NAVAIR 01-60ABC-1

NATOPS FLIGHT MANUAL

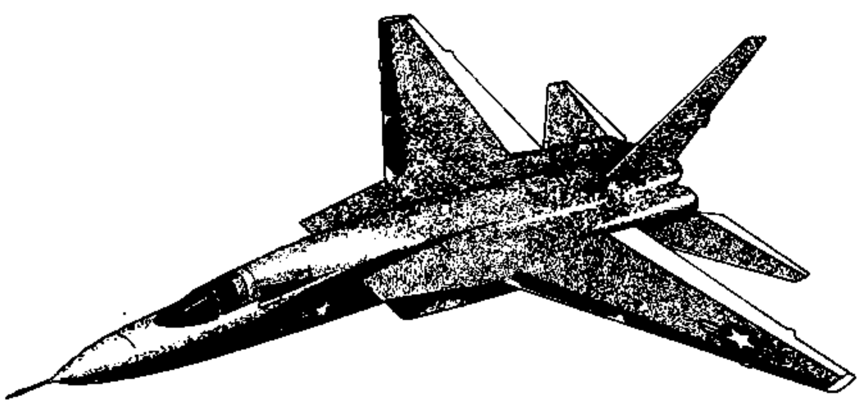
NAVY MODEL

RA-5C

AIRCRAFT

North American Rockwell Corporation

THIS MANUAL SUPERSEDES NAVAIR 01-60ABC-1 DATED 15 JUNE 1970, CHANGED 1 APRIL 1976



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

1 June 1977

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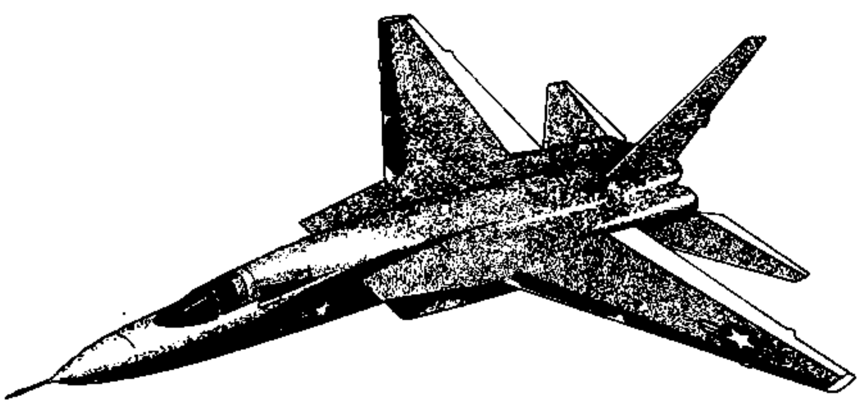


ISSUED BY AUTHORITY OF THE CHIEF OF NAVAL OPERATIONS AND UNDER THE DIRECTION OF THE COMMANDER, NAVAL AIR SYSTEMS COMMAND

1 June 1977

LIST OF EFFECTIVE PAGES

Total number of pages in this manual is 711, consisting of the following:

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

1 June 1977

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.

F.C. Turner

F.C. TURNER
Vice Admiral, USN
Deputy Chief of Naval Operations
(Air Warfare)

INTERIM CHANGE SUMMARY

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

INTERIM CHANGE NUMBER(S)	REMARKS/PURPOSE
1 through 29	Previously incorporated

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

INTERIM CHANGE NUMBER	REMARKS/PURPOSE
30	Generator reset

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

Table of Contents

*Also refer to the Supplemental NATOPS Flight Manual (NAVAIR 01-60ABC-1A)

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 01-60ABC-1A (Supplement)

NAVAIR 01-60ABC-1B (Checklist)

NAVAIR 01-60ABC-1T(A) (Tactical Manual)

HOW TO GET COPIES

Each flight crewmember is entitled to personal copies of the NATOPS Flight Manual and appropriate applicable publications.

Automatic Distribution

To receive future changes and revisions to this manual or any other NAVAIR aeronautical publication automatically, a unit must be established on an automatic distribution list maintained by the Naval Air Technical Services Facility (NATSF). To become established on the list or to change existing NAVAIR publication requirements, a unit must submit NAVAIR Form 5605/3, Parts I through IV to NATSF, 700 Robbins Ave., Philadelphia, Pa. 19111, listing this manual and all other NAVAIR publications required. For additional instructions refer to NAVAIRINST 5605.4 series and Introduction to Navy Stocklist of Publications and Forms NAVSUP Publication 2002 (S/N 0535-LP-004-0001).

Additional Copies

Additional copies of this manual and changes thereto may be procured by submitting DD Form 1348 to NAVPUBFORMCEN Philadelphia in accordance with Introduction to Navy Stocklist of Publications and Forms NAVSUP Publication 2002.

UPDATING THE MANUAL

To ensure that the manual contains the latest procedures and information, NATOPS review conferences are held in accordance with OPNAVINST 3510.9 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 Manger on OPNAV Form 3500-22 shown on the next page. The address of the Model Manager of this aircraft is:

Commanding Officer, RVAH-3
NAS Albany, Georgia 31701

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.

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

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.

CHANGE SYMBOLS

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 either new infomation, 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 may result in damage to equipment if not carefully observed or followed.

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.

SECTION I — THE AIRCRAFT

TABLE OF CONTENTS

PART 1 — GENERAL DESCRIPTION

THE AIRCRAFT

The RA-5C is a two-place, two-engine reconnaissance aircraft designed for carrier-based or land-based operation. The aircraft is capable of all-weather, high- or low-altitude tactical reconnaissance. Basic appearance includes a long, slightly humpbacked fuselage, a sharply swept, shoulder-mounted wing, large, swept empennage surfaces, and side-mounted, rectangular air intakes. The vertical stabilizer, wings, and radome may be folded for aircraft storage. The wing center sections contain a spoiler-deflector lateral control system and slotted full-span wing flaps extending from the fuselage to the fold line. The wings also incorporate complete-span droopable leading edges with a boundary layer airflow control system. The aircraft has four underwing external store stations. The operating weight (zero fuel) of aircraft 145157 through 151728 without reconnaissance pod or external stores is approximately 40,000 pounds. Aircraft 156608 through 156643 have widened inlet ducts and extended wing root fillets. Operating weight (zero fuel) for aircraft 156608 through 156643 with the same configuration is approximately 40,900 pounds. See figure 1-5 for general arrangement information, figure 1-6 for a panoramic view of the pilot's controls and indicators, and figure FO-1 for a panoramic view of the RAN's cockpit.

MISSION

The primary mission of the RA-5C is tactical reconnaissance. The aircraft and its systems comprise one-half of the U.S. Navy Integrated Operational Intelligence

System (IOIS). The airborne systems counterpart is the ship- or ground-based Integrated Operational Intelligence Center (IOIC). This system is designed to provide tactical commanders with the full and up-to-the-minute intelligence picture on any target area. This information is comprised of photographic coverage, radar coverage, and Electronic Order of Battle (EOB) data.

AIRCRAFT DIMENSIONS

Overall static dimensions of the aircraft are as follows:

Wing Span .... 53.04 feet
  wings folded .... 42.00 feet
Length .... 76.55 feet
  vertical stabilizer and radome folded .... 65.57 feet
Height
  vertical stabilizer folded .... 15.50 feet

AIRCRAFT LOADING

See figures 1-1 through 1-3 for a simplified method of calculating aircraft gross weight and center-of-gravity location. Procedures consist of adding the weights of all items carried to the average basic weight and algebraically adding load item incremental cg index values to the basic weight index. Final index is then used with take-off gross weight to determine cg location in percent MAC.

AIRCRAFT	AVERAGE BASIC WEIGHT (POUNDS)	ARM	BASIC INDEX
145157 through 151728	38,500	511.50	69.5
156608 through 156643*	39,400	514.50	75.59

Note

All figures are typical averages from Chart C of the Weight and Balance Data Manual (NAVAIR 01-1B-40) for delivered aircraft and includes:

- Trapped fuel.
- Trapped and operating engine oil.
- Full oxygen service and emergency controllers.
- Seat kits, including parakits, pans, and parachutes.

CAUTION

The center-of-gravity location method should be used only as a check for small changes in configuration. For each new configuration (not previously calculated, and for which a Form F is not on file), the Weight and Balance Data Manual (NAVAIR 01-1B-40) *must* be used.

*Also aircraft having AFC 328 complied with.

Note

Weights and incremental cg index values are given for *single units*. If two are carried (e.g., pylons and drop tanks), double (or quadruple) given weight and index values.

COMPUTING GROSS WEIGHT AND CG

1. Add weights of all load items for the desired configuration to the average basic weight provided. Total is take-off gross weight.
2. Note basic weight cg index number (69.5). Add (algebraically, using the given sign convention), the incremental index numbers for all load items in the desired configuration to this value. Final sum is take-off gross weight cg index.
3. Enter the applicable cg locator (figure 1-1 or 1-2) with take-off gross weight and final cg index. Project gross weight horizontally and index number vertically. The meeting point may be read in cg, percent MAC. Be certain this point falls within a useful area on the chart.
4. Even though the take-off cg may be within prescribed limits, a comparison with a similar loading presented in the Weight and Balance Data Manual (NAVAIR 01-1B-40) should be made to assure that the cg will not exceed specified limits during flight.
5. The most simplified method of computing CG can be accomplished by having the squadron weight and balance office prepare aircraft basic weights and reconnaissance CG indexes (excluding fuel) for various configurations (3 cans, 2 cans, no cans). The flight crew can then apply their fuel load/CG index to the applicable basic weight and reconnaissance CG index to obtain take-off weight/CG index.

Note

- A detailed discussion on the gross weight index method is presented in Section VII of Basic Technical Order, Weight and Balance (T.O. 1-1B-50).
- If a specific aircraft weight from Chart C of the Weight and Balance Data Manual (NAVAIR 01-1B-40) is used in lieu of the average shown, the following formula should be used to arrive at basic cg index:

$$\text{Index} = 63 + \frac{\text{Basic Weight} \times (508.11 - \text{Basic Arm})}{20{,}000}$$

- For items not listed, the following formula should be used to arrive at incremental cg index number:

$$\text{Increment} = (\pm)\left(\frac{\text{Item Weight} \times [508.11 - \text{Item Arm}]}{20{,}000}\right)$$

- *Arms* are locations in terms of fuselage station reference, and are shown in Charts A and E of the Weight and Balance Data Manual (NAVAIR 01-1B-40).

EXAMPLE:

Find take-off gross weight and cg location for the high- or low-altitude general reconnaissance configuration.

ITEM	WEIGHT (POUNDS)	INCREMENTAL CG INDEX
Average Basic Weight	38,500	69.5
Pilot	200	−3.6
RAN	200	−2.9
Mid Can (bomb bay)	175	+1.1
Aft Can (bomb bay)	175	+2.0
Carriage (2 cans, no store)	70	+0.5
Tail Cone	117	+1.7
Recon		
(miscellaneous installations)	446	−3.5
Sensor Station 1	113	−0.9
Sensor Station 3	143	−1.0
Sensor Station 3	180	−1.0
Sensor Station 3A	10	+0.1
Sensor Station 4		
Module 2 (18- and 3-inch pans)	1,418 (1,445*)	−3.9
Sensor Station 5		
Basic Recon and PECM	545	−1.4
Sensor Station 6	1,115	+1.1
Sensor Station 8		
Basic Recon and PECM	937	+3.3
Fuel (JP-5)		
Forward Tank	3,094	−27.1
Sump Tank	3,332	−20.3
Wing Tank	11,152	−5.2
Aft Tank	884	+5.8
Mid Can (bomb bay)	2,006	+12.6
Aft Can (bomb bay)	2,006	+22.6
Take-off Gross Weight	66,818 (66,844*)	
Take-off CG Index		49.5

Enter figure 1-1 or 1-2 to determine cg in percent MAC.
Take-off cg location = 28.8 percent MAC.

*Aircraft with camera module having PHC 33 complied with

AIRCRAFT CHANGE LIST AND SERIAL NUMBER SUMMARY

The aircraft change list contains those changes applicable to RA-5C aircraft, and includes only those changes which are incorporated in this manual. Each change is listed in figure 1-4 along with the affected aircraft (by Bureau Number), its purpose, and the degree of urgency (category). A complete listing and summary of applicable aircraft changes can be found in the NavSandA Publication 2002, Section VIII, Parts C and D. Abbreviations used to designate various types of aircraft changes are as follows:

ACC	Aircrew Systems Change
ASC	Aircraft Service Change (obsolete)
AFC	Airframe Change
IAFC	Interim Airframe Change
AVC	Avionics Change
AAC	Aircraft Armament Change
EMC	Electronics Material Change
PHC	Photographic Change
PCR	Product Configuration Record

SERIAL NUMBER SUMMARY

SERIAL NUMBERS	MANUFACTURING NUMBERS
149300 — 149317	60 — 77 (YA-5C Converted)
150823 — 150842	1 — 20
151615 — 151634	21 — 40
151726 — 151728	41 — 43
145157 — 149299	C44 — C86 (A-5A Converted)
156608 — 156643	87 — 122

A-5A CONVERSION BREAKDOWN

CONVERSION SEQUENCE	SERIAL NUMBER	CONVERSION SEQUENCE	SERIAL NUMBER	CONVERSION SEQUENCE	SERIAL NUMBER
44	149279	58	147850	72	149297
45	149285	59	149287	73	149295
46	149280	60	148925	74	149298
47	149277	61	149281	75	149299
48	146702	62	149293	76	148926
49	148932	63	148933	77	149296
50	149283	64	147858	78	148928
51	149284	65	149288	79	147852
52	149276	66	145157	80	147857
53	149289	67	146695	81	147861
54	149278	68	146696	82	147860
55	149286	69	146698	83	147859
56	149294	70	146701	84	147854
57	149291	71	148929	85	147853
				86	147856

AIRCRAFT 145157 THROUGH 151728 NOT HAVING AFC 328 COMPLIED WITH

CG LOCATOR

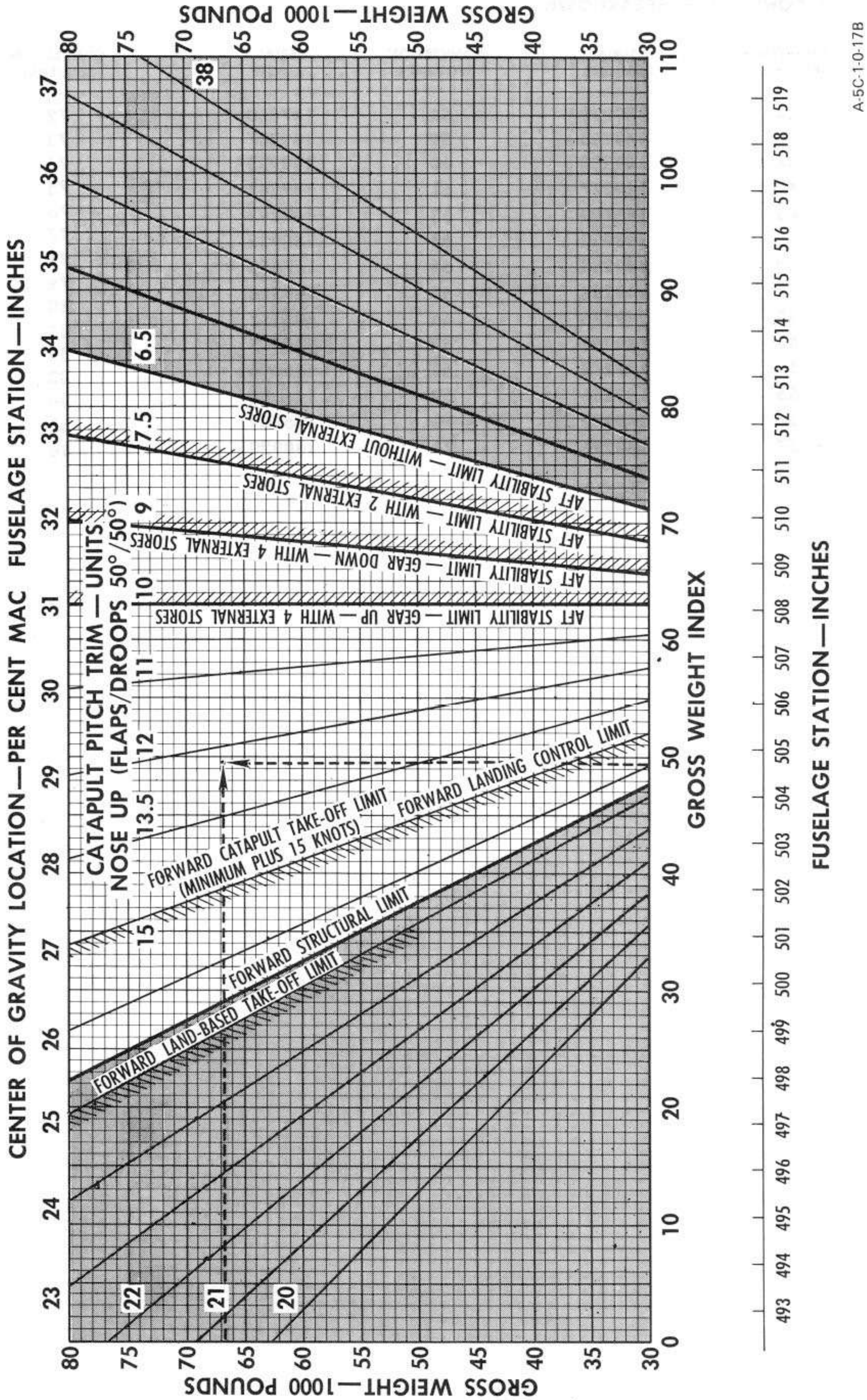


Figure 1-1

CG LOCATOR

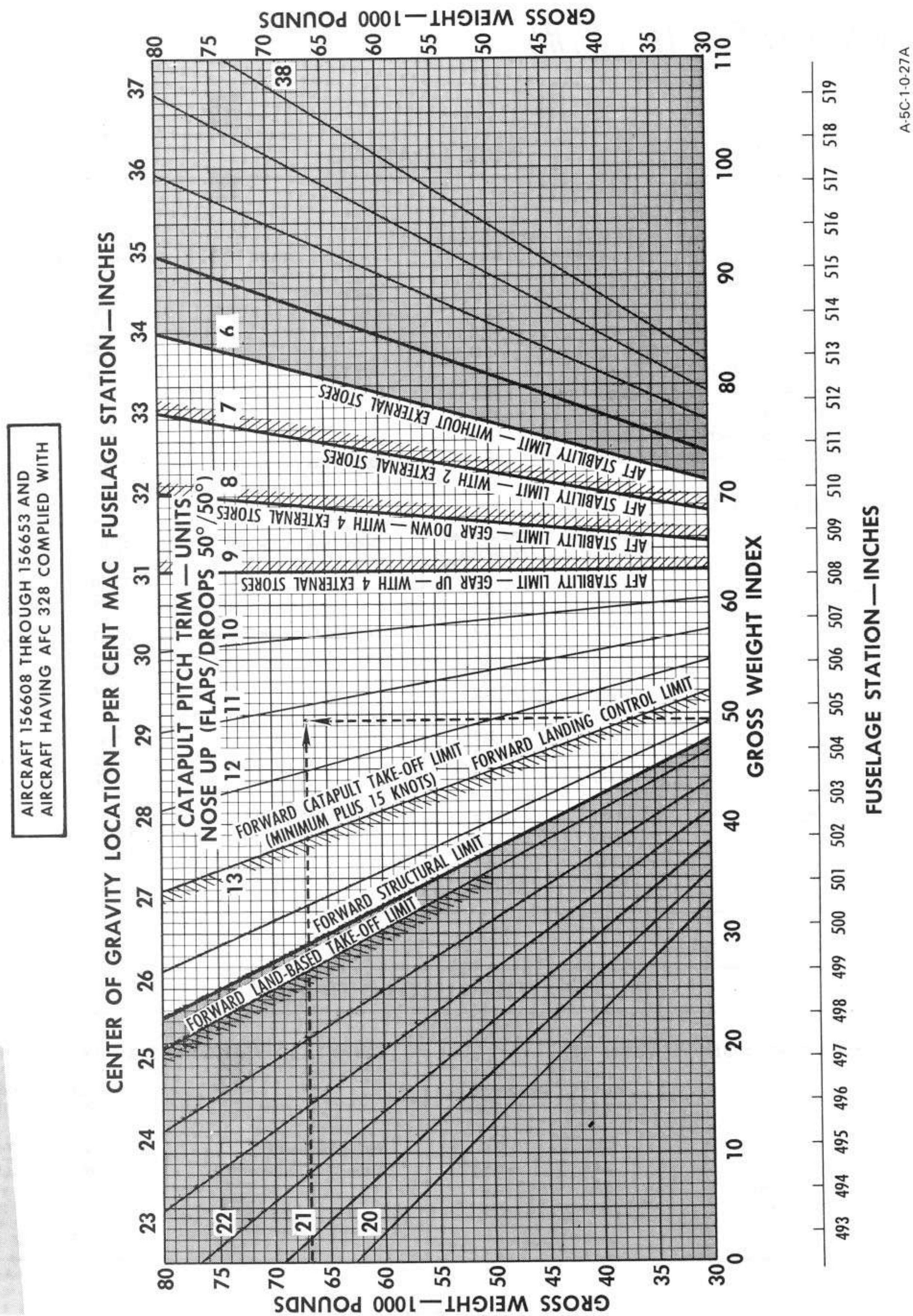


Figure 1-2

AIRCRAFT LOAD ITEMS

FUEL LOADING

FULL TANKS

TANK	WEIGHT (POUNDS–JP-5)	INCREMENTAL CG INDEX
Forward	3,094	–27.1
Sump	3,332	–20.3
Aft	884	+5.8
Wing	11,152	– 5.2
Forward Can (bomb bay)	2,006	+2.8
Mid Can (bomb bay)	2,006	+12.6
Aft Can (bomb bay)	2,006	+22.6
Inboard Drop Tank (each)	2,720	– 5.7
Outboard Drop Tank (each)	2,720	+0.7

PARTIAL FUEL LOAD DATA

ITEM	WEIGHT (POUNDS - JP-5)	INCREMENTAL CG INDEX
Wing Fuel	10,000	– 2.2
	9,000	– 0.0
	8,000	+ 1.7
	7,000	+ 3.0
	6,000	+ 3.8
	5,000	+ 4.2
	4,000	+ 4.2
	3,000	+ 3.9
	2,000	+ 3.0
	1,000	+ 1.7
Forward Tank	3,000	–26.3
	2,000	–17.5
	1,000	– 8.8
	500	– 4.4

TANK	WEIGHT (POUNDS – JP-5)	INCREMENTAL CG INDEX
Sump Tank	3,000	–18.3
	2,000	–12.2
	1,000	– 6.1
	500	– 3.1
Aft Tank	800	+ 5.2
	600	+ 3.9
	400	+ 2.6
	200	+ 1.3
Drop Tank (inboard)	2,000	– 4.2
	1,500	– 3.2
	1,000	– 2.1
	500	– 1.1
Drop Tank (outboard)	2,000	+ 0.5
	1,500	+ 0.4
	1,000	+ 0.2
	500	+ 0.1
Forward Can (bomb bay)	2,000	+ 2.8
	1,500	+ 2.1
	1,000	+ 1.4
	500	+ 0.7
Mid Can (bomb bay)	2,000	+12.6
	1,500	+ 9.4
	1,000	+ 6.3
	500	+ 3.1
Aft Can (bomb bay)	2,000	+22.5
	1,500	+16.9
	1,000	+11.2
	500	+ 5.6

EXTERNAL LOAD ITEMS

INBOARD STATIONS (STATION 110)

ITEM	WEIGHT (POUNDS)	INCREMENTAL CG INDEX
Pylon (inboard)	480	–0.5
Flasher Pod	347	+0.6
Drop Tank (inboard)	260	–0.4
RCPP 105-1 Pod	2000	–5.3

OUTBOARD STATIONS (STATION 175)

ITEM	WEIGHT (POUNDS)	INCREMENTAL CG INDEX
Pylon (outboard)	440	+0.5
Drop Tank (outboard)	260	+0.2

A-5C 1 0 22 A

Figure 1-3 (Sheet 1)

ITEM	AIRCRAFT 145157 THROUGH 151728		AIRCRAFT 156608 THROUGH 156653 **	
	WEIGHT (POUNDS)	INCREMENTAL CG INDEX	WEIGHT (POUNDS)	INCREMENTAL CG INDEX
INTERNAL LOAD				
PILOT	200	-3.6	200	-3.6
RECONNAISSANCE ATTACK NAVIGATOR (RAN)	200	-2.9	200	-2.9
FORWARD CAN (EMPTY)	175	+0.2	177	+0.2
MID CAN (EMPTY)	175	+1.1	177	+1.1
AFT CAN (EMPTY)	175	+2.0	177	+2.0
CARRIAGE (2 CANS)	70	+0.5	61	+0.5
CARRIAGE (3 CANS)	89	+0.6	72	+0.5
TAIL CONE	117	+1.7	117	+1.7
FUSELAGE PANEL (BOMB BAY)	92	-0.1	92	-0.1
FUSELAGE PANELS (MISCELLANEOUS)	15	-0.1	15	-0.1
RECONNAISSANCE EQUIPMENT				
MISCELLANEOUS FUSELAGE (PECM ANTENNAS), VIEWFINDER HOISTS, ELECTRICAL AND CONDITIONING EQUIPMENT	446	-3.5	455	-3.5
SENSOR STATION NO. 1	113	-0.9	111	-0.9
SENSOR STATION NO. 2	143	-1.0	133	-0.9
SENSOR STATION NO. 3				
BASIC RECON	140	-0.7	140	-0.7
WITH PECM	180	-1.0	180	-1.0
CLOSEOUT	--	--	24	-0.1
SENSOR STATION NO. 3A	10	+0.1	9	+0.1
SENSOR STATION NO. 4				
Module #1 Two Side Obliques	442	-1.3	428	-1.2
Two Obliques, 3-Inch Pan	832	-2.0	815	-1.9
Module #2 18-inch Pan	1092 (1119*)	-3.3	1090 (1117*)	-3.3
18-Inch Pan and 3-Inch Pan	1418 (1445*)	-3.9	1414 (1441*)	-3.9
Module #3 Forward	501	-1.5	497	-1.5
Aft	501	-1.2	497	-1.2
Both	733	-2.0	725	-2.0
SENSOR STATION NO. 5				
BASIC RECON	233	-0.6	242	-0.7
BASIC RECON AND PECM	545	-1.4	554	-1.4
SENSOR STATION NO. 6	1115	+1.1	1042	+1.0
SENSOR STATION NO. 8				
BASIC RECON AND IR	1099	+3.5	1216	+3.5
BASIC RECON, PECM and IR	1244	+3.5	1077	+3.5
SENSOR STATION NO. 9				
FLASHER POD (each)	347	+0.6	347	+0.6
NOTE: Do not Add Flasher Pods if Pods Were Previously Added Under Inboard External Stores				
LANDING GEAR				
Retraction/Extension Effect				
OPERATION				
Down to Up	--	-3.2	--	-3.4
Up to Down	--	+3.2	--	+3.4

*AIRCRAFT WITH CAMERA MODULE HAVING PHC 33 COMPLIED WITH

**ALSO AIRCRAFT HAVING AFC 328 COMPLIED WITH

N6/77

A SC 1 0-23

Figure 1-3 (Sheet 2)

AIRCRAFT CHANGE LIST

AFFECTED SYSTEM AND CHANGE	AIRCRAFT PRODUCTION INCORPORATION	RETROFIT INCORPORATION	CATEGORY
ELECTRONICS Installation of additional electronic warfare capabilities	156608–156653	AFC 216 (Parts 1 and 2)	Urgent
RADAR ALTIMETER, AN/APN-120 Modification to provide automatic Turn-off of high-altitude system	156608–156653	AVC 442	Urgent
ELECTRICAL Installation of pilot's kneeboard lights	156608–156653	AFC 227	Routine
BOMB DIRECTING SET B/N module improvement	156608–156653	AFC 228/ AVC 564	Urgent
AIR CONDITIONING Modification of primary heat exchanger jet pump control circuit	156608–156653	AFC 229	Urgent
AVIONICS Installation of ECM system, AN/ALQ-100	Classified	AFC 246/ AVC 667	Urgent
POWER PLANT Speed modulated afterburner thrust System (SMATS)	156628–156653	AFC 247	Urgent
PECM SYSTEM, AN/ALQ-61 Band 1 and Band 2 ON-OFF cycling	156608–156653	AFC 176/ AVC 424	Urgent
WHEEL BRAKES Anti-skid test modification	156608–156653	AFC 252	Urgent
INSTRUMENTS Compensated pitot-static tube.	156608–156643	AFC 159	Urgent
ARRESTING GEAR Improved hook bumper.	156608–156643	AFC 223	Urgent
CAMERA, 18-INCH PANORAMIC Prism enclosure installation.	156608–156643	PHC 33	Routine
ECM Destruct switch deletion.	156628–156643	AFC 303	Urgent

RA 5C 1 0 25A

Figure 1-4 (Sheet 1)

AFFECTED SYSTEM AND CHANGE	AIRCRAFT PRODUCTION INCORPORATION	RETROFIT INCORPORATION	CATEGORY
PROPULSION SYSTEM Approach power compensator modification.	156608–156643	AFC 304	Routine
INSTRUMENTS Stand-by gyro horizon replacement.	156628–156643	AFC 321	Routine
ARRESTING GEAR Two-position hook installation.	156628–156643	AFC 293	Routine
INSTRUMENTS EGT indicator improvement.	156641–156643	AFC 317	Routine
CAMERAS, 18-INCH PAN Automatic focus and increased Vg/H range	....	AFC 292	Routine
CAMERAS, OBLIQUE Oblique sight installation.	....	AFC 312	Routine
CAMERAS, PAN AND SFC Simplified stabilization, mount caging switch	....	AFC 297/PHC 37	Routine
AVIONICS IFF (AIMS) Reporting system installation	....	AFC 296	Urgent
Automatic Carrier Landing provisions	....	AFC 233	Urgent
Approach Control system (ILS) installation	....	AFC 302	Urgent
DECM Radar receiver and countermeasures receiver system replacements	....	AFC 340	Urgent
Improved countermeasures system	....	AFC 350	Urgent
PROPULSION SYSTEM Modification of airframe and other systems to accommodate either J79-GE-8 or 10 engines	....	AFC 328	Routine
RECONNAISSANCE SYSTEM IR Detector Set modification	....	AFC 313	Routine
PILOT'S COCKPIT Navigation Bag stowage provisions	....	AFC 338	Routine
ENGINES Rerouting of CSD oil return line	....	AFC 351	Routine
ESCAPE SYSTEM Low altitude, low speed recovery capability modification	....	AFC 311	Urgent
ARMAMENT Removal of armament control provisions	....	AFC 349	Routine
ENGINES Engine door operation, single generator	....	AFC 359	Routine
LIGHTING Taxi light, switch in aft cockpit	....	AFC 372	Routine

N6/77

Figure 1-4 (Sheet 2)

RA-5C-1-0-26K

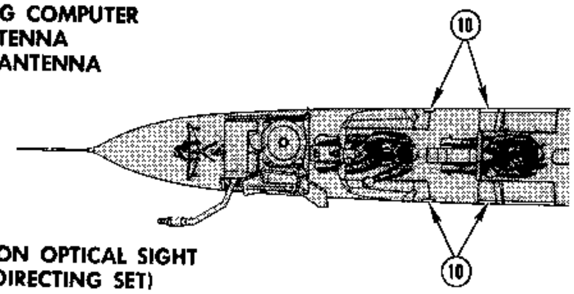
GENERAL ARRANGEMENT

1. PITOT STATIC BOOM
2. AIR REFUELING PROBE (SHOWN EXTENDED)
3. GENERAL PURPOSE RADAR ANTENNA
4. AIR REFUELING PROBE LIGHT
5. INERTIAL AUTONAVIGATOR
6. WINDSCREEN RADIATION SHIELD
7. PROJECTED DISPLAY INDICATOR (DELETED BY AFC 233)
8. OPTICAL VIEWFINDER
9. LIQUID OXYGEN BOTTLES
10. ECM ANTENNAS
11. MAIN ELECTRONICS BAY
12. IFF-SIF ANTENNA
13. FORWARD FUSELAGE FUEL TANK
14. FUSELAGE SUMP FUEL TANK
15. TOP CAP FUEL TANK
16. INTEGRAL WING FUEL TANK
17. ANTI-COLLISION BEACON
18. AFT FUSELAGE (SADDLE) FUEL TANK
19. FUSELAGE FORMATION LIGHT
20. TACAN-COMM DUPLEX ANTENNA
21. TAIL POSITION LIGHT
22. FUEL SYSTEM VENT OUTLET
23. ECM TAIL BOOM ANTENNA ASSEMBLY
24. EXPENDABLE TAIL CONE
25. FUEL DUMP TUBE (SHOWN EXTENDED)
26. ARRESTING HOOK BUMPER
27. CATAPULT HOLD BACK
28. ARRESTING HOOK
29. ENGINE STARTING CONNECTION
30. IR DETECTOR SET FAIRING
31. INFRARED DETECTOR SET
32. AFT REFUELING RECEPTACLE
33. CHAFF DISPENSERS
34. EMERGENCY RAM-AIR TURBINE

34A. EPU (AFC 350)

34B. ECM ANTENNA (AFC 350)

35. CATAPULT HOOKS
36. EXTERNAL ELECTRICAL POWER AND CONDITIONING AIR ACCESS (AIR ON BOTH SIDES)
37. FORWARD REFUELING RECEPTACLE
38. RECONNAISSANCE FAIRING
39. TAXI LIGHT
40. APPROACH LIGHT
41. REMOTE ALIGN CONNECTOR
42. IFF-SIF ANTENNA
43. AUX BRAKE ACCUMULATOR REPEATER GAGE
44. ECM ANTENNA
45. RADAR ALTIMETER
46. UHF COMM ANTENNA
47. BOMBING COMPUTER
48. ADF ANTENNA
49. TACAN ANTENNA



50. TELEVISION OPTICAL SIGHT (BOMB DIRECTING SET)

50A. AN/APN-202 ANTENNA (AFC 233)

50B. AN/ARA-63 ANTENNA (AFC 302)

51. LEADING EDGE BLC DUCT
52. WING TIP POSITION LIGHT
53. WING TIP FORMATION LIGHT
54. 400-GALLON DROP TANKS
55. 295-GALLON FUEL CANS
56. EXPENDABLE BOMB BAY FUEL CANS

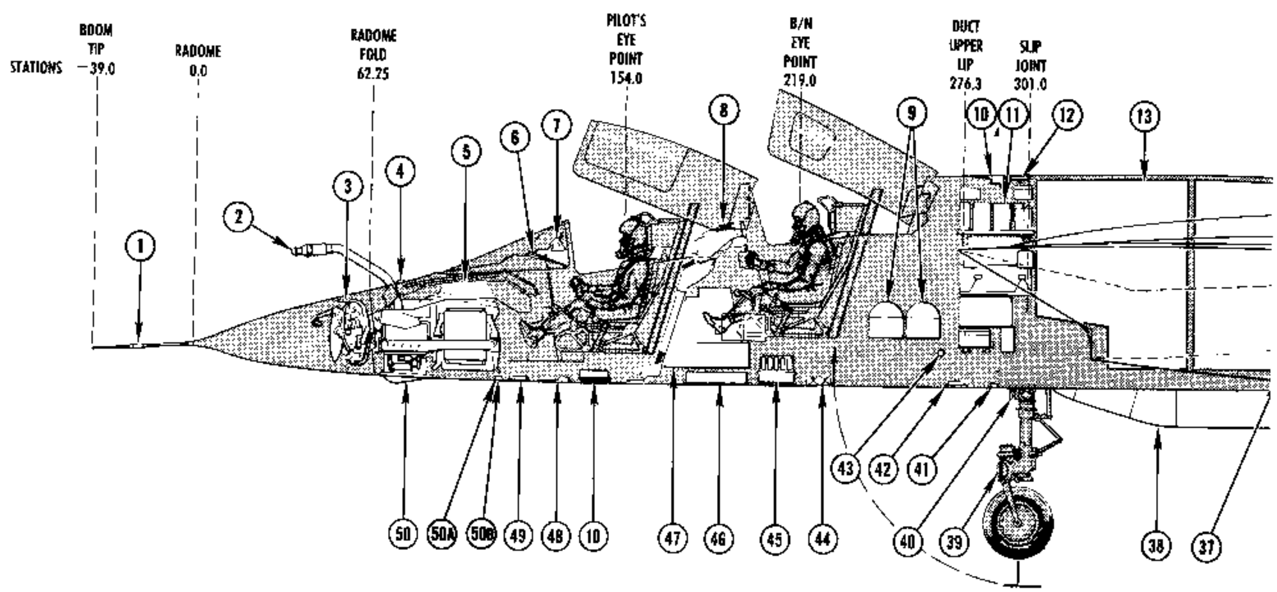


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Figure 1-5 (Sheet 1)

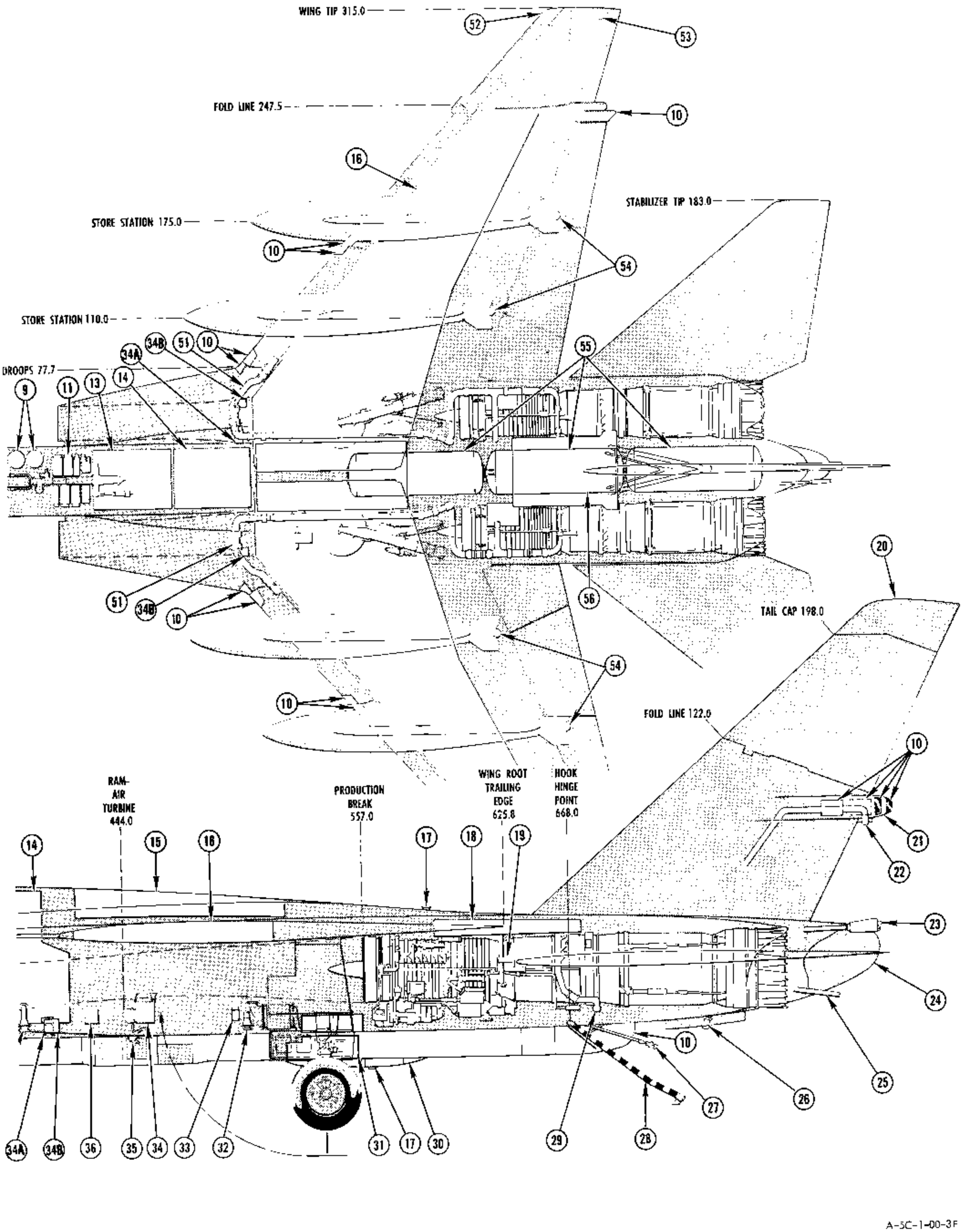

Figure 1-5 (Sheet 2)

PILOT'S COCKPIT (TYPICAL)

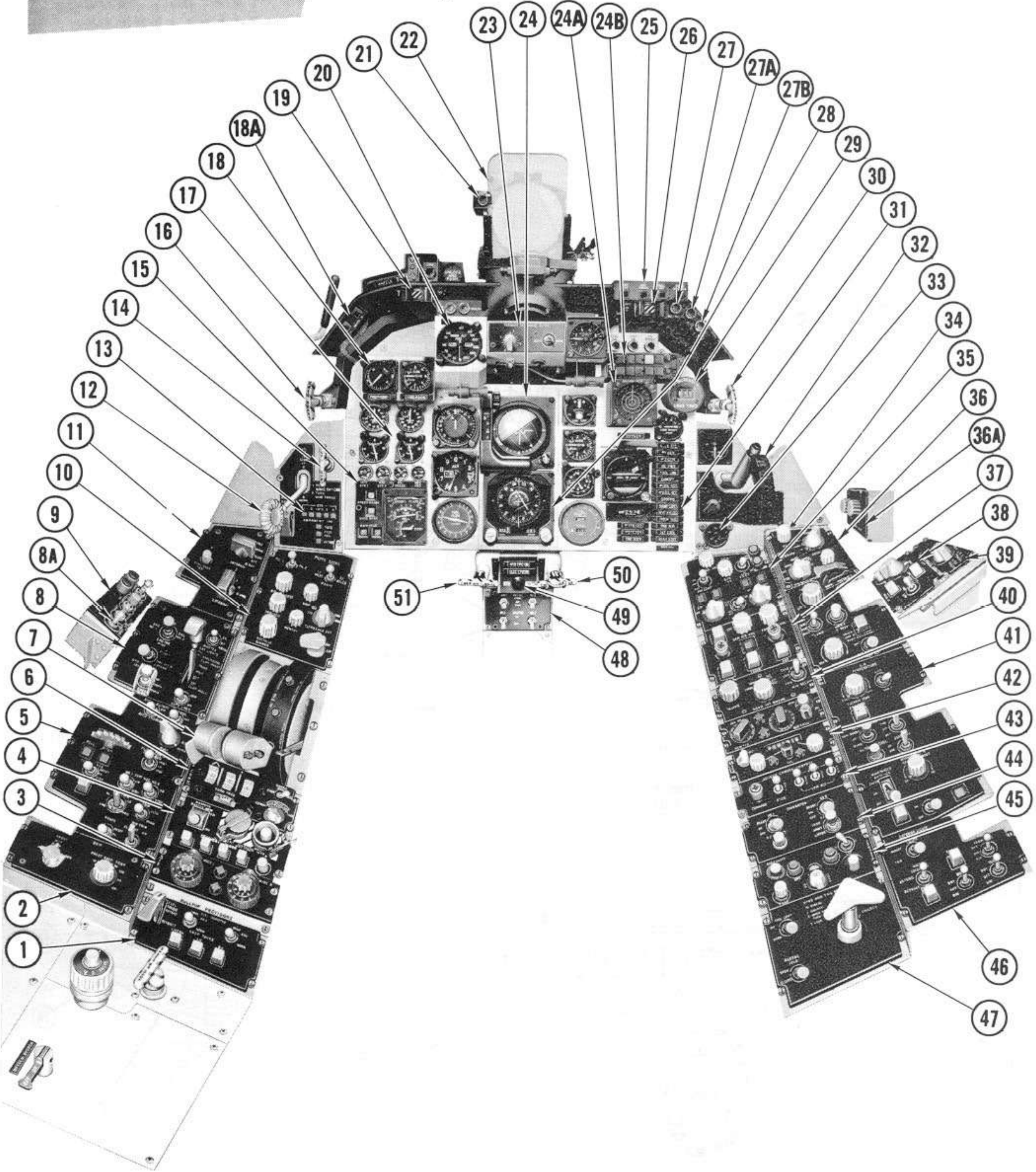

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Figure 1-6 (Sheet 1)

1. FUEL TRANSFER PANEL
2. SUIT PANEL
   EXPOSURE SUIT PANEL *
3. SIF PANEL
4. WEAPONS PANEL
5. FLIGHT CONTROL AND AFCS PANEL
6. UHF COMM PANEL
7. THROTTLES
8. FLAP-DROOP PANEL

8A. SMATS SELECTOR SWITCH

9. APPROACH POWER COMPENSATOR AND ANTI-SKID CONTROLS
10. SCOPE PANEL (PPDI)
11. FUEL QUANTITY PANEL
12. LANDING GEAR HANDLE
13. ARMAMENT INDICATORS
14. FUEL DUMP HANDLE
15. GEAR, SPEED BRAKE
16. EMERGENCY BRAKE HANDLE
17. ENGINE INDICATORS
18. ANGLE-OF-ATTACK INDICATOR

18A. SMATS ADVISORY LIGHT PANEL

19. MASTER WARNING LIGHT
20. RADAR ALTIMETER (LOW)
21. RADAR LOW ALTITUDE WARN LIGHT
22. PROJECTED DISPLAY INDICATOR (FOLDING PPDI SHOWN)
23. T/A ALPHA PANEL
24. ALL-ATTITUDE INDICATOR (AAI)

24A. AZIMUTH INDICATOR

24B. TDU PANEL

25. AFCS INDICATORS
26. MASTER CAUTION LIGHT
27. MA/ML LIGHT

27A. X-BAND WARNING LIGHT

27B. S/C-BAND WARNING LIGHT

28. HORIZONTAL SITUATION INDICATOR (HSI)
29. LABS TIMER
30. CANOPY JETTISON HANDLE
31. CAUTION LIGHT PANEL
32. ARRESTING HOOK HANDLE
33. INLET AIR TEMP INDICATOR
34. COMM SECURITY CONTROLS
35. DECM PANEL
36. INTERIOR LIGHTS PANEL

36A. KNEEBOARD LIGHTS PANEL

37. AUDIO SELECT PANEL
38. IFF PANEL OR AUX IFF PANEL
39. CAMERA PULSE MONITOR KNOB
40. INTERCOM PANEL
41. AIR TEMP AND ANTI-ICE PANEL
42. TACAN PANEL
43. CAMERA CONTROL PANEL (T-375 AMAC PROVISIONS DELETED BY AFC 349)
44. ELECTRICAL SYSTEM PANEL
45. COMPASS PANEL
46. EXTERIOR LIGHTS PANEL
47. FOLD CONTROL PANEL
48. ENGINE START PANEL
49. RAT RETRACT BUTTON
50. LANDING GEAR EMER HANDLE
51. RAT RELEASE HANDLE

* AIRCRAFT 156618 THROUGH 156643

A-5C 1C 00-2M

Figure 1-6 (Sheet 2)

PILOT'S COCKPIT

(AFC'S 233, 302, 340, 350)

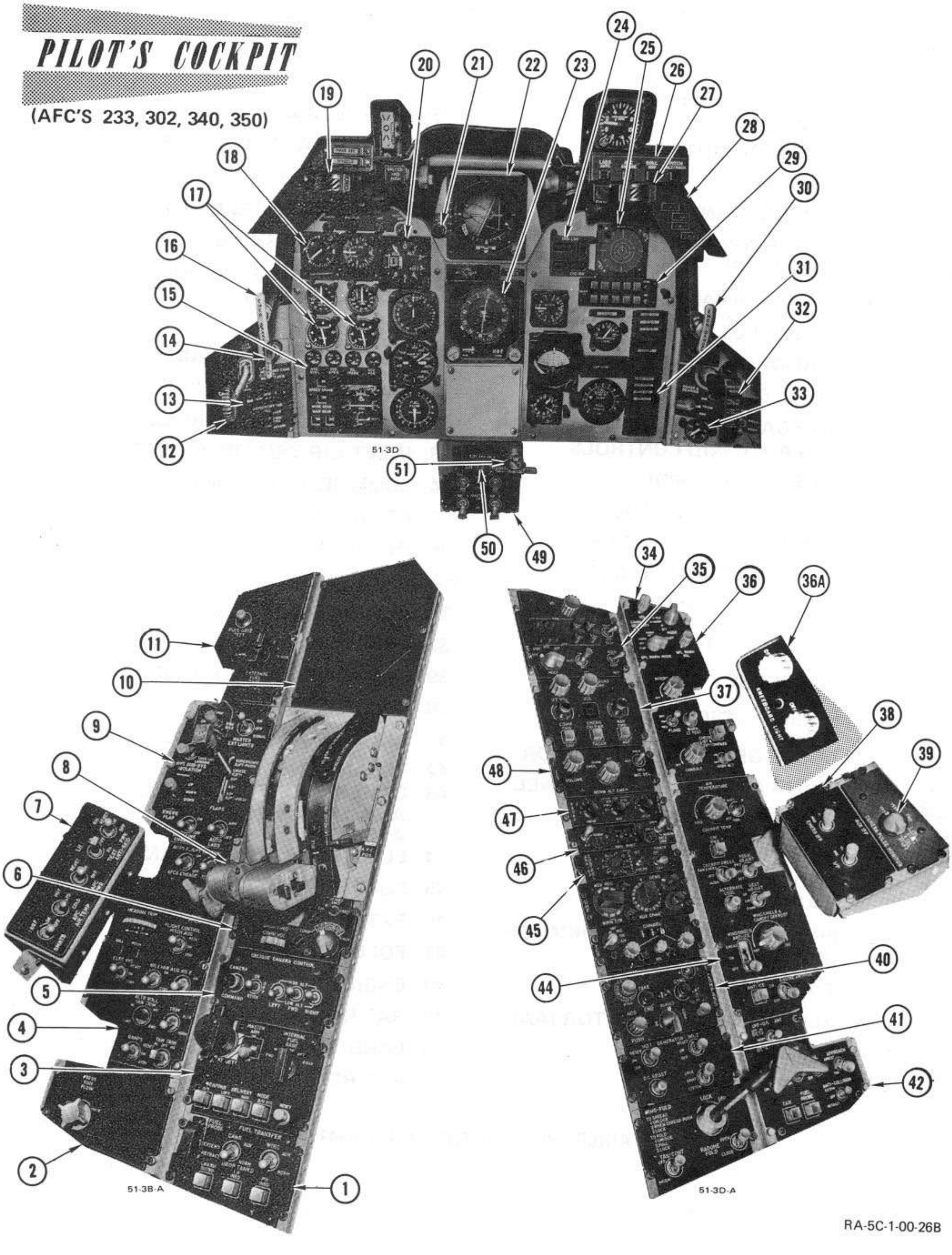


Figure 1-6A (Sheet 1)

1. FUEL TRANSFER PANEL
2. EXPOSURE SUIT PANEL
3. WEAPONS PANEL
4. FLIGHT CONTROL AND AFCS PANEL
5. OBLIQUE CAMERA CONTROL PANEL
6. UHF COMM PANEL
7. APPROACH POWER COMPENSATOR AND ANTI-SKID CONTROLS
8. THROTTLES
9. FLAP-DROOP PANEL
10. COVER PLATE
11. FUEL QUANTITY PANEL
12. LANDING GEAR HANDLE
13. ARMAMENT INDICATORS
14. FUEL DUMP HANDLE
15. LANDING GEAR, SPEED BRAKE INDICATORS
16. EMERGENCY BRAKE HANDLE
17. ENGINE INDICATORS
18. ANGLE-OF-ATTACK INDICATOR
19. MASTER WARNING LIGHT
20. ALTIMETER
21. RADAR LOW ALTITUDE WARN LIGHT
22. ATTITUDE DIRECTOR INDICATOR
23. HORIZONTAL SITUATION INDICATOR
24. DISCRETE READOUT INDICATOR
25. AZIMUTH INDICATOR
26. AFCS INDICATORS
27. MASTER CAUTION LIGHT
28. DECM ADVISORY INDICATORS (AFC 340, PART 2)
29. TDU PANEL
30. CANOPY JETTISON HANDLE
31. CAUTION LIGHT PANEL
32. ARRESTING HOOK HANDLE
33. INLET AIR TEMP INDICATOR
34. COMM SECURITY CONTROLS
35. ECM PANEL (AFC 350)
36. INTERIOR LIGHTS PANEL

36A. KNEEBOARD LIGHTS PANEL

37. AUDIO SELECT PANEL
38. AUX IFF PANEL
39. CAMERA PULSE MONITOR KNOB
40. COMPASS PANEL
41. ELECTRICAL SYSTEM PANEL
42. EXTERIOR LIGHTS PANEL
43. FOLD CONTROL PANEL
44. AIR TEMP AND ANTI-ICE PANEL
45. APPROACH CONTROL (ILS) PANEL (AFC 302)
46. DATA LINK CONTROL PANEL (AFC 233)
47. RADAR BEACON CONTROL PANEL (AFC 233)
48. INTERCOM PANEL
49. ENGINE START PANEL
50. EPU TEST BUTTON (AFC 350)
51. LANDING GEAR EMER HANDLE

RA-5C-1-00-27B

Figure 1-6A (Sheet 2)

PART 2—SYSTEMS

ENGINES

The aircraft is powered by two J79-GE-8 or J79-GE-10 axial-flow, turbojet engines. Aircraft 145157 through 151728 not having AFC 328 complied with have J79-GE-8 engines installed. J79-GE-10 engines are installed in aircraft 156608 through 156643 and 145157 through 151728 having AFC 328 complied with. These aircraft have provisions for installation of either J79-GE-8 or -10 engines. Engine components include variable inlet guide vanes that are heated for anti-icing, variable stator vanes in the first six stages of the 17-stage compressor, a three-stage turbine, and 10 can-annular-flow combustion chambers. Variable-thrust afterburner and a hydromechanically controlled exhaust nozzle are also incorporated.

- J79-GE-8

These engines develop an uninstalled Maximum Thrust of 17,000 pounds each in maximum afterburner at 100% (7695) rpm at sea level conditions. The uninstalled Military Thrust rating is 10,900 pounds.

- J79-GE-10

These engines have an uninstalled Maximum Thrust of 17,859 pounds each in maximum afterburner at sea level conditions. The uninstalled Military Thrust rating is 11,894 pounds.

ENGINE FUEL SYSTEMS

Fuel flow to the engine-driven pumps, fuel control, and the combustion chambers is controlled to establish and maintain desired rpm under various engine operating conditions. The main fuel controls combine inputs of throttle position, compressor inlet temperature, engine speed, and compressor discharge pressure in metering fuel for combustion. They also position the variable stator vanes for optimum compressor performance. Throttle linkage simultaneously provides coordinated signals to the main fuel control, nozzle area control, and afterburner control. Fuel flows from the main fuel manifold through a flowmeter and an oil cooler into the pressurizing and drain valve, then to the 10 fuel nozzles for spray injection. See figure FO-2. As engine operating power is selected by the throttles, fuel is regulated for changes in compressor inlet temperature and discharge pressure. A fuel cutoff valve within the fuel control unit stops fuel flow to the combustion chambers when the throttles are retarded to OFF. On some aircraft,* the engine fuel system has been modified to provide for a speed modulated afterburner thrust system (SMATS), and the engine is redesignated J79-GE-8C.

ENGINE-DRIVEN FUEL PUMPS

Before entering the main fuel control, the low-pressure fuel supply is boosted to high pressure by an engine-driven pump located on the bottom of each engine accessory section. This pump is composed of an impeller-type booster element and single positive displacement, gear-type pumping elements.

*Aircraft having AFC 247 complied with

MAIN FUEL CONTROLS

Independent hydromechanical fuel control units meter fuel flow to establish and maintain engine rpm. They also initiate afterburner operation, and regulate servo pressure to control the inlet vanes and variable stator blades for optimum engine compressor performance. During steady-state operation, fuel metering is controlled by a governor in response to throttle position. The fuel control units limit engine maximum rpm at low compressor inlet temperatures and raise engine minimum rpm at high compressor inlet temperatures.

OIL COOLERS

Each engine is equipped with a main oil cooler and an afterburner oil cooler to reduce and control the temperature of scavenged oil. This is accomplished by using the fuel supply as a coolant. During cold engine operation, the coolers bypass scavenged oil until oil temperature reaches normal operating limits. The coolers also bypass scavenged oil when oil inlet/outlet differential pressure exceeds maximum limits or falls below a minimum limit.

FUEL FILTERS

Two filters are mounted on the engine, upstream of the fuel control unit. Should the main engine filter become clogged, a pressure drop of approximately 25 psi will cause the fuel filter pressure switch to actuate. A filter caution light is provided as an indication that the filter has clogged and that bypass will occur if the differential pressure continues to rise. The high-pressure fuel filter is provided with a bypass but no warning light. Two fuel filter caution indicators (figure 1-7) are installed on the instrument panel in the pilot's cockpit. An indication of impending fuel filter bypass is provided by differential pressure sensing switches which are set to energize their respective caution indicators before sufficient pressure drop occurs to cause opening of the bypass valve. Should illumination of a FILTER caution indicator be accompanied by fuel flow fluctuations exceeding 300 pounds per hour, the flight should be discontinued, the fuel filter inspected, and corrective action taken prior to the next flight.

OIL SUPPLY SYSTEMS

Each engine is provided with a pressure-type oil supply system. In addition to providing necessary lubrication, the system also supplies oil to the constant-speed drive units and to the variable exhaust nozzle system. An oil tank is mounted on the compressor housing of each engine. Each engine oil tank has a usable capacity of 5.2 gallons. This supply is sufficient for an 8-hour air refueling mission. The tanks are designed so that failure or leakage of a constant-speed drive unit will not cause engine oil starvation. The oil scavenge systems filter and cool oil from the lubrication, engine hydraulic, and

ENGINE CONTROLS AND INDICATORS

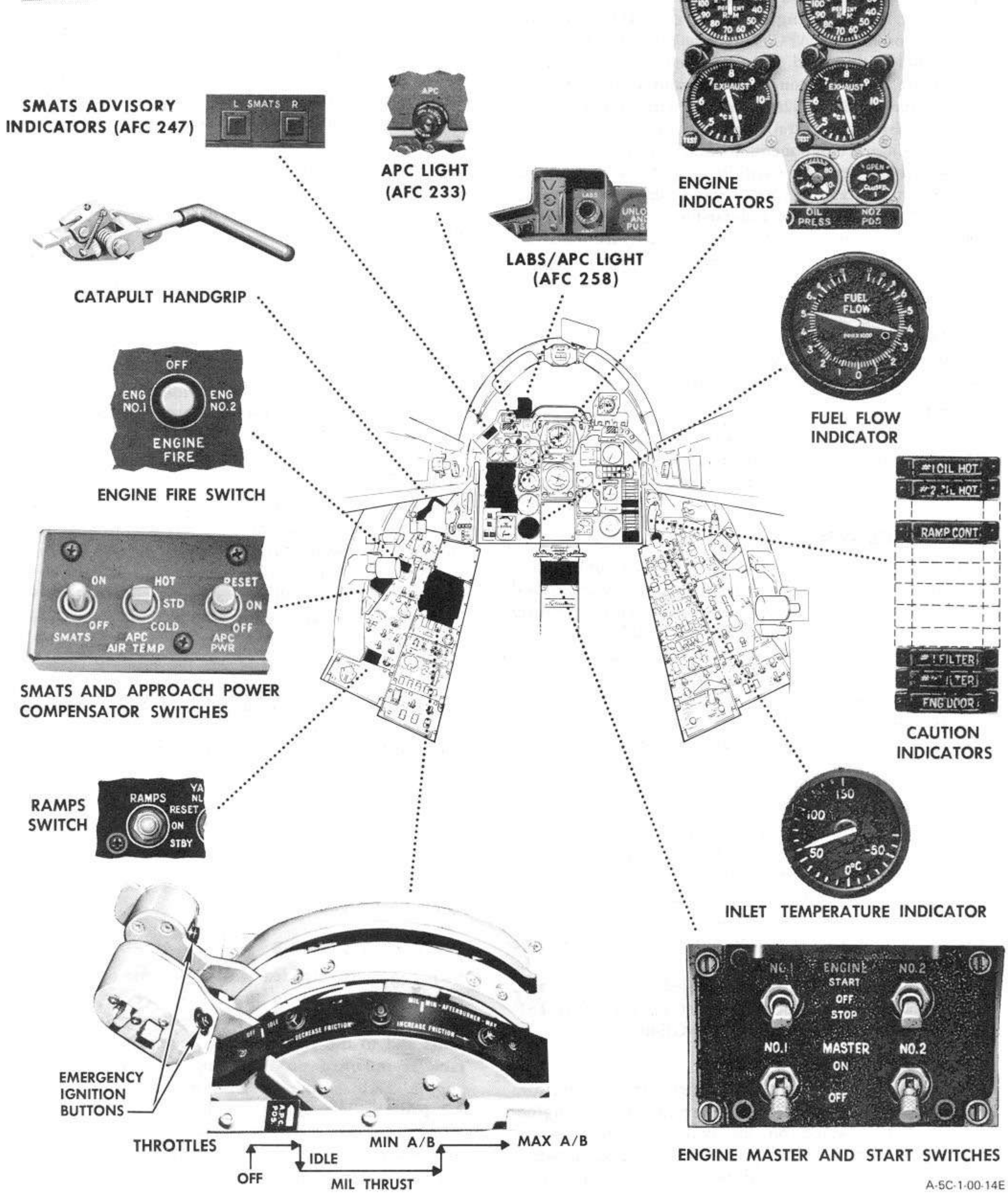


Figure 1-7

constant-speed drive systems and return the oil to the tanks for re-use. After scavenged oil passes through the engine filter, it flows through the afterburner oil cooler and then through the main oil cooler. On some aircraft,* the CSD return oil line is rerouted directly to the oil tank, bypassing the oil coolers (figure FO-3). If the temperature in the oil tank reaches 295°F, an overheat thermoswitch turns on the applicable OIL HOT caution indicator (figure 1-7) on the pilot's instrument panel. The main and afterburner oil coolers transfer oil heat to the fuel passing through the coolers. The oil tanks, gear-cases, and sumps are interconnected and vented to a common overboard vent through a pressurizing valve which maintains approximately 4 to 5 psi above ambient pressure at any altitude.

*Aircraft having AFC 351 complied with

AFTERBURNERS

A variable-thrust afterburner is installed on each engine. The afterburners are self-igniting and self-controlled by separate pilot burners, afterburner fuel pumps, and fuel control units. When afterburner power is selected by moving the throttles to the MIN AFTERBURNER position or beyond, fuel is pumped under high pressure to the afterburner fuel controls, which schedule fuel to the afterburner manifolds and sectors through flow dividers. Afterburning fuel flow is divided into core and annulus flows. Core flow is injected in a small area near the center of the exhaust gas system. As fuel flow increases, the manifold flow control schedules the additional fuel to the annular area around this central core. As afterburning is selected, the afterburner ignition units supply ignition to the pilot burners, which, in turn, ignite the fuel spray. Afterburner thrust may be varied between MIN and MAX for both engines or for either engine independently.

VARIABLE AREA EXHAUST NOZZLES

The variable area exhaust nozzles control engine exhaust area in order to maintain exhaust gas temperature and engine thrust at optimum within design limts. This feature is primarily important for efficient engine operation at military power and in the afterburner power range. The variable exhaust nozzle control systems utilize engine oil for hydraulic power to position the nozzle actuators. The nozzles are approximately full open during starting and at idle rpm. As engine speed increases above idle, nozzle area is reduced mechanically by throttle position until, at approximately 87% rpm, the nozzle stops closing. The nozzle is modulated according to EGT and rpm requirements while rpm is increased in the cruise power range. After reaching 100% rpm, continued throttle advance opens the nozzle until the maximum operating EGT (Military Thrust) is reached. The nozzle area is then modulated to maintain this temperature by amplified signals from the EGT thermocouple harness whenever rpm exceeds approximately 95%. At AB light-off, rpm drop (rollback) starts. The nozzles are opened further by increasing EGT (temperature limiting) and modulated to maintain maximum operating EGT. Exhaust temperature and rpm signals electronically control the nozzle for maximum performance during rapid throttle movements.

SPEED MODULATED AFTERBURNER THRUST SYSTEM (SMATS)*

On aircraft having J79-GE-8 engines only, the speed modulated afterburner thrust system (SMATS) consists of engine fuel system, nozzle area control and electrical system modifications (redesignated the J79-GE-8C engine) with cockpit control to permit afterburner ignition and operation at less than 100% rpm. The system has the advantage of reducing the thrust response transient times between approach power and minimum or maximum afterburner power by having the afterburner in operation at all engine speeds. A SMATS switch, electrically held in the ON position, located on the SMATS, APC, and anti-skid control panel (figure FO-4), provides cockpit control and two advisory indicators, on the AFCS MODE and SMATS indicator panel (figure FO-4), provide ON indications during system operation. Throttle switches are incorporated to assure that during on-the-deck operation, the engines must be above 67% rpm for system engagement, but as the SMATS nozzle schedule transition is based on turbine pressure change, throttle burst above 85% rpm may be necessary to activate schedule change and cockpit indication. Retarding throttles to less than 67% rpm on-the-deck (weight on the landing gear), automatically deactivates the system, returning the SMATS switch to the OFF position. During in-flight operation (weight off the landing gear), the electrical system is such that once selected, SMATS is operative until the SMATS switch is selected OFF, but 85% rpm is required to initiate the SMATS nozzle schedule and cockpit indications. With the SMATS system OFF, all systems operate normally. The system is designed to be used in the approach/landing configuration and, since fuel flow is increased, should be turned OFF upon attaining maximum power in the wave-off. Approximately 300 pounds of additional fuel are required per circuit, assuming system turn-on at the 180-degree position. SMATS is powered from the No. 1 and No. 2 primary 28-volt d-c buses.

SMATS Selector Switch

A speed modulated afterburner thrust system selector switch (SMATS) is located on the SMATS, APC, and anti-skid control panel (figure 1-7). The switch has two position, ON and OFF; the ON position being electrically held when selected if electrical power is available. The switch is supplied 28-volt d-c power, when the throttles are advanced above 67% rpm (weight of the aircraft on the landing gear), or at all times in flight (weight off landing gear). The switch must be manually selected OFF in flight, but will automatically return to OFF when aircraft weight is on the landing gear and throttles are reduced below 67% rpm. Electrical power is supplied from the No. 1 and No. 2 primary d-c buses.

SMATS Advisory Indicators

Two SMATS ON advisory indicators are located on the AFCS mode and SMATS indicator panel on the pilot's instrument panel right-hand shroud (figure FO-4). These

*Aircraft having AFC 247 complied with

indicators, one for each engine, provide the pilot with an ON indication when the SMATS system is ON and the SMATS nozzle schedule is in effect. The indicators are tested by the warning lights test switch. The indicators are powered by the No. 1 and No. 2 28-volt d-c primary buses.

VARIABLE STATORS AND INLET GUIDE VANES

The engine inlet guide vanes and the first six stages of stator vanes are variable. The system is linked mechanically and is controlled by the main fuel control unit. It is powered by actuators using fuel as the hydraulic medium. The system acts to position the stator and guide vanes as a function of rpm and compressor inlet temperature. This provides maximum compressor efficiency and stall-free acceleration and deceleration.

STARTING SYSTEM

Turbine impingement starting provisions are incorporated. The starting air receptacles are located on the outboard sides of the aft fuselage. See figure 1-40. A manifold supplies external air through seven ports to impinge directly upon the second-stage turbine wheel, providing starting torque to the engine rotor assembly. The starting system provides a connection for automatic shutoff of external air and engine ignition; however, the normal procedure includes the pilot signaling for starting air shutoff as the engine speed reaches approximately 45% rpm. With external electrical power connected and the desired engine MASTER switch positioned to ON, momentarily moving the corresponding engine START switch to START completes a circuit to the external starting air cart, providing air for engine rotation. Movement of the throttle from OFF to IDLE activates the ignition system and opens the master fuel control unit cutoff valve. After engine light-off occurs, starting air is still required to aid in developing self-sustaining engine acceleration. When engine rpm reaches approximately 45% rpm, the centrifugal switch mounted on the rear gearbox opens, shutting off external air and engine ignition.

ENGINE MASTER SWITCHES

The engine MASTER switches (figure 1-7) are located on the pilot's center pedestal. With external electrical power connected, moving either switch to ON completes circuits which energize the transfer pump in the forward cell and the boost pumps in the sump tanks. Subsequent movement of the throttle from OFF to IDLE initiates operation of the engine ignition system.

ENGINE START SWITCHES

The engine START switches (figure 1-7) are located on the center pedestal. Momentarily placing either START switch to START, with the corresponding engine MASTER switch ON, completes electrical circuits to supply air to the starting system and allows activation of the engine ignition system with either the throttle or the emergency ignition button. Once activated, the ignition system remains energized until the engine attains approximately 45% rpm, at which time a speed-sensing switch cuts off ignition and external starting air supply. An engine start may be aborted at any time by moving the throttle to OFF and momentarily moving the engine START switch to STOP, when engine is clear of fuel.

ENGINE FIRE SWITCH

The ENGINE FIRE switch (figure 1-7) operates the engine bay fuel shutoff valves. The firewall shutoff valves are powered through the engine MASTER switch circuits.

THROTTLES

The engines are controlled by separate throttles (figure 1-7), located in a quadrant on the left console. The No. 1 throttle grip incorporates a plate-type handguard. Throttle stops are provided for positive control of engine power setting and to prevent inadvertent engine shutdown. Throttle stops provided are OFF, IDLE, MIL (military), MIN AFTERBURNER (minimum afterburner), and MAX ATFERBURNER (maximum power). The No. 2 throttle grip contains a radio and ICS microphone switch and a speed brake switch. On some aircraft,* throttle position switches have been incorporated. During ground operation, these switches prevent SMATS system engagement below 67% rpm and will automatically deactivate SMATS when throttles are retarded below 67% rpm. The switches have no function while airborne.

THROTTLE FRICTION LEVER

The throttle friction lever (figure FO-4) is mounted on the inboard side of the throttle quadrant for use as a throttle force control and locking device. The friction level must be in the full aft (off) position to allow engagement of the approach power compensator.

EMERGENCY IGNITION BUTTONS

An emergency ignition button (EMER IGN, figure FO-4) is installed in the forward face of each throttle grip. These buttons provide engine ignition system operation for air starts. Providing essential a-c bus power is available and the respective engine MASTER switches are ON, the system is energized when the EMER IGN buttons are depressed and held. The ram-air turbine-powered (or hydraulically powered†) emergency power unit can provide the essential a-c bus electrical power for ignition if both generators are inoperative.

CATAPULT HANDGRIP

An adjustable catapult handgrip (figure 1-7) is mounted on the cockpit bulkhead above and forward of the throttle quadrant. It is spring loaded to the stowed position and is pulled down and aft to aid in holding the throttles at the MAX AFTERBURNER power setting during catapulting.

***Aircraft having AFC 247 complied with**
†Aircraft having AFC 350 complied with

EGT INDICATORS

An exhaust gas temperature indicator for each engine (figure 1-7) is located on the instrument panel. A press TEST button is provided on each indicator. Depressing the button causes temperature indication to increase to a stop above 1000°C. Upon releasing the button, the needle should return to its original indication. Electrical power for operation of the EGT indicators is supplied by the essential a-c bus. No power-off warning is provided; however, the indicators "freeze" upon power failure. For maximum exhaust gas temperatures, refer to Section I, Part 4.

On some aircraft,* ground operation of the EGT indicators requires placing either or both of the engine master switches to ON.

TACHOMETERS

A tachometer for each engine (figure 1-7) is located on the instrument panel. They are calibrated in percent of engine speed in rpm and are powered by their respective engine tachometer generators. Engine top speed (100%) corresponds to 7685 rpm. Failure of a tachometer generator results in failure of the indicator, the rpm reading falling to zero.

NOZZLE POSITION INDICATOR

A single miniature indicator located on the instrument panel (figure 1-7) reflects the position of both afterburner nozzles. The indicators are powered by the essential d-c bus and receive electrical position signals from the nozzle area controllers, indicating nozzle position from fully closed to fully open. On some aircraft,† the needles of the nozzle position indicator may cross at idle power when the nozzles are in the full open position.

FUEL FLOW INDICATOR

A fuel flow indicator (figure 1-7) is located on the instrument panel. This dual-needle instrument indicates engine fuel consumption in thousands of pounds per hour flow and is scaled in varying increments from 0 to 12. The indicator is powered by the essential instrument a-c bus. Interruption of electrical power freezes the indication.

Note

Fuel flow to the afterburners is not indicated.

OIL PRESSURE INDICATOR

The oil pressure indicator (figure 1-7) is an electrically operated, dual-needle instrument, receiving electrical inputs from two direct, engine-mounted oil pressure transmitters. The indicator is powered by the essential instrument a-c bus. Loss of electrical power causes the indicator needles to remain at their last position. For engine oil pressure limits, refer to Section I, Part 4.

RAMPS SWITCH

The RAMPS switch (figure 1-7) is located in the flight control panel on the left console and has three positions: STBY, RESET, and ON. When the system is disengaged, the RAMP CONT caution indicator is illuminated. To engage, hold the switch in the RESET position momentarily, then release to the ON position. The RAMP CONT caution indicator will extinguish, indicating the system is engaged.

RAMP CONTROL CAUTION INDICATOR

The ramp control caution indicator (RAMP CONT, figure 1-7) is located on the pilot's instrument panel. This indicator will be illuminated until the ramps are reset and at any time the inlet control system shuts off.

ENGINE ANTI-ICE SWITCH

The ENGINE ANTI-ICE switch (figure 1-25), a two-position switch (ON OFF) located on the pilot's right console, controls anti-ice airflow to the engines. Selecting the ON position opens a solenoid-operated valve which regulates the flow of hot air through the engine compressor struts and guide vanes and through the accessory bullet nose. The air is discharged from the trailing edge of the guide vanes and the bullet nose into the engine.

ENGINE ANTI-ICE INDICATOR

The engine anti-ice indicator (figure 1-25) displays "ON" when the ENGINE ANTI-ICE switch is ON, both engine anti-ice air valves have opened, and air is flowing as required. Lack of an "ON" indication may be interpreted as a valve malfunction, loss of power to the indicator, or a pressure switch failure.

ENGINE CHARACTERISTICS

ACCELERATION

During normal operation, engine accelerations can be made from any power setting without encountering compressor stall or exceeding EGT limits. For slow accelerations, the exhaust nozzle closes directly with throttle advance until maximum operating EGT is reached. For "burst" accelerations, closure of the nozzle is limited by combined signals of engine rpm and EGT in the nozzle controller ("speed derivative control"). Time to accelerate from IDLE to MIL is less than 10 seconds (BLC off), and may increase to approximately 13 seconds with BLC operating, depending upon initial airspeed. For accelerations, the exhaust nozzle control system overrides the throttle mechanical schedule at engine speeds as low as 79% rpm, modulating the area larger or smaller to control EGT. Maximum engine speed and ground idle speed are ground adjusted at the engine main fuel control unit.

ENGINE ACCELERATION TIME

J79-GE-8 Engines

Rapid acceleration from IDLE to Military Thrust should be attained within 7 to 9 seconds, measured from throttle advance to fuel flow cutback. From IDLE, the throttles may be advanced immediately to MAX AFTERBURNER, and stabilized Maximum Thrust should be attained within not more than 12 seconds, also measured from throttle advance to initial fuel flow cutback.

*Aircraft 145157 through 156640 having AFC 317 compied with
and aircraft 156641 through 156643
†Aircraft 156608 through 156643

J79-GE-10 Engines

Rapid acceleration from IDLE to Military Thrust should be attained within approximately 5 seconds or less, measured from throttle advance to fuel flow cutback. From IDLE, the throttles may be advanced immediately to MAX AFTERBURNER, and stabilized Maximum Thrust should be attained within 8 seconds or less.

Note

Compressor bleed requirements can degrade acceleration capability. With droops extended, dual engine acceleration from IDLE to Military Thrust may require as much as 10 seconds for 25 degree droops and 13 seconds for 50 degree droops on -8 engines, or 6 seconds for 25 degree droops and 8 seconds for 50 degree droops on -10 engines. During single-engine accelerations, with droops extended, throttle bursts into maximum afterburner range may produce engine over-temperature. The EGT should be monitored and throttles advanced at a rate not exceeding temperature/time limits.

AFTERBURNERS

The afterburners should light off with a maximum of 3 seconds after the throttles are moved outboard of the MIL detent and forward into afterburner range. Lights should be obtained at any engine rpm above approximately 98%, and any "hard" or late light should not be accepted as normal. As the throttles are advanced in afterburner range, thrust increase should be smooth and positive, displaying direct control with the throttles. Fuel flow to the afterburners is not indicated. However, combined engine and afterburner fuel flow at MAX AFTERBURNER is approximately four times that of the engine at Military Thrust.

Variable Nozzles

The variable area exhaust nozzle system schedules engine nozzle area to obtain optimum thrust while maintaining EGT within design limits. At all power settings above approximately 79% rpm, variable area exhaust nozzle is automatically controlled as a function of EGT and throttle position, except during accelerations. At lower power settings, nozzle area is a direct function of throttle position. During throttle bursts, speed derivative signals (engine speed and EGT) cause the nozzle amplifier to compare rates of rpm and EGT change, scheduling nozzle opening accordingly. As the engine accelerates to near the Military Thrust limit, the nozzle area controller opens and modulates nozzle area, maintaining EGT within steady-state limits. A malfunction in the nozzle hydraulic (engine oil) system causes the nozzle to freeze or drift open, resulting in excessive EGT or loss of EGT and thrust.

Flight Idle Reset

To reduce the effects of insufficient engine airflow on reduction of throttle setting at supersonic speeds, the minimum idle rpm schedule of the main fuel control unit is reset by the governor override. As CIT increases from 57° to 110°C, minimum idle rpm increases from 65% to 100%. Once reset has occurred, rpm cannot be throttle-reduced until CIT is reduced.

J79-GE-8 CHARACTERISTICS

Military Thrust is reached at 100% rpm (above approximately 4°C compressor inlet temperature) and is indicated as MIL on the throttle quadrant. Normal Thrust is reached at 96% rpm and is the highest continuous (nonlimited) rpm. At ambient temperatures less than approximately 4°C, the maximum engine mass airflow rating may be exceeded at 100% rpm. Mass airflow is limited, therefore, by lowering engine maximum rpm below this temperature. As compressor inlet temperature (CIT) decreases from approximately 6° to −54°C, engine top speed decreases from 100% to 92%. EGT decreases as rpm drops below approximately 98%. As a typical example, −27°C CIT (approximately ambient temperature at 21,000 feet under standard conditions) results in a cutback from 100% rpm and 625°C EGT to about 90% rpm and 590°C EGT. On some aircraft,* a speed modulated afterburner thrust system (SMATS) is installed. This system permits afterburner ignition and operation at engine speeds below MIL, providing a smooth transition into maximum power range. A special nozzle schedule is automatically initiated once SMATS operation is selected and turbine pressure rises sufficiently to initiate an amplifier circuitry change. Refer to SPEED MODULATED AFTERBURNER THRUST SYSTEM, in this section.

J79-GE-10 CHARACTERISTICS

The J79-GE-10 engines incorporate an exhaust gas temperature reset which functions only during jam acceleration to Military. This results in a temporary maximum EGT of 599 (±6) degrees Celsius until military rpm is achieved. The -10B engine will reset to 616 (+13/-11) degrees Celsius. EGT reset prevents certain engine components from exceeding their operating temperatures. Then when military rpm is achieved EGT becomes a function of rpm versus CIT. Engine speed at Military and maximum Thrust is a function of compressor inlet temperature (CIT) and varies linearly from 100 percent at a

*Aircraft havaing AFC 247 complied with

CIT of 45°C to 90 percent at a CIT of -53°C. The 100% engine rpm will occur only during high inlet temperature conditions such as during supersonic flight. CIT between engines can vary, resulting in as much as 2% difference in rpm between engines. A difference in indicated EGT readings will also be noted. EGT decreases as rpm drops below 100% rpm, maintaining EGT within steady-state limits. A malfunction in the nozzle hydraulic (engine oil) system causes the nozzle to freeze or drift open, resulting in excessive EGT or loss of EGT and thrust.

The -10B engine has virtually the same performance characterisitcs as the -10. Exceptions are a possible rumble at idle rpm due to slight combustion instability, and slightly higher fuel flow and EGT from start throughout the engine operating range. Refer to part 4 of this section for specific limits and schedules.

APPROACH POWER COMPENSATOR SYSTEM

APC THEORY

The AN/ASN-54(V) approach power compensator system operates the throttles automatically to assist the pilot in maintaining the desired reference approach angle of attack. Throttle movement is accomplished by electrical control of the throttle linkage torque boosters on the engine fuel control units. The APC system utilizes the following input signals plus a manual AIR TEMP switch input to compute and command the thrust required to seek 15 (±¼) units angle of attack at all times while engaged:

- Horizontal Stabilizer — Provides glide-slope corrections with stick inputs keeping aircraft pitch changes small by causing thrust adjustments in anticipation of glide-slope deviations.

- Accelerometer — Provides thrust adjustments for deviations from 1-g flight, always opposing any vertical acceleration changes regardless of what initiated the "g" change. For stick inputs which initiate deviations from 1 "g," the accelerometer input provides throttle damping by reducing power due to positive "g," and vice versa.

- Angle-of-Attack Probe Position — Provides thrust adjustments for deviations from 15 units angle of attack.

- Angle-of-Attack Probe Integration — Provides integration for trimming of the power setting until the precise thrust is applied to establish 15 units angle of attack.

- Left and Right Throttle Linkage Torque Booster Feedback — Each engine torque booster provides a feedback signal to control a commanded throttle position.

The manual AIR TEMP switch shifts the following three parameters inside the APC computer.

- Output-to-input gain ratio.

- Initial engage rpm command.

- Minimum rpm APC electrical limit.

Each of these three parameters is progressively increased with temperature selection from COLD to STD to HOT. The shift of these parameters provides compensation to make the APC flying qualities essentially the same under increased temperature conditions when engine thrust decreases. Horizontal stabilizer, accelerometer, and angle-of-attack probe position inputs are high-gain inputs which provide a given thrust command for a given input change. Because of the varying conditions which determine the thrust necessary to maintain 15 units, these three inputs are scaled to command the approximate thrust necessary to maintain 15 units. The angle-of-attack integration input continues to integrate or trim by adding or substracting power precisely, at a rate proportional to the deviation from 15 units, until 15 units angle of attack is regained, continuing after the effects of the horizontal stabilizer, accelerometer, and angle-of-attack probe position inputs have stabilized. When APC PWR is selected ON but not RESET, the APC computer output follows the angle-of-attack probe inputs to command the approximate thrust necessary to hold 15 units initially upon RESET of APC PWR. If upon RESET the computer output is not exactly the corresponding thrust command for 15 units of angle of attack, the angle-of-attack integrating channel will trim thrust setting until an attitude of 15 units is attained. Prior to RESET, the horizontal stabilizer and accelerometer inputs contribute no steady-state output. A momentary output results from an input change of the horizontal stabilizer or accelerometer but decays to the same value existing prior to the input change.

An APC mechanical stop exists in each engine torque booster to prevent travel to less than a nominal 70% rpm in the event of a low-limit APC electrical failure. Torque booster installation tolerances can result in a mechanical stop setting of up to 77% rpm. APC should be engaged at engine rpm above this mechanical stop. If APC is engaged below the mechanical stop rpm setting, the added friction from the mechanical stop may be sufficient to stall the automatic mode of the torque booster and the throttles may not advance to the electrically commanded position. The APC system is energized by moving the APC PWR switch to ON. The APC light illuminates, indicating system engagement readiness. To complete the electrical holding circuit for engagement of APC or extinguishing the APC light, the SPEED BK switch must be in the OFF position, the throttle friction lever must be fully off, and the left-hand main gear must be free of aircraft weight. Holding the APC PWR switch momentarily in RESET extinguishes the APC light and engages both engine torque boosters to computer amplifier output signals. With APC engaged, manual override of throttle action is possible, requiring approximately 16 pounds force (8 pounds per each throttle) to move and hold the throttles off the automatic position. The J79-GE-10 engine APC operating range is limited to between 77% rpm and MIL with the AIR TEMP switch in STD. The low-rpm limit changes to approximately 1.5% rpm below or above that of STD for the COLD and HOT temperature selections, respectively.

The J79-GE-8 engine APC operating range is limited to between 79% rpm and MIL with the AIR TEMP switch in STD. The low-rpm limit is approximately 1.5% rpm below or above that of STD for the COLD and HOT temperature selections, respectively.

APC CONTROLS AND INDICATORS

The approach power compensator controls (figure FO-4) are located above the pilot's left console on a panel which also includes the anti-skid system switches.

APC Power Switch

The APC power switch (APC PWR) provides control of APC primary a-c bus electrical power (ON/OFF) and APC engagement for operation (RESET position). With power on, as indicated by illumination of the APC light, holding the switch momentarily in RESET will place the system in operation and extinguish the APC light.

Air Temperature Switch

The air temperature (AIR TEMP) switch provides gain (sensitivity) selections for approximate temperature conditions. The HOT position provides the most rapid throttle response. The switch should be preset for existing outside air temperature as follows:

SWITCH POSITION	OUTSIDE AIR TEMPERATURE (°F)
HOT	80 and warmer
STD	40 to 80
COLD	40 and colder

†Aircraft having J79-GE-10 engines installed

APC Light

The APC light (figure FO-4A) is illuminated any time the APC PWR switch is ON to indicate electrical readiness for engagement. The light does not reflect system malfunctions. On some aircraft the light is time-shared between the APC system and the LABS function of the B/N system (figure FO-4).

APC OPERATION

The approach power compensator system is engaged by moving the APC PWR switch to ON (APC light illuminates). After transition to landing configuration is complete (gear extended, flaps extended, hook down as required), the APC PWR switch is momentarily selected to RESET. The pilot controls pitch trim, pitch attitude, and heading to maintain the optimum glide path. When the APC system is engaged at angles of attack higher or lower than optimum, the throttles automatically advance until speed approaches optimum and then modulate to maintain 15(±¼) units angle of attack. Pitch trim should be set for normal descent, using momentary control stick inputs to correct flight path.

AIR INDUCTION SYSTEM

The air induction system (figure FO-3) provides a stable air supply at sufficient total pressure and controlled velocity to ensure maximum engine efficiency under varying flight conditions. Inlet air pressure recovery is accomplished through controlled velocity reduction by variable ramps. Each inlet duct contains three ramps. The first ramp is a fixed, 8.5-degree wedge. The second ramp has a slotted surface for bleeding turbulent boundary layer air and is hydraulically variable from 0 to 21.5 (0 to 24.0†) degrees down. The third ramp is separated from the second ramp by a slot and moves with the second ramp to form a variable geometric inlet. The ramp system reduces duct air velocity and provides satisfactory pressure recovery through creation of a series of shock waves in the air stream ahead of the duct lip. To match engine demand with duct supply, an electrically driven, modulating bypass gap is mounted around the front frame of each engine. The gaps pass excess duct airflow around the engines, through the engine compartments, and out the afterburner ejector nozzles. The excess air provides the secondary airflow for engine compartment and engine cooling. The ramps and gaps are automatically scheduled and controlled by an electrical inlet control system. An rpm sensing override circuit provides ramp and duct overload protection in the event of rpm reduction at high supersonic speeds.

SECONDARY AIRFLOW

The air induction system provides air for cooling the engines and engine compartments and supplies air to the variable area exhaust nozzles. During flight, inlet duct air in excess of that required for efficient engine operation is guided around the compressor inlets and into the engine compartments. This airflow cools the engine compartments and flows overboard between the primary and secondary exhaust nozzle flaps. The air creates an aerodynamic convergent/divergent nozzle for the engine primary exhaust flow. During ground operation and with the flaps or landing gear extended, engine compartment cooling air is provided by the engine cooling and overpressure doors, which also provide some engine primary air through reverse airflow.

ENGINE PRESSURE RELIEF DOORS

A motor-operated, bungee-loaded door is installed on the bottom center section of each engine compartment. During ground or in-flight operation with flaps extended 25 degrees or more or with landing gear extended, the doors open to provide outside air for engine compartment cooling and additional primary air for engine operation. Should engine compartment pressure exceed ambient by 8 psia or more, the pressure opens the door, because of the off-center mounting of its hinge, far enough to allow bungee action to complete full opening. The doors are then automatically closed electrically when engine compartment pressure is reduced to less than 7 psia above ambient. If the doors remain open (caution indicator on) after reducing power or airspeed, the remainder of the flight should be conducted at subsonic speeds and below 35,000 feet. On the ground, the doors can be opened by turning on an engine MASTER switch if a source of electrical power is provided. Single generator operation disables the automatic opening function of the doors when the landing gear is extended, thus resulting in possible engine compartment overheat and fire warning. With AFC 359 the doors operate normally during single generator operation.

CAUTION

If a fire warning light illuminates, the engine compartment temperature may be lowered by reducing power setting and/or increasing airspeed.

*Aircraft having J79-GE-10 engines installed

Engine Door Caution Indicator

The engine door caution indicator (ENG DOOR, figure 1-7) is illuminated whenever either engine compartment cooling and overpressure door is open. Illumination on the ground is normal. Illumination during flight with the landing gear and flaps retracted indicates engine compartment overpressure due to incorrect scheduling of the secondary air gaps or a mechanical malfunction.

AIR INDUCTION SYSTEM OPERATION

The air induction system is designed to provide an air supply to the engine at high-pressure recovery with low inlet drag. The system includes variable geometry inlets, variable secondary air bypass gaps, and an automatic control system. The inlet control system is composed of amplifiers which combine electronic signal inputs of duct static pressure, ambient pressure, and aircraft Mach number to control the variable inlet ramps and bypass gaps and includes a fail-safe ramp monitor system. Portions of both the forward and aft variable ramps are slotted and separated by an additional slot for removing ramp turbulent boundary layer airflow. This air is directed into plenum chambers above the ramps. The aft plenum air is routed into the bomb bay for cooling and purging; forward and mid plenum air passes overboard through vents at the top of each duct. A cooling and overpressure relief door, located on the underside of each engine compartment, provides engine compartment overpressure relief as necessary under high "Q" conditions, and cooling air and engine supplementary air during low-speed and ground operation. Refer to ENGINE PRESSURE RELIEF DOORS, in this section.

Inlet Control

Protection against duct airflow instability is required for the air induction system at high Mach numbers during power reductions and in the event of engine or fuel control failure. To prevent severe inlet buzz, the inlet control system, when on, will fully extend the affected ramp to the 21.5-degree (24.0-degree*) (down) position whenever the airspeed is above 1.3 (1.6*) Mach and the engine rpm drops below approximately 95%, either by pilot action or a failure. This will not illuminate the RAMP CONT caution indicator, since the monitor circuit, which normally indicates failure if the ramps are more than 3 degrees apart, is bypassed in this case. When speed drops below 1.3 (1.6*) indicated Mach or rpm is increased above approximately 95%, the monitor circuit will be reactivated, allowing the system to monitor off and illuminate the indicator. Holding the RAMPS switch in RESET for 3 seconds will reset the ramp to the normal schedule. Should reset be unsuccessful, follow the ramp control system inoperative procedures discussed under RAMP MONITOR, in this section.

Variable Ramps

Below 0.3 Mach, the variable ramps are maintained in the fully retracted position with the inlet control system in normal operation. Between 0.3 Mach and 0.95 (1.27*) Mach, the system maintains a 2-degree (4-degree*) ramp down position on normal schedule. Above 0.95 (1.27*) Mach, the variable ramps are automatically positioned by hydraulic actuators in accordance with a programmed schedule, increasing to about 15.1 degrees down at maximum speed. At high supersonic speeds, inlet airflow is decelerated through two oblique shock waves and a normal shock wave. The ramp schedule provides duct airflow with high-pressure recovery for good engine performance throughout the airspeed envelope.

Ramp Monitor

Should a failure occur which results in the inlet control system driving the ramps to positions differing by more than 3 degrees, the control system will monitor off, providing a "fail-safe" mode of operation. The RAMP CONT caution indicator will illuminate. At the higher subsonic speeds and above, positive inlet duct pressures will drive the ramps slowly toward the fully retracted position. At lower airspeeds, however, negative inlet duct pressures will tend to draw the ramps very slowly toward the extended position because tolerances allow a small leakage past the integral bypass valve on the ramp actuator. Flight speed should be limited to 1.4 indicated Mach with the ramp control system inoperative. At low airspeeds, and particularly in the landing configuration, be alert for higher than normal thrust requirements indicating that one or both ramps have bled down excessively. If this occurs, avoid rapid throttle movement but use power as required up to maximum afterburner, and land as soon as possible. Precautionary single-engine landing procedures, including 30 degrees flaps/25 degrees droops, are recommended. Refer to Section V.

CAUTION

Subsequent to ramp control system failure, DO NOT repeatedly or continuously hold the RAMPS switch in RESET if reset is not successful. The RESET position overrides the ramp monitor circuit and hydraulic shutoff to the ramp actuators. This condition may cause one ramp to be driven full down, resulting in a large loss of thrust. If both ramps are confirmed to be full down prior to or during landing, holding the switch in RESET is recommended, since the system will not be damaged.

Single-Engine Operation

Under single-engine conditions at speeds above 0.3 Mach, and with the inlet control system reset in normal operation, windmilling drag may be reduced by turning off the MASTER switch of the windmilling engine, which will bypass the monitor circuit and position the respective ramp between 17 and 21.5 (24.0*) degrees down, depending on speed. To protect the aircraft from a failure of these override circuits at low speed, neither ramp will extend when the aircraft speed is below 0.3 Mach, regardless of other conditions. If speed is reduced below 0.3 Mach when one ramp has been extended as above, the RAMP CONT caution indicator will illuminate. The ramps should then be reset, returning the extended ramp to the scheduled position (retracted) and ensuring that the other ramp remains retracted as scheduled. If the RAMP CONT caution indicator cannot be extinguished by resetting the ramps, be alert for loss of thrust from the operating engine.

CAUTION

With the inlet control system operative, moving an engine MASTER switch to OFF at any Mach number above 0.3 will cause the corresponding ramp to extend (down), regardless of engine operation or rpm.

Bypass Gaps

On aircraft with J79-GE-8 engines, a variable area secondary air gap, located around each engine immediately ahead of the compressor inlet, acts to properly match engine airflow demand and inlet duct supply. These gaps, which are actuated by electrically powered rotary actuators, can modulate from a maximum of 80 square inches opening to a minimum of 30 square inches. Below 1.3 Mach, there is no requirement to decrease the bypass area, and the gaps are maintained at 80 square inches. Above 1.3 Mach, the gaps decrease to 30 square inches as a function of duct static pressure, ambient pressure, and aircraft Mach number. Air which is directed into the engine compartments by the gaps is used for engine and structural cooling and is ejected through the secondary nozzle of the variable area exhaust nozzle. Utilizing the bypass air in this manner forms an aerodynamic convergent/divergent exhaust nozzle, increasing engine thrust as much as 5 percent. The gaps also serve to minimize inlet drag and match engine and inlet airflow.

On aircraft with J79-GE-10 engines, the gaps can operate from a maximum of 110 square inches *(open)* position to a minimum of 30 square inches *(closed)* position.

***Aircraft having J79-GE-10 engines installed**

Below Mach 0.3, the gaps are maintained at the *closed* position. From 0.3 to 1.27 Mach, they are positioned to the *open* position and from 1.27 to maximum Mach, they are at approximately 1/5 *open* (45 square inches). If a low engine rpm condition occurs while above 1.6 Mach, the gaps will drive to the *open* position. An overpressure condition in the engine compartment while above 1.6 Mach will position the gaps to the *closed* position. In the event of a low rpm and an overpressure condition, the low rpm signal will predominate and cause the gaps to go to the *open* position.

Duct Airflow Instability

In the event of improper variable ramp angle scheduling at speeds above 0.95 (1.27*) Mach, the position of the duct normal shock wave becomes unstable and may alternately enter and leave the duct, causing rapid fluctuations in pressure. If caused by faulty ramp scheduling this instability is characterized by a low amplitude, moderate frequency buffet which increases in intensity with increasing Mach number. If caused by structural failure of an inlet ramp or failure of an engine rpm sensing switch during a power reduction, fully developed inlet buzz may occur. Should airflow instability or buzz onset occur, Mach number should be reduced as quickly as possible by extending speed brakes and retarding the throttles to not less than Military Thrust. If this buffet coincides with illumination of the RAMP CONT caution indicator, reset should also be attempted. Normally, if engine rpm is reduced to less than 95% rpm above 1.3 (1.6*) Mach, the engine rpm switch extends the ramp of the affected inlet to the full down position to preclude inlet buzz. When rpm is reestablished above the rpm switch limit or speed is reduced to below 1.3 (1.6*) Mach, the RAMP CONT caution indicator will illuminate and the ramp control system should be reset.

Inlet Buzz

Inlet shock wave instability and rapid cyclic oscillation constitute a phenomenon known as "inlet buzz." This may occur above 1.3 (1.6*) Mach when engine airflow demand is suddenly reduced by an abrupt change in rpm, flame-out, or compressor stall. At high Mach numbers, inlet buzz can occur below 95% rpm, as well as at low engine airflow (idle rpm or windmilling) conditions. It is characterized by extremely heavy airframe buffet combined with aircraft lateral/directional oscillations of low amplitude and high frequency. This phenomenon is violent and abrupt, calling for immediate pilot action to slow the aircraft to 1.3 (1.6*) Mach by extending the speed brakes and retarding the throttles to Military Thrust. Fully developed inlet buzz is considered unlikely to occur unless the ramps or rpm sensing switches should fail in conjunction with a throttle chop at high supersonic speed. If fully developed buzz is initiated by a throttle reduction with a malfunction of rpm sensing switches, the buzz can be eliminated by advancing the throttles to Military Thrust, while slowing by use of the speed brakes.

Inlet Buffet

Inlet duct flow instability or roughness can occur at Mach numbers greater than 1.6. This disturbance begins as a low-amplitude, light airframe buffet at 1.6 to 1.7 Mach. This buffet increases to mild or moderate levels at 1.95 Mach and varies at a constant level to V_L. This flow instability is primarily the result of inlet shock wave boundary layer interaction. This interaction is aggravated by inlet ramp mis-scheduling, secondary airflow modulation gap control malfunction, or colder than standard ambient air temperatures. There is no degradation in aircraft flying qualities such as that occurring during inlet buzz. No corrective action by the pilot is required. The buffet intensity can be reduced by climbing to altitudes above 45,000 feet.

Note

- When inlet ramps are fully extended by the rpm switch above 1.3 (1.6*) Mach, or when extended by turning the engine MASTER switch to OFF above 0.3 Mach, rapid engine acceleration to high rpm may cause compressor stall.
- To avoid compressor stall below 1.3 (1.6*) Mach with ramps extended, inlet ramp control should be reset prior to rapid throttle movements.
- Above 1.3 (1.6*) Mach, inlet ramps will extend full down whenever engine speed decreases below 95% rpm. Compressor stall can be avoided by accelerating to this engine rpm limit. When the RAMP CONT caution indicator illuminates, reset the inlet ramp control and continue engine acceleration.
- Resetting the ramp control system is unnecessary if engine rpm is maintained at 100% rpm above 1.3 (1.6*) Mach.

*Aircraft having J79-GE-10 engines installed

ENGINE COMPARTMENT OVERPRESSURE

If the engine compartment pressure exceeds 8 psi differential, the overpressure relief doors will open and the ENG DOOR caution indicator will be illuminated. The relief doors will automatically close when the compartment pressure decreases to less than 7 psi differential. If the light remains on, high airspeed, altitude, and power settings should be avoided in order to prevent engine compartment overheat and possible fire: land as soon as practicable.

ENGINE OPERATION

ENGINE STARTING

Engine ground starting requires both external a-c electrical power and engine starting air. Normal starts may be made with or without automatic shutoff of the air source, using the RCPP-105-1 pod or RCPT-105-3 unit. When using the automatic feature (electrical connection from aircraft to air unit), flow of start air begins when the engine START switch is moved to START, ignition operation is automatic, and start air is shut off automatically when an engine rpm of about 45% is reached. During pilot-controlled starts (electrical connection not used), the pilot must signal for airflow, depress the EMER IGN button or use engine START switch to obtain ignition, and signal for airflow shutoff at about 45% rpm. During pilot-controlled starts, the engine START switches need not be used. Since airflow is direct to the impingement starting ducts. However, the start switch is recommended for all pilot controlled starts to ensure proper utilization of heat and vent fault detection system. For complete engine operation procedures, refer to Section III.

CAUTION

Engine start should not be attempted with droops extended. Engine compressor loss due to BLC flow may cause hot starts. If droops are extended, move the flap control switch to CRUISE or SUPERSONIC, move the engine START switch to START or signal for airflow, and delay moving the throttle to IDLE until the droops have retracted to less than 25 degrees.

COMPRESSOR STALLS

Compressor stall is a breakdown of airflow in the engine compressor due to separation of airflow from the compressor blades, similar to the separation from a wing during an aircraft stall. Such stalls usually result from an inlet control or engine fuel control unit malfunction or compressor blade damage. Compressor stalls are recognized by (1) loss of rpm or "hanging" acceleration. (2) rise in EGT and abnormal change in nozzle area, or (3) a pulsating, explosive sound, possibly accompanied by light to severe vibration. During normal operation, the main fuel control unit automatically controls compressor stator vane angle by servo fuel pressure. Vane angle is modulated to regulate airflow rate and pattern through the early stages of compression to reduce the possibility of stall. The main fuel control unit also schedules engine rpm as a function of CIT and inlet guide vane angle to maintain adequate compressor stall margin. Refer to Section V for emergency procedures.

ENGINE OVERHEAT

Engine compartment overheat with resultant fire warning indication can be caused by extended gear down flight with only one generator operating, extended asymmetric engine operation (such as single-engine simulation), and prolonged AB operation as slow airspeeds. With AFC 359 the doors operate normally during single generator operation.

AIR STARTS

Best conditions for air start are found below 45,000 feet at less than 1.0 indicated Mach. The areas of positive and probable air start capability, as well as the operational limits of the engine, can be determined from figure 5-2. It should be noted that not all engines will perform exactly as depicted. Some engines will exceed these factors; some will fall short. The area of the afterburner blowout boundary may be preceded by an area of cyclic afterburner operation prior to final blowout. Should dual flame-out occur in a zoom climb, the aircraft should be returned to the area of probable air start before attempting a relight. For complete procedures and air start envelope, refer to Section V and see figure 5-2.

Note

If both engines are below 36% rpm, it is necessary to extend the RAT to obtain flight control hydraulic pressure and electrical power for air start. On some aircraft,* essential electrical power is provided automatically by the EPU if No. 2 hydraulic system pressure is available.

*Aircraft having AFC 350 complied with

AIRCRAFT FUEL SUPPLY SYSTEM

The aircraft fuel supply system includes internal tanks in the fuselage and wings, and provisions for additional fuel in the bomb bay and at four wing external store stations. Normal system transfer is automatic, except for transfer of drop tank fuel which must be selected by the pilot. In flight, all internal tanks are automatically pressurized to 5.5 psi by the air conditioning system. This pressure minimizes fuel loss due to altitude "boil-off" and improves the performance of transfer and boost pumps. For a system functional diagram, see figure FO-5. For tank and total quantities, see figure 1-8.

INTERNAL TANKS

FORWARD TANK

The forward tank is located aft of the main electronics bay. This tank contains a single low-duty transfer pump and is refueled by overflow from the sump tank when the sump is filled through the forward receptacle or air refueling probe. Should the forward tank transfer pump fail, fuel will gravity-feed into the sump tank through a gravity-flow check valve which maintains an even level in the two tanks, and prevents flow from the sump back to the forward tank.

SUMP TANK

The sump tank is located directly aft of the forward tank. All fuel is directed into this tank for distribution to the engine fuel systems. The sump tank is connected to the forward tank and receives fuel from the forward tank transfer pump or by gravity. Sump tank fuel is forced into the engine supply lines through a manifold by two dual-speed boost pumps. With both generators operating, selection of afterburning switches both pumps to high-speed operation. For single-generator operation, the sump tank boost pumps remain on low duty during afterburner operation. The two pumps incorporate standpipes which provide in excess of 30 seconds of inverted flight fuel supply at all power settings under negative "g" conditions.

WING TANKS

The wing fuel tank complex is composed of an overwing (top cap) tank and integral wing tanks. Top cap fuel gravity-feeds directly into the wing tanks. The integral tanks contain a two-speed transfer pump and a scavenge pump in each wing section. These pumps operate only when wing and overwing fuel is transferred to the sump in the normal sequence or when auxiliary transfer operation is selected. With both generators operating, the transfer pumps switch to high-speed operation on selection of afterburning when sump level is below approximately 2500 pounds, or WING AUX transfer, and during wing fuel dumping. The scavenge pumps, located on the outer portion of the main wing tanks, ensure movement of fuel to the central portion and the transfer pumps.

CAUTION

Low-duty wing transfer pump pressure with single-generator operation may result in sump tank depletion under maximum afterburner fuel flow conditions below 18,000 feet.

AFT TANK

The saddle-shaped aft fuselage tank is located above the bomb bay, forward of the vertical stabilizer. Fuel from the aft tank is transferred to the sump tank through the wing fuel transfer lines by three single-speed, low-pressure transfer pumps. Under normal (automatic) sequencing, aft tank pumps are activated concurrently with wing pumps, and fuel begins transfer to the sump tank when approximately 400 to 700 pounds of wing tank fuel remain. This sequence may be initiated manually by moving the WING switch to AUX with the bomb bay cans empty or depressurized (arresting hook down, refueling probe out, or weight of the aircraft on landing gear). During wing fuel dumping, aft tank fuel is dumped concurrently.

BOMB BAY FUEL CANS

Two or three 295-gallon fuel cans may be installed in the linear bomb bay. Can fuel is transferred directly to the sump tank by pressure from the air conditioning system. Under normal conditions, bomb bay fuel will be transferred automatically upon lifting of aircraft weight from the landing gear (after drop tank fuel depletion), when sump fuel level drops to approximately 2700 to 2900 pounds. The bomb bay cans are automatically depressurized on landing touchdown, when the arresting hook is extended, the refueling probe is extended, when can fuel is exhausted, or when wing dump is selected.

EXTERNAL FUEL TANKS

Four 400-gallon drop tanks can be installed at wing external store stations. When drop tank fuel transfer is selected, the tanks are pressurized by the air conditioning system, forcing fuel directly into the sump and wing tanks. If necessary, the tanks can be jettisoned, or released normally. Emergency jettison releases the tanks by gravity through pyrotechnic retraction of retaining hooks. Normal release retracts the hooks and force-ejects the tanks from the pylons.

Note

When stores (including drop tanks, empty or full) are retained on three or four external stations, move the WING switch to AUX as soon as bomb bay cans are empty (when sump level begins to fall below 2600 pounds) to avoid exceeding aft stability limits.

AIR REFUELING PROBE

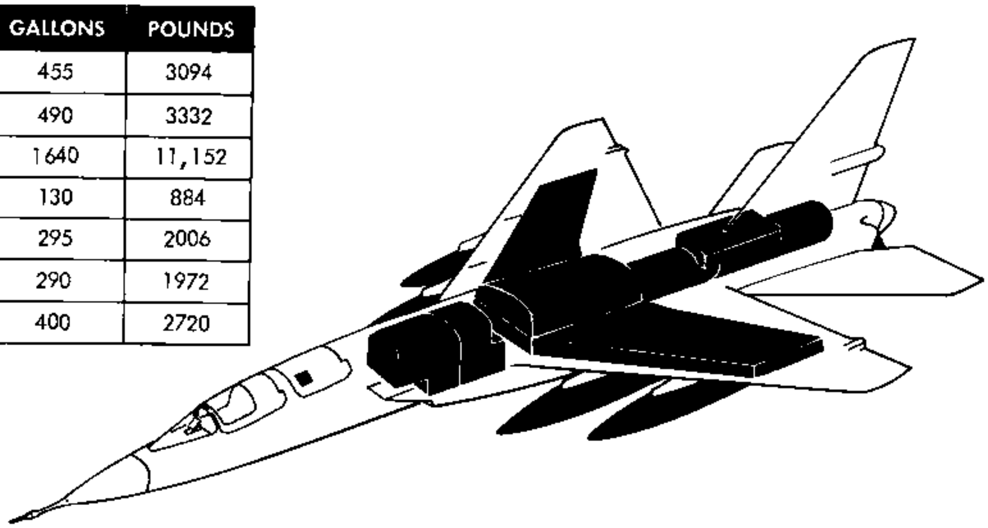
A hydraulically actuated, retractable air refueling probe is installed on the left side of the nose section. The probe is extended and retracted by No. 2 hydraulic system pressure, and controlled by essential d-c bus power. The probe forward fairing door is attached to the probe body and opens with the probe. The center and aft doors are operated by the No. 2 hydraulic system and are mechanically sequenced with the probe, remaining open when the probe is extended. On probe extension, internal air pressure in the external fuel tanks and the bomb bay fuel cans is relieved and vented overboard. Fuel received through the probe is directed to all internal and external tanks in the same manner as when fueling through the forward receptacle.

FUEL QUANTITY DATA

JP-5 FUEL (6.8 POUNDS/GAL STANDARD DAY ONLY)
FOR JP-4 FUEL USE 6.5 POUNDS/GAL FOR STANDARD DAY

TANK CAPACITIES (USABLE)

TANK	GALLONS	POUNDS
FORWARD	455	3094
SUMP	490	3332
WING (AND OVERWING)	1640	11,152
AFT (SADDLE)	130	884
BOMB BAY CAN (EACH)	295	2006
BUDDY TANK	290	1972
DROP TANK (EACH)	400	2720



FUEL LOADS FOR TYPICAL MISSIONS

CLEAN		2 DROP TANKS		4 DROP TANKS		LONG RANGE	
FULL INTERNAL BOMB BAY CANS (2)		FULL INTERNAL BOMB BAY CANS (2) DROP TANKS (2)		FULL INTERNAL BOMB BAY CANS (2) DROP TANKS (4)		FULL INTERNAL BOMB BAY CANS (3) DROP TANKS (4)	
GALLONS	POUNDS	GALLONS	POUNDS	GALLONS	POUNDS	GALLONS	POUNDS
3305	22,474	4105	27,914	4905	33,354	5200	35,360

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Figure 1-8

FUEL QUANTITY DATA

For fuel quantity data, see figure 1-8. Due to inherent gaging and fuel system characteristics, a 1.5 percent difference exists between the actual JP fuel dielectric constant/density relationship and the design value required by specification. In addition, approximately 300 pounds of usable fuel that is not gaged exists in the lines and tanks when the total fuel remaining exceeds approximately 10,000 pounds. It is recommended that the following conversion formula be used to compensate for this difference when planning a mission:

$$\text{Total Actual Fuel} = \frac{\text{Total Reading}}{0.985} + 300$$

The totalizer and sum of the individuals may differ by up to 400 pounds.

FUEL DUMPING

Wing and bomb bay can fuel may be dumped through a tube at the aft end of the fuselage. Refer to FUEL DUMP HANDLE, in this section. Bomb bay can fuel is forced through the dump line by air pressure in approximately 3 minutes (two cans) or 5 minutes (three cans). At normal (nose high) flight attitudes, wing (and top cap) tank fuel is pumped through the dump line in excess of 1020 pounds per minute by the wing transfer and scavenge pumps. Monitor sump fuel quantity closely to avoid inadvertent dumping of sump fuel.

CAUTION

- Due to fire hazard, fuel dumping is not to be accomplished during afterburner operation, except in an emergency.
- CANS and WING switches should be in NORM during dump operations.

CONTROLS AND INDICATORS

CANS SWITCH

The CANS switch (figure 1-9) is located on the FUEL TRANSFER panel. This solenoid-held switch is spring loaded to NORM, and held electrically in AUX if selected in flight. After the aircraft is airborne, the cans pressurize and the fuel transfers on depletion of drop tank fuel, if tanks are installed and selected for transfer. Use of the AUX position allows bomb bay can pressurization at any time, and permits immediate transfer of bomb bay fuel to the sump tank.

WARNING

Do not engage can AUX on deck with engines in afterburner as possible vent mast fuel overflow constitutes a serious fire hazard.

Note

- To obtain pressurization of bomb bay cans on the ground, the CANS switch must be manually held in AUX. On release, the cans will be depressurized and vented.
- The CANS switch automatically returns from AUX to NORM when can fuel is exhausted, the arresting hook is extended, when wing fuel dumping is selected, or upon landing.

DROP TANK TRANSFER BUTTONS

The drop tank transfer buttons (figure 1-9) are depressed to select fuel transfer from either inboard tank or both outboard tanks. Fuel transfer may be stopped

FUEL TRANSFER CONTROLS

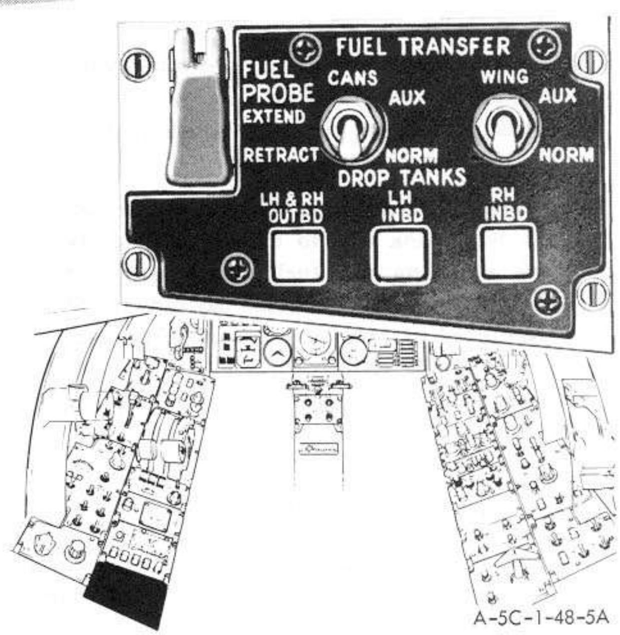

Figure 1-9

at any time by momentarily depressing the drop tank transfer buttons. This depressurizes the selected tanks.

Note

It is recommended that outboard tank fuel be transferred prior to transfer from the inboard tanks.

WING SWITCH

The WING switch (figure 1-9) is used to select normal or auxiliary transfer of wing and aft tank fuel. This solenoid-held switch is spring loaded to NORM, and held electrically in AUX if selected in flight with the bomb bay cans depressurized. Placing the landing gear handle to the DOWN position returns the switch to NORM. The NORM position allows automatic transfer in the normal sequence, following depletion of the bomb bay can fuel. The AUX position should be selected in the event of failure of wing fuel to transfer. Auxiliary wing transfer switches the wing pumps to high duty as required to maintain sump level at 2900 to 3100 pounds.

WARNING

Do not engage wing AUX on deck with engines in afterburner as possible vent mast fuel overflow constitutes a serious fire hazard.

Note

- The WING switch must be held manually in AUX for ground checks of the wing transfer and scavenge pumps.
- The CANS switch must be at NORM while transferring wing fuel in AUX. If the CANS switch is at AUX, the AUX position of the WING switch is inoperative.
- Common transfer lines direct both aft tank and wing tank fuel to the sump tank. Aft tank and wing tank fuel can be transferred out of sequence only if bomb bay cans are depressurized by extending the arresting hook, extending the refueling probe, or when on the deck, by holding the WING switch in AUX.

FUEL PROBE SWITCH

The FUEL PROBE switch (figure 1-9) controls air refueling probe extension and retraction. Probe extension, which requires approximately 8 seconds, automatically dumps internal fuel tank and bomb bay can pressure. Placing the switch to RETRACT restores fuel system pressurization and makes bomb bay can fuel transfer available.

Note

The FUEL PROBE switch guard provides switch protection in either the EXTEND or RETRACT position.

FUEL DUMP HANDLE

The FUEL DUMP handle (figure 1-18) is located on the left forward console. This handle has two fuel dumping positions. When the handle is pulled straight back, the bomb bay cans are pressurized and bomb bay fuel is dumped overboard. If the handle is further rotated 45 degrees to the right, the bomb bay cans are depressurized, the wing transfer and dump valve opens, the wing transfer pumps switch to high-speed operation, and wing and aft tank fuel is pumped overboard via the dump tube. Primary bus a-c electrical power is required for operation of the wing transfer pumps; however, with the landing gear handle up, some dumping occurs because of the 5.5-psi differential pressure in the tanks. On some aircraft,* the 5.5-psi differential pressure is maintained in the fuel tanks during wing dump regardless of landing gear handle position. Dump rate is improved by maintaining a normal flight (nose-up) attitude.

Note

During bomb bay can fuel dumping, periodically check the fuel dump handle to ensure that it has not slipped out of the dump position.

FUEL QUANTITY INDICATOR

A FUEL QUANTITY indicator (figure FO-4) is installed on the instrument panel. By using the fuel quantity selectors, individual tank quantities may be checked. Total fuel quantity is indicated by a digital counter, calibrated in pounds remaining. During individual tank selections of either internal or external tanks, individual tank quantity is indicated by the triangular pointer, while the total fuel counter remains fixed at the indicator before selection. A window on the face of the indicator shows the tank selected for check. With the EXTERNAL selector held at any drop tank position, the symbol "DT" appears. For internal positions, the window display corresponds to selector position. The totalizer and sum of the individual may differ by up to 400 pounds. The sum of the individual tank readings is usually more accurate than the totalizer.

FUEL QUANTITY SELECTORS

Two fuel gage selector handles (figure 1-10) are installed on the forward and aft portions of the left console. The INTERNAL selector is spring loaded to the SUMP position,

*Aircraft having AFC 299 complied with

FUEL QUANTITY CONTROLS

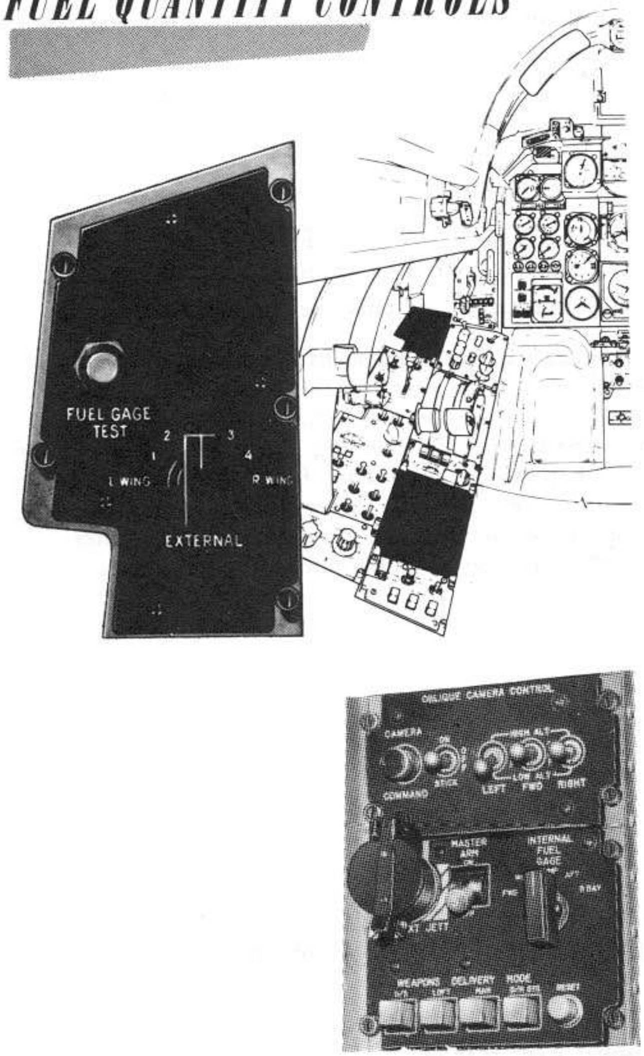

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Figure 1-10

and switches the indicating system to read fuel remaining in the FWD (forward), WING, AFT, and B. BAY (bomb bay) tanks. The EXTERNAL selector is spring loaded to a neutral (internal) position and, on selection, overrides the INTERNAL selector for indication of fuel remaining at external stations 1, 2, 3, and 4. With AFC 233 the internal fuel gage selector was relocated aft of the camera control panel.

FUEL GAGE TEST BUTTON

The FUEL GAGE TEST button (figure 1-10) is located outboard of the fuel gage selectors. When depressed to test FUEL QUANTITY indicator, the fuel totalizer and tank quantity pointer should run toward zero. On release, the indicator window and pointer should return to their original readings.

FUEL LOW CAUTION INDICATOR

The fuel low caution indicator (FUEL LOW, figure FO-4) automatically illuminates when the fuel level in the sump tank drops to between 1600 and 1950 pounds.

FUEL SYSTEM OPERATION

The normal transfer of bomb bay, forward, wing, and aft tank fuel to the sump tank is automatic. Drop tank fuel must be manually selected. With external electrical power connected, placing either engine MASTER switch to ON activates the forward tank transfer and sump tank boost pumps. Prior to take-off, the bomb bay CANS switch should be in NORM, and drop tank transfer buttons selected off. During ground operation, fuel from the forward tank will gravity-feed to the sump tank, as the proportioning valve remains closed until the aircraft is airborne. If take-off is delayed, the sump tank may be filled by ground transfer from the cans by holding the CANS switch in AUX. With normal load, this transfer should not exceed 2000 pounds. After the desired tank levels are attained, release the CANS switch to NORM.

CAUTION

If an empty drop tank is installed, selection of on-deck transfer of full tanks alone results in transfer of fuel into the empty tank.

FUEL TRANSFER

The forward tank transfer pump and sump tank boost pumps operate with electrical power available and either engine MASTER switch positioned to ON. With drop tanks installed and the transfer buttons depressed, transfer of drop tank fuel maintains the forward and sump tanks full until drop tank fuel is depleted. When airborne, the forward tank and the bomb bay can fuel transfer concurrently to the sump through a proportioning system. This proportioning controls the center of gravity of the aircraft to within acceptable limits. During this proportioning, when the sump reaches the 2900-pound (nominal) level, fuel is transferred to the sump until the 3100-pound (nominal) level is reached. Repeated cycling of the sump through this range, until the forward tank and bomb bay cans empty, indicates normal operation of the proportioning system. Gage reading will normally indicate between 2700 and 3200 pounds. Due to variance in engine demand and tolerances on individual components in the transfer system, either the forward tank or the bomb bay cans may empty first. Wing tank (and top cap) fuel transfers automatically when sump quantity falls to approximately 2300 pounds. As wing fuel is exhausted, the aft tank transfers to the sump until empty. When total fuel remaining drops below 3000 pounds, transfer volume is reduced and extended AB operation should be avoided.

Note

- Whenever the hook is in the down position, the air refueling probe is extended, or weight of the aircraft is on the landing gear, bomb bay can fuel will not normally transfer. This may result in increased longitudinal control sensitivity due to an aft center of gravity and/or a dangerously low sump fuel condition. If the FUEL PROBE switch is in EXTEND position, or arresting hook is extended and cannot be retracted, bomb bay fuel may be transferred by holding the CANS switch in AUX.

- During wing fuel transfer, the sump should maintain a level of 2200 to 2300 pounds. Under level flight conditions, aft tank fuel is normally last to transfer to the sump, occurring when about 700-pound wing fuel remains. Under maneuvering flight conditions, transfer of aft tank fuel may occur earlier.

Pressurization of the bomb bay cans cannot occur until the weight of the aircraft is off the landing gear to de-energize the air safety switch; internal fuel tanks are pressurized when the landing gear handle is raised to the UP position. Drop tank fuel transfer is manually selected after take-off. Under normal conditions, the drop tanks will keep the forward and sump tanks full (3100 and 3300 pounds) until drop tank fuel is exhausted.

FUEL TRANSFER SEQUENCE

The following table presents the normal transfer sequence without external tanks and with bomb bay cans installed. For fuel planning purposes, actual usable fuel aboard at the time of engine start may exceed the totalizer reading by as much as 600 pounds. This is due to an inherent gage error of 1.5 percent of the total, plus 300 pounds of usable, "ungaged" fuel existing in the fuel lines and tanks.

	NOMINAL GAGE READINGS				
SEQUENCE	FORWARD	SUMP	WING	AFT	BOMB BAY (TWO CANS)
Start	3100	3300	10,400 — 10,600	800 — 900	3900
Taxi, take-off	2500	2900	10,400	800 — 900	3900
Proportioning system transfer	(4)	2900(1)	10,400	800 — 900	(4)
Sump transfer	—	2300	10,400	800 — 900	—
Wing transfer	—	2300	700(2)	400 — 800(3)	—
Aft transfer	—	2300	—	—	—
FUEL LOW warning	—	1600 — 1950	—	—	—

(1) Sump indicates from 3100 to 2700 pounds (depending on actual fuel density) as fuel is transferred from forward and bomb bay

(2) Aft tank positive transfer starts with approximately 700 pounds in wing

(3) Some aft tank fuel will transfer concurrently with wing fuel transfer in maneuvering flight

(4) Due to variance in engine demand and tolerance on individual components in the transfer system, either the forward tank or the bomb bay cans may empty first

CAUTION

The WING and CANS switches should be held (not simultaneously) in AUX prior to take-off to check for positive transfer. Continuous wing aux or can aux operation on deck can overfill the forward tank and result in excessive fuel overflow in main fuel vent system and low point fuel drain. If bomb bay fuel fails to transfer after take-off, move the CANS switch to AUX and recheck. Failure to transfer bomb bay can fuel results in an aft center-of-gravity condition, seriously affecting pitch control during a landing approach.

Normal consumption will drop the sump tank level to approximately 2300 pounds when wing tank transfer begins. If normal sequencing fails, WING AUX should be selected. Alternate transfer procedures are described in Section V under ALTERNATE WING FUEL TRANSFER PROCEDURES. Aft tank transfer will maintain approximately 2000 pounds sump level (at cruise power settings) until exhausted. The FUEL LOW caution indicator will be illuminated when the remaining fuel reaches approximately 1600 to 1950 pounds.

INVERTED FLIGHT

The fuel system incorporates boost pump inverted flight standpipes controlled by gravity-sensitive valves. During negative-g flight, essentially all sump tank fuel is available for continuous flow to the engines.

FUEL SYSTEM VENTING

All internal fuel tanks are pressurized and climb/dive vented. The wing, aft, and sump tanks vent through the forward tank and into the normally open main vent valve and vent outlet pipe. The main vent valve is electrically energized (closed) when the landing gear is retracted, and relieves vent pressure at approximately 6.5 psi differential. A negative/positive relief valve is also provided in a line between the vent line and dump tube vent line (negative relief during defueling and positive relief for a clogged overboard vent). The bomb bay cans vent directly through a separate line, containing a pneumatically operated vent shutoff valve, to the vent outlet pipe. The shutoff valve is open for can venting and closed when the cans are pressurized. A bomb bay can relief valve bypasses any overpressurization to the vent outlet. A drop tank pressure vacuum relief valve will vent excessive air pressure overboard and relieve drop tank vacuum during descents. A small amount of fuel will normally discharge through the vent mast on take-off or catapult rotation and possibly during initial taxi following carrier arrestment.

REFUELING

All internal tanks may be refueled in approximately 7 minutes through two pressure refueling receptacles. The forward receptacle is located aft and slightly left of the nose gear well and the aft receptacle is located aft of the left main landing gear well. Aircraft with four drop tanks can be refueled in approximately 15 minutes. External a-c electrical power is required for refueling the drop tanks and level control valve testing. If the forward receptacle is used alone, complete refueling may require up to 30 minutes. The drop tanks may be separately hose-fueled, if desired. Refer to Section I, Part 3.

Note

- After refueling, the push-pull refuel-defuel select lever, located in the forward receptacle access, must be pushed upward to the FLIGHT AND DEFUELING position.
- Should operational requirements dictate refueling with the engines running, the air refueling probe must be extended to obtain fuel in cans, aft tank, and drop tanks. For carrier qual/FCLP fuel loads utilize the aft receptacle and wing aux for proper distribution.

FUEL SYSTEM FAILURES

Failure of fuel system boost or transfer pumps is not apparent using JP-5 fuel with the system pressurized. However, dropping fuel flow, erratic or subnormal engine operation (i.e., 80% rpm with throttles at MIL detent), or abnormal depletion of forward or sump tank fuel level should be sufficient reason to reduce throttle settings and maintain as high an altitude as possible where transfer rate meets engine demand. Failure of the 5.5-psi internal tanks pressurization feature together with boost or transfer pump failure may require descent to as low as 25,000 feet before Military Thrust can be obtained. The level of fuel in the sump tank is normally continuously indicated, and serves as the main guide to checking system operation and sequencing. Any radical change in sump level during the transfer sequence from that shown under FUEL TRANSFER SEQUENCE should be noted on the "yellow sheet" for maintenance investigation and/or corrective action. Failure of drop tanks to transfer can be noted by bomb bay can and forward tank transfer occurring prematurely and the sump cycling between 2700 and 2900 pounds, instead of being maintained at the 3100-pound level.

Note

Carrier arrestments are not permitted with fuel in external tanks.

Failure of bomb bay can fuel to transfer poses a potentially more serious problem than drop tank failure, since two full cans provide approximately 3700 to 3900 pounds contribution to aft center-of-gravity problems. Sump level drops to about 2300 pounds (after forward tank transfer), allowing wing fuel to transfer to begin. Recommended procedure is to maintain economical altiture and power settings while allowing normal wing fuel transfer and to attempt to regain can transfer by moving the CANS switch to AUX. If unsuccessful, rock and porpoise the aircraft to check for a sticking level control valve. Pull the ESS FUEL circuit breaker to cut power to the can pressure valve (held closed electrically). If all attempts to transfer bomb bay can fuel fail, pull the FUEL DUMP handle to the first detent and check the fuel quantity indicator for dump reaction.

WARNING

With fuel trapped in cans refer to Part 4 of this section for CG and arrestment limits.

ELECTRICAL POWER SUPPLY SYSTEMS

See figure FO-7 for schematic of electrical power supply systems.

A-C POWER SYSTEM

The basic power supply is a 400-cycle, constant-frequency, alternating-current system supplying three-phase power at 115 volts per phase. Voltage measured across any two phases is 200 volts. Normal a-c power is provided by two engine-driven generators. Essential a-c bus power can be provided by an emergency power unit which is driven by a dropout ram-air turbine. On some aircraft,* the emergency power unit is hydraulically operated.

GENERATORS

The aircraft is provided with two 42-kva a-c generators, providing a total system capacity of 84 kva. The generators are powered by independent, engine-driven, constant-speed drives which are cooled by passing oil from the engine oil tank through the frame and shaft of each generator. The constant-speed drives are hydromechanical transmissions which, by differential action, convert variable engine speed to constant speed to drive the a-c generators. A governor system is provided to serve two functions: to control drive output speed and to provide overspeed and underspeed protection. A pressure-sensitive switch is included in each circuit to disconnect generator output from the system in the event of an underspeed or overspeed condition. In the event of an overspeed condition, the generator will trip and will not reset until the engine has been shut down. If the generator drops out because of a temporary underspeed condition, operation is regained automatically without requiring reset.

Generator-on Lights

A generator-on indicator light for each generator is located in the external power access. The lights will be illuminated when generator output is at proper frequency and voltage, at which time it is permissible to switch from external to aircraft power. Although switchover can be initiated when either of these lights come on, disconnect should be delayed until both lights are on.

A-C POWER DISTRIBUTION

The a-c power distribution is divided into two independent systems. See figure FO-7. The No. 1 system is normally energized by the No. 1 generator and consists of the No. 1 primary, No. 1A and No. 1B secondary, and monitored a-c buses. The No. 2 system is normally energized by the No. 2 generator and consists of the No. 2 primary and essential a-c buses. If the output of either generator falls below approximately 95 volts, the generator is automatically disconnected and both bus systems are connected through a crossover by means of line contactors to receive power from the proper operating generator. Normally, power is supplied by the generators to the primary buses which energize the monitored, secondary, and essential buses. The monitored bus (which supplies nonessential equipment, all high-duty fuel pump operation, and the two nonprimary systems as selected through the SYSTEM switch) are cut off when one generator or one engine has failed. This ensures sufficient a-c power to the remaining systems. The essential a-c bus supplies power to equipment essential to navigation and communications. The essential bus is normally connected to the No. 2 primary bus, but in the event of failure of the No. 2 generator, power will be supplied by the No. 1 generator through the line contactors. The essential bus can also be powered by the ram-air turbine-driven emergency power unit.

D-C POWER SYSTEM

D-C CONVERTERS

D-C power is provided by two 200-ampere transformer-rectifier units (converters) which direct 28 volts to the d-c distribution system.

*Aircraft having AFC 350 complied with

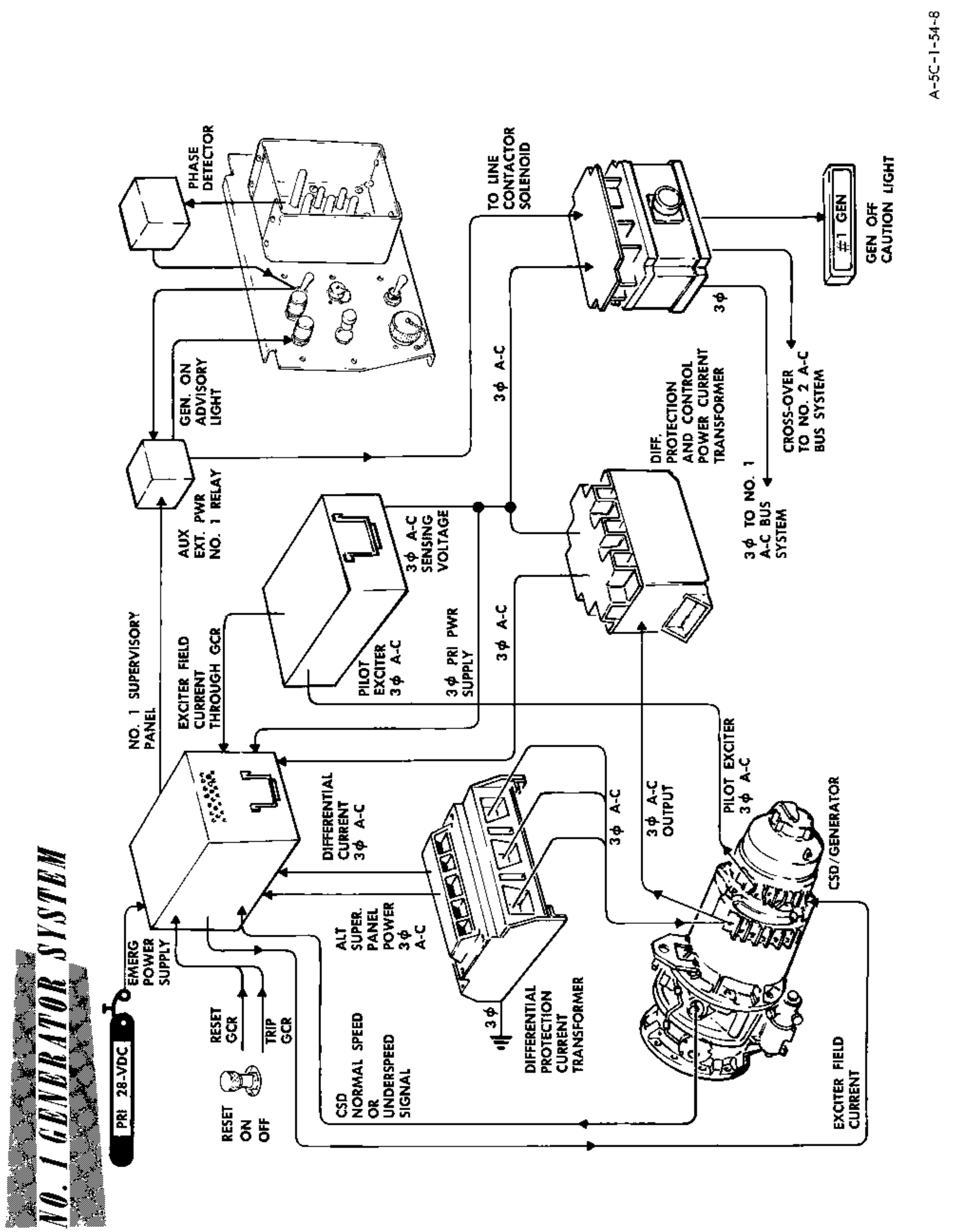
A-5C-1-54-8
NO. 1 GENERATOR SYSTEM
PRI 28-VDC
EMERG POWER SUPPLY
RESET GCR
TRIP GCR
RESET ON OFF
CSD NORMAL SPEED OR UNDERSPEED SIGNAL
NO. 1 SUPERVISORY PANEL
EXCITER FIELD CURRENT THROUGH GCR
AUX EXT. PWR NO. 1 RELAY
GEN. ON ADVISORY LIGHT
PHASE DETECTOR
PILOT EXCITER 3φ A-C
3φ PRI PWR SUPPLY
3φ A-C SENSING VOLTAGE
DIFFERENTIAL CURRENT 3φ A-C
ALT SUPER. PANEL POWER 3φ A-C
3φ
DIFFERENTIAL PROTECTION CURRENT TRANSFORMER
3φ A-C
3φ A-C OUTPUT
3φ A-C
3φ A-C
TO LINE CONTACTOR SOLENOID
DIFF. PROTECTION AND CONTROL POWER CURRENT TRANSFORMER
3φ TO NO. 1 A-C BUS SYSTEM
PILOT EXCITER 3φ A-C
CSD/GENERATOR
EXCITER FIELD CURRENT
3φ
CROSS-OVER TO NO. 2 A-C BUS SYSTEM
#1 GEN
GEN OFF CAUTION LIGHT

Figure 1-11

D-C POWER DISTRIBUTION

D-C power is distributed by two primary buses, two secondary buses, and an essential bus. See figure FO-7. The primary buses will receive power from either the No. 1 or the No. 2 transformer-rectifier unit. Should d-c bus voltage fall to 24 volts for 30 seconds, or should bus voltage drop to zero for 6 seconds, the system will automatically switch the faulty converter off the line. Should the fault be transient, the unit may be reset to operate normally. If the remaining converter should fail, the essential d-c bus can receive power from the emergency power unit if the ram-air turbine is extended. On some aircraft,* the essential d-c bus receives power automatically from the emergency power unit when required.

EMERGENCY ELECTRICAL POWER

In the event of a complete primary electrical power failure, emergency a-c and d-c power is obtained from the EPU, a hydraulically driven motor-generator unit. The EPU is supplied with hydraulic power by a dropout ram-air turbine which can be extended and retracted as desired. On extension of the turbine, the EPU provides 4-kva, 400-cycle, three-phase, 115/200-volt a-c power and 28-volt, 20-ampere d-c power for the essential buses. The EPU is capable of providing sufficient electrical power to effect an air start and make an emergency landing. On some aircraft,* windmilling rpm greater than 25% is required for hydraulic power to drive the EPU. If the EPU is supplying emergency electrical power, excessive flight control movements may cause momentary shutoff of the EPU electrical generator, extinguishing the ELEC EPU ON advisory light and deenergizing the essential buses. On some aircraft,* the EPU is relocated to the lower right-hand nacelle and is supplied hydraulic power by No. 2 hydraulic system to provide essential bus electrical power only. The EPU is initiated automatically if the primary a-c or d-c electrical power system fails, and can be tested on the ground or in flight at any time by depressing (and holding) the EPU TEST button.

EXTERNAL POWER

For ground operation of all buses, external a-c electrical power and cooling air must be supplied. The external power access is located on the left side of the fuselage, forward of the main gear. Equipment cooling air must be supplied to complete external electrical power circuits to aircraft components. If autonavigator alinement procedure has been initiated, care should be taken to disconnect external electrical power prior to removing cooling air. This precludes AN/ASB-12 power interruption and loss of alinement.

Note

The starting power source must be a 45-kva (minimum), 115-volt, three-phase (A, B, C rotation), 400-cycle unit.

GROUND COOLING

During ground operations with external electrical power applied to the aircraft, reconnaissance equipment and other electronic components require cooling air to prevent overheating. Electrical power to this equipment is controlled by relays and cooled component air temperature detectors. For normal ground operation of cooled equipment, cooling air temperature and flow rate must not exceed specified limits within the cooled components. In the event of insufficient cooling airflow, faulty hose connection, or abnormal air temperature, electrical power to the equipment is interrupted by the relays through the detectors.

Note

For external electrical power cooling air and engine starting units and requirements, refer to Section I, Part 3.

Aircraft Power Switch

The aircraft power switch is located on the external power access panel (figure 1-40). To apply external power to aircraft systems, this switch must be positioned to EXT with equipment cooling air applied. After engine start, the aircraft power switch is positioned to GEN by ground personnel, prior to removal of cooling air, to transfer the aircraft electrical system to generator output.

B/N Aline Power Switch

The B/N ALINE power switch is installed adjacent to the aircraft power switch on the external power panel. See figure 1-40. During autonavigator alinement with external power, the switch is positioned to EXT. After successful transfer of aircraft systems to generator power with the aircraft power switch, the alinement process may continue on external power as required. On completion of alinement, the B/N ALINE power switch is moved to GEN by ground personnel to complete transfer of the autonavigator to generator power without interruption.

CONTROLS AND INDICATORS

SYSTEM SELECT SWITCH

The SYSTEM select switch (figure 1-12) is provided for selection of the desired priority for distribution of a-c and d-c electrical power in the event of a generator or d-c

*Aircraft having AFC 350 complied with

converter failure. The switch is normally maintained in either the LOOK or LISTEN position as briefed for the primary mission. During normal operation of the electrical system, switch position has no effect on power distribution to reconnaissance and armament systems. To determine the switch position required to maintain power for the primary mission in event of an a-c and/or d-c electrical failure, refer to the SYSTEM SELECT SWITCH FUNCTIONS table.

SYSTEM SELECT SWITCH FUNCTIONS

ELECTRICAL COMPONENT FAILURE	SWITCH POSITION	EQUIPMENT POWER RETAINED
Generator	LOOK	SLR and cameras
	LISTEN	PECM
	ARMT	Armament equipment
D-C converter	LOOK	SLR, cameras, and PECM
	LISTEN	SLR, cameras, and PECM
	ARMT	Armament equipment
Generator and d-c converter	LOOK	SLR and cameras
	LISTEN	PECM
	ARMT	Armament equipment

ELECTRICAL SYSTEM CONTROLS

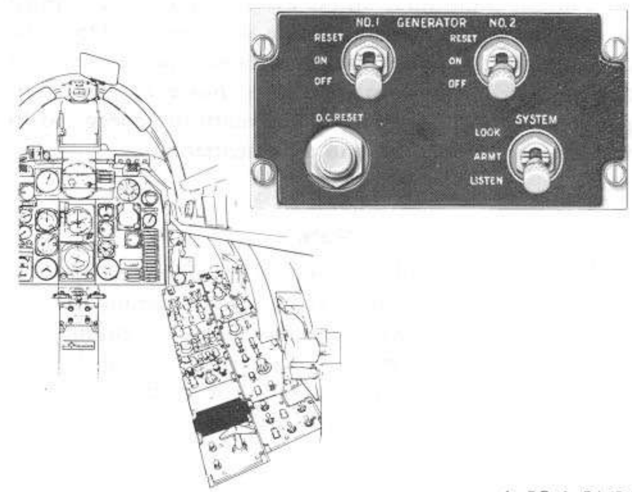

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Figure 1-12

GENERATOR SWITCHES

A control switch for each generator (figure 1-12) is located on the pilot's right console. The generator switches have three positions (OFF, ON, and RESET) and are maintained in either the ON or the OFF position. The a-c generators will assume the electrical load when external power is removed if the engines are up to idle speed and generator output voltage and frequency are within limits. Should the generator-on indicator lights at the external power receptacle remain extinguished after engine start is complete, the pilot will be advised and the generator switches should be held momentarily in RESET and released. If an attempt is made to reset the generator circuit while a fault still exists in the system, the circuit will reset and trip again. Additional reset attempts will result in no response.

Note

Properly operating generators will reset automatically as engine rpm builds. However, if the generator switches were placed at OFF prior to a previous engine shutdown, the generators must be reset after start. The aircraft power switch is not moved from EXT to GEN until both generators are "on the line" or reset.

EPU TEST BUTTON

On some aircraft,* the EPU TEST button (figure FO-4A) replaces the EMER AIR TURBINE handle located on the left side of the center pedestal. The switch is functional only for testing the EPU, since the EPU is energized automatically if the primary a-c or d-c electrical power system fails. Depressing and holding the EPU TEST button interrupts 28-volt d-c electrical power to the EPU control valve, allowing the valve to admit No. 2 hydraulic system pressure to the EPU hydraulic motor. The ELEC EPU advisory light comes on when the EPU reaches full operation. Releasing the EPU TEST button shuts off hydraulic flow to the EPU, causing the advisory light to go out.

*Aircraft having AFC 350 complied with

GENERATOR-OUT CAUTION INDICATORS

Generator-out caution indicators (#1 GEN and #2 GEN, figure FO-4) are located on the pilot's instrument panel. Each indicator is automatically illuminated when its respective generator line contactor is not connected to the bus system. In the event of loss of both generators, all cockpit lights will extinguish, including the generator-out caution indicators, unless external power is applied or the emergency ram-air turbine is extended. On some aircraft,* loss of both generators causes momentary loss of generator-out caution indicators; however, the emergency electrical power unit is automatically energized to provide power to the a-c and d-c essential buses.

Note

On engine shutdown with external power applied, check that the generator-out caution indicators illuminate at not less than 28% engine rpm. Illumination at lower rpm should be noted on the "yellow sheet" for maintenance corrective action.

D-C POWER CAUTION INDICATOR

A d-c power caution indicator (DC PWR, figure FO-4) is installed on the instrument panel. This a-c powered indicator signifies that either d-c converter is inoperative. Subsequent failure of the remaining d-c converter is indicated by the appearance of "power-off" warning flags in all d-c operated indicators, such as barber poles in the landing gear and speed brake position indicators.

D.C. RESET BUTTON

The D.C. RESET button (figure 1-12) is used to restore the output of a d-c converter in the event of dropout, or to obtain normal converter operation upon switchover from external a-c power. If the DC PWR caution indicator illuminates, this button should be momentarily depressed to restore both converters to normal operation.

EMERGENCY ELECTRICAL ADVISORY LIGHT

An emergency electrical advisory light (ELEC EPU ON, figure FO-4) is installed on the pilot's center pedestal.

CIRCUIT BREAKERS AND LIMITERS

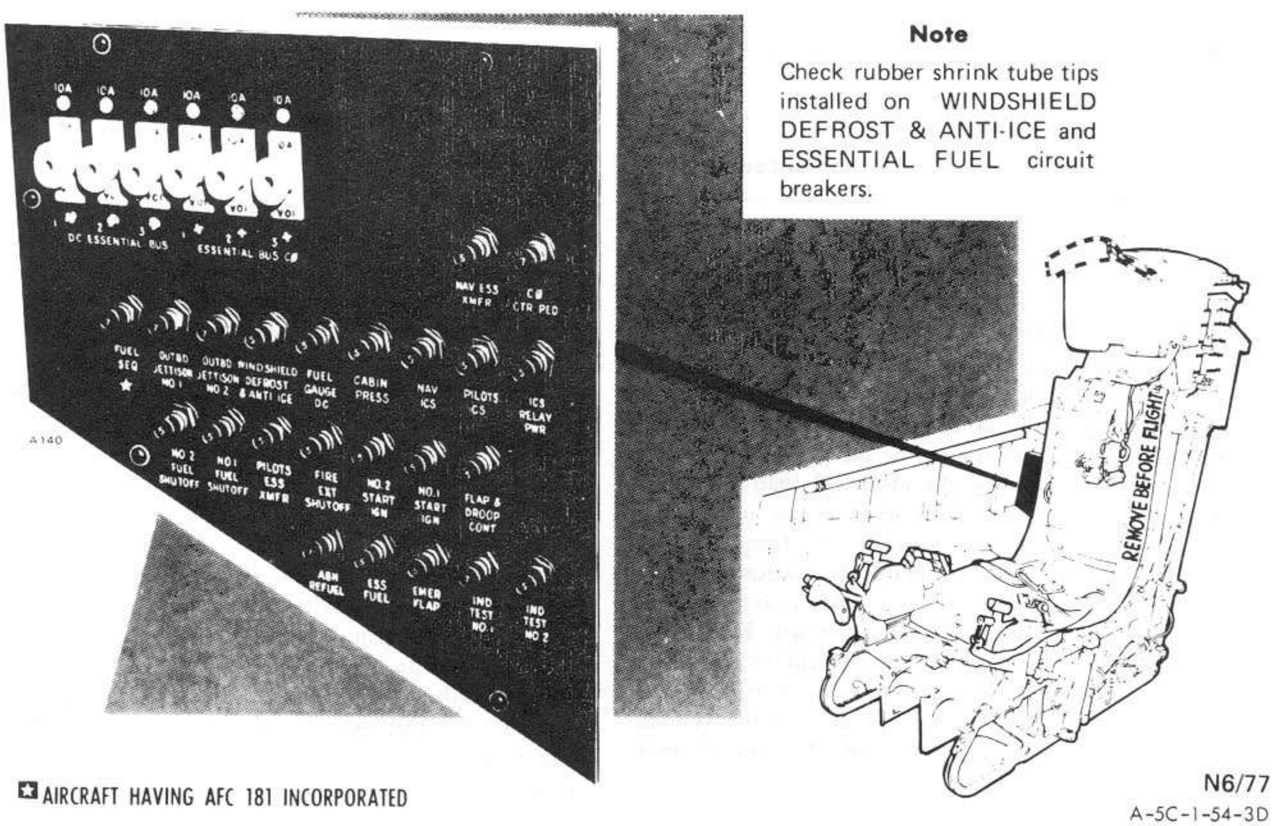

Figure 1-13

*Aircraft having AFC 350 complied with

This green light is illuminated when the RAT is extended and the emergency power unit is supplying the required a-c and d-c voltages. Proper operation of the emergency electrical system is indicated by restoration of power to essential indicators such as the landing gear and speed brake position indicators and AAI.

On some aircraft,* the advisory light is illuminated when EPU operation is automatically initiated by an aircraft primary electrical power failure. During shutdown of both engines on these aircraft,* the advisory light comes on as the generators monitor off and goes out when rpm decreases to 25%.

CIRCUIT PROTECTION

Aircraft electrical circuits are protected by circuit breakers, voltage limiters, and fuses. The pilot's circuit-breaker and limiter panel (figure 1-13) is located aft of the right console. Voltage limiters located on this panel protect essential a-c and d-c bus components. Protection for the instrument and lighting circuits is provided by fuses in the center pedestal and on the RAN's right console. The main bus distribution circuit-breaker panels are located in the electrical distribution bay above the nose wheel well and are not normally accessible to the flight crew for inspection.

AFT COCKPIT FUSES

A fuse panel (figure FO-1) is installed on the RAN's right console. These fuses control power distribution to the armament system indicator lights and the AN/ASB-12, as well as the essential cockpit lighting circuits. The RAN's fuses provide power for systems operation as follows:

FUSE	SYSTEM
MASTER ARM	ARM MAST'R on caution light power only
BOMB AWAY	BOMB AWAY advisory light power only
CNI	NAV COMD, COMM COMD, compass command, and SYNC light power
CAUTION LTS	CANOPY caution light power only
FIRE	FIRE warning light power (aft)
ALTR INSTR	Alternate source of 28-volt a-c power to the essential instrument a-c bus (oil pressure, hydraulic pressure, fuel flow indicators)
MAP LTS	Map lights power
POSITION LTS	Position and destination indicator lighting
B/N	Radar mode advisory lights, TSPI, ARI compass card, bombing computer, and range portion of pilot's HSI
FLOOD LTS	White floodlights
CONSOLE & INST LTS	Panel lighting and individual lights

*Aircraft having AFC 350 complied with

HYDRAULIC POWER SUPPLY SYSTEMS

Hydraulic power is supplied by two separate systems. See figure FO-9. Both systems have two independent pumps, a reservoir, and separate lines, delivering a basic no-flow pressure of 2800 to 3250 psi. The reservoirs are pressurized to provide adequate fluid supply to the engine-driven pumps under all conditions. Both systems are used at full pressure to power the vertical stabilizer, horizontal stabilizers, spoiler-deflectors, and the droop leading edge. Operation of the flight control systems on one system produces no noticeable difference from two-system operation for normal low-rate control movements. Sudden, high-rate longitudinal or lateral stick movements can, however, drop single-system pressure sufficiently to cause momentary stiffness. Should operating pressure in either system fall below approximately 650 psi, a pressure-operated switch energizes the master and HYD PRESS caution indicators. With the engines at equal rpm, operating pressure of a pump in either system should be within 300 psi of the opposing pump at all times.

NO. 1 SYSTEM

The No. 1 system provides hydraulic power to all basic flight control actuators and the droop leading edge. The No. 1 system supplies pressure to the No. 1 yaw augmentation system. In the event of complete failure of both No. 1 system pumps and no indication of fluid loss, pressure may be restored in this system by the emergency ram-air turbine (RAT). On some aircraft,* the RAT is removed from the system.

NO. 2 SYSTEM

The No. 2 system provides power to all basic flight control system actuators, the droop leading edge, and all other hydraulically operated systems and components. The No. 2 system pressure is reduced to 1500 psi for use in the longitudinal and lateral master actuators, pitch augmentation, and No. 2 yaw augmentation actuators, lateral free play link actuator, speed brake control, and SLR. No. 2 system pressure is used at full force to operate the landing gear, flaps, arresting hook, nose wheel steering, wheel brakes, fuel probe, pneumatic compressor, wing and tail fold, variable inlet ramps, ram-air turbine retracts, and gear stiff systems. A priority valve is located downstream of the flight controls and retains pressure upstream for the primary flight controls, should the pressure fall below 2200 psi. On some aircraft,* a normally open hydraulic, solenoid shutoff control valve is installed downstream from the subsystem priority valve to power the emergency electrical power unit (EPU); the EPU is not affected by the isolation valves. The subsystems for the ramps, fuel probe, and buddy tanker provisions are located downstream of the priority valve and upstream of two isolation valves. These isolation valves are operated by the No. 2 reservoir float switch so that if the fluid level of the No. 2 reservoir drops below 2.8 gallons, hydraulic pressure will be retained upstream to operate essential services. One isolation valve can be controlled by the HYD SUB-SYS ISOLATION switch and, when moved to the FLIGHT position, removes hydraulic power from nonessential systems and systems which have an independent emergency system. The following systems are never isolated: all flight controls, speed brakes, ramps, air refueling probe, buddy tanker provisions, and SLR. The pneumatic compressor and No. 2 system power to the leading edge droops are isolated only when there is a loss of fluid in the No. 2 reservoir. All other systems are isolated when there is a loss of fluid or when the HYD SUB-SYS ISOLATION switch is moved to the FLIGHT position. The SLR system is located downstream of the reservoir float controlled isolation valve so that low fluid level will isolate it.

CONTROLS AND INDICATORS

HYDRAULIC PRESSURE INDICATORS

Two miniature indicators are installed on the instrument panel (figure FO-4). The No. 1 and No. 2 system indicators each have two needles to provide pressure indications for both left and right engine pumps. No indication of emergency power unit hydraulic pressure is provided except for the HYD EPU ON advisory light on the center pedestal. The HYD PRESS caution indicator remains on if the ram-air turbine is the only source of power. The hydraulic pressure indicators receive power from the a-c essential instrument bus.

On some aircraft,* the HYD EPU ON advisory light and emergency hydraulic power unit (RAT) are removed from the aircraft.

HYDRAULIC PRESSURE CAUTION INDICATOR

A HYD PRESS caution indicator on the instrument panel (figure FO-4) is provided to warn the pilot when hydraulic system output falls below a safe minimum. Loss of pressure from one pump does not illuminate the indicator, but the affected pressure indicator needle will show the loss. The caution indicator illuminates if the pressure in either system falls below approximately 650 psi.

Note

Illumination of the HYD PRESS caution indicator with no pressure drop indicated for either system is an indication that a hydraulic isolation valve has closed and loss of fluid in the No. 2 system reservoir has probably occurred, and that systems powered by the No. 2 system alone will be inoperative.

HYDRAULIC SUBSYSTEMS ISOLATION SWITCH

The HYD SUB-SYS ISOLATION switch (figure FO-4) is located on the left console. This two-position switch is labeled TAKE-OFF/LANDING and FLIGHT. The FLIGHT position enables the pilot to close one of the isolation valves in the No. 2 hydraulic system. Isolated systems include the landing gear, flaps, wheel brakes, emergency wheel brakes, nose wheel steering, tail fold, wing fold, arresting gear, nose gear stiff and ram-air turbine retract. The switch must be placed in the TAKE-OFF/LANDING position for ram-air turbine retraction and all flight operations requiring the use of isolated subsystems. After returning to the TAKE-OFF/LANDING position, emergency operation of the isolated hydraulic subsystems may still be required. In the event a No. 2 hydraulic system leak does exist, a complete failure of the system may occur.

EMERGENCY HYDRAULIC POWER

If No. 1 hydraulic system pumps have failed without loss of fluid, pressure may be restored by extending the emergency ram-air turbine. At speeds at and above 150 KIAS, this turbine will supply sufficient pressure for operation of the flight controls at normal movement rates. However, an approach speed of 160 knots is recommended to assure pressure for all conditions. Lateral control should be kept to minimum rates. Under normal operation, the RAT hydraulic pump is isolated from system pressure by check valves. The emergency electrical power unit is hydraulically driven by the ram-air turbine. Retraction of the ram-air turbine is accomplished through use of No. 2 hydraulic system pressure.

On some aircraft,* the RAT, air turbine handle, and HYD EPU ON light are removed and the EPU is hydraulically driven by the No. 2 hydraulic system.

AIR TURBINE HANDLE

The air turbine handle (figure FO-4) is located on the left-hand side of the center pedestal. This handle is labeled EMER AIR TURBINE. Pulling the handle releases the turbine door-locking mechanism, allowing an actuator bungee to push the turbine into the air stream. The air stream then pulls the turbine fully extended, where it is locked in position. On some aircraft,* the air turbine handle is removed.

*Aircraft having AFC 350 complied with

TURBINE RETRACT BUTTON

Pushing the turbine retract button (EPU RETRACT, figure FO-4) on the center pedestal operates the turbine retract solenoid valve, causing No. 2 hydraulic system pressure to actuate the air turbine retract cylinder. The button must be held depressed for approximately 4 seconds or until turbine is fully retracted. Upon retraction of the turbine, the ELEC EPU ON and HYD EPU ON advisory lights are extinguished.

Note

> The HYD SUB-SYS ISOLATION switch must be in the TAKE-OFF/LANDING position before the air turbine can be retracted.

On some aircraft,* the EPU RETRACT button is labeled EPU TEST.

Emergency Hydraulic Advisory Light

An emergency hydraulic advisory light (HYD EPU ON, figure FO-4) is installed on the center pedestal. When electric power is available from either or both of the engine-driven generators, this green light is illuminated if the hydraulic pressure generated by the ram-air turbine-driven emergency power unit exceeds approximately 1750 psi. This light will extinguish if emergency pressure drops below approximately 1450 psi. When no electric power is available from the engine-driven generators, the emergency hydraulic advisory light can only illuminate if the emergency electrical power unit is operating (above approximately 2500 psi). Refer to EMERGENCY ELECTRICAL POWER, in this section. **On some aircraft,* the HYD EPU ON advisory light is removed.**

SINGLE-ENGINE HYDRAULIC OPERATION

During single-engine flight, the two remaining pumps will provide sufficient hydraulic power for normal flight control and/or subsystems operation. However, sudden high-rate longitudinal or lateral stick movements can cause automatic pressure monitor shutoff of pitch and yaw augmentation, electric flight control, and the inlet ramp control systems.

WARNING

> During single-engine flight or single pump No. 2 system operation, the pilot must use normal low-rate control movements. In the event that high-rate movements are necessary, the pilot should be prepared for monitoring off of the pitch and yaw augmentation, electric flight control, inlet ramp control systems, and illumination of their associated caution lights. The monitoring off of these systems will produce a significant change in the feel of the controls. If pitch aug monitors off be prepared to make pitch trim corrections to a new stick trim position approximately one inch aft of normal.

HYDRAULIC SYSTEM FAILURE

HYD PRESS CAUTION INDICATOR ON

Should the HYD PRESS caution indicator and master caution indicator illuminate with no accompanying loss of pressure in either system, a fluid leak in the No. 2 system is indicated. The most common failure would be located in one of the isolated secondary system, such as the landing gear, nose wheel steering, or arresting hook retract cylinder. If no pressure loss of fluctuations occur following illumination of the HYD PRESS caution indicator, it is assumed that automatic isolation of the secondary systems has stopped the loss of hydraulic fluid, and emergency methods must be used to operate the subsystems. Land as soon as possible.

PUMP FAILURES

Failure of one pump in the No. 1 system has no adverse effect on flight control or subsystems operation. Failure of one pump in the No. 2 system can, however, cause automatic pressure monitor shutoff of pitch and yaw augmentation, electric flight control systems, and the inlet ramp control system, should flight control demands reduce No. 2 system pressure sufficiently. The failure of a hydraulic pump will normally be indicated by a drop in pressure on the appropriate needle of the hydraulic pressure indicator. Should one pump fail (pressure zero or stabilized straight up) land as soon as practicable, or if on deck secure corresponding engine as soon as practicable to prevent system contamination (secure both engines on deck as soon as practicable). Failure of both pumps on either system shall be considered an immediate action emergency. The hydraulic systems have variable delivery pumps which pump as required upon demand and return to a feathered position. Should the pump fail to feather, pressure will build to the relief valve setting and continue to pump, generating sufficient heat that leakage may result. This will be indicated by a rise in pressure on the appropriate needle to a stabilized, near vertical position on the indicator. Should a pump fail in this manner, the appropriate engine should be reduced to idle and a landing made as soon as practicable.

*Aircraft having AFC 350 complied with

NO. 1 SYSTEM FAILURES

Complete failure of the system will be indicated by illumination of the master caution and HYD PRESS and YAW AUG caution indicators, and an associated drop in pressure on the No. 1 system (below 650 psi). Under these conditions, the No. 2 system will provide hydraulic power with loss of approximately 50 percent of normal control surface hinge power. Adequate control will be available; however, rapid control movements should be avoided. System fluid loss (or fluid loss associated with pump failure) can be suspected if the HYD PRESS caution indicator remains illuminated with RAT extension and the HYD EPU ON advisory light does not illuminate. Temporary extinguishment of the HYD PRESS caution indicator and illumination of the HYD EPU ON advisory light, followed by a return to the previously described condition of these lights, also indicates fluid loss. Dual pump failure can be assumed if system pressure is restored by RAT extension (indicated by illumination of the HYD EPU ON advisory light and extinguishment of the HYD PRESS caution indicator).

Note

Intermittent illumination of the HYD PRESS caution indicator will occur when large demands (especially lateral inputs) are placed on the system when a pump has failed, or when both pumps have failed and system pressure is being provided by the RAT.

On some aircraft,* the RAT and HYD EPU ON light are removed.

NO. 2 SYSTEM FAILURES

Complete failure of the No. 2 system will be indicated by a pressure drop of the applicable pressure indicators and illumination of the master caution and HYD PRESS caution indicators. The following systems will be lost: electric flight control, pitch and No. 2 yaw augmentation, speed brakes, variable inlet ramp operation, air refueling probe retraction and extension, normal landing gear retraction and extension, normal wing flap and droop operation, unlimited normal power brake applications, RAT retraction, EPU* hook retraction, nose wheel steering, wing and tail fold, pneumatic air compressor operation, SLR antenna, and gear stiff. If a complete failure, or any indication of an impending failure of the system occurs, the "kill" button should be depressed in order to secure the electric flight control and pitch augmentation systems while under optimum flight conditions. The pilot will declare an emergency and the field arresting gear shall be utilized when readily available.

DUAL HYDRAULIC SYSTEM FAILURES

Refer to HYDRAULIC FAILURES, in Section V.

PNEUMATIC POWER SUPPLY SYSTEM

The pneumatic power supply system provides high-pressure air for canopy normal operation, canopy emergency jettison, emergency flap extension, and emergency droop valve selection. Separate pressure storage bottles are provided for the canopy jettison and emergency flap extension system. The emergency flap bottle provides pressure for normal canopy operation when the aircraft is on the deck. On some aircraft,† a ground-operated canopy seal valve is provided for use in preventing rain entry to the cockpit when the aircraft is not in operation. Refer to PNEUMATIC SYSTEMS, Part 3 of this section, for further information. The pneumatic system bottles are precharged to 3200 psi, prior to flight, through the pneumatic service panel under the aircraft, inboard of the right main landing gear. The panel also contains check switches for the emergency flap system isolation valve and the pneumatic compressor. During flight, a hydraulic motor-driven air compressor maintains the bottles at 3000 psi. The compressor is powered by the No. 2 hydraulic system. Refer to CANOPIES, in this section, and see figure FO-10 for pneumatic system schematic.

CAUTION

Minimum pre-flight pneumatic pressure is 2800 psi to prevent compressor burn up on deck and to ensure adequate pressure is available for flap/droop emergency extension.

FLIGHT CONTROL SYSTEMS

The flight control systems are hydraulically powered and irreversible. The longitudinal and lateral systems are electrically controlled, hydraulically operated systems with a stand-by mechanical control system. The directional system is mechanically controlled and hydraulically actuated. The longitudinal and lateral systems use master actuators which are capable of accepting either mechanical inputs from the control stick or electrical inputs from the electrical control system. The master actuators mechanically position the control valves on the horizontal stabilizer and spoiler surface actuators. Movement of the control pedals is transmitted directly to the vertical stabilizer surface actuator. Electric trim actuators (controlled with conventional trim switches) are used for roll, yaw, and alternate pitch trim. Normal pitch trim is provided by using the same electric trim actuator and controlling it electronically using an input from the pitch trim synchro on the pilot's stick grip. Electronic augmentation systems are provided for both directional and longitudinal stability. Augmentation is accomplished by using inputs from gyros and accelerometers, air data computer information, and servo loop circuitry.

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*Aircraft having AFC 350 complied with
†Aircraft having AFC 280 complied with

CONTROL SURFACES

The horizontal stabilizers are one-piece all movable slabs attached to a spindle on each side of the aft fuselage. The vertical stabilizer is a one-piece all movable slab attached to a spindle on top of the aft fuselage. Six spoilers and six deflectors located on the upper and lower surfaces of each wing are used for lateral control.

LONGITUDINAL CONTROL SYSTEM

The horizontal surface actuators are tandem units powered by 3000 psi supplied by two independent hydraulic systems. The longitudinal master actuator is a tandem unit powered by reduced pressure (1500 psi) supplied by both hydraulic systems. Movement of the control stick, by the pilot, electrically or mechanically commands movement of the master actuator. As the master actuator moves, it mechanically positions the horizontal surface actuator control valves, causing movement of the surfaces. A flap-to-horizontal stabilizer interconnect system automatically changes the attitude of the horizontal stabilizers to offset pitch trim changes due to flap extension and retraction. Stabilizer position is shifted approximately 6 degrees leading edge down for full extension of flaps. Refer to LONGITUDINAL INTERCONNECT, in this section. See figure FO-11 for a schematic diagram of the longitudinal flight control system. See figure 1-14 for pitch control authority.

LONGITUDINAL ELECTRIC CONTROL

Normal control of the longitudinal system is electric. With the electric flight control system engaged, the longitudinal free-play link is energized to induce some free play into the mechanical linkage. With this free play induced, the electrical system functions to control the master actuator. Potentiometers connected to the control stick linkage produce signals (as the stick is moved) which are amplified and fed to the longitudinal master actuator servo valve. As the servo valve responds (to electrical commands), the master actuator moves, mechanically positioning the control valves of the horizontal stabilizer actuators, causing movement of the control surface. A follow-up potentiometer, moved by master actuator linkage, sends a position signal back to the amplifier, nulling the command signal when the proper control surface position is reached.

LONGITUDINAL MECHANICAL CONTROL

Stand-by control of the longitudinal system is mechanical. With the electric flight control system disengaged, the free-play link is disengaged and the stick movements are transmitted directly to the master actuator through cables, push rods, and bell cranks. Master actuator movements are directed to the surface actuator control valves in the same manner (push rods and bell cranks) as they are during electrical control.

PITCH CONTROL AUTHORITY

STICK/STABILIZER RELATIONSHIPS FOR
SPEEDS LESS THAN 0.3 MACH NUMBER

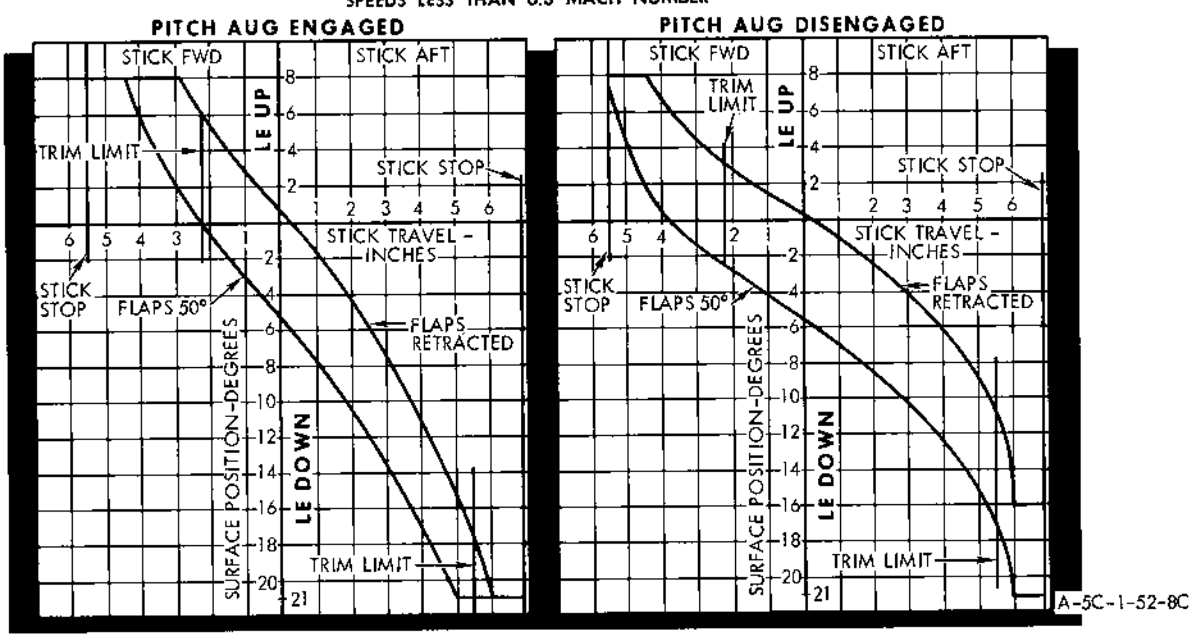


Figure 1-14

LONGITUDINAL INTERCONNECT

The flap to horizontal stabilizer interconnect screw jack is connected to the longitudinal series actuator and is driven by cables from the flap sector. As the flaps are raised or lowered, the screw jack is extended or retracted to reposition the series actuator. Repositioning the series actuator moves the control linkage to the horizontal stabilizer control valves and moves the stabilizers to a new neutral position. Stabilizer repositioning is proportional to flap extension. Normal or emergency extension of flaps to 50 degrees moves the stabilizer 5¾ degrees leading edge down and proportionately less for intermediate flap positions. Control stick position is not affected by this interconnect action.

LONGITUDINAL FREE-PLAY LINK

This link is installed in the output linkage of the control stick. When deenergized, it is actually a solid link connecting the stick movements directly to the cables controlling the master actuator. When the electric flight control system is engaged, the free-play link (solenoid clutch) is energized to produce free play in the mechanical linkage and permit the mechanical linkage to track the movements of the system as it operates electrically.

PITCH AUGMENTATION SYSTEM

The pitch augmentation system provides relatively constant pitch control characteristics over the entire range of speed and altitude. The system provides constant "feel" and accepts control signals from the pitch axis of the automatic flight control system (AFCS). The system provides direct horizontal stabilizer position control below 0.3 Mach, pitch damping above 0.3 Mach, and "g" command with pitch damping above 0.55 Mach. All components are dual for flight safety and include pitch rate gyros, longitudinal (normal) accelerometers, longitudinal series amplifiers, and a pitch augmentation servo actuator. The series actuator (operating through a mixer bell crank) operates the horizontal stabilizer actuators, adding to or subtracting from the control authority of the pilot's electrical or mechanical input. A differential pressure transducer in the series actuator constantly compares the operating pressures of the series actuator, providing a signal proportional to the unbalance. A balancer corrects the signal to the servo valves, resulting in equal piston pressures. Differential pressure switches in the actuator will shut off the system in the event of an unbalance beyond balancer capability. A failure of the No. 2 hydraulic system will also shut off the system through operation of hydraulic pressure switches which are a part of the control circuitry. A mechanical monitor is provided to disengage the system in the event of significant system opposition to pilot inputs. The monitor mechanism consists of a self-resetting hydraulic pressure dump valve, a roller attached to the series/master actuator output bell crank, and a slotted idler link attached to the dump valve. This mechanism is in addition to the electrical and hydraulic pitch augmentation monitors and bypasses the normal 2-second time delay prior to hydraulic shutoff of the series actuator.

LONGITUDINAL SYSTEM AUTHORITY

The following table summarizes horizontal stabilizer travel in relation to flap position and pitch augmentation system operation.

PITCH AUG	FLAPS	DEGREES AT LEADING EDGE UP (STICK FORWARD)		DEGREES AT LEADING EDGE DOWN (STICK AFT)
STBY	Up	8		16
ON	Up	8		21
STBY	50°	2.5	(Free-play link unlocked and bottomed; electric system disengaged)	21
STBY	50°	7 to 8	(Free-play link centered and locked; electric system disengaged)	21
ON	50°	8		21

PITCH (STICK) TRIM SYSTEM

Pitch trim is accomplished by repositioning the control stick, thereby moving the horizontal stabilizers to a new neutral position to trim the aircraft. There are three methods of controlling the stick trim actuator (normal, alternate, and emergency), which, in turn, changes the "no load" position of the longitudinal artificial feel bungee.

Normal Pitch Trim

Normally, pitch trim is accomplished by rotating the pitch trim control (synchro) on the pilot's stick grip. Normal pitch trim functions with pitch augmentation engaged or in a stand-by condition. As the trim control on the stick grip is rotated, command signals are generated in a control circuit and drive the trim actuator. As the actuator moves, it repositions the control stick, causing a corresponding movement of the longitudinal master actuator and pitch augmentation actuator (if pitch augmentation is engaged). Movement of these actuators causes the horizontal surface actuator to move and reposition the stabilizers to a new trim position. A feed-back potentiometer connected to the trim actuator linkage nulls out the command signal after the trim actuator has moved the necessary distance.

Alternate Pitch Trim

An alternate method of controlling the pitch trim actuator is available in the event that normal (electronic) control fails. The alternate method of trimming functions the same as the normal method except that the trim actuator is powered directly (through the trim switch on stick grip) with 115 volts ac instead of being controlled electronically through a synchro amplifier circuit. The TRIM select switch must be in the ALTR position to provide a-c essential bus power to the alternate pitch trim circuit. In the event of a complete failure of primary electrical power, the alternate pitch trim system operates on EPU electrical power.

Emergency Pitch Trim

A mechanical emergency pitch trim system is installed. A trim crank (in the forward cockpit) is connected to the pitch trim actuator by a flexible shaft. In the event of complete failure of normal and alternate pitch trim, the trim crank is used to drive the pitch trim actuator. Refer to EMERGENCY PITCH TRIM CRANK, in this section.

Pitch Trim System Authority

The authority of the pitch trim system is the same in all modes of operation (normal, alternate, and emergency). The following table summarizes pitch trim authority in relation to flap position and pitch augmentation operation (below 0.3 Mach).

PITCH AUG	FLAPS	DEGREES AT LEADING EDGE UP (NOSE DOWN)	DOWN (NOSE UP)
STBY	Up	3.5	11
ON	Up	6	17
STBY	50°	—	2 to 16
ON	50°	0	21

LONGITUDINAL SYSTEM CONTROLS AND INDICATORS

Control Stick

The control stick (figure 1-15) incorporates a normal pitch trim control, a five-position trim button, a STEER/TERRAIN button, a flight control systems off ("kill") button, and an armament initiation trigger. Full stick travel is 5.5 inches forward, 7 inches aft, and 3.37 and 3.42 inches left and right of neutral, respectively. With pitch augmentation engaged, apparent longitudinal stick stops may be felt because of bottoming surface actuators before reaching stick travel limits.

Electric Flight Control System Switch

The electric flight control system switch (ELEC SYS) is located on the flight control panel (figure 1-15). This three-position (STBY, RESET, ON), spring-loaded switch controls the longitudinal and lateral electric systems. To place the systems in operation, hold this switch in RESET until both the PITCH and ROLL indicators show "ON" and the ELEC F/C caution indicator goes out; then release the switch to the ON position. This operation disengages the free-play links in the mechanical systems, energizes the lateral and longitudinal master actuators in the electric mode of operation, and completes the circuit to the PITCH and ROLL indicators.

Electric System Pitch Indicator

The electric system PITCH indicator (figure 1-15) is located on the flight control panel, adjacent to the electric system switch. This indicator window displays "ON" when the longitudinal electric flight control system is in operation and blank when it is disengaged.

Electric Flight Control Caution Indicator

The ELEC F/C caution indicator (figure 1-15) is located on the right-hand side of the instrument panel. This indicator is illuminated when either the longitudinal or lateral electric system is disengaged.

Pitch Augmentation Switch

The pitch augmentation switch (PITCH AUG, figure 1-15) is located on the flight control panel. This switch has three positions: STBY, RESET, and ON. When the system is disengaged, the PITCH AUG caution indicator is on. To engage, hold the switch in RESET until the PITCH AUG caution indicator goes out, then release the switch to the ON position. With TRIM select switch in NORM, this action moves the stick to a neutral position (by centering the pitch trim actuator), energizes the pitch augmentation hydraulic shutoff valves, and energizes a holding circuit for system operation, extinguishing the PITCH AUG caution indicator.

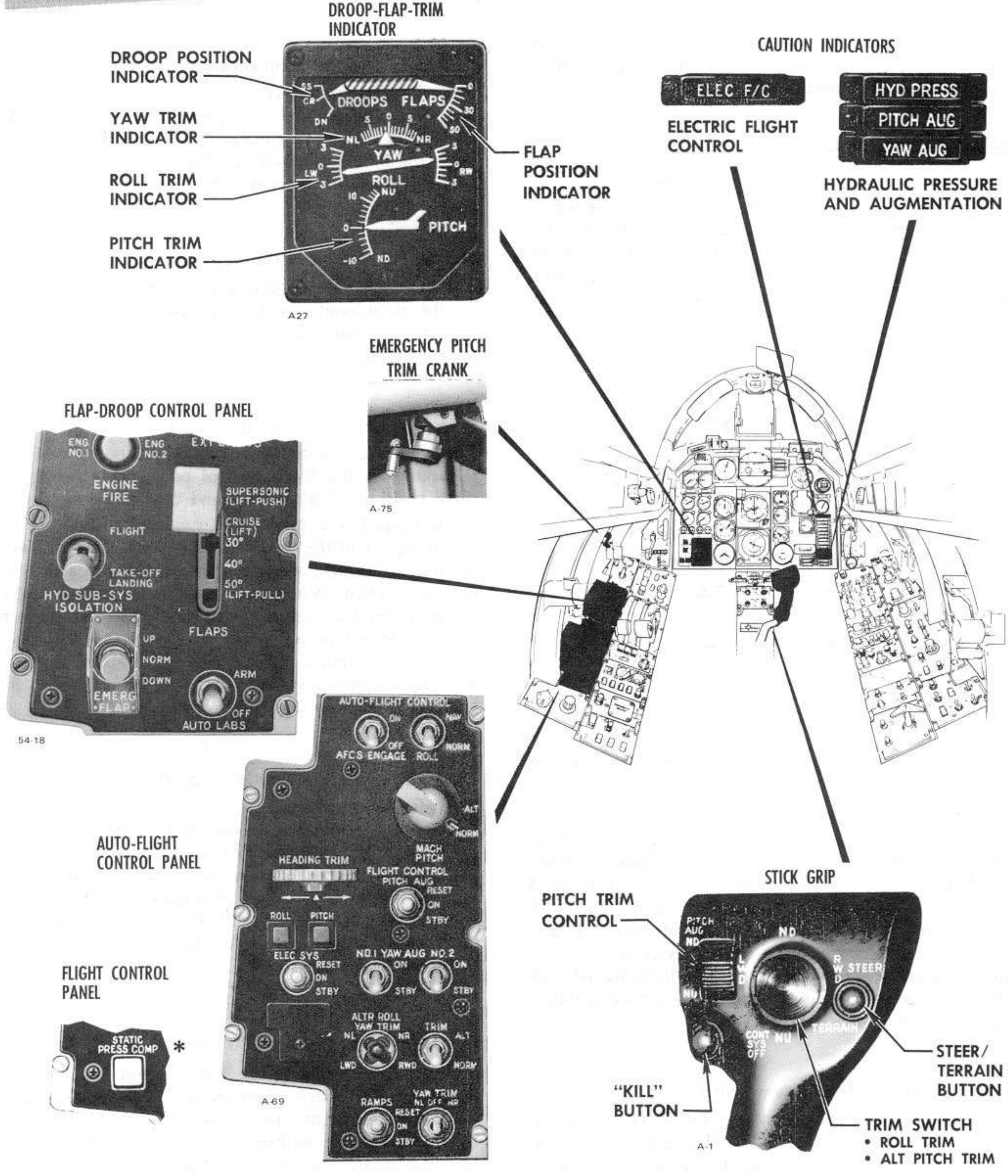
Pitch Augmentation Caution Indicator

The pitch augmentation caution indicator (PITCH AUG, figure 1-15) is located on the instrument panel. This indicator will be illuminated until the system is reset and at any time the system shuts off. The PITCH AUG caution indicator will not extinguish and the system will not remain engaged until the switch has been held in RESET a sufficient time to allow centering of the stick by the pitch trim actuator.

Control Systems Disable ("Kill") Button

Momentarily depressing the "kill" button (figure 1-15) disengages the electric flight control, pitch augmentation, and automatic flight control systems. The normal pitch trim system is also disabled as long as the "kill" button is held down, but the alternate trim system is available. Aircraft control is then accomplished through the mechanical flight control system. Electric systems may be re-engaged at any time after "kill" button use by resetting individual control switches.

FLIGHT CONTROLS AND INDICATORS



* AIRCRAFT NOT HAVING AFC 159 COMPLIED WITH

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Figure 1-15

Pitch Trim Control Wheel (Synchro)

Normal pitch trim is adjusted through a rotary synchro-type control (figure 1-15) installed on the face of the control stick grip. This control [NU (nose up), ND (nose down)] enables the pilot to neutralize stick forces through normal trim or to command aircraft normal acceleration ("g") through the pitch augmentation system. With pitch augmentation engaged below 0.3 Mach, the pitch trim control is used to trim horizontal stabilizer position, relieving control stick loads during take-off and landing. Above 0.55 Mach, the pitch trim control is a means of trimming normal acceleration ("g"). Trim control rotation changes the "no load" position of the stick, which changes the output voltage of the stick position potentiometer. Summing circuits in the amplifier compare the reference signal with acceleration signals from the normal accelerometers. The result is an error signal which is sent to the series actuator, causing the aircraft to nose up or down, seeking the trimmed condition.

Normal Roll and Alternate Pitch Trim Switch

The normal roll and alternate pitch trim switch (figure 1-15) is located on the control stick grip, to the right of the normal pitch trim control. This switch is spring loaded to neutral (off) from four trimming positions. The lateral positions are LWD (left wing down) and RWD (right wing down). These positions control normal lateral trim through differential displacement of the horizontal stabilizers. The vertical positions (alternate pitch trim) are NU (nose up) and ND (nose down). These positions may be used to trim out longitudinal stick force or command aircraft normal acceleration ("g") with normal pitch trim inoperative.

Trim Select Switch

The trim select switch (TRIM, figure 1-15) is located at the rear of the flight control panel. This switch has two positions: NORM and ALTR. In the NORM position, primary a-c bus power is supplied to all normal trim circuits. The ALTR position is used, in the event of electrical system failure or normal trim failure, to transfer control to the alternate roll/yaw and pitch trim switches and to shift the electrical power supply for all trim circuits to the essential a-c bus.

Droop, Flap, and Trim Indicator

All trim positions and droop and flap positions are indicated by a single unit (figure 1-16) installed on the instrument panel. Droop position is indicated at the SS (supersonic), CR (cruise), or DN (down) position. Flap position is indicated from 0 to 50 degrees. Vertical stabilizer trim is indicated from 0 to 8 degrees nose left and nose right. Horizontal stabilizer differential displacement (roll trim) is indicated from 0 to 3 degrees wing up or down for either wing. Horizontal stabilizer position is indicated from 0 to 16 degrees nose up and from 0 to 10 degrees nose down. The pitch needle is a miniature aircraft, indicating the degrees of horizontal stabilizer movement.

Emergency Pitch Trim Crank

The emergency pitch trim crank (figure 1-15) is used to mechanically drive the pitch (stick) trim actuator in the event of complete electrical pitch trim failure. This crank is located above the left console. Rotating the crank clockwise will trim the aircraft nose down. Counterclockwise rotation will trim the aircraft nose up. Each revolution of the crank displaces the horizontal stabilizers approximately 0.14 degree (seven revolutions per degree surface travel). The crank may be used at any time; however, if rotated during normal trim operation (TRIM select switch at NORM), all manual input is removed automatically.

LONGITUDINAL CONTROL SYSTEM OPERATION

With pitch augmentation and electric systems engaged, longitudinal electric flight control may monitor off at extreme stick travels as a result of remaining stick travel after the surfaces have reached bottom. If this remaining stick travel is applied, no additional master actuator travel can result so the stick motion will override the electric system and monitor off longitudinal electric system. With pitch augmentation on, the longitudinal electric system may monitor off with flaps full up and full forward stick applied. With pitch augmentation on, the longitudinal electric system may monitor off with flaps at 30 to 50 degrees and full aft stick applied.

LONGITUDINAL ELECTRIC CONTROL FAILURE

Should a malfunction occur in the longitudinal electric system, the pilot can return the system to mechanical control by (1) depressing the "kill" button on the stick grip, (2) restraining the control stick (hard-over condition) or applying a stick force to oppose the control movement, or (3) selecting the stand-by position of the electric system switch.

Note

- Depressing the "kill" button on the stick grip also disengages the pitch augmentation, automatic flight control, and lateral electric systems.
- Restraining the control stick or applying a stick force to oppose the control movement will disengage only the longitudinal electric flight control.
- Selecting the STBY position of the ELEC SYS switch will also disengage the lateral electric flight control.

PITCH AUGMENTATION OPERATION

The following conditions must be met for engagement of the pitch augmentation system:

1. A warm-up of at least 90 seconds.
2. No. 2 hydraulic pressure of 1150 psi or above.
3. Stick trimmed to neutral.
   (This is done automatically if TRIM select switch is at NORM and PITCH AUG switch is held in RESET).

Note

The TRIM select switch should be at NORM in order to engage pitch augmentation, but pitch augmentation may be engaged with the TRIM select switch at ALTR if the PITCH AUG switch is held in RESET and trim is moved to neutral by any trim method.

The pitch augmentation system consists of an electrically controlled, tandem piston hydraulic actuator, effectively in series with the longitudinal master actuator. Augmented system operation provides position trim at low speeds, pitch damping at speeds greater than 0.3 Mach and, relatively constant stick force and displacement per "g" command and long term stability at speeds above 0.55 Mach. The augmentation system controls the movements of a series actuator, which is attached to a mixer bell crank in the longitudinal control linkage. The final mixer bell crank output to the surface actuators is the algebraic sum of movements of both the master actuator (parallel system) and the series actuator (augmentation system). Each half of the tandem series actuator is controlled by a separate servo valve which accepts inputs from one-half of the dual electronic system. The output of these valves is constantly measured and a dual system balancer acts to equalize the output of the servo valves. Should an unbalance in signal beyond the capability of the balancer exist, differential pressure switches on the series actuator will disable the system, causing the series actuator to center and illuminate the PITCH AUG caution indicator. If the condition which caused the unbalance is transient, the system may be reset by placing the PITCH AUG switch in the RESET position. The PITCH AUG caution indicator will go out.

Low Speed

At speeds less than 0.3 Mach, stick movement by the pilot or through the trim system will produce direct stabilizer response for precise control of pitch attitude during take-off or landing.

Pitch Damping

Above 0.3 Mach, the system provides damping of short-period pitch oscillations. This feature is provided by using pitch rate signals from a pitch rate sensing gyro. The pitch signal is washed out to eliminate the steady-state signal such as that produced during a pull-up and/or a stabilized turn, and to allow only changes in the pitch rate signals to pass through. The pitch signals are summed with other inputs in the series amplifiers, and stabilizer position is modulated independent of stick position to maintain an effective zero pitch rate change.

High Speed

At high speeds (above 0.55 Mach), the stick position potentiometer output functions as a "g" command. This is accomplished by transition from series actuator position follow-up (position system) to an accelerometer ("g") follow-up system. During this mode of operation, the pitch trim control acts as a "g" trim control, allowing the pilot to trim normal acceleration as desired. Stick position potentiometer output is transmitted to the series actuators as a "g" command at the rate of one additional "g" for each 3/4 inch of stick travel. As the "g" change begins, pitch accelerometers send a signal into the series amplifiers, where the signal is compared with stick position input. Stabilizer position is varied by the resultant series amplifier signal, and the "g's" are maintained at the value commanded by control stick input. Constant stick force per "g" is automatically provided above 0.55 Mach, as the artificial feel bungee in the control linkage exerts a 5.6-pound force for every 3/4 inch of stick travel. When no acceleration command signal is present (no stick movement or trim control input), the accelerometer signal maintains the aircraft at steady-state acceleration, providing constant normal acceleration (long term stability).

Pitch Augmentation Failure

Normally, a malfunction in the pitch augmentation system will cause an unbalance in the operating pressures of the dual pistons in the pitch augmentation actuator. The dual system balancer tries to rematch these pressures. If the balancer cannot rematch these pressures, the differential pressure switches in the actuator will shut off the system and the PITCH AUG caution indicator will come on.

CAUTION

Pitch augmentation malfunctions can occur which will not monitor the pitch augmentation system off or illuminate the PITCH AUG caution indicator.

On some aircraft,* a mechanical monitor is provided to immediately disengage the pitch augmentation system in

*Aircraft having AFC 184 complied with

the event of significant pitch augmentation inputs in opposition to pilot stick command. This mechanism bypasses the 2-second time delay and immediately mechanically dumps the hydraulic pressure supply to the series actuator, thereby causing the actuator to recenter. This loss of pressure will energize the PITCH AUG caution light after 2 seconds. Electrical (parallel) control system operation is unaffected by this process. The monitor valve resets automatically. Special ground test procedures are required to check operation of this mechanical monitor system. Failure of pitch augmentation may be the result of No. 2 hydraulic system pressure loss or electrical malfunction. Should failure occur with the electrical and hydraulic systems operating normally, attempt to reset the system as desired.

WARNING

A malfunctioning pitch augmentation system cannot be monitored off by the use of opposing stick forces. On some aircraft,* a mechanical monitor provides system shutoff in the event of significant pitch augmentation opposition to stick commands. In any case, disable pitch augmentation by depressing the "kill" button if flight control system malfunction is encountered. Be prepared to make pitch trim corrections to a new stick trim position approximately one inch aft of normal.

CAUTION

Should an attempt to reset pitch augmentation result in an abrupt nose-up or nose-down pitch, move the PITCH AUG switch to STBY and do not make further reset attempts.

Large changes in airspeed (above 0.55 Mach with pitch augmentation in STBY mode) require more adjustment of pitch trim to maintain 1-g flight. This is required due to lack of automatic trimming ("g" feedback) with pitch augmentation off. In addition, flight in or through the transonic speed range is accomplished by stick force lightening or reversal. For landing, larger and heavier stick movement and force are required to correct pitch attitude and pitch trim corrections will not be as responsive. Firm, positive attitude corrections are required for glide path correction because stick to stabilizer gain is reduced with pitch augmentation off.

LATERAL CONTROL SYSTEM

Lateral control is provided by an arrangement of conventional and inverted spoilers and deflectors located on the inboard wing panels. The conventional spoilers, located at the mid and inboard positions, open a maximum of 70 degrees. The deflectors, located on the lower surfaces under the conventional spoilers, open a maximum of 35 degrees. The outboard spoilers and deflectors are inverted, the spoilers being on the lower surfaces and the deflectors on the upper surfaces. The inverted spoilers open a maximum of 70 degrees. With the droop leading edge fully retracted (SUPERSONIC), outboard spoiler-deflector opening is reduced to 48 degrees and mid and inboard spoilers to 40 degrees. With the flap control switch at CRUISE or lower (droops extended), full spoiler-deflector authority is regained. The deflectors and spoilers are mechanically interconnected so that movement of the spoilers results in movement of the deflectors. During rolling maneuvers with the flaps retracted, the inverted spoiler and deflector on the outside wing induce drag, offsetting the yaw effect of the mid and inboard spoilers on the inside wing. With flaps extended, the inboard, mid, and inverted spoiler-deflectors on the same wing operate together. A series of override bungees is installed in the mechanical linkage to the spoiler actuators to allow control of the lateral system in the event one set of actuators should fail. The spoiler-deflectors are also used for speed brakes. Refer to SPEED BRAKES, in this section.

LATERAL ELECTRIC CONTROL

The lateral electric system is designed to provide control for the corresponding hydromechanical system. Electrical operation eliminates mechanical system friction and provides reduced breakout force for lateral control. The master actuator servo valve requires No. 2 hydraulic system pressure for electrical operation. The master actuator servo valve is capable of accepting either mechanical commands through the control stick linkage, or electrical commands through an amplifier from a control stick position potentiometer. During electrical operation, stick movement produces a signal from the potentiometer which is amplified and fed into the lateral master actuator. The master actuator responds to the command signal, mechanically positioning the control valves of the spoiler actuators. A follow-up potentiometer, mounted in the master actuator linkage, sends a position signal back to the amplifier, nullifying the command signal when the proper control surface position is reached.

Lateral electric system operation independent of the mechanical system is maintained by a free-play mechanism which acts as a clutch in the mechanical linkage. This free-play mechanism is disengaged during electrical operation and the mechanical linkage aft of the free-play mechanism is forced to follow movements of the control stick through master actuator movements. With the flap control switch in SUPERSONIC, lateral electric control provides a reduced stick to spoiler gain through the lateral ratio changer. Spoiler control is limited by the lateral mechanical supersonic stops to 40 degrees (mid and inboard), and 48 degrees (outboard).

*Aircraft having AFC 184 complied with.

LATERAL MECHANICAL CONTROL

Stand-by control of the lateral system is mechanical. With the electric flight control system disengaged, the free-play mechanism is locked and stick movements are transmitted directly to the lateral master actuator through cables, push rods and bell cranks. Master actuator movements are directed to the surface actuator control valves in the same manner as they are during electrical control. With the flap control switch in SUPERSONIC, spoiler control is limited mechanically by the lateral mechanical supersonic stops.

LATERAL FREE-PLAY MECHANISM

The lateral free-play mechanism is a hydromechanical device consisting of a hydraulically extended, spring-retracted actuator and associated linkages. No. 2 hydraulic system pressure to operate the actuator is provided from the lateral master actuator shutoff valves. When the electric system is operative, hydraulic pressure extends the actuator and unlocks the mechanical movement from the cable system. If the electric system is switched off or fails, the solenoid-operated shutoff valves close off hydraulic power and the spring returns the free-play mechanism into mechanical engagement.

LATERAL CONTROL TRANSFER

To improve lateral control response at low speeds, a lateral control transfer mechanism is installed. With flaps extending toward 30 degrees, lateral system transitions from "upwing inverted spoiler" to simultaneously open all three sets of spoilers and deflectors on the "down" wing. With flaps less than 30 degrees and retracting, the lateral system transitions from the "all spoilers on down wing" configuration to the normal "up wing inverted spoiler" operation.

LATERAL RATIO CHANGER

The lateral ratio changer functions (with electric flight control operating) to reduce lateral control sensitivity and prevent excessive roll rates at high speed. The flap control switch provides for an electrical reduction in control stick-to-spoiler ratio when placed in the SUPERSONIC position. With the flap control switch at CRUISE or below (flaps extended), the lateral system operates at full deflection ratio.

LATERAL MECHANICAL SUPERSONIC STOPS

When the droops are in the cruise or take-off and landing position, the lateral master actuator has 70 degrees of spoiler authority in electrical or mechanical modes. When the droops are in the supersonic position, the master actuator authority will be limited (by the mechanical supersonic stops) to 40 degrees (mid and inboard) and 48 degrees (outboard) of spoiler travel in both the mechanical and electrical modes.

LATERAL SYSTEM AUTHORITY

Degrees of spoiler and deflector travel are shown in the following table:

	FLAP POSITION	
	SUPERSONIC	CRUISE
Inboard		
Spoiler	40	70
Deflector	20	35
Mid		
Spoiler	40	70
Deflector	21.5	35
Outboard		
Spoiler	48	70
Deflector	26	39

ROLL TRIM SYSTEM

Normal Roll Trim

Lateral (roll) trim is provided through differential displacement of the horizontal stabilizers. An electrical actuator is connected through reversing linkage to the control valves of the horizontal stabilizer actuators. When the trim switch (on stick grip) is moved, the electrical trim actuator causes differential displacement of the horizontal stabilizers, trimming the aircraft about the roll axis. Maximum displacement of horizontal stabilizers through use of the trim system is 3¼ degrees up on one stabilizer and 3¼ degrees down on the other stabilizer.

Note

- An override bungee is provided in the lateral trim linkage to allow any lateral trim to be removed if full nose-up or nose-down longitudinal control displacement is required. The lateral trim will automatically return when the control stick is returned toward neutral.
- A cam and roller mechanism is provided in the horizontal stabilizer control linkage to remove (wash out) roll trim when the stick is moved forward. With full roll trim in, moving the stick forward will start to wash out roll trim at the 1-degree leading edge down position of horizontal stabilizer. Roll trim is completely washed out at 3 degrees leading edge up of stabilizer.

Alternate Roll/Yaw Trim

With TRIM select switch in ALT, the alternate roll/yaw trim system will assume operation of lateral and directional trim in the event of normal trim switch or electric system failure. This system is powered by the essential a-c bus and, if necessary, may be operated on power supplied by the emergency ram-air turbine.

LATERAL SYSTEM CONTROLS AND INDICATORS

Electric System Roll Indicator

The electric system ROLL indicator (figure 1-15) is located on the flight control panel. This indicator displays ON when the lateral electric flight control system is in operation and is blank when the system is disengaged.

Alternate Roll/Yaw Trim Switch

The ALTR ROLL/YAW TRIM switch (figure 1-15) provides control of roll and yaw trim with the TRIM select switch at ALT. Roll and yaw-trim function is the same when trimmed with this switch as when trimmed with normal roll and YAW TRIM switches (TRIM select switch in NORM position), except that electrical power from the essential bus is used.

LATERAL CONTROL SYSTEM OPERATION

With flap control switch in SUPERSONIC and control stick held full left or right, the electric flight control system will monitor off when CRUISE is selected. This is due to the lateral ratio changer being switched out. Immediately, full spoiler opening (70 degrees) is commanded, driving the master actuator input linkage against the mechanical supersonic stops. Since the stops have not had enough time to reposition, they restrict the input linkage and trip the force switches in the master actuator, causing the electric system to monitor off.

Note

- If the roll trim system fails, the TRIM select switch should be moved to ALT and the ALTR ROLL/YAW TRIM switch should be used to remove control forces. If both generators are inoperative and the EPU is providing electrical power, select ALT position of the TRIM select switch and use alternate trim switch for trim control. Failure of the roll trim actuator cannot be corrected by selecting alternate trim.
- Selecting alternate trim for any trim axis requires that all axes be trimmed by the alternate method as long as the TRIM select switch is in ALT.

LATERAL ELECTRIC CONTROL FAILURE

Procedures for a lateral electric control failure are the same as for the longitudinal electric system. Refer to LONGITUDINAL ELECTRIC CONTROL FAILURE, in this section.

*Aircraft 151623 and subsequent and aircraft having AFC 150 complied with

DIRECTIONAL CONTROL SYSTEM

DIRECTIONAL RATIO CHANGER

To prevent high-speed overcontrol, the authority of the vertical stabilizer is controlled by the flap mechanical interconnect. With flaps retracted, full pedal travel results in 2 degrees stabilizer deflection. When flaps are extended to 30 degrees, stabilizer full deflection is proportionally increased to 8 degrees either side of neutral. This ratio mechanism affects yaw trim equally. With flaps retracted (SUPERSONIC or CRUISE), trim is restricted to 1½ degrees left or right. As flaps extend, trim authority increases to 7.5 degrees of travel on either side of neutral. To prevent radical trim change during flap extension, the yaw trim actuator incorporates centering switches which return the vertical stabilizer and the control pedals toward neutral during the ratio change.

Note

For a complete listing of flap system functions, see figure 1-17.

LATERAL/DIRECTIONAL INTERCONNECT

To improve roll characteristics at low speeds, lateral stick movements exceeding 1 inch from center provide linear displacement of the vertical stabilizer up to ±4 degrees if the flaps are extended 30 degrees or more. See figure FO-12.

YAW AUGMENTATION SYSTEM

A dual yaw augmentation system, comprised of two independent systems, provides fail-safe directional stability and damps out short-duration yaw oscillations. The total authority of the dual yaw augmentation system is limited to ±2 degrees of vertical stabilizer travel. Each system provides half the total vertical stabilizer movement of the dual system. With the flaps extended, the yaw rate and acceleration signals are cut off, and the yaw augmentation systems receive signals from roll/yaw rate sensing gyros, allowing the system to provide "dutch roll" damping. On some aircraft,* a 2-second time-delay relay prevents system transients from causing nuisance shutoffs during flap retraction. The high-speed system consists of yaw rate gyros, yaw accelerometers, two yaw amplifiers, and two hydraulic servo actuators (directional series) installed in the mechanical system. The directional series actuators control the vertical stabilizer actuator without affecting control pedal position. Yaw motions and skids result in signals from the yaw rate gyro and accelerometers. The signals are then fed to the yaw amplifiers, which boost the signals and relay them to the directional series actuators. The series actuators then cause the vertical stabilizer actuator to move, stabilizing the aircraft at zero yaw rate and acceleration about the yaw axis. The output signals of the accelerometers and gyros are fed to the yaw amplifiers through contacts of the ground safety relay. When the weight of the aircraft is on the extended landing gear, the system is rendered insensitive to input, eliminating spurious vertical stabilizer movements during ground operation.

CAUTION

If a rapid, undamped oscillation of the vertical stabilizer is encountered during taxi or other ground operation, indicating a ground safety relay failure, move both YAW AUG switches to STBY immediately.

YAW TRIM SYSTEM

The aircraft is trimmed about the yaw axis by changing the "no load" position of the directional artificial feel bungee. As the YAW TRIM switch is moved, the directional control pedals assume a new "no load" position, and the vertical stabilizer is displaced, trimming the aircraft about the yaw axis. The authority of the directional trim system and the total travel of the vertical stabilizer are controlled through the directional ratio changer. Cables from the wing flap system are attached to the drive bell crank and cause the ratio changer to operate as the flaps are extended or retracted. The drive bell crank through a link pivots the ratio changer arm. Movement of the arm changes the fulcrum point of the mechanism, thus providing a variable ratio in the input linkage to the vertical stabilizer. With the flaps extended more than 30 degrees, 7.5 degrees of left or right trim can be obtained. With the flaps retracted (SUPERSONIC or CRUISE), trim is restricted to 1½ degrees of left or right travel. To prevent a radical trim change during flap extension, the yaw trim actuator incorporates a centering feature which returns stabilizer trim toward neutral when the FLAPS switch is selected to 30° position or more.

DIRECTIONAL SYSTEM CONTROLS AND INDICATORS

Directional Control Pedals

The conventional style directional control pedals are electrically adjustable for leg length over a 7-inch range. When angle of attack exceeds 19 units, a vibrator on the right pedal is actuated as a stall warning device. The nose wheel steering system is operated through the directional control pedals in conjunction with the STEER-TERRAIN button on the control stick grip.

Control Pedal Adjust Switch

The control PEDAL ADJUST switch is located on the right-hand console and has three positions: FWD, OFF, and AFT. Adjustment of the rudder pedals is provided by an electric screw jack which is controlled by use of this switch.

Yaw Trim Switch

The YAW TRIM switch (figure 1-15) has three positions (NL/NR/OFF) and is located on the flight control panel. Yaw trim is controlled by holding this switch to NL (nose left) or NR (nose right) until the undesirable load is removed from the control pedals.

Yaw Augmentation Switches

The YAW AUG NO. 1 and YAW AUG NO. 2 switches (figure 1-15) have two positions: STBY and ON. With either or both systems inoperative, the YAW AUG caution indicator will be on. To place the systems in operation, move each switch to ON. This action opens hydraulic shutoff valves and energizes a holding circuit for system operation. The YAW AUG caution indicator should go out on successful engagement of the second system, engaged in either order.

Yaw Augmentation Caution Indicator

The yaw augmentation caution indicator (YAW AUG, figure 1-15) is installed on the instrument panel. This indicator will be illuminated whenever the aircraft electrical system is energized and one or both yaw augmentation systems are not engaged.

DIRECTIONAL CONTROL SYSTEM OPERATION

YAW TRIM

To prevent a large magnification of trim, the yaw trim actuator is automatically driven toward neutral upon selection of 30° flaps or more. The trim system will completely recenter under most conditions, depending on the amount of trim in the system and flap extension time (dependent upon air loads). Since yaw trim centering is deactivated when the flap position is 25° or greater, the trim will more closely approach neutral during slow flap extension. During flap extension, the trim indicator follows the movement of the vertical stabilizer. A change in yaw trim usually requires a slight change in roll trim.

Note

- In-flight selection of the 30-degree flap switch position (HYD SUB-SYS ISOLATION switch — FLIGHT) causes yaw trim to be inoperative.

- If the yaw trim system fails, the TRIM select switch should be moved to ALTR, and the ALTR ROLL/YAW TRIM switch should be used to remove control forces. If both generators are lost and the RAT is extended to regain electrical power, select ALTR position of the TRIM select switch and use alternate trim switch for trim control. Failure of the yaw trim actuator cannot be corrected by selecting alternate trim.
- Selecting alternate trim for any trim axis requires that all axes be trimmed by the alternate method as long as the TRIM select switch is in ALTR.

YAW AUGMENTATION OPERATION

The following conditions must be met for engagement of the yaw augmentation system:

1. A warm-up of at least 90 seconds.
2. No. 1 hydraulic system pressure (for No. 1 yaw augmentation actuator).
3. No. 2 hydraulic system pressure (for No. 2 yaw augmentation actuator).

With flaps down (30, 40, or 50 degrees), the yaw augmentation system receives signals from the roll/yaw rate gyros only. With flaps up (SUPERSONIC or CRUISE), the yaw augmentation system receives signals from the lateral accelerometers and yaw rate gyros only.

Yaw Augmentation Failure

Failure of a yaw augmentation system may indicate loss of No. 1 or No. 2 hydraulic system pressure or electrical malfunction within the directional series system. Should failure occur at high speeds, speed should be reduced cautiously to below current maneuvering limitations. The YAW AUG switches should then be checked to determine which system has failed. Landing in turbulence or cross wind with both systems inoperative may result in lateral/directional oscillation, requiring pilot control with directional control pedals.

AUTOMATIC FLIGHT CONTROL SYSTEM (AFCS)

The automatic flight control system (AFCS) is designed to provide automatic control of the longitudinal and lateral flight control systems from touchdown speeds at sea level to 2.0 Mach at approximately 55,000 feet. Refer to Part 4 of this section for current restrictions. During normal AFCS operation, the pilot can make pitch and roll stick steering corrections (within limits) without disengaging the system. The system utilizes inputs from the air data computer, flight reference set, AN/ASN-26, and the AN/ASB-12, and provides outputs to the longitudinal and lateral control systems. The automatic flight control system controls the aircraft longitudinally (hold altitude, hold pitch, hold Mach switching, and programmed "g's" during automatic LABS) through the pitch augmentation system. The aircraft is controlled laterally (hold heading, hold bank angle, automatic navigation, and automatic rollout to complete an automatic LABS maneuver) through the lateral channel of the parallel amplifier. The automatic flight control system amplifier outputs are used in place of the stick position potentiometer outputs during autoflight operation. However, the stick trim system will move the stick, causing the stick position potentiometer outputs to null any pitch error signals existing at the time AFCS is engaged. Output signals are limited to prevent the automatic flight control system from causing undesirable flight conditions. Interlocks (control circuits) are utilized to prevent automatic flight control system engagement until the lateral electric, longitudinal electric, and pitch augmentation systems are operating.

NORMAL MODE

Normal mode AFCS operation provides "hold pitch" control within 1 degree of the desired pitch attitude, and "hold heading" control within 1 degree of flight reference set heading output. Aircraft attitude limits in this mode are ±55 degrees of pitch and ±60 degrees of bank. Pilot stick-steering corrections to these limits may be initiated at any time in this mode without disengaging the system. For stick-steering, approximately 2.25 pounds maximum breakout force is required for pitch corrections and 2.25 pounds force is required for roll. Release of stick-steering breakout force at a bank angle of less than 5 degrees results in AFCS resumption or "hold heading" control. A stick-steering correction with stick centering at between 5 and 60 degrees of bank will switch the lateral system to "hold bank," resulting in a sustained, coordinated turn at the existing bank angle. This turn will be maintained until the aircraft is stick-steered to within 5 degrees of the wings level attitude and the control stick is centered. Should the pilot make a stick-steering correction in pitch, the longitudinal system will revert to "hold pitch" and will maintain the pitch angle at stick recentering, up to the 55-degree limit. A pilot-initiated correction of more than 55 degrees pitch or 60 degrees bank will disengage the AFCS. Any time the AFCS is disengaged or stick steering corrections are made, the ROLL switch and PITCH knob will revert to NORM (if not in NORM already).

ALTITUDE MODE

The altitude mode of operation is a function of the longitudinal control system, utilizing true pressure altitude signals from the air data computer. Altitude should be maintained within ±50 feet (or 0.2 percent, whichever is greater) above 10,000 feet, and ±30 feet below 10,000 feet. A longitudinal stick-steering correction reverts the system to "hold pitch." After the aircraft has been leveled at the new altitude, the ALT mode may be reselected.

MACH MODE

The MACH (hold Mach number) mode is a function of the longitudinal pitch augmentation control system, utilizing Mach number signal output of the air data computer. This mode should modulate aircraft pitch attitude to maintain true Mach number within 0.01 Mach of that present at time of mode selection.

NAV MODE

The ROLL switch may be placed to NAV as soon as desired after the AFCS is engaged. The aircraft will turn on course for the selected destination only when autonavigator equipment is installed and properly functioning. The longitudinal system will continue to operate in the selected mode. Refer to BOMB DIRECTING SET, AN/ASB-12, in this section.

AFCS CONTROLS AND INDICATORS

AFCS Engage Switch

The AFCS ENGAGE switch (figure 1-16) has two positions: OFF and ON. The electronic components of the AFCS are energized and warmed up when external or aircraft electrical power and cooling air are applied. After the electric flight control and pitch augmentation systems are engaged, placing this switch to ON, during flight within AFCS attitude limits, places the AFCS in operation. Should these limits be exceeded while stick-steering, the system will automatically disengage and the AFCS ENGAGE switch will return to the OFF position.

Roll Mode Switch

The ROLL mode switch (figure 1-16) has two positions: NORM and NAV. The NORM position provides "hold heading" or "hold bank" control. With the ROLL mode switch in NORM, stick-steering is available at all times. Steering corrections will revert the system to "hold bank" if the control breakout force is relieved at more than a 5-degree bank angle. The AFCS will then maintain a coordinated turn at the bank angle existing at stick release. To return to "hold heading," the aircraft must be stick-steered to a bank angle of less than 5 degrees and the control stick centered. The NAV position locks out the heading input of the flight reference set and supplies a steering signal from the AN/ASB-12. The use of stick-steering for heading corrections causes the lateral system to revert from NAV to NORM mode operation.

Pitch Mode Knob

The PITCH mode knob (figure 1-16) is a three-position rotary selector, with ALT (hold altitude), NORM (hold pitch), and MACH (hold Mach number) positions. After the AFCS has been engaged (in the NORM mode), and the aircraft is flying at the desired altitude or Mach number, the PITCH knob may be moved to the ALT or MACH position. These positions should not be engaged when rapid (abnormal) variations of altitude or Mach exist. A stick-steering pitch correction moves the knob from ALT or MACH to NORM. Once the correction is concluded and breakout force is relieved from the control stick, the knob may be repositioned as desired.

Heading Trim Wheel

The HEADING TRIM wheel (figure 1-16) provides vernier-trim control of aircraft heading in the NORM (hold heading) mode. Should a heading change be desired, the pilot may roll this control toward the desired direction of heading correction (1 degree per notch). The aircraft will roll into a coordinated turn and roll out when the selected number of degrees of heading has been reached.

Autoflight Indicators

These autoflight indicators are located on the upper right-hand shroud of the pilot's instrument panel (figure 1-16) and are as follows:

LABS AUTO — Blends with panel when off and indicates "ON" when the following conditions are met: AFCS engaged; store is aboard or MANEUVER switch is at PRACTICE; B/N SYS, LOFT, or O/S selected; AUTO LABS switch to ARM. Light will go out when store is released or at 90 degrees of pitch, whichever occurs first.

AUTOFLIGHT SYSTEM CONTROLS AND INDICATORS

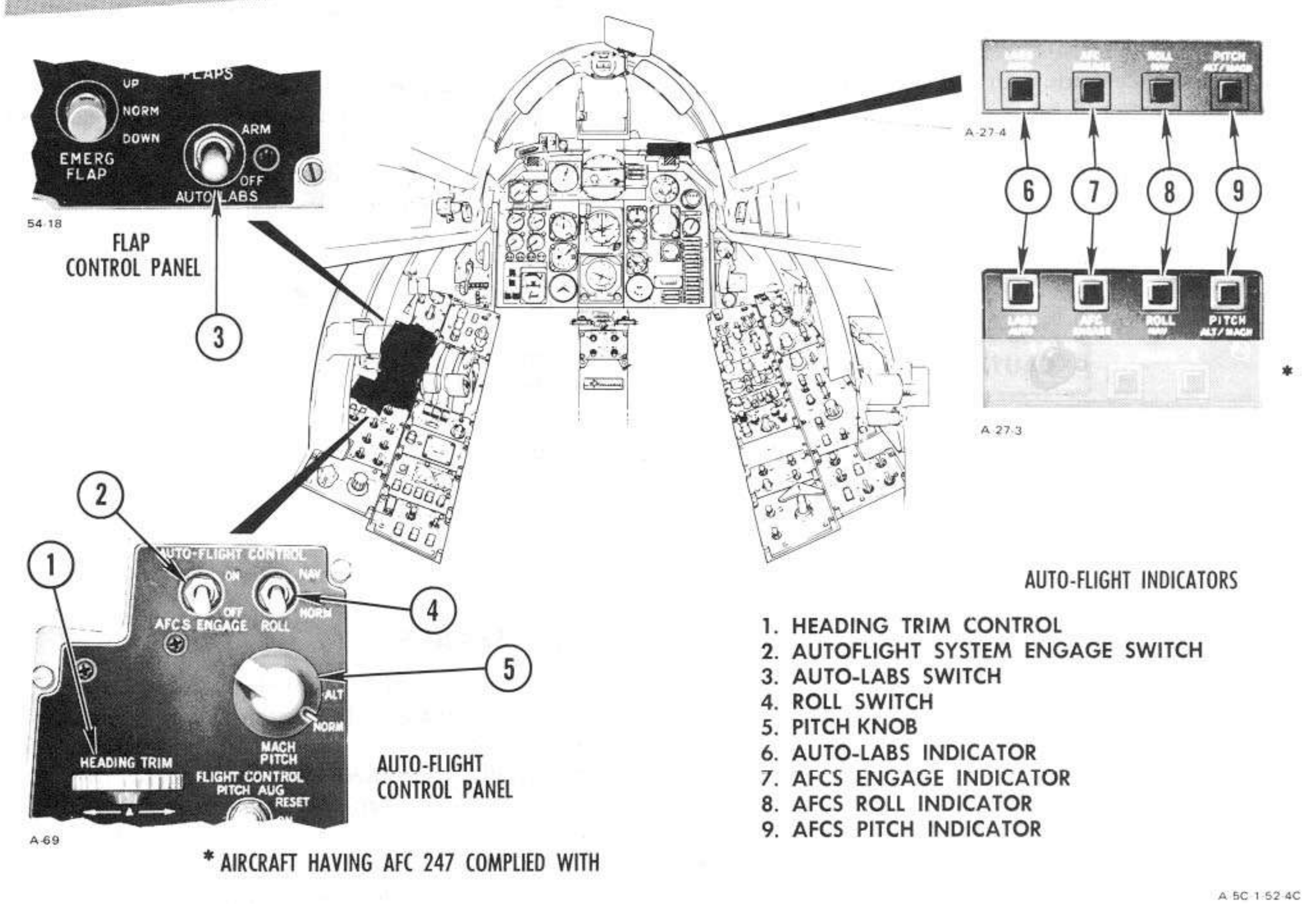


Figure 1-16

AFC ENGAGE	Blends with panel when off and indicates "ON" when AFCS ENGAGE switch is positioned to ON.
ROLL NAV	Blends with panel when off and indicates "ON" when AFCS ENGAGE switch is in NAV position.
PITCH ALT/MACH	Blends with panel when off and indicates "ON" when PITCH switch is in ALT or MACH position.

AFCS OPERATION

Normal Mode

1. Check the PITCH knob and ROLL switch at NORM and move the AFCS ENGINE switch to ON.

   Note the AFC ENGAGE indicator "ON." If the system is engaged in a turn, the aircraft will hold existing bank angle until changed by control stick steering.

2. Control climb Mach number by stick-steering pitch attitude as desired.
3. Make all fine heading changes by rotating the HEADING TRIM control.
4. Turns are accomplished by stick-steering the roll-in and rollout.

Note

- Do not use trim. Trim control rotation causes aircraft response; however, the effect is removed within a maximum of 15 seconds, depending upon the amount of trim input.
- Failure of the pitch augmentation or lateral and longitudinal electric flight control systems results in loss of AFCS operation.

Altitude Mode

1. When the desired altitude is reached, stick-steer the aircraft to a level attitude and move the PITCH knob to ALT.
2. Check PITCH ALT/MACH indicator "ON."
3. When accelerating or decelerating through the transonic speed range, a transient pitch effect may occur due to compressibility effects of the transonic speed range on the air data computer pressure sensing and compensation system. The NORM (hold pitch) mode of the AFCS should be selected, if required, to eliminate the transient effect.

CAUTION

- Changing SPC mode while in hold altitude (ALT) at subsonic speeds will cause aircraft pitch response, with severity depending on altitude and Mach number at time of change.
- Altitude should not be trimmed through use of the normal pitch trim control. Use of trim will produce an out-of-synchronization condition, causing a transient pitch response upon AFCS mode change or when a stick-steering correction is initiated.

Mach Mode

1. With the AFCS engaged, establish Mach number as desired.
2. PITCH knob—MACH.
3. Check PITCH ALT/MACH indicator "ON."
4. Adjust power as required for altitude control.

CAUTION

- Mach number should not be adjusted through use of the normal pitch trim control. Use of trim will produce an out-of-synchronization condition, causing a transient pitch response upon AFCS mode change or when a stick-steering correction is initiated.
- Exercise caution when engaging MACH mode while at low altitude or in rough air.

Nav Mode

1. When desired after take-off, engage AFCS in the pitch and roll NORM mode.
2. Stick-steer the aircraft to approximate heading desired and move the ROLL switch to NAV.
3. Check ROLL NAV indicator "ON."

Note

- The NAV mode is operable only when the AN/ASB-12 is in operation.
- During NAV mode, the PITCH mode knob may be in ALT, NORM, or MACH.

4. If a stick-steering heading change is made, the ROLL switch will move to NORM and the ROLL NAV indicator will go blank. When the aircraft is returned to the desired course, return the ROLL switch to NAV to resume operation.

AFCS FAILURE

Should a malfunction occur in the AFCS, causing pitch to exceed ±55 degrees or roll to exceed ±60 degrees, the system will monitor off automatically (if not in an automatic LABS maneuver). The system can also be disengaged at any time by momentarily depressing the "kill" button on the stick grip or placing the AFCS ENGINE switch to OFF.

SPEED BRAKES

Deceleration control is provided through the lateral flight control surfaces by opening all spoilers and deflectors simultaneously. The spoiler speed brake system is electrically controlled and operated by the No. 2 hydraulic system when the flap control switch is in CRUISE or SUPERSONIC. When the speed brake switch is moved to OUT, hydraulic pressure is ported to a spring-loaded speed brake actuator, which positions the lateral system mechanical linkage to obtain any desired position to a maximum deflection of 52 degrees inboard, 58 degrees outboard.

Lateral control is provided with the speed brake in any position through differential movement of the spoiler-deflectors while operating as speed brakes. An interconnect is provided which retracts and deenergizes the spoiler speed brake when the flap control switch is moved from SUPERSONIC or CRUISE to any position calling for extended flaps.

Note

Due to design air load limits, the inverted spoilers (outboard speed brakes) may not extend fully at speeds above approximately 500 KIAS.

CONTROLS AND INDICATORS

SPEED BRAKE SWITCH

A speed brake switch (figure FO-4) is located on the No. 2 throttle grip. This thumb-actuated switch has three positions: OUT (aft), IN (forward), and OFF (center). The switch is spring loaded to OFF (neutral) from the OUT position. The OUT position is deactivated with flap settings of 30, 40, or 50 degrees.

SPEED BRAKE DUMP HANDLE

A speed brake dump handle (figure FO-4) is located at the rear of the pilot's left console. This handle permits manual positioning of the speed brake selector valve so that No. 2 system hydraulic fluid is routed back to the reservoir. This allows the spring-loaded actuator to move the spoiler-deflector control linkage to the closed position. Either system hydraulic pressure now returns the speed brakes to the position demanded by the control stick input. This handle is held in the dump position by a ratchet incorporated in the handle shaft. To return the handle to the down position, the handle must be twisted clockwise. Spring action will return the handle to the console.

SPEED BRAKE INDICATOR

A speed brake indicator (figure FO-4) is located on the instrument panel. The indicator shows the fully open ("OUT") and fully closed ("IN") positions of the speed brake and displays a barber pole during speed brake movement, during the absence of electrical power, and whenever the speed brakes are stopped in an intermediate position.

CHARACTERISTICS

Speed brake extension at subsonic speeds is accompanied by an easily controlled nose-down pitch and moderate airframe buffet. Extension at supersonic speeds is characterized by high deceleration forces and speed brakes should be extended in increments. When decelerating through 1.0 Mach, pitch trim may reverse and pilot-induced oscillation may be encountered, particularly with pitch augmentation inoperative.

Note

- The mid and outboard spoilers may not extend fully at speeds above approximately 500 KIAS.
- A slight increase in roll sensitivity may be noted as the speed brakes open and close.

HIGH-LIFT SYSTEMS

FLAPS

The semi-full-span, slotted, double section flaps are electrically controlled and powered by the No. 2 hydraulic system. Normal no-load extension through the full 50 degrees of travel requires approximately 8 seconds and no-load retraction requires approximately 11 seconds. Flap emergency extension is provided by direct application of pneumatic pressure into the flap control valve and the flap actuators to extend the flaps to 50 degrees. Refer to EMERGENCY FLAP SWITCH and FLAP/DROOP OPERATION, in this section.

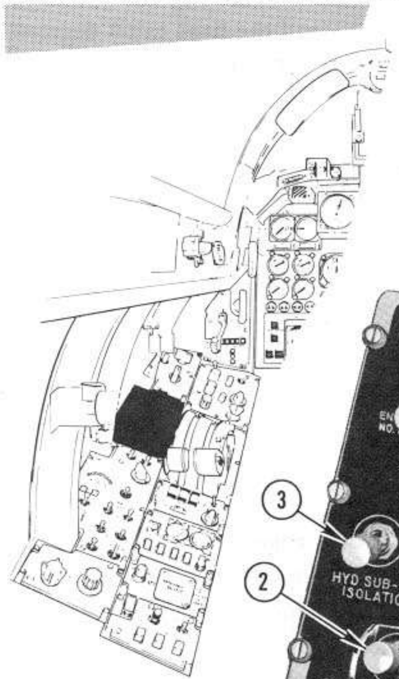
CAUTION

Extension of the flaps with the forward engine access doors open will result in damage to the flaps, the access door, or both.

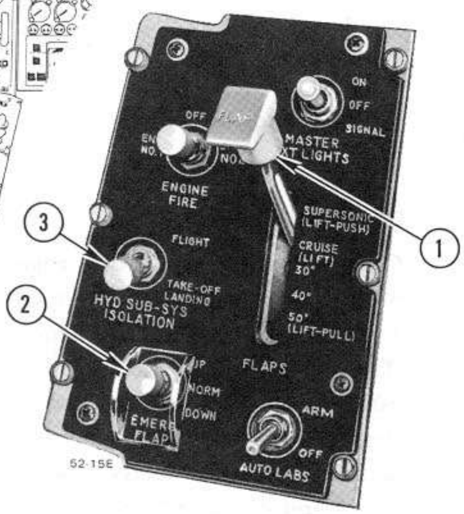
DROOP LEADING EDGE

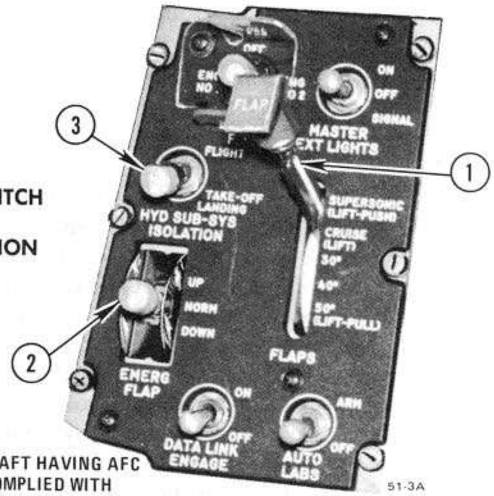
Complete-span droop leading edges are installed on each wing. Each wing droop leading edge consists of three hydraulically powered mechanically operated sections. The middle and outboard sections extend a maximum of 50 degrees, while the inboard section extends to 28.5 degrees maximum. The droops are operated through a series of hydraulic rotary actuators, driven by both the No. 1 and No. 2 hydraulic systems. Droop leading edge operation continues normally in the event of failure of a single hydraulic system. The combined change in airfoil resulting from lowered flaps and drooped leading edge sections increases lift and decreases stall speeds. For flight at less than transonic speeds, the CRUISE position provides best performance. In this position, the middle and outboard droop leading edge sections are lowered to 5 degrees and the inboard section to 3 degrees. For high-speed flight, the leading edges are fully retracted by placing the flap control switch in SUPERSONIC. Beyond the CRUISE position, droop operation lags flap movement slightly. At the 30° flap position, the droops get a direct signal to extend to 25°. At the 40°/50° flap position, the flaps must pass 25 degrees down before the droops get a signal to extend. In an emergency, it may be possible to extend the droops to 25 degrees for landing by first moving the flap control to 30° before selecting the 40°/50° flap position. Droop leading edge emergency extension is provided concurrent with flap emergency extension. Emergency pneumatic pressure is applied to an emergency droop position actuator, which mechanically opens the control valves on the droop rotary actuators, allowing No. 1 or No. 2 hydraulic system pressure to extend the droops to 50 degrees. Refer to EMERGENCY FLAP SWITCH and FLAP/DROOP OPERATION, in this section.

FLAP AND DROOP CONTROLS



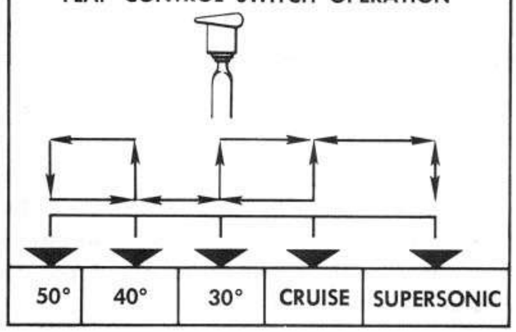
1. FLAP AND DROOP CONTROL SWITCH
2. EMERGENCY FLAP SWITCH
3. HYDRAULIC SUB-SYSTEMS ISOLATION SWITCH





AIRCRAFT HAVING AFC 233 COMPLIED WITH

FLAP CONTROL SWITCH OPERATION



FLAP/DROOP-OPERATED FUNCTIONS

FUNCTION	CONTROLLED BY	FLAP CONTROL SWITCH POSITION			
		SUPERSONIC	CRUISE	30°	40 OR 50
Flap position	Electric actuator	Zero	Zero	30°	40 or 50
Droop position	Electric actuator	Zero	5°	25°	50
Flap droop position	EMERG FLAP switch	50/50	50/50	50/50	50/50
BLC airflow	Droop position	Closed	Closed	Partially Open	Full
Spoiler-deflectors	Droop position	48°	70°	70°	70°
Speed brake travel	Flap control switch	55°	55°	None	None
Lateral stick stops	Droop position	In	Out	Out	Out
Inverted spoiler	Flap position	Norm	Norm	Trans	Trans
Longitudinal inter-connect (compensation)	Flap position	None	None	Yes	Yes
Vertical stabilizer travel	Pedals/flaps	±2°	±2°	±8°	±8°
Lateral directional interconnect	Stick/flaps	None	None	±4°	±4°
Yaw trim available	Flap position	±1.5°	±1.5°	±7.5°	±7.5°
Yaw trim recentering	Flap control switch	–	–	0-1.5°	0-1.5°
AFCS gain	Flap position	Norm	Norm	Incr	Incr
Nose wheel steering	Flap position	±75°	±75°	±40°	±40°
Engine cooling doors	Flap position	Closed	Closed	Open	Open
Wing fold operative	Droop position	Yes	No	No	No

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Figure 1-17

BOUNDARY LAYER CONTROL

Overwing leading edge boundary layer control is provided to increase the lift available for take-off and landing. BLC is automatically coordinated with droop leading edge operation. A BLC valve, installed in the compressor bleed line from each engine, directs high-velocity air over the wings, beginning when the droops approach the 25-degree position. Flow reaches maximum when the outboard and middle droop sections are extended approximately 40 degrees. This high-velocity flow effectively increases lift available for landing and take-off. Operation of the droop leading edge BLC valves is monitored to provide indication of proper operation. Operation of the valves during both opening and closing (droop extension and retraction) is indicated through the DROOPS caution indicator. Refer to DROOPS CAUTION INDICATOR, in this section.

FLAP/DROOP CONTROLS AND INDICATORS

FLAP CONTROL SWITCH

The flap control switch (figure 1-17) is located outboard of the throttle quadrant on the left console. Operation of the wing flaps and droop leading edge, plus various automatic features, is coordinated through the use of this multiple lever-lock switch. The flap control switch has 50°, 40°, 30°, CRUISE, and SUPERSONIC positions. For flap control functions, see figure 1-17.

Note

> The HYD SUB-SYS ISOLATION switch must be in TAKE-OFF/LANDING position to obtain flap normal operation. The yaw trim recentering function prevents operation of either normal or alternate yaw trim whenever the flap control switch is in 30°, 40°, or 50° until the flaps have actually reached at least 25-degree deflection.

Selecting SUPERSONIC results in restricting spoiler-deflector travel to 40 degrees inboard and 48 degrees outboard. In the CRUISE position, full spoiler-deflector travel is available and the droops extend to 5 degrees. In the 30°, 40°, or 50° position, the following flap-interconnected functions are obtained: BLC airflow, increased droop extension, lateral control transfer, automatic speed brake retraction, lateral/directional interconnect, and directional ratio change and trim recentering.

The flap control switch may be moved directly between the 40°, 30°, and CRUISE positions, but must be lifted and moved into the 50° position, and lifted and moved into and out of SUPERSONIC. The control switch may be pushed directly from 50° to 40°; however, if lifted while in the 50° position, a mechanical stop prevents movement to 30° or CRUISE. On some aircraft,* a detent prevents inadvertent movement of the flap control switch directly to CRUISE from the 30° position. See figure 1-17.

Note

> To prevent inadvertent movement directly from SUPERSONIC to 30° at high speeds, the flap control switch must be dropped into CRUISE before 30° can be selected. This provision prevents inadvertent deactivation of speed brakes.

Selection of the various flap positions results in pitch trim compensation for flap movement, which shifts horizontal stabilizer position without changing the control stick trimmed position. Stabilizer leading edge deflection increases to a maximum of 5.75 degrees down for a flap extension of 50 degrees, and retraction of flaps applies the reverse correction.

Note

> If PITCH AUG is engaged and the stick is held or trimmed full aft during flap retraction, system loads may prevent flap retraction until stick pressure/trim is returned toward neutral.

FLAP/DROOP POSITION INDICATOR

Refer to DROOP, FLAP, AND TRIM INDICATOR, in this section.

DROOPS CAUTION INDICATOR

The DROOPS caution indicator (figure FO-4) indicates to the pilot that further increase in airspeed with the droop leading edge at CRUISE will result in increased drag and fuel consumption and decreased acceleration performance, and provides a monitor of proper operation of the leading edge BLC valves. Speed warning consists of indicator illumination at approximately 590 KIAS or 1.3 IMN and above, with the flap control switch at CRUISE. Moving the switch to SUPERSONIC or slowing to less than 590 KIAS or 1.3 IMN will extinguish the indicator. Failure of the leading edge BLC valves to open or close properly is indicated by illumination of the DROOPS caution indicator as the droops pass the 10-degree position.

*Aircraft having AFC 251 complied with

The DROOPS light will also illuminate at any droop position if the droops are not in the position selected. See figure FO-13 for other associated causes of DROOPS light.

CAUTION

DROOPS caution indicator illumination on extension or retraction indicates faulty valve operation, which can cause dangerous loss of lift or structural damage from high-temperature/high-velocity airflow.

EMERGENCY FLAP SWITCH

The EMERG FLAP switch (figure 1-17) operates the flap emergency pneumatic subsystem. This lever-lock switch has NORM, UP, and DOWN positions. In the event of failure of the No. 2 hydraulic system, moving this switch to DOWN extends the flaps by direct application of pneumatic pressure through the flap control valve into the flap actuator. In the event of failure of the flap and droop control electrical circuit, moving this switch to DOWN extends the flaps by direct application of pneumatic pressure to hold open the flap control valve and allow No. 2 hydraulic system to extend the flaps. Flap system air/hydraulic separation during use of the emergency system is provided by floating pistons in the flap actuators which are inactive during normal operation. If the switch is returned to NORM after emergency extension, the flaps are locked down.

Note

- Emergency extension results in full flap (air loads permitting) and droop deflection regardless of flap control switch position.
- Loss of all electrical power after emergency extension does not affect flap/droop position.

EMERGENCY FLAP RETRACTION

Selection of the EMERG UP position relieves the pneumatic pressure from the flap actuator and is intended for ground maintenance use. Emergency flap extension is a one-time operation and the UP position should not be selected in flight. However, if overriding considerations warrant, retraction may be attempted.

WARNING

Be alert for split flaps. Prior to retraction, ensure sufficient altitude is available, wings are level, and aircraft is in symmetric flight. Symmetric flight is emphasized so that flap air loads are equalized, thus decreasing the possibility of a split flap condition. When placing the EMERG FLAP switch to UP, be alert for the development of split flaps. If split flaps are indicated, promptly return the EMERG FLAP switch to DOWN.

FLAP/DROOP OPERATION

Flap/droop normal operation is controlled through the flap control switch. Failure of the No. 1 hydraulic system alone has no effect on flap/droop operation. Failure or automatic isolation of the No. 2 system, if not detected, results in failure of the flaps to extend normally. Failure of droops to extend during flap emergency extension following failure of the No. 1 hydraulic system indicates an isolated condition in the No. 2 hydraulic system. In this case, droop leading edge extension is not available.

FLAP/DROOP EMERGENCY EXTENSION

Flap emergency extension is obtained by moving the EMERG FLAP switch to DOWN. Full flap and droop should be obtained below 190 KIAS. Flap/droop emergency extension occurs regardless of the position of the flap handle. The 230 KIAS limit for 50° flaps applies; however, the amount of flap extension will be limited by airloads on the flaps. Flap handle position is not critical; however, the 50° position should be selected to ensure operation of flap control switch associated functions as noted under FLAP CONTROL SWITCH, in this section.

Aircraft handling qualities, particularly at higher gross weights, are improved if the flap handle is placed in the 30° position until 25° droops are obtained and then 50° flaps selected. Moving the flap handle directly to the 50° position will not cause the droops to extend until the flaps are lowered by the EMERG FLAP switch.

Note

Full (50°) flaps may not be obtained until airspeed is reduced to less than 170 KIAS.

Droop Emergency Extension

Flap/droop emergency extension by use of the EMERG FLAP switch operates the droop emergency pneumatic actuator to the extend position, causing extension of droops by either or both hydraulic systems as available. Flap control switch position does not affect droop emergency extension, but must be considered when the flap/droop control switch functions are desired. Refer to FLAP CONTROL SWITCH, in this section.

LANDING GEAR

The retractable tricycle landing gear is electrically controlled and hydraulically operated. The landing gear swings forward on retraction, the main gear rotating 90 degrees and locking into the fuselage. Normal retraction requires 7 to 9 seconds. In the event of hydraulic failure, the forward retraction feature allows the gear to be extended by gravity and air load by pulling the emergency landing gear handle. The wheel well and fairing doors are electrically sequenced so that they are open whenever the gear is in any unlocked position.

Note

The gear fairing and wheel well doors do not close after landing gear emergency extension.

CONTROLS AND INDICATORS

LANDING GEAR HANDLE

The landing gear handle (figure 1-18) is located on the left forward console in the pilot's cockpit.

LANDING GEAR WARNING LIGHT

The landing gear handle (figure 1-18) contains a red warning light. This light will illuminate during normal operation whenever the landing gear is not locked in the position called for by the landing gear handle. After gear retraction, the light remains on if any gear or door does not lock in the retracted position. After extending, the light stays on if the gear fails to lock down. The warning light will not be illuminated should the gear doors and fairing doors fail to close with the gear locked down. Turning the instrument lights knob out of OFF connects this light to a reduced power source for dim lighting.

EMERGENCY GEAR UP SWITCH

A guarded emergency gear up switch (EMERG GEAR UP, figure 1-18) is installed on the left forward console in the pilot's cockpit. This switch is provided for retracting the landing gear in the event of electrical power to the normal landing gear control circuits, malfunction of the landing gear control switch or ground safety circuit. Should emergency retraction in flight be necessary, the switch may be moved to the up position to retract the gear. With essential bus and No. 2 hydraulic system power available, the landing gear will retract regardless of gear handle position only if there is a malfunction of the normal landing gear down control (handle) circuit. Other malfunctions could occur which require that the gear handle be placed in the UP position to provide gear retraction from the emergency gear retract switch.

LEFT FORWARD CONSOLE

1. EMERGENCY BRAKE HANDLE
2. FUEL DUMP HANDLE
3. LANDING GEAR CONTROL HANDLE
4. EMERGENCY GEAR UP SWITCH
5. ARMAMENT INDICATORS

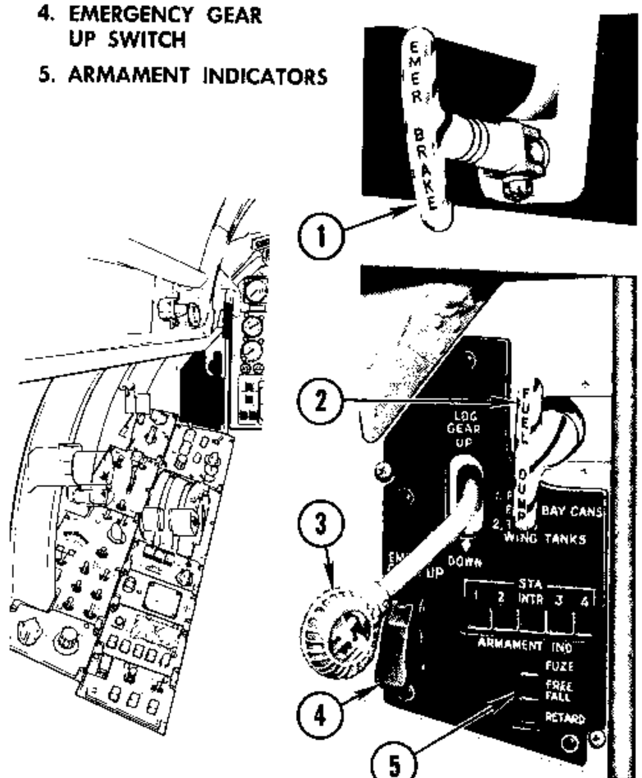

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Figure 1-18

WARNING

- Should a failure in landing gear ground safety circuit or loss of power in the normal landing gear control (handle) circuit occur, retraction may occur with the weight of the aircraft on the gear.
- With electrical and hydraulic power available, moving the emergency gear up switch to the up position bypasses the normal gear retraction circuit, unlocks the gear door uplocks and landing gear downlocks, and sequences the landing gear system to retract.

LANDING GEAR POSITION INDICATOR

A landing gear position indicator (figure FO-4) is installed on the instrument panel. This indicator contains a window for each landing gear, indicating "UP," "DN," or a barber pole for an unsafe condition or the absence of electrical power.

WHEELS WARNING INDICATOR

The WHEELS warning indicator (figure FO-4) is installed on the instrument panel shroud. This indicator is illuminated and the master warning indicator will flash whenever either throttle is retarded to a position corresponding to approximately 95% engine rpm and the landing flaps are extended 25 degrees or more, if the landing gear handle is *not down.* There is no dimming feature for this indicator. The WHEELS warning indicator is powered by the essential d-c bus and can operate on emergency electrical power from the ram-air turbine-powered emergency power unit.

Note

Extinguishing of the WHEELS warning indicator is not an indication that the gear is locked down.

LANDING GEAR EMERGENCY EXTENSION HANDLE

A landing gear emergency extension handle (figure FO-4) is installed on the right side of the center pedestal. When the retaining safety clip is pushed down and the handle is pulled outward and held at full travel (approximately 15 inches), all gear and fairing door uplocks are released, allowing gravity and air loads to extend the gear to the down and locked position.

GEAR STIFF CAUTION INDICATOR

The GEAR STIFF caution indicator (figure FO-4) is provided to indicate the hydraulically extended and stiffened, catapulting position of the nose gear strut. The nose gear strut stiffening system is designed to position the nose gear for catapult launch. On manual extension of the right-hand catapult hook, the nose gear strut is pressurized by the No. 2 hydraulic system, limiting strut stroke to 9 inches. After launch, retraction of the right-hand hook or the landing gear relieves the strut stiffening pressure.

LANDING GEAR OPERATION

Landing gear normal retraction occurs in three phases: (1) doors open, (2) gear retracts, and (3) doors close. Failure of either the gear to retract or the doors to close causes the landing gear warning light to remain illuminated and the position indicator to remain barber-poled. Landing gear normal extension occurs in reverse order to retraction.

CAUTION

On engine start, the landing gear doors will close abruptly as No. 2 hydraulic system pressure builds. Ensure that all ground personnel are clear of the gear wheels prior to starting engines.

Note

The landing gear fairing doors normally will be open for preflight inspection. During the walkaround, ensure that the GEAR DOOR switch (electrical power access panel) is positioned to NORMAL.

ARRESTING GEAR

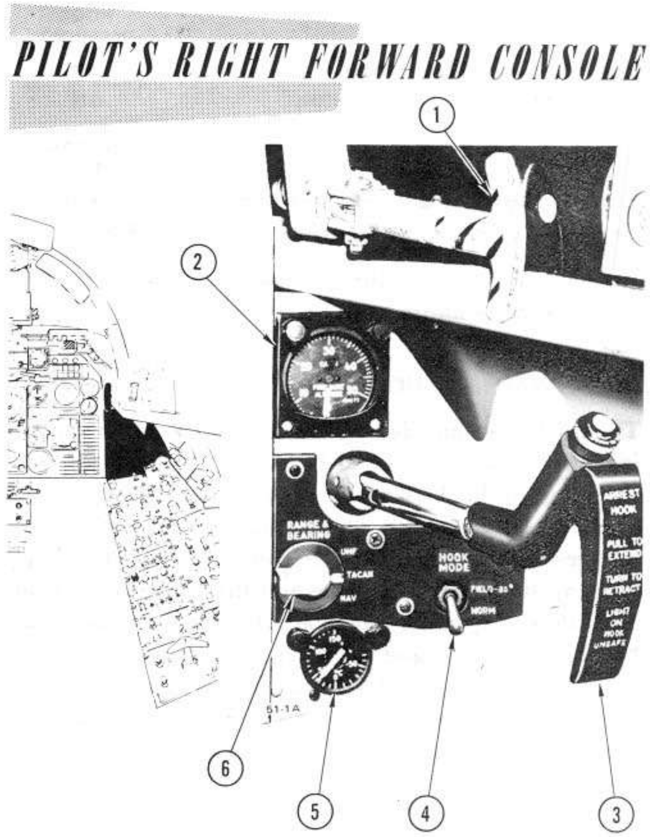
The arresting hook is located on the aft lower fuselage and is hinged adjacent to the root of the horizontal stabilizer leading edges. The V-shaped arresting gear is faired into the fuselage by mechanically operated trunnion, hook point doors, and beam fairing doors. The hook extends to 55 degrees from vertical. The hook is extended and retracted by operation of a snubber actuator that has an integral piston-type hydraulic air accumulator. Retraction utilizes No. 2 hydraulic system pressure while extension is accomplished by gravity and precharged air pressure in the accumulator portion of the snubber actuator. While the hook is extended, the snubber actuator acts to snub hook bounce to prevent arresting wire skip. On some aircraft,* movable stops alter the snubber stroke to provide either a 55-degree (carrier arrestment) or a 35-degree (field arrestment) trail angle; the trail angle control is spring loaded to the normal (55 degrees) position. Hook point doors are installed to cover the hook point when the arresting gear is retracted. These doors are opened and closed mechanically by the hook during the cycle. On some aircraft,† the air/oil hook bumper is replaced with an oil/spring bumper unit. Either unit prevents the hook from bouncing into the access well during arrested landings and retracts before the hook is retracted.

ARRESTING HOOK HANDLE

An arresting hook handle (figure 1-19) is located on the pilot's right forward console. The hook is extended by pulling the handle aft approximately 5 inches. This unlocks the doors, releases the hook uplock, and allows the hook to drop by gravity, assisted by air pressure in a snubber actuator. Pulling the handle to the extend position energizes the hook warning light until the hook is extended. On some aircraft,* with the HOOK MODE switch at FIELD-35°, a 35-degree position switch actuates as the hook nears the fully extended position extinguishing the hook warning light and energizing the approach light flasher to indicate hook extension as selected. When the hook is extended to either the NORM (55 degrees) or FIELD-35° position, the hook must be retracted before a different extension position is selected. The hook may be lowered at a speed of 250 knots or less. The arresting gear may be retracted by turning the handle counterclockwise and allowing it to return to the stowed position. This allows No. 2 hydraulic system pressure to act upon the bottom of the actuator, retracting the hook. Hook extension is not dependent upon hydraulic system pressure or electrical power; therefore, no separate emergency system is provided. Should the control valve stick in the "hook up" position, a mechanical override linkage forces the valve to the selected "hook down" position.

*Aircraft 156628 through 156643 and aircraft having AFC 293 complied with

†Aircraft having AFC 223 complied with



1. CANOPY EMERGENCY RELEASE HANDLE
2. COCKPIT PRESSURE ALTIMETER
3. ARRESTING HOOK HANDLE
4. HOOK MODE SWITCH
5. INLET AIR TEMPERATURE INDICATOR
6. RANGE AND BEARING KNOB

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Figure 1-19

HOOK MODE SWITCH

On some aircraft,* a HOOK MODE selector switch provides the capability of extending the arresting hook to a trail angle of either 35 or 55 degrees (from the vertical) for field or carrier arrestments, respectively. Since the hook trail angle control is designed fail-safe to the carrier (NORM) position, the HOOK MODE switch is solenoid-held in the FIELD-35° position and recycles to the NORM position each time the hook handle is pushed into the stowed position.

The HOOK MODE switch is connected to the landing and arresting gear indicator light network to provide the following indications of proper operation or malfunction while airborne with the landing gear down with the APPROACH lights switch in ARREST and the arresting hook handle actuated:

	HOOK WARNING
Hook in selected position	OFF
Hook not in selected position	ON

	APPROACH LIGHTS
Hook in NORM (55 degrees) position	Steady
Hook not in NORM (55 degrees) position	Flashing①

①For steady indication, select T & G position of APPROACH lights switch

HOOK WARNING LIGHT

The hook warning light is located on top of the arresting hook handle. This red light will come on any time the arresting hook is not in the position selected by the arresting hook handle. Should the control cable break between the handle and the control sector, the hook warning light will illuminate and the hook will extend, regardless of handle position. A control cable break between the sector and the emergency bungee causes the hook and doors to unlock, but the hook warning light will remain off and the hook will remain retracted until the handle is pulled.

CAUTION

High-rate blinking of the hook warning light indicates an out-of-adjustment condition of the hook uplock switch mechanism, causing rapid extend/retract commands to the hook snubber actuator. This condition could result in hydraulic line or snubber actuator failure, loss of proper arresting hook action, and No. 2 hydraulic system failure. In the event of hook light blinking, place the HYD SUB-SYS ISOLATION switch to FLIGHT. This results in a steady illumination of the warning light.

HOOK OPERATION — NO. 2 HYDRAULIC SYSTEM FAILURE

The arresting hook retraction is powered by the No. 2 hydraulic system. On some aircraft,* the hook may be positioned to a NORM (55 degrees) or FIELD-35° trail angle. This position selection is also powered by the No. 2 hydraulic system. In the event of a No. 2 hydraulic system failure/automatic isolation, hook extension is not affected, but the hook cannot be retracted. Hook position selection, in the event of No. 2 system failure/isolation, is powered by a hydraulic hook position accumulator. With the hook extended in the NORM position, the field position may be obtained by selecting FIELD-35° on the HOOK MODE switch, however, damage to the arresting gear actuator could result.

NOSE WHEEL STEERING

Nose wheel steering authority to 75 degrees either side of center is provided through the control pedals when the STEER/TERRAIN button is depressed. When the button is not depressed, the nose wheel is in the damping, swiveling configuration which allows 360-degree swiveling of the nose wheel for ground handling purposes and unlimited steering deflection through differential braking. System design is such that, as the flaps are extended to full down, the nose wheel steering authority is reduced to 40 degrees on either side of the center. Differential braking will still produce unlimited steering. As a safety feature, the nose wheel steering system will operate only when the weight of the aircraft is on the left-hand main landing gear. On some aircraft,† nose wheel steering will operate with the weight of the aircraft on either main landing gear.

Note

A yaw trim change during nose wheel steering operation repositions the control pedals, turning the nose wheel.

STEER/TERRAIN BUTTON

A momentary contact button labeled STEER/TERRAIN, is located on the control stick grip (figure 1-15). Nose wheel steering is activated by holding the button depressed, and control is maintained through movement of the directional control pedals. The STEER/TERRAIN button is also used as a radar mode control when the aircraft is in flight and, in addition, has several AN/ASB-12 functions. Refer to BOMB DIRECTING SET, AN/ASB-12, in this section.

WHEEL BRAKES

The wheel brake system consists of two independent hydraulic systems: the normal brake system, with an auxiliary accumulator, and the emergency brake system. They are completely separate down to the shuttle valve at each main gear wheel. The normal system consists of two brake power metering valves, a brake

*Aircraft 156628 through 156643 and aircraft having AFC 293 complied with

†Aircraft 149300 through 149317, and 150823 through 151728 having AFC 129 complied with

auxiliary accumulator, and necessary connections. The power brake valves, one for each wheel, provide differential pressure at the wheel in proportion to the degree the pedals are depressed. Pressure from the No. 2 hydraulic system is metered from the valves to each brake unit. The hydraulic auxiliary brake accumulator in the normal system is capable of a minimum of three full brake applications and up to as many as 12 lesser applications of a magnitude necessary to stop a fully loaded aircraft during ground handling operations. An externally mounted brake accumulator pressure repeater gage is located on the left side of the forward fuselage, just ahead of the intake duct. This gage must indicate a precharge of 1000 psi at 40° to 90°F (or 3000 psi if the hydraulic system has been operating and pressure has not been bled) and is used to check that adequate auxiliary accumulator pressure is available for power-off braking.

WARNING

When the auxiliary accumulator has been depleted to 1000 psi precharge, no further braking can be obtained.

BRAKE AUXILIARY HAND PUMP

A braking system auxiliary hand pump is located on the auxiliary brake accumulator service panel in the forward end of the nose wheel well. The pump handle is stowed on the left hand side of the nose wheel well.

EMERGENCY BRAKES

The emergency brake accumulator receives pressure from the No. 2 hydraulic system. The system is operated by an emergency brake handle located on the left forward console (figure 1-18), and provides equal pressure to both brake assemblies simultaneously in proportion to the extent the handle is pulled. Optimum emergency braking is obtained by slowly pulling outward on the handle, increasing braking force as speed decreases. The emergency brake accumulator provides a minimum of three full brake applications and up to as many as 12 lesser applications. On some aircraft,* a thermal relief valve protects the system against thermal expansion.

WARNING

When the emergency accumulator has been depleted to the 1000 psi precharge, no further braking can be obtained.

Note

For field landings utilizing emergency brake accumulator, it is recommended that the emergency brakes be used first to conserve auxiliary brake accumulator action for directional control of the last stages of landing rollout.

ANTISKID SYSTEM

On some aircraft,† automatic skid control is incorporated in the normal brake system to detect incipient wheel skids and reduce hydraulic pressure to the appropriate wheel brake as required for optimum deceleration. The system consists of a control box, control valve, sensors, and exciter rings. A skid rate detector converts wheel deceleration rate into d-c proportional voltages to the control valve. The controller compares these voltages with a preset value equal to maximum braking effectiveness. If wheel slip (skid) is sensed, the controller applies a restriction signal to the proper side of a dual pressure control valve, reducing braking hydraulic pressure in proportion to severity of the detected slip. Control valve crossover relief is also provided in case of a locked wheel occurring while the other wheel is rolling. Touchdown, with brakes applied, is prevented by brake pressure lockout until the main landing gear ground safety load switches have been actuated and wheel spin-up has occurred. The antiskid system incorporates a test "go, no-go" feature, allowing the pilot to check complete electrical continuity and control valve operation. Should certain system malfunctions occur, or should No. 2 hydraulic system pressure drop below 650 psi, the antiskid system shuts off automatically, illuminating the ANTISKID advisory light.

ANTISKID CONTROLS AND INDICATORS

The antiskid controls (figure FO-4) are located above the pilot's left console. In addition, the HYD SUB-SYS ISOLATION switch must be in the TAKE-OFF/LANDING position for antiskid operation.

*Aircraft 149300 through 14917, and 150823 through 151728 having AFC 138 complied with

†Aircraft 145157 and subsequent and aircraft having AFC 170 and AFC 252 complied with

Antiskid Power Switch

The antiskid power switch (ANTI-SKID PWR) controls system electrical power (ON/OFF) and provides system reset. Under normal conditions, the system can be engaged whenever the HYD SUB-SYS ISOLATION switch is in TAKE-OFF/LANDING position. RESET is used to restore operation if the system should monitor off. The momentary RESET position must be engaged to turn the system on. Should a malfunction be suspected which is not accompanied by the system shutting off, the ANTI-SKID PWR switch should be moved to OFF.

Antiskid Test Switch

The ANTI-SKID TEST switch is provided to allow a "go, no-go" continuity check of the system. The momentary switch operationally checks the respective left- or right-hand skid detector circuit and checks continuity to the sensors and valves for short circuits.

CAUTION

The ANTISKID advisory light illuminates whenever a fault exists which causes the system to monitor off. Other faults may exist which do not cause the system to monitor off and do not illuminate the advisory light. These faults can be detected by the test circuit, making compliance with the test procedure mandatory.

Antiskid Test Lights

The green antiskid test lights (LH, RH) are provided as indicators of satisfactory self-test for the respective automatic brake control circuit. On the ground and in flight with the landing gear handle up, these lights reflect system readiness by flashing green momentarily following release of the ANTI-SKID TEST switch. In flight, with the landing gear handle in the down position, the test lights are illuminated as an indication of normal system operation; this indication serves as a check of the 28-volt d-c circuit enabling locked wheel skid pressure relief upon landing touchdown. On touchdown, the lights go out and remain out except during skid relief actuation.

Antiskid Advisory Light

The amber ANTISKID advisory light is located on the pilot's instrument panel. See figures FO-4 and FO-4A. This light is illuminated whenever the ANTI-SKID PWR switch is in the OFF position and the HYD SUB-SYS ISOLATION switch is in TAKE-OFF/LANDING. Also, the advisory light is illuminated during testing of interior lights and whenever the system power switch is ON while a failure has caused the system to monitor off.

WHEEL BRAKE SYSTEMS OPERATION

The wheel brake systems are capable of stopping the aircraft under various mission conditions. In addition to normal full power braking, limited duration braking is supplied by the auxiliary brake accumulator.

NORMAL

Normal braking requires relatively light pedal forces and pedal deflection. Up to 85 pounds force is normally sufficient for field landing rollout braking at typical gross weights. Directional control is easily maintained in the event of nose wheel steering failure, and differential braking can be used to execute turns exceeding the 75-degree swivel of the nose wheel steering system.

Note

- A pedal force of about 100 pounds is required to hold the aircraft with both engines at Military Thrust.
- Provided gross weight is sufficient to prevent tire skidding, properly operating brakes will hold the aircraft at MIN AFTERBURNER.

For a discussion of optimum braking technique, refer to STOPPING THE AIRCRAFT, in Section III, Part 3.

EMERGENCY

Note

Upon the first indication of any brake malfunction, the aircraft should be stopped. Do not attempt to taxi or maneuver the aircraft (unless an overriding emergency situation exists); request a tow. Refer to BRAKE FAILURE in Section V of this manual.

In the event of failure of the No. 2 hydraulic system or during towing operations, the charge in the auxiliary brake accumulator may be used to obtain braking. If a single, increasing pressure application is used, sufficient power is available to stop. Approximately three "on and off" type applications are available with a fully charged auxiliary accumulator, and up to 12 lesser applications of the "towing and spotting" type. Auxiliary brake accumulator charge for ground operation is indicated by an auxiliary pressure gage on the left fuselage below the aft cockpit.

ANTISKID OPERATION

Primary a-c and d-c electrical and No. 2 hydraulic system power is required for antiskid operation. Use of the self-test feature is necessary to assure system integrity before relying on antiskid. After engine start, moving the ANTI-SKID PWR switch momentarily to RESET should cause the amber ANTISKID advisory light to go out. With the system engaged, the ANTI-SKID TEST switch can be actuated momentarily to the LH and RH positions. This initiates a simulated skid signal through sensor, detector, and control valve circuits, resulting in illumination of the green test lights for 1 — 3 seconds after release of the test switch. If either test fails, or if any malfunction is suspected, the system should be secured.

CAUTION

Antiskid ground tests should be accomplished only in the chocks, since brake pressure is locked out momentarily during the test.

In flight, with the power switch ON, system operation is initiated whenever the HYD SUB-SYS ISOLATION switch is in TAKE-OFF/LANDING. The momentary RESET position must be engaged for system operation. Prior to extending the landing gear, the "go, no-go," self-test should be accomplished by actuating the ANTI-SKID TEST switch to LH and RH positions and noting that each test light comes on momentarily when the test switch is released, indicating system continuity. With the gear handle DOWN and no load on the main landing gear, the green lights are illuminated as an indication of normal system operation. The indicators (green test lights on and amber advisory light out) should be monitored whenever anticipating use of antiskid. After touchdown, in contrast to braking without antiskid, high pedal pressures can be applied as soon as MSBI is reached. All other normal stopping distance considerations, such as brake capacity and the use of aerodynamic braking, remain applicable. Optimum braking is obtained by holding the system in a mildly cycling condition to keep control valve spool excursions to a minimum. At high speeds, cycling at lighter pedal pressures will be felt; as speed decreases, more pressure can be applied to maintain cycling. As the aircraft slows further, pedal pressure can be decreased as desired to prevent severe antiskid pressure cycling. At less than approximately 15 knots, system sensitivity decreases to reduce interference during taxi turns. At less than 8 knots, a threshold amplifier eliminates skid control system response. When taxiing in close quarters, the ANTI-SKID PWR switch should be turned off to preclude loss of control in the event of system malfunction. With the ANTI-SKID PWR switch on in flight and the HYD SUB-SYS ISOLATION switch in TAKE-OFF/LANDING, the system is ready for operation. The RESET position must be selected momentarily prior to selecting the ON position for test and operation. Prior to extending the landing gear, the self-test can be accomplished by actuating the ANTI-SKID TEST switch to the LH and RH positions. When the switch is released, the lights illuminate momentarily and then go out if the system is operating normally. After selecting the DOWN position of the landing gear handle, a check for green lights and a self test for extinguishing them (hold switch in test 3-5 seconds) must be made to assure tie-in of the locked wheel skid relief circuit and overall circuit integrity prior to landing touchdown. If either check fails, turn anti-skid off prior to landing.

FOLD SYSTEMS

WING AND TAIL FOLD

Power folding of the wings and vertical stabilizer is accomplished by No. 2 hydraulic system pressure. A hydraulic lock valve is provided in the wing fold line to prevent inadvertent wing spreading in the event of hydraulic pressure loss during wing folding, and to maintain the folded position when hydraulic pressure is removed. A manual override lever is installed on the wing fold lock valve to permit manual spreading of the wings. A similar lever on the tail fold control valve (located on the bottom of the aft fuselage left of the arresting hook point doors) also allows manual folding and unfolding of the vertical stabilizer. Positive hydraulic sequencing actuates the lockpins upon completion of the wing spread cycle. Manually operated locks, actuated from the cockpit, secure the lockpins in position. Folding and unfolding of the wings and vertical stabilizer can be accomplished simultaneously by using the fold control handle. The wings can be cycled independently, if desired, by selecting the OFF position of the tail control switch.

Note

An electrical interlock between the droop position and the wing fold controls is designed to prevent folding of the wings with droops in any position but SUPERSONIC. Attempting to fold the wings with droops other than fully retracted (SUPERSONIC) may cause damage to leading edge BLC.

FOLD CONTROL HANDLE

Operation of the wing and tail fold system is controlled by the use of the fold control handle (figure 1-20), installed at the rear of the right console. With the wings folded, clockwise rotation of the handle to the UNLOCK position spreads the wings and extends the vertical stabilizer. The pilot should then pause for 10 seconds to ensure that the wing and tail lockpins have been sequenced into position. The handle should then be pushed down and twisted counterclockwise to the LOCK position. This action provides mechanical security for the wing and tail hydraulic lockpins. For wing and tail folding, this procedure is reversed.

CAUTION

- If the wings are folded, check that the control handle is in the LOCK position prior to engine start.
- Ensure that the flap control switch is at SUPERSONIC before folding wings, as damage to the leading edge can occur at CRUISE or below.

Note

The handle must be lifted slightly before it can be moved to either the locked or unlocked position.

Tail Control Switch

The TAIL CONT switch (figure 1-20) is used to select simultaneous folding of the outboard wing panels and the vertical stabilizer (NORM position), or folding of the outboard wing panels only (OFF position).

FOLD SYSTEMS CONTROLS

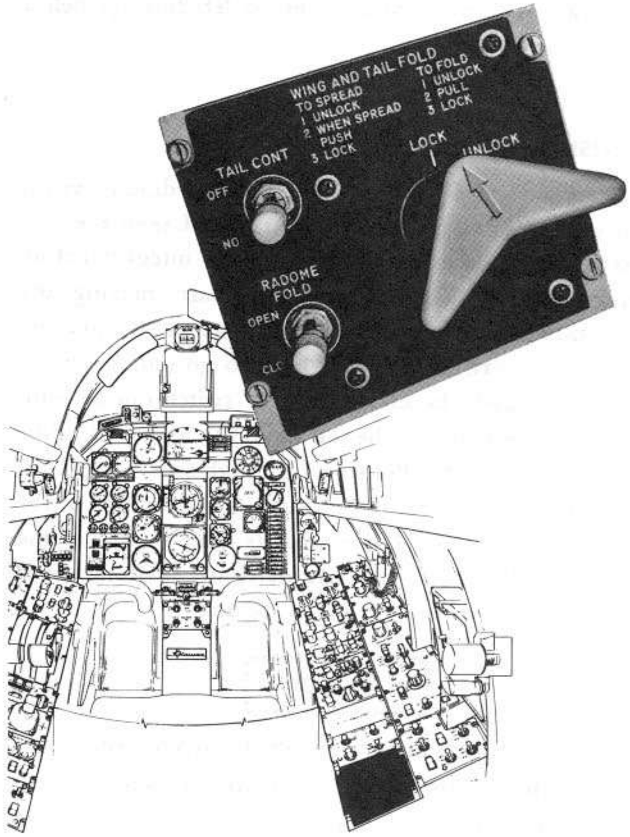

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Figure 1-20

Wing and Tail Fold Warning Flags

Red warning flags are installed at the fold lines of the wings and vertical stabilizer. These flags extend on both sides of each folding surface when the fold control handle is pulled (unlocked) and retract when the handle is pushed in (locked).

RADOME FOLD

To permit access to the radar compartment and to facilitate handling, the radome can be opened and rotated upward and aft through operation of an electrical actuator. A warning flag protrudes on each side of the radome as an indication that the latches are not locked. An interlock relay prevents operation of the fold circuit unless the aircraft is on the ground and the radar antenna is in its stowed position.

RADOME FOLD SWITCH

Moving the two-position RADOME FOLD switch (figure 1-20) to OPEN supplies monitored bus a-c electrical power to a latch drive motor. When the latches are fully unlocked, the fold actuator extends, opening the radome. Moving the switch to CLOSE causes the actuator to retract the radome toward the closed position until a limit switch energizes the locking latches. This mechanically positions the warning flags flush with the radome exterior.

External Control Switch

An external radome fold control switch (interlock bypass) is installed inside the right jowl door aft of the radome. This switch is used to open or close the radome with the aircraft electrical system energized and the cockpit RADOME FOLD switch at OPEN.

Note

Should radome fold fail to operate when selected, check that the external control switch is positioned to CLOSE.

CANOPIES

Both cockpits are provided with separate jettisonable, clamshell canopies. The pilot's canopy is of conventional design.

CAUTION

Do not open canopy above 60 knots.

The aft canopy is primarily of metal construction with a small window on each side, restricting the amount of light in the cockpit for monitoring radar and television equipment. Both canopies are opened and closed by pneumatic cylinders, which are controlled by pneumatic toggle valves on the left forward fuselage. Internal and external manual release is also provided. Power for the normal canopy operation is supplied by the aircraft pneumatic system 500-cubic-inch storage bottle. Canopy operation does not require electric power. Sufficient air is stored for approximately 25 canopy cycles. When the weight of the aircraft is off the gear, a flap isolation valve automatically closes and limits the use of this bottle to emergency flaps. A test switch for the flap isolation valve is located in the pneumatic system service panel. An independent emergency air bottle is provided for each canopy, supplying 3000 psi air for emergency jettison. When normal opening is initiated, the canopies move rearward approximately 1 inch to unlock, then swing upward 33 degrees to the fully open position. Normal opening or closing time is 8 to 14 seconds.

Note

During the closing or opening cycle, the canopy may "bounce" slightly. This is not an abnormal condition.

CANOPY CONTROLS AND INDICATORS

CANOPY TOGGLE VALVE (PILOT)

The canopy toggle valve (figure FO-4) is located above the left console. This three-position pneumatic valve has CLOSE, NORMAL, and OPEN positions and is spring loaded to NORMAL. Prior to actuating the canopy, hold toggle valve in same position as canopy to prevent possible rough operation.

CAUTION

Should the canopy toggle valve be held momentarily to OPEN at any time after the canopy is closed (before take-off), ensure that the canopy is locked by holding the toggle valve in CLOSED. This will prevent possible in-flight loss of the canopy due to movement of the locking overcenter linkage.

CANOPY TOGGLE VALVE (RAN)

The aft canopy toggle valve (figure FO-1) is located on the left console. This three-position pneumatic toggle is spring loaded to NORMAL from OPEN and CLOSED positions. When closing the canopy, the toggle valve should be held in CLOSED until a definite "pop" is heard (overcenter linkage operation), and until the CANOPY caution light goes out.

CAUTION

- To prevent possible loss of the canopy, do not open the canopy when wind and/or taxi speeds exceed 60 knots.
- Should the canopy toggle valve be held momentarily to OPEN at any time after the canopy is closed (before take-off), ensure that the canopy is locked by holding the toggle valve in CLOSED. This will prevent possible in-flight loss of the canopy due to movement of the locking overcenter linkage.

Note

- The canopy is not securely locked until the CANOPY caution light goes out and the overcenter linkage "pop" is heard.
- When closing or opening the canopy, first hold the toggle valve momentarily in the position opposite to desired movement to prevent the possibility of the canopy falling to the closed position or springing violently to full open.

EXTERNAL TOGGLE VALVES

A toggle valve for each canopy is installed in a canopy control access below the pilot's left-hand canopy skirt. These toggles are used for normal external opening or closing of either canopy and utilize the canopy pneumatic system.

CANOPY JETTISON HANDLE

The pilot's canopy jettison handle (figure 1-19) is located above the right forward console above the cockpit pressure altimeter. The RAN's canopy jettison handle (figure FO-1) in the aft cockpit is located on the left forward console inboard of the canopy toggle valve. Pulling these handles will jettison the canopies without arming the ejection seats.

CAUTION

Canopies should not be jettisoned when the aircraft is stationary, since canopy trajectory is greatly dependent upon wind. Under no-wind conditions, the forward canopy will fall directly on the aft cockpit. Manual canopy release should be used when aircraft is stationary, except in extreme emergencies. When canopy jettison is required, pilot should jettison first to prevent possible injury to RAN during canopy separation.

CANOPY MANUAL RELEASE HANDLES

External Release Handles

Two external manual release handles are installed on each canopy, one on each side. A square pushbutton, located just aft of each handle, must be depressed to release the handle. Once the handle springs out, it should be pulled full forward to a latched position. By using both external handles, one or two men can open or remove either canopy. With one sweeping motion, pull the canopy aft approximately 1 inch to disengage the hold-down hooks and lift upward. When the canopy is manually opened, a ratchet arrangement allows the canopy to be held in one of three positions as it is being manually raised (10°, 20°, or 30°). The canopy can be removed by raising and rotating aft until it becomes free of the tracks and pivot point.

Note

- The canopy is physically disconnected from the actuator when any of the manual release handles are used. If the manual canopy uplock must be used, raise the canopy just enough to permit rotation of the uplock handle. Should the canopy rollers come out of the tracks, the canopy will jam.
- No canopy external jettison provisions are installed.

Internal Release Handle

Both canopies are equipped with an internal release handle on the left side of the skirt. These handles operate the same linkage as the external release handles. To operate, the handle lock is pushed forward, allowing the handle to spring out and downward. Approximately 50 pounds aft force on the handle may be required to unlock the overcenter linkage and move the canopy aft 1 inch. For in-flight manual operation, the canopy should release when unlocking of the overcenter linkage occurs.

WARNING

When attempting in-flight manual release, grasp the handle PALM UP, with the thumb TUCKED IN, as serious injury can occur as the canopy departs. The handle should be operated in as close to the vertical position as possible.

Canopy Manual (Ground) Opening Procedure

After manually opening the canopy on the ground, the actuator must be reconnected and pressurized to the up position for normal operation. Operating the manual release handle (internal or external) actuates a spring-loaded, automatic uplock pawl. After unlocking, when the canopy is raised and reaches the second or third ratchet position, the canopy may be released and will be retained, or may be completely raised, or detached from the aircraft. In order to close the canopy, after manual opening, the uplock pawl must be manually reset to the stowed position.

To manually open the canopy using the internal release handle, proceed as follows:

1. Handle release latch—Push forward and down.
2. Handle—Pull down to dump pneumatic pressure (30 to 45 degrees).
3. Pause 3 to 5 seconds or until actuator bleed-off is complete.
4. Handle—Pull aft and assist bungee in unlocking canopy overcenter linkage (may require up to 50-pound force).
5. Raise canopy.

Disconnect Override Handles

Both canopies are equipped with an actuator disconnect override handle under an access door on the left rear portion of the frame. When rotated counterclockwise, these handles prevent disconnection of the canopy manual release mechanism from the canopy actuators. If manual access to the cockpits is required under high wind conditions, using these override handles will prevent inadvertent canopy loss. To assure disconnection of the canopy actuator rod end, the handle must be in the down position immediately prior to raising the canopy after the canopy has moved aft. The canopy should then be raised to a minimum height sufficient to allow engaging the canopy uplocks. If the canopy is raised too high, the canopy guide rollers will separate from the guide rails.

MANUAL UPLOCK HANDLE

Each canopy is provided with a manual uplock and handle. These handles are located directly aft of the ejection seat headrests and are a part of the canopy operating mechanism. If the canopies are opened and it is desired that they remain open for a prolonged period, the manual uplocks should be engaged by rotating the manual uplock handles aft until the indicator flag reads "UPLOCK ENGAGED." To unlock the canopies, rotate the handles forward until the forward lock indicator reads "UPLOCK DISENGAGED," and the aft indicator retracts from sight.

Note

To relieve binding of the canopy manual uplocks, pressurize the top side of the canopy actuators by holding the canopy toggle valves to OPEN for at least 5 seconds before disengaging.

CANOPY CAUTION INDICATOR

Each cockpit is provided with a CANOPY caution indicator. These indicators are located in the caution indicator bank on the main instrument panel in the front cockpit and on the top center portion of the display panel in the rear cockpit. The pilot's caution indicator is a flip-shutter type which is energized when one or both canopies are unlocked and electrical power is applied to the circuit from the generators or external power units. The RAN's caution light will come on only when his canopy is unlocked. An electrical interconnect between the two canopies requires that both canopies be closed and locked before the pilot's indicator will go out.

ESCAPE SYSTEM

The escape system provides safe emergency egress from the aircraft under nearly all flight conditions. If aircraft attitude and rate of sink are within seat recovery capability, escape is possible at ground level at speeds as low as approximately 100 knots through supersonic speeds. Ejection of the aft seat can be initiated by the pilot or the RAN through an ejection interconnect system.

WARNING

If ejection becomes necessary on the deck, canopies must be fully closed; otherwise proper canopy "camming" action and/or actuator extension cannot occur.

Safe escape at transonic and supersonic speeds depends in part on the use of the arm retention system. Studies of past ejections indicate that ejection occurring with unrestrained arms at speeds above 500 knots could cause injuries which may prove fatal during the postejection survival phase. Such ejections in which the arms are not restrained and which occur at speeds greater than 600 knots are extremely hazardous and can result in multiple injuries.

On some aircraft,* an improved escape system (HS-1A) provides reduced time delays, increased catapult impulse, an improved parachute assembly incorporating a ballistic spreading gun and modified deployment hardware, plus changes to provide canopy retention through 60 degrees. Except for a speed sensor and the spreading gun, the system is identical in operation at high speeds to the original (HS-1) system. For reduced opening shock under high-altitude, high-speed conditions (above 10,000 feet or 200 knots), the speed sensor automatically selects a high mode time delay for harness release and separation bladder action after catapult rocket burnout. Total low mode sequence timing is reduced by 1 second, including the new catapult delay reduction. Recovery capability in the high mode is the same as that for the unmodified (HS-1) escape system. Installation of an NES-15A parachute is required for the HS-1A system.

BALLISTIC SPREADING GUN

On some aircraft,* to assure rapid and symmetrical inflation of the main parachute canopy at low speed and to reduce random canopy inflation time at high speed, a mechanically activated, ballistic spreading gun is provided. The spreader gun assembly is positioned at the hem of the main parachute. A firing lanyard is attached to a suspension line connector link. The firing pin and spring-loaded striker mechanism is threaded into the spreader housing, which contains 14 pistons positioned against 14 slugs held in place by a shear band assembly. In the event of cartridge malfunction, a fail-safe backup sleeve firing lanyard tension acts on and retracts the shear band assembly, releasing the slugs and allowing aerodynamic inflation of the canopy.

*Aircraft having AFC 311 complied with

WARNING

The NES-15A parachute ballistic spreader safety pin must be attached to the right hand lap strap. If the safety pin is in the ballistic spreader gun, the parachute canopy will not open.

EJECTION SEATS

The ejection seats (figure FO-8) are designed to provide integrated crew environmental services (personal disconnect), as well as safe escape under nearly all flight conditions. The seat bucket is electrically adjustable through a vertical range of 5 inches. The seat is equipped with an NB-7E or NES-15A personnel parachute, requiring use of the standard integrated harness garment.

CAUTION

When adjusting the seat bucket, allow a 2-minute "off" time after each full actuator stroke to prevent overheating.

Note

Crew members will personally connect parachute riser and lap strap fittings when entering, and disconnect when leaving, the aircraft to maintain skill and check for proper operation.

Seat ejection is initiated by pulling the face curtain handle forward and down sharply to full travel, or by turning (unlocking) and pulling either alternate ejection knob. After ejection is initiated, the crewman is automatically positioned in the proper ejection posture by ballistic prepositioning devices. Postejection sequencing provides automatic seat trajectory stabilization and descent to below 13,000 feet, crew member/seat separation, and automatic parachute deployment. Escape from the seat in the event of ditching or crash landing is provided by a single handle, which severs or releases all connections to the seat except the Scott disconnect, which separates automatically when the crewman stands up during egress. A hinged lift plate, attached to the bottom of the seat, is opened as the seat rises on ejection. This plate provides additional aerodynamic lift and stability as the seat enters the air stream.

Note

For low-altitude ejections, use of the left-hand alternate ejection pull-knob while maintaining altitude control with the right-hand on the stick, is recommended.

SPEED SENSOR

Low mode ejection timing is selected by a speed sensor* through the action of an arming key puller, powered by the same ballistic gas which drives the arm retention take-up reel. The passive escape system is automatically armed for low mode ejection. If high mode conditions (greater than 200 KIAS and/or 10,000 feet) exist at the time ejection is initiated, the speed sensor automatically blocks the low mode time delay. The high mode system then operates in the same manner as the existing HS-1 system. For low mode ejection, the speed sensor remains passive and the low mode time delay is initiated. The high mode time delay is initiated for all ejections, acting as a backup during low mode ejections.

The speed sensor is mounted on a bulkhead at the right side and aft of each seat, a small inspection port is provided on each speed sensor. A red indication in this port is unacceptable, since this reflects speed sensor aneroid leakage. The speed sensor utilizes an aneroid bellows and an airspeed diaphragm to react to varying flight conditions and reduce ejection sequence timing by 1 second, compared to the high mode sequence. Crossover conditions for the two modes are 200 KEAS and 10,000 feet pressure altitude, but temperature changes and mechanical tolerances result in variations of 35 knots and 1200 feet from the nominal conditions. In the low mode, harness release occurs immediately following rocket burnout, and the crewman is released and propelled from the seat by the separation bladders, reducing the time to parachute deployment. Typical HS-1A escape system sequence under low mode conditions is as follows:

EVENT	TIME (SECONDS)
Eject initiation	0.0
Aft seat catapult fires	0.33
Seat separation from aircraft (tip-off)	0.48
Harness release	1.1
Parachute pack open	1.8
Spreader gun fires	4.0
Recovery (parachute inflated)	5.0

CATAPULT ROCKETS

Seat ejection thrust is provided by a single unit catapult rocket. When actuated, the catapult portion fires, thrusting the seat up the rails and clear of the cockpit. As the seat leaves the rails, the rocket portion ignites,

*Aircraft having AFC 311 complied with

providing a directionally and longitudinally stable thrust. This force is sufficient to propel the seat to a height of approximately 125 feet above the aircraft at low speeds, providing ample height for safe recovery.

On some aircraft* increased catapult rocket impulse results in increased trajectory altitude and improves the safe recovery capability at low altitude/low speed conditions by approximately 30 feet.

DROGUE PARACHUTES

A 52-inch diameter, stabilizing drogue parachute is installed in each headrest. Approximately 0.11 second after seat begins to move, the drogue chute is deployed by a thruster actuated by a lanyard which is pulled as the seat ascends the rails. For ejections at high altitudes (above 13,000 feet), the drogue chute remains attached to the seat, providing stabilized crewman/seat free-fall to 13,000 feet, where automatic crewman separation and personnel parachute deployment sequencing takes place. Upon seat/man separation, the drogue lower riser attachments are released, allowing the seat to rotate forward about the upper riser attach points simultaneously with separation bladder inflation. As the crewman leaves the seat, the parachute "pulloff" lanyard extends to its full 14-foot length. The drogue upper attachments are then released from the seat, allowing the drogue to deploy the main chute canopy. After approximately 0.5 second of lanyard tension, a small ballistic cutter separates the drogue from the main parachute.

INERTIA REEL

A ballistically operated inertia reel provides crew member retention in an upright position during maneuvering, deceleration, and ejection. The reel may be manually locked and unlocked during normal use by the shoulder harness lock handle. The reel mechanism is attached to the upper portion of the personnel parachute by a strap which, when in the unlocked condition of the reel, allows the crew member to lean forward as desired. When locked by the handle or a 2- to 3-g deceleration, the reel prevents any further play-out. On ejection, the inertia reel ballistic device is actuated, winding in the strap and restraining the crew member in the retracted position in the seat.

KNEE BAR AND FOOT RETRACTORS

During the initial phase of seat ejection, leg positioning and restraint and positioning of the lower torso are accomplished by lowering the seat bucket to bottom, lifting the knees, and locking the feet in foot wells. The knee-raising bar contacts the legs behind the knees. As the knees are lifted, the feet fall into foot wells, and the wells are closed by hooks. If acceleration is being experienced, such that the feet will not fall into the wells, the hooks contact the lower legs and push the feet into the wells. On automatic crewman/seat separation, the foot retractors are ballistically ejected from their housing rods. The knee bar is ballistically rotated through 90 percent of its travel and the crewman's weight shifting forward completes the travel for release from open slots. The foot retractors can be manually spring-ejected by placing the thumb and forefinger behind a release on each retractor rod and pushing down and forward, parallel to the rod. The knee bar may be manually released by pushing forward and down.

ARM RETENTION SYSTEM

The arm retention system is designed to provide protection from windblast-induced injuries to the flight crew member's hands, arms, and shoulders when either the face curtain or secondary ejection knobs are used. The system acts during the pre-ejection phase of escape, forcibly drawing both wrists against the flight crew member's chest, prior to his exposure to the full windblast force. This position causes the arms to be supported by the flight crew member's chest during exposure to windblast. The system is comprised of sleeve assemblies with arm retention pull-tapes connected to the wrist of the garments, a ballistically powered arm retention cable retraction reel located under the cockpit floor, an arm restraint cable and latch connecting the reel and the arm retention pull-tapes, and a latching receptacle located on the front of the survival kit. The receptacle locks the arm restraint latch in the retracted position during the ejection sequences. The system is also equipped with a cable cutter actuated by the harness release handle to free the aircrewman during manual emergency egress of the cockpit. The latch of the arm restraint cable is a partial ring with a spring-loaded locking pin. The end links of the arm retention pull-tapes hook onto the horns of the partial ring and are prevented from slipping off by the locking pin. Arm retention pull-tape disconnects are provided at each wrist for manual release of the tapes when necessary.

Arm Retention Sleeves

The sleeves consist of sleeve assemblies, cuffs with adjustment straps, and gloves. The separate sleeves are connected by elasticized straps across the chest and back. The front strap is equipped with a buckle to permit adjustment. Nylon pull-straps retracting the arms are connected by a quick-disconnect at each wrist. The straps are normally stowed along the sleeve under velcro tape enclosures and are routed through guide rollers on the shoulder harness. The sleeves are available with normal or fingerless gloves attached to the sleeves by zippers. The latter are to be worn under regular flight gloves.

*Aircraft having AFC 311 complied with

Latch and Receptacle

The arm retention latch is a spring-loaded lockpin-jaw device used to secure the sleeve pull-straps to the retention cable. The latch and cable are stowed in spring clips on the forward surface of the survival kit.

Arm Retention Operation

Following initiation of the ejection sequences, gas pressure causes the arm retention reel to wind in the cable, pulling the latch into the receptacle. A system of cams and catches locks the latch into the receptacle and allows the cable to release and reel in freely, remaining with the aircraft. The arm pull-straps, attached to the latch, pull the wrists to the body, level with the collar bones. The arms remain in this position until seat/man separation or until manually released by rotating the quick-disconnect knobs to the released position (90 degrees rotation in either direction). On seat/man separation, inflation of the separation bladders forces the receptacle assembly (attached to the survival kit) to slide up and out of the channel on the front of the seat, allowing the locking cams to rotate. The center locking pin in the latch is then retracted by two hooks, freeing the pull-strap links. Following release from the latch, the pull-straps remain attached at the wrist quick-disconnects and should be released to avoid possible entanglement.

Note

During ditching or bail-out, pulling the harness release handle fires the cable cutter, freeing the crew member to exit with the latch assembly attached to the pull-straps. If the cable cutter fails to fire, the cable can be extracted from the reel by applying approximately 50 pounds pull force.

SEPARATION SYSTEM

The automatic seat/man separation system consists of a preset aneroid, a ballistic thruster, and ballistically operated mechanical release devices or cutters. The seat remains in the stabilized attitude until it has decelerated to separation velocity and descended below a pressure altitude of 13,000 feet. Then, simultaneously, the lower drogue chute risers, leg hooks, and harness release attachments are released, and separation bladders, located under the survival kit and behind the personnel parachute, are inflated. Refer to ESCAPE SYSTEM OPERATION, in this section.

Separation Aneroid Indicator

The separation aneroid indicator is installed behind an inspection hole in the back of the seat. The indicator is viewed by unlocking the shoulder harness, leaning the parachute forward, and moving the seat back separation bladder to one side. A satisfactory aneroid is indicated if only white can be seen in the inspection window.

Note

At field elevations of 5000 feet and higher, it is acceptable for a small portion of red to be visible in the inspection window.

SEAT ADJUST SWITCH

The SEAT ADJUST switch (figures FO-1 and FO-4) is located on the right console in each cockpit. This switch provides electrically operated seat height adjustment. After moving the seat through one complete cycle, allow 2 minutes for cooling to prevent overheating the seat actuator. The seat adjust circuit is inoperative with one generator inoperative.

HARNESS LOCK HANDLE

The harness lock handle (figure FO-8) is located on the left side of the seat. Moving the handle to the LOCK (forward) position prevents the crew member from leaning forward by locking the inertia reel. The reel may be unlocked by leaning back to remove tension from the reel and moving the handle back to UNLOCK. If the reel is locked automatically, the reel may be unlocked by cycling the handle.

EJECTION INTERCONNECT

The ejection seats are connected by a system of ballistic lines and a delay device to allow the pilot to operate the escape sequence in both cockpits. This interconnect does not allow the RAN to eject the pilot, nor does it in any way affect the RAN's ability to initiate his own ejection. In the event of an emergency, initiation of ejection by the pilot jettisons both canopies. The aft seat is then automatically ejected, followed approximately 0.75 second later by the forward seat. This sequence provides safe separation from the canopies and ensures crew member separation.
On some aircraft,* ejection initiation by the pilot jettisons the aft canopy. Then the aft seat is automatically ejected, followed approximately 0.75 second later by the forward canopy and seat.

WARNING

- On being warned of emergency ejection by the pilot, the RAN must make every effort to assume the appropriate position for ejection.
- If ejection sequence is initiated by the pilot, safety pins in the RAN's ejection seat will not prevent RAN's seat ejection.

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*Aircraft having AFC 311 complied with

HARNESS RELEASE HANDLE

The harness release (ditching) handle (figure FO-8) allows complete crew member separation from the seat through the action of this single handle. When pulled up through full travel, this handle performs the following:

1. Releases survival kit hold-down attachments.
2. Fires parachute static pulloff lanyard cutter.
3. Releases shoulder harness and lap belt attachments.
4. Fires arm retention cable cutter, cutting cable at the survival kit.
5. Releases parachute automatic opener lanyard (if seat is NOT ejected).

WARNING

- After ejection, the harness release handle may be used, if required, to override the automatic separation and chute deployment sequence. The parachute automatic opener is armed on separation from the seat. If, however, the harness release handle is used to obtain freedom from the seat for *unejected bail-out*, the automatic opener cable is *released* and the *manual "D" ring* must be pulled to obtain parachute deployment.
- Manual separation at high altitudes can result in severe tumbling or spinning, causing possible injury or death.

FACE CURTAIN

The face curtain is stowed in the seat headrest. In the event ejection is to be initiated, the curtain "B" handle should be gripped firmly with both hands and pulled sharply outward and down over the head in one continuous motion (approximately 22 inches).

ALTERNATE EJECTION PULL-KNOBS

The alternate ejection pull-knobs are located on each side of the seat frame at the knee position. To operate, either knob must be turned inward to unlock (about 40 pounds force), then pulled upward 3/4 inch with a force of about 30 pounds to initiate ejection.

ESCAPE SYSTEM SAFETY HARNESS

Three separate safety harnesses are used to safety the ejection seat under different circumstances. These harnesses are the E6774 ground safety harness, the E7583 maintenance harness, and E6794 removal harness. The E6774 ground safety harness consists of the alternate pull-knobs safety pins (two) and the face curtain safety pin. It is normally removed and installed under the direction of the flight crew. The E7583 harness is used for safety while removing the parachute or survival kit, and the E6794 harness is used while removing the ejection seat from the aircraft. For detailed location of the safety harness pins, see figure 1-21.

ESCAPE SYSTEM OPERATION

Once initiated, operation of the ejection and escape sequence is entirely automatic. For minimum safe ejection altitudes, see figure 1-22. Figure 1-23 illustrates the escape system trajectory. Figure 1-22A is a chronology of a pilot-initiated, ground-level ejection (KEAS), with escape and recovery of both crew members.

HS-1A ESCAPE SYSTEM CAPABILITY

On some aircraft,* ejection capability is improved in the airspeed range of 0 to 200 knots. Figure 1-23A shows the system recovery capability in reference to terrain clearance required for ejection under various flight conditions.

Figure 1-23A (Sheet 1) also shows initiation requirements for pilot and RAN at various dive angles in the high mode.

Altitudes shown are minimums at which the escape system consistently will provide recovery capability. As an example of chart usage, assume the seat is in the high mode, aircraft speed is 400 knots, and a dive angle of 30 degrees exists. For safe recovery of both crewmen, the pilot must initiate the system above 980 feet. The RAN could initiate his system above 700 feet and safely recover.

In the event a 90-degree roll also exists for the preceding cases, an additional terrain clearance requirement applies for both pilot and RAN, amounting to 120 feet for the high mode and 75 feet for the low mode (Figure 1-23A, Sheet 2). This method of estimating the effects of combined dive and roll conditions on terrain clearance required is accurate for intermediate conditions of dive, roll, and airspeed. This method of estimating is generally conservative for the extreme attitude and airspeed conditions, except for airspeeds of 400 KIAS or greater, where such an estimate results in lower terrain clearance than is actually required in some cases.

SURVIVAL KIT

A land and water survival kit is installed in the seat bucket. This kit contains the emergency high-pressure oxygen supply and a standard PK-2 life raft and survival package. The pressure gage for the emergency oxygen

*Aircraft having AFC 184 complied with.

EJECTION SEAT SAFETY HARNESSES

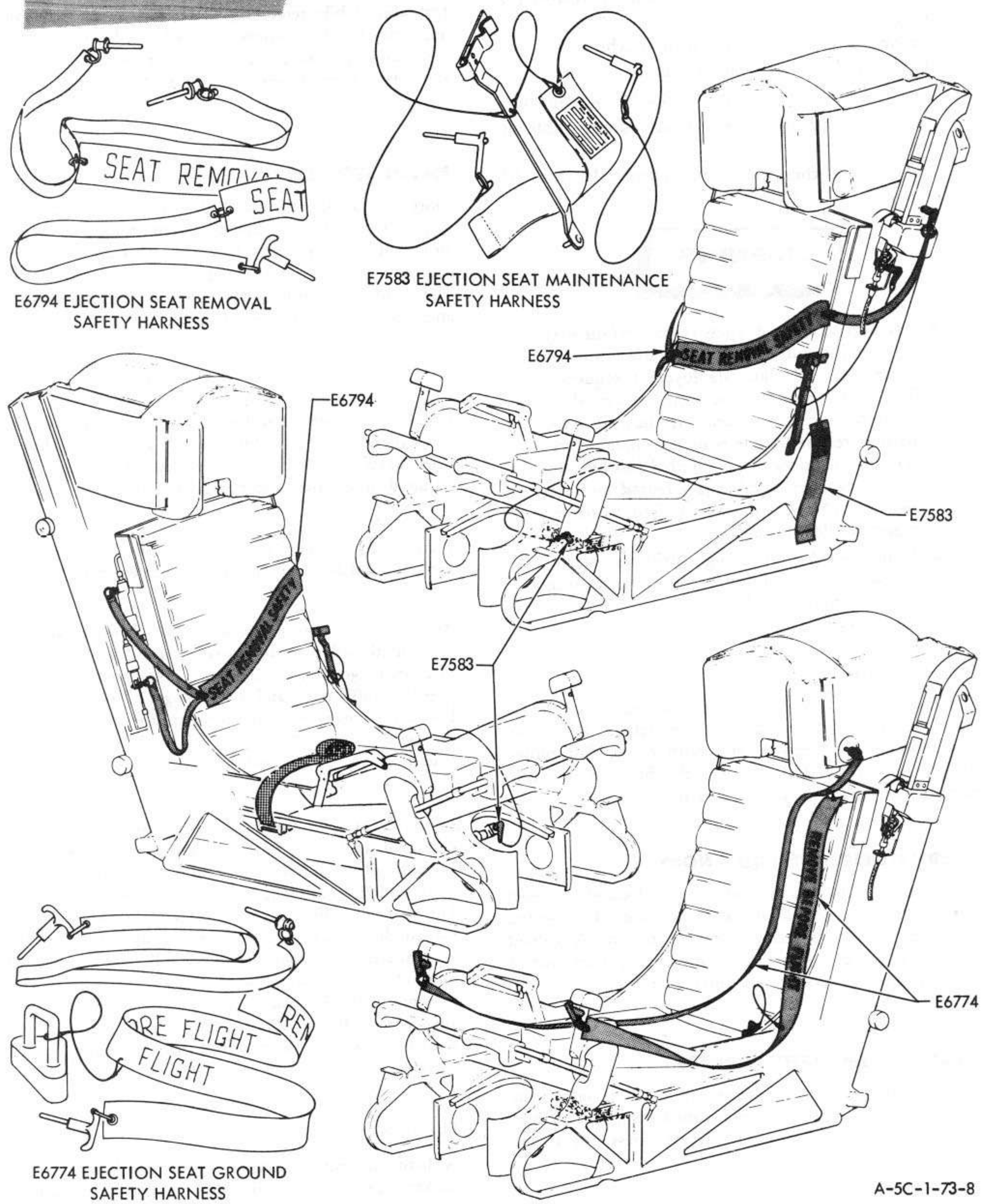
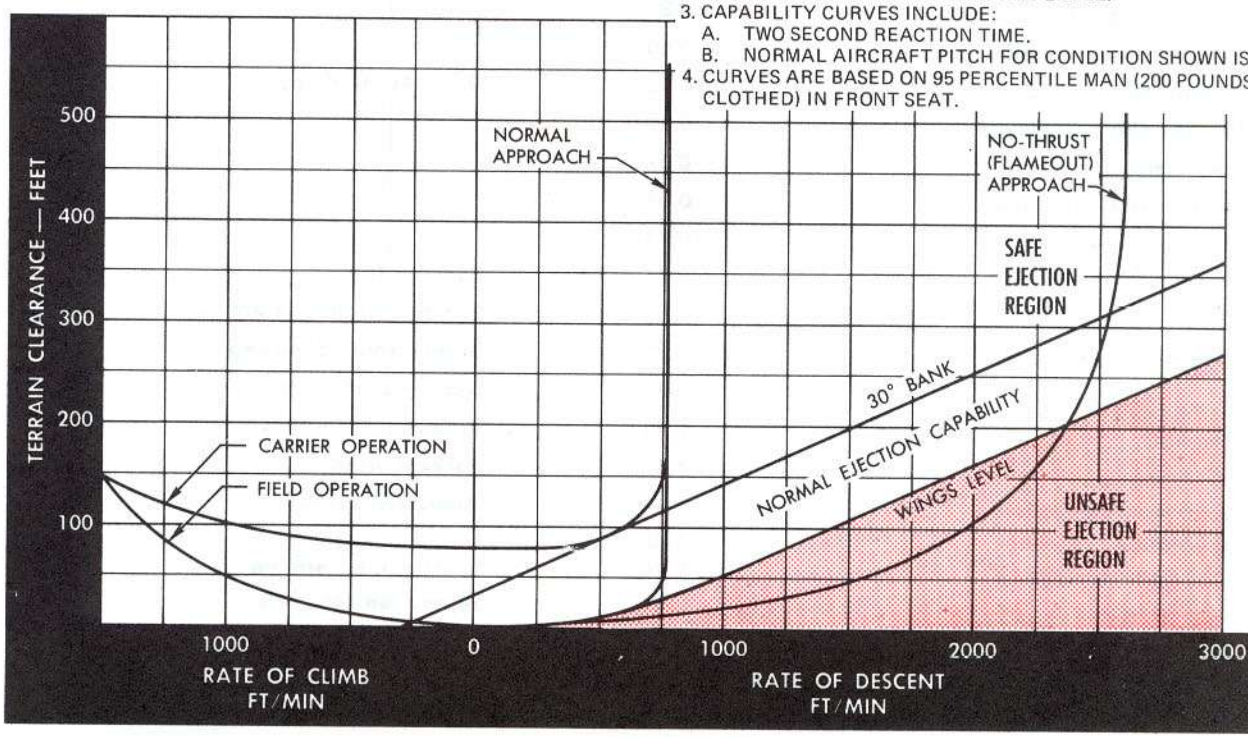


Figure 1-21

MINIMUM SAFE EJECTION ALTITUDES

NOTE:
1. FOR 90° BANK ADD 400 FEET TO TERRAIN CLEARANCE REQUIRED FOR WINGS LEVEL.
2. FOR INVERTED FLIGHT ADD 700 FEET TO TERRAIN CLEARANCE REQUIRED FOR WINGS LEVEL.
3. CAPABILITY CURVES INCLUDE:
   A. TWO SECOND REACTION TIME.
   B. NORMAL AIRCRAFT PITCH FOR CONDITION SHOWN IS ±15°.
4. CURVES ARE BASED ON 95 PERCENTILE MAN (200 POUNDS, UNCLOTHED) IN FRONT SEAT.

- AIRCRAFT NOT HAVING AFC 311 COMPLIED WITH



NOTE:
1. CURVES INCLUDE 2 SECOND PILOT REACTION TIME.
2. CURVES ARE BASED ON WINGS LEVEL DIVE ATTITUDE AND APPROPRIATE ANGLE OF ATTACK.
3. TERRAIN CLEARANCE REQUIRED IS BASED ON 5000 FOOT TERRAIN AND IS CONSERVATIVE FOR LOWER TERRAIN.
4. CURVES ARE BASED ON 95 PERCENTILE MAN IN FRONT SEAT.

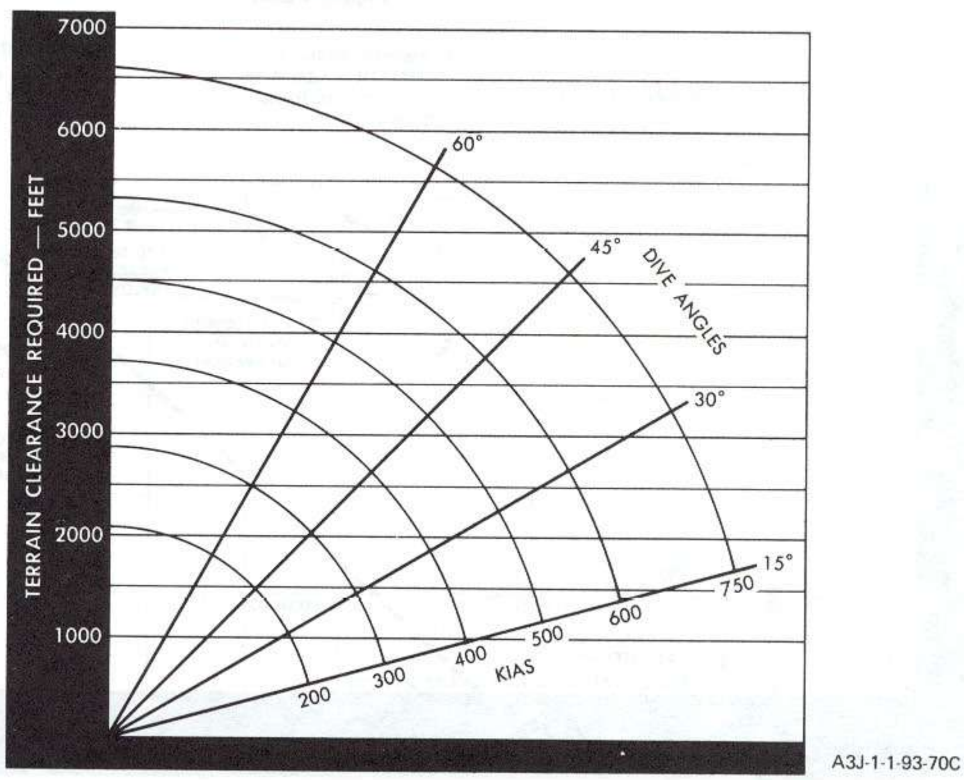


Figure 1-22

PILOT INITIATED GROUND LEVEL EJECTION

AFT SEAT	TIME IN SECONDS (CUMULATIVE)	FORWARD SEAT
—	Zero	Initiation
Canopy jettisoned	0.10	Canopy jettisoned
Seat bottomed, RAN restrained	0.20	Seat bottomed, pilot restrained
Front canopy clear	0.30	↑
Catapult fired (automatic IFF)	0.40	
Separation aneroid armed	0.50	(0.75-second delay)
Drogue chute deployed	0.52	
Seat clear of cockpit	0.57	
Drogue chute inflated	0.58	
Rocket burnout	0.78	↓
↑	1.15	Catapult fired
	1.25	Separation aneroid armed
(Stabilized ascent)	1.27	Drogue chute deployed
	1.32	Seat clear of cockpit
	1.33	Drogue chute inflated
↓	1.53	Rocket burnout
Seat/man separation	1.95	(Stabilized ascent)
Separation complete	2.26	—
Parachute deployed	2.70	Seat/man separation
—	3.01	Separation complete
—	3.45	Parachute deployed
Parachute inflated	5.00	—
—	5.75	Parachute inflated

Figure 1-22A

ESCAPE SYSTEM TRAJECTORY

PILOT-INITIATED SEQUENCE AT 101 KNOTS EAS IN STRAIGHT AND LEVEL ATTITUDE; ZERO ALTITUDE, ZERO SINK-RATE.

NOTE:
FOR RAN INITIATED EJECTION, RAN SEQUENCE IS AS SHOWN FOR AFT SEAT.

