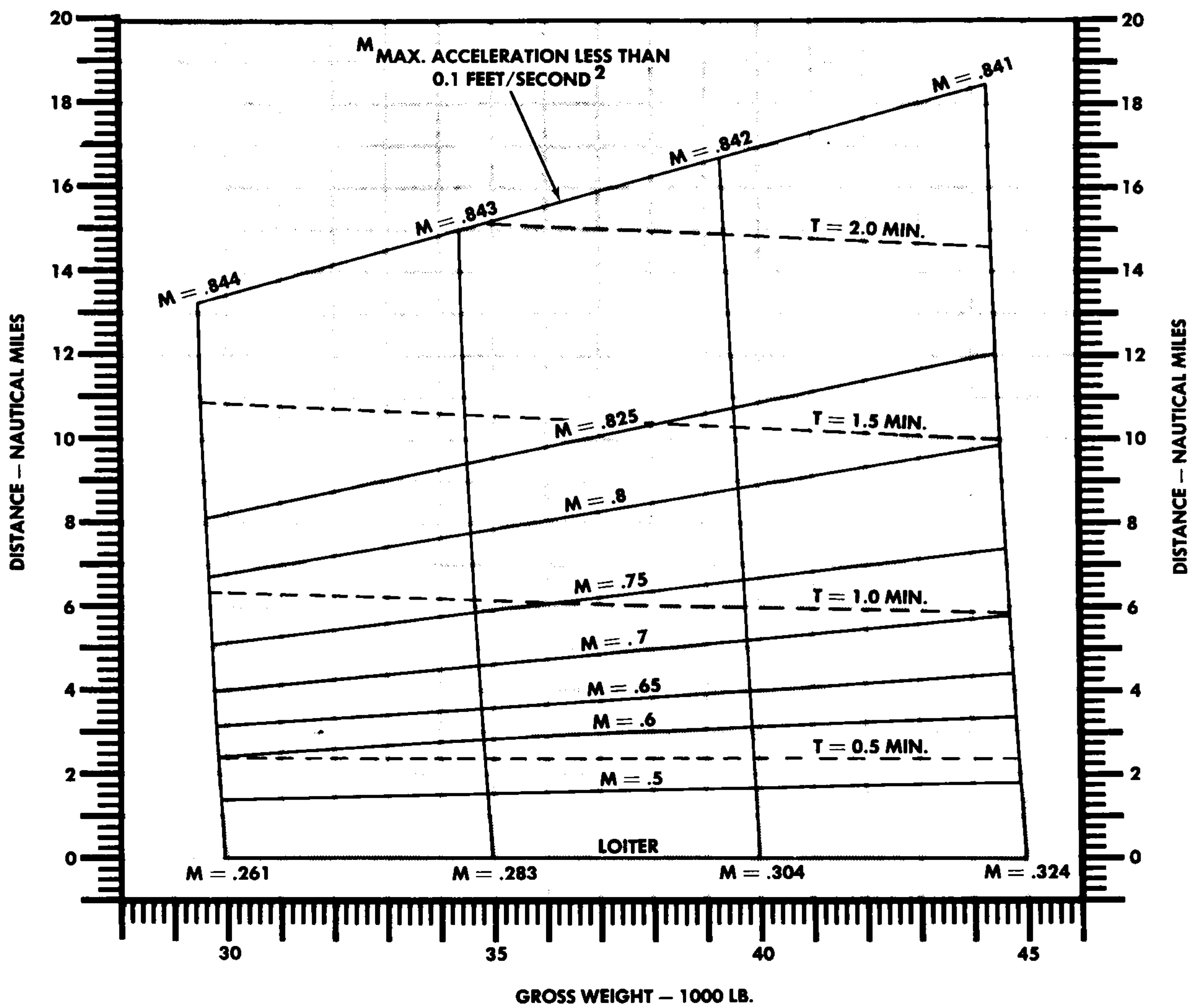
LEVEL FLIGHT SEA LEVEL

AIRCRAFT CONFIGURATION:
CLEAN

DATE 15 MARCH 1971
DATA BASIS: ESTIMATED

REMARKS
ICAO STANDARD DAY

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB./GAL.



GROSS WEIGHT — 1000 LB.

Figure 11-23

MILITARY POWER ACCELERATION

P-8 ENGINE

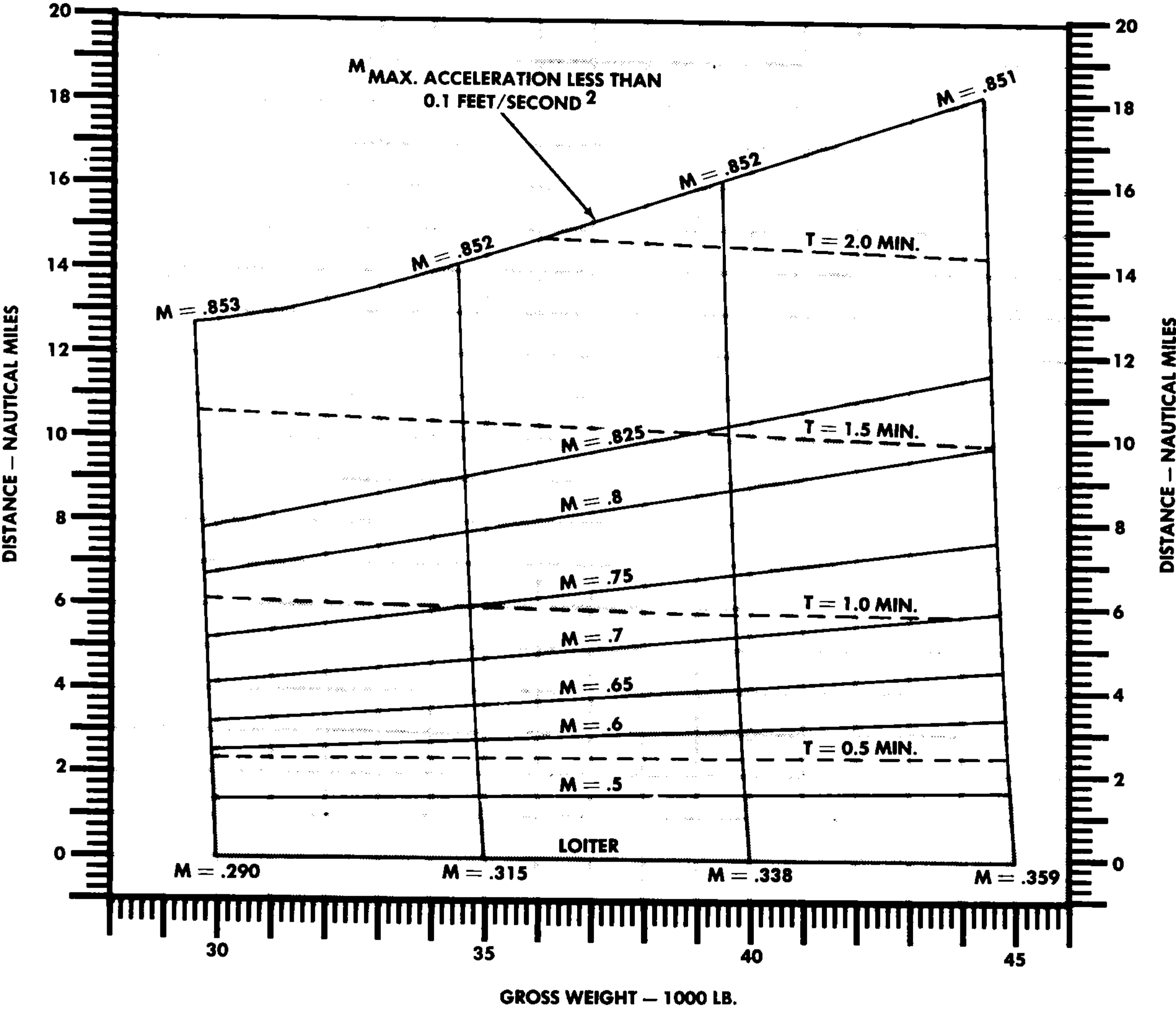
LEVEL FLIGHT 5000 FT.

AIRCRAFT CONFIGURATION:
CLEAN

DATE 15 MARCH 1971
DATA BASIS: ESTIMATED

REMARKS
ICAO STANDARD DAY

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB./GAL.



ADF1-324

Figure 11-24

MILITARY POWER ACCELERATION

P-8 ENGINE

LEVEL FLIGHT 15,000 FT.

AIRCRAFT CONFIGURATION:
CLEAN

DATE 15 MARCH 1971
DATA BASIS: ESTIMATED

REMARKS
ICAO STANDARD DAY

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB./GAL.

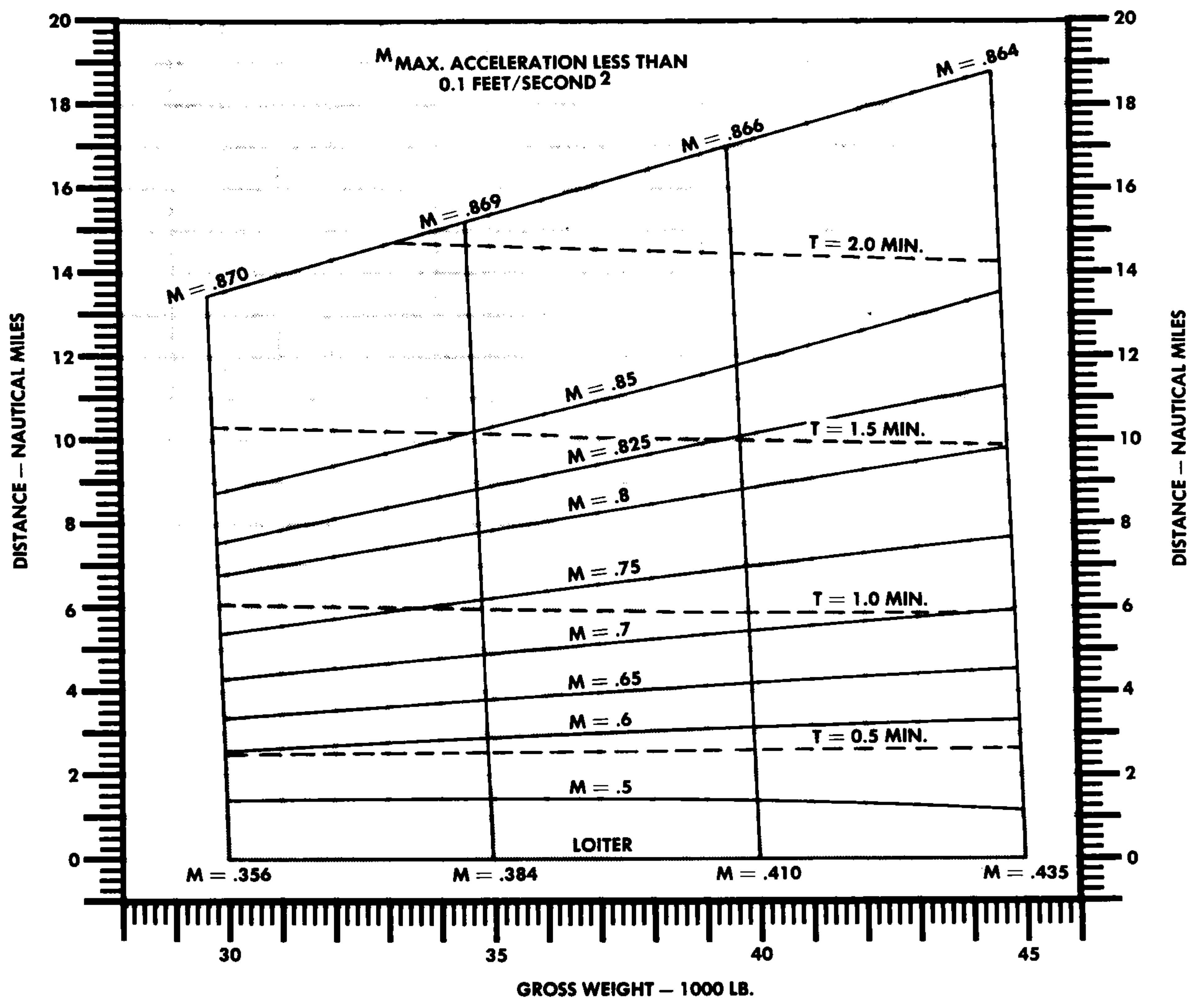


Figure 11-25

MILITARY POWER ACCELERATION

P-8 ENGINE

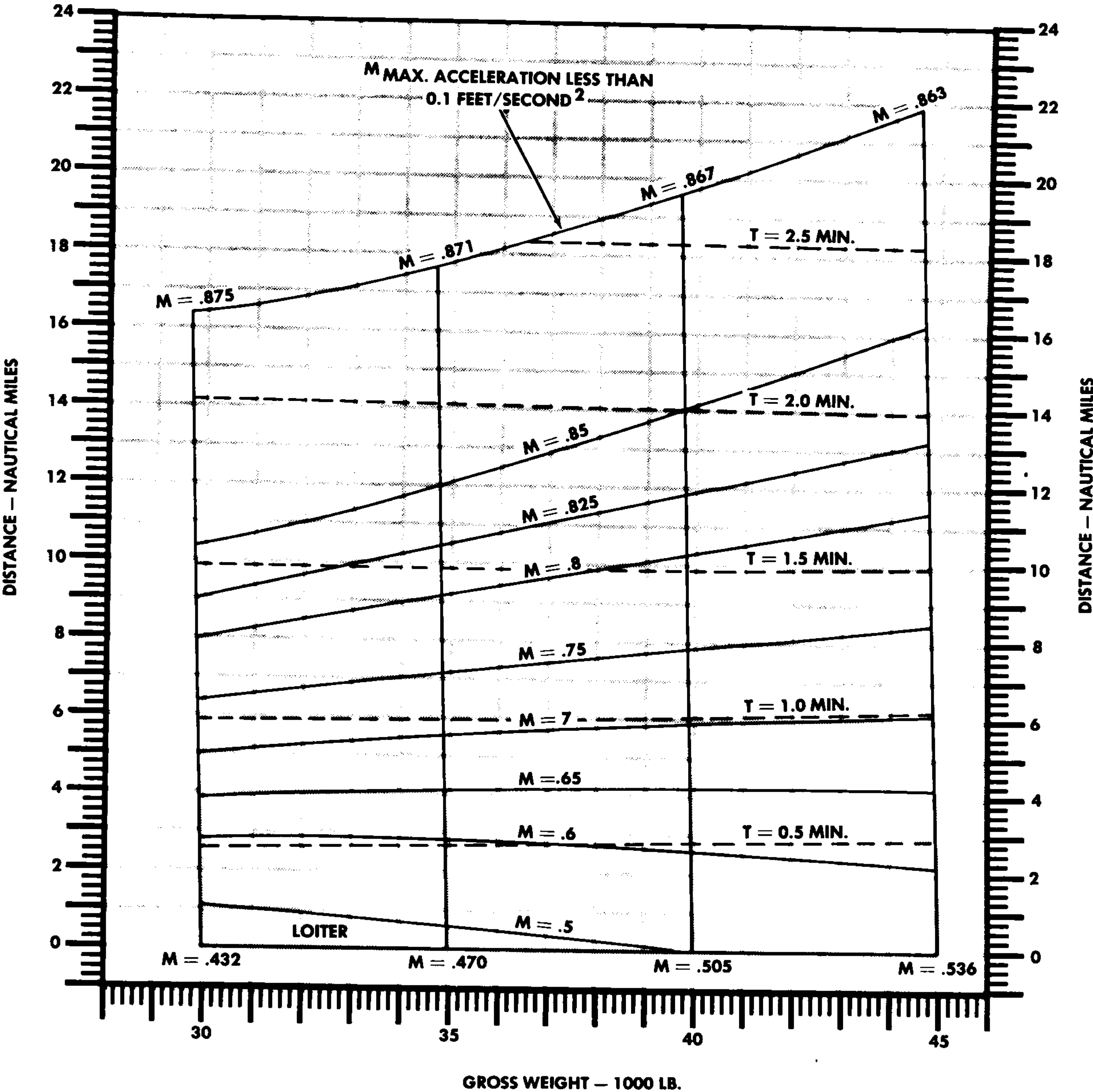
LEVEL FLIGHT 25,000 FT.

AIRCRAFT CONFIGURATION
CLEAN

DATE 15 MARCH 1971
DATA BASIS: ESTIMATED

REMARKS
ICAO STANDARD DAY

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB./GAL.



ADF1-326

Figure 11-26

MILITARY POWER ACCELERATION

P-8 ENGINE

LEVEL FLIGHT 35,000 FT.

AIRCRAFT CONFIGURATION
CLEAN

DATE 15 MARCH 1971
DATA BASIS: ESTIMATED

REMARKS
ICAO STANDARD DAY

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB./GAL.

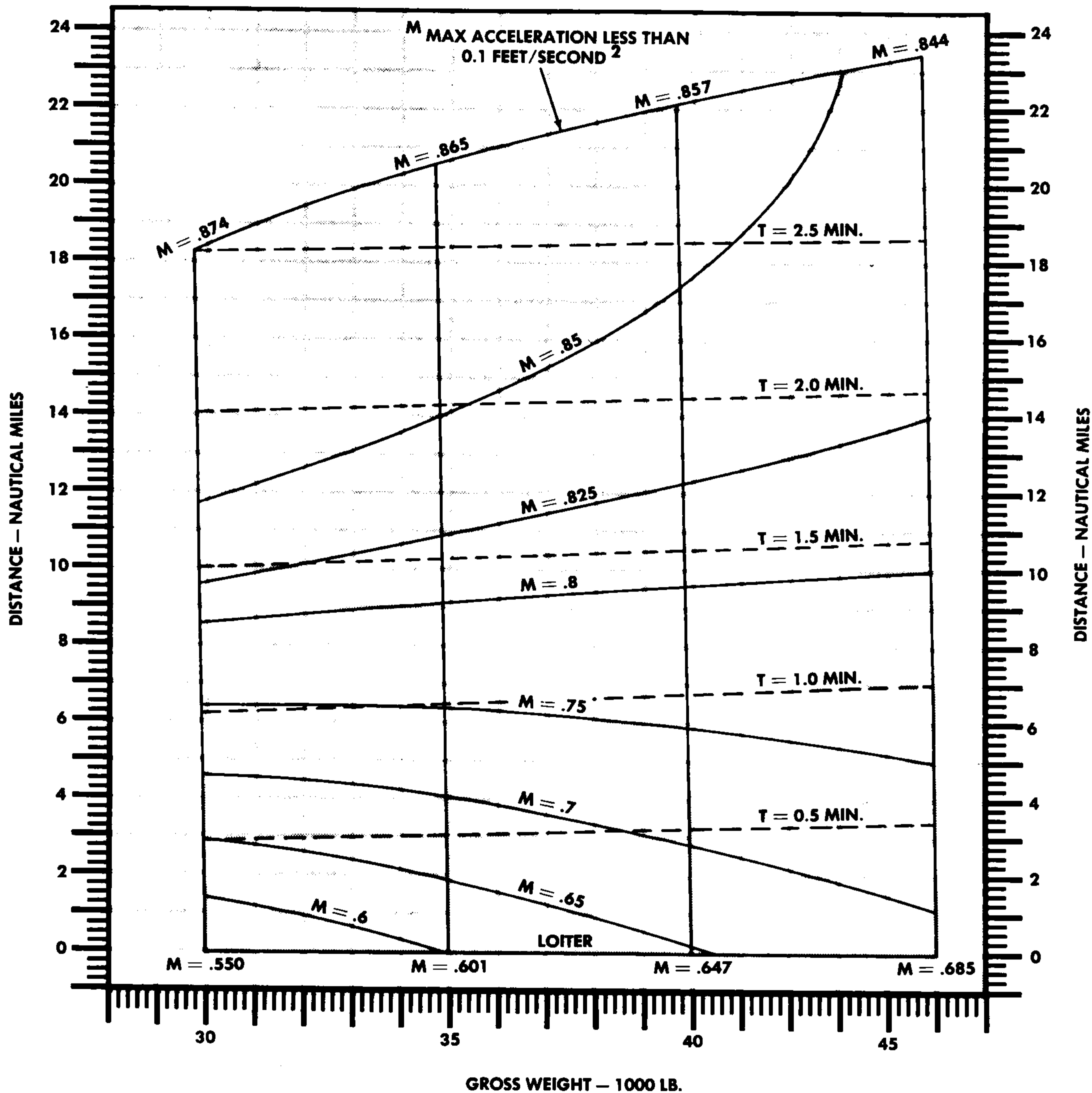


Figure 11-27

MILITARY POWER ACCELERATION

P-8 ENGINE

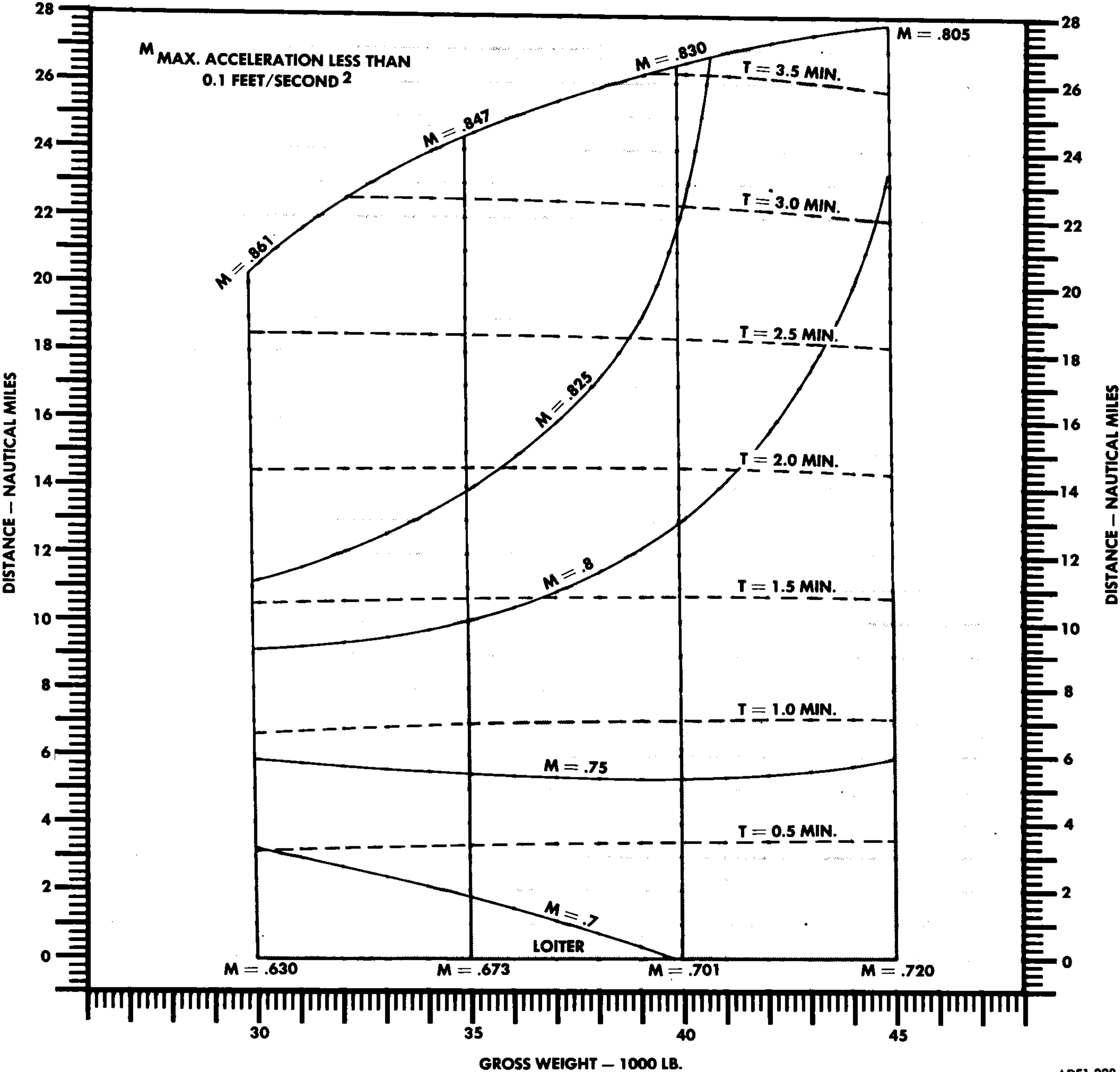
LEVEL FLIGHT 40,000 FT.

AIRCRAFT CONFIGURATION
CLEAN

DATE 15 MARCH 1971
DATA BASIS: ESTIMATED

REMARKS
ICAO STANDARD DAY

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB./GAL.



ADF1-328

Figure 11-28

MILITARY POWER ACCELERATION

P-8 ENGINE

LEVEL FLIGHT SEA LEVEL

AIRCRAFT CONFIGURATION
(1) 6 MK-28 STORE +
(4) 300 GALLON DROP TANKS

DATE 15 MARCH 1971
DATA BASIS: ESTIMATED

REMARKS
ICAO STANDARD DAY

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB./GAL.

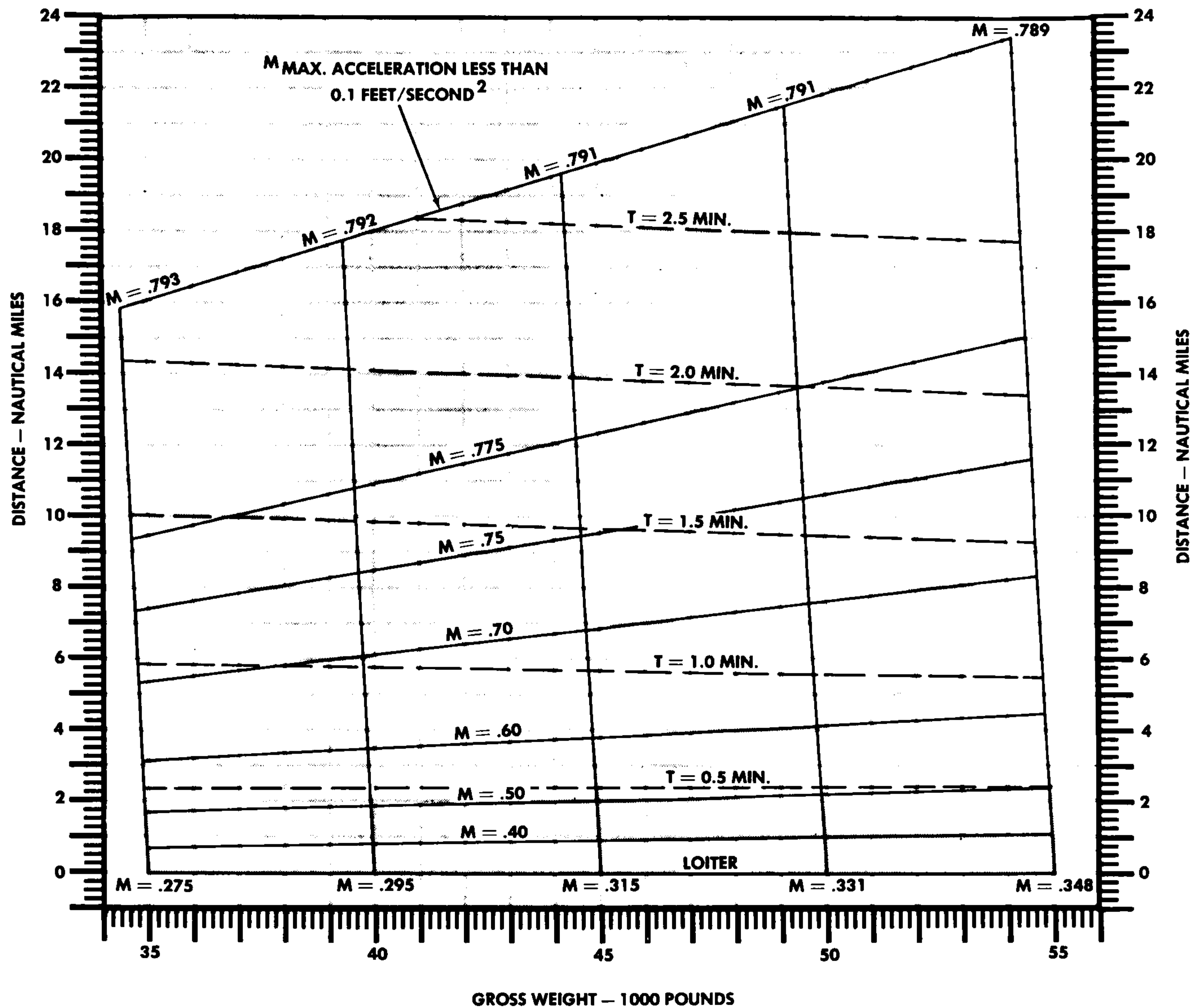


Figure 11-29

MILITARY POWER ACCELERATION

P-8 ENGINE

LEVEL FLIGHT 5000 FT.

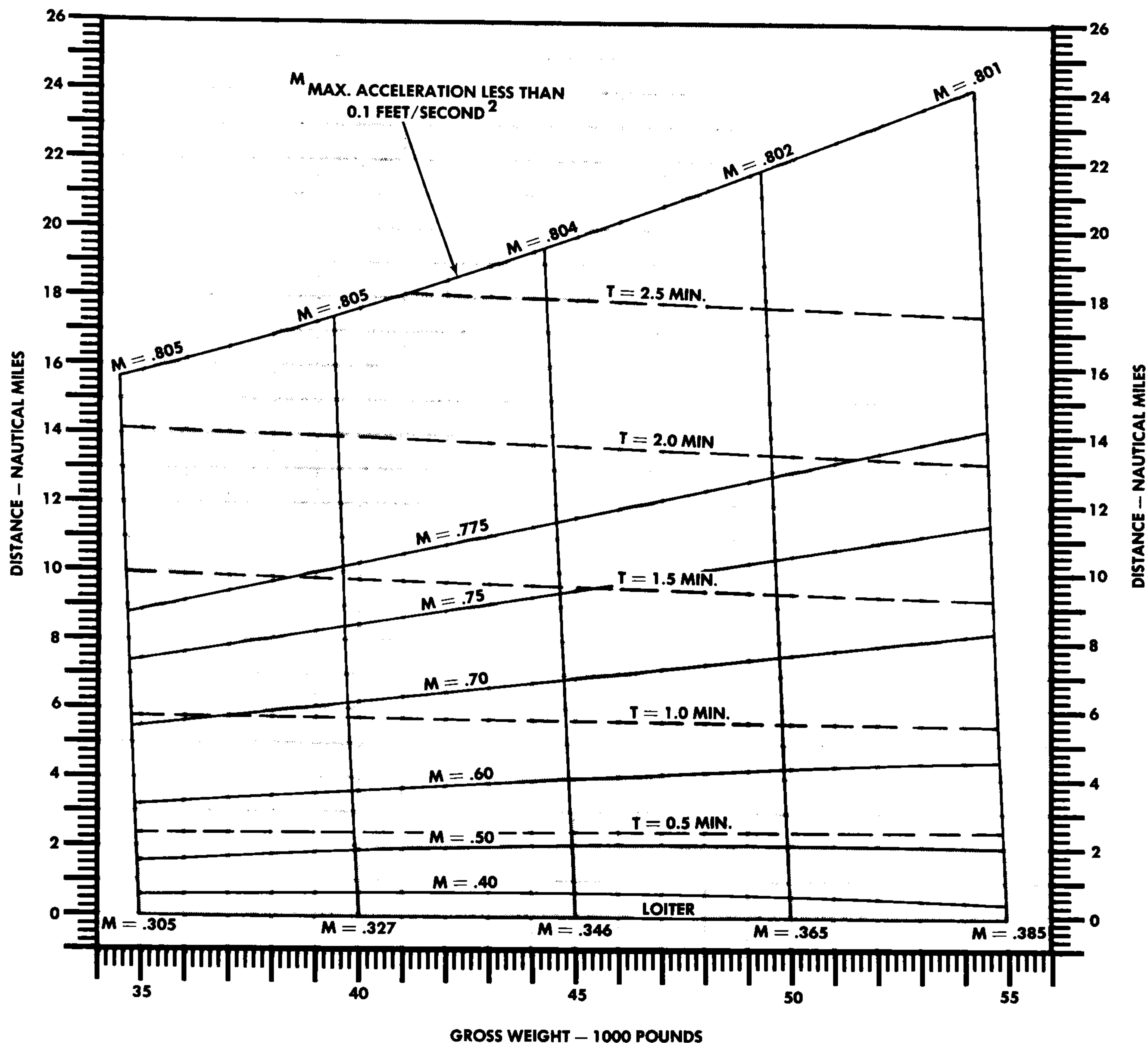
AIRCRAFT CONFIGURATION

- (1) 4 MK-28 STORE +
- (4) 300 GALLON DROP TANKS

DATA BASIS: ESTIMATED
DATE 15 MARCH 1971

REMARKS
ICAO STANDARD DAY

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB./GAL.



ADF1-330

Figure 11-30

MILITARY POWER ACCELERATION**P-8 ENGINE****LEVEL FLIGHT 15,000 FT.**

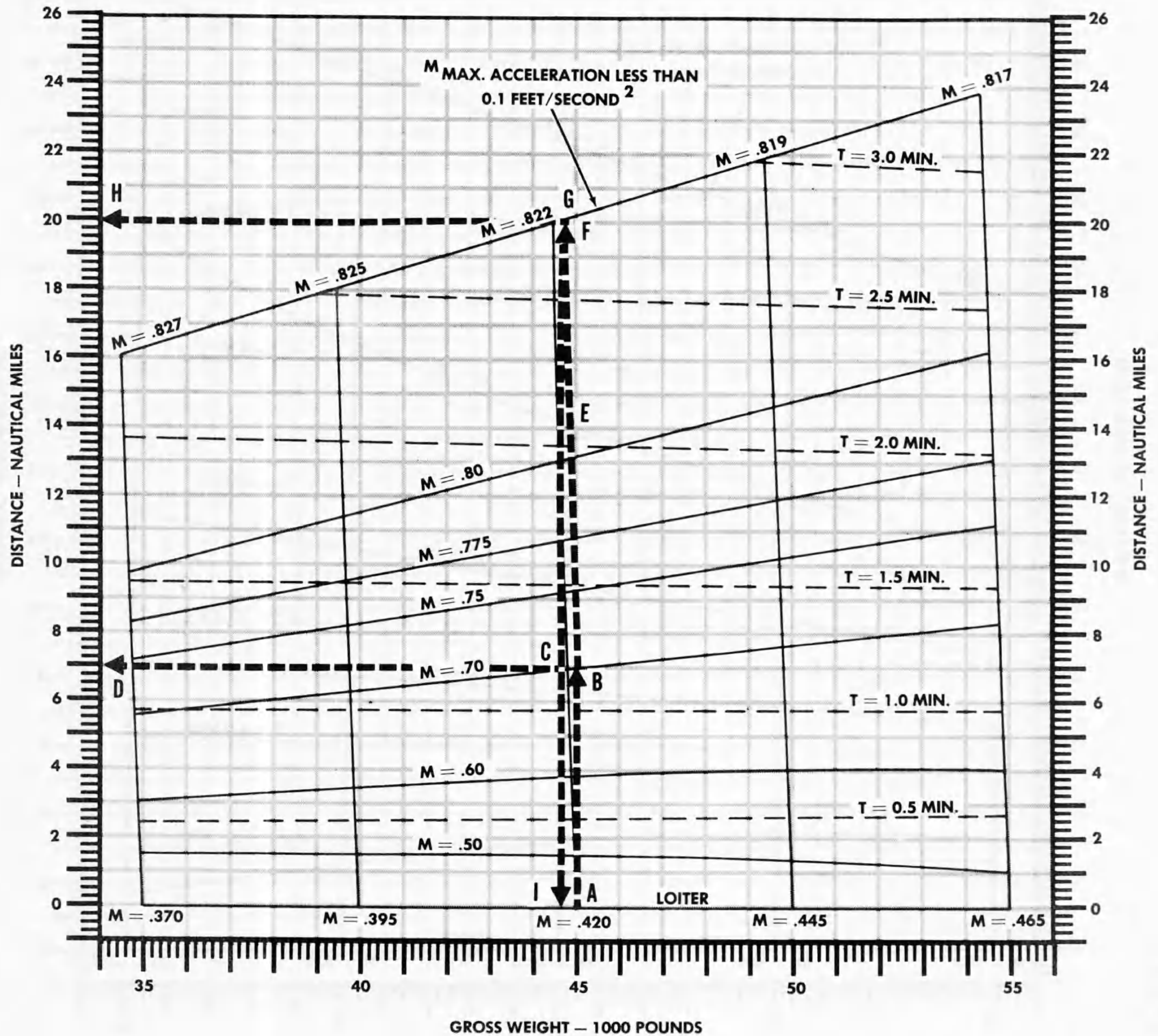
AIRCRAFT CONFIGURATION

- (1) 4 MK-28 STORE +
(4) 300 GALLON DROP TANKS

DATE 15 MARCH 1971
DATA BASIS: ESTIMATED

REMARKS
ICAO STANDARD DAY

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB./GAL.



ADF1-331

Figure 11-31

MILITARY POWER ACCELERATION

P-8 ENGINE

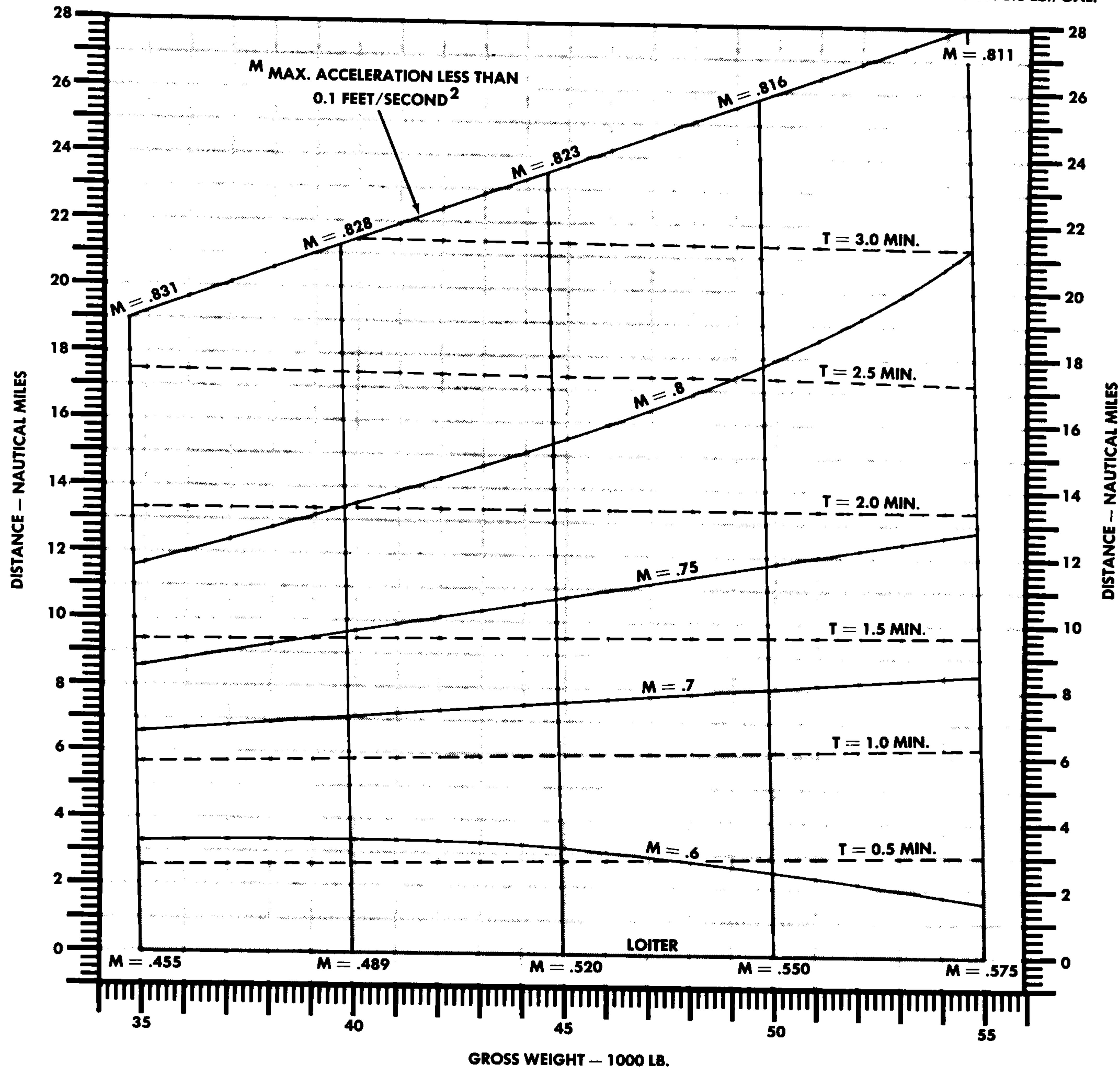
AIRCRAFT CONFIGURATION
(1) 4 MK-28 STORE +
(4) 300 GALLON DROP TANKS

LEVEL FLIGHT 25,000 FT.

DATE 15 MARCH 1971
DATA BASIS: ESTIMATED

REMARKS
ICAO STANDARD DAY

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB./GAL.



ADF1-332

Figure 11-32

MILITARY POWER ACCELERATION

P-8 ENGINE

AIRCRAFT CONFIGURATION
(1) 4 MK-28 STORE +
(4) 300 GALLON DROP TANKS

LEVEL FLIGHT 35,000 FT.

DATE 15 MARCH 1971
DATA BASIS: ESTIMATED

REMARKS
ICAO STANDARD DAY

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB./GAL.

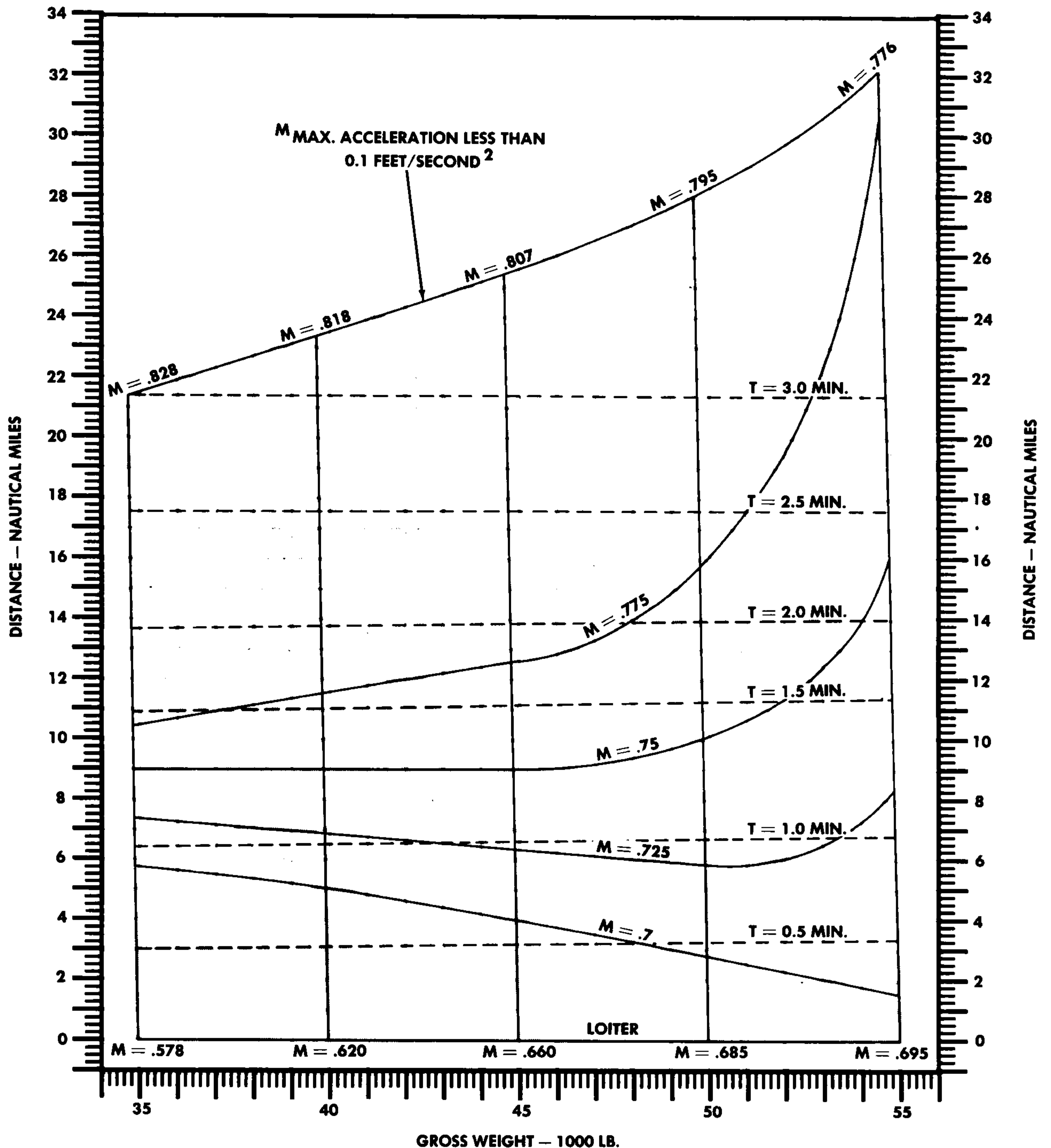


Figure 11-33

P-8 ENGINE

MAXIMUM TURN PERFORMANCE

MILITARY POWER
CONSTANT SPEED AND ALTITUDE

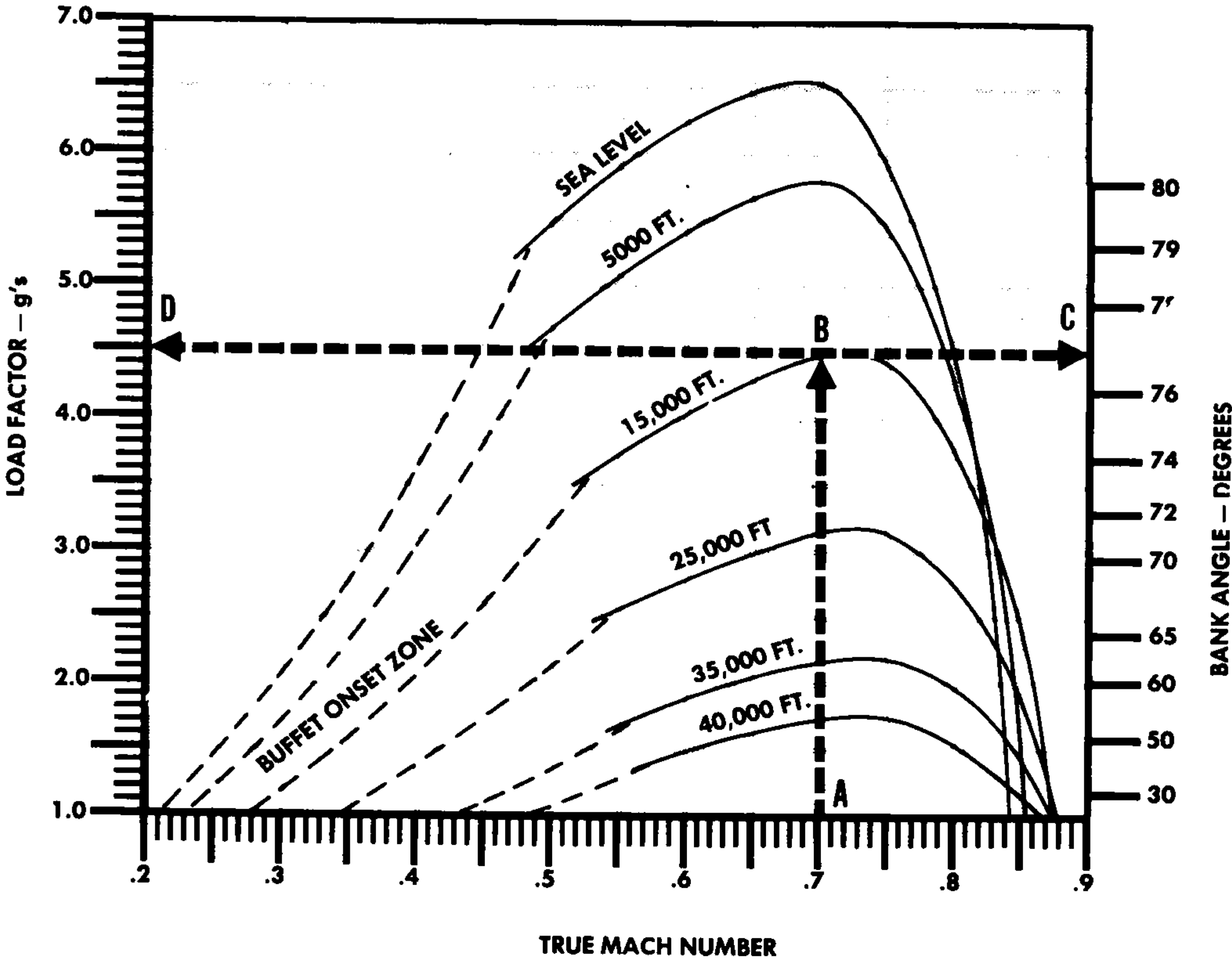
AIRCRAFT CONFIGURATION
CLEAN

DATE 15 MARCH 1971
DATA BASIS: ESTIMATED

REMARKS
ICAO STANDARD DAY

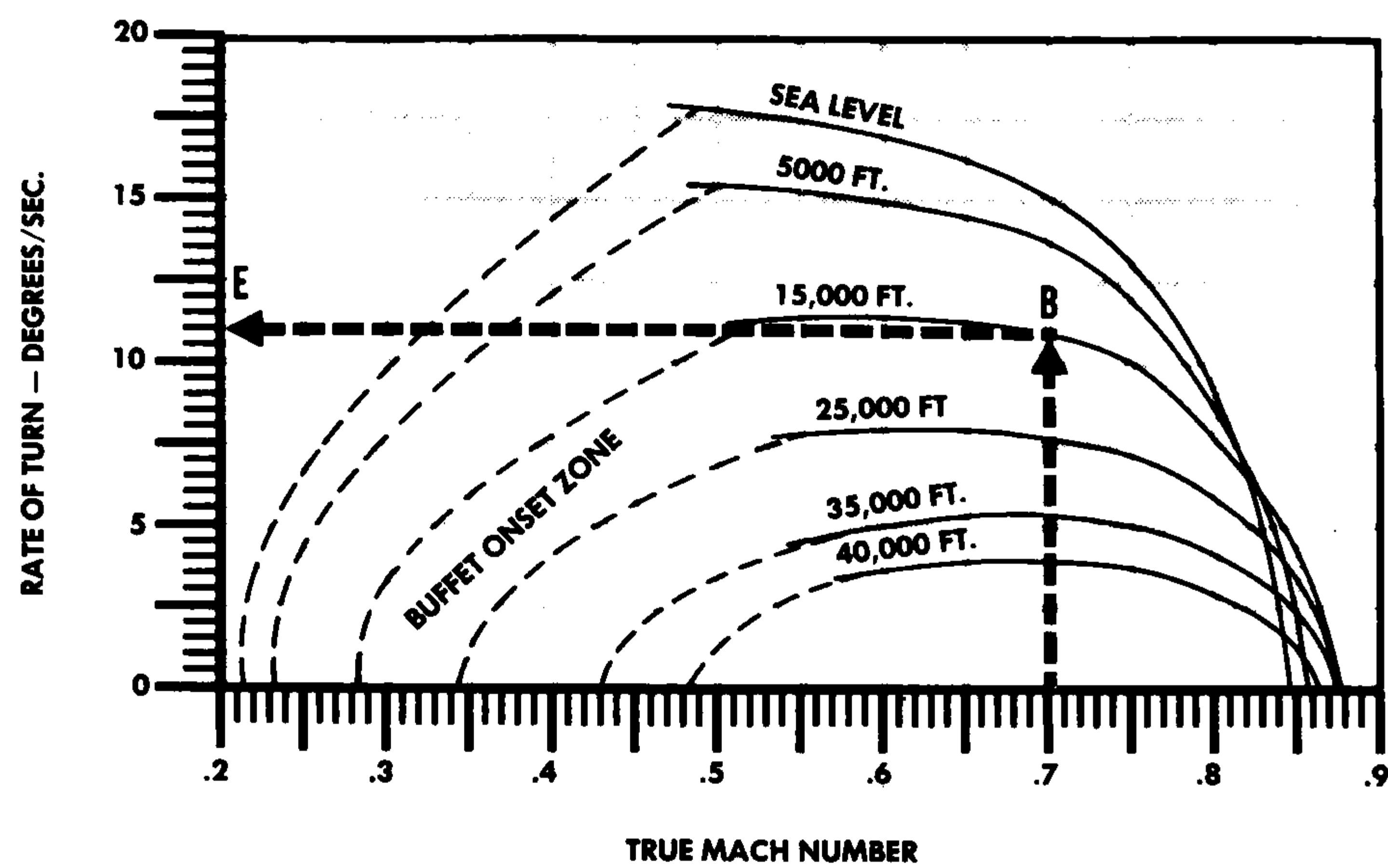
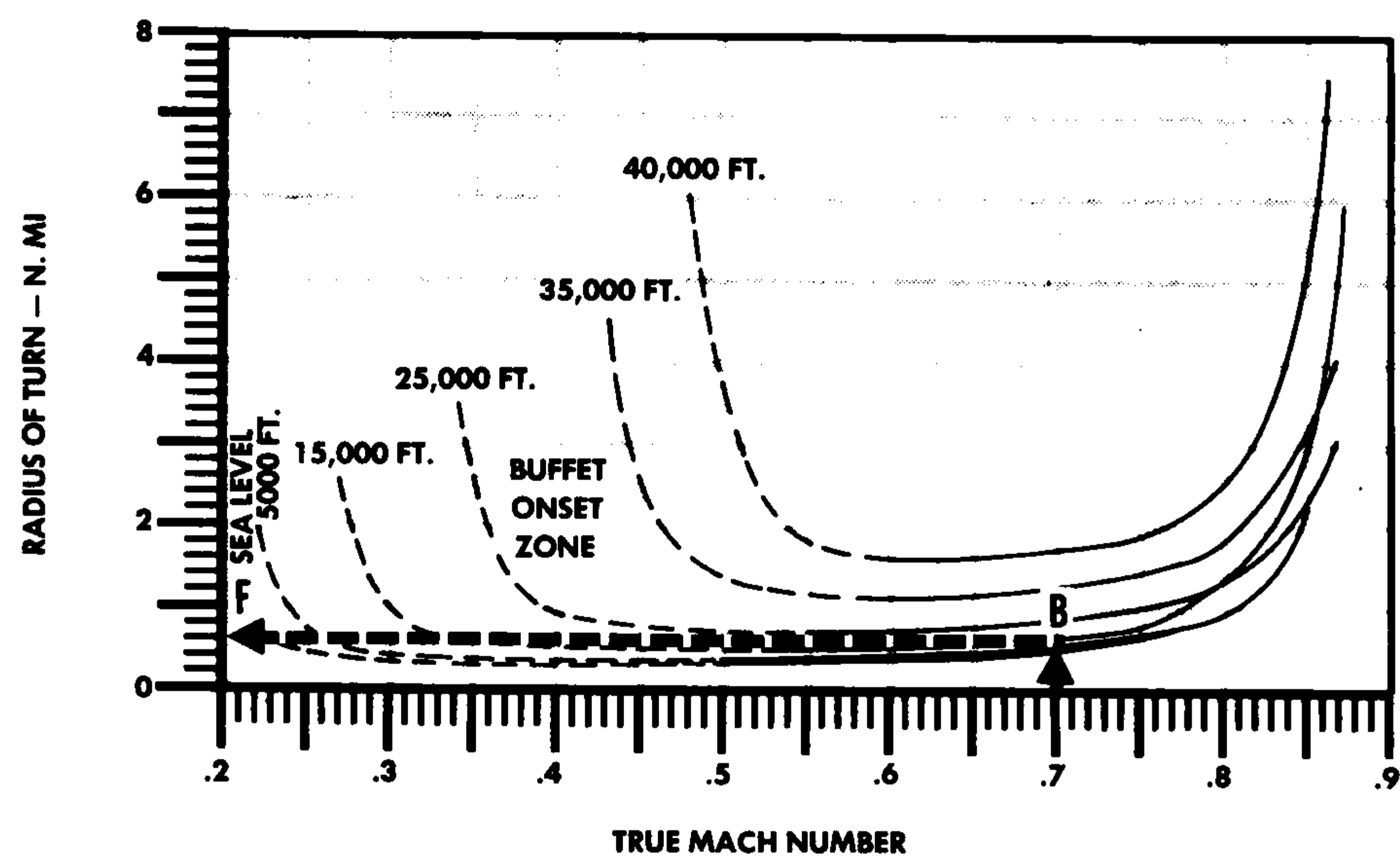
FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB./GAL.

GROSS WEIGHT — 30,000 POUNDS



ADF1-334-1

Figure 11-34 (Sheet 1)



ADF1-334-2

Figure 11-34 (Sheet 2)

MAXIMUM TURN PERFORMANCE

P-8 ENGINE

MILITARY POWER CONSTANT SPEED AND ALTITUDE

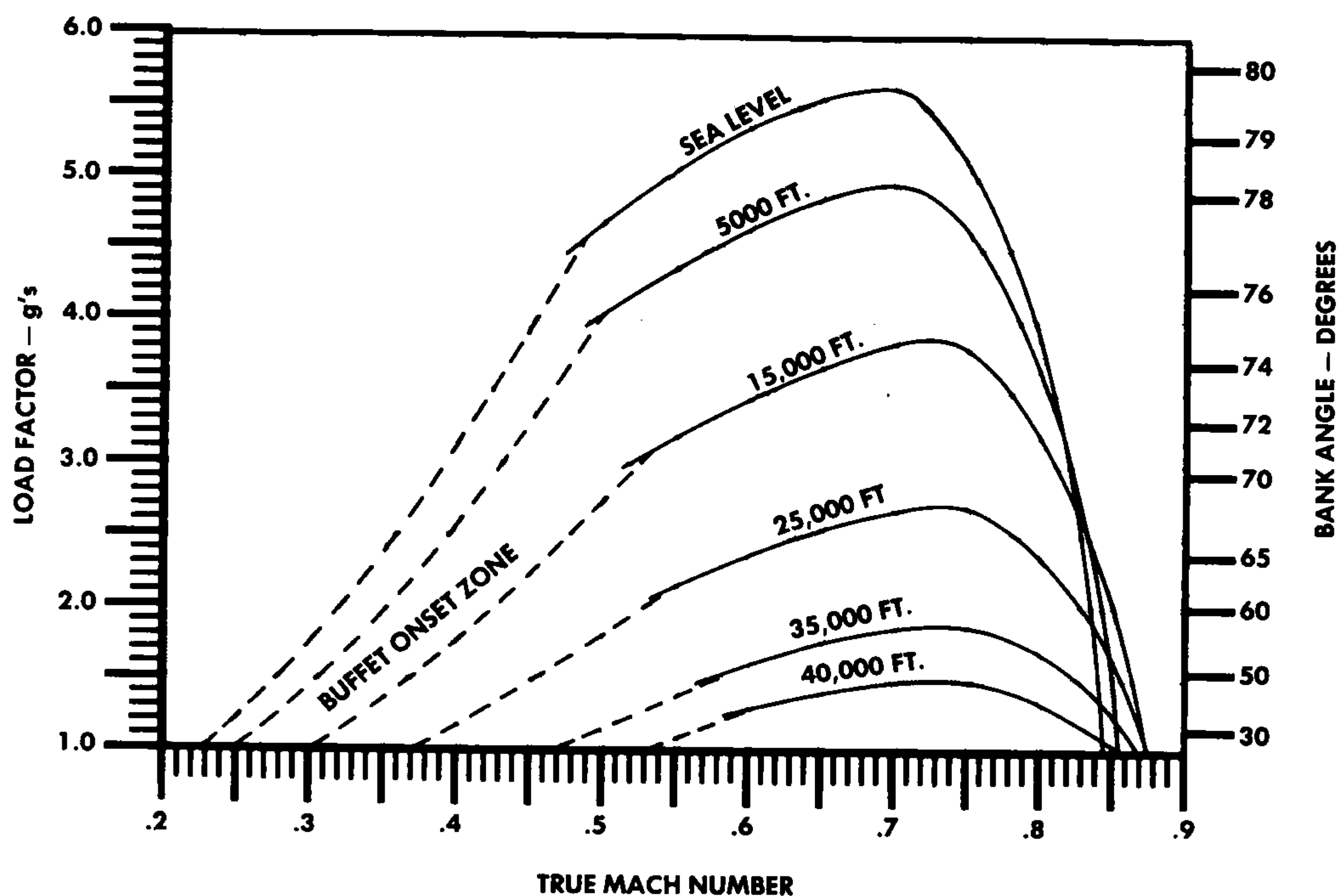
AIRCRAFT CONFIGURATION
CLEAN

DATE 15 MARCH 1971
DATA BASIS: ESTIMATED

REMARKS
ICAO STANDARD DAY

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB./GAL.

GROSS WEIGHT — 35,000 POUNDS



ADF1-335-1

Figure 11-35 (Sheet 1)

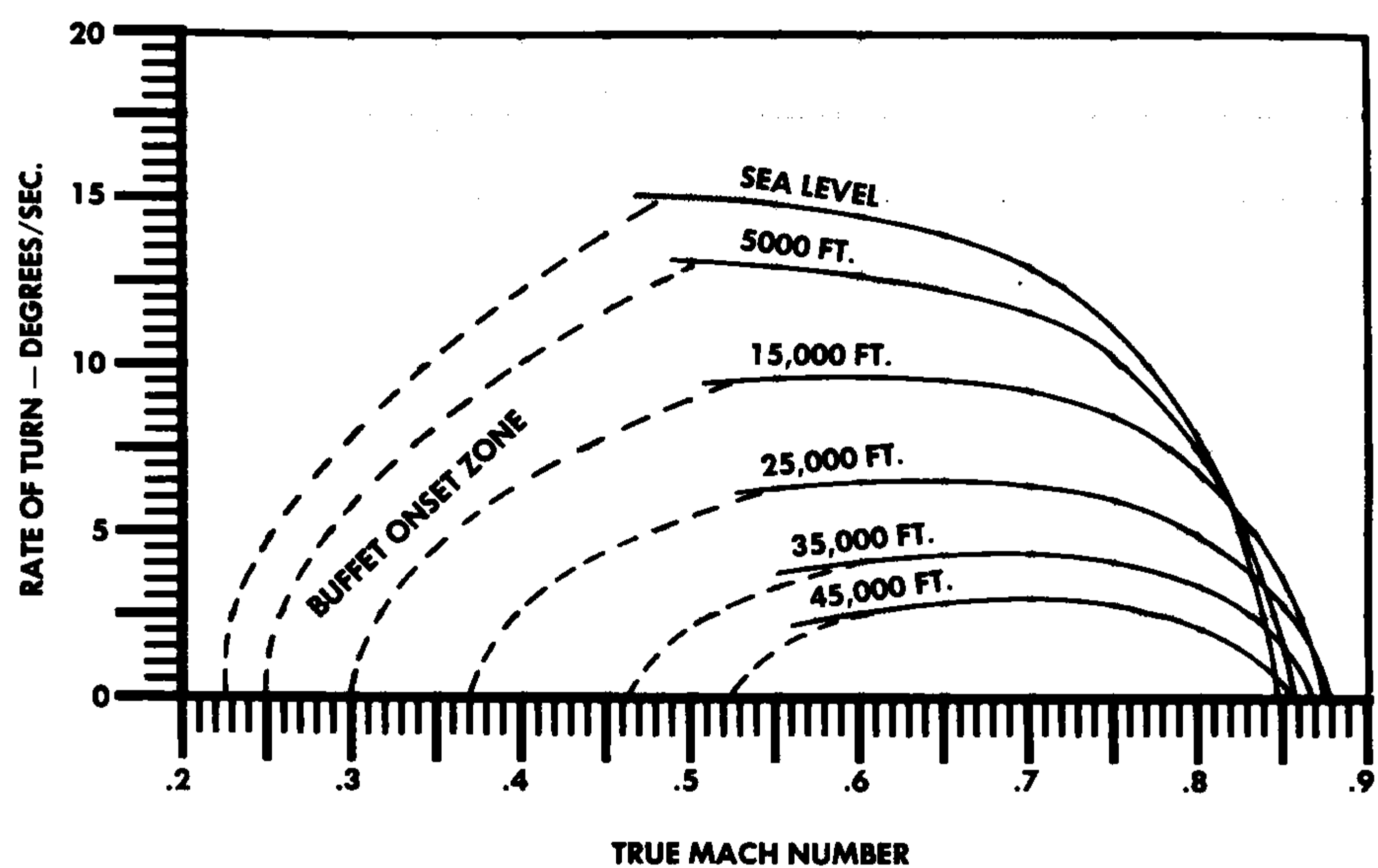
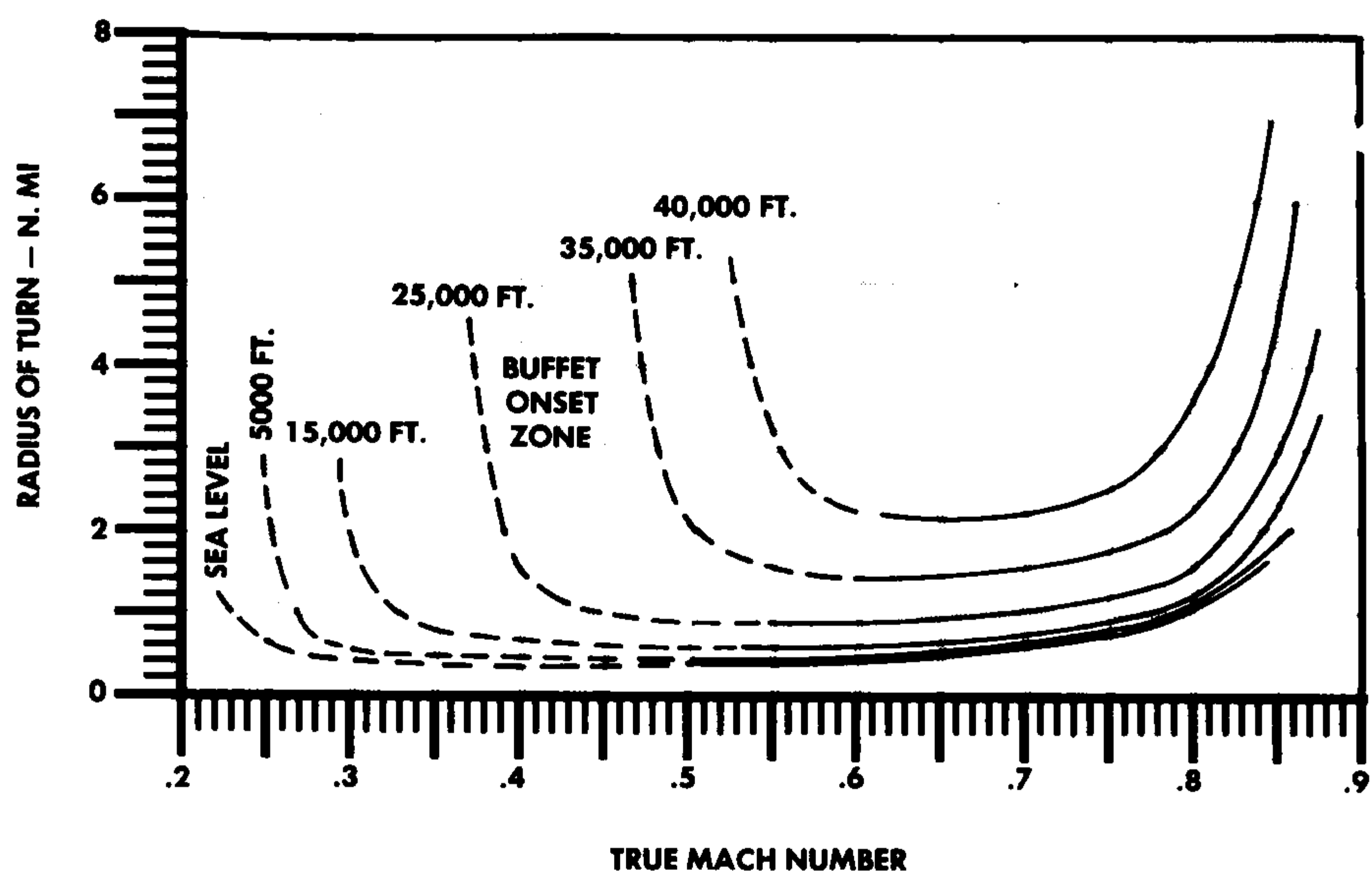


Figure 11-35 (Sheet 2)

MAXIMUM TURN PERFORMANCE

P-8 ENGINE

MILITARY POWER CONSTANT SPEED AND ALTITUDE

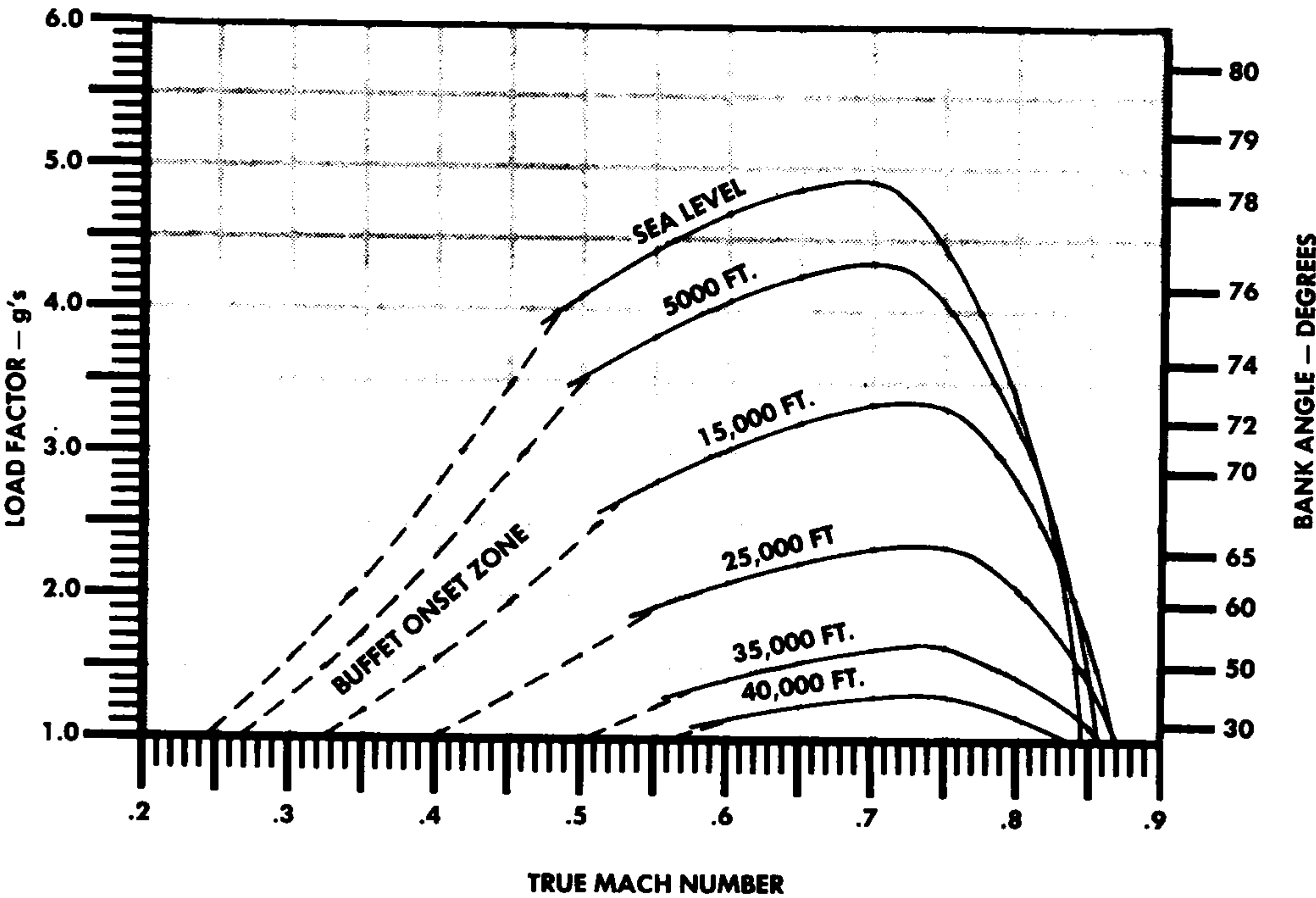
AIRCRAFT CONFIGURATION
CLEAN

DATE 15 MARCH 1971
DATA BASIS: ESTIMATED

REMARKS
ICAO STANDARD DAY

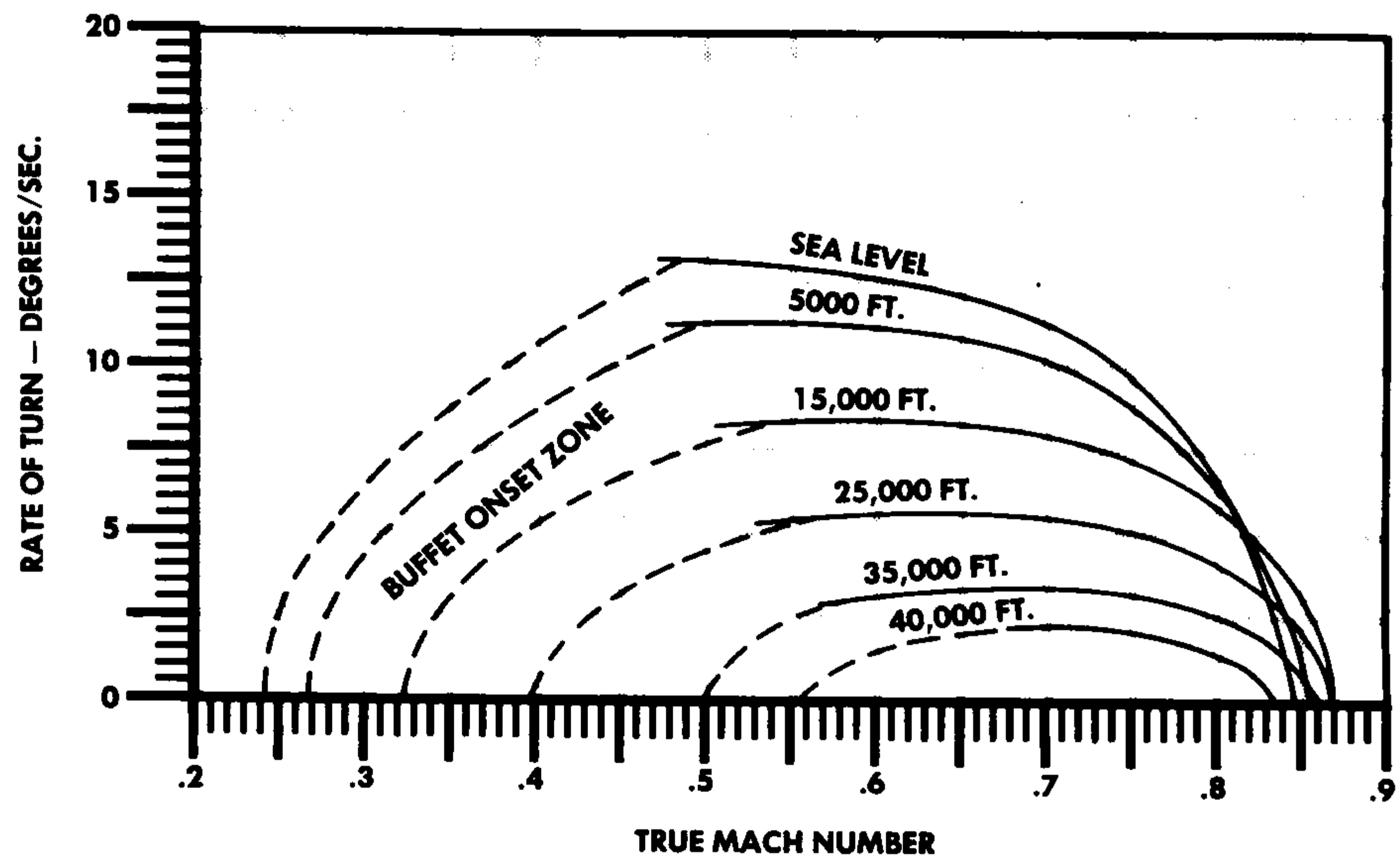
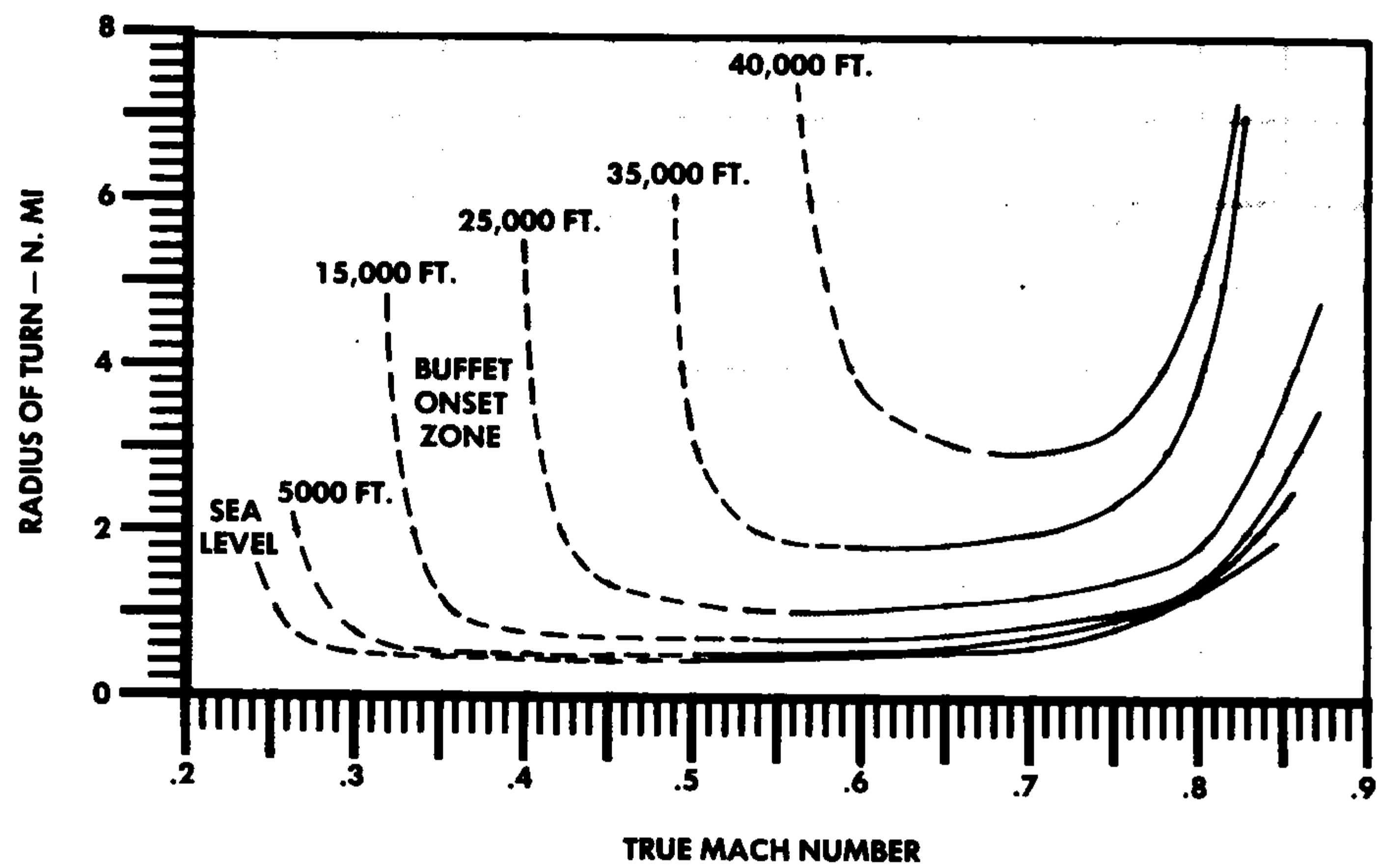
FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB./GAL.

