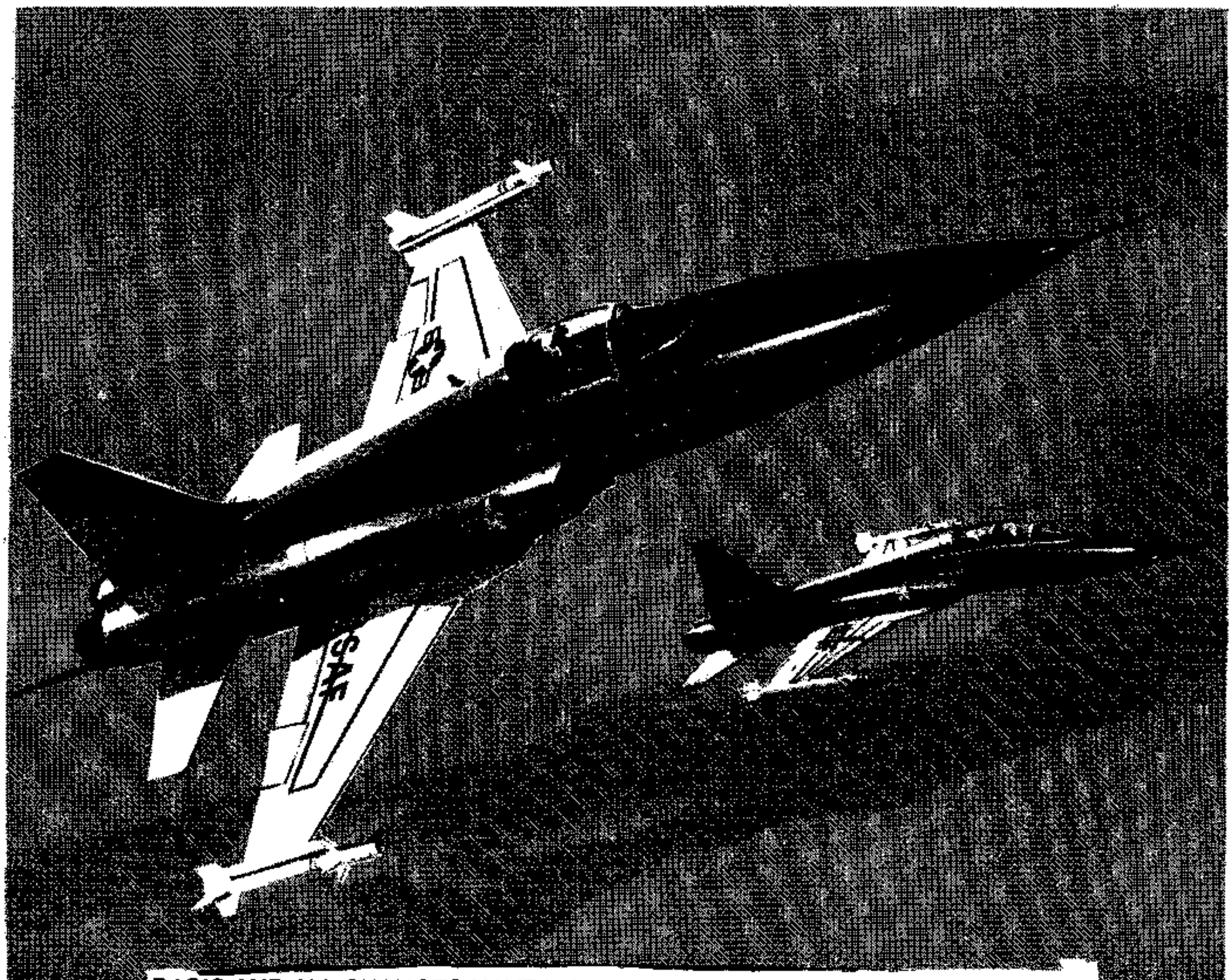
USAF SERIES

T.O. 1F-5E-1

F-5E/F FLIGHT MANUAL

AIRCRAFT

F33657-70-C-0717
F33657-85-C-2083
F41608-90-D-1819



BASIC AND ALL CHANGES HAVE BEEN MERGED TO MAKE THIS A COMPLETE PUBLICATION.

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

PUBLISHED UNDER AUTHORITY OF THE SECRETARY OF THE AIR FORCE

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AIR FORCE 5 MAY 95-200 REPRINT

1 AUGUST 1984

CHANGE 9 — 15 NOVEMBER 1990

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T.O. 1F-5E-1CL-1

1 AUGUST 1984

CHANGE 8 — 15 NOVEMBER 1990

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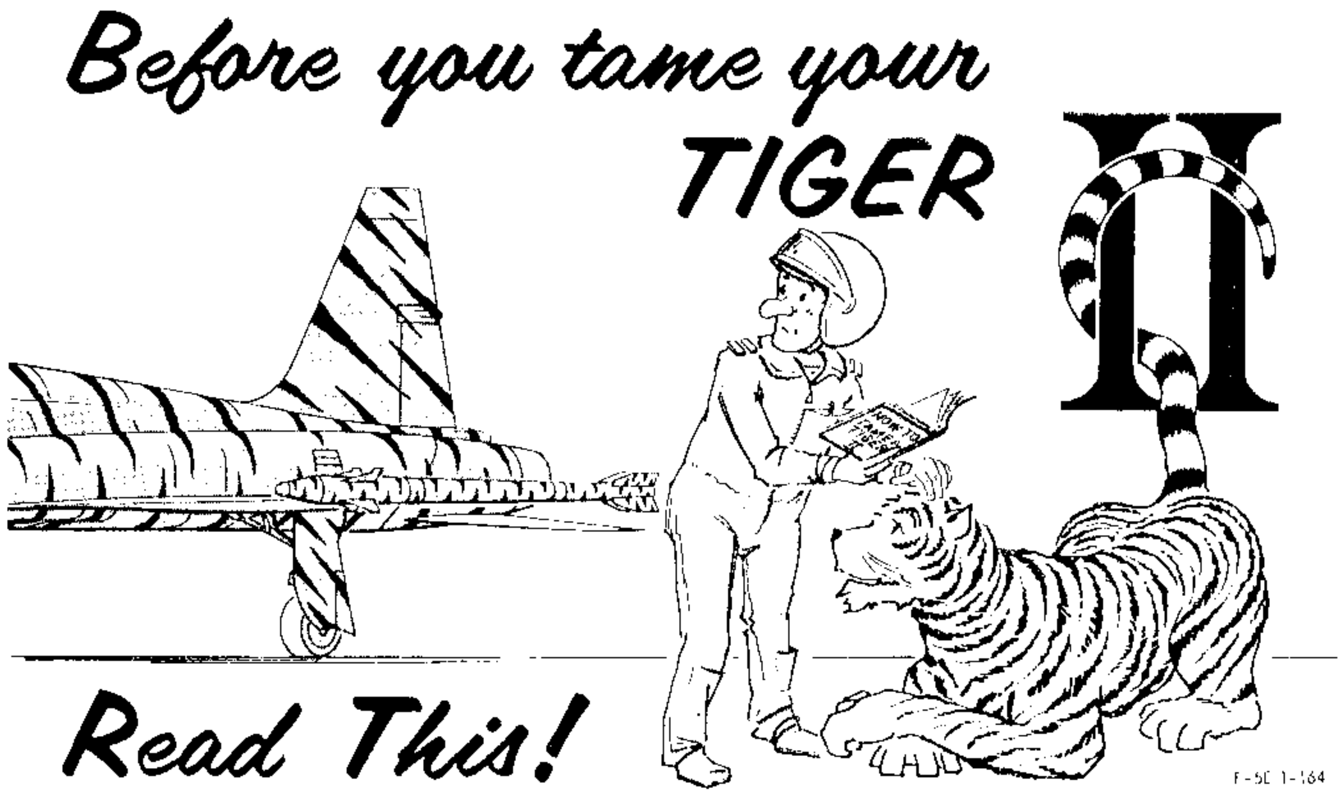

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SCOPE

This manual contains the necessary information for safe and efficient operation of your aircraft. These instructions provide you with a general knowledge of the aircraft and its characteristics and specific normal and emergency operating procedures. Your experience is recognized; therefore, basic flight principles are avoided. Instructions in this manual are prepared to be understandable by the least experienced crew that can be expected to operate the aircraft. This manual provides the best possible operating instructions under most conditions, but is not a substitute for sound judgment. Multiple emergencies, adverse weather, terrain, etc, may require modification of the procedures.

PERMISSIBLE OPERATIONS

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

HOW TO BE ASSURED OF HAVING LATEST DATA

Refer to T.O. 0-1-1-4 for a listing of all current flight manuals, safety supplements, operational supplements, and checklists. Also, check the flight manual title page, the title block of each safety and operational supplement, and all status pages attached to formal safety and operational supplements. Clear up all discrepancies before flight.

ARRANGEMENT

The manual is divided into seven fairly independent sections and an appendix to simplify reading it straight thru or using it as a reference manual.

SAFETY SUPPLEMENTS

Information involving safety will be promptly forwarded to you in a safety supplement. Urgent information is published in interim safety supplements and transmitted by teletype. Formal supplements are mailed. The supplement title block and status page (published with formal supplements only) should be checked to determine the supplement's effect on the manual and other outstanding supplements.

OPERATIONAL SUPPLEMENTS

Information involving changes to operating procedures will be forwarded to you by operational supplements. The procedure for handling operational supplements is the same as for safety supplements.

CHECKLIST

The flight manual contains itemized procedures with necessary amplifications. The checklist contains itemized procedures without the amplification. Primary line items in the flight manual and checklist are identical. If a formal safety or operational supplement affects your checklist, the affected checklist page will be attached to the supplement. Cut it out and insert it over the affected page but never discard the checklist page in case the supplement is rescinded and the page is needed.

HOW TO GET PERSONAL COPIES

Each pilot is entitled to a personal copy of the flight manual, safety supplements, operational supplements, and a checklist. The required quantities should be ordered before you need them to assure their prompt receipt. Check with your publication distribution officer — it is his job to fulfill your T.O. requests. Basically, you must order the required quantities on the appropriate Technical Order Index. T.O. 00-5-1 and T.O. 00-5-2 give detailed information for properly ordering these publications. Make sure a system is established at your base to deliver the publications to the pilots immediately upon receipt.

FLIGHT MANUAL BINDERS

Looseleaf binders and sectionalized tabs are available for use with your manual. They are obtained thru local purchase procedures and are listed in the Federal Supply Schedule (FSC Group 75, Office Supplies, Part I). Check with your supply personnel for assistance in procuring these items.

WARNINGS, CAUTIONS, AND NOTES

The following definitions apply to Warnings, Cautions, and Notes found throughout the manual.

WARNING

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

CAUTION

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

NOTE

An operating procedure, technique, etc, which is considered essential to emphasize.

USE OF WORDS SHALL, WILL, SHOULD, AND MAY

The words shall or will are used to indicate a mandatory requirement. The word should is used to indicate a nonmandatory desire or preferred method of accomplishment. The word may is used to indicate an acceptable or suggested means of accomplishment.

YOUR RESPONSIBILITY — TO LET US KNOW

Every effort is made to keep the flight manual current. Review conferences with operating personnel and a constant review of accident and flight test reports assure inclusion of the latest data in the manual. We cannot correct an error unless we know of its existence. In this regard, it is essential that you do your part. Comments, corrections, and questions regarding this manual or any phase of the flight manual program are welcomed. These should be forwarded on AF Form 847 thru your command headquarters to: San Antonio ALC/MMUA, Kelly AFB, TX 78241-5000.

PUBLICATION DATE

The date appearing on the title page of this flight manual represents the currency of material contained herein. The publication date is not the printing or distribution date. When referring to the manual, use the publication date plus the date of the latest change (when published).

AIRCRAFT DESIGNATION CODES

A code system to identify text, illustrations, charts and procedures peculiar to specific blocks or models of aircraft in this flight manual is as follows:

	APPLICABLE AIRCRAFT	CODE
a.	All F-5E and F-5F aircraft	No Code
b.	All F-5E aircraft only	Ⓔ
c.	All F-5F aircraft only	Ⓕ
d.	AF71-1417 thru AF71-1421 AF72-1386 thru AF72-1406 AF73-0846 thru AF73-0888 AF73-0890 AF73-0892 thru AF73-0902 AF73-1626 thru AF73-1646 AF74-0958 thru AF74-0997 AF74-1445 thru AF74-1462 AF74-1467 thru AF74-1575 AF74-1586 thru AF74-1603 AF74-1612 thru AF74-1617 AF75-0314 thru AF75-0373 AF75-0442 thru AF75-0461 AF75-0491 thru AF75-0527 AF75-0573 thru AF75-0603 AF75-0609 thru AF75-0627 AF76-0471 thru AF76-0490 AF76-1616 thru AF76-1639 AF76-1643 thru AF76-1683 AF77-0328 thru AF77-0331 AF77-1771 thru AF77-1777 AF78-0770 thru AF78-0773 AF78-0789 thru AF78-0798 AF78-2447 AF79-1688 thru AF79-1691 AF79-1698 thru AF79-1701	[E]
e.	AF76-1526 thru AF76-1591 AF77-0332 thru AF77-0335 AF77-0366 thru AF77-0379 AF77-1767 thru AF77-1770 AF78-0028 thru AF78-0037 AF78-0814 thru AF78-0821 AF78-0826 thru AF78-0829 AF78-0865 thru AF78-0875 AF79-1920 thru AF79-1941	[E-1]
f.	AF74-1463 thru AF74-1466 AF74-1582 thru AF74-1585 AF74-1604 thru AF74-1611 AF75-0604 thru AF75-0608 AF76-1685	[E-2]
g.	AF79-1681 thru AF79-1687 AF79-1694 thru AF79-1697 AF79-1702 thru AF79-1707 AF79-1717 thru AF79-1720 AF80-0299 thru AF80-0319 AF81-0006 thru AF81-0019 AF81-0558 thru AF81-0593 AF81-0632 thru AF81-0638 AF81-0823 thru AF81-0857 AF82-0634 thru AF82-0639 AF82-0644 and AF82-0645 AF83-0083 thru AF83-0112 AF84-0183 and AF84-0184 AF84-0490 and AF84-0491 AF85-0043 and AF85-0044 AF85-0057 and AF85-0058 AF85-1586 thru AF85-1595	[E-3]
h.	AF73-0889 and AF73-0891 AF75-0709 thru AF75-0711 AF75-0735 thru AF75-0742 AF75-0753 thru AF75-0755 AF76-1611 thru AF76-1615 AF76-1640 thru AF76-1642 AF77-0336 thru AF77-0350 AF77-1778 and AF77-1779 AF78-0774 thru AF78-0787 AF78-0802 and AF78-0803 AF78-2435 and AF78-2436 AF78-2444 thru AF78-2446 AF79-1709 AF79-1916 thru AF79-1919 AF81-0641 and AF81-0642	[F]

i. AF76-1592 thru AF76-1597 F-1
AF77-0359 thru AF77-0361
AF78-0822 thru AF78-0825
AF78-0876 thru AF78-0884
AF79-1942 thru AF79-1945

j. AF79-1692 and AF79-1693 F-2
AF79-1708
AF79-1721 thru AF79-1726
AF80-0296 thru AF80-0298
AF81-0594 thru AF81-0613
AF81-0639 and AF81-0640
AF81-0858 thru AF81-0863
AF82-0004 and AF82-0005
AF82-0089 thru AF82-0091
AF82-0187 thru AF82-0189
AF82-0640 thru AF82-0643
AF83-0072 thru AF83-0074
AF83-0113 thru AF83-0142
AF84-0456 and AF84-0457
AF85-0053 thru AF85-0056
AF86-0090 and AF86-0091

When complete paragraphs or illustrations are applicable to specific blocks of aircraft, the appropriate code will appear opposite the heading. Notes, cautions, warnings, and steps of a procedure applicable to specific blocks of aircraft will have the code appear as the first item of the sentence or procedure.

SUPPLEMENTAL FLIGHT MANUALS

Aircraft equipped with systems and/or equipment not included in this manual are covered in supplemental flight manuals. To ensure proper use of the code system in this flight manual for these particular serial numbered aircraft, reference to a supplemental flight manual is required. Specific blocks of aircraft designated as configuration peculiar are as follows:

a. T.O. 1F-5E-1-2
AF74-1505
AF74-1512 thru AF74-1519
AF74-1536 thru AF74-1541

b. T.O. 1F-5E(III)-1
AF75-0442 thru AF75-0456
AF75-0709 thru AF75-0711
AF76-1614 and AF76-1615
AF76-1677 thru AF76-1686
AF81-0641 and AF81-0642

c. T.O. 1F-5E(IV)-1
AF76-1526 thru AF76-1597
AF81-0826 thru AF81-0857
AF81-0858 thru AF81-0863

d. T.O. 1F-5E(V)-1
AF73-0884
AF73-0886 thru AF73-0888
AF73-0890
AF73-1626
AF73-1629 thru AF73-1634
AF73-1641 thru AF73-1646
AF74-1471 thru AF74-1479
AF74-1482 and AF74-1483
AF74-1485 thru AF74-1494
AF75-0457 thru AF75-0461
AF75-0501 thru AF75-0527
AF75-0573 thru AF75-0603
AF75-0626 and AF75-0627
AF76-1643 thru AF76-1663
AF81-0558 thru AF81-0615

e. T.O. 1F-5E(VI)-1
AF77-0359 thru AF77-0361
AF77-0366 thru AF77-0379
AF77-1767 thru AF77-1770
AF79-1926 thru AF79-1931
AF82-0187 thru AF82-0189
AF85-1586 thru AF85-1591
AF86-0090 and AF86-0091

f. T.O. 1F-5E(VII)-1
AF78-0814 thru AF78-0829

g. T.O. 1F-5E(VIII)-1
AF75-0351 thru AF75-0373
AF76-0472 thru AF76-0490
AF76-1616 thru AF76-1642
AF77-0328 thru AF77-0350
AF78-0028 thru AF78-0037
AF78-0865 thru AF78-0884
AF79-1717 thru AF79-1726
AF80-0296 thru AF80-0319
AF81-0006 thru AF81-0019
AF83-0083 thru AF83-0142

h. T.O. 1F-5E(IX)-1
AF79-1681 thru AF79-1687
AF79-1692 thru AF79-1697
AF79-1702 thru AF79-1708

i. T.O. 1F-5E(X)-1
AF81-0632 thru AF81-0640
AF81-0823 thru AF81-0825

j. T.O. 1F-5E(XI)-1
AF79-1920 thru AF79-1925
AF79-1932 thru AF79-1945

k. T.O. 1F-5E(XIII)-1
AF78-0802 and AF78-0803
AF79-1916 thru AF79-1919

l. T.O. 1F-5E(XIV)-1
AF82-0634 thru AF82-0645

m. T.O. 1F-5E(XV)-1
AF85-0043 and AF85-0044
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AF85-1592 thru AF85-1595

n. NTM 1F-5E-1(2)
AF74-1582 thru AF74-1617

o. NTM 1F-5E-1(N)
AF73-0858 and AF73-0868
AF73-0872 and AF73-0883
AF73-0895
AF73-0900 and AF74-1533
AF74-1480
AF75-0753 thru AF75-0755

ADDITIONAL EFFECTIVITIES

This manual applies to the following aircraft with reference to the VOR/ILS, marker beacon and attitude director indicator.

AF71-1417 thru AF71-1421
AF72-1386 thru AF72-1406
AF73-0846 thru AF73-0855
AF73-0865 and AF73-0866
AF73-0879 thru AF73-0882
AF73-0885
AF73-0896 thru AF73-0899
AF73-1635 and AF73-1636
AF73-1640
AF74-1484
AF74-1505 thru AF74-1519
AF74-1528 thru AF74-1575
AF75-0612 thru AF75-0617
AF82-0089 thru AF82-0091
AF83-0072 thru AF83-0074

This manual applies to the following aircraft with reference to the dual UHF & RWR.

AF82-0089 thru AF82-0091
AF83-0072 thru AF83-0074

TIME COMPLIANCE TECHNICAL ORDERS

The following TCTOs and ECPs are applicable to this Flight Manual. Reference to T.O. or ECP number within brackets [ ] in the text and illustrations of the Flight Manual requires referral to this list. TCTOs not yet released, or those known to be completed, are not included. Referenced TCTOs will be deleted from this list after one year beyond the rescission date published on the TCTO or supplement extension, if issued. For a complete list of TCTOs affecting F-5E and F-5F aircraft, refer to Technical Order Indexes, T.O. 0-1-71, T.O. 0-1-1-4, and supplements thereto.

T.O. NUMBER	TITLE	PRODUCTION EFFECTIVITY	RETROFIT EFFECTIVITY
1F-5E-594	Installation of Ballast (ECP 211)	AF74-1571 thru AF74-1575 AF75-0338 thru AF75-0373 AF75-0454 thru AF75-0456 AF75-0499 and AF75-0500	AF71-1417 thru AF71-1421 AF72-1386 thru AF72-1406 AF73-0846 thru AF73-0888 AF73-0890 AF73-0892 thru AF73-0902 AF73-0933 thru AF73-0990 AF73-1626 thru AF73-1646 AF74-0958 thru AF74-0997 AF74-1362 thru AF74-1570 AF74-1582 thru AF74-1617 AF75-0314 thru AF75-0337 AF75-0442 thru AF75-0453 AF75-0457 thru AF75-0461 AF75-0491 thru AF75-0498 AF75-0501 thru AF75-0527
1F-5-941	Hydraulic Overtemp Indicating System		All F-5E/F
1F-5-954	Relocation of Anti-G Valve		All F-5E/F
1F-5E-630	Aggressor Radar Upgrade		AF71-01418 AF72-01386 AF73-00855 AF73-00865 AF73-00879 AF73-00885 AF73-01635 AF74-01528 thru AF74-01531 AF74-01536 AF74-01537 AF74-01539 thru AF74-01541 AF74-01558 AF74-01564 AF74-01567 AF74-01570 AF74-01572 AF74-01573

Pages ix and x are deleted.

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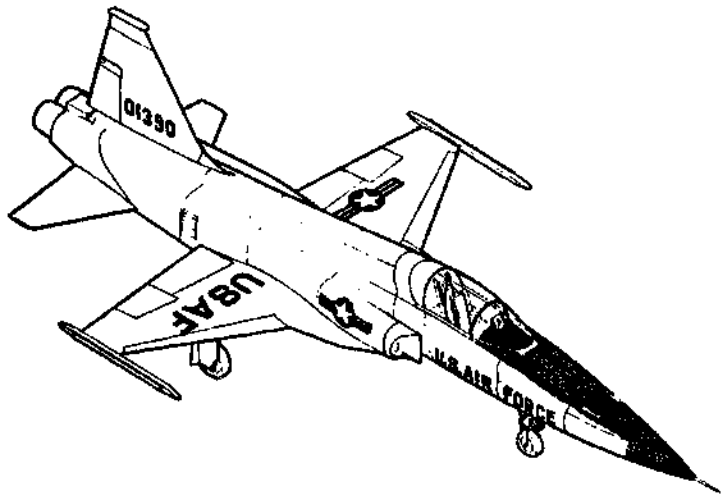
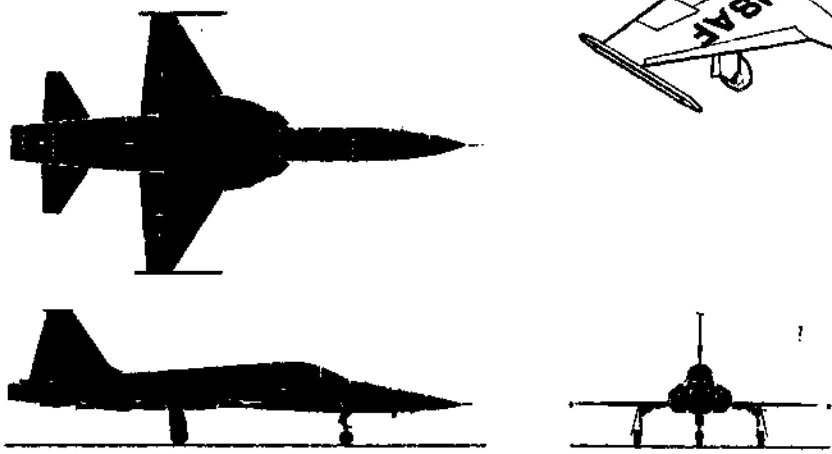
TACTICAL FIGHTER





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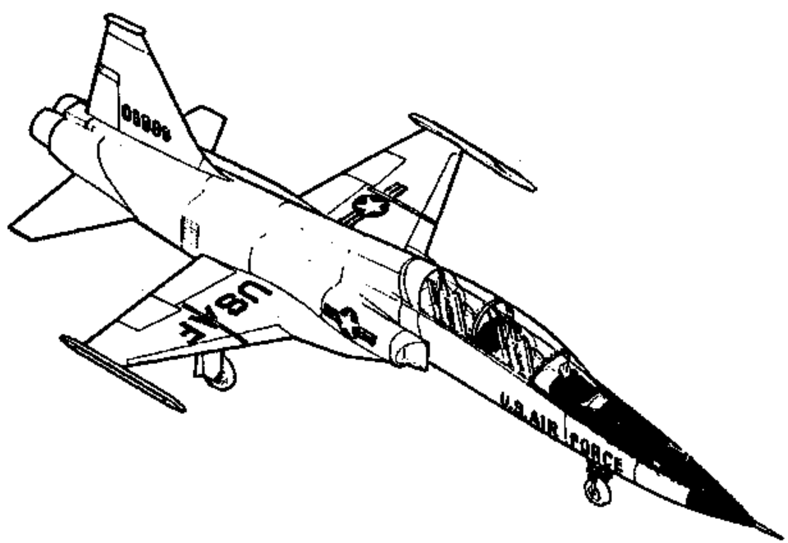

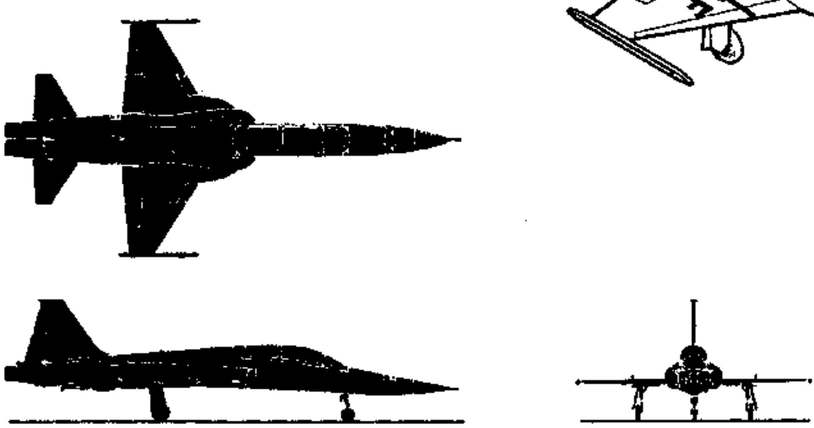

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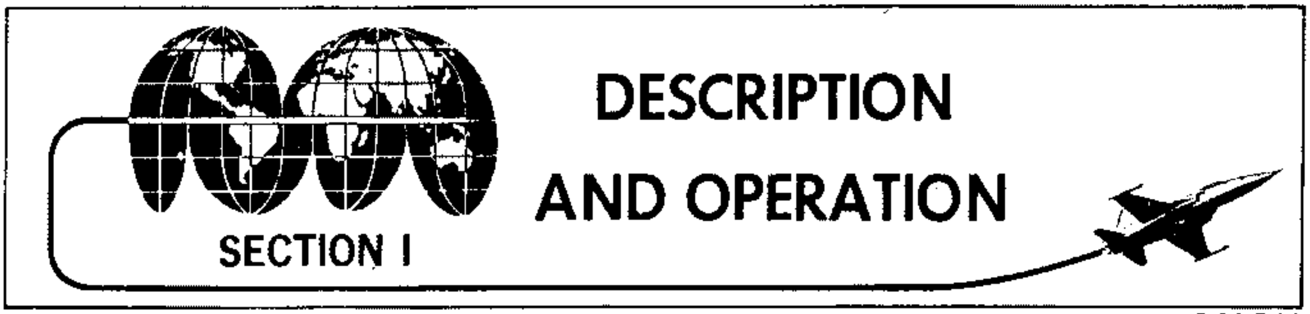

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THE AIRCRAFT

The Ⓔ single-place and the Ⓕ two-place high-performance, multipurpose tactical fighters are produced by the Northrop Corporation, Aircraft Division. In addition to twin-engine reliability, the aircraft are capable of supersonic flight. Similarity of operating procedures and flight characteristics will allow a pilot qualified in either aircraft to fly the other with a minimum of training. The Ⓕ rear cockpit is equipped with dual controls and instrumentation to allow the aircraft to be used as a pilot trainer or dual-piloted tactical fighter; however, minimum crew requirement is one pilot. Thrust is provided by two turbojet engines equipped with afterburners. An automatic auxiliary intake door on each side of the fuselage above the wing trailing edge provides additional air to the engines during takeoff and low-speed flight. The fuselage is an area-rule (coke-bottle) shape. The wing, horizontal tail, and vertical stabilizer are moderately sweptback. The Ⓔ wing is fitted with wing fences to improve boundary layer control. Each wing is equipped with leading and trailing edge flaps used for takeoff, landing, loiter, and inflight maneuvering. The maneuver flap system incorporated on earlier aircraft provides automatic control of flap position by the central air data computer (CADC). On later aircraft ([E-3] [F-2]), an auto flap system allows fully automatic selection of flap position thru signals from both an angle-of-attack switching unit and the CADC. Deceleration equipment includes a speed brake under the central fuselage, a drag chute to decrease landing roll, and an arresting hook under the aft fuselage for runway emergency arrestment. The tricycle landing gear has a steerable nosewheel and a two-position extendable nose gear strut used for takeoff. Flight controls are hydraulically actuated by two independent hydraulic systems equipped with artificial feel devices to simulate feel to the pilot. The cockpit(s) are enclosed by manually-operated clamshell canopy(ies). Fuel cells are in the fuselage, with additional fuel carried in external tanks. The fire control system includes a fire control radar with search and range tracking or (some aircraft) range and angle tracking capability, a lead computing optical sight, and a sight camera. Basic armament includes two 20mm guns in the nose (Ⓕ left gun only), and air-to-air missile on each wingtip. Additional weapons consisting of various bombs, rockets, and flares are carried on five jettisonable pylons. Later aircraft, in addition to the above, incorporate improved handling quality (IHQ) modifications consisting of a shark nose radome with shortened pitot boom, and wing leading edge extensions (LEX). The shark nose design improves directional stability at high angles-of-attack while the increased wing surface area of the LEX improves lift and maximum turn rate, further enhancing combat performance.

AIRCRAFT DIMENSIONS

The overall dimensions of the aircraft with normal tire and strut inflation are:

	Ⓔ	Ⓕ
Length	48 ft 2 in	51 ft 8 in
(with shark nose)	47 ft 5 in	50 ft 11 in
Wingspan with wingtip launcher rails	26 ft 8 in	26 ft 8 in
Height	13 ft 4 in	13 ft 2 in
Tread	12 ft 6 in	12 ft 6 in
Wheelbase	16 ft 11 in	21 ft 2 in

See section II for turning radius and ground clearance.

AIRCRAFT GROSS WEIGHT (TYPICAL)

The average gross weights, including pilot (one pilot Ⓕ), full internal fuel (JP-4), oil, full ballast, and no ammunition are as follows:

	E E-2	E-1 E-3
With wingtip launcher rails (no pylons)	15,050 lb	15,170 lb
With wingtip launcher rails and full centerline 275-gallon tank	17,250 lb	17,370 lb

	F	F-1 F-2
With wingtip launcher rails (no pylons)	15,650 lb	15,860 lb
With wingtip launcher rails and full centerline 275-gallon tank	17,850 lb	18,060 lb

The above gross weights shall not be used for mission planning. For exact aircraft gross weight, refer to the current Form 365-4 (Form F) for the aircraft to be flown.

AIRCRAFT DIFFERENCES

The aircraft main difference table (figure 1-1) lists various systems or equipment considered significant to affect operation of the aircraft. See figure 1-2 for a typical aircraft general arrangement, and figures 1-3 thru 1-29 for typical cockpit arrangements.

MAIN DIFFERENCE TABLE

Note

SEE FOREWORD FOR AIRCRAFT EFFECTIVITIES

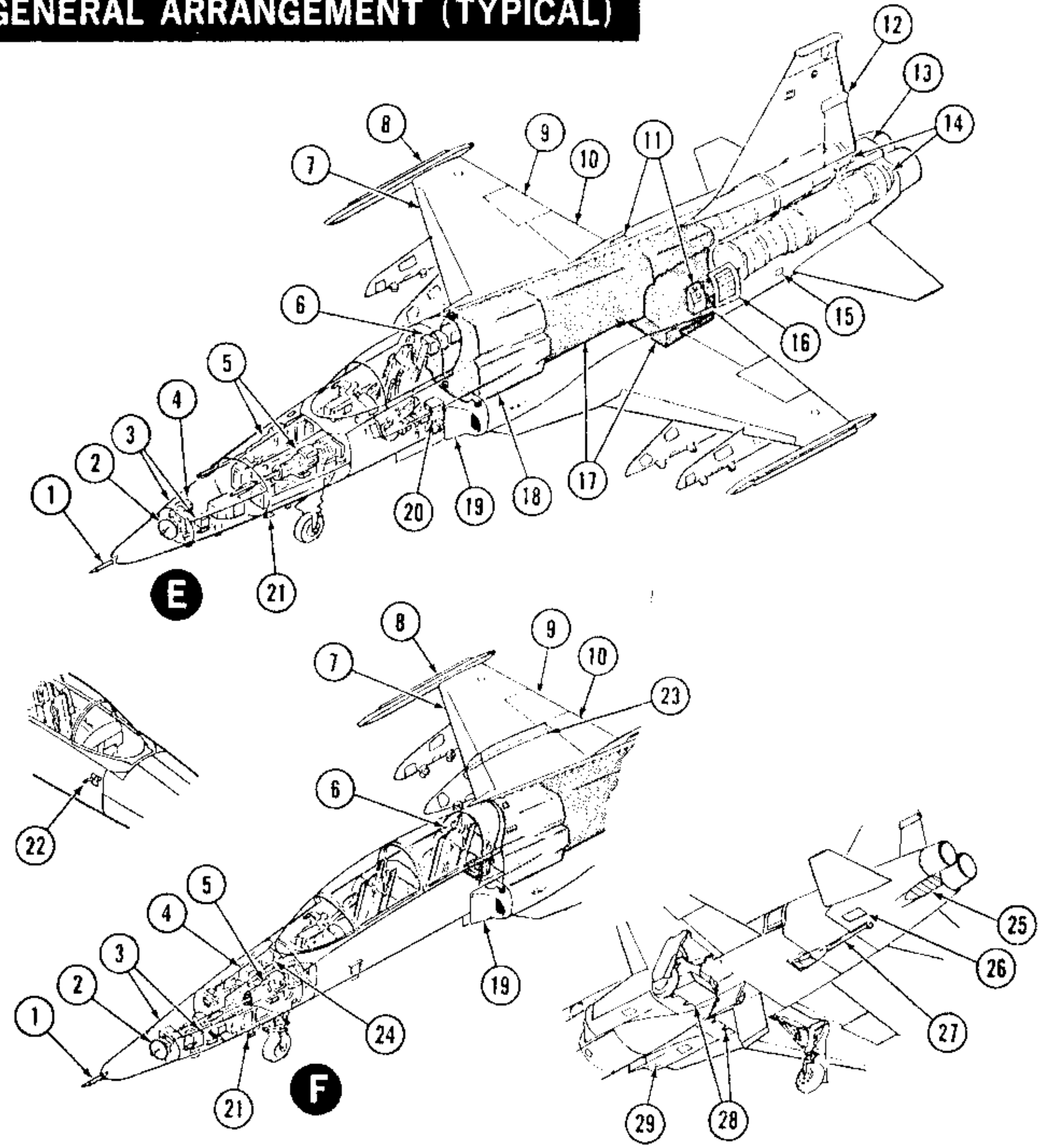
SYSTEM	AIRCRAFT CODE						
	E	E-1	E-2	E-3	F	F-1	F-2
APQ-153 RADAR	⊙		*O				
APQ-157 RADAR					O		
APQ-159(V)-3 RADAR		O		O			
APQ-159(V)-4 RADAR						O	O
APQ-159(V)-5 RADAR	⊙						
ASG-29 OPTICAL SIGHT	O		O		O		
ASG-31 OPTICAL SIGHT		O		O		O	O
RECON NOSE (REMOVABLE)			*O				
WINDSHIELD RAIN REMOVAL	⊙		O				
IMPROVED HANDLING QUALITIES	⊙			O	⊙		O
MANUEVER FLAP	O	O	O		O	O	
AUTO FLAP				O			O
ALR-46(V)-3 RWR							⊙
ARN-127 VOR/ILS	⊙						⊙

O INSTALLED ⊙ SOME AIRCRAFT * RADAR REMOVED WHEN RECON NOSE INSTALLED

F-5 1-157(1)R

Figure 1-1.

GENERAL ARRANGEMENT (TYPICAL)



1 PITOT-STATIC BOOM
2 RADAR ANTENNA
3 AVIONICS EQUIPMENT BAYS
4 BATTERY
5 GUNS (F LEFT ONLY)
6 ELECTRICAL EQUIPMENT BAY
7 LEADING EDGE FLAP
8 LAUNCHER RAIL
9 AILERON
10 TRAILING EDGE FLAP
11 HYDRAULIC RESERVOIRS
12 FUEL VENT
13 DRAG CHUTE COMPARTMENT
14 ENGINES
15 EXTERNAL ELECTRICAL RECEPTACLE
16 ENGINE AUX INTAKE DOOR
17 R FUEL (AFT) SYSTEM CELLS
18 L FUEL (FWD) SYSTEM CELL
19 ENGINE AIR INLET DUCT
20 LIQUID OXYGEN CONVERTER
21 TOTAL TEMPERATURE PROBE
22 AOA VANE
23 WING FENCE
24 LIQUID OXYGEN CONVERTER
25 EXTERNAL TAIL BALLAST F
26 ENGINE STARTER AIR INLET
27 ARRESTING HOOK
28 SPEED BRAKE
29 INTERPHONE RECEPTACLE (GROUND CREW TO PILOT)

F-5 1-20(1)H

Figure 1-2.

COCKPIT ARRANGEMENT (TYPICAL)

E **E-2**

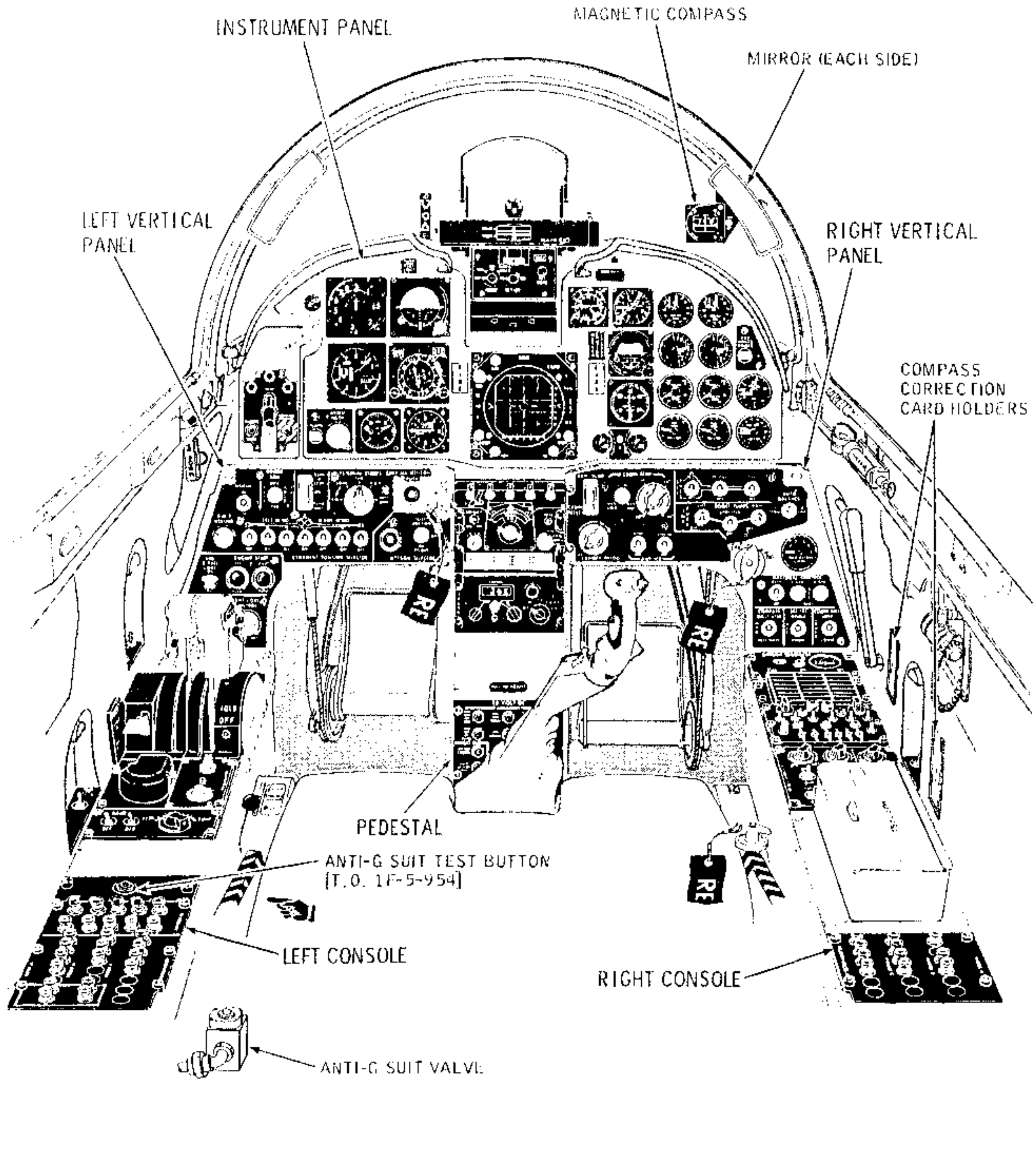


Figure 1-3.

COCKPIT ARRANGEMENT-FRONT (TYPICAL) F

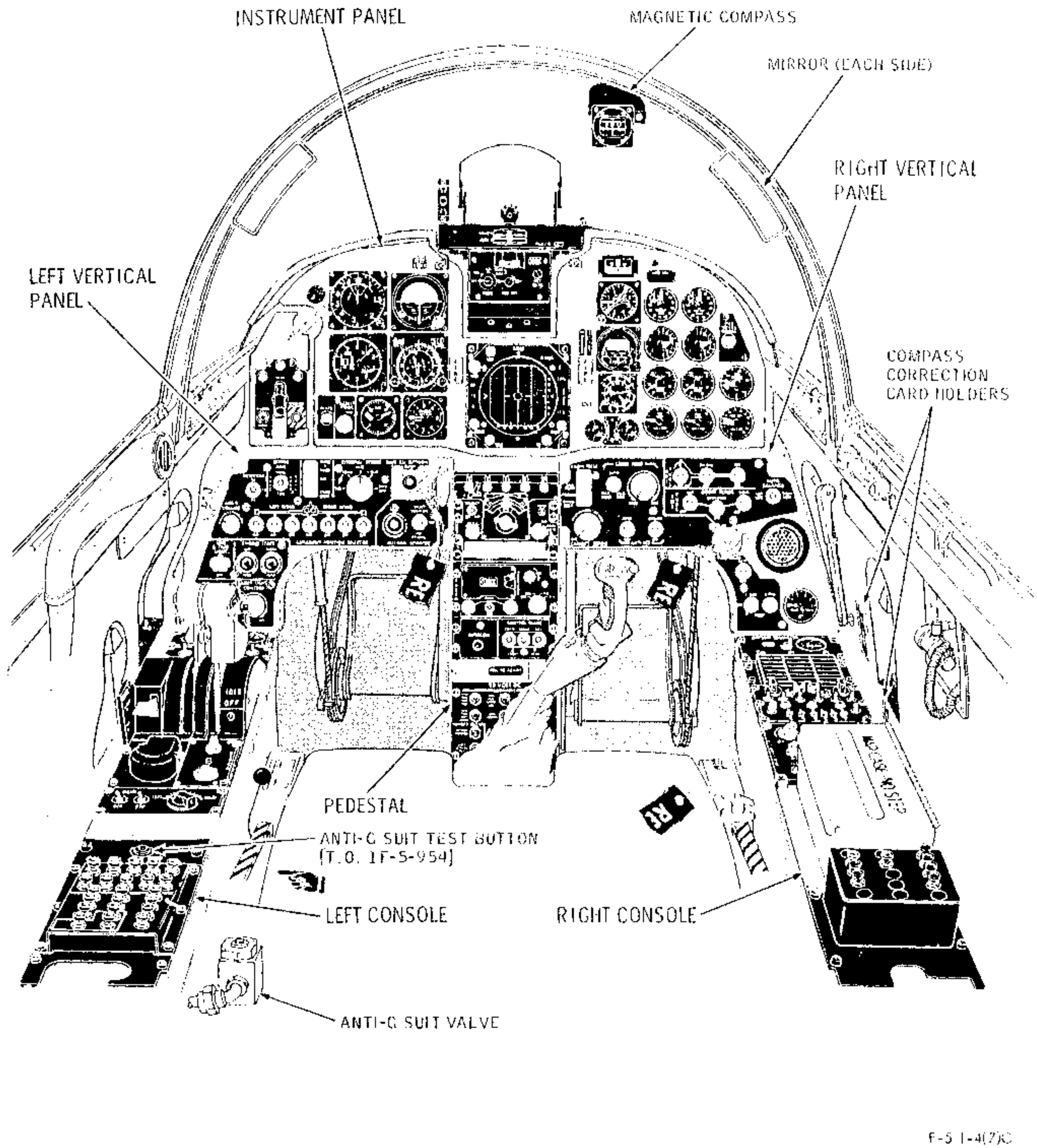


Figure 1-4.

COCKPIT ARRANGEMENT-REAR (TYPICAL)

F

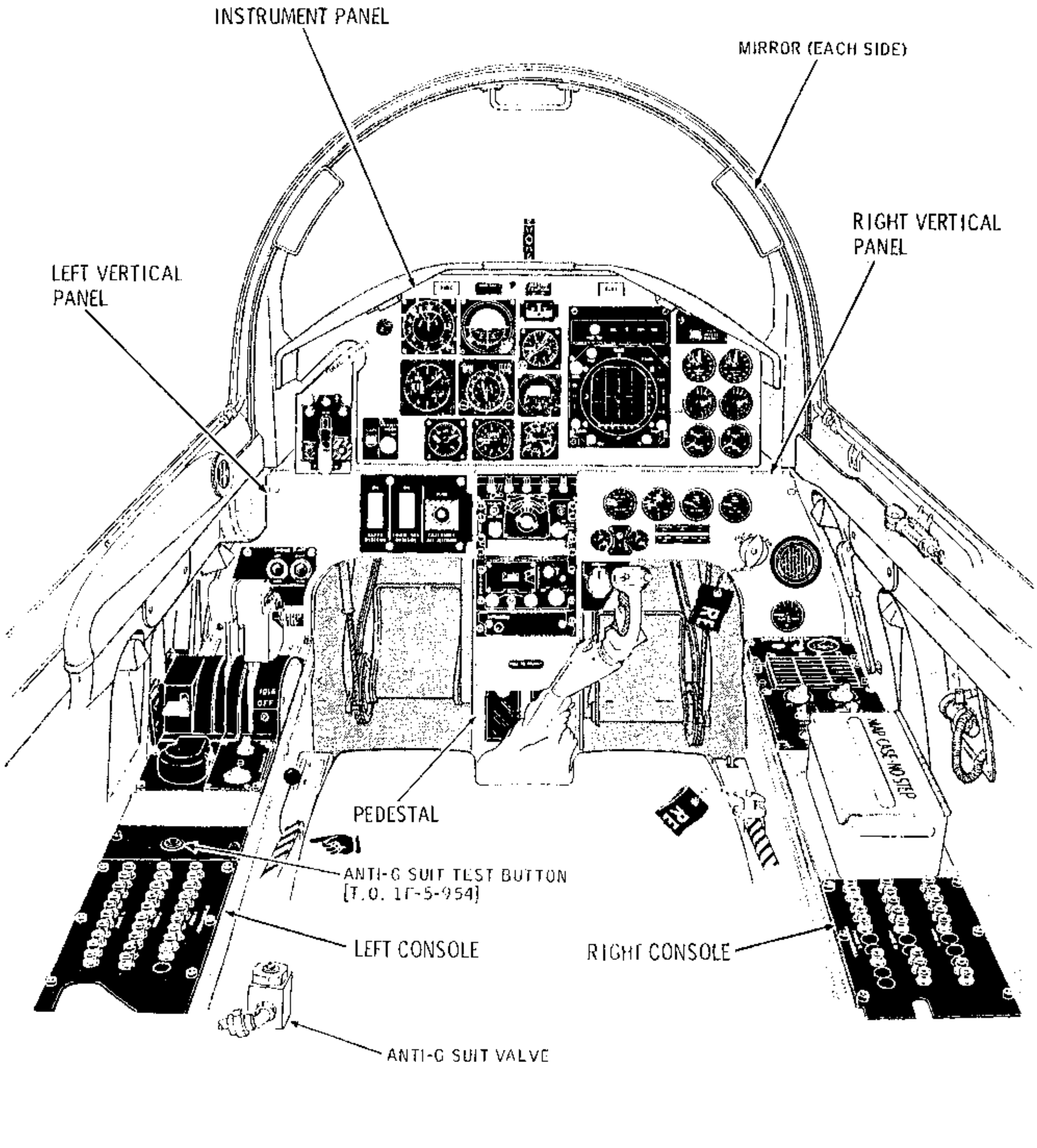


Figure 1-5.

COCKPIT ARRANGEMENT (TYPICAL) E-1 E-3

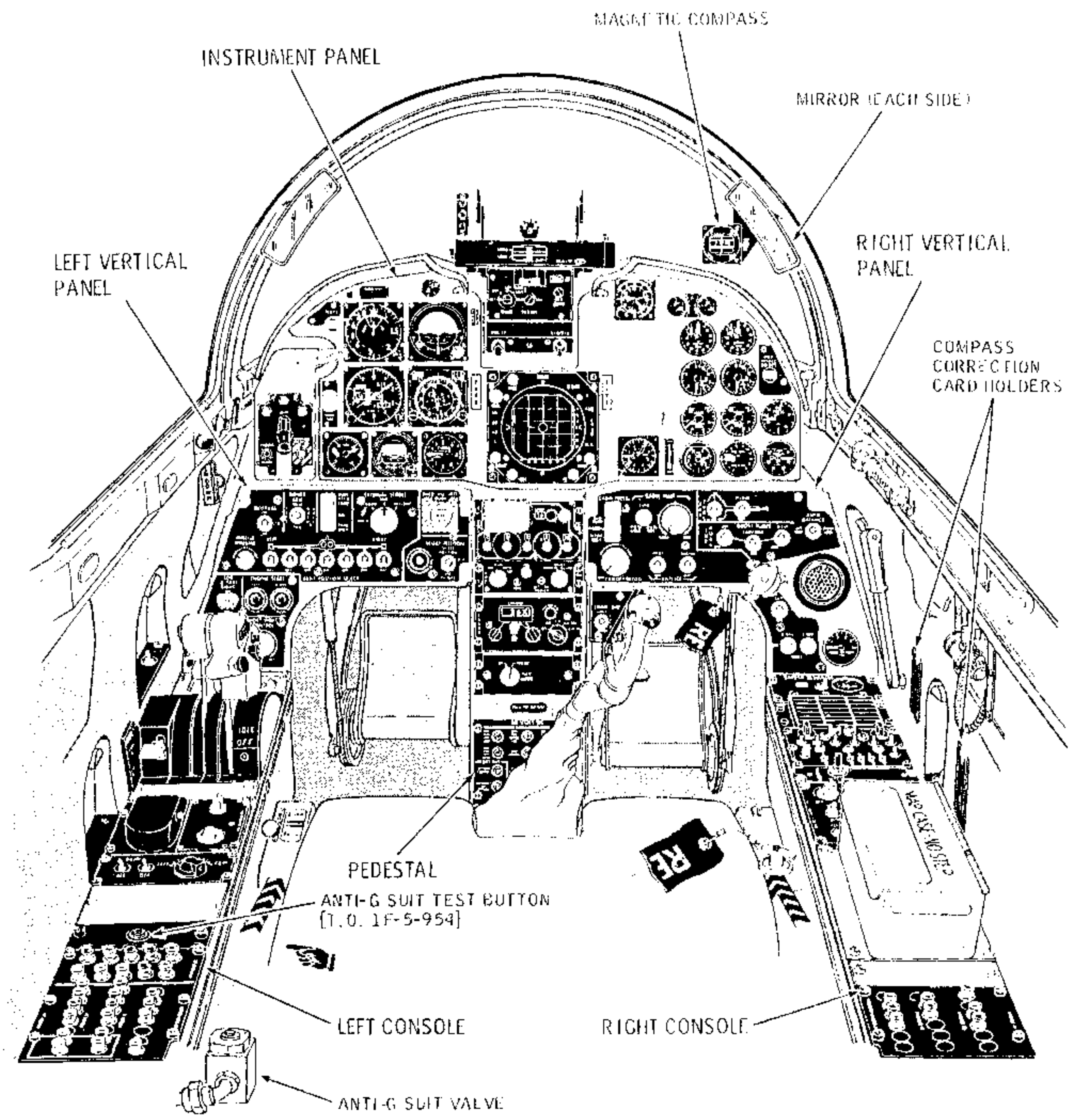


Figure 1-6.

COCKPIT ARRANGEMENT-FRONT (TYPICAL) F-1 F-2

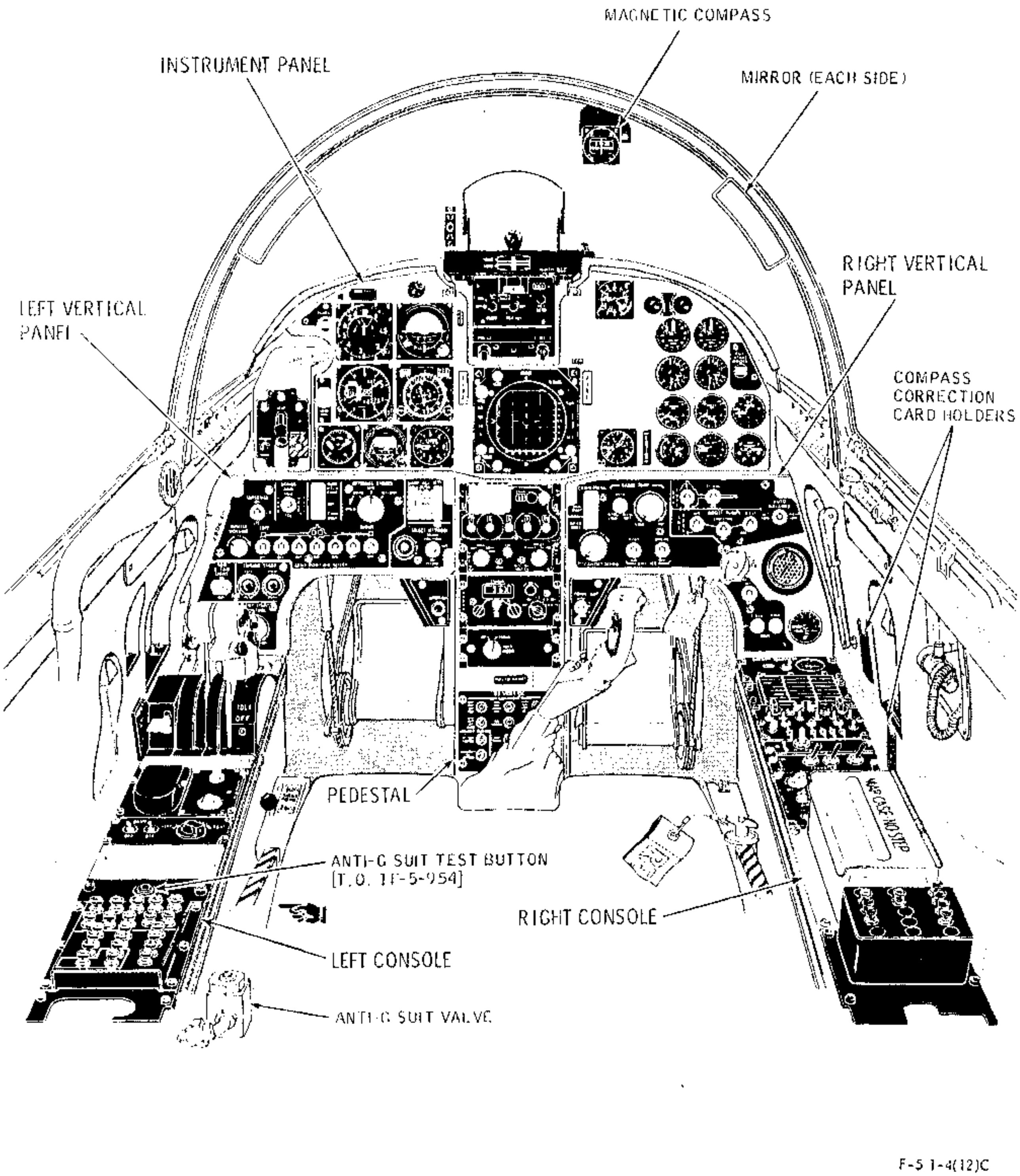


Figure 1-7.

COCKPIT ARRANGEMENT – REAR (TYPICAL) F-1 F-2

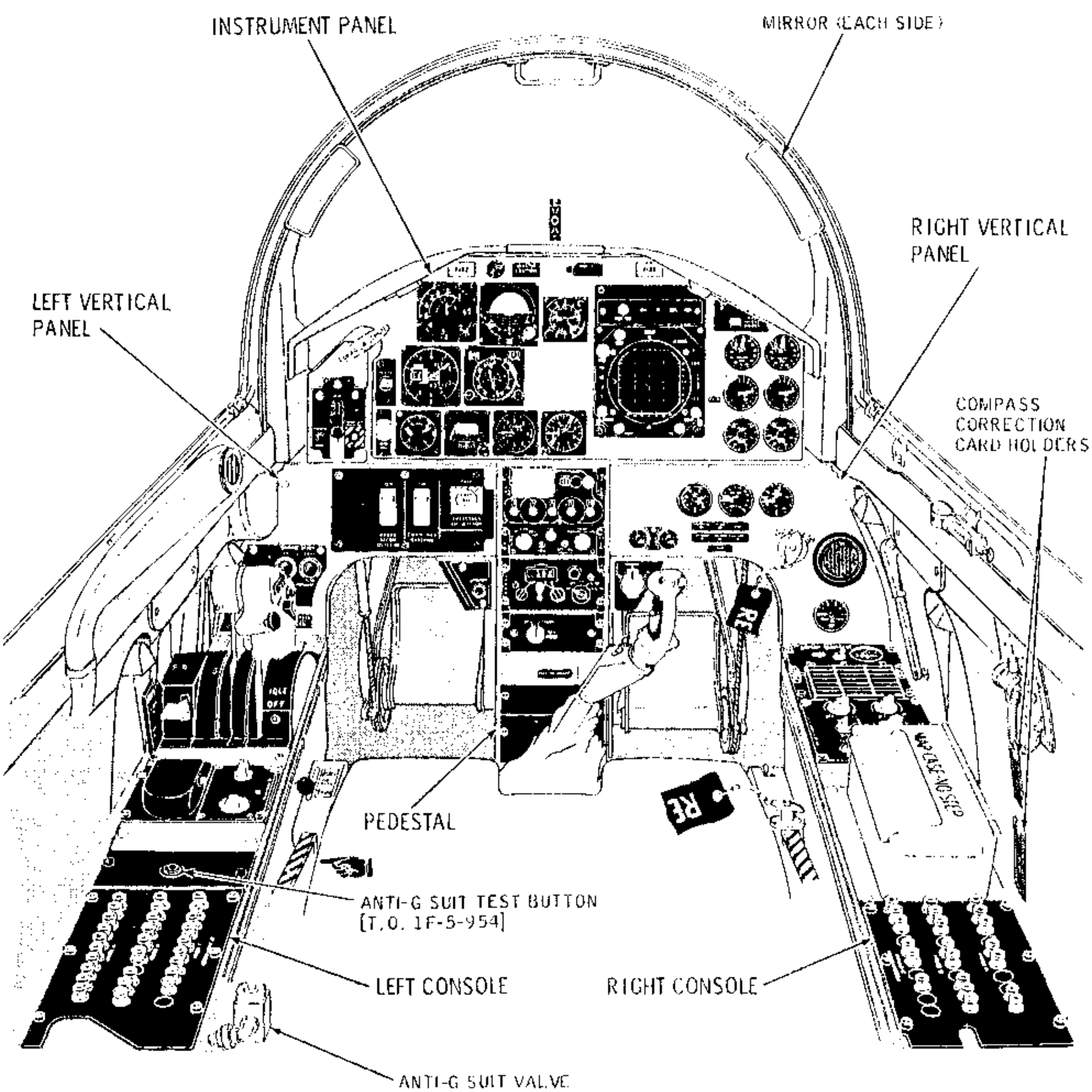
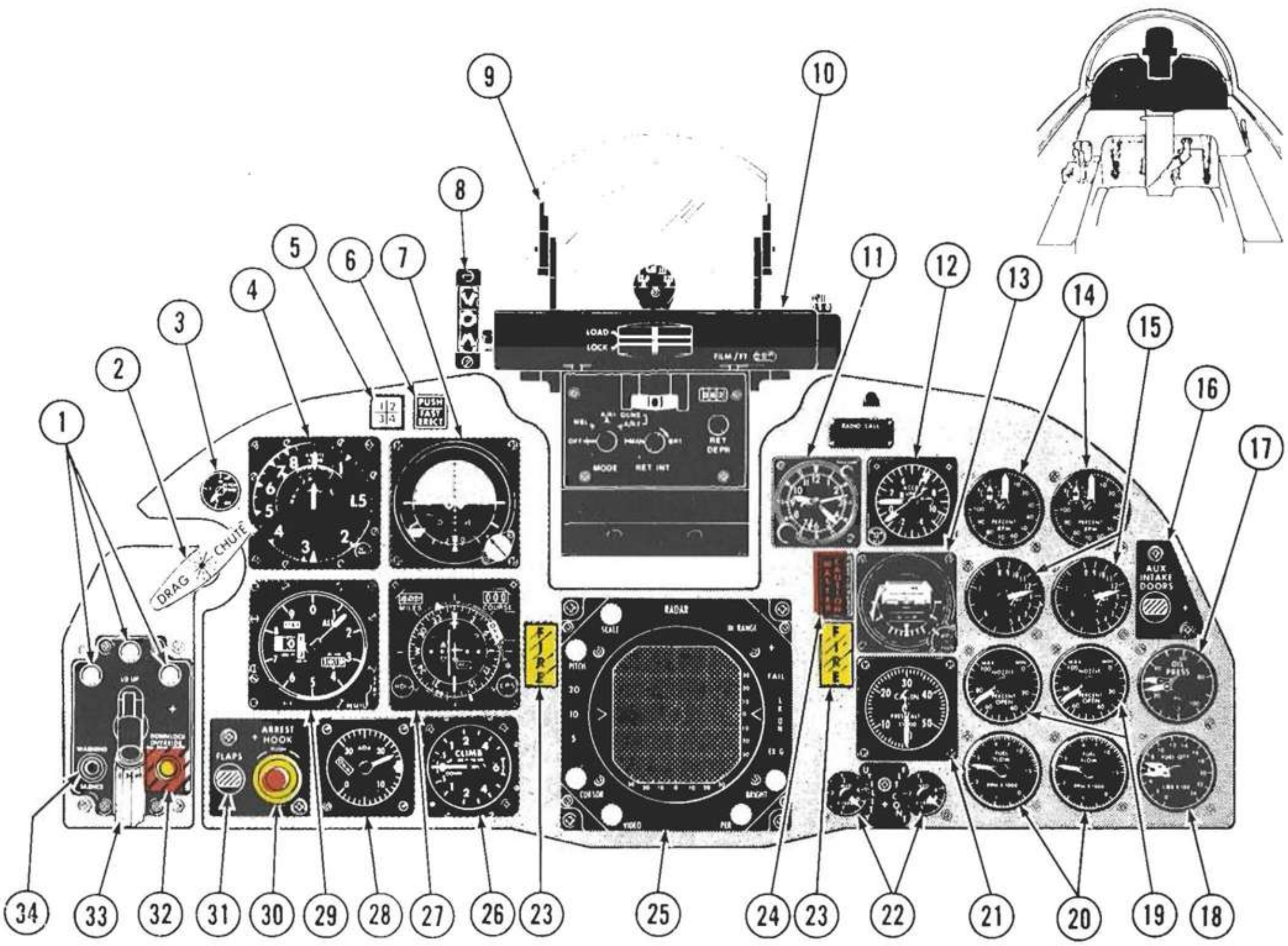


Figure 1-8.

INSTRUMENT PANEL (TYPICAL)

E E-2



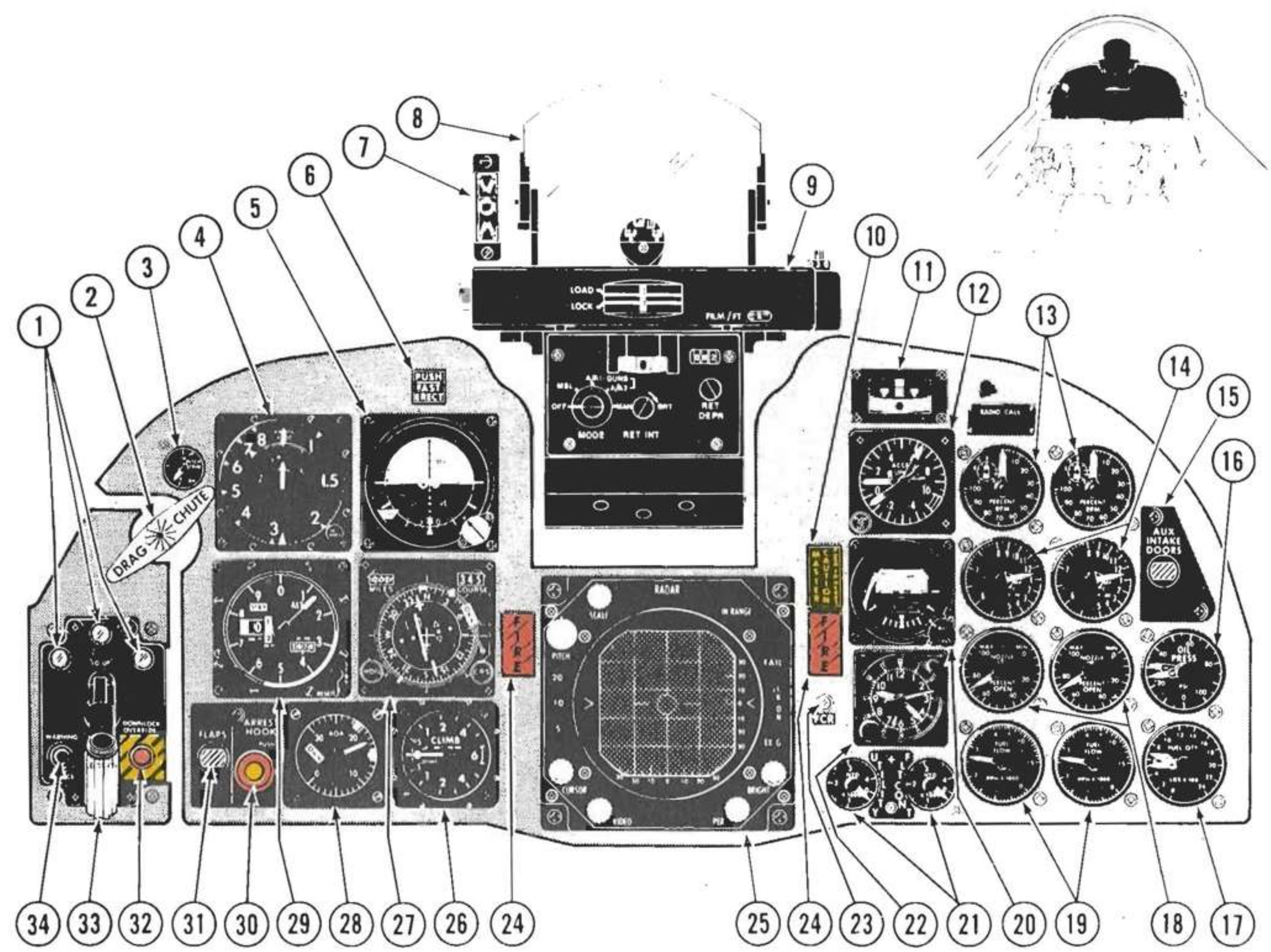
1 LANDING GEAR POSITION INDICATOR LIGHTS
2 DRAG CHUTE T-HANDLE
3 PITCH TRIM INDICATOR
4 AIRSPEED/MACH INDICATOR
5 CAMERA OPERATE LIGHTS (W/RECON NOSE)
6 ATTITUDE INDICATOR FAST-ERECT SWITCH
7 ATTITUDE INDICATOR
8 ANGLE-OF-ATTACK INDEXER
9 COMPUTING OPTICAL SIGHT
10 SIGHT CAMERA
11 CLOCK
12 ACCELEROMETER
13 STANDBY ATTITUDE INDICATOR
14 ENGINE TACHOMETERS
15 EXHAUST GAS TEMPERATURE INDICATORS
16 AUX INTAKE DOORS INDICATOR
17 OIL PRESSURE INDICATOR (DUAL)
18 FUEL QUANTITY INDICATOR (DUAL)
19 NOZZLE POSITION INDICATORS
20 FUEL FLOW INDICATORS
21 CABIN PRESSURE ALTIMETER
22 HYDRAULIC PRESSURE INDICATORS
23 FIRE WARNING LIGHT
24 MASTER CAUTION LIGHT
25 RADAR INDICATOR (W/O RECON NOSE)
26 VERTICAL VELOCITY INDICATOR
27 HORIZONTAL SITUATION INDICATOR
28 ANGLE-OF-ATTACK INDICATOR
29 ALTIMETER
30 ARRESTING HOOK BUTTON
31 FLAP INDICATOR
32 LANDING GEAR DOWNLOCK OVERRIDE BUTTON
33 LANDING GEAR LEVER
34 LANDING GEAR AND FLAP WARNING SILENCE BUTTON

F-5 1-8(1)J

Figure 1-9.