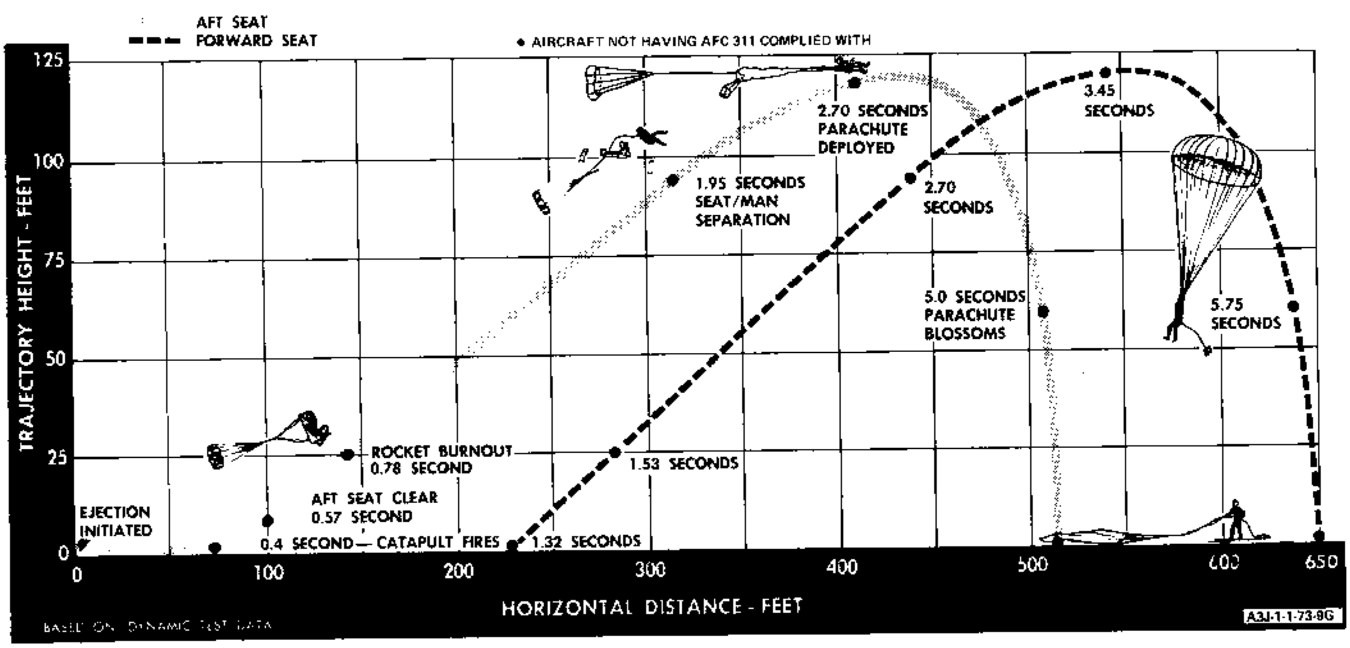
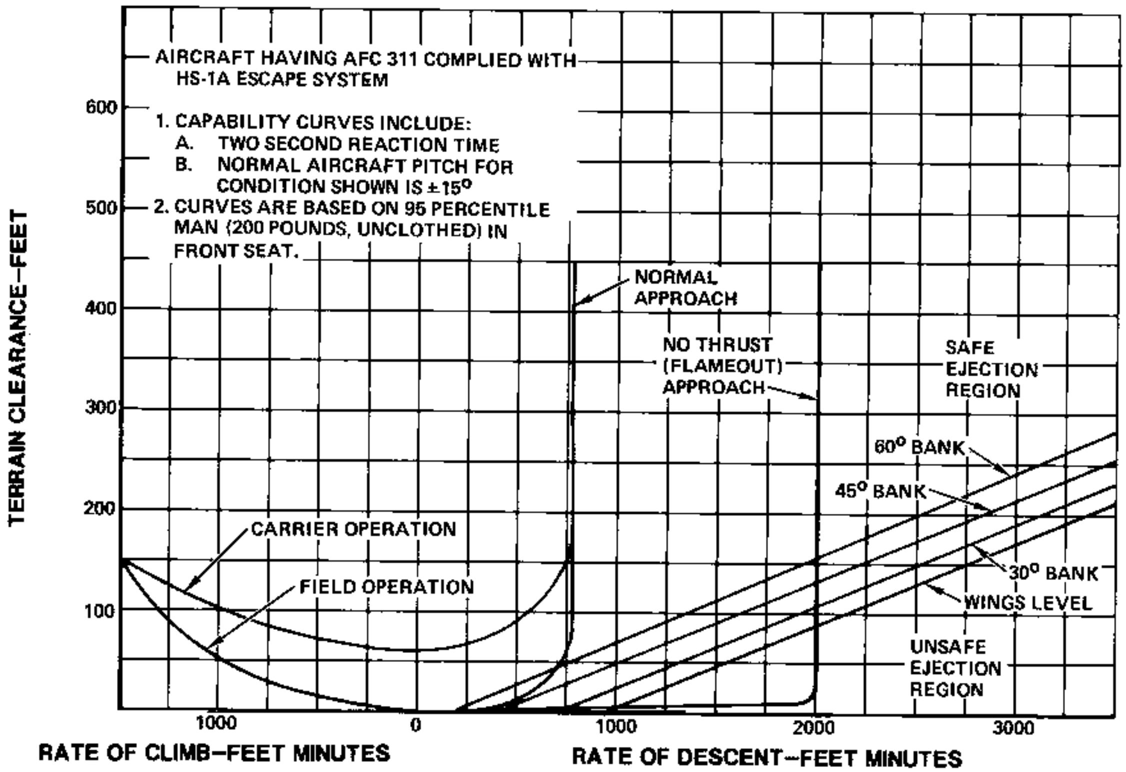


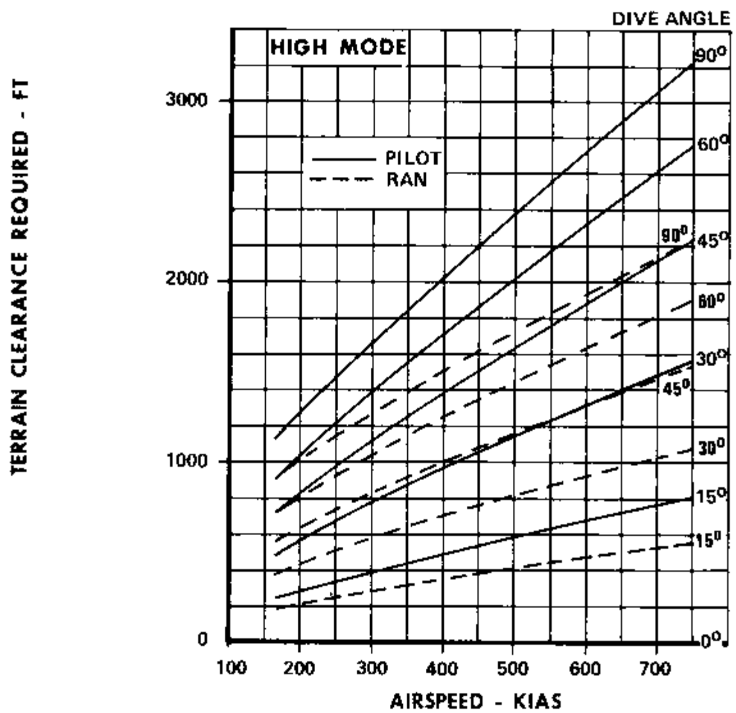
Figure 1-23

HS-1A ESCAPE SYSTEM CAPABILITY

● MINIMUM SAFE EJECTION ALTITUDES



● ALTITUDE VS DIVE ANGLE AIRCRAFT HAVING AFC 311 COMPLIED WITH



NOTES
1. TERRAIN CLEARANCE REQUIRED BASED ON:
- ZERO REACTION TIME
- WINGS LEVEL ATTITUDE
- AVERAGE CREW WEIGHT AND SYSTEM CONDITIONS

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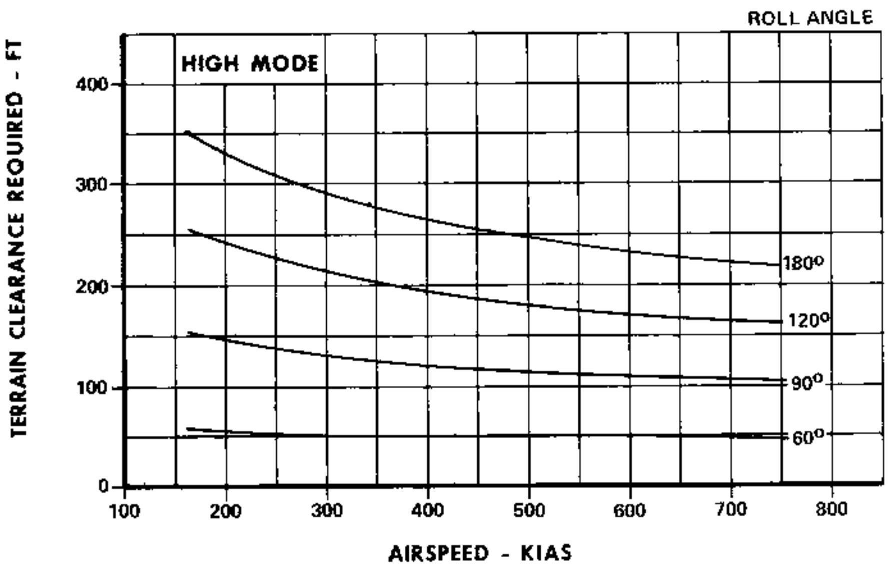
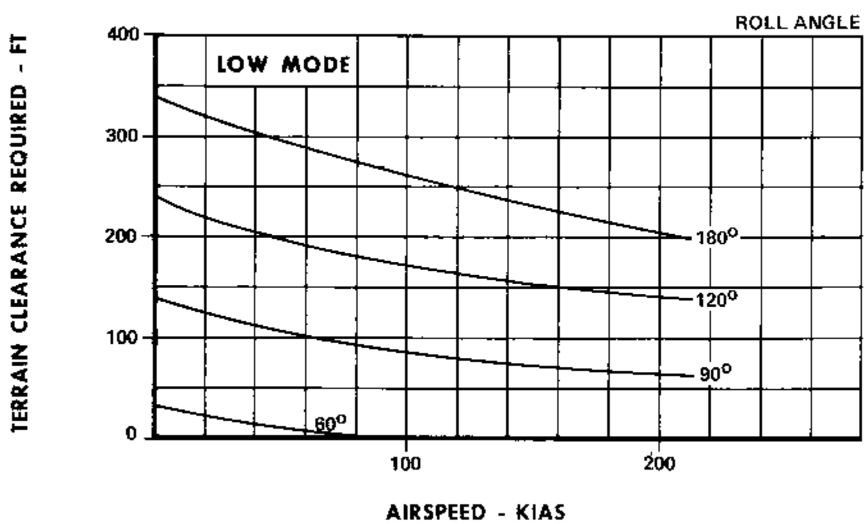
Figure 1-23A (Sheet 1)

HS-1A ESCAPE SYSTEM CAPABILITY

AIRCRAFT HAVING AFC 311 COMPLIED WITH

• ALTITUDE VS ROLL ANGLE





NOTES

1. TERRAIN CLEARANCE REQUIRED BASED ON:
   - ZERO REACTION TIME
   - NOSE LEVEL ATTITUDE
   - AVERAGE CREW WEIGHT AND SYSTEM CONDITIONS
2. DATA APPLIES TO BOTH PILOT AND RAN

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Figure 1-23A (Sheet 2)

system, along with its emergency pull-ring, is located on the left forward portion of the kit as viewed by the seated crew member.

WARNING

Do not use supplemental seat cushions on top of the survival kit. Serious injury can result on ejection due to cushion compression and seat center-of-gravity movement.

Note

During the ejection sequence, the emergency oxygen system is automatically operated.

After crewman/seat separation and parachute deployment, the survival kit and raft are manually deployed for water landing by pulling a yellow handle on the right side of the kit. As the raft and equipment package falls to the full length of its retaining lanyard (about 25 feet), the life raft is automatically inflated by its integral CO_2 bottle. A retractable knife for emergency cutting of parachute shroud lines is located in the kit release handle.

SURVIVAL KIT CONTENTS

The contents of the kit may be changed as required by the Operational Commander. The basic equipment included in the survival kit is as follows:

- Pararaft, PK-2
- Day/Night Distress Signal (2)
- Dye Markers (2)
- Nylon Shroud Line (50 feet)
- Solar Still
- Chemical Desalting Kit
- Canned Rations
- Water Storage Bag
- Signal Mirror
- Sponge
- Poncho

EMERGENCY BEACON

On aircraft having Aircrew Systems Change 44 complied with, an AN/PRC-49/49A emergency beacon is installed in the ejection seat survival kit. This miniature, battery-powered transceiver assists in locating aircrew members following aircraft abandonment. The emergency beacon transmitter is automatically actuated on seat/man separation by a lanyard connected to the seat bucket, and transmits on UHF/GUARD frequency continuously until turned off. The unit also provides two-way voice communications on 243.0 megacycles.

AIR CONDITIONING SYSTEM

For a simplified schematic of the air conditioning system, see figure FO-14. The air conditioning system provides:

1. Cockpit conditioning and pressurization or exposure suit conditioning.
3. Anti-G suit operation.
4. Windshield and canopy defrosting, windshield anti-icing, and rain removal.
5. Boundary layer control air.

AIR SUPPLY

The final stage of both engine compressors is tapped at four points to provide a high-pressure air supply. The compressor bleed air lines are cross-connected and checked to prevent backflow during single-engine operation. Between the check valves and the primary heat exchangers, air is tapped off to supply the boundary layer control system. The BLC valves are mechanically operated and are open only when the droop leading edge is extended.

HEAT EXCHANGERS AND COOLING TURBINES

The compressor air supply is directed to two primary heat exchangers. The right-hand primary heat exchanger reduces compressor air supply temperature, providing the main hot air supply for cockpit conditioning, defrosting, and a portion of the hot air supply for equipment conditioning. The left-hand primary heat exchanger reduces compressor supply air temperature, providing the main hot air supply for equipment conditioning. Both primary heat exchangers reduce supply air temperature through use of ram air extracted from the engine inlet ducts. Modified supply air is directed from the primary heat exchangers to two secondary heat exchanger/cooling turbine units, which reduce the temperature of a portion of the supply air to a refrigerated level. Environmental requirements of the cockpits and electronic equipment are controlled by cooling effect detectors, which automatically supply air at the required temperatures, through mixing and shutoff valves which combine hot and cold air as required.

JET PUMPS

Cooling airflow through the primary and secondary heat exchangers is increased, when required, through the action of jet pumps which offset the effect of low air speed on engine inlet air velocity (ram cooling airflow). The jet pumps, using engine compressor air, create low pressure at the heat exchanger outlets, causing an increase in cooling airflow.

COCKPIT CONDITIONING

The air conditioning system provides a regulated air supply for control of cockpit temperature and pressurization. Cockpit air temperature is controlled by manual or automatic mixing or warm air from the right-hand primary heat exchanger with cold air from the No. 4 refrigeration turbine.

COCKPIT PRESSURIZATION

A cockpit pressure regulator, mounted aft of the RAN's left console, maintains the following pressure schedule. See figure 1-24.

1. An ambient cockpit to 8000 feet MSL.
2. A constant 8000-foot level pressure from 8000 to approximately 23,400 feet MSL.
3. A constant 5.0-psi differential pressure at all altitudes above approximately 23,400 feet MSL.

In the event of pressure regulator failure, a combination dump/vacuum pressure relief valve prevents cockpit pressure differential from exceeding approximately 5.5 psi. The vacuum relief function of this valve prevents cockpit pressure from falling below a pressure level 0.25 psi less than atmospheric pressure, thus avoiding possible canopy or cockpit structural collapse. Cockpit ventilation is achieved by exhausting cockpit air through the cockpit pressure regulator into the main electronics bay and through the combination dump/vacuum pressure relief valve into the forward electronics bay.

CAUTION

If malfunction or damage to the cabin pressure regulator is suspected, select RAM EMERG for 1 minute and ensure cabin altitude is essentially the same as field elevation prior to opening either canopy.

EQUIPMENT CONDITIONING

Electronic equipment environment is controlled by air from both primary and secondary heat exchangers and turbine compressor refrigeration units No. 1, No. 2, and No. 3. Equipment cooling air controls the environment of components such as the a-c power supervisory panels, voltage regulators, autoflight control system, AN/ASB-12, and reconnaissance systems. On some aircraft,* the two temperature controllers, located in the flight control electronics bay, have external two-position switches which provide selection of either normal or humid weather mode. The NORMAL position provides cooling air temperature of 70.0 (±6.0)°F. The switch is set to this position when the aircraft is operated in normal weather conditions. When the aircraft is operated in humid climates or weather conditions, the switch is set to HUMID position. This provides a cooling air temperature of 80.0 (±6.0)°F which reduces the formation of free water in the electronics equipment cooling air. The setting of this switch is a ground maintenance function.

Note

With flaps retracted, the equipment conditioning system has priority over the cockpit conditioning and pressurization systems in the event of a malfunction of the No. 3 refrigeration turbine compressor unit.

ALTERNATE COOLING

The equipment and cockpit conditioning systems are interconnected to increase total system reliability. If equipment cooling capacity becomes inadequate, a cooling effect detector, located in the equipment refrigeration unit discharge line, energizes relays. These relays accomplish the switching required to supply equipment cooling air from the No. 4 turbine compressor refrigeration unit. If the overheat condition is eliminated, normal cooling system operation may be restored by depressing the ALTERNATE COOL reset button.

EXTERNAL COOLING AIR REQUIREMENTS

Externally supplied cooling airflow is required at two servicing receptacles for ground ventilation of exposure suits† and for operation of radios, reconnaissance equipment, and other electronics components, prior to starting engines. For acceptable external conditioning air units, refer to Section I, Part 3. Approximately 20 pounds per minutes flow is required at 1.6 psig (50°F) for the right receptacle, and 60 pounds per minute at 4.7 psig (50°F) is required at the left (main) receptacle. The autonavigator (forward) cooling air access requires approximately 12 pounds per minute at 1.6 psig (50°F) for alinement only.

CAUTION

If the autonavigator cooling air access (ship package) is used alone (for alinement), the RADAR/TV POWER and BOMB COMPUTER POWER switches should NOT be turned on until after the engines are started.

Note

Radio communications are impossible prior to engine start without external electrical power and cooling air applied at the main (left) receptacle.

*Aircraft having AFC 291 complied with and aircraft 156608 through 156643

†Aircraft 156618 through 156643

COCKPIT PRESSURIZATION SCHEDULE

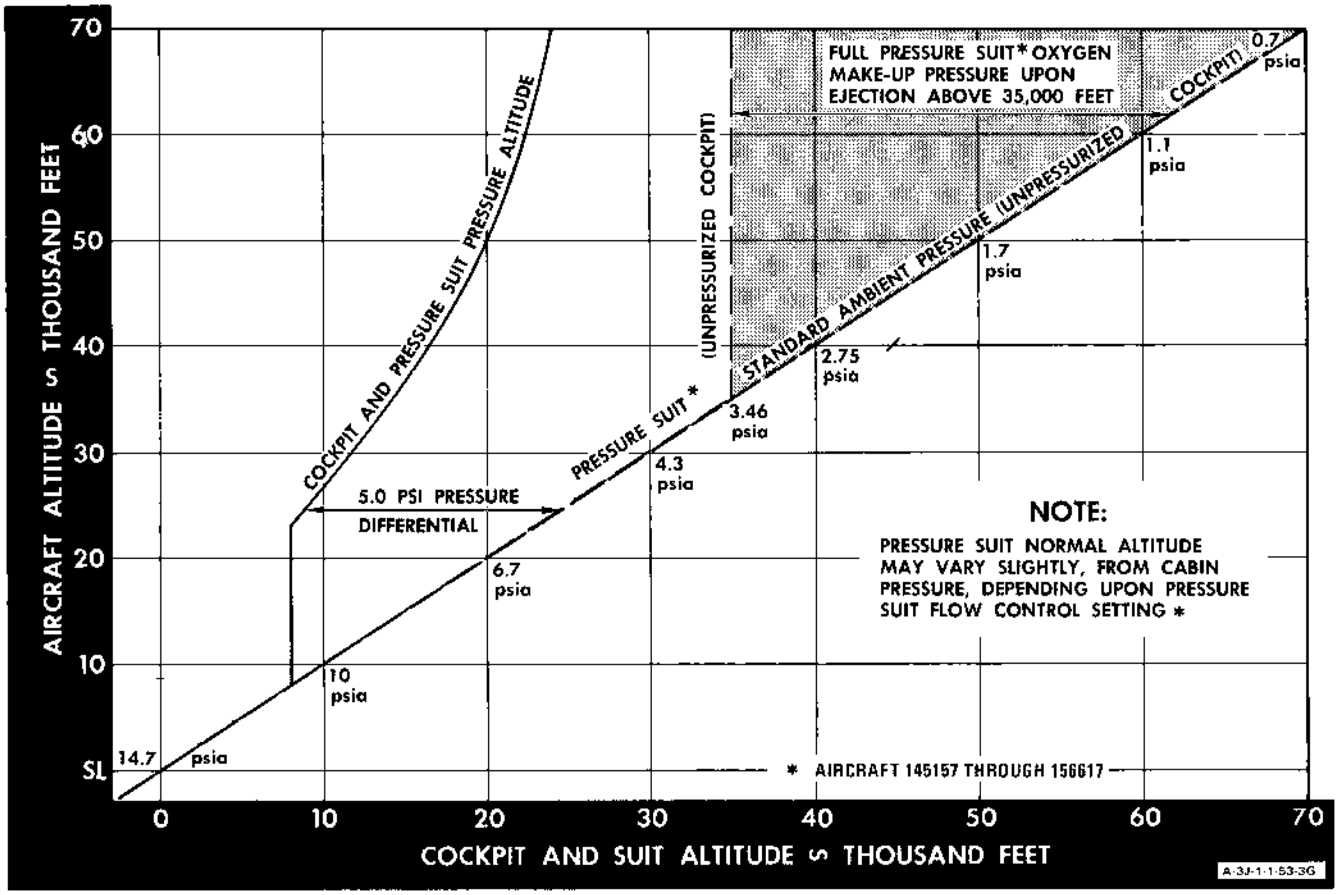


Figure 1-24

AIR CONDITIONING CONTROLS AND INDICATORS

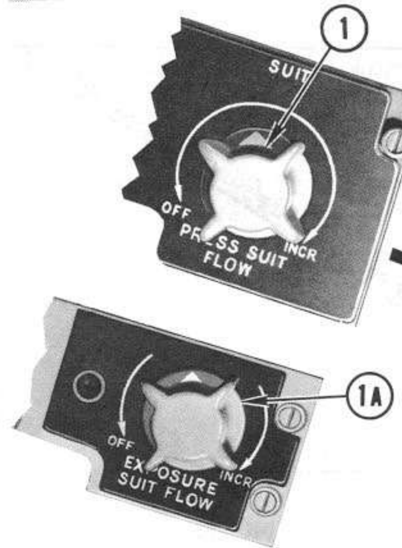
COCKPIT TEMPERATURE KNOB

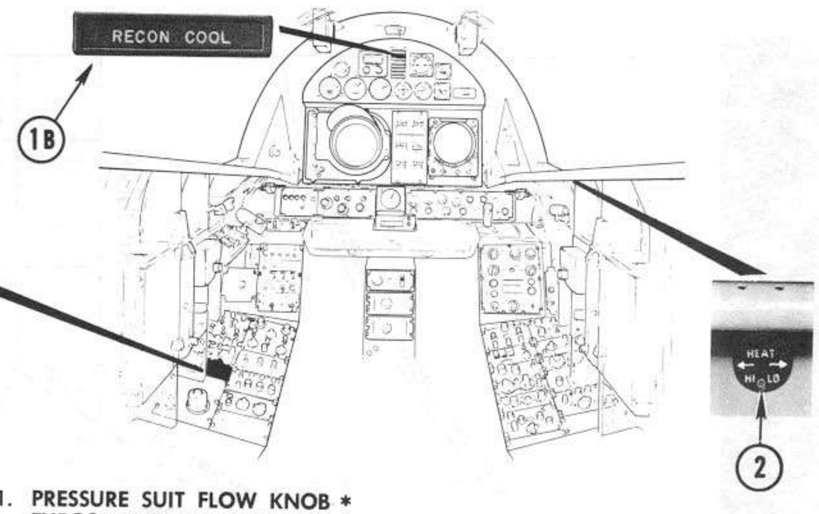
The COCKPIT TEMP knob (figure 1-25) is operated in conjunction with the AUTO/MAN switch in controlling cockpit air temperature. With the AUTO/MAN switch in MAN, the COCKPIT TEMP knob directly controls cockpit supply air temperature through mixing of warm air from the right-hand primary heat exchanger and cold air from the No. 4 refrigeration unit in the supply line. With the AUTO/MAN switch in AUTO, cockpit supply air temperature is maintained constant at the COCKPIT TEMP knob setting. Supplemental heat is available by selecting a desired amount of defrost airflow. When operating in AUTO, a change in flight conditions (altitude or Mach number) may require a change in knob setting to maintain the desired temperature. When operating in MAN, changes in power setting or flight conditions will require more frequent changes in setting to maintain cockpit temperature as desired. The COCKPIT TEMP knob can be used to modify uncomfortable cockpit temperatures caused by defrost system operation.

CAUTION

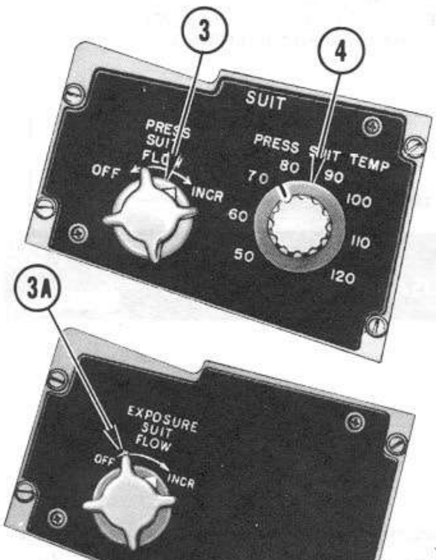
Before taking off in humid weather, the COCKPIT TEMP knob should be set at "2" or the COCKPIT PRESS switch set at RAM EMERG to preclude formation of cockpit fog. Under high-humidity conditions, turning the knob toward COLD will increase the intensity of fog formation and can cause frosting of the canopy and instruments.

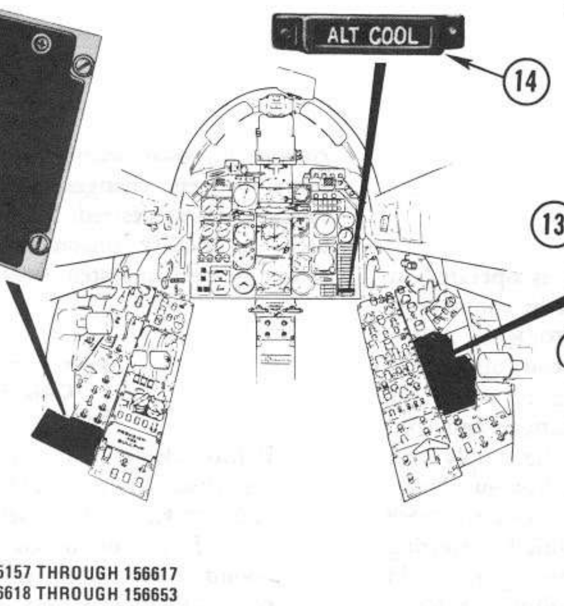
AIR CONDITIONING AND PRESSURIZATION CONTROLS

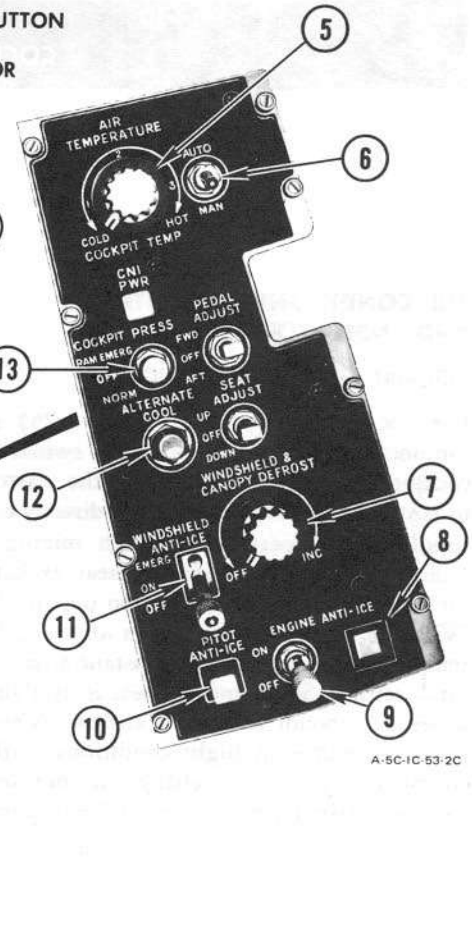




1. PRESSURE SUIT FLOW KNOB *
1A. EXPOSURE SUIT FLOW KNOB †
1B. RECON COOL CAUTION LIGHT (RAN)
2. HEAT CONTROL LEVER (RAN)
3. PILOT'S PRESSURE SUIT FLOW KNOB *
3A. PILOT'S EXPOSURE SUIT FLOW KNOB †
4. PRESSURE SUIT TEMPERATURE KNOB *
5. COCKPIT TEMPERATURE KNOB
6. AUTO-MANUAL SWITCH
7. WINDSHIELD AND CANOPY DEFROST KNOB
8. ENGINE ANTI-ICE "ON" INDICATOR
9. ENGINE ANTI-ICE SWITCH
10. PITOT ANTI-ICE BUTTON
11. WINDSHIELD ANTI-ICE SWITCH
12. ALTERNATE COOLING RESET BUTTON
13. COCKPIT PRESSURE SWITCH
14. ALT COOL CAUTION INDICATOR







* AIRCRAFT 145157 THROUGH 156617
† AIRCRAFT 156618 THROUGH 156653

A-5C-IC-53-2C

Figure 1-25

Note

The temperature of the aft cockpit is varied by an airflow control lever which ports defrost system flow to the cockpit. Under some conditions, changing the position of the cockpit temperature knob and varying the position of the aft cockpit heat lever may be required.

AUTO/MAN SWITCH

The AUTO/MAN switch (figure 1-25) provides automatic or manual control of cockpit air temperature. The AUTO position allows the temperature control unit to maintain cockpit supply air temperature automatically at the preset position of the COCKPIT TEMP knob. Should cockpit temperature become uncontrollable because of system malfunction, the switch should be placed in MAN and cockpit temperature controlled manually with the COCKPIT TEMP knob. Should an extreme temperature malfunction occur when the pressure suit is being worn, the effect may be offset by manually changing suit temperature. It may be desirable to move the COCKPIT PRESS switch to RAM EMERG for cooling or to select defrost for additional heat as applicable.

COCKPIT PRESSURE SWITCH

The COCKPIT PRESS switch (figure 1-25), located on the AIR TEMPERATURE control panel, has three positions: NORM, OFF, and RAM EMERG. In the OFF position, no cockpit pressurization or ventilation is provided. In the NORM position, automatic cockpit pressurization and ventilation airflow are provided according to the schedule shown in figure 1-24. If cockpit air is contaminated by smoke or fumes, placing the COCKPIT PRESS switch to RAM EMERG will dump cabin pressure and ventilate the cockpits.

Note

In the OFF and RAM EMERG positions of the COCKPIT PRESS switch, crew member environment may be modified with the pressure suit controls or by selecting windshield and canopy defrost operation.

COCKPIT PRESSURE ALTIMETER

The cockpit pressure altimeter (figure 1-19) indicates cockpit pressure altitude in feet. When the full pressure suit is worn, suit altitude is indicated by a suit-mounted altimeter.

ALTERNATE COOLING CAUTION INDICATOR

The alternate cooling caution indicator (ALT COOL, figure 1-25) is located on the instrument panel. This indicator will come on if cockpit conditioning air is diverted to provide equipment conditioning.

ALTERNATE COOL RESET BUTTON

The ALTERNATE COOL reset button (figure 1-25) is located on the AIR TEMPERATURE control panel. This button is depressed to regain normal cockpit conditioning airflow after diversion by a transient overheat condition.

RECON COOL CAUTION LIGHT (RAN)

A RECON COOL caution light on the RAN's display panel (figure 1-25) illuminates on lift-off (with flaps extended more than 25 degrees), and remains illuminated until approximately 1 minute after flap retraction, indicating normal shutdown of the No. 2 and No. 3 cooling turbines during null flow operation. The light illuminates approximately 15 seconds after flap extension and remains on until touchdown. Flight operations (with flaps extended more than 25 degrees) for a period exceeding 2 minutes will require that reconnaissance systems POWER switches be turned OFF.

VENTILATION OUTLETS

Cockpit ventilation is provided by footwarmers and air distribution tubes, located below the canopy rails on both sides of each cockpit. Airflow direction is controlled through manual rotation of the ventilation tubes.

HEAT CONTROL LEVER (RAN)

The RAN's heat lever (figure 1-25) controls the flow of additional hot air to the rear cockpit. This air is ducted through a variable control valve directly from the defrost system supply line to supplement normal cockpit air conditioning and compensate for the temperature difference between cockpits.

AIR CONDITIONING SYSTEM OPERATION

The heat exchanger jet pumps and the cooling turbines are controlled by an overheat protection system. Equipment conditioning airflow is maintained at a constant level during the post take-off "null flow" phase (160 to 250 knots) through automatic shutdown of the No. 2 and No. 3 cooling turbines on lift-off, and maintaining this state until approximately 1 minute after the flaps retract through 25 degrees. During ground operation with flaps extended 25 degrees or more, all jet pumps operate as long as primary heat exchanger discharge air temperature is within limits, and engine rpm is less than approximately 80%. Advancing rpm to more than 80% results in shutdown of the primary heat exchanger jet pumps. On some aircraft,* the primary heat exchanger jet pumps are operated at all times during ground operation below 80% to 85% rpm as long as heat exchanger discharge air is within temperature limits. Should air temperature from either primary heat exchanger exceed limits, the jet pump in the overheated exchanger is shut off. This turbine overheat protection feature is installed to minimize the effect of high idle rpm (T_2 reset), caused by elevated inlet duct air temperature, resulting in increased compressor supply air temperature and a possible null in airflow across the heat exchangers. On modified aircraft,* the automatic jet pump shutoff feature is tested by the ground crew through use of a PRI JET PUMP TEST switch on the fuel pump test panel. A ground check after engine start for jet pump automatic shutoff is necessary to ensure that air reaching the turbines will not exceed limits. This check is accomplished by the ground crew in coordination with the pilot by advancing engine rpm to a maximum of 85% and noting that jet pump overboard airflow cuts off properly. Failure of automatic shutoff can result in cooling turbine and heat exchanger overheat due to reverse airflow through the primary heat exchangers.

CAUTION

Do not operate the engines above 85% rpm with the ground safety circuit breaker out as serious damage to the cooling turbines can result.

On some aircraft,† the secondary jet pumps are operated with the gear extended or flaps extended 25 degress or more, both on the ground and in flight. In addition, single-engine operation results in shutoff of the right-hand secondary jet pump to increase equipment conditioning airflow. For a simplified schematic of the air conditioning system, see figure FO-14.

COCKPIT CONDITIONING PROCEDURES

Operation of the cockpit conditioning and pressurization system is accomplished as follows:

Preflight

1. AUTO/MAN switch—AUTO.
2. COCKPIT TEMP knob—midposition (2).
3. COCKPIT PRESS switch—NORM.
4. RAN's heat lever—midposition.
5. WINDSHIELD & CANOPY DEFROST knob—as desired.
   Some defrost flow should be maintained during all pressure suit operations to ensure adequate warmth for the pressure suit conditioning lines.
6. Jet pump check—complete prior to taxi.
7. Canopies—closed.
   Caution indicator out.

In-flight

1. The pilot controls cockpit temperature by rotating the COCKPIT TEMP knob toward HOT or COLD as desired.

   If additional heat is required, move the WINDSHIELD & CANOPY DEFROST knob toward INC as necessary.
2. Check cockpit pressure altimeter for normal schedule.
3. If formation of cockpit fog is anticipated during take-off or approach, it is recommended that the COCKPIT PRESS switch be positioned to OFF and maximum canopy defrost be selected.

Note

Excessive cockpit heat resulting from defrost airflow can be modified by use of the COCKPIT TEMP knob.

4. Aft cockpit temperature is controlled by moving the heat lever toward LO (aft) or HI (forward).
5. If automatic temperature control fails, move the AUTO/MAN switch to MAN and control temperature directly with the COCKPIT TEMP knob.

Note

Should temperature controller failure during flight cause fog formation in the cockpit, the best corrective action is to utilize windshield and canopy defrost airflow as required. Turning the COCKPIT PRESS switch OFF also aids fog dissipation, if pressurization is not required.

6. If emergency cockpit cooling is mandatory, check the WINDSHIELD & CANOPY DEFROST knob is off and move the COCKPIT PRESS switch to RAM EMERG.
   A reduction in airspeed may also be required.

*Aircraft having AFC 229 complied with

†Aircraft having IAFC 199 complied with

7. If normal operation cannot be obtained through use of the ALTERNATE COOL reset button, reduce altitude as necessary for safe flight.

CAUTION

If a crack should develop in the windshield, move the COCKPIT PRESS switch to OFF, descend, reduce airspeed to minimum practical, and land as soon as possible.

EQUIPMENT CONDITIONING PROCEDURES

Alternate Cooling On Ground

Equipment conditioning system normal operation is entirely automatic. If the ALT COOL caution indicator is illuminated prior to take-off, proceed as follows:

1. Increase engine speed to 80% rpm or higher.
2. Depress the ALTERNATE COOL reset button until the ALT COOL caution indicator extinguishes.
3. If the ALT COOL caution indicator illuminates after button release, it can be assumed that the equipment conditioning system has failed and cockpit conditioning and pressurization will not be available.

CAUTION

If ALT COOL light illuminates prior to engine start, attempt reset. If reset is unsuccessful, further reduced BLC may be expected during single engine operation. Multiple ALT COOL resets may cause damage.

Alternate Cooling In Flight

If the ALT COOL caution indicator illuminates in flight, proceed as follows:

1. Pilot warns RAN to prepare for rapid recompression.
2. Depress ALTERNATE COOL reset button.
3. If light illuminates after 15 seconds, increase engine rpm and increase airspeed.
4. Depress ALTERNATE COOL reset button.
5. If light illuminates again, reduce cockpit altitude to below 25,000 feet.
6. Ram emergency as required.
7. Windshield and canopy defrost — ON (if too cold).
8. During post-flight shutdown, hold ALT COOL reset button depressed until both generators and EPU drop off the line.

EXPOSURE SUIT VENTILATION SYSTEM

Anti-exposure suit ventilating air is provided by the electronics equipment cooling supply and does not require additional temperature control by the flight crew. A shutoff and flow control valve is utilized, along with a pressure relief valve. The upper composite disconnect assembly conforms to the requirement of ACC 62.

EXPOSURE SUIT FLOW KNOBS

The EXPOSURE SUIT FLOW knobs* (figure 1-25) are located on the left console in each cockpit. Suit ventilation airflow is adjusted by rotating each knob toward INCR or OFF, as required.

ANTI-G SUIT SYSTEM

The defrost, anti-ice, and rain removal line of the cockpit conditioning system is tapped as a source of pressurized air for anti-G suit operation. G-suit air is routed to an anti-G valve on the left console in both cockpits. On demand, the air flows into the suits through the composite disconnects.

ANTI-G SUIT VALVES

The anti-G valves each consist of a spring-balanced valve which is opened when positive "g" force is sufficient to overcome valve spring tension. The valve automatically controls the outlet pressure to 1.5 psi per "g." A manual operation button is incorporated for checking valve operation. Anti-G suit operation is entirely automatic. To ease discomfort caused by long-duration flight, the anti-G valve manual button can be depressed to provide changes in suit pressure.

Note

To remove any moisture from the system, the anti-G valve should be operated manually prior to connecting the anti-G suit.

DEFROST AND ANTI-ICE SYSTEMS

Hot air from the cockpit conditioning primary heat exchanger modulating valve provides windshield and canopy defrosting and windshield external anti-ice and rain removal. When the pilot's canopy is closed, hot air is available to the defrost and anti-ice valves for system operation.

*Aircraft 156618 through 156643

DEFROST AND ANTI-ICE CONTROLS

WINDSHIELD AND CANOPY DEFROST KNOB

A WINDSHIELD & CANOPY DEFROST knob is provided (figure 1-25). With this knob, a flow of windshield and canopy defrost air is routed through perforated tubing around the lower inside surfaces of the windshield and canopy. This knob should be turned on well in advance of descent from high altitudes so that the large area of the canopy may be warmed thoroughly before being exposed to warm, moist air at lower altitudes. During adverse flying weather, it may be necessary to maintain continuous defrost flow to keep the windshield and canopy clear. Defrost flow is turned on and increased as desired by turning the WINDSHIELD & CANOPY DEFROST knob clockwise from the OFF position.

WINDSHIELD ANTI-ICE AND RAIN REMOVAL SWITCH

The WINDSHIELD ANTI-ICE switch (figure 1-25) is located on the right console. This switch has three positions: OFF, ON, and EMERG. During flight in adverse weather, especially during precision instrument approaches in icing conditions or precipitation, this switch should be in the ON position. High-velocity, hot air is directed onto the outer surface of the windshield to remove rain droplets or ice crystals for improvement of pilot visibility. A safety provision for overpressure and/or overtemperature is built into the anti-icing and rain removal system. Should anti-icing air temperature exceed 350°F or nozzle pressure exceed 50 psi, a sensing circuit returns the switch to the OFF position. Should airflow be needed for flight safety under these conditions, the switch can be lifted and moved from ON into the EMERG position, where a detent holds it in place and overrides the safety features.

CAUTION

- The windshield anti-icing and rain removal system should only be operated when absolutely essential, as the airflow temperature and pressure may damage the windshield.
- The windshield anti-icing and rain removal switch will automatically return to the OFF position under over-temperature/over-pressure conditions. If EMERG is selected, damage to the windshield may occur under high RPM, low speed conditions.

Note

- Any time the EMERG position has been used, a notation should be made on the yellow sheet, and the windshield and overheat detection switch should be inspected.
- When absolutely necessary, the ON position may be used on the ground if such use is limited to a maximum of 10 seconds between 1-minute OFF periods.
- Windshield anti-ice air must be turned off as soon as possible after landing to prevent possible damage to windshield.

PITOT ANTI-ICE BUTTON

When depressed, the PITOT ANTI-ICE button (figure 1-25) provides essential a-c bus power to heater elements in the pitot-static boom.

ENGINE ANTI-ICE SWITCH

Engine anti-ice airflow is controlled by the ENGINE ANTI-ICE switch (figure 1-25), a two-position switch (ON/OFF) located on the pilot's right console. Moving this switch to ON opens a solenoid-operated valve which regulates the flow of hot air internally through the struts and guide vanes. This switch also controls flow of anti-icing air to the engine accessory bullet nose. The air is discharged from the trailing edge of the guide vanes and from the engine bullet nose into the engine.

Engine Anti-ice Indicator

The ENGINE ANTI-ICE indicator (figure 1-25) displays "ON" when the ENGINE ANTI-ICE switch is ON, both engine anti-ice air valves have opened, and air is flowing as required. Lack of an "ON" indication means either a valve malfunction, loss of power to the indicator, or pressure switch failure.

DEFROST AND ANTI-ICE OPERATION

For flight under adverse weather conditions, set the defrost and anti-ice controls as follows:

1. WINDSHIELD & CANOPY DEFROST knob — as desired.
   For warm, humid conditions, a defrost setting of about one-half is recommended. The COCKPIT TEMP knob can be used to modify the temperature, if necessary.
2. WINDSHIELD ANTI-ICE switch — as desired.
   If precipitation limits visibility, move this switch to ON.
3. PITOT ANTI-ICE button — Depress.
4. ENGINE ANTI-ICE switch — ON as desired.
   The ENGINE ANTI-ICE switch should be moved to ON whenever visible moisture is encountered and ambient temperature is at or near the freezing point.

OXYGEN DURATION

AIRCRAFT ALTITUDE		COCKPIT ALTITUDE			OXYGEN QUANTITY ~ LITERS						
FEETX1000	PSIA	FEETX1000	PSIA	HOURS ~ TWO CREW MEMBERS	20	16	12	8	4	2	LESS THAN 0.8
70	0.65	24.2	5.65		20.5	16.4	12.3	8.2	4.1	2.0	EMERGENCY DESCEND TO ALTITUDE NOT REQUIRING OXYGEN
60	1.05	22.6	6.05		19.1	15.3	11.5	7.6	3.8	1.9	
50	1.69	20.3	6.69		17.2	13.7	10.3	6.9	3.4	1.7	
45	2.14	18.6	7.14		15.9	12.7	9.5	6.4	3.2	1.6	
40	2.72	16.8	7.72		14.6	11.7	8.8	5.8	2.9	1.5	
35	3.46	14.6	8.46		13.1	10.5	7.9	5.2	2.6	1.3	
30	4.36	12.0	9.36		11.6	9.3	7.0	4.7	2.3	1.2	
25	5.45	9.2	10.45		10.4	8.3	6.2	4.1	2.1	1.0	
20	6.75	8.0	10.91		9.9	7.9	5.9	4.0	2.0	.9	
8	10.91	8.0	10.91		9.9	7.9	5.9	4.0	2.0	.9	
5	12.23	5.0	12.23		8.9	7.1	5.3	3.6	1.8	.8	
SEA LEVEL	14.70	SEA LEVEL	14.70		7.5	6.0	4.5	3.0	1.5	.7	

A-SC-1-73-4

Figure 1-26

CAUTION

The only cockpit indications of failure of the pitot anti-icing system are abnormal pitot-static instrument readings. Should failure occur under icing conditions, pitot-static boom ice can cause erroneous airspeed/Mach and altitude readings, as well as undesired changes in inlet ramp operation. If such icing should occur at cruising speeds, placing the RAMPS switch to STBY will prevent the inlet ramps from being driven toward the minimum opening position and causing loss of engine airflow and possible flame-out.

OXYGEN SYSTEMS

Two independent oxygen systems (normal and emergency) are installed. The normal breathing oxygen supply is provided by a liquid oxygen conversion system. An emergency oxygen supply is incorporated into the survival kit in each seat, providing emergency breathing supply and emergency pressure suit inflation when actuated. The seat composite disconnect provides connection to both normal and emergency oxygen systems.

Note

The Scott composite disconnect block should be checked immediately for connection in the event of oxygen interruption.

NORMAL OXYGEN SYSTEM

A 20-liter liquid oxygen system is installed, which is supplied by separate 10-liter converters. Liquid oxygen is evaporated under controlled pressure and routed at 70 psi to the cockpit supply valves. The oxygen conversion system is located in the forward portion of the nose wheel well, above the well cover. See figure 1-26 for oxygen system duration.

Note

The forward converter must be installed to obtain an operational system. If the aft converter is removed, a dummy capacitor must be connected to obtain oxygen quantity indication. The dummy disconnects must be connected to prevent liquid oxygen spillage into the electronics bay.

OXYGEN SUPPLY VALVES

An oxygen system supply ON/OFF valve (figures FO-1 and FO-4) is provided on the left console in each cockpit.

To obtain oxygen pressure at the composite disconnect in each cockpit, the valve control lever is moved to the ON (forward) position.

OXYGEN QUANTITY INDICATORS

An oxygen quantity indicator (figures FO-1 and FO-4) is installed in both cockpits. The forward cockpit indicator contains an amplifier which receives power from the essential a-c electrical bus. The aft cockpit indicator is a repeater instrument, connected to the forward indicator. Up to 20 liters is indicated in increments of 1 liter. An indicator TEST button is located on the pilot's indicator. While this TEST button is depressed, the quantity indicator needles in both cockpits rotate in a counterclockwise direction. Each time the needles pass 0.8 liter, the OXYGEN warning indicators illuminate and remain illuminated until the needle passes "20 liters."

OXYGEN WARNING INDICATORS

An OXYGEN warning indicator is mounted on the instrument panel in both cockpits. These red warning indicators come on if the liquid quantity in the system drops below 0.8 liter or if total gas pressure falls below 45 psi. The pilot's indicator incorporates a 4-second delay to prevent nuisance flashing as the result of pressure fluctuations only. The warning light circuit may be checked by use of the WARN LT TEST button (figure 1-30).

EMERGENCY OXYGEN SYSTEM

A high-pressure (1800 psi), gaseous emergency oxygen supply bottle is installed in each of the seat-mounted survival kits. Utilization of this supply is automatic upon initiation of ejection. Check valves in the composite Scott block prevent emergency oxygen flow back into the normal system. Emergency oxygen is not available with the upper Scott block disconnected. A manual ring is provided on each survival kit for obtaining emergency oxygen flow. If used as an emergency breathing supply with the standard mask, normal breathing is available for approximately 25 minutes at a cabin altitude of 20,000 feet or 10 minutes at sea level.

EMERGENCY OXYGEN PRESSURE GAGES

An emergency oxygen supply pressure gage is installed in each survival kit. For all flights, this gage should read a minimum of 1800 psi and a maximum of 2200 psi.

EMERGENCY OXYGEN RINGS

An emergency oxygen manual actuator ring is installed on the survival kits near the pressure gage. If emergency oxygen flow is required, this ring should be pulled sharply upward, separating it from the survival kit.

PERSONAL COMPOSITE DISCONNECT

A Scott composite disconnect is installed at the left rear corner of the ejection seat. The composite disconnect consists of three separate blocks. These three blocks (upper, intermediate, and lower) are joined together to form the junction for the personal leads from the crewman to the aircraft. The lower disconnect block is attached to the cockpit floor with a cable, which remains in the aircraft at all times. The intermediate block is fastened to the survival kit as a permanent part and has an oxygen port connected to the emergency oxygen bottle in the survival kit. Lanyards are routed to the intermediate block for actuation of the pressure suit exhaust disconnect and the emergency oxygen supply valve. On ejection, the lower block (attached to the cockpit floor by a lanyard) separates from the intermediate block, leaving the intermediate and upper blocks connected. This connection provides emergency oxygen flow to the crewman upon descent. The upper block is attached to the intermediate block by squadron personnel upon installation of the parachute. A button is located in the center of the manual release (yellow pear) handle. With the upper block positively seated in the intermediate block, the button will be flush. If the button is raised, the upper block is not positively locked in place.

Note

- The modified "yellow pear" knob is *not* used for normal exit disconnect purposes. The oxygen, communications, and anti-G lines are disconnected manually from the upper block.
- Should interruption in communications or oxygen flow be encountered, check the composite disconnect upper block positively seated or the indicator button flush on the disconnect knob.

OXYGEN SYSTEMS OPERATION

NORMAL

Normal operation of the oxygen system is fully automatic, requiring only a proper connection at the disconnect and positioning the supply valve lever in each cockpit to ON. 100 percent oxygen is supplied. Ensure the position of the emergency oxygen manual ring, and verbally acknowledge proper operation of the pilot's oxygen quantity indicator and warning light check.

INTERCOMMUNICATIONS SYSTEM (ICS)

The ICS provides communication between cockpits, serves as a selector station and audio amplifier for

ECM and CNI subsystems, and provides communication between the cockpits and ground crew, or between the RAN and the carrier SINS center in HOT mike position. The system incorporates a basic control unit installed in each cockpit, consisting of two transistorized amplifiers, their controls, and a panel of selector switches. Two remote ICS stations, one located in the external canopy toggle access and another near the external electrical power receptacle, may be utilized by the ground crew members for aircraft preflight and starting checks or during AN/ASB-12 preflight operations. The ICS is powered by the essential d-c bus and is thus operative through the RAT-powered emergency unit in the event of dual generator failure. For a complete listing of electronic equipment, see figure 1-27.

MICROPHONE SWITCH

The pilot's microphone switch is located on the No. 2 throttle grip. The microphone switch has two positions: ICS and XMIT. The ICS position (down) is used for intercommunication with the aft cockpit or the external ground stations. The XMIT position (up) actuates the main communications transmitter. For aft cockpit communications, a foot-operated microphone switch is provided on the right footrest. The ICS position of the microphone switch and the aft cockpit foot-operated ICS switch duplicate the function of the ICS CALL position of the microphone select switch.

ICS CONTROLS

ICS FUNCTION SELECTOR

The ICS function selector (figure 1-28) has four positions: EMER, NORM, ALT ICS, and ALT RAD. These positions function as follows:

POSITION	FUNCTION
NORM	NORMAL ICS OPERATION. The ICS and radio amplifiers are operative.
ALT RAD	USED IF RADIO AMPLIFIER FAILS. ICS amplifier handles ICS output as well as all incoming signals.
ALT ICS	USED IF ICS AMPLIFIER FAILS. Radio amplifier handles ICS output as well as all incoming signals.
EMER	EMERGENCY COMMUNICATIONS. Used if both amplifiers in either control unit fail. Provides UHF communications, TACAN, and ADF signals direct to the headphones, plus intercom through UHF communications sidetone. (AN/APR-18 audio is not provided.)

ICS VOLUME KNOB

The VOLUME knob (figure 1-28) controls ICS audio level without affecting the level of selected receivers.

MICROPHONE SELECT SWITCH

The microphone select switch (MIC SEL, figure 1-28) is independent of the ICS function selector and has three positions: COLD, HOT, and CALL. If the MIC SEL switches in both cockpits are not in the same positon, the momentary CALL position may be used, or the microphone switch on the throttle held in ICS.

AUDIO SELECT BUTTONS

Audio select buttons (figure 1-28) are positioned immediately forward of the UHF COMM panel. These buttons may be depressed to monitor the audio output from the communications, navigation, and ECM systems receivers. All receivers, or as many as desired for monitoring, can be selected. Audio monitoring of the following components is controlled by these buttons.

BUTTON	COMPONENT
UHF	UHF communications radio
TACAN	UHF navigation audio
ADF	Auxiliary receiver
RADAR WARN	Radar passive warning receiver

CARRIER ICS VOLUME KNOB (RAN)

The CAR ICS VOL knob (figure 1-28) allows the recon/attack navigator (RAN) to select and control the volume of communications from the carrier SINS center during autonavigator platform alinement. Rotating the CAR ICS VOL knob clockwise from the OFF detent permits contact between the RAN and the carrier SINS center through the communications provisions in the deck edge alinement umbilical cable. If the carrier ICS system is capable and electrical power is applied to the aircraft, two-way communication between the RAN and the carrier SINS center may be accomplished.

TRANSMIT CONTROL SWITCH (RAN)

The TRANSMIT CONT switch (figure 1-28) is located in the interior lights panel and has two positions: RADIO and ICS CALL. The switch is used to select operation of the ICS or UHF communications system.

ICS OPERATION

The ICS is operative when the aircraft electrical system is energized by external or generator power. With the ICS function selector in the NORM position, reception of main UHF signals and any other selected receiver

TABLE OF ELECTRONIC EQUIPMENT

EQUIPMENT	FUNCTION	CHARACTERISTICS	CONTROL PILOT	CONTROL RAN
COMMUNICATIONS-NAVIGATIONS-IDENTIFICATION SYSTEM, AN/ASQ-56A/B				
UHF COMM unit	Voice communication, ADF	1750 frequencies	X	X
AUX UHF unit	ADF, Voice Reception	20 preset channels	X	X
AN/ARN-52 (V) TACAN	Station range, bearing, Airborne ranging	126 channels	X	X
IFF-SIF units	Radar identification (IFF)	64 Identity Codes	X	X
AIMS IFF (AFC 296)	IFF and Air Traffic Control	4096 Identity Codes		X
COMM Security System	Communications Security		X	
MISCELLANEOUS ELECTRONIC EQUIPMENT				
ICS	Intercommunications	Cockpit/External/Ship	X	X
AN/APN-120	Radar Altimeter	Low system-0 to 3000 feet	X	
		High System-500 to 75,000 feet		X
AN/ASN-26	Flight Reference Set	Attitude and heading reference	X	compass
AN/ASW-25A (AFC 233)	Automatic Carrier Landing	Digital Data Link, 250UHF channels	X	
AN/APN-202 (AFC 233)	Radar Beacon Set	Radar Augmentor for ACLS	X	
AN/ARA-63 (AFC 302)	Approach Control System	ILS-type, 20 channels	X	
BOMB DIRECTING SET, AN/ASB-12				
Inertial Navigator	Position, Velocity	Unlimited range		X
Radar	Navigational, Mapping, ranging	140 N. Mi. range	T/A	X
Television	Visual aid	High resolution	Monitor	X
ELECTRONIC COUNTERMEASURES EQUIPMENT				
AN/APR-25 (V) AN/ALR-45 (V) (AFC 340)	Radar Homing and Warning	Visual-Aural Discrimination	X	X
AN/APR-27 AN/ALR-50 (V) (AFC 340)	Special Warning	L-Band	X	
AN/ALQ-41 (Deleted by AFC 350)	Radar Jammer	X-Band	X	
AN/ALQ-51A, -100	Radar Jammer	S/C-Band	X	
AN/ALQ-126 (AFC 350)	Radar Jammer	E, F, G, H, I BANDS	X	
AN/ALQ-55	Comm Jammer			X
AN/ALE-29A	Chaff Dispenser		X	X
AN/APR-18 (Deleted by AFC 216)	Radar Passive Warning	Visual-Aural	X	
RECONNAISSANCE EQUIPMENT				
Aerial Photo System	CAMERAS			
KA-51A	Forward Oblique	6-Inch Focal Length	X	X
KA-53A	Side Oblique and Split Vertical	1¾, 3, 6 or 12-Inch Focal Length	X	X
KA-50A, 62A, 51A/B, 53A	Vertical Cameras	1¾, 3, 6 or 12-Inch Focal Length		X
KS-68A, KS-69A	Panoramic Cameras	3 or 18-Inch Focal Length		X
AN/APD-7	Side-Looking Radar	Oblique Pattern Recording		X
AN/AAS-21	IR Mapping	8 to 14 Micron Detecting		X
ELECTRONIC DATA COLLECTION EQUIPMENT				
AN/ALQ-61	Passive ECM	Multi-Band Detection and Recording		X

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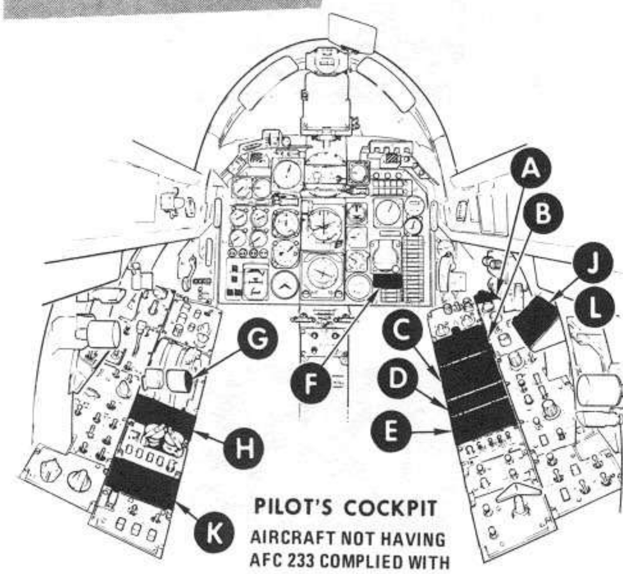
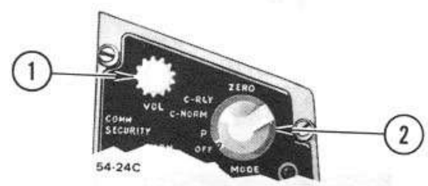
Figure 1-27

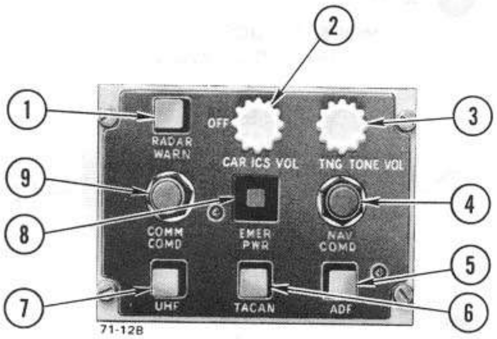
ICS-CNI CONTROLS





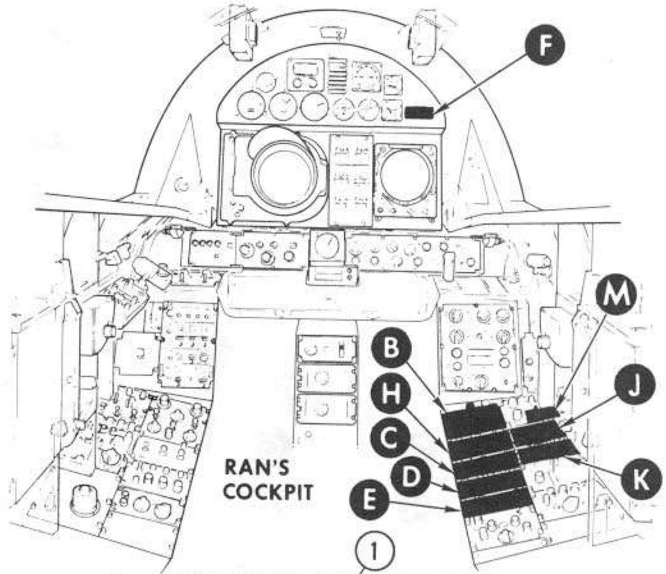
A COMM SECURITY CONTROL PANEL

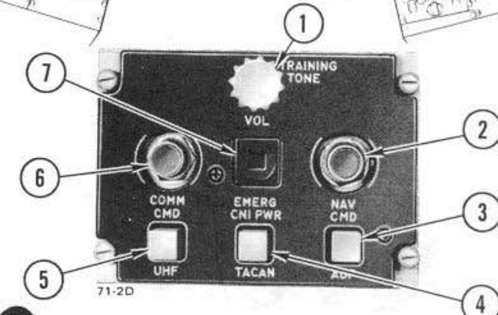
1. VOLUME KNOB
2. MODE SELECT KNOB



B ICS AUDIO SELECT PANEL (AIRCRAFT 145157 THROUGH 151728 NOT HAVING AFC 216 COMPLIED WITH)

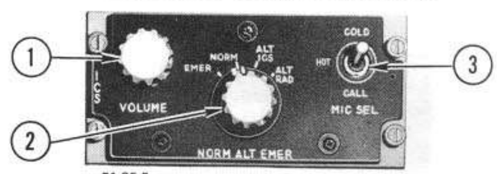
1. RADAR WARNING RECEIVE BUTTON
2. CARRIE ICS VOLUME
3. TRAINING TONE VOLUME KNOB
4. NAV COMMAND BUTTON
5. ADF RECEIVE BUTTON
6. TACAN RECEIVE BUTTON
7. UHF RECEIVE BUTTON
8. EMERGENCY POWER INDICATOR
   COMM COMMAND BUTTON





B ICS AUDIO SELECT PANEL (AIRCRAFT 156608 THROUGH 156643 AND AIRCRAFT HAVING AFC 216 COMPLIED WITH)

1. TRAINING TONE VOLUME KNOB
2. NAV COMMAND BUTTON
3. ADF RECEIVE BUTTON
4. TACAN RECEIVE BUTTON
5. UHF RECEIVE BUTTON
6. COMM COMMAND BUTTON
7. EMERGENCY POWER INDICATOR



C ICS CONTROL PANEL

1. ICS VOLUME KNOB
2. ICS FUNCTION SELECTOR
3. MICROPHONE SELECT SWITCH

D AUX UHF RECEIVER PANEL

1. SENSITIVITY KNOB (INOPERATIVE)
2. CHANNEL SELECTOR
3. VOLUME CONTROL
4. FUNCTION KNOB (INOPERATIVE)

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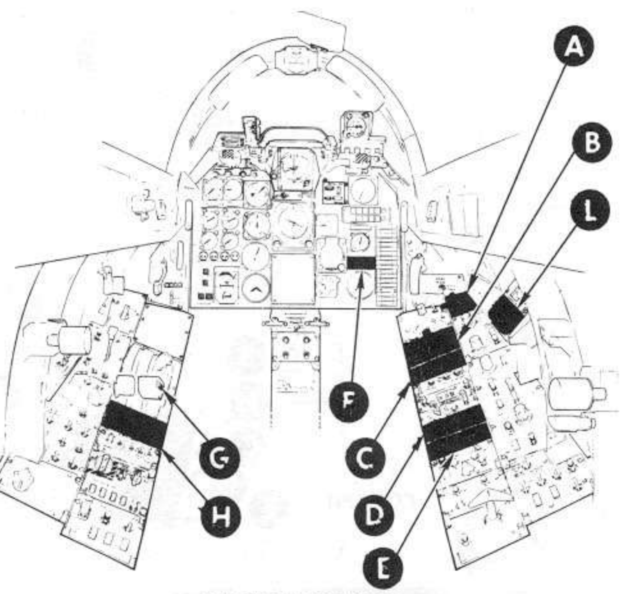
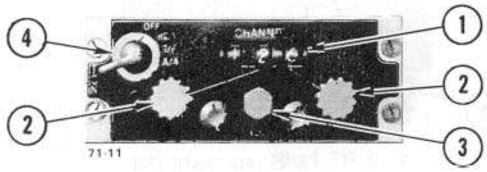
Figure 1-28 (Sheet 1)



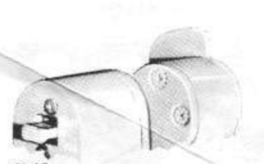
PILOT'S COCKPIT
(AIRCRAFT HAVING
AFC 233 COMPLIED WITH)



E TACAN CONTROL PANEL

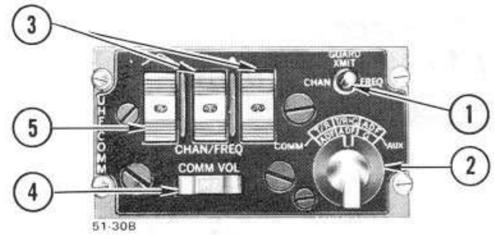
1. CHANNEL INDICATOR
2. CHANNEL SELECT KNOBS
3. VOLUME CONTROL
4. FUNCTION SELECT KNOB

F UHF CHANNEL/FREQUENCY INDICATOR



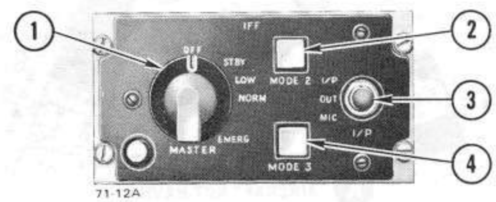
G PILOT'S TRANSMIT SWITCH

* AIRCRAFT NOT HAVING AFC 296 COMPLIED WITH



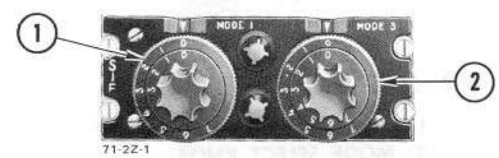
H UHF COMM PANEL

1. FUNCTION CONTROL SWITCH
2. MODE SELECT KNOB
3. FREQUENCY SLEW SWITCHES
4. VOLUME KNOB
5. CHANNEL/FREQUENCY SLEW SWITCH



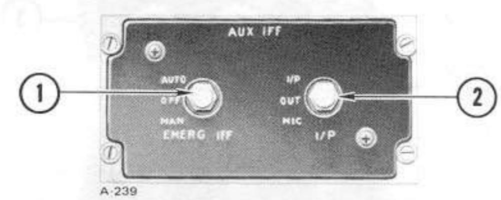
J IFF CONTROL PANEL *

1. FUNCTION SELECT KNOB
2. MODE 2 BUTTON
3. I/P-MIC SWITCH
4. MODE 3 BUTTON



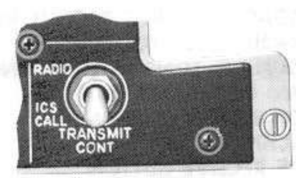
K SIF CONTROL PANEL *

1. MODE 1 CODE KNOBS
2. MODE 3 CODE KNOBS



L AUX IFF CONTROL PANEL

1. EMERGENCY IFF SWITCH
2. I/P SWITCH



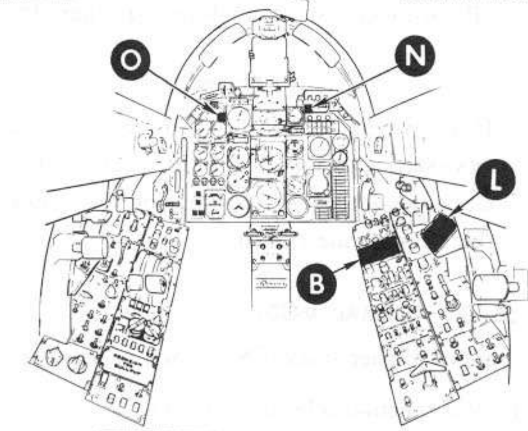
M RAN'S TRANSMIT CONTROL SWITCH

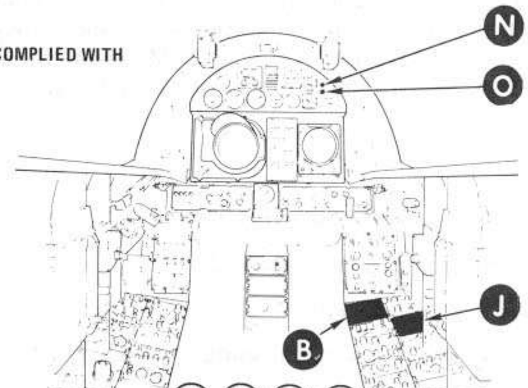
A-5C-1-71-6G

Figure 1-28 (Sheet 2)

ICS-CNI CONTROLS

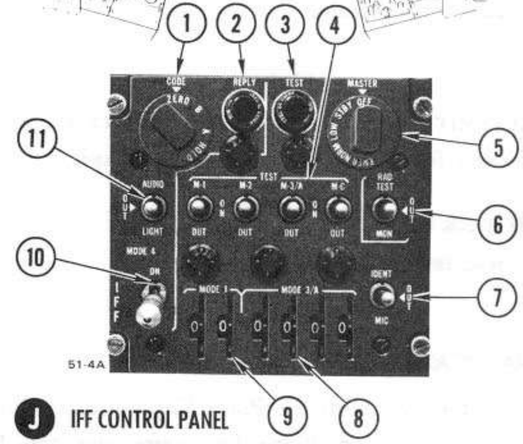
AIRCRAFT HAVING AFC 296 COMPLIED WITH





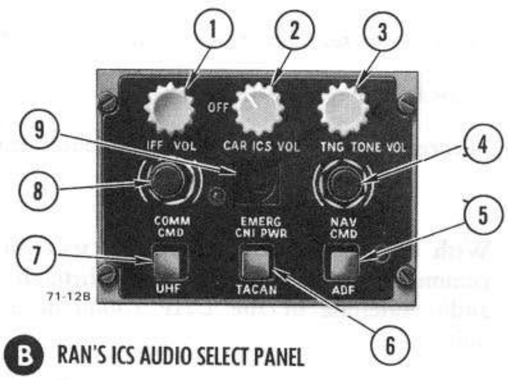
B PILOT'S ICS AUDIO SELECT PANEL

1. IFF VOLUME KNOB
2. TRAINING TONE VOLUME KNOB
3. NAV COMMAND BUTTON
4. ADF RECEIVE BUTTON
5. TACAN RECEIVE BUTTON
6. UHF RECEIVE BUTTON
7. COMM COMMAND BUTTON
8. EMERGENCY POWER INDICATOR



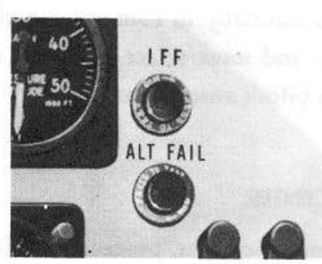
J IFF CONTROL PANEL

1. MODE 4 CODE KNOB
2. MODE 4 REPLY LIGHT
3. TEST LIGHT
4. MODE SELECT SWITCHES
5. IFF MASTER KNOB
6. RAD/TEST MON SWITCH
7. IDENT SWITCH
8. MODE 3/A SIF CODE DIALS
9. MODE 1 SIF CODE DIALS
10. MODE 4 SELECT SWITCH
11. MODE 4 AUDIO/LIGHT SWITCH



B RAN'S ICS AUDIO SELECT PANEL

1. IFF VOLUME KNOB
2. CARRIER ICS VOLUME
3. TRAINING TONE VOLUME KNOB
4. NAV COMMAND BUTTON
5. ADF RECEIVE BUTTON
6. TACAN RECEIVE BUTTON
7. UHF RECEIVE BUTTON
8. COMM COMMAND BUTTON
9. EMERGENCY POWER INDICATOR



N IFF MODE 4 WARNING LIGHT

(DELETED FROM PILOT'S COCKPIT ON AIRCRAFT HAVING AFC 233 COMPLIED WITH

O ALTIMETER FAIL LIGHT

(RELOCATED FROM PILOT'S COCKPIT TO RAN'S COCKPIT BY AFC 233)

A-5C-1-71-8B

Figure 1-28 (Sheet 3)

signals is available, provided the selected receivers are energized. Simultaneous monitoring of navigation and ECM equipment is accomplished through the associated audio select buttons by controlling the volume through the individual UHF, TACAN, and ECM system volume controls. To operate the ICS, proceed as follows:

NORMAL

1. ICS function selector—NORM.
2. Adjust ICS volume as desired.
3. MIC SEL switch—COLD.

   Check ICS operation, using microphone switch ICS position.

Note

TRANSMIT CONT switch must be in ICS CALL position for operation from RAN cockpit.

4. Recheck the ICS.

   MIC SEL switch—as desired.

EXTERNAL STATIONS

For communication with the Plane Captain or crewman during starting or postflight procedure, use the ICS as follows:

1. ICS function selectors—NORM (both cockpits).
2. MIC SEL switches—HOT (both cockpits).
3. Increase ICS volume as required.
4. Establish communication with external stations.

Note

The RAN is normally in contact with the forward station and must select CALL for the aft station if the pilot's switch is at COLD.

CARRIER SINS CENTER

For one-way communications, proceed as follows:

1. Umbilical cable—Ensure connected.
2. ICS function knob—NORM.
3. CAR ICS VOL knob—clockwise as desired.

For two-way communications, proceed as follows:

1. Umbilical cable—Ensure connected.
2. Power and cooling air—connected.
3. ICS function knob—NORM.
4. MIC SEL switch—HOT.
5. CAR ICS VOL knob—clockwise as desired.
6. Check ICS operation.
7. Return CAR ICS VOL knob to OFF when desired.

Note

If the MIC SEL switch is left in COLD, ensure the TRANSMIT CONT switch is in ICS CALL to preclude possible UHF transmission on depressing the microphone switch.

LOSS OF NORMAL MODE

If a crew member loses ICS contact, proceed as follows:

1. ICS function selector—ALT ICS.
2. Check intercommunication as in normal operation.

If selected receiver signals fail:

1. ICS function selector—ALT RAD.
2. If signals are regained, the ICS intercom amplifier has assumed the function of the failed intercom radio amplifier.

LOSS OF ALTERNATE MODE

Should NORM and ALT ICS fail, intercommunications may be regained as follows:

1. ICS function selector—EMER.
2. RAN's TRANSMIT CONT switch—RADIO.
3. UHF audio select button—Depress.
4. COMM VOL control—maximum.
5. Proceed as for normal radio communications.

Note

With the ICS function knob in EMER, intercommunication is accomplished through the audio sidetone of the UHF communications unit.

COMMUNICATIONS-NAVIGATION-IDENTIFICATION SYSTEM (CNI)

CNI POWER BUTTON

The CNI PWR button (figure FO-4) is located on the pilot's right console, forward of the COCKPIT PRESS switch. With external electrical power and cooling air applied, depressing the CNI PWR button supplies main aircraft a-c and d-c power to the CNI power supply unit, which in turn, provides the separate power required for all CNI system units.

Note

Operation of CNI system components should be delayed at least 90 seconds to allow warm-up.

EMERGENCY CNI POWER INDICATOR

The EMER CNI PWR indicator (figure 1-28), normally blank, will flip to "ON" if a CNI power malfunction (130- or 430-volt a-c to d-c rectifier) or loss of essential bus power (28 volts dc or 115 volts ac three-phase) in auxiliary receiver power supply occurs. Loss of 28-volt d-c primary bus power will not result in an "ON" indication since the "ON" flag is primary d-c powered, but will result in the CNI system operating on emergency power. In addition, failure of the CNI power supply 275-volt a-c to d-c rectifier will cause loss of IFF (KY-308 only) and TACAN (RT-541/KY-309 only) without an "ON" indication of the EMER CNI PWR indicator. The resulting CNI system operation and EMER CNI PWR indicator status for these failures are as follows:

FAILURE	EMER CNI PWR INDICATOR	UHF COMM	TACAN ①		IFF ②		AUXILIARY RECEIVER
			RT-541/KY-309	AN/ARN-52	KY-308	KY-533	
130-volt rectifier	ON	Reduced transmitter power	Off	On	Off	On	On
430-volt rectifier	ON	Reduced transmitter power	Off	On	On	On	On
Essential bus 28 volts dc	ON	Off	Off	Off	Off	Off	On
Essential bus 115 volts ac	ON	Off	Off	On	Off	Off	On
275-volt rectifier	Blank	Not affected	Off	On	Off	On	On
Primary bus 28 volts dc	Blank	Reduced transmitter power	Off	On	On	On	Off

① On aircraft 151615 and subsequent and aircraft having AFC 230/AVC 125 complied with either TACAN system, RT-541/KY-309 or AN/ARN-52 may be installed.

② On aircraft 156608 and subsequent (and on aircraft prior to 156608, if fleet installed as spare for KY-308) IFF system KY-533 is installed.

Note

On RAT power the CNI system is operating on emergency power; however, the EMER CNI PWR indicator will not indicate "ON." Additionally, on RAT or EPU power, only UHF COMM, UHF ADF/AUX RECEIVER, and IFF remain operative.

UHF COMMUNICATIONS UNIT

The UHF communications unit (UHF COMM) transmits and receives AM signals in the frequency range from 225.0 to 399.9 megacycles. Through this unit, either crew member may select any of 20 preset channels, standard military emergency frequency, or manually tune to any of 1750 transmitter-receiver frequencies.

CONTROLS AND INDICATOR

Communications Command Button

The COMM COMD button (figure 1-28) is used to assume command of the main and auxiliary UHF communications units. The button contains a dimmable green indicating light. The button in the cockpit having command is illuminated.

Mode Selector

The communications mode selector (COMM/AUX, figure 1-28) is used to control the operation of both the main and auxiliary UHF communications units. With this selector, the main unit can be operated as a transmitter-receiver, with or without monitoring of the military emergency (GUARD) frequency, or as an ADF receiver for navigation purposes. The auxiliary receiver can be used as an ADF receiver or to monitor the military emergency frenquency.

Volume Control

With CNI power on, the COMM VOL control (figure 1-28) is used to apply operating level voltage and to control main UHF receiver volume.

Function Control Switch

The function control switch (figure 1-28) is used to select the transmitter frequency option of the main UHF unit. The function control switch operates as follows:

POSITION	FUNCTION
CHAN	Operation in mode preset channel (using the left-hand UHF slewing switch).
GUARD XMIT	Main unit is automatically tuned to military emergency frequency (243.0 mc).
FREQ	Operation in manual tuning mode (any of 1750 frequencies using all three UHF slewing switches).

Channel/Frequency Slew Switches

The channel/frequency slew switches (figure 1-28) are used to select operating frequency or channel of the main UHF unit through touch-tuning. With the function control switch in CHAN, the left switch is used to select the desired channel (1 through 20). With the function control switch in FREQ, all three switches are used to select frequency between 225.0 and 399.9 megacycles. When the function control switch is in the GUARD XMIT position, the touch-tuning circuits are inoperative.

Channel/Frequency Indicator

A channel/frequency remote indicator (figure 1-28) is installed in both cockpits. This indicator reads the operating channel (1 through 20 or GUARD) or the selected frequency between 225.0 and 399.9 megacycles. When the slewing switches are operated, the indicator changes reading in pulses at a rate of approximately three digits per second.

AUXILIARY UHF RECEIVER UNIT

The auxiliary UHF receiver unit provides ADF operation and emergency reception of 20 preset channels between 265.0 and 284.9 megacycles or emergency reception on a fixed GUARD frequency. The auxiliary receiver is controlled through the lower row of functions of the COMM/AUX selector on the main UHF control panel. Auxiliary receiver channels are selected with the AUX CHAN knob on the auxiliary receiver control panel.

CONTROLS

Auxiliary Channel Knob

The AUX CHAN knob (figure 1-28) selects any of the 20 preset auxiliary receiver channels.

Volume Knob

The auxiliary receiver VOL knob (figure 1-28) is used to control auxiliary receiver volume level.

Note

The AUX REC function selector and sensitivity (SENS) knob are not operational in this installation.

COMMUNICATIONS SECURITY SYSTEM*

The description and operation of the communications security system are contained in the Supplemental NATOPS Flight Manual (NAVAIR 01-60ABC-1A). The system controls are located on the pilot's interior lights control panel (figure 1-28). The COMM SECURITY VOL knob may be set to desired audio level. The COMM SECURITY MODE switch has OFF, P, C-NORM, C-RLY, and ZERO positions. Switch positions will be selected in flight according to preflight mission briefing.

UHF COMMUNICATIONS OPERATION

Note

If UHF equipment is to be operated prior to engine start, external equipment cooling air and electrical power must be connected.

1. CNI PWR button—Depress.
2. COMM VOL—Rotate to right as desired.
3. Mode (COMM/AUX) selector—T/R—ADF or T/R + G—ADF.
4. Function control switch—CHAN.
5. COMM COMD button—Depress; check illuminated.
6. UHF audio select button—Depress.
7. COMM SECURITY VOL knob—Rotate clockwise to desired volume.
8. COMM SECURITY MODE switch—as directed.*
9. Operate channel (left) slewing switch, setting desired channel into channel/frequency indicator.
10. After allowing 90 seconds for warm-up, check communications as desired.
11. To select a manual frequency, move the function control switch to FREQ and, using the slewing switches, set desired frequency in channel/frequency indicator.
12. To secure the main UHF unit, rotate the COMM VOL control left to OFF.

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*Aircraft having AFC 250 complied with

AUXILIARY RECEIVER

The auxiliary receiver may be used to monitor military emergency frequency while using the main receiver in the ADF mode. Proceed as follows:

1. Mode (COMM/AUX) selector—ADF—G.
2. UHF audio select button—Depress.
3. RANGE & BEARING knob—UHF.
4. Auxiliary volume—as desired.

MAIN UHF/ADF

For main receiver ADF operation, proceed as follows:

1. Function control switch—CHAN or FREQ.
2. Set desired channel or frequency into channel/ frequency indicator.
3. Mode (COMM/AUX) selector—ADF—G.
4. RANGE & BEARING knob—UHF.
5. Observe bearing to selected facility indicated on the horizontal situation indicator.

AUXILIARY UHF/ADF

For navigation purposes, the auxiliary receiver is used in the ADF mode as follows:

1. Mode (COMM/AUX) selector—T/R—ADF or T/R + G—ADF.
2. ADF audio select button—Depress if desired and adjust auxiliary volume.
3. AUX CHAN knob—desired channel.
4. RANGE & BEARING knob—UHF.
5. Observe bearing to facility on the horizontal situation indicator.

TACAN

The TACAN (Tactical Air Navigation) operates with ground- or ship-based beacons in the UHF band between 962 and 1213 megacycles. This band is divided into 126 operating channels. TACAN provides displays of magnetic bearing to station, deviation from selected inbound or outbound course, and slant-range distance to selected station. Bearing, course, and distance are displayed to the pilot by the horizontal situation indicator. Bearing and distance are displayed to the RAN by the azimuth and range indicator. On some aircraft,* an AN/ARN-52(V) TACAN is installed which incorporates an air-to-air ranging function, capable of displaying line-of-sight distance to a suitably equipped aircraft for purposes such as air refueling rendezvous.

*Aircraft 151615 and subsequent and aircraft having AFC 230/AVC 125 complied with

TACAN CONTROLS

A TACAN control panel (figure 1-28) is installed on the right console in both cockpits. Control of the system is assumed by depressing the NAV COMD button on the ICS audio select panel (figure 1-28).

Function Selector

The TACAN function selector (figure 1-28) controls operation and mode. The selector has OFF, REC, T/R, and A/A* positions. Function selector positions operate TACAN as follows:

POSITION	FUNCTION
OFF	System secured.
REC (Receive)	System receives and indicates magnetic bearing only to selected station.
T/R (Transmit/ Receive)	System receives and indicates magnetic bearing and slant-range distance in nautical miles to selected station.
A/A* (Air-to-air)	System transmits and receives slant-range distance in nautical miles to selected airborne beacon.

Channel Knobs

The TACAN channel knobs (figure 1-28) are used to select operating channels 001 through 126. Channels 127, 128, and 129 may be selected but are inoperative. After the initial 90-second warm-up period, up to 12 seconds are normally required to achieve lock-on after changing channels.

Volume Knob

The VOL knob (figure 1-28) allows control of station identification audio signals as selected by depressing the TACAN audio select button on the ICS audio select panel. Ground- or ship-based stations transmit a Morse-coded identification signal every 38 seconds. No identification signal is present during the absence of station lock-on and in the A/A mode.*

TACAN OPERATION

Ground- or Ship-based Beacons

The TACAN unit presents precision displays of bearing, course deviation, and distance. Bearing is accurate to within an average of ±1 degree. Distance is accurate to within 0.1 nautical mile at less than 50 miles, and to 0.2 nautical mile from 50 to 196 (300*) miles, the maximum obtainable. Bearing and distance memory circuits allow continuous indications and lock on retention during mild maneuvers or spurious signal operation. The bearing indication holds for 3 to 8 seconds, and the distance indication will hold for 8 to 15 seconds. The unit is capable of maintaining bearing track during turns of up to 20 degrees per second, depending upon clear line-of-sight access to the station.

Audio Identifier

In the REC or T/R modes, a garbled or unreadable station identifier is an indication of malfunction of the aircraft unit or the surface station. Unless confirmed by known landmarks or ship sighting, range and bearing displays accompanied by an unreadable identifier should not be trusted.

False Bearing

TACAN will occasionally lock on to a false bearing which will be 40 degrees, or any multiple of 40 degrees, in error on either side of the correct bearing. Switching to another channel and then returning to the desired channel should recycle the search mode. This deficiency does not affect the distance indication provided by the TACAN unit.

Air-to-air Ranging (AN/ARN-52)*

TACAN airborne ranging provides line-of-sight distance indication up to 300 nautical miles between any suitably equipped transponder (tanker or aircraft acting as the station) and up to five suitably equipped interrogator (homing) aircraft. A/A mode mechanization requires that the transponder and interrogator systems be set 63 channels apart. Use of the A/A mode requires prearrangement and preflight or in-flight briefing as necessary. When transponding to more than one interrogator, the distance displayed in the transponder aircraft will probably be to the closest interrogator beyond 0.1 nautical mile. With two or more interrogators at approximately the same distance, it is unknown which interrogator distance is being displayed. During A/A mode operation, the HSI bearing pointer searches (no bearing is displayed). The ADF function of the UHF COMM unit or the auxiliary receiver must be set and used periodically to determine bearing between transponder and interrogator.

Note

Although the AN/ARN-52(V) TACAN system is capable of 300 nautical miles line-of-sight ranging, the pilot's HSI is unlimited for readout, altitude permitting, but the RAN'S ARI is limited to 186 nautical miles.

* Aircraft 151615 and subsequent and aircraft having AFC 230/AVC 125 complied with

TACAN PROCEDURES

Ground- or Ship-based Beacons

1. CNI power — on.
2. TACAN audio select button — Depress.
3. Function selector — REC.
4. NAV COMD button — Depress.
   Check light on.
5. RANGE & BEARING knob — TACAN.
6. Select desired station channel.
7. After lock-on, adjust volume and identify station.
8. Function selector — T/R.
9. Observe bearing and distance on HSI.
10. To secure TACAN, move function selector to OFF.

Air-to-air Ranging*

1. Normal T/R mode operation — check.
2. Function selector — A/A.
3. Prebriefed channel — Select.
4. UHF COMM unit or auxiliary receiver channel — as desired (ADF function).
5. Note distance on HSI.
6. To determine UHF/ADF bearing, move RANGE & BEARING knob to UHF, request transmission, and note HSI bearing indication.
7. With aircraft in sight and confirmed, move function selector to T/R, REC, or OFF.

RANGE AND BEARING KNOBS

A RANGE & BEARING knob (figures 1-28 and 1-34) is installed in each cockpit to provide selection of signal source from the UHF communications system, TACAN, or the AN/ASB-12 (NAV) for navigation display. The knobs are independent so that each crew member can select a separate source. In the UHF position, the bearing pointer of the horizontal situation indicator or the RAN's azimuth and range indicator displays relative bearing to the selected radio facility. In TACAN, these indicators display magnetic bearing and distance (as selected) to the TACAN beacon. In NAV, the horizontal situation indicator or the RAN's azimuth and range indicator displays bearing and distance to selected AN/ASB-12 navigation checkpoint or target.

AZIMUTH AND RANGE INDICATOR (ARI)

Depending on the selection of the RANGE & BEARING knob, TACAN bearing and slant-range distance, UHF/

HORIZONTAL SITUATION INDICATOR

1. COURSE DEVIATION BAR
2. BEARING POINTER
3. LUBBER LINE
4. COMPASS CARD
5. HEADING MARKER
6. TACAN MODE LIGHT
7. BOMB MODE LIGHT
8. COURSE POINTER
9. TO/FROM POINTER
10. UHF MODE LIGHT
11. COURSE SET KNOB
12. COURSE SETTING READOUT
13. DISTANCE READOUT
14. HEADING SET KNOB
15. RECIPROCAL COURSE POINTER
16. NAV MODE LIGHT

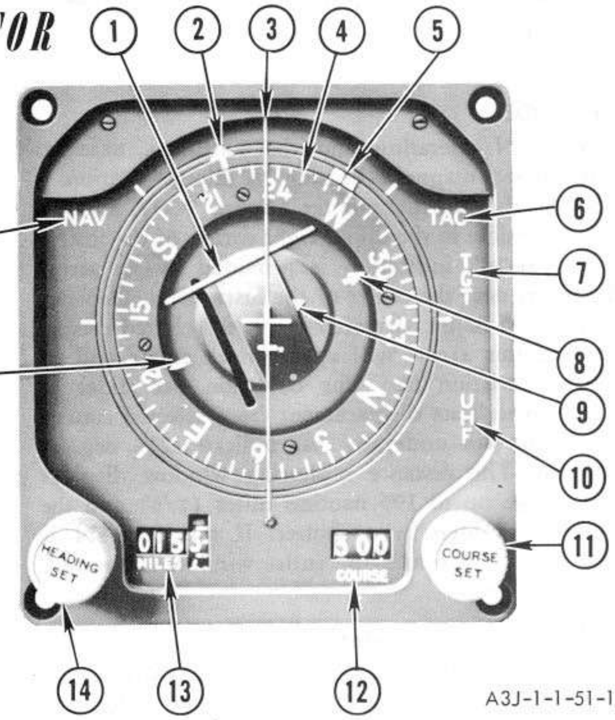


Figure 1-29

ADF bearing, or AN/ASB-12 distance and bearing is provided by the azimuth and range indicator (figure FO-1), located on the RAN's display panel. Aircraft magnetic heading is indicated by a compass ring which is positioned by the flight reference set, duplicating the heading read-out of the pilot's all-attitude indicator. Bearing to selected facility is shown by the pointer and range is indicated in a distance window in the lower half of the indicator.

Note

> The BOMB COMPUTER POWER switch must be ON to obtain operation of the ARI in any AN/ASB-12 mode. With BOMB COMPUTER POWER switch OFF, the ARI functions normally for ADF and TACAN bearing; however, no TACAN distance display is available.

HORIZONTAL SITUATION INDICATOR (HSI)

The horizontal situation indicator (figure 1-29) provides selected radio and AN/ASB-12 navigation displays. The compass ring (figure 1-29) is controlled by the flight reference set, duplicating the heading indication of the all-attitude indicator. The bearing pointer indicates magnetic bearing to station or destination. The heading marker indicates desired heading as adjusted with the HEADING SET knob. During TACAN operation, the course pointer, the course deviation bar, and the reciprocal course pointer form a single arrow when flight path is on the selected course. The deviation bar is deflected when the flight is off the selected course. Selection of the desired inbound or outbound course is made by setting the desired course into the course setting indicator with the COURSE SET knob. Mode of operation indicator lights are provided on the face of the instrument.

ADF MODE

When homing on a selected UHF facility (RANGE & BEARING knob at UHF), the UHF light (figure 1-29) appears. The course deviation bar is locked at center and the distance indicating window is covered by a shutter. Relative bearing to the selected station is indicated by the bearing pointer.

TACAN MODE

With TACAN operating and the RANGE & BEARING knob at TACAN, magnetic bearing to selected station is indicated by the bearing pointer (figure 1-29), and the TAC light is visible in the upper right corner of the instrument. "TO/FROM" indication is provided by an arrow which appears near the center of the instrument. Depending on position of the aircraft relative to selected course, the head of this arrow will appear near either end of the course deviation bar. The deviation bar slides to either side to indicate displacement from selected course. Each deviation dot under the bar indicates 2½ degrees displacement. The distance indicating window displays TACAN range up to 196 nautical miles (T/R) and the 1000 digit is hidden by a shutter. If the TACAN is switched from T/R to REC, the entire window is covered.

Note

When changing TACAN channel (RANGE & BEARING knob at TACAN), the course deviation bar centers, the bearing pointer searches, and the distance window flag appears until lock-on is achieved.

NAV MODE

TGT indicator light is out. Bearing and range to the selected SET/CORR point is displayed to a maximum of 186 nautical miles. Beyond 186 nautical miles, bearing is caged at 12 o'clock and the range window is covered.

BOMB MODE

TGT indicator light is on. Bearing to aimpoint is displayed. At more than 46.5 nautical miles to selected NAV/BOMB target, range to target is displayed. When range to target is less than 46.5 nautical miles, range display depends on selected attack mode as follows:

MODE	MORE THAN 46.5	LESS THAN 46.5
ALL WEATHER LEVEL		
Range	Target	Release point
Bearing	Target	Aimpoint
ALL WEATHER LOFT or O/S		
Range	Target	Pull-up point
Bearing	Target	Aimpoint
VISUAL (except LEVEL)		
Range	Covered	Covered
Bearing	12 o'clock	12 o'clock
VISUAL LEVEL		
Range		Release point (less than 2.5 miles)
Bearing		Aimpoint (after radar lock-on)

IDENTIFICATION UNITS (IFF AND SIF)

The IFF/SIF transponder units provide coded display responses, along with the basic video return of the aircraft, on the scope of any properly equipped and interrogating air or surface radar. The IFF unit (Identification, Friend or Foe) supplies a basic reply pulse in any of three modes. The SIF unit (Selective Identification Feature) provides coded response for the three basic modes. In-flight selection of 32 codes is available for MODE 1, and 64 codes are available for MODE 3. MODE 2, the classified military identification mode, is preset by maintenance personnel, and is not available for in-flight SIF code selection. In addition to the military identification applications, navigation assistance, traffic separation, and distress identification are available through the IFF/SIF system. If preselected by the pilot, the IFF automatically responds in the emergency mode upon ejection of either crew member. On some aircraft,* the IFF/SIF control panels may be moved to the pilot's cockpit.

Note

- Operation of SIF requires that the NORM/MOD switch on the SIF unit in the electronics bay be set to MOD. NORM position results in a basic IFF response (no SIF). Ground stations equipped with SIF are not capable of receiving unmodified IFF signals.
- An emergency IFF mode switch is located on the pilot's right-hand console and an emergency IFF switch is under each crew member's seat. Refer to EMERG IFF SWITCH, in this section.

IFF/SIF CONTROLS

Master Function Selector

The MASTER function selector controls operation of the IFF/SIF system in any or all selected modes. With the

*Aircraft 149289 and subsequent and aircraft having AFC 146 complied with

SIF unit NORM/MOD switch at MOD, the MASTER function selector operates the system as follows:

POSITION	OPERATION
OFF	Partial filament power (90 seconds after CNI power is turned on).
STBY	Warmed up and ready.
LOW	Transponder responds at low power in selected modes.
NORM	Transponder responds at normal power in selected modes.
EMERG (SIF)	Four Mode 1 replies, a single Mode 2 reply, two Mode 3, Code 77 replies (plus a partial third Mode 3, Code 77 reply in modified aircraft).

Note

- Pilot selection of MAN (EMERG IFF switch) overrides all positions of the MASTER function selector, including OFF. Direct selection of MAN with the MASTER function selector at OFF requires no delay before response is available if CNI power has been on for at least 90 seconds.
- Aircraft modified by Avionics Change 170 respond automatically in Mode 3, Code 77, during emergency operation. The MODE 3 button need *not* be depressed to obtain this feature.

Mode 2 and Mode 3 Buttons

The MODE 2 and MODE 3 buttons provide selection of transponder operation in two additional modes. MODE 2 is the classified military mode of identification MODE 3 is used in conjunction with civilian and some military agencies, such as FAA Air Traffic Control Centers and GCA or CCA. MODE 2 and MODE 3 can be selected separately or simultaneously, and are initiated in the LOW or NORM positions of the MASTER function selector.

Identify Position (I/P) Switch

The I/P switch allows a radar agency to single out, by radio request, an individual aircraft in a high-density traffic area. A momentary I/P or a permanent MIC position may be selected. Upon holding the switch momentarily in I/P, or selecting MIC and depressing the microphone switch, a 30-second I/P response is activated, after which normal response returns. The I/P function operates in the various modes as follows:

NORM/MOD SWITCH POSITION	MODE 2	MODE 1	MODE 3	RESPONSE
MOD	Double reply	Normal reply	Double reply (1)	IFF/SIF
NORM	Normal reply	Normal reply (2)	Normal reply	IFF only

(1) The IFF is capable of transmitting an I/P response in Mode 3

(2) With Mode 2 out, a 30-second reply

SIF Mode 1 and Mode 3 Code Dials

The MODE 1 and MODE 3 code dials are two concentric-type switches. The outer dial sets the first digit of the MODE 1 or MODE 3 codes, while the inner dial sets the second digit.

Emergency IFF Switch

The EMERG IFF switch (figure 1-28) is used to select IFF emergency response. The EMERG IFF switch has three positions: MAN, OFF, and AUTO. In OFF, the IFF emergency mode is deenergized and control is maintained at the IFF control panel. The MAN (manual) position is used to select emergency IFF response, overriding the MASTER function selector. The AUTO position is selected to prepare the system to response in the emergency mode in the event of ejection. Automatic IFF emergency response will not occur with the switch in the OFF position, which may be used over territory where the emergency transmission would be considered undesirable.

IFF/SIF OPERATION

1. MASTER function selector—STBY.
2. Position MODE 1 and MODE 3 SIF code dials to desired codes.

   The outer dial selects "tens," the inner dial selects units.
3. I/P switch—OUT.
4. MASTER function selector — NORM, when desired.
5. Rotate MASTER function selector to LOW (partial sensitivity) when requested to do so by properly identified surface or air challenger.

   This position is utilized for surface tracking when close to the challenging radar.
6. Set MODE 2 and MODE 3 buttons as requested.
7. For emergency operation, press dial stop and rotate MASTER function selector to EMERG.

   The IFF will automatically transmit an emergency response when interrogated.

Note

Most civilian agencies do not interrogate IFF Mode 1. Until all aircraft are modified by AVC 170, and when time permits, select Code 77 on MODE 3 to ensure that all interested agencies will be made aware of an emergency.

8. For "Ident" or "Squawk Flash" requests, hold I/P switch momentarily in I/P, or move I/P switch to MIC and momentarily depress the microphone switch.
9. To secure IFF/SIF emission, rotate MASTER function selector to OFF.

IFF OPERATION

1. EMERG IFF switch—AUTO for normal operations (or OFF only if no automatic emergency IFF response is desired for tactical reasons).
2. For "Squawk Flash" or "Ident" requests, hold I/P switch momentarily in I/P as directed, or place I/P switch in MIC and actuate the microphone switch in XMIT, as desired. Either action will activate a 30-second I/P response, after which normal response returns.

Note

- On aircraft not having Avionics Bulletin 46 complied with, the I/P function in MODE 3 is not available.
- The MAN position of the EMERG IFF switch overrides any position of the RAN's MASTER function selector, including OFF.
- Prior to flight with the aft cockpit unoccupied, ensure that the IFF MASTER function selector is positioned to NORM, the MODE 3 button is depressed, the I/P switch (aft cockpit) is at OUT, and the desired MODE 3 SIF code is selected.

AIMS IFF SYSTEM

On some aircraft,* the standardized AIMS components (Air traffic control radar beacon system-IFF-MARK XII identification-Systems) are installed to provide increased IFF/SIF codes for Mode 3 (redesignated Mode 3/A), corrected aircraft altitude reporting (Mode C), Mode IV Military IFF, crypto computer KIT-1A/TSEC, a servoed altimeter (AN/AAU-19/A), transponder controls, and operational test and monitor provisions. IFF computer failure and corrected altimeter output failure are indicated by warning lights mounted on the instrument panels. For a description of the servoed altimeter, refer to STANDARD INSTRUMENTS, in this section.

In operation, an interrogation pulse group (in Mode 1, 2, 3/A, or C) is transmitted from an interrogator through a directional antenna. These interrogations trigger airborne transponders in the main beam of the antenna, causing pulse-coded replies to be transmitted. The surface interrogator decodes aircraft responses, measures range, and determines azimuth. When Mode C is interrogated, aircraft altitude is reported in 100-foot increments of corrected pressure altitude, referenced to 29.92 inches Hg. Code 7700 (Mode 3/A) is the universal aircraft emergency code; however when the pilot or RAN's seat is ejected, emergency replies to Modes 1, 2, and 3/A interrogations (plus normal reply to Mode C interrogation) are enabled, regardless of the mode switch positions. When installed for Mode 4 operation, the KIT-1A/TSEC computer encodes transponder replies in one of many classified military codes for security identification. Mode 2 code selection dials are located on the transponder unit and are preset for military identification. Transponder control panel dial selections provide 32 Mode 1 discrete codes and 4096 Mode 3/A identity codes. Mode C selection enables automatic altitude reporting. A go/no go test function checks receiver frequency and sensitivity, transmitter frequency and power, coding and decoding, and transmission line voltage standing wave ratio (VSWR). System "go" indication is provided by a control panel test light.

IFF CONTROLS AND INDICATORS*

Transponder controls are grouped on a panel located on the right console in the RAN's cockpit. See figure 1-28. These switches control the receiver-transmitter and test units, Mode 1, 2, and 3/A code replies, position identification, emergency coding, and Mode 4 computer operation. Additional IFF system controls include an IFF volume knob on the right console in each cockpit and an IFF computer failure light on the instrument panel.

Master Knob

The MASTER knob is a five-position rotary switch which controls the sensitivity of the transponder receiver and provides for emergency reply operation. To prevent inadvertent selection of the OFF or EMER position, the knob must be pulled out to turn to either of these positions.

Mode Select Switches

Four mode-enabling switches are provided to select the transponder operating mode. The three-position toggle switches for Mode 1, 2, 3/A, and C also include a momentary TEST position for transponder monitor test signal activation, as indicated by the TEST light. However, no test light illumination occurs for modes 1 and C.

Reply Code Selectors

Reply code selection and digit display thumb wheel switches are provided for Modes 1 and 3/A, SIF code control, and indication. Two code selectors for Mode 1 and four selectors for Mode 3/A are provided.

*Aircraft having AFC 296 complied with

Position Identification (I/P) Switch

A three-position toggle switch provides two methods of enabling identifier reply pulses. These are the momentary IDENT position and the MIC position, which allows the microphone switch to remotely enable interrogation replies.

Rad Test Switch

Transponder test set monitor circuits are energized through the MON position of the three-position RAD TEST switch. The RAD TEST position enables transponder reply to TEST modes interrogations from suitable ground test equipment, such as AN/UPM-92 and AN/APM-123(V).

Indicator Lights

The IFF control panel includes two press-to-test, dimmable indicators. The TEST light functions in conjunction with the transponder test circuits. The REPLY light is provided as part of the Mode 4 control circuit, which is operative only when the KIT-1A/TSEC computer is installed.

Mode 4 Controls

The controls for Mode 4 operation are grouped on the left side of the IFF control panel and are operative only when the KIT-1A/TSEC computer is installed. The MODE 4 ON-OUT switch handle must be pulled outward to move to the OUT position; the ON position enables transponder processing of Mode 4 interrogations. A three-position MODE 4 AUDIO-OUT-LIGHT switch selects the method of Mode 4 monitoring, either by audio and reply light monitoring (AUDIO) or by reply light monitoring only (LIGHT). To prevent the MODE 4 CODE selector knob from inadvertent placement in the ZERO position, the knob must be pulled out to turn to ZERO. This knob is also spring-loaded to the A position from the momentary HOLD. To retain mode 4 codes, select HOLD momentarily prior to landing. On deck select HOLD momentarily and wait 15 seconds prior to securing transponder or aircraft power.

IFF Volume Knob

An IFF Mode 4 reply aural monitor volume knob is provided on the ICS audio select panel in each cockpit. See figure 1-28.

IFF Light

An IFF light is mounted on the instrument panel in each cockpit. See figure 1-28. The light indicates KIT-1A/TSEC computer failure and comes on for 2 to 5 seconds whenever the transponder fails to reply to a Mode 4 interrogation. On some aircraft,† the light is removed from the pilot's cockpit.

Altimeter Failure Light

An ALT FAIL light is mounted on the pilot's instrument panel as an indication of uncorrected barometric altitude information. See figure 1-28. The light indicates failure of the barometric altitude functions in the air data computer, and loss of the altitude reporting function. On some aircraft,† this light is relocated to the RAN's instrument panel.

IFF CONTROL FUNCTIONS*

The operating controls and indicators, and their functions, are summarized as follows:

CONTROL OR INDICATOR	FUNCTION
MASTER Switch	**Turns transponder set on and off, selects receiver sensitivity, and selects emergency operation:** **OFF — Removes power from transponder set and transponder computer.** **STBY — Enables transponder receiver and computer; disables transponder transmitter.** **LOW — Places transponder set in operation at reduced receiver sensitivity.** **NORM — Places transponder set in operation at reduced receiver sensitivity.** **EMER — Causes automatic transmission of emergency reply signals to Mode 1, 2, or 3/A interrogations only, regardless of mode switch settings (not affected by Mode C or 4 interrogations).**
M-1 Switch	**ON — Selects Mode 1 operation of transponder set.** TEST — No function in present configuration. **OUT — Turns off Mode 1 operation.**

***Aircraft having AFC 296 complied with**

†Aircraft having AFC 233 Complied with

CONTROL OR INDICATOR	FUNCTION
M-2 Switch	ON — Selects Mode 2 operation of transponder set. TEST — Selects Mode 2 test operation. OUT — Turns off Mode 2 operation.
M-3/A Switch	ON — Selects Mode 3/A operation of transponder set. TEST — Selects Mode 3/A test operation. OUT — Turns off Mode 3/A operation.
M-C Switch	ON — Selects Mode C operation of transponder set. TEST — No function in present configuration. OUT — Turns off Mode C operation.
MODE 1 Reply-code Selector Switches (two)	Select and indicate Mode 1 two-digit reply code number.
MODE 3/A Reply-code Selector Switches (four)	Select and indicate Mode 3/A four-digit reply code number.
IDENT-OUT-MIC Switch	IDENT — Selects identifier pulse. MIC — Permits selection of identifier pulse when microphone keying switch is closed. OUT — Turns off identifier pulse circuit.
RAD TEST-OUT-MON Switch	Selects test signals: RAD TEST — Permits transponder set to be interrogated by selected Mode signals from suitable ground test equipment. MON — Turns on the monitoring circuits of the transponder test set. OUT — Disables test circuits.
TEST Light	Lamp lights when transponder set responds properly to Mode 1, 2, 3/A, or C test signal.
MODE 4 CODE Switch	Selects type of Mode 4 operation: HOLD — When held in position, overrides zeroizing function and enables transponder computer to retain Mode 4 code settings when a-c power is removed. When released, returns to A position. A — Enables transponder system to respond to Code A interrogations. B — Enables transponder system to respond to Code B interrogations. ZERO — Cancels (zeroizes) Mode 4 code settings from transponder computer provided other operational requirements are met.
MODE 4 ON-OUT Switch	ON — Enables transponder system to reply to Mode 4 interrogations. OUT — Disables Mode 4 operation.
MODE 4 AUDIO-OUT-LIGHT Switch	Selects Mode 4 monitoring method: AUDIO — Enables aural monitoring (short burst 300- to 400-cycle buzz) of Mode 4 interrogations (valid or invalid) and REPLY light monitoring of Mode 4 replies. LIGHT — Enables only REPLY light monitoring of Mode 4 replies. OUT — Disables aural and REPLY light monitoring.
MODE 4 REPLY Light	Lights to indicate valid Mode 4 replies when MODE 4 AUDIO-OUT-LIGHT switch is set to either AUDIO or LIGHT.

IFF OPERATION*

To operate the IFF system, proceed as follows:

1. MASTER knob—STBY.
   Transponder warm-up requirement varies from 1 minute at normal temperature conditions to 5 minutes in extreme temperatures.
2. MODE 1 reply code selectors—AS REQUIRED.
3. MODE 3/A reply code selectors—AS REQUIRED.
4. M-1 switch—ON.
5. M-2 switch—AS REQUIRED.
6. M-3/A switch—ON.
7. M-C switch – ON.
8. IDENT switch—OUT.
9. MODE 4 switch—OUT.
10. AUDIO switch—OUT.
11. MODE 4 CODE switch—AS REQUIRED.
12. MASTER knob—NORM.
13. RAD TEST switch—AS REQUIRED.
14. To perform mode function check, select the TEST position of M-2 and M-3A mode switches and observe TEST light indications.
15. When requested, perform position identification (I/P) check as follows:
    (a) IDENT switch—IDENT.
        The momentary switch position provides identifier replies to Mode 1, 2, or 3/A interrogations for 15 to 30 seconds after releasing the switch.
    (b) IDENT switch—MIC.
        Identifier reply activation is enabled by pressing the microphone switch.
16. In event of emergency, pull MASTER knob outward and rotate to EMER to enable emergency coded replies to Mode 1, 2, or 3/A interrogations.

AUTOMATIC CARRIER LANDING SYSTEM

The automatic carrier landing system (ACLS) consists of the shipboard radar/computer, AN/SPN-42, interconnected with the Navy Tactical Data System (NTDS) and data link transmitter, plus the airborne digital data communications set, AN/ASW-25A†, and AN/APN-202† radar beacon and K-band receiver equipment. The independent instrument landing system (ILS), AN/SPN-41, provides localizing reference from marshal on a straight-in approach to the ACLS acquisition window, an alternate ILS-type manual approach method, and a comparison reference for approach path deviations. The AN/ARA-63 equipment required for this system is installed on some aircraft.‡ The shipboard ACLS equipment uses UHF signals for time-diversion digital data transmission. After radar lock-on is established at the 4- to 6-mile acquisition gate, the data link electrically positions the pitch and bank steering bars of the attitude director indicator (ADI) in the direction the aircraft must be flown to maintain or regain the desired glide path. When suitable conditions are indicated, the autoflight control system (AFCS) can be engaged and coupled into the data link control loop. Pitch and bank commands based on azimuth and elevation errors are then relayed to the aircraft for automatic glide path control. Discrete messages are also relayed on a time-sharing basis for pilot display. For ACLS controls and indicators, see figure 1-29A.

AUTOMATIC CARRIER LANDING EQUIPMENT

ACLS

The digital data communications set, AN/ASW-25A†, is a one-way data link for instrument approaches to aircraft carriers, receiving digital command and control messages on one of 250 UHF channels (300.0 to 325.0 MHz) and providing parallel digital message readouts and specific analog error and AFCS command signals to the aircraft. The AN/APN-202 radar beacon equipment includes a K-band receiver, antenna, and a crossband transponder which receives interrogations from the AN/SPN-42 K-band radar and transmits replies at I-band frequencies. Reply signals from the beacon prevent target scintillation by providing echo enhancement to aid AN/SPN-42 tracking. The AN/APN-202 and AN/ARA-63 antennas are located on the lower centerline of the forward fuselage. The AN/ASW-25A shares the existing UHF slot and scimitar antennas, utilizing a coaxial switch and priority circuit to maintain data link and communications signals on opposite antennas.

ILS

The shipboard system, AN/SPN-41, utilizes two J-band transmitters to define a glide slope stabilized in roll, pitch, and yaw in close agreement with that of the ACLS and Fresnel optical landing system. The AN/ARA-63 receiver in some aircraft‡ decodes the pulse-coded signals on 1 of 20 available channels and provides analog output signals proportional to the angular displacement of the aircraft from the glide slope to the cross pointers of the ADI. Controls are shown in figure 1-29A.

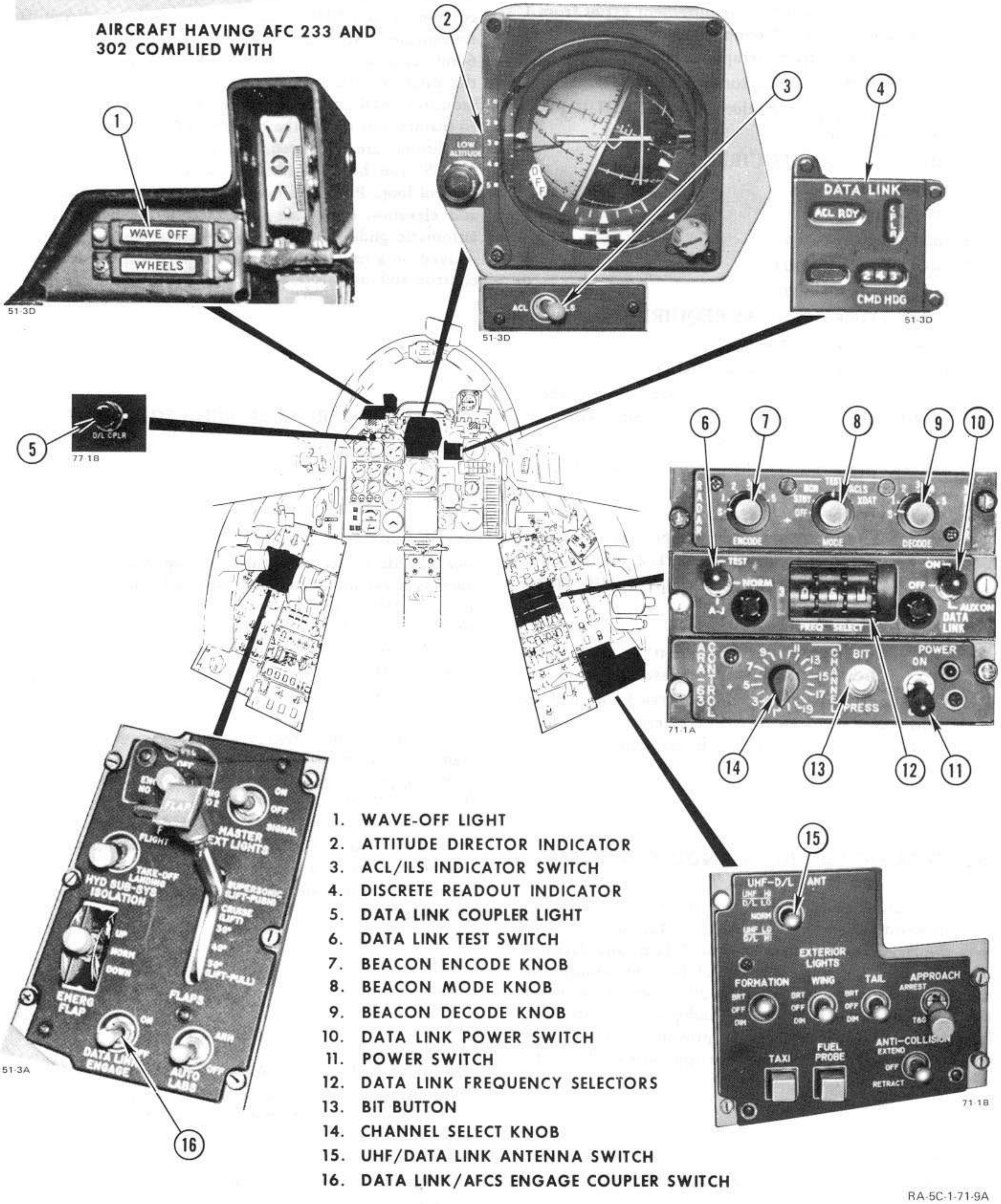
*Aircraft having AFC 296 complied with

†Aircraft having AFC 233 complied with

‡Aircraft having AFC 302 complied with

AUTOMATIC CARRIER LANDING SYSTEM CONTROLS AND INDICATORS

AIRCRAFT HAVING AFC 233 AND 302 COMPLIED WITH



1. WAVE-OFF LIGHT
2. ATTITUDE DIRECTOR INDICATOR
3. ACL/ILS INDICATOR SWITCH
4. DISCRETE READOUT INDICATOR
5. DATA LINK COUPLER LIGHT
6. DATA LINK TEST SWITCH
7. BEACON ENCODE KNOB
8. BEACON MODE KNOB
9. BEACON DECODE KNOB
10. DATA LINK POWER SWITCH
11. POWER SWITCH
12. DATA LINK FREQUENCY SELECTORS
13. BIT BUTTON
14. CHANNEL SELECT KNOB
15. UHF/DATA LINK ANTENNA SWITCH
16. DATA LINK/AFCS ENGAGE COUPLER SWITCH

Figure 1-29A

ACLS AND ILS CONTROLS AND INDICATORS

The following is a summary of ACLS and ILS controls, indicators, and functions:

CONTROL	FUNCTION/INDICATION
DATA LINK PANEL	Digital data communications, AN/ASW-25A.
DATA LINK power switch	
OFF, ON	Controls electrical power to data link.
AUX ON	(Not used.)
Frequency selectors	Tune data link receiver to desired frequency.
Data link mode switch	
TEST	Provides Universal Test Message (UTM) displays for functional check.
NORM	Position for normal operating mode.
A-J	Anti-jam feature. Do not use.
Upper left readout (DRO No. 1)	
NO MSG	Data link is operating but no discrete message is being transmitted.
LAND CHK	Proper aircraft address insertion in AN/SPN-42 by controller and reminds pilot to check configuration.
ACL RDY	Radar lock-on and readiness to assume command of the aircraft. ADI flags retract and steering bars indicate glide slope direction.
CMD CNTRL	Aircraft vertical and lateral commands are being transmitted to the AFCS through the data link system.
10 SEC	Aircraft is approximately 12.5 seconds from touchdown.
WAVE OFF	Wave-off being transmitted.
TILT	Missed message (automatically decouples and disengages AFCS).
Upper right readout (No. 2)	
MAN	Reliable glide slope signals.
CPLR	Data link available for coupling to AFCS.
Lower right readout (No. 4)	
CMD HDG	Desired final approach heading.
Lower left readout (No. 3)	(Inoperative.)
RADAR XPNDR PANEL	Radar beacon, AN/APN-202.
DECODE, ENCODE knobs	
S	Single pulse (used for ACLS).
1, 2, 3, 4, 5	(Not used.)
MODE knob	
OFF, ON	Controls electrical power to radar beacon.
STBY	Warm-up or nontransmitting mode.
BCN	I-band beacon only.
TEST	Built-in-test function—illuminates both BCN and ACLS advisory lights if test is normal.
ACLS	Crossband operation; receives on K-band—transmits on I-band.
XDAT	(Not used.)
DATA LINK (COUPLER) ENGAGE	Electrically couples AN/ASW-25A data link to aircraft AFCS.
UHF—D/L ANT	Communications/ECM antenna switching control.
UHF HI—D/L LO	Data link connected to lower (annular slot UHF) antenna.
NORM	Data link OFF: normal connumications lobing. Data link ON: data link uses lower antenna.
UHF LO—D/L HI	Data link connected to upper (tail cap scimitar) antenna.
ACL/ILS SWITCH	Selects display of ADI cross pointers.
D/L CPLR LIGHT	Both axes of AFCS have disengaged (press-to-reset).
WAVE OFF LIGHT	Wave-off being transmitted (indicator flashes at 2 cps).
AN/ARA-63 PANEL	ILS approach/ACLS independent monitor system.
CHANNEL knob	Selects channel in the AN/SPN-41 system.
BIT PRESS button	Actuates built-in-test provisions.
POWER switch	Controls electrical power to ILS receiver-decoder group and attitude director indicator.
OFF, ON	

APPROACH MODES

Four modes have been designated for ACLS:

Mode 1– Fully automatic from AN/SPN-42 radar acquisition window to touchdown.

Note

Mode 1 approaches are not authorized under actual instrument conditions to less than 200 feet-1/2 mile, pending flight test evaluation and certification by Naval Air Systems Command.

Mode 1A– Automatic from radar acquisition window to 200 feet above and 1/2 mile from touchdown point.

Mode 2– Manual control of aircraft by reference to precision azimuth and glide slope information provided to cockpit displays.

Mode 3– Precision radar talk down.

ACLS OPERATION

During Mode 1 approaches, pitch and bank command signals are routed from the AN/ASW-25A data link converter to the autoflight control system (where they are summed with master flight reference system signals) to control aircraft flight path. When coupled to the data link, the AFCS is locked in hold pitch and wings-level attitude modes when no data link commands are available. Prior to engaging the AFCS and coupling to data link, the PITCH AUG, ELEC SYS, AND APC systems should be checked and engaged, NORM positions of PITCH and ROLL selected, and the aircraft should be trimmed for level flight. The APC system maintains an angle of attack of 15 units and data link pitch command authority (following AFCS engagement) is limited to ±13.5 degrees from this reference attitude. AFCS/bank commands are limited to ±20 degrees laterally from wings-level. If data link signals are reliable, and LAND CHK and command heading readouts are energized and as the aircraft passes through the acquisition window, the ship's ACLS radar locks on the aircraft radar beacon signal and the ACL RDY and MAN discrete readouts are energized. Flight path error display (ADI) is initiated. The AFCS and data link systems can be coupled when CPLR readout is received. When the pilot reports "coupled," the CMD CNTRL message and pitch and roll commands are transmitted simultaneously. The pilot monitors the approach by reference to the ADI needles and maintains voice communication with the ACLS controller. At 12.5 seconds before touchdown, a 10 SEC readout replaces the CMD CNTRL readout to indicate that deck motion compensation commands are being superimposed on pitch commands. During a Mode 1 approach, undesirable command inputs can be overridden by control stick forces if necessary; this uncouples AFCS from the data link and turns the AFCS off. If vertical or horizontal flight path limits are exceeded during a coupled approach, an automatic wave-off signal is received. The LSO or PRI-FLY can transmit a manual wave-off signal at any time after the aircraft is within 1 mile from touchdown. A manual wave-off signal results in data link uncoupling, AFCS disengagement, and a WAVE OFF readout which disables the ADI needles. If ACLS pitch and roll commands should become unsuitable for a coupled approach, data link decoupling action causes the AFCS to disengage, and the MAN readout to appear; also, the D/L CPLR warning light comes on, indicating the need for immediate pilot take-over of the controls. Approach path deviation signals are maintained so that a Mode 2 approach can be continued. For a Mode 1A approach, the AFCS is uncoupled at 1/2 mile before touchdown and control reverts to Mode 2 for the remainder of the approach. For a Mode 2 approach, the CMD CNTRL and CPLR signals are not received, and the approach is flown by following the ADI steering bar indications. For ACLS procedures, refer to Section III, Part 4.

DATA LINK/AFCS COUPLING

With the DATA LINK power switch ON, proper ACLS frequency selected, and the data link mode switch in NORM, the attitude director elevation needle is driven to the extreme upper position (pegged) and the azimuth needle is driven to the right, out of sight. If ACLS message transmission has not been initiated, the TILT message is displayed in the discrete readout indicator in approximately 10 seconds along with the CMD HDG message of "000." If the universal test messages are being transmitted, the data link mode switch can be held in the TEST position for 12 seconds for a "go/no-go" status check of the system. Either of the following two 6-second test displays can occur initially, accompanied by discrete readouts of CPLR and LAND CHK:

ACLS INDICATOR	ALTERNATE 6-SECOND TEST INDICATIONS	
WAVE-OFF light	Blinks at 2 cps	Remains out
CMD HDG readout	045 degrees	315 degrees
ADI needles	90 percent full scale, lower left quadrant	90 percent full scale, upper right quadrant

ILS OPERATION

The AN/ARA-63 approach control system is used as a navigational aid in transitioning to the ACLS final approach path at distances of 4 to 20 miles from the carrier. This system can be utilized for final approach to Mode II minimums (200 feet, ½-mile visibility) in the event of data link malfunction. Procedures are similar to those required for a Mode II ACL approach, except that the ADI selector switch must be in ILS, and the appropriate ARA-63 CHANNEL number must be selected. Unless otherwise directed by CCA, transition to the landing configuration is made at the 10-mile gate, 1200 feet. The AN/SPN-41 glide path should be intercepted at approximately 8 miles, at which time the "fly-up" ADI indication will be noted. Tip-over to the 3-degree glide slope should be accomplished at approximately 4 miles. Corrections to remain on glide path are then flown "to the needles" until acquiring the meatball.

LIGHTING SYSTEMS

EXTERIOR LIGHTS

Exterior lighting equipment consists of wing and tail position lights, low-intensity formation lights, retractable, rotating anticollision lights, a taxi light, and approach lights.

POSITION LIGHTS

Position lights are located on the wing tips and the vertical stabilizer. Controls for the position lights are located on the exterior lighting panel on the right console.

ANTICOLLISION LIGHTS

Retractable, rotating anticollision lights are installed on the top of the fuselage and on the bottom aft of the cockpit section. The anticollision lights can be utilized as steady, white fuselage position lights by placing the MASTER EXT LIGHTS switch to ON with the ANTICOLLISION switch at RETRACT. There are no speed limitations for operation of the anticollision lights.

TAXI LIGHT

A single taxi light is located on the nose wheel landing gear.

FORMATION LIGHTS

The aircraft is equipped with wing tip and fuselage low-intensity formation lights. The fuselage formation lights are installed aft of each wing trailing edge. The wing tip formation lights are single units with lenses on both the upper and lower surfaces, permitting the lights to be viewed from positions above and below the lead aircraft.

FUEL PROBE LIGHT

A retractable, red-lensed light is installed in the upper nose section forward of the windshield for illumination of the fuel probe. This light is controlled by the FUEL PROBE light button. On some aircraft,* the light is a permanently extended fixed installation.

*Converted aircraft 145157 and subsequent and aircraft having AFC 155 complied with

APPROACH LIGHTS

Refer to ANGLE-OF-ATTACK SYSTEM, in this section.

EXTERIOR LIGHTS CONTROLS

Master Exterior Lights Switch

The MASTER EXT LIGHTS switch (figure 1-30) is located on the pilot's left console immediately forward of the flap control switch. This toggle switch has ON, OFF, and SIGNAL positions. The MASTER EXT LIGHTS switch must be moved from the OFF position before the anticollision or position lights can be illuminated. The purpose of the switch is to enable the pilot to signal for night catapult and to extinguish the exterior lights after a night carrier landing. When the switch is positioned to ON, all position lights will be illuminated if their individual switches are at BRT or DIM and the ANTICOLLISION switch is at RETRACT. When the switch is *held* in the SIGNAL position, it will perform the same function as it does when in the ON position. If one or both of the WING or TAIL light switches are positioned to BRT or DIM, the corresponding position lights will be illuminated as long as the MASTER EXT LIGHTS switch is held in SIGNAL. The taxi light and the approach lights system are not part of the exterior lights master circuit.

Note

At least one of the position light switches must be in BRT or DIM position for a signal application.

Wing and Tail Light Switches

The function and brightness of the wing and tail position lights are controlled by two selector switches (TAIL and WING, figure 1-30) on the pilot's exterior lights control panel.

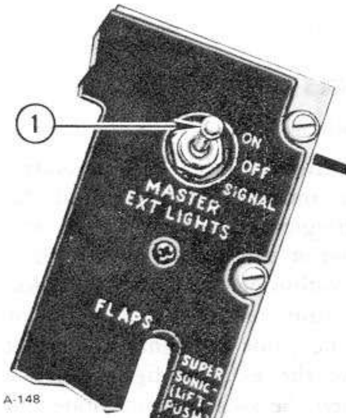
Anticollision Lights Switch

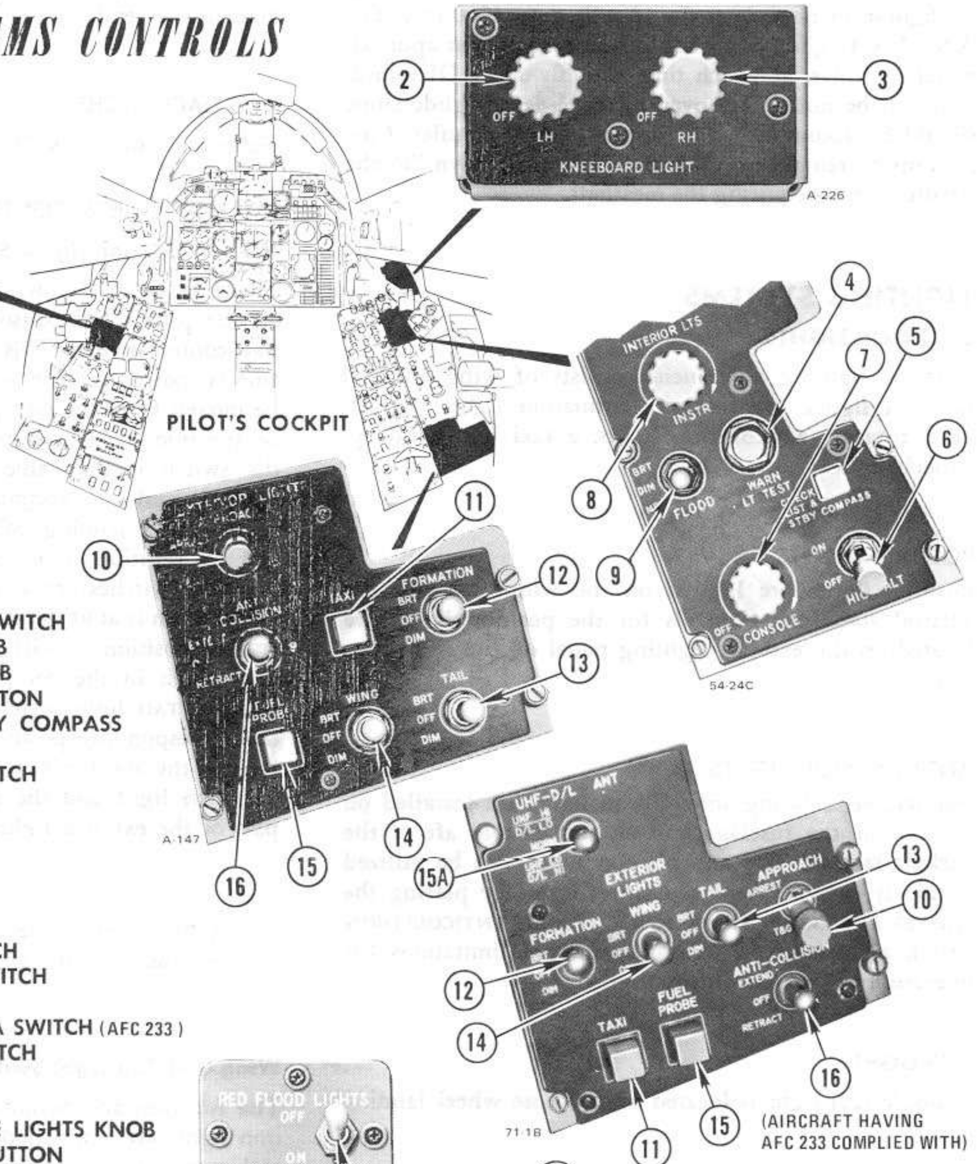
The pilot's ANTICOLLISION lights switch (figure 1-30) controls the retractable anticollision lights. Extension, retraction, and illumination power is supplied by the MASTER EXT LIGHTS switch. With the MASTER EXT LIGHTS switch in ON or SIGNAL, the ANTICOLLISION lights switch will illuminate the lights when moved from the OFF position: EXTEND causing them to extend and rotate as anticollision lights, RETRACT causing them to remain in or retract into the fuselage and act as position lights.

Formation Lights Switch

A FORMATION lights switch (figure 1-30) is installed on the pilot's exterior lights control panel. This switch has BRT, DIM, and OFF positions.

LIGHTING SYSTEMS CONTROLS





1. EXTERIOR LIGHTS MASTER SWITCH
2. LH KNEEBOARD LIGHT KNOB
3. RH KNEEBOARD LIGHT KNOB
4. WARNING LIGHTS TEST BUTTON
5. CHECK LISTS AND STAND-BY COMPASS LIGHTS BUTTON
6. HIGH ALTITUDE LIGHTS SWITCH
7. CONSOLE LIGHTS KNOB
8. INSTRUMENT LIGHTS KNOB
9. FLOODLIGHTS SWITCH
10. APPROACH LIGHTS SWITCH
11. TAXI LIGHT BUTTON
12. FORMATION LIGHT SWITCH
13. TAIL POSITION LIGHT SWITCH
14. WING POSITION LIGHTS SWITCH
15. FUEL PROBE LIGHT BUTTON
15A. UHF/DATA LINK ANTENNA SWITCH (AFC 233)
16. ANTICOLLISION LIGHTS SWITCH
17. MAP LIGHTS KNOB
18. RED FLOODLIGHTS SWITCH
19. INSTRUMENT AND CONSOLE LIGHTS KNOB
20. INDICATING LIGHTS TEST BUTTON
21. FLOODLIGHTS KNOB

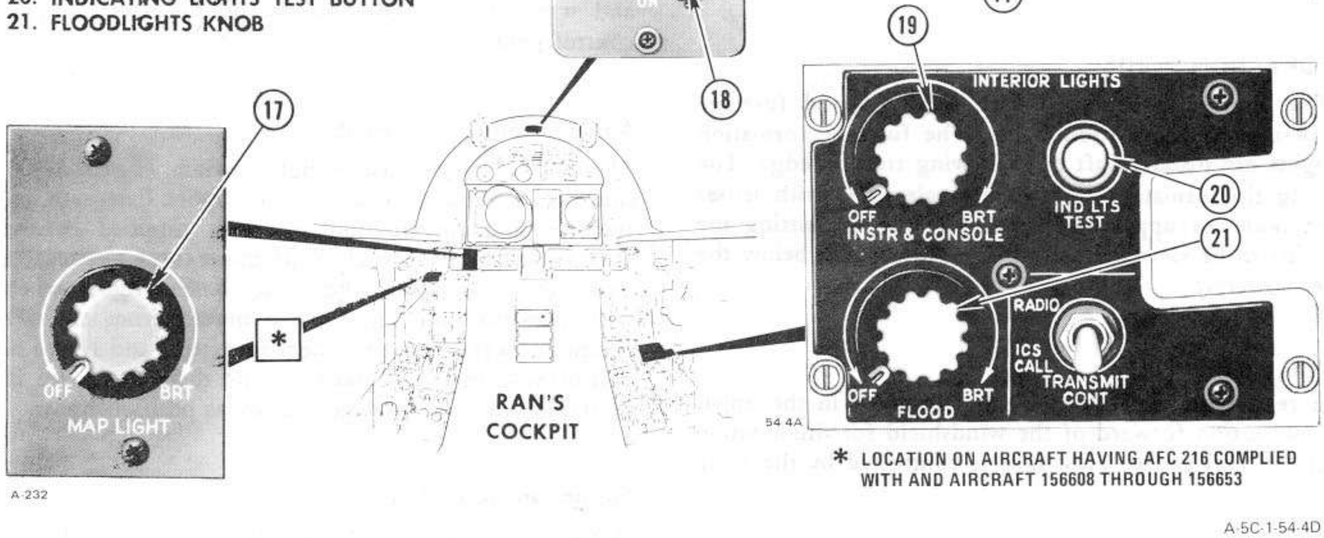


Figure 1-30

Fuel Probe Light Button

The FUEL PROBE light button (figure 1-30) is provided for pilot's control of night illumination of the extended air refueling probe. Depressing the button extends and illuminates the light. Redepressing and releasing the button turns out the light and retracts the assembly. On some aircraft,* the FUEL PROBE light button turns the fixed refueling probe light on (depressed) and off (released).

Approach Lights Switch

The flashing function of the approach lights and approach indexer may be bypassed for field carrier landing practice or carrier touch-and-go by selecting the T & G position of the APPROACH lights switch (figure 1-30), located on the pilot's exterior lights control panel.

Taxi Light Switches

There are two taxi light switches; one is located on the pilot's exterior lights control panel (figure 1-30) and the other is on the right hand side of the RAN's compartment. The taxi light is illuminated by activating either switch. If the light is on when the landing gear is retracted, the light will extinguish. If the switch is left on, the light will illuminate upon extension of the landing gear.

PILOT'S INTERIOR LIGHTS

The following interior cockpit lighting is installed:

1. Right and left console red floodlights.
2. Right and left console white high-altitude lights.
3. Console refractor panels red lights (indirect).
4. Individual red instrument lighting (instrument panel).
5. Indirect red lighting for checkoff lists and stand-by compass.
6. Warning, caution, and advisory lights.
7. Utility (Emergency) light.
8. Left and right kneeboard lights.†

PILOT'S INTERIOR LIGHTS CONTROLS

Flood Switch

The intensity of console red floodlighting is controlled by the FLOOD switch (figure 1-30). On/off selection is made through the CONSOLE lights knob. The FLOOD switch allows, BRT, DIM, or MED selection. Flood lights operate on RAT or EPU (AFC 350).

*Aircraft 145157 and subsequent and aircraft having AFC 155 complied with

†Aircraft having AFC 227 complied with

Instrument Lights Knob

The brightness of individual instrument lights and checkoff lists lights is controlled by the INSTR knob (figure 1-30). When the knob is turned clockwise from the OFF position for night operation, the following lights are automatically dimmed: landing gear warning light, hook warning light, compass SYNC and TAKE CMD lights, HSI function lights, LABS light, radar advisory lights, and the master warning and caution indicators.

Console Lights Knob

The console lights intensity is controlled by the CONSOLE knob (figure 1-30).

High-altitude Lights Switch

The high-altitude lights are selected through the HIGH ALT switch (figure 1-30).

Checklist and Stand-by Compass Button

Lighting of the take-off and landing checklists and stand-by compass is controlled through the CHECK LIST & STBY COMPASS button (figure 1-30). The checklists lights intensity is dependent upon CONSOLE knob position.

Warning Light Test Button

The WARN LT TEST button (figure 1-30) provides an operational check of all cockpit warning, caution, and advisory indicators.

Kneeboard Lights†

Left and right kneeboard lights are installed on the instrument panel. See figures FO-4 and FO-4A. These lights may be positioned to provide the desired lighting of the left and/or right leg area, as required. The outer knob on each light assembly may be rotated to select white or red light. The inner dial on each light assembly adjusts the vertical angle (fore or aft) of the light.

Kneeboard Light Knobs

The LH and RH KNEEBOARD LIGHT knobs (figure 1-30) provide control of the left and right kneeboard lights. Both knobs are provided with OFF positions and may be adjusted to provide any light setting up to maximum.

Utility (Emergency) Light

The cockpit emergency light (figure FO-4) provides mobile utility or emergency white or red light. Illumination and brightness are controlled by a rheostat on the back of the light. A small button, located on the rheostat, provides momentary full bright intensity. The lens at the front of the light may be rotated to provide four light patterns: white spot, white flood, red spot, and red flood. This light is provided by the essential a-c bus and may be operated with power supplied by the RAT-driven emergency unit or the EPU (AFC 350).

RAN'S INTERIOR LIGHTS

Lighting of the RAN's cockpit is provided by white floodlights, indirect instrument (red) lighting, white map (chartboard) lights, and red flood (boarding) light. For fuses, refer to AFT COCKPIT FUSES, in this section, and see figure FO-1. The map light, white floods, and utility lights operate on RAT or EPU (AFC 350).

RAN'S INTERIOR LIGHT CONTROLS

Instrument and Console Lights Knob

The INSTR & CONSOLE lights knob (figure 1-30) is used to turn on and control the intensity of instrument and console indirect lighting.

Map Light Knob

Selection and intensity of the map lights are controlled by the MAP LIGHT knob (figure 1-30).

Floodlights Knob

The floodlights knob (FLOOD, figure 1-30) is used to select and control white compartment floodlights mounted on the canopy.

Red Floodlights Switch

The RED FLOOD LIGHTS switch (figure 1-30) provides selection (OFF/ON) of low-intensity red entrance lights.

Utility (Emergency) Lights

The utility lights provide mobile utility or emergency white or red light. Illumination and brightness are controlled by a rheostat on the back of each light. A small button, located on the rheostat, provides momentary full bright intensity. The lens at the front of each light may be rotated to provide four light patterns: white spot, white flood, red spot, and red flood. These lights are powered by the essential a-c bus and may be operated with power supplied by the RAT-driven emergency unit or the EPU (AFC 350).

MISCELLANEOUS LIGHTING

Interior lighting of the bomb bay is provided by four dome lights. The electronics compartment is lighted by a single floodlight. These lights are controlled by the BOMB BAY LTS switch, located in the right aft portion of the nose wheel well. See figure 1-40.

WARNING, CAUTION, AND ADVISORY INDICATORS

The warning, caution, and advisory indicator system consists of yellow caution indicators, red warning indicators, and green and yellow advisory lights. All indicators are automatically dimmed when the instrument lights are turned on for night operations. The warning and caution indicators are of a flip-shutter design, appearing black until energized.

WARNING INDICATORS

The red FIRE no. 1 ENG and FIRE no. 2 ENG warning indicators are installed on the upper left portion of the pilot's instrument panel. The red OXYGEN warning indicator is located on the upper right of the instrument panel (without AFC 233). Three additional warning indicators are installed on the pilot's instrument panel: the WHEELS warning indicator, the illuminated landing gear handle, and the hook handle-mounted warning light. The landing gear handle and hook handle warning lights are not on the master warning circuit. See figure FO-4B for identification of lights and functions for each cockpit.

CAUTION INDICATORS

A bank of yellow caution indicators is installed on the lower right portion of the pilot's instrument panel. See figure FO-4B for identification of lights and functions for each cockpit.

ADVISORY LIGHTS

Yellow and green advisory lights are installed on the consoles in both cockpits and on the pilot's center pedestal. The console-mounted advisory lights indicate the operational status and cockpit in command of the various communications and navigation equipment. See figure FO-4B for identification of lights and functions for each cockpit.

WARNING LIGHTS TEST BUTTONS

A warning lights test button is installed on the right console in each cockpit. The crew members can depress their respective buttons to test operation of the indicating lights. In addition to testing the lights, depressing these buttons also provides functional checks of the fire warning system, armament indicating circuits, and the CNI emergency power indicator.

MASTER WARNING AND MASTER CAUTION INDICATORS

A master warning and a master caution indicator are installed under the pilot's instrument panel shroud. These barber-poled, rotating lights are designed to draw the pilot's attention to a warning or caution indicator which might otherwise be missed. The master warning and caution indicators are turned off by depressing and releasing the face of the light assemblies. The potential brightness of the master warning and caution indicators is reduced by moving the INSTR lights knob from OFF.

Note

> The master warning indicator is energized by the FIRE no. 1 ENG, FIRE no. 2 ENG, OXYGEN (without AFC 233), and WHEELS warning indicator circuits only. Landing gear handle and hook handle warning lights are not on the master warning circuit.

INSTRUMENTS

A standard group of pitot-static instruments is provided: airspeed/Mach indicator, counter-pointer altimeter, and vertical speed indicators. The pitot-static system receives pitot (total) and static pressure through the radome-mounted pitot boom. The pitot-static instruments receive a corrected static pressure input from a pressure compensator in the air data computer. This corrected static pressure feature may be disabled by the pilot in the event of a suspected malfunction in the air data computer. * In addition to the pitot-static group, other flight instruments include an all-attitude indicator, an angle-of-attack indicator, an accelerometer, a turn-and-bank indicator, and a stand-by attitude indicator for use in the event of failure of the all-attitude indicator. The pilot's navigation instruments include a horizontal situation indicator (HSI), a stand-by magnetic compass, and a clock. The RAN's cockpit is provided with an azimuth and range indicator, a clock, wind speed and direction, true airspeed/ground speed, and radar/barometric altitude indicators. Engine instruments and other system indicators are described with their applicable systems in this section.

*Aircraft not having AFC 159 complied with

†Aircraft having AFC 296 complied with

AIR DATA COMPUTER

The air data computer is an analog device which receives static and pitot pressures from the pitot-static boom, indicated angle of attack from the airstream direction detector (right forward fuselage), and total temperature from a probe mounted in the right inlet duct. An electrical output of altitude is provided to the inlet duct control system and flight control augmentation systems, and is displayed on the RAN's radar/barometric altimeter as selected. A pneumatic output of altitude is provided for the pilot's altimeter, airspeed, Mach, and vertical speed indicators. On some aircraft,† failure of the barometric altitude function is indicated by the ALT FAIL light. Mach number is computed from the ratio of static and pitot pressures, and electrical outputs are provided for pitch augmentation, inlet duct and autoflight control systems, and for special reconnaissance systems if installed. True airspeed is computed from Mach number and total temperature, and electrical outputs are provided to the AN/ASB-12 and flight reference set and displayed in the RAN's cockpit. True angle of attack is computed from indicated angle of attack and Mach number, and electrical outputs are provided to the AN/ASB-12 radar antenna (in the alpha AUTO mode of terrain avoidance) and to the bombing computer. Normal velocity is computed from TAS and true angle of attack for the bombing computer.

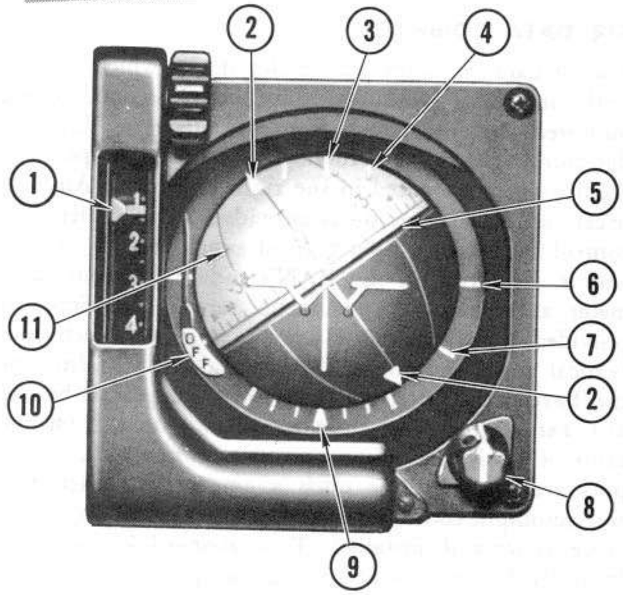
STATIC PRESSURE COMPENSATOR (SPC)

On aircraft* not having the compensated pitot-static tube installed, static pressure is corrected for position error by a static pressure compensator (pneumatic generator) in the air data computer. The output pressure, controlled by Mach number, is supplied to the pilot's flight instruments (airspeed, altitude, and vertical speed) and is converted to electrical outputs which are provided for the pitch augmentation, inlet duct, and autoflight control systems. Electrical outputs which can be corrected for local atmospheric pressure variation from standard conditions are supplied to the AN/ASB-12 and displayed in the RAN's cockpit. The correction is made by the RAN's setting in known terrain elevation and selecting the BARO CAL mode, which uses the radar altimeter.

SPC BUTTON

Some malfunctions of the SPC mechanism which cause erroneous output will initiate a fail-safe condition. In order to attain the next most accurate static pressure, the SPC is automatically bypassed and indicated static pressure is routed to the pilot's pressure-operated instruments and to the altitude computing portions of the air

ALL-ATTITUDE INDICATOR



1. LABS "G"-PROGRAMMER
2. ROLL POINTER
3. LATERAL STEERING AND ROLL-YAW POINTER
4. 5-DEGREE STEERING MARKS
5. HORIZON LINE AND HEADING SCALE
6. 90-DEGREE BANK MARKER
7. 60-DEGREE BANK MARKER
8. PITCH TRIM KNOB
9. BANK SCALE (0, 10, 20, 30 DEGREES)
10. OFF FLAG
11. PITCH REFERENCE MARKS (30 DEGREES)

A-5A-1-51-1A

Figure 1-31

data computer. A barber pole will show in the RAN's radar/barometric altimeter when operating in the BARO mode. Because some inert failures cannot be detected by this fail-safe feature, cockpit control is provided. Depressing the SPC button (figure FO-4) routes the output of the SPC to the instruments. A second depression and release of the button (away from the panel) routes indicated static pressure from the pitot-static boom directly to the instruments. The resulting display will be lower than actual altitude and airspeed. See figures 11-6 and 11-7 in Section XI of this manual. The SPC button will have no effect on the true airspeed display in the RAN's cockpit.

CAUTION

With the SPC turned off during a catapult launch, rate of descent and loss of altitude may be indicated on the cockpit instruments as a transient condition, due to increased position error in the airspeed system as airspeed increases.

Note

The error which can be introduced by the SPC is nearly equal to the amount of error present at landing touchdown speeds. Because of this, and due to the possibility of a failure at a critical time, it is recommended that the SPC be turned off for landings.

ALL-ATTITUDE INDICATOR

The all-attitude indicator (figure 1-31) is an electrically operated servodriven instrument which displays aircraft attitude and heading 360 degrees about all axes. Basically, the indicator consists of a 3¾-inch sphere suspended in a sealed case. The sphere is capable of unrestricted movement around three axes, representing the relative movement of the earth and sky as viewed from the cockpit. A trim knob in the lower right-hand corner of the instrument rotates the sphere for change in zero pitch reference. Aircraft roll while in a vertical pitch attitude results in a heading change indication. The heading numerals are inverted during inverted flight. A vertical pointer is provided which indicates errors in lateral steering for the NAV or BOMB modes of the AN/ASB-12. The pointer indicates linear steering error left or right of the true run-in course. The pointer also provides roll/yaw deviation error during alternate LABS pull-ups. The vertical indices are equivalent to 5 degrees from the true run-in course. The indicator receives power through its own amplifier from the flight reference set, which in turn is powered by the essential a-c bus. A red "OFF" flag becomes visible at the lower left of the sphere when the indicator is not receiving the proper voltage inputs. If instrument power failure occurs, the stand-by attitude indicator provides reliable information for a short period even though the "OFF" flag is displayed.

CAUTION

- On some aircraft,* if the No. 2 engine fails, undervoltage resulting from rpm decrease may cause the all-attitude indicator to tumble prior to electrical system switchover to engine No. 1. Placing the NO. 2 GENERATOR switch to OFF before No. 2 engine rpm reaches 36% will prevent AAI tumble.

*Aircraft not having AFC 167 complied with

CAUTION

- Should the "OFF" flag of the all-attitude indicator appear in flight, the instrument is *immediately* unreliable. If necessary, refer to the stand-by attitude indicator on the instrument panel.

During flight under instrument conditions, a periodic cross-check between the all-attitude indicator and the stand-by attitude indicator is recommended. Under stabilized flight conditions, the gyro platform corrects transient wing-down indications at a rate of approximately 5 degrees per minute.

G-PROGRAMMER

A G-programmer is mounted on the left side of the instrument bezel of the all-attitude indicator. This indicator is used during loft or toss bombing maneuvers. The desired "g" index may be alined with the horizon bar of the all-attitude indicator by means of a knob at the top of the instrument. Upon activation by the pull-up signal from the AN/ASB-12, weapon initiation trigger, or LABS timer, a motor-driven pointer moves down scale at a predetermined rate. During manual pull-ups, keeping the pointer alined with the moving reference pointer by steadily increasing control stick back pressure assures proper entry into the weapon delivery maneuver. The programmer is inoperative when the autoflight control system is engaged.

AAI OPERATION

The vertical pointer of the all-attitude indicator provides a lateral steering reference in the NAV and BOMB modes of the AN/ASB-12. The indication is wind-corrected and, when maintained centered, results in a constant great-circle track to selected target or checkpoint. Steering from one of these modes is always present except during LABS or AN/ASB-12 failure. The pilot may distinguish NAV mode steering from BOMB mode steering by the absence of the HSI TGT indicator light. In NAV mode, steering indications to the target, selected by the NAV/BOMB target selector, are great-circle course indications. "Fly to" type steering indications will be available to the pilot to within 20 nautical miles of the target when the RAN's COURSE LINE NAVIGATION switch is in C/L NAV steering. When range is less than 20 nautical miles from target, the steering pointer will hold in a constant-course-type presentation. If steering is not kept centered inside the 20-nautical-mile radius (allowing the aircraft to deviate from great-circle route), a subsequent centering correction by the pilot will result in a flight path parallel to the great-circle route existing at the 20-nautical-mile point. Within 20 nautical miles of a selected target or checkpoint, the steering display is modified to permit stability and outbound tracking to 20 nautical miles beyond checkpoint, without reselection. Beyond 20 nautical miles from selected NAV/BOMB target, NAV steering signal is back to the target and cannot be flown outbound in reverse. In the BOMB mode (TGT light in the HSI will illuminate), steering indications are always to the release point, by a direct course, and steering corrections are made "toward" the pointer. During flight reference set LABS pull-ups, the steering pointer becomes a vertical steering indicator and wings-level-type (yaw) steering corrections are made. When steering signals are furnished by the AN/ASB-12, the pilot will receive identical steering presentations on both the AAI and the PPDI (in TA, CM, MONITOR, and STEER modes). AAI display in BOMB mode is essentially identical to NAV steering with small differences due to selected attack mode.

Note

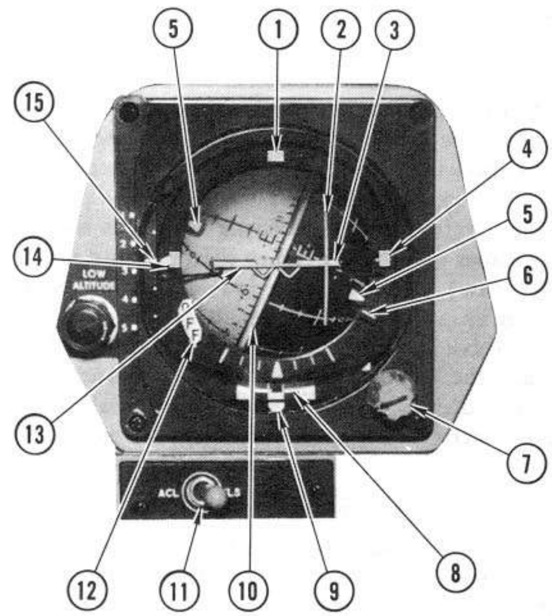
- Maintaining the steering indication centered results in passage directly over the selected checkpoint or target if present position was corrected prior to reaching the 20-nautical-mile radius point, and if wind remains constant. If steering is *not* maintained at center within the 20-nautical-mile radius, subsequent centering corrections result in a path parallel to the great-circle route existing at the 20-nautical-mile point.
- If the RAN corrects present position inside 20 nautical miles in NAV mode, HSI and ARI range and bearing indication is corrected but steering signals do not change unless C/L NAV is selected.
- If a new checkpoint is not selected after tracking outbound for 20 nautical miles, steering indication will reverse and, with AFCS engaged in NAV mode, the aircraft will turn in the direction of the least number of degrees of heading change and return to selected point.

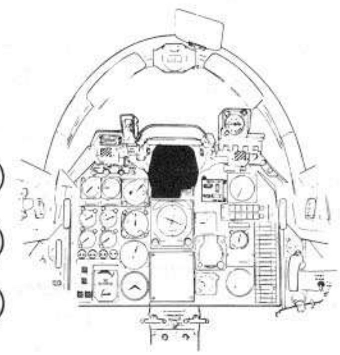
ATTITUDE DIRECTOR INDICATOR

On some aircraft,* the AAI is replaced by an attitude director indicator (ADI), which is similar in appearance and operation, except for the addition of vertical and horizontal cross pointer needles for use in maintaining the glide path during ILS-type approaches. Rate-of-turn and slip indications are also provided. See figure 1-31A. The needles are utilized for operation of both the auto-

*Aircraft having AFC 233 complied with

ATTITUDE DIRECTOR INDICATOR





1 VERTICAL NEEDLE ALARM FLAG
2 VERTICAL NEEDLE
3 HORIZONTAL NEEDLE
4 HORIZONTAL NEEDLE ALARM FLAG
5 BANK ANGLE INDEX
6 BANK ANGLE SCALE MARKING
7 PITCH TRIM KNOB
8 SLIP INDICATOR
9 RATE OF TURN INDICATOR
10 ARTIFICIAL HORIZON
11 ACL/ILS DISPLAY SELECTOR SWITCH
12 POWER OFF INDICATOR
13 ATTITUDE REFERENCE SYMBOL (MINIATURE AIRCRAFT)
14 G-PROGRAMMER POINTER ALARM FLAG
15 G-PROGRAMMER SCALE AND POINTER

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Figure 1-31A

matic carrier landing (AN/ASW-25A) and the approach control/guidance (AN/ARA-63) equipment. Vertical, horizontal, and G-programmer pointer alarm flags are provided to show signal unreliability, and an "OFF" flag indicates electrical power interruption. A selector switch (ACL/ILS) is provided below the ADI to enable the pilot to monitor approach path deviation indications being supplied by either the AN/SPN-42 (ACL) or AN/SPN-41 (ILS) systems, as desired.

STANDARD INSTRUMENTS

STAND-BY ATTITUDE INDICATOR

A stand-by attitude indicator (figure FO-4) is provided for the pilot's emergency use in case of malfunction of the flight reference set or the all-attitude indicator. The indicator is electrically operated and will permit rolls and loops without tumbling the gyro. If a malfunction occurs as a result of a power failure, a warning flag becomes visible, indicating "OFF." When not in use, the indicator face is obscured from view by a spring-loaded cover. Under critical conditions, the stand-by attitude indicator provides valuable information and should be used as a primary instrument during night catapult launches or during flight in turbulence.

On some aircraft,* provisions are made for replacement of the stand-by attitude indicator with the ID-1712/A. This instrument presentation closely parallels that of the all-attitude indicator. Operation of the instrument is similar to the previous stand-by attitude indicator installation, except that the caging knob can be locked in the cage position and the "miniature aircraft" attitude adjustment feature is incorporated in the cage knob assembly.

The ID-1712/A caging/trim knob should be pulled fully outward momentarily after application of power to permit initial erection stabilization of the horizon. The instrument should not be recaged unless errors of greater than 10 degrees are present as smaller errors are erected out at 2.5 degrees per minute during normal operation. Recage only when in a level flight attitude. The instrument should not be left in the caged position except when removed from the aircraft. The ID-1712/A will provide 9 minutes of useful vertical reference during run-down after removal or loss of power.

***Aircraft 145157 through 156627 having AFC 321 complied with and aircraft 156628 through 156643**

Note

Allow 2 minutes for ID-1712/A to align to true vertical after recaging.

AIRSPEED/MACH INDICATOR

The airspeed/Mach indicator (figure FO-4) is a pressure-operated instrument which presents calibrated Mach number and airspeed in knots to the pilot. The instrument provides indicated airspeed readings from 80 to 850 knots on a fixed dial and from 0.4 to 2.5 Mach on a moving scale. On some aircraft,* the instrument receives total pressure from the pitot-static boom and true static pressure from the air data computer. Should the static pressure compensator fail, or if the SPC button is released to the off position because of unreliable airspeed or altitude instrument readings, the indications will read IAS, IMN, and indicated altitude (with no correction for static pressure system error).

INLET AIR TEMPERATURE INDICATOR

An inlet air temperature indicator (figure 1-19) is installed on the pilot's right forward console. This indicator (−70° to 150°C) presents the free air stream total temperature, measured at the engine inlet duct. This temperature can be used to determine ambient air temperature effects on flight performance by considering aircraft Mach number. Refer to Section XI.

ALTIMETER

A standard counter/pointer altimeter (figure FO-4) is installed. On some aircraft,† the standard altimeter is replaced by the AN/AAU-19/A servoed altimeter, which is controlled by a remotely located altitude computer. The AN/AAU-19/A altimeter can be identified by the STBY/RESET switch in the lower right-hand corner of the instrument and the three-digit counter window. In the servoed mode of operation (RESET), the altimeter displays altitude corrected for position error by the air data computer. The AN/AAU-19/A counter-drum-pointer display provides direct digital readout of altitude in increments of 100 feet (from −100 to 80,000 feet). The pointer repeats the 100-foot indications of the drum in a vernier-type function; the pointer indication is added to the two counter indicator readouts for complete altitude information. The AN/AAU-19/A altimeter setting operation is identical to that for the standard altimeter, except that the ±75-foot maximum altimeter error check should be made in both STBY and RESET. An ALT FAIL light is mounted on the instrument panel to indicate failure of the ADC barometric altitude functions. In the event of a-c electrical power interruption or servo failure, the pneumatic (STBY) mode of operation is automatically actuated, as indicated by appearance of a "STBY" flag in the upper left portion of the instrument. Pitot-static position error data application is required to correct observed altitude indications when operating in STBY. In the event of transient electrical or servo malfunctions, the RESET position will return the system to servoed mode, as indicated by disappearance of the "STBY" flag. If manual selection of STBY mode is desired, hold the lever in STBY for 1 to 3 seconds, until the "STBY" flag appears. An internal vibrator is automatically energized by d-c electrical power when the AN/AAU-19/A altimeter is in STBY mode to provide smoother altitude change display. Failure of the vibrator does not affect altimeter function, but results in rougher instrument indications during changes in altitude.

VERTICAL SPEED INDICATORS

Two standard vertical speed indicators are installed. The uppermost indicator (figure FO-4) is used as a cross-check indicator for terrain avoidance flight.

CLOCK

A standard 8-day clock (figure FO-4) with a 12-hour dial is located on the instrument panel. An elapsed time mechanism is provided and is set by the use of a button on the upper right corner of the face rim.

ANGLE-OF-ATTACK SYSTEM

The angle-of-attack system consists of an airstream direction detector and an angle-of-attack indicator which controls the approach lights on the nose landing gear and the pilot's approach indexer. Refer to APPROACH LIGHTS, in this section. The airstream direction detector is located on the right side of the fuselage, forward of the right intake duct. The detector alines with the direction of the local air stream and sends a resultant signal voltage to the angle-of-attack indicator. The detector probe is automatically heated through contacts of the air safety relay when the aircraft is airborne.

***Aircraft not having AFC 159 complied with**

†Aircraft having AFC 296 complied with

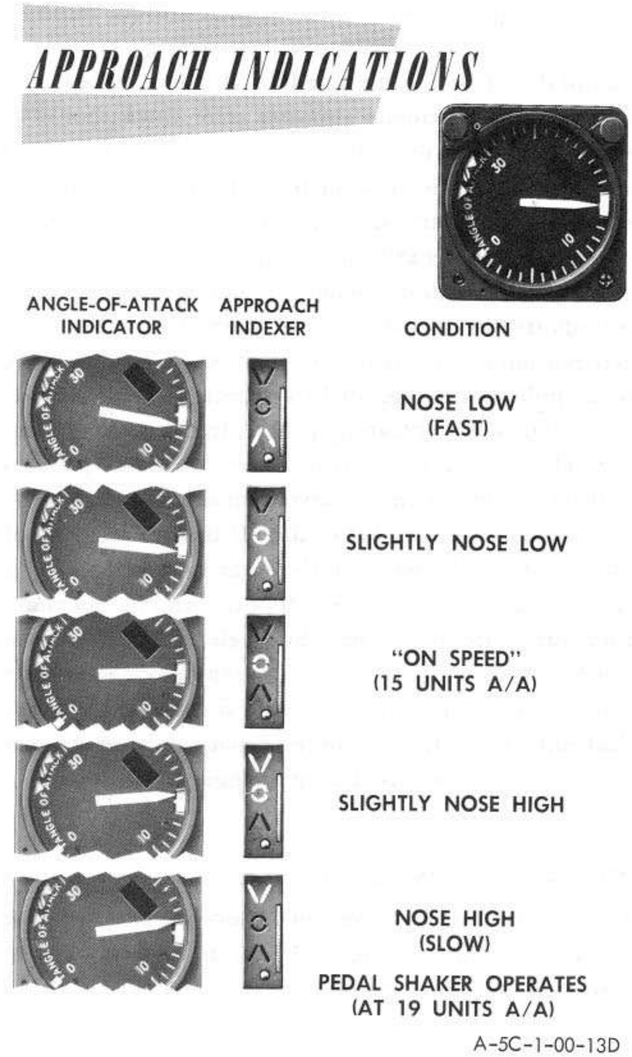


Figure 1-32

ANGLE-OF-ATTACK INDICATOR

The angle-of-attack indicator (figure FO-4) displays aircraft local angle of attack as sensed by the airstream direction detector. This indicator operates whenever d-c electrical power is available (d-c converter operating), and requires no control initiation by the pilot. The face of the indicator is adjusted to place the nominal approach angle of attack (15 units) under an index at the 3-o'clock position. An "OFF" flag, located near the center of the indicator, appears in the event of failure. In the event of failure or when not powered, the indicator pointer rests at zero. A system of cam-operated switches within the indicator operates the approach lights and approach indexer.

APPROACH INDEXER

The approach lights system is supplemented by the approach indexer (figure FO-4). The indexer is illuminated under the same conditions as the approach lights, since operation is also controlled by the position of the landing gear and arresting hook. The indexer is also controlled by the hook bypass relay and will flash if the landing gear is locked down and the hook is up or unlocked (with the APPROACH lights switch in ARREST). The red-lighted approach indexer is located on the instrument panel shroud and is a visual aid to the pilot in determining the optimum landing approach attitude. A press-to-test button and a mechanical dimmer controlled by a knurled wheel are incorporated. The wheel may be rotated upward to provide dimming, as desired, through rotation of polaroid lenses on each indexer lamp. No control action is required from the pilot to utilize the approach lights and approach indexer systems. For indications of the angle-of-attack system, see figure 1-32.

APPROACH LIGHTS

The approach lights, installed on the nose gear strut, aid the Landing Signal Officer in determining aircraft landing approach attitude. These lights signify fast (red), "Roger" (amber), and slow (green) approach attitudes, respectively, as viewed by the Landing Signal Officer. The approach lights system is automatic. It is activated when the landing gear is down and locked and is controlled by the angle-of-attack indicator. Refer to ANGLE-OF-ATTACK INDICATOR, in this section. When the landing gear and arresting hook are down, the applicable approach light is on "steady." If the landing gear is down and the hook is retracted, the applicable approach light is on "steady" or flashing, as controlled by the APPROACH lights switch. The approach lights system is dimmed for night operations by placing the MASTER EXT LIGHTS switch to ON. The approach lights are extinguished when the weight of the aircraft compresses the landing gear struts. On some aircraft* the approach lights circuits are modified to provide two additional approach attitude indications. These indications are achieved by combined illumination of the red and amber lights which appear as an orange light (slightly fast) and the green and amber lights which appear as a white light (slightly slow).

PEDAL SHAKER (SPEED WARNING)

A vibration motor is mounted on the back side of the right-hand control pedal to produce a stall warning. It receives signals from the angle-of-attack system and will actuate when angle of attack reaches or exceeds 19 units.

*Aircraft having IAFC 212 complied with

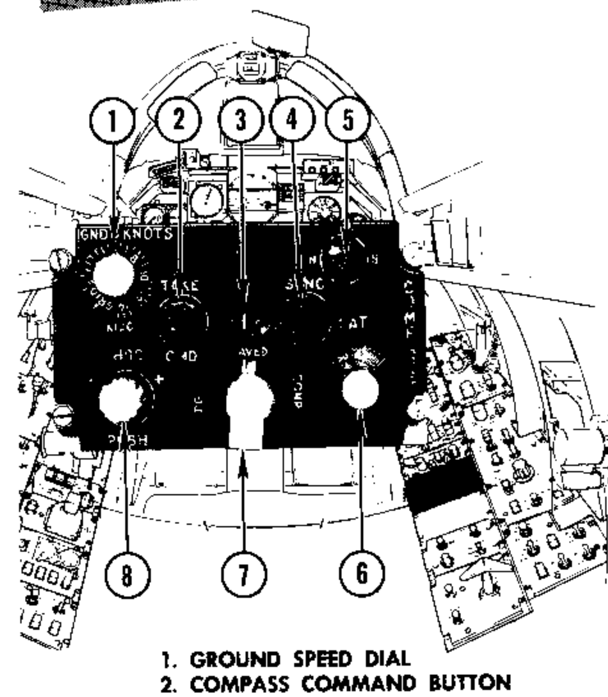
FLIGHT REFERENCE SET, AN/ASN-26

The flight reference set, AN/ASN-26, provides heading, pitch, roll, yaw and timing signals for use in other aircraft systems. Components include a flight reference gyro, stabilization data converter, heading compensator, induction compass transmitter, control indicator, the pilot's AAI and G-programmer, and the LABS timer. The flight reference set provides outputs for automatic flight control systems (AFCS) operation, reconnaissance systems operation, CNI operation, weapons release, and backup stabilization for the AN/ASB-12 general-purpose radar antenna.

GYROCOMPASS SYSTEM

Components of the flight reference set, AN/ASN-26, provide a gyro-stabilized, magnetic compass system. Three modes of compass operation are available to the crew members in each cockpit. The normal mode of compass operation is designated the SLAVED mode and provides a gyro-stabilized magnetic heading indication. An alternate mode of operation is the directional gyro (DG) mode which is used during operation in high latitudes and during failure of the SLAVED mode. For emergency compass operation, a magnetic induction compass reference is used and is designated the compass (COMP) mode.

COMPASS CONTROL PANEL



1. GROUND SPEED DIAL
2. COMPASS COMMAND BUTTON
3. ANNUNCIATOR
4. SYNCHRONIZING BUTTON
5. HEMISPHERE SWITCH
6. LATITUDE DIAL
7. COMPASS MODE SELECTOR
8. HEADING SET KNOB

A-5C-1-71-4

Figure 1-33

CONTROLS AND INDICATORS

COMMAND BUTTONS

The compass control panels are equipped with a TAKE CMD (take command) button (figure 1-33). Either crew member can take command of the compass system by momentarily depressing the TAKE CMD button. Command of the system is indicated by steady illumination of a dimmable green light within the button.

HEMISPHERE SWITCH

The hemisphere switch (figure 1-33) provides controlled reversal of the correction voltages from the ground speed and latitude dials for the hemisphere (north or south) in which flight is being conducted.

MODE SELECTOR

The compass mode selector (figure 1-33) is used to select compass modes of operation. Three modes of operation are available: DG (directional gyro), SLAVED, and COMP (compass).

SYNCHRONIZING BUTTON

The SYNC button (figure 1-33) activates a fast servo loop which overrides the normal compass slaving rate of 2 degrees per minute, thus providing synchronization of heading presentation with magnetic heading in 10 seconds maximum during SLAVED mode operation. Synchronization is accomplished automatically on initial turn-on or reselection of the SLAVED mode, but may be initiated as desired by depressing the button momentarily. An amber light, which may be dimmed for night operation, is incorporated within the button. During synchronization, the light should come on, indicating continuity of electrical power to the fast slave servo. The annunciator needle should center and the SYNC button indicator light should extinguish when synchronization is achieved.

Note

> The SYNC light illuminates momentarily when compass mode is changed, and when the TAKE CMD button is depressed.

GROUND SPEED DIAL

The ground speed dial (figure 1-33) introduces the proper correction for system drift caused by the east-west component of aircraft velocity. When setting this dial, the compass mode selector should be in the DG or SLAVED position.

LATITUDE DIAL

The LAT dial (figure 1-33) is used to manually set known flight latitude to the heading compensator, in conjunction with ground speed, when operating in the DG mode. The LAT dial should be manually adjusted upon each 5-degree change of latitude in DG mode.

ANNUNCIATOR

The annunciator (figure 1-33) provides visual indication of the error in synchronization existing between the signals from the magnetic induction compass transmitter and the gyro-stabilized platform (directional gyro) heading indication. With the annunciator indicating minus or plus, the heading indications of all instruments are in corresponding error in the SLAVED mode.

Note

Oscillation of the annunciator needle is normal in SLAVED mode, signifying continuous slaving correction.

HEADING SET KNOB

The heading set knob (HDG, figure 1-33) is used, in conjunction with the DG and SLAVED modes of compass operation, to manually synchronize heading signals from the induction compass transmitter, located in the left wing tip, and the gyro-stabilized platform. The heading set knob is provided for manually changing, left or right, the heading indications of the AAI, the ARI, and the HSI. Synchronization is achieved by turning the knob left or right (- and + directions) until the annunciator needle is centered. Synchronizing while wings are folded can result in a compass error of up to 180 degrees.

HEADING INDICATORS

ALL-ATTITUDE INDICATOR (AAI)

Aircraft heading is displayed by the sphere of the AAI in all modes of compass system operation. Refer to INSTRUMENTS, in this section.

HORIZONTAL SITUATION INDICATOR (HSI)

The compass ring of the HSI is driven by the compass system in all modes of operation.

Note

Heading indications of the AAI, HSI, and the aft cockpit ARI should agree at all times, unless the flight reference set gyro has tumbled due to engine or generator failure.

AZIMUTH AND RANGE INDICATOR (ARI)

The ARI (figure FO-1) presents magnetic heading to the RAN. The compass card is driven by the heading compensator, which receives signals from the stabilized platform and the induction compass transmitter in normal operation.

COMPASS SYSTEM OPERATION

Compass components of the flight reference set receive electrical power when external power is applied or when the engine-driven generators are producing proper voltage. In the event that one or both engine-driven generators fail, the compass system is fully operational with electrical power from one generator or from the ram-air turbine. On initial application of electrical power, the compass control in the forward cockpit is in command of the compass system. It is recommended that before command is transferred, the crew member taking command select compass mode to coincide with the control presently in command.

SLAVED (NORMAL)

The SLAVED mode is normally used during all flights at latitudes where magnetic induction compass sensing is reliable. In this mode, signals from the flight reference set gyro-stabilized platform and the induction compass transmitter are integrated in the heading compensator. Heading compensator output is then fed to the AAI, HSI, and the aft cockpit ARI. Should gyro heading differ from magnetic, as will normally be the case when selecting the SLAVED mode, the control will synchronize the AAI, the HSI, and the ARI to aircraft magnetic heading at the rate of approximately 18 degrees per second. Should this "fast slaving" be desired, the crew member in command of the compass system may depress his SYNC button momentarily and observe the annunciator and the amber light within the button. When synchronization is accomplished, the annunciator needle will be centered between the minus and plus signs and the amber light will be extinguished.

1. After the AAI erects, check that the compass mode selector is in the SLAVED position.
2. Check the annunciator needle and depress the SYNC button if the needle is not centered.

Note

- Do not depress the SYNC button until the wings are spread and locked.
- Synchronization should NOT be attempted during turns or radical maneuvers, or in conditions of extreme turbulence. Erratic indications may result from the turn and acceleration errors imposed upon the magnetic induction compass transmitter.
- The SYNC button should not be *held* down, as the fast slave circuit is operated by a thermal time-delay relay. Slaving synchronization should be achieved within 10 seconds after the button is momentarily depressed.

DG (ALTERNATE)

If the compass SLAVED mode fails to operate properly, the DG mode should be selected. In addition, at high latitudes (usually above 60 degrees) where magnetic heading is unreliable, the output of the magnetic induction compass transmitter should be cut out by selecting the DG mode. In this mode, the flight reference gyro alone transmits electrical signals through the heading compensator to the heading indicating instruments. Automatic correction for apparent drift and east-west ground speed is accomplished by adjusting the ground speed dial for each major speed change and adjusting the LAT dial upon each 5 degrees of change in latitude.

1. Compass mode selector—DG.
2. Hemisphere switch—as applicable.
3. LAT dial—local.
4. When established at stabilized climb, cruise, or descent ground speeds, set computed ground speed into the ground speed dial.
   Average ground speed settings may be desired during climbs and descents.
5. Periodically cross-check the stand-by compass indicator and correct heading indication with the heading set knob as desired.
6. During operation of the autonavigator in the STBY-NAV mode, the SLAVED mode should be selected momentarily every 30 minutes to correct for changing magnetic variation.

Note

- The SYNC button should not be used in the DG or COMP mode as it will have no effect. The heading set knob should be used in these modes.
- When operating the AN/ASB-12 in the STBY-NAV mode at latitudes exceeding 60 degrees, the compass system should be set in DG mode.

COMP (EMERGENCY)

The COMP mode of operation is used in the event of malfunction of both the SLAVED and DG modes. Selection of the COMP mode utilizes the unstabilized signal of the magnetic induction compass transmitter. The heading presentation is that of a basic earth inductor compass and is provided for use as a stand-by system.

1. Ensure adequate electrical power is available.
2. Compass mode selector—COMP.
3. Observe unstabilized magnetic heading.
4. Periodically cross-reference the stand-by magnetic compass.

CAUTION

The COMP mode of operation should only be used in the event of component damage or malfunction. The COMP mode is subject to turning and acceleration errors associated with all induction compass transmitters and magnetic compasses, and is also affected by local magnetic variations. During operation in the COMP mode, do not exceed 20 degrees of bank angle if minimum turn error is desired.

STAND-BY MAGNETIC COMPASS

A common Air Path stand-by magnetic compass is installed with the sun visor on the canopy bow.

RADAR ALTIMETER SET, AN/APN-120

The radar altimeter, which is part of the electronic altimeter set, AN/APN-120, furnishes accurate altitude calibration data to the air data computer for correction of barometric altitude factor used by the AN/ASB-12 system. This corrected data is used to:

- Provide control inputs to photographic and side-looking radar systems.
- Provide inputs for recording altitude in various reconnaissance systems. The recorded data is also used with barometric altitude data to construct "meteorological" (flight path) data reports.

In addition, the set furnishes precision height-above-terrain data from terrain level to 75,000 feet to the crew members. The set consists of two independent sections: a low system and a high system, operating from a common power supply.

Note

Accurate radar altimeter indication is dependent upon level aircraft attitude.

HIGH-ALTITUDE SYSTEM

The high-altitude system measures aircraft altitude from 500 to approximately 75,000 feet. A signal from the high-altitude system is transmitted to the RAN's radar/barometric altimeter when a radar mode of operation is selected. The high system operates on the pulse propagation principle at a frequency of 4225 megacycles. Time delay between pulse transmission and reception is converted into aircraft altitude above the terrain. Below 500 feet, the system switches from high- to low-altitude system inputs (±40 feet tolerance to the radar/barometric altimeter and reconnaissance systems). The high system ceases to transmit when radar low system altitude is less than approximately 500 feet. If BARO mode is selected, barometric altitude controls all reconnaissance systems until the low system switches on, BARO altitude is displayed, and the "BAR" flag remains in view.

LOW-ALTITUDE SYSTEM

The low-altitude system measures aircraft height above terrain from ground level to 3000 feet. The low system utilizes a frequency-modulated, continuous-wave (FM-CW) radio transmission at a frequency of 4300 megacycles, by which the measure of altitude is accomplished through monitoring of frequency differential between transmitted and received signal. An automatic turn-on signal from the high system (in RADAR mode) energizes the low-altitude system below approximately 4000 (+500/−700) feet above the terrain. In BARO mode, the low system is automatically energized by the air data computer at 4000 (+500/−700) feet MSL. In the event automatic turn-on does not occur, as indicated by appearance of the "FAIL" flag when the aircraft is below 3000 feet, the pilot may effect turn-on through an override button located on the indicator. The pilot's LOW ALTITUDE warning light and the RAN's radar/barometric altimeter are operated by the low system below 500 feet above the terrain when the RAN has selected RADAR.

Note

- If the RAN has selected BARO mode and has increased altitude indication to above 4000 (+500/−700) feet through use of the ALTITUDE SET switch, the air data computer is prevented from causing low system turn-on at the design switchover altitude.
- On some aircraft,* the static pressure compensator (SPC) should be on during all reconnaissance runs. The SPC ensures accurate barometric altitude readings with changes in airspeed.
- If the pilot's low-altitude system is operated in override (OVRD) above 5000 feet in BARO mode, the low system may be energized by cloud return or by the influence of outside emitters. The low system servo is stowed at a position equal to 1500 feet when not operating. Under these conditions, erroneous turn-on will cause the pilot to momentarily see a 1500-foot indication, which then returns to the proper altitude reading. This momentary error causes a transient in altitude signal input to the camera IMC, SLR, and PECM systems.

LOW-ALTITUDE INDICATOR

Electrical power to the low-altitude indicator (figure 1-34) is controlled by the radar altimeter, AN/APN-120; the red warning light is automatically energized when the aircraft is less than 400 feet above the terrain and deenergized when height above terrain becomes greater than 400 feet. The pilot can deenergize the light below 400 feet by momentarily depressing the light assembly. If the pilot deenergizes the light, aircraft height must be increased to above 400 feet to obtain automatic resetting of the low-altitude indicator. On some aircraft,† the light is relocated adjacent to the ADI.

RADAR ALTIMETER CONTROLS

The pilot's and RAN's radar altimeter controls are shown in figure 1-34.

ALTITUDE MODE KNOB

The RAN's ALTITUDE mode knob (figure 1-34) has four positions: RADAR CAL, RADAR, BARO, and BARO CAL. These positions function as follows:

POSITION	FUNCTION
RADAR CAL (Radar Calibrate)	**Used during ground test by maintenance personnel, with an rf energy-absorbing hat under the system antenna, or in flight to determine high system operation and calibration accuracy. Proper operation and calibration is indicated by a 00000 (±22)-foot indication on the RAN's radar/barometric altimeter.**

CAUTION

Do not select RADAR CAL, RADAR, or BARO CAL on deck.

Note

Radar calibration at high altitudes is impractical because of the time required to complete the slewing operation.

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*Aircraft not having AFC 159 complied with
†Aircraft having AFC 233 complied with

RADAR ALTIMETER CONTROLS AND INDICATORS

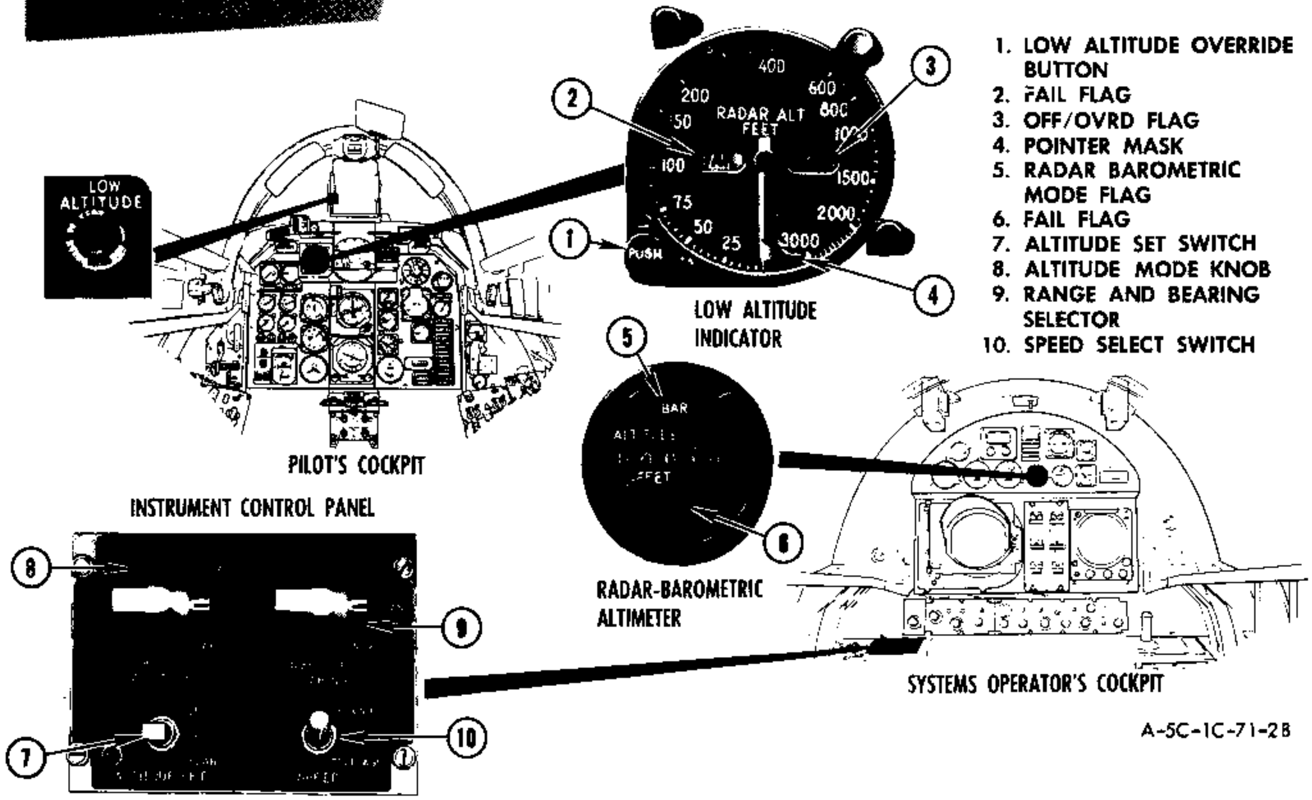


Figure 1-34

RADAR	The electronic altimeter energizes the RAN's radar/barometric altimeter and the "RDR" mode flag is displayed.

Note

Failure of the high system above 3000 feet results in BARO mode operation.

BARO (Barometric)	Corrected barometric altitude is displayed in the RAN's radar/barometric altimeter and the "BAR" mode flag is displayed. A barber pole indicates an OFF* or failed condition of the SPC.
BARO CAL (Barometric Calibrate)	Selected to correct indicated barometric altitude by correcting the air data computer with radar height plus calibration point terrain elevation set in "TARGET ALTITUDE" window.

*Aircraft not having AFC 159 complied with

ALTITUDE SET SWITCH

The ALTITUDE SET switch (figure 1-34) is used by the RAN to correct the radar/barometric altimeter in the BARO mode. Prior to take-off, desired elevation may be set into the altimeter by holding switch in UP or DOWN and releasing at the desired indication.

RADAR/BAROMETRIC ALTIMETER

The radar/barometric altimeter (figure 1-34) provides direct altitude read-out in feet. The instrument consists of a digital counter, a "RDR/BAR" mode flag (figure 1-34), and a red and white striped failure indicating flag (figure 1-34). With the ALTITUDE mode knob in the RADAR or RADAR CAL position, the "RDR" flag is visible; in BARO or BARO CAL, the "BAR" flag is displayed. High system failure while in the RADAR mode results in BARO mode operation regardless of selection.

Note

- With RADAR mode selected below 3000 feet, the failure flag is not displayed unless both the high- and low-altitude systems have failed.

Note

With BARO mode selected, the presence of a barber pole in the radar/barometric altimeter indicates that the SPC is failed or OFF.*

ALTIMETER OPERATION

Control of the altimeter is the responsibility of the RAN. Successful reconnaissance missions depend in part, on accurate altitude information. During reconnaissance runs, RADAR mode altitude should be monitored to ensure that V_g/H, IMC drives, digital data, and SLR sweep delay generation are controlled by valid information. Selecting BARO mode disables the high-altitude system at any altitude. If the high system fails or is disabled above 3000 feet, BARO mode altitude information is used to control the reconnaissance subsystems. It is, therefore, important to BARO CAL the radar altimeter periodically so that, should the high system fail, BARO mode information will be accurate. When the high system has failed below 3000 feet, the low system provides all radar altitude information. It should also be noted that if any reconnaissance equipment is operated with BARO mode selected, above 3000 feet, barometric altitude input is recorded on the data matrices in both the radar and barometric blocks, and barometric altitude controls camera IMC, the viewfinder, etc. Below approximately 500 feet, all radar altitude information is supplied by the low system, and the high system ceases to transmit.

Note

Should a malfunction occur in the low system so that noise lock-on occurs (accompanied by indication running to zero with RADAR mode selected), the high system is prevented from controlling data converter input and erroneous information is present, regardless of ALTITUDE mode knob position. Refer to RECONNAISSANCE SYSTEMS, in Section VIII, Part 7.

ALTITUDE (FEET ABOVE TERRAIN)	ALTITUDE MODE KNOB	SYSTEM IN OPERATION	PILOT'S INDICATION	RAN'S INDICATION	RECON CONTROL/ MATRIX RAD ALT
0—500	RADAR	Low	Low	Low	Low
	BARO	Low	Low	Baro	Low
500—3000	RADAR	High and low	Low	High	High
	BARO	Low	Low	Baro	Low
Above 3000	RADAR	High	—	High	High
	BARO (1)	—	—	Baro	Baro

(1) If the pilot depresses the override button and the low system locks on to noise, erroneous altitude input will control reconnaissance systems

RADAR ALTIMETER ACCURACY

ALTITUDE	ERROR
High setting — 500 to 75,000 feet	±(22 feet plus 0.025 percent of altitude)
Low setting — 25 to 3000 feet	±(2 feet plus 2.5 percent of altitude)
Below 25 feet	−2 feet or (+2 to +7 feet)
Read-out accuracy	
Low — 0 to 100 feet	±2 feet
100 to 200 feet	±3 feet
200 to 600 feet	±5 feet
600 to 1000 feet	±10 feet
1000 to 2000 feet	±20 feet
2000 to 3000 feet	±40 feet

Note

The RAN's indicator follows the pilot's indicator by ±50 feet.

RADAR ALTIMETER PROCEDURES

1. Prior to application of electrical power, move ALTITUDE mode knob to BARO.
   Check indication with known field elevation and correct indication through use of the ALTITUDE SET switch.
2. After take-off, move ALTITUDE mode knob to RADAR CAL.
   Indicator should indicate 99988 to 00022 feet.
3. Select RADAR or BARO as desired.

*Aircraft not having AFC 159 complied with

4. Before landing and above 500 feet, BARO CAL the altimeter while in a level attitude.

Note

The radar altimeter is activated as long as primary ac electrical power is available. For information and procedures for radar altimeter operation with specific reconnaissance systems, refer to SLR OPERATION and PECM OPERATION, in Section IIII.

BAROMETRIC CALIBRATION (BARO CAL) PROCEDURE

To calibrate the radar/barometric altimeter and air data computer prior to cursor correction or over a preset checkpoint, proceed as follows:

1. ALTITUDE mode knob—RADAR.
   Check for stable and logical reading.
2. ALTITUDE mode knob—over checkpoint, hold in BARO CAL until the radar/barometric altimeter stabilizes.
   Target elevation displayed on the target altitude indicator will be added to radar altitude.
3. Release ALTITUDE mode knob to BARO, or select RADAR, as desired.

Note

Repetition of the BARO CAL procedure is required after each change of SPC mode* (OFF or ON) and after each change in aircraft altitude and speed.

ADDITIONAL CHECKPOINT

To perform a barometric calibration over a checkpoint other than one preset, proceed as follows:

1. SYSTEM MODE knob—TARGET SET.
2. COORD SELECT knob—ALT.
3. Using the cursor control handle, slew known elevation into the target altitude indicator.
4. When over checkpoint, follow normal BARO CAL procedure.
5. COORD SELECT knob—NORMAL.
6. SYSTEM MODE knob—NAV (if desired).

BOMB DIRECTING SET, AN/ASB-12

The AN/ASB-12, is composed of an inertial autonavigator, a navigational computer, a bombing computer, tie-in equipment, a general-purpose radar set, and controls and indicators for operation of the entire system. The basic purpose of the system is to provide navigation and aircraft positioning for precision reconnaissance runs. In addition, a closed-circuit television set is provided as a daylight navigation aid. All-environment capability is made possible by the system's ability to provide accurate navigation with unlimited range, position read-outs in latitude and longitude, ground-mapping radar operation, and a steering signal presented on the pilot's all-altitude indicator (AAI) and available to the lateral axis of the AFCS. AN/ASB-12 capabilities include:

- Multiple target or destination capability through preset or in-flight set-in of any five positions.
- All-environment position monitoring, using general-purpose radar equipment.
- Highly accurate visual identification and navigation through a closed-circuit television sight.
- Digital and analog information required for operation of reconnaissance systems.

AUTONAVIGATOR (A/N)

The inertial autonavigator subsystem consists of a gyro-stabilized platform on which are mounted two velocity meters. Part of this subsystem is a digital, navigation computer—VERDAN (VERsatile Digital ANalyzer). The autonavigator provides the main present position, ground velocity, and aircraft attitude signal sources for navigation and control of the remaining components of the AN/ASB-12. The gimbaled three-axis, gyro-stabilized platform provides a mounting for acceleration-sensitive velocity meters which cannot differentiate between gravity and aircraft acceleration. The meters are mounted on the platform with their sensitive axis mutually perpendicular and perpendicular to the local gravity vector, thus eliminating any effect of gravity and send the resulting incremental velocity signals to VERDAN (a digital computer with a general-purpose computing section and a differential analyzer which share a common, rotary, magnetic memory disk). VERDAN integrates the incremental velocity signals to record velocity and distance traveled. Using these signals, VERDAN continuously calculates aircraft position with respect to the earth local level plane, and can calculate range and bearing to selected checkpoint or target. The platform is maintained perpendicular to the local gravity vector with the aid of six gyros. The platform azimuth orientation with respect to true north (wander or Alpha angle) is continuously calculated by VERDAN and applied to all its outputs. The gyros are continually torqued to correct for earth rotation and changing aircraft position. To obtain proper autonavigator operation, the platform is alined parallel to the local level and its orientation toward true north is determined prior to flight. Refer to AUTONAVIGATOR PLATFORM ALINEMENT in this section. Once power is applied to the

*Aircraft not having AFC 159 complied with

autonavigator during alinement and operation, visual readouts are provided for alinement progression and present position, target position, bearing and distance to selected targets. Drive signals are also provided the bombing computer for positioning of the radar, television, and reconnaissance subsystems. In addition, VERDAN computes a great circle steering signal which is sent to the bombing computer for signal conditioning to the AAI and AFCS.

SUPPORTING SYSTEMS

AIR DATA COMPUTER, A/A24G-4

The air data computer (figure 1-35) is an analog device which receives static and pitot pressures from the pitot-static boom, indicated angle of attack from the angle-of-attack probe (right forward fuselage), and total temperature from a probe mounted in the right intake duct. An electrical output of altitude is provided to the inlet duct control, flight control systems, and AN/ASB-12, and is displayed on the RAN's radar/barometric altimeter. An electrical output of Mach number (ratio of static and pitot pressures) is provided to special reconnaissance systems, inlet duct control, and the flight control systems. True airspeed is computed from Mach number and total temperature and provided to the bomb computer and the MFRS, and displayed on the RAN's true airspeed/ground speed indicator. Vertical velocity is computed from TAS and true angle of attack and is provided to the bombing computer. True airspeed output from the air data computer is used in the bombing computer to generate wind speed and direction.

Note

Erroneous wind indications may be caused by an air data computer malfunction.

MASTER FLIGHT REFERENCE SET, AN/ASN-26 (MFRS)

In OPERATE mode, the master flight reference set (MFRS) supplies heading information used by the wind indicator for wind computations. When STBY-NAV mode is selected, MFRS supplies gyro stabilization of the AN/ASB-12 radar antenna, provides attitude information and an angle of transformation reference for the bombing computer. In addition, during stand-by navigation operations, heading and attitude from the MFRS, TAS from the ADC, and manually inserted winds from the wind speed and direction indicator are combined in the bombing computer to provide VERDAN with a velocity vector or ground speed information necessary for continued operations.

Note

When operating the AN/ASB-12, in the STBY-NAV mode in areas of magnetic variation, the compass system should be set to the DG mode and the ARI/HSI (azimuth range indicator/horizontal situation indicator) compass card slewed to read aircraft true heading. If both ADI and HSI are lost (indicating MFRS failure) select COMP mode for HSI/ARI emergency compass operation.

RADAR ALTIMETER

The BARO CAL mode of the radar altimeter is used to calibrate and correct the position of the altitude servos in the air data computer. By maintaining these servos accurately corrected, with respect to target elevation and aircraft radar altitude, increased accuracy in radar cursor generation and platform transport rate signals is ensured. In addition, this ensures accurate BARO (MSL) altitude data is supplied to the AYA-1 data converter. Refer to RADAR ALTIMETER, AN/APN-120, in this section.

BOMBING COMPUTER

The bombing computer is an analog computer with a primary purpose of generating a steering signal to the AAI and AFCS by using the VERDAN velocity vectors, aircraft attitude information provided by the autonavigator gyros, and range-to-target vectors provided by VERDAN. The air data computer provides barometric altitude (MSL), angle of attack, and true airspeed. The bombing computer, by vectorally combining ground velocity signals from VERDAN, TAS from the ADC, and heading information from the MFRS produces wind speed and direction signals and displays them on the wind speed and direction indicator (WSDI) with the A/N MODE knob in OPERATE. When STBY-NAV is selected, the bombing computer combines TAS from the ADC and manual wind inputs and supplies VERDAN a resultant ground speed signal. The bombing computer also performs the following functions:

- Generates radar and television control signals, enabling the RAN to readily locate targets and checkpoints.
- Generates and places radar cursors (azimuth and range) on the radar display and generates drive signals for automatic aiming and tracking of the television sight.

Displays

The bombing computer generates display signals for operation of the RAN's azimuth and range indicator, (ARI), wind speed and direction indicator (WSDI), the ground speed portion of the true airspeed/ground speed indicator, the pilot's horizontal situation indicator (HSI) for NAV readouts, and the lateral steering bar of the pilot's all-attitude indicator (AAI).

Bombing Computer Fuses

The bombing computer fuses (F1, F2, F3, and F4) located on the face of the bombing computer section of the RAN's cockpit below the RAN's center console, control the three phases of a-c power (phase A—F1, phase B—F2, and phase C—F3) to the bombing computer and its subsystems. The F4 fuse is the main source of 28-volt d-c power. These fuses are the "glow when blow" type. Loss of one a-c fuse results in a negligible loss of system accuracy. Loss of two or more a-c fuses or loss of the 28-volt d-c fuse results in loss of all computer functions and cooling air flow.

TIE-IN EQUIPMENT

The AN/ASB-12 tie-in equipment provides integration and control of the autonavigator and bombing computer, automatic or manual insertion of data for autonavigator alinement and operation and provides read-outs and indications associated with all modes of system operation. Various converters are incorporated to convert digital-to-analog information (and vice versa). The cursor control assembly and the position destination indicator (PDI) are also a part of the tie-in equipment. See figures 1-36 and 1-37.

AN/ASB-12 CONTROLS AND INDICATORS

B/N ALINE POWER SWITCH (EXTERNAL)

The B/N ALINE power switch is located in the external electrical power and cooling air access on the left fuselage. This switch is positioned to EXT (external power) during preflight preheat and/or alinement of the autonavigator. After engine start (with generators operating), the B/N ALINE power switch should be moved to GEN (generator power) before external electrical power is removed. This ensures a smooth transition from external to aircraft power with minimum power interruption. Normally, this is performed by the ground crew.

Note

Failure to switch over properly or removal of external power without generators operating results in loss of autonavigator alinement.

AUTONAVIGATOR PREHEAT SWITCH

The autonavigator PREHEAT switch is installed on the inertial platform equipment rack under the radar access door. When moved to PREHEAT position, the autonavigator may be preheated with external electrical power (left access receptacle) without using cooling air, and without energizing other aircraft systems.

Note

AN/ASB-12 power cannot be initiated until PREHEAT switch is OFF.

B/N WARM UP LIGHT

The B/N WARM UP light (figure FO-17) illuminates until the platform attains operating temperature.

Note

The B/N WARM UP light circuit operates on external electrical power only (during preheat or alinement); however, press-to-test circuit operates on aircraft or external power.

CURSOR CONTROL ASSEMBLY

The cursor control assembly consists of the cursor control, the alinement and power control panel, and the navigation control panel.

ALINEMENT AND POWER CONTROL PANEL

Handset Automatic Switch

The HANDSET/AUTOMATIC switch (figure FO-17) is used to select AUTOMATIC (carrier computation center) or HANDSET (manual) data during autonavigator deck alinement. In HANDSET, carrier velocity and heading are set manually. For automatic alinement, carrier velocity and carrier heading are automatically provided through the umbilical cable from ship's SINS.

Note

The autonavigator cannot be started with the HANDSET/AUTOMATIC switch in AUTOMATIC unless the external alinement SINS umbilical cable is connected.

Aline Hold Switch

The hold/alinement function of the ALINE/HOLD switch (figure FO-17) is not used and shall be maintained in the OFF position.

Autonavigator Power Switch

The AN POWER switch (figure FO-17), a three-position switch (OFF, STBY, and ON), controls the main power supply to the inertial autonavigator, VERDAN, tie-in equipment, and associated indicators. Power distribution is the same with STBY or ON selected, except that in

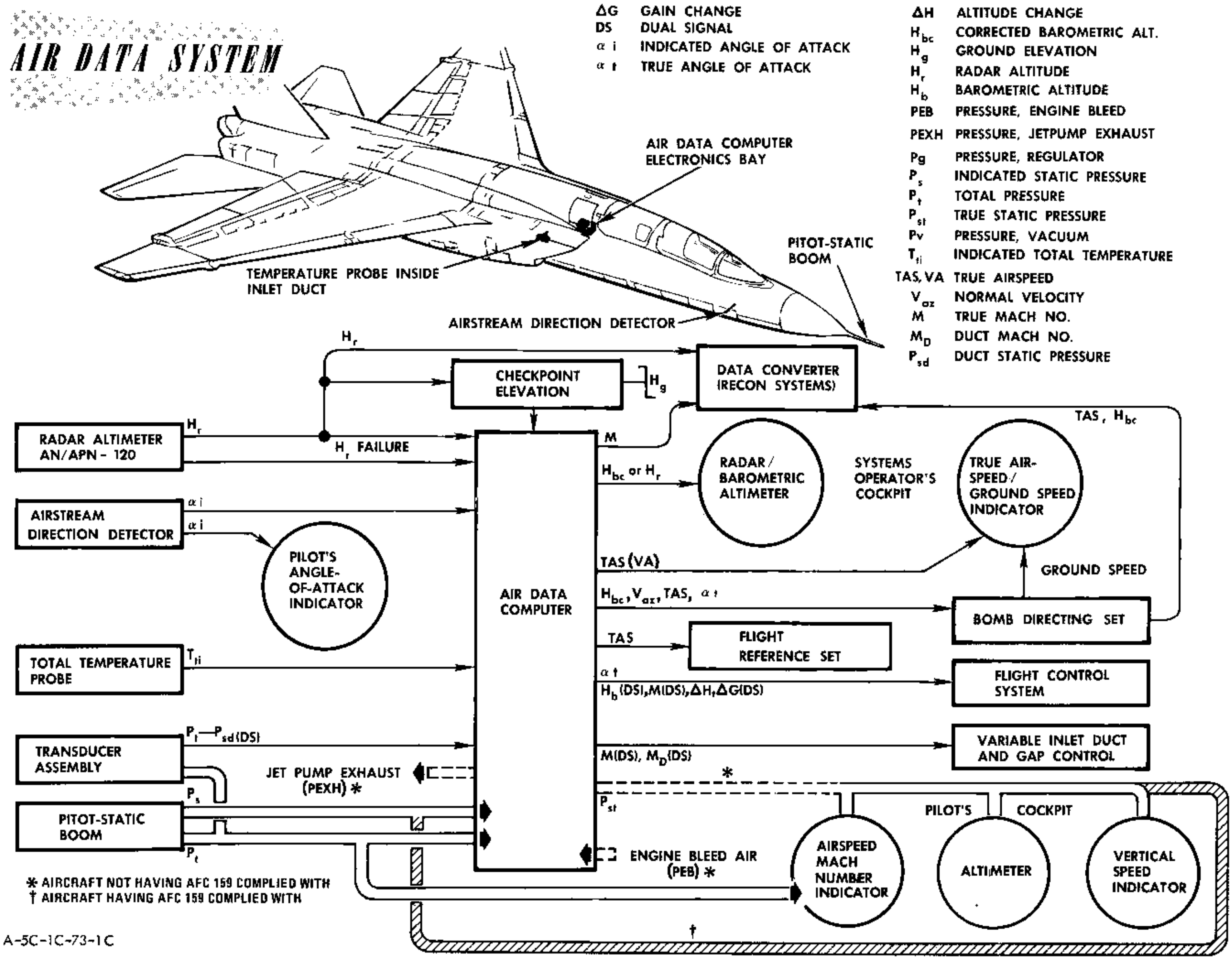


Figure 1-35 (Sheet 1)

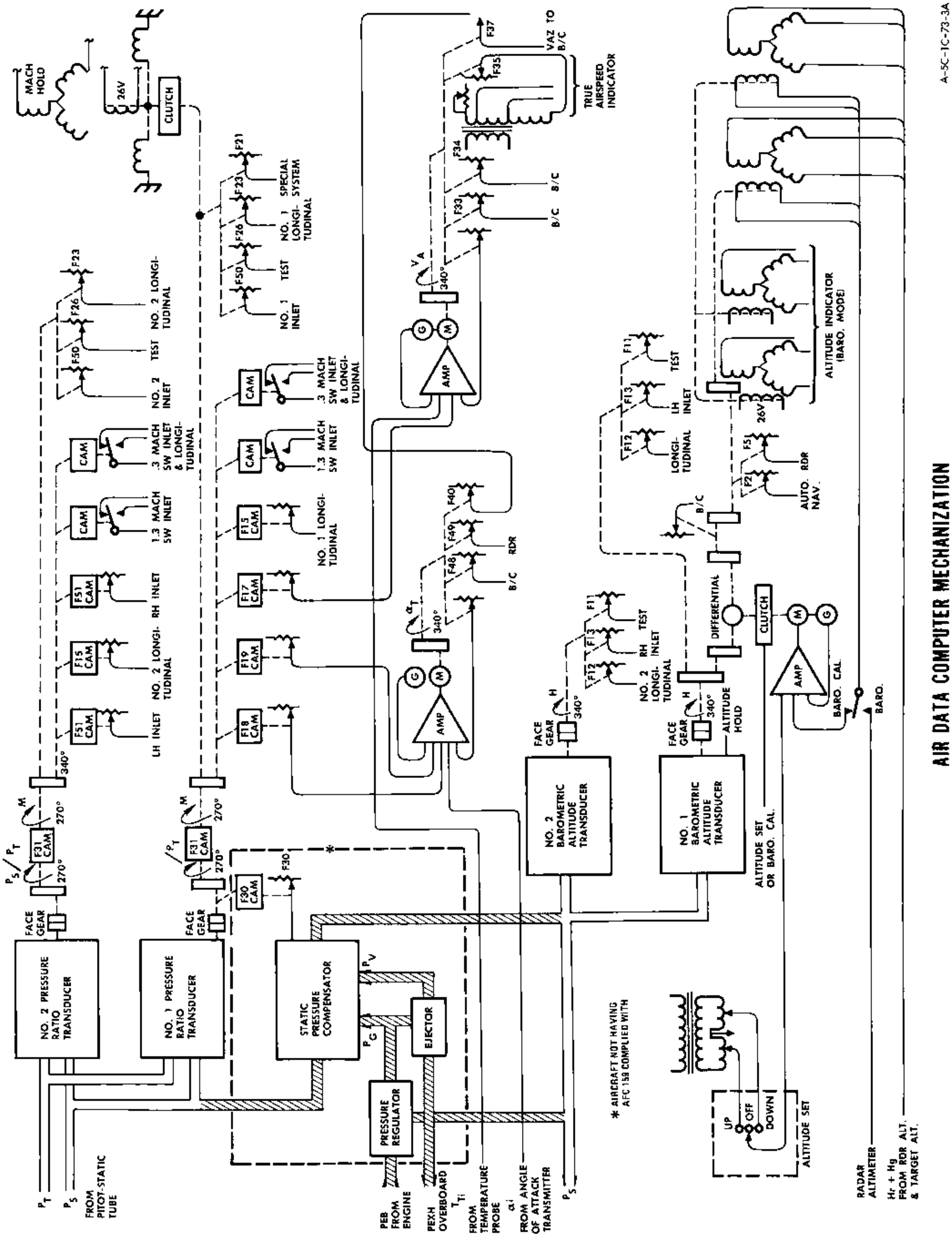


Figure 1-35 (Sheet 2)

STBY, power is not applied to the inertial platform. With external electrical power and cooling air connected prior to flight, the autonavigator, VERDAN, and tie-in equipment may be energized by placing this switch to ON.

Bomb Computer Power Switch

The BOMB COMPUTER POWER switch (figure FO-17), a two-position switch (OFF, ON), controls power to the bombing computer and its associated display indicators. When this switch is OFF, bombing computer operation, all steering signals, all AN/ASB-12 mode indications of the pilot's HSI, RAN's ARI, and RAN's TACAN DME are lost.

Radar/TV Power Switch

The RADAR/TV POWER switch (figure FO-17), a three-position switch (OFF, STBY, and ON) controls power distribution to the radar and TV subsystems. Refer to RADAR AND TELEVISION CONTROLS AND INDICATORS, in this section.

Carrier Data Controls

The carrier heading indicator and slew knob (figure FO-17) provide carrier heading input for use during handset alinement. Two speeds of slewing, coarse and fine, are available. After 1 minute of operation (at the end of each cage cycle), the carrier heading indicator is corrected automatically if the carrier turns during handset carrier alinements. For on-shore alinement, aircraft true heading shall be slewed into the carrier heading indicator. The carrier velocity indicator and slew knob (figure FO-17) are used during autonavigator handset alinement. Two speeds of slewing, coarse and fine, are available. Carrier velocity may be manually set to a maximum of 50.0 knots. The differential heading indicator and slew knob (figure FO-17) are used to set in the aircraft heading relative to the carrier's heading. If the aircraft is headed directly to starboard, the differential heading is 90 degrees (when headed to port, the differential heading is 270 degrees). Two slew speeds, coarse and fine, are available. For on-shore alinements, differential heading and carrier velocity should read zero degrees.

Note

For handset alinements, carrier velocity, carrier heading, and differential heading must be slewed in. During automatic alinement, carrier velocity, and carrier heading are supplied by ship's SINS, but differential heading must be inserted manually.

NAVIGATION CONTROL PANEL

The navigation control panel (figure FO-17) provides controls and displays of various operating modes for the autonavigator and the bombing computer, indications of system operations, and the capability of entering offset and manual wind information to the bombing computer.

Autonavigator Mode Knob

The A/N MODE knob (figure FO-17) is used to control the alinement and operation of the inertial autonavigator. The knob positions are used as follows:

DECK ALINE — Selected to initiate cage cycle and inertial alinement.

Note

Switching from OPERATE to DECK ALINE initiates a new alinement but bypasses the cage cycle.

MASTER — Not used.

OPERATE — This position is selected after autonavigator alinement is complete in the DECK ALINE mode as indicated by the ADVANCE MODE light. When selected, the system is released for navigation operation.

AIR ALINE — Not used.

STBY-NAV — The STBY-NAV (stand-by navigation) position is used in the event of failure of the inertial platform. In STBY-NAV, the bombing computer and radar receive roll, pitch, and heading signals from the MFRS gyro platform and the equivalent signals from the autonavigator platform are cut off. Intertial autonavigator power is retained and platform alinement is maintained during STBY-NAV operation. Should STBY-NAV procedures prove totally ineffective, the A/N MODE knob can be returned to OPERATE as desired, although performance may be degraded.

Note

In the event of VERDAN failure, the AN POWER switch should be moved to OFF.

Advance Mode Light (AML)

The ADVANCE MODE light (figure FO-17) indicates VERDAN readiness prior to alinement, proper alinement sequencing, and VERDAN malfunctions during alinement or either mode of operation (OPERATE or STBY-NAV). On completion of the 30-minute alinement program, the light will begin a 1.28-second on and off cycle; however, the fine aline averaging phase will continue. This cycling will continue until the A/N MODE

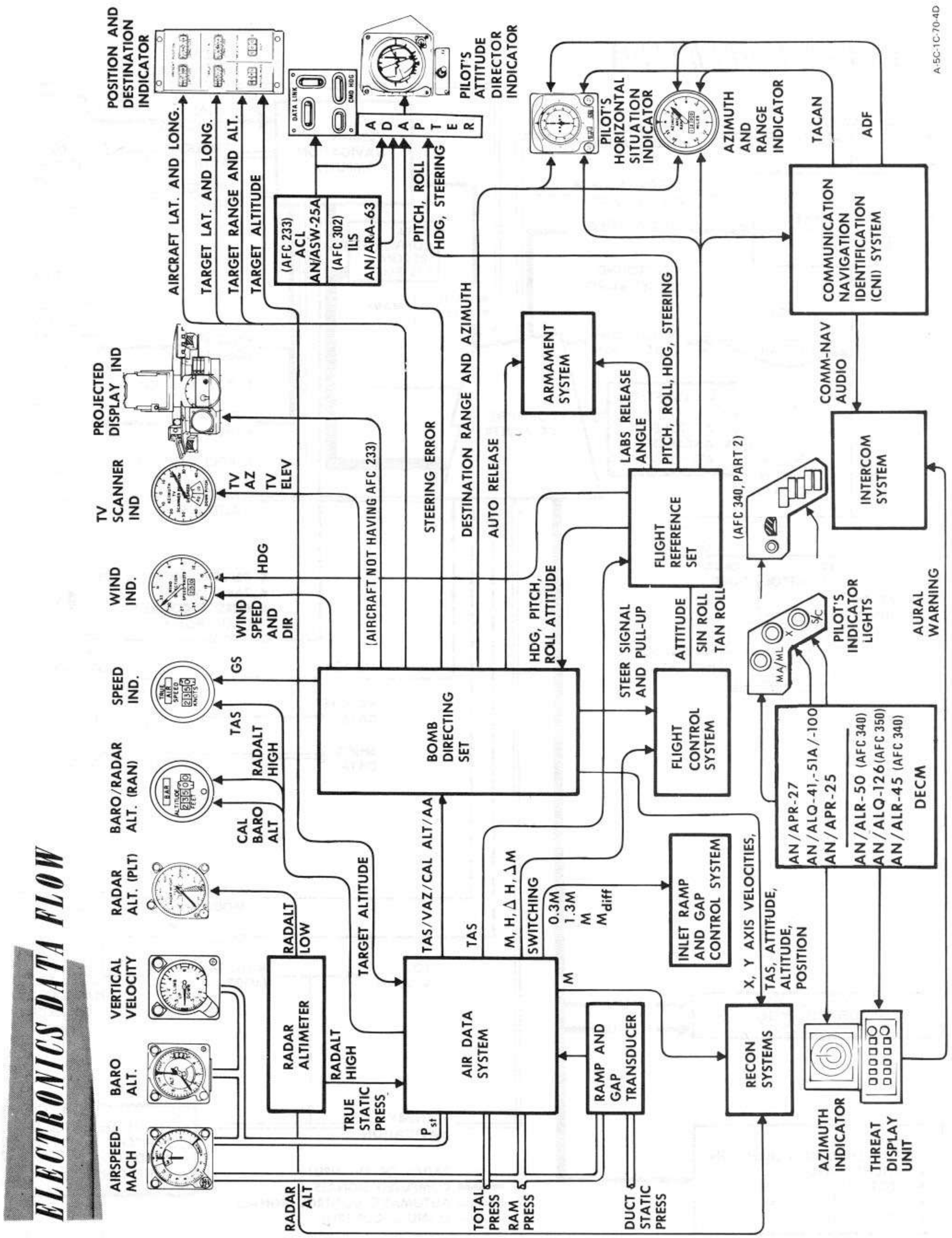

ELECTRONICS DATA FLOW
A-5C-1C-70-4D
POSITION AND DESTINATION INDICATOR
PILOT'S ATTITUDE DIRECTOR INDICATOR
DATA LINK
CMD HDG
ADAPTER
PILOT'S HORIZONTAL SITUATION INDICATOR
AZIMUTH AND RANGE INDICATOR
TACAN
ADF
AIRCRAFT LAT. AND LONG.
TARGET LAT. AND LONG.
TARGET RANGE AND ALT.
TARGET ALTITUDE
(AFC 233) ACL AN/ASW-25A
(AFC 302) ILS AN/ARA-63
PITCH, ROLL
HDG, STEERING
COMMUNICATION NAVIGATION IDENTIFICATION (CNI) SYSTEM
PROJECTED DISPLAY IND
TV SCANNER IND
TV AZ
TV ELEV
(AIRCRAFT NOT HAVING AFC 233)
STEERING ERROR
DESTINATION RANGE AND AZIMUTH
AUTO RELEASE
ARMAMENT SYSTEM
LABS RELEASE ANGLE
PITCH, ROLL, HDG, STEERING
COMM-NAV AUDIO
INTERCOM SYSTEM
(AFC 340, PART 2)
FLIGHT REFERENCE SET
WIND IND.
HDG
WIND SPEED AND DIR
SPEED IND.
GS
TAS
BARO/RADAR ALT. (RAN)
RADALT HIGH
CAL BARO ALT
RADAR ALT. (PLT)
RADALT LOW
VERTICAL VELOCITY
BARO ALT.
AIRSPEED-MACH
RADAR ALTIMETER
RADALT HIGH
TRUE STATIC PRESS.
P_{st}
TARGET ALTITUDE
BOMB DIRECTING SET
HDG, PITCH, ROLL ATTITUDE
STEER SIGNAL AND PULL-UP
ATTITUDE
SIN ROLL
TAN ROLL
FLIGHT CONTROL SYSTEM
PILOT'S INDICATOR LIGHTS
MA/ML
X
S/C
AURAL WARNING
TAS/VAZ/CAL ALT/AA
TAS
M, H, Δ H, ΔM
SWITCHING
0.3M
1.3M
M
M_{diff}
INLET RAMP AND GAP CONTROL SYSTEM
X, Y AXIS VELOCITIES, TAS, ATTITUDE, ALTITUDE, POSITION
AN/APR-27
AN/ALQ-41,-51A/-100
AN/APR-25
AN/ALR-50 (AFC 340)
AN/ALQ-126 (AFC 350)
AN/ALR-45 (AFC 340)
DECM
AIR DATA SYSTEM
M
RAMP AND GAP TRANSDUCER
RECON SYSTEMS
AZIMUTH INDICATOR
THREAT DISPLAY UNIT
RADAR ALT
TOTAL PRESS
RAM PRESS
DUCT STATIC PRESS

Figure 1-36

AN/ASB-12 OPERATION

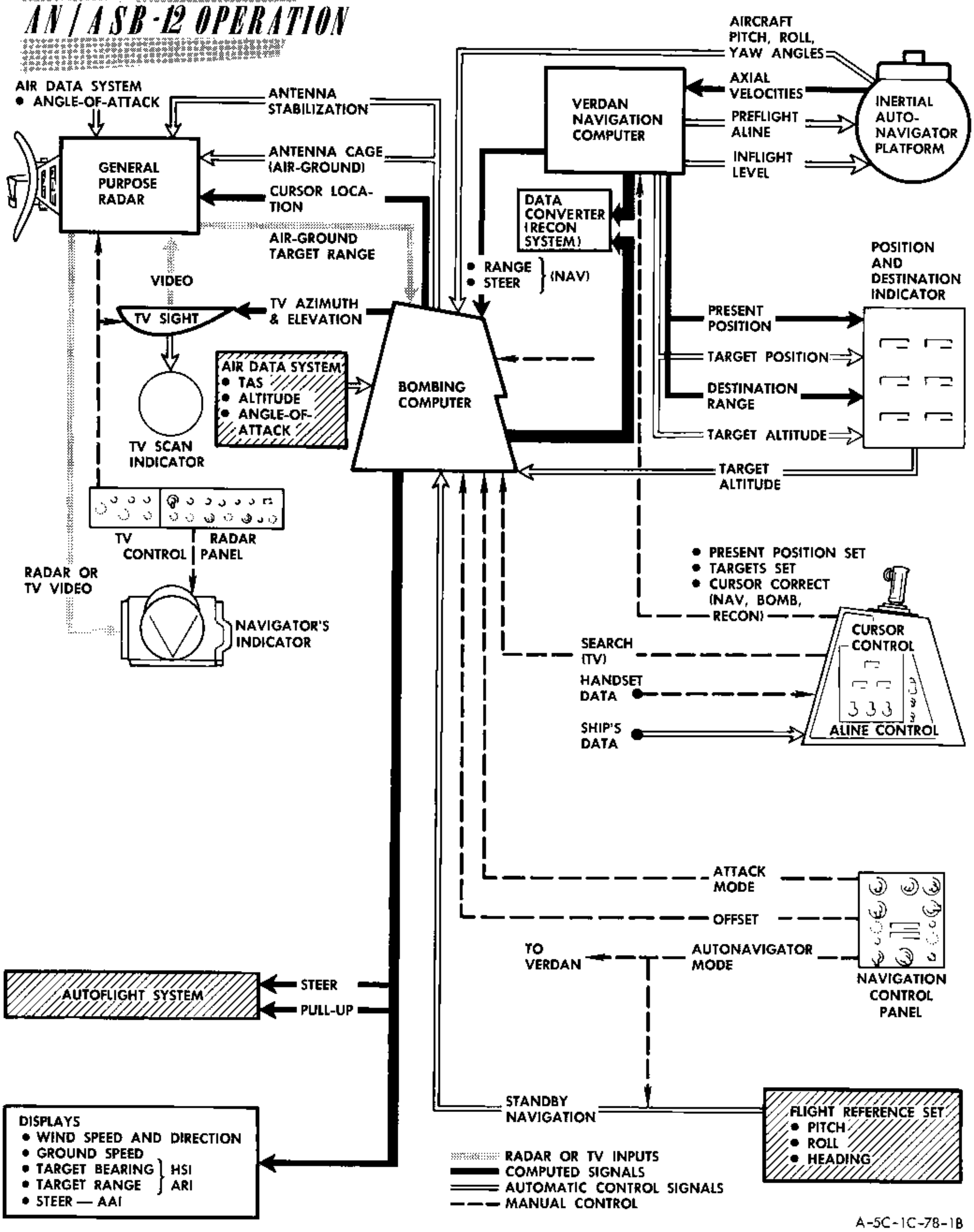


Figure 1-37

knob is moved to OPERATE, which turns the ADVANCE MODE light out. Refer to AUTONAVIGATOR PLATFORM ALINEMENT, in this section. The OPERATE position may be selected any time after 5 minutes have elapsed, but navigational accuracy will not be of the quality obtained with the full 30-minute alinement. Should the ADVANCE MODE light illuminate during flight, failure of the VERDAN is indicated and alternate navigation procedures must be used. System failures are indicated by the AML in the following table:

A/N MODE	MALFUNCTION	AML INDICATIONS	REQUIRED ACTION
DECK ALINE (AN POWER—ON)	None—VERDAN memory not up to operating speed	On	None—Light should go out in 20 to 40 seconds.
DECK ALINE (sequence)	None—Refer to AUTONAVIGATOR PLATFORM ALINEMENT	On/Off	
DECK ALINE, OPERATE, or STBY-NAV	VERDAN power failure	On	AN POWER—OFF; down system.
DECK ALINE, OPERATE	Precision power failure (400 cycles ac)	On	Down system, or select STBY-NAV and continue.

Note

- **The AML light will illuminate if, during automatic alinement with DECK ALINE selected, SINS umbilical cable is removed. Upon selecting OPERATE, light will go out.**
- **If PP is not tracking, select STBY-NAV and if light goes out, remain in STBY-NAV. If light remains on more than 5 minutes, turn AN POWER OFF 5 minutes, then ON. If out in 1 minute, continue in STBY-NAV.**
- **If not storing coordinates, turn AN POWER OFF for 5 minutes then ON. If still not storing, turn AN POWER OFF.**
- **If no PP tracking, slewing, or storing, turn AN POWER OFF for 5 minutes, then ON. If light stays on more than 5 minutes, turn AN POWER OFF.**

Overtemperature Light

The amber OVERTEMP RESET light (figure FO-17) illuminates to indicate an overtemperature condition of the autonavigator or the VERDAN. Any overtemperature condition (OVERTEMP RESET light ON) within the autonavigator results in cutoff of electrical power to the stabilized platform, resulting in loss of inertial platform, maximum wind velocity, high ground speed, and maximum PP drift. Overtemperature of the VERDAN is usually initially indicated by "frozen" indications of present position and ARI reading. Once turned ON, the OVERTEMP RESET light remains on until operating temperative within the affected unit is reduced to within limits and the light is subsequently depressed to unlatch the circuit.

System Mode Knob

The SYSTEM MODE knob (figure FO-17) is a six-position, multipurpose selector, used to control AN/ASB-12 operating mode and for setting in data during preflight alinement. The knob positions operate the system as follows (except when C/L NAV is selected):

NAV — The NAV mode provides great-circle steering (in OPERATE or STBY-NAV mode) to any of five targets or checkpoints as selected by the NAV/BOMB knob. The NAV steering signal is presented to the pilot through the AAI and is available to the lateral axis of the automatic flight control system

(AFCS). The NAV steering signal is unlimited in range, although the ARI/HSI range and bearing indications are limited to 186 nautical miles with the RANGE & BEARING knob set at NAV. As distance to target or checkpoint passes 20 nautical miles, the steering signal is modified as follows:

- Maintaining the steering bar centered results in passing directly over the selected NAV/BOMB target if present position was corrected prior to reaching the 20-mile radius, and if wind remains constant.
- If steering indications are not maintained centered inside 20 nautical miles, subsequent action taken to center steering indication will result in a flight path parallel to the great-circle route existing at the 20-mile point.
- If the operator performs a radar cursor or TV reticle position correction inside 20 miles from target, present position, destination range, and bearing indications are updated, but the pilot's (or AFCS) steering signal does not change.
- Selection of a new destination (NAV/BOMB knob) which is within a 20-nautical-mile radius may result in an erroneous steering signal. The pilot's HSI and the RAN's ARI are correct, however, if the SET/CORR knob is moved to the same position.
- If a new destination (NAV/BOMB knob) is not selected at target passage, steering reverses, presenting outbound display to 20 nautical miles, at which point the signal reverses. Steering will return to selected destination and, if the AFCS is operating in NAV, the aircraft returns to destination via the shortest route.

BOMB — The BOMB mode (under 46.5 nautical miles) provides wind-corrected (Rhumb-line) steering in OPERATE or STBY-NAV mode, to any of five targets selected by the NAV/BOMB knob. With BOMB selected, the ATTACK MODE knob is placed in ALL WEATHER LEVEL, LOFT, or O/S. The bomb steering signal is presented to the pilot through the AAI and is available to the lateral axis of the AFCS. The pilot recognizes BOMB mode (as opposed to NAV mode) by illumination of the TGT indicator light on the HSI. The BOMB mode steering signal is to the release or pull-up point. If BOMB mode is selected at ranges greater than 46.5 miles, a great-circle steering signal to the target is provided as in NAV mode.

Note

Cursor corrections are available only if NAV or BOMB mode is selected. When the SYSTEM MODE knob is in any position but BOMB mode, a NAV mode steering signal is provided to the selected NAV/BOMB channel.

TARGET SET — Selected for setting target latitude/longitude coordinates and altitude into VERDAN. When selected in flight, NAV or course line navigation mode steering signal to the NAV/BOMB selected target continues normally.

PP SET — Selected for setting present position (PP) coordinates into VERDAN. If selected in flight, a NAV or course line navigation mode steering signal to the NAV/BOMB selected target continues normally.

RECON — Selected to determine the coordinates of any target located by the radar or TV ("targets of opportunity"). When RECON is selected, the target position readouts on the PDI change to approximately the aircraft's present position. (Actually, the radar cross hairs and TV aiming track a point directly in front of the aircraft by a range equivalent to 1/30 of ground speed.) From that point on, and directly related to the accuracy of the system's present position, target position readouts reflect the position coordinates of the radar cursors or TV reticles which are changed with any movement of the cursor control handles. Radar cursor and TV reticle placement is reflected by the ARI/HSI also. With RECON selected a NAV or course line navigation mode steering signal continues normally. RECON target coordinates may be stored for future use by placing the SET/CORR knob to a usable position and depressing the COORD. STORAGE button. Since latitude and longitude are stored simultaneously in RECON, the COORD SELECT knob must be in NORMAL. In RECON, the altitude in the selected SET/CORR channel remains unchanged, and the action button on the cursor handle need not be used.

Note

The rate of slew in RECON is double that in NAV or BOMB mode, TARGET SET, or PP SET.

SEARCH — Enables the RAN to position the TV optics unit manually with the cursor control handle, without interrupting operation of the bombing or navigation computers or disrupting navigational displays. The TV sight is directed to zero degrees azimuth and approximately 30 degrees depression when SEARCH is selected (cursor control handle neutral). The action button on the cursor handle need not be used for SEARCH operation. The TV scanner head returns to the neutral position when the cursor handle is released.

Attack Mode Knob

The ATTACK MODE knob (figure FO-17) is used to select bombing computer operation for visual or all-weather modes of attack. This nine-position selector has five visual position: DIVE, DIVE TOSS, LEVEL, ROCKETS, and GUNS; and four all-weather position: LEVEL, LOFT, O/S, and DIVE TOSS.

Note

With NAV mode selected and ATTACK MODE knob in ALL WEATHER LEVEL, steering is to the target. With BOMB mode selected (under 46.5 nautical miles from target) and ATTACK MODE knob in ALL WEATHER O/S, steering is directly to the target.

Set/Correct Knob

The set/correct (SET/CORR) knob (figure FO-17) is used to select one of the five channels for storage of target coordinates or for utilization of previously stored coordinates for navigational computations. Within 186 nautical miles of the selected target, with NAV mode selected, the bombing computer places the radar azimuth and range cursors and TV reticle at this location. If the radar cursors and TV reticle are not positioned on the selected target, an error in the navigation system's present position computation is indicated. With the system mode knob in NAV or BOMB, repositioning the cursors on the target updates the system's present position, thus eliminating the error. In the NAV mode, with NAV selected on the RANGE & BEARING knob, distance and bearing to a selected target within 186 nautical miles are displayed on the ARI/HSI. If the distance to the target is greater than 186 nautical miles, the ARI/HSI needles are locked dead ahead and a flag drops over the distance counters.

Note

The SET/CORR knob has no function in the BOMB mode.

Nav/Bomb Knob

The NAV/BOMB knob (figure FO-17) is used to select any of the five targets to which steering, NAV or BOMB mode, is to be directed. Steering signals are provided for either manual or autoflight control, displayed on the pilot's AAI, and available to AFCS. With BOMB mode selected, SET/CORR is disengaged, and ARI/HSI information and radar cursor and TV reticle placement are determined by the selected NAV/BOMB channel coordinates.

Coordinates Select Knob

The COORD SELECT knob (figure FO-17) is used to select the position destination indicator (PDI) counter (latitude, longitude, or target altitude) to be slewed by the cursor control handle during present position or target position set-in procedure. In RECON, coordinate storage is done with this knob in NORMAL.

Coordinates Storage Button

With the SYSTEM MODE knob in PP SET, TGT SET, or RECON, momentarily depressing the COORD-STORAGE button (figure FO-17) erases the previously recorded coordinates in VERDAN and records the new coordinates as selected. When selecting RECON, the COORD. SELECT knob should be in NORMAL to accurately store latitude and longitude positions simultaneously.

Wind Select Knob

The WIND select knob (figure FO-17) is a three-position knob (AUTO, SPEED, and DIR). With the A/N MODE knob in OPERATE, the WIND select knob should be in the AUTO position to allow the bombing computer to automatically display the computed magnetic winds on the WSDI. Selecting either speed or direction freezes the WSDI at the last computed figures. When the A/N MODE knob is placed in STBY-NAV, the same result occurs, but the WIND select knob is used in conjunction with the WIND SET switch for manually inserting winds to be fed to the bombing computer and displayed on the WSDI.

Wind Set Switch

The WIND SET switch (figure FO-17) is a three-position switch [DEC (decrease), INC (increase), and neutral] spring loaded to the neutral position. Used in conjunction with the WIND SELECT knob, the WIND SET switch will slew wind speed and direction data into the bombing computer and onto the WSDI. To set in wind direction, select DIR on the WIND select knob and hold the WIND SET switch to DEC or INC (as applicable) until the desired direction is read on the WSDI. Direction is unlimited through 360 degrees. To set in wind speed, select SPEED on the WIND select knob and follow the same procedure. Wind speed ranges from 0 to 249 knots.

Note

Wind direction in STBY-NAV mode is referenced to true north.

Offset Knobs and Indicators

The offset knobs (figure FO-17) are used to set the desired offsets into the offset indicators (figure FO-17). Offsets are used for two purposes. In DECK ALINE (onboard ship), offsets display aircraft position in relation to the ship's SINS platform and are measured in relative cardinal directions from SINS to aircraft (N being forward of SINS, E being starboard of SINS) and in feet (up to 499 feet in each direction). In OPERATE or STBY-NAV, offsets enable the RAN to use a remote aimpoint for navigating to target which does not provide satisfactory radar-TV return. Offsets are in cardinal directions from the NAV/BOMB target to the aimpoint, measured in 0.01-nautical-mile increments, up to 4.99 nautical miles in each cardinal direction, and are effective only in BOMB mode. Procedures for offset navigation are as follows:

1. Store the actual target coordinates at the desired NAV/BOMB channel.
2. Set offset components from target to aimpoint.
3. With offsets slewed in, selection of BOMB mode displaces the radar cursors (or TV reticles) by the amount of offset inserted.
4. With cursor control handle, keep cursors on aimpoint to update the system and to get correct steering to target.

Note

- Offsets have no effect during HANDSET alinement.
- Offsets have no effect in NAV mode.

COURSE LINE NAVIGATION SWITCH

The COURSE LINE NAVIGATION switch (figure FO-17) is a two-position switch (C/L NAV and NORMAL), on the RAN's right console, through which the RAN may select a modified NAV mode steering signal. With the switch in C/L NAV, a course line NAV steering signal is presented to the pilot on the AAI and available to the AFCS. Course line navigation aids in maintaining the aircraft on, or returning the aircraft to, a great-circle course between successive checkpoints. C/L NAV steering differs from normal NAV steering in that (1) if the aircraft is off selected course, C/L NAV will direct the aircraft to return to the original great-circle route, while (2) NAV steering directs the aircraft on a new great-circle route from its present position directly to checkpoint.

- The C/L NAV steering signal is limited to prevent large angles of bank when the aircraft is within 1000 feet of the course line, and to prevent a spiraling approach to the course line when the aircraft is more than 14,000 feet off course. Due to these limiting factors, the AAI steering pointer may be centered when the aircraft is not on the course line but is being flown toward the course line. In NAV steering, the AAI pointer is centered when the ground velocity vector is pointed at the selected target or checkpoint. In C/L NAV steering, the AAI steering pointer is centered when the ground velocity vector is pointed toward the programmed course line and toward the selected target.

- The computed course will be from present position at the time VERDAN senses that C/L NAV has been selected, to the target as selected by the NAV/BOMB knob. A time delay of up to 3½ seconds may occur on selection; the course computed by VERDAN may differ considerably from the desired course. In order to minimize this error, the pilot should be flying toward the target on a magnetic course close to the magnetic course of the desired course line.

- Present position may be updated by means of cursor correction while in C/L NAV mode. Should the RAN see that computed present position is not correct, he may make a cursor correction. After present position is updated, the aircraft will not be on the desired course. The steering signal will then direct the aircraft to the desired correct course. The position correction may be made using any point within radar or TV range, for which the coordinates are known and stored, using the same technique as for normal NAV mode operation.

- If BOMB mode is selected during C/L NAV operation, BOMB steering will be displayed on the pilot's AAI and will be available to the AFCS.VERDAN will continue computing C/L NAV steering and, on reselection of the NAV mode, original C/L NAV steering is displayed.

Note

The usual NAV mode steering signal lock-up when a cursor correction is made within 20 nautical miles of target does not occur in C/L NAV. However, a pickle update should not be attempted with C/L NAV engaged since erroneous range terms can be introduced.

POSITION DESTINATION INDICATOR

The position destination indicator (PDI) provides the RAN a visual readout from VERDAN of aircraft present position, target position, destination range, and target altitude.

PRESENT POSITION INDICATOR

The PRESENT POSITION indicator (figure FO-17) continuously displays aircraft present position in earth latitude/longitude coordinates in all AN/ASB-12 modes. *Longitude* is digitally indicated from 0 to 180 degrees, and *latitude* is indicated from 0 to 90 degrees. Both *longitude* and *latitude* are shown in increments of 0.1 minute. The PRESENT POSITION indicator may be slewed, with the SYSTEM MODE knob in PP SET, at a maximum rate of 25 degrees of longitude or latitude per minute with the cursor control handle. The last stored present position can be recalled by selecting the system NAV mode, depressing the COORD. STORAGE button, and immediately selecting system mode PP SET.

TARGET POSITION INDICATOR

The TARGET POSITION indicator (figure FO-17) reflects the earth longitude/latitude coordinates of targets set into VERDAN through use of the SET/COOR knob and COORD SELECT knob. When operating in the RECON mode, the radar cursor intersection point is tracked by this indicator. In the BOMB mode, the coordinates of the target selected through the NAV/BOMB knob are indicated. During inertial platform alinement, the target position indicator displays computed platform wander angle. Refer to AUTONAVIGATOR PLATFORM ALINEMENT, in this section.

DESTINATION RANGE INDICATOR

The DESTINATION RANGE indicator (figure FO-17) continuously displays great-circle nautical-mile distance to the checkpoint or target selected through the NAV/BOMB knob. This indicator has a 5000-mile (maximum) numerical read-out; however, range beyond 5000 miles may be interpreted if the nearest 5000-mile increment is known.

Note

When this range is 46.5 nautical miles or less, a BOMB mode steering signal becomes available.

TARGET ALTITUDE INDICATOR

The TARGET ALTITUDE indicator (figure FO-17) reflects height of targets or checkpoints above sea level as set in by placing the COORD SELECT knob in ALT and using the cursor control handle. Target altitude is displayed over a range from 0 to 9999 feet and may be slewed up to a maximum of 6000 feet per minute. In the RECON mode, target altitude is "frozen" at the value for SET/CORR target position last selected. During inertial platform alinement, the TARGET ALTITUDE indicator displays time in alinement after the AN POWER switch is placed to ON. Refer to AUTONAVIGATOR PLATFORM ALINEMENT, in this section.

AZIMUTH AND RANGE INDICATOR (ARI)

With the SYSTEM MODE and RANGE & BEARING knobs in NAV position, the RAN's AZIMUTH AND RANGE indicator (figure FO-17) reads target range and bearing to target selected through the SET/CORR knob. Magnetic bearing is provided by a compass card which moves under a lubber line. When range to selected destination exceeds 186 nautical miles, the bearing pointer is caged at the 12-o'clock position and a red flag covers the range counter. In BOMB mode at ranges greater than 46.5 nautical miles, range and bearing to NAV/BOMB target are displayed. When range decreases to 46.5 miles or less, range to release point and bearing to target are indicated.

HORIZONTAL SITUATION INDICATOR (HSI)

The HSI (figure 1-29) provides magnetic heading and bearing to Navaid or AN/ASB-12 checkpoint or target. In BOMB mode, bearing and range to target or release point is displayed, depending upon range to target and selected attack mode. In NAV mode at more than 186 nautical miles to target, HSI range and bearing are inoperative. For NAV connected functions, the HSI provides the same information as the ARI.

ALL-ATTITUDE INDICATOR (AAI)

The AAI (figure 1-31) provides a lateral steering reference in the NAV and BOMB modes of AN/ASB-12 operation. The steering bar is superimposed over the AAI and is independent of the MFRS. Refer to STEERING SIGNAL DISCUSSIONS (NAV and BOMB), in this section. The pilot may distinguish NAV mode from BOMB mode steering by the absence of the HSI TGT indicator light. Within 20 nautical miles of a selected target or checkpoint, steering display is modified to increase stability, and tracking outbound is available to 20 nautical miles beyond selected checkpoint without reselection.

WIND SPEED AND DIRECTION INDICATOR (WSDI)

During normal AN/ASB-12 operation, with the MFRS supplying magnetic heading, the wind speed and direction indicator (figure FO-17) displays computed wind speed in knots and computed wind direction with reference to magnetic north. The indicator consists of a fixed compass card, a wind direction pointer (figure FO-17), and a digital window (figure FO-17) which displays wind velocity to a maximum of 249 knots. The bombing computer solves for wind by vectorially adding inertial ground speed with true airspeed corrected for aircraft heading and pitch, respectively. Within the indicator, the velocity vectors are corrected for compass heading from the MFRS. When the aircraft is on the ground, wind speed (and true airspeed) will read approximately 125 knots. Proper wind speed readings are obtained in flight when true airspeed exceeds approximately 125 knots. In the event of autonavigator failure and on selection of STBY-NAV, the readings of this indicator freeze and become read-outs of manually inserted inputs to the bombing computer. The accuracy of STBY-NAV depends largely on the accuracy of these inputs. See figure 1-38.

SPEED SELECT SWITCH

The SPEED select switch (figure FO-17) is used to select read-out of true airspeed (TRUE AIR) or ground speed (GROUND) on the TRUE SPEED indicator (figure FO-17). Minimum true airspeed of approximately 125 knots or minimum ground speed of 4 to 10 knots is displayed under static conditions.

CURSOR CONTROL HANDLE

The cursor control handle and action button (figure FO-17) are used to position the radar azimuth and range cursors or the TV reticle to correct the VERDAN for present position error in the NAV and BOMB modes. Additional functions are:

- Setting present position and target positions.
- Directing the TV scanner in the SEARCH mode.
- Directing the radar cursors or TV reticle in the RECON mode.

Radar cursor slewing rate is variable up to the maximum rate. In NAV and BOMB modes, the cursors are positioned at a maximum rate equivalent to 8000 feet per second and in RECON at a maximum of 16,000 feet per second on the surface by moving the cursor handle in the desired direction. Operation of the cursor handle is as follows:

MODE	HANDLE ACTION
PP SET or TARGET SET	**Right to increase; left to decrease**
SEARCH (TV)	**Forward to look down; aft to look up; right/left as desired.**
NAV, BOMB RECON	**Basic movement of the radar cursors or TV reticle in the NAV, BOMB, or RECON mode is mechanized so that the handle must be moved AFT to move the TV down and moved FORWARD to move the TV up. For radar operation, the best action is realized by moving the handle *perpendicular* to the azimuth cursor for left or right slewing, and parallel to the azimuth cursor for range slewing. *True relative motions of the cursor do not result from a given handle action.***

Note

- To set counters in PP SET or TARGET SET, slew at maximum rate by depressing action button and moving handle to limit; then (for more accurate setting), release the action button and "step" the counter by "rocking" the handle in the desired direction from neutral.
- The action button need not be depressed for RECON or SEARCH mode.
- The action button must be depressed to slew in the NAV and BOMB modes, TARGET SET, or PP SET.

TRIGGER

The trigger, located on the pilot's stick grip, is used to perform a variety of functions. In the NAV (LOFT) and BOMB (O/S) modes, with the pilot's B/N SYS button depressed, depressing the trigger for approximately 10 seconds, then releasing directly over a checkpoint, drives present position coordinates to that of target position coordinates to correct for autonavigator drift error.

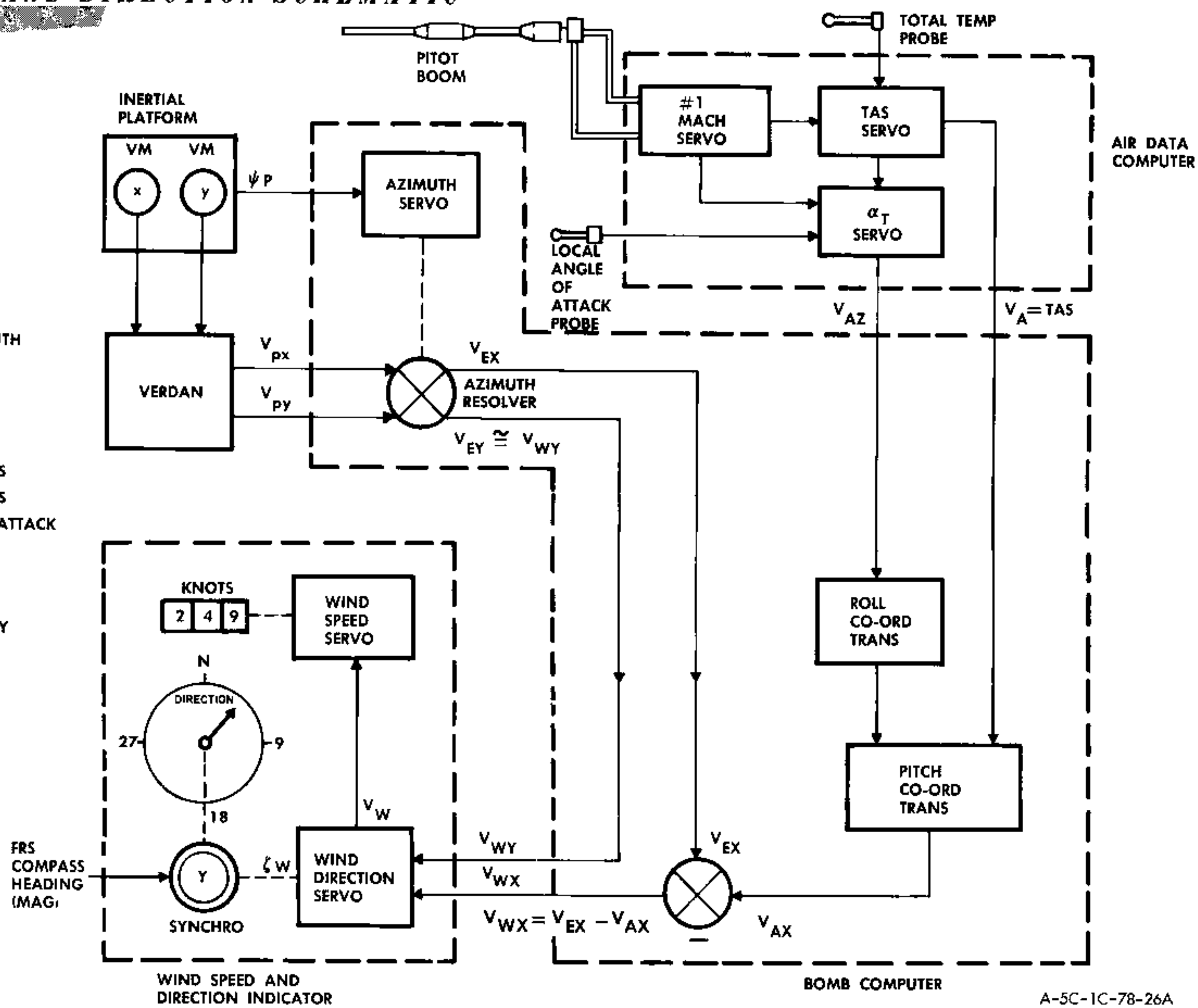
Note

When BOMB (O/S) or NAV (LOFT) is selected for steering, and the pilot is using stick trigger to take pictures or dispense chaff, ensure pilot's B/N SYS button is not depressed. This prevents inadvertent "pickle updating" of the system.

AUTONAVIGATOR PLATFORM PREALINEMENT WARM-UP

The autonavigator inertial platform should be prewarmed to operating temperature prior to alinement. Warm-up can be accomplished by several methods, using both external electrical power and cooling air normally. The platform may be prewarmed using electrical power only by selecting the PREHEAT position of the A/N PREHEAT switch (left jowl access door), and the EXT position of the B/N ALINE power switch (electrical access panel). The platform can also be prewarmed by performing an alinement until warm-up is complete. If an engine alinement is accomplished, the B/N WARM UP light is inoperative. Refer to PREHEAT REQUIREMENTS. Cycling to OPERATE ends warm-up and reselection of DECK ALINE initiates a new alinement.

WIND SPEED AND DIRECTION SCHEMATIC



LEGEND

VM = VELOCITY METER
ψP = PLATFORM AZIMUTH
V_{px} = PLAT VEL, X-AXIS
V_{py} = PLAT VEL, Y-AXIS
V_{EX} = GND VEL, X-AXIS
V_{EY} = GND VEL, Y-AXIS
V_{WX} = WIND VEL, X-AXIS
V_{WY} = WIND VEL, Y-AXIS
α_T = TRUE ANGLE OF ATTACK
V_W = WIND VELOCITY
ζ = WIND DIRECTION
V_{AX} = X-AXIS VELOCITY
V_{AZ} = NORMAL VELOCITY

Figure 1-38

VERDAN PROGRAMMING

The VERDAN memory is tape-programmed for use as either a system self-check device or a navigation computer. The autonavigator will not aline, nor will the STBY-NAV mode operate unless the VERDAN has been programmed with the current operational flight tape. Currently used operational programming tape is the OP VIII (031451 P000).

PREHEAT REQUIREMENTS

The following preheat time is required, depending on ambient temperature and type of alinement desired.

AMBIENT TEMPERATURE (°F)	PREHEAT TIME (MINUTES) 30-MINUTE ALINEMENT	SHORT ALINEMENT (CUTOFF)
100	5	40
90	5	40
80	10	45
70	15	50
60	20	53
50	25	55
40	30	60
30	35	65
20	40	67
10	45	72
0	50	75

AUTONAVIGATOR PLATFORM ALINEMENT

Proper alinement of the autonavigator platform is accomplished in 30 minutes plus required warm-up time (as needed). Total time for alinement depends upon ambient temperature. When preheating on normal external electrical power and cooling air, the B/N WARM UP light will be on until internal temperature of the platform exceeds the minimum required for 30-minute alinement.

Note

If an engine is started to supply cooling air and electrical power (B/N ALINE POWER switch at GEN), the B/N WARM UP circuit is inoperative. (Press-to-test light operative.)

If the platform is sufficiently preheated, the B/N WARM UP light should remain out when external power and cooling air are applied for alinement. For best results, the full 30-minute alinement should be used. When autonavigator power is initially turned on (A/N MODE knob at STBY-NAV), the ADVANCE MODE light (AML) illuminates for approximately 40 seconds while the VERDAN memory disk accelerates to operating speed. After the AN POWER switch has been moved to ON, progression of alinement should follow as indicated under ALINEMENT PROGRESSION, in this section.

ALINEMENT PROGRESSION

NAA OP VIII (031451 P000 Tape)

TIME FROM START (MINUTES)	TARGET ALTITUDE DISPLAY (TIME)	ALINEMENT PHASE	ADVANCE MODE LIGHT	REMARKS
0 to 1	0	Gimbal cage	Off	40 to 100 seconds
1 to 2	0 to 10	Fast leveling	On	Time read-out only in target 5 altitude
2 to 3	10 to 20	Fast leveling	Off	Time read-out only in target 5 altitude
3 to 14	20 to 130	Intermediate aline	Off	$\Delta\alpha i$ in target 5 latitude
14 to 30	130 to 290	Fine aline	Off	αc in target 5 longitude $\Delta\alpha i$ set at zero
30+	290+	Ready for operate (fine aline continues)	On/Off (1.28 seconds/cycle)	$\Delta\alpha i$ computation continues until OPERATE is selected
Switch to OPERATE	—	End	Off	αc updated

Note

- Improved alinement may be obtained after the 30-minute aline phase (AML blinking begins) by delaying selection of OPERATE until just prior to taxiing.

- **Should the alinement umbilical cable be removed with the A/N MODE knob in DECK ALINE, the system switches automatically to OPERATE, but steady illumination of the ADVANCE MODE light occurs. The AML will extinguish when the A/N MODE knob is subsequently moved to OPERATE.**
- **If necessary, OPERATE may be selected after 5 minutes of alinement. The computed $\Delta\alpha$ at time of selection will be stored in VERDAN. In an emergency, OPERATE may be selected after 3 minutes of alinement. If present position "runaway" occurs, select STBY-NAV.**
- **When doing a partial alinement to preheat the platform, if the A/N MODE knob is switched from DECK ALINE to OPERATE, and then back to DECK ALINE to end A/N warm-up, αc remain in the target position LONGITUDE indicator and αi will be as shown under REMARKS.**

ALINEMENT READ-OUTS

During alinement, the target position indicators (LATITUDE/LONGITUDE) are used to monitor platform azimuth (α) angle measurement with respect to true north. The TARGET ALTITUDE indicator is also used to reflect time in alinement. The time indication is *not* a direct function of alinement phasing, but is controlled by a timer, and should *not be* used as a guide for selecting OPERATE. Refer to alinement progression table. With the SET/CORR knob at channel 5, the computed instantaneous difference between true north and platform X-axis ($\Delta\alpha i$) is displayed in the target position LATITUDE indicator. Computed total wander angle (αc) is displayed in the target position LONGITUDE indicator. Upon initiation of the alinement phase, both indicators (LATITUDE and LONGITUDE) run to zero. From 3 to 14 minutes, target position LONGITUDE reading remains zero (except when carrier is moving), and target position LATITUDE fluctuates as azimuth angle error, computation continues. At 14 minutes, target position LATITUDE runs to zero and target position LONGITUDE reading is updated by the value previously shown in target position LATITUDE. From 14 minutes until OPERATE is selected, wander angle ($\Delta\alpha i$) computations continue and are displayed in the LATITUDE indicator. At that time, a total wander angle (αc) is displayed in the LONGITUDE indicator.

Note

- The total reading in target position LONGITUDE is not significant as long as 10 degrees are not exceeded. An αc value exceeding 10 degrees may result in excessive drift of the inertial platform.
- Target position LONGITUDE will not read zero at beginning of intermediate alinement in cases where A/N warm-up procedure includes cycling to OPERATE, then DECK ALINE.
- Between 15 and 30 minutes (ADVANCE MODE light out), target position LATITUDE continues to oscillate and change as $\Delta\alpha i$ is computed. The final average value is not added to αc, however, until OPERATE is selected at end of 30 minutes or more. The target position LATITUDE read-out is not critical in value until approximately 25 minutes (for a full 30-minute alinement) have elapsed. At this time, $\Delta\alpha i$ should be noted closely at approximately 30-second intervals. Excessive shifting or spurious read-outs in target position LATITUDE (exceeding approximately 30 arc-minutes) are an indication that the azimuth computation may not be of sufficient accuracy to produce satisfactory performance. Should this occur, the system should be allowed to remain in DECK ALINE several minutes beyond the normal 30-minute alinement to allow the averaging phase to effect a more accurate computation.
- Degraded A/N performance may result if delta alpha exceeds 20 minutes. Delta alpha is the difference between the 14- and 30-minute alpha.

STAND-BY NAVIGATION

In the event of failure of the inertial platform, navigation may continue in the STBY-NAV mode. In this mode, the velocity signals to VERDAN from the autonavigator platform are eliminated, and replaced with velocity signals computed in the bombing computer from handset wind and true airspeed from the air data computer. Aircraft attitude signals are provided the bombing computer from the flight reference set. Navigational read-outs are updated normally and radar or TV displays continue as before the failure. In this mode, it is important that checkpoint corrections be made as often as possible. For STBY-NAV procedures, refer to Section III.

CAUTION

To prevent damage to the stable platform following selection of STBY-NAV mode from OPERATE mode, proceed as follows: If ground speed indicator and present position counters of position and destination indicator display normal information, place A/N MODE switch back to OPERATE. If the alined mode displays an excessive drift rate, place the AN POWER switch to STBY and return the A/N MODE switch to STBY-NAV.

COMPASS OPERATION IN STBY-NAV

For accurate navigation in the STBY-NAV mode in areas of magnetic variation, the RAN should take command of the compass system, select DG mode, and slew in the aircraft true heading. True heading is obtained by noting the magnetic heading in the SLAVED mode (after depressing the SYNC button), applying local magnetic variation, selecting DG, and slewing the compass ring of the ARI to aircraft true heading. Compass mode should be returned to SLAVED at least once each 30 minutes and magnetic heading should be checked to prevent DG drift errors. The latitude and ground speed dials should be adjusted as necessary. In STBY-NAV, the DG mode must be used to provide proper input for PECM runs.

RADAR AND TELEVISION

RADAR

The general-purpose radar subsystem operates in the J7 band at 60-kw peak power in a narrow, dual-lobe pattern. The radar provides conventional and expanded ground-mapping and contour-mapping in a ±45-degree sector scan, depressed-center PPI-type display. The normal ground-mapping mode provides all-weather navigation assistance and target location with peak performance optimized at 60 nautical miles range at 60,000 feet. Radar operating frequency is fixed between 16 and 17 kmc, with provisions for automatic or manual relock of the AFC circuit. The system includes a self-test feature, which places spaced pulses on the radar-TV indicator to provide a complete end-to-end check of radar operation, calibration, and display features.

ANTENNA

The radar antenna is a dual-surface, paraboloidal reflector containing a flexible mylar diaphragm. This diaphragm is spread over either the front or rear inside surface of the dish by a vacuum pump, driven by engine air, providing a changeable basic antenna pattern. When spread over the rear surface, the diaphragm provides a conventional ground-mapping radiation pattern. When spread over the front surface, the antenna provides a "pencil" beam pattern. The antenna scans in a horizontal plane to 45 degrees each side of center except in expanded modes, when scan is approximately 20 degrees on each side of the azimuth cursor position. For optimum presentation, radar parameters are varied with operating mode and range as follows:

RANGE (NMI)	RADAR MODE	SCAN RATE (DEGREES/SEC)	PRF (PPS)	PULSE WIDTH (μ SEC)
20/10	NORM ANTIJAM MRI CTR MAP/TA MON	90	2400	0.375
	Fixed or variable	90	2400 (at less than 17.5 miles to target)	0.375 (at less than 17.5 miles to target)
60/30	NORM ANTIJAM/ MRI	90	900	1.0
	Fixed or variable	90	900	1.0 (at more than 17.5 miles to target)
140	NORM/ ANTIJAM/ MRI	90	450	2.0

Antenna reflector tilt limits are 0 degrees and −30 degrees. Azimuth, roll, and pitch stabilization is provided by the vertical platform to maintain antenna orientation. Stabilizing gimbal limits are ±15 degrees in roll and +17/−19 degrees in pitch. Moving the A/N MODE knob to STBY-NAV provides radar antenna stabilization from the MFRS. Automatic antenna stowage in a centered position is accomplished when the sweep is observed to collapse (normally within 15 seconds) after the RADAR/TV POWER switch is turned OFF. The radome fold circuit cannot be energized from the pilot's cockpit unless the antenna has assumed its stowed position.

Note

The radar antenna will not properly stow unless the RADAR/TV POWER switch is moved to OFF with the aircraft electrical system energized.

NORMAL DISPLAY

The NORM display consists of a 90-degree sector of a PPI with a depressed center (a conventional ground map). The NORM-RNG CIRCLE IN display places the radar range circles on the scope, dividing the scope (regardless of range selected) into four equal sections.

EXPANDED DISPLAY (BASIC SYSTEM)

A target expansion feature (within 46.5 nautical miles of target) enables the crew members to view a limited scan (approximately 20 degrees on either side of the cross hairs). The expanded modes are not available with the RANGE switch at the 140-mile position. The display is expanded about the point of intersection of the azimuth and range cursors, which are fixed at the computed target position. At ranges exceeding 17.5 nautical miles to target, two types of expansion are available to the RAN: constant scale factor (FIXED) and variable scale factor (VAR).

EXPANDED DISPLAY (MODIFIED)

The modified expanded displays provide the same target expansion features as the basic system with the addition of half-range features. At ranges exceeding 17.5 nautical miles to target (20- or 60-mile range), or 8.75 nautical miles to target (10- or 30-mile range), the FIXED and VAR scale factors are available.

Fixed (20- or 60-mile Range)

The FIXED (constant scale factor) display presents a 30-degree trapezoid scan between 46.5- and 2.25-nautical-mile slant range to selected target depending upon RANGE knob setting. With 20- or 60-mile range selected between 46.5 and 17.5 miles, range expansion is ±16.75 miles about the cursor intersection point; between 17.5 and 5.5 miles, expansion is ±5.5 miles. At less than 5.5 nautical miles, the presentation moves toward the scope apex, becoming unusable. If practical, NORM mode should then be selected.

Fixed (10- or 30-mile Range)

At ground distances between 46.5 and 8.75 miles to target, range expansion factor is ±16.75 nautical miles. At ground distances between 8.75 and 5.5 miles, range expansion is ±2.25 nautical miles. At less than 2.25-mile ground distance, scope presentation moves toward the apex, and NORM display should be selected.

Variable

The VAR (variable scale factor) display is expanded as a direct function of radar energy return time between 46.5 and 8.75 nautical miles. At 17.5 nautical miles with 20- or 60-mile range selected, FIXED mode of operation is automatically resumed. With the 10- or 30-mile ranges selected, FIXED mode operation resumes at 8.75 nautical miles.

RADAR CONTROLS

Radar TV Power Switch

The RADAR/TV POWER switch (figure FO-18) has three positions: OFF, STBY, and ON. The STBY position directs power to the radar amplifiers and television vidicon tube and amplifiers to maintain readiness and permit warm-up. Within 2.5 and 3.5 minutes after this switch is placed at STBY, the ON position may be selected; scans will be evident when brightness is increased. Moving the switch to OFF with power available (engines running or external power connected) causes the radar antenna to stow.

Note

Should presentation be lost, attempt to restore display by cycling the switch to STBY, then back to ON. If the presentation remains lost, cycle to OFF momentarily, then to STBY. After an additional 2.5 to 3.5 minutes, select ON, and the display may reappear.

Radar-TV Mode Knob

The radar-TV MODE knob (figure FO-18) is used to control the operating mode of the radar and to select television sight operation. The positions of the MODE knob function as follows:

TV	Television sight presentation selected on the radar-TV indicator.
MRI	The radar should be operated in this mode for best azimuth resolution.
NORM	Conventional ground-mapping display (utilizes logarithmic amplification).
ANTIJAM	Ground-mapping with fast time constant to decrease jamming effect and improve radar range resolution.
CTR MAP/ AT MON	Selects contour-mapping presentation.

WARNING

Do not attempt to use contour map display for altitude control without current contour map calibration.

Display Knob

The DISPLAY knob (figure FO-18) is used to select the type of radar presentation desired. A normal display (ground-mapping) and two expanded displays (variable and fixed) are available. These displays function as follows:

NORM-RNG CIRCLE IN	The normal display provides ground-scanning with a 90-degree sector scan, divided into four equal parts by three range circles.

NORM — The normal display provides ground-mapping with a 90-degree sector scan.

VAR — The variable display is available within 46.5 nautical miles of the selected destination with the RANGE switch at the 60- or 20-mile position. From 46.5- to 17.5-nautical-mile range to destination, an area of two-thirds the ground distance to the range cursor (computed destination) is centered about the target and is expanded to fill the display. At 17.5 miles, FIXED operation automatically resumes. Scale factor varies from 500,000 to 1 at 46.5 miles, increasing to 160,000 to 1 at 17.5 miles. With 10- or 30-mile range selected, expansion crossover takes place at 8.75 nautical miles, with fixed display resuming at 2.25 miles.

FIXED — In the fixed display (available within 46.5 nautical miles of destination), the presentation is similar to that of variable, except that the area displayed remains constant with decreasing range. From 46.5- to 17.5-mile range, an area having a 16.75-mile radius is displayed about the cursor intersection point. Beyond 17.5-mile range, the display scale factor is 500,000 to 1 for matching with Standard Sectional or Pilotage Charts. Below 17.5 miles to destination, range scale factor automatically switches to 160,000 to 1 with a 5.5-mile radius (20- or 60-mile range selected) or 2.25-mile radius (10- or 30-mile range selected) displayed about the cursor point.

Note

At less than 5.5 miles (2.25 miles with 10- or 30-mile range selected), the presentation moves toward the scope apex, becoming unusable.

Beam Knob

The BEAM knob (figure FO-18) selects the pattern of the rf energy in the vertical plane of the radar antenna and selects sensitivity time control (STC). The BEAM knob has the following positions:

NORM STC — This position selects the cosecant-squared-shaped beam which has a wide radiation pattern and provides a general terrain illumination. At the same time, this position provides an STC which reduces strong signals received from targets at close range (approximately the first 5 miles) for a more uniform presentation.

NORM — Selection of this position provides the cosecant-squared-shaped beam which has a wide radiation pattern and provides a general terrain illumination.

FLAT — This position changes the radiated energy to a pencil beam.

FLAT STC — This position selects the pencil beam and provides an STC which reduces strong signals received from targets at close range for a more uniform presentation. (In FLAT BEAM as in NORM, STC affects only approximately the first 5 miles of the radar presentation.)

Note

In MRI mode with the BEAM knob at NORM STC or FLAT STC, the IF GAIN knob is inoperative.

Range Knob

The RANGE knob (figure FO-18) is used with the NORM, ANTIJAM, or MRI mode of operation to select radar range of operation as desired. A selection of a 10-, 20-, 30-, 60-, or 140-mile range is available.

Brightness Knob

The BRIGHTNESS knob (figure FO-18) allows adjustment of radar indicator threshold, and any subsequent changes with this knob will affect overall display brightness.

Clearance Indicator

The CLEARANCE indicator (figure FO-18) provides readout for manually setting contour-mapping mode radar clearance plane distance. The indicator may be set from 0 (aircraft altitude AGL) to 6000 feet in 100 feet increments.

Clearance Plane Set Knob

The CLEARANCE PLANE SET knob (figure FO-18) is used to set desired distance in the CLEARANCE indicator.

Radar Test Switch

With the radar TEST switch (figure FO-18) in the ON position, test pulses (range circle segments with the antenna scanning) are generated and displayed on the radar-TV scope. These markers are placed at 2-nautical-mile intervals from the display apex outward, properly spaced for selected radar range. A minimum of eight well-defined test markers indicates proper operation and calibration of the transmit, receive, sweep, processing, and display functions of the general-purpose radar.

CAUTION

Radar test should not be accomplished with the TRANSMIT MODE switch in TRANSMIT.

Transmit Mode Switch

The TRANSMIT MODE switch (figure FO-18) selects coupling of the transmitter ouput to either the radar antenna or to a dummy load.

TRANSMIT — When the TRANSMIT MODE is selected, the rf power from the transmitter is coupled to the radar antenna.

SILENCE — In the SILENCE MODE the transmitter output is coupled to a dummy load, and no rf energy is transmitted.

AFC Knobs

The AFC knobs (figure FO-18) are used to select AUTO (automatic) or MAN (manual) operation of the automatic frequency control (AFC) circuit. AUTO or MAN operation is selected by positioning the teardrop-shaped outer knob as desired. The concentric inner AFC knob (figure FO-18), controls the klystron frequency in the MAN mode only. Manual mode tuning allows a check of the MAN versus AUTO receiver frequency control and permits the RAN to maintain video in the event of AFC failure.

IF Gain Knob

The IF GAIN knob (figure FO-18) controls the intensity of all radar target returns. A higher IF gain setting would be used for land/water contrast. This knob has no effect in the MRI mode with the BEAM knob in NORM STC or FLAT STC.

Video Gain Knob

The VIDEO GAIN knob (figure FO-18) is used in conjunction with the IF GAIN knob in controlling brightness of radar target return. Decreasing IF gain may require an increase in video gain and vice versa.

Tilt Knob

The TILT knob (figure FO-18) controls antenna look-down angle in NORM, MRI, and ANTIJAM modes of radar operation. Resolution in the presentation area of peak interest may be optimized by finding best tilt depression angle. Tilt angle is variable from 0 to −30 degrees.

Cursors and Circles

During radar operation at less than 186 nautical miles from selected destination, an azimuth cursor is superimposed on the radar presentation during left-to-right scans of the antenna. The azimuth cursor normally lies along the bearing to the selected checkpoint or destination. At more than 186 nautical miles from checkpoint or target, the azimuth cursor is locked straight ahead. The range cursor does not appear until range to target is less than the selected range of radar operation. The range cursor is presented as a circle sector across the entire scope. This cursor will normally lie across the azimuth cursor at the point of computed checkpoint or destination range. The range cursor is displayed on both left and right scans and shows range to the target indicated by the SET/CORR knob in the NAV mode, or to the target indicated by the NAV/BOMB knob in the BOMB mode. The cursors show reciprocal range and bearing to a selected target passing behind the aircraft. Both cursors may be positioned through use of the cursor control handle. This action provides a means of correcting the VERDAN for autonavigator drift error. Superimposed range circles may be selected to appear on the radar presentation by selection of NORM display, RNG CIRCLE IN. The range circles change in separation scale with selection of radar range as follows:

OPERATING RANGE (NAUTICAL MILES)	CIRCLE SCALE (NAUTICAL MILES)
10	2.5
20	5.0
30	7.5
60	15.0
140	35.0

Range cursor and circle accuracy may be checked against test pulses.

Note

With the AN POWER switch OFF, radar azimuth cursor is locked at the 12-o'clock position.

Cursor and Circle Brightness Knob

The CURSOR & CIRCLE BRT knob (figure FO-18) is used to control the intensity of the azimuth and range cursors and range circles on the radar indicator.

Relative Cursor Brightness Knob

The RELATIVE CURSOR BRT knob (figure FO-18) allows independent adjustment of range cursor brightness.

Radar-TV Scope

The radar-TV scope (figure FO-18), installed on the display panel, is a hooded 7-inch cathode-ray tube with a manually controlled polaroid filter. The inner surface of the tube face is phosphor-coated for radar and television presentation persistence. Offset angle marks are presented in 5-degree increments to 50 degrees left and right on the upper mount frame.

Radar Mode Advisory Lights

Three radar mode advisory lights are installed on the radar-TV scope frame (figure FO-18). These lights have no function in present configuration.

Focus Knob

The FOCUS knob (figure FO-18) controls the focus of the cathode-ray tube in either radar or TV operation.

Light Brilliance Adjustment

The LIGHT BRILLIANCE adjustment screw permits ground adjustment of relative bearing scale and mode advisory lighting. See figure FO-18.

Polaroid Filter Lever

The polaroid filter lever (figure FO-18) allows a filter selection for the radar (yellow) or TV (blue) display.

TELEVISION

A closed-circuit TV sight is installed as part of the AN/ASB-12 system. The sight is composed of a vidicon tube and an optical prism unit which, when selected, will present a view of the area on the RAN's radar-TV indicator and the pilot's projected display indicator. The TV scanner assembly is mounted in a small dome under the nose, aft of the radome. The TV optics unit may be slewed to 45 degrees left or right of center and vertically downward to 55 degrees from the fuselage reference line. In addition, a fixed aft-viewing position may be selected. In the aft position, the optics unit is locked at 10 degrees depression angle. Three beam angles are available for viewing 28 (WIDE), 15 (MED), and 7.5 (NAR) degrees. The TV sight is normally used in the NAV or BOMB mode to correct present position for drift under visual conditions but may be used as a search device by switching the SYSTEM MODE knob to SEARCH. The TV optics unit contains a reticle generator which projects a fixed cross hair aiming image in the center of the TV raster. The TV sight is automatically aimed at the NAV/BOMB selected target in BOMB mode and the SET/CORR selected target in NAV mode. It can be slewed to a target of opportunity in the RECON mode and will continue to track this point. Automatic aperture control maintains constant-intensity illumination to the face of the vidicon tube. Protection from "image burn" is provided for the vidicon tube by a filter which is switched to IN for protection and maintained in the OUT position during normal use.

TELEVISION CONTROLS

Reticle Knob

The RETICLE knob (figure FO-18) is used to select and control brightness of the TV reticle. At the 12-o'clock position, the reticle is off. Counterclockwise rotation selects reticle NO. 1, and clockwise rotation selects reticle NO. 2.

Filter Switch

The FILTER switch (figure FO-18) controls the position of a filter in the TV optics unit. The FILTER switch should be placed to IN for protection of the vidicon tube while the TV unit is not being viewed. TV display is not available with the FILTER switch IN.

View Switch

The VIEW switch (figure FO-18) is used to select either the FWD (forward) controllable viewing TV optics position or the fixed AFT position.

Note

Radar operation is not available if TV VIEW switch is in the AFT position without repositioning the TV VIEW switch to the FWD position. If the TV does not move aft when selected, proper operation may be gained by moving the SYSTEM MODE knob to SEARCH.

View Angle Switch

The VIEW ANGLE switch (figure FO-18) is used to select the width of azimuth view of the TV sight. These fields are WIDE (28 degrees), MED (15 degrees), and NAR (7.5 degrees).

TV Brightness Knob

The TV BRIGHTNESS knob (figure FO-18) controls brightness of the radar-TV indicator in the TV mode.

Aperture Knob

The APERTURE knob (figure FO-18) controls an automatically or manually operated variable-intensity wedge installed on the TV optics unit. In the AUTO position, the total contrast of the TV picture is automatically controlled. If the automatic function fails and a change in picture contrast is desired, the control may be rotated into the manual range and positioned between CLOSED and OPEN as desired.

Azimuth TV Scanner Position Indicator (TSPI)

The AZIMUTH TV SCANNER POSITION indicator (figure FO-18) provides a position reference of azimuth and pitch angle of the TV optics unit. Azimuth is indicated to 45 degrees left or right, and pitch from 0 to 55 degrees down. When the aft viewing position is selected, the word "AFT" appears in the DOWNPITCH window and the azimuth pointer moves to zero. During radar operation, the scanner continues to operate in the tracking mode as indicated by the scanner position indicator.

ARMAMENT SYSTEM

The armament system, which releases externally carried fuel drop tanks or the RCPP-105-1 power pod, consists of provisions for four wing-mounted pylons (equipped with ejector-type racks) and store release and jettison electrical circuits.

EXTERNAL EQUIPMENT

Pylon-mounted drop tanks or power pod are force-ejected by two explosive cartridges which operate linkage to free the tank or pod lugs from the pylon hooks and drive the ejector foot in the MAU-9/A rack. The release cartridges are fired by electrical impulses from the armament manual release circuit or the external emergency jettison button. The pylons (equipped with ejector-type racks) contain two sets of cartridges, one set for tank or pod release or jettison and one set for pylon release, if required, after the tank or pod is released. Flasher pods (installed directly on the wing) may be released in the same manner as tanks or pods. Tanks, power pod, or flashers release through the armament system requires that the landing gear be retracted (gear handle UP), the MASTER ARM switch turned ON and, for a manual release, the RAN may select the proper station and depress the STORE release button. This results in forced ejection of the selected tank or pod by explosive pressure from two MK 2 Mod 1 cartridges. Ground safety pins should be installed in the racks and in the pylons, while on deck, to prevent inadvertent dropping of the tanks, pod, or pylons in the event of failure of the ground safety relay.

JETTISON

The essential d-c bus is utilized to provide power to emergency jettison circuits for drop tanks, power pods, or flashers. The pilot's jettison buttons act to bypass the MASTER ARM switch, enabling the pilot to fire the external tank, pod, or flasher release cartridges with the aircraft weight off the landing gear.

ARMAMENT CONTROLS AND INDICATORS (PILOT)

MASTER ARM SWITCH

The MASTER ARM switch (figure 1-39) is a two-position circuit-breaker switch. The ON position prepares the external release circuits for operation by powering the 115-volt a-c/28-volt d-c master armament bus through the master armament relay. A landing gear handle safety switch prevents power from reaching the master armament relay when the landing gear handle is in the DOWN position, except when bypassed by the armament safety disabling switch in the nose wheel well. Once the bypass switch is momentarily actuated, the landing gear handle safety switch is bypassed, permitting the armament bus to be energized with the handle down. The handle must be energized with the handle down. The handle must be cycled or power removed from the aircraft to remove this bypass condition. With the MASTER ARM switch at ON, the RAN's ARM MAST'R ON advisory light is illuminated.

DELIVERY MODE BUTTONS

B/N System Button

The B/N SYS button (figure 1-39) is not used in aircraft configurations for store delivery. This switch is used in conjunction with the pilot's trigger switch to update AN/ASB-12 present position.

Man Button

The MAN button (figure 1-39) is depressed for manual release of the selected tank, pod, or flasher through the trigger (requiring MASTER ARM switch ON, RAN's STATION SELECT button depressed, and the landing gear handle UP).

Loft Button

The LOFT button (figure 1-39) is not used in present aircraft configurations.

O/S Button

The O/S button (figure 1-39) is not used in present aircraft configurations.

Reset Button

The RESET button (figure 1-39), when depressed, will return any previously depressed DELIVERY MODE button to the up (OFF) position.

Emergency Jettison Buttons

Guarded emergency JETTISON buttons are installed on the pilot's weapons control panel (figure 1-39). The EXT button fires the external cartridges, releasing the drop tanks, pod, or flashers. The INTR button is not used in present aircraft configurations and is deleted on some aircraft.* The emergency JETTISON buttons are intended for use only in emergency. Should both engine-driven generators fail, external cartridges may be fired

*Aircraft having AFC 233 complied with

ARMAMENT CONTROLS AND INDICATORS

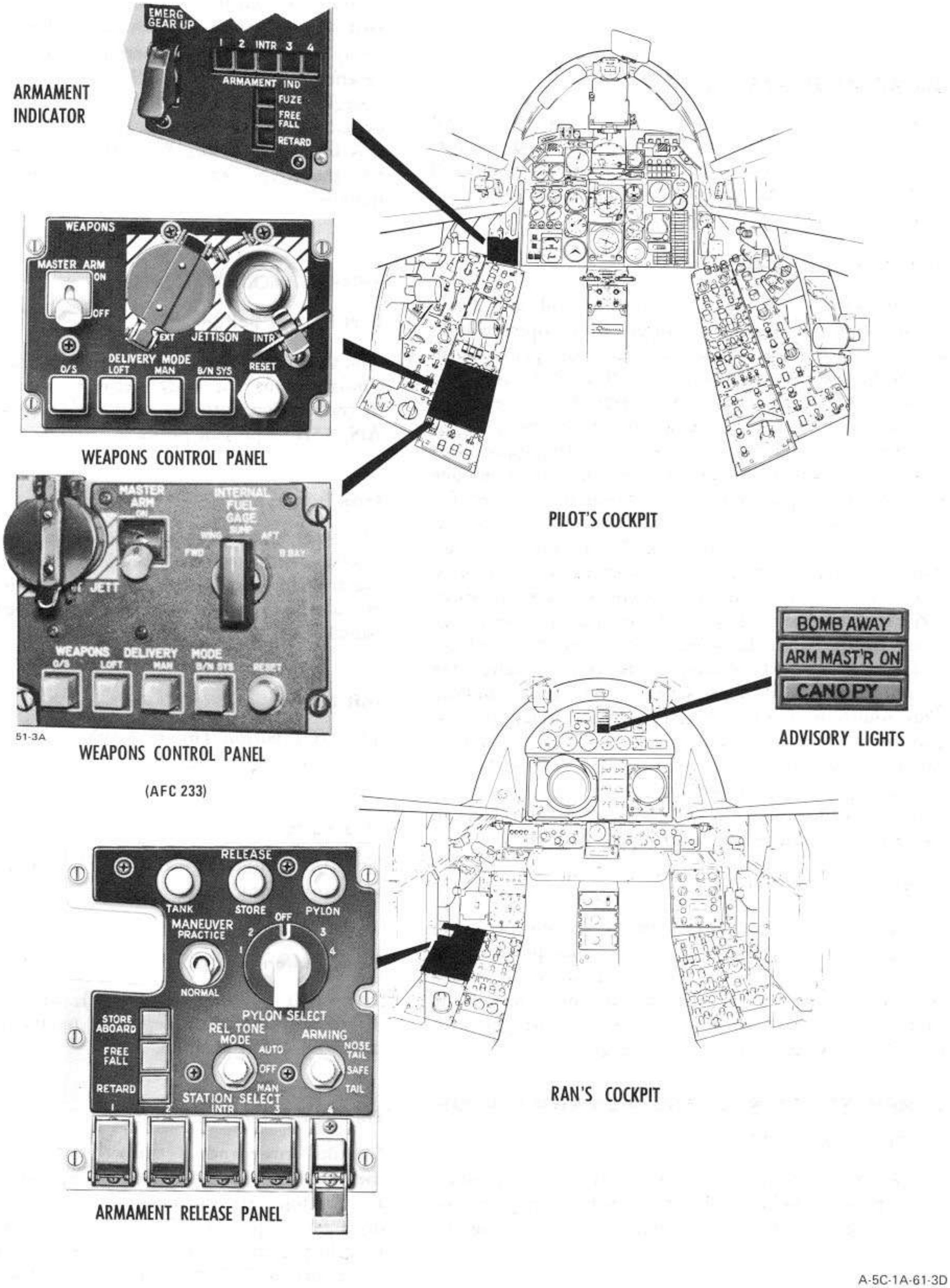


Figure 1-39

with these buttons through electrical power generated by the ram-air turbine emergency power unit.

WARNING

Jettison cannot be accomplished with the weight of the aircraft on the landing gear.

ARMAMENT INDICATOR

An armament indicator (figure 1-39) is installed on the pilot's landing gear control panels. Four indicators (1, 2, 3, and 4) reflect the wing station selected by the RAN for drop tank, pod, or flasher. Without power, the indicator windows appear blank. The windows are energized to an "ON" indication when the RAN depresses a STATION SELECT button for a station loaded with a tank, pod, or flasher. The four remaining indicators (INTR, FUZE, FREE FALL, and RETARD) are not used in the present aircraft configurations.

Note

With the MANEUVER switch in NORMAL, selection of an unloaded station will not actuate the armament indicators but will result in a continuous BOMB AWAY light on the RAN's display panel. The indicators, marked 1, 2, 3, and 4, are illuminated when the associated STATION SELECT button is depressed, if the pilot's instrument lights knob is out of the OFF position. At tank, pod, or flasher drop, the appropriate window will change from "ON" to blank, indicating release.

TRIGGER

The trigger, located on the pilot's stick grip, is used to perform AN/ASB-12, armament, ECM and photo reconnaissance functions. With the MASTER ARM switch ON, and the MAN delivery mode button depressed, the station selected through the RAN'S STATION SELECT buttons may be released by depressing the trigger. In the NAV mode (ALL WEATHER LOFT) or in BOMB mode (ALL WEATHER O/S) with the B/N SYS button depressed, AN/ASB-12 drift error is driven to zero by depressing the trigger 15 to 30 seconds before arriving over a checkpoint; then releasing the trigger over the checkpoint with WARN/CHAFF or ALL selected on the pilot's ECM control, chaff may be released by depressing the trigger. The trigger also operates the oblique cameras when selected by the pilot (in command and STICK mode).

ARMAMENT CONTROLS AND INDICATORS (RAN)

TANK RELEASE BUTTON

If operational by local policy, the TANK release button (figure 1-39) is used to manually release any drop tank as selected through the desired STATION SELECT button. The tank release circuit is not dependent on the pilot's MASTER ARM switch. The tank release circuit is disabled with the weight of the aircraft on the landing gear.

Note

Operation of the TANK release button is dependent on insertion of a circuit shorting plug in each pylon having a drop tank installed. Omission of the plug renders the TANK release button inoperative. In this case, the RAN must request that the MASTER ARM switch be turned ON and the STORE release button must be used.

PYLON RELEASE BUTTON

The PYLON release button (figure 1-39) is used to manually release any wing station pylon as selected through the PYLON SELECT knob. The pylon release circuit is not dependent on the pilot's MASTER ARM switch. The pylon release circuit is disabled with the weight of the aircraft on the landing gear or with the gear handle DOWN.

Note

- Pylons must be selected and released separately.
- In order to arm the pylon release circuits, external stores or tanks must first be released or jettisoned.

PYLON SELECT KNOB

The PYLON SELECT knob (figure 1-39) is used to select pylons for release through the PYLON release button.

STATION SELECT BUTTONS

The guarded STATION SELECT buttons (figure 1-39) are used by the RAN to prepare the external store stations for release. These mechanically held buttons (1, 2, 3, 4) control the pilot's armament indicator. If desired, all wing select buttons may be depressed simultaneously. The STATION SELECT button guards provide receptacles for insertion of safety tags to identify store stations loaded.

STORE ABOARD INDICATOR

The STORE ABOARD indicator (figure 1-39) corresponds to the armament indicators in the pilot's cockpit. When a store is selected through one of the STATION

SELECT buttons, this indicator will show "ON" until drop. At store release, the indicator goes blank. With no pylons or stores, a store aboard indication cannot be obtained.

ARMAMENT MASTER ON LIGHT

The ARM MAST'R ON light (figure 1-39) is located on the RAN's display panel. This light will be illuminated whenever the pilot's MASTER ARM switch is in the ON position and the landing gear handle is in the UP position. The light also illuminates on deck with the MASTER ARM switch ON and the ARM SAFE DISABLE switch (nose wheel well) actuated.

BOMB AWAY LIGHT

The BOMB AWAY light (figure 1-39) is located on the RAN's display panel. This light will illuminate upon release of external stores. The light is extinguished when the previously depressed STATION SELECT button is re-depressed and released to its OFF position.

PART 3 — SERVICING AND HANDLING

INTRODUCTION

Normally, the aircraft will be serviced by qualified maintenance personnel and servicing will not require flight crew supervision. However, navigation flights, diversions, weather alternates, and NATO operations may require the use of various bases. Therefore, the flight crew must have a knowledge of aircraft servicing procedures, sufficient to accomplish normal aircraft turnaround-type servicing. Reference to the following procedures and figure 1-40, or the NATOPS Pocket Checklist (NAVAIR 01-60ABC-1B), should be sufficient to ensure proper aircraft servicing by transient maintenance personnel under the supervision of the flight crew.

CAUTION

Conditioned air must be applied to the left air receptacle if aircraft cooled electronic equipment bus (AN/ASB-12 or CNI) is to be utilized and to the right air receptacle if special systems cooled electronic equipment bus (RECON systems) is to be utilized.

Note

If autonavigator alinement has been initiated, care should be taken to disconnect external electrical power after aircraft generators are operating. This precludes AN/ASB-12 power interruption and loss of alinement.

EXTERNAL POWER AND AIR REQUIREMENTS

The aircraft requires external electrical power, cooling air, and engine starting air. For a list of acceptable external power and conditioned air units, refer to EXTERNAL POWER UNITS, in this section.

ELECTRICAL

For ground operation of all buses, external a-c electrical power must be applied. The external power receptacle is located on the left side of the fuselage, forward of the main gear, at access number 74. For normal line operation, 45-kva, 115-volt (400-cycle, three-phase, four-wire, A, B, C rotation) a-c power is required. If all systems are to be operated, a minimum capacity of 60 kva must be provided. For preheat of the inertial autonavigator only, 4 kva is required. Two indicator lights (green) are mounted beside the external power receptacles and will come on when the generators are operating and ready to assume operation of the system. Although external power may be removed when either of these lights illuminates, the disconnect should be delayed until both lights are on and the aircraft power switch has been moved to GEN.

CONDITIONED AIR

An external cooling air supply is required for ground operation of electrical equipment. The main cooling supply nozzle is connected in the external power receptacle at access number 74. A cooling effect detector disables electrical circuits until sufficient cooling air is available.

An external cooling air receptacle for special systems is located in the right fuselage at access number 189:1. For conditioned air requirements, refer to EXTERNAL POWER UNITS, in this section.

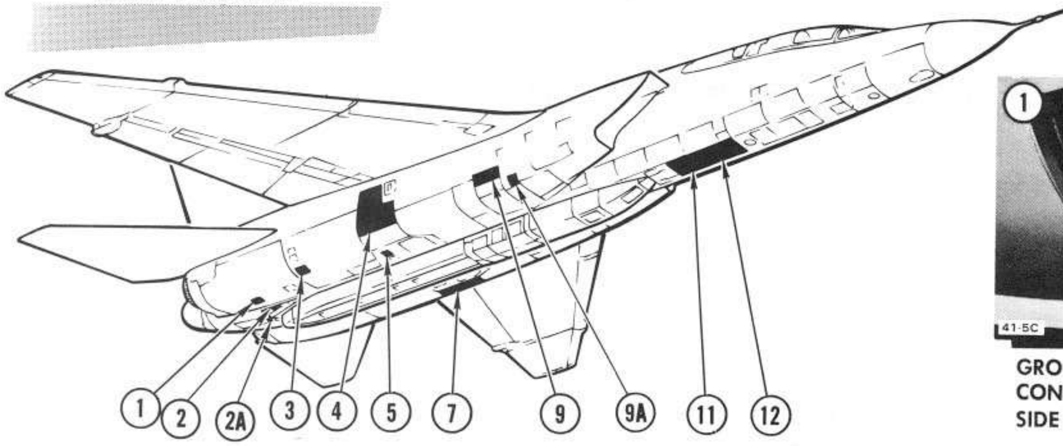
ENGINE STARTING AIR

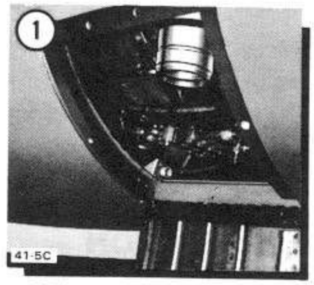
The aircraft engines have an impingement starting system requiring 180 pounds per minute, 75 psia (5:1) airflow. Engine starting air connections are located on the lower left side of each engine at access numbers 109:1 and 155:1 on the aft engine access doors.

POWER UNITS (RCPP-105-1 AND RCPT-105-3)

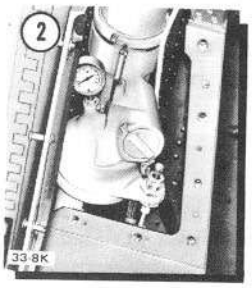
The RCPP-105-1 power unit is a streamlined, self-contained, air-transportable ground support pod. The RCPT-105-3 power unit is a trailerized, non-air-transport-

SERVICING

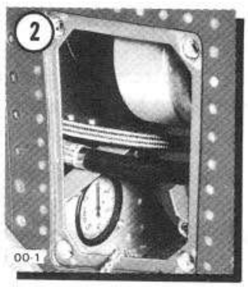




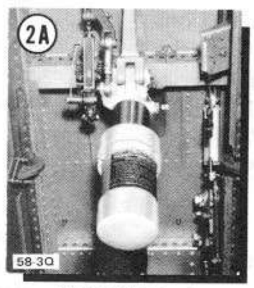
GROUND STARTING AIR CONNECTION (RIGHT SIDE SHOWN)



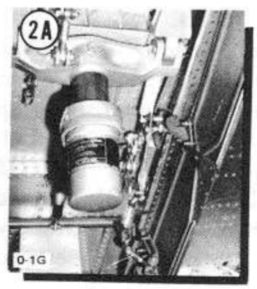
ARRESTING GEAR SNUBBER



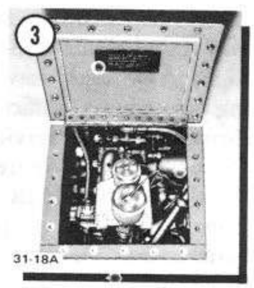
HOOK FIELD POSITION ACCUMULATOR †
PRECHARGE—1000 (±50) psi



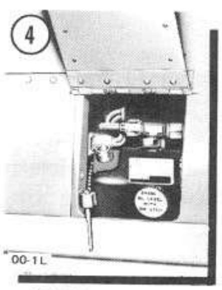
ARRESTING GEAR BUMPER
100 PSI AIR



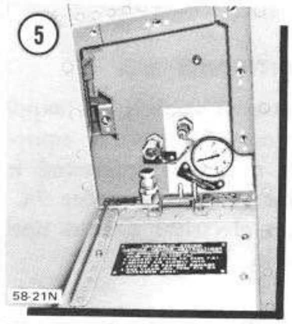
ARRESTING GEAR BUMPER *



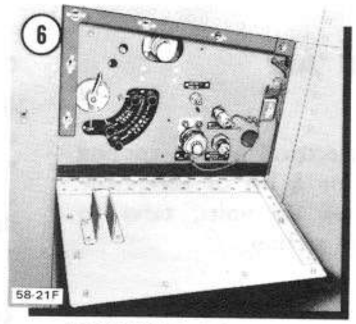
OIL TANK FILLER ACCESS (ON EACH SIDE)
TOTAL FILL CAPACITY — 5.2 GAL



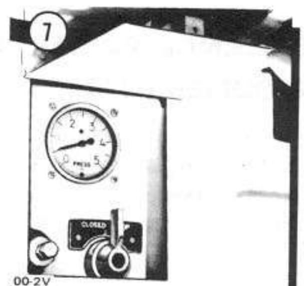
PNEUMATIC COMPRESSOR RESERVOIR



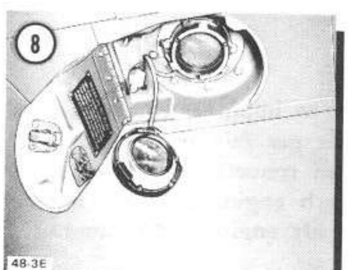
PNEUMATIC SYSTEM SERVICE PANEL
PRECHARGE — 2800-3200 PSI



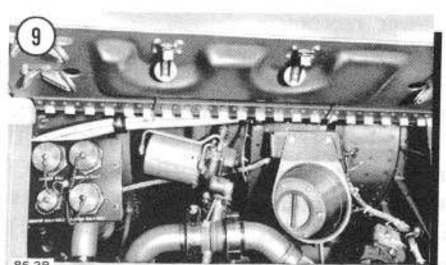
HYDRAULIC SYSTEMS SERVICE PANEL
NO. 1 RES — 2.3 GAL
NO. 2 RES — 5.67 GAL



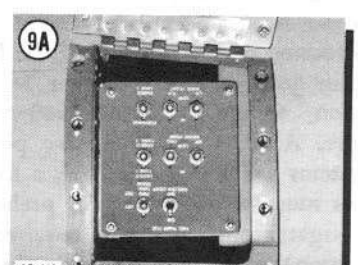
EMERGENCY BRAKE ACCUMULATOR SERVICE PANEL (LEFT GEAR WELL)
PRECHARGE — 1000 PSI



AFT REFUELING RECEPTACLE



SPECIAL SYSTEMS COOLING AIR ACCESS



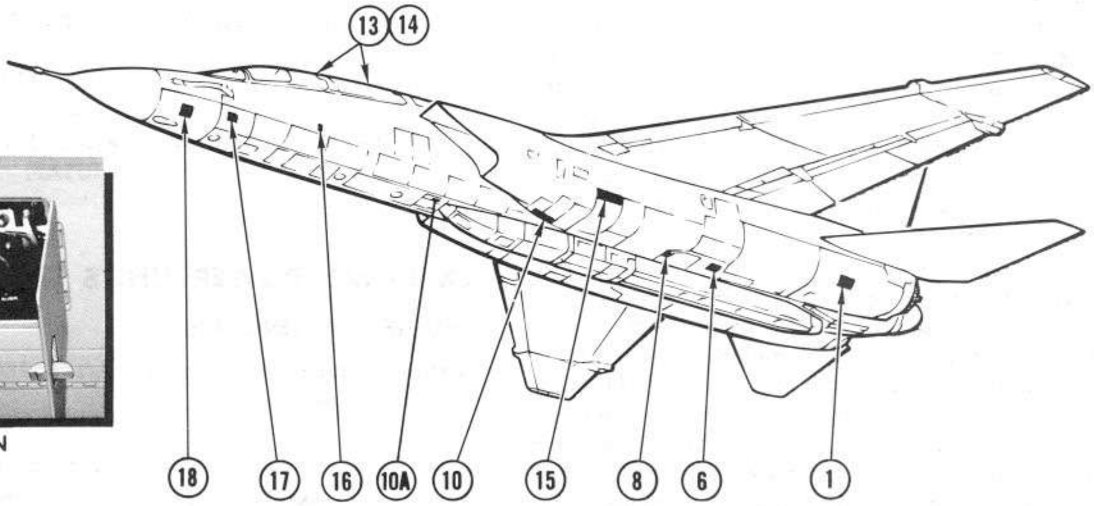
FUEL PUMP TEST PANEL

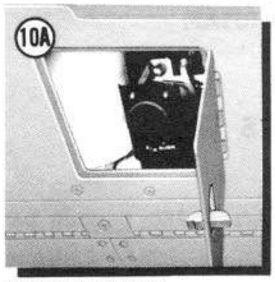
* AIRCRAFT HAVING AFC 223 COMPLIED WITH

† AIRCRAFT 156628 THROUGH 156643 AND AIRCRAFT HAVING AFC 293 COMPLIED WITH

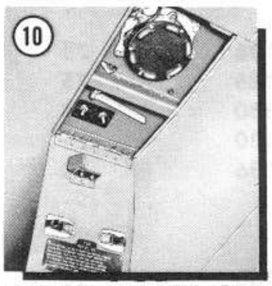
A-5C-1-00-11G

Figure 1-40 (Sheet 1)

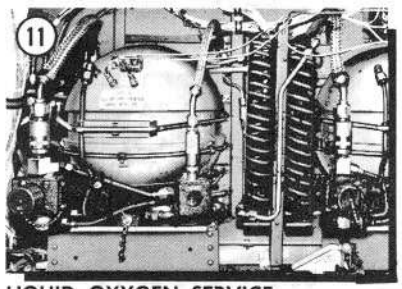




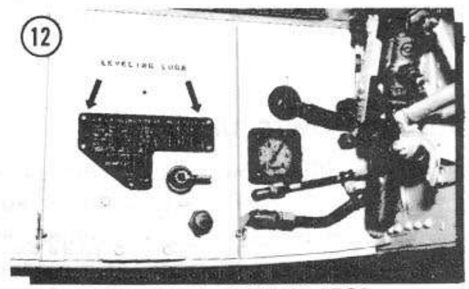
REMOTE ALIGN
CONNECTOR



FORWARD REFUELING
RECEPTACLE
(ALL TANKS)

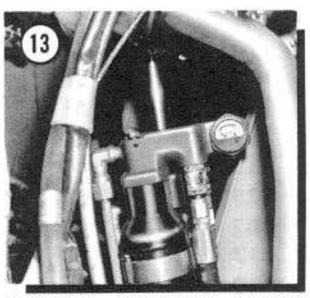


LIQUID OXYGEN SERVICE
(TWO 10 LITER BOTTLES)

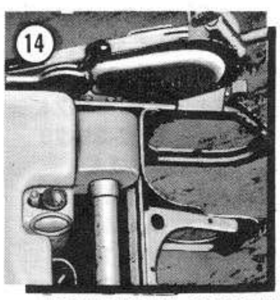


AUXILIARY BRAKE ACCUMULATOR
SERVICE PANEL (PRECHARGE — 1000 PSI)

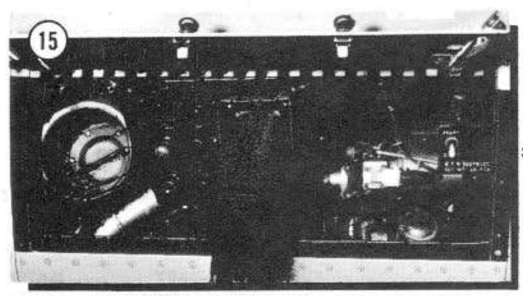
- BRAKE HANDPUMP — RIGHT SIDE
- PUMP HANDLE — STOWED ON LEFT SIDE OF WELL



CANOPY JETTISON GAGES
PRECHARGE-2800 PSI

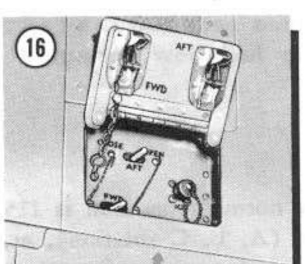


EMERGENCY OXYGEN
1800 TO 2200 PSI

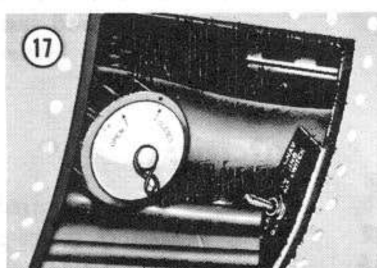


*

EXTERNAL ELECTRICAL POWER AND
EQUIPMENT COOLING RECEPTACLES
* AIRCRAFT HAVING AFC 303 COMPLIED WITH



CANOPY TOGGLE VALVES



AUTONAV COOLING AIR ACCESS
AND SWITCH

AUTO NAV (CHIN PACK) AIR
AND PRE-HEAT SWITCH ACCESS

A-5C-1-00-12E

Figure 1-40 (Sheet 2)

able version of the RCPP-105-1 unit. Internal components include a gas turbine compressor, a 60-kva a-c generator, a turbine refrigeration unit, the required fuel and oil supply, and controls. The pod provides refrigerated air for conditioned systems, engine starting air, and a-c power. Cooling air output temperature may be varied from 50° to 180°F, depending on ambient air temperature. Engine starting air output can be set to 3.6:1 for air turbine start systems, or to 5:1 for turbine impingement starting, as used on this aircraft. For ground aircraft systems operation, 60-kva, 400-cycle a-c electrical power is provided. The power pod can be carried on either inboard wing station, although it is normally transported on the left since the pod refueling receptacle is located on the left fuselage above the main gear wheel door. The pod can be refueled on the ground from the aircraft supply, either by gravity flow or under pressure from the wing transfer pumps. In emergencies, the pod may be jettisoned by the pilot through use of the external jettison button.

B/N AUXILIARY POWER UNIT

The E7488 B/N auxiliary power unit ("chin package") is a self-contained power unit, designed to be attached to the lower forward fuselage. Internal components include an internal combustion engine, an a-c generator, refrigeration unit, required fuel supply, and necessary equipment for mounting. Its purpose is to provide uninterrupted electrical power and temperature-conditioned air to the AN/ASB-12 for alinement operations prior to take-off and for turnaround missions.

SERVICING SPECIFICATIONS

The following materials are required to service the aircraft:

MATERIALS	MILITARY SPECIFICATIONS	NATO CODES
Fuel		
Primary—JP-5	MIL-T-5624 (UK-AvCat)	F-44
Alternate—JP-4	MIL-T-5624 (UK-AvTag)	F-40
—Jet A-1 (U.S. Commercial)	UK AVTUR 50	F-34
Emergency —AVGAS	MIL-G-5572	F-15, F-18, F-22
Hydraulic Fluid	MIL-H-5606	H-515
Engine Oil		
Primary	MIL-L-23699	O-156
Cold Alternate	MIL-L-007808	O-148
Lubricating Oil	MIL-L-6085	O-147
Dry Nitrogen	MIL-N-6011	None
Oxygen		
Gaseous (high pressure)	MIL-O-27210 (Wep), Type I	None
Liquid	MIL-O-27210 (Wep), Type II	None
Liquid or Gaseous (USAF)	MIL-O-27210 (USAF)	None

EXTERNAL POWER UNITS

ENGINE STARTING AIR

Airflow required for normal start is 180 pounds per minute, 75 psia.

		STANDARD DAY PERFORMANCE	
SERVICE	UNIT	POUNDS PER MINUTE	PSIA
NORMAL STARTS			
USN	RCPP-105-1	186	75
USN	RCPT-105-3	186	75
USN	MD-3A	180	75
USN	Wells System	180	75
USAF	GTC-0-105-2	236	78
ACCEPTABLE STARTS			
USN	GTC-85-72	150	50
USAF	MA-2	150	65
USAF	502-7D (Boeing)	182	53
USAF	MA-3MP	150	60
OCCASIONAL USE ONLY (1)			
USN	RC-NCPP-5	110	45
USN	GTC-85-15	110	50
USN	GTC-85-24	117	51
USN	GTC-85-28	122	52
USN	ME-1A	115	50
USAF	MA-1GTC	115	50
USAF	MA-1A(TA)	82	45
USAF	MA-1MP	117	40
USAF	MA-2MP	110	45

(1) Obtain maximum rpm before advancing throttle. Light-off may be commenced as low as 5% rpm, but EGT must be closely monitored and maintained near 600°C by metering or interrupting fuel flow during start

ELECTRICAL

Electrical power required for normal operation is 115 volts, 400 cycles, three-phase (A, B, C rotation), ac, 45 kva. Usable external electrical power units are as follows:

USN UNITS	RATED CAPACITY (KVA)
RCPP-105-1	60
RCPT-105-3	60

NC-5	30/45
NC-6	30
NC-7	30
NC-8	45
NC-10	90
NC-12	125
E7448 (chin package)	4

USAF UNITS	RATED CAPACITY (KVA)
AF/M32A-10	20
B-10, B-10A, B-10B	40
MD-3, MD-3A	60
MD-3M	60
MA-1MP	30
MA-2MP	30
MA-3MP	60

WARNING

To prevent personnel shock and fire hazard, the external power unit must be off before connecting or disconnecting the cable from the aircraft; or before installing or removing the connector adapter; or before modifying the power unit cable.

CAUTION

When using USAF ground power units which have an ac control selector switch incorporated (as in the MD-3 and MD-3A generator sets), the switch must be placed in the AIRCRAFT position before engaging the cable plug to Navy aircraft ac external power receptacle. When using other USAF ground power units, use a Navy cable or a cable adapter. If neither is available, follow the temporary cable modification procedures below.

1. Disconnect cable terminals E and F from the terminal block of the external power source.
2. Connect cable terminals E and F together and cover the connection with insulation to prevent grounding of the circuit.
3. Service aircraft using normal procedures.

CONDITIONED AIR

Cooling air requirements are as follows:

RECEPTACLE	INPUT AIR TEMPERATURE 70°F	50°F
Main (left)	60.0 pm, 4.7 psig	43.0 pm, 3.0 psig
Recon (right)	27.0 pm, 3.0 psig	20.0 pm, 1.6 psig
A/N (forward)	11.5 pm, 2.8 psig	6.0 pm, 0.6 psig

USN UNITS	USAF UNITS
RCPP-105-1	MA-3, MA-7
RCPT-105-3	MA-8, A/M32C-6
NR-2, NR-3	555R
NR-4, NR-5	
NR-7, NR-8	
MD-3A	
E7488 (chin package)	

Note

- Use conditioned air dump valve assembly (E7304) if available to regulate the cooling airflow and temperature at the input receptacles.
- Cooled electronic equipment bus connected loads are inoperative until conditioned air is connected to the aircraft. These loads are automatically disabled upon removal of cooling air.

REFUELING

The aircraft may be refueled by deck edge hoses, trucks, or pits using standard hose couplings. Fuel flow rate desired is 40 to 50 psi and is not to exceed 60 psi. JP-5 fuel should be used if available; however, the alternate and emergency fuels previously listed may be used as necessary.

Note

If AVGAS is used, adjust the main and afterburner fuel control specific gravity to the minimum setting (0.72). If flight time exceeds 5 hours, a fuel nozzle and hot section inspection is required. Top engine speed may have to be adjusted, as lower fuel specific gravity may cause a slight drop in maximum rpm.

GROUND PRESSURE REFUELING

All internal tanks may be refueled in approximately 7 minutes through two pressure refueling receptacles. The forward receptacle is located aft and slightly left of the nose gear well, and the aft receptacle is located aft of the left main landing gear well. Aircraft with four drop tanks can be refueled in approximately 15 minutes. External a-c electrical power is required for refueling the drop tanks and level control valve testing. The aft refueling receptacle can be used to fill only the aft tank and the bomb bay cans, and to fill the sump tank to the 3200-pound level. If the forward receptacle is used alone, complete refueling may require up to 30 minutes. The drop tanks may be separately hose-fueled, if desired.

NORMAL PROCEDURE

For normal refueling, proceed as follows:

1. Check following for freedom from obstruction:
   (a) Main fuel vent outlet on vertical stabilizer.
   (b) Ambient sensing line outlets (forward corner of right-hand intermediate engine access door).
   (c) Drain line outlets (forward corner of right-hand intermediate engine access door).
   (d) Drop tank overboard vent lines (lower forward side of tanks).
2. Ground aircraft with suitable low-resistance ground wire.
3. Check following switches and controls in pilot's cockpit:
   (a) Engine MASTER switches—OFF.
   (b) FUEL PROBE switch—RETRACT.
   (c) Bomb bay CANS switch—NORM.
   (d) WING switch—NORM.
   (e) DROP TANKS switches—off.
   (f) FUEL DUMP handle—completely in.
   (g) ESS FUEL circuit breaker—in.
4. Apply external electrical power.
   Power must be connected and operating for level control valve shutoff test and drop tank refueling.
5. Aircraft power switch (external)—EXT.
6. Open forward refueling door (access number 66:5) and remove cap.
7. Rotate refuel valve handle down.
8. Attach refueling nozzle ground lead to the airframe and connect nozzle by pushing up and turning clockwise to the locked position.
9. Connect a second hose to the aft receptacle (access number 84) if faster refueling is desired.
10. Begin fuel transfer (40 to 50 psi normal and 60 psi maximum).

Note

If difficulty is encountered in attaching the hose, or if leakage is encountered, a spanner wrench adjustment to the nozzle may correct the situation.

11. During first few minutes of refueling, position REFUEL TEST switch to PRI. Fuel flow should become very low within 15 seconds. Repeat procedure with REFUEL TEST switch to SEC. If fuel flow does not become very low within 15 seconds, discontinue refueling operations.
12. Shut down refueling equipment immediately after step 11.
13. Rotate refuel valve handle up and inboard to the defuel and flight position.
14. Reapply refueling pressure to the forward receptacle. *The refueling equipment should show no fuel flow, indicating that the refueling/defueling selector valve is closing properly.*
15. Shut off refueling pressure and return the refuel valve handle to the ground refueling position (down and outboard).
16. Continue refueling until fuel flow stops automatically.
17. Check fuel quantity gage for desired servicing quantities.
18. Secure refueling operation:
   (a) Shut down refueling equipment.
   (b) Refuel valve handle—defuel and flight position (up, inboard).
   (c) Disconnect hoses.
   (d) Secure receptacle caps.
   (e) Close access doors.

HOT REFUELING

The operational need for refueling the aircraft with the engines running is of primary concern when aboard ship and participating in Carrier Qualifications. Also, occasions may arise when the necessary ground support equipment is not available for starting the engines (as in a divert situation), and refueling with engines running becomes necessary. The following procedures are primarily for shipboard operations and are slanted toward Carrier Qualifications, but they may be modified as the situation requires. Complete internal refueling can be accomplished with engines operating in a 15-minute average time by using the forward receptacle. If both the forward and aft receptacles are used, internal tanks may be filled in an average of 7 minutes, and aircraft with four drop tanks may be refueled in approximately 15 minutes.

PREREFUELING CHECKS

1. Have aircraft checked for hot brakes before entering refueling area.
2. Observe the following safety precautions:
   (a) Engine power—IDLE.

(b) Watch the refueling crew for loose clothing, caps, etc, around air intakes.

(c) Be familiar with aircraft gross weight and cg limits for catapulting and arrestment.

(d) Check proper trim settings for fuel loads.

3. Before refueling, refueling crew should accomplish the following:

(a) Vent valve sensing line outlet and ambient sensing line outlets free from obstruction.

(b) Drain lines free from obstruction.

(c) Aircraft properly grounded.

HOT REFUELING PROCEDURE

1. On signal extend fuel probe.
2. When fueling crew signals ready, signal crew to start fueling.
3. When taking on a partial load, the aft receptacle will be used. Monitor the bomb bay cans and when the desired level is reached, retract the fuel probe. Hold the WING switch to AUX until desired total fuel load is reached. Secure fueling, then release WING switch.