GROSS WEIGHT — 40,000 POUNDS



ADF1-336-1

Figure 11-36 (Sheet 1)



ADF1-336-2

Figure 11-36 (Sheet 2)

MAXIMUM TURN PERFORMANCE

P-8 ENGINE

**MILITARY POWER
CONSTANT SPEED AND ALTITUDE**

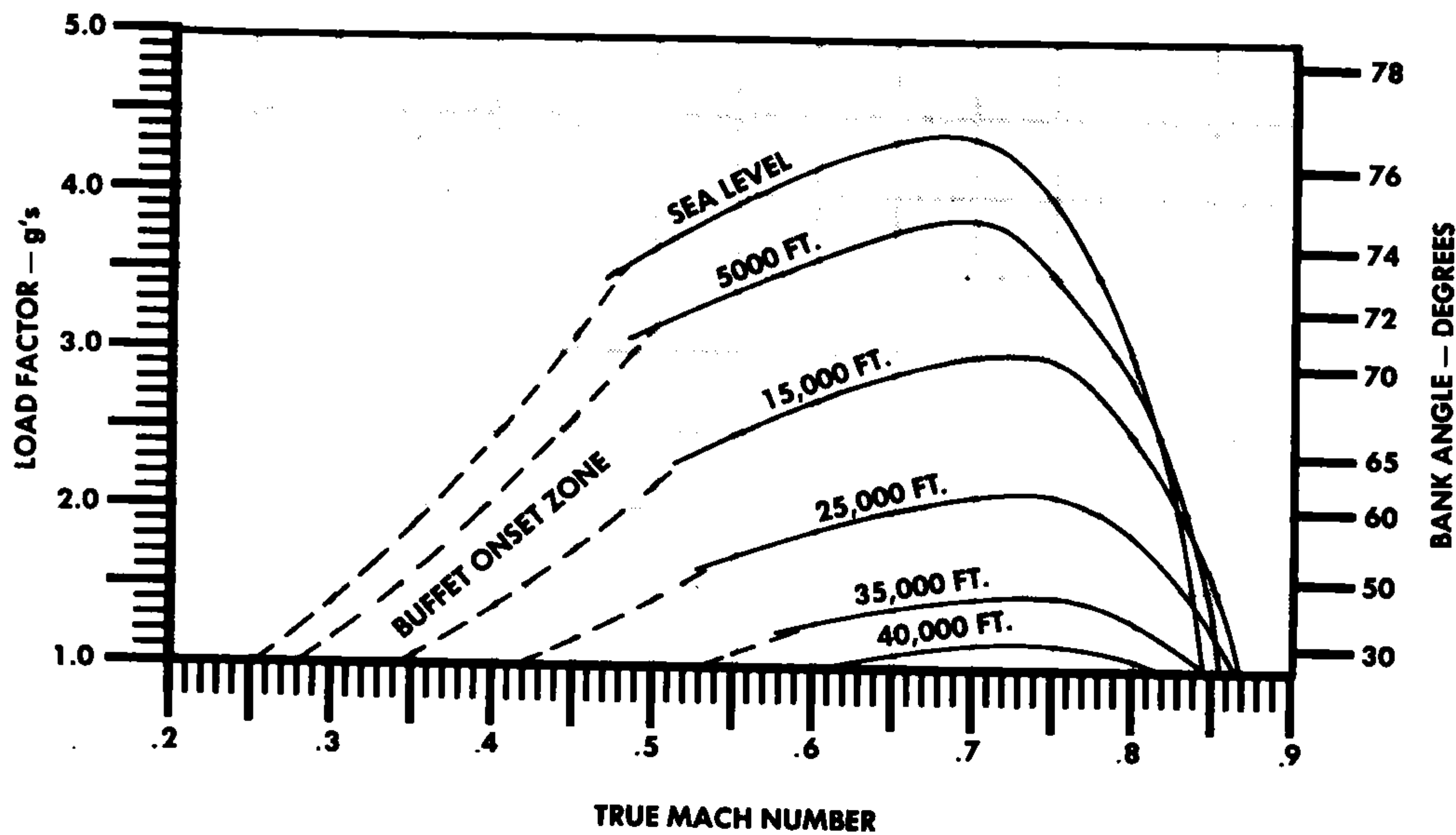
AIRCRAFT CONFIGURATION
CLEAN

DATE 15 MARCH 1971
DATA BASIS: ESTIMATED

REMARKS
ICAO STANDARD DAY

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB./GAL.

GROSS WEIGHT — 45,000 POUNDS



ADF1-337-1

Figure 11-37 (Sheet 1)

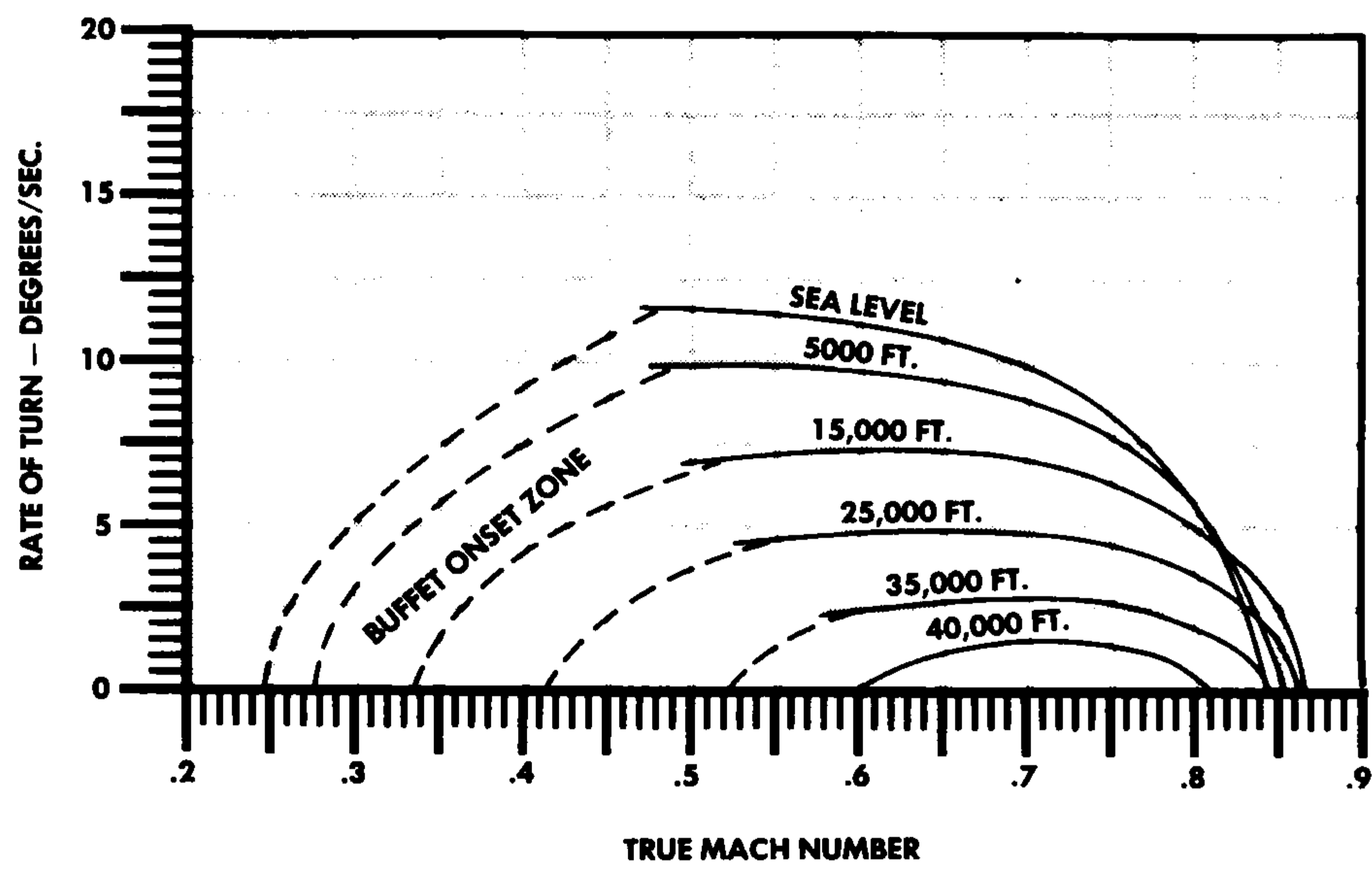
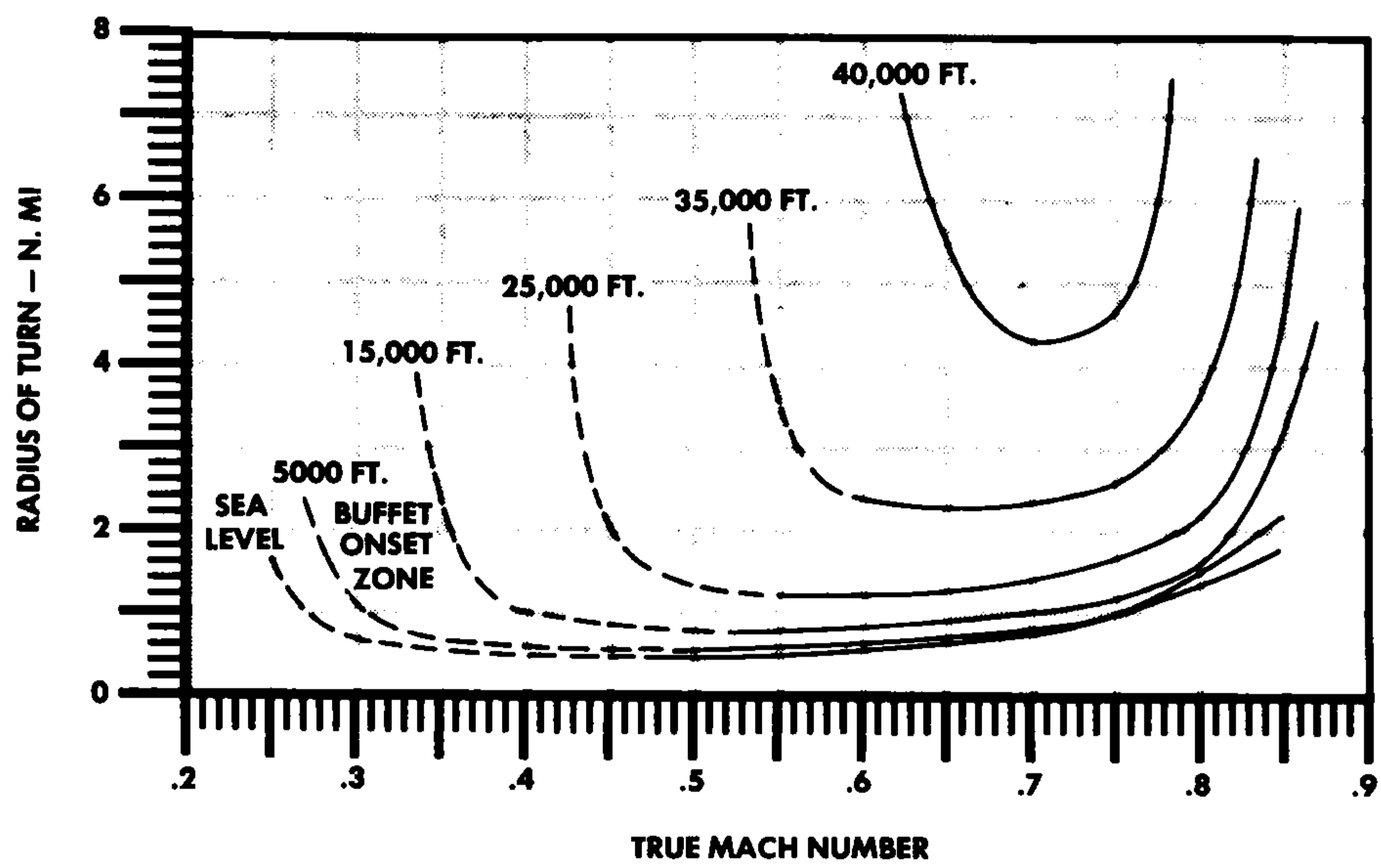


Figure 11-37 (Sheet 2)

MAXIMUM TURN PERFORMANCE

P-8 ENGINE

MILITARY POWER CONSTANT SPEED AND ALTITUDE

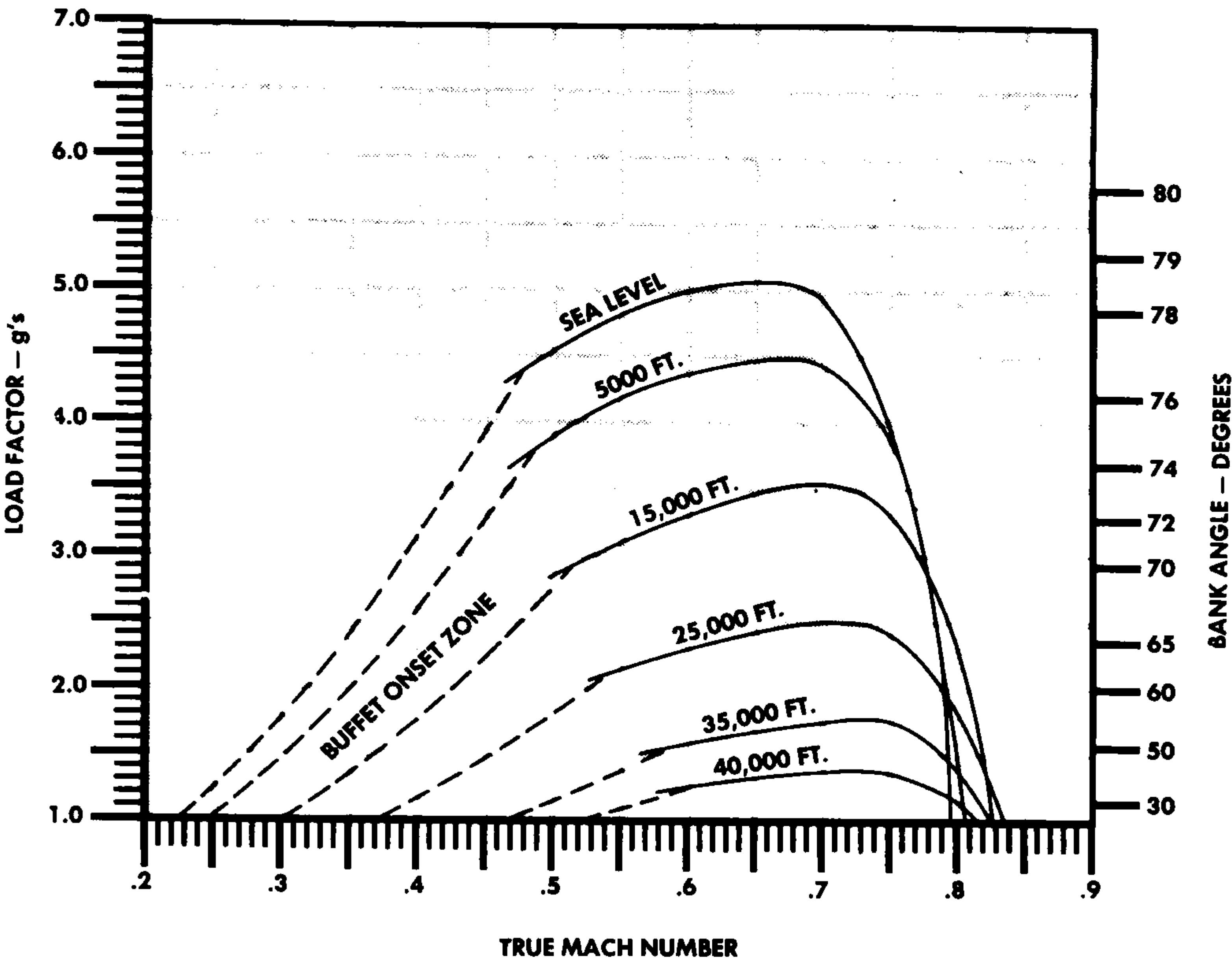
AIRCRAFT CONFIGURATION
(1) MK-28 + (4) 300 GALLON TANKS

DATE 15 MARCH 1971
DATA BASIS: ESTIMATED

REMARKS
ICAO STANDARD DAY

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB./GAL.

GROSS WEIGHT — 35,000 POUNDS



ADF1-338-1

Figure 11-38 (Sheet 1)

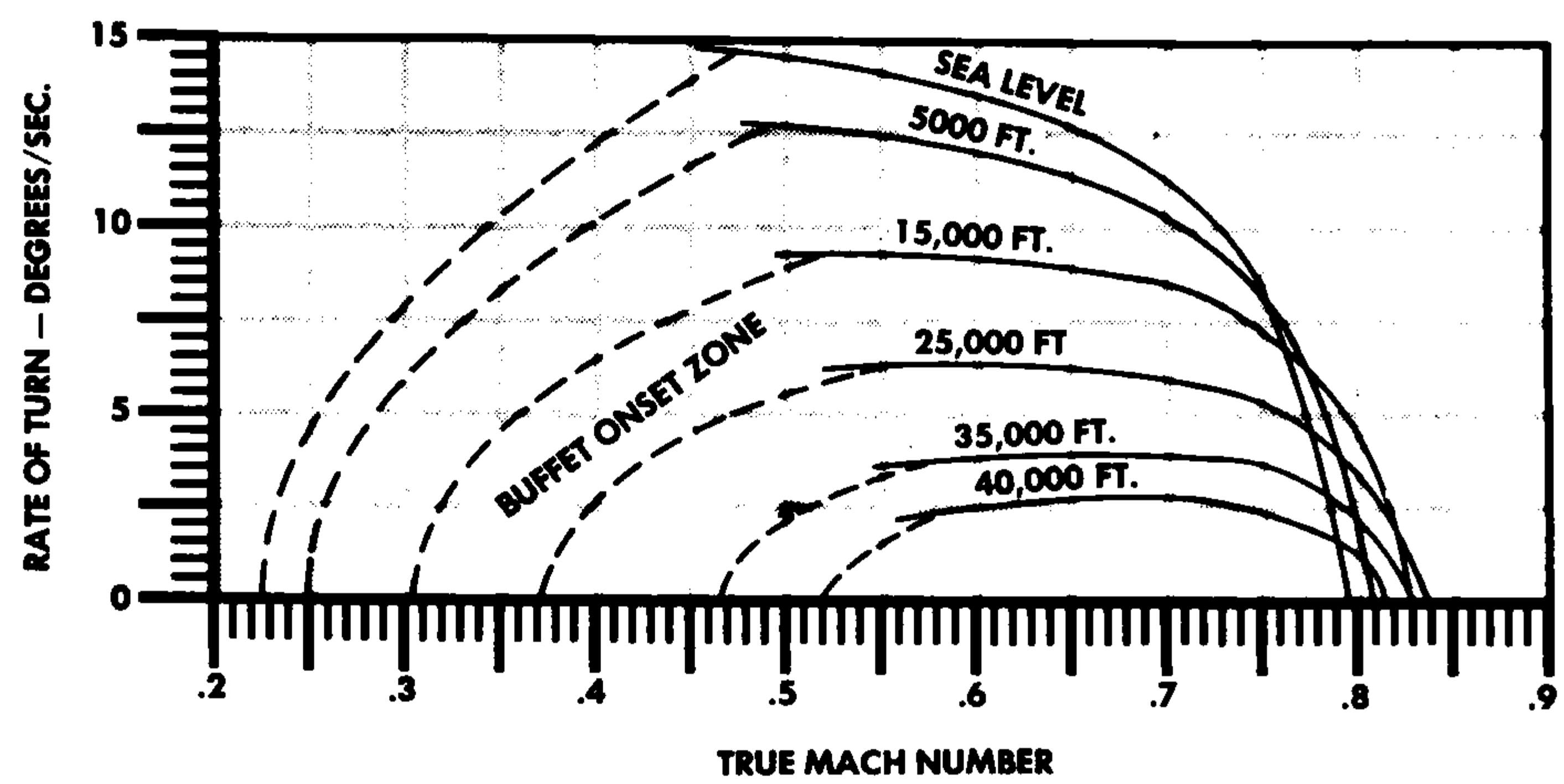
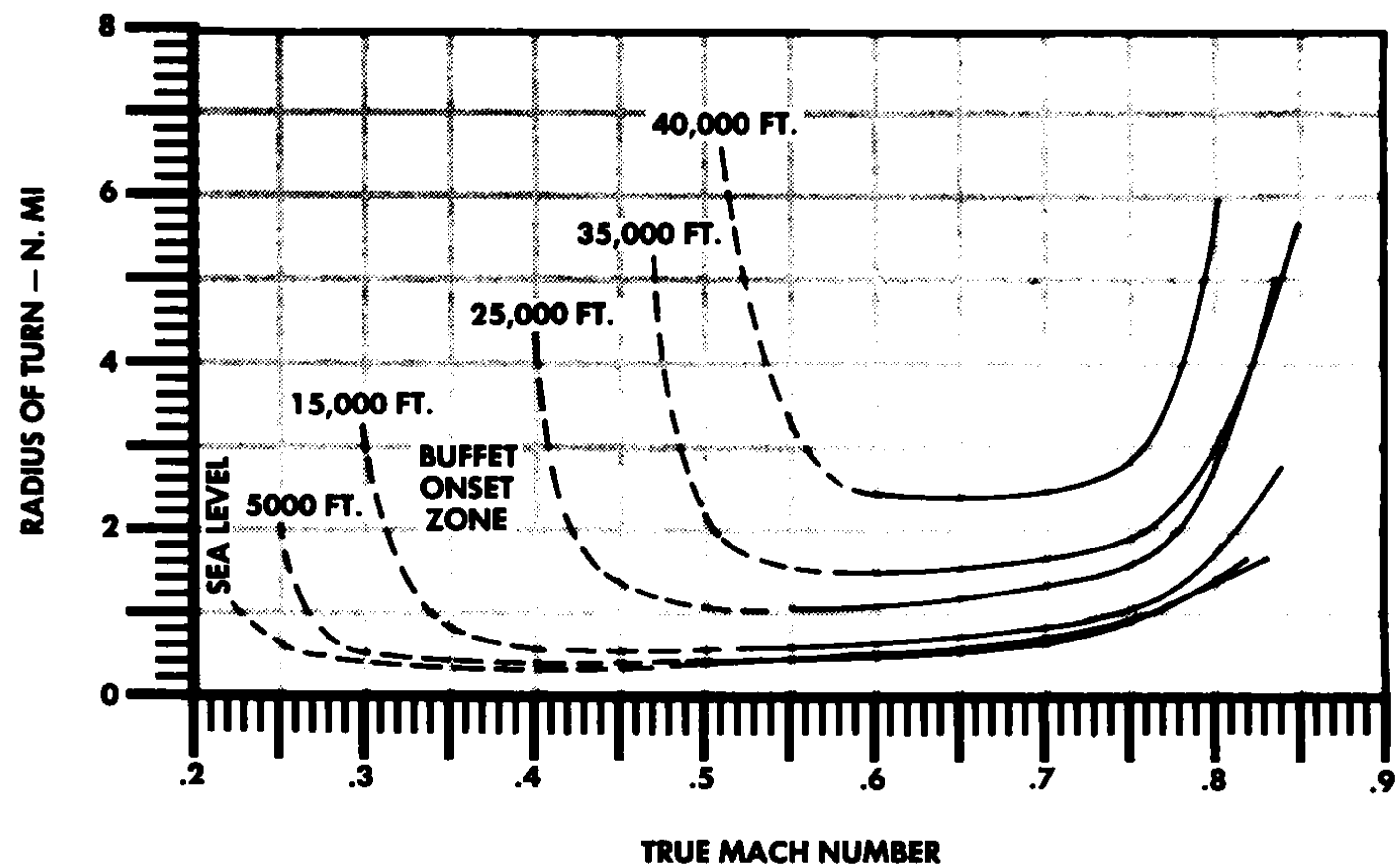


Figure 11-38 (Sheet 2)

P-8 ENGINE

MAXIMUM TURN PERFORMANCE

MILITARY POWER
CONSTANT SPEED AND ALTITUDE

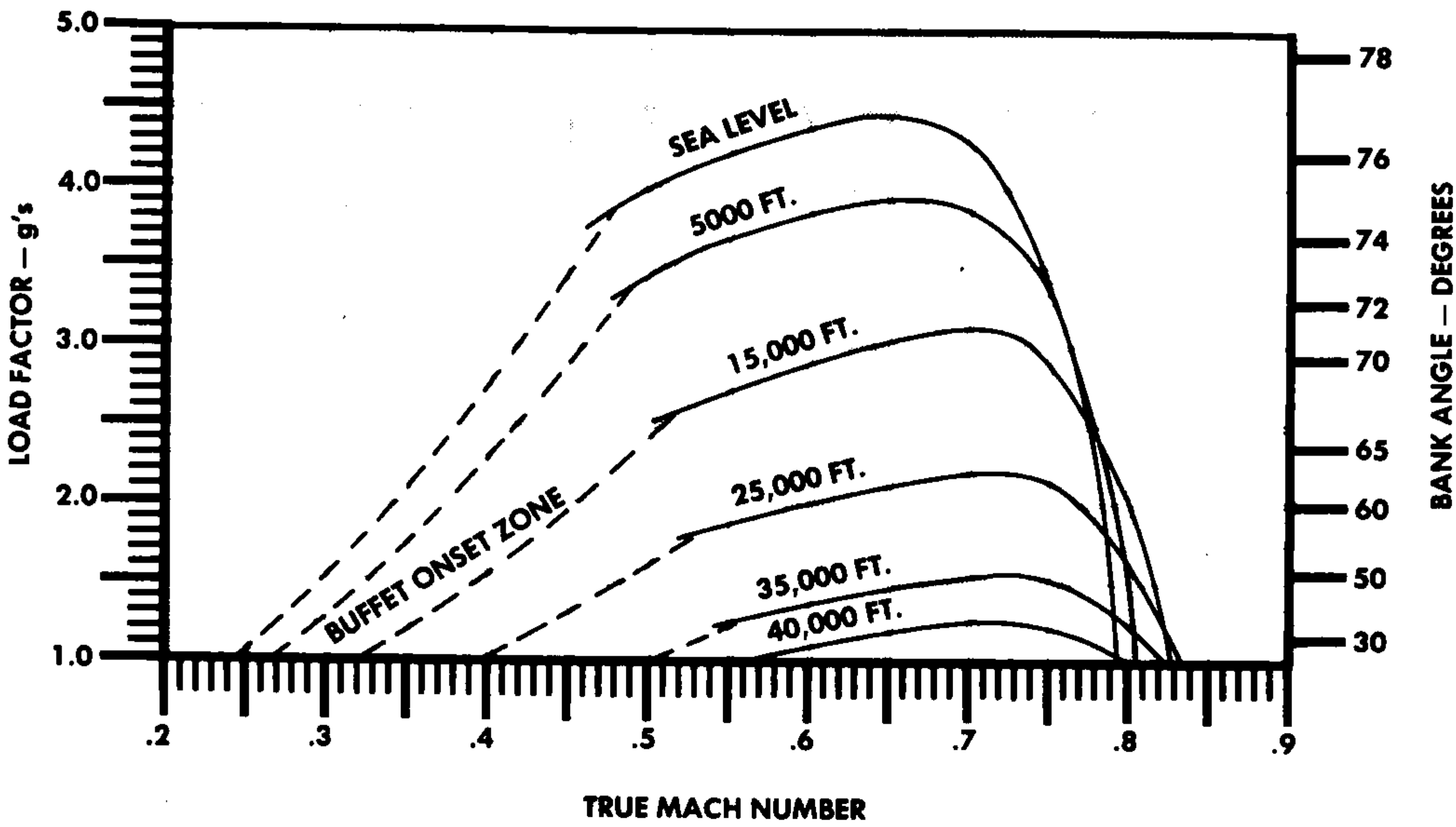
AIRCRAFT CONFIGURATION
(1) MK-28 + (4) 300 GALLON TANKS

DATE 15 MARCH 1971
DATA BASIS: ESTIMATED

REMARKS
ICAO STANDARD DAY

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB./GAL.

GROSS WEIGHT — 40,000 POUNDS



ADF1-339-1

Figure 11-39 (Sheet 1)

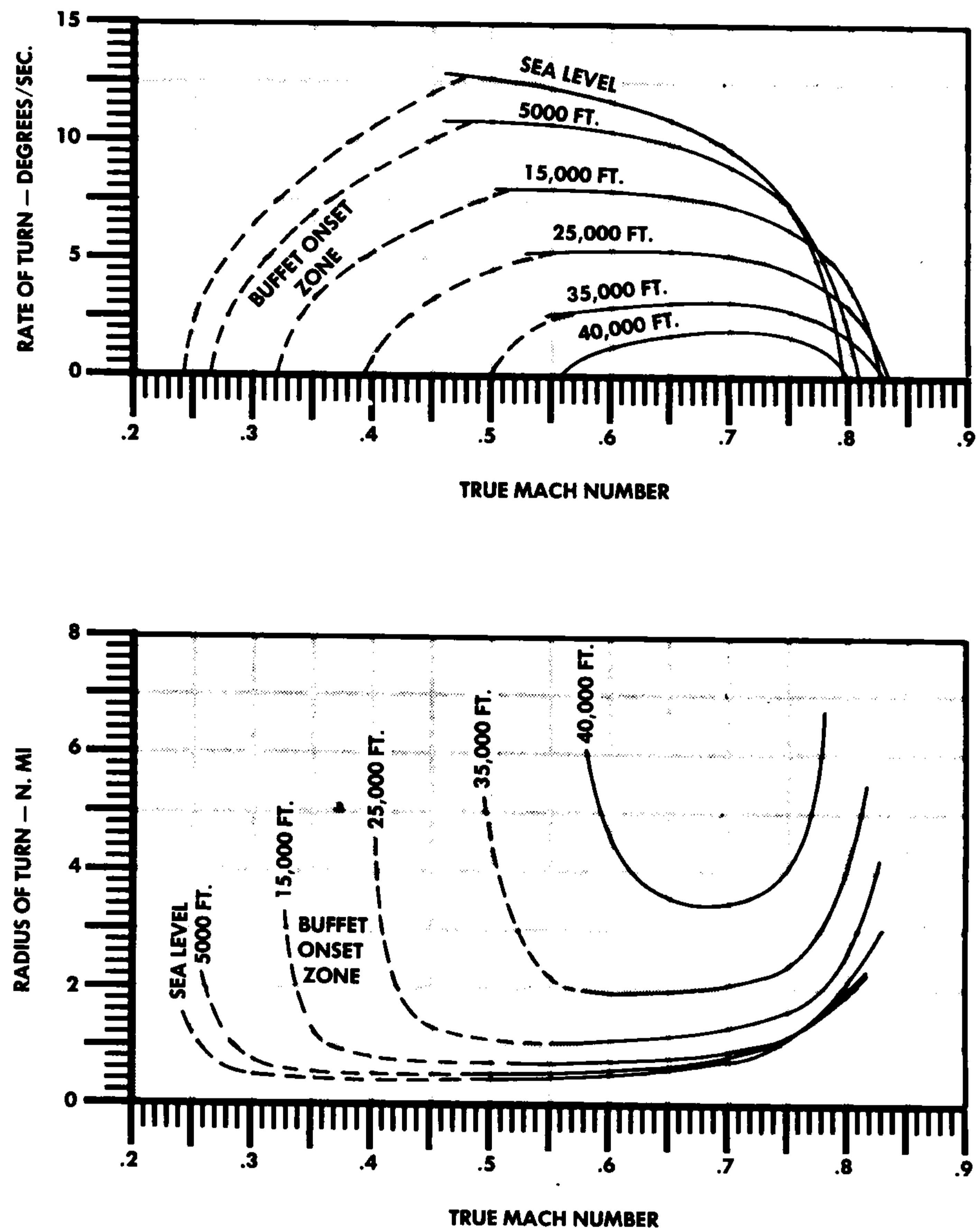


Figure 11-39 (Sheet 2)

MAXIMUM TURN PERFORMANCE

P-8 ENGINE

**MILITARY POWER
CONSTANT SPEED AND ALTITUDE**

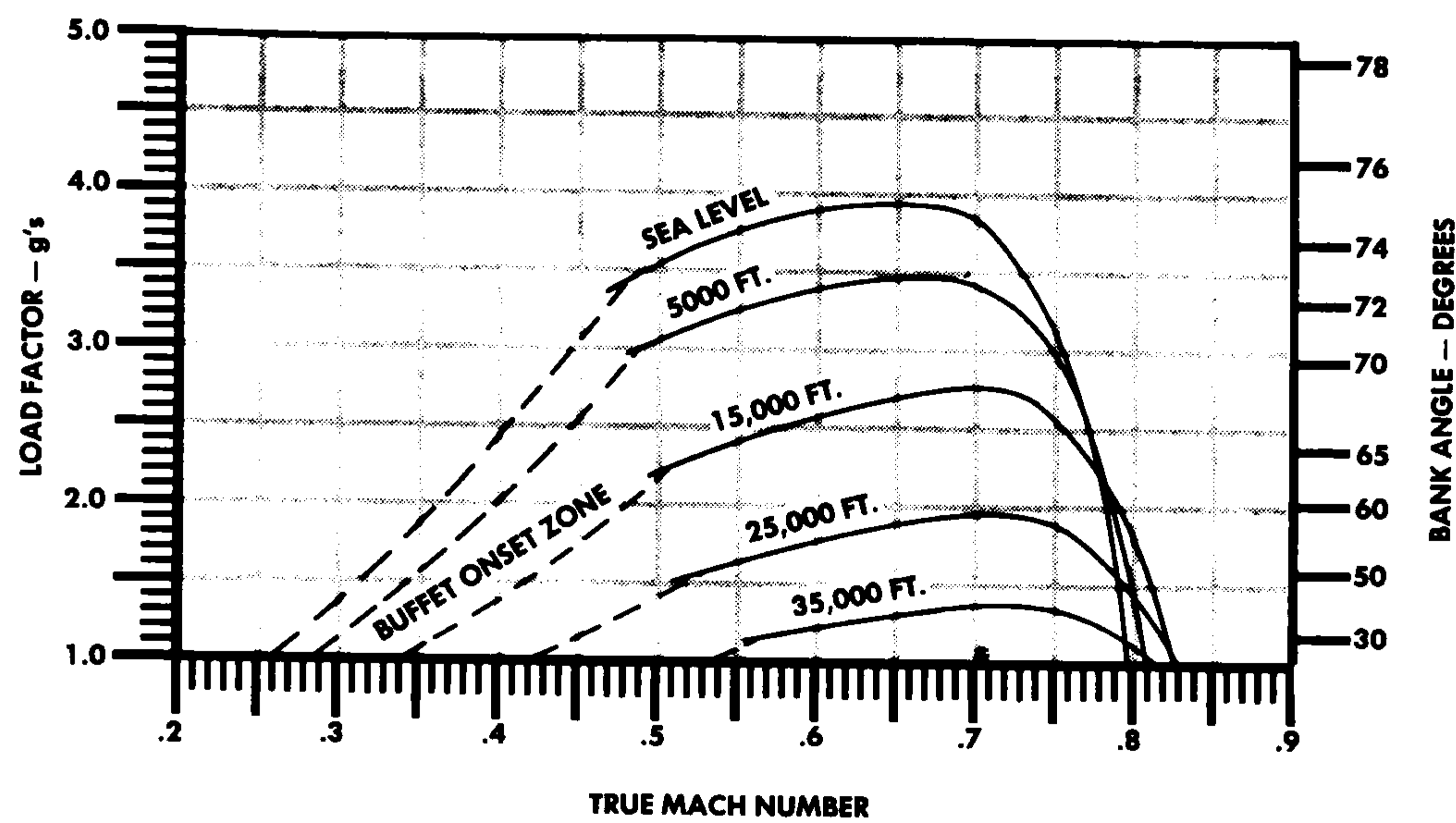
AIRCRAFT CONFIGURATION
(1) MK-28 + (4) 300 GALLON TANKS

DATE 15 MARCH 1971
DATA BASIS: ESTIMATED

REMARKS
ICAO STANDARD DAY

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB./GAL.

GROSS WEIGHT — 45,000 POUNDS



ADF1-340-1

Figure 11-40 (Sheet 1)

are green (high angle of attack), amber (optimum angle of attack), and red (low angle of attack).

During an arrested landing, with the hook bypass switch in ARREST, the approach light will flash when the arresting hook is not in trail and the landing gear is down and locked.

APPROACH INDEXER

The cam-operated switches in the angle-of-attack indicator also control the approach indexer (figure 1-22). Three lamps glow red through apertures on the face of the indexer, giving approach information. The upper arrow is for high angle-of-attack, the lower arrow for low angle of attack, and the circle is for optimum angle of attack. When both an arrow and circle appear, an intermediate position is indicated. During an arrested landing, with the hook bypass switch in ARREST, the approach indexer will flash when the arresting hook is not in trail and the gear is extended.

Note

- The approach lights and approach indexer are disabled until all gear are down and locked.
- To ensure that the approach index lights are operating, depress the lights warning button on the master test panel. Intensity of the approach indexer lights is adjustable using the approach indexer thumbwheel on the master lights panel.

PITOT-STATIC SYSTEM

The pitot-static boom is located on the vertical stabilizer. Pitot pressure is impact air pressure developed as the result of the relative wind velocity and is measured at the opening in the forward end of the sensor. Static pressure, which is a function of altitude and temperature, is measured through a series of small openings on the side of the sensor. Pitot pressure is used in the air data computer and the mach/airspeed/command airspeed indicator. Static pressure is used in the air data computer, counter/pointer altimeter, servoed barometric altimeter, mach/airspeed/command airspeed indicator, and vertical velocity indicator. To prevent or eliminate icing, the pitot-static sensor is electrically heated.

PITOT HEAT SWITCH

The pitot heat switch, on the air-conditioning control panel (figure 1-30) is a two-position switch marked ON and OFF. Placing the switch ON allows electrical power to be supplied from the 28V DC primary bus to a conventional heater in the pitot tube. It also allows, through the left weight-on-wheels switch, heat to be provided to the angle-of-attack and total temperature probes when airborne.

SERVOED BAROMETRIC ALTIMETER

The servoed barometric altimeter on the right side of the pilot's instrument panel (FO-2) displays accurate pressure altitude in feet. The altimeter is electrically operated by a synchro signal received from the air data computer for normal operation. An integral standby mechanism, of the aneroid type, is incorporated and presents pressure altitude with normal barometric setting correction. The face of the altimeter is marked in 50-foot increments around the periphery of the dial and numerals ranging from 1 to 10 indicate the 100-foot increments. A single-dial pointer indicates correct altitude from 0 to 1000 feet in a complete revolution. A single drum-type counter, in the center of the instrument, also shows altitude in 100-foot increments. A dual digital counter to left of the 100-foot counter shows altitude in 1000-foot increments. A four digital counter placarded IN. HG. is used in conjunction with an altimeter setting selector control on the lower left side of the instrument.

A selector lever is on lower right corner of the indicator and marked RESET/STBY. Normally the selector lever will be in the center position and the altimeter will receive its electrical inputs from the air data computer. However, if this system becomes unreliable, the altimeter will receive its inputs automatically and directly from the pitot-static system. A failure warning flag marked STBY will appear on the dial face, indicating the altimeter is in mechanical or standby mode of operation. Selection of STBY or activation of the ADC failure detection circuit will result in standby mode of operation. The STBY flag will be hidden when the instrument is in normal electrical mode of operation. The electrical mode of operation may be selected by manually positioning the standby mechanism to RESET. Conversely, standby mode of operation may be selected by positioning the selector lever to STBY.

MACH/AIRSPEED/COMMAND AIRSPEED INDICATOR

The mach/airspeed/command airspeed indicator (figure FO-2) is calibrated from mach 0.5 to 2.0 and 80 to 650 knots airspeed. Indicated airspeed is read under the pointer which rotates over a nonlinear scale. The pointer is driven by the pressure differential derived from comparing pitot pressure with atmospheric (static) pressure. The mach number is read using the pointer and a rotating card calibrated with mach number. The card is rotated by static pressure from the pitot-static system. By using the rotating card in conjunction with the pointer, the necessary relationship is established between indicated airspeed and atmospheric pressure to produce a mach number.

Maximum mach number and minimum airspeed indices are controlled by the mach limit knob on the lower left side of the instrument. The minimum airspeed index is set by rotating the knob and the maximum mach is set by pushing the knob in and rotating it.

VERTICAL SPEED INDICATOR

A standard vertical velocity indicator (figure FO-2) is mounted on the right side of the pilot's instrument panel. The instrument operates on a pressure differential. Static pressure from the pitot system enters the diaphragm inside the instrument case. The instrument case itself contains static air, which passes through a restriction. Because of the restrictor, changes in altitude causes the air pressure in the diaphragm to increase or decrease more rapidly than air pressure in the instrument case. The resulting difference in pressure is converted to a vertical velocity and is displayed as feet per minute up or down on the instrument face. The needle is damped to minimize oscillation and is mechanically stopped at the extreme travel limits. The range of the instrument is from 0 to 6,000 feet per minute up or down, with the first 1,000 feet graduated in 100-foot increments and the remainder in 500-foot increments.

ATTITUDE INSTRUMENTS

TURN-AND-SLIP INDICATOR MD-1

The turn-and-slip indicator (figure FO-2) gives the pilot information on the rate of turn of the aircraft around its vertical axis and the turn coordination. The driving mechanism for the pointer is a permanent-magnet type, DC, governor-controlled, gyro motor. A needle-width deflection of the pointer will produce a 360° turn in 4 minutes. Pointer motion is damped by an air dashpot and is deflected in the direction of the turn. The inclinometer portion of the instrument contains damping fluid and a ball that moves from center in an uncoordinated turn.

VERTICAL DISPLAY INDICATOR

The vertical display indicator (VDI) (figure FO-2) on the pilot's instrument panel is the instrument of primary reference for flight attitude, vertical and horizontal steering commands, and terrain avoidance, giving the aircraft an all-weather capability during all phases of flight from takeoff to landing. Indications of attitude, vertical and horizontal drift, and steering commands are provided by means of symbols superimposed on a display of the world about the aircraft in analog form. This display, which includes a ground-stabilized horizon line, is presented in either of two modes: contact analog and terrain clearance.

The contact analog display presents all the symbols along with ground and sky texture elements which are separated by the ground-stabilized horizon line providing the attitude reference. To simplify use of the indicator as an attitude reference, a video bank angle marker with a fixed index mark and movable video pitch trim markers are provided.

The terrain clearance display provides the same symbols as contact analog except that the sky and ground textures are deleted for clarity. This mode

provides the pilot with a means of determining the position of the aircraft with respect to the terrain. The terrain is displayed in shades of gray with the lightest shade at the nearest range. The display gives a three-dimensional effect as well as a means of estimating range and is developed from search radar video processed by the radar data converter.

A more complete discussion of the VDI symbols and displays is found in Section VIII.

VERTICAL GYRO INDICATOR (VGI) MM-3

The VGI (figure FO-2) indicates to the pilot the flight attitude of the aircraft. Pitch and roll indications are displayed by a sphere in relation to a fixed miniature aircraft symbol. The sphere is light-colored above the artificial horizon bar, black below the bar, and is marked in 5° pitch increments in both directions, beginning at the horizon bar. Roll indications are given by a marker that moves around the periphery of the sphere. The marker moves across a linear scale that is graduated in 10° increments to 30° and then in 30° increments to 90°.

The sphere is positioned by servomechanisms that receive signals from a remote, independent gyro reference. A warning flag will appear whenever there is no power to the indicator, and will remain displayed for approximately 1 minute after initial power is applied. The flag does not indicate the condition of the instrument. A gyro fast-erect button (figure FO-2) to the lower left of the instrument speeds up the erection process. The flag will be visible while the button is depressed.

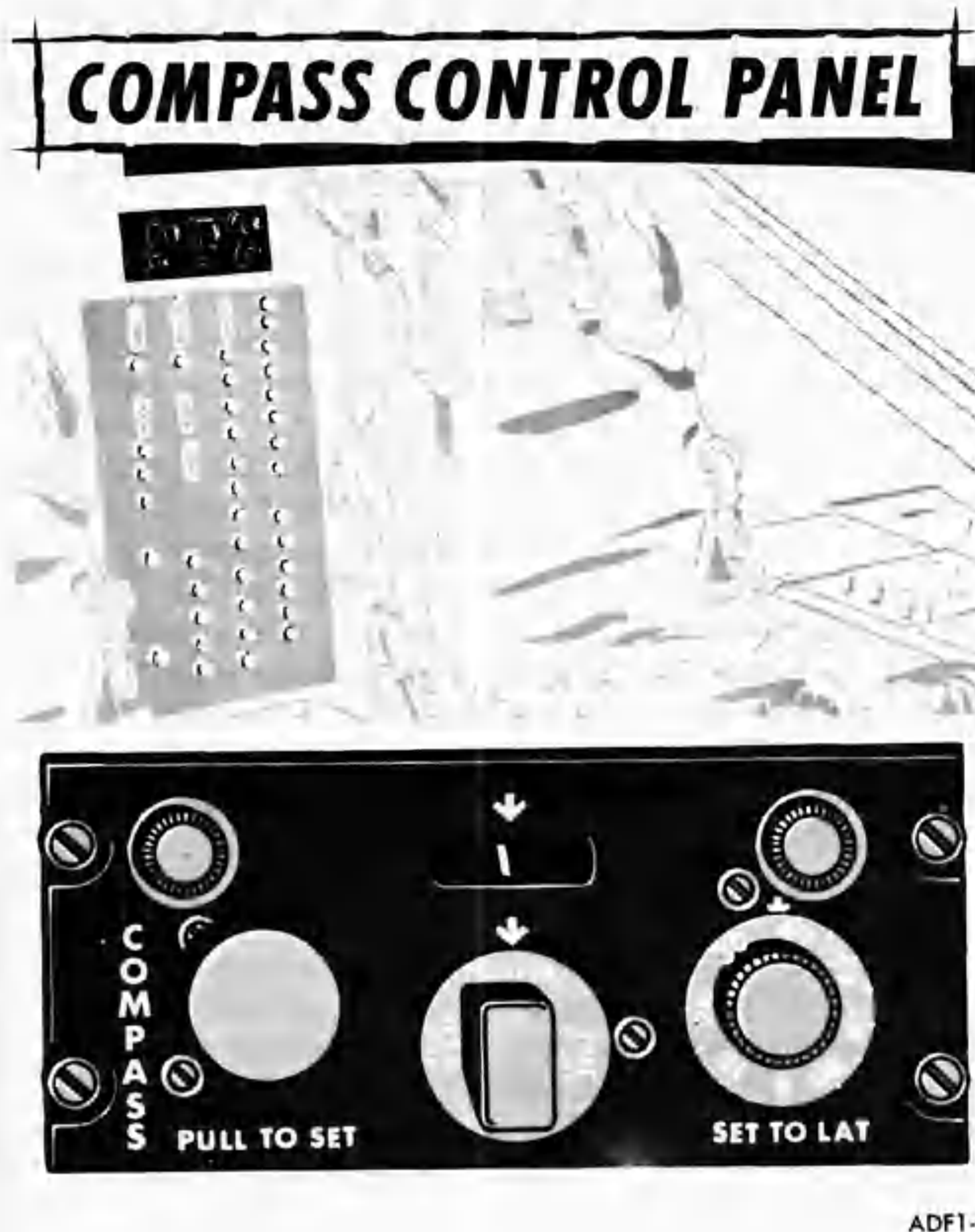
Rolls through 360° are possible without tumbling the gyro. The gyro will flip 180° at 90° of pitch from straight and level flight, but will return to normal after passing through the extreme pitch angles. A pitch trim knob on the lower right face of the instrument is used to adjust the horizontal bar of the sphere to the fixed miniature aircraft.

Note

The gyro fast-erect button must be held down until erection is completed.

COMPASS SYSTEM MA-1

The MA-1 compass system may be used as a directional gyro corrected for apparent drift due to the earth's rotation, or as a directional, gyro-stabilized, magnetic compass. The system is generally operated in the slaved or gyro-stabilized mode that automatically corrects inherent gyro errors of the system. The MA-1 compass system consists of a compass transmitter unit, a directional gyro assembly, an amplifier servo assembly, and a compass control panel (figure 1-23).



ADF1-64

Figure 1-23

COMPASS CONTROL PANEL

The compass control panel (figure 1-23) is on the aft bulkhead, above the circuit breaker panel. The two modes of operation, magnetic slaved or directional gyro, provide accurate directional reference for all latitudes. During periods of flight in areas where the earth's fields make the readings on any magnetic compass questionable, as in the polar regions, the slaved mode should not be used since the gyro will automatically align itself with the incorrect magnetic fields generated by the earth and subsequently transmit erroneous data to the aircraft systems. Operation in these areas is best accomplished by utilizing the directional gyro operating without inputs from the compass transmitter. In this mode, the system functions as a standard directional gyro. Because of inherent system stability, this mode of operation offers reliable heading information over extended periods of operation without subsystem references. At different latitudes, apparent gyro drift varies, with the smallest amount of drift being at the equator and the greatest amount in the polar regions. In the directional gyro mode, with the proper latitude selection made on the control panel, the gyro is made to precess at a rate required to overcome gyro drift at the selected latitude.

The compass system is actuated by power being applied to the essential bus. A power failure indication or a hold indication in the form of a red flag labelled OFF is displayed in the control panel synchronizer window above the selector switch. During normal

operation, this flag will disappear 10 seconds after application of power. After a 3-minute warmup period, the selector switch should be positioned to the mode of operation required to accomplish the mission.

Compass Selector Switch

This three-position rotary switch on the compass panel (figure 1-23) has positions for FREE S LAT, SLAVED, and FREE N LAT. In the SLAVED position, the compass is supplied with inputs from the compass transmitter, relative to the earth's magnetic field. In the FREE S LAT and FREE N LAT positions, the information supplied by the compass transmitter is considered unreliable and the system operates as a directional gyro, precessing at a rate required to compensate earth's normal rotation.

Pull-To-Set Control

This control permits realignment of the radio-magnetic indicator unit. The spring-loaded control is pulled out and rotated until the desired heading appears under the indicator cursor.

Note

During reset operation, the autopilot will be automatically disconnected while this knob is pulled out, permitting normal aircraft operation when introducing heading change information.

Latitude Select Control (SET TO LAT)

The latitude selector knob (figure 1-23) on the compass control panel is used to rotate a circular dial at the base of the knob. The dial is numbered from 0° to 90° of latitude. The latitude selector control is operative in the FREE N LAT and FREE S LAT selector switch positions only, and is used to select the latitude in which the aircraft is operating.

Synchronizer Window

This indicator is on the compass control panel (figure 1-23) and affords readout indications as to system operation. During periods of system power malfunction, warmup, and shutdown, a red flag appears in the window to denote that the system is inoperative. During normal operation, the red flag is retracted and a white bar aligns itself with the fixed arrow marker above the indicator window. Positioning of the bar under the arrow indicates satisfactory system alignment only during the SLAVED mode operation.

COMPASS SYSTEM OPERATION

Gyro Operation (SLAVED)

1. Selector switch - SLAVED (required a 3-minute warmup period).
2. Pull-to-set knob - OUT
Rotate control until approximate magnetic heading of aircraft is under radio-magnetic indicator cursor.

3. Pull-to-set knob - RELEASE

When the pull-to-set knob is released, the indicator should align itself with the exact magnetic heading of the aircraft. A visual indication of system alignment is given when the white bar is below the arrow on the indicator window. Oscillation of the white bar during slaved mode is a normal condition and indicates satisfactory operation of the system.

Note

There are two null positions of the knob 180° apart. An indication of the correct null position is movement of the white bar in the same direction that the knob is turned.

Gyro Operation (UNSLAVED)

1. Selector switch - FREE N LAT or FREE S LAT as required.
2. Pull-to-set knob - OUT
Rotate control until desired heading of aircraft is set under cursor of radio-magnetic indicator.
3. Latitude selector control - ADJUST
Set this control to reflect degrees latitude at which aircraft will be flying. This affords automatic compensation for apparent drift of gyro due to earth's rotation.

Note

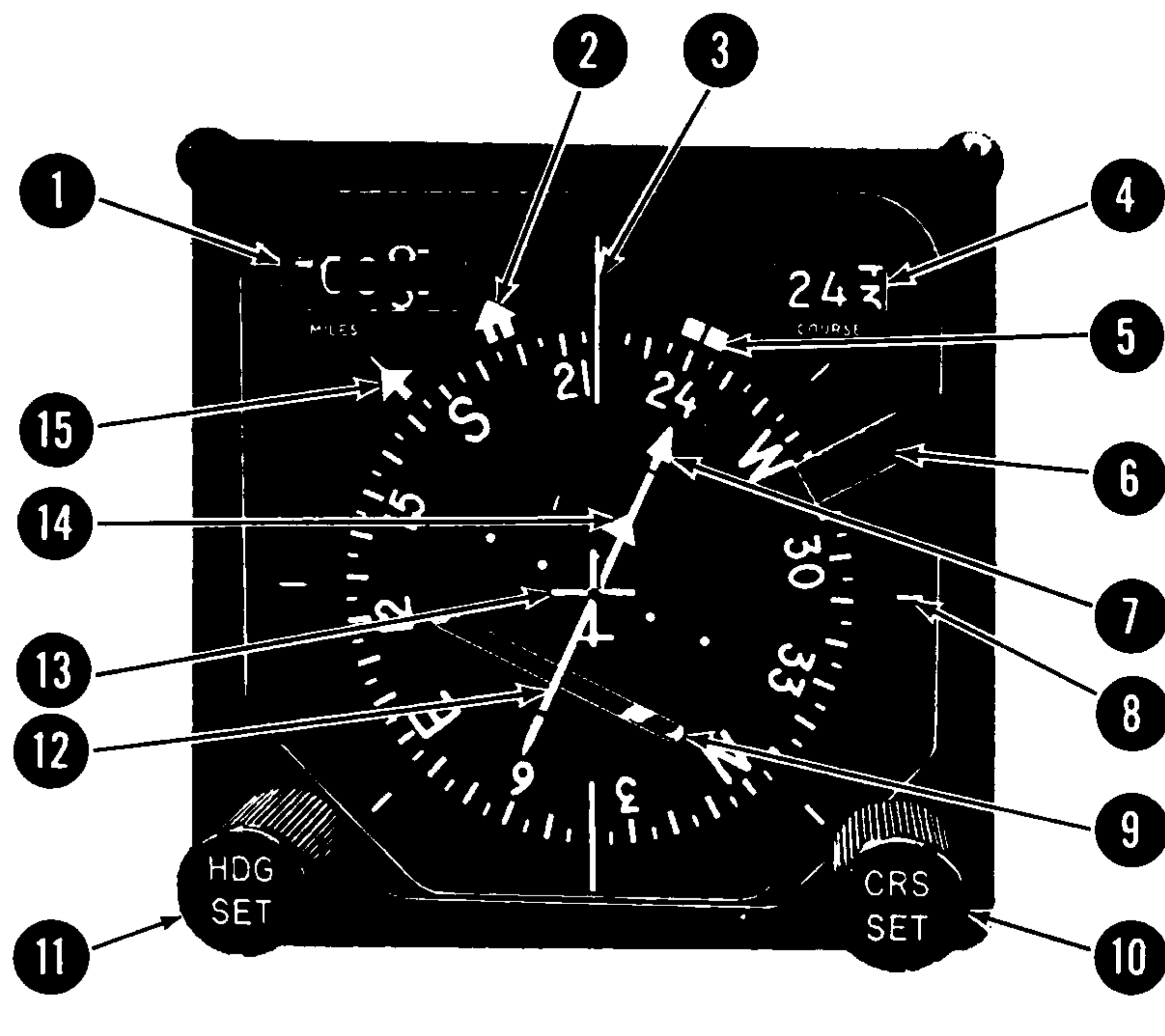
During free gyro operation, the synchronizer indicator window has no significance. If free gyro operation must be used for extended periods, reset the gyro whenever an accurate heading reference can be determined.

HORIZONTAL SITUATION INDICATOR

The horizontal situation indicator (HSI) (figure 1-24), on the pilot's instrument panel, provides range and bearing information, and course-deviation. TACAN bearing (azimuth) information is provided by the small needle head (bug) that moves around the perimeter of the compass card. The HSI needles are identified by the difference in shape: the TACAN needle is a solid triangular indicator; the UHF needle is a broken triangular indicator. When the command ratio is in the ADF mode (COMM AUX selector in the ADF/G position), the UHF indicator reflects the magnetic bearing to the selected UHF transmitter. The TACAN indicator reflects the magnetic bearing to the selected TACAN station. The displacement of the UHF or TACAN needle indicates the heading of the aircraft with respect to the individual ground installation. The course bar on the HSI shows the direction of the ground site with respect to the aircraft.

With a power loss, a red OFF flag appears in the window on the face of the instrument and a mask covers the distance counter. The distance counter is also covered when the TACAN is in REC or with a loss of DME when T/R is selected. A range display in the upper left corner shows the number of nautical miles away from the station. When the radio signal is not readable, a mask covers the numerals. An arrow will simultaneously indicate a TO or FROM direction, depending on whether the aircraft is flying toward or away from the ground station. If the power to the azimuth ceases, the

HORIZONTAL SITUATION INDICATOR



- 1 DISTANCE COUNTER
- 2 BEARING POINTER (ADF)
- 3 LUBBER LINE
- 4 SELECT COURSE COUNTER
- 5 HEADING SELECT MARKER
- 6 POWER OFF WARNING FLAG
- 7 SELECTED COURSE ARROW
- 8 FIXED INDEX
- 9 COURSE BAR SLOT
- 10 COURSE SELECT KNOB
- 11 HEADING SELECT KNOB
- 12 COURSE BAR
- 13 AIRPLANE SYMBOL
- 14 TO-FROM ARROW
- 15 BEARING POINTER (TACAN)

Figure 1-24

A-ADF1-65

NEW TO/FROM arrow will disappear from view. The heading set knob manually adjusts the heading marker. With the course set (CRS SET) knob, the pilot can set in the desired course. Loss of 115 VAC essential or CNI/MA-1 circuit breaker will cause the red "OFF" flag to show in the indicator face.

WARNING

The UHF/ADF (APR-48) antenna is located on the under side of the starboard engine intake beneath the B/N boarding ladder. With landing gear extended, the UHF/ADF magnetic bearing indication displayed on the HSI may be up to 40° in error.

RADAR ALTIMETER SYSTEM AN/APN-141

The radar altimeter is a low-altitude, pulsed, range-tracking radar that measures the surface or terrain clearance below the aircraft. Altitude information is developed by radiating a short-duration RF pulse from the transmit antenna to the earth's surface, and measuring the time interval until RF energy returns through the receiver antenna and is detected in the receiver. The altitude information is continuously presented to the pilot, in feet of altitude, on the dial of an indicator (figure 1-25).

The radar altimeter has two modes of operation. In the search mode, the system successively examines increments of range until the complete altitude range is searched for a return signal. When a return signal is detected, the system switches to the track mode and tracks the return signal, giving continuous altitude information. When the radar altimeter drops out of the track mode of operation, the OFF flag appears and the indicator will drop behind a mask at the base of the instrument. The altimeter remains inoperative until a reliable signal is received from the receiver-transmitter, at which time the altimeter will again indicate the actual altitude above the terrain.

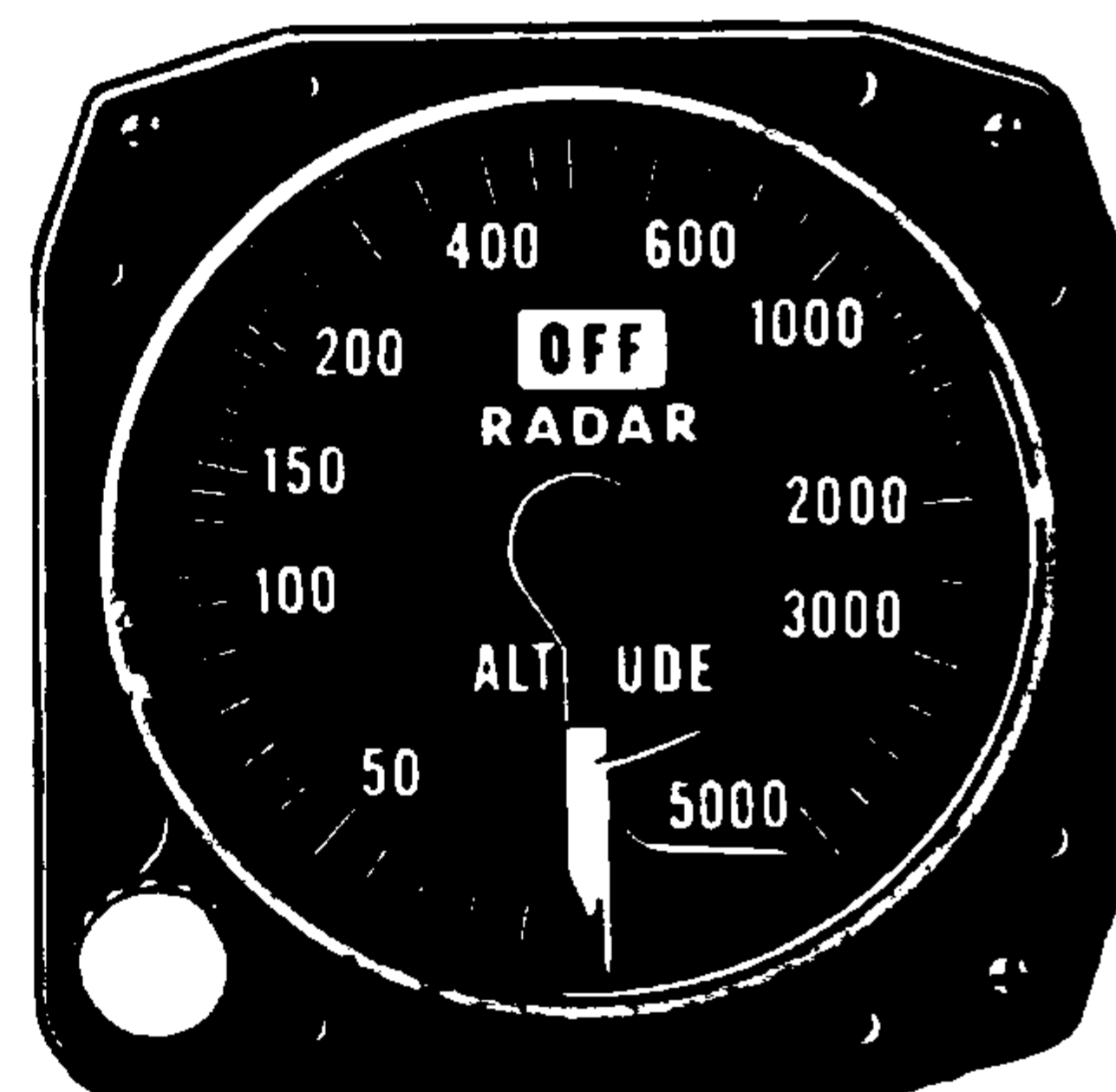
Reliable system operation in the altitude range of 10 to 5,000 feet permits close altitude control at minimum altitudes. The system is inoperative in banks of more than 30°, inclimbs or dives of more than 50° and when the reflected signal is otherwise too weak.

The system includes the height indicator and warning light (figure 1-25) mounted on the pilot's instrument panel, a low-altitude aural warning tone (LAWS), the radar receiver transmitter installed on the rudder actuator access door, and two antennas (transmit and receive) mounted in the rudder actuator access door and in the aircraft skin just forward of the same access door.

RADAR ALTIMETER HEIGHT INDICATOR

This indicator is on the pilot's instrument panel (figure 1-25) and contains the only operating control in the system. The indicator displays radar altitude

RADAR ALTIMETER



ADF1-66

Figure 1-25

above the earth's surface on a single-turn dial that is calibrated from 0 to 5,000 feet in increasing increments. This permits greater definition at lower altitudes.

POWER/SELF-TEST/POSITIONING CONTROL

This control is located in the lower left corner of the indicator. This control is a combination power switch, self-test switch, and a positioning control for the low-altitude limit index (limit bug). The adjustable limit index outside the calibrated scale can be preset to a desired altitude and used as reference for flying at fixed altitudes. By depressing and holding the indicator control knob in flight, the self-test circuit is energized and the indicator will read 5±5 feet. Normal operation is resumed by releasing the control knob.

OFF Flag

The OFF flag in the middle of the indicator is actuated either electronically or mechanically. It is energized electronically when the altitude signal becomes unreliable and exceeds a threshold voltage. Mechanical actuation of the OFF flag is accomplished when the altitude pointer rotates beyond 5,000 feet and actuated the OFF flag switch (figure 1-25).

LOW-ALTITUDE WARNING SYSTEM (LAWS)

The low-altitude warning system provides a low-altitude warning light and low-altitude aural alarm

tone available to the pilot. The system is activated when the aircraft descends below the height set on the limit index of the height indicator, and should be used as an aid to search radar terrain clearance.

In addition, an aural tone and a radar altimeter failure light provide warning of radar altimeter unreliability.

Note

In order for the B/N to hear the aural tone, the pilot must select ALT 1 on his ICS control panel.

Low-Altitude Aural Warning

The low-altitude aural warning alarm provides a 2-second tone through the pilot's headset. The tone is audible if the aircraft descends below the height set on the limit index of the height indicator.

The low-altitude signal alternates between 700 and 1700 Hz at a 2-Hz rate while the unreliable signal alternates between 700 and 1700 Hz at an 8 Hz rate. The volume of the tone must be set prior to flight, since there is no external control that can be adjusted during flight.

Low-Altitude Warning Lamp

The red low-altitude warning lamp is located below the radar altimeter. The low-altitude warning lamp will light whenever the aircraft altitude falls below the pilot's preset limit indexer.

Radar Altimeter Failure Light

A radar altimeter failure light glows RA in black letters on a red background in the lower half of the vertical bar on the right side of VDI. When the output of the radar altimeter is less than 1 volt (20 feet) or greater than 26.5 volts (5000 feet) the light will be lit. Circuitry may be tested by depressing the LTS WARN button on the master test panel.

LAWS PREFLIGHT CHECK

1. The intercommunications set must be on and operating for the signals to be heard through the pilot's headset.
2. Turn the radar altimeter on and set the altitude limit index at 25 feet. On initial turn on, the OFF flag appears and the pointer moves behind the mask. Check that the radar altimeter failure light (RA) is on and the radar altitude curtain on the VDI is not in view.
3. After warmup (1 to 5 minutes) the OFF flag disappears and the pointer moves from behind the mask to an altitude between 0 and 10 feet. As the pointer passes the preset limit index altitude, the low-altitude signal is heard in the pilot's headset and the low-altitude warning light comes on. At this time, the radar altimeter failure light comes on and the altitude curtain disappears.

MISCELLANEOUS INSTRUMENTS

ACCELEROMETER B-6

The B-6 accelerometer (figure FO-2) is a direct-reading instrument used to measure the accelerations of the aircraft along its vertical axis. The dial is graduated in g units from -5g to +10g. The normal reading of the instrument at rest is +1g. The instrument has three pointers. The main pointer gives a continuous indication of the vertical acceleration of the aircraft. The other two pointers stop at the maximum positive acceleration and maximum negative acceleration reached during any specific maneuver. These pointers will remain fixed until reset to +1g by means of depressing the knob on the lower left corner of the instrument.

G-METER

The g meter (figure FO-2) displays the magnitude of normal acceleration in g units. A sensor unit in the left wheel well transmits potentiometer pickoff information from the position of a spring-loaded mass to a servomotor. The servomotor positions the instrument marker, which moves vertically across the instrument face. The range of the instrument is -5g to +10g.

STANDBY COMPASS

A conventional standby compass is above the center of the aircraft instrument panel. It is a semifloat-type compass suspended in compass fluid. A pair of magnets attached to the compass card align with the earth's magnetic field to present magnetic heading indications. Extraneous magnetic fields are minimized by build-in permanent magnets. A compass correction card containing corrections for instrument error for various headings is found above the standby compass.

CLOCKS

Two mechanical, integrally lighted 8-day clocks with 12-hour elapsed-time capability are provided, one on the pilot's instrument panel, and one on the bombardier/navigator's right console. The winding and setting knob is in the lower left corner of the instrument; the elapsed-time setting knob is in the upper right. Successive depressions of the elapsed-time setting knob will start, stop, and reset the sweep second hand and elapsed-time hand to the 12-o'clock position.

OUTSIDE AIR TEMPERATURE INDICATOR

The outside air temperature indicator (OAT) on the lower right corner of the bombardier/navigator's instrument panel has a single pointer dial calibrated in 5° increments from -50°C to +75°C. The temperature bulb aft of the right intake duct is a resistance-type sensor. The bulb and indicator are powered by the 28 V DC monitor bus through the ENG DC INST circuit breaker in the nose-wheel well.

CAUTION, WARNING, AND ADVISORY LIGHTS

The caution, warning, and advisory lights (figure 1-26) include the pilot's indicator lights and the bombardier/navigator's indicator lights. Lighting of a particular light is applicable to the system and a condition associated with it. The description and function of each light is incorporated under the applicable system.

ANNUNCIATOR PANEL

The annunciator panel (figure 1-26) on the lower center portion of the pilot's instrument panel provides caution lights for the various aircraft systems. Lighting of a particular light is advisory of a malfunction or emphasizes a particular condition of the applicable system, and will cause the master caution lights to flash. When the master caution lights are reset, the annunciator light will remain on until the discrepancy is corrected.

The lights are powered by the essential 28V DC bus through the CAUTION LTS circuit breaker on the main circuit breaker panel.

MASTER CAUTION LIGHT AND RESET BUTTON

The master caution light on the left of the optical sight (figure FO-2), and the other above the bombardier/navigator's ECM panel (figure FO-3), will give a flashing indication whenever a caution light on the annunciator panel comes on. The master caution reset button will turn the master caution light off, and rearm the circuit for any subsequent caution lights.



Due to the proximity of the emergency stores jettison button, care should be exercised to prevent inadvertent stores jettisoning (figure FO-2).

MASTER TEST PANEL

The master test panel (figure FO-2) is in the center of the pilot's instrument panel adjacent to the annunciator panel, and contains three press-to-test buttons. The primary purpose of the master test panel is to check the circuitry of the warning and caution lights by means of the LTS WARN and the FIRE/OIL test buttons. The LOX/FUEL/OIL test button will check the quantity gage circuitry of the oxygen, fuel and oil systems. For details of each quantity gage test, refer to the applicable system description.

FIRE/OIL Press-To-Test Button

The button placarded FIRE/OIL on the master test panel, turns on the two fire warning lights. It also turns on the low oil lights on the annunciator panel.

LOX/FUEL/OIL Press-To-Test Button

The LOX/FUEL test button is used to test electrical circuitry of the oxygen quantity gage, the oxygen warning light, and the fuel quantity gage needles. In aircraft placarded LOX/FUEL/OIL, in addition to checking oxygen and fuel quantity gages, lighting of the OIL LOW lights is a check of oil quantity.

LTS WARN Press-To-Test Button

The LTS WARN press-to-test button on the master test panel is used to check for operating circuitry of the following warning and caution lights:

ATTACK	WHEELS WARNING
MASTER CAUTION	WHEELS TRANSITION
COLLISION/NWW TEMP	HOOK LIFT
APPROACH INDEXER	OUTBD WG PSI
ANNUNCIATOR PANEL	INBD WG PSI
ARM WEAPON	RADAR ALTIMETER
APCS STBY	TERRAIN CLEARANCE
BREAKAWAY	RESELECT
IN-RANGE	COMPLETE

BOMBARDIER/NAVIGATOR'S MASTER TEST BUTTON

This test button on the bombardier/navigator's right console (figure FO-3) provides a means of checking the circuitry of the bombardier/navigator's indicator lights (figure 1-26). It also provides a circuitry check of the computer and attack lights on the pilot's VDI.