INSTRUMENT PANEL - FRONT (TYPICAL)

F



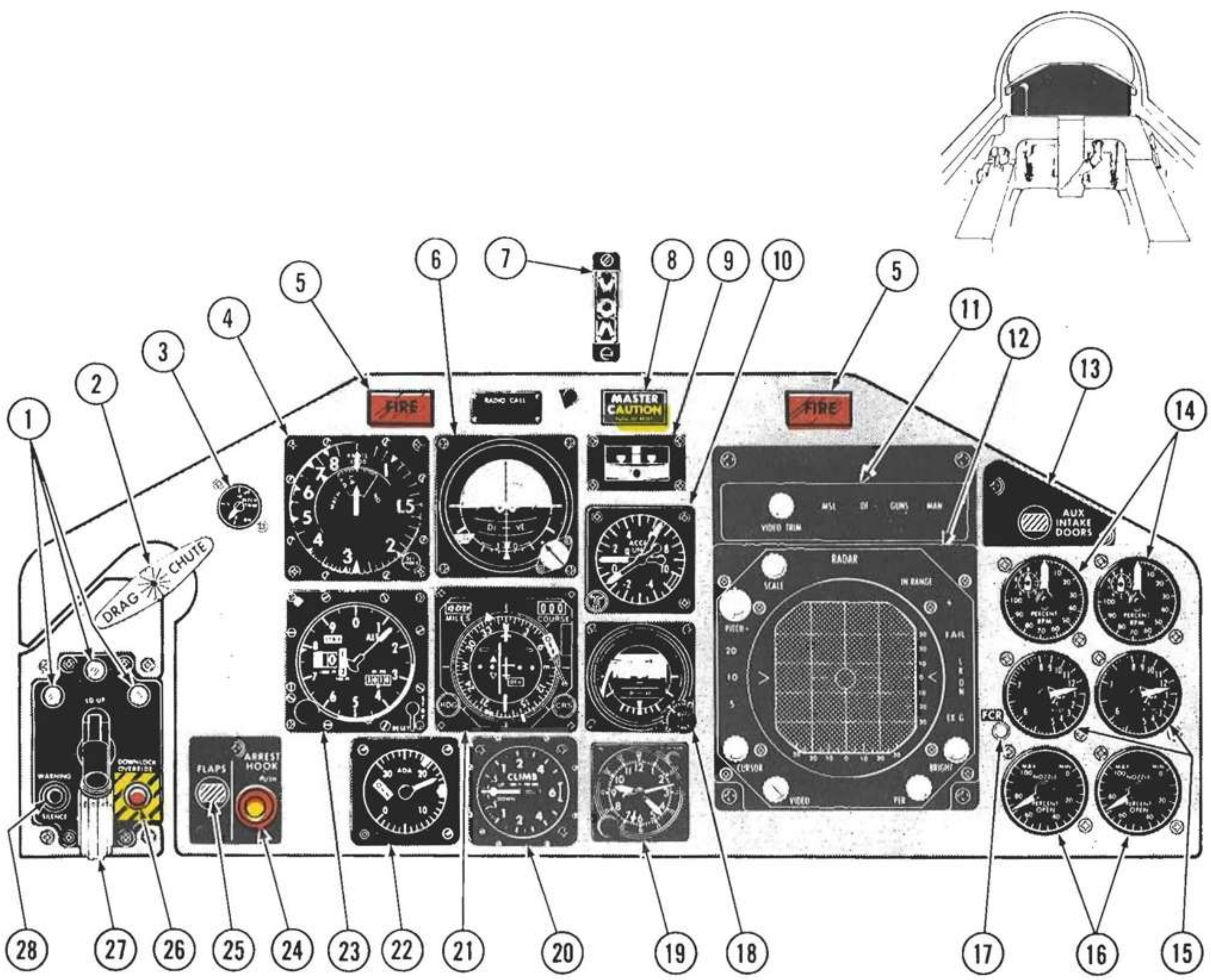
1 LANDING GEAR POSITION INDICATOR LIGHTS
2 DRAG CHUTE T-HANDLE
3 PITCH TRIM INDICATOR
4 AIRSPEED/MACH INDICATOR
5 ATTITUDE INDICATOR
6 ATTITUDE INDICATOR FAST ERECT SWITCH
7 ANGLE-OF-ATTACK INDEXER
8 COMPUTING OPTICAL SIGHT
9 SIGHT CAMERA
10 MASTER CAUTION LIGHT
11 TURN-SLIP INDICATOR
12 ACCELEROMETER
13 ENGINE TACHOMETERS
14 EXHAUST GAS TEMPERATURE INDICATORS
15 AUX INTAKE DOORS INDICATOR
16 OIL PRESSURE INDICATOR (DUAL)
17 FUEL QUANTITY INDICATOR (DUAL)
18 NOZZLE POSITION INDICATORS
19 FUEL FLOW INDICATORS
20 STANDBY ATTITUDE INDICATOR
21 HYDRAULIC PRESSURE INDICATORS
22 CLOCK
23 FIRE CONTROL RADAR LIGHT
24 FIRE WARNING LIGHT
25 RADAR INDICATOR
26 VERTICAL VELOCITY INDICATOR
27 HORIZONTAL SITUATION INDICATOR
28 ANGLE-OF-ATTACK INDICATOR
29 ALTIMETER
30 ARRESTING HOOK BUTTON
31 FLAP INDICATOR
32 LANDING GEAR DOWNLOCK OVERRIDE BUTTON
33 LANDING GEAR LEVER
34 LANDING GEAR AND FLAP WARNING SILENCE BUTTON

F-5 1-8(2)H

Figure 1-10.

INSTRUMENT PANEL - REAR (TYPICAL)

F



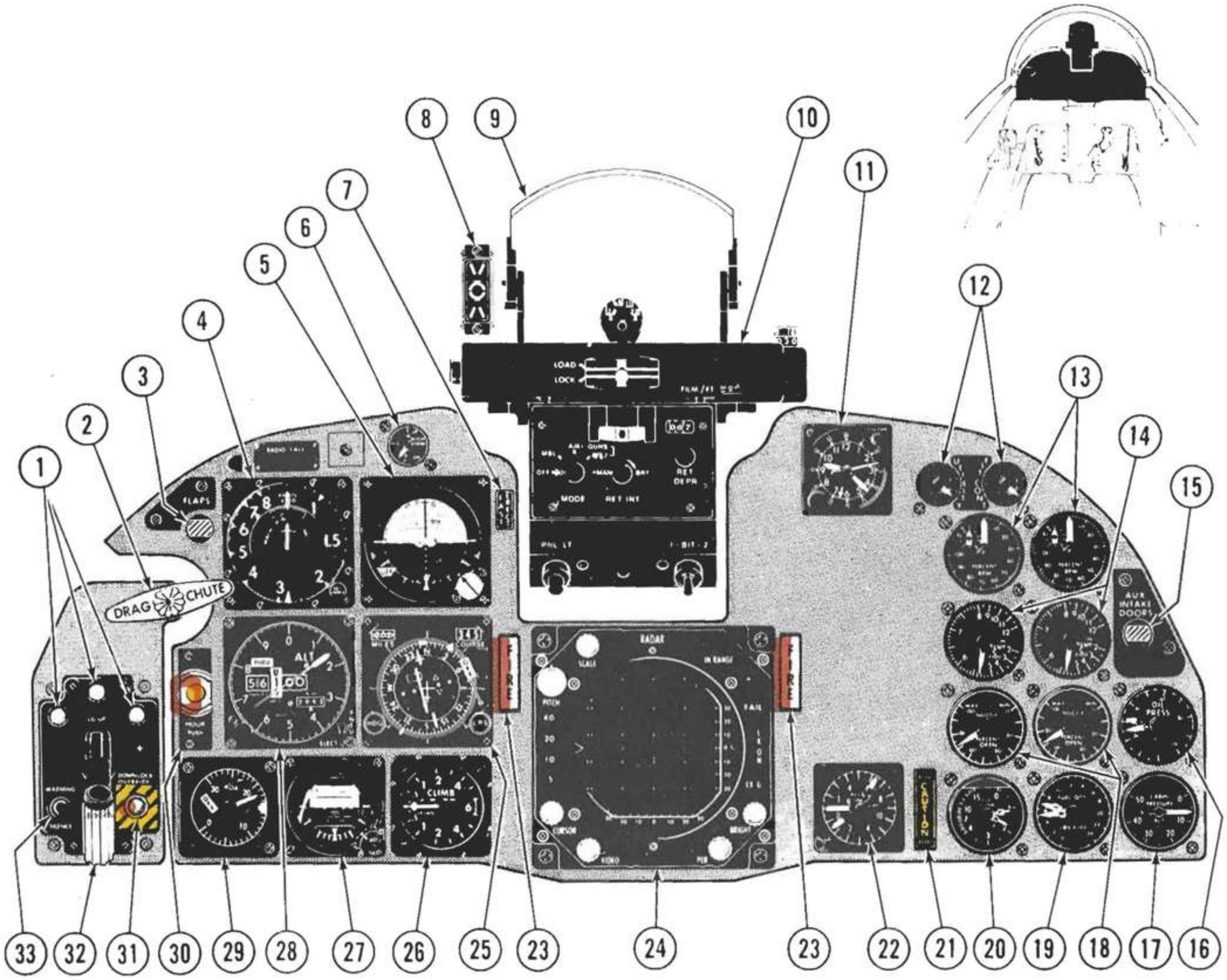
1 LANDING GEAR POSITION INDICATOR LIGHTS
2 DRAG CHUTE T-HANDLE
3 PITCH TRIM INDICATOR
4 AIRSPEED/MACH INDICATOR
5 FIRE WARNING LIGHT
6 ATTITUDE INDICATOR
7 ANGLE-OF-ATTACK INDEXER
8 MASTER CAUTION LIGHT
9 TURN-SLIP INDICATOR
10 ACCELEROMETER
11 RADAR VIDEO TRIM/FIRE CONTROL SYSTEM MODE INDICATOR LIGHTS
12 RADAR INDICATOR
13 AUX INTAKE DOORS INDICATOR
14 ENGINE TACHOMETERS
15 EXHAUST GAS TEMPERATURE INDICATORS
16 NOZZLE POSITION INDICATORS
17 FIRE CONTROL RADAR LIGHT
18 STANDBY ATTITUDE INDICATOR
19 CLOCK
20 VERTICAL VELOCITY INDICATOR
21 HORIZONTAL SITUATION INDICATOR
22 ANGLE-OF-ATTACK INDICATOR
23 ALTIMETER
24 ARRESTING HOOK BUTTON
25 FLAP INDICATOR
26 LANDING GEAR DOWNLOCK OVERRIDE BUTTON
27 LANDING GEAR LEVER
28 LANDING GEAR AND FLAP WARNING SILENCE BUTTON

F-5 1-10(1)H

Figure 1-11.

INSTRUMENT PANEL (TYPICAL)

E-1 **E-3**



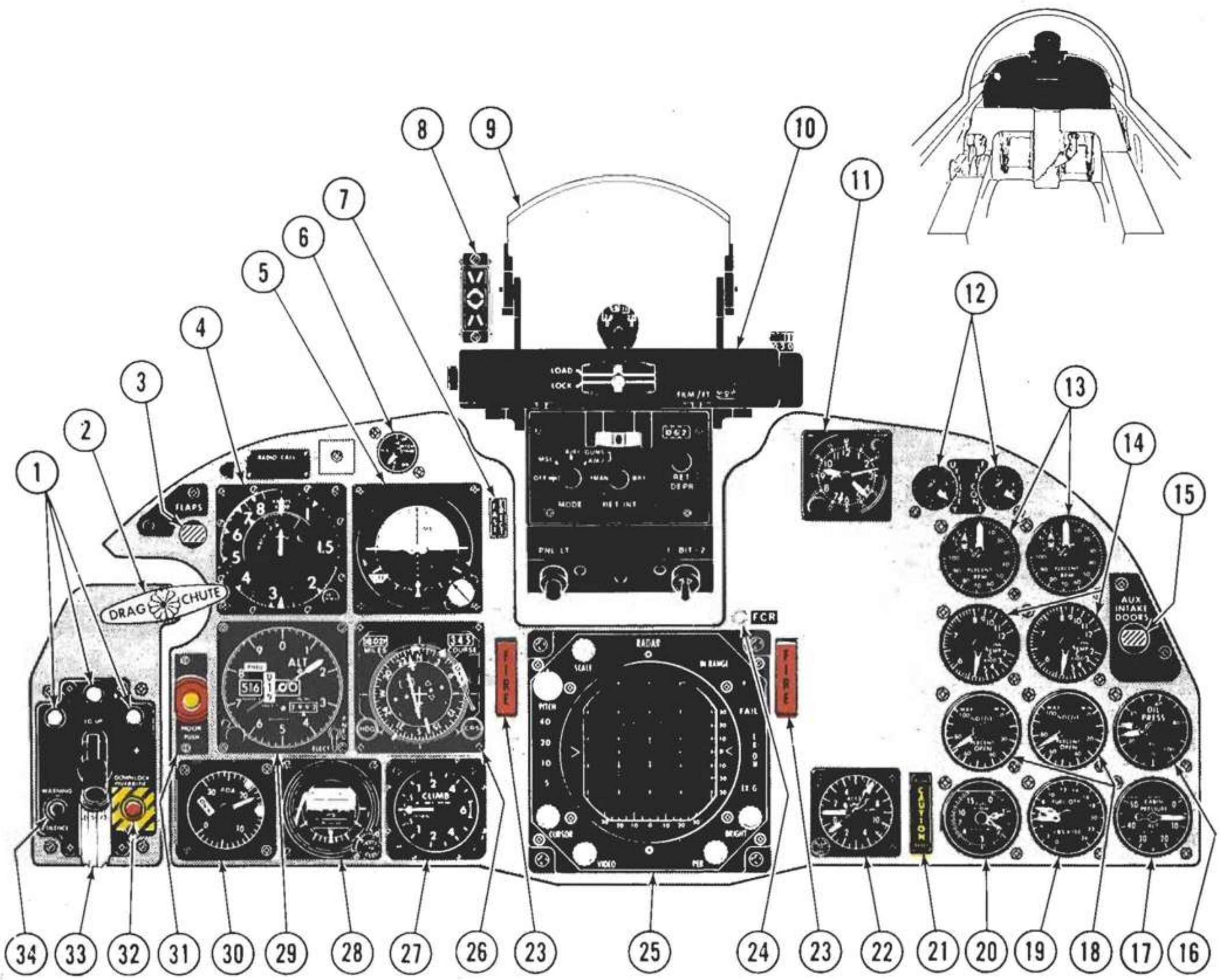
1 LANDING GEAR POSITION INDICATOR LIGHTS
2 DRAG CHUTE T-HANDLE
3 FLAP INDICATOR
4 AIRSPEED/MACH INDICATOR
5 ATTITUDE INDICATOR
6 PITCH TRIM INDICATOR
7 ATTITUDE INDICATOR FAST-ERECT SWITCH
8 ANGLE-OF-ATTACK INDEXER
9 COMPUTING OPTICAL SIGHT
10 SIGHT CAMERA
11 CLOCK
12 HYDRAULIC PRESSURE INDICATORS
13 ENGINE TACHOMETERS
14 EXHAUST GAS TEMPERATURE INDICATORS
15 AUX INTAKE DOORS INDICATOR
16 OIL PRESSURE INDICATOR (DUAL)
17 CABIN PRESSURE ALTIMETER
18 NOZZLE POSITION INDICATORS
19 FUEL QUANTITY INDICATOR (DUAL)
20 FUEL FLOW INDICATOR (DUAL)
21 MASTER CAUTION LIGHT
22 ACCELEROMETER
23 FIRE WARNING LIGHT
24 RADAR INDICATOR
25 HORIZONTAL SITUATION INDICATOR
26 VERTICAL VELOCITY INDICATOR
27 STANDBY ATTITUDE INDICATOR
28 ALTIMETER
29 ANGLE-OF-ATTACK INDICATOR
30 ARRESTING HOOK BUTTON
31 LANDING GEAR DOWNLOCK OVERRIDE BUTTON
32 LANDING GEAR LEVER
33 LANDING GEAR AND FLAP WARNING SILENCE BUTTON

F-5 1-8(14)C

Figure 1-12.

INSTRUMENT PANEL – FRONT (TYPICAL)

F-1 F-2



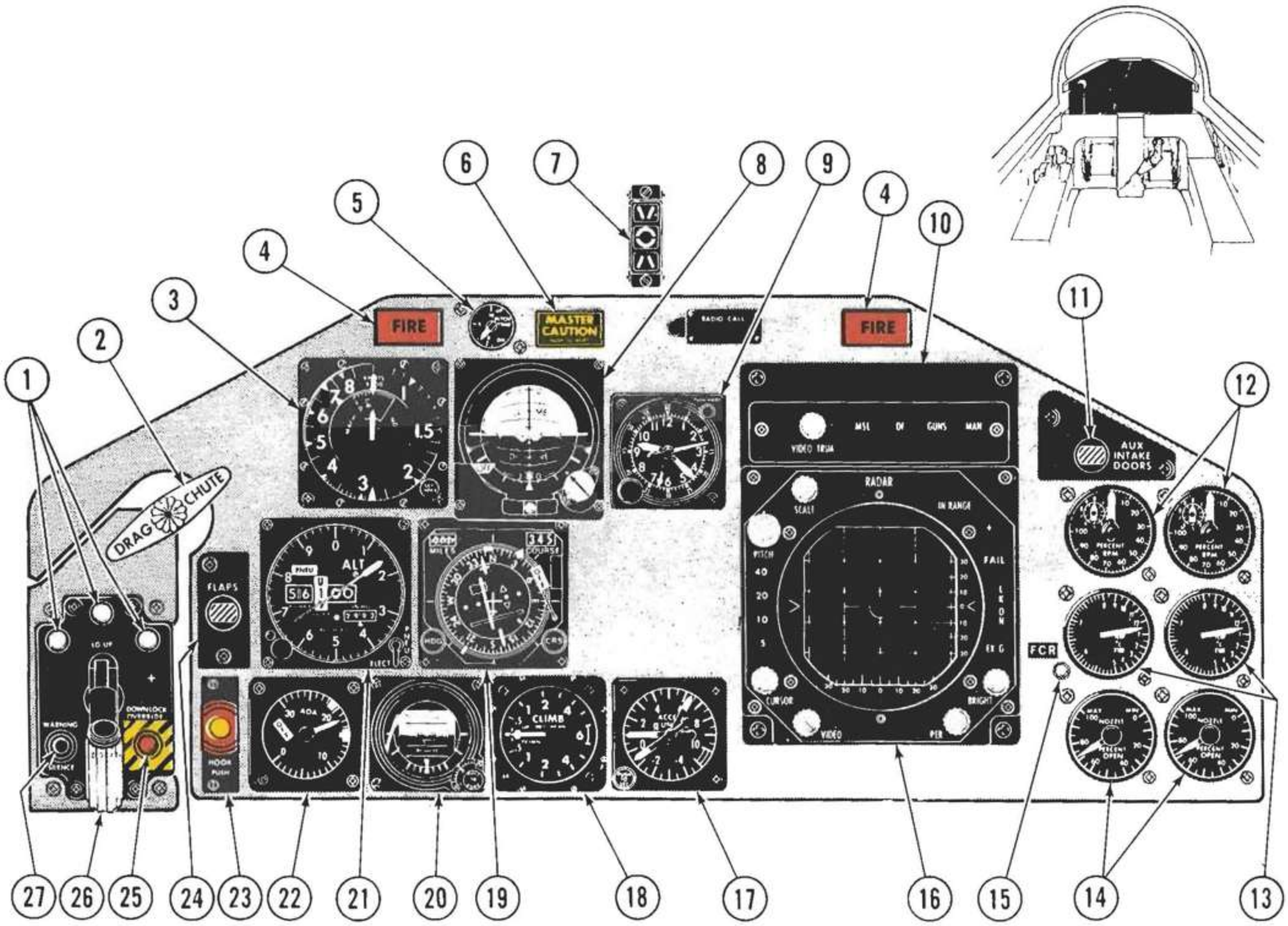
1 LANDING GEAR POSITION INDICATOR LIGHTS
2 DRAG CHUTE T-HANDLE
3 FLAP INDICATOR
4 AIRSPEED/MACH INDICATOR
5 ATTITUDE INDICATOR
6 PITCH TRIM INDICATOR
7 ATTITUDE INDICATOR FAST-ERECT SWITCH
8 ANGLE-OF-ATTACK INDEXER
9 COMPUTING OPTICAL SIGHT
10 SIGHT CAMERA
11 CLOCK
12 HYDRAULIC PRESSURE INDICATORS
13 ENGINE TACHOMETERS
14 EXHAUST GAS TEMPERATURE INDICATORS
15 AUX INTAKE DOORS INDICATOR
16 OIL PRESSURE INDICATOR (DUAL)
17 CABIN PRESSURE ALTIMETER
18 NOZZLE POSITION INDICATORS
19 FUEL QUANTITY INDICATOR (DUAL)
20 FUEL FLOW INDICATOR (DUAL)
21 MASTER CAUTION LIGHT
22 ACCELEROMETER
23 FIRE WARNING LIGHT
24 FIRE CONTROL RADAR LIGHT
25 RADAR INDICATOR
26 HORIZONTAL SITUATION INDICATOR
27 VERTICAL VELOCITY INDICATOR
28 STANDBY ATTITUDE INDICATOR
29 ALTIMETER
30 ANGLE-OF-ATTACK INDICATOR
31 ARRESTING HOOK BUTTON
32 LANDING GEAR DOWNLOCK OVERRIDE BUTTON
33 LANDING GEAR LEVER
34 LANDING GEAR AND FLAP WARNING SILENCE BUTTON

F-5 1-8(13)D

Figure 1-13.

INSTRUMENT PANEL-REAR (TYPICAL)

F-1 F-2



1	LANDING GEAR POSITION INDICATOR LIGHTS	15	FIRE CONTROL RADAR LIGHT
2	DRAG CHUTE T-HANDLE	16	RADAR INDICATOR
3	AIRSPEED/MACH INDICATOR	17	ACCELEROMETER
4	FIRE WARNING LIGHT	18	VERTICAL VELOCITY INDICATOR
5	PITCH TRIM INDICATOR	19	HORIZONTAL SITUATION INDICATOR
6	MASTER CAUTION LIGHT	20	STANDBY ATTITUDE INDICATOR
7	ANGLE-OF-ATTACK INDEXER	21	ALTIMETER
8	ATTITUDE INDICATOR	22	ANGLE-OF-ATTACK INDICATOR
9	CLOCK	23	ARRESTING HOOK BUTTON
10	RADAR VIDEO TRIM/FIRE CONTROL SYSTEM MODE INDICATOR LIGHTS	24	FLAP INDICATOR
11	AUXILIARY INTAKE DOORS INDICATOR	25	LANDING GEAR DOWNLOCK OVERRIDE BUTTON
12	ENGINE TACHOMETERS	26	LANDING GEAR HANDLE
13	EXHAUST GAS TEMPERATURE INDICATORS	27	LANDING GEAR AND FLAP WARNING SILENCE BUTTON
14	NOZZLE POSITION INDICATORS		

F-5 1-10(7)E

Figure 1-14.

VERTICAL PANELS (TYPICAL)

E E-2

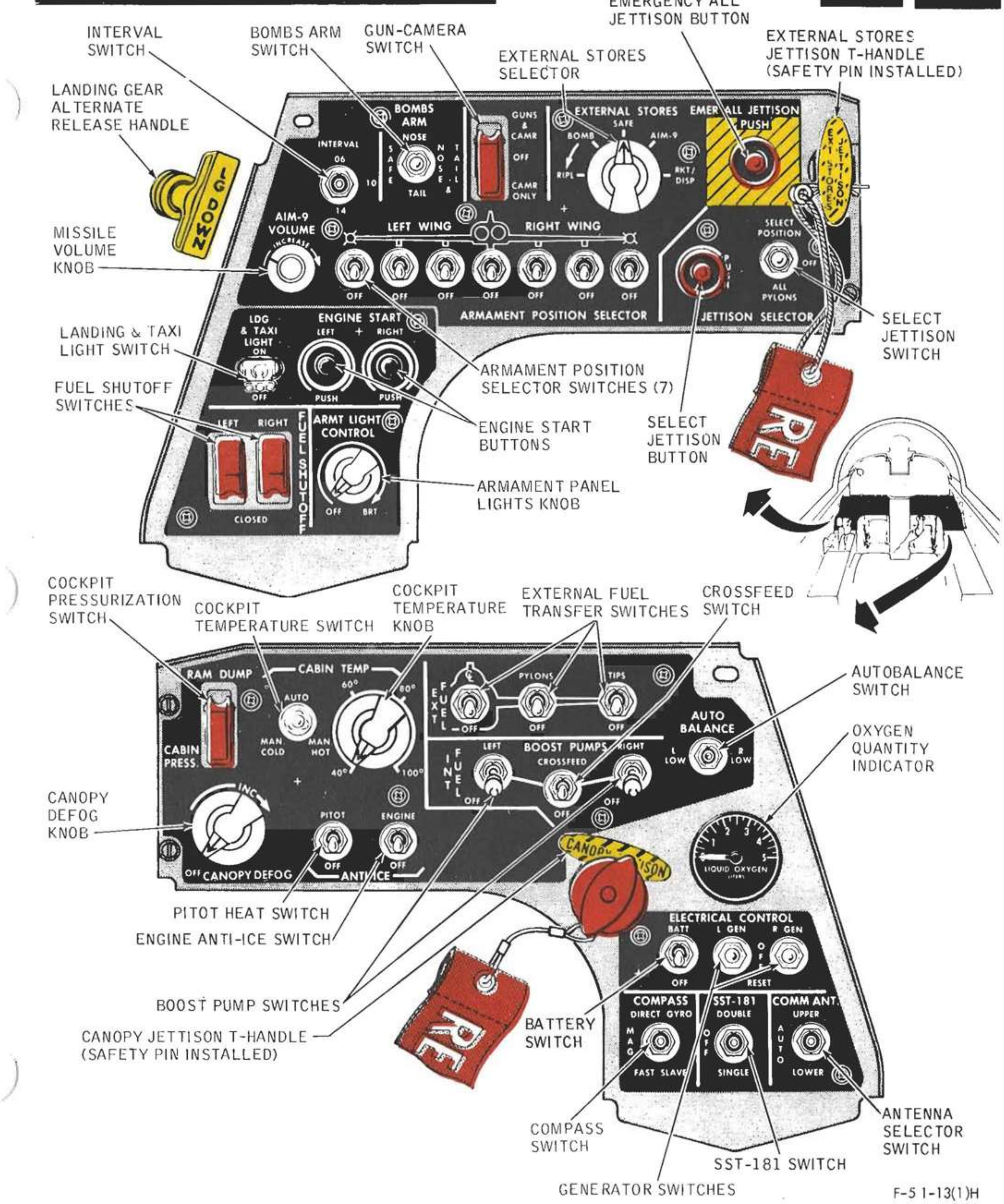


Figure 1-15.

VERTICAL PANELS - FRONT (TYPICAL)

F

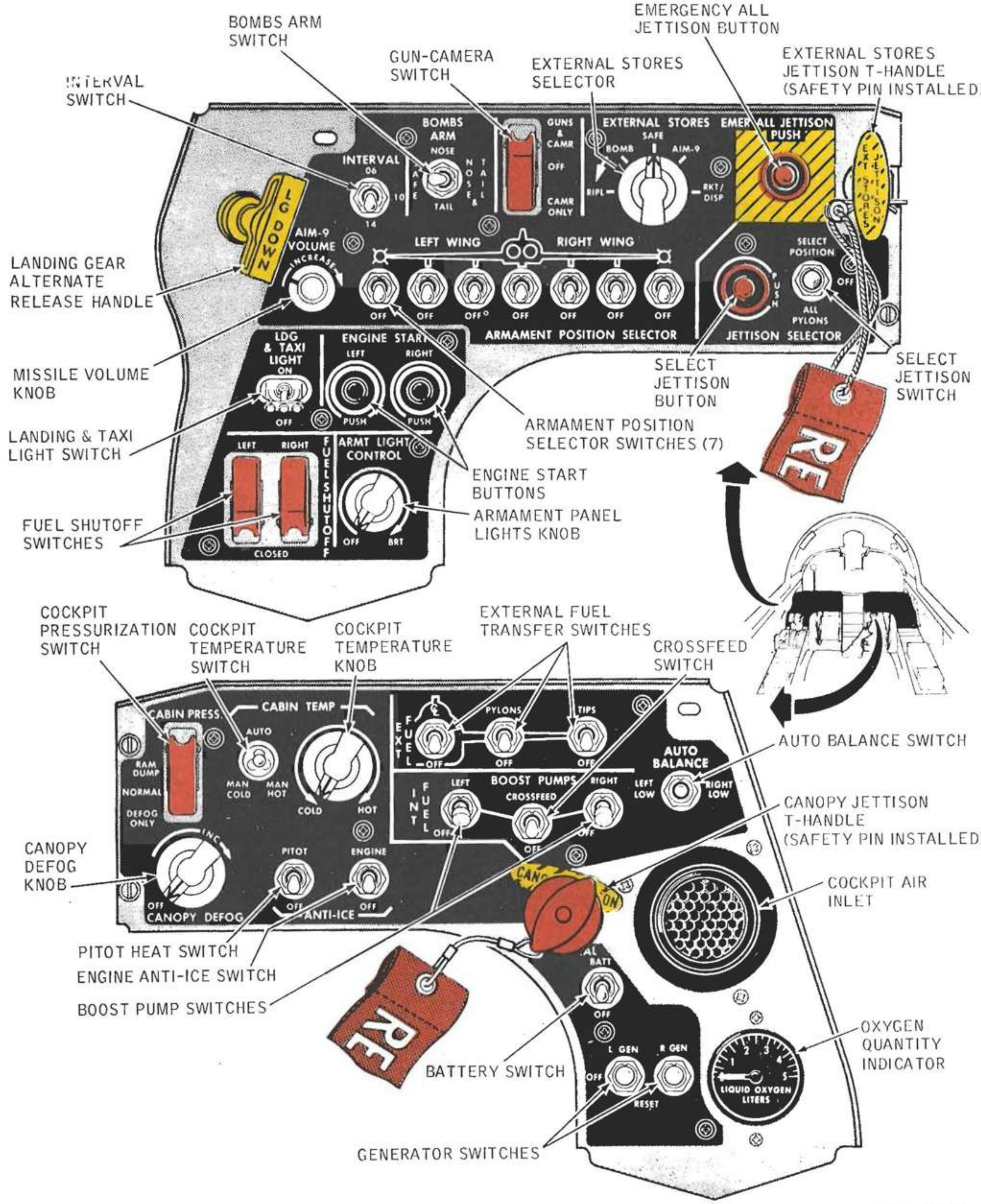


Figure 1-16.

VERTICAL PANELS—REAR (TYPICAL)

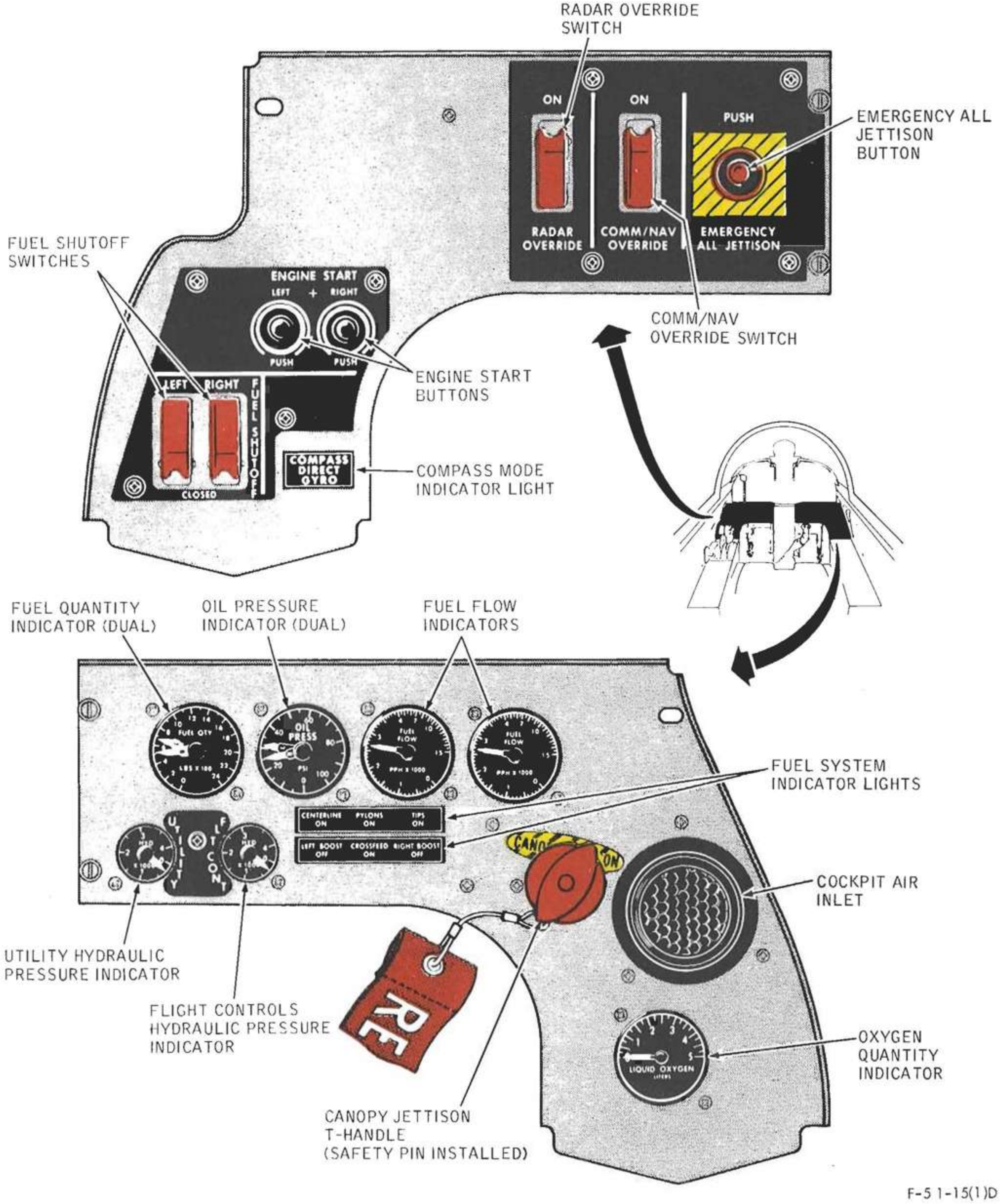


Figure 1-17.

VERTICAL PANELS (TYPICAL)

E-1 E-3

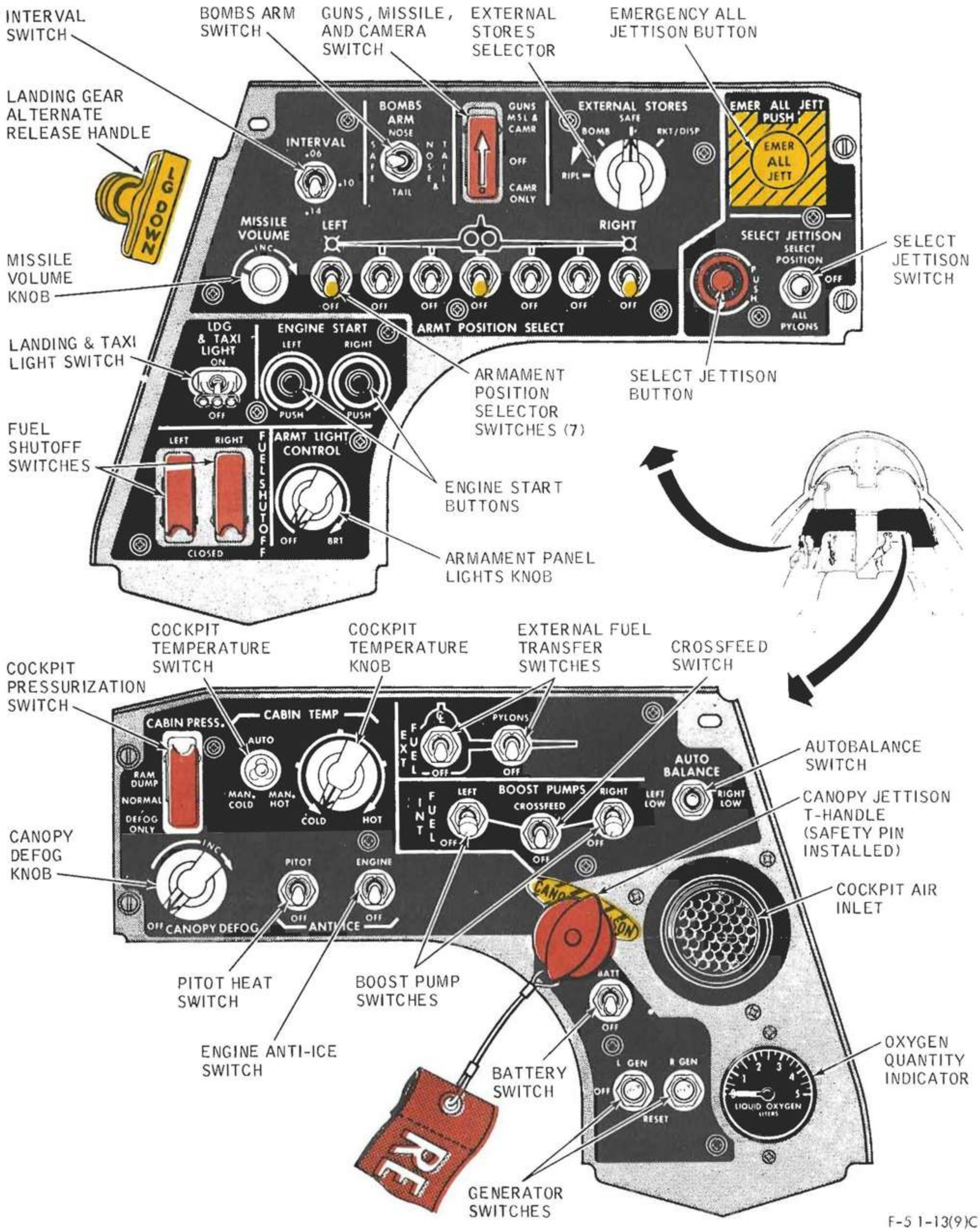


Figure 1-18.

VERTICAL PANELS–FRONT (TYPICAL)

F-1 F-2

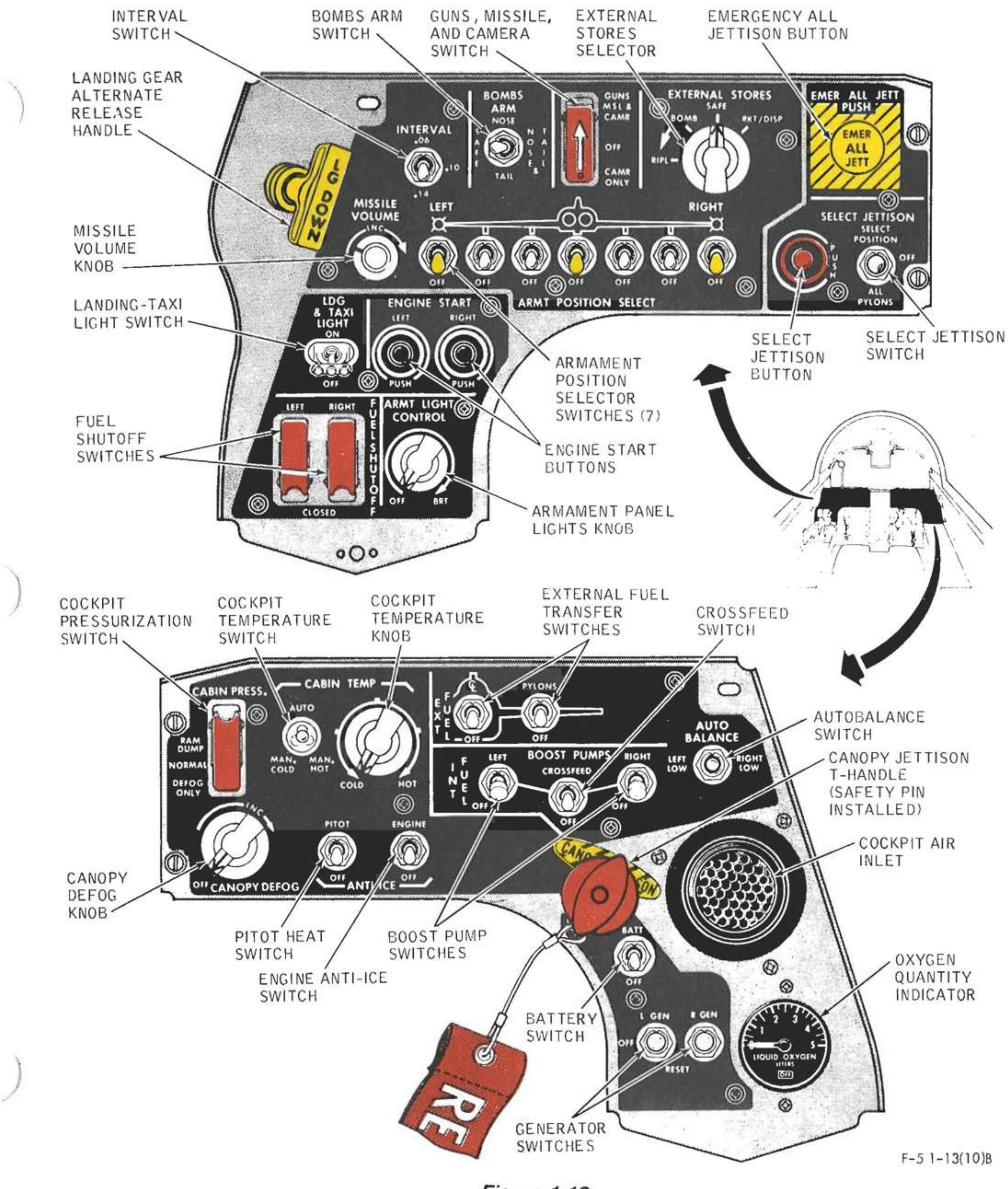


Figure 1-19.

VERTICAL PANELS – REAR (TYPICAL)

F-1 F-2

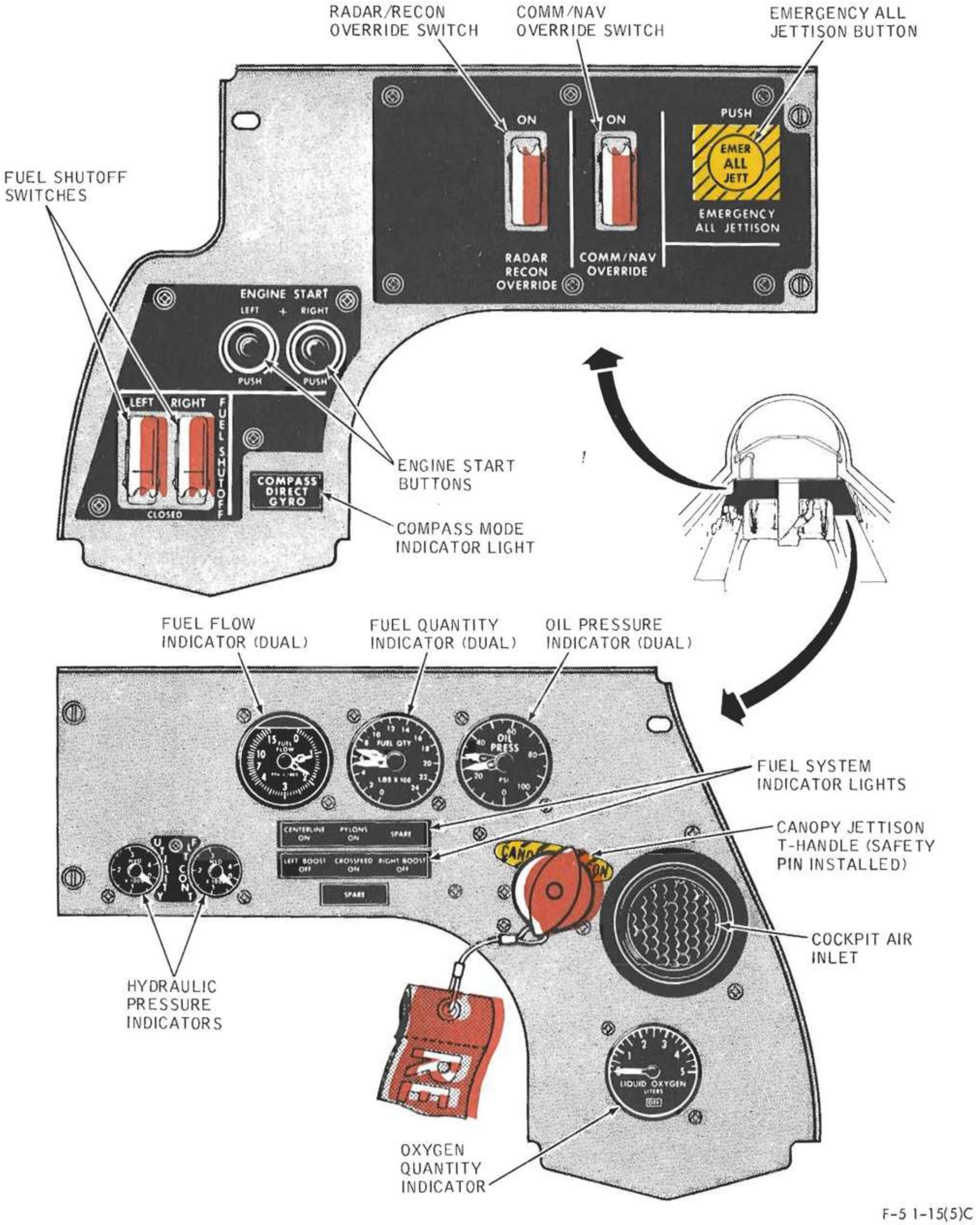


Figure 1-20.

CONSOLE PANELS (TYPICAL)

E **E-2**

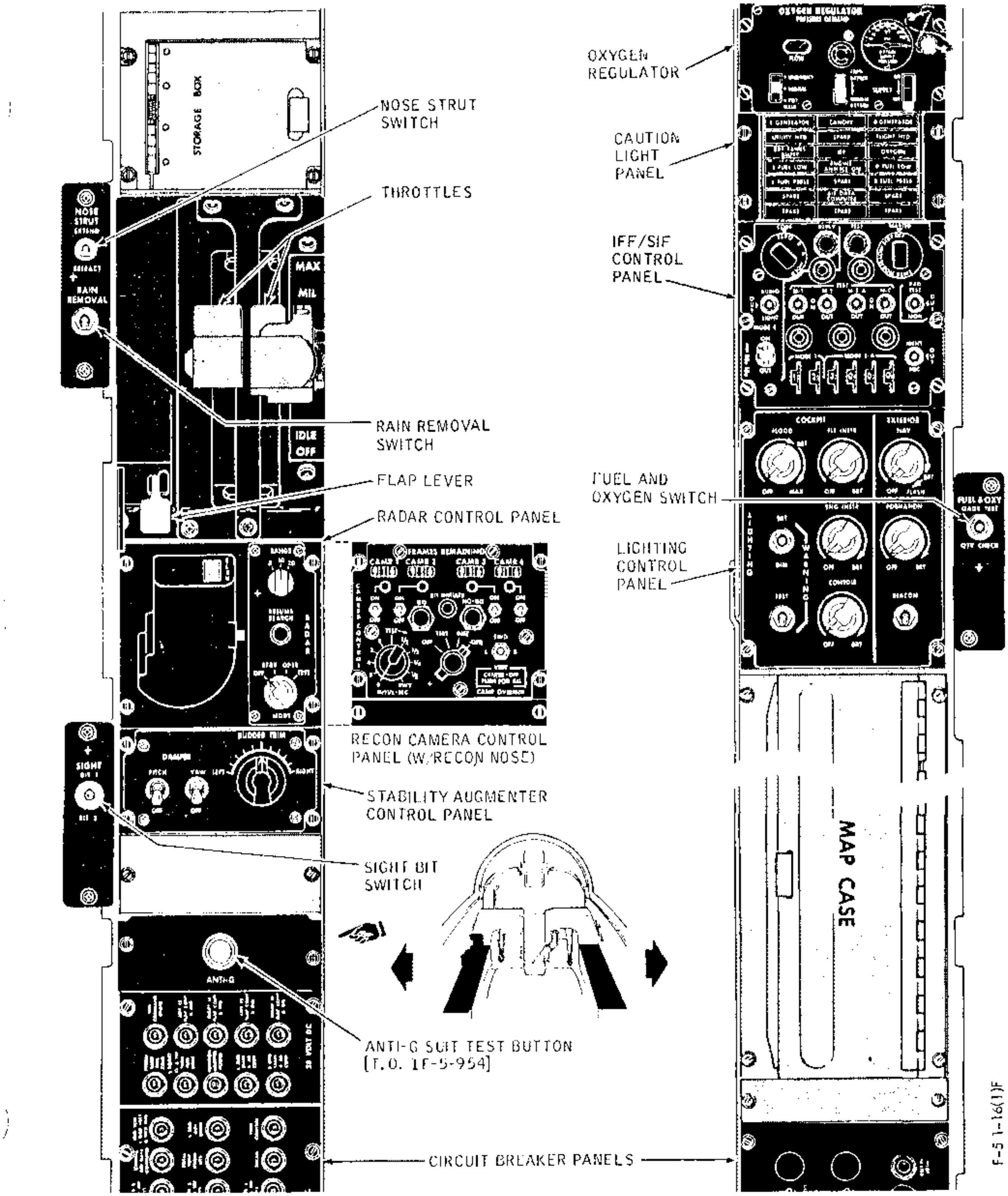


Figure 1-21.

CONSOLE PANELS–FRONT (TYPICAL)

F

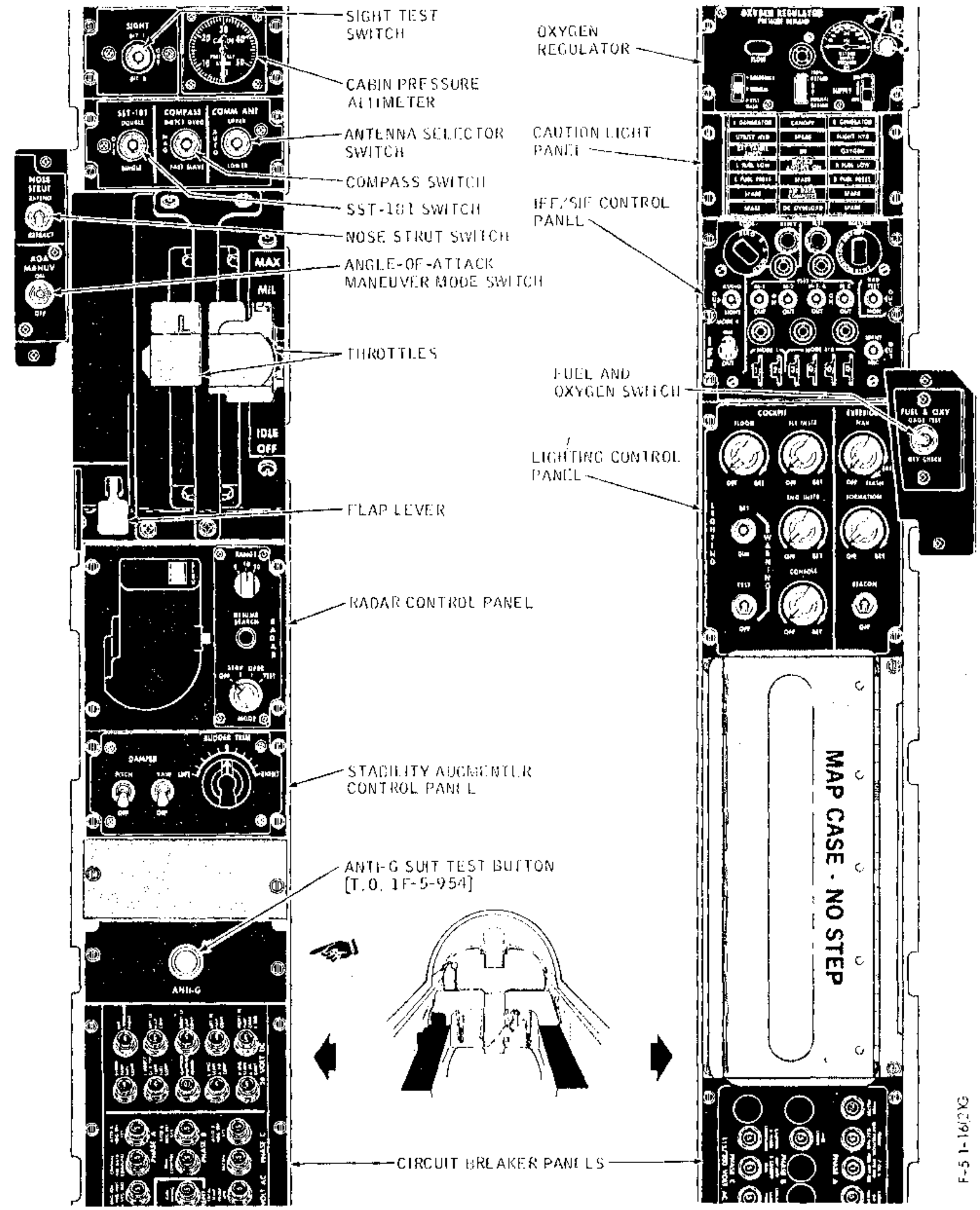


Figure 1-22.

CONSOLE PANELS–REAR (TYPICAL)

F

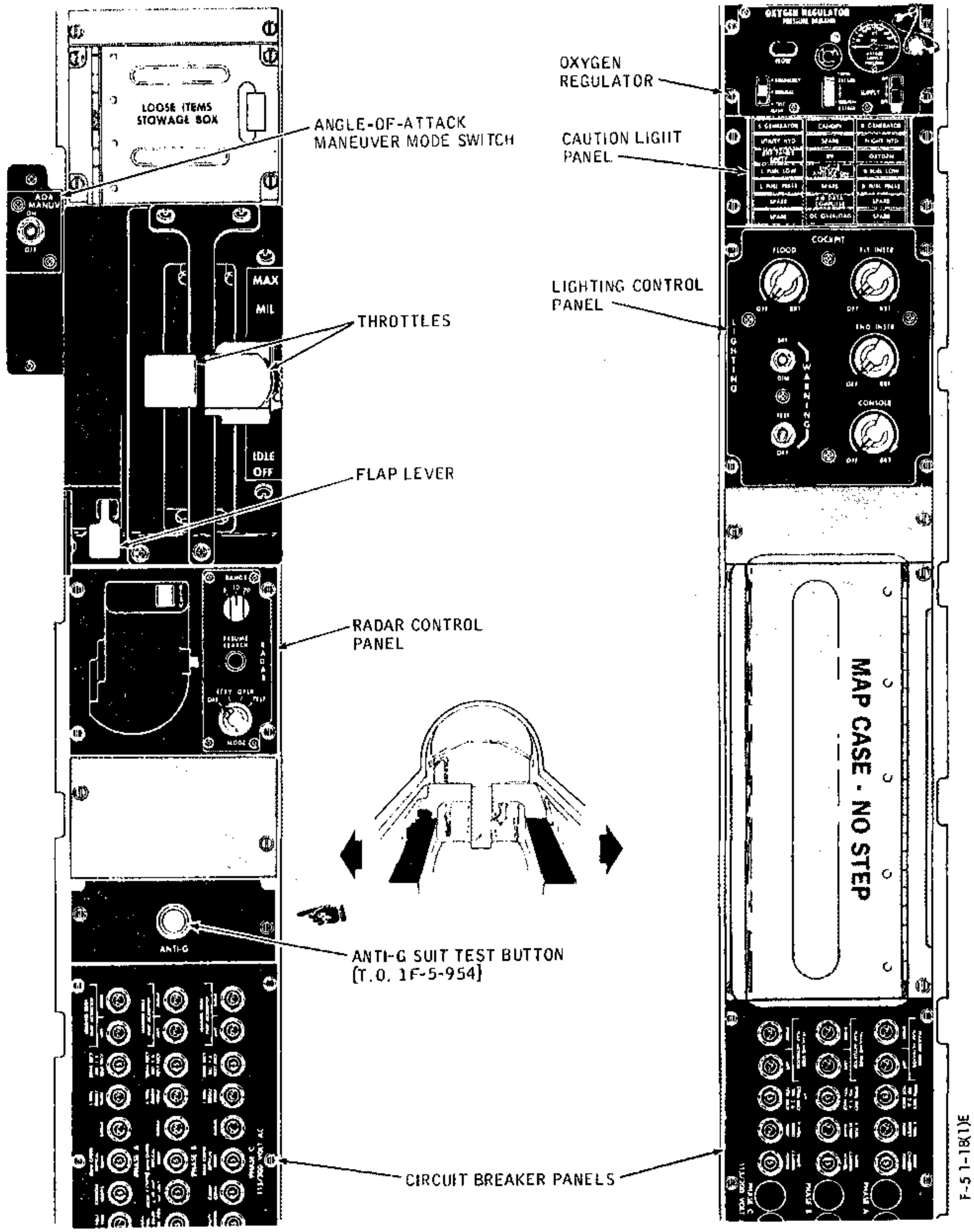


Figure 1-23.

CONSOLE PANELS (TYPICAL)

E-1 E-3

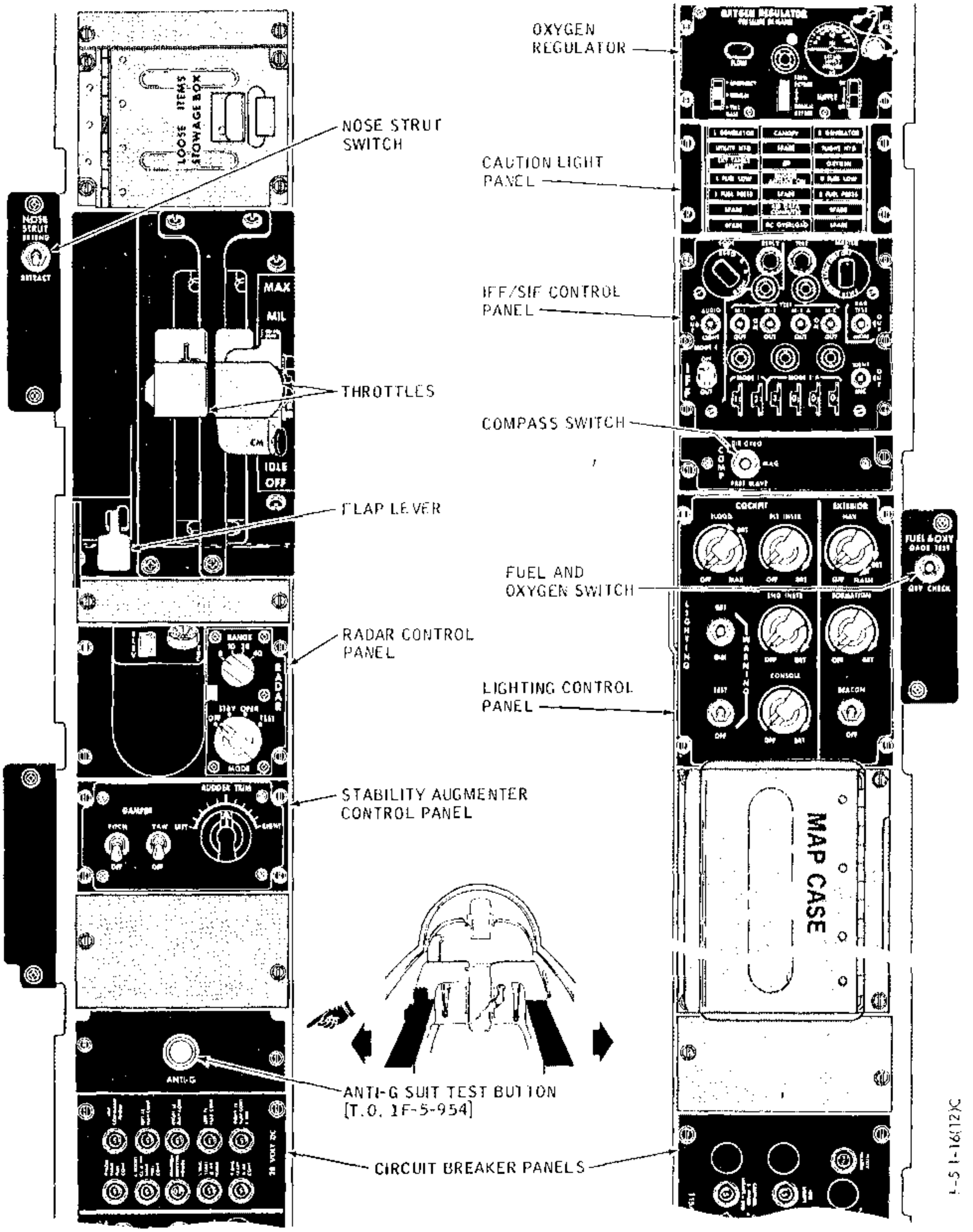


Figure 1-24.

CONSOLE PANELS–FRONT (TYPICAL)

F-1 F-2

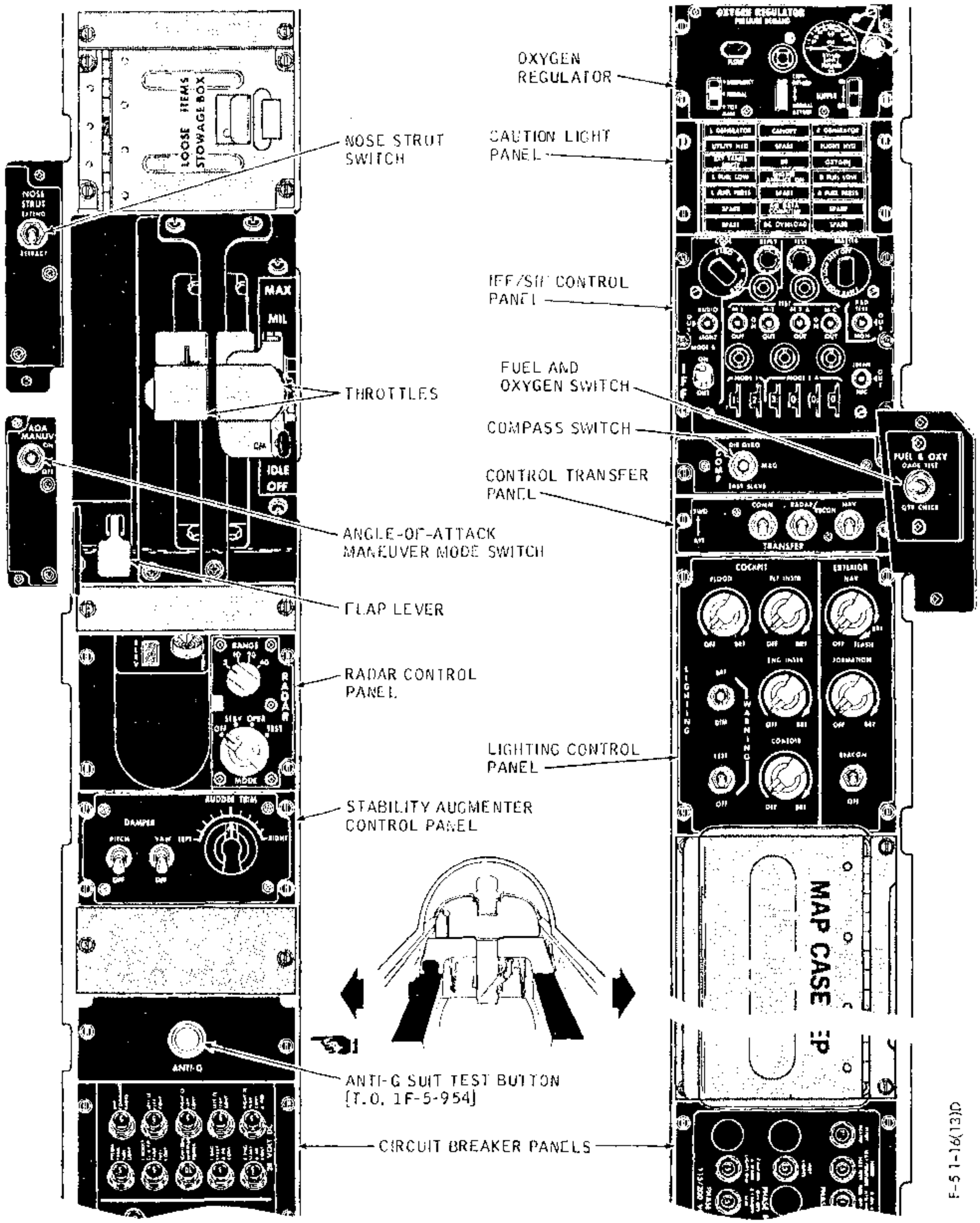


Figure 1-25.

CONSOLE PANELS–REAR (TYPICAL)

F-1 F-2

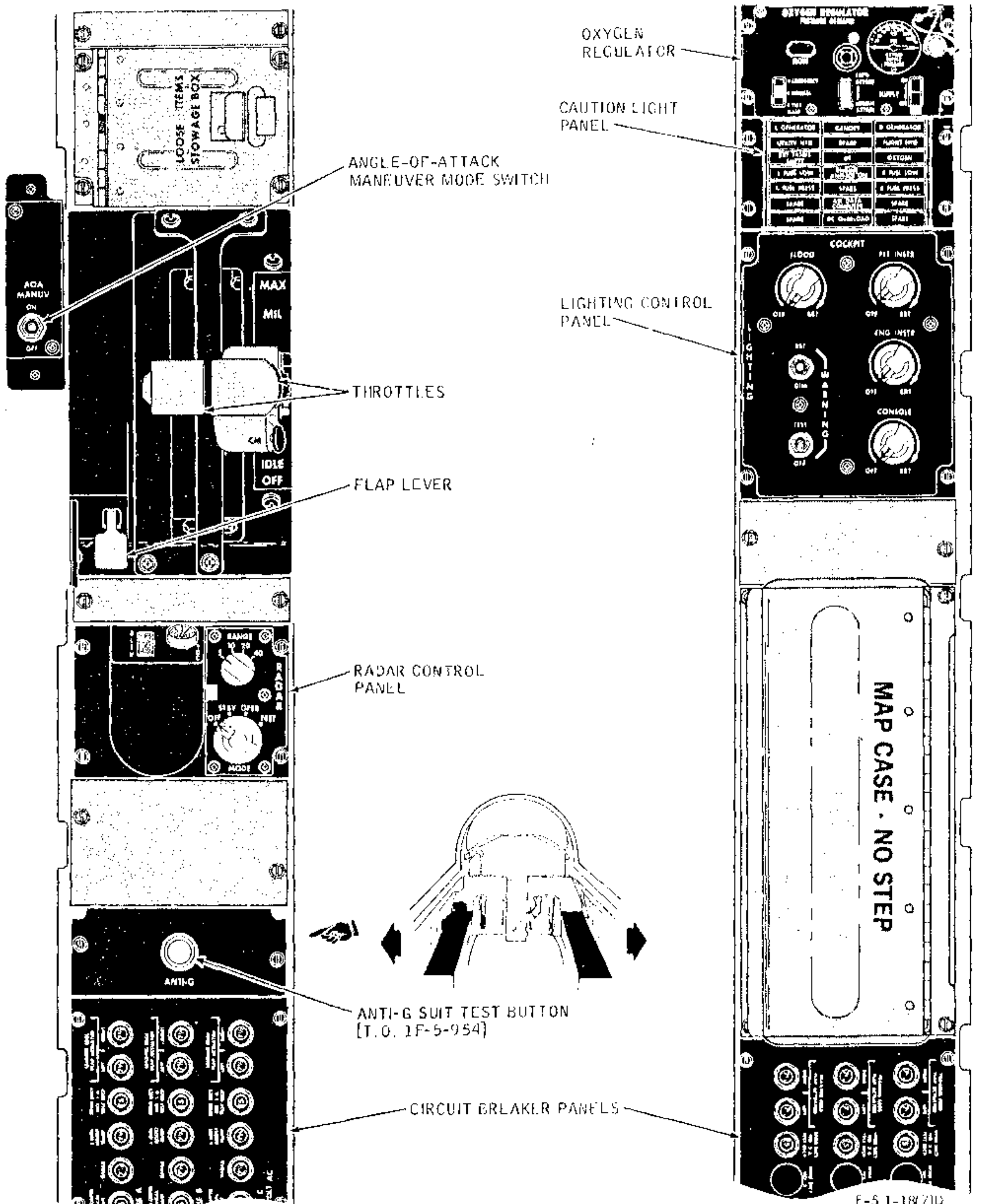
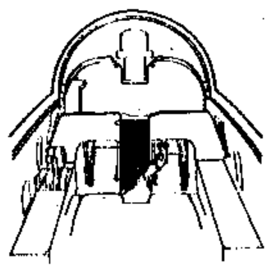


Figure 1-26.