CAUTION

If fueling time is extensive, check that fueling pressure has not dropped below 40 psi. Otherwise, fuel venting onto hot exhaust may occur.

4. Check for proper distribution. Refer to the CARQUAL TRIM (CG) CHART in the NATOPS Pocket Checklist (NAVAIR 01-60ABC-1B) to check center of gravity and ensure correct trim.
5. If too much fuel is in the wing, transfer to SUMP by using WING AUX.
6. The forward receptacle will be used for a full load of fuel. The pilot needs only to extend the fueling probe and to signal the fueling crew.

FUEL QUANTITIES AND LOADINGS

See figure 1-8.

*Aircraft having AFC 233 complied with

SYSTEMS SERVICING

HYDRAULIC

The hydraulic systems are serviced with red hydraulic fluid (MIL-H-5606) at access number 90. The temperature of the fluid must be near ambient when checking the systems. The systems must be serviced if the red light is on or if the level in the reservoir sight gage is at or below REFILL. The sight gages may be checked through access numbers 103 and 168:2 on the top of the aft fuselage. Servicing pressure should be 80 to 85 psig at 1.5 gpm flow rate. Do not exceed 120 psig or 1.5 gpm. After servicing, the reservoirs are to be pressurized to 80 to 120 psi with dry nitrogen (MIL-N-6011).

CAPACITIES	U.S. GAL	IMP. GAL	LITERS
No. 1 reservoir	2.30	1.92	8.71
No. 1 system	6.70	5.58	25.36
No. 2 reservoir	5.67	4.72	21.46
No. 2 system	16.80	14.00	63.60

A servicing instructions placard is located inside access number 90. The hydraulic system accumulators are precharged to 1000 (±50) psi with dry nitrogen. The auxiliary brake accumulator is serviced in the nose wheel well and the emergency brake accumulator is serviced in the left main gear well. Servicing instructions placards are located adjacent to the pressure gages.

ENGINE OIL

The engines are serviced with MIL-L-23699 (Wep) oil through access numbers 97:1 and 162. Servicing should be accomplished within 30 minutes after engine shutdown. If this time limit is exceeded, the engine transfer gearbox must be drained of excess oil. Fill capacity for each engine is 5.2 U.S. gallons, 4.34 Imperial gallons, or 19.7 liters. The servicing cart fill line is to be primed full before connection to the aircraft. The oil tank overflow line must drain into a graduated catch can. With the servicing cart set at zero, fill the tank until a minimum of 1 pint of oil overflows into the catch can. Subtract the amount of oil in the catch can from the amount serviced (as indicated on the oil cart quantity gage). Enter the amount of oil serviced and the date in the engine logbook.

Note

MIL-L-7808 oil should be used at starting ambient temperatures below —40°F.

ARRESTING GEAR SNUBBER AND BUMPER

Service the arresting gear snubber and bumper with hydraulic fluid (MIL-H-5606) and dry nitrogen (MIL-N-6011). On some aircraft,* the bumper is serviced only with hydraulic fluid. Either type of bumper requires the arresting gear to be lowered to service the bumper. Servicing instructions are located on the bumper. The snubber is serviced at access number 154 and its service instructions are located on the snubber and inside access number 154.

LANDING GEAR STRUTS

The landing gear struts are serviced with hydraulic fluid (MIL-H-5606) and dry nitrogen (MIL-N-6011). For correct landing gear strut extension, refer to the servicing instructions placard on the upper part of the struts. Servicing instructions placards are located on each strut.

OXYGEN SYSTEMS

The liquid oxygen system is serviced in the nose wheel well. Two 10-liter bottles are installed and may be removed from the aircraft for servicing if desired. A servicing instructions placard is located on the forward bulkhead of the nose wheel well. The emergency seat kit oxygen bottles are serviced in each cockpit. Fill to 1800 to 2200 psi (black area on the gage). Adapter 21000-T130 will be required.

Note

If liquid oxygen converters are emptied completely, or if any portion of the system is left open after maintenance, a complete system purge and refill is mandatory before flight.

PNEUMATIC SYSTEMS

The pneumatic system storage bottles are serviced to 2800 to 3200 psi with clean dry air or dry nitrogen (MIL-N-6011) at access number 177. Servicing instructions are located on the inside of access number 177. The pneumatic compressor reservoir is serviced in the right main gear well with MIL-L-6085 oil. The oil level is checked with a dip stick attached to the filler cap. Remove the cap, clean the dip stick, replace the cap finger-tight, and then remove again to check oil level. The cap is to be safety-wired after servicing is completed.

On some aircraft,* an additional canopy seal valve is provided in the nose wheel well for manually pressurizing the canopy seals after they are closed to secure the aircraft in heavy rain. The valve incorporates a control button which can be depressed for 20 psi air pressurization of both canopy seals. Using the normal control toggle valves to open the canopies automatically depressurizes the seals before canopy movement occurs. Manual depressurization of the seals can also be accomplished by pulling the canopy seal valve control knob outward to its normal, vent position.

*Aircraft having AFC 280 complied with

TIRES

All tires are serviced with dry air or dry nitrogen (MIL-N-6011). Tire pressure tolerance is ±5 psi.

TIRE	LAND (PSI)	CARRIER (PSI)
Main Gear, 36 x 11, Type VII, 28-ply	325	325
Nose Gear, 26 x 6.6, Type VII, 16-ply	325	325

PITOT-STATIC DRAINS

Pitot-static drains are located inside the radome fold and under access number 222. Remove the caps, drain any moisture, and replace the caps.

HIGH-PRESSURE AIR VALVES

The landing gear struts, arresting gear snubber, arresting hook bumper, hydraulic accumulators, and pneumatic system have high-pressure air valves. After servicing, these valves must be tightened and torqued. Torque valves are:

Valve body .... 100—110 inch-pounds
Valve swivel nut .... 50—70 inch-pounds

DANGER AREAS

NOISE AREAS

The aircraft engines produce noise and heat blast when operating. See figure 1-41. Danger areas are to be avoided and protective ear covering *must* be worn in noise danger areas. In addition, caution should be observed when near the wing fold BLC and nacelle jet pump exhaust ports.

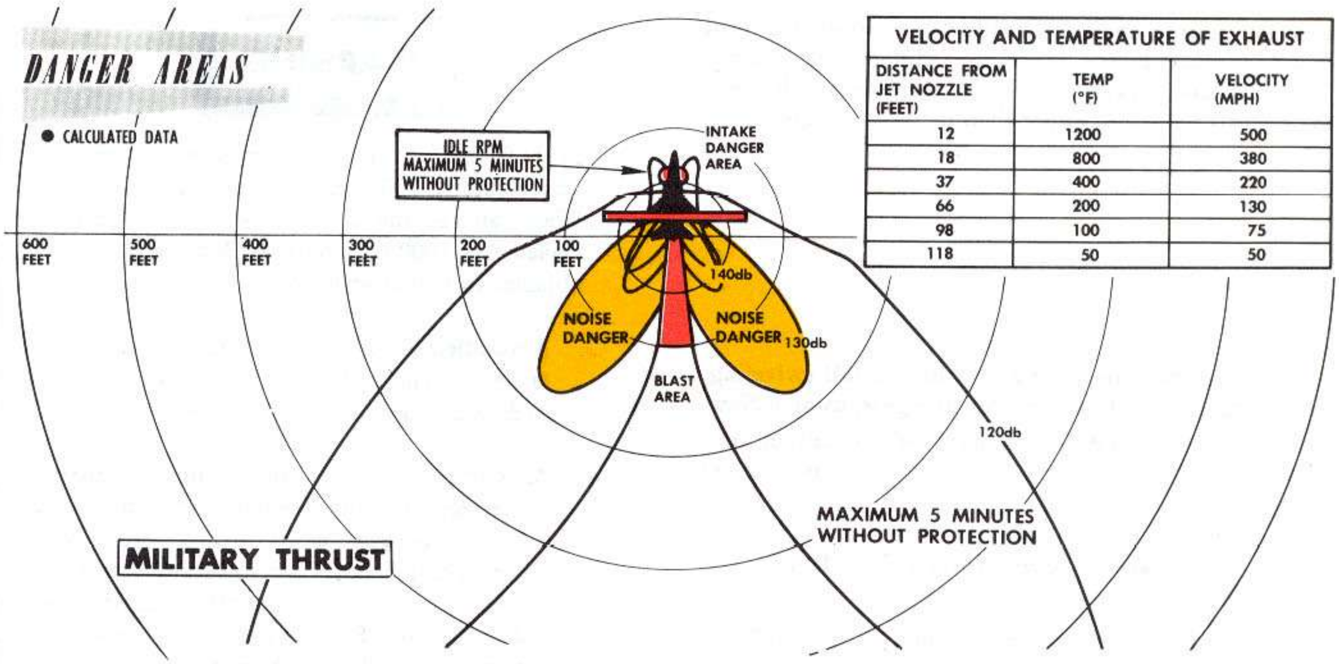
MOVABLE SURFACES

When electrical and hydraulic power are applied to the aircraft, there are numerous surfaces which can cause injury to personnel and damage to the aircraft and equipment if these surfaces are inadvertently operated. Only *qualified* personnel should be permitted to be in the cockpits or to operate these surfaces.

GROUND HANDLING

TURNING RADIUS

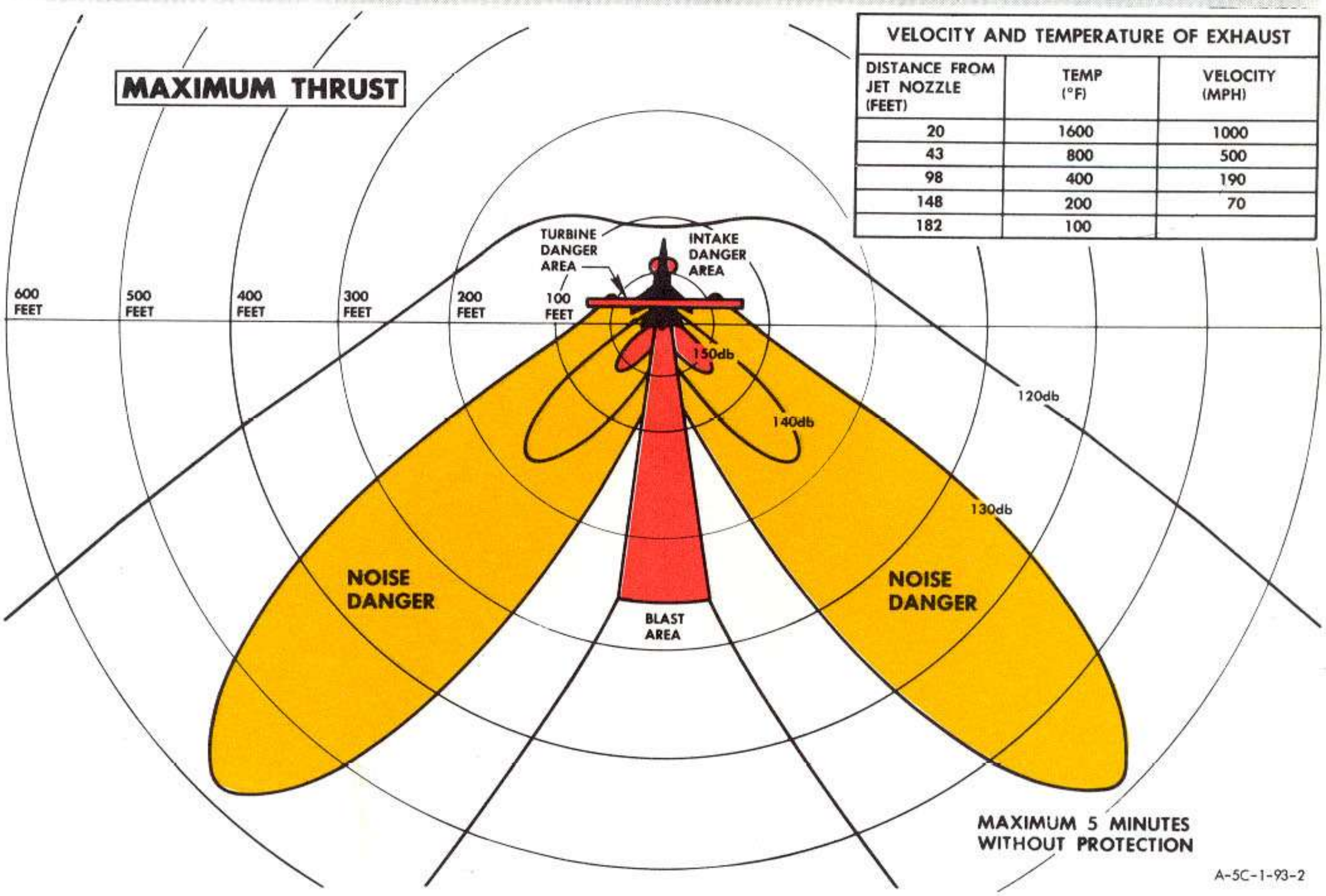
While being taxied, the nose wheel is steerable up to 75 (±5) degrees (flaps up) either side of center. The



VELOCITY AND TEMPERATURE OF EXHAUST		
DISTANCE FROM JET NOZZLE (FEET)	TEMP (°F)	VELOCITY (MPH)
12	1200	500
18	800	380
37	400	220
66	200	130
98	100	75
118	50	50

NOTE:

- WHEN FULL A/B RUN-UP IS MADE, PERSONNEL MUST REMAIN CLEAR OF ALL DANGER AREAS.
- IF BLAST DEFLECTOR IS USED, DANGER PATTERNS ARE DISTORTED DUE TO REFLECTION.
- PERSONNEL WITHOUT EAR PROTECTION MUST REMAIN CLEAR OF NOISE DANGER AREAS.
- WHEN DROOPS ARE EXTENDED WITH WINGS FOLDED, USE CAUTION TO AVOID HIGH VELOCITY, HIGH TEMPERATURE BOUNDARY LAYER CONTROL AIR FROM WING FOLD AREA.



VELOCITY AND TEMPERATURE OF EXHAUST		
DISTANCE FROM JET NOZZLE (FEET)	TEMP (°F)	VELOCITY (MPH)
20	1600	1000
43	800	500
98	400	190
148	200	70
182	100	

Figure 1-41

shortest turning radius is made by releasing the nose wheel steering button and using differential braking. For congested area movement, it is recommended that the aircraft be towed rather than taxied. See figure 1-42.

TOWING

For towing operations, the nose wheel is full swiveling. The aircraft can be towed by the nose gear, using a Navy universal tow bar (NT-2 Model 3 or similar) of suitable length. For towing operations, proceed as follows:

1. Ensure landing gear pins are installed.

2. Check auxiliary brake accumulator for 1800 psi minimum charge, if necessary, charge accumulator using hand pump adjacent to gage in nose wheel well. Pump handle is stowed on the left hand side of the nose wheel well. Check and note emergency brake accumulator pressure.

WARNING

In both the auxiliary and emergency brake accumulators, 1000 psi is a precharge only. When an accumulator pressure has been depleted to 1000 psi, no further braking can be obtained from that accumulator.

3. A qualified person who is familiar with the aircraft brake system operation shall man the pilots cockpit during all towing evolutions.

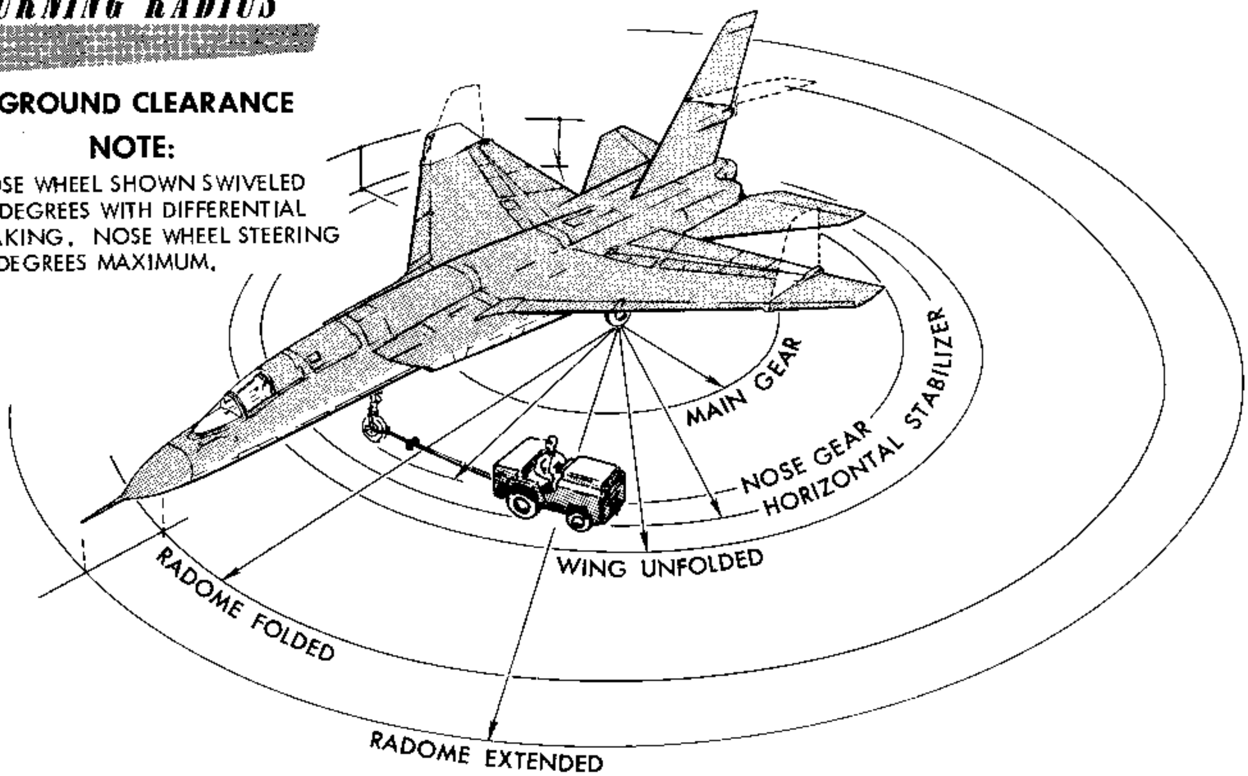
4. An outside observer shall monitor the auxiliary brake accumulator repeater gage on the left forward fuselage until towing evolution is completed. If auxiliary accumulator pressure drops to 1400 psi or below, the aircraft shall be stopped and chocked. Prior to further towing, the accumulator shall be recharged to a minimum of 1800 psi.

5. Prior to removing the tractor and/or towbar the aircraft shall be chocked.

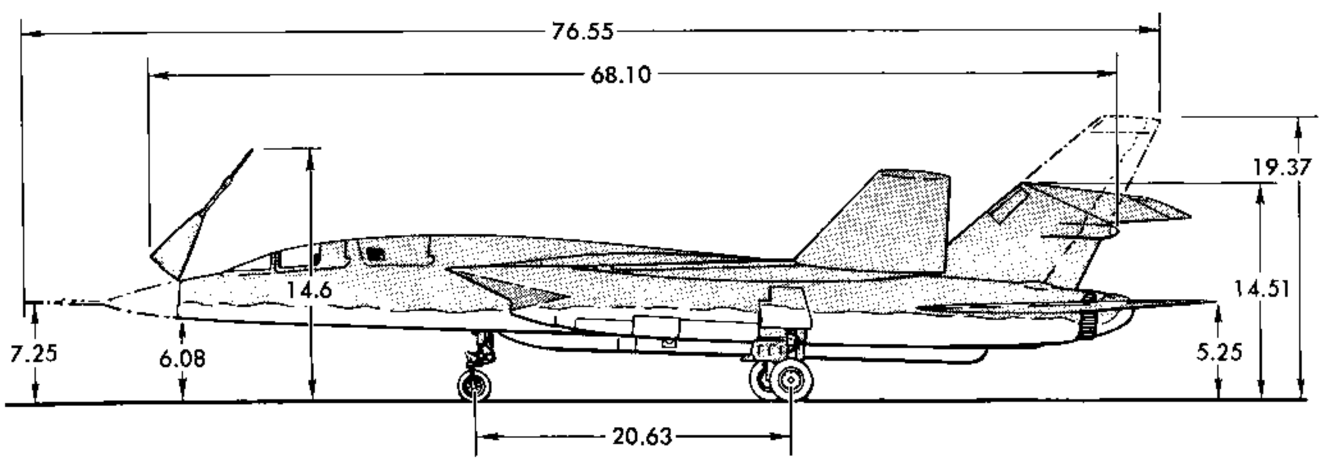
TURNING RADIUS

• GROUND CLEARANCE

NOTE:
NOSE WHEEL SHOWN SWIVELED 90-DEGREES WITH DIFFERENTIAL BRAKING. NOSE WHEEL STEERING 75 DEGREES MAXIMUM.



TURNING RADIUS



GROUND CLEARANCE

TURNING RADIUS			
MAIN GEAR TRACK	11.62 FT	HORIZONTAL STABILIZER	32.14 FT
NOSE GEAR TRACK	21.82 FT	WING UNFOLDED	34.86 FT
VERTICAL STABILIZER	19.40 FT	RADOME FOLDED	43.12 FT
WING FOLDED	28.00 FT	RADOME EXTENDED	49.83 FT

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Figure 1-42

PART 4 — OPERATING LIMITATIONS

INTRODUCTION

This part covers all limitations and flight restrictions which must be observed for safe operation. Instrument markings are illustrated in figure 1-43. The limitations and flight restrictions contained in this part are applicable to all RA-5C aircraft (145157 through 151728 and 156608 through 156643) unless otherwise noted.

ENGINE LIMITATIONS

For a tabulation of engine operating limits, see figures 1-43 and 1-44. See figure 5-2, in Section V of this manual for the engine operating envelope.

Note

The term "remedy," as used in ENGINE OPERATING LIMITS, indicates a requirement for trouble shooting and corrective action to prevent recurrence.

AFTERBURNER LIGHT-OFF AND ROLLBACK

Afterburners should light off within 3 seconds after throttles are moved into afterburning range. On light-off, rpm drop (rollback) of 7% is acceptable, to a minimum of 87% rpm.

OIL PRESSURE

On aircraft having the J79-GE-8 engines installed, minimum oil pressure at idle rpm is 12 psi. At 100% rpm, minimum oil pressure is 40 psi. Normal oil pressure at Military Thrust should be noted prior to each flight. In-flight readings 3 to 5 psi lower than noted normal pressure may be expected, with maximum reductions of as much as 7 psi at maximum flight speeds. Any greater variation from normal should be investigated.

Note

Under conditions of governor override (rpm droop due to altitude or temperature cutback), normal oil pressure decreases about 1 psi for each percent rpm below 100%.

On aircraft having the J79-GE-10 engines installed, minimum oil pressure at idle rpm is 12 psi. At 100% rpm, minimum oil pressure is 40 psi. From flight to flight, indicated oil pressure must repeat within 5 psi of known normal pressure for a particular engine/aircraft combination. During T_2 cutback or any other engine speed reduction, oil pressure will decrease approximately 1 psi per 1 percent reduction in rpm. High oil temperatures can decrease oil pressure as much as 5 psi. During steady-state operation, any erratic pressure change which exceeds 5 psi for more than 5 seconds must be investigated.

OIL PRESSURE FLUCTUATIONS

Oil pressure fluctuations are permitted at altitudes of 20,000 feet and above as follows:

1. A maximum oil pressure fluctuation of 20 psig below normal for a maximum of 3 seconds per drop not to exceed four occurrences per minute.
2. A maximum oil pressure fluctuation of 10 psig below normal for a maximum of 1 second per drop not to exceed 15 occurrences per minute.

ZERO "G"

To prevent starvation of CSD oil supply, intentional flight at zero "g" is not recommended and shall be avoided.

INSTRUMENT MARKINGS

See ENGINE OPERATING LIMITS for additional data.

ALLOWABLE OVERSPEED - 102% (IN FLIGHT)

TACHOMETERS

J79-GE-10

MAXIMUM FOR ACCELERATION — 750°C *

MAXIMUM TEMPERATURE FOR CONTINUOUS USE *

* (See J79-GE-10 ENGINE EGT AND RPM SCHEDULE)

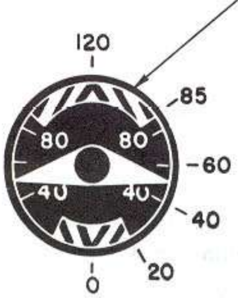
J79-GE-8

MAXIMUM FOR ACCELERATION — 749°C

MAXIMUM TEMPERATURE FOR CONTINUOUS USE — 635°C

EGT INDICATORS

DIAL LIMIT MARKINGS NOT APPLICABLE TO RA-5C

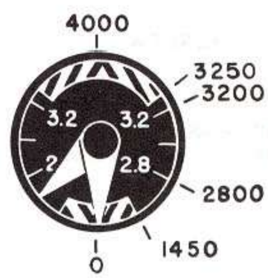


MAXIMUM — 70 PSI

NORMAL OPERATION— 40 TO 70 PSI (100% RPM)

NORMAL IDLE MINIMUM — 12 PSI

OIL PRESSURE INDICATORS



MAXIMUM — 3250 PSI

ACCEPTABLE STATIC RANGE — 2800 TO 3250 PSI

HYDRAULIC PRESSURE INDICATORS

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Figure 1-43

ENGINE OPERATING LIMITS

J79-GE-8A

NOTE: All instances of engine operation beyond limits set forth in this table must be recorded on the "aircraft data sheet".

OPERATING CONDITIONS	MAXIMUM EGT °C	MAXIMUM ENGINE SPEED % RPM	MINIMUM OIL PRESSURE (PSI)	TIME LIMIT	ACTION
STARTING	980 749—980		Indication Indication	Momentary Constant Motion	Reject Reject
OTHER THAN STARTING	749 720 660 644			3 sec 12 sec 30 sec 60 sec	Reject Reject Reject Reject
IDLE	635	65±0.7	12		
NORMAL THRUST (MAX CONTINUOUS)		96		None	
MILITARY THRUST	625±10	100±0.5	40	Below 35M — 30 Minutes Above 35M — 2 Hours	
MAXIMUM THRUST	625±10	100±0.5	40		
ALLOWABLE OVERSPEED (GROUND)		100—103 103—105 103—105 103—105 Over 105		No time limit 0—3 minutes 3—6 minutes Over 6 minutes Each time	Readjust Remedy Tip shake inspection Overhaul Overhaul
ALLOWABLE OVERSPEED (IN-FLIGHT)		100—102 102—103.6 102—103.6 102—103.6 Over 103.6		No time limit 0—1 minute 1—3 minutes Over 3 minutes Each time	Readjust Remedy Tip shake inspection Overhaul Overhaul

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Figure 1-44 (Sheet 1)

NEGATIVE "G"

Intentional flight at negative "g" conditions shall be limited to 30 seconds.

WINDMILL RPM

Windmill engine rpm must be maintained at not less than 7% to ensure proper engine lubrication and is limited to 40,000 feet maximum altitude. Windmilling below 7% rpm is limited to 10-minute intervals. The number of intervals below 7% rpm is not limited if the engine is operated, either running or windmilling above 7% for 10 minutes or more between intervals.

ZOOM CLIMBS

During afterburner climbs above 50,000 feet, the throttles should be modulated, if required, to avoid exceeding the steady-state EGT limit. See figures 1-44, 1-45 and 1-45A.

Note

In the event of afterburner blowout, monitor engine rpm; if indications of definite overspeed are noted, shut down the engine.

FUEL FLOW

On aircraft having the J79-GE-8 engines installed, at sea level, Standard Day fuel flow at stabilized Mili-

ENGINE OPERATING LIMITS

NOTE: All instances of engine operation beyond limits set forth in this table must be recorded on the "aircraft data sheet".

J79-GE-10

OPERATING CONDITIONS	MAXIMUM EGT °C	MAXIMUM ENGINE SPEED % RPM	MINIMUM OIL PRESSURE PSI	TIME LIMIT	ACTION
STARTING	980 749-980		INDICATION INDICATION	EACH TIME CONSTANT MOTION	OVERHAUL REMEDY -
OTHER THAN STARTING	(-10) ABOVE 750 (-10B) ABOVE 775 (-10) 680-750 (-10B) 705-775			3 SEC WITH CONSTANT MOTION 30 SEC	OVERHAUL REMEDY -
IDLE	(-10) 671 (-10B) 696	65 ± 1%	12		
NORMAL THRUST (MAX CONTINUOUS)		96.7		NONE	
MILITARY THRUST	REFER TO J79-GE-10 ENGINE EGT AND RPM SCHEDULE		40 AT 100% RPM	BELOW 35M - 30 MIN ABOVE 35M - 2 HOURS	
MAXIMUM THRUST					
ALLOWABLE OVERSPEED (GROUND)		100-103 103-105 103-105 103-105 OVER 105		NO TIME LIMIT 0 - 3 MINUTES 3 - 6 MINUTES OVER 6 MINUTES EACH TIME	READJUST REMEDY - TIP SHAKE INSPECTION OVERHAUL OVERHAUL
ALLOWABLE OVERSPEED (INFLIGHT)		100-102 102-103.6 102-103.6 102-103.6 OVER 103.6		NO TIME LIMIT 0 - 1 MINUTES 1 - 3 MINUTES OVER 3 MINUTES EACH TIME	READJUST REMEDY - TIP SHAKE INSPECTION OVERHAUL OVERHAUL

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Figure 1-44 (Sheet 2)

tary Thrust in static condition should be approximately 8000 pph per engine, in flight at 0.92 Mach, approximately 12,500 pph per engine. On aircraft having the J79-GE-10 engines installed, the fuel flow at sea level should be approximately 8700 pph for a 59°F day, approximately 8900 pph for a 0°F day, and 8000 pph for a 90°F day, but within 200 pph between engines.

AIRSPEED LIMITATIONS

Maximum permissible airspeeds are as follows:

1. In smooth or moderately turbulent air:

With or without reconnaissance fairing installed, landing gear, wing flaps, and arresting hook retracted .... As shown in figure FO-16

With external stores .... As shown in figure FO-16

With arresting hook extended .... 250 KIAS

With landing gear extended .... 230 KIAS

With wing flaps extended:

- 30 degrees .... 290 KIAS
- 40 degrees .... 255 KIAS
- 50 degrees .... 230 KIAS

With speed brakes extended .... 600 KIAS at 5000 feet and below (no stores)
570 KIAS, 20,000 feet and below (with external stores)

YAW AUG AIRSPEED LIMITS

- NO EXTERNAL STORES

YAW AUGMENTATION SYSTEMS "ON"	MAXIMUM SPEED WITH BANK ANGLE CHANGE LIMITED TO 60° (1)	MAXIMUM SPEED WITH BANK ANGLE CHANGE UNLIMITED
BOTH	LIMIT SPEED OF BASIC AIRCRAFT	MACH 1.7 OR 650 KCAS (WHICHEVER IS LESS)
SINGLE	MACH 1.7 OR 650 KCAS (WHICHEVER IS LESS)	MACH 1.4 OR 550 KCAS (WHICHEVER IS LESS)
NONE	MACH 1.4 OR 550 KCAS (WHICHEVER IS LESS)	MACH .9 OR 450 KCAS (WHICHEVER IS LESS)

(1) CONDITIONS
(a) NO ABRUPT LATERAL CONTROL INPUTS
(b) NO STEADY YAW
(c) NO ENGINE SHUTDOWN

FOR LIMITS WITH EXTERNAL STORES SEE FIGURE FO 16

RA 5C 1 93 99

Figure 1-44A

With cruise droops extended . . . . No limit (refer to MANEUVERING LIMITATIONS)

With four external tanks, pitch augmentation off . . . . 0.9 IMN or 360 KCAS, whichever is less

CAUTION

Should pitch augmentation monitor off at greater than 360 KCAS when carrying four external tanks, longitudinal stick forces become very sensitive, and excessive nose-down pitch occurs with speed brake extension. Reduce air-speed to less than 360 KCAS before attempting to re-engage pitch augmentation or extend speed brakes. Similar though not as aggravated characteristics may also occur on aircraft with no stores.

With either or both yaw augmentation systems inoperative See figure 1-44A

With air refueling probe extended . . . . 280 KEAS (figure FO-16)

With ramp control system inoperative . . . . 1.4 IMN

Note

Should the ramp control system become inoperative, speed must be restricted to avoid possible damage due to inlet duct buzz.

With RAT extended . . . . no speed limit.

2. In severe turbulence:
The aircraft should not be operated in conditions of severe turbulence because gusts can be encountered that may impose excessive accelerations. However, if flight in severe turbulence cannot be avoided, flight shall be conducted in the speed range of 75 to 100 knots above stalling speeds.

MANEUVERING LIMITATIONS

The following maneuvers are NOT permitted:

1. Spins, stalls, or any maneuver such as exceeding 19 units angle of attack in the cruise configuration (25 units in field take-off configuration) which might result in an inadvertent spin.

2. Rolls in excess of 360 degrees.

CAUTION

With pitch augmentation on, 360-degree rolls should not be conducted below 5000 feet AGL at airspeeds less than 250 KCAS due to the excessive loss of altitude which can result.

3. Bank angle changes in excess of 60 degrees, abrupt lateral control inputs, steady yaw, and engine shut-down are prohibited at speeds in excess of those depicted in figures 1-44A and FO-16. See figure 1-44A.

4. With cruise droops extended, lateral control deflections in excess of one-half at airspeeds greater than the 70-degree spoiler limit shown in figure FO-16.

5. Over-the-shoulder LABS maneuvers are not permitted with asymmetric load greater than 500 pounds at wing station 175.

6. Only lateral control for wings level flight or normal turns is permitted when carrying one 400-gallon external fuel tank, three-quarters or more full, at wing station 175 on the side, NOT balanced by a tank with equal fuel at wing station 175 on the opposite side.

Note

The preceding restrictions apply to all RA-5C aircraft. In addition, for aircraft 156608 and subsequent and aircraft 145157 through 151728 having AFC 328 complied with, do not exceed 19 units angle of attack (other than brief transient overshoots) in the catapult take-off configuration.

ACCELERATION LIMITATIONS

Except that moderate and heavy buffeting shall be avoided, the maximum permissible accelerations for flight in smooth or lightly turbulent air without external stores are shown in figure FO-16. Maximum accelerations with external stores are shown in figure 1-46. When flying in conditions of moderate turbulence, it is essential that accelerations resulting from deliberate maneuvers be reduced 1.0 "g" below that shown in figure FO-16 for symmetrical flight. This minimizes the possibility of overstressing the aircraft as a result of the combined effects of gust and maneuvering loads. At gross weights above 53,000 pounds, the maximum permissible accelerations decrease as shown in figure FO-16.

Note

- Cockpit readings above 3.0 "g's" may mean that the aircraft 4.0 "g" meter has been tripped.
- The rolling acceleration limit is that acceleration permitted while simultaneously rolling the aircraft at maximum roll rate. Symmetrical flight is defined as a constant-wing attitude; therefore, it is acceptable technique to roll to the desired bank angle and then pull "g" to the symmetrical limit.

With landing gear and/or flaps extended at the basic take-off gross weight of 64,000 pounds or less, **accelerations resulting from deliberate maneuvers shall not** exceed 0.0 to 2.0 "g's."

Note

- Only under emergency combat conditions and at altitudes of 15,000 feet and below, the maximum permissible positive acceleration for the reconnaissance configuration for flight in smooth or lightly turbulent air is 5.0 "g's" at gross weights up to 56,500 pounds. At gross weights above 56,500 pounds, the maximum permissible positive acceleration is based upon a constant acceleration-weight product and is calculated as follows:
  Maximum Permissible Acceleration =
  $$\frac{282{,}500}{\text{Gross Weight}}$$
- The maximum permissible positive acceleration for rolling maneuvers under the conditions previously described is 0.8 of the permissible acceleration for symmetrical maneuvers, and the maximum permissible negative acceleration is as shown in figure FO-16.

WEIGHT LIMITATIONS

Maximum recommended gross weights are as follows:

Field take-off	80,000 pounds
Field landing (minimum rate of descent)	58,000 pounds
Field landing (other than minimum rate of descent), FMLP, and field arrestments	50,000 pounds

CAUTION

Minimum rate-of-descent field landings at gross weights in excess of 58,000 pounds are permitted only in an emergency.

J79-GE-10 ENGINE EGT AND RPM SCHEDULE

MILITARY AND AFTERBURNER THROTTLE POSITIONS

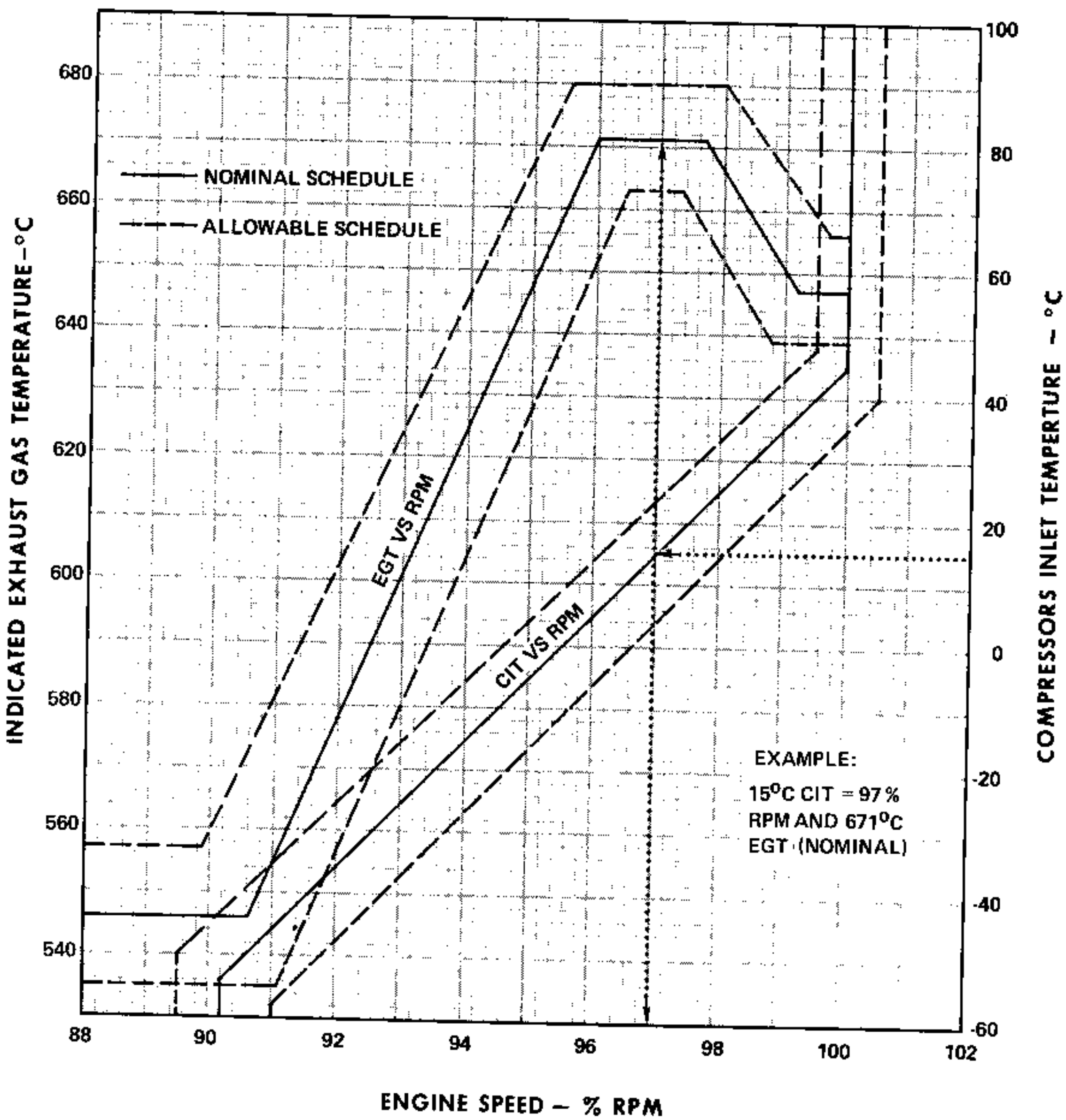

Figure 1-45

J79-GE-10B ENGINE EGT AND RPM SCHEDULE

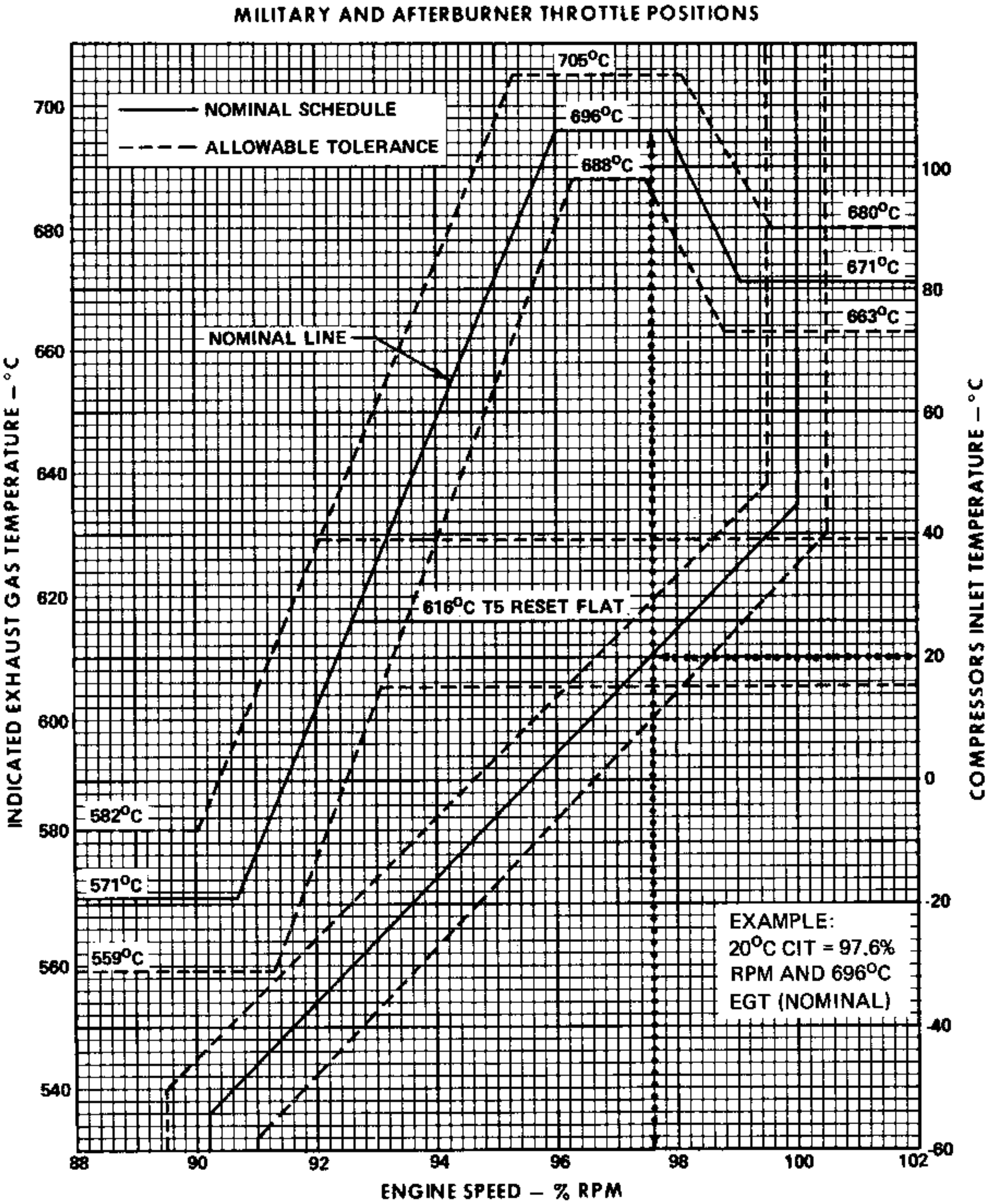

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Figure 1-45A

CAUTION

The glide slope for FMLP at gross weights in excess of 47,000 pounds shall not exceed 3 degrees.

Catapult launch	80,000 pounds
Carrier arrestments	50,000 pounds
Barricade engagements	49,000 pounds

CENTER-OF-GRAVITY LIMITATIONS

The center of gravity for all permissible gross weights, with or without reconnaissance fairing, flasher pods, or empty wing pylons installed, should be maintained between 25.4 and 34.0 percent MAC. For all other external store loadings, refer to the Weight and Balance Data Manual (NAVAIR 01-1B-40) for details regarding center-of-gravity limitations. CG computations, stability limits, and pitch trim for all 50/50 flaps/droops catapults can be easily determined through Carqual trim (cg) charts, load index charts, and cg locator charts. PMCF hops with no cans require precise calculations of fuel load limits especially in the forward and wing tanks.

Center-of-gravity limitations can be exceeded by improper fuel management or by failure of the fuel sequencing system, resulting in cg locations outside allowable limits. Should an extreme aft cg be encountered, the aircraft may become difficult to control in pitch at subsonic cruise speeds and at low-altitude run-in speeds. Should an aft cg be encountered, caution should be exercised during low-altitude missions. Should a cg forward of the structural limit be encountered, aircraft structural loads during maneuvers will be increased. Under this condition, maneuvering is limited to that required for normal flying as defined by NAVAIRINST 3710.2 series. Refer to Section IV and V for landing procedures with a forward or aft cg.

WARNING

Before take-off with a partial fuel load (no wing tank, forward tank, or drop tank fuel), at least 2000 pounds of fuel must be transferred from the bomb bay cans to the forward and sump tanks, or a dangerously aft cg condition will exist.

EXTERNAL STORES

Only the external stores listed in figure 1-46 may be carried and released, singly or in combination, to the limits shown.

MISCELLANEOUS LIMITATIONS

1. Fuel dumping is not permitted during afterburner operation unless safe flight cannot be maintained otherwise.
2. Should failure of intake secondary airflow scheduling cause engine compartment overpressure (ENG DOOR caution indicator on, with gear and flaps retracted), airspeed should be limited to subsonic flight. Cruise power settings may be utilized as required up to 35,000 feet. In the event a fire warning light is encountered, reduce throttle setting and altitude as required to extinguish the warning light.

Note

Below 25,000 feet with the landing gear and flaps extended, power is unrestricted.

3. Installation of air transportable container (E6575) ONLY is authorized and bomb bay fuel cans must be removed. Airspeed limits with clothing in container are as follows:

ALTITUDE (FEET)	MN
Sea level	0.94
10,000	1.15
20,000	1.36
30,000	1.57
36,000 and above	1.69

Note

Container internal temperature may exceed 180°F if these speeds are exceeded.

4. If the AN/ALQ-126 is not installed, gear shall not be stowed in the starboard AN/ALQ-126 bay. The stowage of gear in the port AN/ALQ-126 bay is permissible.

WARNING

Engine bleed air line temperatures in the starboard AN/ALQ-126 bay may ignite clothing stored there.

5. Engaging AFCS below 500 feet above terrain or at less than 0.5 IMN unless on ACLS approach.

EXTERNAL STORES LIMITATIONS

STORES		WING STATION LEFT 175	WING STATION LEFT 110	WING STATION RIGHT 110	WING STATION RIGHT 175	MAXIMUM AIRSPEED OR MACH NUMBER WHICHEVER IS LESS — CARRIAGE	MAXIMUM AIRSPEED OR MACH NUMBER WHICHEVER IS LESS — RELEASE	MAXIMUM ACCELERATION ("g" UNITS)	REMARKS
EMPTY PYLONS			X	X		See OPERATING FLIGHT LIMITS in FOLDOUT section		Carrying; Sym. flight: −1.8 to +4.5 Rolling: 0.0 to +3.6	Maximum jettison speed= 0.95 IMN. Maneuvering limits same as clean airplane.
EMPTY PYLONS		X			X	See OPERATING FLIGHT LIMITS in FOLDOUT section		Carrying; Sym. flight: −1.8 to +4.5 Rolling: 0.0 to +3.6	Maximum jettison speed= 0.95 IMN. Maneuvering limits same as clean airplane.
EMPTY PYLONS		X	X	X	X	See OPERATING FLIGHT LIMITS in FOLDOUT section		Carrying; Sym. flight: −1.8 to +4.5 Rolling: 0.0 to +3.6	Maximum jettison speed= 0.95 IMN. Maneuvering limits same as clean airplane.
NIGHT FLASHER PODS			X	X		See OPERATING FLIGHT LIMITS in FOLDOUT section		Carrying; Sym. flight: −1.8 to +4.5 Rolling: 0.0 to +3.6	Maximum jettison speed= 0.95 IMN. Maneuvering limits same as clean airplane.
400 GALLON FUEL TANKS	Full, Partial or Empty		X	X		See OPERATING FLIGHT LIMITS in FOLDOUT section		Carrying; Sym. flight: −1.5 to +4.0 Rolling: 0.0 to +3.2	Do not jettison at accelerations less than +1.0 "g" nor at airspeeds greater than 0.95 IMN.
400 GALLON FUEL TANKS	Empty	X			X	See OPERATING FLIGHT LIMITS in FOLDOUT section		Carrying; Sym. flight: −1.5 to +4.0 Rolling: 0.0 to +3.2	Do not jettison at accelerations less than +1.0 "g" nor at airspeeds greater than 0.95 IMN.
400 GALLON FUEL TANKS	Full or Partial	X			X	See OPERATING FLIGHT LIMITS in FOLDOUT section		Carrying; Sym. flight: −1.5 to +4.0 Rolling: 0.0 to +3.2	Do not jettison at accelerations less than +1.0 "g" nor at airspeeds greater than 0.95 IMN.
400 GALLON FUEL TANKS	Full, Partial or Empty	X	X	X	X	See OPERATING FLIGHT LIMITS in FOLDOUT section		Carrying; Sym. flight: −1.5 to +4.0 Rolling: 0.0 to +3.2	Do not jettison at accelerations less than +1.0 "g" nor at airspeeds greater than 0.95 IMN.
ALQ-31 ECM POD			X	X		500 KIAS or 0.95 IMN		Carrying; Sym. flight: −1.5 to +4.0 Rolling: 0.0 to +3.2	

NOTE:

1. The limits shown in OPERATING FLIGHT LIMITS (FOLDOUT section) shall take precedence when less than the values stated above.
2. When stores are carried in combination, the lowest limits permitted shall be observed.
3. Airspeed limitations shown are for either symmetrical or asymmetrical external store loadings.
4. Only minimum rate of descent field landings are permitted with fuel in external tanks, or asymmetrical external store loadings in excess of 2500 pounds. External loadings include store, pylon and rack.

Figure 1-46

6. Field crosswind component (90 degrees) limits:

   (a) 15 knots normal landing/arrestment
   (b) 10 knots single engine landing/arrestment, or normal nose high aerodynamic braking.

CAUTION

Main gear structural loading may be exceeded if 15 knot crosswind component exceeded.

7. Flight without linear bombay tail cone is not recommended due to possibility of fuel ingestion/ entrapment in bombay tunnel in the event of fuel dumping.

CARRIER OPERATION LIMITATIONS

1. Catapulting with a center-of-gravity location forward of the following conditions is NOT permitted:

END AIRSPEED	FORWARD CG LIMIT (PERCENT MAC)
Minimum	29.5
Minimum, plus 10 knots	28.0
Minimum, plus 15 knots	27.0

2. Catapulting with partially full integral wing fuel tanks (between 1200 and 8600 pounds) is not permitted. If less than 1200 pounds of fuel in integral wing fuel tanks, asymmetrical moment shall be calculated by multiplying actual pounds of fuel in integral wing fuel tanks times 230 inches. (Moment equals actual pounds times 230 inches). If more than 8600 pounds are in integral wing fuel tanks, subtract actual pounds of fuel from 9724 and multiply this difference times 230 inches. (Moment equals 9724 minus actual pounds times 230 inches).

Note

Fuel in over-wing tank is not considered in these calculations.

3. Carrier operations are permitted with stores at wing stations 110 and 175.

4. Catapulting and arrested landings in an asymmetrical configuration which produces a moment greater than 275,000 inch pounds are not permitted. The asymmetric load at the outboard wing stations times 175 inches plus the asymmetric load at the inboard wing stations times 110 inches plus the moment from asymmetric fuel loading in intregral wing fuel tanks (item 2 above) shall not exceed 275,000 inch pounds.

Note

With no external stores, wing fuel asymmetry is not a factor for arrested landings.

5. Arrested landings with fuel in the external wing tanks, or with more than 2000 pounds of fuel in the bomb bay cans (two-can configuration) or 4000 pounds (three-can configuration), are not permitted except in an emergency. Field landings should be utilized, with rate of descent at touch-down restricted to a minimum.

6. For barricade engagements, jettison external stores if possible. Stores will not interfere with barricade engagement but may tear loose and present a hazard to flight deck personnel.

7. Current Aircraft Launching and Recovery bulletins apply.

SECTION II—INDOCTRINATION

TABLE OF CONTENTS

INTRODUCTION

The standardized procedures in this manual are directed primarily to operational squadrons, but are also used as a basis for establishing procedures within the training squadrons. The assumption is made that flight crew members reporting to operational squadrons will have qualified in basic readiness training in a Reconnaissance/Attack Training Squadron. Training to attain final readiness is accomplished in the operational squadrons. It is important that all flight crews realize a maximum of training during each operational flight. Unit commanding officers are authorized to waive any of the minimum flight qualification or ground training requirements in writing if recent experience in similar aircraft models so warrants.

Note

Training requirements, checkout procedures, evaluation procedures, and weather minimums for Ferry Squadrons are governed by the provisions of OPNAVINST 3710.7 series.

PILOT TRAINING

RECON/ATTACK PILOT COURSE

The current Recon Attack Training Squadron syllabus is applicable.

MINIMUM FLIGHT TIME REQUIREMENTS

The following minimum requirements apply for initial qualifications:

1. Night flight—10 hours.
2. Instrument flight—10 hours.
3. Cross-country flight—20 hours.
4. FMLP—50 hours (15 hours night time).
5. Field landing qualification—8 day and 16 night periods (manual or APC), and/or be considered qualified by LSO.
6. Carrier qualification—as specified by LSO NATOPS Manual or Type Commander.

Pilots must have the following to maintain qualification:

1. Current NATOPS qualification.
2. Five hours, two take-offs and two landings in preceding 90 days, and/or be considered qualified by unit Commanding Officer.

OPERATIONAL SQUADRON TRAINING

Each squadron will establish and maintain a ground and flight training syllabus in order to keep flight crew members current in all phases of training necessary to the maintenance of a high degree of combat readiness. In addition to the basic squadron training program, other specialized training required by various directives is specified in the following paragraphs.

WEAPONS SYSTEM OR COCKPIT PROCEDURES TRAINER

A WST/CPT period is required prior to flying the RA-5C if a pilot or RAN has not flown the aircraft in 30 days. Additionally, for shore based units, flight crews shall complete one WST/CPT per month. RA-5C cockpits shall be utilized by deployed squadrons to fulfill the requirements of this paragraph. Every contingency should be periodically reviewed including all emergency procedures, and recoveries from spins, stalls, and unusual attitudes.

LOW-PRESSURE CHAMBER

All personnel flying in jet aircraft are required to maintain current qualifications in a low-pressure chamber. All personnel will receive pressure suit indoctrination and checkout prior to conducting any flight over 50,000 feet.

EJECTION SEAT

An ejection seat trainer will be used to initially qualify/refresh flight crew members every 3 years. In addition, each crew member will receive basic instruction in the A-5 ejection seat while completing the Training Squadron syllabus: A review lecture and checkout will be given quarterly in the A-5 ejection system, utilizing the ejection seat trainer, when available.

SURVIVAL TRAINING

Each crew member will qualify in the following phases of survival training:

1. Night vision — when reporting from nonoperational duty.
2. Dilbert Dunker — every 3 years.
3. Swimming tests — every 3 years.
4. Underwater breathing with oxygen mask — every 3 years.
5. Helicopter rescue — every 3 years.
6. Parachute harness release and drag — every 3 years.

RAN TRAINING

RECON/ATTACK NAVIGATOR COURSE

The current Reconnaissance/Attack Training Squadron syllabus is applicable.

Note

Training requirements, checkout procedures, evaluation procedures, and weather minima for Ferry Squadrons are governed by the provisions of OPNAVINST 3710.7 series.

OPERATIONAL SQUADRON TRAINING

Each squadron will establish and maintain a ground and flight training syllabus in order to keep flight crew members current in all phases of training necessary to the maintenance of a high degree of combat readiness. In addition to the basic squadron training program, other specialized training required by various directives is specified in the following paragraphs. This training will include systems lectures of 30 to 60 minutes duration, followed by exams.

WEAPONS SYSTEM TRAINER (WST)

This trainer is available through the Training Squadron. Refresher periods will be scheduled after a prolonged time away from the system, and for assistance in overcoming errors in personal technique.

INSTRUMENT GROUND TRAINING COURSE

RAN's should complete the ground academics phase of a formal instrument training course annually.

LOW-PRESSURE CHAMBER

All personnel flying in jet aircraft are required to maintain current qualification in a low-pressure chamber. All personnel will receive pressure suit indoctrination and checkout prior to conducting any flight over 50,000 feet.

EJECTION SEAT

An ejection seat trainer will be used to initially qualify/refresh flight crew members every 3 years. In addition, each crew member will receive basic instruction in the A-5 ejection seat while completing the Training Squadron syllabus. A review lecture and checkout will be given quarterly in the A-5 ejection system, utilizing the ejection seat trainer, when available.

SURVIVAL TRAINING

Each crew member will qualify in the following phases of survival training:

1. Night vision — when reporting from nonoperational duty.
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3. Swimming tests — every 3 years.
4. Underwater breathing — every 3 years.
5. Helicopter rescue — every 3 years.
6. Parachute harness release and drag — every 3 years.

MISSION COMMANDER REQUIREMENTS

The Mission Commander shall be a properly qualified Naval Aviator or Naval Flight Officer designated by the Commanding Officer. He shall be responsible for all phases of the assigned mission except those aspects of safety of flight which are related to the physical control of the aircraft and are considered beyond the qualification of the Mission Commander's designator. The Mission Commander shall direct a coordinated plan of action and shall be responsible for effectiveness of the flight.

Minimum qualification for designation as Mission Commander:

1. Be fully mission qualified.
2. Possess a current NATOPS qualification.
3. Designated in writing.

FLIGHT CREW REQUIREMENTS

The crew will normally consist of a pilot and a RAN, both of whom will meet the requirement for basic readiness. A full flight crew will be used on all operational and training flights, including carrier qualifications. Crew composition for flights other than operational training flights shall be at the discretion of the Commanding Officer, who shall ensure that minimum crews consistent with safe accomplishment of the mission are used for any flight involving an unusual degree of hazard.

PERSONAL EQUIPMENT REQUIREMENTS

Flying equipment considered appropriate per OPNAVINST P3710.7 will be worn by all personnel flying in the aircraft. They will be familiar with the operation and use of all required survival equipment. All survival equipment will be secured in such a manner that it is easily accessible and will not be lost during an emergency. Equipment to be worn is listed in the following paragraph.

TEMPERATE CLIMATE (LOW AND MEDIUM ALTITUDE)

	WINTER	SUMMER
1. MA-2 integrated torso harness with approved life preserver (the MA-2P harness assembly with MK-IV life preserver will be worn only with the full pressure suit or MK 5/5A exposure suit)	x	x
2. Antibuffet helmet, painted and rigged in accordance with latest survival bulletin	x	x
3. An approved oxygen mask with appropriate retention fittings	x	x
4. Flight suit	x	x
5. Anti-G suit	x	x
6. Approved survival knife and sheath	x	x
7. Lace-up, ankle-length boots	x	x
8. Flight gloves	x	x

Note

Gloves may be removed during flight over water for launch, recovery, or low-level operation until such time as antiskid gloves are available.

	WINTER	SUMMER
9. Anti-exposure suit. (Refer to OVER-WATER FLIGHTS.)		
10. Identification tags	x	x
11. Winter trousers or thermal underwear (when applicable)	x	
12. .38-caliber pistol with tracer ammunition	x	x

Note

An approved signaling device is authorized as a substitute for the pistol when operational and/or security conditions warrant.

	WINTER	SUMMER
13. Flashlight with red lens (night only)	x	x
14. Personal survival kit with SV-1/2 survival vest	x	x

OVER-WATER FLIGHTS

The anti-exposure suit will be worn on all over-water flights when the water temperature is 59°F or below, or outside air temperature is 32°F or below, or the combined air/water temperature is 120°F or below. During daylight, within gliding distance of land, the exposure suit need not be worn if water temperature is above 50°F. Operational Commanders may waive the requirement for wearing all types of anti-exposure suits if a possibility exists that high ambient cockpit temperature could cause extreme fatigue and dehydration.

HIGH-ALTITUDE/HIGH-SPEED FLIGHTS

For flights above 50,000 feet, both crew members will wear the full pressure suit* with all approved accessories.

*Aircraft 145157 through 156617

SECTION III—NORMAL PROCEDURES

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PART 1 — BRIEFING AND DEBRIEFING

Successful execution of an assigned mission demands complete familiarity with its requirements. The nature of the assigned mission will determine briefing format and persons responsible for delivering the briefing. If possible, both crew members will attend all mission briefings. It is the responsibility of the Operations Officer to see that correct and complete briefings are conducted. Briefing duties will be assigned to specific individuals of the various squadron departments by the Operations Officer.

GENERAL BRIEFING

The general briefing applies to all flights, including test flights, mission training flights, competitive exercises, operational readiness tests, and flight operations conducted in accordance with Operations Orders. The general briefing will be conducted as soon as possible after receiving the Operations Order; generally not later than 48 hours prior to launch time.

OPERATIONAL BRIEFINGS

TARGET BRIEFING

The target briefing encompasses all phases of flight planning and includes a thorough crew evaluation of all available intelligence information. Mission briefings will normally include the information noted in the following paragraphs.

MISSION PLANNING BRIEFINGS

OPERATIONAL MISSION PLANNING

1. Primary mission.
2. Secondary mission.
3. Operations area.
4. Control agency.
5. Communications.
6. TOT.

RECONNAISSANCE BRIEFING

1. Targets/objectives.
2. Required coverage.
3. Aircraft/sensor configuration.
4. Specific route requirements.
5. Predicted weather.

INTELLIGENCE BRIEFING

1. Rules of engagement.
2. General OOB.
3. SERE.
4. Coordination of friendly/support forces.

PRELAUNCH BRIEFINGS

INTELLIGENCE BRIEFING

1. Current OOB and enemy activity.
2. Rules of engagement.
3. SERE considerations/recommendations.
4. SAR procedures in effect.
5. Coordination of friendly forces.
   (a) Support (ELINT, AEW, tankers, surface units, etc).
   (b) Attack (targets, TOT's, routes, etc).

WEATHER BRIEFING

1. Local.
2. Enroute.
3. Target/objective.
4. Destination, alternate/divert.

FINAL PRELAUNCH BRIEFING

The final briefing will take place just prior to manning aircraft. At this time, all other information needed by the crew in order to accomplish the flight will be available. When attending this briefing, the crew will be in flight clothing appropriate to the mission.

1. Launch/recovery times.
   (a) Weather/alternate
   (b) Clearance/DD175
   (c) Take-off/landing data
   (d) Jet log/NAV charts/fuel packet
2. Marshall, penetration, CCA/GCA.
3. Aircraft assignment, weights, configuration, and status.
4. Deck spot and launch sequence.
5. EMCON.
6. Communications.
7. Flight procedures.
8. Emergencies.
9. Escort brief by tactical crew.

MISSION DEBRIEFING

DEBRIEFING

A thorough debriefing by Intelligence and Maintenance is necessary to obtain maximum value from tactical or training flights and maximum utilization of the aircraft. A postflight debriefing will be conducted by the Air Intelligence Officer and/or his assistant, under the supervision of the Operations Officer. The debriefing will be conducted as soon as practical following recovery of the flight. A standard debriefing form, tailored to meet the tactical mission, will be utilized to ensure that no items are overlooked. Maintenance personnel will debrief the crew as soon as practical after the flight, not to interfere with priority intelligence debriefs, concerning the status of the aircraft and all associated systems.

INTELLIGENCE DEBRIEFING

1. Visual report on targets/objectives.
2. Estimated success of mission.
3. Other observed targets/activity.
4. SAM activity.
5. AAA activity.
6. Fighter activity.
7. EOB activity.
8. Communications.
9. Weather.
10. Route deviations.
11. Sensor/weapon malfunctions.
12. Escort debrief of above as required.

MAINTENANCE DEBRIEF

Aircraft, systems, sensor malfunctions/discrepancies/status.

PART 2 — MISSION PLANNING

The ease and success with which a mission is accomplished is directly affected by the preplanning process. Thorough, detailed planning is mandatory and is a crew function. Both crew members must be thoroughly acquainted with all aspects of the mission, and understand the manner in which each is to assist the other in performance of assigned tasks. All tactical missions should be planned so that an alternate visual approach can be made in the event of failure of the AN/ASB-12.

SUBSONIC/SUPERSONIC MISSIONS

Subsonic missions will be planned, using the performance data in Section XI, aerologic information, and reconnaissance systems criteria. Missions requiring a supersonic dash will be planned in a similar manner, except that for the cruise control portion of the planning, a "canned" problem approach will be used. Refer to FUEL PLANNING, in this section.

RECONNAISSANCE MISSIONS

Equipment installed will depend upon the target and tactical situation. Planning for a reconnaissance mission requires special emphasis on radar-significant checkpoints and IP's for maintaining a proper track and desired ground coverage.

NAV/RECON LOG

The standard NAV/RECON Log should be used in planning and executing all operational missions. A sample of this log, to be reproduced locally, is included in this section. See figure 3-1.

PLANNING RESPONSIBILITIES

CREW RESPONSIBILITIES

1. Briefings.
2. Mission planning.
3. Aircraft performance factors.
4. Fuel management and fuel control log.
5. Communications.
6. DD-175 or appropriate flight plan.
7. Target study/planning.
8. NAV/RECON Log.

OPERATIONAL MISSION PLANNING

When proper planning precedes the mission, the crew conducts the mission primarily by means of checklists and logs.

MISSION PLANNING CONSIDERATIONS

CONSIDERATIONS

Factors to be considered in navigation planning include:

1. OOB enemy defense.
2. Weather.
3. Configuration.
4. Time of day—launch/recovery.
5. Mission radius/profile.
6. Rules of engagement.
7. Coverage.
8. Scale.
9. Requirements.
10. Route—Radar/visual checkpoints.
11. Electronic reconnaissance targeting data.
12. Recon targeting criteria.
13. TOT.
14. Enemy defense criteria.

CREW PLANNING REQUIREMENTS

1. Completeness of navigation bag. Refer to NAVIGATION BAG CHECKLIST (FLIGHT CREW), in this section.
2. Operational and weather briefings.
3. Preparation of two sets of suitable scale charts, depicting the intended flight path, diversionary fields, and other data as may be pertinent.
4. Preparation of NAV/RECON Log.
5. Preparation of pilot's JET NAV Log.
6. Preparation of DD-175 or other required flight plan.
7. When ship-based, knowledge of PIM and condition of ship's navigational aids.
8. Ensuring that required code books and tables are aboard aircraft.

NAV/RECON LOG

NAV/RECON LOG

ALPHA 1	#AUTO	#MAN	BUNO	BASIC WT
ALPHA 2	TIME		TIME OFF	MAX LAND
GND CONT	TOWER		TIME ON	DEP ELEV

ATC CLEARS | TO THE

VIA

MAINTAIN | SQUAWK

DEPARTURE

DEST ELEV	APC CONT	TOWER	GND CONT

IDEN / CHAN	COORD	MAG HDG	DIST	ETE	ETA / ATA	LEG FUEL	EFR / AFR	PLANNING NOTES

CRAW-1 FORM

RA-5C-1-00-21

Figure 3-1 (Sheet 1)

IDEN / CHAN	COORD	MAG HDG	DIST	ETE	ETA / ATA	LEG FUEL	EFR / AFR	PLANNING NOTES

REMARKS:

RA-5C-1-00-22

Figure 3-1 (Sheet 2)

MINIMUM NAVIGATION REQUIREMENTS

A minimum of a fix or DR position is required every 5 minutes.

FUEL PLANNING

The RA-5C fuel planning problem is complicated by a great variety of mission requirements, plus the capability of wide latitude in altitudes and airspeeds. A preflight fuel plan will be incorporated on the JET NAV Log for all flights. The performance data in Section XI should be used for cruise control computations. The latest REST computer may be used if the charts are not available.

All jet aircraft respond to certain performance parameters. The three most important of these, and the ones upon which specific range depends, are (1) gross weight, (2) pressure altitude, and (3) Mach number. The performance data in Section XI indicate range or specific range for various altitudes, weights, and Mach numbers. Also indicated are engine rpm, fuel flow, and TAS. These last, however, are dependent upon Standard Day conditions. For other than standard conditions, the first three factors (weight, altitude, and Mach number) are the controlling parameters. On a warmer-than-Standard Day, engine rpm, fuel flow, and TAS will all be higher than indicated in the curves; however, if proper Mach number is flown, specific range will be accurate.

Note

To obtain the specific range indicated, FLY MACH NUMBER. Do not fly power settings, fuel flow, or TAS. To do so will result in inaccuracies if the day is nonstandard.

SPEED

Missions fall into two categories: (1) entirely subsonic and (2) partially supersonic. The planning for these two missions differs, and is covered separately as follows.

SUBSONIC MISSIONS

The subsonic mission will be planned using the performance data in Section XI. Each mission will be planned separately, based upon requirements.

SUPERSONIC MISSIONS

Fuel consumption at high speeds is very high, and small errors in planning can result in gross errors in available fuel. In addition, temperature plays an important role in the overall range. Because of the difficulty in accurate planning, the crew must plan a fuel remaining figure sufficient to allow the remainder of the mission to be completed at maximum range or termination and return to home base as appropriate. Consideration must be given to the significant change in range created by temperatures higher than those for a Standard Day. Prior to selection of afterburner, the pilot will determine the outside temperature from the inlet temperature gage and adjust the planned profile as required. See figure 11-5 for ambient air temperature determination.

SINGLE-ENGINE FLIGHT

Single-engine specific fuel consumption indicates that "singling-up" will not result in an increase in range. Pilots will refrain from shutting down an engine in flight for this purpose.

FUEL CONTROL LOG

The pilot's JET NAV Log will include a fuel control log, indicating planned fuel remaining at each navigational checkpoint, the IP, and over the target. The crew will monitor fuel closely to determine whether the flight is proceeding as planned. *This is most important on supersonic missions, where an extra minute of afterburning can cost 60 nautical miles overall range.* Fuel computations will be based on forecast winds. However, in applying winds, *all* predicted head-wind factors, but only *half* of any tail-wind factor will be applied.

FUEL REQUIREMENTS

A realistic determination of the fuel requirements can be established only after consideration of all the following elements:

1. Maximum fuel available based on configuration, basic operating weight of the aircraft, and maximum take-off gross weight.
2. Fuel required for ground operation, i.e., turnup and taxi to take-off position.
3. Fuel required for take-off and climb to cruise altitude.
4. Fuel required for cruise in accordance with the mission profile.
5. Fuel required for descent at destination.
6. Fuel required for the alternate, holding, and reserve.

Fuel requirements for field operations will be calculated to allow for the following amounts of fuel upon return:

1. VFR conditions — 2500 pounds at the break.
2. IFR conditions — 3000 pounds at field alternate approach fix.

Note

For normal shipboard training operations, fuel planning must allow for landing approach to be made at maximum allowable gross weight for landing.

Pilots are responsible for adhering to the minimum fuel requirements as stated in current OPNAV Instructions. A reserve of 1500 pounds constitutes a low state.

FUEL STATE

The following definitions are promulgated in OPNAVINST 3710.7:

Minimum fuel — Remaining usable fuel is adequate to reach destination. This fuel state precludes any delay in landing at destination, such as for holding, circling approach or wave-off. Bingo fuel state is considered minimum.

Emergency fuel — Remaining usable fuel is so low that an immediate landing at the nearest airfield is required and NO delay can be accepted. Low fuel state is considered emergency.

BINGO FUEL

Bingo fuel may be defined as the fuel state required to enable the aircraft to proceed to a designated airfield and land with minimum safe fuel remaining. It is particularly applicable to shipboard operations within a reasonable range of a land mass, but may be applied to exercises conducted with an airfield as the operating base where the mission requires a maximum endurance on station. The Bingo data in the NATOPS Pocket Checklist (NAVAIR 01-60ABC-1B) are based on starting at sea level and arriving at destination with 1500 pounds fuel remaining. Bingo fuel for IFR conditions should be increased to arrive over destination at 20,000 feet with 2500 pounds fuel remaining.

NAVIGATION BAG CHECKLIST (FLIGHT CREW)

ITEM	PILOT	RAN
1. NATOPS Pocket Checklist (NAVAIR 01-60ABC-1B)	x	x
2. Flashlight with red lens	x	x
3. FLIP Enroute Supplement	x	x
4. Enroute High-altitude Charts	x	x
5. Enroute Low-altitude Charts	x	x
6. High-altitude Approach Procedures Booklets	x	x
7. Navigation Charts (area of flight)	x	x
8. Plotter and computers	x	x

MISSION CHECKLIST

The following items will be used as a guide in preflight planning. Only those items applicable to the type mission flown need be considered.

NAVIGATION

1. PIM.
2. TAS/GS checks.
3. Checkpoint coordinates and elevations.
4. Bearings and distances enroute.
5. Variation.
6. Control lines and times.
7. TOT.

FUEL MANAGEMENT

1. Climb, descent, and cruise data.
2. NAV/RECON Log.

DETECTION

1. EW.
2. GCI.
3. Aircraft or missile intercept point.

RECONNAISSANCE DATA

1. Tactical situation.
2. Weather.
3. Camera settings.
   (a) Exposure.
   (b) Flasher setting.
4. SLR.
   (a) Target.
   (b) Gain.
5. IR Gain.
6. PECM.
   (a) Sector coverage.
   (b) Checkpoints.
7. IP checkpoints.
8. Altitudes.
9. NAV (tracks).
10. Alternate target.

TACTICAL

1. EMCON.
   (a) Radar.
   (b) Communications and NAVAIDS.
2. Radio signals.
3. Thermal shields.
4. Target defenses.
5. DECM operation.
6. Abort procedures.

REPORTS

1. ADIZ.
2. Tactical control.

PART 3—SHORE-BASED PROCEDURES

When based ashore, the squadrons are responsible through the local wing and/or fleet air commander to the appropriate type commander.

SCHEDULING

LONG-RANGE PLANNING SCHEDULES

Weekly and monthly flight planning schedules will be published to assist the orderly progress of training and the planning of maintenance.

DAILY FLIGHT SCHEDULE

The daily flight schedule will be prepared by the operations department. When approved by the Commanding Officer, the daily flight schedule has the authority of a direct order of the Commanding Officer. Changes to the schedule must be signed by the Commanding Officer or his designated representative. The daily flight schedule will include the following information:

1. Name of the Operations Duty Officer.
2. Time of sunrise and sunset.
3. Water temperature, if applicable.
4. Schedule of flights, to include:
   (a) Briefing times.
   (b) Take-off times.
   (c) Flight duration.
   (d) Flight crews.
   (e) Aircraft, fuel load, and configuration.
   (f) Mission.
   (g) Flight leaders (when appropriate).

LINE OPERATIONS (PILOT)

MANNING AIRCRAFT

Following the final briefing (and filing of flight plans, if required), the pilot will review previous aircraft discrepancies and sign the yellow sheet. A thorough preflight inspection and an orderly, methodical, prestart check will be made.

BEFORE ENTERING AIRCRAFT

EXTERIOR CHECK

1. Conduct aircraft exterior inspection. See figure 3-2.
2. External units — connected and operating.
   An RCPT/RCPP-105 or equivalent unit, and a 400-cycle, three-phase (A, B, C rotation), 120-volt, 45-kva electrical unit is required. If the AN/ASB-12 is to be alined, cooling air is also required.
3. Inspect seat and canopy (figure 3-3).

AFT COCKPIT CHECK (SOLO FLIGHT)

1. Oxygen — OFF.
2. IFF/SIF — NORM/as desired.

WARNING

In the alternate configuration, the AUTO IFF emergency capability is not available to the pilot. IFF EMERG must be selected by the pilot on the IFF control panel prior to ejection.

3. Seat and parachute — SECURED.
4. Loose gear — STOWED.
5. AN POWER switch — OFF.
6. Canopy (listen for "pop") — CLOSED.

ENTERING AIRCRAFT

1. Canopy uplock – ENGAGED.
2. Seat and canopy – INSPECT.
   (a) Speed sensor aneroid* – WHITE OR CLEAR but no red in inner circle.
   (b) Speed sensor* gas line quick-disconnect righthand side) – FASTENED/SAFETIED.
   (c) Ballistic spreader gun pin – WRAPPED in red flag and attached to right hand lap strap.
3. Canopy emergency air – 2800 PSI (minimum).
4. Emergency oxygen — 1800 PSI (minimum).
5. Scott block — SECURED AND BUTTON FLUSH.
6. Harness — FASTEN/ADJUST.
7. Oxygen — CHECKED.
8. ICS — CHECK.

WARNING

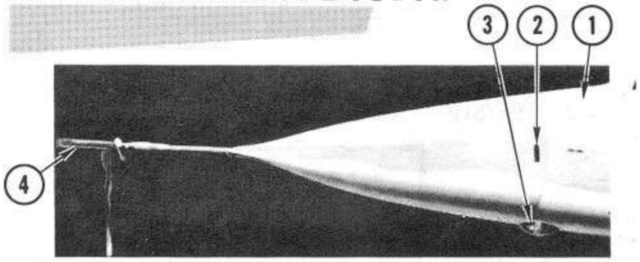
The over-the-shoulder oxygen/communication line must be routed *under* the shoulder harness to preclude possible neck/head injury during ejection.

Note

Crew members will personally fasten and become proficient at fastening and releasing the parachute riser and lower release fittings and adjusting the integrated harness.

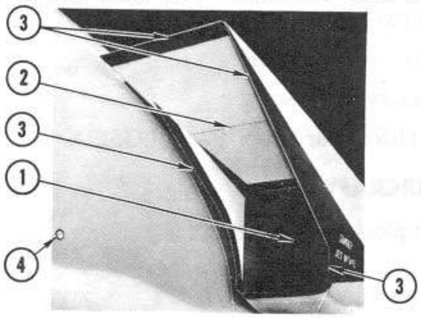
*Aircraft having AFC 311 complied with

EXTERIOR INSPECTION



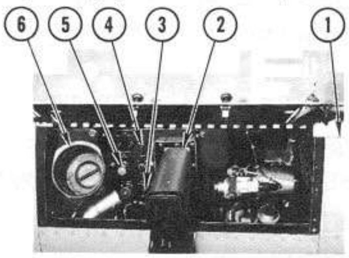
A LEFT NOSE

1. Air refueling probe — RETRACTED. Check all doors flush.
2. Radome — SECURE. Check lock flag flush if closed.
3. TV scanner condition — CHECK.
4. Pitot boom cover — REMOVED. Check pitot boom condition.



Q LEFT INTAKE

1. Duct cover — REMOVED. Duct — CLEAR.
2. Ramp — RETRACTED. Check condition.
3. Condition of leading edges — CHECK.
4. Normal brake accumulator repeater gage — 1000 (±50) psi.



P LEFT-FORWARD FUSELAGE

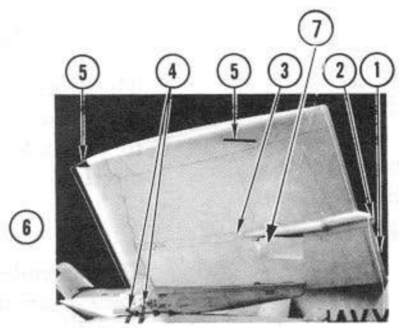
1. Ram-air turbine — RETRACTED.* (Check lock pin flush with fuselage.)
2. External electrical power — CONNECTED.
3. B/N ALIGN PWR switch — EXT.
4. ACFT PWR switch — EXT.
5. GEAR DOOR switch — NORMAL.
6. Equipment cooling air — CONNECTED.

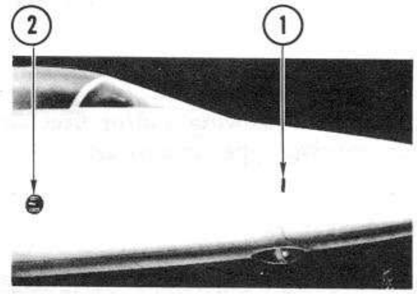
L LEFT STABILIZER AND AFT FUSELAGE (SEE H)

1. Trailing edge guard — REMOVED.
2. Stabilizer condition — CHECK.
3. Engine access doors — SECURE, Check fasteners flush with surface.
4. Fuselage formation light condition — CHECK.
5. Stabilizer retainers safety wired on both sides – CHECK.

N LEFT MAIN GEAR (SEE F)

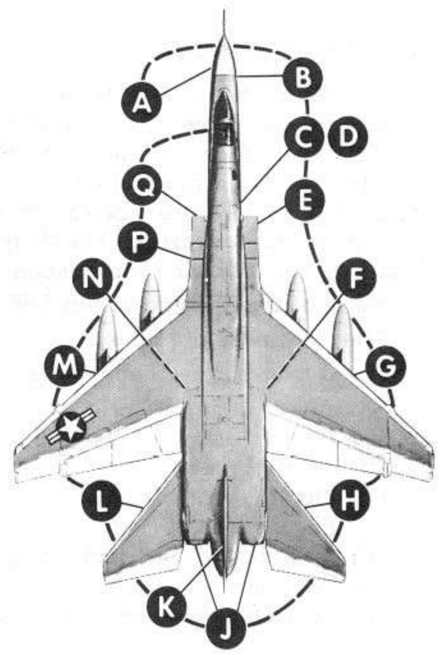
1. Tire condition — CHECK.
2. Brake back-up plate – FREE. Check for 3/8 inch rotational freedom. Locking key installed and nut cotter keyed.
3. Strut extension — CHECK.
4. Door condition — CHECK.
5. Emergency brake accumulator — 1000 psi. (Under pull-out door on inner bulkhead)
6. Ground safety lock — REMOVED.
7. Anti-skid exciter ring sensor gap — CHECK
8. Main landing gear packing nut key lock on lower strut cylinder – CHECK.
9. Ground safety scissors switch and linkage – CHECK.
10. Radius rod for corrosion, cracks, and clevis point lug aft – CHECK.
11. Block out solenoid and cannon plug attached – CHECK.
12. Strut position switch and spring lever for tension and freedom of movement – CHECK.
13. Downlock switch and linkage – CHECK.





B RIGHT NOSE

1. Radome lock flag flush, if closed.
2. Angle-of-attack probe cover — REMOVED. Check probe condition and freedom of movement.



GENERAL CHECK

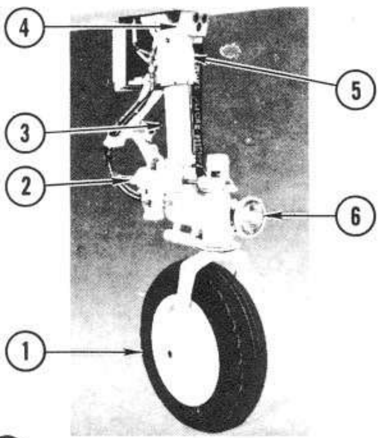
1. All covers, jury struts — REMOVED.
2. Chocks — IN PLACE.
3. Doors, fasteners, exposed lines — SECURED.
4. IFF/TACAN lobing switches — ON.
5. Radome lock flags — RETRACTED.
6. Inlet ramps — RETRACTED.
7. Inlet ducts — CLEAR.
8. Tires/Brake stacks — CHECK/FREE.
9. RAT — RETRACTED. *

M LEFT WING

1. Flap guards — REMOVED.
2. ECM antenna condition — CHECK.
3. Wing fold area for leaks — CHECK.
   a. Droop linkage/bearings intact and wing fold attach points for cracks – CHECK.
4. Drop tank and pylon safety pins — INSTALLED
5. Position and formation lights condition — CHECK.
6. Droops, spoilers for hydraulic leaks — CHECK.
7. Spoiler/deflector attach lugs for cracks – CHECK.

* AIRCRAFT NOT HAVING AFC 350 COMPLIED WITH

Figure 3-2 (Sheet 1)



C NOSE GEAR

1. Tire condition — CHECK.
2. Steer-damp unit condition — CHECK.
3. Strut extension — CHECK.
4. Approach lights condition — CHECK.
5. Ground safety lock — PILOT REMOVE; Check for proper spring tension and positive over-center action; INDICATOR FLANGE POINTED AFT.
6. Taxi light condition — CHECK.

K VERTICAL STABILIZER

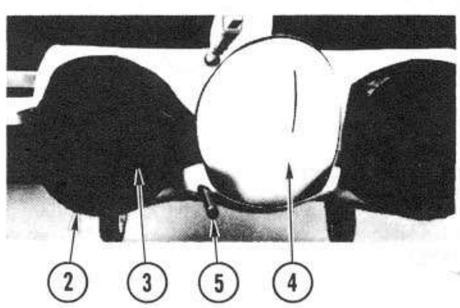
1. Position light condition — CHECK.
2. Buddy tanker lights condition — CHECK.
3. Fuel overboard vent — UNDAMAGED. Check for fuel drainage.
4. ECM antennas condition — CHECK.
5. Tail cap antenna cover condition — CHECK.
6. Leading edge condition — CHECK.
7. Stabilizer retainers safety wired on both sides – CHECK.

J ENGINE OUTLETS

1. Exhaust nozzle covers — REMOVED.
2. Afterburner nozzle flaps — UNDAMAGED. Check for freedom of movement.
3. Spray bars — CHECK. Check for signs of warpage or breaks.
4. Tail cone — SECURE.
5. Dump tube for cracks, leaks, and foreign matter – CHECK.

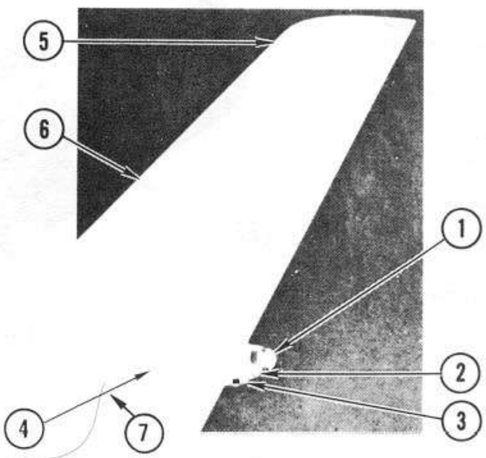
D NOSE WHEEL WELL

1. Training tone switch — TNG TONE
2. CNI antenna switch — NORM.
3. TACAN ANT TEST switch — NORM.
4. UHF COMM ANT TEST switch — NORM.
5. Normal brake accumulator — 1000 (±50) psi (right bulkhead)
6. All circuit breakers in, swing shelf up, LOX converters secure, bathtub up/both pins in – CHECK.
7. Brake pump handle — SECURE.



E RIGHT INTAKE (SEE Q)

1. Duct cover — REMOVED. Duct — CLEAR.
2. Ramp — RETRACTED. Check condition.
3. Condition of leading edges — CHECK.

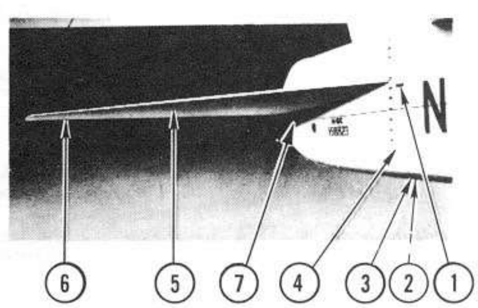


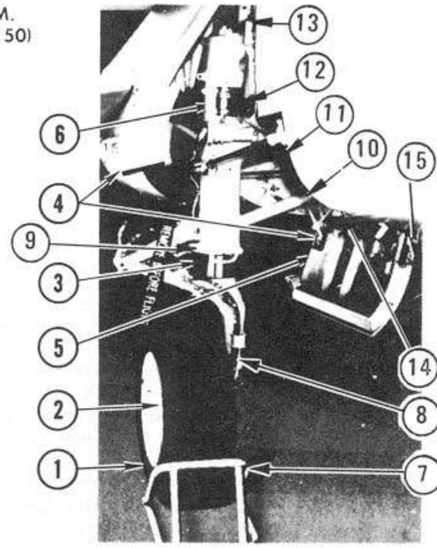
H RIGHT STABILIZER AND AFT FUSELAGE

1. Fuselage formation light condition — CHECK.
2. Hook field position accumulator — 1000 (±50) psi (Inside access plate 153:1)
3. Arresting hook fairing doors — CLOSED.
4. Engine access doors — SECURE. (Check fasteners flush with surface.)
5. Stabilizer condition — CHECK.
6. Trailing edge guard — REMOVED.
7. Stabilizer retainers safety wired on both sides – CHECK.

F RIGHT MAIN GEAR

1. Tire condition — CHECK.
2. Brake back-up plate — FREE. Check for ⅜ inch rotational freedom.





3. Strut extensions — CHECK. Locking key installed and nut cotter keyed.
4. Door condition — CHECK.
5. Emergency flap pneumatic pressure — 2800-3100 psi (Inboard of right main gear door)
6. Ground safety lock — REMOVED.
7. Anti-skid exciter ring sensor gap — CHECK.
8. Main landing gear packing nut key lock on lower strut cylinder – CHECK.
9. Ground safety scissors switch and linkage – CHECK
10. Lug aft – CHECK.
11. Block out solenoid and cannon plug attached – CHECK.
12. Strut position switch and spring lever for tension and freedom of movement – CHECK.
13. Downlock switch and linkage– CHECK.
14. Air Compressor fan – CHECK.
15. Ambient fuel vents for Leaks (forward two) – CHECK.

G RIGHT WING (SEE M)

1. Droops and spoilers for hydraulic leaks — CHECK.
2. Drop tank and pylon safety pins — INSTALLED
3. ECM antenna condition — CHECK.
4. Wing fold area for leaks — CHECK.
   a. Droop linkage/bearings intact and wing fold attach points for cracks – CHECK.
5. Position and formation light condition — CHECK.
6. Flap guards — REMOVED.
7. Spoiler/deflector attach lugs for cracks – CHECK.

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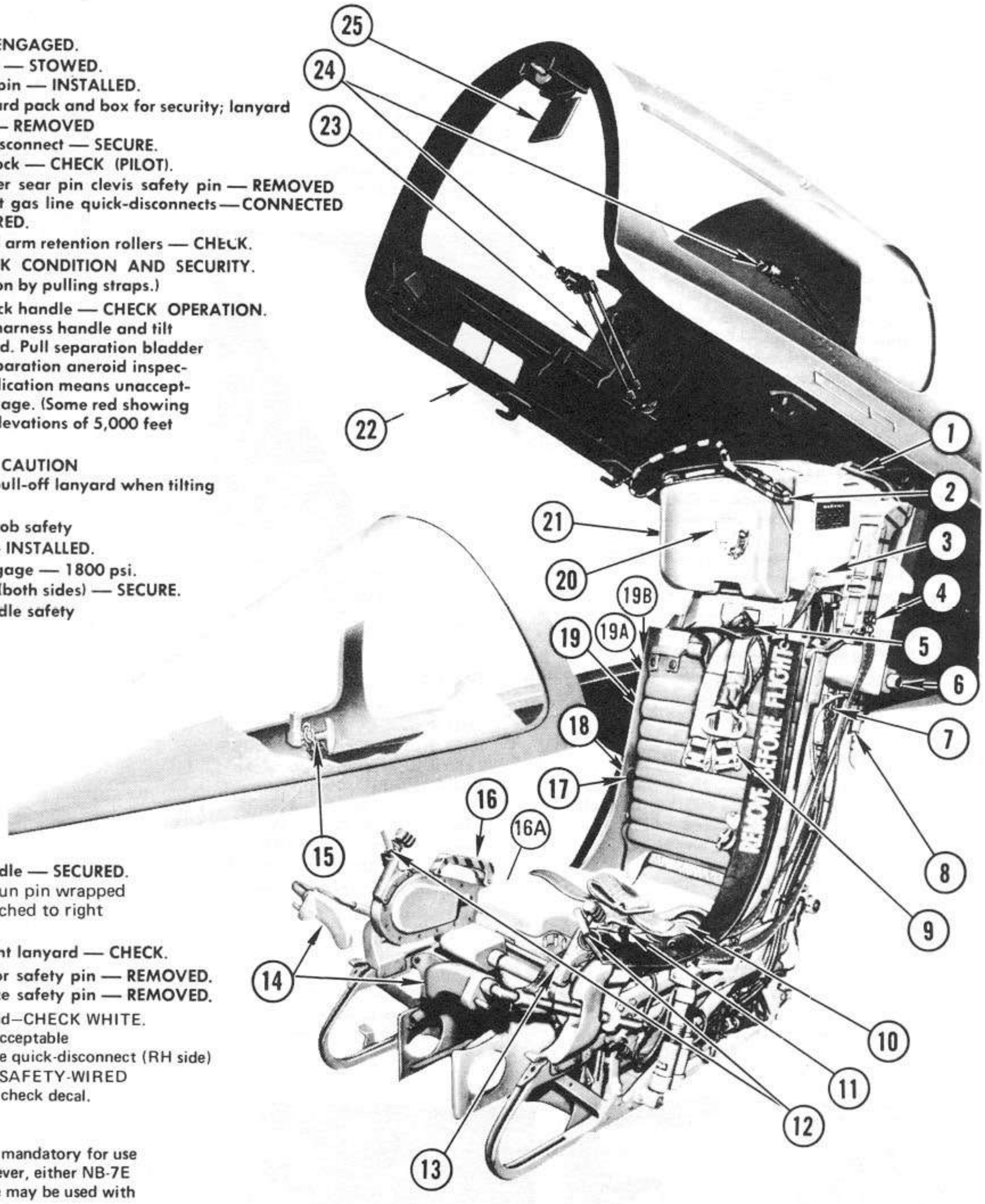
Figure 3-2 (Sheet 2)

CANOPY AND SEAT INSPECTION

1. Canopy uplock — ENGAGED.
2. Face curtain handle — STOWED.
3. Face curtain safety pin — INSTALLED.
4. Check pull-off lanyard pack and box for security; lanyard cutter safety pin — REMOVED
5. Shoulder harness disconnect — SECURE.
6. Canopy cam-off block — CHECK (PILOT).
7. Check lanyard cutter sear pin clevis safety pin — REMOVED
8. Check left and right gas line quick-disconnects — CONNECTED AND SAFETY-WIRED.
9. Shoulder straps and arm retention rollers — CHECK.
10. Lap straps — CHECK CONDITION AND SECURITY. (Check kit retention by pulling straps.)
11. Shoulder harness lock handle — CHECK OPERATION. Unlock shoulder harness handle and tilt parachute forward. Pull separation bladder aside to check separation aneroid inspection hole. Red indication means unacceptable aneroid leakage. (Some red showing is acceptable at elevations of 5,000 feet and higher.)

    CAUTION

    Do not actuate pull-off lanyard when tilting chute forward.
12. Ejection alternate knob safety pin (both sides) — INSTALLED.
13. Emergency oxygen gage — 1800 psi.
14. Leg retention hooks (both sides) — SECURE.
15. Canopy jettison handle safety pin — INSTALLED.



16. Harness release handle — SECURED.
16A. Ballistic spreader gun pin wrapped in red flag and attached to right hand lap strap.
17. Parachute deployment lanyard — CHECK.
18. Drogue chute initiator safety pin — REMOVED.
19. Aneroid power device safety pin — REMOVED.
19A. Speed Sensor * aneroid—CHECK WHITE. Red indication is unacceptable
19B. Speed Sensor * gas line quick-disconnect (RH side) —CONNECTED AND SAFETY-WIRED
20. Ejection seat preflight check decal.

    WARNING

    NES-15A parachute is mandatory for use with HS-1A seat, however, either NB-7E or NES-15A parachute may be used with HS-1 seat.
21. Canopy jettison air gage — 2800 psi (minimum). (Check green arc, visible from right ride)
22. Canopy — CHECK CONDITION.
23. Thermal radiation shield — CHECK.
24. Oblique camera sight † — STOWED
25. Sun visor and compass — CHECK.

* AIRCRAFT HAVING AFC 311 INCORPORATED.

† AIRCRAFT HAVING AFC 312 INCORPORATED.

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A-5C-1-73-2F

Figure 3-3

PRESTART CHECK

1. Seat/canopy safety pins (4) — REMOVED (after entry).
2. Canopy uplock — DISENGAGED.
3. SPEED BR DUMP handle — DOWN.
4. DROP TANKS switch — UP.
5. FUEL PROBE switch — SAME POSITION AS PROBE.
6. MASTER ARM switch — OFF.
7. EMERG JETTISON switch — CHECK COVER SHEAR-WIRED.

7A. Fuel quantity — CHECK AND TEST.*

7B. Camera control switches — OFF.*

8. ACLS switch — NORM, OFF.
9. SMATS,† APC, ANTI-SKID switches — OFF.
10. AFCS ENGAGE switch — OFF.
11. UHF — AS DESIRED.
12. FLAPS switch — SUPERSONIC.
13. MASTER EXT LIGHTS switch — AS DESIRED.
14. EMERG FLAP switch — NORM.
15. HYD SUB-SYS ISOLATION switch — TAKE-OFF/LANDING.
16. ENGINE FIRE switch — OFF.
17. Fuel quantity — CHECK AND TEST.
18. Gear handle — DOWN.
19. EMERG GEAR UP switch — NORM. Lift guard to check.
20. FUEL DUMP handle — IN.
21. Altimeter — SET.
22. Altimeter STBY-RESET switch — STBY.‡
23. EMER AIR TURBINE handle § — IN.
24. EMER LDG GR handle — IN AND GUARDED. Check handle lettering right side up.
25. Oxygen quantity — CHECK, TEST.

25A. ALT COOL light – OUT.

26. EMER CANOPY handle — IN.

***Aircraft having AFC 233 complied with**
†Aircraft prior to 156608 having AFC 247 complied with
‡Aircraft having AFC 296 complied with
§Aircraft not having AFC 350 complied with

27. ARREST HOOK handle — SAME POSITION AS HOOK.
28. COMM SECURITY MODE switch — AS DIRECTED.
29. COMM SECURITY VOL knob — FULL CLOCKWISE.
30. DECM — OFF.
31. WARN LT TEST button — DEPRESS, CHECK LIGHTS.
32. Interior lights — AS DESIRED.
33. Audio select panel — AS DESIRED.
34. ICS, AUX UHF, TACAN — AS DESIRED.
35. CNI PWR button — UP.
36. COCKPIT TEMP switch/knob — AUTO/2.
37. COCKPIT PRESS switch — NORM.
38. Seat and pedals — ADJUST.

CAUTION

Two minutes of cooling time should be allowed after moving the seat through one complete cycle to prevent overheating of the seat actuator.

39. WINDSHIELD & CANOPY DEFROST knob — OFF.
40. WINDSHIELD ANTI-ICE switch — OFF.
41. PITOT ANTI-ICE button — OFF.
42. ENGINE ANTI-ICE switch — OFF.
43. Camera control switches — OFF.
44. Generators — RESET.
45. SYSTEM select switch — AS DESIRED.
46. Exterior lights — AS DESIRED.
47. APPROACH light switch — AS DESIRED.
48. TAIL CONT — SAME POSITION AS TAIL.
49. WING AND TAIL FOLD handle — SAME POSITION AS WINGS.
50. Circuit breakers — IN.

50A. Rubber shrink tube tips on "Windshield Defrost and Anti-Ice" and "Essential Fuel" circuit breakers – CHECK.

51. EMERG IFF switch — AUTO.

STARTING ENGINES

CAUTION

- Attempting starts with the flaps and droops extended can result in hot or false starts.
- If there is no indication of engine rpm within 15 seconds or oil pressure within 30 seconds after start cycle begins, shut down immediately.
- If engine fails to attain 10% rpm within 20 seconds after application of starting air, discontinue start.
- Do not attempt to start engine until 10% rpm is reached. If fuel flow is above 700 pph (J79-GE-8) or 560 pph (J79-GE-10), or the engine does not fire within 15 seconds after achieving fuel flow, abort the start by moving the throttle to OFF and START switch to STOP.
- A rising EGT that will exceed 600°C is sufficient reason to discontinue the start.

Note

Either engine may be started first. With –10B engines, starting fuel flow and EGT, and idle fuel flow may be slightly higher than the –10A; starting EGT above 600 degrees Celsius is not uncommon.

STARTING ENGINES (WITH RCPP-105 ELECTRICAL CONNECTION)

1. Throttles — OFF.
2. Engine MASTER switches — ON.
3. EGT TEST button — DEPRESS.
4. ENGINE START switch — START.
5. At 10% rpm, throttle — IDLE.
6. At 45% rpm, START switch — STOP.
7. GENERATOR switch — RESET.
8. CNI PWR button — DEPRESS.
9. Repeat steps 4 through 7 for other engine.
10. External power — DISCONNECT.
11. HYD SYS 1, HYD SYS 2–3000 (+250/–200) PSI.
12. RAMPS switch — RESET.

STARTING ENGINES (WITHOUT RCPP-105 ELECTRICAL CONNECTION)

1. Throttles — OFF.
2. Engine MASTER switches — ON.
3. EGT TEST button — DEPRESS.
4. Signal crewman to start air.
5. At 10% rpm — DEPRESS/HOLD EMER IGN (or move ENGINE START switch to START), move throttle to IDLE.
   Hold EMER IGN depressed until light-off.
6. At 45% rpm — Signal crewman to secure starting air (move START switch to STOP).
7. GENERATOR switch — RESET.
8. CNI PWR button — DEPRESS.
9. Repeat steps 4 through 7 for other engine.
10. External power — DISCONNECT.
11. HYD SYS 1, HYD SYS 2–3000 (+250/–200) PSI.
12. RAMPS — RESET.

FLIGHT CONTROL AND PRETAXI CHECK

WARNING

Do not move any controls or surfaces until cleared by Plane Captain.

1. Canopies—CLOSED (RAN close first). Check for seal inflation, listen for "pop," check caution light out.
2. DECM — AS REQUIRED.
3. Standby gyro CAGE knob–PULL TO CAGE AND CHECK.
4. Jet pumps — CHECK (must shut off, 78% to 85% rpm).
5. WINDSHIELD & CANOPY DEFROST and WINDSHIELD ANTI-ICE system — CHECK.
6. Air refueling probe, RAT — CHECK.
   EPU TEST button* — DEPRESS AND HOLD. Check ELEC EPU ON advisory light comes on while button is depressed.
7. YAW AUG (NO. 1, NO. 2) switch — ON.
8. ANTI-SKID PWR switch–RESET. CHECK, THEN OFF FOR TAXI.
9. TRIM select — ALT.
   Check roll/yaw/pitch.
10. Emergency pitch trim — CHECK.
11. TRIM select switch — NORM.
    Depress and hold "kill" button; ensure that normal pitch trim is inoperative and alternate pitch trim is operating.
12. Check roll/yaw/pitch; leave 1.5 units nose-left, 3.5 units nose-down.
13. PITCH AUG and ELEC SYS switches — RESET.
    Check pitch trim 0.5 unit nose-down.
14. Stick — CHECK FULL LEFT AND RIGHT, DEPRESS "KILL" BUTTON NEAR CENTER, AND CHECK STICK FOR REDUCED TRAVEL LEFT AND RIGHT.
15. FLAPS switch — CRUISE.
16. Speed brakes — OUT.
    Check spoilers 55 degrees.

***Aircraft having AFC 350 complied with**

17. Stick — CHECK FULL LEFT AND RIGHT.
Check spoilers 70 degrees.
18. ELEC SYS switch – RESET.
19. Stick – FULL LEFT AND RIGHT.
Check spoilers 70 degrees.
20. Stick – FULL FORWARD AND AFT.
Check 8 units nose-down; 16 units nose-up.
21. PITCH AUG – RESET.
Check pitch trim 0.5 units nose down.
22. Stick - FULL FORWARD AND AFT.
Check 8 units nose-down; 21 units nose-up.
Check roll trim zero.
23. FLAPS – 30°. Check flaps 30/droops 25; speed brakes retract and yaw trim does not increase.
24. FLAPS – CRUISE.
25. YAW TRIM – 1.5° NOSE RIGHT.
26. HYD SUB-SYS ISOLATION – FLIGHT.
27. FLAPS – 30°. Check flaps 0/droops 25; yaw trim recenters to approximately 0 degrees.
28. HYD SUB-SYS ISOLATION switch – TAKE-OFF/LANDING.
29. Stick — FULL LEFT AND RIGHT.
Spoilers 70 degrees; vertical stabilizer 4 degrees left, right.
30. Directional control pedals — FULL THROW, 8 DEGREES LEFT, RIGHT.
31. FLAPS switch — 40°.
Check flaps 40/droops 50 degrees.
32. FLAPS switch — 50°.
Check flaps 50/droops 50 degrees; pitch 5 to 6 units nose-up.
33. Stick — FORWARD.
Depress "kill" button prior to 2.5 units and hold stick full forward until all motion stops. Check pitch 2.5 units nose-down minimum; 4.0 units maximum.
34. Stick — AFT TO CENTER FREE-PLAY LINK, THEN FULL FORWARD AND HOLD UNTIL ALL MOTION STOPS.
Check pitch 7 units nose-down, minimum.
35. PITCH AUG and ELEC SYS switches — RESET.
36. Stick — FULL FORWARD.
Depress "kill" button, full aft and hold. Check immediately 10 units nose-up, fast centering 19 units nose-up, slow centering 21 units nose-up.
37. ELEC SYS switch – RESET.

*Aircraft 156628 through 156643 and aircraft having AFC 293 complied with

38. Stick – FULL FORWARD AND AFT.
Check 7 units nose-down minimum, 21 units nose-up.
39. FLAPS switch — 30°.
Check flaps 30/droops 25 degrees.
40. FLAPS switch — SUPERSONIC.
41. PITCH AUG and ELEC SYS switches — RESET.
42. Arresting hook — CHECK.

Note

With two-position hook* installed, check hook in FIELD-35°. The hook handle warning light will not go out when hook is extended and aircraft is on the ground. This is due to lack of ground clearance for hook to extend far enough to actuate the 35-degree position switch. Keep right hand on handle for check.

43. HOOK MODE selector switch* — FIELD-35° (field), — NORM (ship).

CAUTION

- When operating from a shore base, the HOOK MODE selector switch must be positioned to the FIELD-35° position. Failure to do so may result in a failure to engage the arresting gear.
- When operating from a carrier, the HOOK MODE selector switch must be positioned to the NORM position. Failure to do so may result in an in-flight and or dual wire engagement.

44. Pitot Heat – CHECK.
45. Wing, bomb bay fuel transfer, and CG — CHECK.
46. NAVAIDS — CHECK.
47. RECON — CHECK.
48. ACLS – CHECK.
Ensure AN/APN 202 radar beacon in OFF or STBY when aft of island to prevent frequency interference with SPN 42 radars during recovery operations.

49. ECM — CHECK.

50. Radar altimeter — OVRD.

50A. ALTIMETER — STBY.

51. Anti-collision light — ON (ashore only).

52. Pitch trim. — SET.
    (a) 3 units nose-up field (8 units nose-up, ship).†
    (b) 0 units nose-up, field (5 units nose-up, ship).‡

53. External stores pylon safety pins — REMOVED AND STOWED.

LINE OPERATIONS (RAN)

MANNING AIRCRAFT

Following the final briefing (and filing of flight plans, if required) the RAN will review previous AN/ASB-12 and reconnaissance system discrepancies. A thorough preflight inspection and an orderly, methodical, prestart check will be made.

EXTERIOR CHECK

Before entering the aircraft, assist pilot in conducting exterior inspection and conduct inspection of the following items.

1. TV scanner — INSPECT CONDITION.
2. Radome — LOCKED (flags in).
3. Training tone switch — TNG TONE.
4. Viewfinder—CHECK (desiccant blue, glass clean).
5. Stores — INSPECT.
6. Camera configuration — AS BRIEFED.
7. Camera s/c — AS BRIEFED.
8. Serial frame camera light sensors — FACING OUTBOARD.
9. Lens filters — AS BRIEFED.
10. Flashers—CHECK, HEADS INTACT AND PROPELLERS SPIN FREELY (for flasher missions).

ENTERING AIRCRAFT

1. Canopy uplock — ENGAGED.
2. Seat and canopy — INSPECT.
   (a) Speed sensor aneroid* — WHITE or CLEAR but no red in inner circle.
   (b) Speed sensor* gas line quick-disconnect FASTENED SAFETIED.
   (c) Ballistic spreader gun pin - WRAPPED in red flag and attached to right hand lap strap.
3. Canopy emergency air — 2800 PSI (minimum).
4. Emergency oxygen — 1800 PSI (minimum).
5. Scott block — SECURED AND BUTTON FLUSH.
6. Harness — FASTEN/ADJUST.
7. Oxygen — CHECKED.
8. ICS — CHECKED.

WARNING

The over-the-shoulder oxygen/communication line must be routed *under* the shoulder harness to preclude possible neck/head injury during ejection.

Note

Crew members shall personally fasten and become proficient at fastening and releasing the parachute riser and lower release fittings and adjusting the integrated harness.

AFTER ENTERING AIRCRAFT

1. Seat — ADJUST.
2. Canopy uplock – DISENGAGED.
3. Seat and canopy jettison safety pins (4) – REMOVED.

AUTONAVIGATOR PLATFORM ALINEMENT

AUTONAVIGATOR ALINEMENT START

In the HANDSET and AUTOMATIC (SINS) alinement start checklists, it is assumed that the AN/ASB-12 is in an "up" status and that the RAN is to perform the entire alinement. If cooling air is not available, delay until after engine start. If alinement is already started, proceed to BEFORE ENGINE START checklist. If autonavigator alinement is not possible, refer to STAND-BY NAV TURN-ON procedure.

Handset

1. External electrical power — CONNECTED.
2. Autonavigator PREHEAT switch—PREHEAT (ground crew).

Note

Do not apply cooling air to the left or forward (autonavigator) receptacles during preheat.

3. B/N ALINE power switch — EXT (ground crew).
4. Monitor B/N WARM UP light.
5. When B/N WARM UP light goes out, proceed with alinement.
6. Autonavigator PREHEAT switch — NORM (ground crew).
7. Apply cooling air to left receptacle (ground crew).

*Aircraft having AFC 311 complied with

†Aircraft 145157 through 151728 not having AFC 328 complied with

‡Aircraft 156608 through 156643 and aircraft having AFC 328 complied with

8. COURSE LINE NAVIGATION switch — NORMAL.
9. COORD SELECT knob — NORMAL.
10. WIND knob — AUTO.
11. SPEED switch — GROUND.
12. A/N MODE knob — STBY-NAV.
13. SYSTEM MODE knob — SET PP.
14. Radar/barometric altimeter — SET TO DECK OR FIELD ELEVATION.
15. HANDSET/AUTOMATIC switch — HANDSET.
16. BOMB COMPUTER POWER switch — ON.

Note

The BOMB COMPUTER POWER switch is inoperative with cooling air applied at the forward (autonavigator) access only.

17. AN POWER switch — STBY.
    Note AML out in 40 seconds or less.
18. OFFSETS — ZERO.
19. CARRIER HEADING — DEGREES (ashore, aircraft true heading),
    — DEGREES (afloat, ship's true heading).
20. DIFFERENTIAL HEADING—DEGREES (zero ashore).
21. CARRIER VELOCITY — KNOTS (zero ashore).
22. Set and store present position.
23. A/N MODE knob — DECK ALINE.
24. AN POWER switch — ON.
    Note AML out within 100 seconds indicating start of alinement.
25. PRESENT POSITION indicators — CHECK, RESET AS REQUIRED.
26. SET/CORR knob — 5 (Monitor alinement).

Automatic (SINS)

1. A/N preheat — COMPLETE (ground crew).
2. SINS umbilical cable — CONNECTED (ground crew).
3. COURSE LINE NAVIGATION switch — NORMAL.
4. COORD SELECT knob — NORMAL.
5. WIND knob — AUTO.
6. SPEED switch — GROUND.
7. A/N MODE knob — STBY-NAV.
8. SYSTEM MODE knob — SET PP.
9. Altimeter — DECK ELEVATION.
10. HANDSET/AUTOMATIC switch — AUTOMATIC.
11. BOMB COMPUTER POWER switch — ON.
12. AN POWER switch—STBY (AML out in 40 seconds).
13. OFFSETS — SLEW FROM VELOCITY REFERENCE (SINS).
    (a) East/West (starboard/port) — ________feet.
    (b) North/South (forward/aft) — ________feet.
14. DIFFERENTIAL HEADING knob—__________degrees.
    Carrier heading and velocity are supplied by SINS.
15. Set, store present position.
16. A/N MODE knob — DECK ALINE.
17. AN POWER switch — ON.
    Note AML out within 100 seconds, indicating start of alinement.
18. PRESENT POSITION indicator — CHECK, RESET.
19. SET/CORR knob — 5 (Monitor alinement).
20. Note PRESENT POSITION updating (automatic).

BEFORE ENGINE START

1. Compass controls — SET.
2. TACAN — OFF.
3. AN ALQ-55 — OFF, GUARD DOWN.

Note

Do not turn the AN/ALQ-55 on (in flight) during other than normal cruising flight conditions since a momentary aircraft pitch ("thump") may be encountered. With certain malfunctions, the electric flight and pitch augmentation systems may monitor OFF when the AN/ALQ-55 function selector is moved from OFF to STBY.

4. Auxiliary UHF — SELECT CHANNEL, ADJUST VOLUME.
5. COMM SECURITY VOL — FULL CLOCKWISE.
6. IFF/SIF — SET.
7. UHF COMM controls — SET.
8. Audio select buttons — UHF DEPRESSED, OTHERS AS DESIRED.
9. Interior lights — AS DESIRED.
10. TRANSMIT CONT switch — ICS.
11. IND LTS TEST button — PRESS, CHECK FOLLOWING INDICATORS:
    Compass control light
    Compass SYNC light
    NAV COMD light
    COMM COMD light
    CNI EMER POWER indicator ON
    AML light
    Radar advisory lights (3)
    Warning/caution lights
    SLR RANGE lights (3)
    Camera pulse monitor lights (4)
    Store aboard flag
    CAMERA COMMAND lights
    Mount erect lights
    PECM flags (3)
    IR COOLER TEMP light
    IR TEST light
12. HEAT control lever — AFT (LO).
13. B/N WARM-UP light — PRESS TO TEST.

14. OVERTEMP RESET light — PRESS TO TEST.
15. RADAR/TV POWER switch — STBY.
    If cooling air not applied, delay until after start.
16. Radar TEST switch — OFF.
17. TRANSMIT MODE switch — SILENCE.
18. Radar BRIGHTNESS knob — FULL COUNTER-CLOCKWISE.
19. Viewfinder blast SHIELD knob — OUT.
20. Viewfinder POWER switch — OFF.
21. Clock — SET AND WOUND.
22. Attitude indicator — PULL TO ERECT.
23. Oxygen quantity indicator — CHECK.
24. TV FILTER switch — IN.
25. TV VIEW switch — FWD.
26. TV BRIGHTNESS knob—FULL COUNTERCLOCKWISE.
27. CAMERA PULSE MONITOR POWER — DEPRESSED.
28. CAMERA FLASHER MODE knob—OFF (day missions) —ALTERNATE or SIMULTANEOUS (night missions).
29. SENSOR STAB switch* — NORM.
30. ALTITUDE switch — BARO, SET FIELD ELEVATION.
31. CAMERA EXPOSURE OVERRIDE switches — NORM.
32. Camera altitude mode switches — OFF.
33. EXPOSURES REMAIN counters—CHECK SETTING.
34. AN/ALE-29 DISPENSER — OFF.
35. CHAFF counters — SET.
36. AN/ALE-29 programmer — ALL CONTROLS MINIMUM SETTINGS.
37. REL TONE MODE switch — OFF.
38. PYLON SELECT — OFF.
39. STATION SELECT buttons — UP.
40. SLR MODE switch — READY.
41. SLR POWER switch — OFF.
42. PECM POWER switch — OFF.
43. PRESS SUIT FLOW — SET.
44. AUX ECM band switches — NORM.
45. AUX ECM CORR switches — NORM.
46. AUX ECM THRESHOLD knobs — FULL CLOCKWISE.
47. IR POWER knob — OFF.

***Aircraft having AFC 297 complied with**

AFTER ENGINE START

1. Canopy and seals — CHECK.
   Listen for "pop," caution light out, and seal inflated when pilot's canopy closed.
2. IR POWER knob — READY.
   Wait 10 seconds, COOLER TEMP light and IR MAP light on, then lights should go out within 12 minutes.
3. IR POWER knob—TEST, TEST LIGHT ON WITHIN 15 SECONDS.
   IR MAP light out while in TEST.
4. IR POWER knob — OPERATE.
5. IR GAIN knob — AS BRIEFED.
6. PECM POWER switch — READY.
   RECORD flag "OFF," NAV DATA flag "ON" for approximate 60 seconds, then barber pole.
7. SLR POWER switch — ON.
   Sweeps should appear on scope within 60 seconds.
8. Camera POWER switch — READY.
9. RADAR/TV POWER switch — ON.
10. UHF COMM VOL knob — ON.
11. COMM CMD, NAV CMD buttons — DEPRESS.
12. TACAN function select knob — REC.
13. TACAN CHANNEL knob — SET.
14. AN/ALQ-55 function knob — STBY.
15. PECM BAND 1 & 2 — OFF, UNLESS OTHERWISE BRIEFED.
16. PECM ANTENNA — AS BRIEFED.
17. PECM POWER switch — OPERATE.
    Check RECORD flag "ON."
18. PECM POWER switch — READY.
19. Viewfinder POWER — MAN.
    Adjust reticle lights.
20. Viewfinder V/H knob—FULL COUNTERCLOCKWISE (check error).

21. V/H knob — SET (0.30 ±error).
22. S/F camera altitude mode switch — LOW ALT.
    Check camera readiness indicator "ON."
23. Camera POWER switch — OPERATE, START SECOND HAND ON CLOCK.
24. EXPOSURES REMAINING counters — CHECK RUNNING.
25. CAMERA PULSE MONITOR — CHECK FIRING.
26. Camera POWER switch—READY (after time specified below).
    Check number of exposures fired (proper firing rate) as indicated:

CAMERA	TIME (SECONDS)	EXPOSURES
1.75-inch vertical	10	4—5
3-inch vertical	10	8—9
6-inch vertical	5	8—9
6-inch 19.75° oblique	5	5
6-inch 37.5° oblique	5	6—7
6-inch 52° oblique	5	7—8
12-inch vertical	3	10—11

27. Panoramic altitude mode switch — HIGH ALT or LOW ALT.
    Check camera readiness indicator "ON."
28. V/H — SET, 3-inch 0.30 ± error,
    18-inch 0.025 ± error.
29. Camera POWER switch — OPERATE.
    Check EXPOSURES REMAIN counter running.

Note

3- and 18-inch panoramic cameras will not operate simultaneously.

30. Camera POWER switch — OFF (18-inch panoramic camera aboard)
    — OFF or READY (18-inch panoramic camera not aboard).
31. Camera altitude mode switches — OFF.
32. Radar RANGE knob — 30.
33. Radar AFC knob — AUTO.
34. Radar/TV MODE knob — NORM.
35. Radar DISPLAY knob — NORM.
36. Radar BRIGHTNESS knob — ADJUST.
37. VIDEO GAIN, IF GAIN knobs — INCREASE.
38. Polaroid filter — ADJUST.
39. CURSOR & CIRCLE BRT knob — INCREASE.
40. RELATIVE CURSOR BRT knob — INCREASE.
41. Radar TEST switch — ON.
42. Radar AFC knob — MAN; ADJUST FOR BEST TEST MARKERS, RETURN TO AUTO.
43. Radar TEST switch — OFF.
44. TRANSMIT MODE switch — TRANSMIT (unless local regulations or hazardous conditions dictate otherwise).
45. Radar RANGE knob — 10 (check for video).
46. TRANSMIT MODE switch — SILENCE.
47. Radar/TV MODE — TV.
48. TV FILTER switch — OUT.
49. TV APERTURE knob — AUTO.
50. TV BRIGHTNESS knob — ADJUST.
51. Polaroid filter — ADJUST.
52. A/N SYSTEM MODE knob — SEARCH.
53. TV reticles — CHECK BOTH.
54. TV VIEW ANGLE switch—CHECK ALL, RETURN TO WIDE.
55. TV VIEW switch — AFT, CHECK, RETURN TO FWD.
56. Cursor control handle — MOVE, CHECK SCANNER AND TSPI MOVEMENT.
57. Radar/TV MODE knob — AS DESIRED.
58. SLR RANGE — AUTO.
59. SLR GAIN knob — FULL INCREASE.
60. SLR TARGET knob — FULL SOFT.
61. SLR A.F.C. — MANUAL.
62. SLR TUNE knob — FULL CLOCKWISE.
63. SLR monitor scope—ADJUST FOCUS, BRIGHTNESS.
64. SLR MODE switch — OPR (140 seconds after sweeps appear on scope). (Caution light illuminates.)
65. SLR POWER switch — TEST AND HOLD (caution light out).
66. SLR TUNE knob — MAXIMUM PULSES (STILL IN TEST).
67. SLR A.F.C. switch — AUTO.
68. SLR POWER switch — ON (RELEASE).
69. SLR RANGE knob — AS BRIEFED.
70. RANGE & BEARING knob — TACAN.
71. ARI — CHECK FOR AZIMUTH LOCK-ON.
72. TACAN function select knob — T/R.
    Check ARI for distance and azimuth lock-on; check audio for identification.
73. RANGE & BEARING knob — UHF.
    Check ARI for azimuth lock-on; check audio for identification.
74. RANGE & BEARING knob — NAV.

75. Conduct IFF ground check.
76. AN/ALQ-55 function knob — REC, CHECK STBY LIGHT OUT.
77. AN/ALQ-55 SELF TEST button — DEPRESS, CHECK RCVR LIGHT ON, AND XMT LIGHT BLINKING.
78. AN/ALQ-55 function knob — OFF.
79. Continue monitoring A/N alinement; if time permits, store targets, channels 1 through 4.
80. ADVANCE MODE light — CHECK BLINKING AT END OF PROGRAMMED ALINEMENT PERIOD (approximately 30 minutes).

Note

For short alinement (approximately 14 minutes), when target altitude display is 130 (13 minutes) or greater, OPERATE may be selected.

81. A/N MODE knob — OPERATE (before taxi).

Note

Degraded A/N performance may result if △ alpha exceeds 20 minutes.

82. OFFSETS — ZERO.
83. Set and store TARGET channels 1 through 5.
84. IFF MASTER switch — NORM (CHECK BEFORE TAKE-OFF).
85. Radar TRANSMIT MODE switch — TRANSMIT (BEFORE TAKE-OFF).

STAND-BY NAV TURN-ON

1. External power/cooling air or engines operating.
2. A/N MODE knob — STBY-NAV.
3. BOMB COMPUTER POWER switch — ON.
4. AN POWER switch — ON.
   Note AML out in 40 seconds or less.
5. COORD SELECT knob — AS REQUIRED.
6. SYSTEM MODE knob — SET PP.
7. Set and store PRESENT POSITION.
8. A/N MODE knob — DECK ALINE.
9. SYSTEM MODE knob — SET TARGET.
10. Set and store channels 1 through 5.
11. SYSTEM MODE knob — NAV.
12. COORD SELECT knob — NORMAL.
13. Wind indicator—SET TO BEST KNOWN SPEED.
14. Wind indicator—SET TO BEST KNOWN WIND DIRECTION.
15. A/N MODE knob—STBY-NAV (just prior to launch).

TAXI, TAKE-OFF, AND LANDING

TAXI PROCEDURE

1. When taxiing in close quarters (within 10 feet of obstructions), there shall be a director in front and a wing tip walker at each wing to ensure safe clearance of obstructions. The crew shall be alert to spot any obstructions which the aircraft might strike.
2. The aircraft can be taxied using minimum power and nose wheel steering. To start, it is usually necessary to increase rpm to about 80%. Once moving, retard throttles prior to turning out of line. If excess power is required to taxi, check for dragging brakes.

Note

If brakes are dragging, down the aircraft.

3. When moving:
   (a) Check the brakes before getting into close quarters.
   (b) Check emergency brake operation.
4. Do not brake against nose wheel steering. Center the nose wheel before stopping.
5. All taxi tests will be accomplished at normal taxi speeds; aborted take-offs will not be attempted for this purpose.

FUEL CONSERVATION

While taxiing to take-off position, the take-off checklist shall be completed. On long-range flights or where a delay in obtaining IFR clearance is expected, the clearance should be obtained prior to starting engines. It is necessary to use cooling air to operate the radios without engines.

CG MANAGEMENT

For flight with partial fuel load (bomb bay cans full, forward tank empty), hold CANS switch in AUX until 2000 pounds fuel has been transferred from the bomb bay to the forward tank to move center of gravity forward of the aft limit.

CHECKOFF LIST

1. For all flights involving two crew members, the BEFORE TAKE-OFF, AFTER TAKE-OFF, BEFORE DESCENT, and LANDING checklists shall be accomplished by the challenge/reply system, with the RAN providing the challenge and checking for the proper reply from the pilot.
2. The RAN will ensure that all checklists have been completed.

BEFORE TAKE-OFF

RAN CHALLENGE	PILOT REPLY
1. MIC SEL	1. HOT
2. WINGS AND TAIL	2. SPREAD AND LOCKED
3. COMPASS (IFF — NORM)	3. CHECK
4. CAUTION LIGHTS	4. OFF EXCEPT ______
5. HOOK MODE SELECTOR SWITCH	5. FIELD-35° (field) NORM (ship)
6. MY HARNESS LOCKED	6. LOCKED
7. ANTI-SKID	7. ON (field) OFF (ship)
8. FLAPS/DROOPS	8. SET,__/__DEGREES (30/25 degrees, field) (50/50 degrees, ship)
9. PITCH TRIM	9. CHECKED/SET (a) 6 to 8 units nose-up (field)* 12 to 14 units nose-up (ship)* (b) 3 units nose-up (field)† 8 to 11 units nose-up (ship)† (c) roll and yaw zero
10. GEAR STIFF	10. OFF (field) ON (ship)
11. PITOT ANTI-ICE	11. AS REQUIRED
12. CANOPIES	12. CLOSED, LIGHTS OUT, SEALED INFLATED
13. SEAT/CANOPY PINS	13. REMOVED
14. CHECKLIST COMPLETE	

TAKE-OFF PROCEDURES

Maximum Thrust is recommended for all take-offs under normal conditions. See figures 3-4 and 3-5. At gross weights above 56,000 pounds, Maximum Thrust is required for safe take-off. The take-off roll will not be initiated until the BEFORE TAKE-OFF checklist has been completed. Flaps will be set at 30 degrees for all normal take-offs. Take-off distance and airspeed will be determined prior to each take-off.

SMATS CHECK‡

After taxi to an engine run-up position, the SMATS system should be checked. Advance throttles to 85% rpm and place the SMATS switch to ON. Note that the SMATS advisory indicator indicates ON and afterburner is operating. Reduce throttles to IDLE and notice SMATS indicators extinguish, and SMATS switch returns to OFF, while passing through 67 percent throttle position.

BLEED DUCT AIR LEAK CHECK*

After assuming the take-off position and ensuring that the nose wheel is straight, apply brakes with flaps/droops set for take-off, and advance throttles to MIL. Check for bleed duct air leaks by timing the acceleration of both engines simultaneously from idle to Military Thrust, as indicated by fuel flow cutbacks as follows:

1. If the acceleration requires more than 10 seconds for the 30/25-degree flaps/droops position, or more than 13 seconds for the 50-degree droop position, the aircraft should be noted for correction of bleed duct air leaks (downstream of engine).
2. If the previous acceleration limits are not met, another check should be made at 0-degree droops (supersonic flap position) and the aircraft should be rejected if the engine does not accelerate within 7 to 9 seconds.

POWER CHECK*

1. After completion of the bleed duct check, check flaps/droops set for take-off, continue to apply brakes with throttles at MIL.
2. Check the following indications:
   RPM — 100 (±0.5) % (at 5°C and above).
   EGT — 625 (±10) °C.
   Oil pressure — 40 to 70 psi.
   Nozzles – 1/4 to 3/8 open and modulating slightly.
   Fuel flow – 7,000 to 10,000 pph.

MILITARY THRUST RPM vs. AMBIENT TEMPERATURE (INLET AIR TEMPERATURE INDICATOR — STATIC CONDITIONS)

OAT (°C)	% (RPM)
5 and higher	100 (±0.5)
0	99 (±0.5)
−10	98 (±0.5)
−20	96.5 (±0.5)
−30	95 (±0.5)

*Aircraft 145157 through 151728 not having AFC 328 complied with
†Aircraft 156608 through 156643 and aircraft 145157 through 151728 having AFC 328 complied with
‡Aircraft 145157 through 151728 having AFC 247 complied with

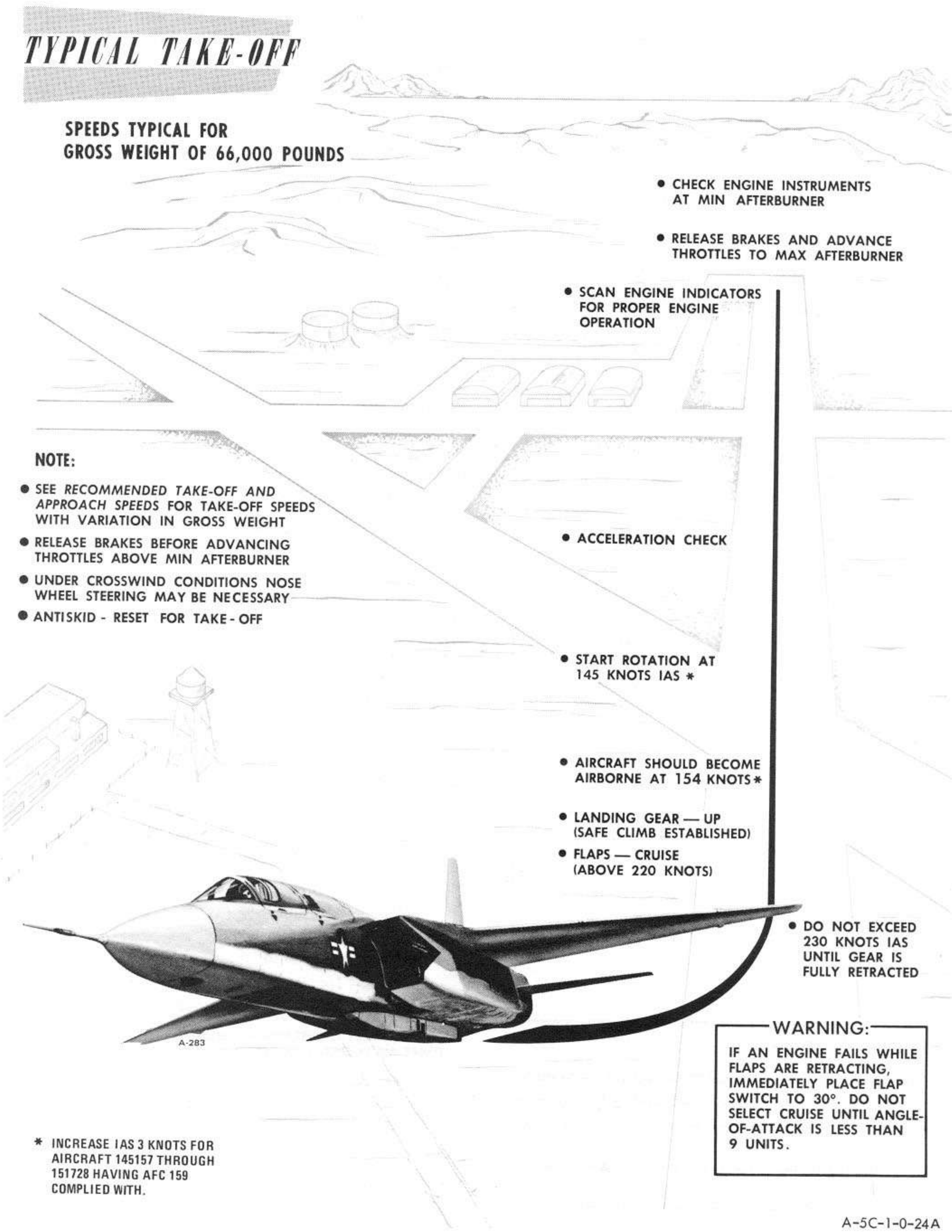
TYPICAL TAKE-OFF
SPEEDS TYPICAL FOR GROSS WEIGHT OF 66,000 POUNDS
• CHECK ENGINE INSTRUMENTS AT MIN AFTERBURNER
• RELEASE BRAKES AND ADVANCE THROTTLES TO MAX AFTERBURNER
• SCAN ENGINE INDICATORS FOR PROPER ENGINE OPERATION
• ACCELERATION CHECK
• START ROTATION AT 145 KNOTS IAS *
• AIRCRAFT SHOULD BECOME AIRBORNE AT 154 KNOTS*
• LANDING GEAR — UP (SAFE CLIMB ESTABLISHED)
• FLAPS — CRUISE (ABOVE 220 KNOTS)
• DO NOT EXCEED 230 KNOTS IAS UNTIL GEAR IS FULLY RETRACTED
NOTE:
• SEE RECOMMENDED TAKE-OFF AND APPROACH SPEEDS FOR TAKE-OFF SPEEDS WITH VARIATION IN GROSS WEIGHT
• RELEASE BRAKES BEFORE ADVANCING THROTTLES ABOVE MIN AFTERBURNER
• UNDER CROSSWIND CONDITIONS NOSE WHEEL STEERING MAY BE NECESSARY
• ANTISKID - RESET FOR TAKE-OFF
A-283
WARNING:
IF AN ENGINE FAILS WHILE FLAPS ARE RETRACTING, IMMEDIATELY PLACE FLAP SWITCH TO 30°. DO NOT SELECT CRUISE UNTIL ANGLE-OF-ATTACK IS LESS THAN 9 UNITS.
* INCREASE IAS 3 KNOTS FOR AIRCRAFT 145157 THROUGH 151728 HAVING AFC 159 COMPLIED WITH.
A-5C-1-0-24A

Figure 3-4

3. Select MIN AFTERBURNER and check that both afterburners light off (3 seconds maximum from MIL.).

Note

If aircraft gross weight is insufficient, tire skidding may be experienced.

4. Check nozzles—three-fourths open.

BLEED DUCT AIR LEAK CHECK*

After assuming the take-off position and ensuring that the nose wheel is straight, apply brakes with flaps/droops set for take-off, and advance throttles to MIL. Check for bleed duct air leaks by timing the accelerations of both engines simultaneously from idle to Military Thrust, as indicated by fuel flow cutbacks as follows:

1. If the acceleration requires more than 6 seconds for the 30/25-degree flap/droop position or 8 seconds for the 50-degree droop position, the aircraft should be noted for correction of bleed duct air leaks (downstream of the engine).
2. If the previous acceleration limits are not met, another check should be made at 0-degree droops (supersonic flap position) and the aircraft should be rejected if the engine does not accelerate within 5 seconds.

POWER CHECK*

1. After completion of the bleed duct check, check flaps/droops set for take-off, continue to apply brakes with the throttles at MIL.
2. Check the following indications:

CIT or OAT			
(°C)	(°F)	% RPM	EGT (± 8°C)
+44	+111	100	647
+34	+ 93	99	651
+24	+ 75	98	667
+14	+ 57	97	671
+ 4	+ 39	96	671
− 6	+ 19	95	648
−16	+ 3	94	625
−26	− 15	93	601

Oil pressure - 40 to 70 PSI.
Nozzles – 1/4 to 3/8 open and modulating slightly.
Fuel flow – 7,000 to 10,000 pph.

Note

During T_2 cutback and other engine speed reductions, indicated oil pressure will decrease about 1 psi per 1% rpm reduction. High oil temperature can decrease oil pressure as much as 5 psi.

3. Select MIN AFTERBURNER and check that both afterburners light off (3 seconds maximum from MIL, 7% rpm rollback maximum to not less than 87%).

Note

At light gross weight, tire skidding may be experienced.

4. Check nozzles—three-fourths open and modulating. Check maximum EGT transient peak 750°C.

TAKE-OFF

Use Maximum Thrust (full afterburner) for all take-offs and acceleration to best climb speed. Acceleration at MAX AFTERBURNER is quite rapid at all gross weights.

1. Release brakes and advance throttles to MAX AFTERBURNER.
2. Check EGT same as during Military Thrust check and nozzles full open and steady. On some aircraft,* nozzles may be modulating slightly (seven-eighths full open).

Note

On some aircraft,* cooler inlet air encountered during and after take-off may reduce CIT, result in slightly reduced rpm and EGT indications.

3. Rudder control is effective at approximately 60 KIAS. Under crosswind conditions, nose wheel steering may be necessary.
4. Maintain control stick in a neutral position until ready for nose wheel lift-off. Take-off distance is increased by early rotation.
5. Rotate the aircraft to take-off attitude (15 units angle of attack) as IAS reaches 10 to 15 knots below take-off speed. See figure 3-5.

CAUTION

Although a definite rotation is required for lift-off, avoid overrotation which could result in increased take-off distance and possible damage from aft section contact with the runway.

6. Utilize straight and level lift-off prior to gear retraction whenever possible to prevent possible off-center nose gear retraction.

*Aircraft 156608 through 156643, and 145157 through 151728 having AFC 328 complied with

7. Establish a positive rate of climb, then raise the landing gear.
   Ensure that landing gear is retracted prior to exceeding 230 KIAS.

8. Flaps to cruise at 9 units AOA (220 to 250 KIAS depending on gross weight) and 200 feet (VFR) or 1000 feet (night/IFR).

9. Maintain afterburner until the flaps are fully retracted. Then at 300 KIAS retard throttles separately to MIL. This is a precaution against possible nozzle/engine failure. For launches into FCLP pattern maintain afterburner until above 200 feet.

AFTER TAKE-OFF

RAN CHALLENGE	PILOT REPLY
1. GEAR Check gear retraction with TV.	1. UP
2. FLAPS	2. UP
3. HYD SUB-SYS ISOLATION	3. FLIGHT
4. DROP TANKS TRANSFER	4. ON (if applicable)
5. RADAR ALTIMETER	5. OFF (above 3000 feet)
5A. ALTIMETER	5A. RESET
6. COMPASS	6. SYNC (check wet)
7. FORWARD AND BOMB BAY FUEL TRANSFER	7. CHECK
8. CHECKLIST COMPLETE	

CLIMBOUT

Passing 10,000 feet MSL

1. Cabin altitude – 8,000 feet.

2. AOA – operating.

LANDING

DESCENT

RAN CHALLENGE	PILOT REPLY
1. DEFROST	1. AS REQUIRED
2. PITOT ANTI-ICE, ENGINE ANTI-ICE	2. AS REQUIRED
3. RADAR ALTIMETER	3. OVERRIDE
4. ALTIMETER	4. SET, SETTING IS____; STBY (below FL 180)
5. HOOK MODE SELECTOR SWITCH	5. FIELD-35° (ashore) NORM (ship)
6. ACL, ILS	6. ON AND CHECKED HOT
7. MIC SEL	7. TAKE-OFF LANDING
HYD SUB-SYS 8. ISOLATION	8. RESET AND
9. ANTI-SKID	9. CHECKED (OFF for ship)
10. AFCS	10. AS DESIRED
11. CHECKLIST COMPLETE	

CAUTION

- If the intended landing will be at a shore base, the HOOK MODE selector switch must be positioned to the FIELD-35° position. Failure to do so may result in a failure to engage the arresting gear.

- If the intended landing will be at a carrier, the HOOK MODE selector switch must be positioned to the NORM position. Failure to do so may result in an in-flight and or dual wire engagement.

- After all catapults, touch and go's, bolters, and waveoffs the RAN shall challenge the pilot with "Flaps to 30".

- During all fuel dumping evolutions the RAN shall call elapsed time in minutes every 60 seconds.

RECOMMENDED TAKE-OFF AND APPROACH SPEEDS

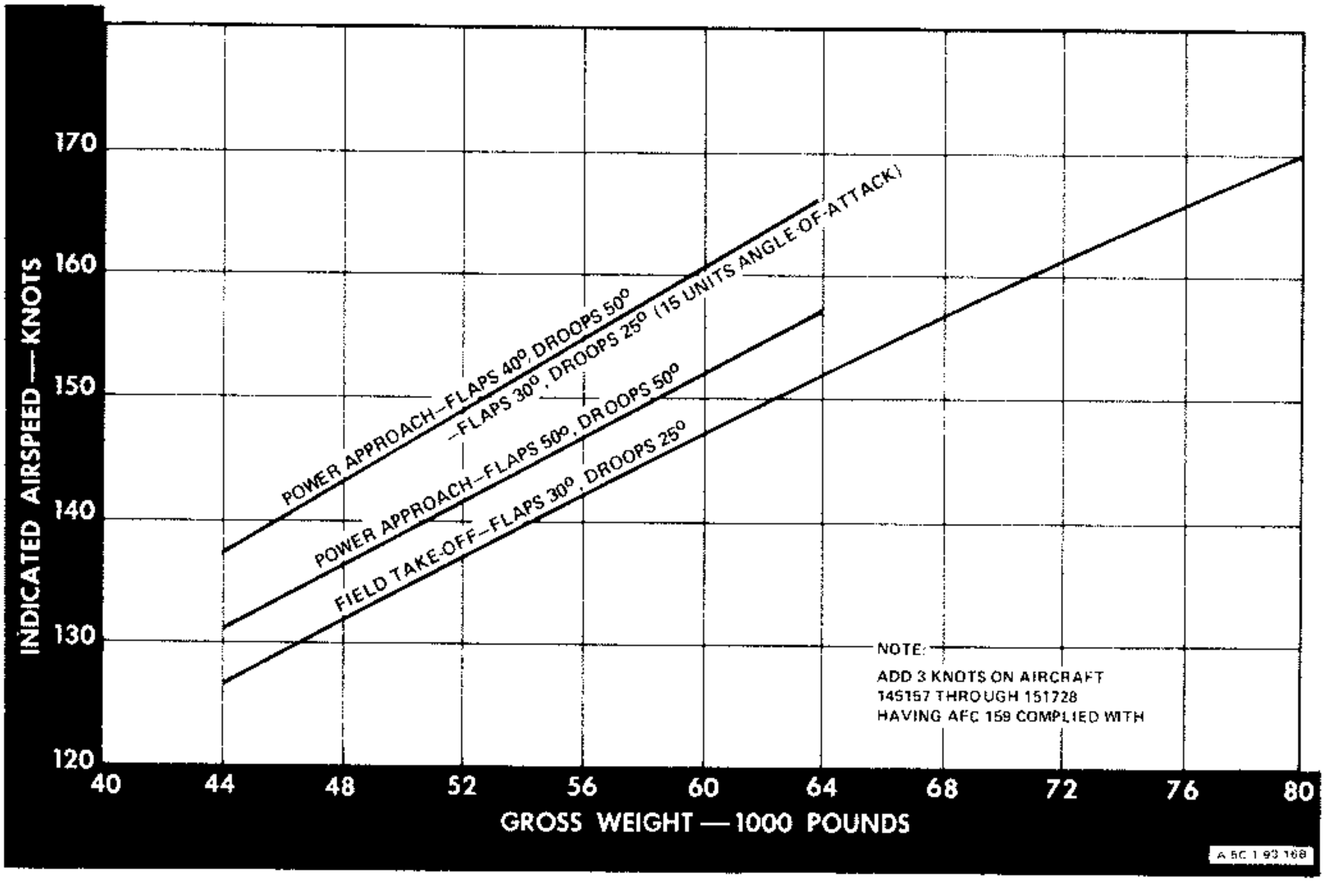

Figure 3-5

FIELD LANDING

1. Enter the landing pattern for break at 300 KIAS and at the specified break altitude for the field. See figure 3-6. At the break, establish bank angle, open speed brakes, and reduce power to approximately 80% rpm. At less than 290 KIAS, lower flaps to 30 degrees. Check for split flaps as the speed brakes retract. When straight and level and less than 230 KIAS, extend landing gear. Select 50 degrees flaps.
2. On the downwind leg, complete the landing checklist as follows:

LANDING CHECKLIST

RAN CHALLENGE	PILOT REPLY
1. FLAPS/DROOPS RECON COOL light ON, all recon systems off.	1. SET. ____°/____°
2. GEAR Check gear extension with TV.	2. DOWN
3. HOOK	3. AS REQUIRED: FIELD-35 (FIELD) NORM (SHIPBOARD)
4. APC	4. ENGAGED AND CHECKED Check: (a) APC TEMP switch –AS REQUIRED. (b) Airspeed – REDUCE to approach AOA/IAS. (c) Speed brake switch - NEUTRAL. (d) Throttle friction - OFF (full aft). (e) APC PWR switch – RESET above 80% RPM; Advisory light out; Positive thrust (fuel flow) response to stick (slab) input. If APC malfunctions or won't stay engaged, APC OFF.
5. FUEL/GROSS WEIGHT	5. ____/____
6. APPROACH SPEED	6. MARK ON SPEED
7. ANTI-SKID	7. RESET AND CHECKED (FIELD)
8. AOA INDEXER	8. ON AND WORKING – CHECK (a) Match with AOA/IAS (b) Match with hook position and approach lights modes.
9. TAXI LIGHT	9. AS REQUIRED
10. MY HARNESS LOCKED	10. LOCKED
11. CHECKLIST COMPLETE	

3. Plan the base leg to allow for a 1½-mile final. Altitude at the 90-degree position should be 600 to 800 feet, with airspeed stabilized at 15 units angle of attack. Maintain 15 units angle of attack throughout the remainder of the approach. Stabilize rate of descent with power and hold 15 units angle of attack until touchdown. For APC technique, refer to Section III, Part 4.
4. Fly the aircraft onto the runway, holding approach speed and attitude.
5. Touchdown should be made in the first 500 feet of runway or on the designated GCA or mirror touchdown point.

   Do not attempt to salvage a bad approach. In the event the landing looks long or a porpoise occurs, the correct course of action is to take a wave-off.
6. On touchdown, retard throttles to IDLE and commence aerodynamic braking.

CAUTION

If throttles are moved outboard or squeezed together during power reduction an inadvertant engine shutdown may occur. If inadvertant shutdown on deck, engine compressor/turbine damage may result from relight attempts.

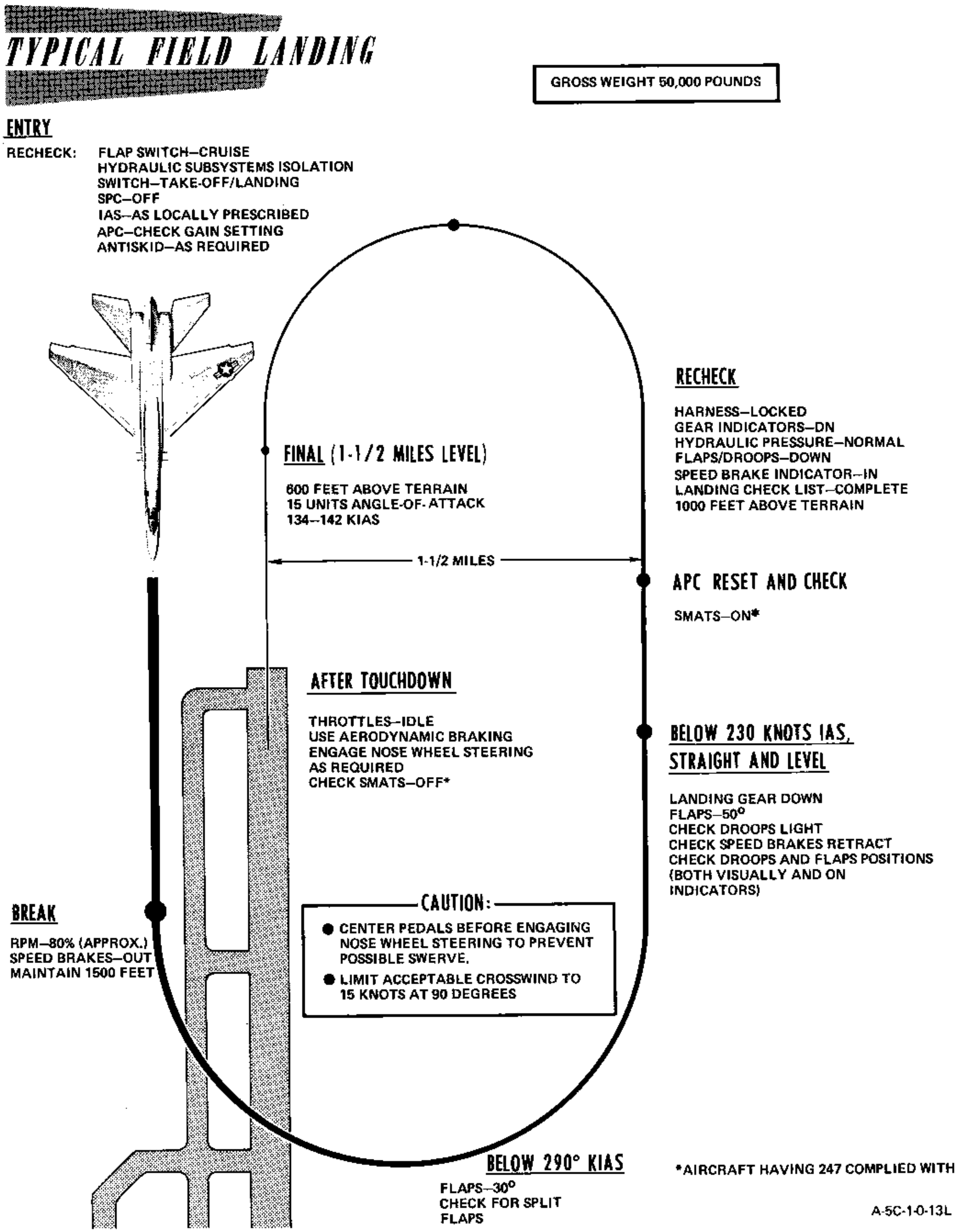
TYPICAL FIELD LANDING
GROSS WEIGHT 50,000 POUNDS
ENTRY
RECHECK: FLAP SWITCH–CRUISE
HYDRAULIC SUBSYSTEMS ISOLATION SWITCH–TAKE-OFF/LANDING
SPC–OFF
IAS–AS LOCALLY PRESCRIBED
APC–CHECK GAIN SETTING
ANTISKID–AS REQUIRED
RECHECK
HARNESS–LOCKED
GEAR INDICATORS–DN
HYDRAULIC PRESSURE–NORMAL
FLAPS/DROOPS–DOWN
SPEED BRAKE INDICATOR–IN
LANDING CHECK LIST–COMPLETE
1000 FEET ABOVE TERRAIN
FINAL (1-1/2 MILES LEVEL)
600 FEET ABOVE TERRAIN
15 UNITS ANGLE-OF-ATTACK
134–142 KIAS
1-1/2 MILES
APC RESET AND CHECK
SMATS–ON*
AFTER TOUCHDOWN
THROTTLES–IDLE
USE AERODYNAMIC BRAKING
ENGAGE NOSE WHEEL STEERING AS REQUIRED
CHECK SMATS–OFF*
BELOW 230 KNOTS IAS, STRAIGHT AND LEVEL
LANDING GEAR DOWN
FLAPS–50°
CHECK DROOPS LIGHT
CHECK SPEED BRAKES RETRACT
CHECK DROOPS AND FLAPS POSITIONS (BOTH VISUALLY AND ON INDICATORS)
BREAK
RPM–80% (APPROX.)
SPEED BRAKES–OUT
MAINTAIN 1500 FEET
CAUTION:
● CENTER PEDALS BEFORE ENGAGING NOSE WHEEL STEERING TO PREVENT POSSIBLE SWERVE.
● LIMIT ACCEPTABLE CROSSWIND TO 15 KNOTS AT 90 DEGREES
BELOW 290° KIAS
FLAPS–30°
CHECK FOR SPLIT FLAPS
*AIRCRAFT HAVING 247 COMPLIED WITH
A-5C-1-0-13L

Figure 3-6

7. Continue aerodynamic braking until:
   (a) The nose drops through at about 115 KIAS, or
   (b) Only 4000 feet of runway remain, whichever occurs first.

8. With all three wheels on deck, continue holding the stick full aft and commence steady braking.

CAUTION

If brake malfunction occurs using antiskid, release brakes, switch antiskid OFF, and resume normal braking.

9. Maintain directional control with rudder and differential braking. Be prepared to use nose wheel steering if any evidence of a directional control problem exists.

CAUTION

- Center pedals before engaging nose wheel steering.
- Braking on slippery runways must be commenced lightly and with caution, increasing in amplitude as the aircraft decelerates. Otherwise, a blown tire may result. Should this occur, it is *most important* to maintain directional control with nose wheel steering.

10. Check for normal braking prior to reaching runway abort gear. If normal braking is not available, LOWER THE ARRESTING HOOK. Emergency brakes should then be checked.

Note

Allow 3 to 5 seconds for hook extension.

LANDING TECHNIQUE

The constant rate of descent to touchdown landing technique shall normally be employed for all landings. If the aircraft is "on" angle of attack, thus having the correct speed for a given gross weight, and pitch attitude is not undergoing any transition at the moment of touchdown, the aircraft will touch down comfortably on the main wheels, rock forward on the nose wheel, and exhibit no tendency to bounce. A bounce or porpoise can be initiated by landing nose wheel first or pushing the nose down at touchdown, and should be avoided. If a porpoise develops, take an immediate wave-off. The possibility of a lateral oscillation (duck waddle) exists if the aircraft is landed one wheel first. This oscillation may be aggravated by pilot attempts to make corrections by rapid lateral control inputs. If the oscillation is severe, a wave-off should be executed.

CROSSWIND LANDINGS

Normally, no serious problems are to be expected when landing in crosswind components up to a maximum of 15 knots. If the 90-degree component exceeds 15 knots, change runways or go to an alternate airfield (if available) where acceptable wind conditions prevail. A combined crabbing and wing-down technique may be used. Lower the nose shortly after touchdown (nose-high aerodynamic braking is not recommended if the component exceeds 10 knots) and utilize nose wheel steering as necessary to maintain directional control. Lateral correction should be used during the rollout. At about 80 knots, the aircraft may tend to "heel" with the wind; however, directional control available is more than adequate. Full stick into the wind is effective.

WAVE-OFF (MANUAL)

The optimum wave-off technique is as follows:

1. Throttles—MIL.
2. Rotate smoothly to 19 units angle of attack (pedal shaker) momentarily, and raise flaps to 30 degrees.
3. Minimize lateral control inputs if possible.
4. When climb rate is obtained, select MAX AFTERBURNER, as required, and reduce angle of attack to value required for climb.
5. SMATS switch—OFF (when safe).*
6. Reduce power as desired when safe.

TOUCH-AND-GO PRACTICE

Touch-and-go landing practice will be accomplished using the same technique as described in FIELD LANDING, in this section. After touchdown, advance the throttles to Military Thrust and climb straight ahead to 500 feet with wings level prior to turning downwind. Utilize 30-degree flaps after touchdown to obtain better single-engine performance, improved fuel economy, or a shortened landing pattern. Thirteen to fourteen units angle of attack should be attained prior to shifting from 50-degree flaps.

NIGHT LANDINGS

Night landings will employ the same techniques described for day landings (power-on approach using a constant rate of descent to touchdown). The taxi light may be used on final approach during shore-based operations only if the pilot keeps the following points in mind:

1. Use of the light is recommended when doubt exists as to construction clearance, lineup, etc.
2. Switching on the light may cause radical readjustment of depth perception at a critical point.
3. Ground personnel, such as runway watches, may be temporarily blinded and unable to perform their duties.

***Aircraft 145157 through 151728 having AFC 247 complied with**

4. Use of the light is prohibited aboard ship; its use ashore should be maximized.

STOPPING THE AIRCRAFT

In-flight performance and handling qualities of this aircraft tend to mask its size and gross weight. It is extremely important, therefore, to know the proper braking techniques and limitations in order that all landings may be safely accomplished.

TOUCHDOWN SPEED

To stay within its capabilities, the brake system must be given the advantage of a properly executed approach with touchdown at the optimum speed for gross weight. A touchdown above recommended speed creates greatly increased kinetic energy over that created by a landing at the correct speed. This energy must be absorbed by the brakes in the form of heat. The hotter brakes become, the less effective they are.

AERODYNAMIC BRAKING

In order to gain the most effective use of the energy-absorbing capabilities of the brakes, aerodynamic braking must be used to decrease the kinetic energy present at touchdown.

Nose-high Method

Optimum aerodynamic braking is obtained by raising the nose after touchdown, keeping the main wheels lightly on the runway. Aft stick travel is increased steadily as speed decreases until full aft stick is attained. The drag rise in this attitude, with flaps extended, results in noticeable deceleration. The nose will fall through at approximately 115 knots with normal internal fuel remaining, but the stick should be held aft to obtain the drag of the displaced horizontal stabilizers.

Note

Flaps should be left extended for aborted take-offs and for landing rollout, since the total deceleration of full aft stick and extended flaps decreases ground roll distance more than if flaps are retracted and wheel braking is started early.

Three-point Method

An alternate method of aerodynamic braking is to lower the nose immediately on touchdown and steadily increase aft stick travel, leaving the nose wheel on the runway. *This method is about 80 percent as effective* as the nose-high method, and safer for use in strong cross winds.

WHEEL BRAKE CAPABILITY

Approximately 51 million foot-pounds of energy may be absorbed before brake fading occurs. This figure is much lower if brakes are hot from previous use. Up to 7 million pounds of energy are absorbed during normal taxiing to the runway with no external stores at average taxi speeds. For an aborted take-off, total capacity is then far less than design. It is, therefore, important that taxiing be accomplished at speeds requiring minimum use of brakes. The following table shows recommended wheel braking initiation speed to obtain 80 and 100 percent of the energy-absorbing capacity of a set of NEW brakes:

GROSS WEIGHT (Pounds)	MAXIMUM SPEED FOR BRAKING INITIATION IN KNOTS (SPC — OFF) 80% CAPACITY (20% remaining when stopped)	100% CAPACITY (Faded when stopped)
44,000	—	—
48,000	130	—
56,000	125	140
60,000	121	135
64,000	117	131
68,000	113	127
72,000	110	123
76,000	107	120
80,000	105	117

Note

During aborted take-offs or landings at high gross weights, constant wheel braking should not be commenced until speed is approximately 110 knots. Intermittent braking may be used if speed is below that shown in the 80 percent column of the table. Refer to BRAKING TECHNIQUE, in this section.

Initiation of constant braking at the speeds shown in the 100 percent column of the table results in brake fade to zero capability as speed approaches zero. The 80 percent capacity speeds assume use of the three-point method of aerodynamic braking from touchdown to stop. The speeds shown are all 105 knots or above; however, it must be remembered that these figures correspond to a set of new brakes with full design capacity.

Note

A speed of 100 knots is considered adequate for initiation of wheel braking for all conditions and will provide a safe margin for old or slightly heated brakes.

BRAKING TECHNIQUE (TYPICAL FIELD LANDING)

Use aerodynamic braking throughout entire landing roll. With all three wheels on the runway and 100 knots, gently apply brake pressure until they feel "solid." Firm pressure should then be applied and held, increasing pressure as speed decreases until taxi speed is reached or the aircraft is stopped. Exercise care, however, since it is difficult to detect tire skidding. Use of the antiskid system will sharply reduce the chance of a blown tire and shorten the stopping distance by allowing the pilot to apply maximum braking. Use of the antiskid system does not change braking technique but the pilot must be vigilant for malfunctions such as a steady release brake signal. Amplification of the antiskid system and its use are discussed in Section I, Part 2.

Intermittent Braking

It has been established that very little effective brake cooling is gained through intermittent braking. However, chances of skidding or blowout, due to excess brake pressure, are reduced. Calculations reveal that landing rollout distance is considerably increased by intermittent braking, inasmuch as there are short periods of zero braking effect. As much as 400 feet may pass between applications of pressure if released for 2 seconds.

Note

Since no significant cooling results from intermittent braking, it is recommended that constant brake pressure be used for normal landings. Above 100 knots, light, steady braking should be used if required. As speed decreases, pedal pressure should steadily increase.

FIELD ARRESTMENTS

Field arrested landings will be made when the aircraft has suffered physical damage which might have rendered braking ineffective (e.g., a blown tire). When available, fly-in type arresting gear will be used for emergency arrested landings. Refer to FIELD ARRESTMENT in Section V.

AFTER LANDING (PILOT)

1. Hook — UP.
2. FLAPS control switch — SUPERSONIC.
3. Anti-ice switches — OFF.
4. Trim — NEUTRAL.
5. Canopy — AS DESIRED.
6. ANTI-SKID PWR — OFF.
7. Wing fold — AS REQUIRED.
8. Taxi light — AS REQUIRED.

CAUTION

- Ensure that the droops are in SUPERSONIC prior to folding the wings.
- Do not open canopy above 60 knots.

PRIOR TO ENGINE SHUTDOWN (RAN)

CAUTION

Do not open canopy above 60 knots.

1. IFF — OFF.
2. Oxygen — OFF.
3. Viewfinder POWER switch — OFF.
4. Radar TRANSMIT MODE — SILENCE.
5. A/N MODE knob — STBY-NAV.
6. UHF/NAVAIDS – OFF.
7. DECM — OFF.
8. ALTITUDE switch — BARO.
9. RADAR/TV POWER switch — OFF.

CAUTION

Ensure pause of at least 30 seconds or wait for collapse of the radar sweep before securing engines; failure to do so may result in damage to the radar antenna.

10. BOMB COMPUTER POWER switch — OFF.
11. AN POWER switch — OFF.
12. Safety pins — IN.

ENGINE SHUTDOWN (PILOT)

The engines should be stabilized at idle for 2-3 minutes (including landing roll and taxi time) to allow temperature stabilization.

1. Chocks/tiedowns – IN PLACE.
2. Wing fold and speedbrakes – AS REQUIRED
3. RAN's shutdown checklist – COMPLETE.
4. Radios/NAVAIDS – OFF.
5. CNI power – OFF.
6. Pedals – FULL AFT.
7. Seat – FULL UP.
8. Generators – CROSSOVER CHECKS (switch number 1 off, check that 2 assumes load, reset 1 and repeat for number 2).
9. Engine masters – OFF (engine door light out indicates engine doors closed).
10. Throttles – Momentarily to 80% (EGT stabilized) then off together.
11. Generator cutout – CHECK 28-35%.
12. EPU – ON until approximately 25%.
13. Canopy/Seat – Safety pins installed, and uplock engaged.
14. Landing gear safety pins – INSTALLED.

PART 4—CARRIER-BASED PROCEDURES

CV NATOPS MANUAL

Refer to the CV NATOPS Manual for detailed information.

AUTONAVIGATOR PLATFORM ALINEMENT (RAN)

When operating aboard ship, it may be assumed that preheat of the inertial platform will be accomplished prior to boarding. This requires use of deck-edge electrical power only. Alinement may be accomplished with complete external provisions (electrical and air) or with engines operating. Refer to AUTOMATIC (SINS) and STAND-BY NAV TURN-ON, in Part 3 of this section. Handset alinement may be performed as indicated.

AUTOMATIC ALINEMENT

1. A/N preheat complete, external power/cooling air or engines operating.
2. SINS umbilical cable — CHECK CONNECTED.
3. COURSE LINE NAVIGATION switch — NORMAL.
4. COORD SELECT knob — NORMAL.
5. WIND knob — AUTO.
6. SPEED switch — GROUND.
7. A/N MODE knob — STBY-NAV.
8. SYSTEM MODE knob — SET PP.
9. Radar/barometric altimeter — DECK ELEVATION.
10. HANDSET/AUTOMATIC switch — AUTOMATIC.
11. BOMB COMPUTER POWER switch — ON.

Note

The BOMB COMPUTER POWER switch is inoperative with cooling air applied at the forward (autonavigator) access only.

12. AN POWER switch — STBY.
    Note AML out in 40 seconds or less.
13. OFFSETS — Slew distance from velocity reference point (SINS).
    (a) East/West (starboard/port) — _______feet.
    (b) North/South (forward/aft) — _______feet.
14. DIFFERENTIAL HEADING indicator—Slew to angular difference, ship's true heading to aircraft true heading in degrees.

    Example: Ship — 090 degrees.
    Aircraft — 330 degrees.
    DIFFERENTIAL HEADING — 240 degrees.

Note

Carrier heading and velocity are supplied by SINS.

15. Set and store present position.
16. A/N MODE knob — DECK ALINE.
17. AN POWER switch — ON.
    Note AML out within 100 seconds indicating start of alinement.
18. PRESENT POSITION indicator — CHECK, RESET, as required.
19. SET/CORR knob — 5 (Monitor alinement).
    $\Delta\alpha$ in TARGET POSITION (LATITUDE).
    α in TARGET POSITION (LONGITUDE).
    Time in alinement in TARGET ALTITUDE.
20. Note PRESENT POSITION updating (automatic).
21. ADVANCE MODE light — Check out at beginning of alinement (TARGET ALTITUDE counters start displaying time) and check blinking at end of alinement (TARGET ALTITUDE time display approximately 30 minutes).
22. A/N MODE knob — OPERATE (prior to moving the aircraft).
    Check AML out.

Note

Degraded A/N performance may result if Δ alpha exceeds 20 minutes. (Δ alpha equals the difference between 14- and 30-minute alpha.)

23. OFFSETS — ZERO.
24. SINS umbilical cable — CHECK (removed before taxiing).

TOWING

Refer to section I, part 3 for basic towing procedures. In addition, when embarked: (1) The person in the cockpit shall maintain visual contact with the director at all times. If visual contact is lost, the person in the cockpit shall apply brakes and stop the aircraft until visual contact is regained. (2) Prior to removing the tractor and/or towbar, the aircraft shall be chocked and a minimum 6 point tiedown shall be applied.

STARTING AND POSTSTART PROCEDURES

Engines shall be started on order from Pri-Fly. A 5-minute warm-up of all systems (other than the AN/ASB-12 and reconnaissance systems) is required after engine start. Complete all items of the FLIGHT CONTROL AND PRETAXI CHECK, in Part 3 of this section. A complete flight control system check is mandatory — do not allow yourself to be rushed. Complete all checks in a thorough and expeditious manner.

CAUTION

- On a carrier deck, the exhaust from other aircraft can affect inlet duct temperature, resulting in higher than expected engine power because of the rpm schedule reset feature. Monitor the inlet temperature gage and be prepared for engine speed reset when more than 45°C (110°F) are indicated.
- Ensure AN/APN 202 radar beacon is in STBY or OFF when aft of the island to prevent frequency interference with SPN-42 radars during recovery operations.

APC STATUS

Unless operational necessity dictates, aircraft shall not be launched with a known inoperative or malfunctioning APC system.

TAXI PROCEDURES

1. Use only as much power as is required to taxi.
2. Use nose wheel steering and differential braking as required for taxi.

PRIOR TO TAXIING ONTO CATAPULT

Prior to crossing the shuttle, complete before take-off check including RAN/pilot challenges. Taxiing onto the catapult is a relatively simple maneuver if the director's signals are followed explicitly. After taxiing into the holdback and until the Catapult Director gives the "tension" signal, maintain sufficient power to prevent slack in the holdback cable. After crossing the shuttle, the starboard catapult hook will be extended, illuminating the GEAR STIFF caution indicator.

If the GEAR STIFF caution indicator does not come on, launch is not recommended without nose gear extension. If launch is necessary, check No. 2 hydraulic pressure. If pressure is normal, launch may be accomplished provided catapult end speed and wind-over-deck requirements are increased to at least 5 knots above minimum airspeed.

CAUTION

- If launch is accomplished without nose gear extension, expect greater than normal sink off the bow and greater nose rotation requirement.
- Never launch with a partial wing fuel load between 1200 and 9000 pounds, as a swerve during the catapult power stroke may result. For partial fuel launches such as carquals, fuel the fuselage tanks and bomb bay cans as required and limit the wing fuel to 1200 pounds.

Note

For procedures required if landing with the GEAR STIFF caution indicator on, refer to Section V, Part 5.

LAUNCH PROCEDURE

On receiving the "take tension" signal, advance throttles to MIL, and complete the POWER CHECK, in Part 3 of this section. After handoff to the Catapult Officer, await signal for maximum afterburner. On receiving the signal, advance throttles to MAX AFTERBURNER and recheck all indicators. When satisfied the aircraft is ready, recheck body position, back up the throttles with the catapult handgrip, alert the RAN for launch, and salute the Catapult Officer (Day), or select the ON position of the EXT LIGHTS MASTER switch (Night).

Note

If, after the "ready" signal, the aircraft goes down, transmit "SUSPEND-SUSPEND." This signal will be heard in Pri-Fly and the suspend button may be pushed in time to hold the launch. Maintain maximum power until the Catapult Officer walks in front of the aircraft and signals to throttle back.

Hold the stick lightly in the trimmed neutral position prior to the launch. Allow the stick to move aft during the catapult power stroke, and allow the aircraft to rotate to 10- to 12-degree nose-up attitude on the AAI after leaving the bow. An aft stick movement may be required to attain the desired rotation rate and attitude if insufficient longitudinal trim was used. Do not exceed 16 units angle of attack (stall warning) for other than a brief transient angle-of-attack overshoot. When launching at or near the minimum catapult minimum end airspeed, expect a peak transient angle of attack of about 21 units. For end airspeeds greater than 15 knots above the minimum, care should be taken to avoid overrotation. Avoid erratic lateral control movements because of the inherent decrease in lift which results from spoiler actuation. If turbulence is experienced immediately after the launch, try only to level the wings; do not attempt to return to course until speed builds up and the increased drag due to lateral inputs is less critical.

WARNING

Exercise caution when launching with partially full integral wing fuel tanks (between 1200 and 8600 pounds is not permitted) since a wing drop may be experienced after catapult release with even less than 1200 pounds integral wing fuel. See carrier operation limitations, page 1-150, for complete definition of associated restrictions.

After launch, cross-check the AAI with the vertical speed indicator, stand-by gyro, and radar altimeter for a positive rate of climb. During the latter phase of the power stroke immediately after becoming airborne, the static pressure instruments will temporarily indicate erroneously (rate-of-climb as much as 1000 fpm down, pressure altimeter at or below zero altitudes) and should not be used as primary references. Every catapult launch, day or night, with or without a horizon, should be made on instruments as drill for a time when there will be no choice. After launch, place the flap control switch in the 30-degree position above single-engine control speed. Then retract the gear. The drag of the gear down (gear doors closed) is minimal, when compared with the increased drag with the gear doors open during the raising/lowering cycle.

Recheck the gear up and at 220 KIAS and 200 feet (VFR), or 1000 feet (night and/or IFR), retract the flaps to the CRUISE position. Maintain afterburner until the flaps are fully retracted. For day VFR carqual launches maintain afterburner until above 200 feet.

BINGO FUEL

Bingo fuel is that amount of fuel required to reach the break at a divert field (not nearest land) under VFR conditions with 1500 pounds of fuel remaining. In addition, sufficient fuel shall be computed to complete a standard jet penetration unless weather at the divert field is 3000 feet and 3 miles visibility or more and forecast to remain so within 1 hour after estimated arrival time. Know your Bingo fuel and be prepared to advise the ship of holding time remaining or the number of passes that can be made before reaching Bingo. (A tight pass requires approximately 600 pounds.) "At Bingo" will be declared at any point in the pattern or during the approach when usable fuel remaining reaches Bingo. "Bingo plus one pass" should be declared when this condition is reached. The pilot will either be given priority in the pattern, directed to the emergency tanker, or diverted. Bingo data is contained in the NATOPS Pocket Checklist. Normally, all flights shall be planned to arrive over the ramp at maximum landing weight. A minimum of 500 pounds of fuel at the 180-degree position is needed to commence the final pass. Decision to use the barricade will be made by the Commanding Officer of the ship.

CARRIER APPROACH

On aircraft configured with SMATS,* the system should be selected ON prior to commencing the approach. Approximately 300 pounds extra fuel per pass are required for SMATS from the 180-degree position through wave-off.

During the approach, aircraft response is adequate if proper speed is maintained. The lateral control system, by means of spoiler/deflectors, is adequate if speed is maintained; however, if speed is allowed to drop below that required for 16 units angle of attack, lateral control becomes marginal and over-nose vision is limited. Each pilot is expected to fly his own approach. The LSO will offer advisory comments as he deems necessary; however, the wave-off is mandatory. A pilot may take a voluntary wave-off at any time he considers an unsafe condition exists; however, late wave-offs are extremely dangerous as thrust is slow to increase and a nose-up rotation to 19 units angle of attack is required to arrest sink rate. For typical carrier landing, see figure 3-9.

CAUTION

At approach speeds, large spoiler deflections resulting from lateral control movements will cause a high sink rate. This condition will be amplified in a slow or decelerating approach, particularly when any ramp turbulence is encountered. This condition is extremely difficult for the pilot or LSO to detect at night, and a dangerous low-at-the-ramp situation may develop. Ramp turbulence and burble increase sharply when wind-over-the-deck optimums are exceeded.

*Aircraft 145157 through 151728 having AFC 247 complied with

RA-5C CARQUAL TRIM (CG) CHARTS

These charts can be used to determine if the center of gravity of the aircraft remains within safe operating limits under varying fuel loads for carrier qualification. However, these charts are not intended to replace the center-of-gravity locator chart in the NATOPS Flight Manual and Pocket Checklist or the trim recommendations for full internal fuel which are in the Take-off Checklist.

Each chart is based on an aircraft having the operating weight and the configuration shown on the chart plus a nominal 2800 pounds of fuel and empty wing tanks. For aircraft 145157 through 151728, see figure 3-7. For aircraft 156608 through 156643, see figure 3-8.

If there is a difference between the chart configurations and the weight and center of gravity of a particular aircraft, this variance should be given consideration in the use of these charts. For example, a plus 1000-pound variation in the basic weight calculation and a minus 1-inch variation in center-of-gravity location from fuselage station 511.35 will result in a change of the forward landing control limit by requiring approximately 300 pounds less fuel in the forward tank with the corresponding amount of bomb bay fuel as shown on the charts. Also, a minus 1000 pounds in the basic weight calculation and a plus 1-inch variation in center-of-gravity location from fuselage station 511.35 will result in a change of the aft cg limit by requiring approximately 300 pounds more fuel in the forward tank with the corresponding amount of bomb bay fuel as shown on the charts.

APC TECHNIQUE

APC IN-FLIGHT CHECKOUT

For in-flight trouble shooting or checkout of the APC, the following guidelines apply for shore-based and shipboard operation.

1. Engage APC at greater than the required approach speed and note that the APC light goes out.
2. Cycle the temperature switch and watch for corresponding fuel flow fluctuations prior to placing it in the appropriate position.
3. After transition to the power approach configuration, trim the aircraft for level flight with no vertical movement. Cross-check the angle of attack, airspeed, gross weight, and trim setting for proper correlation. A fuel flow match indicates symmetrical thrust from the engines; for example: an RA-5C with J79-GE-8 engines, SPC OFF, 50,000 pounds gross weight, and 50/50 flaps/droops should indicate 15 units angle of attack, 137 KIAS, 10 to 11 units nose-up trim, and a fuel flow match between 3500 and 4500 pounds per hour.
4. In this steady-state condition, with wings level and no vertical movement, small cyclic stick movements should produce corresponding fuel flow fluctuations. This is the result of the stabilizer input to the computer in the steady-state condition. The stabilizer input should not be checked in a turn or with rough stick movement as this will influence the accelerometer and angle-of-attack inputs.

GLIDE SLOPE

Trim the aircraft as necessary early in the approach to provide correct rate of descent. Minor retrimming should be accomplished whenever necessary. Small, frequent, "cyclic" stick corrections provide optimum APC performance. "Cyclic" means to move the stick out of the neutral trimmed position and return it to neutral. For instance, in correcting for a climbing ball, momentarily push the stick forward and return it to neutral (cycle it forward), then see what this "nibble" did to stop the climbing ball. Do not push the stick forward and hold it there until the ball starts to respond. Large, single-direction stick inputs will result in divergent glide slope oscillations or overcontrolling. By using the "nibble" or "cyclic" correction technique, the basic landing attitude of the aircraft remains relatively constant and optimal. On aircraft 156608 through 156643, much smaller stick movements are required to effect a glide-slope adjustment than with previous RA-5C aircraft.

POWER CALLS

Response to LSO power calls is best achieved by simply overriding the APC without disengaging. Experience shows that disengaging on a "power" call results in much more erratic throttle and nose movements than overriding. Keep the left hand in contact with throttles, but not so as to limit the APC. At touchdown, APC will disengage, and with no throttle friction on, the throttles may creep aft. The left hand must be ready to apply power manually for touch-and-go landings. APC must be reset after each touchdown.

WAVE-OFF

To wave off, manually advance the throttles smartly to MIL (disengaging APC simultaneously by moving the speed brake switch to IN) and rotate aircraft the same as for wave-off from a manual pass.

CAUTION

- With APC engaged, do not retard the throttles to IDLE prior to touchdown. If throttles are retarded, rpm will remain at approximately 70% due to jamming of the throttle linkages against the APC mechanical stop. Movement of the throttles past 70% rpm will free the torque booster stops to retract and the throttles can then be retarded to idle rpm.
- When using APC, throttle friction must be full off. This condition will allow the throttles to creep aft if they are not held in position after disengagement of the APC, such as during a touch-and-go landing.

ACLS/ILS APPROACHES

EQUIPMENT CHECKLISTS

AN/ASW-25 (ACLS) BUILT-IN TESTS

1. CNI PWR–ON.
2. ACL/ILS–ACL.
3. DATA LINK FREQ SELECT–SET (3__.__).
4. UHF–D/L ANT–NORM.
5. AN/ASW-25–ON.
6. TEST/NORM/A-J–HOLD IN TEST.

UTM NOT RECEIVED

Indicators	Prior 10 to 12 seconds*	After 10 to 12 seconds*
D/L CPLR Light		
DRO Windows		
No. 1	"NO MSG"	"TILT"
No. 2	"CPLR"	"CPLR"
No. 3	Blank	Blank
No. 4†	"000"	"000"
ADI		
Flags	Out	Hidden
Steering Bars		
Bank	Center	Hidden
Pitch	Center	Up
WAVE OFF Light	Off	Off

UTM RECEIVED

Indicators	Prior No change at 10 to 12 seconds* (indications cycle every 6 seconds)	After
D/L CPLR Light	On	On
DRO Windows		
No. 1	"NO MSG"	"WAVE-OFF"
No. 2	"CPLR"	"CPLR"
No. 3	Blank	Blank
No. 4†	"315"	"045"
ADI		
Flags	Hidden	Hidden
Steering Bars		
Bank	Right	Left
Pitch	Up	Down
WAVE OFF Light	Off	Flashes at 2 cps

*After power applied to AN/ASW-25
†CMD HDG (±1 degree)

AN/APN-202 RADAR BEACON BUILT-IN TESTS

1. ENCODE and DECODE–S (single pulse) (1 through 5 not used).
2. MODE–STBY.
3. MODE–TEST (after 30 seconds).
4. BCN and ACLS, test lights–ON.
5. MODE–ACLS–BOTH LIGHTS OUT.

Note

- ACLS test light comes on when antenna painted by Ka-band radar.
- With AVC 1556 the green ACL light will not be visible during test or ACL lock-on until pilot's console lights are on (daylight operations may require full intensity).

AN/ARA-63 (ILS) BUILT-IN TESTS

1. ACL/ILS–ILS.
2. POWER–ON (green light).
3. Channel select knob to CHANNEL 1 (to check channels 1 through 10) and then CHANNEL 11 (to check 11 through 20).
4. BIT check button–PRESS (bank steering bar steps from 3 degrees left to 3 degrees right and pitch steering bar centers).

Note

Channel select knob is difficult to read. CNI PWR not required.

ACLS MODE 1 AND MODE 1A PROCEDURES

Note

Mode 1 approaches are not authorized under actual instrument conditions to less than 200 feet–1/2 mile, pending flight test evaluation and certification by Naval Air Systems Command.

ACLS Modes 1 and 1A approaches are shown in figure 3-6A. The ADI pitch and bank steering bars present vertical and lateral glide slope errors respectively in relation to the aircraft. The following steps describe typical Modes 1 and 1A approach procedures, including cockpit indications as they change after each step.

ACLS MODE 1/1A APPROACH

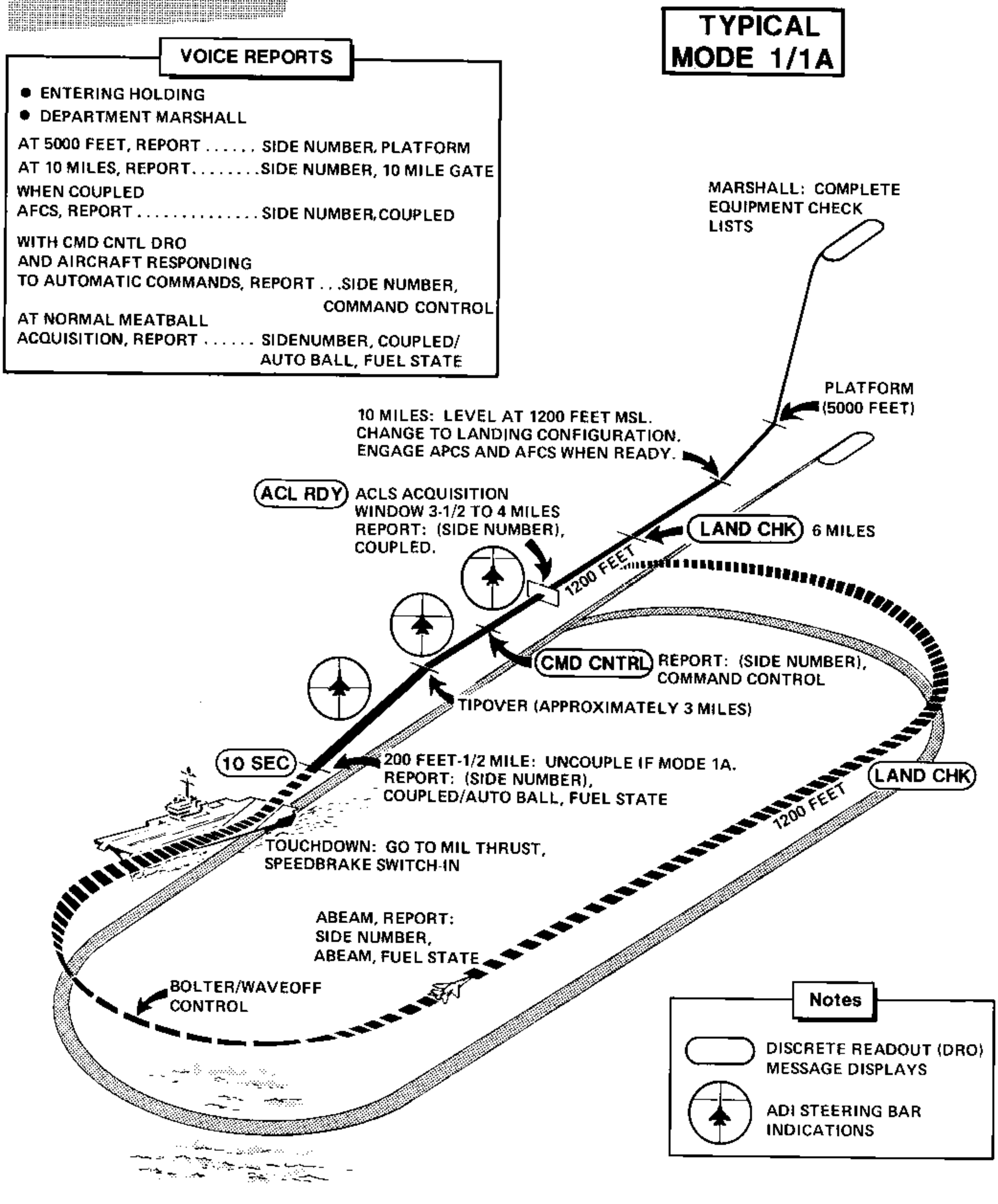

Figure 3-6A

1. Before or while in Marshal complete equipment checklists.
   DRO No. 1–TILT.
   ACL/ILS–ILS.

Note

NAV mode steering is not available when AN/ASW-25 is on.

2. Perform a normal CCA. ILS can be utilized for acquisition of final bearing. At 10-mile gate with aircraft level at 1200 feet MSL or as assigned, change to landing configuration.
3. Engage APC. Conduct APC checks and check APC light out. Stabilize at approach speed.

CAUTION

In the event of an APC malfunction, do not attempt to couple the aircraft. Execute a Mode 2 or a Mode 3 (talk down) approach.

Note

- APC is required for Modes 1 and 1A approaches. APC is strongly recommended but not required for Modes 2 and 3.
- The ILS can be utilized until AN/SPN-42 lock-on. At lock-on, the ACL position should be selected; agreement of the ADI steering bars will verify the AN/SPN-42 is locked on correct aircraft. Shortly after tipover the ILS position should again be selected to verify alignment of AN/SPN-41 with AN/SPN-42 and confirm proper aircraft control. The ILS position should be maintained until the approach is completed. The ILS position does not affect the operation of the ACLS in any way other than the ADI steering bar presentation. The pilot may, therefore, compare the presentations of each system at any time while coupled, but should not attempt switching inside of 1 mile.

4. Engage AFCS. Heading hold feature is inoperative as is heading trim wheel. It is desirable but not required that the aircraft be flown in altitude hold prior to coupling. Altitude hold automatically disengages when aircraft is coupled.
5. At approximately 6 miles, controller inserts aircraft address. Recheck landing checklist.
   DRO No. 1–LAND CHK.
   DRO No. 2–(blank).
   ACL/ILS–ACL.
6. At approximately 4 to 6 miles on final bearing, controller reports "ACL lock on, report coupled." The ADI steering bar warning flags disappear and the pitch and bank steering bars commence providing glide slope line-up indications.
   DRO No. 1–ACL RDY.
   DRO No. 2–CPLR (indicates aircraft is receiving AFCS engage/enable signal) or MAN (indicates aircraft not receiving AFCS engage/enable signal and aircraft cannot be coupled).
   DRO No. 4–(COMMAND HEADING).
   (a) A below glide slope indication by the pitch steering bar is normal. An above glide slope indication indicates erroneous information or passage of the glide slope extension and coupling should not be attempted until established on glide slope.
7. With wings level at assigned altitude on approach speed and DRO No. 2 indicating CPLR, engage coupler switch. The coupler switch should remain locked in the engage position and the D/L CPLR light remain off.

Note

If aircraft is coupled with wings not level, it initially rolls to a wings-level attitude upon coupling.

8. Report "(side number) coupled" and steering bar positions.
9. Controller initiates ACLS commands. In event of radio failure, commands are sent 10 seconds after ACLS lock-on. Upon observing CMD CNTRL and aircraft response to commands, report "(side number) command control."
   DRO No. 1–CMD CNTRL.
   DRO No. 2–CPLR.
10. Under certain circumstances the aircraft may become uncoupled. The cockpit indications and recommended pilot action for each instance are as follows:
    (a) Intentional disengagement by pilot. Pilot moves the control stick and the AFCS and coupler switches disengage.
    DRO No. 1–CMD CNTRL.
    DRO No. 2–CPLR.
    D/L CPLR light–ON.

CAUTION

Due to the very light stick force required to disengage the pitch/roll attitude mode, caution must be exercised "in-close" to preclude inadvertent uncoupling.

(1) If disengagement occurs before intercepting the glide slope, recouple (pilot's discretion) or continue the approach in Mode 2/Mode 3. Recoupling is accomplished by re-engaging the AFCS switch and coupler switch in that order. If the aircraft is uncoupled for an excessive length of time, large initial corrective commands may result when the aircraft is recoupled. Attempt to center the bank and pitch steering bars before recoupling. Never recouple if the ADI pitch steering bar indicates glide slope passage.

(2) If disengagement occurs while on glide slope, continue the approach in Mode 2/Mode 3. Recoupling should not be attempted at ranges less than 2 miles.

(b) ACLS Malfunctions

(1) If the SPN-42 console is set for the wrong aircraft, control movements with data link could be rough. Notify the controller if he has not already discovered the error. The controller can then down grade to Mode II (Glideslope and azimuth needles will still be received) and recouple Mode I.

(2) If the aircraft is experiencing APN-202 radar beacon problems with resultant unlocks, a recouple or skin track Mode II approach will be required. Either aircraft or shipboard beacon range error discrepancies will cause the aircraft to land long and to the right, or short and to the left.

(3) If the controller reports ACL lock on but TILT or NO MESSAGE remains in the DRO, continue the approach Mode III. No needles information will be available at this time.

(a) Check for proper data link frequency set on the data link panel (ASW-25A), and confirm the controller has the proper aircraft address. The aircraft address is preset in the ASW-25A by maintenance. The pilot should know what address is set in the ASW-25A prior to launch and notify the controller if necessary.

(b) Other ASW-25A problems may also cause a TILT and/or NO MESSAGE DRO.

(c) A reacquisition will be necessary for Modes I, IA, or II, and a recouple for Modes I and IA.

(4) The D/L CPLR light illuminates when AFCS disengages during an ACLS approach. The SPN-42 system can be recycled or the approach can be continued Mode II.

WARNING

If, during uncouple, the AFCS remains engaged, place the AFCS to STBY. If this occurs inside 3/4 mile, wave-off. If kill button is necessary for aircraft control wave-off/discontinue approach.

Note

- If APC disengages, it does not uncouple aircraft. Attempt to reengage APC, if APC will not engage, notify the controller that you are downgrading to Mode II approach. ACLS Mode I/IA approaches with manual throttles are prohibited.
- If OPS II program logic is in use on console, reacquisitions could take as long as 15 seconds. In the interim utilize Mode III, SPN-41 ILS needles, or wave-off at OPNAV minimums if ship/runway environment is not in sight.

(c) ACLS wave-off. A system parameter has been exceeded and the AFCS and coupler switches disengage. If a wave-off is received after glide slope interception and in IFR conditions, advise the controller. The aircraft cannot be recoupled.

DRO No. 1—WAVE OFF.
DRO No. 2—MAN
WAVE OFF light—Flashing (extinguished when signal dropped by controller).
D/L CPLR light—ON.
ADI needles—Disabled (warning flags appear).

Note

An operable radar beacon is required for mode 1 approaches. If control is rough, check for a steady green ACLS light on the radar beacon panel. If it appears normal advise controller of rough control. If radar beacon is inoperative, continue with a Mode 1A, 2, or 3 approach.

11. At 1/2 mile in Mode 1A approaches, the controller downgrades the approach to Mode 2. Although the

AFCS and coupler switches automatically disengage, momentary movement of the control stick is recommended to ensure that the switches disengage.

DRO No. 1–CMD CNTRL.
DRO No. 2–MAN.

12. In Mode 1 approaches, the pilot receives the 10 SEC discrete 12.5 seconds before touchdown. Deck motion compensation (DMC) and wave-off are automatically enabled.

DRO No. 1–10 SEC.
DRO No. 2–CPLR.

CAUTION

Do not allow the aircraft to automatically fly a bad pass outside of your judgement as a pilot.

13. At touchdown following a Mode 1 approach, go to Military Thrust and actuate the speed brake switch closed to ensure APC disengaged.

14. If the aircraft bolters, the computer clears the data link discretes and terminates data link transmissions to the aircraft approximately 0.7 second after touchdown.

DRO No. 1–TILT.
DRO No. 2–(blank).

ACLS MODE 2 PROCEDURES

ACLS Mode 2 approach is shown in figure 3-6B. In a Mode 2 approach the pilot flies the aircraft toward the steering bars. DRO messages are noted following the procedural steps as in the ACLS Modes 1 and 1A approach procedures.

1. Perform steps 1 through 3 in the ACLS Modes 1 and 1A approach procedures.

2. At approximately 6 miles, controller inserts aircraft address. Recheck landing checklists.

DRO No. 1–LAND CHK.
DRO No. 2–(blank).
ACL/ILS–ACL.

3. ACLS radar lock-on. At approximately 4 to 6 miles steering bar warning flags disappear and pilot observes fly-up signal on pitch steering bar and final bearing steering on both the bank steering bar and the DRO No. 4 CMD HDG. Report "(side number) needles." (A flydown steering bar indicates erroneous information if further aft of the carrier than approximately 3 miles at 1200 feet or indicates glide slope passage if within 3 miles at 1200 feet. If glide slope passage has occurred, attempts to intercept it are at pilot's discretion.) Fly aircraft level as the pitch steering bar moves down from the top of the ADI. When the pitch steering bar approaches the ADI miniature wings, maintain the aircraft on the glide slope. Fly the glide slope by keeping ADI steering bars centered.

DRO No. 1–ACL RDY or CMD CNTRL. Refer to following steps (a) and (b).
DRO No. 2–MANUAL.
DRO No. 4–(COMMAND HEADING).

(a) For approaches that were begun in Mode 2, DRO No. 1 indicates ACL RDY and remains throughout the approach until 10 seconds is displayed.

(b) If a Mode 1/1A approach was initiated and the pilot uncoupled and continued in Mode 2, the DRO No. 1 indicates CMD CNTRL and remains throughout the approach until 10 seconds is displayed unless the controller recycles his console.

4. At 1/2 mile or sooner (pilot's discretion) transfer to the standard visual approach and call the meatball.

ILS PROCEDURES

1. Perform ARA-63 checklist.

2. ACL/ILS switch–ILS.

3. From a TACAN/radar descent, correct to establish final approach bearing by 12 miles, utilizing bank steering bar as necessary.

4. Follow standard CCA or precision approach procedures, departing 10-mile gate at 1200 feet and commence transition to landing configuration.

5. Continue with steps 3 and 4 of ACLS Mode 2 procedures disregarding DRO indications.

CAUTION

Glide slope information is not valid until within 6 degrees of final bearing.

ACLS Restrictions

1. Aircraft not fully equipped in accordance with AFC 233 are limited to Mode II approaches within established weather minima.

2. Aircraft with an inoperative radar beacon are limited to Mode II approaches except at ACLS installations certified with skin track control.

3. When turbulence or thermal conditions repeatedly cause AOA to exceed ± 1.5 units reference on speed, Mode I approaches should be downgraded to Mode IA.

4. For general restrictions to Mode I approaches aboard CV/CVA's refer to OPNAVINST 3710.7 series.

ACLS MODE 2 APPROACH

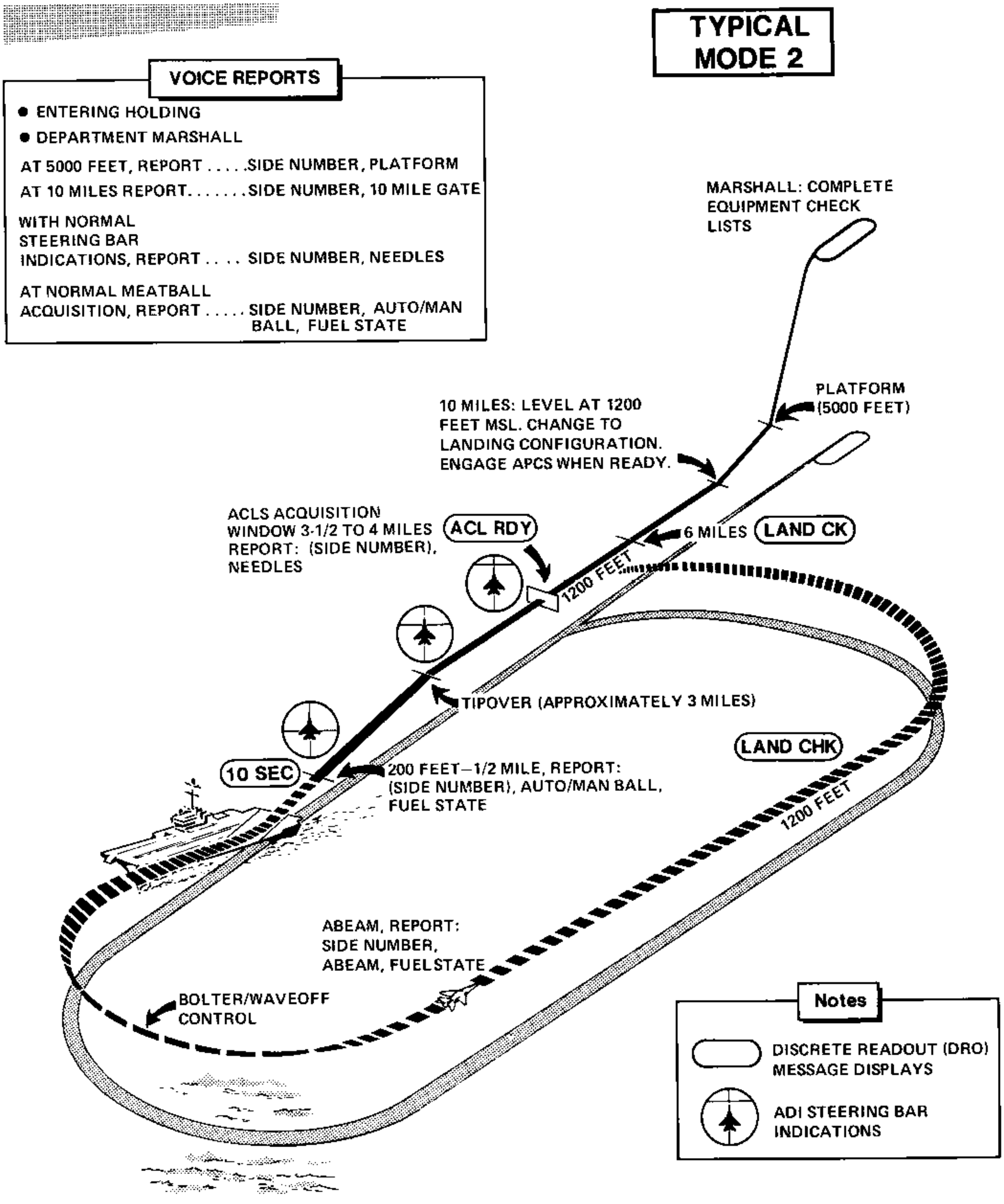

Figure 3-6B

CARQUAL TRIM (CG) CHART

AIRCRAFT 145157 THROUGH 151728 NOT HAVING AFC 328 COMPLIED WITH.

- PECM (TWO CAN) CONFIGURATION – (4-1 MODULE)
- 38,700 POUNDS BASIC WEIGHT @ F.S. 511.35
- 2800 POUNDS SUMP – WINGS EMPTY
- 43,509 POUNDS OPERATING WEIGHT
- 15 KNOTS EXCESS END SPEED

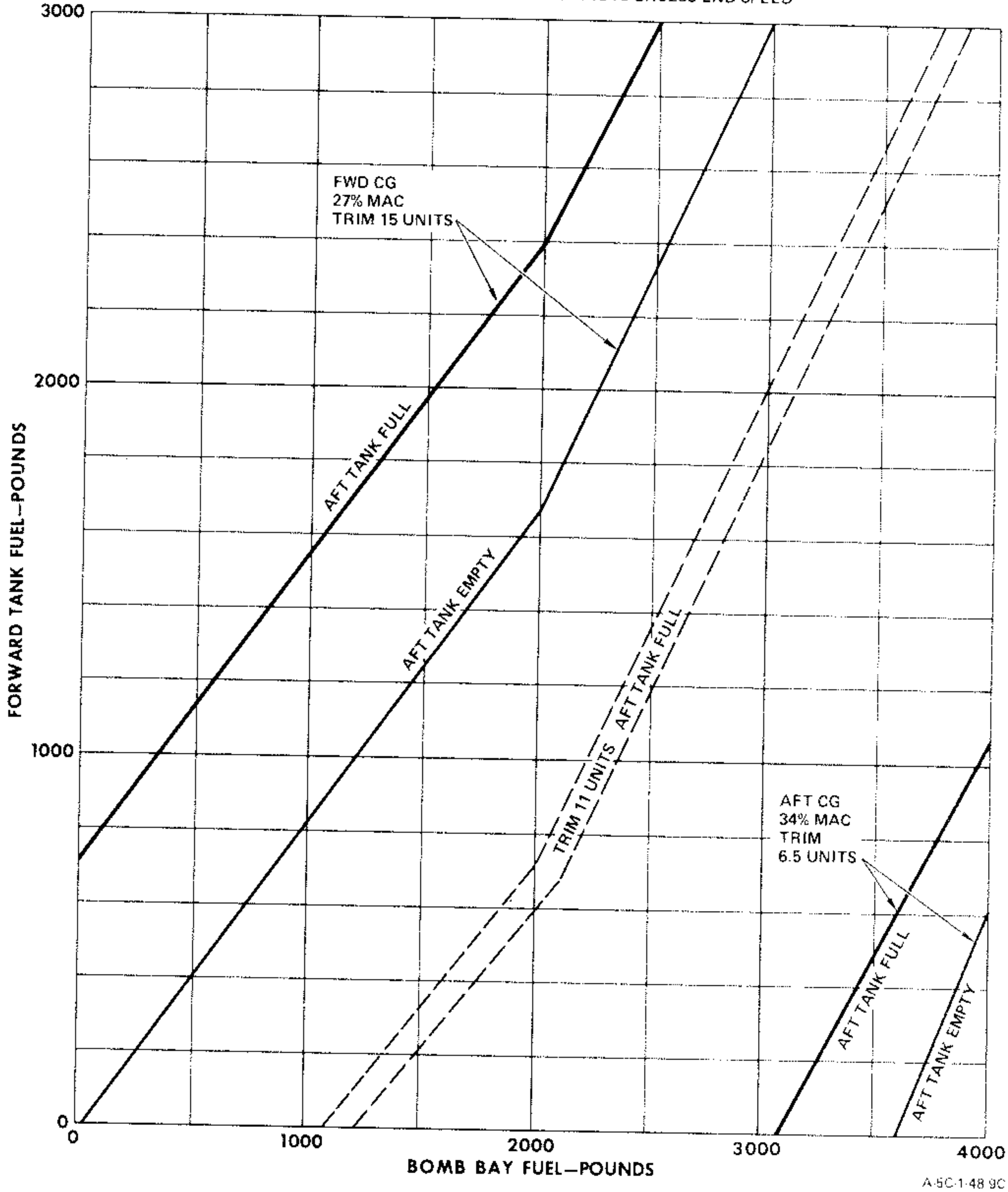

Figure 3-7 (Sheet 1)

CARQUAL TRIM (CG) CHART

- 3 CAN CONFIGURATION – (4-2 MODULE)
- 38,700 POUNDS BASIC WEIGHT @ F.S. 511.35
- 2800 POUNDS SUMP – WINGS EMPTY
- 42,083 POUNDS OPERATING WEIGHT
- 15 KNOTS EXCESS END SPEED

AIRCRAFT 145157 THROUGH 151728 NOT HAVING AFC 328 COMPLIED WITH

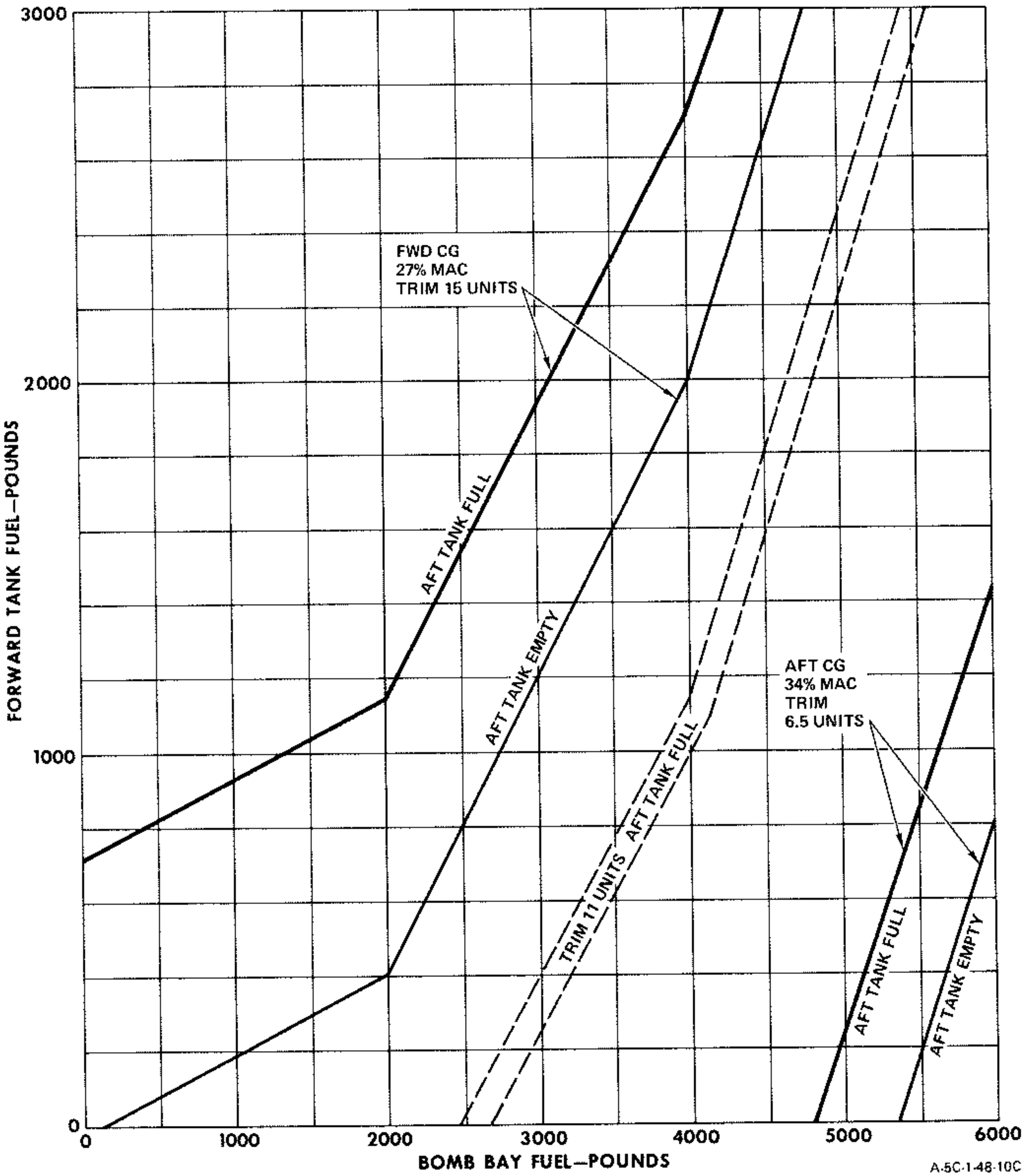

Figure 3-7 (Sheet 2)

CARQUAL TRIM (CG) CHART

PECM (TWO CAN) CONFIGURATION – (4-1 MODULE WITH IR)

- 39,800 POUNDS BASIC WEIGHT @ F.S. 512.60
- 2800 POUNDS SUMP – WINGS EMPTY
- 44,846 POUNDS OPERATING WEIGHT
- 15 KNOTS EXCESS END SPEED

AIRCRAFT 156608 THROUGH 156653
AND AIRCRAFT WITH AFC 328

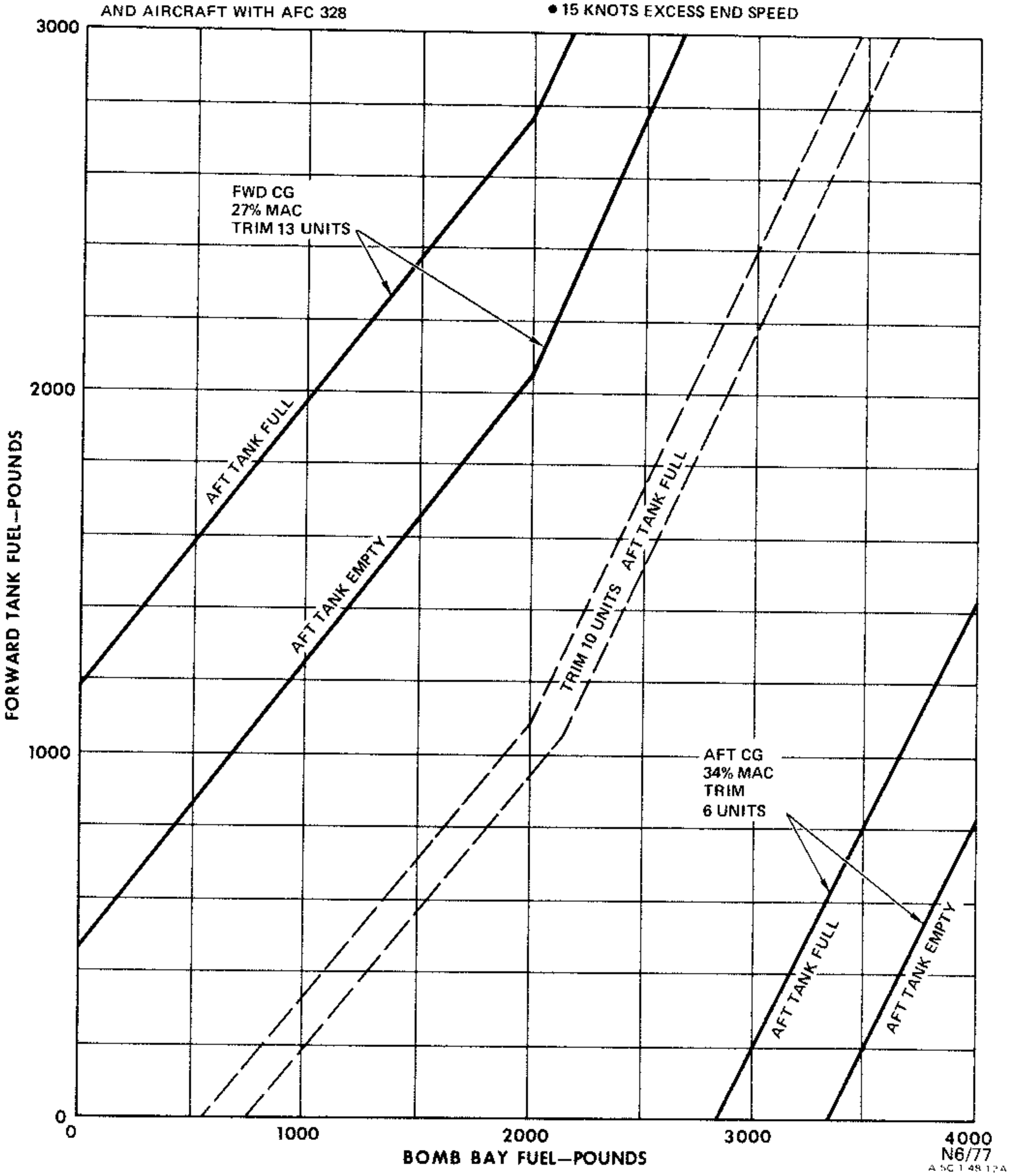

Figure 3-8 (Sheet 1)

CARQUAL TRIM (CG) CHART

- 3 CAN CONFIGURATION – (4.2 MODULE WITH IR)
- 39,800 POUNDS BASIC WEIGHT @ F.S. 512.60
- 2800 POUNDS SUMP – WINGS EMPTY
- 43,384 POUNDS OPERATING WEIGHT
- 15 KNOTS EXCESS END SPEED

AIRCRAFT 156608 THROUGH 156653
AND AIRCRAFT WITH AFC 328

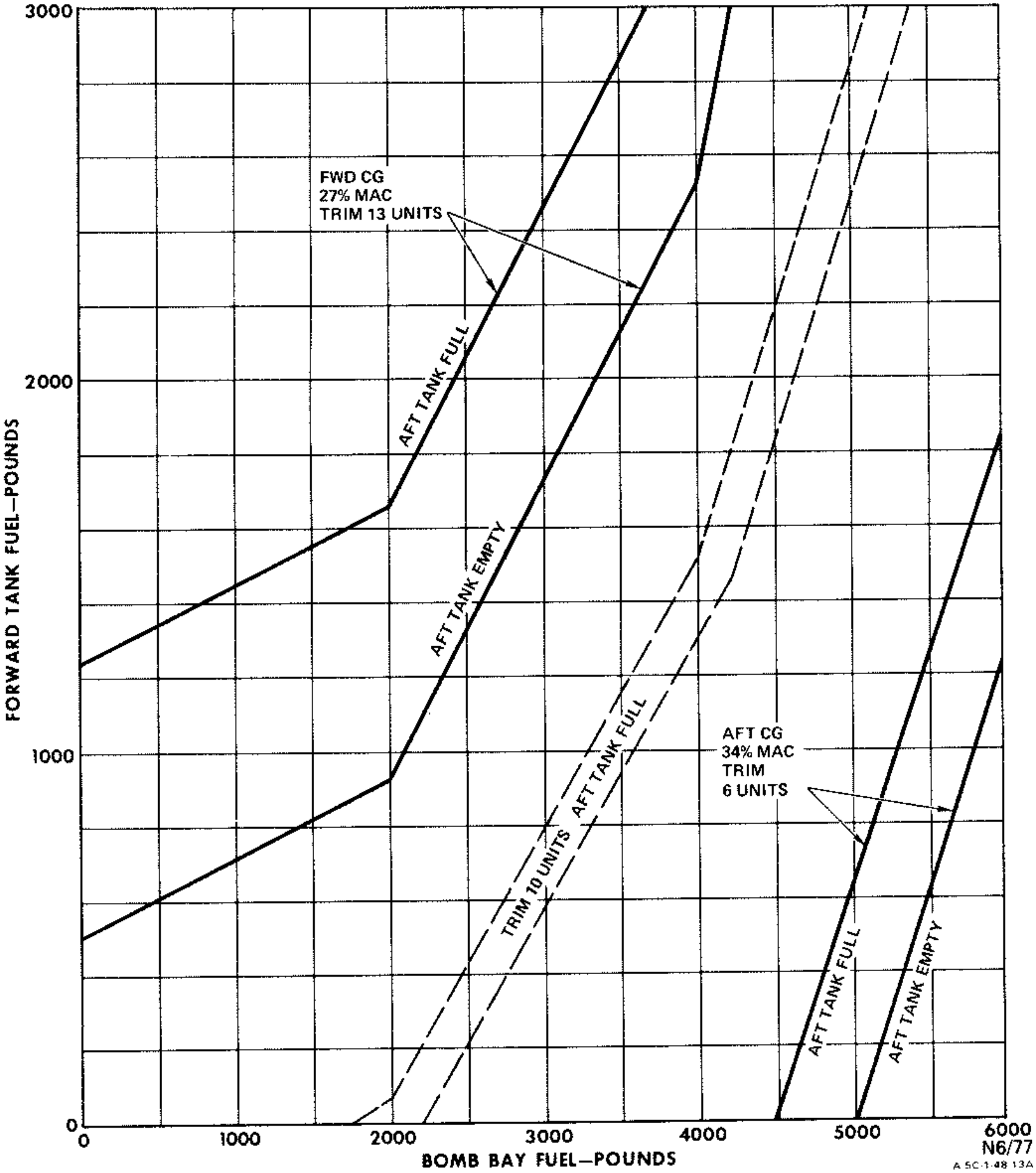

Figure 3-8 (Sheet 2)

TYPICAL CARRIER LANDING

GROSS WEIGHTS 40,000 TO 50,000 POUNDS

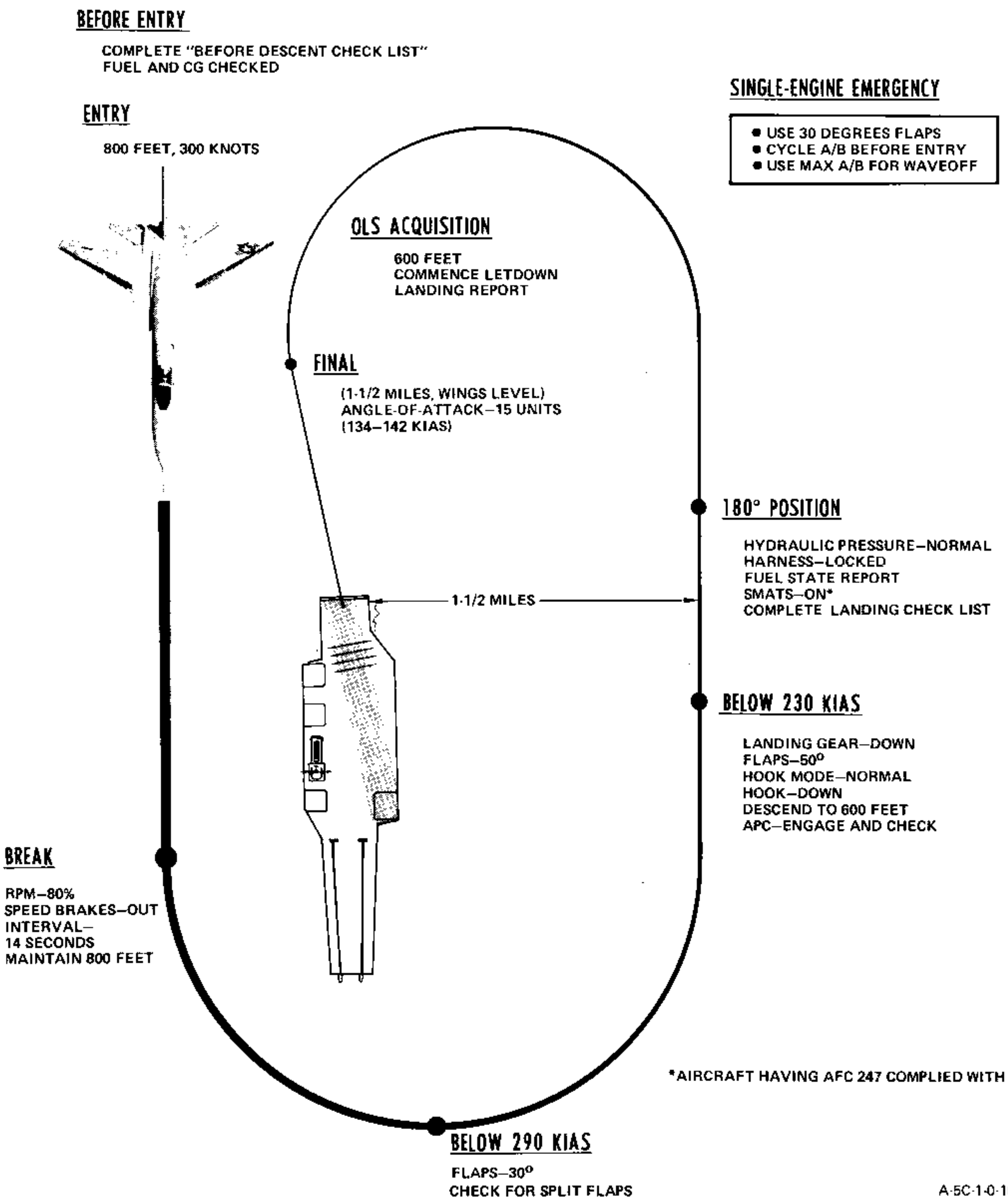

Figure 3-9

ARRESTMENT

Treat every carrier landing as a touch-and-go. As soon as the aircraft touches down, advance throttles to MIL thrust and hold until arrestment is assured and forward motion is nearly stopped. Approaching the end of the runout, reduce power to IDLE, keep rudder pedals in the neutral position, engage nose wheel steering, stay off the brakes, and allow the aircraft to roll back. As the pendant clears the tail hook, the director will give a "hook up" signal, then retract the hook. As the hook retracts, the director will give a series of rapid come-ahead signals. Add power and taxi smartly out of the gear and across the foul line. Once clear of the foul line, retard power and check for brake action. If normal braking is not available, use emergency brake to stop, hook down, transmit "no brakes," and request tow. While taxiing, move the flap control switch to SUPERSONIC, then fold the wings and remain alert for nose wheel steering malfunctions. Should a malfunction occur, stop the aircraft, release the nose wheel steer button, report a failure to primary, and advise that a tow will be required. If an overriding situation exists (i.e., low state aircraft on final, etc), the pilot may deem it necessary to attempt to clear the landing area before stopping. If the aircraft is to be struck below, the radome must be folded. Do not initiate the radome folding cycle until spotted on the elevator, due to restricted forward vision.

CAUTION

- To prevent droop damage, do not fold wings until the droop leading edges are fully retracted.
- The pilot must ensure that the RAN has properly secured the AN/ASB-12 prior to folding the radome.
- If throttles are moved outboard or squeezed during power reduction, inadvertant engine shutdown may occur. If inadvertant shutdown occurs on deck engine compressor/turbine damage may result from relight attempts.

Should the aircraft hang up in the gear and it becomes necessary to pull it back with the arresting gear engine, ensure that nose wheel steering is engaged to prevent the nose wheel from swiveling.

PITCHING DECK TECHNIQUE

The LSO will inform pilots of a pitching deck. The pilot should average out meatball movement so that the average will be a centered ball until the aircraft approaches the ramp. Lineup problems caused by deck motion can be solved in a similar manner. Chasing lineup will produce an excessive sink rate due to spoiler/deflector action. At the ramp, the proper procedure for a rising ball is to stop movement without attempting to recenter it. This procedure will prevent establishing an excessive sink rate. A correction must be made for a settling or low ball at the ramp to prevent decrease of optimum ramp clearance and excessive sink rate in relation to the deck. The proper procedure is to recenter the ball on the lens and hold it there. If the deck movement is excessive when the aircraft reaches the safe wave-off point, the LSO will wave the aircraft off. If the meatball is rapidly moving up inside the safe wave-off point, aircraft attitude and power should be maintained and a proper touchdown be effected even if a bolter results. A higher than normal bolter rate should be accepted.

WAVE-OFF TECHNIQUE

At maximum allowable landing weight, the need for early decision in taking a wave-off cannot be overemphasized. Lateral stick inputs to correct for "island burble" are detrimental due to increased drag (spoiler effect). If a wave-off becomes necessary, immediately advance the throttles to MIL thrust, while smoothly rotating the aircraft nose-up until stall warning pedal shaker action is felt (19 units angle of attack). Hold this attitude until a definite rate of climb is attained. Do not start a clearing turn until safe speed is attained, as the semistalled condition may be aggravated. On SMATS configured aircraft,* the SMATS switch should be selected OFF when safe. This will conserve fuel at reduced power settings.

BOLTERS

If the aircraft bolts the deck, allow it to fly off smoothly, while advancing power as required, then rotate nose-up slightly as the round-down is cleared to establish a positive rate of climb. After the climb is established and comfortably airborne, select SMATS* OFF and take up a heading parallel to the BASE RECOVERY COURSE (BRC). Reenter downwind, taking a normal interval to other aircraft in the pattern.

BROKEN WIRE OR HOOK

In the event of a broken wire or hook, ejection should be initiated immediately utilizing the turn-and-pull knob. Attempt to raise the nose to the take-off attitude for optimum ejection trajectory. The most probable indication of a broken wire or hook will be felt as an initial deceleration followed by a sudden release and pitch-up of the nose.

SINGLE-ENGINE CARRIER LANDINGS

Refer to LANDING EMERGENCIES, Section V, Part 5.

SINGLE-ENGINE CARRIER WAVE-OFF

Refer to LANDING EMERGENCIES, Section V, Part 5.

*Aircraft 145157 through 151728 having AFC 247 complied with

PART 5 — FLIGHT PROCEDURES

FAMILIARIZATION AND TRANSITION

Familiarization and transition will be accomplished in the replacement training squadron. The ground training and flying training accomplished will be in accordance with current directives. Refer to Section II.

GENERAL FLIGHT PROCEDURES

The professional approach to flying is mandatory. All phases of any mission will be thoroughly planned. Each crew must know the aircraft systems, planning, and in-flight procedures thoroughly.

1. The following procedures are common to all flights:
   - Use NATOPS and applicable NAVAIR check-lists.
   - Maintain an alert watch for other aircraft.
   - Both crew members will remain on oxygen at all times. In the event either crew member fails to receive oxygen, descend to 10,000 feet of cockpit altitude if sufficient fuel is available to land safely when flying at this lower altitude. If the fuel situation prohibits this action, and it is necessary to fly in excess of 10,000 feet of cockpit altitude for more than 15 minutes without oxygen, the emergency oxygen system will be actuated 5 minutes prior to landing.
   - The maximum allowable 90-degree crosswind component for take-off or landing is 15 knots.
2. Simulate and review emergency procedures regularly.
3. Check all radio equipment.
4. For procedures to be followed in the event of intercom loss, refer to INTERCOMMUNICATIONS SYSTEM FAILURE, in Section VII, and LOST AIRCRAFT PROCEDURES, in Section V.

AIRSPEED BELOW 10,000 FEET MSL

Considering the flight characteristics and the operational/training requirements of the RA-5C, conduct operations as prescribed in the NATOPS/tactical manuals except:

1. When feasible, comply with 250 KIAS airspeed limit in airspace where FAR, Part 91 applies (normally feasible only at relatively light gross weight during holding, penetration, and landing approach). Maximum holding airspeed is 265 KIAS.
2. 360 KIAS is the normal airspeed for low-altitude training flights, and approved low-level/sandblower routes will be used to the maximum extent practicable. When higher airspeeds are required for selected flights/route segments, overwater routes will be used whenever feasible.
3. For safety of flight below 10,000 feet MSL within CONUS, maintain 360 KIAS on all departures, maximum range airspeed/mach for cruise (unless on approved high speed route), and 300 KIAS for VFR arrivals.

NAVIGATION

METHODS OF NAVIGATION

INERTIAL AUTONAVIGATOR

The primary mode of navigation will be by the full use of the N5H inertial autonavigator (A/N). Except when specifically restricted, the AN/ASB-12 radar or television will be used to improve the accuracy of the autonavigator. The autonavigator, using the inertial gyro platform, will be used on all flights on which it is operating normally. The stand-by navigation mode, utilizing the flight reference set gyro platform, will be used when the inertial gyro platform fails.

DEAD RECKONING

Dead reckoning (DR) navigation is the most basic tool available to the RAN. He shall keep a complete DR plot throughout any navigation flight. This plot shall consist of standard textbook symbols for fixes, courses, positions, etc, and will include a DR position and an air plot and wind vector for each navigation leg. The DR plot normally will not be started anew from a plot of present position, except immediately following correction of present position (A/N) on some known point.

DR navigation is only as good as the information used. To get good information, the crew must use proper navigation procedures. The RAN may judge the adequacy of his DR plot by his ability to show: (1) present position, (2) course to the next checkpoint, and (3) ETA at that point, at any time.

MANUAL WIND DRIFT SOLUTION

The viewfinder may be used to solve for wind drift and ground speed during stand-by navigation mode operation, with VERDAN operative or inoperative. The following procedure is usable in daylight only:

Note

While accomplishing this procedure, ensure that camera POWER switch and IR POWER switch are either OFF or READY.

1. Select radar altitude.
2. Move viewfinder POWER switch to MAN, solve for drift and note drift angle.
3. Adjust V/H knob until grid tracks ground. Note V/H setting.
4. Multiply observed V/H from the viewfinder by radar altitude to derive ground speed.

5. Solve for wind direction and velocity on a navigational computer (E-10B or equivalent), using drift angle, heading, ground speed, and true airspeed.
6. Insert this wind into bombing computer and select autoviewfinder operation.

RADAR

The AN/ASB-12 radar may be used as a secondary mode of navigation in the event of complete autonavigator failure. Following an A/N failure, a fully stabilized radar picture normally remains. Using the fixed range circles, relative bearing scale, and aircraft compass, the RAN has all the information necessary to obtain navigation fixes, ground speed, and track information.

RADIO

Radio navigation (TACAN) will be used on all airways flights, scoring, or navigation flights to check autonavigator accuracy.

LOW LEVEL

Low-level navigation flights may use either radar or visual fixes. Training flights will normally use radar fixes to further operator training. In the event of loss of radar, or EMCON conditions, the pilot can use visual fixes and pickle correct procedures to update the autonavigator. In addition to using radar to obtain fixes, the RAN may use contour-mapping radar, to control aircraft (altitude above the terrain).

Note

Do not use contour mapping for altitude control unless the aircraft is certified to have a current contour map calibration.

Present position must be kept accurate through proper update procedures, will be checked continuously to ensure proper operation, and will be recorded as a fix at least every 5 minutes with time and winds.

NAVIGATIONAL PLANNING

Complete navigational preplanning is required for all flights. Refer to Part 2 of this section. In addition to thorough route planning, careful attention will be given to airspace reservations, Air Defense Zones, high-altitude routing, and cruising altitudes. NOTAMS shall be checked, enroute frequencies verified, and destination and alternate fields checked for current status.

RAN RESPONSIBILITIES

The RAN will be thoroughly versed in the use of navigational charts, publications, and procedures associated with airways navigation, as well as operational use of available electronic aids. He shall be familiar with applicable VFR/IFR flight rules under routine and special conditions and have sufficient knowledge of instrument approach and GCA/CCA procedures to monitor the approach and render assistance to the pilot as required. The RAN shall be capable of making all position reports and taking flight clearance reports.

CRUISE CONTROL

PREFLIGHT

As much of the checkoff list shall be completed prior to turnup as possible to minimize engine ground operation and ground fuel consumption. On IFR flights, a fairly substantial saving of fuel can be realized by using external power and delaying starting of engines until such time as the IFR clearance has actually been received from ATC. An accurate fuel check shall also be made prior to starting engines, as required by the prestart checklist. If proper techniques are employed, a minimum amount of fuel will be expended during ground operation.

TAKE-OFF AND CLIMB

After the aircraft has been positioned for take-off and Military Thrust applied, the RAN shall record total fuel aboard prior to commencement of the take-off roll.

CRUISE

Optimum performance figures for all profiles and configurations are included in Section XI. It is the responsibility of the pilot to exploit every means to obtain the maximum performance from his aircraft, consistent with the assigned mission.

The aircraft is capable of a wide range of altitude/speed combinations. This demands that each flight be thoroughly preplanned, utilizing the latest available fuel planning data for cruise control. This planning must consider the portions of the profile at high, low, and medium altitudes, as well as acceleration schedules and supersonic flight.

When flights are scheduled utilizing point-to-point navigation which will permit positive electronic fixes, a normal route card fuel log will suffice for cruise control purposes. This will provide an instantaneous evaluation of the progress of the flight and will enable the pilot or RAN to extrapolate actual fuel consumption to predict the progress of the remainder of the flight.

DESCENT AND LETDOWN

The procedures to be employed in descent and letdown are categorized as follows:

1. Standard Instrument Penetration—The standard penetration is flown at 250 KIAS (SPC OFF) with approximately 80% rpm and a 4000 to 6000 feet per minute rate of descent. Speed brakes are adjusted to attain the desired rate of descent. From

commencement of penetration, a fuel state of 6000 pounds will permit completion of the penetration to a wave-off, a 150-nautical-mile flight to an alternate (optimum altitude), and an arrival over the alternate approach fix with 2000 pounds of fuel remaining.

2. Maximum Range Descent—The maximum range descent can be used in a descent from high cruising altitudes to the initial approach altitude, or during descent on a high/low profile. The aircraft configuration is throttles at IDLE speed brakes IN, flap control switch in CRUISE, and 250 KIAS. For planning purposes, the maximum range descent charts in Section XI may be used.

Note

With throttles at IDLE, sufficient cooling airflow will not be available in the camera modules. The camera lens and windows may fog up.

3. Maximum Rate of Descent—This type of descent would most probably be required during carrier operations when it is necessary to meet a specified recovery time after a period of operation in the DOG circle, or in an emergency situation when immediate descent is mandatory. Maximum rate of descent is obtained by placing throttles at IDLE, extending speed brakes, and maintaining maximum allowable airspeed consistent with visibility, possible turbulence, and altitude.

FUEL MANAGEMENT

Pilots shall thoroughly plan all flights and ensure that the proper fuel load is aboard prior to manning their aircraft. The fuel system is essentially automatic; however, the pilot must periodically monitor individual fuel tank quantities in flight to determine whether the system is functioning properly. When drop tanks are employed, it is prudent to ensure that all tanks will transfer (drop tank fuel should be used as early as possible during the flight). Failure of forward tank fuel to transfer is the first indication of a fuel sequencing failure. Should this occur, check the ESS FUEL circuit breaker. Should a fuel sequencing failure occur, avoid flight regimes that will require high fuel flow, and closely monitor sump and forward tank fuel. When carrier-based, pilots will hold any excess fuel until assured of getting into the landing pattern. Dump rates are approximately 1200 pounds per minute.

EXTERNAL TANKS

When three or four 400-gallon drop tanks are carried, or two 400-gallon drop tanks are carried in combination with any two other external stores, attempt to maintain a forward center of gravity by using WING AUX fuel sequencing. WING AUX sequencing maintains sump and forward tank level higher than normal sequencing, maintaining cg in a more favorable forward range.

FORMATION FLIGHT

Formation tactics will normally be conducted in accordance with NWIP 41-3, Chapter 8, and as discussed in the following paragraphs.

GENERAL

Carrier operations require a considerable amount of formation flying and it is essential that each pilot be adept in these procedures. A thorough and specific briefing shall be accomplished prior to conducting a formation flight.

A formation is designed to afford tactical concentration, ease of control, and mutual defense. The governing factors are:

1. It must be maneuverable.
2. It must be flexible enough to meet any situation.
3. It must be simple and arranged so that the flight leader can see all elements of the flight.

BASIC FORMATIONS

PARADE

Parade formation will be used when passing in review, orbiting the ship or station (shore-based), or when participating in aerial demonstrations.

Maneuvers performed in parade formation are relative to the leader, and the wingman maintains a fixed wing position on the leader. On turns into the wingman, he will rotate about the leader's longitudinal axis. On turns away from the wingman, he will rotate about his own axis while maintaining a safe stepped-down position.

Parade formations are flown in section, division, or squadron strength.

CRUISE

Cruise formation is used during cross-country navigation and, at other times, to reduce pilot fatigue and to conserve fuel. Cruise formation provides maximum maneuverability.

ECHELON

Echelon is normally used prior to breakup and during rendezvous. Echelon to the right or left will be signaled by the leader. If the leader's wingman is on the same side as the echelon to be formed, the second section will cross under and join on him. If the second section is on the side to which the echelon will be formed, it will move out to make room for the wingman. Turns into an echelon will be avoided.

FORMATION ELEMENTS

The section, consisting of two aircraft, is the basic formation unit from which other elements are formed. The division consists of four aircraft formed from two sections: a division leader with his wingman in the

No. 2 position, and the second section leader in the No. 3 position, with his wingman in the No. 4 position.

PARADE AND ECHELON

In these two basic formations, the wingmen position themselves on a line slightly ahead of the leader's wing, 45 degrees relative to the longitudinal axis of the lead aircraft, and stepped down sufficiently to allow clearance between the tip of their vertical stabilizer and the bottom of the leader's fuselage. This position may be maintained by lining up the outboard leading edge of the engine inlet duct with the aft upper area of the rear canopy. Lateral separation is approximately 10 feet between wing tips.

CRUISE

In cruise formation, the wingmen position themselves on a 60-degree relative bearing, extended laterally sufficiently to provide 20 feet of clearance between the nose of their aircraft and the tail of the preceding aircraft. This position leaves one space between each aircraft. When maneuvering, the wingmen may slide as necessary to maintain the same nose-to-tail distance between aircraft.

BRIEFING

When formation flying is scheduled, the designated leader, or senior pilot if no leader is designated, will conduct the required briefing. The briefing will cover the following points:

1. Radio frequencies.
2. Location, altitude, airspeed, and type of rendezvous.
3. Position of each aircraft in the formation.
4. Alternate leaders.
5. Type of mission to be flown.
6. Lost communication procedures.

RENDEZVOUS AND DEPARTURE PATTERN (SHORE-BASED)

NORMAL RENDEZVOUS

1. The purpose of the rendezvous is to join a formation in a minimum amount of time and proceed on an assigned mission. The 180-degree rendezvous is the basic type.
2. Prior to leaving the line, the flight will check in with the leader on squadron frequency with side number and aircraft status. All aircraft will then switch to ground control frequency, and the leader will call for taxi for the entire flight. The aircraft will leave the line in order and taxi to the head of the runway in column, maintaining sufficient taxi interval to preclude FOD.
3. After switching to tower frequency and receiving appropriate take-off clearance, two aircraft will spot on the runway at a time.
4. The take-off interval shall be 30 seconds, or as briefed, and after take-off, all aircraft shall conform to the leader's flight path.
5. After take-off, the leader will climb straight ahead at 300 KIAS (SPC ON) with 90% rpm. The leader will allow 20 seconds (30 seconds if less than four) for each aircraft in the flight before commencing the rendezvous turn.
6. At the proper time, the leader will commence a 30-degree banked turn and continue climb to briefed altitude.
7. Once the leader commences the rendezvous turn, the succeeding aircraft shall hold a straight course until the leader bears 20 degrees to left or right, at which time a 45-degree banked turn will be executed to establish the relative rendezvous bearing. Once established, the bank angle should be decreased.
8. In joining, the wingman should concentrate on working in the rendezvous cone, which is generally considered to be an imaginary cone 225 to 255 degrees relative to the leader. When there is considerable distance between aircraft, the relative bearing should be further forward; as the distance decreases, the bearing should approach to optimum 225 degrees. Maintaining this rendezvous cone will give a steady closing rate. Each aircraft should stay inside of the leader's turn until joined up, and then cross under to their assigned position. Do not tail chase in the rendezvous turn.
9. After completing 180 degrees of the turn, depending on whether all aircraft have joined, the leader will proceed on course, accelerating to climb schedule speed, or return to the departure point, leveling off at the briefed altitude at 300 KIAS.
10. For TACAN rendezvous refer to CV NATOPS.

RUNNING RENDEZVOUS

1. A running rendezvous may be accomplished at the discretion of the flight leader.
2. After take-off, the leader will immediately turn to the briefed departure heading, maintaining 300 KIAS and 90% rpm.
3. Each succeeding aircraft shall take off with a 30-second interval and conform to the leader's flight path.
4. Speed differential will be utilized to close the distance between aircraft. As the distance is reduced, the speed differential should be reduced accordingly. A speed differential in excess of 20 knots can be dangerous when in close proximity to another aircraft.
5. Wingman will join on the left side of the leader, then cross under to the assigned position.

RENDEZVOUS AND DEPARTURE (CARRIER-BASED)

Adhere to the procedures in the CVA/CVS NATOPS Manual for Case I, Case II, and Case III departures from the ship. Specific rendezvous radial, altitude, and area shall be in accordance with ship/air wing doctrine. The basic techniques discussed under NORMAL RENDEZVOUS and RUNNING RENDEZVOUS still apply, but minor adjustments to airspeed and power settings, may be essential when rendezvousing with dissimilar aircraft.

FORMATION BREAKUP

1. The formation will always break from an appropriate echelon and signal from the flight leader.
2. All breaks will be executed in a 60-degree banked level turn or as briefed.
3. Breaks into a landing pattern shall normally consist of 14 seconds when shipboard (40-second landing interval), and 20 seconds when shore-based, to allow sufficient time for the aircraft ahead to clear the runway.

FORMATION IN CLOUDS

1. Should a formation enter clouds, it can be kept intact if proper wing positions are maintained. Wingmen should maintain the same relative position during all turns, i.e., roll about the leader's axis for both turns into and away from the wingmen.
2. Should an aircraft lose sight of a preceding aircraft, an easy turn away will be in accordance with the following rules: first aircraft to the right of the leader turns 10 degrees right, second aircraft to the right of the leader turns 20 degrees right. Aircraft to the left make similar left turns. These headings will be held for 1 minute, then return to base course. The leader will maintain base course.

NIGHT FORMATION

1. The same general rules for day formations apply to night formations.
2. It is difficult to determine relative motion at night; therefore, no abrupt maneuvers should be attempted and changes in formation should be kept to a minimum. Rendezvous should be accomplished with low closing speeds.
3. While in formation, all aircraft, except the last, should set wing and tail lights DIM, formation lights ON, and anticollision lights OFF. The last aircraft shall have all lights on bright and the anticollision lights ON. When not in formation, all aircraft shall keep lights on bright and the anticollision lights ON.
4. Cockpit lights shall be dimmed to improve exterior visibility.
5. Night breakup will be signaled by flashing position lights and by radio, if radio silence is not imposed. Position lights of all aircraft will be turned on bright following the break.
6. Visual signals for lead change at night are as follows:
   (a) Two aircraft—lead aircraft switches lights to bright/flashing. Wingman puts lights on dim/steady when he accepts the lead.
   (b) More than two aircraft—leader places flight in echelon and proceeds as in step (a).
   (c) External light failure—use flashlight procedures presently in effect.

BASIC FORMATION RULES

1. Rendezvous as briefed.
2. Never lose sight of the aircraft ahead. If a preceding aircraft gets "sucked" in a rendezvous, all succeeding aircraft will drop back.
3. Never pass an aircraft during the rendezvous.
4. In the event an unsatisfactory join-up occurs due to an excessive closure rate, level your wings and go to the outside. Never throw a wing up to stop an excessive closure rate.
5. Do not join another aircraft or formation of aircraft without prior approval of the flight leader.
6. When maneuvering a parade and echelon formation, the leader should be smooth, avoid rapid roll rates and steep bank angles, and maintain constant power settings where possible.
7. Leaders should not use MAX AFTERBURNER, military, or IDLE power settings, thus allowing maneuvering power for the rest of the formation.
8. The flight should always be warned prior to using afterburner, speed brakes, and changing configuration, i.e., gear, flaps, etc.

AIR REFUELING

COMMUNICATION PROCEDURES

1. Receiver calls "lining up" before sliding into position.
2. After engaging the drogue, and amber light goes out, receiver calls "contact."
3. After breakaway, when receiver is clear of the area behind the hose and drogue, receiver calls "clear."

CAUTION

Do not engage the tanker without clearance, use radio contact or standard hand/light signals.

RECEIVER PROCEDURE

Any planned air refueling will be thoroughly briefed. Prior to refueling, tanker/receiver equipment compatibility must be definitely determined. For operational limits with the probe extended, see figures 11-89 and 11-90 in Section XI. Specific recommendations for clean wing aircraft are as follows:

Note

- For air refueling below approximately 24,000 feet, prior to attempting plug-ins, it is recommended the droop be lowered to 25 degrees while maintaining zero flaps. The airspeed must be above 255 KIAS when full internal fuel load is approached, or the receiver can expect to use afterburner, and/or have the tanker "toboggan." When using C-130 tankers, "tobogganing" at about 220 KIAS is recommended. If cruise droops are selected for air refueling, the airspeed must be above 265 KIAS when near full internal fuel load.
- For air refueling at 24,000 to 28,000 feet, cruise droops and 270 KIAS are recommended when air refueling to near full internal fuel load. Expect to use afterburner and/or have the tanker "toboggan" if below this airspeed, or attempting to air refuel above 28,000 feet.

The fueling flow rate is not an important consideration in the fuel system. If the no-flow pressure at the nozzle is maintained at the specification value of 55 psig, the single-hose refueling rate will vary from 600 gpm with an empty aircraft to approximately 100 gpm just before becoming completely filled. The air refueling rate will be approximately the same, depending upon the ability of the tanker to deliver this rate without exceeding 55 psi at the nozzle.

Caution must be exercised to avoid high-rate closure or departure on the trailed drogue to prevent possible FOD from damaged drogue canopies. For night refueling, complete familiarity with tanker signal lights is required. These lights are color-coded as follows: amber—drogue at full trail; green—fuel on (transferring). To successfully complete an air refueling hookup, the following procedure is recommended:

Note

Normal airspeed range for refueling is between 250 and 280 KIAS.

1. Below probe limit airspeed, place the FUEL PROBE switch to EXTEND. For probe airspeed limits at varying altitudes, refer to Section I, Part 4.
2. HYD SUB-SYS ISOLATION switch—FLIGHT.
3. FLAPS control switch—30°.

Note

Directional trim is inoperative with droops down and flaps up. Speedbrakes de-energized with flap handle at 30 degrees.

4. Pitch aug – AS DESIRED

Note

Pitch aug is optional, but following secure of pitch aug a definite pitch trim adjustment must be made prior to drogue engagement.

5. Drop tank transfer—OFF.
6. CANS and wing switches—NORM.
7. Radar—SILENCE.
8. When cleared in, depress FUEL PROBE light button as required.

Note

Refueling pressure should be 40 to 50 psi (60 psi maximum). The aircraft will safely accept any flow rate corresponding to these pressure limits. When refueling from U.S. Air Force tankers, request low-duty fuel transfer rate.

9. Approach the tanker aircraft from the rear and below. Line up with the left edge of the drogue, stabilize aircraft position, and retrim slightly below and approximately 10 to 15 feet astern.
10. Increase power slightly and commence a level even rate of closure on the tanker. Aim the probe at the ten-thirty position of the basket/drogue, halfway between the edge and middle to compensate for the radome bow wave. Maintain a good scan and don't fixate on the drogue. At a slow steady closure (about 3-5 knots) drive the probe into the drogue. If engagement is missed carefully back straight out and reestablish a stable starting position prior to attempting a second engagement.

CAUTION

- A rapid rate of closure will move the drogue forward too fast for proper reel action, causing slack in the hose. This may result in a violent whipping action which could cause structural damage to the probe or drogue.

- If the hose loops on initial contact, or will not retract, a malfunction in the tanker exists. DO NOT ATTEMPT FURTHER ENGAGEMENTS unless an emergency exists.
- If the hose or drogue fouls on the probe, back out very slowly.

11. After hookup is accomplished, push about 10 to 15 feet of hose into the reel. Reduce speed to that of the tanker and maintain the required position during fuel transfer operations.

Note

When the drogue has extended the proper distance, an amber light is illuminated on the tanker aircraft. After contact is made, movement of the drogue inward approximately 6 feet automatically starts fuel transfer from the tanker. This is indicated by a green light on the tanker. When the green light comes on, the yellow light will go out. The sequence is reversed when the receiving aircraft moves the drogue back to full trail to break contact.

WARNING

When receiving fuel from KC-135 aircraft, the maximum total fuel on board shall not exceed the following limitations:

- No bomb bay tanks—14,500 pounds of JP-4 or 15,000 pounds of JP-5.
- Two bomb bay tanks—17,500 pounds of JP-4 or 18,000 pounds of JP-5.
- Three bomb bay tanks—18,500 pounds of JP-4 or 19,000 pounds of JP-5.

Failure to observe these limitations can result in overpressurization and rupture of the fuel tanks.

12. Note progress during fuel transfer by observing the fuel quantity indicator.

    A steady increase in power will be required as fuel transfer progresses.

13. When the refueling is complete, reduce power slightly to pull the hose out at 2 to 3 knots to full trail, disengaging the probe from the drogue reception coupling.

CAUTION

- High rates of separation should be avoided when breaking contact. Sudden separation may damage the probe. If the drogue and/or parts of the hose break off and become entangled on the probe, do not retract the probe. Land as soon as possible.
- Broken parts or pieces may enter the port engine duct. Anticipate reduced power or erratic performance from the port engine due to foreign object damage.

14. FUEL PROBE switch—RETRACT.
15. FUEL PROBE light button—DEPRESS, RELEASE (off) as required.

Note

- In the event of an emergency requiring air refueling with the landing gear down, a speed of 230 knots or less is recommended.
- When air refueling above approximately 24,000 feet, cruise droops and 270 KIAS are recommended.

SYSTEMS OPERATION (RAN)

Note

For malfunction checklists, refer to Part 7 (DEGRADED SYSTEMS OPERATION), of this section.

RADAR/BAROMETRIC ALTIMETER CALIBRATION

1. Approaching checkpoint, ALTITUDE mode knob—RADAR.
2. Radar/barometric altimeter—CHECK.
3. Target altitude—RECHECK.
4. Over checkpoint, hold ALTITUDE mode knob—BARO CAL.

   Hold until altimeter stabilizes.
5. ALTITUDE mode knob—AS DESIRED.

AUTONAVIGATOR SYSTEM

NAVIGATE MODE

The azimuth and range indicator (and pilot's HSI) reflects the correct steering path to the NAV/BOMB selected position. Range and bearing to SET/CORR selected checkpoint is provided to the pilot if range is less than 186 nautical miles.

1. In range, locate checkpoint (SET/CORR) on radar/TV.
2. If not under cursors, use cursor handle to correct.
3. In TV range, select TV and identify checkpoint.
4. If not under reticle, use cursor handle to correct.
5. Over checkpoint, altimeter—BARO CAL.
6. SET/CORR knob—SELECT NEXT CHECKPOINT.
7. If required, set new coordinates in address of previous SET/CORR knob position.

Note

If a checkpoint or secondary target is within 20 miles of both present position and NAV/BOMB selected destination, the following procedure is required to obtain usable steering information:

(a) NAV/BOMB knob—DESIRED POSITION.
(b) SYSTEM MODE knob—BOMB.
(c) ATTACK MODE knob—O/S.
(d) OFFSETS — AS REQUIRED.

RECON MODE

To locate targets of opportunity or to determine position coordinates of radar-TV targets, proceed as follows:

1. SYSTEM MODE knob—RECON.
2. Radar cursors or TV reticle—PLACE, as desired.
3. Read coordinates on TARGET POSITION indicator.
4. If RECON target storage is desired:
   (a) SET/CORR knob — USABLE POSITION.
   (b) COORD. STORAGE button — DEPRESS.
5. SYSTEM MODE knob — DESIRED MODE.

Note

Target altitude, as previously set in, remains unchanged. For precise navigation to, or bombing of, this point, subsequently correct TARGET ALTITUDE indicator using TARGET SET mode.

AUTONAVIGATOR DRIFT CHECK

Recon Method

1. SYSTEM MODE knob — RECON.
2. Radar cursors or TV reticle — Slew to selected SET/CORR checkpoint.
3. TARGET POSITION indicator — compare with actual coordinates.

Note

Navigational steering is maintained normally to NAV/BOMB position in RECON, TARGET SET, and SEARCH modes.

Offset Method

To check for errors less than 5 nautical miles in a cardinal heading or less than 7 nautical miles radially, proceed as follows:

1. Under 46.5 nautical miles to selected target — SELECT BOMB MODE.
2. Using the OFFSET knobs, place radar cursors onto target or checkpoint.
3. Present position error is the opposite of OFFSET indicator readout.

PRESENT POSITION PICKLE CORRECTION

Note

Do not perform "pickle" correction in C/L NAV mode.

1. Store coordinates of a known visual checkpoint in the desired SET/CORR, NAV/BOMB channel.
2. Select NAV (LOFT mode, SET/CORR channel) or BOMB (O/S mode, NAV/BOMB channel) combinations.
3. COURSE LINE NAVIGATION switch — CHECK NORMAL.
4. B/N SYS button — DEPRESS (pilot).
5. Pilot must visually acquire the checkpoint.
6. Pilot should depress and hold trigger at least 10 seconds before arriving over checkpoint.
7. When directly over the checkpoint (pilot visual observation or passage of checkpoint through viewfinder nadir point), the pilot must release the trigger.
8. Check readouts for proper updating.
9. ATTACK MODE knob — ALL WEATHER LEVEL.

CAUTION

The ALL WEATHER LEVEL mode must be selected to avoid subsequent erroneous present position updating by the pilot while operating the oblique cameras in STICK mode.

SEARCH MODE (TV)

1. SYSTEM MODE knob — SEARCH.
2. Radar/TV MODE knob — TV.
3. To slew sight, use cursor handle.
   The action switch need not be depressed in SEARCH.

RADAR/TV COINCIDENCE

1. Store an optically and radar significant target.
2. ALTITUDE — BARO CAL.
3. Cursor correct on radar within 46.5 miles.
4. Check placement of TV reticle.

RANGE CIRCLES ACCURACY CHECK

If range circles are used, do not assume that they are accurate. Measure range to each circle with range cursor, using RECON mode and ARI readout.

COURSE LINE NAVIGATION

For steering along a great circle course from present position to selected NAV/BOMB target, proceed as follows:

1. COURSE LINE NAVIGATION switch — NORMAL.
2. NAV/BOMB — SET AT DESIRED CHECKPOINT.
3. Have pilot fly with wings level and heading stabilized over checkpoint within 10 degrees of desired heading.
4. Over checkpoint, COURSE LINE NAVIGATION switch — C/L NAV.

CAMERA SYSTEMS

VIEWFINDER

1. Camera POWER switch — READY.
2. RESET button — IN.
3. ALTITUDE mode knob — RADAR.
4. Viewfinder POWER switch — AUTO.
5. SHIELD knob — OUT.
6. Polaroid filter — AS DESIRED.
7. V/H LIGHT knob — ADJUST, AS DESIRED.
8. DRIFT LIGHT knob — ADJUST, AS DESIRED.
9. Vg/H grid — CHECK OPERATION.

CAMERAS (RAN)

1. Camera POWER switch — READY.

*Aircraft having AFC 297/PHC 37 complied with

2. CAMERA COMMAND light — ON (for obliques).

2A. SENSOR STAB* — NORM.

3. FLASHER MODE switch — AS REQUIRED.

Note

The FLASHER MODE switch must be in ALTERNATE or SIMULTANEOUS for night operation, and in OFF for day operation. Stations 2 and 4 cannot be operated simultaneously in ALTERNATE and SIMULTANEOUS modes.

4. EXPOSURE OVERRIDE switches — AS BRIEFED.
5. Camera altitude mode switches — SELECT LOW or HIGH ALT, as required.
6. Camera readiness indicators — CHECK ON.
7. CAMERA caution light — CHECK OUT.

Note

The CAMERA caution light should go out after a maximum of 6 minutes (2 minutes*), indicating the panoramic camera mounts have uncaged.

8. Prior to run, move the camera POWER switch to OPERATE.

Note

- Under some circumstances, camera altitude mode switches may be used as ON/OFF controls. Refer to CAMERA CONTROL PANELS, in Section VIII, Part 2.
- With panoramic cameras installed, the CAMERA caution light may come on but should go out within 7 seconds.
- The readiness indicator for the selected panoramic camera may display a blank, then indicate ON within 7 seconds.
- Camera circuit arrangement does not allow simultaneous operation of two panoramic cameras. Should both panoramic altitude mode switches be programmed, protection devices will disable both cameras (or the installed camera if only one is installed) approximately 6 seconds after the camera POWER switch is placed to OPERATE. Should this erroneous selection be made, the CAMERA caution light will illuminate, and both readiness indicators will be blank. To rectify this situation, place the camera POWER switch at READY, place one panoramic camera altitude mode switch to OFF, and then return the camera POWER switch to OPERATE. If this

Note

erroneous selection is made with only the 18-inch panoramic camera installed, *it may not be possible to regain operation of the camera while airborne.*

- Drift correction angles exceeding the 3-degree yaw limit of the 18-inch panoramic camera do not cause excessive photographic degradation. Do not select manual viewfinder operation to correct for large drift angles only.

9. When run is completed, camera POWER switch — READY.
10. Before landing, camera POWER switch — OFF.

CAMERAS (PILOT)

1. If command is desired, depress CAMERA COMMAND button (RAN must have POWER switch in READY or OPERATE).
2. Set camera altitude mode switches as desired.
3. CAMERA PULSE MONITOR knob — AS DESIRED.
4. To operate, move camera control switch ON or select STICK and depress and hold trigger.
5. After photo run, move camera control switch OFF, or release trigger.

Note

The serial frame camera altitude mode switches (except the forward oblique) can be used as camera ON/OFF controls only when operating in the LOW ALT mode. This may result in degradation of the first few frames.

CAUTION

Do not use the serial frame camera altitude mode switches as ON/OFF controls when operating in the HIGH ALT mode. Damage to the camera drive mechanism could result.

ARMAMENT SYSTEM

DROP TANKS MANUAL RELEASE (RAN)

The TANK release button circuit may be disabled, depending on local policy.

Note

Operation of the TANK release button is dependent on insertion of a circuit shorting plug in each pylon having a drop tank installed. Omission of the plug renders the TANK release button inoperative. In this case, the RAN must request that the MASTER ARM switch be turned ON and the STORE release button must be used.

When instructed by the pilot to release drop tanks, proceed as follows:

1. Applicable STATION SELECT button — DEPRESS.
2. TANK release button — DEPRESS.

FLASHER POD MANUAL RELEASE (RAN)

When instructed to release a flasher pod, proceed as follows:

1. Applicable STATION SELECT button — DEPRESS.
2. MASTER ARM switch — ON (pilot).
3. STORE release button — DEPRESS.

FLASHER POD MANUAL RELEASE (PILOT)

1. STATION SELECT button — DEPRESS (RAN).
2. MAN button — DEPRESS (pilot).
3. MASTER ARM switch — ON (pilot).
4. Trigger — DEPRESS (pilot).

PYLON MANUAL RELEASE

If required, unloaded pylons may be released as follows:

1. PYLON SELECT knob — APPLICABLE POSITION.
2. PYLON release button — DEPRESS.

Note

If more than one pylon is to be released, the PYLON SELECT knob must be repositioned and the PYLON release button depressed for each pylon.

SLR SYSTEM

1. MODE switch — OPR.
2. ANT. TRIM — ADJUST TO OBTAIN OPTIMUM DISPLAY.
   Refer to ANTENNA TRIM CONTROLS in Section VIII, Part 4 of Supplemental NATOPS Flight Manual (NAVAIR 01-60ABC-1A).
3. TARGET knob — AS BRIEFED.
4. GAIN knob — AS BRIEFED.

Prior to landing:

5. POWER Switch — READY.
6. MODE switch — READY.
7. POWER switch — OFF.

IR MAPPING SYSTEM

1. POWER switch — READY.
2. COOLER TEMP light — CHECK ON.
3. POWER switch — OPERATE.
4. COOLER TEMP light — CHECK OUT (before 12 minutes).
5. GAIN switch — AS DESIRED.

After take-off:

6. IR MAP light — OFF (scanner doors open).
7. ALTITUDE switch — RADAR.
8. Viewfinder POWER switch — AUTO.
9. GAIN switch — AS DESIRED (during run).

Before landing:

10. POWER switch — OFF.
    Test light illuminates momentarily.

ELECTRONIC DATA RECORDING SYSTEM

AFTER ENGINE START

1. RECORDER switch — NORM.
2. POWER switch–READY.
   NAV DATA RECORD indicator should show ON for 1 minute; may then return to barber pole.

PRIOR TO RUN

1. Perform cursor correction or obtain a good fix as applicable.
2. Recheck ANTENNA switch as required.
3. ALTITUDE–BARO.
   For flights collecting meteorological data, the RAN's ALTITUDE mode knob should be in RADAR. On other flights, the ALTITUDE mode knob may be maintained in the BARO position to reduce interference.
4. On some aircraft,* check BAND 1 & 2 switch at ON or OFF position, as desired.
5. Momentarily depress CLOCK RESET button.

Note

The CLOCK RESET button should NOT be depressed for subsequent PECM runs.

ONE MINUTE BEFORE RUN

Select an SLR mode which will provide coverage for navigational positioning information (external LEFT, RIGHT, or AUTO), and hold the SLR POWER switch in TEST.

STARTING RUN

1. Release SLR POWER switch to ON.
2. Move PECM POWER switch to OPERATE.

DURING RUN

1. Maintain a complete navigation log as to position, time, altitude, true heading, drift and ground speed when PECM coverage begins and ends, any changes in heading and ground speed, and all navigation (cursor, pickle) corrections.
2. Update AN/ASB-12 system as necessary to keep present position as accurate as possible.
3. Monitor PECM control panel indication. The ECM DATA RECORD indicator should display "ON" in the presence of emitters; the NAV DATA RECORD indicator and RECORDER indicator should display "ON" continuously in OPERATE.

AFTER LAST RUN

1. Move POWER switch to READY.
2. RECORDER switch — FAST FWD.
3. Prior to landing, move POWER switch to OFF.

CAUTION

Turn PECM OFF within 2 minutes of illumination of RECON COOL light.

DEFENSIVE ECM (AN/ALQ-55 SYSTEM)

RECEIVING

1. Function knob — RCVR.
2. STBY light — CHECK OUT (after 90 seconds).
3. Check RCVR light for signal reception.

JAMMING

WARNING

The AN/ALQ-55 jamming capability is to be used only in the event of an actual operational emergency as authorized by the Commanding Officer and as briefed by the Electronics Warfare Officer.

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*Aircraft having AFC 176/AVC 424 complied with and aircraft 156608 through 156643

1. Function knob — RCVR.
2. XMT switch guard wire—BREAK, LIFT GUARD.
3. XMT switch — XMT.
4. XMT light — CHECK FOR JAMMING ACTION.

CONFIDENCE CHECK

1. Function knob — RCVR.
2. STBY light — OUT (90 seconds minimum).
3. SELF TEST button — DEPRESS.
4. RCVR light — CHECK ON, XMT LIGHT BLINKING.

CHAFF DISPENSING

1. Pilot's SPL WARN MODE knob — WARN CHAFF or ALL.
2. DISPENSER control knob — BOTH.
3. CHAFF counters — SET.
4. BURSTS, BURST INTERVAL, SALVOS, and SALVO INTERVAL switches — MINIMUM SETTINGS OR AS BRIEFED.
5. RESET switch — RESET; hold 5 to 6 seconds then release.
6. Pilot's stick trigger — DEPRESS. (With BURSTS switch set to position 1 and DISPENSER control knob to BOTH, a single chaff burst will be fired from *each* dispenser.)

Note

The RAN may fire chaff using the SALVO switch (SINGLE or SEQUENCE) regardless of pilot's SPL WARN MODE knob position.

PART 6 — DEGRADED SYSTEMS OPERATION

RADAR FAILURES

SWEEPS MISSING (BRIGHT DOT)

1. RADAR/TV POWER switch—STBY, then ON.
2. BRIGHTNESS knob—INCREASE.
3. TV—CHECK OPERATION.

SCANS MISSING (BLANK SCOPE OR BRIGHT LINE)

1. RANGE knob—20 to 60 or 60 to 20.
2. ATTACK MODE knob—ALL-WEATHER LEVEL.
3. Request aircraft roll; check for sweep movement.
4. RADAR/TV MODE—FIX or VAR (under 46.5 nautical miles).
5. VIEW—AFT then FWD.

NO TARGETS

1. Cursors and circles—CHECK.
2. TRANSMIT MODE switch—TRANSMIT.
3. BEAM knob—NORM or NORM STC. Increase IF GAIN and VIDEO GAIN to maximum and adjust TILT for ground/sea return.
4. AFC—MAN.
5. TRANSMIT MODE switch—SILENCE.
6. Radar TEST switch—ON.
7. Manually tune AFC control for maximum number of 2-mile test circles.
8. AFC—AUTO. Test circles should remain.
9. TRANSMIT MODE switch—TRANSMIT.
10. Radar TEST switch—OFF.
11. BEAM knob—NORM or NORM STC. Adjust TILT for ground/sea return.
12. Try MRI, NORM, and ANTIJAM modes.
13. Request aircraft nose-down attitude to check for targets.

WEAK TARGETS

1. BEAM knob—CYCLE.
2. IF GAIN, VIDEO GAIN knobs—MAXIMUM.
3. AFC—MAN.
4. Manually tune to strengthen video.
5. Try TV, MRI, NORM, ANTIJAM modes.

SHORT RANGE

1. BEAM knob—CYCLE.
2. IF GAIN, VIDEO GAIN, TILT knobs—VARY.
3. AFC—MAN.
4. Manually tune to improve range.
5. Request aircraft altitude increase.

NOISY DISPLAY

1. IF GAIN, VIDEO GAIN, BRIGHTNESS knobs—ADJUST.
2. AFC—MAN.
3. Manually tune to decrease noise.
4. TILT knob—ADJUST.
5. Try all modes, ranges, and beams.
6. Request heading change.
7. Check TV for similar problem.

WEDGED VIDEO (BRIGHT STREAKS)

1. RANGE knob—CHANGE SELECTION.
2. AFC—MAN.
3. Manually tune to best video.
4. Check TV for pulsating video.

VIDEO LOST OR UNUSUAL DISPLAY

1. If in OPERATE mode, check for normal operation.
2. If in STBY-NAV mode, check pilot's AAI/note if FRS has a wing-down error.
3. Roll aircraft/note any change in video return.
4. Check video pattern in FLAT BEAM.

NO RANGE CURSOR

1. Ensure BOMB COMPUTER POWER switch ON/check blower operation.
2. CURSOR & CIRCLE BRT knob—INCREASE.
3. RELATIVE CURSOR BRT knob—INCREASE.
4. Check ARI range less than radar range selected.
5. Check ARI range over and under 46.5 miles.

WAVY RANGE CURSOR

1. Check for oscillations in ARI, PDI, and TSPI.
2. Check TV presentation in NAV and BOMB modes.
3. Change ballistic adapter selection (BOMB mode).

RANGE CURSOR ERROR

1. Store an optically and radar significant target.
2. BARO CAL altimeter.
3. Select BOMB and O/S within 46.5 miles.
4. Cursor correct.
5. Steer to target.
6. Check ARI read-out at visual passage using view-finder nadir.

ALTERNATE RANGE CURSOR CHECK

1. Store coordinates of TACAN station.
2. Cursor correct on selected target.
3. Compare TACAN with ARI range read-out when range is greater than 10 times altitude but less than 46.5 miles.

NO RANGE CIRCLES

1. MODE knob—check NORM RNG CIRCLE IN.
2. Vary CURSOR & CIRCLE BRT knob.

NO AZIMUTH CURSOR

1. Ensure BOMB COMPUTER POWER switch ON/check blower operation.
2. Vary CURSOR & CIRCLE BRT knob.
3. Check relative aimpoint on ARI to ensure that it is within ±45 degrees of aircraft heading or reciprocal.
4. Try expanded display.

MULTIPLE AZIMUTH CURSOR

1. Select RECON and slew azimuth throughout scan limits to ensure that interference is a multiple azimuth cursor.
2. Reduce CURSOR & CIRCLE BRT knob setting.

2. Check TV presentation for similar malfunction.
3. Check bombing computer fuses.

PITCH/AZIMUTH ERROR OR OSCILLATION

1. Check TV presentation for similar malfunction.
2. Attempt correction by moving SYSTEM MODE knob to SEARCH.

NO AFT INDICATION

1. Check TV presentation for similar malfunction.
2. Cycle SYSTEM MODE knob through SEARCH.

ALT FAIL LIGHT

1. Indicates failure of baro altitude functions in the ADC and loss of altitude reporting.
2. Advise pilot that RESET position of altimeter may be unreliable.

TELEVISION FAILURES

NO RASTER

1. Increase TV BRIGHTNESS knob setting.
2. Check radar sweeps.
   Note FILTER operation.

NO VIDEO

1. Check FILTER switch OUT.
2. Cycle VIEW switch FWD, then AFT.
3. Vary TV BRIGHTNESS knob.
4. Try manual APERTURE control.
5. Repeat steps 3 and 4 with SYSTEM MODE knob in SEARCH.
6. Try all view angles.
7. Note weather conditions.

PULSATING VIDEO

1. Select manual APERTURE control.
2. Check radar for wedged video.

RETICLES MISSING

1. Increase reticle brightness.
2. Select other filament.

TV SCANNER POSITION INDICATOR (TSPI)

NO PITCH OR AZIMUTH INDICATION

1. Try operation with SYSTEM MODE knob in SEARCH.

AUTONAVIGATOR FAILURES

BEFORE STARTING ALINEMENT (STBY-NAV)

NO AML

1. A/N MODE knob—RECHECK STBY-NAV.
2. AN POWER switch—RECHECK ON.
3. IND LTS TEST button—DEPRESS.
4. Press—TEST AML.
5. Check AUTO/NAV COOLING AIR switch—ON.
6. PREHEAT switch—CHECK OFF.

STEADY AML (MORE THAN 20 TO 40 SECONDS)

1. A/N MODE knob—RECHECK IN STBY-NAV.
2. Check slewing and storing/if normal, proceed.
3. Cycle AN POWER switch to OFF 1 minute, then to ON.
4. If AML does not go out, down system and check for VERDAN malfunction.

Note

Check umbilical cable connected for AUTOMATIC alinement.

OVERTEMPERATURE LIGHT ON

1. OVERTEMP light—DEPRESS.
2. If light stays on, check PREHEAT switch off.

3. If light stays on, check cursor handle slewing action.
4. If slewing action is normal, investigate for autonavigator overheat.
5. If slewing action is inoperative, notify ground crew of VERDAN overheat condition and move AN POWER switch to OFF.
6. If light goes out, check cursor handle slewing action and continue alinement.

NO PP SLEWING OR STORING

1. Ensure that SYSTEM MODE knob is in SET PP and COORD SELECT knob is in LAT or LONG.
2. Change system mode and attempt storing. If still unable to store, proceed.
3. AN POWER switch—OFF 1 minute, then ON. When computer has timed in, try slewing and storing again.

COUNTER SLEWING LIMITED

If PDI slewing is limited to one compass direction only, proceed as follows:

1. Move COORD SELECT knob to opposite direction.
2. Slew in desired numerical value.
3. Move COORD SELECT knob to correct direction and depress COORD STORAGE button immediately.
4. Recheck slewing after selecting OPERATE.

If PDI slewing is limited to increase and decrease only, move SYSTEM MODE switch to RECON and slew coordinates to desired position.

AFTER STARTING ALINEMENT (DECK ALINE)

STEADY AML

1. Check slewing and storing/if normal, proceed.
2. A/N MODE switch—STBY-NAV and AN POWER switch—OFF. Wait 1 minute and then AN POWER switch—ON. If AML light goes off after 20 to 40 seconds, proceed with alinement.
3. If AML light does not go out, down system and check VERDAN for malfunction.

OVERTEMPERATURE LIGHT ON

1. OVERTEMP light—DEPRESS.
2. If light goes out, check present position and alpha readings. If normal, continue alinement.
3. If light stays on, check cursor handle and storage action. If normal, notify ground crew of autonavigator overheat condition.

Note

If autonavigator overheat occurs, STBY-NAV should be selected for launch.

4. If slewing and storage action is inoperative in STBY-NAV, move AN POWER switch OFF and notify ground crew of VERDAN overheat condition.

PRESENT POSITION AND WIND SPEED DRIFT

- Wind speed not equal to TAS ± 10 knots (BOMB COMPUTER POWER switch—ON).
- Large carrier heading error.
- Present position drifting.

1. Ensure correct carrier velocity is set in (HANDSET).
2. Switch A/N MODE knob to STBY-NAV, AN POWER switch to STBY, wait 2 minutes; then, A/N MODE knob to DECK ALINE, AN POWER switch to ON.
3. If trouble persists, launch in STBY-NAV.

ALPHA READOUT EXCESSIVE

If alpha readout is greater than 10 degrees, check carrier and differential reading inputs. If in error, switch A/N MODE knob to STBY-NAV for 2 minutes, reset carrier or differential heading, and move A/N MODE knob to DECK ALINE, then AN POWER switch to ON.

1. If alpha error is south, increase carrier or differential heading.
2. If alpha error is north, decrease carrier or differential heading.

Note

Degraded autonavigator performance may possibly result if Δ alpha exceeds 20 minutes. (Δ alpha = the difference between 14- and 30-minute alpha.)

IN OPERATE

ERRATIC/UNUSUAL WINDS

1. Do not switch to STBY-NAV until the following checks are made.
   (a) Check accuracy of PP tracking, cursor tracking, and ground speed.

AML INDICATIONS (SYSTEM FAILURES)

A/N MODE KNOB	ADVANCE MODE LIGHT	MALFUNCTION	PROCEDURE
OPERATE	Off	System will not track present position (A/N failure).	Press test AML; select STBY-NAV.
OPERATE or STBY-NAV	On	System will not track present position (VERDAN failure).	Select STBY-NAV. ● If light goes out, stay in STBY-NAV. ● If light stays on more than 5 minutes, move AN POWER to OFF for 5 minutes, then to ON. ● If light goes out after 1 minute, continue in STBY-NAV.
OPERATE or STBY-NAV	On	System will not store co-ordinates (VERDAN failure).	Move AN POWER to OFF. ● Wait 5 minutes, move AN POWER to ON. ● If system will not store, move AN POWER to OFF.
OPERATE or STBY-NAV	On	Present position will not track; cursor handle will not slew; system will not store (VERDAN failure).	Move AN POWER to OFF. ● Wait 5 minutes, move AN POWER to ON. ● If light stays on more than 5 minutes, move AN POWER to OFF.

(b) Check BOMB COMPUTER POWER at ON and check bomb computer fuses.

2. If PP and cursors track properly, remain in OPERATE.

   If abnormal, switch A/N MODE knob to STBY-NAV.

3. Obtain IMN, IAS, CIT, and altitude from pilot (SPC ON). Compute TAS and compare with TAS readout. Retain figures for yellow sheet entry.
4. Check viewfinder tracking in AUTO with camera POWER switch at READY.

If light stays on (readouts normal):
(a) Attempt resets.
(b) Check NAV readouts.
(c) If light resets, cursor correct or select STBY-NAV, as required.

If light stays on (readouts frozen):
(a) Attempt resets.
(b) A/N MODE — STBY-NAV.
(c) If light resets, cursor correct or select STBY-NAV, as required.
(d) AN POWER — OFF (if light will not reset).
(e) Use DR, radar navigation procedures.

OVERTEMPERATURE LIGHT ON

1. OVERTEMP light—Depress.

If light goes out:
(a) Perform cursor correction as soon as practicable.
(b) Continue in NAV mode.

AML ON

If AML light comes on at any other time than those listed, turn AN POWER switch to OFF, as there is a malfunction in the VERDAN.

● When AN POWER switch is initially turned to STBY, the AML light will be on for 20 to 40 seconds.

- When an alinement has been initiated, the AML light will come on in 50 to 100 seconds and remain on for 1 minute.
- Once the alinement sequence has started, the AML light will come on blinking at the end of the alinement (30 minutes) and continue to blink until A/N MODE knob is moved to OPERATE.

EXCESSIVE PP DRIFT

Note

Present position drift rate may be determined by using the RECON mode as shown.

Determine drift rate as follows:

1. Using VAR expanded display under 25 miles, correct PP on a known checkpoint and note time.
2. Select next checkpoint, wait at least 5 minutes, turn SYSTEM MODE knob to RECON.
3. Slew cursors to checkpoint and note time, RECON coordinates, and course.
4. Compute the difference between RECON coordinates and actual coordinates in miles.
5. Compute drift rate.
6. If drift rate exceeds 15 knots, switch A/N MODE knob to STBY-NAV.

STAND-BY NAVIGATION

1. A/N MODE knob—STBY-NAV.
2. WIND select knob—DIR/SPEED. Set best known wind direction and speed.
3. SYSTEM MODE knob—SET PP.
4. Set and store best known present position.
5. SYSTEM MODE knob—NAV.
6. COORD SELECT knob—NORMAL.
7. Compass TAKE CMD button—DEPRESS.
8. Hemisphere switch—CHECK.
9. LAT dial setting—CHECK.
10. Compass mode selector—DG.
11. Ground speed dial—SET TO BEST KNOWN GROUND SPEED.
12. HDG set knob—SET ARI TO AIRCRAFT TRUE HEADING.
13. Perform cursor or "pickle" correction at checkpoint.

STAND-BY NAVIGATION (CALIBRATED V/H*)

1. A/N MODE knob—STBY-NAV.
2. WIND SELECT knob—DIR/SPEED. Set best known wind direction and speed.
3. Viewfinder POWER switch—MAN.
4. DRIFT knob—ADJUST TO CANCEL DRIFT.
5. V/H knob—ADJUST TO CORRECT GRID TRAVEL RATE.
6. Read V/H value on calibrated knob.
7. Compute ground speed.
8. Compute wind direction and speed.
9. Correct set-in wind direction and speed.

NAV/BOMB STEERING ERROR

ARI relative bearing does not equal drift angle with AAI steering at zero. Check inputs as follows:

1. Ensure pilot's and RAN's RANGE & BEARING knobs are both in NAV.
2. Ensure SYSTEM MODE knob is in NAV or BOMB.
3. Check SET/CORR and NAV/BOMB knobs at same channel.
4. Ensure WIND knob is in AUTO.
5. Recheck accuracy of coordinate storage.

Check coincidence of AAI, ARI, and HSI as follows:

1. Turn SYSTEM MODE knob to RECON and store a visible target greater than 20 miles either upwind or downwind.
2. Fly zero AAI (HSI and ARI should point dead ahead).
3. Turn SYSTEM MODE knob to BOMB, ATTACK MODE knob to O/S; all indicators should remain the same.
4. Fly AAI steering to checkpoint and note any bearing deflections on HSI and/or ARI enroute.
5. If AAI is in error, fly HSI bearing.

COURSE LINE STEERING (C/L NAV MODE)

1. Use course line steering procedures to check for proper operation.
2. If errors occur after repeated reciprocal flight paths are flown, extend straight and level inbound legs (15 miles minimum) to allow for FRS erection.
3. Resynchronize compass at start of each inbound run.

CURSOR CONTROL FAILURE

NO NAV OR BOMB CORRECTION

1. Check AML.
2. Ensure that COORD SELECT knob is in NORMAL.
3. Move SYSTEM MODE knob to RECON and check for cursor operation.
4. Check VERDAN storing capability—Select different target and note if cursors move to new target position.

***Aircraft having AVC 582 complied with and aircraft 156608 through 156643**

5. Check for normal pickle correct operation.
6. Store new present position, using SET PP.

WIND CONTROL FAILURES

CANNOT SLEW SPEED OR DIRECTION

1. Ensure BOMB COMPUTER POWER switch ON/check blower operation.
2. Check bombing computer fuses.

MAXIMUM READING OR ZERO IN AUTO

1. Ensure BOMB COMPUTER POWER switch ON/check blower operation.
2. Check bombing computer fuses.
3. Slew wind manually.

ARI ERRATIC OR INOPERATIVE

1. Ensure BOMB COMPUTER POWER switch ON/check blower operation.
2. Check bombing computer fuses.
3. Cycle RANGE & BEARING knob from TACAN to NAV.

TAS/GS INDICATOR ERRATIC OR INOPERATIVE

1. (Deleted.)
2. Ensure BOMB COMPUTER POWER switch ON/check blower operation.
3. Check bombing computer fuses.

POSITION/DESTINATION INDICATOR FROZEN OR ERRATIC

1. Check VERDAN storage capability.
2. Select different target and note if counters move.
3. Try RECON operation.

ALTIMETER FAILURES

HIGH ALTITUDE

(Above 15,000 feet.)

DURING PRESSURE PATTERN NAVIGATION

Obtain pilot's indicated altitude corrected to 29.92 in. Hg. Apply ΔD correction and set radar/barometric altimeter in BARO mode.

HAND COMPUTER METHOD

1. ALTITUDE mode knob—BARO.
2. (Deleted.)
3. Obtain indicated altitude with altimeter set to local station pressure.
4. Correct local indicated altitude to 29.92 in. Hg to obtain pressure altitude.
5. Using computer, solve for true altitude.
6. Radar/barometric altimeter—SET TO TRUE VALUE.

LOW ALTITUDE

(Below 15,000 feet.)

1. ALTITUDE mode knob—BARO.
2. Obtain pilot's indicated altitude with altimeter set to local station pressure.
3. Radar/barometric altimeter—SET TO PILOT'S ALTITUDE.

BARO ERRATIC OR FAILED

1. (Deleted.)
2. Check mode flag is same as selected mode.

BARO CAL INDICATION ERROR

Indication should read 0 (±22) feet.

1. Check mode flag is same as selected mode.
2. (Deleted.)

RADAR ALTITUDE ERROR

1. (Deleted.)
2. Ensure that aircraft attitude is less than ±10 degrees pitch and roll, and aircraft altitude is above 500 feet.
3. Check normal operation of RADAR CAL mode.
4. Compare RADAR altitude reading with BARO altitude reading.

BARO CAL ALTITUDE ERROR

1. Check mode flag is same as selected mode.
2. (Deleted.)
3. Ensure that aircraft attitude is less than ±10 degrees pitch and roll, and aircraft altitude is above 500 feet.
4. Compare BARO CAL reading with BARO reading.
5. Compare BARO CAL reading with RADAR reading.

PILOT'S HSI — FROZEN RANGE OR AZIMUTH

1. Cycle SYSTEM MODE knob between NAV and BOMB.

2. Check ARI range and bearing.
3. Cycle RANGE & BEARING knob from TACAN to NAV.

PILOT'S AAI—STEERING POINTER FROZEN

1. Ensure BOMB COMPUTER POWER switch ON/check blower operation.
2. Check bombing computer fuses.
3. Store target coordinates in new channel and check.
4. Turn course line steering off if on (ALINE/HOLD—OFF).
5. Check ARI/HSI for proper operation.

SIDE-LOOKING RADAR FAILURE

SLR CAUTION LIGHT ON

MONITOR SCOPE NORMAL

1. MODE switch — READY.
   If light goes out, select OPR.
2. If light persists, MODE switch — DATA.
   If light still on, a film drive failure, film jam, magazine failure, or film expended is probable cause.
3. POWER switch — OFF, wait 1 minute, then ON.
4. If SLR caution light persists in all modes after recycling, SLR is inoperative.

NO TARGET RETURNS ON MONITOR SCOPE

1. MODE switch — READY.
   If light goes out, reselect OPR.
2. If light illuminates when OPR is reselected, a high-pressure system failure probable.
3. Descend to lower altitude.
4. POWER switch — OFF, wait 1 minute, then ON.

Note

If high-pressure system is lost, SLR operation probably will not be regained.

MONITOR SCOPE BLANK, NO VIDEO OR SWEEPS

1. MODE switch — READY.
   If light goes out, select OPR.
2. If light persists, MODE switch — DATA.
   If light goes out, probable low-pressure system failure.
3. MODE switch — READY.
4. POWER switch — OFF, wait 1 minute, then ON.
5. Descend if possible.

Note

If low-pressure system malfunctions, SLR operations may be regained at lower altitudes.

TEST PULSES ON ONLY ONE SIDE OF MONITOR SCOPE WHEN TEST POSITION SELECTED

1. Circulator failure and one-side operation only available.

SLR CAUTION LIGHT OFF

MONITOR SCOPE BLANK

1. Check POWER switch — ON.
2. MODE switch — READY.
3. POWER switch — OFF, wait 1 minute, then ON.
4. MODE switch — OPR.
5. If scope remains blank or sweeps are erratic, select normally used GAIN and TARGET settings, trim ANT. TRIM controls, and continue mission. Refer to Section VIII, Part 4 of Supplemental NATOPS Flight Manual (NAVAIR 01-60ABC-1A) for ANTENNA TRIM CONTROLS procedures.

TARGETS ONE SIDE OF MONITOR SCOPE ONLY

1. POWER switch — TEST.
   If SLR caution light illuminates, probable circulator failure. If test pulses appear on both sides of scope, check antenna trim.
2. POWER switch — OPR.
3. Continue single-side operation.

BASELINE ERRATIC, SLR RANGE LIGHTS CYCLING ERRATICALLY

1. Select BARO ALTIMETER.
2. If indications disappear, probable radar altimeter malfunction. Continue mission in BARO.

VIDEO LOST OR ERRATIC, BASELINE ERRATIC

1. A.F.C. switch — MANUAL.
2. TUNE control — TUNE FOR MAXIMUM TARGET RETURN.
3. A.F.C. switch — AUTO.
   If malfunction indications return, select MANUAL and continue mission. Continued manual tuning will be required.

CAMERA FAILURE

CAMERA CAUTION LIGHT ON

1. Check camera pulse monitor lights, and readiness and EXPOSURES REMAINING indicators for malfunctioning camera or a camera which has no exposures remaining. 18-inch panoramic camera operation is assured if exposures remaining counters continue to decrease, even though CAMERA caution light remains on.

2. Isolate by cycling camera (altitude) mode switches.
3. Failed camera (altitude) mode switches — OFF.
   Check CAMERA caution light out.
4. Check that only one panoramic camera (altitude) mode switch is in an operating position.
5. With panoramic cameras installed and film jamming suspected:
   (a) Place the camera POWER switch to READY for 10 seconds, then return to OPR.
   (b) If normal operation is not restored, move altitude mode switch of malfunctioning panoramic camera to OFF.
6. Continue operating all remaining cameras.

CAMERA CAUTION LIGHT OFF

1. FLASHER MODE switch — CHECK OFF.

MOUNTS RE-ELECT LIGHT ON

1. If the MOUNTS RE-ERECT light stays on in level flight or if the light stays on after prolonged maneuvering, depress RE-ERECT button.
2. On some aircraft,* the RE-ERECT light will illuminate when the mount is against the roll or pitch stops. If this occurs in level flight, position the SENSOR STAB switch to CAGE; the RE-ERECT light should extinguish within 2.5 minutes. If the light remains on, a mount failure is indicated. If the light goes out, a faulty system stabilization signal is indicated. Operation may be continued in the CAGE mode; however, roll stabilization will not be available to any sensors, including IR or SLR.

CAUTION

A carrier landing with the camera POWER switch in READY or OPERATE may damage the prisms of an installed 18-inch panoramic camera, even though in the CAGE mode.

VIEWFINDER FAILURE

GRID HALTED OR NOT TRACKING

1. Camera POWER switch — READY or OPERATE.
2. Wind, altitude, and ground speed — check indications.
3. If the inertial autonavigator platform has failed, use STBY-NAV mode.
4. Camera POWER switch — READY (if at OPERATE).
5. With failure of inertial platform and/or VERDAN:
   (a) Select STBY-NAV.
   (b) Leave bombing computer power ON.
   (c) Set in manual winds.
   (d) Check for proper viewfinder grid tracking.
   (e) If correct, continue viewfinder operation in AUTO mode.
6. For a viewfinder failure, select MAN mode.
   If operation is not regained, select AUTO.

CAUTION

With the camera POWER switch at OPERATE, do not immediately move the viewfinder POWER switch to MAN, as camera damage may occur. Stop film feed by selecting READY, switch the viewfinder to MAN, adjust V/H rate, and then select camera operation as required.

Note

If cameras operate normally, remain in AUTO mode.

V/H LIGHT OR DRIFT LIGHT FAILURE

1. SHIELD knob — CHECK OUT.
2. RESET button — CHECK IN.
3. V/H LIGHT knob — CHECK LIGHT ACTION.
4. DRIFT LIGHT knob — CHECK LIGHT ACTION.
5. Viewfinder POWER switch — OFF.
   If the cameras operate normally, continue the mission.

IR MAPPING FAILURE

IR MAP ADVISORY LIGHT ON

1. System power failure.
2. Film drive failure.
3. Film broken or jammed.
4. Three or more glow-modulator tubes failed.
5. IR detector temperature too high.
6. Synchronization failure.
7. Door not open (gear up, POWER switch — OPERATE).

COOLER TEMP LIGHT FAILS TO GO OUT

1. Cooler failure.
2. Detector failure.
3. Preamplifier and/or postamplifier failure.

*Aircraft having AFC 297 complied with

TEST LIGHT FAILS TO COME ON IN TEST MODE (IR MAP ADVISORY LIGHT NOT ON)

If the IR test light does not come on in the TEST mode at any time, IR performance should be considered questionable.

*Aircraft not having AFC 349 complied with

ARMAMENT SYSTEM FAILURE

NO RELEASE CHECK

1. ARM MAST'R ON light — CHECK.
2. STATION SELECT buttons — CHECK.
3. T-375 arming selector *—CHECK.
4. Check with pilot:
   (a) Delivery mode button — DEPRESSED.
   (b) MASTER ARM switch — ON.
5. If positive release is required before landing:
   (a) Request MASTER ARM switch — ON.
   (b) STATION SELECT button — DEPRESS.
   (c) MAN button — DEPRESS, when directed.

PART 7 – FUNCTIONAL CHECKFLIGHT PROCEDURES

CHECK PILOTS

Good checkflights are dependent upon thorough evaluation by experienced pilots. Commanding Officers shall designate, in writing, those pilots qualified to assume these duties.

CHECKFLIGHTS AND FORMS

Checkflights shall be performed when required in accordance with OPNAVINST 4790.2 series, OPNAVINST 3710.7 series, and other appropriate authority.
Functional checkflight requirements and applicable minimums are described.

REQUIREMENTS

CONDITIONS REQUIRING FUNCTIONAL CHECKFLIGHTS

Checkflights are required to determine whether the airframe, power plant, accessories, and items of equipment are functioning properly in the operational environment. Such flights are conducted when it is not possible to determine proper operation by ground checks (aerodynamic reaction, air loading, or signal propagation).

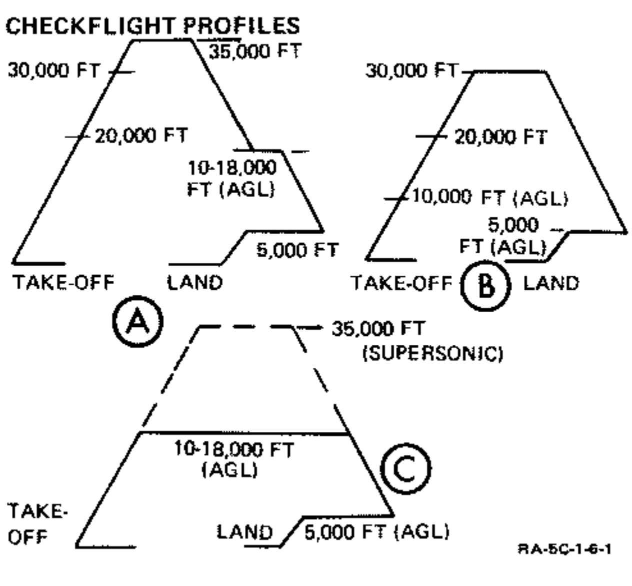

Figure 3-11

The following conditions require functional checkflights:

A. At the completion of aircraft rework (all checkflight items required are prefixed A).

B. After the installation or reinstallation of an engine, fuel control, major fuel system components, or any components which cannot be checked in ground operation (minimum required items are prefixed B).

C. When fixed flight surfaces have been installed or reinstalled, or when movable flight surfaces or flight controls have been installed, reinstalled, adjusted or rerigged, and improper adjustment or replacement of such components could cause an unsafe operating condition (minimum items required are prefixed C).

FORMS

Functional Checkflight Checklists are promulgated separately.

PROCEDURES

FUNCTIONAL CHECKFLIGHT

The following items provide a detailed description 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, or condition, for which the checkflight is being flown (as described under REQUIREMENTS). The applicable letter identifying the profile prefixes each check both in the following text and in the Functional Checkflight Checklist (NAVAIR 01-60ABC-1F). Checkflight personnel shall familiarize themselves with these requirements prior to the flight. NATOPS procedures apply during the entire checkflight unless specific deviation is required by the functional check to record data or to ensure proper operation within the approved aircraft envelope. A "Daily" inspection is required prior to the checkflight.

PILOT PROCEDURES

PROFILE

PRETAKE-OFF

Ensure all NATOPS checklists and procedures are performed.

TAXI

A — 1. Fuel Quantity:
- Totalizer — RECORD.
- Forward — RECORD.
- Wings — RECORD.
- Sump — RECORD.
- Aft — RECORD.
- Bomb Bay — RECORD.
- Added Total — RECORD.

Record fuel quantity before and after flight.

A — 2. Oxygen Quantity — RECORD.
a. Record oxygen quantity before and after flight.

A — 3. Lights — PRESS TO TEST.
a. RAN fire warning.
(1) Check for illumination of warning lights.
(2) Check RAN for illumination of fire warning lights in aft cockpit.

A — 4. Cockpit Lights — CHECKED.
a. Check for illumination of cockpit lights.

A — 5. Exterior Lights — CHECKED.
a. Check for illumination of exterior lights.

A — 6. Anti-G Pressure — CHECKED.
a. Press to test and check airflow from disconnect.

A — 7. ICS (ALT ICS, EMER, HOT, COLD, MIC SEL) — CHECKED.

A — 8. Nose Wheel Steering — CHECKED.
a. Check nose wheel steering just after leaving chocks to ensure LH and RH steering is available.

A — 9. Turn and Slip Indicator — CHECKED.
a. Check for needle deflection and ensure ball is free in race.

A — 10. AAI — CHECKED.
a. Check for smooth heading change and proper erection.

A — 11. Stand-by Gyro — CHECKED.

A — 12. Vertical Speed Indicators — CHECKED.
a. Check to ensure both vertical speed indicators read the same.

A — 13. HSI — CHECKED.
a. Check for smooth heading changes.

A — 14. Magnetic Compass — CHECKED.
a. Check for free movement and proper fluid level.

SMATS AND TAKE-OFF POWER CHECK (IF INSTALLED)

A B — 1. Throttles 85% to 90% — CHECKED.

A B — 2. SMATS Switch — ON.
a. Advisory lights ON and AB operating — CHECKED.
(1) The afterburner secondary cone should light off in 2 seconds or less and SMATS ON advisory lights should come on.

Note

When SMATS ON advisory lights come on, a special SMATS T versus N schedule is controlling modulation of nozzle area.

PROFILE

A B — 3. Throttle — RETARD.

a. Note lights out and SMATS switch return to OFF at 67% throttle position.
(1) No. 1 — CHECKED.
(2) No. 2 — CHECKED.

A B — 4. Acceleration IDLE to MIL with 30° Flaps — RECORD.

Note

Maximum J79-GE-8 — 10 seconds; maximum J79-GE-10 — 6 seconds.

a. Check for bleed duct air leaks by timing the acceleration of both engines simultaneously from IDLE to MIL as indicated by fuel flow cutback.
(1) No. 1 — RECORD.
(2) No. 2 — RECORD.

A B — 5. RPM.

a. J79-GE-8 — CHECK; rpm is 100 (+5) % at 5°C and above.
b. J79-GE-10 — CHECK; rpm is 97 (±1) % at 15°C sea level static operation.
c. Refer to EGT and RPM schedule.
(1) No. 1 — RECORD.
(2) No. 2 — RECORD.

A B — 6. EGT.

a. J79-GE-8, check for 625 (±10) °C.
b. J79-GE-10. Refer to EGT and RPM schedule.
(1) No. 1 — RECORD.
(2) No. 2 — RECORD.

A B — 7. Oil Pressure.

a. Record oil pressure, which should be in range of 40 to 70 psi.
(1) No. 1 — RECORD.
(2) No. 2 — RECORD.

A B — 8. Nozzles.

a. Check 1/4 to 3/8 open and modulating slightly.
(1) No. 1 — CHECKED.
(2) No. 2 — CHECKED.

A B — 9. Fuel Flow.

a. Record fuel in pounds per hour; should be in range of 7,000 to 10,000 pounds per hour.
(1) No. 1 — RECORD.
(2) No. 2 — RECORD.

A B — 10. Inlet Duct Temperature, Degrees C — RECORD.

A B — 11. Hydraulic Pressure.

a. Record hydraulic pressure on No. 1 and No. 2 system LH and RH. Pressure in all systems should be in range of 3000 (±250) psi.
(1) No. 1 system:
(a) LH—CHECKED.
(b) RH—CHECKED.
(2) No. 2 system:
(a) LH—CHECKED.
(b) RH—CHECKED.

A B — 12. MIN AB Check Nozzles — CHECKED.

Note

J79-GE-8 – 3/4 open; J79-GE-10 – 3/4 open (may be modulating).

a. Check for light off (3 seconds max) and RPM rollback (7% max to not less than 87%).

PROFILE

TAKE-OFF ROLL (MAXIMUM AB)

A B
1. Note Time — RECORD.
   a. Record time.

A B
2. EGT.
   a. J79-GE-8, check that EGT returns to 625 (±10)°C.
   b. J79-GE-10, check that EGT returns to scheduled EGT at MIL.
      (1) No. 1 — CHECKED.
      (2) No. 2 — CHECKED.

A B
3. Nozzles.
   a. Check that nozzles are full open at full afterburner.
      (1) No. 1 — CHECKED.
      (2) No. 2 — CHECKED.

IN FLIGHT

WHEN AIRBORNE

A
1. Radar Altimeter — CHECKED.
   a. Record radar altimeter reading at lift-off.

CLIMBING THROUGH 10,000 FEET

A B
1. RPM.
   a. No. 1 — RECORD.
   b. No. 2 — RECORD.

A B
2. EGT.
   a. No. 1 — RECORD.
   b. No. 2 — RECORD.

A B
3. Oil Pressure.
   a. No. 1 — RECORD.
   b. No. 2 — RECORD.

A B
4. Fuel Flow.
   a. No. 1 — RECORD.
   b. No. 2 — RECORD.

A B
5. Inlet Duct Temperature, Degrees C — RECORD.

A B
6. Cabin Altitude — RECORD.
   a. Record cabin pressure; should read 8,000 feet at 10,000 feet.

CLIMBING THROUGH 20,000 FEET

A B
1. RPM.
   a. No. 1 — RECORD.
   b. No. 2 — RECORD.

A B
2. EGT.
   a. No. 1 — RECORD.
   b. No. 2 — RECORD.

A B
3. Oil Pressure.
   a. No. 1 — RECORD.
   b. No. 2 — RECORD.

A B
4. Fuel Flow.
   a. No. 1 — RECORD.
   b. No. 2 — RECORD.

A B
5. Inlet Duct Temperature, Degrees C — RECORD.

A B
6. Cabin Altitude, Feet — RECORD.
   a. Cabin pressure should read 8,000 feet at 20,000 feet altitude.

PROFILE	
	CLIMBING THROUGH 30,000 FEET (PROFILE B — LEVEL OFF AT 30,000 FEET)
A B	1. RPM. a. No. 1 — RECORD. b. No. 2 — RECORD.
A B	2. EGT. a. No. 1 — RECORD. b. No. 2 — RECORD.
A B	3. Oil Pressure. a. No. 1 — RECORD. b. No. 2 — RECORD.
A B	4. Fuel Flow. a. No. 1 — RECORD. b. No. 2 — RECORD.
A B	5. Inlet Duct Temperature, Degrees C — RECORD.
A B	6. Cabin Altitude, Feet — RECORD. a. Cabin pressure should be 12,000 feet at 30,000 feet.
	LEVEL OFF 35,000 FEET (MAY BE CHECKED AT 10,000 to 18,000 FEET IF SUPERSONIC IS NOT REQUIRED)
A	1. Note Time — RECORD.
A	2. AFCS. a. Hold heading — CHECKED. (1) Control within 1 degree of flight reference set heading output. b. Hold attitude — CHECKED. (1) Aircraft attitude limits in normal mode are ±55 degrees of pitch and ±60 degrees of bank. Pilot stick steering corrections to these limits may be initiated at any time in this mode without disengaging system. c. Hold bank — CHECKED. (1) A stick steering correction with stick centering between 5 and 60 degrees of bank will switch the lateral control system to hold bank mode, resulting in a sustained, coordinated turn at existing bank angle. d. Hold altitude — CHECKED. (1) Altitude should be maintained within ±50 feet or 0.2 percent, whichever is greater, above 10,000 feet and ±30 feet below 10,000 feet. A longitudinal stick steering correction reverts system to hold pitch mode. e. Heading trim — CHECKED. (1) The heading trim wheel provides vernier-type trim control of aircraft heading in NORM (hold heading) mode. Should a heading change be desired, the pilot may roll this control toward the desired direction of heading correction (1 degree per notch). The aircraft will roll into a coordinated turn and roll out when the selected number of degrees of heading has been reached. f. Hold Mach — CHECKED. (1) Hold Mach should modulate aircraft pitch attitude to maintain true Mach number within 0.01 Mach of that existing at time of mode selection. g. Lateral retrim — CHECKED. h. Nav steer — CHECKED.
A	3. Nav Aids. a. UHF/ADF AUX — CHECKED. b. UHF/ADF (main) — CHECKED. c. TACAN — CHECKED. d. IFF/SIF — CHECKED.

PROFILE

A 4. DECM Systems.
a. AN/ALQ-41 — CHECKED.
b. AN/ALQ-51A/100 (AN/ALQ-126) — CHECKED.
c. AN/APR-25 (AN/ALR-45) — CHECKED.
d. AN/APR-27 (AN/ALR-50) — CHECKED.

A B 5. Fuel Transfer — CHECKED.

A B 6. Fuel Sequencing — CHECKED.

A B 7. Fuel Dump — CHECKED.

A 8. Disengage electric flight and PITCH AUG.
a. Manual flight controls for friction — CHECKED.
(1) Check for dragging and binding of controls. Observe normal stick friction in relation to aircraft response.
b. Engage electric flight — No control transients — CHECKED.
c. Engage PITCH AUG — 0.2-g maximum pitch transients.

A B 9. ENGINE ANTI-ICE — CHECKED.
Check the ENGINE ANTI-ICE switch is ON and engine anti-ice indicator displays "ON."

A 10. Cockpit Temperature Control.
a. MAN — CHECKED.
(1) Check manual control through full range.
b. AUTO — CHECKED.
(1) Check AUTO control through full range.

A 11. WINDSHIELD & CANOPY DEFROST — CHECKED.
Turn on WINDSHIELD & CANOPY DEFROST; defrost flow is increased as knob is turned clockwise from OFF position.

A 12. Supersonic Performance and Stability (as practical).
a. Afterburner operation — CHECKED.
b. 1.2 IMN lateral and directional stability by rolling — CHECKED.

Note

Maximum 60 degrees roll.

c. YAW AUG operation — CHECKED.
d. 1.4 IMN longitudinal stability force per "g" — CHECKED.
e. RPM.
(1) No. 1 — RECORD.
(2) No. 2 — RECORD.
f. EGT.
(1) No. 1 — RECORD.
(2) No. 2 — RECORD.
g. Inlet duct temperature, degrees C — RECORD.

DESCENT TO 10,000 TO 18,000 FEET

A C 1. Reduce Speed to Subsonic — CHECKED.

A C 2. Speed Brakes out 400 KIAS or 0.9 Mach (No Roll) (360 KIAS if Pitch Augmentation Inoperative and four drop tanks installed) — CHECKED.

A C 3. Speed Brake Dump — CHECKED.

A C 4. Longitudinal, Lateral, and Directional Stability (Force per "g") — CHECKED.

A C 5. Rolls, Maximum Rate — CHECKED.

A C 6. Accelerometer — CHECKED.

A C 7. Anti-G Suit — CHECKED.

LEVEL 5000 FEET OR SAFE ALTITUDE

A C 1. Normal Flaps/Droops Extension — CHECKED.

A C 2. Normal Landing Gear Extension — CHECKED.

PROFILE	
A C	3. Angle of Attack — CHECKED. a. Gross weight — RECORD. b. KIAS at 15 units — RECORD. c. Indexer lights — CHECKED. d. Rudder pedal shaker (19 units) — CHECKED.
A C	4. Tail hook normal extension/retraction(gear and flaps down) check approach indexer functions and hook positioning with hook down in both approach modes in each hook position.
A C	5. Air Refueling Probe Extension/Retraction (Below 280 KIAS) — CHECKED.
A C	6. Cockpit RAM EMERG — CHECKED.
A B	7. APC. a. Reaction to angle of attack — CHECKED. b. Horizontal stabilizer input — CHECKED. c. Manual override — CHECKED. d. Speed brake and throttle friction cutout — CHECKED.
A C	8. Retract Landing Gear — CHECKED.
A C	9. Flaps and Droops to CRUISE — CHECKED.
A C	10. HYD SUB-SYS ISOLATION Switch — FLIGHT — CHECKED.
A C	11. Normal flap handle-30/25 (below 290 KIAS), droops to 25, then EMER FLAP switch DOWN (below 230 IAS)--CHECKED, (full flaps should be obtained by approximately 170 KIAS).
A C	12. Extend Landing Gear by Emergency Procedure — CHECKED.
A C	13. Normal Flap Handle to 50° — CHECKED.
A C	14. HYD SUB-SYS ISOLATION Switch — TAKE-OFF/LANDING — CHECKED.

LANDING

Ensure all NATOPS checklists and procedures are performed.

BEFORE LANDING

PROFILE	
A	1. Radar Altimeter — CHECKED.
A	2. Wheel Brakes/ANTI-SKID — CHECKED.

AFTER LANDING

PROFILE	
A C	1. EMERG FLAP Switch — UP, then centered. **Note** Wait 15 seconds.
A C	2. FLAPS Handle to CRUISE Position — CHECKED.
A	3. Engine Masters/Ramps — CHECKED.
A	4. Oxygen Quantity — RECORD.
B	5. Fuel Quantity: Totalizer — RECORD. Forward — RECORD. Wings — RECORD. Sump — RECORD. Aft — RECORD. Bomb Bay — RECORD. Added Total — RECORD

RAN PROCEDURES

PROFILE

PRETAKE-OFF

LIGHTS

A B C — 1. Indicator Lights — CHECKED.
   a. The IND LTS TEST button on interior lights panel provides operational check of caution, warning, and advisory lights except B/N WARM-UP, T-375, OVERTEMP RESET. Advisory and AN/ALQ-55 panel lights must be press-tested.

A B C — 2. MAP LIGHT — CHECKED.
   a. Selection and intensity are controlled by MAP LIGHT knob.

A B C — 3. FLOOD — CHECKED.
   a. Selection and control of white compartment floodlights.

A B C — 4. INSTR & CONSOLE — CHECKED.
   a. INSTR & CONSOLE knob selects and controls instrument and console indirect lighting.

A B C — 5. B/N WARM-UP (Press to Test) — CHECKED.
   a. Illuminates on moving the AN POWER switch to ON if autonavigator platform temperature is below minimum for alinement.

A B C — 6. OVERTEMP RESET (Test) — CHECKED.
   a. Amber overheat and reset light illuminates to indicate overtemperature of autonavigator, VERDAN computer, or A/N power supply.

A B C — 7. Boarding Lights — CHECKED.
   a. The RED FLOOD LIGHTS switch provides selection and control of low-intensity red entrance lights.

SECURITY

A B C — 1. Mounting Boxes for Security.
   a. Control boxes — CHECKED.

A B C — 2. Instruments — CHECKED.

MISCELLANEOUS

A B C — 1. Oxygen Mask/Quantity/Light — CHECKED.
   a. Light on indicates less than 45 psi oxygen pressure or 0.8 (±0.2) liter.

A B C — 2. Clock — CHECKED.
   a. Elapsed time setting to 12-o'clock start position.

A B C — 3. Anti-G Suit Valve — CHECKED.
   a. Press to test and check for airflow from disconnect.

A B C — 4. Manual HEAT — CHECKED.
   a. Rotate air temperature control handle to 0 position — check for increase in airflow temperature from distribution tubes.

A B C — 5. EXPOSURE SUIT FLOW — CHECKED.
   a. Flow control knob — rotate knob toward INCR position, check for slight airflow; rotate knob to full INCR, check for airflow increase.

A B C — 6. Attitude Gyro Indicator Uncaged – CHECKED.

A B C — 7. SEAT ADJUST — CHECKED.
   a. Position SEAT ADJUST switch to UP then to DOWN position. Check seat position movement.

A B C — 8. Radar/TV Scope FILTER — CHECKED.

A B C — 9. Cockpit Pressure — CHECKED.
   a. With COCKPIT PRESS switch to NORM visually check for proper indication of field altitude.

A B C — 10. Light Shields — CHECKED.

A B C — 11. Windows — CHECKED.
   a. Condition of glass area and cleanliness.