FIRE WARNING LIGHTS

Two fire warning lights, one for each engine, are on opposite sides of the optical sight (figure 1-26). The lights will come on when the heat-sensing elements, which are placed where excessive heat is likely to occur, are grounded. If a fire occurs, the semiconductor section of the sensing element heats up, decreasing resistance, and grounding the circuit. The circuit can also be grounded by the FIRE/OIL test button on the master test panel.

The system includes a short discriminator; however, if a short occurs, the light may flash on momentarily.

NWW TEMP LIGHT

In aircraft 158533 and subsequent and those incorporating AFC No. 268, the COLLISION light is replaced by a NWW TEMP light on the lower right side of the optical sight. The light will come on when the heat-sensing element array placed near the bleed-air ducting in the nose-wheel well and radome areas senses excessive heat. The light is tested by the FIRE/OIL press-to-test button.

COLLISION LIGHT

The collision light, located on the lower right side of the optical sight, has no operational function. AFC No. 268 replaces the collision light with the NWW TEMP light.

CAUTION, WARNING, AND ADVISORY LIGHTS

The caution, warning, and advisory lights (figure 1-26) include the pilot's indicator lights and the bombardier/navigator's indicator lights. Lighting of a particular light is applicable to the system and a condition associated with it. The description and function of each light is incorporated under the applicable system.

ANNUNCIATOR PANEL

The annunciator panel (figure 1-26) on the lower center portion of the pilot's instrument panel provides caution lights for the various aircraft systems. Lighting of a particular light is advisory of a malfunction or emphasizes a particular condition of the applicable system, and will cause the master caution lights to flash. When the master caution lights are reset, the annunciator light will remain on until the discrepancy is corrected.

The lights are powered by the essential 28V DC bus through the CAUTION LTS circuit breaker on the main circuit breaker panel.

MASTER CAUTION LIGHT AND RESET BUTTON

The master caution light on the left of the optical sight (figure FO-2), and the other above the bombardier/navigator's ECM panel (figure FO-3), will give a flashing indication whenever a caution light on the annunciator panel comes on. The master caution reset button will turn the master caution light off, and rearm the circuit for any subsequent caution lights.



Due to the proximity of the emergency stores jettison button, care should be exercised to prevent inadvertent stores jettisoning (figure FO-2).

MASTER TEST PANEL

The master test panel (figure FO-2) is in the center of the pilot's instrument panel adjacent to the annunciator panel, and contains three press-to-test buttons. The primary purpose of the master test panel is to check the circuitry of the warning and caution lights by means of the LTS WARN and the FIRE/OIL test buttons. The LOX/FUEL/OIL test button will check the quantity gage circuitry of the oxygen, fuel and oil systems. For details of each quantity gage test, refer to the applicable system description.

FIRE/OIL Press-To-Test Button

The button placarded FIRE/OIL on the master test panel, turns on the two fire warning lights. It also turns on the low oil lights on the annunciator panel.

LOX/FUEL/OIL Press-To-Test Button

The LOX/FUEL test button is used to test electrical circuitry of the oxygen quantity gage, the oxygen warning light, and the fuel quantity gage needles. In aircraft placarded LOX/FUEL/OIL, in addition to checking oxygen and fuel quantity gages, lighting of the OIL LOW lights is a check of oil quantity.

LTS WARN Press-To-Test Button

The LTS WARN press-to-test button on the master test panel is used to check for operating circuitry of the following warning and caution lights:

ATTACK	WHEELS WARNING
MASTER CAUTION	WHEELS TRANSITION
COLLISION/NWW TEMP	HOOK LIFT
APPROACH INDEXER	OUTED WG PSI
ANNUNCIATOR PANEL	INBD WG PSI
ARM WEAPON	RADAR ALTIMETER
APCS STBY	TERRAIN CLEARANCE
BREAKAWAY	RESELECT
IN-RANGE	COMPLETE

BOMBARDIER/NAVIGATOR'S MASTER TEST BUTTON

This test button on the bombardier/navigator's right console (figure FO-3) provides a means of checking the circuitry of the bombardier/navigator's indicator lights (figure 1-26). It also provides a circuitry check of the computer and attack lights on the pilot's VDI.

FIRE WARNING LIGHTS

Two fire warning lights, one for each engine, are on opposite sides of the optical sight (figure 1-26). The lights will come on when the heat-sensing elements, which are placed where excessive heat is likely to occur, are grounded. If a fire occurs, the semiconductor section of the sensing element heats up, decreasing resistance, and grounding the circuit. The circuit can also be grounded by the FIRE/OIL test button on the master test panel.

The system includes a short discriminator; however, if a short occurs, the light may flash on momentarily.

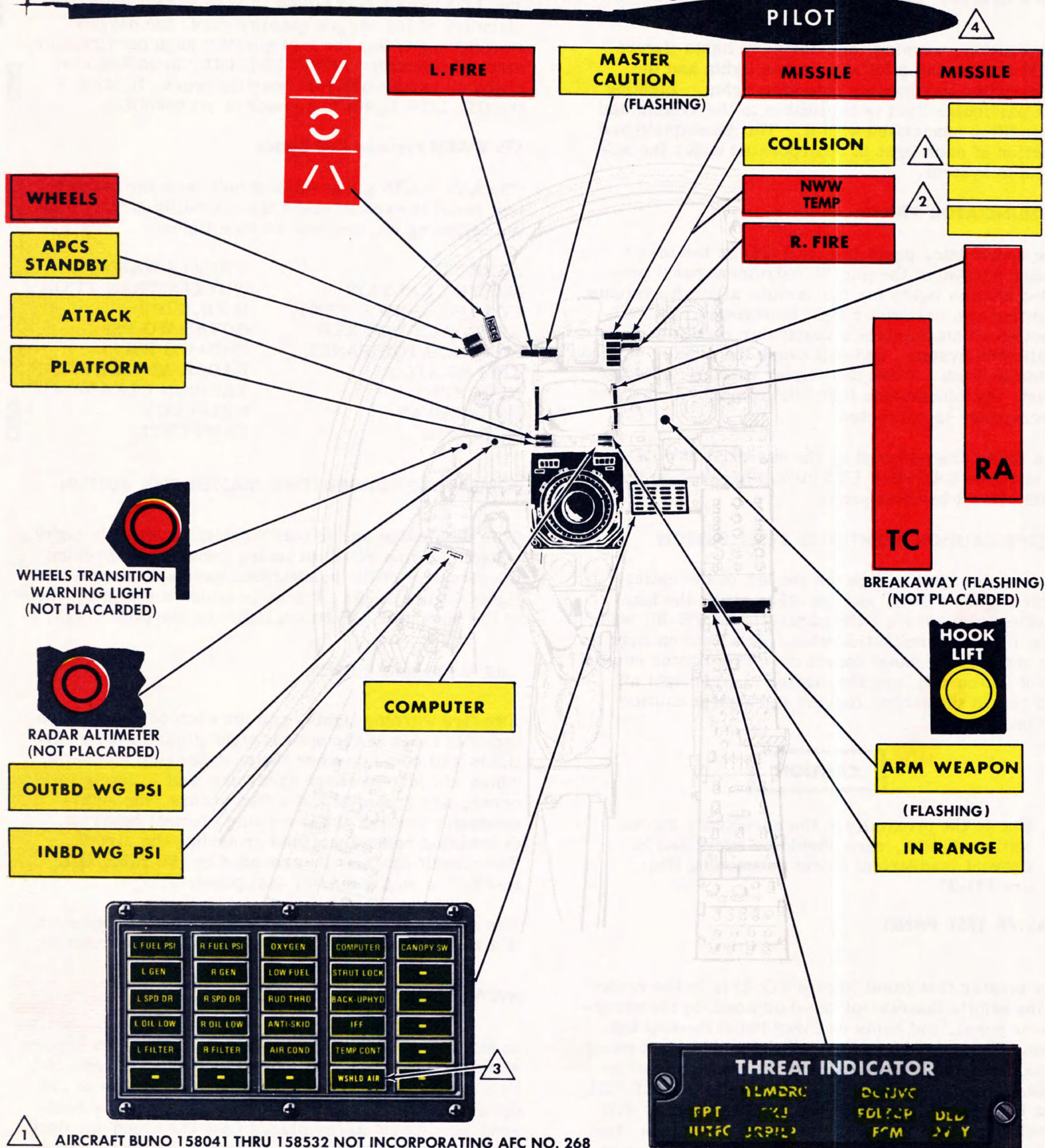
NWW TEMP LIGHT

In aircraft 158533 and subsequent and those incorporating AFC No. 268, the COLLISION light is replaced by a NWW TEMP light on the lower right side of the optical sight. The light will come on when the heat-sensing element array placed near the bleed-air ducting in the nose-wheel well and radome areas senses excessive heat. The light is tested by the FIRE/OIL press-to-test button.

COLLISION LIGHT

The collision light, located on the lower right side of the optical sight, has no operational function. AFC No. 268 replaces the collision light with the NWW TEMP light.

WARNING, CAUTION AND ADVISORY LIGHTS



B-ADFI-29-1

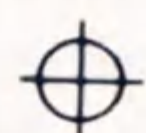
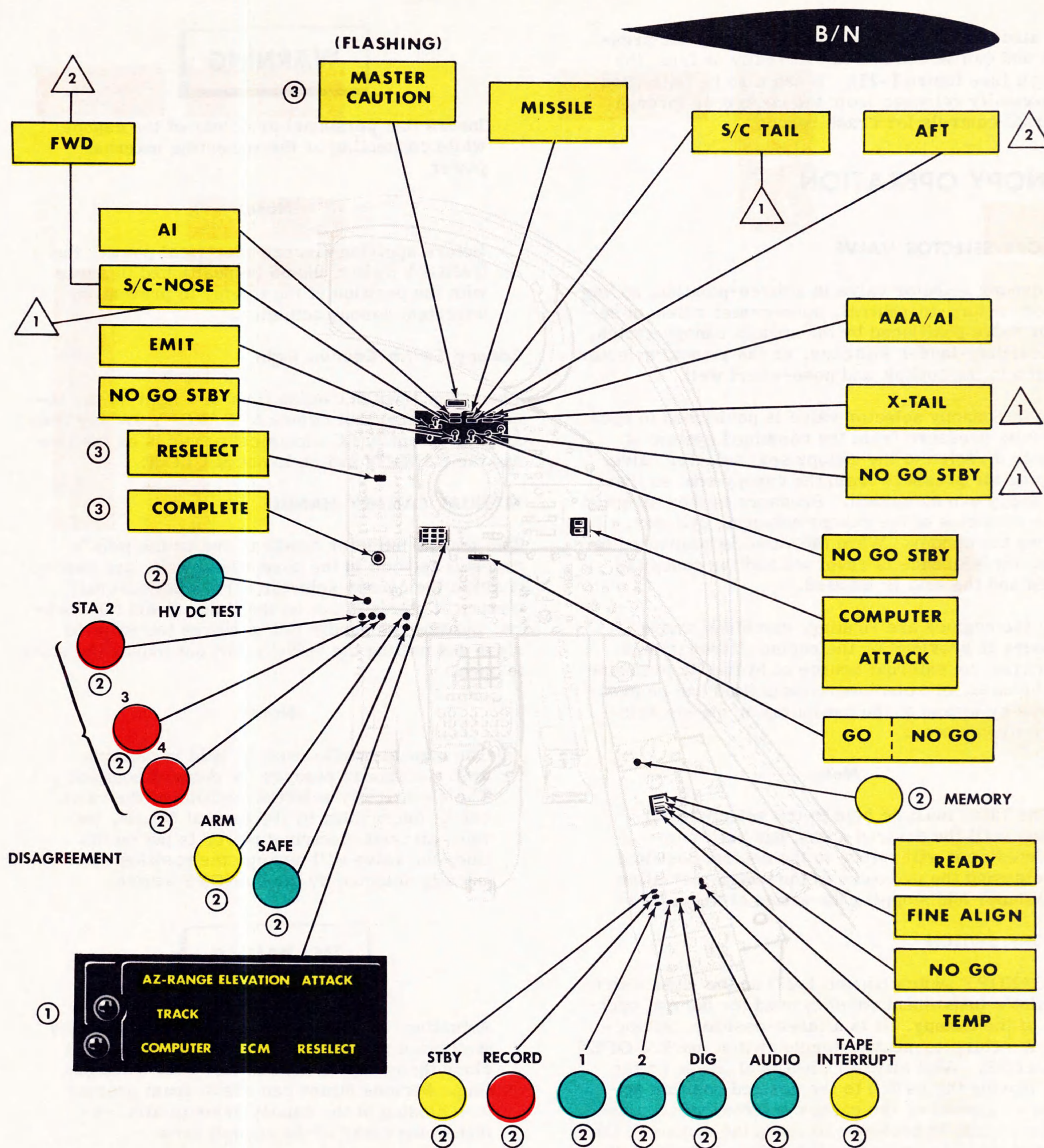


Figure 1-26 (Sheet 1)



① MAY BE TESTED BY PRESSING EITHER PILOT'S OR B/N'S MASTER TEST BUTTON

② DOES NOT ILLUMINATE WHEN B/N'S MASTER TEST BUTTON IS DEPRESSED

③ MAY ONLY BE TESTED BY DEPRESSING PILOT'S MASTER TEST BUTTON

① AIRCRAFT NOT INCORPORATING A.F.C. NO. 287

② AIRCRAFT INCORPORATING A.F.C. NO. 287

A-ADFI-29-2

Figure 1-26 (Sheet 2)

CANOPY

The aircraft canopy is operated by hydraulic pressure and can be controlled externally or from the cockpit (see figure 1-27). It can also be jettisoned or manually released from the cockpit or through external controls for crash rescue.

CANOPY OPERATION

CANOPY SELECTOR VALVE

The canopy selector valve is a three-position, spring-loaded, return-to-neutral, open-center solenoid selector valve positioned by the cockpit canopy switch, the boarding-ladder switches, or the manual selector handles in the cockpit and nose-wheel well.

When the canopy selector valve is positioned to open, hydraulic pressure from the combined system is initially directed to the canopy seal selector valve, dumping air pressure from the canopy seal so that the canopy can be opened. Pressure is then directed to the open side of the canopy actuating cylinder, opening the canopy. When the valve is positioned to close, the sequence is reversed and the canopy is closed and the seal is inflated.

When the engines are running, combined system pressure is provided by the engine-driven pumps. Otherwise, an external source of hydraulic pressure may be used, or combined system fluid can be pressurized by means of the handpump or the electric-motor-driven pump.

Note

The valve must be held in the selected position until the desired action has been completed or it will return to the neutral position, releasing the pressure to the canopy actuating cylinder and stopping the action of the canopy.

CANOPY SWITCH

The CANOPY switch (figure 1-27) on the right side of the pilot's instrument panel is used for normal operation of the canopy. It is a three-position, spring-loaded, return-to-neutral toggle switch marked OPEN and CLOSE. With aircraft electrical power on the line, moving the switch to the desired position actuates a solenoid on the canopy selector valve, permitting hydraulic pressure to move the canopy to the selected position as long as the switch is held in the desired position. To help ensure positive canopy lock, a magnetic holding device holds the CANOPY switch in the CLOSE position when selected until aircraft electrical power drops off the line or the switch is repositioned manually. A CANOPY SW light on the annunciator panel comes on when the canopy switch is not at CLOSE with aircraft electrical power on the line. Moving the switch to CLOSE turns off the light.

WARNING

Insure that personnel are clear of the canopy while connecting or disconnecting external power.

Note

Before applying aircraft electrical power, the CANOPY switch should be positioned to agree with the position of the canopy to prevent inadvertent canopy actuation.

Canopy Switch Caution Light

The canopy switch caution light is a light on the annunciator panel that comes on CANOPY SW any time aircraft primary DC electrical power is on the line and the CANOPY switch is not at CLOSE.

MANUAL CANOPY HANDLE

Two manual selector handles, one on the pilot's pedestal and one in the nose-wheel well, are used to position the canopy selector valve when aircraft electrical power is not on the line. From the cockpit, pushing the handle full in moves the valve to close and pulling the valve to full out moves the valve to open.

Note

The manual handle must be held in position until the canopy reaches the desired position. The electrically selected position of the valve can be overridden by the manual handle, but when aircraft electrical power is put on the line, the valve will assume the position electrically selected by the CANOPY switch.

WARNING

Actuating the manual canopy selector handle to the closed position after engine shutdown will close the canopy if engines are still windmilling. Serious injury can result from premature closing of the canopy prior to aircrewmen being clear of the cockpit area.

Note

If the manual canopy selector handle is actuated while operating on aircraft electrical power, the position of the cockpit electrical switch will determine the canopy position when the handle is released.

CANOPY CONTROLS AND INDICATORS

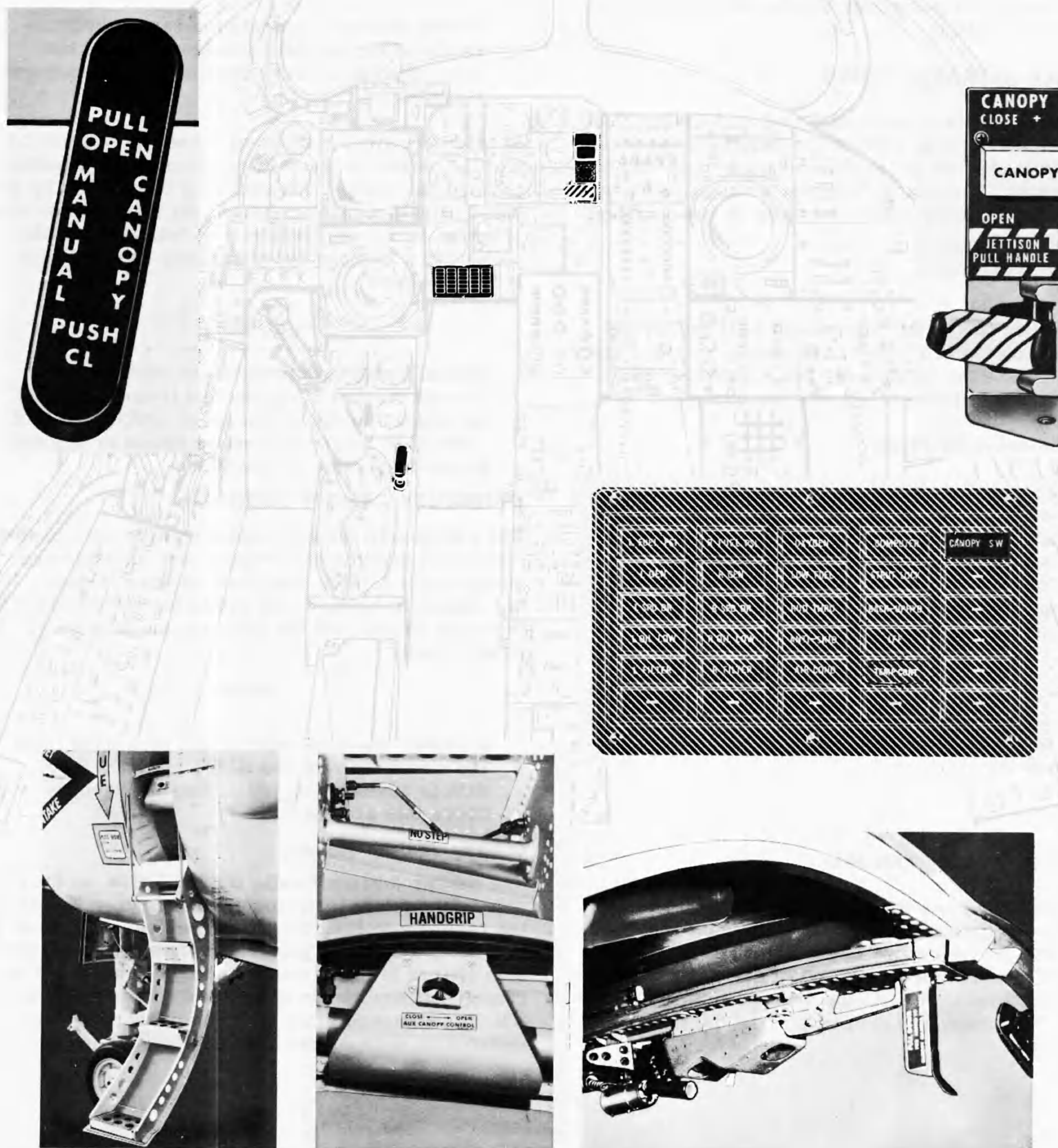


Figure 1-27

BOARDING-LADDER SWITCHES

Two three-position, spring-loaded, return-to-neutral switches, one in each boarding-ladder well, are provided for external operation of the canopy. These switches are placarded AUX CANOPY CONTROL. Holding either switch in the OPEN or CLOSE position actuates the canopy selector valve and operates the electric-motor-driven pump to move the canopy to the selected position.

AUXILIARY HYDRAULIC PUMPS

When the engines are secured, combined system fluid can be pressurized to operate the canopy by means of the handpump or the battery-powered electric-motor-driven pump. The canopy selector valve is positioned by the manual canopy selector handle or the boarding-ladder switches.

Hand Pump

Two handles, one in the nose-wheel well and one in the cockpit on the left side of the center console, are used to operate the handpump, which provides combined system pressure to operate the canopy.

Electric-Motor-Driven Pump

The electric-motor-driven pump provides combined system pressure for canopy operation on the ground and is operated by a pushbutton switch in the cockpit placarded AUX HYD PUMP MOTOR, or by the boarding-ladder switches. The pushbutton switch is on the handpump handle stop on the left side of the center console.

Note

Insure that personnel are clear of the canopy while connecting or disconnecting external power.

CANOPY REMOVAL (MANUAL)

If the canopy seal has first been deflated, the canopy can be removed manually by pulling the manual release handle on the canopy beam (figure 1-27) (or the external T-handles on the aft end of the canopy) disconnecting the canopy from the hydraulic actuating piston. The canopy can then be slid off the tracks and removed.

The canopy seal is best deflated by cracking the canopy slightly with the hydraulic handpump or the electric-motor-driven pump. This opens the canopy seal selector valve, dumping air pressure from the seal and frees the canopy for opening.

CAUTION

Do not attempt to operate the canopy hydraulically after the manual release handle has been pulled until the actuating piston has been reconnected.

In an emergency, if the seal cannot be deflated by the normal means and it is impractical or impossible to jettison the canopy, the seal may be deflated by puncturing it with a knife. Cutouts for this purpose are provided in the seal retainer on both sides of the cockpit at a location approximately even with the B/N's backrest.

CAUTION

Manual canopy removal is not intended as a normal method of egress and if used, should be entered in the yellow sheet (OPNAV FORM 3760-2) to insure corrective action or appropriate inspection is completed.

EMERGENCY CANOPY JETTISON

The emergency canopy jettison system uses pressure from a precharged air bottle to fire an explosive charge placed in the canopy actuating cylinder. When the charge is fired, a rod within the piston rod will drive the canopy and its retaining mechanism off the canopy track.

Note

Although canopies have safely separated from the aircraft above 220 KIAS, no flight test data is available on jettisoning the canopy above this airspeed.

Canopy Jettison Handle

The canopy jettison handle (figure 1-27), on the right side of the pilots instrument panel is used to jettison the canopy. Pulling the handle releases air from a precharged bottle to pneumatically activate an explosive charge in the canopy actuating cylinder. The canopy jettison handle is guarded with a safety pin which is removed prior to flight. For detail procedures on escape, see Section V of this manual.

NEW

ESCAPE SYSTEM

Safe escape from the aircraft is provided by individually controlled MK GRU-7 rocket-assisted ejection seats for each crewmember. The seats are not interlocked with the canopy and may be ejected through the canopy. The seat catapult guns are equipped with water-tight seals, permitting under-water ejection.

The seats are capable of safe ejection on the deck at zero airspeed, and in straight and level flight throughout the operational envelope of the aircraft. Capabilities of the seat are shown in Section V.

Preflight procedures and location of safety pins are shown in Section III. Ejection procedures are discussed in Section V.

EJECTION SEAT

N E W The seat (figure (1-28)) consists of a main beam assembly composed of two vertical beams and three horizontal members plus the following components and assemblies: a seat-stabilizer drogue-parachute container assembly with headrest; primary firing mechanism and attached face curtain; secondary firing handle; parachute withdrawal-line guillotine; drogue gun; time-release mechanism; powered inertia-reel mechanism and attached leg garters and leg-restraint cord assemblies; ventilated parachute back pad; ventilated seat cushion; RSSK-7 survival kit containing an emergency oxygen bottle, and the seat-bucket height-adjustment actuator. Each seat contains an emergency harness-release handle, a 28-foot personnel parachute and container, and a rocket motor triggered by a gas-generating initiator.

N E W A powered retraction inertia reel triggered by a gas-generating initiator, which is actuated by the face-curtain handle or alternate firing handle, insures that the occupant is pulled back into the seat prior to ejection. Ejection of either seat sets the IFF/SIF modes 1 and 3 to emergency and actuates the equipment destruct system.

EJECTION SEAT OPERATION

N E W The ejection sequence is initiated by pulling the face-curtain firing handle or the alternate firing handle. When either firing handle is pulled, the catapult sear and inertia-reel sear are withdrawn. The powered inertia reel pulls the occupant back into the seat to an upright position. When the catapult gun fires, the expanding gases drive the catapult tubes upward and eject the seat and occupant from the aircraft. As the seat rises, the leg-restraint cords are pulled tight, holding the occupant's legs back against the leg pads. As the seat continues to rise, tension built up in the restraint cords shear rivets (securing the cords to the deck), freeing the cords from the

aircraft. The occupant's legs remain secured to the seat by snubbers wedging against the restraint cord, preventing any flailing of the occupant's legs. The occupant's legs remain secured to the seat until the time-release mechanism actuates a plunger freeing the occupant's legs prior to separation from the seat. While the set is going up the rail, the following events occur:

- The drogue-gun trip rod is pulled.
- The time-release mechanism trip rod is pulled.
- Personnel services disconnect lanyard is pulled.
- The emergency oxygen bottle is activated.
- The IFF/SIF emergency code is activated.
- The rocket-motor gas-generator lanyard is pulled.

When fully extended, the rocket-motor lanyard fires the gas generator, which fires the rocket motor under the seat.

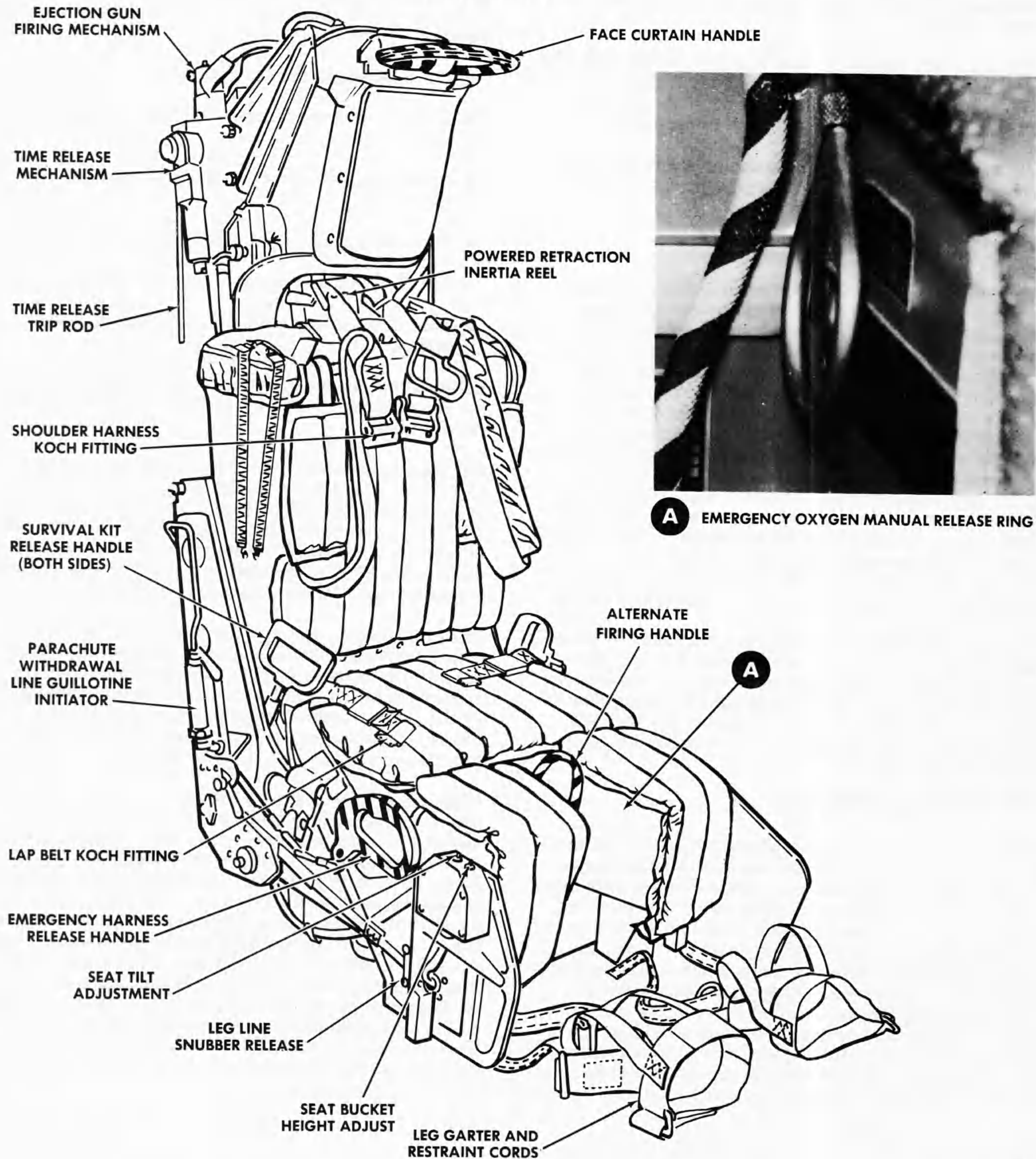
One-half second after the drogue-gun trip rod is extracted, a small controller drogue chute is drawn from the pack by a metal piston fired from the drogue gun. The controller drogue chute then tows the stabilizer chute out of its container. The stabilizer chute is secured to the seat by a scissor shackle until released by the time-release mechanism.

During ejection, the occupant is held in the seat by upper restraint straps, lap belt, and leg-restraint cords. Deployment of the personnel parachute and separation of the occupant from the seat are delayed by the time-release mechanism until the occupant has descended from the upper atmosphere or until expiration of a 2.0-second time delay.

When the seat is below an altitude of 11,500 to 14,500 feet (barostat setting), the time-release mechanism starts a 2.0-second time delay, after which the time-release mechanism releases the drogue parachute from the scissors shackle, allowing the drogue chute to pull the personnel parachute withdrawal line out of the guillotine and deploy the personnel parachute. At the same time, the shoulder harness restraints, leg restraints, survival kit, and face blind are unlocked. The occupant is then free to be pulled from the seat sticker clips by the line stretch of the main parachute as the seat rotates away. When the occupant is free from the seat, he makes a normal parachute descent with his (RSSK-7) survival kit connected to him by the integrated torso harness.

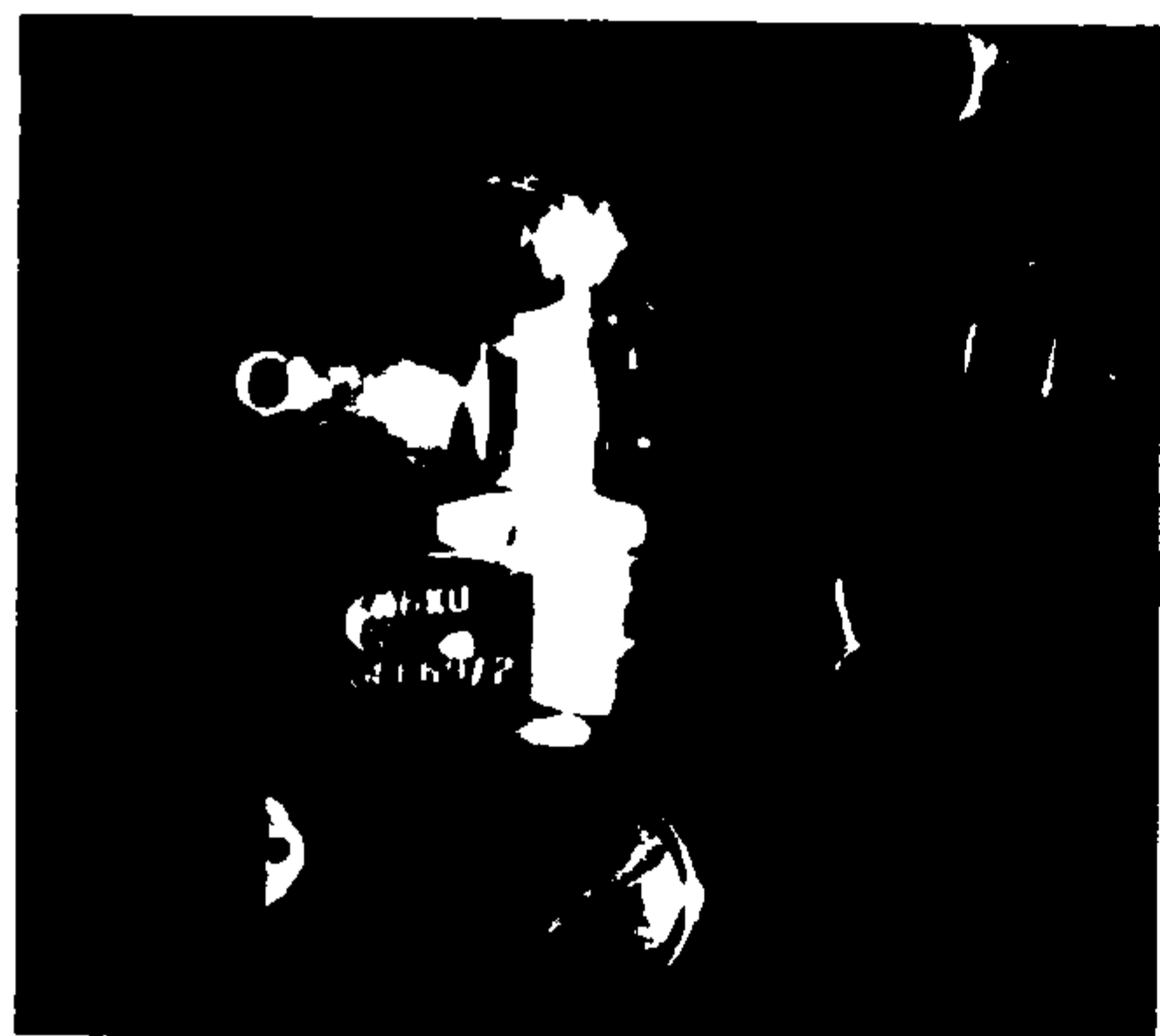
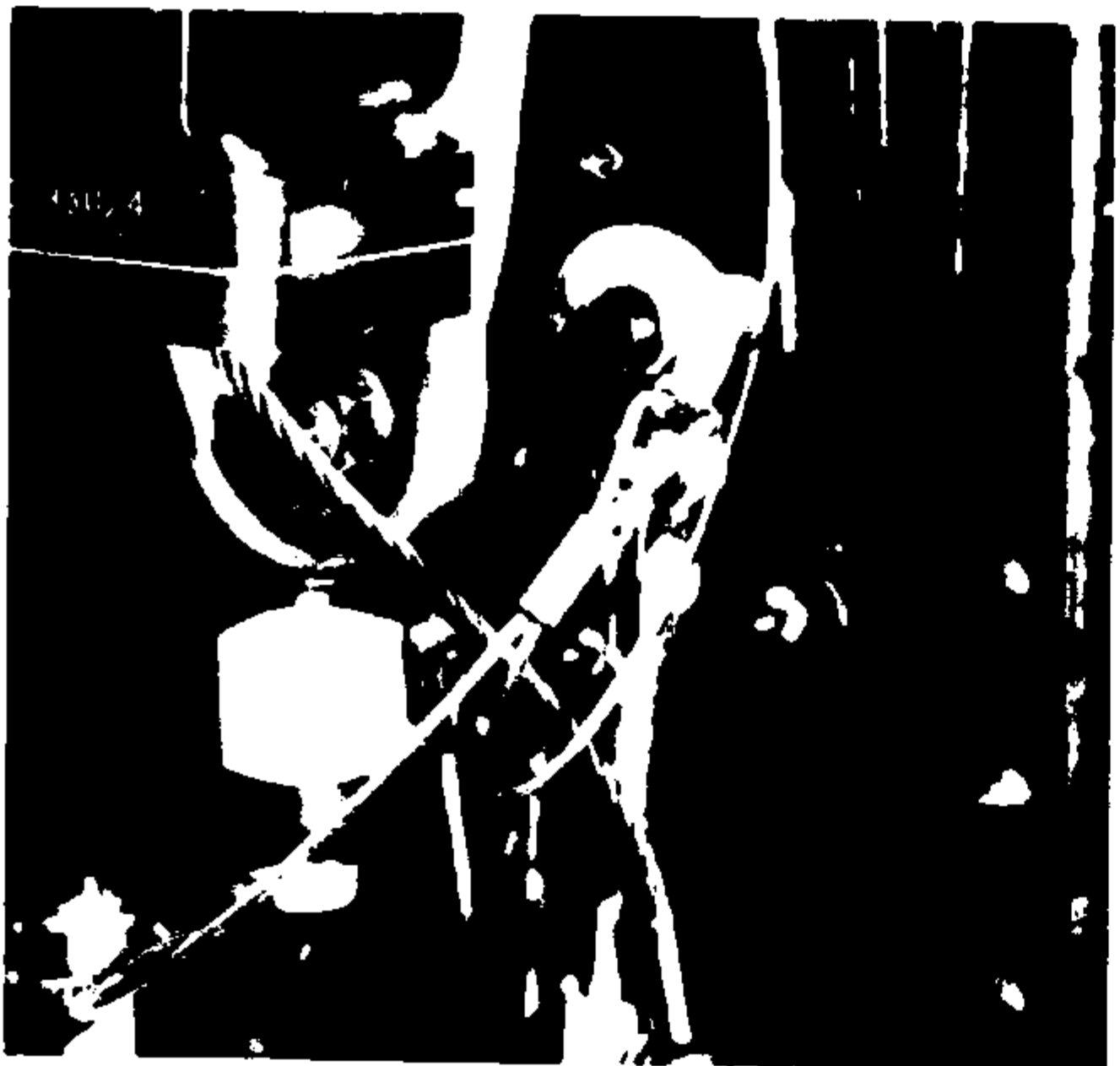
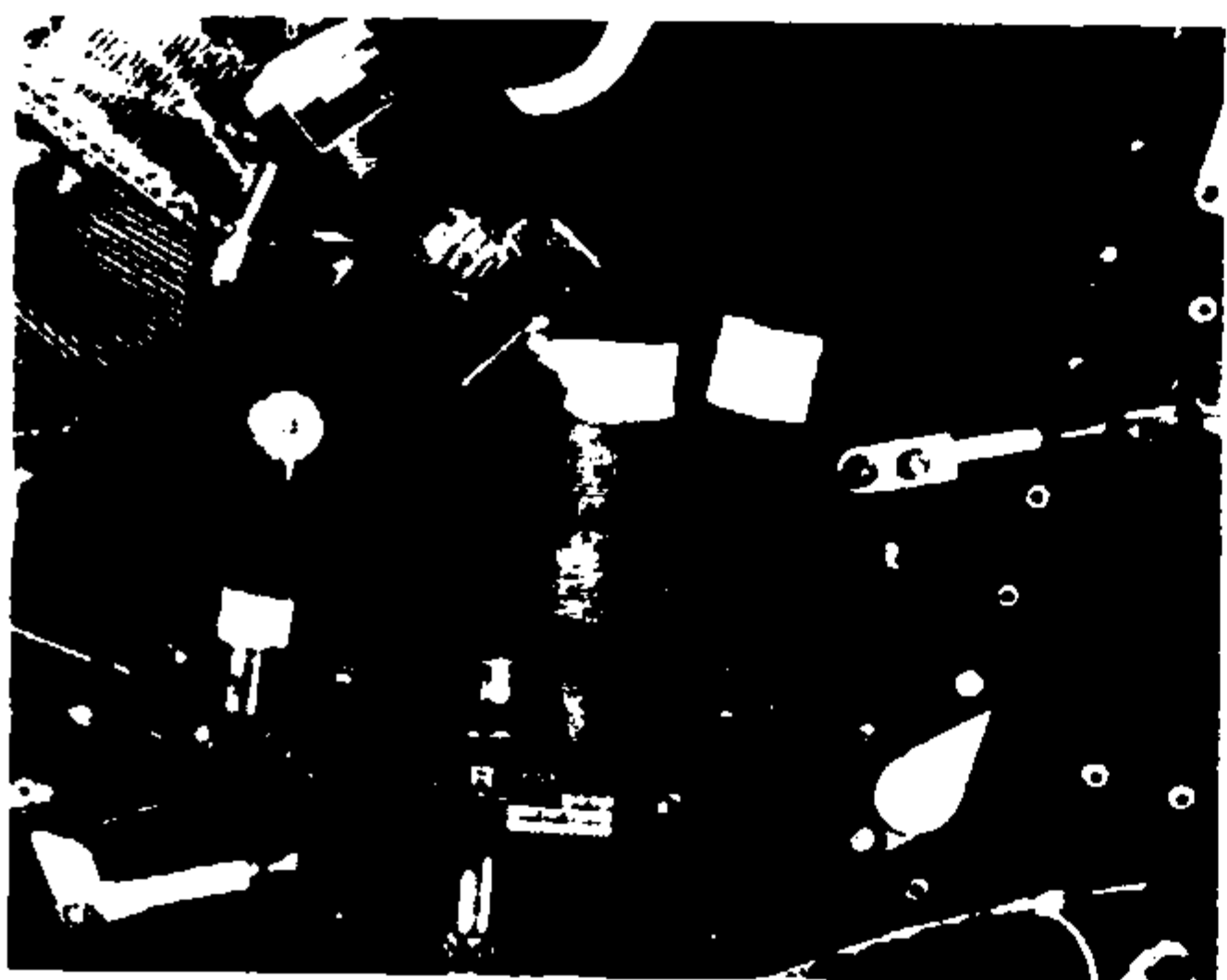
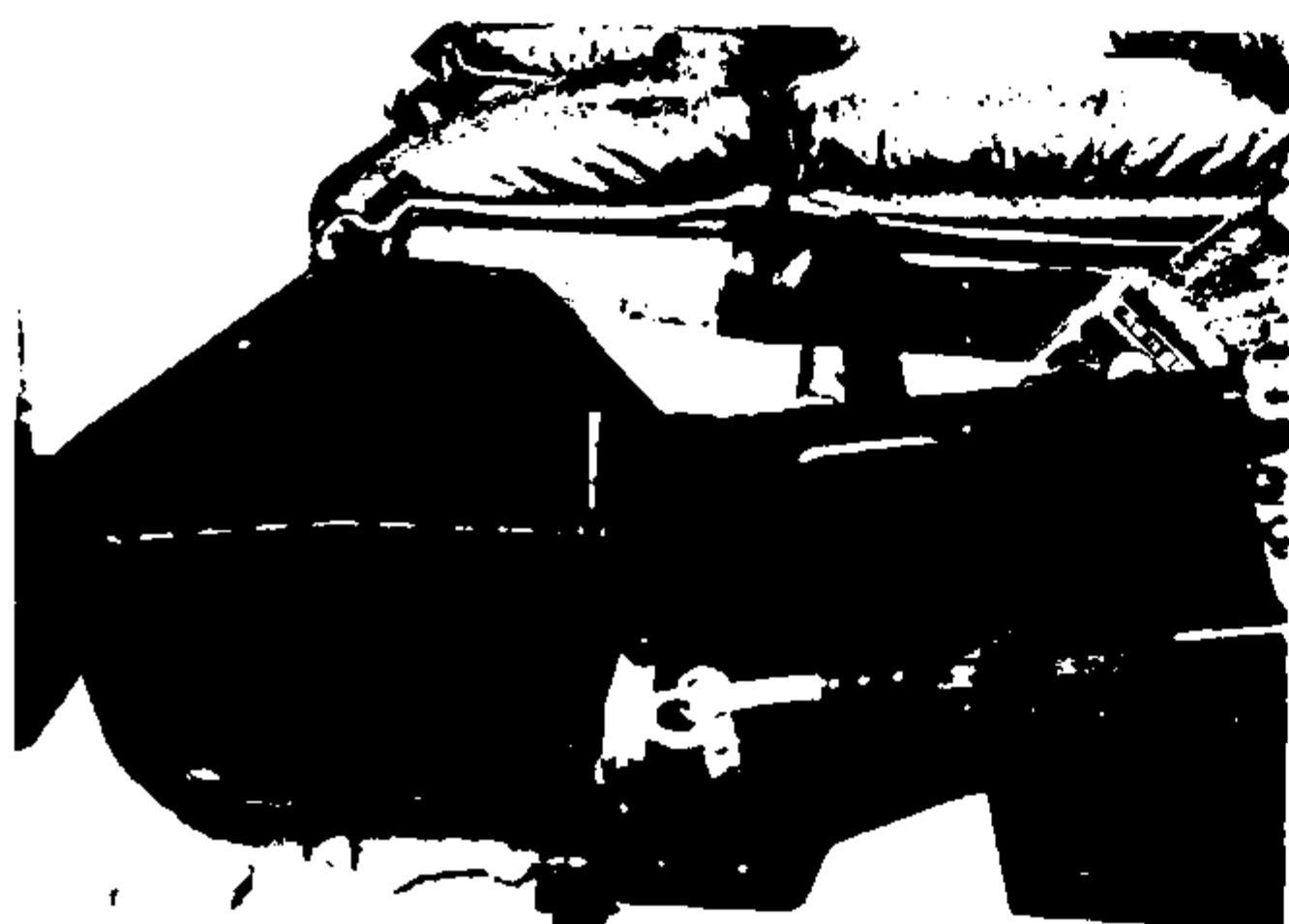
EJECTION SEAT

MK GRU 7



A-ADF1-24-1

Figure 1-28 (Sheet 1)


B ROCKET MOTOR INITIATOR

C ROCKET MOTOR INITIATOR
STATIC LINE

D PERSONNEL DISCONNECT LINES

E SURVIVAL KIT FRONT
LOCK RELEASE LEVER

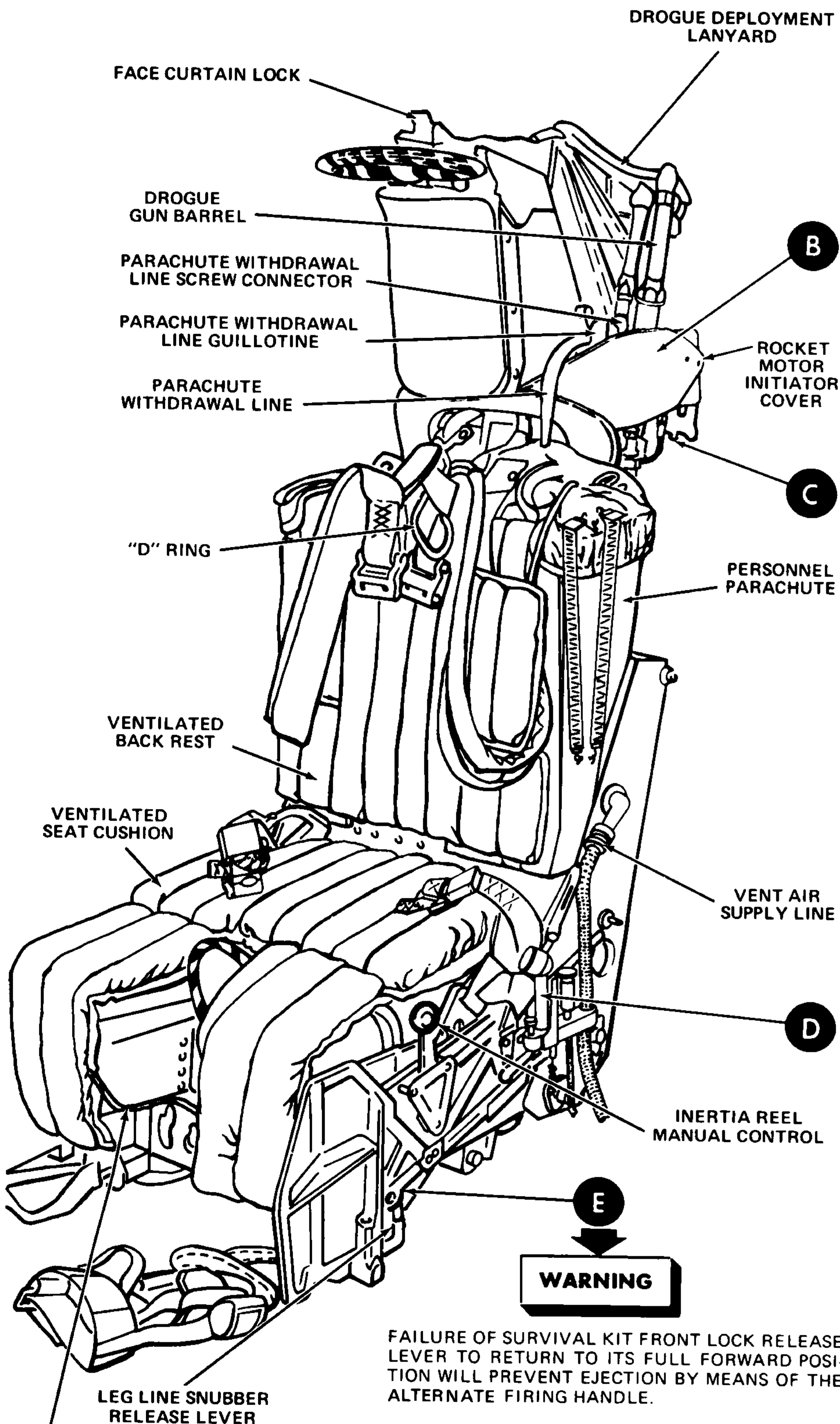
RADIO BEACON
ACTUATING LANYARD


Figure 1-28 (Sheet 2)

MANUAL SEAT SEPARATION

If the time-release mechanism fails, the crewmember can manually separate from the seat by pulling up and aft on the harness emergency-release handle (front right side of seat bucket). Rotating the harness emergency-release handle fires the guillotine severing the personnel parachute withdrawal line and releasing the shoulder-harness restraint straps the lap belt, the leg-line straps, parachute container, and survival kit. The occupant must kick free of the seat and manually deploy the personnel parachute by pulling the D-ring.

WARNING

The personnel parachute must be deployed manually if the harness emergency-release handle has been pulled.

EJECTION CONTROLS

Face-Curtain Handle

The automatic ejection sequence is initiated by pulling the face-curtain handle immediately aft and above the occupant's head. When the face-curtain handle is pulled, the primary firing mechanism sear and the ballistic inertia reel sear are mechanically withdrawn and the primary cartridge is fired. As the seat rises, the drogue-gun and time-release mechanism sears are extracted by trip rods and the emergency IFF and equipment destruct are activated.

Note

The seat is fired after 7 inches of face-curtain travel.

Alternate Firing Handle

The alternate firing handle is on the front of the seat bucket, between the occupant's legs. The sequence of operation remains the same, since both the face-curtain handle and the alternate firing handle initiate seat firing by mechanically extracting the sear from the ejection-gun firing mechanism.

Note

- If the face-curtain handle does not actuate the ejection seat, the face-curtain handle should be held while the alternate firing handle is actuated, to prevent the possibility of entanglement with the drogue gun when it fires.
- The seat is fired after 2 inches of alternate firing handle travel.

PARACHUTE

The personnel parachute is contained in a rectangular back pack aft of the occupant. The parachute pack is

attached to the seat by two lock-in fittings. On ejection, the locks are automatically released by the time-release mechanism at both points. The parachute pack is attached to the occupant by two risers connected to the top Koch-fittings of the integrated torso harness.

TIME-RELEASE MECHANISM

The time-release mechanism is on the right side of the ejection-seat headrest and is armed upon ejection by a time-release mechanism trip rod, which is secured to the trip-rod bracket.

The time-release mechanism contains an altitude-sensing barostat to prevent premature deployment of the parachute at high altitudes. At approximately 13,000 ($\pm 1,500$) feet or less, the time-release mechanism releases the drogue parachute from the scissors shackle, pulling the personnel parachute withdrawal line from the guillotine and deploying the occupant's personnel parachute. At the same time, the shoulder-harness restraints, lap belt, leg restraints, parachute container survival kit, and face-curtain are unlocked.

The occupant is then free to be pulled from the seat sticker clips by the line stretch of the main parachute.

PARACHUTE WITHDRAWAL LINE

The parachute withdrawal line is connected from the personnel parachute to the seat drogue parachute with an acorn screw connector. In normal ejection, this line is pulled out by the drogue parachute after the time-release mechanism fires to deploy the personnel parachute. The line is routed through a gas-operated guillotine that severs the line for manual seat separation.

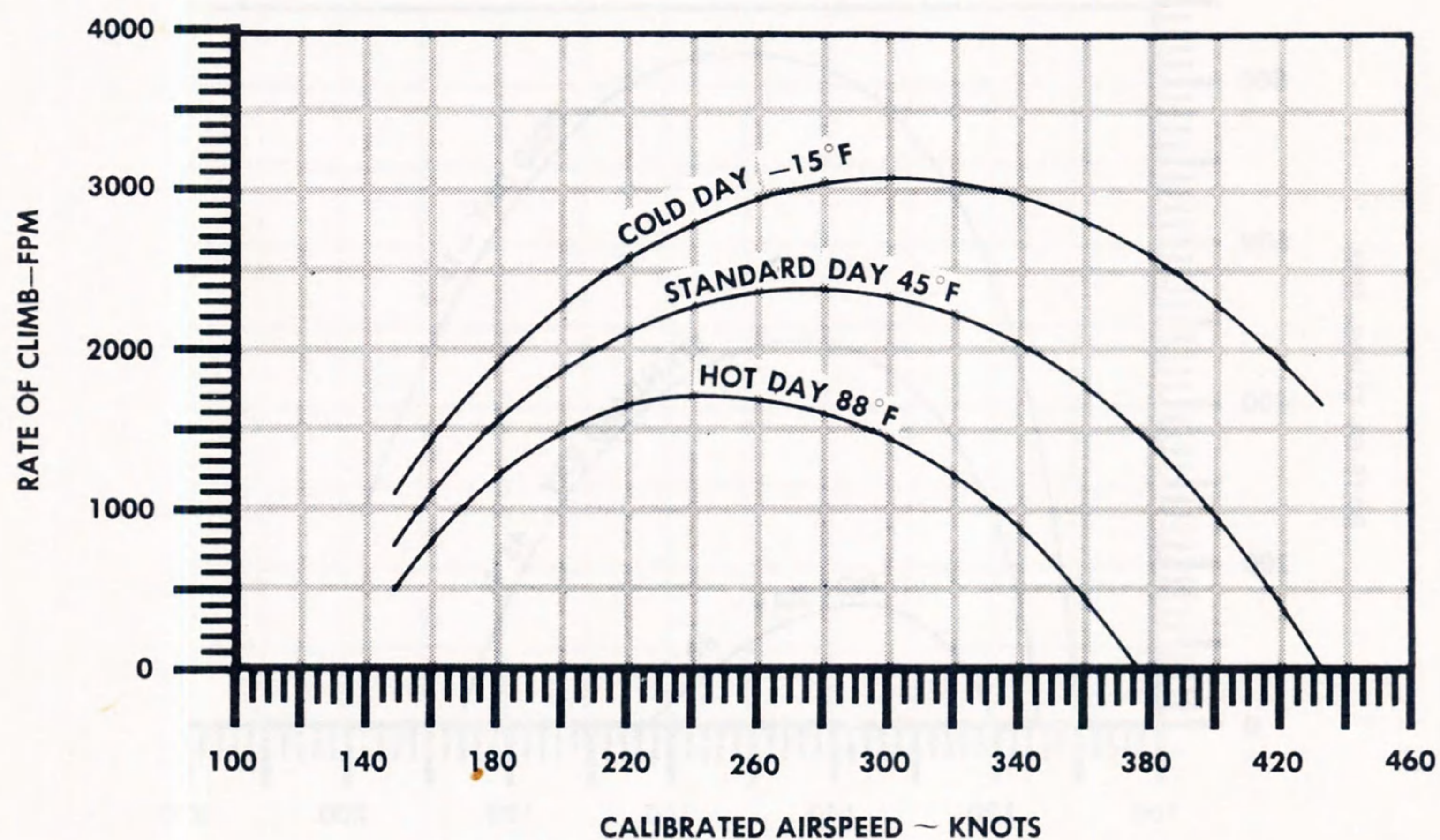
Guillotine

The guillotine on the left side of the seat is fired by the initial travel of the emergency harness-release handle. The guillotine initiator is mounted on the right aft side of the seat bucket. The guillotine severs the personnel parachute from the seat and drogue parachute; the personnel parachute must then be manually deployed by pulling the D-ring.

EMERGENCY HARNESS-RELEASE HANDLE

(EMERGENCY OVERRIDE LEVER)

This control is the black-and-yellow-striped handle forward on the right side of the seat bucket. In the forward (locked) position, the occupant and his personal equipment are secured to the seat. When the emergency harness equipment-release lever is lifted and rotated to the aft (unlocked) position, the occupant and his personal equipment are disconnected from the seat except for the sticker clips. The initial travel of this handle fires the parachute withdrawal-line guillotine, severing the personnel parachute from the seat and drogue parachute. The personnel parachute must be manually deployed by pulling the D-ring.

CLIMB PERFORMANCE AFTER TAKE-OFF
*(single engine)***P-8 ENGINE****MILITARY POWER**AIRCRAFT CONFIGURATION: CLEAN
FLAPS UP AND GEAR UPDATE: 1 DECEMBER 1972
DATA BASIS: ESTIMATEDREMARKS
GROSS WEIGHT = 42,834 LB
4000 FT.FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

ADF1-421

Figure 11-52

CLIMB PERFORMANCE AFTER TAKE-OFF (single engine)

P-8 ENGINE

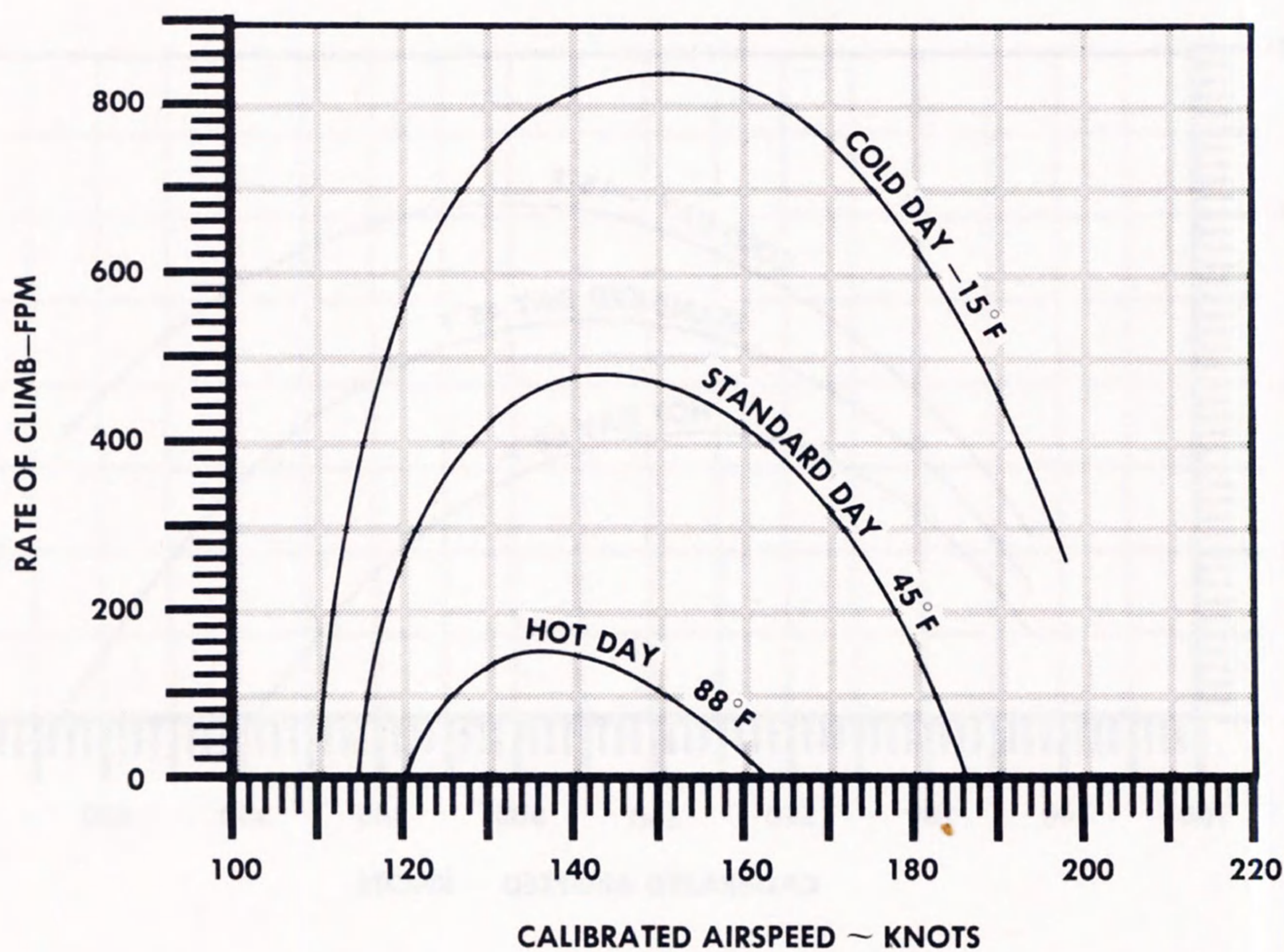
MILITARY POWER

AIRCRAFT CONFIGURATION: CLEAN
FLAPS 30°, GEAR UP

DATE: 1 DECEMBER 1972
DATA BASIS: ESTIMATED

REMARKS
GROSS WEIGHT = 42,834 LB
4000 FT.

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



ADF1-422

Figure 11-53

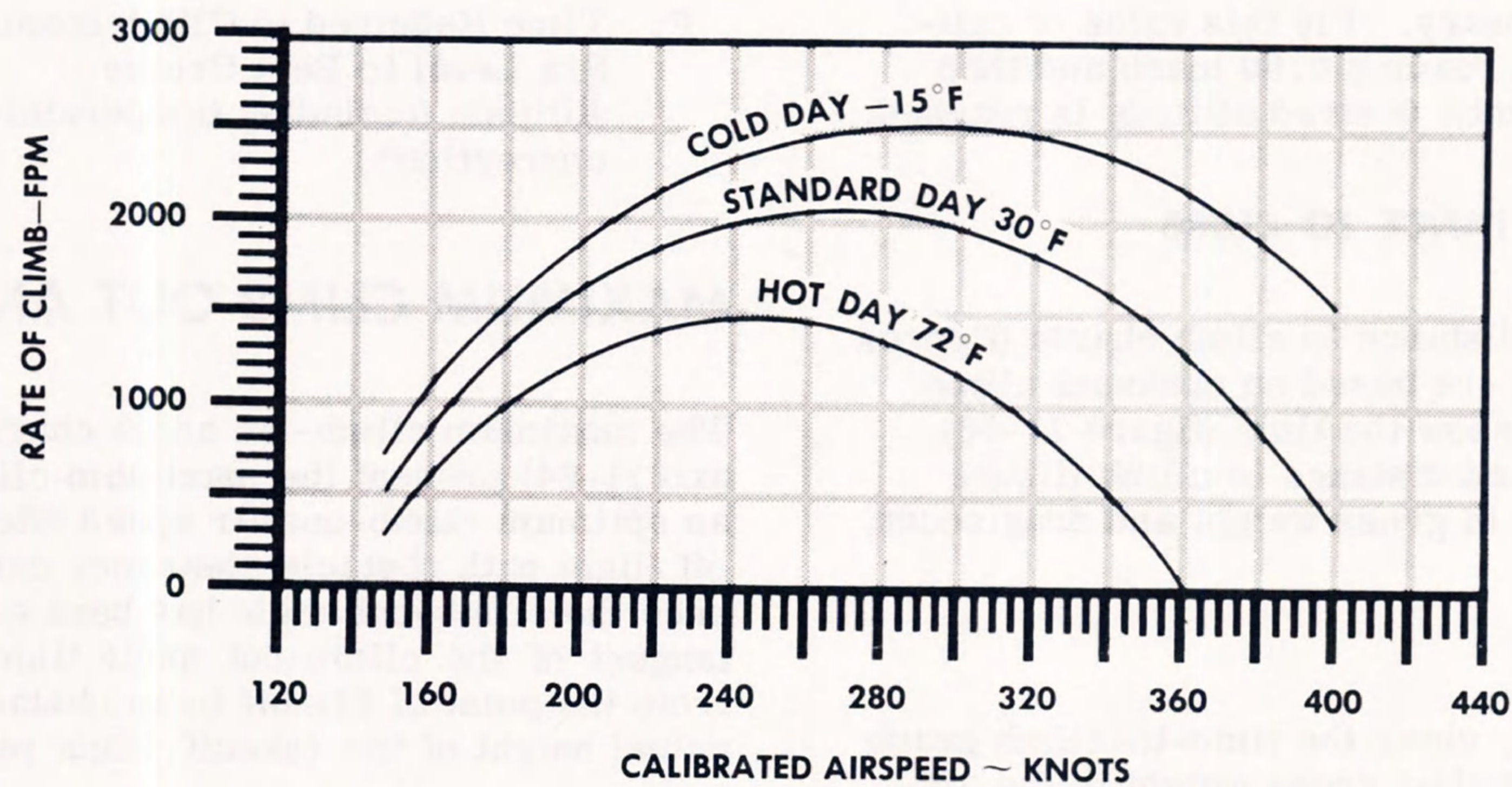
CLIMB PERFORMANCE AFTER TAKE-OFF
(single engine)**P-8 ENGINE****MILITARY POWER**AIRCRAFT CONFIGURATION: CLEAN
FLAPS UP AND GEAR UPDATE: 1 DECEMBER 1972
DATA BASIS: ESTIMATEDREMARKS
GROSS WEIGHT = 42,834 LB
8000 FT.FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

Figure 11-54

ADF1-423

part 4

Climb

MILITARY POWER CLIMB

CLIMB SPEED SCHEDULE

The climb speed schedule chart (figure 11-55) is a plot of the speed for military power climbs at various drag counts ranging from 0 to 250 as revised to agree with pilot technique. This climb speed schedule is not the one that corresponds to maximum rates of climb, but it does result in near optimum values of time, fuel, and distance to climb. The climb speed (calibrated airspeed) is plotted vs pressure altitude.

USE

To obtain military power climb calibrated airspeed, enter the chart at sea level for the calibrated airspeed corresponding to the appropriate drag count, interpolating if necessary. Fly this value of calibrated airspeed until reading 0.60 mach and then climb at 0.60 mach until desired altitude is reached.

TIME, FUEL, AND DISTANCE TO CLIMB

The time, fuel, and distance to climb charts (figures 11-56 through 11-58) are based on optimum climb speeds. The charts show the time (figure 11-56), fuel (figure 11-57), and distance to climb (figure 11-58) for variations in gross weight and drag count.

USE

To obtain climb time, enter the time-to-climb graph (figure 11-56) at the initial gross weight of the aircraft at start of climb. From initial gross weight, proceed horizontally to the selected altitude at end of climb reflector line and project a line downward to the appropriate drag count reflector line. From the drag count reflector line, project horizontally to the temperature base line and parallel the nearest guide line to apply correction for the effect of temperature. Follow the guide line until intercepting the vertical projection of the temperature deviation, then move horizontally to read time to climb from sea level to selected altitude. To obtain time to climb best cruise altitude, enter the chart at initial gross weight and proceed horizontally to the broken line corresponding to the best altitude for the known drag count. From that point, proceed vertically down and proceed as given above for climb to a constant altitude. The fuel to climb (figure 11-57) and distance to climb (figure 11-58) can be found by following the time-to-climb procedure explained above.

Sample Problem - Time to Climb From
Sea Level to Cruise Altitude

Aircraft Configuration:

(1) MK-28 store plus (4) 300-gallon drop tanks.

A. Initial Gross Weight	50,000 lb
B. Altitude at End of Climb	Cruise Altitude
C. Drag Count	50
D. Time Required to Climb from Sea Level to Best Cruise Altitude (standard day)	10.2 min.
E. Temperature Deviation from Standard Day	+10° C
F. Time Required to Climb from Sea Level to Best Cruise Altitude (including temperature correction)	11.7 min.

MAXIMUM CLIMB-OUT ANGLE

The maximum climb-out angle charts (figures 11-63 and 11-64) present the maximum climb-out angle at an optimum climb-out air speed after lift-off. Take-off flight path obstacle clearance can be calculated once the climb-out angle has been established. The tangent of the climb-out angle times the distance from the point of lift-off to an obstacle equals the actual height of the takeoff flight path at the point.

USE

Enter the chart at the aircraft gross weight and proceed horizontally to intersect the appropriate pressure altitude. Descend to intersect the temperature scale, and proceed horizontally to read maximum climb-out angle.

Reenter the chart at the aircraft gross weight, and proceed horizontally to intersect the climb speed guide line. From this point, project vertically and read indicated airspeed.

Sample Problem

Aircraft Configuration: All External Stores,
Gear Up & Takeoff Flaps.

A. Takeoff Gross Weight	50,000 lb
-------------------------	-----------

B. Pressure Altitude	2,000 ft
C. Temperature	90° F
D. Climb-Out Angle	8 degrees
E. Takeoff Gross Weight	50,000 lbs
F. Climb Speed Guide Line	Intersect
G. Optimum Speed (IAS)	140 kts

A. Takeoff Gross Weight	54,000 lb
B. Pressure Altitude	2000 ft
C. Ambient Temperature	90° F
D. Optimum Speed (IAS)	169 kts

MAXIMUM RATE OF CLIMB

The maximum rate of climb charts (figure 11-65) present the maximum takeoff flight path climb-out rate of climb at an optimum climb-out airspeed after lift-off.

USE

Enter the chart at the aircraft gross weight and proceed horizontally to intersect the appropriate pressure altitude. Descend to intersect the temperature scale, and proceed horizontally to read maximum rate of climb.

Reenter the chart at the aircraft gross weight, and proceed horizontally to intersect the climb speed guide line. From this point, project vertically and read indicated airspeed.

Sample Problem

Aircraft Configurations: All External Stores, Gear Up & Takeoff Flaps.

A. Takeoff Gross Weight	54,000 lb
B. Pressure Altitude	2,000 ft
C. Ambient Temperature	90° C
D. Rate of Climb	1900 ft/min

MAXIMUM CLIMB SPEED

The maximum climb speed charts (figures 11-67 and 11-68) present the optimum climb-out airspeed after lift-off that will give maximum rate of climb.

USE

Enter the chart at the aircraft gross weight and proceed horizontally to intersect the appropriate ambient temperature line. Descend to intersect the appropriate pressure altitude line, and proceed horizontally to read indicated airspeed.

Sample Problem

Aircraft Configuration:

All External Stores, Gear Up and Takeoff Flaps.

COMBAT CEILING

The combat ceiling graph is presented as the upper section of figure 11-75. Pressure altitude vs gross weight is plotted for a drag count range of 0 to 250.

USE

Enter chart at aircraft gross weight and proceed vertically to the appropriate drag count reflector line. From this point proceed horizontally to the left scale of the graph to read combat ceiling.

Sample Problem

Aircraft Configuration:

(1) MK-28 store plus (4) 300-gallon drop tanks.

A. Gross Weight	48,000 lb
B. Drag Count	47
C. Combat Ceiling	39,000 ft

SERVICE CEILING

The service ceiling graph is presented as the lower section of figure 11-75. Pressure altitude vs gross weight is plotted for a drag count range of 0 to 250.

USE

Enter chart at aircraft gross weight and proceed vertically to the appropriate drag count reflector line. From this point proceed horizontally to the left scale of the graph to read service ceiling.

Sample Problem

Aircraft Configuration:

(1) MK-28 store plus (4) 300-gallon drop tanks.