PEDESTAL PANELS (TYPICAL)



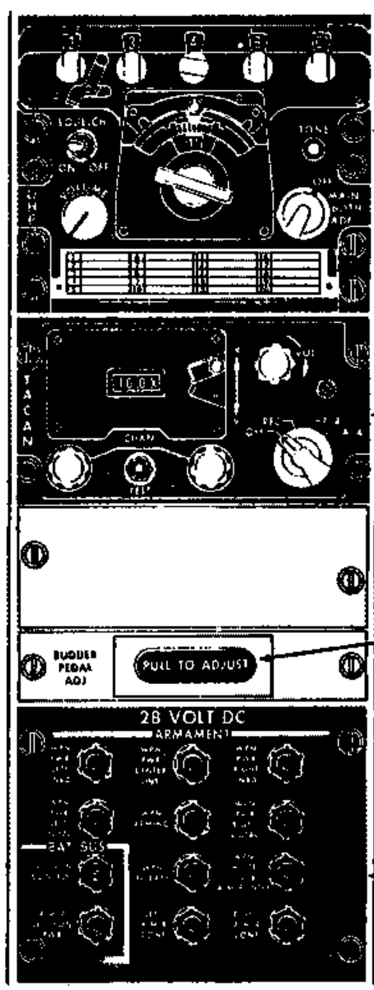


Figure 1-27.

PEDESTAL PANELS (TYPICAL)

F

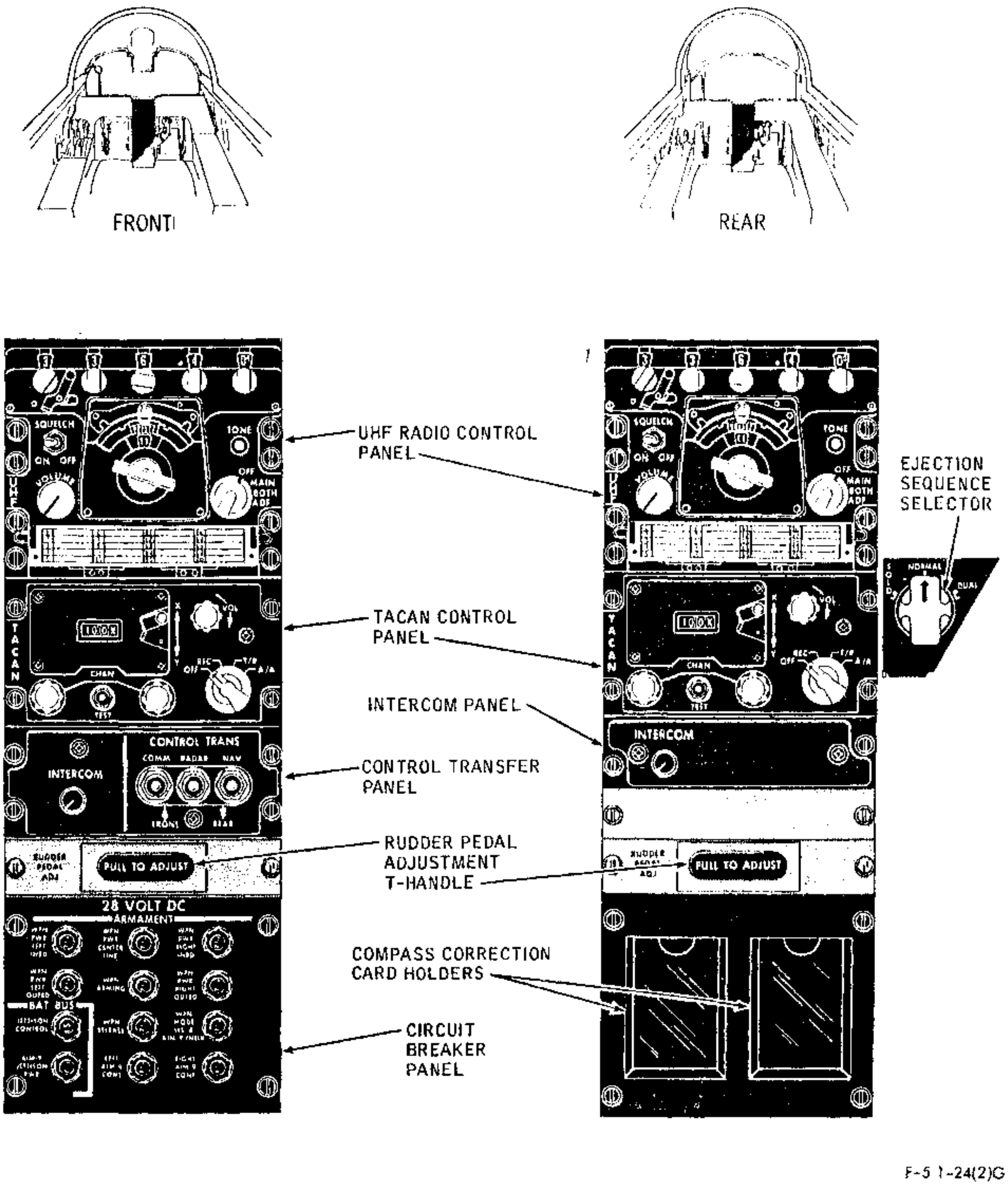


Figure 1-28.

PEDESTAL PANELS

E-1 E-3 F-1 F-2

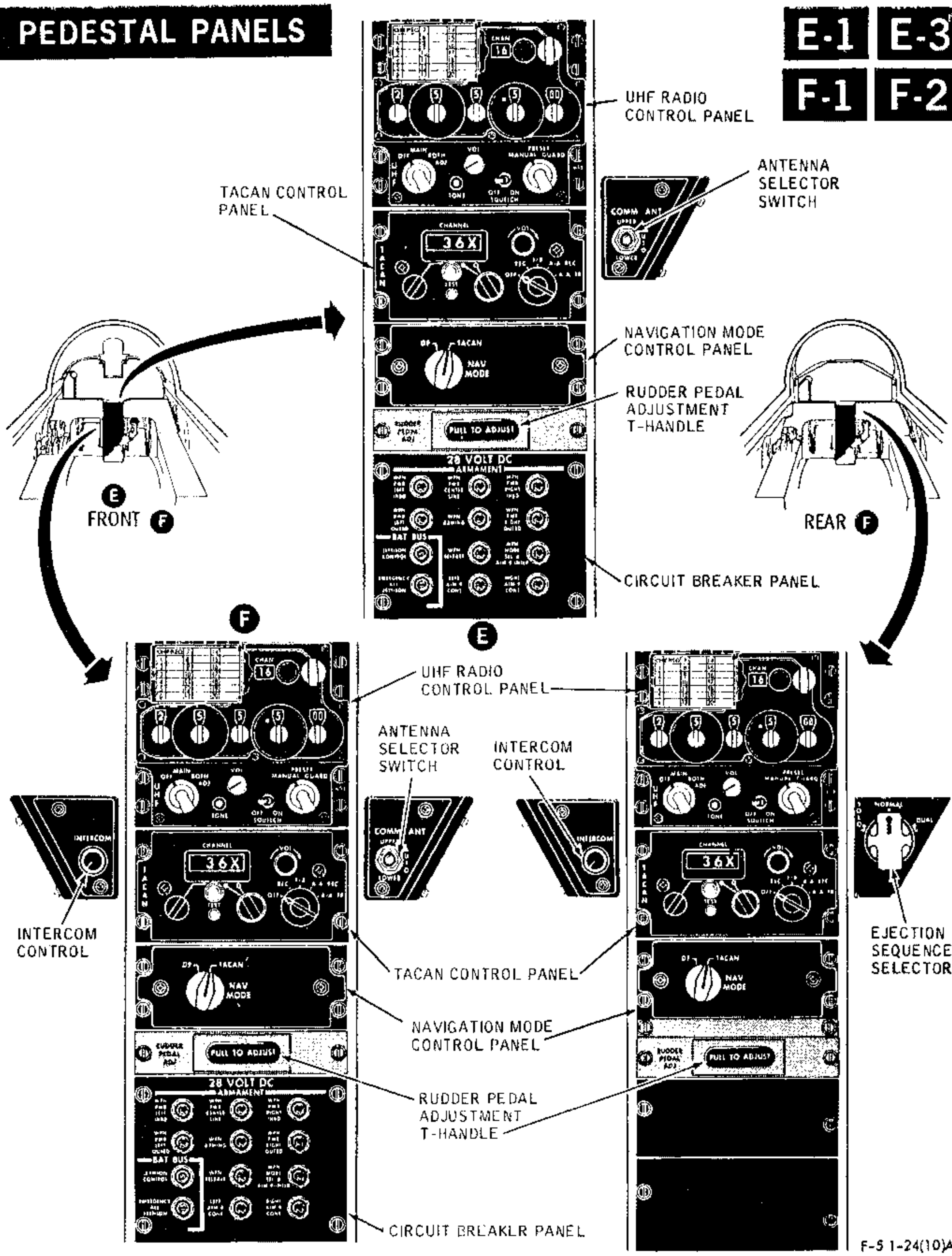


Figure 1-29.

ENGINES

The aircraft is powered by two J85-GE-21 turbojet engines equipped with afterburners (figure 1-30). Sea level, standard day, static thrust at military (MIL) power is 3250 pounds and at maximum afterburner (MAX) power, 4650 pounds. Air to each engine enters thru an air inlet duct on the side of the fuselage and is directed into the engine compressor section by a variable geometry system consisting of inlet guide vanes and variable stator vanes. The variable geometry system reduces the possibility of a compressor stall. Compressor bleed air is used to provide anti-icing to the inlet guide vanes, bullet nose, and T_2 sensor of the engine and pressurization to the radar waveguide, windshield and canopy seals, anti-G suit, and external fuel tanks for transferring fuel. Compressor bleed air also provides windshield and canopy defog, cockpit pressurization, and pressurization and cooling of the aft electrical bay and the forward avionics bay. The nine-stage axial flow compressor is coupled directly to a two-stage turbine. Exhaust gases from the combustor section pass thru the two-stage turbine section and are discharged thru a variable exhaust nozzle. An exhaust gas temperature (EGT) control system electrohydraulically varies the opening of the nozzle to provide overtemperature protection and maintain EGT within allowable limits in MIL and afterburner (AB) power ranges.

AUXILIARY INTAKE DOORS

An auxiliary (aux) intake door on each side of the fuselage above the wing trailing edge provides additional air to the engines for added thrust during takeoff and low-speed flight. The doors are ac powered and automatically and individually controlled by a true mach signal from the central air data computer (CADC). After takeoff, the doors close at approximately mach 0.4 (255±10 KIAS). During descent and landing pattern entry, the doors open at approximately mach 0.375 (235±5 KIAS). An aux intake doors indicator on the instrument panel provides an indication of closed, intermediate, or open position of the doors. During engine start, the auxiliary intake doors open after each individual generator comes on the line.

J85-GE-21 ENGINE

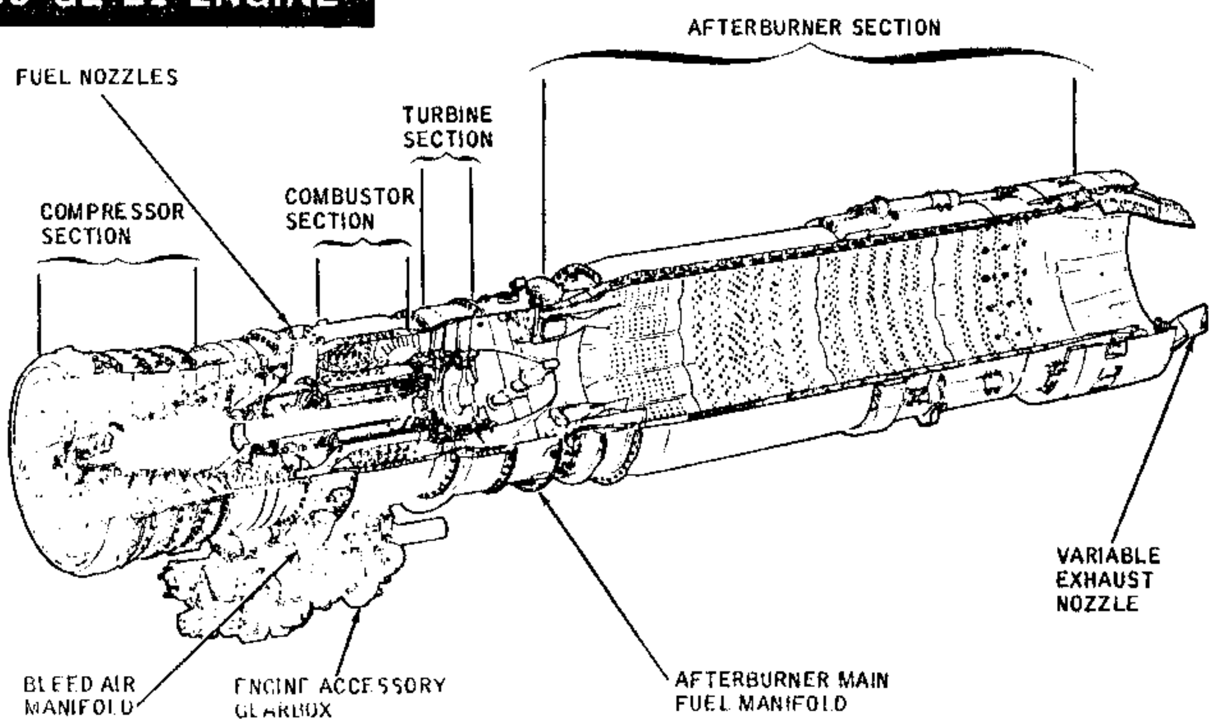


Figure 1-30.

F-5 1-22(1)

Upon loss of ac power, the doors move to closed position as the doors are spring-loaded closed and actuated open.

CAUTION

- Ground operations — If a door or both doors fail to open following engine start, reject the aircraft. If either or both doors fail to open fully during ground operations, the engines are restricted to IDLE or MAX power settings during ground operations to prevent overheating, with occasional transient settings permissible for taxiing. (See section V for limitations.)
- Takeoff — If the doors fail in the close position during takeoff roll, a thrust loss of approximately 7 percent and a corresponding increase in takeoff ground run should be expected. (See appendix I for performance.)
- In Flight — Doors failed in the open position. An increase in fuel consumption of up to 10 percent, depending on flight conditions, may occur, and flight planning should be adjusted accordingly.
- In Flight — Doors failed in the close position. Since this failure is most probable at low altitudes and airspeeds, the most probable effect is upon landing pattern entry and the subsequent pattern, approach, and landing. With this condition, the approximate thrust loss of 7 percent should be kept in mind for possible go-around or missed approach power requirements.
- In Flight — Doors failed in an intermediate position. With this condition, assume the worst case of the inflight failures discussed above and proceed accordingly and as mission requirements dictate.

Normal airstarts can be made with doors failed in the open or intermediate position.

NOTE

Engine demanded airflow at high power settings and low airspeeds will cause reverse airflow through the keel.

THROTTLES

The throttle (figure 1-31) for each engine provides main engine control from OFF to IDLE, IDLE to MIL and afterburner control from minimum to maximum (MAX) afterburner operation. Each throttle controls respective engine fuel supply, fuel shutoff valve, main fuel control throttle angle and stopcock valve, main and afterburner ignition circuitry, engine speed, and afterburner control operation. The left throttle also controls crossbleed start valve circuitry. Fingerlifts on the forward side of each throttle (Ⓕ front cockpit) provide a stop detent at IDLE. Raising the fingerlift permits retarding the throttle from IDLE to OFF. In the IDLE to MIL range, throttle friction is constant. A spring detent between MIL and MIN afterburner must be passed over for afterburner or nonafterburner operation. Afterburner thrust modulation is provided throughout the afterburner range. Throttle friction in the afterburner range is slightly greater than that provided from IDLE to MIL position. Throttle friction is preset and not adjustable by the pilot.

WARNING

To avoid inadvertent engine shutdown while retarding the throttle(s) toward idle, do not rest the extended fingers on the fingerlifts.

IGNITION SYSTEM

The ignition system provides electrical ac power for starting either engine on the ground or during flight. The ignition system for each engine consists of an engine start button, arming circuits, 40-second ignition timer, and main and afterburner igniters. AC power can be provided by an external electrical power unit, aircraft generator power, or aircraft battery powered static inverter. Engine start buttons are provided in both Ⓕ cockpits. With the battery switch OFF, the engine start button ignition circuits are inoperative. With the battery switch at BATT and the throttle at OFF, pushing the engine start button arms the ignition circuit and starts the ignition timer. The

THROTTLE QUADRANT (TYPICAL)

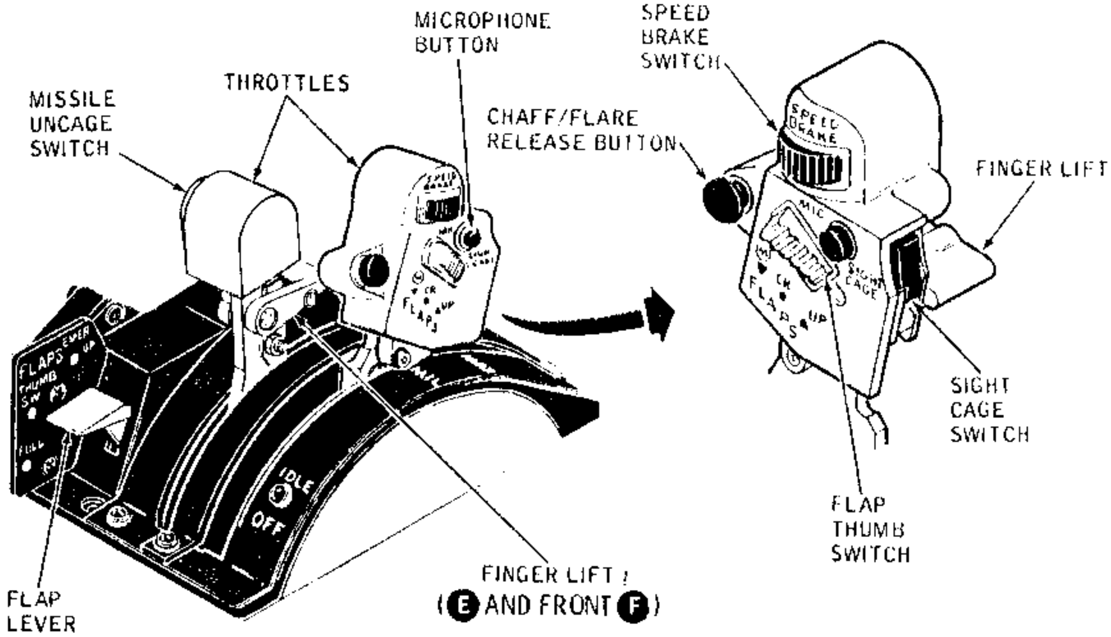


Figure 1-31.

ignition circuit is completed to the main and afterburner igniters when the throttle is positioned at IDLE. When the throttle is advanced from MIL into AB range, (with or without external power) the ignition circuit is completed to the main and afterburner igniters, starting the ignition timer for approximately 40 seconds. Afterburner ignition and timer operation may be discontinued at any time by retarding the throttle out of AB range. For ground starts only, the ignition duty cycle is: 3 attempted starts, 3 minutes off, an additional 3 attempted starts, and 23 minutes off. See figure 1-32 for location and function of engine controls and indicators.

ENGINE FUEL CONTROL SYSTEM

The engine fuel control system (figure 1-33) meters the proper amount of fuel to the engine for optimum performance throughout the engine operating range.

Main Fuel Pump

The engine-driven main fuel pump is a combination boost and high-pressure pump mounted on the engine accessory gearbox. The main fuel pump also provides servo fuel pressure to the afterburner servos and the afterburner shutoff valve.

Main Fuel Control

A hydromechanical main fuel control, consisting of a metering section and a computing section, regulates the fuel flow to the engine and schedules the variable geometry system to maintain operation within limits. Pressurized fuel from the engine-driven fuel pump flows thru the main fuel control to the overspeed governor, the oil coolers, pressurizing and drain valve, and is distributed by the main fuel manifold to the 12 main fuel nozzles.

ENGINE CONTROLS/INDICATORS (TYPICAL)

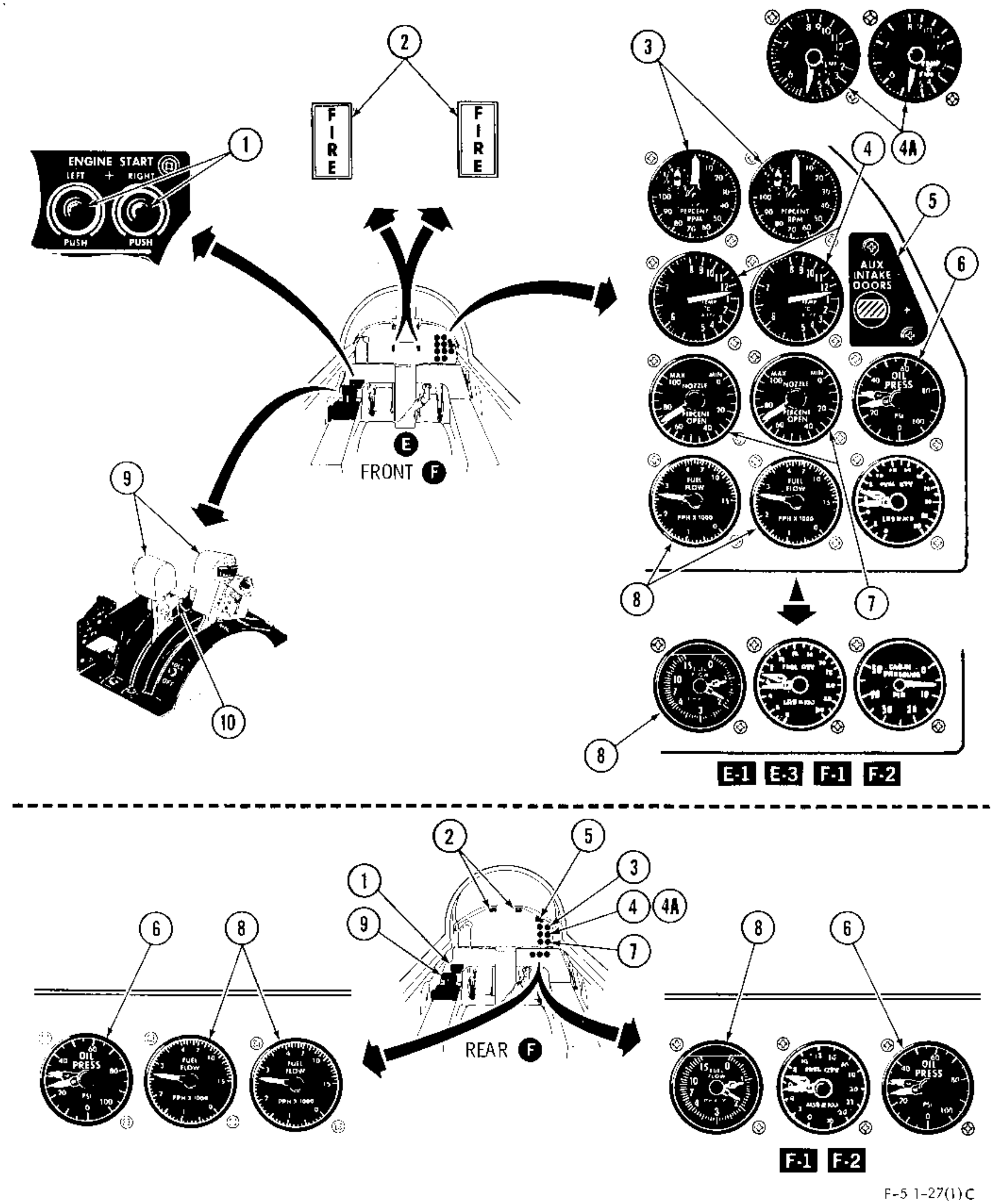


Figure 1-32.

ENGINE CONTROLS/INDICATORS (TYPICAL) (Figure 1-32)

<table>
<tr><th>CONTROLS/INDICATORS</th><th colspan="2">FUNCTION</th></tr>
<tr><td>1 ENGINE START Buttons (LEFT and RIGHT)</td><td>Push</td><td>— Momentarily pushing button for selected engine electrically arms ignition circuit and allows ignition timer to run for approximately 40 seconds. The P3 compressor dump system is deactivated.</td></tr>
<tr><td>2 FIRE Warning Lights (RED) (L&R)</td><td>On</td><td>— (FIRE) Indicates a fire or overheat condition in respective engine compartment. Light remains on until condition is corrected and then goes out. If condition recurs, light comes on again.</td></tr>
<tr><td>3 Engine Tachometers (L&R)</td><td colspan="2">Indicates engine rpm from 0 to 110%.</td></tr>
<tr><td>4 Exhaust Gas Temperature (EGT) Indicators (L&R) (EHU-31/A)</td><td colspan="2">Indicates biased engine EGT in °C.</td></tr>
<tr><td>4A Exhaust Gas Temperature (EGT) Indicators (L&R) (EHU-31A/A)</td><td>ON Legend (EHU-31/A/A)</td><td>— Indicates ac power is available.

NOTE

(EHU-31A/A) It is possible to experience an unrecognized engine lightoff or flameout because this instrument does not indicate below 200°C.</td></tr>
<tr><td>5 AUX INTAKE DOORS Indicator</td><td>CLOSE</td><td>— Indicates both intake doors fully closed.</td></tr>
<tr><td></td><td>OPEN</td><td>— Indicates both intake doors fully open.</td></tr>
<tr><td></td><td>Barber Pole</td><td>a. Indicates one or both intake doors are at intermediate position.
b. Indicates one intake door open, the other intake door closed.
c. Indicates dc power is not available.</td></tr>
<tr><td>6 Oil Pressure Indicator-Dual (L&R Pointers)</td><td colspan="2">Indicates engine oil system pressure in psi.</td></tr>
<tr><td>7 Nozzle Position Indicators (L&R)</td><td colspan="2">Indicates nozzle position in percent of fully open position.</td></tr>
<tr><td>8 FUEL FLOW Indicators (L&R)</td><td colspan="2">Indicates total fuel flow (including afterburner) in PPH to each engine.</td></tr>
</table>

ENGINE CONTROLS/INDICATORS (TYPICAL) (Figure 1-32) (Continued)

CONTROLS/INDICATORS	FUNCTION	
9 Throttles (L&R)	OFF	— Disables ignition circuit to engine; closes engine main fuel control stopcock valve, immediately stopping fuel to the engine at the fuel control; electrically motors the aircraft main fuel shutoff valve closed, stopping aircraft fuel supply upstream of the engine driven fuel pump.
	IDLE	— a. During start, completes engine ignition circuit, opens engine main fuel control stopcock valve, electrically motors aircraft main fuel shutoff valve open. b. Operates engine at IDLE power.
	MIL	— Operates engine at MIL power.
	MAX	— Going from MIL to Max activates ignition circuit to fire main and AB igniters for approximately 40 seconds. Enables AB fuel pump lockout valve to open when RPM and acceleration criteria are met for AB operation. Activates P3 compressor dump system for approximately 16 seconds (if available and at intermediate or high altitude).
10 Fingerlifts (L&R Throttles) (Ⓕ Front Cockpit)	Down	— Prevents movement of throttles from IDLE to OFF position.
(Springloaded Down)	Raised	— Permits movement of throttles from IDLE to OFF position.

Overspeed Governor

The hydromechanical overspeed governor is provided to limit engine speed to a maximum steady state of about 106% rpm if the main fuel control fails.

VARIABLE EXHAUST NOZZLE OPERATION

Variable exhaust nozzle operation is controlled by throttle position and EGT. When the throttle is advanced slowly to MIL, nozzle opening decreases toward 0% until approximately 85% rpm. At this point, the nozzle remains constant at a fixed cruise flat position (16% to 22%) until the throttle is advanced to where the nozzle starts to further close toward 0%. The engine delivers best cruise power performance with minimum fuel consumption when on the cruise flat. When the throttle is advanced beyond the cruise flat toward MIL rpm, the nozzle continues to close until an EGT above 670° ±5° is momentarily reached. The nozzle then opens via the T_5 amplifier control to maintain EGT within limits. This is called T_5 modulation. Just prior to T_5 modulation, the nozzle is still mechanically controlled by the throttle. A throttle setting just prior to T_5 modulation improves fuel consumption rates. When T_5 modulation occurs, the nozzle opens slightly. During a rapid throttle burst from IDLE to MIL or MAX, the nozle closes to 43% to 53%, and stays at that opening momentarily. Nozzle hesitation at this point during acceleration minimizes exhaust back pressure to provide rapid acceleration and to preclude compressor stall. The nozzle then closes to 0% to 3% until T_5 modulation occurs. At high altitude, low airspeed, when a throttle burst from IDLE or cruise to MIL or MAX is made, the nozzle opens toward the 43% to 53% area, then closes to approximately 7% to 12% to minimize rpm rollback and compressor stall prior

ENGINE FUEL CONTROL SYSTEM (TYPICAL)

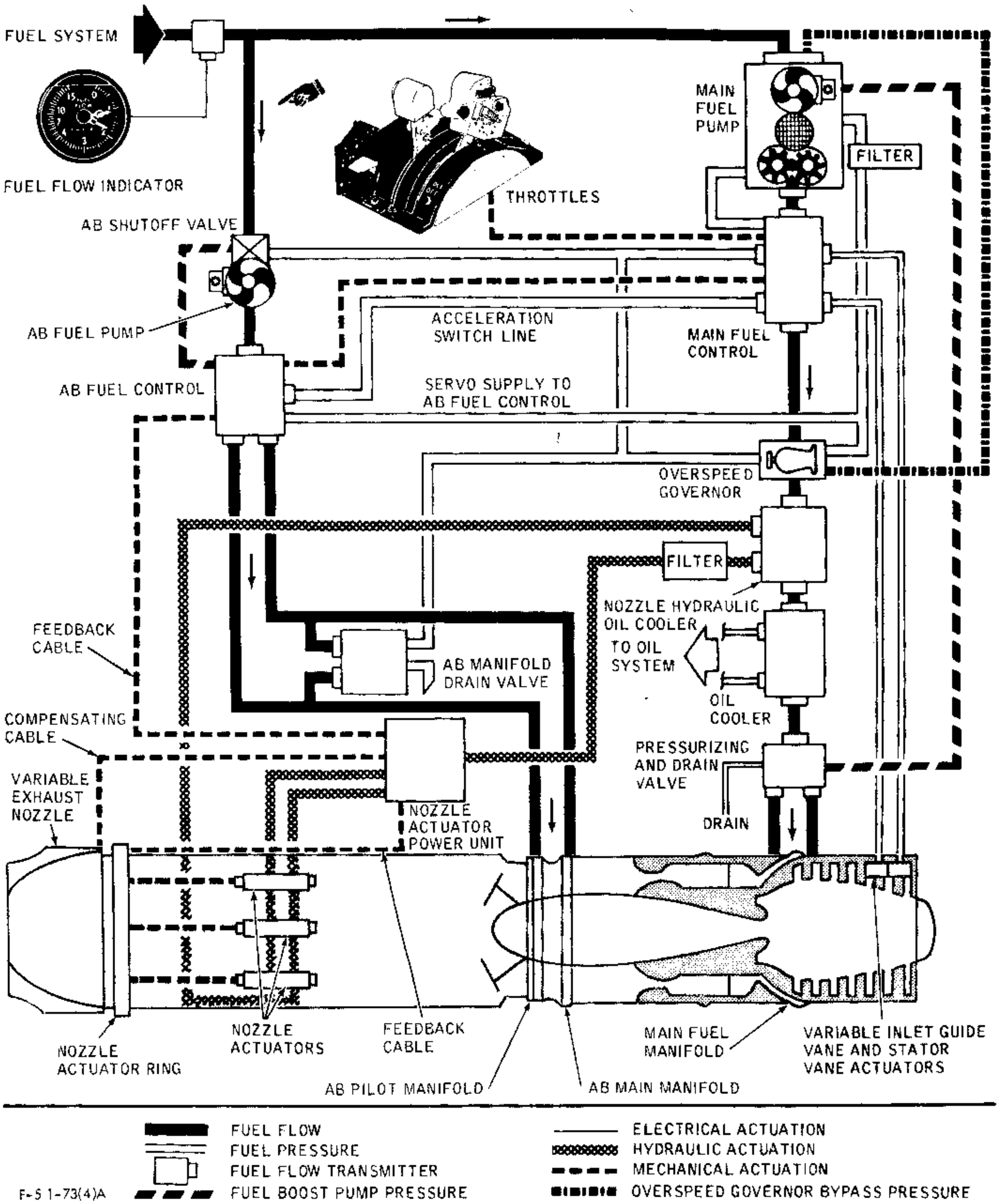


Figure 1-33.

to T_5 modulation. During a throttle burst to AB range at low altitude, the main afterburner fuel flow is delayed by a sequence valve, momentarily causing the nozzle to pause (approximately 6% to 14% above MIL steady-state nozzle position) to allow afterburner pilot fuel to light off first; permitting a softer afterburner lightoff, thus reducing rpm rollback and compressor stall. In the event of engine overtemperature during nozzle modulation, the nozzle opens to approximately 28% to 38% to maintain safe EGT operation. This nozzle position is known as the T_5 lockout area. At high altitudes and low airspeeds, MIL nozzle opening may be larger and EGT lower than observed at low altitudes and high airspeeds. During ground operation at MIL power, nozzle opening should be approximately 10%. As the throttle advances into the AB range, opening should approximate 25% to 50% in minimum afterburner, increasing to approximately 80% at maximum afterburner. Nozzle indication of 75% or higher indicates a fullopen nozzle (nozzle-limited) condition. Under this condition, fuel flow to the affected engine is reduced to maintain EGT within limits. If the T_5 amplifier fails during MIL or AB power, retard the throttle to maintain EGT within limits if flight conditions permit.

T_5 AMPLIFIER SYSTEM

The T_5 amplifier system maintains a preset turbine discharge EGT within allowable limits during MIL and AB power operation by varying the exhaust nozzle opening. Operation is automatic with ac power supplied by the engine tachometer generator. If EGT is higher than the reference temperature, the amplifier causes the nozzle to open; if lower, the nozzle closes. The system operates primarily in MIL and AB power ranges.

Engine Inlet Temperature

The T_2 sensor and the T_2 resistance-temperature-detector are two engine components that indirectly control MIL/AB rpm and EGT. The T_2 sensor in the main fuel control repositions the three-dimensional cam to schedule rpm, variable geometry system, and set the proper acceleration fuel flow schedule during throttle transients throughout the operational envelope. T_2 temperature controls MIL/AB rpm. For example, as airspeed increases, T_2 temperature increases and MIL/AB rpm increases. When T_2 temperature decreases, as in a sustained climb, MIL/AB rpm also decreases. With T_2 temperature of -43°C and below, MIL/AB rpm may be as low as 90%. The T_2 resistance-temperature-detector biases the T_5 amplifier at cold engine inlet temperatures to cut back fuel flow and corresponding EGT to prevent compressor and turbine stresses.

AFTERBURNER SYSTEM

Afterburner operation is initiated by advancing the throttle from MIL to AB range. Afterburner lightoff on ground should occur within approximately 5 seconds.

Afterburner Fuel Pump and Shutoff Valve

The engine-driven afterburner fuel pump is a single-stage centrifugal pump. The pump supplies fuel to the afterburner fuel control during afterburner operation. The afterburner shutoff valve, actuated by fuel pressure from the main fuel control, prevents fuel supply to the afterburner fuel pump inlet until the throttle is positioned in the afterburner range and the engine is operating at nearly military rpm.

Afterburner Fuel Control

The hydromechanical afterburner fuel control contains a fuel metering section, a computing section, and a nozzle control section. Fuel is scheduled to the afterburner main manifold spraybars as a function of throttle position, compressor discharge pressure, and nozzle position, and to the pilot manifold spraybars as a function of compressor discharge pressure only.

ENGINE OIL SYSTEM

Each engine has an independent, self-contained oil supply and lubrication system with a serviceable capacity of 4 quarts. The system consists of an oil reservoir, a lubricating and scavenging six-element pump, oil filter and bypass, and an oil cooler (oil-to-fuel heat exchanger) with a pressure-controlled bypass valve. Oil is pumped from the reservoir and delivered under pressure thru the oil cooler and the oil filter to the engine accessory drive gearbox, main bearings, and other internal moving parts. Oil is returned to the reservoir thru the scavenging system. A sump vent system maintains a positive pressure, making the lubrication system insensitive to altitude. Large oil pressure fluctuations and zero oil pressure may occur during maneuvering flight. (See section V, Operating Limitations.)

FIRE WARNING AND DETECTION SYSTEM

The fire warning and detection system provides a visual indication of a fire or an overheat condition in either engine compartment. When the system detects a fire or overheat condition, the fire warning light for the respective engine comes on. There are two bulbs in each fire warning light. For test purposes only, each bulb is connected to a different fire detection sensing loop. Any fire or overheat condition in either engine compartment will illuminate both bulbs in the respective fire warning light.

AIRFRAME-MOUNTED GEARBOX

An airframe-mounted gearbox is located forward and below each engine. Each engine-driven gearbox operates a hydraulic pump and an ac generator. Automatic gearbox shift occurs in the 68% to 72% engine rpm range.

ENGINE OPERATION

Ground Start

Starting the left engine requires an external low-pressure air source for initial motoring of the engine. After starting the first engine, the other engine is started by using the same external air source directed by a manually operated diverter valve. With external ac power applied, battery switch in BATT position, and the engine motoring at 10% rpm or above, momentarily pushing the start button arms the ac-powered ignition circuit and permits the ignition timer to run for approximately 40 seconds. The ignition circuit to the main and afterburner igniters is completed and fuel flow starts to the engine when the throttle is advanced to IDLE. Without external ac power and the battery switch at BATT, a battery-powered static inverter activates to provide ac power for engine start when the start button is pushed. For battery start, the left engine should be started first as the static inverter supplies ac power to the left engine instruments during the start cycle. After one engine has been started and the generator is on the line, the static inverter is automatically disconnected.

Crossbleed Start

A crossbleed start capability without external air is provided for starting the right engine after the left engine has been started. Compressed air from the ninth stage of the left engine compressor section is used for initial motoring of the right engine. A crossbleed control valve installed as part of the left engine compressor ducting system is alerted for activation when the left engine throttle is advanced above 70% rpm. Actuation of the right engine start button opens the crossbleed control valve, permitting air to flow from the left to the right engine. The right engine ignition circuit is then completed by moving the right throttle from OFF to IDLE position. In order to ensure an adequate flow of air for starting, the left engine should be operating at approximately 95% rpm. The crossbleed control valve closes and power is removed from the valve-open circuit any time the left throttle is below approximately 70% rpm, the aircraft is airborne, or approximately 40 seconds after the right engine start button has been actuated.

Airstart

If the throttle is at OFF, the airstart is accomplished by pushing the engine start button and advancing the throttle to IDLE, the same as for ground starts. If the throttle is in the IDLE to MIL range, alternate airstart is accomplished by advancing the throttle into AB range. This activates the engine ignition circuits to the main and afterburner igniters, allows the ignition timer to run for approximately 40 seconds and enables the P3 compressor dump system. If the throttle is in AB range, the throttle must be cycled to MIL and returned to AB range to activate the ignition circuits and timer; or a start may be obtained with throttle in AB range by pushing and holding engine start button until lightoff occurs. The battery switch must be at BATT to activate the static inverter when the engine start button is pushed to complete engine start. With no ac power, the battery switch must be at BATT to provide ignition when throttle is moved into AB range.

COMPRESSOR STALL

A compressor stall is an aerodynamic interruption of airflow thru the compressor. The stall sensitivity of an engine is increased by foreign object damage, high angles of attack at low airspeeds and high altitudes, abrupt yaw impulses at low airspeeds (below approximately 150 KIAS), temperature distortion, engine anti-ice system in operation, and ice formation on the engine inlet ducts or inlet guide vanes. (See discussion in section VII, Adverse Weather Procedures.) Compressor stalls can also be caused by component malfunctions; engine rigged out of limits; throttle bursts to MIL or MAX power at high altitude and low airspeed; hot gas ingestion from other aircraft or during gun firing at high altitudes and negative g conditions; and maneuvering flight with landing gear down at altitudes above 30,000 feet. Variable inlet guide vanes and variable stators have been installed in the engine to reduce the possibility of compressor stall. Operation is automatic as a function of engine rpm and inlet temperature. A P_3 compressor dump system activates for approximately 16 seconds to reduce the possibility of compressor stall when a throttle is burst to AB range at intermediate or high altitudes; however, installed engines must also be modified with a connecting P_3 dump system. During sustained maneuvering without throttle movement, increased stall margin can be obtained by positioning the throttle at 85% to 95% rpm.

FLAMEOUT

Flameout may be caused by component malfunctions, compressor stall, fuel starvation, fuel contamination (water), fuel icing, engine inlet guide vane icing (see section VII) and by throttle transients outside the normal flight envelope. Improper recovery from an unusual attitude such as a high pitch attitude stall (see section VI) can produce an abrupt yaw at low airspeed, causing compressor stall and flameout.

FUEL SYSTEM

The fuel system (figure 1-34) consists of three bladder-type fuel cells in the fuselage divided into two independent systems. With the exception of some modified aircraft, each cell contains a network of explosion and fire suppressant foam material. The forward cell supplies fuel to the left engine; the center and aft cells supply the right engine. Either system can supply fuel to both engines. Additional fuel may be carried in jettisonable external tanks. Fuel is transferred from external tanks to the internal systems thru the single-point manifold by air pressure supplied by the compressor ninth stage of each engine. Each internal system contains an individually controlled fuel boost pump, a fuel shutoff valve controlled by either the throttle or a shutoff switch, a fuel flow indicator, and low fuel and pressure caution lights. A dual-pointer fuel quantity indicator serves both internal systems. Fuel quantity and fuel flow indications are provided in both Ⓕ cockpits. The internal system contains a 2-way semi-automatic fuel crossfeed balancing system controlled by the autobalance switch. A crossfeed switch and left and right fuel boost pump switches (Ⓕ front cockpit) are provided to manually control crossfeed operation. The internal system contains a common vent to vent fuel vapors overboard at the vertical stabilizer trailing edge just above the rudder. Control of external fuel transfer to internal system is provided by external fuel transfer switches (Ⓕ front cockpit). An external tanks empty caution light (Ⓕ both cockpits) indicates that selected external tanks are empty.

FUEL SYSTEM INDICATOR LIGHTS Ⓕ

Rear cockpit fuel system indicator lights provide indication of external fuel, boost pump, and crossfeed switch positioning. With fuel system in autobalance operation, the indicator lights indicate left or right boost pump off and crossfeed on.

FUEL BOOST PUMPS

Two ac-powered dual-inlet fuel boost pumps provide fuel under pressure to the engine-driven main fuel pump, and during afterburner operation, to the engine-driven afterburner fuel pump. The left system boost pump is in the inverted flight compartment of the forward fuel cell; the right system boost pump is in the inverted flight compartment of

FUEL SYSTEM (TYPICAL)

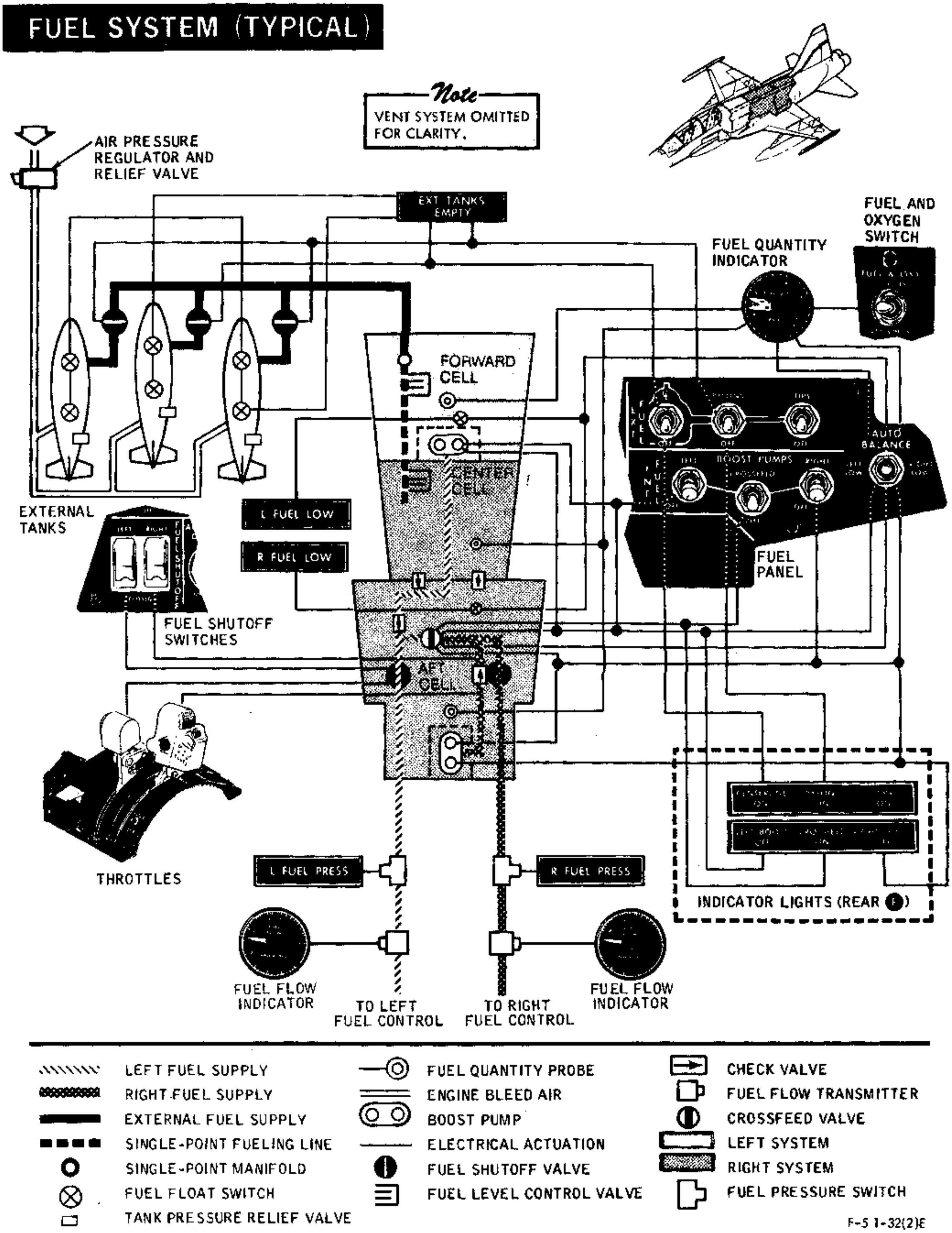


Figure 1-34.

the aft fuel cell. Either boost pump is capable of supplying sufficient fuel to both engines throughout the IDLE to MAX power range with the fuel system in crossfeed operation. If both boost pumps are inoperative, sufficient fuel flows by gravity to maintain maximum afterburner power from sea level to 6000 feet. Sufficient fuel may flow by gravity to maintain maximum afterburner power to 25,000 feet. Reduced power and flight at the lowest practical altitude for terrain clearance and emergency requirements further assure continued stable engine operation with boost pumps inoperative. With both boost pumps off or inoperative, crossfeed is not available and less usable fuel is available due to location of the gravity feed fuel inlet in each system.

FUEL FLOAT SWITCHES

A low-level volume-sensing float switch in each internal fuel system closes when the fuel level drops to approximately 350 to 400 pounds, dependent upon switch positioning, indicating system tolerances, and fuel density. A 10-second time delay relay is energized when the float switch closes. If fuel quantity level does not increase and open the float switch, the respective fuel low caution light comes on and the autobalance holding solenoid for the opposite system is deactivated. For example, when the autobalance switch is at the left low position and the float switch in the right system closes, the autobalance switch returns to the center position.

FUELS

Each engine is adjusted prior to installation to provide proper airstart minimum fuel flow and density settings for the primary fuel. See figure 1-81, Servicing Diagram, for listing of primary, alternate, and emergency fuels. See section III for airstart envelopes to be used with primary and alternate fuels and section V for limitations when using alternate or emergency fuels.

FUEL QUANTITY

Fuel quantity data for the internal and external fuel systems are shown in figure 1-35. Quantities listed for 275-gallon external tanks are shown as minimum capacities for tank manufacture variances or restricted capacity refueling procedure. Actual total weight of fuel depends on the specific gravity of the fuel.

External 275-Gallon Tank Capacity Differences

Internal differences in 275-gallon type external fuel tanks can cause fuel capacity to vary. Tank differences are caused by procurement from different manufacturing sources, internal modifications, or procedural restrictions for refueling certain tank configurations. Mixed tank configurations are possible throughout the inventory; therefore, actual total usable fuel quantity for each aircraft should be verified before flight.

FUEL SYSTEM MANAGEMENT

Fuel balancing is required on each flight because the right (AFT) system has a greater fuel capacity than the left (FWD) system (see figure 1-35 for fuel quantity data) and because the engines may use fuel at different rates causing unequal fuel quantities. During flight, check indicated fuel quantities against known or expected quantities at preplanned flight stages and check fuel quantity gages for proper operation with the FUEL & OXY switch (see figure 1-36 for location and function of controls and indicators). If a malfunctioning indicator is suspected or discovered, fuel quantity can be estimated by using available information such as opposite system quantity or by using fuel consumption vs time. With indicator malfunction do not select manual crossfeed operation to avoid possible dual engine flameout caused by fuel starvation.

Autobalance Operation

Autobalance operation is initiated by pulling the autobalance switch out of detent and positioning it to the left or right low position corresponding to the internal system with the lower fuel quantity. The switch is held at the selected position by a holding solenoid. Selecting the left low position opens the crossfeed valve and reverses rotation of the left boost pump to permit fuel feeding from the right system to both engines. Selecting right low position opens the crossfeed valve and turns off the right boost pump to permit fuel feeding from left system

FUEL QUANTITY DATA

DATA BASIS

- CAPACITIES CALIBRATED FOR STANDARD DAY CONDITION.
- SINGLE-POINT REFUELING — LEVEL RAMP ATTITUDE.
- FUEL DENSITY:
  - JP-4 — 6.5 LB/US GAL
  - JET A-1 OR JP-8 — 6.7 LB/US GAL
  - JP-5 — 6.8 LB/US GAL

		FULLY SERVICED				USABLE			
		GAL	POUNDS JP-4	POUNDS JET A-1 JP-8	POUNDS JP-5	GAL	POUNDS JP-4	POUNDS JET A-1 JP-8	POUNDS JP-5
	INTERNAL FUEL								
	TOTAL (BOTH SYSTEMS)	698	4537	4676	4746	677	4400	4536	4604
	LEFT (FWD) SYSTEM	306	1989	2050	2081	296	1924	1983	2013
	RIGHT (AFT) SYSTEM	392	2548	2626	2666	381	2477	2553	2591
	INTERNAL FUEL	[T.O. 1F-5-921]							
	TOTAL (BOTH SYSTEMS)	715	4647	4790	4862	694	4511	4650	4719
	LEFT (FWD) SYSTEM	313	2034	2097	2128	303	1970	2030	2060
	RIGHT (AFT) SYSTEM	402	2613	2693	2734	391	2541	2620	2659
	EXTERNAL FUEL								
275-GAL TANKS	CL W/275 GALS	275	1788	1843	1870	273	1775	1829	1856
275-GAL TANKS	2 INBDS, EACH W/275 GALS	550	3575	3685	3740	546	3549	3658	3713
275-GAL TANKS	CL W/260 GALS	262	1703	1755	1782	260	1690	1742	1768
275-GAL TANKS	2 INBDS, EACH W/260 GALS	524	3406	3511	3563	520	3380	3484	3536
150-GAL TANKS	CL W/150 GALS	152	988	1018	1034	150	975	1005	1020
150-GAL TANKS	2 INBDS, EACH W/150 GALS	304	1976	2037	2067	300	1950	2010	2040
	MAXIMUM FUEL								
275-GAL TANKS	INTERNAL & 3 EXTERNAL TANKS, EACH W/275 GALS	1523	9900	10,204	10,356	1496	9724	10,023	10,173
275-GAL TANKS	INTERNAL & 3 EXTERNAL TANKS, EACH W/260 GALS	1484	9646	9942	10,091	1457	9470	9762	9908
150-GAL TANKS	INTERNAL & 3 EXTERNAL TANKS, EACH W/150 GALS	1154	7501	7731	7847	1127	7325	7551	7664
	MAXIMUM FUEL	[T.O. 1F-5-921]							
275-GAL TANKS	INTERNAL & 3 EXTERNAL TANKS, EACH W/275 GALS	1540	10,010	10,318	10,472	1513	9834	10,137	10,288
275-GAL TANKS	INTERNAL & 3 EXTERNAL TANKS, EACH W/260 GALS	1501	9756	10,056	10,207	1474	9581	9875	10,023
150-GAL TANKS	INTERNAL & 3 EXTERNAL TANKS, EACH W/150 GALS	1171	7611	7845	7963	1144	7436	7664	7779

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Figure 1-35.

FUEL SYSTEM CONTROLS / INDICATORS (TYPICAL)

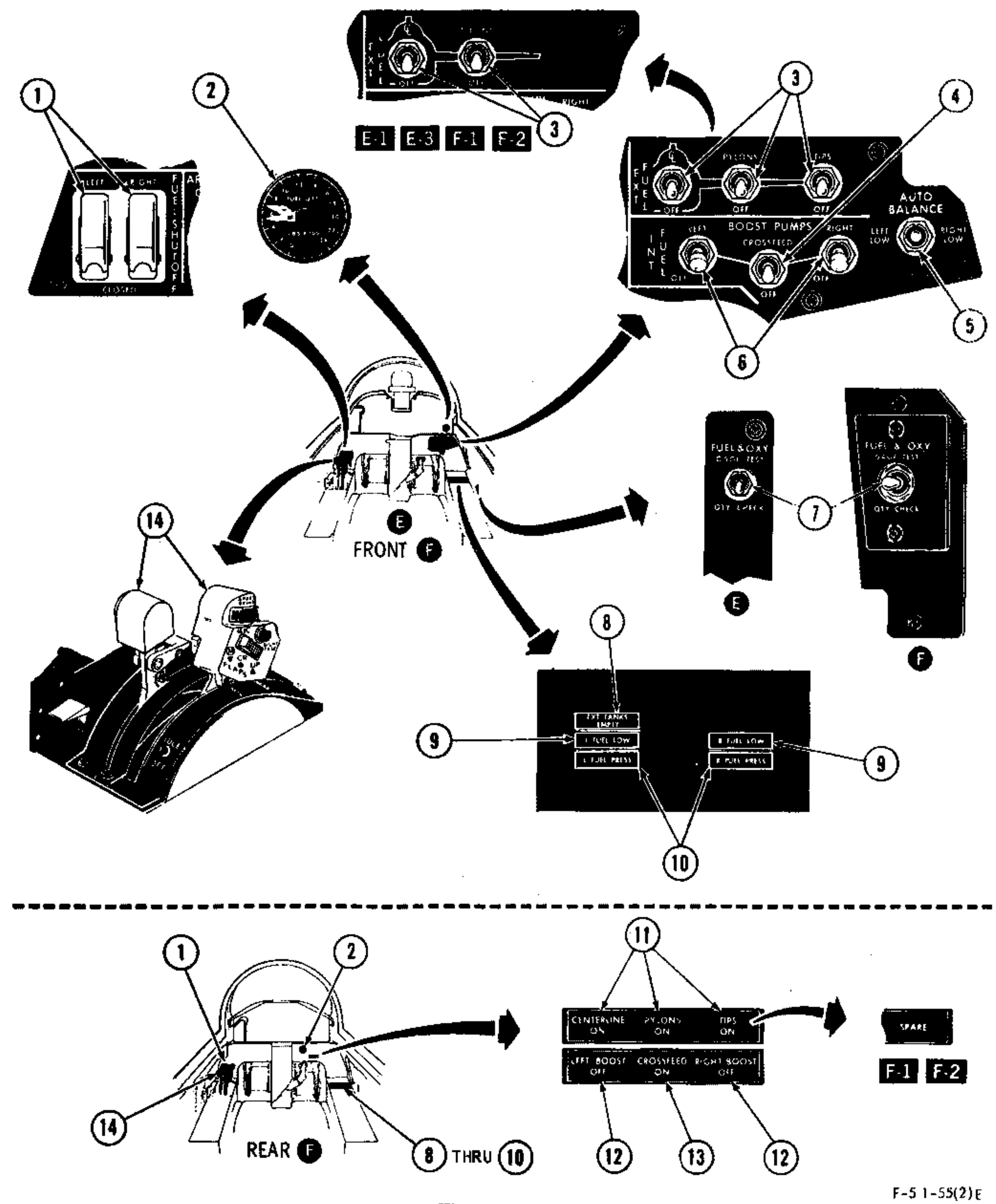


Figure 1-36.

FUEL SYSTEM CONTROLS/INDICATORS (TYPICAL) (Figure 1-36)

CONTROLS/INDICATORS	FUNCTION	
1 FUEL SHUTOFF Switches (L&R) (Guarded)	CLOSED	— (Guard Open) Shuts off fuel to engine by closing corresponding fuel shutoff valve, regardless of throttle position. Ⓕ Rear cockpit switch is inoperative when front cockpit switch is at CLOSED. CAUTION The switch(es) should be used only in an emergency, as damage to the engine driven fuel pumps and main fuel control may occur.
	LEFT/ RIGHT	— (Guard Closed) Fuel shutoff valves controlled by throttle.
2 FUEL QUANTITY Indicator (L&R Pointers)	Indication	— Each pointer indicates pounds of usable fuel in respective internal fuel system. Also centers autobalance switch when pointers aligned within 50 to 125 pounds, when autobalance is used. Capacitance type ac-operated. **NOTE** With JET A-1, JP-8, or JP-5 fuel, clockwise rotation of the right fuel quantity pointer may occur during takeoff and inflight while transferring external fuel. This is caused by a high density cold fuel condition when the right internal fuel system is filled beyond the indicating capability. Rotation will stop when the right system capacity reduces to capability of indicator.
3 EXT FUEL Transfer Switches (Ⓕ Front Cockpit)	OFF	— Closes fuel shutoff valve(s) in pylon(s).
	CL & PYLONS	— Opens fuel shutoff valve(s) in pylon(s) for transfer of fuel to internal system.
	TIP	— (Switch not used.)

FUEL SYSTEM CONTROLS/INDICATORS (TYPICAL) (Figure 1-36) (Continued)

CONTROLS/INDICATORS	FUNCTION	
4 CROSSFEED Switch (Ⓕ Front Cockpit)	OFF	— Closes crossfeed valve.
	CROSS-FEED	— Opens crossfeed valve to provide one of the following: a. Fuel supply to both engines from one boost pump. b. Fuel supply to one engine from both boost pumps. c. Gravity fuel flow from both internal systems to one engine if both boost pumps inoperative. d. Shuts off autobalance system and discontinues automatic crossfeed, if selected.
5 AUTO BALANCE Switch (Springloaded to Detented Center Position) (Ⓕ Front Cockpit)	Center (Off)	— Crossfeed valve closed.
	L (LEFT) LOW	— Opens crossfeed valve and reverses rotation of left boost pump to provide fuel feeding from right internal system. Turns on Ⓕ rear cockpit CROSSFEED ON and LEFT BOOST OFF lights.
	R (RIGHT) LOW	— Opens crossfeed valve and turns off right boost pump to provide fuel feeding from left internal system. Turns on Ⓕ rear cockpit CROSSFEED ON and RIGHT BOOST OFF lights.
6 BOOST PUMP Switches (L&R) (Ⓕ Front Cockpit)	OFF	— Turns off boost pump. Pull out and push down.
	LEFT/ RIGHT	— Turns on boost pump.
7 FUEL & OXY Switch (Springloaded to center) (Ⓕ Front Cockpit)	GAGE TEST	— Fuel and oxygen quantity indicator pointers rotate counterclockwise toward zero. (Pointer rotation provides operational check of static inverter on ground or during flight, and oxygen caution light illuminates when pointer reaches 0.5 liter.)
	QTY CHECK	— Indicates total internal fuel and oxygen quantities.

FUEL SYSTEM CONTROLS/INDICATORS (TYPICAL) (Figure 1-36) (Continued)

CONTROLS/INDICATORS		FUNCTION
8 EXT TANKS EMPTY Caution Light	On	— Fuel transfer from external tanks group completed (CL or both wing inboard tanks). Placing EXT FUEL transfer switch(es) at OFF turns light out. **NOTE** If carrying only one inboard fuel tank, the light does not illuminate when external transfer is complete.
9 L and R FUEL LOW Caution Lights	On	— Fuel remaining in respective internal system is approximately 350 to 400 pounds or less for longer than 10 seconds or aircraft is placed in negative-G condition for 10 seconds or longer.
10 L and R FUEL PRESS Caution Lights	On	— Low-pressure warning indicates a pressure of 6.5 psi or less.
11 Ⓕ CENTERLINE, PYLON, TIPS Indicator Lights (Rear Cockpit) (GREEN)	On	— Respective external fuel transfer switch(es) in the front cockpit are on (up).
12 Ⓕ LEFT BOOST OFF & RIGHT BOOST OFF Indicator Light (Rear Cockpit) (YELLOW)	On	— Respective boost pump switch in front cockpit is at OFF position, or AUTOBALANCE switch is at LEFT LOW or RIGHT LOW.
13 Ⓕ CROSSFEED ON Indicator Light (Rear Cockpit) (YELLOW)	On	— Crossfeed switch in front cockpit is at CROSSFEED position, or autobalance crossfeed system has opened crossfeed valve.
14 Throttles (L&R)	OFF	— Shuts off fuel by closing fuel shutoff valve.
	IDLE	— Provides fuel by opening fuel shutoff valve.
	MIL	— Operates engine at military power.
	MAX	— Operates engine at maximum power.

to both engines. Autobalance operation ceases when: (1) fuel quantity indicator pointers are within 50 to 125 pounds; (2) the low level float switch in the system supplying fuel closes for longer than 10 seconds, or; (3) the crossfeed switch is positioned to CROSSFEED. When autobalance operation ceases, the holding solenoid is deenergized, allowing the autobalance switch to return to center, the low system boost pump resumes normal operation, and the crossfeed valve automatically closes (unless the crossfeed switch has been positioned to CROSSFEED). Maneuvering flight may produce fuel sloshing sufficient to affect fuel quantity indicator pointers and low level float switches and could cease autobalance operation prematurely. When using JP-5 fuel, right hand quantity pointer rotates constantly with full internal fuel. Autobalance should be delayed until sufficient fuel is used from right system to achieve stabilized indication. Autobalance operation functions normally with only one engine running (ac power available and both boost pumps operating).

NOTE

- Crossfeed switch must be at OFF and boost pump switches at LEFT and RIGHT for autobalancing to function.
- Intentional zero- or negative-g conditions should be avoided during crossfeed or gravity feed operation due to the probability of uncovering one or both boost pump inlets and the possibility of engine flameout due to fuel starvation.

Manual Crossfeed Operation (Manual Balancing)

Manual crossfeed is accomplished by turning the crossfeed switch on to open the crossfeed valve and turning off the boost pump switch of the system with the lower fuel quantity. When the fuel quantities of both systems indicate within 100 pounds of each other, the boost pump switch that is off should be turned on. After the pump has operated for a minimum of 2 minutes, turn the crossfeed switch OFF. If the switches are not repositioned after the systems indicate balanced, the systems become unbalanced in the opposite direction.

Low Fuel Operation

If an internal fuel system has less than 650 pounds of fuel, the quantity of fuel falls below the fuel boost pump upper-inlet and the boost pump output is reduced approximately 40%. During crossfeed operation, if the engines are operated at power settings requiring a fuel flow of 6000 pounds per engine per hour or greater, the low pressure light may come on and engine rpm fluctuations may occur because of insufficient fuel pressure. If the fuel is below approximately 400 pounds in either system, do not attempt to ensure fuel flow to both engines by selecting crossfeed operation with both fuel boost pumps operating. If the fuel supply in one system is depleted, or is pulled away from the boost pump by g-forces and the boost pump in the other system fails, air may be supplied to engines causing dual engine flameout. There is no cockpit indication of boost pump failure. With both fuel systems below approximately 400 pounds, autobalance operation is not available.

Single Engine Operation

Autobalance operation should be used to maintain fuel balanced until approximately 400 pounds remain in each system (800 pounds total). Then, with both boost pumps operating, place the crossfeed switch to CROSSFEED and allow the engine to be fed from both systems simultaneously.

External Fuel Sequencing

When external tanks are carried, use inboard tanks first, centerline tank next, and internal fuel last. During ground operation, delay or stop transfer of external fuel when either the left system indicates 1700 pounds or more, or right system indicates 2300 pounds or more. When inboard tanks are empty (indicated when EXT TANKS EMPTY caution light comes on), check fuel quantity indicator for a decrease in quantity to assure that inboard tanks are empty. To transfer centerline tank fuel, turn off PYLONS fuel transfer switch and turn on CL fuel transfer switch. Failure to turn off the fuel transfer switch when inboard tanks are empty prevents EXT TANKS EMPTY light from indicating when the centerline tank is empty. The light remains on until the switch is turned off.

NOTE

Fuel balancing should be delayed until external fuel transfer is complete.

Fuel Venting

Fuel may vent overboard if fuel level shutoff valves in the internal system fail while transferring fuel from external tanks.

WARNING

Fuel venting during ground operation is a fire hazard.

If fuel venting occurs on ground or in flight, discontinue fuel transfer from external tank until fuel quantity indicator indicates less than total capacity. If in a climb, level aircraft and do not climb to a higher altitude until internal fuel quantities have been reduced.

JETTISON SYSTEM

The jettison system provides selective or salvo jettison of pylon carried stores and selective jettison of wingtip stores. On later aircraft (E-1, E-3, F-1, F-2) the system is powered by the battery or when ac power is available, by the transformer rectifiers thru the 28 vdc bus. On earlier aircraft (E, E-2, F) the system is powered by the battery only; however, a one shot thermal battery emergency jettison system provides backup power. Controls consist of an emergency all jettison button, and a select jettison switch and button. The earlier aircraft are additionally equipped with an external stores jettison T-handle in lieu of the 28-vdc power capability. Armament position selector switches are also used for selective jettison. Stores and pylons (if jettisonable) may be jettisoned on the ground or in flight regardless of battery switch or landing gear position. See figure 1-37 for system schematic and location of controls. See section V for jettison limits.

STORES SALVO-JETTISON

When the emergency all jettison button or the external stores jettison T-handle (if installed) is actuated, the system jettisons the outboard stores first, the centerline store 200 milliseconds later, and inboard stores or empty fuel tanks 300 milliseconds later (or 800 milliseconds later for tanks containing fuel) regardless of the armament position selector switch settings.

SELECT JETTISON SWITCH AT SELECT POSITION

The centerline store, any wing store, or paired wing store (both outboard or both inboard) may be jettisoned individually as selected by the armament position selector switches. Only one release or paired release occurs for each actuation of the select jettison button. The released station or stations must be deselected before another store can be jettisoned. Sequencing logic provides priority to release centerline, inboard, outboard, and wingtips in that order. For example, with inboard and outboard selected the inboard jettisons and must be selected OFF before outboard can be jettisoned.

SELECT JETTISON SWITCH AT ALL PYLONS

A single actuation of the select jettison button jettisons wing and centerline stores and also actuates the pylon jettison circuits. If pylons are jettisoned with stores, the stores jettison from the pylons first followed by the pylons 1 second later.

WARNING

- Following an attempted release or jettison, any munition that does not separate from the aircraft should be considered armed and susceptible to inadvertent release during landing.
- For [E] [E-2] [F], jettison control circuit breaker must be in for emergency all jettison circuit or select jettison circuit to operate.
- For [E-1] [E-3] [F-1] [F-2], the jettison control circuit breaker and emergency all jettison circuit breaker must be in for the respective jettison circuit to operate.

NOTE

Pylons jettison only if equipped with necessary hardware and explosive bolts.

JETTISON SYSTEM

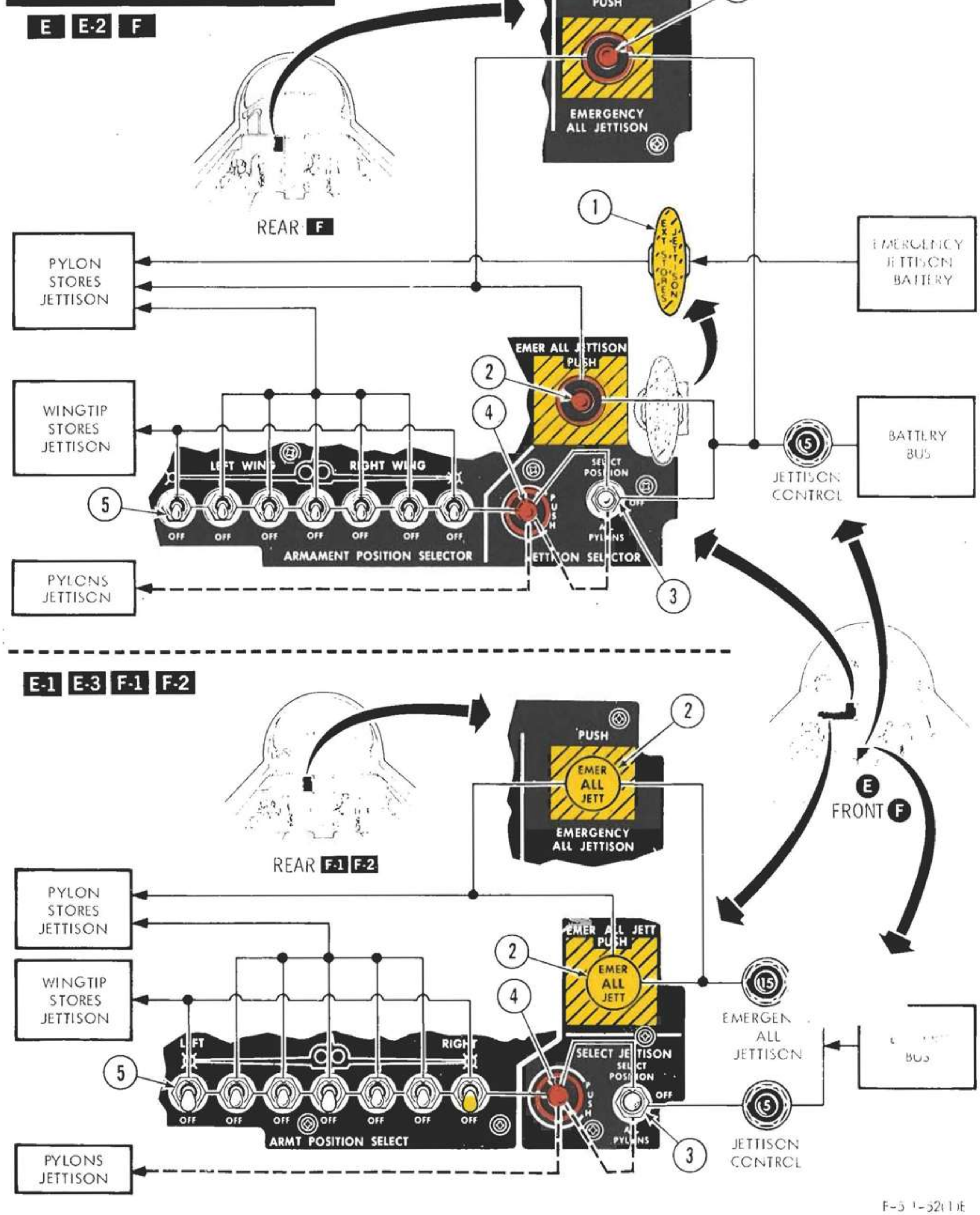


Figure 1-37.