PROFILE	
	COMPASS
A B C	1. Command Transfer — CHECKED.
	a. Either crew member by pressing TAKE CMD button. Green light on compass control panel illuminates after 10 seconds.
A B C	2. Mode.
	a. Modes of operation.
	(1) DG — CHECKED.
	(a) Provides free gyro heading of directional gyro.
	(2) SLAVED — CHECKED.
	(a) Provides magnetically controlled heading.
	(3) COMP — CHECKED.
	(a) Utilize for emergency magnetic heading.
A B C	3. SYNC — CHECKED.
	a. Automatically synchronizes gyro heading information with magnetic heading during SLAVED mode. Amber light in pushbutton will illuminate when system is in fast slave mode.
	AUTONAVIGATOR
A B C	1. HANDSET/SINS.
	a. α-1 — RECORD.
	b. α-2 — RECORD.
	c. Record final α.
A B C	2. Alinement Sequence — CHECKED.
	a. Alinement of autonavigator platform performed in accordance with Part 3 of this manual.
A B C	3. PP Track During Alinement — CHECKED.
	VERDAN
A B C	1. PDI Panel — CHECKED.
	a. Position/destination indicator panel.
A B C	2. Slew/Storage — CHECKED.
A B C	3. RECON — CHECKED.
	IN FLIGHT
	BOMBING COMPUTER
A B C	1. Steering (PDI, AFCS, AAI) — CHECKED.
A B C	2. ARI/HSI.
	a. UHF — CHECKED.
	b. TACAN — CHECKED.
	c. NAV — CHECKED.
A B C	3. Wind Speed/Direction.
	a. AUTO — CHECKED.
	b. Manual — CHECKED.
A B C	4. Altimeters: RADAR/RADAR CAL, BARO/BARO CAL — CHECKED.
A B C	5. GROUND SPEED — CHECKED.
A B C	6. Pickle Correct.
	a. NAV/LOFT — CHECKED.
	b. BOMB/O/S — CHECKED.
A B C	7. Drift Rate in OPERATE — RECORD.
A B C	8. STBY-NAV PP Track — CHECKED.
A B C	9. Offsets — CHECKED.
	RADAR
A B C	1. Modes — CHECKED.
	a. TV/MRI/NORM/ANTIJAM.

PROFILE

PROFILE	
A B C	2. Displays — CHECKED. a. FIX, VAR, NORM, NORM RNG CIRCLE IN.
A B C	3. Beams — CHECKED. a. NORM STC, NORM, FLAT, FLAT STC.
A B C	4. Ranges — CHECKED. a. 10, 20, 30, 60, 140.
A B C	5. RELATIVE CURSOR BRT — CHECKED.
A B C	6. BRIGHTNESS — CHECKED.
A B C	7. CURSOR & CIRCLE BRT — CHECKED. a. Range circles 3, range cursor, azimuth line.
A B C	8. IF GAIN — CHECKED.
A B C	9. TILT — CHECKED.
A B C	10. VIDEO GAIN — CHECKED.
A B C	11. AFC and MAN Tune — CHECKED.
A B C	12. TRANSMIT/SILENCE — CHECKED.
A B C	13. Test Circles — RECORD.
A B C	14. Cursors — CHECKED.
A B C	15. Stabilization. a. OPERATE — CHECKED. b. STBY — CHECKED.
A B C	16. FOCUS — CHECKED.
A B C	17. Maximum Usable Range (FLAT Beam) — RECORD.
A B C	18. LIGHT BRILLIANCE — CHECKED. a. Relative azimuth marks on.
	TV
A B C	1. FILTER — CHECKED.
A B C	2. Views — CHECKED. a. FWD and AFT checked.
A B C	3. VIEW ANGLE — CHECKED. a. Wide, medium, and narrow checked.
A B C	4. Reticles — CHECKED. a. NO. 1 and NO. 2 checked.
A B C	5. APERTURE — CHECKED. a. AUTO/manual checked.
A B C	6. BRIGHTNESS — CHECKED.
A B C	7. SEARCH MODE — CHECKED.
A B C	8. Radar/TV Coincidence — CHECKED.
A B C	9. TSPI — CHECKED.
	VIEWFINDER
A B C	1. POWER. a. AUTO — CHECKED. b. MAN — CHECKED.
A B C	2. DRIFT. a. AUTO — CHECKED. b. MAN — CHECKED.
A B C	3. V/H. a. AUTO — CHECKED. b. MAN — CHECKED.
A B C	4. V/H LIGHT — CHECKED.
A B C	5. DRIFT LIGHT — CHECKED.
A B C	6. SHIELD — CHECKED.

PROFILE

CAMERAS

A B C 1. CAMERA COMMAND Light — CHECKED.

A B C 2. PULSE MONITOR.
a. Pilot — CHECKED.
b. RAN — CHECKED.

A B C 3. Oblique.
a. EXPOSURES REMAINING Indicators.
(1) Pilot — CHECKED.
(2) RAN — CHECKED.
b. ALT Mode HIGH/LOW.
(1) Pilot — CHECKED.
(2) RAN — CHECKED.
c. Readiness indicator.
(1) Pilot — CHECKED.
(2) RAN — CHECKED.

A B C 4. Vertical.
a. EXPOSURES REMAIN Indicators — CHECKED.
b. RE-ERECT light — CHECKED.
c. Readiness indicator — CHECKED.

SIDE LOOKING RADAR

A B C 1. A.F.C.
a. AUTO — CHECKED.
b. MANUAL — CHECKED.
c. TEST pulse.
(1) AUTO — RECORD.
(2) MANUAL — RECORD.
d. Test pulse characteristics appear nearly identical in both modes.

A B C 2. Monitor Scope.
Visual means for adjusting radar during flight.
a. Sweep position — CHECKED.
(1) Both sides of aircraft, starting from a common center.
b. BRIGHTNESS — CHECKED.
c. FOCUS — CHECKED.
(1) Optimum clarity.

A B C 3. RANGE Lights — CHECKED.
a. Indicates respective operating range. Range 3 light remains illuminated during extended range operation.

A B C 4. Ranges.
a. AUTO — CHECKED.
b. 1 — CHECKED.
(1) Refer to Supplemental NATOPS Flight Manual (NAVAIR 01-60ABC-1A).
c. 2 — CHECKED.
(1) Refer to Supplemental NATOPS Flight Manual (NAVAIR 01-60ABC-1A).
d. 4 — CHECKED.
(1) Refer to Supplemental NATOPS Flight Manual (NAVAIR 01-60ABC-1A).
e. 5 — CHECKED.
(1) Refer to Supplemental NATOPS Flight Manual (NAVAIR 01-60ABC-1A).
f. 6 — CHECKED.
(1) Refer to Supplemental NATOPS Flight Manual (NAVAIR 01-60ABC-1A).
g. 7 — CHECKED.
(1) Refer to Supplemental NATOPS Flight Manual (NAVAIR 01-60ABC-1A).

PROFILE	
A B C	5. ANT. TRIM. a. Refer to Supplemental NATOPS Flight Manual (NAVAIR 01-60ABC-1A). (1) LEFT — CHECKED. (2) RIGHT — CHECKED.
	INFRARED
A B C	1. COOLER TEMP Light/Cool Down Time — RECORD. a. Press to test. 2. IR MAP Light — CHECKED. 3. TEST Light — CHECKED. a. Press to test.
	ECM
A B C	1. AN/APR-25 (AN/ALR-45) — CHECKED.
A B C	2. AN/APR-27 (AN/ALR-50) Audio — CHECKED.
A B C	3. AN/ALQ-41 (Pilot) — CHECKED.
A B C	4. AN/ALQ-100 (AN/ALQ-126) Audio — CHECKED.
A B C	5. AN/ALQ-55 — CHECKED.
A B C	6. AN/ALE-29A — CHECKED.
A B C	7. AN/ALQ-61 — CHECKED.
	IFF/SIF
A B C	1. Modes — CHECKED.
A B C	2. I/P/MIC — CHECKED.
	CNI
A B C	1. Command Transfer. a. COMM — CHECKED. b. NAV — CHECKED.
A B C	2. ICS. a. HOT/COLD/CALL — CHECKED. b. EMER/NORM/ALT ICS/ALT RAD — CHECKED.
A B C	3. TACAN. a. VOL — CHECKED. b. REC/A/A/T/R — CHECKED.
A B C	4. UHF. a. CHAN/FREQ/guard — CHECKED. b. ADF — CHECKED.
A B C	5. AUX REC — Test. a. Channel — CHECKED. b. GRD — CHECKED. c. ADF — CHECKED. d. Frequency cards — CHECKED.
	AIR DATA COMPUTER
A B C	1. TAS — CHECKED.

CHECKFLIGHT OPERATIONS WITH NO BOMB BAY CANS INSTALLED

With full internal fuel and no bomb bay cans installed, the center of gravity may be forward of the maximum permissible forward CG limit for take-off and flight. To achieve safe accomplishment of required maintenance checkflights, each operation without bomb bay fuel cans installed must be carefully planned to consider existing aircraft configuration (clean, tanks, pylons) and its effect on aircraft CG location. Computation of an accurate take-off and landing CG limitation shall be accomplished prior to each operation in accordance with Weight and Balance Data Manual (NAVAIR 01-1B-40), in order to determine the proper fuel load and distribution for safe take-off. CG should be maintained between 25.4 and 34.0 percent MAC or within any applicable more stringent CG restriction. PMCF hops with no cans require precise calculations of fuel load limits especially in the forward wing tanks.

SECTION IV – FLIGHT CHARACTERISTICS

TABLE OF CONTENTS

FLIGHT CHARACTERISTICS

STABILITY

Stability and control are good throughout the normal envelope of operation. The thin, 43-degree sweptback wing and 52-degree sweptback tail surfaces provide excellent high-speed flight characteristics. The droop leading edges decrease drag, provide improved maneuverability at cruising speed, and lower stall speeds.

HIGH-LIFT DEVICES

Wing trailing edge flaps and leading edge droops with boundary layer control (BLC) on the droops provide high lift for carrier take-off and field and carrier approaches. The high-lift devices provide aircraft capability for catapult at high gross weights and for controllability about all axes.

FLIGHT CONTROLS

Positive control about all three axes is provided by the all-movable vertical and horizontal stabilizers and the spoiler-deflectors. The spoiler-deflector system of lateral control provides effective roll-rate capability at all flight speeds, including the low-altitude, high-speed region where conventional aileron effectiveness is low. All control surfaces are hydraulically powered and the stick pedal linkage is provided with artificial feel. The directional control system includes dual yaw augmentation, which provides effective directional stability for all flight conditions. The longitudinal control system with pitch augmentation provides pitch damping, "g" trim, relatively constant stick force and displacement per "g" above 0.55 Mach, and a positive, nonlinear mode of control with position trim for take-off and landing. Refer to LONGITUDINAL CONTROL, in this section.

MACH EFFECT

For ease of reference, many speeds in this section are given in terms of Mach number instead of indicated airspeed. An aircraft handling characteristic or aircraft tendency will occur at the same Mach number regardless of altitude. The intensity of a characteristic will, however, vary in proportion to indicated airspeed. The lower the altitude, the higher the indicated airspeed will be for a given Mach number. Increasing indicated airspeed is an indication of increasing dynamic pressure forces on the aircraft. Consequently, it will be noticed that although a specific handling quality will occur at the same Mach number at all altitudes, the effect on aircraft control may be more pronounced at low altitudes.

LONGITUDINAL CONTROL

The longitudinal system is augmented to provide ease of control throughout the entire speed and altitude range of operation. Below 0.25 Mach, the system provides positive horizontal stabilizer position response to control stick movements for take-off and landing. As airspeed is increased above 0.25 Mach, a transition begins which changes the system from a "position" system to a "rate" system at 0.55 Mach. Pitch damping is operative at all speeds above 0.3 Mach. Above 0.55 Mach, control stick deflection commands a "g" force rather than a set stabilizer position. During normal operation with pitch augmentation, a stick movement of 3/4 inch commands 1 "g" of additional acceleration. These control force and deflection characteristics are constant above 0.55 Mach over the entire operating range of speed and altitude. By moving the control stick and then holding it fixed, the pilot generates a "g" command signal proportional to stick movement. The pitch augmentation system holds aircraft acceleration at the "g" commanded by comparing the command signal with detected acceleration signal.

UNAUGMENTED CONTROL

With pitch augmentation disengaged or inoperative, variations in airspeed and altitude result in changing requirements for control stick movement and force, and the aircraft handles in a manner similar to that of slower, transonic aircraft not having augmented flight controls. At low altitudes, loss of pitch damping requires cautious handling and trimming in the transonic speed range to prevent pilot-induced oscillations. Available horizontal stabilizer aircraft nose-up displacement is reduced approximately 5 degrees and pitch corrections at low speeds require larger stick movements than when operating with pitch augmentation engaged. Refer to LOW-SPEED FLIGHT, in this section.

AUGMENTED CONTROL

With pitch augmentation operating, stick displacement required remains approximately constant above 0.55 Mach. For better control and safety, pitch augmentation should be disengaged during air refueling operations. During rolling maneuvers at speeds less than 250 KIAS, forward stick pressure is required to hold pitch attitude as inverted flight is approached. This is due to the 1-g reference used by pitch augmentation. If a correction is not anticipated, altitude will be lost during low-speed rolls.

CAUTION

> Pitch augmentation dropout during high-g maneuvers may cause the aircraft to pitch up or "dig in," requiring a change in stick force at a moderate rate. If dropout occurs during transonic turns or pull-ups, the resultant change in "g" (±1.5 "g's" without pilot correction) could exceed structural limits. Upon illumination of the PITCH AUG and master caution indicators, be alert to trim out the forces which may be produced.

LATERAL CONTROL

Lateral control is provided by a combination of conventional and inverted spoiler-deflectors. With this system, adequate roll control is provided for all configurations (power approach, cruise, and supersonic).

MECHANICAL LATERAL STOPS

A mechanical stop mechanism controlled by the flap control system provides 70 degrees spoiler-deflector throw for full stick displacement with the flap control switch at CRUISE, 30°, 40°, and 50°. It also provides 40 degrees inboard/48 degrees outboard spoiler-deflectors throw at SUPERSONIC. This reduction in spoiler deflection prevents excessive roll rates and provides a more favorable balance of yaw during rolls at high speeds. The ratio change is initiated mechanically through movement of the droops. Moving the flap control switch from CRUISE to SUPERSONIC limits the deflection to 40—48 degrees.

LATERAL/DIRECTIONAL INTERCONNECT

With flaps extended, a mechanical lateral/directional interconnect is employed to reduce adverse sideslip during large control deflection rolls. The interconnect provides 4 degrees of coordinating vertical stabilizer deflection for 70 degrees of spoiler deflection. The interconnect system is designed to allow ±16 degrees of spoiler deflection before actuating the vertical stabilizer, to minimize cross control required during crosswind take-offs and landings.

LATERAL CONTROL EFFECTIVENESS

At low airspeeds, the aerodynamic effectiveness of the spoilers is considerably greater with flaps extended than with flaps retracted. To ensure adequate lateral control for asymmetrical store loadings or possible engine failure, flaps should not be retracted to less than 30 degrees at angle-of-attack indications greater than 9 units or airspeeds below 220 KIAS. At approach airspeeds, large lateral stick deflections may produce cyclic roll response due to adverse yaw at high angles of attack. In order to minimize this effect, large stick deflections must be accompanied by application of coordinating rudder.

SPOILER SPEED BRAKES

The spoiler-deflector system is used as a speed brake by extending all surfaces simultaneously. Speed brake extension at subsonic speeds is accompanied by an easily controlled nose-down pitch and moderate airframe buffet.

Extension at supersonic speeds is characterized by high deceleration forces, and speed brakes should be extended in increments.

Note

- With pitch augmentation inoperative, care should be taken when decelerating through 1.0 Mach at low altitudes. Pitch trim may reverse and pilot-induced oscillation tendency may be encountered.
- Speed brake extension at low altitudes and high speeds with pitch augmentation off is accompanied by a definite pitch-down reaction.

DIRECTIONAL CONTROL

The all-movable, hydraulically powered vertical stabilizer provides excellent directional control throughout the aircraft operational envelope.

DIRECTIONAL RATIO CHANGER

The change in vertical stabilizer deflection ratio flaps up to flaps down is accomplished through a ratio-changing mechanism, operated by mechanical linkage attached to the flap actuating linkage. The directional shift begins at 6 degrees, and the shift is complete when the flaps reach 23 degrees. The vertical stabilizer ratio mechanism reduces pedal travel with flaps down.

WARNING

To avoid any danger of overloading the vertical stabilizer, abrupt control pedal movements should be avoided at airspeeds above 450 KIAS or 1.2 IMN, whichever is less.

YAW AUGMENTATION

At high altitudes, the aircraft may be flown with one or both yaw augmentation systems inoperative as long as lateral or directional control inputs are limited. Refer to SUPERSONIC FLIGHT, in this section, and to Section I, Part 4. With one system inoperative, no difference in yaw damping characteristics should be noted.

TRIM

PITCH TRIM

NORMAL

The normal pitch trim control is through the PITCH trim wheel on the control stick. It may be used with pitch augmentation either engaged or disengaged. In either case, stick position will follow trim changes. With pitch augmentation engaged, the pitch trim functions as a position trim control below 0.3 Mach and as a "g" trim control above 0.55 Mach. Pitch augmentation will engage if the TRIM select switch is in the NORM position. It will engage in the alternate position only if the trim is centered. With augmentation disengaged, the pitch trim wheel functions as a position trim control.

ALTERNATE

Pitch trim with the normal system inoperative is provided by the alternate pitch trim pulse switch on the control stick. The alternate trim system functions in the same manner as the normal trim system by repositioning the no-load position of the artificial feel bungee.

EMERGENCY

Should both the normal and alternate pitch trim circuits fail, the emergency pitch trim system must be used. The emergency pitch trim crank mechanically operates the normal pitch trim actuator, repositioning the stick through the artificial feel bungee.

LATERAL TRIM

Lateral trim is provided by differential deflection of the horizontal stabilizers. Full lateral trim displaces each surface of the stabilizer 3 degrees in opposite directions. Due to a washout feature, no lateral trim is available with the stick more than 3 degrees ND. Because of a trim interaction characteristic of this system, a large lateral trim change may require some directional trim change.

DIRECTIONAL TRIM

The directional (YAW TRIM) trim switch is located on the pilot's left-hand console. Directional trim is provided by adjusting the no-load position of the directional system artificial feel bungee. This action repositions the control pedals and linkage, moving the vertical stabilizer actuator to a new trim position. Through the directional control ratio changing mechanism, a maximum 7.5 degrees of directional trim is provided with the flaps extended, and 1.5 degrees with the flaps retracted. Because of trim interaction, a change in directional trim usually requires a change in lateral trim.

DIRECTIONAL TRIM CENTERING

To prevent a large magnification of any trim setting upon flap extension, the vertical stabilizer trim actuator is returned toward neutral as the flaps extend to 25 degrees. During flap extension, the trim indicator follows the trim actuator toward zero. Directional retrimming may be required following flap extension.

Note

During flap retraction, the yaw trim indicator will move if a trim input has been made. Trim will be reduced to approximately one-quarter of the original input. When the stabilizer shift occurs, the indicator will move, since the indicator reflects the actual surface position.

SUBSONIC FLIGHT

Subsonically, the aircraft is highly maneuverable. The augmentation systems provide good damping and control characteristics. Operation with the electric flight control system engaged results in reduced control stick forces and improved lateral and longitudinal control. Low-altitude operation in the transonic speed range, with pitch augmentation inoperative, results in increased pitch sensitivity. High-altitude subsonic maneuvering flight may produce buffet which limits maneuvering capability.

SUPERSONIC FLIGHT

The aircraft has good supersonic stability and control characteristics about all axes with the pitch and yaw augmentation systems operating. At Mach numbers above 1.7, or speeds in excess of 650 KIAS, directional stability is weakened, and maneuvering above this speed is limited. Refer to Section I, Part 4. High-speed buffet may be encountered just under limit airspeed at some altitudes.

MANEUVERING FLIGHT

The aircraft is easily handled in maneuvering flight and good low-speed maneuverability is available. When fully operative under normal conditions, the pitch augmentation and yaw damper systems produce desirable flight characteristics in all phases of flight.

ROLL/YAW COUPLING

RA-5C roll/yaw coupling tendencies are most pronounced at Mach numbers above 1.7, especially with the yaw augmentation system off. Limitations have been set to maintain safe flight subsequent to a failure of one of the dual systems. Roll/yaw coupling is characterized by an uncontrolled rolling maneuver. It is caused by favorable sideslip producing large rolling moments due to the aircraft strong positive dihedral effect. If the sideslip is allowed to progress too far, these rolling moments could exceed the counteracting capability of the lateral control system. Roll rate and sideslip angle would increase very rapidly to an uncontrolled (divergent) situation. This roll/yaw coupling tendency can be avoided by maintaining balanced flight (ball centered) during flight at high Mach number. This is accomplished automatically by the yaw augmentation system and half of the system provides adequate lateral-directional stability for the maneuvers permitted.

At low supersonic Mach numbers and high indicated airspeeds (low altitudes), the aircraft experiences an adverse yaw characteristic with lateral control deflection. Roll rate is reduced and high loads are imparted to the vertical tail. This characteristic becomes more apparent with increasing positive "g." It can be alleviated by keeping the ball centered during rolling maneuvers. The yaw augmentation system does this automatically.

PILOT-INDUCED OSCILLATIONS

Pilot-induced oscillations are rapid up and down pitching motions caused by inadvertent overcontrol. Caution should be exercised in the transonic speed region at low altitudes with pitch augmentation inoperative, as the aircraft is responsive and sensitive to control movement. The pitch augmentation system will reduce any pronounced pitch oscillations. The best method for correcting a pilot-induced oscillatory condition is to relax pressure on the control stick, allowing the aircraft to fly itself out of the condition.

CAUTION

DO NOT attempt to stop pilot-induced oscillation by pushing and pulling fore and aft on the control stick in opposition to aircraft motion. Pilot reaction time, coupled with pilot body motions, make it almost impossible to apply corrective action in relation to oscillation phases.

Should pitch augmentation monitor off at airspeeds greater than 360 KEAS when carrying four external tanks, longitudinal stick forces become very sensitive. Throttle retardation should be made and a slight climb established to clear the critical area above 360 KEAS.

CAUTION

Speed brake extension should not be made at speeds greater than 360 KEAS with pitch augmentation off due to the excessive nose-down pitch accompanying speed brake extension. Similar though not as aggravated characteristics may also occur on aircraft with no stores.

ALTITUDE LOSS IN DIVE RECOVERY

Altitude loss in dive recovery is dependent upon angle of dive, altitude and airspeed at start of pull-out, speed brake position, load factor, and power setting maintained during pull-out. These factors must be considered collectively in estimating the altitude required for recovery from any dive. Buffet may be encountered in pull-outs at Mach numbers less than 1.0. High-speed, high-angle dives should never be attempted below 25,000 feet until the pilot is completely familiar with the aircraft. See figure 4-6.

ANGLE-OF-ATTACK RELATIONSHIP

Angle-of-attack data are presented in Section XI, Part 9.

LOW-SPEED FLIGHT

TAKE-OFF

Take-off characteristics are noticeably affected by the high-lift wing with leading edge BLC and semi-full-span flaps. Pitch trim for take-off is 5 to 6 units aircraft nose-up for normal loadings and 8 units for heavy weights. Ground effect during field take-off significantly increases the stabilizer deflection required for nose wheel lift-off. Nearly full nose-up stabilizer deflection is required to rotate the aircraft to take-off attitude at minimum take-off speed. Following aircraft lift-off, the required stabilizer deflection decreases rapidly as speed increases. After take-off, the landing gear should be retracted as soon as practicable. However, in order to provide adequate directional control for all emergencies, the flaps should not be retracted until angle of attack is 9 units or less. For heavy external loads, the flaps should be retracted in increments at speeds corresponding to 9 units angle of attack or less.

TAKE-OFF WITH FORWARD CG

Field takeoffs are not recommended with CG forward of 25.4 percent MAC. Take-offs can be accomplished with the center of gravity ahead of the nose wheel lift-off limit of 25 percent of the mean aerodynamic chord. It should be noted, however, that nose wheel lift-off speed will increase 4 knots for each one percent of forward movement ahead of this center-of-gravity limit, and take-off distance increases approximately 250 feet for each one percent of center-of-gravity travel. Pitch trim should be increased 1 unit aircraft nose-up for each percent of cg forward movement. Full aft stick will be required to initiate aircraft rotation at nose wheel lift-off speed; however, aircraft nose-up stabilizer travel required following lift-off will decrease rapidly. For catapult end airspeed requirements at forward cg conditions, refer to Section I, Part 4.

APPROACH TO STALL (CLEAN)

Low-speed flight characteristics are similar to those of other high-performance aircraft. With the droops in the SUPERSONIC (retracted) position at 45,000 to 48,000 pounds gross weight, light buffet commences at 200 to 220 KIAS, depending on altitude. With the droops in the CRUISE position (5 degrees), buffet commences at 170 to 190 KIAS (15 units angle of attack). As speed is decreased, buffet intensity increases, becoming moderate

at about 160 KIAS (17 units angle of attack). After moderate buffet is noticed, lateral control deterioration begins and, as speed is further decreased, full lateral stick deflections are required to maintain wings level. Lateral control is lost at 21 units angle of attack as buffet comes heavy.

WARNING

Avoid abrupt, large magnitude, longitudinal control motions in maneuvering flight. If the stall warnings of lateral control deterioration, moderate-to-heavy aircraft buffet, and rudder pedal shaker actuation are ignored, or if extreme control motions cause the aircraft to depart abruptly from controlled flight, the aircraft may enter a developed spin from which recovery is highly unlikely.

CAUTION

The aircraft should not be flown at speeds lower than those corresponding to 21 units angle of attack unless ample altitude is available for recovery from an unusual attitude.

Note

Minimum control speed, defined as the speed where both lateral and directional control requirements to maintain level flight become excessive, is presented under MINIMUM CONTROL SPEEDS, in this section. Spoiler effectiveness deteriorates at airspeeds *higher* than those shown, but proper use of directional control will pick up a wing after lateral effectiveness is lost.

At approximately 17 units angle of attack, lateral control deteriorates and the pedal shaker operates at approximately 19 units as an artificial stall warning. As speed is further decreased, buffet becomes heavy in intensity, increasing difficulty is encountered in longitudinal and directional control, and rate of sink starts to build up. The aircraft is considered stalled at 21 units angle of attack, even though it is possible to maintain controlled wings level flight in a high sink condition to 28 units angle of attack. Complete loss of control occurs at approximately 28 units angle of attack, or approximately 115 KIAS at 52,000 pounds gross weight. Recovery can be effected satisfactorily at any point (up to 28 units of angle of attack) by brisk positive application of full forward stick. Similar characteristics are experienced and commensurate warnings are provided in accelerated stall approaches. During maneuvering flight while decelerating from supersonic to subsonic Mach numbers (particularly in the speed range around 0.92 IMN), a very slight tendency for the aircraft to "pitch up" may be noted. This tendency is easily controlled but caution should be exercised. With pitch augmentation off, or in the event of a pitch augmentation failure, a push force will be required to keep from increasing "g" when decelerating through this speed range. Because of the design characteristics of the pitch augmentation system, full leading edge down horizontal stabilizer is reached somewhat before the stick is full aft with pitch augmentation engaged. Thus, stick position is not always a good indication of stabilizer position. With pitch augmentation disengaged, full aft stick is required to obtain full leading edge down horizontal stabilizer.

APPROACH TO STALL (FLAPS AND GEAR EXTENDED)

At 18 units angle of attack, natural stall buffet begins. The pedal shaker operates at 19 units angle of attack. Lateral and directional control remains effective throughout the stall approach to the minimum speed attainable at 28 units angle of attack. The aircraft is considered stalled at 28 units angle of attack. Recovery from the stall approach can be easily executed by reducing back pressure on the stick and allowing the nose to lower to approach attitude. The characteristics of landing stalls (power off) are similar, with a noticeable loss in lateral control at angles of attack above 17 units. Roll attitude is controllable, however, above 17 units, with directional control input.

Note

- With less than 4000, or with 13,000 to 19,000 pounds fuel remaining, the forward cg limits longitudinal control availability to approximately 22 units angle of attack during slow approaches to stall. Full 28-unit stalls can be obtained in dynamic maneuvers.
- At Military Thrust in the take-off configuration (30-degree flaps/25-degree droops), initial tip stall occurs at approximately 21 units.
- In some cases, when the aircraft is flown at angles of attack exceeding 10 units during transfer of wing fuel, an asymmetrical condition can result. This condition is caused by unequal distribution of fuel in the wings. Under such conditions, one wing may drop during a stall approach. However, recovery may be effected as noted.

POWER APPROACH AND LANDING

Low-speed flight with the landing gear and flaps extended results in good aircraft control. The aircraft control in this configuration remains "solid" down to the minimum speed. Flap buffet is light to moderate above 140 KIAS, but this buffet becomes generally unnoticeable below 140 KIAS.

Normal approach speed and attitude correspond to 15 units angle of attack. Controllability is adequate, however, to allow approach speeds corresponding to 16 units angle of attack. With flaps extended, lateral/directional ("Dutch Roll") damping is provided by the yaw augmentation systems through a tilted, rate-measuring gyro which senses both yaw rate and roll rate. In addition, a lateral/directional interconnect between the lateral control system and the vertical stabilizer reduces adverse yaw during roll maneuvers.

WARNING

Above 50,000 pounds APC approach stability gradually deteriorates in gusty or turbulent air until at 58,000 pounds and above aircraft response to APC inputs is extremely sluggish.

CAUTION

If a minimum-rate-of-descent landing is executed, do not rotate to more than 20 units angle of attack. Touchdown at more than 20 units may cause the fuel dump tube or aft fuselage to strike the runway.

WAVE-OFF TECHNIQUE

At normal landing gross weights and ambient temperatures, Military Thrust is sufficient to execute a wave-off. At gross weights up to maximum landing weight, or at high ambient temperatures, afterburner thrust is definitely required. At all gross weights, positive pitch rotation is required in addition to power increase in order to stop rate of sink and to establish a rate of climb. During carrier approaches, lateral control corrections made to offset "island burble" may prove detrimental due to increased drag (spoiler effect). Immediate selection of power in the afterburner range may also prove detrimental in that a pause occurs between throttle advance and aircraft response to thrust increase, due to rpm rollback. At maximum landing weights, the need for early decision and action in taking a wave-off cannot be overemphasized. Refer to section 3 for wave-off procedures.

BOUNDARY LAYER CONTROL (BLC)

BLC effectiveness varies with engine rpm. During final approach, retarding the throttle below approach power results in a decrease in BLC flow. The aircraft will be slightly less stable with the reduced BLC and a slight nose-up pitch tendency will be experienced. The pitch-up tendency is easily controlled. During all approaches, it is recommended that normal approach power (82% to 88% rpm) be maintained until touchdown, at which time the throttles may be retarded to IDLE.

BLC VALVE FAILURES

Should failure of a BLC valve occur on droop extension for take-off (DROOPS caution indicator remains on), catapult launch should *not* be attempted. The 30-degree flaps/25-degree droops field take-off position is not guarded by the DROOPS caution indicator. Field take-off characteristics with 25-degree droops/30-degree flaps will be essentially unchanged if a BLC valve has failed closed. In the event of a valve-closed failure prior to landing, stall buffet is noted at higher than normal speed, accompanied by a tendency to roll uncontrollably toward the failed valve at speeds well above those presented under MINIMUM CONTROL SPEEDS. If characteristics near approach speed are poor, utilize the emergency single-engine approach configuration (30-degree flaps).

MINIMUM CONTROL SPEEDS

Figure 4-1 presents minimum control speeds in KIAS (SPC OFF)* for various configurations, gross weights, and power settings.

STALLS

WARNING

Intentional stalls are prohibited due to the possibility that a spin may develop from which recovery is highly unlikely. Practice approaches to stall in the 50/50 configurations may be beneficial and are permitted above 5000 feet AGL, below 52,000 pounds gross weight.

*Aircraft not having AFC 159 complied with

MINIMUM CONTROL SPEEDS

(TWO ENGINE OPERATION)
COMPENSATED PITOT STATIC TUBE

NOTE: DECREASE SPEEDS SHOWN BY 4 KNOTS FOR AIRCRAFT NOT HAVING AFC 159 INCORPORATED.

TAKE-OFF

(FLAPS 30 DEGREES/DROOPS 25 DEGREES — GEAR DOWN — POWER ON)

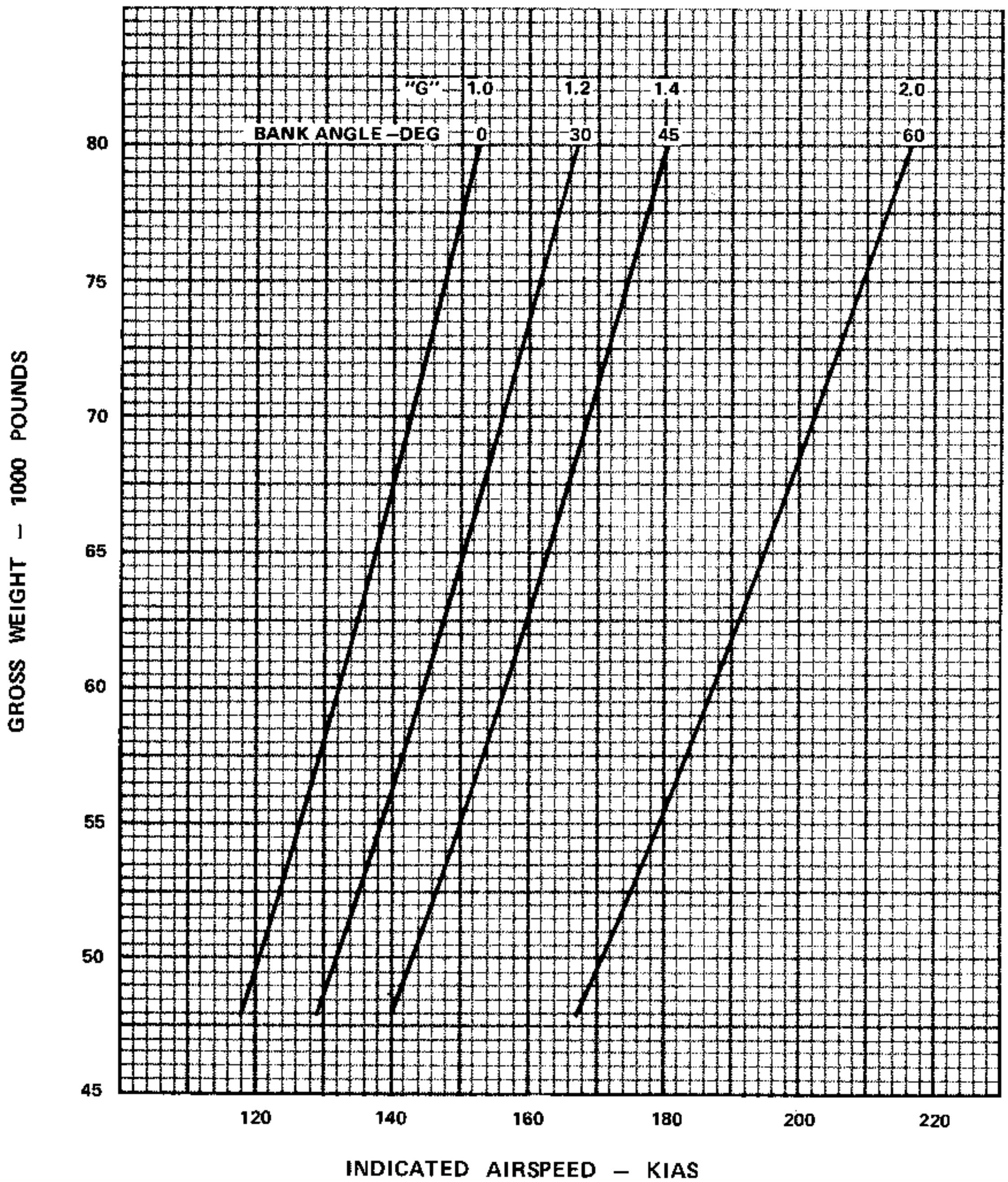

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Figure 4-1 (Sheet 1)

MINIMUM CONTROL SPEEDS

(TWO ENGINE OPERATION)
COMPENSATED PITOT STATIC TUBE

NOTE: DECREASE SPEEDS SHOWN BY 4 KNOTS FOR AIRCRAFT NOT HAVING AFC 159 INCORPORATED

CRUISE

(DROOPS 5 DEGREES – GEAR UP – POWER ON)

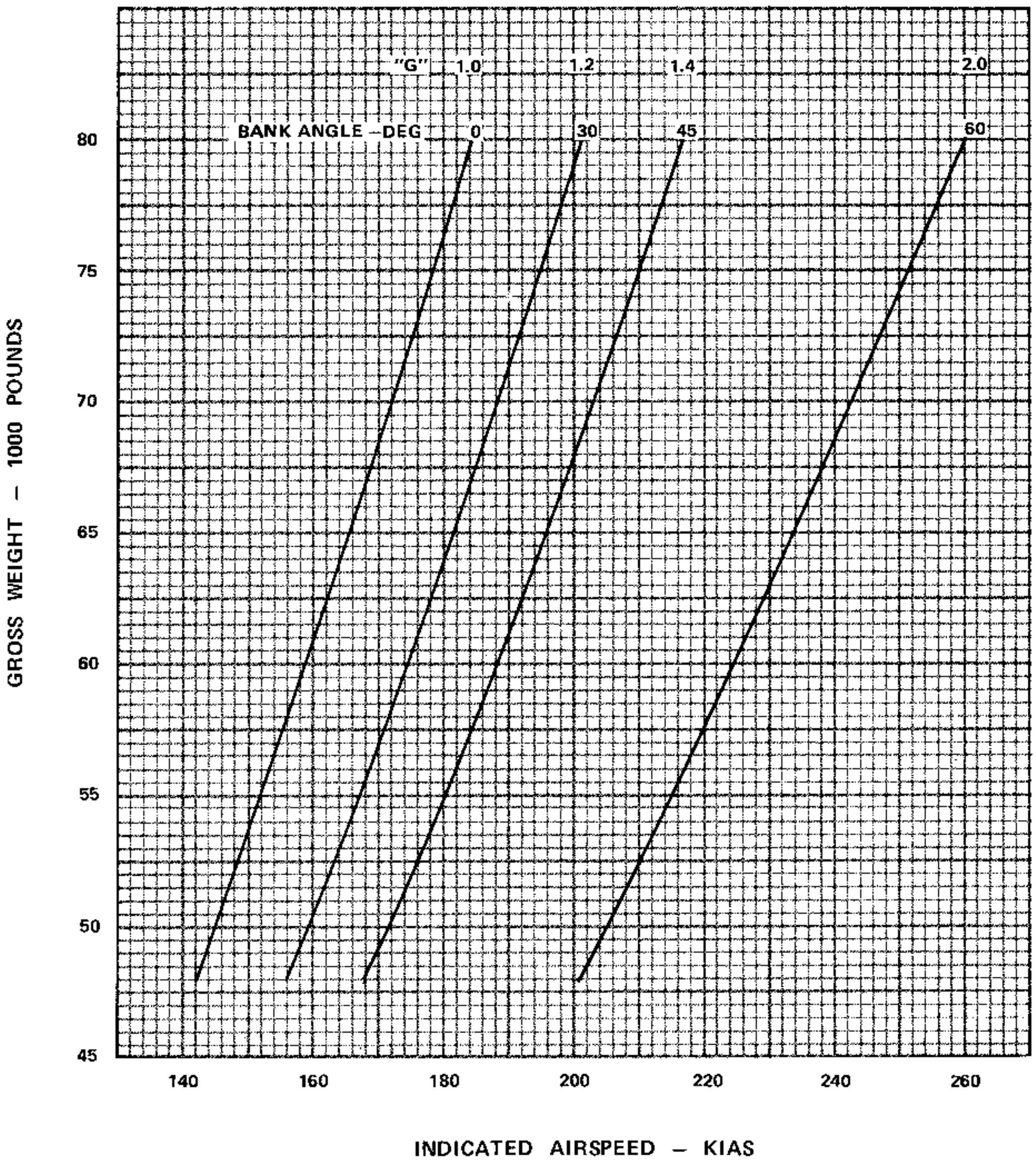

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Figure 4-1 (Sheet 2)

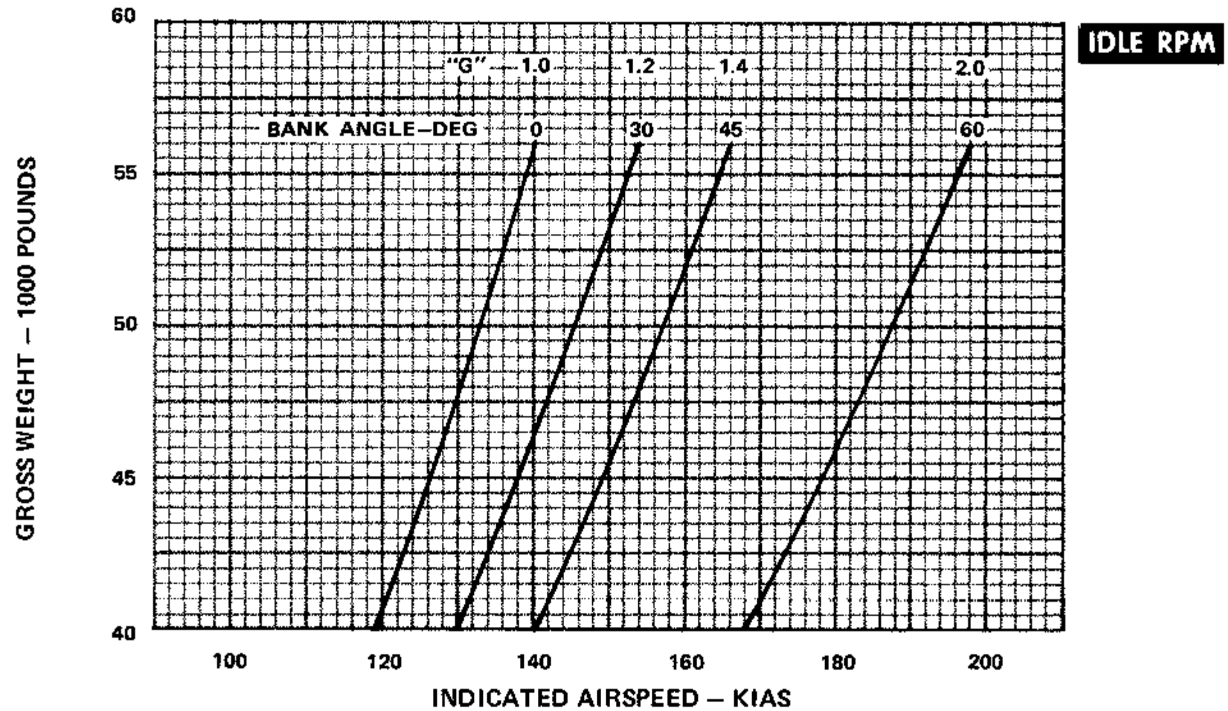
MINIMUM CONTROL SPEEDS

(TWO ENGINE OPERATION)
COMPENSATED PITOT STATIC TUBE

LANDING

NOTE: DECREASE SPEEDS SHOWN BY 4 KNOTS FOR AIRCRAFT NOT HAVING AFC 159 INCORPORATED

(FLAPS 40 OR 50 DEGREES – GEAR DOWN – IDLE RPM)



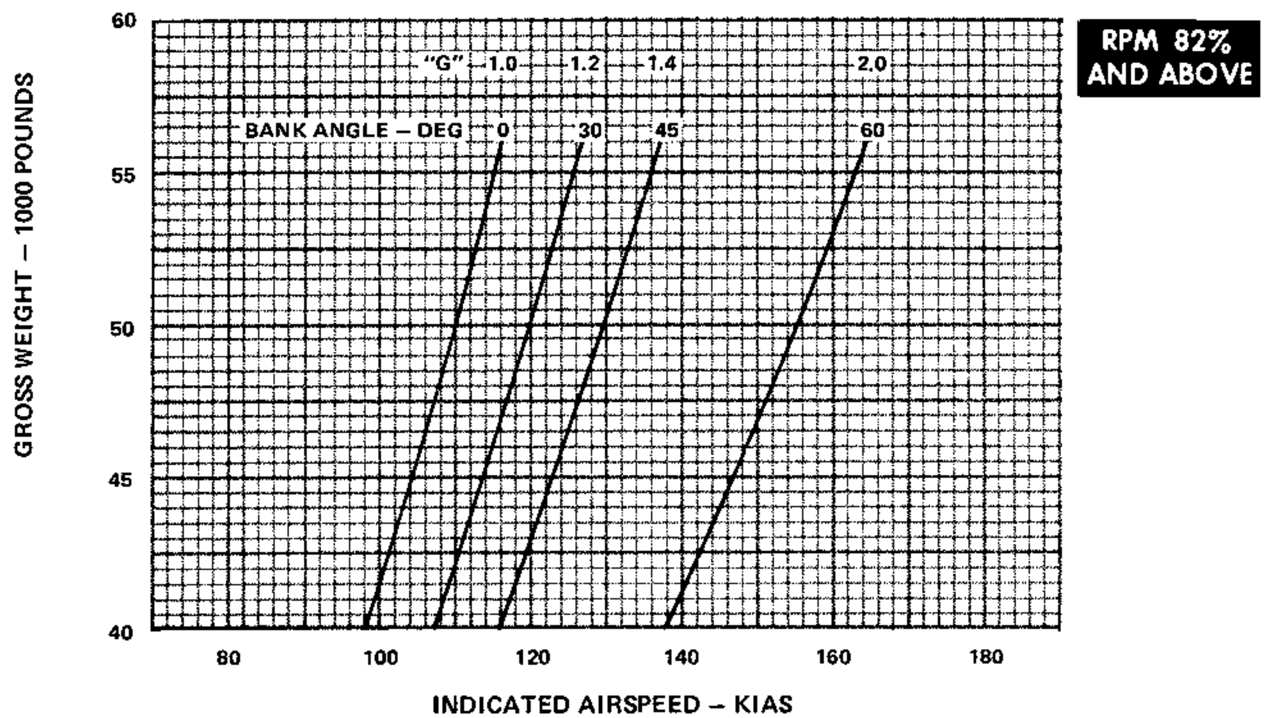


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Figure 4-1 (Sheet 3)

TAKE-OFF

The 1-g stall approach with no external stores and the flap control switch at 30° (field take-off configuration, 30-degree flap/25-degree droops) with Military Thrust is characterized by buffet onset at 18 units angle of attack, a slight rolling tendency between 19.5 and 20.5 units, and initial (tip) stall at approximately 21 units. An increase in attitude above initial stall results in a light pitch-up at 23 to 24 units and lateral control ineffectiveness above 25 units. Deep aerodynamic stall occurs at 27 to 27.5 units angle of attack, generally characterized by sideslip and roll excursions. Large departures from controlled flight can result from deep stall penetrations. The addition of external wing stores and/or pylons may decrease the severity of the sideslip and roll excursions at stall.

Inadequate longitudinal control effectiveness in the catapult take-off configuration (50-degree flap/50-degree droops) with maximum afterburner prevents the aircraft from attaining a true aerodynamic stall in steady 1-g flight. Minimum flying speed with full aft stick occurs at 29 to 30 units at aft cg positions. This maximum attainable angle of attack decreases as the cg moves forward and only 20 to 22 units may be attained near the forward cg limit.

CRUISE

1-G STALL

At 21 units angle of attack in a 1-g stall approach (droops at CRUISE or SUPERSONIC) the aircraft loses directional stability rather abruptly, and will generally yaw left or right, depending on asymmetry or trim. Lateral control is relatively ineffective for holding wings level prior to reaching minimum speed.

ACCELERATED STALLS

In accelerated stalls, the aircraft will generally slow down to a speed where less than 2 "g's" result with the stick full aft before it yaws. If the stick is moved to a "neutral" position when the yaw begins, the aircraft will probably recover in one-fourth to one-half turn.

Note

- "Neutral" stick is defined as that position resulting in approximately zero horizontal stabilizer angle.
- The more quickly the stick is allowed to return to approximately trim neutral position, the better are the chances of a quick recovery.

POWER APPROACH

AIRCRAFT 145157 THROUGH 151728 NOT HAVING AFC 328 COMPLIED WITH

The stall approach and 1-g stall characteristics with landing gear down, flaps DOWN, and approach power are relatively mild. Natural stall buffet commences between 17 to 18 units angle of attack and the pedal shaker operates at 19 units. Lateral and directional control remain good down to stall. The stall is defined as either an aerodynamic wing stall (sudden wing drop) or a minimum speed attainable with full aft stick. Aerodynamic wing stall will occur only with relatively aft cg positions. Angle of attack will be 28 to 29 units. At more forward cg positions, full aft stick will not be sufficient to rotate the aircraft to this angle of attack in 1-g flight and the stall becomes a minimum flying speed. The maximum attainable angle of attack decreases as cg moves forward, and only 20 to 22 units may be attained near the forward cg limit.

AIRCRAFT 156608 AND SUBSEQUENT AND AIRCRAFT 145157 THROUGH 151728 HAVING AFC 328 COMPLIED WITH

Buffet onset occurs at 16 to 16½ units angle of attack followed by a slight rolling tendency between 19.5 and 20.5 units. A mild pitch-up occurs at 23.5 units at the forward cg positions. As the cg moves aft to 34 percent MAC, pitch-up becomes imperceptable. Stall, defined by a mild wing drop, occurs at 27 units angle of attack. At forward cg positions, full aft stick will not be sufficient to rotate the aircraft to stall angle of attack in 1-g flight.

WAVE-OFF

Stalls with Military Thrust (wave-off) are similar to the stalls described under POWER APPROACH. The characteristics of landing stalls (idle power) are also similar except lateral control power decays above 17 units angle of attack and lateral control is completely ineffective above 25 units angle of attack.

POSTSTALL GYRATIONS

The characteristics of the pitch augmentation system, which provides light stick forces and high maneuverability, tend to mask the fact that the aircraft is relatively large and heavy. During the stall and poststall phases of flight, the aircraft behaves as a heavy aircraft would be expected to behave. It is reluctant to enter the poststall condition, but once it has entered, it is somewhat reluctant to recover rapidly. The poststall gyration is not physically uncomfortable to the pilot, but the lack of immediate response to recovery controls is disconcerting. Depending on gross weight, individual aircraft asymmetry, and other variables, the aircraft will continue to yaw in an uneven manner in the initial direction or may possibly reverse direction.

Note

It is important to remember that there is nothing that can be done to speed up the recovery and the pilot should continue to hold neutral stick until the aircraft begins flying.

Aircraft pitch attitude varies from nose-down past vertical to above the horizon, and yaw rate decreases at the minimum and maximum pitch attitudes. Indicated airspeed oscillates from 0 to about 100 KIAS. IAS increase above 100 knots is an indication that recovery is occurring. As airspeed reaches approximately 150 to 160 KIAS, the aircraft may be flown normally.

INVERTED ATTITUDE

Inverted stall characteristics are straightforward. Directional stability is quite high during inverted flight and any rotation which develops can be stopped immediately with opposing directional control. The aircraft may be flown out of the inverted stall condition by applying opposite directional control pedal to stop any rotation and pulling back on the stick to increase "g."

VERTICAL ATTITUDE

Vertical entries usually result in upright poststall gyrations similar to those previously described. The more nearly vertical the attitude, the more abruptly the aircraft "swaps ends." If the nose falls backward from a near vertical entry, the aircraft will continue to rotate approximately 270 degrees in pitch to an upright attitude and enter an upright poststall gyration from that point. If the nose falls forward from a near vertical attitude, the aircraft will again rotate approximately 270 degrees to an inverted attitude, hesitate, rotate in the opposite direction until it assumes approximately an upright attitude, from which it will enter a poststall gyration.

WARNING

By establishing an upright pitch attitude of approximately 60 degrees and leaving hands off the controls, it is possible to enter a developed spin from which *recovery is highly unlikely.*

A stall entry in the 60-degree attitude allows the aircraft to arc over-the-top in such a way that the angle of attack does not exceed approximately 45 degrees. The aircraft then begins a yaw rotation in one direction or the other as it descends vertically. With an attitude steeper than 60 degrees, the angle of attack reaches values well above 90 degrees as the aircraft "backs down." When it abruptly "swaps ends," a dynamic pitching moment is provided, allowing the aircraft to recover "hands off." At upright pitch attitudes below 60 degrees, angle of attack is lower and the aircraft will fly out in a normal manner.

RECOVERY FROM POSTSTALL GYRATIONS

As previously noted, neutralizing all controls provides recovery from most poststall gyrations. However, in order to improve the possibility of recovery from certain vertical entries and still maintain a standardized technique, a single procedure is required. When it is recognized that the aircraft is no longer responding normally to longitudinal control inputs:

1. Stick—FULL AFT.
2. When the nose drops below the horizon with the aircraft in an upright attitude, depress the flight control "kill" button (on the stick grip) to disengage pitch augmentation.
3. Immediately allow the stick to center longitudinally and LEAVE IT THERE.
4. Throttles—IDLE (to prevent excessive altitude loss in recovery).

For 1 "g" and accelerated entries, the horizontal stabilizer has to be full leading edge down before an out-of-control condition can be attained, so it is merely necessary to hold full aft stick until the nose drops below the horizon. For vertical entries, holding aft stick decreases the possibility of entering a developed spin from certain attitudes. If the aircraft pitches nose-backward from a near vertical entry, the stick should be held aft until the aircraft is upright and the nose is below the horizon and dropping.

GENERAL

During some of the recoveries in the A-5A spin test program, the pitch augmentation system produced undesirable inputs just as the aircraft commenced flying in the recovery. These pitch inputs are caused by system characteristics in response to pitch rate or "g" at the initiation of recovery. At times, pitch augmentation would cause a rather abrupt pitch-up, which tended to cause a secondary stall. At other times, pitch augmentation would cause a fairly violent pitch-down, which was uncomfortable and disconcerting. Due to these inputs, and to definitely establish neutral longitudinal control, pitch augmentation should be disabled by depressing the flight control disable button (on the stick grip). The stick should be allowed to center longitudinally as noted. The average altitude lost in recovery during the spin test program was approximately 13,000 feet and was never less than 8000 feet.

WARNING

If the aircraft is not under control at 15,000 feet above the terrain, EJECT.

UNUSUAL ATTITUDE RECOVERY

As noted, directional stability is high during inverted stalls. Any rotation in yaw which exists will be low rate and easily stopped with opposite directional control. Application of aft stick will result in a positive load factor and the aircraft will commence flying. In the event the aircraft is at low speed in a nearly vertical attitude, the following technique should be employed:

1. The aircraft should be rotated to the nearest horizon, using longitudinal control.
   (a) If pitch attitude is past vertical as noted on the attitude indicator, the stick should be pulled aft to achieve an inverted attitude.
   (b) If pitch attitude is short of vertical, the stick should be pushed forward to achieve an upright attitude.
   (c) If pitch attitude is so nearly vertical that there is no real choice, forward stick should be applied, as forward stick is much more effective in rotating the aircraft than is aft stick.

Note

With an airspeed of 100 KIAS in a vertical attitude, the aircraft can be rotated to an upright level attitude with forward stick.

2. Once the aircraft stops responding normally to longitudinal control application, the recovery procedures previously covered under RECOVERY FROM POSTSTALL GYRATIONS should be used.

SPINS

WARNING

INTENTIONAL SPINS ARE PROHIBITED. During the A-5A spin test program, a spin mode was encountered from which no satisfactory recovery, using the production design control systems, was possible.

INCIPIENT SPINS

For all entries except vertical entries, more than adequate aerodynamic stall warning is provided. The recovery procedures described are satisfactory for an incipient spin or poststall gyration. From a vertical entry, it is possible to recover from the steep attitude at a relatively low airspeed. Once normal longitudinal control is lost, chances are good that the recovery procedure described will enable the aircraft to recover from the worst vertical entry condition. *It must be remembered, however, that any time the aircraft is fully stalled or flown vertically to a low airspeed, there is a definite possibility that a developed spin will be entered, from which recovery is highly unlikely.*

DEVELOPED SPIN

The developed spin is characterized by higher yaw rate (rotation) and less pitching oscillation than is encountered in an incipient spin or poststall gyration. Pitch attitude is from 40 to 60 degrees nose-down and steady. There are some generally diminished roll and yaw rate oscillations. There may be some transverse (back-to-front) "g" imposed upon the crew members, which is quite uncomfortable.

WARNING

In the event the poststall gyration progresses to a fully developed spin, it is highly unlikely that recovery can be effected.

Should a developed spin be encountered at high altitude, the best control positions are:

1. Stick—FULL AFT.
2. Depress kill button to disengage pitch augmentation.
3. Stick—Laterally FULL IN DIRECTION OF SPIN.
4. Directional control pedals — FULL AGAINST SPIN.
5. Thottles—IDLE (to prevent excessive altitude loss in recovery).
6. Controls neutralized as yaw rate (turn needle) approaches zero.

During the contractor's A-5A spin test program, insufficient altitude was available to determine the number of turns required for the described control combination to effect recovery. Tests determined that this combination will possibly effect recovery from a low yaw rate developed spin if initial altitude is high enough.

WARNING

EJECT IMMEDIATELY on reaching 15,000 feet above the terrain if the aircraft is not under control.

AEROBATIC MANEUVERS

The following are descriptions of typical aerobatic maneuvers.

ROLLS

Minimum entry speed should be 350 KIAS above 5000 feet altitude. Use power required to maintain entry airspeed in level flight. Attain nose position 5 to 10 degrees above level flight attitude on AAI, release back pressure (stick neutral longitudinally), move stick laterally about one-half displacement so that roll rate is approximately 90 degrees per second. Stick neutral laterally so that maneuver is completed after 360-degree roll. Maintain level flight for a brief period prior to commencing another roll to avoid aerodynamic coupling.

LOOP-RECOMMENDED ENTRY ALTITUDE AND AIRSPEED

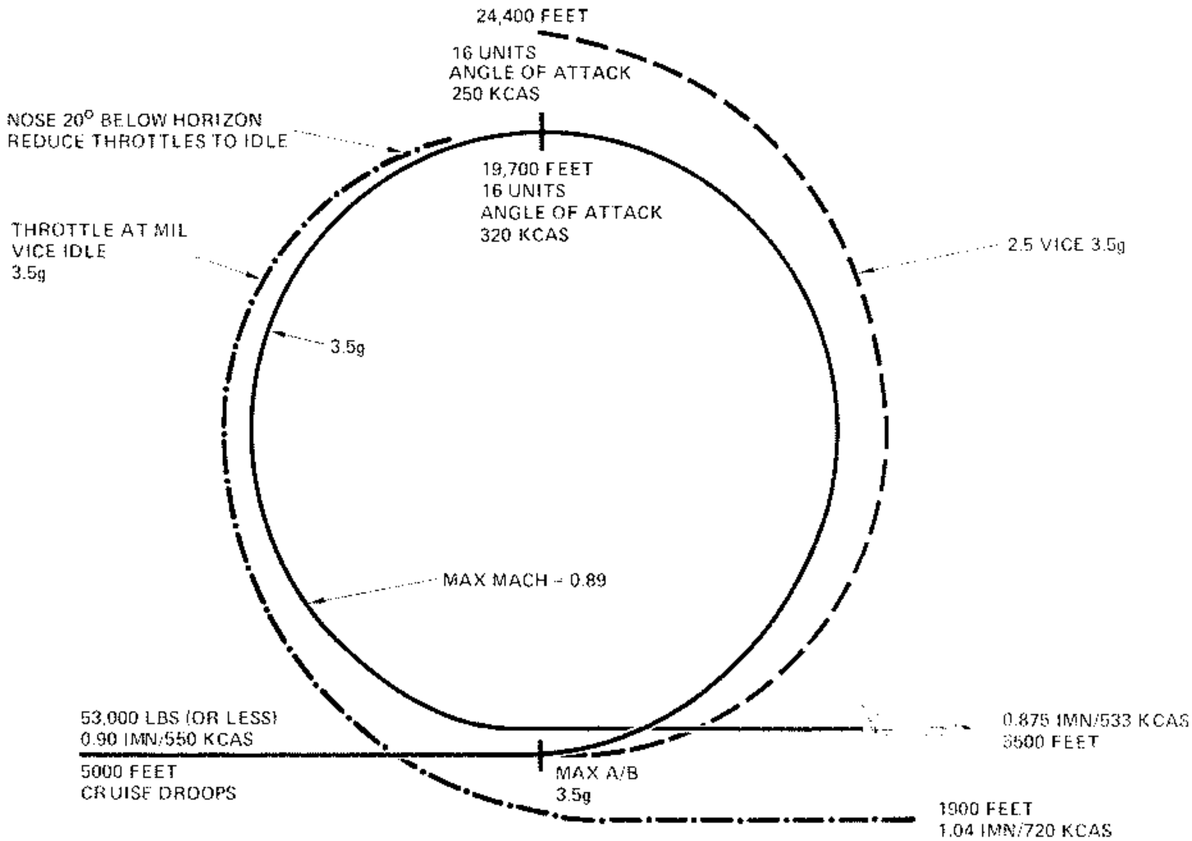


Figure 4-2

WINGOVER

Minimum entry speed should be 400 KIAS at 12,000 to 15,000 feet altitude. Use power required to maintain entry airspeed in level flight. Gross weight should be less than 55,000 pounds. Use 2 "g's" to attain an initial nose position of 15 to 20 degrees above level flight attitude on AAI. Maintain sufficient back stick pressure as the aircraft is rolled so that the nose is about 30 to 35 degrees above the horizon after 45 degrees of turn. After 90 degrees of turn, the angle of bank should be 80 to 90 degrees, and the nose position near the horizon and the airspeed about 250 KIAS. Continue so that the maneuver is completed 180 degrees from entry heading and nose is about 10 to 15 degrees below horizon with the wings level. Recover to level flight at entry altitude and airspeed.

BARREL ROLL

Minimum entry speed should be 450 KIAS at 12,000 to 15,000 feet altitude. Use power required to maintain entry airspeed in level flight. Gross weight should be less than 55,000 pounds. Use 2 "g's" to attain an initial nose position of 20 degrees above level flight attitude on the AAI. Commence a constant rate of roll so that 90 degrees of roll have been completed after 45 degrees of turn. The aircraft should be inverted with the nose near the horizon after 90 degrees of turn and at about 250 knots. Continue the roll so that the nose is approximately 20 degrees below the horizon after 270 degrees of roll. Attain a shallow dive, wings level, and recover to level flight at entry altitude on initial heading.

LOOP

Recommended entry conditions are gross weight, 53,000 pounds or less, 5000 feet MSL (but not less than 5000 AGL), 0.90 IMN and leading edge DROOPS in the CRUISE position. To initiate the maneuver, advance throttles to maximum afterburner and smoothly apply 3.5 "g's." Maintain 3.5 "g's" to buffet onset and then fly in light buffet (approximately 16 units angle of attack) over the top. As the aircraft starts down back side of the loop (nose approximately 20 degrees below the horizon),

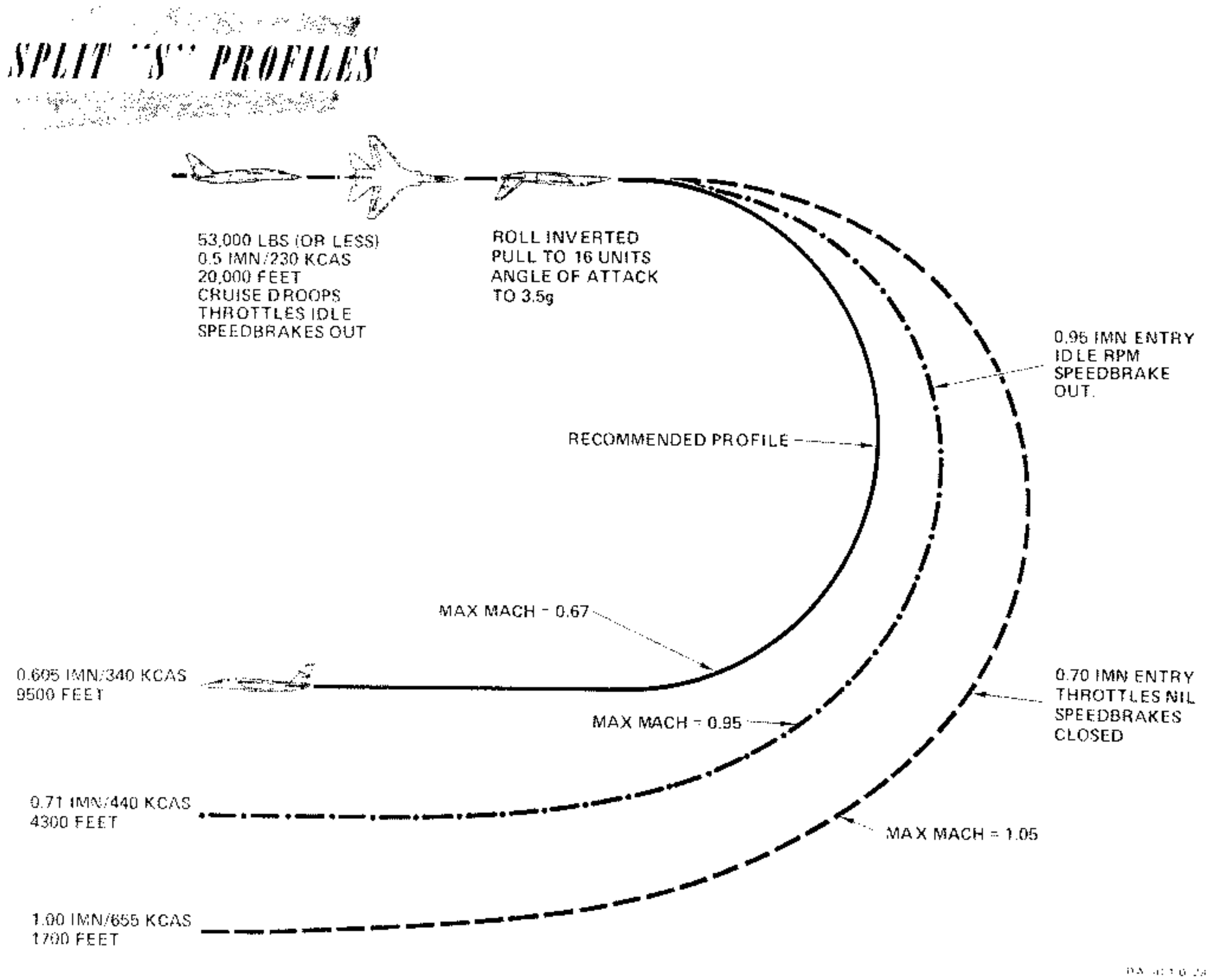


Figure 4-3

retard throttles to IDLE to minimize altitude loss and prevent supersonic speeds. Continue at 16 units angle of attack until 3.5 "g's" is reached and then hold 3.5 "g's" until level flight is achieved. Minimum entry conditions should be 0.85 Mach between 5000 and 10,000 feet MSL with greater than 3.0 "g's" maintained throughout the maneuver except while experiencing light buffet. Altitude gain during the maneuver will vary from 14,000 to 20,000 feet depending upon entry gross weight, Mach, altitude, and "g" schedule maintained. See figure 4-2.

SPLIT "S"

Recommended entry conditions are gross weight 53,000 pounds or less, 0.5 Mach, 20,000 feet MSL (but not less than 15,000 AGL for 0.5 Mach entry or 22,000 AGL for 0.95 Mach entry), CRUISE DROOPS, IDLE thrust and speed brakes out. Roll inverted and pull to 16 units angle of attack or 3.5 "g's," whichever is less. When level flight is reached, retract speed brakes and add thrust. The recommended entry altitudes (AGL listed previously) provide approximately 4000 feet of terrain clearance at maneuver completion provided entry conditions and angle-of-attack schedule are adhered to. See figure 4-3.

IMMELMANN

Begin the maneuver in the same manner as the loop. When the aircraft is inverted with the nose 20 degrees above the horizon at the top of the maneuver, relax longitudinal stick pressure and commence rolling to level flight. As the aircraft rolls past the 90-degree bank position to level flight, forward stick must be applied to keep the nose of the aircraft coming down. If forward stick is not applied, the pitch augmentation system will try to maintain 1 "g" and program in trailing edge up horizontal stabilizer resulting in a nose-high slow-speed climb. See figure 4-4.

HALF-CUBAN EIGHT

Begin the maneuver in the same manner as the loop. When the aircraft is inverted with the nose 30 degrees below the horizon, relax longitudinal stick pressure and

IMMELMANN-RECOMMENDED PROFILE

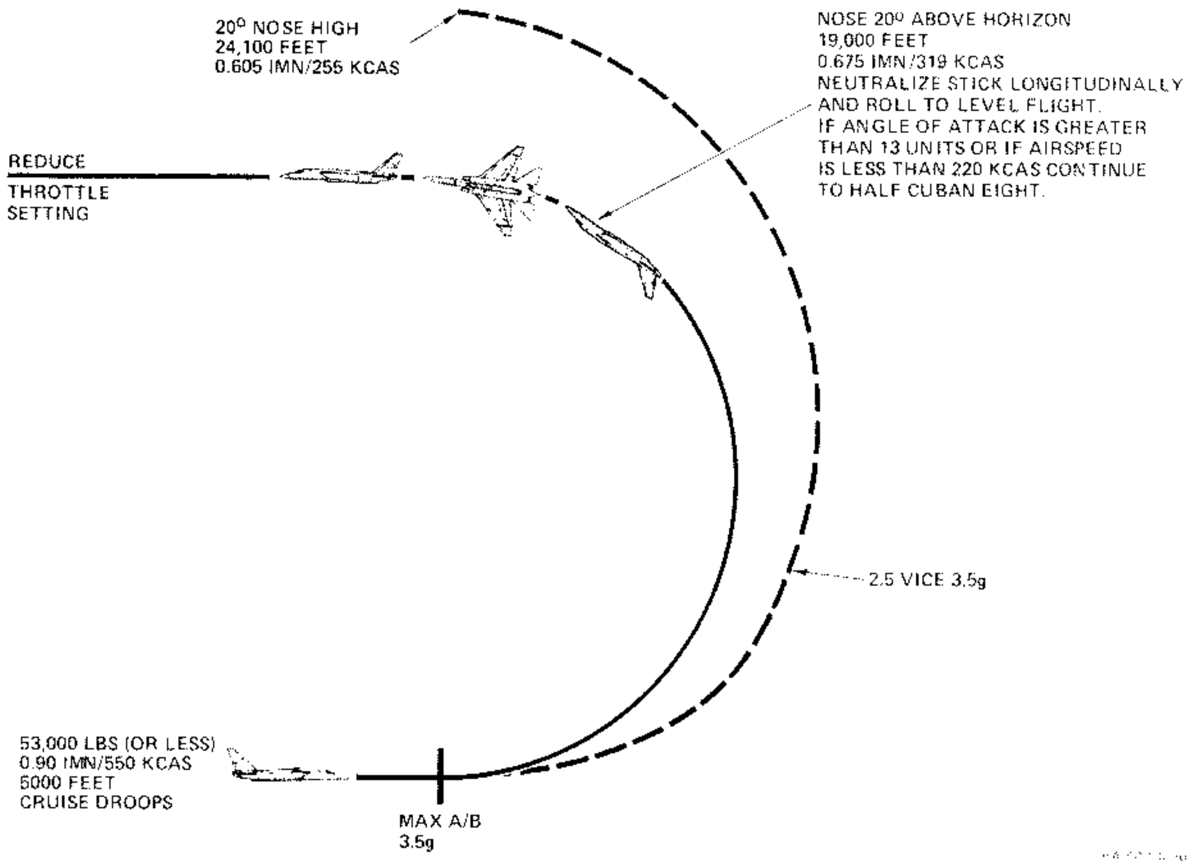


Figure 4-4

roll upright, then reduce throttle setting to IDLE. Commence pullout so as to be in level flight at original entry altitude. The same limitations apply as for the loop except entry altitude range should be sea level to 10,000 feet MSL. See figure 4-5.

LANDING APPROACH WITH FORWARD CG

Landing approaches with the center of gravity ahead of the forward landing limit of 27 percent MAC (27.5 with 50-degree flaps) can be made satisfactorily. However, to ensure adequate control for all emergencies, the minimum approach speed should be increased 6 knots for each percent forward movement ahead of 27 percent MAC (27.5 with 50-degree flaps). As a guide, approach angle of attack should be decreased 1.5 units for each percent forward of 27 percent MAC (27.5 with 50-degree flaps).

LANDING APPROACH WITH AFT CG

Under normal operating conditions, approaches and landings, as described in Sections III and VI, can be accomplished with two full bomb bay cans and empty wing tanks. However, flight tests show that the static longitudinal stability of the aircraft at an aft center of gravity becomes weak, which provides poor flying qualities during a landing approach, particularly in turbulent air. The flying qualities are further aggravated when the pitch augmentation system is disengaged, as evidenced by a requirement for larger control corrections, especially in turbulent air.

TECHNIQUE

Adequate longitudinal control authority is available under all conditions for landing at centers of gravity well aft of the limit for power approach. Speed control will not be precise, although the aircraft will respond satisfactorily with coordinated use of both pitch and power corrections. Concentrate on maintaining attitude prior to touchdown and ease the aircraft onto the runway by addition of power, not by attempting to abruptly flare with aft stick. If a bad bounce should occur, corrective action would be the addition of power for a complete

HALF CUBAN EIGHT-RECOMMENDED PROFILE

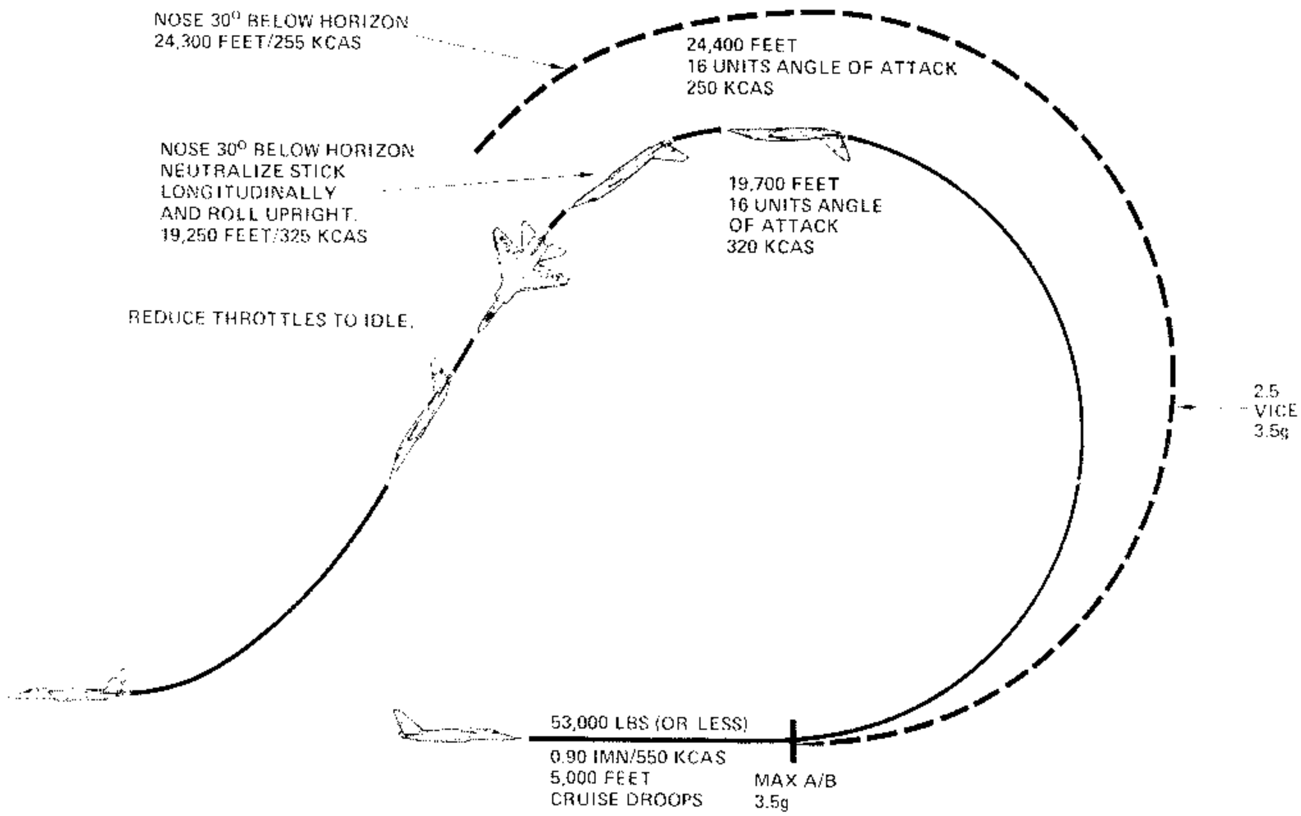


Figure 4-5

wave-off. It is emphasized that adequate control authority is available under all conditions to safely counteract any pitch change due to thrust increase. However, remember that initial longitudinal response will be slow and no abrupt large magnitude longitudinal stick inputs should be applied in attempting to correct for a bad bounce. Admit to yourself that a bad landing was made and wave off. Utilize the same technique following a carrier landing bolter, add power as necessary for a wave-off, and avoid abrupt, large magnitude longitudinal stick inputs.

ENGINE COMPARTMENT OVERPRESSURE

If the engine compartment pressure exceeds 8 psi differential, the overpressure relief doors will open and the ENG DOOR caution indicator will be illuminated. The relief doors will automatically close when the compartment pressure decreases to less than 7 psi differential. If the light remains on, high airspeed, altitude, and power settings should be avoided in order to prevent engine compartment overheat and possible fire: land as soon as practicable.

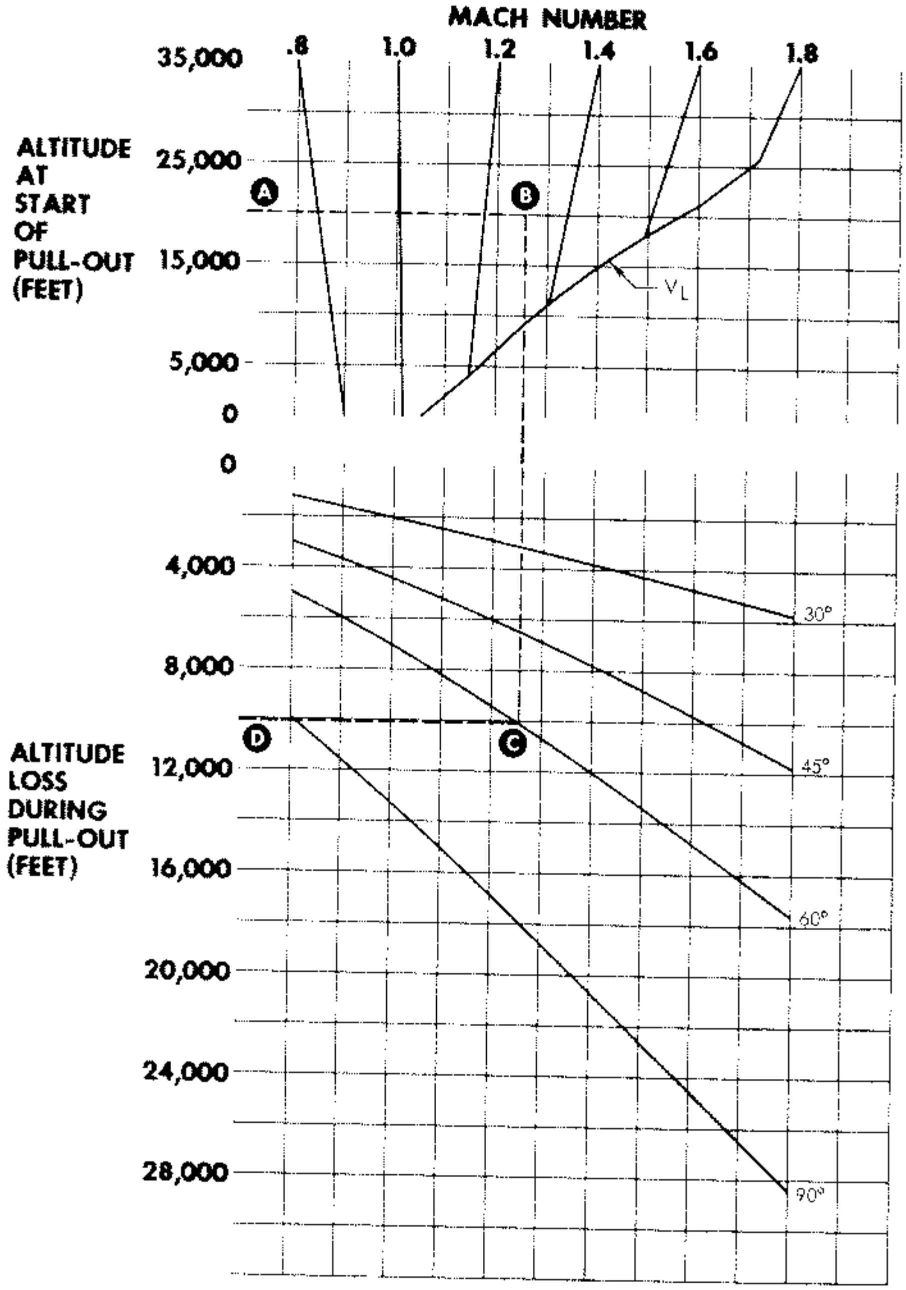
DIVE RECOVERY AND PULL-OUT

Altitude loss in dive recovery is dependent upon angle of dive, altitude and airspeed at start of pull-out, speed brake position, load factor, and power setting maintained during pull-out. These factors must be considered collectively in estimating the altitude required for recovery from any dive. The altitude loss in dive recovery for constant-g pull-outs is shown in figure 4-6, based on fully extended speed brakes at initiation of pull-out and power reduced to idle rpm. The minimum pull-out altitude shown in figure 4-7 is also for constant-g pull-outs. This altitude is the minimum altitude above sea level at which dive recovery can be initiated and still clear sea level by 2000 feet upon completion of dive recovery. Buffet may be encountered in pull-outs at less than 1.0 Mach. Pull-outs from high-speed, high-angle dives should never be attempted below 25,000 feet until the pilot is completely familiar with the aircraft.

ALTITUDE LOSS IN DIVE RECOVERY

3.0 g

SPEED BRAKES EXTENDED AND IDLE RPM AT START OF PULL-OUT



NOTE:

1. BUFFET MAY BE ENCOUNTERED WHEN PERFORMING PULL-OUT MANEUVERS BELOW 1.0 IMN.
2. DIVE RECOVERY LOAD FACTOR (G) MUST BE REDUCED FOR HEAVY GROSS WEIGHTS.
3. REFER TO SECTION I, PART 4 FOR OPERATING LIMITATIONS.
4. INLET RAMPS MAY HAVE TO BE RESET AFTER COMPLETION OF PULL-OUT.

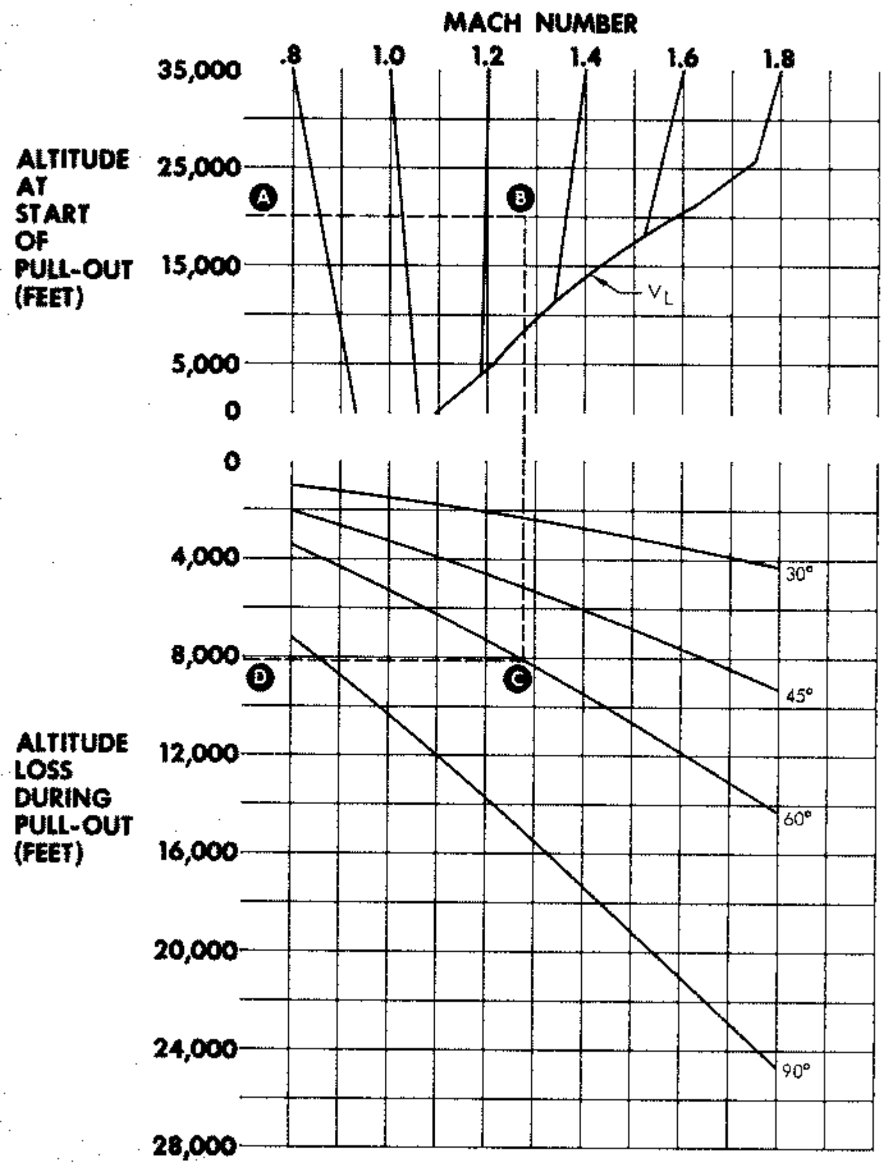
MODEL: RA-5C
ENGINES: (2) J79-GE-8/10
DATA AS OF: 1 OCTOBER 1964
BASED ON: FLIGHT TEST DATA (NA63H-2)

A5C-1A 93-96A

Figure 4-6 (Sheet 1)

SPEED BRAKES EXTENDED AND IDLE RPM AT START OF PULL-OUT

3.5g



HOW TO USE CHARTS:

SELECT APPROPRIATE CHART, DEPENDING ON NORMAL LOAD FACTOR (3.0g OR 3.5g) TO BE HELD IN PULL-OUT; THEN —

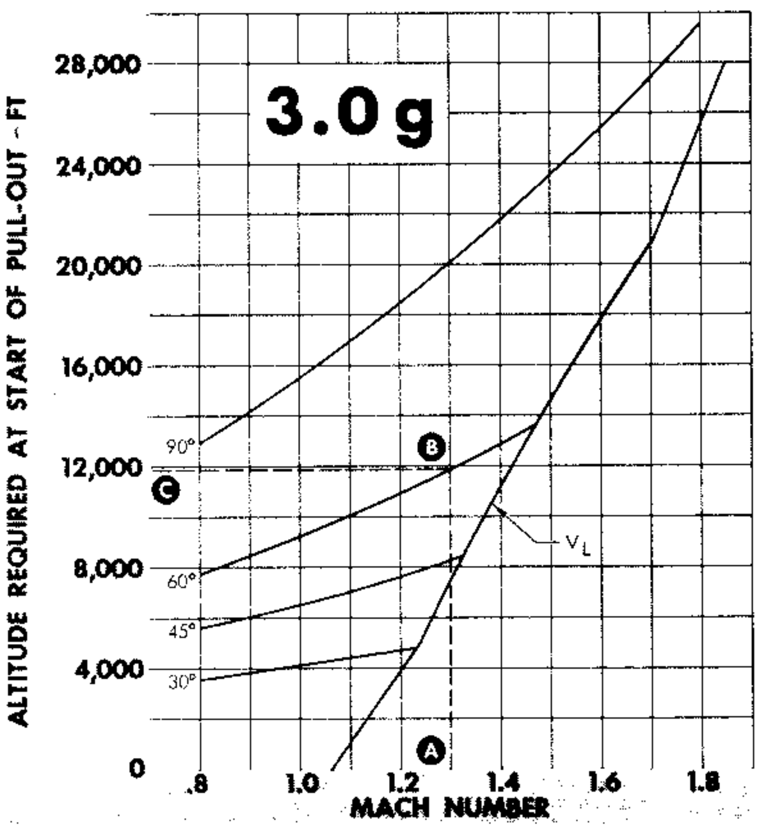
- **A** ENTER CHART AT ALTITUDE AT START OF PULL-OUT (FOR EXAMPLE, 20,000 FEET).
- **B** ALONG ALTITUDE LINE, SELECT MACH NUMBER AT WHICH PULL-OUT IS STARTED (1.3M).
- **C** VERTICALLY BELOW THE MACH NUMBER (1.3M) ENTER APPROPRIATE ANGLE OF DIVE CURVE (60°).
- **D** THE ALTITUDE LOSS DURING PULL-OUT IS READ FROM THE SCALE TO THE LEFT (CONSTANT 3.0g PULL-OUT, 10,100 FEET; CONSTANT 3.5g PULL-OUT, 8,100 FEET).

A-5C-1A-93-97

Figure 4-6 (Sheet 2)

MINIMUM PULL-OUT ALTITUDE

ALTITUDE ABOVE SEA LEVEL REQUIRED AT START OF PULL-OUT FOR 2000 FT SEA LEVEL CLEARANCE
SPEED BRAKES EXTENDED AND IDLE RPM AT START OF PULL-OUT

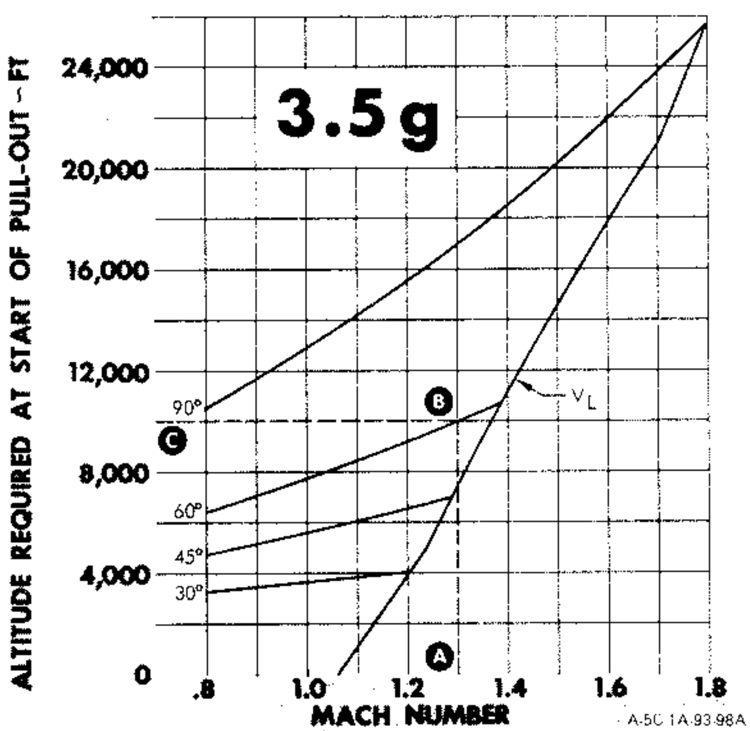


NOTE:

1. BUFFET MAY BE ENCOUNTERED WHEN PERFORMING PULL-OUT MANEUVERS BELOW 1.0 IMN.
2. DIVE RECOVERY LOAD FACTOR (G) MUST BE REDUCED FOR HEAVY GROSS WEIGHTS.
3. REFER TO SECTION I, PART 4 FOR OPERATING LIMITATIONS.
4. INLET RAMPS MAY HAVE TO BE RESET AFTER COMPLETION OF PULL-OUT.

HOW TO USE CHARTS:

- **A** ENTER AT MACH NUMBER (1.3 FOR EXAMPLE).
- **B** MOVE VERTICALLY TO ANGLE OF DIVE (60° FOR EXAMPLE).
- **C** ALTITUDE REQUIRED FOR PULL-OUT IS READ FROM SCALE AT LEFT (11,850 FEET FOR CONSTANT 3.0g PULL-OUT AND 10,000 FEET FOR CONSTANT 3.5g PULL-OUT).



MODEL: RA-5C
ENGINES: (2) J79-GE-8/10
DATA AS OF: 1 OCTOBER 1964
BASED ON: FLIGHT TEST DATA (NA63H-2)

Figure 4-7

SECTION V — EMERGENCY PROCEDURES

TABLE OF CONTENTS

PART 1 — EJECTION AND BAIL-OUT

EJECTION (PILOT)

CONTROLLED EJECTION

WARNING

It is ALWAYS preferable to eject rather than to attempt crash landing or ditching.

In the event controlled ejection is required and feasible, reduce airspeed to 250 KIAS. The pilot will accomplish as much of the following procedure as time permits:

1. Inform RAN to PREPARE FOR EJECTION. Both crew members will check the following:
   (a) Helmet—TIGHT.
   (b) Parachute lap and shoulder straps—TIGHT.
   (c) Oxygen mask—TIGHT.
   (d) Helmet visor—DOWN.
2. COCKPIT PRESS switch—RAM EMERG.
3. If the situation and time permit:
   (a) Obtain terrain clearance between 8,000 and 10,000 feet.
   (b) IFF—EMERGENCY.
   (c) Have RAN transmit MAYDAY.
4. ORDER RAN TO EJECT.

WARNING

At low altitude or in unusual attitudes, keep one hand on the stick for control of the aircraft and utilize an alternate ejection knob.

5. Initiate ejection, using the face curtain or alternate knobs, keeping elbows in.

EJECTION SEAT OPERATION

① Prepare to Eject...

A. REDUCE SPEED TO 250 KNOTS OR ZOOM-CLIMB IF NECESSARY: INITIATE EJECTION BEFORE SINK-RATE CANCELS LOW ALTITUDE EJECTION CAPABILITY.

B. TRANSMIT MAYDAY AND TURN AIRCRAFT AWAY FROM POPULATED AREAS AS TIME PERMITS.

C. WARN CREW MEMBER TO PREPARE TO EJECT

D. ORDER CREW MEMBER TO EJECT

1. SEAT INITIATORS FIRE.
   - CANOPY IS JETTISONED.
   - SEAT BUCKET IS BOTTOMED.
   - SHOULDER HARNESS IS RETRACTED.
   - RETENTION DEVICES ACTUATED.
2. CATAPULT-ROCKET FIRES.
   - EMERGENCY OXYGEN ACTUATED AS SEAT RISES.
   - IFF SWITCHED TO EMERGENCY (PROVIDED PILOT'S IFF SWITCH IS IN AUTO POSITION).
   - LIFT-PLATE IS EXTENDED.
3. DROGUE PARACHUTE DEPLOYED.

NOTE: IF PILOT INITIATES EJECTION, EJECTION OF PILOT'S SEAT IS AUTOMATICALLY DELAYED UNTIL 0.75 SECOND AFTER AFT SEAT EJECTS.

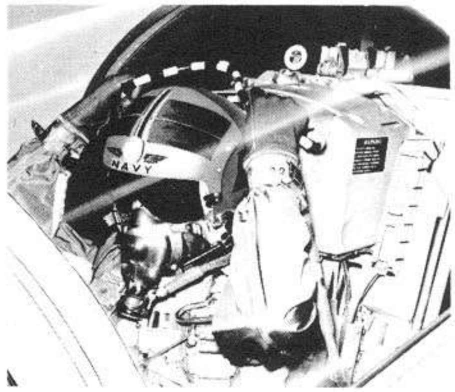
③ When Clear of Cockpit...

- FOR HIGH-ALTITUDE EJECTION, DURING STABILIZED FREE-FALL, OPERATE ARM RETENTION STRAP QUICK RELEASE KNOBS.
- RELEASE LEG RETRACTORS — PLACE THUMB AND FOREFINGER AROUND SLIDE RELEASE AND PUSH FORWARD.

CONTROLLED EJECTION

② Initiate Ejection

PULL FACE CURTAIN



- "SLAM" CURTAIN OUTWARD AND DOWN UNTIL REACHING FULL TRAVEL. BANG AGAINST STOPS IF REQUIRED

OR . . .

TURN AND PULL EITHER KNOB

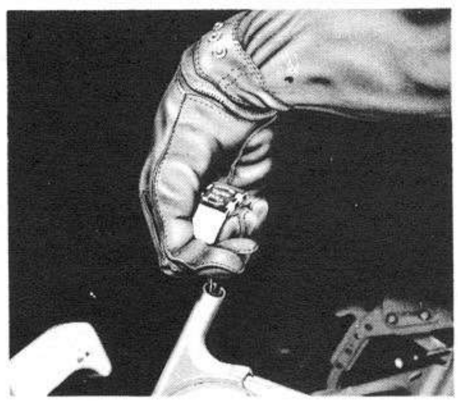


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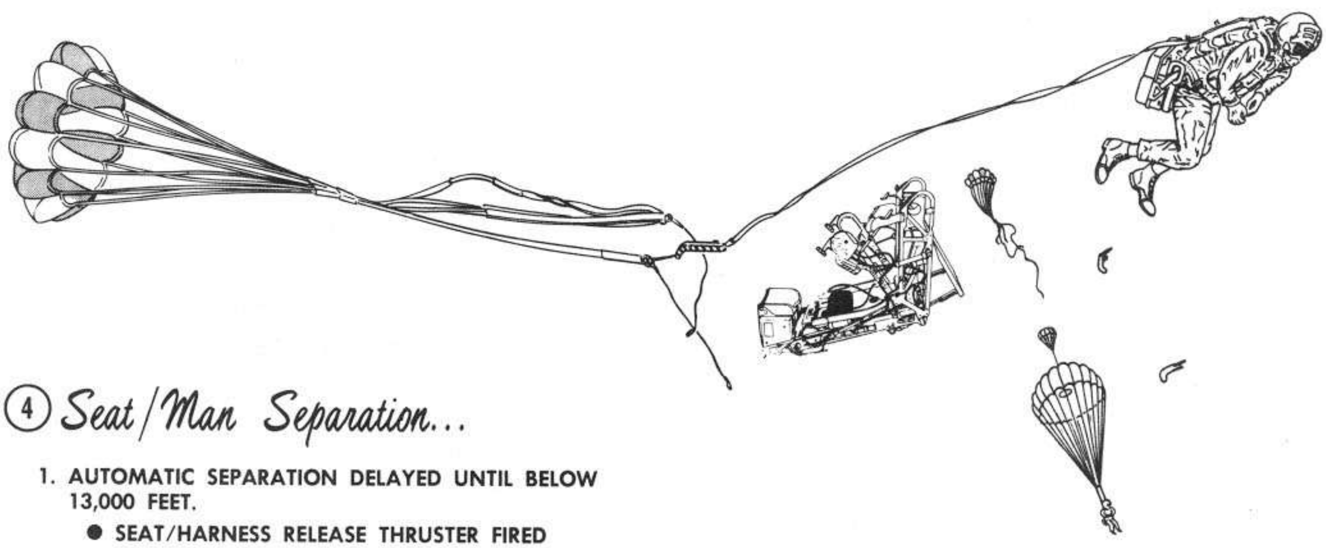
Figure 5-1 (Sheet 1)



④ *Seat/Man Separation...*

1. AUTOMATIC SEPARATION DELAYED UNTIL BELOW 13,000 FEET.
   - SEAT/HARNESS RELEASE THRUSTER FIRED
   - FACE CURTAIN CABLES CUT
   - LEG RETRACTORS JETTISONED
   - KNEE-BAR RELEASED
2. SEAT SEPARATION BLADDERS INFLATE, RELEASING ARM RETENTION STRAPS, SEPARATING CREW MEMBER FROM SEAT AND KNOCKING KNEE BAR CLEAR.

IF AUTOMATIC SEPARATION FAILS:

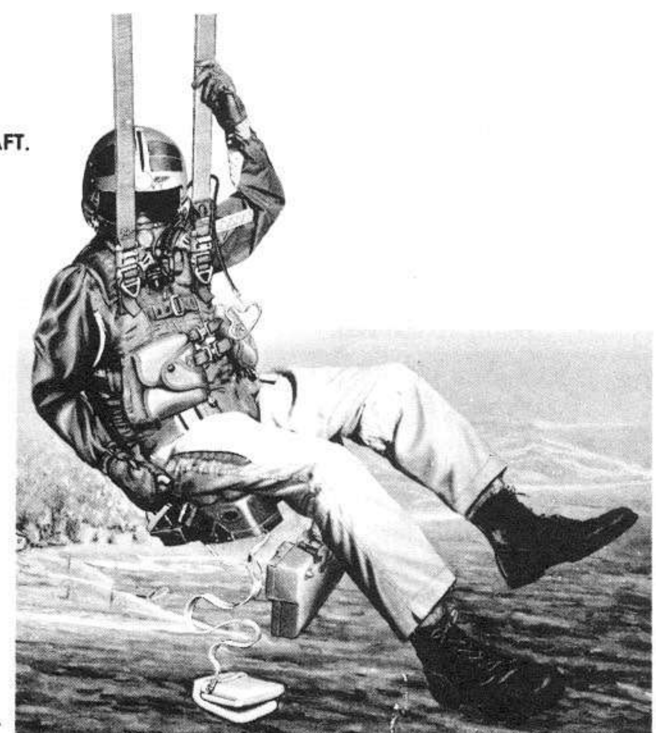
1. ARM RETENTION QUICK DISCONNECTS — RELEASE.
2. LEG RETRACTORS — RELEASE SLIDES.
3. KNEE BAR — ROTATE AND PUSH FORWARD.
4. HARNESS RELEASE HANDLE — PULL UP.
5. ROLL CLEAR OF SEAT; PARACHUTE WILL DEPLOY 0.75 SECOND AFTER SEPARATION IF BELOW 10,000 FEET.

⑤ *Descent and Survival...*

1. BEFORE GROUND OR WATER CONTACT, ENSURE THAT RIPCORD GRIP IS REMOVED FROM RETAINER CLIP POCKET AND SEPARATE FROM HARNESS/RISER STRAP. FAILURE TO DO THIS WILL RESULT IN FIXED ATTACHMENT BETWEEN PARACHUTE CONTAINER AND RISER EVEN WITH SHOULDER HARNESS FITTINGS RELEASED
2. PULL SURVIVAL KIT RELEASE HANDLE TO DEPLOY LIFE RAFT.

   NOTE

   - THE SURVIVAL KIT SHOULD BE DEPLOYED AT SUFFICIENT ALTITUDE TO ALLOW FULL EXTENSION OF THE KIT LANYARD, WHICH ACTIVATES THE CO_2 CYLINDER, INFLATING THE LIFE RAFT.
   - DO NOT RELEASE EITHER LOWER HARNESS FITTING PRIOR TO SURVIVAL KIT DEPLOYMENT AND WATER ENTRY.
3. INFLATE MK-3C LIFE PRESERVER (OVER WATER)
4. OXYGEN MASK SHOULD BE REMOVED OR FULL PRESSURE SUIT FACEPLATE RAISED TO PREVENT SUFFOCATION ON EMERGENCY OXYGEN DEPLETION.
5. INSURE ARM RETENTION PULL STRAPS RELEASED AT QUICK-DISCONNECTS TO PREVENT ENTANGLEMENT.
6. ON CONTACT, RELEASE SHOULDER-HARNESS ROCKET-JET FITTINGS TO SEPARATE FROM PARACHUTE.



A-5C-1-73-7C

Figure 5-1 (Sheet 2)

Note

In any ejection using the face curtain, be sure to "slam" the curtain out and forward rather than just pull. If ejection does not take place, either "bang" the curtain against the stops or use the alternate knobs.

6. After seat separation (below 10,000 feet), "D" ring—PULL HOUSING FREE OF RISER.
7. Survival kit—RELEASE.
8. Inflate life preserver (if over water).
9. Mask—OFF (when oxygen is of no further use).

EMERGENCY EJECTION

In an emergency situation requiring immediate ejection:

1. EJECT—It is assumed the RAN is in the correct position for ejection during take-offs, landings, low-altitude flights, or when other than normal operating conditions exist.
2. When practicable, the pilot will tell the RAN to eject, allowing him to initiate his own ejection.
3. Complete steps 6 through 9 under CONTROLLED EJECTION.

EJECTION SEAT FAILURE

MANUAL SEPARATION

If automatic separation fails, proceed as follows:

1. Leg retainer release slides—PUSH FORWARD.
2. Knee bar—ROTATE AND PUSH FORWARD.
3. Harness release handle—PULL.
4. Roll clear of seat.
   Parachute deploys 0.75 second after separation below 10,000 feet.
5. Complete steps 6 through 9 under CONTROLLED EJECTION.

EMERGENCY BAIL-OUT (SEAT FAILURE)

In the event the seat positioning devices operate but seat fails to eject or fails completely, use the following procedure as required to escape:

1. Emergency oxygen ring—PULL.
2. Leg retainer release slides—PUSH FORWARD.
3. Knee bar—ROTATE AND PUSH FORWARD.
4. Canopy jettison handle—PULL (if not jettisoned).

Note

If at high altitude, move COCKPIT PRESS switch to RAM EMERG prior to jettisoning canopy.

5. Trim aircraft nose-down, roll inverted, and maintain positive "g."
6. Harness release handle—PULL/Push free of cockpit as required.
7. Complete steps 6 through 9 under CONTROLLED EJECTION.

WARNING

When emergency bail-out is accomplished without use of the ejection seat, automatic personal parachute deployment is NOT AVAILABLE. PULL THE "D" RING AT YOUR LEFT SHOULDER.

EJECTION (RAN)

CONTROLLED EJECTION

In the event controlled ejection is required and feasible, airspeed should be reduced to 250 KIAS or less. The crew will accomplish as much of the following procedure as time permits:

1. IFF—EMERGENCY (MODE 3, Code 77).
2. UHF—GUARD XMIT.
3. Send the following radio report:
   (a) MAYDAY, MAYDAY, MAYDAY.
   (b) Identification.
   (c) Position.
   (d) Heading.
   (e) Situation.
   (f) Intentions.
4. Both crew members will check the following:
   (a) Helmet—TIGHT.
   (b) Parachute laps and shoulder straps—TIGHT.
   (c) Oxygen mask—TIGHT.
   (d) Helmet visor—DOWN.
   (e) The pilot will order the RAN to INITIATE EJECTION.
5. If the face curtain is used to initiate ejection, hold elbows in and sit erect.

Note

- In any ejection using the face curtain, be sure to "slam" the curtain out and forward rather than just pull. If ejection does not take place, either "bang" the curtain against the stops or use the alternate knobs.
- Time consideration may dictate using alternate knobs.

6. After seat separation (below 10,000 feet) and with the parachute inflated, check the canopy and pull the "D" ring housing free of the left riser strap to aid in separation from the parachute after landing.
7. Survival kit—RELEASE.
8. Inflate life preserver prior to water entry.
9. Mask—OFF.

EMERGENCY EJECTION

WARNING

It is ALWAYS preferable to eject rather than to attempt crash landing or ditching.

In an emergency situation requiring immediate ejection:

1. EJECT—It is assumed that the RAN is in the correct position for ejection during take-offs, landings, low-altitude flight, or when other than normal operation conditions exist.
2. When practicable, the pilot will tell the RAN to eject, allowing him to initiate his own ejection.

Note

Whenever possible, the RAN should initiate his own ejection. This will ensure proper positioning. Use the face curtain, if possible, to ensure maximum protection from wind blast. Use of the face curtain will also tend to prevent arm flailing in the absence of arm retention. See figure 5-1 for ejection seat operation.

3. Complete steps 6 through 9 under CONTROLLED EJECTION.

MANUAL SEPARATION

1. Leg retainer release slides—PUSH FORWARD.
2. Knee bar—ROTATE AND PUSH FORWARD.
3. Harness release handle—PULL.
4. Roll clear of seat.

   Parachute deploys 0.75 second after separation below 10,000 feet.
5. Complete steps 6 through 9 under CONTROLLED EJECTION.

EJECTION SEAT FAILURE

EMERGENCY BAIL-OUT (SEAT FAILURE)

In the event the seat positioning devices operate but seat fails to eject or fails completely, use the following procedure as required to escape:

1. Emergency oxygen ring—PULL.
2. Leg retainer release slides—PUSH FORWARD.
3. Knee bar—ROTATE AND PUSH FORWARD.
4. Canopy jettison handle—PULL (if not jettisoned).
5. Pilot—TRIM AIRCRAFT NOSE-DOWN AND ROLL INVERTED.
6. Harness release handle—PULL.
7. Complete steps 6 through 9 under CONTROLLED EJECTION.

WARNING

- If the ejection seat fails to operate, notify the pilot immediately and PREPARE TO BE EJECTED.
- When emergency bail-out is accomplished without use of the ejection seat, automatic personal parachute deployment is NOT AVAILABLE. PULL THE "D" RING AT YOUR LEFT SHOULDER.

PART 2 — GROUND EMERGENCIES

ENGINE START MALFUNCTIONS

FALSE START

Should an engine fail to light off within 30 seconds after the throttle is moved to IDLE, proceed as follows:

1. Throttle—OFF.
2. Allow engine to crank for 40 seconds.
3. Start and ignition circuit breaker and engine MASTER switches—CHECK.
4. START switch—STOP.
5. Inspect engine.
6. Commence restart.

   Depress EMER IGN button and advance throttle to idle, continuing to hold button down. If EMER IGN was used on first attempt, try manual (normal) start.
7. If engine fails to light off, move throttle to OFF and down the aircraft for investigation.

HOT OR HUNG START

Should starting EGT exceed limits, down the aircraft for engine inspection. Should rpm build up, then hang short of normal idle, proceed as follows:

1. Throttle—OFF.
2. Allow engine to crank for 40 seconds.
3. Instruct Plane Captain to check start air and electrical connections.
4. If EGT has exceeded limits, down the aircraft.

CAUTION

Do not attempt additional starts if EGT limits have been exceeded.

AUTOACCELERATION

If an engine autoaccelerates above idle rpm, exhaust gas from other aircraft may have caused high inlet temperatures, resulting in idle speed reset. A slight change in heading should correct this condition.

ENGINE FIRE DURING START

If a fire warning indicator comes on during a start, or if there are other indications of fire, the following procedures are recommended.

TAIL-PIPE FIRE

If a tail-pipe fire should occur during a start, the condition will probably be detected by the ground crew rather than by illumination of a fire warning indicator. If a tail-pipe fire exists, the pilot should proceed as follows:

1. Both throttles—OFF.

   Maintain starting air supply.
2. Appropriate START switch—START.

   Motor engine until the ground crew signals fire is out.
3. Evacuate the aircraft as soon as possible and have the ground crew disconnect external electrical power and cooling air.
4. If fire is not extinguished by motoring, instruct ground crew to direct a stream of CO_2 agent into the tail pipe.

OTHER THAN TAIL-PIPE FIRES

Should a fire occur other than in the tail pipe during starting, it normally will be indicated by illumination of a fire warning indicator. Should a fire warning indicator illuminate, the pilot should proceed as follows:

1. Both throttles—OFF.
2. ENGINE FIRE switch—TOWARD FIRE.

   a. Engine masters – OFF.
3. Instruct ground crew to direct a stream of CO_2 agent into the fire door on the outboard side of the forward engine door.

Note

Opening the fire door requires a sharp rap with the fire extinguisher nozzle.

4. Instruct ground crew to disconnect external power and cooling air.
5. Leave the aircraft immediately.

PART 3 — TAKE-OFF EMERGENCIES

SINGLE-ENGINE TAKE-OFF

Single-engine failures occurring at speeds between refusal speed and minimum safe, single-engine speed require quick, positive decision and immediate action. The governing factors of gross weight, field elevation, runway length, and ambient temperature must be considered prior to initiating the take-off run. Single-engine decision speed charts and a single-engine take-off speed chart are presented in Section XI, and should be consulted prior to every take-off at the same time a refusal speed is computed. Section XI also presents further discussion and data concerning the following procedures.

ABORTED TAKE-OFF

Should take-off abort prove necessary, proceed as follows:

WARNING

Applying brakes at speeds above MSBI can result in faded brakes. If no loss of thrust is involved, no arresting gear is available, and speed is above refusal speed, CONTINUE TAKE-OFF.

1. Throttles – IDLE.
2. Hook – DOWN 1000 feet prior to arresting gear.
3. Stick – FULL AFT for aerodynamic braking to MSBI. Below 140 KIAS flaps to 50 degrees. If crosswind component exceeds 10 knots use 3 point aero braking techniques.

CAUTION

Relax wheel brake pressure before engaging arresting gear.

Note

During aborted take-offs at high gross weights, steady wheel braking should not be commenced until airspeed is reduced to predetermined maximum speed for braking initiation or 4000 feet of runway remains, whichever occurs first. Refer to WHEEL BRAKE CAPABILITY, in Section III, Part 3.

4. At MSBI—Use MAXIMUM BRAKING.

If abort gear missed and it appears aircraft will leave runway:

5. Throttles—OFF.
6. Jettison canopies (front first).
7. If overrun unsafe – Consider EJECTION. Ejection is not feasible below 100 KIAS without AFC 311.

Note

Field arrestment most probable with nosewheel off the deck (single position or NORM hook), or in three point attitude (FIELD hook), both below approximately 80 knots and no brakes applied.

TAKE-OFF ABORT FACTORS

Aborted take-offs must be planned and executed prior to reaching refusal speed if they are to be accomplished successfully. The most important considerations are: (1) a quick, positive decision, and (2) immediate action. Decision to abort is critical near refusal speed at high gross weight, since *stores cannot be jettisoned* with aircraft weight on the landing gear. In the event of an abort, total braking capacity is realistically only about 80 percent of normal total capacity, since approximately 20 percent is used in taxiing. The aircraft should be allowed to continue rolling until clear of the runway, as the brakes may "fuze" on coming to a stop.

Should aerodynamic braking prove only marginally effective and runway remaining become critical, light braking may be used to the recommended maximum speed for braking initiation (MSBI). If arresting gear is available, extend arresting hook.

Where no field arrestment gear is available, nearly all aborted take-offs starting above refusal speed result in accidents of varying degrees of seriousness. The refusal speed charts in Section XI should be consulted and a refusal speed computed prior to every take-off. For additional information, refer to STOPPING THE AIRCRAFT, in Section III, Part 3. For a discussion of landing on wet or icy runways, refer to Section VI.

ENGINE FAILURE ON TAKE-OFF

In the event of engine failure, aircraft performance may be marginal or inadequate on one engine until minimum safe speed is attained. See single-engine performance data charts, in Section XI.

BELOW REFUSAL SPEED

ABORT. Refer to ABORTED TAKE-OFF, in this section.

DURING FIELD TAKE-OFF – ABOVE REFUSAL SPEED

1. Where field arresting gear is available – Take-off should be aborted.

2. If no arresting gear is available and single engine take-off capability exists:

   (a) Accelerate to single engine take-off speed.
   (b) Maintain 16 units AOA for climb.
   (c) Obtain 15 units AOA prior to retracting gear.

CAUTION

Exceeding 17 units angle of attack will dissipate airspeed and cause increased sink rate.

3. If no arresting gear is available and no single engine take-off capability exists – ABORT.

DURING CATAPULT: (56,000 TO 66,000 POUNDS GROSS WEIGHT)

1. Retract flaps/droops to 30/25 degrees.
2. Rotate to (but do not exceed) 16 units angle of attack (17 units for J79-GE-10 engines).
3. Maintain airspeed above 155 KIAS* (single-engine control airspeed) by reducing rate of climb.
4. Maintain wings-level flight with directional controls.
5. External stores – JETTISON.
6. If single-engine control airspeed and level flight cannot be maintained—EJECT.
7. Accelerate to decrease angle of attack to 15 units prior to retracting gear.

DURING CATAPULT: (UNDER 56,000 POUNDS GROSS WEIGHT)

1. Retract flaps/droops to 30/25 degrees.
2. Rotate to (but do not exceed) 17 units angle of attack.
3. Maintain airspeed above 145 KIAS* (single-engine control airspeed) by reducing rate of climb.
4. Maintain wings-level flight with directional controls.
5. If single-engine control airspeed and level flight cannot be maintained—EJECT.
6. Accelerate to decrease angle of attack to 15 units prior to retracting gear.

DURING BOLTER OR CARRIER TOUCH AND GO

1. Throttle—MAX AFTERBURNER.
2. Rotate to 17 units angle of attack and allow aircraft to sink to maintain speed.
3. Retract flaps/droops to 30°/25°.
4. Accelerate to 15 units angle of attack before retracting gear.

CAUTION

Exceeding 17 units angle of attack will dissipate airspeed and cause increased sink rate.

DURING FIELD TOUCH AND GO (FMLP) — ABOVE REFUSAL SPEED

1. Throttles—MAX AFTERBURNER simultaneously with leveling wings.
2. Flaps/droops—30°/25°.
3. Accelerate to take-off speed—140 knots at 50,000 pounds.
4. Accelerate to 15 units angle of attack—RETRACT GEAR.
5. Best climb—11 UNITS ANGLE OF ATTACK.
6. Flaps/droops—SELECT CRUISE AT 9 UNITS ANGLE OF ATTACK.
7. Failed engine—SECURE.

Note

For performance data, refer to Section XI.

ENGINE FAILURE AFTER TAKE-OFF

Note

During maximum afterburner operations or prolonged Military Thrust operations in the 165- to 180-knot speed range, a strong probability exists of encountering a fire warning indication due to engine bay overheat.

*Reduce by 4 KIAS for aircraft not having AFC 159 complied with

Should one engine fail immediately after take-off (flaps retracted or retracting), the marked tendency of the aircraft to roll and yaw into the failed engine is accentuated by reduced rudder effectiveness due to the directional ratio changer. Proceed as follows:

1. Throttles—MAX AFTERBURNER.
2. FLAPS—30°/25°. DO NOT RETRACT.
3. External stores—JETTISON, if required.
4. Dump fuel to reduce weight if required.
5. Accelerate to 15 units angle of attack—RETRACT GEAR.
6. Best climb—11 UNITS ANGLE OF ATTACK.
7. Flaps/droops—SELECT CRUISE AT 9 UNITS ANGLE OF ATTACK.
8. Failed engine—SECURE.
9. Attempt air start, *if safe.*
10. If air start unsuccessful, engine MASTER switch—OFF for secured engine (above 1.3 IMN).

AFTERBURNER BLOWOUT

Afterburner blowout may or may not cause an emergency situation, depending upon phase of flight at time of blowout. In flight, afterburner blowout is recognized by a distinct loss of thrust or rate of acceleration, unexpected change in nozzle position, slight yawing, and a trail of fuel vapor. If single afterburner blowout occurs below refusal speed, abort. Above refusal speed, take-off can be accomplished and some swerve will be noted. If refusal speed is passed and take-off cannot be safely accomplished, the decision to use field arrestment gear must be weighed against ejection. Refer to ABORTED TAKE-OFFS, in this section. Should afterburner blowout occur during take-off, proceed as follows:

1. If below refusal speed—ABORT.
2. If above refusal speed—CONTINUE TAKE-OFF.
3. Maintain MAX AFTERBURNER on both engines.

Note

At speeds above 100 knots, ground ejection is feasible on aircraft without AFC 311.

ENGINE FIRE ON TAKE-OFF

BELOW REFUSAL SPEED

Should a fire warning indicator illuminate or a fire be otherwise confirmed during take-off below refusal speed, proceed as follows:

1. ABORT.
2. Fire confirmed (or light remains on)—THROTTLE OFF AND FIRE SWITCH TOWARD AFFECTED ENGINE.

ABOVE REFUSAL SPEED

Should a fire warning indicator illuminate or a fire be otherwise confirmed during take-off above refusal speed (safe stop cannot be made), CONTINUE TAKE-OFF and proceed as follows:

1. Throttles—MAX AFTERBURNER.
2. Accelerate to take-off speed.
3. Maintain 16 units angle of attack for climb.
4. Safe altitude—THROTTLE (AFFECTED ENGINE) TO IDLE OR UNTIL LIGHT GOES OUT.
5. Refer to FIRE WARNING LIGHT IN-FLIGHT procedures.

SINGLE-ENGINE RECOMMENDED SPEEDS

With a 50/50-degree flap/droop setting, gear down, and 50,000-pound gross weight on a Standard Day (47,000 pounds on a Tropical Day—90° F), the single-engine take-off rate of climb at Maximum Thrust is approximately 100 feet per minute at sea level. The safe, single-engine speed for this condition is 135 KIAS.

For safe single-engine speeds and single-engine maximum rate-of-climb data with 30/25 degrees and 0/5 degrees flap/droop settings, see figures 11-137, 11-140, 11-154, and 11-157.

NOSE WHEEL STEERING FAILURE

Should the aircraft fail in any way to respond normally to nose wheel steering, immediately release the STEER/TERRAIN button and use differential braking. Taxi slowly and closely monitor No. 2 hydraulic system indicator and HYD PRESS indicator. If No. 2 hydraulic pressure is lost or if HYD PRESS indicator illuminates, stop immediately and request assistance.

Note

In the event nose wheel steering malfunction is suspected, plan to engage fly-in gear. Runway foaming should be requested if available.

Where no field arrestment gear is available, nearly all aborted take-offs starting above refusal speed result in accidents of varying degrees of seriousness. The refusal speed charts in Section XI should be consulted and a refusal speed computed prior to every take-off. For additional information, refer to STOPPING THE AIRCRAFT, in Section III, Part 3. For a discussion of landing on wet or icy runways, refer to Section VI, Part 3.

LANDING GEAR EMERGENCY RETRACTION

Should the gear fail to retract after take-off, emergency gear retraction may be initiated. The emergency gear switch bypasses normal electrical circuits through the landing gear handle and thus retracts the gear if the malfunction in the normal gear system is electrical. Proceed as follows:

1. Maintain aircraft speed below 230 KIAS.

2. Any gear unsafe (with no "DN" indication).

   (a) Cycle gear handle.
   (b) Still unsafe, EMERG GEAR UP switch – UP.
   (c) When gear is up and locked EMERG GEAR UP switch to normal.
   (d) If gear does not retract when EMERG GEAR UP switch is used, return switch to normal position, and move LANDING GEAR handle to DOWN position, and perform normal landing procedures.

3. Any gear unsafe (with any "DN" indication).

   (a) HYD SUB-SYS ISOLATION switch – FLIGHT.
   (b) Extend gear by emergency method (refer to LANDING GEAR EMERGENCY EXTENSION PROCEDURES).

Note

Attempt to verify position of gear with TV or other visual means.

   (c) Prepare to land as if malfunctioning gear were still unsafe (refer to RECOMMENDATIONS FOR SHIPBOARD AND FIELD EMERGENCIES INVOLVING LANDING GEAR).

PART 4 — IN-FLIGHT EMERGENCIES

ENGINE MALFUNCTIONS

THROTTLE LINKAGE FAILURE

FIELD PROCEDURE

APC Not Available

1. Precautionary single-engine approach.
2. Make a short-field arrestment.
3. On touchdown, throttles—IDLE.
4. ENGINE FIRE switch—TOWARD AFFECTED ENGINE.

APC Available

1. Make normal approach.
2. Make a short-field arrestment.
3. On touchdown, throttle—IDLE.
4. ENGINE FIRE switch—TOWARD AFFECTED ENGINE.

Note

Consider securing engine prior to touchdown.

SHIPBOARD

APC Not Available

1. Divert if suitable field available.
2. Precautionary single-engine approach to rigged barricade.
3. On arrestment, ENGINE FIRE switch–TOWARD AFFECTED ENGINE.

APC Available

1. Divert if suitable field available.
2. Make a normal approach to rigged barricade.
3. On arrestment, ENGINE FIRE switch–TOWARD AFFECTED ENGINE.

WARNING

Engine response after touchdown is unpredictable.

ENGINE FAILURE IN FLIGHT

Failure of one engine in cruising flight is accompanied by an easily controlled yaw and roll into the failed engine. Should failure occur at high Mach (above 1.4), these tendencies may be sharply increased. Cautious use of controls is required, especially if the yaw augmentation system is inoperative. Satisfactory single-engine cruise, with no external stores, may be obtained at altitudes up to approximately 20,000 feet. The drag of one inoperative engine may be simulated with the left engine at IDLE and the right engine at the required power setting.

FLAME-OUT

1. Throttles—MAX AFTERBURNER simultaneously with leveling wings.
2. Power—AS REQUIRED TO MAINTAIN SAFE FLIGHT.
3. EMER IGN—DEPRESS.
4. If no relight, throttle—OFF.
5. Attempt air start *if safe.*

COMPRESSOR STALL

1. Establish safe single-engine climb.
2. Reduce power on affected engine.
3. If stall persists, throttle—OFF.
4. EMER IGN button—DEPRESS.
5. Throttle—IDLE.
6. Check engine operation after light-off.
7. Use precautionary single-engine landing pattern with IDLE power on affected engine.

CAUTION

In no case should a restarted engine which has experienced compressor stall be considered a dependable engine.

ENGINE FAILURE DURING CARRIER APPROACH

1. Level wings—MAKE MAXIMUM USE OF RUDDER, PARTICULARLY IF SLOW.
2. Throttles—MAX AFTERBURNER simultaneously with leveling wings.
3. Rotate momentarily to 19 units angle of attack to arrest sink.

4. Retract flaps/droops to 30°/25°
5. Maintain 17 units angle of attack to safe altitude.
6. Accelerate to 15 units angle of attack before retracting gear.

CAUTION

Exceeding 17 units angle of attack will dissipate airspeed and cause increased sink rate.

BOTH ENGINES FAILED

Should both engines fail at high altitude, proceed as follows:

1. Emergency RAT — EXTEND.

   Check ELEC EPU ON advisory light illuminates. On some aircraft,* the EPU automatically provides essential electrical power upon failure of the a-c or d-c system.

WARNING

In the event both engines fail on aircraft having AFC 350 complied with, full generator is available for engine start at supersonic speeds. At subsonic speeds, full generator output remains until rpm decays to approximately 40%, which occurs in approximately 20 seconds. Adequate hydraulic power is available for EPU operation and air starts for another 30 seconds until the rpm decays to less than 25% and the ELEC EPU ON light goes out. Windmill rpm above 25% can be maintained by increasing airspeed to greater than 0.75 IMN if altitude permits.

2. If the nature of the failure permits, attempt immediate restart with the EMER IGN buttons.
3. If the engines do not respond, move both throttles to OFF.
4. Attempt single air starts, using both emergency and manual ignition.
5. IFF/SIF—EMERGENCY (MODE 3, Code 7700).
6. If engines will not start, EJECT.

Note

In the event a no-thrust glide to a favorable ejection area becomes necessary, sufficient hydraulic power is available to control the aircraft with rate-limited stick inputs with engines windmilling as low as 10% rpm.

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*Aircraft having AFC 350 complied with

AIR STARTS

Air starts may be attempted within a wide range of altitudes and airspeeds. See figure 5-2. Best conditions are found below 45,000 feet at less than 1.10 indicated Mach. Below 25,000 feet, optimum speed for air starts is 300 KIAS. Although in an emergency it is not expected that all engine limits will be observed, the EGT and windmill rpm limits stated in Section I, Part 4, should be kept in mind.

If one or both engines flame out, depress the EMER IGN button(s) before too much engine rpm is lost.

If the engine(s) fails to start, use the following procedure:

1. EMER IGN—DEPRESS. Try immediate restart.
2. No relight, throttle—OFF.
3. START IGN circuit breakers, engine MASTER switches—CHECK.
4. RPM—12% to 30% (300 KIAS).

   On some aircraft,* dual-engine start requires 25% rpm; single starts can be made at 12% to 30% rpm.

Note

When using the RAT/EPU for electrical power, do not move the flight controls more than required to maintain wings-level flight while attempting air starts. Large demands on the hydraulic system may cause the priority valve within the EPU to close, stopping the supply of electrical power for engine ignition.

5. Normal START switch START, EMER IGN—DEPRESS.
6. Throttle—1 TO 2 INCHES ABOVE IDLE.
7. No light-off in 30 seconds—ADVANCE TO MIL.
8. No light-off in 30 seconds—REPEAT STEPS 2 THROUGH 7.
9. RAMPS—RESET BELOW 95% IF RAMPS LIGHT ON.
10. GENERATOR—RESET.
11. Land as soon as practicable. See PRECAUTIONARY SINGLE-ENGINE LANDING (figure 5-3).

Note

In no case should an engine which has been restarted be considered a dependable engine.

EXHAUST NOZZLE FAILURES

NOZZLE FLUCTUATION (MIL AND AB)

An oversensitive nozzle control system can cause nozzle fluctuations at MIL and afterburner power settings. To stabilize exhaust nozzle position, retard the throttle below MIL to obtain mechanically scheduled nozzle area control. Should each advance to MIL cause fluctuations, plan to land as soon as practicable.

BOTH NOZZLES FULL OPEN

If both nozzle systems fail in the fully open position, engine thrust may be extremely marginal at throttle settings up to MAX AFTERBURNER. Afterburner light-off is very unreliable with the nozzle in the full open position, the most probable light-off being at the MAX AFTERBURNER throttle setting. In addition, an afterburner operating at MIN AFTERBURNER will probably blow out when the nozzle opens. Should both nozzles fail open, select Military Thrust.

WARNING

Should both nozzles fail open below 150 knots during a MIN AFTERBURNER take-off, insufficient power remains below MAX AFTERBURNER for safe flight.

With *both* nozzles failed open under Standard Day conditions in CRUISE configuration at Military Thrust (flaps retracted, droops 5 degrees), 20,000 feet can be maintained at gross weights up to 56,000 pounds. With flaps at 30 degrees, landing gear down at weights up to 50,000 pounds, only 2500 feet can be maintained at Military Thrust. Therefore, under these conditions, the *landing gear should not be extended until the final approach*. Normal field approach and landing should be made with 30-degree flaps with both nozzles open if gross weight is reduced to approximately 48,000 pounds or less at temperatures up to standard. At weights over 48,000 pounds or temperatures above standard, sufficient thrust may not be available for a safe landing.

ENGINE OPERATING ENVELOPE

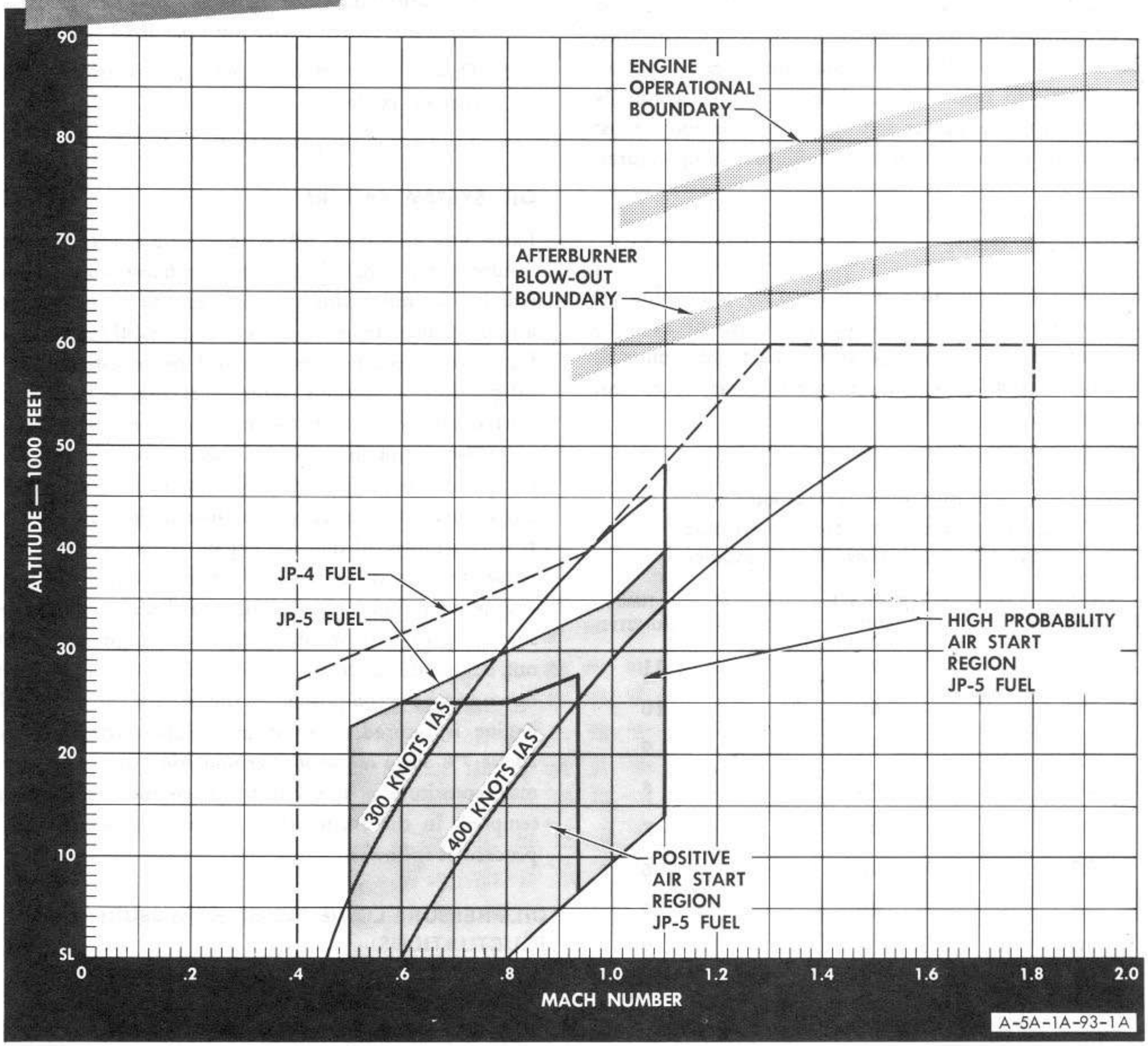

Figure 5-2

WARNING

Careful monitor of speed control and drag is required to avoid operation on the back side of the power curve. Jettison external stores and/or dump fuel if safe altitude or airspeed cannot be maintained. If power is still dangerously marginal, ejection is recommended rather than an attempt to land.

For performance capabilities with exhaust nozzle full open, refer to Section XI.

SINGLE NOZZLE FULL OPEN

1. Affected throttle — MIL.
2. Jettison external stores if required.
3. Land as soon as possible. Recommended gross weight maximum 47,000 pounds.
4. See PRECAUTIONARY SINGLE-ENGINE LANDING (figure 5-3).
5. Shipboard — RECOMMENDED DIVERT.

NOZZLE FULL CLOSED

Serious engine overtemperature can result from a failure of the EGT regulating system, causing the nozzle area to be reduced to the minimum mechanically scheduled condition. If the EGT limitations are exceeded, retard the throttle to below MIL and regulate EGT manually with the throttle. Power settings of MIL or above must be avoided to prevent further engine overtemperatures.

NO-THRUST GLIDE

Maximum glide distance is obtained by jettisoning all external stores and maintaining 250 KIAS or 11 units angle of attack. The emergency ram-air turbine must be extended to obtain hydraulic power necessary to control the aircraft.

NO-THRUST GLIDE PERFORMANCE
NO WIND — 250 KIAS — STORES JETTISONED
(GEAR AND FLAPS UP/DROOPS SUPERSONIC)

ALTITUDE (X 1000 FEET)	DISTANCE (NMI)	TIME (MINUTES)
45	70	11
40	60	10
35	50	9
30	40	8
25	35	7
20	25	6
15	20	4
10	13	3
5	5	1.5

Note

Optimum glide distance and time with droops at cruise exceed the above performance by approximately 5 percent.

ENGINE OIL OVERHEAT

Overheating of an engine oil system (OIL HOT caution indicator on) may be accompanied by associated constant-speed drive and generator failure. Should an OIL HOT caution indicator come on, the following procedure is recommended.

1. Set throttle of affected engine at cruise power or higher.
2. If caution indicator remains on, place associated generator switch to OFF until needed.
3. Descend to allow increased fuel flow through main fuel/oil cooler.
4. Land as soon as practicable.

OIL SYSTEM FAILURE

Early indications of oil system failure are generator failure, due to CSD oil starvation, exhaust nozzle failure, and low or fluctuating oil pressure. Oil pressure fluctuations of more than 5 psi from the established pressure for a given engine speed should be investigated. For oil pressure limitations, refer to Section I, Part 4. Excessive oil pressure fluctuations and generator failure are reason enough to make preparations for landing, but premature engine shutdown should be avoided. An engine need not be secured because of low oil pressure. It is recommended that the engine power setting not be reduced to less than cruise power; however, if continued engine operation appears dangerous because of oil pressure drop to zero or vibration, and if flight safety will not be compromised by the loss of thrust, engine shutdown can be accomplished in the normal manner. If the engine is secured, attempt to maintain windmill rpm above 7% since oil vapor accumulation in the oil sump may constitute a fire hazard if engine restart is attempted. In the event of oil system failure indications, proceed as follows:

OIL PRESSURE LOW/EXCESSIVE PRESSURE FLUCTUATIONS

1. Nozzle response – CHECK.
2. Throttle – CRUISE POWER.

Note

Oil pressure fluctuations above 20,000 feet are limited to the following: Maximum 20 PSIG below normal up to 3 seconds per drop not to exceed 4 drops per minute.

OIL PRESSURE ZERO

1. Throttle – CRUISE POWER.
2. With other indications, nozzle failure, generator failure, or on vibration – SECURE.

3. Land as soon as possible.

WARNING

Do not attempt air start except in extreme emergency.

FIRE

ENGINE FIRE DURING FLIGHT

Should a fire warning indicator illuminate and engine overheat is suspected, reduce power on the affected engine to IDLE, using the other engine as required. Engine overheat is most probable at slow airspeeds (165 to 180 KIAS) and high power settings, and during prolonged asymmetric engine operation.

CAUSES OF FIRE WARNING LIGHT

- FIRE
- ENGINE BAY OVERHEAT
- HOT AIR LEAK

1. Throttle (affected engine)—Reduce rpm.
   (a) If light goes out suspect engine bay overheat and land as soon as practicable.
   (b) If light remains on:
      (1) Throttle—OFF. If light goes out suspect hot air leak and land as soon as practicable.
      (2) Check for secondary indications of fire.

WARNING

If fire warning light is accompanied by illumination of hydraulic and/or generator caution light, suspect bomb bay fire. Any time the fire light goes out, depress warning lights test button to check fire warning circuitry/bulb.

2. If light remains on and/or fire confirmed:
   (a) ENGINE FIRE switch—TOWARD FIRE.
   (b) Engine MASTER switch—OFF.
   (c) Land as soon as possible.
3. If fire is confirmed and persists—WARN RAN AND EJECT.

BOMB BAY FIRE

Experience has shown that although there is no fire warning system for the bomb bay, there are indications from other systems which should alert the crew. Historically, the first indication has been a generator caution light followed or accompanied by a hydraulic caution and/or fire warning light. If these conditions are encountered, proceed as follows:

1. Drop hook and slow to 250 KIAS.
2. Prepare to eject.
3. No other indication of fire – LAND AS SOON AS POSSIBLE, using Precautionary/Single Engine Approach or Auto Isolate Procedures as applicable. If can dump required, dump may be possible with hook down, if not stow hook and dump.
4. If fire confirmed or loss of control experienced – EJECT.

SMOKE AND FUMES (PILOT)

If smoke or fumes are detected in the cockpit, proceed as follows:

1. Check and tighten oxygen mask.
2. COCKPIT PRESS switch—RAM EMERG.

Note

Control of cockpit temperature is inoperative and, at altitudes above 8000 feet, cockpit pressure will be dumped.

3. Prepare for landing as soon as possible, continuing to check for contaminants.
4. WINDSHIELD & CANOPY DEFROST knob—INC, as desired (if too cold).

ELECTRICAL FIRE

1. Secure all unnecessary electrical equipment.
2. Land as soon as possible.

FIRE (RAN)

FIRE WARNING LIGHT ON

Should the FIRE warning light illuminate, NOTIFY THE PILOT IMMEDIATELY and prepare for possible ejection.

HOT AIR LEAKS

Any abnormal change in pressurization air and/or low pressurization airflow should be regarded as a possible hot air leak. NOTIFY THE PILOT IMMEDIATELY and prepare for ejection should fire or other failures make such action necessary.

ELECTRICAL FIRE

1. All equipment POWER switches—OFF.
2. NOTIFY THE PILOT IMMEDIATELY.
3. Prepare for possible ejection.

SMOKE AND FUMES

1. NOTIFY THE PILOT IMMEDIATELY.
2. Check and tighten oxygen mask.
3. Check navigation data to nearest landing facility, as applicable.

ALT COOL LIGHT ON

An ALT COOL light ON may be experienced as a result of a failure of the turbine-compressor units or associated equipment. The cabin air supply will be diverted for electronic equipment cooling and cabin conditioning and pressurization will be lost. At the higher altitudes, the loss of pressurization is a serious problem and some action must be taken. Whether or not the loss constitutes an emergency condition is dependent upon the altitude of the aircraft. If the ALT COOL light comes on, proceed as follows:

1. Pilot should warn the RAN to prepare for rapid recompression.
2. Depress the ALTERNATE COOL reset button.
3. If the ALT COOL light comes on after 15 seconds, increase engine rpm and increase airspeed.
4. Depress ALTERNATE COOL reset button.

CAUTION

Multiple alternate cool resets may cause damage.

5. If the ALT COOL light comes on again, reduce cockpit altitude to below 25,000 feet.
6. RAM EMERG—AS REQUIRED.
7. WINDSHIELD & CANOPY DEFROST knob—INC (if too cold).
8. During postflight shutdown hold ALT COOL reset button depressed until both generators drop off line.

ABNORMAL COCKPIT TEMPERATURE

COCKPIT TEMPERATURE CONTROL FAILURE

Should cockpit temperature become too hot or too cold, proceed as follows:

1. Check AUTO/MAN switch—AUTO.
2. Check temperature response to changing the setting of the COCKPIT TEMP knob.
3. If automatic control is inoperative, move AUTO/MAN switch to MAN.
4. Check temperature response by changing the setting of the COCKPIT TEMP knob.
   Should manual control respond properly, the temperature controller or temperature sensor may be inoperative.
5. COCKPIT PRESS switch—RAM EMERG or OFF.
6. WINDSHIELD & CANOPY DEFROST knob—INC (if too cold).

WINDSHIELD DEFROST FAILED ON

Should windshield and canopy defrost air continue to flow with WINDSHIELD & CANOPY DEFROST knob turned OFF, proceed as follows:

1. WINDSHIELD DEFROST & ANTI-ICE circuit breaker—PULL.

If heat persists:

2. COCKPIT TEMP knob — MANUAL FULL COLD.
3. Ventilation air control tubes — MAXIMUM TO CANOPY.
4. Clean up and accelerate to 250 to 300 knots.
5. WINDSHIELD DEFROST & ANTI-ICE circuit breaker—RESET.
6. WINDSHIELD ANTI-ICE switch—ON.

Note

Under some flight conditions, placing the WINDSHIELD ANTI-ICE to ON may increase cockpit temperatures.

If heat becomes intolerable:

7. Descend and jettison canopy.
8. Land as soon as possible.
9. WINDSHIELD ANTI-ICE switch—OFF when flaps lowered.

CAUTION

A wave-off with WINDSHIELD ANTI-ICE ON or operation on deck in excess of 10 seconds will result in damage to the windshield. Damage may also occur under high RPM, low speed condition if in the EMERG switch position.

EMERGENCY OXYGEN

The first indication of oxygen supply exhaustion will be illumination of the OXYGEN warning indicator. If the warning light circuit is defective and the liquid oxygen quantity indicator is not periodically checked, system supply exhaustion will be indicated by a sudden onset of difficult inhalation. If this occurs, crew member detecting the failure shall immediately pull the emergency oxygen supply ring and advise other crew member to follow suit; pilot shall initiate descent to lower altitude.

WARNING

- Should the OXYGEN warning indicator illuminate in flight and more than 0.8 liter of oxygen is aboard, a system malfunction has occurred. Check connection of Scott composite disconnect. Descend to a safe cockpit altitude and be prepared to pull emergency oxygen supply ring upon noting a restriction to inhalation.
- If the Scott block assembly becomes disconnected, both normal and emergency oxygen are unavailable to that cockpit. This situation also results in ICS loss. The pilot should immediately descend to an altitude at which oxygen is not required. If the aft cockpit Scott block becomes disconnected, the RAN should immediately notify the pilot, using the appropriate UHF communications system frequency code and procedures.

PRESSURE SUIT EMERGENCY PRESSURIZATION*

The oxygen system supplies pressure suit pressurization in the event of complete failure of the aircraft air conditioning and pressurization system above 35,000 feet. The sequence of events which results in the aircraft oxygen system being used for suit pressurization is completely automatic and requires no attention from the crew members. With the pressure suit, oxygen system pressure will adequately protect the crew members for descent and landing from any altitude.

ENG DOOR LIGHT (Clean Configuration)

1. Reduce power.
2. If light still on,remain subsonic and below 35,000 feet, and land as soon as practicable.

*Aircraft 145157 through 156617

PITOT-STATIC SYSTEM FAILURE

The airspeed indicator will show characteristic reactions in the event of total pressure loss (such as might be caused by ice forming on the pitot boom) or static pressure loss (caused by water frozen in the static lines). Refer to ICE AND RAIN, in Section VI.

1. CHECK PITOT ANTI ICE ON, REFER TO AOA EQUIVALENT DATA. Reduction in aircraft attitude and smooth application of military power may be required if initially slow.

WARNING

Should the pitot anti-icing system fail, no positive cockpit indication is available. Pitot boom icing may cause the inlet ramps to be driven toward the down position, reducing duct airflow and possibly causing flame-out. Additionally, the ejection seat speed sensors may be affected and failed to the low mode. Avoid operating at angle-of-attacks of less than 9.5 units.

TOTAL PRESSURE SOURCE FAILURE

1. If the aircraft is in a climb, the indicated airspeed increases as the decreasing static pressure is sensed. Altimeter and vertical speed indications are not affected.
2. If the aircraft is in a descent, increasing static pressure is sensed, resulting in decreasing airspeed indications.

STATIC PRESSURE SOURCE FAILURE

1. Altimeter and vertical speed indications will be incorrect, since they tend to remain at their last indications before failure.
2. Airspeed indications will be low during a climb and high during descent.

ANGLE-OF-ATTACK EQUIVALENT DATA

The following angle-of-attack data are provided for reference in the event of airspeed indicator failure and are applicable to aircraft gross weights of 56,000 to 76,000 pounds with no external load:

FLIGHT CONDITION		ANGLE-OF-ATTACK UNITS
Climb		
Military Thrust	Sea Level	7
	10,000/20,000	8
	30,000	9
	35,000	10
	40,000	11

FLIGHT CONDITION		ANGLE-OF-ATTACK UNITS
Maximum Thrust	Sea Level	6
	10,000/20,000	7
	30,000	8
	35,000	9
	40,000	10
Cruise		
Sea Level and Best Cruise Altitude		9.5
Maximum Endurance		11.5
Holding		10.0
Sea Level Run-in (0.9 Mach)		6.0
Descent		
250 KIAS, All Configurations		11.0
Flap Extension		11.0
Landing Gear Extension (Flaps Down)		11.0
GCA Downwind (Flaps and Gear Down)		14.0
GCA Base Leg and Final Approach		15.0
Stall Warning		19.0

FUEL SYSTEM FAILURE

BOOST PUMP FAILURE

With JP-5 fuel and fuel system pressurization operating, engines will operate normally with both sump tank boost pumps inoperative. Should fuel system pressurization failure occur with both boost pumps inoperative, military power operation may not be obtainable above approximately 25,000 feet with JP-5 fuel (16,000 feet with JP-4).

Note

There is no direct indication of boost or transfer pump failure except for possible fuel flow fluctuations.

Should engine surging or partial power loss occur, proceed as follows:

1. Immediately reduce power and maintain the highest altitude at which satisfactory engine operation occurs.
2. ESS FUEL circuit breaker—CHECK IN.
3. If both sump tank boost pumps are inoperative, the forces produced by large decelerations and high angles of descent may cause the sump tank suction feed valve to become uncovered, resulting in flame-out.
4. Land as soon as practicable, avoiding excessive deceleration and steep descent angles.

CAUTION

Afterburner operation is not recommended.

FUEL FILTER LIGHT ON

Illumination of a low-pressure fuel filter caution indicator indicates impending fuel filter bypass. In this event, proceed as follows:

1. Fuel Flow Fluctuations – CHECK
2. Land as soon as practicable.
3. With accompanying RPM, EGT, or NOZZLE fluctuations – LAND AS SOON AS POSSIBLE.

FORWARD TANK TRANSFER FAILURE

1. ESS FUEL circuit breaker—PULL.
2. If no transfer results, ESS FUEL circuit breaker—RESET.

WING FUEL TRANSFER FAILURE

With the WING switch in the NORM position, failure of wing fuel to transfer is indicated by a drop in sump tank fuel to below 2000 pounds after transfer of all drop tank, bomb bay, and forward tank fuel. Aft tank transfer rate is not sufficient to maintain more than 8000 pounds per hour combined fuel flow. If wing fuel fails to transfer, proceed as follows:

1. WING switch—AUX.
2. If WING AUX fuel transfer does not occur, use procedure described under ALTERNATE WING FUEL TRANSFER PROCEDURES.

Note

Bomb bay cans must be empty (or depressurized) for WING AUX to be operative. The WING switch returns from AUX to NORM on extension of the landing gear.

ALTERNATE WING FUEL TRANSFER PROCEDURES

The following alternate procedures are recommended for obtaining wing fuel auxiliary transfer to eliminate the requirement for holding the WING switch in the AUX position and to bypass malfunctions in the fuel sequencing control circuits.

WING DUMP

To bypass bomb bay cans low-level switch, cans dump switch, and can connectors:

1. CANS switch—NORM.
2. FUEL DUMP handle—WING DUMP POSITION.
3. WING switch—AUX.
4. FUEL DUMP handle—STOWED.

AIR REFUELING PROBE

If transfer does not occur with the wing dump method:

1. Reduce speed to less than 280 KIAS.
2. CANS switch—NORM.
3. FUEL PROBE switch—EXTEND.
4. WING switch—AUX.
5. FUEL PROBE switch—RETRACT.

HOOK DOWN

If transfer still does not occur, the bomb bay cans low-level switch can be bypassed as follows:

1. Reduce speed to less than 250 KIAS.
2. Arresting hook—DOWN.
3. WING switch—AUX.
4. HYD SUB-SYS ISOLATION switch—TAKE-OFF/LANDING.
5. Arresting hook—UP.
6. HYD SUB-SYS ISOLATION switch—FLIGHT.

OTHER FUEL MANAGEMENT PROCEDURES

WING FUEL TRANSFER TO CANS AND SUMP

1. CANS switch —NORM.
2. Reduce speed to less than 280 KIAS.
3. FUEL PROBE switch—EXTEND.
4. WING switch—AUX.
5. Monitor bomb bay can fuel.

WING FUEL GRAVITY FEED

1. If wing transfer does not occur using alternate transfer methods and range is a consideration:
   (a) Climb at Military Thrust to 20,000 to 25,000 feet or until sump level reaches 800 pounds.
   (b) Maintain best cruise fuel flow.
2. If range is not a consideration, maintain sump level at 800 to 2300 pounds with nose attitude less than 4.5 degrees on stand-by gyro. If possible plan descent so as to have sump at 2300 pounds prior to dirty up.
3. To obtain last 1200 pounds of wing tip fuel, maintain 5 degrees nose-down pitch attitude for 5 minutes or rock wings.
4. At least 1400 pounds of wing fuel is required to maintain sump level at 800 pounds in both clean and approach configurations.

Note

Wing dump may be available at approximately 800 pounds per minute.

DROP TANK TRANSFER FAILURE

Should drop tank fuel fail to transfer, the level of fuel in the sump tank will drop to approximately 3000 pounds and be maintained at this level by transfer from the bomb bay cans and forward tank. Selection of quantity indication will show a drop in bomb bay level from that noted prior to engine start, with drop tank quantity remaining static. Transfer may be presented by a faulty drop tank air shutoff valve. In this event, the procedure covered in the following step 3 should result in complete recovery of drop tank fuel. However, electronic equipment operation is interrupted and autonavigator alinement is lost. Attempt to obtain drop tank fuel as follows:

1. DROP TANKS transfer buttons—Cycle OFF/ON.
2. Check sump and forward tanks for rising fuel level.
3. If transfer does not occur, warn the RAN of intention to secure generators and extend RAT. When ELEC EPU ON indicator is illuminated, move generator switches to OFF and check for transfer after at least 2 minutes. With a full outboard tank, JETTISON.
4. For landing with one full inboard tank, use full opposite wing down trim.

CAUTION

Do not attempt to land with a single full outboard drop tank, as directional control may be lost after touchdown. If a single outboard drop tank fails to feed, it should be released.

BOMB BAY CAN TRANSFER FAILURE

If drop tanks are installed and full, failure of bomb bay can fuel to transfer will not be detected until all drop tank fuel has transferred. Should this occur, the level of fuel in the forward tank will decrease faster than normal. Should the forward tank be allowed to transfer completely, sump level will drop to 2300 pounds and transfer of wing fuel will begin. If this occurs, proceed as follows:

1. CANS switch—AUX.
2. Fuel gage—BOMB BAY.
   Check for slow transfer.
3. If can fuel does not transfer, pull ESS FUEL circuit breaker.
4. If transfer does not occur, re-engage circuit breaker.

CAUTION

Under normal conditions, bomb bay CANS and WING switches should be in NORM when dumping.

5. Fuel dump handle—PULL (cans).
6. If fuel will not dump, return dump handle to stowed position.

AFT CG CONSIDERATIONS

With trapped fuel in bomb bay cans, maintain sump at 2800 to 3000 pounds using wing fuel auxiliary transfer or an alternate wing fuel transfer method.

To transfer wing fuel to the forward tank, proceed as follows:

1. HYD SUB-SYS ISOLATION switch—FLIGHT.
2. LDG GEAR handle—DOWN.
3. Use wing dump, air refueling probe, or hook down alternate procedure, depending on airspeed considerations.
4. WING switch—HOLD IN AUX.
5. Monitor fuel level in forward tank.
6. Refer to AFT CG LANDING, in this section.

To return to normal operation, proceed as follows:

1. LDG GEAR handle—UP.
2. HYD SUB-SYS ISOLATION switch—TAKE-OFF/LANDING.
3. Hook—Retract.
4. HYD SUB-SYS ISOLATION switch—FLIGHT.

AIR REFUELING PROBE RETRACT FAILURE

1. FUEL PROBE switch—RETRACT (only if not damaged).
2. CANS switch—AUX (to regain normal transfer when probe must remain extended or if switch malfunctions).
3. If transfer of wing fuel does not occur, pull the ABN REFUEL circuit breaker. Main system pressure is lost in this event. Avoid high rates of descent.

CAUTION

Do not exceed 280 KIAS.

ELECTRICAL POWER SYSTEM FAILURES (PILOT)

Failure of one generator should pose no serious problem if the d-c converters continue in operation. If a generator will not reset after one attempt, switch it to OFF, and be alert for Bomb Bay Fire indication. Land as soon as practicable. On an operational mission, immediately ensure that the SYSTEM switch is positioned to provide power to the primary equipment.

CAUTION

During single-generator operation, high engine power settings may deplete sump tank fuel. Under these conditions, sump level should be closely monitored.

Failure of both generators is unlikely. However, if dual failure does occur, immediate results, especially at night, may be startling. Since no battery is installed, dual-generator failure results in complete failure of all electrically powered components and, at night, complete "blackout." All circuits essential to safe flight may be powered by extending the RAT (i.e., restoring communications, intercom, cockpit floodlighting, fuel sequencing, and boost pump control). Under these conditions, alternate roll and yaw trim must be used, and the alternate trim switch is used to control pitch trim. Altitude should be reduced to less than 39,000 feet to ensure sufficient gravity flow of wing tank fuel. If the RAT*/EPU is used alone to obtain electrical power, extended speed brakes must be dumped prior to landing, and gear and flaps must be extended by emergency means. The arresting hook will extend normally when selected. Should both d-c converters fail, the RAT may be extended to power essential d-c bus items. However, even with both generators operating, failure of both d-c converters results in loss of normal operation of all following systems: (1) landing gear extension, (2) speed brake operation, (3) pitch and yaw augmentation, (4) electric flight control system, (5) nose wheel steering, (6) flaps operation, and (7) hydraulic subsystems with subsequent HYD PRESS caution indication. For detailed information on equipment lost on complete or partial a-c or d-c failures, refer to A-C ELECTRICAL FAILURE ANALYSIS and D-C ELECTRICAL FAILURE ANALYSIS, in this section.

On some aircraft,* the RAT is removed and emergency electrical power is automatically supplied by a hydraulically powered (No. 2 system) EPU, in the event of a-c or d-c system failure. All essential circuits and equipment operate in the same manner as unmodified aircraft.

CIRCUIT BREAKER LOSS LIST

Following is a resume of losses encountered due to failure of circuits controlled through the pilot's cockpit circuit-breaker panel (figure 1-13).

CIRCUIT BREAKER	LOST	REMARKS
EXT JETTISON (NO. 1, NO. 2)	External jettison	Use normal manual release (MASTER ARM and trigger).
NAV ESS XMFR	In aft cockpit:	
	Chart lights	
	Utility lights	
	CNI command	Pilot has command.
	Compass command	Pilot has command.
	Warning lights	
	Caution lights	
CG CTR PED	Stand-by attitude indicator	Cross-check. Turn-and-slip indicator may run sluggishly.
FUEL GAUGE DC	Quantity selector indicator	Gage remains operative.
WINDSHIELD DEFROST & ANTI-ICE	Canopy defrost knob WINDSHIELD ANTI-ICE switch (associated safety factors)	If failed on, reduce power and land. Not available if failed off.
EMER FLAP	Emergency flap switch	If No. 2 hydraulic system has failed, reduce to minimum fuel and land no-flap.

*Aircraft having AFC 350 complied with

CIRCUIT BREAKER	LOST	REMARKS
CABIN PRESS	Pressurization lost (dumped)	Land as soon as practicable
	ALTERNATE COOL reset inoperative	
NAV ICS	RAN cannot receive or transmit, ICS or UHF COMM, in NORM, ALT ICS, or ALT RAD	Use UHF sidetone in ICS EMER mode
PILOTS ICS	Pilot cannot receive or transmit, ICS or UHF COMM, in NORM, ALT ICS, or ALT RAD	Use UHF sidetone in ICS EMER mode
ICS RELAY PWR	ICS completely dead in both cockpits in NORM, ALT ICS, ALT RAD	Use UHF sidetone in ICS EMER mode
NO. 1 FUEL SHUTOFF NO. 2 FUEL SHUTOFF	Applicable engine firewall valve will not close on operation of ENGINE FIRE switch	
PILOTS ESS XMFR	DC PWR caution indicator	
	ECM mode indicators	
	Indicating lights dimming	
	CNI emergency power indicator (light)	
	Armament indicator	Confirm verbally
	Hook warning light	Use TV (day)
	LABS advisory light	Use O/S mode
	HSI mode lights	
	Emergency lights	
	Compass command	
	Anti-ice indicator	
	Electric flight control indicators	
	Floodlights	
	CNI command lights	Check channel change for control
	CNI command transfer	
	ECM indicator	
	Console lights	
	AFCS indicators	
NO. 1 START IGN NO. 2 START IGN	Applicable EMER IGN button inoperative (air start impossible)	
FIRE EXT SHUTOFF	ENGINE FIRE switch OFF position will not open valves	Firewall shutoff

CIRCUIT BREAKER	LOST	REMARKS
FUEL SEQ	Forward transfer pump	
	Forward boost pump	
	Wing scavenge pump	
	Wing transfer pump	
	Saddle tank pump	
	Engine bay cooling door open (flaps up)	
ABN REFUEL	Fuel system internal pressure vented	
	FUEL PROBE switch inoperative:	
	Probe retracted	Normal transfer.
	Probe extended	Normal transfer.

Note

If circuit or switch fails with probe extended, bomb bay fuel may be transferred by selecting AUX or by pulling circuit breaker.

CIRCUIT BREAKER	LOST	REMARKS
IND TEST NO. 1	Fire warning system	
	Master warning indicator	
	Master caution indicator	
	Systems caution indicators	
	OXYGEN warning and test	
	WHEELS warning indicator	
IND TEST NO. 2	CNI emergency power indicator	
	LOW ALTITUDE warning light	
	Radar altimeter low-altitude override button	
	Landing gear advisory light	
	ECM indicators test	
	Armament indicator test	
	HYD EPU ON* and ELEC EPU ON advisory lights test	
	Radar advisory lights test	
	Pilot's and RAN's lights test	
FLAP & DROOP CONT	Normal flap/droop control	Use emergency.
	Engine door control relays	
	Yaw trim recentering	Trim manually after flap emergency extension.
ESS FUEL	Sump aft boost pump out	Fuel trapped.
	Can pressure on (fail-safe)	
	Forward tank proportioning valve open (fail-safe)	Forward tank will gravity transfer.

*Aircraft not having AFC 350 complied with

A-C ELECTRICAL FAILURE ANALYSIS

For analysis of a-c electrical failure, refer to the following table:

EQUIPMENT	FAILED
Monitored (Not available on one generator)	Wing Scavenge Pumps* Radome Fold Seat and Pedal Adjust Engine Cooling Doors (electrical operation; without AFC 359) All high-duty fuel pump operation
Primary A-C (Not available with both generators inoperative; special systems inoperative with loss of primary a-c bus)	Fuel: Sump tank, wing transfer, forward boost, and forward tank pumps* Power Plant: Afterburner ignition Ramp and gap* Engine anti-ice Flight Controls: Pitch and yaw augmentation* Autoflight* Electric flight control* Normal trim Electronics: Air data, CNI* AN/ASB-12, radar, radar altimeter* TACAN, HSI, ECM* Armament: Armament initiation Armament master circuit Tank and pylon release Mode release control
	Heat and Vent: Primary and secondary heat exchanger jet pumps* AN/ALQ-55 cooling Liquid heat exchanger air valves Miscellaneous: Interior and exterior lights Engine Cooling Doors (AFC 359) RAN stand-by gyro Position instruments Ground safety and air safety
Essential A-C (Not available with both generators inoperative; available with ram-air turbine extended or EPU on (AFC 350))	Heat and Vent: Cabin equipment and special systems temperature control Alternate cooling Suit temperature Ram-air control Oxygen quantity Fuel: Aft boost pump* Fuel fire wall shutoff valves* Fuel flow Fuel quantity (Can transfer is automatic and cannot be controlled) Power Plant: EGT, fire detectors, engine instruments Firewall shutoff Start and ignition system

*D-C power required for control

EQUIPMENT	FAILED
	Flight Controls: Flap, droop, and trim indicator Flap and droop control Alternate trim Flight Instruments: Flight reference set (AAI/ADI, heading compensator; and three-gyro platform) Pilot's STBY GYRO ARI (if COMP selected) Electronics: CNI UHF COMM AUX REC IFF, AIMS (AFC 296) ACLS (AFC 233) Miscellaneous: Internal jettison Pitot heater Indicator, warning, and caution lights Instrument vibrators Emergency jettison Oxygen quantity HYD and oil pressure Pilot/RAN utility lights Cockpit flood lights

D-C ELECTRICAL FAILURE ANALYSIS

For analysis of d-c electrical failure, refer to the following table:

Primary D-C (Not available with both converters inoperative)	Fuel: All pumps except sump tank aft boost pump* Wing and bomb bay can auxiliary transfer* Flight Control: Pitch and yaw augmentation* Inlet ramp* Autoflight* Electric flight control* Speed brake control* Electronics: AN/ASB-12, ECM, passive warning, CNI* Radar* ALQ 41, 55, 100, 126 ARA 63 and D/L control Heat and Vent: Primary and secondary heat exchanger jet pumps Power approach bleed reduction Canopy seal Miscellaneous: Air temperature detector Pneumatic compressor Nose wheel steering* Wing and tail fold Angle of attack Hydraulic subsystems isolation Pedal shaker and accelerometer Landing gear sequence APC system Indicator lights Chaff Hook light

*D-C control. A-C power also required for operation

EQUIPMENT	FAILED
Essential D-C (Lost with both converters inoperative; available with ram-air turbine extended or EPU on (AFC 350)	Indicators: Turn and slip Nozzle position Landing gear Fuel gage selector Indicator test (button) Pilot's caution and warning indicators Heat and vent: Defrost and anti-ice Cabin pressure Left- and right-hand primary heat exchanger bypass temperature control Fuel: Air refueling probe* Sump aft boost pump* Miscellaneous: Flight reference set, ICS, emergency flap UHF communications (reduced power) IFF/SIF
	External jettison CNI essential Emergency ignition
No. 1 Secondary D-C (Lost with one converter inoperative and SYSTEMS switch in LOOK or LISTEN; lost with one generator inoperative and SYSTEMS switch in LOOK or LISTEN)	Armament: All armament functions ECM destruct Emergency jettison
No. 2 Secondary D-C (Lost with one converter inoperative and SYSTEMS switch in ARM)	Special Systems: All special systems

*D-C control. A-C power also required for operation

FAILURE OF BOTH GENERATORS

Failure of both generators is a rather remote possibility. However, if a complete electrical power failure should occur, or if for any reason it becomes necessary to turn off the generator switches, follow this procedure:

1. Ram-air turbine*—EXTEND.
   Illumination of the ELEC EPU ON advisory light indicates proper output from the emergency electrical power unit to the a-c and d-c essential buses, allowing operation of the sump tank aft boost pump. The EPU is initiated automatically on aircraft having AFC 350 complied with.
2. Generators – RESET (once each). If reset(s) unsuccessful, generator(s) OFF.
3. TRIM select switch—ALT.
   For trim, use the ALTR ROLL/YAW TRIM switch.
4. If necessary, reduce altitude to below 25,000 feet and/or engine rpm to maintain engine operation, as fuel flow may be impaired because of loss of fuel boost pressure at altitudes above 39,000 feet.
5. Refer to WING FUEL GRAVITY FEED.

Note

Wing fuel cannot be dumped without generator operation unless WING AUX has been selected prior to generator failure.

6. Refer to automatic isolation procedure under Hydraulic Failures.

Note

When using the RAT/EPU for electrical power, do not move the flight controls more than required to maintain wings-level flight while attempting air starts. Large demands on the hydraulic system may cause the priority valve within the EPU to close, stopping the supply of electrical power for engine ignition.

7. Land as soon as possible.

Note

Only NAVAIDS available are UHF, ADF, AUX RECEIVER and ACL needles. IFF may be used to obtain radar vectors. Systems lost are: Radar, ASB-12 navigation, Tacan and HSI.

8. Minimum airspeed on final* — 145 KIAS (with operating hydraulic system).

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*Aircraft not having AFC 350 complied with

FAILURE OF ONE GENERATOR

Generator failure is indicated by illumination of a generator-out caution indicator located on the pilot's instrument panel. When this occurs, all selected bus loads are assumed by the remaining generator. If the SYSTEM switch is in ARMT (armament), loss of d-c power occurs in special reconnaissance systems (if installed).

With the switch at LOOK or LISTEN, all arming and fuzing functions are lost. Proceed as follows:

1. SYSTEM switch—AS DESIRED.
2. Oil pressure and nozzle position—check.
3. Hold generator switch momentarily in RESET, then release.
   The caution indicator may extinguish momentarily with the switch in RESET, even though the fault may still exist. If the indicator remains extinguished, the temporary fault may have been due to overvoltage, undervoltage, open phase protection, or differential current protection.
4. GENERATOR switch—OFF.

Note

If generator will not reset on first attempt, generator switch-OFF. Operation of the wing fuel scavenge pumps, seat and pedal adjustment, all high-duty fuel pump operations, and operation of engine overpressure relief doors (without AFC 359) are lost.

5. Drop hook to depressurize cans and slow to 250 KIAS. Prepare to land as soon as practicable. The remaining generator will assume primary and essential electrical loads through the action of line contactors. Flaps, hook, and landing gear operate normally. If no indication of bomb bay fire exists and can dump required, dump may be available with hook down, but if not raise hook and dump.

WARNING

If generator caution light is followed or accompanied by illumination of hydraulic and/or fire warning light, suspect bomb bay fire.

CAUTION

- Loss of normal engine cooling door operation and prolonged use of high power settings in the power approach configuration can cause an overheat condition and possible fire warning.
- Flight idle (T_2) reset may occur because of increased CIT.

6. When operating on one generator, check sump tank fuel level during high power (afterburner) operation at low altitude. Reduce power as required to allow fuel transfer rate to maintain sump fuel at safe level (arrested landing not required).

Note

Initial generator reset may monitor other generator off.

7. Other generator – attempt one reset. If no reset, generator switch off.

D-C POWER FAILURE

The essential d-c bus provides the minimum requirements for d-c powered equipment. Illumination of the DC PWR caution indicator reflects failure of the primary d-c converter. The DC PWR caution indicator is powered by an a-c source so that, if both converters fail, the DC PWR caution indicator will be the only indicator illuminated and all d-c powered indicators will be inoperative. With both d-c converters inoperative, electrical power can be supplied to the essential d-c bus by extending the ram-air turbine. With one converter out and the SYSTEM switch in LOOK or LISTEN, d-c power is provided to No. 2 secondary d-c bus components. *With both converters inoperative, the following systems remain inoperative with the ram-air turbine extended:* (1) No. 2 hydraulic subsystems, (2) electric flight control systems, (3) angle of attack and pedal shaker, (4) position lights, (5) cockpit pressurization, (6) normal trim, and (7) all fuel system pumps, except the aft boost pump. If d-c power failure is caused through double generator loss, the ram-air turbine should be extended to provide power to the essential a-c and d-c buses for starting and ignition during air starts. After air start, when a-c generator output is restored, the ram-air turbine can be retracted by means of the EPU RETRACT button on the pilot's center pedestal (HYD SUB-SYS ISOLATION switch must be in TAKE-OFF/LANDING). On some aircraft,* essential bus electrical power is provided automatically by the EPU.

COMPLETE D-C POWER FAILURE PROCEDURE

1. RAT—EXTEND.
   Check ELEC EPU ON light on. On some aircraft,* EPU power is initiated automatically.
2. Attempt reset.
3. TRIM switch—ALT.
4. Descend below 25,000 feet.
5. Use WING GRAVITY TRANSFER procedure.

Note

Wing aux gravity transfer and gravity dump are available with one generator.

6. Refer to automatic isolation procedure under HYDRAULIC FAILURES.
7. Land as soon as practicable.

Note

Radar and ASB 12 navigation are lost.

8. Minimum airspeed final**–145 KIAS (with operating hydraulic system).

ELECTRICAL POWER SYSTEM FAILURES (RAN)

Should both generators fail, all electrical power must be supplied by the ram-air turbine powered emergency power unit. Though failure of both generators is extremely rare, such failures have occurred. On EPU power only, the following systems or equipment *remain operational* in the RAN'S cockpit:

Map, white flood, and utility lights.	UHF channel/frequency indicator
Canopy (pneumatic)	Compass COMD button
Oxygen quantity indicator	TRANSMIT CONTROL switch
Canopy caution light	Indicating lights test button
Oxygen warning light	IFF-SIF system
Fire warning light	UHF COMM (reduced transmit power)
Cockpit altimeter	Cockpit heat lever
ARI heading card	Compass system

Note

When depressed, the indicating lights test button will illuminate the SLR, CAMERA, RECON COOL, BOMB AWAY, and ARM MAST'R ON lights. The primary function of these lights remains inoperative under EPU power only conditions.

*Aircraft having AFC 350 complied with
**Aircraft not having AFC 350 complied with

TOTAL ELECTRICAL FAILURE (RAT/EPU INOPERATIVE)

Total failure may be caused by either a RAT/EPU malfunction or the loss of their associated hydraulic system accompanied by a dual generator (A-C) power failure.

1. Maintain VFR. If unable to maintain VFR/orientation, or regain generator operation (if IMC/NIGHT, unlimited reset attempts are allowed) – EJECT.

2. Refer to wing fuel gravity feed.

Note

Although fuel indicators are inoperative fuel feed to the engines is available through sump manifold.

3. Refer to automatic isolation procedures under Hydraulic Failures. Gear will extend. Flaps/droops will not.

4. Land as soon as possible.

5. For pitch trim utilize emergency pitch trim crank.

6. Utilize survival radios.

WARNING

If aft CG creates unsafe nose high attitude in landing configuration increase airspeed if practicable, or EJECT.

HYDRAULIC FAILURES SYSTEM, PUMP, OR AUTO ISOLATE.

Failure of both No. 1 or No. 2 system pumps is indicated by illumination of the HYD PRESS caution indicator and loss of pressure from the pumps and/or in the system to less than approximately 650 psi.

1. HYD SUB-SYS ISOLATION switch—FLIGHT.
2. Reduce speed below 1.4 IMN or 550 KCAS, whichever is less.
3. "Kill" button—DEPRESS.
4. YAW AUG NO. 1 and YAW AUG NO. 2 switches—STBY.
5. Ramps switches–TO STBY IF RAMPS CAUTION LIGHT ON. If ramps bleed down at slow airspeed avoid rapid throttle movements. Reset ramps below .3 IMN if malfunction in number 1 system.
6. Speed brakes—RETRACT.

   With No. 2 system failure, speed brake dump handle must be pulled.

7. Plan to land as follows:

   (a) With a system failure or auto isolate – LAND AS SOON AS POSSIBLE.

   (b) With pump failure (pressure zero or straight up) – LAND AS SOON AS PRACTICABLE. A single pump failure may be followed by failure of the second pump.

      1. If needle straight up associated throttle to idle until ready to commence approach.

      2. If on deck secure associated throttle. Secure both engines as soon as practicable.

8. Flap/Droop Emergency Extension:

   (a) Below 290 KIAS flap handle to 30 degrees, check for 25 degree droops then select 50.

Note

Failed number 1 system and auto isolate of number 2 system will prevent droop extension See approach speeds.

   (b) Below 190 KIAS EMERG FLAP switch DOWN. Check Flaps/Droops full down.

Note

Full flaps may not be attained until approximately 170 KIAS.

9. Landing Gear Emergency Extension:

   (a) Below 230 KIAS Gear Handle – DOWN

   (b) EMERG LDG GEAR Handle – PULL AND HOLD (check gear with TV).

   (c) Safe indication – RELEASE HANDLE.

Note

Gear may extend more easily at higher than approach speeds (but less than 230 KIAS).

10. Landing with number 2 system failure, single pump failure number 2 system, or auto isolate.

    (a) Utilize arresting gear if readily available.

    (b) If gear is missed, stay on deck unless directional control problems encountered.

    (c) Use EMER BRAKE handle, save AUX brake accumulator for directional control. Normal brake system and nose steering inoperative.

    (d) Normally do not maneuver or taxi. Stop straight ahead on runway, call for tow, and shut down.

WARNING

If bingo/divert requires flap/droop retraction accelerate to 200 KIAS before selecting EMERG UP, and be alert for possible roll caused by split flaps (reselect EMERG DOWN).

Note

Landing gear can not be retracted with number 2 system failure or auto isolate.

11. Landing with number 1 system failure or single pump failure number 1 system:

    (a) Utilize arresting gear if readily available.

    (b) Following shipboard arrestment, or field arresting gear missed/not availble, select TAKE OFF/LANDING during rollout for normal brakes and nose wheel steering.

    (c) Taxi clear of runway/landing area call for a tow and shut down.

    (d) If bingo/divert requires flap/droop retraction accelerate to 200 KIAS, select TAKE OFF/LANDING and then EMERG UP, wait 15 seconds then raise flaps/droops and gear normally.

*Aircraft not having AFC 350 complied with

COMPLETE HYDRAULIC FAILURE

Complete failure of both hydraulic systems (four pumps) is an extremely remote possibility. In the event of complete failure, all hydraulically operated systems are lost, followed closely by "freezing" of all flight controls and complete loss of control of the aircraft. Proceed as follows:

WARNING

The RAT is removed by AFC 350. Eject while in control of aircraft.

1. RAT*—EXTEND.
   Check HYD EPU ON advisory light illuminates.
2. If control stick action is not restored, EJECT IMMEDIATELY. Control is not possible without hydraulic pressure.
3. In order to ensure maximum RAT* output under all conditions, approximately 160 KIAS should be maintained. This is especially important in turbulence. Control movements must be restricted to a minimum to avoid loss of pressure at a critical point during landing.

Note

When using the RAT EPU for electrical power, do not move the flight controls more than required to maintain wings-level flight while attempting air starts. Large demands on the hydraulic system may cause the priority valve within the EPU to close, stopping the supply of electrical power for engine ignition.

4. Extend flaps by emergency method.
5. Extend gear by emergency method.
6. Fly final approach at 160 KIAS, under optimum conditions, flaring prior to touchdown.

WARNING

- Should emergency (RAT) hydraulic power fail when flight control power is obtained on the RAT alone, EJECT WITHOUT DELAY.
- Carrier landing should not be attempted.

FLIGHT CONTROL SYSTEMS MALFUNCTIONS

For flight control systems malfunctions, proceed as follows:

1. "Kill" button—DEPRESS.
2. If normal trim runaway, select alternate trim prior to releasing "kill" button.

PITCH AUGMENTATION DISENGAGEMENT

WARNING

Pitch augmentation malfunctions can occur which will not monitor the pitch augmentation system off or illuminate the PITCH AUG caution indicator. A malfunctioning pitch augmentation system cannot be monitored off by use of opposing control stick forces.

Note

On some aircraft,* pitch augmentation will monitor off in the event of significant pitch augmentation opposition to stick commands.

1. "Kill" button—DEPRESS.
2. PITCH AUG switch—STBY.

ELECTRIC FLIGHT CONTROL DISENGAGEMENT

1. "Kill" button—DEPRESS.
2. ELEC SYS switch—STBY.
   Opposing stick force will monitor electric flight off.

FLIGHT CONTROL SYSTEMS FAILURES

PITCH AUGMENTATION FAILURE

Failure of pitch augmentation is indicated by illumination of the master and PITCH AUG caution indicators, followed by a slight change in pitch trim. Continued use of the normal (PITCH AUG) trim control will trim out the associated change. Proceed as follows:

1. Retrim and check No. 2 hydraulic system pressure.
2. PITCH AUG switch—ATTEMPT RESET.
3. PITCH AUG switch—STBY if reset fails.

WARNING

When the Pitch Aug light illuminates, be prepared to make pitch trim corrections to a new stick trim position approximately one inch aft of normal. If light comes on inside 3/4 mile, wave off carrier approach.

YAW AUGMENTATION FAILURE

Failure of yaw augmentation presents no serious problems at medium-to-low flight speeds under normal operating conditions. Without yaw damping, landing configuration power approaches in turbulent air may produce lateral/directional "wallowing." The frequency of this yawing is very low, allowing sufficient pilot damping. Failure of both systems during high-altitude, high-speed flight, or during the execution of high-roll-rate maneuvers will require cautious control handling to avoid excessive yawing. Yaw augmentation failure is usually indicated by a change in aircraft yaw damping tendencies and illumination of the YAW AUG caution indicator. Proceed as follows:

1. Maintain balanced flight by use of rudder pedals.

WARNING

At high Mach, directional stability is critical. Keep the ball centered.

2. Minimize roll rate; limit lateral stick movement to avoid inducing roll/yaw coupling.
3. Reduce airspeed; smoothly reduce power in order to decelerate. If at high speed, do not extend speed brakes.
4. Check positions on NO. 1 and NO. 2 YAW AUG switches.
5. Check hydraulic system pressures.
6. YAW AUG—RESET.
7. If unable to reset, do not exceed the following recommended airspeeds, or 60-degree bank angle changes:

   One YAW AUG inoperative,
   with clean aircraft — 1.7 Mach or 650 KCAS
   with external stores — 0.9 Mach or 550 KCAS
   Both YAW AUGS inoperative,
   with clean aircraft — 1.4 Mach or 550 KCAS
   with external stores — 0.9 Mach or 550 KCAS

Note

Observe IMN or KCAS limit, whichever is less.

8. For rapid undamped oscillation of the vertical stabilizer:

   (a) On deck -- both yaw augs STBY.

   (b) Airborne -- both yaw augs to STBY simultaneously and slow to below 1.4 IMN or 550 KIAS, whichever is less.

Refer to AIRSPEED LIMITATIONS and MANEUVERING LIMITATIONS in Section I, Part 4.

ELECTRIC FLIGHT CONTROL SYSTEM FAILURE

Failure or "monitoring off" of the roll or pitch electric system has no effect on flight control operation. Should the system fail to automatically disengage, proceed as follows:

1. Check No. 2 hydraulic system pressure.
2. ELEC F/C SYS switch—Attempt reset.
3. ELEC F/C SYS switch—STBY, if reset fails.

*Aircraft having AFC 184 complied with

TRIM SYSTEMS FAILURE

NORMAL PITCH TRIM FAILURE

Should the normal pitch trim control become inoperative with pitch augmentation engaged or disengaged, proceed as follows:

1. TRIM select switch—ALT.

Note

Should pitch trim runaway occur, depress the "kill" button and hold until the TRIM select switch can be moved to ALT. While the "kill" button is depressed, alternate trim is also available through the stick trim switch.

2. Control pitch trim with alternate trim switch or emergency trim crank.

ALTERNATE PITCH TRIM FAILURE

Should alternate pitch trim action fail, proceed as follows:

1. Oppose stick force manually.
2. Emergency pitch trim crank — TURN CLOCKWISE (NOSE DOWN) OR COUNTERCLOCKWISE (NOSE UP) TO RELIEVE CONTROL STICK PRESSURE.
3. Adjust trim with crank as required.

ROLL OR YAW TRIM FAILURE

Failure of the roll or yaw trim systems may place high control forces on the pilot upon changes of airspeed or configuration. Select the ALT position of the TRIM select switch and attempt to regain trim control through the ALTR ROLL/YAW TRIM switch. Should the roll trim actuator fail in a "full travel" position, some of the lateral stick load may be relieved by adding yaw trim in the direction opposite to the load.

Note

In the event both generators fail and the RAT is the only source of electrical power, the TRIM select switch must be placed at ALT to provide power for trim systems operation.

CAUTION

If the yaw trim actuator fails at "full travel," the vertical stabilizer will increase trim input from 1½ to 7½ degrees when the flaps are extended. The only alternative is tõ use control pedal deflection to counteract yaw.

SPOILER DEFLECTOR FAILURE

Failure may result from malfunctions in lateral control linkage or cables.

If wing drop occurs during takeoff or landing with insufficient response to lateral stick inputs, level wings with rudder.

1. Check for runaway trim.

WARNING

If spoilers on the down wing are failed open, repeated opposite lateral stick will result in spoilers open on both wings. With 50 degree flaps/droops, severe wing drop may occur.

2. Select 30/25 flaps/droops and accelerate until aircraft under control.

When aircraft safely under control:

3. Check hydraulic pressure and the spoiler/deflector operation in rear view mirrors.

If spoilers failed open:

4. Select SPEED BRAKE dump.

If SPEED BRAKE dump unsuccessful or spoiler(s) failed closed:

5. Dump fuel to max trap and slow flight aircraft at 30/25 flaps/droops, gear down, to determine safe approach speed.
6. Plan on short field arrestment within arresting gear limits. If gear missed remain on deck.
7. Maximize use of rudders to maintain lateral/directional stability.

DROOP LIGHT ON (BOUNDARY LAYER CONTROL VALVE FAILURES)

BOUNDARY LAYER CONTROL VALVE FAILURE CLOSED

Failure of one or both BLC valves to open as droops extend is indicated by illumination of the DROOPS caution indicator.

1. Consider diverting or carrier recovery if engaging speed is within limits.

2. Maintain 13 units AOA at 50/50 flaps/droops for approach.

3. If characteristics near approach speed are poor, utilize 14 units AOA at 30/25 flaps/droops for approach.

BOUNDARY LAYER CONTROL VALVE FAILURE ON

Should BLC fail on (DROOPS caution indicator illuminated after flap and droop retraction), proceed as follows:

1. Select 25-degree droops, zero flaps as follows:
   (a) HYD SUB-SYS ISOLATION switch—FLIGHT.
   (b) FLAPS switch—30°.
   Check droop indicate DN, flaps up.
2. Power settings—MAINTAIN 290 KIAS (or less).
3. Cruise altitude Bingo fuel increase – REFER TO BINGO CHART, NOTE 3.

Note

Failure of the BLC valves to close on droop retraction is indicated by illumination of the DROOPS caution indicator. At the 25-degree droop setting (flaps at 30 degrees for field take-off and single-engine emergency), the indicator circuit is bypassed and there is no indication of valve failure. Flying qualities and wing structural temperatures are not seriously affected with BLC failed on at 25-degree droops.

RAMP CONT LIGHT ON

If the RAMP CONT light comes on during flight, proceed as follows:

1. Attempt reset, hold switch for 3 seconds.
2. If no reset, RAMPS switch to STBY.
3. Reduce airspeed to below 1.4 IMN.
4. After gear and flaps down, check for abnormally high power requirements for existing airspeed.

Note

With inlet control system inoperative, the ramps may slowly bleed downward at low airspeeds resulting in reduced engine thrust.

If ramp extension suspected:

5. Avoid rapid throttle movements.
6. See PRECAUTIONARY SINGLE-ENGINE LANDING (figure 5-3).

INTERCOMMUNICATIONS SYSTEM FAILURE

If a normal ICS failure is experienced, first try all alternate modes. If a complete ICS failure exists, the following procedure should be attempted in order to establish some degree of communication between the pilot and RAN.

PILOT

1. Select ALT ICS, ALT RAD, and EMER.
2. Check circuit breakers.
3. Stamp feet on cockpit floor.
4. MASTER ARM switch ON/OFF (three times).
5. UHF COMM FREQ 333.3.
6. RAN answers by switching UHF command: Redialing 333.3.
7. Refer to LOST ICS- UHF CODE.

WARNING

The loss of communications with the RAN may also indicate a loss of oxygen due to a disconnected Scott block. If communications cannot be established using normal and emergency procedures, and if cockpit altitude is above 10,000 feet, the pilot should descend immediately to a safe altitude.

RAN

1. Select ALT ICS, ALT RAD, and EMER.
2. Stamp feet on cockpit floor.
3. REL TONE MODE switch—MAN/OFF (three times).
4. Pilot acknowledges—UHF FREQ 333.3.
5. Refer to LOST ICS- UHF CODE.

LOST ICS–UHF CODE

Dial frequencies right to left. Prior to selecting a new frequency for transmission, select GUARD XMIT momentarily to warn crew member that the next frequency is a transmitting frequency.

BOTH CREW MEMBERS

Upon receiving the loss of ICS signal, both crew members will refer to LOST ICS—UHF CODE procedure in their NATOPS Pocket Checklist (NAVAIR 01-60ABC-1B). The following codes will be used for further communication:

333.3	Select LOST ICS—UHF CODE.
333.0	Prepare to Eject.
333.1	Squawk MAYDAY.
333.2	Affirmative (Yes).
333.4	Heading to nearest airfield.
333.5	Commence Emergency Descent.
333.6	Oxygen Inoperative.
333.7	Prepare to land.
333.8	Returning to home base.
333.9	TACAN Out.

320.0 Are you injured?
320.1 I read you OK.
320.2 TACAN OK.
320.3 Can we continue mission?
320.4 Use survival radio.
320.5 Follow HSI.
320.6 Prepare for Emergency Landing.
320.7 Is your UHF OK?
320.8 Landing checklist complete.
320.9 Negative (No).

310.0 Signal is divert.
310.1 HSI to destination.
310.2 HSI to nearest field.
310.3 HSI to next checkpoint.
310.4 Altimeter follows.
310.5 Can you read me on ICS?
310.6
310.7
310.8
310.9

Note

- Use codes 310.6 through 310.9 as locally directed or as prebriefed between individual crew members.
- Before selecting a UHF frequency for transmitting, switch to GUARD XMIT (243.0 mc) momentarily to let the other crew member know that the next frequency selected will be a transmitting frequency.
- The LOST ICS—UHF CODE procedure in the NATOPS Pocket Checklist (NAVAIR 01-60 ABC-1B) should be used for in-flight reference.

LOST AIRCRAFT PROCEDURES

Publications used for developing lost aircraft procedures are NWP 41(A), ACP 125B and 130, and FLIP, Enroute Supplement.

IF YOU ARE LOST

1. Admit to yourself that you are lost.
2. Use and cross-check all available navigation equipment.
3. CONSERVE fuel by flying at maximum endurance airspeed.
4. Select IFF EMERGENCY (SIF MODE 3, Code 7700).

VOICE PROCEDURE

1. PAN, PAN, PAN.
   Use MAYDAY if immediate assistance is required.
2. Aircraft identification three times.
3. Type aircraft.
4. Estimated position and time.
5. Magnetic heading, true airspeed, and altitude.
6. Fuel remaining (hours and minutes).
7. Situation.
8. Intentions.
9. Assistance required.
10. COMPLY with instructions when contact is established.

ADDITIONAL PROCEDURES (SHORE-BASED)

To aid radar facilities, depending upon radio communications, proceed as follows:

1. With a radio receiver, fly right triangular patterns, using 120-degree turns, 1-minute legs.
2. Without a radio receiver, fly left triangular patterns, using 120-degree turns, 1-minute legs.
3. Fly two complete patterns before proceeding on course.
4. Repeat pattern every 20 minutes.
   Refer to FLIP, Enroute Supplement, for complete procedures.

ADDITIONAL PROCEDURES (CARRIER-BASED)

1. Lost procedures under EMCON conditions will be established during briefing.
2. When EMCON conditions allow, make radio report using procedures listed under VOICE PROCEDURE.
3. Select proper IFF/SIF mode/code.
4. When over the carrier's estimated position, commence a square search, using left turns.
5. Use AN/ASB-12 radar, transmitting 1 minute and silent 1 minute.
6. If carrier is not located, land at a friendly field, fuel permitting.

DOWNED AIRCRAFT SURVEILLANCE

If two or more aircraft are present at the scene of an accident, the senior aviator present shall take immediate charge and carry out the following:

1. Instruct all aircraft at the scene to squawk MAYDAY.

2. Designate one aircraft to climb to altitude (if necessary), establish communications with a ground station, and act as relay. Transmit the following on GUARD frequency:
   (a) CRASH, CRASH, CRASH.
   (b) Identify yourself.
   (c) Position of crash.
   (d) Estimate of the situation.
   (e) Your intentions and endurance.
   (f) Request immediate coverage.
3. Designate one aircraft to remain on the scene and keep survivors in sight. This aircraft will:
   (a) Transmit any pertinent information to the relay plane.
   (b) Remain on station until aid arrives or as fuel permits.

COMPASS FAILURE

1. Select DG.
2. Adjust ground speed/latitude dial as applicable.
3. If DG unusable, select COMP.
4. Periodically cross reference ADI/HSI/ARI with standby magnetic compass.

ADI FAILURE

1. Utilize standby gyro.
2. Check compass operation.

MFRS FAILURE (ADI and COMPASS INOPERATIVE)

1. Utilize standby gyro.
2. Select COMP.
3. Periodically cross reference ADI/HSI/ARI with standby magnetic compass.

PART 5—LANDING EMERGENCIES

SINGLE-ENGINE LANDING

Should a precautionary or an actual single-engine approach and landing become necessary, a GCA/CCA straight-in approach with LSO assistance is recommended. The recommended maximum crosswind component is 10 knots. A subsequent take-off should not be attempted unless considered absolutely necessary. All field single-engine landings should be arrestments if arresting gear is available and operating conditions permit. All shipboard single-engine landings shall be made with the barricade rigged. In aircraft with the two-position hook installed, field arrestment problems are minimized, including the possible effects of crosswind and asymmetric thrust, by making a three-point attitude roll-in with the hook in the field position (35-degree trail angle). In aircraft with the one-position hook, field arrestment is most probable in the approach attitude. See figures 5-4 and 5-5 for recommended approach speeds with gross weight and flap/droop configurations.

Single-engine flight results in the loss of one hydraulic pump in each control system and single-generator operation. (Refer to applicable emergency procedures.) Engine cooling doors remain in position selected when the generator drops off the line. Since cooling doors normally are closed, prolonged use of high-power settings in the power approach (PA) configuration may cause an overheat condition, fire warning light, and auto-acceleration (T_2 reset) on the operating engine. Flight control response will not be adversely affected under normal, low-rate control movements; however, sudden, high-rate lateral and/or longitudinal stick movements may cause momentary pressure drop sufficient to cause control stiffness, automatic pressure monitor shutoff of pitch and yaw augmentation, electric flight control systems, and the inlet ramp control system, with illumination of the associated caution lights. Under conditions of gusty wind or turbulence, consideration should be given to securing PITCH AUG and ELEC FLIGHT prior to commencing the approach.

CAUTION

- T_2 reset may cause the engine to idle as high as 100% rpm. This could result in the engine developing 50% of MIL thrust, thereby extending landing roll significantly if arrestment is not made.
- Shutoff of PITCH AUG causes a nose-down trim change.
- Ensure that control pedals are centered prior to engaging nose wheel steering.

SINGLE-ENGINE WAVE-OFF

Use MAX AFTERBURNER on all single-engine bolters or wave-offs. A single-engine wave-off and landing pattern require about 200 pounds more fuel than a normal pattern without afterburner. If leaving pattern, retract landing gear only when safe climb is established, as touchdown may be required in the event of a late wave-off. Retract flaps above 220 KIAS, when clear of all obstacles.

CAUTION

- Be prepared to counteract yaw as the flaps retract. Rudder effectiveness decreases with flap retraction.
- Reduce afterburner operations under the following conditions:
  - (a) Double generator failure.
  - (b) Fuel state 3000 pounds or less.
- Early recognition of wave-off is required on carrier approaches to prevent hook/barricade engagement.

ASYMMETRICAL BLC FAILURE

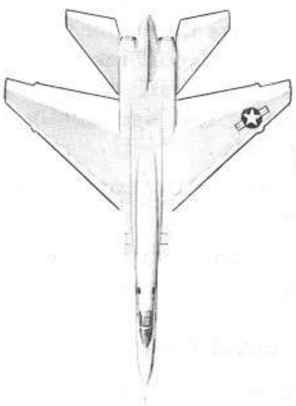
Should one BLC valve fail in the full closed or full open position, failure is indicated by illumination of the DROOPS caution indicator and a rolling and/or yawing tendency toward the no-flow wing during slow flight. For landing under these conditions, the following procedure is recommended:

1. Fly a normal pattern, adjusted as desired.

PRECAUTIONARY/SINGLE-ENGINE LANDING

BEFORE ENTRY

- JETTISON EXTERNAL STORES
- REDUCE GROSS WEIGHT TO 47,000 POUNDS OR LESS.
- DESCENT AND EMERGENCY CHECK LISTS—COMPLETE.
- UTILIZE GCA AND/OR LSO FOR GLIDE SLOPE IF AVAILABLE
- CHECK A/B LIGHT—OFF ON OPERATING ENGINE
- PLAN FOR ARRESTED LANDING IF GEAR IS AVAILABLE (Review Short/Long Field Arrested Landing Check List)
- UNDER GUSTY WIND OR TURBULENT CONDITIONS CONSIDER SECURING ELEC. FLIGHT AND PITCH AUG
- RECOMMENDED MAXIMUM CROSSWIND COMPONENT—10 KNOTS



SAFE SINGLE-ENGINE SPEEDS
(GROSS WEIGHTS TO 47,000 POUNDS)

- GEAR UP, DROOPS CRUISE—180 KIAS†
- GEAR AND FLAPS DOWN—135 KIAS†
- REFER TO APPROACH SPEEDS CHART FOR VARIATION IN GROSS WEIGHT AND FLAP/DROOP CONFIGURATION
- RECOMMENDED MAXIMUM CROSSWIND COMPONENT—10 KNOTS

CAUTION

In no case should an engine which has been restarted be considered a dependable engine.

BASE

- NORMAL ALTITUDE
- HOLD 13 UNITS ANGLE-OF-ATTACK

1 ½ to 2 MILES

FINAL/TOUCHDOWN

- 14 UNITS ANGLE-OF-ATTACK
- SHIP—FLY NORMAL APPROACH AND TOUCH DOWN WITH BARRICADE RIGGED.
- ASHORE (WITH ARRESTING GEAR)— FLY NORMAL APPROACH TO TOUCH DOWN 500 FEET SHORT OF FLY-IN GEAR ON CENTERLINE; ROLL-IN AND ENGAGE IN 3-POINT ATTITUDE, POWER IDLE (AIRCRAFT WITH 2-POSITION HOOK) ‡ OR ENGAGE GEAR IN NOSE-HIGH ATTITUDE, POWER AT 80% RPM (AIRCRAFT WITH SINGLE POSITION HOOK) UNTIL ARRESTMENT.
- ASHORE (WITHOUT ARRESTING GEAR) — FLY NORMAL APPROACH AND TOUCH DOWN.
- ASHORE—AFTER TOUCHDOWN, IF GEAR MISSED (OR NO GEAR), THROTTLE IDLE, MAINTAIN RUNWAY, BRAKING AS REQUIRED TO STOP.
- ASHORE—IF AIRCRAFT APPEARS TO BE LEAVING RUNWAY, JETTISON CANOPIES PRIOR TO STOPPING

BELOW 230 KIAS

- LANDING GEAR DOWN
- RECHECK HARNESS—LOCKED
- HYDRAULIC PRESSURE—NORMAL
- SMATS*—ON

WARNING

Avoid high rate control movements to prevent control freezing and/or monitoring off Pitch Aug, Yaw Aug, Elect Flight, Ramps and illumination of these caution lights.

- FLAPS/DROOPS—30°/25°
- LANDING CHECK LIST—COMPLETE
- HOLD 13 UNITS ANGLE-OF-ATTACK
- HOOK-DOWN (FIELD-35°—SHORE; NORM— SHIP)‡

BREAK

SPEED BRAKES—OUT

WAVE OFF

- USE MAX AFTERBURNER AND ROTATE TO 17 UNITS ANGLE-OF-ATTACK
- RETRACT FLAPS ABOVE 220 KIAS

BELOW 290 KIAS

- FLAPS—30°
- YAW TRIM—AS REQUIRED BY FLAP CHANGE
- CHECK SPEED BRAKES IN
- HOLD 13 UNITS ANGLE-OF-ATTACK

CAUTION

Prolonged use of high power in power approach configuration may cause over-heat condition, resulting in fire warning and autoacceleration (T_2 reset) caused by loss of normal engine cooling door operation.

*AIRCRAFT HAVING AFC 247 COMPLIED WITH
†INCREASE IAS BY 4 KNOTS ON AIRCRAFT 145157 THROUGH 151728 HAVING AFC 159 COMPLIED WITH
‡AIRCRAFT HAVING AFC 293 COMPLIED WITH

A-5C-1-0-15L

Figure 5-3

APPROACH SPEEDS

APPROACH SPEED VARIATION FOR VARIOUS FLAP AND DROOP SETTINGS

AIRCRAFT 145157-151728 NOT HAVING AFC 159 COMPLIED WITH

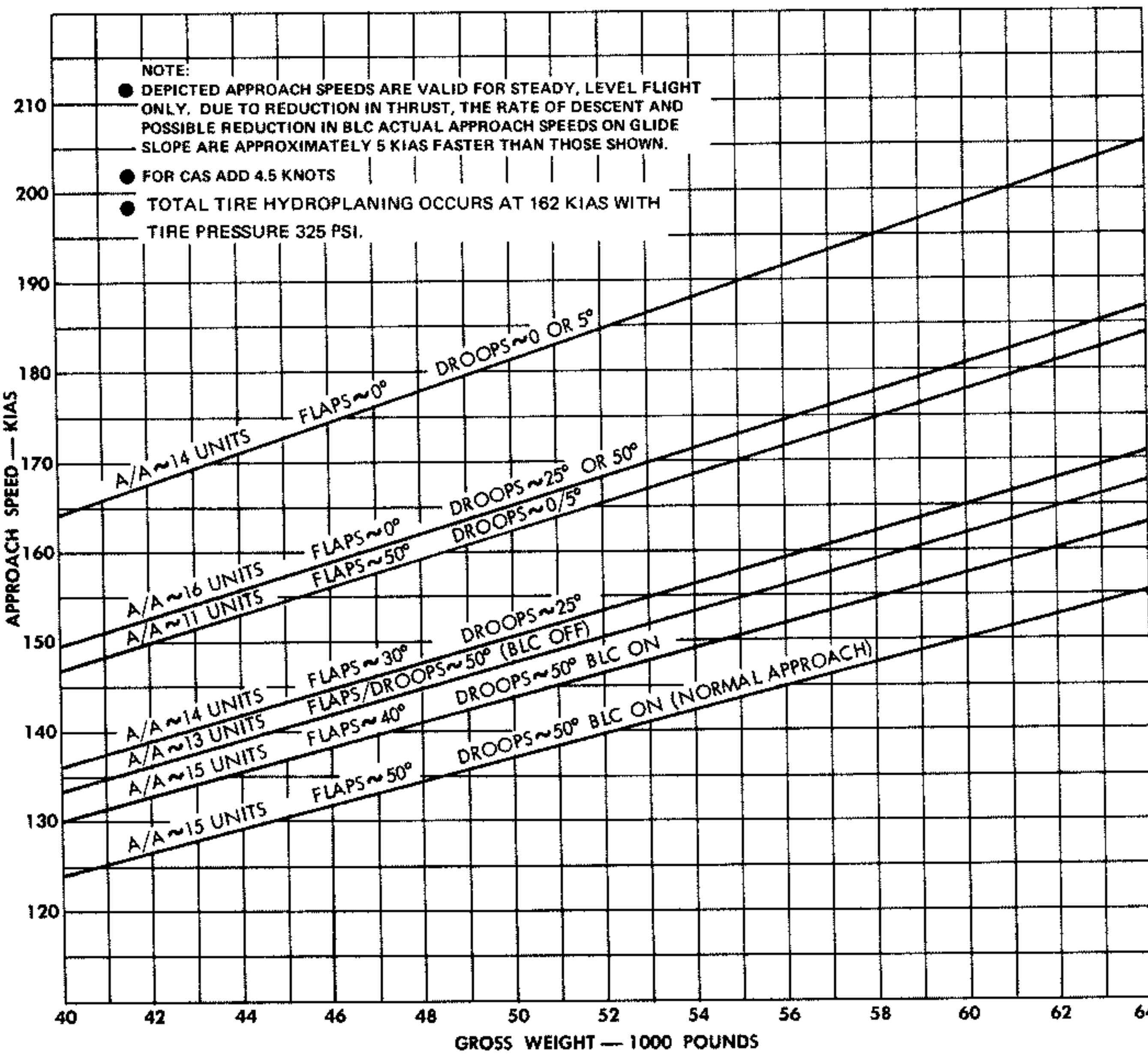


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Figure 5-4

APPROACH SPEEDS

APPROACH SPEED VARIATION FOR VARIOUS FLAP AND DROOP SETTINGS

AIRCRAFT 145157 THROUGH 151728 HAVING AFC 159 COMPLIED WITH AND AIRCRAFT 156608 THROUGH 156653

COMPENSATED PITOT-STATIC TUBE

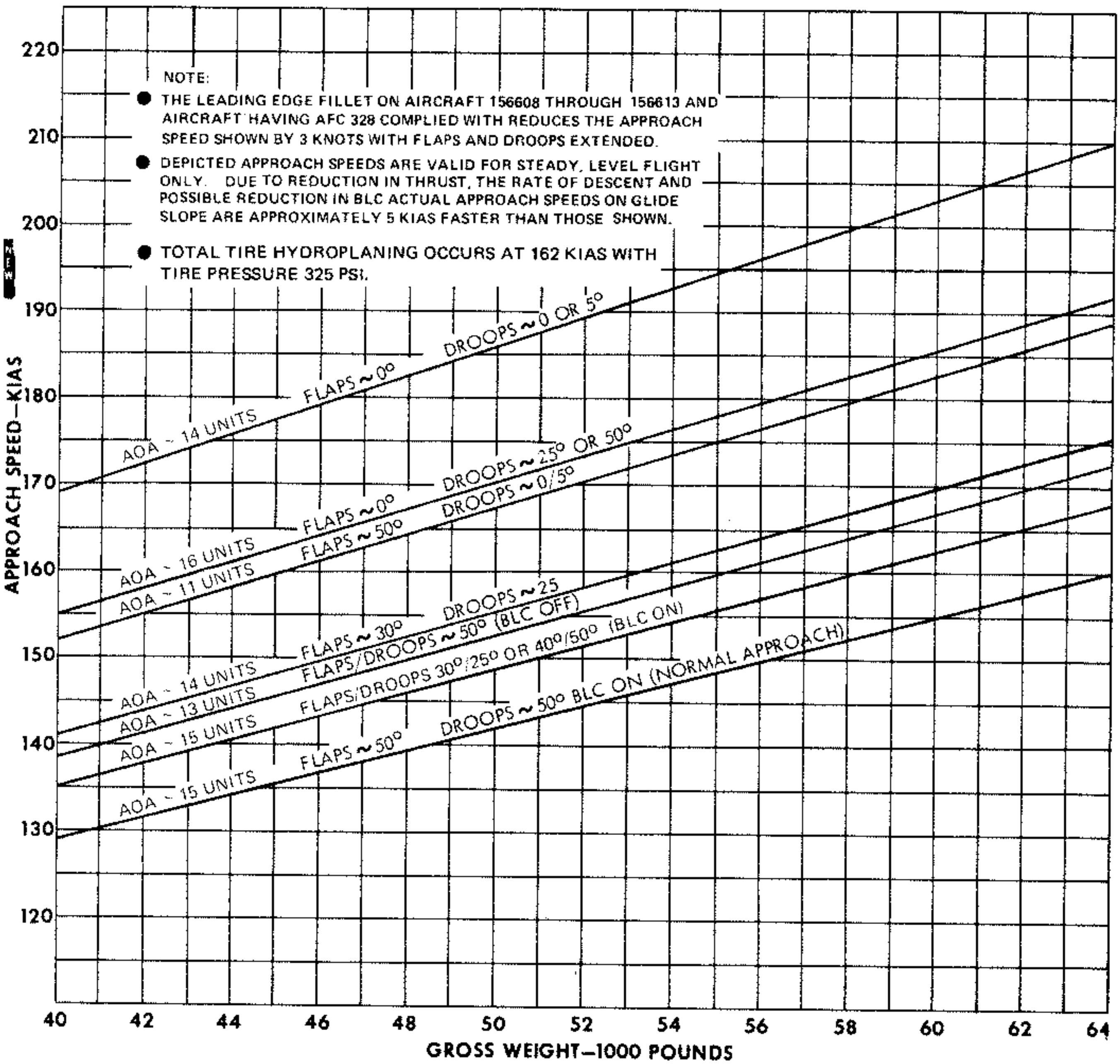

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Figure 5-5

2. Apply full wing-down lateral trim as required.
3. Utilize 30-degree flaps and hold 14 units angle of attack during approach.

   In the event a 50-degree flap approach is required due to emergency flap extension, hold 13 units angle of attack.

TIRE FAILURE

In the event of one main gear tire failure, adequate directional control is available with nose wheel steering on a dry runway. On a wet runway, the decreased coefficient of friction (especially on asphalt surfaces) may not provide adequate traction for directional control. During landings, brake disc temperature may exceed 1000°F. Most of this heat is dissipated into the atmosphere, but some is transmitted into the tire. Though the fusible plugs in the main wheels should deflate the tire of an overheated wheel, a tire blowout is possible for as long as 30 minutes after a brake has been used to capacity.

CAUTION

Allow sufficient time between flights or after an aborted take-off for adequate cooling. If operational necessity dictates immediate take-off, gear should be left extended as long as possible (at least 3 minutes) to permit maximum cooling, precluding possible wheel well explosion.

LANDING WITH TIRE FAILURE

For landing with any tire failure, use short-field arresting gear if available. Refer to SHORT-FIELD ARRESTMENT, in this section. In the event field arresting gear is not available, proceed as follows:

NOSE GEAR TIRE

1. Dump and consume fuel to minimum practical.
2. Make normal approach to center of runway with minimum sink touchdown.
3. Make a short-field arrestment.
4. If arresting gear is missed, lower nose gently at 120 KIAS.
5. Stop aircraft straight ahead.

   Do not attempt to taxi.

MAIN GEAR TIRE

1. Dump and consume fuel to minimum practical.
2. Use arresting gear if available.
3. If not available, make normal approach with minimum sink touchdown.

   LAND ON SIDE OF RUNWAY NEAR GOOD TIRE.
4. DO NOT USE BRAKE ON FAILED MAIN TIRE.
5. Lower nose on touchdown and engage nose wheel steering.
6. Stop aircraft straight ahead if possible.

LANDING GEAR MALFUNCTIONS

NOSE GEAR STIFF

Should the GEAR STIFF caution indicator remain on after gear retraction, proceed as follows:

1. If nose GEAR STIFF indicator does not go out after catapult hook is automatically retracted, raise and then lower landing gear in an attempt to dump gear stiff system pressure.
2. If GEAR STIFF caution indicator remains on, land ashore at a minimum rate of descent.

CAUTION

If divert is not possible and a carrier landing is made, nose wheel and/or strut damage will probably be sustained.

3. Without nose gear stiff, 15 knots excess end speed is recommended; sink off the bow will be more pronounced and a positive nose rotation is necessary. Night launches are not recommended.

LANDING GEAR UNSAFE

An unsafe "DOWN" indication of the landing gear may be the result of a malfunction of the landing gear selector valve, the hydraulic system, the electrical system, radius rod(s) or landing gear position indicating system.

If an unsafe indication is encountered, proceed as follows:

1. Maintain airspeed below 230 KIAS.

Note

If momentary unsafe occurs following touch and go, suspect radius rod damage, remain in TAKE OFF/LAND and make an arrested landing. If on deck discontinue taxi.

2. Cycle landing gear handle twice. Do not allow gear to cycle all the way into the wheel well. Return gear handle to DOWN position immediately.

WARNING

Full retraction of landing gear with radius rod damage may prevent subsequent gear extension.

3. If unsafe indication persists with gear handle down, pull EMER LDG GR handle and hold (check with TV).
4. If gear is still unsafe, HYD SUB SYS ISOLATION switch- FLIGHT.
5. Landing gear handle—DOWN.
6. EMER LDG GR handle—PULL and HOLD.
7. On safe indication—Return EMER LDG GR handle.
8. Remain in FLIGHT position of HYD SUB-SYS ISOLATION switch.
9. For landing refer to RECOMMENDATIONS FOR SHIPBOARD AND FIELD EMERGENCIES INVOLVING LANDING GEAR (regardless of whether landing gear is still unsafe or not).

CAUTION

Do not reselect TAKE-OFF/LANDING position of the HYD SUB-SYS ISOLATION switch as unsafe condition may recur.

10. If the landing gear indicates unsafe after extension for landing and if fuel permits, every resource should be used to determine gear position before attempting to land or eject. Should fly-by for inspection prove the gear to be "cocked" or unsafe, the following factors must be considered:
    (a) Fuel state.
    (b) Crosswind effect.
    (c) Runway length.
    (d) Availability of field arresting gear.
    (e) Runway foam equipment capability.

WARNING

- Ejection is recommended unless combined landing factors are entirely favorable.
- Do not retract the landing gear once a safe indication is obtained.

11. Following landing, stop, call for a tow, and pin gear prior to shutting down.

LANDING GEAR EMERGENCY EXTENSION

For landing gear emergency extension procedure, see figure 5-6.

CAUTION

Do not attempt to retract the landing gear after emergency extension because of failure of the No. 2 hydraulic system.

FLAP EMERGENCY EXTENSION

The wing flaps may be extended to 50 degrees by the pneumatic emergency system in the event of hydraulic or flap system electrical failure. Operation of the spoiler control lateral ratio changer is dual for fail-safe full spoiler-to-stick ratio with the flaps extended through either the normal or emergency system. Loss of power to the lateral ratio changer results in full (70-degree) spoiler authority without regard to the position of the flaps or the flap control switch. For flap emergency extension, proceed as follows:

1. HYD SUB-SYS ISOLATION switch—FLIGHT.
2. At less than 290 KIAS, normal flap handle—30°.
3. Check for 25° droops and reduce to 190 KIAS or less.

LANDING GEAR EMERGENCY EXTENSION

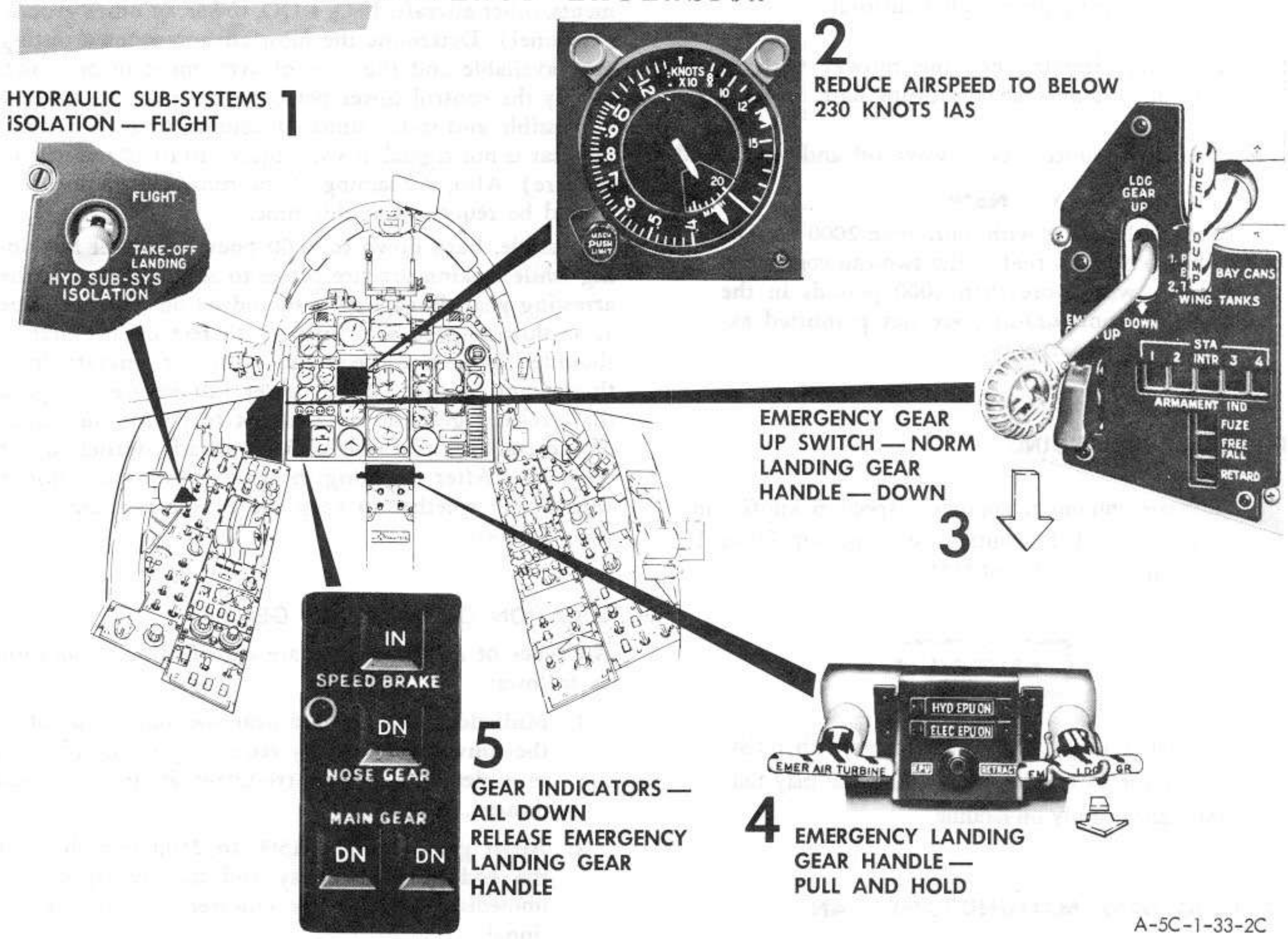

Figure 5-6

4. EMERG FLAP switch–DOWN.
   Check droop, flap, and trim indicator. Full flaps and droops should be obtained with speed less than 190 KIAS.

Note

If necessary to retract flaps after emergency extension, attain wings-level flight and additional altitude. Select UP position and be alert for possible roll caused by split flap condition. Immediately return switch to DOWN position if split flap condition occurs.

DROOP EMERGENCY EXTENSION

Emergency extension of flaps will, under nearly all circumstances, result in extension of the droops to 50 degrees, regardless of flap control switch position. To extend droops, proceed as follows:

1. EMERG FLAP switch—DOWN.
2. If droops do not extend, divert as primary option. If carrier landing is to be made, use approach speeds of figure 5-4 or 5-5, as applicable; use minimum FLOLS glide slope angle setting and maintain high wind over deck to reduce flight path angle and possibility of nose wheel first landing.

AFT CG LANDING

Should bomb bay cans fail to transfer or dump, or alternate transfer methods fail, an excessively aft center of gravity exists. During landings with the cg aft of the stability limit, nose-up motions will continue until opposed by forward stick. Adequate control is available but pitch control is very sensitive and is aggravated by turbulent air. The following procedure is recommended:

1. Concentrate on proper pitch attitude.
2. Ease the aircraft onto the runway with power addition rather than an abrupt flare.
3. If a bad bounce occurs, wave off and go around.

Note

Arrested landings with more than 2000 pounds of bomb bay can fuel in the two-can configuration, or with more than 4000 pounds in the three-can configuration, are not permitted except in an emergency.

FORWARD CG LANDING

1. Increase minimum approach speed 6 knots and decrease AOA 1.5 units for each percent forward of 27.0 to 25.4 percent MAC.

CAUTION

Neutralize longitudinal stick forces with pitch trim prior to touchdown as the nose may fall through abruptly on landing.

LANDING GEAR MALFUNCTIONS (RAN)

If a decision is made to land with unsafe or partially extended gear, or if a barricade is to be taken, the following procedures are recommended.

FIELD LANDING

1. Loose gear—STOW.
2. Harness—LOCKED.

CAUTION

- If it becomes apparent that the aircraft is out of control and leaving the runway, JETTISON CANOPY.
- If making a fly-in with an unsafe or retracted nose gear, DO NOT JETTISON CANOPY.

CARRIER LANDING

1. Loose gear—STOW.
2. Harness—LOCKED.

EMERGENCY FIELD ARRESTING GEAR

In an emergency situation, first determine the extent of the emergency by whatever means are available (instruments, other aircraft, LSO, RDO, tower, or other ground personnel). Determine the most advantageous arresting gear available and the type of arrestment to be made. Notify the control tower personnel as much in advance as possible and state estimated landing time in minutes (if gear is not rigged, it will require 10 to 20 minutes to prepare). Also, if foaming of the runway is required, it should be requested at this time.

If possible, burn down to 3000 pounds of fuel remaining while making practice passes to accurately locate the arresting gear. Engagement should be on the centerline at as slow a speed as possible with feet off the brakes, shoulder harness locked, and with the aircraft in a three-point attitude. 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. After engaging the gear, existing conditions will dictate whether to keep the engine running or to shut it down.

LOCATION OF ARRESTING GEAR

All types of arresting gear are classified as to location as follows:

1. Midfield gear—Located near the midway point of the runway and 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 end of the runway and usually rigged for immediate use. May be unidirectional or bidirectional.
3. Overrun gear—Located just past the end of the runway and usually rigged for immediate use.

Some fields will have arresting gear in all three locations, others may be only in one location. For this reason, it is imperative that all pilots be aware of the type, location, and compatibility of the gear with the aircraft, and also the policy of the local air station as to when each gear is rigged and ready for use.

WARNING

Severe damage to the aircraft is usually sustained if an engagement into the chain gear is made in the wrong direction.

TYPES OF ARRESTMENT

Depending on the aircraft emergency, there are three general categories of aircraft arrestment.

Short-Field Arrestment

This is an arrestment with the aircraft hook engaging the pendant just after touchdown. All of the energy of the aircraft must be absorbed by the arresting gear, and since the engaging speed will be approximately the same as the approach speed, the weight may have to be limited. If at any time prior to landing, it is known that a directional control problem exists, a minimum rollout is desired, or insufficient runway is available for braking to a stop, a short-field arrestment should be made and the assistance of an LSO requested. The hook should be lowered while airborne and a positive hook-down check should be made. The first suitable gear should be utilized. A constant glide slope approach to touchdown on centerline is recommended 500 feet prior to the arresting wire. Use an approach speed commensurate with the emergency experienced. For bolter capability in the event of a missed wire, maintain approach power until arrestment. Then retard throttle(s) to IDLE or secure the engine and apply brakes. Brakes are applied to prevent two-blocking of the arresting gear on high speed arrestments. However, brakes should be released during the roll back after an arrestment or pendant hang-up may result.

Long-Field Arrestment

This is an arrestment with the aircraft engaging the pendant after a ground roll during which the aircraft speed has been reduced. This type of arrestment is used when a stopping problem exists with insufficient runway remaining for rolling to a stop (aborted take-offs, icy or wet runways, loss of brakes after touchdown). Approach touchdown at a minimum rate of descent and line up the aircraft on the runway centerline. A roll-in type of engagement is mandatory. After touchdown, lower the hook early enough to permit it to extend fully prior to engagement; however, caution should be taken not to lower the hook too early and weaken the hook point due to abrasion with the runway surface. Inform the control tower of your intention to engage the arresting gear so that aircraft landing behind you may be waved off. Retard throttle(s) to IDLE at touchdown if no directional control problem exists.

Aborted Take-off

When an aircraft take-off must be aborted, a roll-in type of engagement is mandatory to prevent overrun.

Decision to abort should be based on the usual parameters of remaining runway and distance required for stopping using brakes. The arresting gear will then serve as an assist in keeping the aircraft from rolling onto unprepared surfaces.

WARNING

Under no circumstances should a pilot's decision to abort a take-off be delayed because of knowledge that an emergency arresting gear is available at the end of the runway.

ENGAGING SPEEDS

The maximum permissible engaging speed, gross weight, and off-center engagement distance for field arrestment of the RA-5C aircraft are listed in figure 5-7. The data provided in the Long Field Landing columns may be used for lightweight aborted take-off where applicable. Also, data provided in the Aborted Take-off columns may be used for heavy gross weight landings.

As various modifications to the basic types of arresting gear and aircraft are incorporated, engaging speeds or gross weight limitations may change. For this reason and for more information consult the applicable Aircraft Recovery Bulletin.

LONG FIELD ARRESTING GEAR ENGAGEMENT

Refer to ABORTED TAKE-OFF procedure.

SHORT-FIELD ARRESTMENT

Note

Utilize GCA and LSO, if available, and prior to approach, make decision to takeoff or remain on deck if arresting gear is missed. A subsequent takeoff should not be attempted unless considered absolutely necessary.

Two-Position Hook

1. HOOK—DOWN (FIELD-35°).

CAUTION

If hook handle light illuminates, place approach light switch in arrest position and check for flashing approach indexer lights. If indexers are steady, hook is in normal position. Refer to step 4 of "One-Position Hook" paragraph below.

2. Fly a normal approach at a gross weight less than 50,000 pounds (if single-engine, refer to SINGLE-ENGINE LANDING procedures).

EMERGENCY FIELD ARRESTMENT DATA

MAXIMUM ENGAGING SPEED (KNOTS) (a)

	GROSS WEIGHT X 1000 POUNDS	TYPE OF ARRESTING GEAR: M-2	E-14-1	E-27	E-15 (200) FT SPAN	E-15 (300) FT SPAN	M-21	E-28	E-5 (STD CHAIN)	E-5-1 (STD CHAIN)	E-5 (HVY CHAIN)	E-5-1 (HVY CHAIN)	BAK-6	BAK-9	BAK-12
SHORT FIELD LANDING (b, c)	43	93	160	143	180	180	125	160	146	146	150	165	150	160	160
	47	90	160	140	178	180	125	160	141	141	150	165	148	160	160
	50	88	160	136	176	180	125	160	138	138	150	165	146	160	160
LONG FIELD LANDING (d)	54	85	144	132	173	179	125	160	134	134	150	165	142	150	160
	58	82	136	128	170	176	125	160	130	130	150	159	138	141	160
ABORTED TAKE-OFF (f)	62	80	130	124	166	172	110	156	127	127	150	154	133	135	155
	66	77	125	120	162	169	110	145	124	124	150	150	129	128	150
	70	75	121	116	156	166	110	145	121	121	145	145	125	122	145
	74	72	118	109	150	163	110	145	118	118	142	142	121	116	140
	78	70	115	90	143	161	110	145	115	115	138	138	118	110	137
	80	69	113	81	140	160	110	145	114	114	136	136	117	108	135
MAXIMUM OFF-CENTER ENGAGEMENT FEET		20	50	35	35	50	10	40	(e)	(e)	(e)	(e)	15	30	50

(a) All Engaging Speeds Limited by Arresting Gear Capacity.
(b) Maximum of 3.0 Degree Glide Slope.
(c) Consult Appropriate Section for Recommended Approach Speed.
(d) Flared or Minimum Rate of Descent Landing.
(e) Off-center Engagement May not Exceed 25% of the Runway Span.
(f) Data Provided in the Aborted Take-off Columns May be Used for Emergency High Gross Weight Arrestments.

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Figure 5-7

3. Land 500 feet short of fly-in arresting gear, on centerline.

4. After touchdown, throttles—IDLE; allow control stick to go to the neutral longitudinal position and engage gear in three-point attitude.

5. If arresting gear is missed and if aircraft appears to be leaving runway, jettison canopies prior to stopping.

One-Position Hook

1. HOOK—DOWN.

2. Fly a normal approach at a gross weight less than 50,000 pounds (if single-engine, refer to SINGLE-ENGINE LANDING procedures).

3. Land 500 feet short of fly-in arresting gear, on centerline.

4. After touchdown, maintain a nose-high attitude with power at 80% rpm until arrestment.

5. If arresting gear is missed and if remaining on deck, throttles IDLE.

6. If aircraft appears to be leaving runway, jettison canopies prior to stopping.

FIELD BARRIER

If a field barrier is to be engaged, the aircraft should be in the three-point attitude and the engines secured prior to barrier engagement. For engagement of USAF BAK-6, BAK-9, or MA-1 type barriers, ensure that the hook is extended at least 1000 feet short of the barrier to prevent the possibility of the hook skipping over the cable.

BARRICADE ENGAGEMENT

If use of the barricade is required, the following procedures are recommended:

1. Lower hook if possible. The hook will assist the barricade in stopping the aircraft and will help keep the aircraft on deck at barricade entry.

2. Jettison stores if possible. Stores will not interfere with barricade engagement, but may be torn loose and present a hazard to the flight deck crew.

WARNING

DO NOT JETTISON CANOPIES.

3. Fly a normal approach: on speed, centerline, and meatball.

Note

Anticipate loss of meatball for a short period of time during the approach as barricade stanchions will obscure.

BRAKE FAILURE

Should brake failure be suspected before landing, use long or short field A-gear. In the event of any brake system malfunction, the aircraft should be brought to a stop as soon as possible; normally, no maneuvering or taxiing will be attempted. The following procedures apply for both ship and field operations:

Day	Night
1. Hook DOWN.	1. Hook DOWN.
2. Transmit "No Brakes."	2. Transmit "No Brakes."
3. Request chocks/tow.	3. External lights ON.
	4. Request chocks/tow.

Note

For wheel brake failure accompanying failure of the No. 2 hydraulic system, use emergency braking for initial deceleration, saving the pressure in the auxiliary brake accumulator for terminal rollout directional control.

USE OF EMERGENCY BRAKES

The fully charged emergency brake accumulator provides approximately three full "on and off" applications of pressure of equal force to both brakes. Operation with the emergency brake handle is similar to that obtained through the pedals with the auxiliary accumulator, except that both brakes are operated simultaneously. A single application of emergency braking is normally sufficient to stop the aircraft if the handle is pulled gently until deceleration is felt, then pulled slowly outward, increasing force as speed decreases.

WARNING

A sudden pull on the emergency brake handle may lock the main wheels, causing tire failure and possible loss of directional control. Optimum technique is to slowly pull the emergency brake handle until deceleration is detected. Handle displacement can be increased as speed decreases.

Note

When new brake assemblies are installed, it is recommended that the pilot be notified and that several applications of moderate braking be applied while taxiing out for flight. This procedure will wear off the metal protective primer, reducing smoking on landing rollout.

DITCHING (PILOT)

WARNING

Rather than attempting to ditch and risking needless injury, ejection should be accomplished when feasible.

If conditions preclude ejection, the pilot must accomplish as much of the following procedure as time permits:

1. Notify RAN.
2. Landing gear—UP.
3. RAT—EXTEND.
4. Flap control switch—40°.
   Position EMERG FLAPS to DOWN, if required.
5. Speed brakes—IN ARREST HOOK—DOWN.
6. Stores—JETTISON.
7. EMERG IFF switch—EMERG.
8. Harness—LOCKED.
9. Dump all possible fuel.
10. Canopies—JETTISON (front first).
11. Emergency oxygen ring—PULL PRIOR TO TOUCHDOWN.

Note

- Do not pull Scott disconnect knob.
- The emergency oxygen system provides a 6- to 7-minute supply at sea level. If time precludes pulling the emergency oxygen ring, standing in the cockpit (pulling survival kit from seat) automatically actuates the system.

12. Touch down at 100 fpm or less, in a nose-high attitude.
13. FLY THE AIRCRAFT UNTIL ALL FORWARD MOTION IS STOPPED.
14. Harness release handle—PULL.

Note

- Observe wind/sea state and use to best advantage.
- With both engines out, maintain 160 KIAS until flare for touchdown.

DITCHING INFORMATION

If the sea is calm, land into the wind. If there is a swell running, touch down parallel to the swell crest or just after the crest has passed. In the event of high winds or a rough sea, land into the wind, touching down on the crest of a wave. Generally, the advantage gained from a slower touchdown speed will offset the disadvantage of a head-on impact with a wave crest. Rate of descent and airspeed at touchdown are the most important variables under the pilot's control. High touchdown speeds will greatly increase deceleration forces and increase the possibility of the flight crew being rendered unconscious. High rate-of-descent landings are likely to cause high impact forces and serious structural failures, resulting in a very short flotation period. A rate of descent of 100 feet per minute or less should be maintained at touchdown, if at all possible.

DITCHING (RAN)

WARNING

Rather than attempting to ditch and risking needless injury, ejection should be accomplished when feasible.

If conditions preclude ejection, the RAN must accomplish as much of the following procedure as time permits:

1. IFF—EMERGENCY (MODE 3, Code 77).
2. The RAN will switch UHF to GUARD XMIT.
3. MAYDAY, MAYDAY, MAYDAY.
   Identification, Position, Heading, Situation, Intentions.
4. Canopy—JETTISON on pilot's order (after pilot).
5. Emergency oxygen ring—PULL PRIOR TO TOUCHDOWN. DO NOT PULL SCOTT DISCONNECT KNOB.
6. Harness—LOCKED.
7. Brace feet firmly.
8. When aircraft stops completely, pull harness release handle.

WARNING

If the aircraft is touched down in a flat attitude (less than 8 degrees), it may dive violently after contact. *Because of the shoulder wing mounting, the cockpits will be under water when forward motion stops.* If a properly adjusted mask is maintained, an underwater breathing supply is provided by the emergency oxygen system for approximately 5 minutes.

HELICOPTER WATER RESCUE

Prior to and during helicopter rescue after ditching or ejection over water, perform the following procedure:

1. Oxygen mask—OFF.
2. Upper "Rocket-Jets" and parachute "O" ring—RELEASE.
3. Scott disconnect yellow knob—PULL.
4. LOWER rocket jets—RELEASE.
5. If the life raft lanyard has been tied to the torso garment—DISCONNECT.
6. Abandon life raft to avoid rotor wash.

CAUTION

Avoid high handhold or rescue seat shank to preclude possible injury during hoisting and loading.

EMERGENCY COCKPIT ENTRANCE AND ESCAPE

For emergency cockpit entrance and rescue information, see figure 5-8.

RECOMMENDATIONS FOR SHIPBOARD AND FIELD EMERGENCIES INVOLVING LANDING GEAR AND HOOK

See figures 5-10 and 5-11 for recommended procedures to be followed in the event of a shipboard or field emergency involving the landing gear and hook. For emergency divert criteria, see figure 5-9.

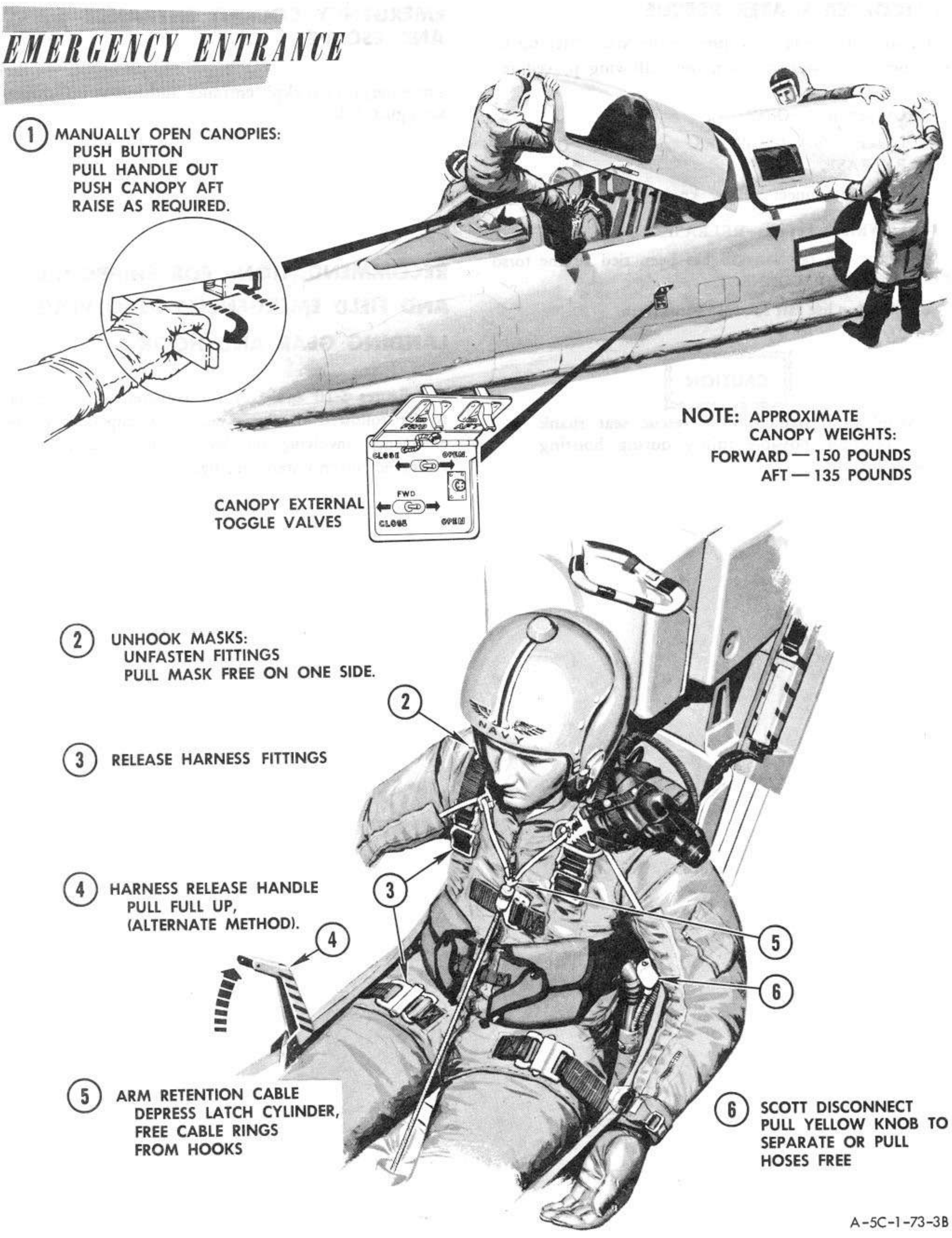
EMERGENCY ENTRANCE
1 MANUALLY OPEN CANOPIES:
PUSH BUTTON
PULL HANDLE OUT
PUSH CANOPY AFT
RAISE AS REQUIRED.
NOTE: APPROXIMATE CANOPY WEIGHTS:
FORWARD — 150 POUNDS
AFT — 135 POUNDS
CANOPY EXTERNAL TOGGLE VALVES
FWD
AFT
CLOSE
OPEN
2 UNHOOK MASKS:
UNFASTEN FITTINGS
PULL MASK FREE ON ONE SIDE.
3 RELEASE HARNESS FITTINGS
4 HARNESS RELEASE HANDLE
PULL FULL UP,
(ALTERNATE METHOD).
5 ARM RETENTION CABLE
DEPRESS LATCH CYLINDER,
FREE CABLE RINGS
FROM HOOKS
6 SCOTT DISCONNECT
PULL YELLOW KNOB TO
SEPARATE OR PULL
HOSES FREE
NAVY
A-5C-1-73-3B

Figure 5-8

EMERGENCY/DIVERT CRITERIA

DISCREPANCY	DIVERT	IF NO DIVERT AVAILABLE
1. Bomb bay fuel transfer dump failure (if more than 2000 lbs, 2 cans or 4000 lbs, 3 cans).	Yes	Land aboard within arresting gear limits or if unable, utilize barricade.
2. BLC valve failure.	No Deferred	
3. Canopy loss.	No Deferred	

WARNING

Do not engage barricade with canopy loss.

DISCREPANCY	DIVERT	IF NO DIVERT AVAILABLE
4. D-C converter (both).	Yes	Land aboard —IMMEDIATE. wing gravity dump is slower than normal dump
5. Droops failure. (See APPROACH SPEEDS).	Yes	Land aboard within arresting gear limits —DEFERRED.

CAUTION

With 0-degree droops (50-degree flaps), the area of lateral control ineffectiveness is approached. If carrier landing is to be made, use minimum FLOLS glide slope angle setting and maintain high wind over deck to reduce flight path angle and possibility of nose wheel first landing.

DISCREPANCY	DIVERT	IF NO DIVERT AVAILABLE
6. Drop tank transfer.	Only if unable to jettison	
7. Fire warning light.	No immediate	
8. Flaps up.	Yes	EJECT
9. Fuel filter bypass.	No Deferred	
10. Fuel quantity failure.	No Deferred	
11. Generator failure (single).	No Deferred	
12. Generator failure (both).	Yes	Land aboard —IMMEDIATE, wing fuel dump not available unless wing aux selected prior to failure.
12(a). Total electric.	Yes	EJECT
13. Hydraulic failures		
(a) Single pump	No	Deferred
(b) No. 1 system	No	Immediate
(c) No. 2 system/ auto isolate	Yes	Immediate
14. Nozzles blown open.		
(a) Single.	Yes	Consider barricade.
(b) Both.	Yes	EJECT
15. Oil hot.	No Deferred	
16. Oil pressure low or zero.		
(a) Low.	No Immediate	
(b) Zero with other indications (nozzles, generator, or on vibration).	Yes	Utilize single-engine approach to barricade.
17. Oxygen or mask.	No Deferred	
18. Pitot-static instruments failure.	No With AOA and radar altimeter	
19. Single engine.	Yes	Land aboard with barricade.
20. With smoke and fumes, electrical fire, or windshield defrost failed on.	No	Immediate
21. Wing fuel transfer failure.		
(a) If unable to dump wing fuel.	No Air refuel	
(b) If unable to dump wing fuel.	Yes (unless day VFR)	Land aboard —Deferred.
22. Throttle linkage failure.	Yes	Land aboard with barricade.

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Figure 5-9

SHIPBOARD RECOMMENDATIONS

FINAL LANDING GEAR CONFIGURATION	BARRICADE	HOOK	DIVERT	REMARKS
1. Nose gear retracted or trailing, or indicated unsafe.	No	Up	Yes	Refer to field recommendations. EJECT if no field available.
2. One main gear retracted or trailing, stub, cocked, or indicated unsafe.	Yes	Down	No	Refer to latest revised ARB 12-12 series. Second option, divert to fly-in gear.
3. Stub or cocked nose gear.	Yes	Down	No	Refer to latest revised ARB 12-12 series. Second option, divert.
4. One or both main gear stub or cocked.	Yes	Down	No	Refer to latest revised ARB 12-12 series. Second option, divert.
5. Nose gear and one main gear retracted or trailing.	No	Up	No	EJECT. If unable, refer to latest revised ARB 12-12 series for barricade.
6. Both main gear retracted or trailing.	No	Up	Yes	Divert only if sea-state/temperature conditions dictate.
7. All gear up.	No	Up	Yes	Divert only if sea-state/temperature conditions dictate.
8. No hook. **WARNING** If hook fails to extend when handle is pulled, do not attempt to bounce hook down.	Yes		Yes	Divert if field available.
9. Blown tire.	No	Down	No	Normal arrested landing.
10. Blown main tire with only rim remaining.	Yes	Down	Yes	

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Figure 5-10

FIELD RECOMMENDATIONS

Notes

- LSO will be utilized for all field landing emergencies when possible.
- All landings, ensure all loose gear is stowed/harness locked.
- Hook — Select FIELD −35° position.
- Consider controlled ejection of RAN prior to landing aircraft with main landing gear emergencies.
- Jettison canopies if aircraft appears to be leaving runway.

FINAL LANDING GEAR CONFIGURATION	ARRESTING GEAR (FLY-IN)	HOOK	REMARKS
1. Nose gear retracted or trailing, or indicated unsafe.	No	Up	(a) Remove all cross-deck pendants. (b) Dump fuel to 3000 pounds. (c) Foam is not recommended. (d) Hydraulic subsystem—TAKE-OFF AND LAND. (e) Flaps—30°. (f) Touch down with minimum sink rate and fly nose to runway prior to loss of pitch control. (g) Secure engines after nose touchdown.
2. One main gear retracted, trailing, stub, cocked, or indicating unsafe.	Yes	Down	(a) Dump fuel to 3000 pounds. (b) Flaps −50°. (c) Utilize foam if time permits. (d) Make low-sink rate touchdown. Keep power on. Hold failed landing gear off the runway until arresting wire is engaged and continue to hold off as long as possible. Note If wire is missed, WAVE OFF (MAX AFTERBURNER). (e) Engine to IDLE after wire engagement. (f) Use aux braking as required. (Hold gear off as long as possible.)
3. Stub or cocked nose gear.	Yes	Down	(a) Ensure wire is engaged in nose-high attitude. (b) If wire is missed, keep nose stub/wheel off the runway and make touch and go. (c) Utilize foam.
4. Both main gear stub or cocked.	No	Up	(a) Remove all cross-deck pendants. (b) Utilize foam, if time permits. (c) Nose wheel steering and opposite brake as required.
5. Nose gear and one main gear retracted or trailing.	No		EJECT.
6. Both main gear retracted or trailing.	No		EJECT.
7. All gear up.	No		EJECT.
8. Blown tire. N6/77 RA-5C-1-0-34	Yes	Down	(a) Refer to TIRE FAILURE, in this section. If aircraft is towed with flat tire, utilize arresting hook rather than nose gear.

Figure 5-11

SECTION VI—ALL-WEATHER OPERATIONS

TABLE OF CONTENTS

PART 1 — SIMULATED INSTRUMENT PROCEDURES

INTRODUCTION

All-weather operation is discussed in this section for such conditions as instrument flight, ice and rain, turbulence, and temperature extremes. This material supplements the information contained in other sections of the manual and is not intended as a substitute for normal operating procedures. Procedures for simulated (hooded) instrument flight are also included.

SIMULATED INSTRUMENT FLIGHT

Hooded instrument take-offs will not be practiced. Simulated instrument flying under the hood will require a chase aircraft which will conduct radio checks once every 5 minutes above 10,000 feet or once a minute below 10,000 feet. The lookout chase will advise the instrument aircraft by clock code of any approaching aircraft. The instrument pilot will pop the hood and advise whether or not the aircraft is sighted. The chase pilot will continuously advise the instrument pilot of the intruding aircraft's position until it is clear or seen by the instrument pilot.

The chase pilot will fly as close formation as possible, consistent with the maneuver being performed.

1. On GCA, the chase will fly 500 feet above and 500 feet astern at either the 5- or 7-o'clock position in order to be on the outside of all turns.
2. Enough separation to avoid undue concentration on formation flight vice lookout duties will be maintained.

Should the instrument pilot not receive the prescribed radio checks, or lose radio communication with the chase, he will immediately pop the hood. Should the chase pilot lose radio contact with the instrument pilot, he will fly ahead of the instrument pilot in order to cause the instrument pilot to fly through his slip stream. If the instrument pilot feels unusual turbulence, he will pop his hood.

PART 2—INSTRUMENT FLIGHT PROCEDURES

INSTRUMENT FLIGHT

The capabilities of this aircraft make it highly adaptable for instrument flight. Mission accomplishment is enhanced by the effectiveness of the autoflight control system, CNI systems, and the AN/ASB-12. However, thorough preflight planning and current instrument proficiency are always necessary for successful instrument flight operations. Effective aircraft range may be reduced by air traffic control procedures and unexpected weather developments. The hazard of icing can be reduced by use of engine, windshield, and pitot anti-ice systems. Thunderstorms should be circumnavigated through the use of radar. Control of the UHF communications, IFF, ADF, and TACAN is available from either cockpit. Control of the SIF is available in the rear cockpit only. Flights in positive control areas cannot be accomplished without a crew member in the rear cockpit.

FUEL PLANNING

1. The following fuel reserves and allowances shall be used as a guide for instrument flight fuel planning on nonoperational flights:

Landing reserve	2000 pounds
Holding reserve	1500 pounds
GCA allowance	1000 pounds
Teardrop penetration	1000 pounds
Arcing penetration with extended low approach	1500 pounds

2. A departure fuel allowance must be provided if an adverse departure must be used.
3. All instrument flights shall be planned to arrive at the approach fix at cruising altitude. Enroute descent fuel savings shall not be planned.

BEFORE TAKE-OFF

The RAN will perform normal ground checks of all systems required during the flight. The RAN will be thoroughly versed in the use of navigational charts, publications, and procedures associated with airways navigation, positive-controlled airspace, and ADIZ procedures, as well as operational use of available electronics aids. He will be familiar with applicable VFR/IFR flight rules under routine and special conditions. In addition, the RAN will be capable of copying and reading back flight clearances and making position reports. The following checks are to be made before take-off:

1. AN/ASB-12 system — Check.
2. UHF radio and auxiliary receiver—checked and set.
3. TACAN — checked and set.
4. IFF/SIF — on and set.
5. Stand-by gyro indicator, uncaged – CHECKED.

Note

Momentarily cage standby gyro indicator at least 2 minutes prior to take off to allow spin axis to orient to true vertical. Rotate knob to trim miniature airplane to approximate pitch attitude. Do not recage gyro.

6. PRESS SUIT FLOW knob — OFF.
7. Lighting controls — as required.

TAKE-OFF (PILOT)

Normal operating procedures apply to preparation for instrument flight, with increased necessity for proper operation of the CNI and lighting systems. Before take-off, make the following additional checks:

CAUTION

To prevent the formation of fog and frost in the cockpit during take-off under conditions of high humidity, or to clear the cockpit anti-ice and defrost ducting system of moisture, set the COCKPIT TEMP knob at "3" (HOT) during ground engine operation and perform steps 1 and 2 of the following check. Any visible moisture will clear within 10 to 20 seconds.

1. Pitot anti-ice — ON.
2. Windshield and canopy defrost — ON (if required).
3. WINDSHIELD ANTI-ICE switch —as required.
4. PRESS SUIT FLOW knob — OFF.
5. Standby gyro indicator, pitch trim attitude set – CHECKED

Note

Amount of pitch trim required will vary with aircraft loading. Do not recage gyro unless known error exceeding 10 degrees exists.

6. Lighting controls — check.
7. Anticollision lights — ON.

If take-off is made under conditions of extremely reduced visibility, rotate the aircraft to approximately 10 degrees (16 units angle of attack) nose-up pitch attitude as lift-off speed is reached. When catapulted ITO's are made, the flight instruments must be carefully cross-checked for precession produced by the catapult acceleration. A wings-level, 1000 fpm climb should be maintained during post-take-off transitions.

Note

After lift-off, an increase in pitch attitude may be required to limit airspeed until landing gear and flaps are retracted.

TAKE-OFF (RAN)

During take-off, it is recommended that the UHF radio be set to departure control frequency and the auxiliary receiver to control tower frequency, in addition to monitoring GUARD frequency.

CLIMB (PILOT)

Under IFR conditions, or at night, it is recommended that 1000 feet of terrain clearance and 220 KIAS be attained before retracting flaps to CRUISE. Turns to departure heading should not be commenced until reaching 1000 feet and a minimum of 250 KIAS. This procedure will avoid low-level turns at changing airspeeds and altitudes. Since Maximum Thrust may result in excessively steep climb angle, Military Thrust is recommended during the instrument portion of departure climbs.

CLIMB (RAN)

In the event of an aircraft malfunction or emergency condition requiring landing immediately after take-off, the RAN must be able to assist the pilot by setting radio and navigation aid frequencies as required. In addition, changing of flight plan, navigation information, emergency airfield data, and flight clearance change may become the responsibility of the RAN. The RAN shall handle all frequency changes below 2500 feet, so that the pilot may devote his full attention to controlling the aircraft.

CRUISE

All instrument flights, except those involving an operational clearance, shall be conducted in accordance with current regulations. All radio traffic involving reports, requests, or acknowledgments, shall be clear and concise. Requests for weather and miscellaneous information shall be requested from Pilot-to-Forecaster Service (METRO) or Airways Communications Stations. Pilots shall monitor destination and alternate weather closely, especially when the weather at these two points is marginal. If the weather at the filed alternate station goes below authorized minimums, some other suitable alternate shall be requested or, lacking one, the destination shall be changed.

RADAR NAVIGATION

The AN/ASB-12 radar may be used as a secondary mode of navigation in the event of complete autonavigator failure. Following an autonavigator failure, a fully stabilized radar picture normally remains. Using the fixed range circles, relative bearing scale, and aircraft compass, the RAN has all the information necessary to obtain navigation fixes, ground speed, and track information.

HOLDING

Hold at 10 units AOA with CRUISE flaps (5-degree droops). Bank angles of more than 30 degrees may require added power to maintain altitude and airspeed. The following table may be used to determine recommended holding airspeed:

ALTITUDE (FEET)	FUEL REMAINING (LBS x 1000) 2	4	6	8	12
	KNOTS IAS				
Sea Level	200	205	210	215	220
10,000	205	210	215	220	230
20,000	215	220	225	230	240
30,000	230	235	240	245	260
40,000	235	240	245	255	275

DESCENT

Maximum-range enroute descent should be made at 80% rpm, holding 250 KIAS, speed brakes IN, flaps CRUISE. Rate of descent will average 3000 feet per minute.

PENETRATION

Prior to descent, pilot heat, engine anti-ice, windshield anti-ice, and canopy defrost should be checked ON. Airspeed and altitude control will be smoother if angle of bank is limited to 30 degrees. Normal penetrations will be the published jet penetration for the facility. Maintain 250 KIAS and 4000 feet per minute rate of descent with the speed brakes extended, when compatible with the published penetration. At 1000 feet above level-off, close speed brakes while maintaining 250 KIAS. The last 500 feet prior to level-off altitude should be used to slowly transition the aircraft to level flight. GCA pickup from the penetration point will be used whenever possible.

Note

> If failure of the cockpit temperature controller causes fog to form in the cockpit upon descent, fog can be dissipated most rapidly by utilizing full windshield and canopy defrost airflow and turning the COCKPIT PRESS switch OFF.

Throughout the penetration, the RAN should monitor both barometric and radar altitude, keeping the pilot informed of the lower indicated altitude at each 5000-foot level until reaching 5000 feet above terrain; then calling out each 1000-foot level until level-off. At start of descent, a fuel state of 6000 pounds will allow an instrument penetration, followed by a wave-off, 150-mile flight to a VFR alternate base, with 1000 pounds of fuel remaining at landing.

INSTRUMENT APPROACHES

With the use of TACAN for continuous bearing and distance reference and surface radar for approach and traffic control, the remaining factor in an instrument approach is control of altitude and airspeed. See figure 6-1 for suggested typical procedure.

CAUTION

> Changes in airspeed exceeding 35 knots per minute during or before turns may cause the all-attitude indicator to display a transient, erroneous, wing-down bank attitude indication of up to 5 degrees.

AN/ASB-12 APPROACHES

The possibility of executing satisfactory instrument approaches with AN/ASB-12 equipment to land stations or to carriers is limited primarily by crew interest, effort, and experience in developing the necessary techniques. All practice and actual (weather) approaches should be executed with the AN/ASB-12 tracking the station being approached and, if possible, the runway being approached. AN/ASB-12 altitude, range, airspeed, and bearing information can provide the RAN with aids to monitor the pilot's approach which might not otherwise be available. With experience and satisfactory equipment conditions, the AN/ASB-12 may be relied upon as the sole approach aid. The following factors and restrictions must be observed:

1. The AN/ASB-12 can be used to make an approach under actual instrument conditions or as a navigational aid in following a duly approved and published instrument approach pattern.
2. Measured and reported surface winds will be set into the system when commencing an approach using the stand-by navigation mode.

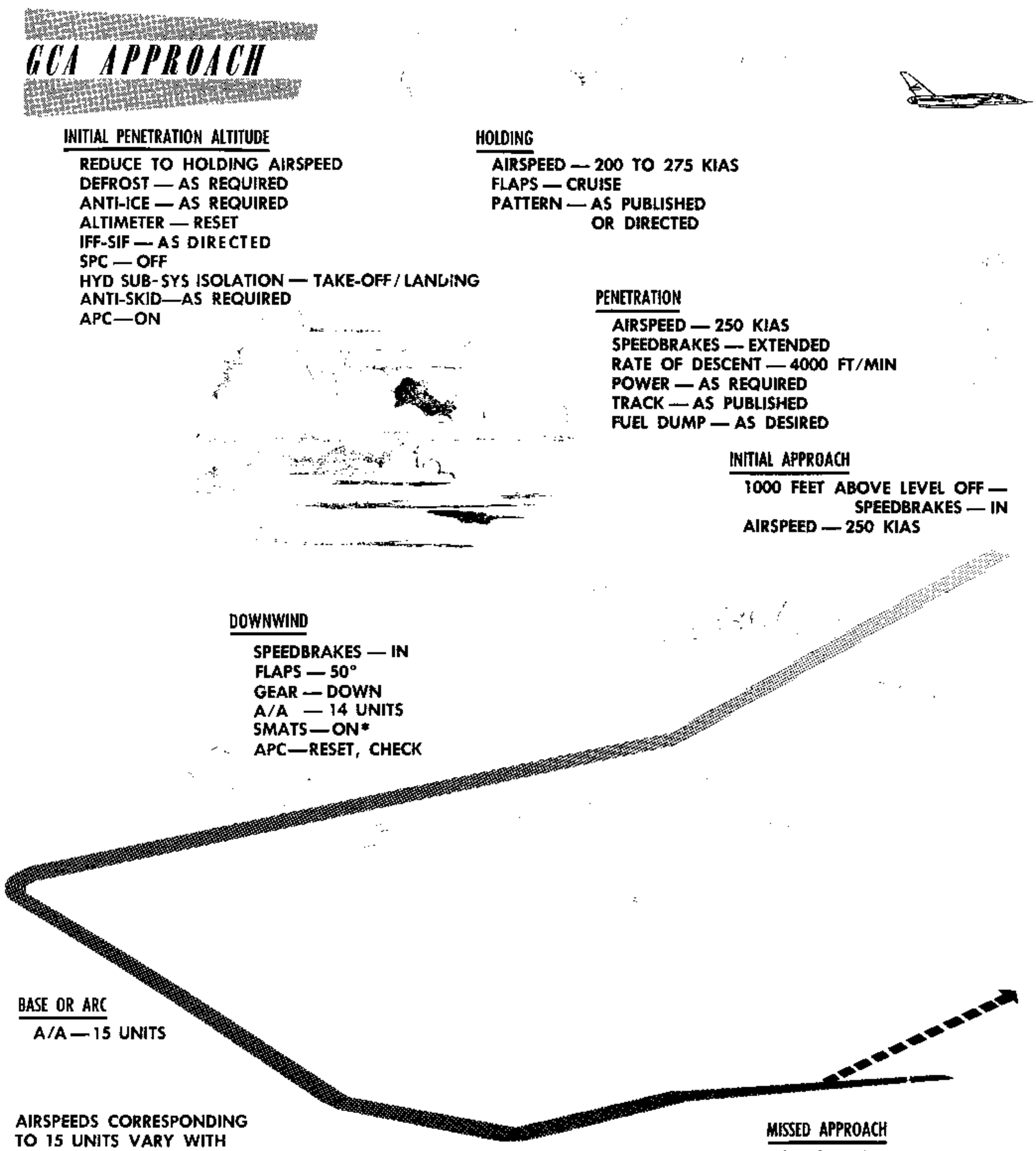
   This is necessary since automatic wind solution is not available in this mode.
3. The AAI steering signal is accurate only a few degrees either side of zero.

   For large corrections, the AAI should be cross-checked with the HSI.
4. The HSI needle may be used, as on a normal instrument approach, to maintain proper outbound track, and may also be used on an arcing approach to the station. The HSI or AAI may be used on the initial part of the inbound approach but, for the final approach, the AAI steering display is more sensitive and accurate.
5. In the AN/ASB-12 approach, it is not necessary that the radar aimpoint coincide with the approach end of the runway but, if an offset distance is used, it must be carefully measured prior to the flight.

Any AN/ASB-12 instrument approach depends on the accuracy of either the inertial autonavigator or the flight reference set gyro platform, and air data computer and wind inputs. This accuracy must be monitored and updated throughout the approach.

RECOMMENDED PROCEDURE

The RAN should store the coordinates of the ADF or TACAN facility and set the SET/CORR and NAV/BOMB knobs to this channel. The pilot then selects the NAV position of the RANGE & BEARING knob (HSI) and the RAN selects the NAV positions of the SYSTEM MODE knob. The pilot may then execute a published instrument approach by using the HSI, as on a TACAN or ADF approach. The main limitation is that the pilot cannot select a desired radial for HSI steering. However, when established on an inbound radial, the RAN may select course line navigation to provide the pilot with AAI steering in order to stay on the radial. During the approach, the RAN should monitor the accuracy of the autonavigator by momentarily switching SET/CORR channels to check cursor position on some known checkpoint.



AIRSPEEDS CORRESPONDING TO 15 UNITS VARY WITH GROSS WEIGHTS AS FOLLOWS:

GROSS WEIGHT	KIAS	KIAS †
44,000 LB	131	134
48,000 LB	136	139
52,000 LB	141	144
56,000 LB	147	150
60,000 LB	152	155
64,000 LB	157	160

FINAL AND GLIDE PATH
A/A — 15 UNITS

MISSED APPROACH
THROTTLES — AS REQUIRED (MAX A/B FOR SINGLE ENGINE)
GEAR — UP
FLAPS — CRUISE, ABOVE 1000 FEET AT 220 KIAS
FOLLOW PUBLISHED PROCEDURE.

* AIRCRAFT HAVING AFC 247 COMPLIED WITH
† AIRCRAFT 145157 THROUGH 151728 HAVING AFC 159 COMPLIED WITH

A-5C-1-0-14K

Figure 6-1

CAUTION

When distance to the stored ADF or TACAN facility position is less than 20 miles, AAI steering will be erroneous unless C/L NAV or the BOMB mode is selected.

A more precise final approach is possible if the RAN stores the coordinates of and tracks the approach end of the runway. If the runway cannot be "broken out" of the surrounding radar ground return, a radar-significant point near the end of the runway should be stored in another channel. The RAN may then select this channel periodically during the approach for radar cursor corrections. When established on the inbound bearing to the runway, the RAN should select C/L NAV for proper steering.

An alternate method is to track the approach end of the runway or an offset radar target in the BOMB mode (O/S). However, with this procedure, AAI steering is toward the end of the runway, *not* to the inbound bearing. HSI bearing and range indications are toward the offset aimpoint, making lineup for landing transition more difficult. The pilot must be aware of the procedure being used, and he must know when HSI and AAI presentations are correct. In general, for any procedure, the pilot should follow HSI bearing and monitor HSI range during the penetration (AAI course line navigation steering may be utilized when established on an inbound radial), and AAI steering should be used on final approach. (Correct HSI bearing and range will be available when the RAN has the SET/CORR knob set to the position for the end of the runway and has selected C/L NAV.)

CARRIER APPROACHES

An AN/ASB-12 instrument approach to a carrier may be accomplished by periodically acquiring the ship in RECON mode and using the same penetration procedures as those used to a shore base. The final approach, however, should be made in the normal (ground-mapping) radar mode, with steering, lineup, relative bearing, and range information being called out to the pilot. If operating in STBY-NAV mode, false winds may be set in so that the system "tracks" the ship. The same final approach technique may be used as is used during an approach to a shore station.

VOICE PROCEDURE

A constant flow of information between the RAN and the pilot is required to accomplish an AN/ASB-12 instrument approach. The following is an example of crew communications procedure:

1. RAN: "Your outbound heading is 290, maintain HSI bearing 110 to NRJ."
2. RAN: "Shifting channels for cursor correction, maintain heading, disregard HSI."
3. RAN: "Cursor correction complete, HSI on NRJ."
4. Pilot: "Fifteen miles out, commencing penetration."
5. Pilot: "Commencing penetration turn, 14,000 feet."
6. RAN: "NRJ bears 098 at 20 miles, should bear 094."
7. RAN: "On bearing, course line navigation selected, follow AAI steering."
8. Pilot: "Sixteen miles out, altitude 2500."
9. RAN: "Shifting channels to runway coordinates, course line navigation out, fly HSI to 090 bearing."
10. RAN: "On bearing, course line navigation selected, follow AAI steering."
11. Pilot: "7-mile Gate, gear and flaps down, check list complete."
12. RAN: "Shifting channels for cursor correction, HSI on tower, AAI steering to runway, follow AAI."
13. RAN: "Cursor correction complete, HSI and AAI on end of runway, follow AAI."
14. RAN: "Range 4½ miles, intercepting glide slope."
15. RAN: "Range 3 miles, your altitude should be 1000 feet MSL."
16. RAN: "Range 2 miles, your altitude should be 700 feet."
17. RAN: "Range 1½ miles, your altitude should be 550 feet, ½ mile from approach minimums."
18. RAN: "At approach minimums."
19. Pilot: "I have the runway in sight."

The RAN should monitor all instrument approaches to gain proficiency in providing the pilot with accurate steering, lineup, bearing, and range information. In addition, the RAN should act as a safety observer on all approaches, using the appropriate approach plate and local charts while monitoring heading, airspeed, and altitude throughout the approach.

WARNING

The RAN's ALTITUDE mode knob should be maintained in the RADAR position for IFR approaches; however, altitude and true airspeed should be monitored closely throughout all approaches.

LOW-VISIBILITY APPROACHES

The low-visibility approach procedure provides final approach alinement for landing, when misalinement existed at visual pickup. The procedure is essentially a close-in orientation to a circling approach and shall not be used in conditions less than those authorized for a circling approach.

EXECUTION

The aircraft should be in the power approach configuration.

1. Maintain contact with the ground; if lost, execute a missed approach.
2. Turn the shorter arc to fly the aircraft *over* the desired runway, parallel to it.
3. If proceeding upwind, immediately perform an 80- to 260-degree turn to proceed downwind *over* the desired runway.
4. Proceed downwind and, after passing over the approach end of the desired runway, perform an 80- to 260-degree turn. Commence descent to landing, coming out of the 260-degree turn with the runway in sight.

HAZARDS

The low-visibility approach is not an approved maneuver except as a form of circling approach. It is not a means of salvaging a missed approach to a straight-in approach. It is not an invitation to half-instrument and half-contact flight, nor should it be combined with the transition to landing configuration. Again, if contact flight with reference to the ground is not possible, a missed approach shall be executed.

GCA APPROACH

See figure 6-1 for suggested typical GCA procedure. IFF and bearing indicator equipment may be desirable for assistance in orientation and traffic control under adverse conditions. On some aircraft,* check static pressure compensator button off before final approach. An angle-of-attack indication of 15 units should be used for final approach.

NIGHT FLIGHT

Night flight in this aircraft presents no additional problems. Both crew members should have a reliable flashlight and should be familiar with the location of all switches and controls. Aircraft lighting and flight instruments should be checked completely before take-off. The aircraft is not equipped with landing lights; however, the nose-gear-mounted taxi light is provided for night ground operation.

FLIGHT IN TURBULENCE

Flight in light to moderate turbulence presents no serious problems. Use of the AFCS will improve the damping of undesirable aircraft motions. In moderate to severe turbulence, however, use of the AFCS is not recommended, as it may monitor off abruptly due to severe gust loads. In instrument flight conditions, its loss can induce vertigo if the pilot is not holding the stick. The relatively long moment arm between the crew and the aircraft center of gravity aggravates the effects of severe turbulence, and the crew should keep shoulder harnesses locked to avoid injury. Instruments become blurred, making accurate interpretation impossible. Increasing airspeed increases the effects of turbulence; however, too slow an airspeed may result in engine compressor and/or aircraft stall, particularly at altitudes above 35,000 feet. The following subsonic airspeeds are recommended for flight through severe turbulence and thunderstorms:

Below 35,000 feet	250 to 300 KIAS
35,000 to 40,000 feet	270 KIAS to 0.92 IMN

Subsonic operations in severe turbulence above 40,000 feet are not recommended; supersonic operations in severe weather have not been evaluated at this time.

THUNDERSTORM PENETRATION

Whenever possible, flight through thunderstorms and areas of heavy precipitation should be avoided by alternate routing, vectoring by ground radar facilities, or in-flight use of the AN/ASB-12 radar. Attempting to climb above severe weather increases the possibility of compressor stall or aircraft stall at high altitudes and low airspeeds. If penetration is unavoidable, the pilot must prepare for the disorienting effects of severe turbulence, precipitation (in the forms of hail, ice, and rain), lightning strikes, and rapid fluctuation of pitot-static instruments. The following procedures are recommended prior to entry:

1. Stabilize on penetration altitude, airspeed, and attitude, using the speeds recommended for flight in severe turbulence.

   If necessary, use afterburner to maintain minimum speeds.
2. Turn on high-altitude lights.
3. Lower helmet visor.
4. Turn on engine and pitot anti-ice switches.
5. Lock shoulder harness.
6. Maintain heading and a level attitude by reference to the AAI, using the stand-by gyro horizon as a backup.

   Do not chase altitude and airspeed.
7. Do not extend landing gear or flaps as structural damage may result.

Note

- The stand-by compass may not be reliable if the aircraft is struck by lightning.
- Completion of a training mission does not warrant penetration of a known thunderstorm.

***Aircraft not having AFC 159 complied with**

ICE AND RAIN

This aircraft is not equipped to fly continuously in icing conditions. Flights shall be planned to avoid altitudes of prolonged icing. No provision is made for in-flight structural anti-icing. At moderate- to high-speed flight, impact pressure is sufficient to prevent ice buildup. Should heavy, clear ice be encountered, an immediate climb should be made in order to clear the icing area. For penetrations through icing or rain, the WINDSHIELD ANTI-ICE switch should be placed in the ON position and maintained until landing is accomplished. The canopy defrosting system should be turned on well in advance of a descent to avoid fogging.

Note

If relative humidity conditions result in fogging during take-off or letdown, the cockpit temperature control can be increased to the maximum until the fog clears, at which time the heat can be lowered to a more comfortable setting.

PITOT-STATIC ICE

The PITOT ANTI-ICE button should be depressed prior to and during flight through visible moisture to prevent unreliable readings of the pitot-static system instruments.

WARNING

Failure of the pitot anti-icing system is not positively indicated to the pilot. Pitot-static or pitot anti-ice failure during climb through freezing level or in visible moisture may have an insidious effect if air speed versus AOA is not monitored. Reduced airspeeds, combined with reduced thrust (from ramp mis-scheduling) could lead to a stall and/or possible flameout. Additionally, the ejection seat speed sensors may be affected and failed to the low mode. Avoid operating at AOA of less than 9.5 units.

Note

Pitot line freezing may occur when the aircraft is operated in cirrus-type clouds for extended periods of time. Melted ice crystals can reach the rear of the pitot-static tube and freeze at the connections. The pitot heater should be turned ON prior to penetration. If freezing occurs, it may be indicated by an erroneous indicated airspeed increase when altitude is increased. If this condition is noted, the angle-of-attack indicator should be used to maintain a safe attitude until aircraft altitude is decreased to a level where melting of the ice will occur.

ADC MOISTURE

The presence of excessive moisture in the air data computer may cause erratic, unreliable readings in airspeed, Mach number, and altitude. This is indicated by radical transients in the flight instruments and/or a barber-pole indication on the RAN's radar/barometric altimeter. Should this occur, depress to release the static pressure compensator button and utilize the uncorrected indications of airspeed, Mach number, and altitude.

COCKPIT FOG

Under warm, humid conditions, or when the aircraft has been subjected to soaking precipitation, heavy cockpit fog and instrument frosting may form during operation at high engine power settings unless cockpit temperature has been raised sufficiently to warm the cockpit area. In addition, windshield and canopy defrost should be utilized to prevent frosting. If accomplished prior to take-off, this procedure reduces the possibility of heavy fogging and reduces frosting as high altitudes are reached. Under humid conditions, it is recommended that the COCKPIT TEMP knob be placed at "3" (HOT) and that the WINDSHIELD CANOPY DEFROST knob be turned on to a low setting as soon as the engines are started.

ENGINE ICING

The effect of moisture or icing conditions on engine operation, although predictable, is difficult to quickly and accurately detect from engine instruments. Generally, the magnitude of changes in instrument indication is small. For example, changes noted after 5 to 10 minutes of exposure to icing conditions are similar to changes resulting from an increase in altitude of 3000 feet or a decrease in Mach number of 0.15. Therefore, the absence of marked changes in indication with respect to time, and the relatively small magnitude of change, would require almost continuous monitoring of engine instruments to detect engine inlet icing. In addition to the presence of freezing moisture, other factors (such as altitude, throttle setting, rate of water and/or ice ingestion, and the amount of ice buildup) affect the direction and amount of change in engine parameters. For example, high water or ice ingestion rates can affect engine speed holding capability. At extreme ingestion rates (i.e., thunderstorms or heavy rain), engine speed will decay as a function of the water/airflow ratio. Ice buildup on the compressor inlet during high-altitude flight decreases compressor efficiency and, under extreme conditions, can result in compressor stall and engine flame-out. The number of possible interactive effects of all factors on engine instrument indication are so numerous that detection is difficult, if not impossible.

There are two basic forms of engine or inlet duct icing: water ingestion in the form of water or ice, and ice buildup on the compressor inlet surfaces. Both forms have distinct characteristics; however, actual icing progression usually begins with ingestion and culminates in combined ingestion and ice buildup. This progression requires approximately 6 to 10 minutes. Since a relatively long time is required for this progression, there will be no sudden change in engine instrument indications.

INGESTION OF ICE AND WATER

When ice and water are ingested, evaporation in the engine compressor occurs, reducing pressures and temperatures. The direction of engine parameter change will depend, however, upon engine power setting.

Low Power Settings

At low power settings (exhaust nozzles mechanically scheduled), EGT and fuel flow decrease, while nozzle position and rpm hold constant. Since the nozzle is on the fixed mechanical schedule, lowered engine temperatures caused by water evaporation will result in a decrease in EGT and fuel flow. Engine rpm holding capability will be relatively unaffected except at extreme ingestion rates.

High Power Settings

At cruise, Military Thrust, and Maximum Thrust settings (exhaust nozzles modulate to maintain EGT at rated maximum), nozzle area decreases, fuel flow increases, and rpm and EGT hold constant. At throttle settings above approximately 92% rpm, the exhaust nozzle controllers will decrease nozzle area to maintain EGT as the water evaporates. Decreased nozzle area increases tailpipe pressure, requiring an increase in fuel flow to maintain engine speed. If ingestion rate increases, the nozzles close to the minimum area scheduled by the throttle and engine operation is the same as that covered under LOW POWER SETTINGS.

ICE BUILDUP

The effects of ice buildup on the compressor inlet surfaces are usually obscured by the presence of ingestion characteristics occurring simultaneously. Ice buildup results in a condition similar to engine operation at low ram pressure recovery.

Low Power Settings

At low power settings (exhaust nozzle on mechanical schedule), EGT and fuel flow increase, while nozzle position and rpm hold constant. Engine pressures are low at 80% rpm and below, and further reduction of engine pressures from ice buildup results in an increase in EGT and fuel flow.

High Power Settings

At cruise, Military Thrust, and Maximum Thrust settings (exhaust nozzle modulates to maintain EGT at rated maximum), nozzle position and fuel flow decrease, while EGT and rpm hold constant. Reduction of engine pressures from ice buildup at high engine speed tends to reduce fuel flow. Reduction in fuel flow tends to lower EGT. The nozzle control system senses the change and reduces nozzle area to maintain a constant EGT.

RECOMMENDATIONS

Serious ice buildup can occur before a significant change is noted in the engine instruments. Therefore, engine instruments should NOT be relied upon for diagnosing possible engine icing conditions. Move the ENGINE ANTI-ICE switch to ON and depress the PITOT ANTI-ICE button prior to entering any known or suspected area of icing conditions.

PART 3 — EXTREME WEATHER OPERATIONS

COLD WEATHER PROCEDURES

PREFLIGHT

When ambient temperature is below 32°F, it is necessary to preheat the electronic and reconnaissance compartments. Sudden surges of electrical power through extremely cold components may result in serious damage due to sudden heat expansion. In extremely cold weather, avoid touching metal surfaces with bare hands. Hot air should also be directed into the intake ducts, the landing gear wells, and the cockpits. This procedure will evaporate moisture which may have collected and frozen under controls, microswitches, etc. Ensure that all ice, snow, and frost accumulation is removed from all aircraft surfaces and activating linkages prior to flight. At ambient temperatures below −40°F, MIL-L-7808 engine oil should be used in place of the normally prescribed MIL-L-23699 (Wep) oil.

Note

> Failure to remove all ice, snow, and frost from all aircraft surfaces could result in dangerous disruption of airflow characteristics and loss of lift.

GROUND OPERATION

Exercise caution when running up the engines since wheels and chocks frequently slide on ice or snow. For engine check above idle rpm, aircraft should be tied down. Taxi and take-off procedures on ice-covered taxiways and runways are hazardous. The full-power brakes may act to hinder rather than to aid in taxiing. USE NOSE WHEEL STEERING AT ALL TIMES WHEN TAXIING ON SLIPPERY SURFACES. If necessary, have the aircraft towed to a point close to the runway before starting engines. On icy taxiways, once a skid is started, the aircraft may slide a considerable distance before control can be regained, even when using nose wheel steering. Always taxi SLOWLY using a minimum of power and brakes. The retarding effect of soft snow or slush on the runway will lengthen the take-off ground run.

WET OR ICY RUNWAYS

The increase in rollout distance on wet or icy runways depends on the braking conditions encountered. Normal landings with an increase of 1000 to 2000 feet of ground roll may be accomplished on wet runways where precipitation has stopped and drainage occurred. A landing in rain or on standing water may result in up to 75 percent increase in normal rollout distance. Crosswind conditions may affect wet or icy runway landings to an equal degree in that safe aerodynamic braking is limited. In general, a wet runway landing should be accomplished by using the recommended final approach speed, touching down in the first 500 feet of the runway. If crosswind conditions permit, use nose-high aerodynamic braking. The nose should be held off down to 115 knots, then allowed to drop with the stick full aft. Continue to hold the stick as far aft as possible and commence cautious, steady braking. If a yaw develops, cease braking and use nose wheel steering. Continue to hold the stick aft, and as speed decreases, increase brake pressure until taxi speed is reached. For icy runways, the same factors are involved except that stopping distance may be increased by more than 100 percent. For "patchy" ice conditions, extreme care must be taken to brake on clear runway and to reduce braking on ice to prevent skidding when passing from ice to clear runway. Except for possible yawing, wheel lock is difficult to detect, and a tire may fail without warning. For landings on wet or icy runways, prepare for field arrestment, or request barrier, if gear is available.

POSTFLIGHT

Attempt to park the aircraft on a clear spot if possible. Make sure the wheels are properly chocked and tiedowns installed before making any postflight engine runups. All aircraft covers and plugs should be installed immediately after postflight inspection.

HOT WEATHER PROCEDURES

PREFLIGHT

In hot weather, the aircraft surfaces may become extremely hot. Crew members and ground maintenance personnel should wear gloves to prevent injury. In extreme heat, the pilot and RAN should make as many of his operational checks as possible before starting engines. Before entering the aircraft, complete normal preflight items and devote particular attention to the following:

1. Check intake ducts for accumulated sand, etc.
2. Check tires, seals, and antenna covers for cracks and blisters.
3. Cockpit covers should be left on as long as possible to prevent excessive heating of metal surfaces and controls in the cockpit.
4. Check canopies for excessive scratches, particularly before night flight.

GROUND OPERATION

After engines are started, taxi rpm in hot temperature areas should be the lowest practical rpm for aircraft movement desired. Overheating of brakes is critical in hot weather. In most cases, small quantities of sand do no harm in passing through a turbojet engine; however, during hot weather and desert operation, pilots are reminded to:

1. Make ground run-up as short as possible.
2. Do not allow the engines to operate at IDLE rpm for more than 2 minutes with flaps extended with an alined autonavigator platform.
3. Avoid running up engines toward equipment or personnel, even from longer than usual distances. Sand blast can result in serious damage to other aircraft and injury to ground personnel.

Double-check the flight control system for proper operation and freedom of control surface movement. Hydraulic pressures which exceed or fall short of limitations should not be accepted as normal. Adjust cockpit air conditioning to desired temperature. If ALT COOL caution indicator is ON, reset when engine rpm is above 80%.

TAKE-OFF AND CLIMB

Power required for take-off in hot weather will depend upon aircraft configuration, weight, ambient temperature, and field elevation. During extremely hot weather and at high field elevations, maximum afterburner is recommended to avoid a prolonged take-off. This power setting should also be used to accelerate to best climb speed.

LANDING

Use of higher than normal power settings can be expected during landing approaches in hot weather. Expect gusts and turbulence at low altitudes and anticipate longer landing rollout.

POSTFLIGHT

If possible, park the aircraft crosswind to prevent sand or dust from collecting in the intake ducts or afterburners. Canopies should be closed and wing tips and tail should be spread and locked. All covers and plugs should be installed immediately after the postflight inspection.

SECTION VII—COMMUNICATIONS PROCEDURES

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PART 1—ELECTRONIC EQUIPMENT PROCEDURES

RESPONSIBILITY

It is the responsibility of the pilot to ensure that all voice and visual communications and electronic transmissions from his aircraft are in compliance with applicable directives.

RADIO COMMUNICATIONS AND ELECTRONIC NAVIGATION EQUIPMENT

Adhere to the following instructions:

1. Do not interrupt another transmission.
2. Make only necessary transmissions.
3. Keep all transmissions brief and concise.
4. Use the phonetic alphabet.
5. Use approved phraseology.
6. Have message prepared before beginning transmission.
7. Use correct calls.
8. Be familiar with the Communications Section of USAF/USN FLIP Planning Document.

Note

Monitor GUARD frequency (243.0 mc) at all times. Do not transmit on GUARD except in an actual emergency.

RADIO COMMUNICATION EQUIPMENT

Multichannel frequency UHF is the sole means of two-way voice communications. The RAN will carry a copy of the current frequency plan for UHF on all flights. The auxiliary receiver may be used as a backup communications receiver.

ELECTRONIC NAVIGATION EQUIPMENT

The aircraft contains three electronic aids to navigation:

1. TACAN.
2. UHF airborne direction finder.
3. AN/ASB-12.

IFF/SIF PROCEDURES

Aircraft operating within the CONUS will operate the IFF/SIF equipment to conform with OPNAV/FAA regulations. During carrier operations, IFF will be operated as prescribed by current directives.

AUTHENTICATION

Authentication will be in accordance with the appropriate KAC series, or as assigned by the Operational Commander.

EMERGENCY COMMUNICATIONS

Comply with OPNAV Instructions and the steps on the inside rear cover of FLIP, Enroute Supplement. Refer to Section V, Part 4 for aircraft distress reporting.

PART 2 — VISUAL PROCEDURES

VISUAL COMMUNICATIONS

BETWEEN AIRCRAFT

Communications between aircraft within a formation will be conducted visually whenever practicable, provided no sacrifice in operational efficiency is involved.

Flight leaders will ensure that all aircraft in the formation receive and acknowledge signals when given. Visual signals as set forth in NWP 41(A) will be used. For emergency signaling, the FAA standard HEFOE system should be used:

1 finger	H	Hydraulic
2 fingers	E	Electrical
3 fingers	F	Fuel
4 fingers	O	Oxygen
5 fingers	E	Engine

AIR REFUELING SIGNALS

BY RECEIVER	MEANING	RESPONSE
One finger turn-up signal.	Start turbine.	Tanker execute. Receiver gives "thumbs up" when turbine starts.
Form cone shape with hand, all fingers extended aft.		
1. Cone moved aft.	Extend drogue.	Tanker execute.
2. Cone moved forward.	Retract drogue.	Tanker execute.

BY TANKER	MEANING	RESPONSE
Make hand into cup shape and make repeated pouring motions.	I am going to dump fuel.	Receiver nods and gives "thumbs up" when dumping commences.
Slashing motion of index finger across throat.	I have stopped dumping fuel.	Receiver gives "thumbs up" when dumping stops.

SECTION VIII — RECONNAISSANCE SYSTEMS

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PART 1 — RECONNAISSANCE CAPABILITIES

RECONNAISSANCE SYSTEMS

The RA-5C aircraft has the capability of obtaining reconnaissance data such as aerial photographs, radar maps, infrared imagery, or ground-based radar characteristics. The type of data obtained will depend on the equipment installed in the aircraft. The various missions of the aircraft require different packages of equipment for obtaining reconnaissance data. The data obtained is utilized during postmission analysis and for future mission planning. Systems providing reconnaissance data collection capabilities are the photographic systems, side-looking radar system, infrared system, and passive electronic countermeasures system. The digital data system provides control signals for these systems and information required for full utilization of the data obtained from the reconnaissance systems. This data is complementary since, by comparison, more information can be obtained than would be possible by using any single system.

PART 2—PHOTOGRAPHIC SYSTEMS

AERIAL PHOTOGRAPHIC SYSTEMS

The aerial photographic systems installed in the RA-5C aircraft provide the aircraft with a capability of obtaining day and night high-resolution aerial photographs over a broad range of aircraft speed, altitude, and atmospheric conditions.

Photographic reconnaissance operations have, in recent years, changed from missions at medium altitudes to very low altitudes. High-altitude photography requires cameras with longer focal lengths and high-resolution lenses to maintain a scale that will provide sufficient image size and produce enough resolution for detailed study. Low-altitude photography requires short focal length lenses to provide a reasonable field of coverage. To fulfill these requirements for the RA-5C aircraft, two panoramic cameras (one for low-altitude and one for high-altitude operation) are installed with rotating prisms which scan from horizon to horizon to obtain wide rectangular overlapping frames in the direction of flight. Still picture (serial frame) cameras, exposing a series of overlapping square frames, are also installed at various stations to accomplish additional specific photographic reconnaissance recordings. In addition to the cameras, the photographic equipment includes stabilized camera mounts, camera control panels, electronic control assemblies, and related equipment. Related equipment includes a viewfinder in the RAN's compartment, video amplifiers associated with each camera, and flash units for night photography housed within two detachable pods, one mounted under each wing.

S/C CONTROL

The serial frame and panoramic cameras incorporate an S/C control on the lens cone or lens train assembly. The S/C factor is a ratio with values which must be determined and preset prior to flight to effect proper automatic exposure control. This factor is based on a number of variables, including film type, filter type, altitude, target reflectivity, target type, location, season of the year, time of day, and ground cover variations. The final factor is preset on the ground prior to flight. The S/C function is not applicable for night photography. The S/C control circuits are bypassed (lens wide open) by moving the CAMERA FLASHER MODE switch to either SIMULTANEOUS or ALTERNATE.

AUTOMATIC EXPOSURE

Each camera installation is equipped with a light sensor, providing integrated control of exposure within preset limits. Automatic exposure settings may be overridden (plus or minus one effective f-stop) by the RAN to compensate for special conditions.

IMAGE MOTION COMPENSATION

IMC is provided through the camera control systems. Input signals of aircraft ground speed (Vg) are integrated with altitude signals from the air data computer or radar altimeter. Correct IMC is achieved when film motion relative to the ground is zero. Four factors are involved: (1) ground speed, (2) altitude above terrain, (3) camera focal length, and (4) depression angle. Normally, the camera (altitude) mode switches are set at LOW ALT (IMC) regardless of altitude.

CAMERA SENSOR STATIONS

SENSOR STATION 1 (FORWARD OBLIQUE)

Sensor station 1 contains a forward oblique KA-51A or KA-51B, 6-inch focal length (FL) serial frame (S/F) camera. This camera is secured to fixed mounts which may be installed to provide 11.5- or 16-degree depression angles from the FRL. The camera is used for day photography only and operates in the pulse mode of operation (without IMC) with 50 percent forward overlap approximately 10 degrees from the bottom of the format, regardless of the position of the mode selector switch. The operation of the F/O camera can be controlled from either the pilot's OBLIQUE CAMERA control panel or the RAN's CAMERA CONTROL panel.

SENSOR STATION 2 (AZIMUTH/VERTICAL CAMERA)

Sensor station 2 contains an azimuth/vertical (Az/V) S/F camera. A KA-50A (1¾-inch FL), KA-62A (3-inch FL), KA-51A/B (6-inch FL) camera can be used in sensor station 2. A switching arrangement is used to obtain proper IMC action (autocycle and over lap for the three different FL cameras. The camera is mounted in an azimuth-controlled mount secured to position the camera at approximately a 90-degree depression angle at a normal level flight attitude. (The camera axis is at an angle of 94 degrees to the FRL.) In addition to providing a mounting surface for the camera, the azimuth-controlled mount is supplied with signals to correct the camera for aircraft drift angles as large as ±10 degrees. This station can be used for night, as well as day, photographic missions; however, night missions should employ the 6-inch FL camera in order to maintain the complete camera field of view within the flasher cone of light. This station is operated by the RAN only, and provides 60 percent overlap in either high- or low-altitude mode with the 1¾- or 3-inch FL camera installed. The 6-inch FL camera provides 20 percent overlap in the high-altitude mode and 60 percent in the low-altitude mode. The azimuth/vertical camera can also be operated to form part of a tri-fan camera configuration with the obliques in station 4.

SENSOR STATION 4

This station is the most versatile area of the reconnaissance systems and can house one of three modules in various configurations. Each module is identical in shape but contains a diversified camera arrangement.

Module No. 4-1

In the forward compartment, this module houses the right and left oblique serial frame cameras. They can be of various focal lengths, hard-mounted, to provide various depression angles. The two 6-inch FL cameras can be installed at a 5- , 19.75- , 37.5- or 52- degree depression angle. If tri-fan coverage is desired, these depression angles will be determined by the camera focal length used in station 2. For example, a 1¾-inch azimuth vertical camera requires 6-inch oblique cameras depressed at 19.75 degrees.

Some No. 4-1 modules have been modified to house two KA-53A (12-inch) FL cameras installed at depression angles of either 5 or 19.75 degrees.

The right and left oblique cameras are used for daylight missions and can operate in either the non-IMC (pulse) mode of operation or IMC (autocycle) mode of operation. Operation of these cameras can be controlled from either the pilot's control panel or the RAN's control panel. When the pilot has control, the cameras can be operated either singly or together; however, when the RAN has command, the cameras can only be operated together.

Module No. 4-1 (Configuration A)

This module contains the same oblique camera arrangement as the No. 4-1 module; however, a 3-inch pan camera which is controlled from the RAN's control panel, is included in the aft part of the module. The 3-inch pan camera and both side oblique cameras may be operated individually or simultaneously.

Module No. 4-2

This module contains provisions to accommodate an 18-inch focal length panoramic camera (KA-58A) in the forward compartment and a 3-inch focal length panoramic camera (KA-57A), in the aft compartment. These cameras are controlled by the RAN and are mounted in fully stabilized mounts. The 3-inch pan provides the normal 60 percent forward overlap while the 18-inch pan provides 66 percent forward overlap. Both cameras operate in the IMC mode of operation regardless of ALTITUDE MODE switch selection. The cameras cannot be operated simultaneously.

Both panoramic camera systems include stabilized mounts which will stabilize the camera to aircraft motions subject to the following limitations: 18-inch pan ± 4 degrees in roll, +1/ 6 degrees in pitch, and ± 3 degrees in azimuth; 3-inch pan ± 5 degrees in roll, pitch, and azimuth. The camera systems also include a self-contained automatic exposure control system. The film capacity of the 3-inch pan is 3000 feet of 70 mm thin base film (3600 exposures). The 18-inch pan camera film capacity is 2500 feet of 5-inch thin base film (535 exposures). The Vg/H capability of the 3-inch pan is 0.056 to 0.90 knot per foot. The Vg/H capability of the 18-inch pan is 0.002 to 0.045 knot per foot (0.01 to 0.10 knot per foot with AFC 292 incorporated). Flights made at higher Vg/H values will not damage the camera but will result in degraded imagery and reduced overlap. A minimum 5-hour preheat is required for the 18-inch pan camera to obtain the highest resolution imagery. The prisms enclosure* (greenhouse) is a glass enclosure surrounding the 18-inch pan camera prisms which prevents module No. 4-2 environmental thermal fluctuations reaching the prisms, thereby preserving camera resolution. The prisms enclosure contains a heater, thermostat, and blower to aid in preheating but does not reduce preheat time to less than 5 hours.

On some aircraft,† a barometric altitude signal is provided to special system module No.4-2 for the 18-inch panoramic camera in conjunction with PHC 36, which modifies the KA-58A camera assembly for increased V/H range and automatic focus control. With the increased V/H range and automatic focusing, improved resolution of imagery is obtained at all scan angles from 4,000 to 40,000 feet within a V/H range of 0.01 to 0.10 knot per foot.

Module No. 4-3

This module can accommodate two 6-inch focal length serial frame cameras (STAB 1 and STAB 2) installed in fully stabilized mounts providing pitch and roll stabilization of ± 5 degrees and azimuth correction of ±10 degrees. In the normal level-flight attitude, the camera depression angle is approximately 90 degrees; however, the camera axis is set at 94 degrees with respect to the FRL.

This module provides both day and night photographic capabilities. During night operations, the stabilized mount should be manually caged to maintain camera orientation within the light area of the electronic flashers. The electronic flasher system provides the necessary high-intensity light output for night photography. This module can also accommodate the 1¾-inch camera. STAB 1 and STAB 2 may be operated individually or simultaneously by the RAN.

Module No. 4-3 (Configuration A)

This configuration of module No. 4-3 houses 12-inch focal length serial frame cameras in the forward compartment of the module, mounted in a split vertical configuration. The cameras are fixed-mounted with a depression angle of 81 degrees. An optional configuration is the single 12-inch camera mounted vertically. Either configuration can be operated from the RAN's CAMERA CONTROL panel using existing control circuits. The split 12 configuration provides approximately the same lateral coverage as a 6-inch focal length camera with twice the scale. The single 12-inch vertical configuration provides approximately one-half the lateral coverage of the 6-inch camera with twice the scale.

***Aircraft having PHC 33 complied with**
†Aircraft having AFC 292 complied with

SENSOR STATION 9 (FLASHER PODS)

The electronic flasher pods are installed at wing station 110 (right- and left-hand). The pods supply directed high-intensity light in a 43-degree cone of illumination. The flasher pods operate in conjunction with the station 2 or station 4 vertical cameras (6-inch focal length).

The CAMERA FLASHER MODE switch should be positioned in either ALTERNATE (pods flash alternately for lower altitudes and higher speeds) or SIMULTANEOUS (pods flash together for higher altitudes.) Selection of ALTERNATE or SIMULTANEOUS, places the cameras in the night mode of operation and supplies power to the flasher pods. The camera system can be operated either in the pulse mode by selection of HIGH ALT mode or in the auto-cycle (IMC) mode by selection of the LOW ALT mode. Choice of mode should be established by the aircraft speed and altitude, based upon the envelopes shown in figure 11-167. The LOW ALT mode and SIMULTANEOUS flasher mode should be used if exposure interval is 1 second or more (allowing for full flasher charge). If less than 1 second is available, HIGH ALT mode and SIMULTANEOUS flasher mode should be selected to double the time interval between exposures. When exposure interval in HIGH ALT mode is less than 0.72 second (one-half flasher charge), the ALTERNATE flasher mode should be selected.

Operation at V_R/H values between 0.7 and 1.0 knot per foot of altitude is possible; however, degraded imagery will result due to the limited charge time available. Under these circumstances, ALTERNATE flashers and LOW ALT mode must be used since the V_R/H exceeds the camera capability in HIGH ALT.

Because of camera and flasher synchronization requirements, only one night vertical camera station (4 or 2) can be used at a time. If station 2 is selected for operation with ALTERNATE or SIMULTANEOUS selected on the flasher control panel, station 4 will automatically be locked out until station 2 is positioned to OFF. However, with two vertical cameras in station 4, both cameras may be selected. In this event, only one camera will operate until it runs out of film or fails, at which time, the other camera will automatically begin to operate.

WARNING

- The flasher pod capacitor system operates at 2600 volts. Stay clear of the flash units for at least 10 minutes after use, since residual capacitor charge requires considerable discharge time.
- The brightness of the flash units can inflict PERMANENT BLINDNESS.

WARNING

- DO NOT LOOK DIRECTLY AT UNITS DURING PREFLIGHT TEST PROCEDURES.

CAUTION

The FLASHER MODE switch must be in the OFF position above 10,000 feet MSL.

Note

A reduction in quality may result between 2500 and 3000 feet above the terrain. Photographic results are degraded rapidly at higher altitudes.

CAMERA CONTROL SYSTEM

All camera systems are controlled from a camera control panel located in the RAN's compartment, with the pilot having the means of taking over control of the oblique still picture cameras. Control of the cameras is accomplished automatically and controlled by constants applied by the IMC and shutter control assembly in sensor station 5 (for serial frame cameras) and by self-contained control electronics (for panoramic cameras). The IMC and shutter control assemblies translate a positive d-c voltage (V/H), received from the data converter into the required signals for camera operation and image motion compensation (IMC). These signals are used for serial frame and panoramic camera film drive and panoramic lens control. The V/H signal is monitored on the viewing screen of the viewfinder by the RAN. If incorrect signals are observed on the screen, the RAN can, through signals on the viewfinder control panel, supply correct V/H signals to the cameras. On some aircraft,* the panoramic and serial frame cameras utilize stabilization signals from the bomb directing set, AN/ASB-12, stable platform. The individual camera mount stabilization gyros are removed and the RAN is provided with an electrical means of caging the camera mounts in the event of stabilization system malfunction. During maneuvers exceeding the stabilization limits, the RE-ERECT light may come on, but immediate stabilization is gained following the maneuver and the light should go out. If the light remains on, the SENSOR STAB switch can be moved to CAGE and the light should go out within 2.5 minutes. Operation in the CAGE mode deprives roll stabilization from AN/AAS-21 and AN/APD-7 as well as from camera mounts. However, the panoramic camera mounts are not mechanically caged until the camera POWER switch is in the OFF position. A carrier landing with the camera POWER switch in READY or OPERATE may damage the prisms of an installed 18-inch panoramic camera, even though in CAGE mode.

*Aircraft having AFC 297 complied with

CAMERA CONTROL PANELS

Controls of the cameras are provided on two camera control panels, one in each cockpit. See figure FO-20 for location of controls and indicators located on the control panels. The pilot's camera control panel permits the pilot control of the oblique mounted S/F cameras. There are five switches on the pilot's control panel; figure 8-1 lists and defines the function of the related controls and indicators. The RAN's control panel provides the means of controlling all cameras. Exposure remaining counters and readiness indicators for each camera are included on the panel. Exposure override switches enable the RAN to manually override the automatic exposure control (AEC) of all cameras. Figure 8-2 lists and defines the function of all switches and indicators along with related controls and indicators. Figure 8-2 indicates that normal operation of camera controls consists of programming the desired altitude mode switches first, and then selecting the OPERATE position of the POWER switch (RAN), or selecting ON or STICK and depressing the trigger (pilot). The panoramic camera control circuitry provides the RAN with the option of reversing this sequence and using the ALTITUDE mode switch as an ON/OFF control with no undesirable effects. However, serial frame camera altitude mode switches should not be used as ON/OFF controls by either pilot or RAN when operating in the pulse mode. Damage to the camera drive mechanism could result. When operating in autocycle mode, either pilot or RAN may use serial frame altitude mode switches as ON/OFF controls, although this procedure offers the remote possibility of blowing a fuse if the camera should be turned off exactly during shutter recycle. The flight crew must evaluate whether the advantages gained from this procedure on a particular mission justify the risk of losing operation of that camera. If serial frame camera ALTITUDE mode switches are used as ON/OFF controls during autocycle mode of operation, the first two or three frames of imagery after turn-on may be degraded.

OBLIQUE CAMERA SIGHTS

On some aircraft,* oblique camera sight assemblies are installed on the left- and right-hand sides of the pilot's canopy. See figure 3-3. The calibrated sight heads provide the capability of improved target acquisition for oblique camera photography. See figure FO-20. The sights are utilized by raising the assembly vertically to a comfortable eye level and rotating the calibrated sight head to the applicable focal axis depression angle for the oblique camera configuration of the aircraft.

SERIAL FRAME CASSETTES

Two sizes of cassettes are available for use with serial frame cameras. A KA-51 or KA-62 installed in sensor station 2 must utilize the smaller cassette. A KA-51 or KA-62 installed in sensor station 2, or 52-degree depressed 6-inch obliques in module 4-1 or 4-1a, must utilize the smaller cassette. Cassette capacity will depend on film thickness as follows:

TOTAL FILM THICKNESS	SMALL CASSETTE CAPACITY	LARGE CASSETTE CAPACITY
4.3 mils	360 frames (150 feet)	840 frames (350 feet)
5.6 mils	240 frames (100 feet)	600 frames (250 feet)

CAMERA PULSE MONITOR PANEL

Both cockpits contain monitor lights which indicate each exposure of serial frame cameras. The pilot's camera pulse monitor panel provides for monitoring of any one serial frame camera at a time, while the RAN may monitor all serial frame cameras simultaneously. Camera pulse monitors do not indicate panoramic camera operation. The RAN's camera pulse monitor panel also contains a night photography mode select switch (CAMERA FLASHER MODE) and may include a stabilized mount cage control switch (SENSOR STAB) (PHC 37 and AFC 297). See figures 8-1 and 8-2 for functions of all switches and indicators in both cockpits.

***Aircraft having AFC 312 complied with**

PILOT'S CAMERA CONTROL AND INDICATOR FUNCTIONS

SWITCH NOMENCLATURE			FUNCTIONAL DESCRIPTION
CAMERA COMMAND			Transfers control of the oblique cameras from the RAN to the pilot (RAN'S camera POWER switch must be in READY or OPERATE). A green light within the switch informs the pilot he has control. Control reverts to the RAN whenever he selects OFF position of the camera POWER switch or depresses the RAN'S CAMERA COMMAND switch.
OFF-ON-STICK			The ON position enables the FWD, RIGHT, and LEFT mode selectors for continuous operation when selected. The STICK position enables the trigger switch (pilot's control stick) to control operation of the selected oblique camera(s).
OBLIQUE HIGH ALT-OFF LOW ALT	FWD	HIGH ALT	F/O camera ON - operates in pulse mode.
		LOW ALT	F/O camera ON - operates in pulse mode.
	LEFT	HIGH ALT	L/O camera ON - operates in pulse mode.
		LOW ALT	L/O camera ON - operates in autocycle mode.
	RIGHT	HIGH ALT	R/O camera ON - operates in pulse mode
		LOW ALT	R/O camera ON - operates in autocycle mode.
GENERATOR CONTROL PANEL			
SYSTEM LOOK-ARMT-LISTEN			LOOK position permits continued operation of cameras in the event of loss of single generator. LISTEN position permits operation of PECM in simular situations. In the event of single converter loss, either LOOK or LISTEN will permit operation of both PECM and cameras
CONTROL STICK			
Trigger switch			With the pilot in command of the oblique cameras, the FWD, LEFT, or RIGHT mode selector switches positioned to either HIGH-ALT or LOW-ALT, and the ON-OFF-STICK switch positioned to STICK, the selected camera(s) will operate whenever the trigger switch is squeezed and will continue to operate until the switch is released.
INTERIOR LIGHTS CONTROL PANEL			
WARNING LIGHTS TEST switch			Checks indicating lights without turning on the camera control systems.
CAMERA PULSE MONITOR PANEL			
CAMERA PULSE MONITOR switch	VERT		Energizes the pilot's camera pulse monitor lamp momentarily for each exposure of the AZ/V camera.
	FWD		Energizes the pilot's camera pulse monitor lamp momentarily for each exposure of F/O camera.
	L OBL STAB 1		Energizes the pilot's camera pulse monitor lamp momentarily for each exposure of the L/O, forward stab or left split twelve camera.
	R OBL STAB 2		Energizes the pilot's camera pulse monitor lamp momentarily for each exposure of the R/O, aft stab or right split twelve camera.

NOTE

The panoramic camera's operation is not monitored by the pilot's Camera Pulse Monitor Panel.

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Figure 8-1

RAN'S CAMERA CONTROL AND INDICATOR FUNCTIONS

SWITCH NOMENCLATURE		FUNCTIONAL DESCRIPTION
POWER/OPERATE-READY-OFF	OFF	In the OFF position, power is removed from the camera system.
	READY	The READY position energizes relays to supply electrical power to those areas of the camera systems that require a warmup period.
	OPERATE	The OPERATE position starts operation of the preselected cameras.
CAMERA COMMAND		Transfers control of the oblique cameras from the pilot to the RAN (RAN'S camera POWER switch must be in READY or OPERATE). An indicating lamp within the switch comes on indicating the RAN has control. Control also reverts to the RAN whenever he selects the OFF position of the camera POWER switch.
OBLIQUE HIGH ALT-OFF LOW ALT	HIGH ALT	All obliques operate in pulse mode.
	LOW ALT	F/O operates in pulse mode, while all other obliques operate in the autocycle mode.
OBLIQUE CAMERA READINESS indicators	LEFT FWD RIGHT	Indicator(s) displays ON when the POWER switch is either at the READY or OPERATE position, the OBLIQUE camera mode selector is positioned at HIGH ALT or LOW ALT, and the camera is operating properly. When the pilot has command, the indicators will not display ON until cameras are operating.
OBLIQUE CAMERA EXPOSURE REMAINING indicators	LEFT FWD RIGHT	Displays the number of exposures remaining for the oblique cameras if properly set prior to camera operation
CAMERA EXPOSURE OVERRIDE switches	LEFT — OVER	Increases exposure of L/O camera by one f-stop.
	LEFT — UNDER	Decreases exposure of L/O camera by one f-stop.
	RIGHT — OVER	Increases exposure of R/O camera by one f stop.
	RIGHT — UNDER	Decreases exposure of R/O camera by one f stop
	VERT — OVER	Increases exposure of all centerline cameras (including split twelves) by one f-stop.
	VERT — UNDER	Decreases exposure of all centerline cameras (including split twelves) by one f-stop.
VERT HIGH ALT-OFF-LOW ALT	HIGH ALT	AZ/V camera operates in pulse mode.
	LOW ALT	AZ/V camera operates in autocycle mode.
VERT CAMERA READINESS indicator		Indicator displays ON when the POWER switch is either at the READY or OPERATE position, and the VERT camera mode selector is positioned at HIGH ALT or LOW ALT and the camera is operating properly.
VERT EXPOSURE REMAINING indicator		Displays the number of exposures remaining for the AZ/V camera if properly set prior to camera operation.
STAB 1/18-INCH PAN HIGH ALT-OFF-LOW ALT	HIGH ALT	18-inch pan operates in IMC mode with 66% forward overlap (the 3-inch and 18-inch pan cannot be operated simultaneously). STAB 1 or left split 12-inch operates in pulse mode with reduced overlap.
	LOW ALT	18-inch pan operates in IMC mode with 66% forward overlap (the 3-inch and 18-inch pan cannot be operated simultaneously). STAB 1 or left split 12-inch operates in autocycle mode with 60% overlap.
STAB 1/18-INCH CAMERA READINESS indicator		Indicator displays ON when the POWER switch is in either the READY or OPERATE position and the STAB 1/18-INCH PAN camera altitude mode switch positioned at HIGH ALT or LOW ALT, and the camera is operating properly.
STAB 1/18-INCH CAMERA EXPOSURE REMAINING indicator		Displays the number of exposures remaining for the 18-inch pan or STAB 1 camera configuration if properly set prior to camera operation.
MOUNTS RE-ERECT		When depressed, initiates re-erect action for the serial frame and panoramic stabilized mounts (station 4) and illuminates when mounts are against stops or stabilization fails. Re-erect function inoperative on AIRCRAFT HAVING AFC 297 COMPLIED WITH

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Figure 8-2 (Sheet 1)

RAN'S CAMERA CONTROL AND INDICATOR FUNCTIONS

SWITCH NOMENCLATURE		FUNCTIONAL DESCRIPTION
STAB 2/3-INCH PAN HIGH ALT-OFF-LOW ALT	HIGH ALT	3-inch pan operates in IMC mode with 60% forward overlap (the 3-inch and 18-inch pans cannot be operated simultaneously). STAB 2 or right split 12-inch operates in pulse mode with reduced overlap.
	LOW ALT	3-inch pan operates in IMC mode with 60% forward overlap (the 3-inch and 18-inch pans cannot be operated simultaneously). STAB 2 or right split 12-inch operates in autocycle mode with 60 percent overlap.
STAB 2/3-INCH CAMERA READINESS indicator		Indicator displays ON when the POWER switch is in either the READY or OPERATE position, the STAB 2/3-INCH PAN altitude mode switch is positioned at HIGH ALT, or LOW ALT, and the camera is operating properly.
STAB 2/3-INCH CAMERA EXPOSURE REMAINING indicator		Displays the number of exposures remaining for the STAB 2 or 3-inch camera configuration if properly set prior to camera operation.
INSTRUMENT PANEL		
CAMERA (SYSTEMS CAUTION LIGHT)		The CAMERA caution light should come on for any of the following conditions of the selected camera: A. Camera POWER switch OFF-- 3-inch or 18-inch pan mount NOT mechanically caged. B. Camera POWER switch READY-- • 3-inch or 18-inch pan mount NOT mechanically uncaged. • Cassette not seated properly (serial frame cameras only). • Film jam, film breakage, or out of film (except 18-inch pan cameras). • Camera not installed or connected in selected station. • Overtemperature condition (pan cameras only) caused by liquid cooling failure. • Pan camera film loop sensor out of adjustment. Normal operation probable when camera power switch moved to operate C. Camera POWER switch at OPERATE-- • 3-inch or 18-inch pan mount NOT mechanically uncaged. • Cassette NOT seated properly (serial frame cameras only) • Film jam, film breakage, or out of film. • Camera not installed or connected in selected station. • Overtemperature condition (pan cameras only) caused by liquid cooling failure. • 3-inch and 18-inch pan camera selected simultaneously.
RECON COOL light		Illuminates with weight off the gear and flaps down 25 degrees or more to indicate loss of recon cooling air.