A. Gross Weight	48,000 lb
B. Drag Count	47
C. Service Ceiling	41,000 ft

MILITARY POWER CLIMB

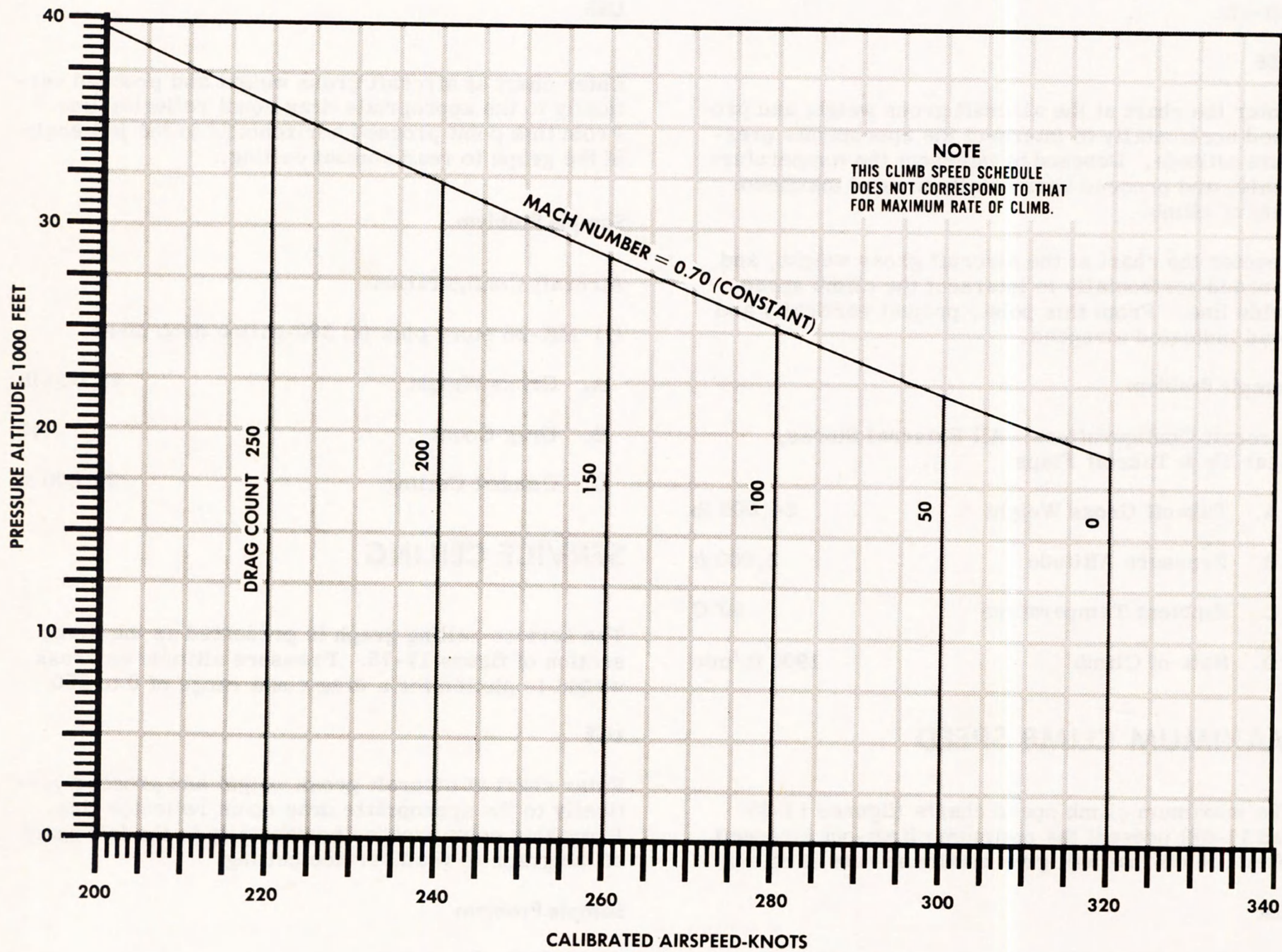
P-8 ENGINE

CLIMB SPEED SCHEDULE
(SIMPLIFIED TO AGREE WITH PILOT TECHNIQUE)
ALL GROSS WEIGHTS

DATE: 1 DECEMBER 1972
DATA BASIS: ESTIMATED

REMARKS
ICAO STANDARD DAY

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



A-ADF1-349

Figure 11-55

MILITARY POWER CLIMB

P-8 ENGINE

TIME REQUIRED TO CLIMB FROM SEA LEVEL TO SELECTED ALTITUDE
(DATA CORRESPONDS TO CLIMB SPEED SCHEDULE)

DATE: 1 DECEMBER 1972
DATA BASIS: ESTIMATED

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

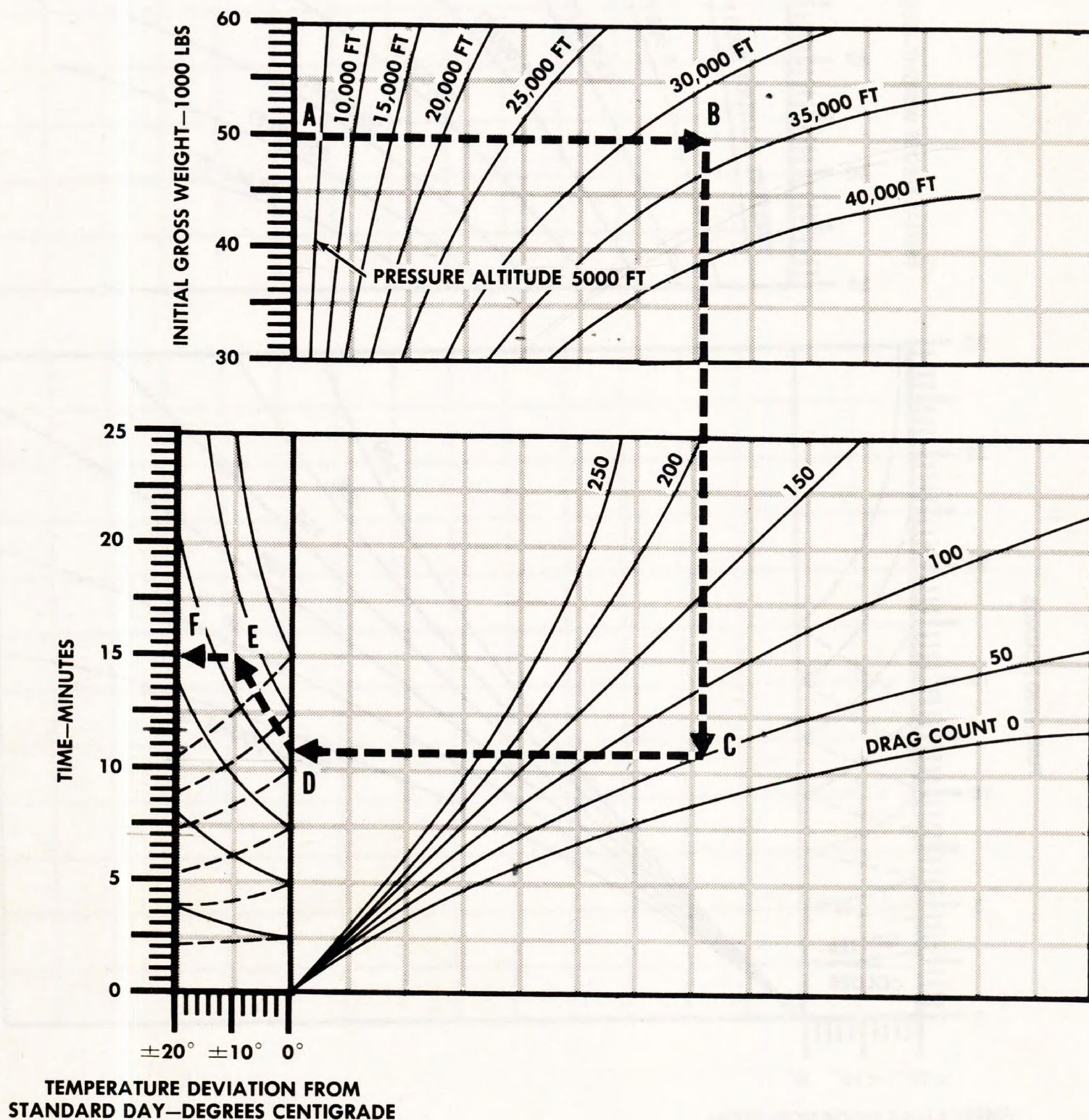


Figure 11-56

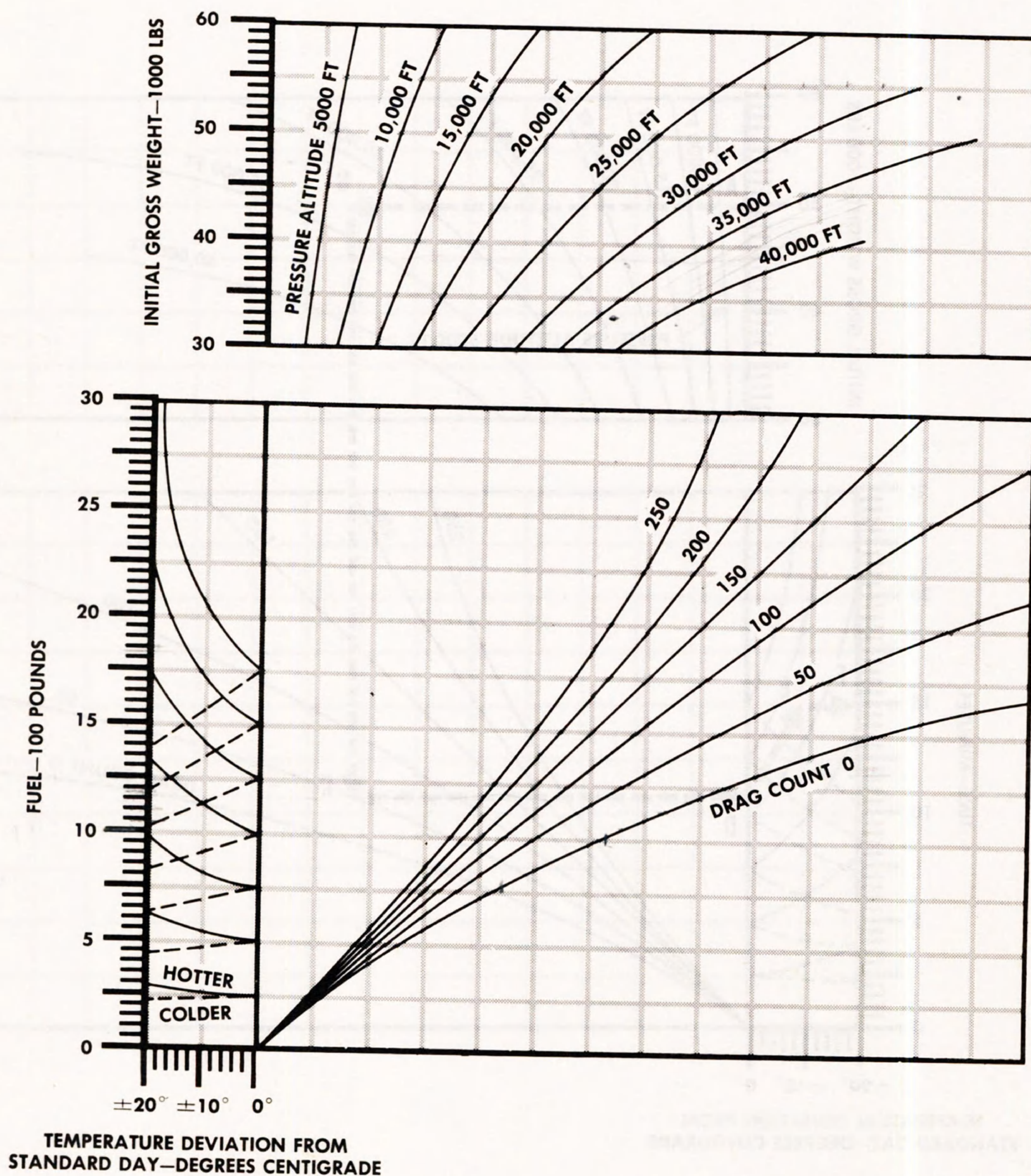
MILITARY POWER CLIMB

P-8 ENGINE

FUEL REQUIRED TO CLIMB FROM SEA LEVEL TO SELECTED ALTITUDE
(DATA CORRESPONDS TO CLIMB SPEED SCHEDULE)

DATE: 1 DECEMBER 1972
DATA BASIS: ESTIMATED

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



A-ADF1-351

Figure 11-57

MILITARY POWER CLIMB

P-8 ENGINE

DISTANCE REQUIRED TO CLIMB FROM SEA LEVEL TO SELECTED ALTITUDE
(DATA CORRESPONDS TO CLIMB SPEED SCHEDULE)

DATE: 1 DECEMBER 1972
DATA BASIS: ESTIMATED

FUEL GRADE: JP5
FUEL DENSITY: 6.8 LB/GAL

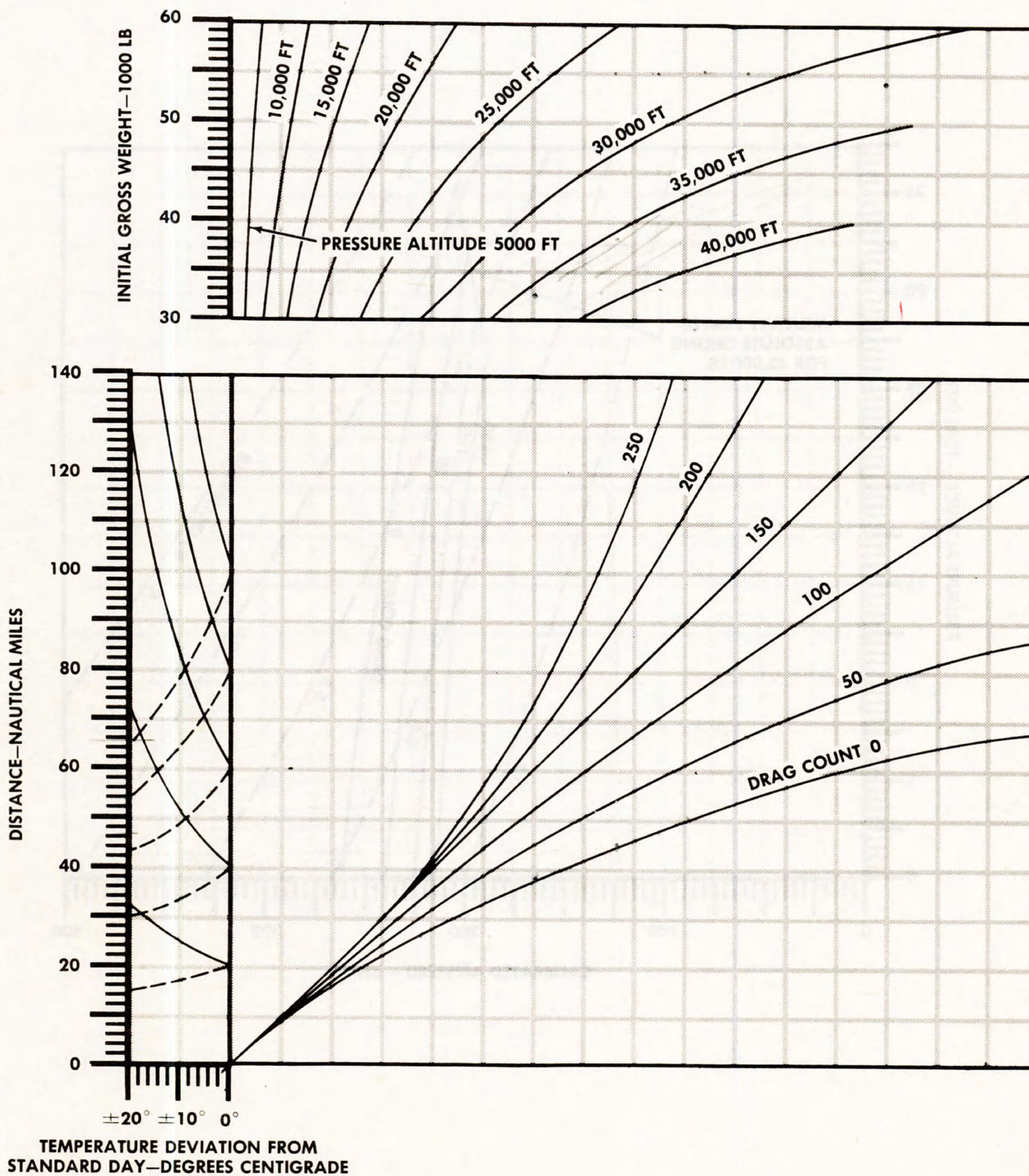


Figure 11-58

A-ADF1-352

MILITARY POWER CLIMB (single engine)

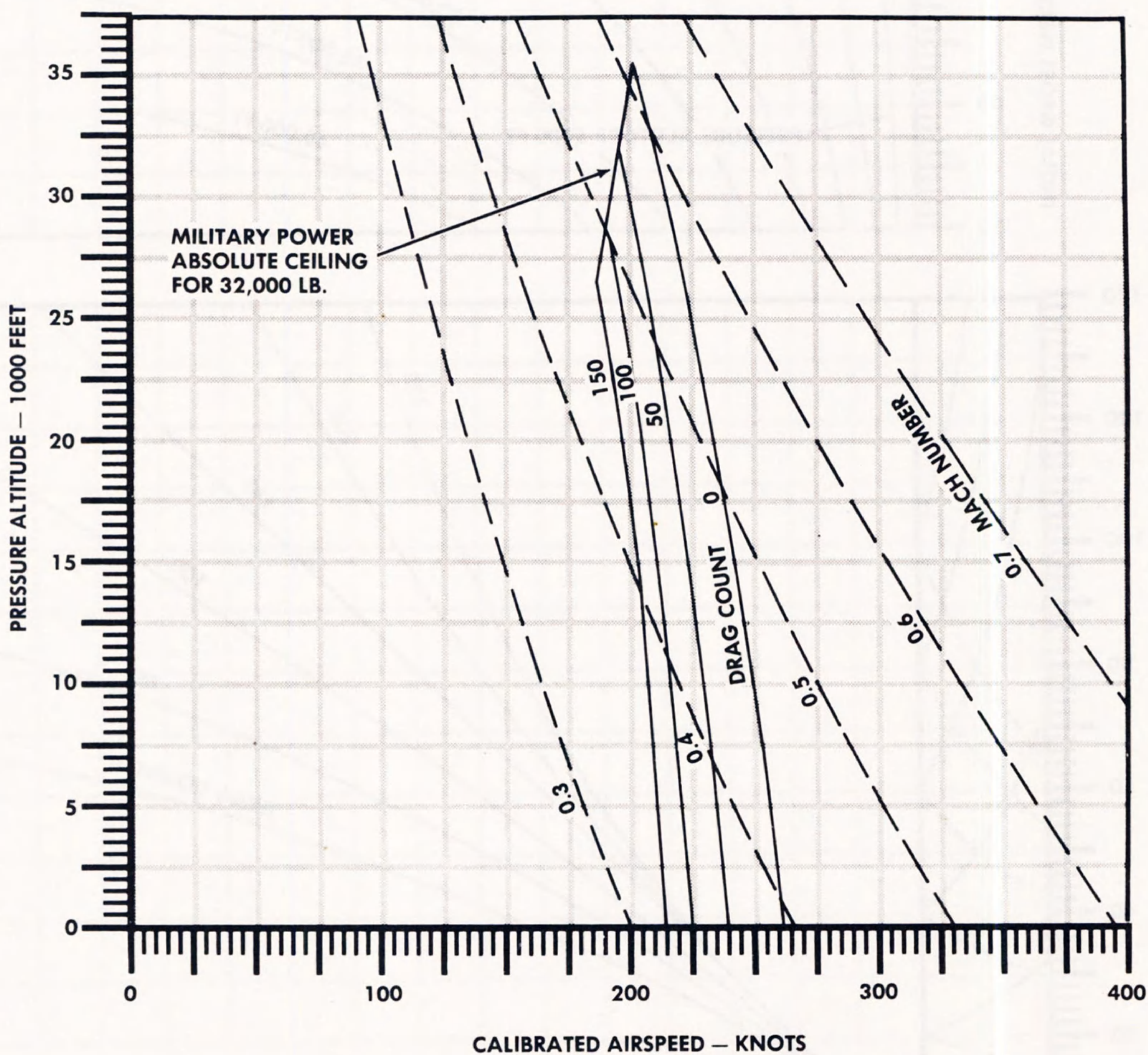
P-8 ENGINE

CLIMB SPEED SCHEDULE

DATE 15 MARCH 1971
DATA BASIS: ESTIMATED

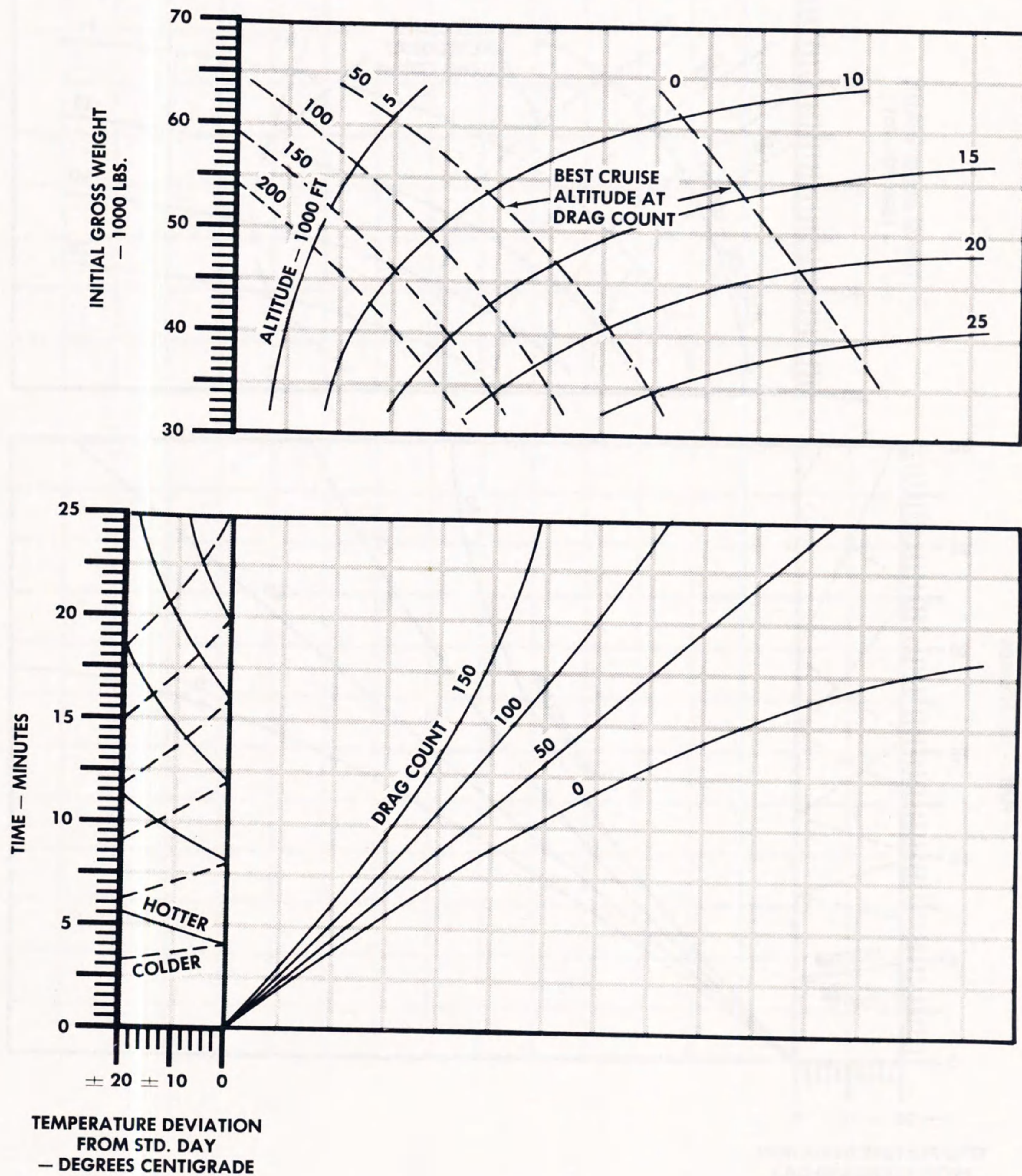
REMARKS
INOPERATIVE ENGINE WINDMILLING
ICAO STANDARD DAY

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB./GAL



ADF1-353

Figure 11-59

MILITARY POWER CLIMB (single engine)**P-8 ENGINE****TIME REQUIRED TO CLIMB FROM SEA LEVEL TO SELECTED ALTITUDE
(DATA CORRESPONDS TO CLIMB SPEED SCHEDULE)**DATE 15 MARCH 1971
DATA BASIS: ESTIMATEDREMARKS
INOPERATIVE ENGINE WINDMILLING
ICAO STANDARD DAYFUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB./GAL.

ADF1-354

Figure 11-60

MILITARY POWER CLIMB (single engine)

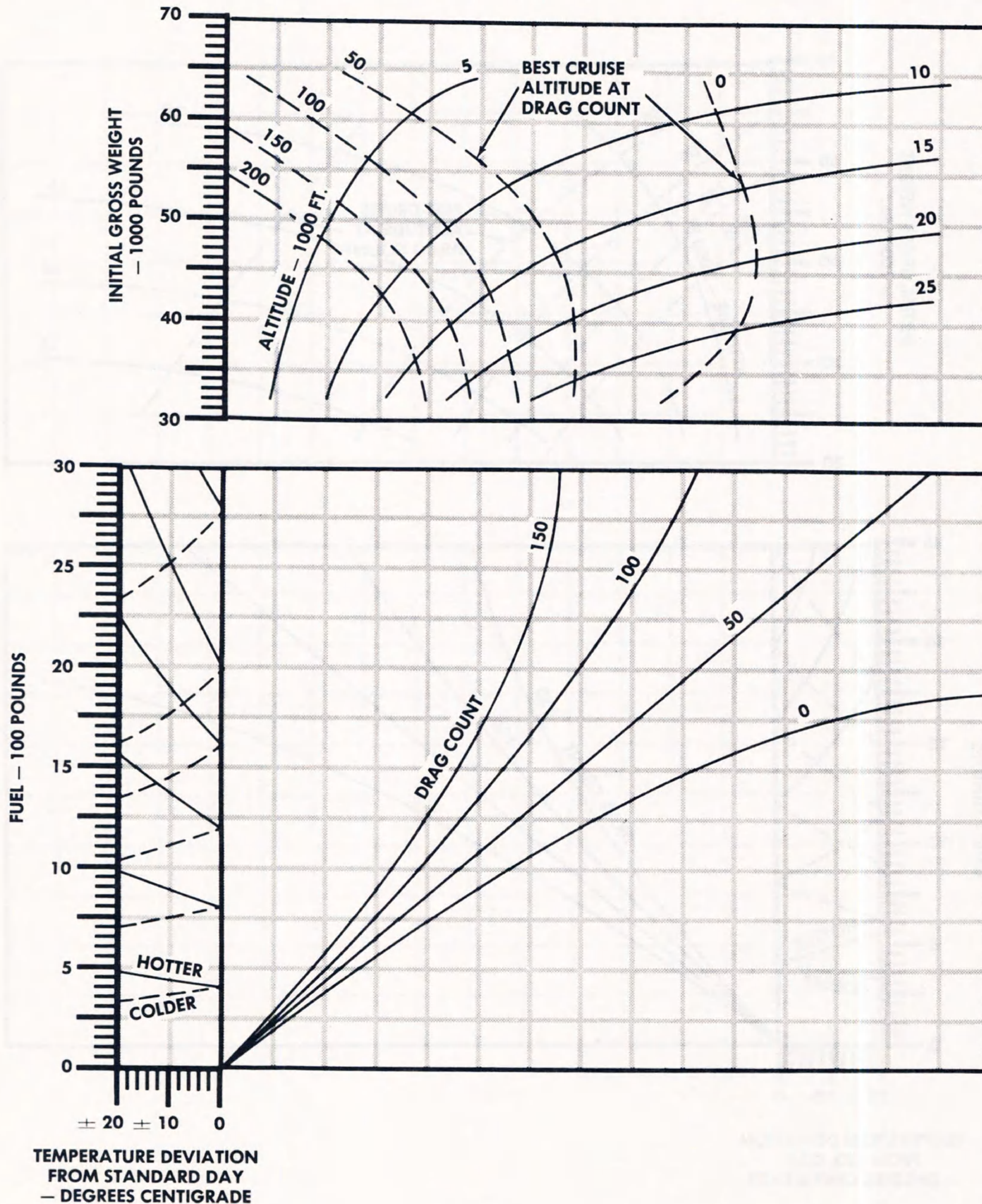
P-8 ENGINE

FUEL REQUIRED TO CLIMB FROM SEA LEVEL TO SELECTED ALTITUDE (DATA CORRESPONDS TO CLIMB SPEED SCHEDULE)

DATE 15 MARCH 1971
DATA BASIS: ESTIMATED

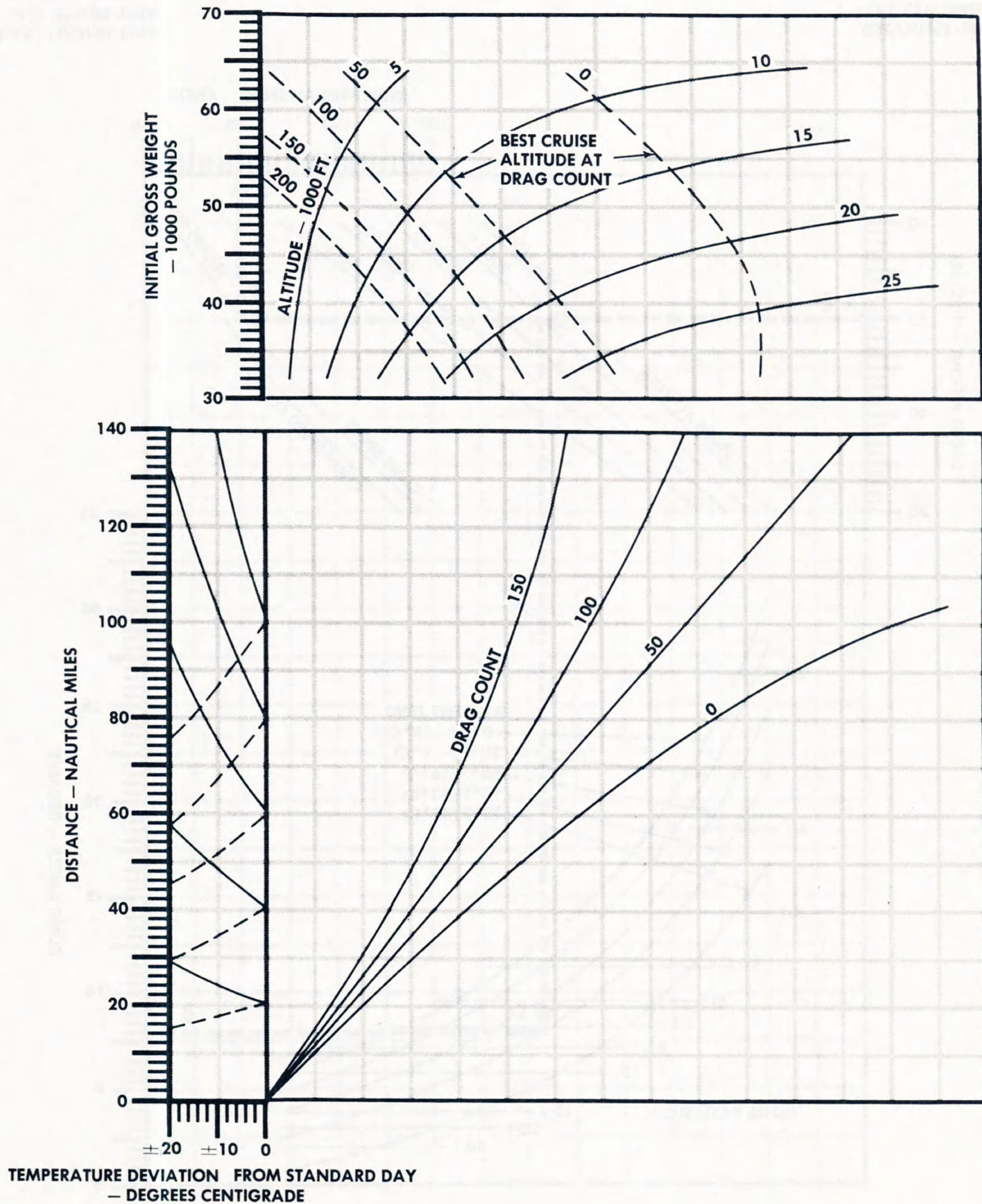
REMARKS
INOPERATIVE ENGINE WINDMILLING
ICAO STANDARD DAY

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB./GAL.



ADF1-355

Figure 11-61

MILITARY POWER CLIMB (single engine)**P-8 ENGINE****DISTANCE REQUIRED TO CLIMB FROM SEA LEVEL TO SELECTED ALTITUDE
(DATA CORRESPONDS TO CLIMB SPEED SCHEDULE)**DATE 15 MARCH 1971
DATA BASIS: ESTIMATEDREMARKS
INOPERATIVE ENGINE WINDMILLING
ICAO STANDARD DAYFUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB./GAL.

ADF1-356

Figure 11-62

MAXIMUM CLIMB-OUT ANGLE

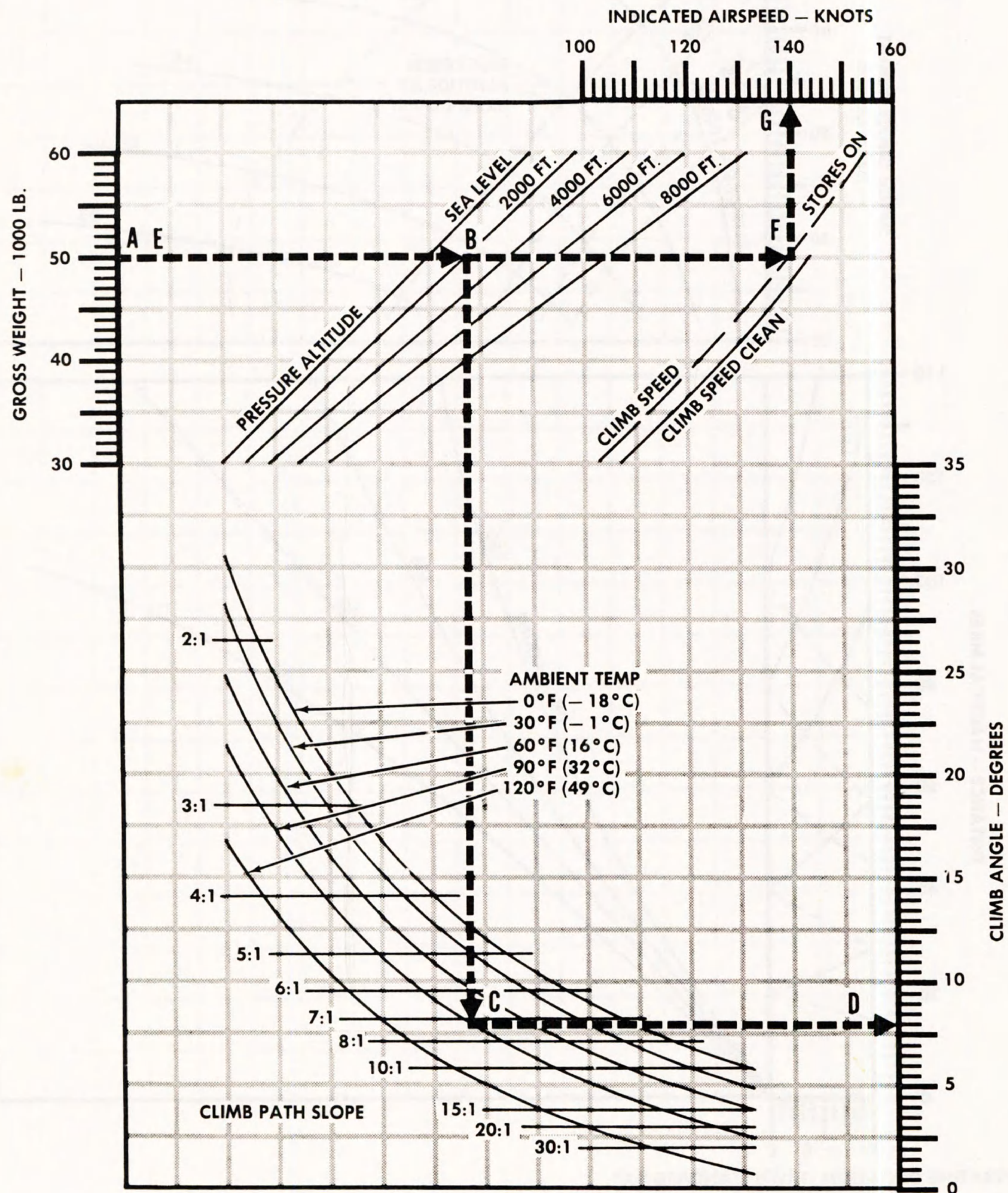
P-8 ENGINE

MILITARY POWER

AIRCRAFT CONFIGURATION
ALL EXTERNAL STORE CONFIGURATIONS
TAKEOFF FLAPS, GEAR UP

DATE 15 FEBRUARY 1971
DATA BASIS: ESTIMATED

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



ADF1-357

Figure 11-63

MAXIMUM CLIMB-OUT ANGLE (single engine)

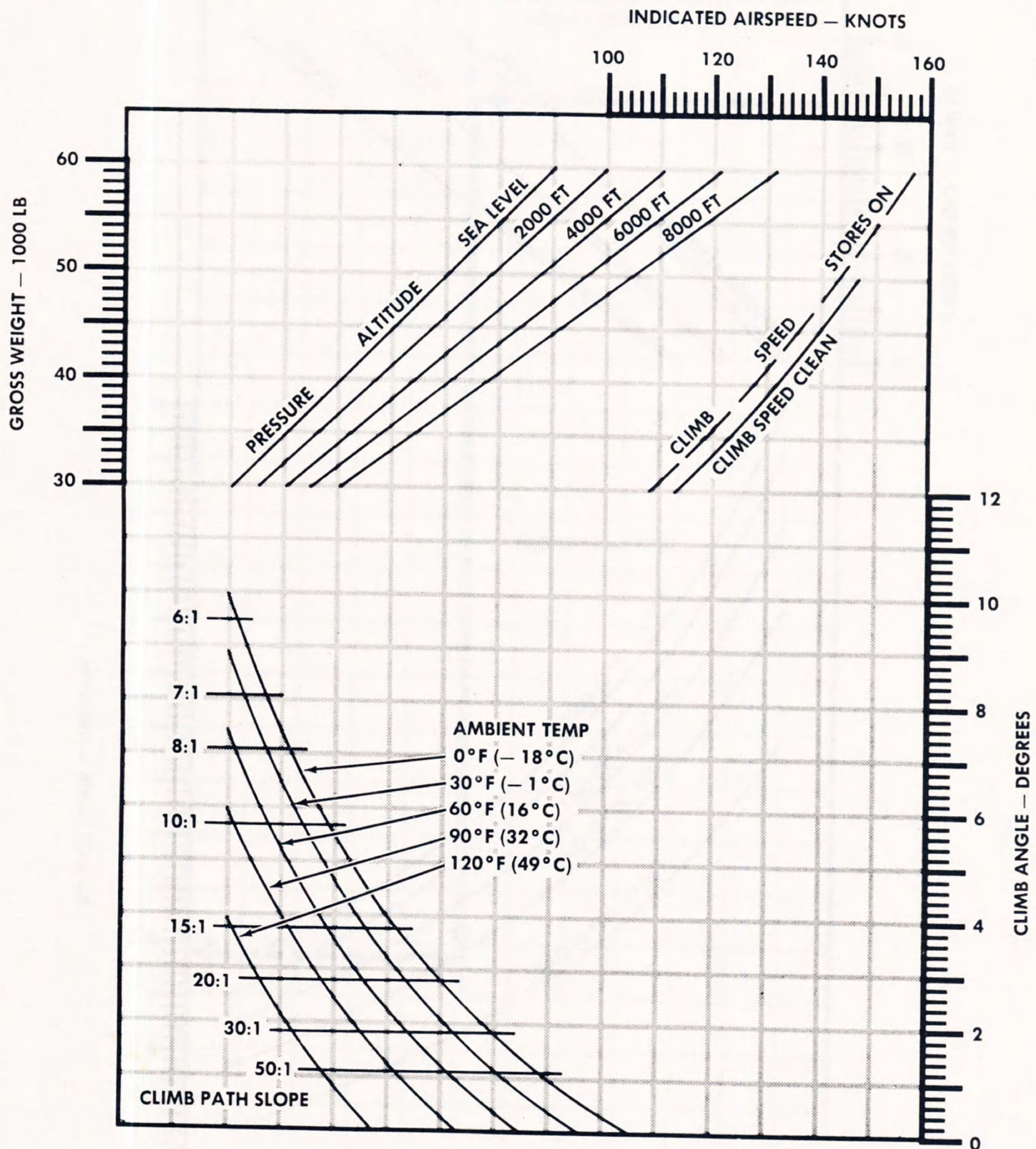
P-8 ENGINE

AIRCRAFT CONFIGURATION
ALL EXTERNAL STORE CONFIGURATIONS
TAKEOFF FLAPS, GEAR UP

DATE 15 FEBRUARY 1971
DATA BASIS: ESTIMATED

REMARKS
INOPERATIVE ENGINE WINDMILLING

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



ADF1-358

Figure 11-64

MAXIMUM CLIMB (instantaneous)

P-8 ENGINE

RATE OF CLIMB MILITARY POWER

AIRCRAFT CONFIGURATION
TAKEOFF FLAPS, GEAR UP

DATE 15 FEBRUARY 1971
DATA BASIS: ESTIMATED

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

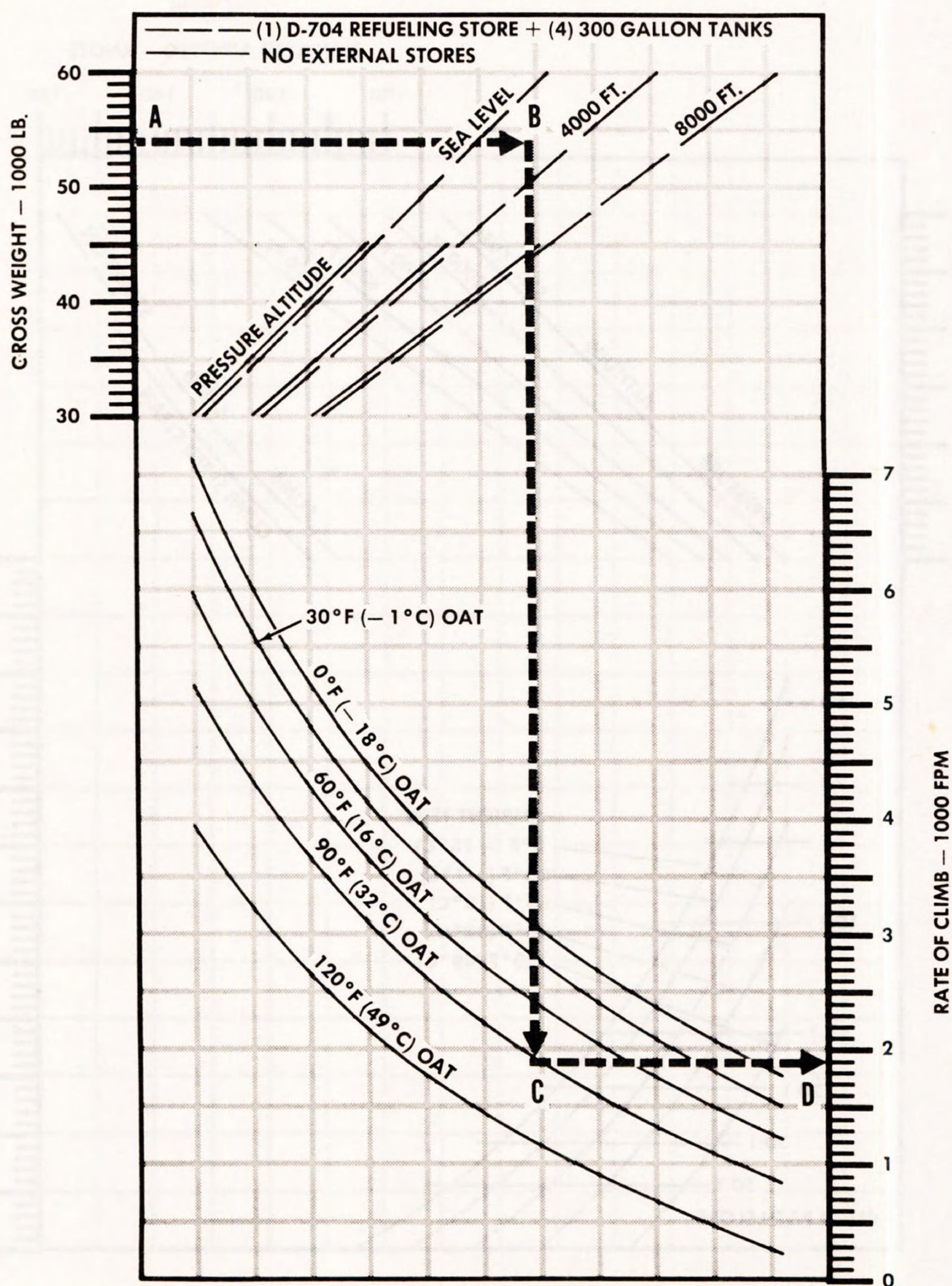
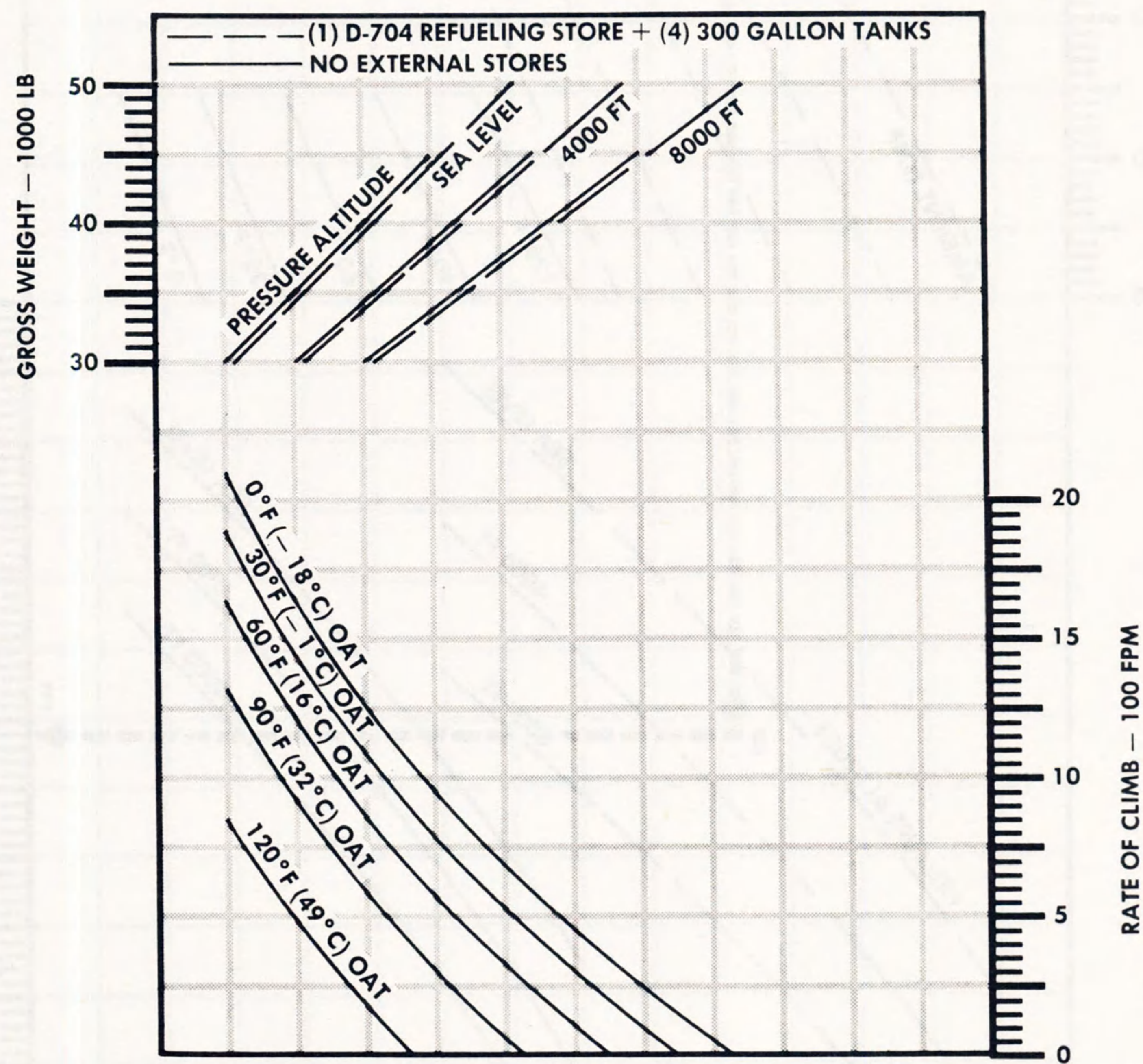


Figure 11-65

ADF1-360

MAXIMUM CLIMB
*(instantaneous, single engine)***P-8 ENGINE**AIRCRAFT CONFIGURATION
TAKEOFF FLAPS, GEAR UPDATE 15 FEBRUARY 1971
DATA BASIS: ESTIMATED**RATE OF CLIMB
MILITARY POWER**FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

ADF1-361

Figure 11-66

P-8 ENGINE

**AIRCRAFT CONFIGURATION
TAKEOFF FLAPS, GEAR UP**

DATE 15 FEBRUARY 1971
DATA BASIS: ESTIMATED

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

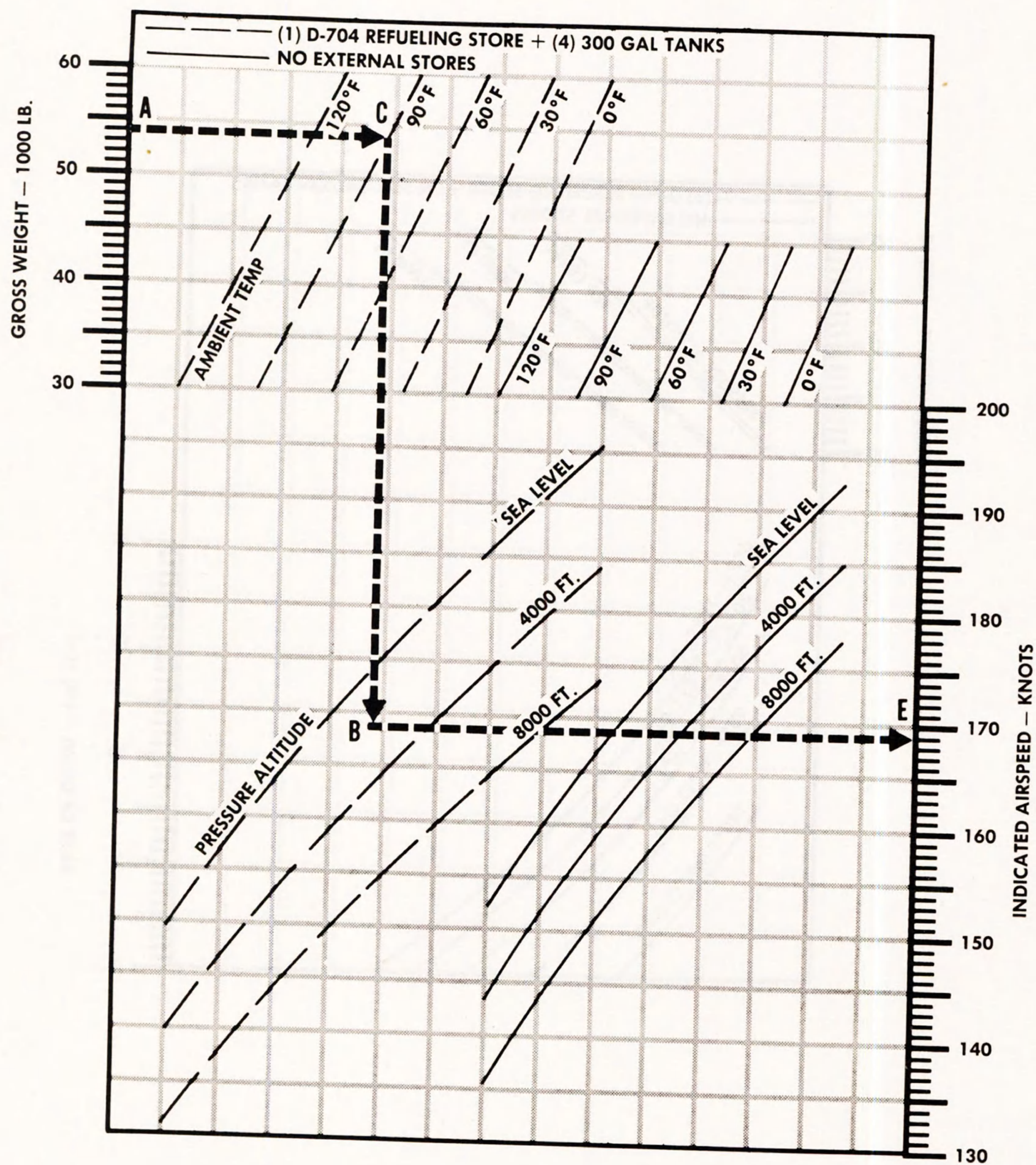


Figure 11-67

ADF1-362

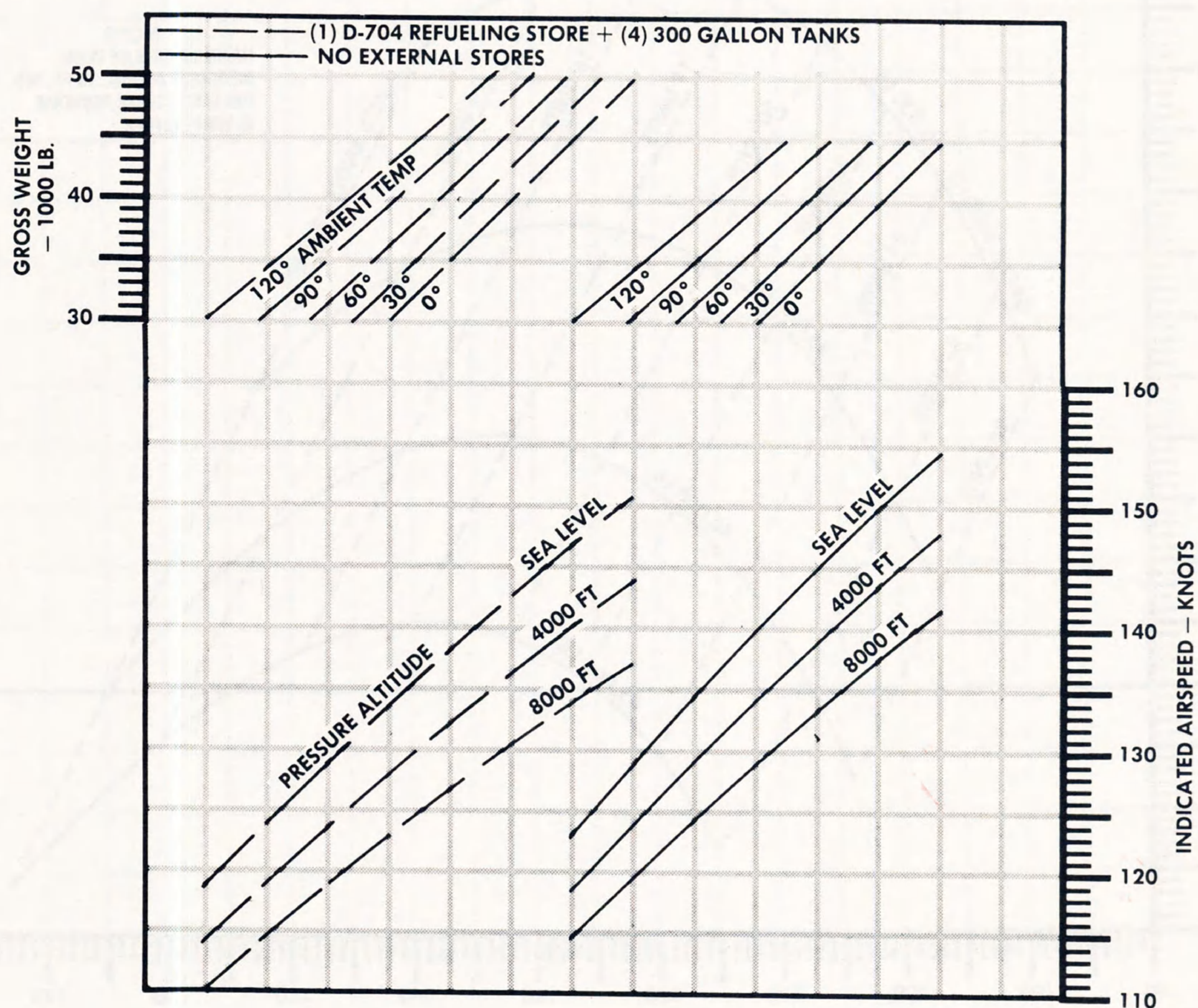
MAXIMUM CLIMB (*Instantaneous, single engine*)**P-8 ENGINE****CLIMB SPEED
MILITARY POWER**AIRCRAFT CONFIGURATION
TAKEOFF FLAPS, GEAR UPDATE 15 FEBRUARY 1971
DATA BASIS: ESTIMATEDFUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

Figure 11-68

RATE OF CLIMB (single engine)

P-8 ENGINE

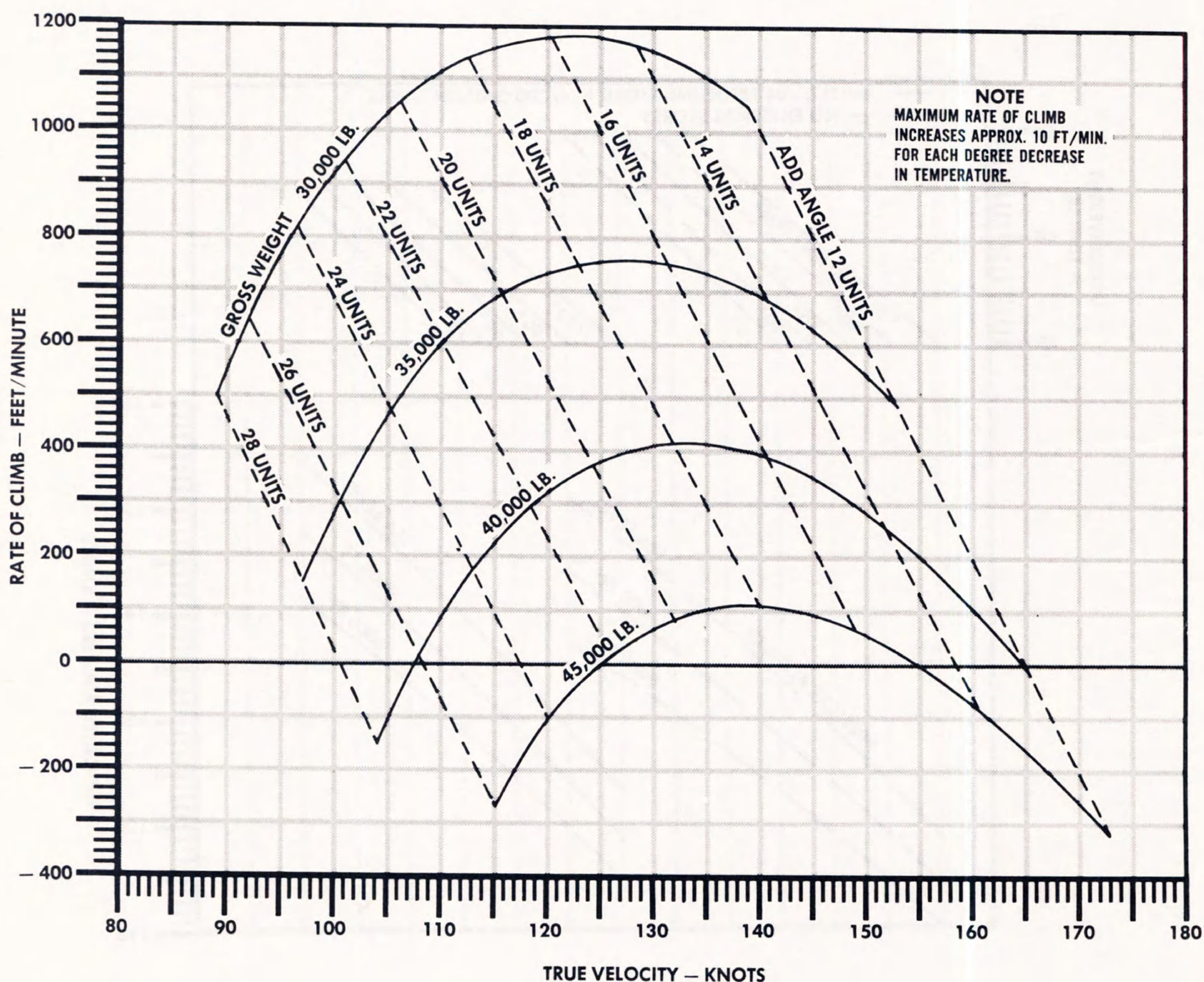
CONFIGURATION
NO EXTERNAL STORES
TAKEOFF FLAPS; GEAR DOWN

SEA LEVEL MILITARY POWER

DATE 15 FEBRUARY 1971
DATA BASIS: ESTIMATED

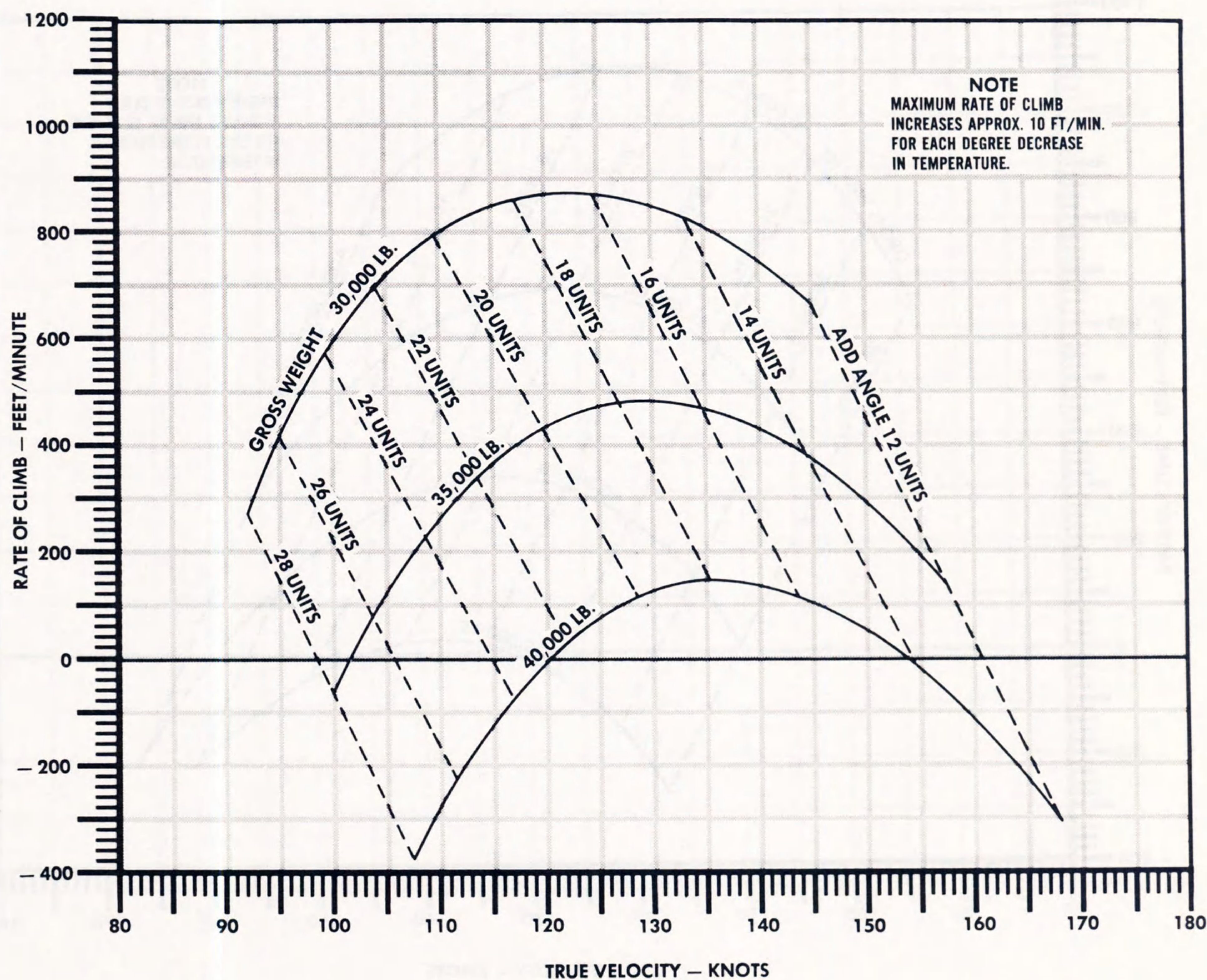
REMARKS
ICAO STANDARD DAY
INOPERATIVE ENGINE WINDMILLING

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



ADF1-364

Figure 11-69

RATE OF CLIMB (single engine)**P-8 ENGINE****SEA LEVEL
MILITARY POWER**CONFIGURATION
NO EXTERNAL STORES
TAKEOFF FLAPS; GEAR DOWNDATE 15 FEBRUARY 1971
DATA BASIS: ESTIMATEDREMARKS
TROPICAL DAY
INOPERATIVE ENGINE WINDMILLINGFUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

ADF1-365

Figure 11-70

RATE OF CLIMB (single engine)

P-8 ENGINE

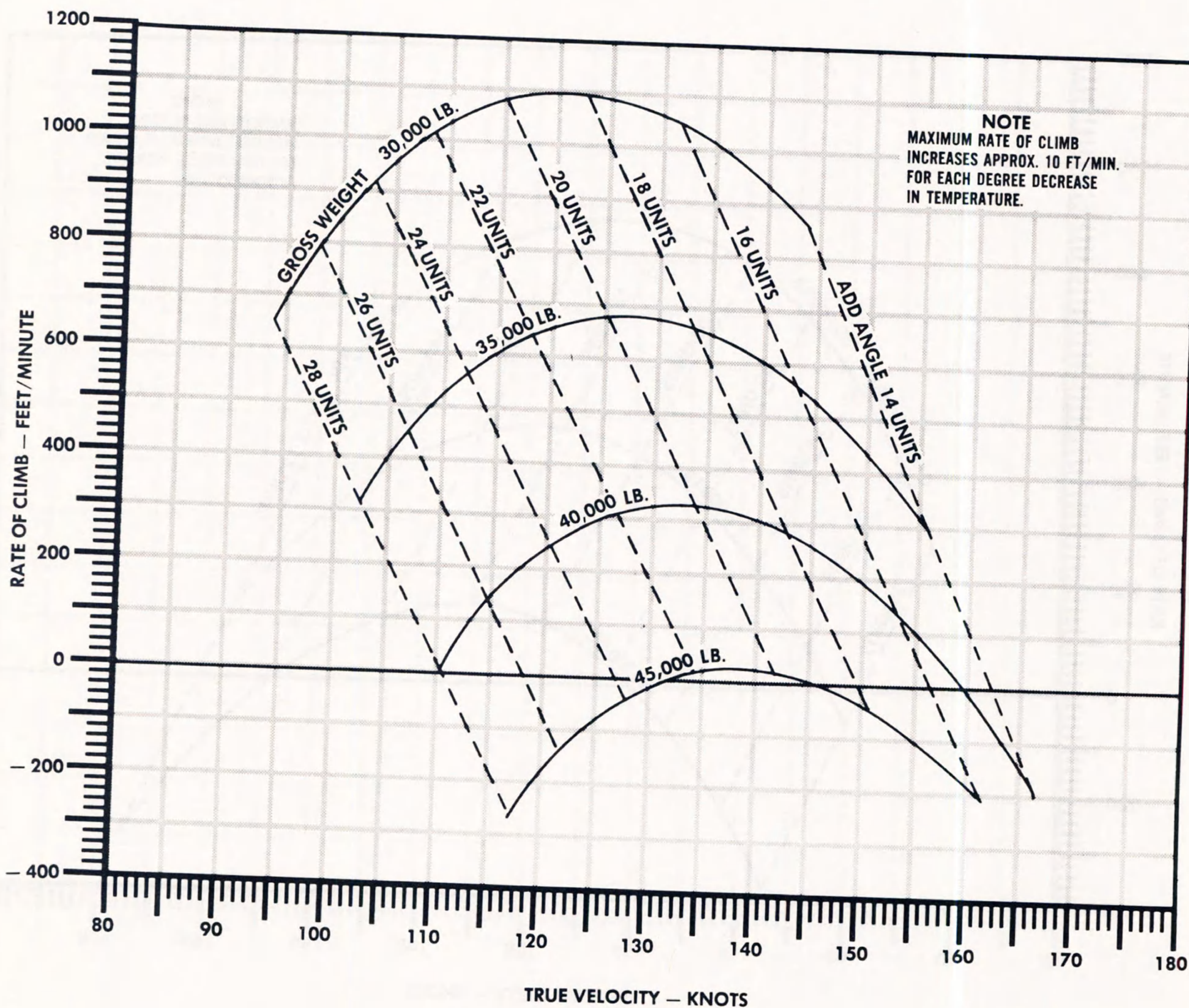
CONFIGURATION
(1) MK-28 STORE+(4) 300 GALLON
DROP TANKS
TAKE OFF FLAPS, GEAR DOWN

DATE 15 FEBRUARY 1971
DATA BASIS: ESTIMATED

SEA LEVEL MILITARY POWER

REMARKS
ICAO STANDARD DAY
INOPERATIVE ENGINE WINDMILLING

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



ADF1-366

Figure 11-71

RATE OF CLIMB (single engine)

P-8 ENGINE

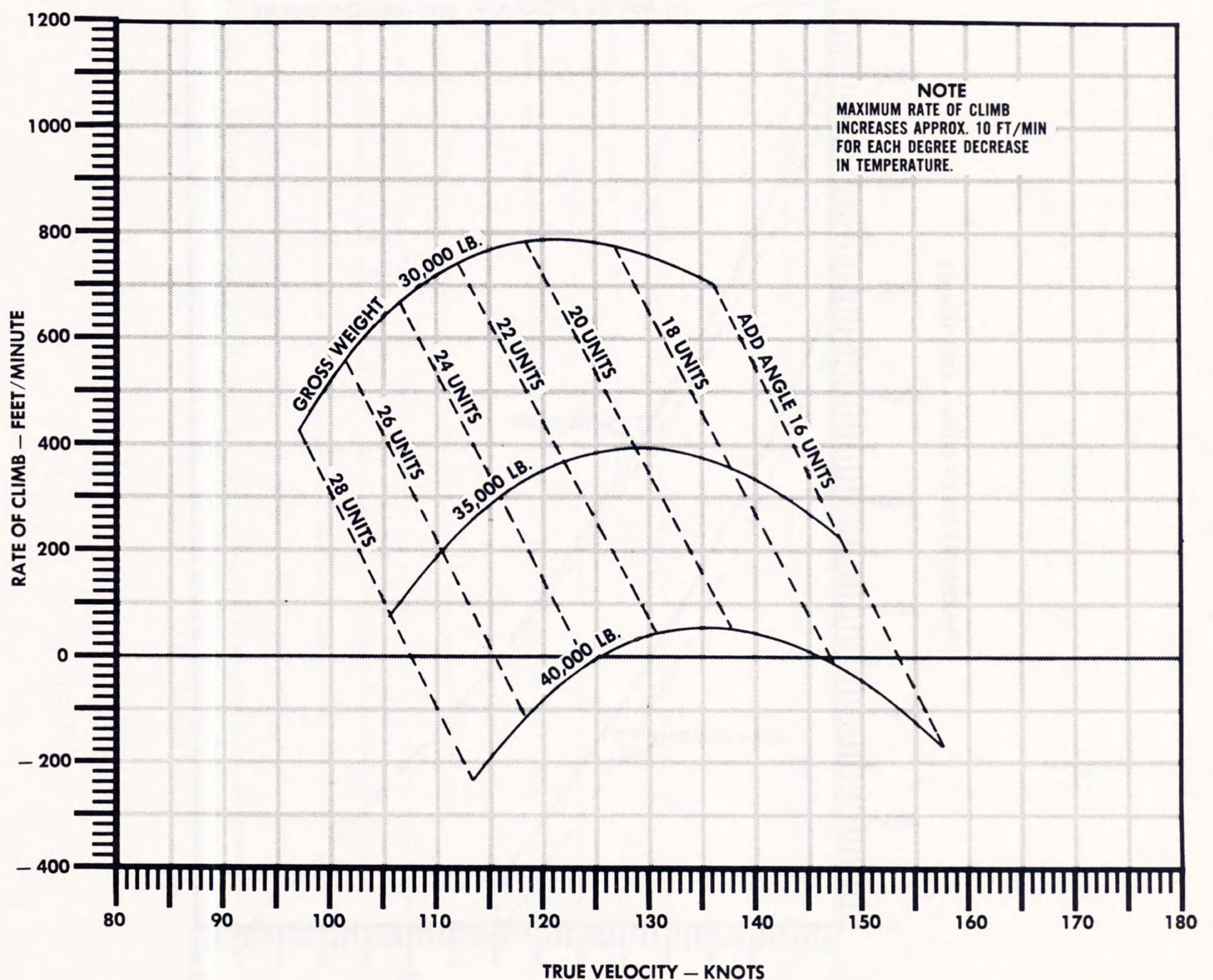
CONFIGURATION
(1) MK-28 STORE+(4) 300 GALLON
DROP TANKS
TAKE OFF FLAPS, GEAR DOWN

SEA LEVEL MILITARY POWER

DATE 15 FEBRUARY 1971
DATA BASIS: ESTIMATED

REMARKS
TROPICAL DAY
INOPERATIVE ENGINE WINDMILLING

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



MAXIMUM RATE OF CLIMB (instantaneous) (single engine)

P-8 ENGINE

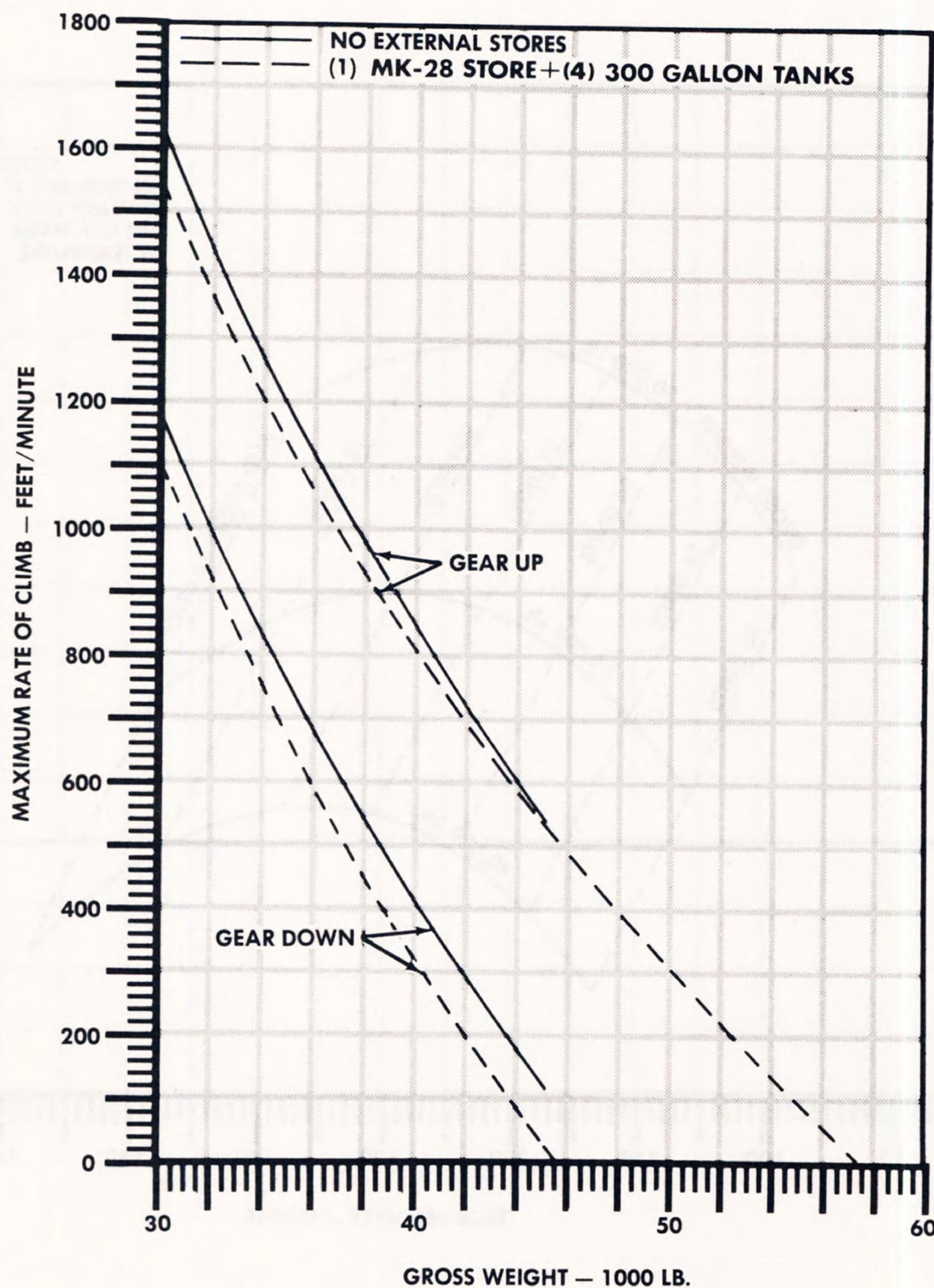
CONFIGURATION
(1) MK-28 STORE + (4) 300 GALLON
DROP TANKS
TAKE OFF FLAPS

DATE 15 FEBRUARY 1971
DATA BASIS: ESTIMATED

SEA LEVEL MILITARY POWER

REMARKS
ICAO STANDARD DAY

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



ADF1-368

Figure 11-73

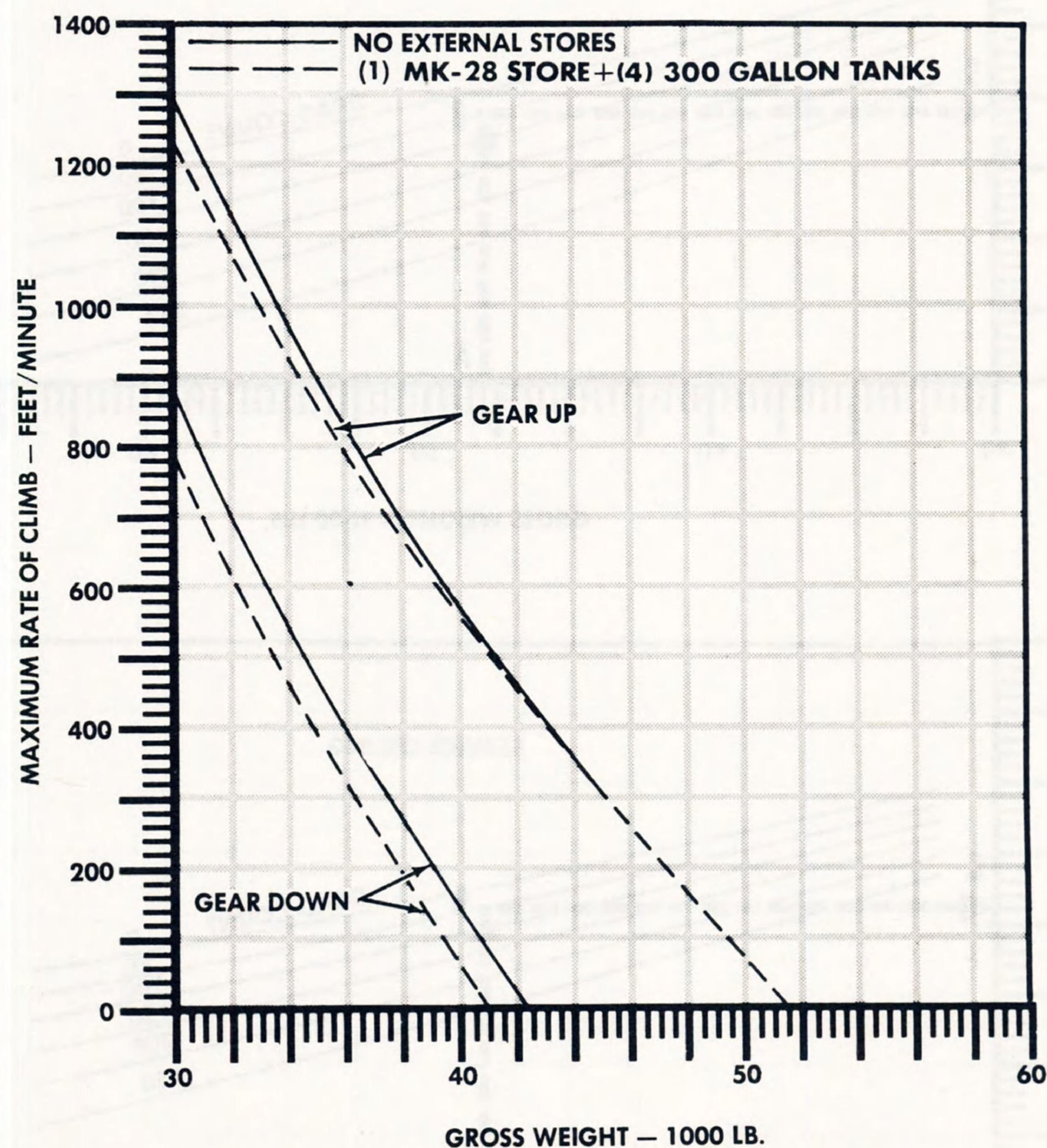
MAXIMUM RATE OF CLIMB
(instantaneous) (single engine)**P-8 ENGINE**