JETTISON SYSTEM CONTROLS (Figure 1-37)

CONTROLS/INDICATORS	FUNCTION	
1 EXTERNAL STORES JETTISON T-Handle ([E] [E-2] and [F] Front Cockpit)	Pull	— Connects emergency jettison battery power to electrically salvo-jettison stores in safe condition from all pylons, bypassing all armament control selections.
2 EMERGENCY ALL JETTISON Button	PUSH	— Connects aircraft battery bus power to electrically salvo-jettison stores in safe condition from all pylons, bypassing all armament control selections.
3 SELECT JETTISON Switch (Ⓕ Front Cockpit)	SELECT POSITION	— Completes stores jettison electrical circuits to pylons or wingtip launchers selected by armament position selector switch(es). Switch must be pulled out and up.
	OFF	— Disconnects electrical power to select jettison circuits. **NOTE** Switch must be at OFF for normal release/firing circuits to function.
	ALL PYLONS	— Completes pylon jettison electrical circuits to all pylons. Switch must be pulled out and down.
4 SELECT JETTISON Button (Ⓕ Front Cockpit)	PUSH	a. With select jettison switch at SELECT POSITION, connects aircraft battery bus power to electrically jettison selected stores, individually or in pairs, in safe condition from selected pylons and wingtip launchers (fired safe). **NOTE** All armament position selector switches must be off except the switch of the selected station of the store to be jettisoned. b. With select jettison switch at ALL PYLONS, connects aircraft battery bus power to electrically jettison stores in safe condition (if carried) from all pylons followed by jettison of all pylons.
5 ARMAMENT POSITION SELECTOR Switches (7) (Ⓕ Front Cockpit)	OFF	— Opens respective select jettison circuits.
	Up	— Closes respective select jettison circuits.

ELECTRICAL SYSTEM

Electrical power is supplied by two ac systems and one dc system (figure 1-38). An external receptacle is provided for ac power input to the aircraft when the engines are not in operation. DC power is supplied by a battery and two 33-ampere transformer-rectifiers. See figures 1-39 thru 1-48 for cockpit circuit breaker panels.

AC POWER SYSTEM

AC power is supplied by two 13/15 kva 320 to 480 Hz generators, one operating from each engine. Each generator functions independently and supplies 115/200-volt three-phase power to the ac buses. Normally, power distribution is divided between the right and left systems. One generator automatically assumes the full load, except the corresponding aux intake door, without disruption if the other generator is off or inoperative. Generators cut in individually when each engine reaches approximately 48% rpm and should be on the line at engine idle. Generator dropout occurs at approximately 43% rpm.

Generator Switches and Caution Lights

Two switches placarded L GEN and R GEN are on the right vertical panel (Ⓕ front cockpit) (figures 1-15, 1-16, 1-18, and 1-19). Generator caution lights, placarded L GENERATOR and R GENERATOR, on the caution light panel (Ⓕ both cockpits) (figures 1-21 thru 1-26) come on any time the respective generator fails or is turned off. Each generator switch has a RESET position, permitting the pilot to reset the generators if necessary.

DC POWER SYSTEM

DC power is obtained from each ac system thru a transformer-rectifier which converts ac to dc. A 24-volt, 11-ampere-hour ([E-1] [E-3] [F-1] [F-2] 13-ampere-hour) nickel-cadmium battery serves as a standby source of power for all dc circuits and is charged by the transformer-rectifiers. If one transformer-rectifier fails, the other continues to supply all dc power. A caution light placarded DC OVERLOAD (Ⓕ [E-1] some [E-3] [E-2]) on the caution light panel (Ⓕ both cockpits) warns of a dc overload. See section III for dc overload emergency procedures.

Battery Switch

The battery switch (figures 1-15, 1-16, 1-18, and 1-19) on the right vertical panel (Ⓕ front cockpit) is a two-position switch placarded BATT and OFF. During normal flight conditions, the switch should remain in BATT position.

NOTE

If the battery relay does not close when battery switch is placed at BATT, a normal start cannot be accomplished.

STATIC INVERTER

A static inverter, powered by the dc bus, converts 24-volt dc from the battery to 115-volt ac. The inverter, when activated, provides an alternate source of ac power for the following:

a. Engine ignition on the ground or in flight.

b. Operation of left engine instruments and utility hydraulic pressure indicator during start of left engine.

c. Fuel and oxygen quantity indicators.

On the ground, with dc power only (battery switch at BATT), the inverter is activated when either engine start button is pushed or when the fuel and oxygen (Ⓕ front cockpit) switch is held at GAGE TEST or QTY CHECK position. In flight, with dual engine flameout (battery switch at BATT), the inverter is activated when either engine start button is pushed or either throttle is moved into AB range for engine restarts, or when the fuel and oxygen switch is held at GAGE TEST or QTY CHECK position. In flight, with normal ac-dc power, operation of the static inverter can be checked by positioning the fuel and oxygen switch to GAGE TEST and observing counterclockwise movement of fuel and oxygen quantity indicator pointers.

ELECTRICAL SYSTEM (TYPICAL)

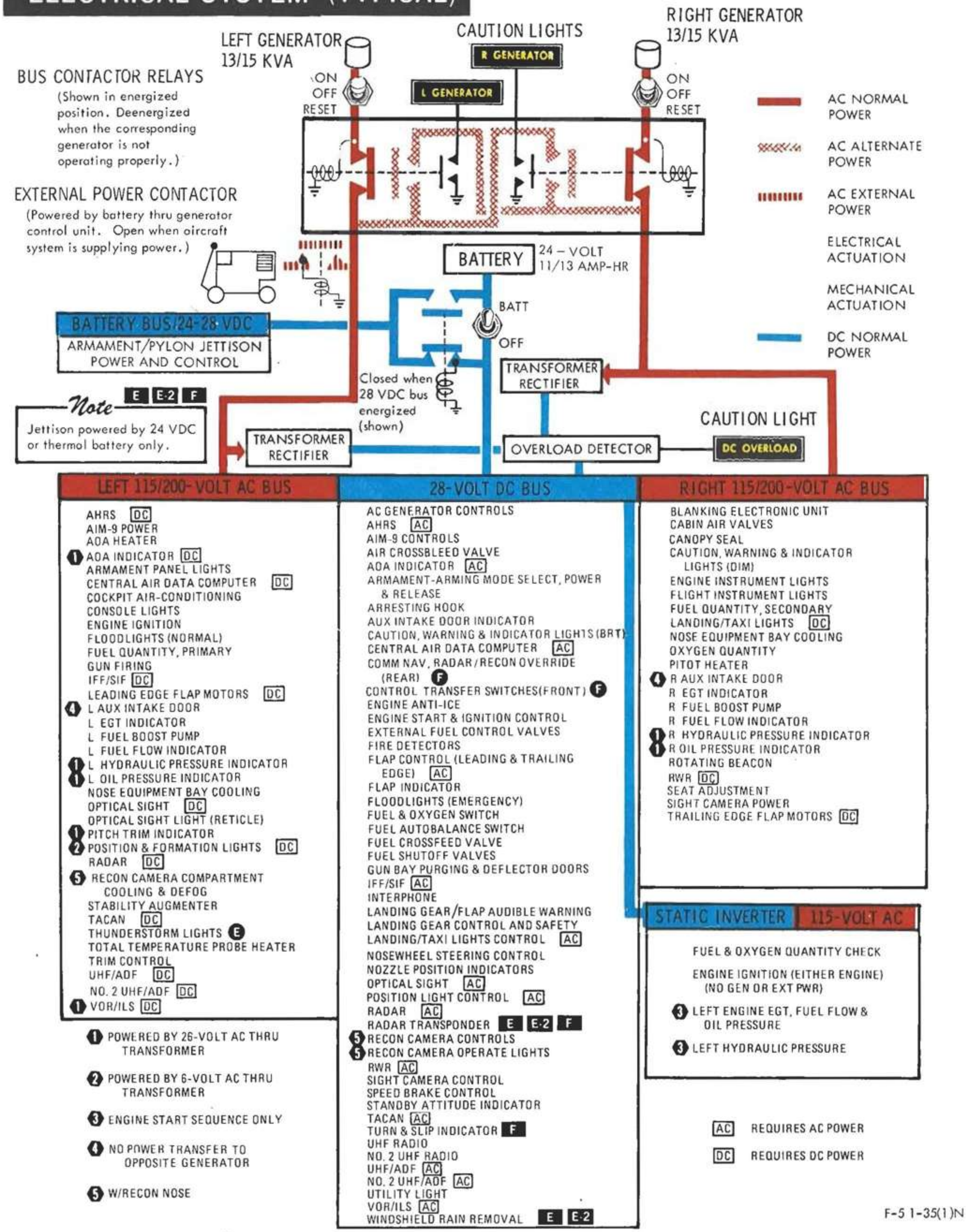
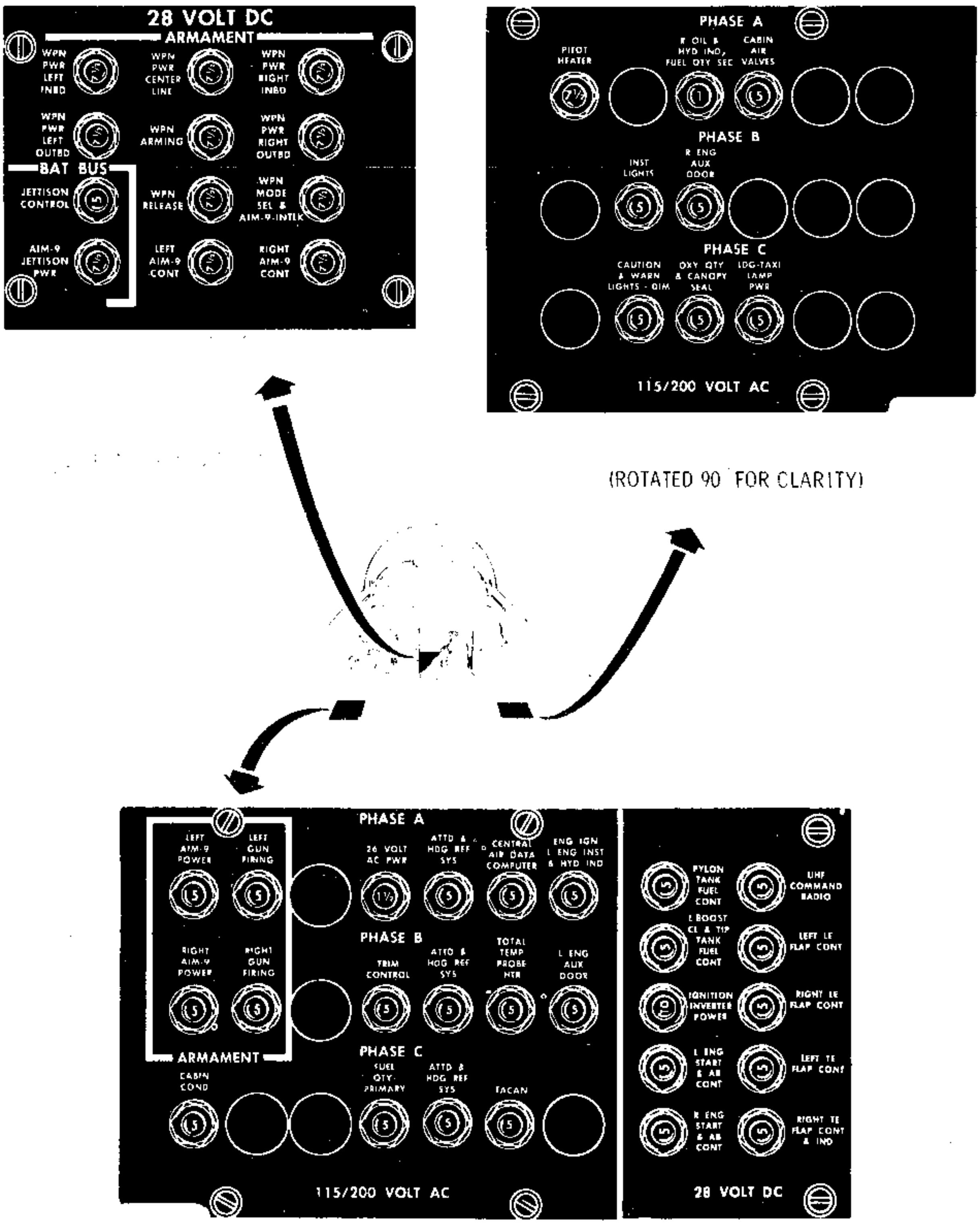


Figure 1-38.

CIRCUIT BREAKER PANELS

E **E-2**



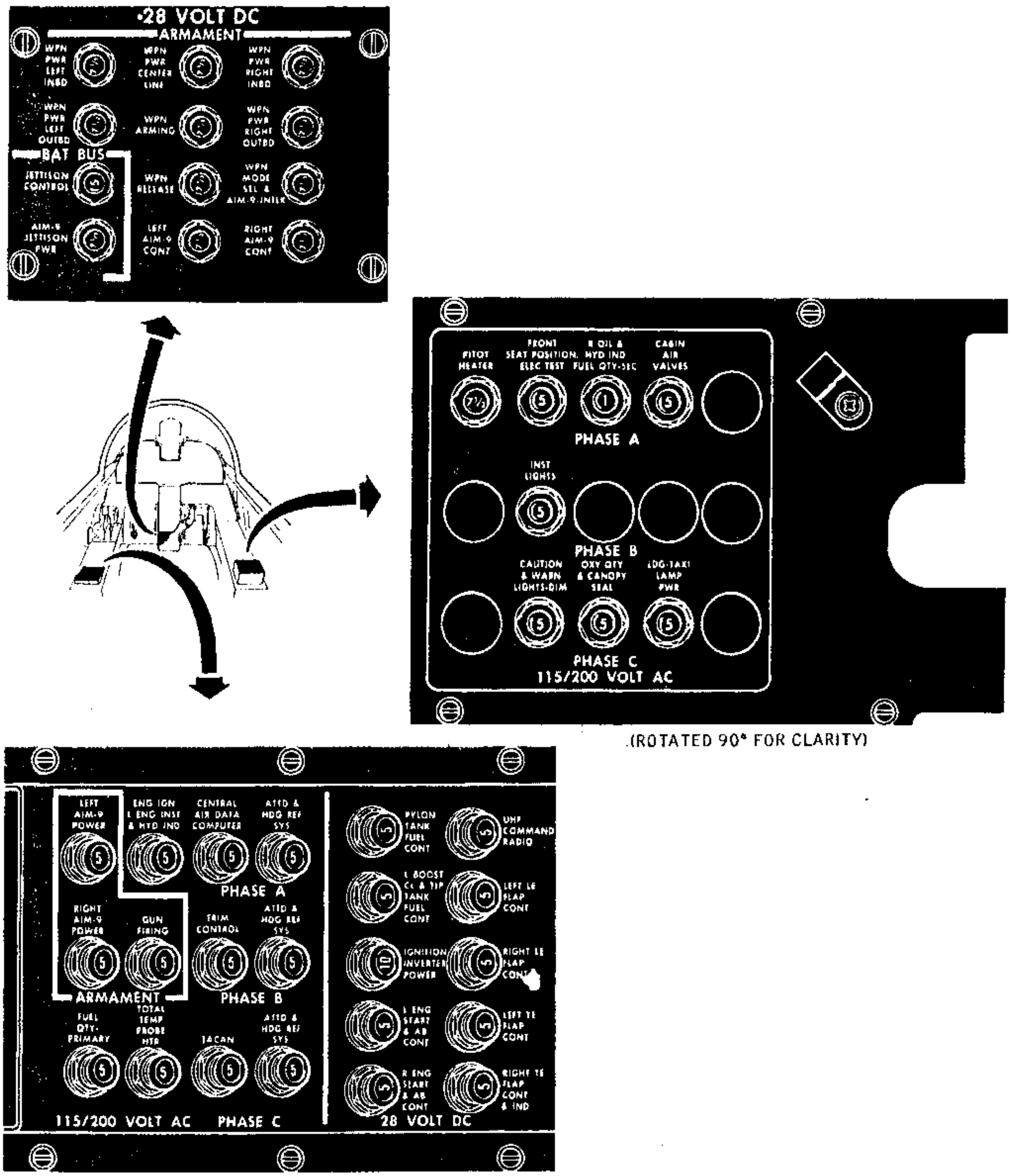
(ROTATED 90 FOR CLARITY)

F-5 1-37(1)G

Figure 1-39.

CIRCUIT BREAKER PANELS -FRONT

F



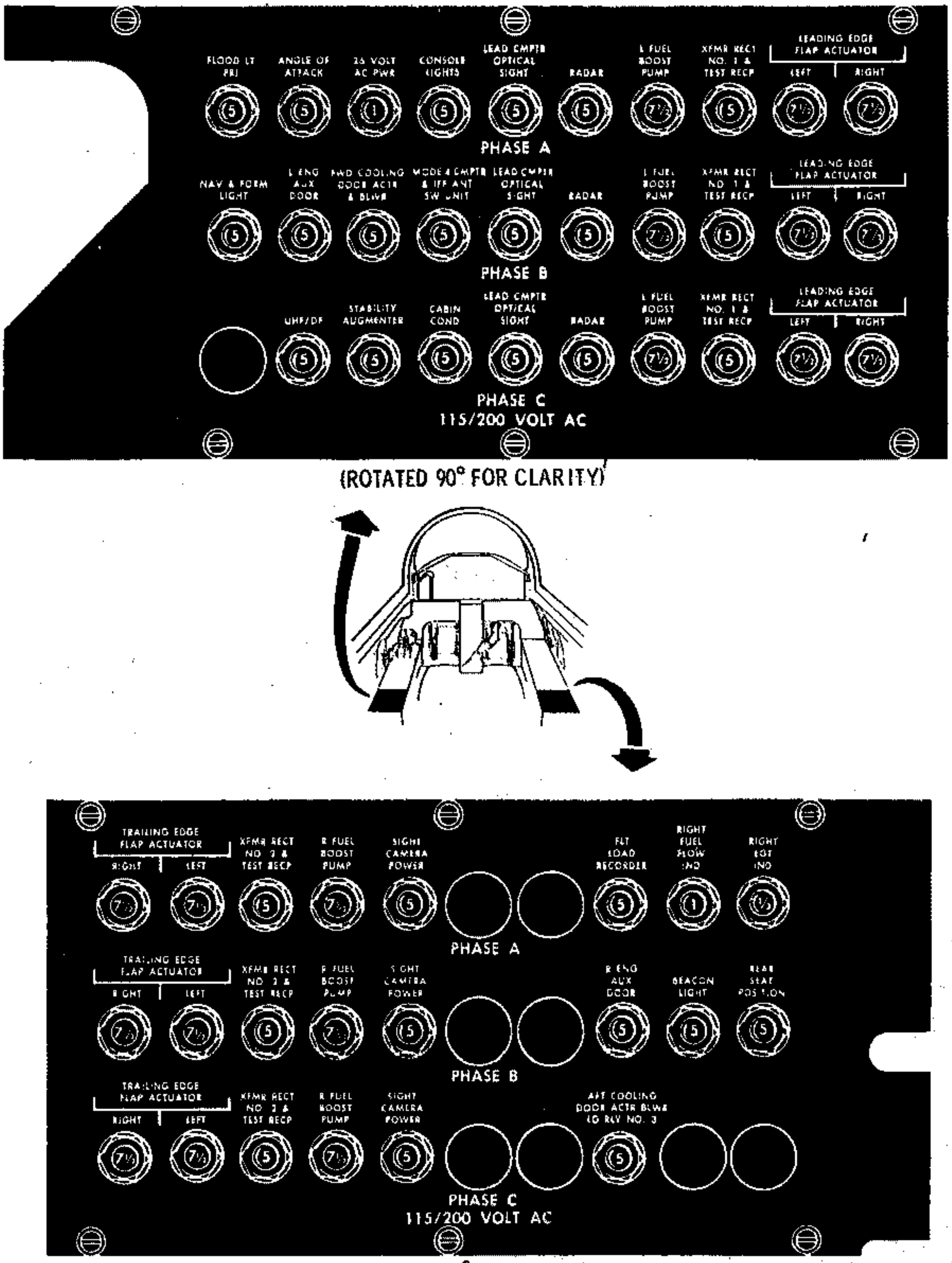
(ROTATED 90° FOR CLARITY)

(ROTATED 90° FOR CLARITY)

Figure 1-40.

CIRCUIT BREAKER PANELS - REAR

F



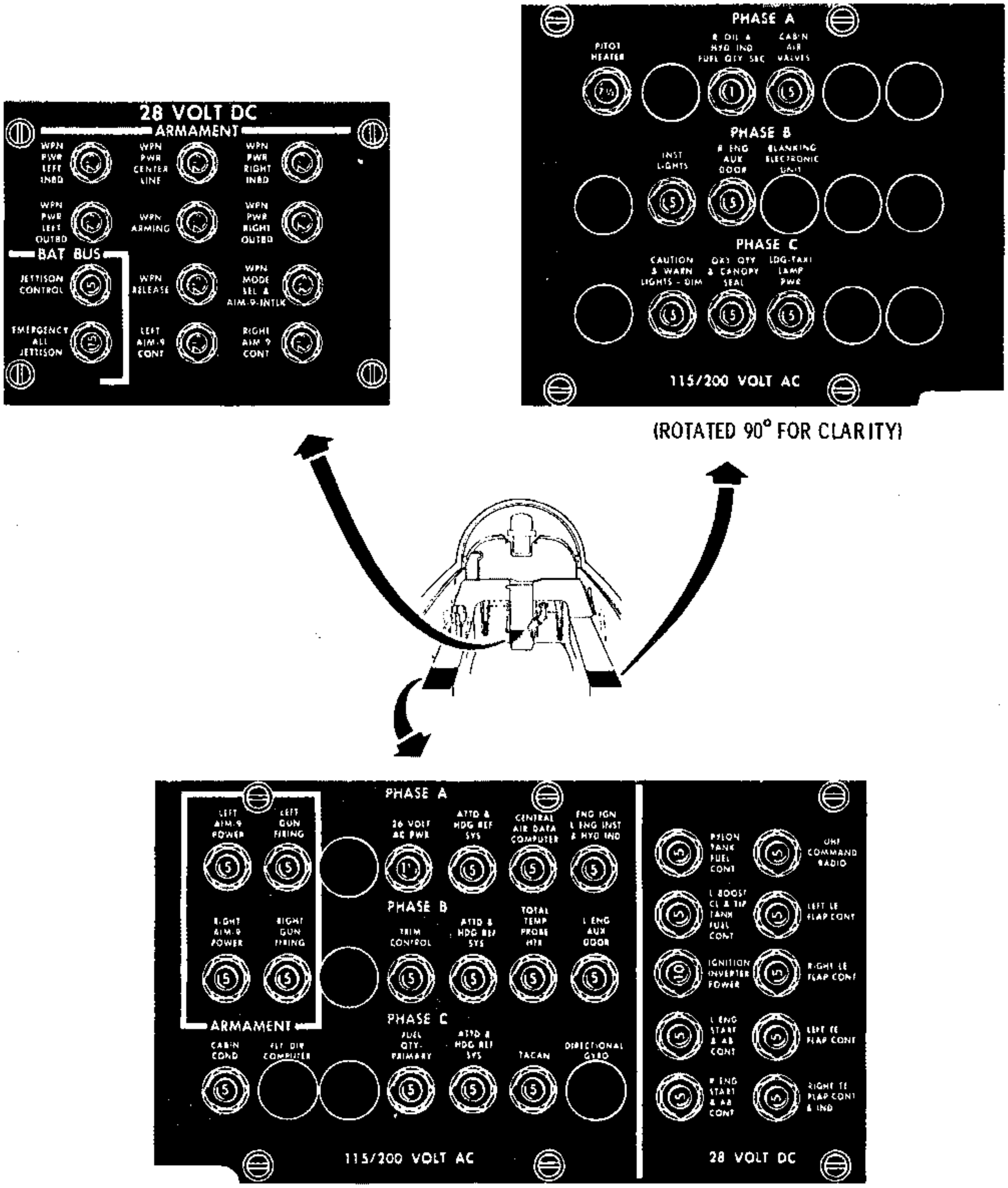
(ROTATED 90° FOR CLARITY)

F-5 1-39(1)B

Figure 1-41.

CIRCUIT BREAKER PANELS

E-1 E-3



(ROTATED 90° FOR CLARITY)

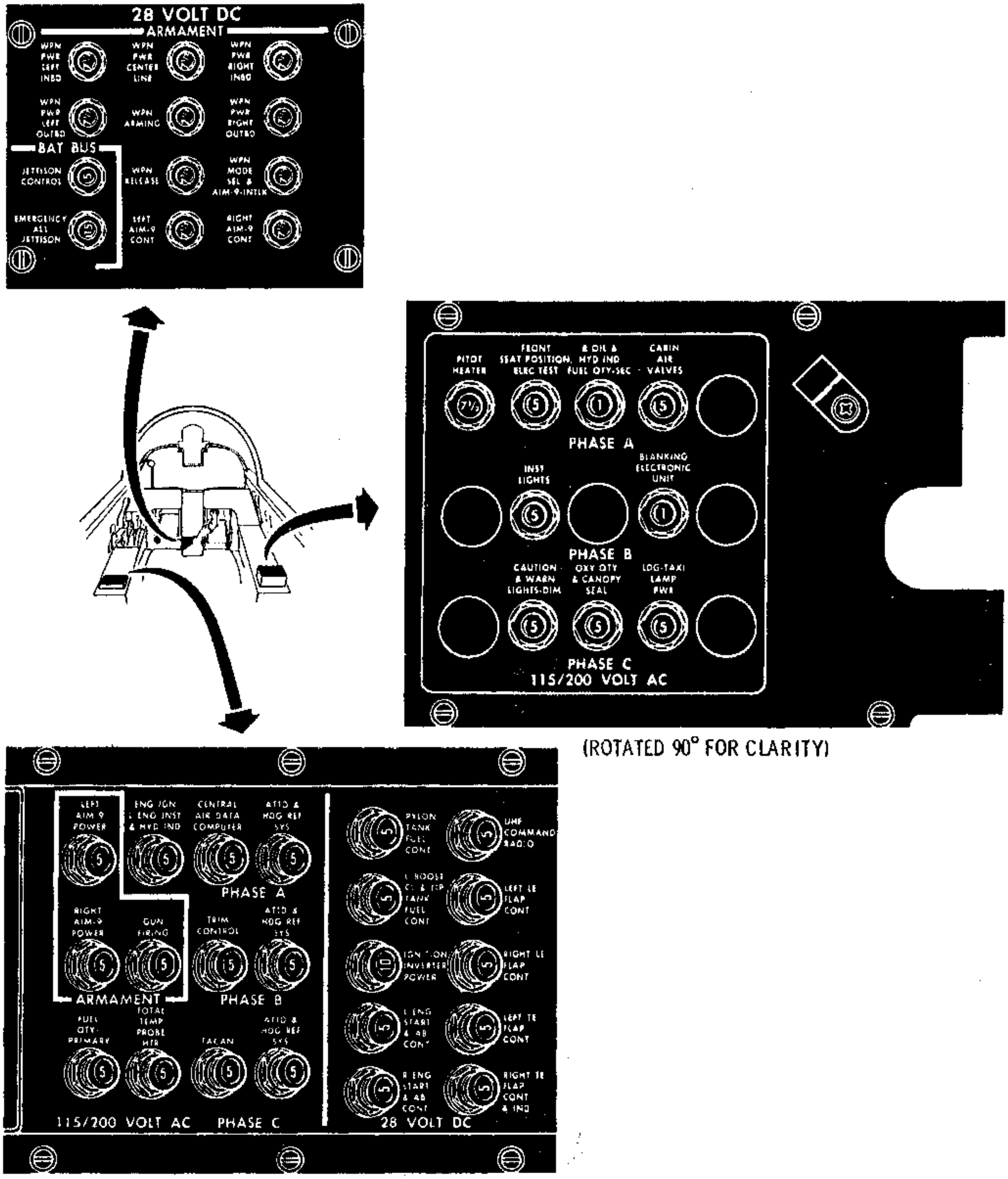
(ROTATED 90° FOR CLARITY)

F-5 1-37(12) A

Figure 1-42.

CIRCUIT BREAKER PANELS–FRONT

F-1 F-2



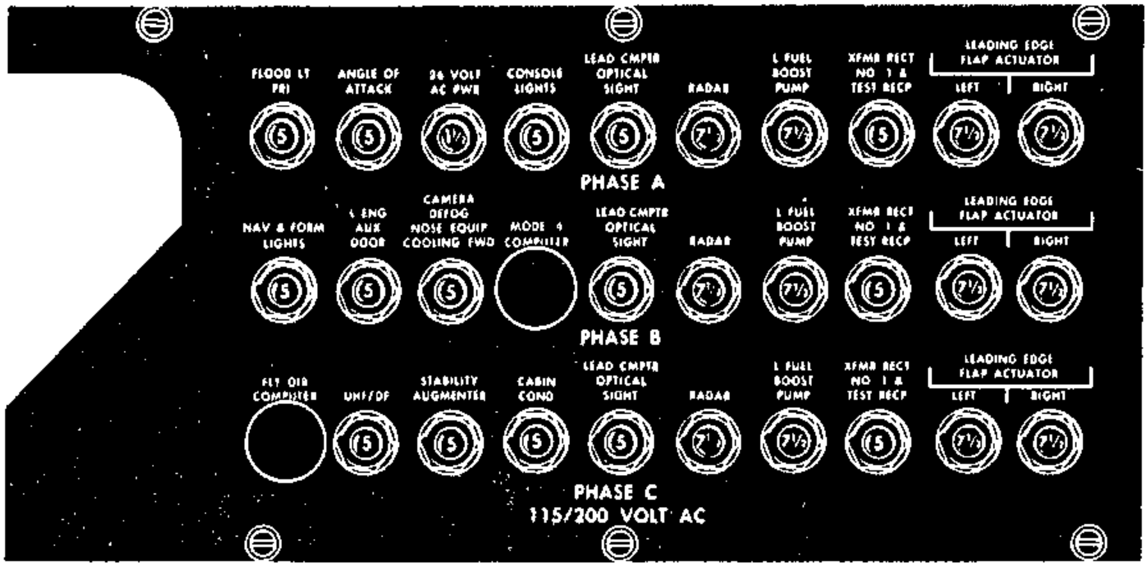
(ROTATED 90° FOR CLARITY)

F-5 1-37(11)B

Figure 1-43.

CIRCUIT BREAKER PANELS—REAR

F-1 F-2



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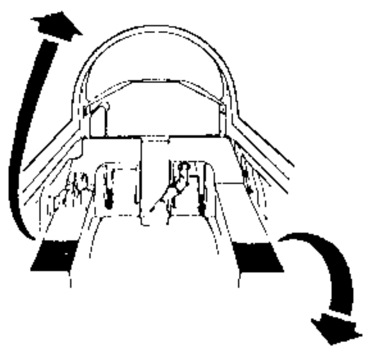
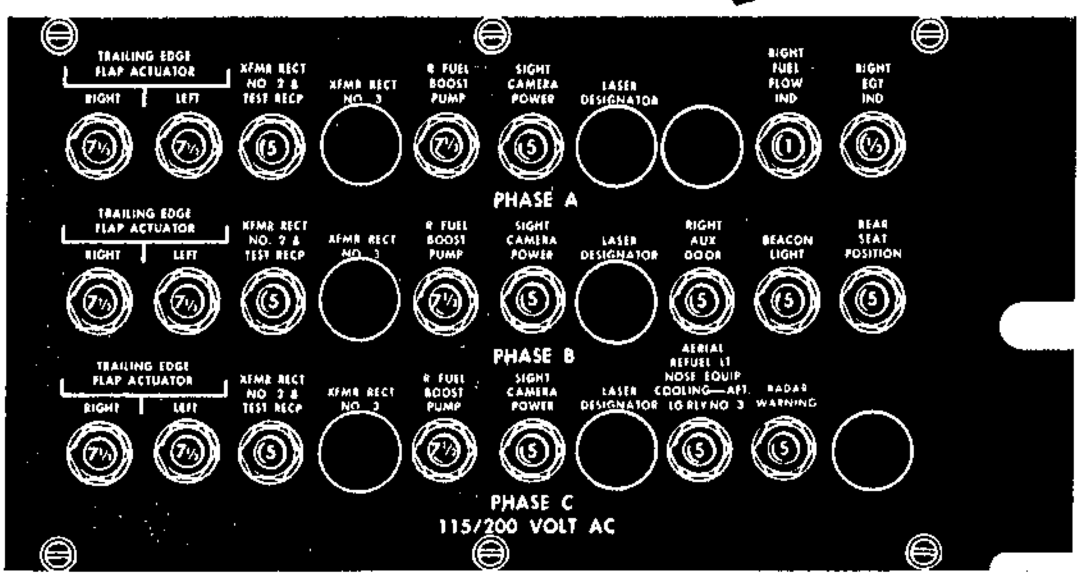




(ROTATED 90° FOR CLARITY)

F-5 1-39(4)B

Figure 1-44.

CIRCUIT BREAKER PANELS (TYPICAL)

E E-2

BEHIND SEAT

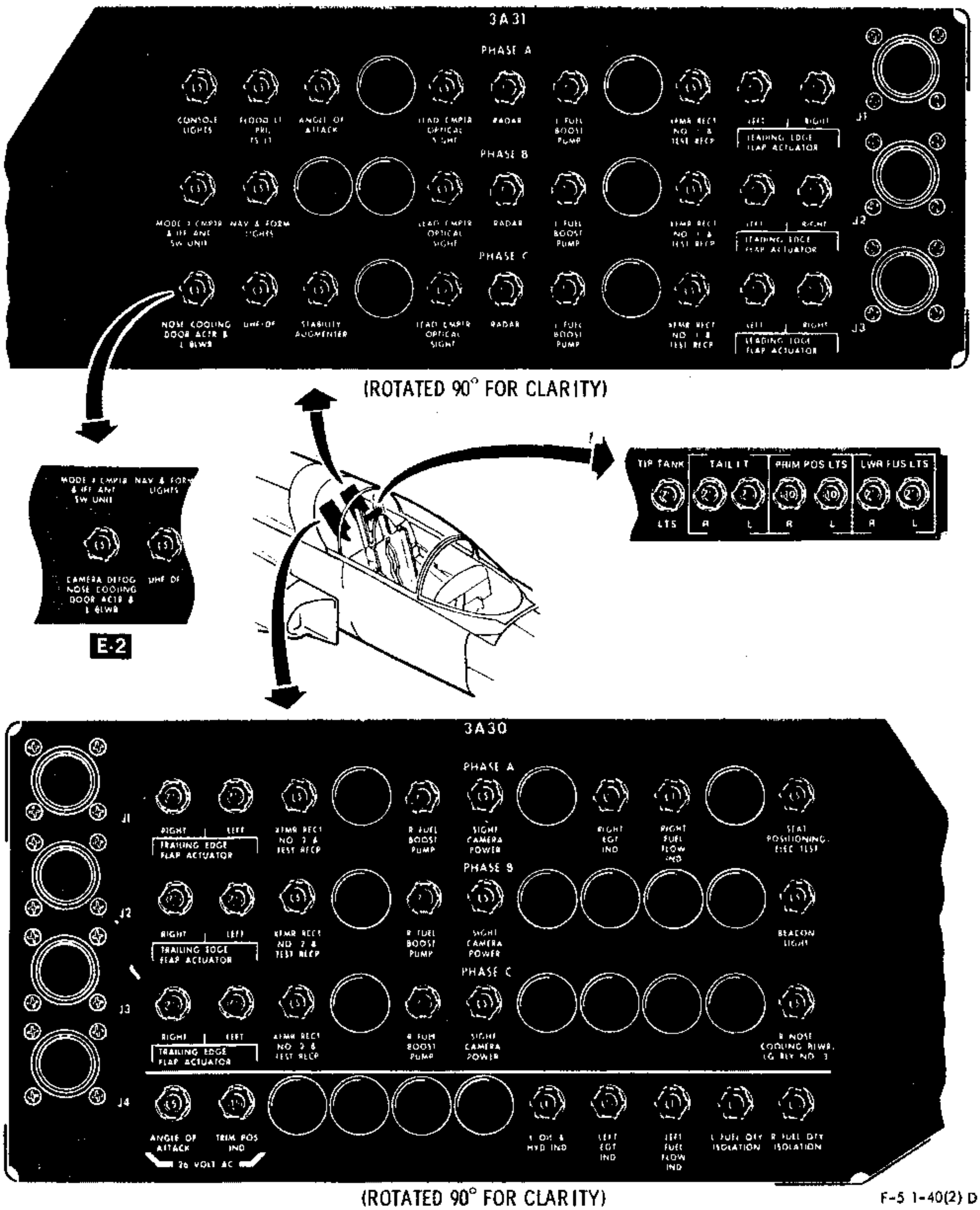


Figure 1-45.

CIRCUIT BREAKER PANELS

F

BEHIND REAR SEAT

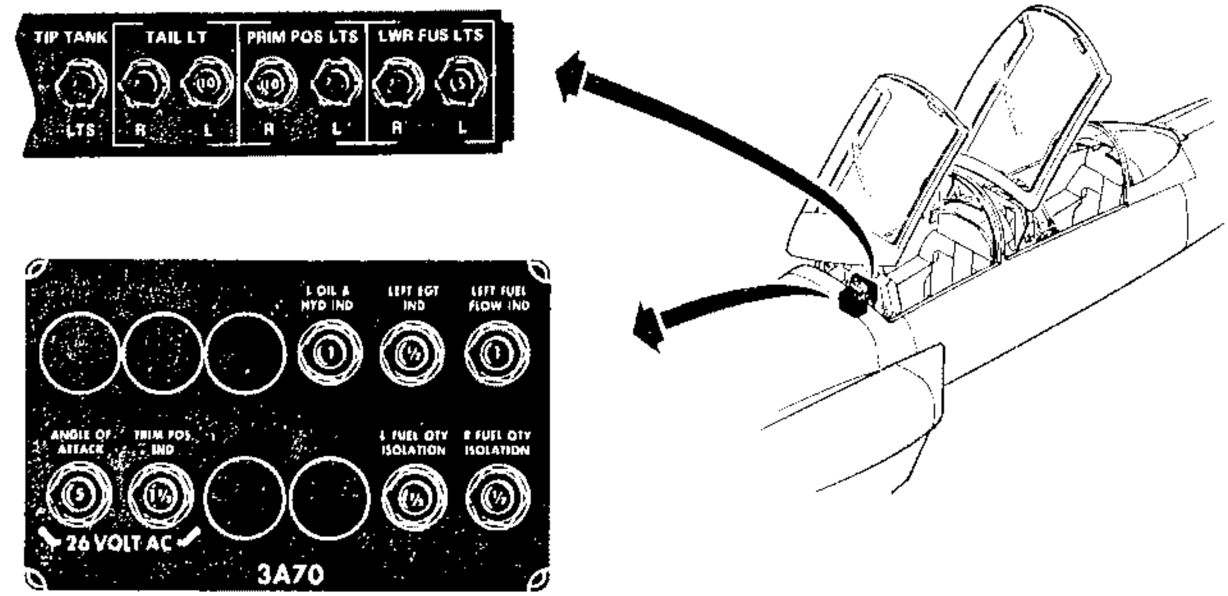


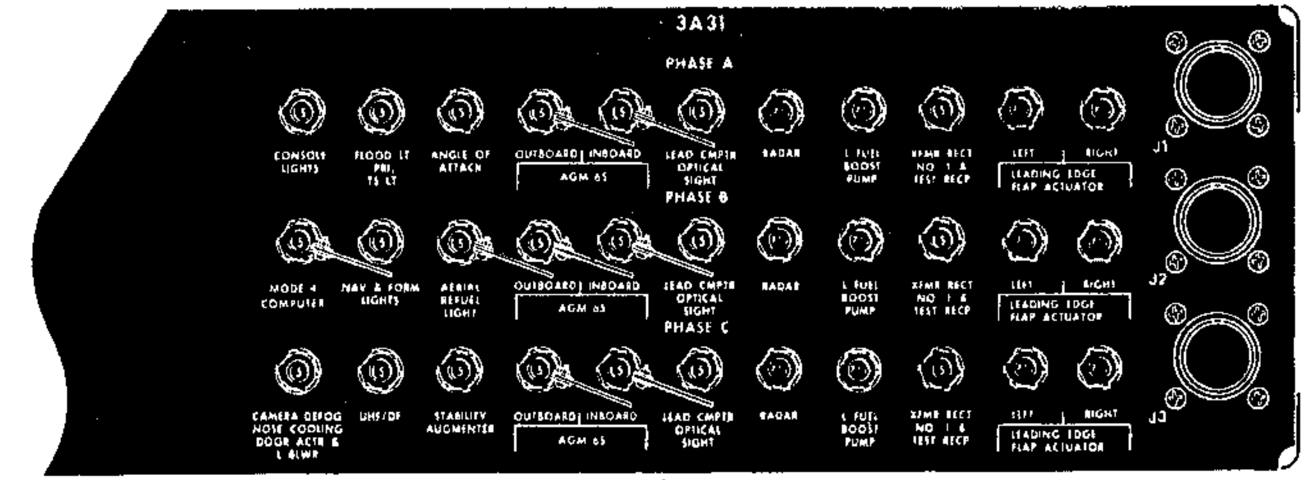
Figure 1-46.

F-5 1-40(1)B

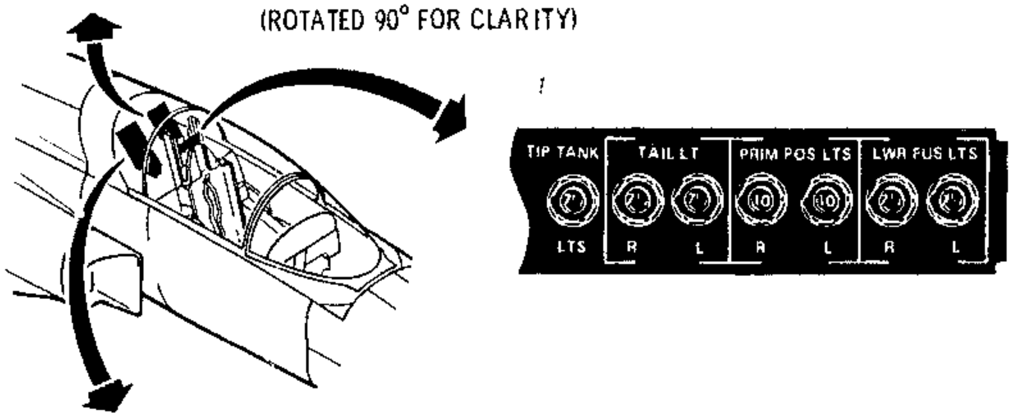
CIRCUIT BREAKER PANELS

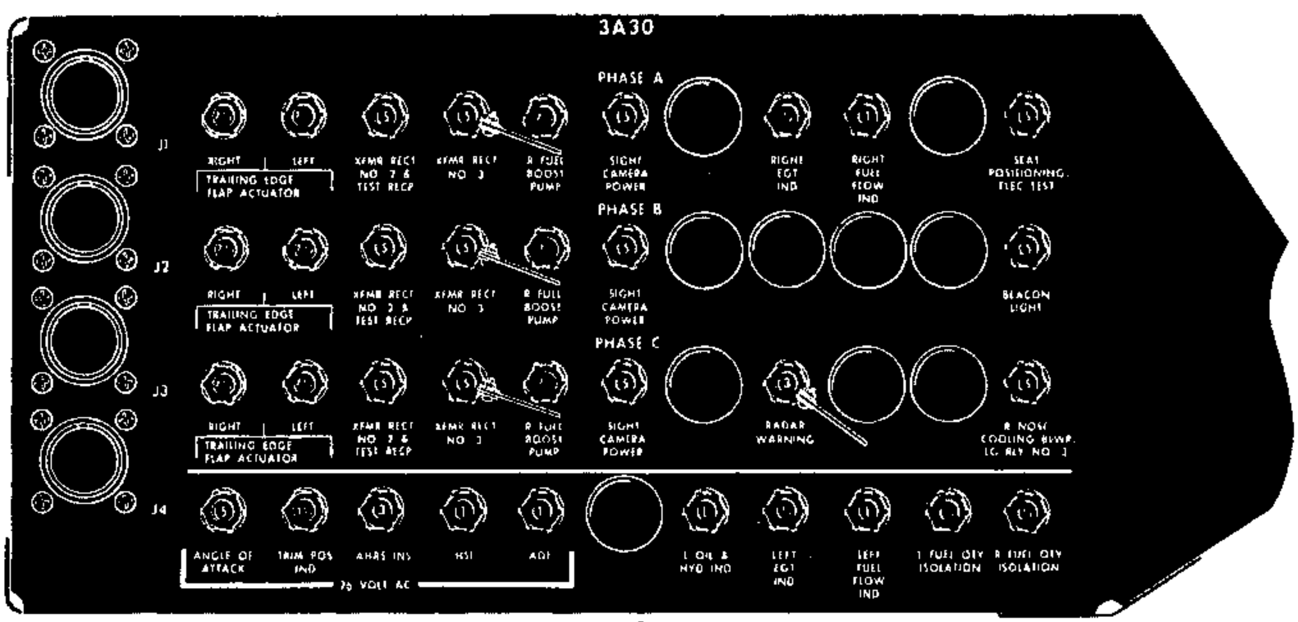
E-1 **E-3**

BEHIND SEAT



(ROTATED 90° FOR CLARITY)





(ROTATED 90° FOR CLARITY)

F-5 1-40(8)A

Figure 1-47.

CIRCUIT BREAKER PANELS

F-1 F-2

BEHIND REAR SEAT

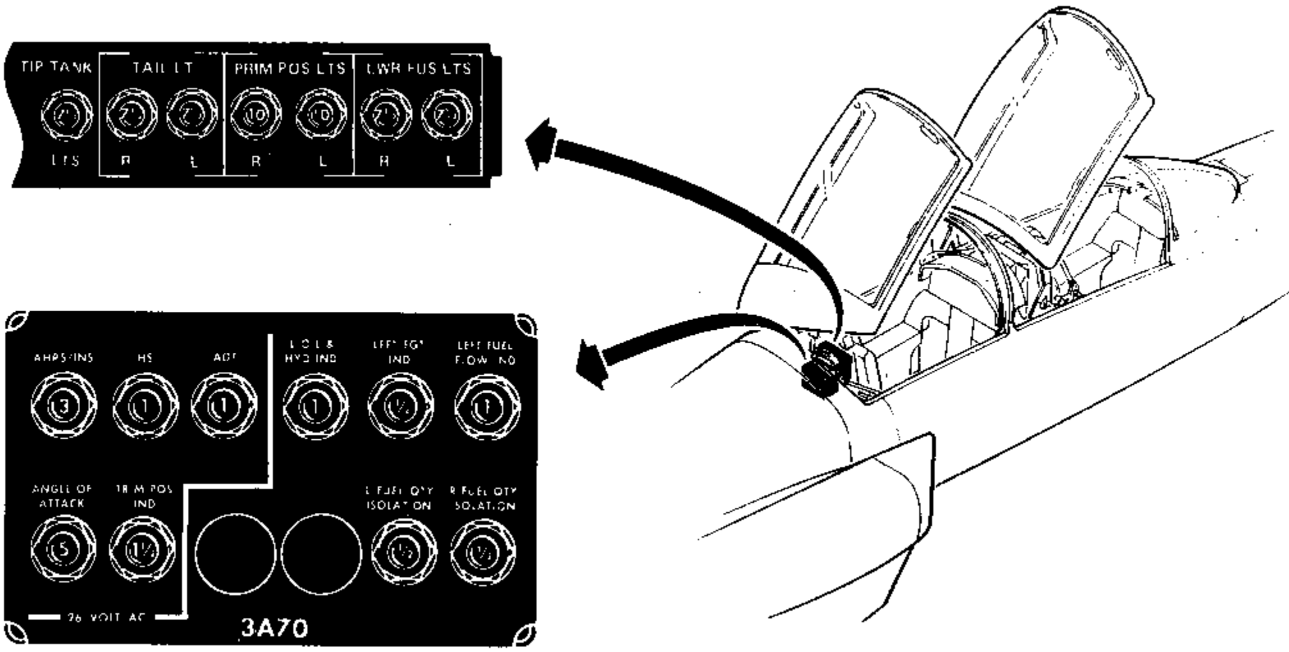


Figure 1-48.

F-5 1-40(7)A

HYDRAULIC SYSTEMS

Hydraulic power is supplied by two independent systems, the flight control hydraulic system and the utility hydraulic system (figure 1-49). Each system is powered by a positive displacement piston-type pump. The right airframe-mounted gearbox drives the flight control hydraulic system pump, and the left airframe-mounted gearbox drives the utility hydraulic system pump. Both systems operate at 3000 psi. The flight control and utility hydraulic systems both provide the hydraulic power for the flight controls. In addition, the utility hydraulic system provides the hydraulic power to operate the landing gear, gear doors, speed brake, wheel brakes, stability augmenter, nosewheel steering, two-position nose gear strut, gun bay purge doors, and gun gas deflector doors.

HYDRAULIC PRESSURE INDICATORS

The hydraulic pressure indicators on the instrument panel (Ⓕ rear cockpit right vertical panel) (figures 1-9, 1-10, 1-12, 1-13, 1-17, and 1-20) provide visual indication of hydraulic pressure in each system. See section V for indicator markings and pressure limits.

HYDRAULIC CAUTION LIGHTS

A hydraulic caution light for each system, placarded UTILITY HYD and FLIGHT HYD, on the caution light panel (figures 1-21 thru 1-26) comes on when the respective system pressure drops to 1500 psi or less to indicate a low-pressure condition. The light automatically goes out when a pressure of approximately 1800 psi is restored. On aircraft incorporating T.O. 1F-5-941, the hydraulic caution lights will also illuminate to indicate a hydraulic fluid overtemperature condition. If the caution light is caused by a fluid overtemperature, it will remain on until the temperature returns to normal. To determine which condition (low pressure or high temperature) has caused the light to come on, the corresponding hydraulic pressure indicator must be checked.

HYDRAULIC SYSTEMS

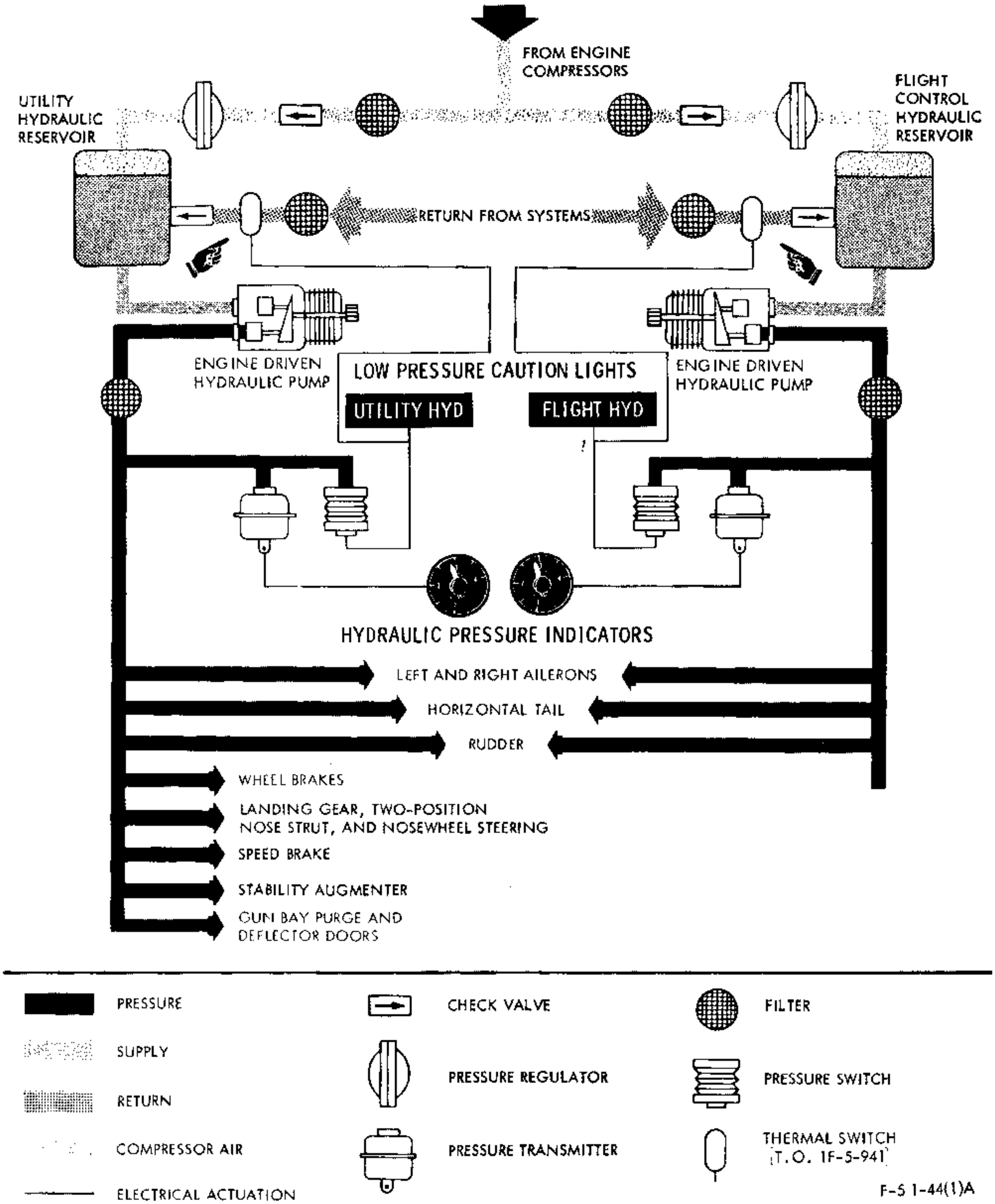


Figure 1-49.

LANDING GEAR SYSTEM

The landing gear system provides normal extension and retraction of gear, alternate extension of gear, nose gear strut hike-dehike, and nosewheel steering. The landing gear is extended and retracted by utility hydraulic system pressure electrically controlled by the landing gear lever (Ⓕ both cockpits). Retraction time is 9 seconds with nose gear strut hiked and 6 seconds with nose gear strut dehiked. Gear extension time is 6 seconds. The main gear is held in the retracted position by individual uplocks hydraulically actuated. The nose gear uplock is contained within the gear dragbrace mechanism. All gears are held down by hydraulic pressure on the gear actuators and locked in the down position by spring-loaded overcenter downlocks. Three green lights, a red warning light, and an audible warning signal (beeper) heard thru the headset are provided to indicate when the landing gear is in a safe or unsafe position. A landing gear alternate release is provided in case of utility hydraulic system or electrical malfunction. See figure 1-50 for location and function of all controls and indicators.

NOTE

To prevent possible hydraulic fluid overventing during single engine taxi/ground operation, avoid unnecessary flight control inputs.

NOSE GEAR STRUT HIKE-DEHIKE

The nose gear strut can be extended (hiked) 13 inches or retracted (dehiked) on the ground by the nose strut switch outboard of the throttle quadrant (Ⓕ front cockpit). Full hiking of the strut adds approximately 3 degrees to the pitch attitude, which shortens takeoff ground run. The nosewheel is steerable in the hiked and dehiked positions; however, steering response may be slower during transit. Automatic strut dehike occurs anytime aircraft weight is off the main gear, regardless of the position of the gear lever. The strut fully dehikes before it enters the wheel well.

LANDING GEAR CONTROLS/ INDICATORS (TYPICAL)

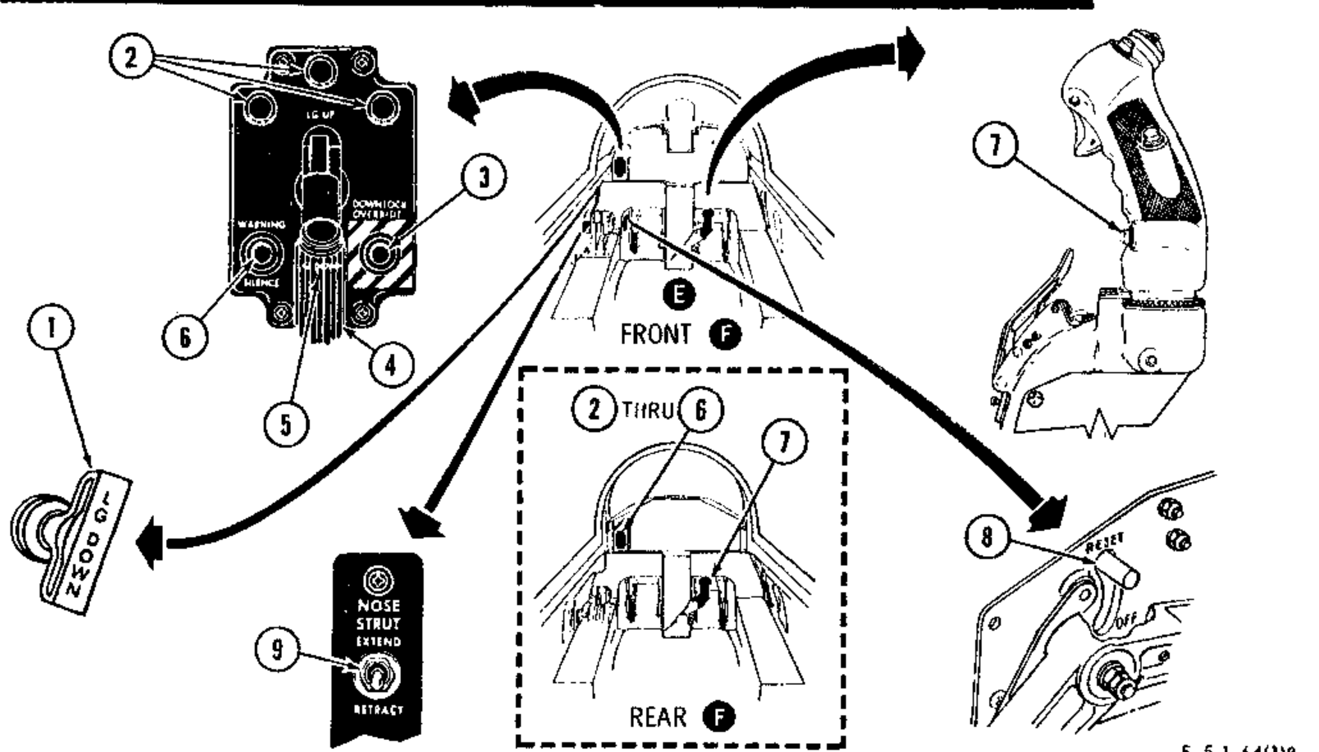


Figure 1-50.

LANDING GEAR CONTROLS/INDICATORS (TYPICAL) (Figure 1-50)

CONTROLS/INDICATORS	FUNCTION	
1 Landing Gear Alternate Release Handle (Ⓕ Front Cockpit)	Pull and Hold (Until Gear Unlocks)	— Extends landing gear (gear lever up or down).
2 Landing Gear Position Indicator Lights (GREEN)	On	— Indicates each respective landing gear is down and locked.
3 Landing Gear DOWNLOCK OVERRIDE Button	Push and Hold	— Overrides locking solenoid to permit raising of gear lever.
4 Landing Gear Lever	LG UP/ LG DOWN	— Retracts or extends landing gear. CAUTION Do not place the left foot outboard or behind the rudder pedal because of the possibility of striking the landing gear linkage causing uncommanded landing gear operation.
5 Landing Gear Lever Warning Light (RED)	On	a. Indicates one or more gear unsafe. b. Indicates one or more gear doors open when landing gear lever is up. c. With the gear lever up, the red light and audible warning beeper activate at altitudes below 9500 feet, at an airspeed less than 210±10 KIAS, with one or both throttles retarded below approximately 96% rpm. d. The red light comes on and the audible warning beeper sounds when the landing gear lever is down and the gear door switch in the wheel well is used to open the main gear doors.
6 Landing Gear and Flap WARNING SILENCE Button	Push (Momentary)	— Silences audible warning signal.
7 Nosewheel Steering Button	Depress and Hold	— On ground — Engages nosewheel steering. Steering is controlled by movement of the rudder pedals. — In flight — Used as an alternate microphone button.

LANDING GEAR CONTROLS/INDICATORS (TYPICAL) (Figure 1-50) (Continued)

CONTROLS/INDICATORS	FUNCTION	
8 Gear Alternate Release Reset Control (Ⓕ Front Cockpit)	OFF	— No function.
	RESET	— Resets landing gear to normal system. CAUTION With utility hydraulic pressure available, landing gear safety pins shall be installed before using the reset control to prevent possible gear collapse.
9 NOSE STRUT Switch (Ⓕ Front Cockpit)	EXTEND	— Lengthens nose gear strut to hiked position.
	RETRACT	— Shortens nose gear strut to dehike position.

NOTE

Hiking nose gear strut may cause utility hydraulic reservoir to show low level.

LANDING GEAR ALTERNATE EXTENSION

A landing gear alternate release D-handle (Ⓕ front cockpit) (figure 1-50) permits gear extension with the landing gear lever up or down should the normal extension system fail. Pulling the handle deenergizes the landing gear hydraulic and electrical systems and releases the main gear uplocks, main gear inboard door locks, nose gear, and nose gear forward door to allow the landing gear to extend, assisted by gravity and airloads. With all gear fully extended, the green lights come on and the red light in the gear handle goes out if the gear lever is down; however the gear doors remain open. Only nosewheel steering is inoperative after alternate extension of the gear.

CAUTION

If handle is improperly stowed, not fully in and in vertical position, it may prevent gear normal retraction/extension and cause loss of nosewheel steering.

LANDING GEAR DOWNLOCK OVERRIDE

The landing gear downlock override button to the right of the landing gear lever (figure 1-50) enables the landing gear lever to be raised to the LG UP position while the aircraft is on the ground with the struts compressed. If the locking solenoid fails to release the landing gear lever from the LG DOWN position when the struts are extended, as after takeoff, the button can be pressed and held to allow the lever to be placed at LG UP.

LANDING GEAR DOOR SWITCH

The landing gear door switch is located in the right main landing gear well. The switch is placarded GEAR DOORS and has two positions. NORMAL position allows normal operation of the landing gear doors. With utility hydraulic pressure, OPEN position opens landing gear doors.

NOSEWHEEL STEERING

The nosewheel steering system provides directional control and shimmy damping during ground operation. With the nosewheel steering button pressed and held, nosewheel steering is controlled by movement of the rudder pedals. Nosewheel steering is available when the aircraft weight is on the right main gear. When the nosewheel steering button is released, the system provides viscous shimmy damping capability. Damping is effected by use of hydraulic fluid trapped within the nosewheel steering actuator and is not dependent upon utility hydraulic system pressure.

WHEEL BRAKE SYSTEM

Each main wheel is equipped with hydraulically operated multiple-disk power brakes. Brakes are operated by conventional toe-type brake pedals (rudder pedals) and use utility hydraulic system pressure to operate brake control valves. Proper brake disc operating clearances are automatically provided when the brake pedals are momentarily pressed hard while engines are running. Should the utility system fail, the brake valve acts as a brake master cylinder, and brake pressure is proportional to the amount of foot pressure applied to the brake pedal. After utility system failure, unlimited brake applications are still available.

DRAG CHUTE SYSTEM

The drag chute system consists of a 15-foot ring-slot deceleration parachute, packed in a deployment bag and stowed in an air-cooled compartment at the base of the rudder, and a T-handle (Ⓕ both cockpits) to deploy the chute.

DRAG CHUTE T-HANDLE

The drag chute T-handle on the instrument panel (figures 1-9 thru 1-14) is mechanically connected to the drag chute release mechanism. To deploy the chute, the handle is pulled straight out (without turning) to the first stop (approximately 3-1/4 inches). Initial movement of the handle latches the drag chute to the aircraft. Further movement of the handle unlocks the compartment door latch, allowing the spring-loaded pilot chute to deploy and withdraw the drag chute into the airstream. The handle will lock in the deployed position. The drag chute can be jettisoned by turning the T-handle 90 degrees clockwise and pulling it out to the next stop (approximately an additional 3-1/4 inches). The handle is under spring tension during the final pull to jettison chute. When released, the handle retracts to the first stop. To stow, rotate the handle counterclockwise and push it in.

CAUTION

To avoid inadvertent jettisoning of the drag chute, ensure that handle is pulled to first stop and locked without rotation.

ARRESTING HOOK SYSTEM

The arresting hook system is an emergency system consisting of a retracted hook under the fuselage aft section and a button (Ⓕ both cockpits) (figure 1-9 thru 1-14) to electrically release and extend the hook for runway arrestment. The hook is held in the up position by a lock assembly. A ground safety pin is provided to prevent inadvertent actuation on the ground and must be removed before flight. The gear lever must be down for hook to extend. For extension, the uplock is released electrically by pushing the arresting hook button. The hook then extends by torsion bar spring force, maintaining a positive downward force on the hook while a self-contained hydraulic damping unit acts as a snubber to minimize hook bounce. Activation of the arresting hook button illuminates the light in the button to indicate hook release, and automatically dehikes the nose gear strut, if hiked. See section V for maximum hook arrestment speeds.

SPEED BRAKE SYSTEM

An electrically-controlled, hydraulically-actuated speed brake is located under the fuselage center section. The speed brake is powered by the utility hydraulic system and controlled by a three-position speed brake switch on the right throttle (figure 1-31). The variable speed brake has a full extension of 45° without a centerline (CL) store and 30° with a CL store. After release or jettison of CL store, full speed brake extension is obtained by cycling the speed brake switch. High airspeeds may prevent full extension. The speed brake and horizontal tail are mechanically interconnected to minimize trim change during speed brake operation.

SPEED BRAKE OPERATION

Positioning the switch aft opens speed brake (out); forward position closes speed brake (in). The center (off) position neutralizes hydraulic pressure. Intermediate speed brake positions can be obtained by short intermittent actuation of the switch. For the open and intermediate speed brake positions, the switch (Ⓕ front cockpit) should be returned to center position after positioning speed brake. The speed brake switch in the Ⓕ rear cockpit is springloaded to the center position.

NOTE

- Ⓕ Actuation of the rear cockpit speed brake switch overrides front cockpit selection of speed brake. To prevent the possibility of speed brake creeping open after being closed from rear cockpit, cycle the front cockpit switch to the center and then to the forward position. After closing the speed brake from front cockpit, leave switch at forward position.
- Ⓕ To regain control of speed brake operation in the front cockpit, place the front cockpit speed brake switch in the center position, then actuate to obtain desired speed brake position.

WING FLAP SYSTEM

Aircraft are equipped with either a maneuver flap system ([E] [E-1] [E-2] [F] [F-1]) or an auto flap system ([E-3] [F-2]). Either flap system consists of leading and trailing edge flaps used for takeoff, inflight maneuvering/loiter, and landing. Each flap surface is operated by an ac-powered electrical actuator. The left and right leading edge actuators and the left and right trailing edge actuators are mechanically interconnected to prevent asymmetric flap extension. Both the leading and trailing edge flaps are electrically interconnected and, in turn, mechanically interconnected to the horizontal tail operating mechanism to minimize trim changes automatically when the flaps are operated.