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Figure 8-2 (Sheet 2)

RAN'S CAMERA CONTROL AND INDICATOR FUNCTIONS

SWITCH NOMENCLATURE		FUNCTIONAL DESCRIPTION
INTERIOR LIGHTS CONTROL PANEL		
IND LTS TEST		Checks indicating lights and displays, except for camera readiness indicators, without turning on the camera control systems.
CAMERA PULSE MONITOR AND FLASHER MODE PANELS		
POWER		When depressed, energizes the RAN's VERT, FWD, L OBL, R OBL, STAB 1, or STAB 2 pulse monitor lamps.
CAMERA FLASHER MODE	ALTERNATE	Supplies power to the electronic flasher pods for night operations (alternate mode) and places the selected vertical cameras in the NIGHT mode (selected cameras in sensor stations 2 and 4 automatically operate at 1/60 second exposure time with aperture full open). A safety feature is included to prevent sensor station 4 from operating when sensor station 2 is selected. If both cameras in module 4-3 are selected, the forward stab will operate until failed or out of film, then the aft stab will automatically operate.
	SIMULTANEOUS	Supplies power to the electronic flasher pods for night operations (simultaneous mode) and places the selected vertical cameras in the NIGHT mode (selected cameras in sensor stations 2 and 4 automatically operate at 1/60 second exposure time with aperture full open). A safety feature is included to prevent sensor station 4 from operating when sensor station 2 is selected. If both cameras in module 4-3 are selected, the forward stab will operate until failed or out of film, then the aft stab will automatically operate.
SENSOR STAB (AIRCRAFT HAVING AFC 297 COMPLIED WITH)	NORM	Selects zero pitch and roll command signals for all recon systems.
	CAGE	Erects PAN and SFC mounts in case of stabilization system malfunction
VERT monitor lamp		Light momentarily illuminates for each exposure of sensor station 2 camera
FWD monitor lamp		Light momentarily illuminates for each exposure of sensor station 1 camera
L/O STAB 1 monitor lamp		Light momentarily illuminates for each exposure of left oblique, forward stab, or left split camera
R/O STAB 2 monitor lamp		Light momentarily illuminates for each exposure of right oblique, aft stab, or right split camera

NOTE

The panoramic camera operation is not monitored by the RAN'S Camera Pulse Monitor and Flasher Mode Panel.

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Figure 8-2 (Sheet 3)

PART 3 — OPTICAL VIEWFINDER SYSTEM

OPTICAL VIEWFINDER

The optical viewfinder (figure FO-20) serves as a monitor and backup for the following functions:

1. Location of photographic targets.
2. Presentation of velocity/altitude (V/H) and drift angle data.
3. Course line navigation.

The viewfinder system allows the RAN to monitor the accuracy of externally generated V/H and drift angle signals or, through visual observation and manual adjustment, to generate these signals for the camera and IR systems. The initial lens in the system is a wide-angle objective lens which views through a quartz window integral with the fuselage lower skin. Through a system of optic relays, the objection image is conveyed to the viewing screen. The complete system is sealed and pressurized with dry nitrogen to 5 psig. In addition, replaceable dehumidifiers, with associated humidity indicator (figure FO-20), are located in the system. The field of view extends from 5 degrees aft of the nadir (perpendicular to aircraft) to 80 degrees forward of nadir, for a total of 85 degrees. The lateral extent of the field also encompasses 85 degrees. The viewfinder nadir is directed 93.75 degrees from the fuselage reference line to adjust for average aircraft angle of attack in placing the nadir directly beneath the aircraft. Two separate reticles are superimposed on the viewing screen, the first of which is a nonadjustable, fixed field display. This reticle includes a drift angle pointer and coverage boundaries applicable to the forward oblique camera. The second reticle is automatically or manually positioned to correspond to the aircraft flight path and includes a calibrated drift angle scale (±15 degrees), a fixed nadir (point perpendicular to aircraft and camera principal point), track line and exposure interval lines. This adjustable reticle also incorporates coverage boundaries applicable to the fully stabilized vertical cameras and panoramic cameras. A traveling V/H grid is displayed on the reticles in a narrow corridor in the center of the viewing screen from approximately 1 inch above the center and expanding downward, disappearing at the nadir. The rate at which the grid moves down the viewing screen is automatically or manually adjusted to be equal to the aircraft velocity/altitude (V/H). See figure 8-3 for a functional description of the viewfinder controls and indicators.

CONTROLS AND INDICATORS

PRESSURIZATION FITTING

The pressurization fitting (figure FO-20) is used by ground maintenance personnel to purge and pressurize (dry nitrogen) the viewfinder unit.

HUMIDITY INDICATOR

The viewfinder unit is equipped with two humidity indicators; one for the lower assembly and one for the upper assembly. The indicator for the lower assembly can be observed at the objective lens window and provides a humidity status of the two desiccant cartridges located on either side of the indicator near the objective lens. The indicator for the upper assembly is located at the upper left corner of the viewing screen assembly and provides a humidity status of the large desiccant cartridge located behind the viewing screen.

Note

Blue desiccant indicates a dry condition, and pink desiccant indicates excessive moisture present.

POLAROID FILTER

A variable polaroid filter is installed on the face of the optical viewfinder. This filter allows variable adjustment of viewfinder light as desired. Viewfinder light intensity may be increased by moving the filter lever (figure FO-20) to the right, or decreased by moving the lever to the left. The filter may be removed from the viewfinder by loosening two knurled bolts on the right side of the frame and sliding the case to the right.

BLAST SHIELD KNOB

A blast shield is installed in the viewfinder optic system. The shield is inserted or removed mechanically through selection of the IN or OUT position of the SHIELD knob (figure FO-20).

VELOCITY/HEIGHT LIGHT KNOB

The V/H LIGHT (figure FO-20) enables the operator to adjust the brightness of the traveling V/H grid.

VELOCITY/HEIGHT CONTROL KNOB

The V/H control knob (figure FO-20) provides the RAN with a means of correcting the speed at which the V/H traveling grid moves down the viewing screen when the POWER switch is in the MAN position. With the POWER switch in the AUTO position, the speed of the grid is controlled by the AN/ASB-12 and CV-1408/AYA-1 ground speed altitude ratio and the control knob has no effect on the display. To obtain accurate photographic coverage, a terrain reference point must move across the viewing screen at the same rate as the traveling grid lines. Should a malfunction in the automatic system cause the grid lines to move faster or slower than

VIEWFINDER CONTROL AND INDICATOR FUNCTIONS

SWITCH OR CONTROL NOMENCLATURE	FUNCTIONAL DESCRIPTION
POWER MAN-OFF-AUTO	In the MAN mode, drift and V_g/H signals are generated from the viewfinder by the RAN making the proper drift and V_g/H control settings. In the AUTO or OFF mode, drift and V_g/H signals are generated from the signal data converter. The RAN monitors these signals on the viewing screen for accuracy.
RESET	This is a circuit breaker in the 115-volt a-c, 400-cycle, phase A line. If the RESET button is extended, the circuit breaker is disengaged.
DRIFT	This control is operative in the MAN mode only and controls the angular position of the moving reticle. Maximum movement of the reticle is 15 degrees either side of the zero dirft angle. Drift angle is determined by lining up the "track" line with a ground object as it travels across the viewing screen.
V_g/H	This control is operative in the MAN mode only and controls the speed of the traveling grid down the viewing screen. Proper grid speed is accomplished by synchronizing the speed of the traveling grid with the motion of a ground object down the viewing screen. NOTE On viewfinders having AVC 582 incorporated, the V_g/H control has the added capability of providing a calibrated readout of V_g/H.
DRIFT light	The drift light control provides illumination of the lines in both the fixed and movable reticles. In the OFF position, the lines show up as dark opaque lines against a light background. The OFF position should be used on "bright" days or when over sand or snow. This control operates in both MAN and AUTO modes.
V_g/H light	The traveling grid image is not produced by a reticle but is superimposed into the field of view and is not visible when the V_g/H light control is OFF. Normal setting of this control is near maximum brightness and is variable in either mode.
SHIELD	When this control is moved to the IN position, the viewfinder optical path is blocked so that external light cannot enter the RAN's compartment, nor will the traveling grid or reticles be displayed.
POLARIZED LIGHT FILTER RA-5C-1-78-9	This filter will variably reduce the amount of light transmitted through the viewfinder so that the RAN's vision is not impeded by the high contrast of the viewing screen and the darkness of his compartment. It is also an effective haze penetrator. This filter can be installed or removed during flight.

Figure 8-3

the reference point, the RAN may select the MAN position of the POWER switch and manually adjust the speed of the grid lines. Manual adjustments to the V/H control knob will have a direct effect upon the camera exposure interval (overlap). On some aircraft,* a calibrated V/H knob is installed. With this knob, ground speeds may be computed and the V/H value set directly for manual mode operation. The calibrated knob is marked in increments of 0.002 with digits from 0.100 to 1.0000. If the viewfinder traveling grid is noted to be in error, the viewfinder POWER switch may be placed in MAN, the V/H knob adjusted until grid travel matches ground object rate, and V/H ratio read directly on the face of the knob. This procedure is useful in recording ground speeds and calculating winds should the inertial autonavigator platform fail.

CAUTION

Should a malfunction of the V/H system occur during camera operation, place the camera POWER switch in READY. Adjust V/H and, after tracking is regained, camera operation can be resumed.

Note

- If V/H grid fails or is in error, set up a 1:10 ratio, using the photo computer and V/H control knob. For example: 360 knots ground speed at 3000 feet equal a 0.12 V/H. When multiplied by 10, this equals 1.2. Move the viewfinder POWER switch to MAN and rotate the V/H control knob one and two-tenths turns from minimum for the correct setting. In this case, the calibrated V/H knob would read 0.120.
- The viewfinder may be used with POWER switch in MAN mode, in conjunction with increased V/H setting, for air-to-air and special targets of opportunity. Increased V/H is used to obtain a higher number of photo images of such targets. An improper (due to increased V/H or loss of high-altitude/pulse mode) image motion compensation may result in degraded imagery. The high-altitude mode (pulse) is recommended for use during this type of photography.

CAUTION

Do not exceed two exposures per second in the high-altitude (pulse) mode of operation for serial frame cameras.

DRIFT LIGHT KNOB

The DRIFT LIGHT knob (figure FO-20) enables the RAN to adjust the brightness of the drift reticle.

DRIFT CONTROL KNOB

The DRIFT control knob (figure FO-20) enables the RAN to adjust the position of the drift reticle, when the POWER switch is in the MAN position, to correspond to the actual ground track of the aircraft up to 15 degrees left or right of aircraft heading. With the POWER switch in AUTO position, the reticle is automatically alined with, and maintained on, the actual ground track of the aircraft up to 15 degrees to the left or right of the aircraft heading. The drift angle can be determined visually from the drift angle scale on the drift reticle. To obtain accurate photographic coverage, a terrain reference point must move across the viewing screen in a direction parallel with the track line reticle. Should a reference point move in a direction other than parallel to the track line, indicating a malfunction of the automatic control function, the RAN can select the MAN position on the POWER switch and manually correct the indicator position. Drift indicator corrections made through the DRIFT control knob will simultaneously reposition the camera mounts.

POWER SWITCH

The POWER switch (figure FO-20) is a three-position switch (AUTO, OFF, and MAN). In the AUTO (automatic) position, the drift and V/H displays are automatically positioned and adjusted to the aircraft speed and track. This position will normally be used whenever operation of the viewfinder is desired. In the OFF position, the reticles and traveling grid are removed from the viewing screen; however, the object viewing portion will continue to function. The MAN (manual) position need be selected only when an obvious error or malfunction is present and manual control is required.

CAUTION

DO NOT move the viewfinder POWER switch between AUTO and MAN with cameras operating. Before changing modes, move the camera POWER switch to READY, adjust V/H and note tracking, then move the camera POWER switch to OPERATE.

Note

With failure of the viewfinder or with the viewfinder POWER switch in the OFF position, V/H signals continue to control the camera systems; however, no monitor of these signals is available.

*Aircraft having AVC 582 complied with

RESET BUTTON

Should the reticle or traveling grid fail to appear after either AUTO or MAN position has been selected, attempt correction by depressing the RESET button (figure FO-20) on the control panel. The RESET button positions a circuit breaker; if the RESET button is extended, the circuit breaker is open.

VIEWFINDER DISPLAY

For optical viewfinder display, see figure FO-20.

DRIFT ANGLE SCALE

The drift angle scale is graduated in 1-degree increments to 15 degrees left and right. Aircraft drift may be read directly from this scale.

TRACK LINE

The track line should be automatically or manually adjusted to parallel aircraft flight path. Manual control is accomplished with the DRIFT control knob.

TRAVELING GRID

The traveling grid lines are automatically or manually controlled to monitor aircraft V/H. The lines appear closer together at the center than at the lower portion of the viewfinder.

OVERLAP LINES

The rate at which a ground object moves the length of an overlap line enables the RAN to monitor camera film speed to ensure optimum photo overlap coverage. The upper line is for the 1.75-inch focal length camera, the centerline is for the 6-inch focal length and 3-inch panoramic cameras. The lower line is for the 18-inch panoramic camera. The selected camera should take one exposure as a ground object moves the length of the appropriate overlap line.

NADIR POINT

The fixed nadir point is an end view of a line fixed at 93.75 degrees to the FRL. This point is also the station 2 vertical camera principal point.

CAMERA COVERAGE AREAS

The partial ground format lines on the viewfinder display indicate the photographic coverage of the various camera installations. The area below (behind) each partial ground format line may be photographed as indicated, except that the area above (forward of) the forward oblique partial ground format line will be photographed.

OBJECT SIZE

The viewfinder projects an 85-degree field of view (80 degrees forward and 5 degrees aft of nadir point) optically displaying it as a 15-degree field of view. Therefore, objects seen through the viewfinder will appear approximately one-sixth of their relative size.

FORWARD VIEWING DISTANCE

The distance forward of the nadir point that may be observed through the viewfinder will vary with altitude above the terrain. This distance may be approximated by multiplying altitude above the terrain by 5.7 (tangent of 80 degrees is 5.6713). For example, at 800 feet terrain clearance, forward viewing distance would be approximately 4560 feet, or 0.75 nautical mile (5.7 x 800 = 4560 ÷ 6080, or 0.75). At 50,000 feet, viewing distance would be approximately 47 nautical miles. As a "rule of thumb," the forward viewfinder coverage is slightly less than 1 mile for each 1000 feet of altitude above the terrain.

Note

Due to light-gathering limitations and compression of the field view, the average usable maximum view ahead is limited to approximately 20 nautical miles.

PART 4 — SIDE-LOOKING RADAR SYSTEM

SIDE-LOOKING RADAR SYSTEM, AN/APD-7

Descriptive information on the side-looking radar system is contained in Section VIII, Part 4 of the Supplemental Flight Manual (NAVAIR 01-60ABC-1A). Section III in this manual contains the procedures necessary to operate the system. For additional information regarding the side-looking radar system, refer to the following manuals:

1. Maintenance Instructions Manual, Radar Set, AN/APD-7 (NAVAIR 01-60ABC-2-10.2).
2. Utilization Manual, Integrated Operational Intelligence System, Image-Forming Systems (NAVAIR 10-1-781).
3. Tactical Manual, RA-5C Aircraft [NAVAIR 01-60ABC-1T(A)].
4. Operational Utilization of the AN/APD-7 Side-Looking Radar 0030322, USNRDL-TR-67-96, 1 August 1967.
5. AN/APD-7, Effectiveness Evaluation in Project Underbrush, Final Report. 0028702, USNRDL-TR-1073, 27 September 1966.

PART 5—INFRARED SYSTEM

INFRARED DETECTING SET, AN/AAS-21*

The infrared detecting set, AN/AAS-21, commonly referred to as the IR mapping system, is an airborne system which detects, records, and photographs infrared radiation. The system consists of a receiver unit (scanner), recorder, control panel, and advisory light. The receiver and recorder are located in the recon package sensor station 7 (figure FO-19), forward of the three-headed video amplifier and between the SLR antennas. Figure 8-4 is a block diagram of the AN/AAS-21. The control panel is located on the RAN's aft left-hand console (figure FO-1) and the advisory light is located on the display panel (figure FO-20). Cooling air is supplied by the heat and vent system (recon equipment cooling No. 3 system). An aerodynamic fairing below sensor station 7 protects the IR receiver scanner optics. A sliding door opens forward when the system is turned to OPERATE and the landing gear handle is in the UP position. Roll, drift, and ground velocity (V/H) information is supplied to the receiver from the signal data converter. Infrared information from the terrain is gathered by the receiver scan mirror's rotation about an axis parallel to the aircraft track. Ground mapping presentation is focused by an optical system on a six-detector array and converted to electrical impulses. The electrical impulses, fed to the recorder, are recorded on a 5-inch wide film as an IR map of the radiation emitted by the terrain. A coded matrix box containing auxiliary data is also photographed by the film.

The following summarizes the characteristics of the IR detecting set.

Field of View	140 degrees
Mapping presentation	Continuous 4-inch IR map on a 5-inch wide film
Operating altitude	0 to maximum altitude
Stabilization of receiver unit	Roll — ±12 degrees within ±0.25 degree (±30 degrees†) Drift — ±10 degrees within ±0.25 degree
Cool-down period	9 to 12 minutes
Film	350-foot roll unperforated
Vg/H range	0.012 to 1.420 knots/foot
Recorded data	Ground map in cartesian coordinates Correlation marks every 1.25 inches Digital data block every 1.25 inches
Input requirements	Signal data converter, CV-1408/AYA-1 Synchro transmitter amplifier‡ Data translator, CV-1412/AYA-1
Outputs supplied	Linear radiation map of terrain Correlation marks to aid in interpretation Data matrix of navigational information

The IR detecting set system inputs are as follows:

SIGNAL	SOURCE	PURPOSE
Gound Speed (V/H)	**Signals from AN/ASB-12 are supplied to signal data converter, CV-1407/AYA-1, where they are processed and supplied to the IR system.**	**Provides V/H to recorder to control film speed travel.**
Drift	**Signals from AN/ASB-12 are supplied to signal data converter, CV-1408/AYA-1, where they are processed and supplied to the IR system.**	**To position the scanner mechanism in drift to provide presentation on film perpendicular to flight path of aircraft.**
Roll	**Signals from AN/ASB-12 are supplied to signal data converter, CV-1408/AYA-1 (or synchro transmitter amplifier‡) where they are processed and supplied to the IR system.**	**To provide IR system roll compensation in the IR recorder synchronization circuitry.**
Data Matrix	**Data demand signals from the IR recorder are directed to signal converter, CV-1412/AYA-1, which supplies data information to the IR system.**	**To provide a record of flight parameters and fixed data corresponding to adjacent portion of mapping film for postmission analysis.**

***Aircraft having AFC 244 complied with and aircraft 156608 through 156643**
†Aircraft having AFC 313/AVC 996 complied with
‡Aircraft having AFC 297 complied with

INFRARED DETECTING SYSTEM

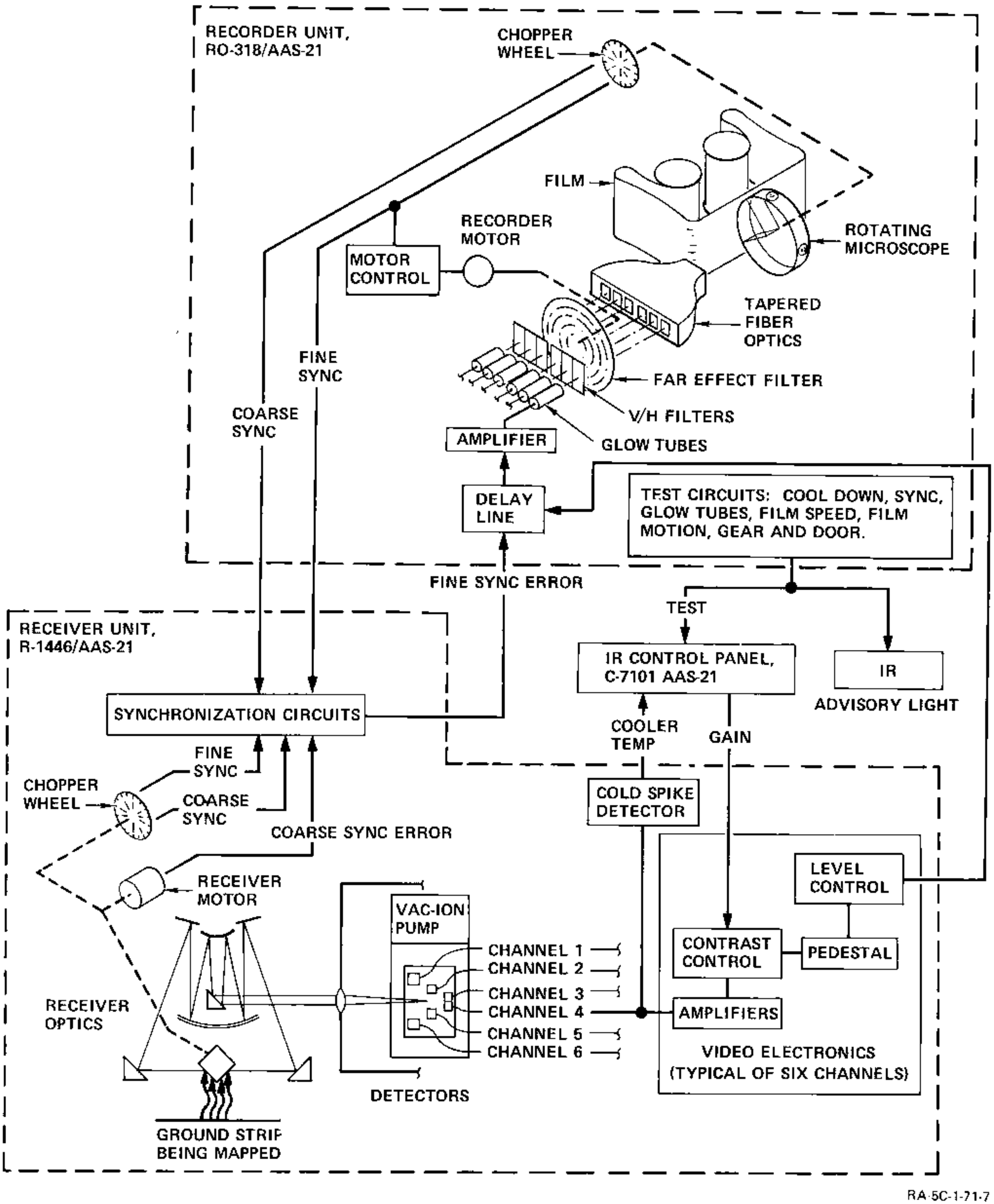


Figure 8-4

RECEIVER (SCANNER) UNIT

The receiver (scanner) unit consists of a scanner motor and mirror, scanner optics, cooler assembly with detector and refrigerator, drift servo system, receiver/recorder synchronization circuits, video circuits, and receiver power supplies. See figure 8-4. The scanner portion of the receiver unit has a four-sided scan mirror mounted on a rotating shaft parallel to the aircraft track. Aircraft drift information from the data converter is used to maintain the receiver unit parallel to the aircraft track up to a maximum of ±10 degrees of drift. The scan mirror rotates at 6000 rpm to produce 400 scans per second. On some aircraft,* with the SENSOR STAB switch in CAGE, the system is electrically caged to zero reference; in NORM, roll reference signals are received through the synchro transmitter amplifier. Roll stabilization of ±12 (±30†) degrees is provided by adjusting the rotation rate of the scanner mirror. At any one time, radiation from the terrain is reflected from two faces of the four-sided mirror, and then combined by scanner relay mirrors. By a reflective doubling effect, a 140-degree ray sweep is made for only a 70-degree mechanical movement of the scan mirror. The IR radiation gathered by the scan mirror is reflected and focused on a six-detector array where it is converted to electrical impulses. The detectors are enclosed in a closed-cycle cooler and maintained at a cryogenic temperature of approximately 26 degrees Kelvin (—247°C). This temperature is required to provide maximum sensitivity. Each detector produces an electrical signal which is amplified, processed, and fed to a separate glow-modulator tube in the recorder. The scanner portion of the receiver unit provides coarse and fine synchronization pulses for the recorder unit.

RECORDER UNIT

The recorder unit consists of a recorder drum motor, recorder drum with associated optics, roll compensator circuits, variable-delay lines, glow-modulator tubes and modulators, V/H servo system, recorder synchronization circuits, film magazine and film drive components, data display cathode-ray tube (CRT) circuit, and recorder power supplies. See figure 8-4. Electric signals are received from the receiver unit by six glow-modulator tubes. The modulated light from these tubes is transmitted through a fiber optic bundle to the microscope objective of the recording drum. The microscope lens rotates to expose photographic film which moves at a speed proportional to V/H.

Note

> In the MANUAL mode of operation, the viewfinder must be adjusted to provide correct V/H signals when the IR system is in operation. Failure to do so will result in grossly distorted imagery.

A neutral density filter (V/H filter) is provided to prevent over and under exposure of the film due to aircraft speed variations. A rotating (6000 rpm) far effect filter is also provided to correct for panoramic distortion. A coded data matrix block containing navigational, position, and fixed data which correspond to the adjacent target image on the film, is exposed on to the film every 1.25 inches by a 1-inch cathode-ray tube. A correlation marker, used to determine aircraft drift, is also exposed on the film every 1.25 inches.

FILM

The 5-inch wide film is supplied in a magazine consisting of a supply and takeup cassette. The film presentation is a continuous 4-inch IR map of the terrain, with correlation marks and digital data blocks every 1.25 inches. Normally, a 250-foot film supply spool is used; however, the thinner IR film results in a full spool supply of 350 feet.

MODES OF OPERATION

The modes of operation of the IR mapping system are as follows:

MODE	OPERATION
READY	A 12-minute (maximum) cooling period for detectors; door is closed. System is ready for operation (after cool-down period) except for film drive.
OPERATE	Door opens; film drive and data matrix operate if landing gear handle is up.
TEST	Film speed, synchronization, and glow-modulator tubes are checked for a "go" or "no-go" condition.

IR SYSTEM CONTROLS AND INDICATORS

The IR MAPPING control panel is located on the aft left-hand console (figure FO-1). The control panel contains a TEST light, a COOLER TEMP light, a GAIN switch, and a POWER switch. See figure FO-20 for location of controls and indicators.

The POWER switch positions and their functions are as follows:

OFF	Electrical power removed from the system.
READY	Closed-cycle cooler energized for detector cool down. System operational after cool down (approximately 10 minutes required) except for film drive and data matrix.
OPERATE	Door opens (landing gear handle up) and system is operational.
TEST	Activates selected fail circuits and provides a fixed rate V/H input to film-drive circuit for test only purposes. Film drive, film speed, synchronization, and operation of at least four glow-modulator tubes are checked.

*Aircraft having AFC 297 complied with
†Aircraft having AFC 313/AVC 996 complied with

GAIN SWITCH

The GAIN switch positions and their general functions are as follows:

LOW — Decreases video gain (industrial areas and very distinct targets).

NORMAL — Normal contrast for average targets and conditions.

HIGH — Increases video gain for low-level radiation from targets.

HOT TGT — Hot target suppresses background of IR strip map while enhancing detectability of targets hotter (100° to 300°C) than ambient background.

Gain Switch Selection Guide

In addition to the general functions of the GAIN switch positions, the following switch positions for the various target objectives, terrain, and weather conditions are to be used to obtain the best IR mapping results.

On some aircraft,* best results are obtained by selecting the next higher GAIN switch position for a given reconnaissance objective.

RECONNAISSANCE OBJECTIVES	DRY TERRAIN	SNOW-COVERED TERRAIN	WET TERRAIN (RECENT RAIN)
DAY			
General Mapping	LOW	LOW	NORMAL
Cities/Industrial Sites	LOW	LOW	NORMAL
Very Hot (Open Fires, Blast Furnaces)	HOT TGT	HOT TGT	HOT TGT
NIGHT			
General Mapping	NORMAL	NORMAL	HIGH
Cities/Industrial Sites	LOW/NORMAL	LOW	NORMAL/HIGH
Very Hot (Open Fires, Blast Furnaces)	HOT TGT	HOT TGT	HOT TGT

COOLER TEMP LIGHT

The COOLER TEMP light (amber) is a press-to-test light. The light will come on when the OPERATE switch is positioned to READY. The light will remain on while the detector array is cooling down to operating temperature of 26 degrees Kelvin (−247°C). The cooling period is approximately 10 minutes. If the COOLER TEMP light comes on during flight (accompanied by an IR MAP advisory light on), there is a malfunction in the detector array cooling system.

Note

The COOLER TEMP light may come on momentarily during rapid altitude changes.

TEST LIGHT

Illumination of the TEST light (green) after the POWER switch has been placed in the TEST position provides a positive self-test of the following systems:

- Glow-modulator tubes (five or more tubes operating properly).
- Film drive.
- Film speed.
- Synchronization.

If one or more of these systems are not operational, the TEST light will not illuminate, and the IR MAP light will come on. When the POWER switch is placed in the TEST position, the TEST light should come on within 15 seconds. Any time the system is switched from OPERATE or TEST mode to READY or OFF, the system is automatically switched into the TEST mode (even though the POWER switch is not in the TEST position) for approximately 15 seconds, the purpose being to pull all exposed film into the magazine. During this automatic test, the TEST light may illuminate.

*Aircraft not having AFC 313/AVC 996 complied with

IR MAP ADVISORY LIGHT

The IR MAP advisory light (figure FO-20) is located on the display panel. This light indicates that one or more of the following malfunctions have occurred:

- System power failure.
- Film drive failure.
- Film broken or jammed.
- Four of six glow-modulator tubes have failed.
- IR detector temperature too high.
- Synchronization failure.
- Door not open (gear up and the POWER switch — OPERATE).

During flight, when the POWER switch is moved to OPERATE, the IR MAP light will come on for approximately 30 seconds to indicate the IR scanner door is opening. The light will go out when the door is fully open. (The IR scanner door cannot be seen with the TV.)

IR SYSTEM LIGHTS AND INDICATIONS SUMMARY

The IR system lights and their respective indications are summarized as follows:

POWER SWITCH POSITION	IR MAP LIGHT	TEST LIGHT	COOLER TEMP LIGHT
READY	Cooler Glow tubes (two or more failed) Synchronization		ON until cool-down
OPERATE	Cooler Glow tubes (two or more failed) Synchronization Film drive ON while door opens		ON until cool-down
TEST		Self-test of: Glow tubes (four or more) Film drive Film speed Synchronization	ON until cool-down

Note

If the IR MAP light illuminates and remains on, the IR system is inoperative and reconnaissance collection should not be attempted.

PART 6 — PASSIVE ELECTRONIC COUNTERMEASURES SYSTEM

ELECTRONIC RECONNAISSANCE SYSTEM (PECM), AN/ALQ-61

The electronic reconnaissance system (PECM), AN/ALQ-61, is a multiband, passive detection and recording set. The system receives emitter signals, and records source characteristics, source bearing, time of recording, navigational data, and status information data on tape for use by intelligence personnel. The recording tape system will record continuously up to 56 or 112 minutes, as adjusted by ground personnel prior to flight. When installed, the system is controlled and monitored by the RAN.

Operation of band 1 and band 2 receivers can be controlled by an ON-OFF switch on the PECM control panel (figure FO-1) and a mode selector (MODE SEL) switch mounted on the band 1 receiver front panel. The MODE SEL switch must be set prior to flight and controls operation of band 1 and band 2 receivers as follows:

1. Both receivers operate whenever the PECM system is operating.
2. Both receivers inoperative, regardless of PECM system operation.
3. Both receivers cycle on and off for preset periods of time, depending upon the preflight setting of the MODE SEL switch.

CONTROLS AND INDICATORS

POWER SWITCH

The POWER switch (figure 8-5) provides the main control of PECM operation. The READY position prepares the system for operation through a warm-up of up to 15 minutes for all receivers and the recorder. The OPERATE position turns on the recorder tape transport, allowing the system to record data.

RECORDER SWITCH

The RECORDER switch (figure 8-5) controls tape transport speed. The NORM position selects the normal preset tape speed (up to 112 minutes) with the POWER switch in OPERATE. On completion of a mission, moving the switch to FAST FWD allows the tape to be transported onto the recorder tape spool at increased speed. Fast forward operation will transport a full tape in 8 minutes. After all tape is transported to the takeup reel, the RECORDER switch returns automatically to NORM.

Note

If aborted FAST FWD transport is desired, move the POWER switch to OFF, then to READY, and wait 15 minutes before making any attempt to record.

ANTENNA SWITCH

The ANTENNA switch (figure 8-5) allows selection of data collection from the LEFT antennas (port side), BOTH (both sides), or the RIGHT antennas (starboard side), as required.

CLOCK RESET BUTTON

The CLOCK RESET button (figure 8-5) allows the operator to reset a 4-hour electronic clock to zero with the POWER switch in READY or OPERATE. This ensures accurate recording on the tape of relative time span between the first and last data recorded.

NAV DATA RECORD INDICATOR

The NAV DATA RECORD indicator (figure 8-5) displays "ON" during recording operation. This signifies recording of aircraft present position from the AN/ASB-12 system on the data tape. With the POWER switch in OFF or READY, the indicator displays a barber pole.

Note

During warm-up in READY, the indicator displays "ON." On completion of warm-up, the barber pole returns.

ECM DATA RECORD INDICATOR

With the POWER switch at OPERATE or READY, the ECM DATA RECORD indicator (figure 8-5) displays "ON" when an emitter is received. During normal operation in the presence of many emitters, the indicator may blink between "ON" and barber-pole displays.

RECORDER INDICATOR

The RECORDER indicator (figure 8-5) displays OFF with the POWER switch at READY, and ON if the tape recorder is operating normally with the POWER switch at OPERATE. Failure of the recorder or tape exhaustion is indicated if OFF is displayed with the POWER switch in OPERATE.

BAND 1 AND 2 SWITCH

The BAND 1 & 2 switch (figure 8-5) controls operation of the band 1 and band 2 receivers. With the POWER switch at READY or OPERATE, and the BAND 1 & 2 switch at OFF, band 1 and band 2 receivers are inoperative. With the POWER switch at READY or OPERATE, and the

BAND 1 & 2 switch at ON, the band 1 and band 2 receivers operate as selected by the preflight setting of the MODE SEL switch on the band 1 receiver front panel (sensor station 6).

The MODE SEL switch positions and their functions are as follows:

OFF — Band 1 and band 2 receivers are inoperative regardless of other switch positions.

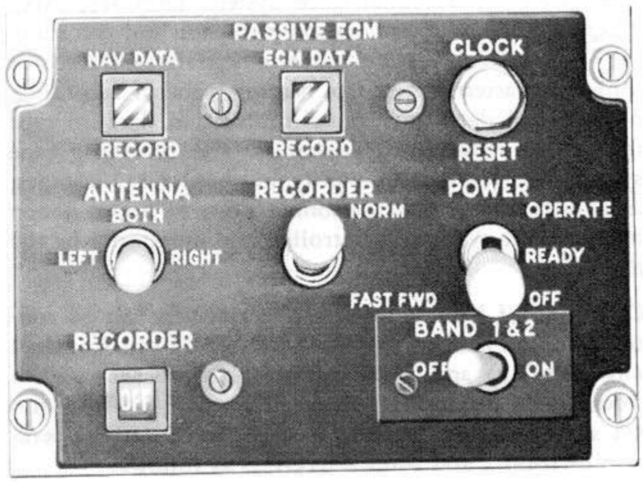
ON — Band 1 and band 2 receivers operate continuously with the system POWER switch in READY or OPERATE position, and BAND 1 & 2 switch in the ON position.

3 — Band 1 and band 2 receivers scan for approximately 16 seconds (one scan) and are off for approximately 3.5 minutes.

5 — Band 1 and band 2 receivers scan for approximately 16 seconds and are off for approximately 5.5 minutes.

10 — Band 1 and band 2 receivers scan for approximately 16 seconds and are off for approximately 10.5 minutes.

AN/ALQ-61 CONTROLS



A-5C-1C-70-3B

Figure 8-5

PART 7 — DIGITAL DATA SYSTEM

DIGITAL DATA SYSTEM, AN/AYA-1

The digital data system, AN/AYA-1 collects aircraft flight data from AN/ASB-12, radar altimeter, AN/APN-120, and air data computer set, A/A24G-4. This data is processed in data converter, CV-1408/AYA-1, and data translator, CV-1412/AYA-1, and distributed to the various reconnaissance systems in the form of digital data matrix and tape format signals and analog stabilization and reference voltages. Figure FO-21 shows the signal flow for the DDS flight data collection and distribution. The number and types of video amplifiers installed on the aircraft depend on the type of reconnaissance package installed. The video amplifiers provide signals to the CRT's which print the data matrices on film. The signal data converter group components are as follows:

AN NOMENCLATURE	COMMON NOMENCLATURE
Converter, Signal Data, CV-1408/AYA-1	Data Converter
Converter, Signal Data, CV-1412/AYA-1	Data Translator
Amplifier, Video, AM-3670/AYA-1	High-intensity, Two-head Video Amplifier
Amplifier, Video, AM-3671/AYA-1	Two-head Video Amplifier
Amplifier, Video, AM-3672/AYA-1	Three-head Video Amplifier

DATA CONVERTER, CV-1408/AYA-1

The data converter unit receives analog and digital signals from the bombing computer, digital computer, air data computer, and radar altimeter. The data converter sends analog signals to the camera, IR, and SLR systems, digital signals to the data translator, and digital feedback to the digital computer. See figure FO-22 for the block diagram of the converter group. The signals from the bombing computer consist of analog voltages representing pitch, roll, barometric altitude, true speed, heading, and the X and Y coordinates of ground velocity. Whenever the AN/ASB-12 is in standby, pitch, roll and heading data are received from the flight reference set. Signals from the digital computer consist of digital drive signals which drive the latitude, longitude, and wander angle servos. Mach number and radar altitude are provided by the air data computer and the radar altimeter, respectively. Pitch, roll, drift, angle, ground velocity, and altitude are not only encoded, but are also used as analog outputs. Pitch, roll, and drift analog signals are distributed to the stabilized camera mounts to compensate for aircraft pitch, roll, or drift. The roll output is also used to compensate the SLR antennas and the IR scan mirror for changes in the roll attitude of the aircraft. The drift output is used by both the SLR and IR systems to compensate the systems for changes in aircraft drift angle. Outputs representing ground velocity (V_g) and altitude (H) are used by the SLR system for film drive control and automatic range switching, respectively. The IR system uses the output representing ground velocity/altitude (V/H) for film drive control. The voltage level representing ground velocity/altitude (V/H) is distributed to the panoramic camera systems and is sent to the IMC and shutter control assembly where it is modified and distributed to the serial frame camera systems. The modified V/H voltage is utilized in performing image motion compensation (IMC) and controlling the picture-taking intervals to provide proper photographic overlap.

DATA TRANSLATOR, CV-1412/AYA-1

The primary functions of the data translator are as follows:

- Supply data to each sensor station where it is recorded on film in the form of the data block as shown on figure 8-6.
- Supply data to the passive ECM (AN/ALQ-61) where it is recorded on tape.

The data translator receives inputs from the data converter and from internal sources, processes the data, and distributes it to each sensor station on demand. The two general types of data are as follows:

- Variable data consisting of flight data received from the data converter. This information is supplied to the data converter for encoding from the aircraft navigational systems and consists of aircraft pitch, roll, drift, heading, altitude, latitude, and longitude. The encoders in the data converter are interrogated by signals from the data translator. Time is generated by the time encoder which is an integral part of the translator.
- Fixed data is set into fixed encoders prior to each mission and also is an integral part of the translator.

DATA MATRIX FORMAT

DATA VALUE – N-3

CODE	0	1	2	3	4	5	6	7	8	9	10	11	12	13
ACTUAL	SPACE	–		0	1	2	3	4	5	6	7	8	9	+

MINUS (code 1) — PLUS (code 13) — SIGN

DATA FROM EXAMPLE	
DATE	MAY 3, 1963
SORTIE	41
SENSOR IDENT	002 (SEE SENSOR IDENT CHART)
BARO ALTITUDE	2000 FEET
HEADING	038.7 DEGREES
DRIFT	00.9° NOSE RIGHT
ROLL	00.1° RIGHT WING UP
PITCH	01.7° NOSE UP
TIME	12 HOURS 13 MINUTES 21.6 SECONDS
LATITUDE	39° 24.7′ NORTH
LONGITUDE	083° 52.1′ WEST
RADAR ALTITUDE	1060 FEET
B/N MODE	NORMAL

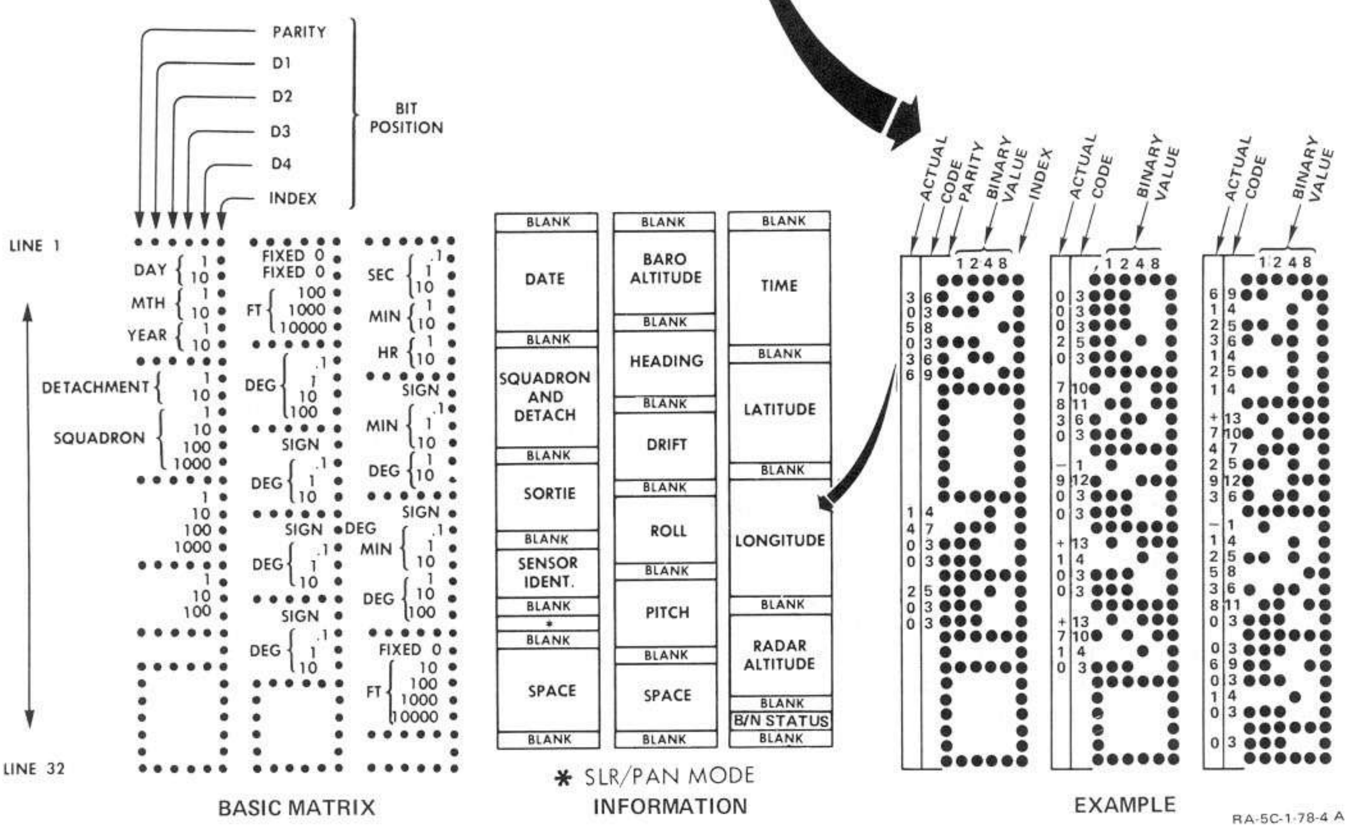


Figure 8-6

SECTION IX—FLIGHT CREW COORDINATION

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CREW COORDINATION

In order for the reconnaissance crew to function as a unit, each crew member must know his duties, be intimately familiar with the duties of the other crew member, and provide timely information. While the exchange of information between crew members is essential, excessive transmissions are to be avoided for they may destroy concentration and interfere with performance, and/or block necessary external communication. This is particularly true in demanding phases of flight such as carrier landing final.

CREW DUTIES

PLANNING

Planning shall be accomplished through the joint participation of both crew members. Both shall be familiar with NATOPS emergency procedures.

FLIGHT PROCEDURES

The following list of common duties required for successful completion of the mission is intended only as a guide.

PILOT	RAN
Advise RAN prior to taxi.	Inform pilot when changing navigational aids and status.
Inform RAN of tension and saluting for catapult launch.	Describe target and significant checkpoints.
Inform RAN when 100 knots reached on take-off roll.	Inform pilot of target/aimpoint and when it is identified.
Inform RAN prior to deploying refueling probe.	Advise pilot when HSI/AAI steering/hold heading is desired.
Advise RAN of visual identification of significant points along route.	Advise pilot when engaging COURSE LINE NAVIGATION.
Advise RAN when fuel dump commenced/secured.	Advise cumulative/elapsed time in minutes each minute dump continues.
Inform RAN of significant weather changes.	Advise pilot when using offsets.
Inform RAN when altering the aircraft configuration.	Advise pilot when turning on AN/ALQ-55.
Inform RAN when turning cameras on/off.	Advise pilot when switching to bomb steering.
	Inform pilot when operating in manual viewfinder mode
Remind RAN to secure camera after target.	Monitor desired altitude and airspeed.
Inform RAN of any unusual occurrences.	Inform pilot when turning cameras on/off.
	Inform pilot of any unusual occurrences.
Inform RAN when engaging NAV steering (ROLL NAV).	Coach pilot in wing position to center target in format.
Inform RAN when changing navigational aids and status.	Inform pilot when synchronizing compass.

Communications

The RAN shall make all frequency changes below 2500 feet. Both crew members are responsible for monitoring external communications and ensuring a response is made. The preflight briefing shall cover which crew member will respond during each phase of flight.

Checklists

The before take-off, after take-off, descent, and landing checklists shall be accomplished through the challenge and reply method with the RAN initiating the challenge and the pilot making the reply. During emergencies, the RAN shall read emergency procedures from the pocket checklist.

SECTION X — NATOPS EVALUATION

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PART 1 — NATOPS EVALUATION PROGRAM

CONCEPT

The standard operating procedures described in this manual represent the optimum method of operating the RA-5C aircraft. The NATOPS evaluation is intended to evaluate compliance with NATOPS procedures by observing and grading individuals and units. This evaluation is tailored for compatibility with 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 through constructive comment. Maximum benefit from the NATOPS evaluation program is achieved only through the vigorous support of the program by commanding officers as well as the flight crew members.

DEFINITIONS

The following terms, used throughout this section, are defined as to their specific meaning within the NATOPS evaluation program.

NATOPS EVALUATION

A periodic evaluation of individual flight crew member standardization consisting of an open book examination, a closed book examination, an oral examination, and a flight evaluation.

NATOPS RE-EVALUATION

A partial NATOPS evaluation administered to a flight crew member 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 be observed during a re-evaluation.

QUALIFIED

That degree of standardization demonstrated by a reliable flight crew member 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 crew member who meets the minimum acceptable standards. He is considered safe enough to fly as a pilot in command or to perform normal duties as a RAN without supervision but more practice is needed to become Qualified.

UNQUALIFIED

That degree of standardization demonstrated by a flight crew member 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 procedures which are observed and graded during an evaluation flight.

SUBAREA

A performance subdivision within an area, which is observed and evaluated during an evaluation flight.

CRITICAL AREA

Any area or subarea 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 a condition which requires instantaneous, recognition, analysis, and proper action.

MALFUNCTION

An aircraft component or system failure, or a condition which requires recognition and analysis, but which permits more deliberate action than that required for an emergency.

IMPLEMENTATION

The NATOPS evaluation program shall be carried out in every unit operating naval aircraft. The various categories of flight crew members desiring to attain/retain qualification in the RA-5C shall be evaluated initially in accordance with OPNAVINST 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 observation of 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 Instructor, shall administer the program as outlined in OPNAVINST 3510.9 series. Evaluees who receive a grade of Unqualified on a ground or flight evaluation shall be allowed 30 days in which to complete a re-evaluation. A maximum of 60 days may elapse between the date the initial ground evaluation was commenced and the date the evaluation flight is satisfactorily completed.

PILOT/RAN EVALUATION

GROUND EVALUATION

Prior to commencing the flight evaluation, an evaluee must achieve a minimum grade of Qualified on the open book and closed book examinations. 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 shall use the question bank in preparing written examinations. The question bank shall be maintained by the Evaluator. New questions shall be considered part of the bank upon submission to the Evaluator.

OPEN BOOK EXAMINATION

The open book examination shall consist of 40 questions taken from the question bank. The purpose of the open book examination is to evaluate the pilot's/RAN's knowledge of appropriate publications and the aircraft. The maximum time for this examination should not exceed 2 hours.

CLOSED BOOK EXAMINATION

The closed book examination shall consist of 40 questions taken from the question bank. 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. In this case, the maximum grade assigned shall be 3.29. The maximum time for this examination should not exceed 1 hour.

RETAKE EXAMINATION

The average score of all examinations for any portion of the evaluation must be equal to that required for a grade of Qualified.

GRADING INSTRUCTIONS

Examination grades shall be computed on a 4.0 scale and converted to an adjective grade of Qualifed or Unqualified.

Open Book Examination

To obtain a grade of Qualified, an evaluee must obtain a minimum score of 3.5.

Closed Book Examination

To obtain a grade of Qualified, an evaluee must obtain a minimum score of 3.3.

Oral Examination

A grade of Qualified or Unqualified shall be assigned by the Instructor/Evaluator.

FLIGHT EVALUATION

The number of flights required to complete the evaluation flight should be kept to a minimum; normally one flight. The areas and subareas to be observed and graded during the flight evaluation 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. Area grades, if desired, shall also be determined in this manner. The WST may be used to evaluate a crew member instead of the aircraft where available. In areas not served by the WST, an evaluee may be placed in a cockpit and appropriate questions administered. When the WST or cockpit is substituted for an actual flight, reconnaissance results from a typical flight should be used to assist in evaluating the crew members performance.

EVALUATION GRADING CRITERIA

Only those areas and subareas provided or required will be graded. The grades assigned for a subarea shall be determined by comparing the degree of adherence to standard operating procedures with a rating of Qualified, Conditionally Qualified, and Unqualified, as applicable. Momentary deviations from standard operating procedures should not be considered as unqualifying provided such deviations do not jeopardize flight safety and the evaluee applies prompt corrective action. In answering each question: if yes, mark Qualified; if only a qualified yes, mark Conditionally Qualified; if no, mark Unqualified.

*MISSION PLANNING (RAN)

*1. Route Planning.

*(a) Were all necessary charts and publications drawn?

(b) Was planning commenced in sufficient time to permit meeting the scheduled launch time without undue hurrying and/or omitting necessary items?

(c) Was an accurate in-flight card prepared, showing distance, time, and Navaids for each leg?

(d) Were alternate landing fields appropriate to the flight preplanned?

(e) Were all NOTAMS and other necessary information sources checked?

(f) Were predicted winds used in flight planning?

*(g) Was an alternate plan computed in the event fuel ran below that predicted?

2. Fuel Planning.

(a) Were fuel checks computed at the end of each leg or each half hour?

(b) Was fuel, time, and speed information taken from the NATOPS Flight Manual or appropriate REST computer?

(c) Were cruising speeds computed as either Mach number or KIAS?

3. Flight Plan.

(a) Was weather briefing completed, including wind data?

(b) Was DD-175 or other applicable flight plan properly filled out without error or omission in accordance with existing directives?

*4. Take-off Computations.

*(a) Were take-off computations accurately computed in accordance with existing directives?

*MISSION PLANNING (RAN)

	QUALIFIED (Q)	CONDITIONALLY QUALIFIED (CQ)	UNQUALIFIED (U)
*1. Charts	Charts prepared without error or omission.	Charts prepared with minor errors or omissions.	Charts grossly misplotted or courses and distances in error.
*2. NAV/RECON Log	Log was prepared with no errors or omissions.	Log was prepared with minor errors or omissions.	Log was prepared with serious errors or omissions.
3. Forms	Forms applicable to the mission were available and properly completed.	Forms were prepared with minor errors or omissions.	Forms were either not available or were prepared with serious errors or omissions.
4. Checklists	All prescribed checklists were available.		The prescribed checklists were not available.
5. Target Study	An intensive and complete target area study was made.	Target study was completed with minor errors or omissions that did not affect the successful completion of the mission.	Target study was not completed. The successful completion of the mission was adversely affected.
6. Navigation Bag Contents	Bag contained all items as listed in NAVIGATION BAG CHECKLIST (FLIGHT CREW), in Section III, Part 2.		Not up to the standards of Qualified.
7. Personal Flying Equipment	Equipped as required in Section II.		Not up to the standards of Qualified.

*Critical area or subarea

*PREFLIGHT (PILOT)

*1. Acceptance of the Aircraft.

(a) Were a minimum of 10 yellow sheet parts "B" checked if available?

(b) Was the Plane Captain's preflight completed and the yellow sheet part "A" properly filled in and signed prior to acceptance of the aircraft?

*(c) Did the pilot accept an aircraft with unexplained discrepancies which could affect safety of flight and/or accomplishment of the mission? (Grade either Q or U.)

2. Preflight Inspection.

(a) Did the pilot complete the external inspection, noting each item on the inspection check list?

(b) Was pilot wearing appropriate flight gear considering type of flight and time of year?

*(c) Was pilot's personal equipment operable and within a current inspection period?

PREFLIGHT INSPECTION (RAN)

	QUALIFIED (Q)	CONDITIONALLY QUALIFIED (CQ)	UNQUALIFIED (U)
1. NATOPS Pocket Checklist	Systems checked in accordance with the NATOPS Pocket Checklist. A review of recent system history was made.	Checklist was used with minor errors or omissions.	Checklist was not completed or items were missed causing adverse mission effects.

TAXI AND PRETAKE-OFF (RAN)

	QUALIFIED (Q)	CONDITIONALLY QUALIFIED (CQ)	UNQUALIFIED (U)
*1. NATOPS Pocket Checklist	Procedures conducted in accordance with the NATOPS Pocket Checklist.	NATOPS Pocket Checklist used with minor errors or omissions.	Checklist was not followed jeopardizing safety of flight.

*EMERGENCIES (PILOT)

Emergency procedures will be graded by utilizing the WST or CPT. If these trainers are not available, the pilot will be visually and verbally graded in the cockpit of the actual aircraft, if an actual emergency occurs during the flight evaluation, it should be evaluated as feasible. Emergencies should be graded according to the following criteria.

Qualified — Recognized the emergency situation with a minimum of delay or within time limits specified. Took timely and appropriate action in accordance with governing directives.

Conditionally Qualified — Recognized emergency situation with delay not endangering safety of flight. Successfully coped with the situation but deviated from governing directives.

Unqualified — Failed to recognize situation. Use of improper procedures or unnecessary delay in commencing corrective action allowed controllable situation to proceed out of control. Endangered safety of flight.

*1. Engine Malfunctions.

(a) Wet Start.

(b) False Start.

(c) Hot start.

*(d) Engine failure.

*(e) Engine fire.

(f) Low oil pressure.

(g) Autoacceleration.

*2. Fuel System Failures.

(a) Failure of bomb bay can transfer.

(b) Failure of wing tank transfer.

*Critical area or subarea

*3. Electrical System Failures.

(a) Loss of either a-c generator.

*(b) Loss of all a-c power.

(c) Loss of d-c converter.

* (d) Loss of all a-c and d-c power.

*4. Hydraulic System Malfunctions.

(a) Loss of either pump, No. 1 system.

(b) Loss of both pumps, No. 1 system.

(c) Loss of either pump, No. 2 system.

(d) Loss of both pumps, No. 2 system.

(e) Loss of hydraulic fluid in No. 2 system.

*(f) Wing flap emergency operation.

*(g) Landing gear emergency operation.

(h) Failure of gear to retract.

*5. Flight Control System Malfunctions.

(a) Loss of pitch aug.

*(b) Runaway trim (roll, pitch, or yaw).

(c) Failure of normal trim system.

*(d) Malfunction in lateral or longitudinal system.

6. Flight Reference Set Malfunctions.

*OPERATING PROCEDURES (RAN)

	QUALIFIED (Q)	CONDITIONALLY QUALIFIED (CQ)	UNQUALIFIED (U)
*1. Navigation	Utilized applicable navigational aids and techniques to accomplish mission.	Did not fully utilize applicable navigational aids and techniques.	Not able to utilize available navigational aids to navigate the aircraft safely.
2. General-purpose Radar (a) High Altitude	Operated the radar in an acceptable manner for navigation and made cursor corrections when necessary to update present position.	Did not utilize all radar modes available to navigate and correct present position.	Not able to utilize radar to navigate the aircraft or update present position.
3. VERDAN	Utilized VERDAN to its utmost throughout the mission.	Did not take advantage of all of VERDAN capabilities.	Not proficient enough to accomplish assigned mission.
4. Inertial Platform	The platform was properly alined and operated.	The platform was so operated as to induce errors into the system.	The platform was either not properly alined or was not properly operated.
5. Reconnaissance Systems	Operated all equipment per the NATOPS Pocket Checklist.	Operated equipment per NATOPS Pocket Checklist with minor deviations.	Did not operate equipment in compliance with the NATOPS Pocket Checklist.

*Critical area or subarea

IN-FLIGHT MALFUNCTIONS (RAN)

	QUALIFIED (Q)	CONDITIONALLY QUALIFIED (CQ)	UNQUALIFIED (U)
1. Radar	Recognized the radar malfunction immediately and took appropriate corrective action.	Was unduly slow in recognizing the malfunction and in taking corrective action.	Did not take appropriate corrective action to overcome the radar malfunction.
2. VERDAN	Quickly recognized the malfunction and took appropriate corrective action.	Was slow in recognizing the malfunction and lost valuable time in trying to correct it.	Did not see the malfunction or did not know how to correct it.
3. Inertial Platform	Quickly noticed the failure and followed the correct procedures.	Noticed the failure but did not follow the correct procedures.	Did not notice the failure or did not know how to put the system in the stand-by navigation mode of operation.
4. Bombing Computer	Quickly recognized the failure and utilized alternate method of operation.		Recognized the failure but failed to take appropriate action, or did not recognize the failure.
5. Reconnaissance Systems	Quickly recognized the system failure and took appropriate action, if applicable, to ensure successful reconnaissance coverage.	Recognized the failure but did not take appropriate and timely corrective action.	Did not notice failure and/or did not know corrective action to take.

*AIRMANSHIP (PILOT/RAN)

	QUALIFIED (Q)	CONDITIONALLY QUALIFIED (CQ)	UNQUALIFIED (U)
*1. Crew Coordination	Coordinated smoothly and effectively in all crew endeavors.	Coordination was sufficiently low so as to hinder crew performance and reduce mission effectiveness.	Coordination was at a level sufficiently low so as to hinder crew performance and/or jeopardize safety.
2. Radio Procedures	Demonstrated the ability to copy, understand, and read back ATC clearances in minimum time. Monitored frequencies and/or facilities at the appropriate time. Was familiar with communications equipment and facilities. Understood and correctly transmitted position reports.	Met the criteria for Qualified except for discrepancies or delays that indicated lack of thorough familiarity with procedures, equipment, or facilities.	Failed to transmit or receive mandatory reports through omission or lack of familiarity with equipment or procedures.

*Critical area or subarea

	QUALIFIED (Q)	CONDITIONALLY QUALIFIED (CQ)	UNQUALIFIED (U)
3. Navigational Charts and Publications	Demonstrated complete familiarity with the following charts and publications: (a) Flight Planning Document. (b) Enroute Supplement. (c) Enroute FLIP Charts. When required in flight, was able to assist the pilot in changes to the flight plan through proper use of navigational charts and publications.	Generally understood the procedures for proper use of publications and charts. Was slow in rendering assistance required by the pilot when questions concerning the route of flight came up or when changes to the flight plan occurred.	Completely unfamiliar with publications and charts. Gave the pilot no assistance in handling subject documents in flight.

PRELANDING, TAXI, AND SHUTDOWN (PILOT/RAN)

	QUALIFIED (Q)	CONDITIONALLY QUALIFIED (CQ)	UNQUALIFIED (U)
*1. NATOPS Pocket Checklist.	Checklist was completed in a timely, orderly manner.	Checklist was completed with minor errors or omissions.	Checklist was not followed jeopardizing safety of flight.

POSTFLIGHT AND DEBRIEFING (PILOT)

1. Postflight.
   (a) Did pilot perform postlanding aircraft inspection?
2. Debriefing.
   (a) Were yellow sheet entries made accurately and correctly?
   (b) Were discrepancies reported in writing, using accepted terminology and in a clear, concise manner?
   (c) Were debriefing and other required postflight forms filled out?
   (d) Was crew debriefed by applicable debriefing officer in accordance with governing directives?

DEBRIEFING (RAN)

	QUALIFIED (Q)	CONDITIONALLY QUALIFIED (CQ)	UNQUALIFIED (U)
1. Equipment	The AN/ASB-12 and reconnaissance debriefing sheet was completed without errors or omissions, including a clear, concise description of discrepancies.	The AN/ASB-12 and reconnaissance debriefing sheet was completed with minor deviations or omissions.	Major discrepancies in completing the AN/ASB-12 and reconnaissance debriefing sheet were noted.
*2. Mission	All required debriefing forms, charts, cards, and logs were completed accurately.	Minor errors or omissions were made in log keeping; however, it was possible to reconstruct the mission from available information.	Required forms, charts, cards, and logs were not complete, left out, or neglected entirely.

*Critical area or subarea

FLIGHT EVALUATION 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 subarea. Only the numeral 0, 2, or 4 will be assigned in subareas. No interpolation is allowed.

Unqualified — 0.0

Conditionally Qualified — 2.0

Qualified — 4.0

To determine the numerical grade for each area and the overall grade for the flight, add all the points assigned to the subareas and divide this sum by the number of subareas graded. The adjective grade shall then be determined on the basis of the following scale.

Unqualified — 0.0 to 2.19

Conditionally Qualified — 2.2 to 2.99

Qualified — 3.0 to 4.0

Example: Add subarea numerical equivalents:

$$\frac{4+2+4+2+4}{5} = \frac{16}{5} = 3.20 \text{ Qualified}$$

FINAL GRADE DETERMINATION

The final NATOPS evaluation grade shall be the same as the grade assigned to the evaluation flight. An evaluee who receives an Unqualified grade on any ground examination or the flight evaluation shall be placed in an Unqualified status until he achieves a grade of Conditionally Qualified or Qualified on a re-evaluation.

RECORDS AND REPORTS

A NATOPS evaluation report (OPNAV Form 3510-8) shall be completed for each evaluation and forwarded to the evaluee'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/RAN flight logbook under "Qualifications and Achievements" as follows:

			DATE	SIGNATURE	
NATOPS EVALUATION	(Aircraft Model)	(Crew Position)	(Date)	(Authenticating Signature)	(Unit which Administered Evaluation)

In the case of enlisted crew members, the following entry shall be made in the administrative remarks portion of his personnel record upon satisfactory completion of the NATOPS evaluation.

(Date) Completed a NATOPS evaluation in (aircraft designation) as (flight crew position) with an overall grade of (Qualified or Conditionally Qualified).

NATOPS EVALUATION QUESTION BANK

The following bank of questions is intended to assist the unit NATOPS Instructor/Evaluator in the preparation of written examinations and to provide a study guide. The questions from the bank shall be combined with questions obtained from the Model Manager in the preparation of examinations.

1. The AN/ALE-29 RESET switch is normally used only when the chaff dispensers are fully loaded.
   (a) True.
   (b) False.

2. Should illumination of a FILTER caution indicator be accompanied by fuel fluctuations exceeding ______ pounds per hour, the flight should be discontinued.
   (a) 100.
   (b) 150.
   (c) 250.
   (d) 300.

3. What is the maximum allowable fuel flow fluctuation with which the flight can be continued?
   (a) 100.
   (b) 200.
   (c) 300.
   (d) 500.

4. What does illumination of a fuel FILTER caution indicator indicate? ______

5. Engine oil tanks provide sufficient supply for an ______ mission.

6. Fuel is used as a coolant for engine scavenged oil.
   (a) True.
   (b) False.

7. Illumination of the fuel #1 FILTER caution indicator indicates:
   (a) That the high-pressure filter on that engine is bypassing.
   (b) That the high-pressure filter on the engine is about to bypass.
   (c) The low-pressure filter on the #1 engine is about to bypass.
   (d) The low-pressure filter on the #1 engine is bypassing.

8. A fuel FILTER caution indicator indicates:
   (a) Low-pressure filter about to bypass.
   (b) High-pressure filter bypassing.
   (c) None of the preceding.
   (d) Both (a) and (b).

9. The emergency ignition buttons on the throttles will continue to operate for 30 seconds after indication.
   (a) True.
   (b) False.

10. Moving the engine MASTER switch to OFF with the engine running will secure all fuel to the engine.
   (a) True.
   (b) False.

11. The emergency igniters located on the throttles will not operate unless engine rpm is 10%.
   (a) True.
   (b) False.

12. The fuel flow indicator registers basic engine fuel flow only.
    (a) True.
    (b) False.

13. In performing an engine acceleration check, time is measured from ______________________________ to______________________________.

14. The afterburner may take up to ______ seconds between selection and light-off.

15. In MIL, J79-GE-8, EGT should normally read ____ (maximum), for the J79-GE-10, __________ (maximum)

16. Mechanical scheduling of the engine nozzle ceases at approximately ______________ % rpm under normal conditions.

17. The J79-GE-10 normally accelerates from IDLE to MIL in ____________, seconds (BLC off) and may increase to approximately __________ seconds with the BLC operating.

18. Failure of the engine to obtain 100% rpm or 625 degrees EGT at altitude would normally be due to ______ ______________________________.

19. Stabilizer position signals to the APC system provides:
    (a) Anticipation of the angle-of-attack change.
    (b) Airspeed compensation inputs.
    (c) Correction for thrust changes.
    (d) Gain adjustments for the angle-of-attack input.

20. The APC has a three-position gain switch incorporated, which is labeled HOT, STD, COLD. Which position provides the most rapid throttle response? ______________.

21. For temperatures above ______ °F the HOT position of the APC AIR TEMP switch should be selected.

22. The RA-5C has two engine pressure relief doors which may open during flight if engine compartment pressure exceeds 8 psi. If the doors open in flight, what restrictions are placed on the aircraft? ______________ ______________________________.

23. The engine bay cooling and pressure relief doors normally open under what conditions? ______________ ______________________________.

24. Moving an engine MASTER switch to OFF at any Mach number above 0.3 will cause corresponding ramp to extend (down) only if engine speed is below 95% rpm:
    (a) True.
    (b) False.

25. The engines should not be started with the flaps and droops down because of the possibility of __________ __________ ; to eliminate this situation, what action should be taken? ______________ ______________________________.

26. ______________ psi air pressure is provided by the air conditioning system to pressurize the internal fuel tanks.

27. If you man an aircraft with the droops extended, what should you do? ______________ ______________________________.

28. List three possible indications of compressor stall.
    (a) ______________________________.
    (b) ______________________________.
    (c) ______________________________.

29. The aft fuselage tank contains ______ transfer pumps.

30. List the three methods of obtaining high-duty operation of the wing pumps.
    (a) ______________________________.
    (b) ______________________________.
    (c) ______________________________.

31. The bomb bay fuel CANS switch automatically returns from AUX to NORM if wing dump is selected.
    (a) True.
    (b) False.

32. The WING fuel transfer switch will remain in the AUX position if the aircraft is airborne and:
    (a) Wing dump is selected.
    (b) Bomb bay cans are empty.
    (c) Tail hook is down.
    (d) All of the preceding.

33. The FUEL LOW caution indicator will illuminate when the fuel level in the sump reaches approximately ______ pounds.

34. Wing fuel and bomb bay can fuel can be dumped simultaneously by pulling the FUEL DUMP handle.
    (a) True.
    (b) False.

35. The bomb bay tanks will not be pressurized if:
    (a) The forward tank pump is energized.
    (b) Drop tank fuel is selected.
    (c) The landing gear is down.
    (d) Wing dump is selected.

36. If the FUEL PROBE switch is in the EXTEND position or the hook is extended and cannot be retracted, bomb bay fuel may be transferred by ____.

37. If the bomb bay cans fail to transfer normally, normal wing transfer can be expected when the sump level reaches approximately 2200 pounds.
    (a) True.
    (b) False.

38. The wing tanks normally transfer to and maintain the sump level at:
    (a) 4200 pounds.
    (b) 4800 pounds.
    (c) 2200 pounds.
    (d) 1800 pounds.

39. What sump level do the drop tanks maintain?
    (a) 3300 pounds.
    (b) 4800 pounds.
    (c) 3000 pounds.
    (d) 2200 pounds.

40. The low-duty wing transfer pumps are energized when:
    (a) The weight is off the right landing gear.
    (b) The engine MASTER is turned ON.
    (c) The 2500-pound float switch is closed.
    (d) The landing gear handle is up.

41. If you lose one generator and cannot reset it, you will lose:
    (a) Wing fuel scavenge pumps.
    (b) Seat and rudder pedal adjust.
    (c) High-duty fuel pump operation.
    (d) All of the preceding.
    (e) (a) and (c) above.

42. The SYSTEM select switch must be in the LOOK position to maintain camera operation in the event of a generator failure.
    (a) True.
    (b) False.

43. The pilot must be in the LOOK position of the SYSTEM select switch to maintain camera operation in the event of what failure? ______.

44. On engine shutdown, the generators should cut off prior to ______ % rpm.
    (a) 26.
    (b) 28.
    (c) 30.
    (d) 36.

45. What is the indication of a single d-c converter failure? ______. What are some of the indications of a dual d-c converter failure? ______.

46. The d-c power caution indicator is an a-c powered light.
    (a) True.
    (b) False.

47. A fuse panel is installed on the right console in the aft cockpit. These fuses control power distribution to the:
    (a) Armament system indicating lights, reconnaissance systems, and the bomb directing set.
    (b) Essential bus-powered lighting circuits, reconnaissance systems, and bomb directing set.
    (c) Armament system indicating lights, bomb directing set, and essential bus-powered lighting circuits for the cockpits.
    (d) Reconnaissance systems and essential bus-powered cockpit lighting circuits.

48. The d-c converter will automatically come on the line after both generator switches have been moved from OFF to RESET (on deck).
    (a) True.
    (b) False.

49. Illumination of the ELEC EPU ON advisory light when the RAT is extended indicates ______.

50. If the hydraulic pressure from either pump in the No. 1 or No. 2 system falls below 650 psi the HYD PRESS caution light will illuminate.
    (a) True.
    (b) False.

51. The isolation valve will close under what conditions? ______.

52. The air compressor will not operate if:
    (a) The No. 1 system hydraulic pressure is lost.
    (b) Pilot has selected the FLIGHT position of the HYD SUB-SYS ISOLATION switch.
    (c) The automatic hydraulic isolation valve has closed.
    (d) All of the preceding.

53. Can the tail hook be raised with the HYD SUB-SYS ISOLATION switch in the FLIGHT position?
    (a) Yes.
    (b) No.

54. With a dual-generator failure and the RAT extended, the HYD EPU ON caution light will be illuminated with a good No. 1 hydraulic system.
    (a) True.
    (b) False.

55. With a complete No. 1 hydraulic system failure, which of the following will be inoperative?
    (a) Electric flight.
    (b) Pitch augmentation.
    (c) Autoflight.
    (d) None of these systems.

56. The HYD SUB-SYS ISOLATION switch must be in the TAKE-OFF/LANDING position before the ram-air turbine can be retracted.
    (a) True.
    (b) False.

57. With no pressure indicating on the No. 1 hydraulic system, extending the RAT will restore pressure indications (assuming there has been no loss of fluid in No. 1 system).
    (a) True.
    (b) False.

58. Illumination of the HYD PRESS caution indicator with no pressure loss indicated for either system shows ________ ____.

59. With a No. 2 hydraulic system failure or auto isolation, normal operation of the droops can be expected without use of the emergency pneumatic pressure.
    (a) True.
    (b) False.

60. With a No. 2 hydraulic system failure, all flight control augmentation is inoperative.
    (a) True.
    (b) False.

61. Can the ram-air turbine be retracted with a No. 2 hydraulic system isolation?
    (a) Yes.
    (b) No.

62. The hook will retract normally with No. 2 hydraulic system failure.
    (a) True.
    (b) False.

63. Both yaw augmentation systems will be lost with loss of the No. 2 hydraulic system.
    (a) True.
    (b) False.

64. With the HYD PRESS caution indicator illuminated and all hydraulic pressures reading normal, it is possible to actuate the refueling probe.
    (a) True.
    (b) False.

65. Normal canopy operation utilizes air from the:
    (a) Emergency flap bottle.
    (b) Canopy jettison bottle.
    (c) Canopy air bottle.
    (d) Pneumatic compressor reservoir.

66. With the flaps full down, maximum nose-up authority is ________ ° with PITCH AUG ON and ________ ° with PITCH AUG STBY.

67. With the "kill" button depressed, the following items are inoperative:
    (a) Pitch augmentation only.
    (b) Pitch augmentation and electric flight control only.
    (c) Pitch augmentation, electric flight control, and autoflight only.
    (d) Pitch augmentation, electric flight control, autoflight, and normal trim.

68. Depressing the "kill" button will disengage normal roll trim and keep it disengaged as long as the "kill" button is depressed.
(a) True.
(b) False.

69. The emergency pitch trim crank may be used at any time to make inputs to the pitch trim actuator.
(a) True.
(b) False.

70. Pitch augmentation malfunctions may be overridden by opposing stick force although the force required may be high.
(a) True.
(b) False.

71. To utilize the emergency pitch trim crank, the TRIM select switch must be positioned to ____________ because ____.

72. Will pitch augmentation operate if the No. 2 hydraulic system fails completely?
(a) Yes.
(b) No.

73. With an uncalled for nose-down control input the pilot should attempt to ascertain if the problem is pitch augmentation or pitch trim prior to depressing the "kill" button.
(a) True.
(b) False.

74. Changes in lateral trim are selected and accomplished by ____.

75. Yaw trim is automatically reset toward neutral when the wing flaps are lowered.
(a) True.
(b) False.

76. Full control displacement of the directional control pedals produces _____ degrees of vertical stabilizer deflection with flaps extended and ______ degrees with flaps retracted.

77. The purpose of the lateral/directional interconnect is to:
(a) Give coordinated turns with flaps up.
(b) Decrease directional pedal sensitivity with the flaps down.
(c) Cause lateral inputs as the control pedals are moved.
(d) Improve roll characteristics at low speeds.

78. Both yaw augmentation systems will be lost with failure of the No. 2 hydraulic system.
(a) True.
(b) False.

79. With droops down and flaps up, the directional trim system is
(a) Not affected.
(b) Deactivated.
(c) Limited to ± 8 degrees.
(d) Limited to ± 2 degrees.

80. The B/N system button must be depressed for:
(a) Course line navigation.
  (1) True.
  (2) False.
(b) Autoflight in NAV mode.
  (1) True.
  (2) False.

81. The speed brakes have a blow back feature which prevents full speed brake extension above 500 KIAS.
    (a) True.
    (b) False.

82. If the No. 2 hydraulic system fails with speed brakes extended:
    (a) They will automatically retract upon emergency extension of the flaps.
    (b) They will operate normally as they are not affected by the No. 2 system.
    (c) Pulling the speed brake dump handle will allow the airflow on the surfaces to close them.
    (d) Pulling the speed brake dump handle will cause No. 1 hydraulic system pressure to retract the speed brakes.

83. Full speed brake extension may not be attained at speeds above .... knots.

84. Spoiler speed brakes are retracted when the:
    (a) Flap handle is placed in the 30°, 40°, or 50° positions.
    (b) No. 2 hydraulic system is lost.
    (c) Flap handle is placed in the SUPERSONIC position.
    (d) Flaps extend to 30°, 40°, or 50° positions.

85. Leading edge droops are driven by ....

86. The leading edge droops are moved by:
    (a) No. 1 hydraulic system only.
    (b) No. 2 hydraulic system only.
    (c) Both No. 1 and No. 2 hydraulic systems.
    (d) The emergency air accumulator.

87. Although there are no airspeed restrictions imposed with cruise droops, of what aircraft limitation should the pilot be aware at high Mach number with cruise droops extended? ....
....

88. A DROOPS caution indicator with gear and flaps down normally indicates:
    (a) The droops are in SUPERSONIC.
    (b) The droops are in CRUISE.
    (c) BLC has failed.
    (d) Either BLC valve is not fully opened.

89. The flaps have been extended by the emergency method. What happens when the EMERG FLAP switch is placed in the NORM position?
    (a) Flaps will retract.
    (b) Flaps and droops will retract.
    (c) Droops will retract.
    (d) None of the preceding.

90. The EMERG FLAP switch provides air to select the droops.
    (a) True.
    (b) False.

91. Under what conditions could you obtain full flaps yet be unable to move the droops? ....
....

92. What is the speed limitation placed on emergency flap extension? ....

93. The WHEELS warning indicator will flash whenever either throttle is retarded below 95% and:
    (a) The flaps are extended 25 degrees or more and all three gear are indicating unsafe.
    (b) The flaps are extended 25 degrees or more and the landing gear handle is not down.
    (c) The landing gear are not locked in either the up or down position.
    (d) The flaps are down and one gear is indicating unsafe.

94. How is the nose gear stiff system reset?
    (a) Catapult hook retraction.
    (b) Nose gear retraction.
    (c) Either of the preceding.
    (d) Neither of the preceding.

95. A positive indication of landing gear extension is the extinguishing of the WHEELS warning indicator.
    (a) True.
    (b) False.

96. With the flaps down, nose wheel steering authority is:
    (a) 75 degrees.
    (b) 40 degrees.

97. What corrective action should be taken if the arresting hook warning light is flashing at a high rate? ______. Failure to do so might result in a ______.

98. Moving the HYD SUB-SYS ISOLATION switch to the FLIGHT position will cause the antiskid to monitor off.
    (a) True.
    (b) False.

99. The auxiliary brake accumulator should be precharged to ______ psi.
    (a) 800 (± 50).
    (b) 1000 (± 50).
    (c) 2800 (± 50).
    (d) 3000 (± 50).

100. In flight with the gear extended, the antiskid lights should show green and blink out during antiskid test.
    (a) True.
    (b) False.

101. Taxi speed with the canopies open must be maintained below ______ knots.

102. The minimum safe airspeed for ground level ejection ______ knots.

103. The pilot's CANOPY caution light will illuminate if:
    (a) Only the RAN's canopy is unlocked.
    (b) Only his canopy is unlocked.
    (c) Either canopy is unlocked.
    (d) There is no pilot's CANOPY caution light.

104. Approximately ______ pounds of force on the internal canopy release handle is required to unlock the overcenter linkage and move the canopy aft 1 inch.

105. The RA-5C escape system provides safe ejection (straight and level, no sink rate) at any altitude from ______ knots through ______ knots (without arm retention system).

106. Describe the procedures used to manually open the canopy. ______

107. On ejection, the inertia reel will:
    (a) Lock at the last position selected.
    (b) Be wound in, restraining the crew member in the retracted position.
    (c) Become disengaged since the face curtain acts as a restrainer.
    (d) Not be affected.

108. When checking the aneroid indicator behind the parachute, the window is completely red. You should:
    (a) Down the aircraft.
    (b) Go ahead and fly — this is a normal condition.
    (c) Aircraft is up for low-altitude flight only.
    (d) None of the preceding.

109. While preflighting the ejection seat at Denver, Colorado, a small portion of the red flag of the aneroid power device indicator is visible. Is this condition normal?
    (a) Yes.
    (b) No.

110. How many ejection seat maintenance safety pins are there?

111. Can the pilot eject the RAN if the RAN's safety pins are installed.
    (a) True.
    (b) False.

112. For safe ejection in a 90-degree bank, add feet to terrain clearance required for wings level.

113. On a carrier-controlled approach with an indicated vertical speed of -750 fpm, what is the minimum safe altitude for ejection initiation with the wings level?

114. At 50 feet altitude, wings level, what is the maximum rate of descent that ejection can be made and still be within the seat envelope?

115. For safe ejection during inverted flight, add feet to terrain clearance required for wings level.

116. What is the minimum airspeed and altitude for safe ejection given conditions of zero sink rate and a level attitude?
    (a) 100 knots/100 feet.
    (b) 150 knots/0 feet.
    (c) 100 knots/0 feet.
    (d) 95 knots/50 feet.

117. The seat survival kit release handle is located

118. After ejection, crewman/seat separation and parachute deployment:
    (a) The survival kit and raft are automatically deployed.
    (b) The survival kit and raft must be manually deployed, after which the raft is automatically inflated as it falls to the end of the lanyard.
    (c) The survival kit and raft are manually deployed and the raft must be inflated manually.
    (d) None of the preceding.

119. A cockpit pressure regulator, mounted in the aft cockpit, maintains the cockpits:
    (a) Unpressurized to 13,000 feet MSL.
    (b) At a constant 13,000-foot pressure altitude above 13,000 feet MSL.
    (c) At a constant 8,000-foot pressure altitude from 8,000 to approximately 23,000 feet MSL.
    (d) At a constant 3.5 psi differential pressure at all altitudes above approximately 35,000 feet MSL.

120. The RECON COOL caution indicator illuminates:
    (a) Airborne with flaps extended 25 degrees or more as an indirect indication that cooling turbine compressor refrigeration units No. 2 and No. 3 are shut down.
    (b) With flaps extended 25 degrees or more as a direct indication that turbine compressor refrigeration units No. 1 and No. 4 are shut down.
    (c) Continuous illumination over an extreme period requires no action to turn off reconnaissance systems power switches.
    (d) During ground operation.

121. Flight operations with the flaps extended more than 25 degrees for a period exceeding minutes will require that power switches be turned off.

122. With flaps extended degrees or more and aircraft weight off the landing gear, turbine compressor No. 2 and No. 3 are shut down to reduce engine compressor bleed requirements.

123. Windshield anti-ice and rain removal air must be turned off after landing to prevent possible damage to the windshield:
(a) True.
(b) False.

124. The WINDHIELD ANTI-ICE and rain removal switch will automatically be returned to OFF by either or . Both conditions may be overriden by selecting

125. The pilot's and RAN's O_2 systems are entirely independent.
(a) True.
(b) False.

126. If abnormal pitot-static instrument readings indicate severe icing conditions, placing the RAMPS switch to will prevent possible flame-out.

127. Access to the oxygen converters is provided through the:
(a) Nose wheel well.
(b) Port engine bay.
(c) Linear bomb bay.
(d) None of the preceding.

128. List three instances when the OXYGEN warning indicator will illuminate:
(a) .
(b) .
(c) .

129. The emergency oxygen bottle in the seat is serviced to:
(a) 800 psi minimum.
(b) 1000 psi minimum.
(c) 1800 psi minimum.
(d) 3000 psi minimum.

130. If the RAN's oxygen valve is turned off or his Scott block becomes disconnected, the pilot's OXYGEN warning indicator will illuminate?
(a) True.
(b) False.

131. Approximately minutes normal breathing is available with the emergency oxygen supply at sea level.

132. It is necessary to activate the emergency oxygen supply manually for a nonejected bail-out.
(a) True.
(b) False.

133. If incoming radio signals are weak or unreadable, the ALT RAD position on the ICS panels may remedy this situation.
(a) True.
(b) False.

134. It is not necessary for the CNI PWR button to be depressed to obtain ICS operation.
(a) True.
(b) False.

135. With the ICS function knob in EMER, intercommunications are accomplished through the use of:
    (a) The radio amplifier.
    (b) The UHF sidetone.
    (c) The ICS amplifier.
    (d) Both ICS and UHF amplifiers .

136. If both pilot and RAN have selected the EMER position on the ICS panel the MIC SEL position must be used to gain communications with the other crewmember and the transmission will be voiced over the air on the preset UHF channel.
    (a) True.
    (b) False.

137. The TACAN occasionally locks onto a false bearing at 40 degrees off the correct bearing. The recommended procedure for correcting this is:
    (a) Secure the TACAN for 2 to 3 minutes.
    (b) Switch to another channel then back to the desired channel.
    (c) Secure the system since there is no in-flight correction.
    (d) Select ADF or NAV then return to TACAN.

138. TACAN distance indication is accurate to within:
    (a) 0.1 nautical mile at 196 nautical miles.
    (b) 0.2 nautical mile at 196 nautical miles.
    (c) None of the preceding, but is within 50 nautical miles.

139. The TACAN unit provides displays of:
    (a) Distance, true bearing to station, and deviations from course.
    (b) Slant range distances, true bearing to station, and deviations from course.
    (c) Distances to fix over station, magnetic bearing to station, and indications of deviations from course.
    (d) Slant range distance and magnetic bearing to station, and course deviation indication.

140. The pilot's EMERG IFF switch operates the system as follows:
    (a) In the MAN position, the IFF responds in emergency if the MASTER function selector is in the EMERG position.
    (b) In the MAN position, the IFF responds in emergency if the MASTER function selector is in any position other than OFF.
    (c) In the MAN position, the IFF responds in emergency regardless of MASTER function selector position.
    (d) In the AUTO position, the IFF responds in emergency when the MASTER function selector is in the EMERG position.

141. What does the MAN position of the EMERG IFF switch do?

142. The MASTER EXT LIGHTS switch must be ON in order to retract the anticollision light.
    (a) True.
    (b) False.

143. The anticollision light will come on without the MASTER EXT LIGHTS switch being ON.
    (a) True.
    (b) False.

144. The flight reference set provides attitude information to both the stand-by gyro horizon and the all-attitude indicator.
    (a) True.
    (b) False.

145. TAS output from the air data computer is used in the bombing computer to generate:
   (a) Wind velocity and direction.
   (b) Ground speed.
   (c) Present position.
   (d) Range to target.

146. The anti-ice feature of the detector probe is routed through the pitot anti-ice circuit.
   (a) True.
   (b) False.

147. The stall warning indicator portion of the system energizes the rudder pedal shaker on the right rudder pedal at ______ units angle of attack.

148. In the power approach configuration with the APPROACH lights switch in the ARREST position, the approach lights and cockpit indexer will indicate the hook is not in the down position by ______.

149. Failure of the approach lights to illuminate would indicate:
   (a) Landing gear is unsafe.
   (b) Tail hook not extended.
   (c) Weight of aircraft is off the landing gear.
   (d) Failure of angle-of-attack indicator.

150. The anti-ice feature of the AOA detector probe is routed through the pitot anti-ice circuit.
   (a) True.
   (b) False.

151. Magnetic heading of the aircraft should be displayed in the following places at all times:
   (a) ______.
   (b) ______.
   (c) ______.
   (d) ______.

152. With a MFRS failure, moving the compass mode switch to SLAVED will return magnetic compass information to the AAI HSI.
   (a) True.
   (b) False.

153. The compass latitude knob should be changed for each 5-degree change in latitude in the ______ mode.
   (a) SLAVED.
   (b) DG.
   (c) COMP.
   (d) All the preceding.

154. When operating in STBY-NAV what procedures would you use to ensure correct heading information to the navigation system? ______.

155. The radar altimeters which are installed in the aircraft can measure altitude from ______ to ______.

156. At what altitude will the radar altimeter high-altitude system cease to operate in a descent? ______.

157. While flying in a RA-5C between 500 and 3000 feet with the low-and high-altitude modes of the radar altimeter both operating normally, the RAN selects BARO:
   (a) What altitude information will appear on the radar altimeter block of the data matrix? ______.
   (b) What information will appear if flying above 3000 feet? ______.

158. Why should the pilot depress the override button of his radar altimeter (removing the OVRD flag from the window) climbing out through 5000 feet?

159. With a failure of the high-altitude radar altimeter system, how is the low-altitude system turned on in a descent?

160. With a failure of the low system radar altimeter, the RAN's radar altimeter will become inoperative below feet.

161. When should the pilot's radar altimeter not be operated in the OVRD mode? Why?

162. If the radar altitude was 20,000 feet over water, what would be the probable cause of a 20,300-foot reading in BARO after a BARO CAL.?

163. The primary reason for establishing the inertial platform in a local level condition during alinement is to:
   (a) Supply attitude data to the AAI.
   (b) Calculate a gravity vector.
   (c) Provide a reference for the velocity meters.
   (d) Both (b) and (c).

164. The flight reference set gyro is used:
   (a) To stabilize the radar antenna in OPERATE mode.
   (b) To stabilize the radar antenna in STBY-NAV mode.
   (c) During alinement as a leveling signal to the inertial platform.
   (d) To provide a platform for the velocity meters.

165. With the A/N MODE knob in OPERATE, the bombing computer calculates wind speed and direction by vectorally adding:
   , , and .

166. A B N WARM-UP light in flight indicates an overtemperature of the digital computer.
   (a) True.
   (b) False.

167. Preheating the inertial platform requires both ground power and cooling air.
   (a) True.
   (b) False.

168. Displays lost when the BOMB COMPUTER POWER switch is OFF are:
   (a) Barometric altitude and TAS.
   (b) All ARI displays except TACAN bearing.
   (c) Destination range and present position.
   (d) Present position and target altitude.

169. What does an ADVANCE MODE light illumination during flight indicate?

170. During an automatic alinement the umbilical cable is inadvertently removed. What indications would the RAN have and what would be the result?

171. Overtemperature of the VERDAN computer is usually indicated by the OVERTEMP RESET light only.
   (a) True.
   (b) False.

172. The RAN may switch from autonavigation operation to STBY-NAV and keep the option of returning to autonavigation by:
   (a) Moving the AN POWER switch from OPERATE to STBY-NAV.
   (b) Moving the A/N MODE knob from OPERATE to STBY-NAV.
   (c) Both (a) and (b).
   (d) Neither (a) or (b).

173. On selection of RECON mode:
   (a) The target position runs to approximately the aircraft present position.
   (b) The azimuth and range cursors continue to track selected target.
   (c) A TV picture is displayed on the scope.
   (d) The cursors move to the target selected in the NAV/BOMB channel.

174. The autonavigator can provide great circle steering:
   (a) Up to 186 nautical miles.
   (b) Up to 5000 nautical miles.
   (c) To any point on earth.
   (d) Only to coordinates of the selected SET/CORR target.

175. If a present position correction is made within 20 nautical miles to destination in the NAV mode, are the pilot's HSI range and bearing corrected?
   (a) Yes.
   (b) No.

176. Coordinates of a target of opportunity can be determined and stored if desired by selecting mode.
   (a) SEARCH.
   (b) STBY-NAV.
   (c) RECON.
   (d) Air ALINE.

177. Two occasions when you would use offset distances are and . How would you apply the offset and in what increments?

178. Course line navigation is selected and operating properly. The aircraft is flying a track of 270 degrees. The target is identified and is 10 degrees right of course. What happens when the correction is made?

179. Can present position be updated by means of cursor correction while in C/L NAV mode?
   (a) Yes.
   (b) No.

180. Wind direction in the STBY-NAV mode is referenced to magnetic north.
   (a) True.
   (b) False.

181. In the OPERATE mode, ground speed is determined by:
   (a) True airspeed plus wind input.
   (b) The autonavigator.
   (c) Radar tracking of checkpoints.
   (d) The air data computer.

182. Destination range readout is displayed:
   (a) To any point on earth.
   (b) Up to 5000 nautical miles.
   (c) Up to 186 nautical miles.
   (d) To SET/CORR selected targets.

183. The cursor control handle is used to:
   (a) Set PP, TARGET SET, slew radar cursors, and TV reticle.
   (b) Slew TV in SEARCH, and control the aircraft when the pilot engages the B/N SYS button.
   (c) Set PP, set CAR VEL, and set differential heading.
   (d) Set target altitude and set terrain avoidance plane.

184. Wind velocity is displayed to a maximum of ______ knots.

185. Proper wind speed readings are obtained in flight when TAS exceeds approximately ______ knots.
(a) 100.
(b) 125.
(c) 199.
(d) 229.

186. The action button has to be depressed for using the SEARCH or RECON mode.
(a) True.
(b) False.

187. When and where are alpha 1 and alpha 2 readouts available?

188. During an autonavigator alinement, what is the greatest acceptable alpha readout?

189. Can drift rate in the inertial platform be eliminated after take-off by cursor correction?
(a) Yes.
(b) No.

190. During STBY-NAV operations the MFRS provides ______ to the bomb directing set:
(a)
(b)
(c)
ADC supplies:

191. Radar antenna stabilization limits are:
(a) ±15 degrees roll, +17/−19 degrees pitch.
(b) ±17 degrees roll, +15/−19 degrees pitch.
(c) ±19 degrees roll, ±15 degrees pitch.
(d) ±10 degrees roll, ±20 degrees pitch.

192. With the expanded mode selected the radar antenna scans ______ degrees either side of the azimuth cursor position.

193. If the aircraft is placed in a 30-degree bank, radar presentation:
(a) Disappears completely.
(b) Requires 5 minutes of level flight after roll-out to regain stabilization.
(c) Partially disappears.
(d) Is not affected.

194. Variable display (expanded sweep, variable scale factor) becomes available at ______ miles to selected target.
(a) 60.
(b) 46½.
(c) 20.
(d) 17.

195. Selection of the radar FIXED expanded display:
(a) Has no effect with 0 to 140 range selected.
(b) Is effective only when range to target is 17 nautical miles or less.
(c) Has no effect unless the pilot has selected TA.
(d) Causes the pilot's HSI TGT light to illuminate.

196. Monopulse Resolution Improvement (MRI) enhances ______ resolution. ANTI JAM enhances ______ resolution.

197. There is a time delay of approximately ________ before TV will be ready for operation after the RADAR/TV POWER switch is moved from OFF to STBY.
   (a) 6 minutes.
   (b) 6 seconds.
   (c) 3 minutes.
   (d) 3 seconds.

198. For radar ground mapping with a 90-degree sector scan, the DISPLAY knob position to select should be:
   (a) VAR.
   (b) FIXED.
   (c) NORM or NORM-RNG CIRCLE IN.
   (d) None of the preceding.

199. Blooming of close-range radar targets at low altitudes can be controlled by using:
   (a) MRI mode.
   (b) ANTIJAM mode.
   (c) STC (normal or flat) mode.
   (d) CTR MAP/TA MON mode.

200. Which of the following controls regulates intensity of radar target return?
   (a) BRIGHTNESS knob.
   (b) IF GAIN knob.
   (c) VIDEO GAIN knob.
   (d) Both (b) and (c).

201. When the TRANSMIT MODE switch is placed in SILENCE:
   (a) The magnetron is switched off.
   (b) RF energy is diverted into a dummy load.
   (c) Klystron is driven to cut-off.
   (d) Radar system power is removed.

202. Varying VIDEO GAIN knob setting will change:
   (a) Antenna pattern.
   (b) Tilt.
   (c) Receiver signal-to-noise ratio.
   (d) Receiver range sweep.

203. Following failure of the inertial platform with navigation continuing in STBY-NAV mode:
   (a) The velocity signals to VERDAN from the autonavigator platform are eliminated.
   (b) Signal sources of TAS and altitude are used from the air data computer.
   (c) Signal sources of aircraft attitudes are used from the flight reference set.
   (d) All of the preceding.

204. In MRI mode with the BEAM knob at NORM STC or FLAT STC, the IF GAIN knob is inoperative.
   (a) True.
   (b) False.

205. During radar operation at more than ________ nautical miles from selected checkpoint or target, the azimuth cursor is locked straight ahead.
   (a) 100.
   (b) 150.
   (c) 186.
   (d) 220.

206. With the 140-mile scale selected on the radar, the range circles are ______ miles apart.

207. The result of slewing the radar cursors or the TV reticle onto a target in NAV or BOMB mode is:
(a) A correction to present position.
(b) A correction in the bombing computer.
(c) A correction in steering only.
(d) A correction in release range only.

208. In the AFT position of the VIEW switch, the TV sight:
(a) Remains fixed at 180 degrees azimuth and 10 degrees depression.
(b) Is fully controllable.
(c) Is fixed in azimuth only.
(d) Is fixed in depression angle only.

209. To jettison external stores utilizing the pilot's jettison buttons, which two of the following conditions must be met?
(a) MASTER ARM—ON.
(b) Weight off main mounts.
(c) STORE ABOARD indicator "ON."
(d) Essential d-c bus energized.
(e) Station to be jettisoned selected by RAN.

210. The TV reticle:
(a) Is generated by the radar sweep generator.
(b) Can be illuminated by either one of two light sources.
(c) Is of a constant intensity.
(d) Is switched on automatically when TV is selected.

211. The TV reticle is ______.
(a) Generated by the radar.
(b) Selected manually.
(c) Generated automatically when TV mode is selected.
(d) Always displayed.

212. The TV has three beam angles: WIDE, MED, NAR. What are they in degrees?
(a) ______.
(b) ______.
(c) ______.

213. Having used TV to check gear retraction after take-off, no radar targets appear upon moving the radar/TV MODE knob to NORM. Adjustment of brightness and gain controls has no effect. Which of the following would most likely solve the problem?
(a) Cycle FILTER switch from IN to OUT.
(b) Place radar /TV MODE knob in MRI position.
(c) Cycle VIEW switch from AFT to FWD.
(d) None of the preceding — radar malfunction has occurred.

214. The TV blast FILTER ______.
(a) Is automatically inserted for AFT viewing.
(b) Must be switched in manually if required.
(c) Is used only on catapult launches.
(d) Is used for detecting infrared emissions from other aircraft.

215. To release drop tanks, it is necessary to turn on the MASTER ARM switch and use STORE RELEASE button.
(a) True.
(b) False.

216. Stores cannot be jettisoned with aircraft weight on the landing gear.
(a) True.
(b) False.

217. Flasher pods are dropped in the same manner as pylons.
(a) True.
(b) False.

218. The MASTER ARM must be ON in order to jettison pylons.
(a) True.
(b) False.

219. Normal refueling pressure for the RA-5C is:
(a) 20 psi.
(b) 30 psi.
(c) 40 to 50 psi.
(d) 50 to 60 psi.

220. Hydraulic system fluid level sight gages are located ____________.
(a) In the port wheel well.
(b) On the hydraulic servicing panel.
(c) On top of the aft fuselage under access plate No. 103 and No. 168.2.
(d) Next to the engine bay hydraulic system quick-disconnects.

221. During preflight inspection the minimum allowable pressure in the pneumatic system is:
(a) 2600 psi.
(b) 2800 psi.
(c) 3000 psi.
(d) 3200 psi.

222. Afterburners should light off within ________ seconds after selection. On light-off, rpm drop to a minimum of ____________ is acceptable.

223. Windmill engine rpm must be maintained at not less than ________% to ensure proper engine lubrication.

224. What is the maximum oil pressure for the J79-GE-8A engine? ____________

225. What is the time limit for operation of the J79-GE-8 or J79-GE-10 engine at Military Thrust below 35,000 feet?
(a) 15 minutes.
(b) 30 minutes.
(c) 60 minutes.
(d) No time limit.

226. What is the maximum EGT at Military Thrust for the J79-GE-8 engine?
(a) 610 (±10) degrees.
(b) 615 (±10) degrees.
(c) 625 (±10) degrees.
(d) 640 (±10) degrees.

227. What are the EGT limitations for start and acceleration to idle rpm?
(a) J79-GE-8.
(b) J79-GE-10.

228. What is the maximum continuous rpm for the J79-GE-8 engine?
    (a) 94.5%.
    (b) 96.0%.
    (c) 92.0%.
    (d) 100.0%.

229. What is the maximum continuous rpm for the J79-GE-10 engine?
    (a) 94.5%.
    (b) 96.7%.
    (c) 92.0%.
    (d) 100.0%.

230. After take-off maintain an airspeed below ______ knots until gear are completely up.

231. What are the speed restrictions for operation of the following items?
    (a) Hook ______.
    (b) Landing gear ______.
    (c) Flaps (50°) ______.
    (d) Flaps (30°) ______.
    (e) Probe ______.
    (f) Droops (25°) ______ CRUISE ______.

232. The maximum EGT at turn up for take-off is ______ —8, ______ —10.

233. The maximum allowable airspeed with cruise droops extended is:
    (a) 420 knots.
    (b) 520 knots.
    (c) 0.92 IMN.
    (d) 1.5 IMN.
    (e) No limit.

234. AFCS (autopilot) should not be engaged at airspeeds below ______ IMN and altitudes below ______ feet.

235. The maximum airspeed with flaps up and droops at 25 degrees is ______.

236. What does illumination of the ALT FAIL light indicate?
    (a) Failure of Mode 4.
    (b) Failure of Mode C.
    (c) Failure of the altimeter STBY function.
    (d) You are below the altitude set on the radar altimeter.

237. Minimum oil pressure at Military Thrust is ______ psi.

238. Maximum gross weight for normal field landings is ______.

239. Minimum rate of descent field landings are permitted up to a gross weight of ______.

240. With landing gear and/or flaps extended at gross weights of 64,000 pounds or less, the maximum acceleration from deliberate maneuvers is ______ to ______ "g's."

241. Angle of bank or bank angle changes in excess of 60 degrees are not permitted at airspeeds greater than ______ (with both yaw augmentation systems off).

242. Wing fuel limits for a catapult launch are ______.

243. The center-of-gravity limits for a reconnaissance configured aircraft operating from a carrier are ______ to ______ % MAC (15 knots excess).

244. The TV sight may be used for observation without affecting navigation by placing the:
    (a) ATTACK MODE knob in ALL WEATHER LEVEL.
    (b) SYSTEM MODE knob in SEARCH.
    (c) A/N MODE knob in STBY-NAV.
    (d) COORD SELECT knob in NORMAL.

245. The anti-exposure suit is to be worn on all overwater flights when the water temperature is 59° F or below and/or when outside air temperature is ______ °F or below.
(a) 32.
(b) 40.
(c) 50.
(d) 59.

246. The primary heat exchanger jet pumps should shut off between 78% and 85% engine rpm.
(a) True.
(b) False.

247. With the HOOK MODE switch in the FIELD-35° position the hook light will remain on when the hook is lowered during pre-taxi check.
(a) True.
(b) False.

248. Camera viewfinder ground checks should be made with the viewfinder POWER switch in:
(a) AUTO.
(b) MAN.
(c) OFF.

249. All take-offs and landings will be made with the ICS MIC SEL switch in HOT mike position.
(a) True.
(b) False.

250. How can a pilot check for bleed air duct leaks? ______.

251. In MIN AFTERBURNER, nozzles should indicate:
(a) ½ open.
(b) ¼ open.
(c) ¾ open.
(d) Full open.

252. What steps must be taken to engage the APC?
(a) ______.
(b) ______.
(c) ______.

253. The maximum allowable 90-degree crosswind for take-off or landing is ______ knots.

254. It is recommended that nose-high aerodynamic braking be used in a strong crosswind.
(a) True.
(b) False.

255. Describe the technique for optimum braking at high gross weights with no crosswind and no antiskid. ______.

256. Catapult shots are not permitted with wing fuel between ______ pounds and ______ pounds.

257. How should the APC be disengaged during a wave-off? ______.

258. Proper procedure for a wave-off in the RA-5C is:
(a) Military Thrust and 15 units angle of attack.
(b) Military Thrust and 17 units angle of attack.
(c) Military Thrust and 19 units angle of attack.
(d) Maximum Thrust and 19 units angle of attack.

259. Coordinates of a target of opportunity can be determined and stored if desired by selecting ______ mode.
(a) SEARCH.
(b) STBY-NAV.
(c) RECON.
(d) Air ALINE.

260. Range circle accuracy can be checked by measuring the distance to each circle with the range cursor, using ______ mode and ______ readout.

261. List the switch settings for the two options of "pickle correct."

262. With pan cameras installed, the camera POWER switch should be left in the READY position during flight to maintain temperature control and mount stabilization.
(a) True.
(b) False.

263. Initial erection of the stabilized pan camera after selection of READY takes approximately ______ (AFC 297 PHC 37 not incorporated).
(a) 4 minutes.
(b) 5 minutes.
(c) 6 minutes.
(d) 7 minutes.

264. In what position should the PECM POWER switch be during launch?
(a) OFF.
(b) READY.
(c) OPERATE.

265. What is the proper procedure for initiating operation of the AN/ALQ-55 DECM system?

266. Camera caution indicator illumination indicates:
(a) Camera malfunction, system failure, or film supply exhaustion.
(b) Improper altitude mode selection, system failure, or camera malfunction.
(c) The pilot has assumed command of the oblique cameras.
(d) All the preceding.

267. If the aircraft has entered poststall gyrations and is not under control at ______ feet, ejection is mandatory.

268. The correct procedure for recovering from a poststall gyration is:
(a) ______.
(b) ______.
(c) ______.
(d) ______.

269. Approximately ______ feet of altitude is lost in a recovery from a 60-degree dive if recovery is commenced at 20,000 feet and 1.2 IMN. (Use 3.5-g recovery, IDLE power, and full speed brakes).

270. In the event controlled ejection is required and feasible, airspeed should be reduced to ______ knots.
(a) 150.
(b) 200.
(c) 250.
(d) 275.

271. During a parachute descent, over water, what action should be taken prior to contact?
(a) .
(b) .
(c) .
(d) .

272. Following an ejection at 10,000 feet, automatic seat/man separation failed. What action should be taken?
(a) .
(b) .
(c) .
(d) .

273. What is the reason for pulling "D" ring after normal ejection?
.

274. If you bailed out unejected, would automatic parachute opening occur?
.

275. It is recommended to activate the emergency oxygen system manually for a nonejected bail-out.
(a) True.
(b) False.

276. On manual separation after ejection, the harness release should be pulled before removing the leg retainers.
(a) True.
(b) False.

277. During an aborted take-off, for reasons of an engine fire, it is recommended that the pilot secure both engines.
(a) True.
(b) False.

278. After retracting the gear by use of the EMERG GEAR UP switch, the gear must then be extended by emergency means.
(a) True.
(b) False.

279. In the event of a throttle linkage failure, what procedures are required to accomplish a safe two-engine landing? .

280. While flying at FL 250 No. 1 engine quits. What steps are necessary to relight the engine?
(a) .
(b) .
(c) .
(d) .
(e) .
(f) .
(g) .

281. During a normal air start attempt, if no light-off occurs after 30 seconds with throttle at IDLE what is the next step?
.

282. The optimum air start airspeed below 25,000 feet is ______ and ______ rpm.

283. The most probable first indication of an engine oil leak is ______.
(a) Oil caution indicator.
(b) Generator failure caution indicator.
(c) Nozzle failure.
(d) Low and/or zero oil pressure.

284. Should the exhaust gas temperature amplifier or associated equipment fail, the nozzles would normally seek what position? ________

285. What components can you expect to be affected in the event of an engine oil leak? ________

286. With a failure of the engine temperature amplifier, what will happen to the nozzle? ________

287. In case of smoke and fumes in the cockpit, the cockpit pressure control switch should be moved to ________

288. The ALT COOL light denotes transfer of cooling air to electronic equipment in event of failure of the equipment cooling refrigeration unit. If the alternate cool button is depressed and the light remains on, will the cockpit be pressurized?
(a) Yes.
(b) No.

289. With an airspeed indicator failure, the AOA equivalent for maximum endurance is:
(a) 9.5.
(b) 10.
(c) 11.5.
(d) 14.

290. If one of the sequencing switches (2800 to 3000 pounds) in the sump tank sticks in the no-transfer position, how may fuel be transferred from the forward tank to the sump tank other than by gravity? ________

291. If the air refueling probe fails to retract, normal operation of the fuel system will usually be regained by leaving the switch in the RETRACT position.
(a) True.
(b) False.

292. If it is not possible to dump or transfer bomb bay can fuel, WING AUX can be selected to improve CG after:
(a) Selecting wing dump.
(b) Moving the FUEL PROBE switch to extend.
(c) Dropping the arresting hook.
(d) Placing the landing gear handle in the down position and one of the above.

293. Name at least four items that will not operate with one generator inoperative.
(a) ________
(b) ________
(c) ________
(d) ________

294. What fuel system functions will be lost with a failure of one generator?
(a) ________
(b) ________

295. After landing with a No. 1 system hydraulic failure, it is allowable to taxi back to the line.
(a) True.
(b) False.

296. If the ram-air turbine is the only source of electrical power, normal pitch trim is available.
(a) True.
(b) False.

297. Pitch augmentation malfunctions can occur which will not monitor the pitch augmentation system off or illuminate the PITCH AUG caution indicator.
(a) True.
(b) False.

298. The first step to take when any flight control malfunction occurs is __________. List four results of this action.
(a) __________.
(b) __________.
(c) __________.
(d) __________.

299. List two methods of obtaining alternate trim.
(a) __________.
(b) __________.

300. The lost ICS-UHF code for prepare to eject is __________.

301. If the RAMPS warning light illuminates in flight, the correct procedure is: __________.

302. The RAN shall handle all radio frequency changes below _____ feet.
(a) 500.
(b) 1000.
(c) 2000.
(d) 2500.

303. The recommended speed for flight through turbulence is: __________.

304. Below 35,000 feet, what is the recommended airspeed for flight through turbulence? _____ knots.

305. List the procedures necessary to regain communications following a total ICS failure. __________.

306. With the oblique camera altitude mode switch placed in LOW ALT: _____.
(a) Pulse operation with IMC is provided for all oblique cameras.
(b) Autocycle operation is provided for all oblique cameras.
(c) Pulse operation without IMC is provided for the forward oblique camera and autocycle operation is provided for side oblique cameras.
(d) Pulse operation with IMC is provided for the side oblique cameras and autocycle operation is provided for the forward oblique camera.

307. The factors involved in determining correct image motion compensation are: _____.
(a) Ground speed, altitude above terrain, film size, and depression angle.
(b) Ground speed, altitude above terrain, shutter speed, and depression angle.
(c) Film speed (ASA) rating, shutter speed, altitude, and ground speed.
(d) Ground speed, altitude above terrain, camera focal length, and depression angle.

308. The normally carried camera in the forward oblique station has a focal length of _____ inches.
(a) $1\frac{1}{2}$.
(b) 3.
(c) 6.
(d) 12.

309. The 6-inch vertical camera in sensor station 2 provides percent overlap in the HIGH ALT mode.
(a) 60.
(b) 20.
(c) 50.
(d) None of the preceding.

310. The 1.75-inch azimuth vertical camera provides percent overlap in either the high- or low-altitude mode. The 6-inch azimuth vertical camera provides percent overlap in the high-altitude mode and percent in the low-altitude mode.

311. List five variables that affect S/C settings.
(a) .
(b) .
(c) .
(d) .
(e) .

312. List three factors that determine correct compensation (IMC) rate.
(a) .
(b) .
(c) .

313. The full stabilized vertical cameras are stabilized to .
(a) ±10 degrees in pitch and roll.
(b) ±5 degrees in pitch and roll; ±10 degrees drift.
(c) ±3 degrees in pitch and roll.
(d) ±2 degrees in pitch and roll.

314. It is possible to carry the two 6-inch side oblique cameras and the 3-inch panoramic camera in the 4-1A module.
(a) True.
(b) False.

315. The flasher pods operate in conjunction with the 6-inch vertical cameras in sensor station 2 or 4.
(a) True.
(b) False.

316. The flasher pods operate in conjunction with the cameras installed in:
(a) Sensor station 4, module 1 only.
(b) Sensor station 4, modules 2 and 3.
(c) Sensor station 4, modules 1 and 2.
(d) Sensor station 2, and sensor station 4, module 3.

317. What are the stabilization limits of the two 6-inch cameras utilized in module 4-3 for a daylight mission?
(a) Pitch . Roll . Azimuth .

318. The necessary position of the camera POWER switch for flasher pod operation is.
(a) READY.
(b) OPERATE.
(c) Either READY or OPERATE with appropriate mode switches at HIGH ALT or LOW ALT.
(d) The camera POWER switch does not control flasher pod operation.

319. The 3-inch and 18-inch pan cameras may be operated simultaneously.
(a) True.
(b) False.

320. The 3-inch pan camera provides ______ percent overlap while the 18-inch pan provides ______ percent overlap.
(a) 50, 60.
(b) 50, 66.
(c) 60, 60.
(d) 60, 66.

321. When the oblique camera altitude mode switch is in the HIGH ALT position: ______.
(a) Pulse operation without IMC is provided.
(b) Pulse operation with IMC is provided.
(c) Autocycle (IMC) mode is provided.
(d) Any of the preceding may be selected prior to selecting the HIGH ALT position.

322. IR stabilization limits (AFC 313/AVC 996 incorporated) are:
(a) Roll ______.
(b) Pitch ______.
(c) Azimuth ______.

323. The RAN has three exposure control switches: LEFT, VERT, and RIGHT. The VERT switch controls exposure setting (±1 f-stop) of the following cameras ______.
(a) Forward oblique and verticals.
(b) 1.75-inch vertical and 6-inch vertical cameras only.
(c) All centerline mounted cameras, including the forward oblique and panoramic cameras.
(d) All centerline mounted serial frame cameras only.

324. With CAMERA caution indicator on:
(a) Check readiness indication and exposures remaining indicators for malfunctioning camera, or a camera which has no exposures remaining.
(b) Failed camera altitude mode switch — Cycle OFF (check light), then to former position.
(c) Check that only one panoramic camera altitude mode switch is in an operating position.
(d) All of the preceding.

325. The RAN'S camera POWER switch must be in the READY or OPERATE position for the pilot's controls to be operative.
(a) True.
(b) False.

326. The RAN may give or take command of the oblique cameras by depressing the CAMERA COMMAND button.
(a) True.
(b) False.

327. Viewfinder limits of view are:
(a) From 5 degrees below horizontal to 10 degrees aft of vertical.
(b) From 10 degrees below horizontal to 5 degrees aft of vertical.
(c) From horizontal to 85 degrees below horizontal.
(d) From 10 degrees below horizontal to 10 degrees aft of vertical.

328. The V/H (velocity/height) control knob enables the RAN to:
(a) Adjust brightness of traveling grid.
(b) Correct traveling grid speed with the viewfinder POWER switch in MAN.
(c) Correct traveling grid speed with the viewfinder POWER switch in AUTO.
(d) Both (b) and (c).

329. By observing the color of the desiccant through the viewfinder humidity indicator, the internal moisture content can be determined. Select the correct statement.
    (a) Blue desiccant indicates excessive moisture present.
    (b) Pink desiccant indicates excessive moisture present.
    (c) The viewfinder unit is equipped with a single desiccant (dehumidifier) cartridge.
    (d) Pink desiccant indicates a dry condition.

330. With the viewfinder POWER switch in the OFF position:
    (a) No control of the cameras is available.
    (b) Control of camera systems is available, but is erroneous.
    (c) Monitor of control signals is available; however, no control of camera systems is available.
    (d) V_g/H signals continue to control the systems.

331. What color should the viewfinder dehydrant be for normal indication?

332. Why should the oblique camera altitude mode switch be in the HIGH ALT position for air-to-air photography? When would you operate the azimuth vertical or stabilized cameras in the HIGH ALT position? Why?

333. The viewfinder POWER switch should be placed in the position to change from automatic to manual V/H.

334. Corrections made with the viewfinder DRIFT knob:
    (a) Automatically reposition cameras with the viewfinder POWER switch in AUTO.
    (b) Automatically reposition cameras with the viewfinder POWER switch in MAN.
    (c) Do not automatically reposition cameras.
    (d) Both (a) and (b).

335. What is the approximate range of the viewfinder at 20,000 feet?
    (a) 10 nautical miles.
    (b) 19 nautical miles.
    (c) 15 nautical miles.
    (d) 20 nautical miles.

336. The field of view of the viewfinder is degrees.
    (a) 41.
    (b) 85.
    (c) 90.
    (d) 104.

337. The fixed field display of the viewfinder
    (a) Is an adjustable wide angle view.
    (b) Gives coverage boundaries for the vertical cameras.
    (c) Gives coverage boundaries for the forward oblique cameras.
    (d) Gives coverage boundaries for both forward oblique and vertical cameras.

338. While flying at 3500 feet and 550 knots, how many turns would be required on the V/H knob in MANUAL viewfinder to provide 60 percent overlap on the azimuth vertical camera (1¾-inch)?

339. The IR system may be operated between and 50,000 feet.

340. The IR system (AN/AAS-21) POWER switch in the READY position will cause the system to be operational (after cool down) except for:
    (a) Doors open.
    (b) Film drive.
    (c) Both (a) and (b).
    (d) Neither (a) or (b).

341. The IR film magazine contains ______ feet of film fully loaded, or approximately ______ miles of coverage at 1000 feet.

342. The IR receiver unit is stabilized in pitch and roll.
(a) True.
(b) False.

343. When would illumination of the IR TEST light be considered normal if the RAN did not have the switch in the TEST position? ______

344. The cooling period for the IR detector array is approximately ______ minutes.

345. During a PECM mission the RECORDER switch is inadvertently placed in FAST FWD, what steps should be taken?
(a) System POWER OFF.
(b) Ensure RECORDER switch in NORM.
(c) System POWER to READY for 15 minutes, then select OPERATE as desired.
(d) All of the preceding.

346. Maximum continuous record time for the PECM is approximately ______ minutes.

347. List five steps to be taken to achieve maximum radiation silence during flight.
(a) ______.
(b) ______.
(c) ______.
(d) ______.
(e) ______.

348. To retain qualifications, RA-5C crew members shall be evaluated once during the ______ months following initial or subsequent evaluations.

349. What is the distance required to clear a 50-foot obstacle under the following conditions? Gross weight, 66,500 pounds; runway temperature 35°C; field elevation, 4000 feet; J79-GE-8 engines ______; J79-GE-10 engines ______.

350. Assuming a take-off gross weight of 64,000 pounds, no external loads, MAX AB, flaps/droops 30°/25°, runway temperature, 104°F at sea level, no wind, 8000 feet runway, no antiskid, and a dry runway; determine:
(a) Take-off distance.
(b) Take-off speed.
(c) 2000-foot line speed.
(d) Refusal speed.
(e) Refusal distance.
(f) MSBI.

351. The maximum range airspeed for a 56,000-pound recon configured aircraft on a Standard Day at 5000 feet is ______. At this speed and altitude you would expect to get ______ miles per 1000 pounds of fuel.

352. Two-engine BINGO at 1000 nautical miles to go requires ______ pounds of fuel?

353. List the following for a 110-mile BINGO with gear and flaps up:
(a) Fuel required (sea level).
(b) Airspeed (sea level).
(c) Optimum altitude.
(d) Fuel required (optimum altitude).
(e) IMN (optimum altitude).
(f) Fuel required (sea level gear down).

354. Starting at 0.85 Mach Number, at 35,000 feet, 60,000 pounds with J79-GE-8 engines on a 10°F Hot Day, determine time, distance, and fuel to accelerate in level flight to 1.5 IMN (recon configured). ______

355. At 600 KIAS with a 60-degree angle of bank, the turning radius is ______ feet.

356. In order to provide adequate directional control for single-engine operation, the flaps should not be raised to CRUISE after take-off until the AOA is ______ units. This is approximately ______ knots for a 64,000-pound aircraft.

357. What is the minimum speed for use of the 3-inch panoramic camera at 4000 feet? ______

358. What is the field of view for:
(a) All the 6-inch cameras utilized.
(b) The 1¾-inch camera.
(c) The flasher pod.
(d) The viewfinder.

359. The distance from nadir to the inside of the format at an altitude of 3000 feet using a 6-inch serial frame camera with 19.75 degrees depression angle is ______ feet.

360. What is the ground coverage of a 6-inch camera at 4700 feet? ______

361. With 1250 feet of film in the 3-inch panoramic camera at 4000 feet, what distance do you have the capability of covering? ______

362. The two-pod flasher "maximum altitude" envelope is limited to ______ feet with Tri-X (8403) film installed.
(a) 3550.
(b) 2350.
(c) 1675.
(d) 1850.

363. Maximum film load for the 3-inch panoramic camera is:
(a) 3000 feet of 70 mm film.
(b) 2500 feet of 5-inch film.
(c) 3000 feet of 5-inch film.
(d) 2500 feet of 70 mm film.

364. Describe procedures/steps to be followed in a MODE I ACLS approach ______.

365. At 3500 feet of altitude, the coverage from centerline to the outside limit of the IR film is ______ feet.

366. The MASTER WARNING indicator is energized by the following warning indicators: ______

367. When operating the RA-5C with one generator failed, you lose seven items which receive power from the monitored bus. List three of these items. ______

368. With a complete d-c converter failure, the refueling probe will operate if the RAT is extended.
(a) True.
(b) False.

369. The acceleration limits for a clean recon configured aircraft in symmetrical flight at a gross weight of 58,000 pounds is ______/______ "g's." This limit decreases to ______/______ "g" during rolling flight.

370. Bombing computer power:
(a) Is supplied by the monitor bus.
(b) Is turned on by the bottom power switch on the alinement control panel.
(c) Is not required for the NAV steering signal.
(d) Comes through the RADAR/TV POWER switch.

371. The acceleration limits with or without external stores at a gross weight of 50,000 pounds are ______ and ______.

372. The azimuth-stabilized vertical camera in sensor station 2 is stabilized to:
(a) ±5 degrees of flight path.
(b) ±10 degrees of flight path.
(c) ±41 degrees of flight path.
(d) None of the preceding.

373. If zeroing of the KY-28 at a remote site becomes necessary, it can be done by ______.

374. SLR roll stabilization limits are ______.

375. In manual range 2 at 500 feet and 500 knots, the optimum recommended ANT TRIM knob position is:
(a) 1/4 down.
(b) MID.
(c) 1/4 to 1/2 up.
(d) 1/2 to 3/4 down.

376. What inputs from manual viewfinder affect the SLR? ______.

377. SLR operating range is dependent upon: ______.
(a) MODE switch selection.
(b) ALTITUDE.
(c) RANGE knob setting.
(d) ALTITUDE and RANGE knob setting.

378. With the SLR RANGE knob in AUTO, switchover to range 3 occurs at ______ climbing, at ______ descending.

379. The ON position of the SLR POWER switch opens the SLR hydraulic shutoff valve, providing No. 2 hydraulic system pressure to the antenna trim servo valves.
(a) True.
(b) False.

380. There are ______ EXTENDED ranges of the AN/APD-7 SLR.
(a) Two.
(b) Three.
(c) Four.
(d) Five.

381. The monitor scope BRIGHTNESS knob can be used to increase the intensity of targets on the recorded ground map.
(a) True.
(b) False.

382. With a malfunctioning radar altimeter, the altitude input to the SLR will be erroneous. What, if anything, can the RAN do to provide the correct signal? ______.

383. At an altitude of 32,000 feet, range 1 is manually selected on the SLR and a descent to 5000 feet is initiated. What range is the SLR operating when range 1 is selected? At what altitude will the system switch to the 0- to 3-nautical-mile range? ______.

384. Given a 6-inch azimuth vertical camera with a resolution of 35 lines per millimeter and an aircraft at 10,000 feet and 400 knots, find the following:
(a) 4 1/2-inch negative ground coverage in feet. ______.
(b) Ground gain forward at 60 percent overlap. ______.
(c) Exposure interval at 60 percent overlap. ______.
(d) Distance between flight lines at 50 percent sidelap. ______.
(e) Minimum spot size resolution. ______.

385. Using a 6-inch camera and assuming 35 lines per millimeter, what altitude should you fly to be able to resolve a spot size of 0.2 foot? ______

386. What occurs when the ACL RDY is displayed on the ACLS discrete readout indicator? ______

387. On film processed from the RA-5C, fiducial marks indicate the direction of flight and the principal point of the frame.
(a) True.
(b) False.

388. Airborne an alternating red and green light signaled from the control tower means:
(a) Return to the field for landing.
(b) Give way to other aircraft.
(c) Use extreme caution.
(d) Return to starting point on the field.

389. The MK 79 pencil flare should be loaded:
(a) In the unlocked position.
(b) In the cocked position.
(c) Before each flight for quick access.
(d) Is not authorized.

PART 2 — NATOPS EVALUATION REPORT

NATOPS EVALUATION REPORT

OPNAV FORM 3510-8 (8-65) 0107-723-0000

NAME *(Last, first initial)*	GRADE	SERVICE NUMBER
SQUADRON/UNIT	AIRCRAFT MODEL	CREW POSITION
TOTAL PILOT/FLIGHT HOURS	TOTAL HOURS IN MODEL	DATE OF LAST EVALUATION

NATOPS EVALUATION

REQUIREMENT	DATE COMPLETED	GRADE		
		Q	CQ	U
OPEN BOOK EXAMINATION				
CLOSED BOOK EXAMINATION				
ORAL EXAMINATION				
*EVALUATION FLIGHT				

FLIGHT DURATION	AIRCRAFT BUNO	OVERALL FINAL GRADE

REMARKS OF 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, OPT, COT, or cockpit check in accordance with OPNAVINST 3510.9 (effective edition)*

PILOT GRADING FORM

(PHASES I AND II)

ITEM	DATE	GRADE
CLOSED BOOK		
OPEN BOOK		
WST/CPT		
ORAL EXAMINATION		

FLIGHT (PHASE III)

AREA	SUBAREA/ITEM								AREA GRADE		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	Q	CQ	U
MISSION PLANNING											
PREFLIGHT											
EMERGENCIES											
TACTICS											
POSTFLIGHT AND DEBRIEFING											

PART 3 — PILOT NATOPS EVALUATION WORKSHEETS

Pilot's Oral Examination Worksheet

PHASE I

Pilot_______________

Squadron_______________ Date_______________

Evaluator/Instructor_______________

Part I EXTERIOR INSPECTION

Q—95% or better; CQ—90% to 95%; U—less than 90%
Failure to properly check any one essential item—U.

Part I Grade_______________

Part II AIRCRAFT SERVICING

Mark the questions Q or U as indicated by the level of knowledge observed. The grade for each system should indicate whether or not the pilot observed can satisfactorily supervise the servicing of the aircraft in that system.

SYSTEM	MATERIAL REQ'D	EQUP'T REQ'D	SERV. TECHNIQUE	GRADE
FUEL				
HYDRAULIC				
ENGINE OIL				
PNEUMATIC				
LIQUID OXYGEN				

A grade of Q is required in each system or the grade for part II will be U.

Part II Grade_______________

Part I Part II FINAL GRADE

page 1

STANDARDIZATION/EVALUATION WORKSHEET
WST/CPT CHECK — PILOT

SQUADRON____________________ DATE____________________

NAME	RANK	SSN

EVALUATOR/INSTRUCTOR

____

DESCRIPTION OF FLIGHT

MISSION PLANNING

	YES	NO	COMMENTS
(1) Route Planning			
1. Were necessary charts and pubs drawn?			
2. Adequate time allowed for planning?			
3. Suitable in-flight card prepared?			
4. Alternate fields?			
5. NOTAMS, etc, checked?			
6. Predicted winds used?			
7. Alternate plans?			
Comments:			
(2) Fuel Planning			
1. Fuel checks planned?			
2. Source for fuel planning was:			
3. Hot Day fuel plan made if required?			
4. Cruising speeds computed as IMN or KIAS?			
Comments:			
(3) Flight Plan			
1. Complete Wx briefing obtained?			
2. DD-175 completed without error?			
Comments:			

(4) Take-off Computations

T. O. Alt________ GWT/CG________. Runway Temp.________, Wind________.

Pilot Comp　　Evaluator Comp

T. O. Roll

T. O. Airspeed

*PREFLIGHT

		YES	NO	COMMENTS
*I	Aircraft Acceptance			
	1. How many prior yellow sheets checked?	___	___	___________
	2. Plane Captain's preflight completed and yellow sheet signed off?	___	___	___________
	*3. Plane accepted with unexplained critical gripes?	___	___	___________
	Comments:			

		YES	NO	COMMENTS
II	Preflight Inspection			
	1. External inspection complete all items?	___	___	___________
	2. Pilots flight gear adequate?	___	___	___________
	3. Pilots personal equipment current?	___	___	___________
	Comments:			

III Prestart
Items missed on checklist:

ITEM NO.	ITEM	RESPONSE

page 2

START/GROUND CHECKS

		U	CQ	Q
I	Emergencies/Malfunctions			
	1.			
	2.			
	3.			
	4.			

Comments:

II Items missed on Ground Checks

ITEM NO.	ITEM	RESPONSE

III Flight Control Check

PRE-TAXI/TAKE-OFF

I Items missed on Pretake-off Check

ITEM NO.	ITEM	RESPONSE

II Full Power Check

III Take-off Time

page 3

		U	CQ	Q
IV	Emergencies/Malfunctions			
	1.________________________	__	__	__
	2.________________________	__	__	__
	3.________________________	__	__	__
	4.________________________	__	__	__

Comments:

DEPARTURE

		U	CQ	Q
I	Followed Departure Clearance			
II	Voice Reports	__	__	__
	Gear Up:______KIAS______Rate of Climb	__	__	__
	Flaps Up:______KIAS______Altitude			
III	Climb Schedule	__	__	__
IV	Posttake-off Items Missed	__	__	__
	1.________________________	__	__	__
	2.________________________	__	__	__
	3.________________________	__	__	__
	4.________________________	__	__	__
V	Emergencies/Malfunctions			
	1.________________________	__	__	__
	2.________________________	__	__	__
	3.________________________	__	__	__
	4.________________________	__	__	__
	5.________________________	__	__	__

Comments:

page 4

LEVEL-OFF/CRUISE

		U	CQ	Q
I	Voice Reports	___	___	___
II	Followed Clearance	___	___	___
III	Aircraft Control	___	___	___
IV	Knowledge of FAA Procedures	___	___	___
V	Emergencies/Malfunctions			
	1.________	___	___	___
	2.________	___	___	___
	3.________	___	___	___
	4.________	___	___	___
	5.________	___	___	___
	6.________	___	___	___
	7.________	___	___	___
	8.________	___	___	___
	9.________	___	___	___
	10.________	___	___	___

Comments:

LOW-LEVEL CRUISE/LOW-LEVEL PHOTO

		U	CQ	Q
I	Followed NAV Steering	___	___	___
II	Airspeed Control	___	___	___
III	Altitude Control	___	___	___
IV	Camera Control	___	___	___

Comments:

RECONNAISSANCE

		U	CQ	Q
I	Photo coverage:			
	On preplanned track?	___	___	___
	On preplanned altitude?	___	___	___
II	SLR:			
	On preplanned track?	___	___	___
	On preplanned altitude?	___	___	___

Comments:

page 5

		U	CQ	Q
III	Emergencies/Malfunctions			
	1. ______	___	___	___
	2. ______	___	___	___
	3. ______	___	___	___
	4. ______	___	___	___

Comments:

HOLDING/PENETRATION/APPROACH

		U	CQ	Q
I	Holding Pattern Entry	___	___	___
	Holding Pattern	___	___	___
	Holding Airspeed	___	___	___
	Holding Altitude	___	___	___
	Number of Circuits Made	___	___	___
II	Penetration Procedures	___	___	___
	Penetration Airspeed	___	___	___
	Penetration Rate of Descent	___	___	___
	Transition to Level-off	___	___	___
III	Transition to P/A	___	___	___
	Final Approach Airspeed	___	___	___
	Final Approach MIN ALT	___	___	___
	Recognized Missed Approach + ______ − ______			
IV	Voice Procedures	___	___	___
V	Emergencies/Malfunctions			
	1. ______	___	___	___
	2. ______	___	___	___
	3. ______	___	___	___
	4. ______	___	___	___
	5. ______	___	___	___
	6. ______	___	___	___

Comments:

page 6

*EMERGENCIES

Actual emergencies occurring in flight should be written up as well as possible under the circumstances.

Type Emergency:

Pilot Reaction:

*TACTICS

page 7

POSTFLIGHT AND DEBRIEFING

	YES	NO	COMMENTS
(1) Postflight			
1. Aircraft parked and shut down IAW SOP?	____	____	________
2. Did pilot perform postlanding aircraft inspection?	____	____	________

Comments:

	YES	NO	COMMENTS
(2) Debriefing			
1. Yellow sheet entries proper?	____	____	________
2. Discrepancies written up clearly and concisely?	____	____	________
3. Debriefing forms filled out as applicable?	____	____	________
4. Crew debriefed as required?	____	____	________

Comments:

page 8

GRADING

NORMAL PROCEDURES	U	CQ	Q
TOTAL GRADED	___	___	___
NORMAL PROCEDURES GRADE______________			
EMERGENCIES/MALFUNCTIONS			
TOTAL GRADED	___	___	___
EMERGENCY PROCEDURES GRADE__________			
PHASE II GRADE____________________________			

NATOPS EVALUATOR/INSTRUCTOR

PART 4 – RAN NATOPS EVALUATION WORKSHEETS

sheet 1

NATOPS EVALUATION WORKSHEETS (RAN)

Squadron__________ Date__________ BuNo__________

Name__________ Rank__________ SSN__________

Evaluator/Instructor__________

EVALUATION DESCRIPTION AND GENERAL COMMENTS

---

*MISSION PLANNING

*(1) Charts

1. Annotation:__________
2. Detail information:__________

*(2) NAV/RECON Log

1. DEST __________
2. COORD __________
3. MH __________
4. DIST __________
5. ETE __________
6. ETA __________
7. LEG FUEL __________
8. EFR __________
9. RECON DATA IN NOTES __________

RAN EVAL

sheet 2

(3) Forms

1. DD-175 or appropriate flight plan:

   Discrepancies noted:

2. NAV RECON Log:

3. Other:

(4) Checklists

1. NATOPS Pocket Checklist:

(5) Target Study

1. Predictions:

2. Offset:

3. Best target approach:

4. Altitude:

5. Spot size:

6. Scale:

7. Exposure interval:

8. Exposure required:

9. V_R/H:

sheet 3

RAN EVAL

(6) Navigation Bag Contents

Discrepancies noted:

(7) Personal Flying Equipment

Discrepancies noted:

Evaluator's Comments:

PREFLIGHT INSPECTION

(1) NATOPS Pocket Checklist

Omissions or errors:

*TAXI AND PRETAKE-OFF

*(1) NATOPS Pocket Checklist

Omissions or errors:

RAN EVAL

sheet 4

*OPERATING TECHNIQUES

*(1) Navigation

YES/NO

1. Made full use of AN/ASB-12 system navigational capability. ______

2. Utilized radio navigational aids. ______

3. Utilized pilotage and DR techniques. ______

Evaluator's Comments:

(2) General-Purpose Radar

1. Used radar to maintain the aircraft on the intended track. ______

2. Proper checkpoint identification. ______

3. Used the radar properly to update present position. ______

4. Used the various operating modes of the radar to the best advantage during the flight. ______

Evaluator's Comments:

RAN EVAL sheet 5

(3) VERDAN YES/NO

1. Understood the function and use of the VERDAN. ______

2. Used the VERDAN to maximum advantage. ______

Evaluator's Comments:

(4) Inertial Platform

1. Platform was properly alined (if applicable). ______

2. Platform was properly operated throughout the flight. ______

Evaluator's Comments:

RAN EVAL sheet 6

(5) Reconnaissance Systems (if graded from training device procedures check or flight data evaluation) — YES/NO

1. Proper procedures used for type of reconnaissance planned.
2. Displayed good coordination in the use of reconnaissance systems.
3. Used radar properly to update present position.
4. Assisted pilot in maintaining planned tracks and altitudes.
5. Correct coverage was obtained.
6. Used the various operating modes of systems to the best advantage during the flight.

Evaluator's Comments:

IN-FLIGHT MALFUNCTIONS

(1) Radar — YES/NO

1. Quickly recognized the malfunction.
2. Took appropriate corrective action.

Evaluator's Comments:

RAN EVAL sheet 7

(2) VERDAN YES/NO

1. Quickly recognized the malfunction. ______

2. Took appropriate corrective action. ______

Evaluator's Comments:

(3) Inertial Platform

1. Quickly recognized the failure. ______

2. Took appropriate corrective action. ______

Evaluator's Comments:

(4) Inertial Computer

1. Quickly recognized the failure. ______

2. Took appropriate corrective action. ______

Evaluator's Comments:

(5) Reconnaissance Systems (if graded from training device procedures check or flight data evaluation)

1. Quickly recognized the failure. ______

2. Took appropriate corrective action. ______

Evaluator's Comments:

RAN EVAL sheet 7

(2) VERDAN YES/NO

1. Quickly recognized the malfunction. ______

2. Took appropriate corrective action. ______

Evaluator's Comments:

(3) Inertial Platform

1. Quickly recognized the failure. ______

2. Took appropriate corrective action. ______

Evaluator's Comments:

(4) Inertial Computer

1. Quickly recognized the failure. ______

2. Took appropriate corrective action. ______

Evaluator's Comments:

(5) Reconnaissance Systems (if graded from training device procedures check or flight data evaluation)

1. Quickly recognized the failure. ______

2. Took appropriate corrective action. ______

Evaluator's Comments:

RAN EVAL sheet 8

*AIRMANSHIP

*(1) Crew Coordination

1. Coordination:

2. Demands anticipated:

3. Overall performance:

(2) Radio Procedures

1. ATC clearance copied and correctly repeated:

2. Appropriate frequencies monitored:

3. Position reports proper:

4. Familiarity with equipment:

(3) Navigational Charts and Publications

1. Familiarity:

2. Navigational assistance rendered:

Evaluator's Comments:

*PRELANDING, TAXI, AND SHUTDOWN

*(1) NATOPS Pocket Checklist

Omissions or errors:

Evaluator's Comments:

RAN EVAL

sheet 9

DEBRIEFING

(1) Equipment

1. Adequate write-up of discrepancies:

2. Errors or omissions on debrief sheets:

(2) Mission

1. Debrief forms properly filled out:

2. Flight reconstructed accurately:

3. General conduct of debriefing:

Evaluator's Comments:

SECTION XI — PERFORMANCE DATA

TABLE OF CONTENTS

PART 1 — STANDARD DATA

INTRODUCTION

Performance data is separated into parts corresponding to the phases of flight planning. In each part, charts are grouped in order of engine application: J79-GE-8, J79-GE-8/-10, J79-GE-10. Descriptions of each type of chart and sample problems are included to illustrate their correct use except where simplicity of the chart makes the usage obvious.

ENGINE PERFORMANCE

Performance data for aircraft 156608 through 156643 and aircraft 145157 through 151728 having AFC 328 complied with indicates that aircraft performance with J79-GE-10 engines at Maximum Thrust is generally improved, particularly during supersonic acceleration. Military Thrust take-off, climb, and wave-off performance with J79-GE-10 engines is estimated to exceed J79-GE-8 engines performance by 10 to 15 percent. Cruise performance differs less than 5 percent from the charts presently included in this section.

Note

Test data indicate that each fully rated J79-GE-8 engine (when installed in the aircraft) develops 8400 pounds of thrust at Military Thrust and 13,900 pounds at the Maximum Thrust level for take-off on a standard temperature and pressure day at sea level with 30-degree flaps/25-degree droops extended. The sea level static thrust rating of each engine (uninstalled) is 10,900 pounds at 100% rpm (Military Thrust) and 17,900 pounds at Maximum Thrust.

Aircraft 145157 through 151728 having AFC 328 complied with are configured for and normally have J79-GE-10 engines installed; however, the capability for substitution of J79-GE-8 engines does exist in these aircraft which require certain performance data adjustments. These adjustments are noted on the applicable J79-GE-10 performance charts. On some charts, as Take-off, Climb, Acceleration, Supersonic and Single-engine Performance, the adjustment consists of reference to the applicable J79-GE-8 chart. Performance charts labeled J79-GE-8/-10 require no adjustment for this configuration. Charts that are labeled J79-GE-8 contain performance data only for those aircraft 145157 through 151728 not having AFC 328 complied with.

STANDARD CHARTS

All standard charts in this section are based on ICAO Standard Day conditions. Any air temperature or density deviations from Standard Day conditions will have an effect on the overall mission radius or range. Fuel and time requirements for climb or acceleration are increased under above-standard temperature conditions, especially at supersonic speeds. Below-standard temperature conditions decrease fuel and time required. Cruise performance is not affected by temperature as long as the prescribed Mach number and altitude are maintained; however, for very heavy gross weights at above-standard temperatures, the aircraft may not be able to reach the level-off altitude given as optimum for Standard Day. Engine speeds above 94% rpm should be avoided for cruise by decreasing altitude and/or speed, since nozzle schedules above this rpm are not optimum for cruise conditions. The charts included in this part of this section permit the crewmen to make the necessary corrections to indicated airspeeds and altitudes to convert them to true values. To determine true airspeed (TAS) from indicated airspeed (IAS), the following steps can be taken:

IAS corrected for position error = Calibrated Airspeed (CAS)

CAS corrected for compressibility effect = Equivalent Airspeed (EAS).

EAS corrected for atmospheric density = TAS.

The charts used for making these corrections are described in the following paragraphs.

AIRSPEED/MACH NUMBER CURVES

Airspeed/Mach number relationship with altitude is presented in the Airspeed/Mach Number Curves chart (figure 11-1). The chart is used to obtain true Mach number by entering the chart with calibrated airspeed and true pressure altitude. Calibrated airspeed may be obtained by entering the chart with true Mach number and true pressure altitude. Superimposed on the chart are true airspeed lines applicable to Standard Day conditions. To determine true airspeed, enter the chart at the determined calibrated airspeed. Move vertically to the desired true pressure altitude line. (CAS and true pressure altitude can be determined from the Position Error Correction chart, figures 11-6 and 11-7). Read right and down, parallel to the guide lines, to obtain true airspeed for a Standard Day atmosphere (sea level curve). An example problem is included on the chart to illustrate its use.

STANDARD ATMOSPHERE TABLE

The Standard Atmosphere Table (figure 11-2) exhibits Standard Day conditions for density ratio, $\frac{1}{\sqrt{\sigma}}$, temperature, speed of sound ratio, and pressure. The symbol σ represents the ratio of the density at any given altitude to the density at sea level. To find the value of any item on a Standard Day, read the figure directly to the right of the altitude under the column containing the value desired.

DENSITY ALTITUDE CHART

The Density Altitude Chart (figure 11-3) can be used to convert equivalent airspeed to true airspeed, and exhibits $\frac{1}{\sqrt{\sigma}}$ and density altitude when the pressure altitude and ambient temperature are known. The chart is used to obtain density altitude and $\frac{1}{\sqrt{\sigma}}$ under other than Standard Day conditions. To use the chart, enter at the known temperature and move vertically to the known pressure altitude. Reading of density altitude is directly to the left of the point and $\frac{1}{\sqrt{\sigma}}$ is directly to the right of the point. Multiplying a given EAS by the factor $\frac{1}{\sqrt{\sigma}}$ gives TAS.

RANGE FACTOR CHART

The Range Factor chart (figure 11-4) has been prepared to account for wind from any direction, relative to aircraft course. On a course of 270 degrees true, a wind from 300 to 240 degrees true has the same effect on aircraft range. The relative angle between the course of the aircraft and the wind direction in each of the preceding cases is 30 degrees. The performance data has been calculated for a no-wind condition. Thus, in planning a mission, wind has to be considered for range, fuel, and time. Enter the Range Factor chart at the proper relative wind angle. Read across from the TAS and read down from the wind velocity to obtain a range factor. The no-wind range is multipled by this range factor, which may increase or decrease range according to whether the component is a head wind or tail wind. The resulting figure is the distance or range you may fly with wind considered. The Range Factor chart has been calculated for 50-knot increments of TAS and 40-knot increments of wind velocity. For airspeeds or wind velocities between the figures given, interpolate to get the proper range factor.

AMBIENT AIR TEMPERATURE DETERMINATION

The ambient air temperature during flight and the variation of the ambient air temperature from Standard Day conditions can be determined by entering the charts of figure 11-5 with the inlet air temperature and Mach indicator readings. Data are provided both for low altitudes (sea level to 30,000 feet) and for altitudes of 36,000 feet and above. The estimated accuracy of the air inlet system indicated total temperature is ±4.5°C, which is equivalent to an accuracy of approximately ±3.5° to ±4°C ambient air temperature.

Note

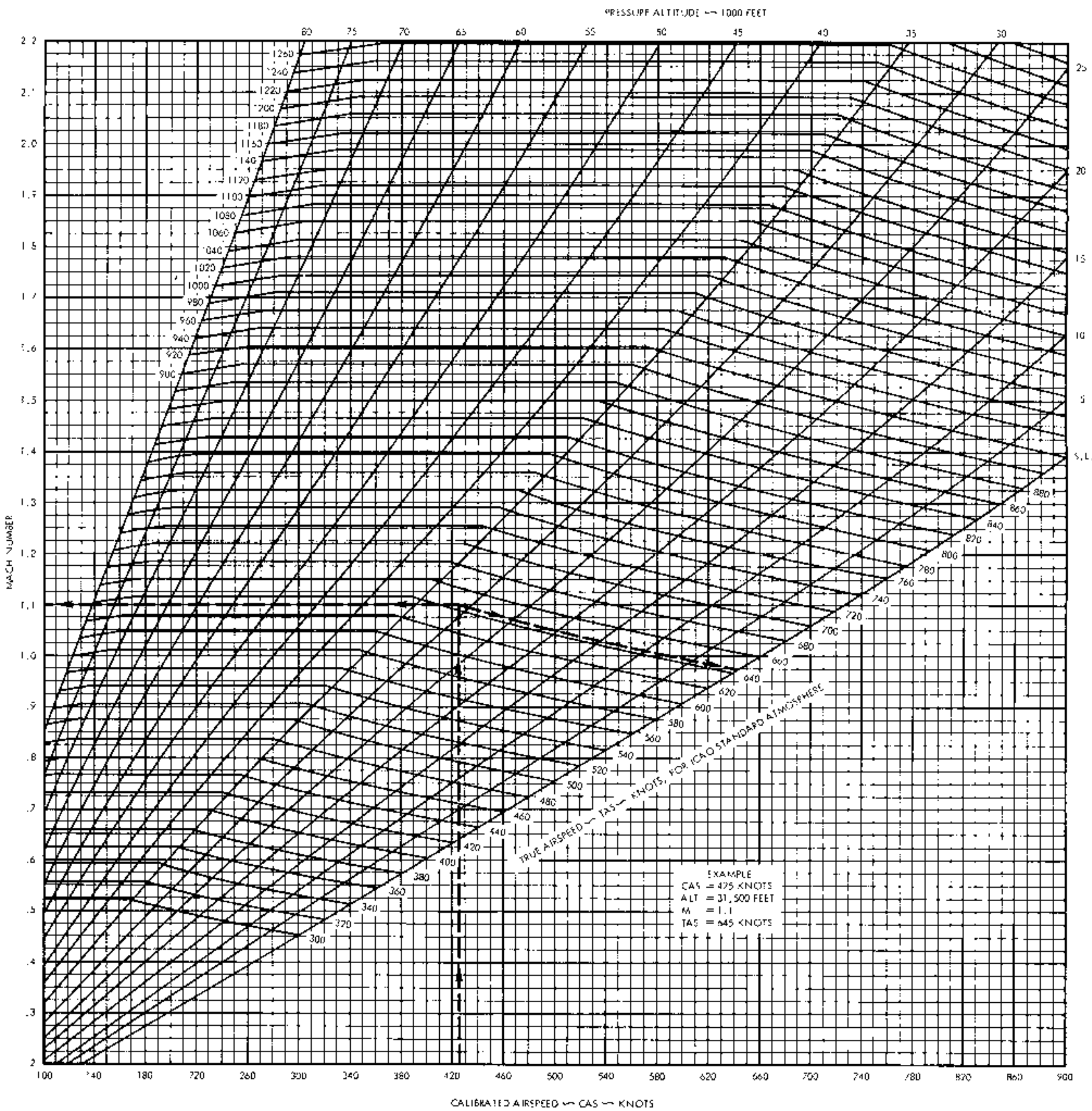
The following temperature conditions at sea level are defined for reference

- Intermediate Hot .... 81°F
- Tropical Day .... 90°F
- Hot Day 104°F

POSITION ERROR CORRECTION CHART

For precision mission planning, indicated airspeed (IAS), altitude, and Mach number must be corrected to calibrated airspeed (CAS), true pressure altitude, and true Mach number. A position error in the static pressure source exists below 1.05 Mach with the production nose boom. The position error corrections are given in the airspeed and altitude Position Error Correction charts for aircraft having the compensated pitot-static tube (figure 11-6) and aircraft having the uncompensated pitot-static tube (figure 11-7). Calibrated airspeed is obtained by applying any known instrument error to the observed airspeed reading, then adding the position error correction (ΔV) from the chart to the indicated airspeed. True pressure altitude and true Mach number may be determined in a similar manner by calling the ΔH and ΔM corrections from the chart to the indicated altitude and Mach number.

AIRSPEED—MACH NUMBER CURVES



DATA AS OF: 8-6-56

A3J-1-1-93-5A

Figure 11-1

STANDARD ATMOSPHERE TABLE

STANDARD SEA LEVEL CONDITIONS:
TEMPERATURE 15°C (59°F)
PRESSURE 29.921 IN. Hg (ρ)
DENSITY .002377 SLUGS/CU FT (ρ_0)
SPEED OF SOUND 1117 FT/SEC (661.7 KNOTS) (A_0)

CONVERSION FACTORS:
1 IN. Hg = 70.732 LB/SQ FT
1 IN. Hg = 0.4912 LB/SQ IN.
σ = DENSITY RATIO

ALTITUDE FEET	DENSITY RATIO ρ/ρ_0	$\frac{1}{\sqrt{\sigma}}$	TEMPERATURE DEG C	TEMPERATURE DEG F	SPEED OF SOUND RATIO A/A_0	SPEED OF SOUND KNOTS	PRESSURE IN. OF Hg	PRESSURE 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	.8963
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	.8321
6000	.8359	1.094	3.1	37.6	.979	648.7	23.98	.8014
7000	.8107	1.111	1.1	34.1	.976	645.6	23.09	.7717
8000	.7860	1.128	-0.8	30.5	.972	643.3	22.23	.7429
9000	.7620	1.146	-2.8	26.9	.969	640.9	21.39	.7149
10000	.7385	1.164	-4.8	23.4	.965	638.6	20.58	.6878
11000	.7156	1.182	-6.8	19.8	.961	636.2	19.80	.6616
12000	.6933	1.201	-8.8	16.3	.958	633.9	19.04	.6362
13000	.6715	1.220	-10.8	12.7	.954	631.5	18.30	.6115
14000	.6502	1.240	-12.7	9.1	.951	629.0	17.58	.5877
15000	.6294	1.260	-14.7	5.6	.947	626.6	16.89	.5646
16000	.6092	1.281	-16.7	2.0	.943	624.2	16.23	.5423
17000	.5894	1.303	-18.6	-1.5	.940	621.8	15.58	.5206
18000	.5702	1.324	-20.6	-5.1	.936	619.4	14.95	.4997
19000	.5514	1.347	-22.6	-8.7	.933	617.0	14.35	.4795
20000	.5331	1.370	-24.6	-12.2	.929	614.6	13.76	.4599
21000	.5153	1.393	-26.6	-15.8	.925	612.1	13.20	.4410
22000	.4980	1.417	-28.5	-19.3	.921	609.6	12.65	.4228
23000	.4811	1.442	-30.5	-22.9	.918	607.1	12.12	.4051
24000	.4646	1.467	-32.5	-26.5	.914	604.6	11.61	.3881
25000	.4486	1.493	-34.5	-30.0	.910	602.1	11.12	.3716
26000	.4330	1.520	-36.5	-33.6	.906	599.6	10.64	.3557
27000	.4178	1.547	-38.4	-37.1	.903	597.1	10.18	.3404
28000	.4031	1.575	-40.4	-40.7	.899	594.6	9.742	.3256
29000	.3887	1.604	-42.4	-44.3	.895	592.1	9.315	.3113
30000	.3747	1.634	-44.4	-47.8	.891	589.5	8.904	.2976
31000	.3612	1.664	-46.4	-51.4	.887	586.9	8.507	.2843
32000	.3480	1.695	-48.3	-54.9	.883	584.4	8.125	.2715
33000	.3351	1.727	-50.3	-58.5	.879	581.8	7.757	.2592
34000	.3227	1.760	-52.4	-62.1	.876	579.2	7.402	.2474
35000	.3106	1.794	-54.3	-65.6	.872	576.6	7.061	.2360
36000	.2989	1.829	-56.2	-69.2	.868	574.0	6.733	.2250
37000	.2853	1.872	-56.5	-69.7	.867	573.7	6.418	.2145
38000	.2719	1.918	-56.5	-69.7	.867	573.7	6.118	.2045
39000	.2592	1.964	-56.5	-69.7	.867	573.7	5.832	.1949
40000	.2471	2.012	-56.5	-69.7	.867	573.7	5.559	.1858
41000	.2356	2.019	-56.5	-69.7	.867	573.7	5.299	.1771
42000	.2245	2.110	-56.5	-69.7	.867	573.7	5.051	.1681
43000	.2140	2.161	-56.5	-69.7	.867	573.7	4.815	.1609
44000	.2040	2.214	-56.5	-69.7	.867	573.7	4.590	.1534
45000	.1945	2.267	-56.5	-69.7	.867	573.7	4.376	.1462
46000	.1854	2.322	-56.5	-69.7	.867	573.7	4.171	.1394
47000	.1768	2.379	-56.5	-69.7	.867	573.7	3.976	.1329
48000	.1685	2.436	-56.5	-69.7	.867	573.7	3.791	.1267
49000	.1606	2.495	-56.5	-69.7	.867	573.7	3.614	.1208
50000	.1531	2.556	-56.5	-69.7	.867	573.7	3.445	.1151
51000	.1460	2.617	-56.5	-69.7	.867	573.7	3.284	.1098
52000	.1392	2.681	-56.5	-69.7	.867	573.7	3.131	.1046
53000	.1327	2.746	-56.5	-69.7	.867	573.7	2.984	.0997
54000	.1265	2.612	-56.5	-69.7	.867	573.7	2.845	.0951
55000	.1206	2.880	-56.5	-69.7	.867	573.7	2.712	.0906
56000	.1149	2.950	-56.5	-69.7	.867	573.7	2.586	.0864
57000	.1096	3.021	-56.5	-69.7	.867	573.7	2.465	.0824
58000	.1044	3.094	-56.5	-69.7	.867	573.7	2.350	.0785
59000	.0996	3.169	-46.5	-69.7	.867	573.7	2.240	.0749
60000	.0949	3.246	-56.5	-69.7	.867	573.7	2.136	.0714
61000	.0905	3.324	-56.5	-69.7	.867	573.7	2.036	.0680
62000	.0863	3.405	-56.5	-69.7	.867	573.7	1.941	.0649
63000	.0823	3.487	-56.5	-69.7	.867	573.7	1.850	.0618
64000	.0784	3.571	-56.5	-69.7	.867	573.7	1.764	.0590
65000	.0748	3.657	-56.5	-69.7	.867	573.7	1.682	.0562
66000	.0713	3.746	-56.5	-69.7	.867	573.7	1.603	.0536
67000	.0680	3.836	-56.5	-69.7	.867	573.7	1.529	.0511
68000	.0648	3.929	-56.5	-69.7	.867	573.7	1.457	.0487
69000	.0618	4.024	-56.5	-69.7	.867	573.7	1.389	.0464
70000	.0589	4.121	-56.5	-69.7	.867	573.7	1.325	.0443

THIS TABLE IS BASED ON ICAO STANDARD ATMOSPHERE FROM NACA TN NO. 3182 AND WADC TR 54-215 (h = 65000 FT.)

A3J-1-1A-93-23

Figure 11-2

DENSITY ALTITUDE CHART

BASED ON ICAO STANDARD ATMOSPHERE
(REFERENCE NACA TN NO. 3182 AND WADC TR 54-215)

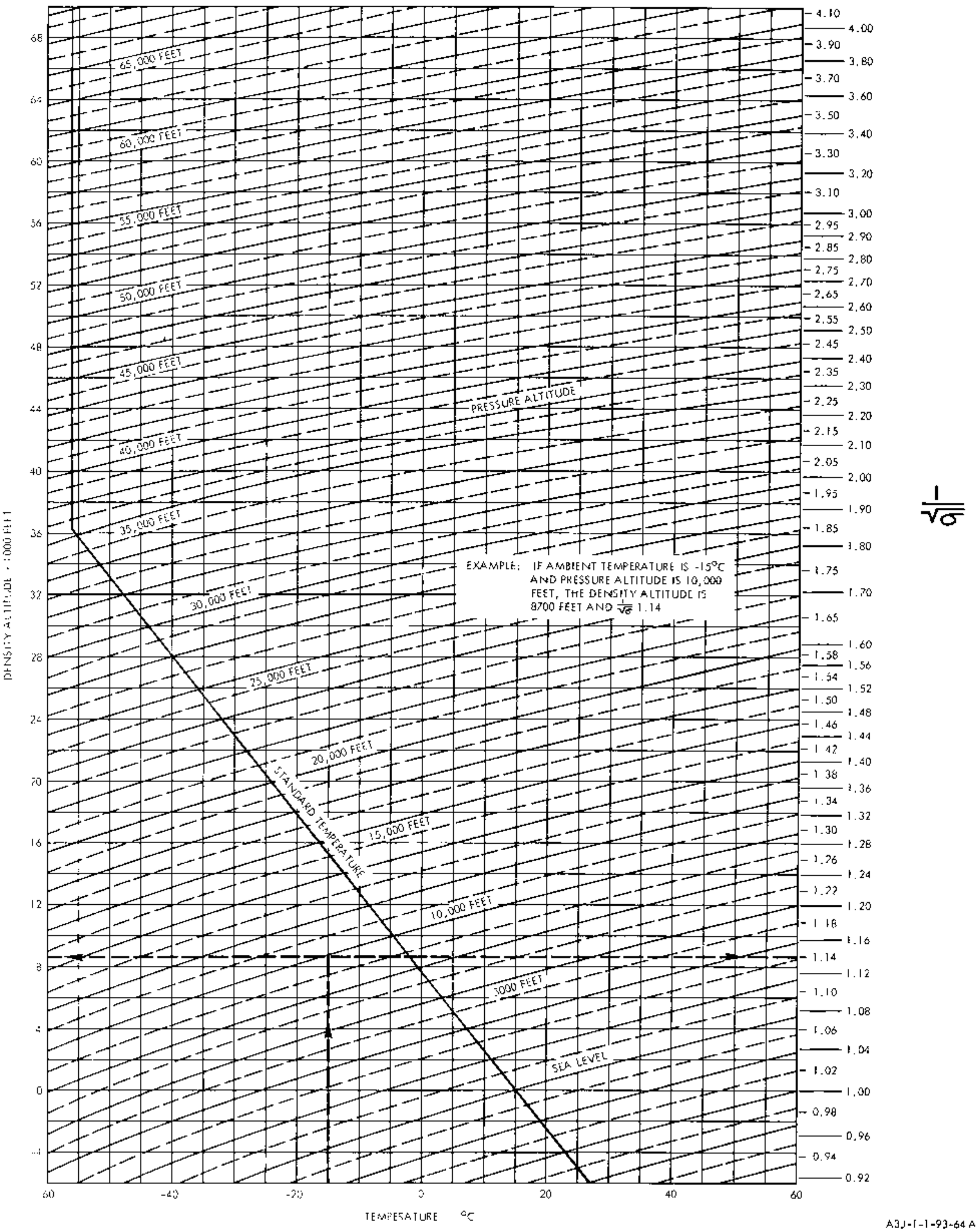


Figure 11-3

RANGE FACTOR

RELATIVE WIND ANGLE IN DEGREES θ	TAS	WIND VELOCITY IN KNOTS				
		40	60	80	100	120
0°	350	0.886	0.829	0.772	0.714	0.657
	400	0.900	0.850	0.800	0.750	0.700
	450	0.911	0.867	0.822	0.778	0.733
	500	0.920	0.880	0.844	0.800	0.760
	550	0.927	0.891	0.855	0.818	0.782
30°	350	0.899	0.848	0.796	0.742	0.688
	400	0.912	0.867	0.822	0.776	0.729
	450	0.922	0.882	0.842	0.801	0.760
	500	0.930	0.894	0.858	0.822	0.785
	550	0.936	0.904	0.871	0.839	0.805
60°	350	0.938	0.903	0.866	0.824	0.784
	400	0.946	0.917	0.885	0.852	0.816
	450	0.953	0.927	0.889	0.870	0.840
	500	0.958	0.935	0.910	0.885	0.858
	550	0.962	0.941	0.919	0.897	0.873
90°	350	0.994	0.985	0.974	0.959	0.941
	400	0.995	0.989	0.980	0.969	0.955
	450	0.996	0.991	0.984	0.975	0.964
	500	0.997	0.992	0.987	0.980	0.971
	550	0.997	0.994	0.989	0.984	0.976
120°	350	1.062	1.097	1.134	1.176	1.216
	400	1.054	1.083	1.115	1.148	1.184
	450	1.047	1.073	1.101	1.130	1.160
	500	1.042	1.065	1.090	1.115	1.142
	550	1.038	1.059	1.081	1.103	1.127
150°	350	1.101	1.152	1.205	1.258	1.312
	400	1.088	1.133	1.178	1.224	1.271
	450	1.078	1.118	1.158	1.199	1.240
	500	1.070	1.106	1.142	1.178	1.215
	550	1.064	1.096	1.129	1.162	1.195
180°	350	1.114	1.172	1.228	1.286	1.343
	400	1.100	1.150	1.200	1.250	1.300
	450	1.089	1.133	1.178	1.222	1.267
	500	1.080	1.120	1.160	1.200	1.240
	550	1.073	1.109	1.146	1.182	1.218

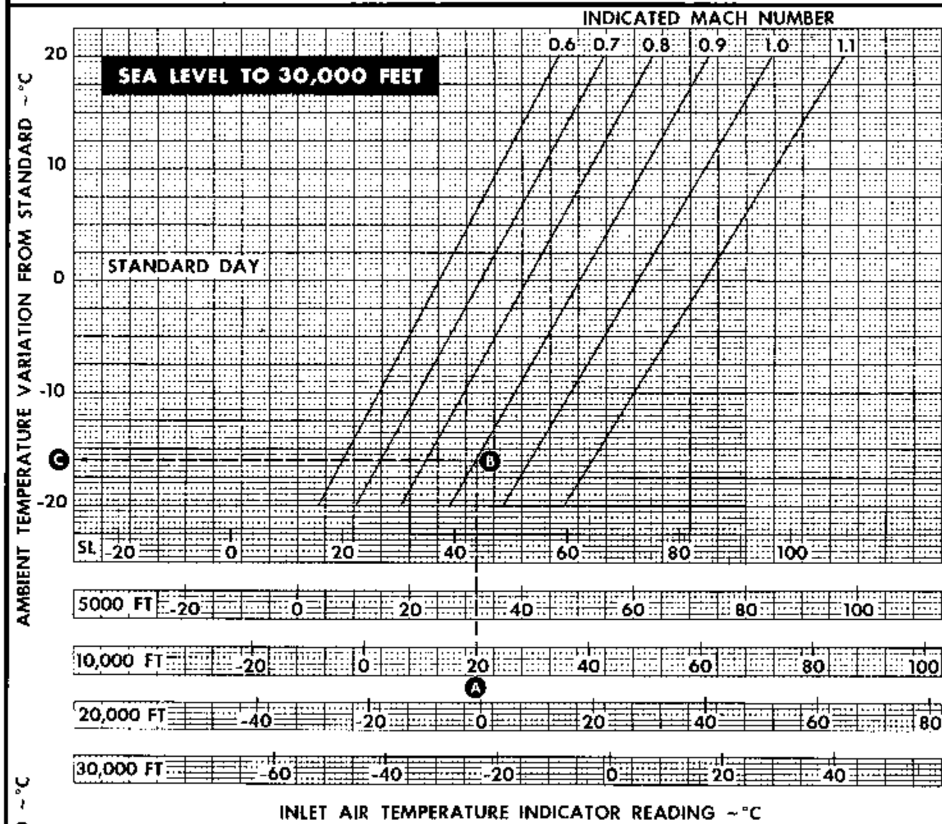
A3J-1-1-93-44

Figure 11-4

AMBIENT AIR TEMPERATURE DETERMINATION

MODEL: A-5A/RA-5C
BASED ON: FLIGHT TEST DATA
DATE: 1 JANUARY 1964

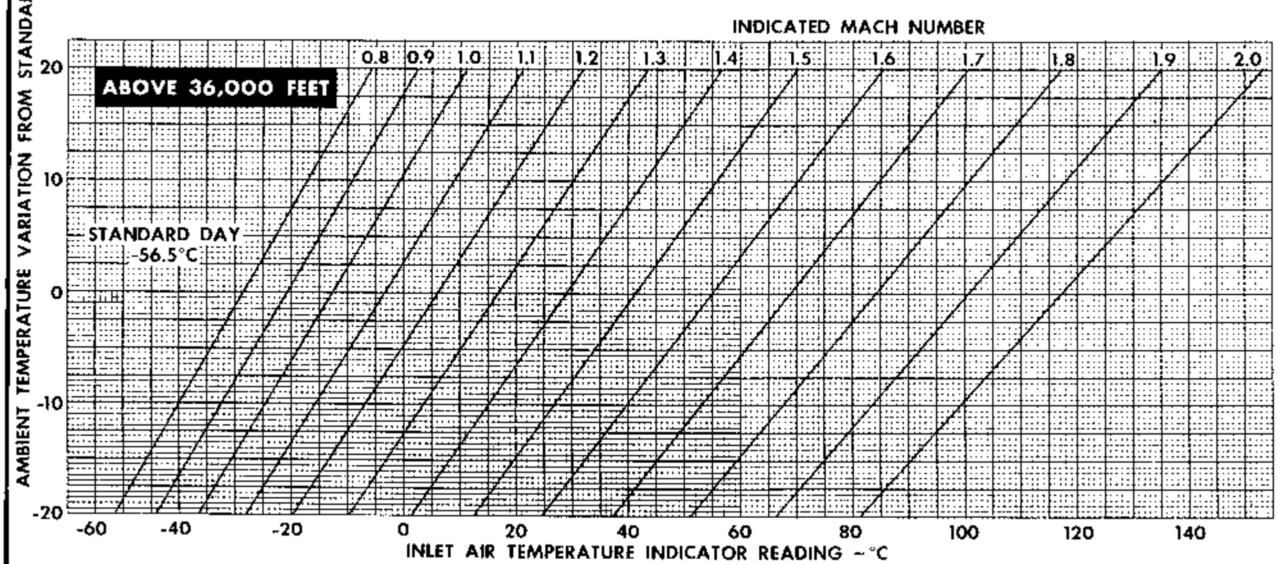
(USING INDICATED MACH NUMBER AND INLET AIR TEMPERATURE INDICATIONS)



STANDARD DAY AMBIENT TEMPERATURE ALT.	°C.
S. L.	15.0
5,000	5.1
10,000	− 4.8
20,000	−24.6
30,000	−44.3
+36,000	− 56.5

NOTE:

1. POSITION ERROR = ZERO
2. INLET TEMPERATURE ACCURATE TO ± 4.5°C
3. INLET TEMPERATURE GAGE INDICATES AMBIENT TEMPERATURE AT STATIC CONDITIONS



EXAMPLE: Ⓐ ALTITUDE 10,000 FEET, INLET TEMPERATURE 20°C
Ⓑ INDICATED MACH NUMBER — 0.9
Ⓒ AMBIENT VARIATIONS — MINUS 16 DEGREES
AMBIENT TEMPERATURE — MINUS 20.8°C
(−16°C ADDED TO −4.8°C −20.8°C)

A3J-1-1A-93-708

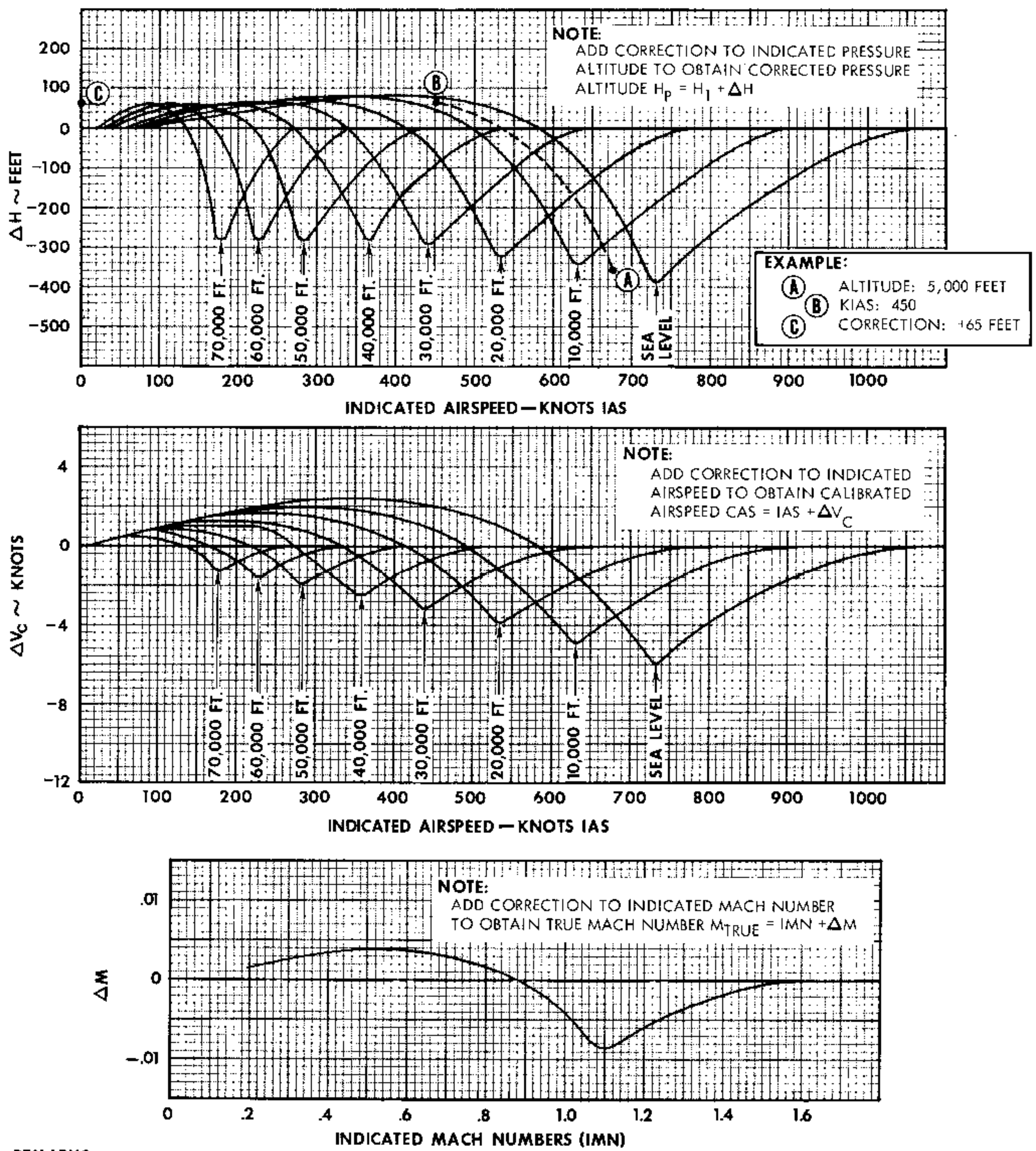
Figure 11-5

POSITION ERROR CORRECTION

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA
DATE: 15 JUNE 1970

COMPENSATED PITOT-STATIC TUBE

(AIRCRAFT 156608 - 156653 AND AIRCRAFT HAVING AFC 159 COMPLIED WITH)



REMARKS

1. INDICATED AIRSPEED IS ASSUMED CORRECTED FOR INSTRUMENT ERROR
2. CORRECTION IS ZERO AT GREATER THAN 1.6 MACH NUMBER
3. ALTITUDE AND AIRSPEED POSITION ERROR IS ZERO WITH FLAPS DOWN

A-5C-1A-93-130A

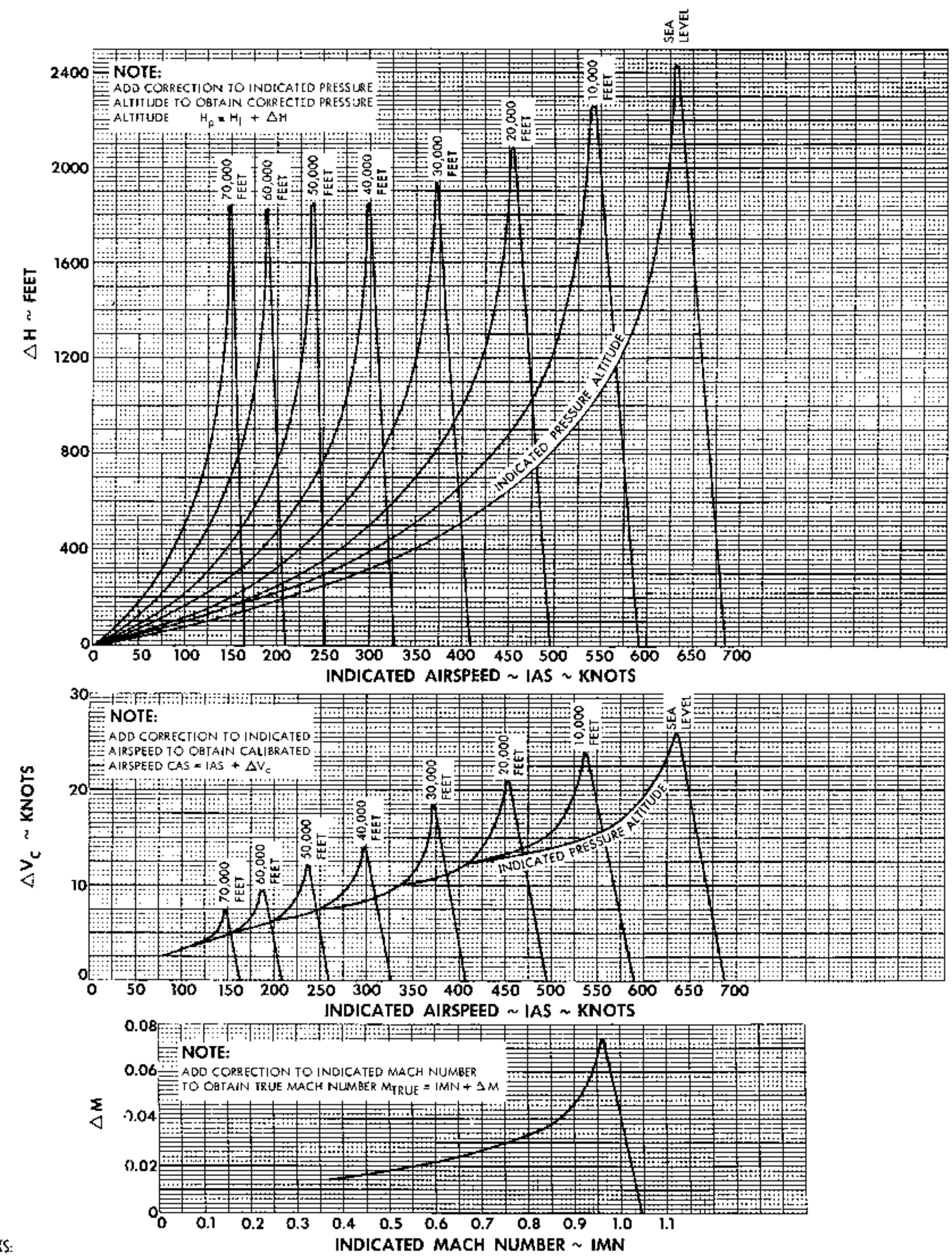
Figure 11-6

POSITION ERROR CORRECTION

UNCOMPENSATED PITOT-STATIC TUBE

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA
DATE: 15 JUNE 1970

(AIRCRAFT 145157 - 151728
NOT HAVING
AFC 159 COMPLIED WITH)



REMARKS:

1. DATA APPLIES TO ALL CONFIGURATIONS
2. DATA IS APPLICABLE WITH SPC OFF ONLY
3. INDICATED AIRSPEED IS ASSUMED CORRECTED FOR INSTRUMENT ERROR
4. CORRECTION IS ZERO AT GREATER THAN 1.05 MACH NUMBER

A3J-1-1A-93-128

Figure 11-7

PART 2 — TAKE-OFF

TAKE-OFF DATA SUMMARY CHARTS

The Take-off Data Summary charts (figures 11-8, 11-9, 11-14, and 11-15) provide the following information:

- Take-off speed and distance.
- Refusal speed and distance.
- Line speed and distance.
- Maximum speed for brake initiation.
- Refusal speed stopping distance.

Charts for Military and Maximum Thrust for Standard Day (59°F/15°C) and Hot Day (104°F/40°C) are provided. Data for operations during other than these temperature conditions may be obtained by computing data for both temperatures and interpolation, or by using one temperature as the "worst condition" basis. An example is included on figure 11-9 to illustrate the use of the charts. These charts are also included in the NATOPS Pocket Checklist (NAVAIR 01-60ABC-1B).

TAKE-OFF DISTANCE CHARTS

Ground run distances and total distance to clear a 50-foot obstacle are presented in the Take-off Distances charts (figures 11-10, 11-11, 11-16, and 11-17) for Military and Maximum Thrust. Both charts are applicable to 30-degree flaps and "no external load or with symmetrical external stores" configurations. An example is included to illustrate the use of the charts. A Take-off Distances chart for Maximum Thrust is also included in the NATOPS Pocket Checklist (NAVAIR 01-60ABC-1B).

REFUSAL SPEEDS CHARTS

Refusal Speeds charts for Maximum and Military Thrust take-offs are presented in figures 11-12, 11-13, 11-18, and 11-19. These charts show the highest indicated airspeed at which a take-off can be aborted and the aircraft brought to a stop within a given runway length. The effects of ambient temperature, field elevation, and head-wind conditions on refusal speed are shown on the charts. The charts are based on dry, hard-surface runway conditions and include a 3-second time delay for decision and brake application. The ground roll distance required to accelerate to refusal speed can be determined by subtracting the stopping distance as shown on the Landing and Stopping Distances chart (figures 11-95 and 11-96) from the runway length used in determining the refusal speed. It should be noted that, at the heavy take-off gross weight conditions, the refusal speeds exceed the maximum recommended IAS for initiation of wheel braking. Aerodynamic braking is required to reduce the indicated airspeed to approximately 115 knots before applying wheel braking at heavy gross weights in order not to expend the available brake energy absorption capability in the initial phase of the deceleration. Braking capability is further discussed under LANDING AND STOPPING DISTANCES CHARTS, in this section. Refer to STOPPING THE AIRCRAFT, in Section III, Part 3, of the NATOPS Flight Manual (NAVAIR 01-60ABC-1) for a discussion of optimum aerodynamic braking and wheel braking techniques.

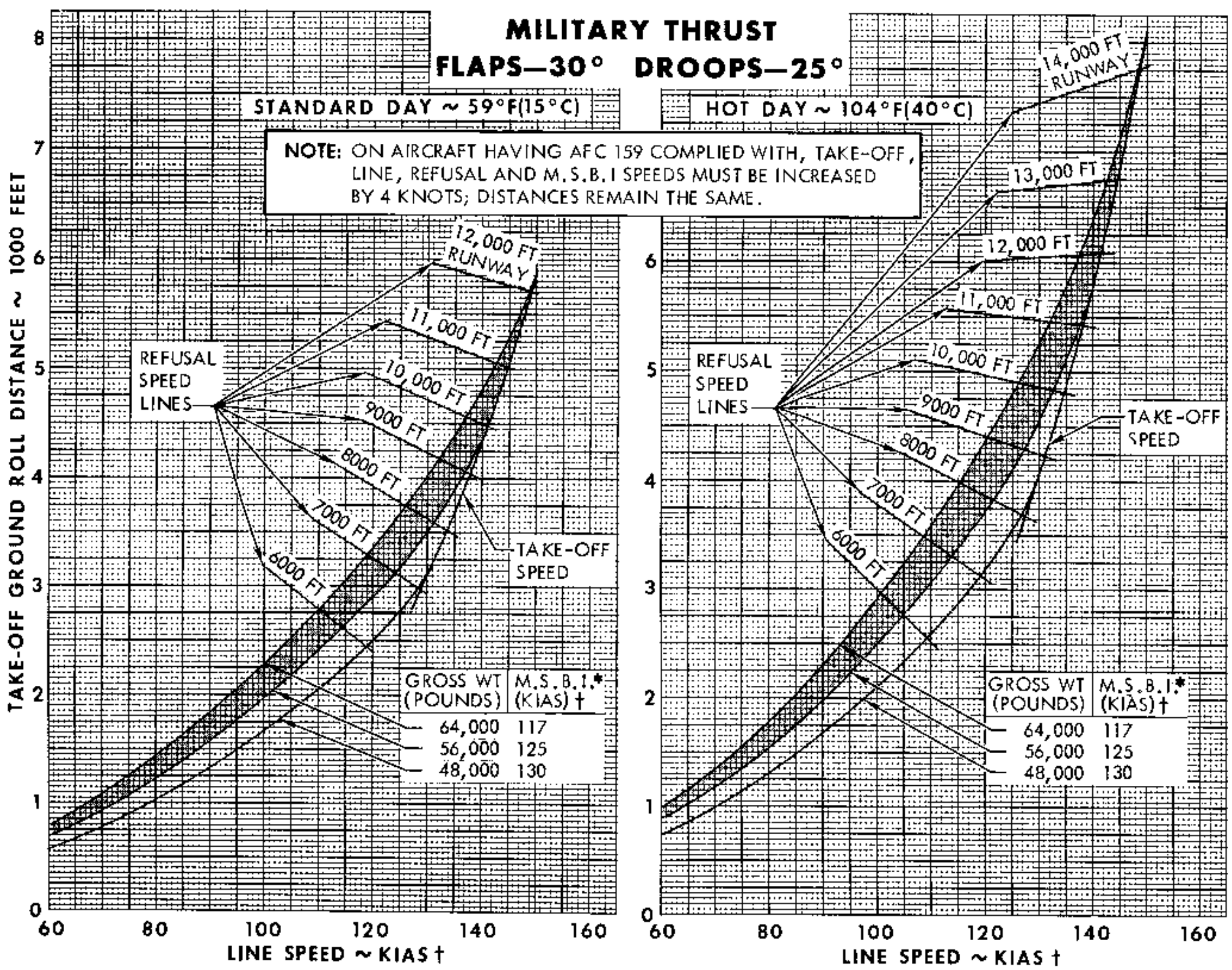
TAKE-OFF DATA SUMMARY

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NA63H-2)
DATE: 1 MARCH 1964

- TAKE-OFF SPEED AND DISTANCE
- REFUSAL SPEED AND DISTANCE
- LINE SPEED AND DISTANCE
- M.S.B.I. AND STOPPING DISTANCE

ENGINES: (2) J79-GE-8
FUEL GRADE: MIL-J-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL

ALL CONFIGURATIONS, SEA LEVEL, SPC OFF,† ZERO WIND, HARD SURFACE RUNWAY



* M.S.B.I. = MAXIMUM SPEED FOR BRAKE INITIATION

† AIRCRAFT NOT HAVING AFC 159 COMPLIED WITH

NOTE:

1. INCREASE LINE SPEED AND REFUSAL SPEED BY 7 KNOTS FOR EACH 10 KNOTS OF HEADWIND.
2. DECREASE LINE SPEED BY 3 KNOTS AND REFUSAL SPEED BY 2 KNOTS FOR EACH 1000 FEET OF FIELD ELEVATION ABOVE SEA LEVEL.
3. DECREASE THE TAKE-OFF DISTANCE SHOWN BY 10% FOR EACH 10 KNOTS OF HEADWIND.
4. INCREASE THE TAKE-OFF DISTANCE BY 10% FOR EACH 1000 FEET OF FIELD ELEVATION.
5. STOPPING DISTANCE IS EQUAL TO RUNWAY LENGTH MINUS REFUSAL SPEED DISTANCE.
6. FOR DETAILED INFORMATION REFER TO THE TAKE-OFF, REFUSAL SPEED, LANDING, AND STOPPING DISTANCE CHARTS.
7. **MAXIMUM THRUST IS RECOMMENDED FOR TAKE-OFFS IN EXCESS OF 56,000 POUNDS.**
8. FOR ANTI-SKID BRAKES ON DRY RUNWAY, INCREASE THE REFUSAL SPEEDS SHOWN BY 3 KNOTS.
9. FOR WET RUNWAY CONDITIONS, REDUCE THE REFUSAL SPEEDS BY 20 KNOTS (15 KNOTS FOR ANTI-SKID BRAKES).

A-5C-1A-93-79E

Figure 11-8

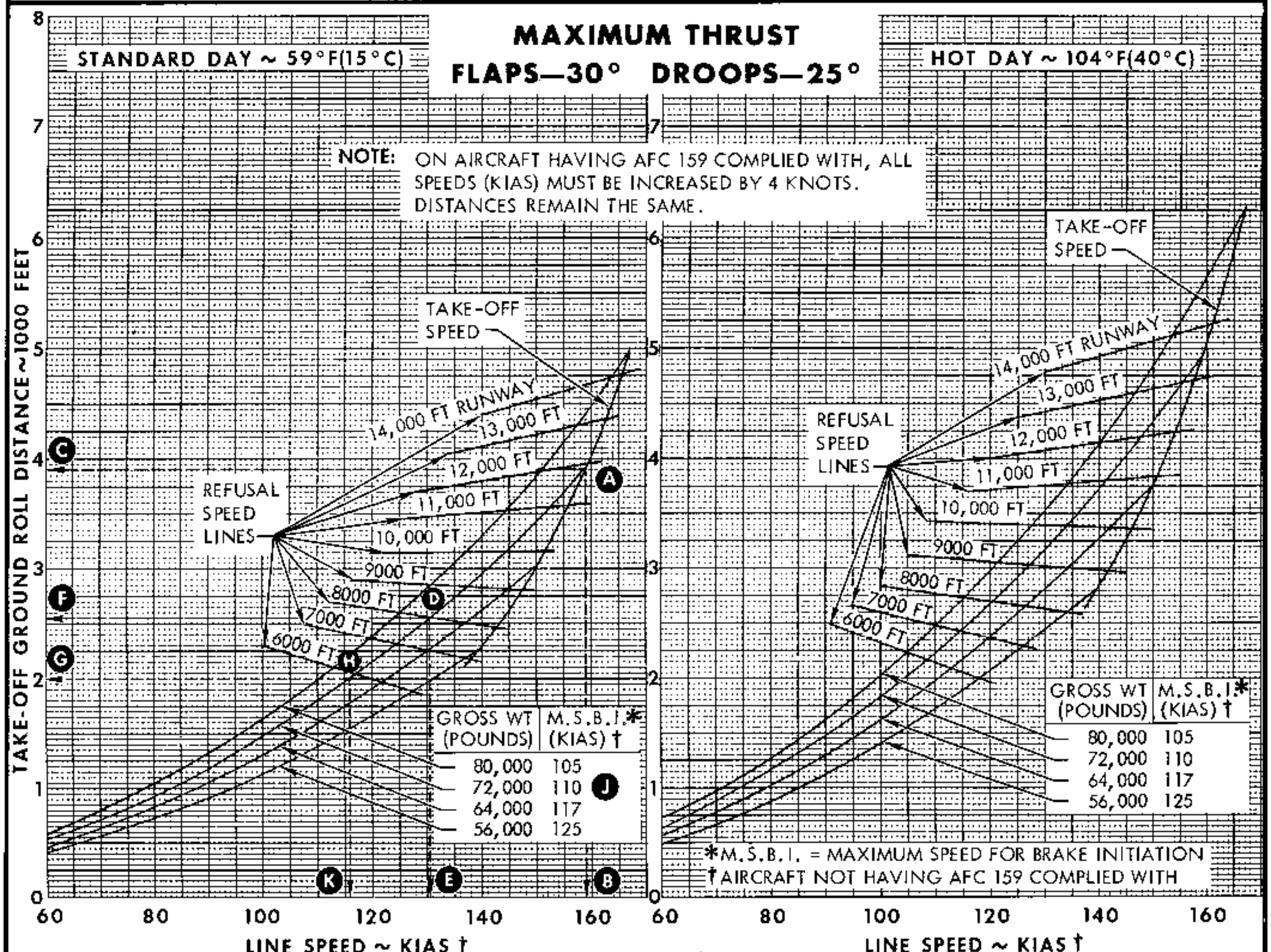
TAKE-OFF DATA SUMMARY

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NA63H-2)
DATE: 1 MARCH 1964

- TAKE-OFF SPEED AND DISTANCE
- REFUSAL SPEED AND DISTANCE
- LINE SPEED AND DISTANCE
- M.S.B.I. AND STOPPING DISTANCE

ENGINES: (2) J79-GE-8
FUEL GRADE: MIL-J-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL

ALL CONFIGURATIONS, SEA LEVEL, SPC OFF, † ZERO WIND, HARD SURFACE RUNWAY



EXAMPLE:

STANDARD DAY, 72,000 POUNDS GROSS WEIGHT
8000 FOOT RUNWAY

- (A) GROSS WEIGHT (72,000 POUNDS)/TAKE-OFF SPEED CURVES
- (B) TAKE-OFF SPEED (159 KIAS)†
- (C) TAKE-OFF GROUND ROLL DISTANCE (3900 FEET)
- (D) GROSS WEIGHT (72,000 POUNDS)/RUNWAY LENGTH (8000 FEET) LINES
- (E) REFUSAL SPEED (131 KIAS)†
- (F) REFUSAL SPEED DISTANCE (2600 FEET)
- (G) LINE SPEED CHECK DISTANCE (2000 FEET)
- (H) GROSS WEIGHT (72,000 POUNDS)
- (J) MAXIMUM SPEED FOR BRAKE INITIATION (110 KIAS)†
- (K) LINE SPEED (116 KIAS)†
- (L) REFUSAL SPEED STOPPING DISTANCE (8000 - 2600 = 5400 FEET)

REFER TO NOTES

NOTE:

1. INCREASE LINE SPEED AND REFUSAL SPEED BY 7 KNOTS FOR EACH 10 KNOTS OF HEADWIND.
2. DECREASE LINE SPEED BY 3 KNOTS AND REFUSAL SPEED BY 2 KNOTS FOR EACH 1000 FEET OF FIELD ELEVATION ABOVE SEA LEVEL.
3. DECREASE THE TAKE-OFF DISTANCE SHOWN BY 10% FOR EACH 10 KNOTS OF HEADWIND.
4. INCREASE THE TAKE-OFF DISTANCE BY 10% FOR EACH 1000 FEET OF FIELD ELEVATION.
5. STOPPING DISTANCE IS EQUAL TO RUNWAY LENGTH MINUS REFUSAL SPEED DISTANCE.
6. FOR DETAILED INFORMATION REFER TO THE TAKE-OFF, REFUSAL SPEED, LANDING, AND STOPPING DISTANCE CHARTS.
7. FOR ANTI-SKID BRAKES ON DRY RUNWAY, INCREASE THE REFUSAL SPEEDS SHOWN BY 5 KNOTS.
8. FOR WET RUNWAY CONDITIONS, REDUCE REFUSAL SPEEDS SHOWN BY 20 KNOTS (13 KNOTS WITH ANTI-SKID BRAKES).

A-5C-1A-93-78E

Figure 11-9

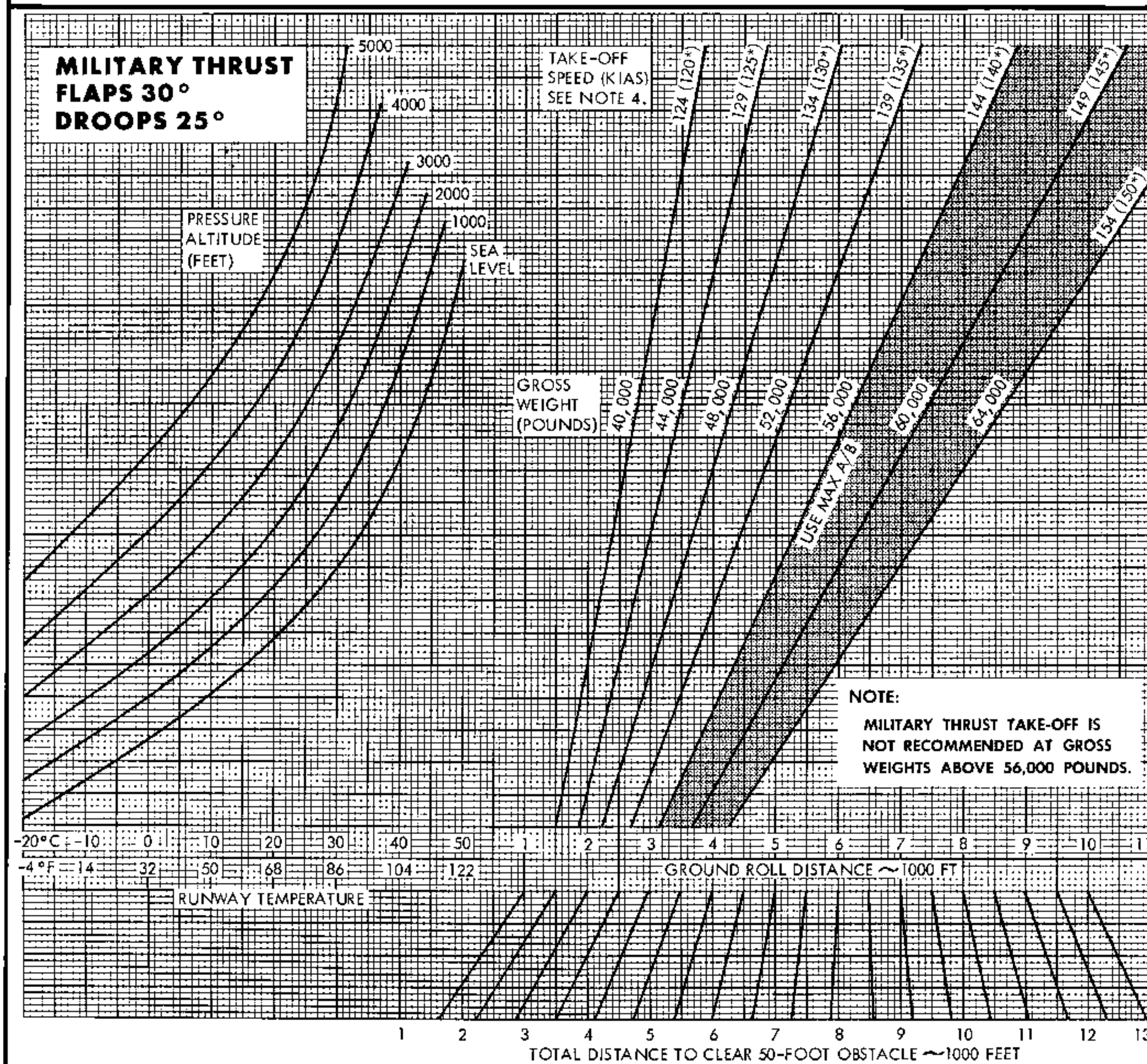
TAKE-OFF DISTANCES

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NA63H-2)
DATE: 1 APRIL 1964

NO EXTERNAL LOAD OR WITH
SYMMETRICAL EXTERNAL STORES

(HARD-SURFACE RUNWAY)

ENGINES: (2) J79-GE-8
FUEL GRADE: MIL-J-5624(JP-5)
FUEL DENSITY: 6.8 LB/GAL



NOTE:

1. DECREASE GROUND ROLL AND TOTAL DISTANCE OVER A 50 FOOT OBSTACLE BY 10% FOR EACH 10 KNOTS OF HEADWIND.
2. INCREASE TAKE-OFF SPEED 4 KNOTS AND MINIMUM TAKE-OFF DISTANCE 250 FEET FOR EACH PERCENT MAC CG FORWARD OF 25 PERCENT.
3. TAKE-OFF GROUND ROLL DISTANCE VARIES APPROXIMATELY 5% FOR EACH 1% RUNWAY GRADIENT SLOPE.
4. ON AIRCRAFT HAVING AFC 159 COMPLIED WITH, TAKE OFF SPEEDS (KIAS) ARE INCREASED BY 4 KNOTS. (DISTANCES REMAIN THE SAME.)

* SPC-OFF, AIRCRAFT NOT HAVING AFC 159 COMPLIED WITH

A-5C-1A-93-77E

Figure 11-10

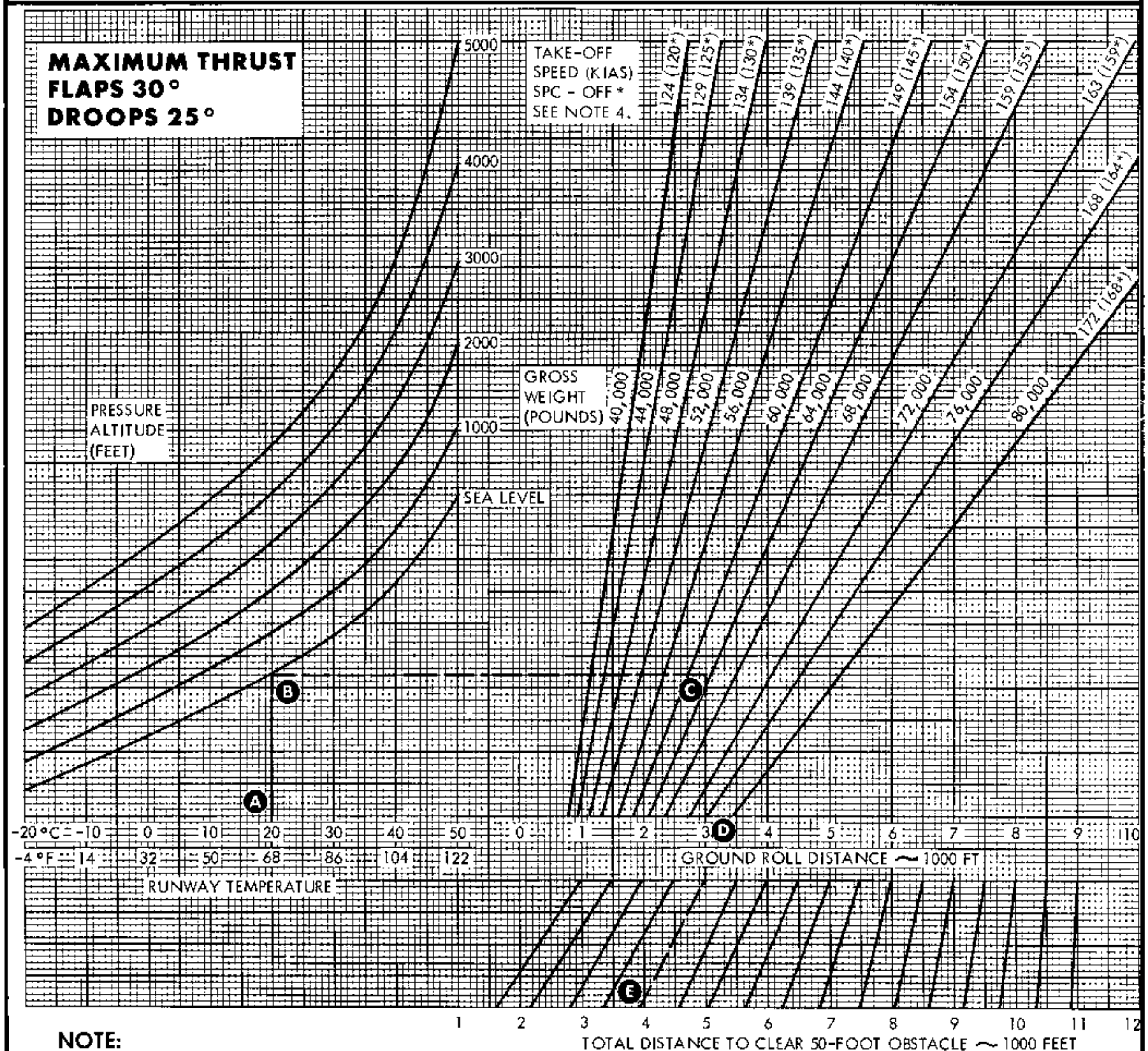
TAKE-OFF DISTANCES

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NA63H-2)
DATE: 1 APRIL 1964

NO EXTERNAL LOAD OR WITH
SYMMETRICAL EXTERNAL STORES

(HARD-SURFACE RUNWAY)

ENGINES: (2) J79-GE-8
FUEL GRADE: MIL-J-5624(JP-5)
FUEL DENSITY: 6.8 LB/GAL



NOTE:

1. DECREASE GROUND ROLL AND TOTAL DISTANCE OVER A 50 FOOT OBSTACLE BY 10% FOR EACH 10 KNOTS OF HEADWIND.
2. INCREASE TAKE-OFF SPEED 4 KNOTS AND TAKE-OFF DISTANCE 250 FEET FOR EACH PERCENT MAC CG FORWARD OF 25 PERCENT.
3. TAKE-OFF GROUND ROLL DISTANCE VARIES APPROXIMATELY 5% FOR EACH 1% RUNWAY GRADIENT SLOPE.
4. FOR AIRCRAFT HAVING AFC 159 COMPLIED WITH, TAKE OFF SPEEDS ARE INCREASED BY 4 KNOTS. (DISTANCES REMAIN THE SAME.)

EXAMPLE:

- **A** RUNWAY TEMPERATURE (20°C) (68°F)
- **B** PRESSURE ALTITUDE (SEA LEVEL)
- **C** GROSS WEIGHT (62,700 POUNDS)
- **D** GROUND ROLL DISTANCE WITH ZERO WIND (3000 FEET)
- **E** TOTAL DISTANCE TO CLEAR 50-FOOT OBSTACLE WITH ZERO WIND (4000 FEET)

* AIRCRAFT NOT HAVING AFC 159 COMPLIED WITH

A-5C 1A-93-76E

Figure 11-11

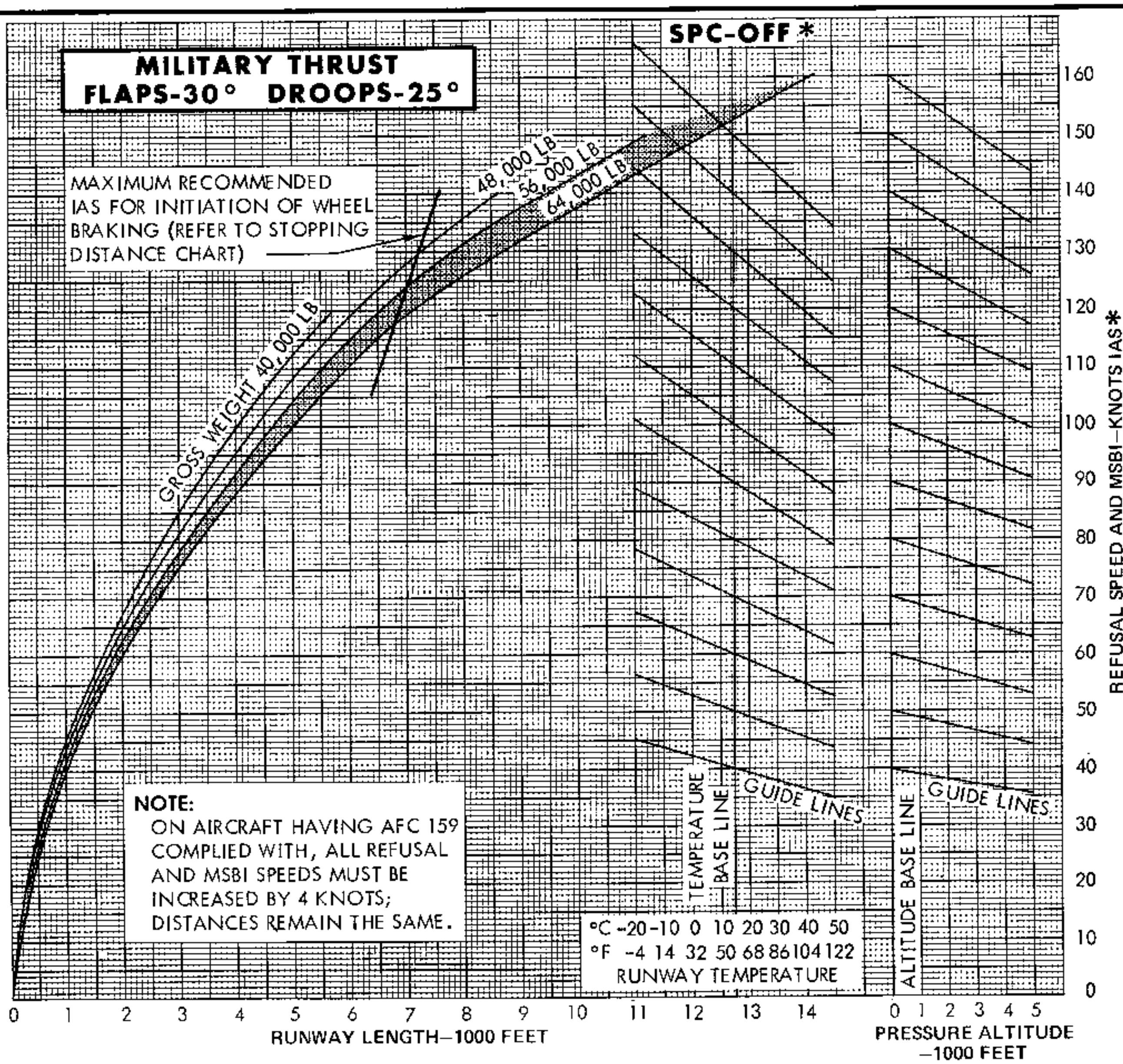
REFUSAL SPEEDS

ALL CONFIGURATIONS
ZERO WIND

(HARD-SURFACE RUNWAY)

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NA63H-2)
DATE: 1 MARCH 1964

ENGINES: (2) J79-GE-8
FUEL GRADE: MIL-J-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL



NOTE:

1. INCREASE REFUSAL SPEEDS BY 7 KNOTS FOR EACH 10 KNOTS OF DIRECT HEADWIND.
2. TO FIND DISTANCE TO ACCELERATE TO REFUSAL SPEED, ENTER THE TAKE-OFF DATA SUMMARY CHART (MIL) WITH REFUSAL SPEED AND READ ACCELERATION DISTANCE.
3. **MILITARY THRUST TAKE-OFF IS NOT RECOMMENDED AT GROSS WEIGHTS ABOVE 56,000 POUNDS.**
4. FOR ANTI-SKID BRAKES ON DRY RUNWAY, INCREASE THE REFUSAL SPEEDS BY 3 KNOTS.
5. FOR WET RUNWAY CONDITIONS, REDUCE THE REFUSAL SPEEDS BY 20 KNOTS (15 KNOTS FOR ANTI-SKID BRAKES).

*AIRCRAFT NOT HAVING AFC 159 COMPLIED WITH

A-5C-1A-93-81E

Figure 11-12

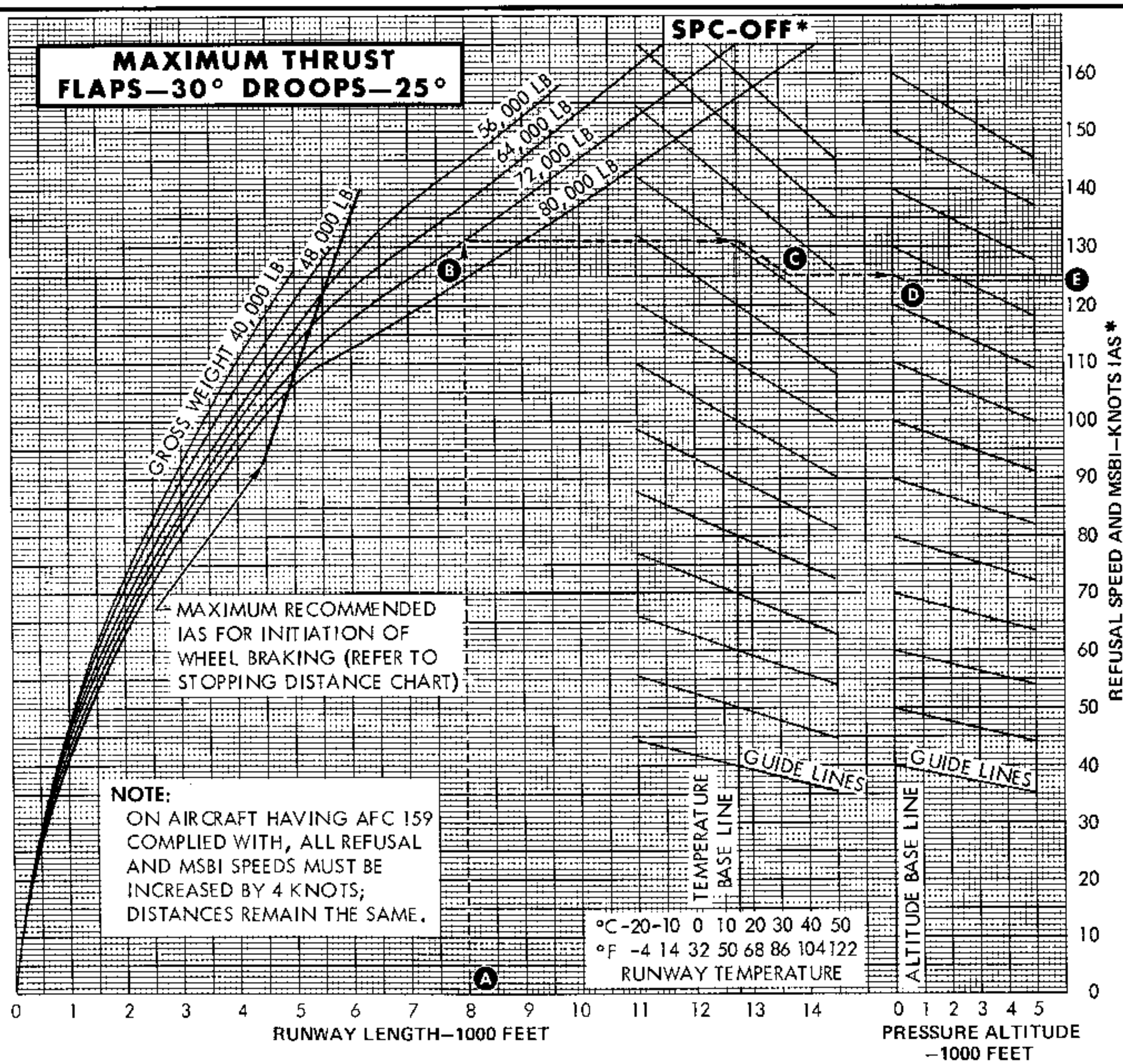
REFUSAL SPEEDS

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NA63H-2)
DATE: 1 MARCH 1964

ALL CONFIGURATIONS
ZERO WIND

(HARD-SURFACE RUNWAY)

ENGINES: (2) J79-GE-8
FUEL GRADE: MIL-J-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL



NOTE:

1. INCREASE REFUSAL SPEEDS BY 7 KNOTS FOR EACH 10 KNOTS OF DIRECT HEADWIND.
2. TO FIND DISTANCE TO ACCELERATE TO REFUSAL SPEED, ENTER THE TAKE-OFF DATA SUMMARY CHART (MAX) WITH REFUSAL SPEED AND READ ACCELERATION DISTANCE.
3. FOR ANTI-SKID BRAKES ON DRY RUNWAY, INCREASE REFUSAL SPEEDS BY 5 KNOTS.
4. FOR WET RUNWAY CONDITIONS, REDUCE THE REFUSAL SPEEDS BY 20 KNOTS (13 KNOTS FOR ANTI-SKID BRAKES).

EXAMPLE:

- Ⓐ RUNWAY LENGTH (8000 FEET)
- Ⓑ GROSS WEIGHT (72,000 POUNDS)
- Ⓒ AMBIENT RUNWAY TEMPERATURE (32°C, 90°F)
- Ⓓ PRESSURE ALTITUDE (500 FEET)
- Ⓔ REFUSAL SPEED - 124 KIAS*

* AIRCRAFT NOT HAVING AFC 159 COMPLIED WITH

A-5C-1A-93-80E

Figure 11-13

TAKE-OFF DATA SUMMARY

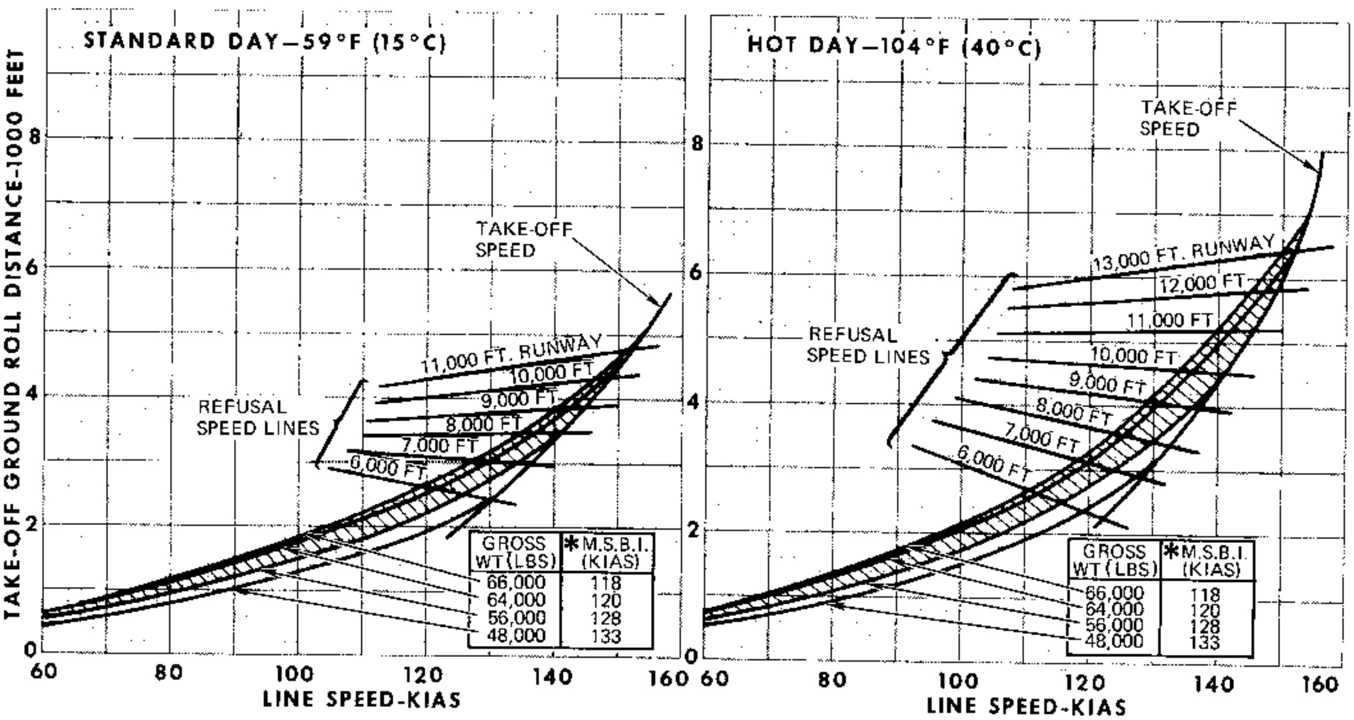
- TAKE-OFF SPEED AND DISTANCE
- REFUSAL SPEED AND DISTANCE
- LINE SPEED AND DISTANCE
- M.S.B.I. AND STOPPING DISTANCE

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NR69H 2)
DATE: 15 JUNE 1970

ENGINES: (2)J 79-GE-10 (-8)*
FUELGRADE: MIL-T 5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL
*SEE NOTE 9

ALL CONFIGURATIONS, SEA LEVEL, ZERO WIND, HARD SURFACE RUNWAY

MILITARY THRUST
FLAPS-30° DROOPS-25°



NOTE

1. INCREASE LINE SPEED AND REFUSAL SPEED BY 7 KNOTS FOR EACH 10 KNOTS OF HEADWIND
2. DECREASE LINE SPEED BY 3 KNOTS AND REFUSAL SPEED BY 2 KNOTS FOR EACH 1000 FEET OF FIELD ELEVATION ABOVE SEA LEVEL
3. DECREASE THE TAKE-OFF DISTANCE BY 10% FOR EACH 10 KNOTS OF HEADWIND
4. INCREASE THE TAKE-OFF DISTANCE BY 10% FOR EACH 1000 FEET OF FIELD ELEVATION
5. STOPPING DISTANCE IS EQUAL TO RUNWAY LENGTH MINUS REFUSAL SPEED DISTANCE
6. FOR DETAILED INFORMATION REFER TO THE TAKE-OFF, REFUSAL SPEED, LANDING AND STOPPING DISTANCE CHARTS
7. MAXIMUM THRUST IS RECOMMENDED FOR TAKE-OFFS IN EXCESS OF 56,000 POUNDS
8. FOR WET RUNWAY CONDITIONS, REDUCE REFUSAL SPEEDS SHOWN BY 15 KNOTS
9. FOR AIRCRAFT HAVING AFC 328 COMPLIED WITH AND J79-GE-8 ENGINES INSTALLED, SEE FIGURE 11-8.

* M.S.B.I. = MAXIMUM SPEED FOR BRAKE INITIATION

RA-5C-1-93-56A

Figure 11-14

TAKE-OFF DATA SUMMARY

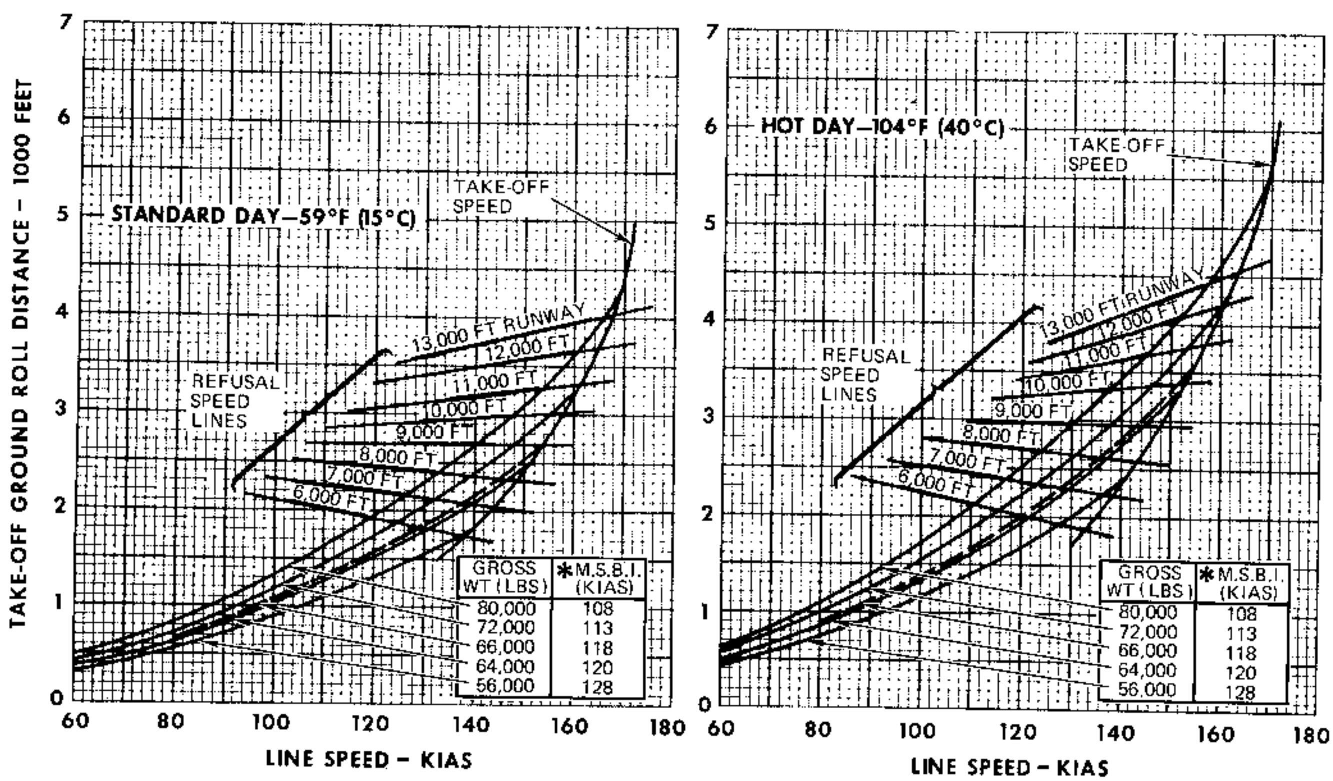
- TAKE-OFF SPEED AND DISTANCE
- REFUSAL SPEED AND DISTANCE
- LINE SPEED AND DISTANCE
- M.S.B.I. AND STOPPING DISTANCE

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NR69H-2)
DATE: 15 JUNE 1970

ENGINES: (2) J79-GE-10 (-8)*
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB./GAL.
*SEE NOTE 8

ALL CONFIGURATIONS, SEA LEVEL, ZERO WIND, HARD SURFACE RUNWAY

MAXIMUM THRUST
FLAPS-30°/DROOPS-25°



NOTE

1. INCREASE LINE SPEED AND REFUSAL SPEED BY 7 KNOTS FOR EACH 10 KNOTS OF HEADWIND.
2. DECREASE LINE SPEED BY 3 KNOTS AND REFUSAL SPEED BY 2 KNOTS FOR EACH 1000 FEET OF FIELD ELEVATION ABOVE SEA LEVEL.
3. DECREASE THE TAKE-OFF DISTANCE SHOWN BY 10% FOR EACH 10 KNOTS OF HEADWIND.
4. INCREASE THE TAKE-OFF DISTANCE BY 10% FOR EACH 1000 FEET OF FIELD ELEVATION.
5. STOPPING DISTANCE IS EQUAL TO RUNWAY LENGTH MINUS REFUSAL SPEED DISTANCE.
6. FOR DETAILED INFORMATION REFER TO THE TAKE-OFF REFUSAL SPEED, LANDING AND STOPPING DISTANCE CHARTS.
7. FOR WET RUNWAY CONDITIONS, REDUCE REFUSAL SPEEDS SHOWN BY 13 KNOTS.
8. FOR AIRCRAFT HAVING AFC 328 COMPLIED WITH AND J79-GE-8 ENGINES INSTALLED, SEE FIGURE 11-9.

*M.S.B.I. = MAXIMUM SPEED FOR BRAKE INITIATION

RA-5C-1-93-51A

Figure 11-15

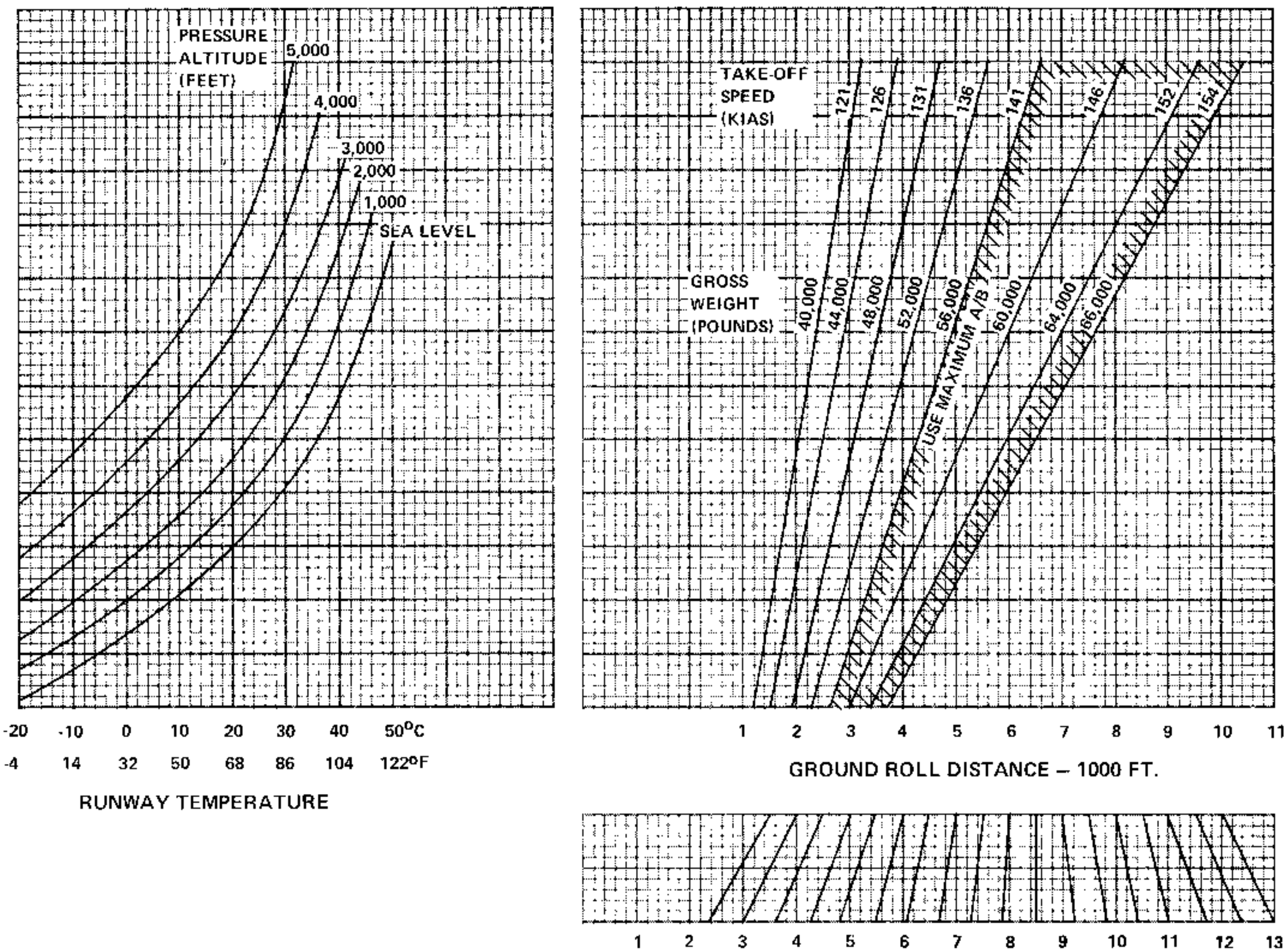
TAKE-OFF DISTANCES

NO EXTERNAL LOAD
OR WITH SYMMETRICAL EXTERNAL STORES
HARD SURFACE RUNWAY

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NR69H-2)
DATE: 15 JUNE 1970

ENGINES: (2) J79-GE-10 (-8)*
FUEL GRADE: MIL-T-5624(JP-5)
FUEL DENSITY: 6.8 LB./GAL.
*SEE NOTE 5

MILITARY THRUST
FLAPS 30°/DROOPS 25°



NOTE:

1. DECREASE GROUND ROLL AND TOTAL DISTANCE OVER A 50 FOOT OBSTACLE BY 10% FOR EACH 10 KNOTS OF HEADWIND.
2. MAXIMUM THRUST IS RECOMMENDED FOR TAKE-OFFS IN EXCESS OF 56,000 POUNDS.
3. INCREASE TAKE-OFF SPEED 4 KNOTS AND MINIMUM TAKE-OFF DISTANCE 250 FEET FOR EACH PERCENT MAC CG FORWARD OF 25 PERCENT.
4. TAKE-OFF GROUND ROLL DISTANCE VARIES APPROXIMATELY 5% FOR EACH 1% RUNWAY GRADIENT SLOPE.
5. FOR AIRCRAFT HAVING AFC 328 COMPLIED WITH AND J79-GE-8 ENGINES INSTALLED, SEE FIGURE 11-10

A-5C-1-93-57A

Figure 11-16

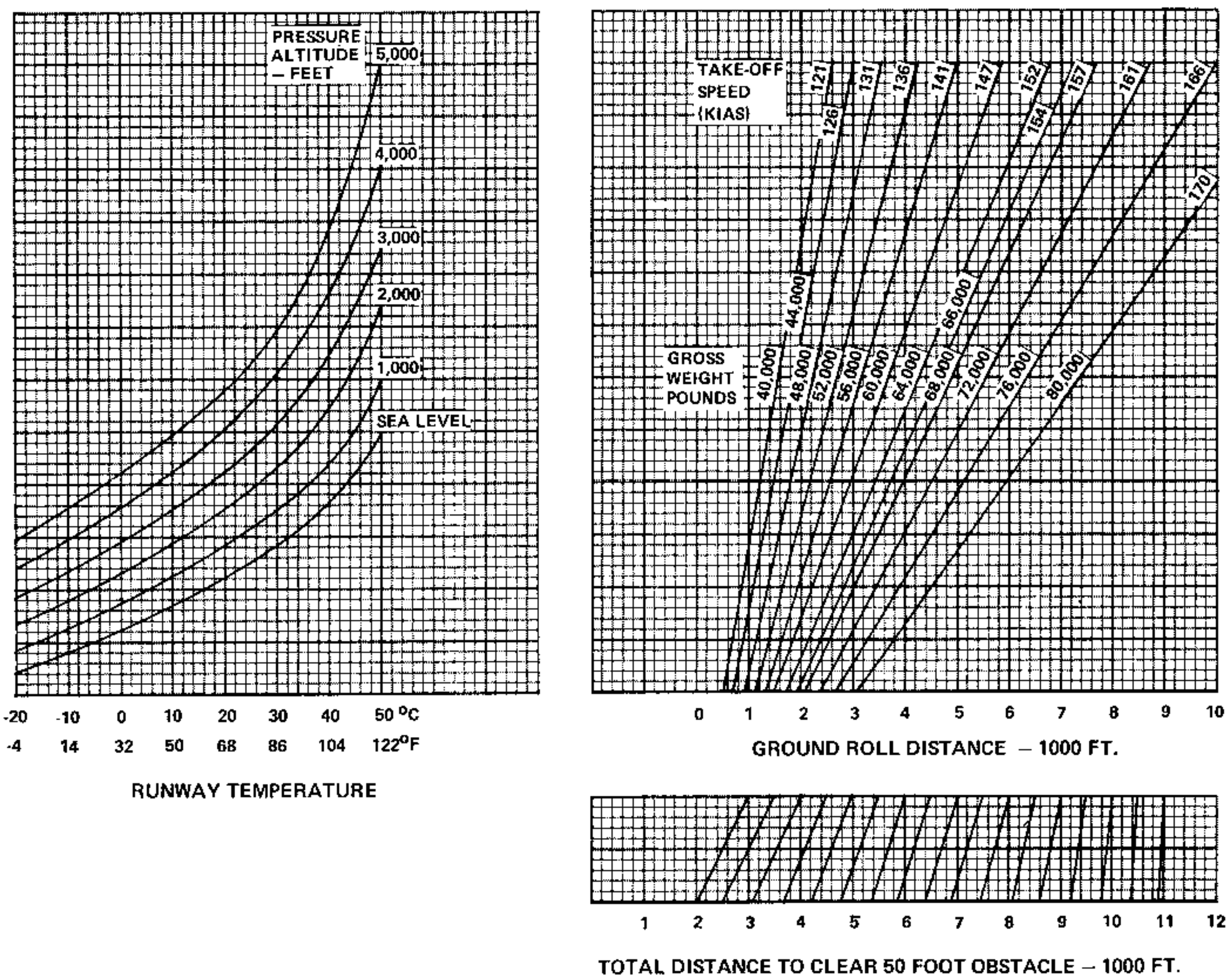
TAKE-OFF DISTANCES

NO EXTERNAL LOAD
OR WITH SYMMETRICAL EXTERNAL STORES
(HARD SURFACE RUNWAY)

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NR69H-2)
DATE: 15 JUNE 1970

ENGINES: (2) J79-GE-10 (-8)*
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB./GAL.
*SEE NOTE 4.

MAXIMUM THRUST
FLAPS 30°/DROOPS 25°



NOTE:

1. DECREASE GROUND ROLL AND TOTAL DISTANCE OVER A 50 FOOT OBSTACLE BY 10% FOR EACH 10 KNOTS OF HEADWIND.
2. INCREASE TAKE-OFF SPEED 4 KNOTS AND TAKE-OFF DISTANCE 250 FEET FOR EACH PER CENT M.A.C. C.G. FORWARD OF 25 PER CENT.
3. TAKE-OFF GROUND ROLL DISTANCE VARIES APPROXIMATELY 5% FOR EACH 1% RUNWAY GRADIENT SLOPE.
4. FOR AIRCRAFT HAVING AFC 328 COMPLIED WITH AND J79-GE-8 ENGINES INSTALLED, SEE FIGURE 11-11.

RA-5C-1-93-52A

Figure 11-17

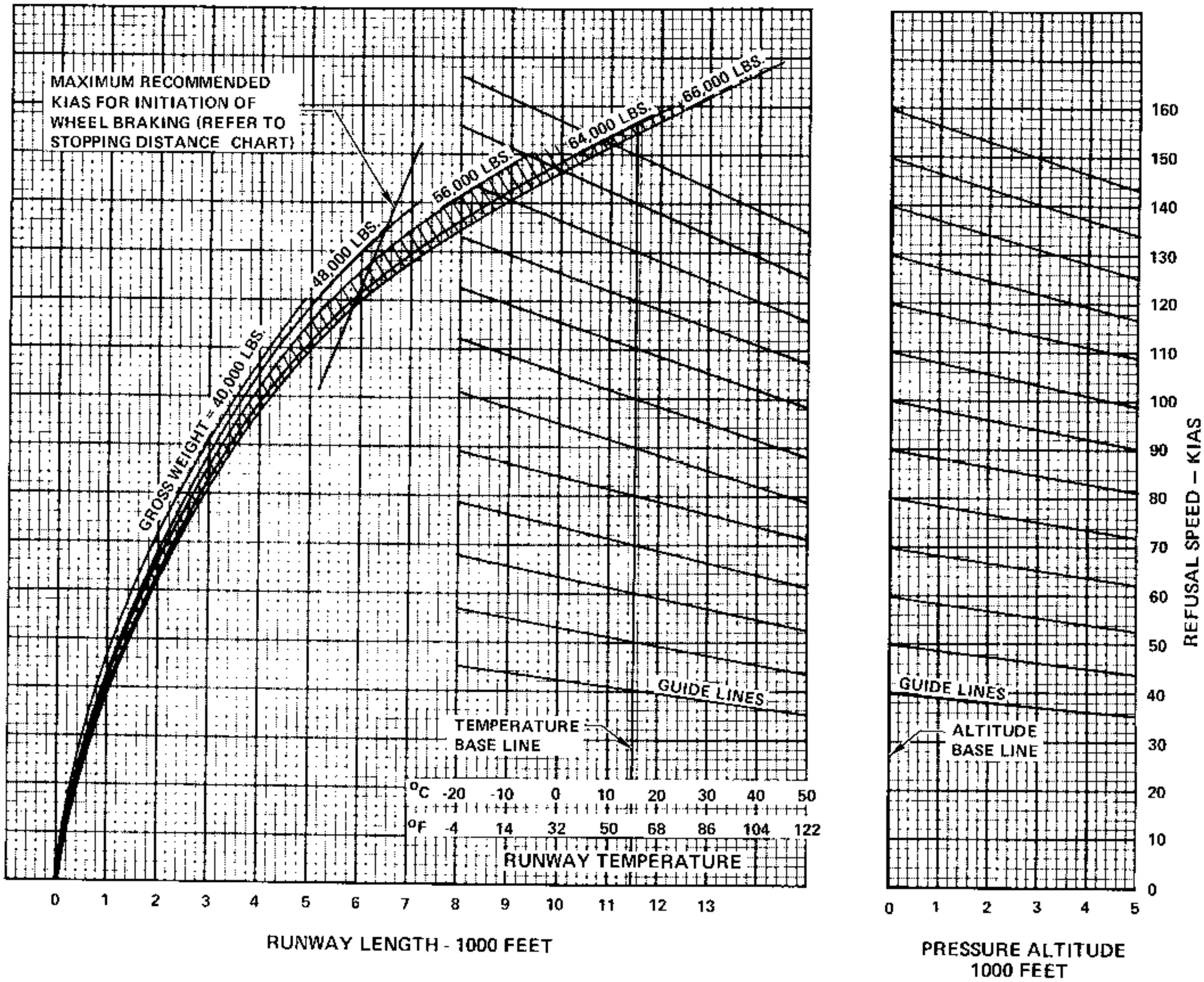
REFUSAL SPEEDS

ALL CONFIGURATIONS
ZERO WIND
(HARD SURFACE RUNWAY)

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NR69H-2)
DATE: 15 JUNE 1970

ENGINES: (2) J79-GE-10 (-8)*
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB./GAL.
*SEE NOTE 5.

MILITARY THRUST
FLAPS 30°/DROOPS 25°



NOTE:

1. INCREASE REFUSAL SPEEDS BY 7 KNOTS FOR EACH 10 KNOTS OF HEADWIND.
2. TO FIND DISTANCE TO ACCELERATE TO REFUSAL SPEED, ENTER THE TAKE-OFF DATA SUMMARY CHART (MIL) WITH REFUSAL SPEED AND READ ACCELERATION DISTANCE.
3. MAXIMUM THRUST IS RECOMMENDED FOR TAKE-OFFS IN EXCESS OF 56,000 POUNDS.
4. FOR WET RUNWAY CONDITIONS, REDUCE THE REFUSAL SPEEDS SHOWN BY 15 KNOTS.
5. FOR AIRCRAFT HAVING AFC 328 COMPLIED WITH AND J79-GE-8 ENGINES INSTALLED, SEE FIGURE 11-12.

RA-5C-1-93-58A

Figure 11-18

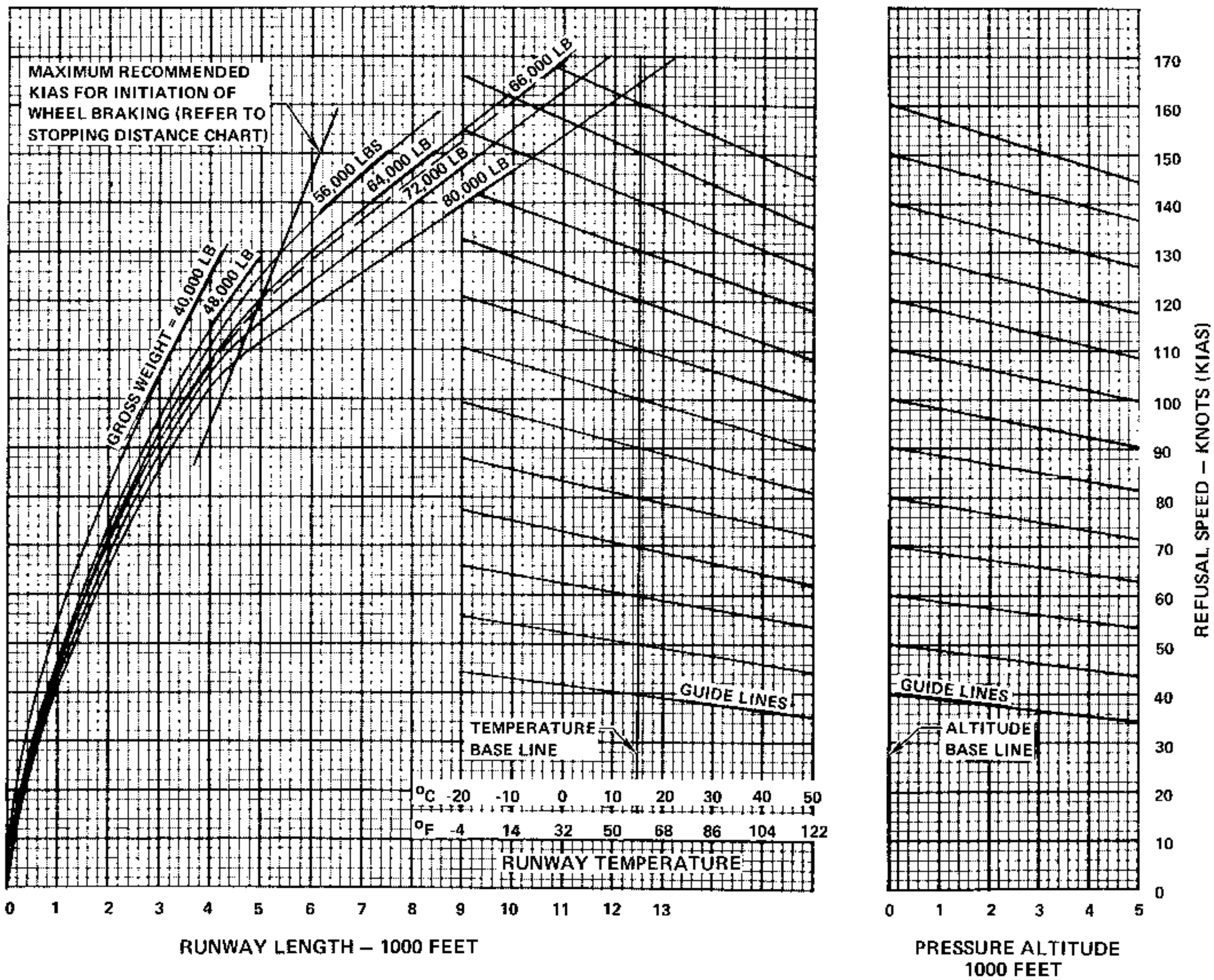
REFUSAL SPEEDS

ALL CONFIGURATIONS
ZERO WIND
(HARD SURFACE RUNWAY)

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NR69H-2)
DATE: 15 JUNE 1970

ENGINES: (2) J79-GE-10 (-8)*
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8LB/GAL.
*SEE NOTE 4.

MAXIMUM THRUST
FLAPS 30°/DROOPS 25°



NOTE:

1. INCREASE REFUSAL SPEEDS BY 7 KNOTS FOR EACH 10 KNOTS OF DIRECT HEADWIND.
2. TO FIND DISTANCE TO ACCELERATE TO REFUSAL SPEED, ENTER THE TAKE-OFF DATA SUMMARY CHART (MAX) WITH REFUSAL SPEED AND READ ACCELERATION DISTANCE.
3. FOR WET RUNWAY CONDITIONS, REDUCE THE REFUSAL SPEEDS BY 13 KNOTS.
4. FOR AIRCRAFT HAVING AFC 328 COMPLIED WITH AND J79-GE-8 ENGINES INSTALLED, SEE FIGURE 11-13.

RA-5C-1-93-53A

Figure 11-19

PART 3 — CLIMB

MILITARY AND MAXIMUM THRUST CLIMB CHARTS

From the Climb charts (figures 11-20 through 11-25), the time, the distance traveled, and the fuel consumed can be determined for Military and Maximum Thrust climbs. At altitudes above 30,000 feet, an rpm decrease of as much as 8% can be expected when operating in Normal, Military, or Maximum Thrust at subsonic Mach numbers. This is because of the engine speed temperature cutoff control which retards rpm when the compressor inlet total temperature drops below approximately 41°F (5°C) to provide necessary engine compressor stall margin. To reduce engine rpm decay (rollback) during afterburner light-off and to improve engine acceleration characteristics during high compressor bleed rates encountered with BLC operation, a speed derivative feature is incorporated in the J79-GE-8 engine. A revised schedule of EGT versus rpm that allows the engine to operate at a higher EGT for the same rpm has been incorporated to improve military power performance at altitude. The recommended climb schedule is tabulated on each graph and the best cruise altitude, cruise ceiling, and service ceiling are also given. No allowances are made for starting, taxi, and take-off. Notes are included on the charts to cover fuel and time allowance from brake release to best climb speed. The example included on the Military Thrust Climb (no external load) chart illustrates the use of these charts, starting at an initial pressure altitude of sea level. To determine the fuel used in a climb from one altitude to another, enter the chart at the initial gross weight and move up vertically to the initial pressure altitude. Follow the guide lines to the final pressure altitude and read the final gross weight vertically below this point. The difference between the initial and final gross weights represents the fuel consumed during the climb. The distance traveled and time to climb from one altitude to another are obtained by taking increments in distance and time from the left and right sides of the chart. Refer to the example shown on the chart. Military Thrust climbs should be made when maximum range is desired. See figures 11-27 through 11-30 for climb data for J79-GE-10 engines.

MILITARY THRUST RATE OF CLIMB

Two-engine take-off rate of climb (sea level, gear down, 50°/50° flap/droop configuration) for Standard, Tropical, and Hot Days, utilizing Military Thrust is presented in figure 11-26 for the J79-GE-8 engine and figure 11-31 for the J79-GE-10 engine. Gross weights of 46,000, 48,000 and 50,000 pounds versus indicated airspeeds and units angle of attack are included in the plots. The bank angle effect of deviations from wings level flight may be determined by using the bank angle effect graph on the left side of the chart. Take-off rate of climb may be determined by entering the chart at indicated airspeed, extend vertically to the gross weight curve, read units angle of attack, and extend left to read rate of climb in hundreds of feet per minute. Bank angle effect can be determined by extending left to the wings level baseline, following guide lines to the bank angle desired, then horizontally right to read corrected rate of climb.

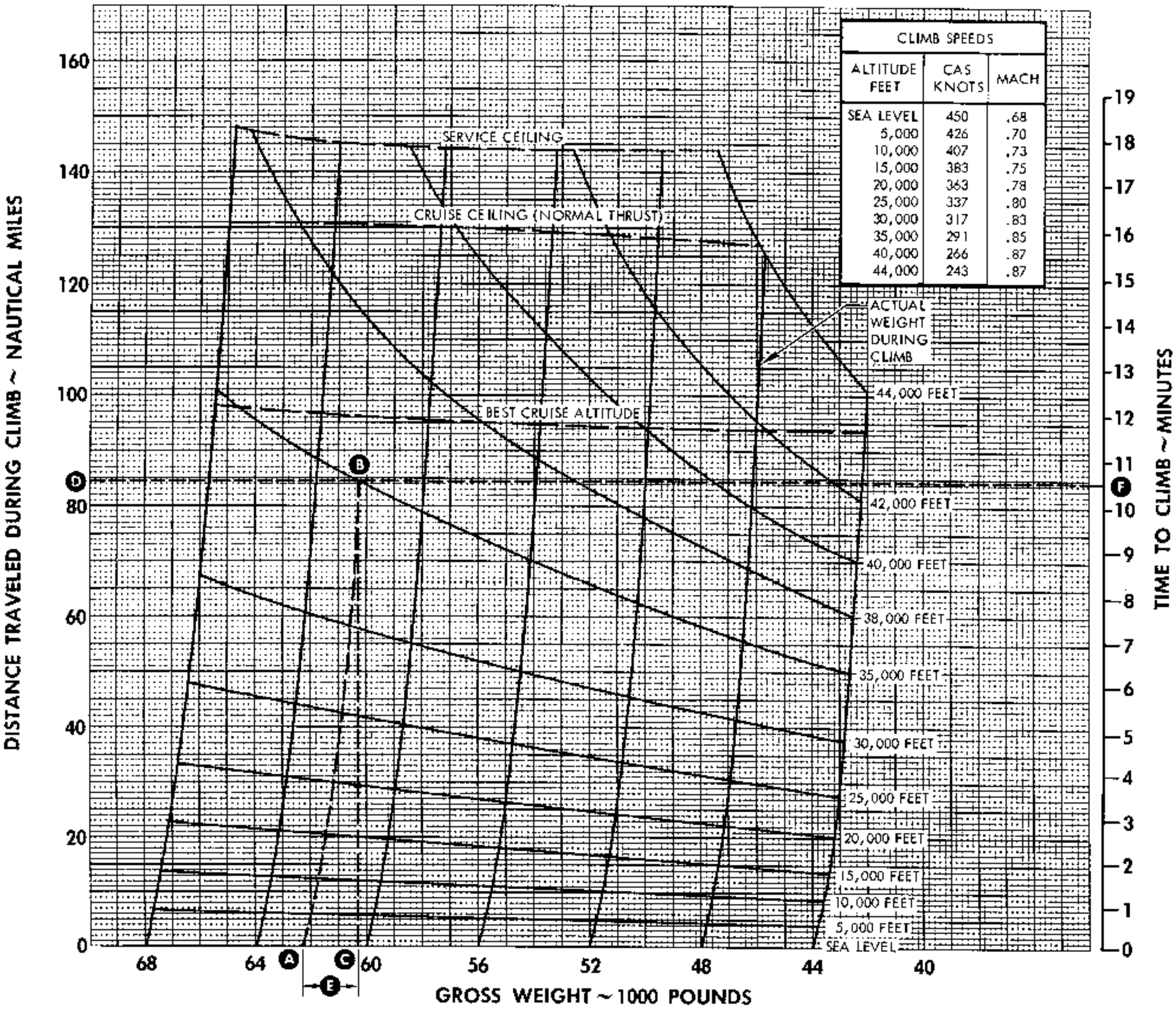
If an engine failure occurs while in this configuration, the resulting rate of climb that can be obtained by applying maximum afterburner to the good engine and selecting 30°/25° flap/droop configuration may be determined by referring to the single-engine take-off rate-of-climb charts.

MILITARY THRUST CLIMB

RECONNAISSANCE CONFIGURATION
NO EXTERNAL LOAD
STANDARD DAY
DROOPS—CRUISE

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NA63H-2)
DATE: 1 JULY 1963

ENGINES: (2) J79-GE-8
FUEL GRADE: MIL-J-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL



CLIMB SPEEDS		
ALTITUDE FEET	CAS KNOTS	MACH
SEA LEVEL	450	.68
5,000	426	.70
10,000	407	.73
15,000	383	.75
20,000	363	.78
25,000	337	.80
30,000	317	.83
35,000	291	.85
40,000	266	.87
44,000	243	.87

NOTE:

1. DECREASE ATTACK CONFIGURATION GROSS WEIGHT BY 2500 POUNDS AND ENTER CHART WITH THE ADJUSTED WEIGHT TO OBTAIN ATTACK CONFIGURATION CLIMB PERFORMANCE.
2. INCREASE GROSS WEIGHT BY 4000 POUNDS WHEN ENTERING CHART FOR 10°C RISE IN AMBIENT TEMPERATURE ABOVE STANDARD DAY CONDITIONS. APPLY SAME CORRECTION IN OPPOSITE DIRECTION FOR 10°C AMBIENT TEMPERATURE BELOW STANDARD DAY CONDITIONS.
3. TIME, FUEL AND DISTANCE START FROM SEA LEVEL AT CLIMB SPEED. ADD APPROXIMATELY TWO MINUTES AND 800 POUNDS FOR TIME AND FUEL FROM BRAKE RELEASE TO CLIMB SPEED FOR MILITARY THRUST TAKE-OFF.
4. FOR MAXIMUM THRUST TAKE-OFF AND ACCELERATION FROM BRAKE RELEASE TO CLIMB SPEED ADD APPROXIMATELY ONE MINUTE AND 900 POUNDS TO TIME AND FUEL.

EXAMPLE:

TAKE-OFF GROSS WEIGHT (63,500 POUNDS)

- A INITIAL GROSS WEIGHT AT BEST CLIMB SPEED (62,300 POUNDS; 63,500 POUNDS MINUS 1200 POUNDS TAKE-OFF ALLOWANCE)
- B FINAL PRESSURE ALTITUDE (35,000 FEET)
- C FINAL GROSS WEIGHT (60,300 POUNDS
- D DISTANCE TRAVELED DURING CLIMB (84.5 NAUTICAL MILES)
- E FUEL USED DURING CLIMB FROM SEA LEVEL (2000 POUNDS)
- F TIME REQUIRED TO CLIMB (10.5 MINUTES)

A-5C-1A-93-3B

Figure 11-20

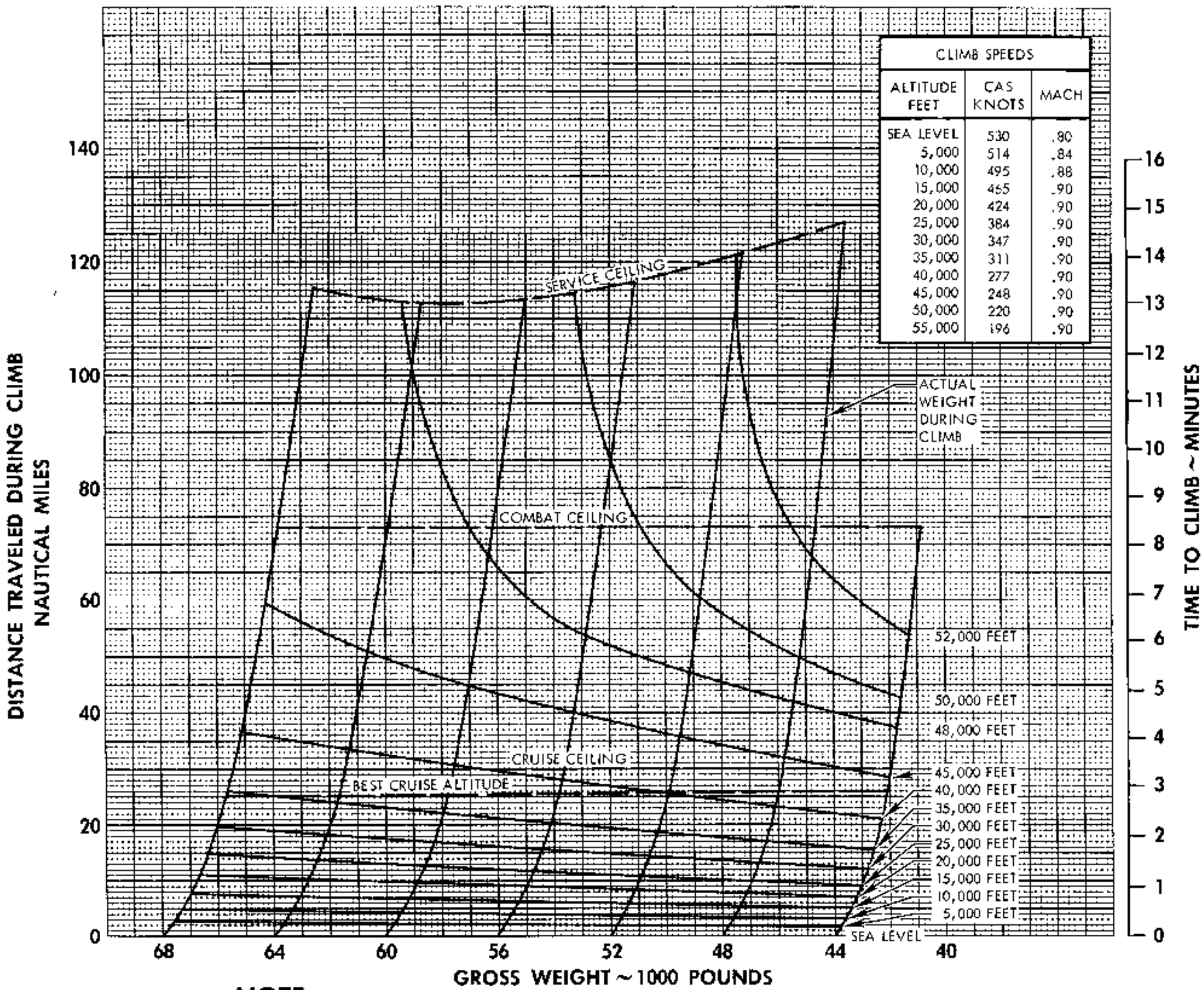
MAXIMUM THRUST CLIMB

RECONNAISSANCE CONFIGURATION

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NA63H-2)
DATE: 1 JULY 1963

NO EXTERNAL LOAD
STANDARD DAY

ENGINES: (2) J79-GE-8
FUEL GRADE: MIL-F-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL



CLIMB SPEEDS

ALTITUDE FEET	CAS KNOTS	MACH
SEA LEVEL	530	.80
5,000	514	.84
10,000	495	.88
15,000	465	.90
20,000	424	.90
25,000	384	.90
30,000	347	.90
35,000	311	.90
40,000	277	.90
45,000	248	.90
50,000	220	.90
55,000	196	.90

NOTE:

1. DECREASE ATTACK CONFIGURATION GROSS WEIGHT BY 3000 POUNDS AND ENTER CHART WITH THE ADJUSTED WEIGHT TO OBTAIN ATTACK CONFIGURATION CLIMB PERFORMANCE.
2. INCREASE GROSS WEIGHT BY 4000 POUNDS WHEN ENTERING CHART FOR 10°C RISE IN AMBIENT TEMPERATURE ABOVE STANDARD DAY CONDITIONS. APPLY SAME CORRECTION IN OPPOSITE DIRECTION FOR 10°C AMBIENT TEMPERATURE BELOW STANDARD DAY CONDITIONS.
3. TIME, FUEL AND DISTANCE START FROM SEA LEVEL AT CLIMB SPEED. ADD APPROXIMATELY ONE MINUTE AND 1000 POUNDS FOR TIME AND FUEL FROM BRAKE RELEASE TO CLIMB SPEED FOR MAXIMUM THRUST TAKE-OFF.
4. SUPERSONIC DROOPS TO 25,000 FEET, CRUISE DROOPS ABOVE 25,000 FEET.

A-5C-1A-93-4A

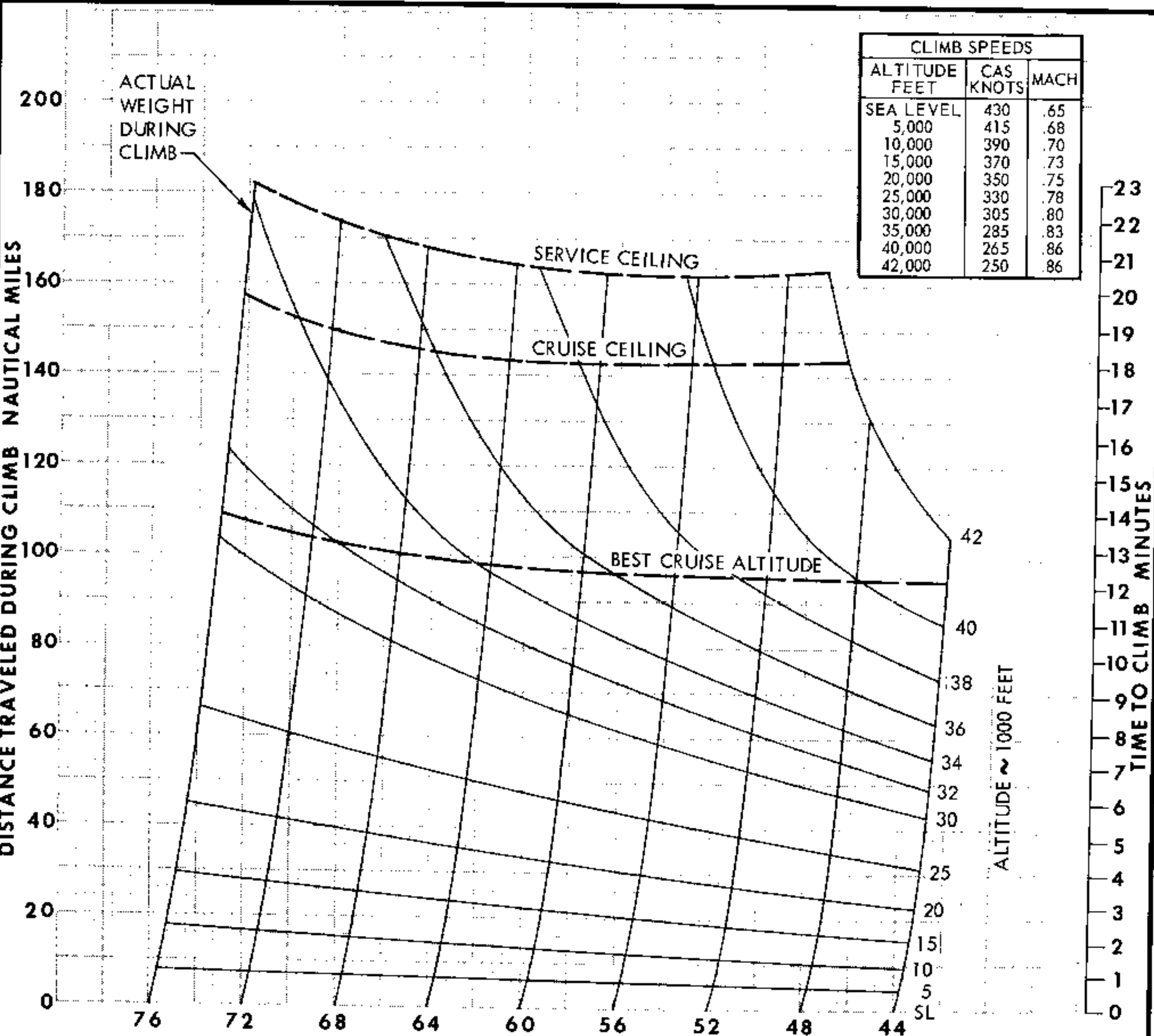
Figure 11-21

MILITARY THRUST CLIMB

RECONNAISSANCE CONFIGURATION
TWO 400-GALLON DROP TANKS
STANDARD DAY
DROOPS—CRUISE

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NA63H-2)
DATE: 1 MAY 1964

ENGINES: (2) J79-GE-8
FUEL GRADE: MIL-J-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL



CLIMB SPEEDS		
ALTITUDE FEET	CAS KNOTS	MACH
SEA LEVEL	430	.65
5,000	415	.68
10,000	390	.70
15,000	370	.73
20,000	350	.75
25,000	330	.78
30,000	305	.80
35,000	285	.83
40,000	265	.86
42,000	250	.86

NOTE:

1. TIME, FUEL AND DISTANCE START FROM SEA LEVEL AT CLIMB SPEED. ADD APPROXIMATELY TWO MINUTES AND 800 POUNDS FOR TIME AND FUEL FROM BRAKE RELEASE TO CLIMB SPEED FOR MILITARY THRUST TAKE-OFF.
2. FOR MAXIMUM THRUST TAKE-OFF AND ACCELERATION FROM BRAKE RELEASE TO CLIMB SPEED ADD APPROXIMATELY 1.5 MINUTES AND 1000 POUNDS TO TIME AND FUEL.

EXTERNAL CONFIGURATION	*EQUIVALENT WEIGHT ADJUSTMENT
(2) FLASHER PODS	2000 POUNDS - DECREASE
ATTACK CONFIGURATION (RECONNAISSANCE POD REMOVED) (2) 400 GAL. DROP TANKS	2500 POUNDS - DECREASE
AMBIENT TEMPERATURE	
10°C HOTTER THAN STD DAY	4000 POUNDS - INCREASE
10°C COLDER THAN STD DAY	4000 POUNDS - DECREASE

*APPLY WEIGHT ADJUSTMENT TO RESPECTIVE AIRCRAFT CONFIGURATION WEIGHT TO OBTAIN EQUIVALENT WEIGHT FOR ENTERING CHART.

A-5C-1A-93-93A

Figure 11-22

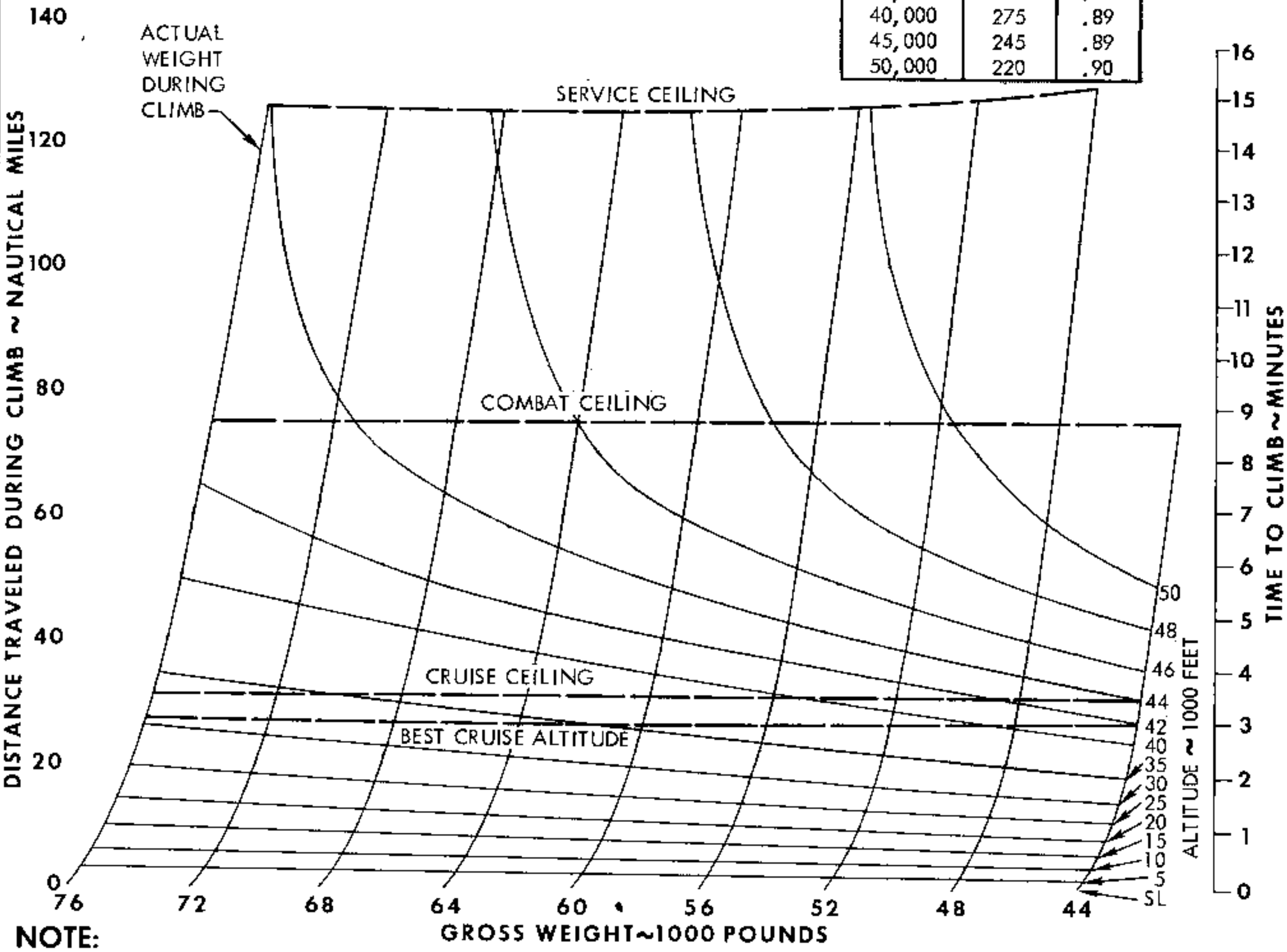
MAXIMUM THRUST CLIMB

RECONNAISSANCE CONFIGURATION
TWO 400-GALLON DROP TANKS
STANDARD DAY

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NA63H-2)
DATE: 1 MAY 1964

ENGINES: (2) J79-GE-8
FUEL GRADE: MIL-J-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL

CLIMB SPEEDS		
ALTITUDE FEET	CAS KNOTS	MACH
SEA LEVEL	530	.80
5,000	515	.84
10,000	495	.88
15,000	460	.89
20,000	420	.89
25,000	380	.89
30,000	345	.89
35,000	305	.89
40,000	275	.89
45,000	245	.89
50,000	220	.90



NOTE:

1. DECREASE ATTACK CONFIGURATION GROSS WEIGHT BY 3000 POUNDS AND ENTER CHART WITH THE ADJUSTED WEIGHT TO OBTAIN ATTACK CONFIGURATION CLIMB PERFORMANCE.
2. INCREASE GROSS WEIGHT BY 4000 POUNDS WHEN ENTERING CHART FOR 10°C RISE IN AMBIENT TEMPERATURE ABOVE STANDARD DAY CONDITIONS. APPLY SAME CORRECTION IN OPPOSITE DIRECTION FOR 10°C AMBIENT TEMPERATURE BELOW STANDARD DAY CONDITIONS.
3. TIME, FUEL AND DISTANCE START FROM SEA LEVEL AT CLIMB SPEED. ADD APPROXIMATELY 1.5 MINUTES AND 1200 POUNDS FOR TIME AND FUEL FROM BRAKE RELEASE TO CLIMB SPEED FOR MAXIMUM THRUST TAKE-OFF.
4. SUPERSONIC DROOPS TO 25,000 FEET, CRUISE DROOPS ABOVE 25,000 FEET.

A-5C-1A-93-89

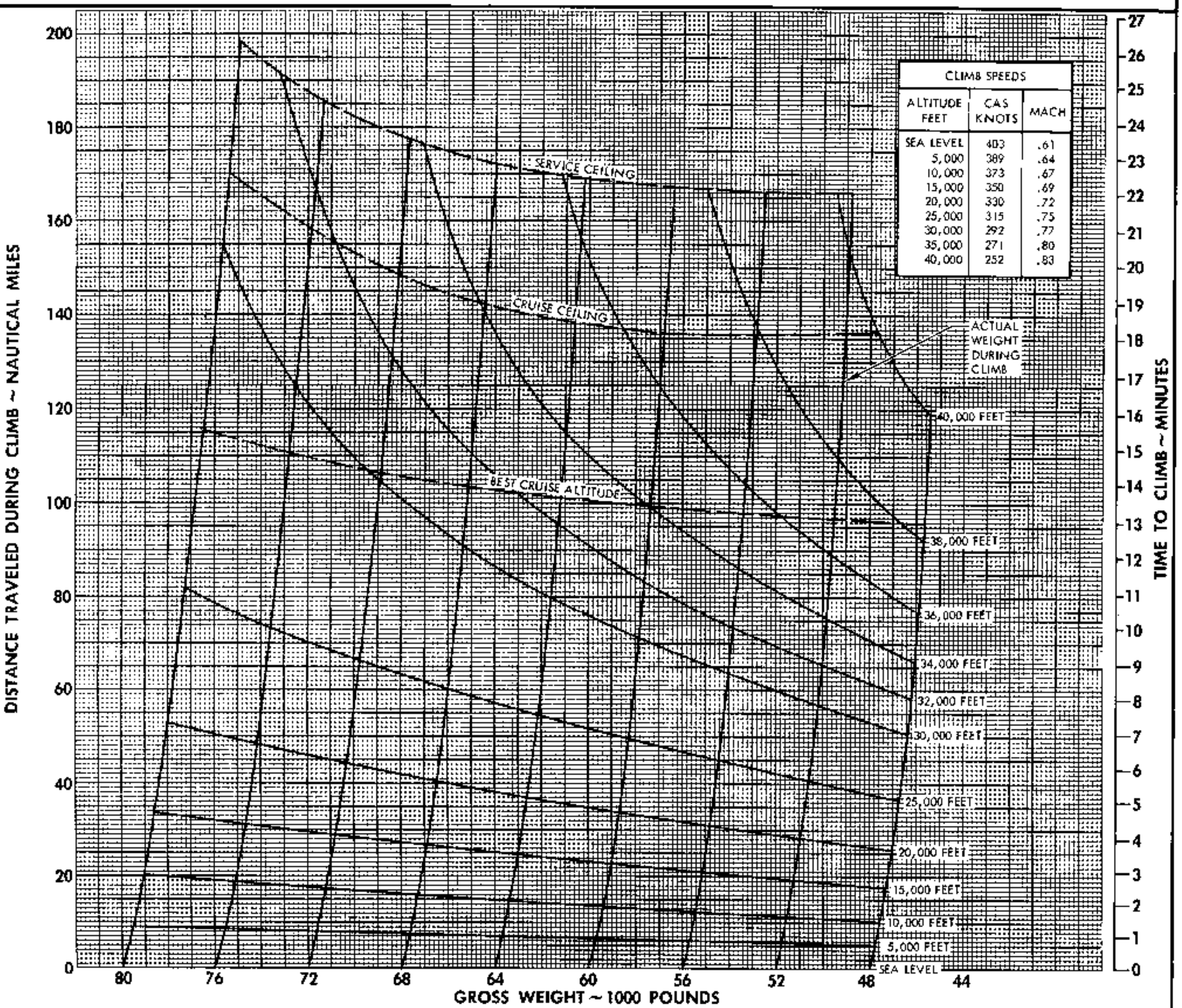
Figure 11-23

MILITARY THRUST CLIMB

RECONNAISSANCE CONFIGURATION
FOUR 400 GALLON DROP TANKS
STANDARD DAY
DROOPS—CRUISE

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NA63H-2)
DATE: 1 JULY 1963

ENGINES: (2) J79-GE-8
FUEL GRADE: MIL-J-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL



CLIMB SPEEDS		
ALTITUDE FEET	CAS KNOTS	MACH
SEA LEVEL	403	.61
5,000	389	.64
10,000	373	.67
15,000	350	.69
20,000	330	.72
25,000	315	.75
30,000	292	.77
35,000	271	.80
40,000	252	.83

EXTERNAL CONFIGURATION	* EQUIVALENT WEIGHT ADJUSTMENT
(2) FLASHER PODS AND (2) 400 GALLON TANKS	2000 POUNDS DECREASE
ATTACK CONFIGURATION (RECONNAISSANCE POD REMOVED) (4) 400 GALLON TANKS	2500 POUNDS DECREASE
AMBIENT TEMPERATURE	
10°C HOTTER THAN STD DAY	4000 POUNDS INCREASE
10°C COLDER THAN STD DAY	4000 POUNDS DECREASE

* APPLY WEIGHT ADJUSTMENT TO RESPECTIVE AIRCRAFT CONFIGURATION WEIGHT TO OBTAIN EQUIVALENT WEIGHT FOR ENTERING CHART

NOTE:

1. TIME, FUEL AND DISTANCE START FROM SEA LEVEL AT CLIMB SPEED. ADD APPROXIMATELY TWO MINUTES AND 800 POUNDS FOR TIME AND FUEL FROM BRAKE RELEASE TO CLIMB SPEED FOR MILITARY THRUST TAKE-OFF.
2. FOR MAXIMUM THRUST TAKE-OFF AND ACCELERATION FROM BRAKE RELEASE TO CLIMB SPEED ADD APPROXIMATELY 1.5 MINUTES AND 1000 POUNDS TO TIME AND FUEL.

A-5C-1A-93-78

Figure 11-24

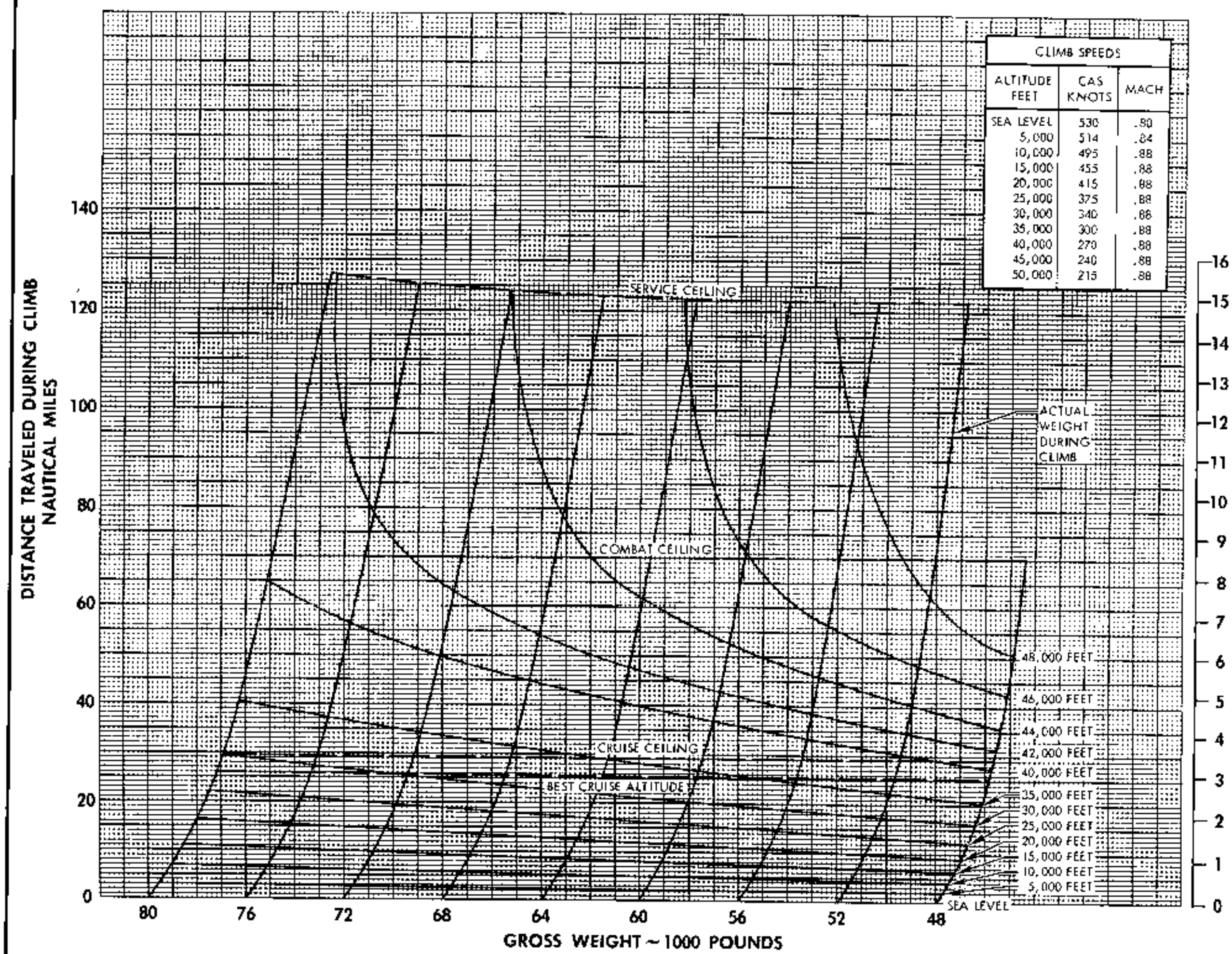
MAXIMUM THRUST CLIMB

RECONNAISSANCE CONFIGURATION

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NA63H-2)
DATE: 1 JULY 1963

FOUR 400 GALLON DROP TANKS
STANDARD DAY

ENGINES: (2) J79-GE-8
FUEL GRADE: MIL-J-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL



CLIMB SPEEDS

ALTITUDE FEET	CAS KNOTS	MACH
SEA LEVEL	530	.80
5,000	514	.84
10,000	495	.88
15,000	455	.88
20,000	415	.88
25,000	375	.88
30,000	340	.88
35,000	300	.88
40,000	270	.88
45,000	240	.88
50,000	215	.88

NOTE:

1. DECREASE ATTACK CONFIGURATION GROSS WEIGHT BY 3000 POUNDS AND ENTER CHART WITH THE ADJUSTED WEIGHT TO OBTAIN ATTACK CONFIGURATION CLIMB PERFORMANCE.
2. INCREASE GROSS WEIGHT BY 4000 POUNDS WHEN ENTERING CHART FOR 10°C RISE IN AMBIENT TEMPERATURE ABOVE STANDARD DAY CONDITIONS. APPLY SAME CORRECTION IN OPPOSITE DIRECTION FOR 10°C AMBIENT TEMPERATURE BELOW STANDARD DAY CONDITIONS.
3. TIME, FUEL AND DISTANCE START FROM SEA LEVEL AT CLIMB SPEED. ADD APPROXIMATELY 1.5 MINUTES AND 1200 POUNDS FOR TIME AND FUEL FROM BRAKE RELEASE TO CLIMB SPEED FOR MAXIMUM THRUST TAKE-OFF.
4. SUPERSONIC DROOPS TO 25,000 FEET, CRUISE DROOPS ABOVE 25,000 FEET.

A-5C-1A-93-6A

Figure 11-25

MILITARY THRUST RATE OF CLIMB

FLAPS 50°/DROOPS 50°

GEAR DOWN

SEA LEVEL

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NA 63H-2)
DATE: 15 JUNE 1969

ENGINES: (2) J79-GE-8
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL

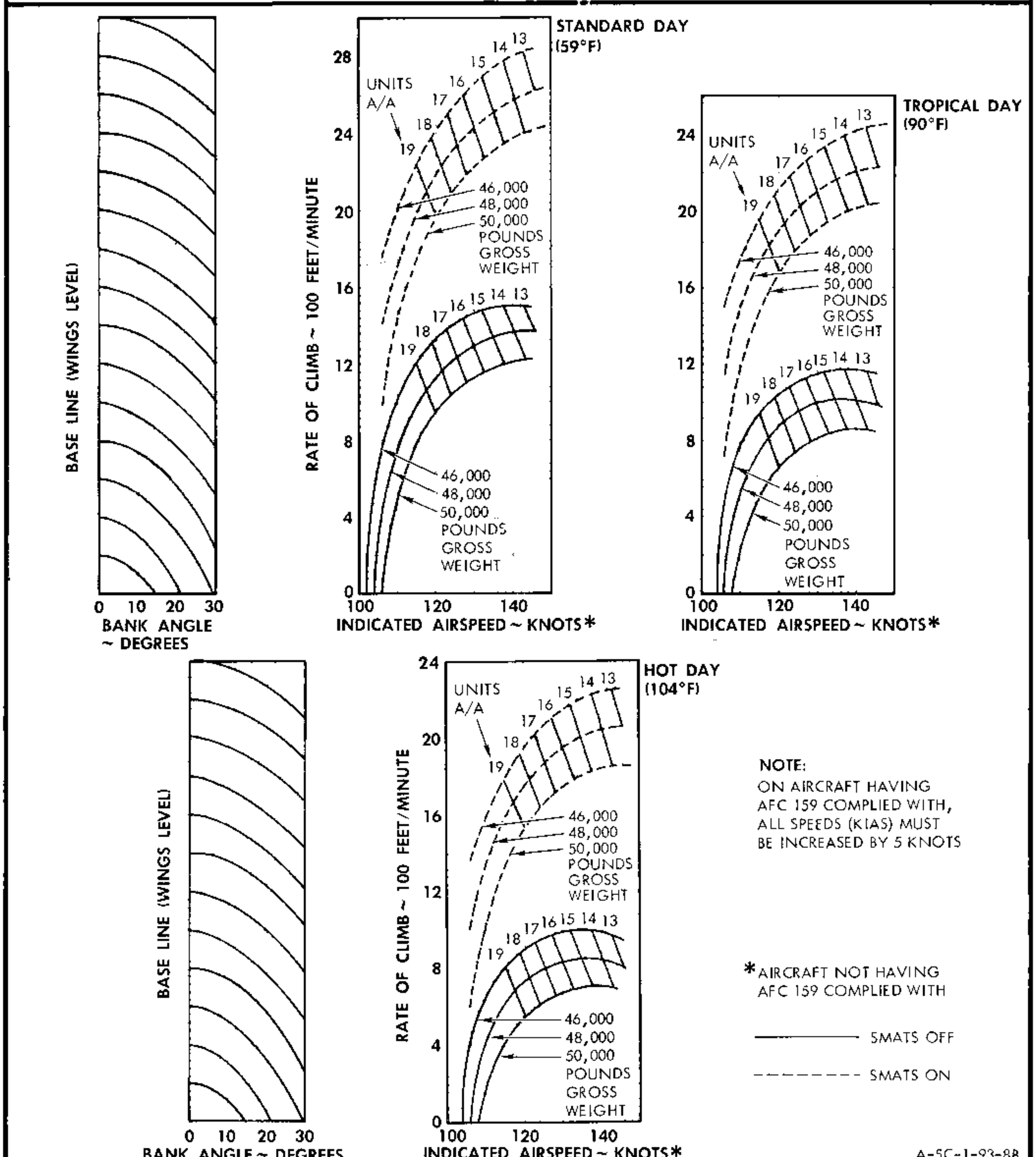


Figure 11-26

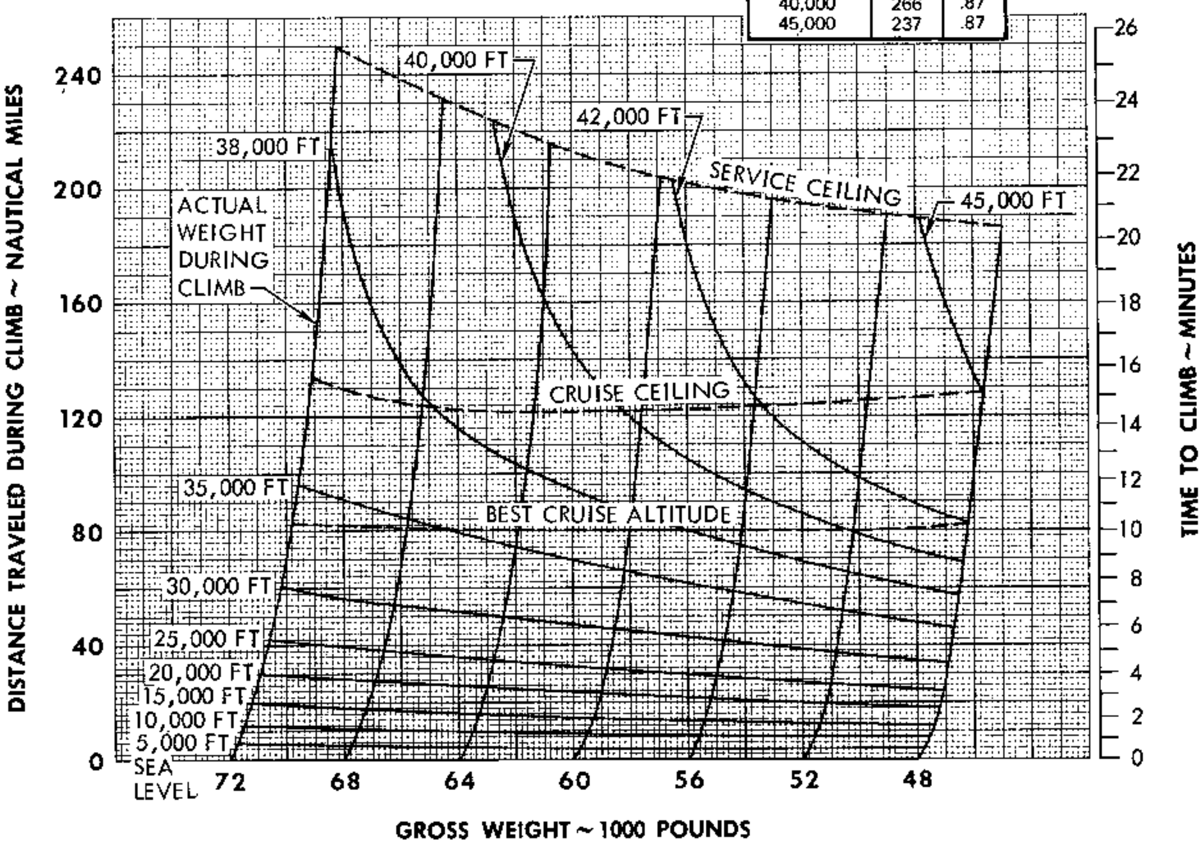
MILITARY THRUST CLIMB

RECONNAISSANCE CONFIGURATION
NO EXTERNAL LOAD
STANDARD DAY
DROOPS CRUISE

MODEL: RA-5C
BASED ON: **FLIGHT TEST DATA** (NR69H-2)
DATE: 1 JULY 1969

ENGINES: (2) J79-GE-10 (-8)*
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL
*SEE NOTE 4

CLIMB SPEEDS		
ALTITUDE FEET	CAS KNOTS	MACH
SEA LEVEL	449	.68
5,000	429	.70
10,000	405	.73
15,000	383	.75
20,000	361	.77
25,000	336	.80
30,000	313	.82
35,000	289	.84
40,000	266	.87
45,000	237	.87



NOTE:

1. INCREASE GROSS WEIGHT BY 4000 POUNDS WHEN ENTERING CHART FOR 10°C RISE IN AMBIENT TEMPERATURE ABOVE STANDARD DAY CONDITIONS. APPLY SAME CORRECTION IN OPPOSITE DIRECTION FOR 10°C AMBIENT TEMPERATURE BELOW STANDARD DAY CONDITIONS.
2. TIME, FUEL AND DISTANCE START FROM SEA LEVEL AT CLIMB SPEED. ADD APPROXIMATELY TWO MINUTES AND 600 POUNDS FOR TIME AND FUEL FROM BRAKE RELEASE TO CLIMB SPEED FOR MILITARY THRUST TAKE-OFF.
3. FOR MAXIMUM THRUST TAKE-OFF AND ACCELERATION FROM BRAKE RELEASE TO CLIMB SPEED ADD APPROXIMATELY ONE MINUTE AND 1000 POUNDS TO TIME AND FUEL.
4. FOR AIRCRAFT HAVING AFC 328 COMPLIED WITH AND J79-GE-8 ENGINES INSTALLED, SEE FIGURE 11-20.

A-5C-1A-93-132A

Figure 11-27

MAXIMUM THRUST CLIMB

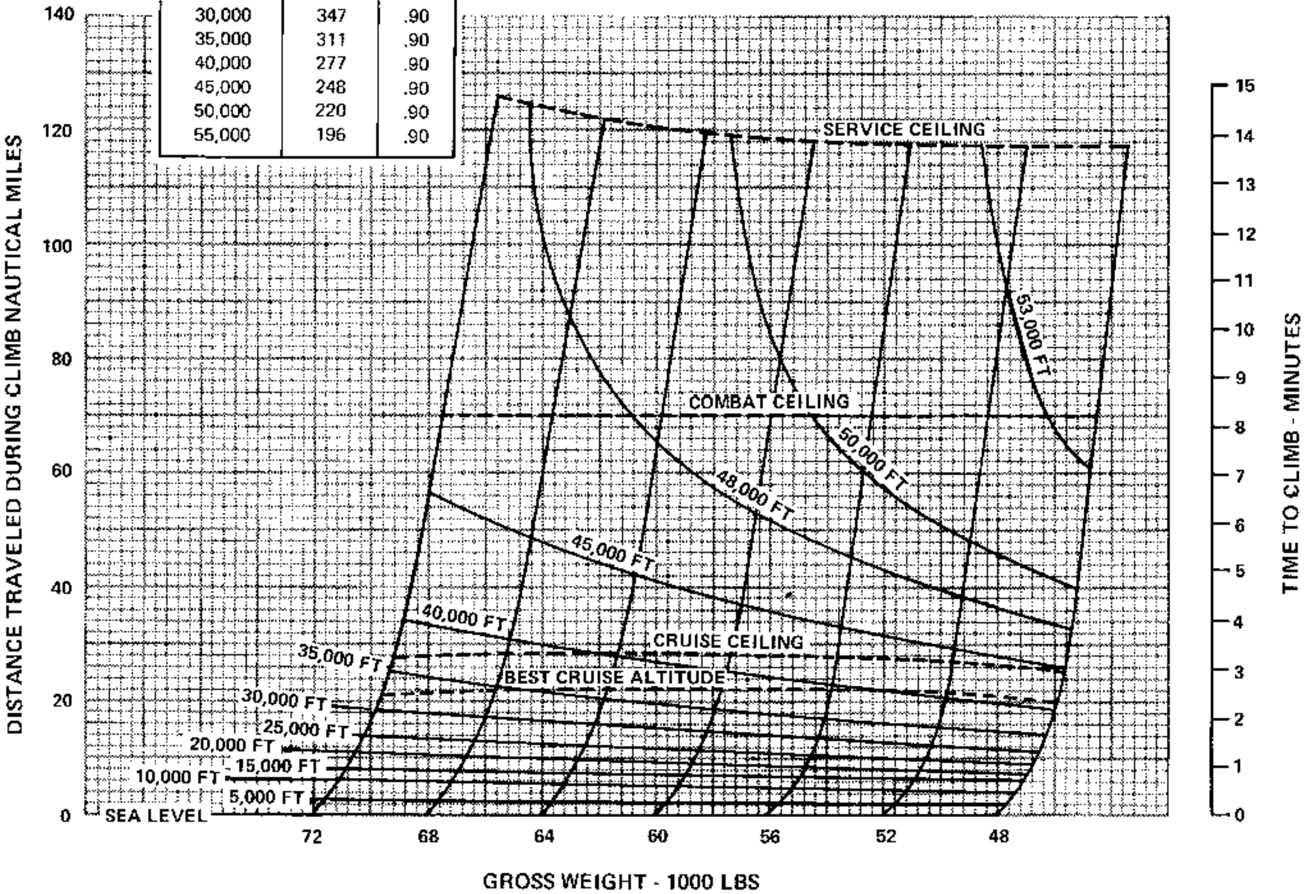
RECONNAISSANCE CONFIGURATION

NO EXTERNAL LOAD

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NR69H-2)
DATE: 15 JUNE, 1970

ENGINE: (2) J79-GE-10 (-8)*
FUEL GRADE MIL-T-5624 (JP-5)
FUEL DENSITY 6.8 LB/GAL
*SEE NOTE 4

CLIMB SPEEDS		
ALTITUDE FEET	CAS KNOTS	MACH
SEA LEVEL	530	.80
5,000	514	.84
10,000	495	.88
15,000	465	.90
20,000	424	.90
25,000	384	.90
30,000	347	.90
35,000	311	.90
40,000	277	.90
45,000	248	.90
50,000	220	.90
55,000	196	.90



NOTE:

1. INCREASE GROSS WEIGHT BY 4000 LBS. WHEN ENTERING CHART FOR 10°C RISE IN AMBIENT TEMPERATURE ABOVE STANDARD DAY CONDITIONS. APPLY SAME CORRECTION IN OPPOSITE DIRECTION FOR 10°C AMBIENT TEMPERATURE BELOW STANDARD DAY CONDITIONS.
2. TIME, FUEL AND DISTANCE START FROM SEA LEVEL AT CLIMB SPEED. ADD APPROXIMATELY ONE MINUTE AND 1000 POUNDS FOR TIME AND FUEL FROM BRAKE RELEASE TO CLIMB SPEED FOR MAXIMUM THRUST TAKE-OFF.
3. SUPERSONIC DROOPS TO 30,000 FEET, CRUISE DROOPS ABOVE 30,000 FEET.
4. FOR AIRCRAFT HAVING AFC 328 COMPLIED WITH AND J79-GE-8 ENGINES INSTALLED, SEE FIGURE 11-21.

RA-5C-1-93-76A

Figure 11-28

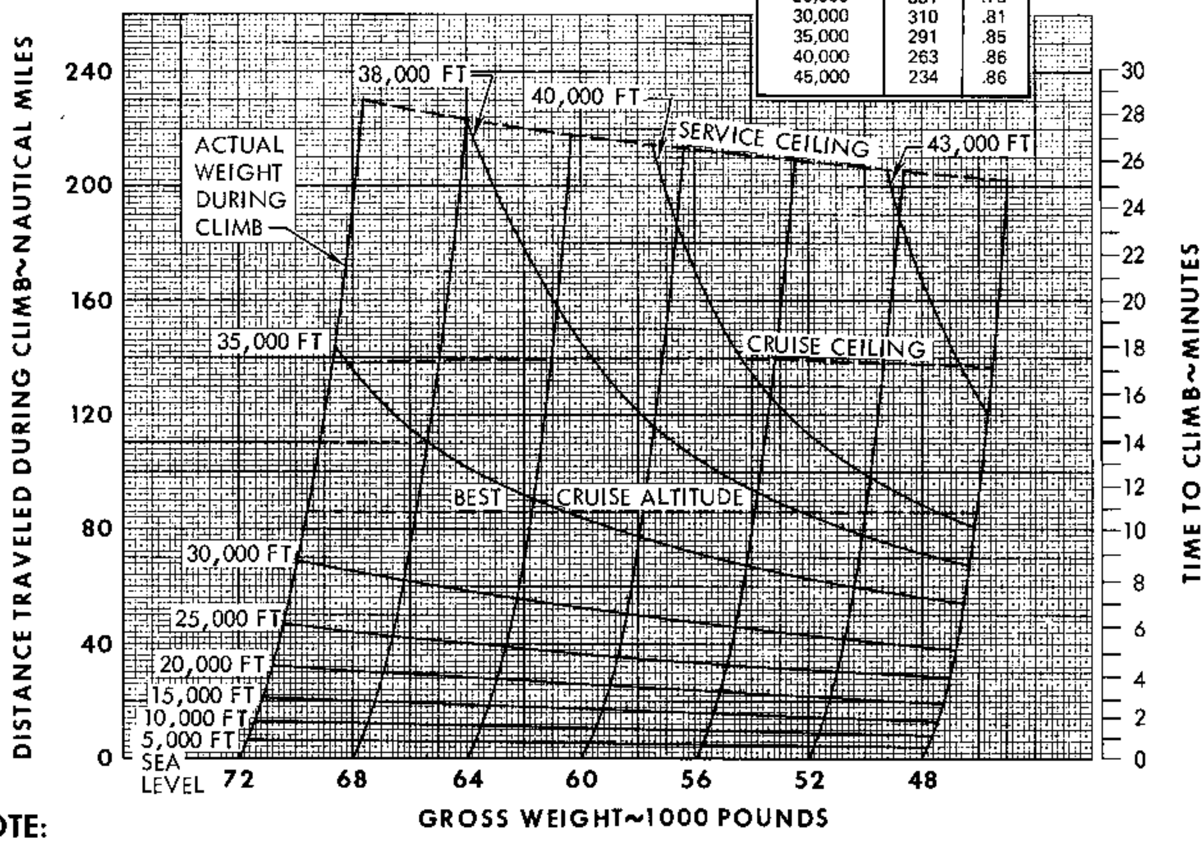
MILITARY THRUST CLIMB

RECONNAISSANCE CONFIGURATION
TWO 400-GALLON DROP TANKS
STANDARD DAY
DROOPS - CRUISE

MODEL RA-5C
BASED ON: **FLIGHT TEST DATA** (NR69H-2)
DATE: 1 JULY 1969

ENGINES: (2) J79-GE-10 (-8)*
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB GAL
*SEE NOTE 4

CLIMB SPEEDS		
ALTITUDE FEET	CAS KNOTS	MACH
SEA LEVEL	423	.64
5,000	407	.67
10,000	390	.70
15,000	370	.73
20,000	351	.75
25,000	331	.78
30,000	310	.81
35,000	291	.85
40,000	263	.86
45,000	234	.86



NOTE:

1. TIME, FUEL AND DISTANCE START FROM SEA LEVEL AT CLIMB SPEED. ADD APPROXIMATELY TWO MINUTES AND 600 POUNDS FOR TIME AND FUEL FROM BRAKE RELEASE TO CLIMB SPEED FOR MILITARY THRUST TAKE-OFF.

2. FOR MAXIMUM THRUST TAKE-OFF AND ACCELERATION FROM BRAKE RELEASE TO CLIMB SPEED ADD APPROXIMATELY 1.5 MINUTES AND 1500 POUNDS TO TIME AND FUEL.

3. INCREASE GROSS WEIGHT BY 4000 POUNDS WHEN ENTERING CHART FOR 10°C RISE IN AMBIENT TEMPERATURE ABOVE STANDARD DAY CONDITIONS. APPLY SAME CORRECTION IN OPPOSITE DIRECTION FOR 10°C AMBIENT TEMPERATURE BELOW STANDARD DAY CONDITIONS.

EXTERNAL CONFIGURATION	†EQUIVALENT WEIGHT ADJUSTMENT
(2) FLASHER PODS	2000 POUNDS DECREASE

† APPLY WEIGHT ADJUSTMENT TO AIRCRAFT CONFIGURATION WEIGHT TO OBTAIN EQUIVALENT WEIGHT FOR ENTERING CHART

4. FOR AIRCRAFT HAVING AFC 328 COMPLIED WITH AND J79-GE-8 ENGINES INSTALLED, SEE FIGURE 11-22.

A-5C-1A-93-133A

Figure 11-29

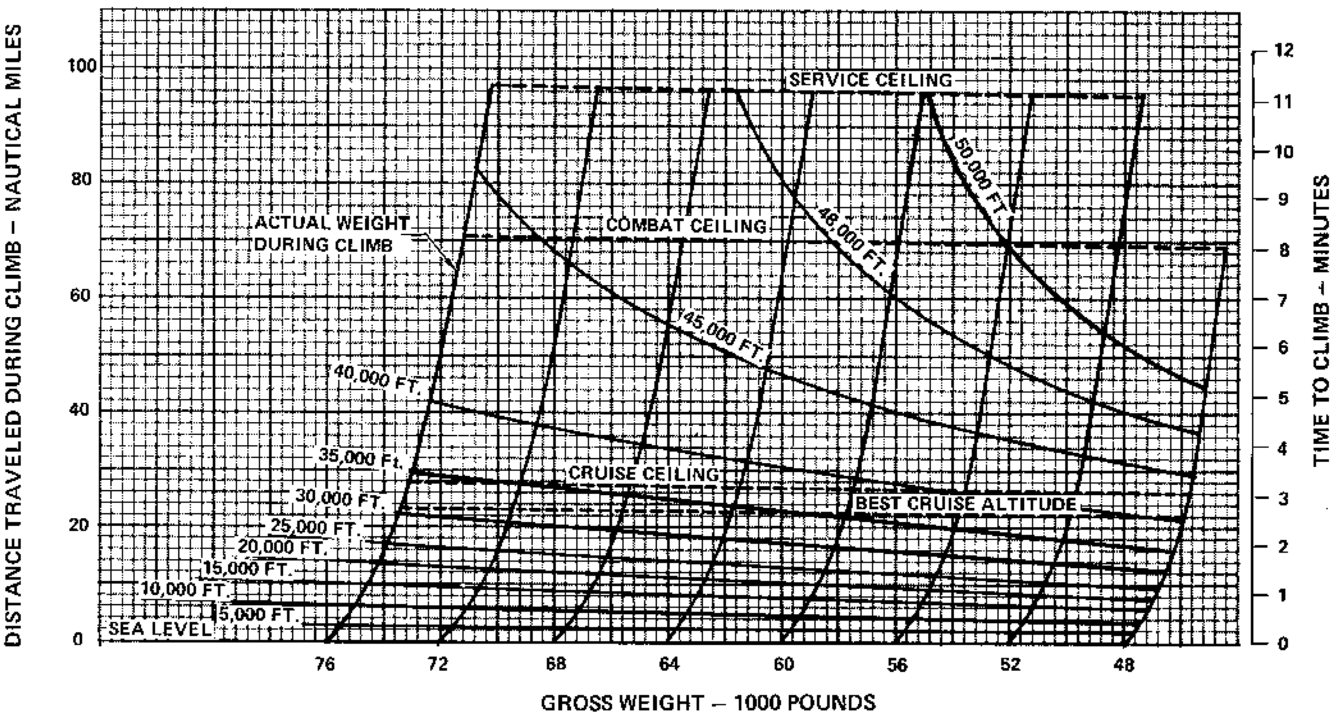
MAXIMUM THRUST CLIMB

RECONNAISSANCE CONFIGURATION
TWO 400 GALLON DROP TANKS
STANDARD DAY

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NR69H-2)
DATE: 15 JUNE 1970

ENGINES: (2) J79-GE-10 (-8)*
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL
*SEE NOTE 4

CLIMB SPEEDS		
ALTITUDE FEET	CAS KNOTS	MACH
SEA LEVEL	530	.80
5000	515	.84
10,000	495	.88
15,000	460	.89
20,000	420	.89
25,000	380	.89
30,000	345	.89
35,000	305	.89
40,000	275	.89
45,000	245	.89
50,000	220	.90



NOTE:

1. TIME, FUEL AND DISTANCE START FROM SEA LEVEL AT CLIMB SPEED. ADD APPROXIMATELY 1.5 MINUTES AND 1500 POUNDS FOR TIME AND FUEL FROM BRAKE RELEASE TO CLIMB SPEED FOR MAXIMUM THRUST TAKE-OFF.
2. INCREASE GROSS WEIGHT BY 4000 POUNDS WHEN ENTERING CHART FOR 10°C RISE IN AMBIENT TEMPERATURE ABOVE STANDARD DAY CONDITIONS. APPLY SAME CORRECTION IN OPPOSITE DIRECTION FOR 10°C AMBIENT TEMPERATURE BELOW STANDARD DAY CONDITIONS.
3. SUPERSONIC DROOPS TO 30,000 FEET, CRUISE DROOPS ABOVE 30,000 FEET.
4. FOR AIRCRAFT HAVING AFC 328 COMPLIED WITH AND J79-GE-8 ENGINES INSTALLED, SEE FIGURE 11-23.

RA-5C-1-93-97A

Figure 11-30

MILITARY THRUST RATE OF CLIMB

FLAPS 50°/DROOPS 50°

GEAR DOWN

SEA LEVEL

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NR69H-2)
DATE: 1 JULY 1969

ENGINES: (2) J79-GE-10(-8)*
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL

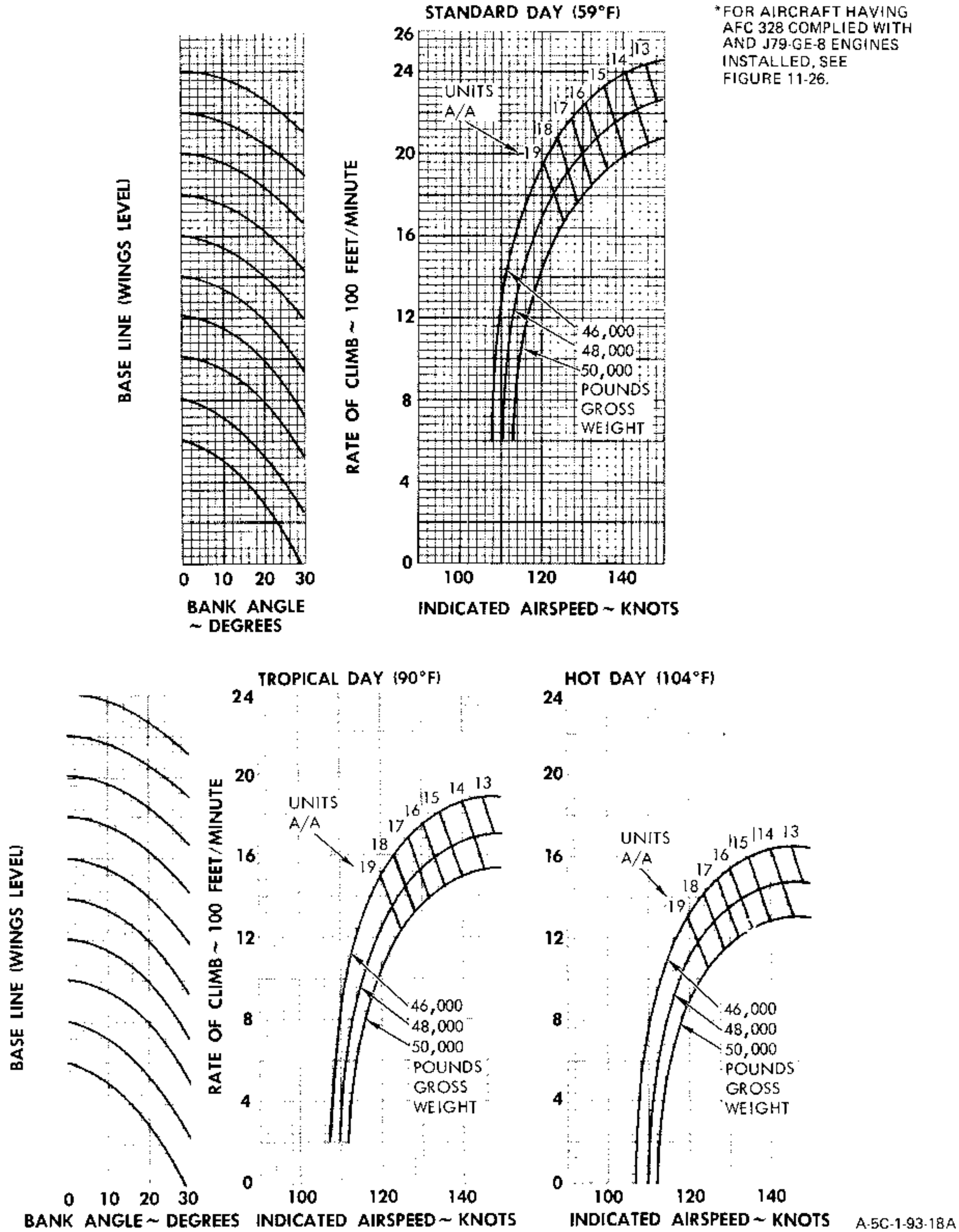


Figure 11-31

PART 4 — RANGE

NAUTICAL MILES PER 1000 POUNDS FUEL

The Nautical Miles Per 1000 Pounds Fuel charts (figures 11-32 through 11-54 and 11-62 through 11-80) show the fuel flow, rpm, and airspeeds (Mach number, CAS, TAS) required for level flight at any specific range for operation at various altitudes. The charts are plotted with consideration given to nautical miles, gross weights, fuel flow, thrust setting, and Mach number. An rpm decrease may be encountered when operating at Normal and Military Thrust at altitudes above 30,000 feet, as explained under CLIMB CHARTS, in this section. The charts also contain curves showing maximum endurance and recommended cruise for the applicable chart altitude and aircraft gross weight. The recommended cruise Mach number is based on an airspeed for maximum nautical miles per pound of fuel and will give maximum range at the specified altitude. Charts for the reconnaissance and attack configurations are provided. Maximum range is obtained by flying at the *best cruise altitude,* which is a cruise climb procedure whereby altitude is gradually increased as fuel is consumed. The *best cruise altitude* is shown on the Climb charts and may be determined for any desired gross weight by reading vertically from the gross weight scale to the *best cruise altitude* line and noting the *best cruise altitude.* This information may be used in conjunction with the Nautical Miles Per 1000 Pounds Fuel charts, interpolating between altitude charts as necessary to set up cruise conditions. See figures 11-149 through 11-152 for single-engine data.