CONFIGURATION
(1) MK-28 STORE + (4) 300 GALLON
DROP TANKS
TAKE OFF FLAPS
DATE 15 FEBRUARY 1971
DATA BASIS: ESTIMATED

**SEA LEVEL
MILITARY POWER**

REMARKS
TROPICAL DAY

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



COMBAT CEILING AND SERVICE CEILING

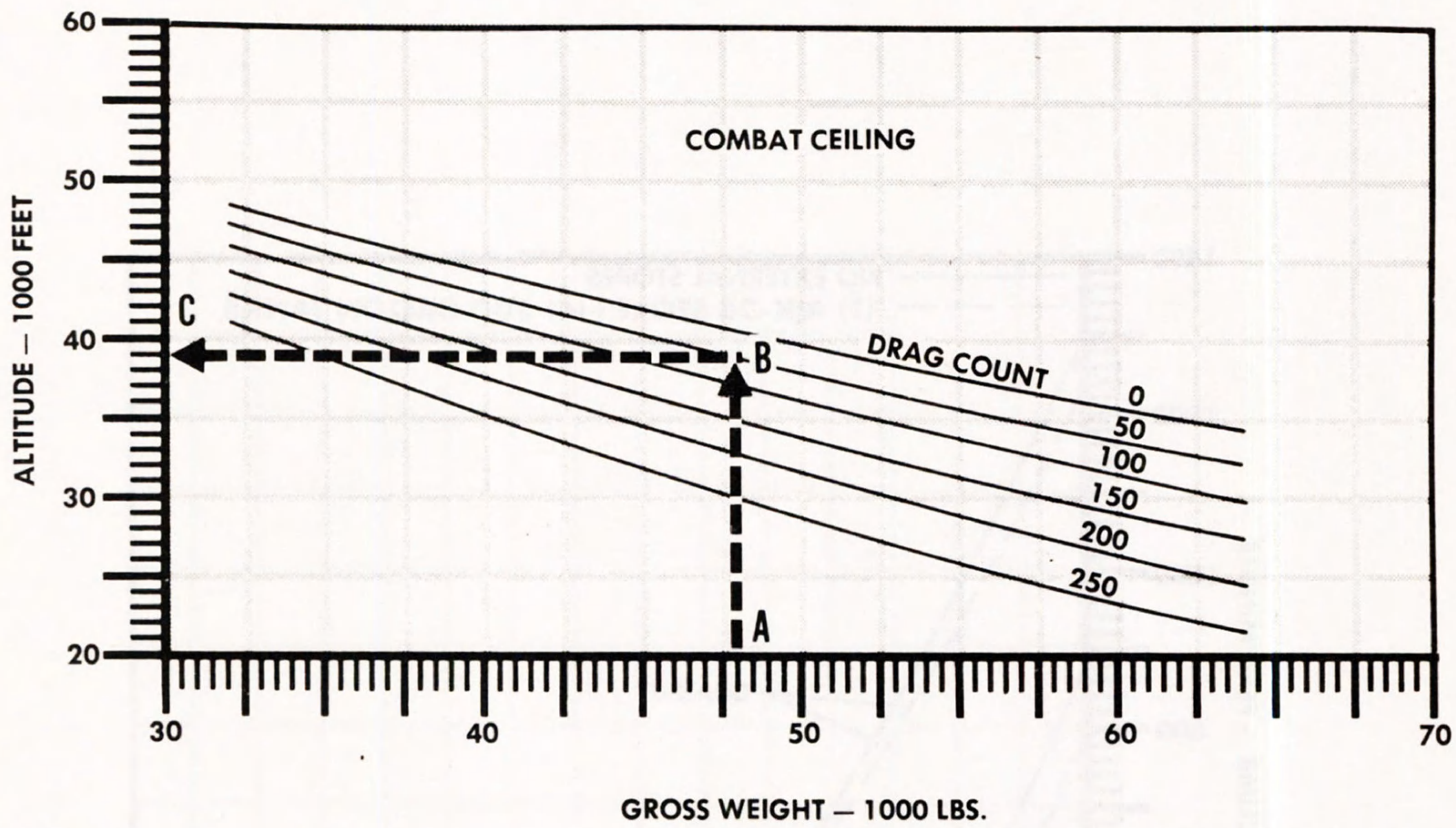
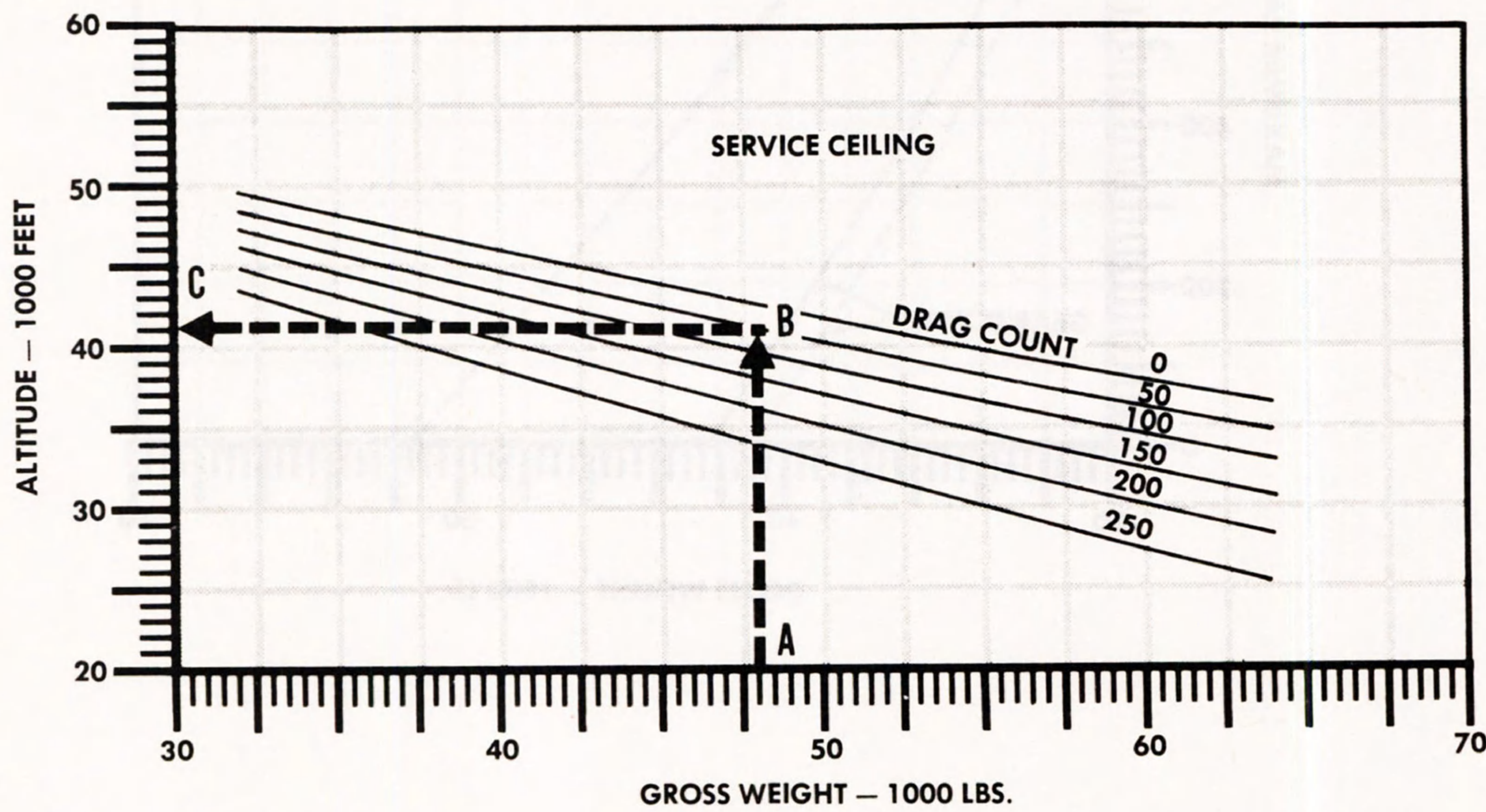
P-8 ENGINE

MILITARY POWER

DATE 15 MARCH 1971
DATA BASIS: ESTIMATED

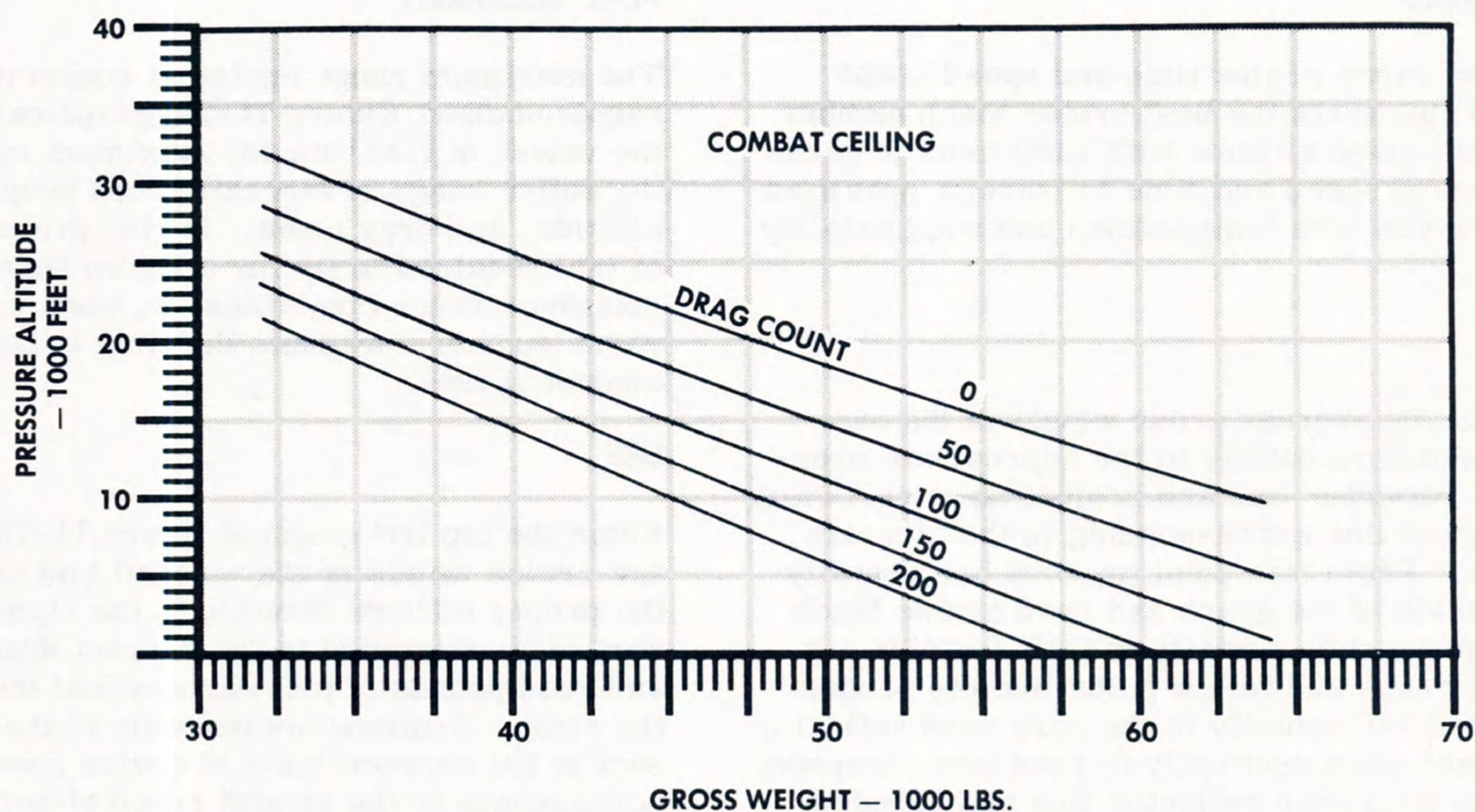
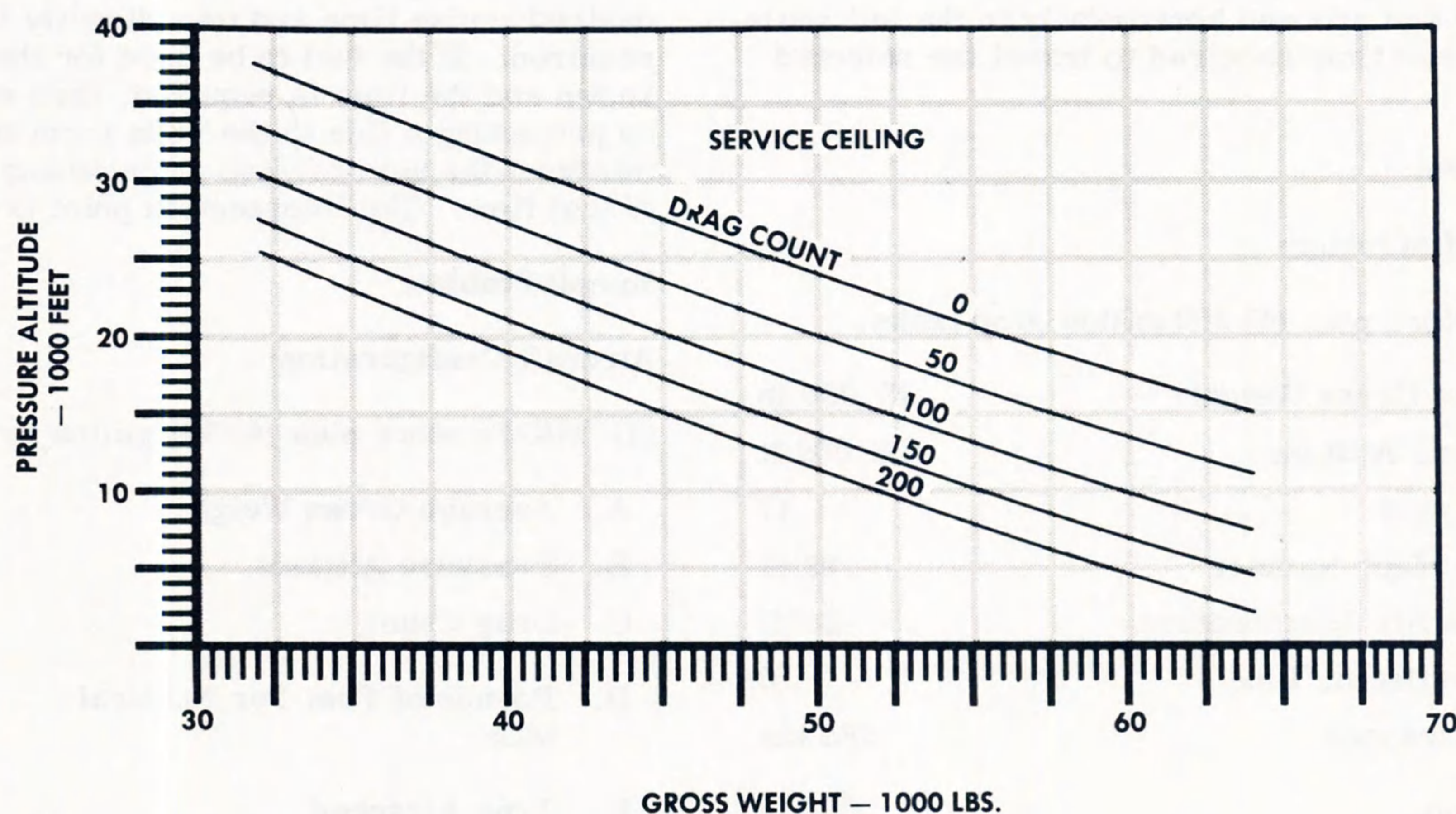
REMARKS
ENGINES: (2) J52-P-8
ICAO STANDARD DAY

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB./GAL.



ADF1-370

Figure 11-75

COMBAT CEILING AND SERVICE CEILING (single engine)**P-8 ENGINE****MILITARY POWER**DATE 15 MARCH 1971
DATA BASIS: ESTIMATEDREMARKS
INOPERATIVE ENGINE WINDMILLING
ICAO STANDARD DAYFUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB./GAL.

ADF1-371

Figure 11-76

part 5

Range

**MAXIMUM RANGE CRUISE AT
CONSTANT ALTITUDE**

TIME AND SPEED

The maximum range cruise time and speed graph (figure 11-77) presents the best cruise Mach number for a constant cruise altitude with variations in gross weights. Ground speed and time to travel a specified distance are given with temperature and wind velocity as variables.

USE

Enter chart at the average gross weight of the aircraft. Proceed horizontally to the appropriate pressure altitude reflector line and project down vertically to the drag count line corresponding to the aircraft configuration. From this point proceed horizontally to the right scale of the graph and read cruise Mach number. Continue horizontally to OAT (outside air temperature) graph and follow guide lines to proper OAT. Proceed horizontally to the zero wind reflector line and project down vertically to read true airspeed. Trace back to zero wind reflector line and proceed horizontally to proper headwind or tailwind reflector line. From this point project vertically to selected distance line and proceed horizontally to the left scale of graph to read time required to travel the selected distance.

Sample Problem

Aircraft Configuration:

(1) MK-28 store plus (4) 300 gallon drop tanks.

A. Average Gross Weight	45,000 lb
B. Pressure Altitude	25,000 ft
C. Drag Count	47
D. Cruise Mach Number	.63 M
E. Outside Air Temperature	-20° C
F. Wind Reflector Line	0
G. True Airspeed	380 kts
H. Tailwind	50 kts
I. Ground Speed	440 kts
J. Selected Distance	300 NM
K. Time Required	44 min

**MAXIMUM RANGE CRUISE AT
CONSTANT ALTITUDE**

FUEL REQUIRED

The maximum range cruise at constant altitude fuel required chart (figure 11-78) graphically presents the values of fuel flow for maximum range throughout the entire range of aircraft gross weight, pressure altitude, and drag count. It also presents the amount of fuel required to fly for a known time interval under maximum range conditions, or when used in an inverse manner, presents the time in flight for a given amount of fuel.

USE

Enter the top left graph of figure 11-73 at the average cruise weight of the aircraft and intersect with the proper altitude directly to the right. Proceed vertically downward to the correct drag count value and read pounds of fuel per nautical mile directly to the right. Continue horizontally to the right to intersect at the correct value of cruise speed (TAS), which corresponds to the ground speed at zero wind read from figure 11-77. Directly above read fuel flow for maximum range cruise. Continue straight up to the desired cruise time and then directly left to read fuel required. If the fuel to be used for the cruise is known and the time is required, then work backwards by projecting a line to the right from the fuel scale to intersect the vertical line projected up from the value of fuel flow. The intersection point is the cruise time.

Sample Problem

Aircraft Configuration:

(1) MK-28 store plus (4) 300 gallon drop tanks.

A. Average Gross Weight	45,000 lb
B. Pressure Altitude	25,000 ft
C. Drag Count	47
D. Pounds of Fuel Per Nautical Mile	10.9 lbs/NM
E. True Airspeed	380 kts
F. Fuel Flow	3950 lbs/hr
G. Time	44 min
H. Fuel Required	3000 lbs

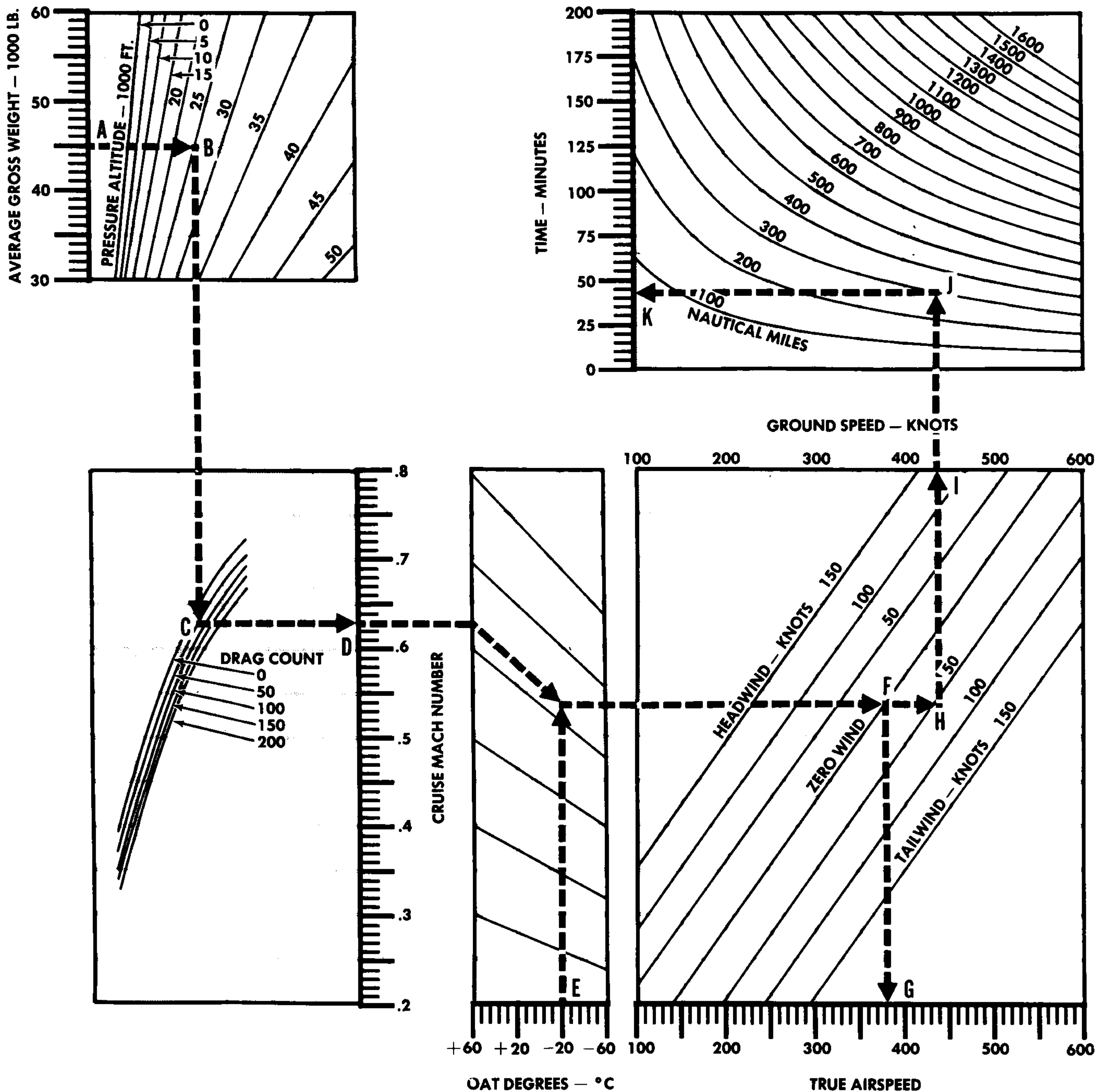
MAXIMUM RANGE CRUISE AT CONSTANT ALTITUDE

P-8 ENGINE

TIME AND SPEED

DATE 15 MARCH 1971
DATA BASIS: ESTIMATED

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB./GAL.



ADF1-372

Figure 11-77

MAXIMUM RANGE CRUISE AT CONSTANT ALTITUDE

P-8 ENGINE

FUEL REQUIRED

DATE 15 MARCH 1971
DATA BASIS: ESTIMATED

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB./GAL.

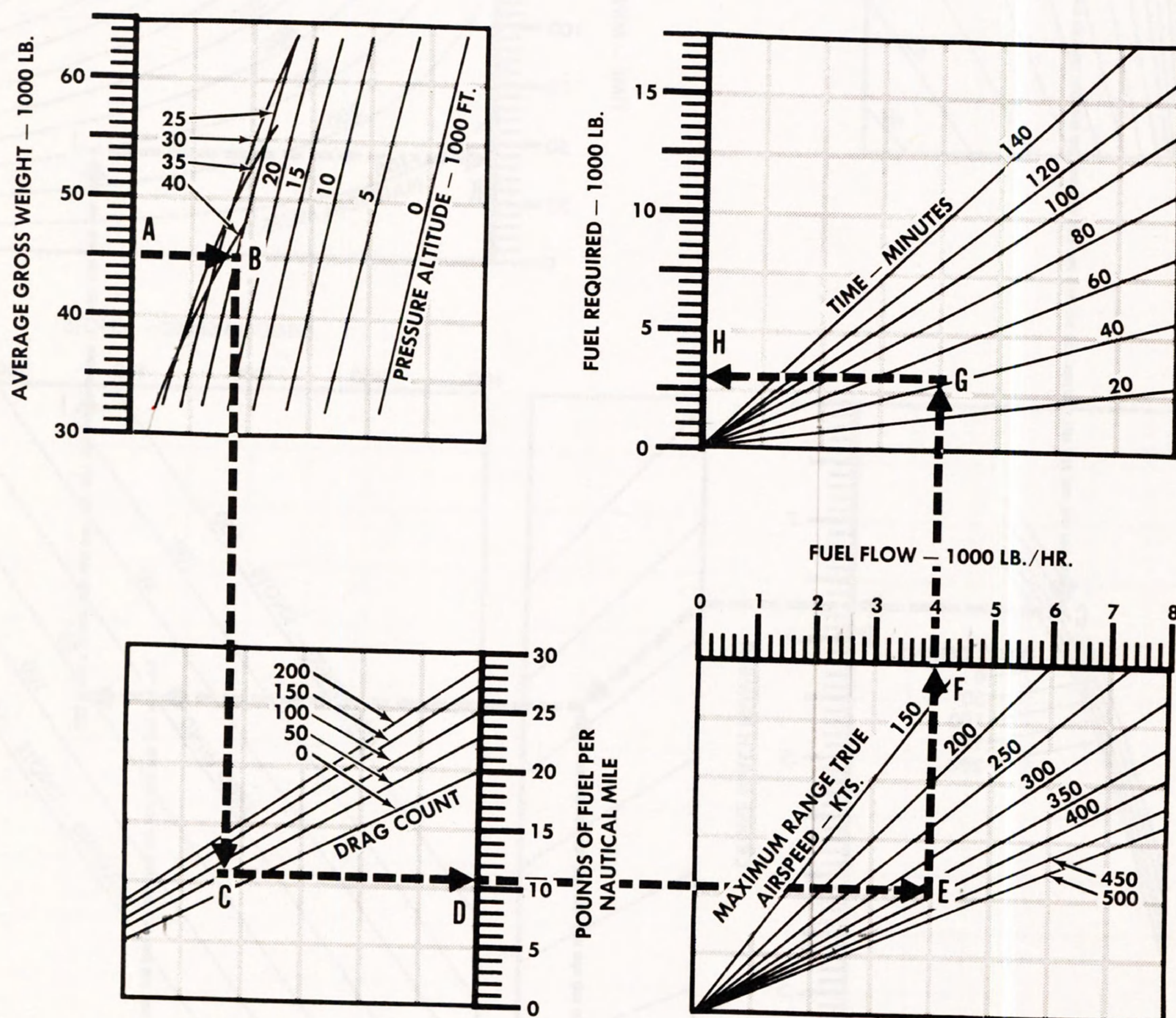


Figure 11-78

ADF1-373

MAXIMUM RANGE CRUISE AT CONSTANT ALTITUDE (single engine)

P-8 ENGINE

TIME AND SPEED

DATE 15 MARCH 1971
DATA BASIS: ESTIMATED

REMARKS
INOPERATIVE ENGINE WINDMILLING
ICAO STANDARD DAY

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB./GAL.

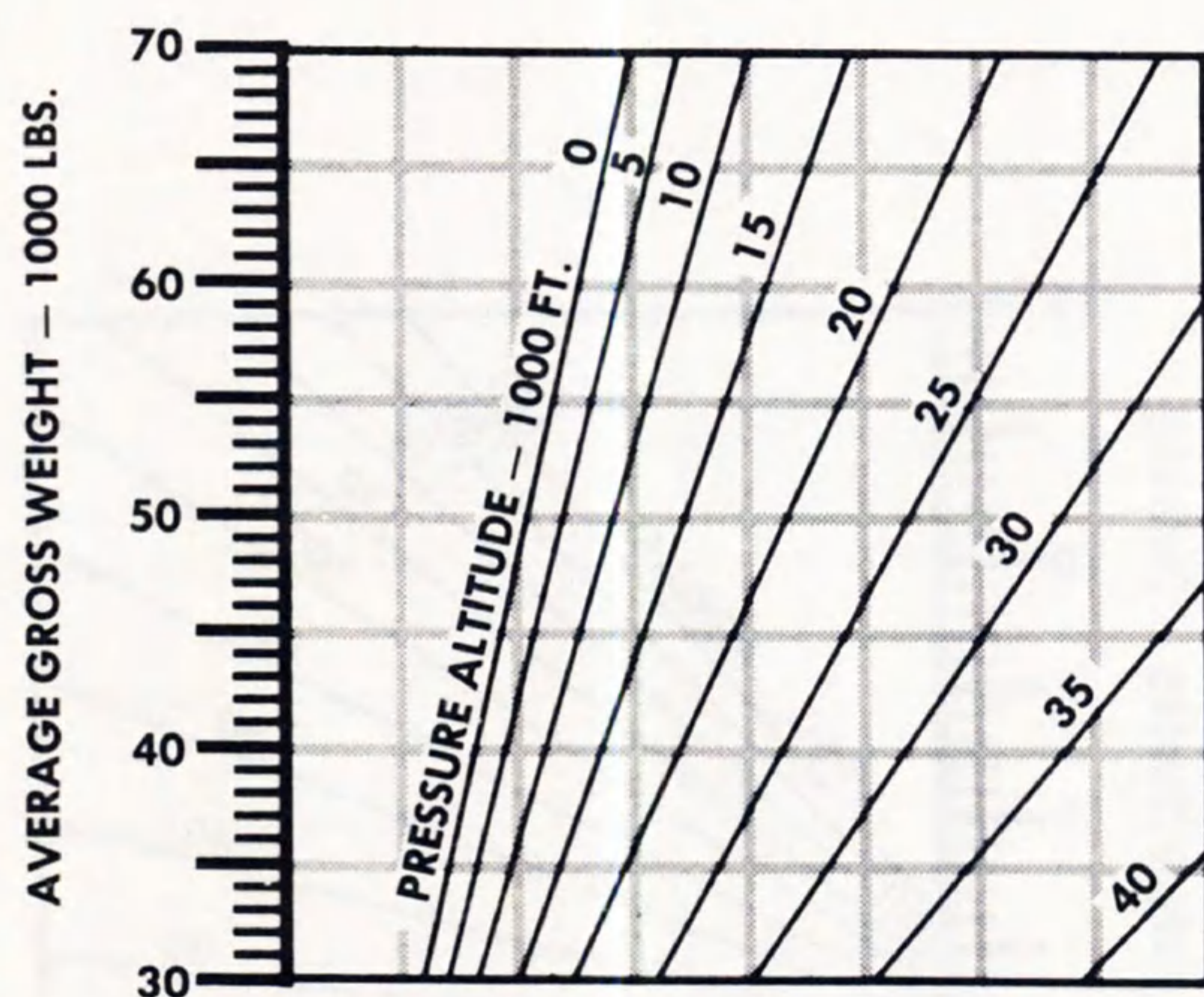
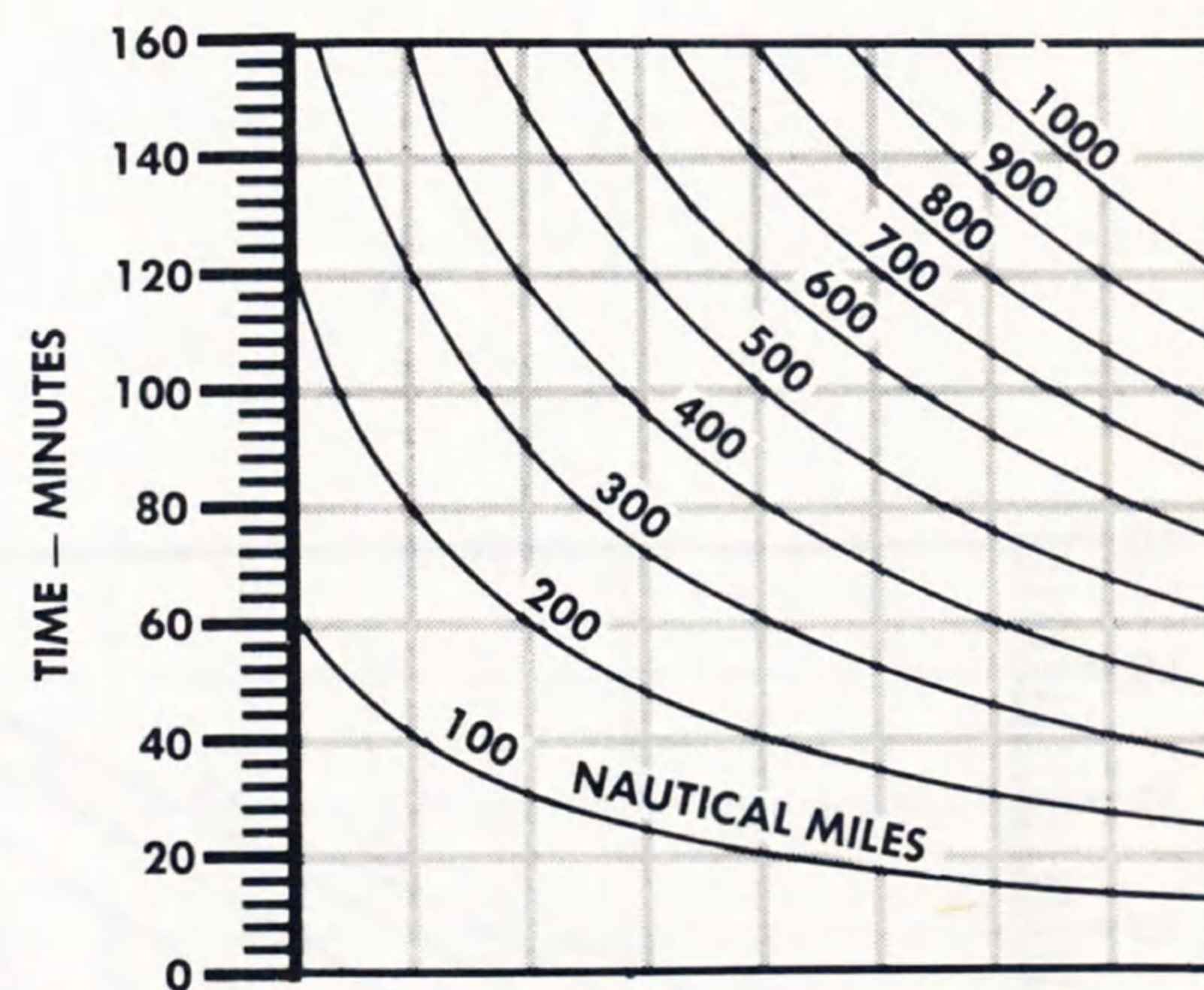
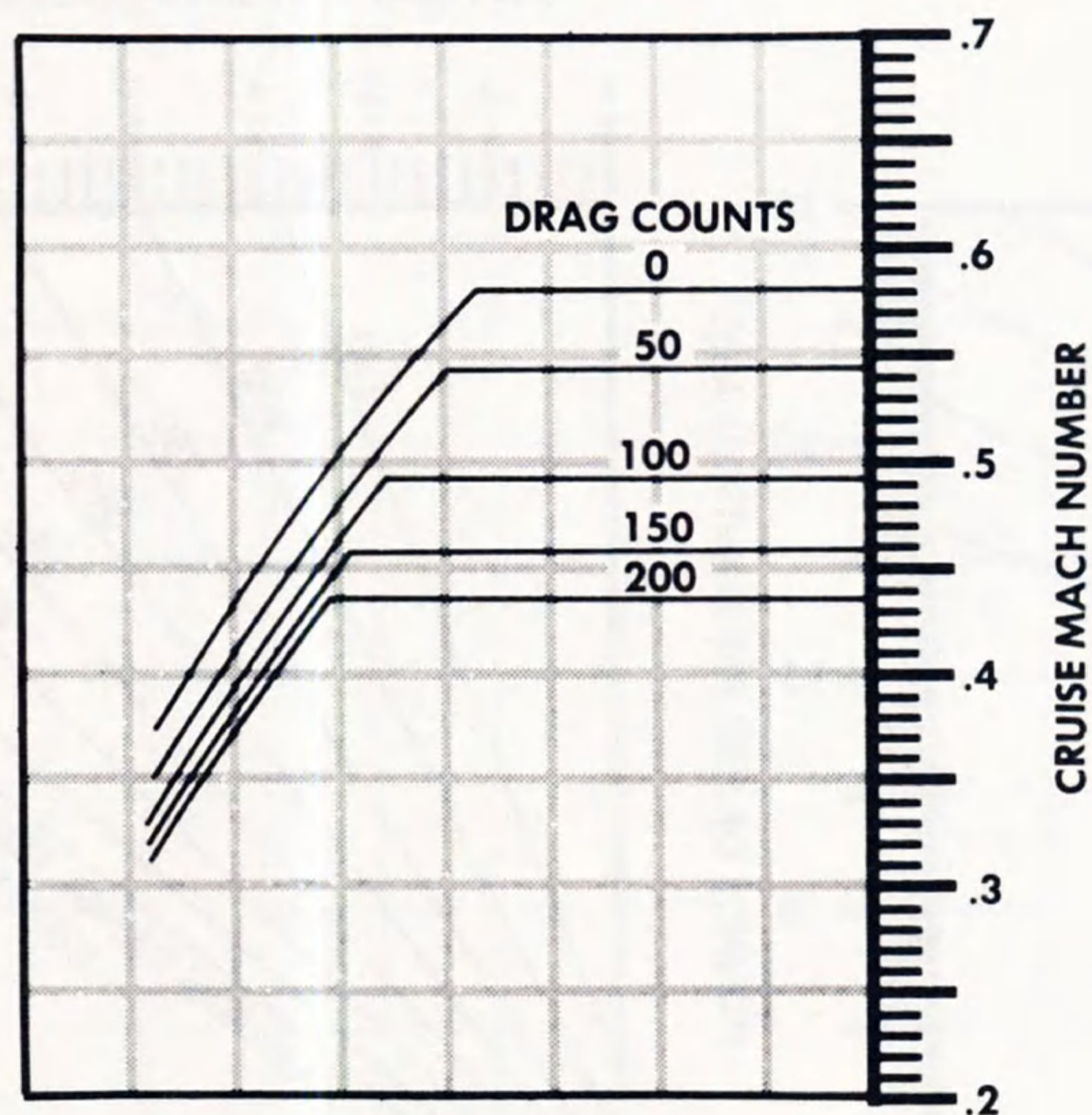
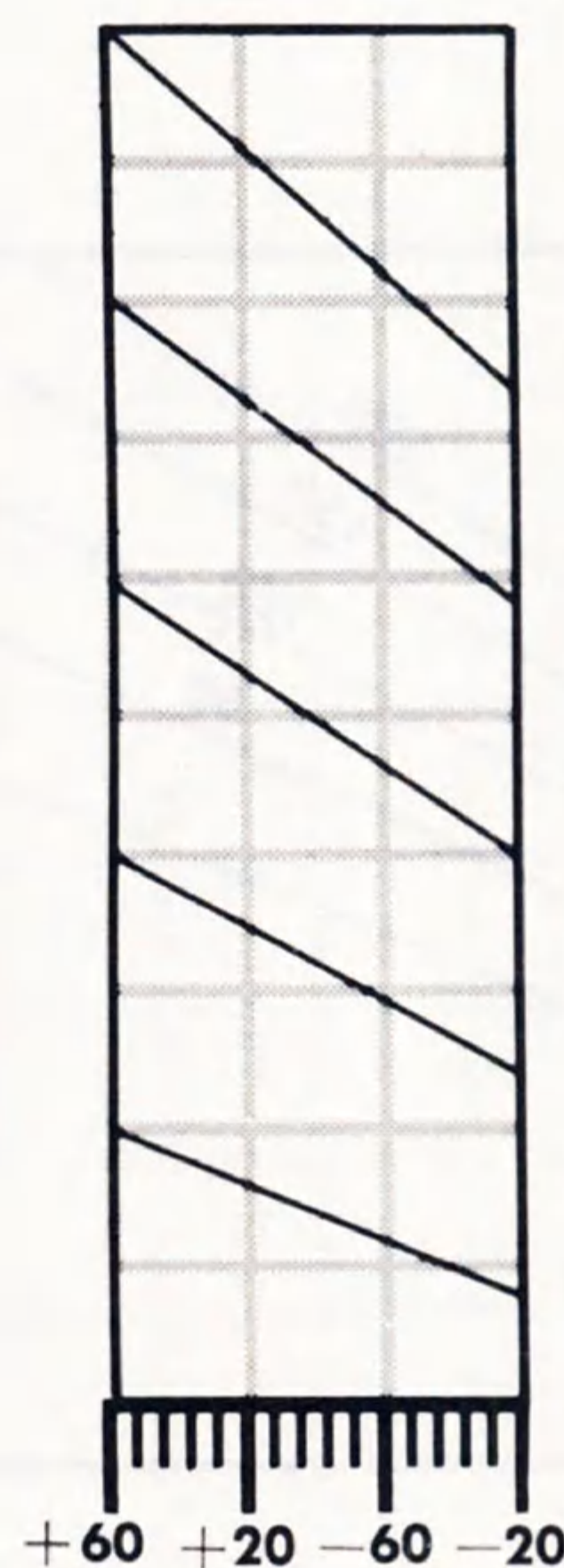
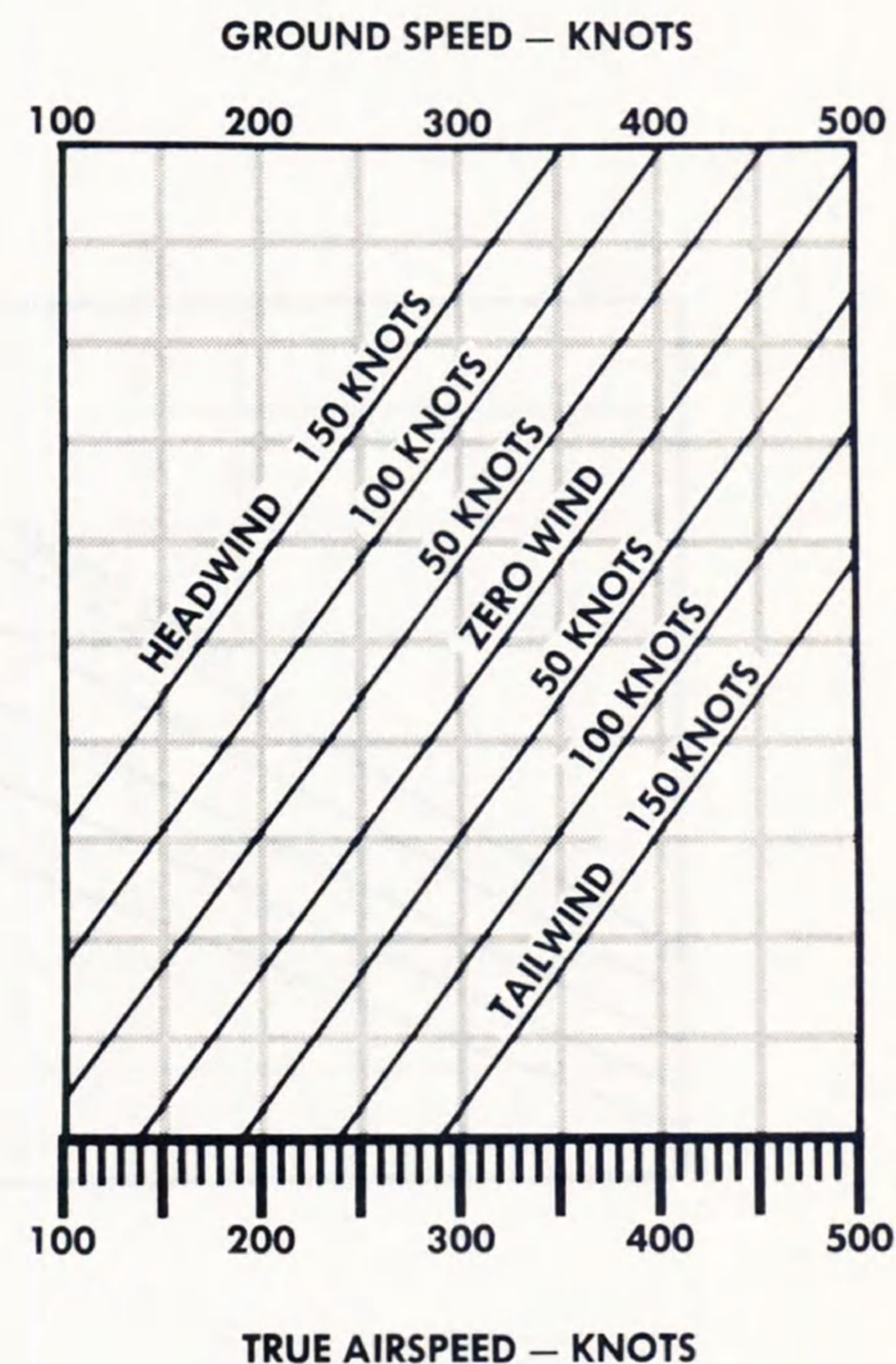


Figure 11-79

MAXIMUM RANGE CRUISE AT CONSTANT ALTITUDE (single engine)

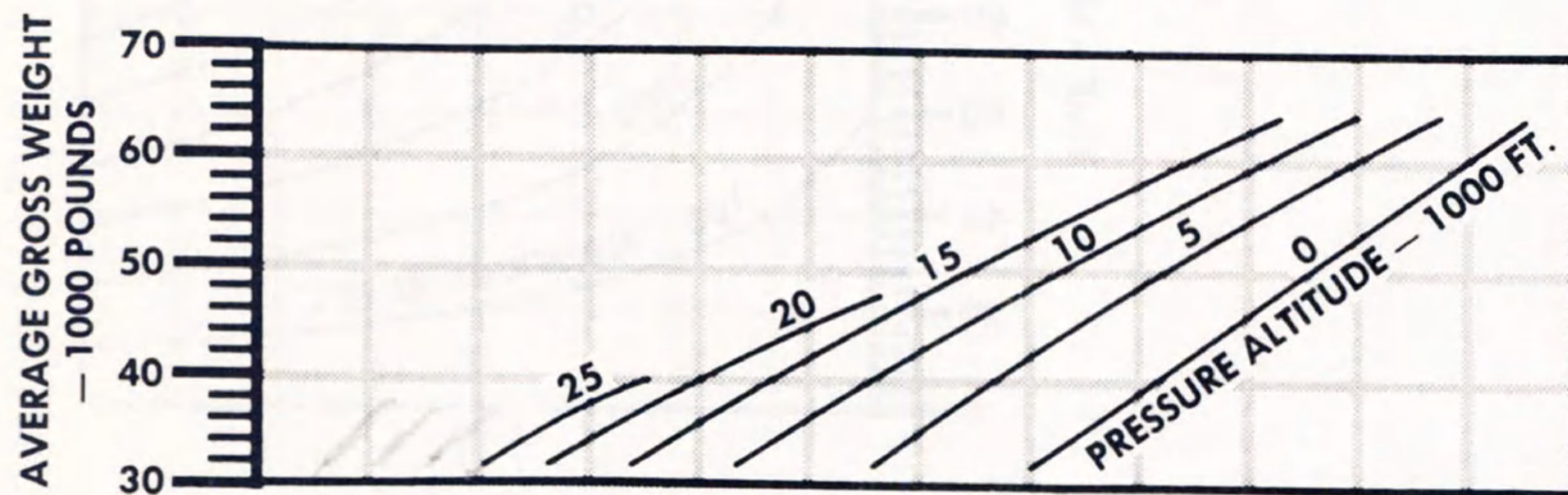
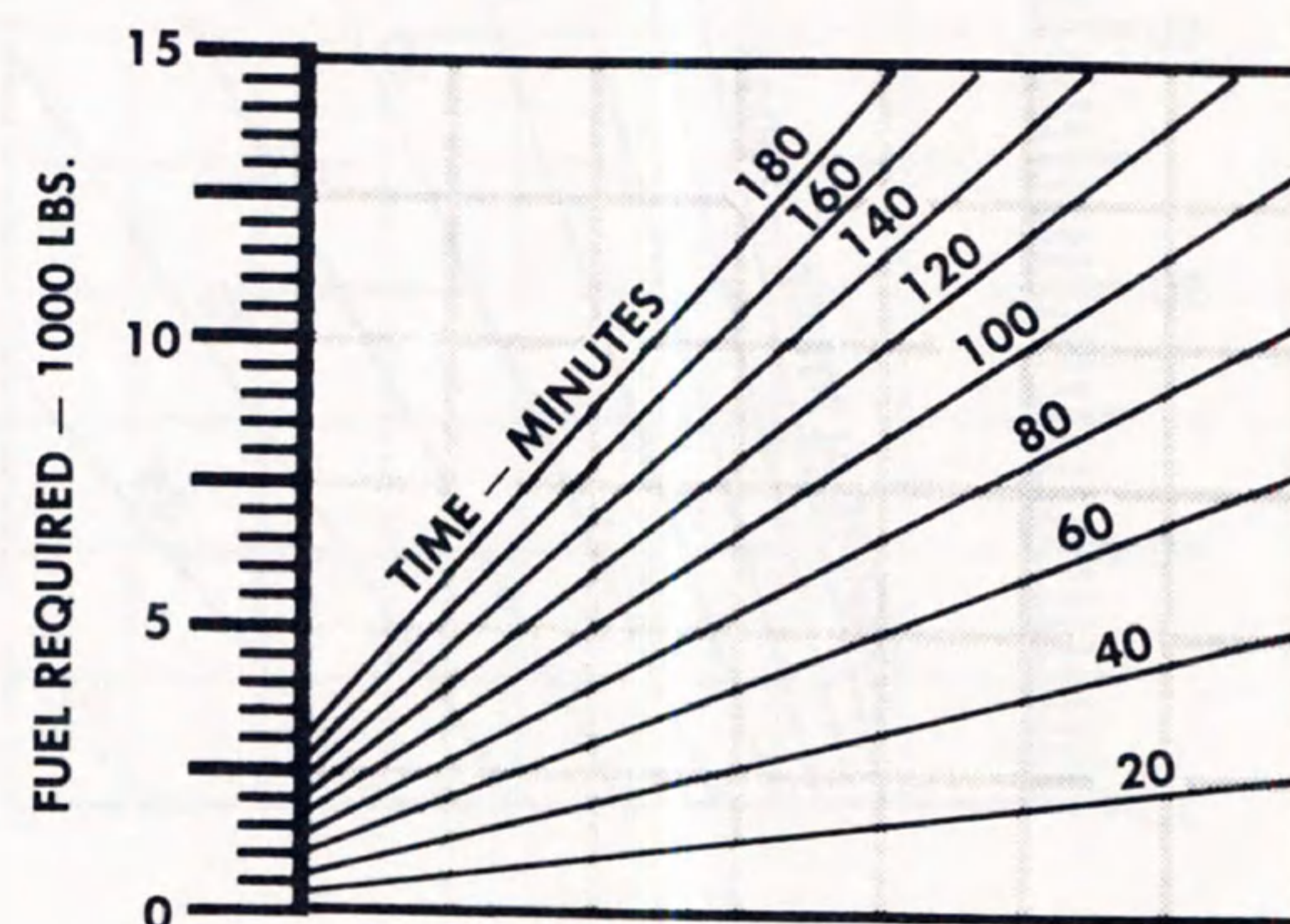
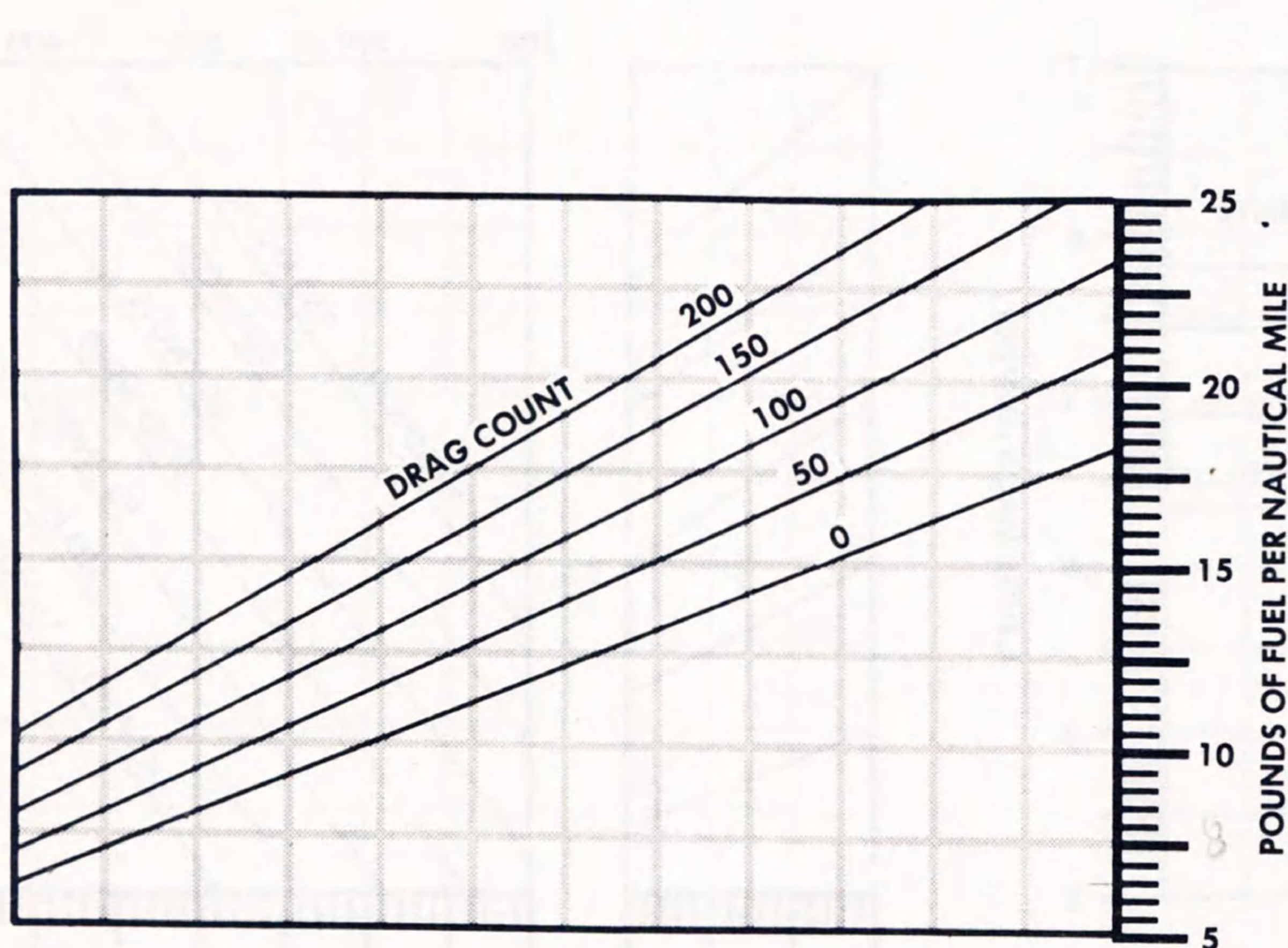
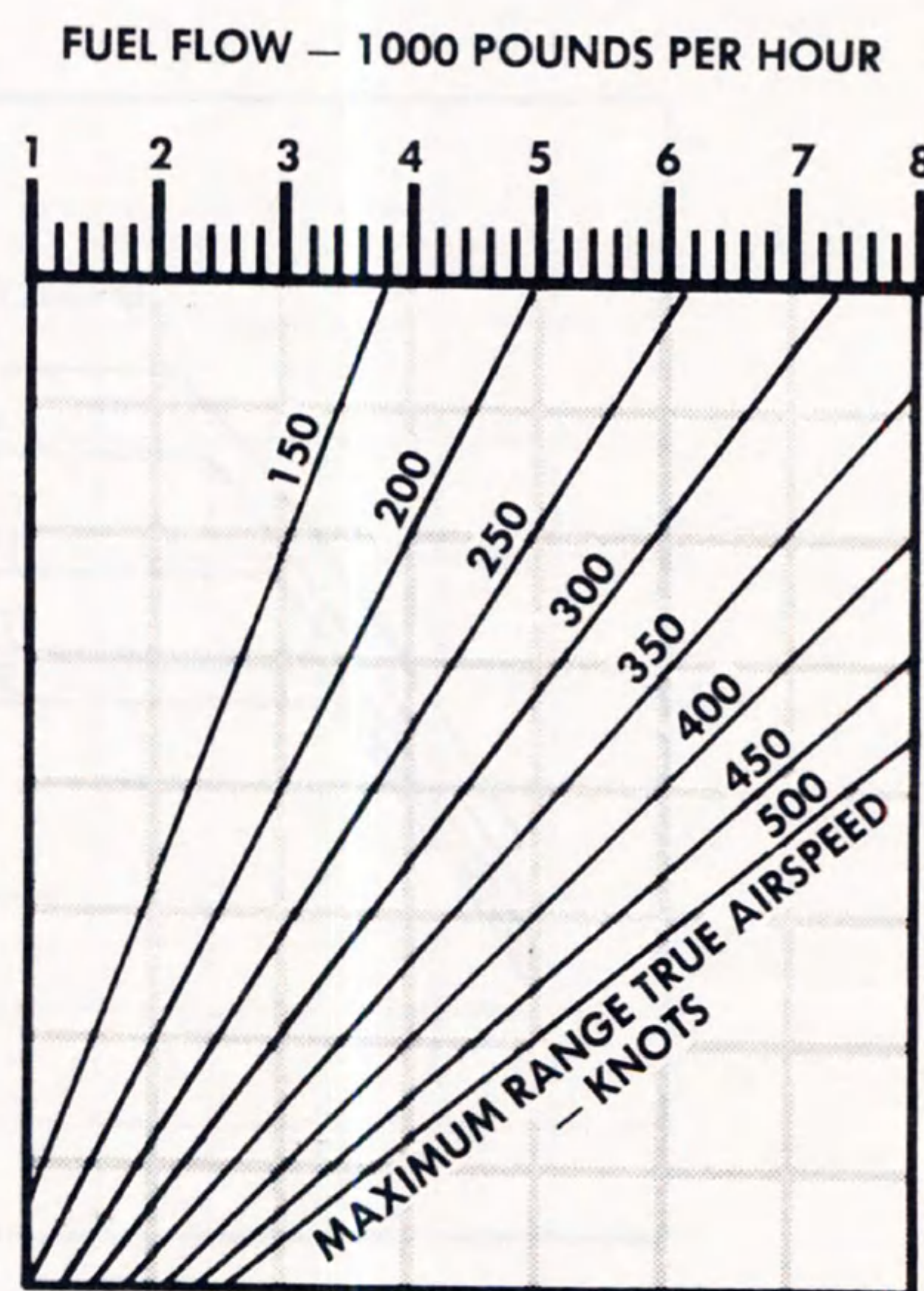
P-8 ENGINE

FUEL REQUIRED

DATE 15 MARCH 1971
DATA BASIS: ESTIMATED

REMARKS
INOPERATIVE ENGINE WINDMILLING
ICAO STANDARD DAY

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB./GAL.



ADF1-375

Figure 11-80

part 6**Endurance****MAXIMUM ENDURANCE****SPEED**

The maximum endurance speed chart (figure 11-81) graphically presents the value of calibrated airspeed recommended for maximum endurance throughout the complete range of aircraft gross weight, pressure altitude, and drag count for values of bank angle from 0 to 50 degrees.

USE

Enter the top right graph of figure 11-81 at the average gross weight of the aircraft. Parallel the guide lines to the correct value of bank angle. Proceed directly to the left to the selected pressure altitude. If it is desired to fly at the altitude for maximum endurance, then proceed instead to the appropriate value of maximum endurance altitude corresponding to the configuration drag count given by the broken lines. Proceed vertically downward to intersect the correct drag count value, and then directly to the right to read the maximum endurance Mach number. Continue horizontally to the right to the correct pressure altitude, and then vertically downward to read the calibrated airspeed for maximum endurance.

Sample Problem

Aircraft Configuration:

(1) MK-28 store plus (4) 300 gallon drop tanks.

A. Average Gross Weight	45,000 lb
B. Bank Angle	25 degrees
C. Pressure Altitude	30,000 ft
D. Drag Count	47
E. Maximum Endurance Mach Number	.62 M
F. Pressure Altitude	30,000 ft
G. Calibrated Airspeed for Maximum Endurance	230 kts

MAXIMUM ENDURANCE**FUEL REQUIRED**

The maximum endurance fuel required chart (figure 11-82) graphically presents the values of minimum

fuel flow throughout the complete range of aircraft gross weight, pressure altitude, and drag count for values of bank angle from 0 to 50 degrees, and standard day temperature deviations of up to $\pm 20^{\circ}\text{C}$. It also presents the amount of fuel required to fly for a known time interval under maximum endurance conditions, or when used in an inverse manner, presents the time in flight for a given amount of fuel.

USE

Enter the top left graph of figure 11-82 at the known gross weight and parallel the guide lines to the appropriate bank angle. Proceed to the right and intersect the appropriate altitude and then vertically downward to the correct drag count value. Proceed horizontally to the right to the proper altitude and project vertically upward to read minimum fuel flow. To obtain minimum fuel flow for a standard day temperature deviation parallel the guide lines until the temperature deviation is reached, then project vertically upward to read minimum fuel flow. Continue vertically to intersect the desired endurance time and then directly to the left to read fuel required. If it is desired to find the endurance time for a known amount of fuel to be used, then proceed as above, but choose the fuel required and proceed to the right to intersect the vertical line to read time.

Sample Problem

Aircraft Configuration:

(1) MK-28 store plus (4) 300 gallon drop tanks.

A. Average Gross Weight	45,000 lb
B. Bank Angle	25 degrees
C. Pressure Altitude	30,000 ft
D. Drag Count	47
E. Pressure Altitude	30,000 ft
F. Temperature Deviation From Standard Day	+10°C
G. Fuel Flow	4050 lbs/hr
H. Endurance Time	80 min
I. Fuel Required	5000 lb

MAXIMUM ENDURANCE

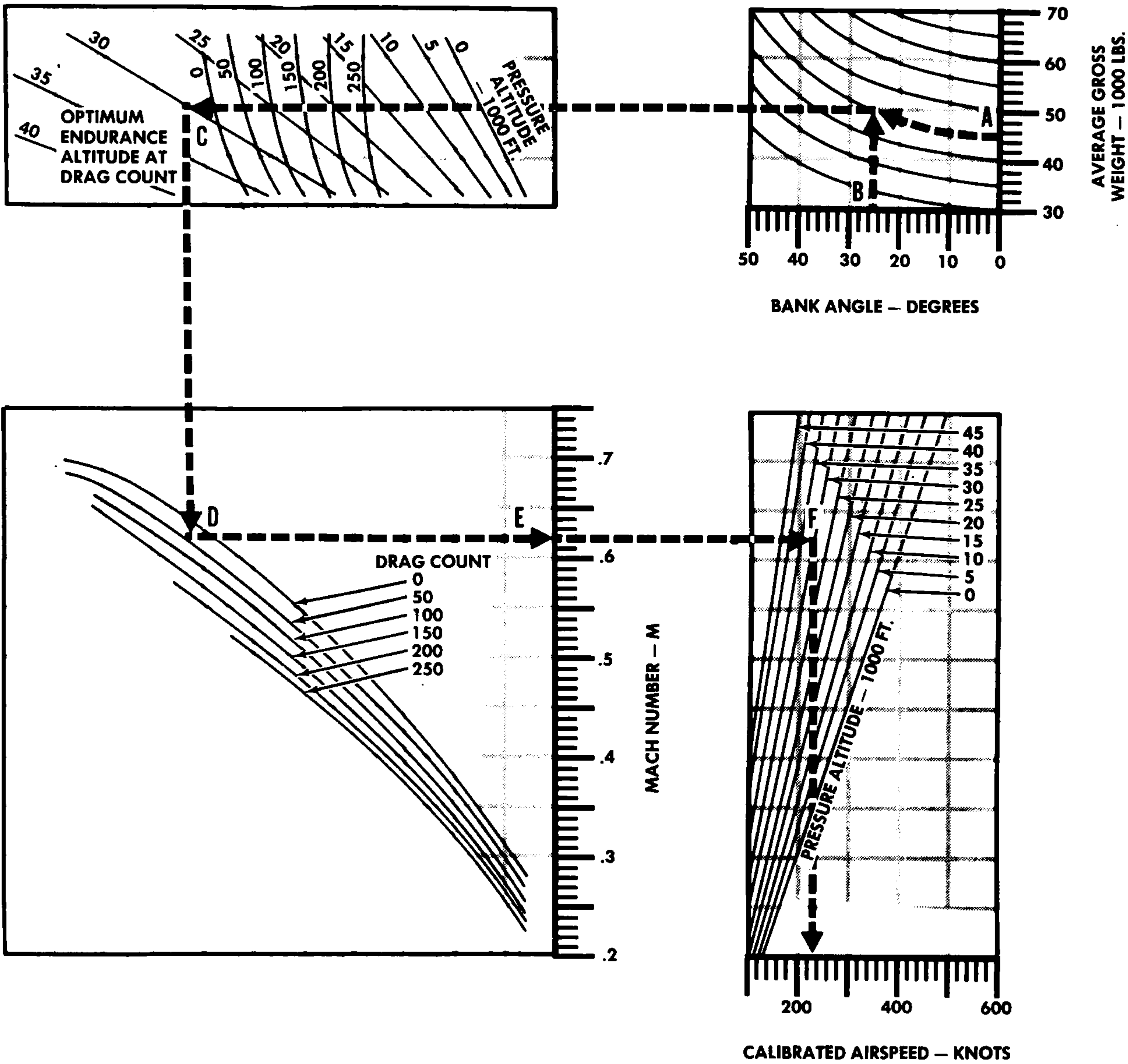
P-8 ENGINE

SPEED

DATE 15 MARCH 1971
DATA BASIS: ESTIMATED

REMARKS
ENGINES: (2) J52-P-8
ICAO STANDARD DAY

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB./GAL.



ADF1-376

Figure 11-81

MAXIMUM ENDURANCE

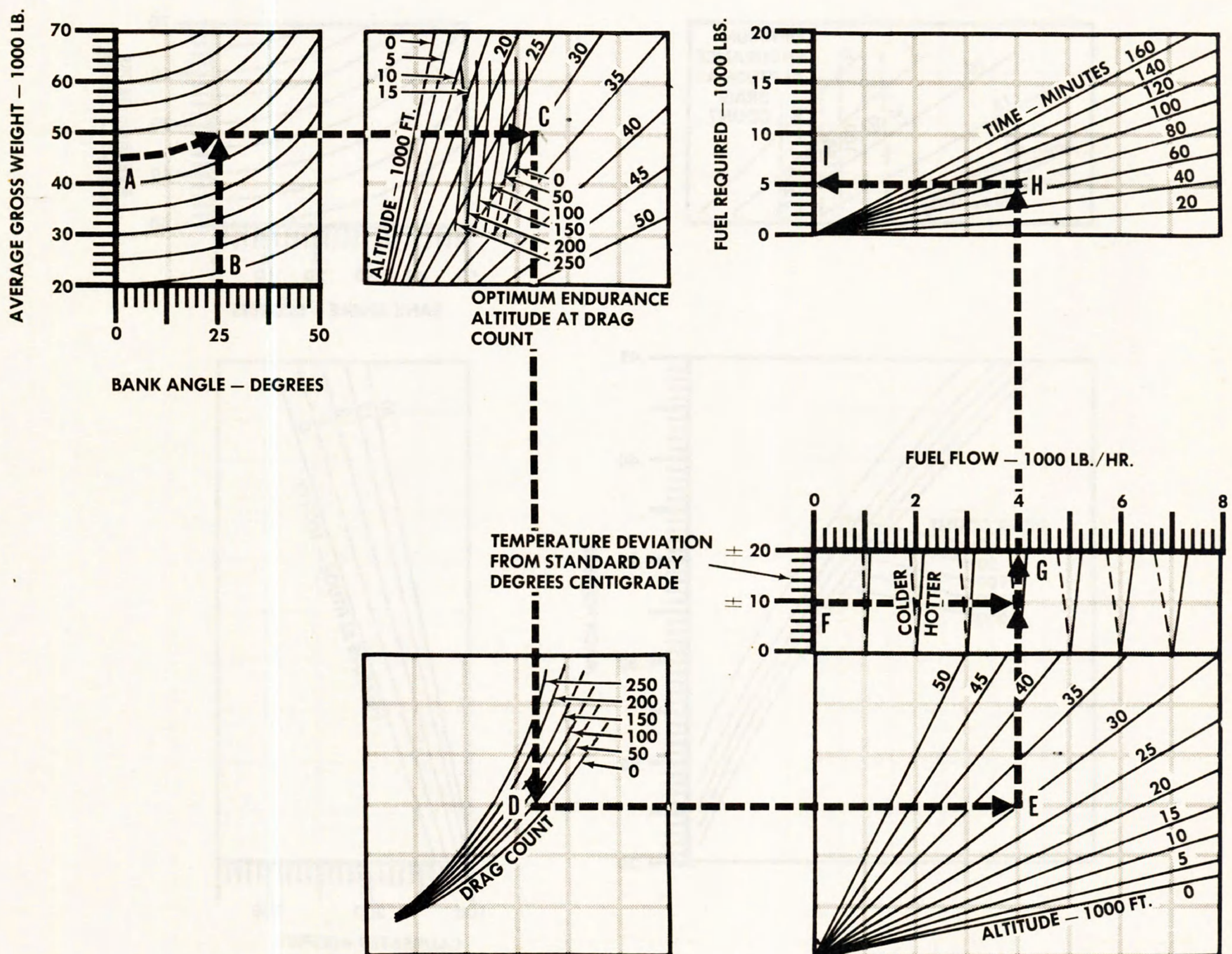
P-8 ENGINE

FUEL REQUIRED

DATE 15 MARCH 1971
DATA BASIS: ESTIMATED

REMARKS
ENGINES: (2) J52-P-8
ICAO STANDARD DAY

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB./GAL.



ADF1-377

Figure 11-82

MAXIMUM ENDURANCE (single engine)

P-8 ENGINE

SPEED

DATE 15 MARCH 1971
DATA BASIS: ESTIMATED

REMARKS
INOPERATIVE ENGINE WINDMILLING
ICAO STANDARD DAY

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB./GAL.