FLAP CONTROLS (MANEUVER AND AUTO FLAP SYSTEMS)

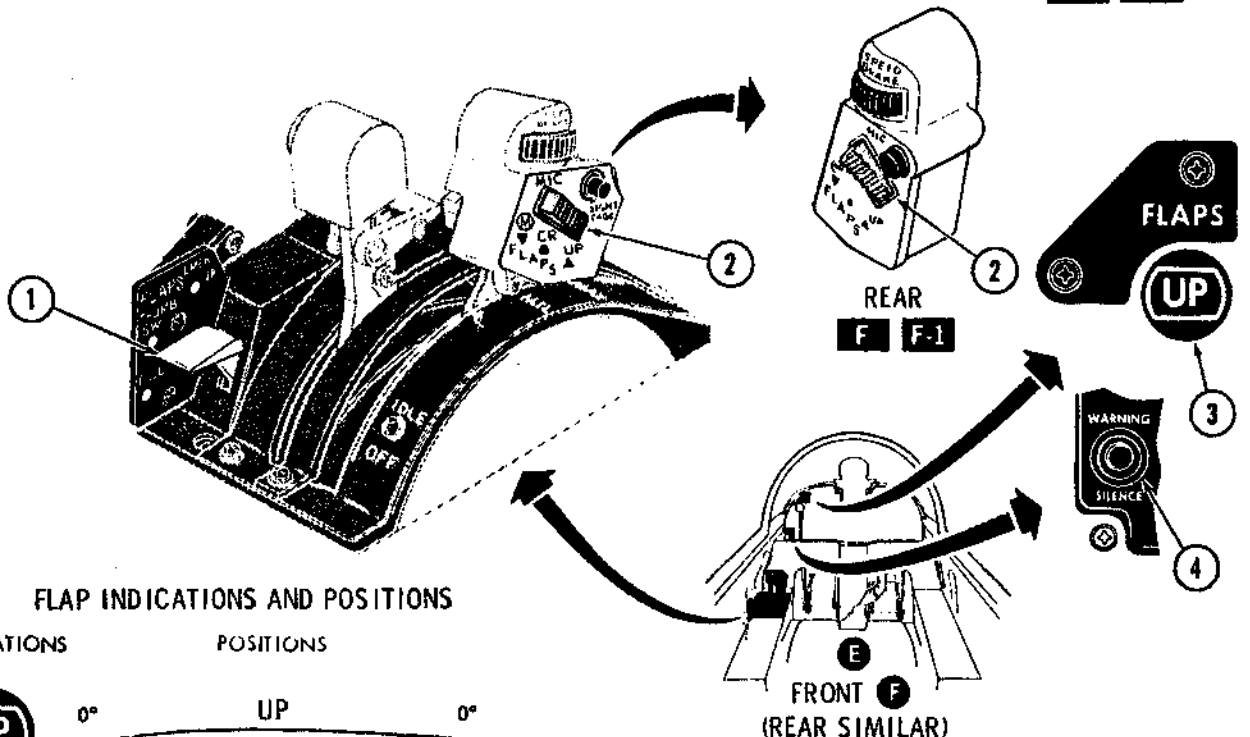
The flaps are controlled by either the flap lever on the throttle quadrant or by the thumb switch on the right throttle. The flap lever has three placarded settings: EMER (emergency) UP, THUMB SW, and FULL. Selecting EMER UP fully retracts the flaps. Selecting THUMB SW transfers control of the flaps to the thumb switch, which in turn has three placarded settings. The thumb switch settings and associated functions differ depending on the flap system installed, and are discussed separately below. Selecting FULL positions the flaps full down. In either flap system, the flap lever overrides all thumb switch settings when set to EMER UP or FULL. A flap indicator on the instrument panel provides visual indications of flap position when controlled by the flap lever, or selected thumb switch setting. See figure 1-51 or 1-52 for location and function of controls for the appropriate wing flap system.

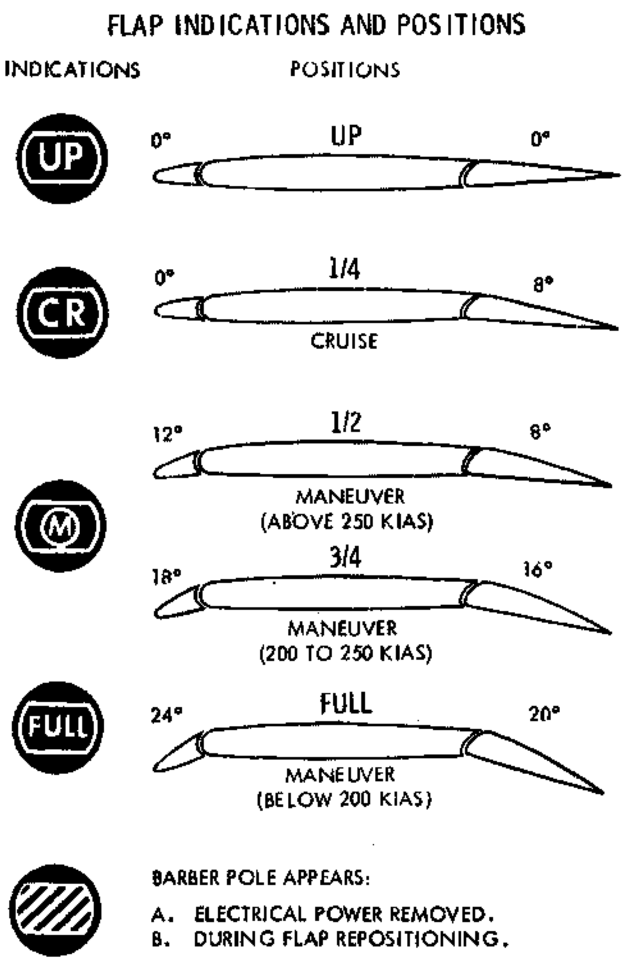
MANEUVER FLAP SYSTEM THUMB SWITCH OPERATION [E] [E-1] [E-2] [F] [F-1]

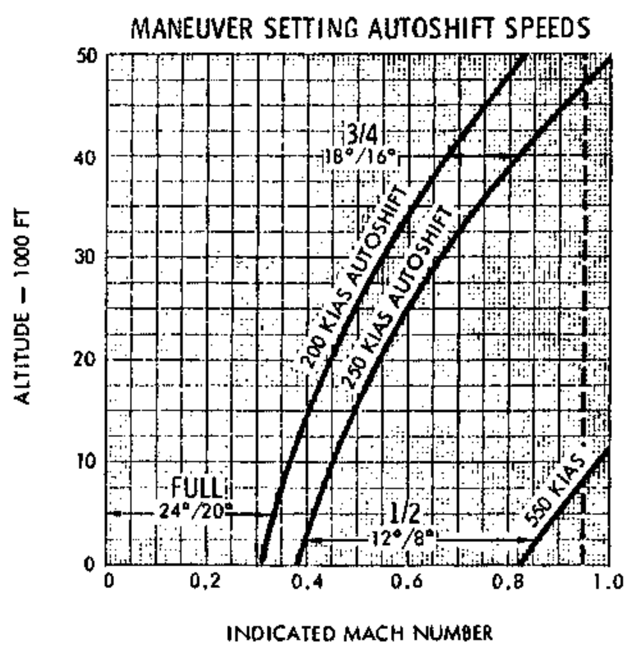
The maneuver flap system thumb switch (figure 1-51) has three settings placarded UP, CR (cruise), and M (maneuver). The up and cruise settings each command a single flap position while in the maneuver setting one of three possible flap positions is automatically determined

MANEUVER FLAP SYSTEM CONTROLS/INDICATOR

E E-1 E-2 F F-1







Note

WHEN REPOSITIONING FLAPS FROM UP TO FULL OR FULL TO UP, THE FLAPS INDICATOR SHOWS **M** MOMENTARILY AS FLAPS PASS THRU 1/2 12°/8° AND 3/4 18°/16° POSITIONS.

F-5 1-46(1)F

Figure 1-51.

MANEUVER FLAP SYSTEM CONTROLS/INDICATOR (Figure 1-51)

CONTROLS/INDICATORS	FUNCTION	
1 Flap Lever	EMER UP	— Flaps fully retract, overriding the flap thumb switch.
	THUMB SW	— Transfers flap control to flap thumb switch.
	FULL	— Flaps fully extend, overriding the flap thumb switch.
2 Flap Thumb Switch	UP	— Flaps fully retract.
	CR	— Trailing edge flap at cruise position.
	M	— Flaps at maneuver setting.
	Unmarked Center Position (Ⓕ Rear Cockpit)	— Transfers thumb switch control of flaps to front cockpit.
3 Flap Indicator	See figure 1-51 for flap indications vs flap position.	
4 Landing Gear and Flap WARNING SILENCE Button	Push (Momentary)	— Silences audible warning signal.

by signals from the central air data computer (CADC).

Flaps Up

In the UP setting, both leading and trailing edge flaps are fully retracted (0°/0°). Maximum range for all store configurations, and maximum endurance for an aircraft without stores is obtained with the flaps in the up position.

Cruise Flaps

In the CR setting, leading and trailing edge flaps are positioned at 0°/8°. This setting provides reduced fuel consumption and improved buffet control when the aircraft is flown at maximum endurance airspeed with stores loaded. Above 550 KIAS or 0.95 IMN, the CADC prevents extension of the flaps by the thumb switch or, if the flaps are extended, initiates a steady audible warning signal.

Maneuver Flaps

In the M setting, the flaps are automatically positioned by signals from the CADC. Above 550 KIAS or 0.95 IMN, the CADC prevents extension of the flaps by the thumb switch or, if the flaps are extended, initiates a steady audible warning signal. The audible warning signal may be silenced by retracting the flaps or pushing the warning silence button next to the gear lever. Maneuver flaps are used for takeoffs and landings, and may be used for inflight maneuvering. See figure 1-51 for maneuver flap autoshift speeds.

AUTO FLAP SYSTEM THUMB SWITCH OPERATION [E-3] [F-2]

The auto flap system thumb switch (figure 1-52) has three settings placarded UP, FXD (fixed), and AUTO (automatic). The UP setting commands a fully retracted flap position, while in FXD or AUTO setting variable flap positions are automatically determined by signals from the angle-of-attack (AOA) switching unit and/or the CADC.

Flaps Up

In the UP setting, both leading and trailing edge flaps are fully retracted (0°/0°). Maximum range for all store configurations is obtained with flaps in the UP position.

Fixed Flaps

Fixed flaps provide reduced fuel consumption and improved buffet control when the aircraft is flown at reduced speed for maximum endurance with stores loaded. In fixed flaps setting, flaps are automatically positioned by the CADC to half (12°/8°) below approximately 32,000 feet MSL and shift to one-quarter (0°/8°) when climbing thru 32,000 feet (±2000 feet). On descent, the flaps shift back to half at approximately 28,000 feet MSL (±2000 feet). Flaps automatically retract to up approaching 550 KIAS or 0.95 IMN, regardless of altitude. If flaps fail to retract upon reaching this speed, a steady audible warning signal sounds. The audible warning is silenced by retracting the flaps or pushing the warning silence button located next to the gear lever.

Auto Flaps

Automatic flap operation is normally used for all phases of maneuvering flight from takeoff thru landing. With AUTO selected, flaps automatically position to up (0°/0°), half (12°/8°), three-quarters (18°/16°), or full (24°/20°) by signals from the AOA switching unit and the CADC. Above 550 KIAS or 0.95 IMN, the CADC prevents extension of the flaps by the thumb switch regardless of AOA. If the flaps are already extended when approaching 550 KIAS or 0.95 IMN, they automatically retract to full up. If the flaps fail to retract approaching this speed, a steady audible warning will sound. The audible warning is silenced by retracting the flaps or pushing the warning silence button located next to the gear lever. See figure 1-53 for auto flap shift schedule. Flaps automatically position to full down any time the gear lever is in the LG DOWN position or the gear alternate release handle is pulled. The flap indicator will also transition from AUTO to FULL. A failure within the AOA switching unit (indicated by illumination of the AOA/FLAPS caution light), or a CADC failure causes the flaps to freeze in their attained position. If only the AOA switching unit fails, control of flaps is regained thru the FXD or UP settings of the thumb switch or use of the flap lever. With CADC failure, only the UP setting of the thumb switch or use of the flap lever controls flap positioning. Flaps also freeze in their attained position during gun firing with the thumb switch set at AUTO.

NOTE

AUTO setting should not be selected during enroute cruise. Turbulence may produce AOA excursions that reposition flaps to half. This results in a significant decrease in cruise range.

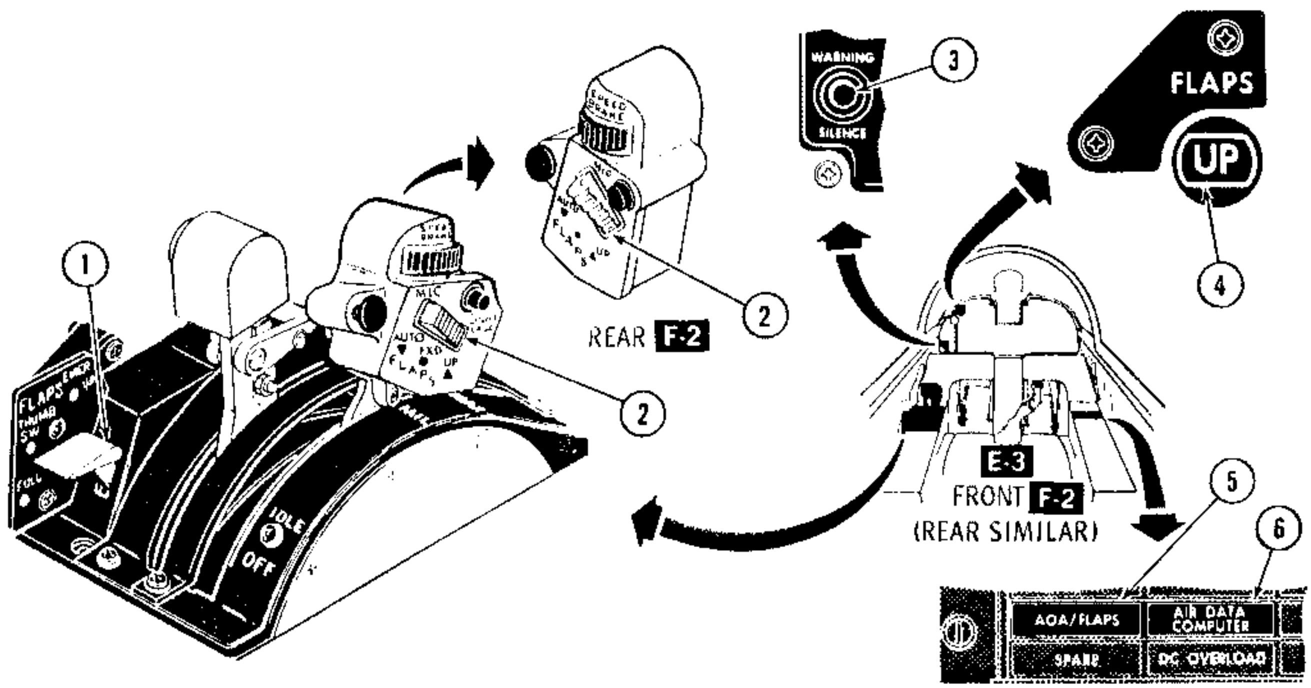
FLAP INDICATOR AND WARNING SIGNAL OPERATION

The flap indicator and warning signal operation for auto/maneuver flap conditions are as follows:

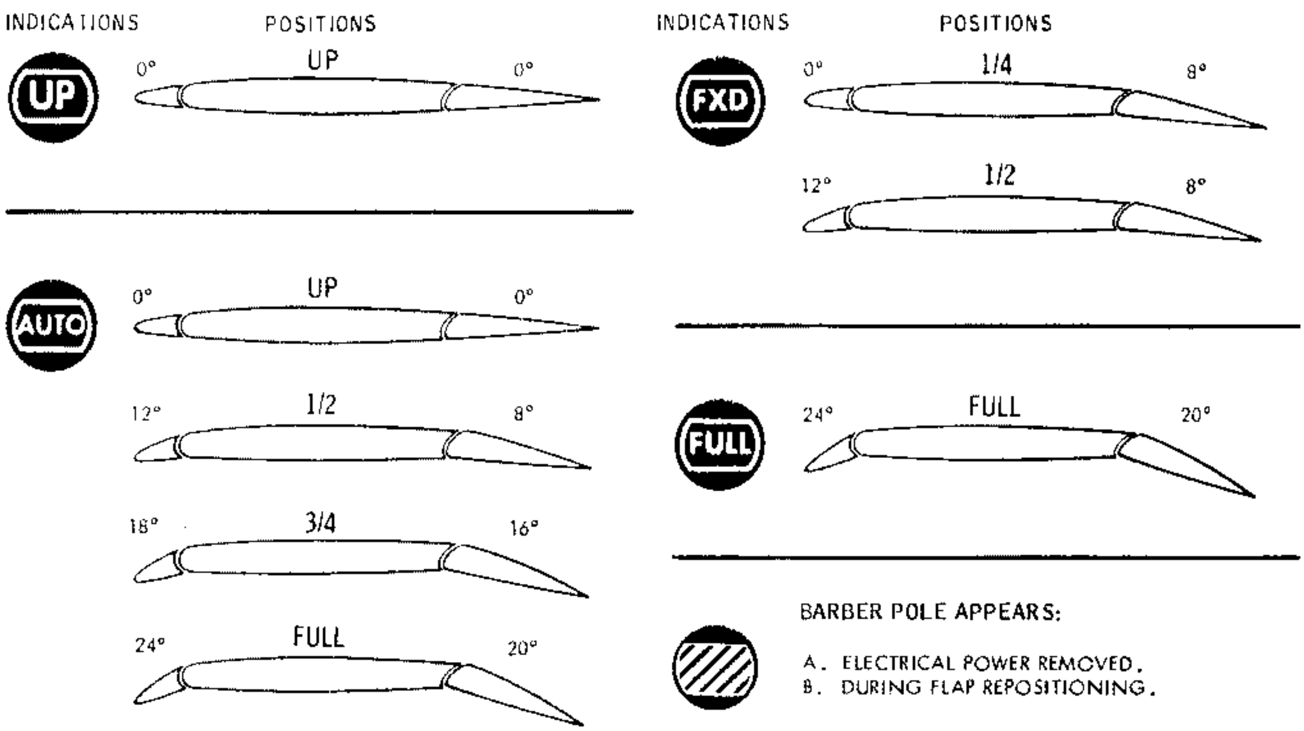
CAUTION

Ⓕ The audible warning signal may be masked by cockpit noise during low altitude, high speed flight.

AUTO FLAP SYSTEM CONTROLS/INDICATORS E-3 F-2



FLAP INDICATIONS AND POSITIONS



Note

WHEN REPOSITIONING FLAPS FROM UP TO FULL OR FULL TO UP, THE FLAP POSITION INDICATOR SHOWS BARBER POLE UNTIL FLAPS REACH THE SELECTED POSITION.

F-5 1-46(5)B

Figure 1-52.

AUTO FLAP SYSTEM CONTROLS/INDICATOR (Figure 1-52)

CONTROLS/INDICATORS	FUNCTION	
1 Flap Lever	EMER UP	— Flaps fully retract, overriding the flap thumb switch.
	THUMB SW	— Transfers flap control to flap thumb switch.
	FULL	— Flaps fully extend, overriding the flap thumb switch.
2 Flap Thumb Switch	UP	— Flaps fully retract.
	FXD	— Permits optimum automatic flap positioning for stores loaded loiter flight.
	AUTO	— Enables automatic operation of flaps.
	Unmarked Center Position (Ⓕ Rear Cockpit)	— Transfers thumb switch control of flaps to front cockpit.
3 Landing Gear and Flap WARNING SILENCE Button	Push (Momentary)	— Silences audible warning signal.
4 Flap Indicator	See figure 1-52 for flap indications vs flap positions.	
5 AOA/FLAPS Caution Light	On	— AOA switching unit failure. AUTO setting on flap thumb switch disabled.
6 AIR DATA COMPUTER Caution Light	On	— CADC unreliable. AUTO and FXD settings of flap thumb switch disabled.

FLAP CONDITION	BARBER POLE	AUDIBLE SIGNAL
Loss of CADC with maneuver/auto flaps selected	No	No
Exceeding 550 KIAS or 0.95 IMN (whichever is less) with flaps extended	No	Yes
Flap setting not in agreement with control position	No	No
Electrical power removed	Yes	No
Flaps repositioning (in transit)	Yes	No

FLAP SYSTEM CONTROL TRANSFER Ⓕ

The rear cockpit thumb switch has two placarded settings (M and UP in [F] [F-1], AUTO and UP in [F-2]), and an unmarked, springloaded center setting. The center setting allows thumb switch control of flaps from the front cockpit. Momentarily positioning the rear cockpit switch to M/AUTO or UP overrides front cockpit thumb switch control of the flaps. The flap system remains in the position selected by the rear cockpit thumb switch until another setting is selected in the rear cockpit, or the front cockpit thumb switch is cycled to another setting. However, holding the rear cockpit thumb switch in M/AUTO or UP overrides any cycling or repositioning attempt by the front cockpit thumb switch. Flap lever selection of EMER UP or FULL in either cockpit overrides thumb switch settings in either cockpit.

NOTE

For critical phases of flight, the front cockpit thumb switch should be set to reflect the flap position selected in the rear cockpit.

AUTO FLAP SHIFT SCHEDULE

E-3 F-2

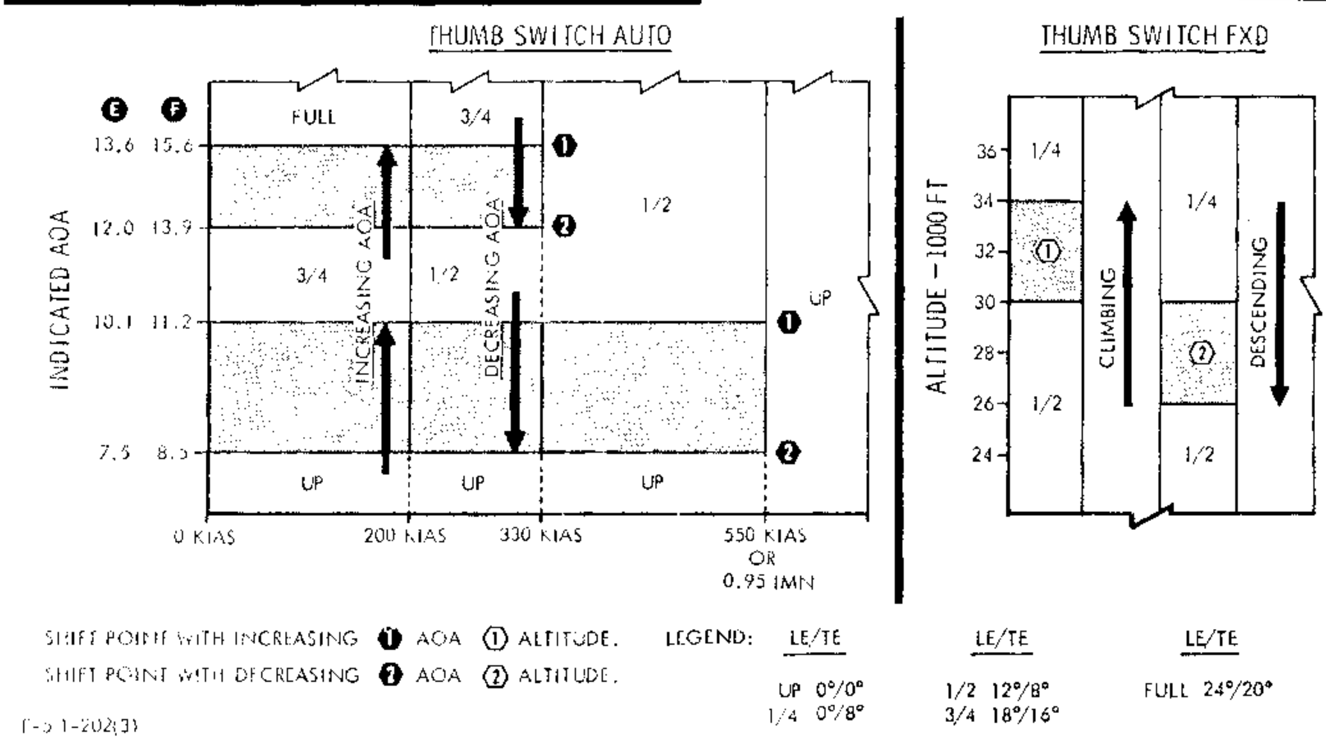


Figure 1-53.

FLIGHT CONTROL SYSTEM

The flight control system consists of an all-movable horizontal tail, ailerons, rudder, and a stability augmenter system. All control surfaces are actuated by dual hydraulic actuators, one powered by the utility hydraulic system and the other by the flight control hydraulic system. If either hydraulic system malfunctions, hydraulic power to the flight control system continues to be available. Artificial feel is built into the system, and electrical trim actuators change the relationship of the feel springs to the control stick. See figure 1-54 for location and function of all controls and indicators.

CONTROL STICK

The control stick incorporates a pitch and aileron trim button, weapon release button, trigger (Ⓕ inoperative in rear cockpit), dogfight button (E-1 E-3 F-1 F-2 dogfight/resume search switch), nosewheel steering button, and a pitch damper cutoff switch. The nosewheel steering button may be used as an alternate microphone button during flight, with landing gear up or down.

STABILITY AUGMENTER SYSTEM

The stability augmenter system (SAS) automatically positions the horizontal tail and rudder to damp out pitch and yaw oscillations and also provides manual rudder trim. With yaw damper off, rudder trim is inoperative and returns to neutral. The system is controlled by pitch and yaw damper switches and a pitch damper cutoff switch. The damper switches are electromagnetically held in the engaged positions and are springloaded to the off positions; and disengage automatically in case of certain system malfunctions or loss of ac power. The CADC senses airspeed and determines the amount of control surface movement required. The aircraft can be safely flown without augmentation throughout the entire flight envelope. However, augmentation improves handling characteristics and may be desirable for particular missions. A gun/rudder interconnect Ⓕ is provided to compensate for yaw

FLIGHT CONTROL SYSTEM CONTROLS/INDICATORS (TYPICAL)

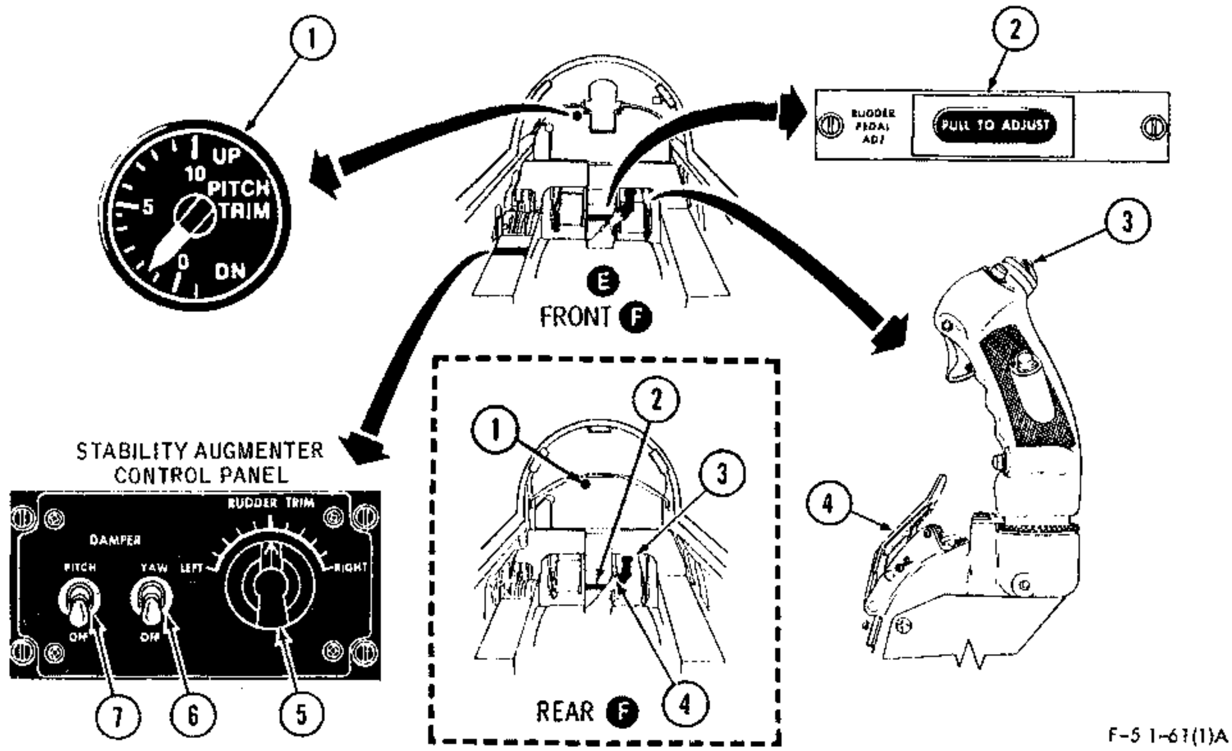


Figure 1-54.

FLIGHT CONTROL SYSTEM CONTROLS/INDICATORS (TYPICAL) (Figure 1-54)

CONTROLS/INDICATORS	FUNCTION	
1 PITCH TRIM Indicator	Indicates trim position of the horizontal tail from -1 to 10 increments.	
2 Rudder Pedal Adjust T-Handle	Pull	— Allows rudder pedal to be adjusted to desired position.
	Stow	— Locks rudder pedals in desired position. CAUTION Allowing handle to snap back may trip circuit breakers and cause the cable to kink and wear excessively.
3 Trim Button	Provides aileron trim in both directions and pitch trim from 10 increments nose-up trim to 1 increment nose-down trim.	
4 Pitch Damper Cutoff Switch	Squeeze	— Disengages the pitch damper.
5 RUDDER TRIM Knob	Provides rudder trim in 5 increments of trim either side of neutral. (Trim effective only when yaw damper switch is at YAW.)	
6 YAW DAMPER Switch	YAW	— Engages the yaw damper.
	OFF	— Disengages the yaw damper.
7 PITCH DAMPER Switch	PITCH	— Engages the pitch damper.
	OFF	— Disengages the pitch damper.

when the gun is fired. The system can be disengaged at any time during flight and may be re-engaged during flight provided the SAS limitations in section V are observed.

AILERON LIMITER

An aileron limiter, which is mechanically positioned by retraction of the landing gear, provides a spring stop which limits the aileron to one-half travel. To obtain full aileron travel of 35 degrees up and 25 degrees down, additional stick force must be applied to override the aileron spring stop. The aileron limiter is disengaged when the landing gear is in the extended position, allowing full aileron travel.

RUDDER TRAVEL

Maximum rudder deflection is 30 degrees either side of neutral with the landing gear extended or retracted; however, the amount of deflection during flight is a function of dynamic pressure force on the rudder surface and varies with airspeed and altitude.

HORIZONTAL TAIL TRAVEL

Maximum Ⓔ horizontal tail travel is 17 degrees up and 5 degrees down. Maximum Ⓕ horizontal tail travel is 20 degrees up and 5 degrees down.

PITOT-STATIC SYSTEM

The pitot-static system supplies both impact and static air pressure to the CADC and the airspeed/mach indicator. The altimeter and vertical velocity indicator receive only static pressure from the system.

ALTIMETER

Aircraft are equipped with one of the following altimeters: AAU-7A/A, AAU-19/A, or AAU-34/A.

AAU-7A/A

The AAU-7A/A is an aneroid altimeter which senses and indicates uncorrected altitude based on static pressure inputs from the pitot-static system. A setting knob at the lower left of the instrument face adjusts the altimeter setting and altitude indications. The AAU-7A/A does not receive corrected altitude inputs from the CADC.

AAU-19/A

The AAU-19/A altimeter (figures 1-9 thru 1-11) indicates up to 80,000 feet, and is settable to sea level pressures from 28.10 to 31.00 inches of mercury. Three drums indicate altitude in 10,000, 1000, and 100-foot increments in a three-digit display, with the last two zeros deleted. A single multi-turn pointer rotates around the dial, which is graduated from 0 to 1000 feet in 50 and 100-foot increments. The altimeter has a primary servoed (RESET) and a standby (STBY) operating mode. In primary mode, the altimeter displays corrected altitude computed by the CADC. In the standby mode, indicated by the STBY flag, the altimeter displays uncorrected altitude. The standby mode automatically takes over in the event of malfunction or CADC failure. The mode control lever is springloaded in a neutral position. To select operating mode, momentarily position the lever to the desired position (RESET or STBY).

AAU-34/A

The AAU-34/A altimeter (figures 1-12 thru 1-14) indicates up to 80,000 feet, and is settable to sea level pressures from 28.10 to 31.00 inches of mercury. Three drums indicate altitude in 10,000, 1000, and 100-foot increments in a five-digit display, with the last two zeros permanently displayed. A single multi-turn pointer rotates around the dial, which is graduated from 0 to 1000 feet in 20 and 100-foot increments. The altimeter has a primary servoed (ELECT) and a standby (PNEU) operating mode. In primary electrical mode, the altimeter displays corrected altitude computed by the CADC. In the standby pneumatic mode, indicated by the PNEU flag, the altimeter displays uncorrected altitude. The standby mode takes over automatically in the event of malfunction or CADC failure. The mode control lever is springloaded in a neutral position. To select operating mode, momentarily position the lever to the desired position (ELECT or PNEU).

NOTE

The AAU-34/A altimeter may trip from primary (ELECT) to standby (PNEU) mode during transonic flight condition. This is caused by transient pressure conditions within the pitot-static system, which does not affect CADC operation. However, allowable internal servo errors within the altimeter may be temporarily exceeded to cause the altimeter to revert to standby mode. When this occurs, normal primary mode of operation should be resumed by momentarily positioning the mode control lever to ELECT position.

AIRSPEED/MACH INDICATOR

The AVU-8 airspeed/mach indicator (figures 1-9 thru 1-14) indicates airspeed in knots from 80 to 850 and in mach number from 0.5 to 2.2 and is driven by the pitot-static system. The indicator includes a maximum allowable airspeed pointer (red) and an index setting pointer. The setting pointer is controlled by a knob in the lower right corner of the instrument.

CENTRAL AIR DATA COMPUTER

The central air data computer (CADC) converts raw air data inputs into computed outputs. See figure 1-55 for CADC functions. The CADC is equipped with a monitoring system which continually monitors the computing functions. Should a malfunction or failure occur, the AIR DATA COMPUTER light on the caution light panel comes on. However, failures within the pitot-static system may cause erroneous inputs to the CADC that are not indicated by caution light illumination.

ANGLE-OF-ATTACK SYSTEM

The angle-of-attack (AOA) system consists of a vane transmitter mounted on the fuselage, an AOA indicator and indexer in the cockpit (Ⓕ both cockpits), and in aircraft equipped with the auto flap system an AOA switching unit. With landing gear down, the system automatically provides angle-of-attack information thru displays on the AOA indicator and indexer. With landing gear up, angle-of-attack information is displayed only on the indicator. AOA transmitter information is also provided to the CADC for use by the optical sight system.

AOA SWITCHING UNIT [E-3] [F-2]

The AOA switching unit (figure 1-56) provides angle-of-attack data to the auto flap control. An AOA/FLAPS caution light on the caution light panel indicates failure of the AOA switching unit. The AOA indicator and indexer lights operate independently of the switching unit. Illumination of the AOA/FLAPS caution light has no effect on the indicator or indexer lights.

CADC FUNCTIONS (TYPICAL)

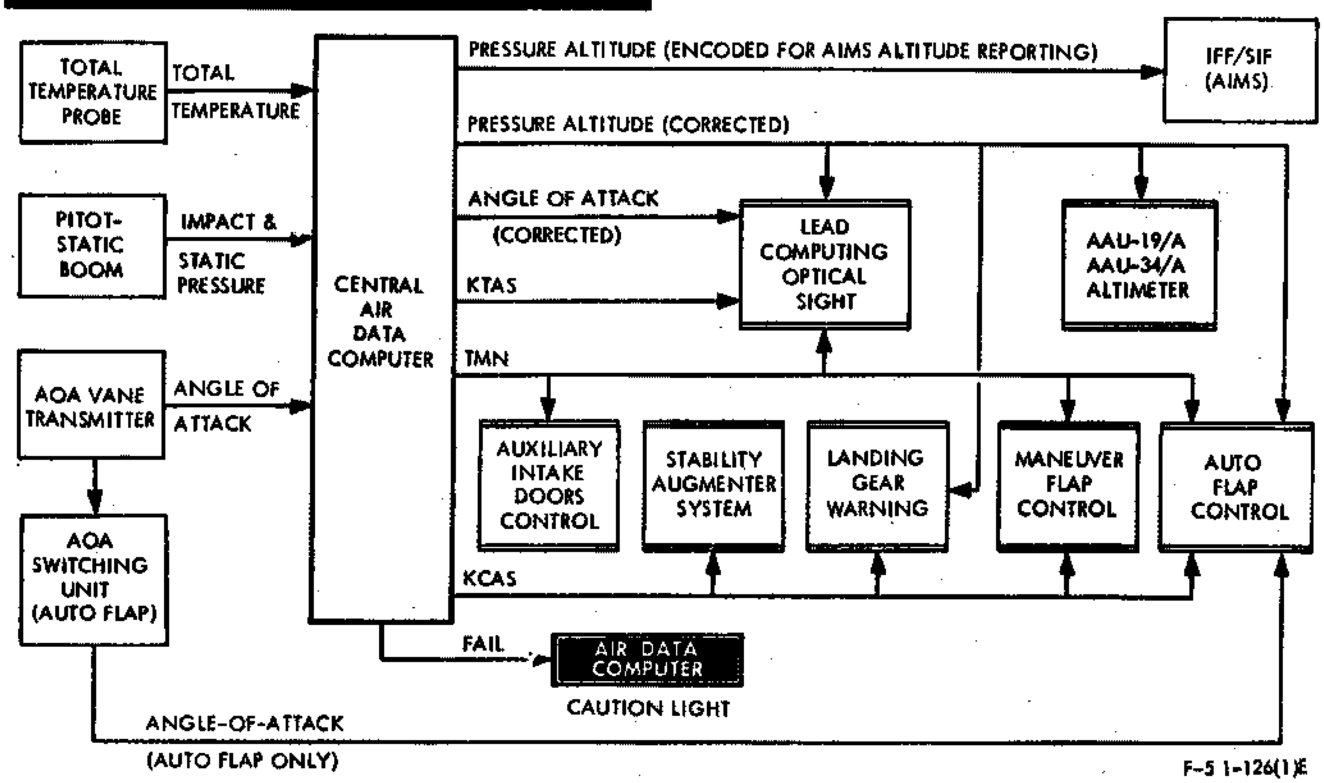
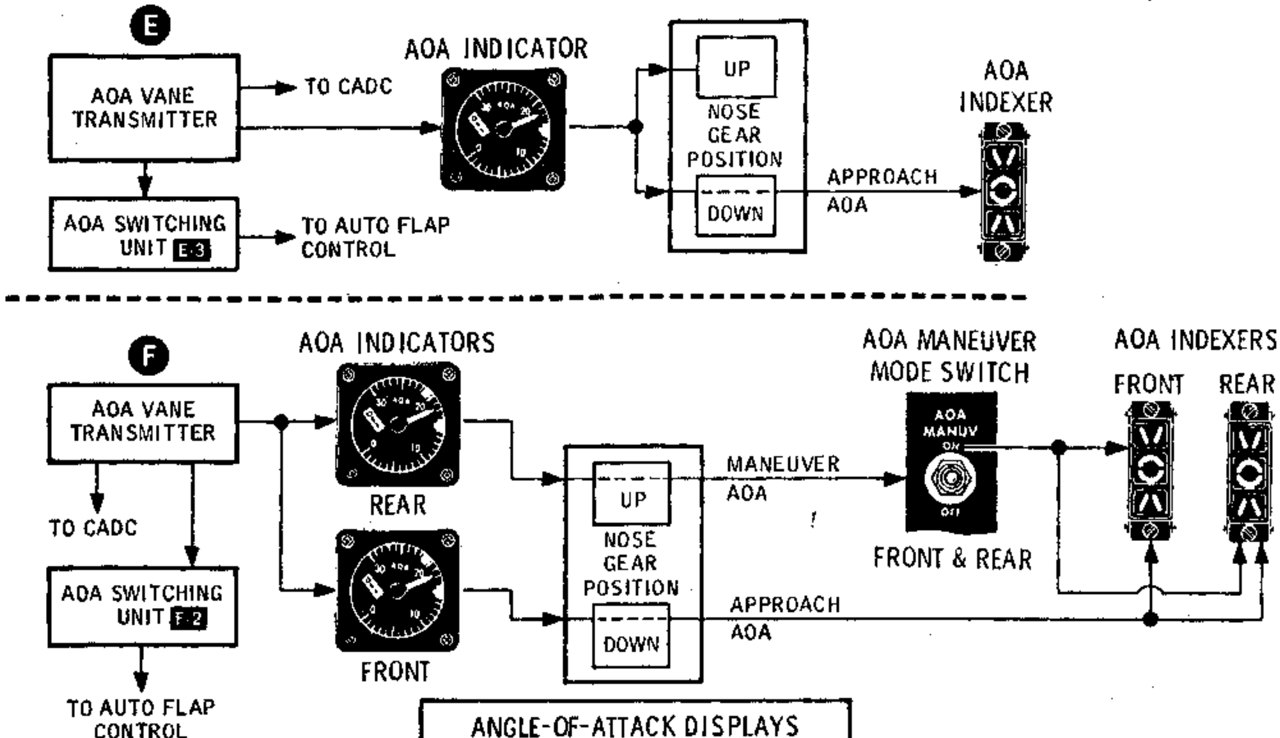


Figure 1-55.

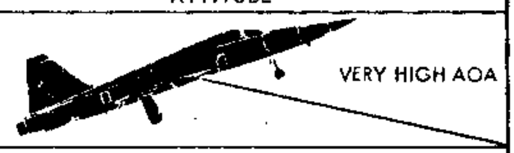
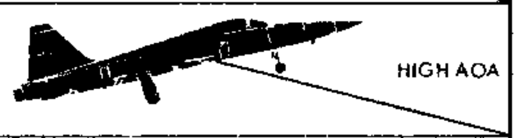
ANGLE-OF-ATTACK SYSTEM/DISPLAYS

Note
OFF FLAG APPEARS ONLY WHEN SYSTEM IS DEENERGIZED.

ANGLE-OF-ATTACK SYSTEM



ANGLE-OF-ATTACK DISPLAYS (GEAR AND FLAPS DOWN) (TYPICAL)

INDICATOR	INDEXER	AIRSPEED	ATTITUDE
	(RED)	SLOW	
	(RED) (GREEN)	SLIGHTLY SLOW	
	(GREEN)	ON SPEED	
	(GREEN) (YELLOW)	SLIGHTLY FAST	
	(YELLOW)	FAST	

F-5 1-21(20)D

Figure 1-56.

AOA INDICATOR

The AOA indicator is calibrated in units from 0 to 30 and operates in all phases of flight. The on-speed index on the face of the indicator is set at approximately 3-o'clock position (15.8 units) (figure 1-56), which is the optimum angle-of-attack for normal landing approaches with gear and flaps down. Each Ⓕ indicator has a maximum rate-of-turn index set at 21 units. When electrical power is removed from the AOA system, an OFF flag appears on the face of the AOA indicator.

AOA INDEXER

The AOA indexer provides a head-up display (figure 1-56) of angle-of-attack information in the form of three lighted symbols. The three lighted symbols include a RED chevron (upper) low-speed symbol, a GREEN (center) circle on-speed symbol, and a YELLOW chevron (bottom) high-speed symbol. Front cockpit Ⓕ AOA indicator controls both indexers when gear is down, and rear cockpit AOA indicator controls both indexers when gear is up. The Ⓔ AOA indexer is operative only when the landing gear is down.

AOA MANEUVER MODE SWITCH Ⓕ

Each cockpit has an AOA maneuver mode switch on the left trim panel (figures 1-22, 1-23, 1-25, and 1-26), placarded ON and OFF and springloaded to the center (neutral) position. Momentarily placing either switch to the ON position, with the landing gear up, activates both front and rear indexer lights. The indexer lights can be turned off by moving either switch from the center position to the OFF position while the gear is up. With the landing gear down, AOA maneuver mode switch is inoperative.

NOTE

- Due to time delay in system, aircraft may have passed thru maximum rate-of-turn angle-of-attack before indexers and indicators display this information. However, accurate information is displayed when maximum rate-of-turn angle-of-attack is entered with smooth, not too rapid, application of flight controls.
- If the indexer lights are on when the gear is moved from the up to the down position, they may flash on and off until approach information is displayed.

ATTITUDE AND HEADING REFERENCE SYSTEM

The attitude and heading reference system (AHRS) (figures 1-57 and 1-58) includes the attitude sensing and indicating subsystem, the heading and navigation subsystem, and the standby instruments. The attitude sensing and indicating subsystem consists of an attitude indicator (AI) or attitude director indicator (ADI), and rate switching gyro to control and coordinate functioning of the subsystem. The heading and navigation subsystem consists of a horizontal situation indicator (HSI), a compass switch, and magnetic azimuth detector and compensator. Standby instruments consist of the standby attitude indicator and the magnetic compass. A power cutoff switch behind the headrest (Ⓕ rear seat headrest) labeled ATT & HDG POWER, used for ground maintenance system check, controls aircraft electrical power to the AHRS and shall be positioned at ON for flight.

ATTITUDE REFERENCE CONTROLS/INDICATORS

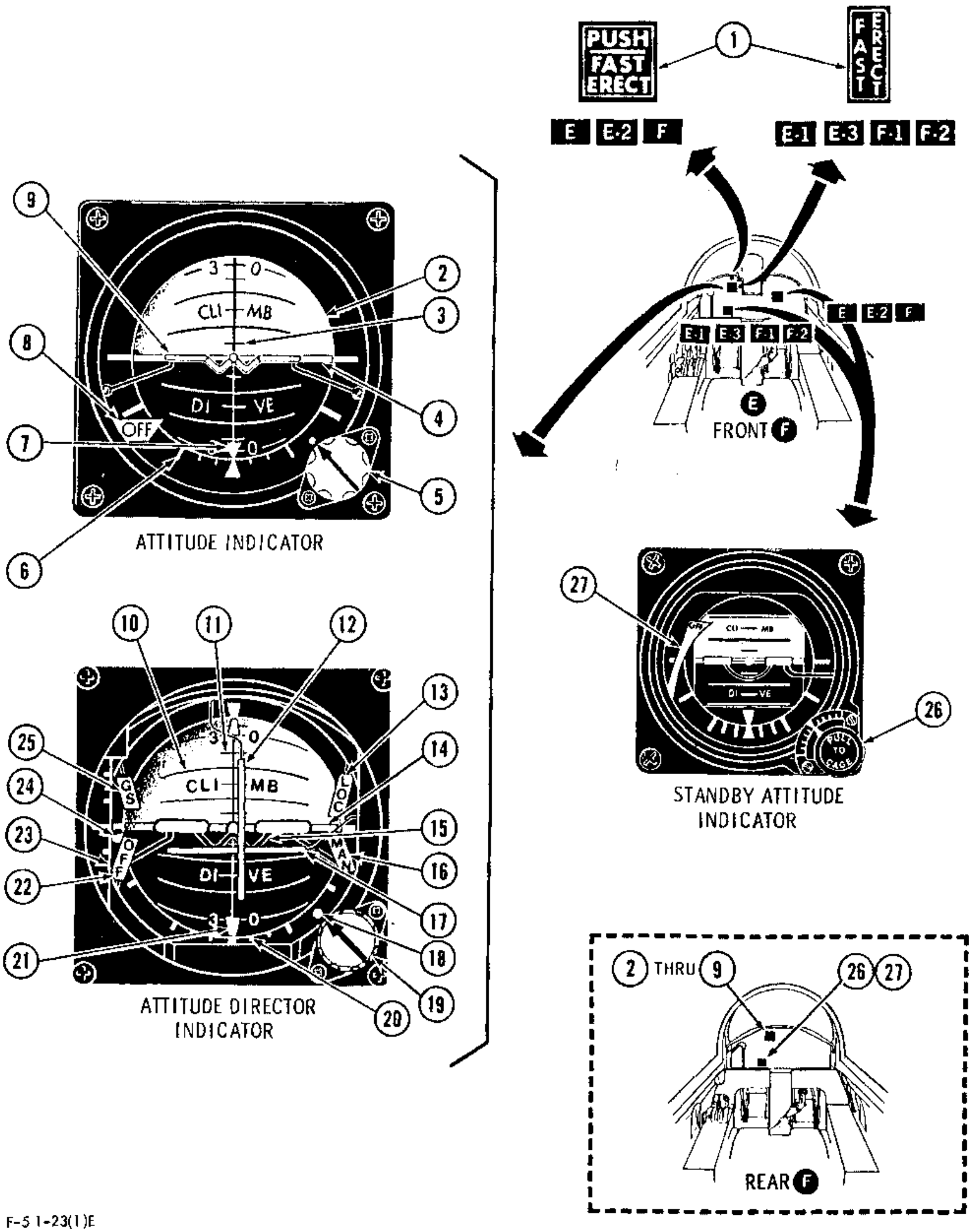


Figure 1-57.

ATTITUDE REFERENCE CONTROLS/INDICATORS (Figure 1-57)

CONTROLS/INDICATORS	FUNCTION	
1 PUSH FAST-ERECT Switch (FAST ERECT [E-1] [E-3] [F-1] [F-2])	Push and Hold	— Provides fast erection of the AI or ADI at a minimum rate of 15 degrees per minute.
ATTITUDE INDICATOR (2 thru 9)		
2 Attitude Sphere	Position relative to miniature aircraft and horizon bar shows pitch and roll attitude.	
3 Pitch Reference Scale	Measures pitch attitude in 5-degree increments.	
4 Horizon Bar	Indicates horizon.	
5 Pitch Trim Knob	Adjusts position of horizon bar relative to miniature aircraft.	
6 Bank Scale	Reference scale for measurement of bank angle in 10-degree increments.	
7 Bank Pointer	Indicates bank angle in conjunction with bank scale.	
8 Attitude Warning Flag	OFF	— In view if electrical power to instrument is interrupted or has failed, and during fast erect cycle, including first 90 seconds after initial power application.
9 Miniature Aircraft	Fixed reference symbol to indicate attitude of aircraft.	
ATTITUDE DIRECTOR INDICATOR (10 thru 25)		
10 Attitude Sphere	Position relative to miniature aircraft and horizon bar shows pitch and roll attitude.	
11 Pitch Reference Scale	Measures pitch attitude in 5-degree increments.	
12 Bank Steering Bar	In ILS mode, functions as course deviation indicator and indicates lateral deviation from selected localizer course.	
13 Localizer Warning Flag	LOC	— Indicates ILS localizer course indications unreliable.
14 Horizon Bar	Indicates horizon.	
15 Miniature Aircraft	Fixed reference symbol to indicate aircraft attitude.	
16 Manual Mode Flag	MAN	— In view when electrical power is off. Out of view when power is on.

ATTITUDE REFERENCE CONTROLS/INDICATORS (Figure 1-57) (Continued)

CONTROLS/INDICATORS	FUNCTION
17 Pitch Steering Bar	In ILS mode, functions as a glide-slope indicator displaying vertical deviation from glide slope.
18 Pitch Trim Index	Index for zero pitch trim.
19 Pitch Trim Knob	Adjusts position of horizon bar relative to miniature aircraft.
20 Bank Scale	Reference scale for measurement of bank angle in 10-degree increments.
21 Bank Pointer	Indicates bank angle in conjunction with bank scale.
22 Attitude Warning Flag	OFF — In view, if electrical power to the instrument is interrupted or has failed, and during fast erect cycle, including first 90 seconds after initial power application.
23 Glide-Slope Scale	Indicates angular vertical displacement above or below glide slope. Each mark indicates 0.25 degree.
24 Glide-Slope Pointer	Indicates glide-slope position and amount of vertical deviation relative to aircraft.
25 Glide-Slope Warning Flag	GS — In view if glide-slope indications unreliable.
STANDBY ATTITUDE INDICATOR (26 and 27)	
26 PULL TO CAGE/Pitch Trim Knob	Pull and Release — Permits initial erection of gyro. Gyro erects to true vertical within 3 minutes. Pull and Turn — Locks in cage position. Turn while In — Adjusts position of miniature aircraft up or down.
27 OFF Flag	In view when electrical power is removed and when caging trim knob is pulled out.

HEADING REFERENCE CONTROLS/INDICATORS

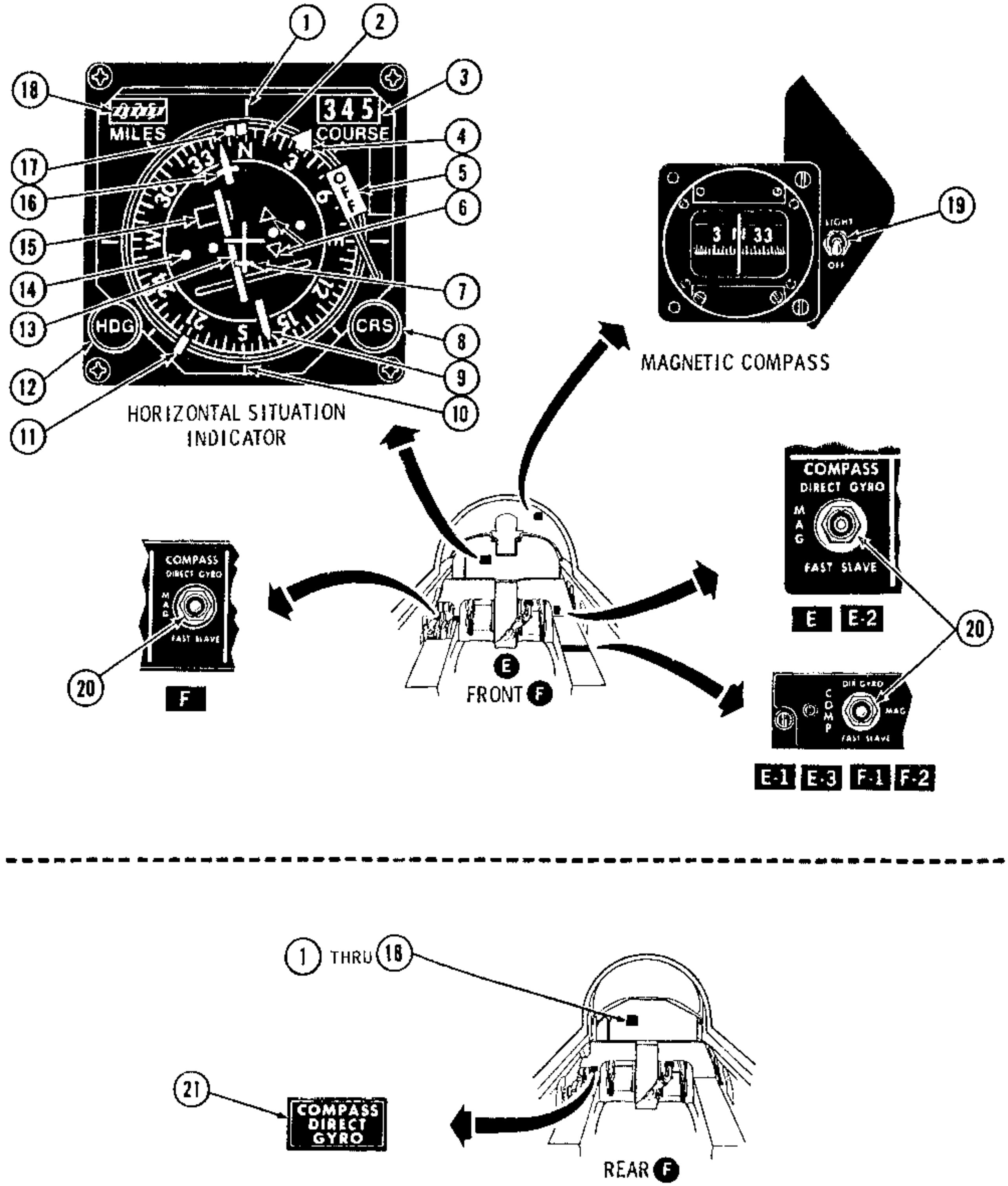


Figure 1-58.

HEADING REFERENCE CONTROLS/INDICATORS (Figure 1-58)

CONTROLS/INDICATORS	FUNCTION
HORIZONTAL SITUATION INDICATOR (1 thru 18)	
1 Upper Lubber Line	Indicates aircraft heading on compass card.
2 Compass Card	Reference scale for course, heading, and bearing indications.
3 Course Selector Window	Displays course selected by CRS set knob.
4 Bearing Pointer (Head)	Indicates magnetic bearing to selected TACAN station or UHF/ADF transmitter.
5 OFF Flag	OFF — Display occurs only when electrical power to the instrument is interrupted or has failed.
6 TO/FROM Indicator (Triangular Windows)	Position of white triangle indicates whether selected course is to or from the station: If same side as course arrow head — TO; if same side as course arrow tail — FROM.
7 Aircraft Symbol	Represents aircraft position and direction of movement relative to selected course.
8 CRS (Course Set Knob)	Positions course arrow. Course in degrees appears in course selector window.
9 Course Arrow (Tail)	Indicates reciprocal of selected course.
10 Lower Lubber Line	Indicates reciprocal of aircraft heading on compass card.
11 Bearing Pointer (Tail)	Indicates reciprocal of magnetic bearing.
12 HDG (Heading Set Knob)	Positions heading marker in all modes.
13 Course Deviation Indicator (CDI) (Center section of course arrow)	Indicates position of, and amount of lateral deviation from, selected TACAN or localizer course.
14 Course Deviation Scale	Indicates position left or right of selected course. Each dot indicates course deviation of 5 degrees in TACAN, 1.25 degrees in ILS.
15 Deviation/DF Window	Blank — Indicates normal operation and valid indications in TACAN mode. Red Flag — Indicates invalid indications in TACAN mode, loss of electrical power, or instrument malfunction. DF — Indicates ADF mode of operation.

HEADING REFERENCE CONTROLS/INDICATORS (Figure 1-58) (Continued)

CONTROLS/INDICATORS	FUNCTION	
16 Course Arrow (Head)	Indicates selected course; manually set by rotating CRS set knob.	
17 Heading Marker	Indicates desired heading when manually set. Once set, the marker remains fixed relative to card.	
18 Range Indicator & Warning Flag	Numeric Display	— Displays slant range (nm) to or from selected TACAN station.
	Warning Flag Display	— Selected station is out of range, electrical power failure, instrument malfunction, or ADF selected.
MAGNETIC COMPASS (19)		
19 LIGHT Switch	LIGHT	— Turns on magnetic compass light. (Engine instrument light control knob out of OFF.)
	OFF	— Turns off light.
20 COMPASS (COMP) Switch (Ⓕ Front Cockpit)	DIRECT (DIR) GYRO	— The compass card maintains orientation to the last magnetic north azimuth. Magnetic sensing is not available and heading displayed is based solely on gyro stability.
	MAG	— (Normal operation) — Switching from DIRECT GYRO to MAG automatically fast slaves the compass card to indicate the correct magnetic heading. The card remains oriented to magnetic north.
	FAST SLAVE (Momentary)	— Erects the compass card to magnetic north orientation within 25 seconds. **NOTE** The aircraft should be maintained in straight and level, unaccelerated flight for at least 30 seconds whenever using FAST SLAVE, or returning to MAG from DIRECT GYRO, or after ac power interruption. Wait 2 minutes between consecutive fast slave cycle attempts.
21 Ⓕ Compass Mode Indicator Light (Rear Cockpit)	On	— Indicates compass switch in front cockpit is in DIRECT GYRO position.

ATTITUDE INDICATOR

The ARU-20/A attitude indicator (AI) (Ⓕ both cockpits) (figure 1-57) is gyro-stabilized to show aircraft pitch and roll attitude. The attitude sphere is stabilized by the displacement gyros (two-gyro platform) powered by the left ac bus and the dc bus. The AHRS rate gyro provides electrical inputs to the displacement gyros so that the attitude sphere maintains position thru a full 360 degrees of pitch and roll. The AI can be tumbled by power interruptions which cause an OFF flag to appear in the lower left of the indicator face. If power failure occurs in any flight condition other than straight and level, the AI may erect to a false vertical when power is returned. The FAST-ERECT switch on the instrument panel next to the AI (Ⓕ front cockpit) is provided to expedite gyro erection. When the switch is pressed and held the attitude sphere and the horizon bar on the radar indicator, when turned on, erect. Inflight erection should be accomplished only in straight and level, unaccelerated flight. The attitude sensing subsystem provides pitch and roll signals to the fire control radar and roll signals to the lead computing optical sight.

ATTITUDE DIRECTOR INDICATOR

The attitude director indicator (ADI) (figure 1-57) is gyro-stabilized to show aircraft pitch and roll attitude. The rate gyro provides electrical inputs to the displacement gyros to stabilize the attitude sphere thru a full 360 degrees of pitch and roll. The ADI can be tumbled by power interruptions which cause an OFF flag to appear at the lower left of the indicator face. If failure occurs in any condition other than straight and level flight, the ADI may erect to a false vertical when power is returned. The ADI also includes pitch and bank steering bars and localizer (LOC) and glide slope (GS) warning flags. In ILS mode the pitch and bank steering bars function as a course deviation indicator and a glide-slope indicator, displaying only course and glide-slope deviation. The LOC and GS warning flags provide warning of failures of the localizer or glide-slope functions of the ILS. The ADI is powered by the left ac bus.

HORIZONTAL SITUATION INDICATOR

The HSI (figure 1-58) (Ⓕ both cockpits) indicates heading, course, range to destination, bearing to selected ground navigation aids, course deviation, and system status. The instrument consists of an aircraft symbol, a compass card graduated in 5-degree increments, a bearing pointer, lubber lines (upper and lower), a course arrow, course selector window, course deviation indicator (CDI), TO/FROM indicator, course (CRS) set knob, heading (HDG) set knob, an OFF flag, and a Deviation/DF window. The Deviation DF window and OFF flag provide HSI status indications. The HSI is powered by the left ac bus.

Heading Information

A three-position compass mode switch (figure 1-58) determines the heading displayed on the compass card of the HSI. With the compass switch at MAG (normal operating position), gyro-stabilized magnetic heading derived from a remote magnetic azimuth detector appears under the upper lubber line, with reciprocal heading displayed under the lower lubber line. When the compass switch is positioned at DIRECT GYRO, magnetic azimuth detector input is removed, and the compass card maintains free-gyro orientation to whatever heading exists at the time DIRECT GYRO is selected. If DIRECT GYRO is selected when the compass card is not properly slaved to magnetic north, the compass card is stabilized but indicates incorrect magnetic heading, and the standby magnetic compass must be used for correct heading information. In FAST SLAVE, the compass card slaves within 25 seconds to magnetic north orientation. When the course arrow is set, it remains aligned (parallel) with the radial or localizer course selected, providing the compass card is slaved to magnetic north.

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

CAUTION

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

Aircraft Symbol

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

TACAN and UHF/ADF Operation

When a TACAN channel is selected and with the compass in MAG mode, the head of the bearing pointer indicates magnetic bearing and the range indicator displays slant range to the station. When the course to the station is selected with the course set knob, a white triangle appears on the same side as head of course arrow (indicating TO), the CDI displays aircraft position relative to the selected course, and the Deviation/DF window is blank. When ADF is selected, the bearing pointer indicates relative bearing to selected ground or airborne station. In this mode, the Deviation/DF window displays DF, the CDI centers, and the range indicator warning flag appears.

VOR/ILS Operation

When the NAV MODE selector is positioned at VOR/ILS and a VOR frequency selected, the navigation mode indicator displays VOR. With compass in MAG mode, the head of the bearing pointer indicates magnetic bearing to the station. When the course to the station is selected with the course set knob, a white triangle appears on the same side as head of course arrow (indicating TO) and CDI displays aircraft position relative to the selected course. When an ILS frequency is selected, the navigation mode indicator displays ILS and the bearing pointer on the HSI stows at approximately 4 o'clock. The CDI displays localizer course position relative to the aircraft.

STANDBY ATTITUDE INDICATOR

The standby attitude indicator (ARU-32/A or ARU-42/A-1) (figure 1-57) is a self-contained indicator that provides a visual indication of the bank and pitch of the aircraft and should be used when the attitude indicator or AHRS fails. The pitch limits are 92 degrees in climb, 78 degrees in dive, and the roll capability is a full 360 degrees. Approximately 3 minutes are required to erect to true vertical after power is applied to the system. The indicator should be caged and locked before power is applied to the system, uncaged and set following engine start and left uncaged for the remainder of the flight. It should be caged and locked prior to removing power from the system. The standby attitude indicator is powered by the 28-volt dc bus. When power is interrupted or the indicator is caged, the OFF warning flag appears on the face of the indicator. Approximately 9 minutes of useful attitude information is provided after power failure.

WARNING

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

CAUTION

Avoid snap-releasing the cage and trim knob after setting to prevent damage to the indicator.

MAGNETIC COMPASS

A magnetic (standby) compass on the upper right windshield frame (figure 1-58) (Ⓕ front cockpit) is provided for use if the primary navigation systems fail. Illumination of the compass is controlled by a switch on the compass mount when the engine instrument light control knob on the lighting control panel is turned on. Compass correction cards are in the holders on the right interior trim panel of the cockpit (figures 1-3, 1-4, and 1-6 thru 1-8) and rear cockpit pedestal (F) (figure 1-28).

COMMUNICATION AND NAVIGATION EQUIPMENT

The communication and navigation equipment are listed in figure 1-59. See figure 1-38 for electrical power requirements.

INTERCOMMUNICATION SYSTEM

The intercom system provides headset amplification for the UHF radio, the radio-navigation systems, flaps and landing gear audio warning signals, the AIM-9 missile tones, cockpit-to-ground crew, and cockpit-to-cockpit communications.

CONTROL TRANSFER (COMM/NAV) Ⓕ

The COMM/NAV control transfer system allows transfer of cockpit operating control of either or both the UHF and navigation radio sets. The system consists of a UHF radio transfer switch and navigation transfer switch in the front cockpit and a UHF and navigation override switch in the rear cockpit. See figure 1-60, sheets 1 and 2 for location and function of controls.

UHF RADIO

Aircraft are equipped with either the AN/ARC-150 UHF radio or the AN/ARC-164 UHF radio. The UHF radio provides two-way voice communication at line-of-sight range. An interface with an AN/ARA-50 UHF/ADF provides direction-finding capability. Twenty UHF frequencies may be preset and selected by the preset channel selector control. The system includes a transceiver, a guard receiver, a control panel (Ⓕ both cockpits), an antenna selector switch (Ⓕ front cockpit), and upper and lower antennas. Frequency range is 225.00 to 399.975 megahertz. A total of 7000 frequencies, spaced 25 kilohertz (0.025 megahertz) apart, may be dialed by using the manual frequency selector knobs and windows. The right window contains the digits 00, 25, 50, or 75. The ARC-150 and ARC-164 radios operate in the same manner and are interchangeable. See figure 1-60, sheets 1 and 2 for location and function of controls.

CAUTION

To preclude damage to the transmitter, do not key ARC-150 or ARC-164 transmitter while changing frequencies.

NOTE

On aircraft equipped with antenna selector switch incorporating AUTO mode position, replacement of ARC-164 with ARC-150 radio causes automatic antenna selection to operate improperly. Manual selection of UPPER and LOWER position is required. AUTO position may be placarded INOP (inoperative) when ARC-150 is installed.

DUAL UHF RADIOS

Some F-2 aircraft are equipped with a second ARC-164 UHF radio with control head in front cockpit only. This second (No. 2) radio functions identically to the No. 1, and is also powered by the dc bus. To accommodate the second radio the antenna selector switch (front cockpit only) is modified and a transmit selector switch is added to each cockpit. The COMM TRANSFER and COMM/NAV OVERRIDE switches provide their normal function only for the No. 1 radio. See figure 1-60, sheet 3 for location and function of controls.

COMMUNICATION / NAVIGATION EQUIPMENT

TYPE	DESIGNATION	USE	OPERATOR	RANGE	CONTROL LOCATION
INTERCOM	AN/AIC-18 AN/AIC-25	Crew intercommunication; flight crew and ground personnel intercommunication when aircraft is parked.	(E) Pilot. (F) Both crewmembers.	Cockpit(s) and exterior when interphone receptacle is used.	(E) None. (F) Pedestal – both cockpits.
UHF RADIO	AN/ARC-150 AN/ARC-164	Air-to-air and air-to-ground communication.	(E) Pilot. (F) Both crewmembers.	Line of sight.	(E) Pedestal. (F) Pedestal – both cockpits.
[F-2] NO. 2 UHF RADIO	AN/ARC-164		Pilot.		Right console – front cockpit
TACAN	AN/ARN-118	Bearing and range information. Reception of coded identification signals.	(E) Pilot. (F) Both crewmembers.	Bearing and DME range 200 NM line of sight. (Air-to-air DME range 250 NM).	(E) Pedestal. (F) Pedestal – both cockpits.
[E] [F-2] VOR/ILS (LOCALIZER, GLIDE-SLOPE, MARKER BEACON)	AN/ARN-127	VOR bearing and course information. Localizer course and glide-slope guidance. Marker beacon light identification reception.	Pilot	VOR - Line of sight 130 nm. Localizer course - 18 nm within 10° of centerline. Glide-slope-10nm. Marker beacon-vertical.	Right console and pedestal.
UHF/ADF	AN/ARA-50	Bearing information to ground or airborne UHF station.	(E) Pilot. (F) Both crewmembers.	Line of sight.	(E) Pedestal. (F) Pedestal – both cockpits. [F-2] Right console – front cockpit
IFF/SIF	AN/APX-72 AN/APX-101	Automatic coded replies to ground interrogation for aircraft identification and air traffic control.	(E) Pilot. (F) Front cockpit crewmember.	Line of sight.	(E) Right console. (F) Right console – front cockpit.
RADAR TRANSPONDER (SKYSPOT) (I)	SST-181X	Automatic radar identification of aircraft for tracking by ground radar.	(E) Pilot. (F) Front cockpit crewmember.	Line of sight.	[E] [F-2] Right vertical panel. [F] Left console – front cockpit.
(F) CONTROL TRANSFER SYSTEM	——	Enables either cockpit to control operation of communication/navigation equipment. Rear cockpit has override capability.	Both crewmembers.	Intercockpit.	Right console – front cockpit. Left vertical – rear cockpit (override).

ANTENNA LOCATIONS

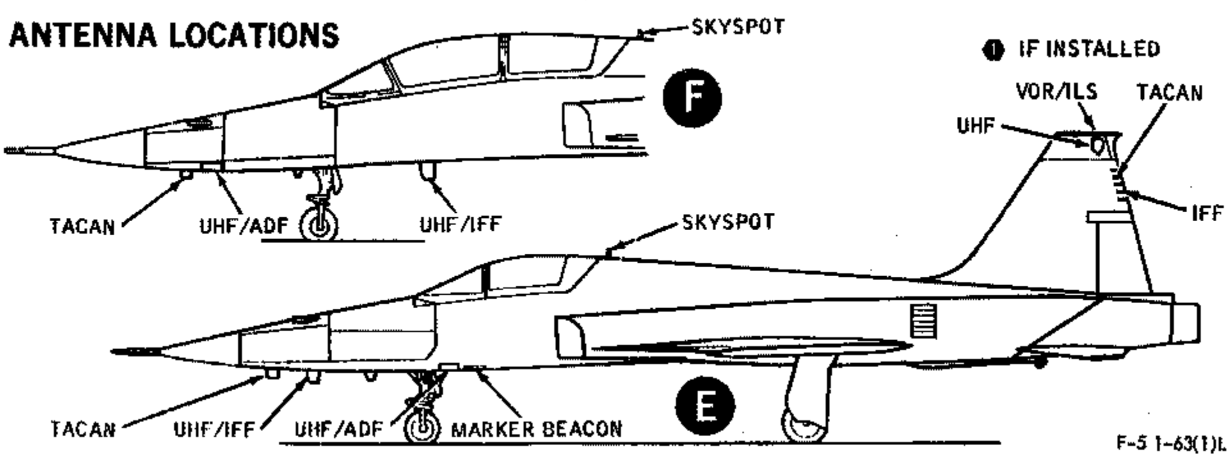


Figure 1-59.