NAUTICAL MILES PER 1000 POUNDS FUEL — SUPERSONIC CHARTS

Nautical Miles Per 1000 Pounds Fuel—Supersonic charts (figures 11-55 through 11-57 and 11-81 through 11-85) are provided for the reconnaissance configuration with no external stores. The data is provided for stabilized Mach numbers for all gross weights for altitudes to 48,000. The last chart contains an example showing its use.

NAUTICAL MILES PER 1000 POUNDS FUEL — GEAR DOWN

Nautical Miles Per 1000 Pounds Fuel, Gear Down charts, for sea level and 10,000 feet, Standard Day, are shown in figures 11-58 and 11-59. The use of the charts is identical with the other nautical miles per 1000 pounds fuel charts, except the 230 KIAS gear limit speed must be observed.

BINGO CHARTS

By using the Bingo Charts (figures 11-60 and 11-147), for two-engine and single-engine Bingo, J79-GE-8 or J79-GE-10 engines, fuel required can be determined for diversion to alternate destination or from ship-to-shore base. The charts are based on distance to go to destination. Fuel required includes 400 pounds for acceleration and turn to divert heading and 1500 pounds reserve over final destination, as well as fuel required for a Military Thrust climb to optimum altitude if indicated. Adjustments in fuel required may be made for various external store configurations by applying the factors noted on the charts. See figure 11-148 for single-engine maximum range data. The Bingo Charts also appear in the Pilot's NATOPS Pocket Checklist (NAVAIR 01-60ABC-1B).

OPTIMUM CRUISE SUMMARY

Cruise performance at optimum cruise conditions with no external load is summarized in the Optimum Cruise Summary Chart (figure 11-61). The chart shows the Mach number that will provide maximum nautical miles per thousand pounds of fuel as a function of aircraft gross weight for constant altitude cruise at altitudes between sea level and 40,000 feet and also for cruise climb at best cruise altitude. The fuel flow and approximate rpm at optimum cruise speed and desired flight altitude are shown on the chart.

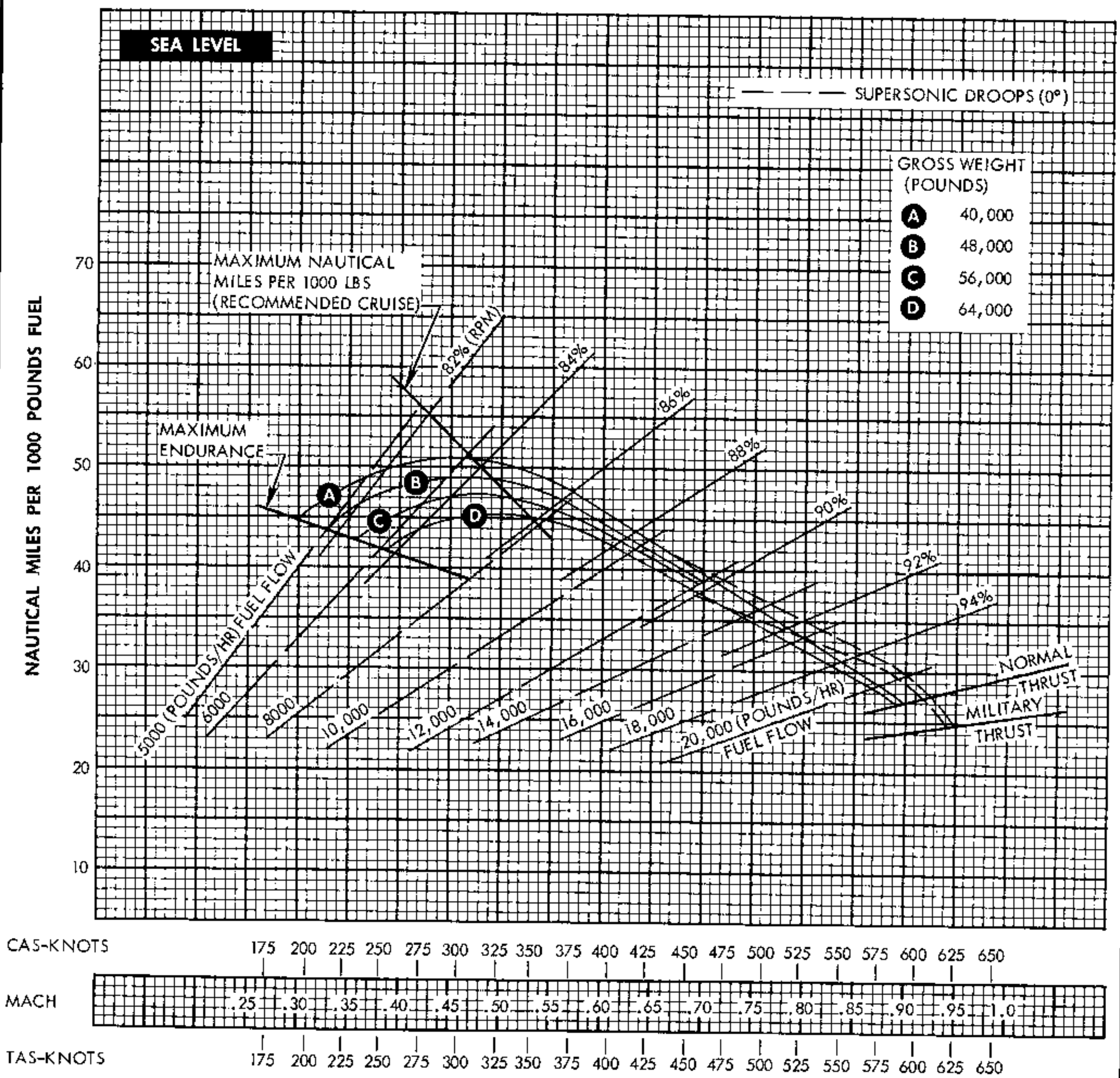
NAUTICAL MILES PER 1000 POUNDS FUEL

RECONNAISSANCE CONFIGURATION

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NA63H-2)
DATE: 15 JUNE 1970

NO EXTERNAL LOAD
STANDARD DAY

ENGINES: (2) J79-GE-8
FUEL GRADE: MIL-F-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL



NOTE:

(1) FOR ATTACK CONFIGURATION WITH RECONNAISSANCE EQUIPMENT POD REMOVED, INCREASE NAUTICAL MILES PER 1000 POUNDS OF FUEL BY 5%. INCREASE CRUISE SPEED BY 0.01MN

(2) RETRACT CRUISE DROOPS ABOVE 0.65 MACH NUMBER FOR INCREASED SPECIFIC RANGE.

A 5C-1A 93-14B

Figure 11-32

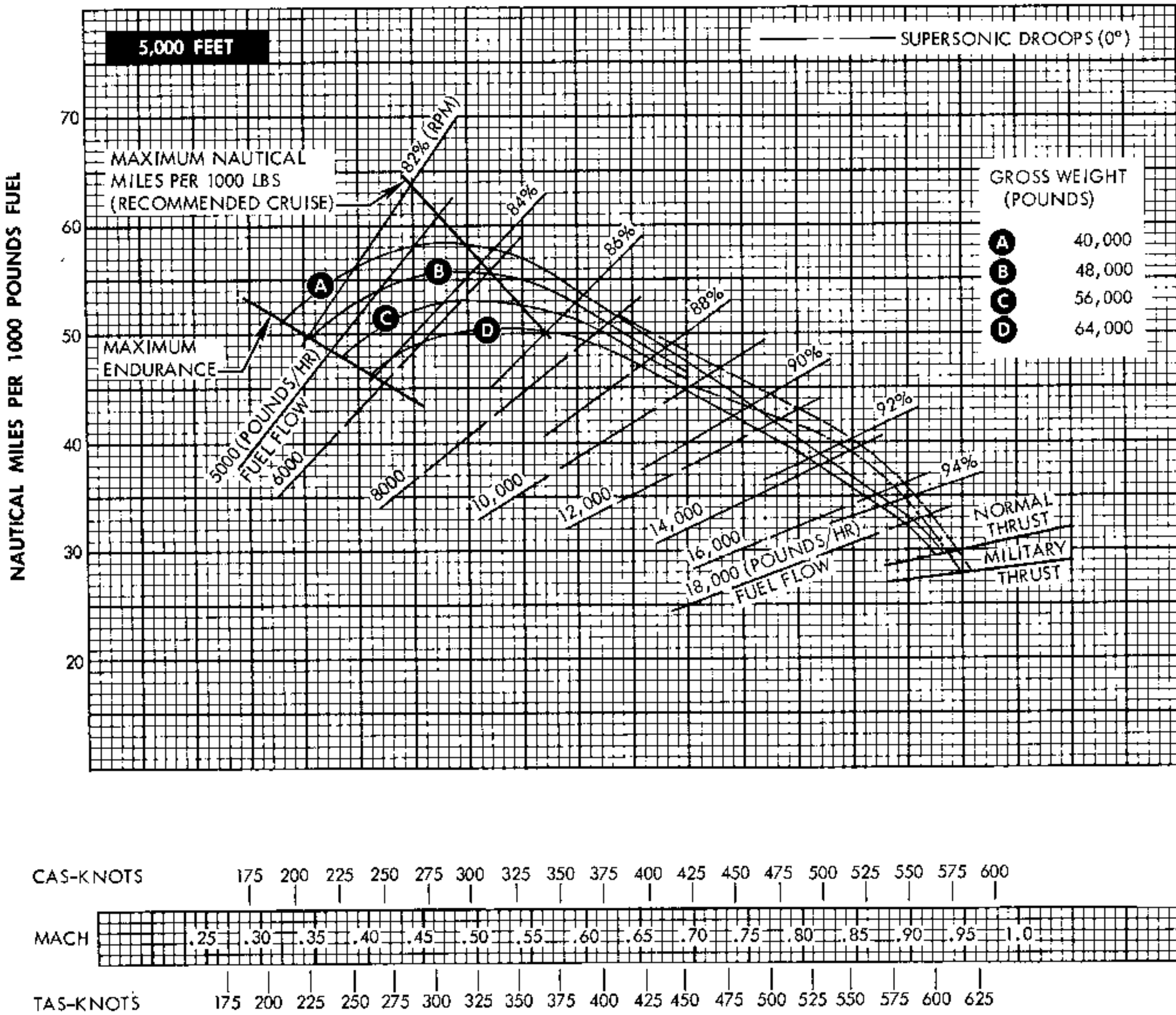
NAUTICAL MILES PER 1000 POUNDS FUEL

RECONNAISSANCE CONFIGURATION

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NA63H-2)
DATE: 15 JUNE 1970

NO EXTERNAL LOAD
STANDARD DAY

ENGINES: (2) J79-GE-8
FUEL GRADE: MIL-F-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL



NOTE:

(1) FOR ATTACK CONFIGURATION WITH RECONNAISSANCE EQUIPMENT POD REMOVED, INCREASE NAUTICAL MILES PER 1000 POUNDS OF FUEL BY 5%. INCREASE CRUISE SPEED BY 0.01MN

(2) RETRACT CRUISE DROOPS ABOVE 0.65 MACH NUMBER FOR INCREASED SPECIFIC RANGE

A-5C-1A-93-15B

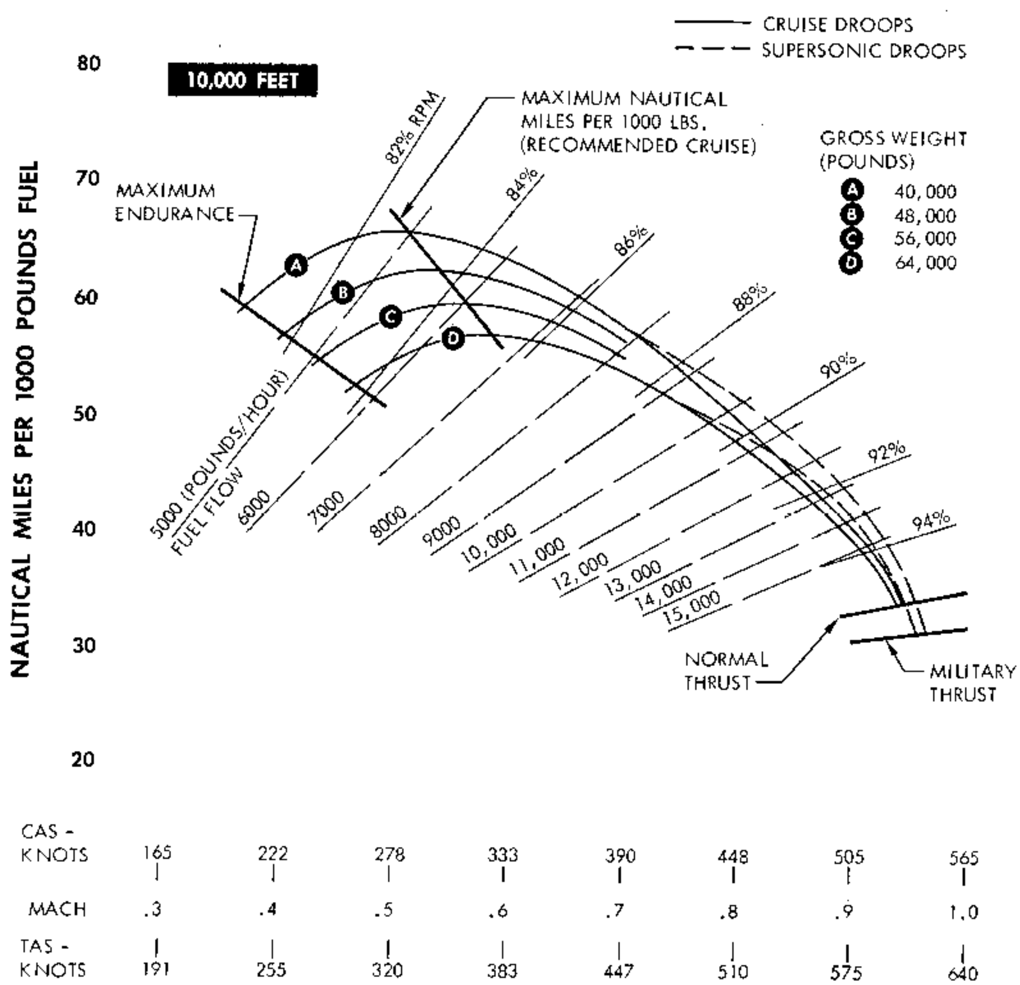
Figure 11-33

NAUTICAL MILES PER 1000 POUNDS FUEL

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NA63H-2)
DATE: 1 JANUARY 1967

RECONNAISSANCE CONFIGURATION
NO EXTERNAL LOAD
STANDARD DAY

ENGINES: (2) J79-GE-8
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL



NOTE:

FOR ATTACK CONFIGURATION WITH RECONNAISSANCE EQUIPMENT POD REMOVED, INCREASE NAUTICAL MILES PER 1000 POUNDS OF FUEL BY 5%. INCREASE CRUISE SPEED BY 0.01 M.

A-5C-1A-93-124

Figure 11-34

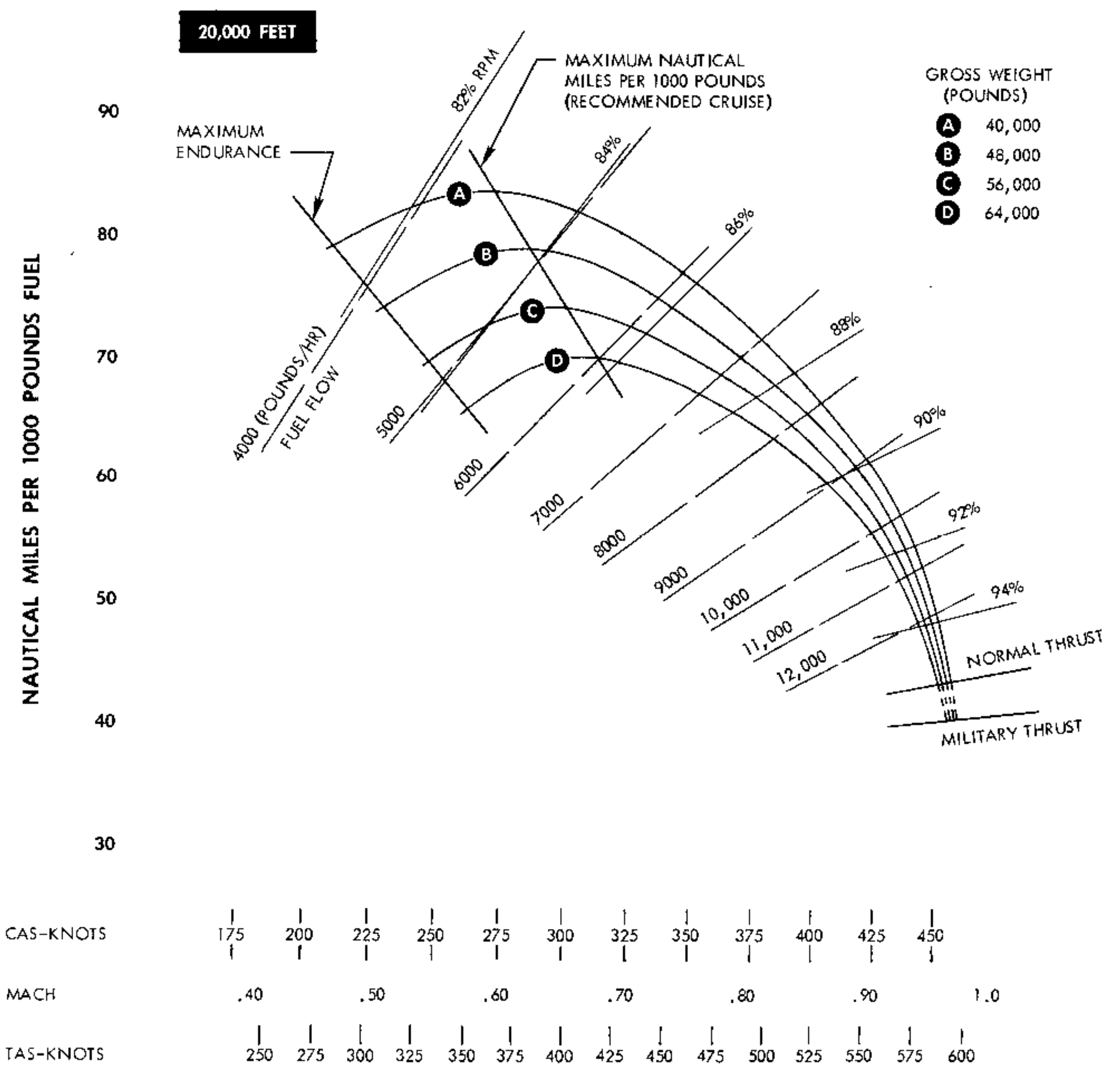
NAUTICAL MILES PER 1000 POUNDS FUEL

RECONNAISSANCE CONFIGURATION

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NA63H-2)
DATE: 1 APRIL 1964

NO EXTERNAL LOAD
STANDARD DAY

ENGINES: (2) J79-GE-8
FUEL GRADE: MIL-J-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL



NOTE:

FOR ATTACK CONFIG WITH RECON EQUIPMENT POD REMOVED, INCREASE N MI/1000 LB FUEL BY 5% AND CRUISE SPEED BY 0.01 MN.

A-5C-1A-93-83

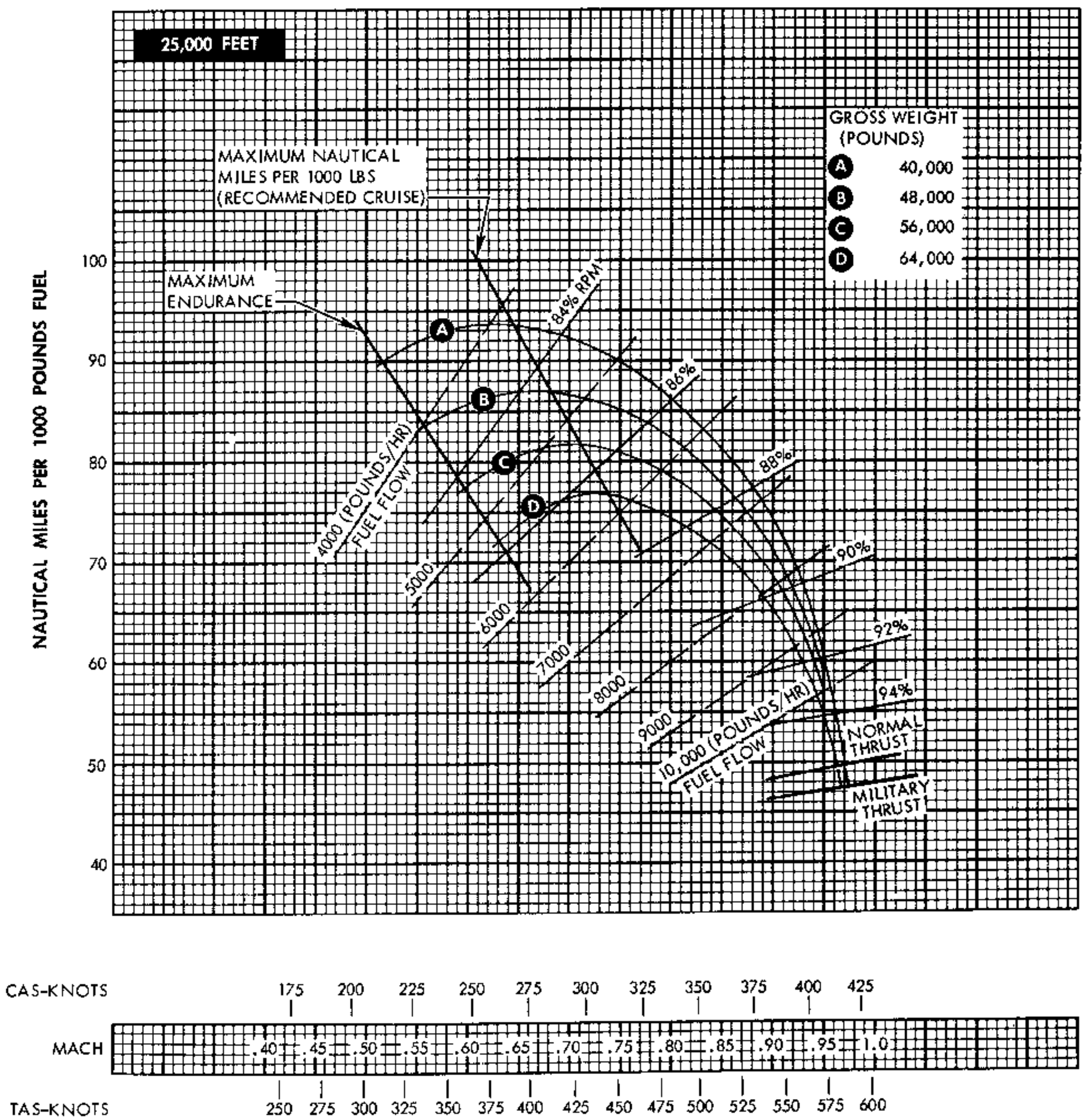
Figure 11-35

NAUTICAL MILES PER 1000 POUNDS FUEL

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NA63H-2)
DATE: 1 JULY 1963

RECONNAISSANCE CONFIGURATION
NO EXTERNAL LOAD
STANDARD DAY

ENGINES: (2) J79-GE-8
FUEL GRADE: MIL-F-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL



NOTE:
(1) FOR ATTACK CONFIGURATION WITH RECONNAISSANCE EQUIPMENT POD REMOVED, INCREASE NAUTICAL MILES PER 1000 POUNDS OF FUEL BY 5%. INCREASE CRUISE SPEED BY 0.01MN

A-5C-1A-93-16 A

Figure 11-36

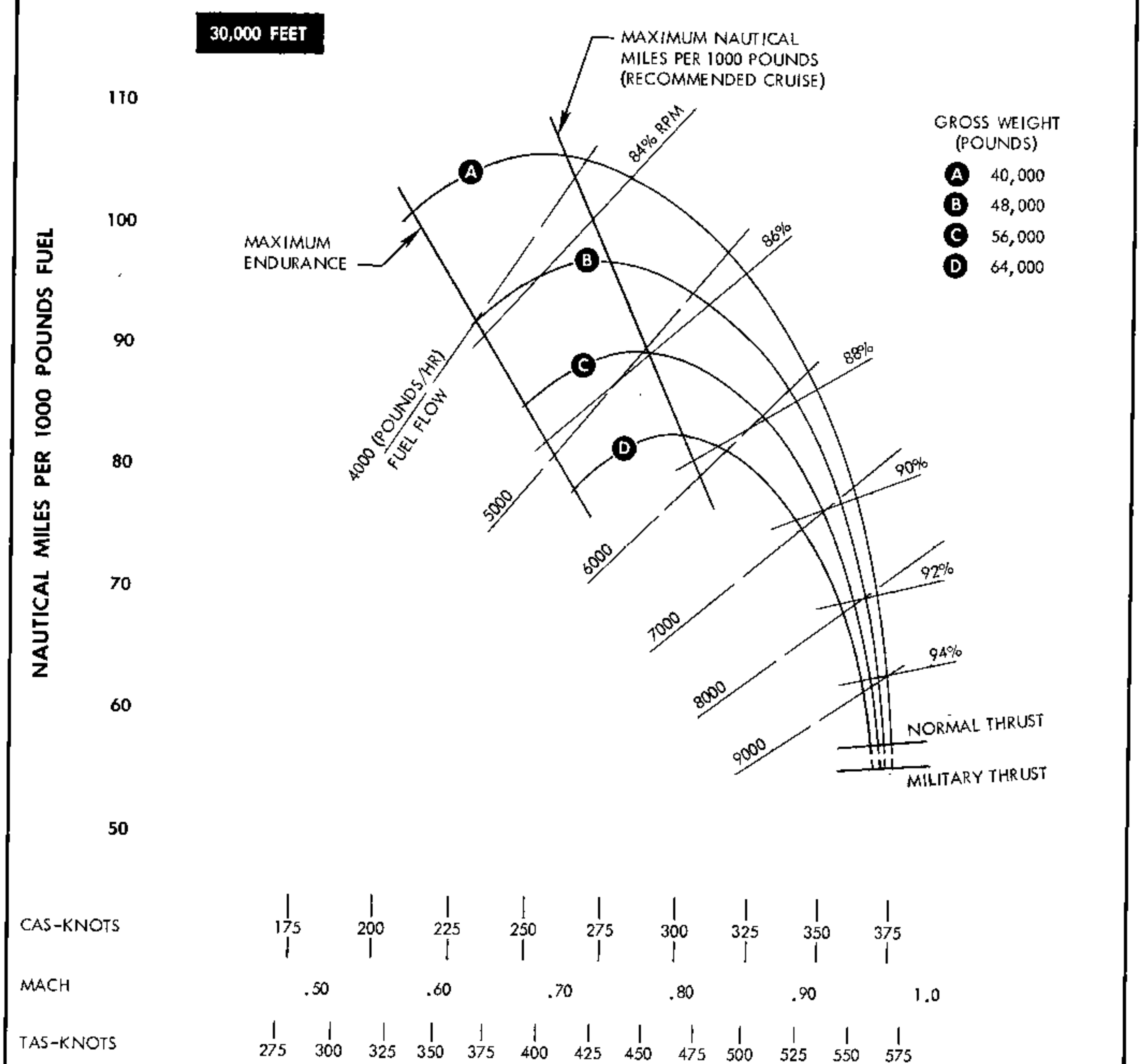
NAUTICAL MILES PER 1000 POUNDS FUEL

RECONNAISSANCE CONFIGURATION

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NA63H-2)
DATE: 1 APRIL 1964

NO EXTERNAL LOAD
STANDARD DAY

ENGINES: (2) J79-GE-8
FUEL GRADE: MIL-J-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL



NOTE:

FOR ATTACK CONFIG WITH RECON EQUIPMENT POD REMOVED, INCREASE N MI/1000 LB FUEL BY 5% AND CRUISE SPEED BY 0.01 MN.

A-5C-1A-93-84

Figure 11-37

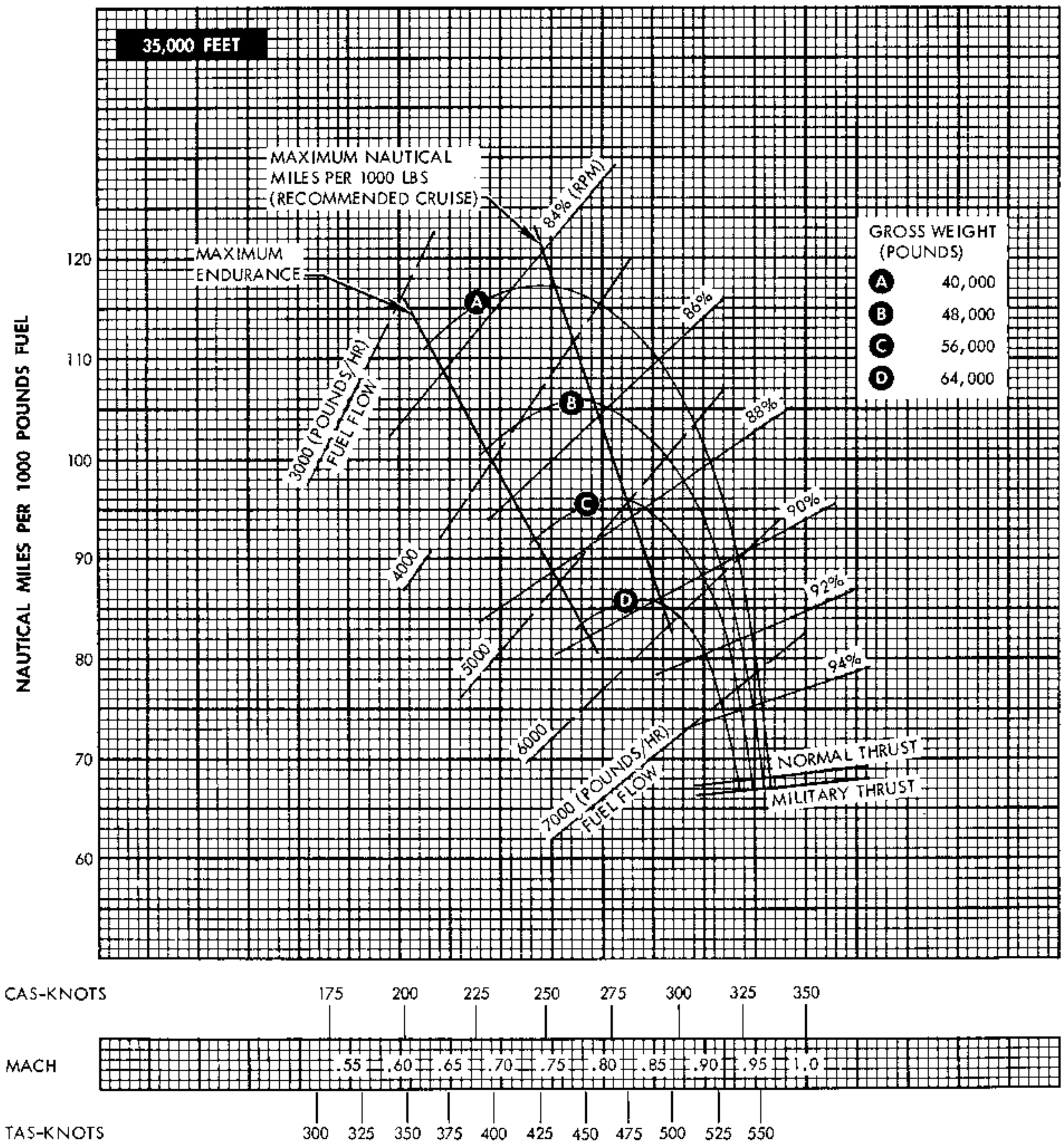
NAUTICAL MILES PER 1000 POUNDS FUEL

RECONNAISSANCE CONFIGURATION

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NA63H-2)
DATE: 1 JULY 1963

NO EXTERNAL LOAD
STANDARD DAY

ENGINES: (2) J79-GE-8
FUEL GRADE: MIL-F-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL



NOTE:
FOR ATTACK CONFIGURATION WITH RECONNAISSANCE EQUIPMENT POD REMOVED, INCREASE NAUTICAL MILES PER 1000 POUNDS OF FUEL BY 5%. INCREASE CRUISE SPEED BY 0.01MN

A-5C-1A-93-17A

Figure 11-38

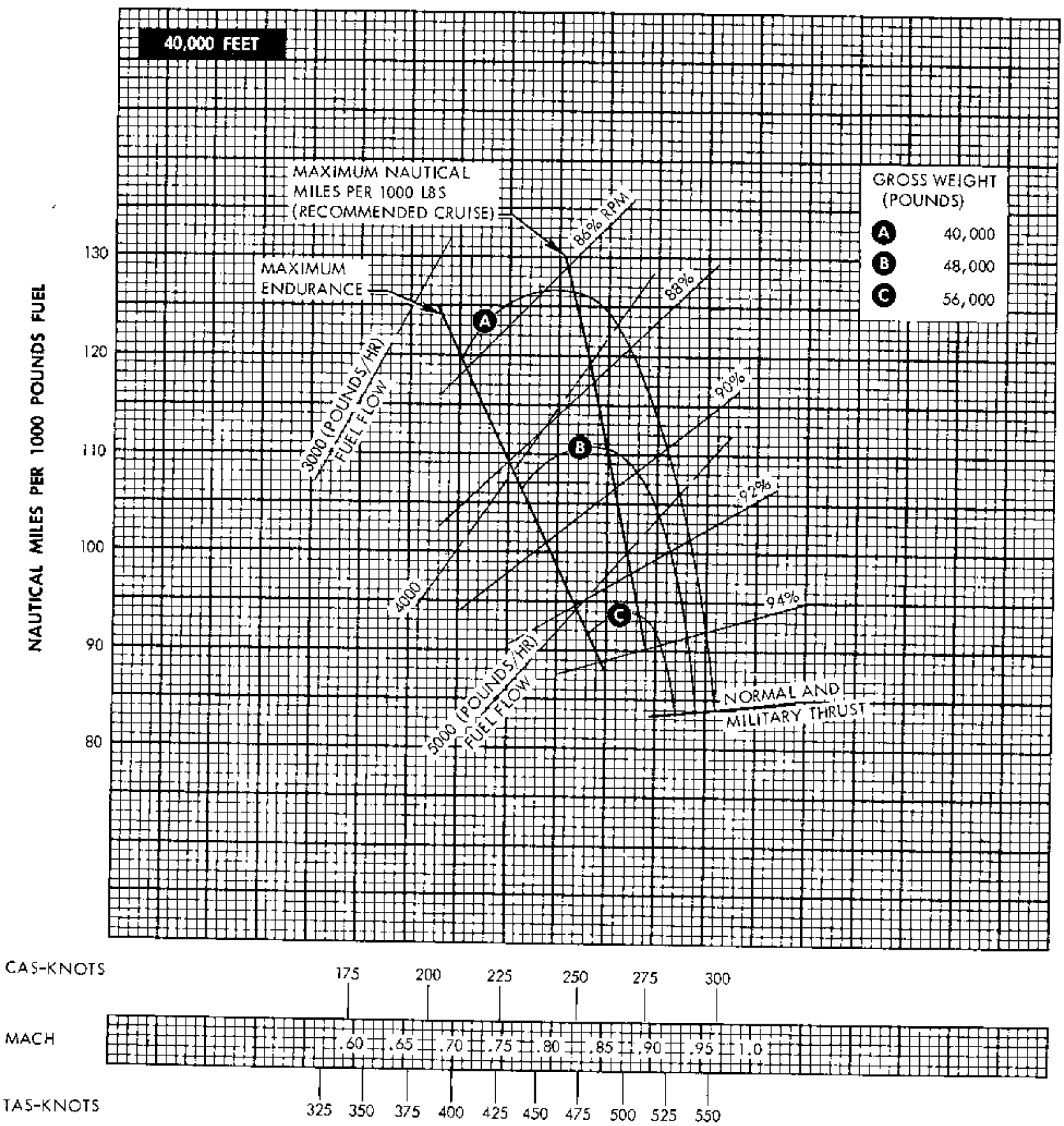
NAUTICAL MILES PER 1000 POUNDS FUEL

RECONNAISSANCE CONFIGURATION

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NA63H-2)
DATE: 1 JULY 1963

NO EXTERNAL LOAD
STANDARD DAY

ENGINES: (2) J79-GE-8
FUEL GRADE: MIL-F-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL



NOTE:

FOR ATTACK CONFIGURATION WITH RECONNAISSANCE EQUIPMENT POD REMOVED, INCREASE NAUTICAL MILES PER 1000 LBS OF FUEL BY 5%. INCREASE CRUISE SPEED BY 0.01 MN

A-5C-1A-93-18A

Figure 11-39

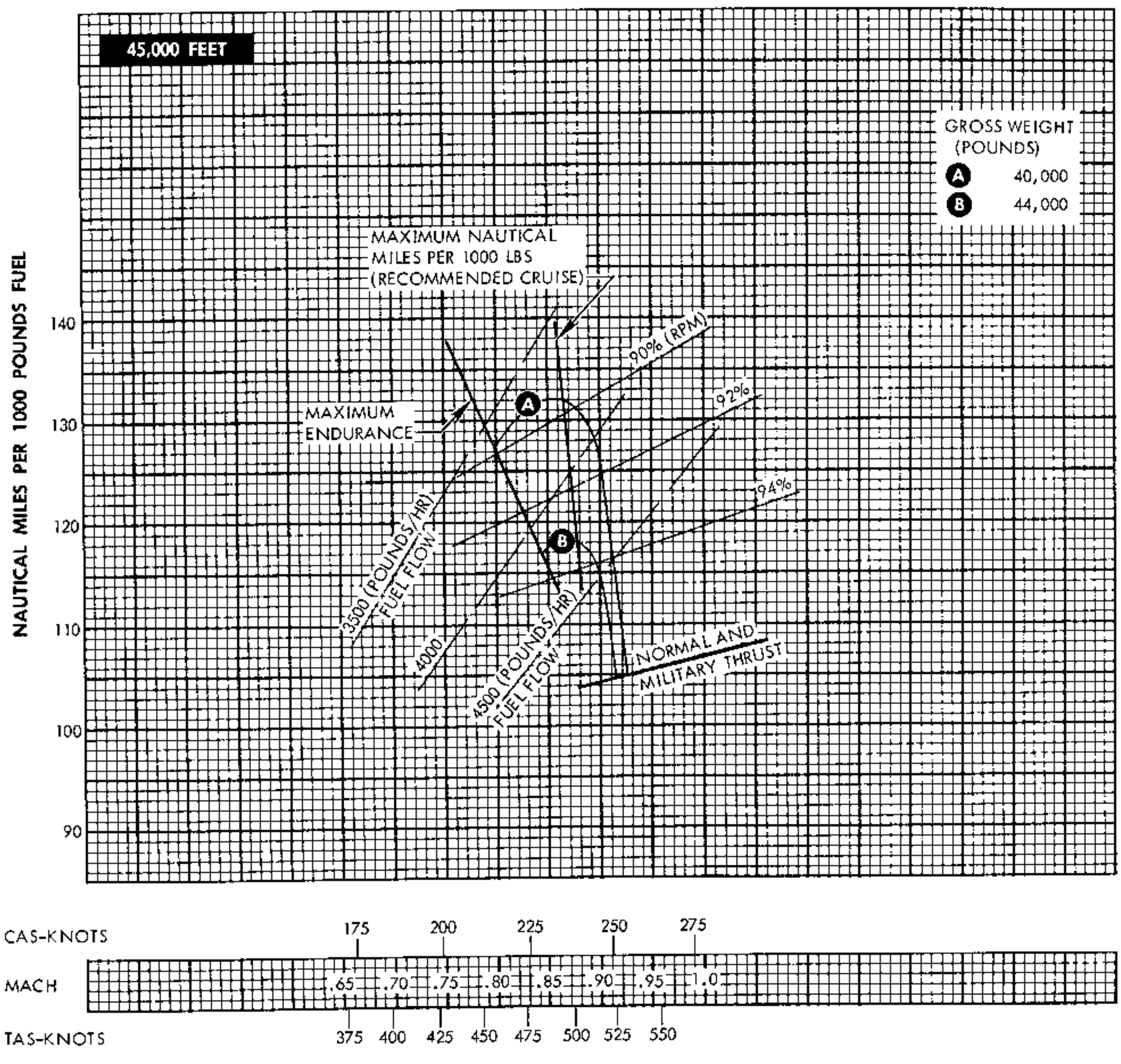
NAUTICAL MILES PER 1000 POUNDS FUEL

RECONNAISSANCE CONFIGURATION

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NA63H-2)
DATE: 1 JULY 1963

NO EXTERNAL LOAD
STANDARD DAY

ENGINES: (2) J79-GE-8
FUEL GRADE: MIL-F-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL



NOTE:
FOR ATTACK CONFIGURATION WITH RECONNAISSANCE EQUIPMENT POD REMOVED, INCREASE NAUTICAL MILES PER 1000 POUNDS OF FUEL BY 5%. INCREASE CRUISE SPEED BY 0.01 MN

A-5C-1A-93-19 A

Figure 11-40

NAUTICAL MILES PER 1000 POUNDS FUEL

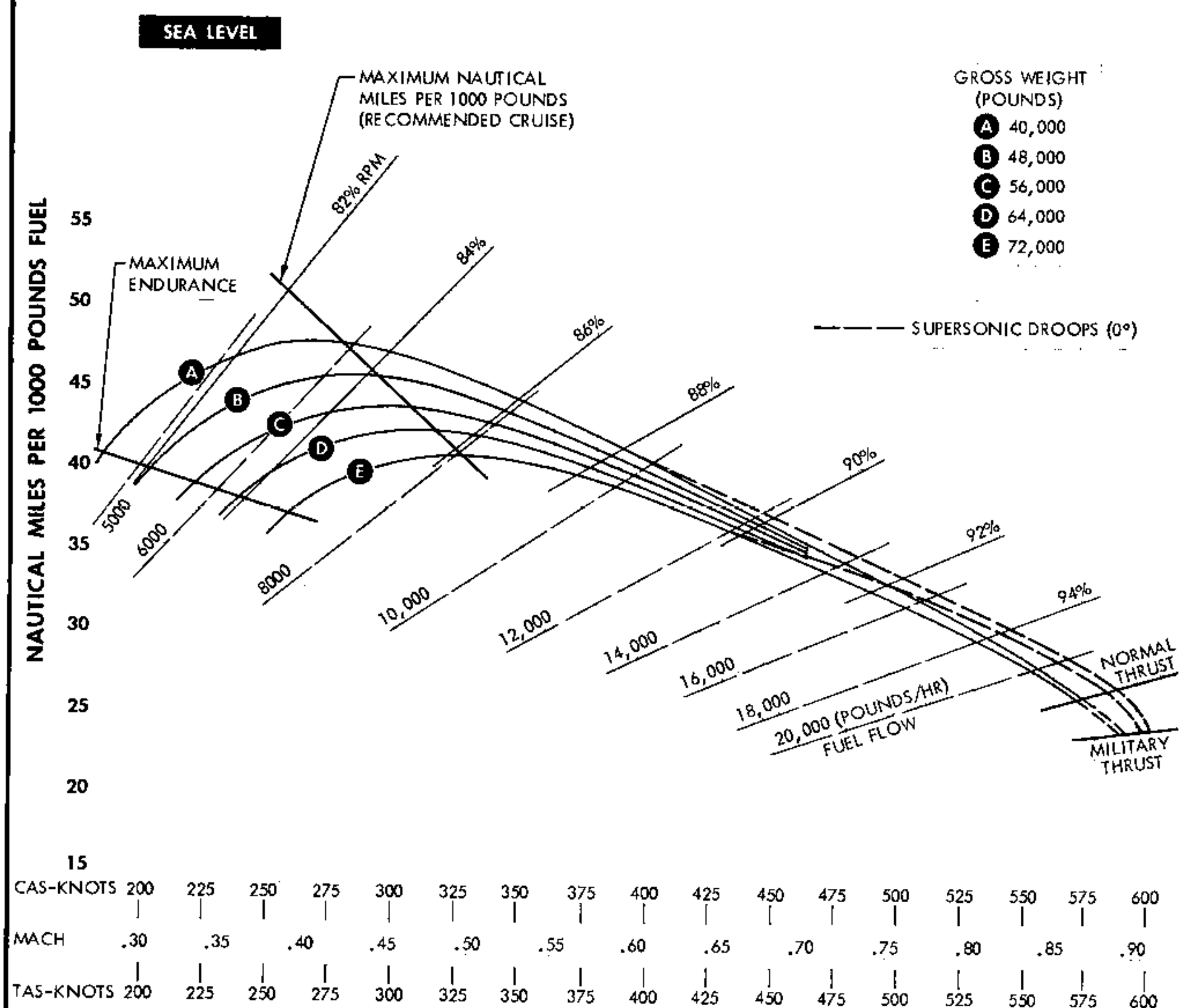
RECONNAISSANCE CONFIGURATION

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NA63H-2)
DATE: 1 MAY 1964

TWO 400-GALLON DROP TANKS

STANDARD DAY

ENGINES: (2) J79-GE-8
FUEL GRADE: MIL-J-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL



NOTE:

1. FOR ATTACK CONFIG WITH RECON EQUIPMENT POD REMOVED, INCREASE N MI/1000 LB FUEL BY 5% AND CRUISE SPEED BY 0.01 MN.
2. RETRACT CRUISE DROOPS ABOVE 0.65 MN FOR INCREASED SPECIFIC RANGE.

A-5C-1A-93-90

Figure 11-41

NAUTICAL MILES PER 1000 POUNDS FUEL

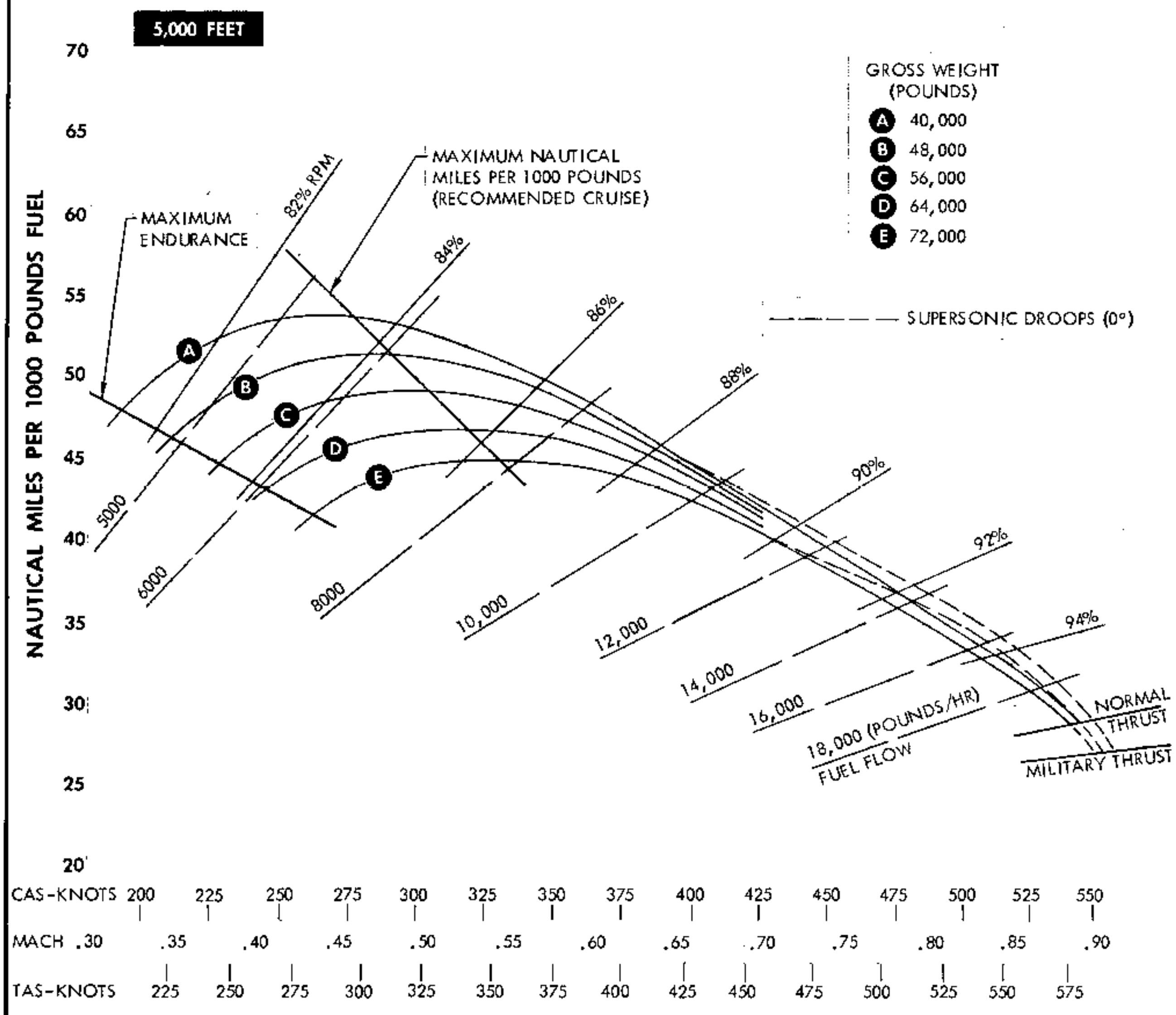
RECONNAISSANCE CONFIGURATION

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NA63H-2)
DATE: 1 MAY 1964

TWO 400-GALLON DROP TANKS

STANDARD DAY

ENGINES: (2) J79-GE-8
FUEL GRADE: MIL-J-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL



NOTE:

1. FOR ATTACK CONFIG WITH RECON EQUIPMENT POD REMOVED, INCREASE N MI/1000 LB FUEL BY 5% AND CRUISE SPEED BY 0.01 MN.
2. RETRACT CRUISE DROOPS ABOVE 0.65 MN FOR INCREASED SPECIFIC RANGE.

A-5C-1A-93-91

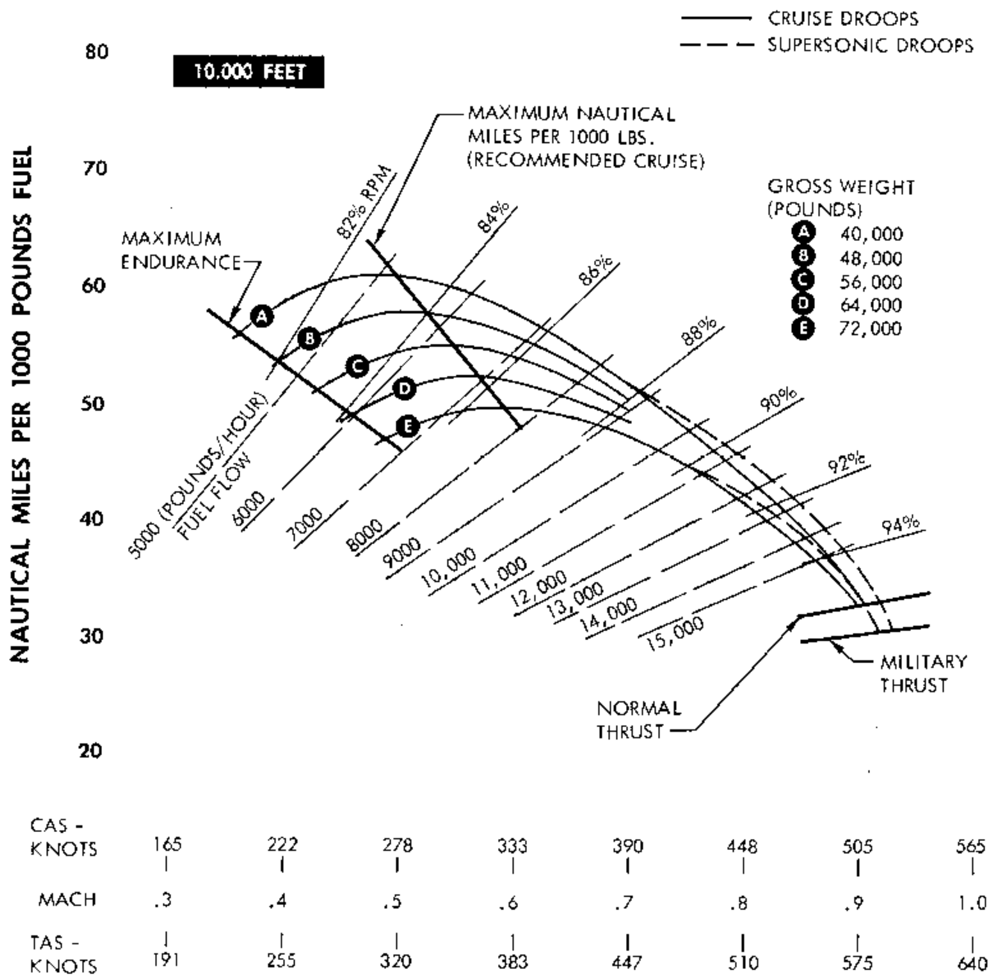
Figure 11-42

NAUTICAL MILES PER 1000 POUNDS FUEL

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NA63H-2)
DATE: 1 JANUARY 1967

RECONNAISSANCE CONFIGURATION
TWO 400-GALLON DROP TANKS
STANDARD DAY

ENGINES: (2) J79-GE-8
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL



NOTE:

FOR ATTACK CONFIGURATION WITH RECONNAISSANCE EQUIPMENT POD REMOVED, INCREASE NAUTICAL MILES PER 1000 POUNDS OF FUEL BY 5%. INCREASE CRUISE SPEED BY 0.01 M.

A-5C-1A-93-125

Figure 11-43

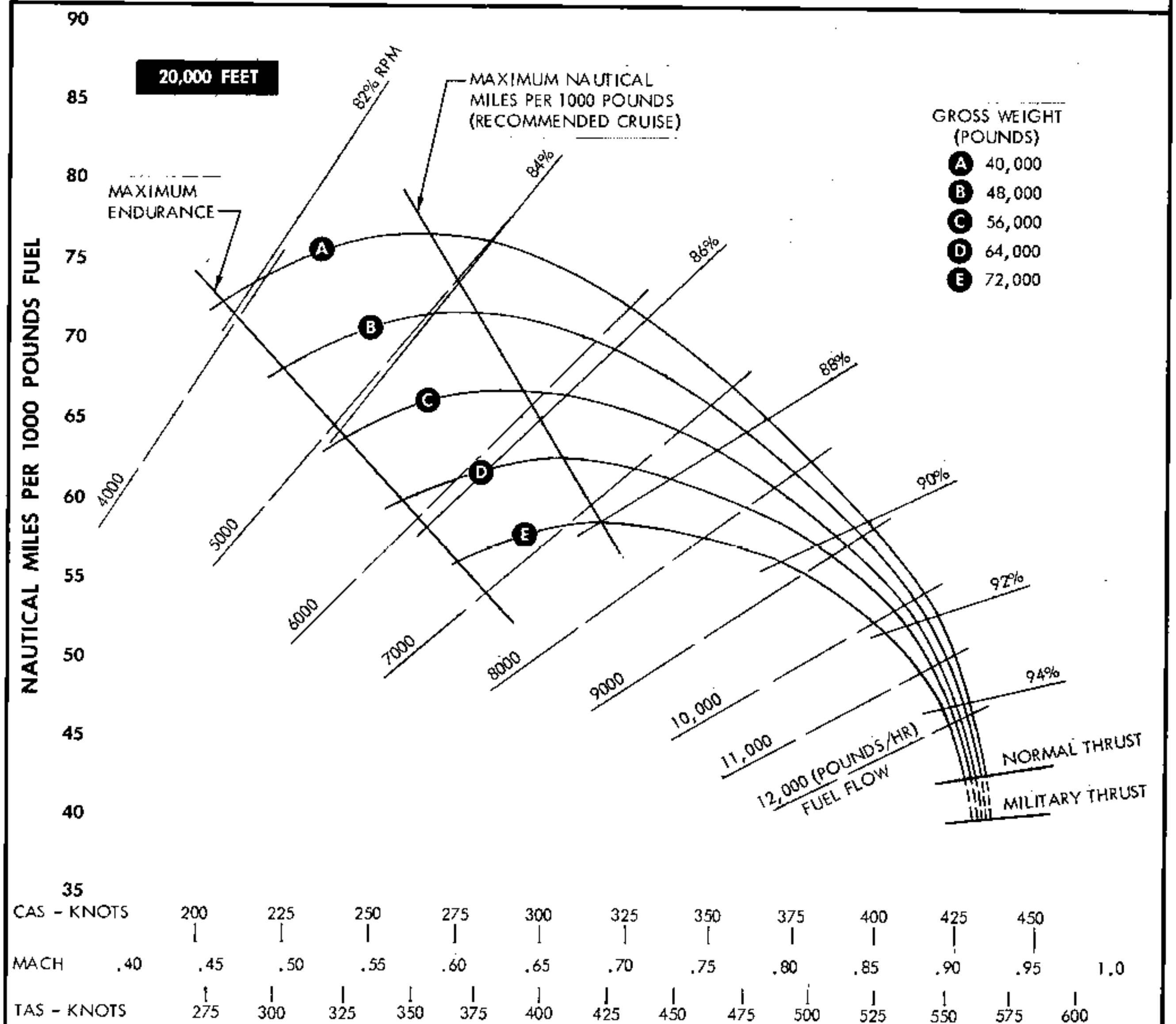
NAUTICAL MILES PER 1000 POUNDS FUEL

RECONNAISSANCE CONFIGURATION

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NA63H-2)
DATE: 1 MAY 1964

TWO 400-GALLON DROP TANKS
STANDARD DAY

ENGINES: (2) J79-GE-8
FUEL GRADE: MIL-J-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL



NOTE:

1. FOR ATTACK CONFIG WITH RECON EQUIPMENT POD REMOVED, INCREASE N MI/1000 LB FUEL BY 5% AND CRUISE SPEED BY 0.01 MN.

A-5C-1A-93-92

Figure 11-44

NAUTICAL MILES PER 1000 POUNDS FUEL

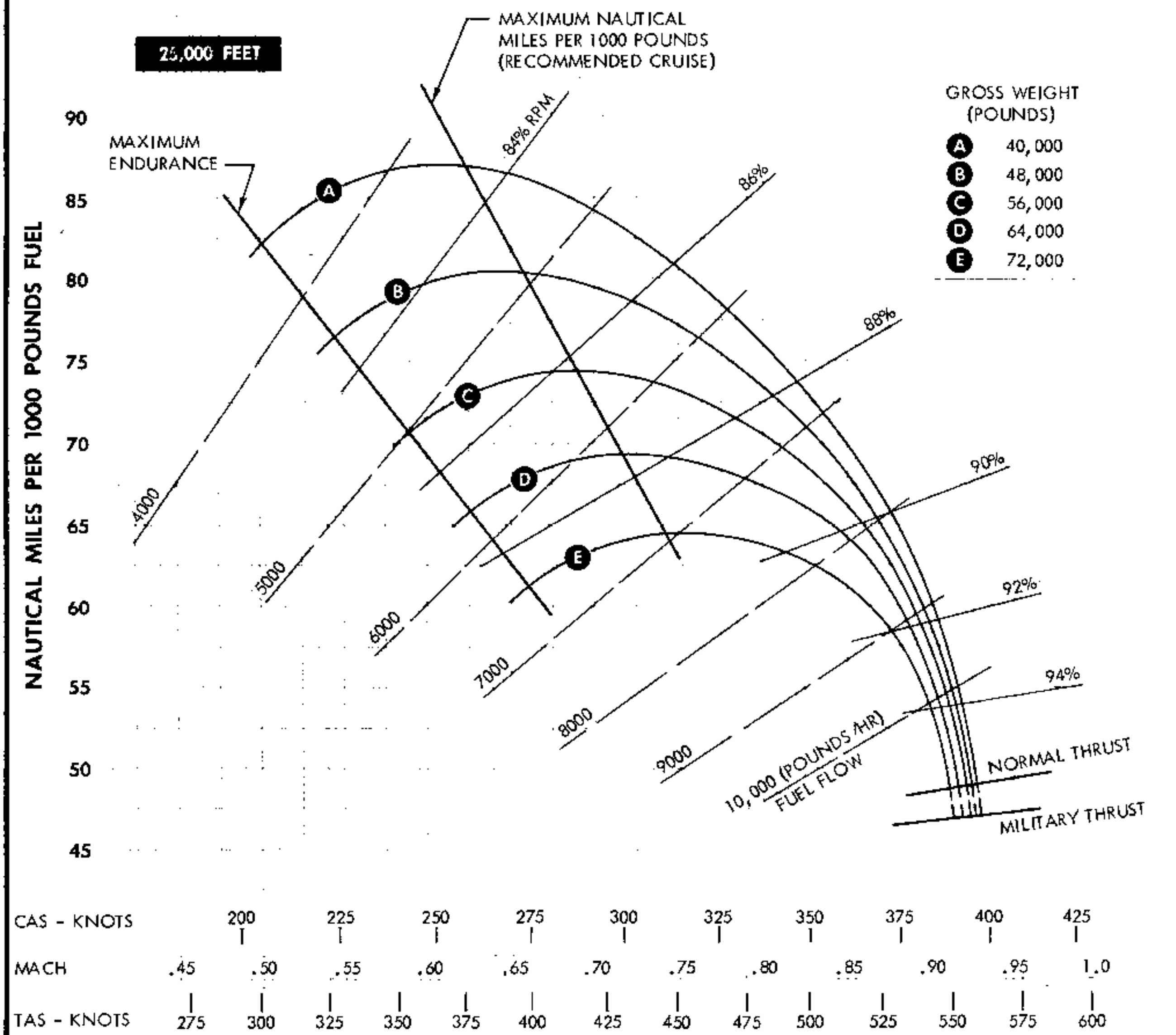
RECONNAISSANCE CONFIGURATION

TWO 400-GALLON DROP TANKS

STANDARD DAY

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NA63H-2)
DATE: 1 MAY 1964

ENGINES: (2) J79-GE-8
FUEL GRADE: MIL-J-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL



NOTE:

1. FOR ATTACK CONFIG WITH RECON EQUIPMENT POD REMOVED, INCREASE N MI/1000 LB FUEL BY 5% AND CRUISE SPEED BY 0.01 MN.

A-5C-1A-93-87

Figure 11-45

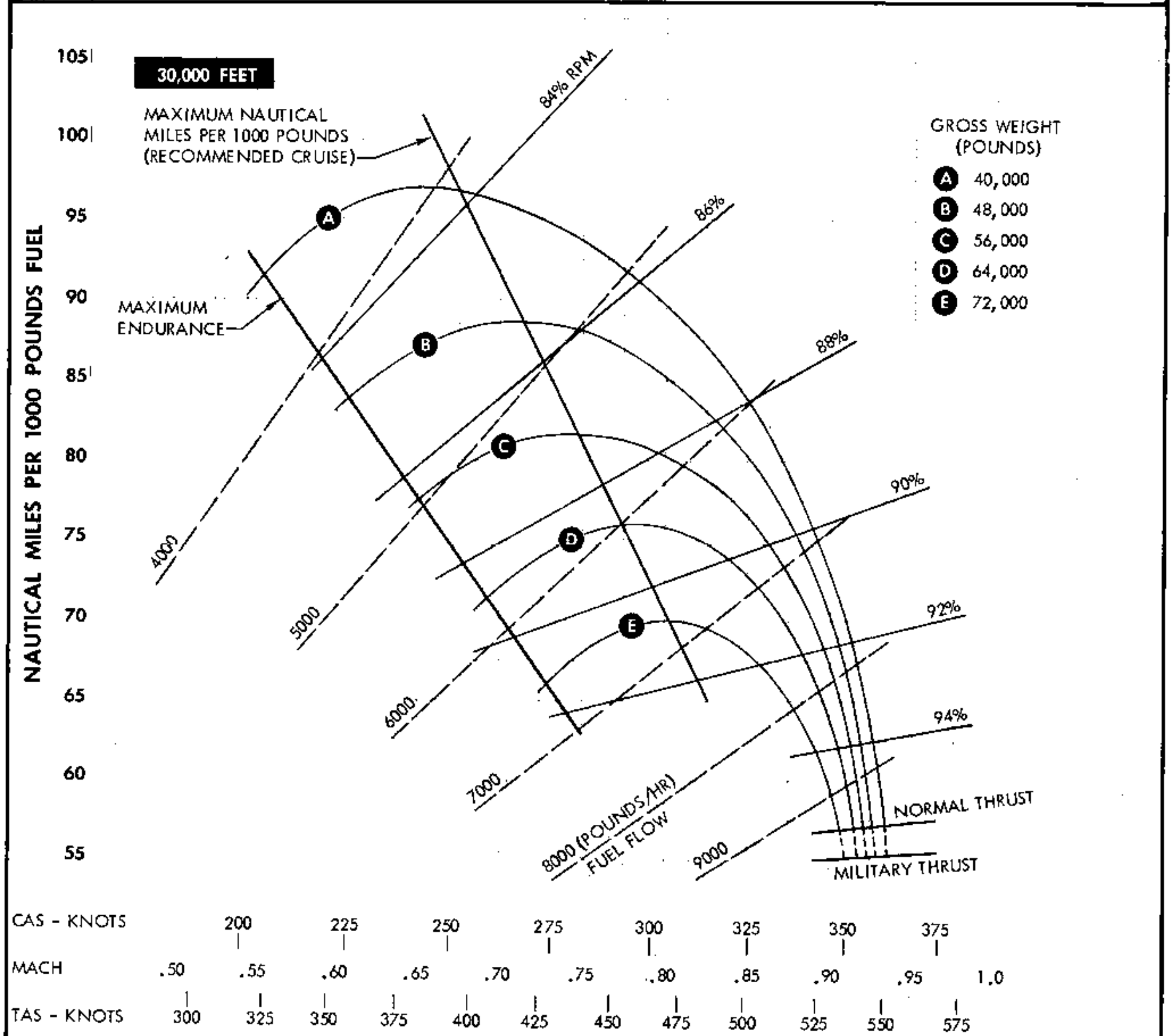
NAUTICAL MILES PER 1000 POUNDS FUEL

RECONNAISSANCE CONFIGURATION

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NA63H-2)
DATE: 1 MAY 1964

TWO 400-GALLON DROP TANKS
STANDARD DAY

ENGINES: (2) J79-GE-8
FUEL GRADE: MIL-J-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL



NOTE:

1. FOR ATTACK CONFIG WITH RECON EQUIPMENT POD REMOVED, INCREASE N MI/1000 LB FUEL BY 5% AND CRUISE SPEED BY 0.01 MN.

A-5C-1A-93-88

Figure 11-46

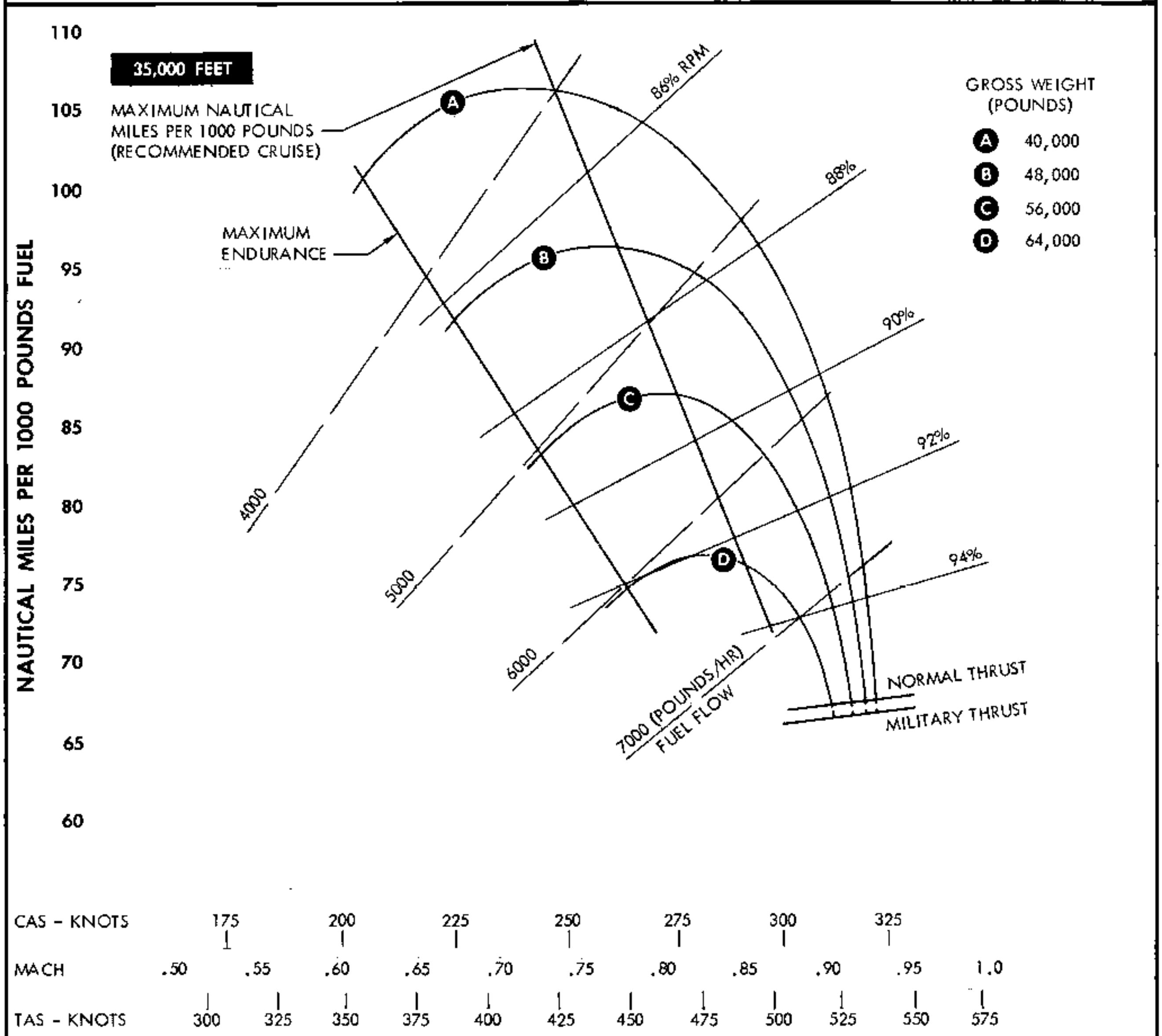
NAUTICAL MILES PER 1000 POUNDS FUEL

RECONNAISSANCE CONFIGURATION

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NA63H-2)
DATE: 1 MAY 1964

TWO 400-GALLON DROP TANKS
STANDARD DAY

ENGINES: (2) J79-GE-8
FUEL GRADE: MIL-J-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL



NOTE:

1. FOR ATTACK CONFIG WITH RECON EQUIPMENT POD REMOVED, INCREASE N MI/1000 LB FUEL BY 5% AND CRUISE SPEED BY 0.01 MN.

A-5C-1A-93-85

Figure 11-47

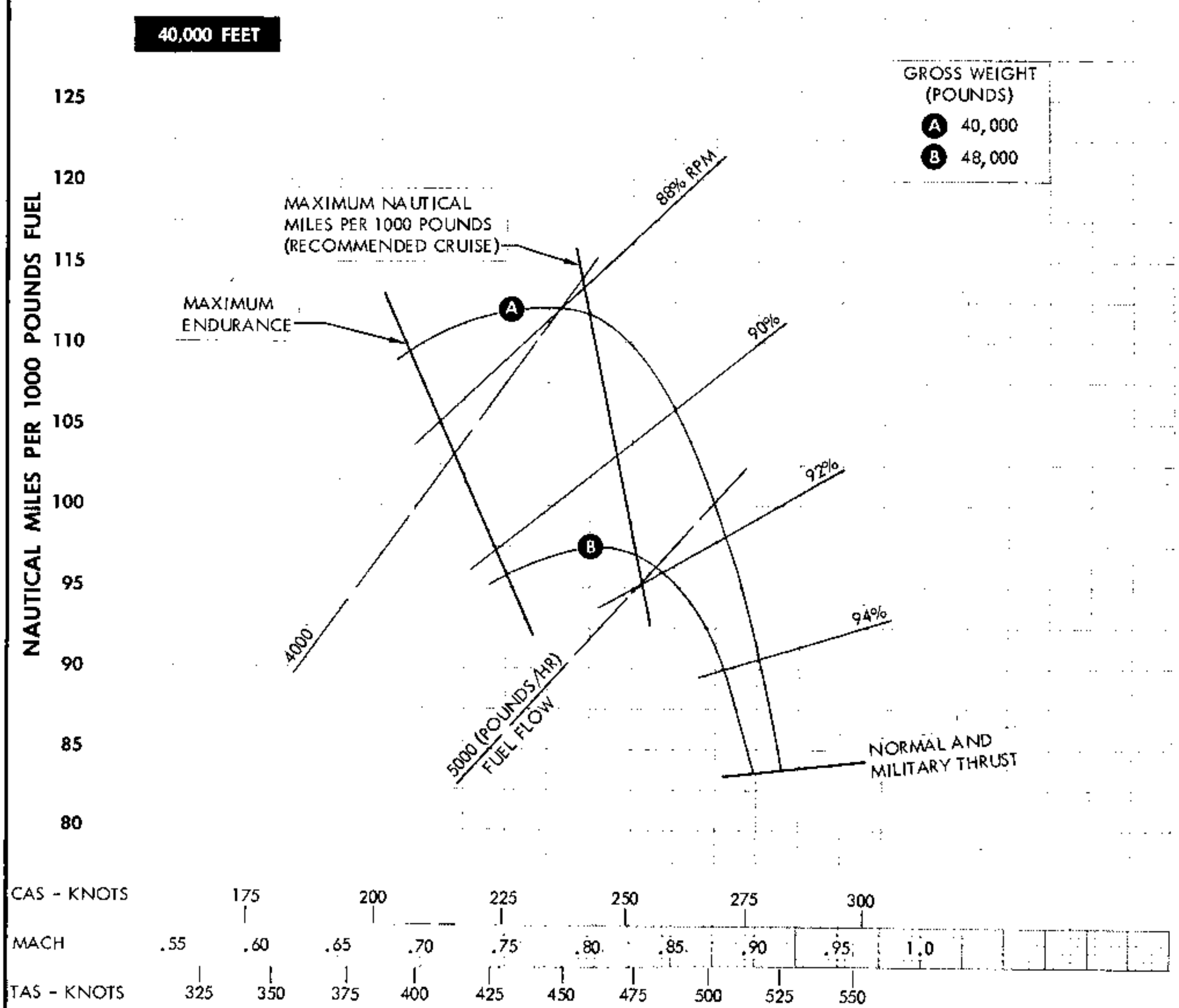
NAUTICAL MILES PER 1000 POUNDS FUEL

RECONNAISSANCE CONFIGURATION

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NA63H-2)
DATE: 1 MAY 1964

TWO 400-GALLON DROP TANKS
STANDARD DAY

ENGINES: (2) J79-GE-8
FUEL GRADE: MIL-J-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL



NOTE:

1. FOR ATTACK CONFIG WITH RECON EQUIPMENT POD REMOVED, INCREASE N MI/1000 LB FUEL BY 5% AND CRUISE SPEED BY 0.01 MN.

A-5C-1A-93-86

Figure 11-48

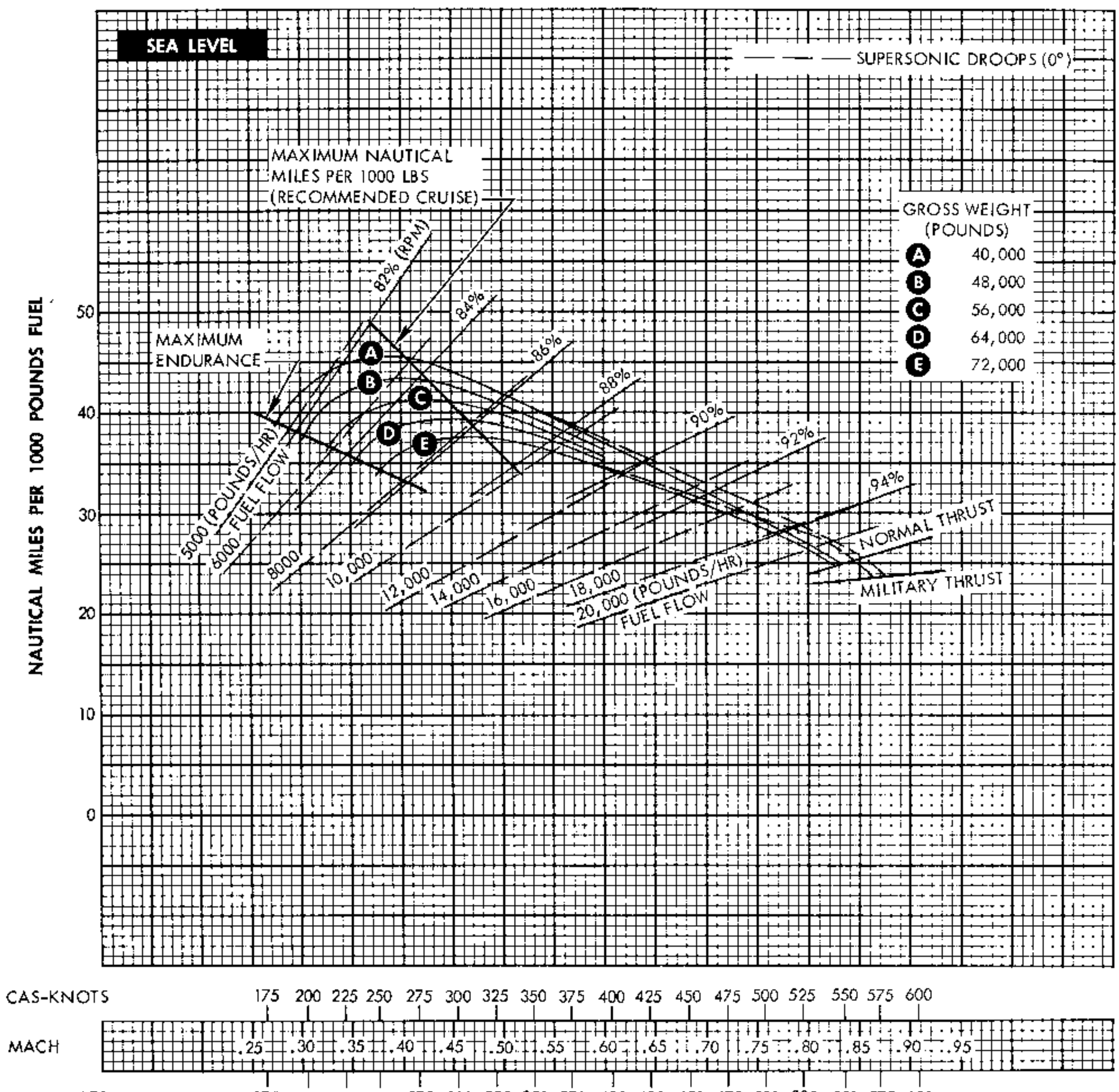
NAUTICAL MILES PER 1000 POUNDS FUEL

RECONNAISSANCE CONFIGURATION

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NA63H-2)
DATE: 1 JULY 1963

FOUR 400 GALLON DROP TANKS
STANDARD DAY

ENGINES: (2) J79-GE-8
FUEL GRADE: MIL-F-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL



NOTE:

(1) FOR ATTACK CONFIG WITH RECONNAISSANCE EQUIPMENT POD REMOVED, INCREASE N MI/1000 LBS FUEL BY 5% AND CRUISE SPEED BY 0.01M

(2) FOR RECON CONFIG WITH 2 FLASHER PODS INCREASE N MI/1000 LBS FUEL BY 10% AND INCREASE CRUISE SPEED BY 0.02MN

(3) FOR RECON CONFIG WITH 2 FLASHER PODS AND (2) 400 GAL EXTERNAL TANKS, INCREASE N MI/1000 LBS FUEL BY 2% AND CRUISE SPEED BY 0.01M

(4) RETRACT CRUISE DROOPS ABOVE 0.65 MACH NUMBER FOR INCREASED SPECIFIC RANGE

A-5C-1A-93-22 A

Figure 11-49

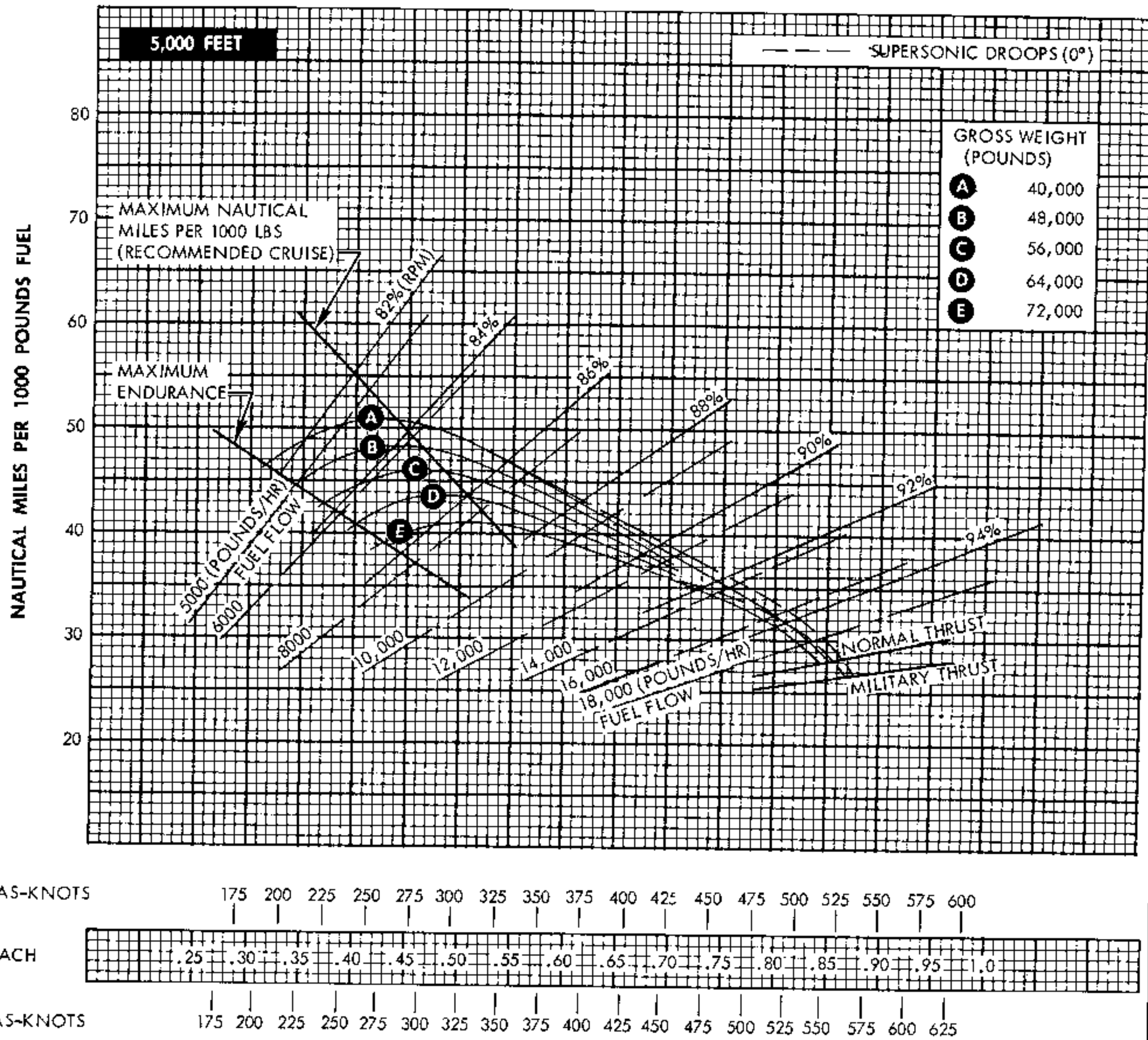
NAUTICAL MILES PER 1000 POUNDS FUEL

RECONNAISSANCE CONFIGURATION

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NA63H-2)
DATE: 1 JULY 1963

FOUR 400 GALLON DROP TANKS
STANDARD DAY

ENGINES (2) J79-GE-8
FUEL GRADE: MIL-F-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL



NOTE:

(1) FOR ATTACK CONFIG WITH RECONNAISSANCE EQUIPMENT POD REMOVED, INCREASE N MI/1000 LBS FUEL BY 5% AND CRUISE SPEED BY 0.01MN

(2) FOR RECON CONFIG WITH 2 FLASHER PODS INCREASE N MI/1000 LBS FUEL BY 10% AND INCREASE CRUISE SPEED BY 0.02MN

(3) FOR RECON CONFIG WITH 2 FLASHER PODS AND (2) 400 GAL EXTERNAL TANKS, INCREASE N MI/1000 LBS FUEL BY 2% AND CRUISE SPEED BY 0.01MN

(4) RETRACT CRUISE DROOPS ABOVE 0.65 MACH NUMBER FOR INCREASED SPECIFIC RANGE

A-5C-1A-93-23 A

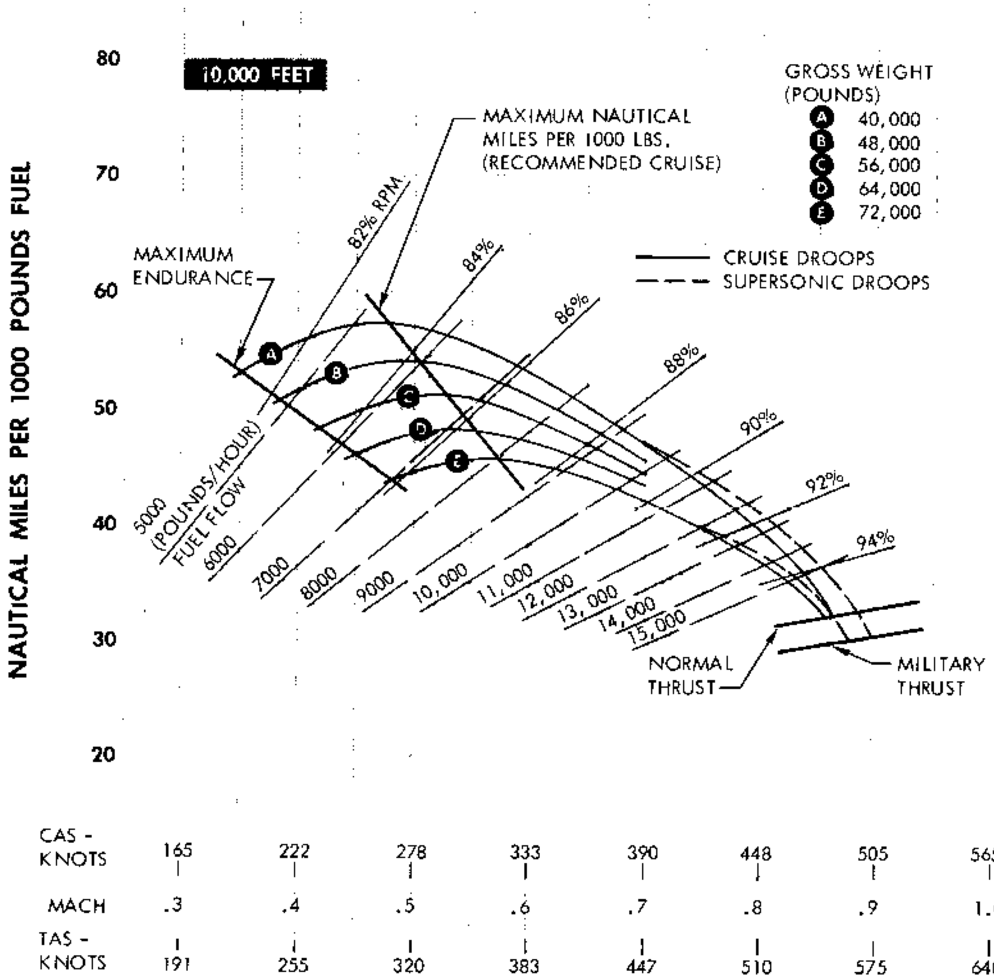
Figure 11-50

NAUTICAL MILES PER 1000 POUNDS FUEL

MODEL: RA-5C
DATA BASIS: FLIGHT TEST (NA63H-2)
DATE: 1 JANUARY 1967

RECONNAISSANCE CONFIGURATION
FOUR 400-GALLON DROP TANKS
STANDARD DAY

ENGINES: (2) J79-GE-8
FUEL GRADE: MIL-T-5624(JP-5)
FUEL DENSITY: 6.8 LB/GAL



NOTE:
FOR ATTACK CONFIGURATION WITH RECONNAISSANCE EQUIPMENT POD REMOVED, INCREASE NAUTICAL MILES PER 1000 POUNDS OF FUEL BY 5%. INCREASE CRUISE SPEED BY 0.01 M.

A-5C-1A-93-126

Figure 11-51

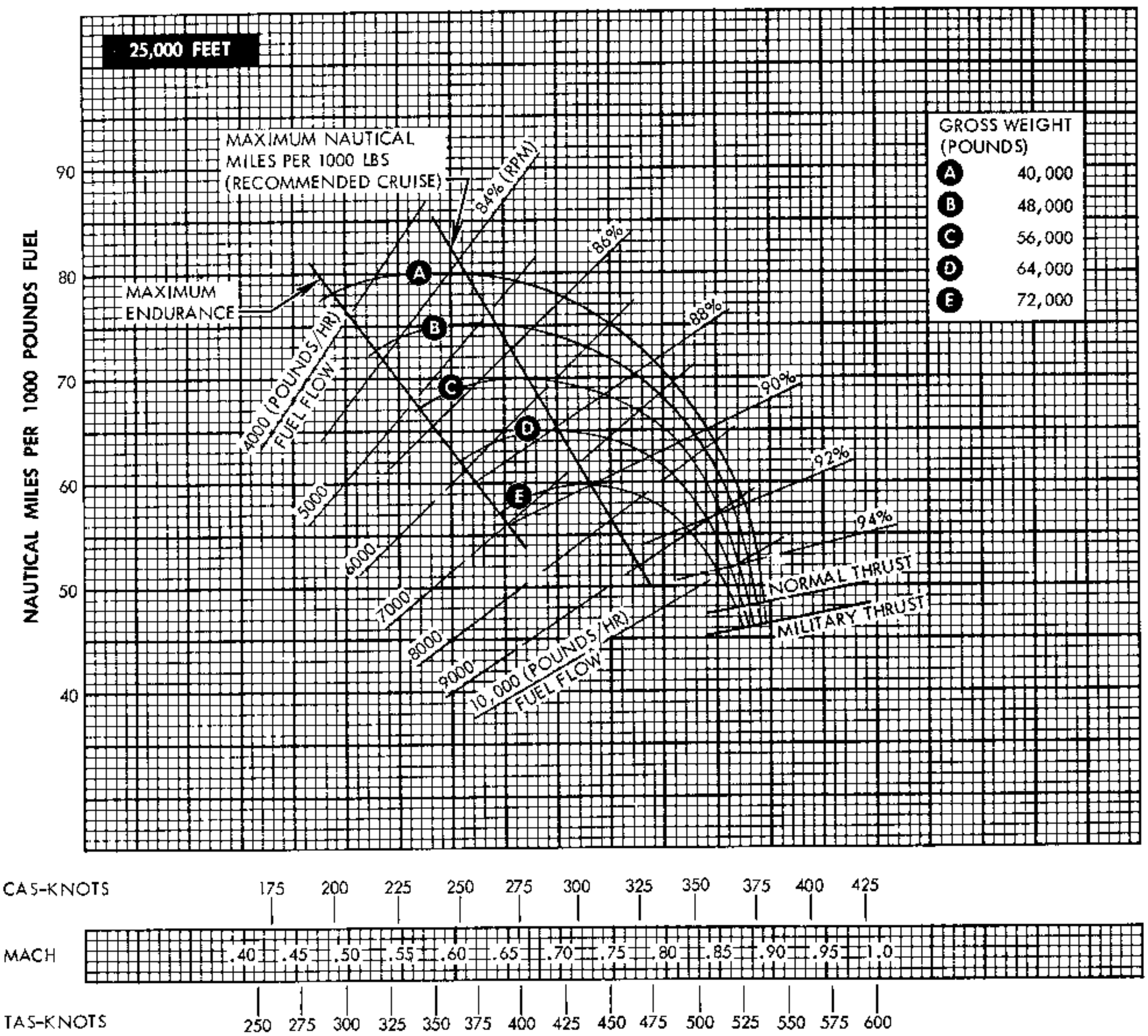
NAUTICAL MILES PER 1000 POUNDS FUEL

RECONNAISSANCE CONFIGURATION

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NA63H-2)
DATE: 1 JULY 1963

FOUR 400 GALLON DROP TANKS
STANDARD DAY

ENGINES: (2) J79-GE-8
FUEL GRADE: MIL-F-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL



NOTE:

(1) FOR ATTACK CONFIG WITH RECONNAISSANCE EQUIPMENT POD REMOVED, INCREASE N MI/1000 LBS FUEL BY 5% AND CRUISE SPEED BY 0.01MN

(2) FOR RECON CONFIG WITH 2 FLASHER PODS, INCREASE N MI/1000 LBS FUEL BY 10% AND INCREASE CRUISE SPEED BY 0.02MN

(3) FOR RECON CONFIG WITH 2 FLASHER PODS AND (2) 400 GAL EXTERNAL TANKS, INCREASE N MI/1000 LBS FUEL BY 2% AND CRUISE SPEED BY 0.01MN

A-5C-1A-93-24 A

Figure 11-52

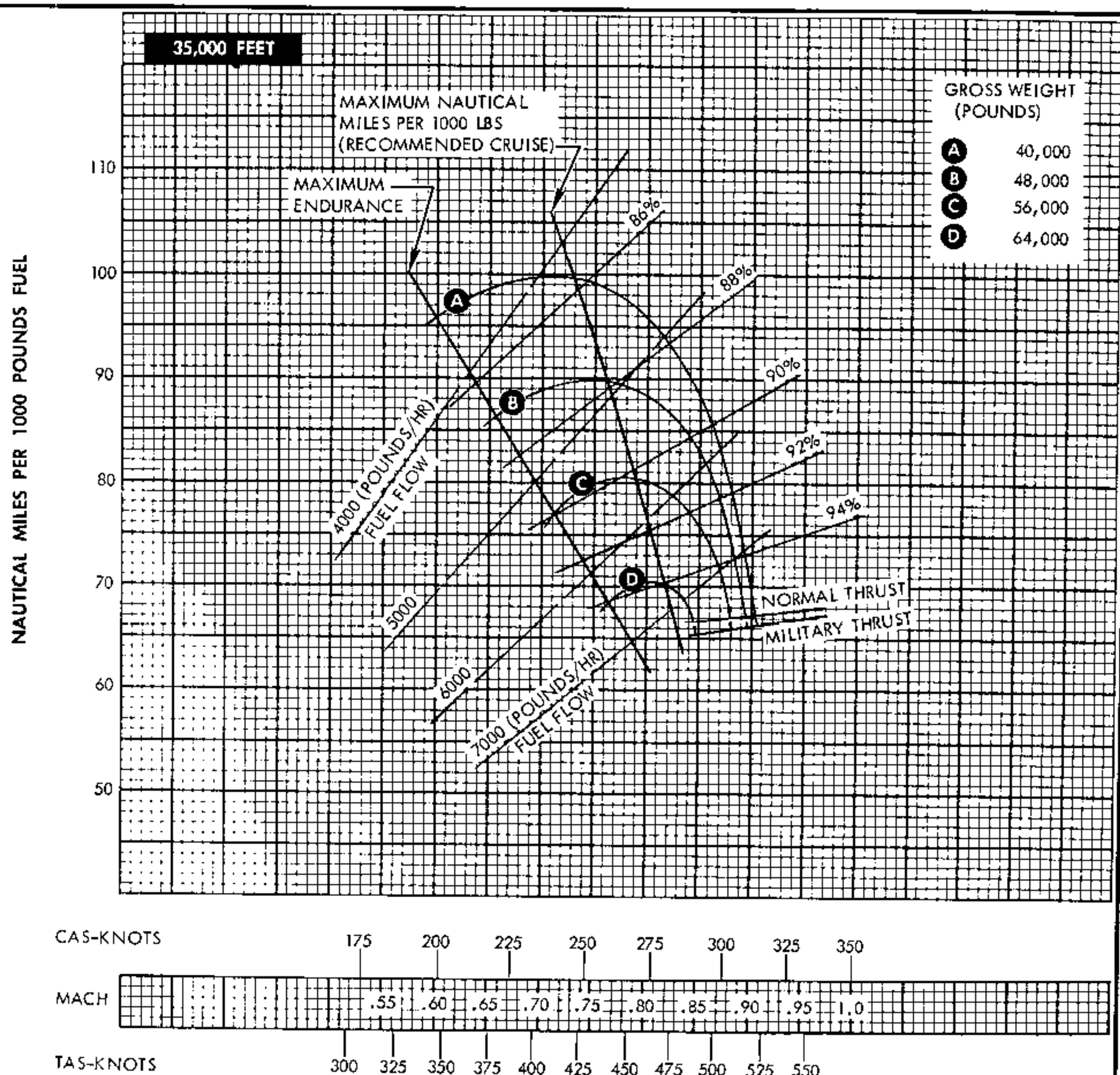
NAUTICAL MILES PER 1000 POUNDS FUEL

RECONNAISSANCE CONFIGURATION

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NA63H-2)
DATE: 1 JULY 1963

FOUR 400 GALLON DROP TANKS
STANDARD DAY

ENGINES: (2) J79-GE-8
FUEL GRADE: MIL-F-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL



NOTE:

1. FOR ATTACK CONFIGURATION WITH RECONNAISSANCE EQUIPMENT POD REMOVED, INCREASE N. MI/1000 LBS FUEL BY 5% AND CRUISE SPEED BY 0.01 MN
2. FOR RECON CONFIGURATION WITH 2 FLASHER PODS INCREASE N. MI/1000 LBS FUEL BY 10% AND INCREASE CRUISE SPEED BY 0.02 MN
3. FOR RECON CONFIGURATION WITH 2 FLASHER PODS AND (2) 400 GAL EXT TANKS, INCREASE N. MI/1000 LBS FUEL BY 2% AND CRUISE SPEED BY 0.01 MN

A-5C-1A-93-25 A

Figure 11-53

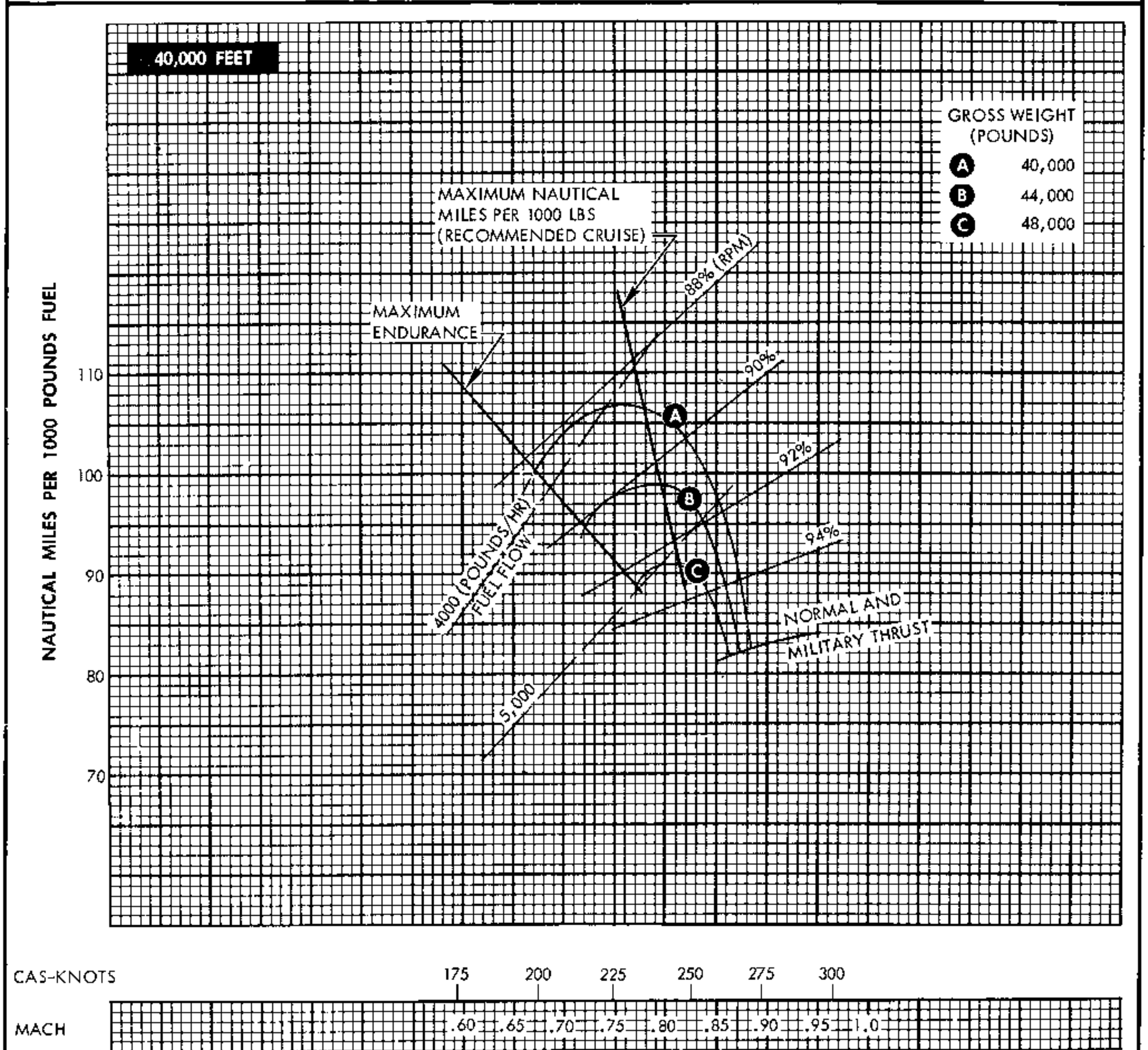
NAUTICAL MILES PER 1000 POUNDS FUEL

RECONNAISSANCE CONFIGURATION

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NA63H-2)
DATE: 1 JULY 1963

FOUR 400 GALLON DROP TANKS
STANDARD DAY

ENGINES: (2) J79-GE-8
FUEL GRADE: MIL-F-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL.



NOTE:

1. FOR ATTACK CONFIGURATION WITH RECONNAISSANCE EQUIPMENT POD REMOVED, INCREASE N MI/1000 LBS FUEL BY 5% & CRUISE SPEED BY 0.01MN
2. FOR RECON CONFIG WITH 2 FLASHER PODS, INCREASE N MI/1000 LBS FUEL 10% AND INCREASE CRUISE SPEED BY 0.02MN
3. FOR RECON CONFIGURATION WITH 2 FLASHER PODS AND (2) 400 GAL EXT TANKS, INCREASE N. MI/1000 LBS FUEL BY 2% AND CRUISE SPEED BY 0.01 MN

A-5C-1A-93-26 A

Figure 11-54

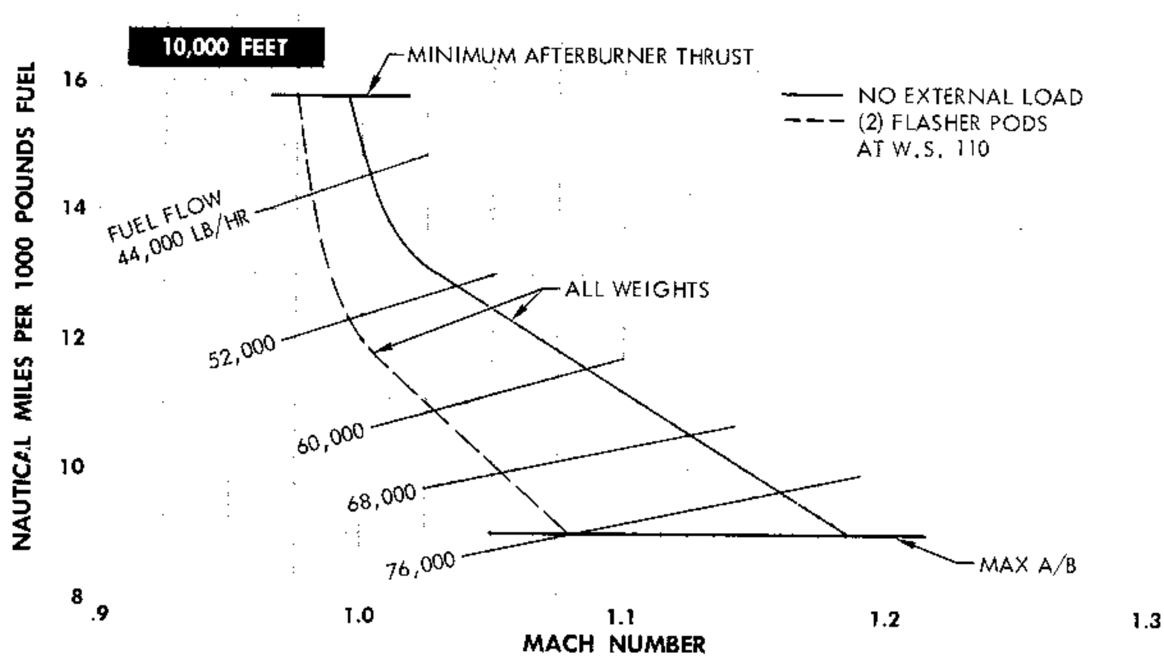
NAUTICAL MILES PER 1000 POUNDS OF FUEL-SUPERSONIC

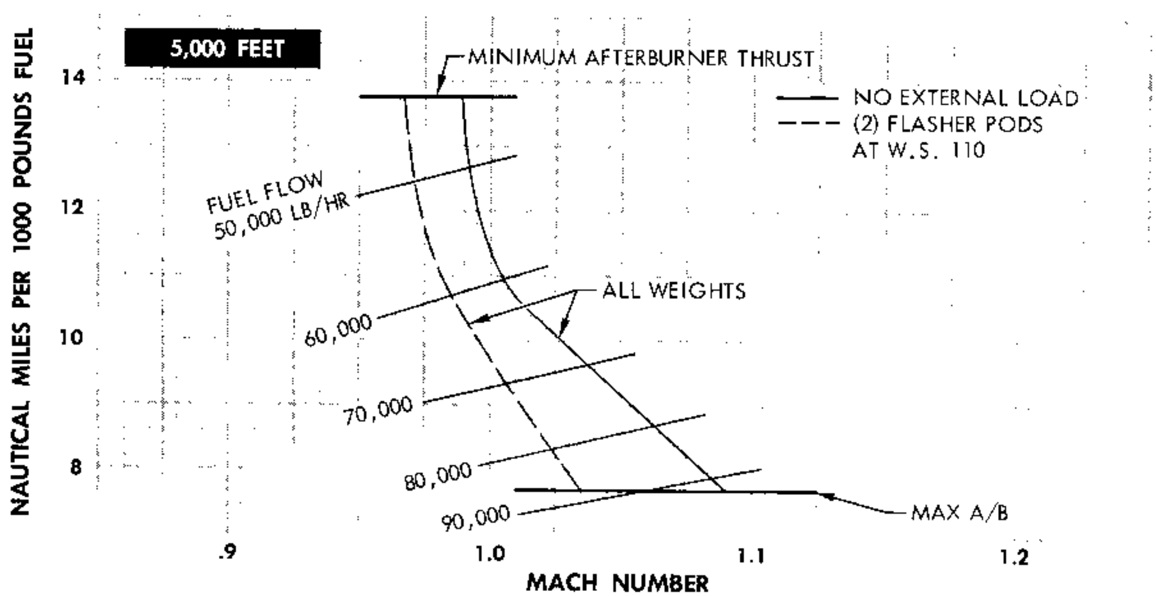
RECONNAISSANCE CONFIGURATION

MODEL: RA-5C
DATA BASIS: FLIGHT TEST (NA63H-2)
DATE: 1 JANUARY 1967

STANDARD DAY

ENGINES: (2) J79-GE-8
FUEL GRADE: MIL-T-5624(JP-5)
FUEL DENSITY: 6.8 LB/GAL





A-5C-1A-93-117

Figure 11-55

NAUTICAL MILES PER 1000 POUNDS OF FUEL-SUPERSONIC

RECONNAISSANCE CONFIGURATION

MODEL: RA-5C
DATA BASIS: FLIGHT TEST (NA63H-2)
DATA: 1 JANUARY 1967

STANDARD DAY

ENGINES: (2) J79-GE-8
FUEL GRADE: MIL-T-5624(JP-5)
FUEL DENSITY: 6.8 LB/GAL

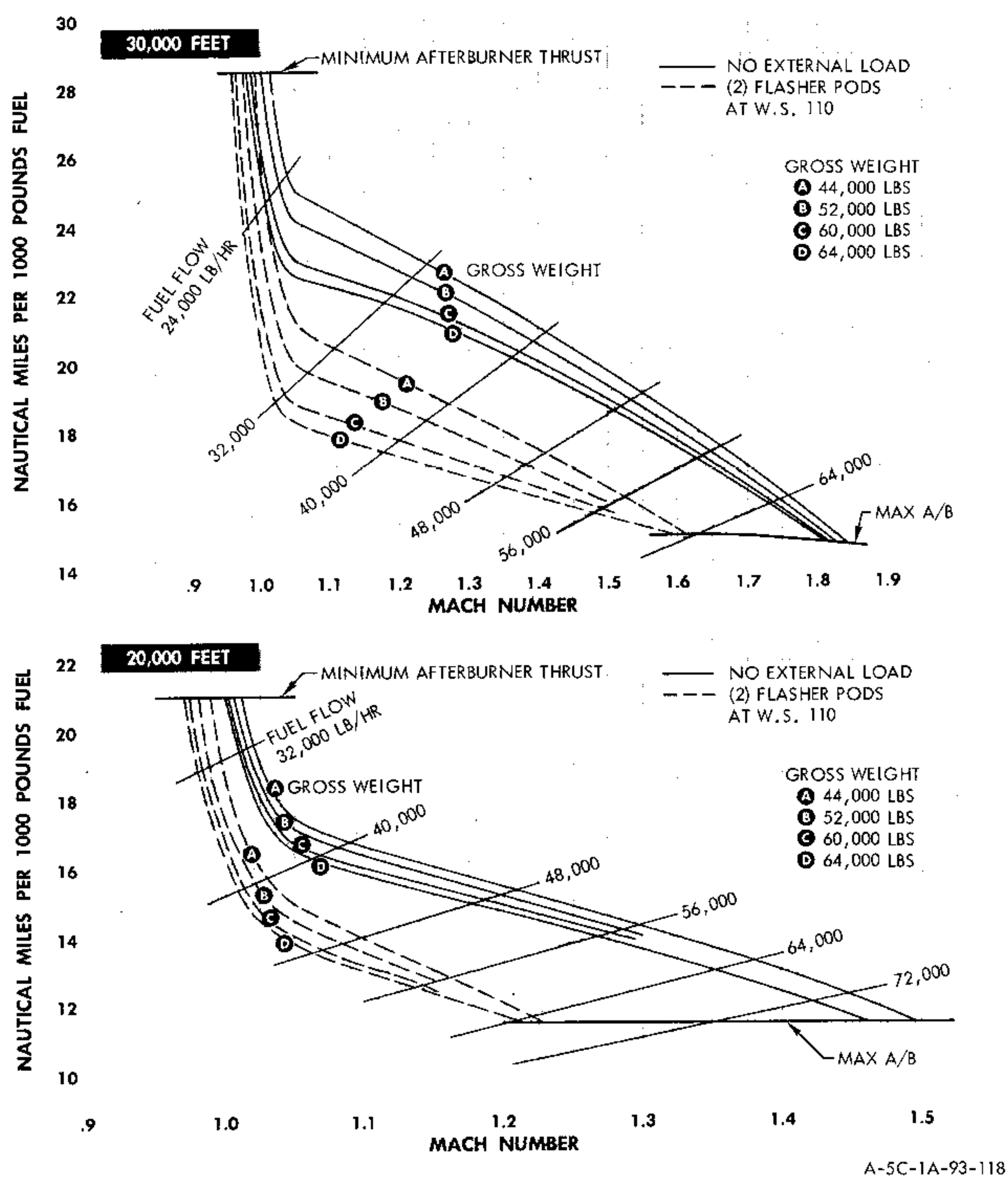


Figure 11-56

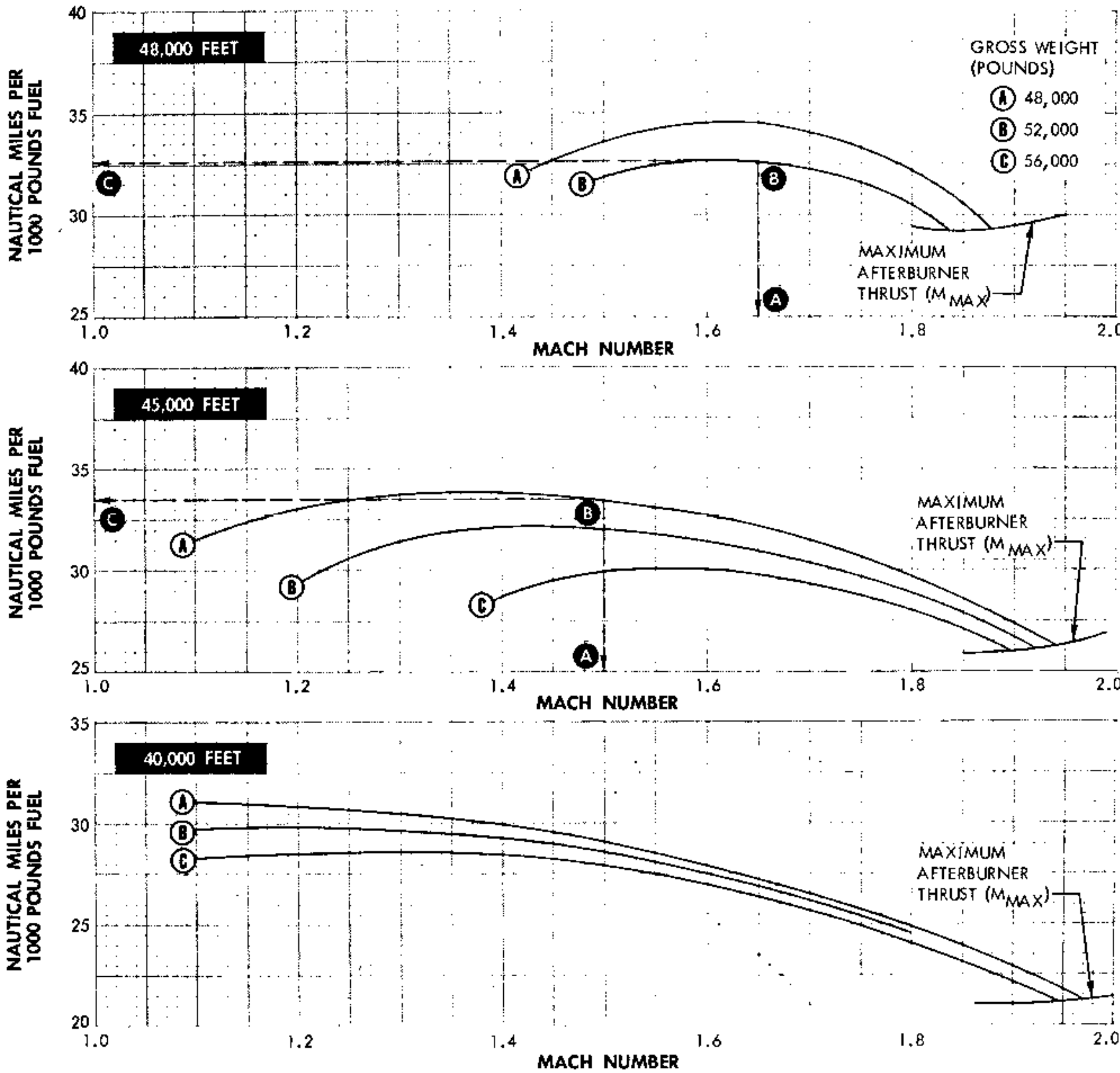
NAUTICAL MILES PER 1000 POUNDS FUEL—SUPERSONIC

RECONNAISSANCE CONFIGURATION

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NA63H-2)
DATE: 1 JANUARY 1964

NO EXTERNAL LOAD
STANDARD DAY

ENGINES: (2) J79-GE-8
FUEL GRADE: MIL-F-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL



NOTE:
FOR ATTACK CONFIGURATION WITH RECONNAISSANCE EQUIPMENT POD REMOVED, INCREASE NAUTICAL MILES PER 1000 POUNDS OF FUEL BY 10%.

EXAMPLE: (45,000 FEET)

- Ⓐ CRUISE MACH NUMBER (1.5)
- Ⓑ GROSS WEIGHT (48,000 POUNDS)
- Ⓒ NM/1000 LB FUEL (33.5)

EXAMPLE: (48,000 FEET)

- Ⓐ CRUISE MACH NUMBER (1.65)
- Ⓑ GROSS WEIGHT (52,000 POUNDS)
- Ⓒ NM/1000 LB FUEL (32.5)

A-5C-1A-93-29

Figure 11-57

NAUTICAL MILES PER 1000 POUNDS FUEL

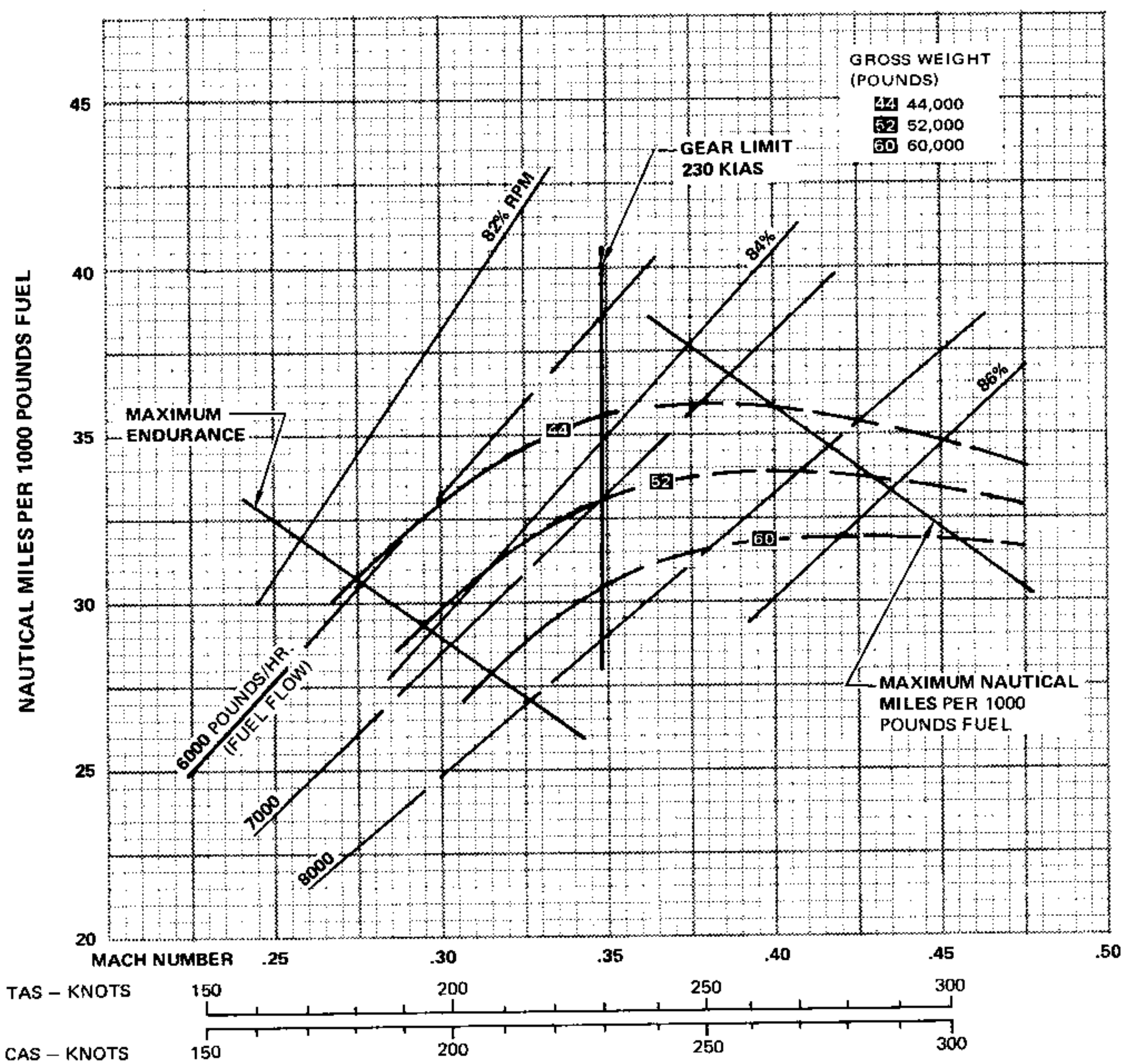
RECONNAISSANCE CONFIGURATION
FLAPS 0°/DROOPS 5°
STANDARD DAY

GEAR DOWN

SEA LEVEL

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NA63H-2 & NR69H-2)
DATE: 15 JUNE 1970

ENGINES: (2) J79-GE-8/10
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB./GAL.



A-5C-1A-93-127A

Figure 11-58

NAUTICAL MILES PER 1000 POUNDS FUEL

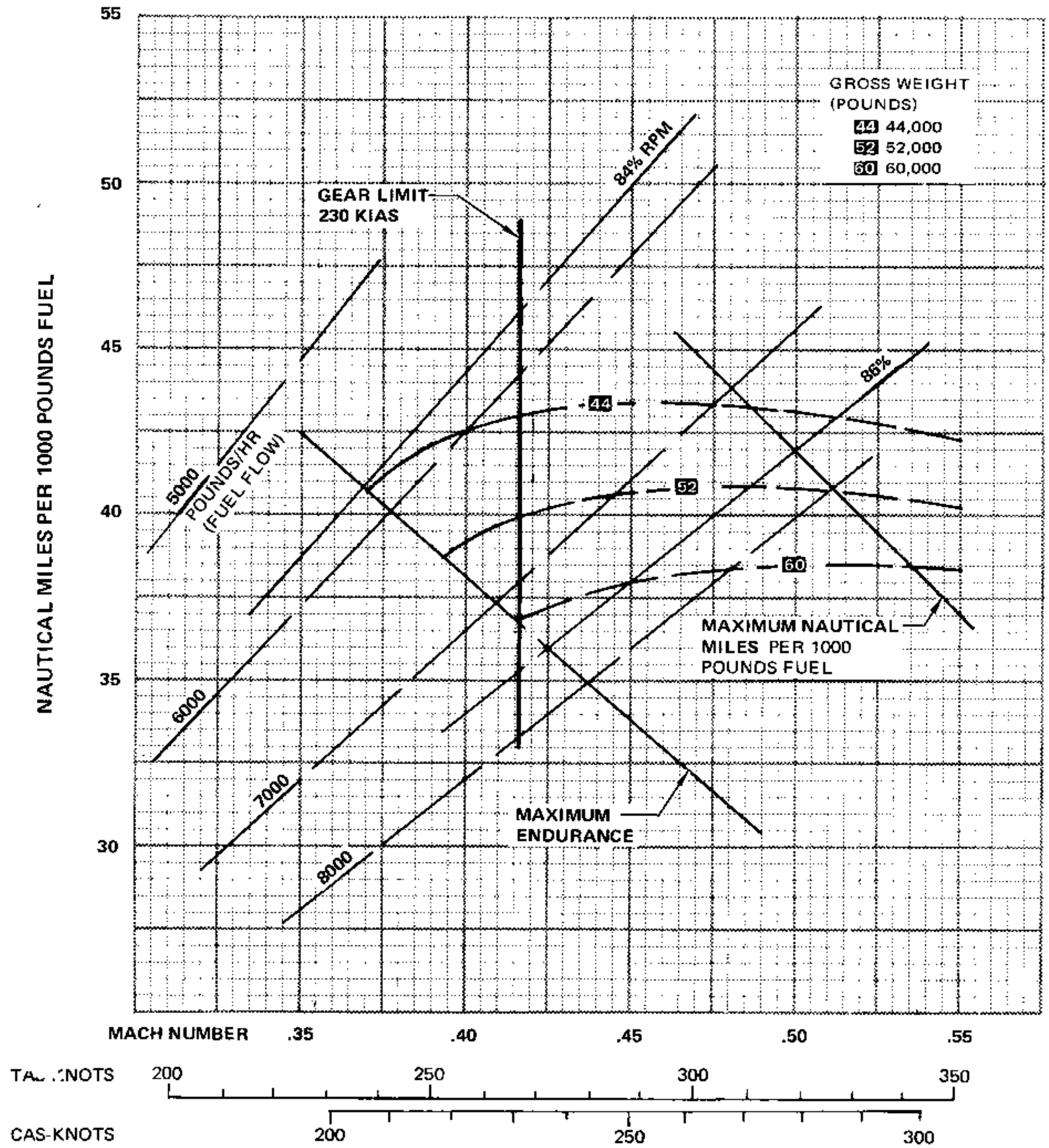
RECONNAISSANCE CONFIGURATION
FLAPS 0°/DROOPS 5°
STANDARD DAY

GEAR DOWN

10,000 FEET

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NA63H-2 & NR69H-2)
DATE: 15 JUNE 1970

ENGINES: (2) J79-GE-8/10
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB./GAL.



A-5C-1A-93-128A

Figure 11-59

BINGO CHART - TWO ENGINE (RANGE DECISION)

RECONNAISSANCE CONFIGURATION

MODEL: RA-5C
DATA BASIS: FLIGHT TEST (NA63H-2) OR (NR69H-2)
DATE: 15 JUNE 1970

No External Load
Standard Day

ENGINES: (2) J79-GE-8/10
FUEL GRADE: MIL-T-5624-(JP-5)
FUEL DENSITY: 6.8 LB/GAL

GROSS WEIGHT WITH 1500 POUNDS OF FUEL = 44,900 POUNDS

DISTANCE TO GO	CRUISE AT SEA LEVEL		CRUISE AT OPTIMUM ALTITUDE				SEA LEVEL-230 KIAS GEAR DN-FLAPS UP
(N.MI.)	FUEL REQUIRED (POUNDS)	KIAS (KNOTS)	OPTIMUM ALTITUDE (FEET X 1000)	START DESCENT AT N.MI. TO GO	FUEL REQUIRED (POUNDS)	KIAS OR MACH No.	FUEL REQUIRED (POUNDS)
10	2100	325	SL	–	2100	325 KIAS	2200
20	2300	325	SL	–	2300	325 KIAS	2500
30	2500	325	SL	–	2500	325 KIAS	2700
40	2700	325	SL	–	2700	325 KIAS	3000
50	2900	326	10	14	2800	.51	3300
60	3100	326	10	14	3000	.55	3600
70	3300	326	13	19	3200	.59	3900
80	3500	327	18	28	3400	.63	4200
90	3700	327	22	35	3500	.66	4400
100	3900	327	25	40	3600	.69	4700
110	4100	328	28	45	3700	.73	5000
120	4300	328	30	49	3800	.75	5300
130	4500	328	32	53	4000	.77	5600
140	4700	329	33	55	4100	.78	5900
150	4900	329	34	56	4200	.79	6200
160	5100	329	35	58	4300	.80	6500
170	5300	330	36	60	4400	.81	6700
180	5500	330	37	62	4500	.82	7000
190	5700	330	39	66	4600	.83	7300
200	5900	330	40	68	4700	.84	7600

MILITARY THRUST CLIMB SCHEDULE		
NO EXTERNAL STORES CRUISE DROOPS	STD. DAY G.W. = 50,000 LBS.	
ALTITUDE FEET	MACH No.	KIAS
SEA LEVEL	.68	450
5,000	.70	425
10,000	.73	407
15,000	.75	383
20,000	.78	363
25,000	.80	337
30,000	.83	315
35,000	.85	290
40,000	.87	265

REMARKS:

1. FUEL REQUIRED INCLUDES 400 POUNDS ALLOWANCE FOR ACCELERATION AND TURN TO DIVERT HEADING AND 1500 POUNDS RESERVE ALLOWANCE FOR LANDING AT DESTINATION.
2. DISTANCE TO GO INCLUDES MIL CLIMB FROM SEA LEVEL TO CRUISE ALTITUDE, CRUISE AND DESCENT (IDLE RPM - 250 KIAS) TO SEA LEVEL.

NOTES:

1. AIRCRAFT GROSS WEIGHT OF 44,900 LB WITH 1500 POUNDS OF FUEL ABOARD IS BASED ON 3 FUEL CANS INTERNAL AND NO PECM. FUEL REQUIRED INCREASES APPROXIMATELY 2% PER 1000 POUNDS INCREASE IN AIRCRAFT NO FUEL GROSS WEIGHT.
2. WITH GEAR DOWN, FLAPS 50° AND GROSS WEIGHTS OF 44,000 TO 50,000 LB, THE AVERAGE FUEL CONSUMPTION AT MAX RANGE CRUISE SPEED OF 165 TO 175 KIAS IS 14 N. MI./1000 LB AT S.L. AND 15 N. MI./1000 LB AT 5000 FT.
3. FOR 0 FLAPS, 25° DROOPS, BLC FAILED ON, INCREASE FUEL REQUIRED BY 10% AT S.L. (CRUISE AT 270 KIAS) OR BY 15% AT OPTIMUM ALTITUDE; REDUCE OPTIMUM ALTITUDE BY 5000 FT AND MACH BY 0.12. LIMIT AIRSPEED TO 290 KIAS WITH DROOPS AT 25°.
4. THIS BINGO CHART CAN BE USED FOR ALTERNATE A AND B CONFIGURATIONS BY APPLYING THE APPROXIMATE ADJUSTMENTS SHOWN (NO CHANGE IN DISTANCE TO GO).
5. SPEEDS SHOWN ARE FOR SPC-ON (AIRCRAFT NOT HAVING AFC 159 COMPLIED WITH)

CONFIGURATION	G.W. RANGE WITH 1500 LBS FUEL	APPROXIMATE ADJUSTMENT FOR CRUISE AT OPTIMUM ALTITUDE		
		OPTIMUM ALTITUDE	FUEL* REQUIRED	MACH. NO'
	LBS	FEET	%	
A. (4) Pylons or (2) Flasher Pods or (2) 400 Gallon Tanks	46,300 TO 47,200	–2500	5	–.05
B. (4) 400 Gal Tanks or (2) Flasher Pods and (2) 400 Gallon Tanks	47,600 TO 48,800	–7000	15	–0.1

6. * PERCENT INCREASE IN FUEL REQUIRED WITH EXTERNAL STORES SHOWN CAN ALSO BE APPLIED TO SEA LEVEL CRUISE DATA IN THE BINGO CHART TO OBTAIN FUEL REQUIRED FOR CRUISE AT SEA LEVEL. THE SPEED FOR CRUISING AT SEA LEVEL REMAINS THE SAME.

A-5C-1A-93-45G

Figure 11-60

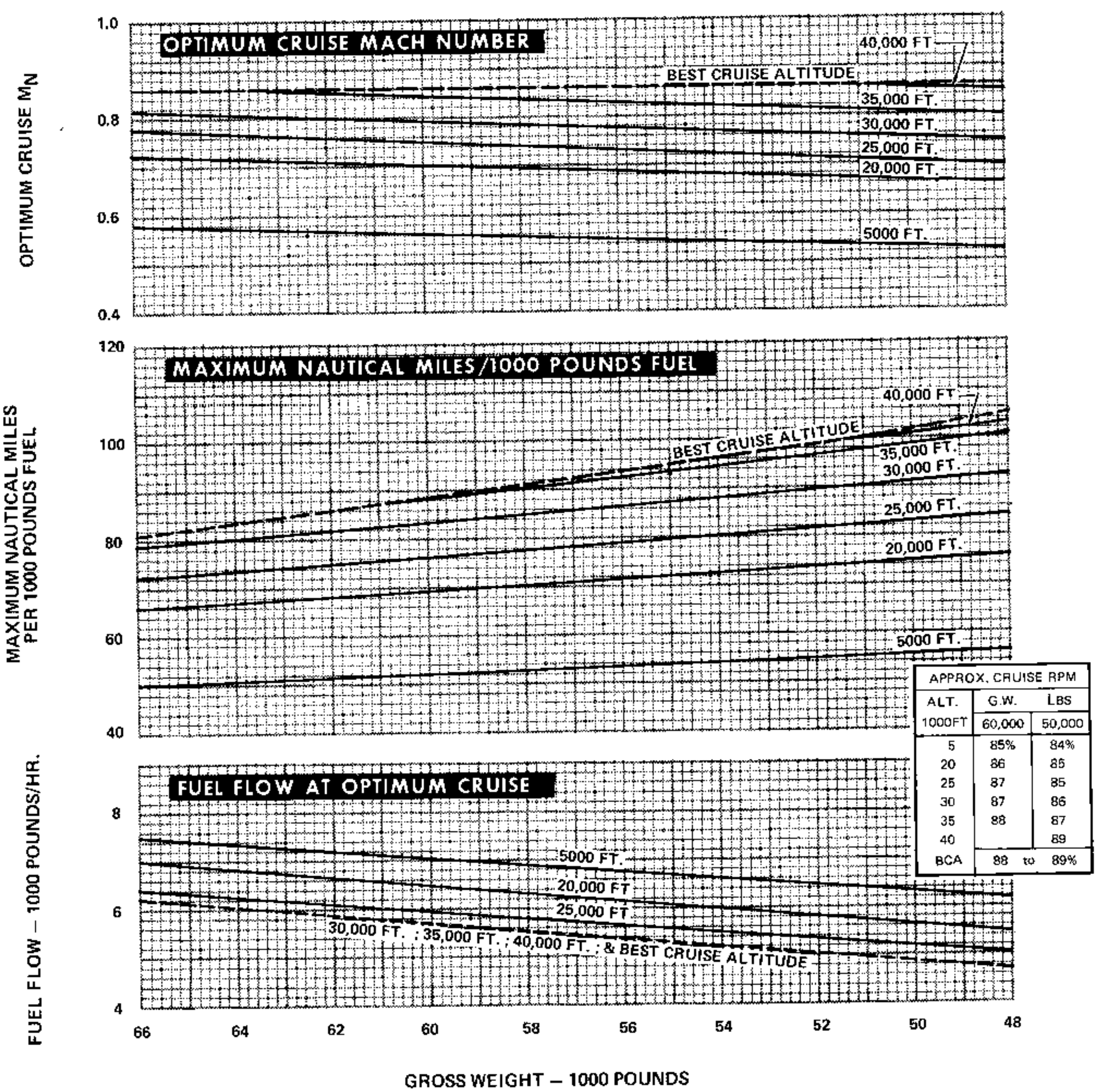
OPTIMUM CRUISE SUMMARY

NO EXTERNAL LOAD

STANDARD DAY

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NR69H-2)
DATE: 15 JUNE 1970

ENGINES: (2) J79-GE-10
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL



APPROX. CRUISE RPM		
ALT.	G.W.	LBS
1000FT	60,000	50,000
5	85%	84%
20	86	85
25	87	85
30	87	86
35	88	87
40		89
BCA	88 to	89%

RA-5C-1-93-40

Figure 11-61

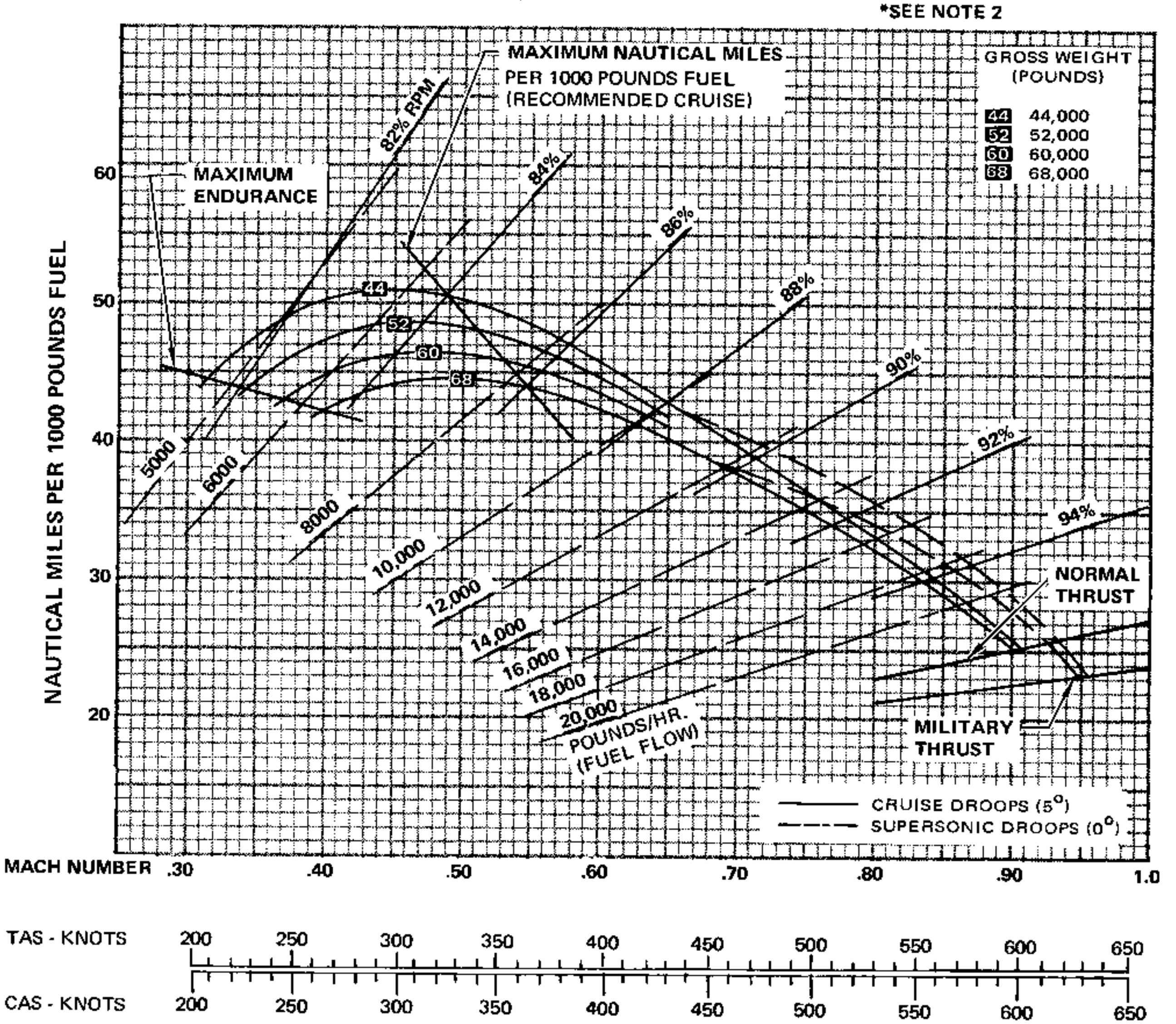
NAUTICAL MILES PER 1000 POUNDS FUEL

RECONNAISSANCE CONFIGURATION
NO EXTERNAL LOAD
STANDARD DAY

SEA LEVEL

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NR69H-2)
DATE: 15 JUNE 1970

ENGINES: (2) J79-GE-10 (-8)*
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB./GAL.
*SEE NOTE 2



NOTE:

1. RETRACT CRUISE DROOPS ABOVE 0.70 MACH NUMBER FOR INCREASED SPECIFIC RANGE.
2. FOR AIRCRAFT HAVING AFC 328 COMPLIED WITH AND J79-GE-8 ENGINES INSTALLED REDUCE NAUTICAL MILES PER 1000 POUNDS FUEL BY 4%.

RA-5C-1-93-21A

Figure 11-62

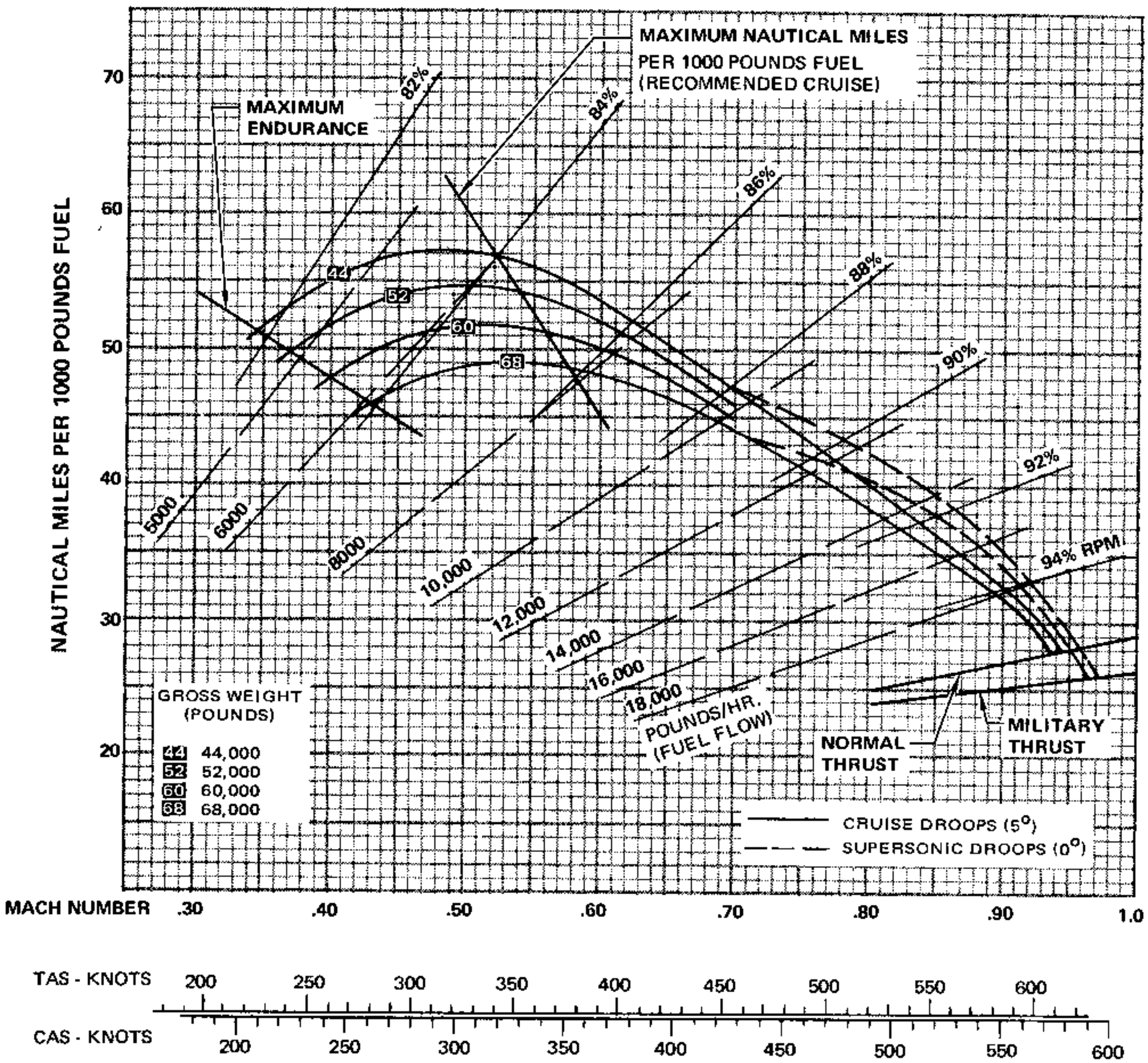
NAUTICAL MILES PER 1000 POUNDS FUEL

RECONNAISSANCE CONFIGURATION
NO EXTERNAL LOAD
STANDARD DAY

5000 FT

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NR69H-2)
DATE: 15 JUNE 1970

ENGINES: (2) J79-GE-10 (-8)*
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB./GAL.
*SEE NOTE 2



NOTE:

1. RETRACT CRUISE DROOPS ABOVE 0.70 MACH NUMBER FOR INCREASED SPECIFIC RANGE.
2. FOR AIRCRAFT HAVING AFC 328 COMPLIED WITH AND J79-GE-8 ENGINES INSTALLED, REDUCE NAUTICAL MILES PER 1000 POUNDS FUEL BY 4%.

RA-5C-1-93-22A

Figure 11-63

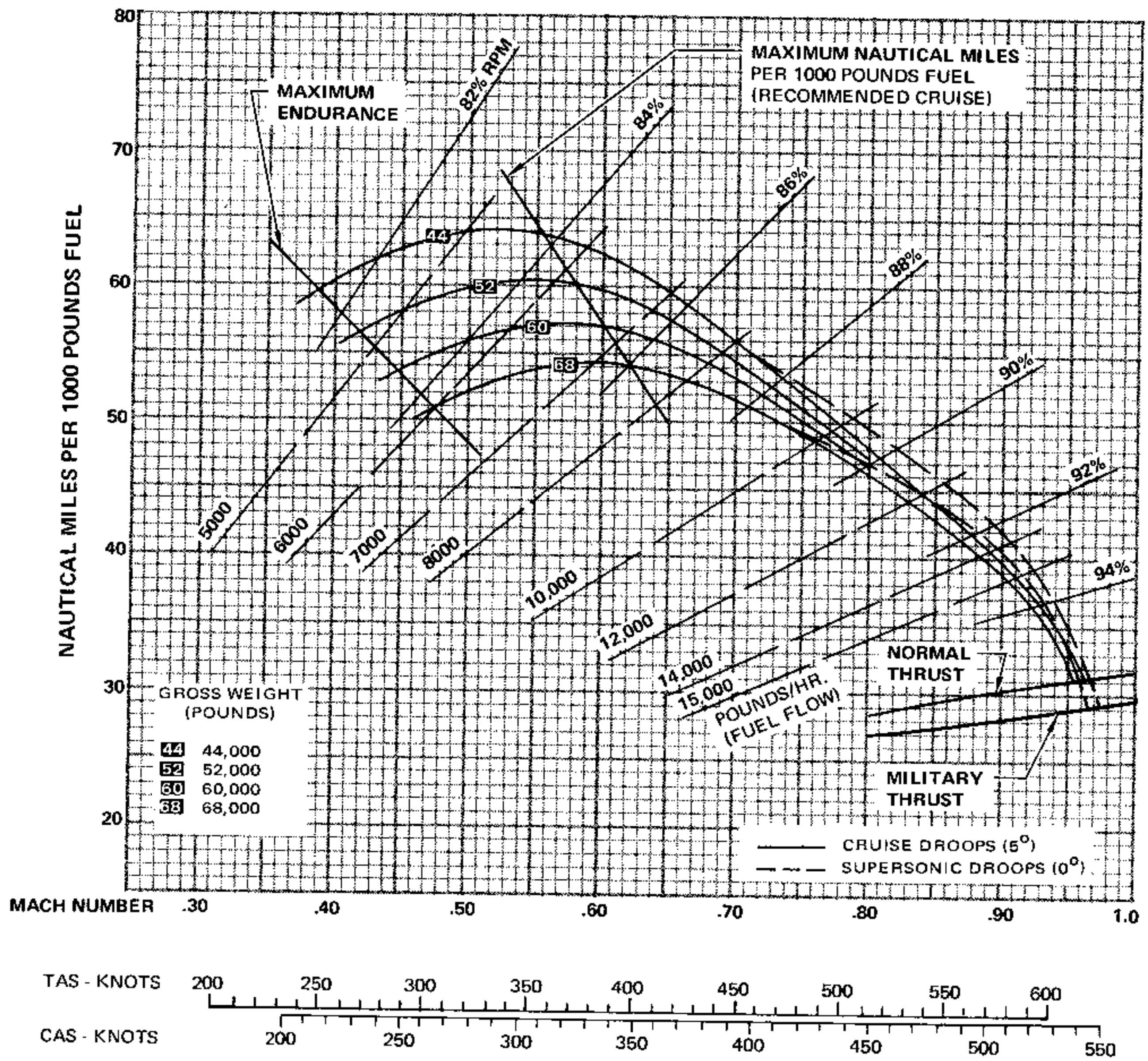
NAUTICAL MILES PER 1000 POUNDS FUEL

RECONNAISSANCE CONFIGURATION
NO EXTERNAL LOAD
STANDARD DAY

10,000 FT

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NR69H-2)
DATE: 15 JUNE 1970

ENGINES: (2) J79-GE-10 (-8)*
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB./GAL.
*SEE NOTE 2



NOTE:

1. RETRACT CRUISE DROOPS ABOVE 0.70 MACH NUMBER FOR INCREASED SPECIFIC RANGE.
2. FOR AIRCRAFT HAVING AFC 328 COMPLIED WITH AND J79-GE-8 ENGINES INSTALLED, REDUCE NAUTICAL MILES PER 1000 POUNDS FUEL BY 4%.

RA-5C-1-93-23A

Figure 11-64

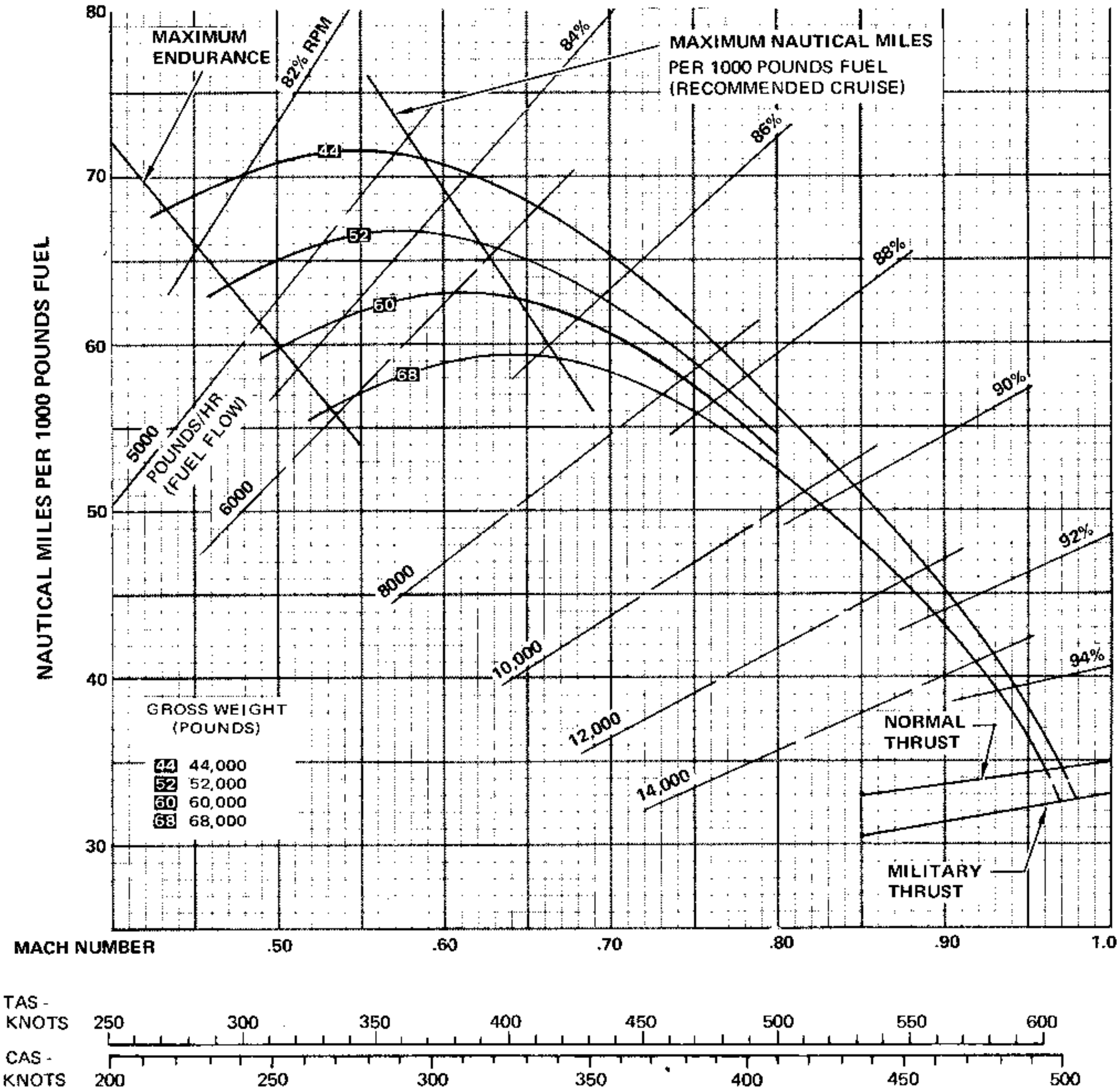
NAUTICAL MILES PER 1000 POUNDS FUEL

RECONNAISSANCE CONFIGURATION
NO EXTERNAL LOAD
STANDARD DAY

15,000 FT

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NR69H-2)
DATE: 15 JUNE 1970

ENGINES: (2) J79-GE-10 (-8)*
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB./GAL.
*SEE NOTE



NOTE:

FOR AIRCRAFT HAVING AFC 328 COMPLIED WITH AND HAVING J79-GE-8 ENGINES INSTALLED, REDUCE NAUTICAL MILES PER 1000 POUNDS FUEL BY 4%.

RA-5C-1-93-24A

Figure 11-65

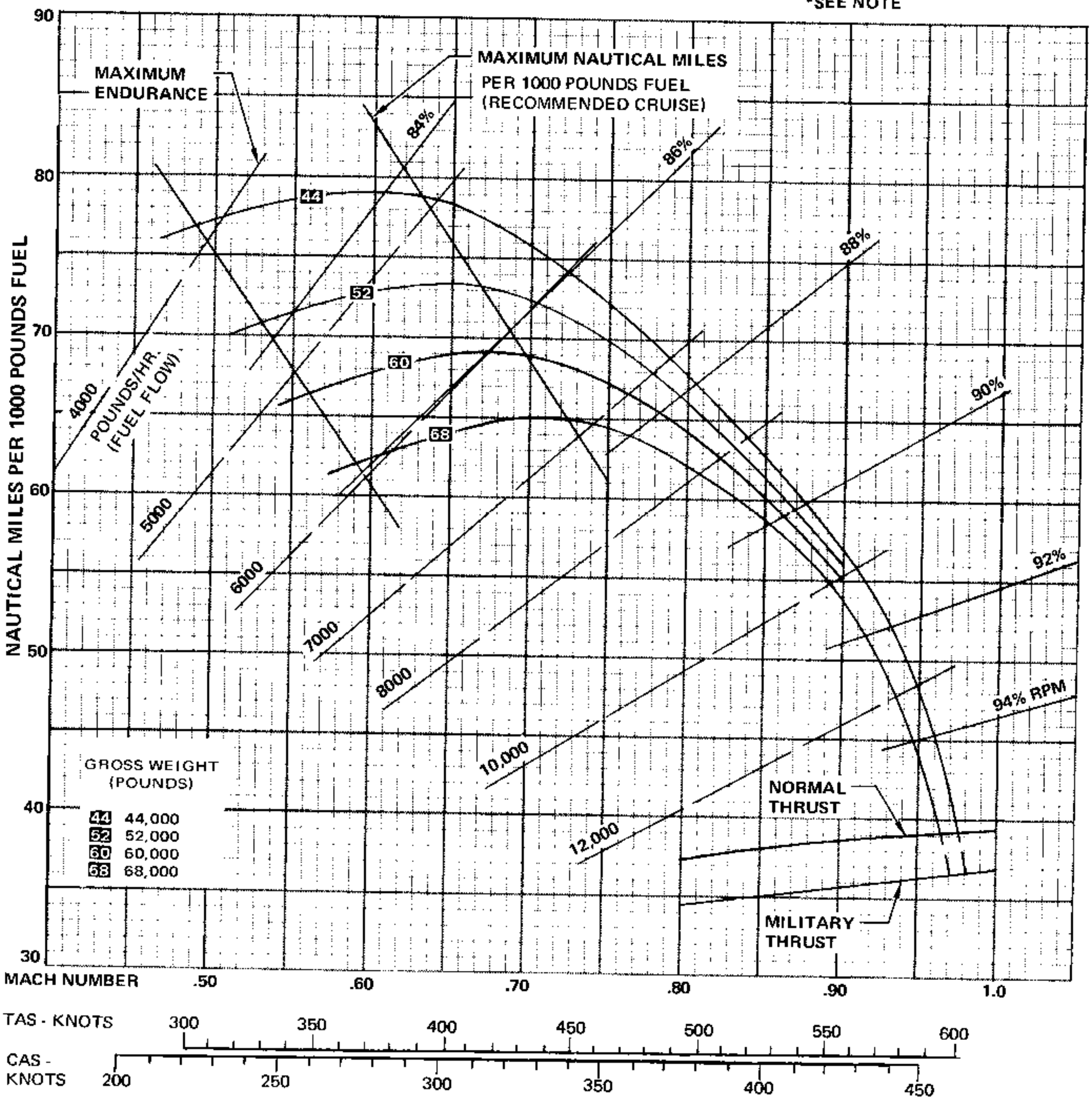
NAUTICAL MILES PER 1000 POUNDS FUEL

RECONNAISSANCE CONFIGURATION
NO EXTERNAL LOAD
STANDARD DAY

20,000 FT

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NR69H-2)
DATE: 15 JUNE 1970

ENGINES: (2) J79-GE-10 (-8)*
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB./GAL.
*SEE NOTE



NOTE:

FOR AIRCRAFT HAVING AFC 328 COMPLIED WITH AND J79-GE-8 ENGINES INSTALLED, REDUCE NAUTICAL MILES PER 1000 POUNDS FUEL BY 4%.

RA-5C-1-93-25A

Figure 11-66

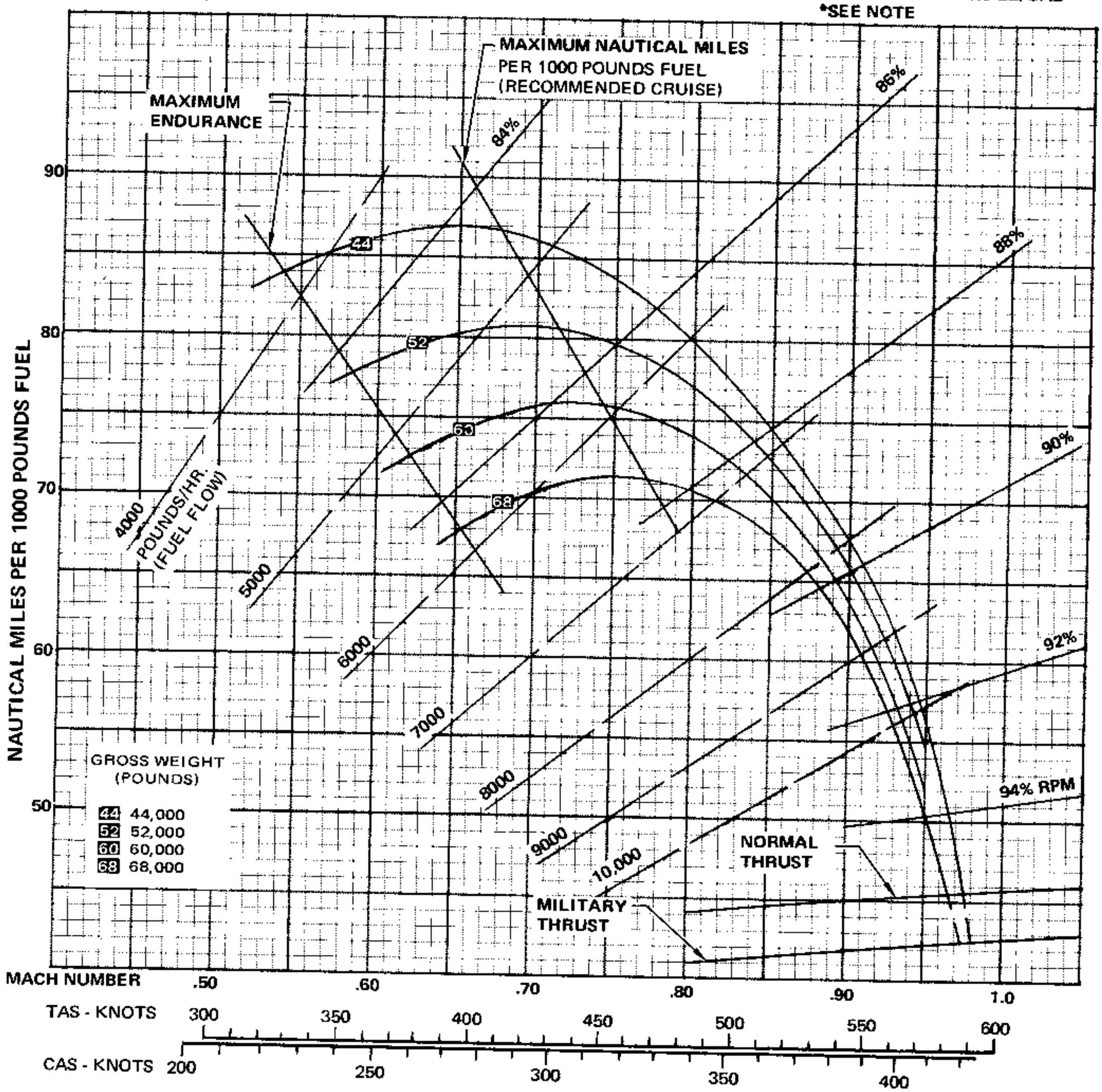
NAUTICAL MILES PER 1000 POUNDS FUEL

RECONNAISSANCE CONFIGURATION
NO EXTERNAL LOAD
STANDARD DAY

25,000 FT

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NR69H-2)
DATE: 16 JUNE 1970

ENGINES: (2) J79-GE-10 (-8)*
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL
*SEE NOTE



NOTE:

FOR AIRCRAFT HAVING AFC 328 COMPLIED WITH AND J79-GE-8 ENGINES INSTALLED, REDUCE NAUTICAL MILES PER 1000 POUNDS FUEL BY 4%

RA-5C-1-93-26A

Figure 11-67

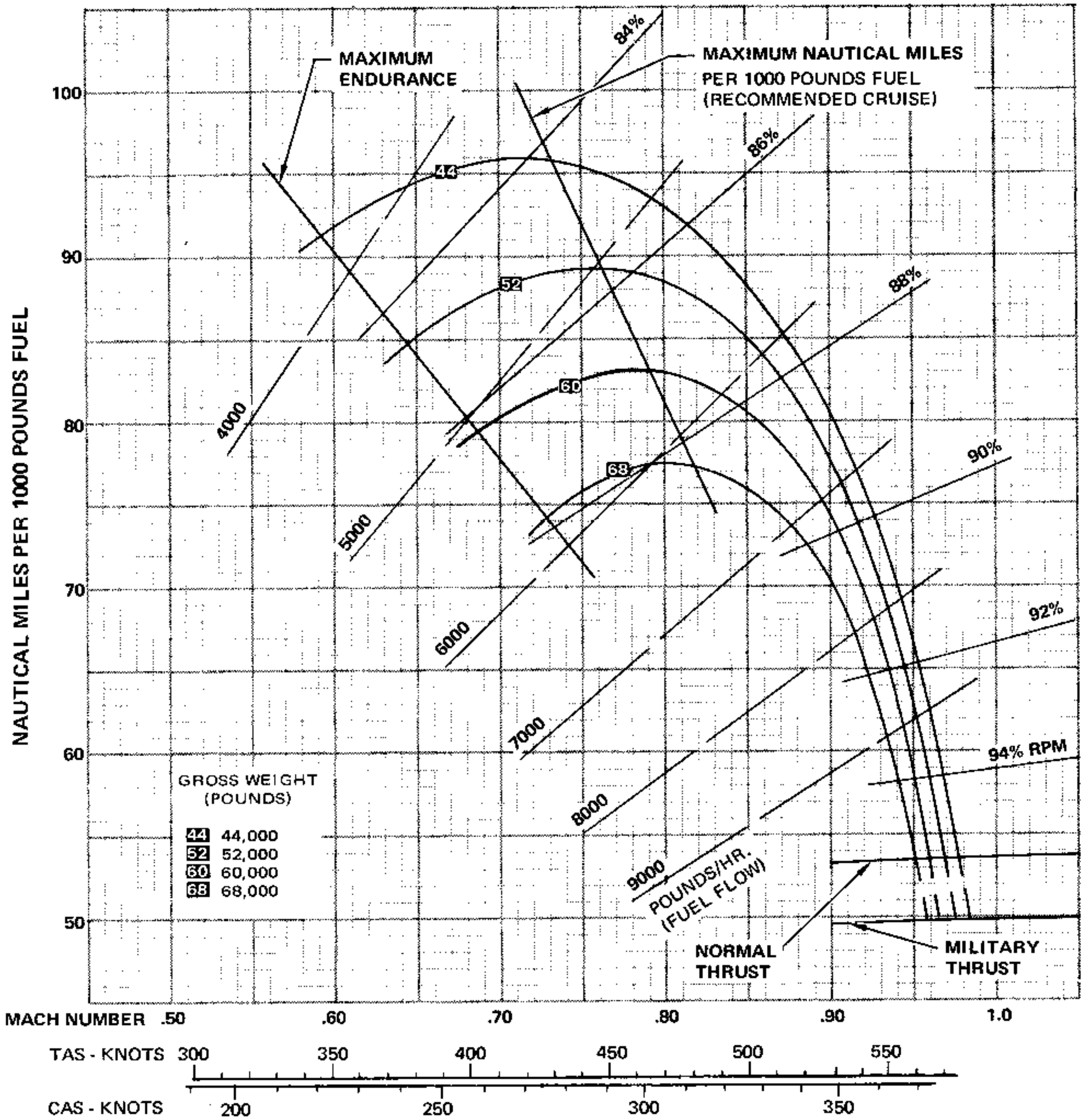
NAUTICAL MILES PER 1000 POUNDS FUEL

RECONNAISSANCE CONFIGURATION
NO EXTERNAL LOAD
STANDARD DAY

30,000 FT

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NR69H-2)
DATE: 15 JUNE 1970

ENGINES: (2) J79-GE-10 (-8)*
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL
*SEE NOTE



NOTE:

FOR AIRCRAFT HAVING AFC 328 COMPLIED WITH AND J79-GE-8 ENGINES INSTALLED, REDUCE NAUTICAL MILES PER 1000 POUNDS FUEL BY 4%

RA-5C-1-93-27A

Figure 11-68

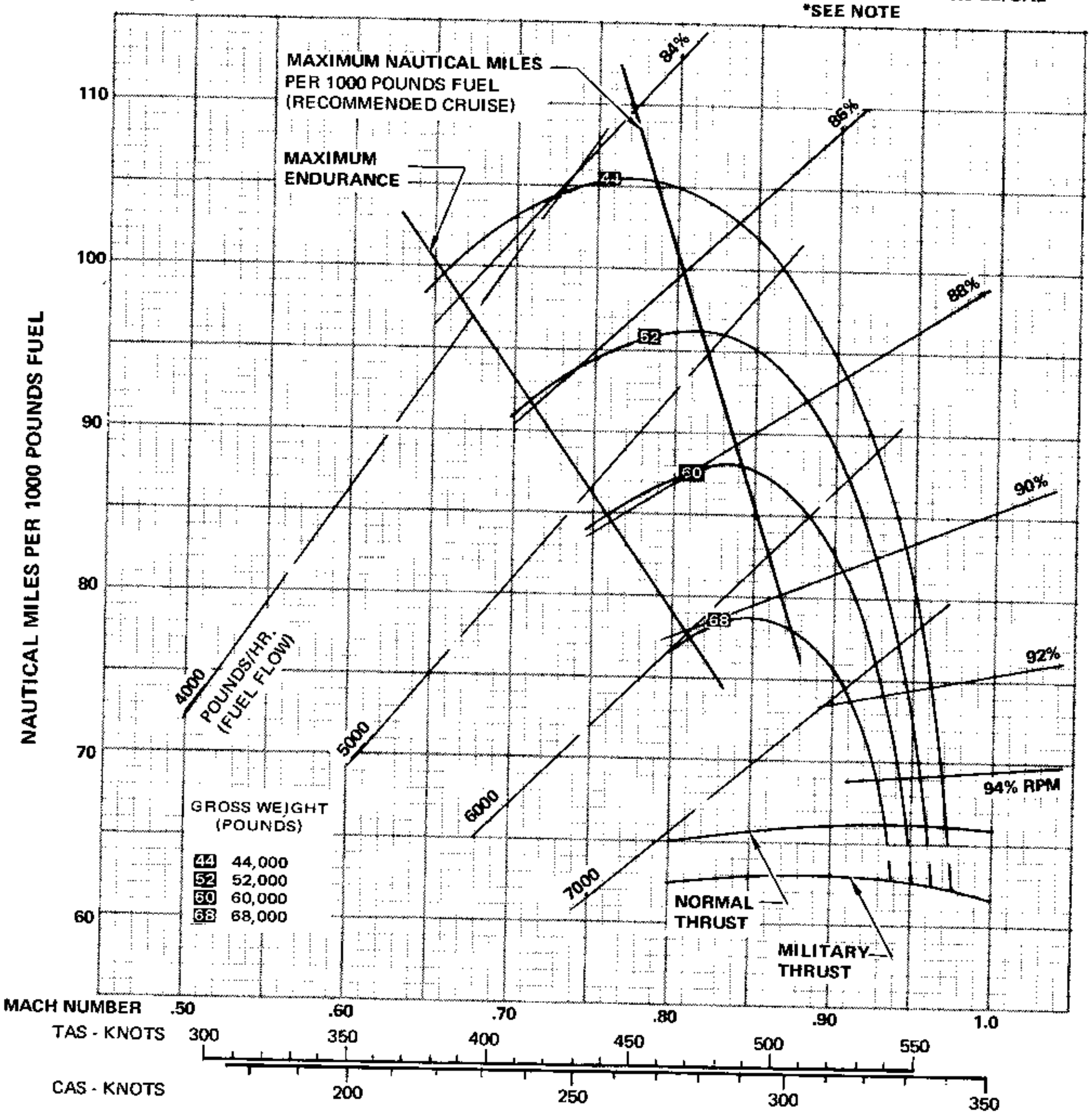
NAUTICAL MILES PER 1000 POUNDS FUEL

RECONNAISSANCE CONFIGURATION
NO EXTERNAL LOAD
STANDARD DAY

35,000 FT

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NR69H-2)
DATE: 15 JUNE 1970

ENGINES: (2) J79-GE-10 (-8)*
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL
*SEE NOTE



NOTE:

FOR AIRCRAFT HAVING AFC 328 COMPLIED WITH AND J79-GE-8 ENGINES INSTALLED, REDUCE NAUTICAL MILES PER 1000 POUNDS FUEL BY 6%

RA-5C-1-93-28A

Figure 11-69

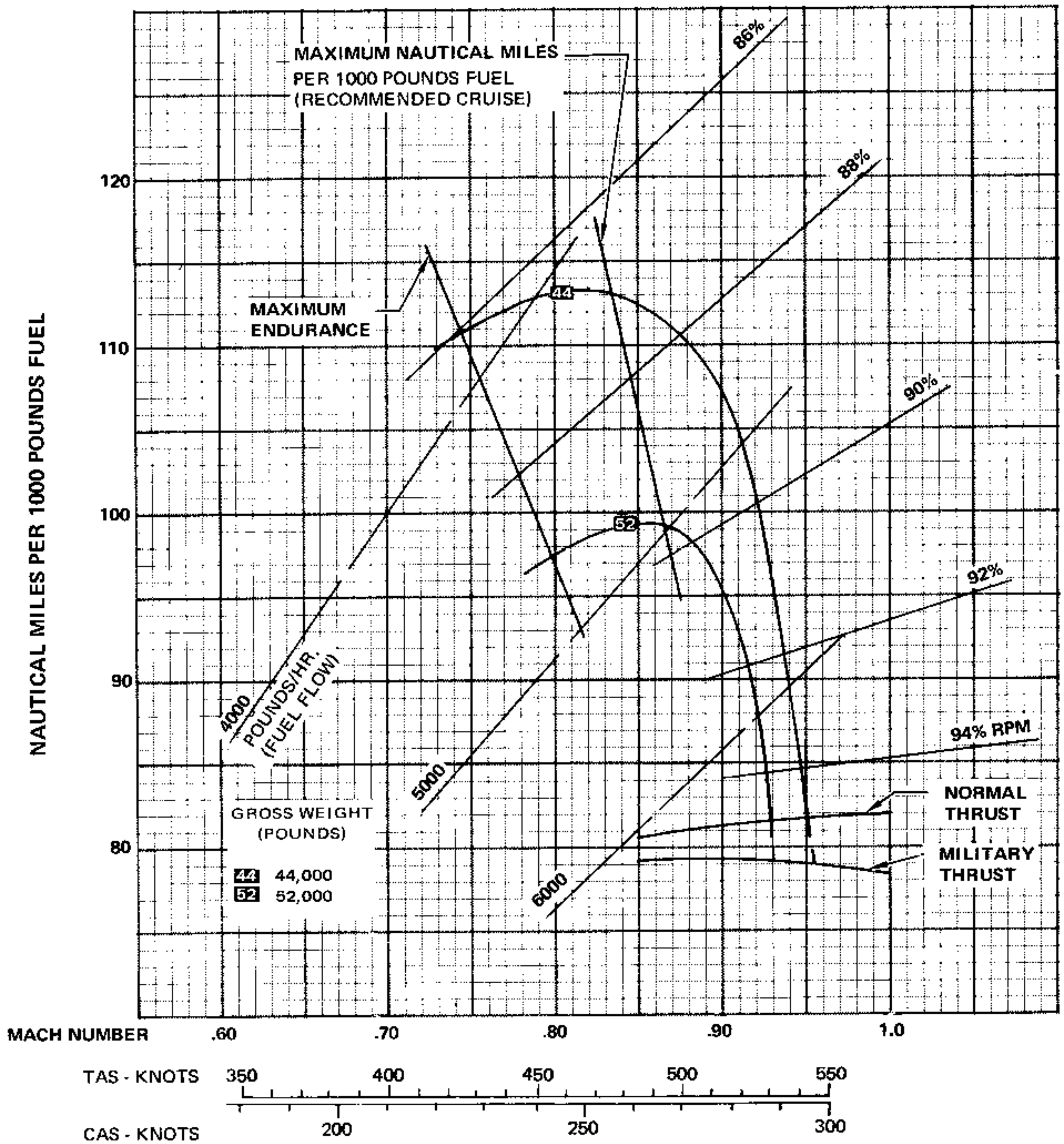
NAUTICAL MILES PER 1000 POUNDS FUEL

RECONNAISSANCE CONFIGURATION
NO EXTERNAL LOAD
STANDARD DAY

40,000 FT

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NR69H-2)
DATE: 15 JUNE 1970

ENGINES: (2) J79-GE-10 (-8)*
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB./GAL.
*SEE NOTE



NOTE:

FOR AIRCRAFT HAVING AFC 328 COMPLIED WITH AND J79-GE-8 ENGINES INSTALLED, REDUCE NAUTICAL MILES PER 1000 POUNDS FUEL BY 6%

RA-5C-1-93-29A

Figure 11-70

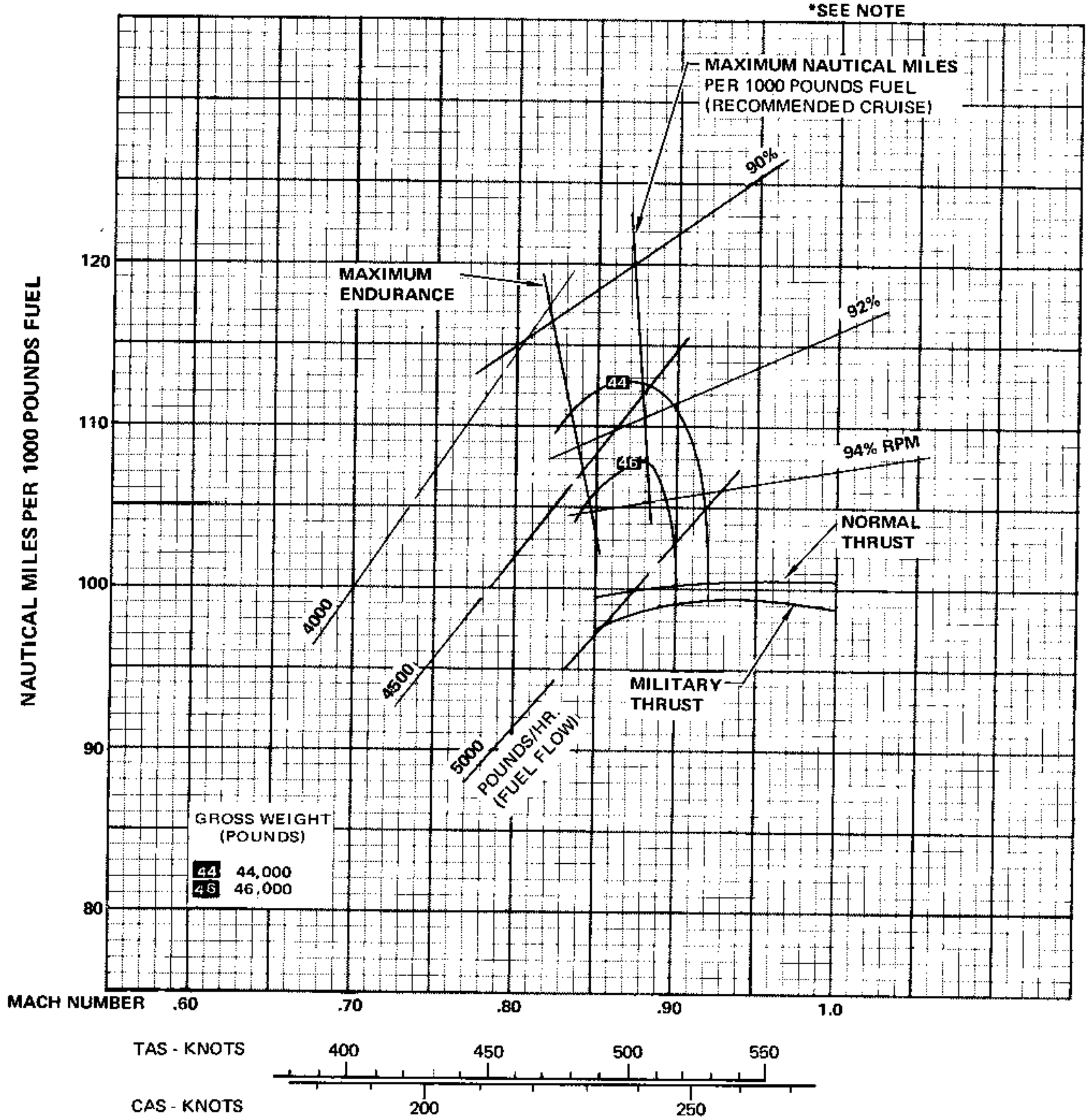
NAUTICAL MILES PER 1000 POUNDS FUEL

RECONNAISSANCE CONFIGURATION
NO EXTERNAL LOAD
STANDARD DAY

45,000 FT

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NR69H-2)
DATE: 15 JUNE 1970

ENGINES: (2) J79-GE-10 (-8*)
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB./GAL.
*SEE NOTE



NOTE:

FOR AIRCRAFT HAVING AFC 328 COMPLIED WITH AND J79-GE-8 ENGINES INSTALLED, REDUCE NAUTICAL MILES PER 1000 POUNDS FUEL BY 6%

RA-5C-1-93-30A

Figure 11-71

NAUTICAL MILES PER 1000 POUNDS FUEL

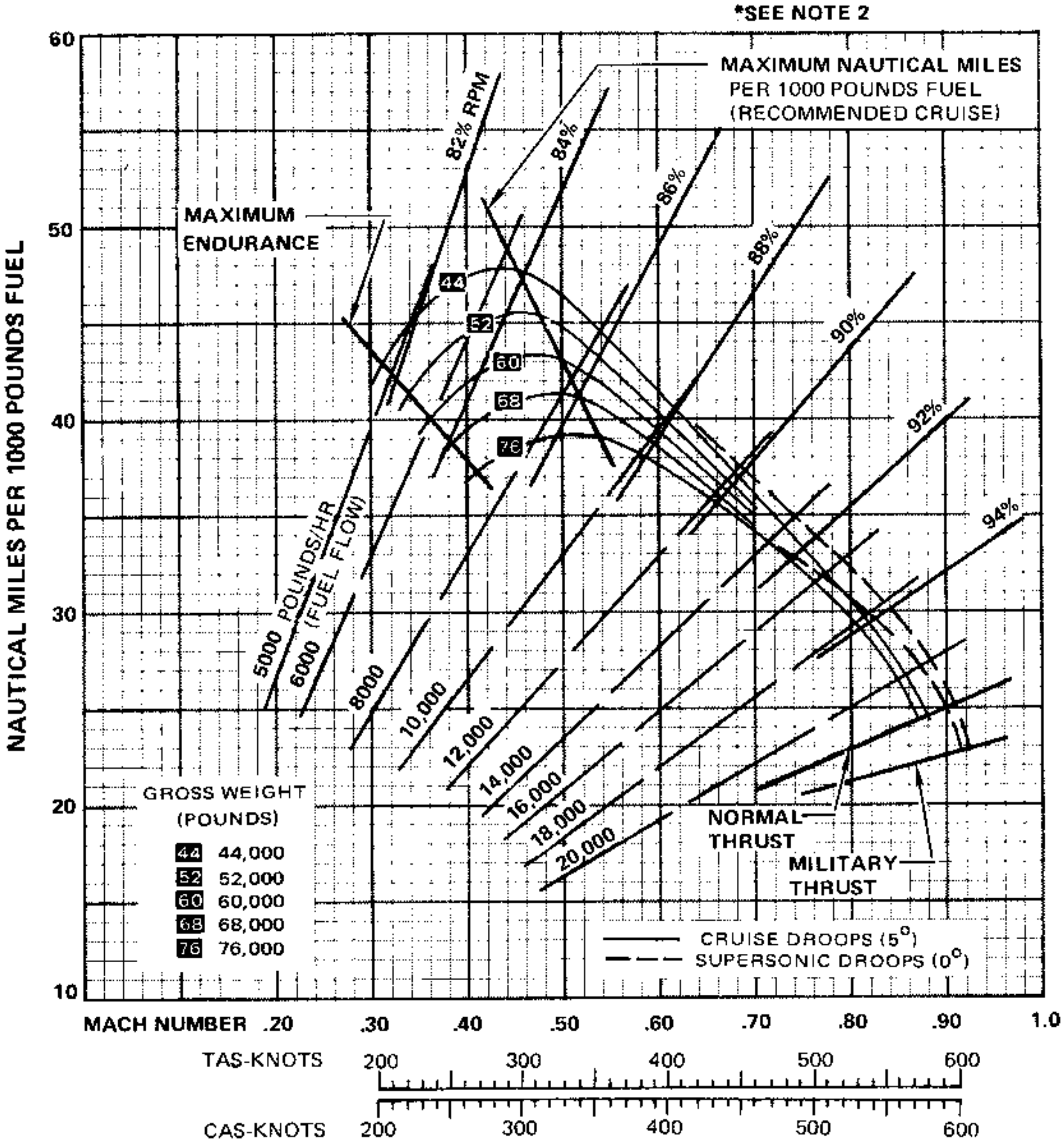
RECONNAISSANCE CONFIGURATION
TWO 400 GALLON DROP TANKS
(OR TWO FLASHER PODS)
STANDARD DAY

TWO TANKS

SEA LEVEL

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NR69H-2)
DATE: 15 JUNE 1970

ENGINES: (2) J79-GE-10 (-8)*
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB./GAL.
*SEE NOTE 2



NOTE:

1. RETRACT CRUISE DROOPS ABOVE 0.65 MACH NUMBER FOR INCREASED SPECIFIC RANGE
2. FOR AIRCRAFT HAVING AFC 328 COMPLIED WITH AND J79-GE-8 ENGINES INSTALLED, REDUCE NAUTICAL MILES PER 1000 POUNDS FUEL BY 4%.

RA-5C-1-93-31A

Figure 11-72

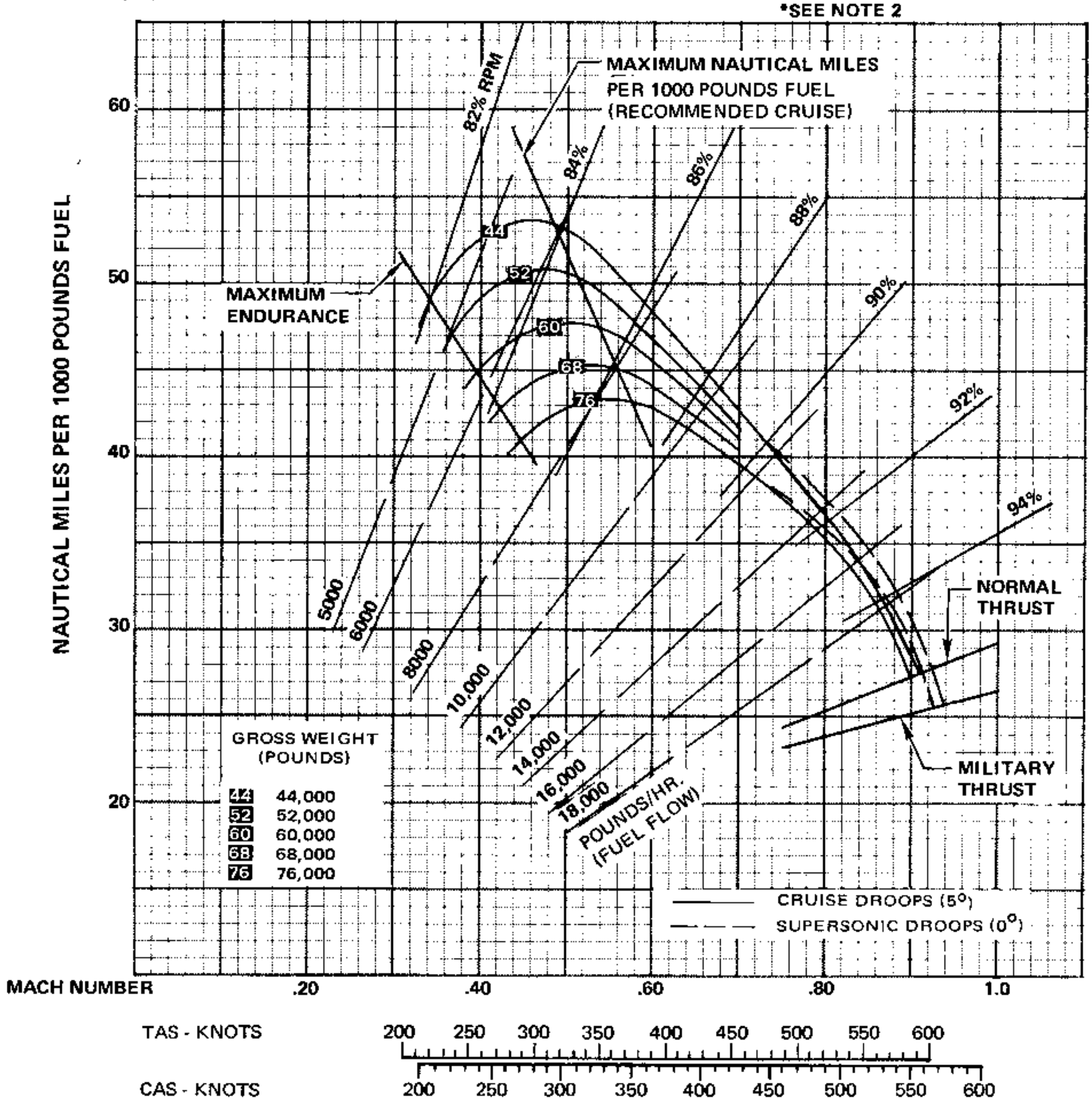
NAUTICAL MILES PER 1000 POUNDS FUEL

RECONNAISSANCE CONFIGURATION
TWO 400 GALLON DROP TANKS
(OR TWO FLASHER PODS)
STANDARD DAY

TWO TANKS
5000 FT

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NR69H-2)
DATE: 15 JUNE 1970

ENGINES: (2) J79-GE-10 (-8)*
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB./GAL.
*SEE NOTE 2



NOTE:

1. RETRACT CRUISE DROOPS ABOVE 0.70 MACH NUMBER FOR INCREASED SPECIFIC RANGE
2. FOR AIRCRAFT HAVING AFC 328 COMPLIED WITH AND J79-GE-8 ENGINES INSTALLED, REDUCE NAUTICAL MILES PER 1000 POUNDS FUEL BY 4%.

RA-5C-1-93-32A

Figure 11-73

NAUTICAL MILES PER 1000 POUNDS FUEL

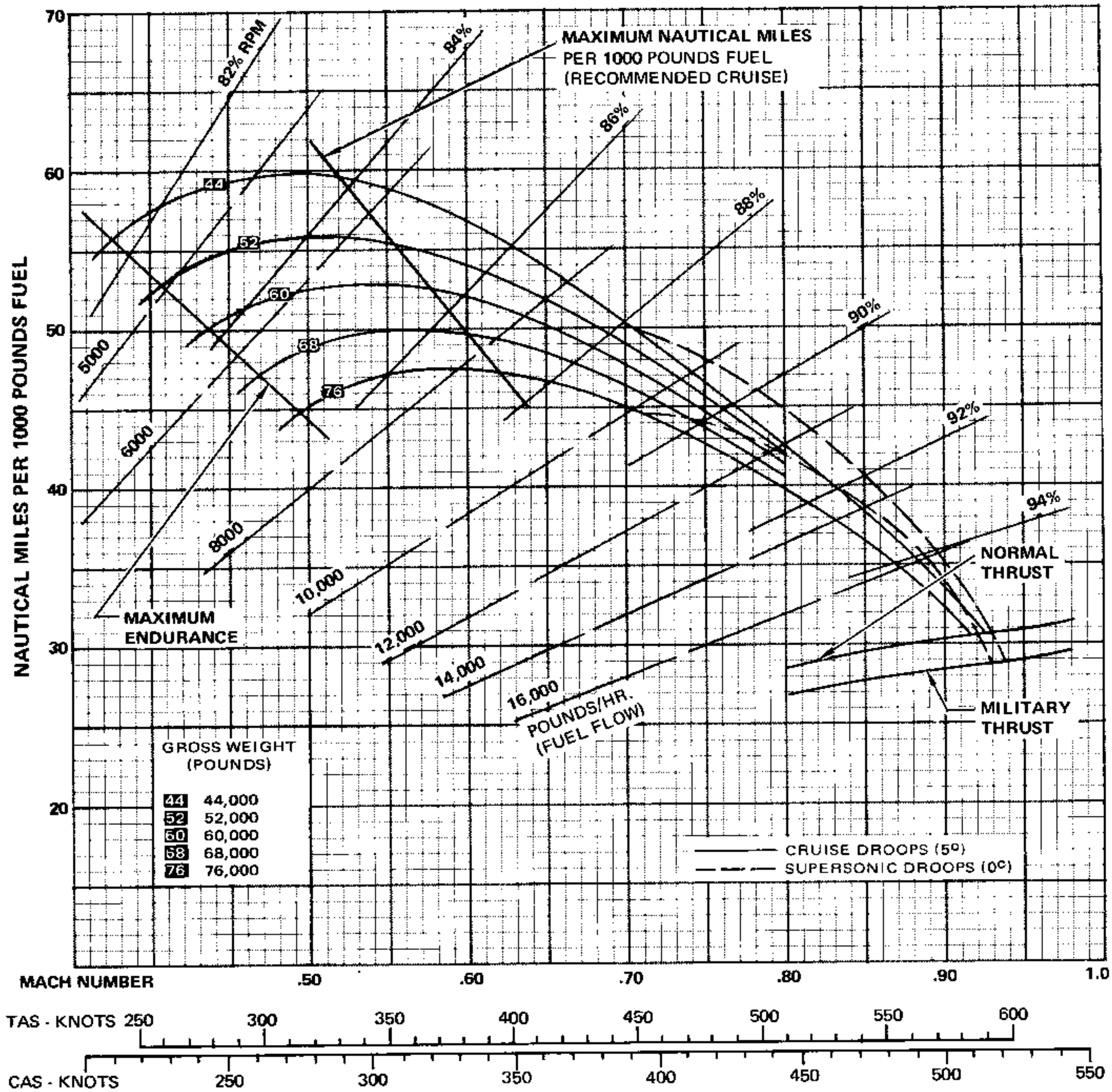
RECONNAISSANCE CONFIGURATION
TWO 400 GALLON DROP TANKS
(OR TWO FLASHER PODS)
STANDARD DAY

TWO TANKS

10,000 FT

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NR69H-2)
DATE: 15 JUNE 1970

ENGINES: (2) J79-GE-10 (-8)*
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB./GAL.
*SEE NOTE 2



NOTE:

1. RETRACT CRUISE DROOPS ABOVE 0.70 MACH NUMBER FOR INCREASED SPECIFIC RANGE
2. FOR AIRCRAFT HAVING AFC 328 COMPLIED WITH AND J79-GE-8 ENGINES INSTALLED, REDUCE NAUTICAL MILES PER 1000 POUNDS FUEL BY 4%.

RA-5C-1-93-33A

Figure 11-74

NAUTICAL MILES PER 1000 POUNDS FUEL

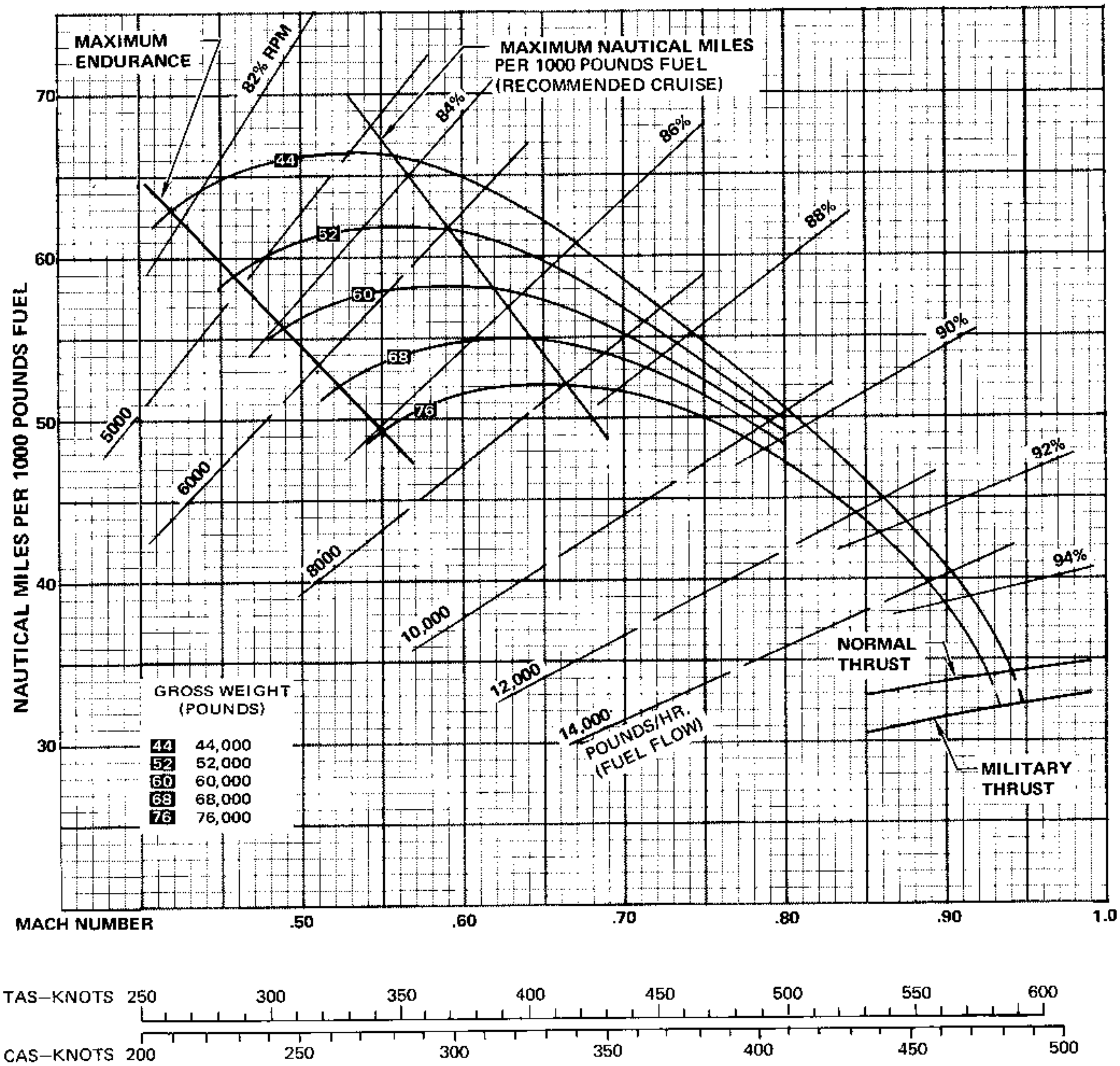
RECONNAISSANCE CONFIGURATION
TWO 400 GALLON DROP TANKS
(OR TWO FLASHER PODS)
STANDARD DAY

TWO TANKS

15,000 FT

ENGINES: (2) J79-GE-10 (-8)*
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB./GAL.
*SEE NOTE

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NR69H-2)
DATE: 15 JUNE 1970



NOTE:

FOR AIRCRAFT HAVING AFC 328 COMPLIED WITH AND J79-GE-8 ENGINES INSTALLED, REDUCE NAUTICAL MILES PER 1000 POUNDS FUEL BY 4%.

RA-5C-1-93-34A

Figure 11-75

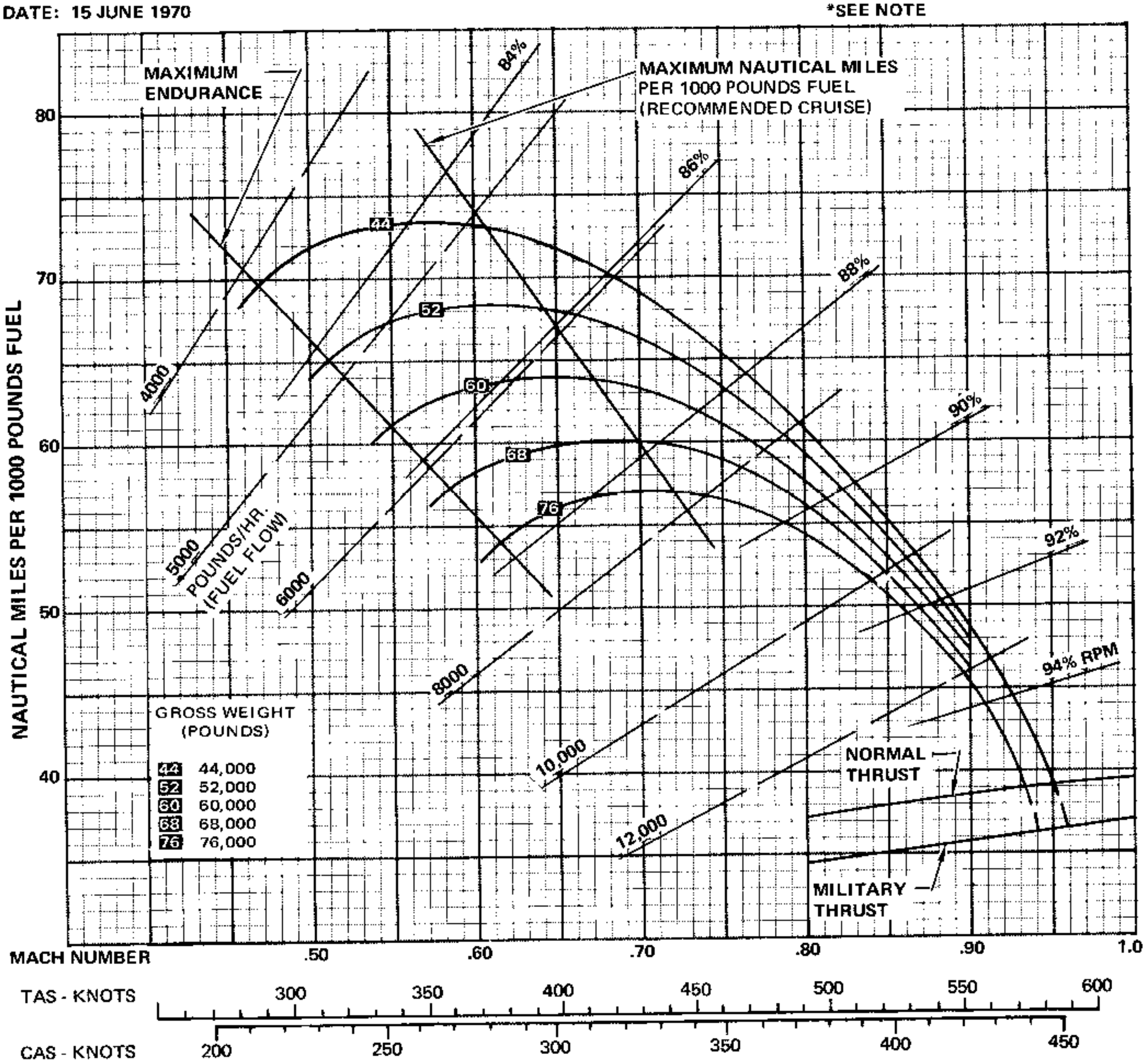
NAUTICAL MILES PER 1000 POUNDS FUEL

RECONNAISSANCE CONFIGURATION
TWO 400 GALLON DROP TANKS
(OR TWO FLASHER PODS)
STANDARD DAY

TWO TANKS
20,000 FT

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NR69H-2)
DATE: 15 JUNE 1970

ENGINES: (2) J79-GE-10 (-8)*
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB./GAL.
*SEE NOTE



NOTE:

FOR AIRCRAFT HAVING AFC 328 COMPLIED WITH AND J79-GE-8 ENGINES INSTALLED, REDUCE NAUTICAL MILES PER 1000 POUNDS FUEL BY 4%.

RA-5C-1-93-35A

Figure 11-76

NAUTICAL MILES PER 1000 POUNDS FUEL

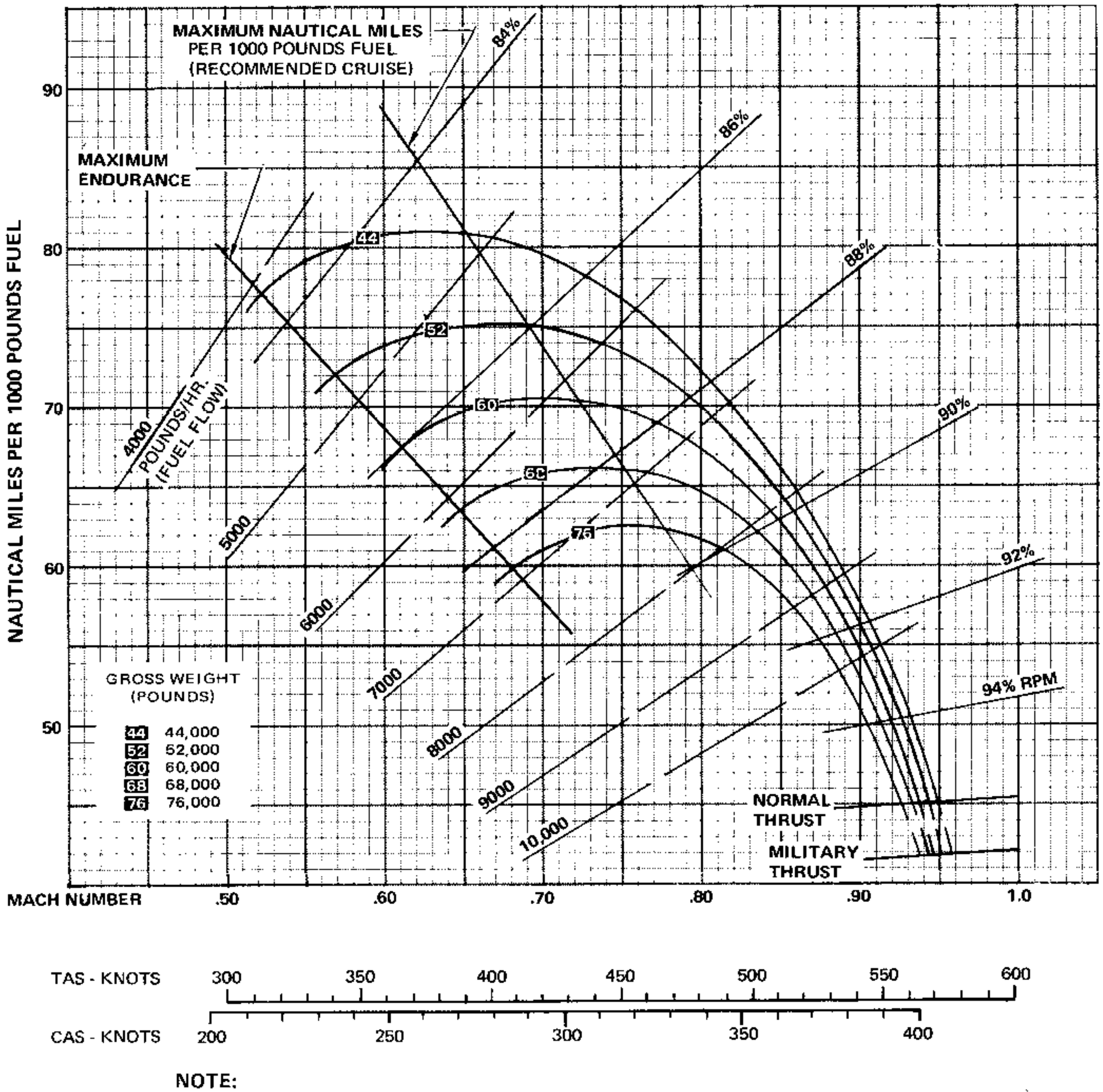
TWO TANKS

25,000 FT

RECONNAISSANCE CONFIGURATION
TWO 400 GALLON DROP TANKS
(OR TWO FLASHER PODS)
STANDARD DAY

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NR69H-2)
DATE: 15 JUNE 1970

ENGINES: (2) J79-GE-10 (-8)*
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB./GAL.
*SEE NOTE



NOTE:

FOR AIRCRAFT HAVING AFC 328 COMPLIED WITH AND J79-GE-8 ENGINES INSTALLED, REDUCE NAUTICAL MILES PER 1000 POUNDS FUEL BY 4%.

RA-5C-1-93-36A

Figure 11-77

NAUTICAL MILES PER 1000 POUNDS FUEL

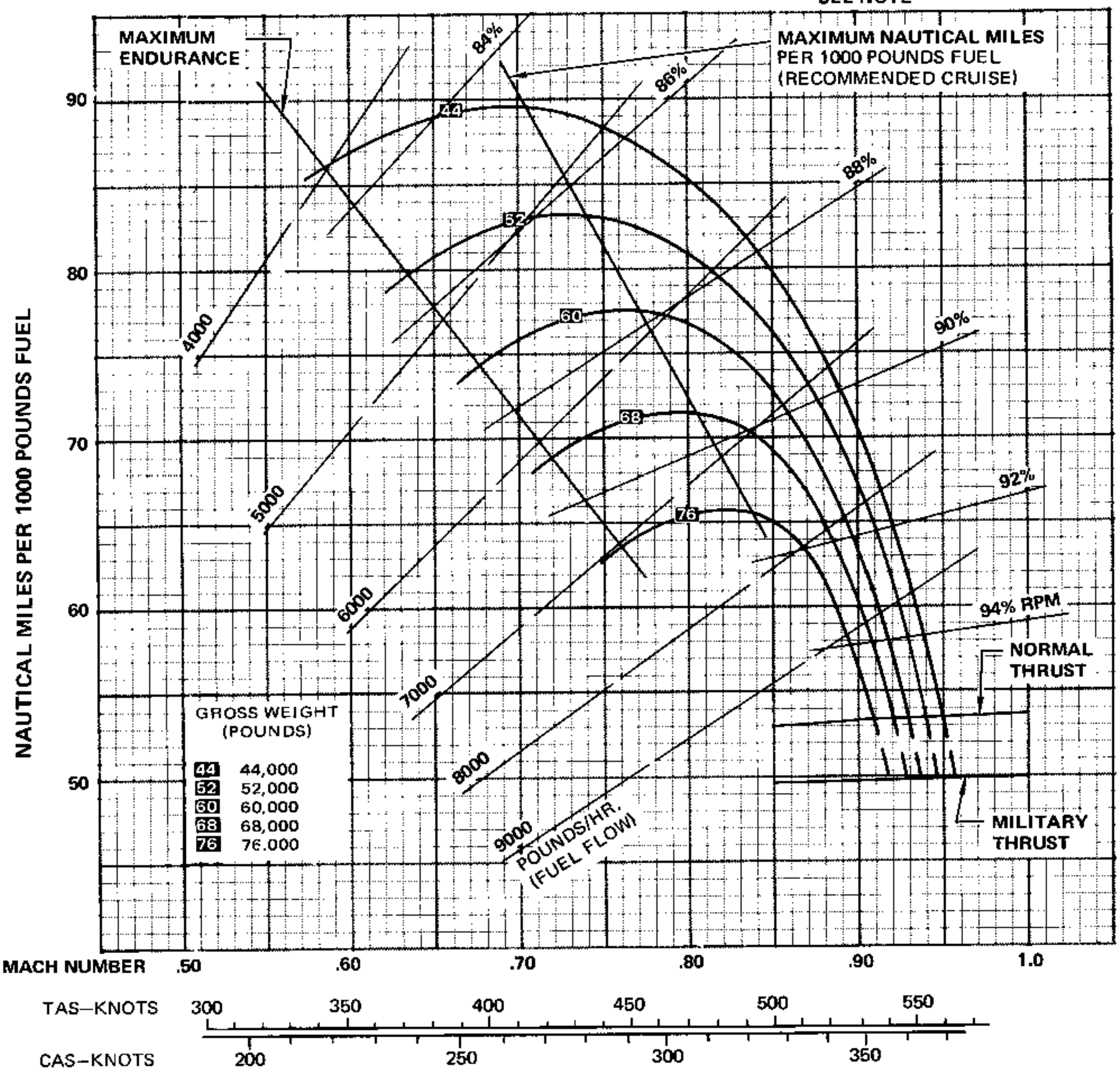
RECONNAISSANCE CONFIGURATION
TWO 400 GALLON DROP TANKS
(OR TWO FLASHER PODS)
STANDARD DAY

TWO TANKS

30,000 FT

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NR69H-2)
DATE: 15 JUNE 1970

ENGINES: (2) J79-GE-10 (-8)*
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB./GAL.
*SEE NOTE



NOTE:

FOR AIRCRAFT HAVING AFC 328 COMPLIED WITH AND J79-GE-8 ENGINES INSTALLED, REDUCE NAUTICAL MILES PER 1000 POUNDS FUEL BY 4%.

RA-5C-1-93-37A

Figure 11-78

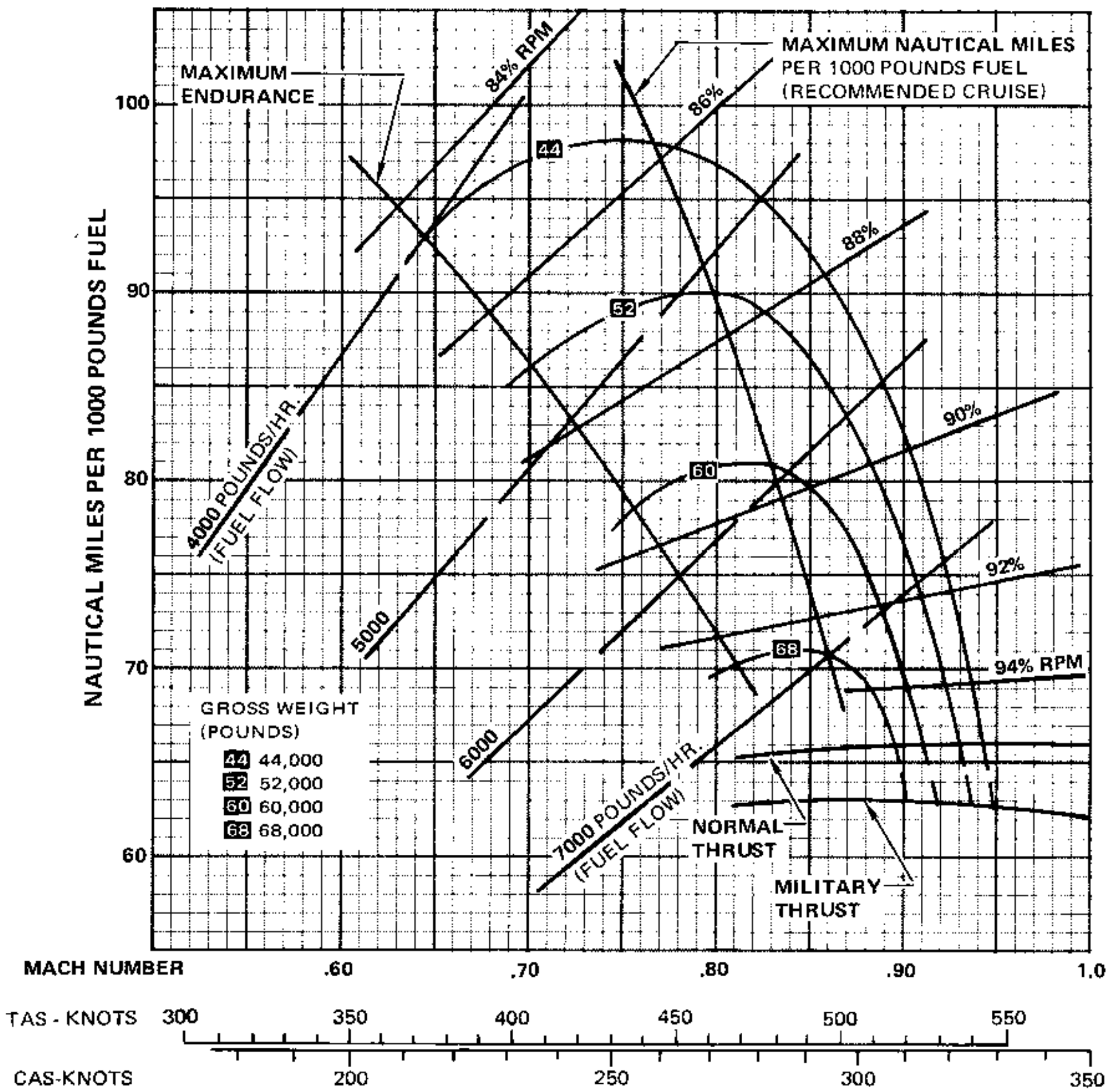
NAUTICAL MILES PER 1000 POUNDS FUEL

RECONNAISSANCE CONFIGURATION
TWO 400 GALLON DROP TANKS
(OR TWO FLASHER PODS)
STANDARD DAY

TWO TANKS
35,000 FT

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NR69H-2)
DATE:

ENGINES: (2) J79-GE-10 (-8)*
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB./GAL.
*SEE NOTE



NOTE:

FOR AIRCRAFT HAVING AFC 328 COMPLIED WITH AND J79-GE-8 ENGINES INSTALLED, REDUCE NAUTICAL MILES PER 1000 POUNDS FUEL BY 6%.

RA-5C-1-93-38A

Figure 11-79

NAUTICAL MILES PER 1000 POUNDS FUEL

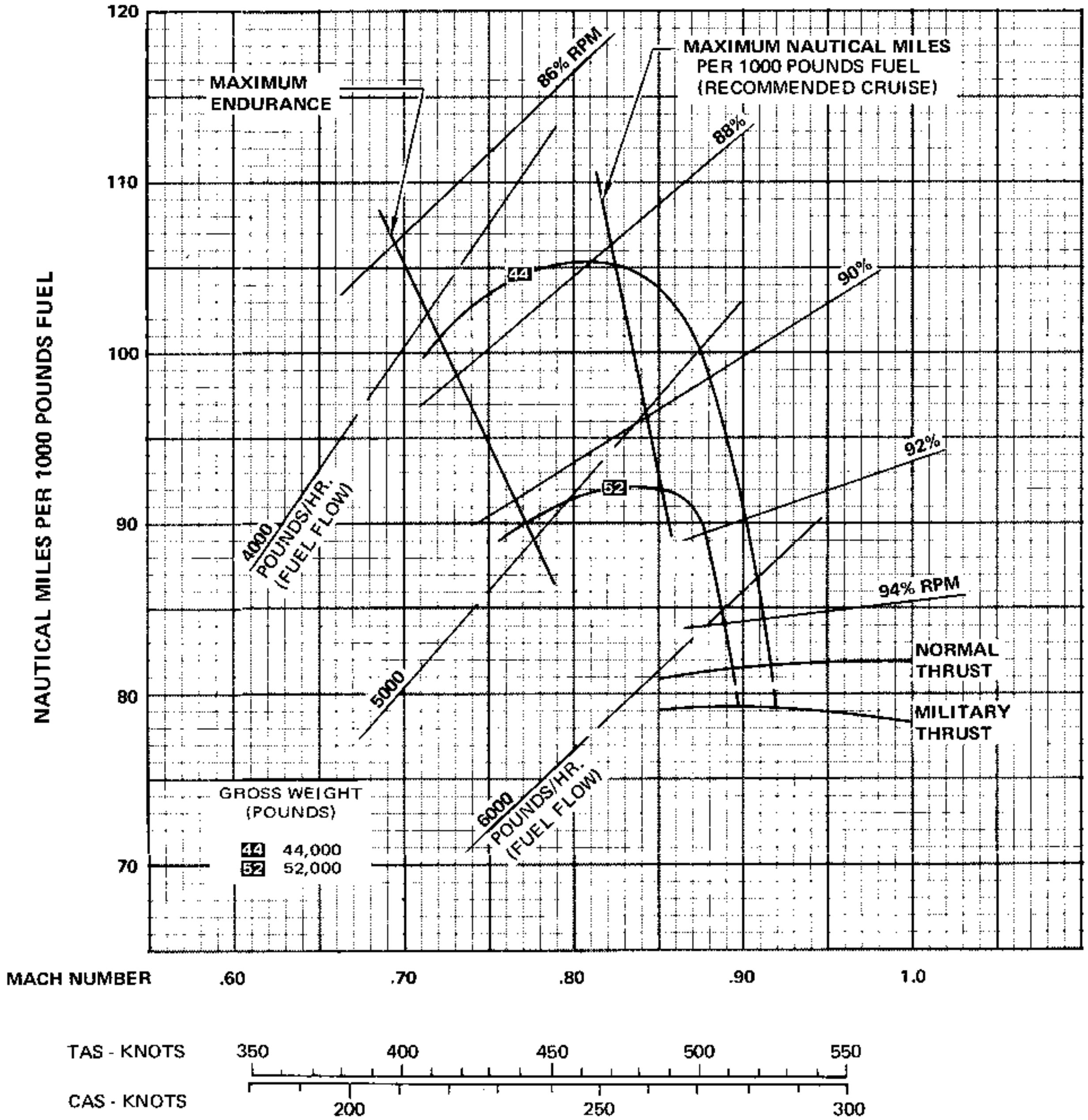
TWO TANKS

40,000 FT

RECONNAISSANCE CONFIGURATION
TWO 400 GALLON DROP TANKS
(OR TWO FLASHER PODS)
STANDARD DAY

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NR69H-2)
DATE: 15 JUNE 1970

ENGINES: (2) J79-GE-10 (-8)*
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB./GAL.
*SEE NOTE



NOTE:

FOR AIRCRAFT HAVING AFC 328 COMPLIED WITH AND J79-GE-8 ENGINES INSTALLED, REDUCE NAUTICAL MILES PER 1000 POUNDS FUEL BY 6%

RA-5C-1-93-39A

Figure 11-80

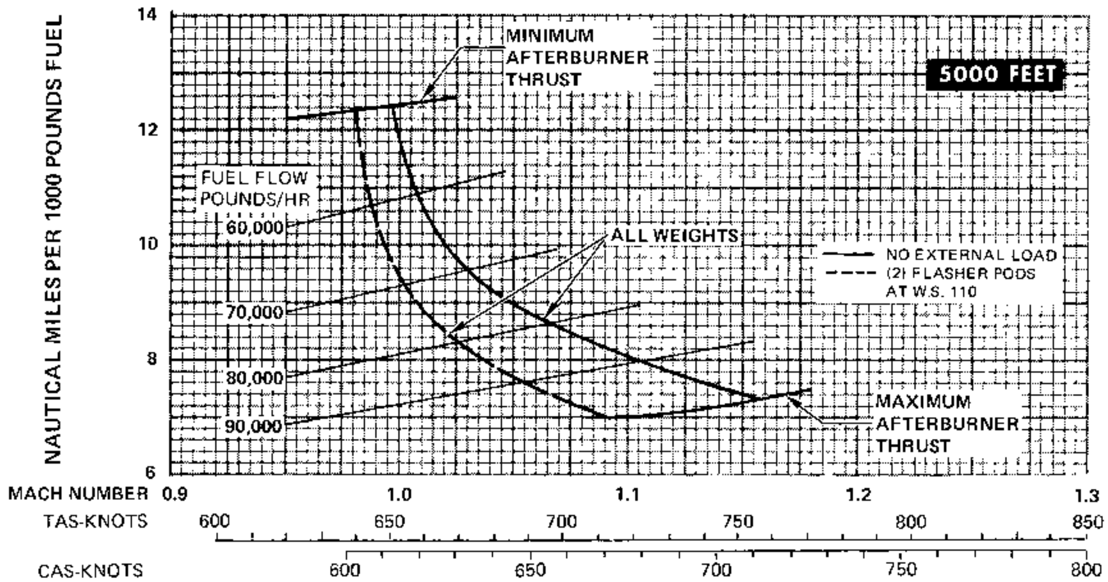
NAUTICAL MILES PER 1000 POUNDS OF FUEL - SUPERSONIC

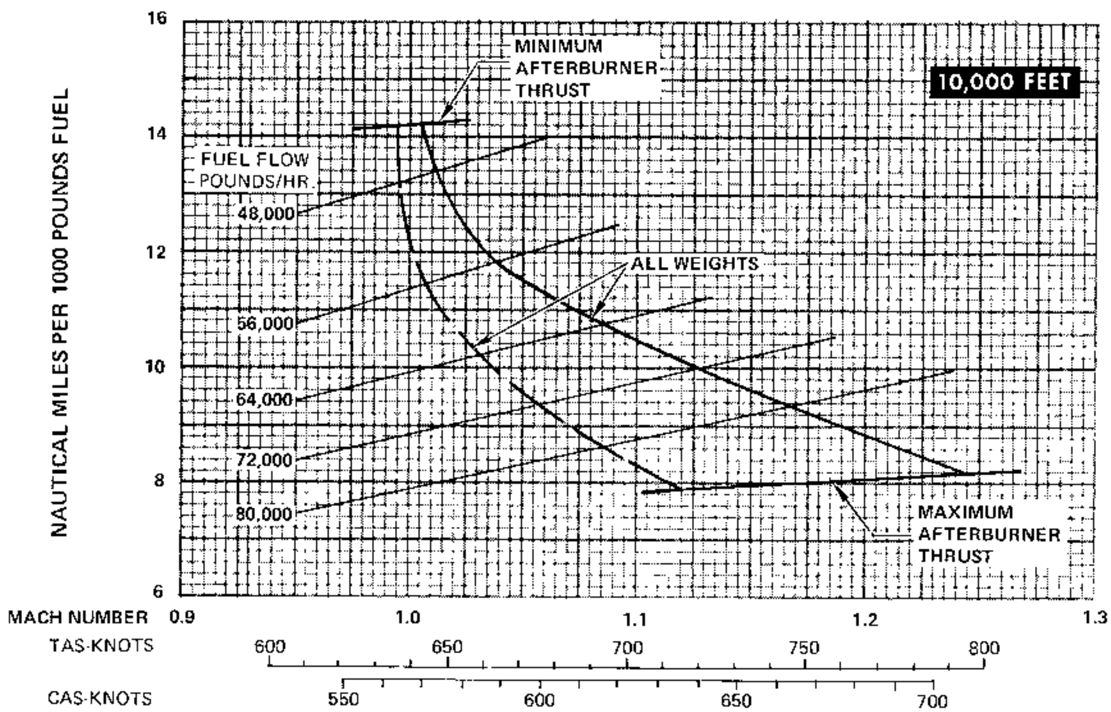
RECONNAISSANCE CONFIGURATION

STANDARD DAY

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NR69H-2)
DATE: 15 JUNE 1970

ENGINES: (2) J79-GE-10 (-8)*
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB./GAL.
*SEE NOTE





NOTE:

FOR AIRCRAFT HAVING AFC 328 COMPLIED WITH AND J79-GE-8 ENGINES INSTALLED, SEE FIGURE 11-55.

RA-5C-1-93-78A

Figure 11-81

NAUTICAL MILES PER 1000 POUNDS FUEL - SUPERSONIC

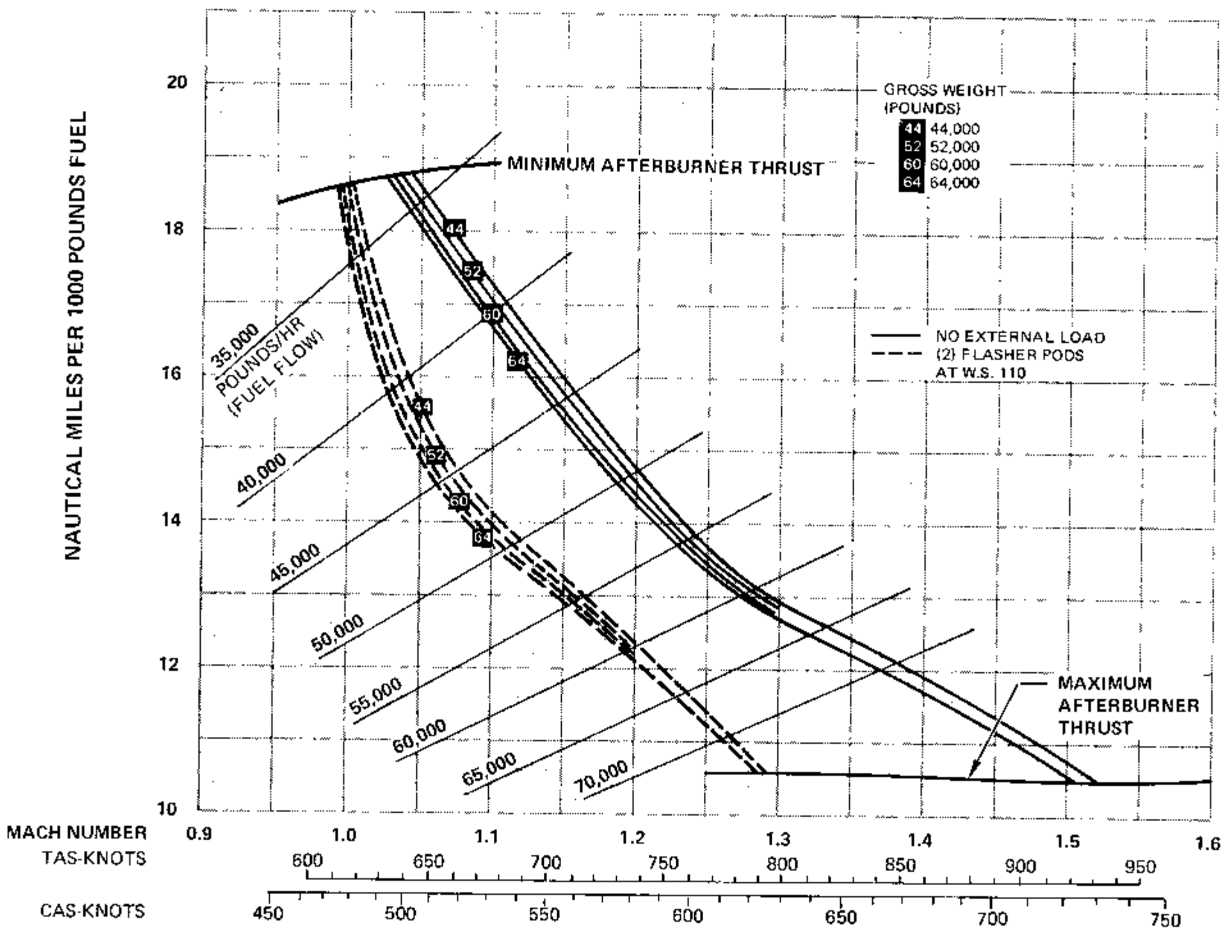
RECONNAISSANCE CONFIGURATION

STANDARD DAY

20,000 FEET

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NR69H-2)
DATE. 15 JUNE 1970

ENGINES: (2) J79-GE-10 (-8)*
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB./GAL.
*SEE NOTE



NOTE:
FOR AIRCRAFT HAVING AFC 328 COMPLIED WITH AND J79-GE-8 ENGINES INSTALLED, SEE FIGURE 11-56.

RA-5C-1-93-81 A

Figure 11-82

NAUTICAL MILES PER 1000 POUNDS FUEL - SUPERSONIC

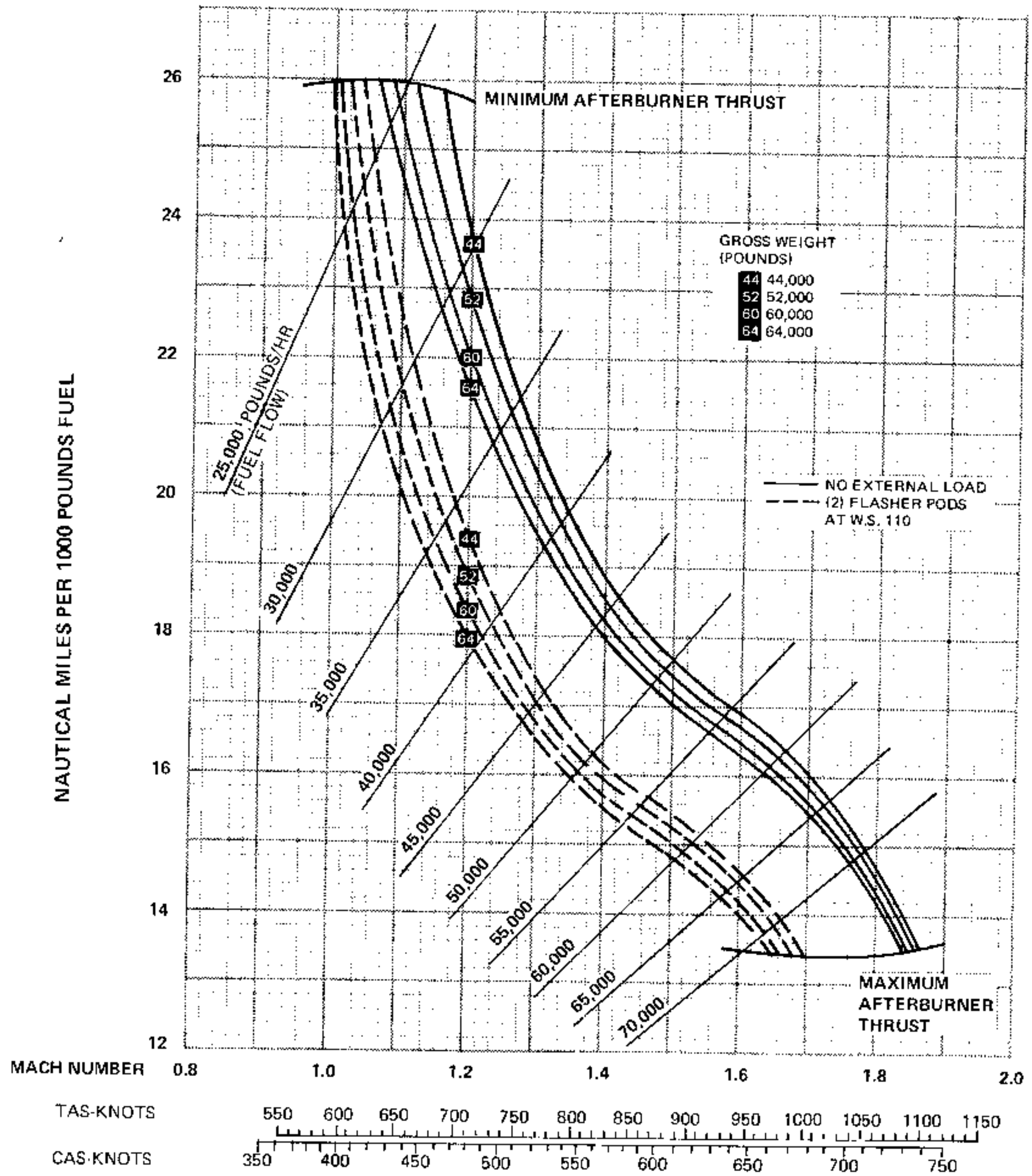
RECONNAISSANCE CONFIGURATION

STANDARD DAY

30,000FEET

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NR69H-2)
DATE: 15 JUNE 1970

ENGINES: (2) J79-GE-10 (-8)*
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB./GAL.
*SEE NOTE



NOTE:

FOR AIRCRAFT HAVING AFC 328 COMPLIED WITH AND J79-GE-8 ENGINES INSTALLED, SEE FIGURE 11-56.

RA-5C-1-93-79A

Figure 11-83

NAUTICAL MILES PER 1000 POUNDS FUEL - SUPERSONIC

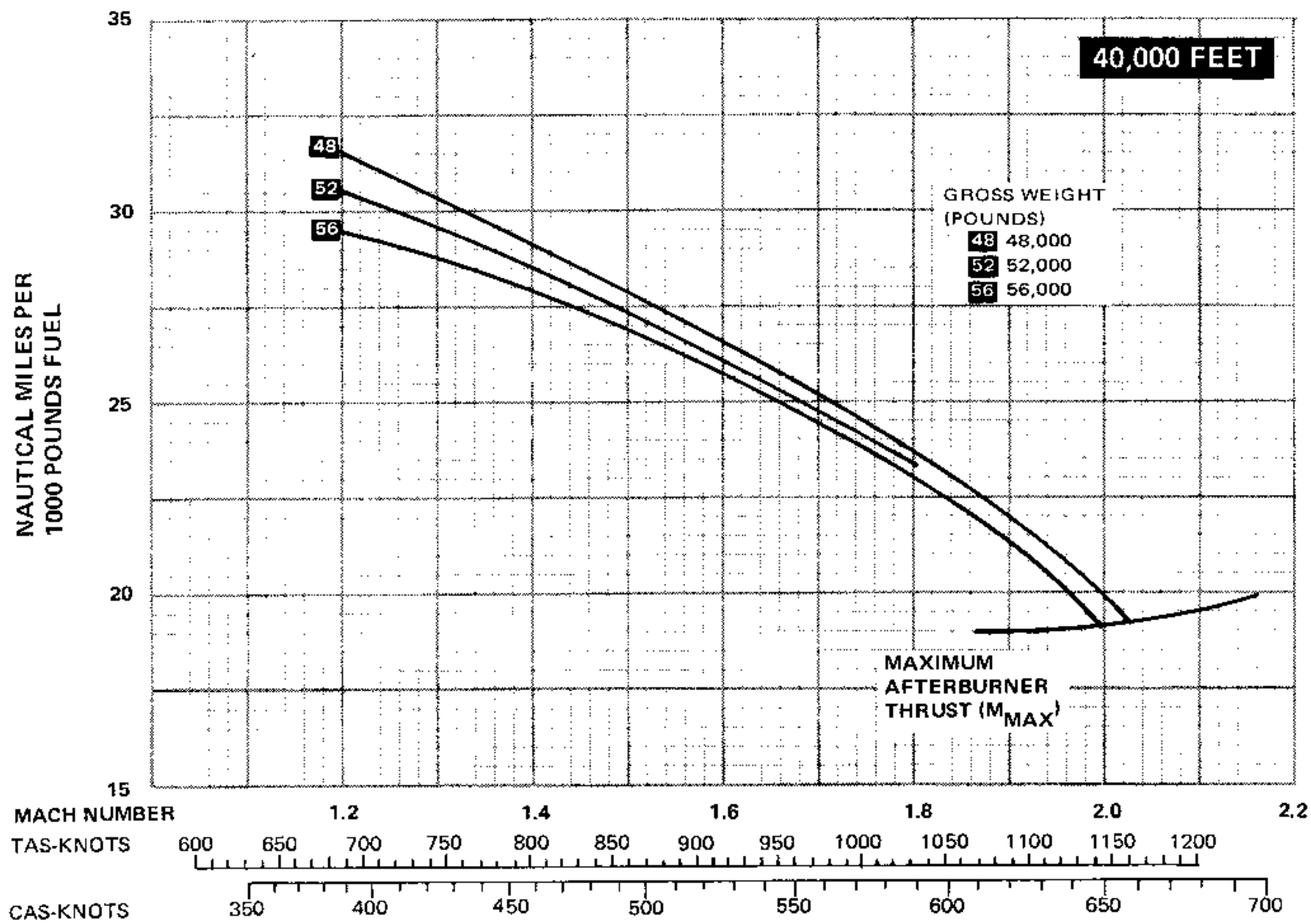
RECONNAISSANCE CONFIGURATION

NO EXTERNAL LOAD

STANDARD DAY

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NR69H-2)
DATE: 15 JUNE 1970

ENGINES: (2) J79-GE-10 (-8)*
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB./GAL.
*SEE NOTE



NOTE:

FOR AIRCRAFT HAVING AFC 328 COMPLIED WITH AND J79-GE-8 ENGINES INSTALLED, SEE FIGURE 11-57 AND REDUCE NAUTICAL MILES PER 1000 POUNDS OF FUEL BY 3%.

RA-5C-1-93-82A

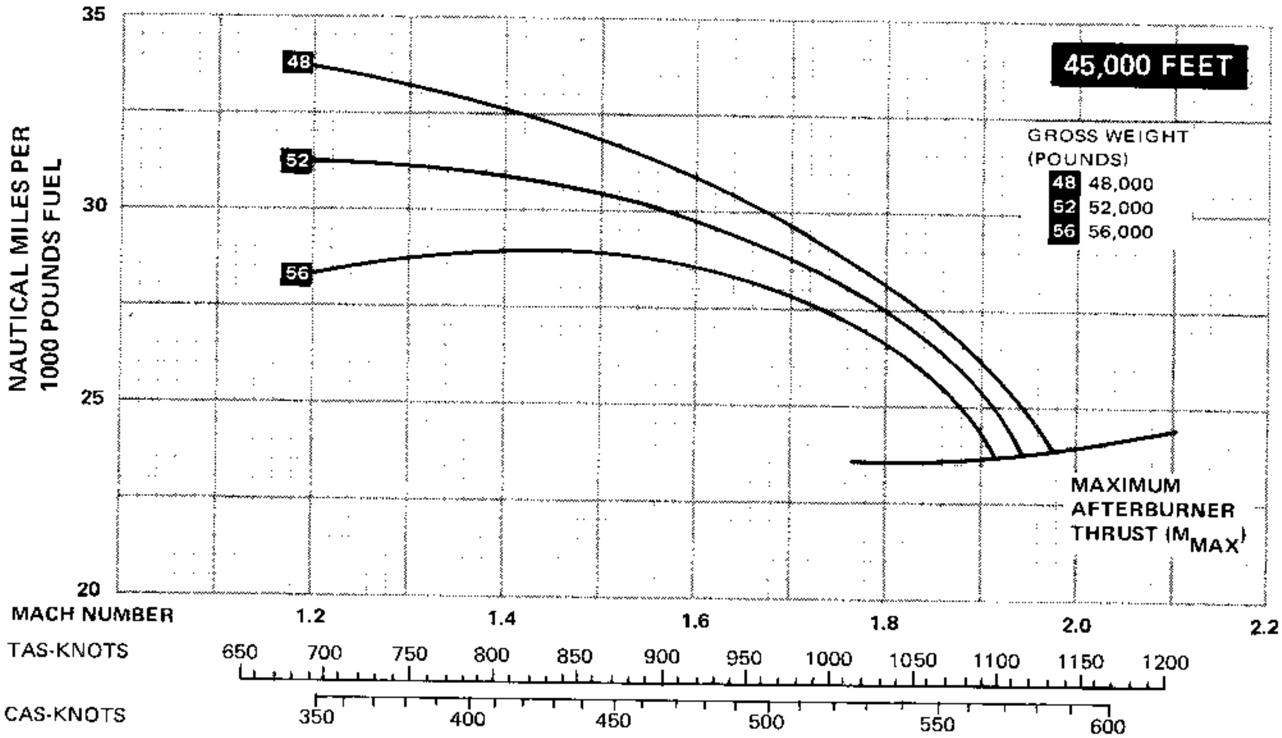
Figure 11-84

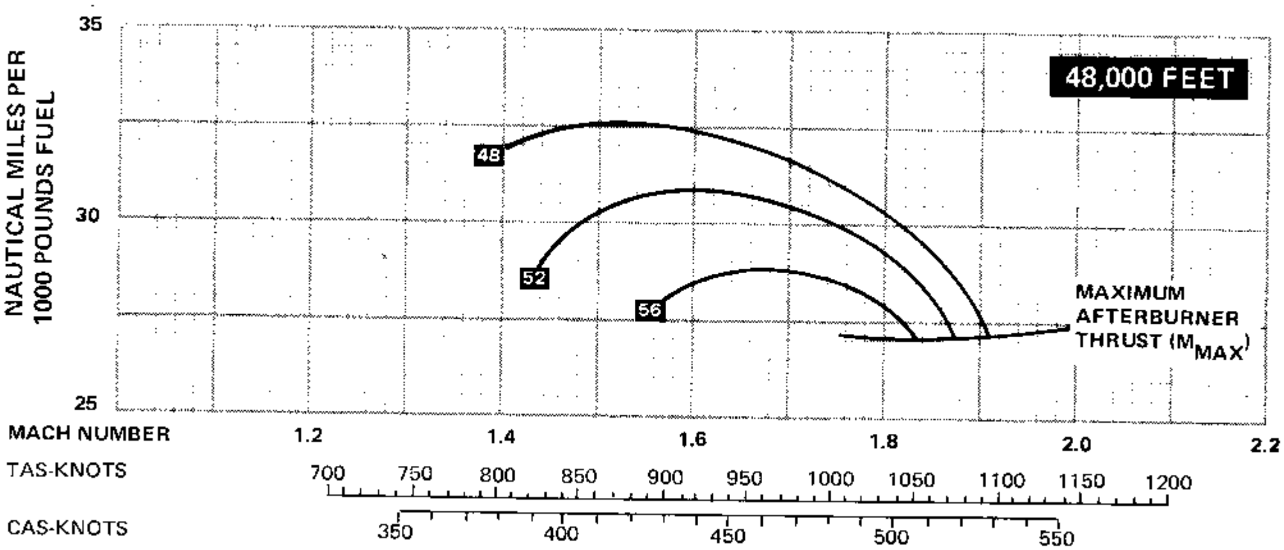
NAUTICAL MILES PER 1000 POUNDS FUEL - SUPERSONIC

RECONNAISSANCE CONFIGURATION
NO EXTERNAL LOAD
STANDARD DAY

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NR69H-2)
DATE: 15 JUNE 1970

ENGINES: (2) J79-GE-10 (-8)*
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB./GAL.
*SEE NOTE





NOTE:

FOR AIRCRAFT HAVING AFC 328 COMPLIED WITH AND J79-GE-8 ENGINES INSTALLED, SEE FIGURE 11-57 AND REDUCE NAUTICAL MILES PER 1000 POUNDS OF FUEL BY 3%.

RA-5C-1-93-80A

Figure 11-85

PART 5 — ENDURANCE

MAXIMUM ENDURANCE PROFILES

The Maximum Endurance Profile charts (figures 11-86, 11-87, and 11-88) show the maximum single-engine and two-engine loiter time available for the fuel on board when loitering at constant altitude. A loiter summary table is provided on each chart, showing the average loiter CAS, Mach, and fuel flow for a gross weight range corresponding to less than 5000 pounds of fuel on board and also for a gross weight range corresponding to 5000 to 10,000 pounds of fuel on board. The use of these charts is illustrated by the following example:

EXAMPLE (figure 11-86): Determine the fuel required to loiter with two engines at 35,000 feet (clean aircraft) for 40 minutes. The fuel on board at the start of loiter is 6000 pounds.

1. Enter the profile chart at 35,000 feet and 6000 pounds fuel remaining, to obtain the initial time of 1 hour and 40 minutes.
2. The final time is 1 hour and 40 minutes—40 minutes = 1 hour.
3. Enter the chart at 35,000 feet and 1 hour to obtain the fuel on board at the end of loiter = 3600 pounds.
4. The fuel required for loiter = 2400 pounds (6000 —3600).
5. The approximate loiter CAS is 229 knots.

MAXIMUM ENDURANCE PROFILE

RECONNAISSANCE CONFIGURATION

STANDARD DAY

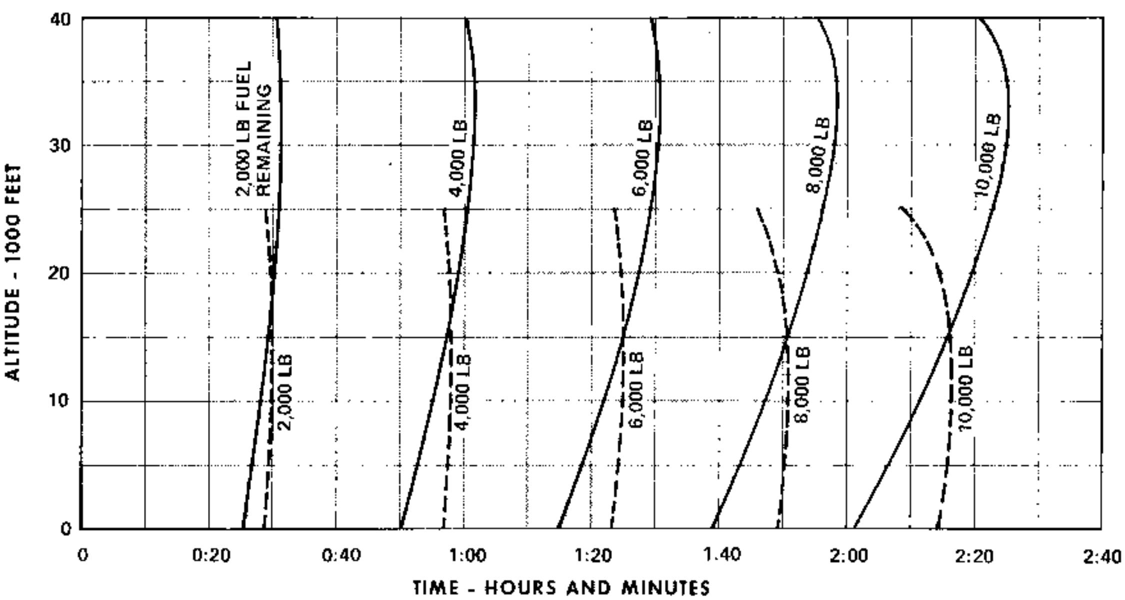
NO EXTERNAL LOAD

GROSS WEIGHT WITH 10,000 POUNDS OF FUEL = 53,400
GROSS WEIGHT WITH ZERO POUNDS OF FUEL = 43,400

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA
DATE: 15 JUNE, 1970

ENGINES: (2) J79-GE-8/10
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL

TWO ENGINE LOITER							SINGLE ENGINE LOITER						
	APPROXIMATE LESS THAN 5000 LB FUEL REMAINING			APPROXIMATE 5000 TO 10,000 LB FUEL REMAINING				APPROXIMATE LESS THAN 5000 LB FUEL REMAINING			APPROXIMATE 5000 TO 10,000 LB FUEL REMAINING		
LOITER ALTITUDE FEET	CAS KNOTS	TRUE MACH NO.	TOTAL FUEL FLOW LB/HR	CAS KNOTS	TRUE MACH NO.	TOTAL FUEL FLOW LBS/HR	LOITER ALTITUDE FEET	CAS KNOTS	TRUE MACH NO.	TOTAL FUEL FLOW LBS/HR	CAS KNOTS	TRUE MACH NO.	TOTAL FUEL FLOW LBS/HR
40,000	226	.75	4050	239	.79	4570	25,000	222	.54	4270	235	.57	4900
35,000	224	.67	3930	235	.70	4340	15,000	227	.45	4240	237	.47	4730
25,000	222	.54	4050	235	.57	4430	SEA LEVEL	225	.34	4270	232	.35	4680
15,000	221	.44	4150	237	.47	4550							
SEA LEVEL	212	.32	4800	225	.34	5100							



LEGEND:

———— MAXIMUM TWO ENGINE LOITER TIME AT INITIAL ALTITUDE (NO CLIMB ASSUMED)

- - - - - MAXIMUM SINGLE ENGINE LOITER TIME AT INITIAL ALTITUDE (NO CLIMB ASSUMED)

REMARKS:

1. LOITER TIME IS FOR CONSTANT ALTITUDE, CONSTANT HEADING (NO CLIMB, DESCENT OR LANDING INCLUDED)
2. USE TWO ENGINES FOR LOITER AT ALTITUDES ABOVE 20,000 FEET.
3. REFER TO OPERATING LIMITATIONS SECTION FOR SINGLE ENGINE OPERATING LIMITATIONS.
4. FOR STANDARD HOLDING PATTERN (8 MIN.) AT 25,000 FEET MAINTAIN 11.5 UNITS ANGLE-OF-ATTACK; INCREASE SPEED BY 0.03 MACH NO. DURING TURNS. FUEL REQUIRED PER CIRCUIT IS 800 POUNDS.
5. FOR A 2000 POUND AIRCRAFT WEIGHT (NON FUEL) INCREASE, DECREASE ENDURANCE TIMES SHOWN BY 5% AND INCREASE ENDURANCE SPEEDS BY.01M. APPLY OPPOSITE ADJUSTMENT FOR 2000 POUND WEIGHT DECREASE.

RA-5C 1-93-71

Figure 11-86

MAXIMUM ENDURANCE PROFILE

RECONNAISSANCE CONFIGURATION

STANDARD DAY

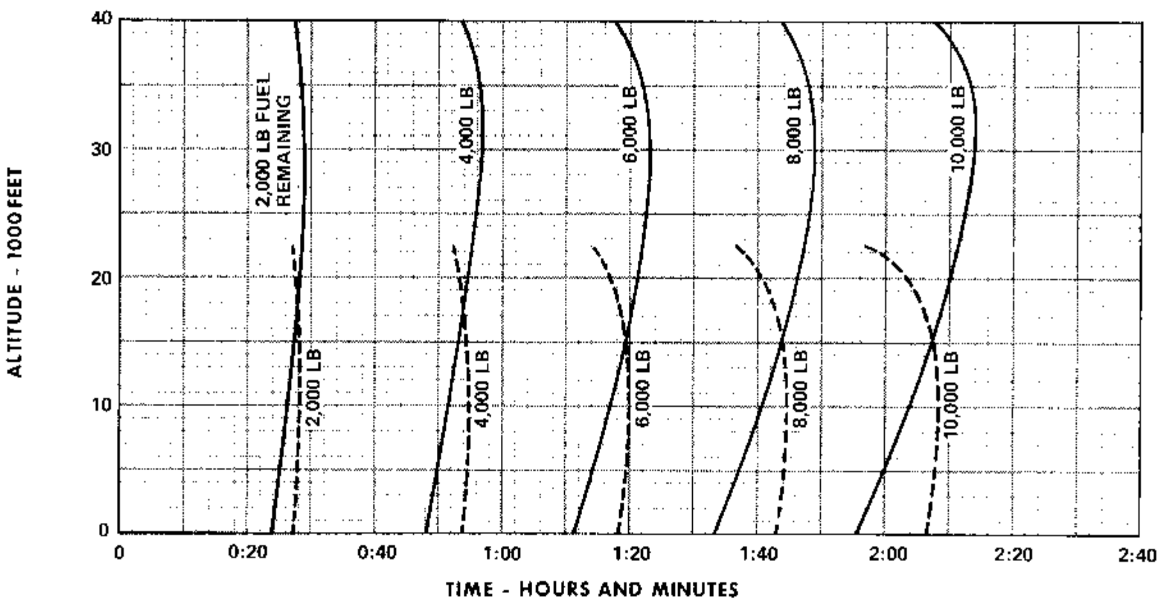
TWO 400 GALLON DROP TANKS (OR 2 FLASHER PODS)

GROSS WEIGH WITH 10,000 POUNDS OF FUEL = 54,870
GROSS WEIGH WITH ZERO POUNDS OF FUEL = 44,870

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NR69H-2)
DATE: 15 JUNE, 1970

ENGINES: (2) J79-GE-8/10
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL

TWO ENGINE LOITER							SINGLE ENGINE LOITER						
	APPROXIMATE LESS THAN 5000 LB FUEL REMAINING			APPROXIMATE 5000 TO 10,000 LB FUEL REMAINING				APPROXIMATE LESS THAN 5000 LB FUEL REMAINING			APPROXIMATE 5000 TO 10,000 LB FUEL REMAINING		
LOITER ALTITUDE FEET	CAS KNOTS	TRUE MACH NO.	TOTAL FUEL FLOW LB/HR	CAS KNOTS	TRUE MACH NO.	TOTAL FUEL FLOW LB/HR	LOITER ALTITUDE FEET	CAS KNOTS	TRUE MACH NO.	TOTAL FUEL FLOW LB/HR	CAS KNOTS	TRUE MACH NO.	TOTAL FUEL FLOW LBS/HR
40,000	222	.74	4260	232	.77	4960	15,000	216	.43	4480	227	.45	5110
35,000	224	.67	4280	235	.70	4730	SEA LEVEL	205	.31	4530	219	.33	5000
25,000	222	.54	4370	235	.57	4800							
15,000	221	.44	4490	231	.46	4900							
SEA LEVEL	212	.32	5050	225	.34	5400							



LEGEND:
——— MAXIMUM TWO ENGINE LOITER TIME AT INITIAL ALTITUDE (NO CLIMB ASSUMED)
– – – – MAXIMUM SINGLE ENGINE LOITER TIME AT INITIAL ALTITUDE (NO CLIMB ASSUMED)

REMARKS:

1. LOITER TIME IS FOR CONSTANT ALTITUDE, CONSTANT HEADING LOITER. (NO CLIMB, DESCENT OR LANDING INCLUDED).
2. USE TWO ENGINES FOR LOITER AT ALTITUDES ABOVE 20,000 FEET.
3. REFER TO SECTION I, PART 4 FOR SINGLE ENGINE OPERATING LIMITATIONS.
4. FOR STANDARD HOLDING PATTERN (8 MIN) AT 25,000 FEET, MAINTAIN 11.5 UNITS ANGLE-OF-ATTACK; INCREASE SPEED BY 0.03 MACH NO. DURING TURNS. FUEL REQUIRED PER CIRCUITS IS 800 POUNDS.
5. AIRCRAFT GROSS WEIGHTS SHOWN ARE FOR TWO 400 GALLON DROP TANKS. ZERO FUEL WEIGHT WITH TWO FLASHER PODS IS 45650 POUNDS. (THIS HEAVIER AIRCRAFT WEIGHT IS OFFSET BY LOWER CONFIGURATION DRAG.)

RA-5C-1-93-72

Figure 11-87

MAXIMUM ENDURANCE PROFILE

RECONNAISSANCE CONFIGURATION

FOUR 400-GALLON DROP TANKS

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NA63H-2)
DATE: 1 JANUARY 1964
(SINGLE ENGINE DATA ESTIMATED)

GROSS WEIGHT WITH 10,000 POUNDS OF FUEL = 53,800 POUNDS
GROSS WEIGHT WITH ZERO POUNDS OF FUEL = 43,800 POUNDS

STANDARD DAY

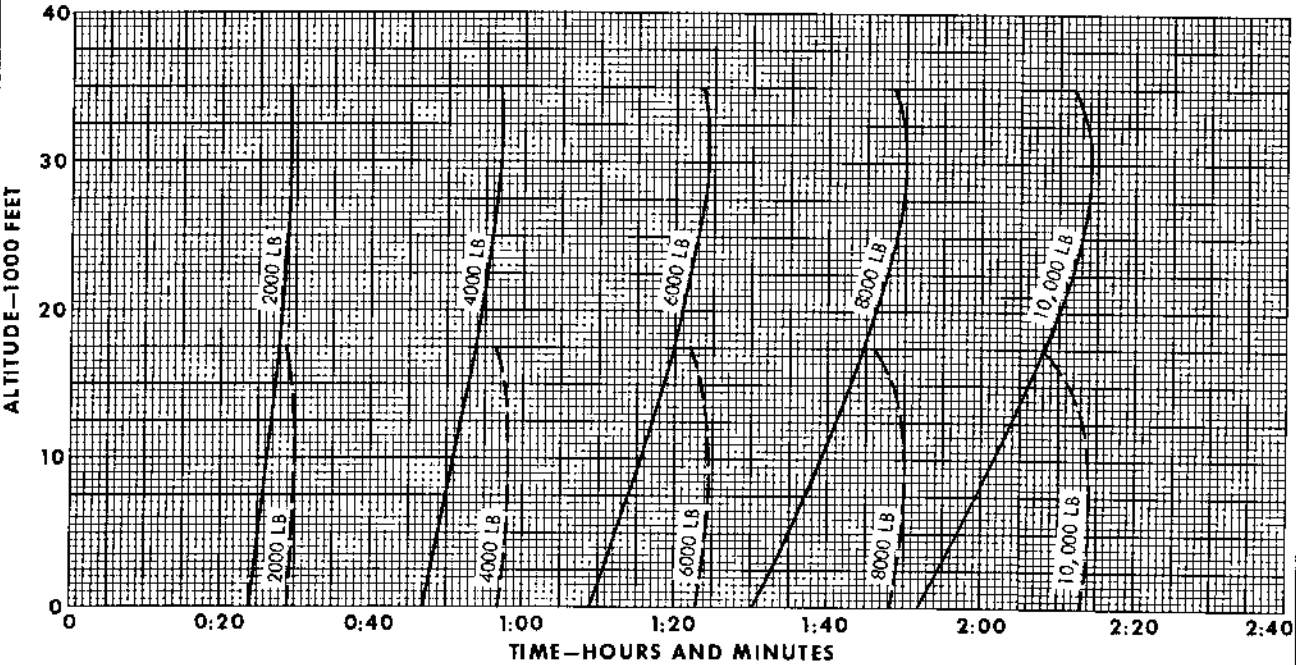
ENGINES: (2) J79-GE-8A
FUEL GRADE: MIL-F-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL

TWO ENGINE LOITER

	APPROXIMATE LESS THAN 5000 LB FUEL REMAINING			APPROXIMATE 5000 TO 10,000 LB FUEL REMAINING		
LOITER ALTITUDE FEET	CAS KNOTS	TRUE MACH NO.	TOTAL FUEL FLOW LB/HR	CAS KNOTS	TRUE MACH NO.	TOTAL FUEL FLOW LB/HR
35,000	217	.65	4220	226	.67	4720
25,000	214	.52	4270	225	.55	4720
15,000	211	.42	4600	221	.44	5020
SEA LEVEL	200	.30	5110	205	.31	5510

SINGLE ENGINE LOITER

	APPROXIMATE LESS THAN 5000 LB FUEL REMAINING			APPROXIMATE 5000 TO 10,000 LB FUEL REMAINING		
LOITER ALTITUDE FEET	CAS KNOTS	TRUE MACH NO.	TOTAL FUEL FLOW LB/HR	CAS KNOTS	TRUE MACH NO.	TOTAL FUEL FLOW LB/HR
15,000	211	.42	4250	221	.44	4910
SEA LEVEL	200	.30	4280	205	.31	4780



LEGEND:

—— MAXIMUM TWO ENGINE LOITER TIME AT INITIAL ALTITUDE (NO CLIMB ASSUMED)

– – – MAXIMUM SINGLE ENGINE LOITER TIME AT INITIAL ALTITUDE (NO CLIMB ASSUMED)

EXTERNAL CONFIGURATION	GROSS WEIGHT WITH ZERO FUEL - POUNDS	* ADJUSTMENT ENDURANCE TIME	* ADJUSTMENT ENDURANCE SPEED
(2) FLASHER PODS + (2) 400 GAL TANKS	45,000	0	+.01 MN
ATTACK CONFIG (RECON EQUIP POD REMOVED) (4) 400 GAL TANKS	42,300	+5%	0
EFFECT OF GROSS WEIGHT CHANGE (FUEL WEIGHT CONSTANT)			
PLUS 2000 POUNDS		-5%	+.01 MN
MINUS 2000 POUNDS		+5%	-.01 MN

* ENTER CHART WITH POUNDS OF FUEL REMAINING AND APPLY ADJUSTMENT TO OBTAIN THE RESPECTIVE CONFIGURATION ENDURANCE TIME AND SPEED

REMARKS:

1. LOITER TIME IS FOR CONSTANT ALTITUDE, CONSTANT HEADING (NO CLIMB, DESCENT OR LANDING INCLUDED)
2. INDICATED FUEL IS TOTAL FUEL ON BOARD.
3. USE TWO ENGINES FOR LOITER AT ALTITUDES ABOVE 15,000 FEET.
4. REFER TO OPERATING LIMITATIONS SECTION FOR SINGLE ENGINE OPERATING LIMITATIONS.
5. FOR STANDARD HOLDING PATTERN (8 MIN.) AT 25,000 FEET MAINTAIN 11.5 UNITS ANGLE-OF-ATTACK; INCREASE SPEED BY 0.03 MACH NO. DURING TURNS. FUEL REQUIRED PER CIRCUIT IS 800 POUNDS.

A-5C-1A-93-478

Figure 11-88

PART 6 — AIR REFUELING

AIR REFUELING SPEEDS AND MAXIMUM ALTITUDES

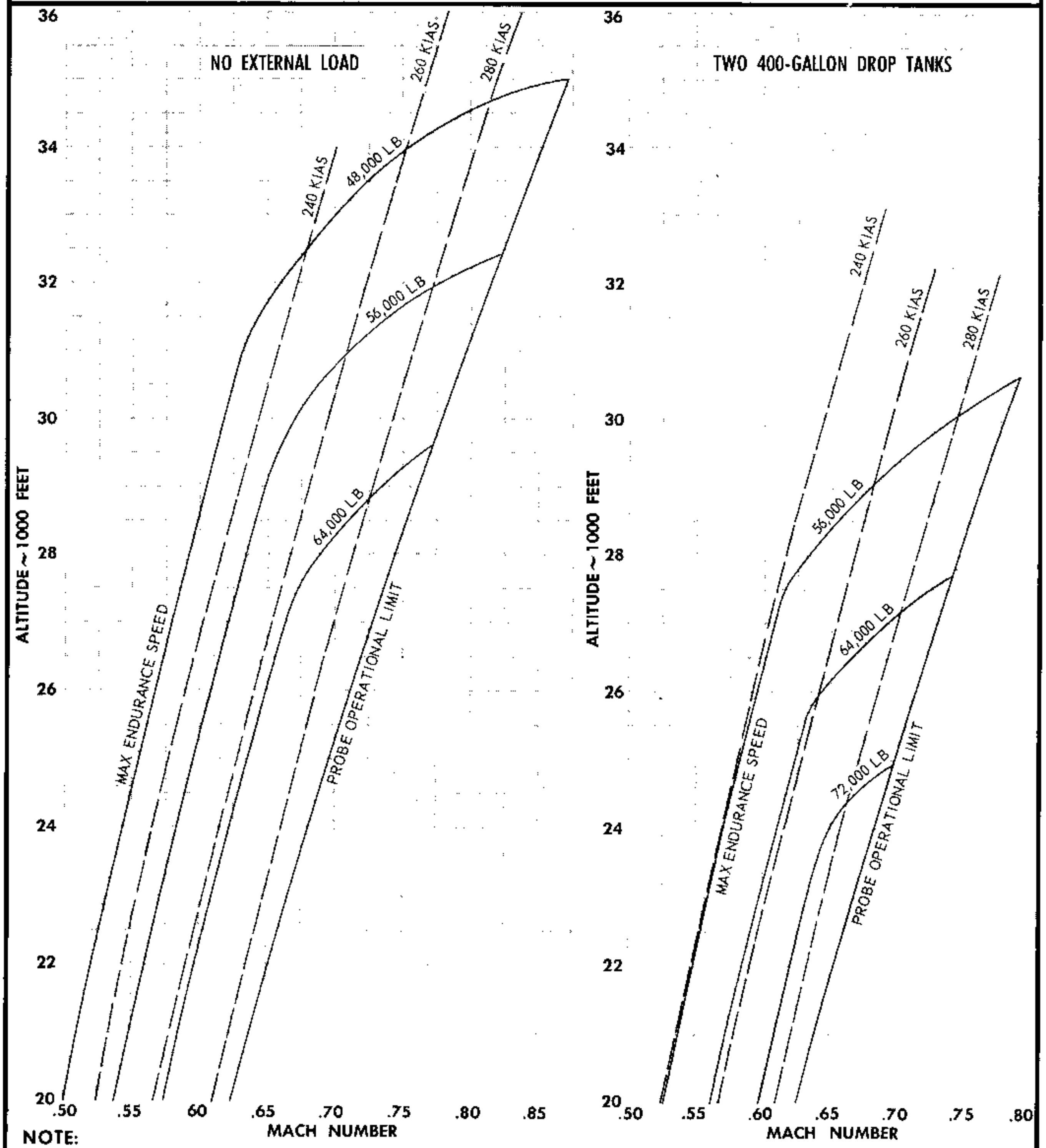
Maximum refueling altitudes for various airspeed/gross weight combinations, clean and drop tank configurations, with 5° droops and 25° droops, are shown in figures 11-89 and 11-90. The air refueling probe airspeed limits and best endurance speeds are also shown, forming the usable operational envelopes.

AIR REFUELING SPEEDS AND MAXIMUM REFUELING ALTITUDES

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA(NA63H-2)
DATE: 1 SEPTEMBER 1964

5° DROOPS/0° FLAPS

ENGINES: (2) J79-GE-8/10
FUEL GRADE: MIL-J-5624(JP-5)
FUEL DENSITY: 6.8 LB/GAL



NOTE:

1. MAXIMUM REFUEL ALTITUDES AT THE GROSS WEIGHTS SHOWN ARE BASED ON THE RECEIVER OPERATING WITH NORMAL OR MILITARY POWER SETTING WITHIN THE TANKER DOWNWASH.
2. TO OBTAIN MAXIMUM REFUEL ALTITUDES WITH FOUR 400-GALLON TANKS, DECREASE REFUELING ALTITUDES SHOWN FOR TWO 400-GALLON TANKS BY 2000 FEET AND THE REFUELING MACH NUMBER BY 0.02M (NO CHANGE IN CAS).

A-5C-1A-93-94B

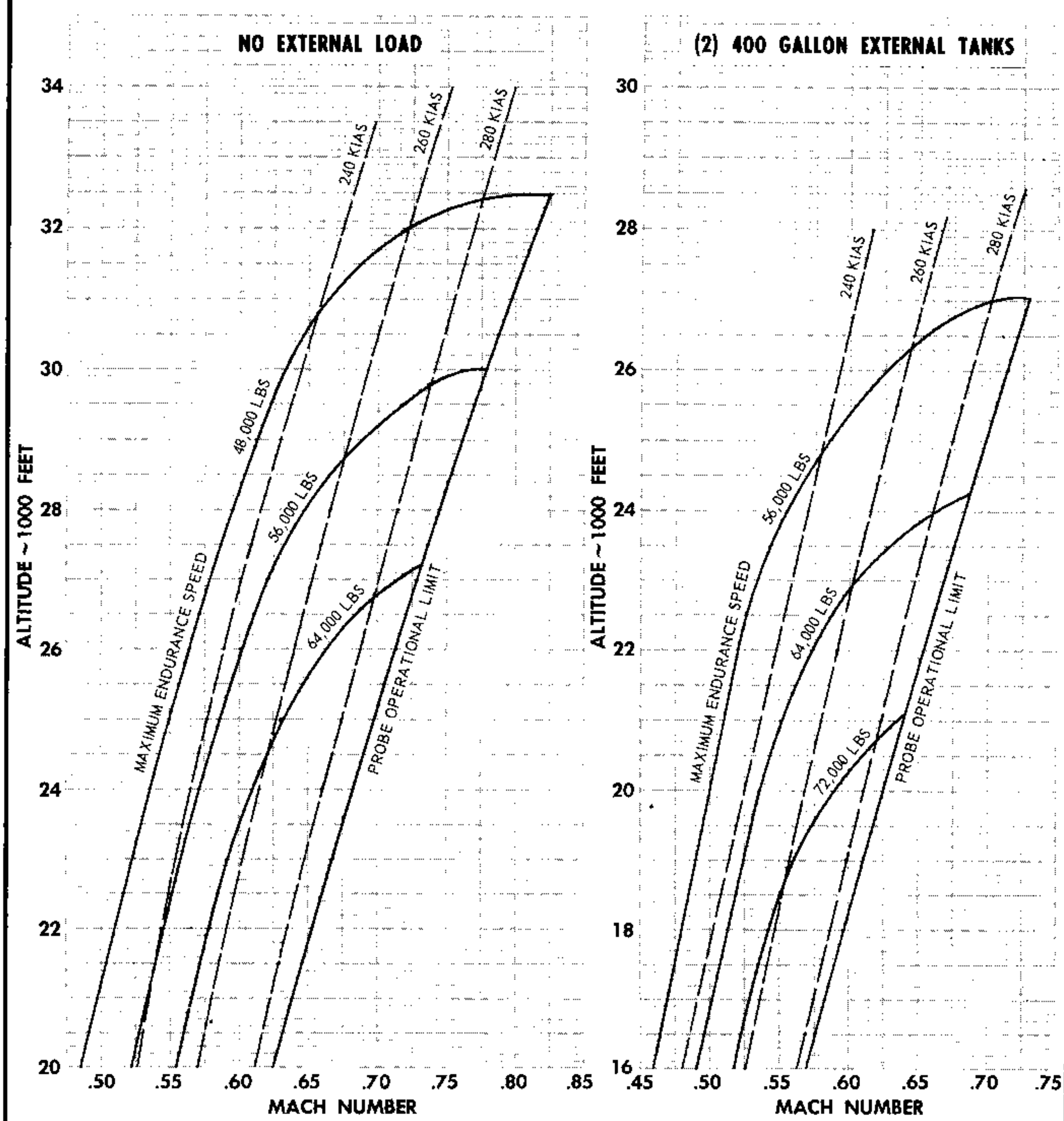
Figure 11-89

AIR REFUELING SPEEDS AND MAXIMUM REFUELING ALTITUDES

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NA63H-2)
DATE: 1 OCTOBER 1967

RECONNAISSANCE CONFIGURATION
25° DROOPS/0° FLAPS

ENGINE: (2) J79-GE-8/10
FUEL GRADE: MIL-T-5624(JP-5)
FUEL DENSITY: 6.8 LB/GAL



1. MAXIMUM REFUEL ALTITUDES AT THE GROSS WEIGHT SHOWN ARE BASED ON THE RECEIVER OPERATING WITH NORMAL OR MILITARY POWER SETTING WITHIN THE TANKER DOWNWASH.
2. TO OBTAIN MAXIMUM REFUEL ALTITUDES WITH (4) 400 GALLON TANKS, DECREASE REFUELING ALTITUDES SHOWN FOR (2) 400 GALLON TANKS BY 1600 FT. AND THE REFUELING MACH NUMBER BY 0.02M (NO CHANGE IN KIAS).

A-5C-1-93-3A

Figure 11-90

PART 7 — DESCENT

DESCENT CHARTS

Descent performance for maximum range during descent (250 KIAS) is based upon the aircraft with a gross weight of 46,000 to 48,000 pounds, speed brakes closed. Descent performance at heavier aircraft gross weights may be determined by reference to the notes included on the charts. This information presented in the Idle and 80% rpm Descent charts (figures 11-91 and 11-92) consists of rate of descent in hundreds of feet per minute, time to descend in minutes, distance traveled in nautical miles, pounds of fuel used, idle rpm during descent, and fuel flow in pounds per hour. 80% rpm Descent charts are also provided for speeds of 0.8 and 0.9 Mach number (figures 11-93 and 11-94).

IDLE DESCENT—250 KNOTS IAS

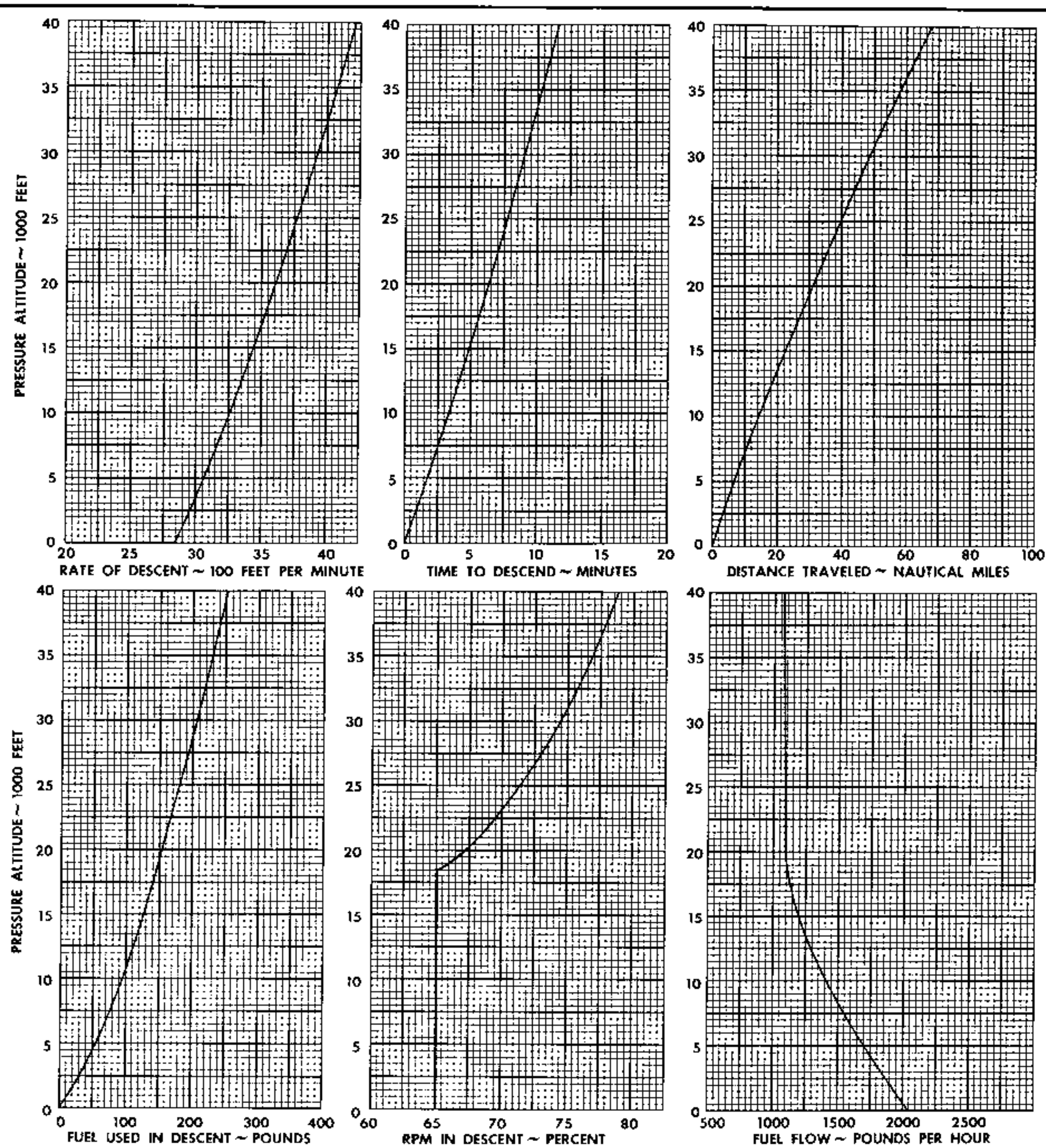
46,000 POUNDS GROSS WEIGHT

ALL CONFIGURATIONS

STANDARD DAY

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA
DATE: 1 JANUARY 1967

ENGINES: (2) J79-GE-8/10
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL



REMARKS:

1. IDLE RPM DESCENT BASED ON 250 KNOTS IAS, CRUISE DROOPS (5°) AND SPEED BRAKES CLOSED.
2. FOR SINGLE - ENGINE DESCENT - INCREASE TIME AND DISTANCE BY 6%; DECREASE FUEL FLOW AND FUEL USED BY ONE-HALF.
3. DECREASE TIME AND FUEL BY 5% AND INCREASE SPEED 20 KNOTS FOR A 10,000 POUND INCREASE IN GROSS WEIGHT - NO CHANGE IN DISTANCE.
4. A SLIGHT INCREASE IN RANGE CAN BE GAINED AT HIGHER ALTITUDES BY ADVANCING THROTTLES (THEREBY CLOSING NOZZLES) UNTIL FUEL FLOW INCREASES BEYOND MINIMUM FLOW. ADJUST THROTTLES TO MAINTAIN MINIMUM FLOW IN DESCENT. THE IMPROVEMENT IN IDLE RPM DESCENT PERFORMANCE WITH MANUAL NOZZLE SCHEDULING IS LESS THAN 5%.

A-5C-1A-93-103E

Figure 11-91

80% RPM DESCENT—250 KNOTS IAS

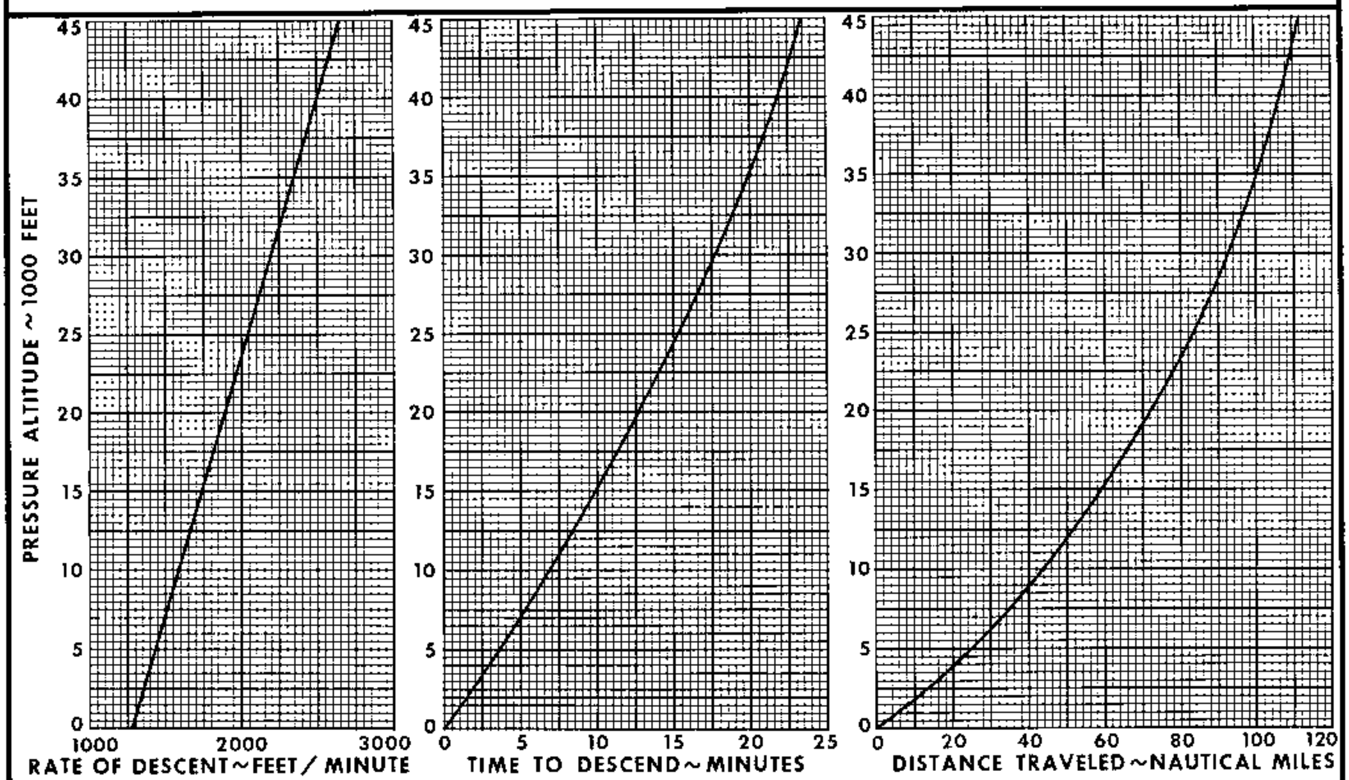
46,000 POUNDS GROSS WEIGHT

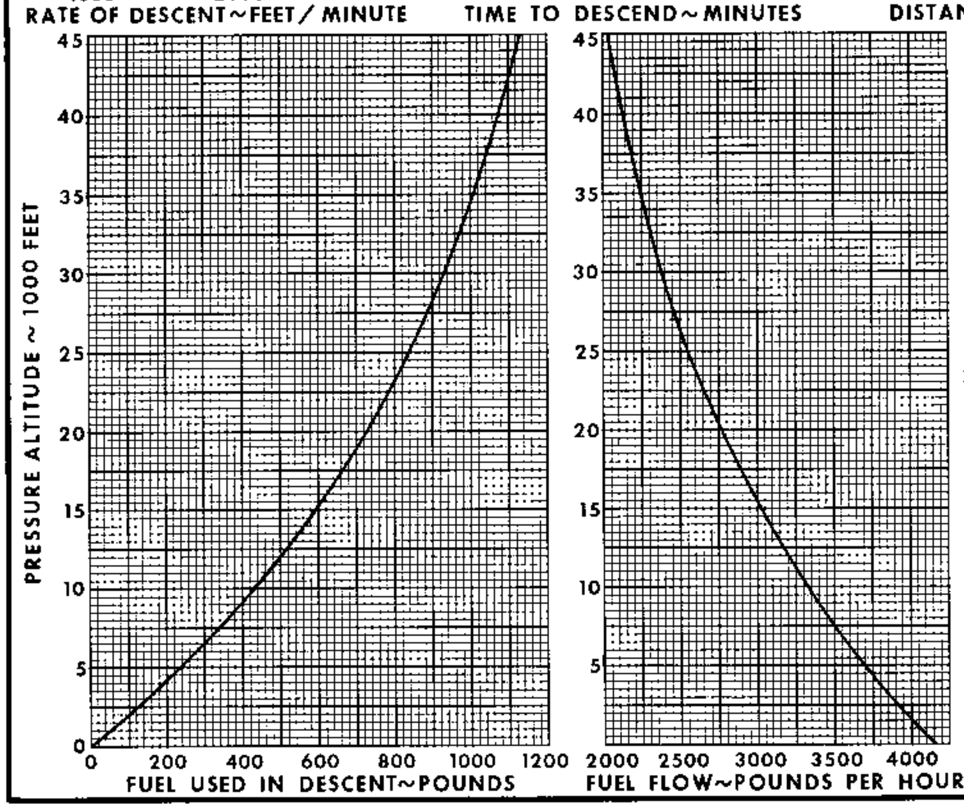
ALL CONFIGURATIONS

STANDARD DAY

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA
DATE: 1 NOVEMBER 1964

ENGINES: (2) J79-GE-8/10
FUEL GRADE: MIL-J-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL





NOTE:

1. TWO ENGINE 80% RPM DESCENT BASED ON 250 KNOTS IAS, CRUISE DROOPS (5°) AND SPEED BRAKES CLOSED.
2. DECREASE TIME AND FUEL BY 5% AND INCREASE SPEED 20 KNOTS FOR A 10,000 POUND INCREASE IN GROSS WEIGHT-NO CHANGE IN DISTANCE

A-5C-1A-93-105C

Figure 11-92

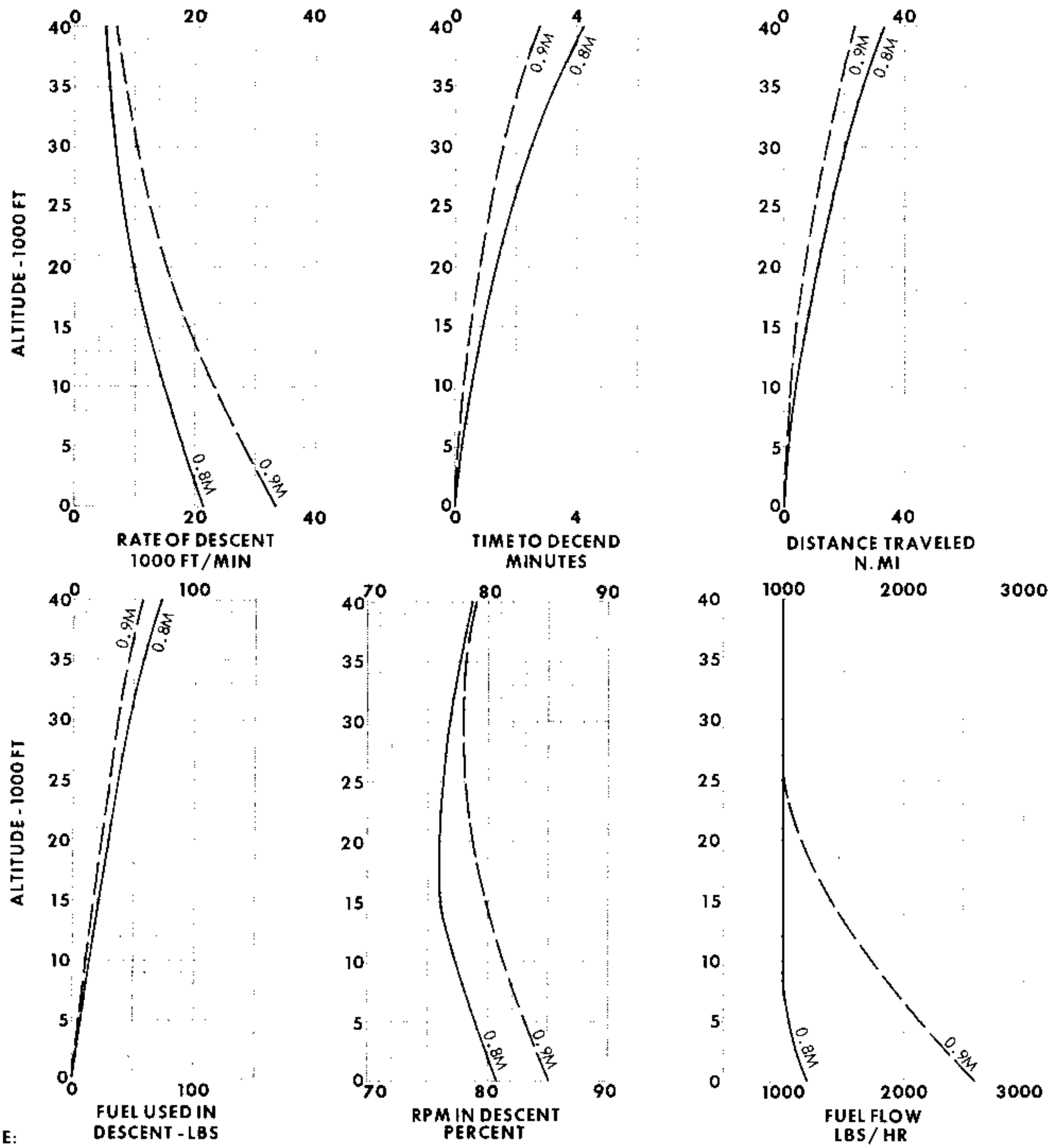
MODEL: RA-5C
DATA BASIS: FLIGHT TEST
DATE: 1 NOVEMBER 1967

DESCENT - IDLE RPM

ALL CONFIGURATIONS
48,000 POUNDS GROSS WEIGHT
STANDARD DAY

ENGINES: (2) J79-GE-8/10
FUEL GRADE: MIL-J-5624-(JP-5)
FULE DENSITY: 6.8 LB/GAL

0.8 AND 0.9 MACH NO. **SPEED BRAKES CLOSED**



NOTE:

1. FOR SINGLE ENGINE DESCENT, INCREASE TIME AND DISTANCE BY 5%. DECREASE FUEL FLOW AND FUEL USED BY ONE HALF.
2. FOR A 10,000 POUND INCREASE IN GROSS WEIGHT, INCREASE TIME, FUEL AND DISTANCE BY 15%.
3. DESCENT IS APPLICABLE FOR EITHER ZERO DEGREE DROOPS OR CRUISE DROOPS (5°).
4. REFER TO OPERATING LIMITATIONS SECTION FOR AIR SPEED LIMITATIONS.

A-5C-1-93-14A

Figure 11-93

MODEL: RA-5C
DATA BASIS: FLIGHT TEST
DATE: 1 NOVEMBER 1967

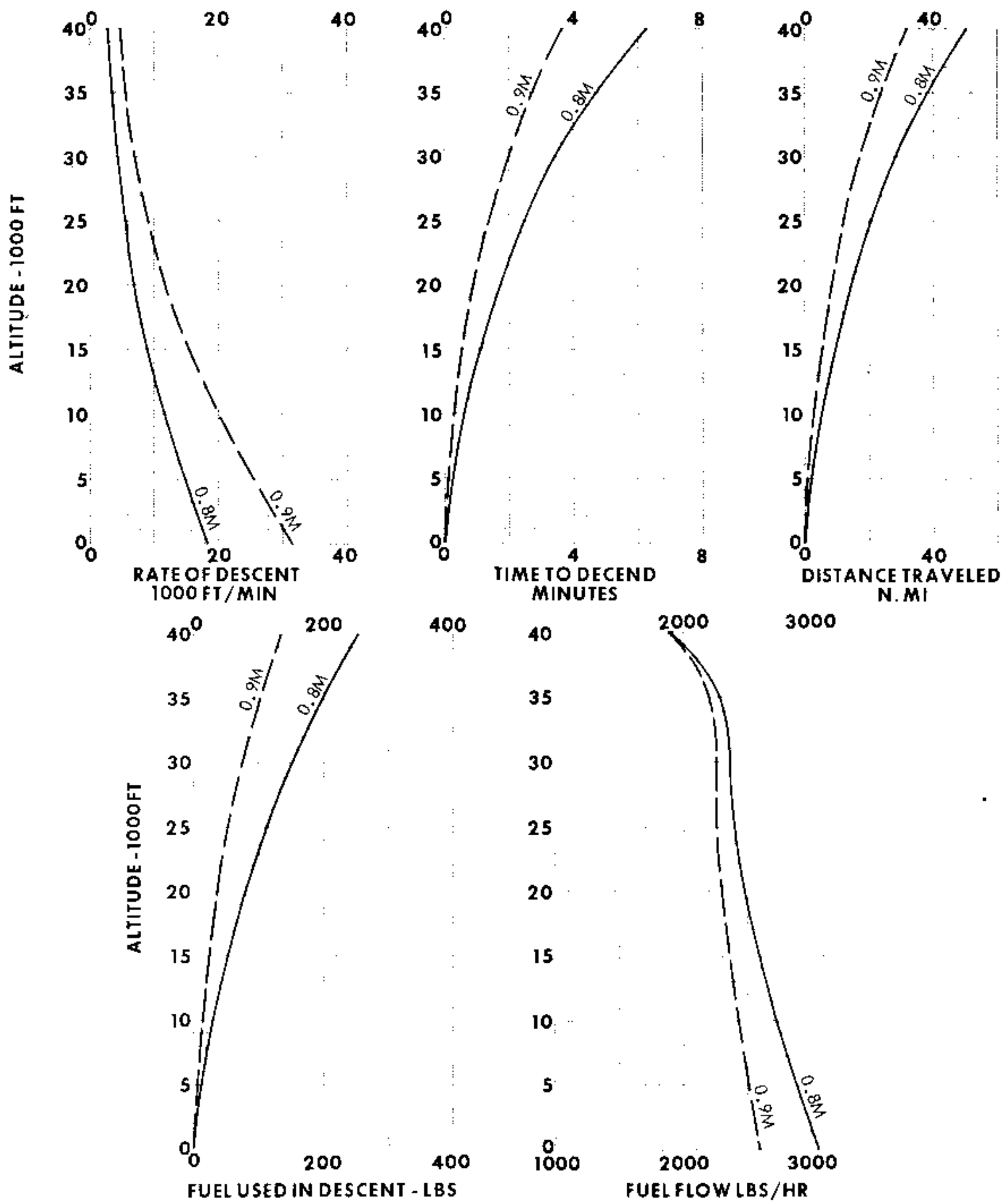
0.8 AND 0.9 MACH NO.

DESCENT - 80% RPM

ALL CONFIGURATIONS
48,000 POUNDS GROSS WEIGHT
STANDARD DAY

ENGINES: (2) J79-GE-8/10
FUEL GRADE: MIL-J-5624-(JP-5)
FUEL DENSITY: 6.8 LB/GAL

SPEED BRAKES CLOSED



NOTE:

1. FOR SINGLE ENGINE DESCENT, DECREASE TIME AND DISTANCE BY 10%, DECREASE FUEL FLOW AND FUEL USED BY ONE HALF.
2. FOR A 10,000 POUND INCREASE IN GROSS WEIGHT, INCREASE TIME, FUEL AND DISTANCE BY 15%.
3. DESCENT IS APPLICABLE FOR EITHER ZERO DEGREE DROOPS OR CRUISE DROOPS (5°)
4. REFER TO OPERATING LIMITATIONS SECTION FOR AIRSPEED LIMITATIONS.

A-5C-1-93-15B

Figure 11-94

PART 8 — LANDING

LANDING AND STOPPING DISTANCES CHARTS

The total landing and stopping distances are shown in figures 11-95 and 11-96. The landing and stopping distances shown for a dry, hard-surface runway are based on flight test measured stopping distance data and include a 3-second time delay for the initiation of wheel braking. The brakes are capable of absorbing a maximum of approximately 51 million foot-pounds of kinetic energy. The landing and stopping distances are based on aerodynamic braking from touchdown to a speed corresponding to 80 percent of the maximum brake absorption capability, and on wheel braking thereafter. This allows a 20 percent margin in the brake energy absorption capability for worn brakes or brakes being heated up from previous use. The speed corresponding to 80 percent of the maximum brake absorption capability is labeled as the maximum recommended IAS for initiation of wheel braking. It may be noted that touchdown or abort speeds at high gross weights exceed maximum recommended IAS for initiation of wheel braking. To preclude exceeding brake capacity, aerodynamic braking should be used, therefore, to reduce speed before brake application. For this reason, aerodynamic braking is normally used down to a rollout speed of approximately 115 knots at the higher gross weights before wheel braking is commenced. Optimum aerodynamic braking techniques are discussed under STOPPING THE AIRCRAFT, in Section III, Part 3, of the NATOPS Flight Manual (NAVAIR 01-60ABC-1). Wet and icy runway conditions are estimated to increase the dry runway wheel braking distance by 67 and 90 percent, respectively. Applying these factors to the dry runway total ground roll distance will provide a conservative stopping distance for adverse runway conditions.

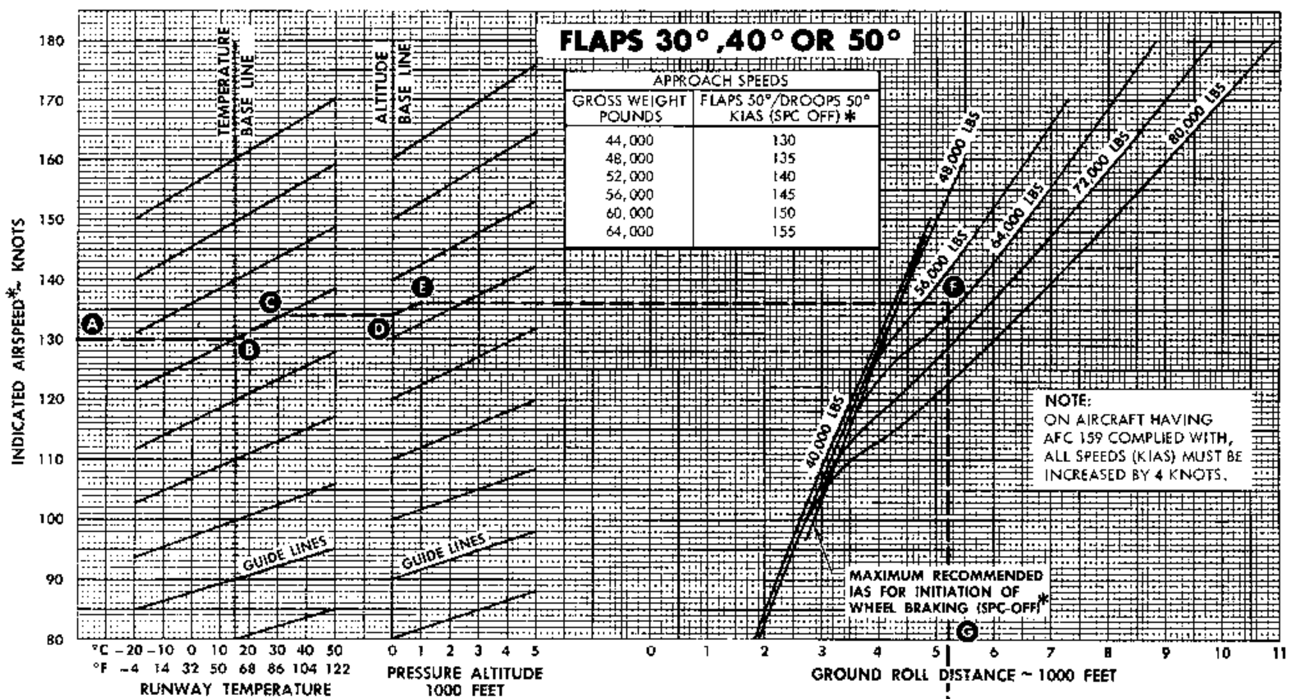
LANDING AND STOPPING DISTANCES

ALL CONFIGURATIONS

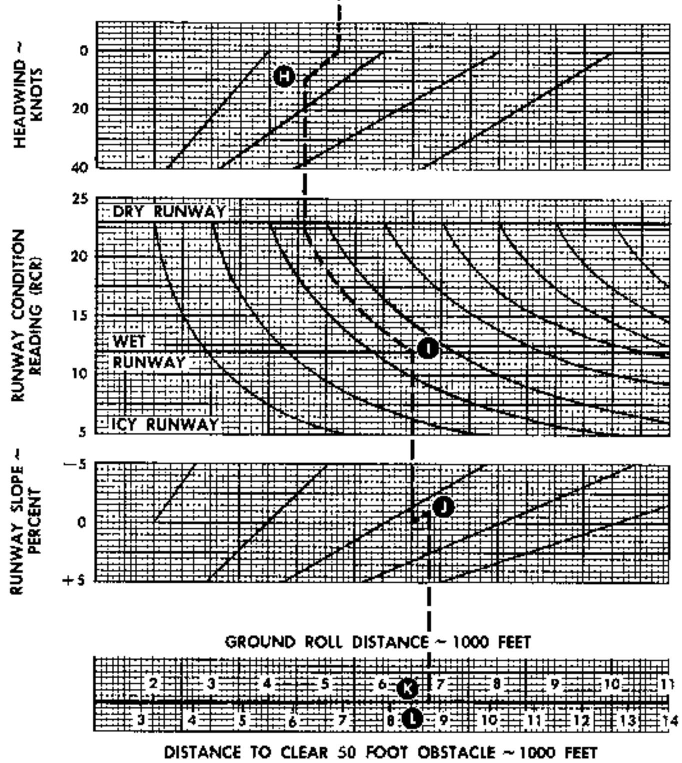
MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NA63H-2)
DATE: 15 DECEMBER 1965

(HARD-SURFACE RUNWAY)

ENGINES: (2) J79-GE-[8]
FUEL GRADE: MIL-J-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL



APPROACH SPEEDS	
GROSS WEIGHT POUNDS	FLAPS 50°/DROOPS 50° KIAS (SPC OFF) *
44,000	130
48,000	135
52,000	140
56,000	145
60,000	150
64,000	155



EXAMPLE

- Ⓐ IAS AT TOUCHDOWN OR ABORT (130 KNOTS IAS)*
- Ⓑ TEMPERATURE BASE LINE
- Ⓒ RUNWAY TEMPERATURE (30°C) (86°F)
- Ⓓ ALTITUDE BASE LINE
- Ⓔ PRESSURE ALTITUDE (1000 FEET)
- Ⓕ GROSS WEIGHT (62,000 POUNDS)
- Ⓖ GROUND ROLL DISTANCE-ZERO WIND, ZERO RCR, ZERO SLOPE, NO 50-FOOT OBSTACLE (5200 FEET)
- Ⓗ HEADWIND (10 KNOTS)
- Ⓘ WET RUNWAY CONDITION (RCR 12)
- Ⓙ RUNWAY SLOPE (1 %)
- Ⓚ GROUND ROLL DISTANCE (6800 FEET)
- Ⓛ TO CLEAR 50 FOOT OBSTACLE (8730 FEET)

NOTE:

1. STOPPING DISTANCES ARE BASED ON 3 POINT ATTITUDE WITH MAX AFT STICK FROM TOUCHDOWN OR ABORT TO STOP. WHEEL BRAKING IS USED FROM THE MAXIMUM RECOMMENDED IAS FOR INITIATION OF WHEEL BRAKING AND INCLUDES 3 SECOND DELAY FOR BRAKE APPLICATION.
2. FULL (NOSE HIGH) AERODYNAMIC BRAKING FROM TOUCHDOWN OR ABORT TO THE MAXIMUM RECOMMENDED IAS FOR INITIATION OF WHEEL BRAKING WILL DECREASE THE DISTANCE COVERED DURING THE FREE ROLL BY 20%.
3. ANTI-SKID BRAKES REDUCE GROUND ROLL DISTANCES BY 15% FOR GROSS WEIGHTS OF LESS THAN 48,000 POUNDS AND BY 5% FOR GROSS WEIGHTS OF 48,000 POUNDS OR GREATER.

* AIRCRAFT NOT HAVING AFC 159 COMPLIED WITH

A-5C-1A-93-107C

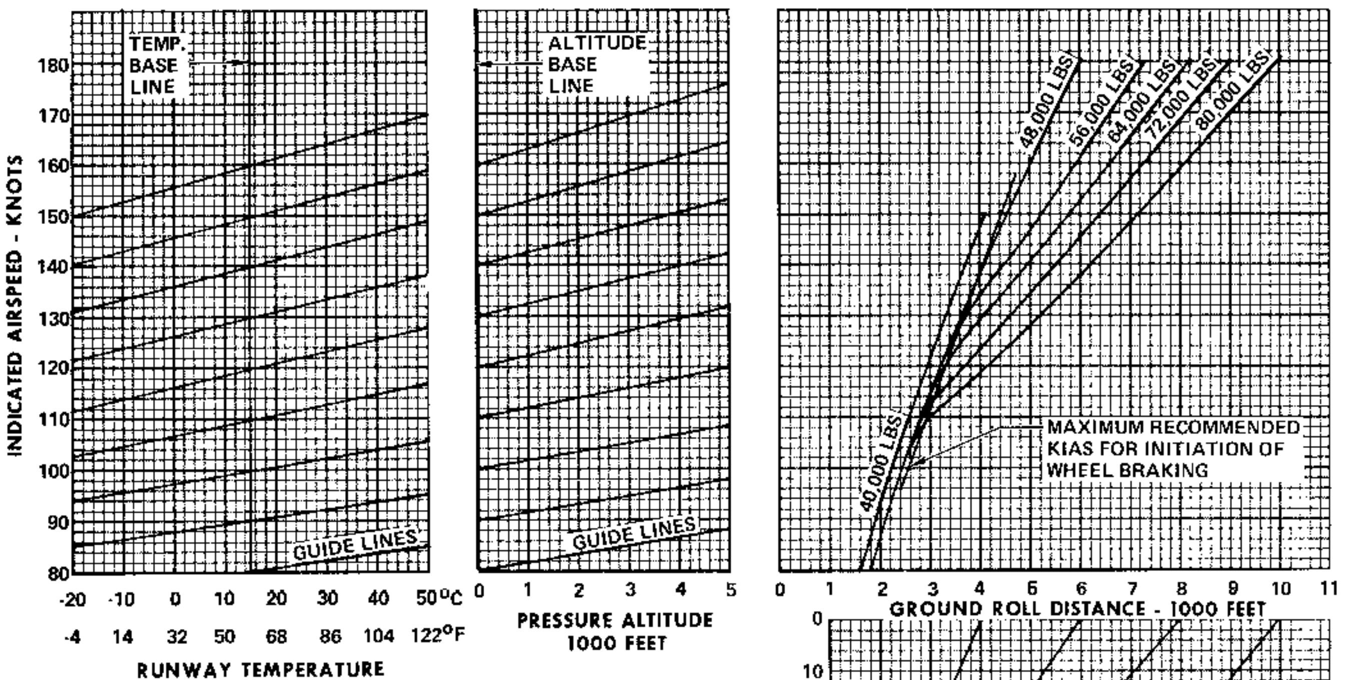
Figure 11-95

LANDING AND STOPPING DISTANCES
ALL CONFIGURATIONS
HARD SURFACE RUNWAY

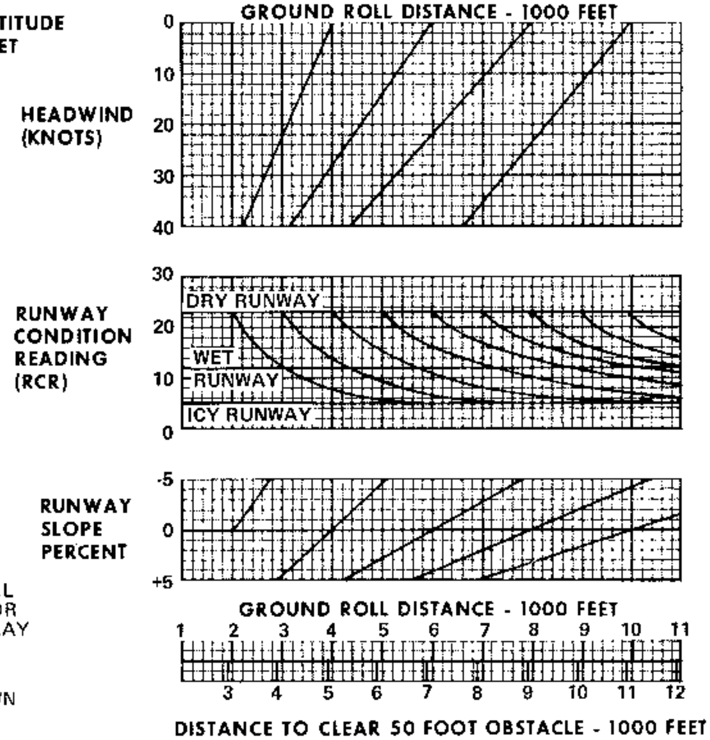
MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NR69H-2)
DATE: 15 JUNE 1970

FLAPS 30°, 40° OR 50°

ENGINES: (2) J79-GE-10 (-8)*
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL
*SEE NOTE 3



APPROACH SPEEDS	
GROSS WEIGHT POUNDS	FLAPS 50° DROOPS 50° KIAS
44,000	131
48,000	136
52,000	142
56,000	147
60,000	152
64,000	157



NOTE:

1. STOPPING DISTANCES ARE BASED ON 3 POINT ATTITUDE WITH MAX AFT STICK FROM TOUCHDOWN OR ABORT TO STOP. WHEEL BRAKING IS USED FROM THE MAXIMUM RECOMMENDED IAS FOR INITIATION OF WHEEL BRAKING AND INCLUDES 3 SECOND DELAY FOR BRAKE APPLICATION.
2. FULL (NOSE HIGH) AERODYNAMIC BRAKING FROM TOUCHDOWN OR ABORT TO THE MAXIMUM RECOMMENDED KIAS FOR INITIATION OF WHEEL BRAKING WILL DECREASE THE DISTANCE COVERED DURING THE FREE ROLL BY 20%.
3. THIS CHART IS APPLICABLE TO AIRCRAFT HAVING AFC 328 COMPLIED WITH AND J79-GE-8 ENGINES.