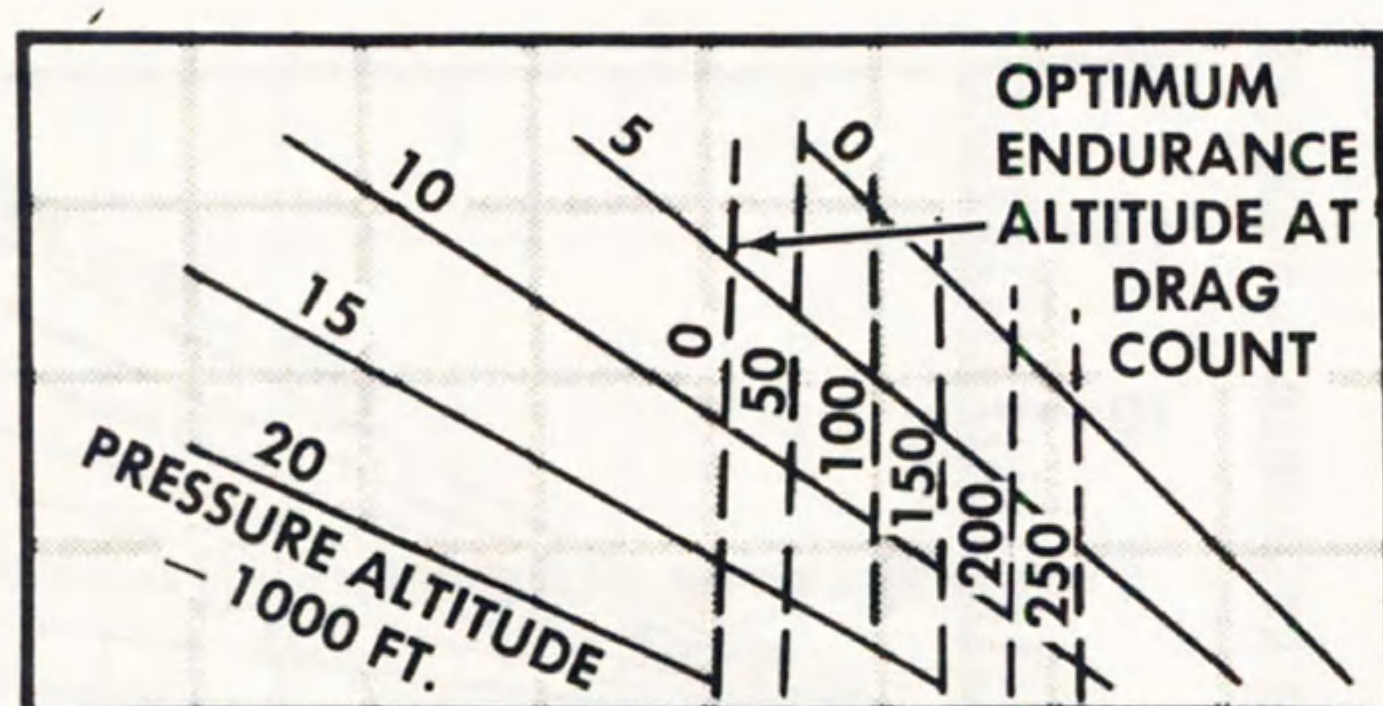
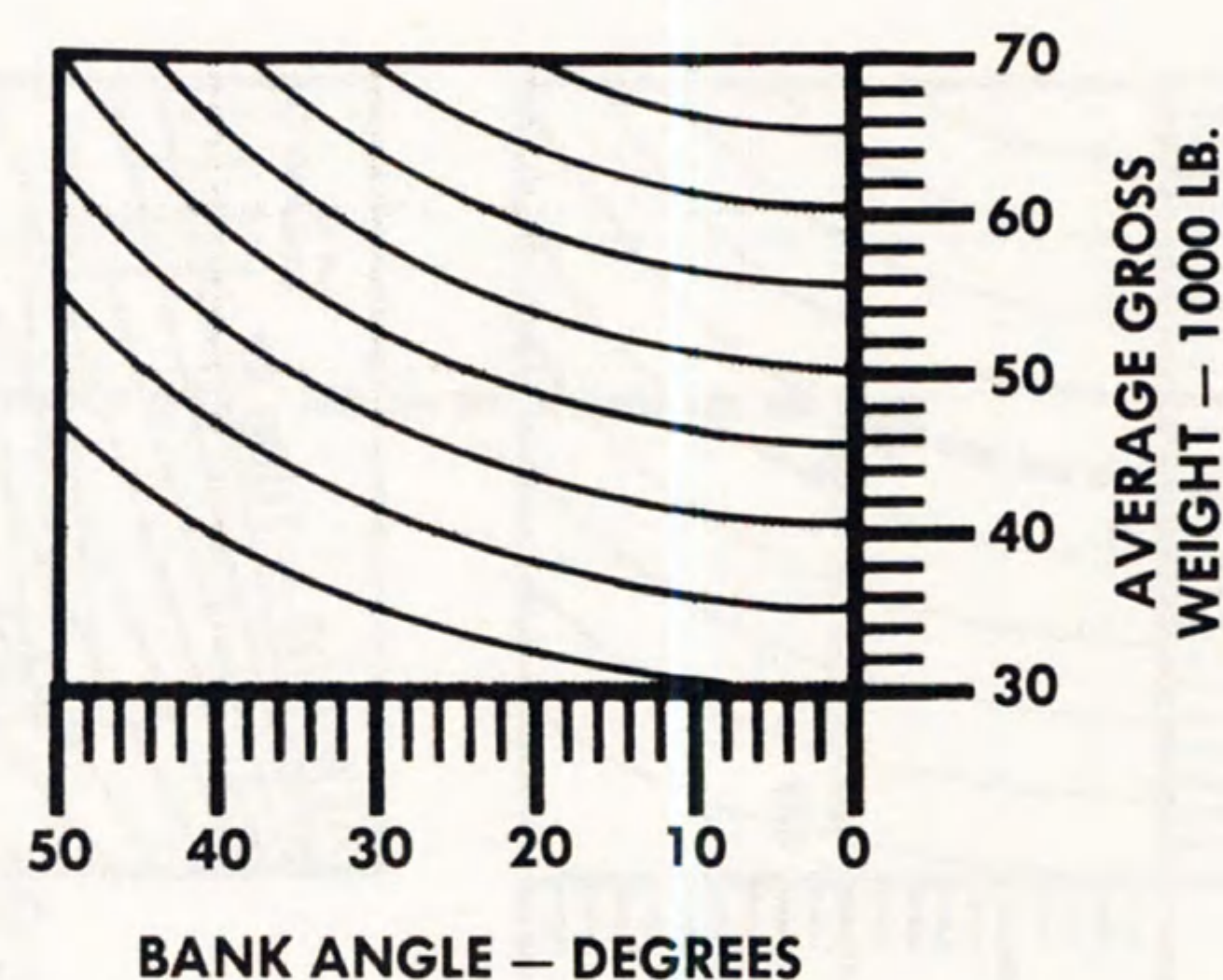
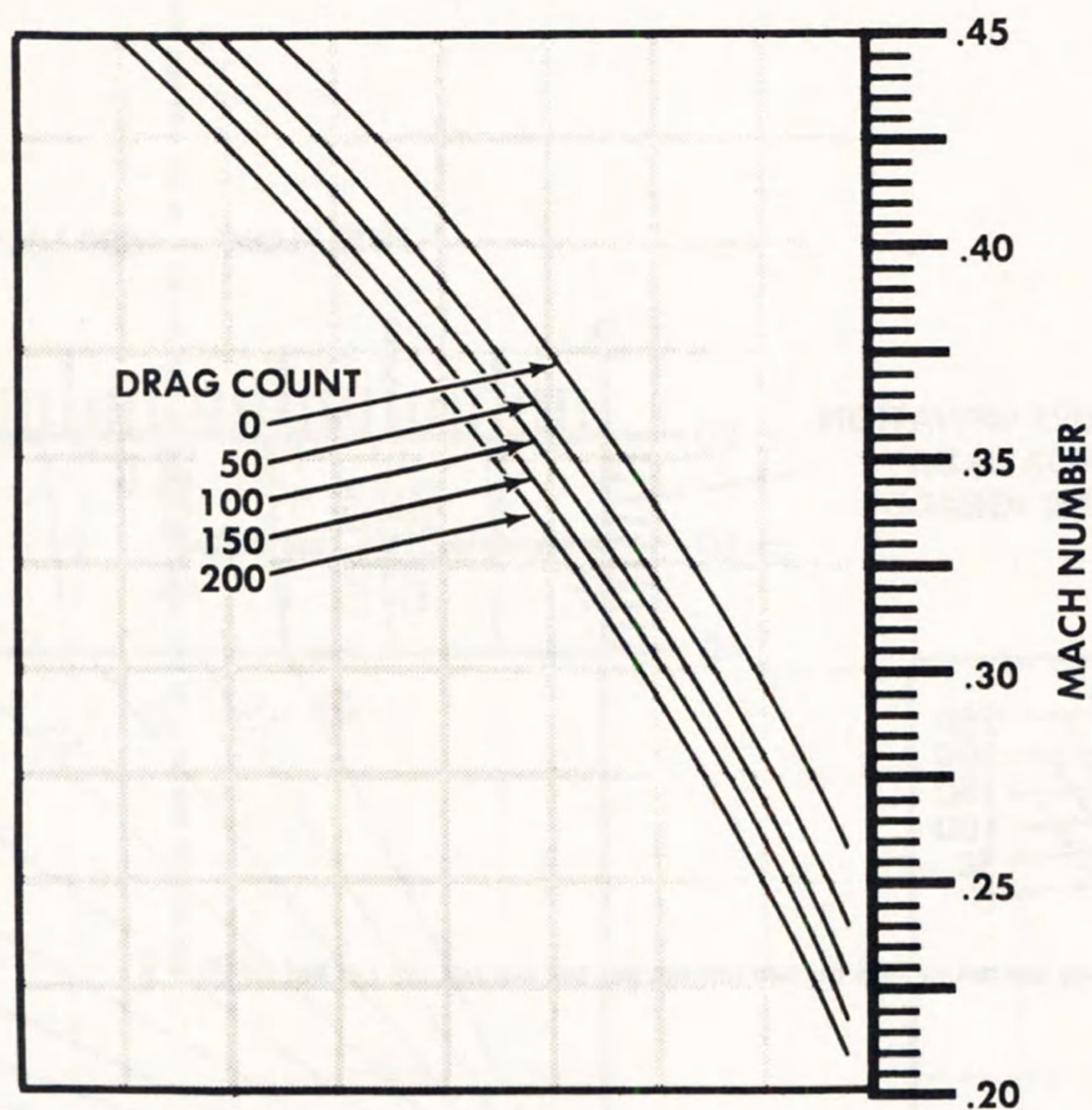
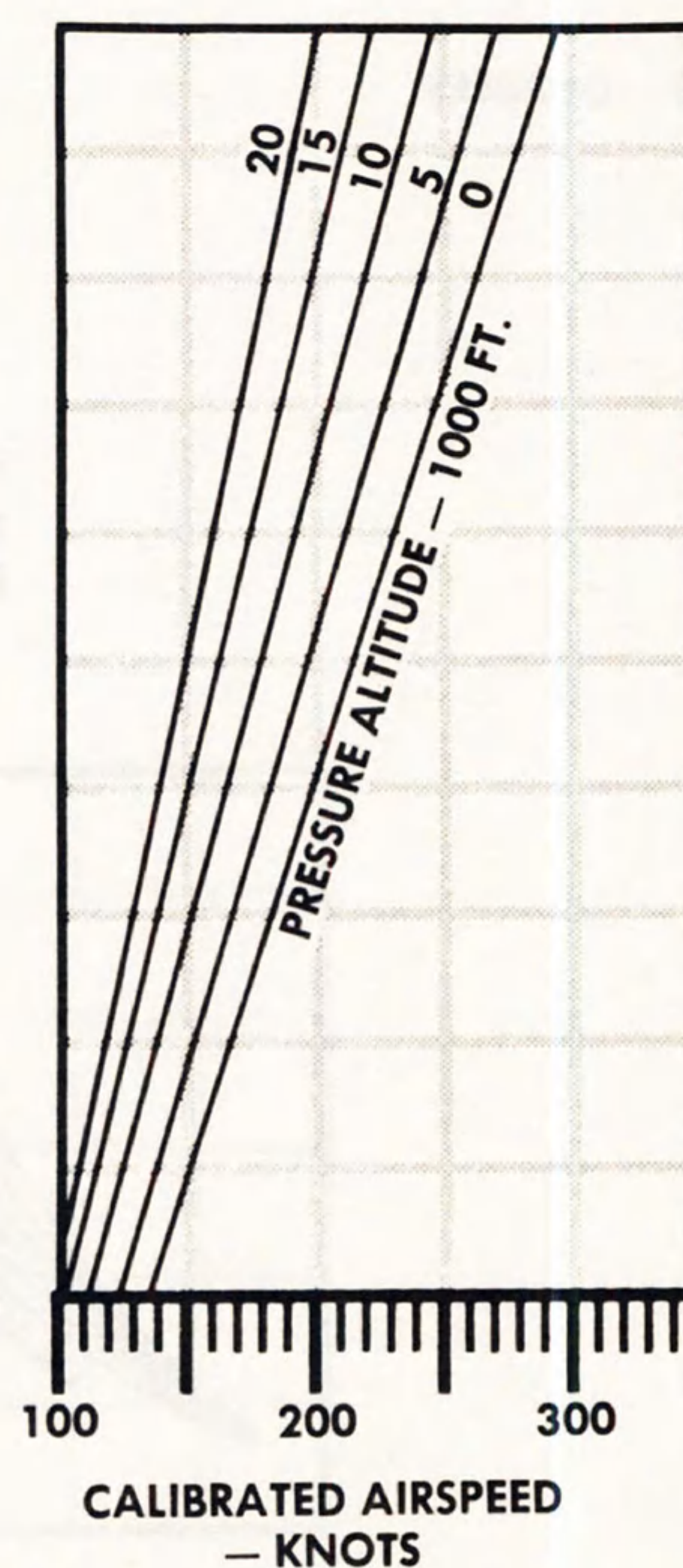


Figure 11-83

MAXIMUM ENDURANCE (single engine)

P-8 ENGINE

FUEL REQUIRED

DATE 15 MARCH 1971
DATA BASIS: ESTIMATED

REMARKS
INOPERATIVE ENGINE WINDMILLING
ICAO STANDARD DAY

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB./GAL.

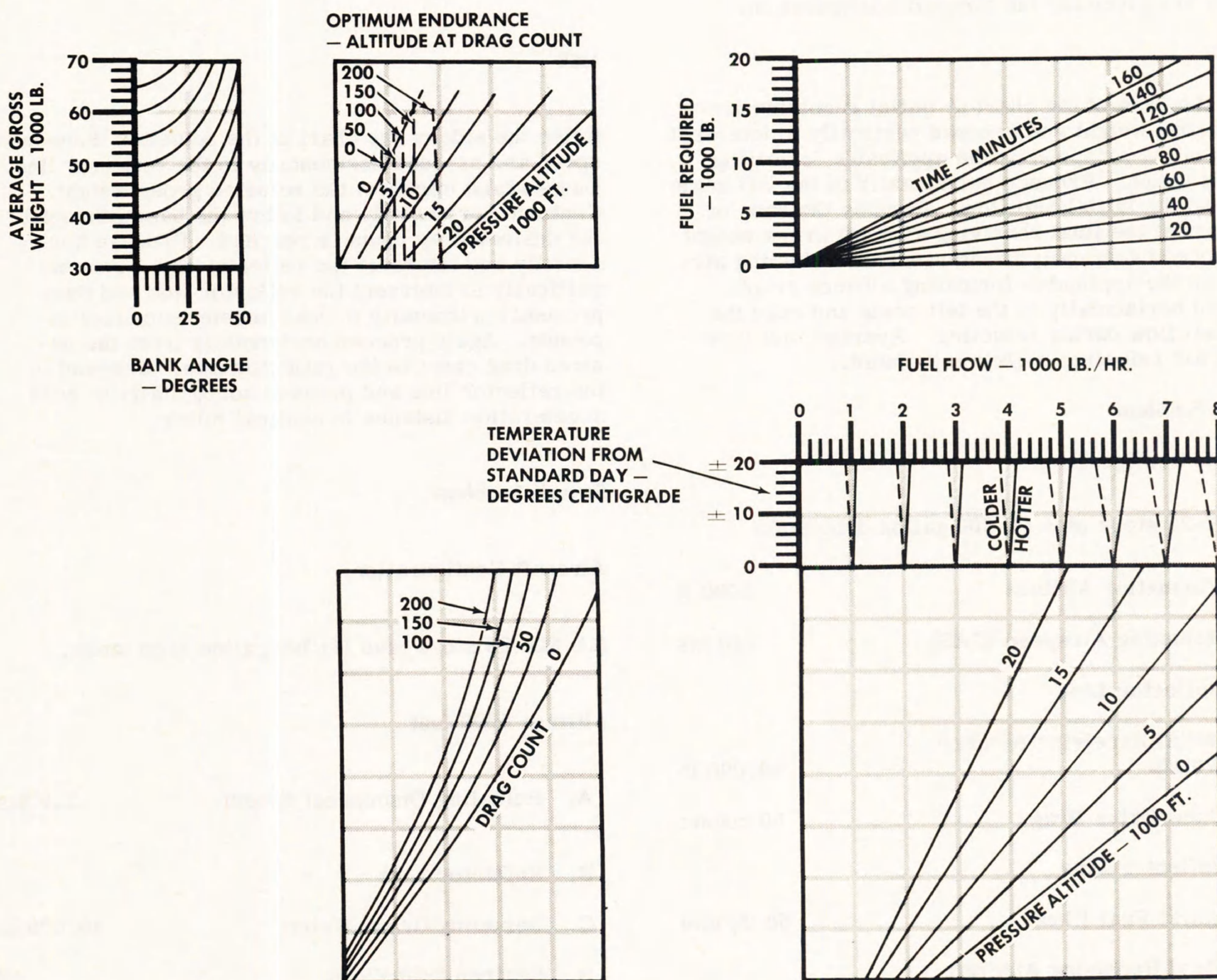


Figure 11-84

part 7

Air Refueling

**FUEL CONSUMPTION DURING
AIR REFUELING**

These charts (figures 11-85 through 11-87) present the fuel flow of the receiver aircraft, based on the refueling speed (KCAS). Three forming altitude graphs are given for the aircraft configuration.

USE

Enter the base of the chart at initial receiving aircraft gross weight and proceed vertically to intersect the refueling airspeed on the applicable forming altitude graph. Proceed horizontally to the left scale and read the initial fuel flow. Reenter the base of the chart at the final receiving aircraft gross weight and proceed vertically to intersect the refueling airspeed on the applicable forming altitude graph. Proceed horizontally to the left scale and read the final fuel flow during refueling. Average fuel flow during air refueling is then calculated.

Sample Problem

Aircraft Configuration:

(1) MK-28 store plus (4) 300 gallon drop tanks.

A. Formating Altitude	5000 ft
B. Refueling Airspeed (CAS)	230 kts
C. Reflector Line	
D. Initial Receiving Aircraft Weight	40,000 lb
E. Total Extra Drag	50 counts
F. Reflector Line	
G. Initial Fuel Flow	68 lb/min
H. Final Receiving Aircraft Weight	50,000 lb
I. Total Extra Drag	50 counts
J. Reflector Line	
K. Final Fuel Flow	78 lb/min
L. Average Fuel Flow During Refueling	73 lb/min

ACCELERATION TO CLIMB SPEED

This chart (figure 11-88) presents acceleration fuel and distance based on the refueled gross weight at disconnect. Climb speed (TAS) conforms to the applicable forming altitude.

USE

Enter the side of the chart at the refueling disconnect speed and proceed horizontally to the reflector line. Descend and intersect the refueled gross weight. Continue horizontally and follow the base line until the desired drag count is reached. Proceed horizontally and intersect the reflector line. Ascend vertically to intersect the reflector line and then proceed horizontally to read acceleration fuel in pounds. Again proceed horizontally from the desired drag count to the reflector line. Descend to the reflector line and proceed horizontally to read acceleration distance in nautical miles.

Sample Problem

Aircraft Configuration:

(1) MK-28 store plus (4) 300 gallon drop tanks.

Altitude 5000 feet

A. Refueling Disconnect Speed	235 kts
B. Reflector Line	
C. Refueling Gross Weight	40,000 lb
D. Desired Drag Count	47
E. Reflector Line	
F. Reflector Line	
G. Acceleration Fuel	112 lb
H. Reflector Line	
I. Acceleration Distance	230 NM

AIR REFUELING

This chart (figure 11-89) presents the time required to transfer a given amount of fuel, and is based on the refueling rate of the tanker aircraft.

USE

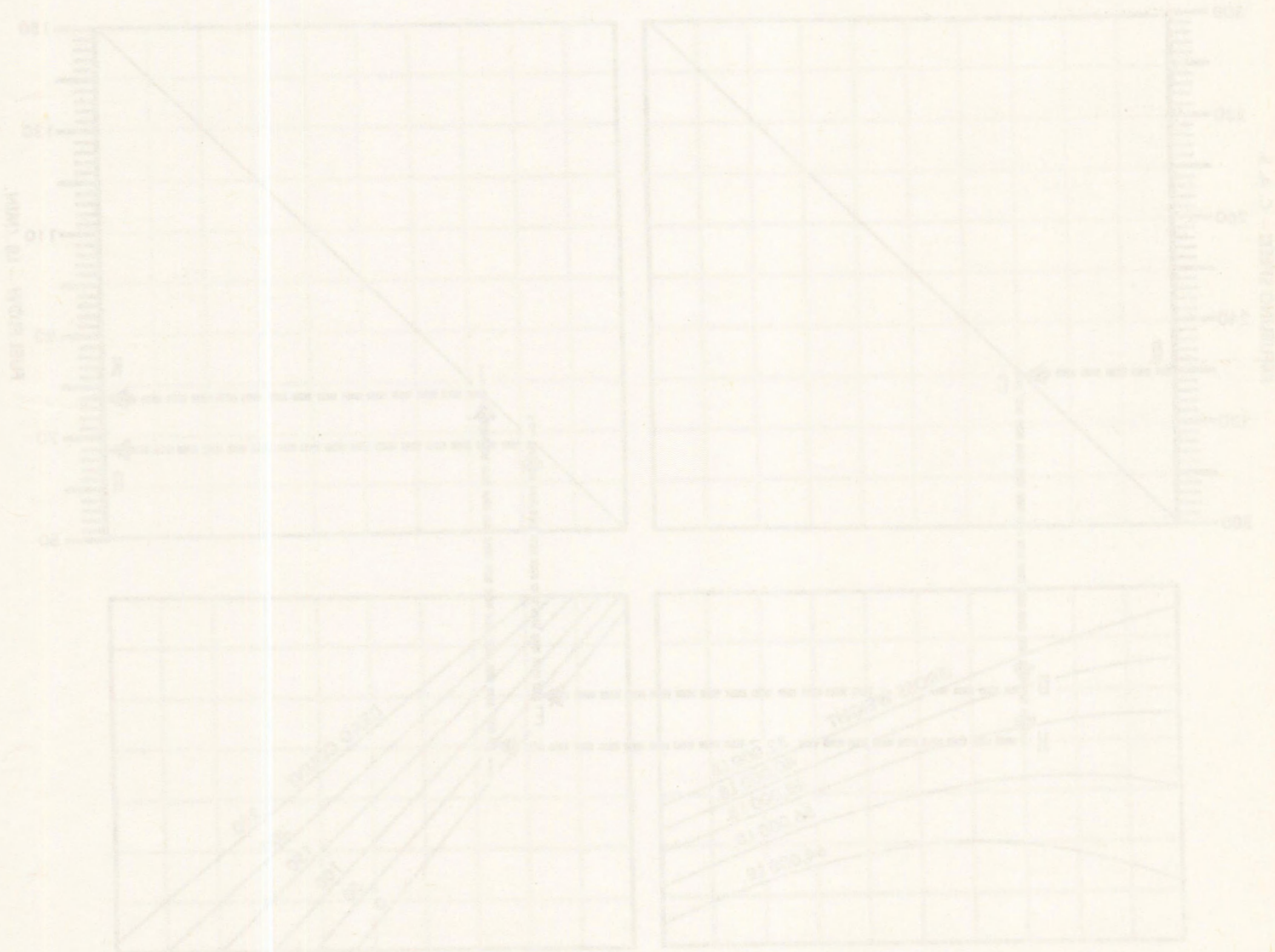
Enter the gross fuel transferred side of the chart. Proceed horizontally to intercept the particular fuel

flow curve. Project vertically to the base of the chart and read time in minutes required to transfer.

Sample Problem

AIRCRAFT CONFIGURATION: ALL

- | | |
|---------------------------|-------------|
| A. Fuel to be Transferred | 10,000 lb |
| B. Fuel Flow | 1500 lb/mib |
| C. Time Required | 6.7 min |



FUEL CONSUMPTION DURING AIR REFUELING

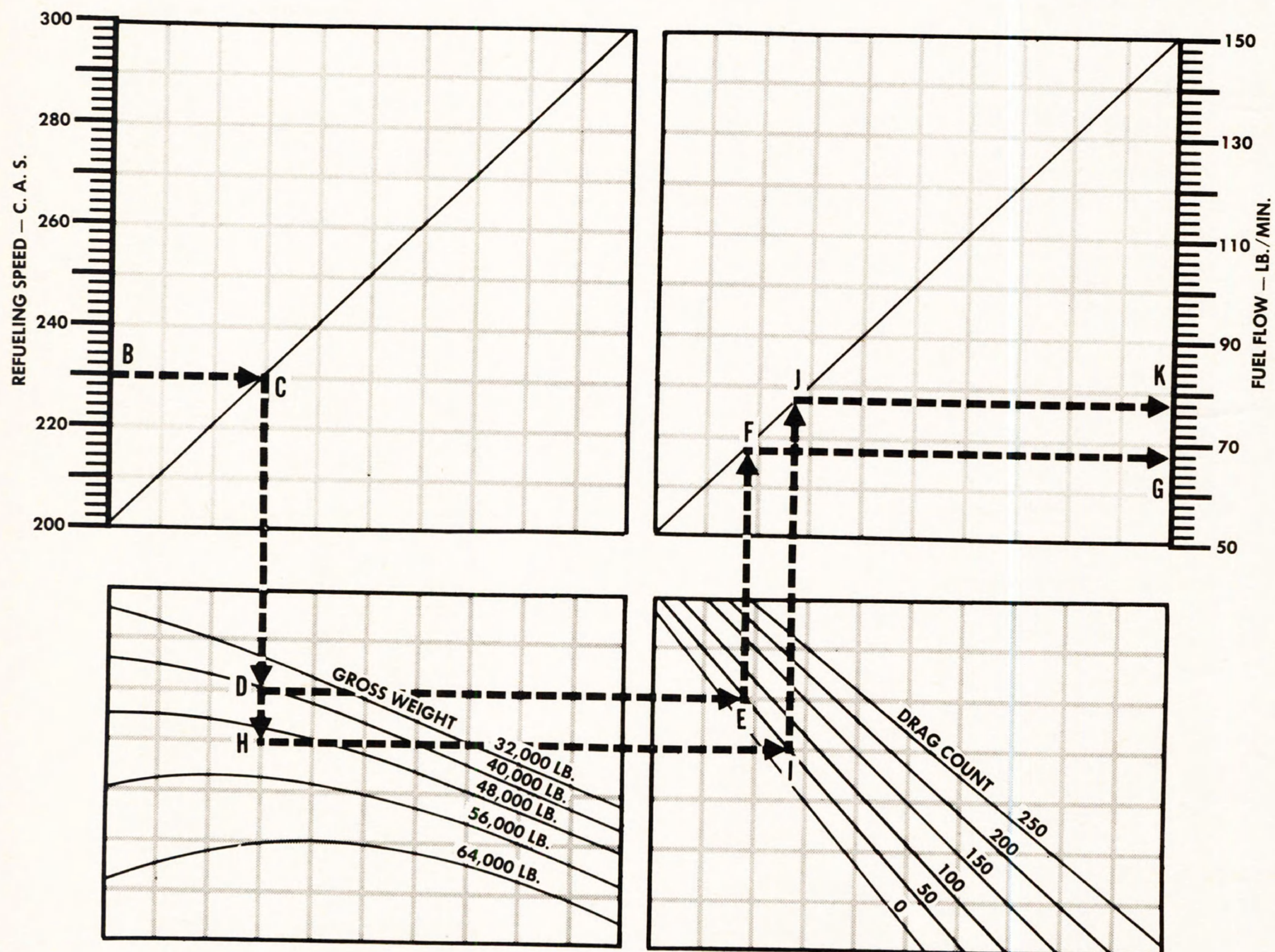
P-8 ENGINE

5000 FT.

DATE: 15 MARCH 1971
DATA BASIS: ESTIMATED

REMARKS
ICAO STANDARD DAY

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB./GAL.



A-ADF1-380

Figure 11-85

FUEL CONSUMPTION DURING AIR REFUELING

P-8 ENGINE

30,000 FT.

DATA BASIS: ESTIMATED
DATE: 15 MARCH 1971

REMARKS
ICAO STANDARD DAY

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB./GAL.

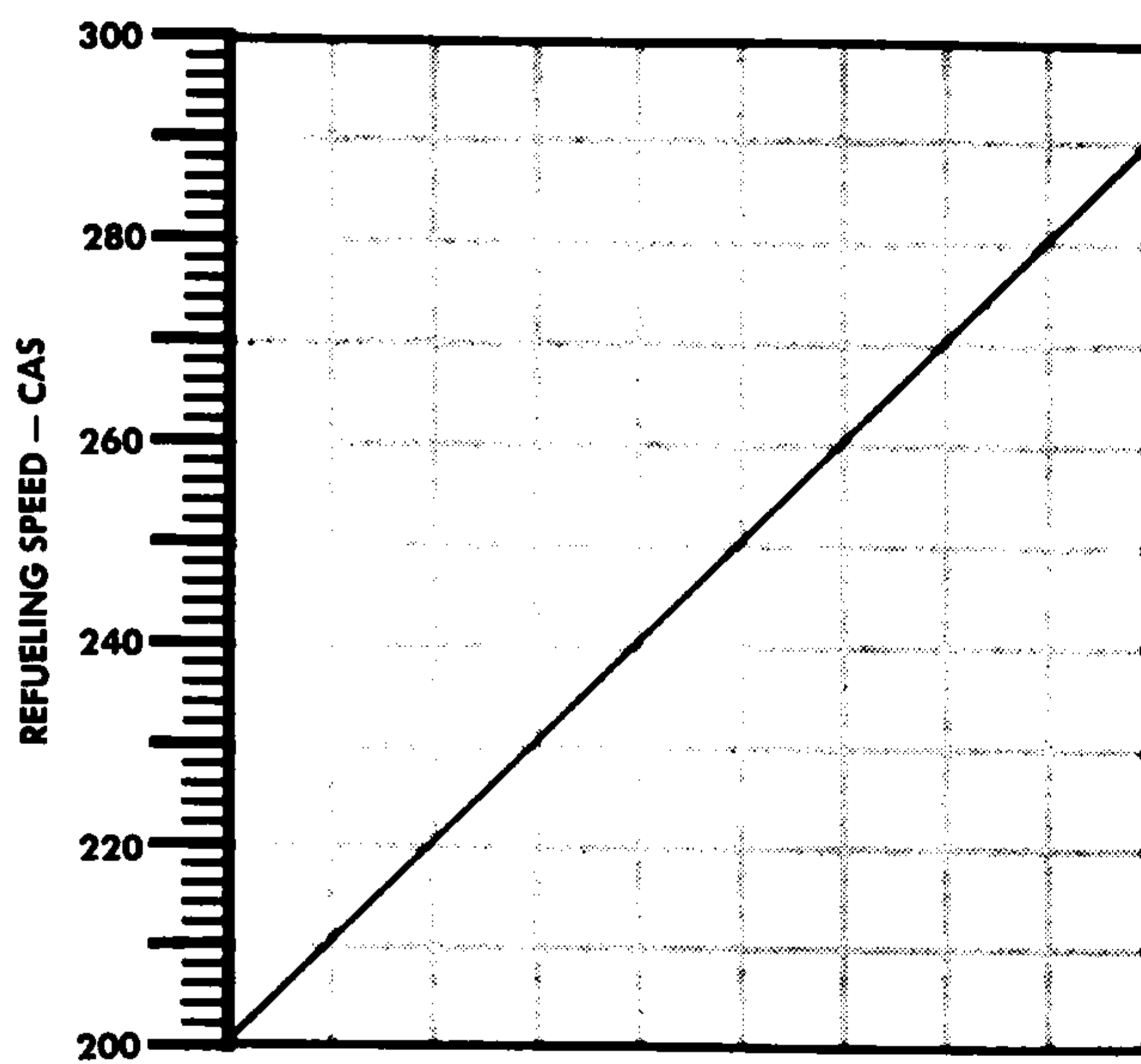
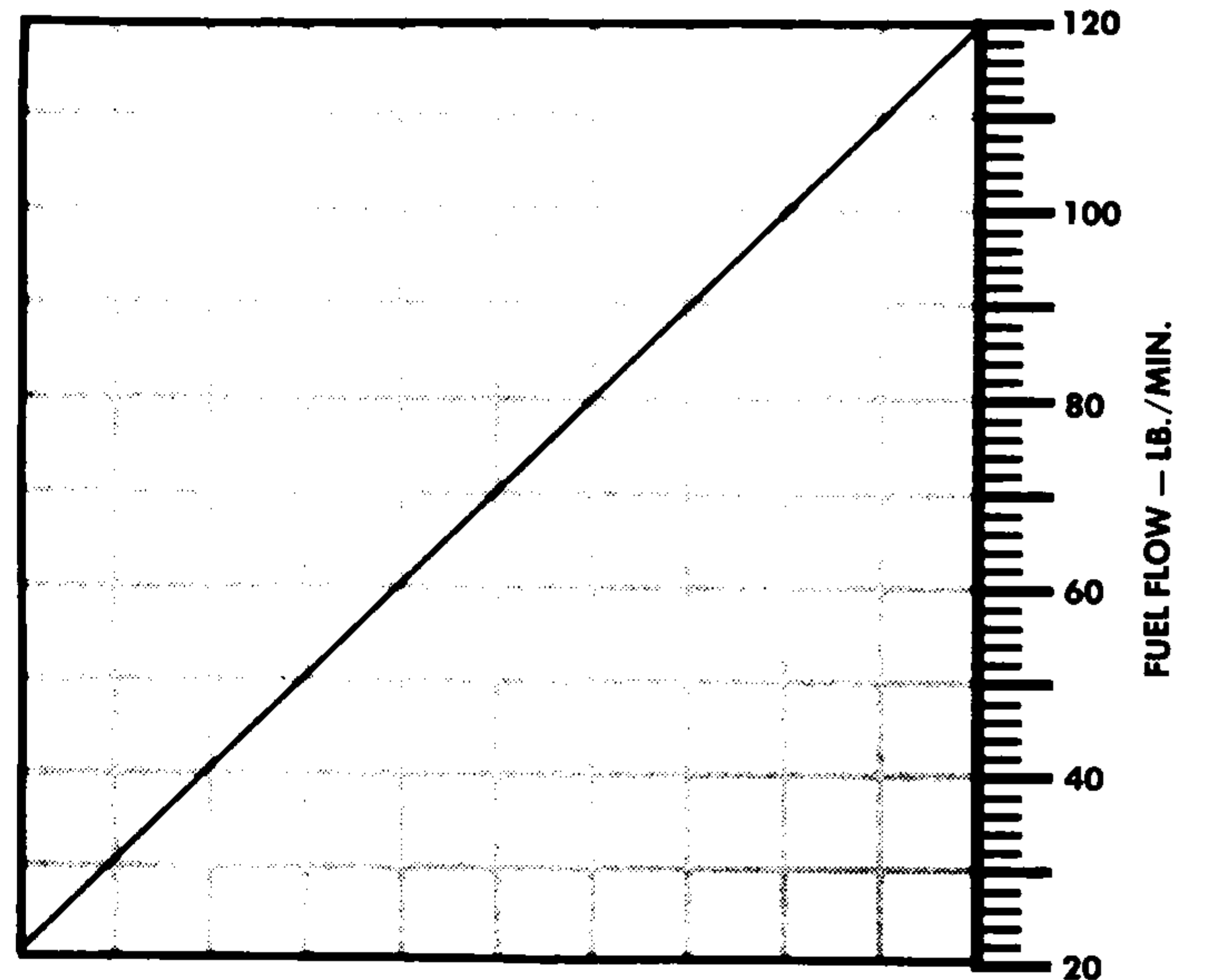
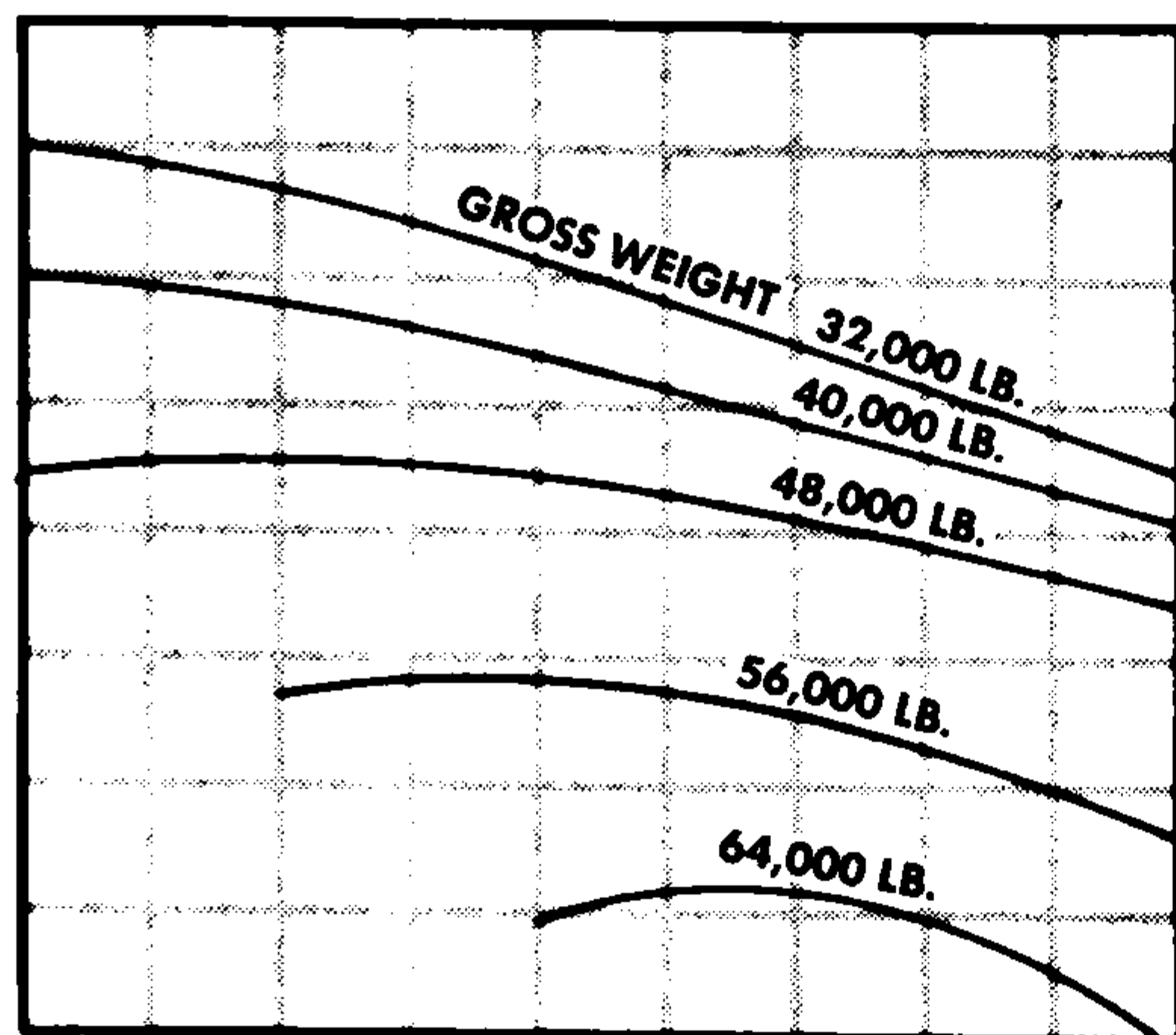
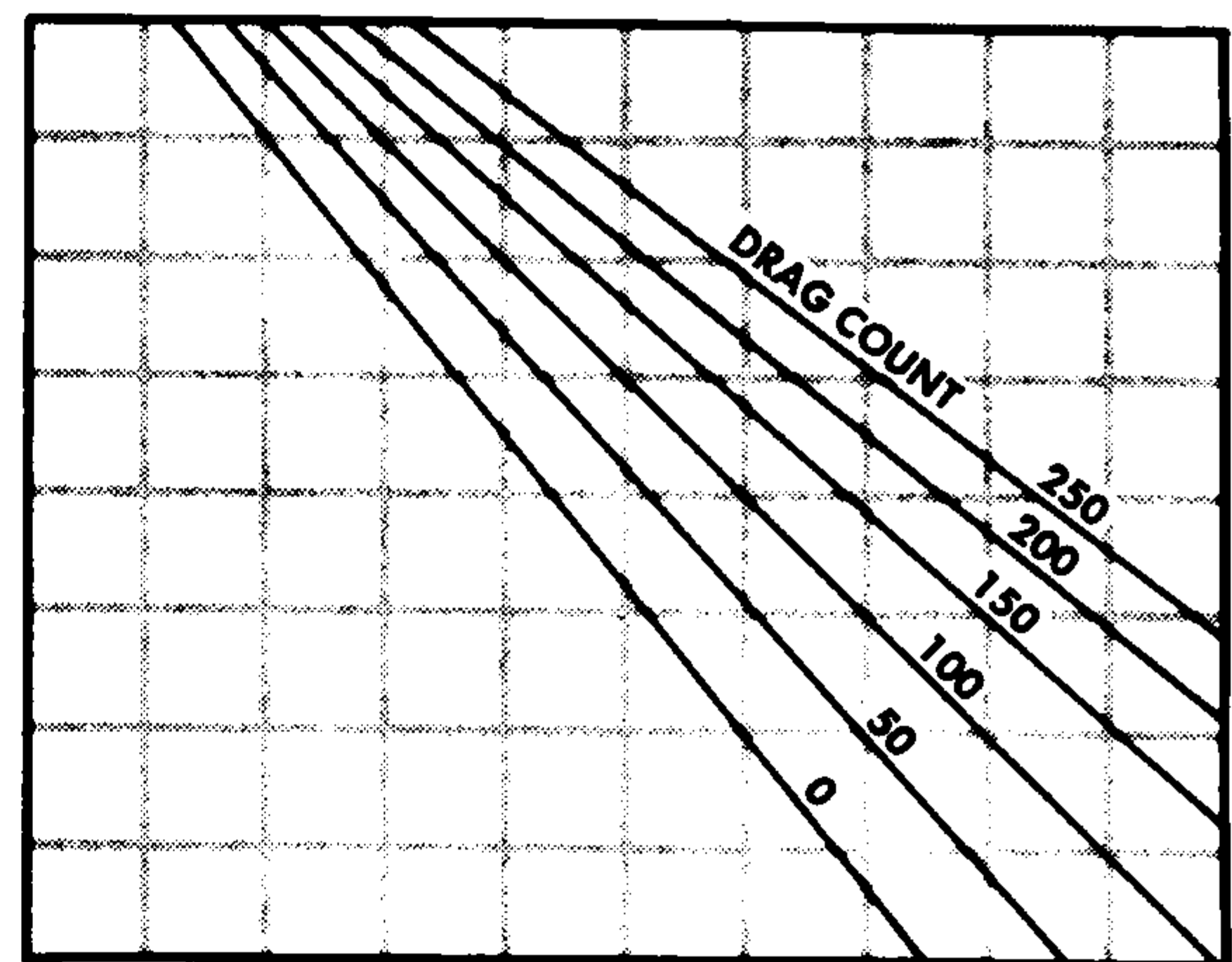


Figure 11-86

FUEL CONSUMPTION DURING AIR REFUELING

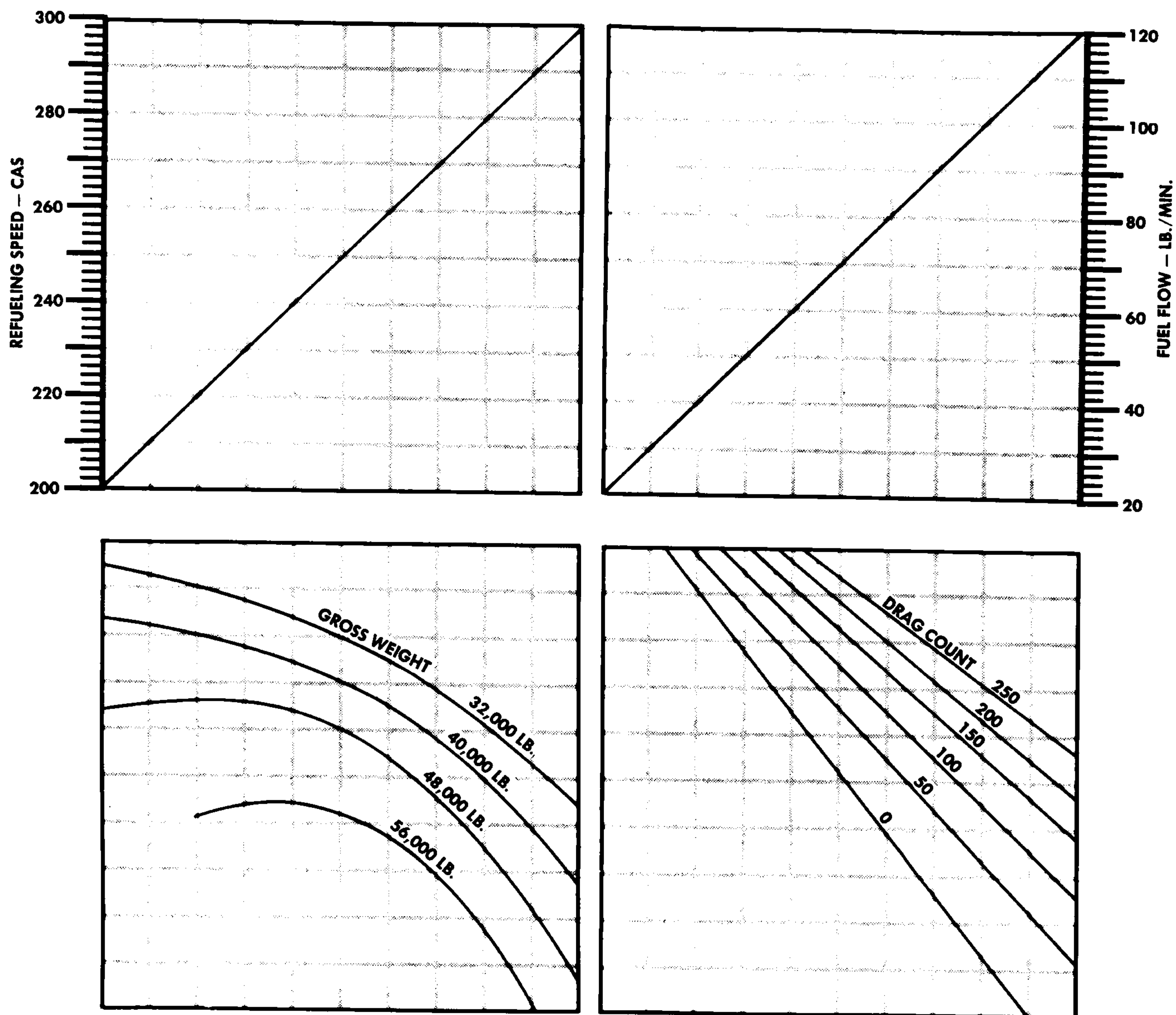
P-8 ENGINE

35,000 FT.

DATE: 15 MARCH 1971
DATA BASIS: ESTIMATED

REMARKS
ICAO STANDARD DAY

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB./GAL.



A-ADF1-382

Figure 11-87

ACCELERATION TO CLIMB SPEED

P-8 ENGINE

ALTITUDE 5000 FT.

DATE 15 MARCH 1971
DATA BASIS: ESTIMATED

REMARKS
ICAO STANDARD DAY

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB./GAL.

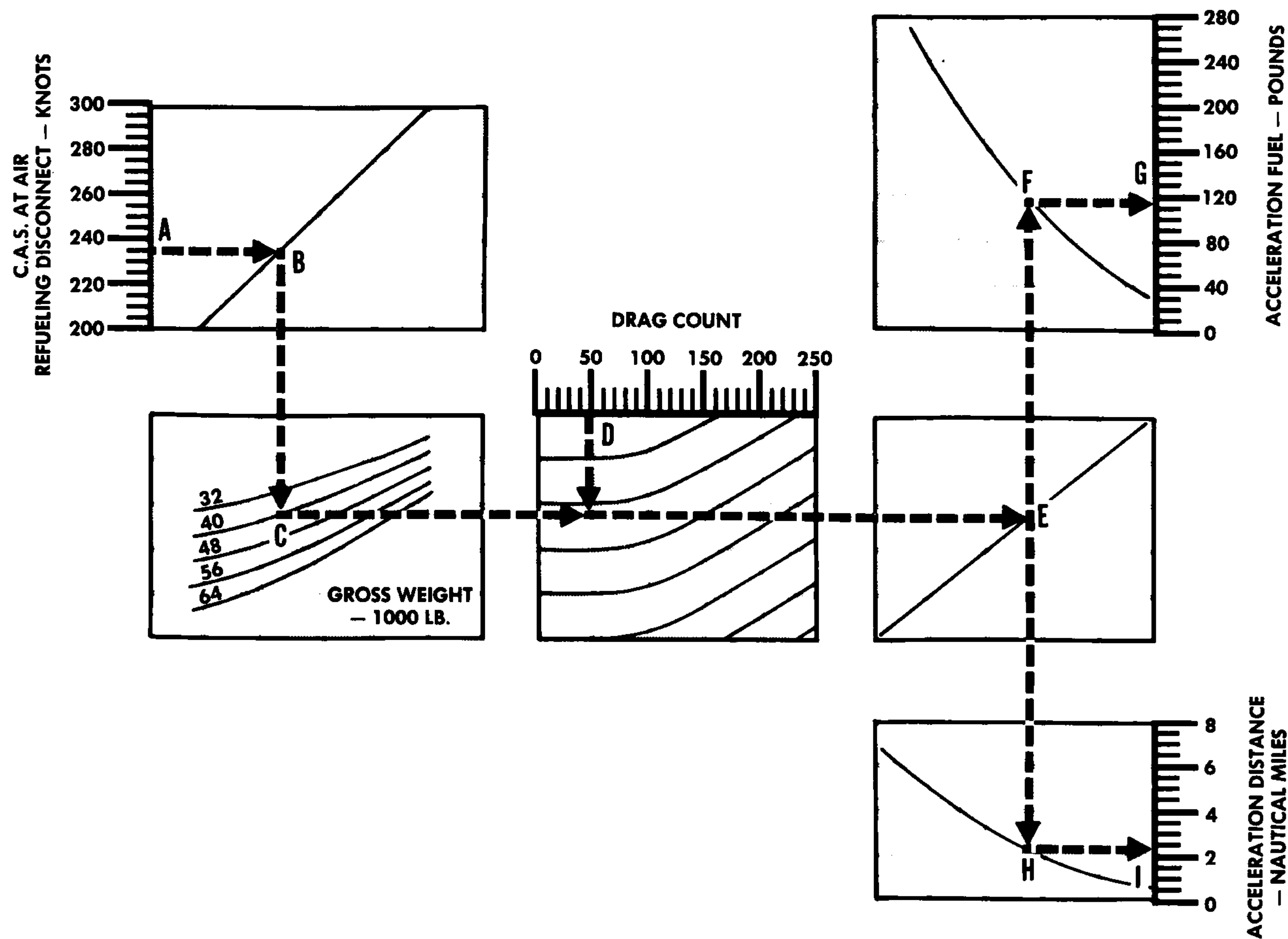


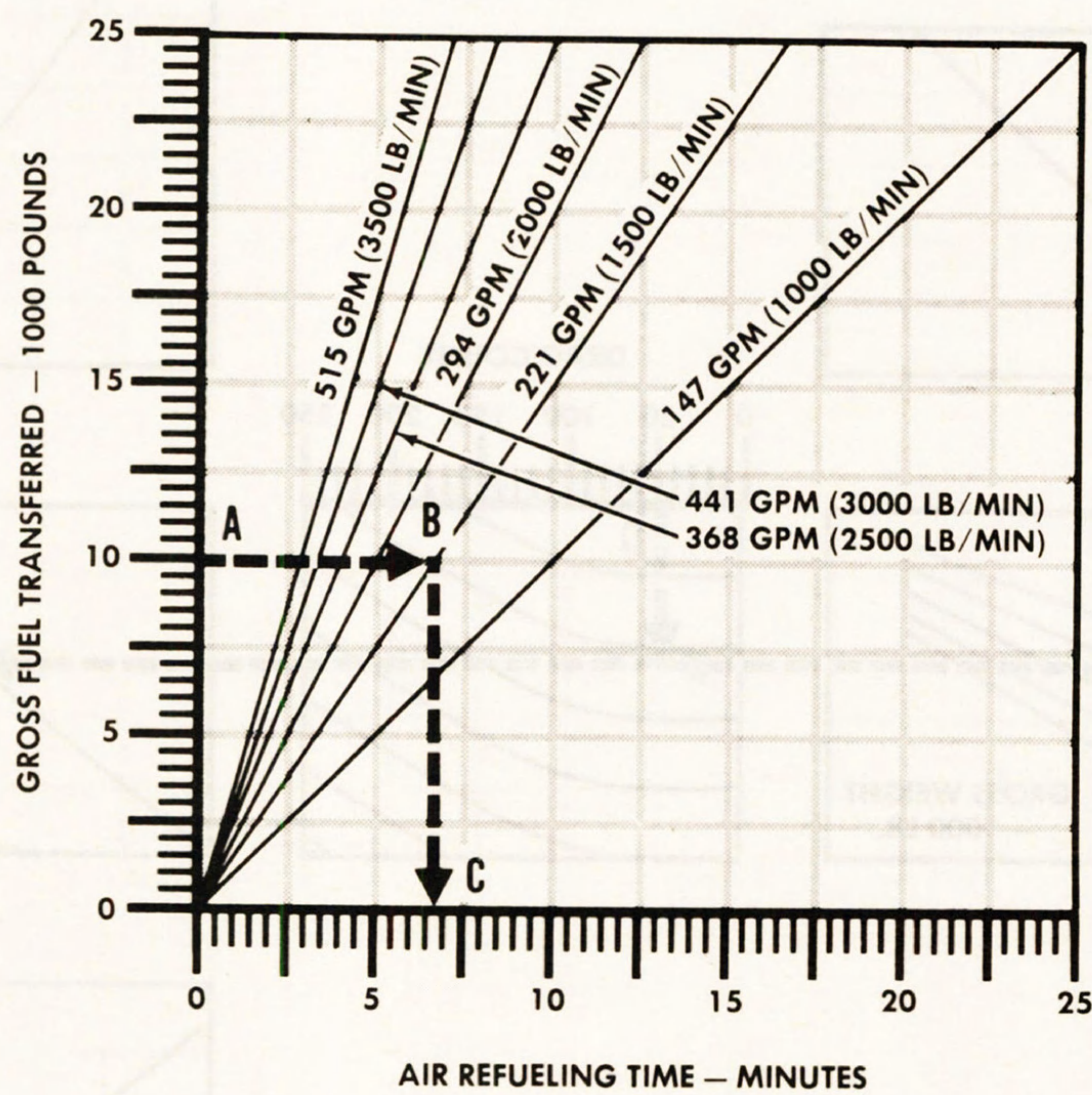
Figure 11-88

AIR REFUELING TRANSFER TIME

P-8 ENGINE

DATE 15 FEBRUARY 1971
DATA BASIS: ESTIMATED

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



A-ADF1-384

Figure 11-89

part 8

Descent

NORMAL DESCENT

The normal landing descent (figure 11-90) corresponds to a normal letdown with recommended airspeeds, throttle settings, and Mach number.

USE

Enter the top graph at the descent altitude and proceed horizontally to intersect all three reflector lines for the applicable gross weight. From the intersection of the first reflector line, proceed vertically to the base of the graph to read fuel consumption; from the intersection of the second reflector line, proceed vertically to the base of the graph to read rate of descent; from the third reflector line, note constant airspeed for descent and proceed vertically to the base of the graph to read corresponding Mach number. Enter the bottom graph at the descent altitude and proceed horizontally to intersect both reflector lines for the applicable gross weight. From the intersection of the first reflector line, proceed vertically to the base of the graph to read time to descend; from the intersection of the second reflector line, proceed vertically to the base of the graph to read distance traveled during descent.

Sample Problem

Aircraft Configuration:

(1) MK-28 store plus (4) 300 gallon drop tanks.

A. Enter Top Graph at Known Altitude	30,000 ft
B. Gross Weight Reflector Line	40,000 lb
C. Total Time Required to Descend	6.6 min
D. Gross Weight Reflector Line	40,000 lb
E. Initial Rate of Descent	6650 ft/min
F. Speed Reflector Line	250 KCAS
G. Initial Mach Number Corresponding to Constant Descent Speed (250 KCAS)	.670 M
H. Gross Weight Reflector Line	40,000 lb
J. Total Time Required to Descend	6.7 min
K. Gross Weight Reflector Line	40,000 lb
L. Distance Traveled	34.2 NM

MAXIMUM RANGE DESCENT

DESCENT SPEEDS

The maximum range descent speed is a plot of calibrated airspeed vs. gross weight for drag count ranging from 0 to 250.

USE

Enter the chart (figure 11-91) at the gross weight at start of descent and proceed horizontally to the applicable drag count. From this point proceed vertically to the base of the graph and read descent speed.

TIME, FUEL AND DISTANCE TO DESCEND

The time, fuel and distance to descend graphs (figures 11-92 through 11-94) are plotted for a drag count range of 0 to 250. These charts are based on the maximum range descent speeds shown in figure 11-84.

USE

To determine descent time, enter the time to descend graph (figure 11-92) at the initial gross weight of the aircraft at start of descent or, if desired, the optimum cruise altitude reflector line, and project vertically to the appropriate drag count reflector line in the bottom graph. From this point proceed horizontally to the left scale of the bottom graph and read time to descend to sea level. The above procedure can be used to determine the fuel required to descend (figure 11-93) and the distance traveled to descend (figure 11-94).

Sample Problem

Aircraft Configuration:

(1) MK-28 store plus (4) 300 gallon drop tanks.

A. Initial Gross Weight at Start of Descent	45,000 lb
B. Initial Altitude at Start of Descent	Best Cruise Altitude
C. Drag Count	50
D. Time Required	16 min

NORMAL DESCENT

P-8 ENGINE

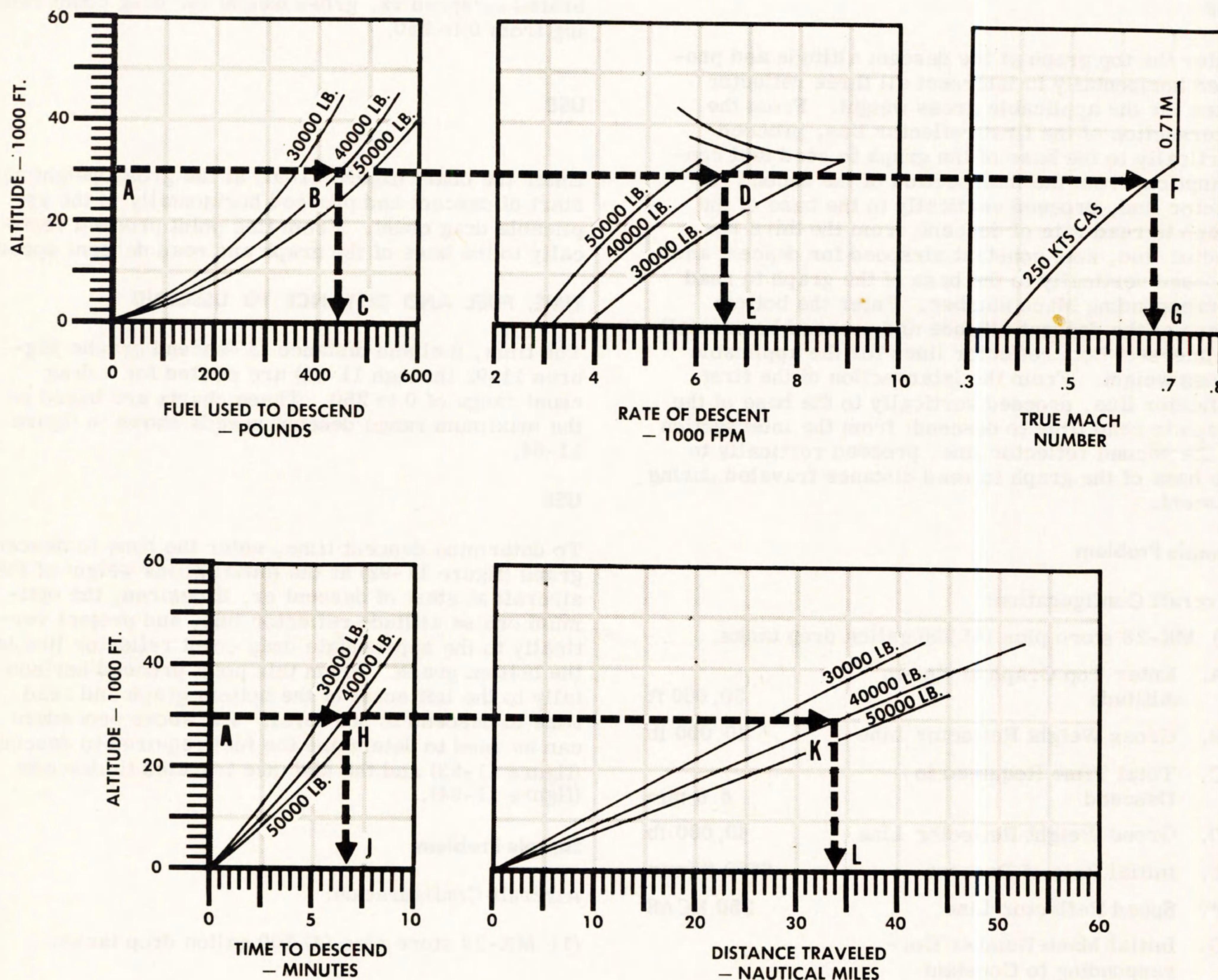
250 KTS CAS 80% RPM WING TIP BRAKES EXTENDED

AIRCRAFT CONFIGURATION
(1) MK-28 STORE +
(4) 300 GALLON DROP TANKS

DATE 15 FEBRUARY 1971
DATA BASIS: ESTIMATED

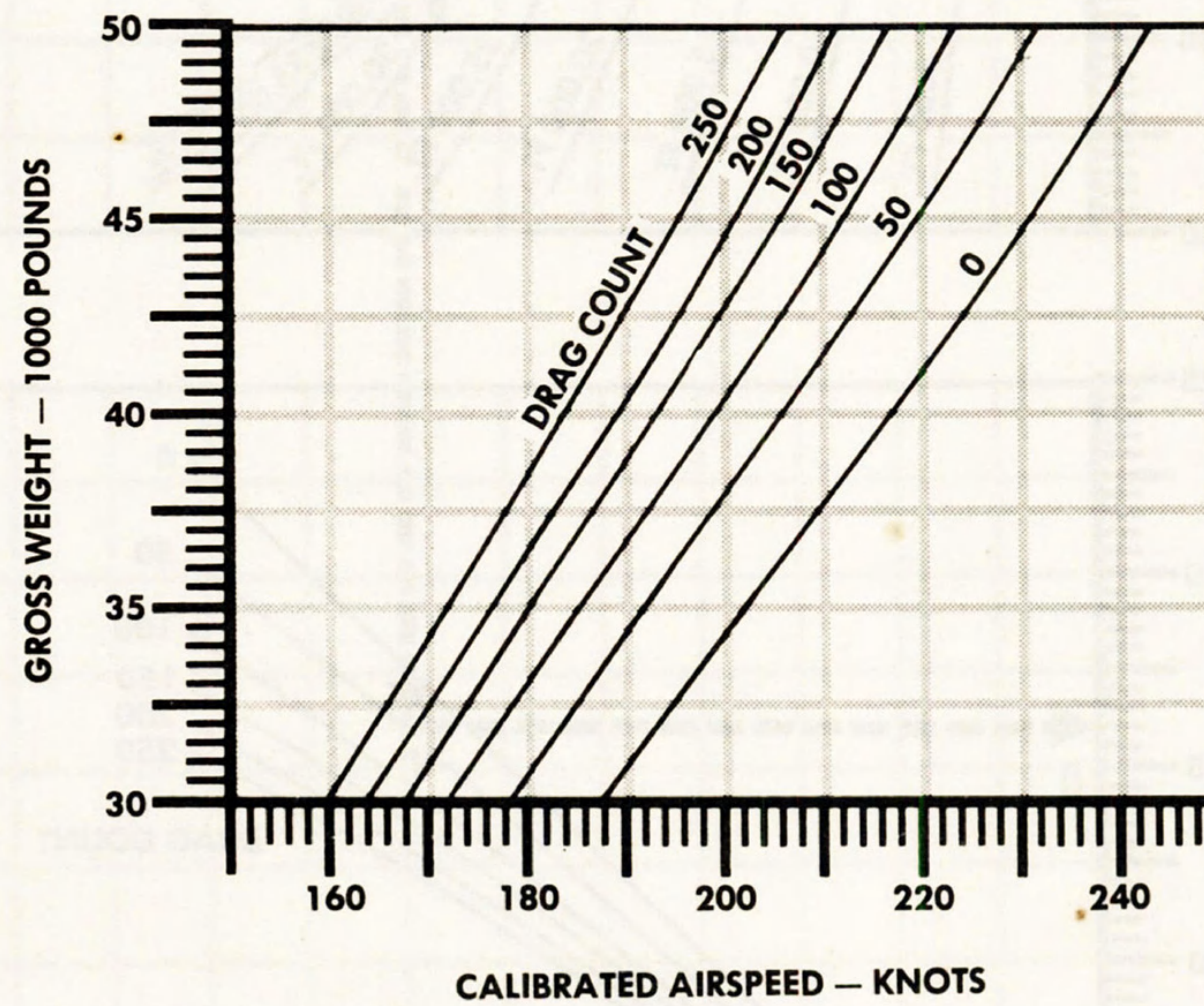
REMARKS
ICAO STANDARD DAY

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



ADF1-393

Figure 11-90

MAXIMUM RANGE DESCENT**P-8 ENGINE****DESCENT SPEED
IDLE POWER**DATE 15 MARCH 1971
DATA BASIS: ESTIMATEDREMARKS
ICAO STANDARD DAYFUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB./GAL.

MAXIMUM RANGE DESCENT

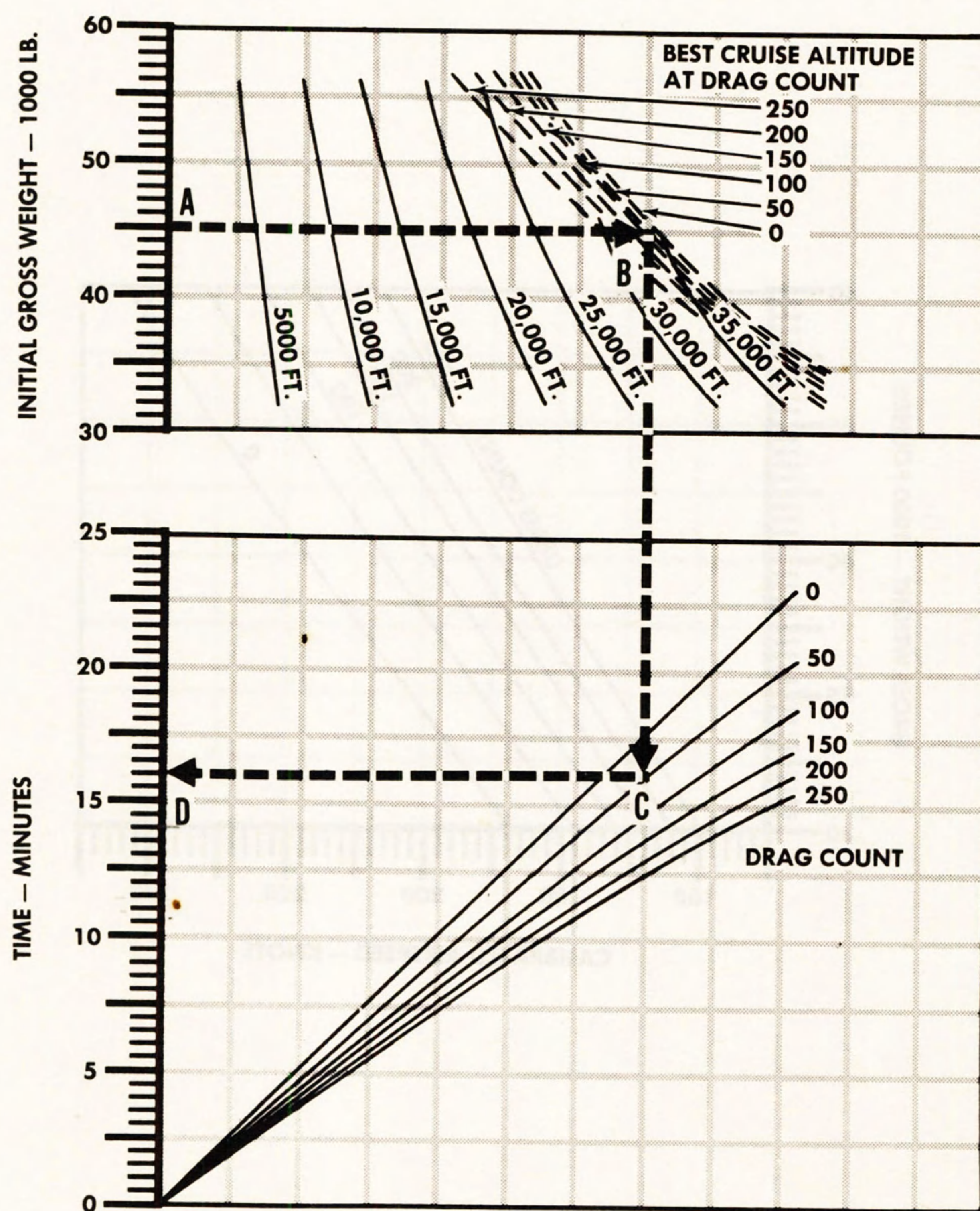
P-8 ENGINE

TIME REQUIRED TO DESCEND FROM SELECTED ALTITUDE TO SEA LEVEL IDLE POWER

DATE 15 MARCH 1971
DATA BASIS: ESTIMATED

REMARKS
ICAO STANDARD DAY

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB./GAL.



ADF1-386

Figure 11-92

MAXIMUM RANGE DESCENT

P-8 ENGINE

FUEL REQUIRED TO DESCEND FROM SELECTED ALTITUDE TO SEA LEVEL IDLE POWER

DATE 15 MARCH 1971
DATA BASIS: ESTIMATED

REMARKS
ICAO STANDARD DAY

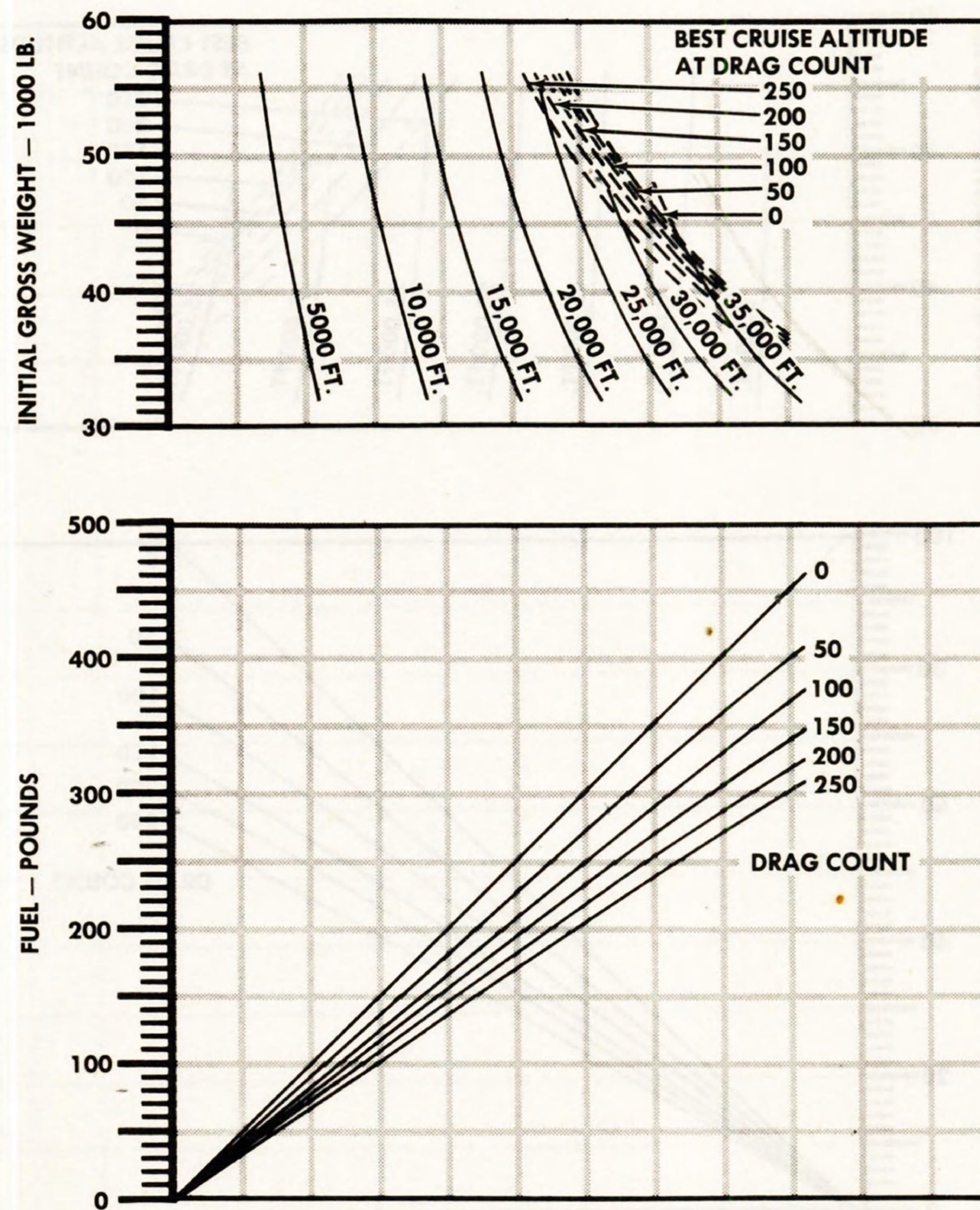
FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB./GAL.