COMMUNICATIONS CONTROLS (TYPICAL) E E-2 F

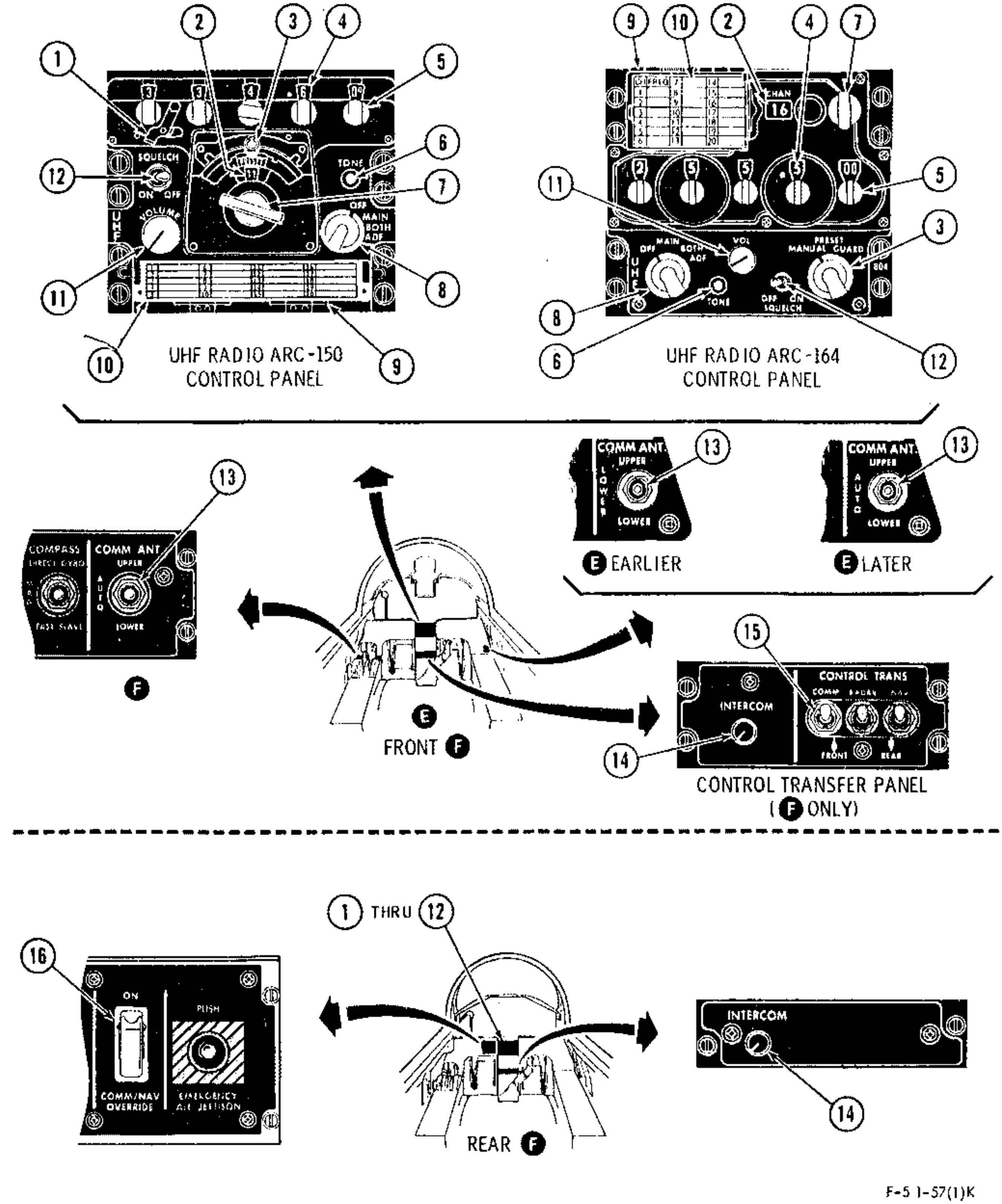


Figure 1-60 (Sheet 1).

COMMUNICATIONS CONTROLS

E-1 E-3 F-1 F-2

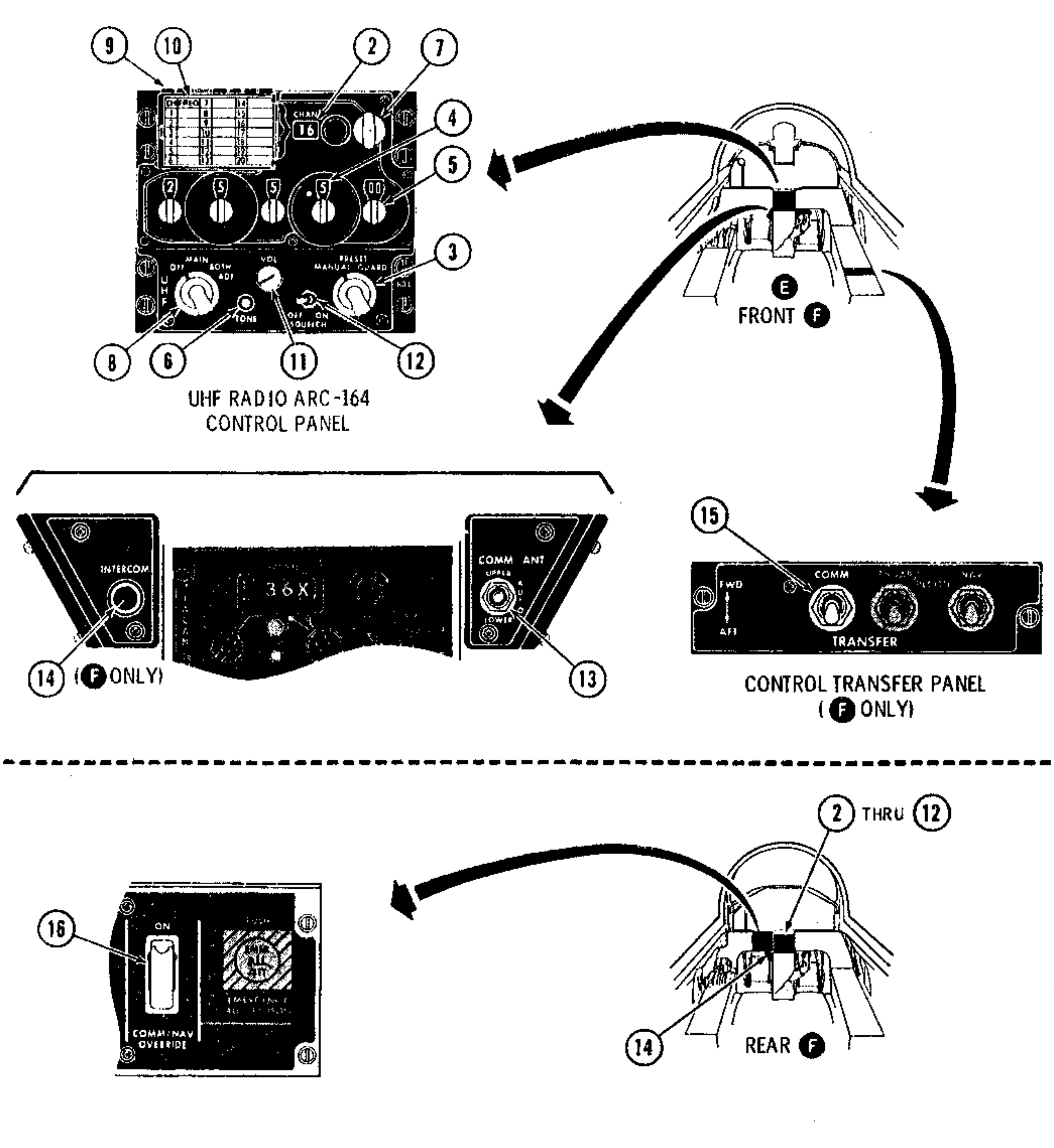
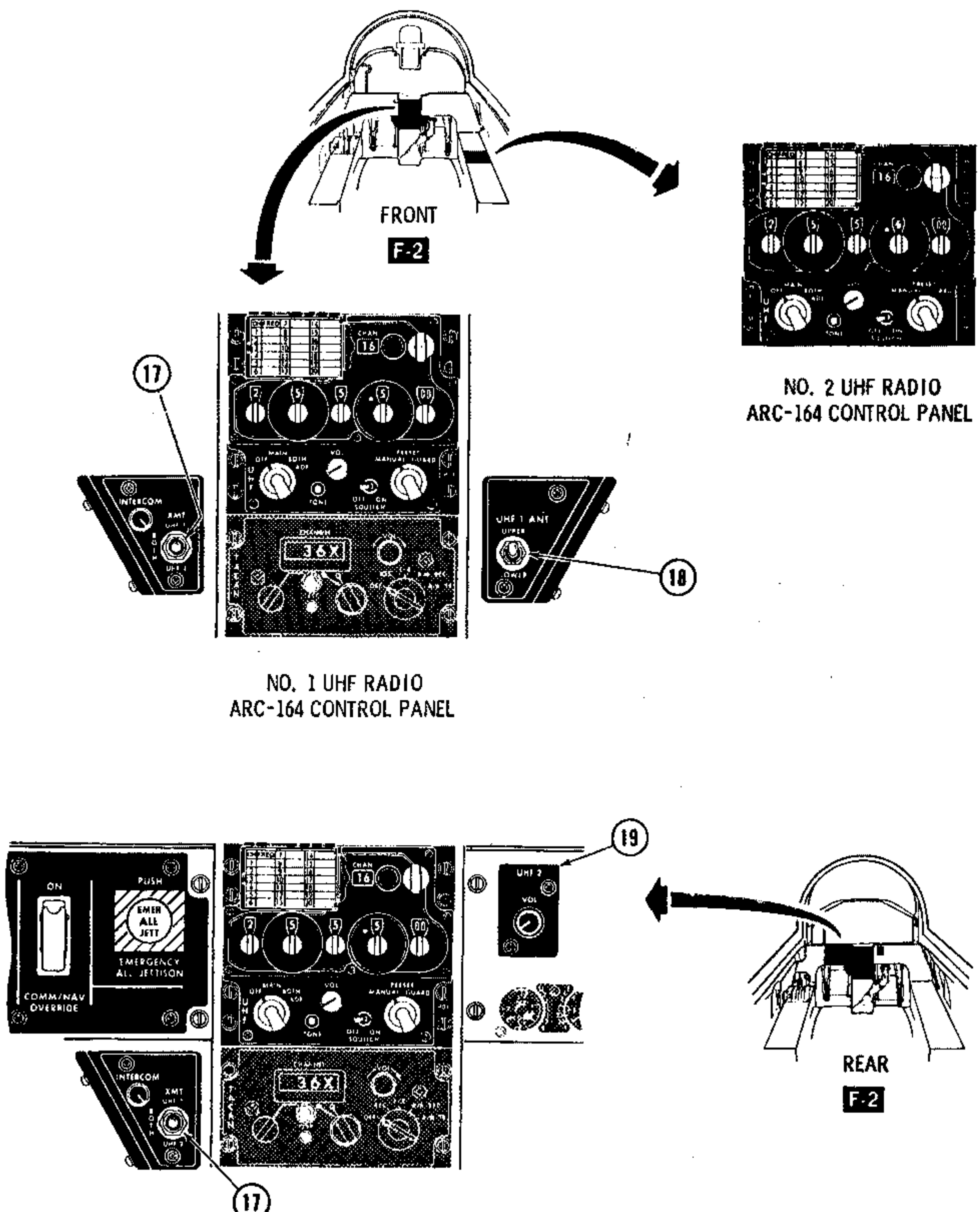


Figure 1-60 (Sheet 2).

COMMUNICATIONS CONTROLS



F-5 1-57(13)A

Figure 1-60 (Sheet 3).

COMMUNICATION CONTROLS (Figure 1-60)

	CONTROLS	FUNCTION	
1	Manual Dial Cover Release Lever (ARC-150 only)	Covers or uncovers the frequency numbers in windows above the manual frequency selector knobs.	
2	Preset Channel Indicator	Displays selected preset channel.	
3	Frequency Selector Mode Control	MANUAL	— UHF frequency is manually selected by setting of the five frequency selector knobs.
		PRESET	— Permits selection of one of the 20 preset frequencies.
		GUARD	— Receiver and transmitter are tuned to 243.000 MHz (Military guard).
4	Manual Frequency Selector Windows	Five windows, displays discrete frequency selected with frequency selector knobs.	
5	Manual Frequency Selector Knobs	Five knobs, to dial discrete UHF frequencies.	
6	TONE Transmit Button	Push and Hold	— Transmits a 1020 cps tone on the selected frequency.
7	Preset Channel Selector Control	Selects one of 20 preset UHF channels.	
8	Function Selector	OFF	— Turns power off.
		MAIN	— Receiver and transmitter operating on the same selected frequency.
		BOTH	— Receiver and transmitter operating on same selected frequency; guard receiver operating on 243.000 MHz.
		ADF	— Relative bearing to tuned station is displayed on HSI (some aircraft nonfunctional).
9	Hinged Access Door for Preset Channel Set Switch	Must be raised for access to preset channel set switch.	
10	Preset Channel Chart	On outer cover of hinged access door. Preset channel frequencies should be noted in appropriate space.	
11	Volume Control	Controls volume of UHF reception.	

COMMUNICATION CONTROLS (Figure 1-60) (Continued)

CONTROLS	FUNCTION	
12 SQUELCH Control Switch	ON	— Eliminates background noise in UHF normal reception.
	OFF	— Disables squelch to permit reception of a weak UHF signal.
13 Antenna Selector Switch (COMM ANT)	UPPER	— Selects upper UHF antenna in vertical stabilizer.
	AUTO	— Automatically selects upper UHF or lower UHF/IFF antenna.
	LOWER	— Selects lower UHF/IFF antenna.
14 Ⓕ INTERCOM Control Knob	Pull (Either Cockpit)	— Turns on intercommunication system for communication between cockpits and to ground crew, without use of microphone button, when plugged in.
	Push (Both Cockpits)	— Turns off intercommunication system.
	Rotate	— Clockwise rotation with intercom knob pulled out increases volume; counterclockwise decreases volume.
15 Ⓕ COMM Control Transfer Switch (Front Cockpit)	FWD	— Front cockpit has control of UHF.
	AFT	— Rear cockpit has control of UHF. **NOTE** Each cockpit retains control of UHF volume and of the TONE transmit button regardless of the position of the COMM control transfer switch.
16 Ⓕ COMM/NAV OVERRIDE Switch (Rear Cockpit)	OFF (guard closed)	— Position of COMM control transfer switch in front cockpit determines cockpit in control of communication equipment.
	ON	— Takes control of communication and navigation equipment in rear cockpit regardless of position of COMM or NAV control transfer switch in front cockpit.

COMMUNICATION CONTROLS (Figure 1-60) (Continued)

CONTROLS		FUNCTION
17 Transmit (XMT) Selector Switch	UHF 1	— Selects NO. 1 UHF radio for transmitting and disables NO. 2 UHF radio for transmitting in the selecting cockpit.
	BOTH	— Selects both NO. 1 and NO. 2 UHF radios for transmitting in the selecting cockpit.
	UHF 2	— Selects NO. 2 UHF radio for transmitting and disables NO. 1 UHF radio in the selecting cockpit.
18 UHF 1 Antenna Selector Switch (COMM ANT) (Front Cockpit)	UPPER	— Connects the upper antenna to the NO. 1 UHF radio, NO. 2 UHF radio is connected to the lower antenna.
	LOWER	— Connects the lower antenna to NO. 1 UHF radio, NO. 2 radio is connected to the upper antenna.
19 UHF 2 Volume Control (Rear Cockpit)		— Enables the rear seat crewmember to control the volume of the NO. 2 UHF radio.

Transmit Selector Switch

The three position switch to the left of the pedestal panel, labeled XMT, allows each crewmember to select transmitting on No. 1, No. 2 or both radios.

NOTE

Intercockpit coordination is required prior to transmitting on a radio controlled by the opposite cockpit.

Antenna Selector Switch

The two position switch (figure 1-60, sheet 3) labeled UHF 1 ANT, is located to the right of the pedestal panel (front cockpit only). Positioning the switch to UPPER or LOWER, selects the respective antenna for No. 1 radio and connects the No. 2 radio to the opposite antenna.

NOTE

Either radio receives UHF/ADF only when it is connected to the lower antenna.

UHF AUTOMATIC DIRECTION FINDER (ADF) AN/ARA-50

The ARA-50 ADF operates in conjunction with the radio to provide bearing indication to any ground or airborne UHF station to which the radio is tuned. Any frequency in the standard UHF communications band may be used. Relative bearing information is displayed on the HSI when the ADF position is selected on the radio control panel. For [E-1] [E-3] [F-1] [F-2] and some [E] aircraft, ADF information is displayed on the HSI when the NAV MODE selector is at DF.

NOTE

Ⓔ UHF/ADF homing signals may be unreliable with landing gear in down position.

Ⓕ For UHF/ADF operation, the COMM and NAV control transfer switches must be selected to the same position (either FWD or AFT).

TACAN SYSTEM

Aircraft are equipped with one of the following TACAN systems: AN/ARN-65, AN/ARN-84, or AN/ARN-118. The system provides bearing, range (DME), and course information to a TACAN ground (or airborne) station. TACAN information is displayed on the HSI. The NAV MODE selector must be at TACAN to display information on the HSI. The system operates in the UHF navigation band and provides 126 channels. In addition, the ARN-84 and ARN-118 provide the capability of selecting an additional 126 channels and also have an air-to-air mode and self-test function.

The air-to-air mode provides range to similarly-equipped cooperating aircraft out to 250 nm. Cooperating aircraft must select TACAN channels spaced 63 channels apart. Bearing information for the ARN-84 is not provided and the bearing pointer rotates continuously. The ARN-118 provides range to cooperating aircraft, and bearing and range to specially-equipped cooperating aircraft. In the A/A REC mode, bearing information is provided to specially-equipped cooperating aircraft. To obtain bearing to a cooperating aircraft, UHF/ADF can be used. Both the ARN-84 and ARN-118 provide a self-test capability; however, the ARN-118 has an automatic self-test. When the TACAN signal becomes unreliable or is lost, the ARN-118 switches to an automatic self-test. Indications of the automatic self-test are:

a. TEST light blinks.

b. Range warning flag and OFF flag appear on HSI.

c. Bearing pointer slews to 270 degrees for 7 seconds.

d. Bearing pointer slews to 180 degrees, CDI centers, and TO indication appears for 15 seconds.

If the TEST light remains on after completion of the test cycle, the TACAN has malfunctioned. See figure 1-61 for location and function of controls.

X-BAND RADAR TRANSPONDER (SKYSPOT) SST-181

The radar beacon encoder-transponder system (skyspot) provides increased tracking capabilities for the X-band ground-based radar. A three-position switch placarded SST-181 on the right vertical panel ([E][E-2], figure 1-15) ([F] left console, figure 1-22), if installed, provides selection of OFF, DOUBLE, and SINGLE pulse reply. A 10-position code selector installed in the encoder-transponder is preset by the ground crew before flight for code pulse spacing. If code position 1 has been preselected, the transponder will provide only single pulse coded replies regardless of the position of the switch.

VOR/ILS NAVIGATION SYSTEM AN/ARN-127

The ARN-127 navigation system consists of a receiver, a control panel, VOR-localizer and glide-slope antenna in the upper vertical tail, and a marker beacon antenna in the lower center fuselage. The system provides VOR navigation, localizer, and glide-sope information to the ADI and HSI (figures 1-57 and 1-58). The system operates on odd decimal frequencies from 108.10 to 111.95 MHz for ILS localizer and glide-slope information. Frequency range for VOR navigation information (displayed on the HSI) is the even decimal frequencies from 108.00 to 111.85 MHz and all frequencies from 112.00 to 117.95 MHz. See figure 1-62 for location and function of control and indicators.

Instrument Landing System (ILS)

The ILS provides visual indications of glide-slope and localizer course. Paired localizer and glide slope frequencies are automatically selected when the localizer frequency is selected. The ARN-127 navigation system operates in the ILS mode whenever the navigation mode selector is at VOR/ILS and ILS frequency is selected. The pitch and bank steering bars function as a glide slope indicator and a course deviation indicator displaying only course and glide slope deviation. Marker beacon passage is indicated by flashing of the green marker beacon light on the instrument panel. The marker beacon light functions when VOR/ILS mode is selected and ILS frequency is tuned.

NOTE

When making an ILS approach with the antenna selector switch in the UPPER or AUTO position, the ADI pitch steering bar may fluctuate during UHF transmission. Selection of LOWER antenna position eliminates this operational characteristic.

IFF/SIF SYSTEM AN/APX-72 OR AN/APX-101

The IFF/SIF system is an airborne pulse transponder which receives coded interrogations from surface or airborne radar (IFF) and automatically transmits coded selective identification (SIF). The system operates in five modes and is capable of I/P (Identification of Position) and emergency identification. The modes are: 1 – Security Identify; 2 – Self Identify; 3 – Air Traffic Identify; 4 (Classified) – Security Identify (when installed); and C – Altitude Reporting. The equipment consists of a control panel (Ⓕ front cockpit) (figure 1-63), a transponder (transmitter-receiver), an airborne test set/in-flight monitor, an IFF caution light on the caution light panel, and an antenna switching unit (lobing switch) in the nose section. The receiver responds only to interrogations in the selected mode and code. Mode 2 is preset into the transponder. An altitude encoder in the CADC provides an interrogating ground station with the aircraft altitude. Automatic altitude reporting is corrected pressure altitude computed by the CADC.

NAVIGATION CONTROLS (TYPICAL)

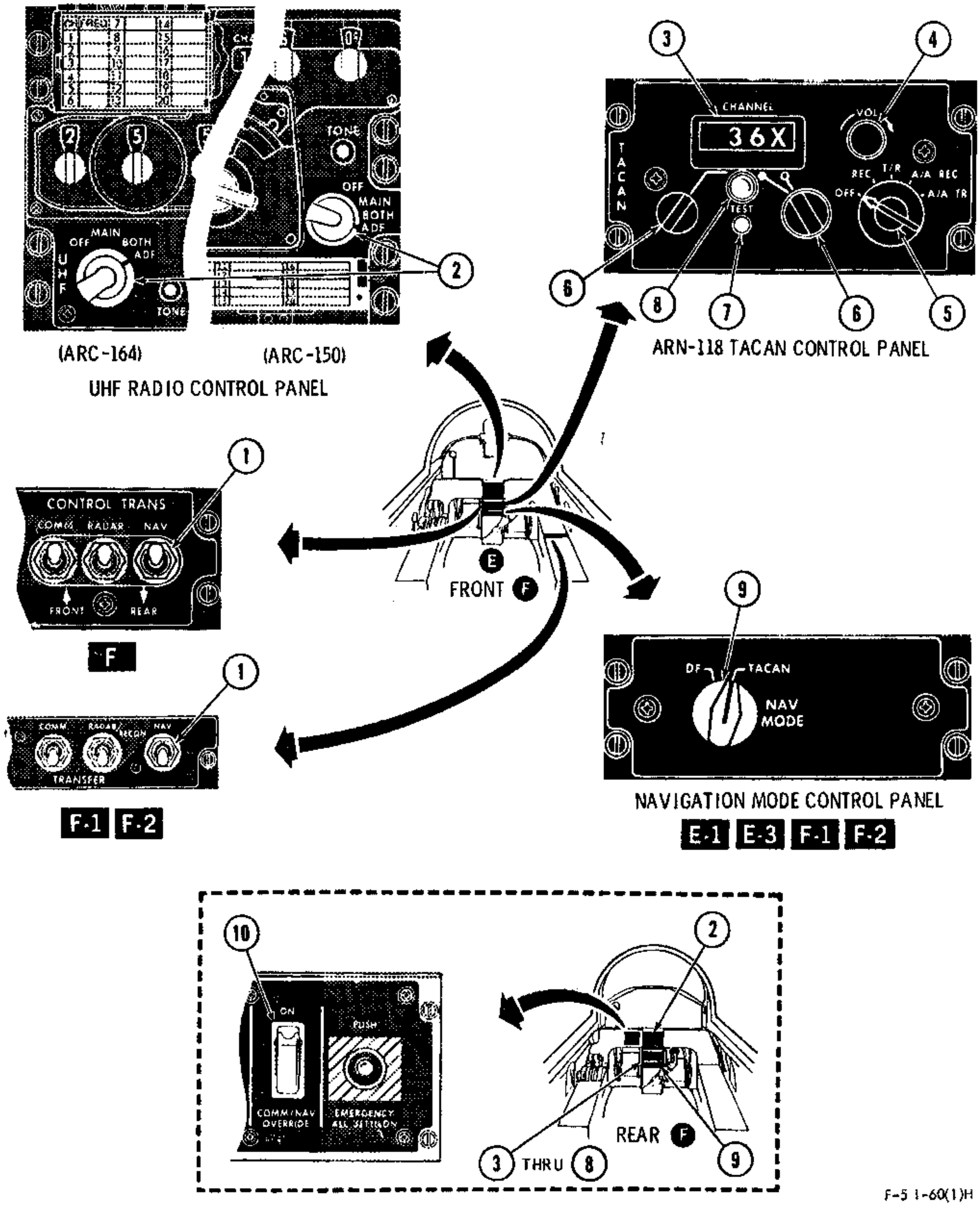


Figure 1-61.

NAVIGATION CONTROLS (TYPICAL) (Figure 1-61)

CONTROLS	FUNCTION	
1 Ⓕ NAV CONTROL TRANS Switch (Front Cockpit)	FRONT	— Front cockpit has control of TACAN.
	REAR	— Rear cockpit has control of TACAN.
2 UHF Radio Function Selector	ADF	— Relative bearing to tuned station is displayed on HSI. Nonfunctional on aircraft with UHF DF selection on NAV MODE selector.
<u>ARN-118</u>		
3 CHANNEL Display Window	Displays selected channel and X/Y designation.	
4 Volume Control	Controls volume of identification signals of selected TACAN channel.	
5 Function Selector	OFF	— Turns off power.
	REC	— Receiving identification signals from selected station and provides bearing to station.
	T/R	— Transmitting and receiving. Provides bearing and range to station.
	A/A REC	— Receiving identification signals and bearing information from specially equipped cooperating aircraft.
	A/A T/R	— Provides range to cooperating aircraft and bearing and range to specially equipped cooperating aircraft.
6 Channel Selector Controls	Right knob controls right (units) digit of channel number and X/Y designation. Left knob controls first two digits (hundreds and tens) of channel number.	
7 TEST Pushbutton	Push (Momentary)	— With function selector switch at T/R, course set to 180 degrees, and any channel selected, observe the following: a. TEST light blinks. b. Range warning flag and OFF flag appear on HSI. c. Bearing pointer slews to 270 degrees for 7 seconds. d. Range warning flag and OFF flag disappear.

NAVIGATION CONTROLS (TYPICAL) (Figure 1-61) (Continued)

CONTROLS	FUNCTION	
7 TEST Pushbutton (Continued)		e. Range window shows 000, bearing pointer slews to 180 degrees, CDI centers, and TO indication appears for 15 seconds. f. Range warning flag and OFF flag reappear. **NOTE** If TEST light comes on during test, repeat test in REC mode. If light does not come on in REC mode, malfunction is probably in the transmitter and bearing information is valid. If light comes on in both T/R and REC, all information is invalid.
8 TEST Light	Blink	— System in test mode.
	On	— TACAN has malfunctioned.
9 NAV MODE Selector	TACAN	— HSI steering and navigation indications provided by TACAN.
	DF	— HSI bearing pointer points to UHF station selected on UHF radio with radio function selector in MAIN or BOTH.
10 Ⓕ COMM/NAV OVERRIDE Switch (Rear Cockpit)	Off (guard closed)	— Position of NAV control transfer switch in front cockpit determines cockpit in control of navigation equipment.
	ON	— Takes control of communication and navigation equipment in rear cockpit regardless of position of COMM or NAV control transfer switch in front cockpit.

NAVIGATION CONTROLS/INDICATORS

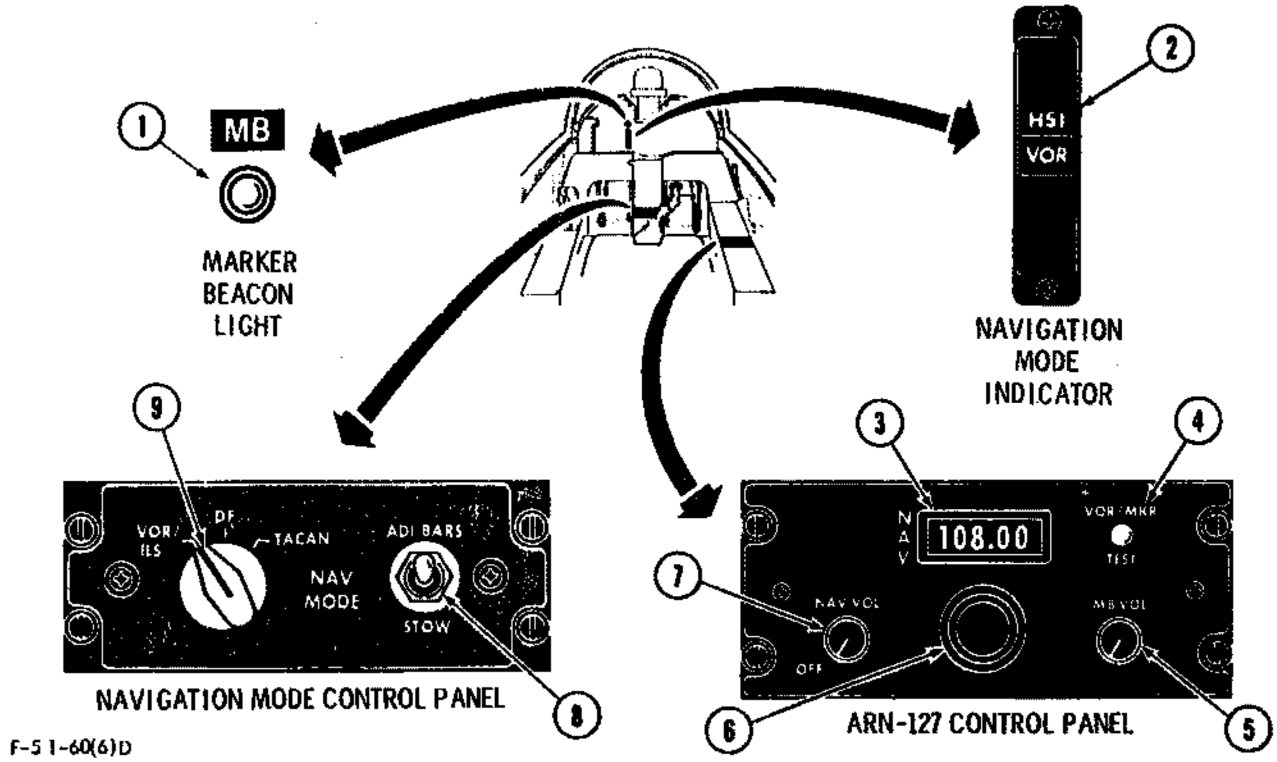


Figure 1-62.

NAVIGATION CONTROLS/INDICATORS (Figure 1-62)

CONTROLS/INDICATORS	FUNCTION	
1 Marker Beacon Light (GREEN)	Flashes on and pulses beacon identification signals over marker beacon.	
2 Navigation Mode Indicator	Lighted legend window displays navigation mode selected and operating mode of ADI and HSI. Indications are TCN, DF, VOR, and ILS.	
ARN-127 (3 thru 7)		
3 Frequency Readout Windows	Displays selected VOR/ILS frequencies.	
4 VOR/MKR TEST Button	Push (Momentary)	Self-tests receiver operation. With 315 set in course window, CDI centers, TO/FROM indicator indicates TO, bearing pointer indicates 315, the OFF flag is not visible, and the marker beacon light illuminates.

NAVIGATION CONTROLS/INDICATORS (Figure 1-62) (Continued)

CONTROLS/INDICATORS	FUNCTION
5 MB VOL Knob	Clockwise rotation increases volume of marker beacon.
6 Frequency Select Knob(s)	Inner Knob — Selects decimal (.00-.95) MHz part of VOR/ILS frequency. Outer Knob — Selects whole (108-117) MHz part of VOR/ILS frequency.
7 OFF/NAV VOL Knob	Clockwise rotation turns on VOR/ILS receiver and increases identifier volume.
8 ADI BARS/STOW Switch	ADI BARS — Allows pitch and bank steering bars to come into view when an ILS frequency selected. STOW — Stows pitch and bank steering bars.
9 NAV MODE Selector	VOR/ILS — Provides VOR navigation data to HSI when VOR frequencies selected. — Provides ILS localizer information to the ADI and HSI, and ILS glide-slope information to the ADI when ILS frequencies selected. The bearing pointer stows at the four o'clock position. DF — HSI bearing pointer points to UHF station selected on UHF radio with radio function selector in MAIN or BOTH. TACAN — Provides TACAN navigation data to HSI. **NOTE** Whenever TACAN is in T/R and an operating TACAN channel is tuned, TACAN DME is displayed in the HSI range window, regardless of the position of NAV MODE selector.

IFF/SIF CONTROLS/INDICATOR (TYPICAL)

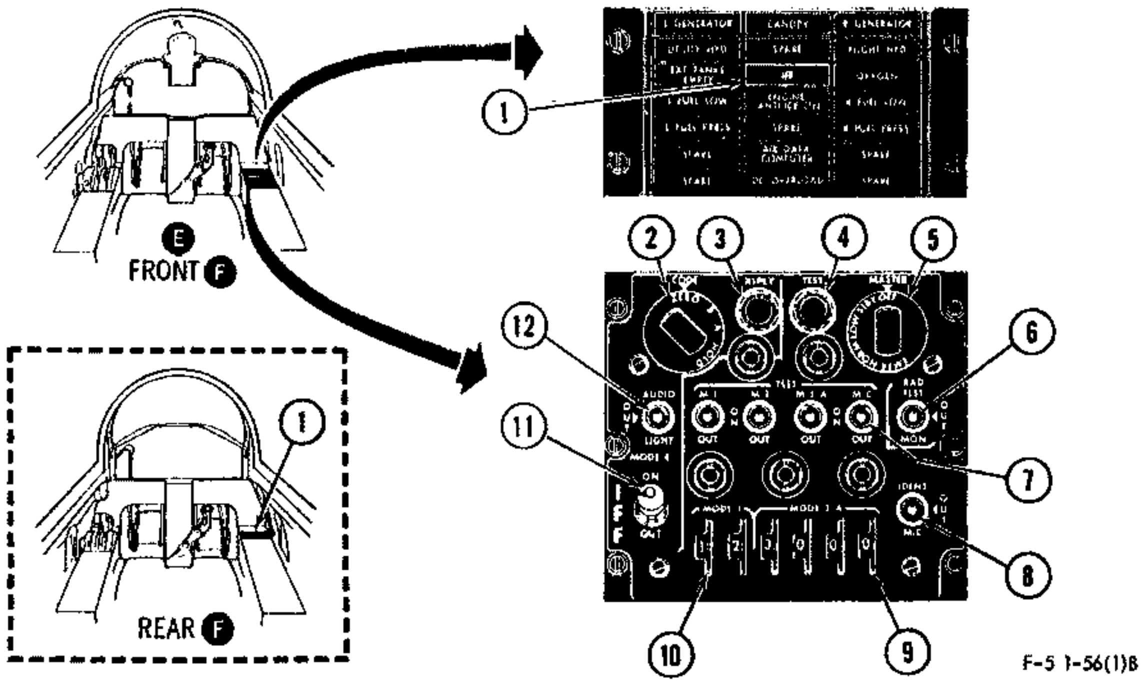


Figure 1-63.

IFF/SIF CONTROLS/INDICATOR (TYPICAL) (Figure 1-63)

CONTROLS	FUNCTION
1 IFF Caution Light (Ⓕ Both Cockpits)	Comes on when mode 4 interrogations are not properly processed and replied to or mode 4 code is zeroed.
2 MODE 4 CODE Selector	ZERO (Pull and Rotate) — Erases mode codes. B — Selects preset codes. A — Selects preset codes. HOLD (Momentary) — Retains preset codes when landing gear is down provided 15 seconds pass before turning electrical (AC & DC) power off.
3 MODE 4 REPLY Light	Comes on when receiver-transmitter responds to mode 4 interrogations.
4 Radiation TEST and Monitor Light	Illuminates when receiver-transmitter responds properly to Modes 1, 2, 3/A, or C.

IFF/SIF CONTROLS/INDICATOR (TYPICAL) (Figure 1-63) (Continued)

CONTROLS	FUNCTION	
5 MASTER Control Selector	OFF	— Disconnects power to system.
	STBY	— Places receiver-transmitter in warmup (standby condition). Allow a minimum of 1 minute when system is first turned on.
	LOW	— Applies power to receiver-transmitter but at reduced receiver sensitivity. Only local (strong) interrogations are recognized and answered.
	NORM	— Applies power to receiver-transmitter at normal receiver sensitivity for full range operation.
	EMER (Pull and Rotate)	— Transmits emergency reply signals to modes 1, 2, or 3/A interrogations regardless of mode control settings. In addition, Mode 3 (7700) is transmitted automatically.
6 RAD TEST/MON Switch	RAD TEST	— Permits reply to test mode interrogations from test equipment.
	MON	— Monitors station interrogations and coded reply. Test light illuminates when replies are transmitted in response to interrogations in Modes 1, 2, 3/A, or C.
	OUT (Spring-loaded from RAD TEST)	— Deenergizes RAD TEST and MON. Switch is placed in OUT position and is not used during flight.
7 Mode Select/TEST Switches (4)	ON (Spring-loaded from TEST)	— Permits receiver-transmitter reply to Modes 1, 2, 3/A, or C interrogations.
	OUT	— Disables the receiver-transmitter for the mode selected.
	TEST	— Built-in test function in receiver-transmitter self-interrogates Modes 1, 2, 3/A, or C.
8 Identification of Position (IP) Switch	IDENT (Momentary)	— Initiates identification reply for approximately 20 seconds.

IFF/SIF CONTROLS/INDICATOR (TYPICAL) (Figure 1-63) (Continued)

CONTROLS	FUNCTION	
8 Identification of Position (IP) Switch (Continued)	OUT (Spring-loaded from IDENT)	— Prevents triggering of IP reply.
	MIC	— Permits IP replies to be transmitted by pressing microphone button.
9 MODE 3/A Code Selectors (4)	Selects and displays Mode 3/A four-digit reply code number. For Traffic Identification.	
10 MODE 1 Code Selectors (2)	Selects and displays Mode 1 two-digit reply code number. For Security Identification.	
11 MODE 4 Control Switch	ON	— Permits reply to Mode 4 interrogations if master control selector is out of OFF/STBY.
	OUT	— Disables Mode 4.
12 MODE 4 Monitor Control Switch	AUDIO	— Audible tone is heard and REPLY light comes on when Mode 4 responds.
	OUT	— Disables audible tone and REPLY light.
	LIGHT	— REPLY light comes on when Mode 4 responds.

WARNING, CAUTION, AND INDICATOR LIGHTS SYSTEM

Warning, caution, and indicator lights warn of failures critical to flight, hazardous or potentially hazardous conditions, or of a change in system status requiring awareness and possible action. The lights consist of two red FIRE warning lights, a red gear unsafe warning light in the landing gear lever, a yellow MASTER CAUTION light, a yellow ARREST HOOK down light, three green landing gear position indicator lights, AOA indexer lights, and a caution light panel with 21 individual word capsules (yellow) for individual aircraft systems. A full set of warning, caution, and indicator lights is provided in both cockpits Ⓕ. A WARNING test switch on the lighting control panel (right console) permits testing the lights and FIRE WARNING circuits. A three-position BRT/DIM switch, spring-loaded to the neutral position, allows a selection of bright or dim operating modes (see figure 1-64 for switch locations and operation). Warning, caution, and indicator lights are powered by the dc bus in the bright mode and by the right ac bus in the dim mode.

NOTE

The fire warning lights cannot be dimmed.

CAUTION LIGHT PANEL

The caution light panel (figure 1-64) contains 21 individual system word capsules, including spare capsules. Spare capsules illuminate only when the WARNING test switch is positioned to TEST.

NOTE

On later aircraft, capsules placarded DIR GYRO and INS illuminate when testing the warning and caution lights, even though these systems are not installed in aircraft.

Each light when illuminated, except ENGINE ANTI-ICE ON, remains on as long as the malfunction exists or the status is unchanged. The individual system caution light does not go out when the MASTER CAUTION light is reset to rearm the circuit. The ENGINE ANTI-ICE ON light will go on when the engine anti-ice switch is in the ON position. For functions of other individual caution lights, see the appropriate system description.

NOTE

The master caution light must be reset after each activation to provide warning of subsequent activation of caution lights.

WARNING TEST SWITCH

The warning test switch on the right console lighting control panel (Ⓕ both cockpits) (figure 1-64) tests all warning, caution, and indicator lights in the cockpit as well as the landing gear audible warning signal, fire detection sensing loops, and angle-of-attack indexer.

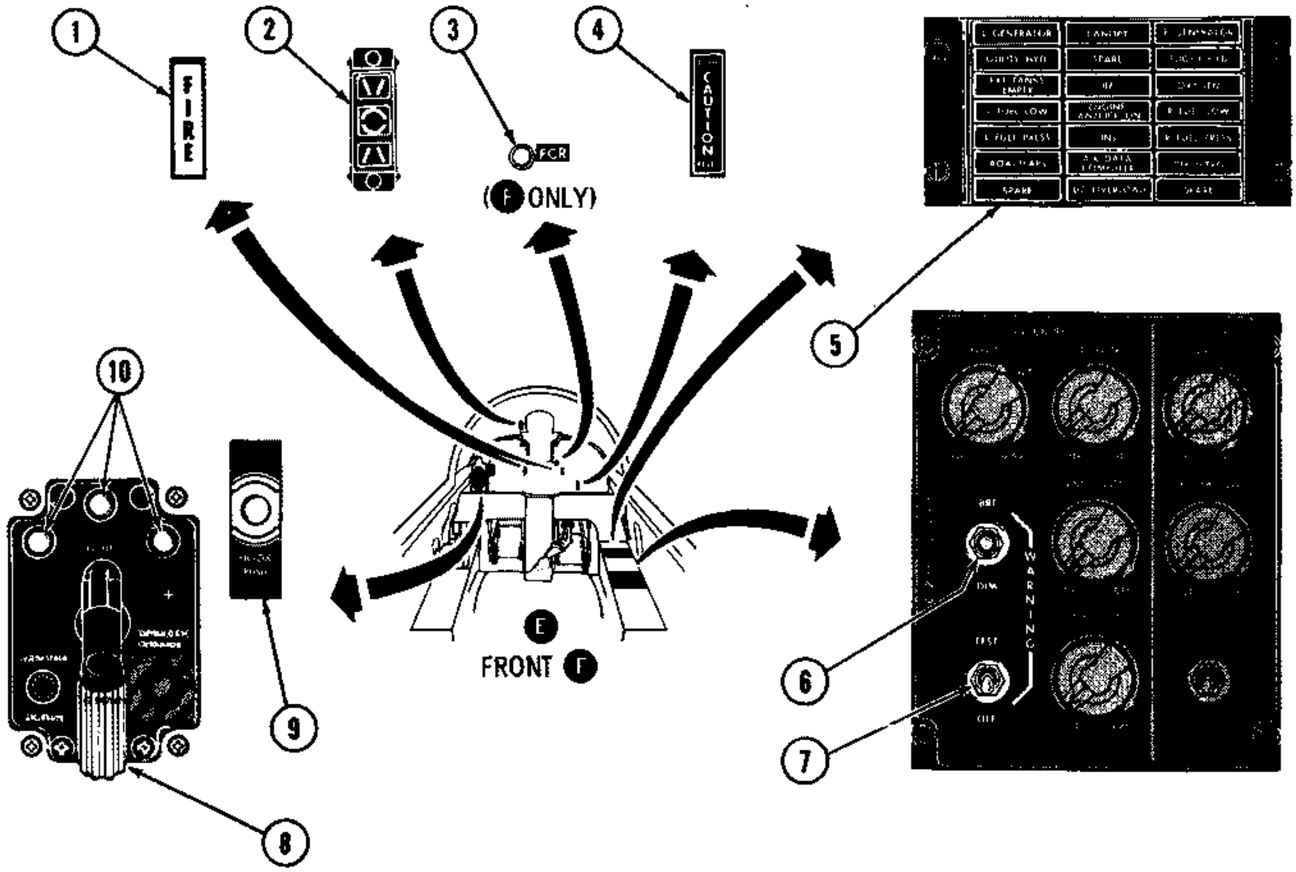
Warning Test Switch Operation Ⓕ

When the test switch in each cockpit is actuated simultaneously, the fire warning lights in both cockpits will come on, the landing gear audible warning signal and AOA lights will not operate in either cockpit.

NOTE

Ⓕ When either cockpit warning test switch is actuated, the fire warning lights in both cockpits will illuminate.

WARNING, CAUTION, AND INDICATOR LIGHTS (TYPICAL)



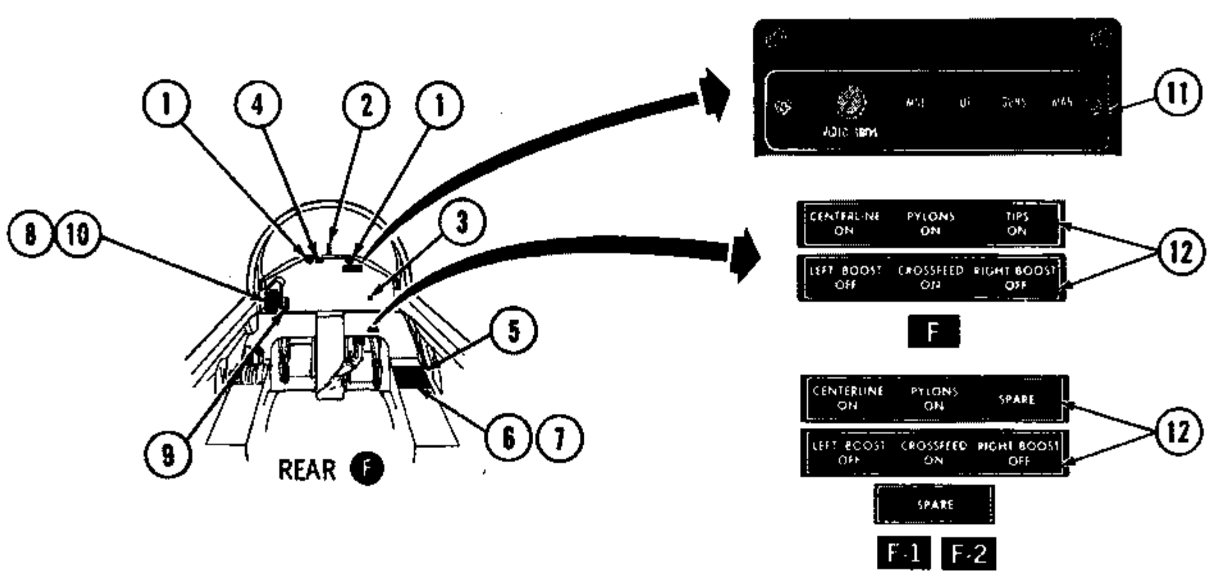


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Figure 1-64.

WARNING, CAUTION, AND INDICATOR LIGHTS & CONTROLS (Figure 1-64)

CONTROLS	FUNCTION	
1 FIRE Warning Lights (RED)	See: ENGINE CONTROLS/INDICATORS.	
2 Angle-of-Attack Indexer Lights (RED, GREEN, YELLOW)	See: ANGLE-OF-ATTACK SYSTEM.	
3 Ⓕ FCR Light (GREEN) (Both Cockpits)	Refer to T.O. 1F-5E-34-1-1.	
4 MASTER CAUTION Light (YELLOW)	On	— Illuminates when a caution light capsule comes on.
	Push	— Light goes out; resets.
5 Caution Light Panel Lights (YELLOW)	On	— Indicates system status or malfunction in the applicable system.
6 BRT/DIM Switch (Spring-loaded to Center)	BRT (Momentary)	— Warning, caution and indicator lights illuminate when activated in bright mode, powered by 28-volt dc bus.
	DIM (Momentary)	— With flight instrument lights on, warning, caution, and indicator lights operate, when activated in dim mode, powered by right ac bus. With flight instrument lights off, or if ac power is lost, warning, caution, and indicator lights operate in bright mode. **NOTE** The fire warning lights cannot be dimmed.
7 WARNING TEST Switch (Spring-loaded OFF)	TEST	— Turns on all warning, caution, and indicator lights (Ⓕ in the cockpit being tested) and tests gear audible warning, fire warning sensing loop in each engine compartment, and angle-of-attack indexer lights. **NOTE** When either cockpit test switch is actuated, the fire warning lights in both cockpits illuminate.
8 Landing Gear Lever Warning Light (RED)	See: LANDING GEAR CONTROLS/INDICATORS.	

WARNING, CAUTION, AND INDICATOR LIGHTS & CONTROLS (Figure 1-64) (Continued)

CONTROLS	FUNCTION
9 HOOK PUSH Button Light (In Button) (YELLOW)	See: ARRESTING HOOK SYSTEM.
10 Landing Gear Position Indicator Lights (GREEN)	See: LANDING GEAR CONTROLS/INDICATORS.
11 Ⓕ Fire Control System Mode Advisory Lights (Rear Cockpit) (WHITE)	Refer to T.O. 1F-5E-34-1-1.
12 Ⓕ Fuel System Indicator Lights Upper (GREEN); Lower (YELLOW); (Rear Cockpit)	See: FUEL SYSTEM CONTROLS/INDICATORS.

LIGHTING EQUIPMENT

The aircraft is equipped with exterior and interior lights (figure 1-65).

EXTERIOR LIGHTS

Exterior lights consist of dual landing-taxi lights, position (navigation) lights, fuselage lights, formation lights, and a rotating anti-collision beacon. See figure 1-65 for location of exterior lights and figure 1-66 for location and function of controls.

Landing-Taxi Lights

Two white landing-taxi lights, one on underside of each engine inlet duct, are electrically controlled, two position, retractable high and low intensity lights. The two positions are full extension for landing and intermediate for taxiing. The lights extend and retract only when the position lights are on. The lights are turned on-off by the LDG & TAXI LIGHT switch. In flight, with gear down and position lights on, the lights are automatically in full extended position and at high intensity when turned on. The lights go out and retract when the gear is raised. On the ground, with weight on main gear, the lights automatically retract to the intermediate position and each beam switches to low intensity.

Position and Fuselage Lights

Position lights consist of primary position lights, one on the side of each engine inlet duct, four auxiliary position lights, one on the upper and lower surface of each wing, and two white tail position lights, one on each side of the vertical stabilizer. The upper auxiliary position lights have an inboard white glass segment to illuminate the fuselage aft section and vertical stabilizer for night formation flying. The fuselage lights consist of two white lights, one on either side of the lower fuselage centerline, forward of the landing-taxi lights. The position and fuselage lights are powered by the left ac bus and controlled by the NAV knob on lighting control panel.

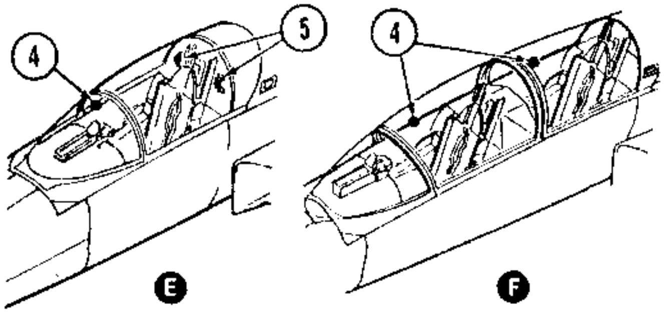
Formation Lights

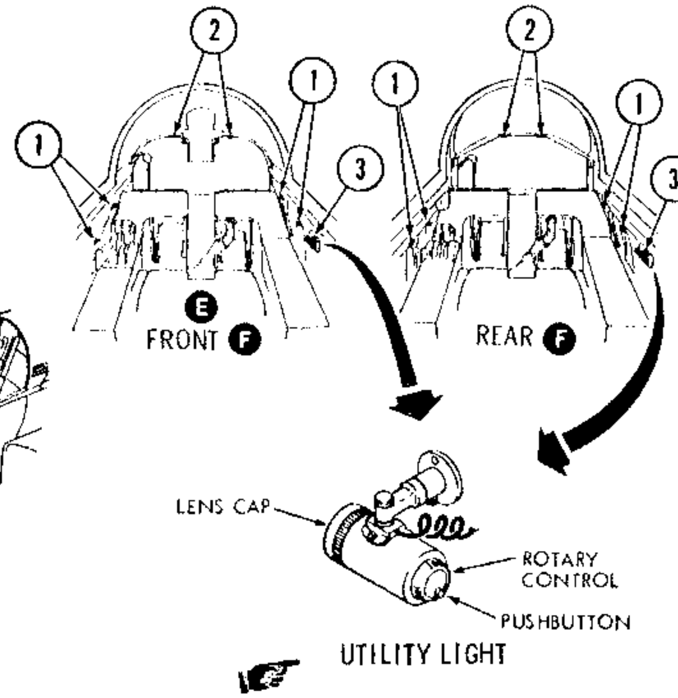
Formation lights consist of two white lights, one on each side of dorsal behind the cockpit, and a light on the aft end of each wingtip launcher. The lights are powered by the left ac bus and controlled by the FORMATION knob on the lighting control panel. The FORMATION knob provides continuously variable control from off to bright.

LIGHTING EQUIPMENT

INTERIOR

1 CONSOLE FLOODLIGHTS (WHITE)
2 INSTRUMENT PANEL FLOODLIGHTS (WHITE)
3 UTILITY LIGHT (STOWED POSITION) (RED/WHITE)
4 UTILITY LIGHT (ALTERNATE LOCATION)
5 THUNDERSTORM LIGHTS (E ONLY) (WHITE)





EXTERIOR

6 FORMATION LIGHT (EACH SIDE) (WHITE)
7 FORMATION LIGHT (L RED) (R GREEN)
8 AUXILIARY POSITION LIGHT (TOP & BOTTOM) (L RED) (R GREEN)
9 ROTATING BEACON (EACH SIDE) (RED)
10 TAIL POSITION LIGHT (EACH SIDE) (WHITE)
11 PRIMARY POSITION LIGHT (EACH SIDE) (L RED) (R GREEN)
12 LANDING-TAXI LIGHTS (EXTENDED) (WHITE)
13 FUSELAGE LIGHTS (WHITE)

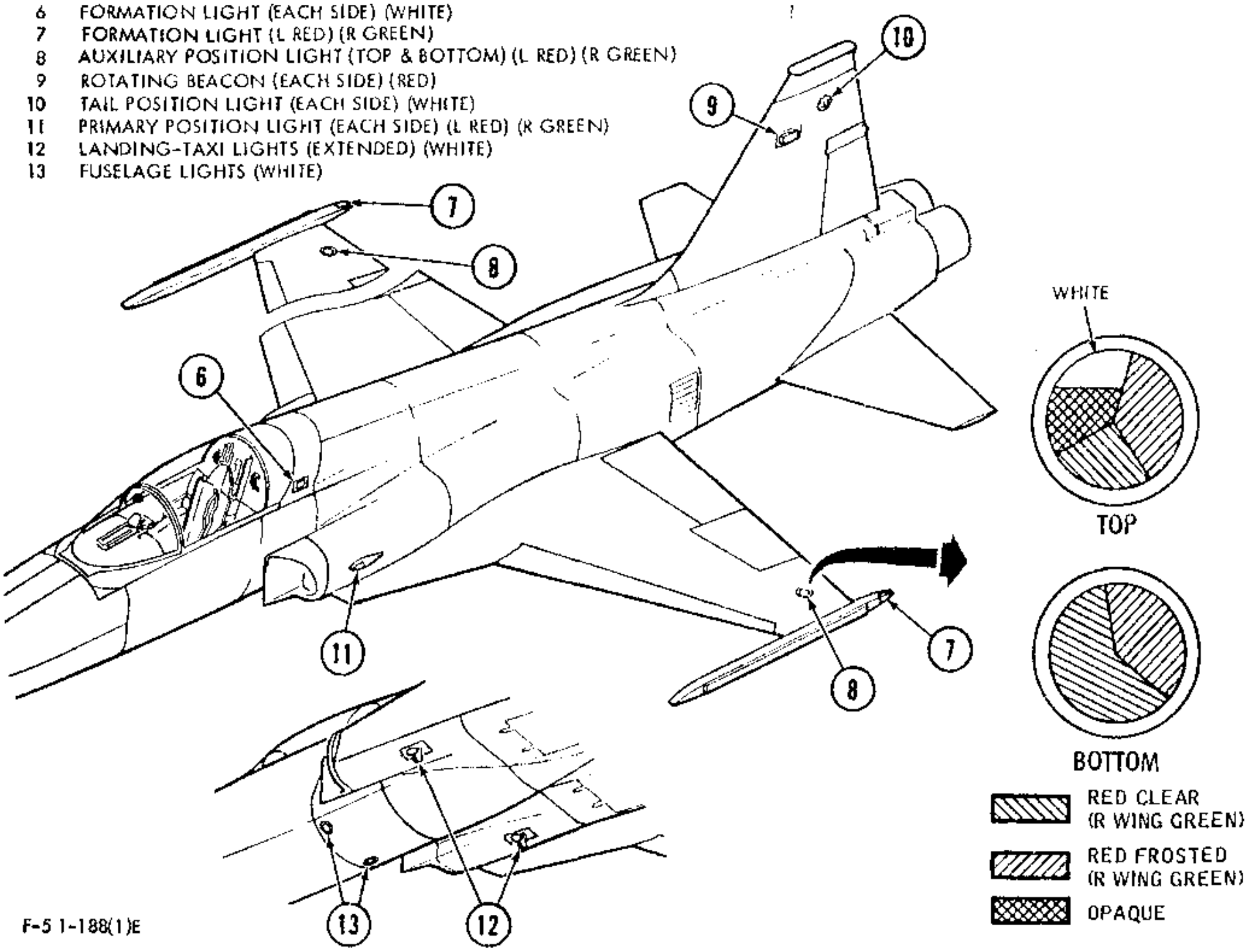


Figure 1-65.

LIGHTING CONTROLS (TYPICAL)

MAJOR CHANGE

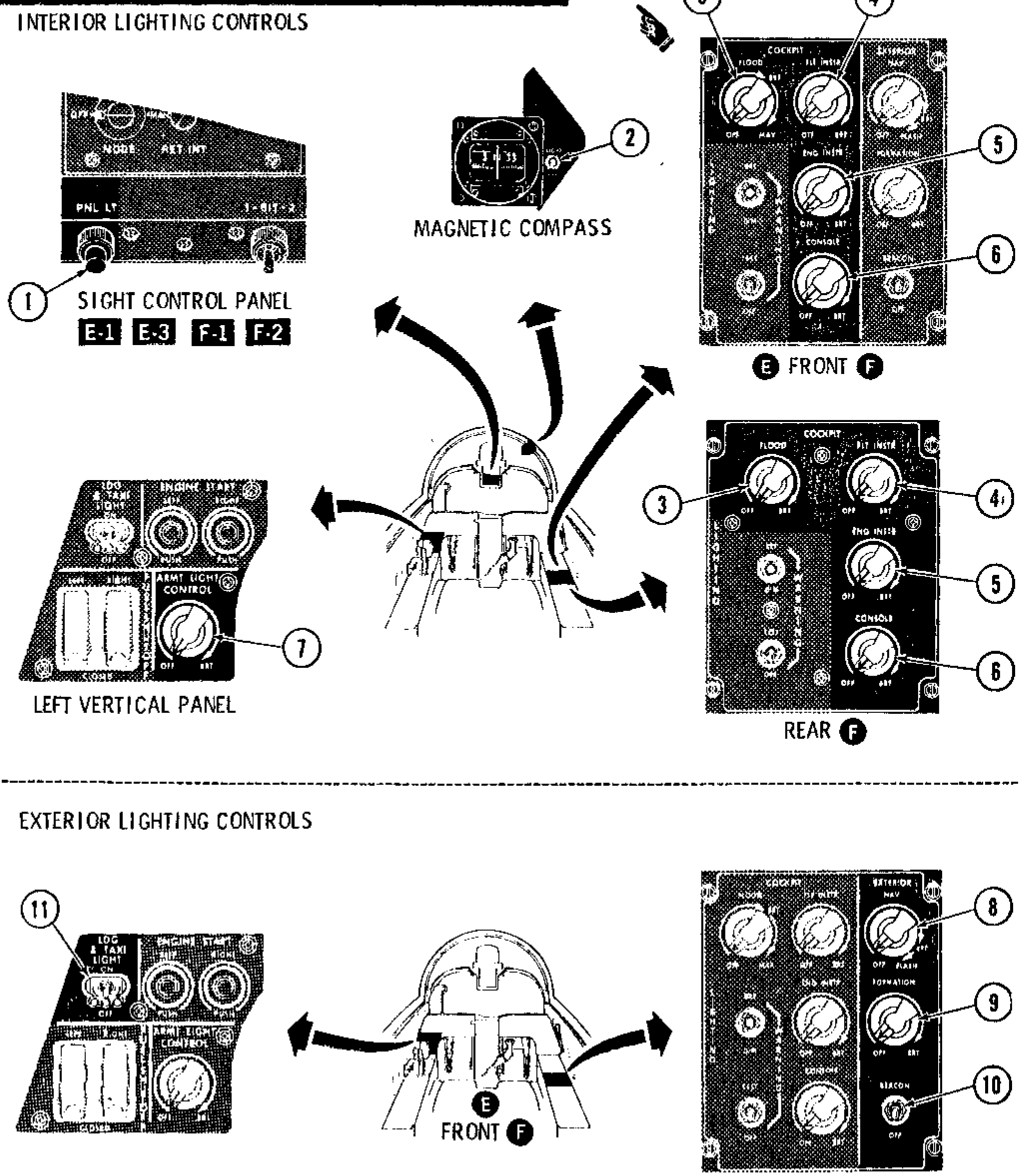


Figure 1-66.

LIGHTING CONTROLS (Figure 1-66)

CONTROLS	FUNCTION	
<u>INTERIOR LIGHTING CONTROLS (1 thru 6)</u>		
1 Sight PNL LT Button (Momentary)	Push On	— With the armament panel lights knob on, turns on the sight control panel lights.
	Push Off	— Turns off sight control panel lights.
2 Magnetic Compass Light Switch	LIGHT	— With engine instrument knob out of OFF, turns on the magnetic compass light.
	OFF	— Turns off the light.
3 FLOOD Knob	OFF to BRT	— Turns on and controls intensity of floodlights. From three-o'clock position to BRT, turns on thunderstorm lights, and prevents dimming of warning, caution, and indicator lights.
4 FLT INSTR Knob	OFF to BRT	— Turns on and controls intensity of flight instrument lights. Knob at OFF prevents dimming of warning, caution, and indicator lights.
5 ENG INSTR Knob	OFF to BRT	— Turns on and controls intensity of engine instrument lights and magnetic compass light (if turned on).
6 CONSOLE Knob	OFF to BRT	— Turns on and controls intensity of edge-lighting of consoles, pedestal, vertical panels and instrument panel (including radar indicator lights).
7 ARMT PANEL LIGHTS Knob (Ⓕ Front Cockpit)	OFF to BRT	— Turns on and controls intensity of edge-lighting of armament panel and sight control panel ([E-1] [E-3] [F-1] [F-2] sight control panel lights must be on).
<u>EXTERIOR LIGHTING CONTROLS (8 thru 11)</u>		
8 NAV Knob (Ⓕ Front Cockpit)	OFF	— All position lights off.
	CW to BRT	— Turns on auxiliary and tail position lights and controls intensity of auxiliary position lights while tail position lights remain dim.
	BRT	— Turns on primary position lights full bright and auxiliary and tail position lights at full bright.

LIGHTING CONTROLS (Figure 1-66) (Continued)

CONTROLS	FUNCTION	
EXTERIOR LIGHTING CONTROLS (8 thru 11) (Continued)		
8 NAV Knob (Ⓕ Front Cockpit) (Continued)	FLASH	— Primary and tail position lights — bright and flashing. — Auxiliary position lights — bright and steady. — Fuselage lights come on — bright and steady.
9 FORMATION Knob (Ⓕ Front Cockpit)	OFF to BRT	— Turns on and controls intensity of formation lights.
10 BEACON Switch (Ⓕ Front Cockpit)	OFF	— Rotating beacon off.
	BEACON	— Rotating beacon on.
11 LDG & TAXI LIGHT Switch (Ⓕ Front Cockpit)	OFF	— Landing-taxi lights off.
	ON	— Turns on both landing-taxi lights when gear is down and position lights on.

NOTE

The left wingtip launcher formation light is removed with the fairing when a target rocket is carried on the left launcher.

Rotating Beacon

Red rotating anti-collision beacon in the vertical stabilizer is powered by the right ac bus and controlled by the BEACON switch on the lighting control panel.

INTERIOR LIGHTS

Interior lights consist of flight and engine instrument lights, console and panel lights, floodlights, thunderstorm lights (Ⓔ only), and a utility light. See figure 1-65 for location of interior lights and figure 1-66 for location and function of controls.

Flight and Engine Instrument Lights

The flight and engine instruments on the instrument panel, right vertical panel, and right console are white-lighted by internal lamps powered by the right ac bus. The lights are controlled by the FLT INSTR and ENG INSTR knobs on the lighting control panel.

Armament Panel Lights

The armament panel lights provide edgelighting of the armament panel and the sight control panel. The lights are powered by the left ac bus and controlled by the ARMT PANEL LIGHTS knob on the left vertical panel. On [E-1] [E-3] [F-1] [F-2], the lights on sight control panel are turned on-off by PNL LT button on sight control panel.

Console Lights

The console lights provide edgelighting of the console, pedestal, instrument, and vertical panels. The lights are powered by the left ac bus and controlled by the CONSOLE knob on the lighting control panel.

Floodlights

Floodlights provide illumination of the instrument panel and the left and right consoles. The floodlights are powered by the left ac bus and controlled by the FLOOD knob on the lighting control panel. If no ac power, the floodlights are emergency-powered bright by the dc bus thru the ENG INSTR knob, bypassing the FLOOD knob. With no ac power, the ENG INSTR knob must be out of the OFF position for the floodlights to operate.

Thunderstorm Lights Ⓔ

The thunderstorm lights on each side of bulkhead behind seat headrest provide white illumination of the cockpit. The lights are powered by the left ac bus and controlled by FLOOD knob (also controls floodlights) on the lighting control panel.

Utility Light

The utility light is located on the right interior trim panel (Ⓕ both cockpits). The light, powered by the dc bus is controlled by a pushbutton to allow momentary operation and a rotary control to allow continuous operation at any desired level of lamp intensity. The rotary lens cap provides selection of red or white spot or floodlighting. Pressing the pushbutton provides full lamp intensity and permits use as a signaling light when pushbutton is intermittently pressed. The light, equipped with an extension cord can be unstowed to allow use anywhere in the cockpit. An auxiliary mounting support at lower right corner of windshield frame provides an alternate light location.

WARNING

Light shall be stowed after use to prevent interference with ejection seat and possible inadvertent initiation of man-seat separation system.

OXYGEN SYSTEM

A 5-liter liquid oxygen system supplies breathing oxygen. An oxygen regulator on the right console controls the flow and pressure of the oxygen and distributes it in the proper proportion to the mask. The oxygen regulator contains a gage, a blinker type flow indicator, emergency flow lever, oxygen diluter lever, and supply lever. Controls and indicators are provided in both Ⓕ cockpits.

OXYGEN REGULATOR

A combination pressure breathing, diluter demand, oxygen regulator (figure 1-67) is used in conjunction with the oxygen mask. The oxygen system is controlled by the supply, diluter, and emergency levers. An interlock between the supply lever and diluter lever causes the diluter lever to trip to 100% position when supply lever is at OFF, preventing any flow of air thru system. Gaseous oxygen is supplied to the regulator in the range of 65 to 110 psi. The regulator reduces the oxygen pressure, mixes oxygen with air in varying amounts, depending on altitude and demand, and delivers it thru a flexible hose to the oxygen mask. At high altitude, the regulator supplies positive pressure breathing. System operation is indicated by the flow indicator and oxygen pressure gage on the oxygen regulator panel. The emergency lever should remain at NORMAL unless an unscheduled pressure increase is required.