RA-5C-1-93-48A

Figure 11-96

PART 9 — MISSION PLANNING

ENGINE FUEL FLOW AND ALTITUDE LIMITATIONS

The Engine Fuel Flow and Altitude Limitations charts for both the J79-GE-8 and J79-GE-10 engines (figures 11-97 and 11-117) provide combined engine fuel flow demand at Military Thrust or afterburner thrust of all altitudes from 0.9 to 2.0 Mach. The charts also indicate the ability of the fuel system to supply engine demand, using JP-4 or JP-5 fuel, pressurized or unpressurized, under normal conditions and with fuel boost pump failure.

COMBAT ALLOWANCE

The Combat Allowance charts (figures 11-98 and 11-99) and 11-118 and 11-119) show the relationship between time and fuel with changes in Military, Normal, and Maximum Thrust settings. Combat flight time or fuel to be used may be determined from this chart for a given thrust setting. No time limit is imposed on a Normal Thrust setting. Enter the chart at the combat altitude. Move laterally to the right until the altitude line intersects the *pounds of fuel* line. Read straight down to obtain the time available in minutes. To obtain the fuel required for combat, enter the chart at the combat altitude and at the time available for combat. The point where these two lines intersect will be the amount of fuel required for combat. The use of the chart is illustrated by the examples shown in figures 11-98 for Military and Normal Thrust settings.

LEVEL FLIGHT ACCELERATION

The Level Flight Acceleration charts (figures 11-100 through 11-110 and 11-120 through 11-129), are provided for altitudes of 35,000, 40,000 and 45,000 feet for the reconnaissance and the attack configurations, for Standard Day, 10°C Cold Day, and 10°C Hot Day, respectively for aircraft with J79-GE-8 engines, and 35,000 and 40,000 feet, reconnaissance configuration for aircraft configured with J 79-GE-10 engines. They are based on maximum afterburner operation to accelerate to supersonic speeds. Information that can be obtained from these charts is distance traveled and time required in acceleration from initial to final Mach number. Fuel consumed during the acceleration can be calculated by taking the difference between the initial gross weight and the final gross weight. These charts can be used in conjunction with the Nautical Miles Per 1000 Pounds Fuel charts in mission planning and cruise control and also for fuel consumption calculation for acceleration to supersonic speeds.

SUPERSONIC PERFORMANCE

Figures 11-111 through 11-113 and 11-130 through 11-132 show the fuel consumed and distance traveled during an acceleration to stabilized Mach numbers of 1.5 and 1.8 at 35,000 and 40,000 feet, and during a maximum afterburner climbing run-in at each of these stabilized Mach numbers. The 1.5 and 1.8 Mach run-in data show the aircraft performance at 10°C Hot Day, Standard Day, and 5° or 10°C Cold Day temperature conditions. The data is presented for initial aircraft gross weights of 50,000 to 60,000 pounds at a stabilized run-in speed of either 1.5 or 1.8 Mach. Aircraft performance at intermediate gross weights or intermediate ambient temperatures may be determined by interpolation.

ANGLE-OF-ATTACK RELATIONSHIP TO CALIBRATED AIRSPEED

Figure 11-114 provides planning data on the effects of varying airspeed, altitude, and gross weights on both aircraft and indicated angle of attack. An example is shown on the chart to demonstrate its use.

GENERAL TURNING PERFORMANCE

Aircraft turning rate and radius for various true airspeeds and angles of bank may be determined from figures 11-115 and 11-133. The Military Thrust limit curves represent turning performance beyond which afterburner power is required to maintain true airspeed at 5000 feet. This chart can be used to determine aircraft performance at a given TAS and bank angle, or to determine required bank angle to achieve a preplanned turn rate or radius.

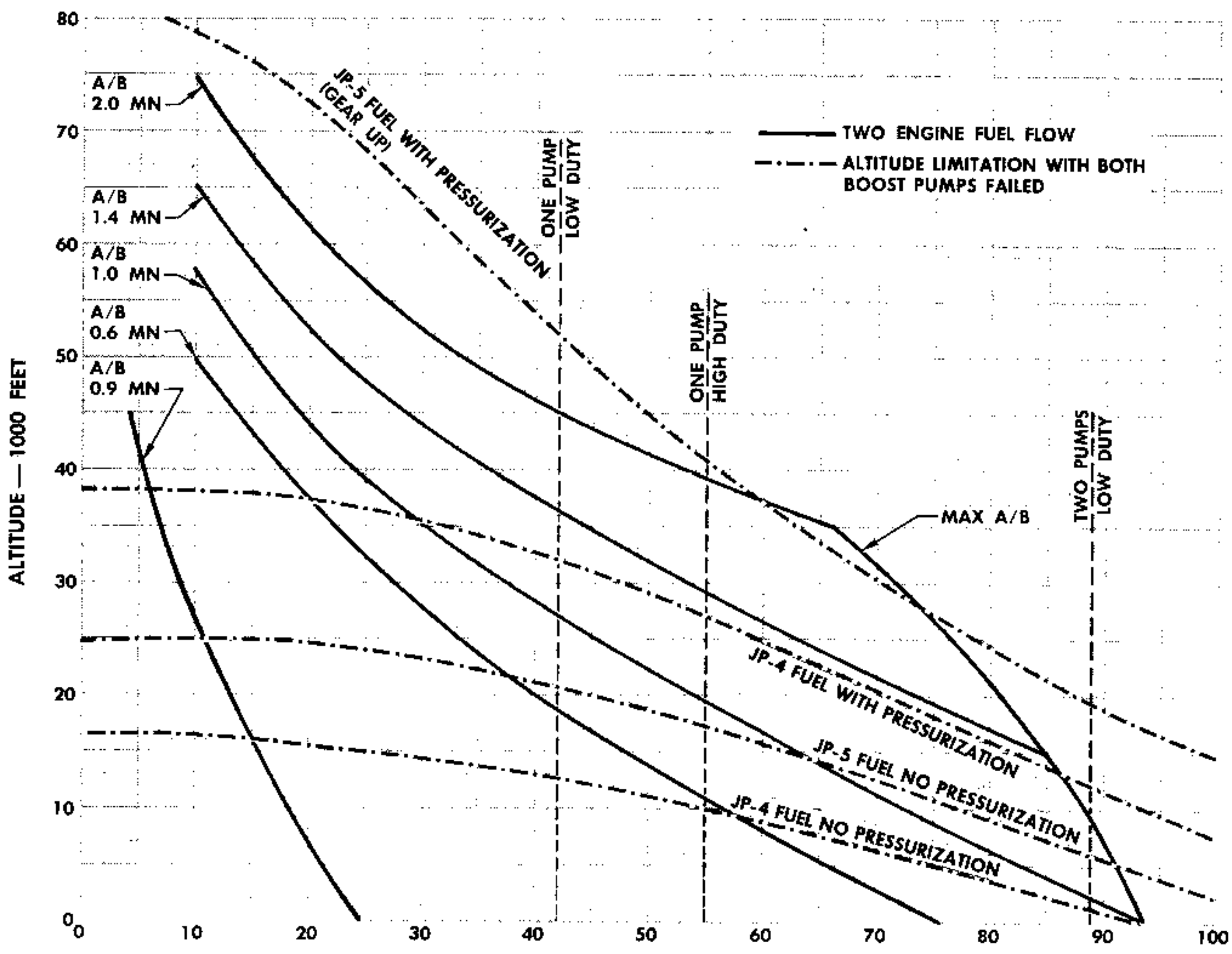
MAXIMUM THRUST TURNING PERFORMANCE

Aircraft maximum thrust, 2.0 and 3.5 "g's," turning rate and radius for various Mach numbers and altitudes may be determined from figures 11-116 and 11-134. Turn rate in degrees per second and turn radius in thousands of feet are plotted at the bottom of the chart. Buffet onset in supersonic droops (0°) and cruise droops (5°) are also included. The curves are predicated on constant speed and constant altitude. In maximum afterburner, the aircraft has excess thrust available and will tend to increase airspeed or climb in the turn. Therefore, if the radius of turn shown for Mach/altitude conditions on the chart are to be accurate, power must be monitored to maintain airspeed and altitude.

ENGINE FUEL FLOW AND ALTITUDE LIMITATIONS

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NR69H-2)
DATE: 1 JULY 1969

ENGINES: (2) J79-GE-8A
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL



A-5C-1A-93-119A

Figure 11-97

COMBAT ALLOWANCE

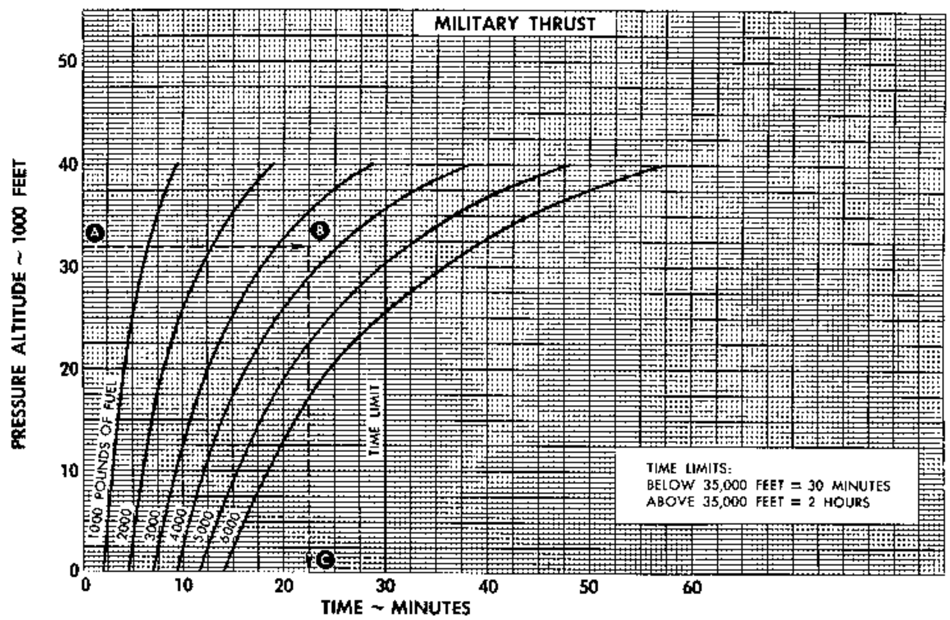
RECONNAISSANCE CONFIGURATION

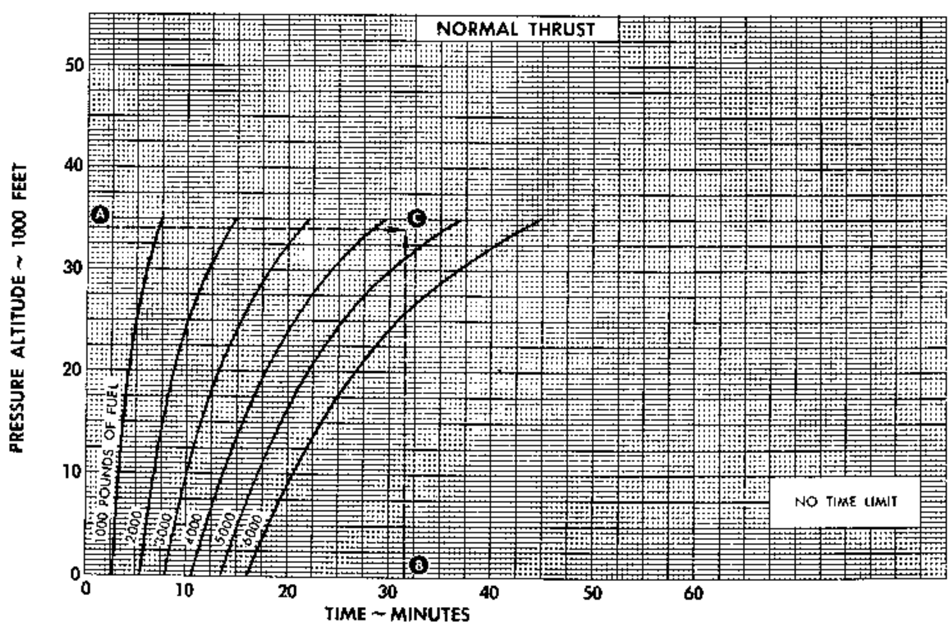
NO EXTERNAL LOAD

STANDARD DAY

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NA63H-2)
DATE: 1 JANUARY 1964

ENGINES: (2) J79-GE-8
FUEL GRADE: MIL-F-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL





NOTE:

1. BASED ON MAXIMUM SPEED AT 55,600 POUNDS GROSS WEIGHT.
2. THIS CHART ALSO APPLIES TO ATTACK CONFIGURATION WITH RECONNAISSANCE EQUIPMENT POD REMOVED.

EXAMPLE: (AT MILITARY THRUST)
Ⓐ PRESSURE ALTITUDE (32,000 FEET)
Ⓑ FUEL AVAILABLE (3500 POUNDS)
Ⓒ COMBAT TIME (22.5 MINUTES)

EXAMPLE: (AT NORMAL THRUST)
Ⓐ PRESSURE ALTITUDE (34,000 FEET)
Ⓑ COMBAT TIME (31.5 MINUTES)
Ⓒ FUEL REQUIRED (4400 POUNDS)

A-5C-1A-93-27

Figure 11-98

COMBAT ALLOWANCE

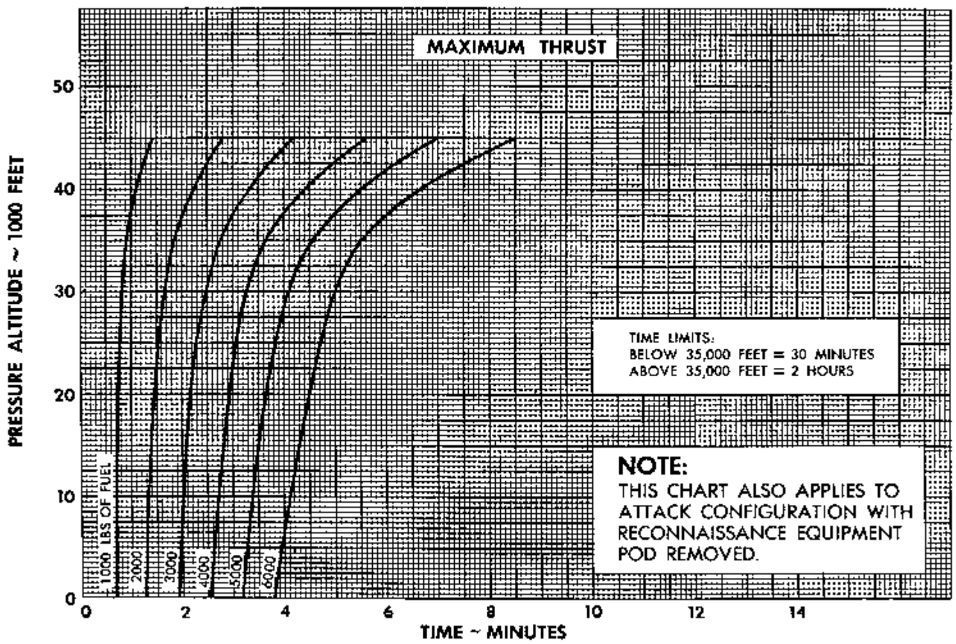
RECONNAISSANCE CONFIGURATION

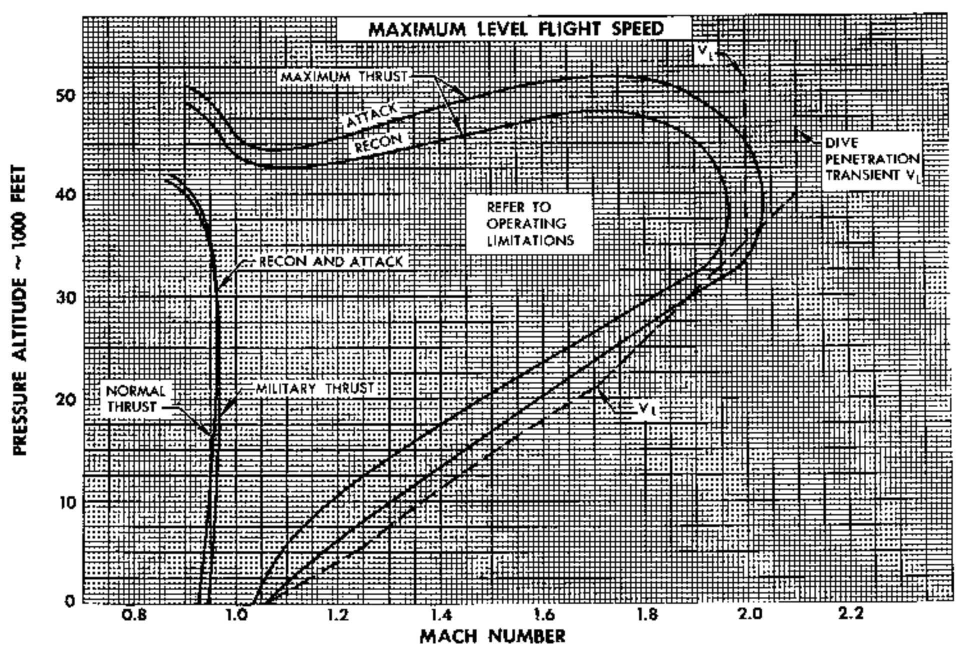
MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NA63H-2)
DATE: 1 JANUARY 1964

NO EXTERNAL LOAD

STANDARD DAY

ENGINES: (2) J79-GE-8
FUEL GRADE: MIL-F-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL





NOTE: 1. BASED ON MAXIMUM SPEED AT 55,600 POUNDS GROSS WEIGHT.

A-5C-1A-93-28

Figure 11-99

LEVEL FLIGHT ACCELERATION
RECONNAISSANCE CONFIGURATION

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NA63H-2)
DATE: 1 JANUARY 1967

MAXIMUM AFTERBURNER
NO EXTERNAL LOAD

ENGINES: (2) J79-GE-8A
FUEL GRADE: MIL-T-5624(JP-5)
FUEL DENSITY: 6.8 LB/GAL

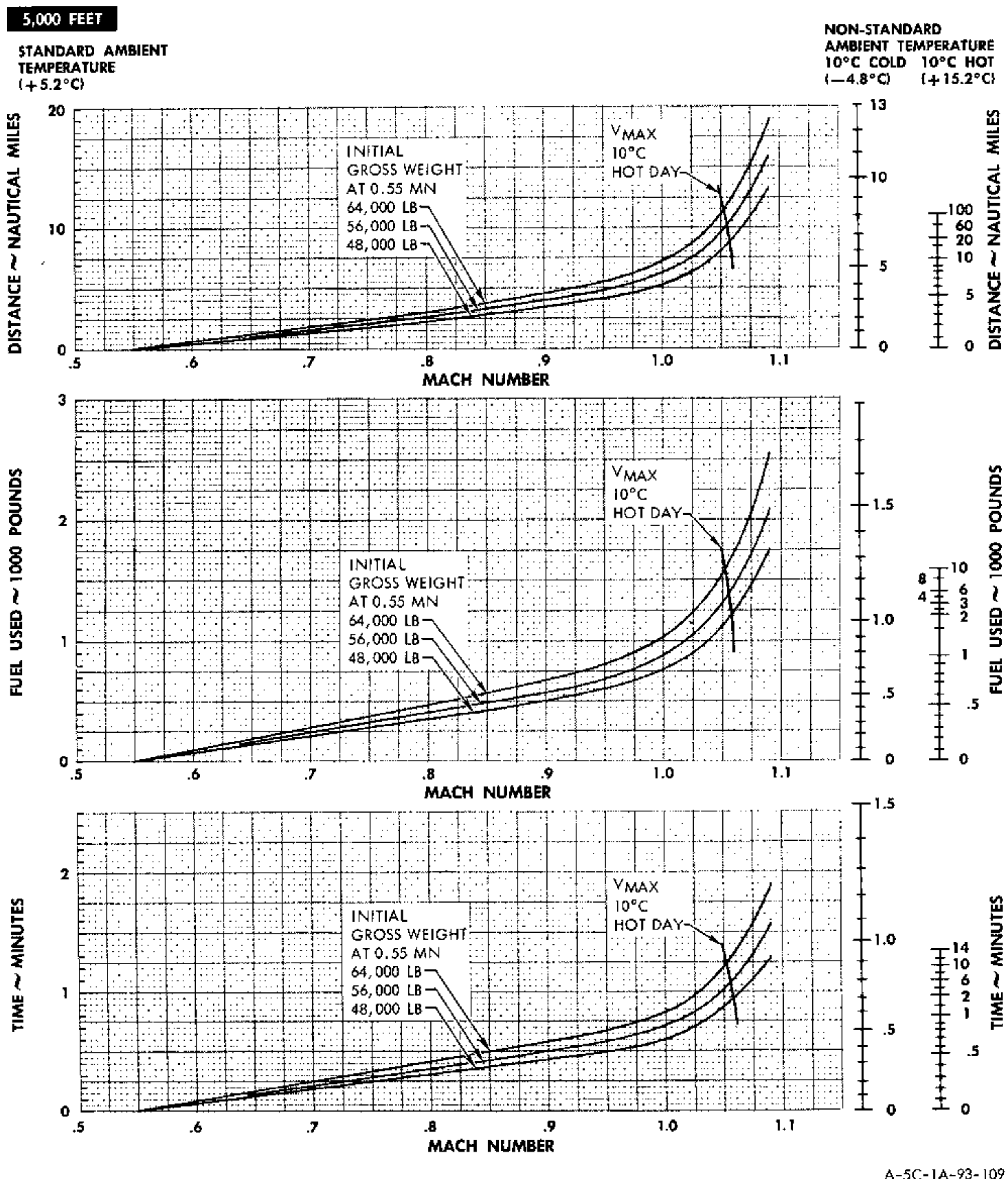


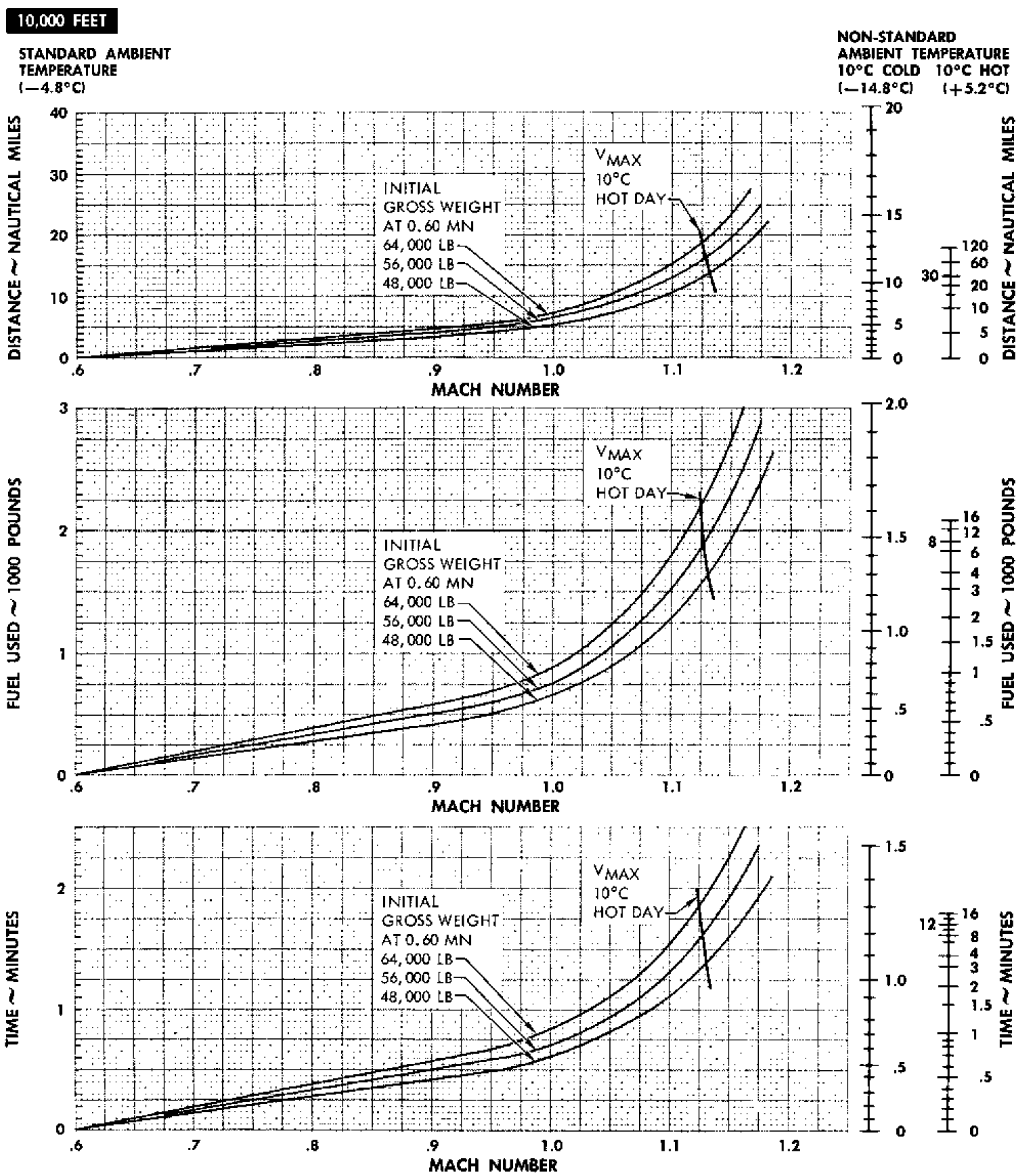
Figure 11-100

LEVEL FLIGHT ACCELERATION
RECONNAISSANCE CONFIGURATION

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NA63H-2)
DATE: 1 JANUARY 1967

MAXIMUM AFTERBURNER
NO EXTERNAL LOAD

ENGINES: (2) J79-GE-8A
FUEL GRADE: MIL-T-5624(JP-5)
FUEL DENSITY: 6.8 LB/GAL



A-5C-1A-93-110

Figure 11-101

LEVEL FLIGHT ACCELERATION

RECONNAISSANCE CONFIGURATION

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NA63H-2)
DATE: 1 JANUARY 1967

MAXIMUM AFTERBURNER
NO EXTERNAL LOAD

ENGINES: (2) J79-GE-8A
FUEL GRADE: MIL-T-5624(JP-5)
FUEL DENSITY: 6.8 LB/GAL

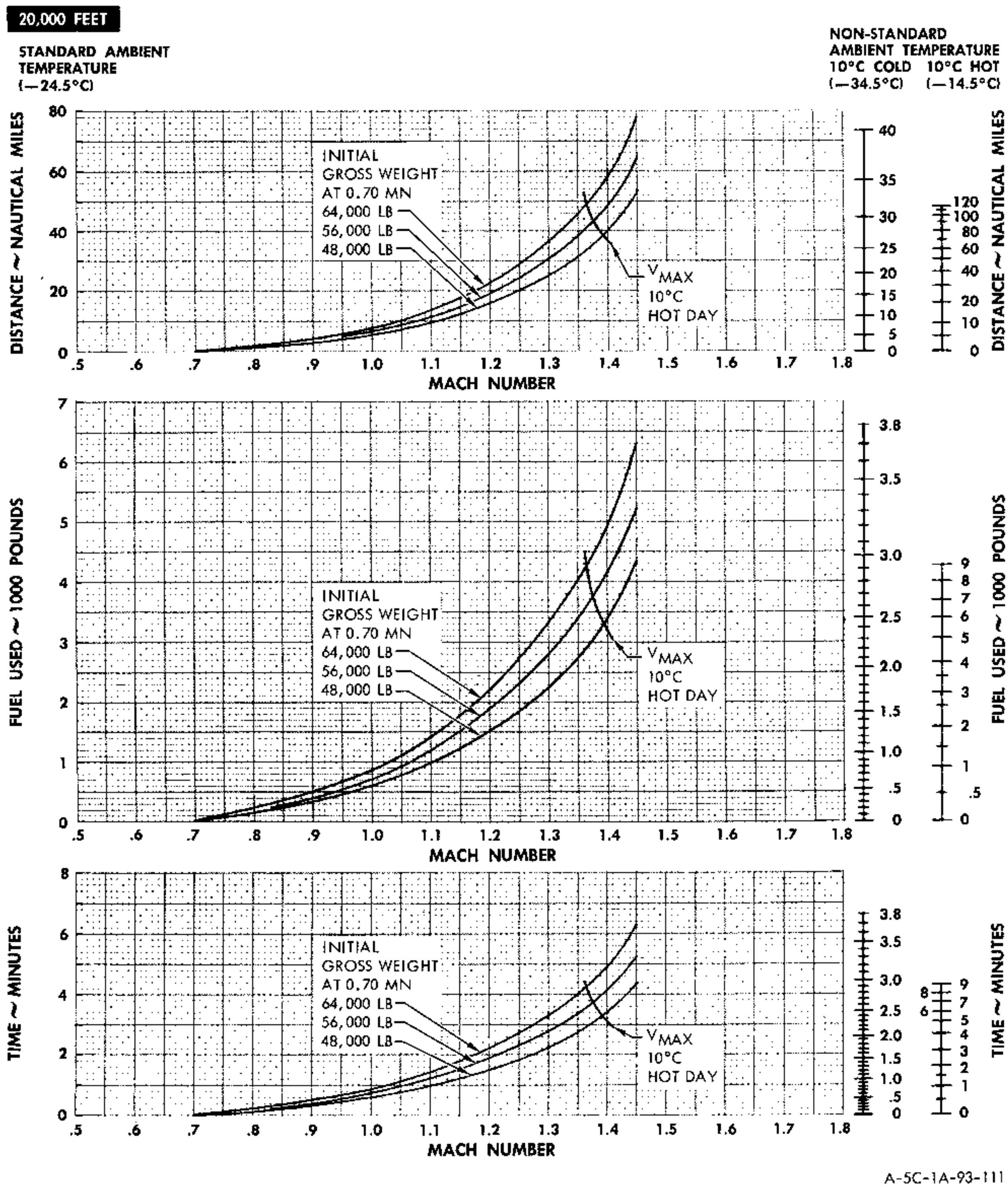


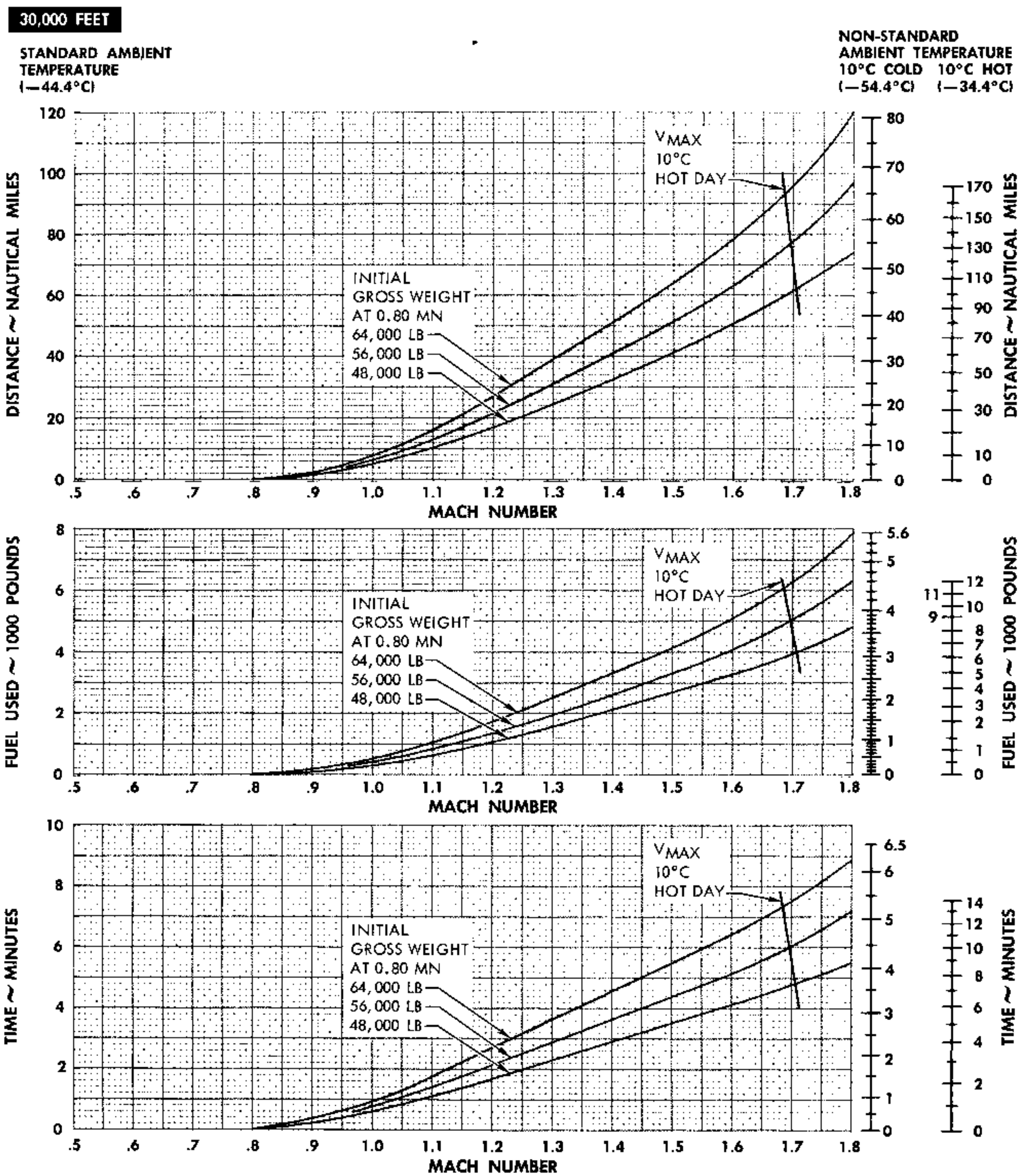
Figure 11-102

LEVEL FLIGHT ACCELERATION
RECONNAISSANCE CONFIGURATION

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NA63H-2)
DATE: 1 JANUARY 1967

MAXIMUM AFTERBURNER
NO EXTERNAL LOAD

ENGINES: (2) J79-GE-8A
FUEL GRADE: MIL-T-5624(JP-5)
FUEL DENSITY: 6.8 LB/GAL



A-5C-1A-93-112

Figure 11-103

LEVEL FLIGHT ACCELERATION

RECONNAISSANCE CONFIGURATION
MAXIMUM AFTERBURNER
NO EXTERNAL LOAD

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NA63H-2)
DATE: 1 JANUARY 1964

ENGINES: (2) J79-GE-8
FUEL GRADE: MIL-F-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL

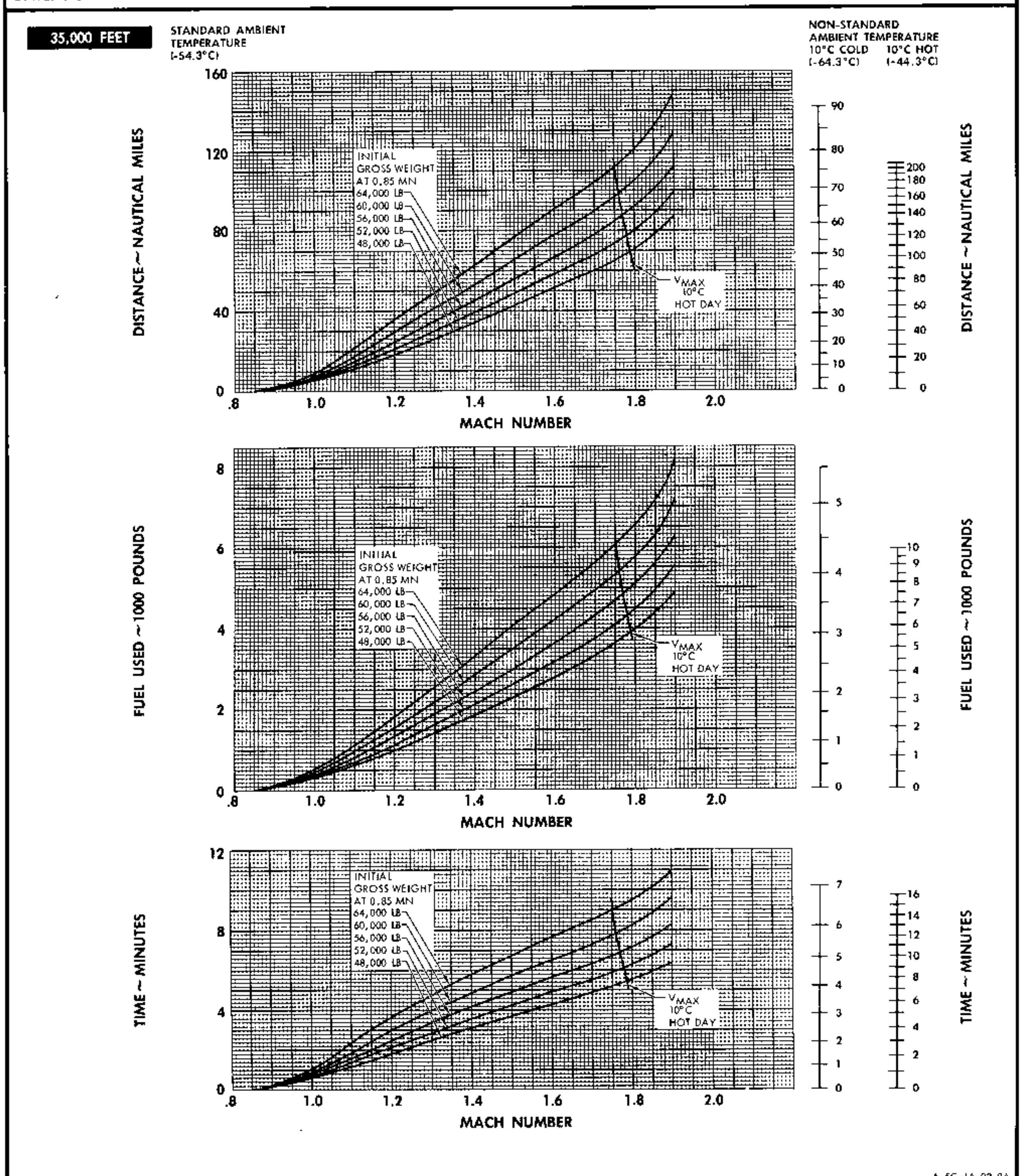


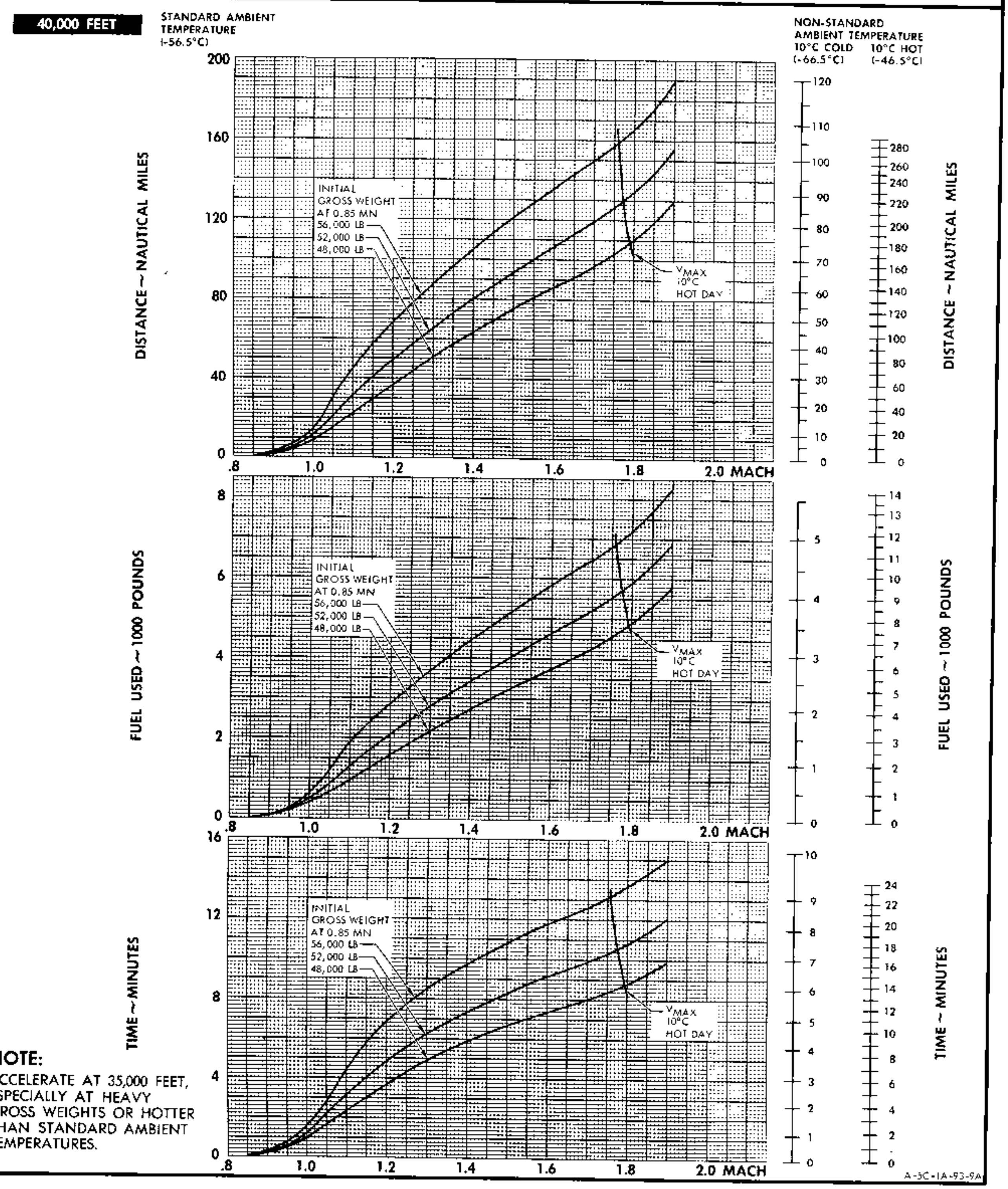
Figure 11-104

LEVEL FLIGHT ACCELERATION

RECONNAISSANCE CONFIGURATION
MAXIMUM AFTERBURNER
NO EXTERNAL LOAD

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NA63H-2)
DATE: 1 JANUARY 1964

ENGINES: (2) J79-GE-8
FUEL GRADE: MIL-F-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL



NOTE:
ACCELERATE AT 35,000 FEET, ESPECIALLY AT HEAVY GROSS WEIGHTS OR HOTTER THAN STANDARD AMBIENT TEMPERATURES.

Figure 11-105

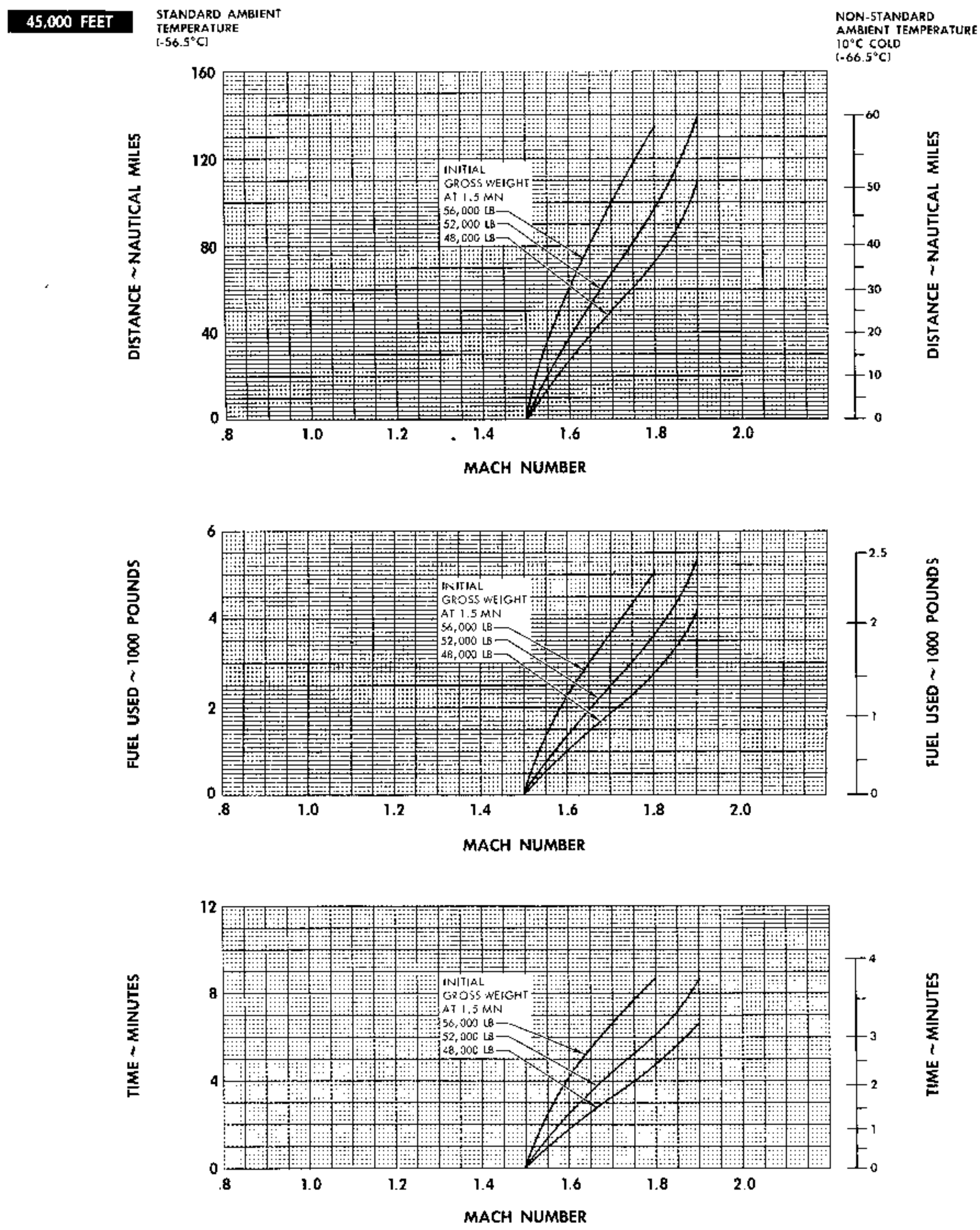
LEVEL FLIGHT ACCELERATION

RECONNAISSANCE CONFIGURATION

MAXIMUM AFTERBURNER
NO EXTERNAL LOAD

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NA63H-2)
DATE: 1 JANUARY 1964

ENGINES: (2) J79-GE-8
FUEL GRADE: MIL-F-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL



A-5C-1A-93-32

Figure 11-106

LEVEL FLIGHT ACCELERATION
RECONNAISSANCE CONFIGURATION

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NA63H-2)
DATE: 1 JANUARY 1967

MAXIMUM AFTERBURNER
TWO FLASHER PODS (W.S.110)

ENGINES: (2) J79-GE-8A
FUEL GRADE: MIL-T-5624(JP-5)
FUEL DENSITY: 6.8 LB/GAL

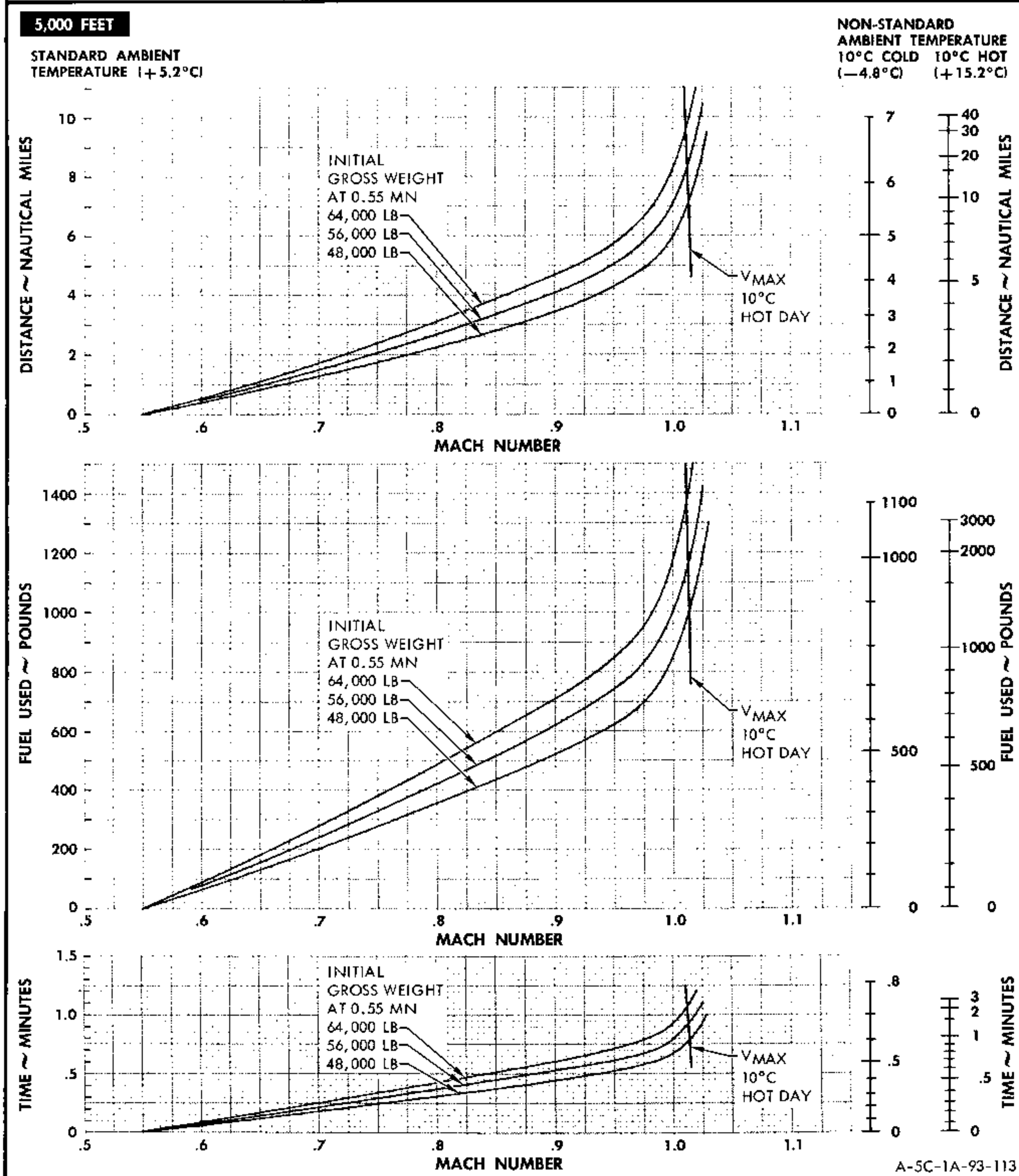


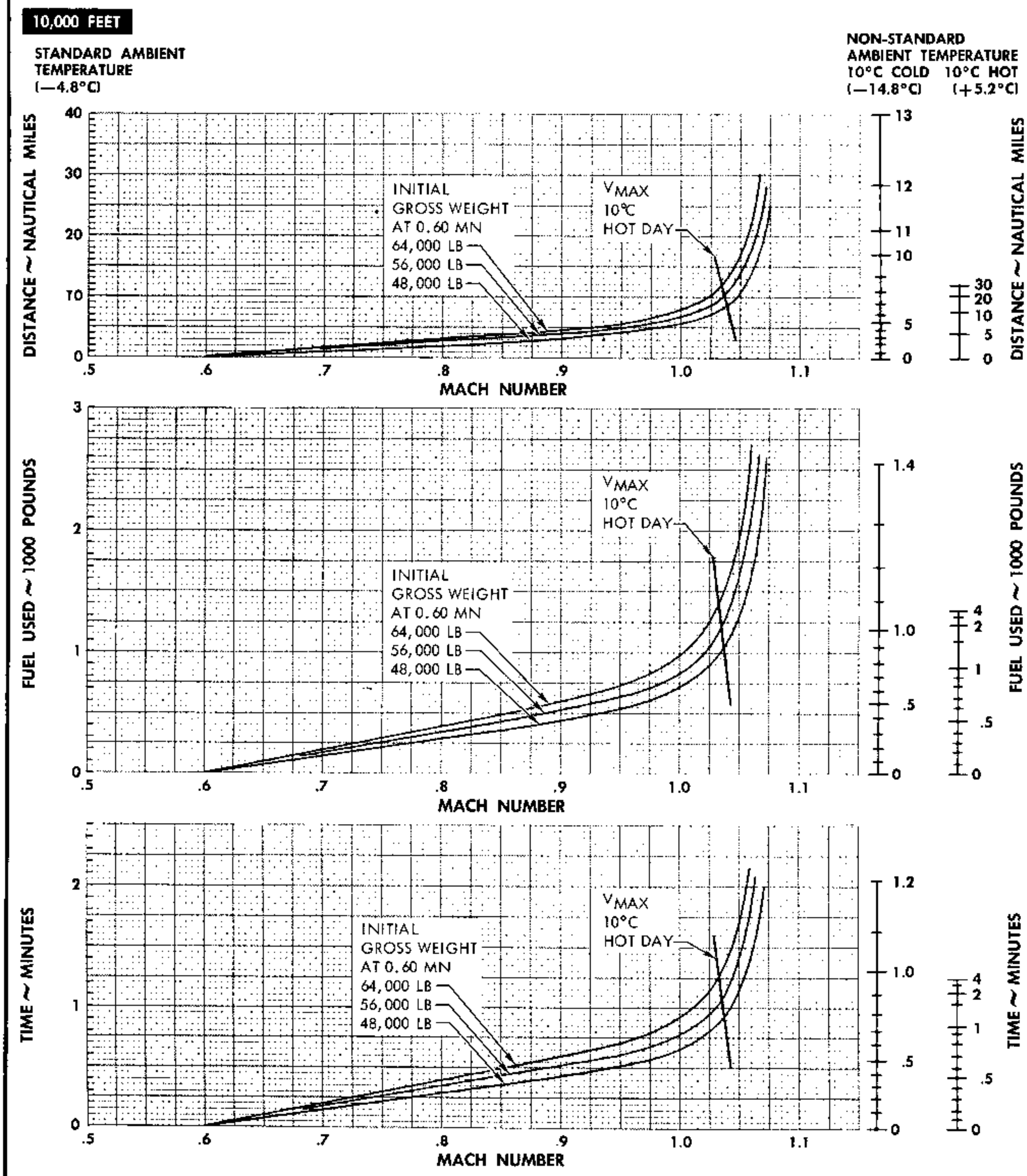
Figure 11-107

LEVEL FLIGHT ACCELERATION
RECONNAISSANCE CONFIGURATION

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NA63H-2)
DATE: 1 JANUARY 1967

MAXIMUM AFTERBURNER
TWO FLASHER PODS (W.S.110)

ENGINES (2) J79-GE-8A
FUEL GRADE: MIL-T-5624(JP-5)
FUEL DENSITY: 6.8 LB/GAL



A-5C-1A-93-114

Figure 11-108

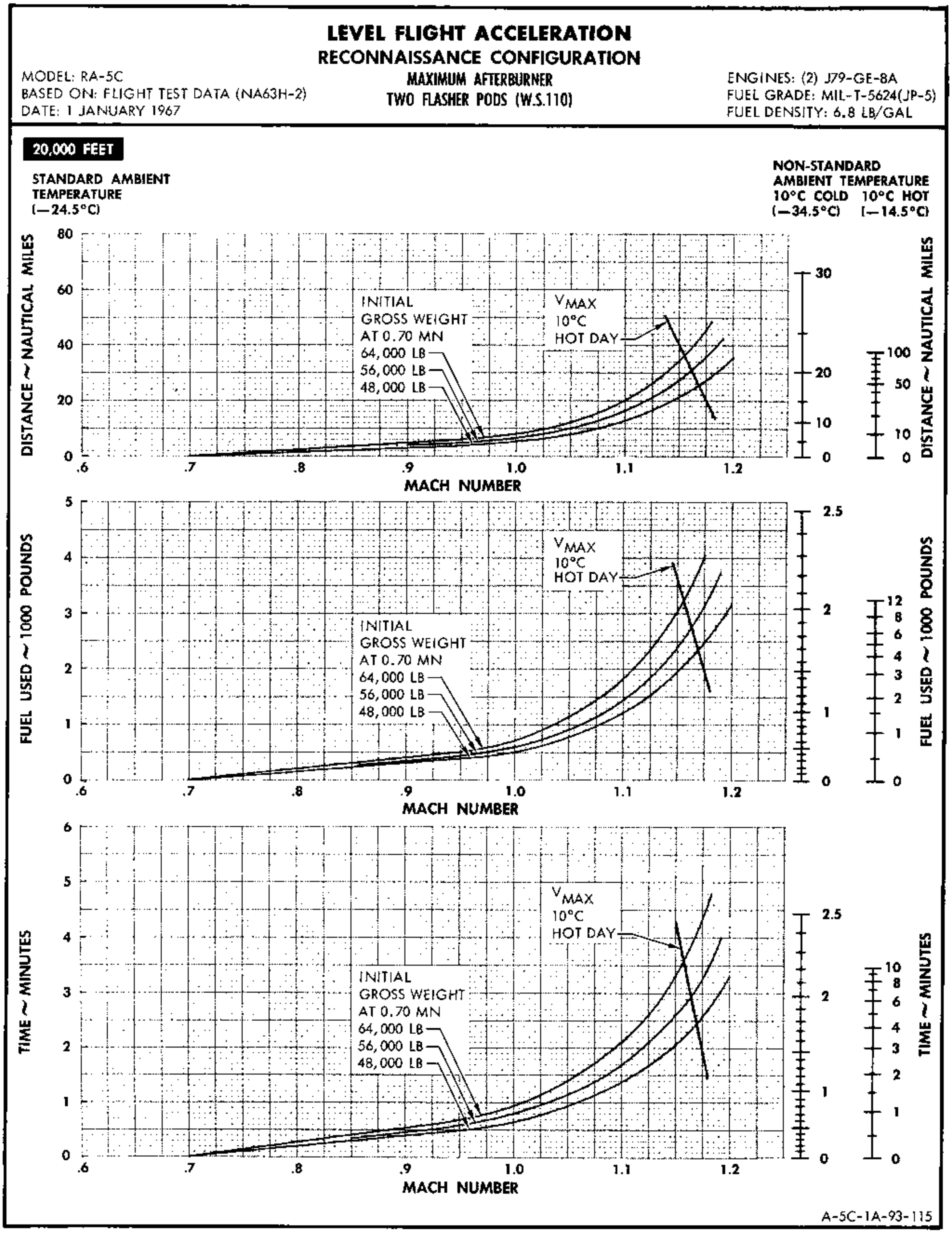


Figure 11-109

LEVEL FLIGHT ACCELERATION

RECONNAISSANCE CONFIGURATION

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NA63H-2)
DATE: 1 JANUARY 1967

MAXIMUM AFTERBURNER
TWO FLASHER PODS (W.S.110)

ENGINES: (2) J79-GE-8A
FUEL GRADE: MIL-T-5624(JP-5)
FUEL DENSITY: 6.8 LB/GAL

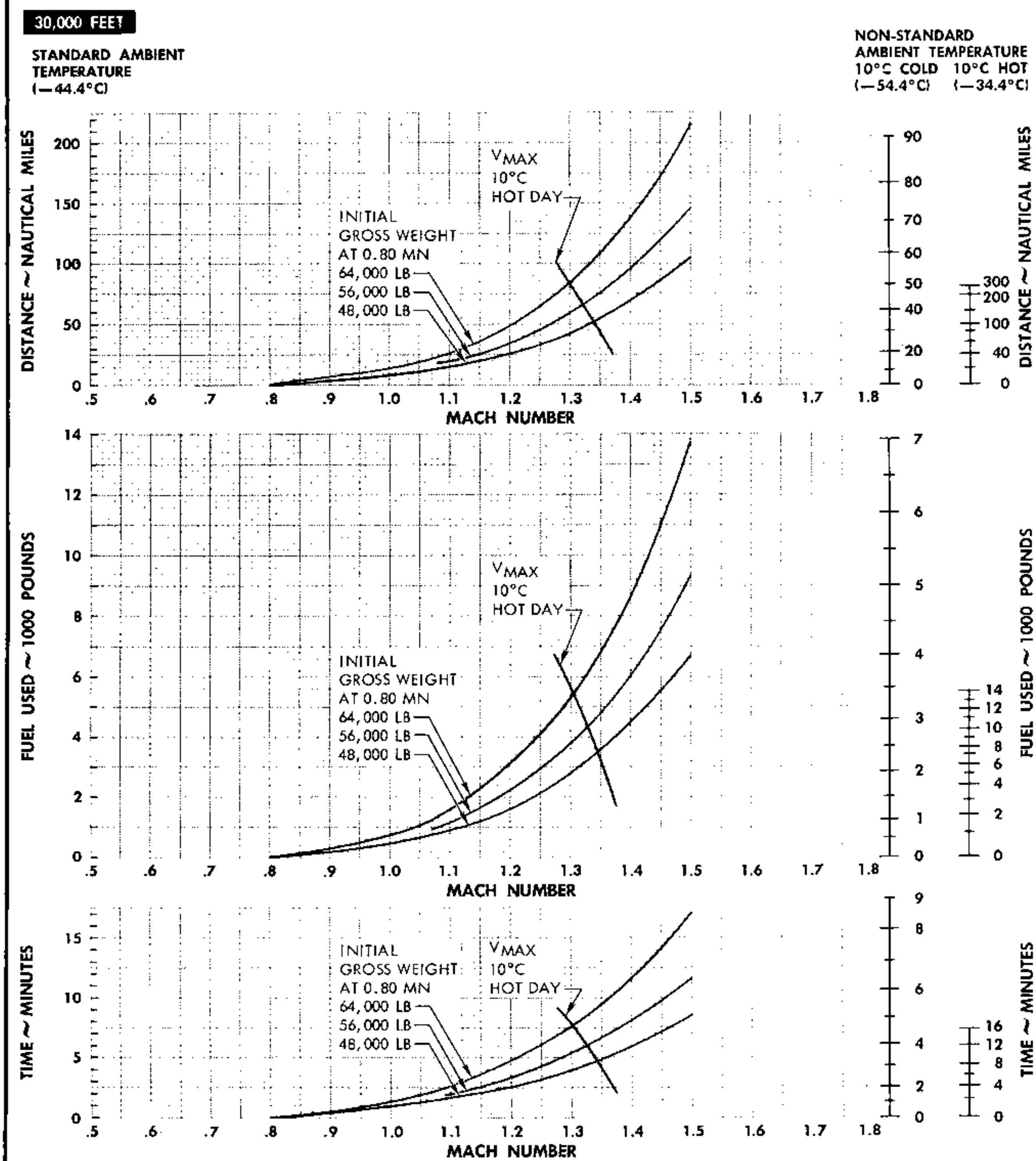


Figure 11-110

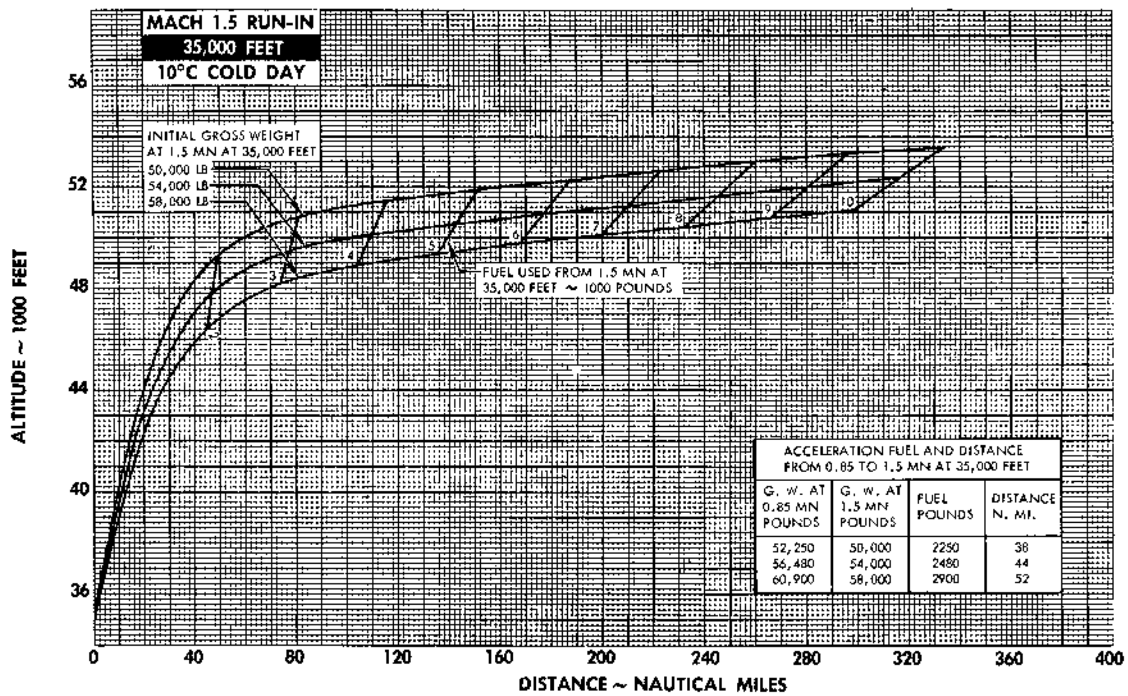
SUPERSONIC PERFORMANCE

RECONNAISSANCE CONFIGURATION

MAXIMUM THRUST
NO EXTERNAL LOAD

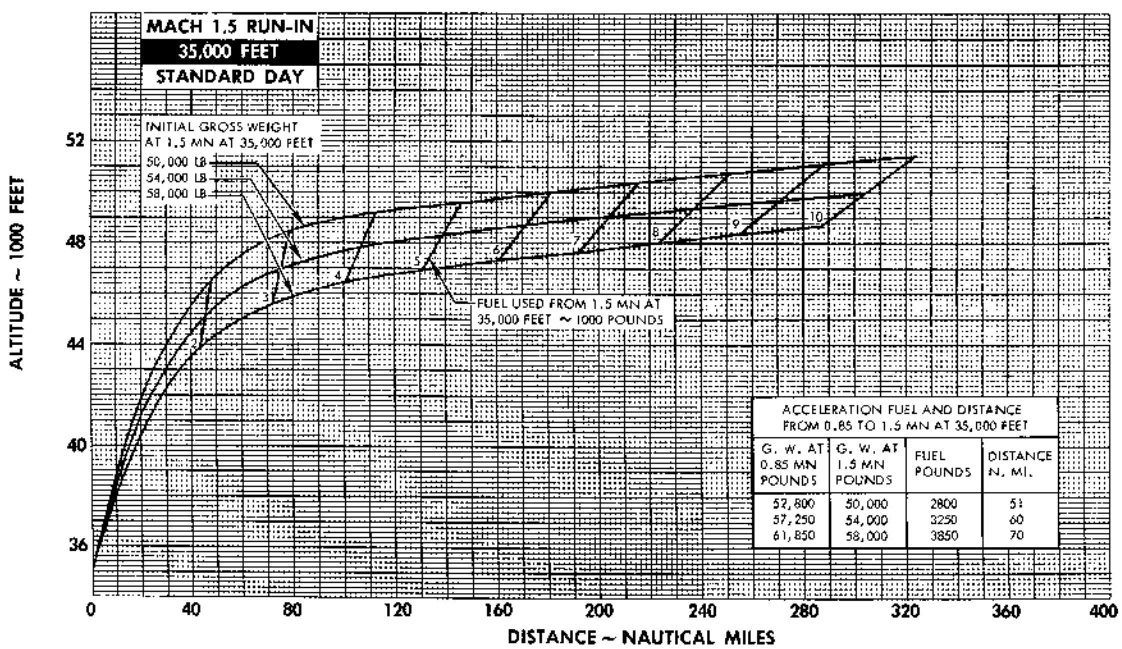
MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NA63H-2)
DATE: 1 JANUARY 1964

ENGINES: (2) J79-GE-8
FUEL GRADE: MIL-F-5624(JP-5)
FUEL DENSITY: 6.8 LB/GAL



ACCELERATION FUEL AND DISTANCE FROM 0.85 TO 1.5 MN AT 35,000 FEET

G. W. AT 0.85 MN POUNDS	G. W. AT 1.5 MN POUNDS	FUEL POUNDS	DISTANCE N. MI.
52,250	50,000	2250	38
56,480	54,000	2480	44
60,900	58,000	2900	52



ACCELERATION FUEL AND DISTANCE FROM 0.85 TO 1.5 MN AT 35,000 FEET

G. W. AT 0.85 MN POUNDS	G. W. AT 1.5 MN POUNDS	FUEL POUNDS	DISTANCE N. MI.
52,800	50,000	2800	51
57,250	54,000	3250	60
61,850	58,000	3850	70

A-5C-1A-93-13A

Figure 11-111

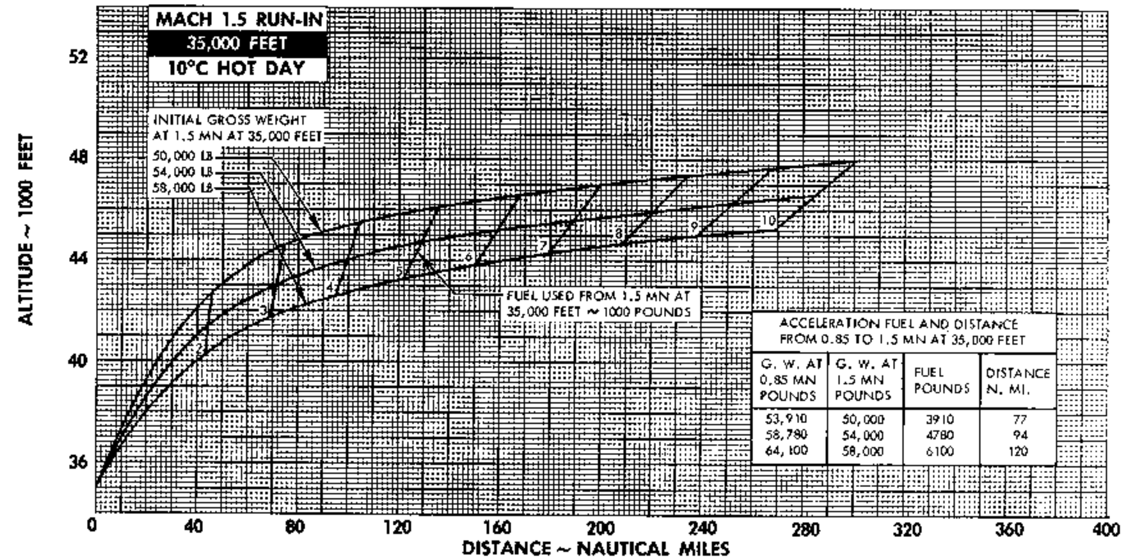
SUPERSONIC PERFORMANCE

RECONNAISSANCE CONFIGURATION

MAXIMUM THRUST
NO EXTERNAL LOAD

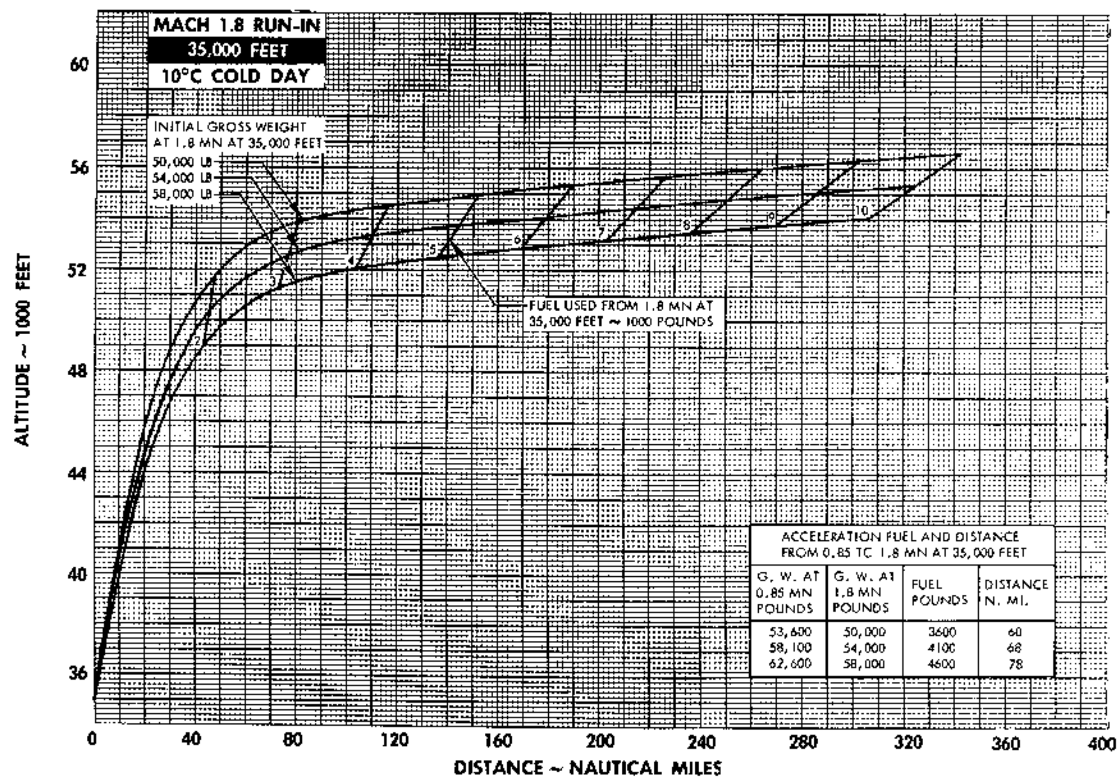
MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NA63H-2)
DATE: 1 JANUARY 1964

ENGINES: (2) J79-GE-8
FUEL GRADE: MIL-F-5624(JP-5)
FUEL DENSITY: 6.8 LB/GAL



ACCELERATION FUEL AND DISTANCE FROM 0.85 TO 1.5 MN AT 35,000 FEET

G. W. AT 0.85 MN POUNDS	G. W. AT 1.5 MN POUNDS	FUEL POUNDS	DISTANCE N. MI.
53,910	50,000	3910	77
58,780	54,000	4780	94
64,100	58,000	6100	120



ACCELERATION FUEL AND DISTANCE FROM 0.85 TC 1.8 MN AT 35,000 FEET

G. W. AT 0.85 MN POUNDS	G. W. AT 1.8 MN POUNDS	FUEL POUNDS	DISTANCE N. MI.
53,600	50,000	3600	60
58,100	54,000	4100	68
62,600	58,000	4600	78

A-5C-1A-93-30

Figure 11-112

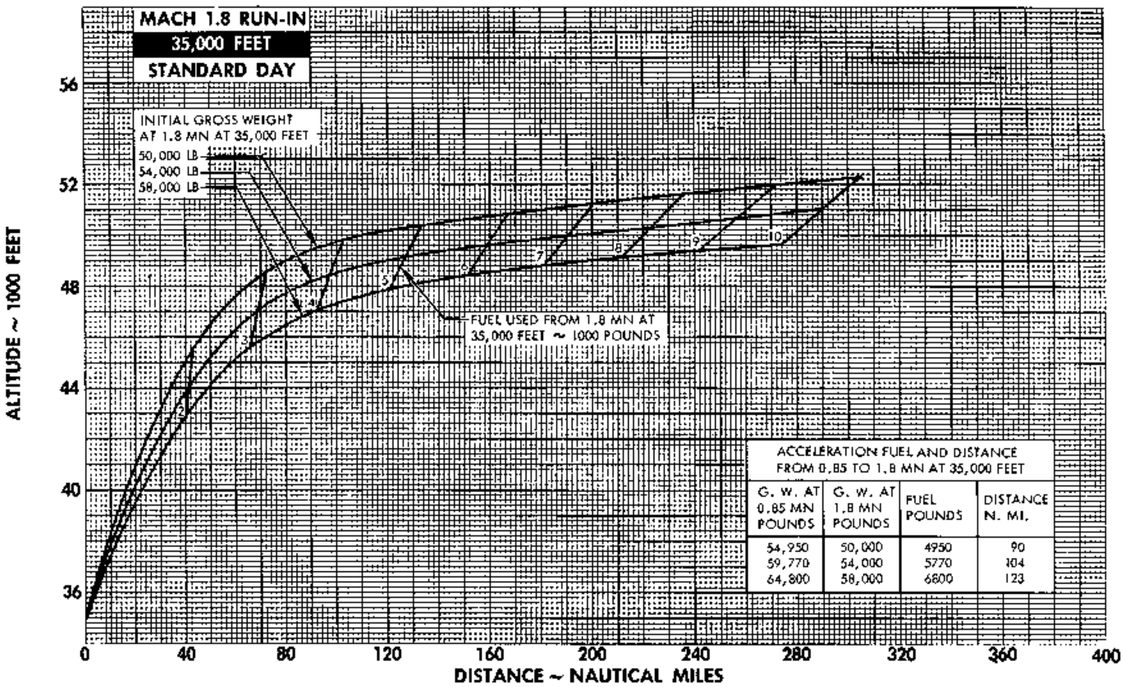
SUPERSONIC PERFORMANCE

RECONNAISSANCE CONFIGURATION

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NA63H-2)
DATE: 1 JANUARY 1964

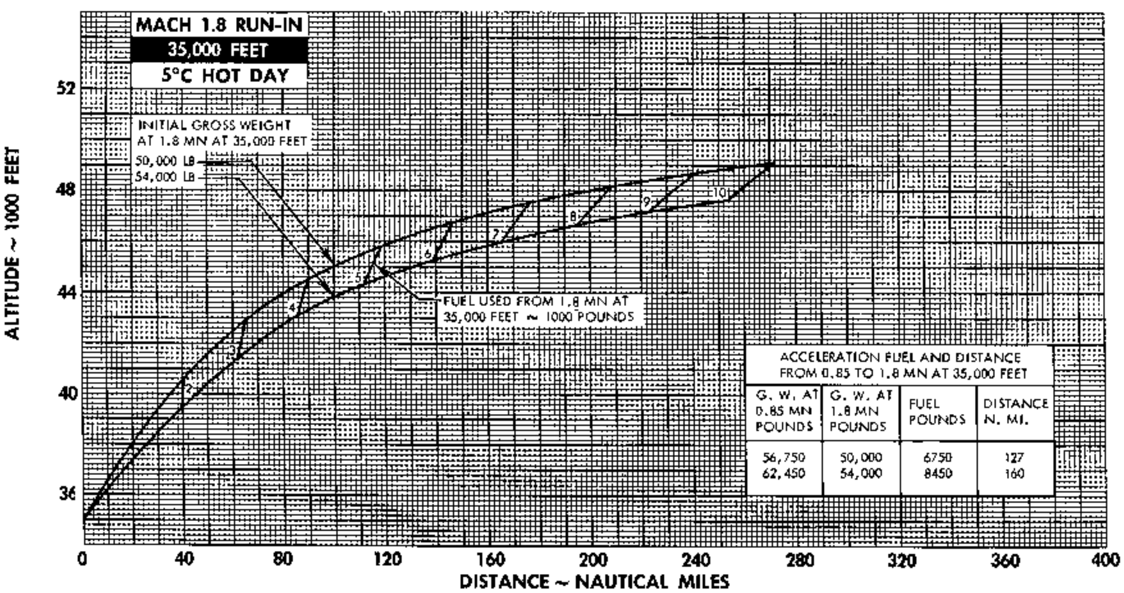
MAXIMUM THRUST
NO EXTERNAL LOAD

ENGINES: (2) J79-GE-8
FUEL GRADE: MIL-F-5624(JP-5)
FUEL DENSITY: 6.8 LB/GAL



ACCELERATION FUEL AND DISTANCE FROM 0.85 TO 1.8 MN AT 35,000 FEET

G. W. AT 0.85 MN POUNDS	G. W. AT 1.8 MN POUNDS	FUEL POUNDS	DISTANCE N. MI.
54,950	50,000	4950	90
59,770	54,000	5770	104
64,800	58,000	6800	123



ACCELERATION FUEL AND DISTANCE FROM 0.85 TO 1.8 MN AT 35,000 FEET

G. W. AT 0.85 MN POUNDS	G. W. AT 1.8 MN POUNDS	FUEL POUNDS	DISTANCE N. MI.
56,750	50,000	6750	127
62,450	54,000	8450	160

A-5C-1A-93-34

Figure 11-113

ANGLE-OF-ATTACK RELATIONSHIP TO CALIBRATED AIRSPEED

ALL SYMMETRICAL CONFIGURATIONS

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA
DATA AS OF: 15 JUNE 1970

ENGINES: (2) J79-GE-8/10
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL

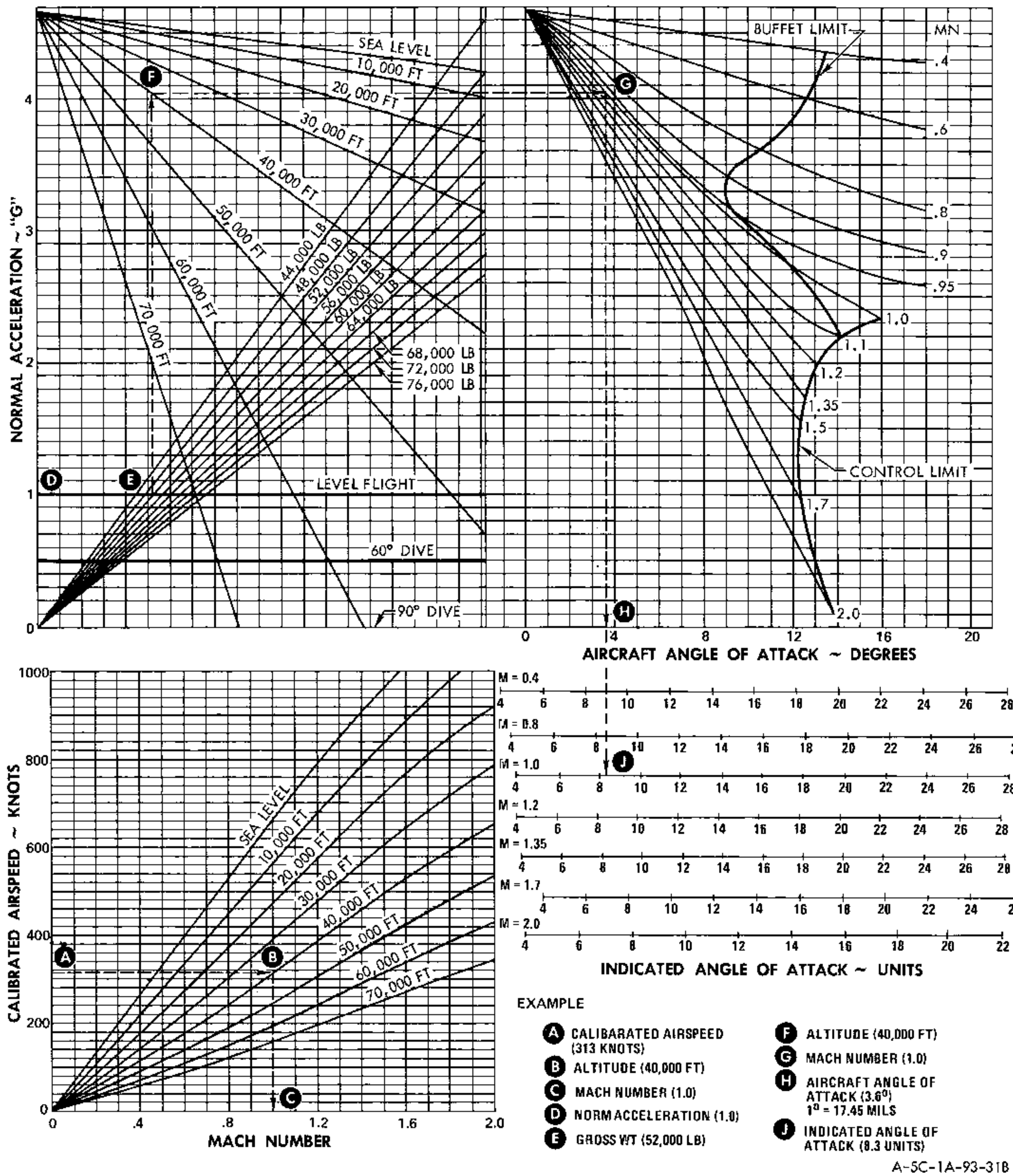


Figure 11-114

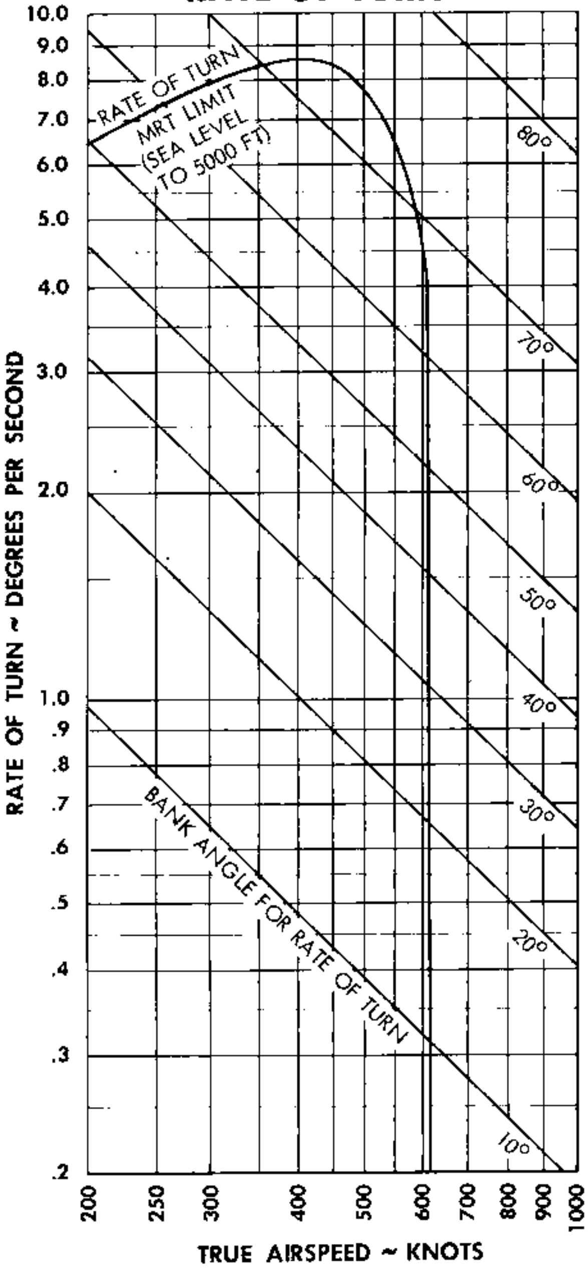
GENERAL TURNING PERFORMANCE

- CONSTANT ALTITUDE CONSTANT SPEED TURNS
- ALL CONFIGURATIONS
- ALL ALTITUDES

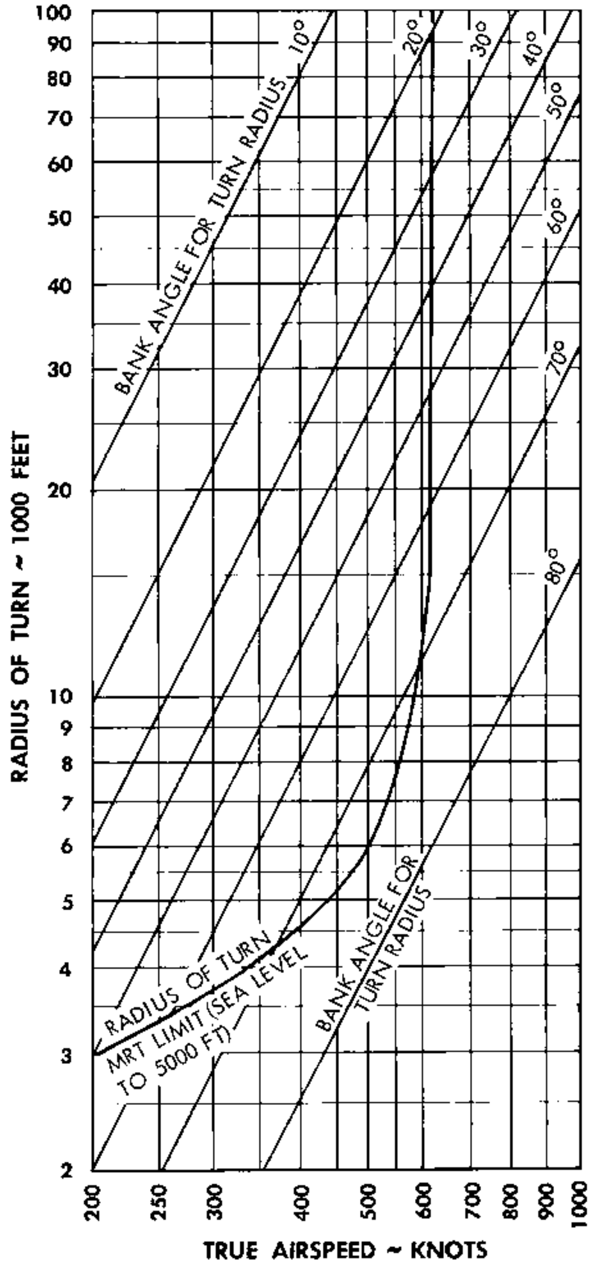
NOTE:

TURN ENVELOPE SHOWN FOR 56,000 POUNDS GROSS WEIGHT, CONSTANT SPEED, CONSTANT ALTITUDE TURNS AT MILITARY THRUST FOR SEA LEVEL TO 5,000 FEET AFTERBURNER THRUST REQUIRED FOR TURNS AT HIGHER SPEEDS OR BANK ANGLES.

RATE OF TURN



RADIUS OF TURN



A-5C-1C-93-1

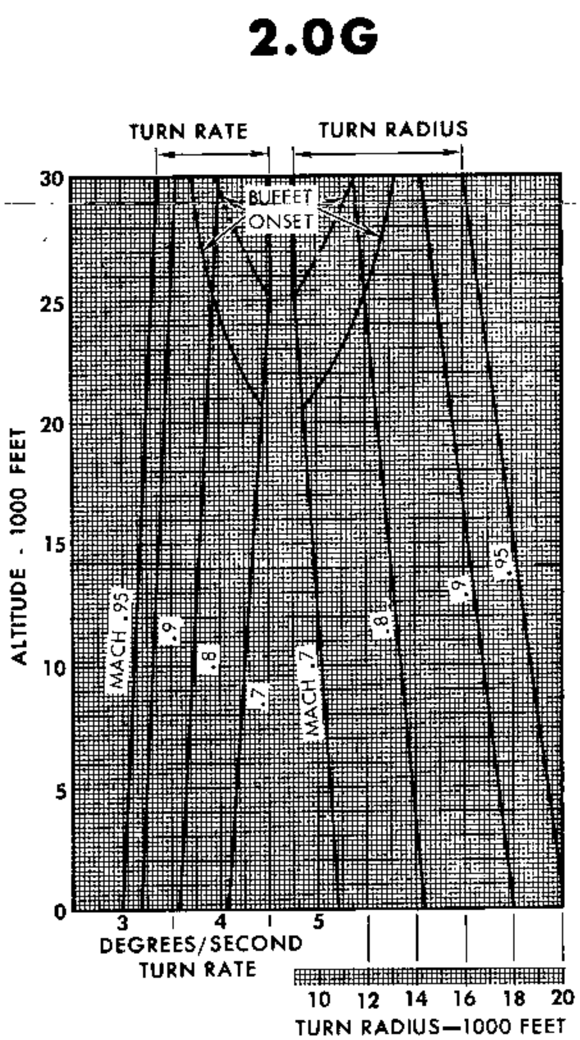
Figure 11-115

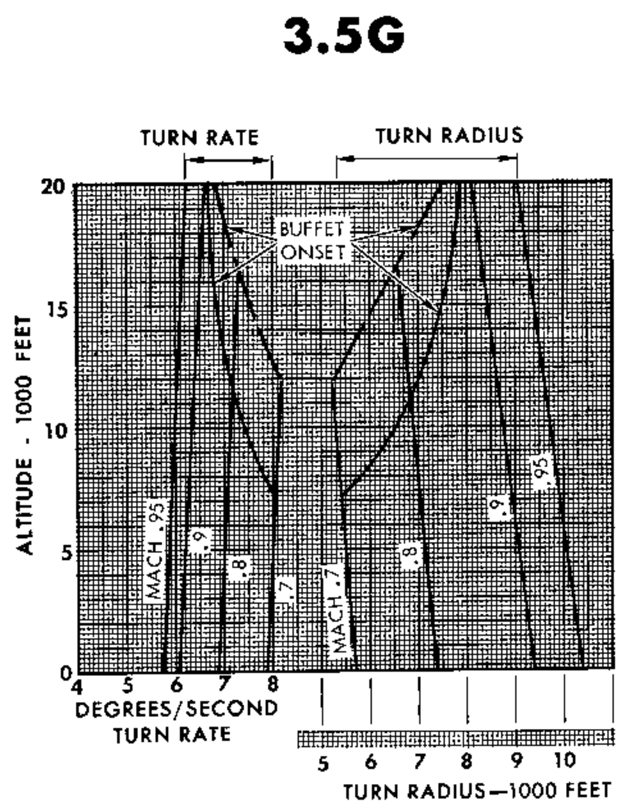
MAXIMUM THRUST TURNING PERFORMANCE

STANDARD DAY
MAXIMUM AFTERBURNER
GROSS WEIGHT - 57,000 POUNDS
NO EXTERNAL LOAD

MODEL: RA-5C
DATA BASIS: FLIGHT TEST
DATE: 1 NOVEMBER 1967

ENGINES: (2)J79-GE-8A
FUEL GRADE: MIL-T-5624(JP-5)
FUEL DENSITY: 6.8 LB/GAL





SUPERSONIC DROOPS (0°)

CRUISE DROOPS (5°)

NOTE: REFER TO OPERATING FLIGHT LIMITS, SECTION I.

A-5C-1-93-13

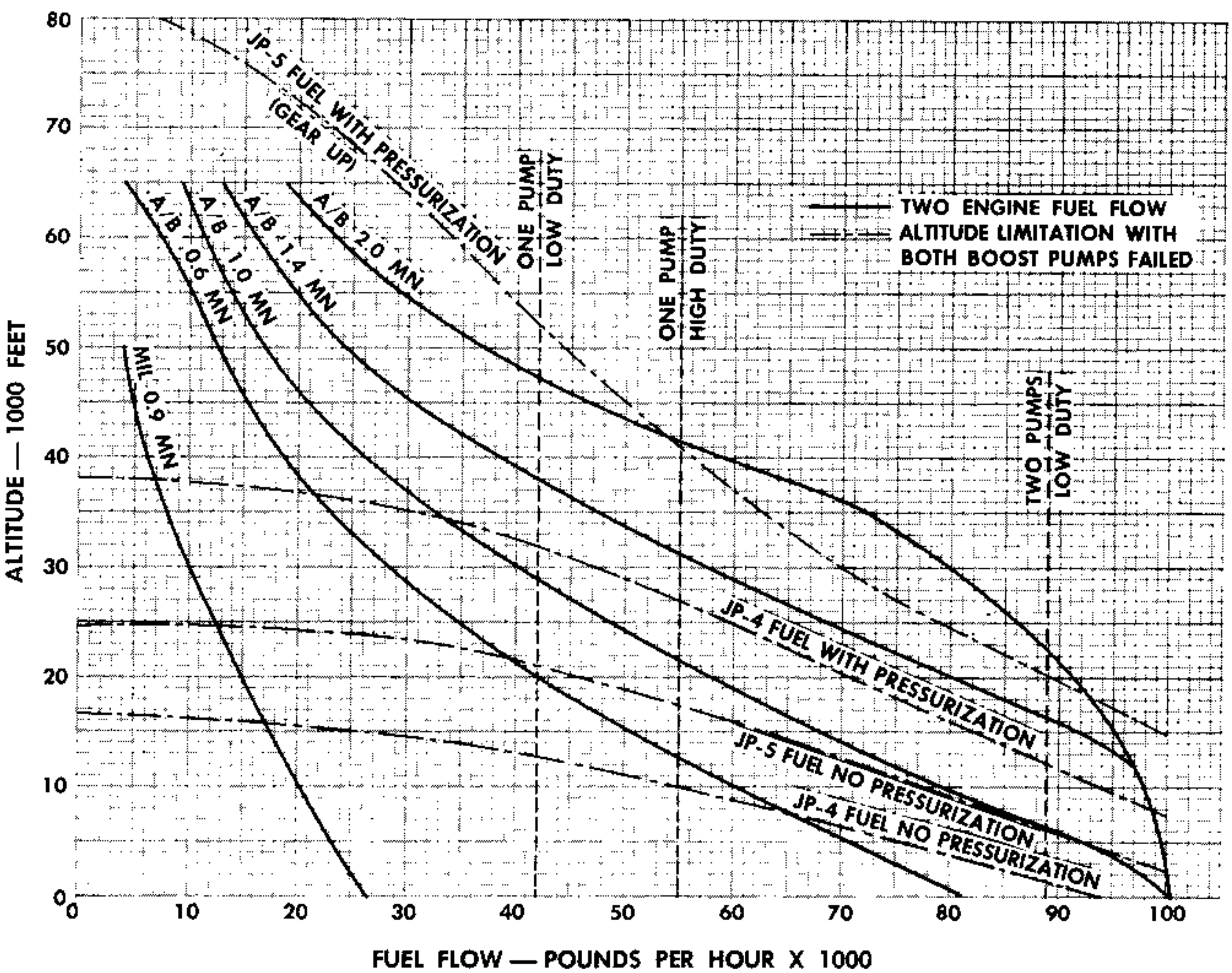
Figure 11-116

ENGINE FUEL FLOW AND ALTITUDE LIMITATIONS

MODEL: RA-5C
BASED ON: ESTIMATED DATA
DATE: 1 JULY 1969

ENGINES: (2) J79-GE-10(-8)*
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL

*FOR AIRCRAFT HAVING AFC 328 COMPLIED WITH AND J79-GE-8 ENGINE INSTALLED, SEE FIGURE 11-97.



A-5C-1A-93-131A

Figure 11-117

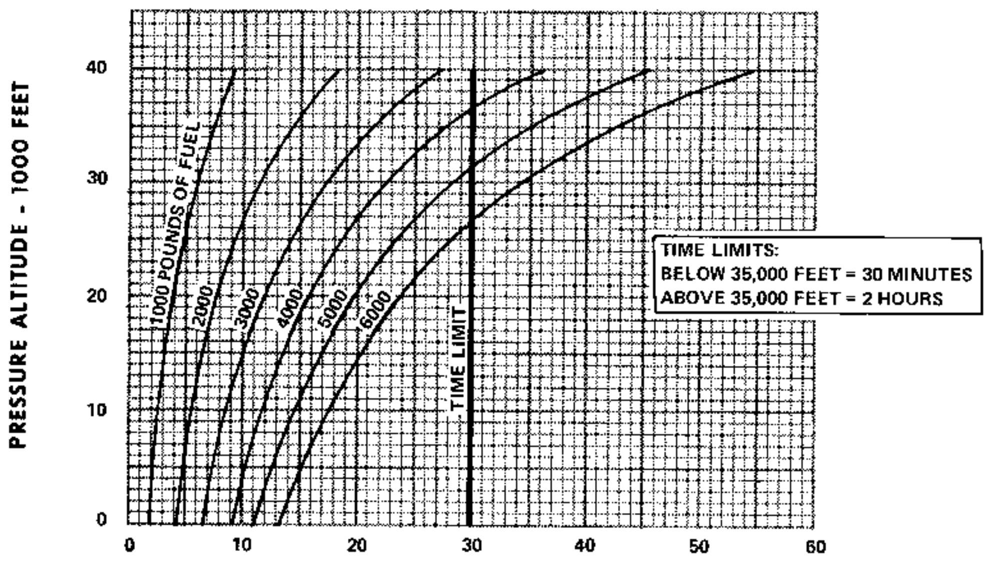
COMBAT ALLOWANCE

RECONNAISSANCE CONFIGURATION
NO EXTERNAL LOAD
STANDARD DAY

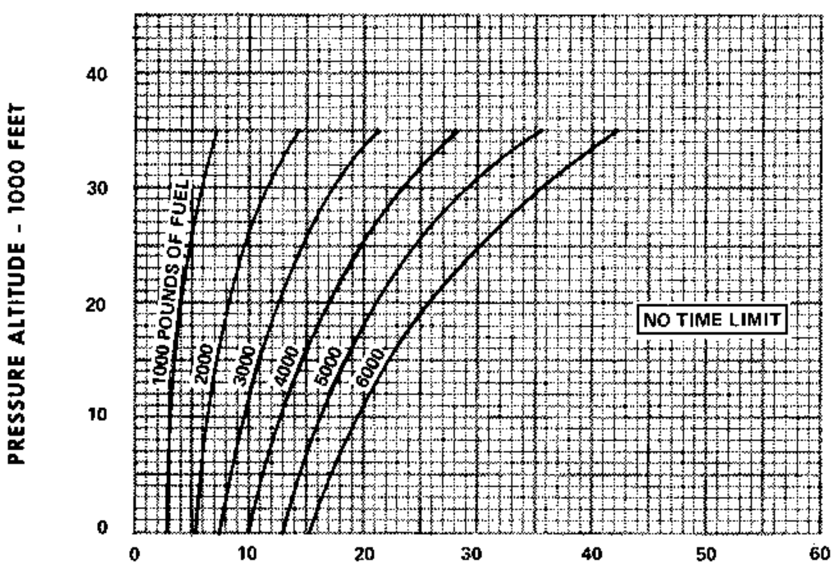
MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NR69H-2)
DATE: 15 JUNE 1970

ENGINES: (2) J79-GE-10 (-8)*
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB./GAL.
*SEE NOTE 2

MILITARY THRUST



NORMAL THRUST



NOTE:

1. BASED ON MAXIMUM SPEED AT 58,000 POUNDS GROSS WEIGHT.
2. FOR AIRCRAFT HAVING AFC 328 COMPLIED WITH AND J79-GE-8 ENGINES INSTALLED, SEE FIGURE 11-98.

RA-5C-1-93-83A

Figure 11-118

COMBAT ALLOWANCE

RECONNAISSANCE CONFIGURATION

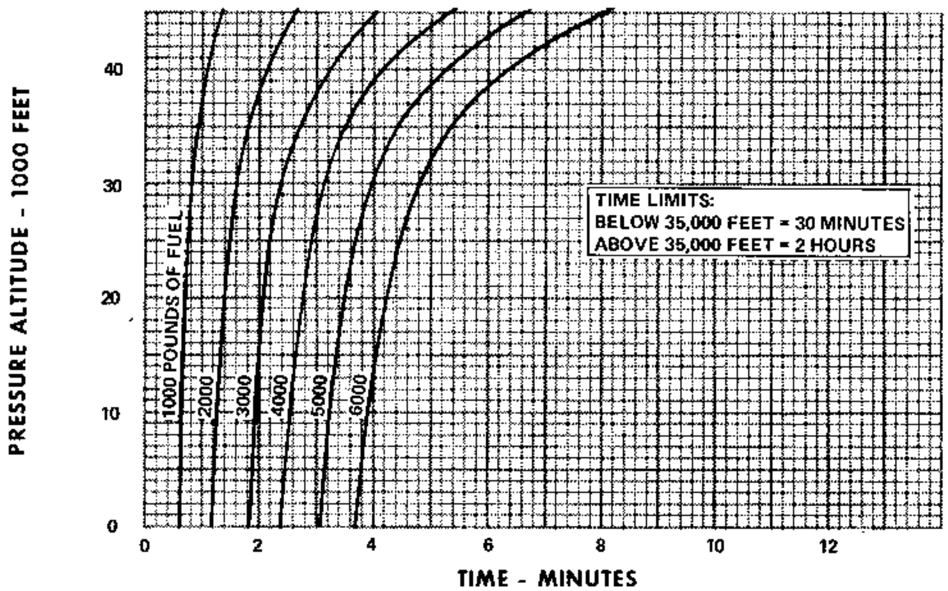
NO EXTERNAL LOAD

STANDARD DAY

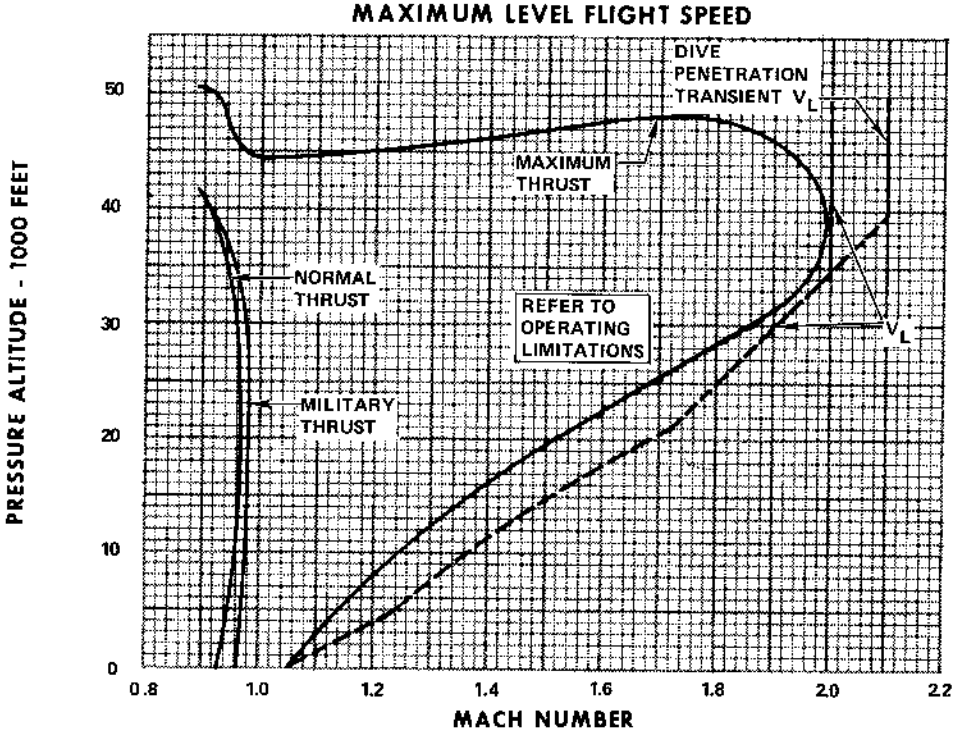
MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NR69H-2)
DATE: 15 JUNE 1970

ENGINES: (2) J79-GE-10 (-8)*
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB./GAL.
*SEE NOTE 2

MAXIMUM THRUST



MAXIMUM LEVEL FLIGHT SPEED



NOTE:

1. BASED ON MAXIMUM SPEED AT 58,000 POUNDS GROSS WEIGHT.
2. FOR AIRCRAFT HAVING AFC 328 COMPLIED WITH AND J79-GE-8 ENGINES INSTALLED, SEE FIGURE 11-99.

RA-5C-1-93-84A

Figure 11-119

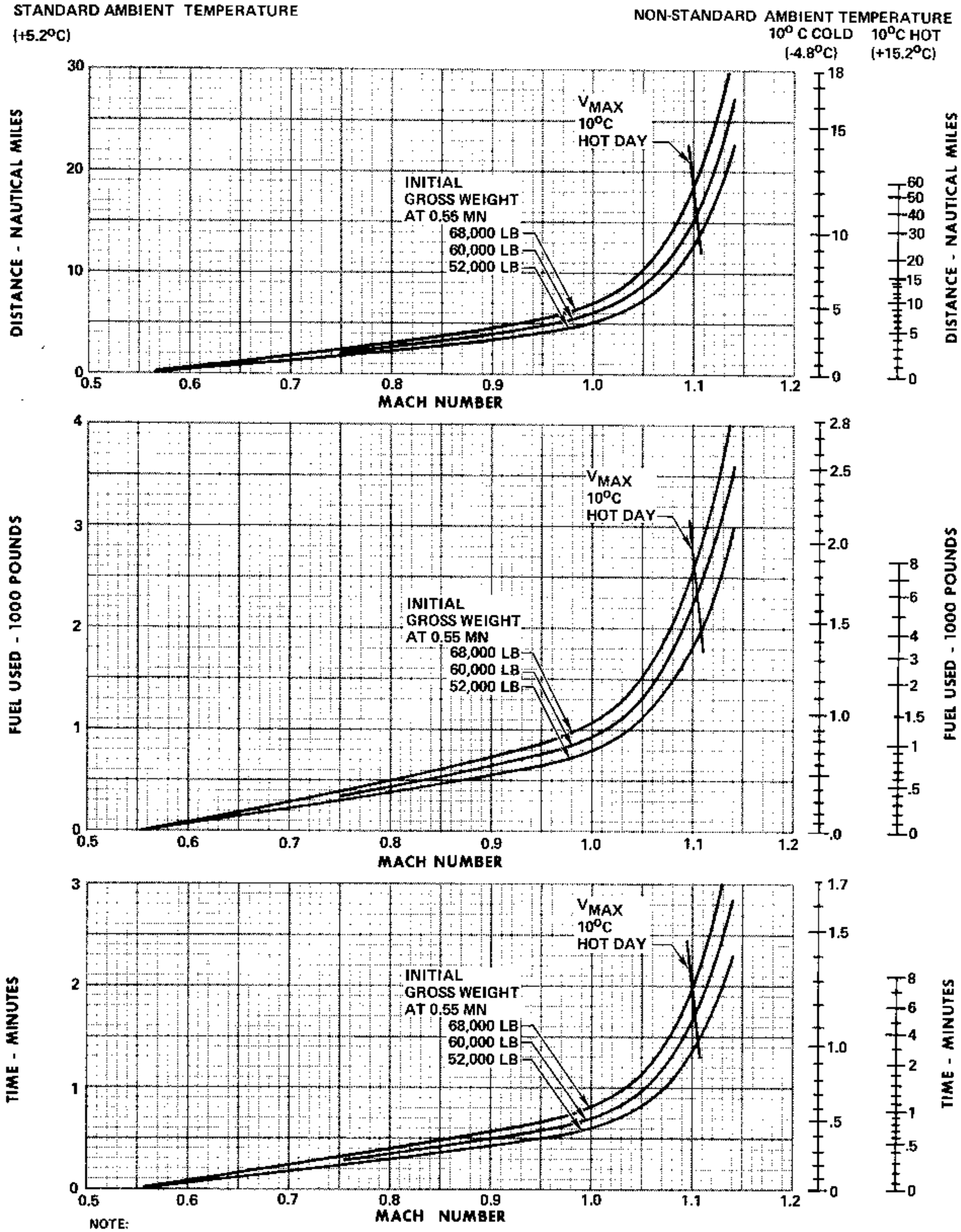
LEVEL FLIGHT ACCELERATION

RECONNAISSANCE CONFIGURATION
MAXIMUM THRUST
NO EXTERNAL LOAD

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NR69H-2)
DATE: 15 JUNE 1970

5000 FEET

ENGINES: (2) J79-GE-10 (-8)*
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL
*SEE NOTE



NOTE:
FOR AIRCRAFT HAVING AFC 328 COMPLIED WITH AND J79-GE-8 ENGINES INSTALLED, SEE FIGURE 11-100.

RA-5C-1-93-86A

Figure 11-120

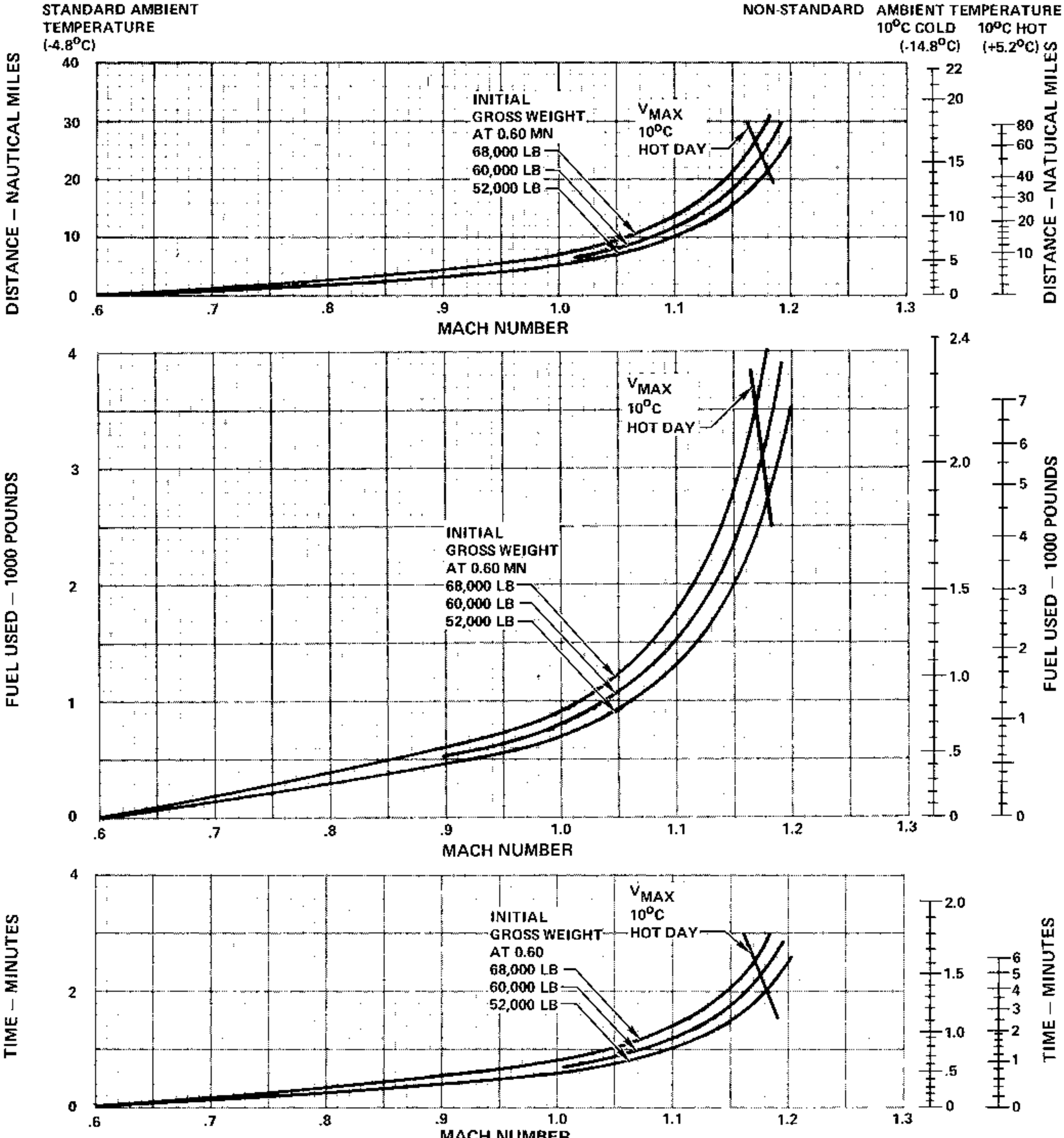
LEVEL FLIGHT ACCELERATION

RECONNAISSANCE CONFIGURATION
MAXIMUM THRUST
NO EXTERNAL LOAD

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NR69H-2)
DATE: 15 JUNE 1970

ENGINES: (2) J79-GE-10 (-8)*
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL
*SEE NOTE

10,000 FEET



NOTE:
FOR AIRCRAFT HAVING AFC 328 COMPLIED WITH AND J79-GE-8 ENGINES INSTALLED, SEE FIGURE 11-101.

RA-5C-1-93-87A

Figure 11-121

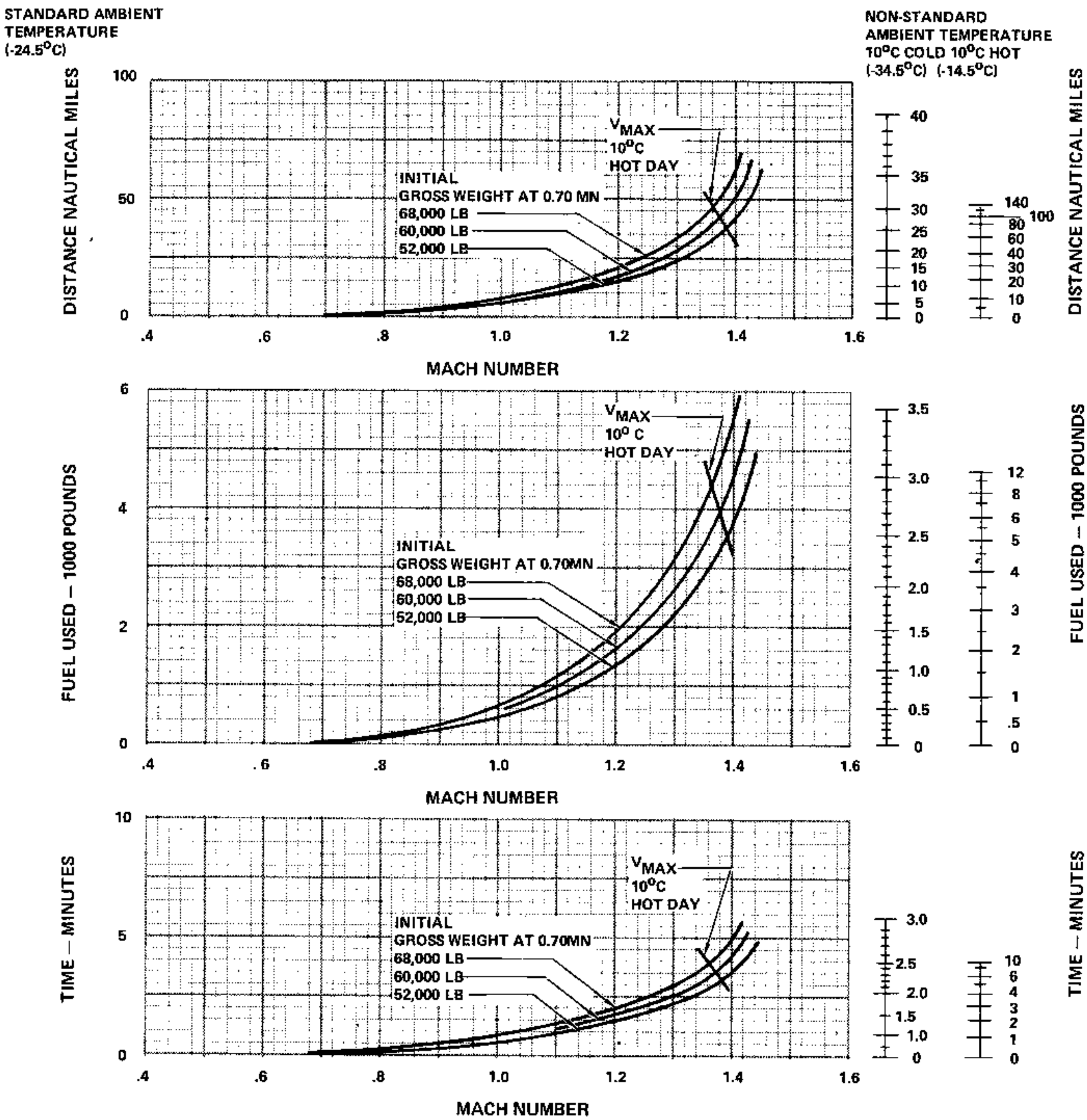
LEVEL FLIGHT ACCELERATION

RECONNAISSANCE CONFIGURATION
MAXIMUM THRUST
NO EXTERNAL LOAD

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NR69H-2)
DATE: 15 JUNE 1970

ENGINES: (2) J79-GE-10 (-8)*
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL
*SEE NOTE

20,000 FEET



NOTE:
FOR AIRCRAFT HAVING AFC 328 COMPLIED WITH AND J79-GE-8 ENGINES INSTALLED, SEE FIGURE 11-102.

RA-5C-1-93-88A

Figure 11-122

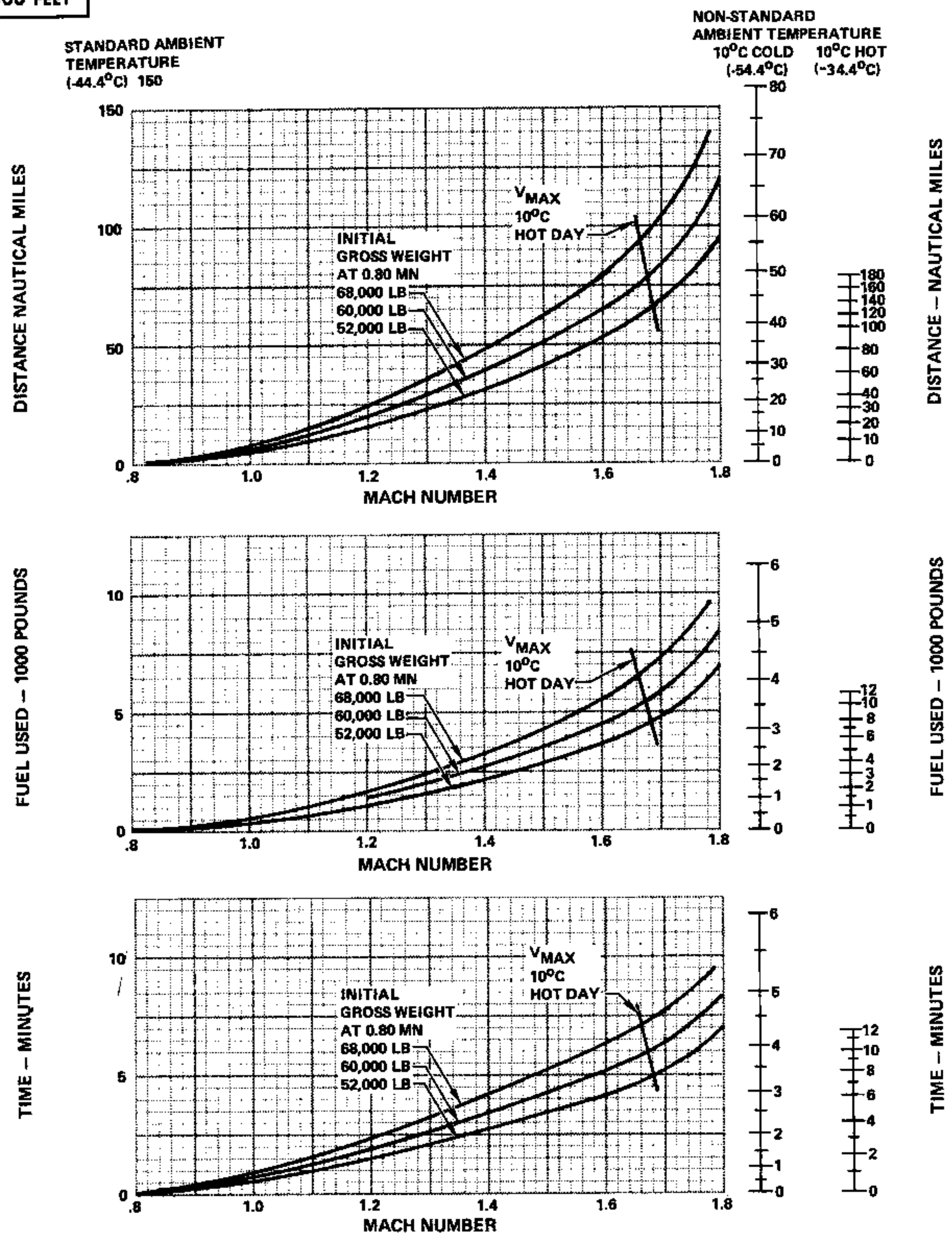
LEVEL FLIGHT ACCELERATION

RECONNAISSANCE CONFIGURATION
MAXIMUM THRUST
NO EXTERNAL LOAD

MODEL:
BASED ON: FLIGHT TEST DATA (NR69H-2)
DATE: 15 JUNE 1970

ENGINES: (2) J79-GE-10 (-8)*
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY 6.8 LB/GAL
*SEE NOTE

30,000 FEET



NOTE:

FOR AIRCRAFT HAVING AFC 328 COMPLIED WITH AND J79-GE-8 ENGINES INSTALLED, SEE FIGURE 11-103 AND INCREASE ALL TIME, FUEL, AND DISTANCE BY 20%.

RA-5C-1-93-89A

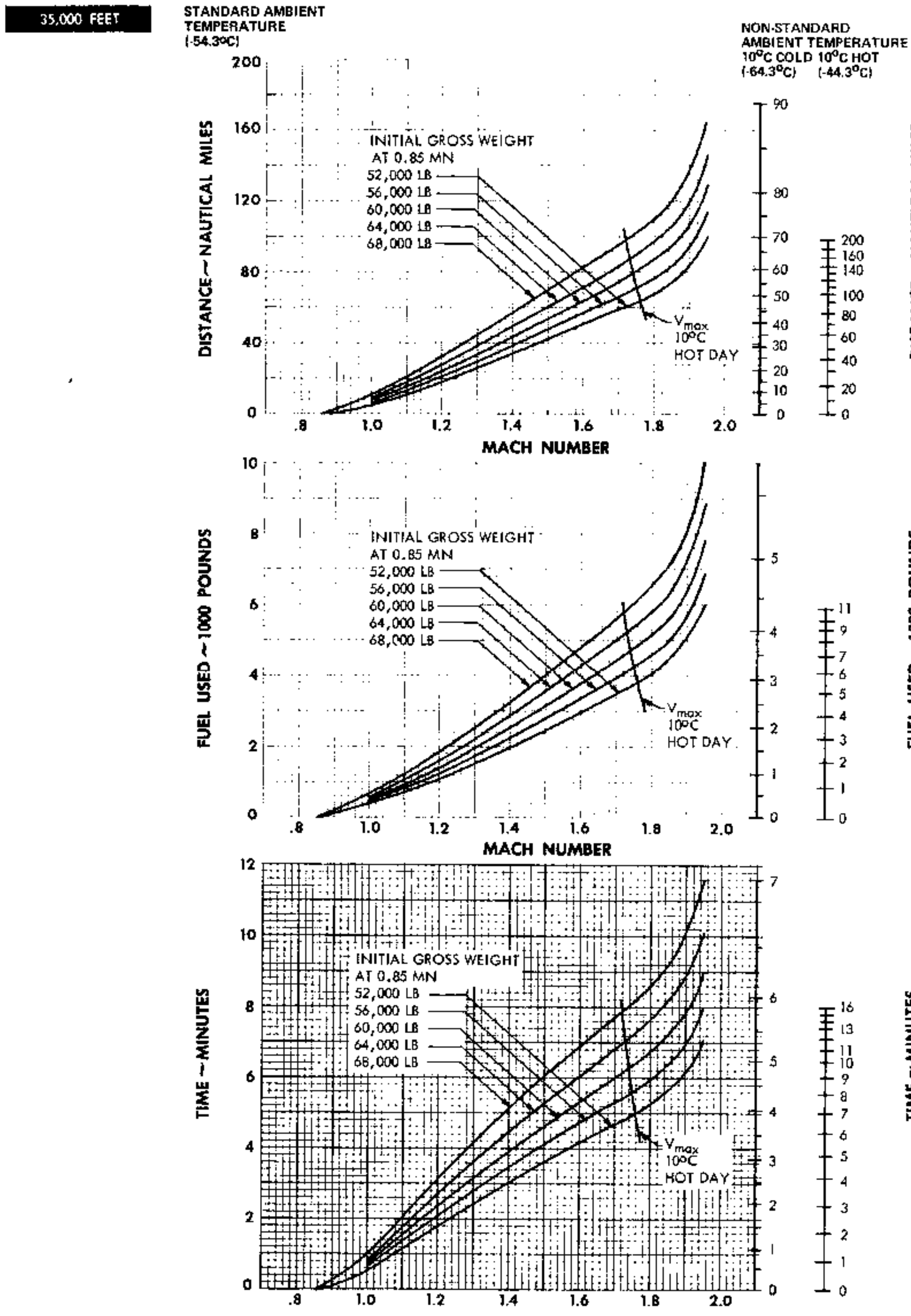
Figure 11-123

LEVEL FLIGHT ACCELERATION

RECONNAISSANCE CONFIGURATION
MAXIMUM AFTERBURNER
NO EXTERNAL LOAD

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NR69H-2)
DATE: 1 JULY 1969

ENGINES: (2) J79-GE-10 (-8)*
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL
*SEE NOTE



NOTE:
FOR AIRCRAFT HAVING AFC 328 COMPLIED WITH AND J79-GE-8 ENGINES INSTALLED, SEE FIGURE 11-104 AND INCREASE ALL TIME, FUEL, AND DISTANCE BY 20%.

A-5C-1A-93-134A

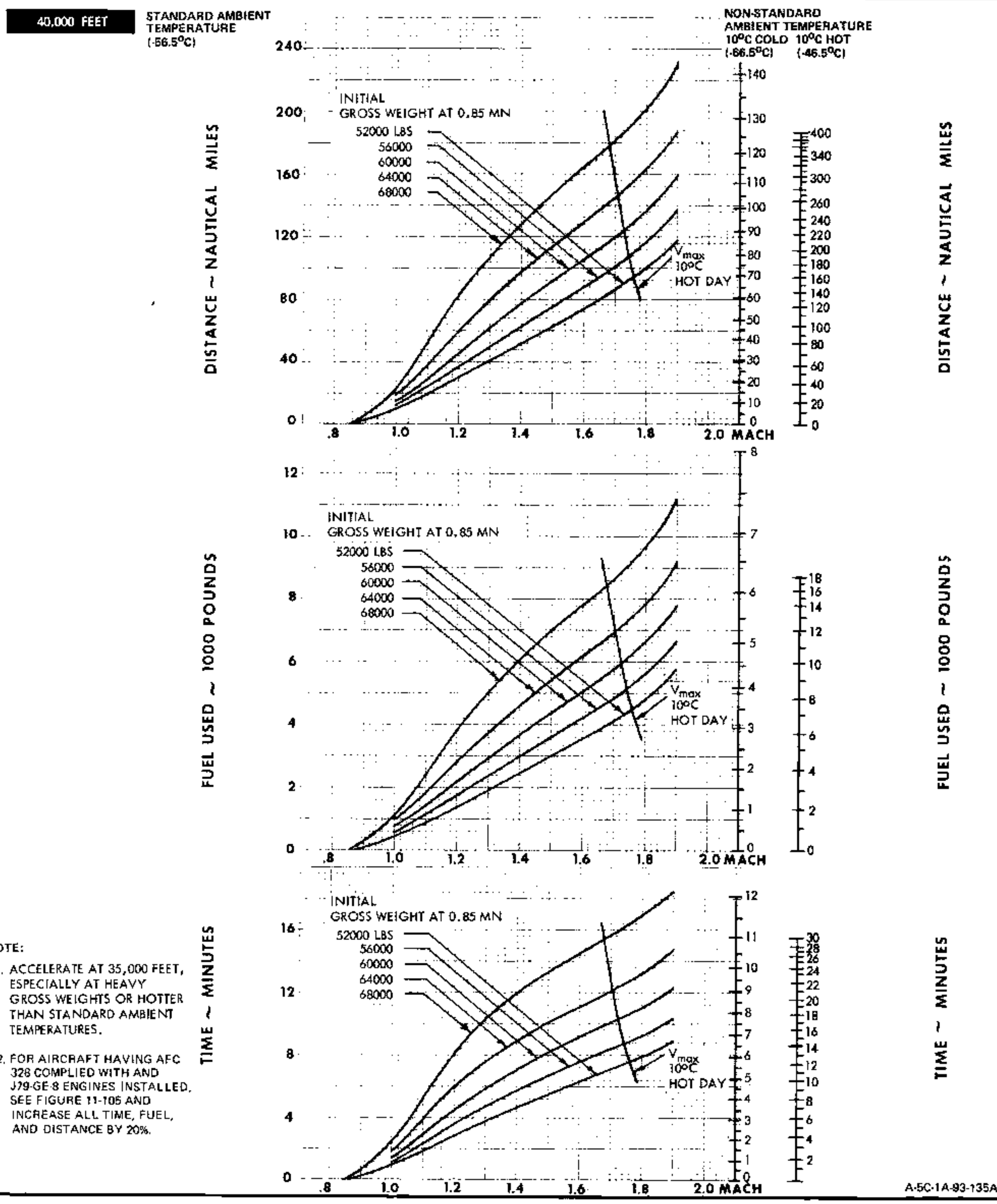
Figure 11-124

LEVEL FLIGHT ACCELERATION

RECONNAISSANCE CONFIGURATION
MAXIMUM AFTERBURNER
NO EXTERNAL LOAD

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NR69H-2)
DATE: 1 JULY 1969

ENGINES: (2) J79-GE-10 (-8)*
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL
*SEE NOTE 2



NOTE:

1. ACCELERATE AT 35,000 FEET, ESPECIALLY AT HEAVY GROSS WEIGHTS OR HOTTER THAN STANDARD AMBIENT TEMPERATURES.
2. FOR AIRCRAFT HAVING AFC 328 COMPLIED WITH AND J79-GE-8 ENGINES INSTALLED, SEE FIGURE 11-105 AND INCREASE ALL TIME, FUEL, AND DISTANCE BY 20%.

A-5C-1A-93-135A

Figure 11-125

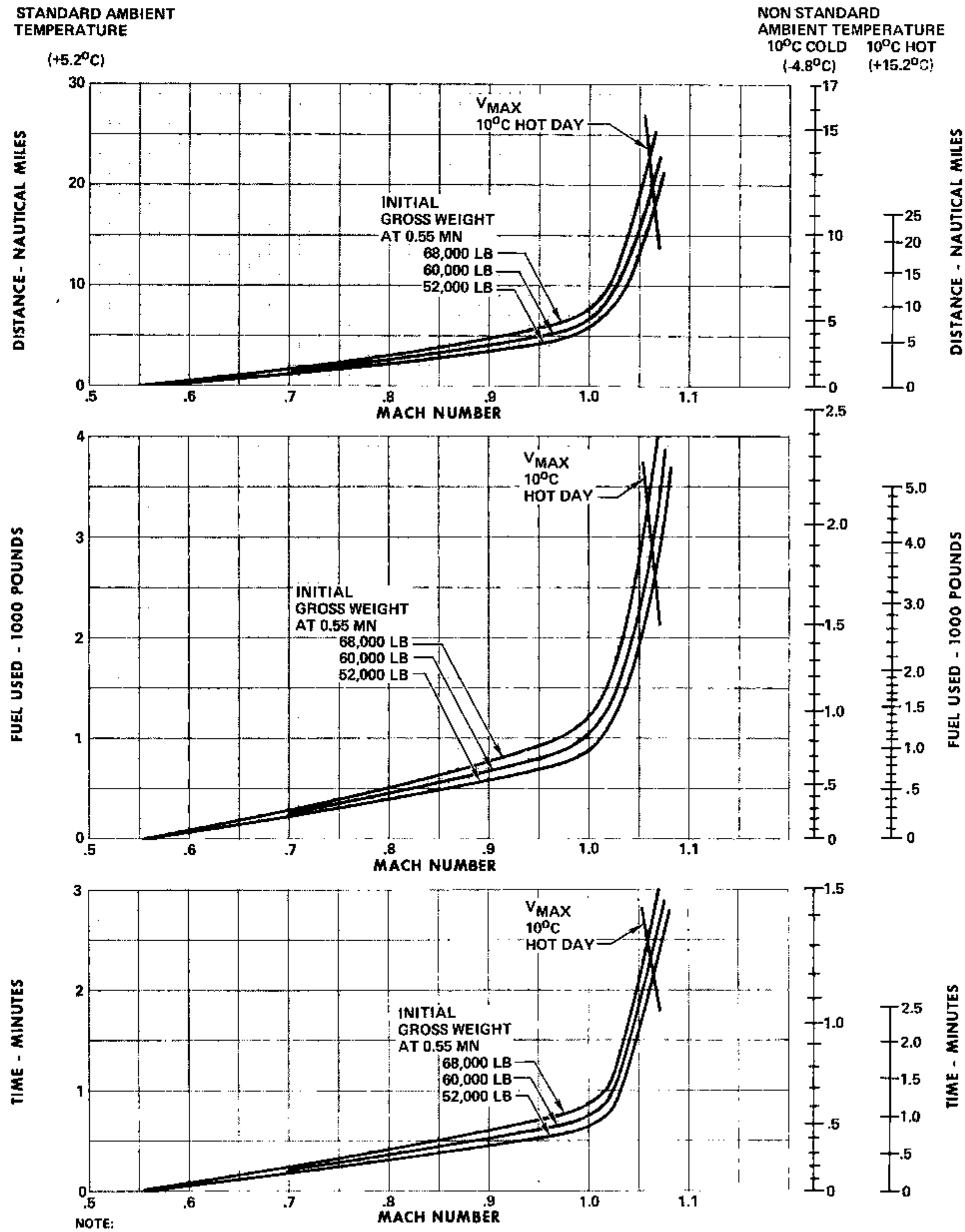
LEVEL FLIGHT ACCELERATION

RECONNAISSANCE CONFIGURATION
MAXIMUM THRUST
TWO FLASHER PODS (W.S. 110)

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NR69H-2)
DATE: 15 JUNE 1970

ENGINES: (2) J79-GE-10 (-8)*
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL
*SEE NOTE

5,000 FEET



NOTE:
FOR AIRCRAFT HAVING AFC 328 COMPLIED WITH AND J79-GE-8 ENGINES INSTALLED, SEE FIGURE 11-107

RA-5C-1-93-90A

Figure 11-126

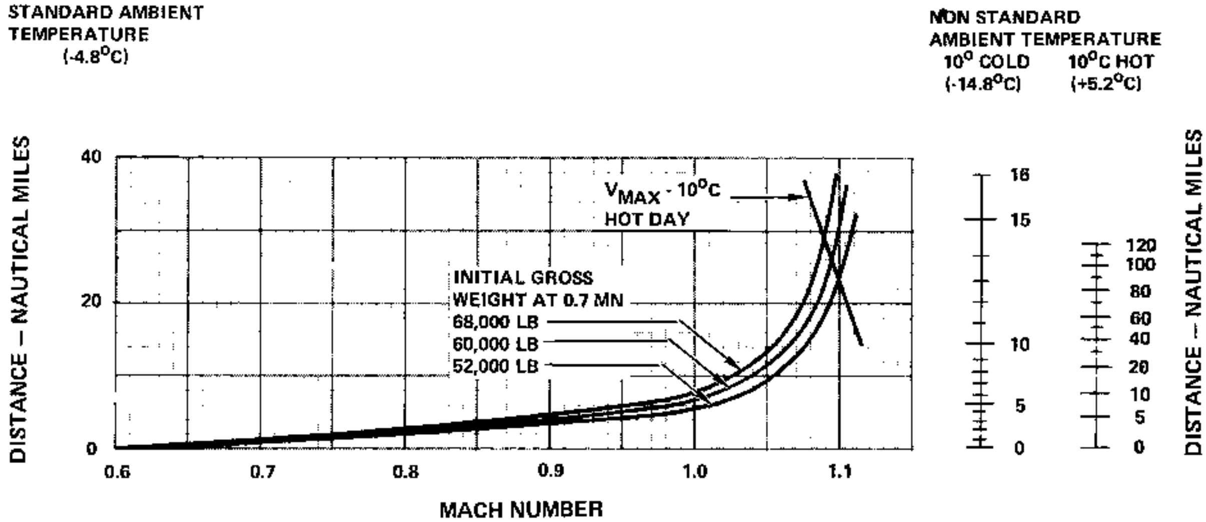
LEVEL FLIGHT ACCELERATION

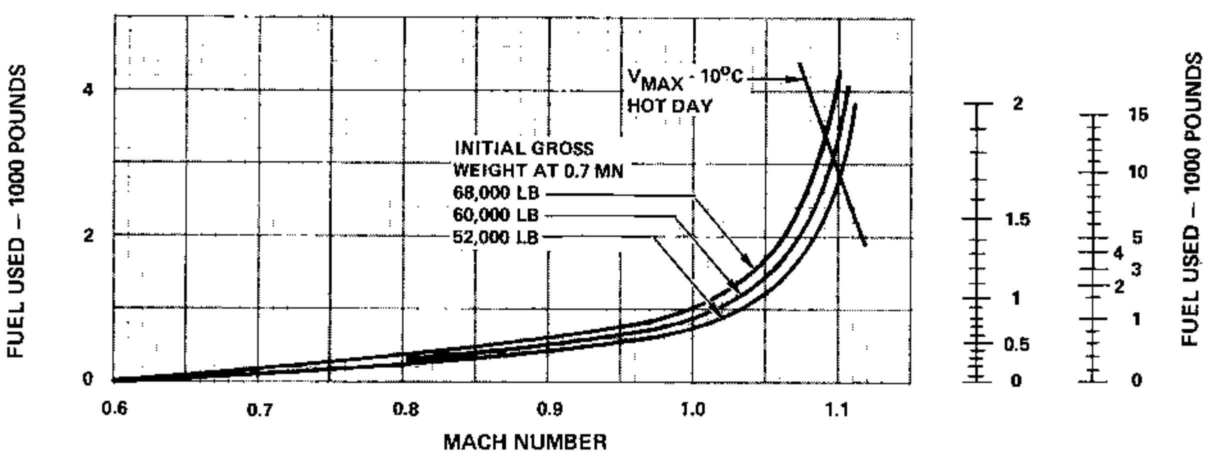
RECONNAISSANCE CONFIGURATION
MAXIMUM THRUST
TWO FLASHER PODS (W.S. 110)

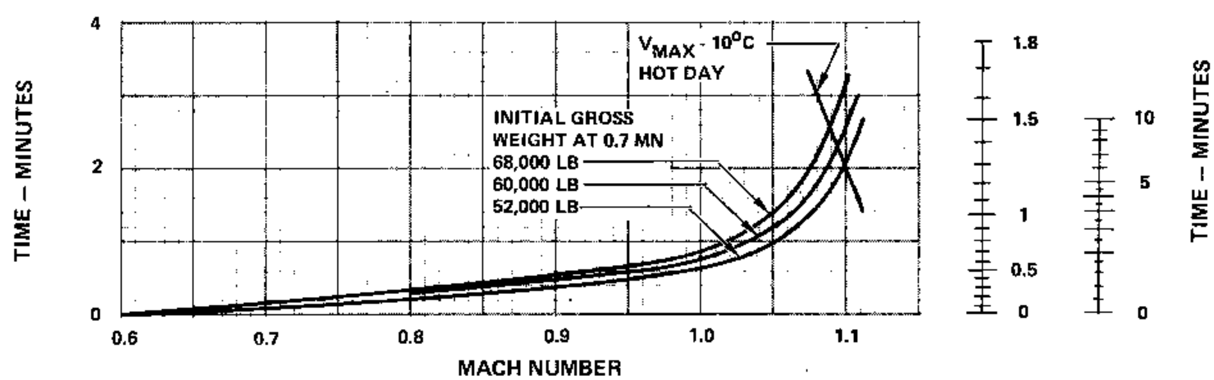
MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NR69H-2)
DATE: 15 JUNE 1970

ENGINES: (2) J79-GE-10 (-8)*
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL
*SEE NOTE

10,000 FEET







NOTE:
FOR AIRCRAFT HAVING AFC 328 COMPLIED WITH AND J79-GE-8 ENGINES INSTALLED, SEE FIGURE 11-108.

RA-5C-1-93-91A

Figure 11-127

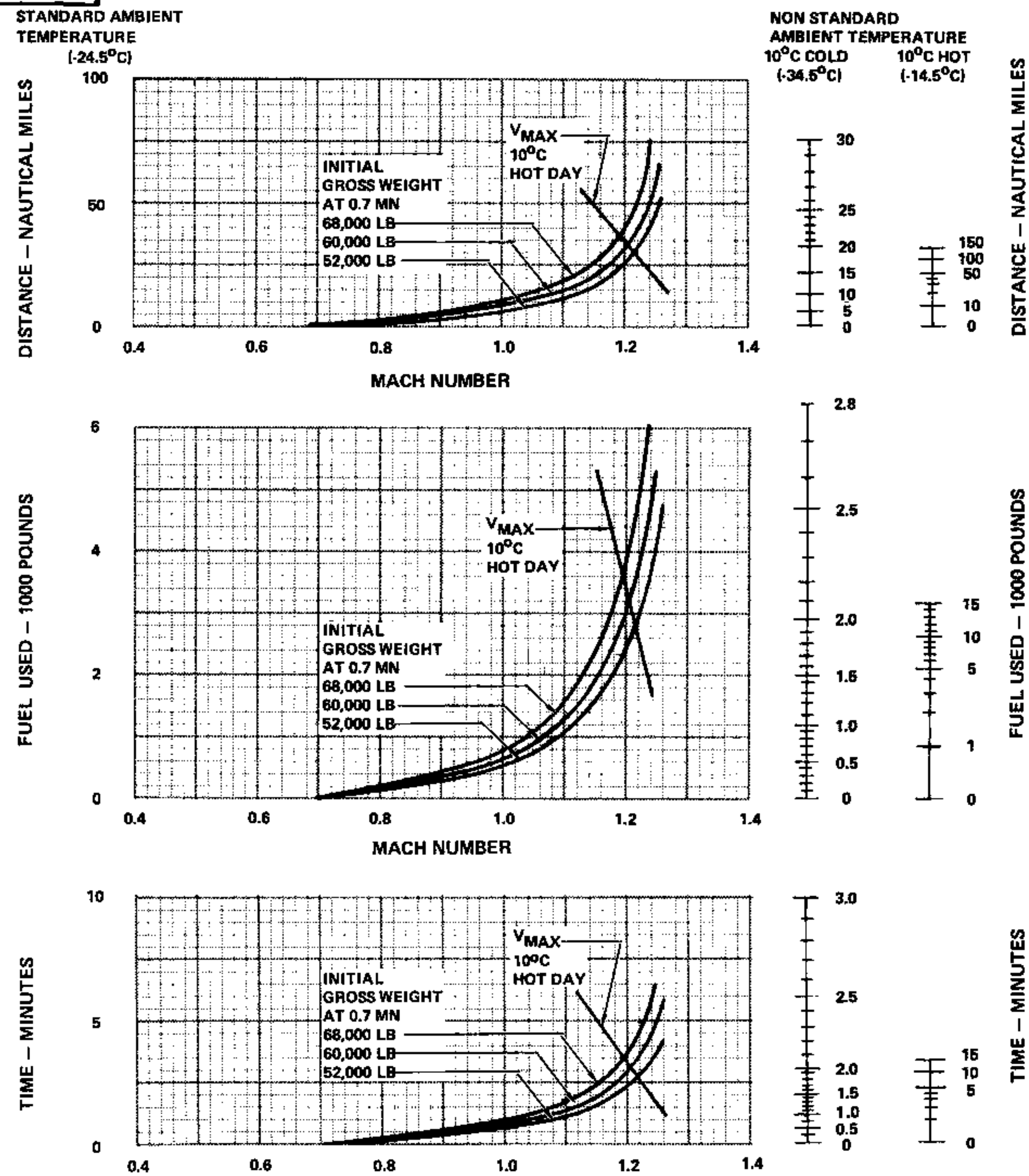
LEVEL FLIGHT ACCELERATION

RECONNAISSANCE CONFIGURATION
MAXIMUM THRUST
TWO FLASHER PODS (W.S. 110)

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NR69H-2)
DATE: 15 JUNE 1970

ENGINES: (2) J79-GE-10 (-8)*
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL
*SEE NOTE

20,000 FEET



NOTE:
FOR AIRCRAFT HAVING AFC 328 COMPLIED WITH AND J79-GE-8 ENGINES INSTALLED, SEE FIGURE 11-109.

RA-5C-1-93-92A

Figure 11-128

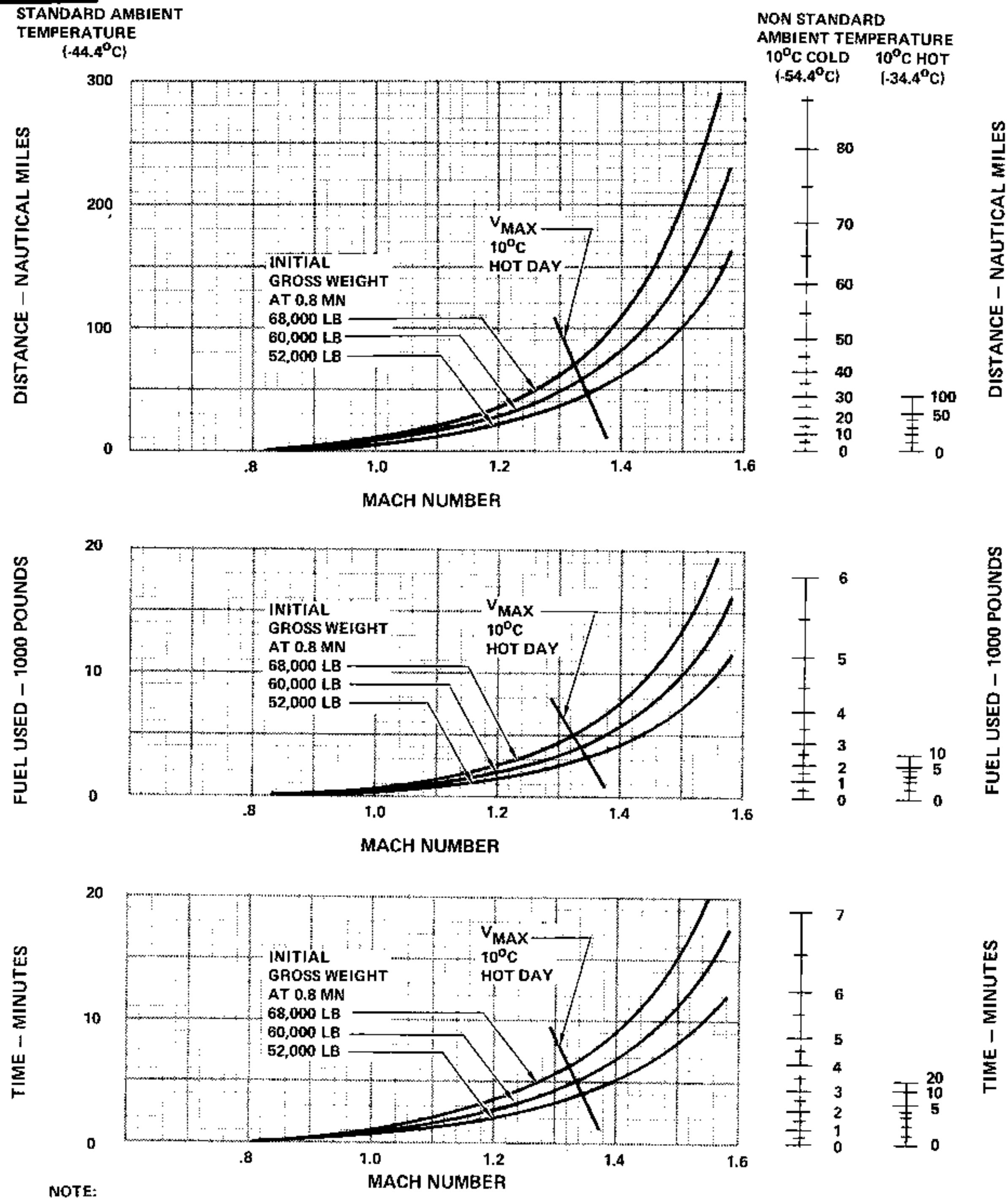
LEVEL FLIGHT ACCELERATION

RECONNAISSANCE CONFIGURATION
MAXIMUM THRUST
TWO FLASHER PODS (W.S. 110)

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NR69H-2)
DATE: 15 JUNE 1970

ENGINES: (2) J79-GE-10 (-8)*
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL
*SEE NOTE

30,000 FEET



NOTE:

FOR AIRCRAFT HAVING AFC 328 COMPLIED WITH AND J79-GE-8 ENGINES INSTALLED, SEE FIGURE 11-110 AND INCREASE ALL TIME, FUEL AND DISTANCE BY 20%

RA-5C-1-93-93A

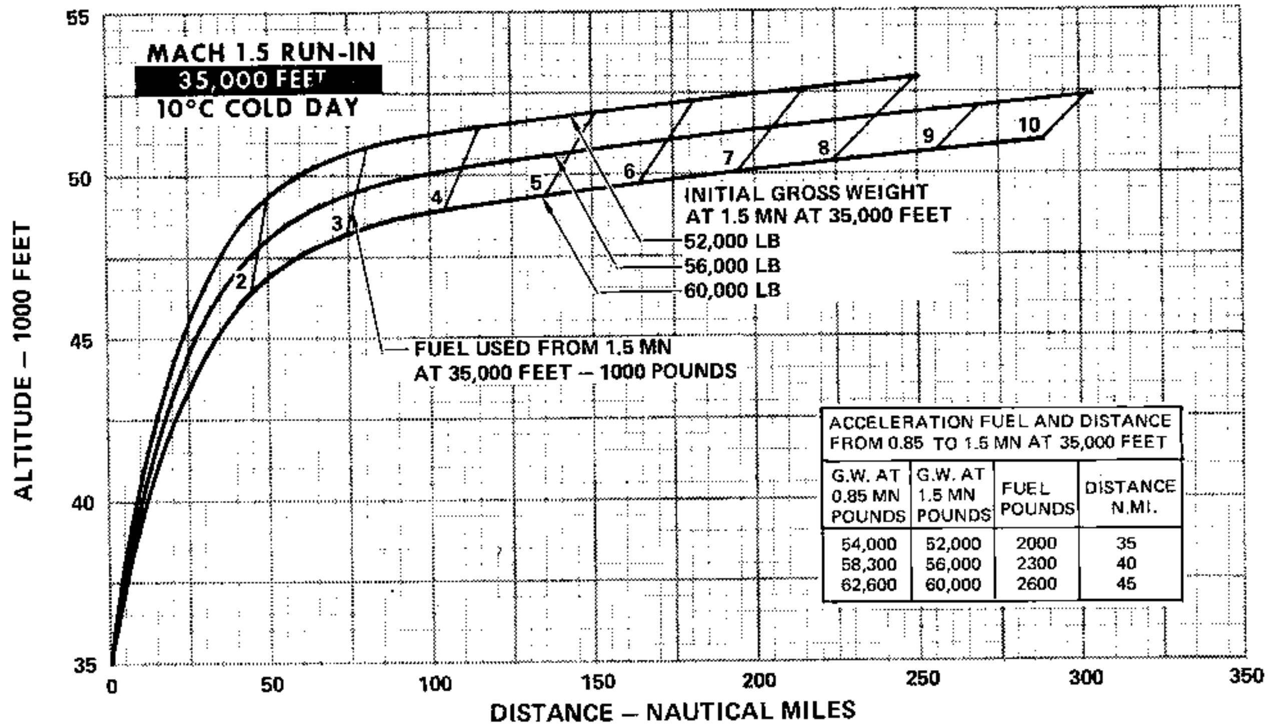
Figure 11-129

SUPERSONIC PERFORMANCE

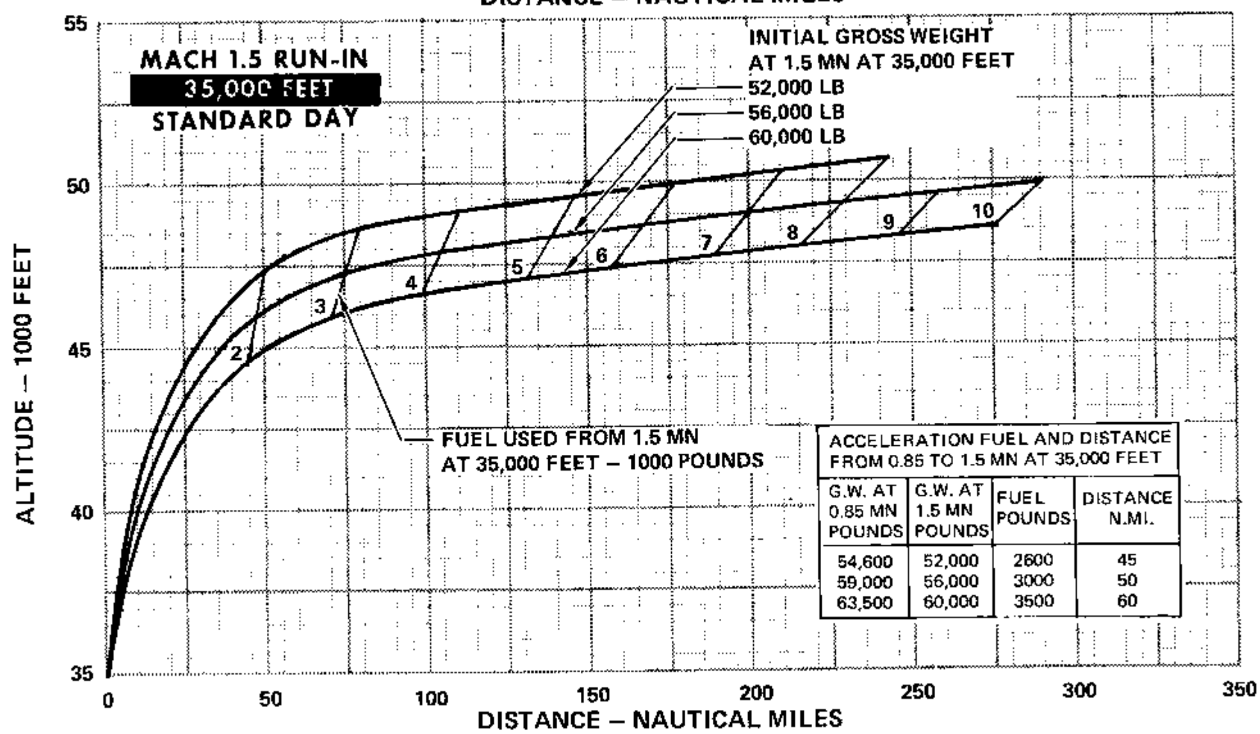
RECONNAISSANCE CONFIGURATION
MAXIMUM THRUST
NO EXTERNAL LOAD

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NR69H-2)
DATE: 15 JUNE 1970

ENGINES: (2) J79-GE-10 (-8)*
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL
*SEE NOTE



ACCELERATION FUEL AND DISTANCE FROM 0.85 TO 1.5 MN AT 35,000 FEET			
G.W. AT 0.85 MN POUNDS	G.W. AT 1.5 MN POUNDS	FUEL POUNDS	DISTANCE N.MI.
54,000	52,000	2000	35
58,300	56,000	2300	40
62,600	60,000	2600	45



ACCELERATION FUEL AND DISTANCE FROM 0.85 TO 1.5 MN AT 35,000 FEET			
G.W. AT 0.85 MN POUNDS	G.W. AT 1.5 MN POUNDS	FUEL POUNDS	DISTANCE N.MI.
54,600	52,000	2600	45
59,000	56,000	3000	50
63,500	60,000	3500	60

NOTE:
FOR AIRCRAFT HAVING AFC 328 COMPLIED WITH AND J79-GE-8 ENGINES INSTALLED, SEE FIGURE 11-111 AND INCREASE ACCELERATION FUEL AND DISTANCE BY 20% AND RUN-IN FUEL BY 3%.

RA-5C-1-93-94A

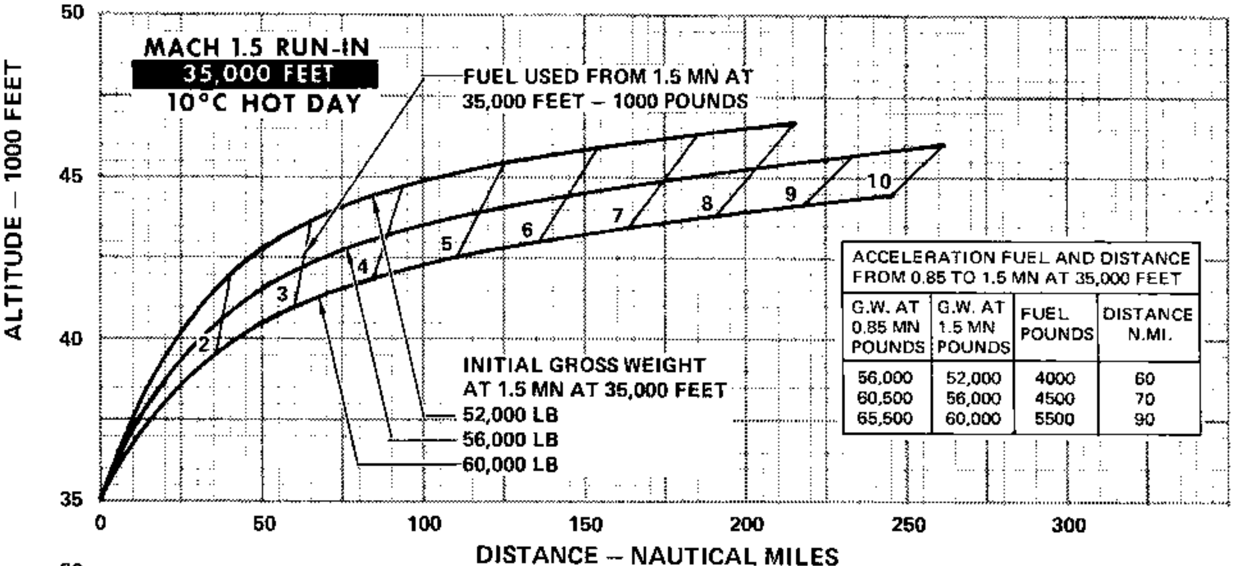
Figure 11-130

SUPERSONIC PERFORMANCE

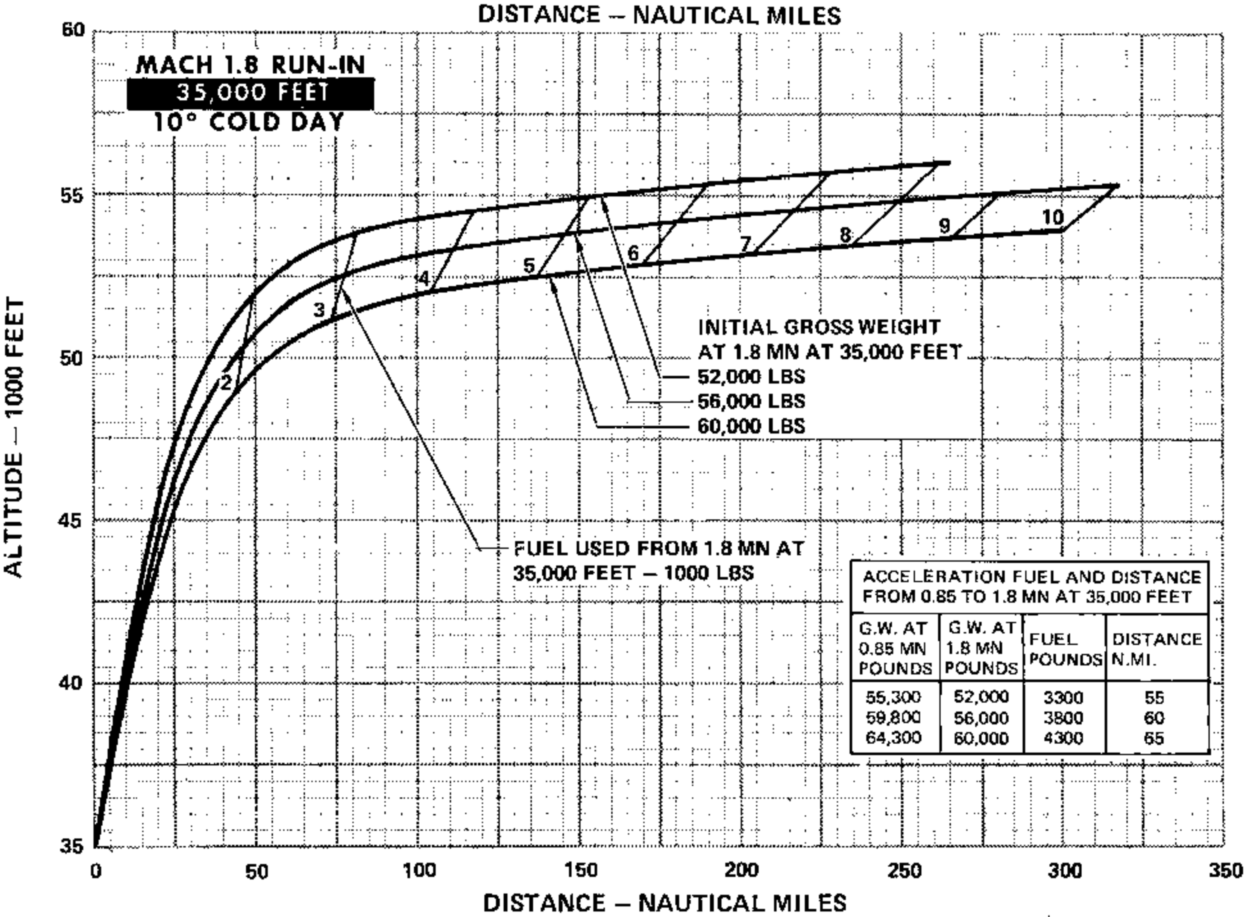
RECONNAISSANCE CONFIGURATION
MAXIMUM THRUST
NO EXTERNAL LOAD

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NR69H-2)
DATE: 15 JUNE 1970

ENGINES: (2) J79-GE-10 (-8)*
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL
*SEE NOTE



ACCELERATION FUEL AND DISTANCE FROM 0.85 TO 1.5 MN AT 35,000 FEET			
G.W. AT 0.85 MN POUNDS	G.W. AT 1.5 MN POUNDS	FUEL POUNDS	DISTANCE N.MI.
56,000	52,000	4000	60
60,500	56,000	4500	70
65,500	60,000	5500	90



ACCELERATION FUEL AND DISTANCE FROM 0.85 TO 1.8 MN AT 35,000 FEET			
G.W. AT 0.85 MN POUNDS	G.W. AT 1.8 MN POUNDS	FUEL POUNDS	DISTANCE N.MI.
55,300	52,000	3300	55
59,800	56,000	3800	60
64,300	60,000	4300	65

NOTE:

FOR AIRCRAFT HAVING AFC 328 COMPLIED WITH AND J79-GE-8 ENGINES INSTALLED, SEE FIGURE 11-112 AND INCREASE ACCELERATION FUEL AND DISTANCE BY 20% AND RUN-IN FUEL BY 3%.

RA-5C-1-93-95A

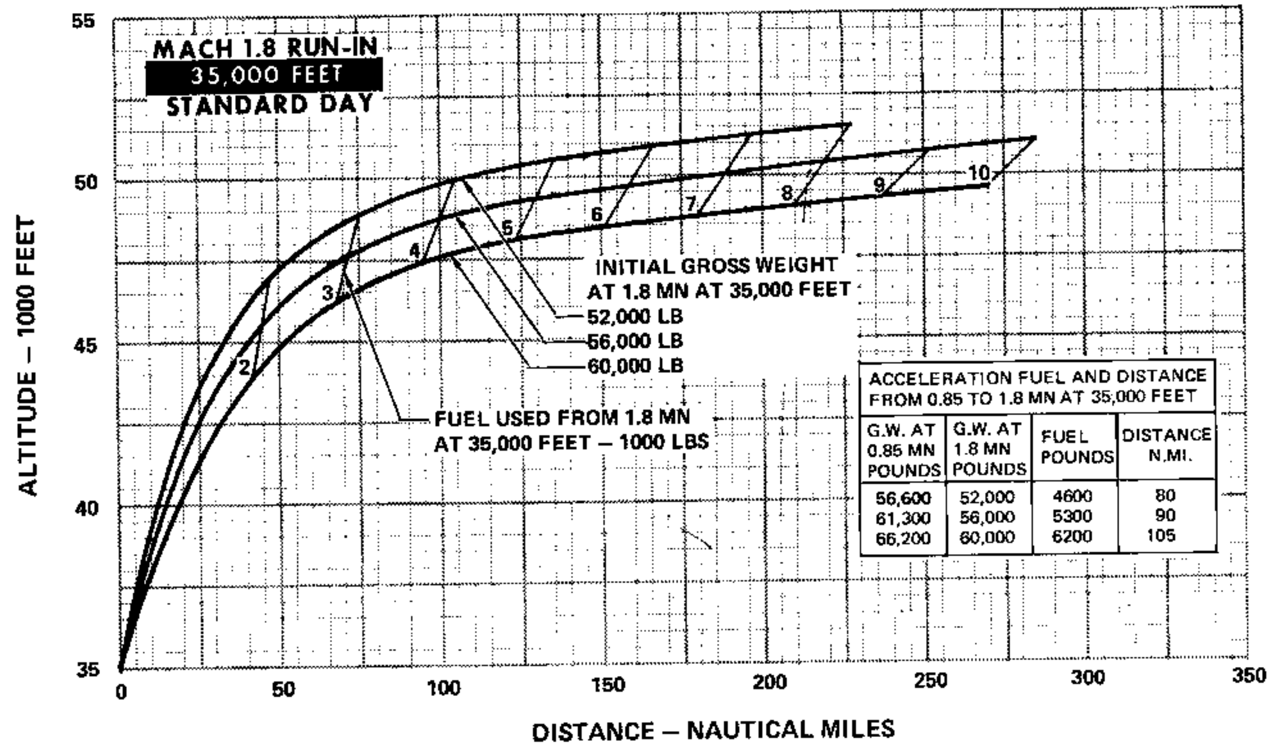
Figure 11-131

SUPERSONIC PERFORMANCE

RECONNAISSANCE CONFIGURATION
MAXIMUM THRUST
NO EXTERNAL LOAD

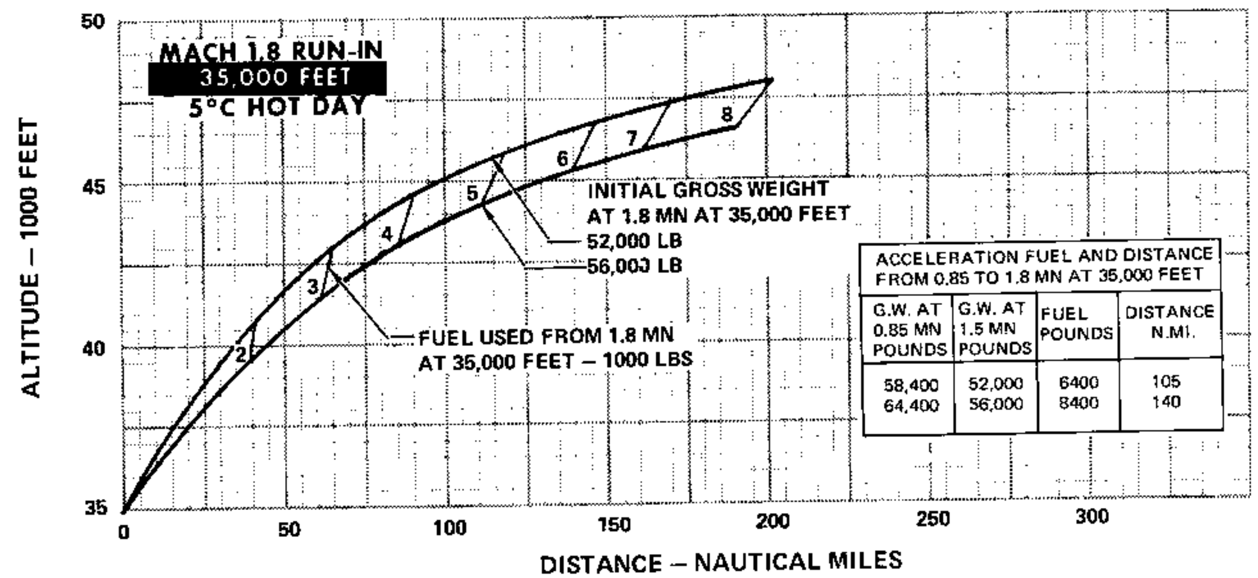
MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NR69H-2)
DATE: 15 JUNE 1970

ENGINES: (2) J79-GE-10 (-8)*
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL
*SEE NOTE



ACCELERATION FUEL AND DISTANCE FROM 0.85 TO 1.8 MN AT 35,000 FEET

G.W. AT 0.85 MN POUNDS	G.W. AT 1.8 MN POUNDS	FUEL POUNDS	DISTANCE N.MI.
56,600	52,000	4600	80
61,300	56,000	5300	90
66,200	60,000	6200	105



ACCELERATION FUEL AND DISTANCE FROM 0.85 TO 1.8 MN AT 35,000 FEET

G.W. AT 0.85 MN POUNDS	G.W. AT 1.5 MN POUNDS	FUEL POUNDS	DISTANCE N.MI.
58,400	52,000	6400	105
64,400	56,000	8400	140

NOTE:

FOR AIRCRAFT HAVING AFC 328 COMPLIED WITH AND J79-GE-8 ENGINES INSTALLED, SEE FIGURE 11-113 AND INCREASE ACCELERATION FUEL AND DISTANCE BY 20% AND RUN-IN FUEL BY 3%.

RA-5C-1-93-96A

Figure 11-132

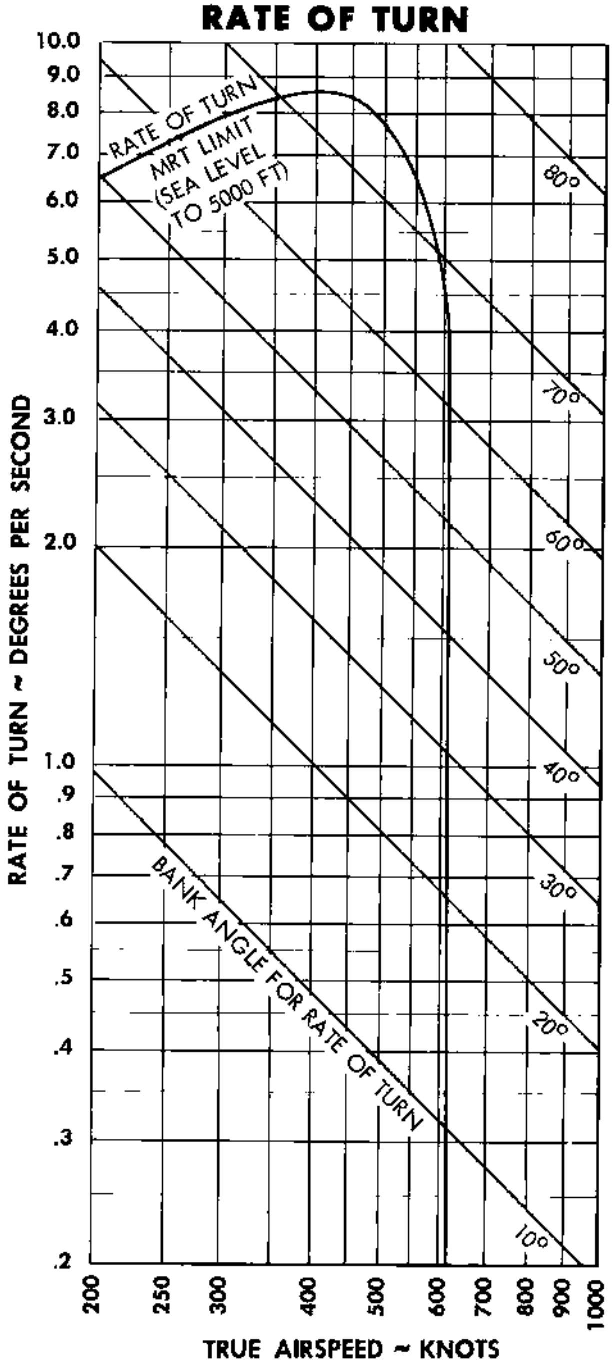
GENERAL TURNING PERFORMANCE

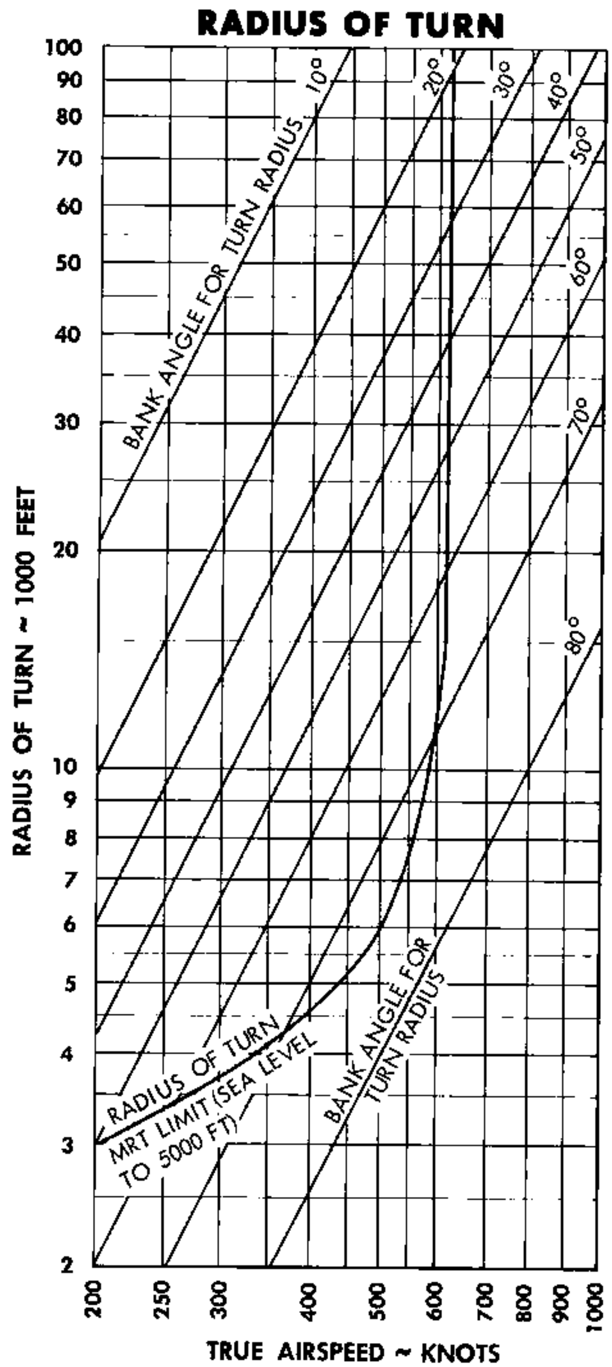
GROSS WEIGHT
AIRCRAFT 145157-151728: 56,000 POUNDS
AIRCRAFT 156608-156653: 58,000 POUNDS

- CONSTANT ALTITUDE CONSTANT SPEED TURNS
- ALL CONFIGURATIONS
- ALL ALTITUDES

NOTE

TURN ENVELOPE SHOWN FOR CONSTANT SPEED, CONSTANT ALTITUDE TURNS AT MILITARY THRUST FOR SEA LEVEL TO 5,000 FEET AFTERBURNER THRUST REQUIRED FOR TURNS AT HIGHER SPEEDS OR BANK ANGLES.





RA-5C-1-93-47

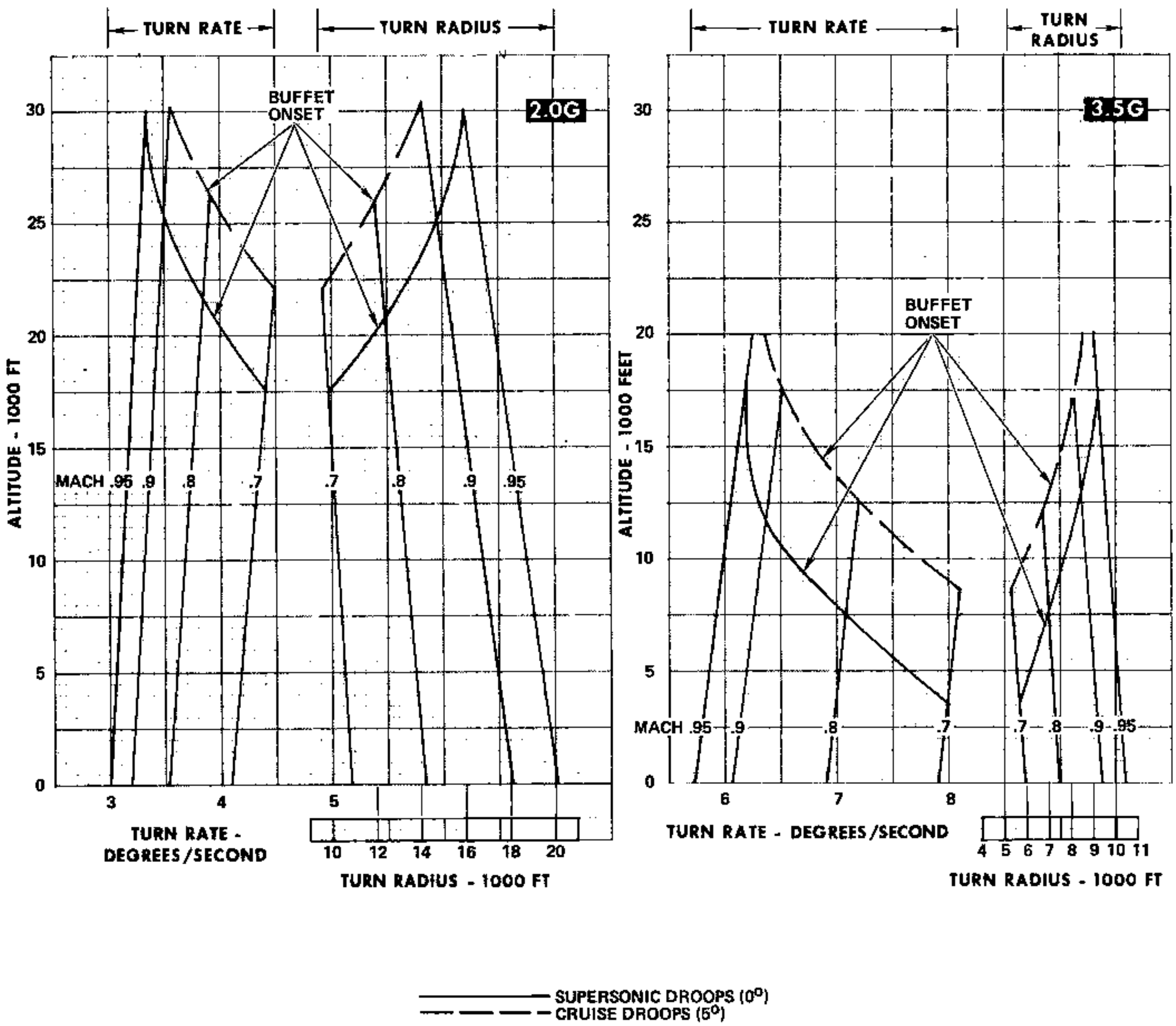
Figure 11-133

MAXIMUM THRUST TURNING PERFORMANCE

STANDARD DAY
MAXIMUM AFTERBURNER
GROSS WEIGHT 58,000 POUNDS
NO EXTERNAL LOAD

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NR69H-2)
DATE: 15 JUNE 1970

ENGINES: (2) J79-GE-10 (-8)*
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL
*SEE NOTE 2



NOTE:

1. REFER TO OPERATION LIMITATIONS, SECTION 1.
2. THIS CHART IS APPLICABLE TO AIRCRAFT HAVING AFC 328 COMPLIED WITH AND J79-GE-8 ENGINES INSTALLED.

RA-5C-1-93-46A

Figure 11-134

PART 10 — EMERGENCY OPERATIONS

SINGLE-ENGINE DECISION SPEED CHARTS

A summary of single-engine decision speeds for abort or take-off versus runway length is presented in figures 11-135, 11-136, and 11-153. Gross weights of 64,000 pounds at take-off altitudes of sea level, Standard, Tropical, and Hot Days, 2000 and 5000 feet Standard Day, and 72,000 pounds at sea level Standard Day only, are presented. The charts are based on 30°/25° flap/droop configuration using maximum afterburner thrust. Three different speed baselines are plotted on each graph: two-engine take-off speed, single-engine take-off speed, and refusal speed. The single-engine take-off speed is based on the speed required for 300 feet per minute rate of climb with the landing gear down. Gear retraction will increase climb rate an additional 400 feet per minute. Deviations from wings level flight prior to gear retraction could result in zero to negative climb rate. High time engine thrust degradation is included in the plots. To use the charts, enter with the available runway length, proceed to the right to intercept the desired speed baseline, and read vertically down to get the indicated airspeed. Interception of the cross-hatched area indicates that insufficient runway exists for abort, without arresting gear, or acceleration to single-engine take-off speed if an engine is lost in this speed range. Interception of the zipped area indicates that refusal speed is exceeded but acceleration to single-engine take-off speed is possible with an engine loss in this speed range.

Although single-engine take-off capabilities are presented in these charts, abort is recommended for take-off engine loss if at all possible.

SINGLE-ENGINE RATE-OF-CLIMB CHARTS

The variation of single-engine maximum rate of climb with aircraft gross weight is shown at sea level for landing gear both up and down configuration. See figure 11-137 for J79-GE-8 engines and figure 11-154 for J79-GE-10 engines. The single-engine maximum rate of climb for maximum rate-of-climb speed and minimum safe level flight speed is shown for various gross weights for the field take-off configuration (30-degree flaps/25-degree droops) using Maximum Thrust, and for the cruise configuration (0-degree flaps/5-degree droops) using Military Thrust. As noted, catapult launch flap settings reduce single-engine rate-of-climb capability severely and retraction to 30 degrees will be required for safe flight. Figures 11-138 and 11-139 and 11-155 and 11-156 show single-engine take-off rates of climb for various gross weights and configurations. The single-engine take-off rate-of-climb performance is shown for the 30°/25° flap/droop configuration and the 50°/50° flap/droop configuration, with the landing gear down, at sea level on Standard, Tropical, and Hot Days. The bank angle effect of deviations from wings level flight is shown at the left side of the charts, angle-of-attack lines are superimposed on the climb rate curves as a function of gross weight and indicated airspeed, and as noted, thrust degradation of high time engines has been taken into consideration. The gross weight conditions shown correspond to loadings of symmetrical external stores and no external stores. In the event of engine failure with insufficient runway remaining for stopping, single-engine take-off using Maximum Thrust may be possible (refer to single-engine decision speed charts), but, in the 50°/50° flap/droop configuration, a selection of 30°/25° flap/droop configuration must be made to gain any appreciable climb rate at any gross weight. However, the take-off climb performance at less than 180 KIAS is marginal, particularly at gross weights in excess of 64,000 pounds with landing gear down and at runway ambient temperature conditions above standard. Single-engine rate of climb is increased by retracting the landing gear and reducing the flap setting; however, the flaps should not be retracted at speeds below 220 KIAS due to lateral and directional control difficulties associated with vertical stabilizer ratio change at slow speed. Figure 11-145 shows single-engine climb with Maximum Thrust being produced by the operating engine, gear up, and zero flap/cruise droops.

SINGLE-ENGINE CONTROL SPEEDS

The Single-engine Control Speeds charts (figures 11-140 and 11-157) present Standard Day take-off speeds for gross weights up to 68,000 pounds. Minimum single-engine control speed, normal catapult end speed, best single-engine climb speed, and correction for temperature and high time engines are included.

SINGLE-ENGINE FAILURE CHARTS

Time histories during a normal wave-off in the landing configuration for both the J79-GE-8 and the J79-GE-10 engines are shown for Standard, Tropical, and Hot Days in figures 11-141 and 11-158. Recommended techniques for handling an engine failure during various take-off and landing phases, flaps and gear down, and under different temperature conditions are shown in figures 11-142, 11-143, 11-159 and 11-160. All of the charts are based on 50,000 pounds gross weight. Figures 11-142 and 11-159, Single-engine Failure During Level or Turning Flight charts, have procedures similar to the other charts and are explained in the following discussion. The altitude loss if an engine failure is encountered in level flight or in 30-degree banked flight, with aircraft configuration of 50°/50° flap/droop, landing gear down, 50,000 pounds gross weight, Tropical Day (90°F), versus time in seconds, is shown in figure 11-142. In the 30-degree bank plot, the upper curve shows the effect of trading off 7 knots of airspeed to reduce altitude loss, thereby reducing rate of climb by 300 feet per minute. Note that the altitude loss difference between the two curves is a total of 15 feet. The curves assume that the engine toward the inside of the turn fails, which presents the more critical case for time required to roll to wings level flight. To minimize the altitude loss of an engine failure in a turn, maximum A/B should be applied to the good engine and aircraft rolled to wings level flight as soon as possible, followed by initiation of flap setting to 30 degrees and rotation to 19 units AOA for sink arrestment. For engine failure in wings level flight, sink arrestment can be initiated immediately after application of maximum A/B and initiation of flaps change to 30 degrees, with a substantial reduction in altitude loss as shown in the plots. High time engines will increase altitude loss by 5 to 10 feet and rate of climb will decrease 100 feet per minute.

Also graphically presented are the single-engine failure on touch-and-go or bolter, and on approach combined in one chart, single-engine failure during carrier operations, with detailed information being entered on each presentation.

EXHAUST NOZZLES FAILED FULL OPEN CHART

Aircraft performance with both exhaust nozzles failed to full open position is presented in figure 11-146 for MIL and CRUISE power settings. The speed, altitude, and cruise performance data shown for Standard and Tropical Day ambient temperature conditions are based on estimated data and information received from flight test results obtained under normal operating conditions. These data have not been substantiated in flight by actual or simulated dual-nozzle failures. The possibility of obtaining afterburner light-off with failed open nozzles is remote. Afterburner operation can probably be sustained if nozzles fail open while operating in maximum afterburner but not at intermediate A/B or minimum A/B power settings. The thrust available with maximum afterburner power setting and nozzles failed full open is sufficient to maintain level flight at all gross weights with gear and flaps down.

Level flight cruise in the clean configuration can be maintained with failed open nozzles. The estimated ceiling at 56,000 pounds gross weight and Standard Day conditions is approximately 19,000 feet with CRUISE power settings (figure 11-146). Failed open nozzles result in approximately 35 percent reduction in maximum cruise nautical miles per 1000 pounds of fuel at similar speeds and altitudes. Figure 11-146 shows that, with gear up, flaps 30 degrees, droops 25 degrees, no external stores, 52,000 pounds gross weight, and Standard Day conditions, the ceiling will be approximately 6500 feet with MIL power setting. On Tropical Days, the Military Thrust ceiling is reduced to approximately 4500 feet. Extending the landing gear will decrease the Military Thrust ceiling on a Standard Day to approximately 2500 feet and, on Tropical Days, level flight cannot be maintained at any altitude. Careful monitoring of speed control is necessary for both the clean and landing configurations to avoid operating on the back side of the thrust-required curve. With 50-degree flap setting, level flight cannot be maintained at any altitude unless maximum A/B is available on one engine. Field approaches and landings can be made with 30-degree flap setting with both nozzles failed open if aircraft weight is reduced to 44,000 pounds, field elevation is approximately 2000 feet or less, and ambient temperature does not exceed 59°F (15°C) [or at field elevations of 500 feet or less when ambient temperature does not exceed 81°F (27.2°C)]. Carrier approaches are not recommended if both nozzles are failed open, due to limited excess thrust available for wave-offs.

If only one exhaust nozzle fails to full open position and the other nozzle is functioning normally, the aircraft performance, with the power reduced to idle on the failed nozzle engine, reverts to single-engine operation and can be obtained by reference to the single-engine performance charts.

ZERO FLAPS LANDING AND STOPPING DISTANCES

The total landing and stopping distances with zero flaps and droop deflections of 0° or 5°, 25° and 50° are shown in figure 11-144 for J79-GE-8 engines, and in figure 11-161 for J79-GE-10 engines, the landing and stopping distances are shown for Standard Day conditions. The effects of nonstandard conditions on total ground roll stopping distances are included on the chart. The stopping distances are based on full (nose high) aerodynamic braking from touchdown to initiation of wheel braking. The maximum speeds for initiation of wheel braking are listed on the chart. Brake absorption capability is the same as described in Part 8 under Landing and Stopping Distances Charts.

SINGLE ENGINE DECISION SPEEDS

SYMMETRICAL EXTERNAL STORES OR NO EXTERNAL LOAD

MODEL: RA-5C
BASED ON: ESTIMATED DATA
DATE: 1 DECEMBER 1967

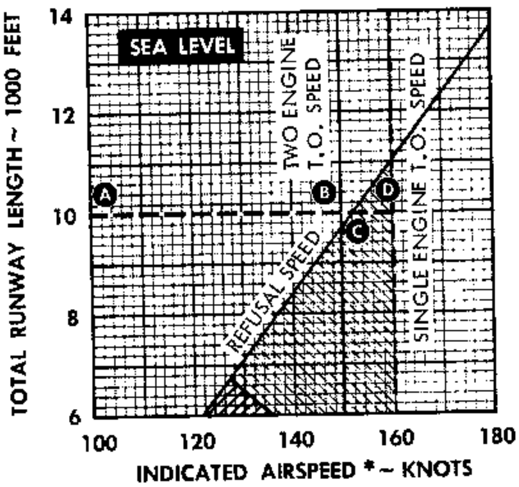
DRY RUNWAY — ZERO WIND

ENGINES: (2) J79-GE-8
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL

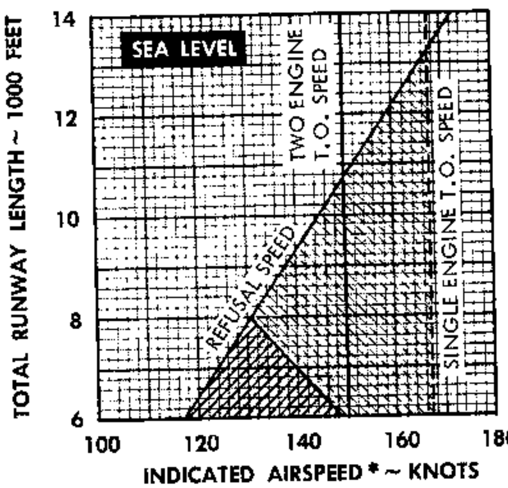
MAXIMUM THRUST
FLAPS 30°/DROOPS 25°

EXAMPLE:
- (A) RUNWAY LENGTH: 10,000 FEET
- (B) TWO ENGINE TAKE-OFF SPEED: 150 KIAS *
- (C) REFUSAL SPEED - 152 KIAS *
- (D) SINGLE ENGINE TAKE-OFF - 160 KIAS *

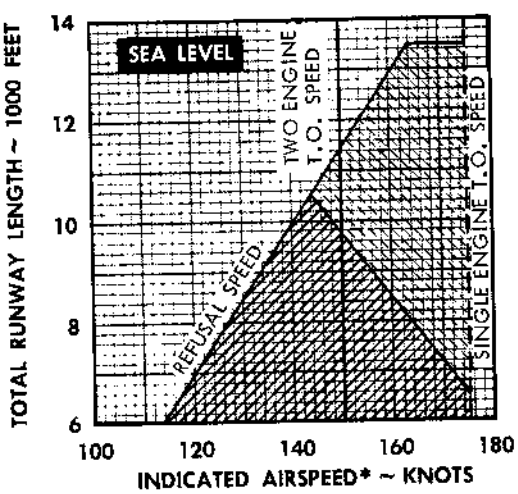
64,000 POUNDS
STANDARD DAY (59°F)



64,000 POUNDS
TROPICAL DAY (90°F)



64,000 POUNDS
HOT DAY (104°F)



NOTE:

1. TAKE-OFF SHOULD BE ABORTED IF ENGINE FAILURE OCCURS BEFORE REFUSAL SPEED IS EXCEEDED OR WITH ENGINE FAILURE AT ANY SPEED PRIOR TO TAKE-OFF WHERE FIELD ARRESTMENT GEAR IS AVAILABLE.
2. SINGLE ENGINE TAKE-OFF SPEEDS ARE BASED ON SPEED FOR APPROXIMATELY 300 FT/MIN RATE OF CLIMB (GEAR DOWN). EXTERNAL STORES SHOULD BE JETTISONED AND GEAR RETRACTED AS SOON AS POSSIBLE FOR INCREASED RATE OF CLIMB. CLIMB CAPABILITIES ARE BASED ON WINGS LEVEL FLIGHT.
3. DO NOT APPLY AFT STICK UNTIL REACHING SINGLE ENGINE TAKE-OFF SPEED AS THE TAKE-OFF DISTANCE WILL BECOME EXCESSIVE.
4. REDUCE REFUSAL SPEEDS BY 20 KIAS FOR WET RUNWAY CONDITIONS.
5. HIGH TIME ENGINE THRUST DEGRADATION INCLUDED.
6. REFER TO EMERGENCY PROCEDURES, SECTION V, FOR ENGINE FAILURE ON TAKE-OFF.
7. ON AIRCRAFT HAVING AFC 159 COMPLIED WITH, ALL SPEEDS (KIAS) MUST BE INCREASED BY 4 KNOTS; DISTANCES REMAIN THE SAME.

INSUFFICIENT RUNWAY LENGTH FOR ABORT OR ACCELERATION TO SINGLE ENGINE TAKE-OFF SPEED.

REFUSAL SPEED EXCEEDED. SINGLE ENGINE TAKE-OFF CAPABILITY EXISTS WITH MARGINAL RATE OF CLIMB. (SEE NOTE 2)

A-5C-1-93-58

* AIRCRAFT NOT HAVING AFC 159 COMPLIED WITH

Figure 11-135

SINGLE ENGINE DECISION SPEEDS

SYMMETRICAL EXTERNAL STORES OR NO EXTERNAL LOAD

MODEL: RA-5C
BASED ON: ESTIMATED DATA
DATE: 1 DECEMBER 1967

DRY RUNWAY — ZERO WIND

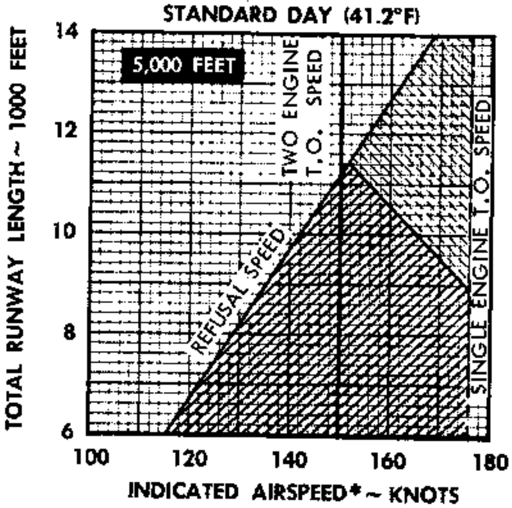
ENGINES: (2) J79-GE-8
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL

MAXIMUM THRUST
FLAPS 30°/DROOPS 25°

64,000 POUNDS

NO SINGLE ENGINE T.O. CAPABILITY EXISTS ON A TROPICAL DAY (70°F)

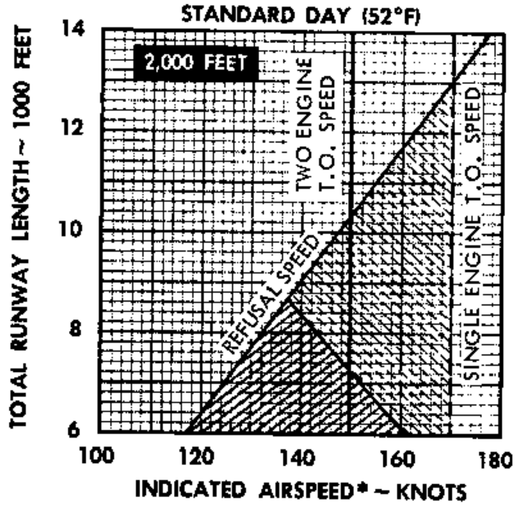
STANDARD DAY (41.2°F)



64,000 POUNDS

SINGLE ENGINE T.O. R/C IS 100 TO 200 FPM AT 175 KIAS* ON A TROPICAL DAY (82°F) WITH GEAR DOWN

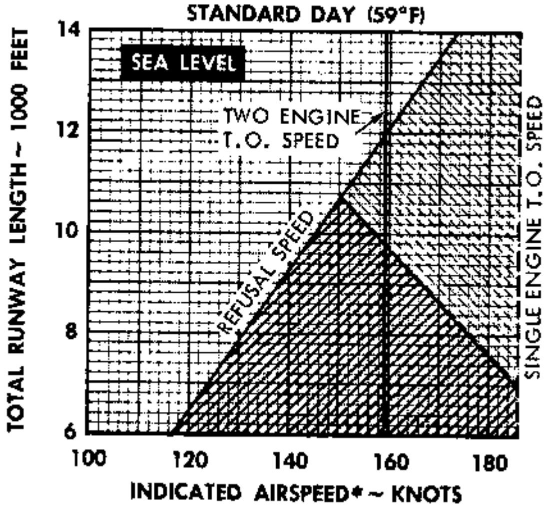
STANDARD DAY (52°F)



72,000 POUNDS

NO SINGLE ENGINE T.O. CAPABILITY EXISTS ON A TROPICAL DAY (90°F)

STANDARD DAY (59°F)



NOTE:

1. TAKE-OFF SHOULD BE ABORTED IF ENGINE FAILURE OCCURS BEFORE REFUSAL SPEED IS EXCEEDED OR WITH ENGINE FAILURE AT ANY SPEED PRIOR TO TAKE-OFF WHERE FIELD ARRESTMENT GEAR IS AVAILABLE.
2. SINGLE ENGINE TAKE-OFF SPEEDS ARE BASED ON SPEED FOR APPROXIMATELY 300 FT/MIN RATE OF CLIMB (GEAR DOWN). EXTERNAL STORES SHOULD BE JETTISONED AND GEAR RETRACTED AS SOON AS POSSIBLE FOR INCREASED RATE OF CLIMB. CLIMB CAPABILITIES ARE BASED ON WINGS LEVEL FLIGHT.
3. DO NOT APPLY AFT STICK UNTIL REACHING SINGLE ENGINE TAKE-OFF SPEED AS THE TAKE-OFF DISTANCE WILL BECOME EXCESSIVE.
4. REDUCE REFUSAL SPEEDS BY 20 KIAS FOR WET RUNWAY CONDITIONS.
5. HIGH TIME ENGINE THRUST DEGRADATION INCLUDED.
6. REFER TO EMERGENCY PROCEDURES, SECTION V, FOR ENGINE FAILURE ON TAKE-OFF.
7. ON AIRCRAFT HAVING AFC 159 COMPLIED WITH, ALL SPEEDS (KIAS) MUST BE INCREASED BY 4 KNOTS; DISTANCES REMAIN THE SAME

INSUFFICIENT RUNWAY LENGTH FOR ABORT OR ACCELERATION TO SINGLE ENGINE TAKE-OFF SPEED

REFUSAL SPEED EXCEEDED. SINGLE ENGINE TAKE-OFF CAPABILITY EXISTS WITH MARGINAL RATE OF CLIMB (SEE NOTE 2).

* SPC OFF, AIRCRAFT NOT HAVING AFC 159 COMPLIED WITH

A-5C-1-93-4B

Figure 11-136

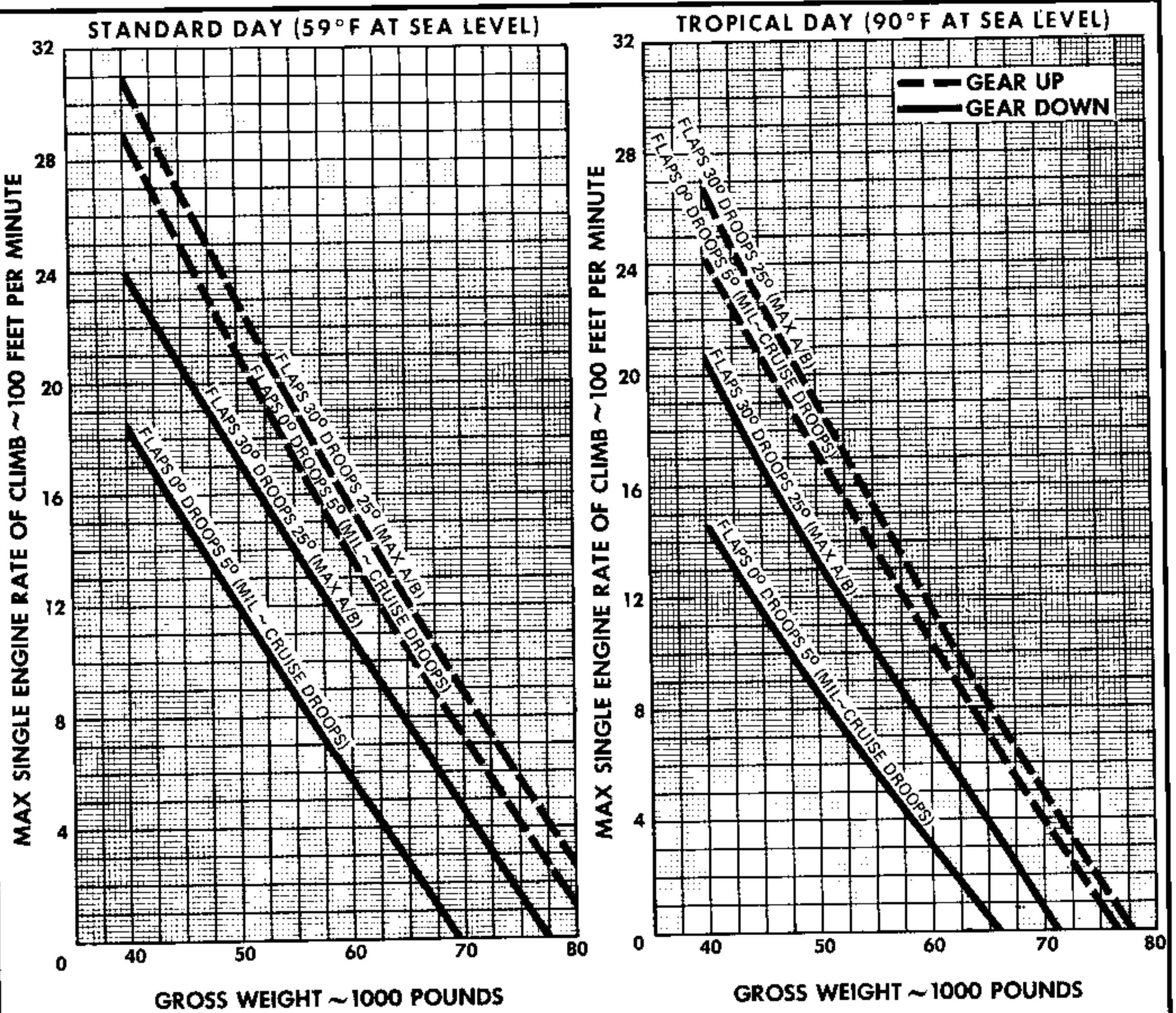
SINGLE ENGINE MAXIMUM RATE OF CLIMB vs. GROSS WEIGHT

RECONNAISSANCE CONFIGURATION

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA
DATE: 15 MAY 1972

SEA LEVEL

ENGINES: (2) J79-GE-8
FUEL GRADE: MIL-J-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL



SAFE SINGLE ENGINE SPEED AND SPEED FOR MAXIMUM RATE OF CLIMB AT SEA LEVEL						
GROSS WEIGHT	FLAPS = 30° DROOPS = 25°			FLAPS = 0° DROOPS = 5° (CRUISE)		
	SAFE SPEED	MAX R/C GEAR DN	MAX R/C GEAR UP	SAFE SPEED	MRT MAX R/C GEAR DN	MRT MAX R/C GEAR UP
POUNDS	KIAS	KIAS	KIAS	KIAS	KIAS	KIAS
80,000	205	—	210	260	—	310
72,000	185	195	205	240	—	302
64,000	159	190	200	220	230	295
56,000	144	185	195	200	224	289
48,000	139	180	190	180	214	283
42,000	139	175	185	180	205	280

* NOTE:

1. DECREASE SINGLE ENGINE MAX RATE OF CLIMB BY 100 FEET PER MINUTE FOR EACH 1000 FEET OF FIELD ELEVATION ABOVE SEA LEVEL.
2. WITH A FLAP/DROOP SETTING OF 50°/50°, GEAR DOWN, 50,000 LB GROSS WEIGHT ON A STANDARD DAY (OR 47,000 LB ON A TROPICAL DAY) THE SINGLE ENGINE TAKE-OFF RATE OF CLIMB AT MAX THRUST IS APPROXIMATELY 100 FEET PER MINUTE. THE SAFE SINGLE ENGINE SPEED FOR THIS CONDITION IS 139 (135) KIAS.

* DECREASE SPEEDS SHOWN BY 4 KTS FOR AIRCRAFT NOT HAVING AFC 159 INCORPORATED

A-5C-1A-93-102D

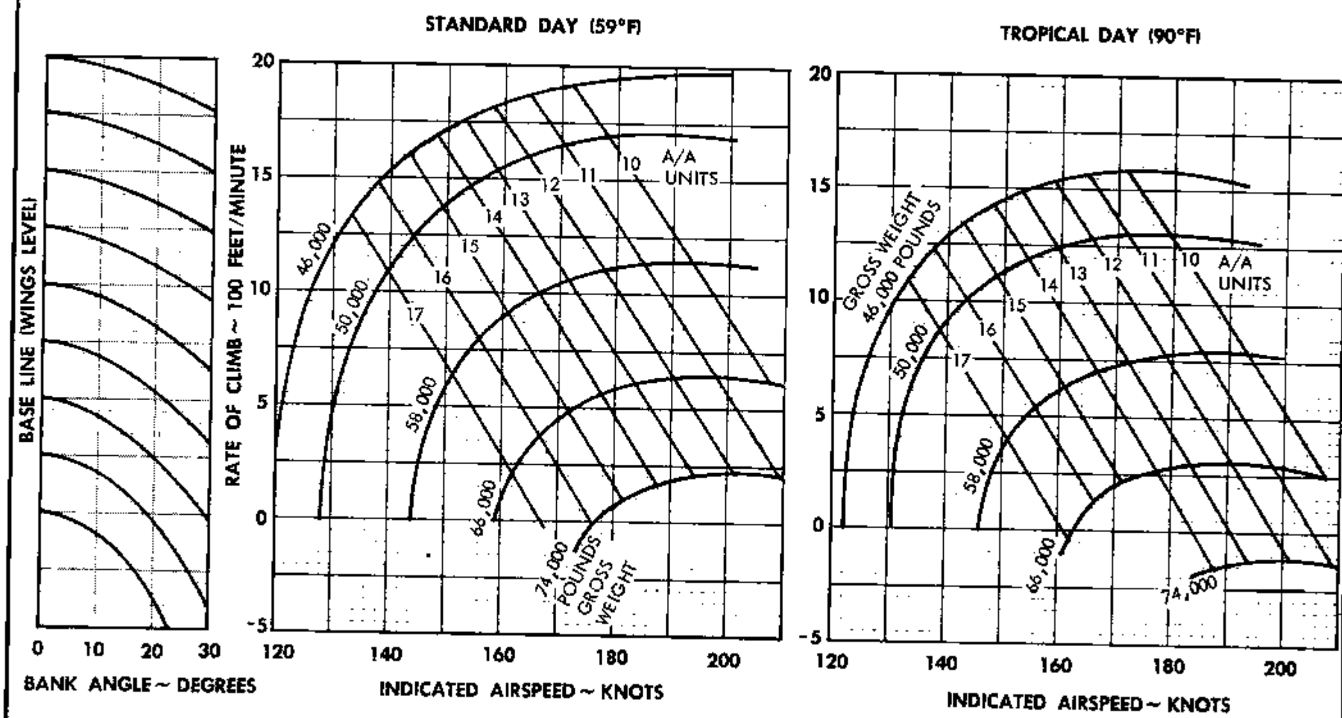
Figure 11-137

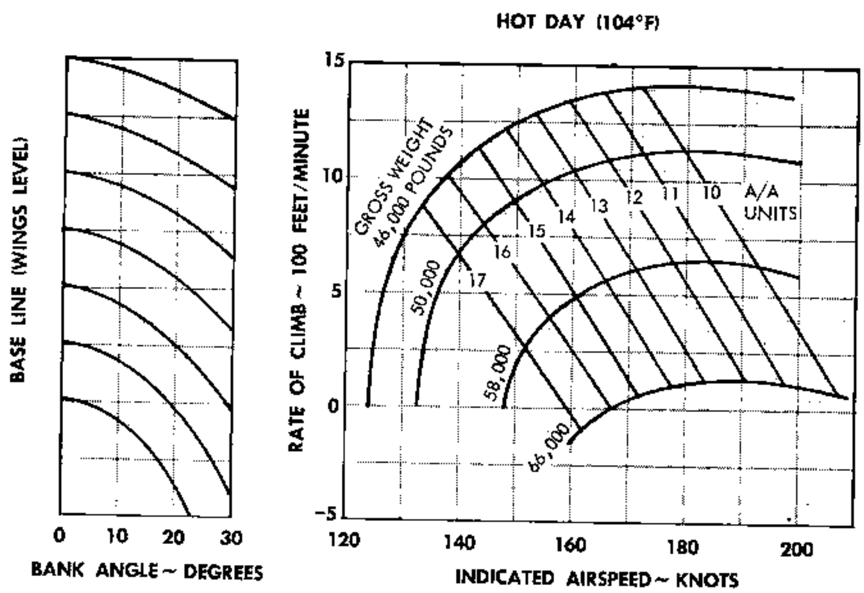
SINGLE ENGINE RATE OF CLIMB – 30° FLAPS

FLAPS 30°/DROOPS 25°
GEAR DOWN
MAXIMUM AFTERBURNER
SEA LEVEL

MODEL: RA-5C
BASED ON: FLIGHT TEST
DATE: 15 DECEMBER 1970

ENGINES: (2) J79-GE-8
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL





NOTE:

1. RATE OF CLIMB IS INCREASED APPROX. 400 FT/MIN AT HEAVY WEIGHTS AND 600 FT/MIN AT LIGHT WEIGHTS WITH GEAR RETRACTED.
2. 74,000 POUNDS G.W. DATA BASED ON SYMMETRICAL EXTERNAL STORES.
3. ON AIRCRAFT NOT HAVING AFC 159 COMPLIED WITH, ALL SPEEDS (KIAS) MUST BE DECREASED BY 4 KNOTS.

RA-5C-1-93-98

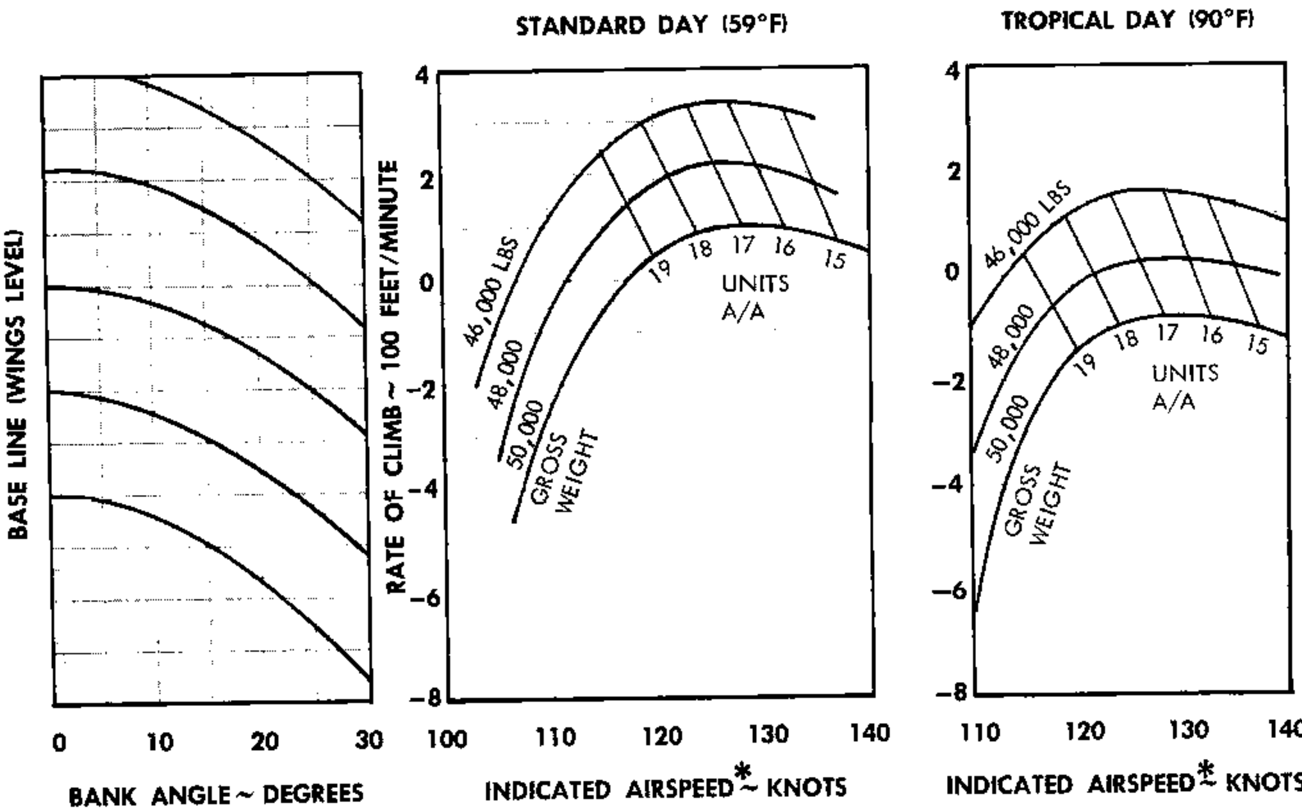
Figure 11-138

SINGLE ENGINE RATE OF CLIMB

FLAPS 50°/DROOPS 50°
GEAR DOWN
MAXIMUM AFTERBURNER
SEA LEVEL

MODEL: RA-5C
BASED ON: ESTIMATED DATA
DATE: 1 DECEMBER 1967

ENGINES: (2) J79-GE-8
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL



NOTE:

1. RATE OF CLIMB IS INCREASED 400 FEET PER MINUTE WITH GEAR RETRACTED.
2. RATE OF CLIMB IS DECREASED 120 FEET PER MINUTE WITH THRUST DEGRADATION OF HIGH TIME ENGINES.
3. ON AIRCRAFT HAVING AFC 159 COMPLIED WITH, ALL SPEEDS (KIAS) MUST BE INCREASED BY 4 KNOTS.

*AIRCRAFT NOT HAVING AFC 159 COMPLIED WITH

A-5C-1-93-7B

Figure 11-139

SINGLE ENGINE SPEEDS

FLAPS 30°/DROOPS 25°
GEAR DOWN
MAXIMUM THRUST
SEA LEVEL

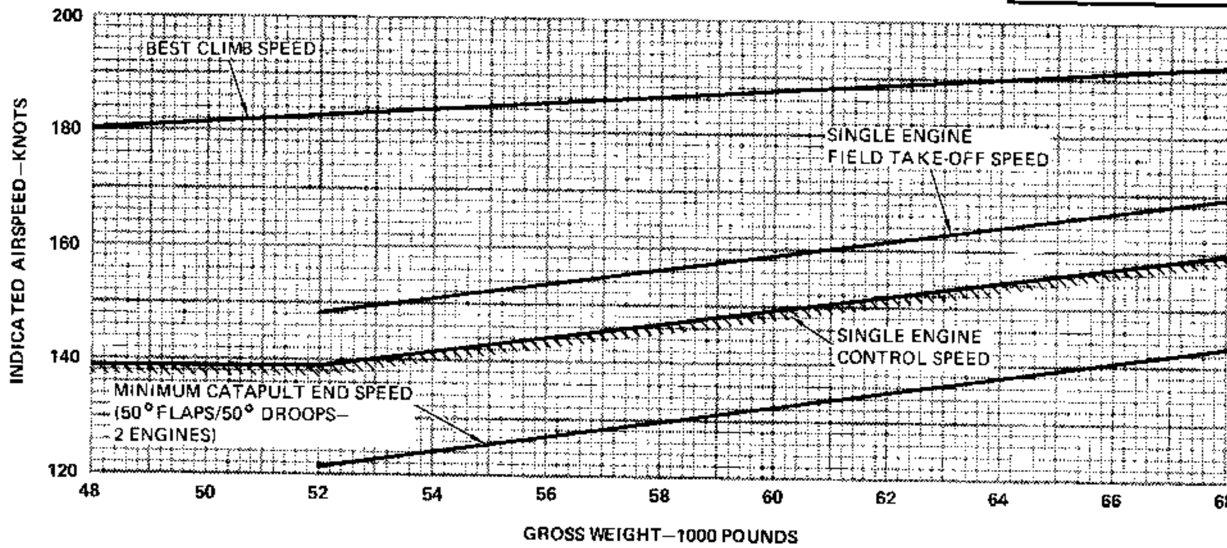
MAX THRUST

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA
DATE: 15 DECEMBER 1970

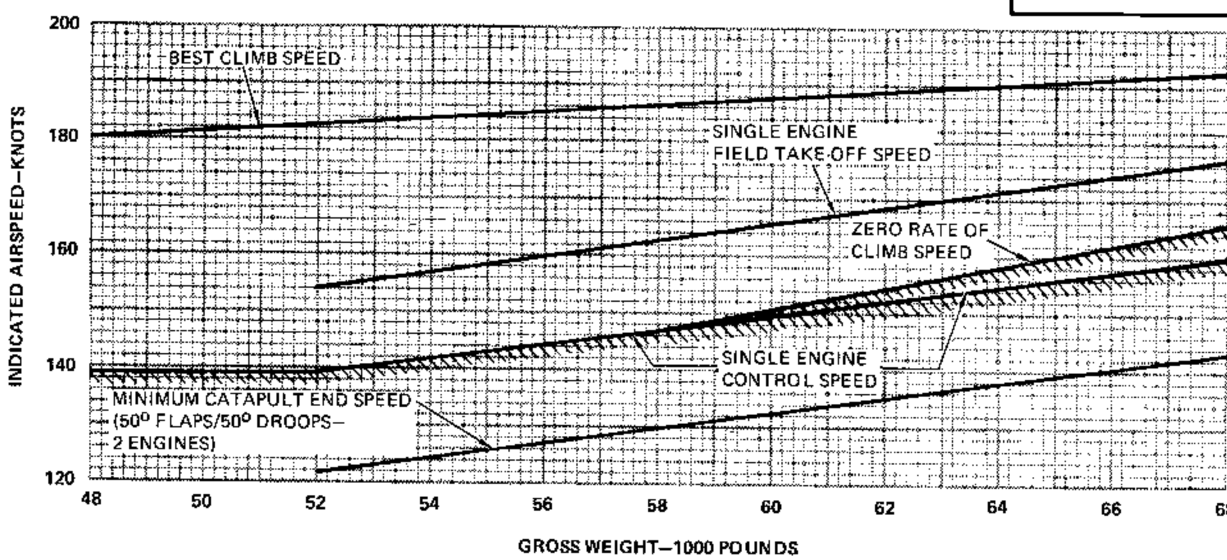
ENGINE: (2) J79-GE-8
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL

DECREASE SPEEDS SHOWN BY 4 KNOTS ON AIRCRAFT 145157 THROUGH 151728 NOT HAVING AFC 159 COMPLIED WITH (SPC OFF).

STANDARD DAY (59°F)



TROPICAL DAY (90°F)



NOTE:

REFER TO SINGLE ENGINE RATE OF CLIMB CHART FOR ADDITIONAL DATA

RA-5C-1-93-66A

Figure 11-140 (Sheet 1)

SINGLE ENGINE SPEEDS

FLAPS 30°/DROOPS 25°
GEAR DOWN
MAXIMUM THRUST
SEA LEVEL

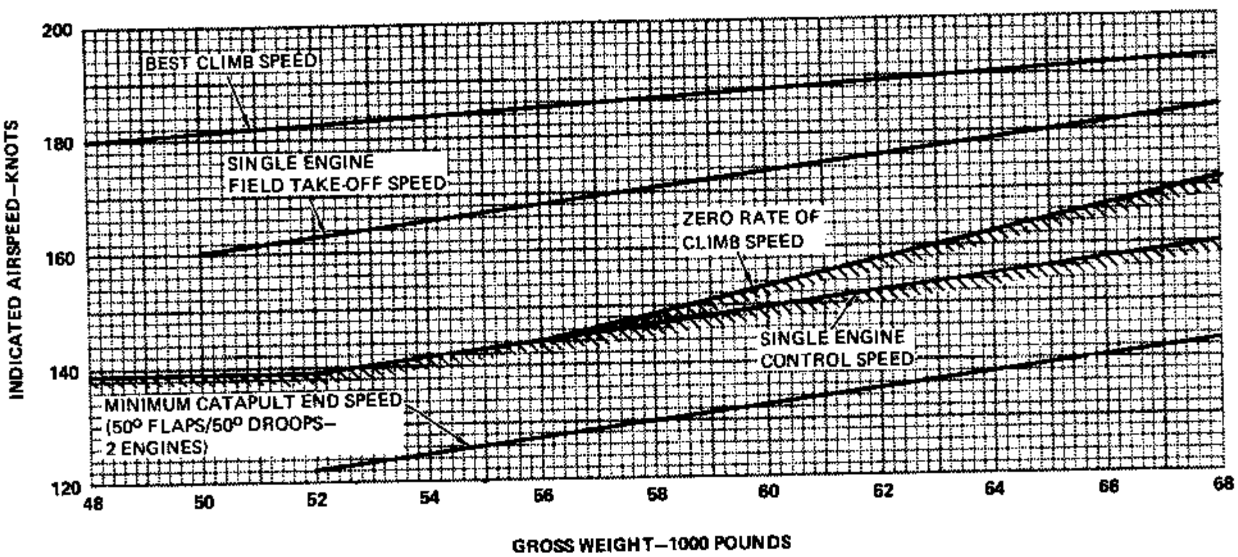
MAX THRUST

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA
DATE: 15 DECEMBER 1970

ENGINE: (2) J79-GE-8
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL

DECREASE SPEEDS SHOWN BY 4 KNOTS
ON AIRCRAFT 145157 THROUGH 151728 NOT
HAVING AFC 159 COMPLIED WITH (SPC OFF)

HOT DAY (104°F)



NOTE:

REFER TO SINGLE ENGINE RATE OF CLIMB CHART
FOR ADDITIONAL DATA

RA-5C-1-93-67A

Figure 11-140 (Sheet 2)

TWO ENGINE NORMAL WAVE - OFF

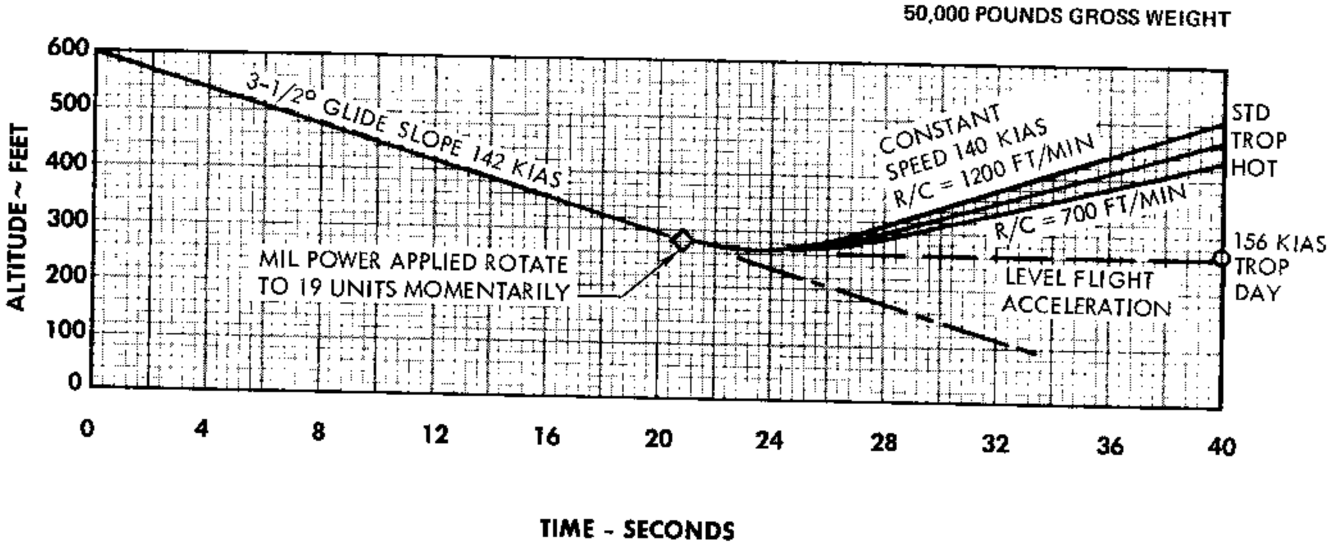
FLAPS 50°/DROOPS 50°

GEAR DOWN

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NA63H-2)
DATE: 15 JUNE 1970

ENGINES: (2) J79-GE-8
FUEL GRADE: MIL-T-5624(JP-5)
FUEL DENSITY: 6.8 LB/GAL

STANDARD DAY (59°F) – TROPICAL DAY (90°F) – HOT DAY (104°F)



NOTE:

DECREASE SPEEDS SHOWN BY 4 KTS ON AIRCRAFT 145157 THROUGH 151728 NOT HAVING AFC 159 COMPLIED WITH (SPC-OFF).

A-5C-1-93-10C

Figure 11-141

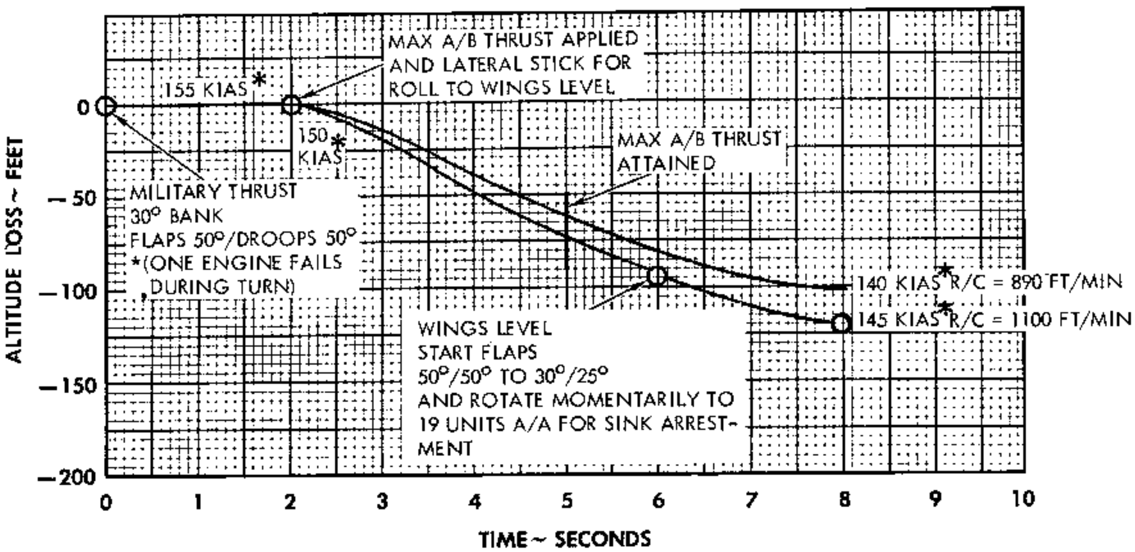
SINGLE ENGINE FAILURE DURING LEVEL OR TURNING FLIGHT

MODEL: RA-5C
BASED ON: ESTIMATED DATA
DATE: 15 JUNE 1970

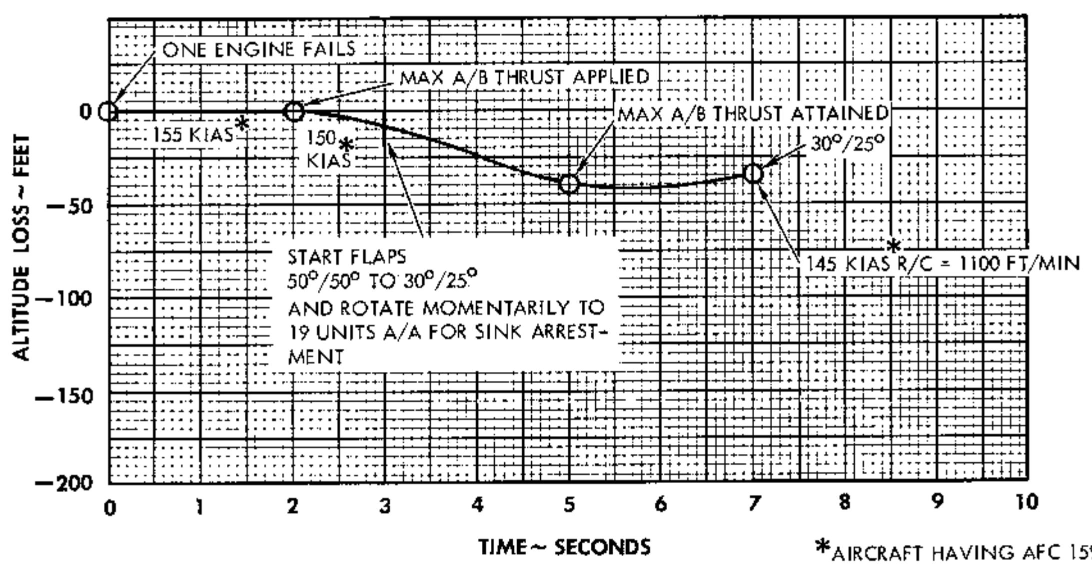
TROPICAL DAY (90°F)
50,000 POUNDS GROSS WEIGHT
FLAPS AND GEAR DOWN

ENGINES: (2)J79-GE-8
FUEL GRADE: MIL-T-5624(JP-5)
FUEL DENSITY: 6.8 LB/GAL

30° BANK



LEVEL FLIGHT



*AIRCRAFT HAVING AFC 159 COMPLIED WITH

NOTE:

1. ENGINE ON INSIDE OF TURN ASSUMED FAILED. IF ENGINE ON OUTSIDE OF TURN FAILED, TIME TO ROTATE TO WINGS LEVEL, WOULD BE REDUCED FROM 4 SECONDS TO 2 SECONDS.
2. DECREASE SPEEDS SHOWN BY 4 KTS ON AIRCRAFT 145157 THROUGH 151728 NOT HAVING AFC 159 COMPLIED WITH (SPC-OFF)
3. HIGH TIME ENGINES INCREASE ALTITUDE LOSS BY 5 TO 10 FEET

A-5C-1-93-11B

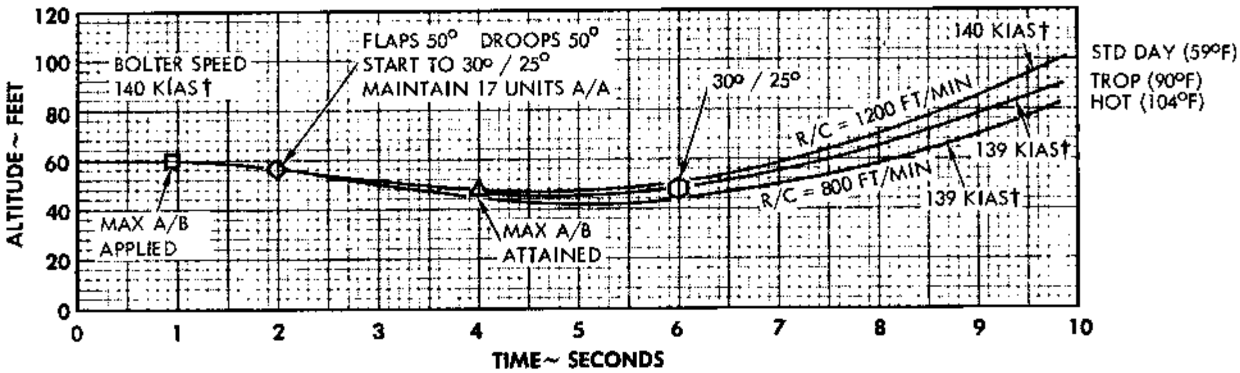
Figure 11-142

SINGLE ENGINE FAILURE DURING CARRIER OPERATIONS

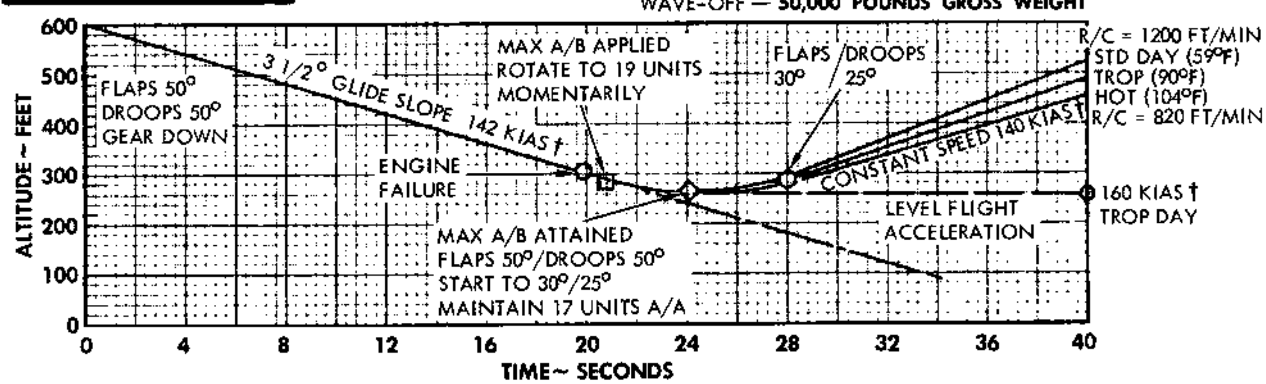
MODEL: RA-5C
BASED ON: ESTIMATED DATA
DATE: 15 JUNE 1970

ENGINES: (2)J79-GE-8
FUEL GRADE: MIL-T-5624(JP-5)
FUEL DENSITY: 6.8 LB/GAL

ON TOUCH & GO OR BOLTER



ON APPROACH



†AIRCRAFT HAVING AFC 159 COMPLIED WITH

NOTE:

1. HIGH TIME ENGINES WILL REDUCE R/C BY 100 FT/MIN
2. DECREASE SPEEDS SHOWN BY 4 KTS ON AIRCRAFT 145157 THROUGH 151728 NOT HAVING AFC 159 COMPLIED WITH (SPC-OFF)

A-5C-1-93-12B

Figure 11-143

ZERO FLAPS LANDING AND STOPPING DISTANCES

SEA LEVEL
ZERO WIND
HARD SURFACE DRY RUNWAY

FOR AIRCRAFT HAVING AFC 159 (COMPENSATED A/S TUBE)

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NA63H-2)
DATE: 15 JUNE 1970

FOR AIRCRAFT NOT HAVING AFC 159 INCORPORATED, SUBTRACT 4 KNOTS FROM KIAS SHOWN.

ENGINES: (2) J79-GE-8
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB./GAL.

GROSS WEIGHT (POUNDS)	SPEED KIAS		DISTANCE FEET			
	APPROACH	M.S.B.I.	TOTAL DIST. OVER 50 FT. OBSTACLE	TOTAL GROUND ROLL STOPPING DISTANCE	AERO BRAKING	WHEEL BRAKING
DROOPS 0° OR 5°						
48,000	181	133	10,500	9,400	5600	3800
52,000	188	130	12,000	10,900	7200	3700
56,000	196	128	13,700	12,600	8900	3700
DROOPS 25°						
48000	167	133	9100	8000	4200	3800
52000	173	130	10,700	9600	5900	3700
56000	179	128	12,300	11,200	7500	3700
DROOPS 50°						
48000	167	133	12,200	11,100	7300	3800
52000	173	130	14,400	13,300	9600	3700
56000	179	128	16,700	15,600	11,900	3700

NOTES:

1. STOPPING DISTANCES ARE BASED ON FULL (NOSE HIGH) AERODYNAMIC BRAKING FROM TOUCHDOWN TO MAXIMUM RECOMMENDED KIAS FOR INITIATION OF WHEEL BRAKING (M.S.B.I.). WHEEL BRAKING IS USED FROM THE MAXIMUM KIAS FOR INITIATION OF WHEEL BRAKING AND INCLUDES 3 SECOND DELAY FOR BRAKE APPLICATION.

2. MINIMUM DIRECTIONAL CONTROL SPEED WITH ZERO FLAPS IS 123 KNOTS FOR A 6 KNOT CROSS WIND. THREE POINT ATTITUDE WITH NOSE WHEEL STEERING REQUIRED BELOW THIS SPEED.

EFFECT OF NON STANDARD CONDITIONS	
CONDITION	CHANGE IN TOTAL GROUND ROLL STOPPING DISTANCE
1. FIELD ELEVATION 2000 FT.	10% INCREASE
2. RUNWAY TEMPERATURE +20° C ABOVE STD. -20°C BELOW STD.	10% INCREASE 10% DECREASE
3. HEADWIND 20 KTS.	20% DECREASE
4. WET RUNWAY (RCR 12)	50% INCREASE
5. ICY RUNWAY (RCR 5)	175% INCREASE (MULTIPLY BY 2.75)

RA-5C-1-93-50

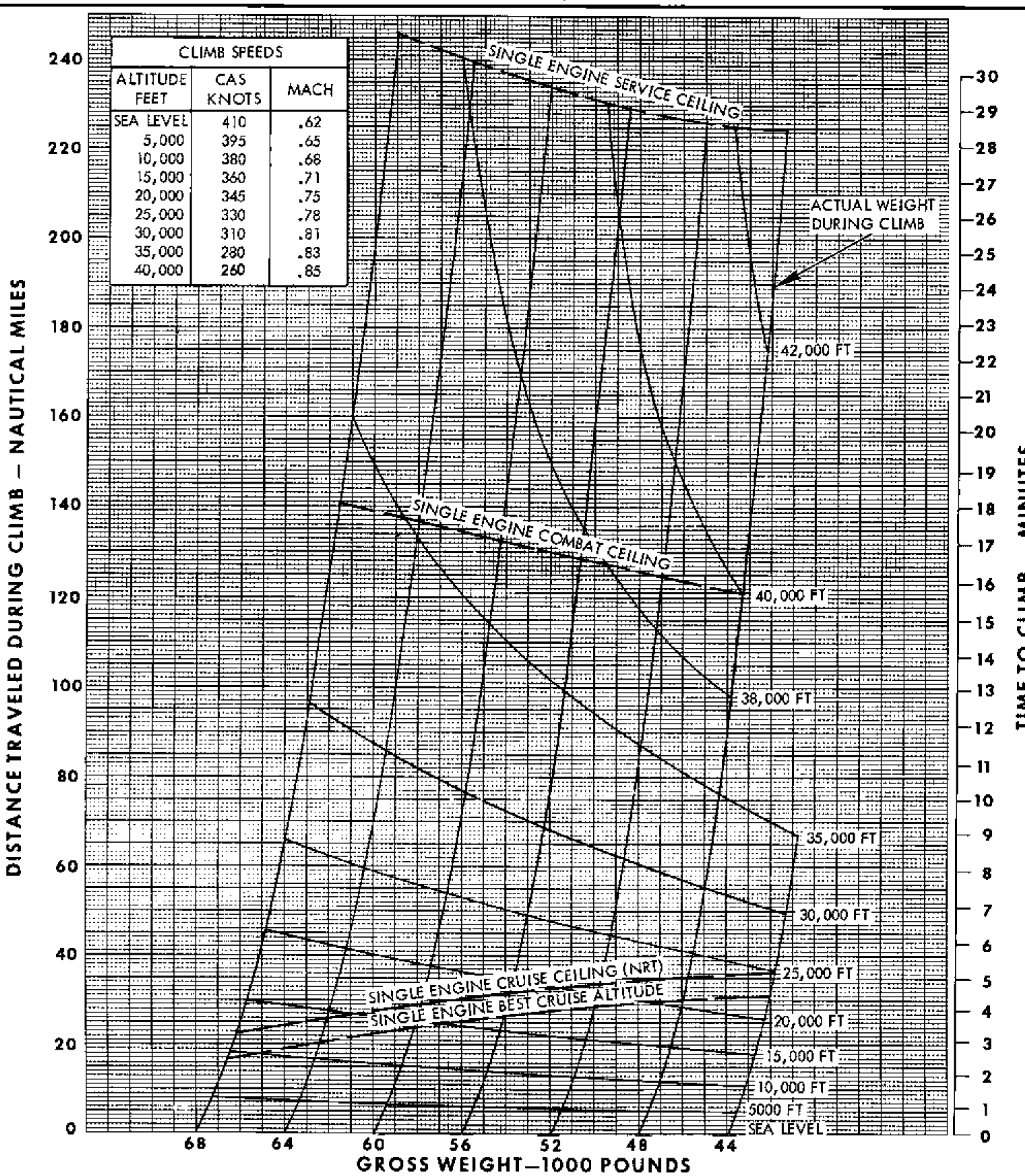
Figure 11-144

MAXIMUM THRUST CLIMB — SINGLE ENGINE

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NA63H-2,NR69H-2)
DATE: 15 JUNE, 1970

RECONNAISSANCE CONFIGURATION
NO EXTERNAL LOAD
STANDARD DAY
DROOPS – CRUISE

ENGINES: (2) J79-GE-8/10
FUEL GRADE: MIL-F-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL



CLIMB SPEEDS		
ALTITUDE FEET	CAS KNOTS	MACH
SEA LEVEL	410	.62
5,000	395	.65
10,000	380	.68
15,000	360	.71
20,000	345	.75
25,000	330	.78
30,000	310	.81
35,000	280	.83
40,000	260	.85

NOTE:

1. INCREASE GROSS WEIGHT BY 4000 LB AND ENTER CHART WITH ADJUSTED WEIGHT, TO OBTAIN CLIMB PERFORMANCE WITH TWO FLASHER PODS
2. TIME, FUEL AND DISTANCE START FROM SEA LEVEL AT CLIMB SPEED

A-5C-1A-93-69A

Figure 11-145

EXHAUST NOZZLES FAILED FULL OPEN

RECONNAISSANCE CONFIGURATION

MODEL: RA-5C
BASED ON: ESTIMATED DATA
DATE: 1 NOVEMBER 1964

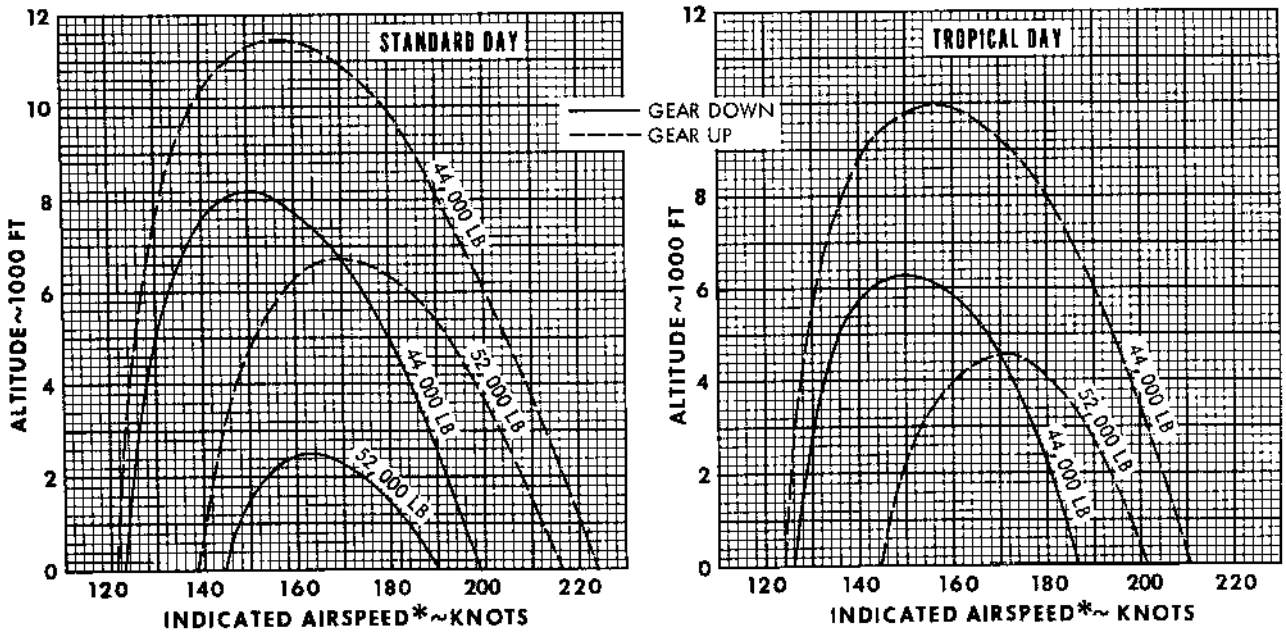
NO EXTERNAL LOAD

ENGINES: (2) J79 GE-8/10
FUEL GRADE: MIL-J-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL

LEVEL FLIGHT SPEED AND ALTITUDE CAPABILITY

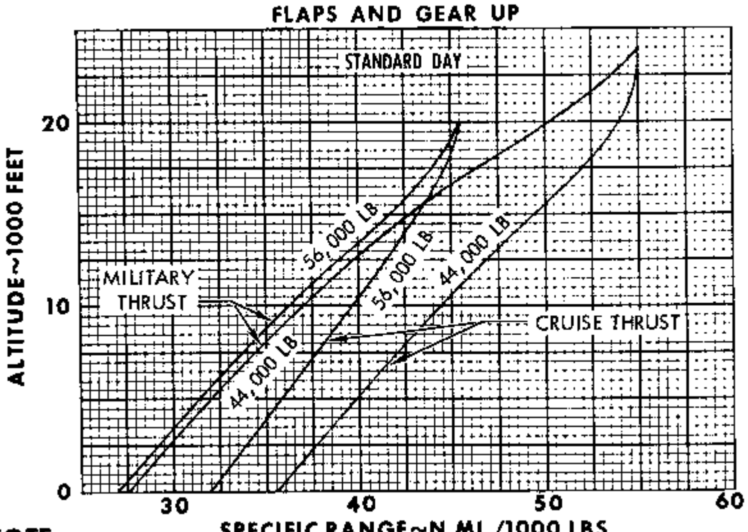
MILITARY THRUST

FLAPS — 30° DROOPS — 25°



MAXIMUM SPECIFIC RANGE

FLAPS AND GEAR UP



ESTIMATED SPEED FOR MAXIMUM SPECIFIC RANGE-CRUISE THRUST ~56,000 LBS G.W.		
ALTITUDE	CAS	MN
SEA LEVEL	282	.43
5,000	281	.46
10,000	277	.50
15,000	272	.54
20,000	267	.58

AMBIENT TEMPERATURE ~ °F		
ALTITUDE	STANDARD DAY	TROPICAL DAY
SEA LEVEL	59	90
10,000	23	51
20,000	-13	12
25,000	-30	-7

NOTE:

1. FOR 50,000 LBS GROSS WEIGHT REDUCE CRUISE IAS BY 10 KNOTS
2. FAILED NOZZLES SPECIFIC RANGE AND CRUISE IAS ON A TROPICAL DAY ARE APPROXIMATELY THE SAME AS ON A STANDARD DAY. THE MAXIMUM CRUISE ALTITUDE ON A TROPICAL DAY IS ABOUT 2000 FEET LOWER THAN THE STANDARD DAY MAXIMUM CRUISE ALTITUDE.
3. ON AIRCRAFT HAVING AFC 159 COMPLIED WITH, ALL SPEEDS (KIAS) MUST BE INCREASED BY 4 KNOTS

*SPC OFF, AIRCRAFT NOT HAVING AFC 159 COMPLIED WITH

A-5C-1A-93-71D

Figure 11-146

BINGO CHART - SINGLE ENGINE (RANGE DECISION)

RECONNAISSANCE CONFIGURATION

MODEL: RA-5C
DATA BASIS: FLIGHT TEST
DATE: 1 DECEMBER 1973

NO EXTERNAL LOAD
SEA LEVEL
STANDARD DAY

ENGINES: (2) J79-GE-8/10
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL.

GROSS WEIGHT WITH 1500 POUNDS OF FUEL = 44,900 POUNDS

DISTANCE TO GO (N. MI.)	GEAR AND FLAPS UP 290 KIAS	GEAR DOWN, FLAPS UP 230 KIAS*	GEAR DOWN, FLAPS-50° 150 KIAS
	FUEL REQUIRED (POUNDS)	FUEL REQUIRED (POUNDS)	FUEL REQUIRED (POUNDS)
10	2200	2300	3500
20	2400	2600	4900
30	2600	2900	6400
40	2800	3200	8000
50	3000	3500	9900
60	3200	3800	12,000
70	3400	4100	
80	3600	4600	(SEE NOTE 2.)
90	3800	4800	
100	3900	5100	
110	4100	5400	
120	4300	5700	
130	4600	6000	
140	4800	6300	
150	5000	6700	
160	5100	7100	
170	5300	7400	
180	5500	7700	
190	5700	8000	
200	6100	8300	

REMARKS:

* GEAR DOWN LIMIT SPEED

1. FUEL REQUIRED INCLUDES 400 POUNDS ALLOWANCE FOR ACCELERATION AND TURN TO DIVERT HEADING, AND 1500 POUNDS RESERVE FOR LANDING AT DESTINATION.

NOTES:

1. ADDITIONAL 15% FUEL REQUIRED FOR EXTERNAL STORES.
2. GEAR DOWN, FLAPS 50°, FUEL REQUIRED IS 5% LESS FOR J79-GE-10 ENGINES
3. SPEEDS SHOWN ARE FOR AFC 159 COMPLIED WITH OR WITHOUT AFC 159 AND SPC ON. SUBTRACT 4 KNOTS IF SPC IS OFF
4. INCREASE FUEL REQUIRED SHOWN FOR GEAR DOWN BY 6% IF GEAR DOORS ARE OPEN

A 5C 1A 93-67F

Figure 11-147

SINGLE ENGINE MAXIMUM RANGE

RECONNAISSANCE CONFIGURATION

NO EXTERNAL LOAD

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA
DATE: 1 DECEMBER 1973

ENGINES: (2) J79-GE-8/10
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB./GAL.

ALTITUDE	IMN	RPM (%)	NMI PER 1,000 LBS. FUEL	
15,000	.57	99	52	64,000 POUNDS GROSS WEIGHT
5,000	.51	93	48	
SL	.47	92	43	
15,000	.55	94	58	56,000 POUNDS GROSS WEIGHT
5,000	.49	91	51	
SL	.46	90	47	
25,000	.60	99	71	48,000 POUNDS GROSS WEIGHT
15,000	.54	92	64	
5,000	.46	90	56	
SL	.44	89	50	

RA-5C-1-93-70A

Figure 11-148

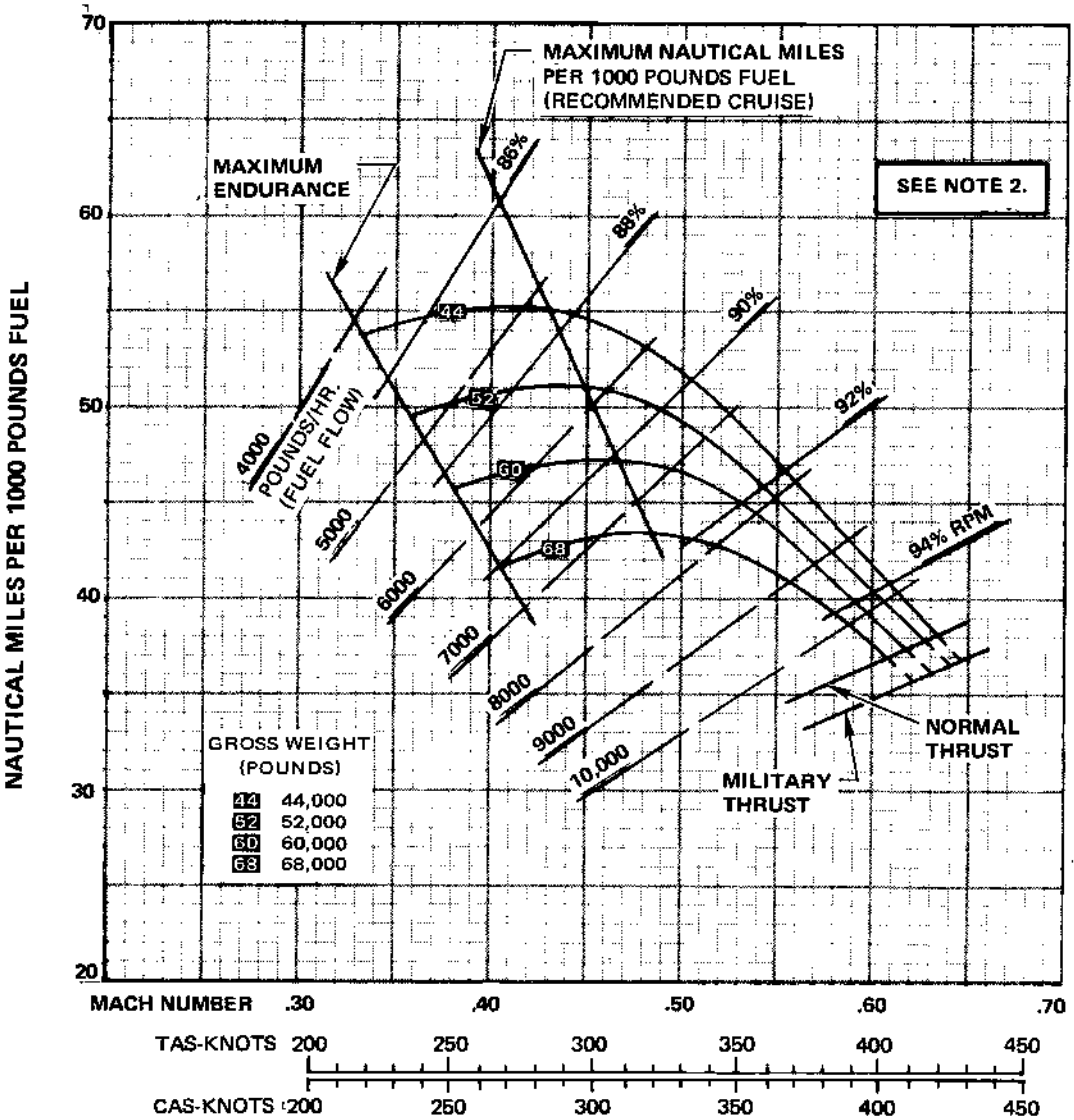
NAUTICAL MILES PER 1000 POUNDS FUEL — SINGLE ENGINE

RECONNAISSANCE CONFIGURATION
NO EXTERNAL LOAD
STANDARD DAY

SEA LEVEL

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA
DATE: 1 DECEMBER 1973

ENGINES: (2) J79-GE-8/10
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB./GAL.



NOTE:

1. REFER TO OPERATING LIMITATIONS SECTION
2. APPLY THE FOLLOWING ADJUSTMENTS TO DATA SHOWN, BASED ON ADDITIONAL FLIGHT TESTS:
   (a) FOR CLEAN CONFIGURATION DECREASE NAUTICAL MILES PER 1000 POUNDS FUEL BY 5% AND BEST CRUISE SPEED BY 0.02 MACH NO.
   (b) WITH FOUR EXTERNAL PYLONS, DECREASE NAUTICAL MILES PER 1000 POUNDS FUEL BY 10% AND BEST CRUISE SPEED BY 0.03 MACH NO.

RA-5C-1-93-42A

Figure 11-149

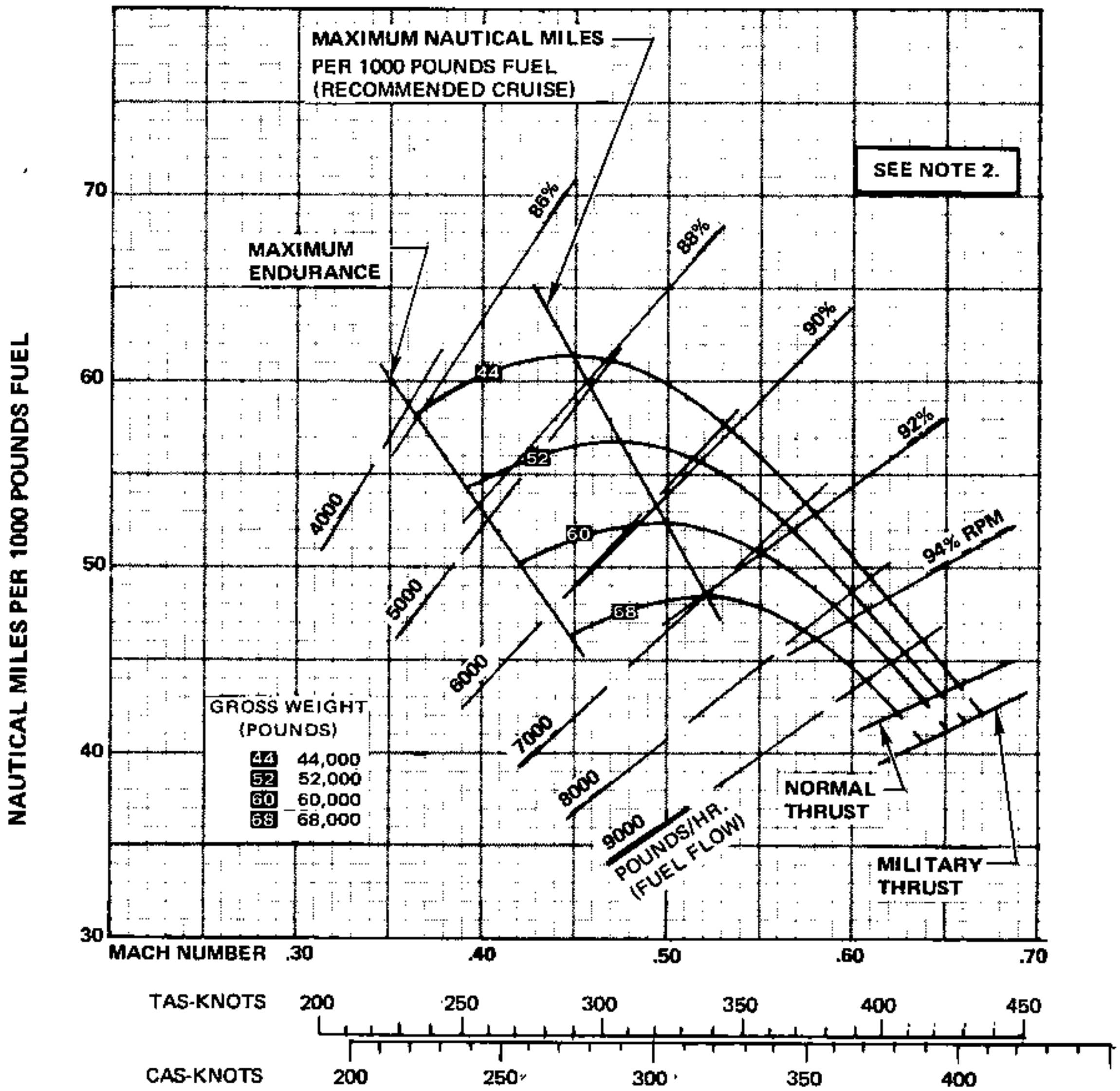
NAUTICAL MILES PER 1000 POUNDS FUEL — SINGLE ENGINE

RECONNAISSANCE CONFIGURATION
NO EXTERNAL LOAD
STANDARD DAY

5000 FT

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA
DATE: 1 DECEMBER 1973

ENGINES: (2) J79-GE-8/10
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB./GAL.



NOTE:

1. REFER TO OPERATING LIMITATIONS SECTION
2. APPLY THE FOLLOWING ADJUSTMENTS TO DATA SHOWN, BASED ON ADDITIONAL FLIGHT TESTS:
   (a) FOR CLEAN CONFIGURATION DECREASE NAUTICAL MILES PER 1000 POUNDS FUEL BY 5% AND BEST CRUISE SPEED BY 0.02 MACH NO.
   (b) WITH FOUR EXTERNAL PYLONS, DECREASE NAUTICAL MILES PER 1000 POUNDS FUEL BY 10% AND BEST CRUISE SPEED BY 0.03 MACH NO.

RA-5C-1-93-43A

Figure 11-150

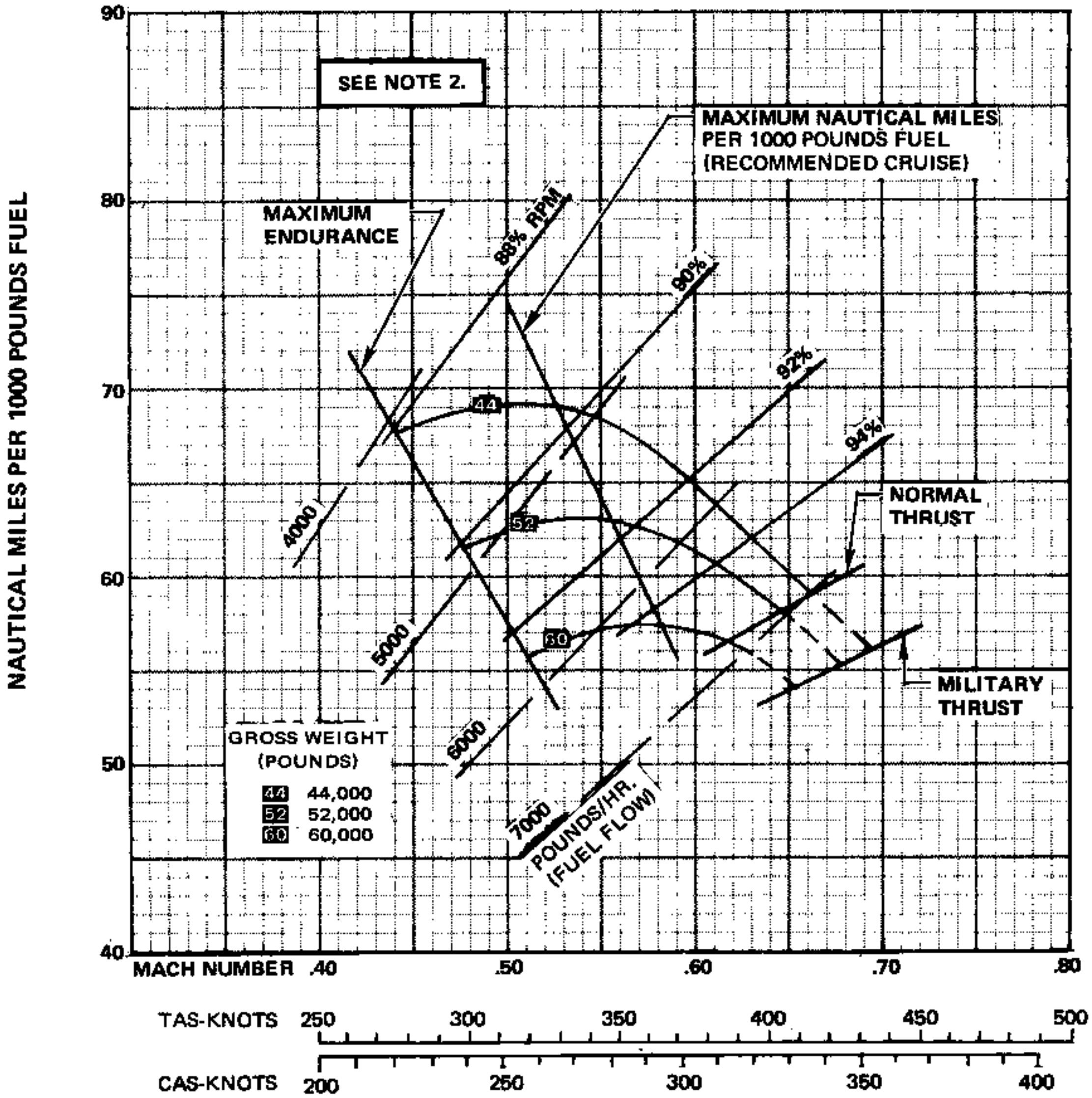
NAUTICAL MILES PER 1000 POUNDS FUEL — SINGLE ENGINE

RECONNAISSANCE CONFIGURATION
NO EXTERNAL LOAD
STANDARD DAY

15,000 FT

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA
DATE: 1 DECEMBER 1973

ENGINES: (2) J79-GE-8/10
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB./GAL.



NOTE:

1. REFER TO OPERATING LIMITATIONS SECTION
2. APPLY THE FOLLOWING ADJUSTMENTS TO DATA SHOWN, BASED ON ADDITIONAL FLIGHT TESTS:
   (a) FOR CLEAN CONFIGURATION DECREASE NAUTICAL MILES PER 1000 POUNDS FUEL BY 5% AND BEST CRUISE SPEED BY 0.02 MACH NO.
   (b) WITH FOUR EXTERNAL PYLONS, DECREASE NAUTICAL MILES PER 1000 POUNDS FUEL BY 10% AND BEST CRUISE SPEED BY 0.03 MACH NO.

RA-5C-1-93-44A

Figure 11-151

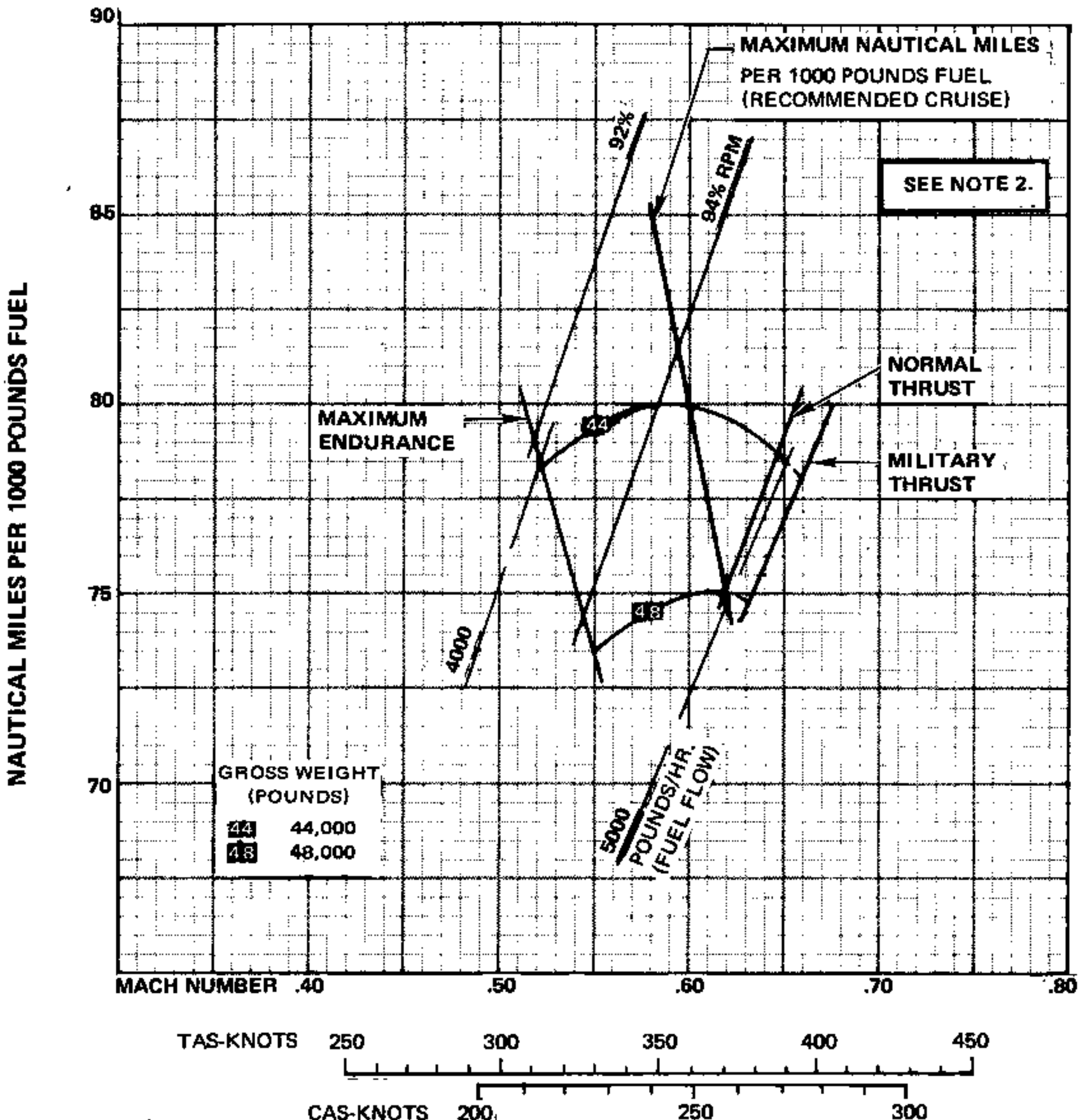
NAUTICAL MILES PER 1000 POUNDS FUEL — SINGLE ENGINE

RECONNAISSANCE CONFIGURATION
NO EXTERNAL LOAD
STANDARD DAY

25,000 FT

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA
DATE: 1 DECEMBER 1973

ENGINES: (2) J79-GE-8/10
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB./GAL.



NOTE:

1. REFER TO OPERATING LIMITATIONS SECTION
2. APPLY THE FOLLOWING ADJUSTMENTS TO DATA SHOWN, BASED ON ADDITIONAL FLIGHT TESTS:
   (a) FOR CLEAN CONFIGURATION DECREASE NAUTICAL MILES PER 1000 POUNDS FUEL BY 5% AND BEST CRUISE SPEED BY 0.02 MACH NO.
   (b) WITH FOUR EXTERNAL PYLONS, DECREASE NAUTICAL MILES PER 1000 POUNDS FUEL BY 10% AND BEST CRUISE SPEED BY 0.03 MACH NO.

RA-5C-1-93-45A

Figure 11-152

SINGLE ENGINE DECISION SPEEDS

SYMMETRICAL EXTERNAL STORES OR NO EXTERNAL LOAD

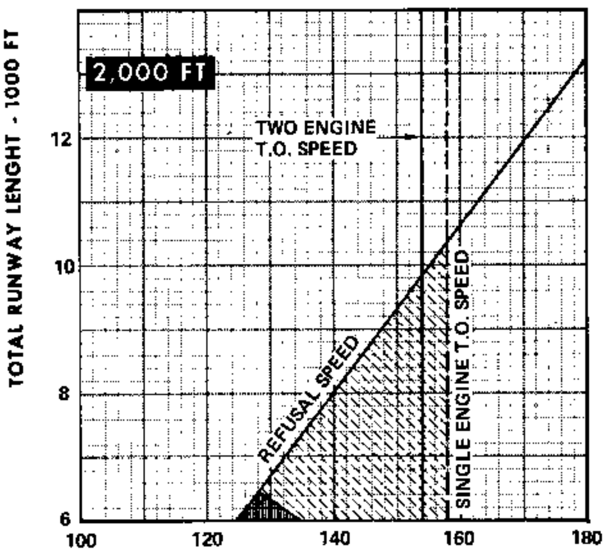
DRY RUNWAY — ZERO WIND

MODEL: RA-5C
BASED ON: ESTIMATED DATA
DATE: 15 JUNE 1970

MAXIMUM THRUST
FLAPS 30°/DROOPS 25°

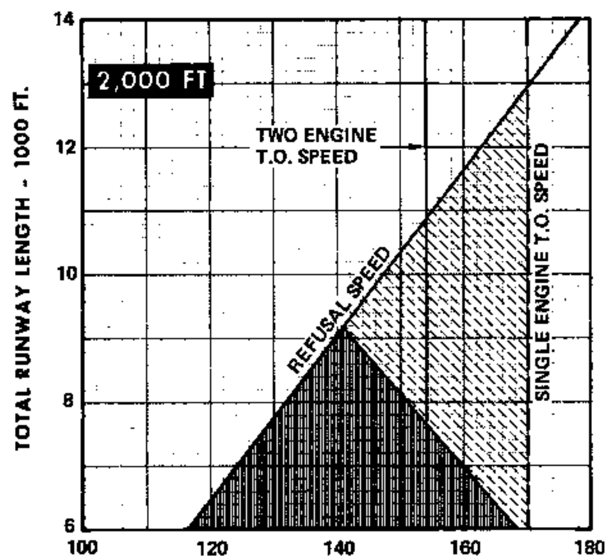
ENGINES: (2) J79-GE-10 (-8)*
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL
*SEE NOTE 6

66,000 LBS
STANDARD DAY (52°F)



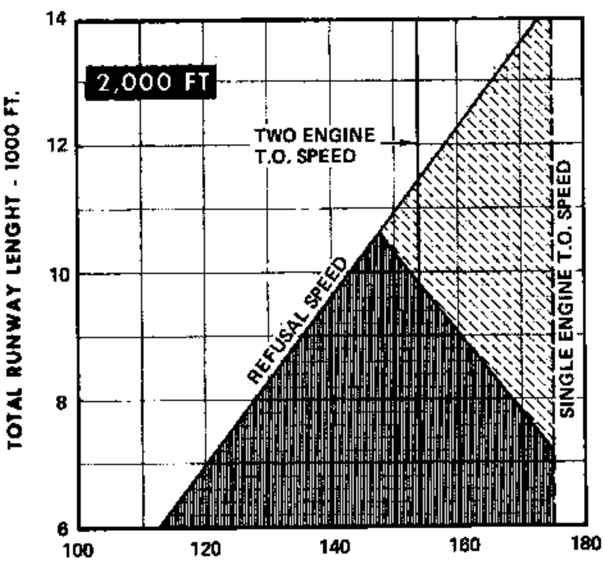
INDICATED AIRSPEED- KIAS

66,000 LBS
TROPICAL DAY (82°F)



INDICATED AIRSPEED - KIAS

66,000 LBS
HOT DAY (95°F)



INDICATED AIRSPEED - KIAS

REFUSAL SPEED EXCEEDED. SINGLE ENGINE TAKE-OFF CAPABILITY EXISTS WITH MARGINAL RATE OF CLIMB. (SEE NOTE 2)

INSUFFICIENT RUNWAY LENGTH FOR ABORT OR ACCELERATION TO SINGLE ENGINE TAKE-OFF SPEED. (SEE NOTES)

RA-5C-1-93-54A

Figure 11-153 (Sheet 1)

SINGLE ENGINE DECISION SPEEDS

SYMMETRICAL EXTERNAL STORES OR NO EXTERNAL LOAD

DRY RUNWAY – ZERO WIND

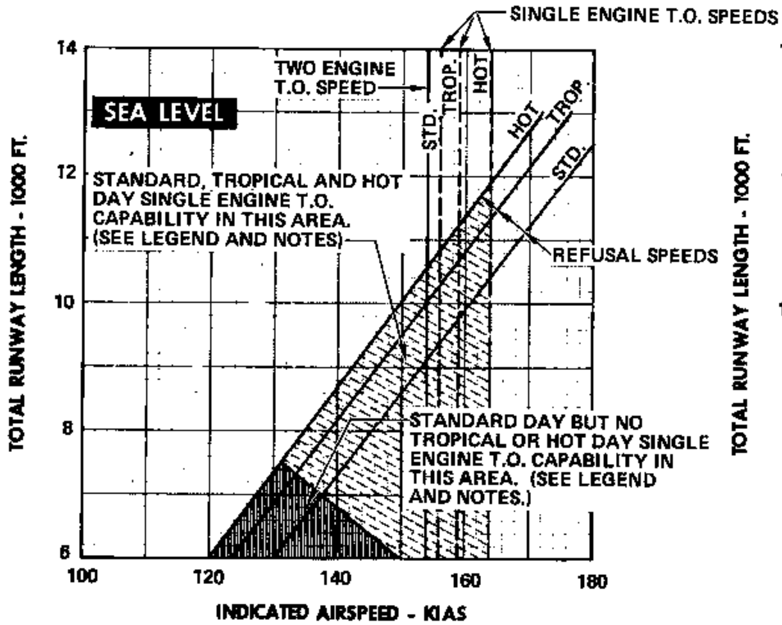
MODEL: RA-5C
BASED ON: ESTIMATED DATA
DATE: 15 JUNE 1970

MAXIMUM THRUST
FLAPS 30°/DROOPS 25°

ENGINES: (2) J79-GE-10 (-8)*
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB./GAL.
*SEE NOTE 6

66,000 LBS.

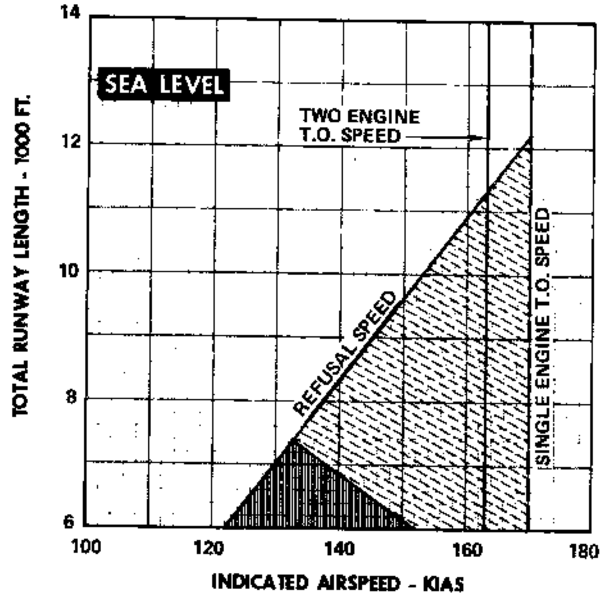
STANDARD DAY (59°F), TROPICAL DAY (90°F) AND HOT DAY (104°F)



74,000 LBS.

NO SINGLE ENGINE T.O. CAPABILITY EXISTS ON A TROPICAL OR HOT DAY

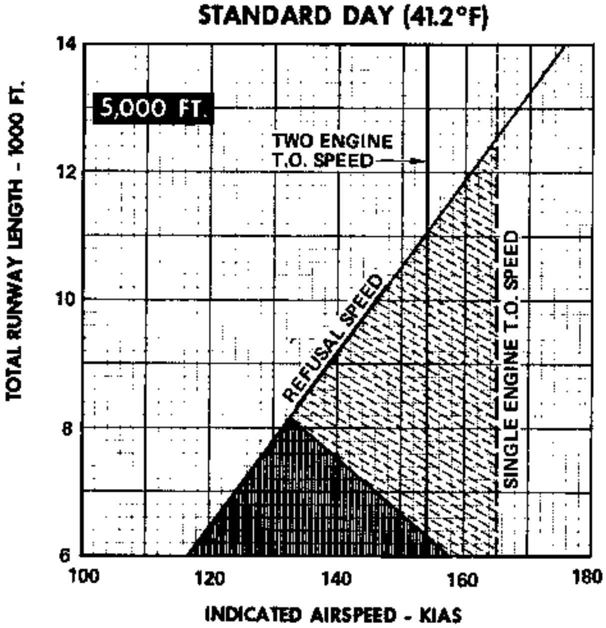
STANDARD DAY (59°F)



66,000 LBS.

NO SINGLE ENGINE T.O. CAPABILITY EXISTS ON TROPICAL OR HOT DAYS.

STANDARD DAY (41.2°F)



(light hatching) REFUSAL SPEED EXCEEDED. SINGLE ENGINE TAKE-OFF CAPABILITY EXISTS WITH MARGINAL RATE OF CLIMB. (SEE NOTE 2)

(dark hatching) INSUFFICIENT RUNWAY LENGTH FOR ABORT OR ACCELERATION TO SINGLE ENGINE TAKE-OFF SPEED.

NOTES:

1. TAKE-OFF SHOULD BE ABORTED IF ENGINE FAILURE OCCURS BEFORE REFUSAL SPEED IS EXCEEDED OR WITH ENGINE FAILURE AT ANY SPEED PRIOR TO TAKE-OFF WHERE FIELD ARRESTMENT GEAR IS AVAILABLE.
2. SINGLE ENGINE TAKE-OFF SPEEDS ARE BASED ON SPEED FOR APPROXIMATELY 300 FT./MIN. RATE OF CLIMB (GEAR DOWN). EXTERNAL STORES SHOULD BE JETTISONED AND GEAR RETRACTED AS SOON AS POSSIBLE FOR INCREASED RATE OF CLIMB. CLIMB CAPABILITIES ARE BASED ON WINGS LEVEL FLIGHT.
3. DO NOT APPLY AFT STICK UNTIL REACHING SINGLE ENGINE TAKE-OFF SPEED AS THE TAKE-OFF DISTANCE WILL BECOME EXCESSIVE.
4. REDUCE REFUSAL SPEEDS BY 13 KIAS FOR WET RUNWAY CONDITIONS.
5. REFER TO EMERGENCY PROCEDURES, SECTION V, FOR ENGINE FAILURE ON TAKE-OFF.
6. FOR AIRCRAFT HAVING AFC 328 COMPLIED WITH AND J79-GE-8 ENGINES INSTALLED, SEE FIGURES 11-135 AND 11-136.

RA-5C-1-93-55A

Figure 11-153 (Sheet 2)

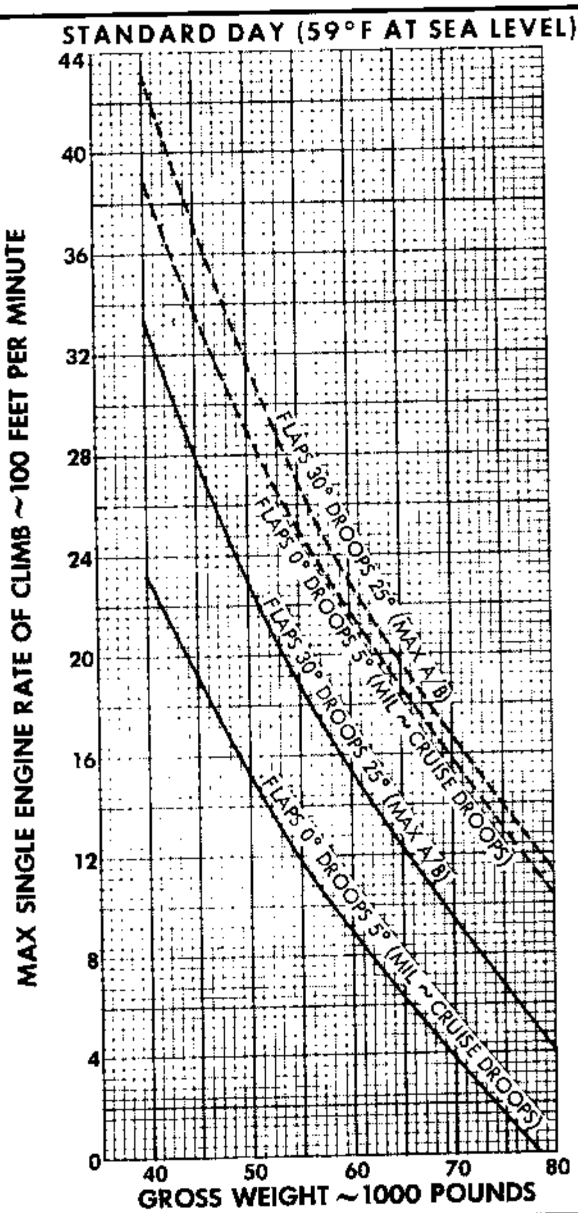
SINGLE ENGINE MAXIMUM RATE OF CLIMB vs. GROSS WEIGHT

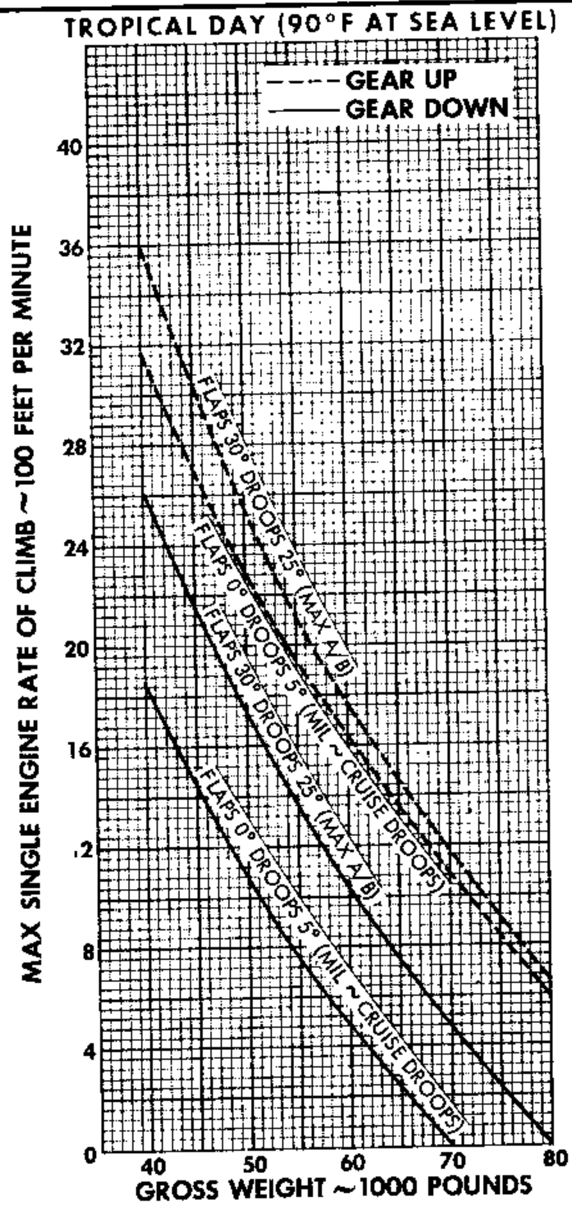
MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NR69H-2)
DATE: 15 JUNE 1970

RECONNAISSANCE CONFIGURATION

SEA LEVEL

ENGINES: (2) J79-GE-10 (-8)*
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL
*SEE NOTE 3





SAFE SINGLE ENGINE SPEED AND SPEED FOR MAXIMUM RATE OF CLIMB AT SEA LEVEL

GROSS WEIGHT	FLAPS = 30° DROOPS = 25°			FLAPS = 0° DROOPS = 5° (CRUISE)		
	SAFE SPEED	MAX R/C GEAR DN	MAX R/C GEAR UP	SAFE SPEED	MRT MAX R/C GEAR DN	MRT MAX R/C GEAR UP
POUNDS	KIAS	KIAS	KIAS	KIAS	KIAS	KIAS
80,000	200	—	224	266	—	310
72,000	172	202	220	246	230	302
64,000	150	196	216	226	230	295
56,000	140	190	214	206	224	289
48,000	135	183	211	186	214	283
42,000	135	180	209	186	205	280

NOTE:

1. DECREASE SINGLE ENGINE MAX RATE OF CLIMB BY 100 FEET PER MINUTE FOR EACH 1000 FEET OF FIELD ELEVATION ABOVE SEA LEVEL.
2. WITH A FLAP/DROOP SETTING OF 50°/50°, GEAR DOWN, 50,000 LB GROSS WEIGHT, THE SINGLE ENGINE MAXIMUM RATE OF CLIMB AT MAX THRUST IS APPROXIMATELY 550 FEET PER MINUTE ON A STANDARD DAY, AND 200 FEET PER MINUTE ON A TROPICAL DAY. THE SAFE SINGLE ENGINE SPEED FOR THIS CONDITION IS 135 KIAS.
3. FOR AIRCRAFT HAVING AFC 328 COMPLIED WITH AND J79-GE-8 ENGINES INSTALLED, SEE FIGURE 11-137.

A-5C-1A-93-136B

Figure 11-154

SINGLE ENGINE RATE OF CLIMB

FLAPS 30° DROOPS 25°

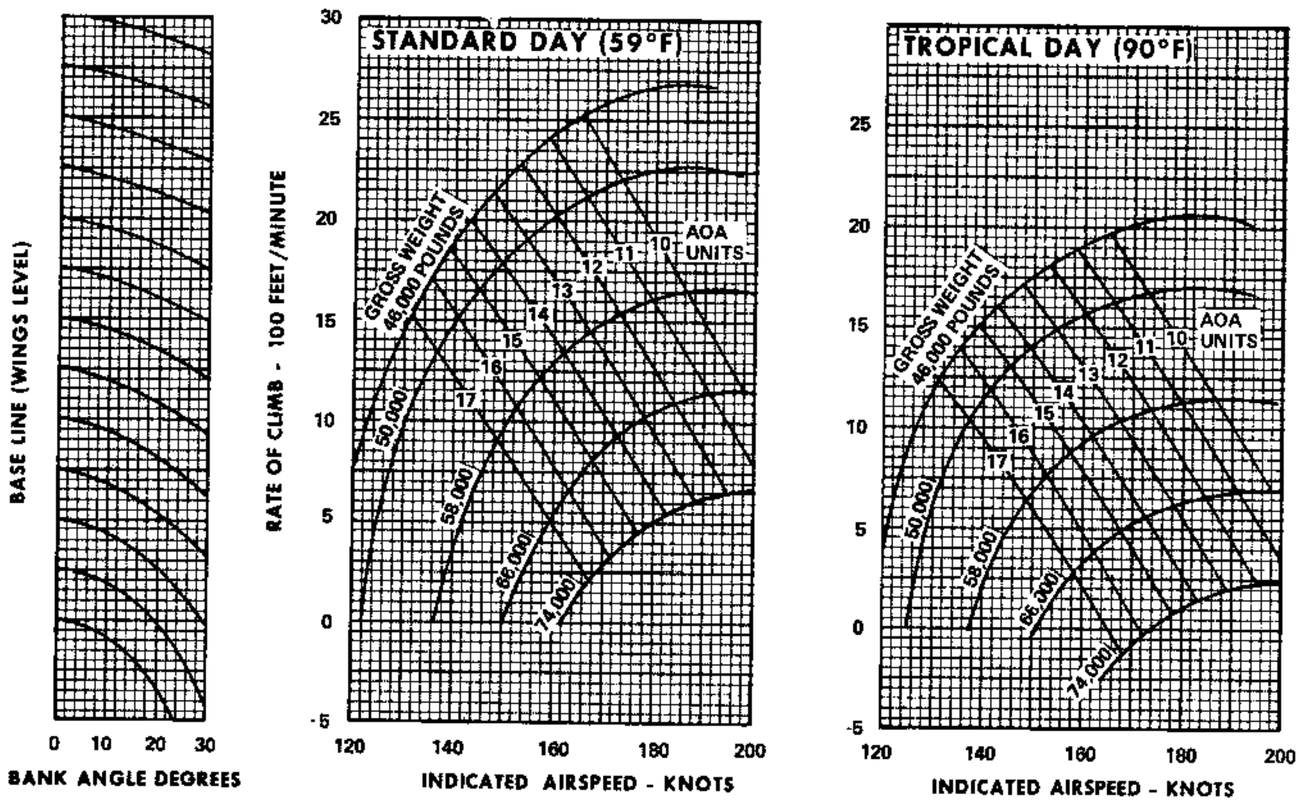
GEAR DOWN

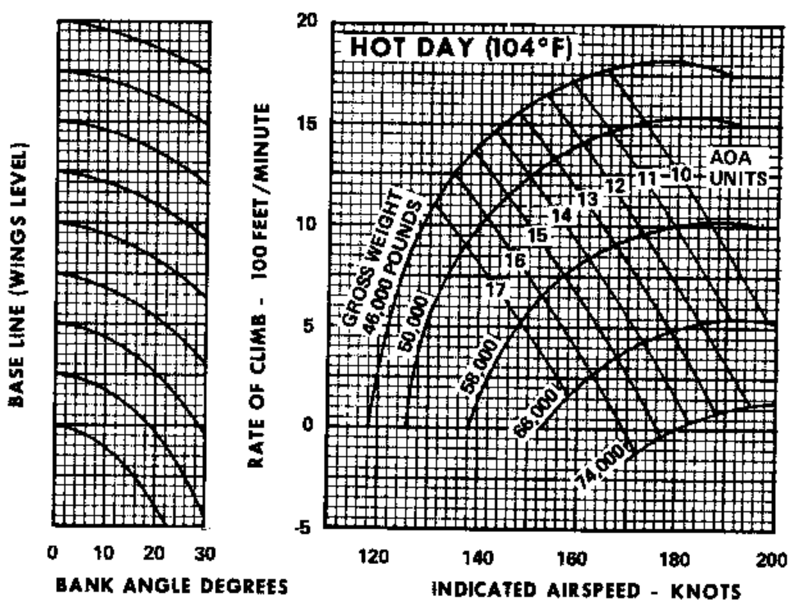
MAXIMUM AFTERBURNER

SEA LEVEL

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NR69H-2)
DATE: 15 JUNE 1970

ENGINES: (2) J79-GE-10 (-8)*
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LBS/GAL
*SEE NOTE 4





NOTE:

1. RATE OF CLIMB IS INCREASED 400 FT/MIN WITH GEAR RETRACTED.
2. 74,000 POUNDS G.W. DATA BASED ON SYMMETRICAL EXTERNAL STORES.
3. REFER TO SINGLE ENGINE MINIMUM CONTROL SPEED CHART.
4. FOR AIRCRAFT HAVING AFC 328 COMPLIED WITH AND J79-GE-8 ENGINES INSTALLED, SEE FIGURE 11-138 AND NOTE THAT AIRSPEED VS. AOA UNITS SHOWN WILL BE APPROXIMATELY 3 KNOTS HIGH DUE TO WING LEADING EDGE FILLETS.

RA-5C-1-93-59A

Figure 11-155

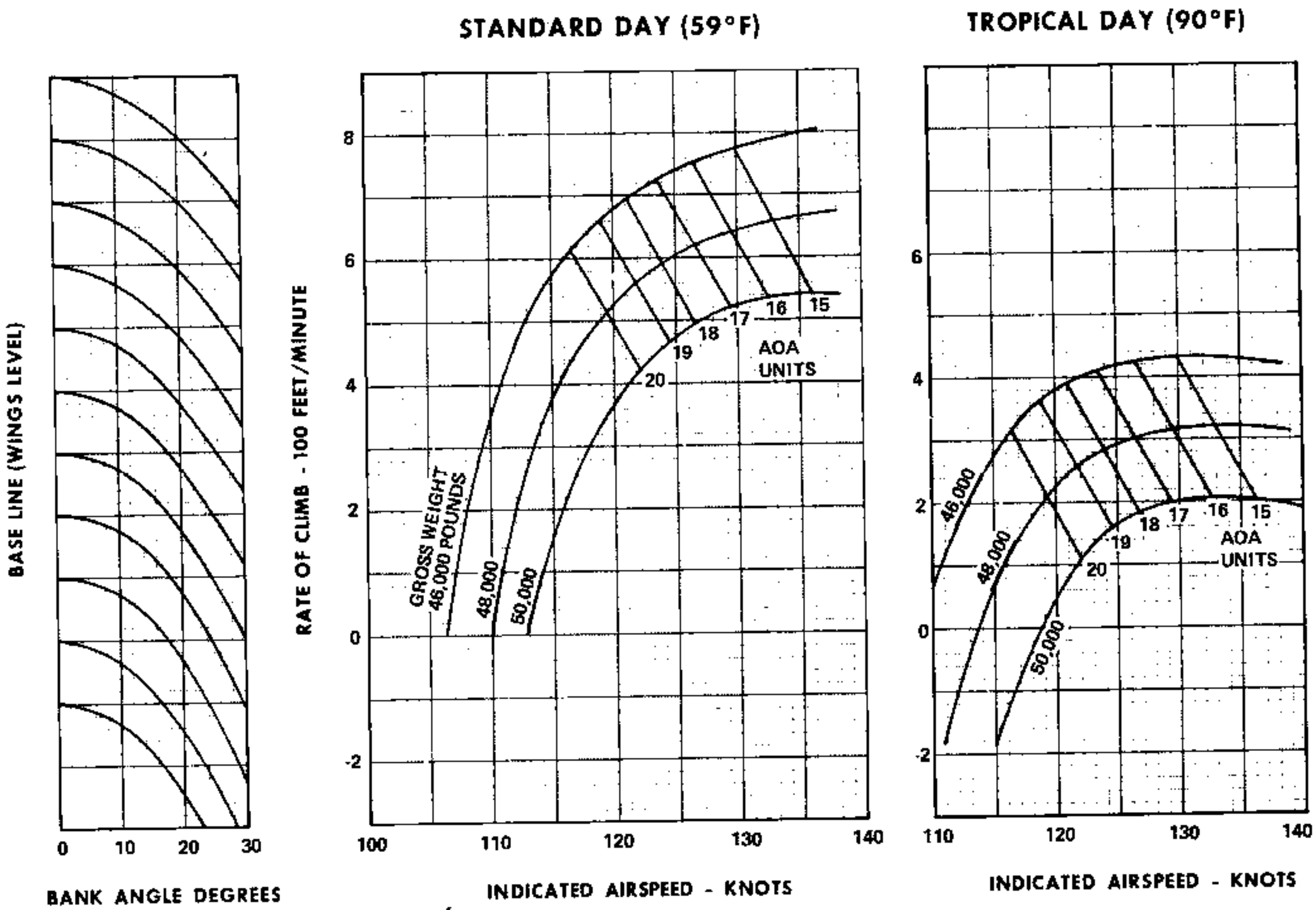
SINGLE ENGINE RATE OF CLIMB

FLAPS 50° DROOPS 50°
GEAR DOWN
MAXIMUM AFTERBURNER

SEA LEVEL

MODEL: RA-5C
BASED ON: FLIGHT DATA (NR69H-2)
DATE: 15 JUNE 1970

ENGINES: (2) J79-GE-10 (-8)*
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL
*SEE NOTE 3.



NOTE:

1. RATE OF CLIMB IS INCREASED 400 FT/MIN WITH GEAR RETRACTED.
2. REFER TO SINGLE ENGINE MINIMUM CONTROL SPEED CHART.
3. FOR AIRCRAFT HAVING AFC 328 COMPLIED WITH AND J79-GE-8 ENGINES INSTALLED, SEE FIGURE 11-139 AND NOTE THAT AIRSPEED VS. AOA UNITS SHOWN WILL BE APPROXIMATELY 3 KNOTS HIGH DUE TO WING LEADING EDGE FILLETS.

RA-5C-1-93-60A

Figure 11-156

SINGLE ENGINE SPEEDS

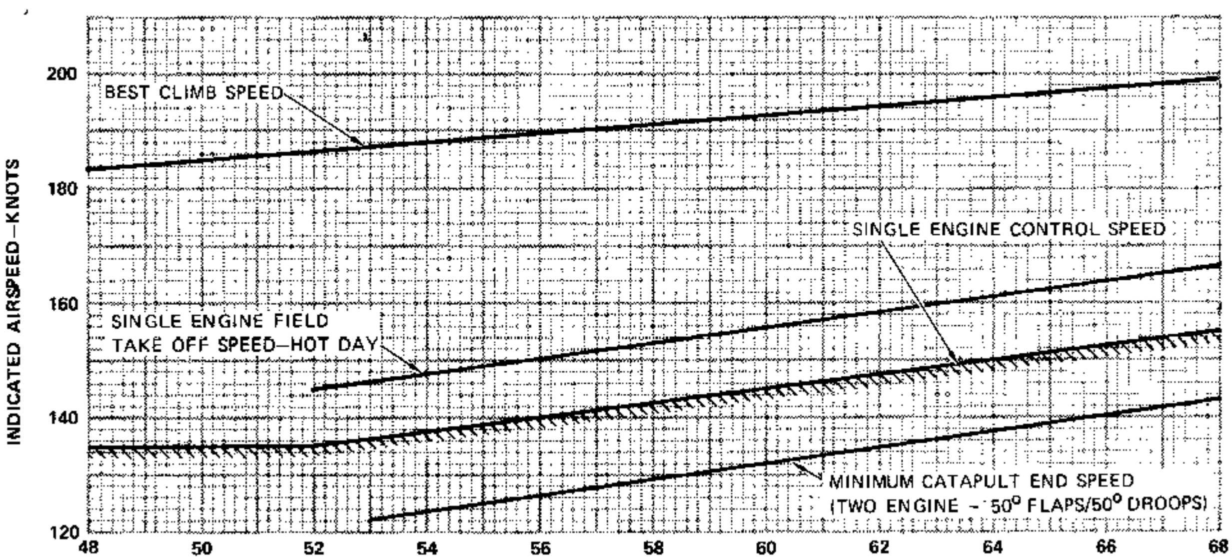
FLAPS 30°/DROOPS 25°
GEAR DOWN
MAXIMUM THRUST
SEA LEVEL

MAX THRUST

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA
DATE: 15 DECEMBER 1970

ENGINE: (2) J79-GE-10 (-8)*
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL
*SEE NOTE 2.

STANDARD (59°F), TROPICAL (90°F), OR HOT DAY (104°F)



GROSS WEIGHT—1000 POUNDS

NOTE:

1. REFER TO SINGLE ENGINE RATE OF CLIMB CHART FOR ADDITIONAL DATA.
2. FOR AIRCRAFT HAVING AFC 328 COMPLIED WITH AND J79-GE-8 ENGINES INSTALLED, SEE FIGURE 11-140 AND NOTE THAT AIRSPEED VS. AOA UNITS SHOWN WILL BE APPROXIMATELY 3 KNOTS HIGH DUE TO WING LEADING EDGE FILLETS.
3. SINGLE ENGINE CONTROL SPEEDS ARE MINIMUM CONTROL SPEEDS. SPOILER EFFECTIVNESS DETERIORATION BEGINS AT AIRSPEEDS EVEN HIGHER THAN MINIMUM CONTROL SPEEDS, THEREFORE PROPER USE OF DIRECTIONAL CONTROL IS NECESSARY TO PICK UP A WING AND MAINTAIN WINGS LEVEL.