Figure 11-93

MAXIMUM RANGE DESCENT

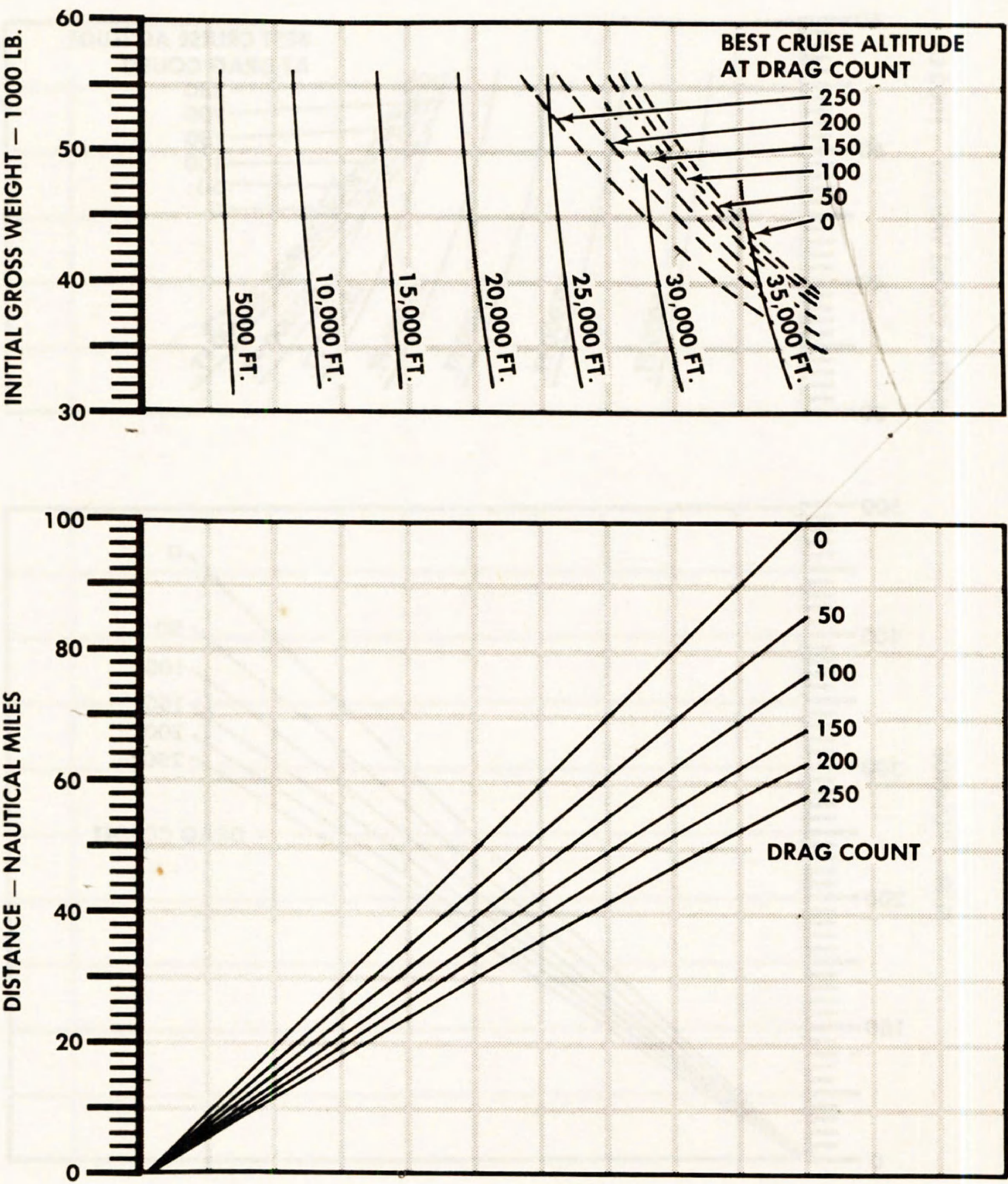
P-8 ENGINE

**DISTANCE REQUIRED TO DESCEND FROM SELECTED
ALTITUDE TO SEA LEVEL IDLE POWER**

DATE 15 MARCH 1971
DATA BASIS: ESTIMATED

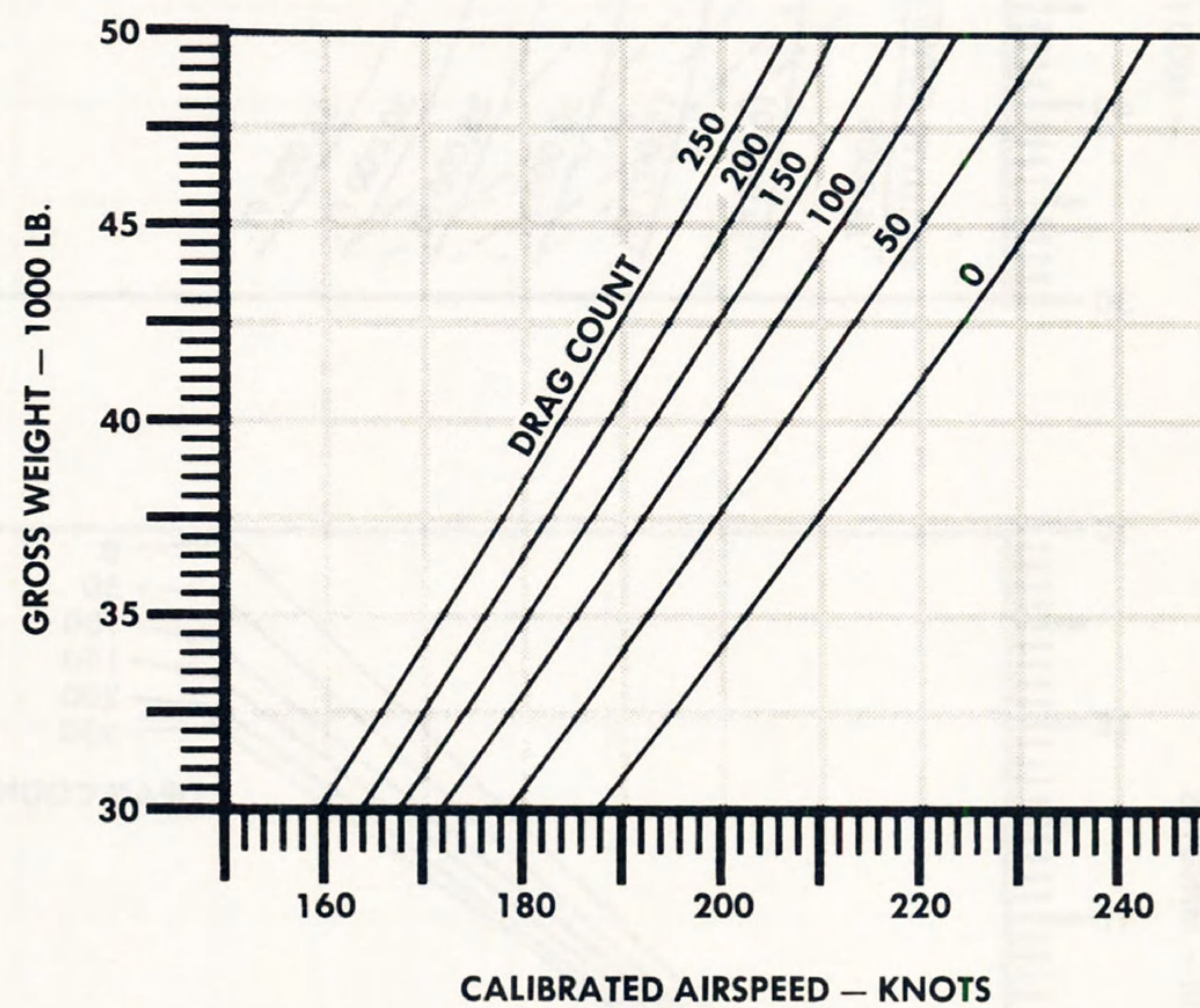
REMARKS
ICAO STANDARD DAY

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB./GAL.



ADF1-388

Figure 11-94

MAXIMUM RANGE DESCENT (single engine)**P-8 ENGINE****DESCENT SPEED
IDLE POWER**DATE 15 MARCH 1971
DATA BASIS: ESTIMATEDICAO STANDARD DAY
REMARKSFUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB./GAL.

ADF1-389

Figure 11-95

MAXIMUM RANGE DESCENT (single engine)

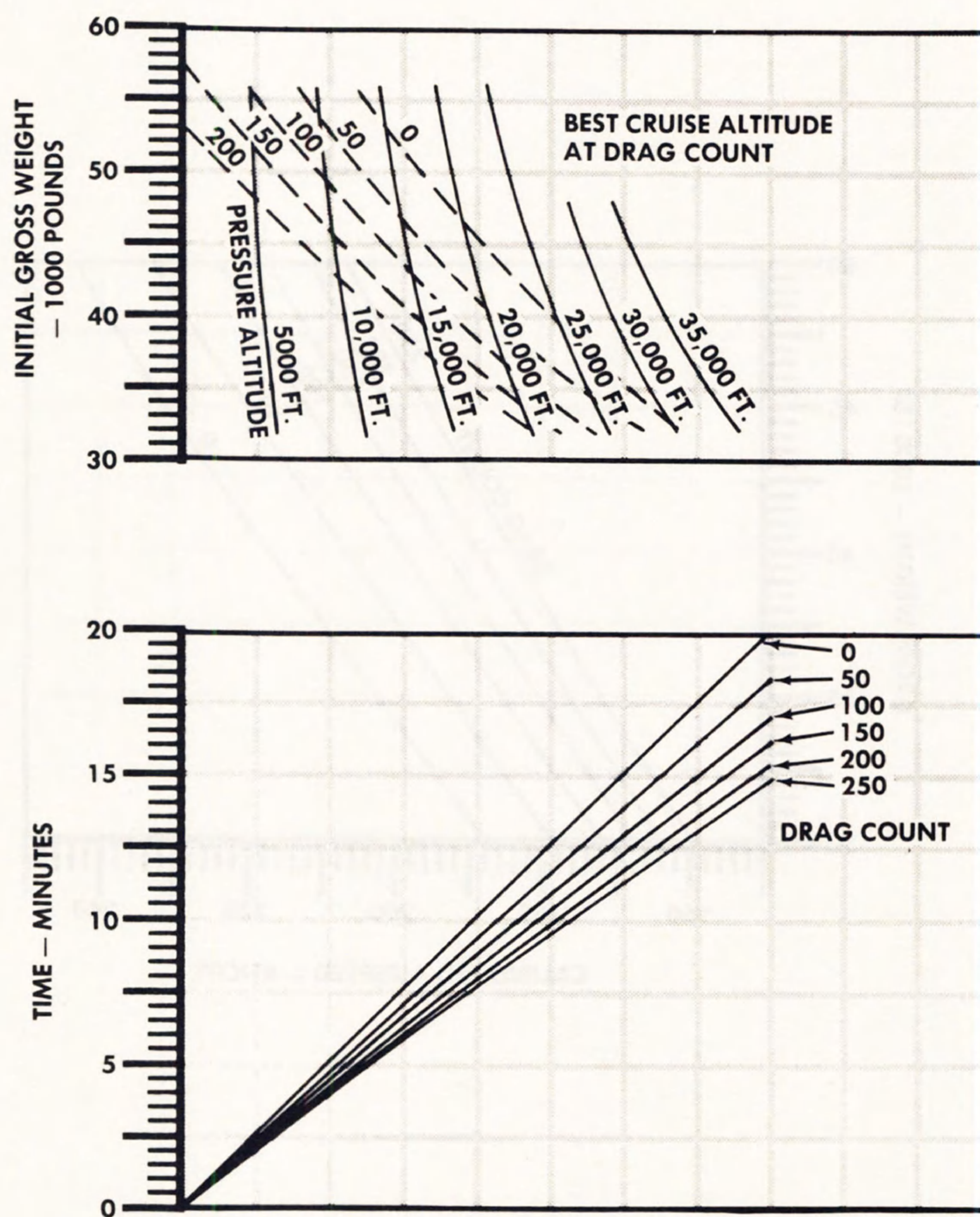
P-8 ENGINE

TIME REQUIRED TO DESCEND FROM SELECTED ALTITUDE TO SEA LEVEL IDLE POWER

DATE 15 MARCH 1971
DATA BASIS: ESTIMATED

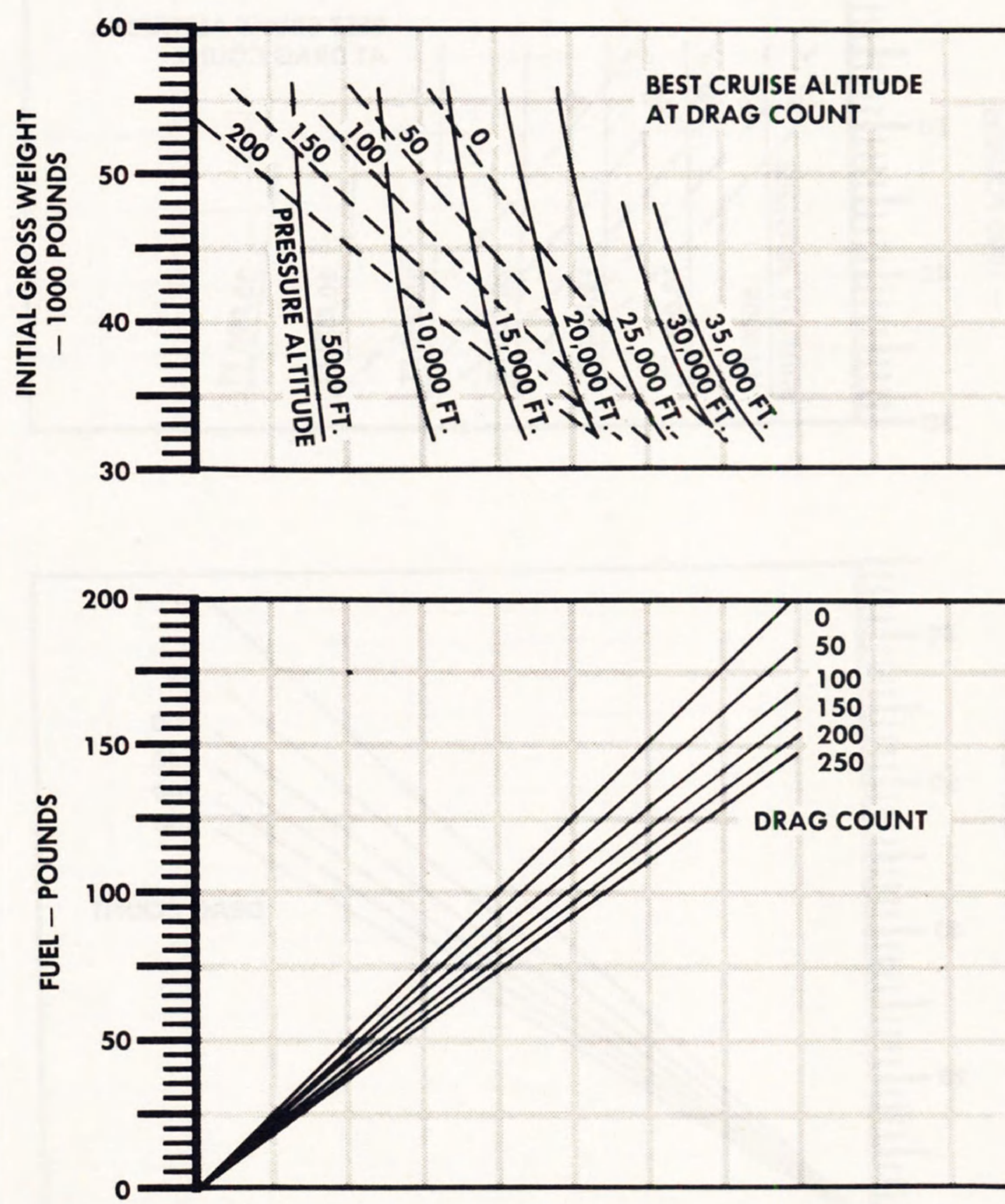
REMARKS
ENGINE(S): (2) J52-P-8
ICAO STANDARD DAY

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB./GAL.



ADF1-390

Figure 11-96

MAXIMUM RANGE DESCENT (single engine)**P-8 ENGINE****FUEL REQUIRED TO DESCEND FROM SELECTED
ALTITUDE TO SEA LEVEL IDLE POWER**DATE 15 MARCH 1971
DATA BASIS: ESTIMATEDREMARKS
ENGINE(S): (2) J52-P-8
ICAO STANDARD DAYFUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB./GAL.

ADF1-391

Figure 11-97

MAXIMUM RANGE DESCENT (single engine)

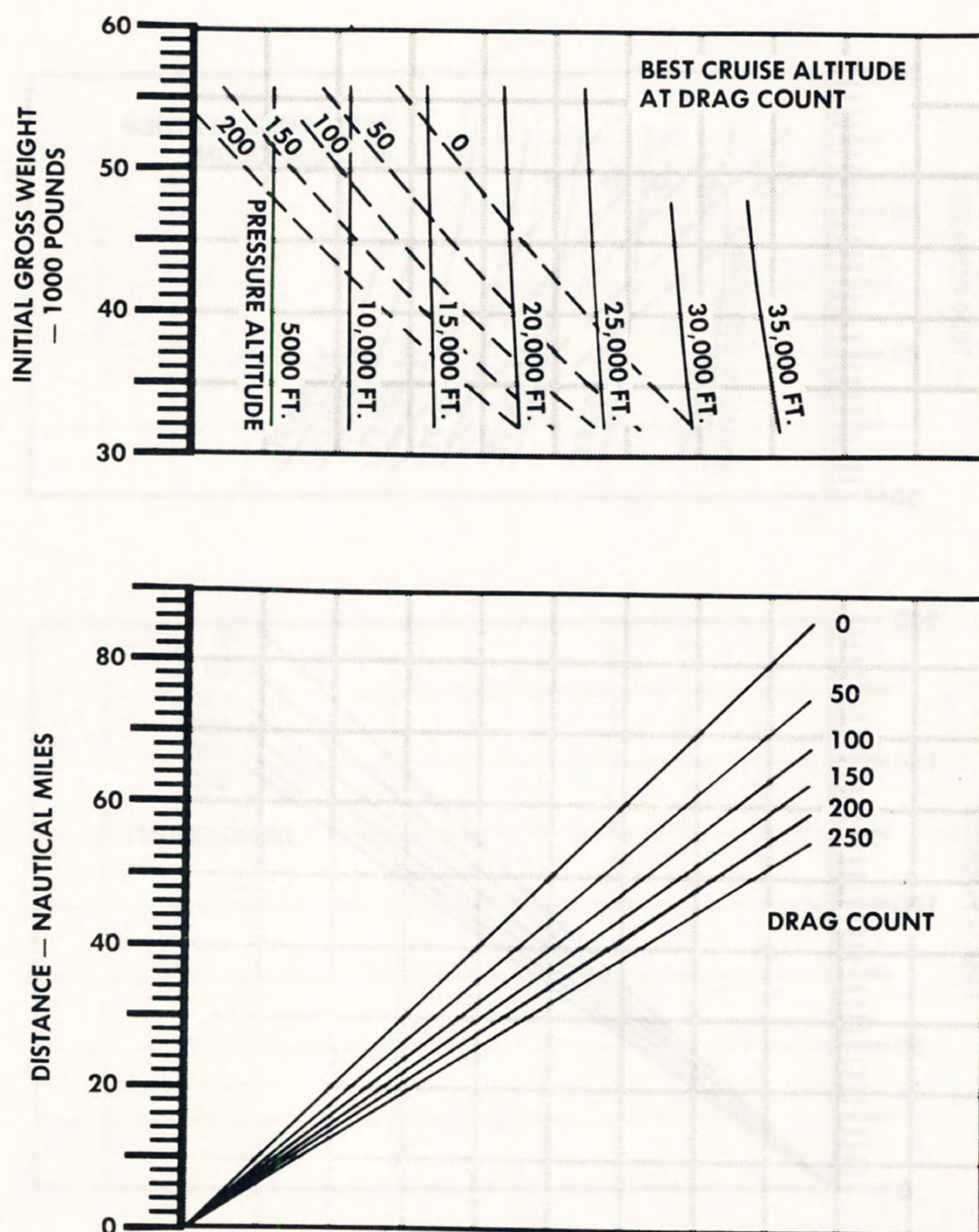
P-8 ENGINE

DISTANCE REQUIRED TO DESCEND FROM SELECTED ALTITUDE TO SEA LEVEL IDLE POWER

DATE 15 MARCH 1971
DATA BASIS: ESTIMATED

REMARKS
ENGINE(S): (2) J52-P-8
ICAO STANDARD DAY

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB./GAL.



ADF1-392

Figure 11-98

part 9**Landing****LANDING APPROACH SPEEDS**

The Landing Approach Speed Chart (figure 11-99) shows the recommended approach speeds and minimum field landing distance approach speeds, together with stall warning and power approach stall speeds. It is pointed out that the standard configuration for landings is: Flaps TAKEOFF (30°) and wing tip speed brakes OPEN.

USE

Enter the chart at estimated landing gross weight. Proceed vertically to the appropriate approach speed reflector line and project horizontally to the left scale to read approach speed. From the intersection of the stall warning and the stall reflector lines, project horizontally to the left scale and read the appropriate stall warning and power approach stall speeds.

Sample Problem

Aircraft Configuration:
All External Store Configuration, Gear Down

- | | |
|---|-----------|
| A. Estimated Landing Gross Weight | 37,000 lb |
| B. Power Approach Stall Speed
Reflector Line | |
| NEW C. Power Approach Stall Speed | 98 kts |
| D. Stall Warning Speed Reflector
Line | |
| E. Stall Warning Speed | 107.5 kts |
| F. Optimum Approach Speed
Reflector Line | |
| G. Optimum Approach Speed | 126.5 kts |

LANDING DISTANCE

Landing distances, ground roll, and total distance required to clear a 50-foot obstacle, are shown in

figure 11-100 for normal landing. The following conditions are considered: Landing on a hard, dry runway; temperature in °F and °C; pressure altitude, sea level through 8,000 feet; gross weight, 25,000 pounds through 40,000 pounds; touchdown speeds for each gross weight; headwind effect, 0 to 50 knots.

USE

Enter the chart at given surface temperature, proceeding vertically to intersect station pressure altitude. Proceed horizontally to the estimated landing gross weight and read touchdown speed. Descend directly to the wind base line and parallel the nearest guide line to apply effective wind. From this point, descend vertically to read landing ground roll distance and further to the reflector line to read total distance required to clear a 50-foot obstacle.

Sample Problem

Aircraft Configuration:
All External Store Configuration
Landing Gear, Flaps-Down
Flaperon Pop-Up, Anti-Skid Utilized

- | | |
|---|-----------|
| A. Temperature | 70° F |
| B. Pressure Altitude | 2,000 ft |
| C. Gross Weight | 40,000 lb |
| D. Touchdown Speed (KIAS) | 123 kts |
| E. Wind Base Line | |
| F. Effective Headwind | 20 kts |
| G. Landing Ground Roll Distance | 1925 ft |
| H. Reflector Line | |
| J. Distance Required to Clear a
50-Foot Obstacle | 3120 ft |

LANDING AND APPROACH SPEEDS

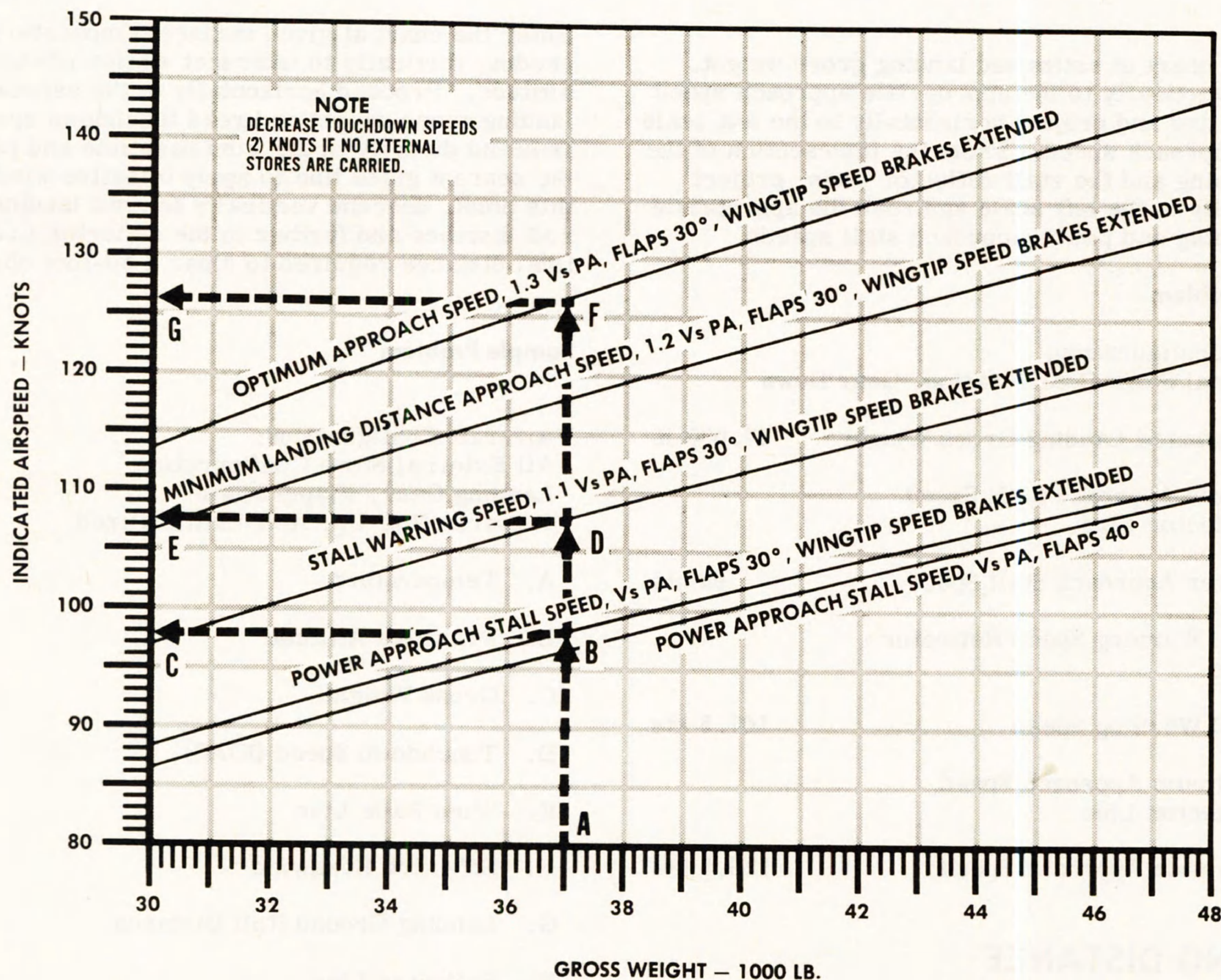
P-8 ENGINE

AIRCRAFT CONFIGURATION
ALL EXTERNAL STORE CONFIGURATIONS
GEAR DOWN

DATE: 15 FEBRUARY 1971
DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

STALL SPEEDS CORRESPOND TO FIN BOOM AIRSPEED SYSTEM



ADF1-394

Figure 11-99

NORMAL LANDING DISTANCE

P-8 ENGINE

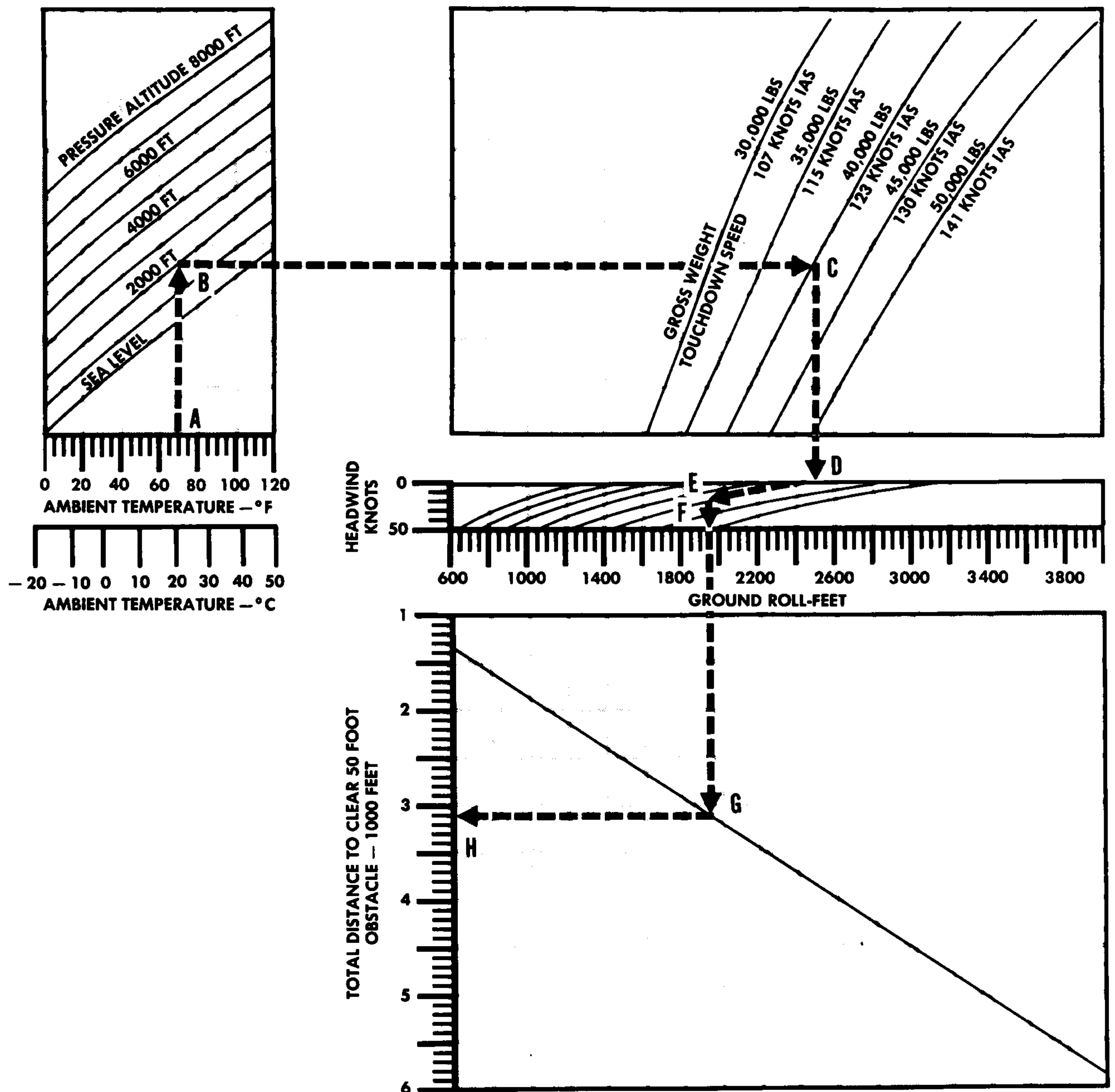
HARD DRY RUNWAY

AIRCRAFT CONFIGURATION
ALL EXTERNAL STORE CONFIGURATIONS
LANDING GEAR DOWN, FLAPS — TAKEOFF
WING TIP SPEED BRAKES OPEN
FLAPERON POP-UP, ANTI-SKID UTILIZED

DATE 15 FEBRUARY 1971
DATA BASIS: ESTIMATED

REMARKS
TOUCHDOWN AIRSPEEDS CORRESPOND TO
OPTIMUM APPROACH SPEED FOR 22 UNITS AOA

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



ADF1-395

Figure 11-100

MINIMUM LANDING DISTANCE

P-8 ENGINE

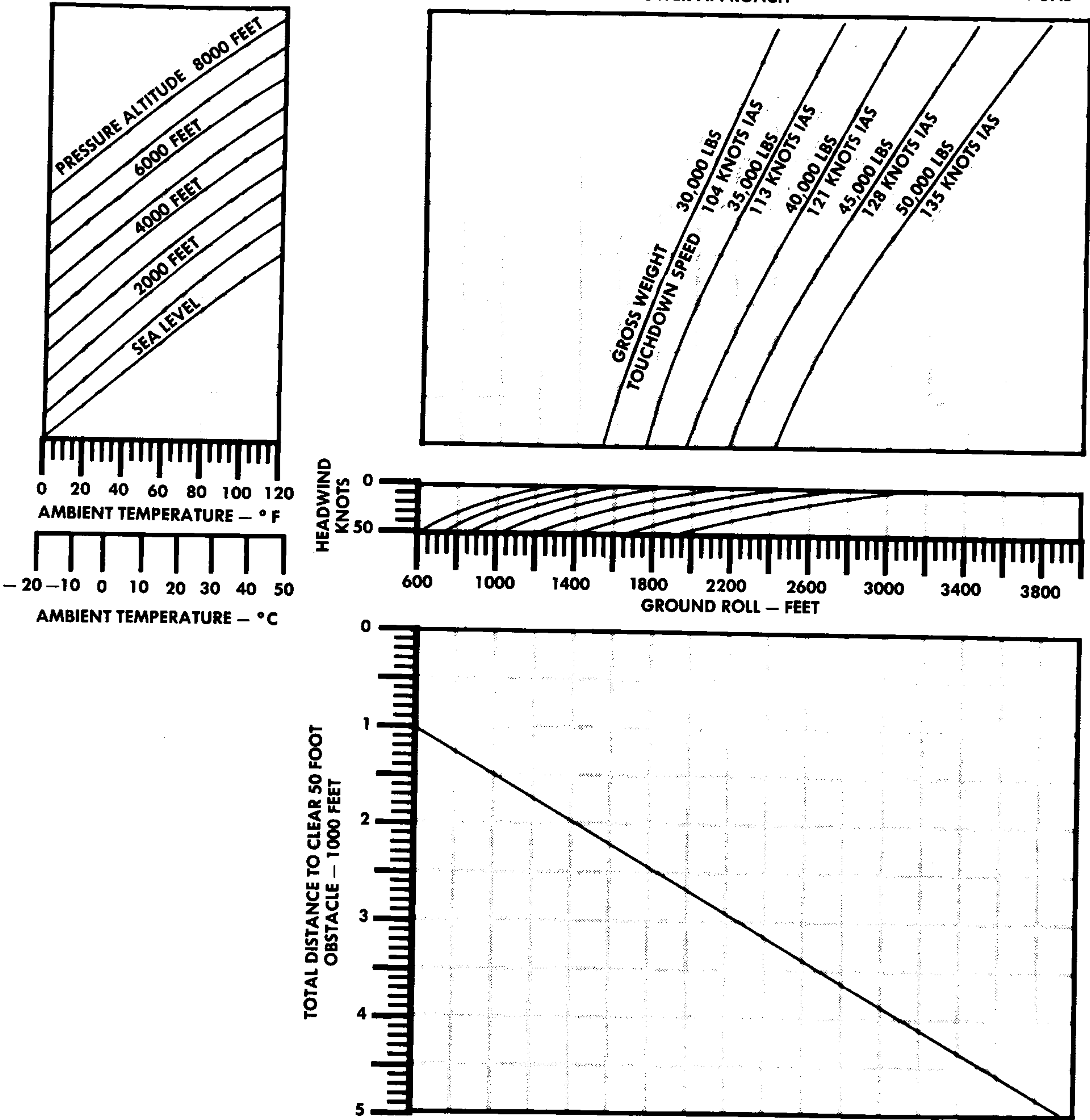
HARD DRY RUNWAY

AIRCRAFT CONFIGURATION
ALL EXTERNAL STORE CONFIGURATIONS
LANDING GEAR DOWN, FLAPS — TAKEOFF
WING TIP SPEED BRAKES OPEN
FLAPERON POP-UP, ANTI-SKID UTILIZED

DATE 15 FEBRUARY 1971
DATA BASIS: ESTIMATED

REMARKS
SPECIFICATION
OVER 50 FOOT OBSTACLE, AIRSPEED 1.20 X V_S POWER APPROACH

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL



ADF1-396

Figure 11-101

ALPHABETICAL INDEX

		Page No.				Page No.	
		Text	Illus			Text	Illus
A				A (cont)			
Aborted Takeoff Arrestments . . .	5-29			air-conditioning caution			
Accelerated Stalls	4-5			light	1-73		
Acceleration Limitations	1-97	1-99, 1-101		air-conditioning cockpit			
landing configuration	1-98			switch	1-72		
Accelerometer B-6	1-58			air-conditioning master			
Accelerometer, Normal	8-2			switch	1-72		
AC Electrical Power	1-24			automatic temperature			
ACLS	1-41			control	1-72		
ACLS data link control				manual/ram-air switch	1-72		
panel	1-42	1-41		Air-Conditioning Full Hot	5-9		
approach modes	1-41			AIR COND Switch/Valve	1-11		
mode 2 approach	3-77	3-78		Aircraft	1-2		
ACLS Control Panel and				designation numbers	1-3	1-5	
Indicators		1-41		dimensions		1-2	
ACLS Mode 2 Approach	3-77	3-78		main differences table	1-2	1-4	
Action Keys	8-49			operating limitations	1-94		
ACU Control Panel	8-69			weight	1-3		
attack mode select buttons	8-70			Aircraft, Damaged	5-22		
complete light	8-71			Aircraft Data Replacement	8-2		
external store station				Aircraft Designation Numbers	1-3	1-5	
controls	8-69			Aircraft Fuel Supply System	1-15	FO-9	
guns charging switch	8-70			engine fuel feed system	1-15		
interval thumbwheel	8-71			fuel dumping system	1-20		
master armament switch	8-69			fuel management control			
mechanical arming switch	8-70			panel	1-15		
missile controls	8-72			fuel quantity data table		1-16	
quantity thumbwheels	8-72			fuel quantity indicating			
release mode select button	8-69			system	1-19		
reselect light	8-71			fuel pressurization, transfer			
rocket switch	8-70			and vent system	1-18		
time thumbwheel	8-72			fuel system controls and			
Address Keys	8-47			indicators		1-17	
ADF Circling Rendezvous	4-19			Aircraft Servicing	1-87		
ADF Running Rendezvous	4-19			aircraft fueling	1-87		
Advisory Lights	1-59	1-60		danger areas		1-90, 1-91	
Aerodynamic Braking	4-4			ground clearance		1-93	
AFCS	1-39			pneumatic pressures	1-87		
emergency disconnect	1-41			power units	1-87	1-87	
After Takeoff — Climb,				servicing data		1-88	
B/N	3-56			tires	1-90		
Pilot	3-27			tire pressures	1-90	1-93	
After Takeoff Procedures,				Air Refueling Control Panel	1-22	1-22	
B/N	3-56			drogue position indicator	1-22		
Pilot	3-27			drogue switch	1-22		
After Landing	3-32			dump light	1-23		
AIC-14 Intercommunications				hose jettison switch	1-23		
Set	7-1			light switch	1-23		
bomb tone	7-6			ship tank switch	1-22		
ECM tone	7-6,			transfer switch	1-22		
	8-68			Air Refueling Master Switch	1-22		
ICS control panel	7-5			Air Refueling (Receiver)	1-21		
missile tone	7-6			probe light	1-21		
radio control panel	7-5			refueling valve manual			
Air-Conditioning Control Panel	1-72			control handle	1-21		

ALPHABETICAL INDEX (Cont.)

		Page No.				Page No.	
		Text	Illus			Text	Illus
A (cont)				A (cont)			
Air Refueling (Refueling Store) . .	3-68			approach lights	1-52		
before takeoff	3-68			Annunciator Panel	1-59		
drogue extension	3-68			Antenna Selector Switch	7-7		
drogue retraction	3-69			Anti-Ice, Engine	1-78		
refueling	3-69			Anti-Ice, Windshield	1-76		
transfer from store to tanker .	3-69			Anti-Skid System	1-50		
Air Refueling Store	1-21			failure	5-32		
drogue light	1-21			APCS	1-42		
pylon lights	1-21			air temperature switch	1-43		
store lights	1-21			power switch	1-43		
Air Refueling Store				standby light	1-43		
Limitations	1-99,			technique	4-4		
	4-23			APN-141 Radar Altimeter	1-57	1-57	
Air Refueling System	1-21	1-22		Approaches, Instrument	6-2		
control panel	1-22			ADF		6-4	
receiver	1-21			GCA/PAR pattern	6-2	6-7	
store	1-21			jet penetrations		6-3	
tanker	1-21			landing mode/radar			
Air Refueling (Tanker)	4-22			recovery	6-3	6-6	
before landing	4-22			tacan approach		6-5	
before takeoff	4-22			Approach Power Compensator			
drogue extension	4-22			System	1-42		
drogue retraction	4-22			air temperature switch	1-43		
jettisoning refueling store . . .	4-22			power switch	1-43		
night refueling	4-24			standby light	1-43		
receiver hookup and				technique	4-4		
refueling	4-22			APQ-148 Search Radar	8-4	8-5	
receiver technique	4-23			built-in-test	8-9	8-10	
store limitations	4-23			controls	8-11	8-5	
tanker safety precautions . . .	4-23			cursors	8-7		
transfer from store to				display modes	8-6		
tanker	4-22			operating modes	8-4		
Airspeed Indicator	1-53			tracking modes	8-8		
Airspeed Indicator Failure	5-23	5-24		APX-64 Identification Radar . . .	7-9		
Airspeed Limitations	1-94			ARE 30 Display Mode	8-7		
air refueling	1-97			ARE 60 Display Mode	8-7		
canopy	1-97			Armament Control Unit	8-67		
flaps/slats	1-94			arming and fuzing	8-68		
flaps/slats emergency	1-97			automatic weapon releases . .	8-68		
landing gear	1-94			manual weapon releases	8-67		
rain-removal system	1-97			Armor Plate	1-83	1-83	
ram-air turbine	1-97			Arrangement, General	1-3	FO-3	
speed brakes	1-97			Arresting Hook Malfunction . . .	5-32		
Air Starts	5-6	5-8		Arresting-Hook System	1-51		
buttons	1-8			dashpot pressure gage	1-52		
Alignment	8-18			hook bypass switch	1-51		
carrier	3-80,			hook-lift button	1-51		
	8-19			hook-release handle	1-51		
Alternate Heading and				hook transition light	1-51		
Attitude References	8-23			Arrestments	3-74		
Altimeter, Barometric	1-53			Artificial Feel	1-33		
Altimeter, Radar	1-57	1-57		ASQ-133 Computer	8-24		
Altitude Hold	1-40			attack modes	8-33		
Amplifier Selector Switch	7-5			controls	8-40	8-41	
AMTI Mode	8-4			digital display units/readouts .	8-42	8-44	
Angle-of-Attack System	1-52	1-52		navigation options	8-25	8-26	
angle-of-attack indicator	1-52			operational readiness test . . .	8-36	8-38	
approach indexer	1-53			program	8-24	FO-19	

ALPHABETICAL INDEX (Cont.)

	Page No.			Page No.	
	Text	Illus		Text	Illus
A (cont)			A (cont)		
steering selections	8-27	8-30	switch	8-50	
system advisory codes	8-37		tracking	3-59,	
velocity correct.	8-35			8-8	
Assist Spin Recovery Switch . . .	1-37		B		
Attack Button	8-50,		Backup Flight Controls Hydraulic		
	8-51		System	1-32,	
Attack Commit Trigger	8-51			4-15	
Attack Light	8-40,		backup hyd caution light . . .	1-32	
	8-52		dihedral effect.	4-16	
Attack Modes	8-33		longitudinal control rate		
boresight target acquisition			limiting	4-16	
and attack	8-34		rudder limits	1-99	1-103
delay	8-34		trim changes	4-16	
lab IP and lab target	8-34		Bailout	5-14	
primary attack modes.	8-33		Ballistic Control Panel	8-74	8-75
shrike target acquisition			Barricade Arrestment	5-31	
and attack	8-35		Basic Flight Path.	8-56	
Attack/Navigation System	8-2	FO-17	Battery.	1-30	
Attack Operation, Computer . . .	8-25		Beacon Mode.	8-4	
Attack Procedures	3-61		beacon control.	8-13	
boresight target acquisition			Before Exterior Inspection, B/N.	3-34	
and attack.	3-64		pilot	3-8	
delay bombing	3-67		Before Landing, B/N	3-69	
general attack	3-64		pilot	3-29	
gunnery attack	3-67		Before Takeoff, B/N	3-56	
hi loft attack	3-62		pilot	3-25	
lab IP attack	3-66		Before Taxiing, B/N	3-54	
lab TGT attack	3-66		pilot	3-24	
mining	3-68		Bleed-Air Isolation Valves. . . .	1-11	
rocket attack	3-61		AIR COND switch/valve. . . .	1-11	
straight path attack	3-63		CSD switch/valve.	1-11	
Attitude Instruments.	1-54		NWW switch/valve	1-11	1-12
Attitude Reference Switch	8-23		Bleed-Air System, Engine. . . .	1-11	
Audio Selector Switches	7-5		Blown Tire	5-31	
Automatic Carrier Landing			Bolter Pattern.	3-74	
System	1-41		Bombardier/Navigator's Control		
ACLS data link control panel .	1-42	1-41	Panel.	8-11	8-5
ACLS mode 2 approach	3-77	3-78	Bombardier/Navigator's Master		
Automatic Flight Control System.	1-39		Test Button.	1-59	
altitude hold mode	1-40		Bombardier/Navigator's Proce-		
auto mode.	1-40		dures, Shore Based	3-34	
auto/stab aug switch	1-40		carrier based	3-80	
control panel	1-39	1-39	Bombtone Switch	7-5	
emergency disengage switch. .	1-41		Boost Pump Test Button	1-15	
mach hold mode.	1-40		Boresight Target Acquisition and		
stability augmentation mode. .	1-39		Attack	3-64	
Automatic Velocity Correct . . .	3-60		Brake System	1-49	
Auxiliary Environmental			anti-skid system	1-50	
Systems	1-75		anti-skid light	1-51	
anti-exposure suit and seat			anti-skid switch.	1-50	
cushion ventilation	1-75		auxiliary braking	1-49	1-49
anti-g suits.	1-75		brake controls and indicators.		
vent suit and cushion airflow			brake cycles gage	1-50	
control	1-75		brake selector handle	1-49	
vent suit and cushion tempera-			emergency/park brakes	1-50	
ture control	1-75		normal braking	1-49	
Auxiliary Receiver (UHF)	7-7		Brake System Failures	5-32	
AWW-4 Control Panel.	8-73		anti-skid system failure	5-32	
Azimuth-Range Light	8-52				

ALPHABETICAL INDEX (Cont.)

		Page No.				Page No.	
		Text	Illus			Text	Illus
B (cont)				C (cont)			
emergency operation	5-32			carrier landing pattern		3-76	
hot brakes	5-32			catapult launch	3-73		
Braking, Aerodynamic	4-4			launch procedures	3-72		
Breakaway Display	8-63			pattern (VFR)	3-74		
Breakaway Lights	8-54			post start	3-72		
Briefing/Debriefing	3-2			preflight	3-72		
briefing/debriefing/				recovery	3-74		
responsibilities	3-2			taxi	3-72		
briefing officer	3-2			wave-off/bolter pattern	3-74		
operational briefing	3-2			Carrier Landing Qualifications . .	2-2		
operating area briefing	3-4			Carrier Limitations		1-98	
pilot in command	3-2			Catapult Grip	1-47		
pre-flight briefing	3-2			Catapult Launch	3-73		
preoperational briefing	3-2			Catapult Malfunction, Aircraft			
Built-In-Test, Radar	8-9			or	3-74		
AMT bit	8-9			Caution, Warning, and Advisory			
ATF bit	8-9			Lights	1-59		
BIT displays		8-10		annunciator panel	1-59		1-60
elevation tracking bit	8-9			bombardier/navigator's			
search bit	8-9			master test button	1-59		
terrain clearance bit	8-9			collision light	1-59		
track-while-scan bit	8-9			fire/oil press-to-test button . .	1-59		
Burner Can Blowout	4-3			fire warning lights	1-59		
C				lox/fuel/oil press-to-test			
				button	1-59		
				master caution light and reset			
				button	1-59		
				master test panel	1-59		
				NWW temp light	1-59		
				warning lights press-to-test			
				button	1-59		
				Ceiling/Visibility Requirements .	2-1		
				Center of Gravity Limitations . .	1-98		
				maximum aft c.g.	1-98		
				maximum forward c.g.	1-98		
				Centerline	8-58		
				Channel Frequency Switches . . .	7-6		
				Characteristics, Flight	4-5		
				backup hydraulic system	4-15		
				climb	4-5		
				dives	4-10		4-11, 4-14
				flight controls	4-10		
				flight with external loads . . .	4-15		
				level flight	4-10		
				single engine	4-15,		
					5-4		
				speed brakes	4-15		
				spins	4-7		
				stalls	4-5		4-6
				Checkflight Procedures,			
				Functional	3-85		
				in-flight	3-89		
				landing	3-94		
				pretakeoff	3-85		
				requirements	3-85		
				Checklists	3-6		3-6
				Cipher/Plain Switch	7-8		
				Circling Rendezvous	4-17		
				Circuit Breakers	1-23		1-25, 1-26
				Clear Button	8-49		

ALPHABETICAL INDEX (Cont.)

	Page No.			Page No.	
	Text	Illus		Text	Illus
C (cont)			C (cont)		
Climb Characteristics	4-5		Compressor Stalls	4-2	
Climb, Instruments	6-2		lessening effect	4-3	
Clocks	1-58		minimizing	4-2	
Cockpit Air-Conditioning and			stall warnings	4-2	
Pressurization System	1-71		Computer	8-24	
air-conditioning caution light .	1-73		attack modes	8-33	
air-conditioning cockpit			controls	8-40	8-41
switch	1-72		digital display unit readouts .	8-42	8-44
air-conditioning control panel.	1-72		navigation options	8-25	8-26
automatic cockpit air-			operational readiness test . .	8-36	8-38
conditioning	1-71		program	8-24	FO-19
automatic temperature			steering selections	8-27	8-30
control	1-72		system advisory codes	8-37	
cabin dump switch	1-75		velocity correct	8-35	
cabin pressure schedule		1-73	Computer Controls	8-40	8-41
cockpit pressurization	1-72		computer control unit	8-43	
manual/ram-air switch	1-72		digital display unit controls . .	8-40	
operation	1-75		digital display unit readouts . .	8-42	8-44
Cockpit (B/N)		FO-7	slew control	8-49	
Cockpit Circuit Breaker Panels .		1-25	Computer Emergency Cooling . . .	1-77	
Cockpit Circuit Breakers, Key . .		1-29	computer emergency cooling		
Cockpit (Pilot)		FO-5	switch	1-77	
Coldweather Procedures	6-7		computer light	1-77	
landing	6-8		temperature control light . . .	1-77	
preflight	6-8		Computer Error Light	8-40	
takeoff	6-8		Computer Flow Block Diagram . .		FO-19
taxiing	6-8		Computer Mode Switch	8-47	
warmup and ground check . . .	6-8		Computer Light	8-52,	
Collision Light	1-59			8-54	
Combined Hydraulic System	1-31		Computer Optical Positioning		
Combined System Auxiliary			Check	3-61,	
Pump Operation	1-31			8-63	
Command/Auxiliary Selector			Constant Speed Drive/Starter		
Switch	7-6		System	1-8	
Command Heading Lines	8-56		engine crank buttons	1-10	
Commit Button	8-51		speed drive failure	5-17	
trigger	8-51		speed drive lights	1-10	
Communication, Navigation, and			speed drive switches	1-10	
Identification System	7-1		Contact Analog Display	8-54	8-55
auxiliary receiver	7-7		Control Checks	3-24	
communications and			Control Stick	1-33	
associated electronic		7-2	Cooling Before Shutdown	4-3	
equipment		7-3, 7-4	Cop Check	3-61,	
communications controls				8-63	
ICS	7-1		Correct Position Button	8-40	
IFF/SIF	7-9		Crank Buttons	1-10	
speech security equipment			Crew Coordination, Flight	9-1	
KY-28	7-7	7-7	pilot-bombardier/navigator		
TACAN	7-8		responsibilities	9-1	
UHF radio	7-6		Cruise	3-29	
Compass, Standby	1-58		Cruising Flight, Instruments . . .	6-2	
Compass System MA-1	1-54		CSD Switch/Valve	1-11	
control panel	1-55	1-55	Cursor Intersection Tracking . . .	3-58,	
latitude select control	1-55			8-8	
pull-to-set control	1-55		Cursors, Radar	8-7	
selector switch	1-55				
synchronizer window	1-55		D		
system operation	1-55		Damaged Aircraft	5-22	
Complete Electrical Failure . . .	5-17		Dashpot Pressure Gage	1-52	

ALPHABETICAL INDEX (Cont.)

	Page No.			Page No.	
	Text	Illus		Text	Illus
D (cont)			D (cont)		
Data Select Switch	8-40		low altitude low airspeed	5-6	
DC Electrical Power	1-30		Double Generator Failure	5-16	
Dead Reckoning Navigation			Drift Corrected Steering	8-27	8-28
Option	8-25		Drogue Light	1-21	
Deep Stall Penetration	4-5		Drogue Position Indicator	1-22	
Defogging	1-76		Drogue Switch	1-22	
canopy defogging	1-76		Drop-Tank Transfer Switch	1-19	
canopy defog knob	1-76		Dump Light	1-23	
defog airflow thumbwheel . . .	1-76		Dump Switch, Fuselage	1-20	
defogging operation	1-76		Dump Switch, Wing	1-20	
Delay Bombing Procedures	3-67		E		
Descent	3-29,		ECM Tones	7-6	
	3-70		ECM Light	8-52	
Descent, Instrument	6-2		EGT	4-3	
Desert Procedures	6-8		EGT and inlet icing	4-3	
Designation Numbers, Aircraft .	1-3	1-5	EGT indicator	1-13	
Digital Computer AN/ASQ-133 .	8-24		EGT limitations	1-94	
attack modes	8-33		Ejection	5-9	5-11
computer controls	8-40	8-41	ejection capability chart	5-9	5-10
computer program	8-24	FO-19	high altitude ejection	5-14	
digital display unit readouts .	8-42	8-44	low altitude ejection	5-9	
navigation options	8-25	8-26	sequence		5-13
operational readiness test . . .	8-36	8-38	Ejection Seat	1-65	1-66
steering selections	8-27	8-30	alternate firing handle	1-68	
system advisory codes	8-37		ejection controls	1-68	
velocity correct	8-35		ejection seat check	3-12,	3-16, 3-44
Digital Display Unit Controls . . .	8-40			3-40	
Digital Display Unit Readouts . . .	8-42	8-44	ejection seat operation	1-65	
flight data attack readouts . . .	8-43		ejection sequence		5-13
flight data non-attack			face curtain handle	1-68	
readouts	8-42		manual seat separation	1-68	
navigation data readouts	8-47		safety pins		3-14, 3-42
Dihedral Effect	4-16		Electrical Fire or Smoke In		
Dimensions, Aircraft		1-2	Cockpit	5-7	
Directives, Technical	1-3	1-6	Electrical Power Supply System .	1-23	FO-11
Direct View Radar Indicator . . .	8-52	8-5	AC electrical power	1-24	
azimuth ring and bearing			battery	1-30	
pointer	8-52		DC electrical power	1-30	
light panel	8-52		distribution	1-24	
range window	8-52		emergency power	1-30	
Display Modes, Radar	8-6		external power	1-24	
ARE 30	8-7		Electrical System Failures	5-16	
ARE 60	8-7		complete electrical failure . .	5-17	
PPI	8-6		double generator failure	5-16	
Displays Pushbuttons	8-12		emergency power distribution .		5-18
Ditching	5-32		loss of essential DC bus	5-17	
ditching chart		5-33	loss of trim button	5-19	
Dives	4-10		single generator failure	5-16	
dive recovery		4-11, 4-14	SPD DR light ON	5-17	
Doppler Navigation Radar	8-17		Elevation Slew Switch	8-50	
control panel	8-17		Elevation Tracking	3-58,	
doppler inertial navigation				8-8	
option	8-27		Elevation Track Light	8-52	
doppler navigation option	8-25		Emergency Approach Configuration		
doppler operating			AOA/Airspeed		5-23
characteristics	8-17	8-17	Emergency Brakes	1-50	
Doppler Panel	8-17				
Double Engine Failure During					
Flight	5-4				

ALPHABETICAL INDEX (Cont.)

		Page No.				Page No.	
		Text	Illus			Text	Illus
E (cont)				E (cont)			
Emergency Canopy Jettison	1-64			oil low warning lights	1-11		
Emergency Electrical Power				oil quantity indicating system .	1-10		
(RAT)	1-30			oil quantity press-to-test. . . .			
Emergency Engine Shutdown . . .	5-2			lights	1-11		
Emergency Entrance	5-2			Engine Operation	4-2		
Emergency Flap Switch	1-38			burner can blowout	4-3		
Emergency Fuel Dumping				compressor stalls	4-2		
(RAT Operating)	5-15			compressor stall warnings . .	4-2		
Emergency Harness Release				cooling before shutdown	4-3		
Lever	1-68			engine ratings	4-3		
Emergency Jettisoning	5-14			exhaust gas temperature	4-3		
emergency stores jettison				exhaust gas temperature and			
button	8-77			inlet icing	4-3		
Emergency Landing Gear				flameout	4-3		
Extension	1-46			lessening compressor stall			
Emergency Oxygen	1-69			effect	4-3		
emergency oxygen manual				smoke after shutdown	4-4		
control	1-69			Engine RPM Indicator	1-13		
Emergency Power Distribution . .		5-18		Engine Shutdown	3-33		
Emergency Procedures	5-1			Engine Shutdown, Emergency . . .	5-2		
ground emergencies	5-2			Engine Start	3-21		
in-flight emergencies	5-4			Engine Starting Malfunctions . . .	5-2		
landing emergencies	5-23			Entry To Cockpit	3-5	3-6	
takeoff emergencies	5-3			Environmental Control System . .	1-71	FO-15	
Engine	1-7	1-7		auxiliary environmental			
Engine and Fuel Master				systems	1-75		
Switches	1-10			circuit protection	1-78		
Engine Anti-Icing System	1-78			cockpit air conditioning and			
engine anti-ice switch	1-78			pressurization system	1-71		
Engine Bleed-Air System	1-11	1-12		controls and indicators		1-74	
Engine Controls and Indicators .		1-9		defogging	1-76		
Engine Crank Buttons	1-10			engine anti-ice system	1-78		
Engine Danger Areas		1-91		equipment cooling	1-77		
Engine Failure	5-4	5-5		oxygen system	1-78		
Engine Failure or Fire/Takeoff				windshield switch	1-76		
Aborted	5-3			Equipment Cooling	1-77,		
Engine Failure/Takeoff				1-97			
Continued	5-3			computer emergency cooling .	1-77		
Engine Fuel Control System	1-13	1-14		computer emergency cooling			
Engine Fuel Feed System	1-15			light	1-77		
engine fuel pump	1-18			computer light	1-77		
Engine Fuel System Failures . . .	5-15			ground cooling system	1-77		
engine fuel pump failure . . .	5-15			temperature control light . . .	1-77		
fuel filter light lit	5-16			Equipment Destruct System	1-84		
fuselage boost pump failure . .	5-16			Erect Spins	4-7,		
throttle linkage failure	5-16			4-8			
transfer pump failure	5-16			Erection Controller Panel	8-22		
Engine Instruments	1-13			Escape System	1-65		
EGT indicator	1-13			ejection	5-9	5-11	
fuel flow indicator	1-13			ejection capability	5-9	5-10	
oil pressure indicator	1-13			ejection seat	1-65	1-66	
power trim indicator	1-13			ejection seat preflight	3-12,	3-16, 3-44	
RPM indicator	1-13			3-40			
Engine Limitations	1-94	1-96		ejection sequence		5-13	
idle	1-94			emergency oxygen	1-69		
exhaust gas temperature . . .	1-94			parachute	1-68		
oil pressure	1-94			personnel services			
overspeed	1-94			disconnects	1-69		
Engine Oil System	1-10			seat adjustment	1-71		

ALPHABETICAL INDEX (Cont.)

		Page No.				Page No.	
		Text	Illus			Text	Illus
E (cont)				F (cont)			
survival kit	1-70			Flak Curtains	1-83	1-85	
Essential DC Bus Loss	5-17			Flameout	4-3, 6-6		
Exhaust Gas Temperature				Flaperon Pop-Up Failure	5-21		
Indicator	1-13			Flaperons	1-35		
EGT	4-3			auto pilot actuator	1-35		
limitations	1-94			pop up switch	1-35		
Exterior Inspection, B/N	3-37	3-38		Flaps and Slats	1-37		
pilot	3-9	3-9		emergency flap switch	1-38		
Exterior Lighting	1-82			flap and slat indicators	1-38		
anti-collision light switch	1-83			flap lever	1-37		
exterior lighting controls	1-82	1-81		Flaps or Slats Fail to Extend			
exterior lights master				Normally	5-26		
switch	1-82			Flaps/Slats Fail to Retract	5-21		
formation light switch	1-83			Flaps Takeoff/No Slats			
key light and key push-				Landing	5-26		
button	1-82			Flight and Combined Hydraulic			
lighting controls		1-81		Systems, Loss of	5-20		
pylon light controls	1-82			Flight Characteristics	3-29, 4-5		
tail light switch	1-82			backup hydraulic system	4-15		
taxi/probe light switch	1-83			climb	4-5		
wing light switch	1-82			dives	4-10	4-11, 4-14	
External Circuit Breaker				flight controls	4-10		
Panels	1-26			flight with external loads	4-15		
External Power	1-24			level flight	4-10		
External Store Limitations	1-98			single engine	4-15, 5-4		
F				speed brakes	4-15		
Familiarization and				spins	4-7		
Transition	4-2			stalls	4-5	4-6	
Field Arresting Gear	5-28			Flight Controls and Indicators	1-32, 4-10	1-34	
aborted takeoff				Flight Crew Coordination	9-1		
arrestments	5-29			pilot-bombardier/navigator			
arrestment data		5-30		responsibilities	9-1		
barricade arrestment	5-31			Flight Data Windows	8-40		
long-field arrestments	5-29			Flight Hydraulic System	1-30		
short-field arrestments	5-29			Flight Instruments and			
Field Mirror Landing				Indicator Lights	1-52		
Practice	3-71			Flight or Combined Hydraulic			
night pattern	3-71			System Failure	5-19		
pattern	3-71			Flight Training Syllabus	2-1		
pattern entry	3-71			carrier landing			
preflight inspection	3-71			qualifications	2-2		
Fire	5-6			ceiling/visibility			
air-conditioning full hot	5-9			requirements	2-1		
electrical fire or smoke				initial qualification and			
in cockpit	5-7			currency requirements	2-2		
elimination of smoke and				minimum crew require-			
fumes	5-9			ments	2-2		
fire warning light lit	5-6			personal flying equipment	2-2		
NWW TEMP light lit	5-7			requirements for night/			
TEMP CONT light remains				instrument flight	2-2		
on	5-7			requirements for various			
Fire/Oil Press-To-Test				flight phases	2-2		
Button	1-59			VIP/orientation			
Fire Warning Lights	1-59			flights	2-2		
Fire Warning Light/Takeoff				Forced Landing	5-31		
Continued	5-3						
Fixed Reticle	8-63						

		Page No.				Page No.	
		Text	Illus			Text	Illus
F (cont)				G			
Formation	4-20	4-21		Gallons-Delivered Counter	1-22		
formation instrument				GCA Approaches	6-2	6-7	
approach	4-20			Gear Down, Unsafe			
free cruise formation	4-20			Indications	5-27		
parade formation	4-20			Gear Handle Cannot Be Raised . .	5-22		
Formation Takeoff	4-17			Gear Handle Up, Indicates			
Frequency Agility Switch	8-13			Unsafe	5-22		
Fuel Caution Light	1-20	1-14		General Arrangement	1-3	FO-3	
Fuel Control System, Engine . . .	1-13			General Attack Procedures	3-64		
Fuel Dumping (RAT				Generator Failures	5-16		
Operating)	5-15			Generator Switches	1-24		
Fuel Filter Light	1-15			Generator Warning Lights	1-30		
Fuel Filter Light Lit	5-16			G-Meter	1-58		
Fuel Flow Indicator	1-18			Gross Weight Limitations	1-98		
Fuel Gage	1-19			Ground Clearance	1-93		
Fuel Heater	1-13			Ground Control Bombing			
Fueling	1-87			System	8-77		
Fuel Management	4-4			address panel	8-77		
control panel	1-15			GCBS panel	8-77		
wing-tank purging system . . .	4-4			Ground Cooling System	1-77		
Fuel Pressure Lights, Low	1-18			ground cooling switch	1-77		
Fuel Pressurizing-and-Dump				Ground Emergencies	5-2		
Valve	1-13			emergency engine shutdown . .	5-2	5-2	
Fuel Pump, Engine	1-18			emergency entrance			
Fuel Quantity Indicating				engine starting			
System	1-19	FO-9		malfunctions	5-2		
fuel gage selector buttons . . .	1-19			Ground Handling Signals	7-10	7-11	
fuel quantity gage	1-19			Ground Track Bombing	8-31		
lox/fuel/oil test button	1-19			Ground Training Syllabus	2-1		
Fuel Ready Switch	1-15			minimum ground training . . .	2-1		
Fuel System	1-15			G-Suits	1-75		
engine fuel feed system	1-15			G-valve test	1-75		
fuel dumping system	1-20			Guillotine	1-68		
fuel management control				Gunnery Attack Procedures	3-67		
panel	1-15	1-16		H			
fuel quantity data table				Hand Pump	1-64		
fuel quantity indicating				Hand Signals, Ground/Deck	7-10	7-11	
system	1-19			in-flight	7-10	7-12	
fuel pressurization transfer				High Altitude Ejection	5-14		
and vent system	1-18			Hi Loft Attack Procedures	3-62		
fuel system controls and		1-17		Holding, Instruments	6-2		
indicators				Hook Malfunction	5-32		
Fuel System Failures	5-15			Hook System	1-51	1-56	
engine fuel pump failure	5-15			Horizontal Situation Indicator . .	1-56		
fuel filter light lit	5-16			Horizontal Stabilizer	1-36		
fuselage boost pump failure . .	5-16			hydraulic power actuator . . .	1-36		
throttle linkage failure	5-16			position indicator	1-36		
transfer pump failure	5-16			trim	1-36		
Functional Checkflight				trim gage	1-36		
Procedures	3-85			Hose Jettison Switch	1-23		
in-flight	3-89			Hot Brakes	5-32		
landing	3-94			Hot Refueling	3-33		
pretakeoff	3-85			Hot Weather and Desert			
requirements	3-85			Procedures	6-8		
Fuselage Boost Pump				landing			

ALPHABETICAL INDEX (Cont.)

		Page No.				Page No.	
		Text	Illus			Text	Illus
H (cont)				I (cont)			
Hydraulic Power Supply				INS failure/unreliable			
System	1-30	FO-13		indications	8-22	8-23	
backup flight controls				orientation axes	8-18		
hydraulic system	1-32,			platform controls and			
	4-15			indicators	8-20	8-21	
combined hydraulic system . .	1-31			pre-set alignment	8-19		
combined system auxiliary				shore-based alignment	8-19		
pump operation	1-31			Inflight Alignment	3-56,		
distribution	1-31				8-19		
flight hydraulic system	1-30			full term, computer on	3-56,		
Hydraulic Pressure Gages	1-30				8-19		
Hydraulic System Failures	5-19			short term, computer off	3-57,		
flaperon pop-up failure	5-21				8-20		
flaps/slats fail to retract . . .	5-21			short term computer on	3-57,		
flight or combined system					8-20		
failure	5-19			In-Flight Emergencies	5-4		
landing gear handle cannot				airstarts	5-6	5-8	
be raised	5-22			bailout	5-14		
landing gear handle up,				double engine failure	5-4		
indicates unsafe	5-22			ejection	5-9	5-11	
loss of flight and combined				electric system failures	5-16	5-18	
systems	5-20			emergency fuel dump	5-15		
single hydraulic pump				emergency jettison	5-14		
failure	5-19			engine failure	5-4		
speed brakes system				fire	5-6		
failure	5-21			fuel system failures	5-15		
weight-on-wheels switch				hydraulic system failures . . .	5-19		
failure	5-22			NWW temp light lit	5-7		
				oil system failures	5-15		
I				In-Flight Visual			
				Communications	7-10	7-12	
Ice and Rain	6-4			Initial Qualification and			
flameouts	6-6			Currency Requirements	2-2		
icing	6-4			In Range Display	8-63		
landing in rain	6-6			In Range Light	8-54		
rain	6-5			INS Controls and Indicators	8-20	8-21	
windshield rain removal	6-5			Instrument Flight Procedures . . .	6-1		
ICS	7-1			ADF approach		6-4	
Identification Radar				flight planning	6-1		
AN/APX-64	7-9			GCA approaches	6-2	6-7	
Idle Limitations	1-94			holding	6-2		
IFR Conditions	6-1			IFR conditions	6-4		
Ignition System	1-8			instrument approaches	6-2	6-3, 6-7	
Impact Point	8-56			instrument climb	6-2		
In Chocks	3-70			instrument cruise	6-2		
Inertia Reel	1-69			instrument descent	6-2		
inertia reel manual control . .	1-69			instrument takeoff	6-1		
Inertial Navigation Option	8-25			jet penetration		6-3	
Inertial Navigation System	8-18			landing mode			
alignment	8-18			approaches	6-3	6-6	
carrier alignment	3-80,			night flying	6-4		
	8-19			PAR pattern		6-7	
erection controller panel . . .	8-22			radar recovery		6-6	
inertial platform				TACAN approach		6-5	
orientation	8-18			VFR conditions	6-4		
in-flight alignment (full				Instrument			
term)	8-19			Markings	1-95		
in-flight alignment (short				Instruments, Engine	1-13		
term)	8-20			flight	1-52		

ALPHABETICAL INDEX (Cont.)

	Page No.			Page No.	
	Text	Illus		Text	Illus
I (cont)			L (cont)		
Intercommunication Set			Landing	3-30	
AN/AIC-14	7-1		crosswind landing	3-31	
bomb tone	7-6		heavy gross weight landing . .	3-31	
ECM tone	7-6,		normal landing	3-30	
	8-68		wet runway landing	3-31	
ICS control panel	7-5		Landing Emergencies	5-23	5-23
missile tone	7-6		airspeed indicator failure . . .	5-24	
radio control panel	7-5		arresting hook malfunction . .	5-32	
Interior Inspection-Power On . .	3-41		blown tire	5-31	
computer entry procedures . .	3-52		ditching	5-32	5-33
computer test procedures . . .	3-49		field arrestment	5-28	5-30
pre-turn-on procedures	3-41		flaps/slats fail to extend		
radar turn-on/test			normally	5-26	
procedures	3-49		flaps takeoff/no slats		
when seated in the cockpit . .	3-41		landing	5-26	
Interior Lighting	1-80		forced landing	5-31	
approach index light			landing gear down with		
control	1-80		unsafe indications	5-27	
bombardier/navigator's			landing gear emergencies . . .		5-27
interior light controls	1-80		no flaps/no slats landing	5-26	
bombardier/navigator's			no flaps/slats down landing . .	5-27	
map light	1-80		single engine landing	5-23	5-25
console lights control	1-80,		wheel brake system failure . .	5-32	
	1-82		Landing Gear Down, Unsafe		
daylight floodlights	1-80,		Indications	5-27	
	1-82		Landing Gear Emergency	5-27	
daylight floodlight switch	1-82		Landing Gear Handle Cannot		
flight instrument lights			Be Raised	5-22	
control	1-80	1-81	Landing Gear Handle Up,		
floodlight control switch	1-82		Indicates Unsafe	5-22	
interior light panel	1-80		Landing Gear System	1-44	
lighting controls			controls and indicators	1-44	1-45
pilot's interior light			emergency extension	1-46	
controls	1-80		handle	1-45	
pilot's kneeboard light	1-80		main gear	1-46	
panel light control	1-82		nose gear	1-46	
utility lights	1-80		nose-wheel steering	1-46	
Inverted Spins	4-8,		position indicator	1-45	
	4-9		wheels transition light	1-44	
Isolation Valve and Switch	1-31		wheels warning light	1-44	
J			Landing in Rain	6-6	
Jet Penetration	6-3		Landing Mode	8-31	8-32
K			approach/radar recovery . . .	6-3	6-6
KB-18B Camera	8-78		Lateral Trim Indicator	1-35	
KB-19A Camera	8-78		Launch Procedures	3-72	
Key Cockpit Circuit Breakers . .	1-29		Leg Garter	1-69	
KY-28 Speech Security			Level Flight Characteristics . . .	4-10	
Equipment	7-7	7-7	pilot induced lateral		
KY-28 operation	7-8		oscillation	4-10	
L			Lighting Systems	1-80	
Lab IP Attack Procedures	3-66		exterior lighting	1-82	
Lab TGT Attack			interior lighting	1-80	
Procedures	3-66		lighting controls		1-81
			Limitations	1-94	
			acceleration limitations	1-97	1-99, 1-101
			airspeed limitations	1-94	
			air starts	1-94	5-8
			carrier		
			limitations	1-98	

ALPHABETICAL INDEX (Cont.)

		Page No.				Page No.	
		Text	Illus			Text	Illus
L (cont)				M (cont)			
center of gravity				Missile Tones	7-6		
limitations	1-98			Mission Planning	3-5		
external store limitations . . .	1-98			conventional weapons	3-5		
engine limitations	1-94	1-96		nuclear weapons	3-5		
equipment cooling	1-97			Mission Recorder Panel	8-16	8-15	
maneuvers	1-99	1-99, 1-100		Movable Reticle	8-63		
refueling store limitations . .	1-99,						
	4-23			N			
Long-Field Arrestments	5-29			NATOPS Evaluation	10-1		
Longitudinal Control Rate				closed-book examination	10-2		
Limiting	4-16			concept	10-1		
Low Altitude Ejection	5-9			definitions	10-1		
Low Fuel Caution Light	1-20			evaluation forms	10-4	10-6	
Low Fuel Pressure Lights	1-18			evaluation report	10-5		
Low Visibility Rendezvous/				final grade determination . . .	10-4		
Rendezvous on Different				flight evaluation	10-3		
Model Aircraft	4-19			flight evaluation grade			
Lox/Fuel/Oil Test Button	1-19,			determination	10-4		
	1-59			flight evaluation grading			
Lts Warn Press-To-Test				criteria	10-3		
Button	1-59			flight evaluation grading			
				forms	10-4	10-6	
M				grading instructions	10-2		
MA-1 Compass	1-54			ground evaluation	10-2		
Mach/Airspeed/Command				implementation	10-2		
Airspeed Indicator	1-53			OFT/WST procedures			
Mach Hold	1-40			evaluation	10-2		
Magnetic Variation	8-40			open-book examination	10-2		
Main Differences Table	1-4			oral examination	10-2		
Main Gear	1-46			question bank	10-9		
Maneuver Limitations	1-99			records and reports	10-4		
asymmetrical loading, roll				safety considerations during			
limits		1-104		evaluation flights	10-3		
prohibited maneuvers	1-104			Navigation Data Switch	8-40		
rolling maneuvers	1-103	1-99		Navigation Data Windows	8-40		
rudder maneuvers	1-99	1-103		Navigation Mode Selector			
Manual Bailout	5-14			Switch	8-40		
Manual Canopy Handle	1-62			Navigation Options	8-25	8-26	
Manual Seat Separation	1-68			Night Flying	6-4		
Manual Velocity Correct	3-61			No Flaps/No Slats Landing	5-26		
Manual Release Button	8-75			No Flaps/Slats Down Landing . .	5-27		
Master Caution Light	1-59			Non-Attack Operation,			
Master Generator Controls	1-24			Computer	8-24		
Master Light Panel	1-80,	1-81		Non-Attack Steering			
	1-82			Selections	8-30		
Master Test Panel	1-59			Nose Gear	1-46		
Maximum Glide Velocity	5-5			nose gear cocked	5-4		
Microphone Switches	7-5			nose-wheel steering	1-46		
Mic Sel Switch	7-5			nose-wheel steering			
Minimum Crew Requirements . .	2-2			button	1-47		
Mining Procedures	3-68			Nose-Tow Catapult System	1-47		
Miscellaneous Equipment	1-83			catapult grip	1-47		
armor plate	1-83	1-83		nose strut indicator	1-48		
equipment destruct system . .	1-84			nose-tow link		1-47	
flak curtains	1-83	1-85		nose-tow link indicator	1-48		
radiation shields	1-84	1-85		Nuclear Panel	8-73		
relief tubes	1-84			NWW Switch/Valve	1-11		
stowage containers	1-84			NWW TEMP Light	1-59		

ALPHABETICAL INDEX (Cont.)