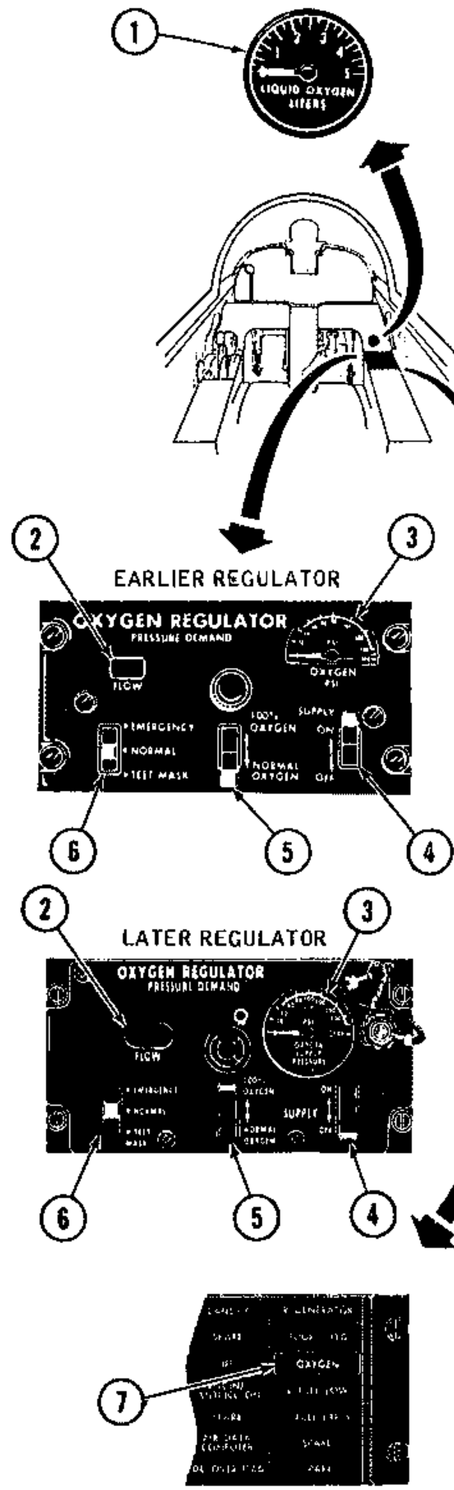
OXYGEN CONTROLS/INDICATORS

COCKPIT ALTITUDE — FEET		DURATION IN HOURS						
LIQUID CONTENTS — LITERS		**5**	**4**	**3**	**2**	**1**	**½**	**BELOW: ½ (E F) ONE CREW; 1 (F) TWO CREW**
35,000 & ABOVE	E (top)	31	25	19	12	6.2	3.1	EMERGENCY — DESCEND TO ALTITUDE NOT REQUIRING OXYGEN.
	E (bottom)	31	25	19	12	6.2	3.1	
	F (top)	15	12	9.3	6.2	3.1	—	
	F (bottom)	15	12	9.3	6.2	3.1	—	
30,000	E (top)	23	18	14	9.1	4.5	2.3	
	E (bottom)	23	18	14	9.2	4.6	2.3	
	F (top)	11	9.1	6.8	4.5	2.3	—	
	F (bottom)	11	9.2	6.9	4.6	2.3	—	
25,000	E (top)	17	14	10	7.0	3.5	1.8	
	E (bottom)	22	17	13	8.7	4.3	2.2	
	F (top)	8.7	7.0	5.2	3.5	1.8	—	
	F (bottom)	11	8.7	6.5	4.3	2.2	—	
20,000	E (top)	13	11	7.9	5.3	2.6	1.3	
	E (bottom)	24	20	15	9.8	4.9	2.5	
	F (top)	6.6	5.3	4.0	2.6	1.3	—	
	F (bottom)	12	9.8	7.3	4.9	2.5	—	
15,000	E (top)	11	8.5	6.4	4.2	2.1	1.1	
	E (bottom)	30	24	18	12	6.0	3.0	
	F (top)	5.3	4.2	3.2	2.1	1.1	—	
	F (bottom)	15	12	9.0	6.0	3.0	—	
10,000	E (top)	8.5	6.8	5.1	3.4	1.7	0.9	
	E (bottom)	30	24	18	12	6.0	3.0	
	F (top)	4.3	3.4	2.6	1.7	0.9	—	
	F (bottom)	15	12	9.0	6.0	3.0	—	

- TOP FIGURES INDICATE DILUTER LEVER "100% OXYGEN".
- BOTTOM FIGURES INDICATE DILUTER LEVER "NORMAL OXYGEN".
- (F) FIGURES ARE FOR TWO CREW. USE (E) FIGURES FOR ONE CREW.

Note

THE EMERGENCY OXYGEN CYLINDER PROVIDES APPROXIMATELY 10 MINUTES ADDITIONAL SUPPLY.



(E) AND (F) FRONT SHOWN — (F) REAR IDENTICAL

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Figure 1-67.

OXYGEN SYSTEM CONTROLS/INDICATORS (Figure 1-67)

CONTROLS/INDICATORS	FUNCTION	
1 Oxygen Quantity Indicator	Indicates oxygen supply from 0 to 5 liters. The indicator is ac powered.	
2 FLOW Indicator	Blinks alternately black and white, indicating air-oxygen flow during pilot's breathing.	
3 Pressure Gage	Indicates gaseous oxygen pressure in psi at regulator.	
4 SUPPLY Lever (Earlier Regulators)	OFF	— Shuts off all oxygen to mask.
	ON	— Turns on oxygen to mask. **WARNING** It is possible for the supply lever of early regulators to stop in an intermediate position between OFF and ON. Care should be taken to push the supply lever fully ON and visually check the flow indicator blinker for proper functioning.
SUPPLY Lever (Later Regulators)	OFF	— Shuts off all air-oxygen to mask.
	ON	— Turns on air-oxygen to mask.
5 Diluter Lever	100% OXYGEN	— Provides regulated 100% oxygen flow to mask.
	NORMAL OXYGEN	— Provides regulated mixture of cockpit air-oxygen flow to mask as determined by cockpit altitude.
6 Emergency Lever	EMERGENCY	— Provides continuous pressure-demand flow of 100% oxygen to mask.
	NORMAL	— Provides demand air-oxygen flow to mask.
	TEST MARK	— Provides increased positive pressure flow to test mask and hose for leaks.
7 OXYGEN Caution Light	On (OXYGEN)	— Illuminates when the liquid oxygen level in the converter is 0.5 liter or less, or that supply pressure is low (40 psi or less).

WARNING

When placing the emergency lever at EMERGENCY or TEST MASK, it is mandatory that the oxygen mask be fitted to the face and not removed. Continuous use of positive pressure with a leaking oxygen mask or the mask removed for extended periods depletes the oxygen supply rapidly.

CANOPY

The cockpit (Ⓕ both cockpits) is enclosed by a manually controlled one-piece clamshell type canopy. The canopy is counter-balanced throughout its travel limits. The canopy drive mechanism is protected against excessive loads by a hydraulic damper, which also restricts canopy opening and closing speeds. An inflatable seal in the canopy inflates only when the canopy is locked and an engine is operating. Exterior and interior normal and jettison controls consist of locking handles and jettison handles and a canopy caution light. The exterior and interior locking handles must be used only to lock and unlock the canopy. Raising and lowering the canopy must be done by hand pressure applied to the canopy frame.

CAUTION

Damage to canopy drive mechanism may result if the locking handles are used to raise and lower the canopy.

The canopy jettison T-handle in the cockpit (Ⓕ both cockpits) is safetied by a removable safety pin. After the pin is removed, a spring clip which safeties the handle must be overridden when the handle is pulled. See figure 1-68 for location of controls and caution light.

CANOPY CONTROLS/INDICATORS

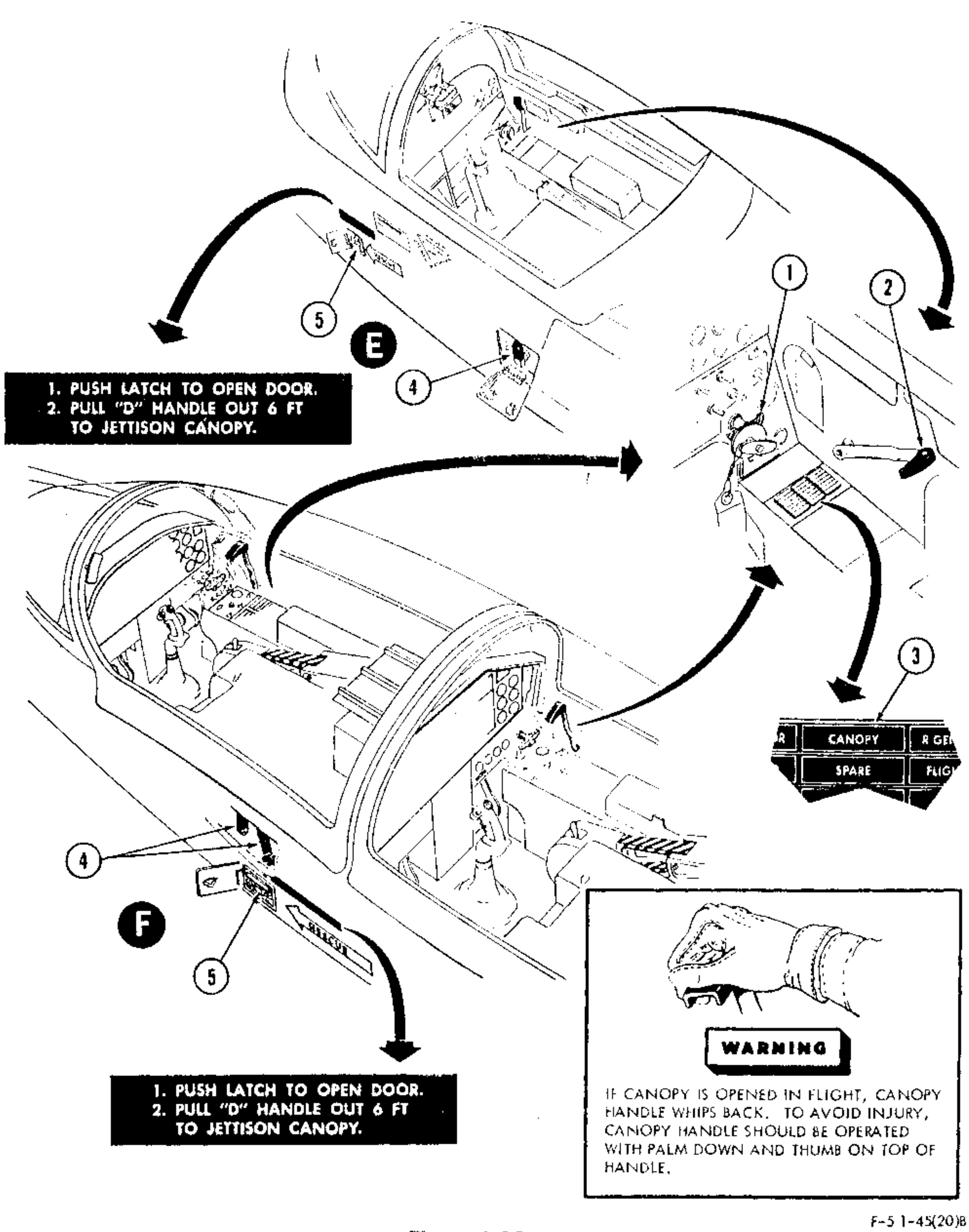


Figure 1-68.

CANOPY CONTROLS/INDICATOR (Figure 1-68)

CONTROLS/INDICATORS		FUNCTION	
1	CANOPY JETTISON T-Handle	Pull	— Jettisons canopy independent of seat ejection.
2	Canopy Handle (Interior)	Fully Forward	— Canopy locked.
		Pull Aft	— Unlocks canopy.
3	CANOPY Caution Light	Out	— Canopy locked. (Ⓕ Both canopies locked.)
		On	— Canopy unlocked. (Ⓕ Either or both canopies unlocked.)
4	Canopy External Handle (Exterior)	Pull Out and Turn CW	— Unlocks canopy.
		Turn CCW	— Locks canopy.
5	Canopy Jettison D-Handle (Each side of fuselage)	Pull (Either Handle)	— (Approximately 6 feet) Jettisons canopy (Ⓕ both canopies; front first, followed 1 second later by rear canopy).

EJECTION SEAT (STANDARD AND IMPROVED)

After TCTO 1F-5E-631 or TCTO 1F-5F-534 the seat is equipped with single motion ejection capability (raising the handgrips initiates the ejection sequence) and a ballistic power inertial reel.

The Ⓔ cockpit is equipped with either the Standard (figure 1-69) or Improved (figure 1-70) rocket catapult ejection seat. The Ⓕ cockpits are equipped with the Improved rocket catapult ejection seat. Both type seats include: a seat adjusting unit and control switch, an automatic-opening safety belt, shoulder harness, inertia reel locking lever, headrest, canopy piercer, calfguard, two legbraces, two catapult firing triggers, a jettison initiator, a survival kit container, a man-seat separator system, and a sequenced seat ejection system (Ⓕ only). The Improved seat additionally includes a drogue chute, which stabilizes the seat (and pilot) during ejection. Either seat ejects thru the canopy if canopy jettison fails. See section III for ejection envelopes and escape parameters.

LEGBRACES

After TCTO 1F-5E-631 or TCTO 1F-5F-534, pulling the handgrips raises the legbraces and initiates the ejection sequence.

Legbraces with handgrips incorporating firing triggers are interconnected and attached to the seat. Raising the legbraces to the fully up and locked position with the handgrips locks the shoulder harness (Ⓔ only) and exposes the firing triggers. After the legbraces have been raised to the locked position, they cannot be lowered to the stowed position.

NOTE

With the seat fully down and the legbraces raised, space between the firing triggers and consoles is severely reduced.

INERTIA REEL LOCK

After TCTO 1F-5E-631 or TCTO 1F-5F-534, when the ejection sequence is initiated through the actuation of the single motion triggering feature of the handgrips, the power-reel is actuated causing the shoulder harness to be forcibly retracted and restrained by gas pressure, regardless of the position of the lock lever.

An inertia reel lock consisting of a reel (Ⓕ gas-driven power reel) and cable attachment provides mechanical locking and unlocking of the shoulder harness controlled by an inertia reel lock lever (figures 1-69 and 1-70). With the harness locked, (LOCK position) any slack remaining in the harness can be reduced by sitting back in the seat. The slack then reels in to assume a new locked position. When unlocked, (AUTO position) the harness is free to reel in and out. The inertial reel automatically locks when the shoulder harness reels out at a rapid

EJECTION SEAT - STANDARD

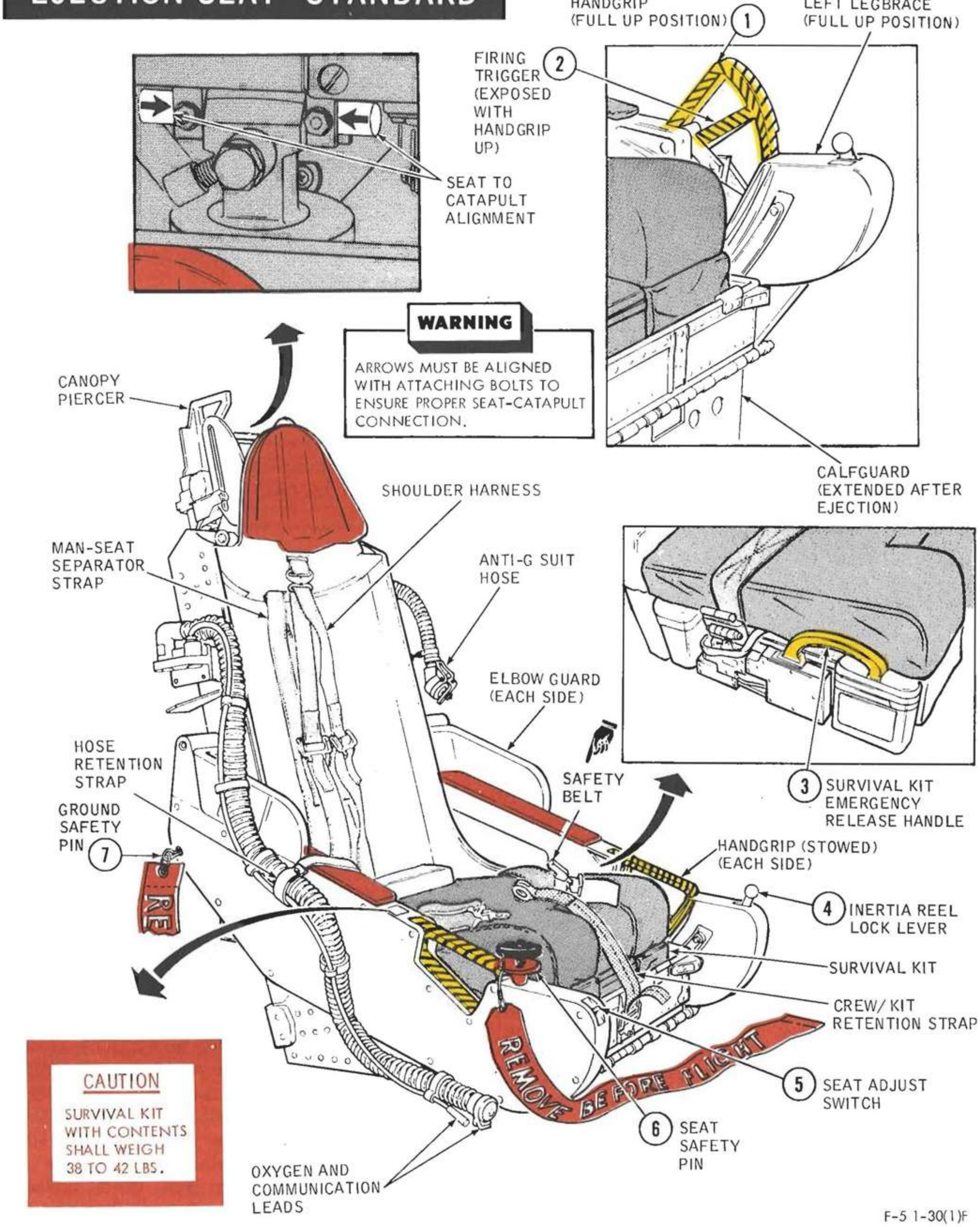


Figure 1-69.

EJECTION SEAT -- STANDARD (Figure 1-69)

CONTROLS	FUNCTION
1 Handgrips (Yellow with black diagonal stripes)	Pulling either or both handgrips up to travel limits raises legbraces to fully up and locked position and exposes triggers. First 12 degrees of travel unlocks both legbraces.
2 Firing Triggers (Yellow with black diagonal stripes)	Squeezing either or both triggers initiates canopy jettison and seat ejection.
3 Emergency Release Handle	a. After ejection, pulling handle releases survival kit and inflates life raft (if installed). b. While seated in aircraft, pulling handle releases both attaching straps from kit.
4 Inertia Reel Lock Lever	LOCK — Locks shoulder harness. AUTO — Unlocks shoulder harness, freeing it to reel in and out. Harness automatically locks during a rapid reel out and/or during seat ejection.
5 Seat Adjust Switch	Forward and Hold — Lowers seat electrically. Center — Spring-loaded neutral position. Aft and Hold — Raises seat electrically.
6 Seat Safety Pin	Inserted — Holds right legbrace handgrip down. The streamer is attached to the canopy jettison pin streamer.
7 Ground Safety Pin	Provides mechanical safing of the safety belt initiator during ground maintenance.

EJECTION SEAT–IMPROVED (TYPICAL)

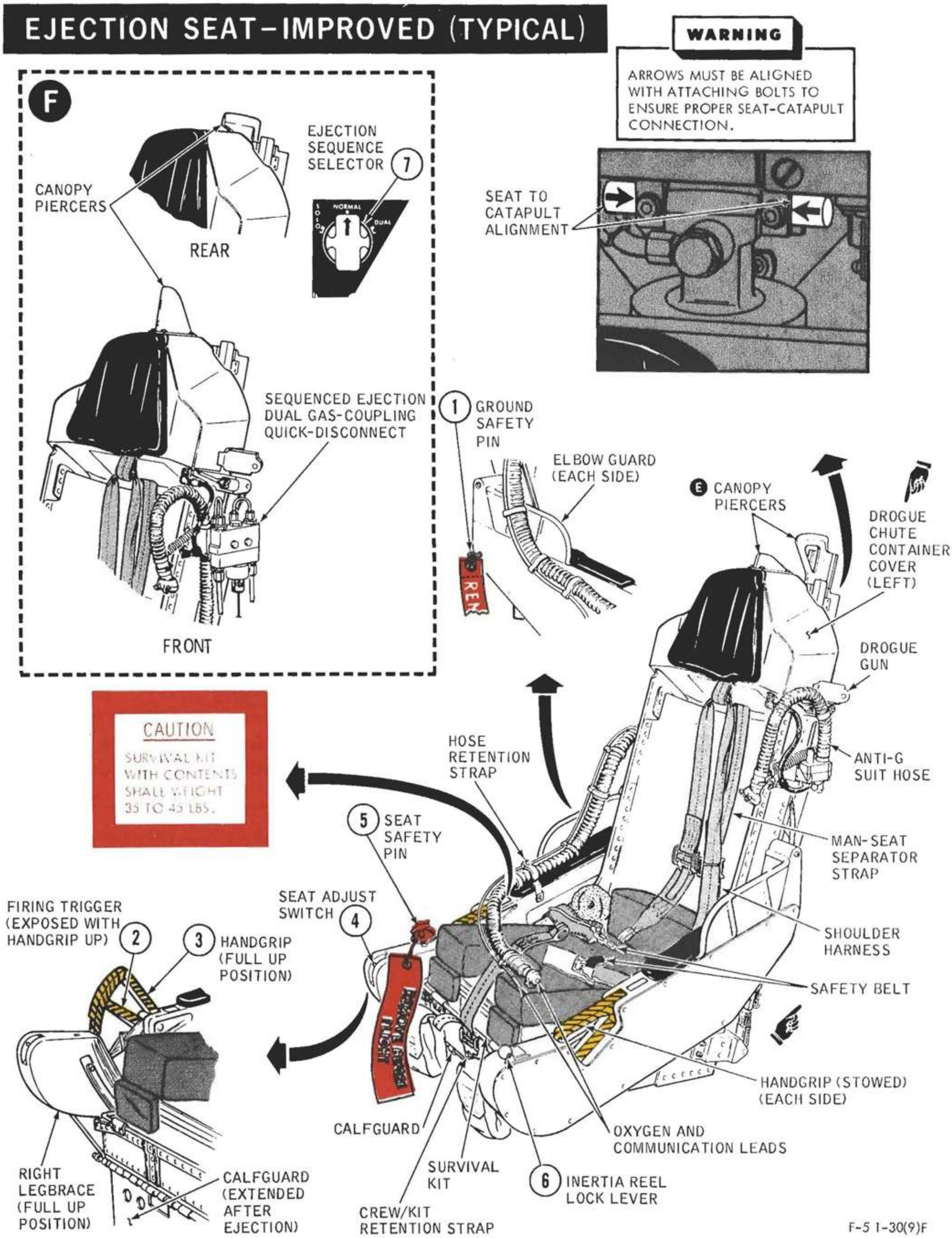


Figure 1-70.

EJECTION SEAT — IMPROVED (Figure 1-70)

	CONTROLS	FUNCTION	
1	Ground Safety Pin	Provides mechanical safing of the safety belt initiator during ground maintenance.	
2	Firing Triggers (Yellow with black diagonal stripes)	Squeezing either or both firing triggers initiates sequenced canopy jettison and seat ejection.	
3	Handgrips (Yellow with black diagonal stripes)	Pulling either or both handgrips up to travel limits raises legbraces to fully up and locked position and exposes firing triggers. First 12 degrees of travel unlocks both legbraces.	
4	Seat Adjust Switch	Forward and Hold	— Lowers seat electrically.
		Center	— Spring-loaded neutral position.
		Aft and Hold	— Raises seat electrically.
5	Seat Safety Pin	Inserted	— Holds right legbrace handgrip down. The streamer is attached to the canopy jettison handle safety pin streamer.
6	Inertia Reel Lock Lever	LOCK	— Locks shoulder harness.
		After TCTO 1F-5E-631 or TCTO 1F-5F-534, when the ejection sequence is initiated through the actuation of the single motion triggering feature of the handgrips, the power-reel is actuated causing the shoulder harness to be forcibly retracted and restrained by gas pressure, regardless of the position of the lock lever.	
		AUTO	— Unlocks shoulder harness, freeing it to reel in and out. Harness automatically locks during rapid reel out and/or during seat ejection.
7	Ⓕ EJECTION SEQUENCE SELECTOR (Rear Cockpit)	SOLO	— No automatic ejection sequencing is provided. Each cockpit must eject independently.
		NORMAL	— Ejection sequencing is automatic if the front cockpit initiates ejection. If ejection is initiated in the rear cockpit, each cockpit must eject independently.

EJECTION SEAT — IMPROVED (Figure 1-70) (Continued)

CONTROLS	FUNCTION
7 Ⓕ EJECTION SEQUENCE SELECTOR (Rear Cockpit) (Continued)	DUAL -- Automatic ejection sequencing occurs when either cockpit initiates ejection. **WARNING** Aircraft incorporating T.O. 1F-5F-523 are authorized unrestricted use of the selector. For all others, SOLO position is the only authorized selection for flight. Due to possible failure of the unmodified inertia reel to retract shoulder harness, SOLO position allows each crewmember to assume proper position before initiating seat ejection. **NOTE** The shoulder harness in both cockpits retracts when the ejection sequence selector is set at NORMAL and the firing triggers in the front cockpit are squeezed or when the ejection sequence selector is set at DUAL and the firing triggers in either cockpit are squeezed. See EJECTION SEQUENCE paragraph this section.

rate and remains locked until the lock lever is cycled. In the Ⓔ, when the handgrips are raised, the shoulder harness is locked. In the Ⓕ, when the firing triggers are squeezed, the power-reel is actuated causing the shoulder harness to be forcibly retracted and restrained by gas pressure, regardless of the position of the lock lever.

AUTOMATIC-OPENING SAFETY BELT

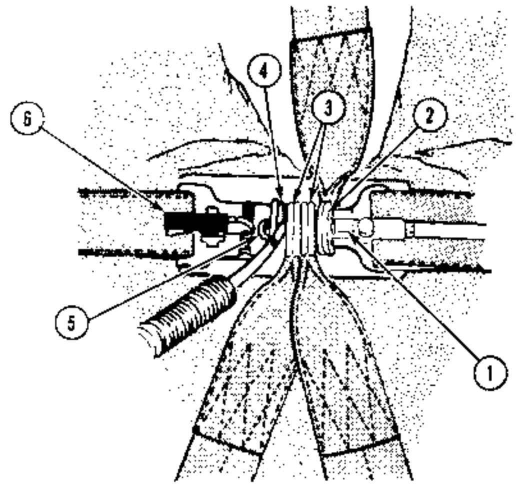
The ejection seat is equipped with an HBU safety belt. The belt incorporates a 1-second (0.65 second in the Improved seat) delay initiator to provide automatic opening of the belt during ejection. Use of the automatic-opening feature of the belt decreases seat separation and parachute deployment time, which reduces the altitude required for safe ejection.

Safety Belt

The modified HBU safety belt has a manual release latch on the left half of the belt, containing a black and silver manual release lever. The manual release lever must be raised slightly to insert the belt link and pressed down to lock the belt. The automatic parachute arming lanyard (gold key) must be installed on the right hand belt link and pressed into the base of latch in order to lock the belt. The manual release lever is squeezed and raised to manually release the belt. Automatic opening of the belt occurs on the right side next to the automatic link disconnect. The gold key is retained on the left belt for automatic parachute actuation. See figure 1-71 for proper connection and operation of the HBU safety belt.

AUTOMATIC OPENING SAFETY BELT HBU

LOCKED



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

WARNING

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

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

WARNING

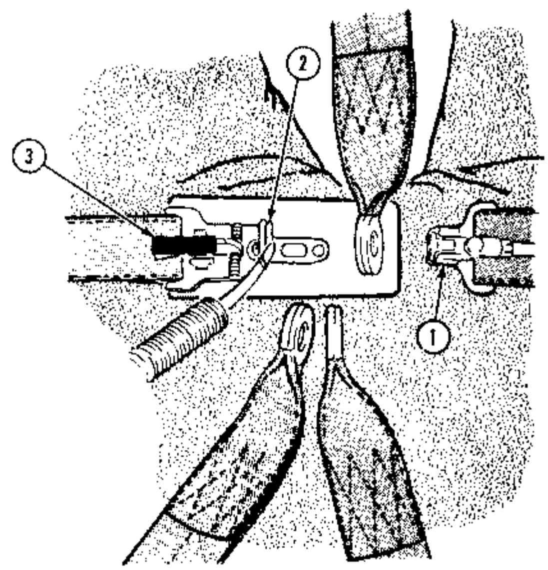
LANYARD MUST BE OUTSIDE PARACHUTE HARNESS AND NOT FOULED ON ANY EQUIPMENT, TO PERMIT CLEAN SEPARATION FROM SEAT.

Note

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

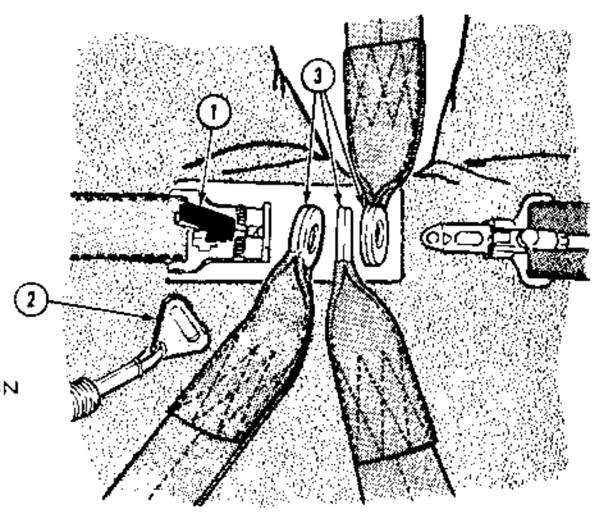
5. BELT LINK INSERTED IN MANUAL LATCH.
6. MANUAL RELEASE LEVER LOCKED AND CHECKED.

AUTOMATICALLY OPENED



1. AUTOMATIC DISCONNECT LINK RELEASED BY GAS PRESSURE FROM INITIATOR.
2. ANCHOR RETAINED IN LATCH ON LEFT BELT AS SEAT FALLS AWAY.
3. MANUAL RELEASE LEVER DOES NOT OPEN.

MANUALLY OPENED



1. SQUEEZE AND RAISE MANUAL RELEASE LEVER.

WARNING

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

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

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Figure 1-71

MAN-SEAT SEPARATOR

The man-seat separator is an inverted Y-shaped web strap assembly routed along the back of the ejection seat. The upper end of the strap is attached to a gas-operated ballistic reel behind the headrest, and the lower ends of the straps are routed under the survival kit and attached to the forward edge of the seat bucket. During ejection, high pressure gas from the safety belt initiator activates the ballistic reel, which draws the web straps taut, forcing the survival kit and pilot to separate from the seat.

ANTI-G SUIT HOSE

The anti-G suit hose on the left side of the seat next to the headrest (figures 1-69 and 1-70) is held in the stowed position by a flexible spring. A spring-loaded dust cover on the end of the hose must be opened to insert the anti-G suit hose connector.

PARACHUTE

The ejection seat may be equipped with either the BA-22 or BA-25 personnel parachute. The ejection seat is compatible with either parachute; however, the BA-22 parachute equipped with a zero-delay lanyard must have the lanyard attached to provide a similar minimum altitude ejection (below 2000 feet AGL) capability (see section III).

BA-22

The BA-22 automatic-opening parachute can be equipped with either an aneroid device incorporating a 1-second delay timer or a 0.25-second delay timer connected to the parachute arming lanyard. The BA-22 parachute with 1-second delay timer is also equipped with a zero-delay lanyard with hook. Connecting the parachute arming lanyard to the automatic-opening safety belt connects the parachute arming lanyard and timer. The zero-delay lanyard (figure 1-72), connects the safety belt and the parachute ripcord to bypass timer operation. Major differences of the BA-22 parachute which affect ejection performance are:

a. Zero-delay lanyard (if installed) must be attached for optimum low-altitude ejection, but disconnected for ejection above 2000 feet above ground level (AGL).

b. BA-22 does not permit use of the automatic deployment feature of the survival kit unless the parachute has been modified with a survival kit auto-release cable. With an unmodified parachute, the AUTO/MANUAL selector on the survival kit is inoperative, and the survival kit must be deployed manually after ejection.

BA-25

The BA-25 automatic-opening parachute is equipped with an aneroid device incorporating a 0.25-second delay timer connected to a parachute arming lanyard. Connecting the parachute arming lanyard to the automatic-opening safety belt connects the parachute arming lanyard and timer (figure 1-72).

PERSONAL EQUIPMENT CONNECTIONS

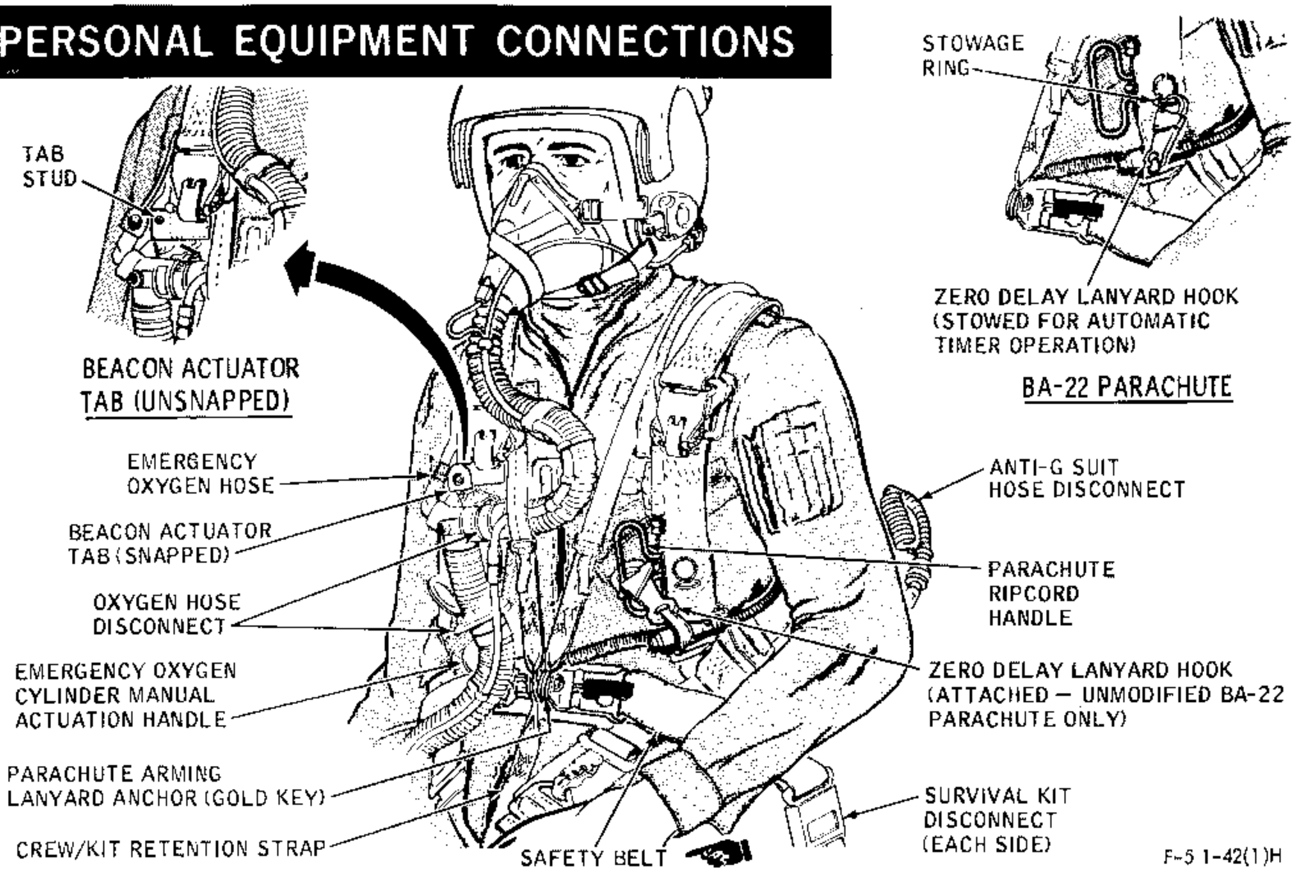


Figure 1-72.

High Altitude Ejection

Above a preset altitude, the aneroid delays automatic opening of the parachute until the occupant free-falls to the preset altitude. At or below the preset altitude, only the timer function is required to deploy the parachute.

EJECTION SEQUENCE Ⓔ

Standard Seat

The ejection sequence is initiated by raising handgrips. This action exposes the catapult firing triggers and automatically locks the shoulder harness inertia reel. Squeezing either or both triggers jettisons the canopy, and seat ejection occurs 0.3 second later. Accompanying this action, the seat adjuster power cable and personal leads are disconnected, the calfguard is lowered into position, and the automatic safety belt 1-second delay initiator is activated. Following the 1-second delay the initiator fires; subsequent pressure buildup opens the safety belt and also actuates the man-seat separator, forcing the crewmember from the ejection seat. The open safety belt releases the shoulder harness straps but retains the parachute arming lanyard. With the zero delay lanyard hook stowed, the parachute arming lanyard arms the parachute aneroid and timer device as the crewmember separates from the seat. Above a preset altitude, the aneroid delays automatic opening of the parachute until the crewmember free-falls to the preset altitude. At or below the preset altitude, only the timer function is required to deploy the parachute. With the zero delay lanyard hook attached to the parachute ripcord handle, the parachute arming lanyard and zero-delay lanyard pull the parachute ripcord. See section II for proper connection of the zero-delay lanyard and to section III for the proper use of ejection equipment.

WARNING

The zero-delay lanyard must be disconnected and stowed when operating at high altitudes to permit the automatic parachute aneroid and timer to function.

Improved Seat

The Improved seat ejection sequence functions in basically the same manner as the Standard seat, except that the automatic safety belt 0.65-second delay initiator is activated during seat/aircraft separation. After TCTO 1F-5E-631 or TCTO 1F-5F-534 the ejection sequence is initiated by raising the handgrips. This action jettisons the canopy and retracts the shoulder harness. Seat ejection occurs 0.3 seconds later. After the seat has left the cockpit, the drogue chute deploys to stabilize the seat, and the safety belt initiator fires, opening the safety belt and actuating the man-seat separator. As the crewmember separates from the seat, the parachute arming lanyard arms the parachute aneroid and timer device. Above a preset altitude, the aneroid delays automatic opening of the parachute until the crewmember free-falls to the preset altitude. At or below the preset altitude, only the timer function is required to deploy the parachute. When the BA-22 parachute is used and with the zero delay lanyard hook attached to the parachute ripcord handle, the parachute arming lanyard and zero-delay lanyard pull the parachute ripcord. See section II for proper connection of the zero-delay lanyard and to section III for the proper use of ejection equipment.

WARNING

The zero-delay lanyard must be disconnected and stowed when operating at high altitudes to permit the automatic parachute aneroid and timer to function.

EJECTION SEQUENCE Ⓕ

The Ⓕ is equipped with a sequenced seat ejection system for automatic or manual ejection of either the front or rear ejection seat, independently or in sequence. Seat ejection sequence is determined by the positioning of an ejection sequence selector on the rear cockpit pedestal (figure 1-70) and whether the ejection is initiated in the front or rear cockpit. A forcible pull of the selector is required to select either of three positions: SOLO, NORMAL, or DUAL.

Selector at SOLO

After TCTO 1F-5E-631 or TCTO 1F-5F-534 the ejection sequence is initiated by raising the handgrips.

With the sequence selector at SOLO, no automatic ejection sequencing is provided. The ejection must be initiated separately for each seat. Squeezing the firing trigger(s) jettisons the canopy and retracts the shoulder harness. The seat ejects 0.3 second after firing trigger squeeze. With SOLO selected, and two crewmembers in the aircraft, the rear seat should eject first. The front seat should initiate ejection 1 second after rear seat ejection.

WARNING

With the ejection sequence selector in SOLO position and both cockpits occupied, intercockpit coordination is required to avoid seat collision after ejection.

Selector at NORMAL

After TCTO 1F-5E-631 or TCTO 1F-5F-534 the ejection sequence is initiated by raising the handgrips.

With the selector at NORMAL, ejection sequence is determined by the crewmember initiating the ejection when the firing trigger(s) are squeezed. If the ejection is initiated in the front cockpit, the rear cockpit canopy is jettisoned and the shoulder harness retracts; 0.3 second later, the rear seat ejects. The front cockpit canopy is jettisoned and the shoulder harness of the front seat retracts 0.45 second after the rear seat ejects. The front seat ejects 0.3 second after the shoulder harness retracts. If the ejection is initiated in the rear cockpit, only the rear seat ejects. The front cockpit crewmember must eject independently.

Selector at DUAL

After TCTO 1F-5E-631 or TCTO 1F-5F-534 the ejection sequence is initiated by raising the handgrips.

With the selector at DUAL, when ejection is initiated in either cockpit by raising the handgrips and squeezing the firing trigger(s), the rear cockpit canopy is jettisoned and the shoulder harness retracts; 0.3 second later, the rear seat ejects. The front cockpit canopy is jettisoned and the shoulder harness of the front ejection seat retracts 0.45 second after rear seat ejects. The front cockpit seat ejects 0.3 second after shoulder harness retracts.

NOTE

To ensure positive selection of SOLO or DUAL positions, pull selector full aft and rotate beyond detent positions (override marking provided) and push selector full forward. Selector automatically detents in selected position.

Seat Ejection

When ejection occurs, the seat adjuster power cable, the personal leads, and the sequenced ejection dual gas-coupling are disconnected, the calfguard is lowered into position, and the automatic safety belt 0.65-second delay initiator is activated. After the seat leaves the cockpit, the drogue chute deploys to stabilize the seat, and the safety belt initiator fires, opening the safety belt and actuating the man-seat separator. The open safety belt releases the shoulder harness straps but retains the parachute arming lanyard. The man-seat separator strap is drawn taut, separating the crewmember from the seat. As the crewmember separates from the seat, the parachute arming lanyard arms the parachute aneroid and timer device. Above a preset altitude, the aneroid delays automatic opening of the parachute until the crewmember free-falls to the preset altitude. At or below the preset altitude, only the timer function is required to deploy the parachute. With the zero delay lanyard hook attached to the parachute ripcord handle, the parachute arming lanyard and zero-delay lanyard pull the parachute ripcord. See section II for proper connection of the zero-delay lanyard and section III for the proper use of ejection equipment.

WARNING

The zero-delay lanyard must be disconnected and stowed when operating at high altitudes to permit the automatic parachute aneroid and timer to function.

PERSONNEL LOCATOR BEACON

A personnel locator beacon in the parachute harness, if installed, is used to locate a pilot who has ejected. The beacon transmits a signal on 243.0 MHz. Upon parachute deployment, the beacon operates automatically when the actuator tab is snapped to the tab stud on the right main lift web of the harness (figure 1-72).

SURVIVAL KIT

The survival kit fits in the ejection seat and is attached to the parachute harness by web straps and quick-disconnect buckles. The forward section of the kit top is equipped with a seat cushion and the rear section provides support for a back type parachute. Depending on local command desires, kit contents vary and may include a life raft.

Standard

The standard survival kit (figure 1-69) must be manually released from the parachute harness following ejection or during emergency exit on the ground. After ejection from the aircraft, the survival kit is deployed by pulling the yellow emergency release handle on the right side of the kit. Pulling the handle up and backward releases the kit from the parachute harness, the kit opens, and the life raft, if installed, deploys and automatically inflates when the survival kit lanyard attached to the harness reaches full length. For emergency exit on the ground, pulling the yellow emergency release handle, with pilot's weight on seat, releases the kit and lanyard from the parachute harness. Normal ground egress from the cockpit should be accomplished by manually disconnecting the two quick-disconnect buckles from the parachute harness.

Improved

The improved survival kit (figure 1-73) incorporates an automatic deployment feature which may be selected by the AUTO/MANUAL selector. This survival kit is for use with the BA-25 or BA-22 parachute modified with auto release cable. The kit is automatically released during the ejection sequence or retained for manual release, depending upon the selected position of the survival kit AUTO/MANUAL selector. During parachute deployment, the parachute right rear riser pulls the kit auto-release cable. If the AUTO/MANUAL selector is at AUTO, the kit auto-release cable pull causes an initiator cartridge to fire, and after a 4-second delay, the survival kit is automatically released. If the selector is at MANUAL, the cartridge is safetied and the kit must then be released manually by pulling the emergency release handle. When the kit is released, either automatically or manually, the quick-disconnect buckles/web straps separate from the kit, permitting it to open and fall away from the crewmember until the lanyard, attached to the parachute harness, is fully extended. The life raft, if included in the kit, automatically deploys and inflates.

For emergency exit on the ground, pulling the emergency release handle, with pilot's weight on seat, releases the kit and lanyard from the parachute harness, regardless of the position of the AUTO/MANUAL selector. Normal ground egress from the cockpit should be accomplished by manually disconnecting the two quick-disconnect buckles from the parachute harness.

SURVIVAL KIT

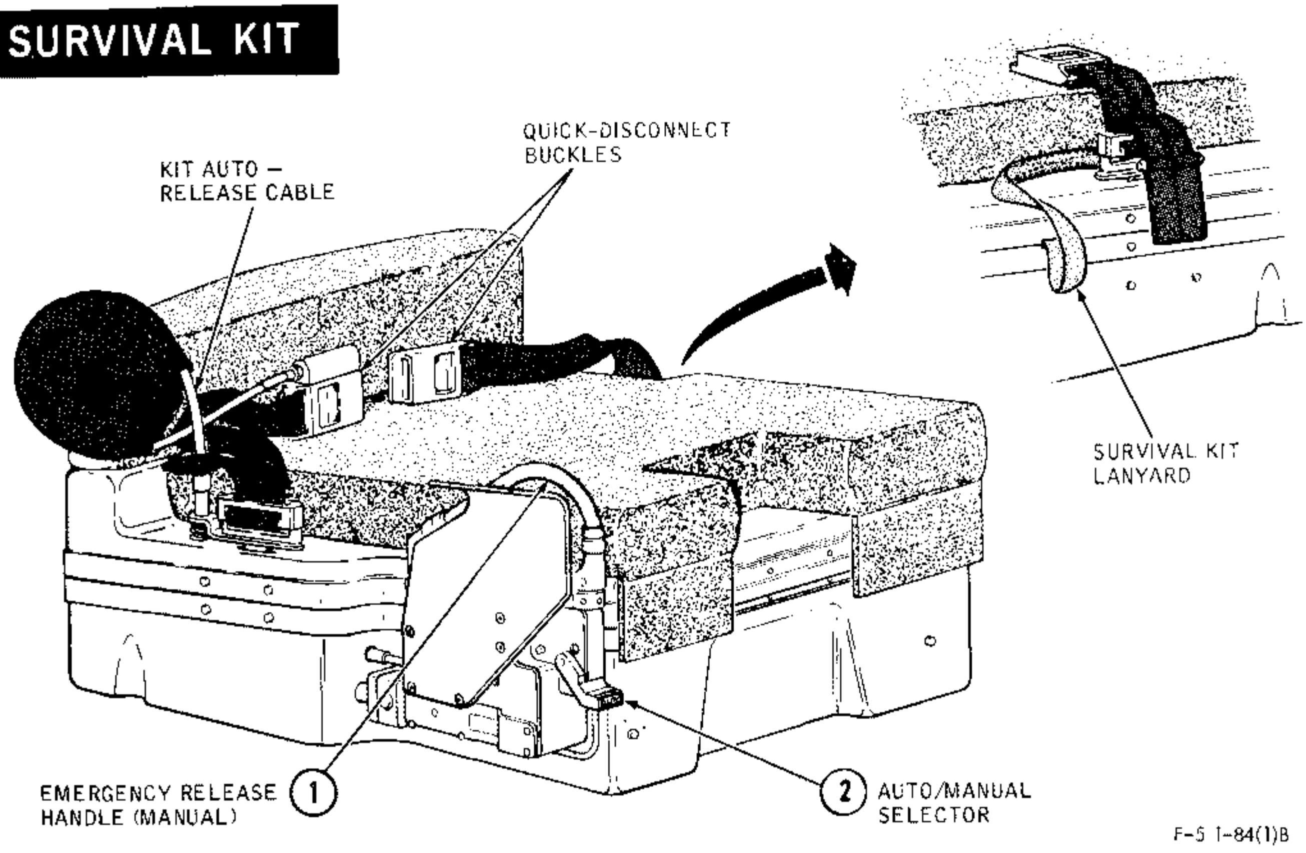


Figure 1-73.

SURVIVAL KIT (IMPROVED) (Figure 1-73)

CONTROLS		FUNCTION
1 Emergency Release Handle	Pull	a. After ejection, with AUTO/MANUAL selector at MANUAL; releases kit. b. While seated on survival kit, regardless of the position of the AUTO/MANUAL selector; releases both straps from survival kit.
2 AUTO/MANUAL Selector	AUTO (Up)	— Permits automatic deployment of survival kit 4 seconds after parachute riser is fully stretched.
	MANUAL (Down)	— Permits manual deployment of survival kit when emergency release handle is pulled.

ENVIRONMENTAL CONTROL SYSTEM

The environmental control system (figure 1-74, sheets 1 and 2) consists of the following: air-conditioning, pressurization, canopy and windshield defog, anti-g, and air distribution systems. All systems except anti-g suit, canopy and windshield seal system, hydraulic reservoirs, external fuel tank and radar waveguide pressurization are controlled by controls on the right vertical panel (Ⓕ front cockpit) (figure 1-15, 1-16, 1-18, and 1-19). Air from the ninth stage of the compressor section of each engine is used to perform cooling, heating, conditioning, and pressurization functions. Either engine provides sufficient air to operate the system in the event of engine failure. Check valves prevent air bleedoff to an inoperative engine.

AIR-CONDITIONING AND PRESSURIZATION SYSTEMS

Air is routed thru a heat exchanger, cooling turbine, and water separator before entering the cockpit area. Cockpit temperature is automatically or manually selected by a temperature switch. In the automatic mode, a temperature control valve automatically maintains the temperature level selected by the temperature knob. In manual mode, the temperature controller is inactive. Temperature is controlled by manual operation of the temperature switch until desired temperature is achieved. Manual mode should be used only if a malfunction occurs in automatic mode.

A pressure regulator automatically maintains the cockpit pressure differential schedule illustrated in figure 1-75. Cockpit pressure altitude is indicated on the cabin pressure altimeter (Ⓕ front cockpit). Static pressure ports on each side of the fuselage below the windshield area provide a static air pressure source reference for the regulator and safety valve. A pressure safety valve incorporated in the system automatically protects the cockpit from excessive high or low pressure and depressurizes the cockpit when the cockpit pressurization switch placarded CABIN PRESS is in the RAM DUMP position. Pressurizing air is supplied to the external tank system, anti-g suit system, canopy and windshield seal system, hydraulic reservoirs and radar waveguide.

ENVIRONMENTAL CONTROL SYSTEM

E **E-2**

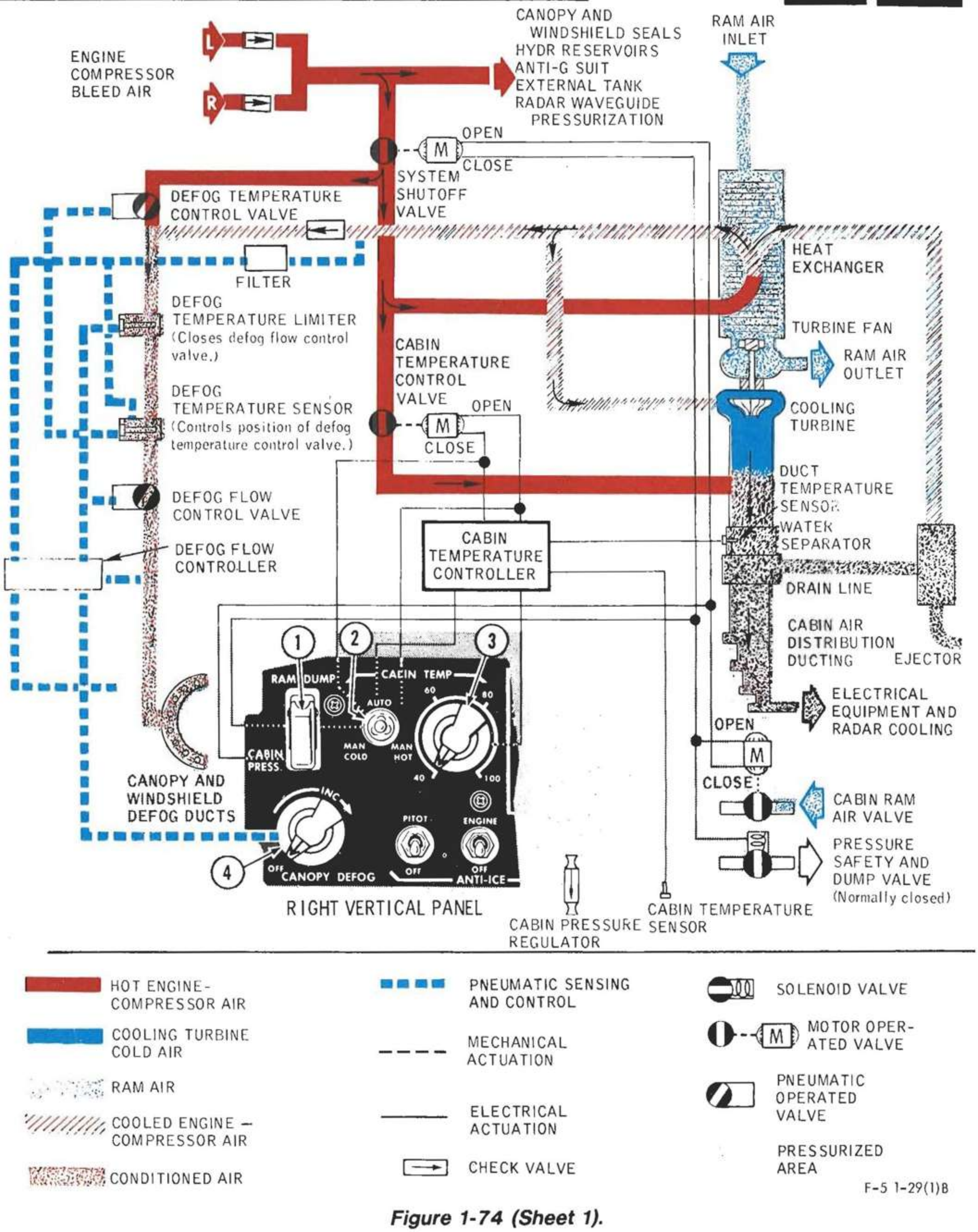


Figure 1-74 (Sheet 1).

ENVIRONMENTAL CONTROL SYSTEM

E-1 E-3 F

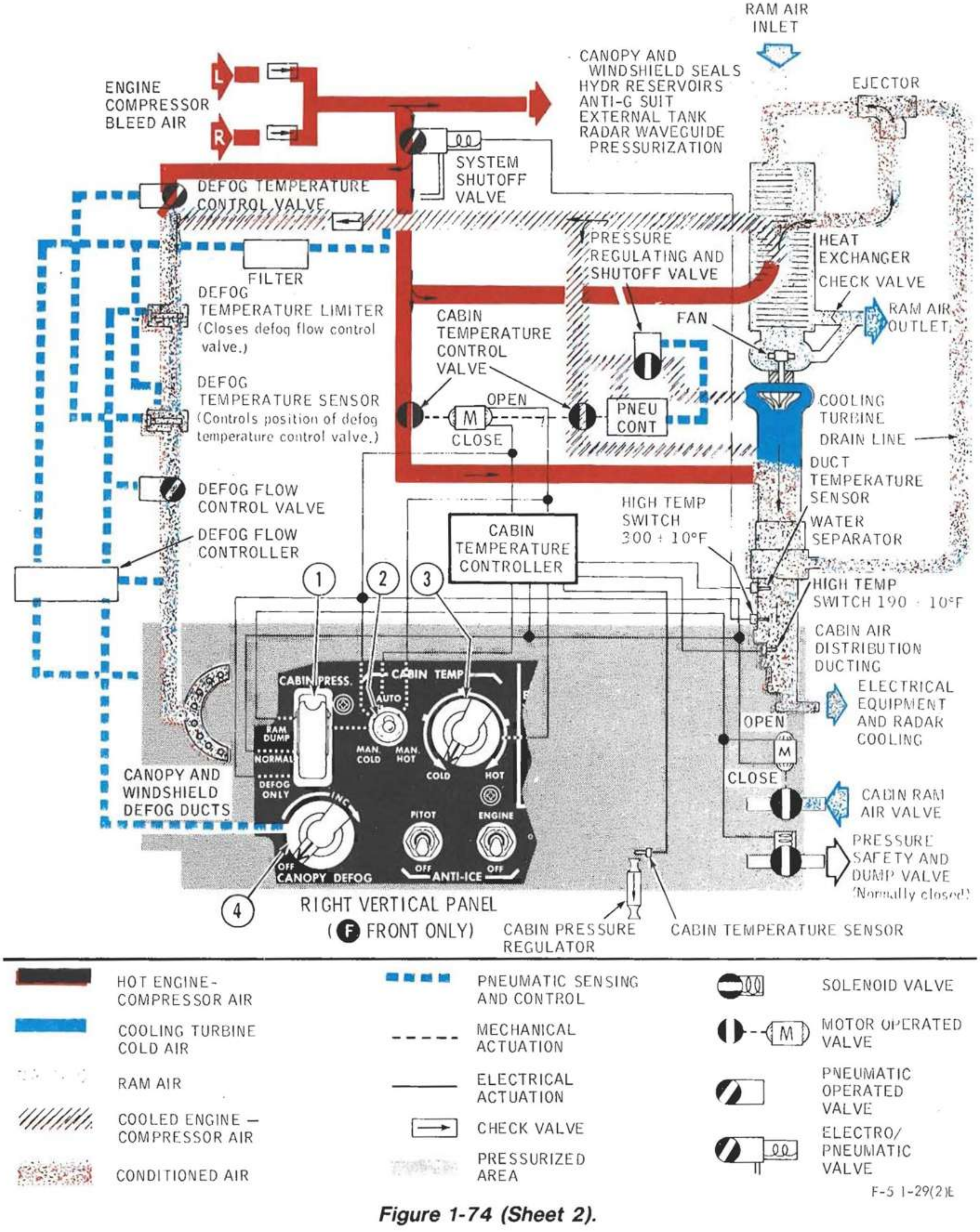
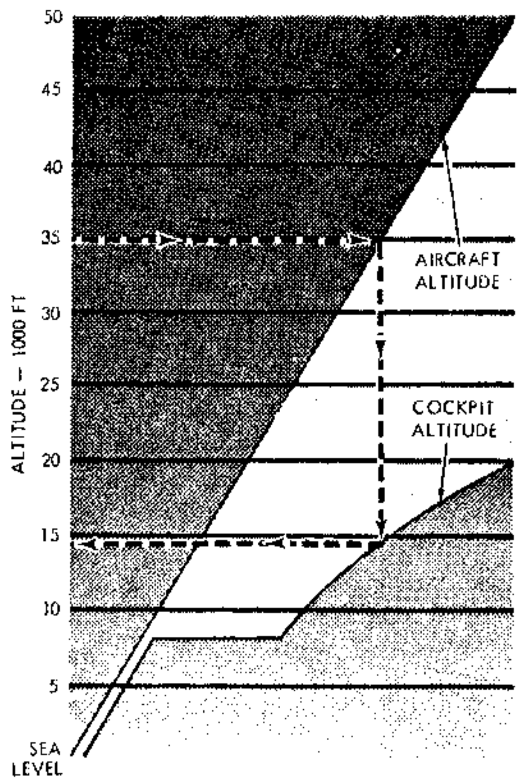


Figure 1-74 (Sheet 2).

ENVIRONMENTAL CONTROL SYSTEM CONTROLS (Figure 1-74)

CONTROLS	FUNCTION	
1 CABIN PRESS Switch (Guarded)	RAM DUMP	— Allows ram air to enter cockpit (Ⓕ both cockpits) and avionics equipment bay thru the air distribution system.
	CABIN PRESS. ([E] [E-2])	— (Guard Closed) Activates system to pressurize and air-condition cockpit.
	NORMAL ([F] [E-1] [E-3])	— (Guard Closed) Activates system to pressurize and air-condition cockpit.
	DEFOG ONLY ([F] [E-1]) [E-3])	— a. Shuts off all air except defog. b. Shuts off cockpit control of inlet air temperature.
2 CABIN TEMP Switch	AUTO	— Automatically maintains cockpit temperature selected by CABIN TEMP knob.
	Center (Neutral)	— Locks bypass valve in the position held at time of switch actuation.
	MAN COLD	— Cockpit air supply temperature decreases until full cold is reached.
	MAN HOT	— Cockpit air supply temperature increases until full hot is reached. **NOTE** When actuating switch, pause momentarily at center position to allow relay to function.
3 CABIN TEMP Knob	Permits selection of cockpit inlet air temperature. **NOTE** Positioning knob toward HOT, increases cockpit temperature and prevents water entering thru cockpit air inlets.	
4 CANOPY DEFOG Knob	OFF	— Shuts off the windshield and canopy defog air.
	INCREASE	— Activates system to control amount of airflow thru defog flow control valve.

COCKPIT PRESSURIZATION SCHEDULE



EXAMPLE

AIRCRAFT ALTITUDE OF 35,000 FEET EQUALS COCKPIT ALTITUDE OF APPROXIMATELY 14,500 FEET (DASH LINE).

F-5 1-43(1)A

Figure 1-75.

CANOPY AND WINDSHIELD DEFOGGING

The canopy and windshield are defogged by a mixture of bleed air and partially cooled package heat exchanger air that is directed thru ducting to the canopy and windshield surfaces. Defogging air temperature is independent of the temperature selected by the cockpit temperature knob, but is maintained within temperature limits by the defog temperature control valve and the defog temperature sensor.

ANTI-G SUIT

Anti-G suit air pressure is routed thru a regulating valve to the anti-G suit. A flexible hose from the regulating valve to the anti-G suit passes thru a quick-disconnect fitting on the left side of the ejection seat to allow automatic disconnection upon ejection. The anti-G suit valve is to the left side of the seat (figures 1-3 thru 1-8). The valve regulates air pressure to the anti-G suit to inflate the suit when positive G is encountered. The valve operates automatically and begins to function at about 1.75G, exerting an increasing pressure as the G-load is increased. When the acceleration decreases below the valve opening G-setting, the valve closes and the suit deflates. The anti-G suit valve test button [T.O. 1F-5-954] is located on the left console.

AIR DISTRIBUTION Ⓔ

The cockpit air distribution system provides air-conditioning and pressurization airflow, and routes cooling air to two cockpit air inlets on the left canopy frame. An additional cockpit air inlet is provided on the right vertical panel of [E-1] [E-3]. Airflow volume of the inlets can be adjusted or shut off by turning the outer opening and can also be adjusted directionally by tilting the inlet left-right or up-down. An inlet in the right lower rear bulkhead of the cockpit provides conditioned air to the floor area and is stationary and permanently open. In an emergency, the pilot can shut down the cockpit air-conditioning and pressurization system by selecting the RAM DUMP position of the cockpit pressurization switch. The RAM DUMP position fully opens the pressure safety valve, opens a small ram air door in the left side of the cockpit to provide ambient airflow ([E-1] [E-3] opens a ram air valve to provide ambient airflow from an opening behind the right engine air inlet duct), and closes the air-conditioning shutoff valve.

NOTE [E]

The ram air door can be opened at any airspeed but cannot be closed at airspeed above 400 KIAS.

AIR DISTRIBUTION Ⓕ

The cockpit air distribution subsystem provides distribution of the air-conditioning and pressurization airflow. Conditioned air is delivered to each cockpit thru an air-conditioning cockpit air inlet on the right vertical control panel and an inlet on the left canopy frame. Airflow from the cockpit air inlet on the right vertical panel can be adjusted or shut off by rotating and/or turning. The canopy inlet can only be rotated for directional airflow. Inlets at the forward end of the left and right consoles of each cockpit provide conditioned air to the floor area of the cockpits and are stationary and permanently open. In an emergency, the pilot in the front cockpit can shut down the cockpit air-conditioning and pressurization system by selecting the RAM DUMP position of the cockpit pressurization switch. The RAM DUMP position fully opens the pressure safety valve, opens a ram air valve to provide ambient airflow from an opening behind the right engine air inlet duct, and closes the air-conditioning shutoff valve. A ram air valve in the forward avionics bay opens to provide cooling air as cabin air is discharged overboard thru the safety valve. This valve also automatically opens to supply cooling air whenever the aircraft is at or above an altitude of 40,000 feet.

ELECTRICAL/ELECTRONIC EQUIPMENT CONDITIONING

On the ground, two ac-powered blowers circulate ambient air within the forward avionics bay when electrical power is on. When the canopy is closed, conditioned air from the cockpit area is discharged thru the cabin pressure regulator to the forward avionics bay. This conditioning maintains temperature limits in flight. The aft electrical bay is cooled by circulating conditioned air.

WINDSHIELD RAIN REMOVAL SYSTEM [E] [E-2]

The windshield rain removal system is provided to improve forward visibility in rain. The system consists of a rain removal switch outboard of the throttles (figure 1-21), windshield spray nozzles at the exterior base of the windshield, a pressurized rain repellent fluid container, timer, and solenoid valve in the nose compartment, and a system pressure gage in the nosewheel well.

SYSTEM OPERATION

Holding the rain removal switch momentarily at RAIN REMOVAL provides approximately 1/2 second of system operation. Rain repellent fluid squirts from the nozzles at the base of the windshield and reacts with the rain, spreading a transparent water-repellent film over the face of the windshield. One 1/2-second application lasts approximately 10 minutes. More than one application may be required initially if windshield is dirty or rain intensity is excessive; thereafter, application is made as necessary to maintain clear visibility. Rewetting starts to occur at the lower outer corners of the windshield. If the rewetted area is allowed to advance toward the center of the windshield, subsequent application of rain repellent fluid may not allow reclearing of the rewetted area. Applications of fluid should be repeated as necessary to prevent the rewetted area from advancing toward the center of the windshield.

NOTE

- Inadvertent application of fluid to a dry windshield or during light rain and prolonged use of the system causes cloudy residue to build up on portions of the windshield.
- A Form 781 entry is required each time system is used.

ANTI-ICING SYSTEMS

ENGINE ANTI-ICE

The engine anti-ice system directs engine ninth-stage compressor hot air to the engine inlet guide vanes, T_2 sensor, and the bullet nose of each engine. An electrically controlled engine anti-ice valve controls the flow of hot air to each engine. Both anti-ice valves are activated by an anti-ice switch on the right vertical panel (Ⓕ front cockpit) (figure 1-74, sheets 1 and 2) and actuated by engine compressor discharge pressure. The switch has two positions:

ENGINE and OFF. A caution light placarded ENGINE ANTI-ICE ON on the caution light panel illuminates when the switch is at ENGINE.

System Operation

The engine anti-ice valves are normally closed until electrically energized and sufficient air pressure is received from the engine to open them. The valves open when the engine anti-ice switch is positioned to ENGINE. At high engine rpm (below T_5 modulation), a slight increase in EGT can be expected when the system is operating. Thrust loss during system operation is approximately 9% at MIL power and 6.5% at MAX power. At MIL power, the opening of the anti-ice valve may produce an approximate 100 lb/hr decrease in fuel flow and a 2% increase in nozzle opening indication. The engine anti-ice valve fails to the closed position if dc power is lost.

NOTE

> To check engine anti-ice system operation prior to flight, with throttle at 75% rpm, position ENGINE ANTI-ICE switch to ENGINE, and check for a slight rise in EGT. Also check that ENGINE ANTI-ICE ON caution light comes on when switch is actuated.

PITOT BOOM, TOTAL TEMPERATURE PROBE, AND AOA VANE ANTI-ICING

The pitot boom, total temperature probe, and AOA vane contain electric heating elements for anti-icing. The pitot heater is powered by the right ac bus; the AOA vane and total temperature probe elements are powered by the left ac bus. Positioning the two-position pitot heat switch on the right vertical panel (Ⓕ front cockpit) (figures 1-15, 1-16, 1-18, and 1-19) to PITOT activates all heating elements.

AIRCRAFT WEAPONS SYSTEM

For detailed description and operation of fire control radar, lead-computing optical sight, sight camera, gun and missile systems, and armament controls, refer to the Aircrew Nonnuclear Weapons Delivery Manual, T.O. 1F-5E-34-1-1. See Jettison System, this section, for description and operation of stores jettison controls. See section V for authorized store configurations and limitations.

RADAR WARNING RECEIVER SYSTEM

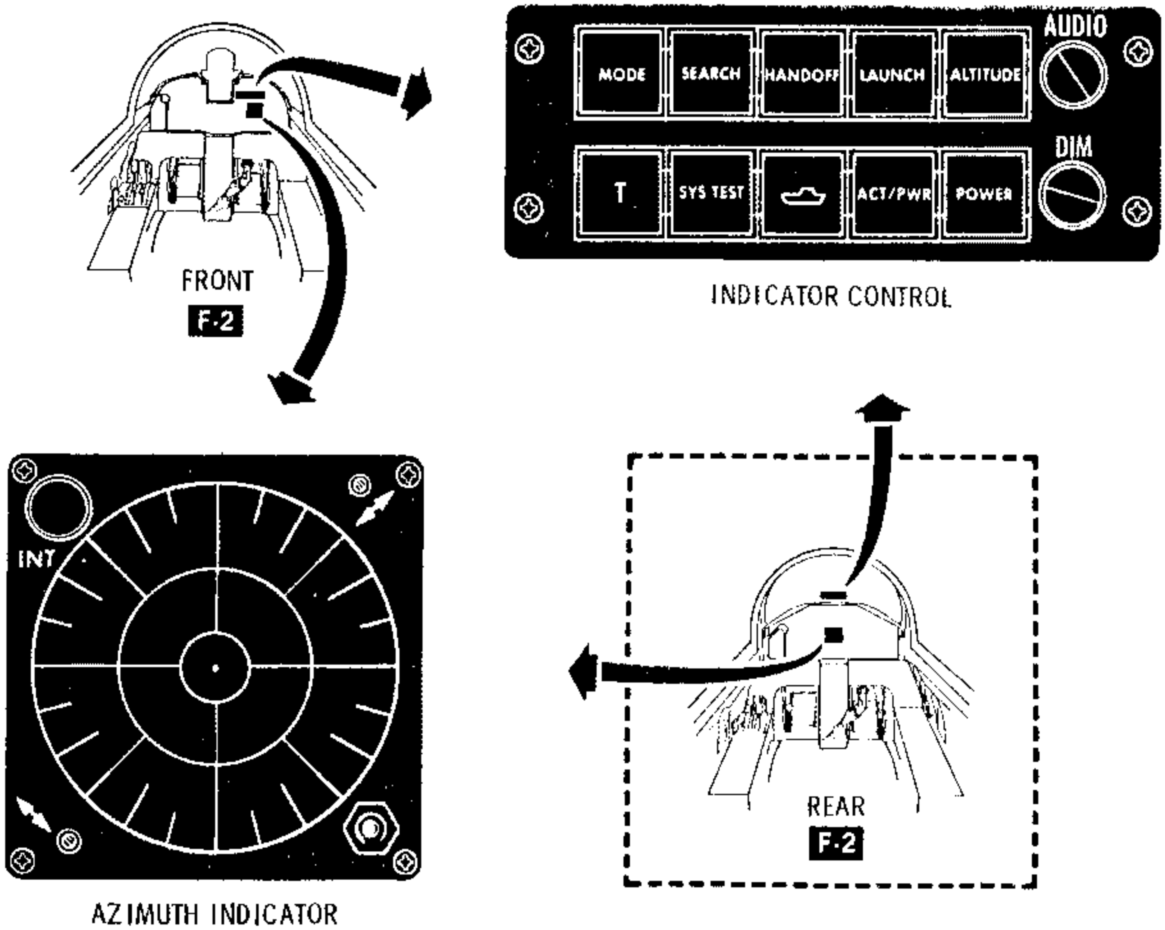
Some [F-2] aircraft are equipped with AN/ALR-46(V)3 radar warning receiver (RWR) system. It provides visual and audio warning of threat radar activity. Visual indications are displayed on an azimuth indicator and an indicator-control on the instrument panel (figure 1-76). An audio alert tone generated with each threat signal detected is routed to the headset. A blanking electronic unit shields the RWR system from interference caused by RF emissions of other systems aboard the aircraft. Refer to T.O. 1F-5E-34-1-1-4 (Confidential) for detailed description, and function of controls.