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RA-5C-1-93-65B

Figure 11-157

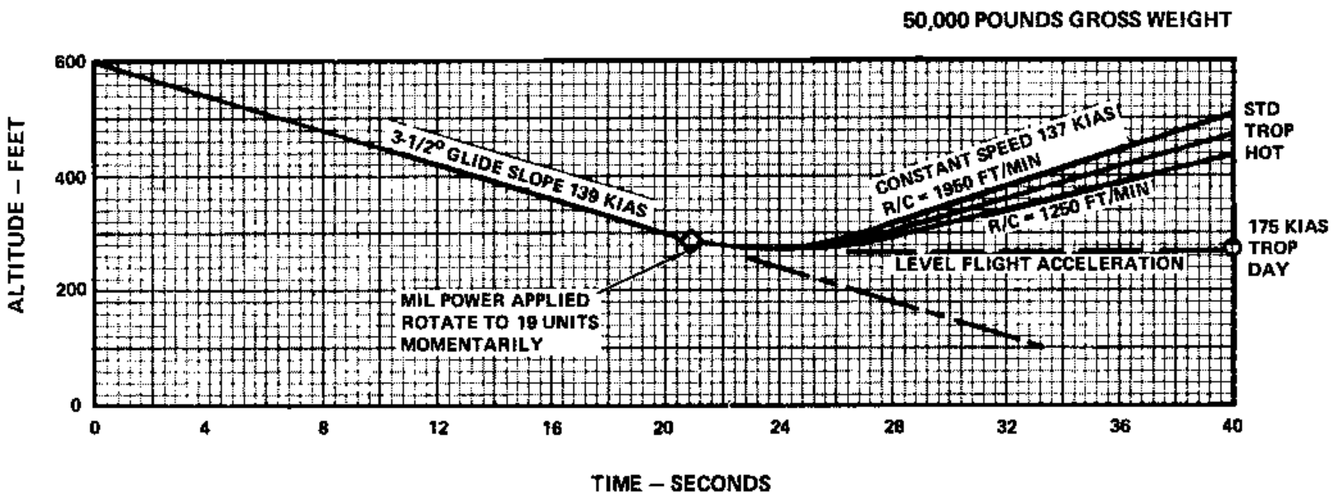
TWO ENGINE NORMAL WAVE-OFF

FLAPS 50°/DROOPS 50°
GEAR DOWN

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NR69H-2)
DATE: 15 JUNE 1970

ENGINES: (2) J79-GE-10 (-8)*
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB/GAL
*SEE NOTE

STANDARD DAY (59°F) - TROPICAL DAY (90°F) - HOT DAY (104°F)



NOTE:

FOR AIRCRAFT HAVING AFC 328 COMPLIED WITH AND J79-GE-8 ENGINES INSTALLED, SEE FIGURE 11-141 AND NOTE THAT AIRSPEEDS SHOWN WILL BE APPROXIMATLEY 3 KNOTS HIGH DUE TO WING LEADING EDGE FILLETS.

RA-5C-1-93-68A

Figure 11-158

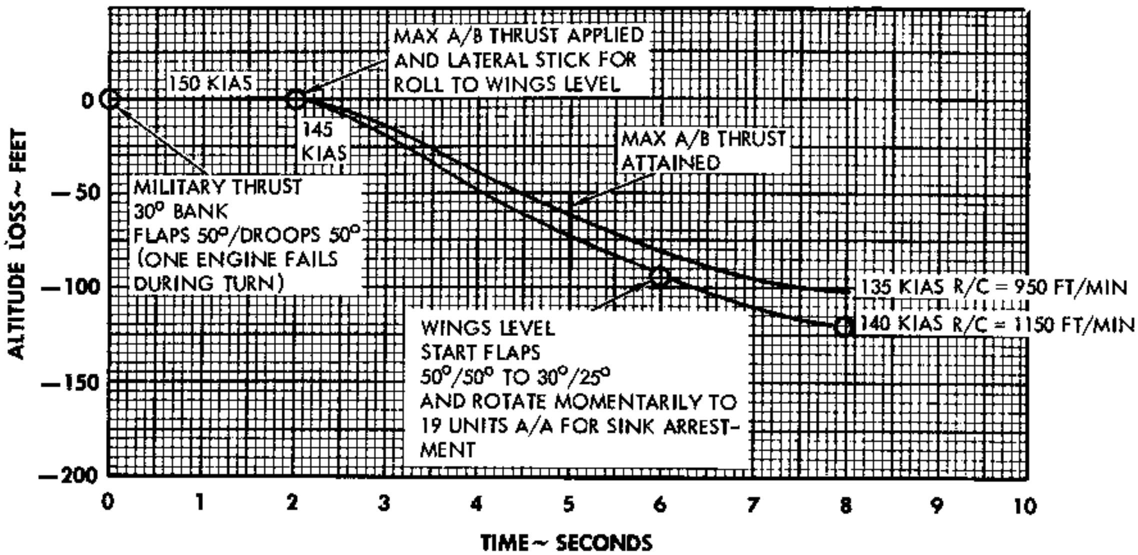
SINGLE ENGINE FAILURE DURING LEVEL OR TURNING FLIGHT

MODEL: RA-5C
BASED ON: ESTIMATED DATA
DATE: 15 JUNE 1970

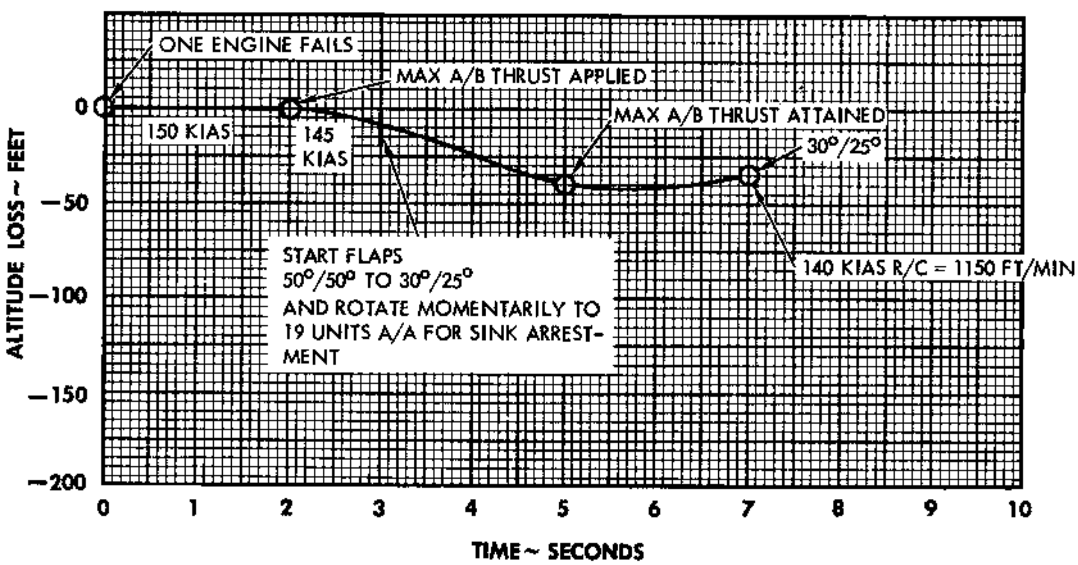
TROPICAL DAY (90°F)
50,000 POUNDS GROSS WEIGHT
FLAPS AND GEAR DOWN

ENGINES: (2)J79-GE-10(-8)*
FUEL GRADE: MIL-T-5624(JP-5)
FUEL DENSITY: 6.8 LB/GAL
*SEE NOTE 2.

30° BANK



LEVEL FLIGHT



NOTE:
1. ENGINE ON INSIDE OF TURN ASSUMED FAILED. IF ENGINE ON OUTSIDE OF TURN FAILED, TIME TO ROTATE TO WINGS LEVEL, WOULD BE REDUCED FROM 4 SECONDS TO 2 SECONDS.
2. FOR AIRCRAFT HAVING AFC 328 COMPLIED WITH AND J79-GE-8 ENGINES INSTALLED, SEE FIGURE 11-142 AND NOTE THAT AIRSPEEDS SHOWN WILL BE APPROXIMATELY 3 KNOTS HIGH DUE TO WING LEADING EDGE FILLETS.

RA-5C-1-93-64A

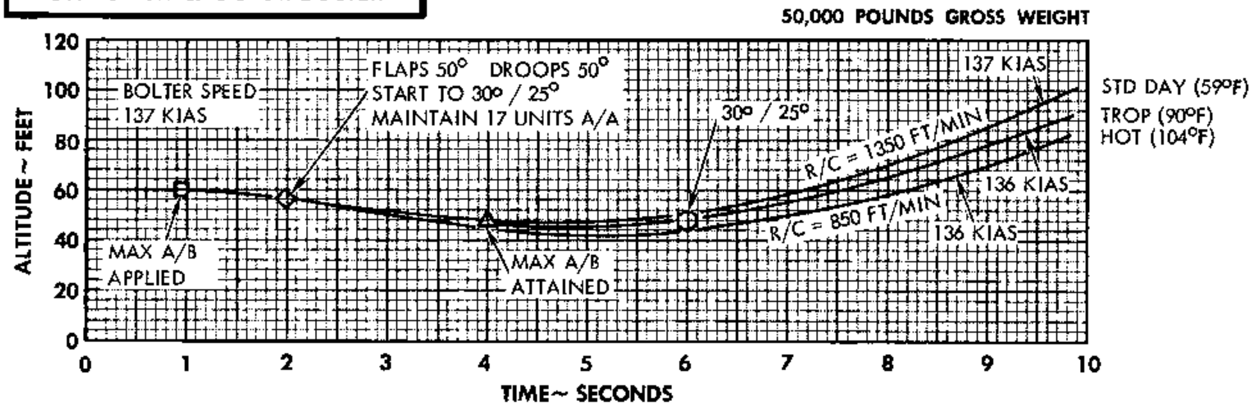
Figure 11-159

SINGLE ENGINE FAILURE DURING CARRIER OPERATIONS

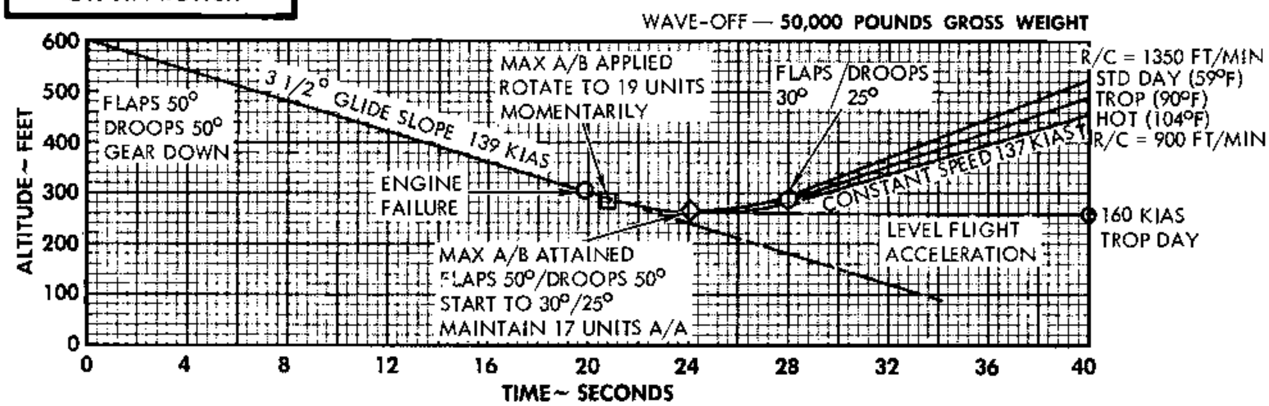
MODEL: RA-5C
BASED ON: ESTIMATED DATA
DATE: 15 JUNE 1970

ENGINES: (2)J79-GE-10 (-8)*
FUEL GRADE: MIL-T-5624(JP-5)
FUEL DENSITY: 6.8 LB/GAL
*SEE NOTE

ON TOUCH & GO OR BOLTER



ON APPROACH



NOTE

FOR AIRCRAFT HAVING AFC 328 COMPLIED WITH AND J79-GE-8 ENGINES INSTALLED, SEE FIGURE 11-143. AND NOTE THAT AIRSPEEDS SHOWN WILL BE APPROXIMATELY 3 KNOTS HIGH DUE TO WING LEADING EDGE FILLETS.

RA-5C-1-93-69A

Figure 11-160

ZERO FLAPS LANDING AND STOPPING DISTANCES

SEA LEVEL
ZERO WIND
HARD SURFACE DRY RUNWAY

MODEL: RA-5C
BASED ON: FLIGHT TEST DATA (NR69H-2)
DATE: 15 JUNE 1970

ENGINES: (2) J79-GE-10(-8)*
FUEL GRADE: MIL-T-5624 (JP-5)
FUEL DENSITY: 6.8 LB./GAL.
*SEE NOTE 3

GROSS WEIGHT (POUNDS)	SPEED KIAS		DISTANCE FEET			
	APPROACH	M.S.B.I.	TOTAL DIST. OVER 50 FT. OBSTACLE	TOTAL GROUND ROLL STOPPING DISTANCE	AERO BRAKING	WHEEL BRAKING
DROOPS 0° OR 5°						
48000	178	133	10,100	9,000	5200	3800
52000	185	130	11,600	10,500	6800	3700
56000	193	128	13,300	12,200	8500	3700
DROOPS 25°						
48000	164	133	8700	7600	3800	3800
52000	170	130	10,300	9200	5500	3700
56000	176	128	11,900	10,800	7100	3700
DROOPS 50°						
48000	164	133	11,800	10,700	6900	3800
52000	170	130	14,000	12,900	9200	3700
56000	176	128	16,300	15,200	11,500	3700

NOTES:

1. STOPPING DISTANCES ARE BASED ON FULL (NOSE HIGH) AERODYNAMIC BRAKING FROM TOUCHDOWN TO MAXIMUM RECOMMENDED KIAS FOR INITIATION OF WHEEL BRAKING (M.S.B.I.). WHEEL BRAKING IS USED FROM THE MAXIMUM KIAS FOR INITIATION OF WHEEL BRAKING AND INCLUDES 3 SECOND DELAY FOR BRAKE APPLICATION.
2. MINIMUM DIRECTIONAL CONTROL SPEED WITH ZERO FLAPS IS 123 KNOTS FOR A 6 KNOT CROSS WIND. THREE POINT ATTITUDE WITH NOSE WHEEL STEERING REQUIRED BELOW THIS SPEED.
3. THIS CHART IS APPLICABLE TO AIRCRAFT HAVING AFC 328 COMPLIED WITH AND J79-GE-8 ENGINES INSTALLED.
4. IF AVAILABLE, FLAP EXTENSION DURING ROLL-OUT MAY REDUCE LANDING ROLL TO SAFE DISTANCE.

EFFECT OF NON STANDARD CONDITIONS

CONDITION	CHANGE IN TOTAL GROUND ROLL STOPPING DISTANCE
1. FIELD ELEVATION 2000 FT.	10% INCREASE
2. RUNWAY TEMPERATURE +20° C ABOVE STD. -20° C BELOW STD.	 10% INCREASE 10% DECREASE
3. HEADWIND 20 KTS.	20% DECREASE
4. WET RUNWAY (RCR 12)	50% INCREASE
5. ICY RUNWAY (RCR 5)	175% INCREASE (MULTIPLY BY 2.75)

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RA-5C-1-93-49A

Figure 11-161

PART 11 — UREST COMPUTER

UREST COMPUTER

Cruise control performance data are available in UREST computer form. General information, configuration lists, and requisition instructions are contained in NATC Universal REST Computer Bulletin 1-66. Bulletin and UREST computer requisitions should be addressed to:

Commander, Naval Air Test Center (FT2125)
Patuxent River, Maryland 20670

PART 12 — RECONNAISSANCE SYSTEMS DATA

RECON PERFORMANCE CHARTS

PHOTOGRAPHIC PERFORMANCE DATA

The camera coverage data shown in figure 11-162 consist of field of view data with changing altitude for the vertical and oblique cameras. The upper plot (stabilized vertical and split vertical cameras) presents one-half the total distance covered; i.e., the distance from the nadir (camera principal) point outward to the limit of field of view. In order to obtain total lateral coverage of the vertical cameras, the distance shown for any altitude must be doubled. The lower plot (oblique cameras) presents the distance from nadir point forward (for the forward oblique) or laterally (for the side obliques) to the nearest point which falls within camera viewing range. Distance shown is maximum offset from target for given altitude. These data may be used to preplan the minimum altitude at which an offset photo pass can be made, while maintaining the target within camera view. In addition, the distance data may be used to obtain the minimum distance for forward oblique camera operation.

CAMERA COVERAGE CHARTS

The oblique, vertical, and panoramic camera coverage charts (figures 11-163 through 11-165) show straight-line ground distance coverable at all operating altitudes. Coverage available for partial and full loads of film (exposures and footage) is shown for various altitudes. Coverage for the 3-inch panoramic is based on a constant 0.97 Mach. Coverage for the 18-inch panoramic is shown for the aircraft operating at the minimum altitude for best photo resolution. Figure 11-165A displays the maximum altitude and airspeed envelope for operation of the KS-69B 18-inch pan camera with no ground gap.

SIDE OBLIQUE ANGULAR COVERAGE CHART

Ground distances may be determined from figure 11-166. These data may be used as an aid in determining proper offset and altitude for an oblique photography run. Angular ground coverage is presented for both the 6- and 12-inch focal length cameras. Angular ground coverage data for the vertical and tri-fan camera configurations are presented in figures 11-166A through 11-166D.

NIGHT PHOTOGRAPHY ENVELOPE

Figure 11-167 presents night photo performance in terms of speed, altitude, flasher mode, altitude mode, and film type to achieve acceptable photography with a minimum of $\Delta D = 0.1$. This chart may be used to determine best setting (ALTERNATE/SIMULTANEOUS) for effective night photography at various speeds and altitudes. For single-pod operation, see figure 11-167 and the FNC-82C photo computer can be used to adjust V/H knob for different overlap settings. For 20 percent overlap, set altitude opposite 6 inches (lens focal length) on photo computer. Select ground speed and read out exposure time, then multiply this time by a factor of 2. Flasher recharged capabilities are shown in figure 11-168.

EXAMPLE:

Altitude—1000 feet
Ground speed—360 knots
Exposure interval—0.5 second (60 percent overlap)
$2 \times 0.5 = 1.0$ (20 percent overlap)

In flight at predetermined altitude and speed, switch viewfinder to MAN, run off a few frames, and adjust V/H knob to the 20 percent exposure time.

Note

For reduced overlap, select the HIGH ALT position of the vertical camera altitude mode switch. For single-pod operation, ALTERNATE flasher mode should be preselected for best night results.

IR MAPPING COVERAGE

The IR Mapping Coverage chart (figure 11-169) shows the straight-line ground distance which can be mapped at all operating altitudes. Data is given for 150-, 200-, 250-, 300-, and 350-foot rolls of film. IR mapping angular coverage is given on figures 11-170 for altitudes up to 10,000 feet.

PANORAMIC CAMERA LIMITS

The Panoramic Camera Limits chart (figure 11-171) shows panoramic camera capability compared to aircraft performance.

SLR RECORDER TIME AND DISTANCE

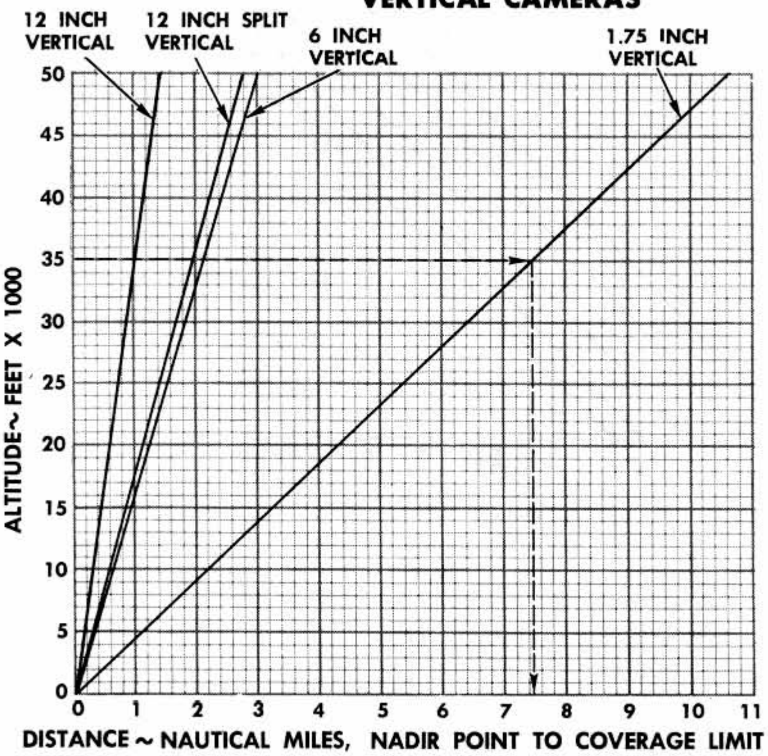
The SLR Recorder Time and Distance and SLR Spot Size charts are presented in the Supplemental NATOPS Flight Manual (NAVAIR 01-60ABC-1A).

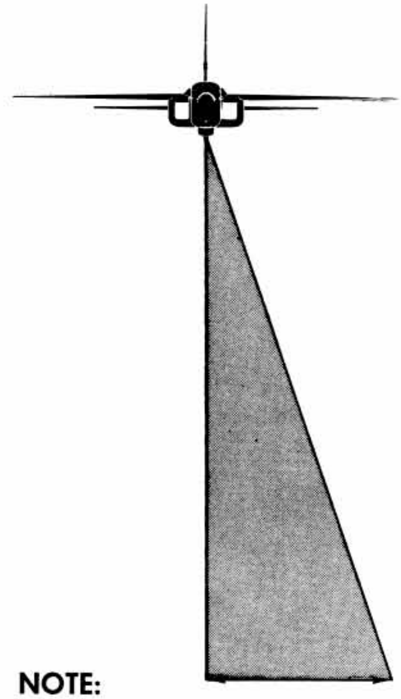
PECM PLANNING GUIDE

A nomogram for use in planning PECM electronic reconnaissance runs on known emitters is presented in Section XI, Part 12 of the Supplemental NATOPS Flight Manual (NAVAIR 01-60ABC-1A).

CAMERA COVERAGE DATA

VERTICAL CAMERAS

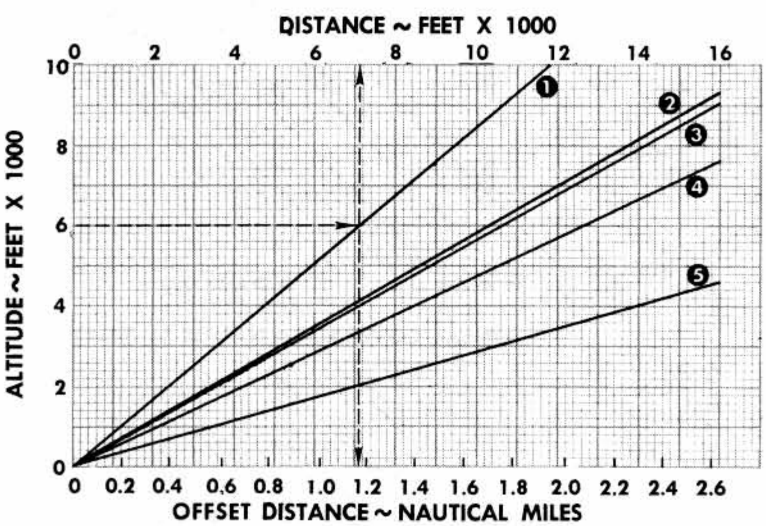


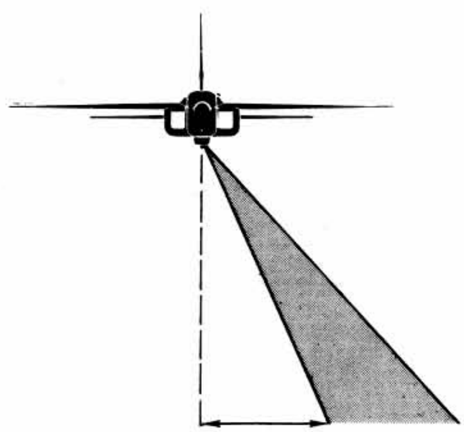


NOTE:

Double distance shown to obtain total coverage.

OBLIQUE CAMERA MINIMUM OFFSET





NOTE:

Distance shown is minimum offset.

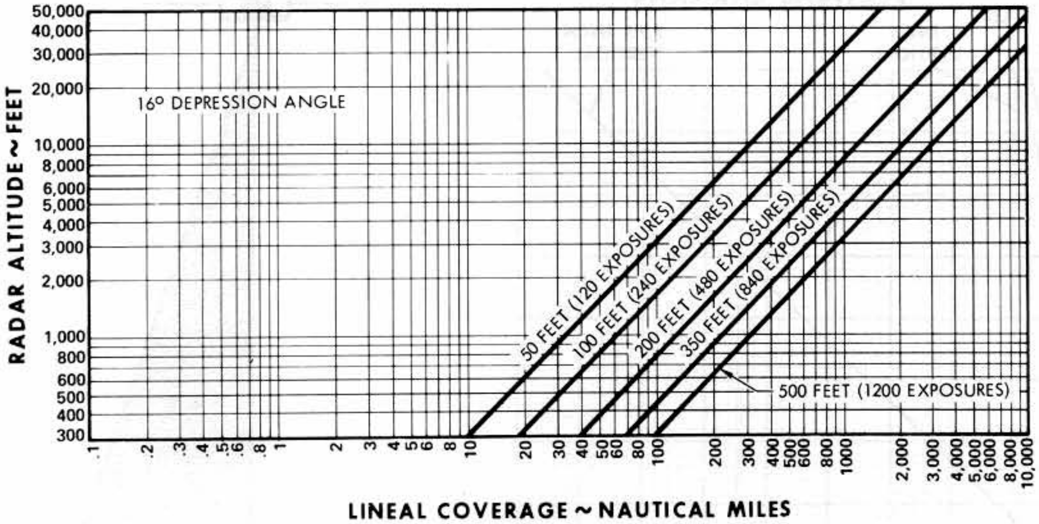
1. 6-INCH OBLIQUE-NADIR TO START OF COVERAGE (19.75° DEPRESSION)
2. 12-INCH OBLIQUE-NADIR TO START OF COVERAGE (19.75° DEPRESSION)
3. 6-INCH FORWARD OBLIQUE-DISTANCE AHEAD TO START OF COVERAGE (2.0° A/A)
4. 6-INCH OBLIQUE-NADIR TO START OF COVERAGE (5° DEPRESSION)
5. 12-INCH OBLIQUE-NADIR TO START OF COVERAGE (5° DEPRESSION)

A-5C-1C-78-12C

Figure 11-162

OBLIQUE CAMERA COVERAGE

KA-51A (6-INCH)



FORWARD

- 4° ANGLE OF ATTACK
- 6-INCH FOCAL LENGTH
- 16° DEPRESSION FROM FUSELAGE REFERENCE LINE (FRL)
- 41° x 41° FIELD
- 4.5" x 4.5" FORMAT
- 50% OVERLAP OF FOREGROUND DISTANCE

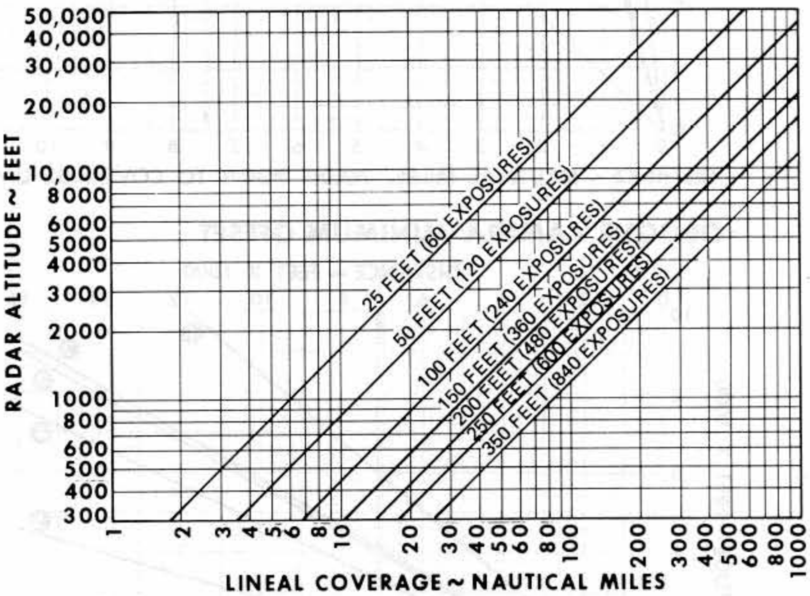
SIDE

19.75° DEPRESSION

- 6" FOCAL LENGTH
- 41° X 41° FIELD
- 4.5" X 4.5" FORMAT

OVERLAP AND COVERAGE DATA

LOW ALTITUDE MODE	OVERLAP	COVERAGE
1.5° UP FROM BOTTOM	50%	SEE CHART
AT OPTICAL AXIS	75%	
HIGH ALTITUDE MODE*	OVERLAP	COVERAGE
1.5° UP FROM BOTTOM	25%	1.5 TIMES CHART
AT OPTICAL AXIS	62%	



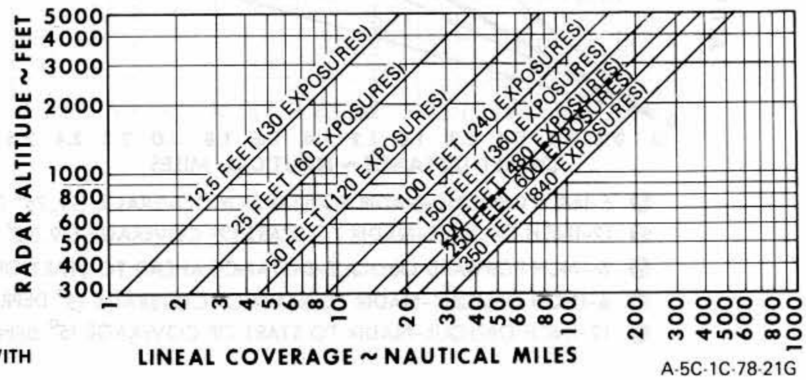
SIDE

5° DEPRESSION

OVERLAP AND COVERAGE DATA

LOW ALTITUDE MODE	OVERLAP	COVERAGE
BOTTOM OF FORMAT	52%	SEE CHART
¼ UP FROM BOTTOM	72%	
HIGH ALTITUDE MODE*	OVERLAP	COVERAGE
BOTTOM OF FORMAT	28%	1.5 TIMES CHART
¼ UP FROM BOTTOM	57.5%	

*AIRCRAFT HAVING AFC 180 AND 198 COMPLIED WITH



A-5C-1C-78-21G

Figure 11-163 (Sheet 1)

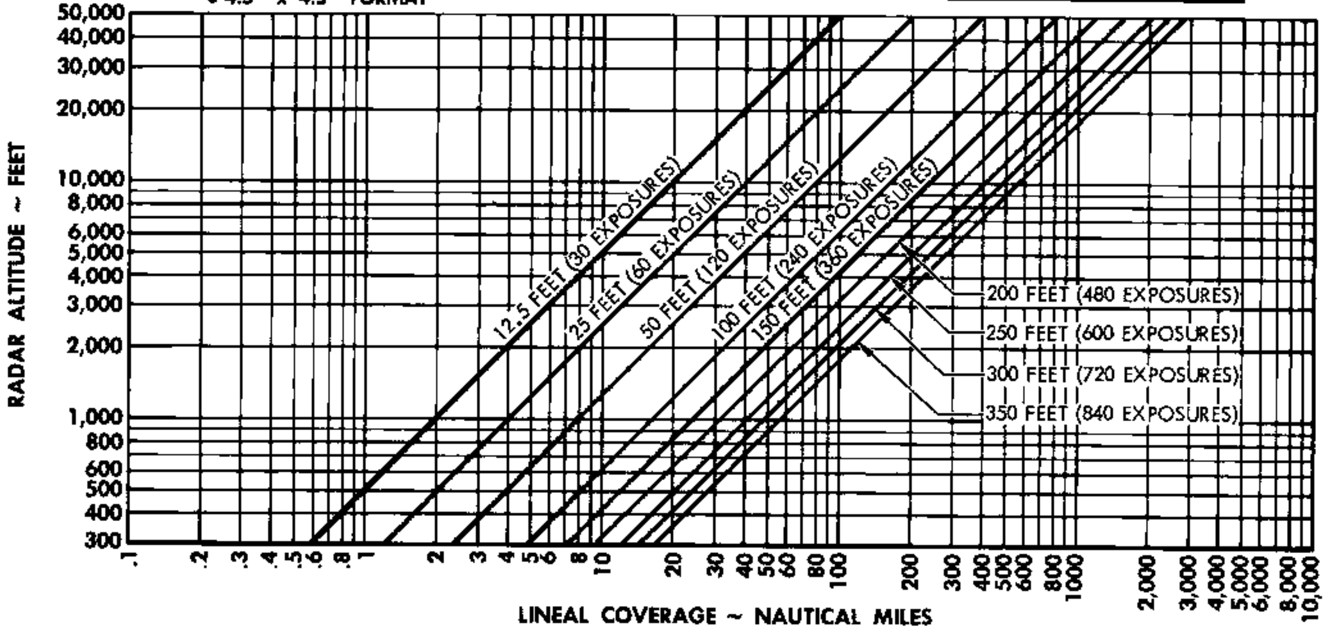
OBLIQUE CAMERA COVERAGE

KA-51A (6-INCH) SIDE OBLIQUE

SIDE 37.5° DEPRESSION

- 41° x 41° FIELD
- 4.5" x 4.5" FORMAT

LOW ALTITUDE MODE	OVERLAP	COVERAGE
BOTTOM OF FORMAT	52%	SEE CHART
OPTICAL AXIS	68%	
HIGH ALTITUDE MODE	OVERLAP	COVERAGE
BOTTOM OF FORMAT	28%	1.5 TIMES CHART
OPTICAL AXIS	52%	

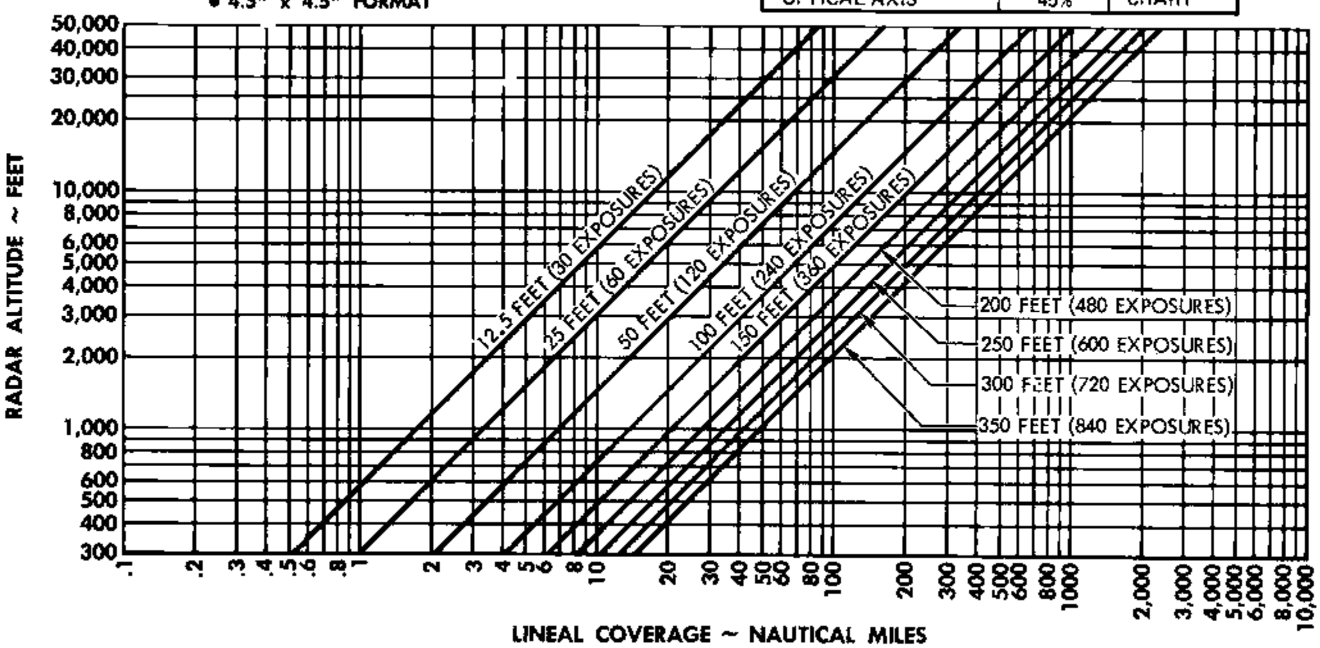


KA-51A (6-INCH) SIDE OBLIQUE

SIDE 52° DEPRESSION

- 41° x 41° FIELD
- 4.5" x 4.5" FORMAT

LOW ALTITUDE MODE	OVERLAP	COVERAGE
BOTTOM OF FORMAT	52%	SEE CHART
OPTICAL AXIS	63%	
HIGH ALTITUDE MODE	OVERLAP	COVERAGE
BOTTOM OF FORMAT	28%	1.5 TIMES CHART
OPTICAL AXIS	45%	



A-5C-1C-78-48A

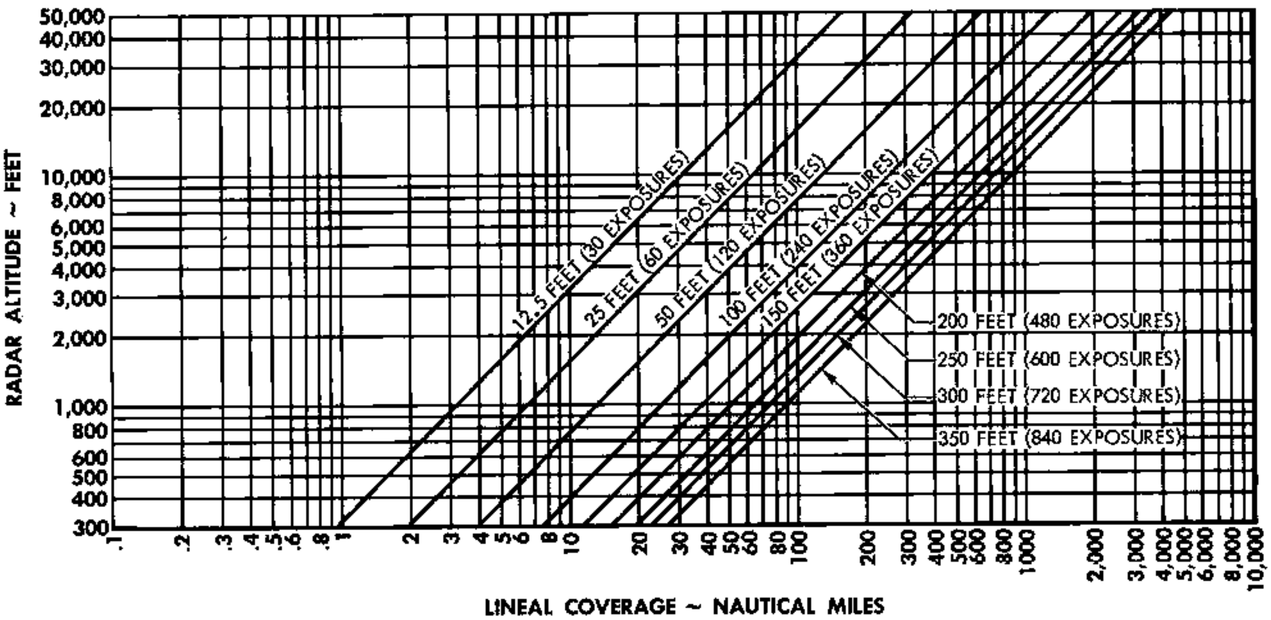
Figure 11-163 (Sheet 2)

OBLIQUE CAMERA COVERAGE

SIDE
5° DEPRESSION

- 21.2° x 21.2° FIELD
- 4.5" x 4.5" FORMAT
- 52% OVERLAP AT BOTTOM

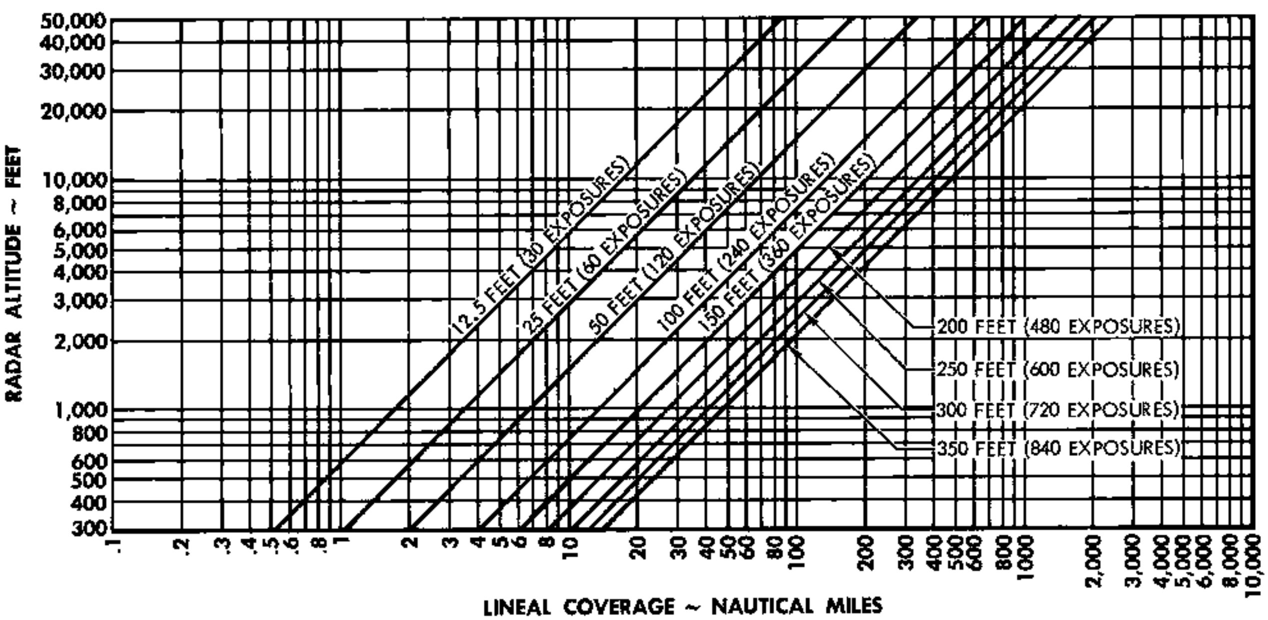
KA-53A (12-INCH) SIDE OBLIQUE



SIDE
19.75° DEPRESSION

- 21.2° x 21.2° FIELD
- 4.5" x 4.5" FORMAT
- 52% OVERLAP AT BOTTOM

KA-53A (12-INCH) SIDE OBLIQUE

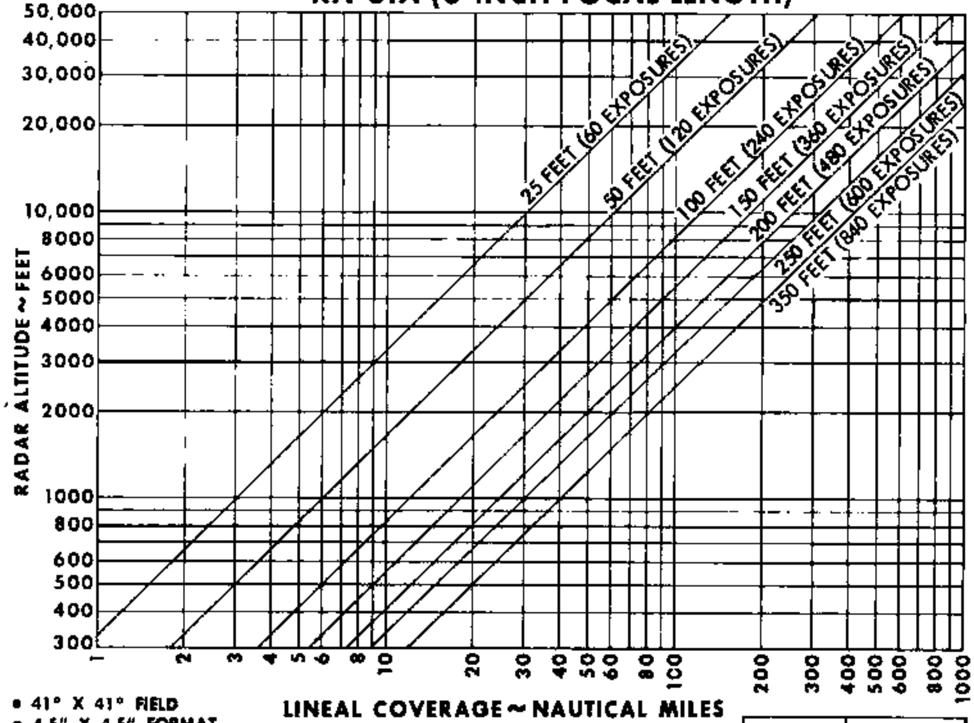


A-5C-1C-78-49

Figure 11-163 (Sheet 3)

VERTICAL CAMERA COVERAGE

KA-51A (6-INCH FOCAL LENGTH)

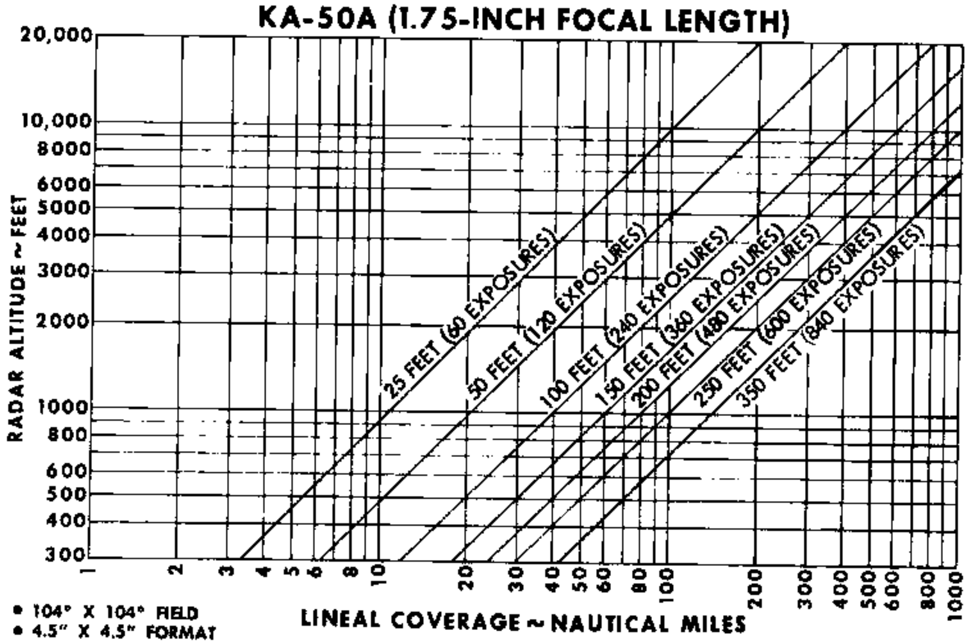


- 41° X 41° FIELD
- 4.5" X 4.5" FORMAT
- COVERAGE AND OVERLAP DATA

NOTE
DOUBLE 6-INCH CAMERA LINEAL COVERAGE FOR HIGH ALT MODE

OVERLAP	COVERAGE
60%	SEE CHART
20% *	2 TIMES CHART

KA-50A (1.75-INCH FOCAL LENGTH)



- 104° X 104° FIELD
- 4.5" X 4.5" FORMAT
- OVERLAP AND COVERAGE DATA

* AIRCRAFT HAVING AFC 198 COMPLIED WITH

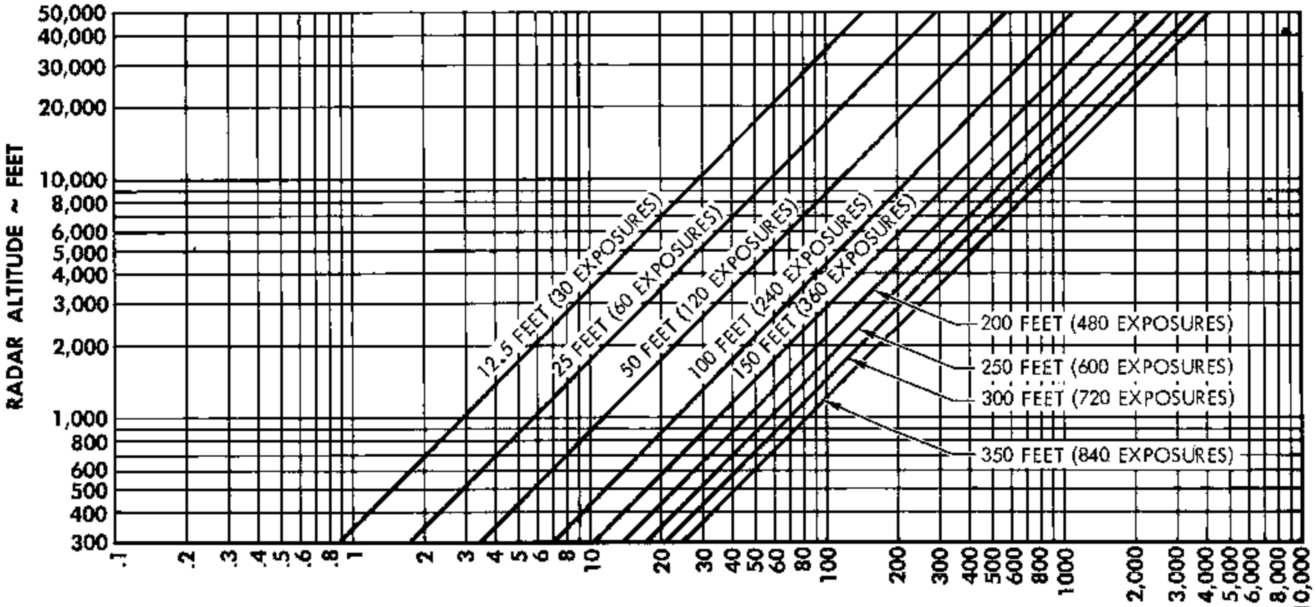
A-5C-1C-78-22D

Figure 11-164 (Sheet 1)

VERTICAL CAMERA COVERAGE

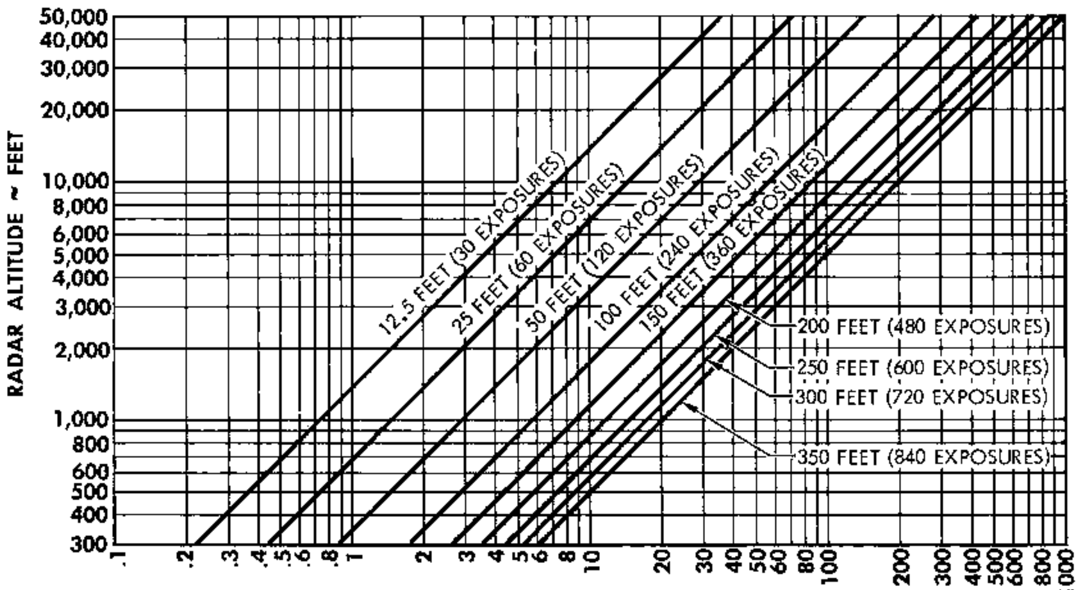
KA-62A (3-INCH) VERTICAL

- 73.7° x 73.7° FIELD
- 4.5" x 4.5" FORMAT
- 60% OVERLAP AT NADIR



KA-53A (12-INCH) VERTICAL/SPLIT VERTICAL

SIDE
90°/81° DEPRESSION
- 21.2° x 21.2° FIELD
- 4.5" x 4.5" FORMAT
- 60% OVERLAP AT NADIR



NOTE

DOUBLE 12-INCH CAMERA LINEAL COVERAGE FOR HIGH ALTITUDE MODE.

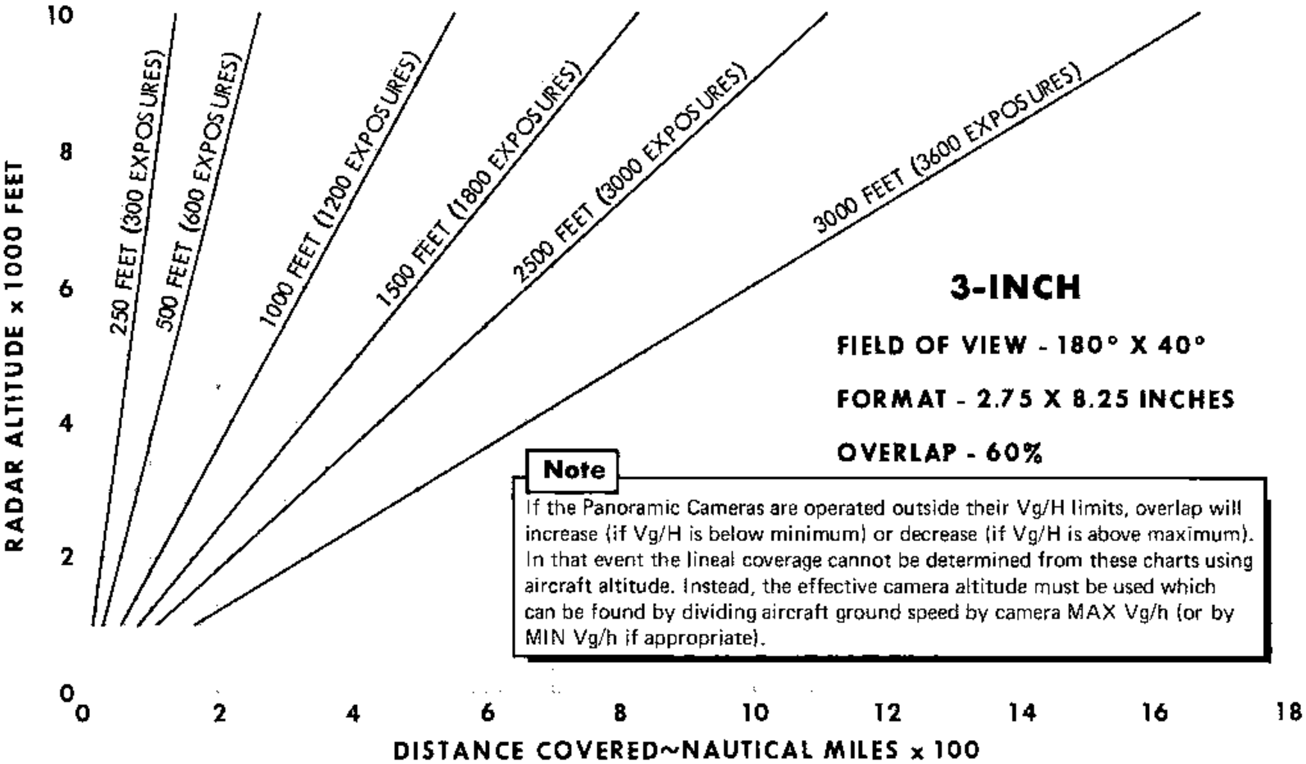
A-5C-1C-78-51B

Figure 11-164 (Sheet 2)

Figure 11-164 (Sheet 3) deleted.

PANORAMIC CAMERA COVERAGE

FILM REQUIRED



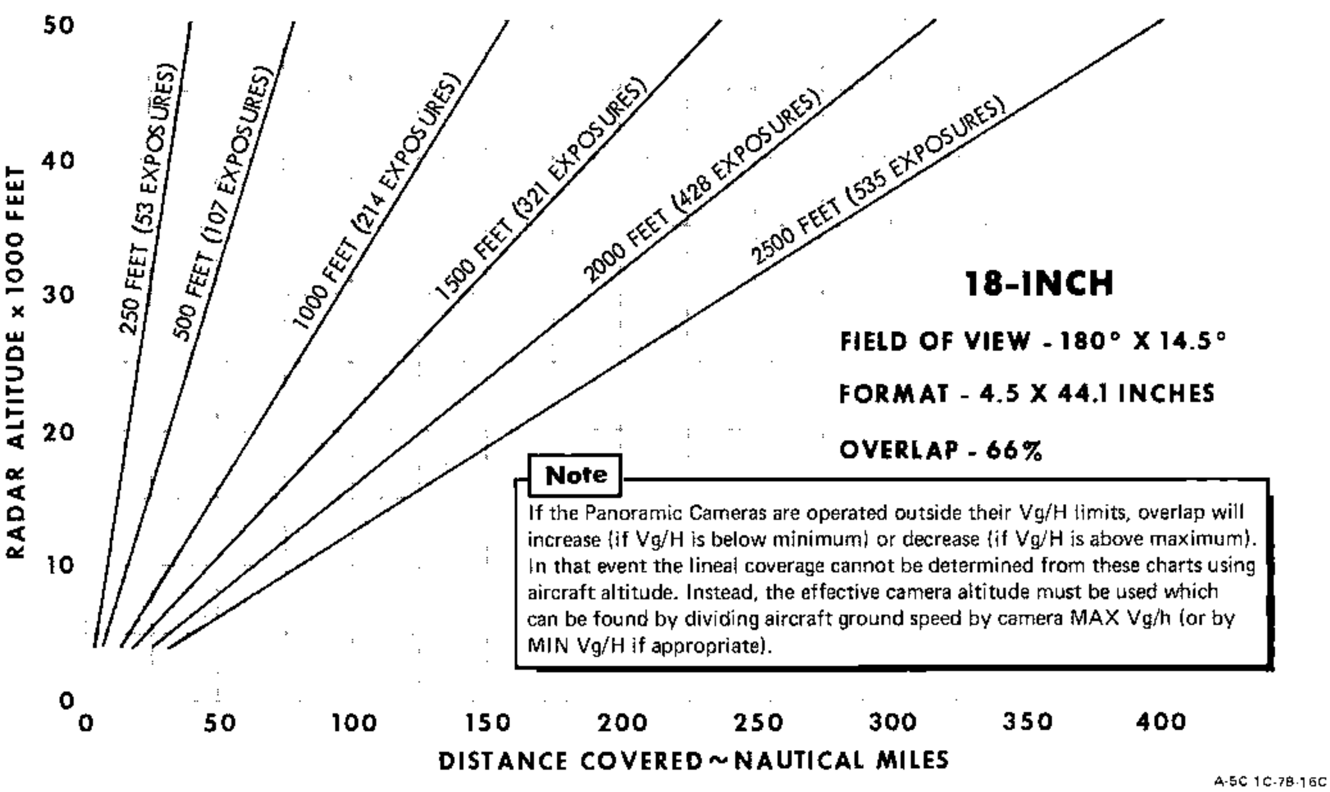


Figure 11-165

18-INCH PAN MAXIMUM OPERATING RANGE

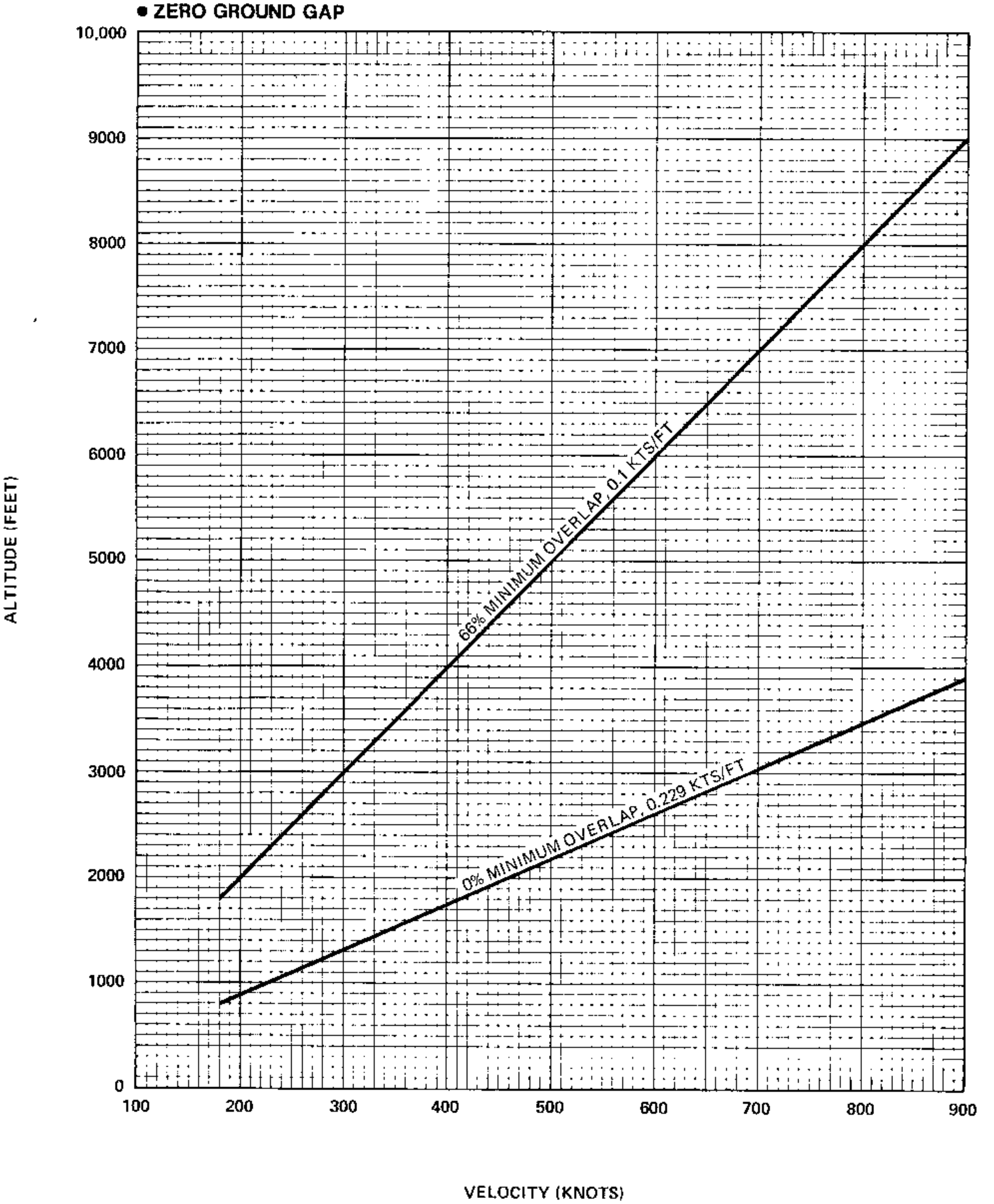
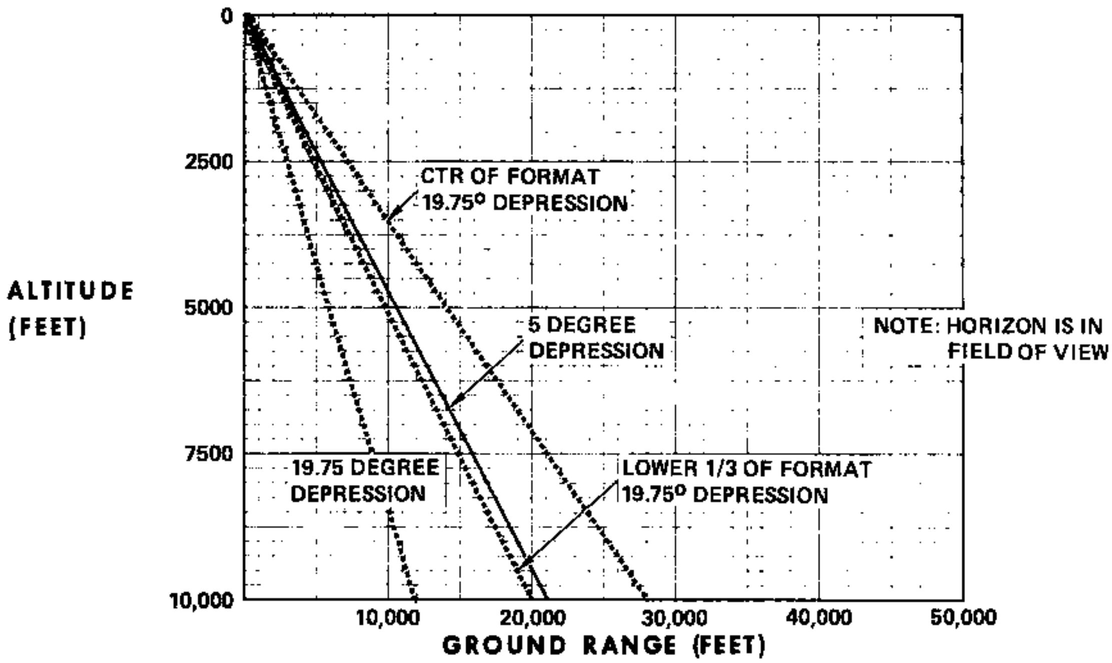


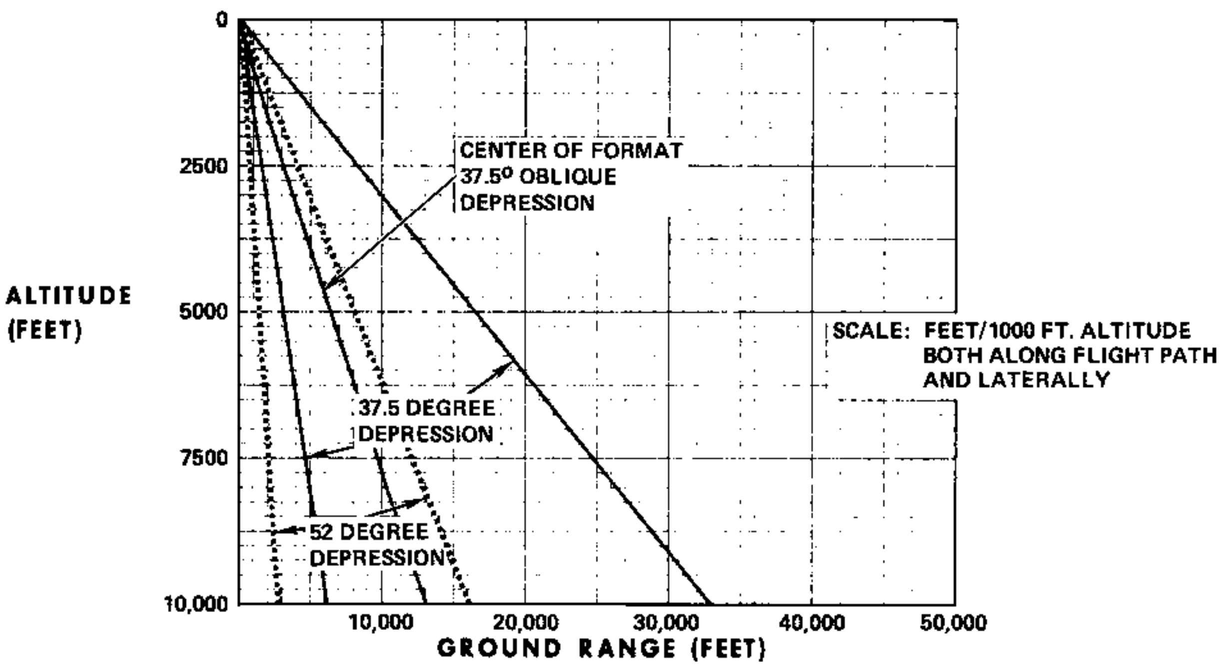
Figure 11-165A

SIDE OBLIQUE ANGULAR COVERAGE

KA-51A 6-INCH FOCAL LENGTH



KA-51A 6-INCH FOCAL LENGTH



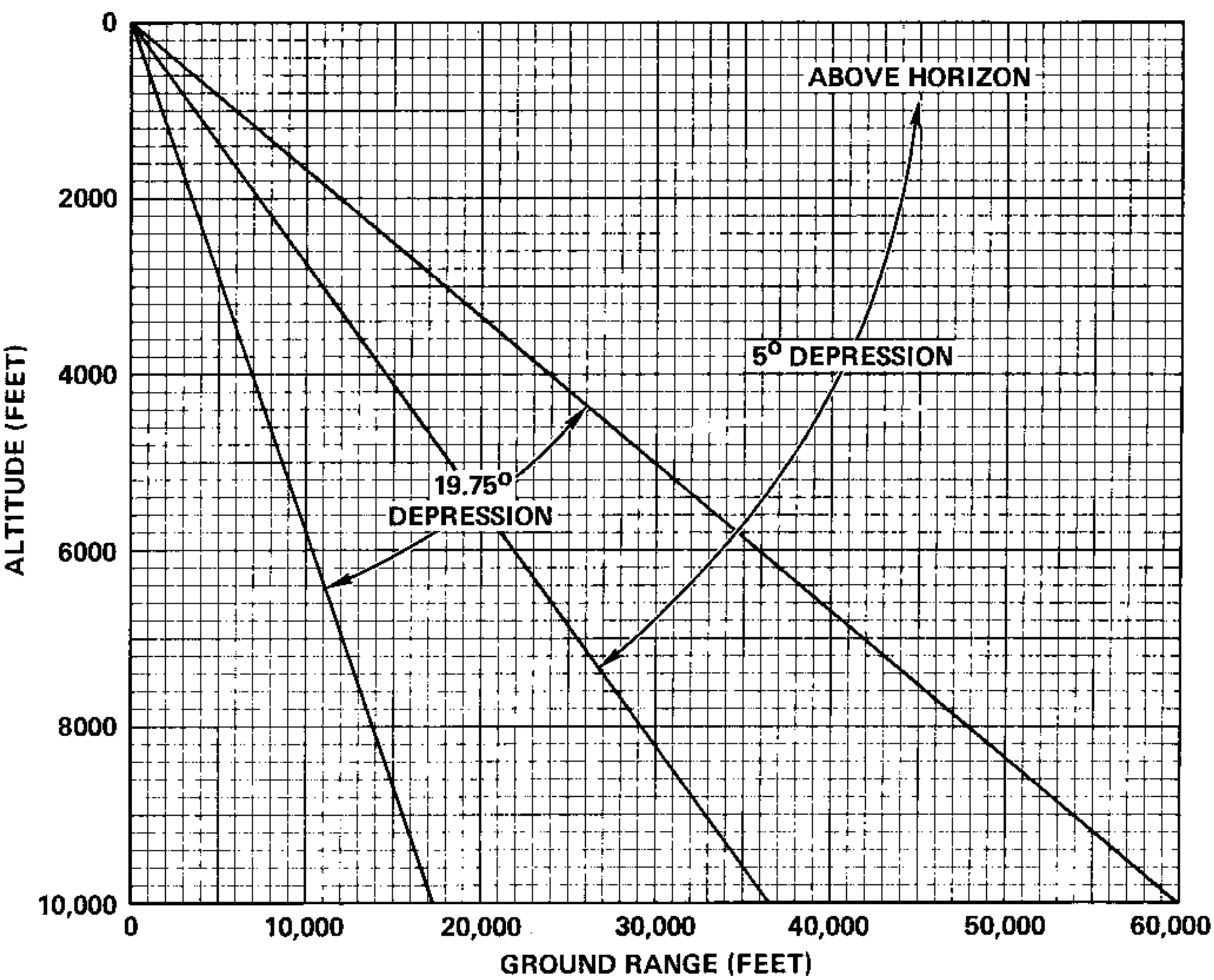
NOTE: WHEN USED IN THE TRI-FAN CONFIGURATION, THERE IS NO MINIMUM GROUND RANGE (NO GAPS IN THE LATERAL COVERAGE) WHEN A 1 3/4-INCH FOCAL LENGTH VERTICAL IS USED WITH THE 19.75 DEGREE DEPRESSION ANGLE, A 3-INCH VERTICAL WITH THE 37.5 DEGREE OR A 6-INCH VERTICAL WITH THE 52 DEGREE.

A-5C-1C-78-40B

Figure 11-166 (Sheet 1)

SIDE OBLIQUE ANGULAR COVERAGE

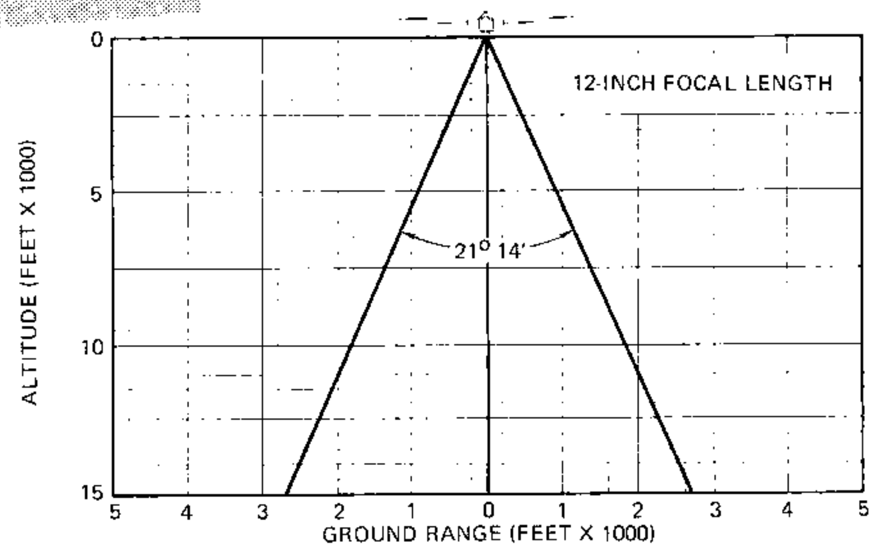
KA-53A 12-INCH FOCAL LENGTH

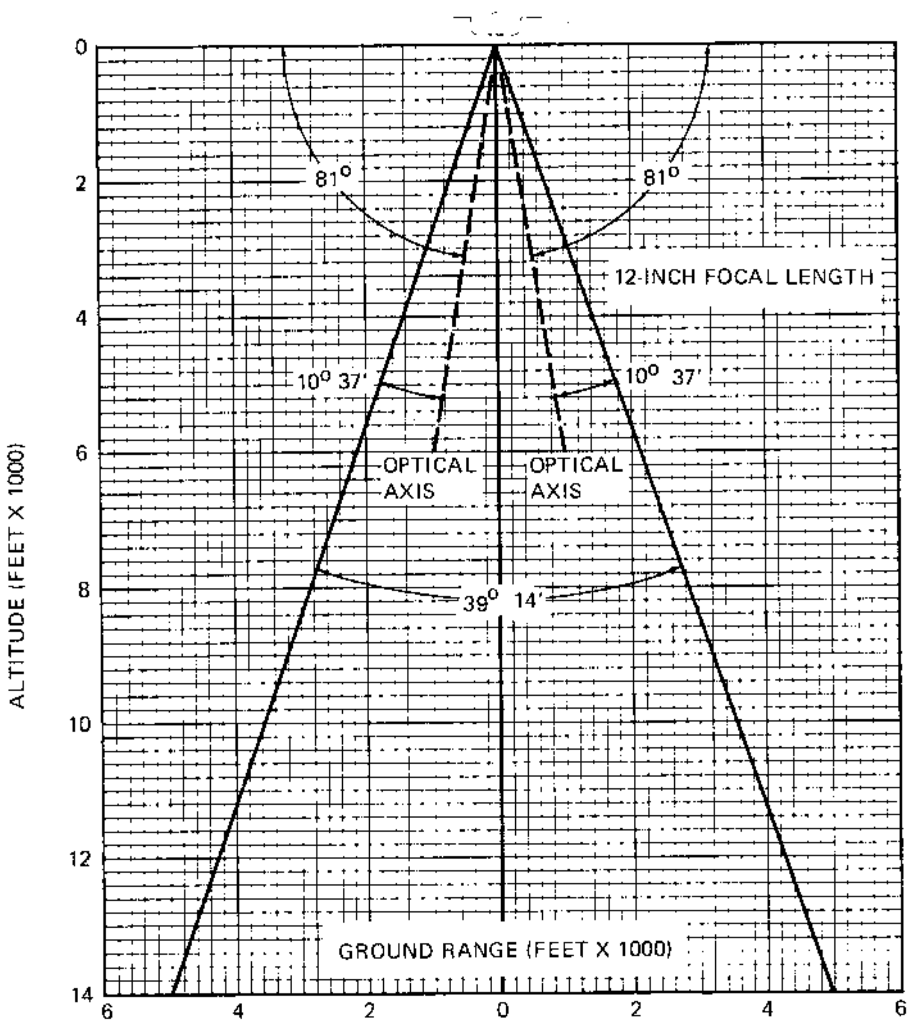


A-5C-1C-78-54

Figure 11-166 (Sheet 2)

VERTICAL ANGULAR COVERAGE





RA-5C-1-78-15

Figure 11-166A

117° TRI-FAN CONFIGURATION

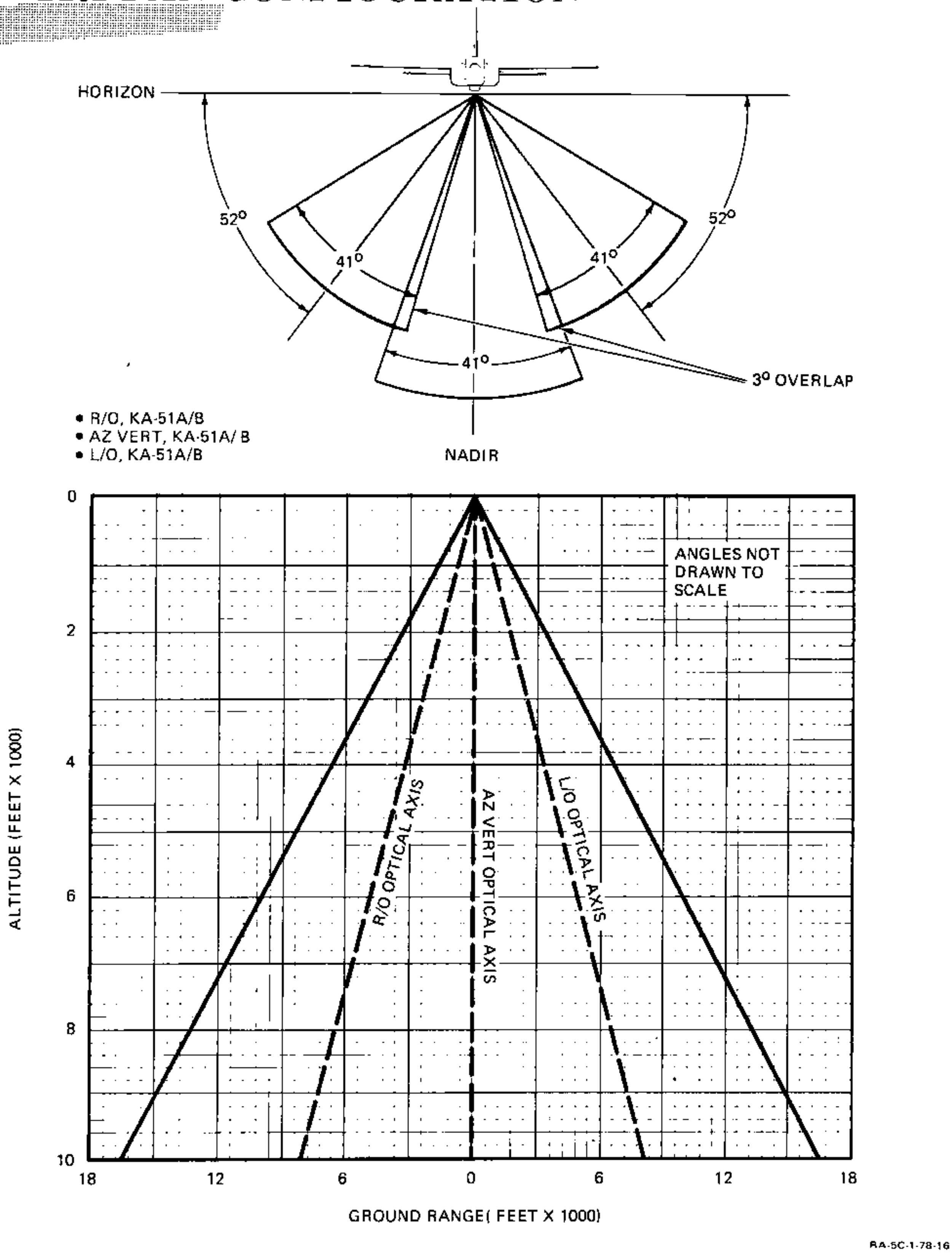
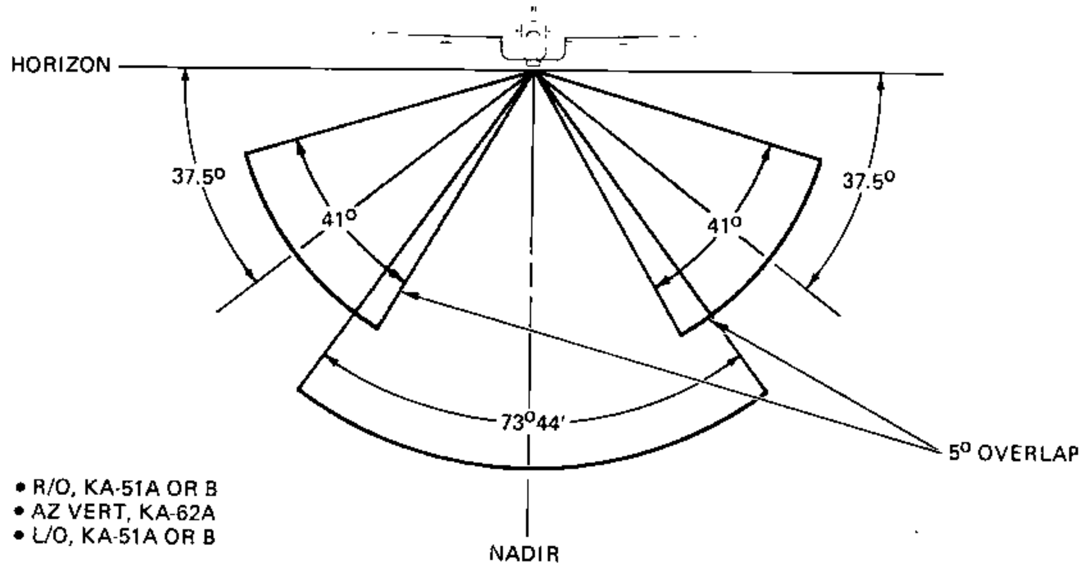


Figure 11-166B

146° TRI-FAN ANGULAR COVERAGE



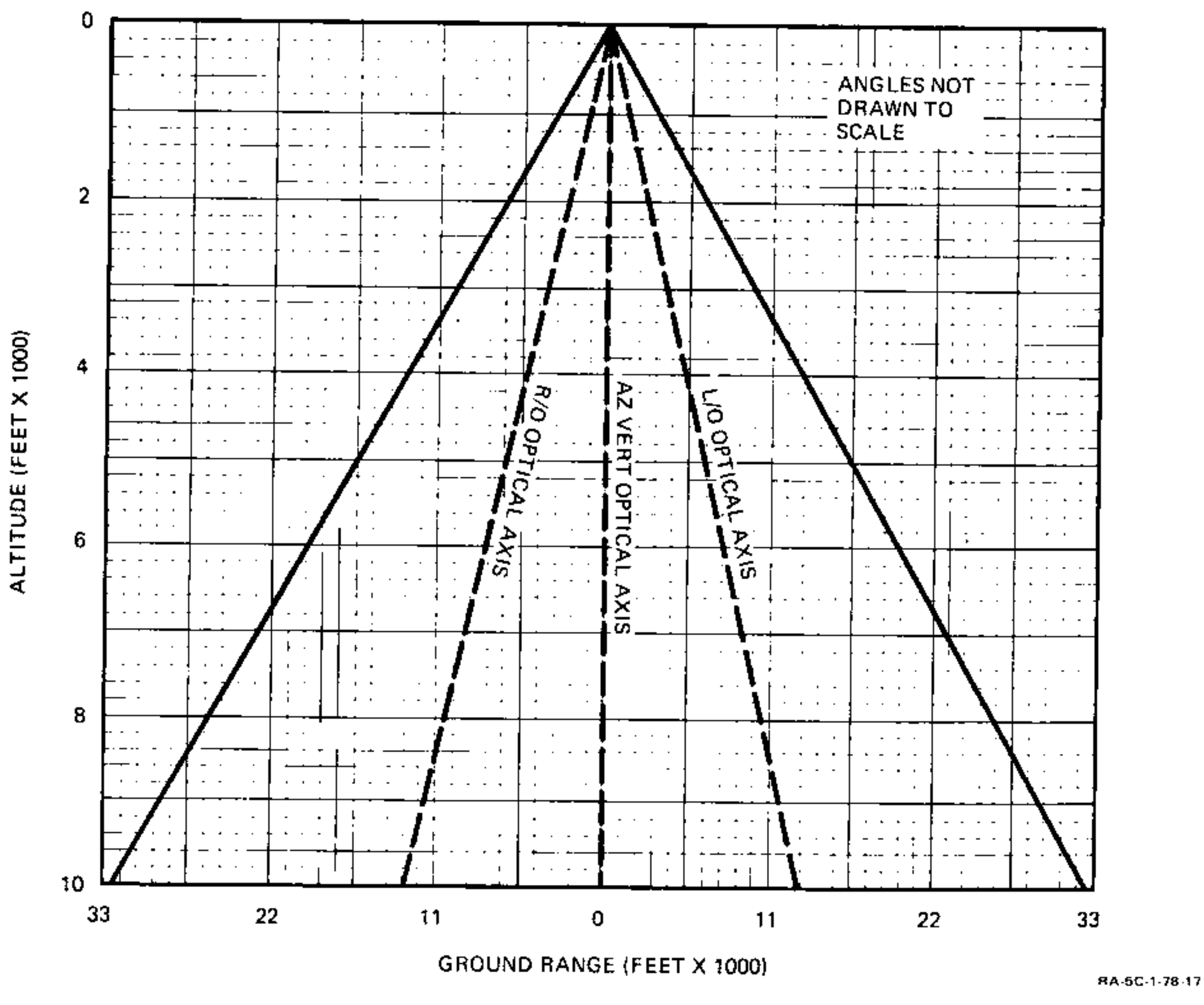


Figure 11-166C

181.5° TRI-FAN CONFIGURATION

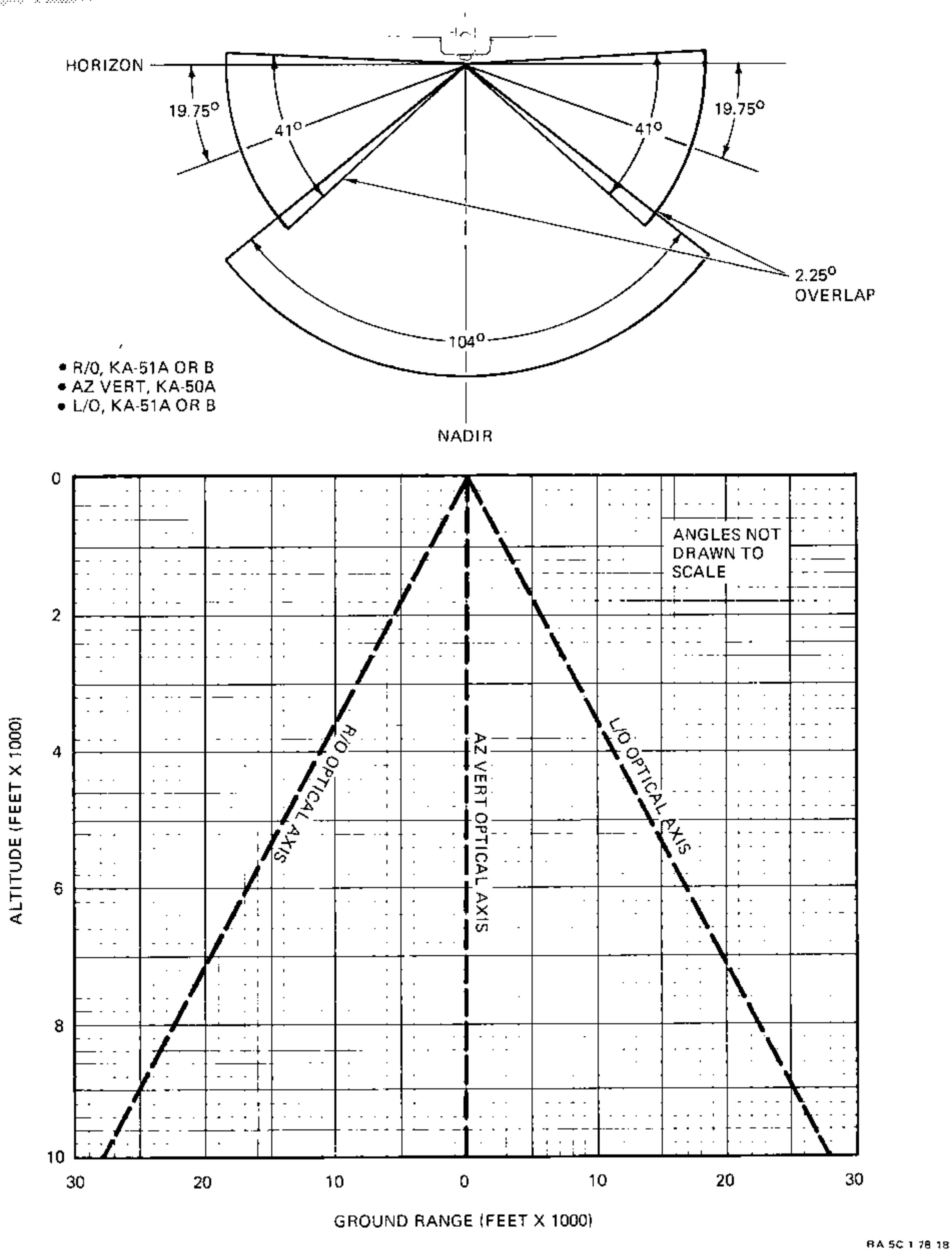


Figure 11-166D

NIGHT PHOTOGRAPHY ENVELOPE

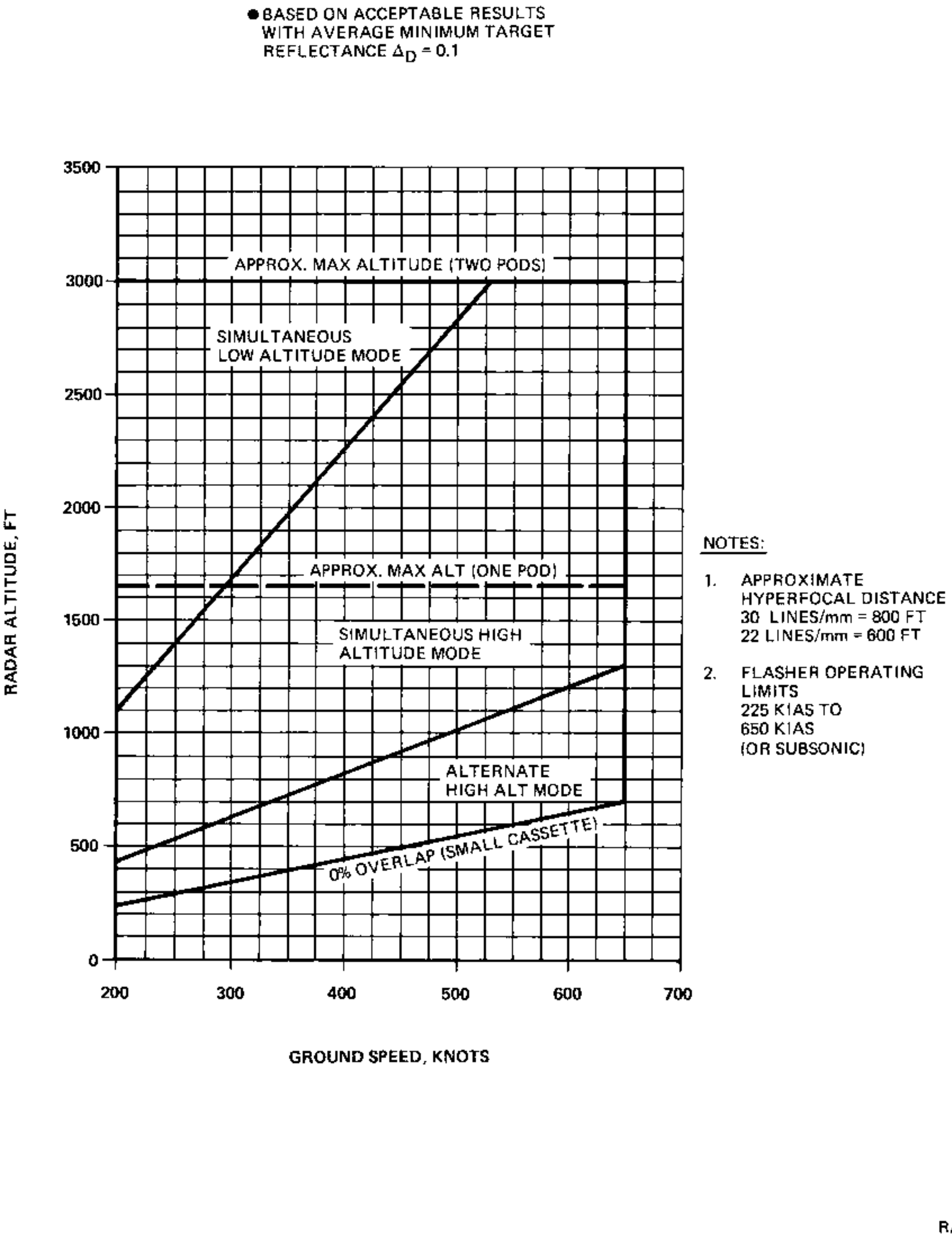


Figure 11-167

FLASHER RECHARGE CAPABILITY

SINGLE POD

FLASH RATE PER SECOND	BCPS RATE PER HEAD	BCPS RATE PER POD
1.0	46,500	139,500
1.5	26,000	78,000
3.0	5,000	15,000

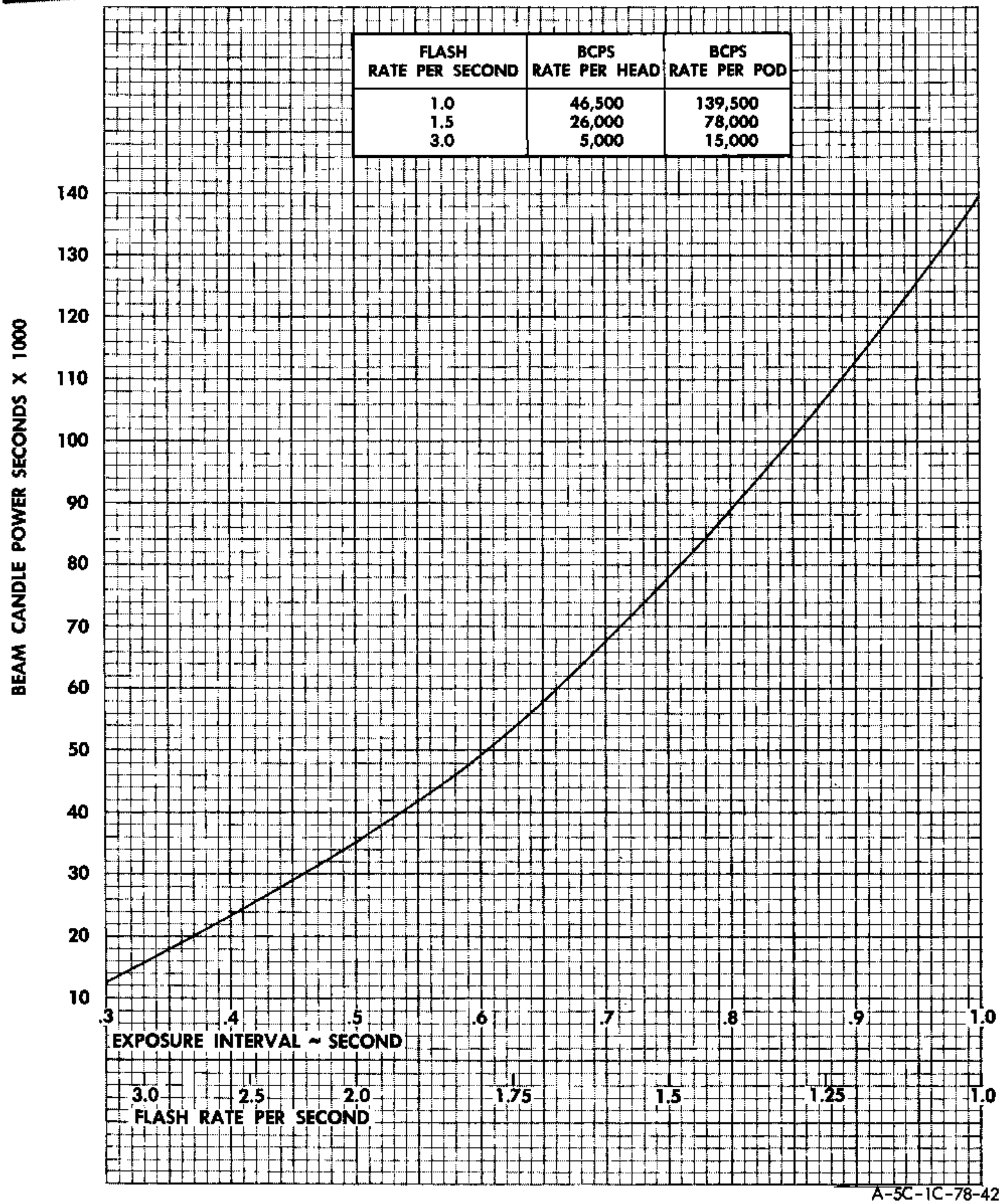
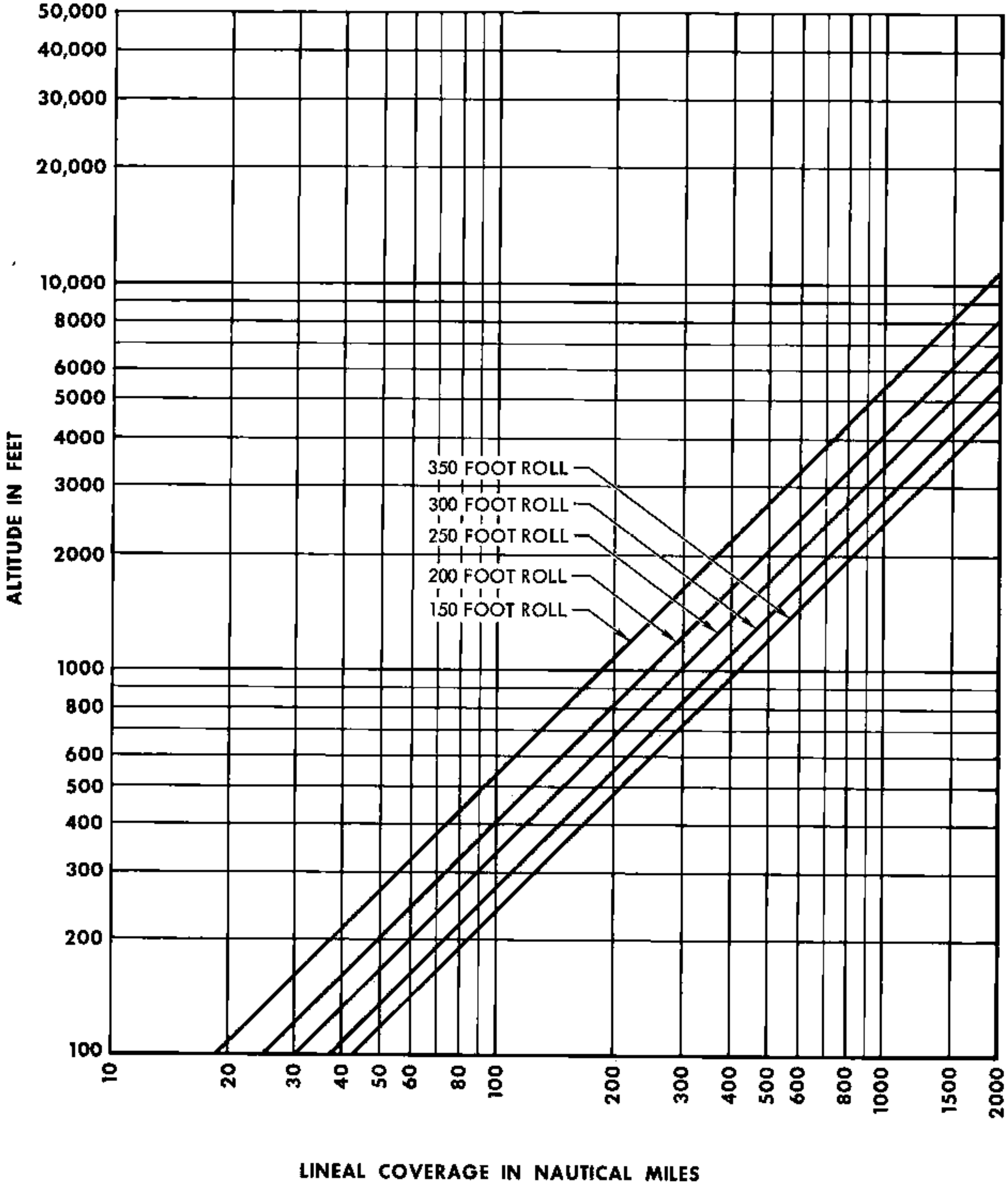


Figure 11-168

IR MAPPING COVERAGE

FILM REQUIRED



A-5C-1C-78-53

Figure 11-169

INFRARED MAPPING ANGULAR COVERAGE

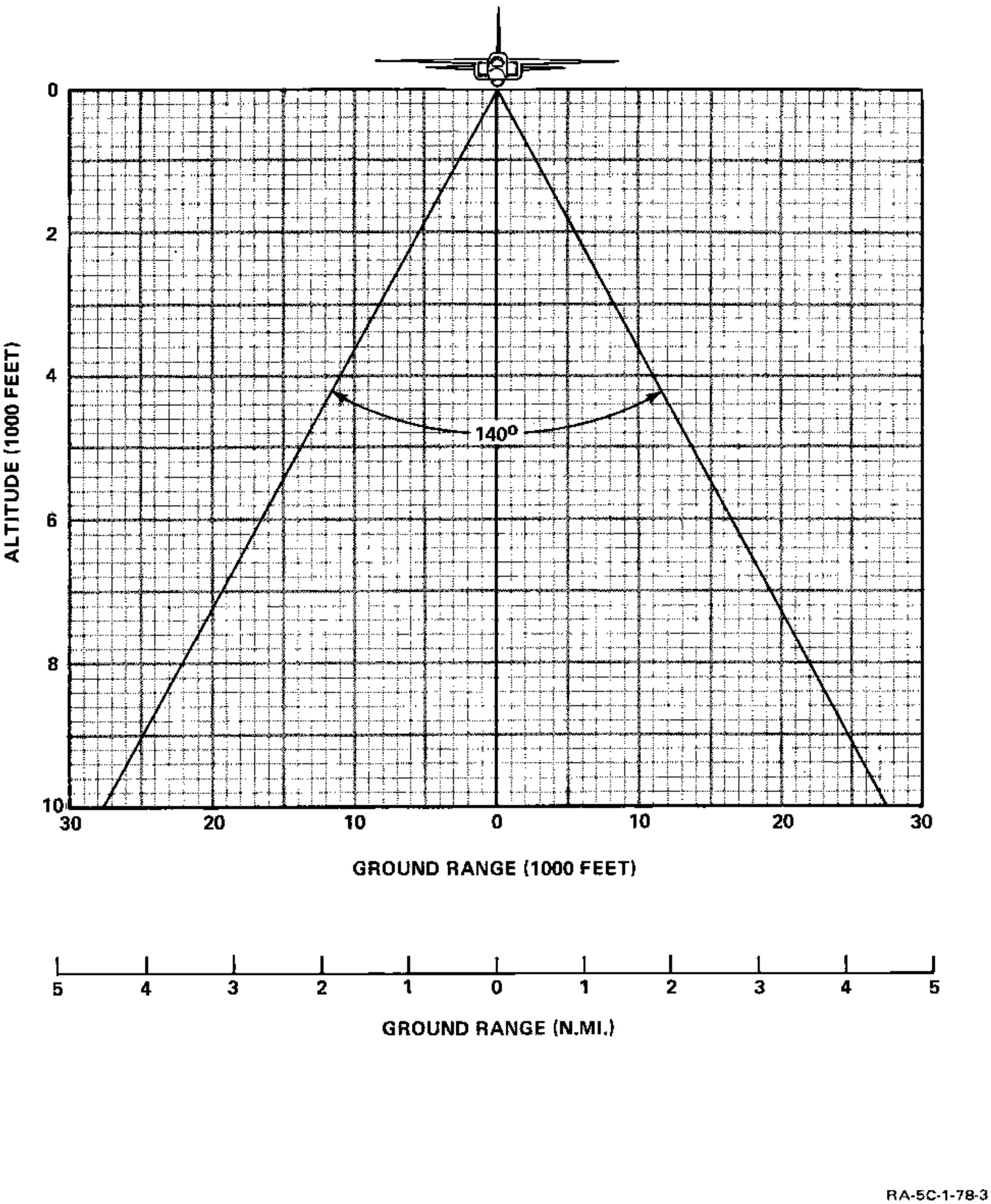


Figure 11-170

PANORAMIC CAMERA LIMITS

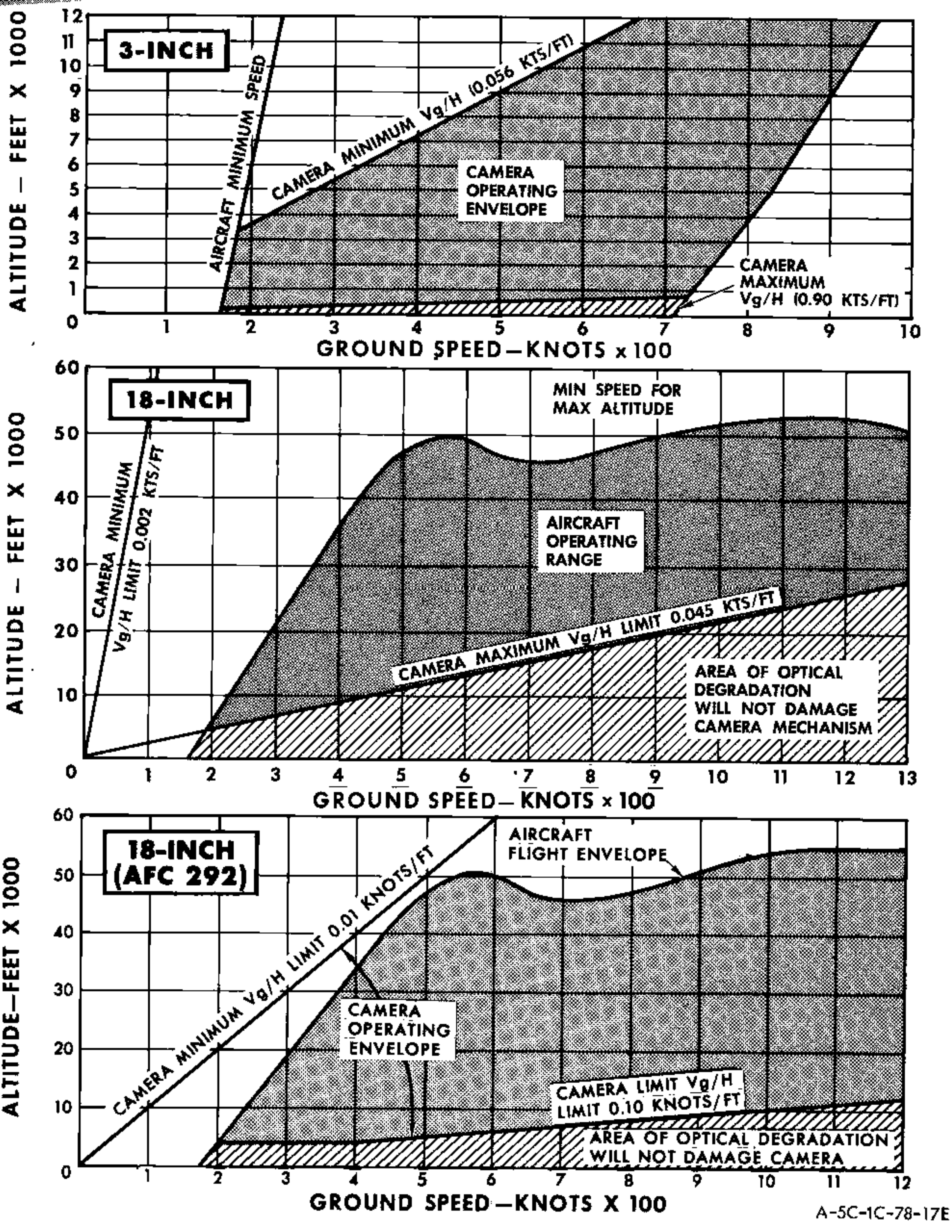


Figure 11-171

ALPHABETICAL INDEX

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FOLDOUT ILLUSTRATIONS

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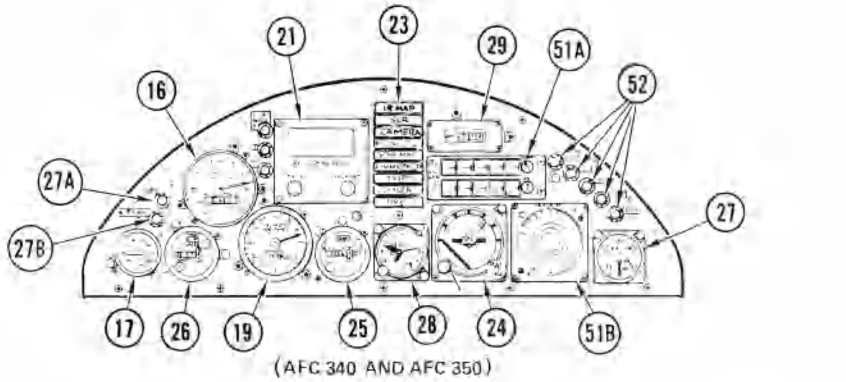
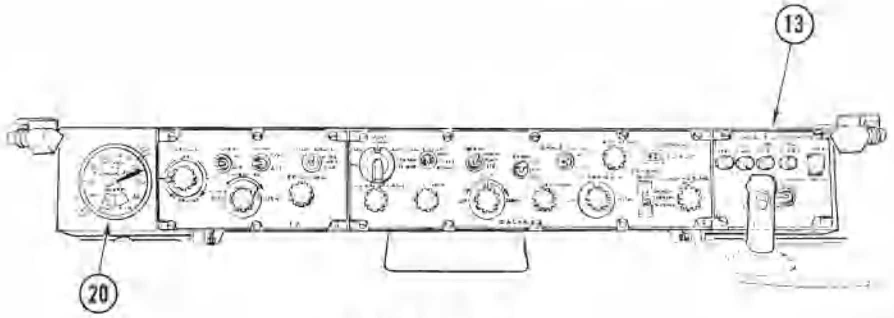
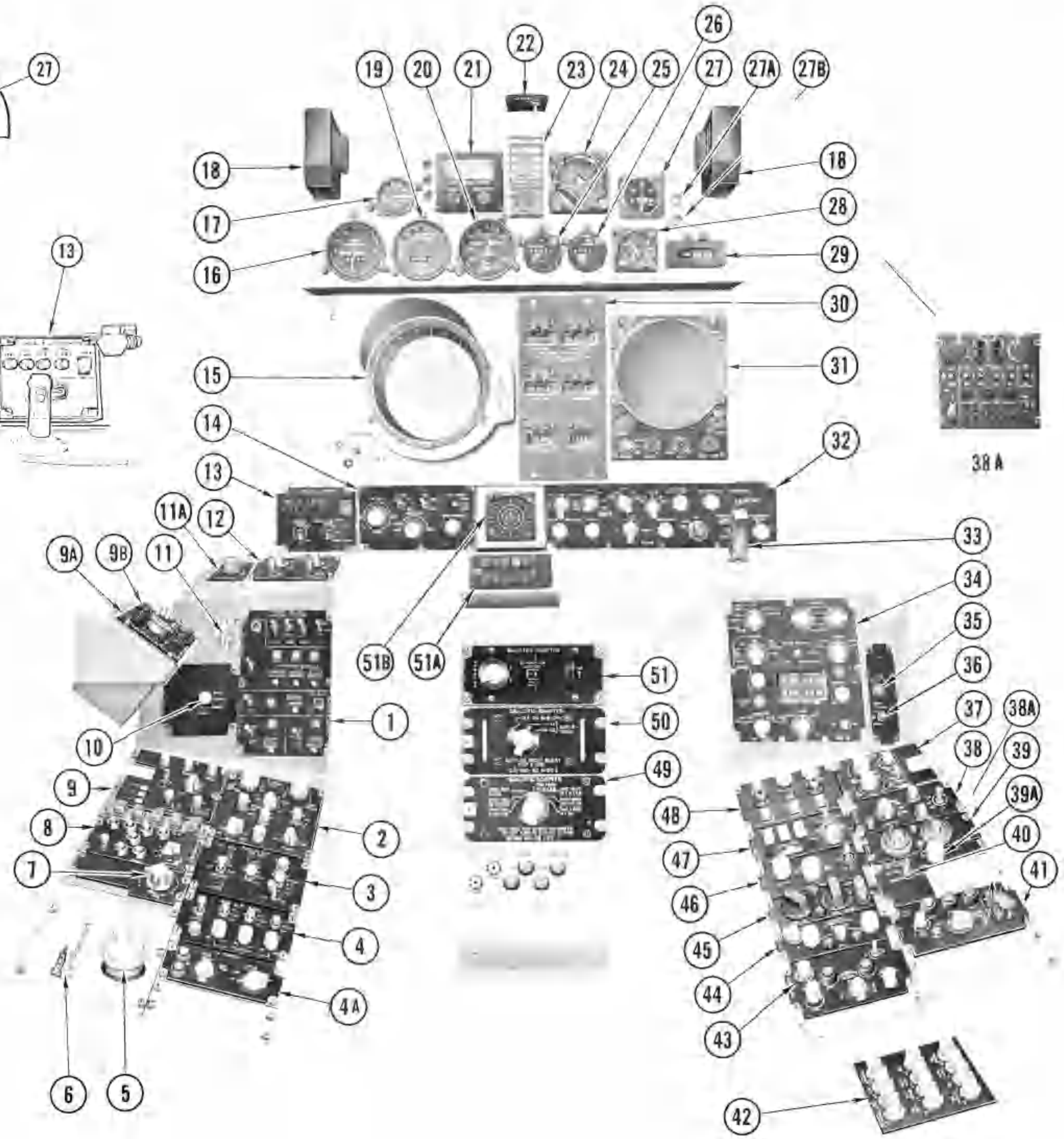
RAN'S COCKPIT (TYPICAL)



(AFC 340 AND AFC 350)



(AFC 340 AND AFC 350)



1. CAMERA CONTROL PANEL
2. SIDE LOOKING RADAR PANEL
3. AN/ALQ-61 CONTROL PANEL
4. AUXILIARY ECM CONTROL PANEL AN/APR-25(V) OR AN/ALR-45(V) (AFC 340)

4A. IR MAPPING CONTROL PANEL

5. ANTI G VALVE
6. OXYGEN VALVE
7. SUIT FLOW KNOB
8. T-375 OR AN/AWW-1 PANEL (DELETED BY AFC 349)
9. ARMAMENT RELEASE PANEL

9A. CHAFF PROGRAMMER

9B. CHAFF CONTROL PANEL

10. CANOPY TOGGLE
11. CANOPY JETTISON HANDLE

11A. MAP LIGHTS KNOB

12. INSTRUMENT CONTROL PANEL
13. CAMERA PULSE MONITOR PANEL
14. TV CONTROL PANEL
15. RADAR TV INDICATOR
16. WIND SPEED/DIRECTION INDICATOR
17. OXYGEN QUANTITY INDICATOR
18. COMPARTMENT FLOOD LIGHT
19. AZIMUTH AND RANGE INDICATOR (ARI)
20. TV SCAN INDICATOR
21. SLR MONITOR SCOPE
22. RED FLOOD LIGHTS SWITCH
23. WARNING/CAUTION LIGHTS
24. ATTITUDE INDICATOR
25. RADAR/BAROMETRIC ALTIMETER
26. TRUE AIRSPEED/GROUND SPEED INDICATOR
27. COCKPIT ALTIMETER

27A. IFF CAUTION LIGHT (AFC 296)

27B. ALTIMETER FAIL LIGHT (AFC 233)

28. CLOCK
29. CHANNEL/FREQUENCY INDICATOR
30. POSITION AND DESTINATION INDICATOR
31. OPTICAL VIEWFINDER
32. RADAR CONTROL PANEL
33. CURSOR CONTROL HANDLE
34. B/N CONTROL PANEL
35. B/N WARMUP LIGHT
36. SEAT ADJUST SWITCH
37. INTERIOR LIGHTS PANEL
38. IFF PANEL

38A. IFF PANEL (AFC 296)

39. SIF PANEL

39A. COMM SECURITY VOLUME KNOB

40. COURSELINE NAV SWITCH
41. ECM PANEL (AN/ALQ-55)
42. FUSE PANEL
43. COMPASS PANEL
44. TACAN PANEL
45. AUX UHF PANEL
46. INTERCOM PANEL
47. UHF COMM PANEL
48. AUDIO SELECT PANEL
49. BALLISTIC ADAPTER B
50. BALLISTIC ADAPTER A
51. BALLISTICS CONTROL PANEL

51A. THREAT DISPLAY UNIT, AN/APR-25(V) CONTROL INDICATOR UNIT, AN/ALR-45(V) (AFC 340)

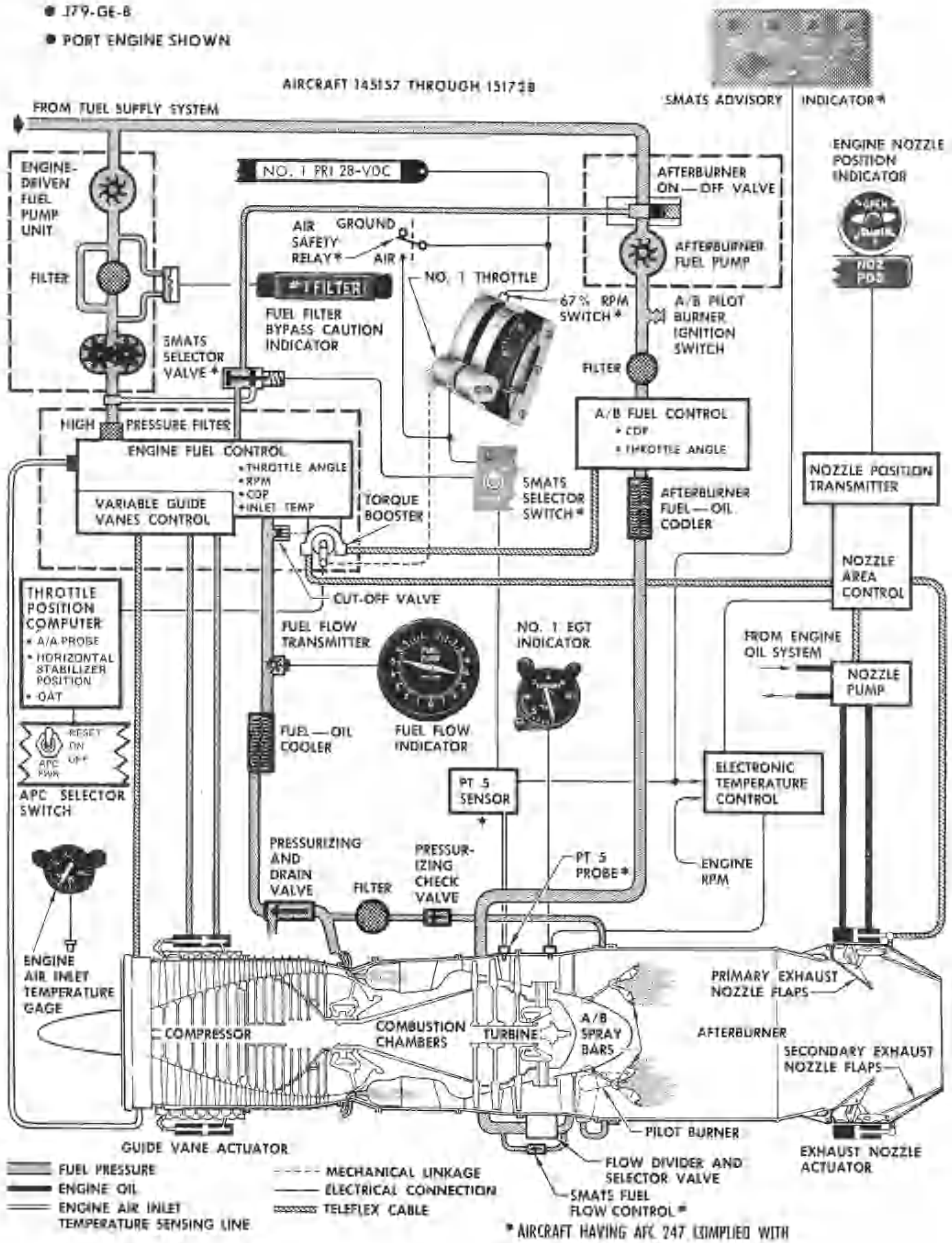
51B. AZIMUTH INDICATOR AN/APR-25(V) OR AN/ALR-45(V) (AFC 340)

52. ECM ADVISORY LIGHTS (AFC 340 AND AFC 350)

RA-5C-1-00-23E

Figure FO-1

ENGINE FUEL SYSTEM



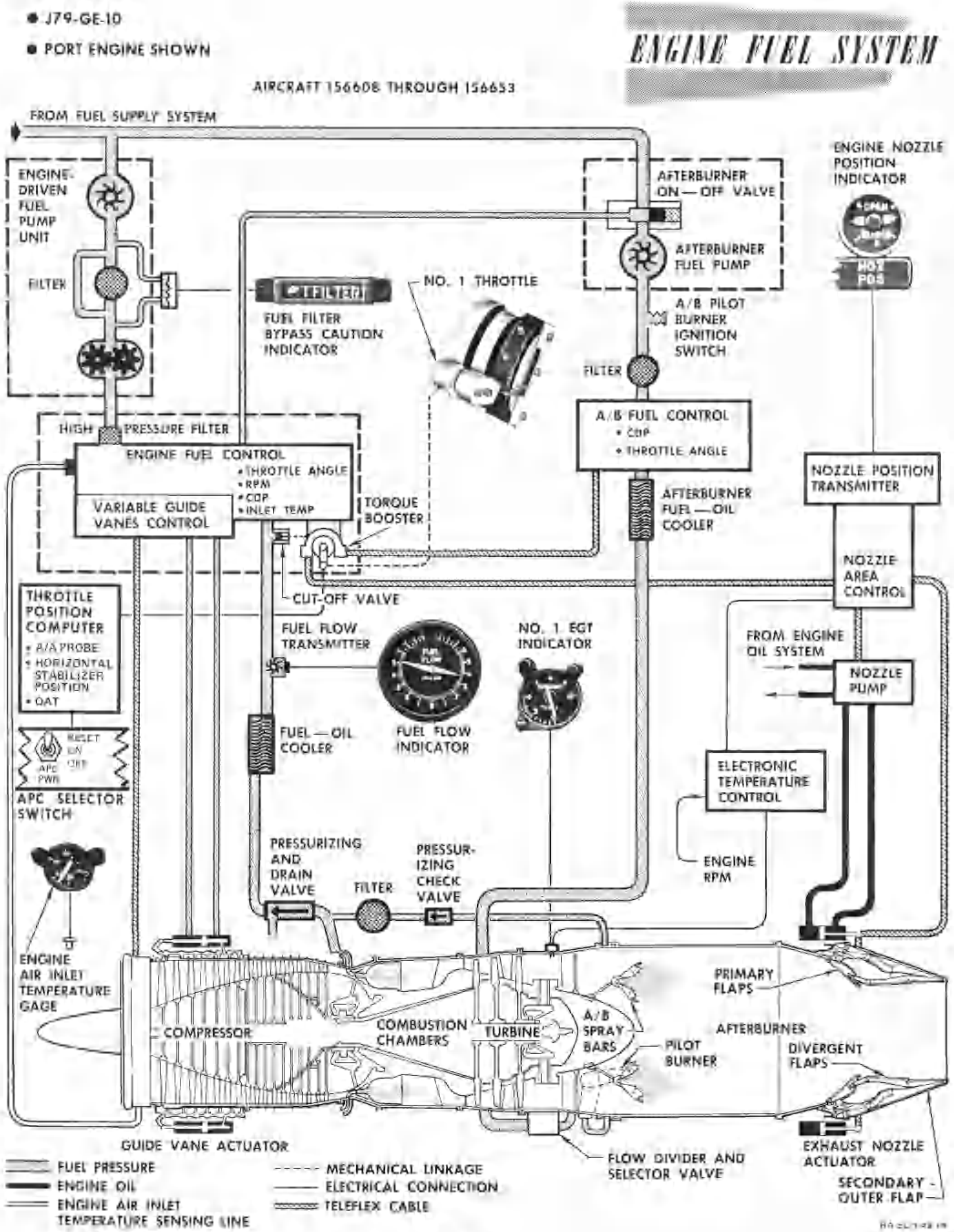
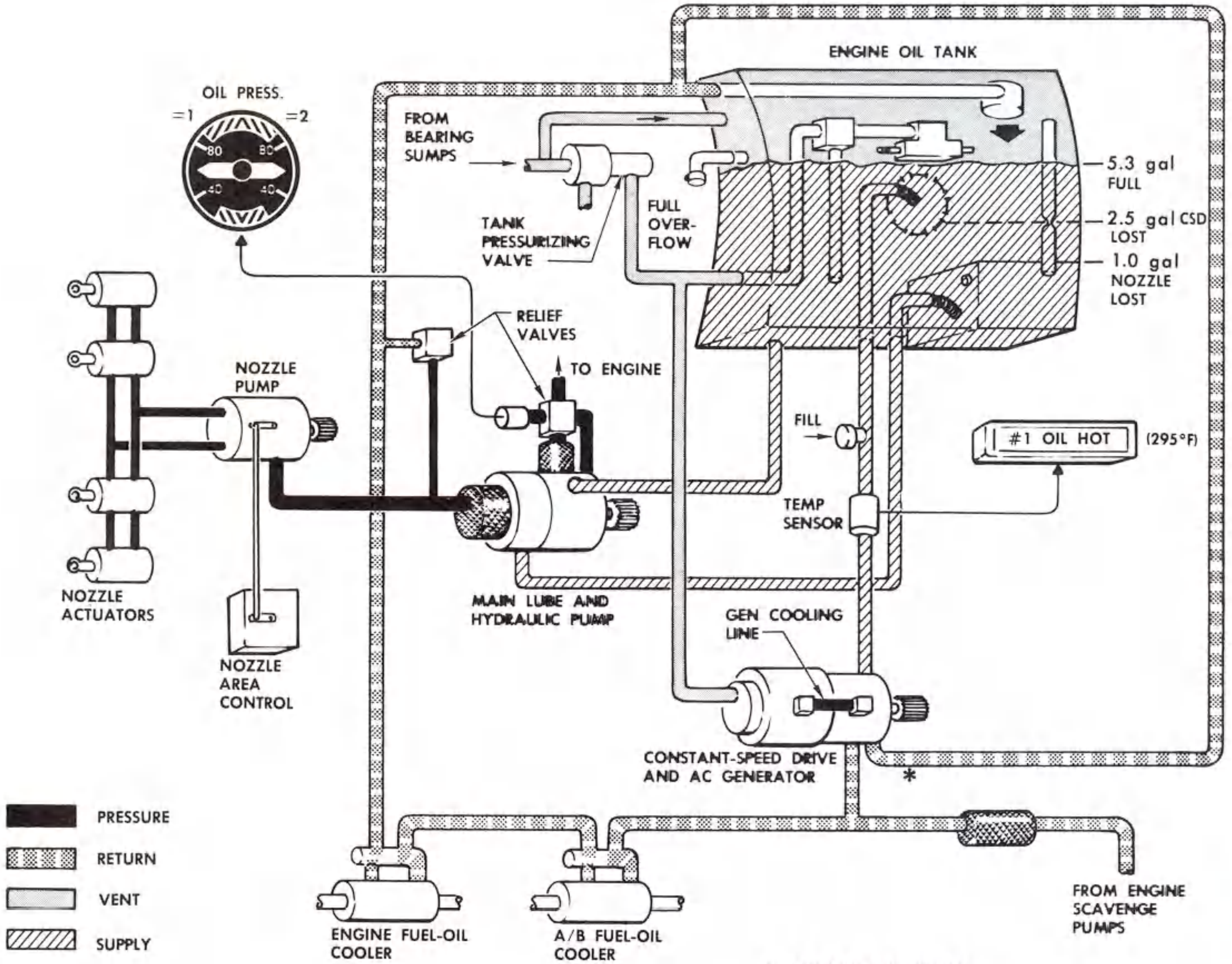


Figure FO-2

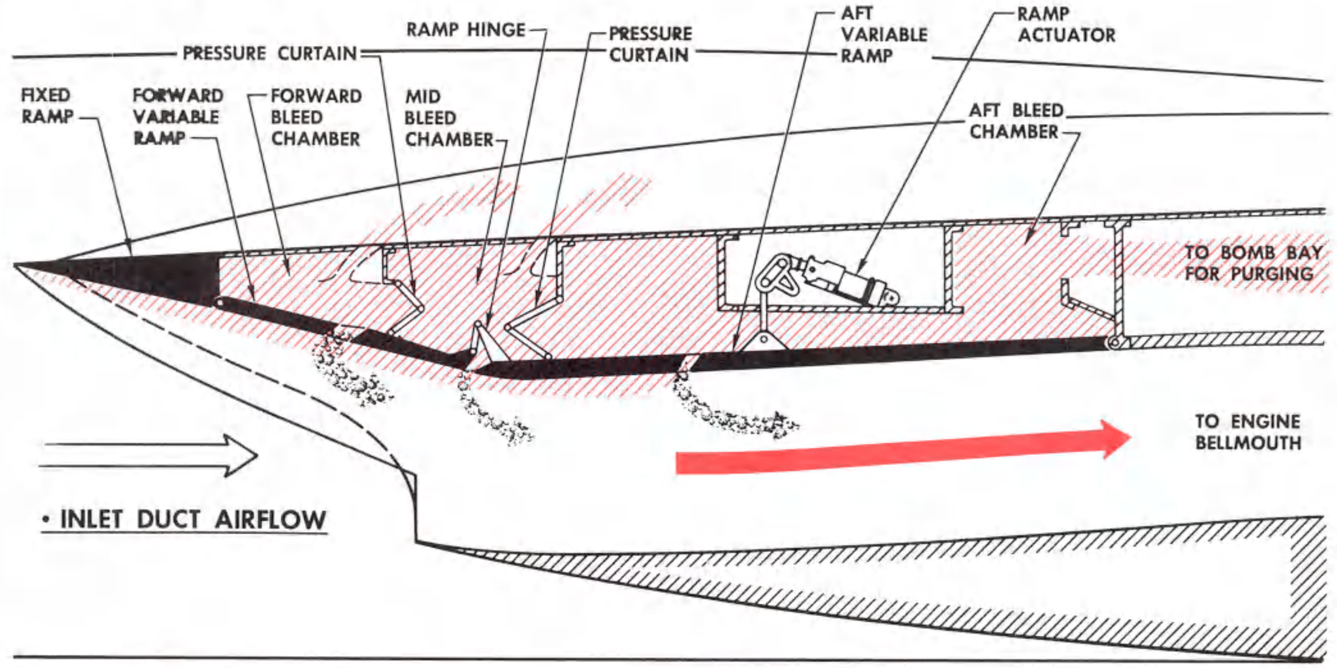
ENGINE OIL AND AIR INDUCTION SYSTEM

ENGINE OIL SYSTEM



* AIRCRAFT HAVING AFC 351 COMPLIED WITH

AIR INDUCTION SYSTEM



• INLET DUCT AIRFLOW

• ENGINE AND AFTERBURNER

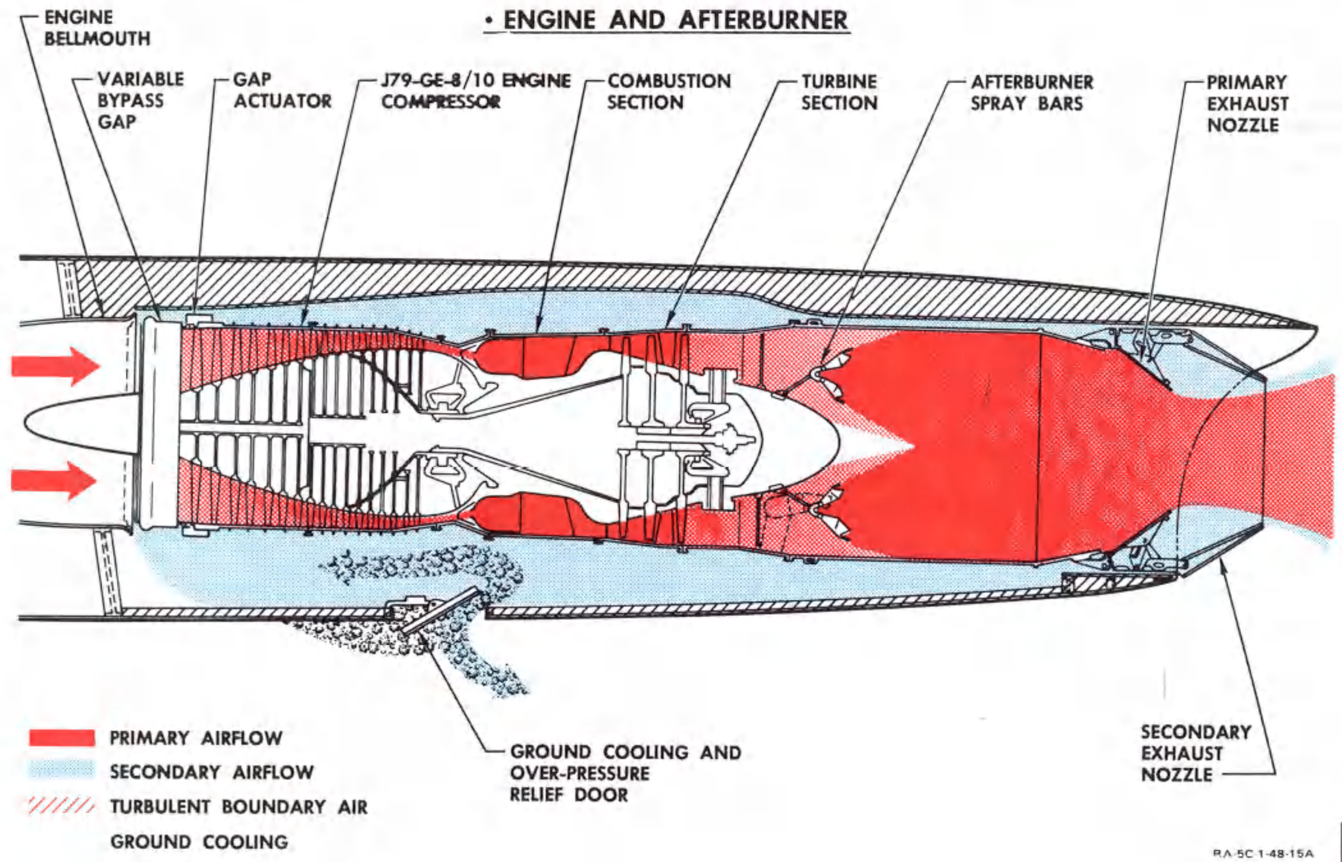
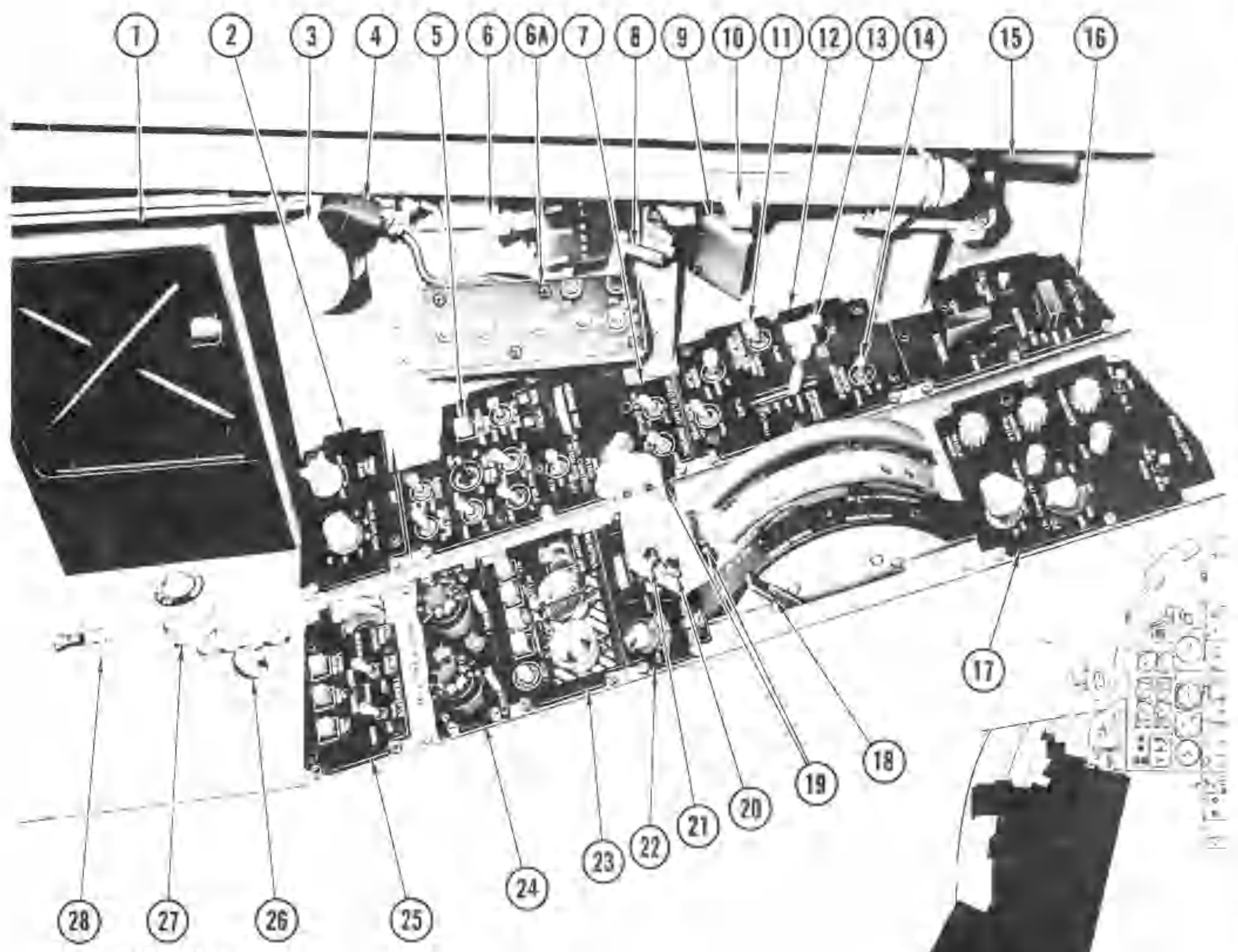


Figure FO-3

PILOT'S COCKPIT

LEFT CONSOLE



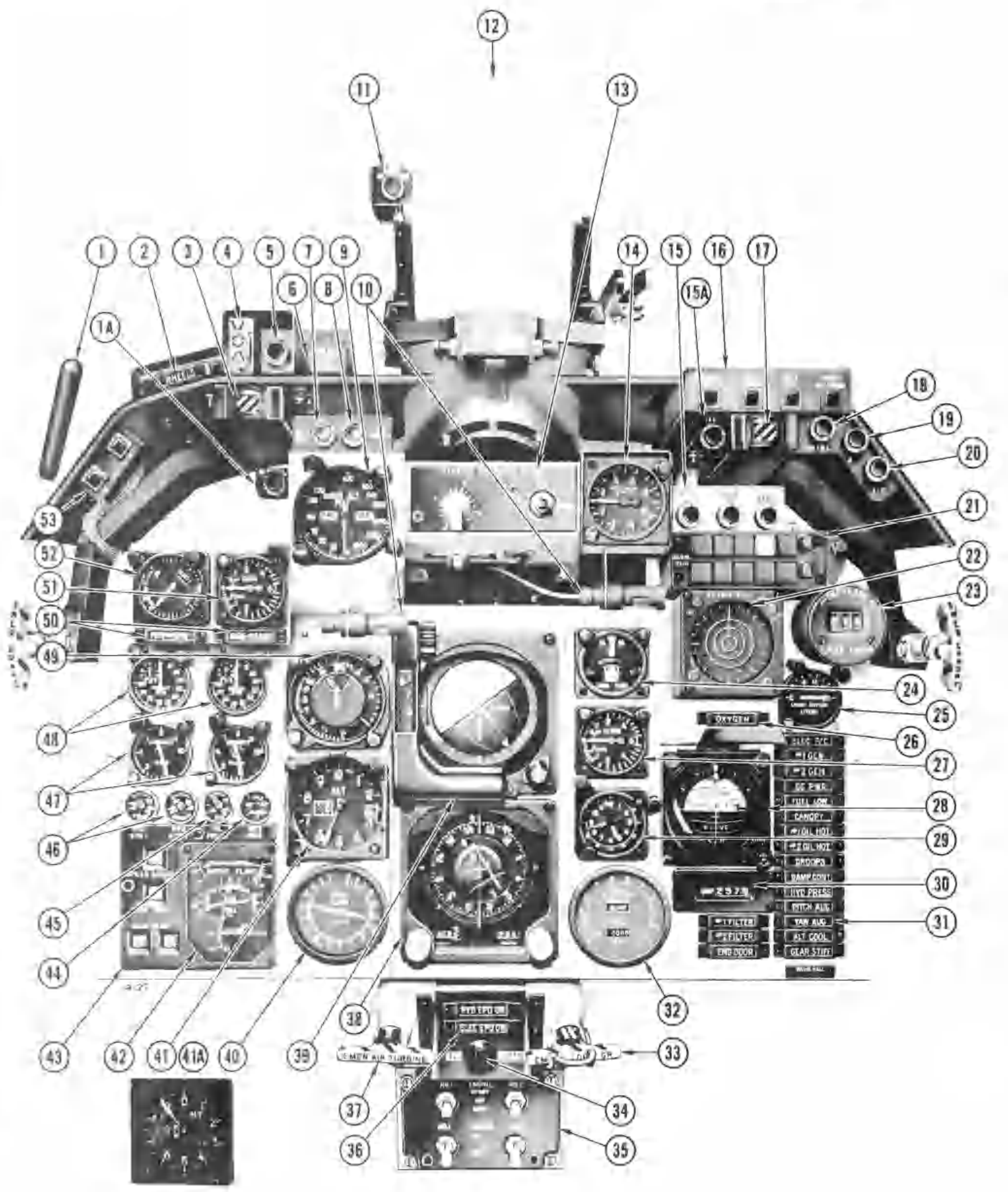
1. DATA CASE
2. SUIT CONTROL PANEL
   EXPOSURE SUIT PANEL (AIRCRAFT 156618-156853)
3. HIGH-ALTITUDE LIGHT
4. CONSOLE FLOODLIGHT
5. STATIC PRESSURE COMPENSATOR BUTTON (DELETED BY AFC 159)
6. CANOPY TOGGLE VALVE

6A. SMATS (AFC 247), APPROACH POWER COMPENSATOR AND ANTI-SKID CONTROL PANEL (AFC 107, AFC 170)

7. AUTOFLIGHT AND FLIGHT CONTROL PANELS
8. EMERGENCY PITCH TRIM CRANK
9. INSTRUMENT PANEL FLOODLIGHT
10. VENTILATION AIR CONTROL
11. HYDRAULIC SUB-SYSTEMS ISOLATION SWITCH
12. FLAP CONTROL PANEL
13. ENGINE FIRE SWITCH
14. EXTERIOR LIGHTS MASTER SWITCH
15. CATAPULT HANDGRIP
16. FUEL QUANTITY INDICATOR CONTROL PANEL
17. SCOPE (PPDI) CONTROL PANEL
18. THROTTLE FRICTION LEVER
19. EMERGENCY IGNITION BUTTONS
20. SPEED BRAKE SWITCH
21. INTERCOM-TRANSMIT SWITCH
22. UHF COMM CONTROL PANEL
23. WEAPONS AND JETTISON CONTROL PANEL
24. SIF CONTROL PANEL (RELOCATED BY AFC 146) (DELETED BY AFC 296)
25. FUEL TRANSFER PANEL
26. SPEED BRAKE DUMP HANDLE
27. ANTI-G VALVE
28. OXYGEN SUPPLY LEVER

INSTRUMENT PANEL

AIRCRAFT NOT HAVING AFC 233 COMPLIED WITH



1. RADIATION CURTAIN HANDLE

1A. ALT FAIL LIGHT (AFC 296)

2. WHEELS WARNING INDICATOR
3. MASTER WARNING INDICATOR
4. APPROACH INDEXER
5. LABS/APC LIGHT
6. RADIATION CURTAIN RELEASE KNOB
7. ANTI-SKID LIGHT
8. CAMERA LIGHT
9. RADAR ALTIMETER
10. KNEEBOARD LIGHTS
11. LOW ALTITUDE WARNING LIGHT
12. PROJECTED DISPLAY INDICATOR (PPDI)
13. TERRAIN AVOIDANCE ALPHA PANEL
14. ACCELEROMETER
15. RADAR ADVISORY LIGHTS

15A. IFF LIGHT (AFC 296)

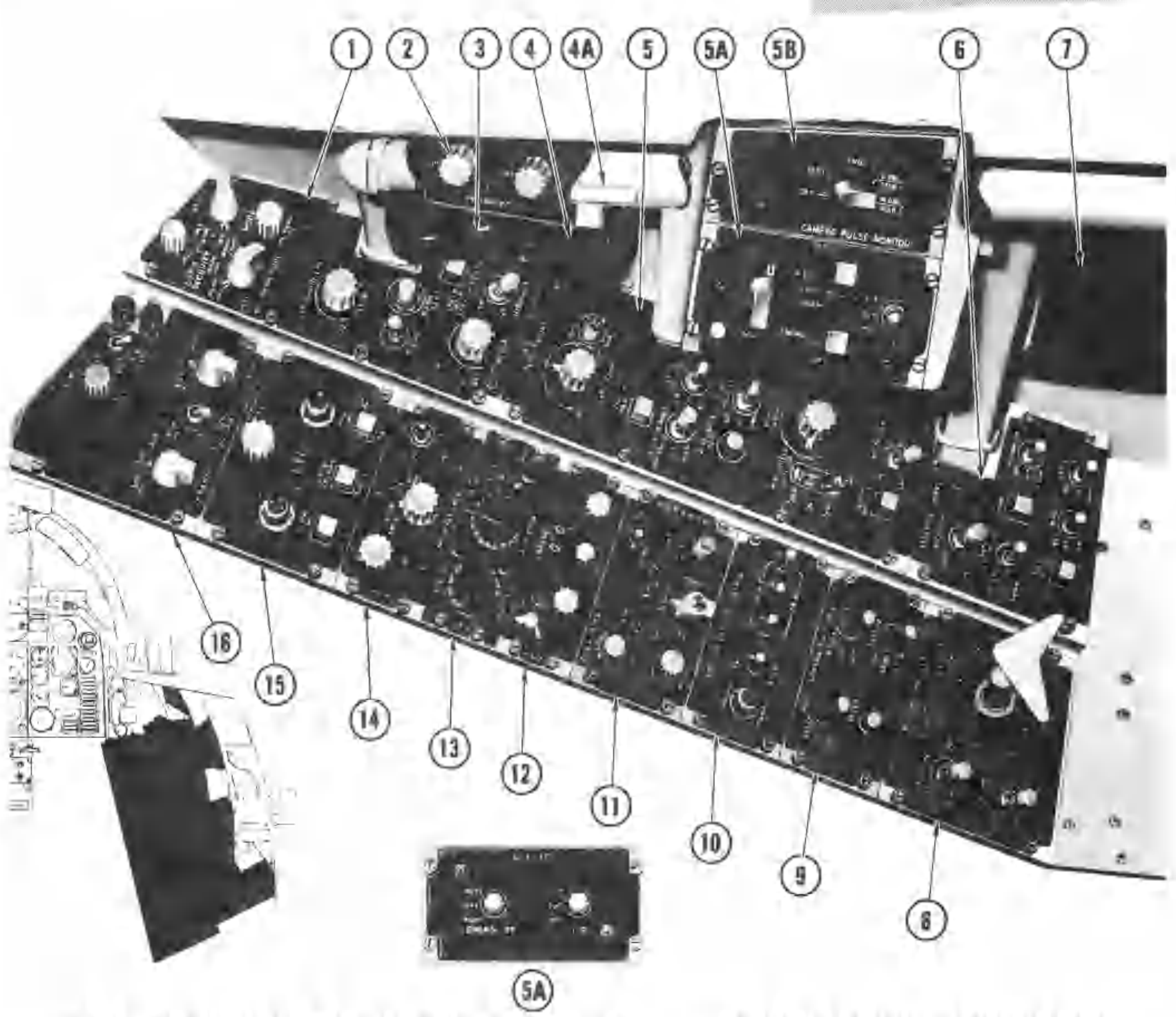
16. AFC MODE INDICATORS
17. MASTER CAUTION INDICATOR
18. MA/ML LIGHT
19. X-BAND WARNING LIGHT
20. S/C BAND WARNING LIGHT
21. THREAT DISPLAY UNIT (TDU)
22. AZIMUTH INDICATOR
23. LABS TIMER
24. TURN AND SLIP INDICATOR
25. OXYGEN QUANTITY INDICATOR
26. OXYGEN WARNING LIGHT
27. VERTICAL SPEED INDICATOR
28. STANDBY ATTITUDE INDICATOR (AFC 321)
29. CLOCK
30. UHF CHAN/FREQ INDICATOR
31. CAUTION INDICATORS
32. FUEL QUANTITY INDICATOR
33. LANDING GEAR EMERGENCY RELEASE HANDLE
34. EPU (RAT) RETRACT BUTTON
35. ENGINE MASTER AND START SWITCHES
36. EPU ADVISORY INDICATORS
37. RAT RELEASE HANDLE
38. HORIZONTAL SITUATION INDICATOR
39. ALL-ATTITUDE INDICATOR
40. FUEL FLOW INDICATOR
41. ALTIMETER

41A. ALTIMETER (AFC 296)

42. DROOP-FLAP-TRIM INDICATOR
43. SPEED BRAKE GEAR INDICATOR
44. NOZZLE POSITION INDICATOR
45. OIL PRESSURE INDICATOR
46. HYDRAULIC PRESSURE
47. EGT INDICATORS
48. RPM INDICATORS
49. AIRSPEED/MACH INDICATOR
50. ENGINE FIRE WARNING LIGHTS
51. VERTICAL SPEED INDICATOR (PRIMARY T/A)
52. ANGLE-OF-ATTACK INDICATOR
53. SMATS ADVISORY INDICATORS

NOTE:
CAUTION AND ADVISORY INDICATORS SHOWN ENERGIZED FOR INFORMATION PURPOSES.

RIGHT CONSOLE



1. INTERIOR LIGHTS CONTROL PANEL (AFC 218, AFC 250, AFC 303)
2. KNEEBOARD LIGHTS PANEL (AFC 227)
3. UTILITY LIGHT
4. FLOODLIGHT

4A. VENTILATION AIR CONTROL

5. AIR TEMPERATURE AND ANTI-ICE CONTROL PANEL

5A. IFF CONTROL PANEL* (AFC 146) OR IFF AUX CONTROL PANEL (AFC 250)

5B. CAMERA PULSE MONITOR KNOB (AFC 180)

6. EXTERIOR LIGHTS CONTROL PANEL
7. STORAGE CASE
8. FOLD CONTROL PANEL
9. ELECTRICAL SYSTEM CONTROL PANEL
10. OBLIQUE CAMERA CONTROL PANEL (INTERCHANGEABLE WITH T-375 AMAC OR AN/AWW-1 FFC CONTROL PANELS)
11. COMPASS CONTROL PANEL
12. TACAN CONTROL PANEL
13. AUX UHF CONTROL PANEL
14. INTERCOM SELECT PANEL
15. AUDIO SELECT PANEL (AFC 216)
16. ECM CONTROL PANEL (AFC 246)

* (DELETED BY AFC 296)

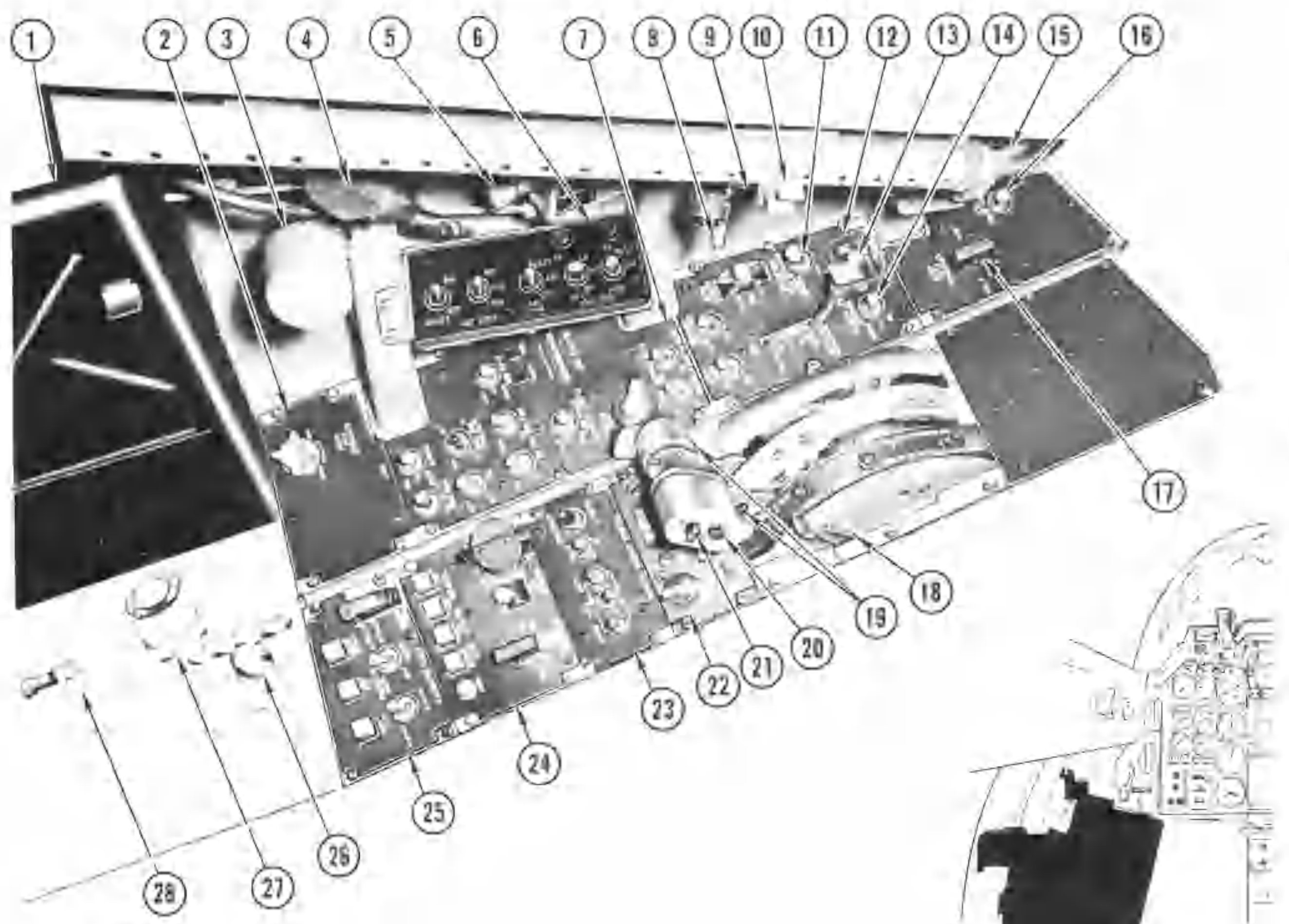
FA-5C-1-00-24B

Figure FO-4

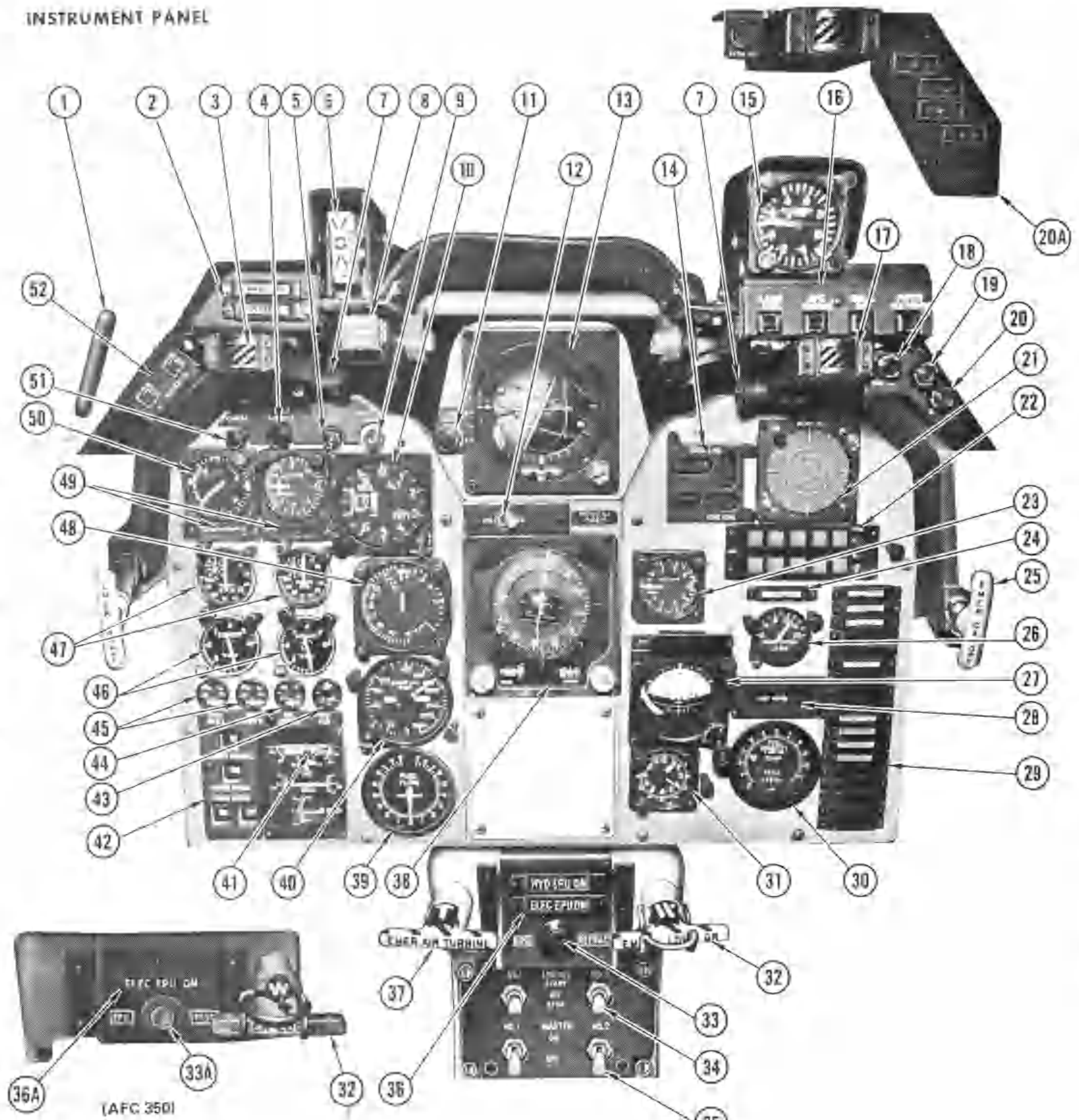
PILOT'S COCKPIT

(AFC'S 233, 302, 340, 350)

LEFT CONSOLE

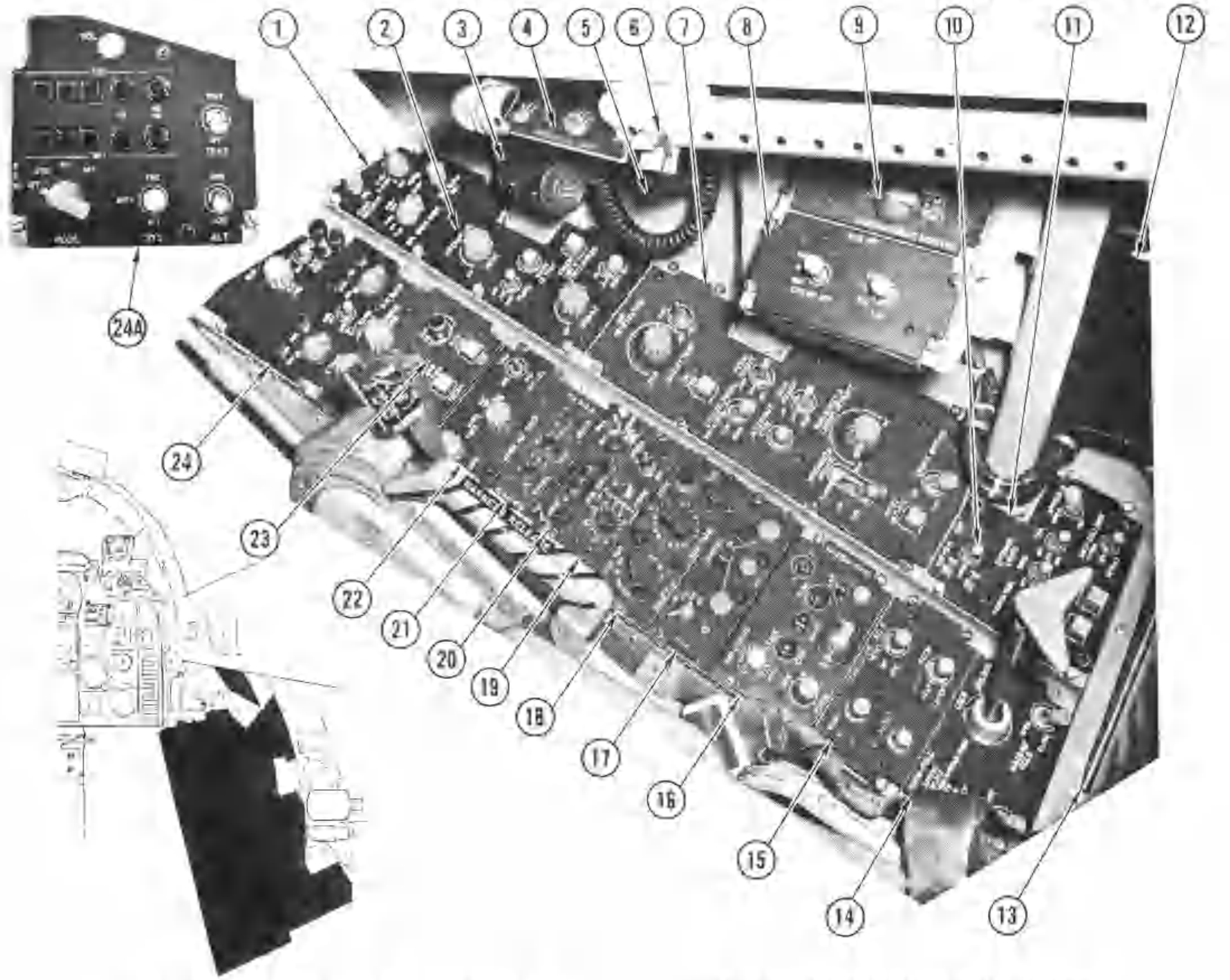


INSTRUMENT PANEL



(AFC 350)

RIGHT CONSOLE



Left Console

1. DATA CASE
2. EXPOSURE SUIT PANEL
3. HIGH-ALTITUDE LIGHT
4. CONSOLE FLOODLIGHT
5. CANOPY TOGGLE VALVE
6. APPROACH POWER COMPENSATOR AND ANTI-SKID CONTROL PANEL
7. AUTOFLIGHT AND FLIGHT CONTROL PANELS
8. EMERGENCY PITCH TRIM CRANK
9. INSTRUMENT PANEL FLOODLIGHT
10. VENTILATION AIR CONTROL
11. HYDRAULIC SUB-SYSTEMS ISOLATION SWITCH
12. FLAP CONTROL PANEL
13. ENGINE FIRE SWITCH
14. EXTERIOR LIGHTS MASTER SWITCH
15. CATAPULT HANDGRIP
16. FUEL GAGE TEST BUTTON
17. EXTERNAL FUEL GAGE CONTROL
18. THROTTLE FRICTION LEVER
19. EMERGENCY IGNITION BUTTONS
20. SPEED BRAKE SWITCH
21. INTERCOM TRANSMIT SWITCH
22. UHF COMM CONTROL PANEL
23. OBLIQUE CAMERA CONTROL PANEL
24. WEAPONS AND JETTISON CONTROL PANEL
25. FUEL TRANSFER PANEL
26. SPEED BRAKE DUMP HANDLE
27. ANTI-G VALVE
28. OXYGEN SUPPLY LEVER

Instrument Panel

1. RADIATION CURTAIN HANDLE
2. ACLS WAVE-OFF AND WHEELS WARNING INDICATORS
3. MASTER WARNING INDICATOR
4. DATA LINK COUPLER LIGHT
5. APC LIGHT
6. APPROACH INDEXER
7. KNEEBOARD LIGHT
8. RADIATION CURTAIN RELEASE
9. ANTI-SKID LIGHT
10. ALTIMETER
11. LOW ALTITUDE WARNING LIGHT
12. ACL/ILS SELECTOR (AFC 233)
13. ATTITUDE DIRECTOR INDICATOR (AFC 233)
14. DISCRETE READOUT INDICATOR (AFC 233)
15. ACCELEROMETER
16. AFC MODE INDICATORS
17. MASTER CAUTION INDICATOR
18. MA/ML LIGHT
19. X-BAND WARNING LIGHT
20. S/C-BAND WARNING LIGHT
20A. DECM ADVISORY INDICATORS (AFC 340)
21. AZIMUTH INDICATOR
22. THREAT DISPLAY UNIT (TDU)
23. VERTICAL SPEED INDICATOR
24. OXYGEN WARNING LIGHT
25. EMERGENCY CANOPY JETTISON KNOB
26. OXYGEN QUANTITY INDICATOR
27. STANDBY ATTITUDE INDICATOR
28. UHF CHAN/FREQ INDICATOR
29. CAUTION INDICATORS
30. FUEL QUANTITY INDICATOR
31. CLOCK
32. LANDING GEAR EMERGENCY RELEASE HANDLE
33. EPU (RAT) RETRACT BUTTON
33A. EPU TEST BUTTON (AFC 350)
34. ENGINE START SWITCHES
35. ENGINE MASTER SWITCHES
36. EPU ADVISORY INDICATORS
36A. EPU ADVISORY INDICATOR
37. RAT RELEASE HANDLE
38. HORIZONTAL SITUATION INDICATOR
39. FUEL FLOW INDICATOR
40. RADAR ALTIMETER
41. DROOP FLAP TRIM INDICATOR
42. SPEED BRAKE/GEAR INDICATOR
43. NOZZLE POSITION INDICATOR
44. OIL PRESSURE INDICATOR
45. HYDRAULIC PRESSURE
46. EGT INDICATORS
47. RPM INDICATORS
48. AIRSPEED/MACH INDICATOR
49. ENGINE FIRE WARNING LIGHTS
50. ANGLE-OF-ATTACK INDICATOR
51. CAMERA LIGHT
52. SMATS INDICATORS

NOTE

CAUTION AND ADVISORY INDICATORS SHOWN ENERGIZED FOR INFORMATION PURPOSES.

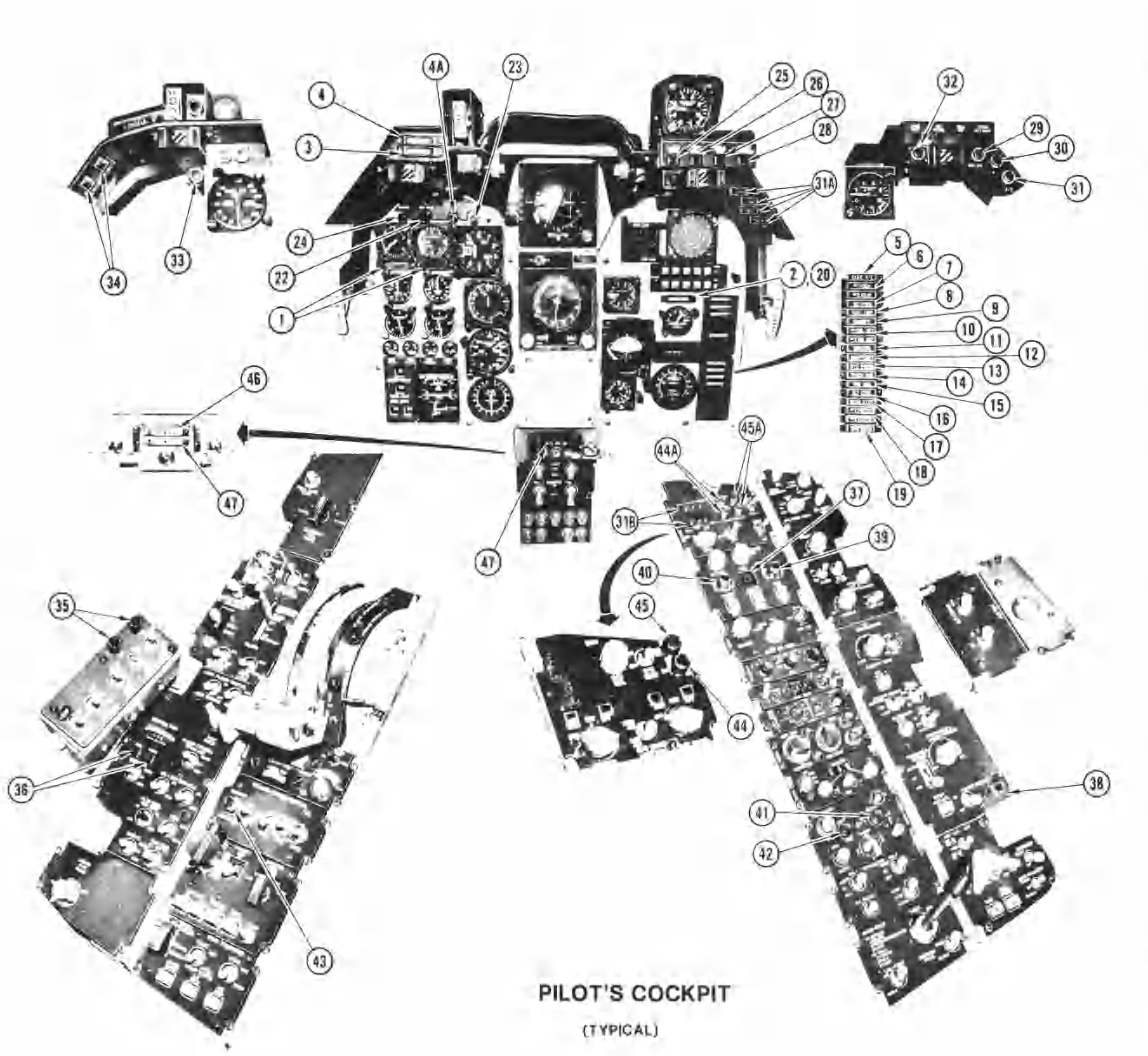
Right Console

1. COMMUNICATIONS SECURITY AND SPECIAL WARNING CONTROLS
2. INTERIOR LIGHTS CONTROL PANEL
3. UTILITY LIGHT
4. KNEEBOARD LIGHTS PANEL
5. FLOODLIGHT
6. VENTILATION AIR CONTROL
7. AIR TEMPERATURE AND ANTI-ICE CONTROL PANEL
8. IFF AUX CONTROL PANEL
9. CAMERA PULSE MONITOR KNOB
10. DATA LINK ANTENNA SELECTOR
11. EXTERIOR LIGHTS CONTROL PANEL
12. STORAGE CASE
13. NAVIGATION BAG STOWAGE (AFC 338)
14. FOLD CONTROL PANEL
15. ELECTRICAL SYSTEM CONTROL PANEL
16. COMPASS CONTROL PANEL
17. TACAN CONTROL PANEL
18. AUX UHF CONTROL PANEL
19. ILS CONTROL PANEL (AFC 302)
20. DATA LINK CONTROL PANEL
21. RADAR BEACON CONTROL PANEL
22. INTERCOM SELECT PANEL
23. AUDIO SELECT PANEL
24. ECM CONTROL PANEL
24A. ECM CONTROL PANEL (AFC 350)

RA-5C-1-00-25B

Figure FO-4A

WARNING, CAUTION AND ADVISORY INDICATORS



PILOT'S COCKPIT

(TYPICAL)

PILOT WARNING INDICATORS

1.	NO. 1 FIRE, NO. 2 FIRE	ENGINE FIRE, ENGINE BAY OVERHEAT, HOT AIR LEAK
2.	OXYGEN ✱	LIQUID SUPPLY LESS THAN 0.8 LITER OR SUPPLY PRESSURE LESS THAN 45 PSI
3.	WHEELS	WHEELS ARE NOT DOWN WITH EITHER THROTTLE LESS THAN 95% ENGINE RPM AND FLAPS EXTENDED 25 DEGREES OR MORE
4.	WAVE-OFF †	ACL APPROACH WAVE-OFF
4A.	APC	APC SWITCH IS ON BUT THE SYSTEM IS DISENGAGED

PILOT CAUTION INDICATORS

5.	ELEC F/C	EITHER LATERAL OR LONGITUDINAL CHANNEL OF THE ELECTRIC FLIGHT SYSTEM HAS MONITORED OFF
6.	NO. 1 GEN NO. 2 GEN	THE INDICATED GENERATOR HAS BEEN DROPPED OFF THE LINE
7.	DC PWR	EITHER DC CONVERTER IS NOT ON THE LINE
8.	FUEL LOW	SUMP FUEL HAS REACHED A LEVEL FROM 1650 TO 1950 POUNDS
9.	CANOPY	LOCKING MECHANISM OF EITHER COCKPIT IS NOT OVERCENTER
10.	NO. 1 OIL HOT NO. 2 OIL HOT	THE INDICATED ENGINE OIL HAS REACHED 295°F
11.	DROOPS	DROOPS AND BLC VALVE OUT OF SEQUENCE IN ANY POSITION EXCEPT 30° FLAPS; FLIGHT SPEED EXCEEDING 590 KCAS OR 1.3 IMN IN CRUISE POSITION.
12.	RAMP CONT	THE RAMPS HAVE AT LEAST 3° DIFFERENTIAL AND HAVE MONITORED OFF.
13.	HYD PRESS	EITHER NO. 1 OR NO. 2 SYSTEM PRESSURE HAS DROPPED TO 650 PSI OR NO. 2 SYSTEM HAS AUTO-ISOLATED
14.	PITCH AUG	PITCH AUG HAS MONITORED OFF
15.	YAW AUG	EITHER YAW AUG HAS MONITORED OFF
16.	ALT COOL	NO. 4 TURBINE HAS BEEN DIVERTED
17.	GEAR STIFF	HYDRAULIC PRESSURE APPLIED TO THE NOSE STRUT
18.	NO. 1 FILTER NO. 2 FILTER	25 PSI OR GREATER DIFFERENTIAL ACROSS THE LOW PRESSURE FUEL FILTER
19.	ENG DOOR	EITHER ENGINE DOOR IS OPEN
20.	OXYGEN ✱	LIQUID SUPPLY LESS THAN 0.8 LITER OR SUPPLY PRESSURE LESS THAN 45 PSI

PILOT ADVISORY LIGHTS

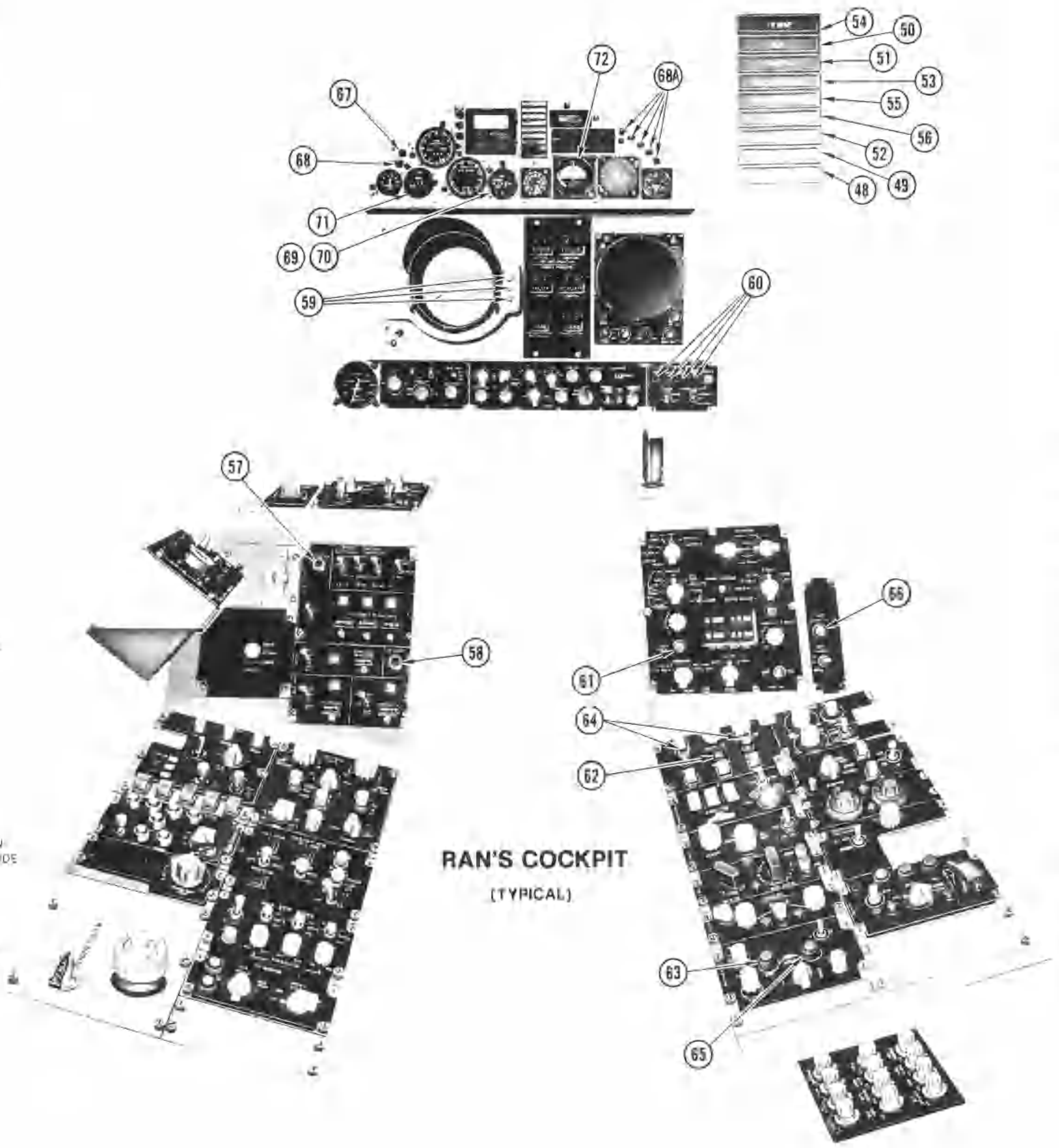
21.	(DELETED)	
22.	D/L COUPLER †	ACL AUTOMATIC CONTROL IS DISENGAGED-IN MANUAL CONTROL
23.	ANTI-SKID	ANTI-SKID SYSTEM DISENGAGED
24.	CAMERA	CAMERA BEING MONITORED IS FIRING
25.	LABS AUTO	NOT USED
26.	AFC ENGAGE	AUTOFLIGHT SYSTEM IS OPERATING
27.	ROLL/NAV	AFCS IN THE POSITION INDICATED
28.	PITCH ALT/MACH	AFCS IN THE POSITION INDICATED
29.	MA/ML	AN/APR-27 RECEIVING
30.	I (X)	AN/ALQ-41 RECEIVING
31.	E/G (R/C)	AN/ALQ-100 RECEIVING
31A.	ECM ADVISORY §§	AN/ALQ-126 RECEIVING
31B.	ECM STANDBY, RECEIVE AND REPEAT ‡	AN/ALQ-126 RECEIVING
32.	IFF ✱✱	AIRCRAFT SYSTEM NOT RESPONDING TO MODE 4 INTERROGATION
33.	ALT FAIL ‡	IN STANDBY (BARO ALTITUDE) MODE NOT TRANSMITTING ALTITUDE INFORMATION TO GROUND
34.	SMATS LH ¶ SMATS RH ¶	INDICATED ENGINE SMAT SYSTEM ENGAGED

PILOT PANEL INDICATORS

35.	LH–ANTI-SKID RH–ANTI-SKID	FULL RELEASE SIGNAL BEING TRANSMITTED TO THE INDICATED BRAKE
36.	ROLL, PITCH	INDICATED CHANNEL OF ELECTRIC FLIGHT IS ENGAGED
37.	EMERG CNI PWR	CNI PACKAGE OPERATING AT REDUCED POWER
38.	ENGINE ANTI-ICE	BOTH ENGINES RECEIVING HOT AIR PRESSURE FROM COMPRESSOR DISCHARGE
39.	NAV COMD	TACAN COMMAND
40.	COMM COMD	RADIO COMMAND
41.	SYNC	COMPASS SYNCHRONIZED
42.	TAKE COMD	COMPASS COMMAND
43.	CAMERA COMMAND	IN COMMAND OF THE OBLIQUES
44.	GO (ALQ-100) §	AN/ALQ-100 SYSTEM TEST SATISFACTORY
44A.	ECM TEST GO ‡	AN/ALQ-126 SYSTEM TEST SATISFACTORY
45.	NO-GO (ALQ-100) §	AN/ALQ-100 SYSTEM TEST UNSATISFACTORY
45A.	ECM TEST NO GO ‡	AN/ALQ-126 SYSTEM TEST UNSATISFACTORY

PILOT PEDESTAL MOUNTED LIGHTS

46.	HYD EPU ON ¶¶	1750 PSI PRESSURE (OFF WITH PRESSURE BELOW 1450 PSI)
47.	ELEC EPU ON	EPU IS SUPPLYING REQUIRED AC AND DC VOLTAGES



RAN'S COCKPIT

(TYPICAL)

RAN WARNING INDICATORS

48.	FIRE	FIRE IN EITHER ENGINE COMPARTMENT
49.	OXYGEN ✱	LIQUID SUPPLY LESS THAN 0.8 LITER OR SUPPLY PRESSURE LESS THAN 45 PSI

RAN CAUTION INDICATORS

50.	SLR	SIDE-LOOKING RADAR MALFUNCTION
51.	CAMERA	CAMERA SYSTEM MALFUNCTION
52.	CANOPY	AFT CANOPY MICROSWITCH NOT PROPERLY DEPRESSED
53.	RECON COOL	FLAPS EXTENDED AND WEIGHT OFF GEAR (TURBINE COMPRESSOR REFRIGERATION UNITS NO. 2 AND NO. 3 SHUT DOWN)
54.	IR MAP	GEAR UP, IR ON, AND SCANNER DOOR CLOSED

RAN ADVISORY LIGHTS

55.	BOMB AWAY	WEAPON SELECTED HAS RELEASED
56.	ARM MAST'R ON	PILOT'S MASTER ARM SWITCH ON
57.	CAMERA COMMAND	IN COMMAND OF OBLIQUE CAMERA SYSTEMS
58.	MOUNTS RE ERECT	VERTICAL OR PANORAMIC CAMERA MOUNTS STABILIZATION LIMITS EXCEEDED
59.	RADAR (TA, LO, IN)	RADAR MODE OF OPERATION
60.	CAMERA PULSE	CAMERA PULSE OPERATION
61.	ADVANCE MODE	AUTONAVIGATOR PLATFORM OPERATION
62.	EMER CNI PWR	RADIOS ON REDUCED POWER
63.	COMPASS TAKE CMD	COMPASS COMMAND
64.	COMM COMD NAV COMD	RADIO, TACAN COMMAND
65.	COMPASS SYNC	COMPASS SYNCHRONIZED
66.	B/N WARM UP	AUTONAVIGATOR PLATFORM TEMPERATURE
67.	IFF ✱✱	AIRCRAFT SYSTEM NOT RESPONDING TO MODE 4 INTERROGATIONS
68.	ALT FAIL ‡	IN STANDBY (BARO ALTITUDE) MODE NOT TRANSMITTING ALTITUDE INFORMATION TO GROUND
68A.	ECM ADVISORY §§	AN/ALQ-126 RECEIVING

RAN ADVISORY FLAGS

69.	BARBER POLE	SELECTED RADAR MODE FAILED, OR SPD (++) OFF OR FAILED IN BARO MODE
70.	RDR/BAR	RADAR ALTITUDE MODE KNOB POSITION BAROMETRIC ALTIMETER
71.	AIR/GND	SPEED SWITCH POSITION (TRUE AIRSPEED, GROUND SPEED INDICATOR)
72.	OFF (AAI)	HORIZON UNRELIABLE OR INOPERATIVE

✱ ON AIRCRAFT HAVING AFC 233 COMPLIED WITH, THE OXYGEN LIGHT IS CHANGED FROM A RED WARNING LIGHT TO A YELLOW CAUTION LIGHT.

† AIRCRAFT HAVING AFC 233 COMPLIED WITH

‡ INSTALLED IN PILOT'S COCKPIT ON AIRCRAFT HAVING AFC 296 COMPLIED WITH. RELOCATED TO RAN'S COCKPIT ON AIRCRAFT HAVING AFC 233 COMPLIED WITH

¶ AIRCRAFT HAVING AFC 247 COMPLIED WITH

§ AIRCRAFT HAVING AFC 246 COMPLIED WITH

✱✱ AIRCRAFT HAVING AFC 296 COMPLIED WITH

†† AIRCRAFT NOT HAVING AFC 159 COMPLIED WITH

‡‡ AIRCRAFT HAVING AFC 350 COMPLIED WITH

¶¶ AIRCRAFT NOT HAVING AFC 350 COMPLIED WITH

§§ AIRCRAFT HAVING AFC 340, PART II, COMPLIED WITH

RA-5C-1-00-28A

Figure FO-48

AIRCRAFT FUEL SUPPLY SYSTEM

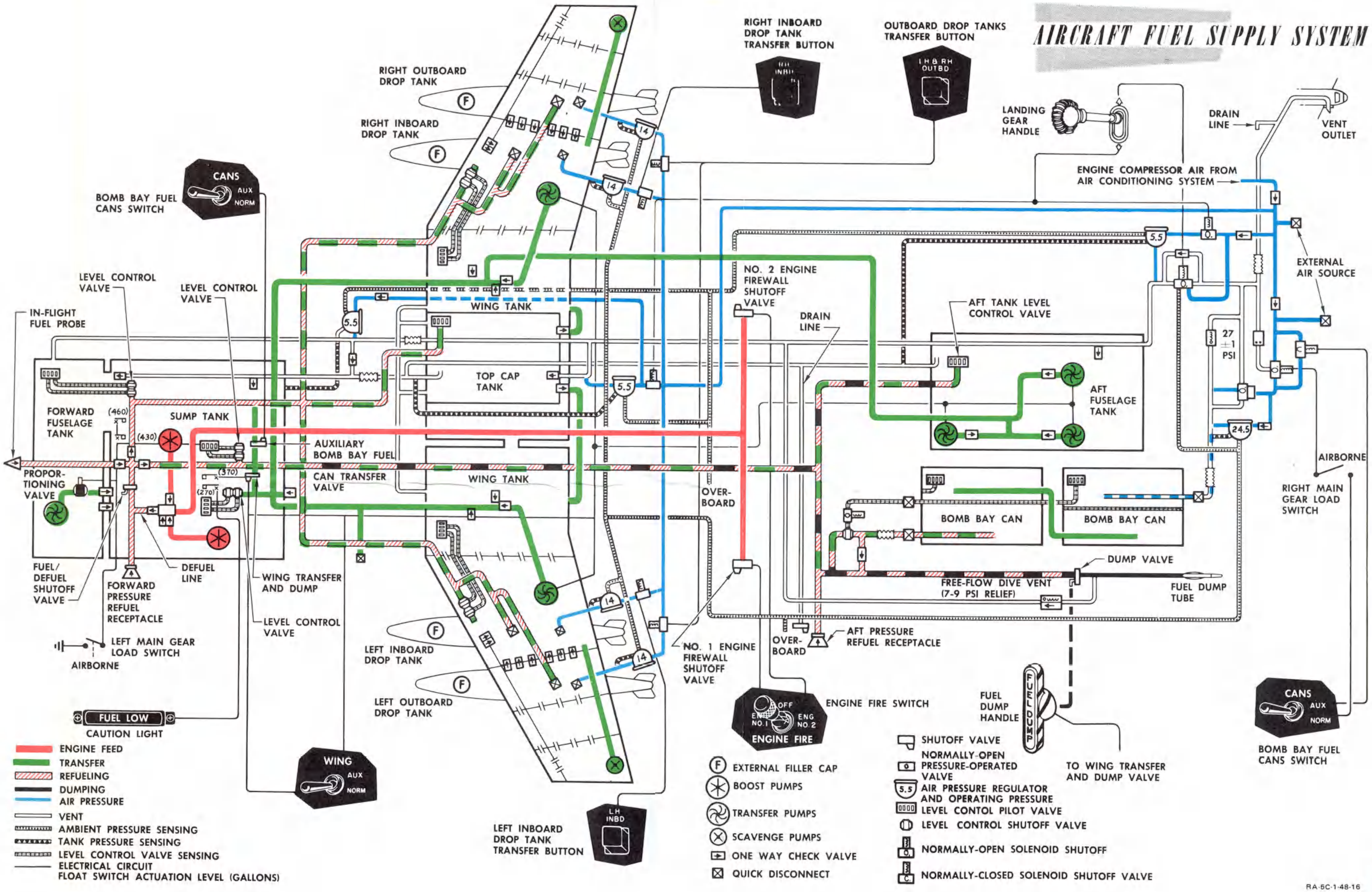
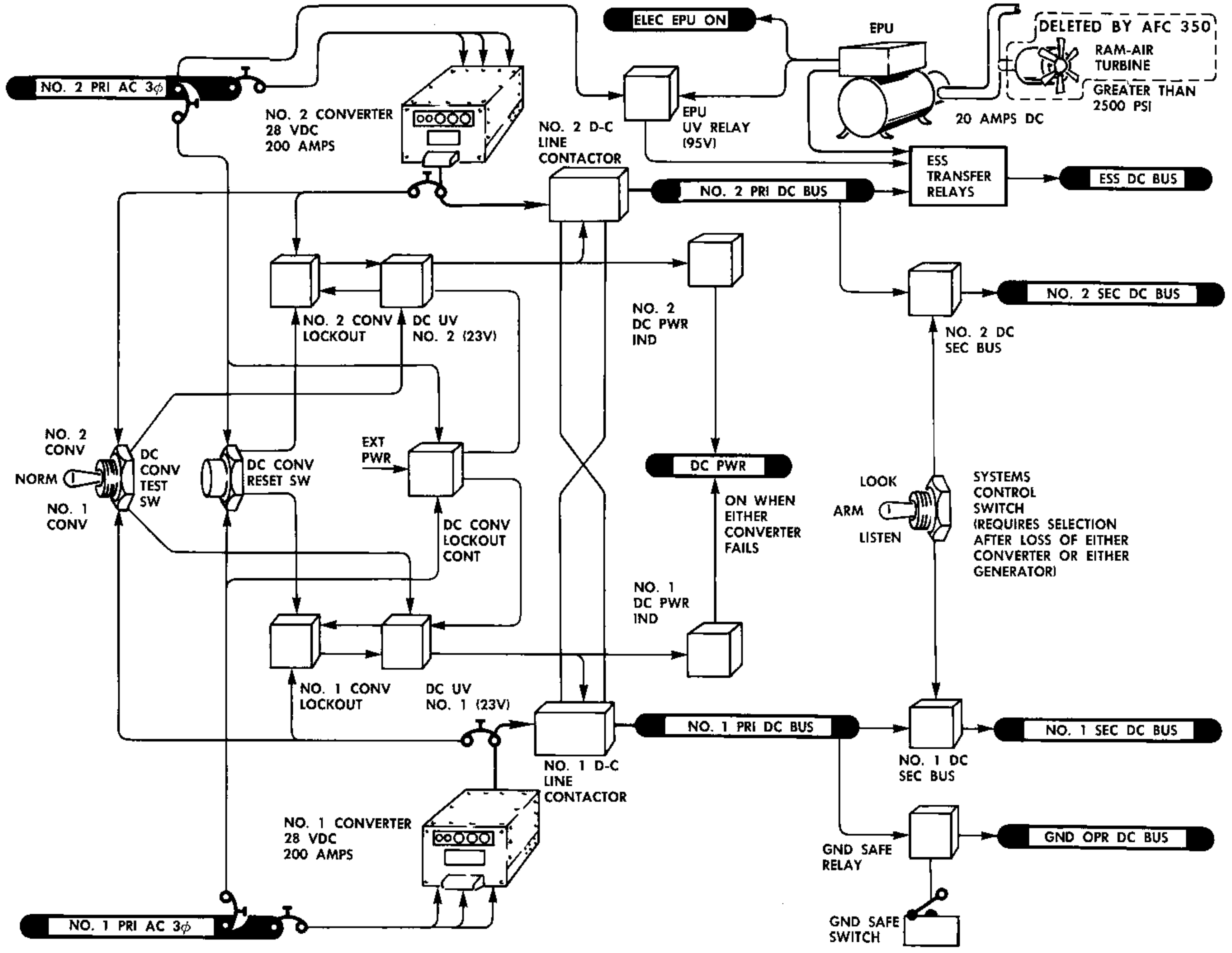


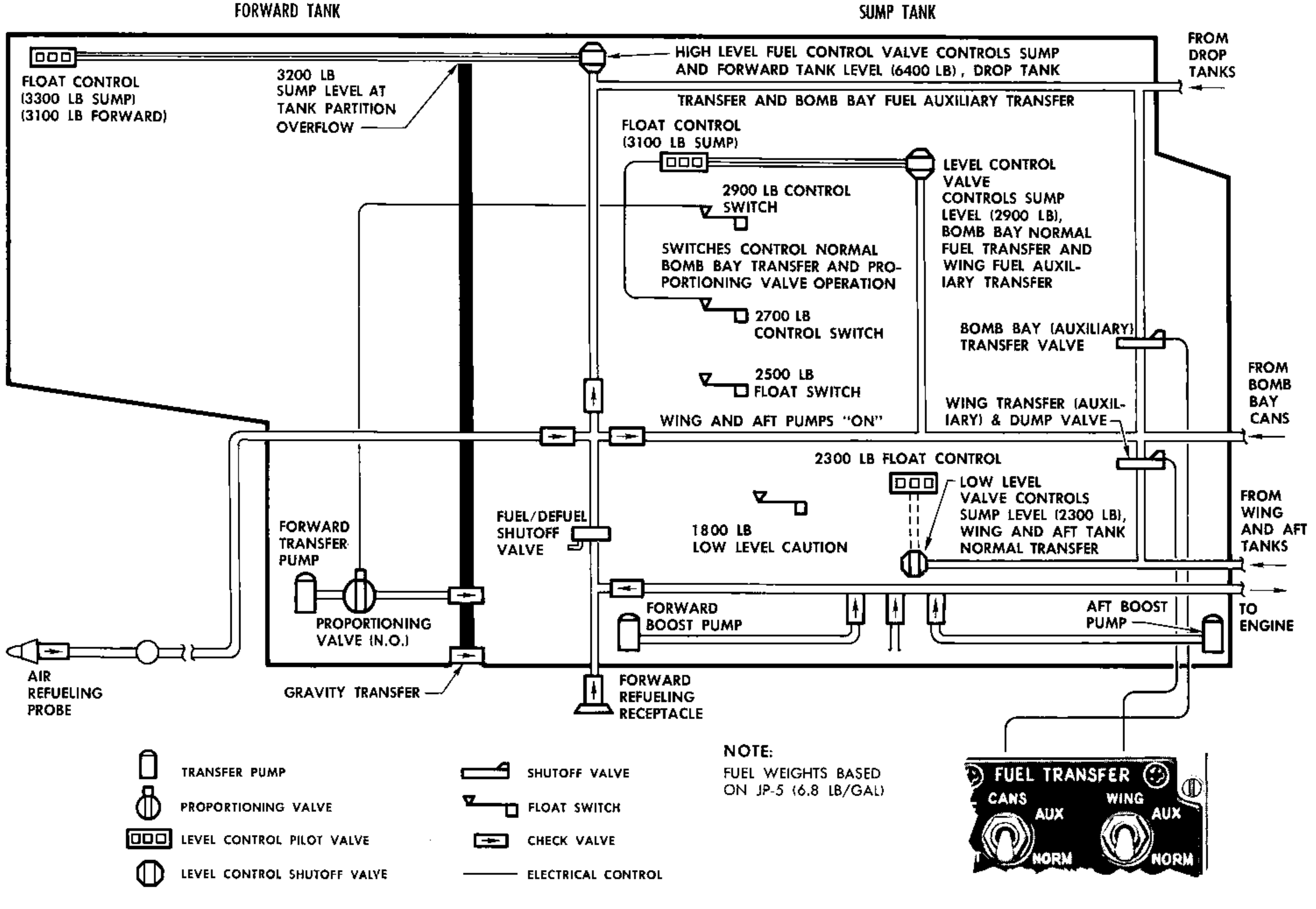
Figure FO-5

D-C POWER SYSTEM AND SUMP FUEL SEQUENCING COMPONENTS

D-C POWER SYSTEM



SUMP FUEL SEQUENCING COMPONENTS



NOTE:
FUEL WEIGHTS BASED ON JP-5 (6.8 LB/GAL)

RA-5C-1-48-17A

Figure FO-6

ELECTRICAL POWER DISTRIBUTION SYSTEM

NO. 1 PRIMARY AC BUS

AIR DATA
ANTI-SKID CONTROL BOX
ARMAMENT MASTER
AN/AWW-1†
BUDDY TRANSFER
B/N
DATA CONVERTER
DIGITAL DATA SYSTEM
ENGINE ANTI-ICE
EXT LIGHTS DIM
FORWARD BOOST PUMP
GENERAL EXT LIGHTS
GENERAL LIGHTS TRANSFORMER
GROUND SAFETY
IR MAPPING AN/AAS-21 (AFC 244)
KNEEBOARD LIGHTS (AFC 227)
LH WING TRANSFER PUMP
MODE RELEASE CONTROL
NAV FLOOD & MAP LIGHTS
NAV CONSOLE & INSTR LIGHTS
NAV RED FLOOD LIGHTS
NAV STANDBY GYRO HORIZON
NO. 1 AB IGNITION
NO. 1 AND 2 AFT TANK PUMPS
NO. 1 DC CONVERTER
NO. 1 DC RESET
NO. 1 YAW AUG
PILOT CONSOLE LIGHTS
PILOT HI ALT & PROBE LIGHTS
PILOT INSTR LIGHTS
PRI HEAT EXCH JETPUMP
RADAR
RADAR ALTIMETER
SECONDARY BUS CONTROL
SECONDARY HEAT EXCH JETPUMP
TACAN
TANK & PYLON RELEASE
TAXI LIGHT
TRIGGER

NO. 2 PRIMARY AC BUS

AC MONITOR BUS CONTROL
AIR DATA
AN/ALQ-41 (DELETED BY AFC 350)
AN/ALQ-51AND -51 MOD II (AFC 246)
AN/ALQ-55 COOLING
AN/ALQ-55 HEAT EXCH AIR
AN/ALQ-100 (AFC 246)
AN/ALQ-126 (AFC 350)
AUTOFLIGHT
B/N
CNI—LESS TACAN
ELECTRIC FLIGHT CONTROL
FORWARD TANK TRANSFER PUMP
GAP ACTUATORS (1, 2)
HSI
INLET RAMPS
LATERAL & DIRECTIONAL TRIM
NO. 2 AB IGNITION
NO. 2 DC CONVERTER
NO. 2 DC RESET
NO. 2 YAW AUG
NO. 3 AFT TANK PUMP
PITCH AUG AIR DATA
POSITION INSTRUMENTS
RH WING TRANSFER PUMP
WING LIGHTS

NO. 1A SECONDARY AC

AZIMUTH-CORRECTED CAMERA MOUNT
CAMERA CONTROL
LIQUID COOLING PUMP
MODULE NO. 1 & NO. 3 DEFROST
NO. 1 STABILIZED CAMERA MOUNT
NO. 2 STABILIZED CAMERA MOUNT
VACUUM PUMP
VIEWFINDER
SERIAL FRAME CAMERA
SLR
3-INCH PAN SYSTEM
18-INCH PAN SYSTEM

NO. 1B SECONDARY AC

PECM

ESSENTIAL AC BUS

AFT BOOST PUMP
ALTERNATE COOLING
ALTERNATE INSTR POWER
ALTERNATE TRIM
CABIN COOLING
CABIN HEAT EXCH BYPASS
CENTER PEDESTAL AC
COCKPIT LIMITER (1, 2, 3)
CNI
- UHF COMM
- AUX REC
- IFF, AIMS (AFC 296)
- ACLS (AFC 233)

EGT (1, 2)
ELECTRONICS COOLING
ELECTRONIC HEAT EXCH BYPASS
EQUIPMENT COOLING
FLAP-DROOP CONTROL
• FIRE DETECTOR (1, 2)
• FIRE SHUTOFF
FLAP-DROOP-TRIM INDICATOR
FLIGHT REFERENCE SET
FUEL LOW WARNING
FUEL QUANTITY INDICATOR
FUEL QUANTITY INDICATOR (TOTAL)
• FUEL SHUTOFF
INDICATING LIGHTS TEST
INTERNAL JETTISON (1, 2)†
INSTRUMENT TRANSFORMER
J-8 GYRO
• NAV ESSENTIAL TRANSFORMER
OXYGEN QUANTITY
• PILOT ESSENTIAL TRANSFORMER
PILOT INSTR VIBRATOR
PITOT HEATER
RAM AIR
• START & IGNITION (1, 2)
SUIT TEMPERATURE
WARNING LIGHTS POWER

MONITOR AC BUS

AFT SEAT ADJUST
ENGINE COOLING DOORS
FORWARD SEAT ADJUST
HIGH DUTY FUEL PUMP OPERATIONS
RADOME FOLD
PEDAL ADJUST
WING SCAVENGE PUMPS

ESSENTIAL INST AC BUS

ENGINE OIL PRESSURE (1, 2)
FUEL FLOW (1, 2)
HYDRAULIC PRESSURE (1, 2)

ARMAMENT AC BUS

INTERNAL RELEASE (1, 2) †

NO. 1 PRIMARY DC BUS

AIR REFUELING PROBE LIGHT
ACCELERATION CUTOFF (ASN-26)
ALTERNATE SUPV POWER (GEN CONTROL)
ANGLE-OF-ATTACK
ANTI-COLLISION LIGHTS
ANTI-SKID CONTROL VALVE
AIR TEMPERATURE DETECTOR
B/N
BUDDY TANKER
CHAFF DISPENSER AN/ALE-29A (AFC 216)
DROP TANKS TRANSFER
EMERGENCY BUDDY TANKER
ECM PASSIVE WARNING
ENGINE OIL COOLING
FLAP SHUTOFF
FUEL SEQUENCE
FUEL AUX TRANSFER
HOOK & APPROACH LIGHT
MAPPING RADAR
NOSE WHEEL STEERING
NO. 1 YAW AUG
PNEUMATIC PRESSURE
SMAT NO. 1 (AFC 247)
WING & TAIL FOLD

NO. 2 PRIMARY DC BUS

ACLS (AFC 233)
AIMS (AFC 296)
AN/ALQ-41 & 51
AN/ALQ-55
AUTOFLIGHT CONTROL
AN/ALR-45 (AFC 340)
AN/ALR-50 (AFC 340)
B/N
CANOPY SEAL
CNI NO. 1
CNI NO. 2
DC SECONDARY BUS SELECT
ELECTRIC FLIGHT CONTROL
EMERGENCY ELEC POWER INDICATOR
FORWARD TRANSFER CONTROL
HYDRAULIC ISOLATION
INLET RAMPS
JET PUMP CONTROL
LANDING GEAR CONTROL
NO. 2 YAW AUG
PEDAL SHAKER & ACCELEROMETER
PITCH AUG
SECONDARY HEAT EXCH SHUTOFF
SPEED BRAKE
SMAT NO. 2 (AFC 247)
TURBINE RETRACT
WARN RECEIVER (AFC 216)

• COCKPIT CIRCUIT BREAKERS
† AIRCRAFT NOT HAVING AFC 349

NO. 1 SECONDARY DC BUS

ARMAMENT MASTER
BULLPUP POWER
BOMBS & BULLPUP
LABS
STORE-STATION MODE SELECT
TANK RELEASE (1, 2)
WEAPON CONTROL †
WEAPON POWER (1, 2, 3)†

NO. 2 SECONDARY DC BUS

AZIMUTH CORRECTED CAMERA MOUNT
DATA CONVERTER
DIGITAL DATA SYSTEM
IR MAPPING AN/AAS-21 (AFC 244)
MODULE NO. 1 & NO. 3 DEFROST
NO. 1 STABILIZED CAMERA MOUNT
NO. 2 STABILIZED CAMERA MOUNT
PECM
SERIAL FRAME CAMERAS
SLR
SPECIAL SYSTEMS CONTROL
VIEWFINDER
3-INCH PAN CAMERA SYSTEM
18-INCH PAN CAMERA SYSTEM

ESSENTIAL DC BUS

• AIRBORNE REFUEL
CABIN HEAT EXCH BYPASS
• CABIN PRESSURE
CNI ESSENTIAL
COCKPIT ESSENTIAL (1, 2, 3)
• DC ESSENTIAL (1, 2, 3)
ECM DESTRUCT (AFC 216)
ELECTRONICS HEAT EXCH BYPASS
• EMERGENCY FLAP
• ESSENTIAL FUEL
• EXTERNAL JETTISON (1)
• EXTERNAL JETTISON (2)
FLIGHT REFERENCE SET
• FUEL GAGE DC (SELECTOR POSITION INDICATOR)
• FUEL SEQUENCE
• ICS RELAY POWER
• INDICATORS TEST (1)
• INDICATORS TEST (2)
LANDING GEAR INDICATOR
MASTER CAUTION
MASTER WARNING
NOZZLE POSITION INDICATOR
• NAV ICS
• PILOT ICS
TURN & SLIP INDICATOR
UHF COMM
• WINDSHIELD DEFROST & ANTI-ICE
WHEELS LIGHT

GROUND-OPERATED DC BUS

FLOOD LIGHTS
INDICATOR
REFUEL TEST & DEFUEL

ARMAMENT DC BUS

CONVENTIONAL STORE ARM
ECM DESTRUCT (AFC 216)
STORE RELEASE (1, 2)†

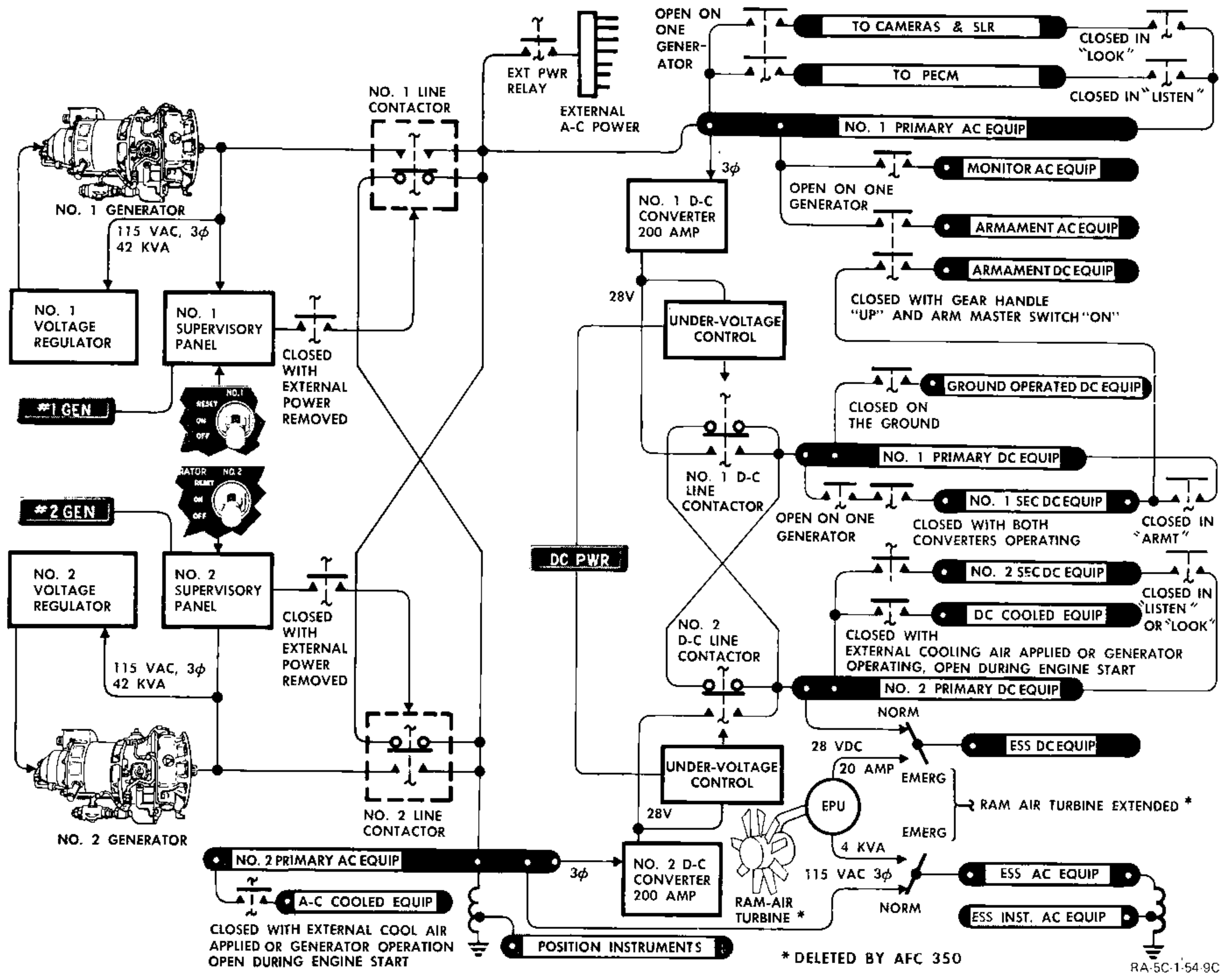


Figure FO-7

EJECTION SEAT AND HYDRAULIC POWER SYSTEM

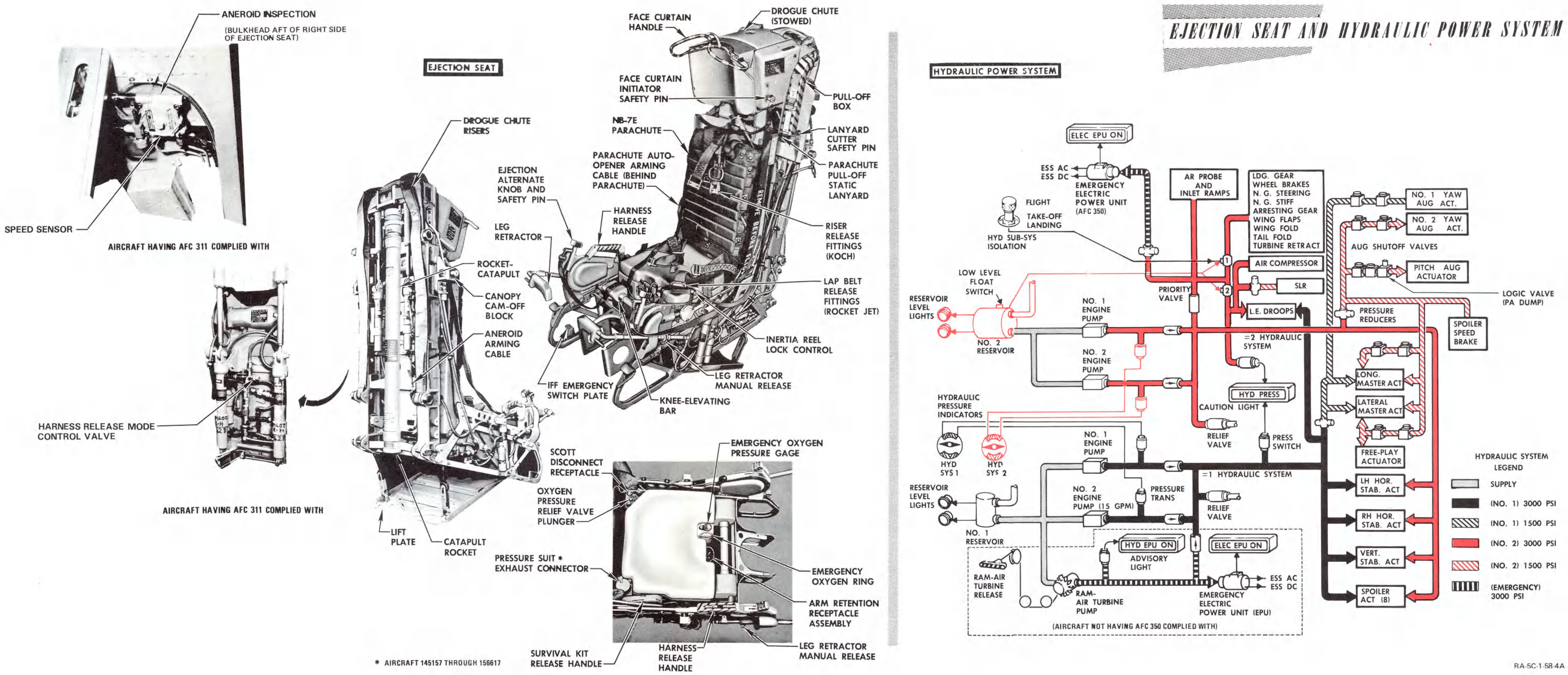
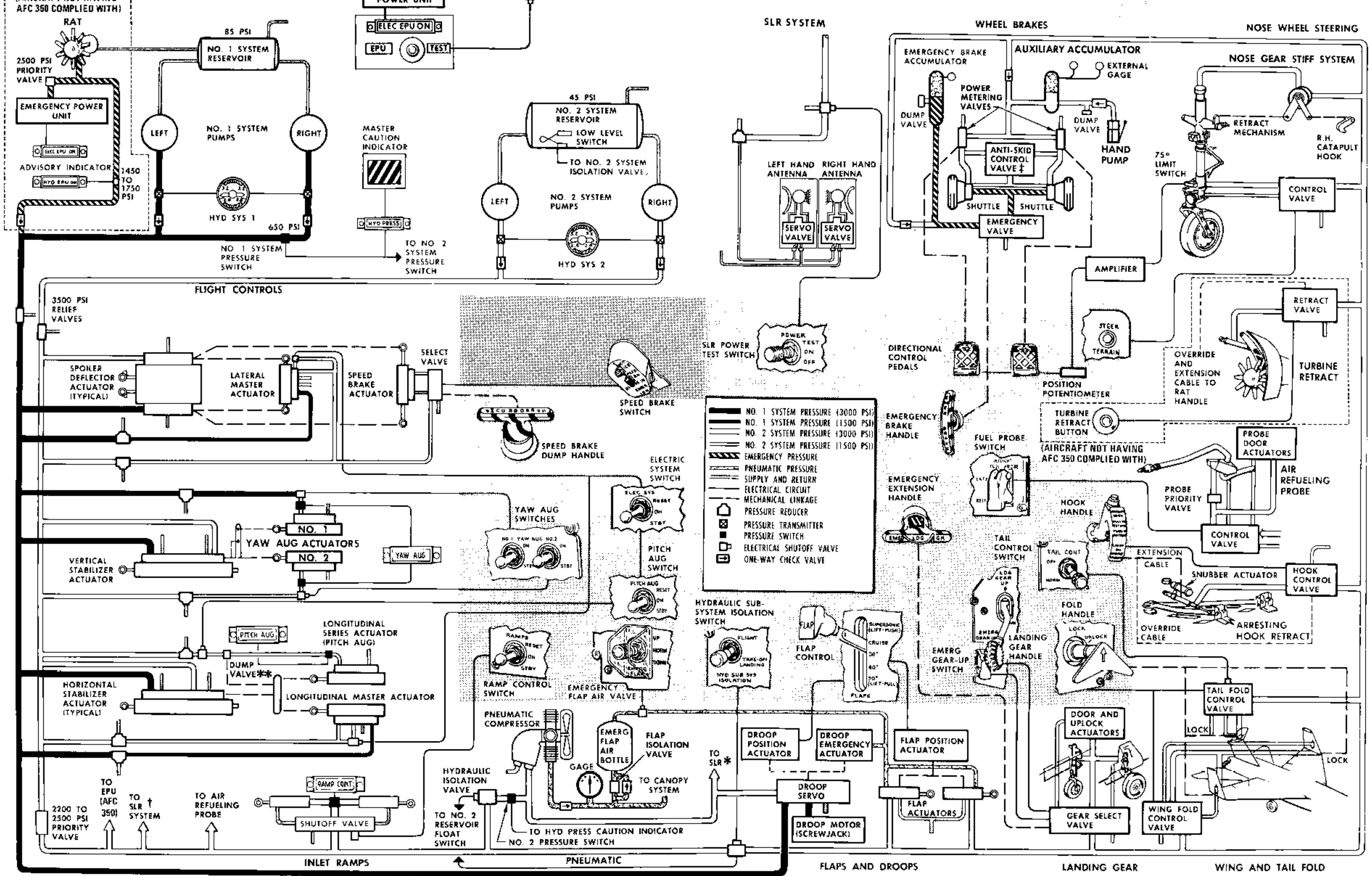


Figure FO-8

HYDRAULIC POWER SYSTEMS



† AIRCRAFT NOT HAVING AFC 137 COMPLIED WITH
** AIRCRAFT HAVING AFC 184 COMPLIED WITH

*AIRCRAFT HAVING AFC 137 COMPLIED WITH
‡ AIRCRAFT HAVING AFC 170 COMPLIED WITH

HA-5C 1 58 9A

Figure FO-9

PNEUMATIC SYSTEM

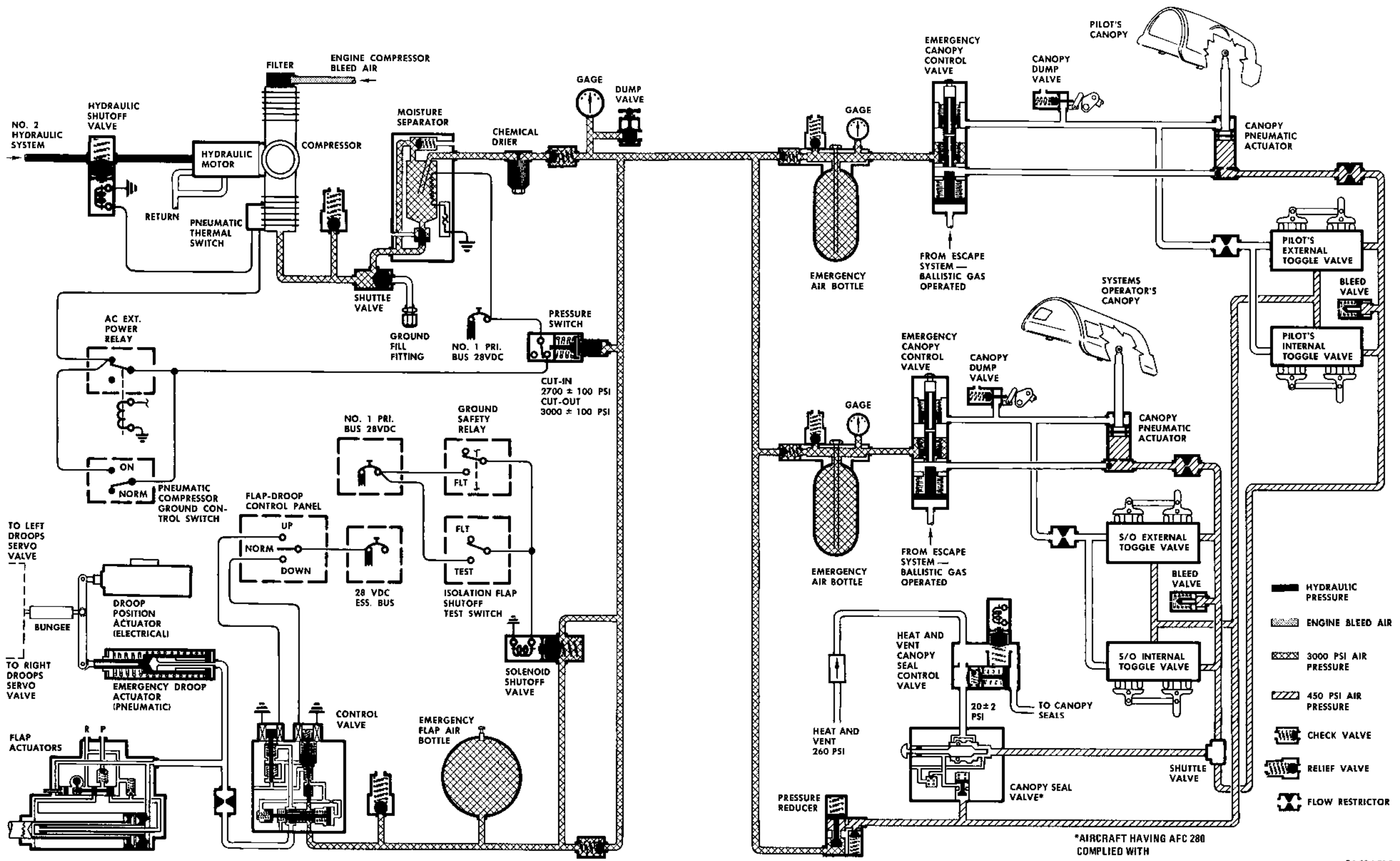
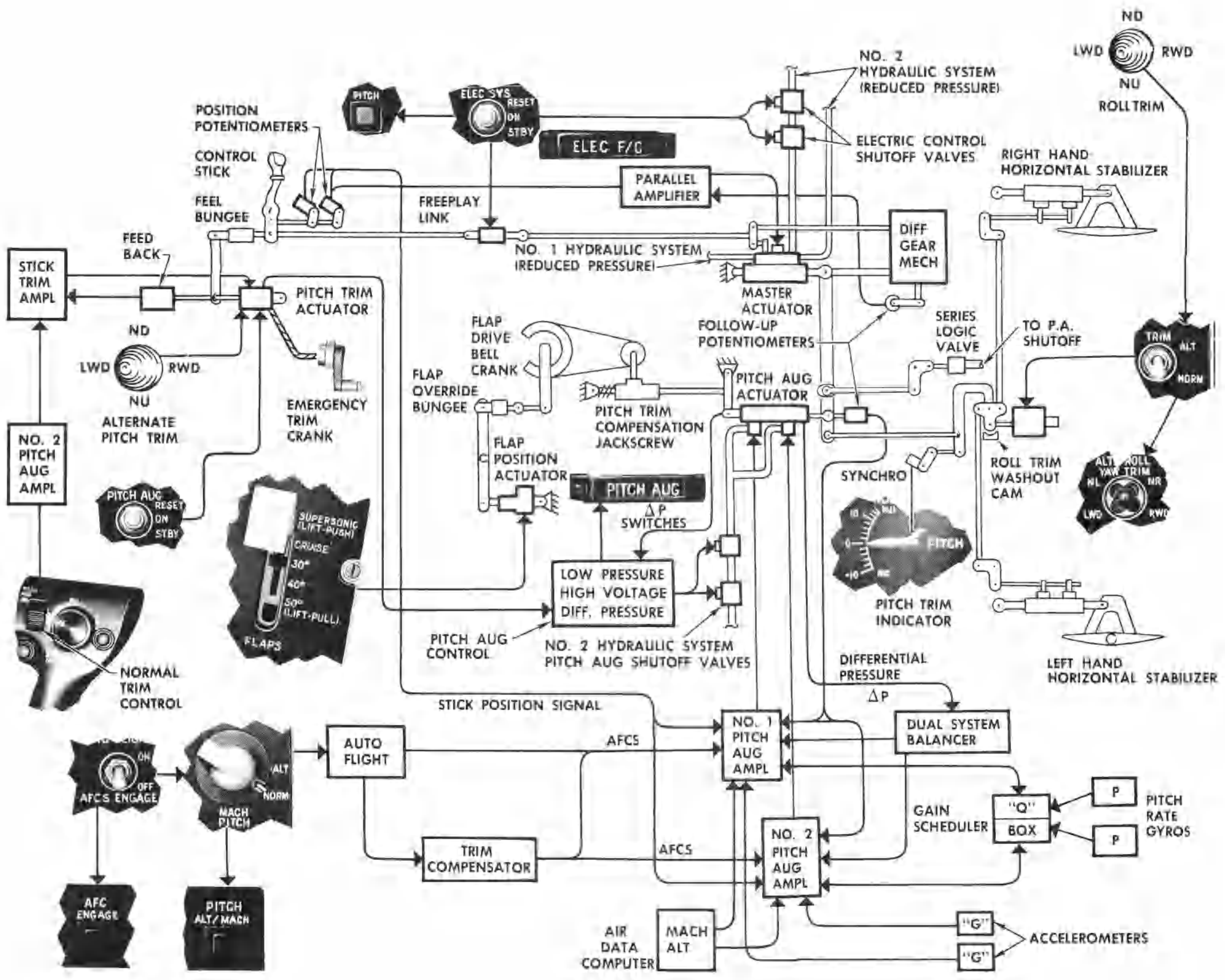


Figure FO-10

LONGITUDINAL AND LATERAL FLIGHT CONTROL SYSTEMS

LONGITUDINAL SYSTEM



LATERAL SYSTEM

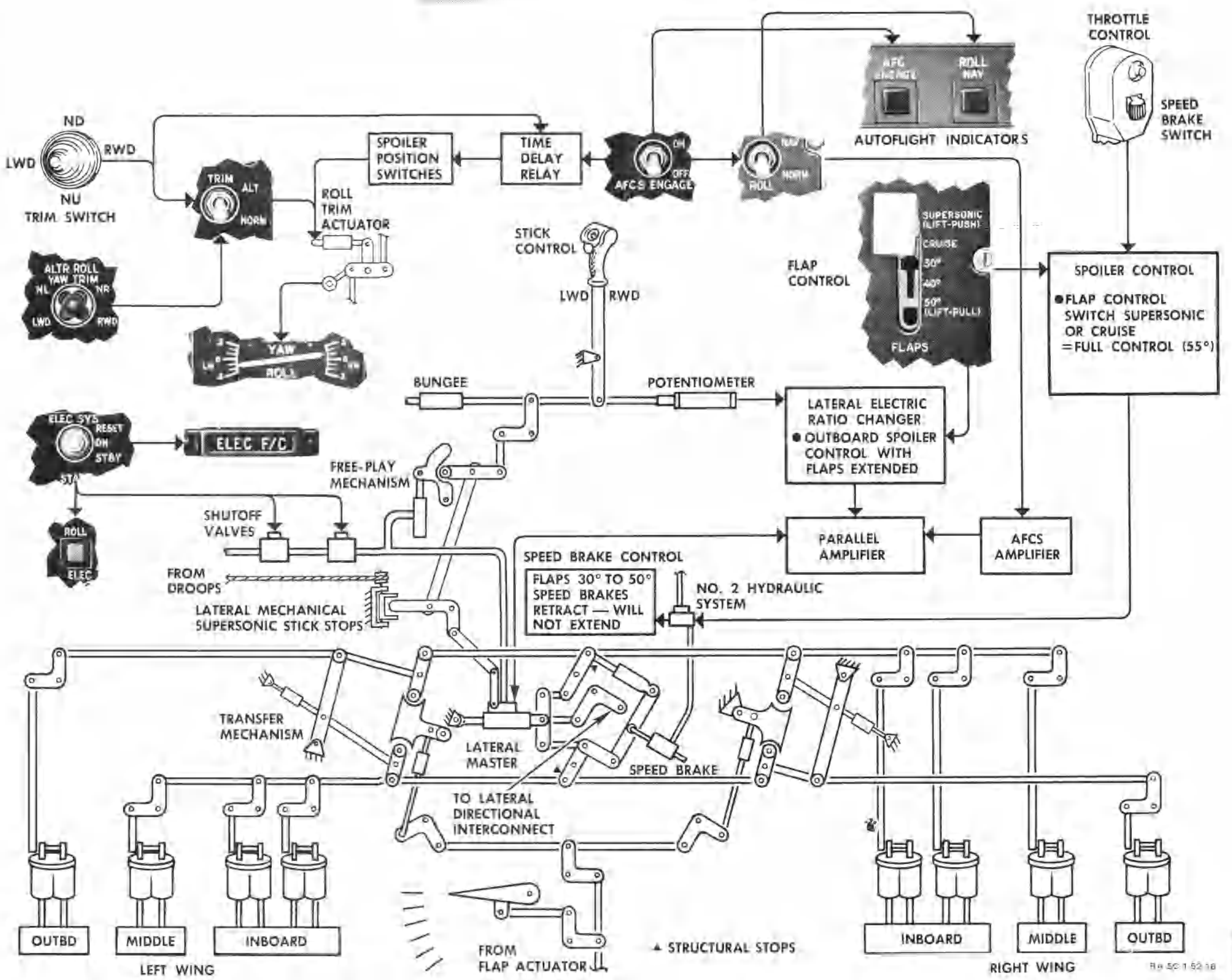
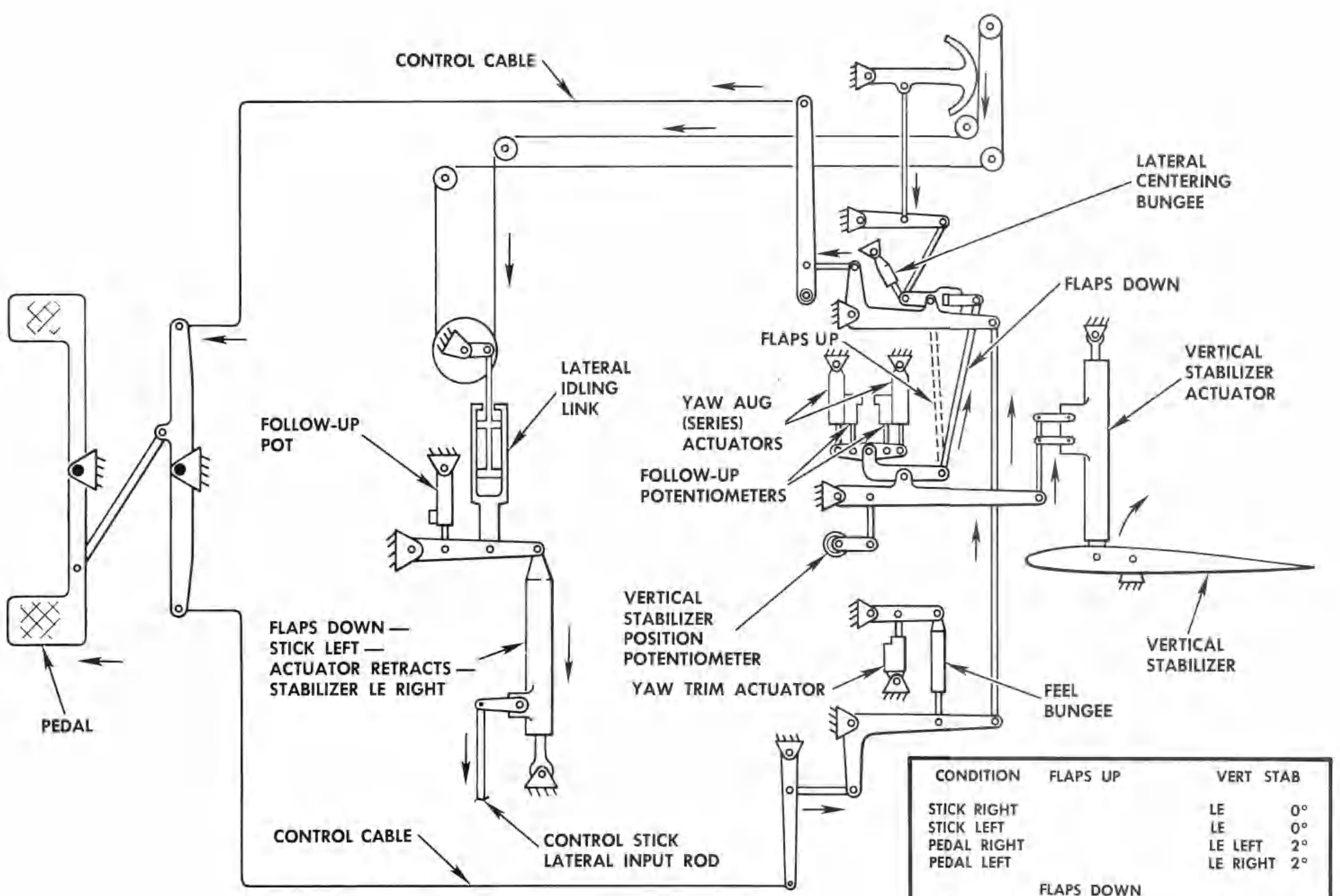


Figure FO-11

DIRECTIONAL FLIGHT CONTROL SYSTEM



CONDITION FLAPS UP	VERT STAB	
STICK RIGHT	LE	0°
STICK LEFT	LE	0°
PEDAL RIGHT	LE LEFT	2°
PEDAL LEFT	LE RIGHT	2°
FLAPS DOWN		
STICK RIGHT	LE LEFT	4°
STICK LEFT	LE RIGHT	4°
PEDAL RIGHT	LE LEFT	8°
PEDAL LEFT	LE RIGHT	8°
STICK RIGHT AND PEDAL LEFT	LE RIGHT	6°
STICK LEFT AND PEDAL RIGHT	LE LEFT	6°

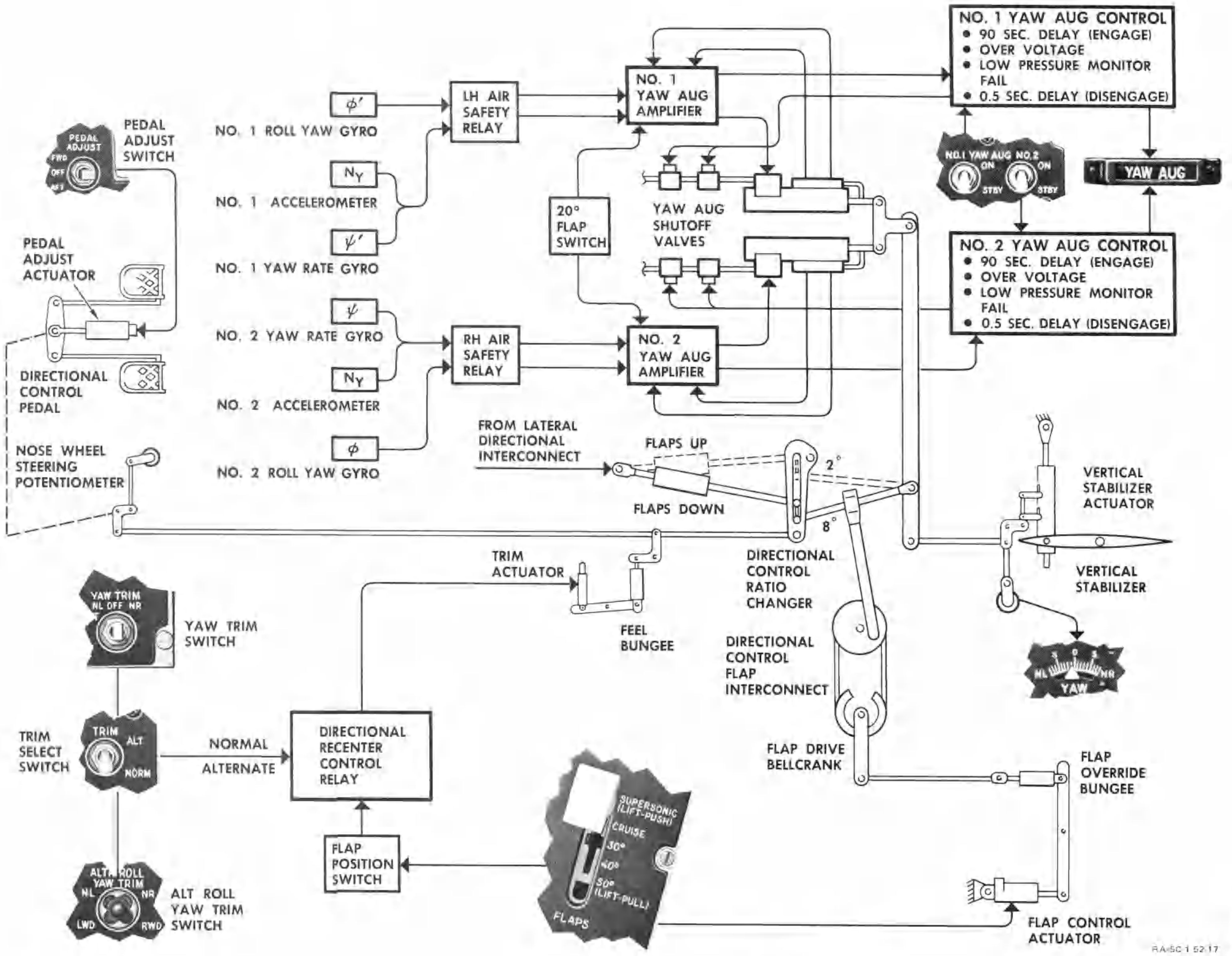


Figure FO-12

WING FLAP AND DROOP LEADING EDGE SYSTEM

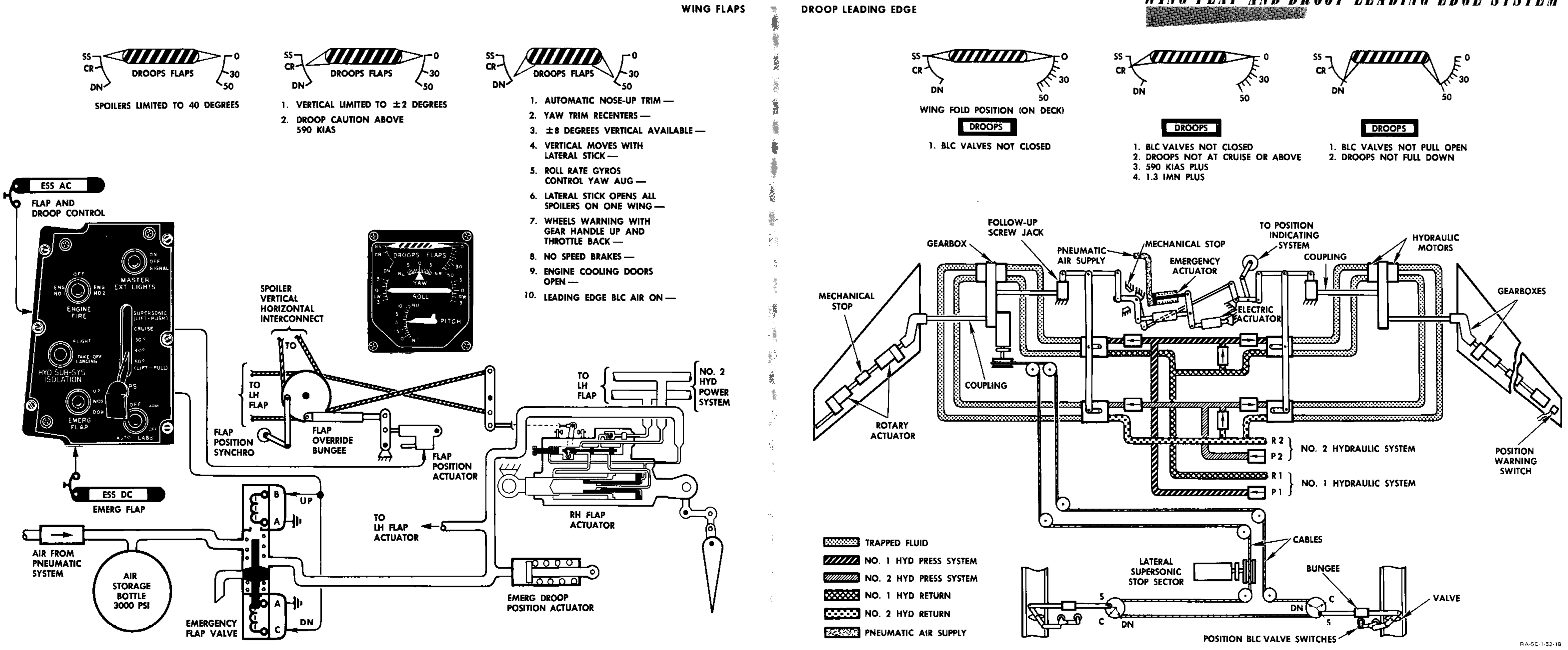


Figure FO-13

AIR CONDITIONING SYSTEMS

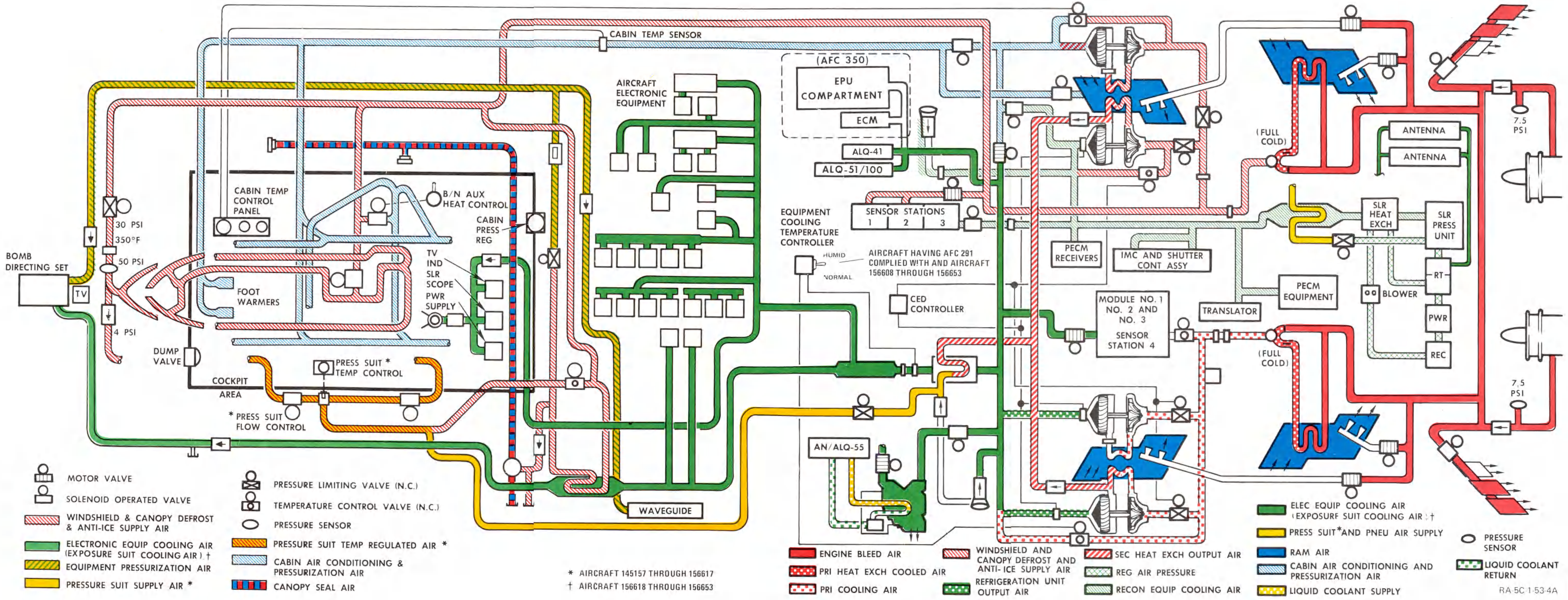
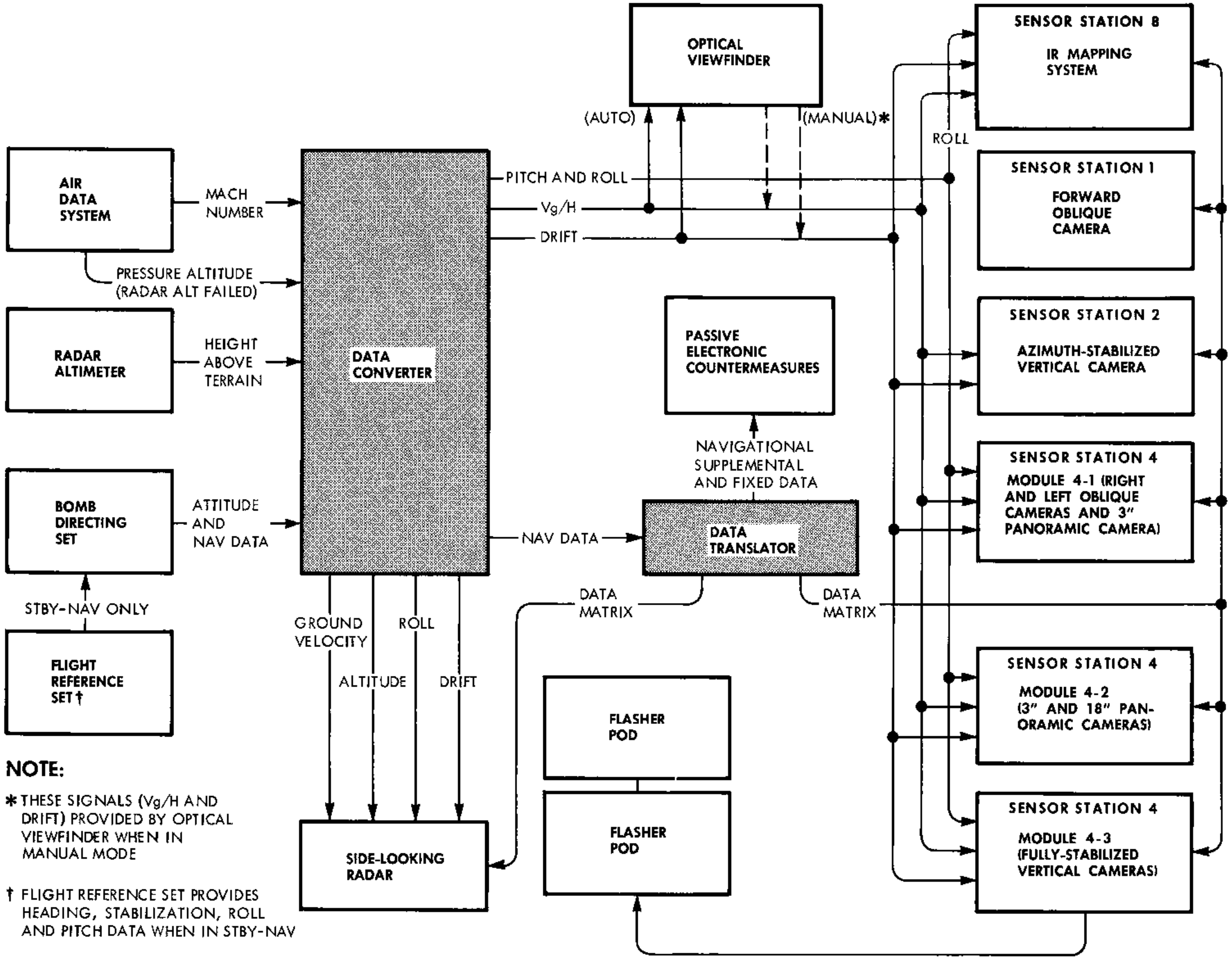


Figure FO-14

RECON SYSTEMS INTEGRATION



NOTE:

* THESE SIGNALS (Vg/H AND DRIFT) PROVIDED BY OPTICAL VIEWFINDER WHEN IN MANUAL MODE

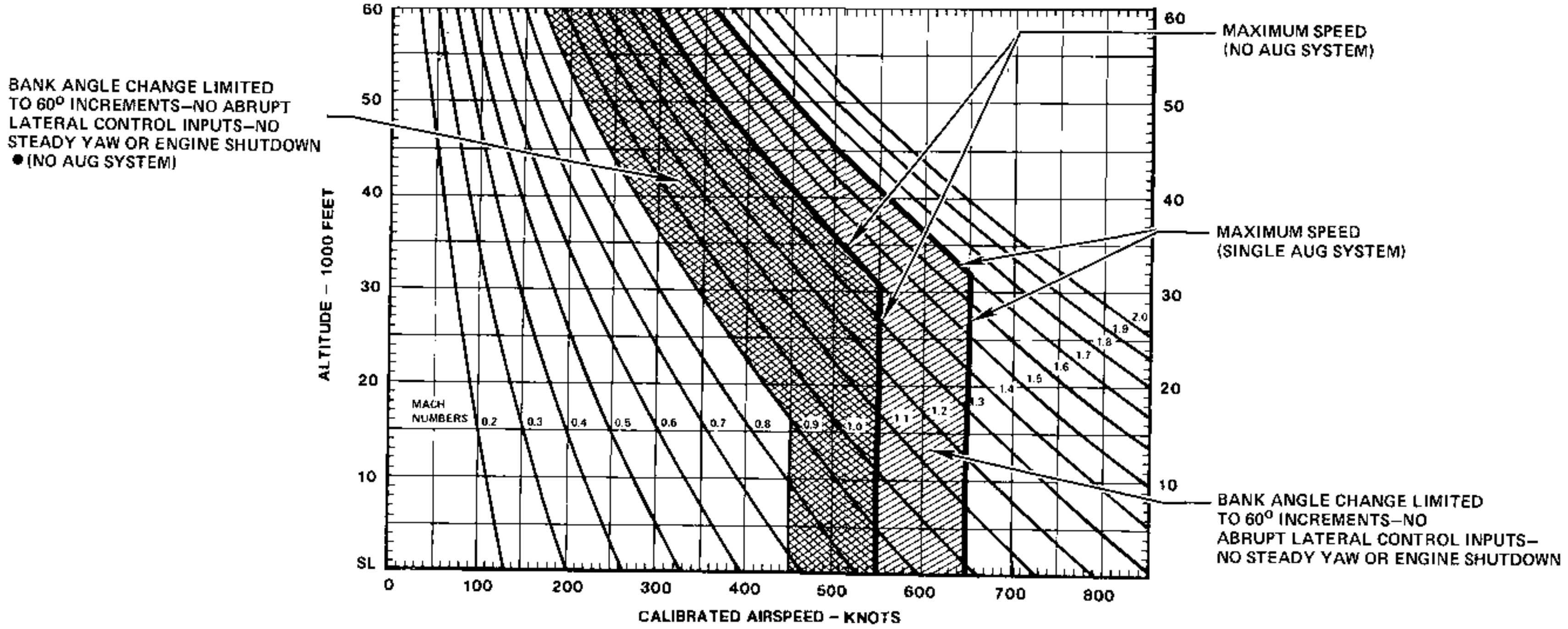
† FLIGHT REFERENCE SET PROVIDES HEADING, STABILIZATION, ROLL AND PITCH DATA WHEN IN STBY-NAV

Figure FO-15

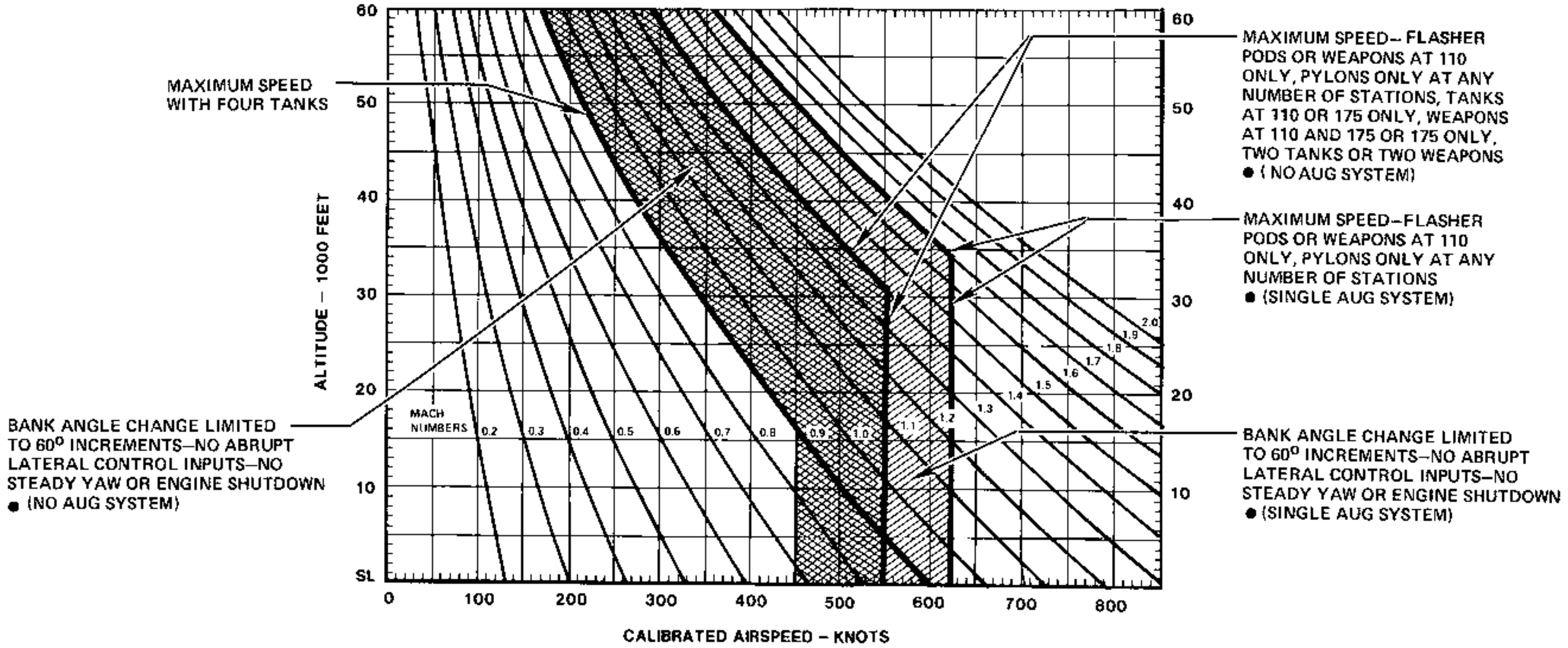
OPERATING FLIGHT LIMITS

AIRSPEED AND MANEUVERING LIMITS

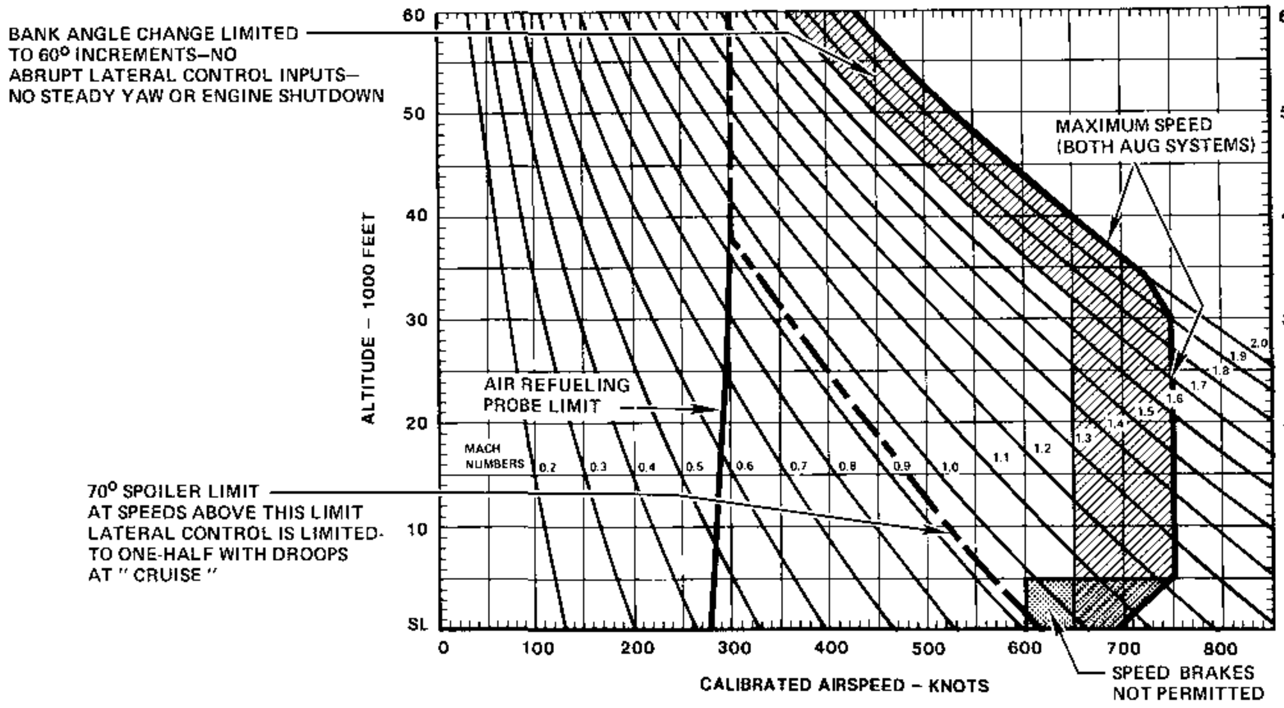
● SINGLE OR NO YAW AUG ON
● NO EXTERNAL STORES



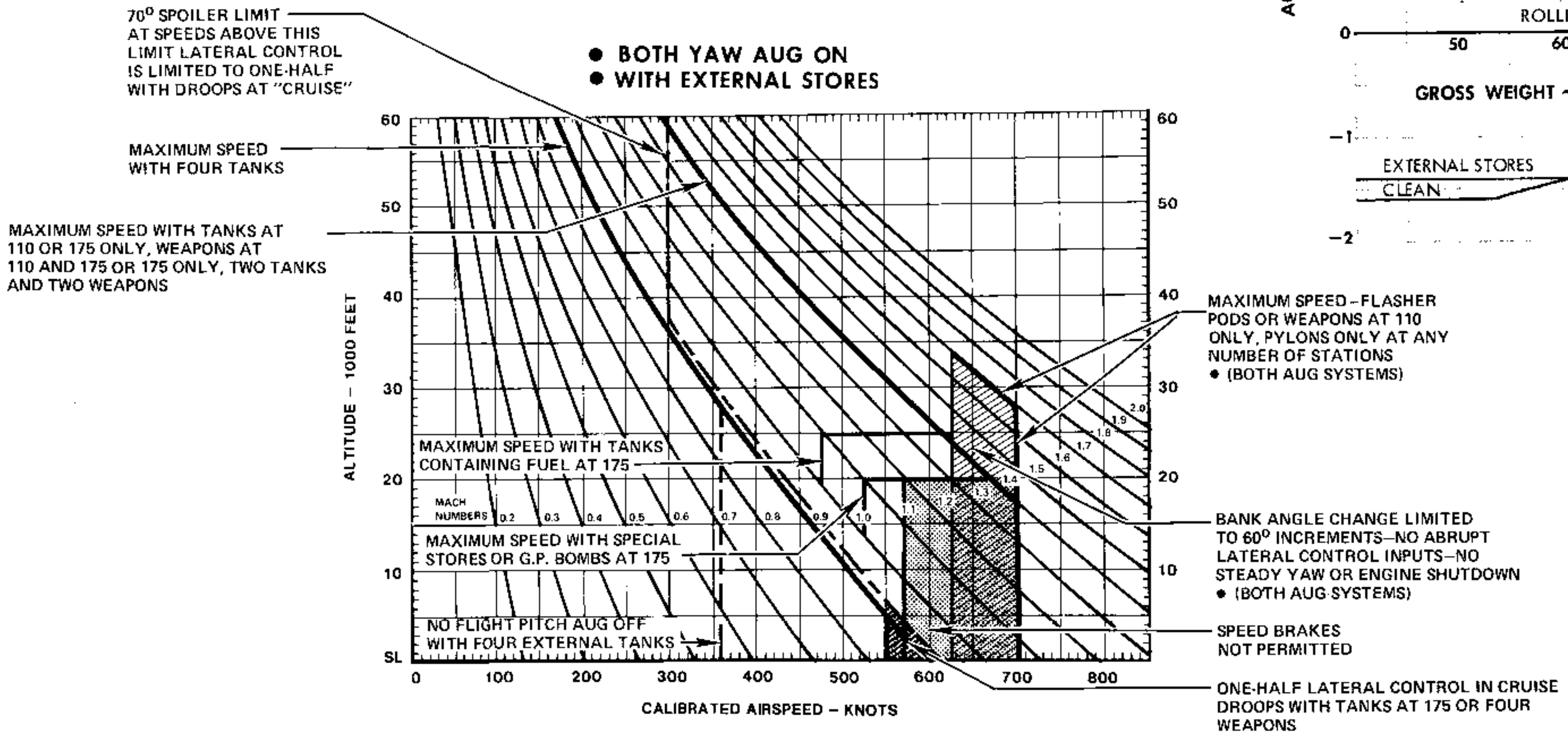
● SINGLE OR NO YAW AUG ON
● WITH EXTERNAL STORES



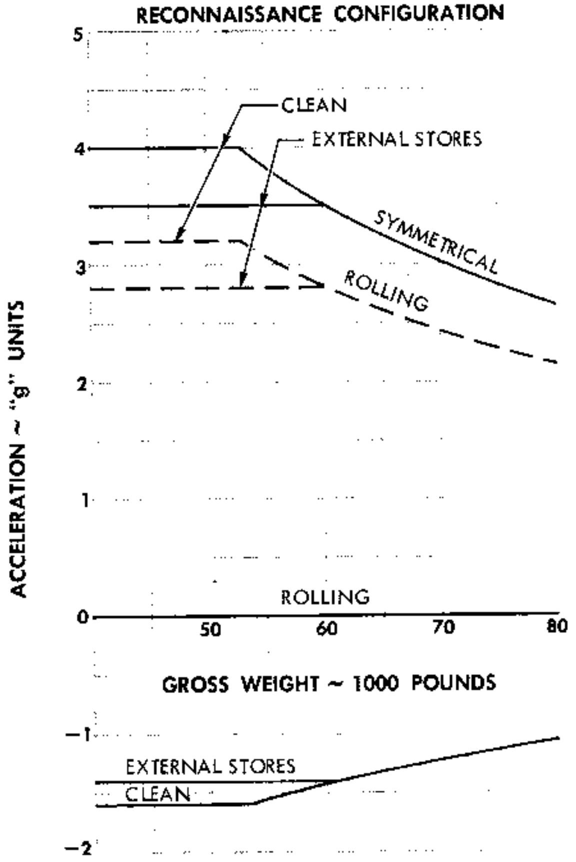
● BOTH YAW AUG ON
● NO EXTERNAL STORES



● BOTH YAW AUG ON
● WITH EXTERNAL STORES



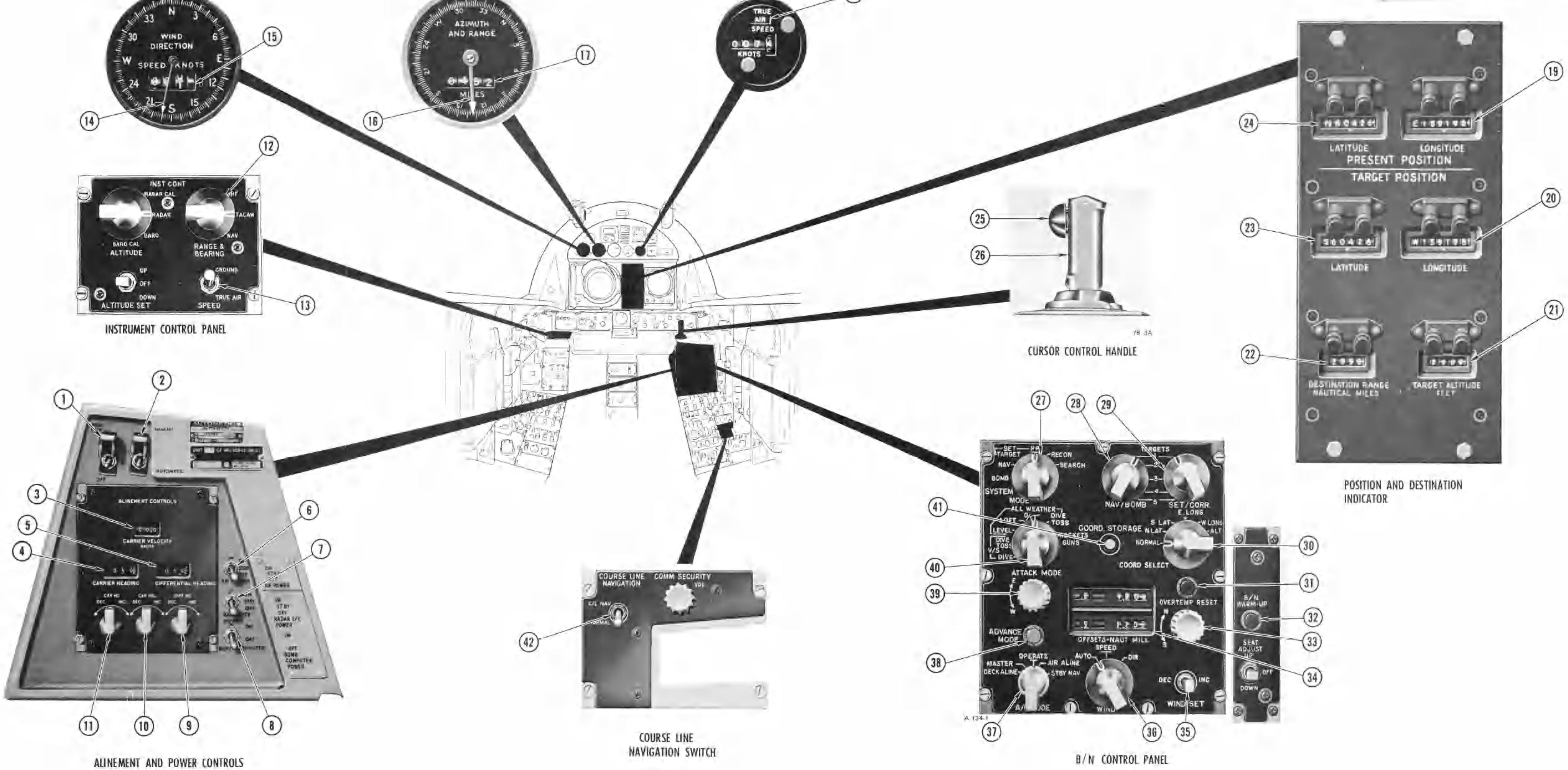
ACCELERATION LIMITS



RA-5C-1-93-73A

Figure FO-16

AUTO NAVIGATOR CONTROLS AND NAVIGATION INDICATORS



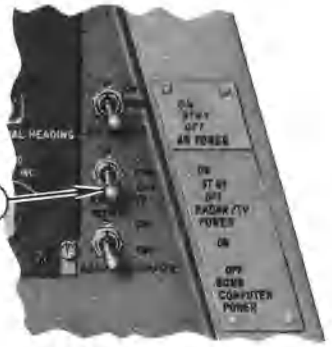
1. HOLD ALINEMENT SWITCH
2. HANDSET / AUTOMATIC SWITCH
3. CARRIER VELOCITY INDICATOR
4. CARRIER HEADING INDICATOR
5. DIFFERENTIAL HEADING INDICATOR
6. AUTONAVIGATOR POWER SWITCH
7. RADAR / TV POWER SWITCH
8. BOMBING COMPUTER POWER SWITCH
9. DIFFERENTIAL HEADING SLEWING KNOB
10. CARRIER VELOCITY SLEWING KNOB
11. CARRIER HEADING SLEWING KNOB
12. RANGE AND BEARING KNOB
13. SPEED SWITCH (TRUE AIR/GROUND)
14. WIND DIRECTION POINTER
15. WIND SPEED INDICATOR
16. BEARING POINTER
17. RANGE INDICATOR
18. TRUE AIR/GROUND SPEED FLAG
19. PRESENT POSITION LONGITUDE INDICATOR
20. TARGET POSITION LONGITUDE INDICATOR
21. TARGET ALTITUDE INDICATOR
22. DESTINATION RANGE INDICATOR
23. TARGET POSITION LATITUDE INDICATOR
24. PRESENT POSITION LATITUDE INDICATOR
25. CURSOR ACTION BUTTON
26. CURSOR CONTROL HANDLE
27. SYSTEM MODE KNOB
28. NAV/BOMB KNOB
29. SET/CORRECT KNOB
30. COORDINATES SELECT KNOB
31. OVERTEMPERATURE LIGHT
32. B/N WARMUP LIGHT
33. NORTH-SOUTH OFFSET KNOB
34. OFFSET INDICATORS
35. WIND SET SWITCH
36. WIND SELECT KNOB
37. AUTONAVIGATOR MODE KNOB
38. ADVANCE MODE LIGHT
39. EAST-WEST OFFSET KNOB
40. ATTACK MODE SELECT KNOB
41. COORDINATES STORAGE BUTTON
42. COURSE LINE NAVIGATION SWITCH

* LOCATION SHOWN FOR AIRCRAFT 151615 AND SUBSEQUENT

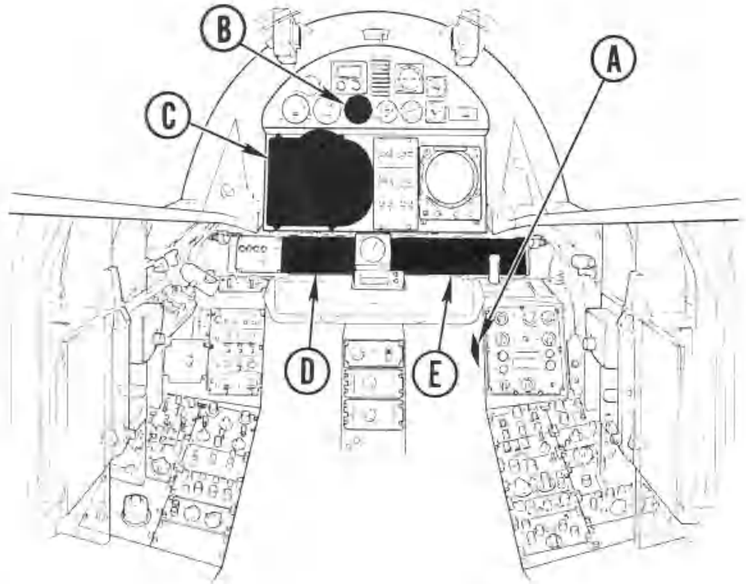
RA-5C-1-78-55

Figure FO-17

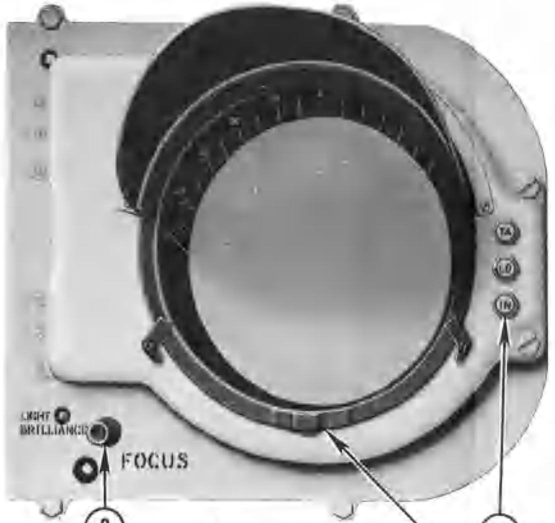
RADAR—TV CONTROLS AND INDICATORS



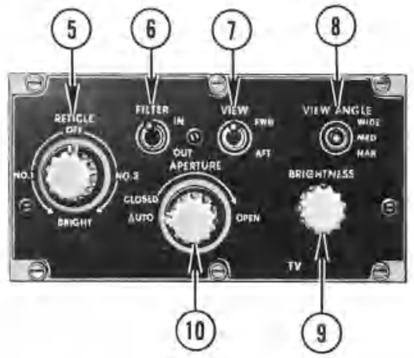
(A) AUTONAVIGATOR RADAR-TV AND BOMB COMPUTER POWER SWITCHES



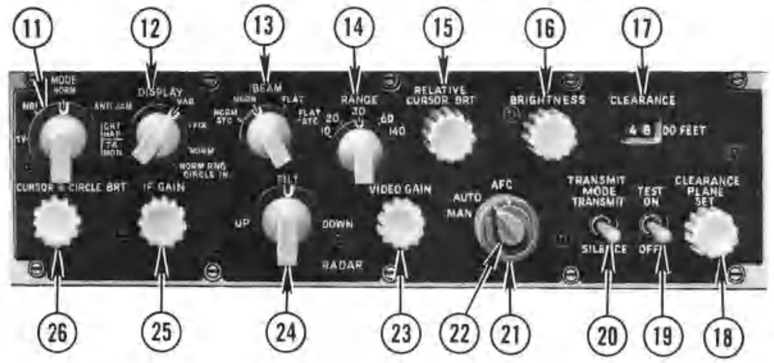
(B) TV SCANNER POSITION INDICATOR



(C) RADAR-TV SCOPE



(D) TV CONTROL PANEL



(E) RADAR CONTROL PANEL

1. RADAR/TV POWER SWITCH
2. FOCUS CONTROL
3. POLAROID FILTER LEVER
4. RADAR ADVISORY LIGHTS
5. RETICLE BRIGHTNESS KNOB
6. FILTER SWITCH
7. VIEW SWITCH
8. VIEW ANGLE SWITCH
9. BRIGHTNESS KNOB
10. APERTURE KNOB
11. RADAR/TV MODE KNOB
12. DISPLAY KNOB
13. BEAM KNOB
14. RANGE KNOB
15. RELATIVE CURSOR BRIGHTNESS KNOB
16. BRIGHTNESS KNOB
17. CLEARANCE PLANE INDICATOR
18. CLEARANCE PLANE SET KNOB
19. RADAR TEST SWITCH
20. TRANSMIT MODE SWITCH
21. AFC KNOB (MANUAL)
22. AUTO-MANUAL AFC KNOB
23. VIDEO GAIN KNOB
24. TILT CONTROL KNOB
25. IF GAIN KNOB
26. CURSOR AND CIRCLE BRIGHTNESS KNOB

A-5C-IC-78-13F

Figure FO-18

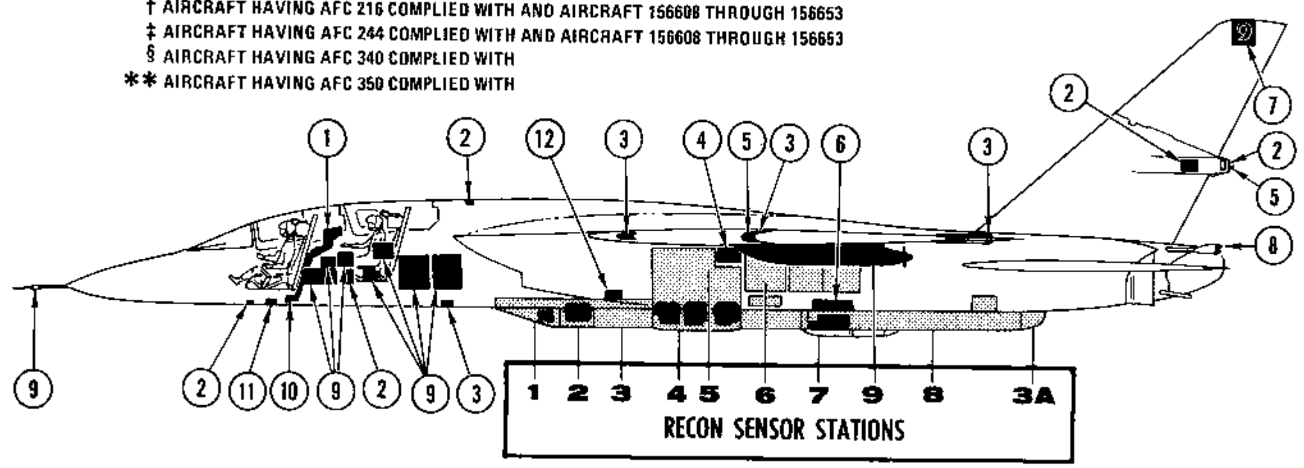
RECONNAISSANCE EQUIPMENT DATA

SENSOR IDENT	SENSOR STATION	STATION 4 MODULE	EQUIPMENT ITEM	DESIGNATION	FOCAL LENGTH INCHES	FIELD OF VIEW	FOCAL AXIS DEPRESSION	STABILIZATION LIMITS		
								ROLL	PITCH	YAW
001	8		Side-looking Radar	AN/APD-7				±5	–	±10°
002	1		Fwd Oblique Camera	KA-51A/B	6	41.1° X 41.1°	−11.5°		Not Stabilized	
003	2		Az Stab Vert Camera	KA-50A	1.75	104.8° X 104.8°	−94°	–	–	±10°
004	4	2-1	Panoramic Camera	KS-69A/B	18	180° X 14.5°	−94°	±4°	+1/−6°	±3°
005	4	1-2	Left Oblique Camera	KA-51A/B	6	41.1° X 41.1°	−5°		Not Stabilized	
006	4	1-3/2-2	Panoramic Camera	KS-68A	3	180° X 14.5°	−92.5°	±5°	±5°	±5°
007	4	1-2	Left Oblique Camera	KA-51A/B	6	41.1° X 41.1°	−19.75°		Not Stabilized	
008	4	1-1	Right Oblique Camera	KA-51A/B	6	41.1° X 41.1°	−5°		Not Stabilized	
009	4	1-1	Right Oblique Camera	KA-51A/B	6	41.1° X 41.1°	−19.75°		Not Stabilized	
010	4	3-1	Stab Vert Camera, Fwd	KA-51A/B	6	41.1° X 41.1°	−94°	±5°	±5°	±10°
011	4	3-1	Stab Vert Camera, Fwd	KA-50A	1.75	104.8° X 104.8°	−94°	±5°	±5°	±10°
012	4	3-2	Stab Vert Camera, Aft	KA-51A/B	6	41.1° X 41.1°	−94°	±5°	±5°	±10°
013	4	3-2	Stab Vert Camera, Aft	KA-50A	1.75	104.8° X 104.8°	−94°	±5°	±5°	±10°
014	4	3-1	Vert Camera, Night, Fwd	KA-51A/B	6	41.1° X 41.1°	−94°	–	Caged	–
015	4	3-2	Vert Camera, Night, Aft	KA-51A/B	6	41.1° X 41.1°	−94°	–	Caged	–
016	2		Vert Camera	KA-51A/B	6	41.1° X 41.1°	−94°		Stabilized	
017	4	3-1A	Left Oblique Camera (Split Vertical)	KA-53A	12	21.2° X 21.2°	−81° (Horiz) −94° (Vert)		Not Stabilized	
018	4	3-1A	Right Oblique Camera (Split Vertical)	KA-53A	12	21.2° X 21.2°	−81° (Horiz) −94° (Vert)		Not Stabilized	
019	4	3-1A/3-1B	Vert Camera	KA-53A	12	21.2° X 21.2°	−94°		Not Stabilized	
020	4	1-2A	Left Oblique Camera	KA-53A	12	21.2° X 21.2°	−19.75°		Not Stabilized	
021	4	1-1A	Right Oblique Camera	KA-53A	12	21.2° X 21.2°	−19.75°		Not Stabilized	
022	3		PECM Antennas	AN/ALQ-61						
023	2		Vert Camera, Night	KA-51A/B	6	41.1° X 41.1°	−94°	–	Caged	–
024	4	3-1	Fwd Vert Camera, Night	KA-53A	12	21.2° X 21.2°	−94°		Not Stabilized	
025	4	3-2	Aft Vert Camera, Night	KA-53A	12	21.2° X 21.2°	−94°		Not Stabilized	
026	4	3-1A	Left Obl Camera, Night	KA-53A	12	21.2° X 21.2°	−81°		Not Stabilized	
027	4	3-1A	Right Obl Camera, Night	KA-53A	12	21.2° X 21.2°	−81°		Not Stabilized	
028	4	3	Left Obl Camera, Night	KA-51A/B	6	41.1° 41.1°	−81°		Not Stabilized	
029	4	3	Right Obl Camera, Night	KA-51A/B	6	41.1° X 41.1°	−81°		Not Stabilized	
030	4	1	Left Oblique Camera	KA-51A/B	6	41.1° X 41.1°	−52°		Not Stabilized	
031	4	1	Right Oblique Camera	KA-51A/B	6	41.1° X 41.1°	−52°		Not Stabilized	
032	4	1	Left Oblique Camera	KA-51A/B	6	41.1° X 41.1°	−37.5°		Not Stabilized	
033	4	1	Right Oblique Camera	KA-51A/B	6	41.1° X 41.1°	−37.5°		Not Stabilized	
034	4	1	Left Oblique Camera	KA-50A	1.75	104.8° X 104.8°	−52°		Not Stabilized	
035	4	1	Right Oblique Camera	KA-50A	1.75	104.8° X 104.8°	−52°		Not Stabilized	
036	4	1	Left Oblique Camera	KA-62A	3	73.7° X 73.7°	−37.5°		Not Stabilized	
037	4	1	Right Oblique Camera	KA-62A	3	73.7° X 73.7°	−37.5°		Not Stabilized	
038	4	1	Left Oblique Camera	KA-62A	3	73.7° X 73.7°	−52°		Not Stabilized	
039	4	1	Right Oblique Camera	KA-62A	3	73.7° X 73.7°	−52°		Not Stabilized	
040	4	3	Vertical Camera	KA-62A	3	73.7° X 73.7°	−94°		Not Stabilized	
041	4	3	Stab Vert Camera, Fwd	KA-62A	3	73.7° X 73.7°	−94°		Stabilized	
042	4	3	Stab Vert Camera, Aft	KA-62A	3	73.7° X 73.7°	−94°		Stabilized	
888	7		Infrared	AN/AAS-21						

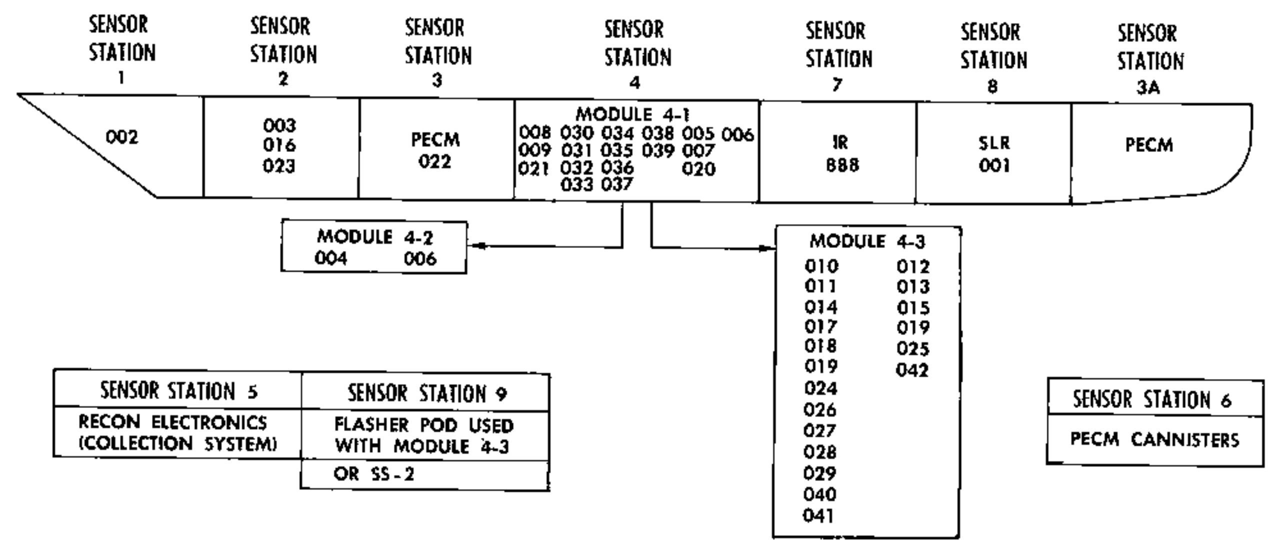
RECON AND ECM EQUIPMENT ARRANGEMENT

1. OPTICAL VIEWFINDER
2. DECM ANTENNAS, AN/APR-18 (DELETED BY AFC 216)
3. DECM ANTENNAS, AN/ALQ-41, AND-51A/-100* OR AN/ALQ-126**
4. RECON CONTROL & INTEGRATION MODULE
5. DECM ANTENNAS, AN/APR-25(V)† OR AN/ALR-45(V) §
6. INFRARED DETECTING SET, AN/AAS-21 ‡
7. DUPLEX UHF COMM/ALQ-55 ANTENNA
8. DECM BOOM ANTENNA, AN/ALQ-41, AND-51A/-100* OR AN/ALQ-12 **
9. PECM ANTENNAS
10. VIEWFINDER OPTICS UNIT
11. DECM ANTENNA, AN/APR-27† OR AN/ALR-50(V) §
12. DECM ANTENNA, AN/ALQ-126 **

* AIRCRAFT HAVING AFC 246 COMPLIED WITH AND AIRCRAFT 156608 THROUGH 156653
† AIRCRAFT HAVING AFC 216 COMPLIED WITH AND AIRCRAFT 156608 THROUGH 156653
‡ AIRCRAFT HAVING AFC 244 COMPLIED WITH AND AIRCRAFT 156608 THROUGH 156653
§ AIRCRAFT HAVING AFC 340 COMPLIED WITH
** AIRCRAFT HAVING AFC 350 COMPLIED WITH



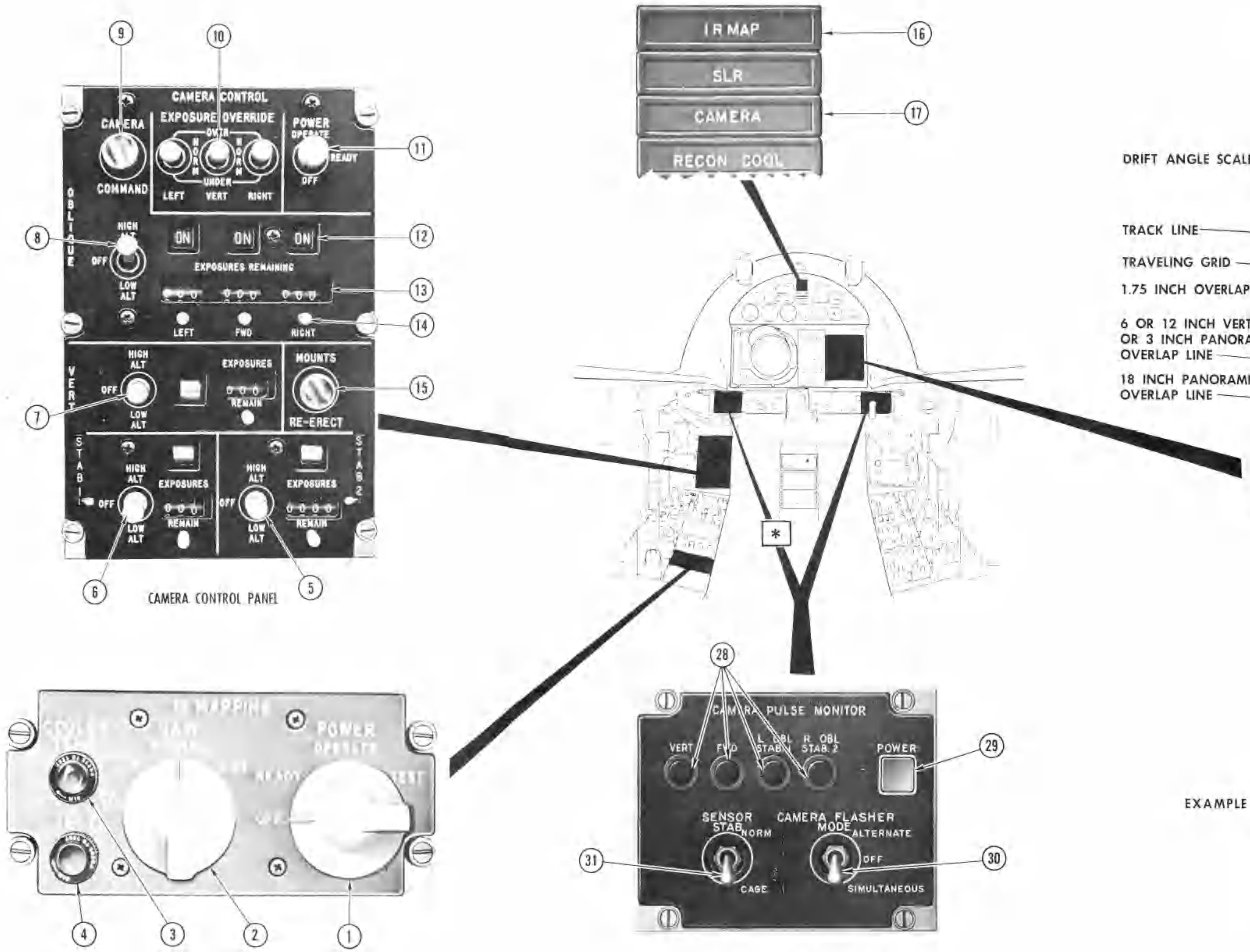
RECON EQUIPMENT INDEX



RA-5C-1-78-5C

Figure FO-19

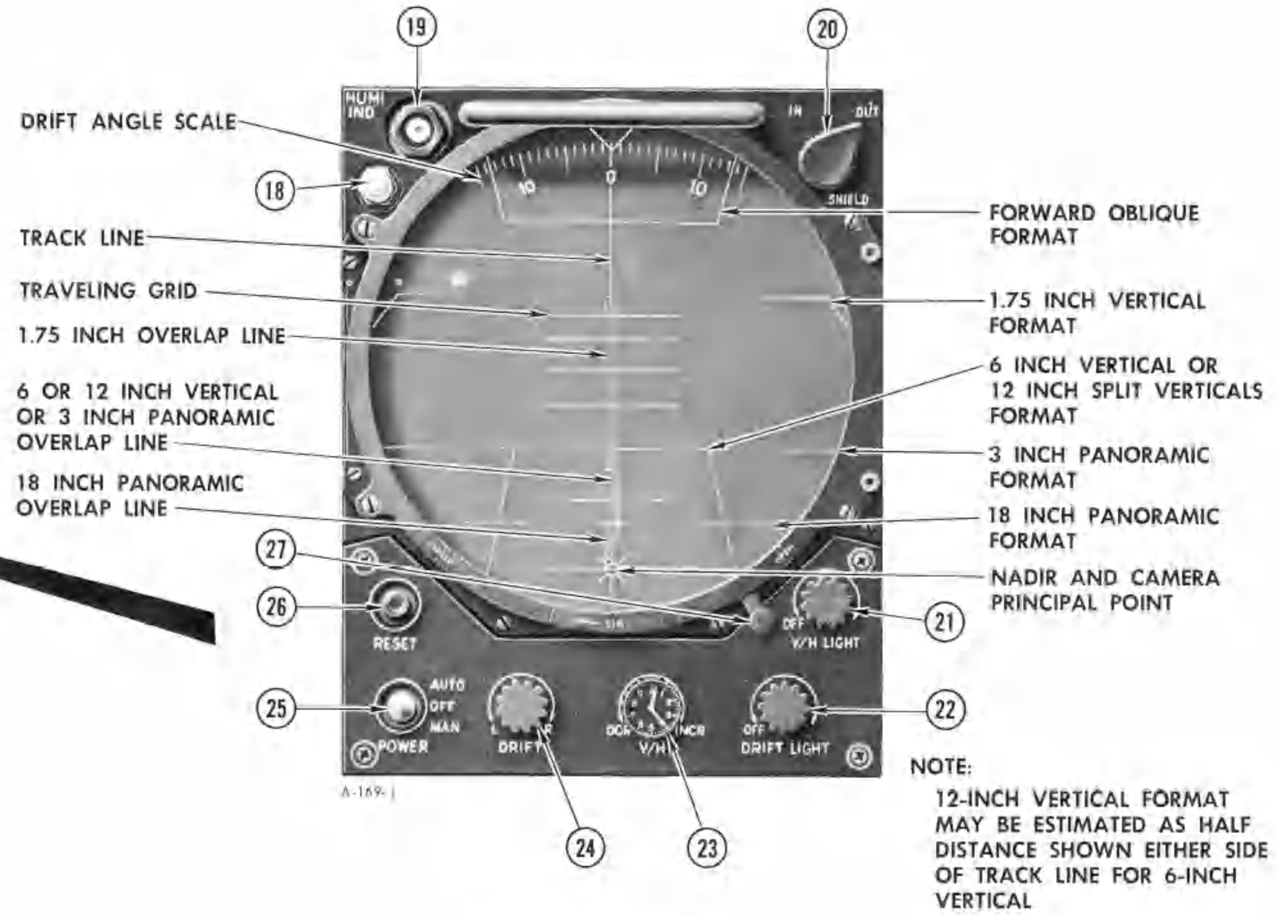
CAMERA, OPTICAL VIEWFINDER, AND IR MAPPING CONTROLS AND INDICATORS



CAMERA CONTROL PANEL

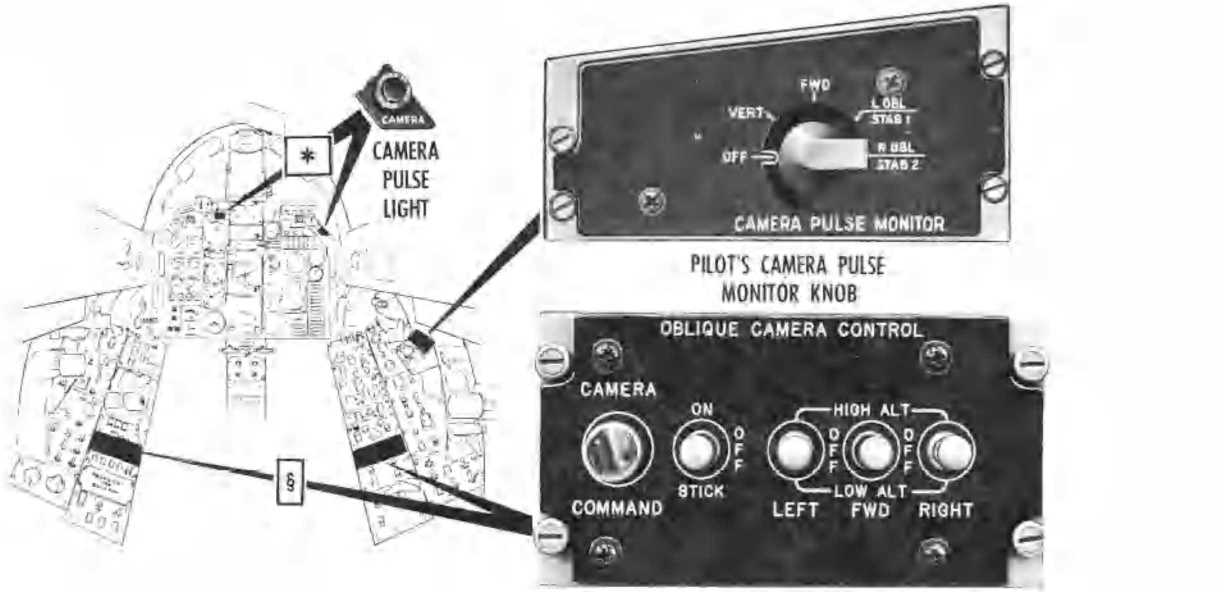
IR MAPPING PANEL

CAMERA PULSE MONITOR PANEL



OPTICAL VIEWFINDER AND CONTROLS

EXAMPLE V/H SETTINGS



PILOT'S CAMERA PULSE MONITOR KNOB

PILOT'S OBLIQUE CAMERA CONTROL PANEL

PILOT'S OBLIQUE CAMERA SIGHT †
(on each canopy rail)

1. IR POWER SWITCH
2. IR GAIN SWITCH
3. IR COOLER TEMPERATURE LIGHT
4. IR TEST LIGHT
5. 3 INCH PAN OR NO. 2 FULLY STABILIZED CAMERA MODE SWITCH
6. 18 INCH PAN OR NO. 1 FULLY STABILIZED CAMERA MODE SWITCH
7. VERTICAL CAMERA MODE SWITCH
8. OBLIQUE CAMERA MODE SWITCH
9. CAMERA COMMAND BUTTON
10. EXPOSURE OVERRIDE SWITCHES
11. MASTER POWER SWITCH
12. READINESS INDICATOR (TYPICAL)
13. EXPOSURES REMAINING COUNTER (TYPICAL)
14. COUNTER SET KNOBS (TYPICAL)
15. MOUNTS ADVISORY LIGHT/RE-ERECT BUTTON
16. IR MAP CAUTION LIGHT
17. CAMERA CAUTION LIGHT
18. VIEWFINDER PRESSURIZATION FITTING
19. HUMIDITY INDICATOR
20. BLAST SHIELD KNOB
21. V/H LIGHT KNOB
22. DRIFT LIGHT KNOB
23. V/H CONTROL KNOB (AIRCRAFT HAVING AVC 582 COMPLIED WITH)
24. DRIFT CONTROL KNOB
25. VIEWFINDER POWER KNOB
26. RESET BUTTON
27. POLAROID FILTER CONTROL LEVER
28. CAMERA PULSE MONITOR SWITCHES
29. CAMERA PULSE MONITOR POWER BUTTON
30. CAMERA FLASHER MODE SWITCH
31. SENSOR STABILIZATION SWITCH ‡

* LOCATION ON AIRCRAFT 156608 THROUGH 156653 AND AIRCRAFT HAVING AFC 216 COMPLIED WITH

† AIRCRAFT HAVING AFC 312 COMPLIED WITH

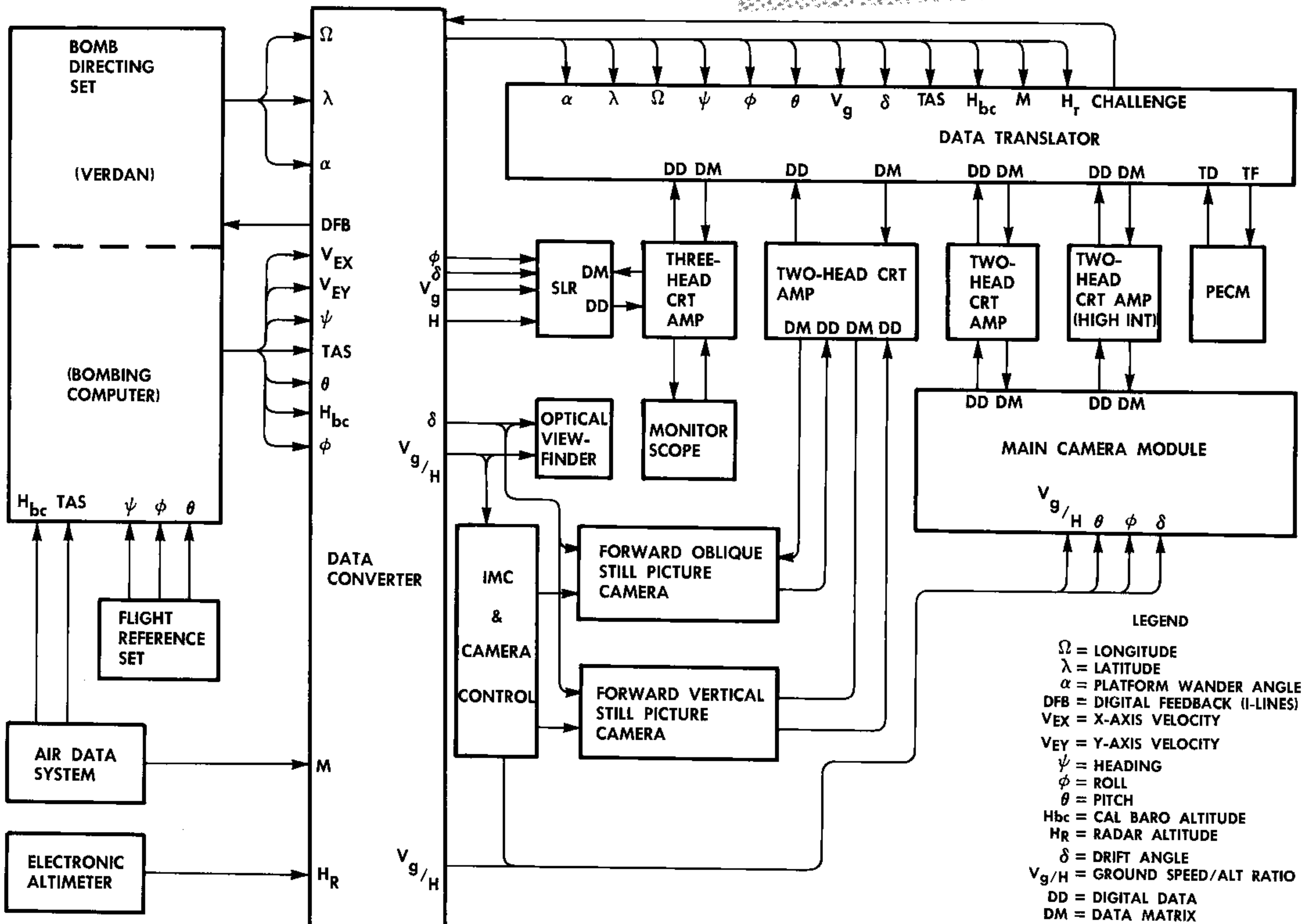
§ (LOCATION ON AIRCRAFT HAVING AFC 233 COMPLIED WITH)

‡ AIRCRAFT HAVING AFC 297 COMPLIED WITH

RA-5C-1-78-10C

Figure FO-20

CONTROL AND INTEGRATION SYSTEM



A-5C-1C-78-28B

LEGEND

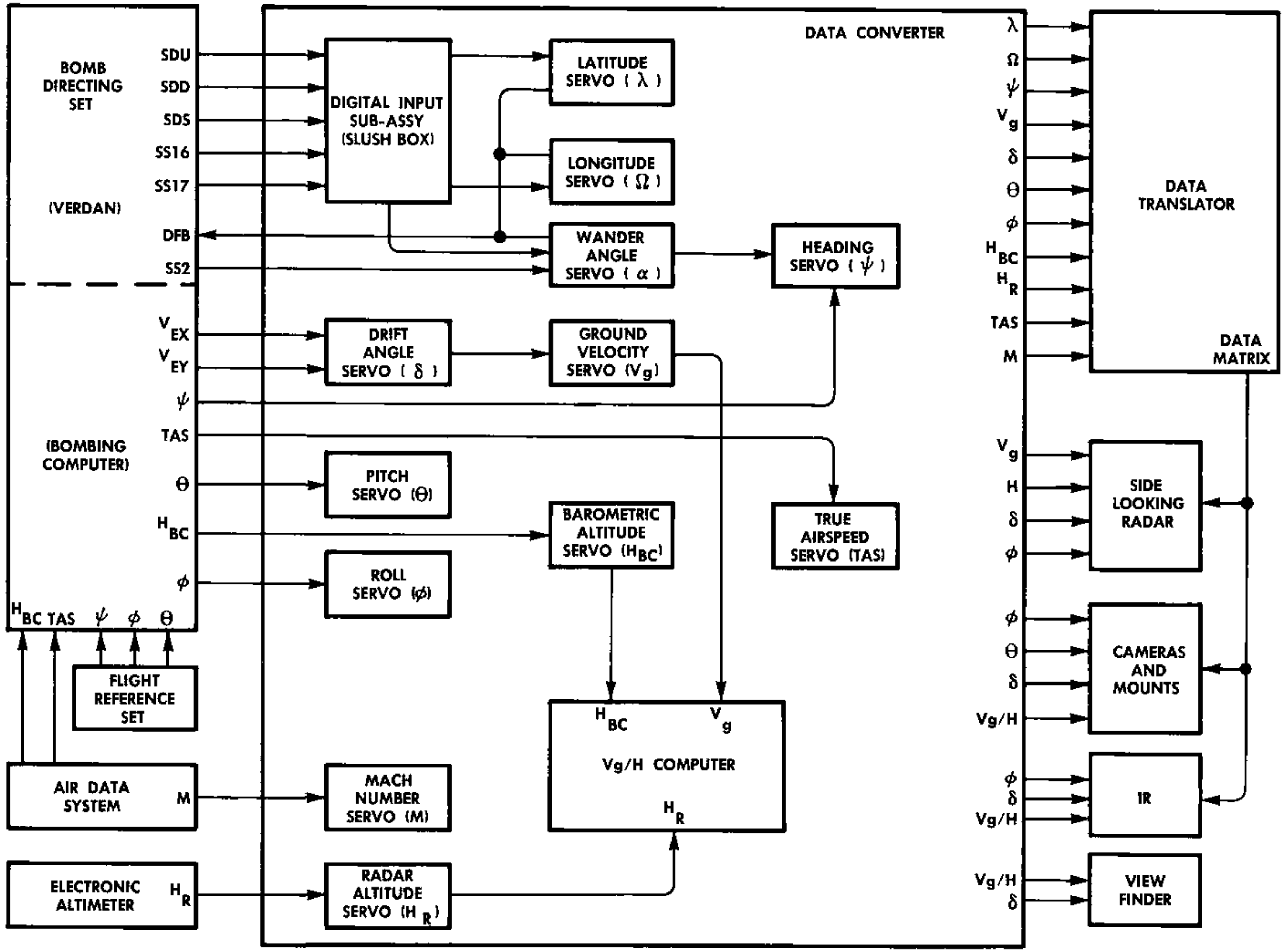
Ω = LONGITUDE
λ = LATITUDE
α = PLATFORM WANDER ANGLE
DFB = DIGITAL FEEDBACK (I-LINES)
V_{EX} = X-AXIS VELOCITY
V_{EY} = Y-AXIS VELOCITY
ψ = HEADING
φ = ROLL
θ = PITCH
Hbc = CAL BARO ALTITUDE
H_R = RADAR ALTITUDE
δ = DRIFT ANGLE
V_g/H = GROUND SPEED/ALT RATIO
DD = DIGITAL DATA
DM = DATA MATRIX
TD = TAPE DEMAND
TF = TAPE FORMAT

Figure FO-21

DATA CONVERTER SYSTEM

LEGEND

V_{EX} = X-AXIS VELOCITY
V_{EY} = Y-AXIS VELOCITY
ψ = HEADING
θ = PITCH ATTITUDE
ϕ = ROLL ATTITUDE
H_{BC} = CAL BARO ALT
H_R = RADAR ALT
δ = DRIFT
λ = LATITUDE
Ω = LONGITUDE
V_g = GROUND SPEED
$V_{g/H}$ = GR SPD/ALT RATIO
SDU = SERVO DRIVE UP
SDD = SERVO DRIVE DOWN
SDS = SERVO DRIVE SLEW
SS16 = PP LATITUDE
SS17 = PP LONGITUDE
DFB = DIGITAL FEEDBACK (I-LINES)
SS2 = PLATFORM WANDER ANGLE



A-5C-1C-78-29C

Figure FO-22