	Page No.			Page No.	
	Text	Illus		Text	Illus
O			P (cont)		
OAT Gage	1-58		powered inertia reel	1-69	
Offset Impact Bar	8-58		time-release mechanism . . .	1-68	
Oil-Pressure Indicator	1-11		Parade Formation	4-20	
Oil Quantity Indicating System . .	1-10		Park Brakes	1-50	
oil low warning lights	1-11		PAR Pattern	6-7	
oil quantity press-to-test			Pathway	8-56	
buttons	1-11		Personal Flying Equipment	2-2	
Oil System	1-10		Personnel Services		
oil low warning lights	1-11		Disconnects	1-69	
oil pressure indicator	1-11		PHD	8-52	8-5
oil pressure limitations	1-94		Pilot Induced Lateral		
oil quantity indicating			Oscillation	4-10	
system	1-10		Pilot's Check Lists	3-6	3-6
oil quantity press-to-test			Pilot's Computer and Weapon		
buttons	1-11		Release Controls		8-51
Oil System Failures	5-15		Pilot's Computer Controls	8-50	8-51
high oil pressure	5-15		attack button	8-51	
loss of oil pressure	5-15		attack commit trigger	8-51	
low oil warning lights	5-15		commit button	8-51	
Operating Limitations	1-94		Pilot's Control Panel	8-14	8-5
Operating Modes, Radar	8-4		Pilot's Horizontal Display	8-52	8-5
AMTI	8-4		azimuth ring and command		
beacon	8-4		heading indicator	8-53	
search	8-4		time and range windows	8-53	
terrain clearance	8-6		Pilot's Procedures, Shore		
Operating Techniques	4-2		Based	3-6	
Operational Briefing	3-2		carrier based	3-71	
Operational Readiness Test	8-36		Pitot-Static System	1-53	
Opportunity Target Steering . . .	8-31		mach/airspeed/command		
Optical Sight	8-63	8-64	airspeed indicator	1-53	
computer optical positioning			pitot heat switch	1-53	
check	8-63		servoed barometric		
controls	8-64,	8-64	altimeter	1-53	
	8-65		vertical speed indicator	1-54	
operation	8-67		Planning, Flight	3-6	
reticle displays	8-63	8-65, 8-66	Planning, Mission	3-5	
Ordnance	3-23		Platform Controls and		
Outside Air Temperature			Indicators	8-20	8-21
Indicator	1-58		Platform Light	8-54	
Overspeed Limitations	1-94		Position Correct Button	8-40	
Oxygen System	1-78		Post Stall Gyration	4-7	
emergency oxygen	1-78		Post Start	3-22	
lox/fuel/oil press-to-test	1-78		Power Distribution,		
button	1-78		Emergency	5-18	
oxygen caution light	1-78		Powered Inertia Reel	1-69	
oxygen duration chart		1-79	inertia reel manual control . .	1-69	
oxygen quantity gage	1-78		Power Plant Systems	1-8	
personal oxygen regulator . . .	1-78		Power Trim Indicator	1-13	
P			PPI Display Mode	8-6	
Parachute	1-68		Pre-Flight Briefing	3-2	
emergency harness release			Pre-Flight Check, B/N	3-34	
handle	1-68		pilot	3-8	
guillotine	1-68		Preoperational Briefing	3-2	
inertia reel manual control . .	1-69		Press-To-Transmit Switches . .	7-5	
leg garter	1-69		Prestart Procedures External		
parachute withdrawal			Power On	3-17	
line	1-68		upon entering cockpit	3-17	
			Pre-Takeoff Procedures, B/N . .	3-56	
			pilot	3-25	

ALPHABETICAL INDEX (Cont.)

		Page No.				Page No.	
		Text	Illus			Text	Illus
P (cont)				R (cont)			
Pre-Taxi Procedures, B/N	3-54			Radio Control Panel	7-5		
pilot	3-24			Rain	6-5		
Pullup Marker	8-56			rain removal	6-5		
Pylon Lights	1-21			Rain Removal (Anti-Ice)	1-76		
Q				operation	1-76		
Quantity Keys	8-49			Ram Air Turbine	1-30		
R				Rate-of-Climb Indicator	1-54		
Radar Altimeter System				Receiver Gain Control	8-12		
AN/APN-141	1-57	1-57		Recovery	3-74		
height indicator	1-57			Recovery, Spin	4-7,		
low altitude warning system . .	1-57				4-8,		
low altitude aural warning . . .	1-58				4-9		
low altitude warning lamp . . .	1-58			Refueling Master Switch	1-22		
off flag	1-57			Refueling Probe Light	1-21		
power/self-test/positioning				Refueling Procedures	3-68		
control	1-57			before takeoff	3-68		
preflight check	1-58			drogue extension	3-68		
radar altimeter failure light. .	1-58,			drogue retraction	3-69		
	8-54			refueling	3-69		
Radar Altitude Curtain	8-59			transfer from store to			
Radar Beacon AN/APN-154(V) . .	8-79			tanker	3-69		
Radar Bit Displays		8-10		Refueling Procedures, Hot	3-33		
Radar Built-In-Test	8-9			air	4-22		
AMTI bit	8-9			Refueling Valve Manual			
ATF bit	8-9			Control Handle	1-21		
bit displays		8-10		Release Marker	8-56		
elevation tracking bit	8-9			Relief Tubes	1-84		
search bit	8-9			Rendezvous	4-17		
terrain clearance bit	8-9			ADF circling	4-19		
track-while-scan bit	8-9			ADF running	4-19		
Radar Cursors	8-7			circling	4-17		
Radar Display Modes	8-6			low visibility/different			
ARE 30	8-7			model aircraft	4-19		
ARE 60	8-7			running	4-19		
PPI 5-75	8-6			safety rules	4-19		
PPI 150	8-6			tacan circling	4-19	4-18	
Radar Operating Modes	8-4			turning	4-17		
AMTI	8-4			Requirements for Night/			
beacon	8-4			Instrument Flight	2-2		
search	8-4			Requirements for Various			
terrain clearance	8-6			Flight Phases	2-2		
Radar Recorder	8-15	8-15		cross-country	2-2		
Radar Recovery		6-6		ferry	2-2		
Radar, Search	8-4	8-5		night	2-2		
Radar, Track	8-14			solo flight	2-2		
Radar Tracking Modes	8-8			Reselect Light	8-52		
azimuth-range	8-8			Reselect Logic	8-75	8-76	
cursor intersection	8-8			Restrictions, Flight	1-99,		
elevation	8-8				3-6		
track-while-scan	8-8			Rocket Attack Procedures	3-61		
Radar Transmission Danger				Roll/Pitch Trim Switch	1-35		
Areas	1-90			Roll-Summed Steering	8-27	8-29	
Radiation Shields	1-84	1-85		Roll Trim Indicator	1-35		
Radio and ICS Controls	7-3,			RPM Indicator	1-13		
	7-4			RPM Limitations	1-94		
				Rudder	1-36		
				pedals	1-36		
				trim gage	1-37		
				trim switch	1-36		

ALPHABETICAL INDEX (Cont.)

		Page No.				Page No.	
		Text	Illus			Text	Illus
R (cont)				S (cont)			
Rudder Throw Caution Light . . .	1-37			Slew Control Panel	8-49		
Running Rendezvous	4-19			attack button	8-50		
S				azimuth range switch	8-50		
Safety Rules for				elevation slew switch	8-50		
Rendezvous	4-19			slew grip	8-49		
Sats Procedures	3-83			slew rate switches	8-50		
catapult emergencies	3-84			velocity correction switch . . .	8-50		
launch procedures	3-83			Smoke After Shutdown	4-4		
limitations	3-83			Smoke and Fumes in Cockpit . . .	5-9		
preflight	3-83			Speech Security Equipment	7-7	7-7	
recovery	3-84			KY-28 operation	7-8		
taxi	3-83			Speed Brakes	1-43		
wave-off/bolter	3-84			blowback	4-15		
Search Mode	8-6			fail-safe provisions	1-44		
Search Radar AN/APQ-148	8-4	8-5		position indicator	1-44		
built-in-test	8-9	8-10		restrictions	4-15		
controls	8-11	8-5		switch	1-44		
cursors	8-7			test switch	1-44		
display modes	8-6			Speed Brakes System Failure . .	5-21		
operating modes	8-4			Speed Drive Lights	1-10		
tracking modes	8-8			switches	1-10		
Seat, Ejection	1-65	1-66		Spin Recovery Switch	1-37		
Selective Stores Jettison				Spins	4-7		
Button	8-77			erect spins	4-7		
Sensors	8-2			inverted spins	4-8		
aircraft data sensors	8-2			spin characteristics	4-7		
display of sensor usage	8-3			spin recovery on			
evaluation and replacement				instruments	4-9		
of aircraft data	8-2			Stability Augmentation	1-39		
Sensor Usage	8-3			Stalls	4-5		
Servicing	1-87	1-88		accelerated stalls	4-5		
Servoed-Barometric				deep stall penetration	4-5		
Altimeter	1-53			normal stalls	4-5		
Ship Tank Switch	1-22			post stall gyrations	4-7		
Shore-Based Alignment	8-19			stall speeds		4-6	
Shore Based Procedures	3-6			Standby Compass	1-58		
bombardier/navigator's				Starting Engines	3-21		
procedures	3-34			Steering Selections	8-27	8-20	
pilot's procedures	3-6			command pullup indications . .	8-27		
Short Field Arrestments	5-29			drift corrected steering	8-27	8-28	
Single Engine Carrier Landing . .		5-25		ground track/bombing	8-31		
Single Engine Landing	5-23			landing mode	8-31	8-32	
Single Engine Failure				opportunity target/steering . .	8-31		
During Flight	5-4			roll-summed steering	8-27	8-29	
Single Engine Operation	4-15			target steering	8-28		
characteristics	4-15,			unstabilized steering	8-31		
	5-4			Steering Symbol	8-56		
performance	4-15			Stores Jettison	5-13,		
procedures	5-4				8-77		
Single Generator Failure	5-16			emergency stores jettison			
Single Hydraulic Pump				button	8-77		
Failure	5-19			selective stores jettison			
Slats	1-37			button	8-77		
emergency flap switch	1-38			Stowage			
flap and slat				Containers	1-84		
indicators	1-38			Straight Path Attack			
flap lever	1-37			Procedures	3-63		
				Strike Camera Control			
				Panel	8-78		

ALPHABETICAL INDEX (Cont.)

	Page No.			Page No.	
	Text	Illus		Text	Illus
S (cont)			T (cont)		
Strike Camera System			Throttle Linkage Failure	5-16	
LB-31A	8-78		Throttles	1-8	
KB-18B camera	8-78		friction lever	1-8	
KB-19A camera	8-78		Thunderstorms	6-6	
strike camera control			Time Release Mechanism	1-68	
panel	8-78		Tone Controls	7-6	
Strut Lock Light	5-4		Tow Link/Nose Gear Cocked . . .	5-4	
Summary of Applicable			Tracking Modes, Radar	8-8	
Technical Directives		1-6	azimuth-range	8-8	
Survival Kit (RSSK-7)	1-69	1-70	cursor intersection	8-8	
Symbols and Markers, VDI	8-56	8-57	elevation	8-8	
System Advisory Codes	8-37		track-while-scan	8-8	
System Displays	8-52		Track Light	8-52	
direct view radar indicator . .	8-52	8-5	Track Radar Controls	8-14	
optical sight	8-63		Track-While-Scan Tracking . . .	8-8	
pilot's horizontal display . . .	8-52	8-5	Transfer Pump Failure	5-16	
vertical display indicator . . .	8-53	8-53	Transfer Switch	1-22	
T			Transition	4-2	
TACAN	7-8		Transmit Switch	8-11	
approach		6-5	Trim Button, Lateral/		
circling rendezvous	4-19	4-18	Longitudinal	1-35	
Takeoff (Ashore)	3-26		Trim Button, Loss of	5-19	
crosswind takeoff	3-27		Turbulence and		
takeoff technique	3-27		Thunderstorms	6-6	
Takeoff Emergencies	5-3		Turn-And-Slip Indicator		
engine failure or fire/			MD-1	1-54	
takeoff aborted	5-3		Turning Rendevous	4-17	
engine failure/takeoff			U		
continued	5-3		UHF Communications Radio	7-6	
fire warning light/takeoff			Unstabilized Steering	8-31	
continued	5-3		USH-17(V) Video Tape		
Takeoff, Instruments	6-1		Recorder	8-15	8-15
Takeoff Procedures, B/N	3-56		V		
pilot (ashore)	3-26		Velocity Correct	8-35	
Tank Pressurization Switch	1-18		automatic	8-36	
Target Steering	8-28		manual	8-36	
Target Symbol	8-56		switch	8-50	
Target Tracking Procedures	3-58		Velocity Correct Procedures . . .	3-60	
azimuth range tracking	3-59		Velocity Required for		
cursor intersection			Maximum Glide		5-5
tracking	3-59		Vent Suits	1-75	
elevation tracking	3-58		Vertical Display Indicator	1-54,	8-53
track-while-scan tracking . . .	3-60			8-53	
Taxi Procedures	3-55		advisory lights	8-54	
Technical Directives	1-3	1-6	contact analog display	8-54	8-55
TEMP CONT Light Remains			controls	8-62	8-53
On	5-7		symbols and markers	8-56	8-57
Temporary Storage Window	8-49		terrain clearance displays . .	8-58	8-59
Terrain Clearance Display	8-58	8-59	terrain clearance operating		
flight technique	8-60		parameters		8-61
operating parameters		8-61	test displays		8-62
operation	8-60		Vertical Gyro Indicator		
range coding	8-58		(VGI) MM-3	1-54	
scaling	8-59		Vertical Speed Indicator	1-54	
Terrain Clearance Failure			VFR Conditions	6-4	
Light	8-54				
Terrain Clearance Mode	8-6				

ALPHABETICAL INDEX (Cont.)

	Page No.			Page No.	
	Text	Illus		Text	Illus
V (cont)			W (cont)		
Video Tape Recorder			Weight-On-Wheels Switch		
AN/USH-17(V)	8-15	8-15	Failure	5-22	
VIP/Orientation Flights	2-2		Wheel Brake System	1-49	
Visual Communications,			controls and indicators		1-49
Ground/Deck	7-10	7-11	Wheel Brake System		
in-flight	7-10	7-12	Failures	5-32	
VN Diagrams	1-97	1-99, 1-102	anti-skid system failure	5-32	
VOX Sensitivity Control	7-5		emergency operation	5-32	
W			hot brakes	5-32	
Warning, Caution and			Wheels Transition Light	1-44	
Advisory Lights		1-60	Wheels Warning Light	1-44	
Warning Lights	1-59	1-60	Windshield Rain Removal	6-5	
test button	1-59		Windshield Switch	1-76	
Wave-Off	3-31		rain removal (anti-ice)	1-76	
Wave-Off Pattern	3-74		windshield wash	1-76	
Weapon Carriage	1-3		Windshield Wash	1-76	
Weapon Mounting	8-77		operation	1-76	
Weapons Release System	8-67		Wing Drop-Tank Transfer		
ACU control panel	8-69		Switch	1-19	
armament control unit	8-67		Wing Dump Switch	1-20	
ballistic control panel	8-74	8-75	Wing Flaps and Slats	1-37	
fuze function control panel	8-73		emergency flap switch	1-38	
ground control bombing			flap and slat indicators	1-38	
system	8-77		flap lever	1-37	
manual release button	8-75		Wing-Fold System	1-48	
nuclear panel	8-73		wing-fold handle	1-48	
radar beacon			wing-fold operation	1-48	
AN/APN-154(V)	8-79		wing lockpin switch	1-48	
reselect logic	8-75	8-76	wing-spread operation	1-48	
stores jettison	8-77		Wing Spread	3-24	
strike camera system			Wing-Tank Purging		
LB-31A	8-78		System	4-4	
weapon mounting	8-77		Z		
Weight, Aircraft	1-3		Zeroize Switch	7-8	
weight and balance	1-98,				
	3-6				

INDEX OF PERFORMANCE DATA

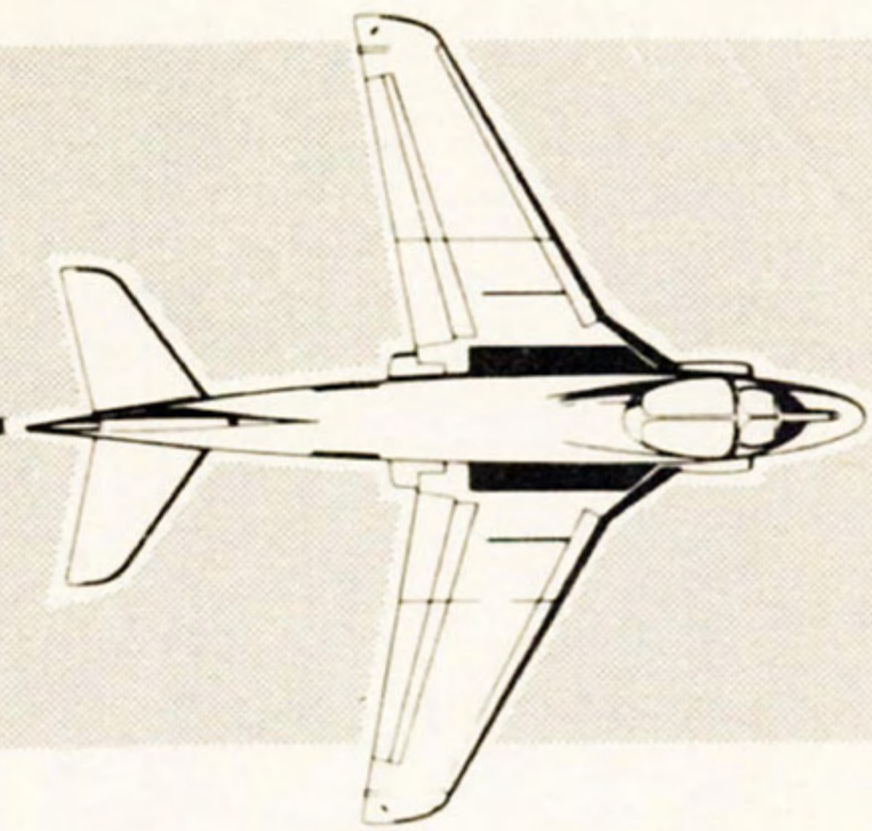
Page No.			Page No.		
Text Illus			Text Illus		
A			C (cont)		
Acceleration To Climb			Cruise Altitude, Best	11-15	11-25
Speed	11-106	11-111	single engine		11-26
Aircraft Configuration Store			Cruise Performance	11-14	11-17,
Drag Count	11-3	FO-21	single engine		11-20
Air Refueling	11-106				11-21,
acceleration to climb					11-24
speed	11-106	11-111			
fuel consumption	11-106	11-108,			
		11-110			
transfer time	11-107	11-112			
Airspeed conversion	11-2	11-6, 11-7			
Airspeed Position Error					
Correction	11-2	11-8, 11-9			
Altimeter Position Error					
Correction	11-2	11-10,			
		11-11			
Altitude Table, Standard		11-4			
B			D		
Best Cruise Altitude	11-15	11-25	Descent	11-113	
single engine		11-26	maximum range descent . . .	11-113	11-115,
					11-122
			normal descent	11-113	11-114
			Drag Count	11-3	FO-21
C			E		
Climb	11-72		Effect of Runway Surface		
combat ceiling	11-73	11-94,	Condition		11-60
		11-95	Endurance	11-101	
maximum climb-out			maximum endurance	11-101	11-102,
angle	11-72	11-82,			11-105
		11-83			
maximum climb speed	11-73	11-86,			
		11-87			
maximum rate of climb	11-73	11-84,			
		11-85			
military power climb	11-72	11-74,			
		11-81			
service ceiling	11-73	11-94,			
		11-95			
Climb Performance After					
Takeoff (single engine) . . .	11-59				
sea level, clean		11-66			
sea level, flaps 30°		11-67			
sea level, flaps 30°					
gear down		11-68			
4,000 feet, clean		11-69			
4,000 feet, flaps 30°		11-70			
8,000 feet, clean		11-71			
Combat Allowance	11-59	11-27,			
		11-28			
Combat Ceiling	11-73				
single engine		11-95			
two engines		11-94			
Critical Field Length	11-59	11-65			
Crosswind Chart, Takeoff					
and Landing	11-3	11-12			
			F		
			Fuel Consumption During		
			Refueling	11-106	
			5,000 feet		11-108
			30,000 feet		11-109
			35,000 feet		11-110
			L		
			Landing	11-123	
			approach speeds	11-123	11-124
			distance	11-123	11-125,
					11-126
			M		
			Maximum Climb-Out Angle . . .	11-72	
			single engine		11-83
			two engines		11-82
			Maximum Climb Speed	11-73	
			single engine		11-87
			two engines		11-86
			Maximum Endurance	11-101	
			fuel required-single		
			engine		11-105
			speed-single engine		11-104
			fuel required-two		
			engines		11-103
			speed-two engines		11-102

INDEX OF PERFORMANCE DATA (Cont.)

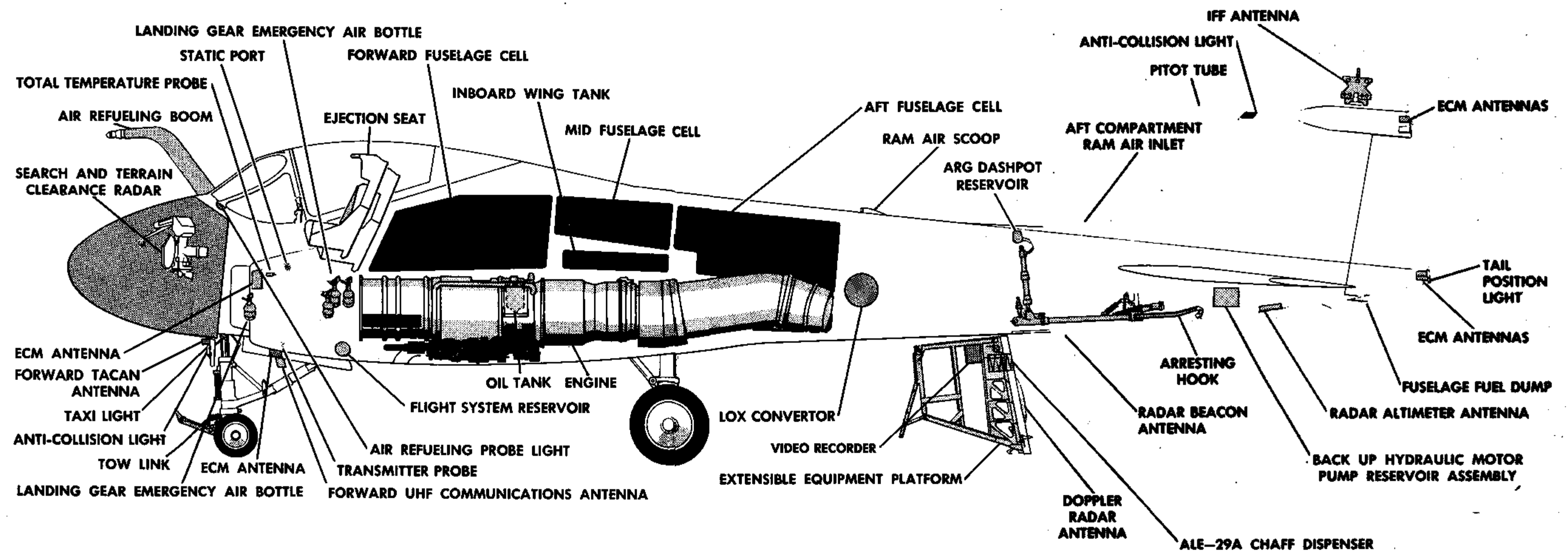
		Page No.				Page No.	
		Text	Illus			Text	Illus
M (cont)				M (cont)			
Maximum Range Cruise at Constant Altitude	11-96			best cruise altitude	11-15		11-25, 11-26
fuel required-single engine			11-100	combat allowance	11-15		11-27, 11-28
time and speed-single engine			11-99	cruise performance	11-14		11-17, 11-24
fuel required-two engines			11-98	optimum endurance altitude	11-15		11-25, 11-26
time and speed-two engines			11-97	maximum turn performance	11-16		11-40, 11-56
Maximum Range Descent	11-113			military power acceleration	11-15		11-29, 11-39
distance required-single engine			11-122	N			
fuel required-single engine			11-121	Normal Descent	11-113		11-114
speed-single engine			11-119	Normal Landing Distance	11-123		11-125
time required-single engine			11-120	Normal Takeoff Distance			11-62
distance required-two engines			11-118	O			
fuel required-two engines			11-117	Optimum Endurance Altitude	11-15		11-25
speed-two engines			11-115	single engine			11-26
time required-two engines			11-116	P			
Maximum Rate of Climb	11-73			Position Error Correction, Airspeed	11-2		11-8, 11-9
single engine			11-85	altimeter	11-2		11-10, 11-11
two engines			11-84	R			
Maximum Refusal Speed	11-58		11-61	Range	11-96		
Maximum Turn Performance	11-16			maximum range cruise at constant altitude	11-96		11-97, 11-100
no stores			11-40, 11-46	Refusal Speed	11-58		11-61
with stores			11-48, 11-56	Runway Surface Conditions, Effect			11-60
Military Power Acceleration	11-15			S			
no stores			11-29, 11-34	Service Ceiling	11-73		
with stores			11-35, 11-39	single engine			11-95
Military Power Climb	11-72			two engines			11-94
climb speed schedule- single engine			11-78	Standard Altitude Table			11-4
distance required- single engine			11-81	Standard Units Conversion Chart			11-5
fuel required-single engine			11-80	Stores Weights			11-3
time required-single engine			11-79				
climb speed schedule-two engines			11-74				
distance required-two engines			11-77				
fuel required-two engines			11-76				
time required-two engines			11-75				
Minimum Landing Distance	11-123		11-126				
Minimum Takeoff Speed			11-63				
Mission Planning	11-14						

INDEX OF PERFORMANCE DATA (Cont.)

	Page No.			Page No.	
	Text	Illus		Text	Illus
T			T (cont)		
Takeoff	11-58		Takeoff and Landing		
climb performance			Crosswind Chart	11-3	11-12
after takeoff	11-59	11-66, 11-71	Takeoff Distance	11-58	
critical field length	11-59	11-65	normal		11-62
effect of runway surface			minimum		11-63
conditions		11-60			
maximum refusal speed . . .	11-58	11-61	V		
takeoff distance	11-58	11-62, 11-63	Velocity During Takeoff		
velocity during takeoff			Ground Run	11-59	11-64
ground run	11-59	11-64			

FOLDOUT ILLUSTRATIONS**TABLE OF CONTENTS**

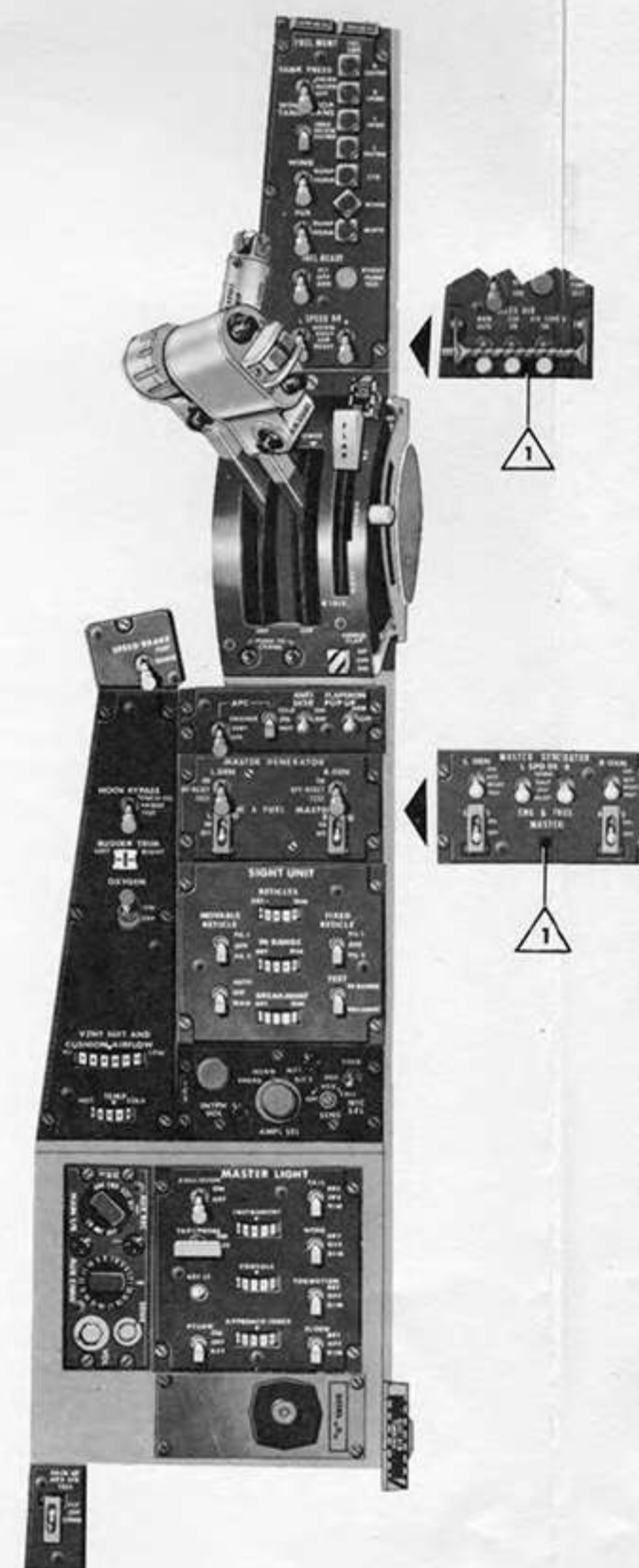
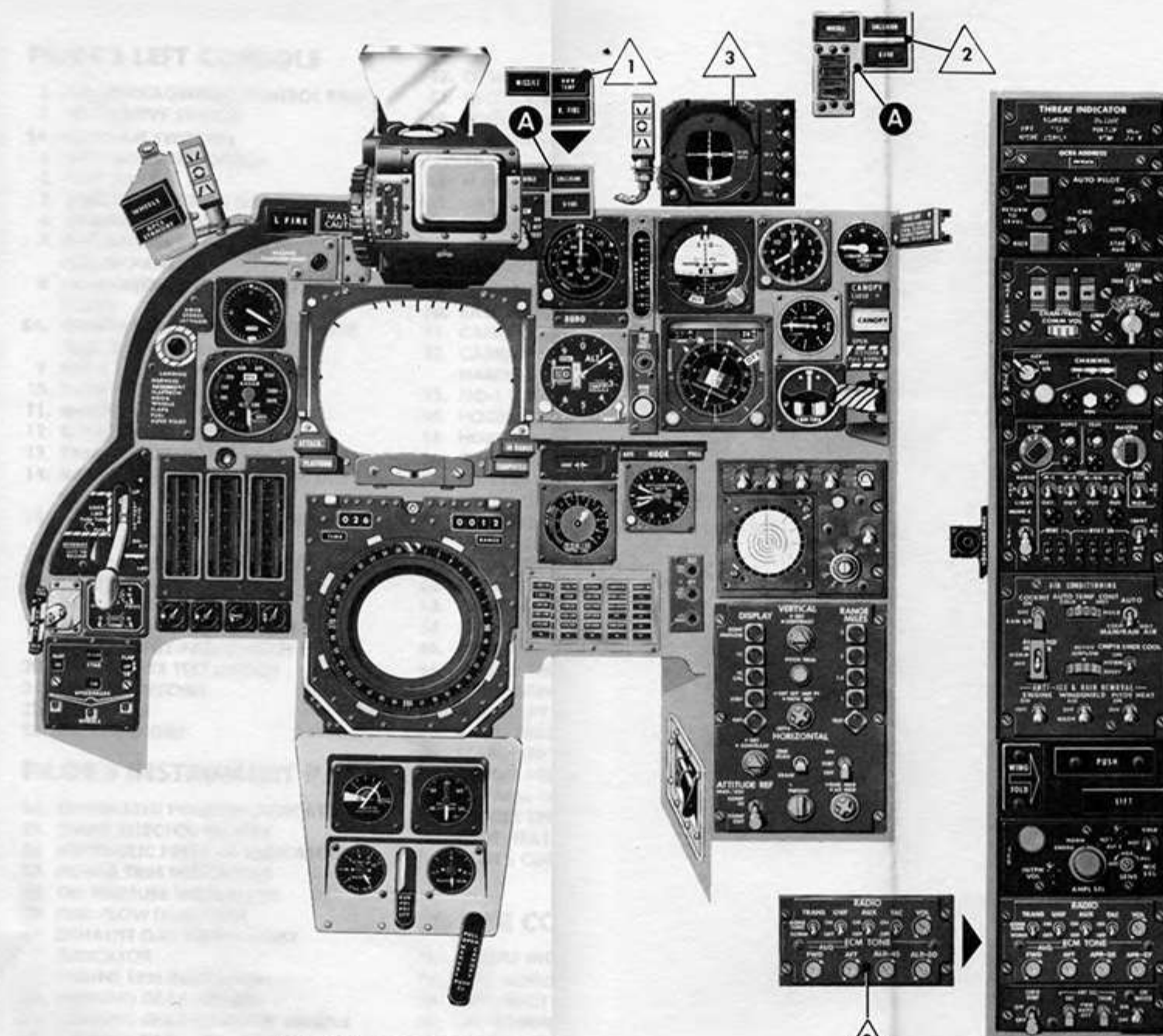
Subject	Page Number
General Arrangement	FO-3
Cockpit (Pilot)	FO-5
Cockpit (B/N)	FO-7
Aircraft Fuel Supply System	FO-9
Electrical Power Supply System	FO-11
Hydraulic Power Supply System	FO-13
Environmental Control System	FO-15
Attack Navigation System	FO-17
Computer Flow Block Diagram	FO-19
Drag Count Table	FO-21

GENERAL ARRANGEMENT**TYPICAL**

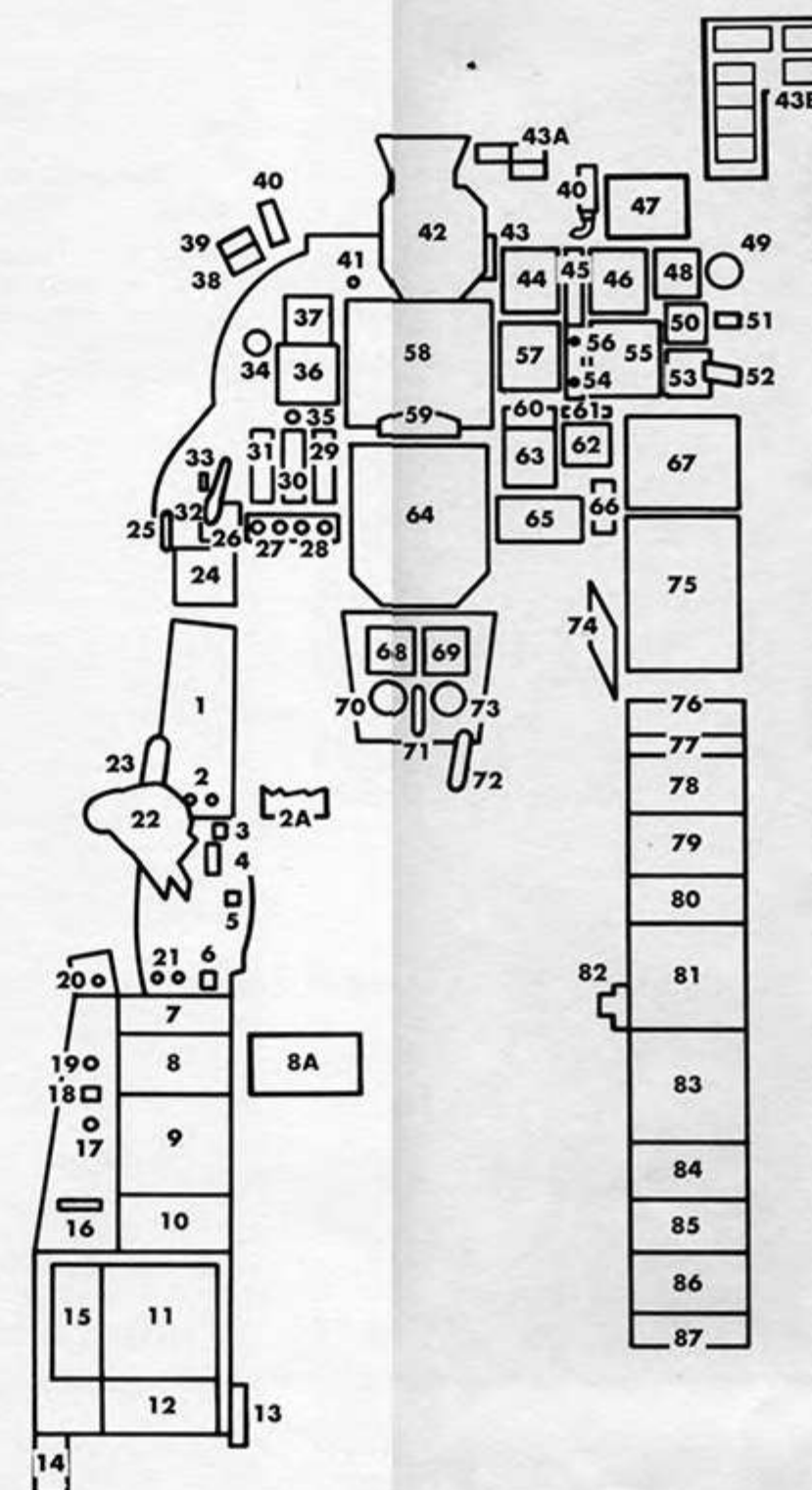
A-ADF1-6

Figure FO-1

FO-3/(FO-4 blank)

COCKPIT (PILOT)**PILOT'S LEFT CONSOLE****PILOT'S INSTRUMENT PANEL**

- 1 AIRCRAFT BUNO 158533 AND 5 SUBSEQUENT AND AIRCRAFT INCORPORATING A.F.C. NO. 268
 2 AIRCRAFT BUNO 158539 AND 5 SUBSEQUENT AND AIRCRAFT INCORPORATING A.F.C. NO. 263
 3 AIRCRAFT INCORPORATING A.F.C. NO. 230

CENTER CONSOLE**PILOT'S LEFT CONSOLE**

1. FUEL MANAGEMENT CONTROL PANEL
2. SPEED DRIVE SWITCH
- 2A. BLEED AIR SWITCHES
3. SPIN RECOVERY SWITCH
4. FLAP LEVER
5. THROTTLE FRICTION LEVER
6. EMERGENCY FLAP SWITCH
7. APC/ANTI-SKID/FLAPERON POP-UP PANEL
8. GENERATOR/ENGINE AND FUEL PANEL
- 8A. GENERATOR/SPEED DRIVE/ENGINE AND FUEL PANEL
9. SIGHT UNIT CONTROL PANEL
10. PILOT'S ICS PANEL
11. MASTER LIGHT CONTROL PANEL
12. G-VALVE TEST BUTTON
13. RAM AIR TURBINE HANDLE
14. BACK-UP HYDRAULIC SYSTEM TEST SWITCH
15. AUXILIARY UHF RECEIVER PANEL ARP 45 ARP 50
16. VENT SUIT-SEAT CUSHION CONTROL
17. OXYGEN SWITCH
18. RUDDER TRIM SWITCH
19. ARRESTING HOOK POSITION WARNING BY-PASS SWITCH
20. SPEED BRAKE TEST SWITCH
21. CRANK SWITCHES
22. THROTTLES
23. CATAPULT GRIP

PILOT'S INSTRUMENT PANEL

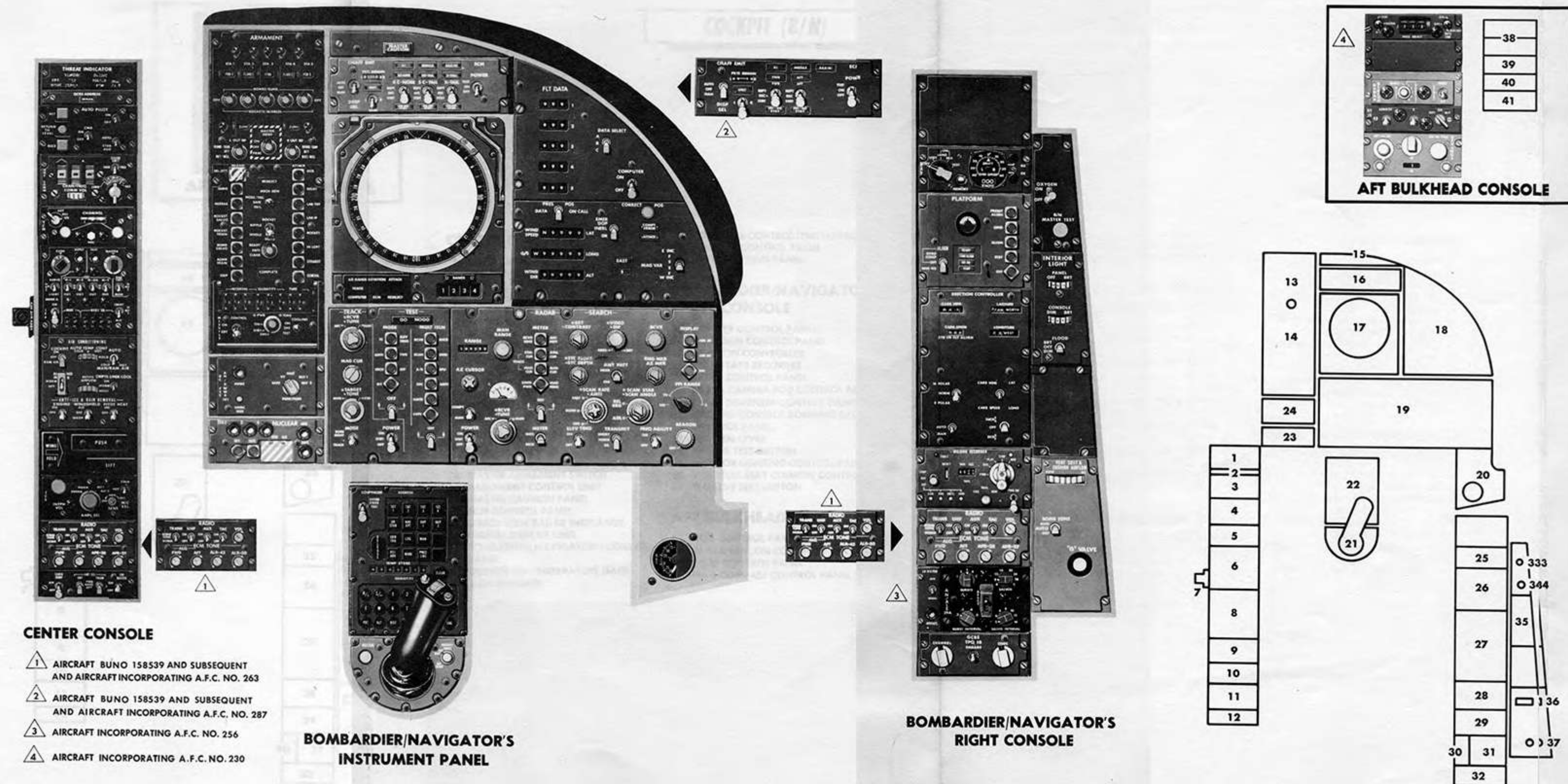
24. INTEGRATED POSITION INDICATOR
25. BRAKE SELECTOR HANDLE
26. HYDRAULIC PRESSURE INDICATORS
27. POWER TRIM INDICATORS
28. OIL PRESSURE INDICATORS
29. FUEL FLOW INDICATOR
30. EXHAUST GAS TEMPERATURE INDICATOR
31. ENGINE RPM INDICATOR
32. LANDING GEAR HANDLE
33. LANDING GEAR OVERRIDE HANDLE
34. EMERGENCY STORES JETTISON BUTTON
35. LOW ALTITUDE WARNING LAMP
36. RADAR ALTIMETER
37. ANGLE OF ATTACK INDICATOR
38. APC'S STANDBY LIGHT
39. WHEELS WARNING LIGHT
40. APPROACH INDEXER
41. MASTER CAUTION RESET BUTTON

42. OPTICAL SIGHT
43. DECM CONTROL PANEL
- 43A. NWW TEMP LIGHT
- 43B. WARNING LIGHT PANEL/THREAT STATUS
44. MACH/AIR SPEED INDICATOR
45. 'G' METER
46. VERTICAL GYRO INDICATOR
47. ACLS INDICATOR
48. CLOCK
49. OXYGEN QUANTITY GAGE
50. RATE OF CLIMB INDICATOR
51. CANOPY SWITCH
52. CANOPY EMERGENCY JETTISON HANDLE
53. MD-1 TURN AND SLIP INDICATOR
54. HOOK LIFT BUTTON
55. HORIZONTAL SITUATION INDICATOR
56. GYRO FAST ERECT BUTTON
57. SERVOED BAROMETRIC ALTIMETER
58. VERTICAL DISPLAY INDICATOR
59. SLIP/SKID INDICATOR
60. UHF CHANNEL/FREQUENCY
61. HOOK RELEASE HANDLE
62. B-6 ACCELEROMETER
63. FUEL QUANTITY GAGE
64. PILOT'S HORIZONTAL DISPLAY
65. ANNUNCIATOR PANEL
66. MASTER TEST PANEL
67. ECM WARNING CONTROL PANEL
68. AUXILIARY BRAKE CYCLE GAGE
69. CABIN PRESSURE ALTITUDE GAGE
70. STABILIZER TRIM GAGE
71. RUDDER PEDAL ADJUST CONTROL
72. MANUAL CANOPY HANDLE
73. RUDDER TRIM GAGE
74. FOOT HEAT CONTROL
75. PILOT'S CONTROL PANEL

CENTER CONSOLE

76. THREAT INDICATOR
77. GCBs ADDRESS PANEL
78. AUTOPILOT CONTROL PANEL
79. UHF COMMUNICATIONS PANEL
80. TACAN PANEL
81. TRANSPONDER-IFF/APX CONTROL
82. AUX. HYD. PUMP BUTTON
83. AIR CONDITIONING CONTROL PANEL
84. WING FOLD CONTROL PANEL
85. B/N's ICS CONTROL PANEL
86. PILOT'S RADIO CONTROL PANEL
87. ANT SEL/CABIN DUMP/CNI MASTER CONTROL PANEL

Figure FO-2

COCKPIT (B/N)**CENTER CONSOLE**

1. THREAT INDICATOR
2. GCBS ADDRESS PANEL
3. AUTOPILOT CONTROL PANEL
4. UHF COMMUNICATIONS PANEL
5. TACAN PANEL
6. TRANSPONDER-IFF/APX CONTROL
7. AUX. HYD. PUMP BUTTON
8. AIR CONDITIONING CONTROL PANEL
9. WING FOLD CONTROL PANEL
10. B/N's ICS CONTROL PANEL
11. PILOT'S RADIO CONTROL PANEL
12. ANT SEL/CABIN DUMP/CNI MASTER CONTROL PANEL

BOMBARDIER/NAVIGATOR'S INSTRUMENT PANEL

13. MASTER ARMAMENT SWITCH
14. ARMAMENT CONTROL UNIT
15. MASTER CAUTION PANEL
16. ECM CONTROL PANEL
17. DIRECT VIEW RADAR INDICATOR
18. DIGITAL DISPLAY UNIT
19. BOMBARDIER NAVIGATOR'S CONTROL PANEL
20. OUTSIDE AIR TEMPERATURE GAGE
21. SLEW CONTROL

22. COMPUTER CONTROL UNIT (KEYBOARD)
23. NUCLEAR CONTROL PANEL
24. AWW-4 FUZING PANEL

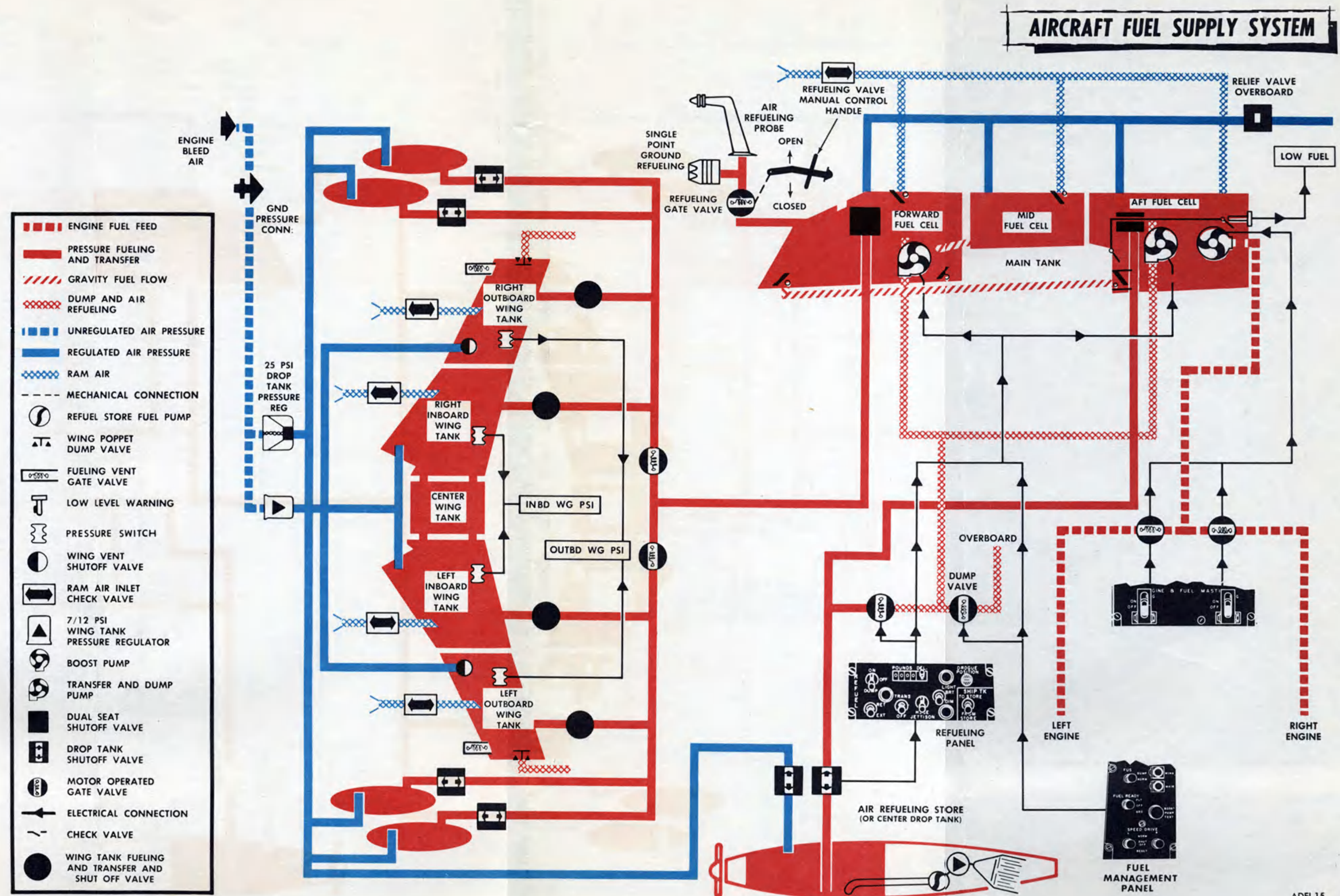
BOMBARDIER/NAVIGATOR'S RIGHT CONSOLE

25. DOPPLER CONTROL PANEL
26. PLATFORM CONTROL PANEL
27. ERECTION CONTROLLER
28. VIDEO TAPE RECORDER
29. RADIO CONTROL PANEL
30. LB-31A CAMERA POD CONTROL PANEL
31. CHAFF DISPENSER CONTROL PANEL
32. GROUND CONTROL BOMBING SYSTEM CONTROL PANEL
33. OXYGEN LEVER
34. MASTER TEST BUTTON
35. INTERIOR LIGHTING CONTROL PANEL
36. VENT SUIT-SEAT CUSHION CONTROL
37. G-VALVE TEST BUTTON

AFT BULKHEAD CONSOLE

38. ACLS CONTROL PANEL
39. RADAR BEACON CONTROL PANEL
40. KY-28 CONTROL PANEL
41. MA-1 COMPASS CONTROL PANEL

Figure FO-3



ADFI-15

Figure FO-4

ELECTRICAL POWER SUPPLY SYSTEM

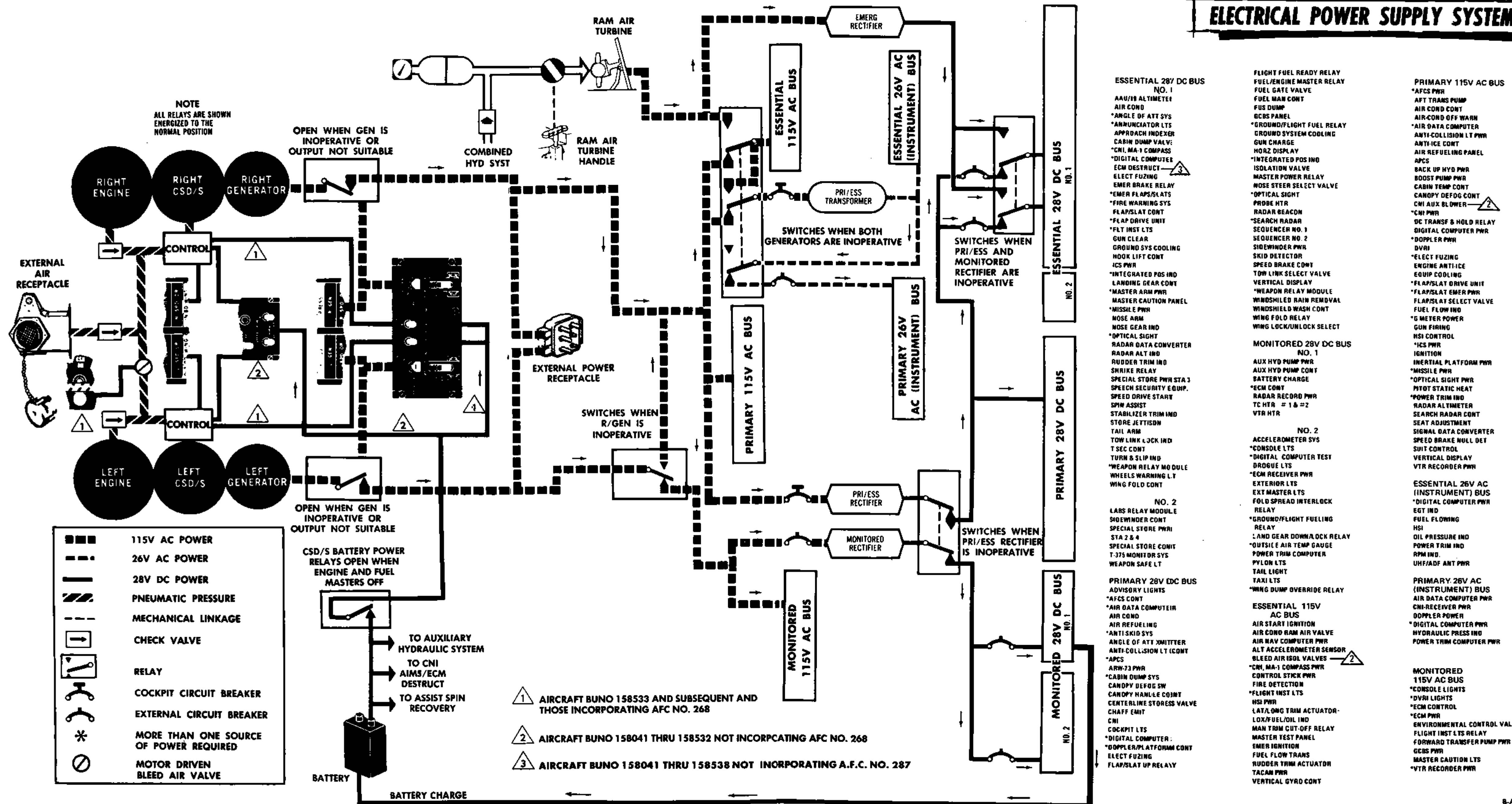
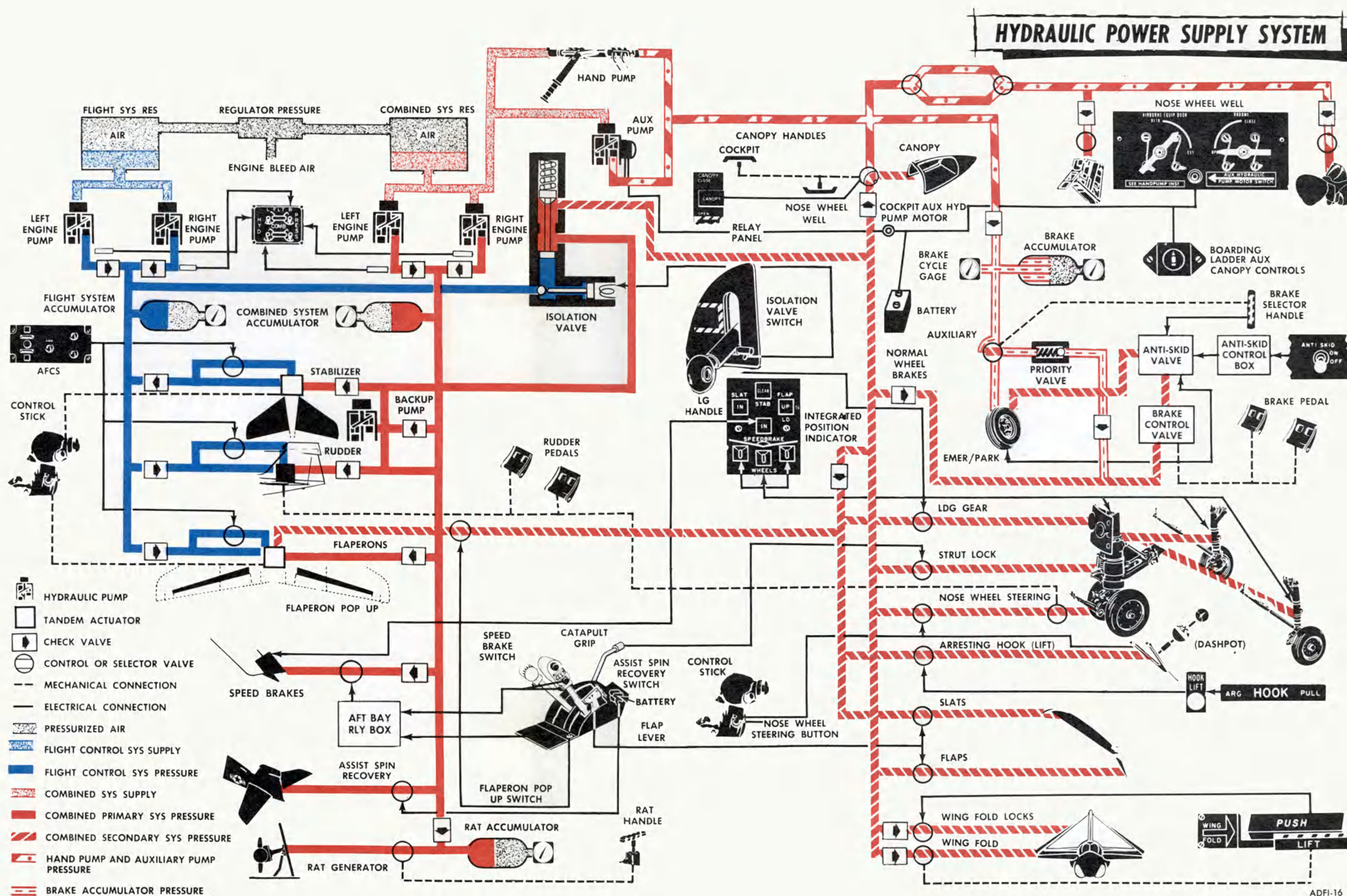


Figure FO-5

FO- 11/(FO- 12 blank)



ADFI-16

Figure FO-6

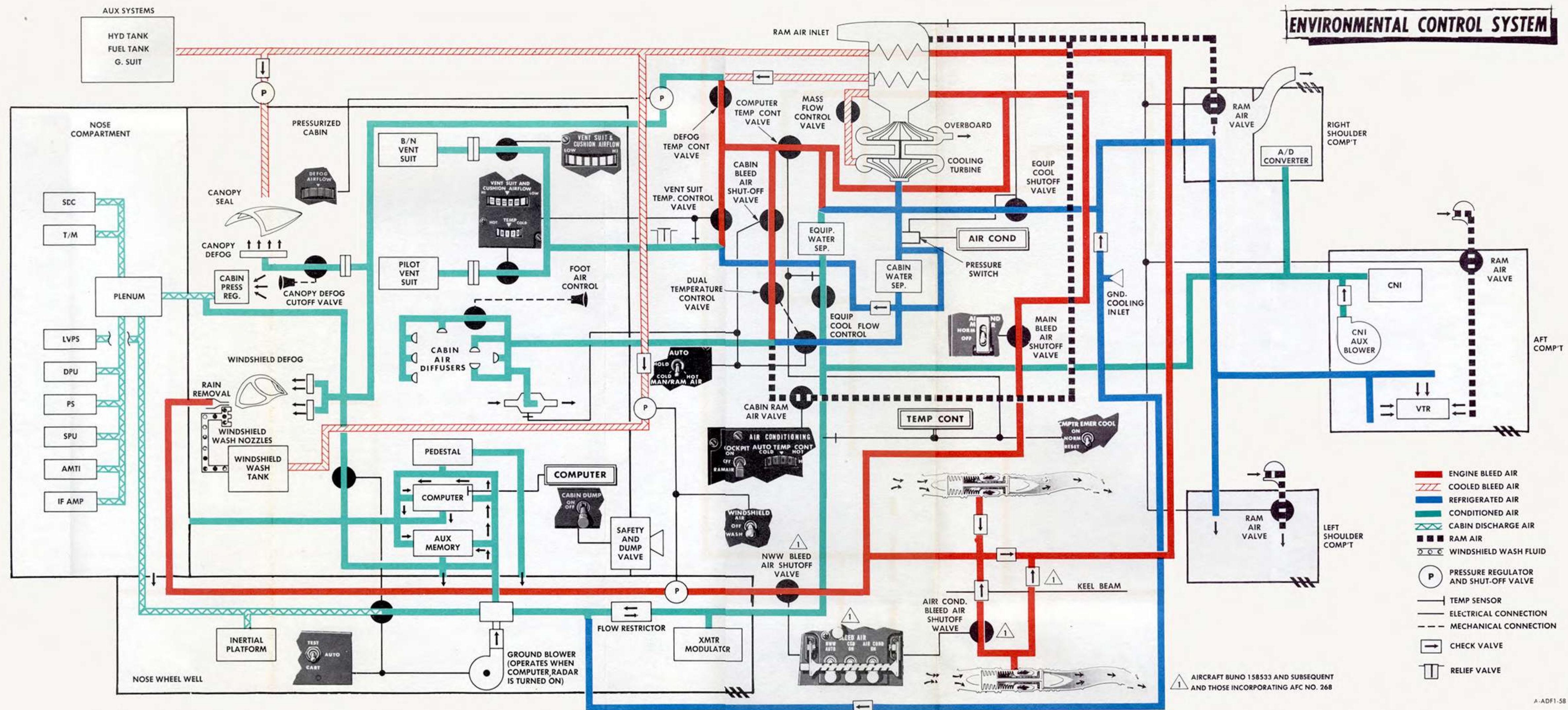


Figure FO-7

ATTACK/NAVIGATION SYSTEM

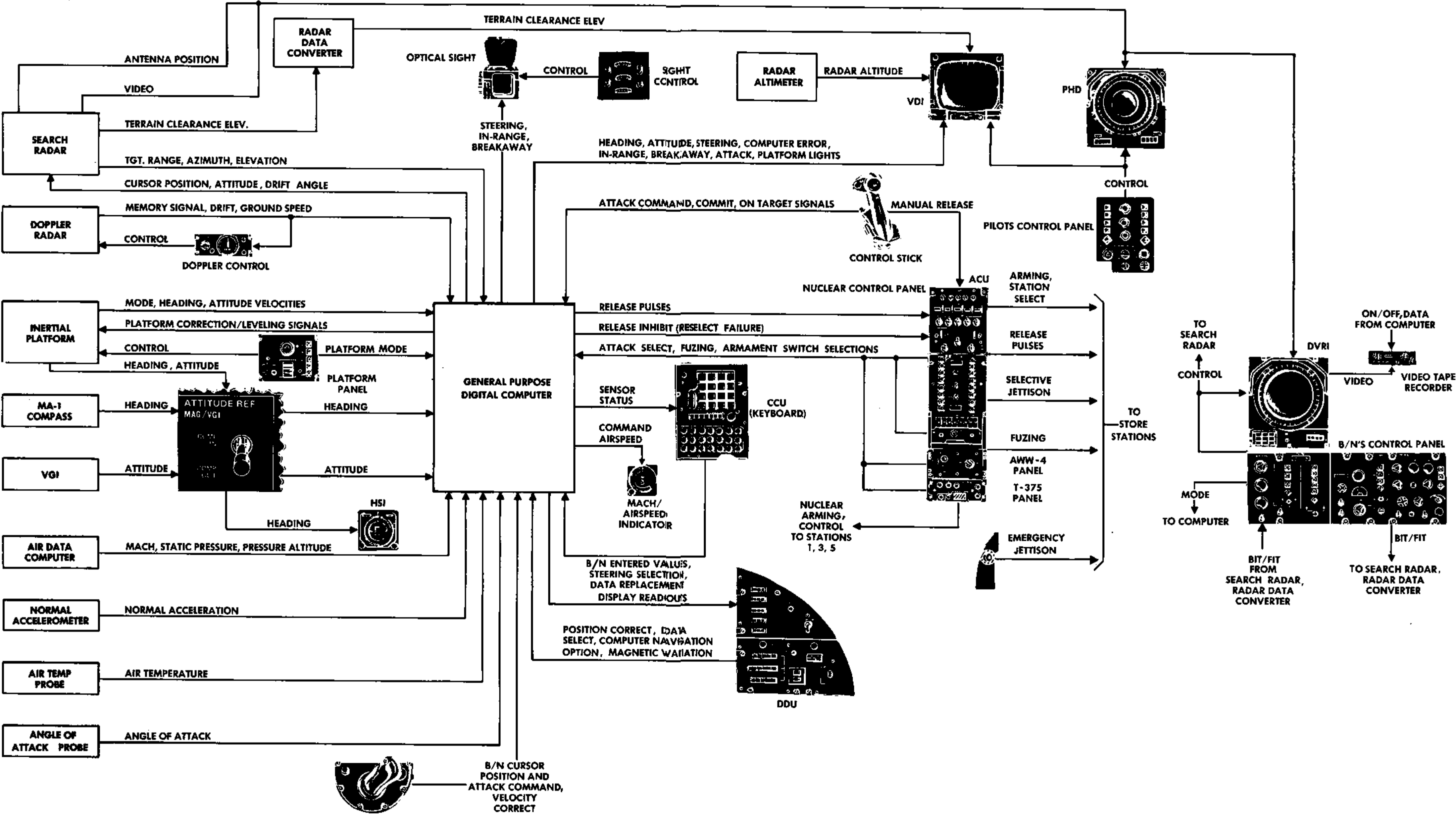
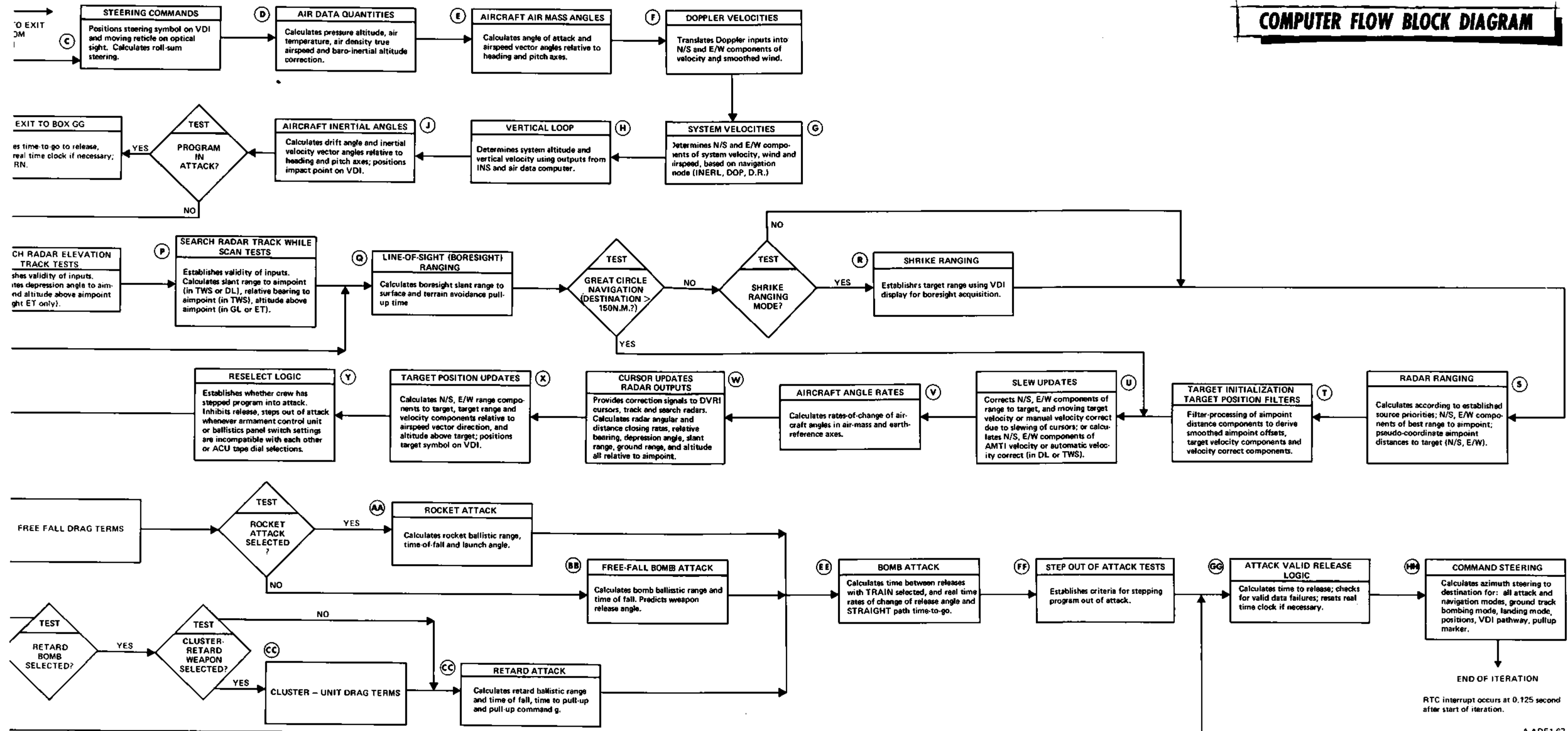


Figure FO-8

COMPUTER FLOW BLOCK DIAGRAM



A-ADF1-67

Figure FO-9

DRAG COUNT TABLE

Store	Loading	Sta 3	Sta 2 & 4	Sta 1 & 5	Store	Loading	Sta 3	Sta 2 & 4	Sta 1 & 5	Store	Loading	Sta 3	Sta 2 & 4	Sta 1 & 5	Store	Loading	Sta 3	Sta 2 & 4	Sta 1 & 5	Store	Loading	Sta 3	Sta 2 & 4	Sta 1 & 5	Store	Loading	Sta 3	Sta 2 & 4	Sta 1 & 5										
MK-81 G.P. BOMB	AERO 7A OR B	3	6	6	MK-82 SNAKEYE MK-36 DESTRUCTOR	AERO 7A OR B	6	12	12	CBU-24 -29 -49	AERO 7A OR B	9	18	18	MK-84 LASER GUIDED BOMB (NON-EXTENDED)	AERO 7A OR B	20	40	40	AGM-45A SHARKHKE MISSILE	AERO 5A-1 LAUNCHER		24	24	AERO 7D LAU-3A/A LAU-61/A LAU-69/A ROCKET POD	AERO 7A		20/88	20/88	ASID-III SEISMIC SENSOR	MER	26	52	52	MK-24 OR MK-45 PARAFIRE	MER	26	52	52
	TER	14	28	28		TER	28	56	56		TER	37		74		TER		52			TER		84/336			TER	19	38	38		PMBR	26	52	52					
	TER		24			TER		40			TER		52			DUAL LAUNCH ADAPTER WITH AERO 5A-1		66	66		MER		50/226			MER			90/342										
	MER	23		46		MER	43		86		MER or	38	76	76							MER					90/342													
	MER		42			MER		78													MER		66/226																
	MER		34			MER		64																															
MK-81 SNAKEYE	AERO 7A OR B	4	8	8	MK-83 G.P. BOMB	AERO 7A OR B	6	12	12	MK-77 MOD 2 & 4 FIREBOMB NOSE FAIRING ON/OFF	AERO 7A OR B	17/27	34/54	34/54	SIDEWINDER-1A AIM-9B	LAU 7A LAUNCHER		10	10	SIDEWINDER-1C AIM-9D	LAU 7A LAUNCHER		10	10	MK-4 GUN POD	AERO 7A		20	20	D-704 REFUELING STORE MK-28	AERO 7B	12			MK-43	AERO 7A OR B	10	20	
	TER	20	40	40		TER	27		54		TER	22/32	44/64	44/64		LAU 7A LAUNCHER		10	10		LAU 7A LAUNCHER		10	10		AERO 7A		22	22		AERO 7A OR B	7	14						
	TER		32			TER		40			MER	30/43	60/86	60/86												AERO 7A		8				AERO 7A OR B	4	8					
	MER	32		64		MER All Loadings	29	58	58		AERO 7A OR B	8	16	16		AGM-78A STANDARD ARM MISSILE	LAU 77A/A LAUNCHER		30		30	AERO 7A		17		34	34	AERO 7A						AERO 7A OR B		106	212	212	
	MER		58			AERO 7A OR B					MK-20 MOD 2 ROCKEYE II	AERO 7A OR B	8	16		16	AERO 7A		8/36		8/36	AERO 7A					30					AERO 7A OR B	73	146		146			
	MER		46			TER	30		60			TER	35			70	TER		40/144		TER		30/98			TER		100					AERO 7A OR B	42		84	84		
MK-82 G.P. BOMB	AERO 7A OR B	4	8	8	MK-40 DESTRUCTOR	AERO 7A OR B	30		60	MK-20 MOD 2 ROCKEYE II		TER		50		AEREO 6A LAU-32A/A LAU-32B/A LAU-58/A LAU-68/A ROCKET POD	AERO 7A				8/36	8/36	ASIO-1 SEISMIC SENSOR	AERO 7A				30				AERO 7A OR B	74	148	148				
	TER	19	38	38		TER		40				MER	55		110		TER		36/104	MER		36/104			MER		78				AERO 7A OR B	41	82	82					
	TER		30			MER All Loadings	29	58	58		TER		98		TER			36/104	MER		36/104			MER		78				AERO 7A OR B	115	230	230						
	MER	31		62		AERO 7A OR B	9	18	18		MK-82 LASER GUIDED BOMB (NON-EXTENDED)	AERO 7A OR B	9	18	18		TER		16/68	16/68	TER			27	54	TER		46			AERO 7A OR B	106	212	212					
	MER		58			AERO 7A OR B	7	14	14			TER	31		62		TER		50/176		TER					TER					AERO 7A OR B	106	212	212					
	MER		48			TER		44				TER					MER			76/268	MER																		
MER				MER or	35	70	70	MER					MER		56/184		MER																						
MK-82 G.P. BOMB	AERO 7A OR B	4	8	8	MK-84 G.P. BOMB	AERO 7A OR B	9	18	18	MK-82 LASER GUIDED BOMB (LOW SPEED FIN)	AERO 7A	18	18	18	LAU-10/A LAU-10A/A ROCKET POD	AERO 7A		16/68	16/68	NOSE FAIRING ON/OFF	AERO 7A		16/68	16/68	300 GAL. FUEL TANK	AERO 7A OR B	10	20	20	MK-58 MARINE MARKER	MER	32	64	64					
	TER	19	38	38		TER					TER					TER		70/262	TER					TER															
	TER		30			TER	31		62		TER					TER		50/176			TER					TER		46											
	MER	31		62		TER		44			TER					MER			76/268		MER																		
	MER		58			TER					TER					MER			76/268		MER																		
	MER		48			TER or	35	70	70		TER					MER		56/184			MER																		

DATE: 1 SEPTEMBER 1969
DATA BASIS: ESTIMATED

NOTE

THE LOADINGS LISTED IN THIS TABLE ARE NOT TO BE TAKEN AS AUTHORITY FOR AIRCRAFT LOADING. FOR AIRCRAFT STORES LIMITATIONS REFER TO NAVAIR 01-85ADA-17

DATE: 1 SEPTEMBER 1969
DATA BASIS: ESTIMATED

NOTE

THE LOADINGS LISTED IN THIS TABLE
ARE NOT TO BE TAKEN AS AUTHORITY
FOR AIRCRAFT LOADING. FOR AIR-
CRAFT STORES LIMITATIONS
REFER TO NAVAIR 01-85ADA-17