TOW TARGET SYSTEM (DART)

The A/A37U-15 (Dart) tow target system can be carried for aerial gunnery. The system consists of an RMU-10/A tow reel pod on the centerline pylon and an adapter and launcher assembly on the left outboard pylon to carry, launch, and tow a TDU-10/B Dart target. A nylon rope is routed under the aft fuselage and the left horizontal stabilizer. The rope is suspended forward to the target and attached to the aircraft with cloth tape. Armament circuitry and switches provide controls for launching, towing, and freeing the target. Cable cutters in the tow reel can be electrically actuated to cut the tow cable. The tow reel pod and target carrier are not jettisonable. See section V for limitations and part 9 of the appendix for performance.

RADAR WARNING RECEIVER SYSTEM

CONTROLS/INDICATORS



ANTENNA LOCATIONS

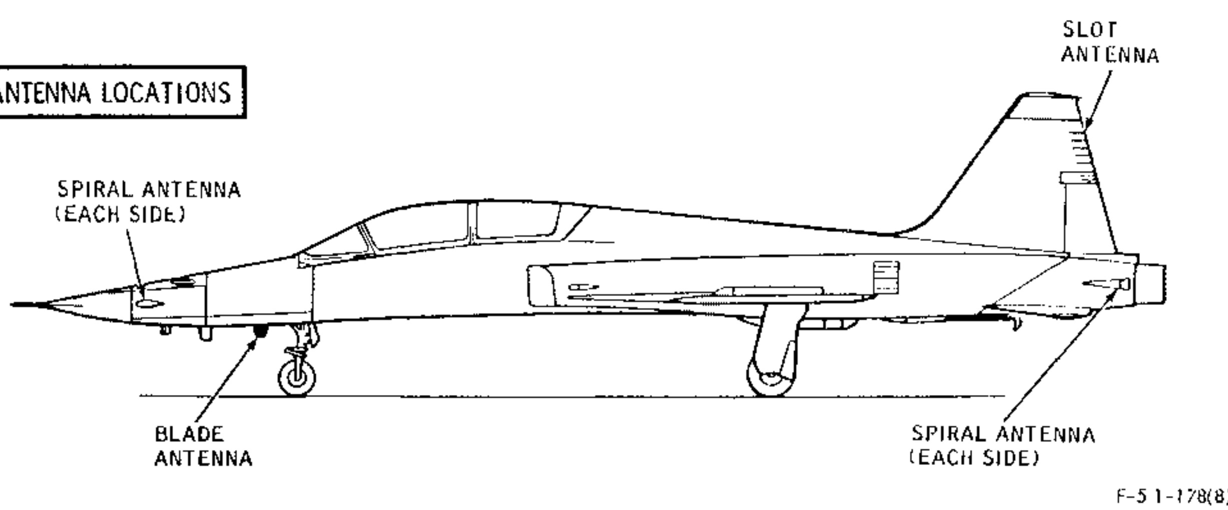


Figure 1-76.

TOW TARGET SYSTEM CONTROLS

Refer to T.O. 1F-5E-34-1-1 for operation of controls.

MISCELLANEOUS EQUIPMENT

INSTRUMENT HOOD Ⓕ

The rear cockpit may be equipped with an instrument hood for simulated instrument training flights. The hood is positioned on guides and is stowed behind the ejection seat when not in use.

MXU-648 BAGGAGE/CARGO POD

The MXU-648 baggage/cargo pod is a modification of the BLU-1 unfinned and BLU-27 unfinned series fire bombs. Each pod has a hinged access door on the left side. Some pods have a removable tail cone for loading a variety of cargo in size and length. The cargo compartment contains a metal floor and a cargo tiedown system, which consists of straps and/or netting secured to permanent hooks installed in the floor. The maximum cargo weight permitted is 300 pounds.

ELASTIC TIEDOWN CORDS Ⓕ

Elastic tiedown cords secure the rear cockpit survival kit in the seat bucket during solo flights for pilot/passenger pickup or delivery missions. They are installed in a criss-cross fashion by attaching the rear cord hooks to the safety belt attachment clevis pins near the back of the seat bucket on one side, and the front hooks to the opposite forward corner of the seat bucket.

PHOTORECONNAISSANCE CAMERA SYSTEM [E-2]

The photoreconnaissance camera system is integrally mounted in the nose section (figure 1-77). The system consists of four KS-121A 70mm cameras, a computer-junction box, camera cooling and a camera window defog ducting, a camera control panel, and camera operate lights. The system provides high-resolution aerial photographic coverage of ground targets at a full range of speeds and at low to medium altitudes.

CAMERA COMPARTMENT ENVIRONMENTAL CONTROL SYSTEM

The camera compartment environmental control system (figure 1-78) controls the compartment temperature and directs defog air to the camera windows. The system draws cooling and defog air from the cockpit air-conditioning unit. The compartment is automatically cooled and the camera windows defogged when the cockpit air-conditioning system is operating and the camera mode selector is at TEST, RMT, or OPR. Temperature in the compartment is maintained between 80° and 90°F, except for occasional transients to 120°F on hot days at maximum airspeed, low-level missions.

CAMERA ARRANGEMENTS

The cameras may be arranged in six basic arrays, depending on specific target and mission requirements (figure 1-79, sheets 1 thru 6). Camera usage in the basic arrangements is dictated by scale, ground coverage, environment (hostile), and type of target. The arrangements provide two trimetrogon arrays, two split-vertical arrays, one split-oblique array, and one left oblique array. Camera and lens usage is restricted to the six basic arrangements.

CAMERAS

The KS-121A camera is an aerial photographic sequential, pulse-operated still picture type with three alternate focal length lenses and shutter speeds of 1/250 to 1/4000 second, which are infinitely variable within that range. The film format is 70mm (2.25 inches) square. A light filter, integral light sensor, and a 200-foot film magazine with a capacity of 916 exposures are included. Lenses are 1.5-inch, 3-inch, and 6-inch focal length. Exposure is automatically controlled by the light sensor and automatic exposure control computer thru adjustment of lens aperture and shutter speed. Shutter speeds are automatically set by the automatic exposure control circuits. The shutter operates at 1/4000 second until the lens is completely open and then automatically adjusts down to the speed required, with 1/250 second the minimum shutter speed. Each camera is electrically connected to the computer-junction box. The computer-junction box and the cameras operate on 28-volt dc power. The computer-junction box controls and coordinates camera operation.

CAMERA CONTROL PANEL

The camera control panel (figure 1-77) has a camera selector switch for each camera, a mode selector, an interval selector, a built-in-test (BIT) button with GO and NO-GO lights, a camera override switch, and four frames-remaining counters with reset controls.

CAMERA OPERATE LIGHTS

A camera operate light for each camera on the instrument panel (figure 1-77) provides monitoring of camera operation head up. The green lights are numbered 1 thru 4 to correspond to cameras, camera selector switches, and frames-remaining counters. Each light comes on while the corresponding camera is operating. If the selected exposure interval is 1 second or less, the light will be on steady. If the interval exceeds 1 second, the light pulses on with the camera for approximately 1 second each cycle.

VERTICAL STEREO — 60 PERCENT OVERLAP COVERAGE

If vertical stereo coverage is required, use the Vertical Stero — 60 Percent Overlap Coverage chart (figure 1-80) as a guide. Vertical stereo coverage is vertical photographs of the same target area taken from slightly different angles. When the stero (overlap) area is viewed thru special stereo viewing equipment, targets show vertical development permitting more effective analysis. Determine the size of the target and the scale required in the photography. Enter the chart with the scale and target size and determine first an altitude and lens focal length to provide the required scale; second, the number of exposures required to cover the longest dimension of the target; and, third, the interval setting required between exposures at your planned groundspeed. The length of your flight line to cover the long dimension is determined by the number of exposures required and the other dimension of the target determines whether additional flight lines are required. Generally, a 20 percent side-overlap between flight lines is considered satisfactory.

STEREO COVERAGE OVERLAP

Stereo coverage requires 60 percent overlap from one exposure to the next, so that only 40 percent of each exposure is actual ground advance. The intervals in figure 1-80 are based on the formula, so the intervals recommended provide optimum stereo overlap coverage.

STEREO PLANNING SAMPLE PROBLEM

To provide stereo coverage of an industrial target area approximately 15,000 feet by 7500 feet at a desired scale of 1:10,000 go to figure 1-80. Determine that a 1.5-inch focal length lens at 1250 feet altitude, a 3-inch focal length lens at 2500 feet altitude, or a 6-inch focal length lens at 5000 feet altitude will satisfy your scale requirements. Considering tactical and other requirements, you select the 6-inch lens. In the GROUND COVERAGE (SINGLE FRAME) column, you find that each exposure with this lens at this altitude covers 1875 feet. With 60% overlap, each exposure advances only 40% of the coverage, so that 1875 X .40 = 750 feet is the ground advance for each exposure. Dividing 750 into 15,000 (the longest dimension of the target) discloses that 20 exposures covers the target lengthwise. Add 1 exposure at each end of each flight line to allow for turning error and lineup. Allowing 20% sidelap (side overlap) for each flight line (80% of 1875) discloses that each flight line covers 1500 feet across the target. Dividing 7500 by 1500 shows that 5 flight lines are required. Selecting 420 knots ground speed gives an INTVL-SEC switch setting of 1.0 second and the complete result is:

LENS	—	6.0-inch
ABSOLUTE ALTITUDE	—	5000 feet
INTVL-SEC Setting	—	1.0 second
EXP PER FLT LINES	—	22
NO. OF FLT LINES	—	5
TOTAL EXPOSURES	—	110

RECONNAISSANCE CAMERA SYSTEM

E-2

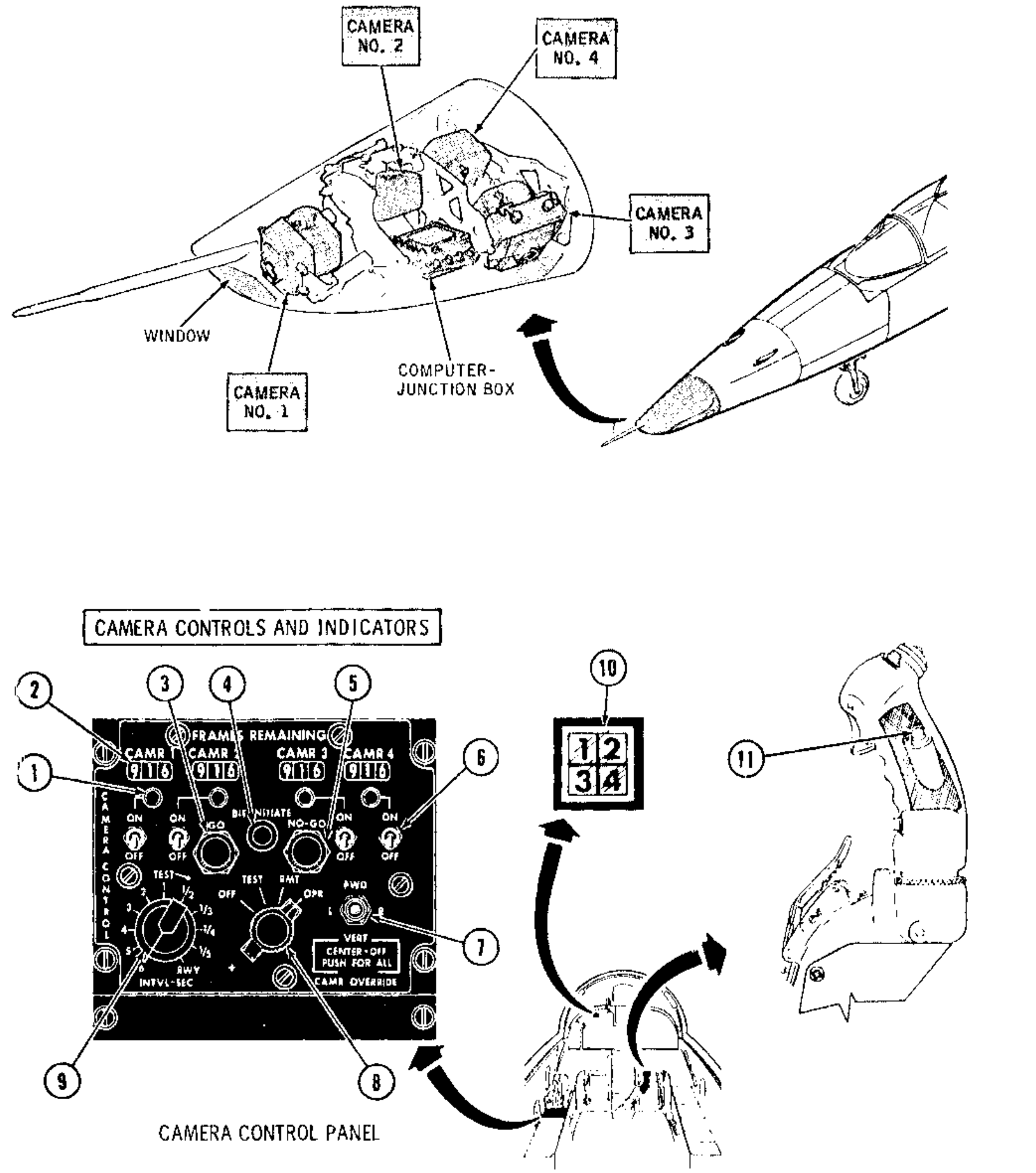


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Figure 1-77.

RECON CAMERA SYSTEM CONTROLS/INDICATORS (Figure 1-77)

CONTROLS/INDICATORS	FUNCTION	
1 FRAMES REMAINING Reset Controls	Used to reset the FRAMES REMAINING readout when film magazine is refilled. Not used in flight.	
2 FRAMES REMAINING Counters	Readout	— Number of frames (exposures) remaining in film magazine. When rotating, camera is operating.
3 GO Light	On	— Camera BIT tested is operative.
4 BIT INITIATE Button (Momentary)	Push	— Activates BIT test of selected camera with INTVL selector and mode selector at TEST. (A go indication is when each counter moves 3 to 5 frames and the GO light comes on after 4 seconds.)
5 NO-GO Light	On	— Camera BIT tested is inoperative.
6 Camera Select Switches (4)	OFF	— Camera is not operating; dc power not available at camera.
	ON	— Camera operates as controlled by mode selector and camera remote operate button or camera override switch.
7 CAMR OVERRIDE Switch	Overrides any position of mode selector and OFF position of camera select switches.	
	FWD	— Operates camera No. 1.
	R	— Operates camera No. 2.
	L	— Operates camera No. 3.
	VERT	— Operates camera No. 4 (or 3 and 4).
	Center	— Pushed in, operates all cameras.
8 Mode Selector	OFF	— Power is off to all cameras.
	TEST	— BIT circuits are selected.
	RMT	— Transfers control of cameras to camera remote operate button (dogfight button) on stick grip.
	OPR	— Operates cameras selected by camera select switches.

RECON CAMERA SYSTEM CONTROLS/INDICATORS (Figure 1-77) (Continued)

CONTROLS/INDICATORS	FUNCTION	
9 INTVL-SEC Switch	TEST 1	— BIT interval circuits are selected.
	Numerical Value	— Selects the placarded interval between exposures in seconds.
	RWY	— Selects 6 exposures per second.
10 Camera Operate Lights (4) (Green)	On Steady	— Corresponding camera is operating at an exposure interval of 1 second or less.
	On & Pulsing	— (Approximately 1-second cycle) Corresponding camera is operating at an exposure interval greater than 1 second.
11 Camera Remote Operate Button	Press	— Operates selected camera(s) with mode selector at RMT.

CAMERA ENVIRONMENTAL CONTROL SYSTEM

E-2

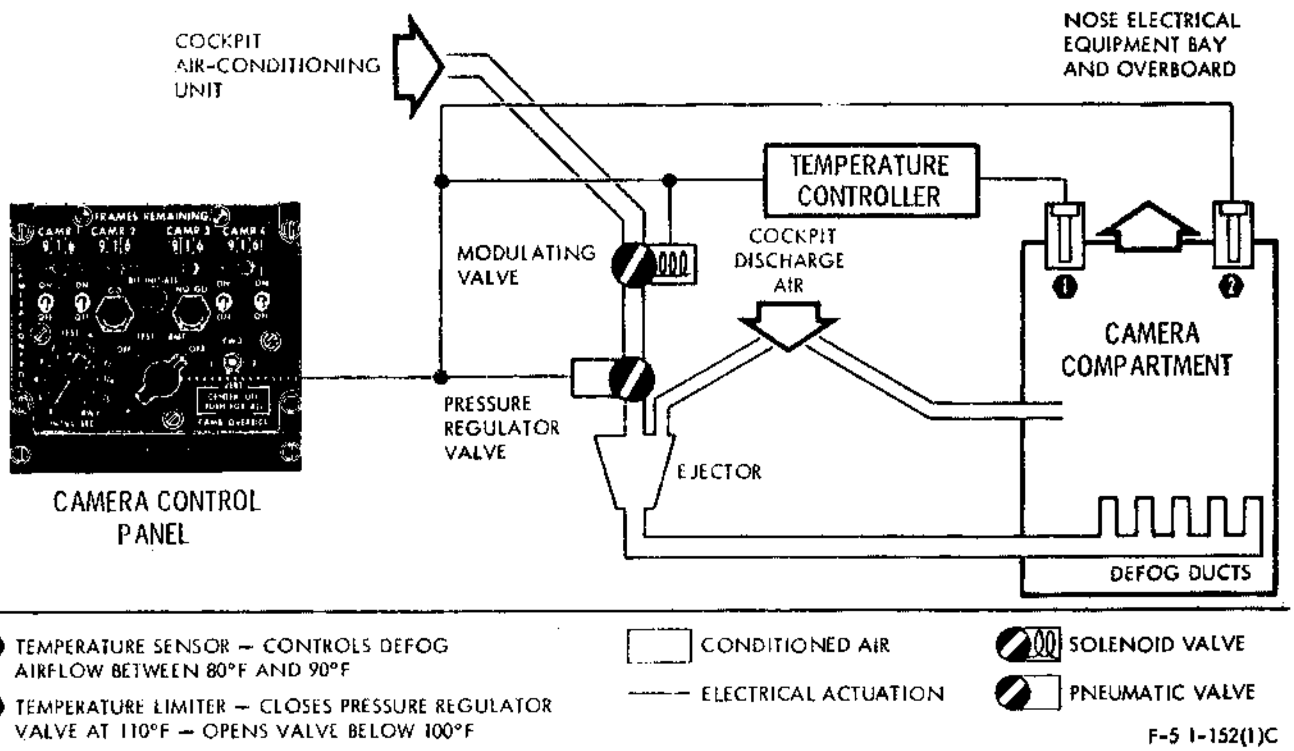


Figure 1-78.

DEFINITIONS

ABSOLUTE ALTITUDE — Actual altitude above terrain (or water).

ARRAY — An arrangement of two or more cameras.

EXPOSURE (Frame) — One photograph, or shutter cycle, of a camera.

COVERAGE — Ground (or other) area covered by one frame or exposure.

LINES PER MILLIMETER — A measure of lens and film quality which governs the resolution capability.

NADIR — The point directly below the aircraft.

SCALE — The ratio of the photograph to the coverage, identical to the term as used in mapping.

PHOTO SCALE RECIPROCAL (PSR) — Denominator of the photo scale. Example photo scale — 1:10,000 PSR — 10,000.

OBLIQUE — A photograph taken at an angle other than vertical. High obliques include the horizon while low obliques do not.

VERTICAL — A photograph taken with the camera axis perpendicular to the terrain.

RESOLUTION — The capability of the system to make distinguishable closely adjacent optical images.

SPLIT-VERTICAL — Two cameras taking vertical photographs of an identical or overlapping area. Cameras may be angled obliquely to left and right with the overlapping coverage being the only portion which is vertical.

TRIMETROGON — A tri-camera array which gives horizon-to-horizon coverage with two oblique and one vertical camera.

PULSE-OPERATED CAMERA — An electrically actuated aerial camera in which actuation operates the shutter (exposes film) and advances the film.

STEREO — Overlapping vertical which, when viewed as stereo pairs with special equipment, give a three-dimensional effect which shows vertical development and characteristics in the overlap (stereo) area.

CAMERA AREA COVERAGE

ARRANGEMENT NO. 1

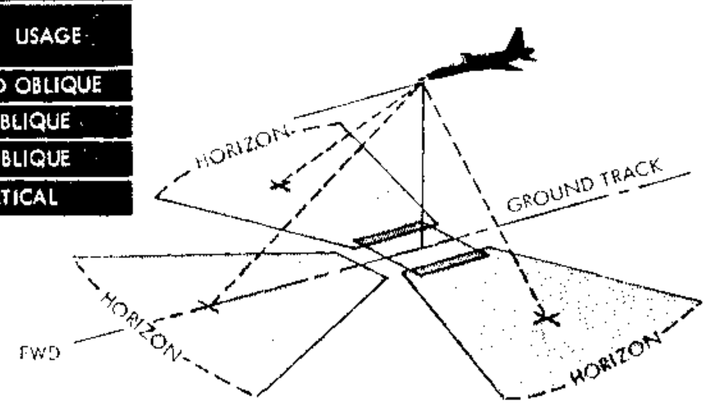
E-2

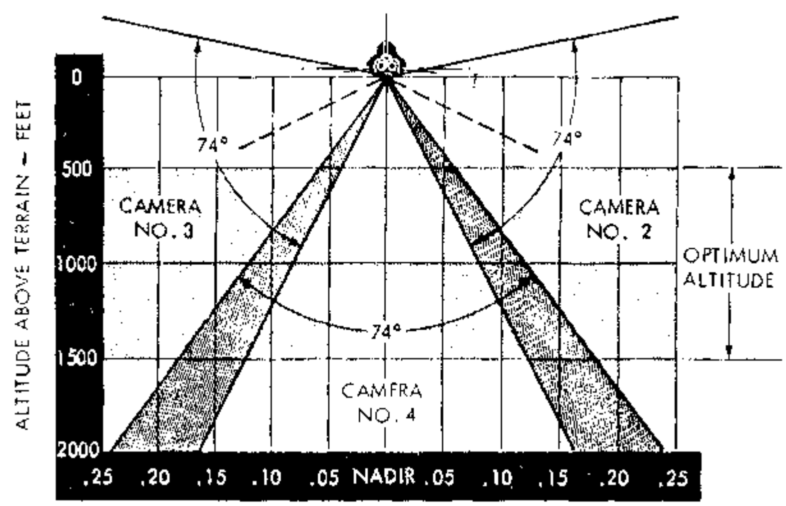
TRIMETROGON			
CAMERA NUMBER	FOCAL LENGTH — INCHES	DEPRESSION ANGLE — DEGREES	USAGE
1	3 OR 6	18	FWD OBLIQUE
2	1.5	26	R OBLIQUE
3	1.5	26	L OBLIQUE
4	1.5	90	VERTICAL

OPTIMUM ALTITUDE — 500 TO 1500 FEET

Note

SATISFACTORY COVERAGE FROM 100 TO 5000 FEET.





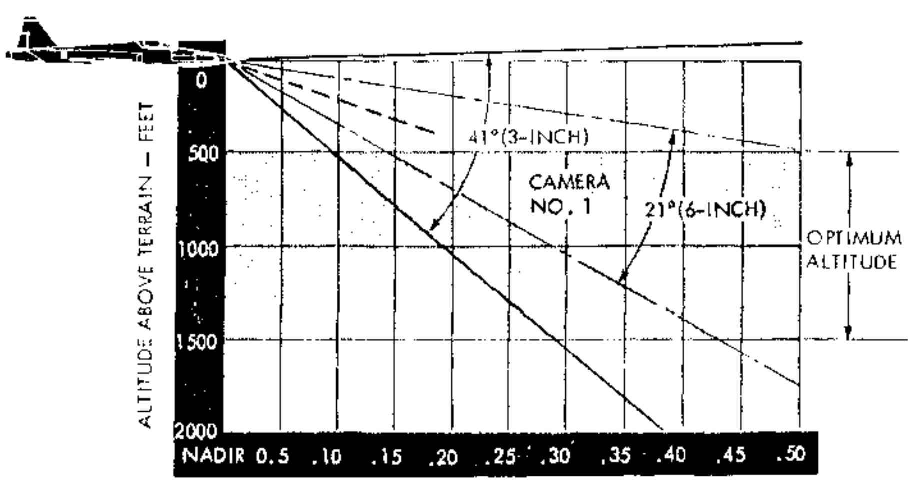


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Figure 1-79 (Sheet 1).

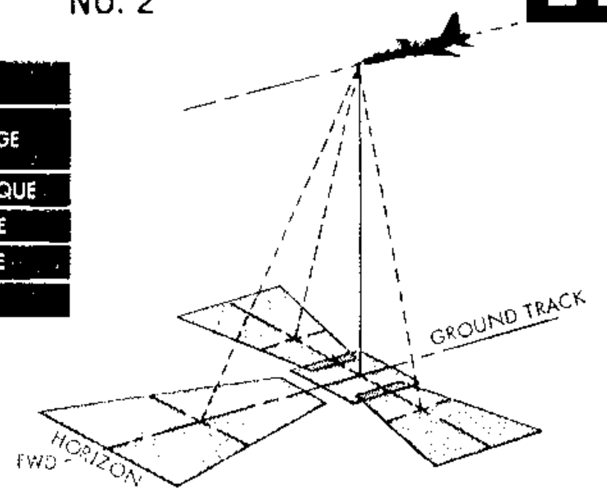
CAMERA AREA COVERAGE

ARRANGEMENT NO. 2

E-2

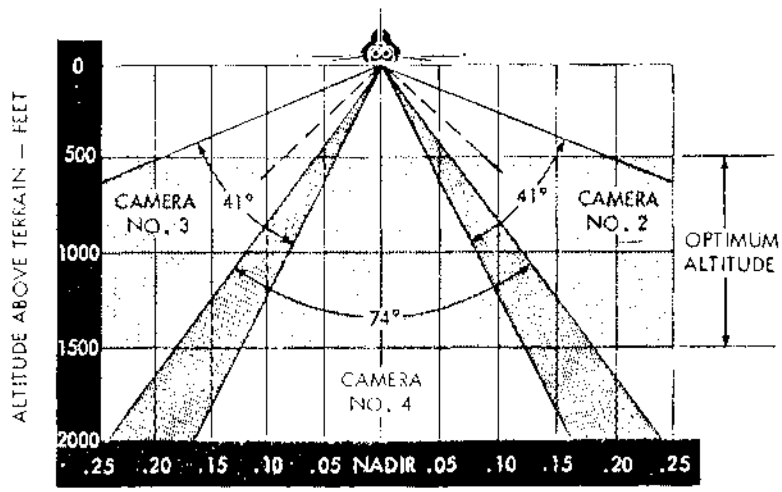
TRIMETROGON			
CAMERA NUMBER	FOCAL LENGTH — INCHES	DEPRESSION ANGLE — DEGREES	USAGE
1	3 OR 6	18	FWD OBLIQUE
2	3	41.5	R OBLIQUE
3	3	41.5	L OBLIQUE
4	1.5	90	VERTICAL

OPTIMUM ALTITUDE - 500 TO 1500 FEET



Note

SATISFACTORY COVERAGE FROM 100 TO 5000 FEET.



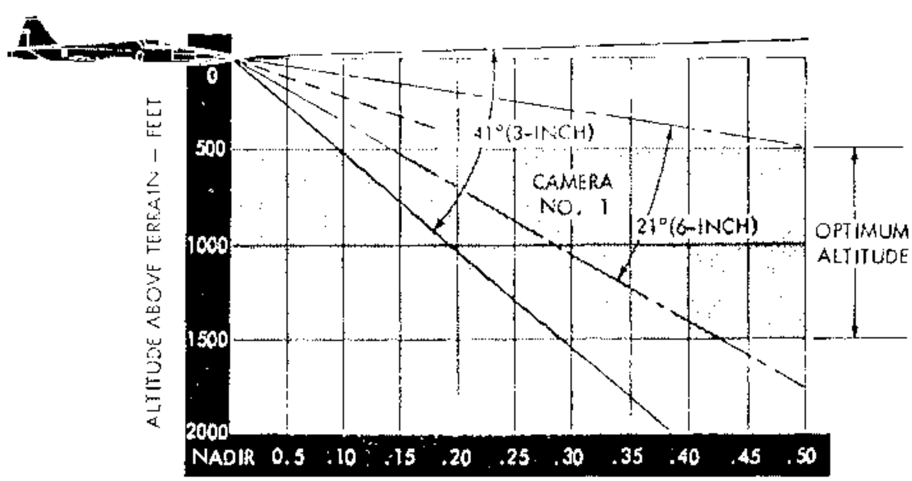


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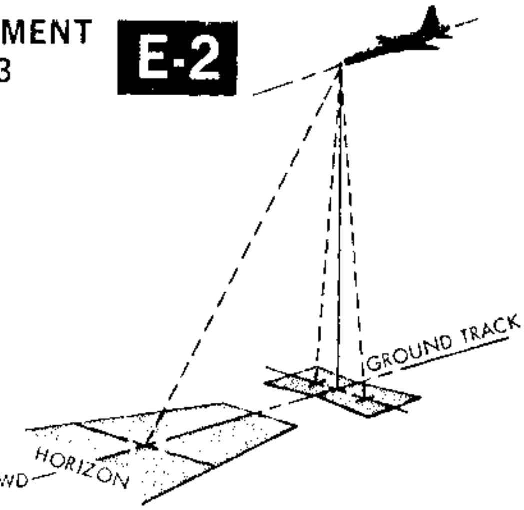
Figure 1-79 (Sheet 2).

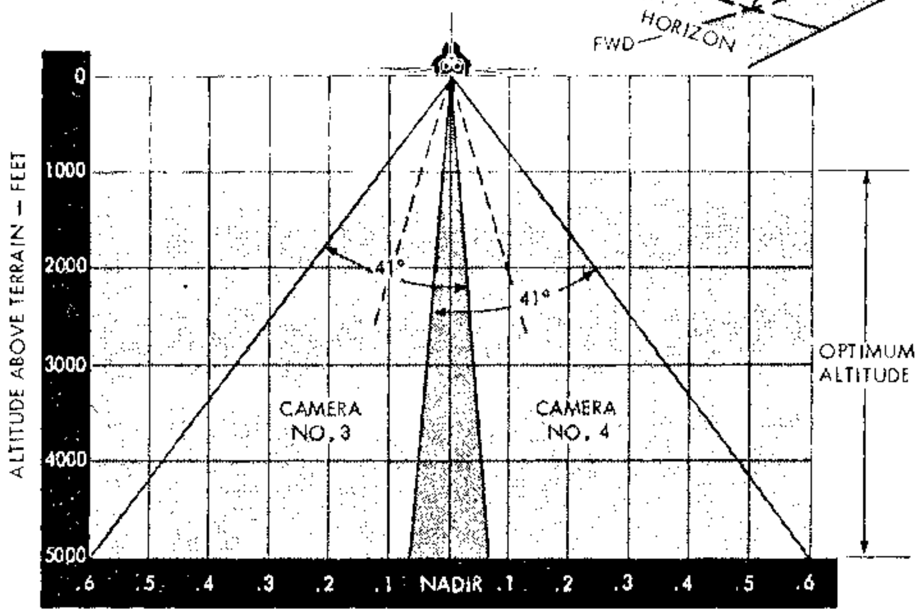
CAMERA AREA COVERAGE

ARRANGEMENT NO. 3 **E-2**



SPLIT VERTICAL			
CAMERA NUMBER	FOCAL LENGTH – INCHES	DEPRESSION ANGLE – DEGREES	USAGE
1	3 OR 6	18	FWD OBLIQUE
2	–	–	NOT USED
3	3	74	SPLIT VERTICAL
4	3	74	SPLIT VERTICAL

OPTIMUM ALTITUDE - 1000 TO 5000 FEET



Note

SATISFACTORY COVERAGE FROM 500 TO 20,000 FEET.

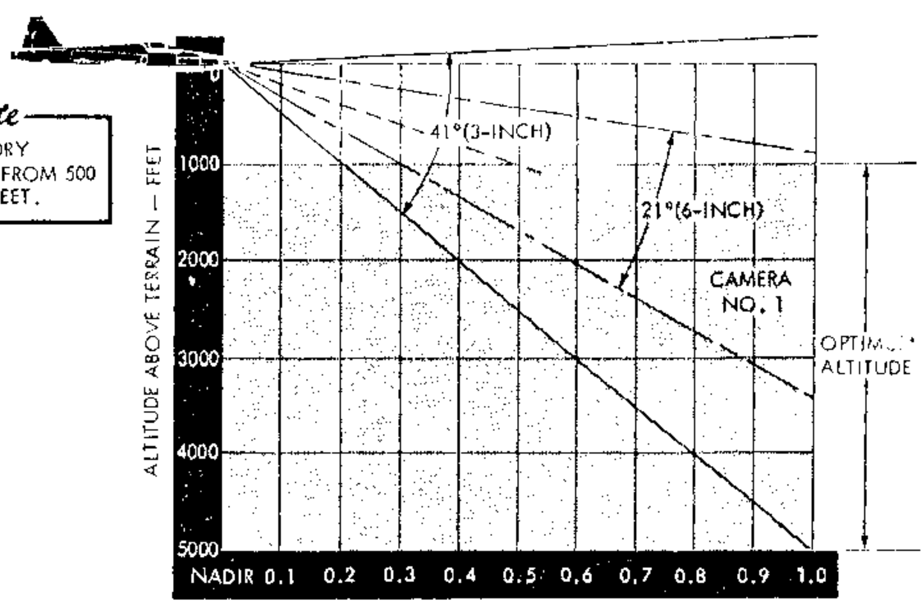


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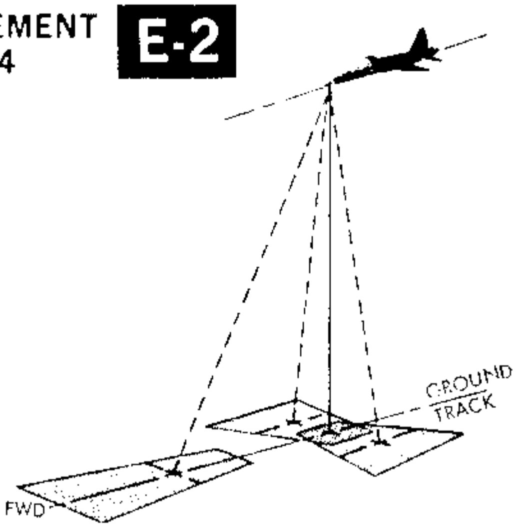
Figure 1-79 (Sheet 3).

CAMERA AREA COVERAGE

ARRANGEMENT NO. 4 E-2

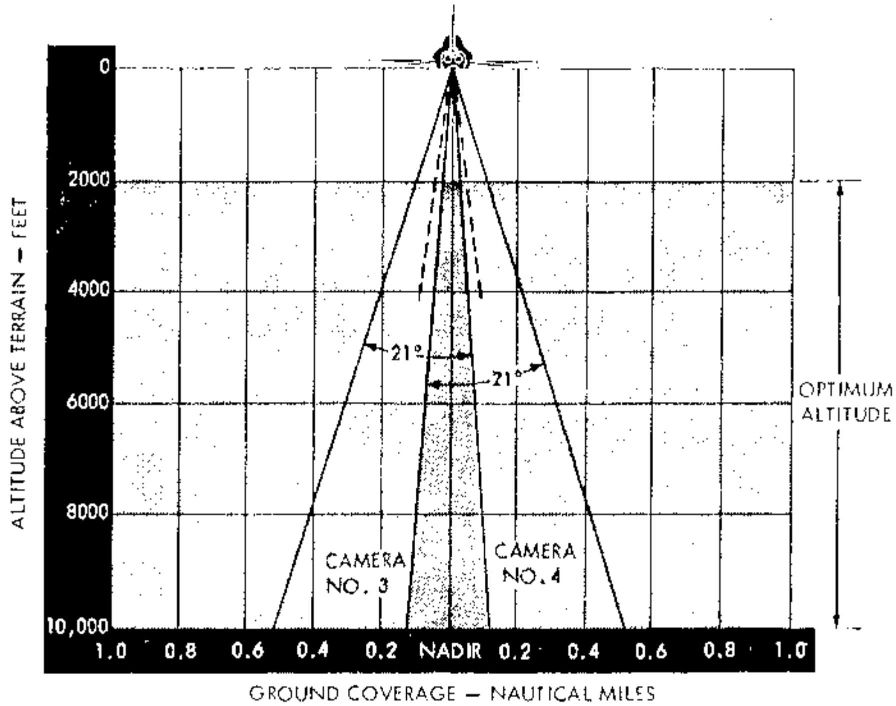


SPLIT VERTICAL			
CAMERA NUMBER	FOCAL LENGTH — INCHES	DEPRESSION ANGLE — DEGREES	USAGE
1	6	18	FWD OBLIQUE
2	—	—	NOT USED
3	6	81.5	SPLIT VERTICAL
4	6	81.5	SPLIT VERTICAL

OPTIMUM ALTITUDE -2000 TO 10,000 FEET

Note

SATISFACTORY COVERAGE FROM 1000 TO 40,000 FEET.



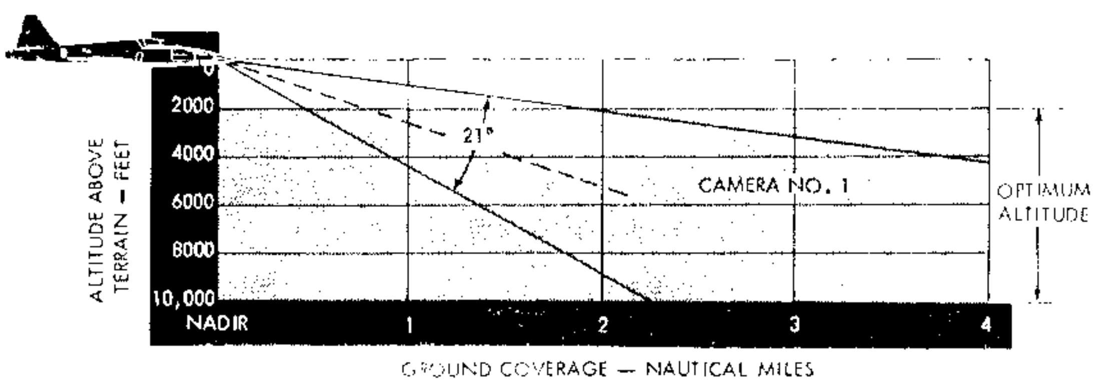


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Figure 1-79 (Sheet 4).

CAMERA AREA COVERAGE

ARRANGEMENT NO. 5

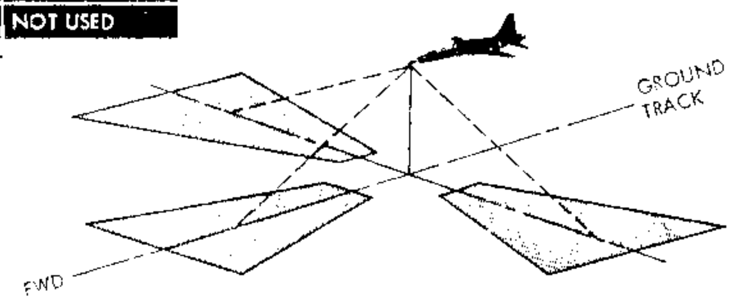
E-2

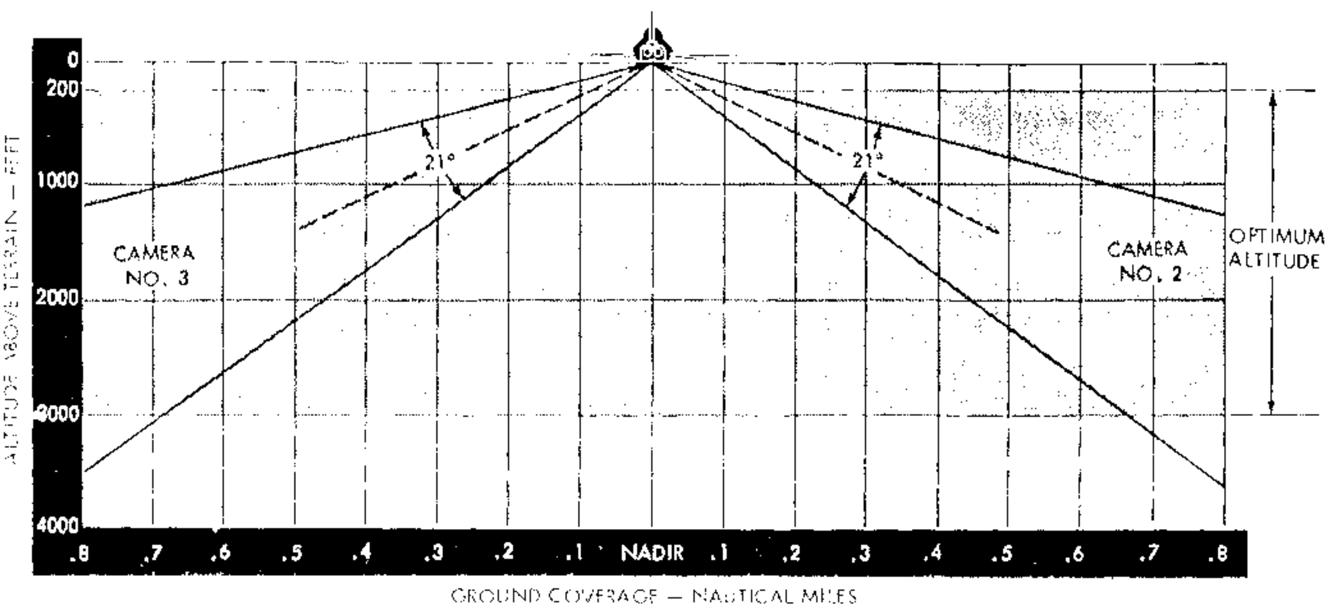
SPLIT OBLIQUE			
CAMERA NUMBER	FOCAL LENGTH – INCHES	DEPRESSION ANGLE – DEGREES	USAGE
1	3 OR 6	18	FWD OBLIQUE
2	6	25	R OBLIQUE
3	6	25	L OBLIQUE
4	–	–	NOT USED

OPTIMUM ALTITUDE - 200 TO 3000 FEET

Note

SATISFACTORY COVERAGE FROM 200 TO 20,000 FEET.





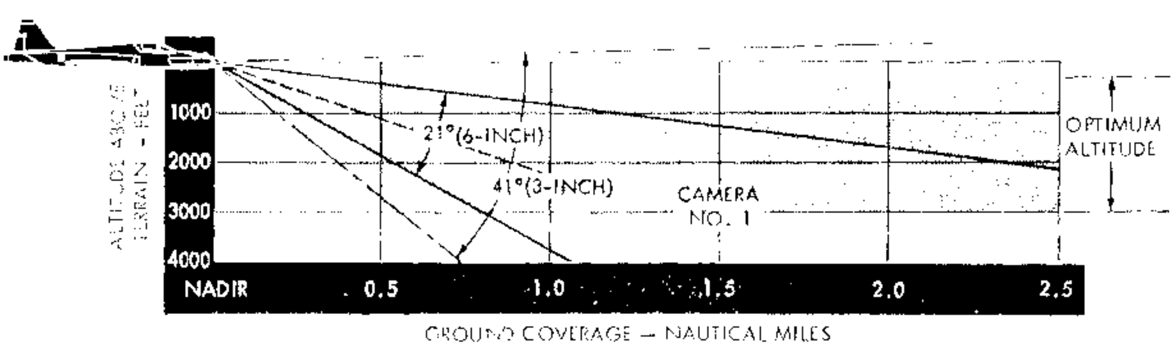


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Figure 1-79 (Sheet 5).

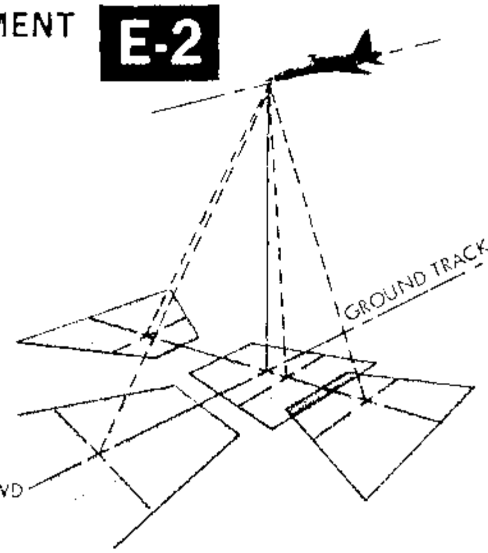
CAMERA AREA COVERAGE

ARRANGEMENT NO. 6

E-2

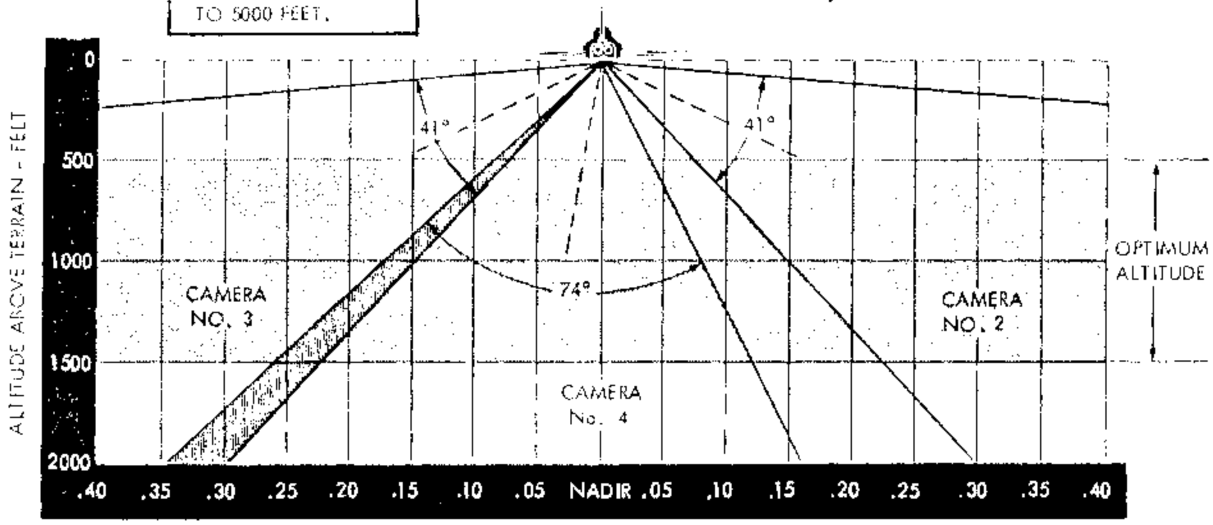
LEFT OBLIQUE			
CAMERA NUMBER	FOCAL LENGTH — INCHES	DEPRESSION ANGLE — DEGREES	USAGE
1	3 OR 6	18	FWD OBLIQUE
2	3	26	R OBLIQUE
3	3	26	L OBLIQUE
4	1.5	80	VERTICAL

OPTIMUM ALTITUDE - 500 TO 1500 FEET



Note

SATISFACTORY COVERAGE FROM 100 TO 5000 FEET.



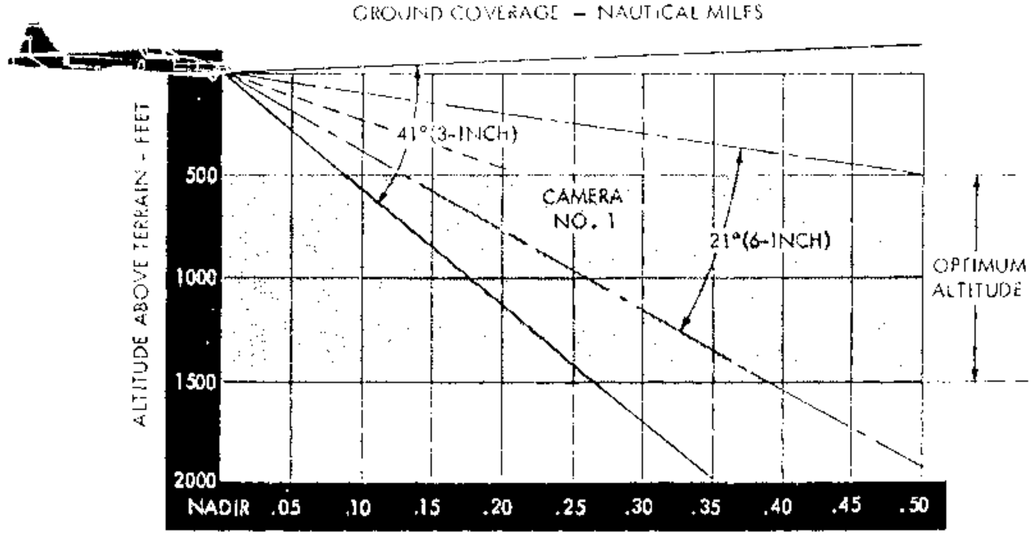


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Figure 1-79 (Sheet 6).

VERTICAL STEREO—60% OVERLAP COVERAGE

E-2

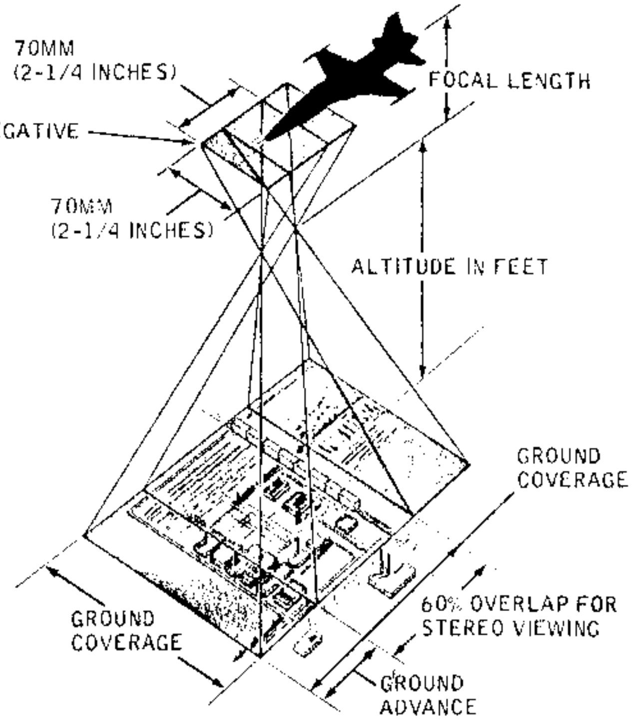

PHOTO SCALE *	ABSOLUTE ALTITUDE — FEET			GROUND COVERAGE SINGLE FRAME		INTVL-SEC SWITCH SETTING FOR GROUNDSPEED — KNOTS						
	LENS											
	1.5-IN	3.0-IN	6.0-IN	FEET LINEAR	METERS LINEAR	240	300	360	420	480	540	600
80,000	10,000	20,000	40,000	15,000	4,572	6.0	6.0	6.0	6.0	6.0	6.0	6.0
40,000	5,000	10,000	20,000	7,500	2,286	6.0	6.0	5.0	4.0	4.0	3.0	3.0
36,000	4,500	9,000	18,000	6,750	2,057	6.0	5.0	4.0	4.0	3.0	3.0	2.0
32,000	4,000	8,000	16,000	6,000	1,829	6.0	5.0	4.0	3.0	3.0	2.0	2.0
28,000	3,500	7,000	14,000	5,250	1,600	5.0	4.0	3.0	3.0	2.0	2.0	2.0
24,000	3,000	6,000	12,000	4,500	1,371	4.0	3.0	3.0	2.0	2.0	2.0	1.0
20,000	2,500	5,000	10,000	3,750	1,143	4.0	3.0	2.0	2.0	2.0	1.0	1.0
18,000	2,250	4,500	9,000	3,375	1,029	3.0	2.0	2.0	2.0	1.0	1.0	1.0
16,000	2,000	4,000	8,000	3,000	914	3.0	2.0	2.0	1.0	1.0	1.0	1.0
14,000	1,750	3,500	7,000	2,625	800	2.0	2.0	1.0	1.0	1.0	1.0	1.0
12,000	1,500	3,000	6,000	2,250	686	2.0	1.0	1.0	1.0	1.0	1.0	1/2
10,000	1,250	2,500	5,000	1,875	571	2.0	1.0	1.0	1.0	1.0	1/2	1/2
8,000	1,000	2,000	4,000	1,500	457	1.0	1.0	1.0	1/2	1/2	1/2	1/2
6,000	750	1,500	3,000	1,125	343	1.0	1/2	1/2	1/2	1/2	1/2	1/3
5,000	625	1,250	2,500	937	286	1.0	1/2	1/2	1/2	1/2	1/3	1/3
4,000	500	1,000	2,000	750	229	1/2	1/2	1/2	1/3	1/3	1/3	1/4
3,000	375	750	1,500	562	171	1/2	1/2	1/3	1/3	1/4	1/4	1/5
2,000	250	500	1,000	375	114	1/3	1/4	1/4	1/5	R	R	R
1,480	185	370	740	281	93	1/4	1/5	R	R	R	R	R
1,000	125	250	——	187	57	R	R	R	R	R	R	R

R = RUNAWAY (0.17-SECOND INTERVAL)
* RECIPROCAL

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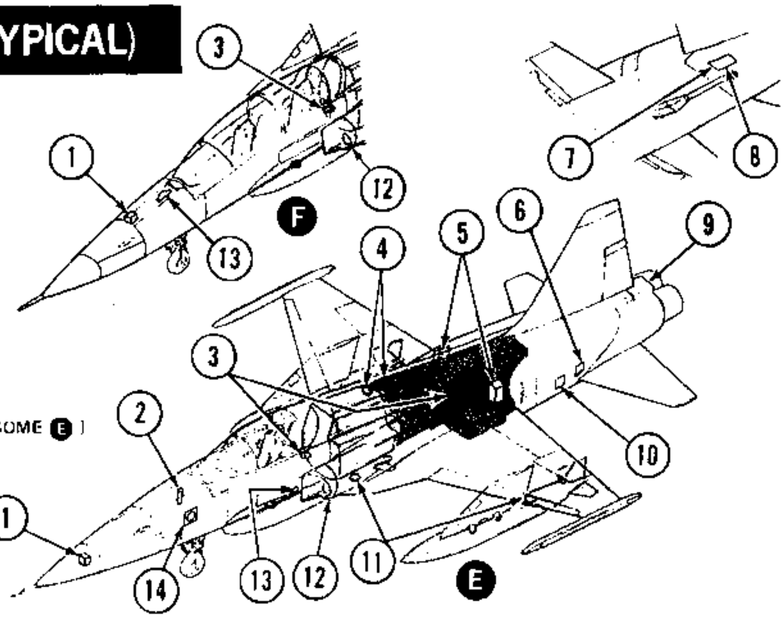
Figure 1-80.

SERVICING DIAGRAM (TYPICAL)

1 BATTERY
2 WINDSHIELD RAIN REMOVAL CONTAINER
3 FUEL CELL DRAINS (UNDER RIGHT SIDE)
4 FUEL SYSTEM MANUAL FILLER CAPS
5 HYDRAULIC RESERVOIR FILLER CAPS
6 OIL FILLER ACCESS DOOR (EACH SIDE)
7 ENGINE STARTER AIR INLET
8 VEN ACTUATOR SERVICE ACCESS (IN STARTER AIR INLET DOOR)
9 DRAG CHUTE COMPARTMENT DOOR
10 EXTERNAL ELECTRICAL POWER RECEPTACLE
11 MANUAL FILLER CAP (EACH TANK)
12 SINGLE-POINT FUEL FILLER (UNDER LEFT SIDE)
13 OXYGEN FILLER VALVE (LOX CONVERTER F)
14 WINDSHIELD RAIN REMOVAL PRESSURE GAGE (SOME E)



SPECIFICATIONS			REMARKS
ITEM	USAF	NATO	
FUEL	PRIMARY: ENGINE ADJUSTED FOR JP-4 (MIL-T-5624) ALTERNATE: NONE EMERGENCY: JET A-1 W/FSII OR JP-8 (MIL-T-83133) JET A-1 W/O FSII JP-5 (MIL-T-5624)	F-40 F-34 F-34 F-35 F-44	1 SINGLE-POINT PRESSURE REFUELING: USE 45-55 PSI SYSTEM. **WARNING** TO PRECLUDE EXCESSIVE ELECTROSTATIC DISCHARGE WHEN REFUELING WITH A FUEL GRADE OTHER THAN PREVIOUSLY CONTAINED IN TANKS, REDUCE SYSTEM PRESSURE TO 15-25 PSI. *Note* SEE SECTION V FOR FUEL SYSTEM LIMITATIONS. 2 MANUAL REFUELING: FILL LEFT INTERNAL SYSTEM FIRST. IF EXTERNAL TANK CARRIED, REFUEL AFTER INTERNAL SYSTEM IN SEQUENCE, CL AND WING TANKS.
	PRIMARY: ENGINE ADJUSTED FOR JET A-1 W/FSII OR JP-8 (MIL-T-83133) ALTERNATE: JP-4 (MIL-T-5624) JP-5 (MIL-T-5624) EMERGENCY: JET A-1 W/O FSII	F-34 F-34 F-40 F-44 F-35	
	PRIMARY: ENGINE ADJUSTED FOR JP-5 (MIL-T-5624) ALTERNATE: JP-4 (MIL-T-5624) JET A-1 W/FSII JP-8 (MIL-T-83133) EMERGENCY: JET A-1 W/O FSII	F-44 F-40 F-34 F-34 F-35	
ENGINE OIL	MIL-L-7808	0-148	CHECK OIL LEVEL IMMEDIATELY AFTER ENGINE SHUTDOWN (WITHIN 15 MINUTES).
HYDRAULIC FLUID	MIL-H-5606 MIL-H-83282	H-515 H-537	1 PRESS FILLER CAP DOWN TO VENT RESERVOIR PRESSURE. 2 CAP UNLOCKED WHEN RED DOT SHOWS; LOCKED-GREEN DOT.
LIQUID OXYGEN	MIL-O-27210, TYPE II	NONE	1 TO BE FILLED ONLY BY QUALIFIED PERSONNEL. 2 USE MA-1 OR TYPE TMU27M TANK FOR SERVICE.
TIRE PRESSURE	SEE DECAL INBOARD OF EACH MAIN GEAR STRUT, UNDERSIDE OF WING SKIN SURFACE OR INSIDE NOSE GEAR DOOR.	NONE	**WARNING** DO NOT USE HIGH-PRESSURE SERVICE SYSTEM.
EXTERNAL ELECTRICAL POWER	M32A-60A (USAF) OR EQUIVALENT NC-5 (USN) OR EQUIVALENT	NONE	OR A POWER UNIT WHICH MUST SUPPLY 3-PHASE, 115/200-VOLT, 400 Hz AC.
EXTERNAL AIR (JASU)	MA-1A (USAF) OR EQUIVALENT GTC-85 OR MA-1E (USN) WELLS AIR START SYSTEM M32A-60A	NONE	JASU RECOMMENDED MINIMUM OUTPUT: 350°F 42 PSIA 100 LB/MIN
WINDSHIELD RAIN REMOVAL	RAIN REPELLENT FLUID CONTAINER, PART NO. 65-38196-2 (BOEING)	NONE	CHECK PRESSURE GAGE FOR GREEN ARC INDICATION (45-200 PSI).
VEN ACTUATOR POWER UNIT	MIL-L-7808	0-148	REQUIRES VEN ACTUATOR SERVICE CART, PN 21C3128G01.

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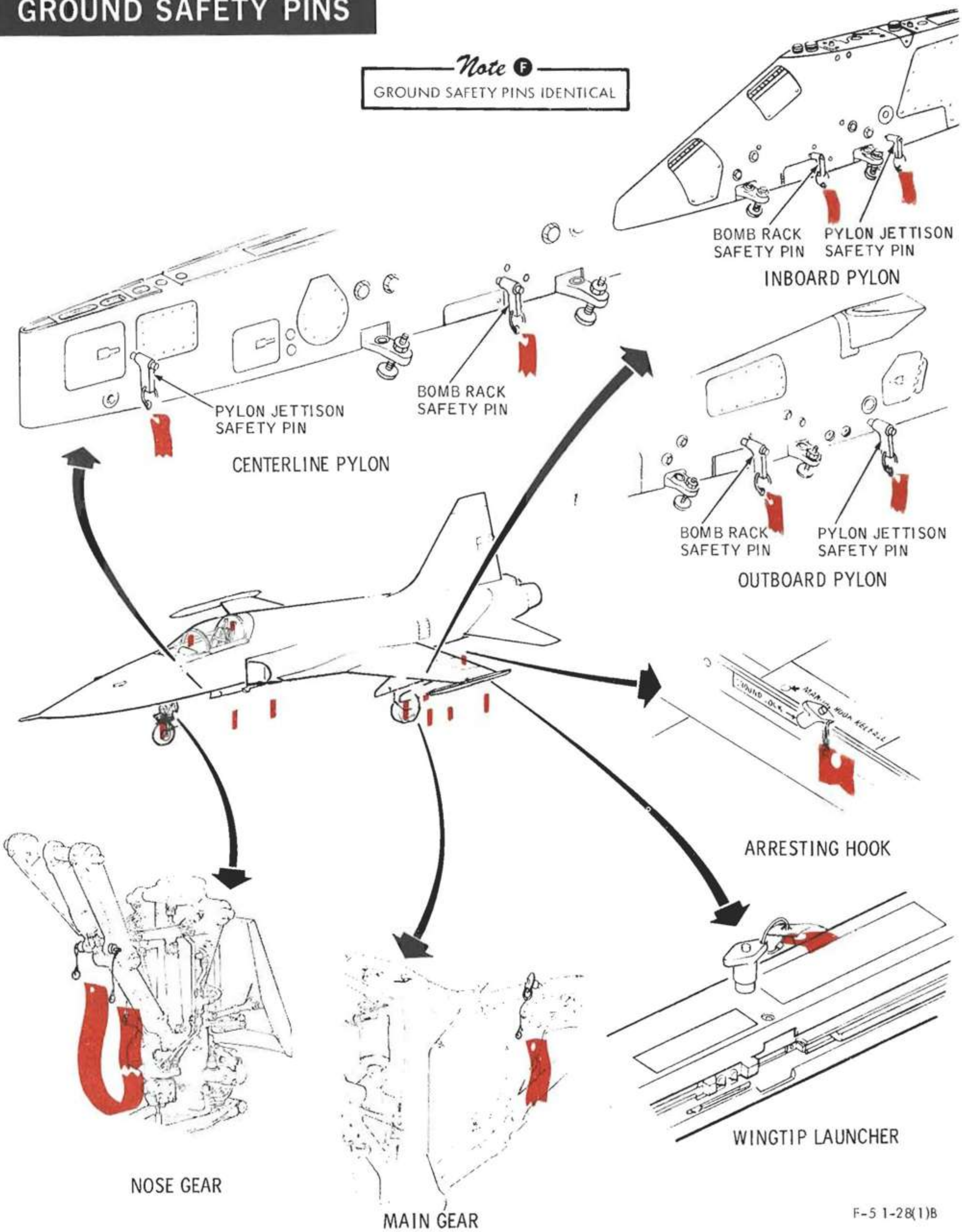
Figure 1-81.

GROUND SAFETY PINS



SOLID BLACK PLATE (-1 COLOR PLATE)

Figure 1-82.

SECTION II

NORMAL PROCEDURES

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TABLE OF CONTENTS

PREPARATION FOR FLIGHT

FLIGHT RESTRICTIONS

See section V for operating limitations.

FLIGHT PLANNING

See appendix I for takeoff, flight, and landing performance data.

TAKEOFF AND LANDING DATA CARD

See appendix I for information necessary to fill out the takeoff and landing data card in the checklist, T.O. 1F-5E-1CL-1.

WEIGHT AND BALANCE

Refer to T.O. 1-1B-40 for weight and balance. Ensure Form 365-4 (Form F) filed for loaded configuration complies with authorized configurations in section V.

CHECKLIST

Your abbreviated checklist is T.O. 1F-5E-1CL-1.

ENTRANCE TO AIRCRAFT

Unlock canopy using the canopy external handle and manually lift canopy to the open position. Entry is from the left side, using a ladder hooked over the canopy rail or the built-in retractable steps.

PREFLIGHT CHECK

BEFORE EXTERIOR INSPECTION

1. Form 781 — Check.
   Check form for both aircraft status and proper servicing.
2. Seat and Canopy Safety Pins — Installed.
3. Ⓕ (Rear CKPT) Survival Kit Elastic Tiedown Cords — Removed and Stored for all Dual Flights.

WARNING

Failure to remove elastic tiedown cords from survival kit equipped seats precludes man-seat separation after ejection.

4. Ⓕ Sequenced Ejection Dual-Gas Coupling Quick-Disconnect — Check.
   Visually verify proper connection of upper and lower halves of disconnect.
5. Seat Attachment Bolts — Check Alignment.
6. (Improved Ejection Seat) Drogue Chute Cover — Check.
   Check that left cover fits closely and conforms to the contour of the drogue chute container. The forward edge of the cover should fit inside or below edge of container.

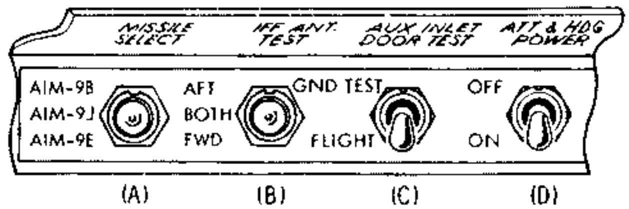
WARNING

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

7. Switches Behind Headrest (Ⓕ rear seat) — Check (4).

   A. MISSILE SELECT Switch — As Required.
   B. IFF ANT (antenna) TEST Switch — BOTH.
   C. AUX INLET DOOR TEST Switch — FLIGHT.
   D. ATT & HDG (attitude and heading) POWER Switch — ON.

SWITCHES BEHIND HEADREST



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8. Seat Ground Maintenance Safety Pins — Removed.
   If safety pins are installed, do not remove until status of system has been checked by maintenance personnel.
9. Gear Lever — LG DOWN.
10. Gear Alternate Release Reset Control — RESET.
11. Armament and Jettison Switches — OFF and SAFE.
12. [E] [E-2] [F] External Stores Jettison T-Handle — In; Safety Pin — Installed.

12A. Standby Attitude Indicator — Caged and Locked (Ⓕ both cockpits).

13. Battery Switch — As Required.

NOTE

- Operation of static inverter and fuel and oxygen quantity indicators may be checked at this point, if desired.
- Failure of indicators to respond indicates static inverter failure.

14. External Power — As Required.
15. Publications — Check.

EXTERIOR INSPECTION

The aircraft should be checked for general condition, access doors and filler caps secured, and

PREFLIGHT CHECK (Continued)

for hydraulic, oil and fuel leaks as well as the following:

1. AOA Vane Cover — Removed.
2. Pitot Cover — Removed.
3. Gear Safety Pins — Removed.
4. Gear Door Switch — NORMAL.
5. Pylon and Launcher Safety Pins — As Required.
6. Pylon Ordnance Selector(s) — As Required.
7. Aux Intake Doors — Closed.
8. Arresting Hook Safety Pin — Removed.
9. Ⓕ External Tail Ballast — As Required. See section V for additional store configuration ballast requirements for one and two crew.
10. Retractable Steps — Stowed.

INTERIOR INSPECTION
REAR COCKPIT (SOLO FLIGHTS) Ⓕ

1. Ejection Sequence Selector — SOLO.
2. Seat and Canopy Safety Pins — Installed.
3. Survival Kit — Removed or Secured with Elastic Tiedown Cords.

WARNING

Automatic safety belt and shoulder harness do not provide adequate restraint for survival kit during zero or negative-g maneuvers.

NOTE

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

4. Safety Belt, Shoulder Harness, and Crew/Kit Retention Strap — Secure. Stow all loose equipment and secure automatic safety belt, shoulder harness, and crew/kit retention strap.
5. Circuit Breakers — Check. All circuit breakers on left and right consoles in (closed).
6. (Improved Ejection Seat) Drogue Chute Cover — Check. Check that left cover fits closely and conforms to the contour of the drogue chute container. The forward edge of the cover should fit inside or below the edge of container.

6A. Standby Attitude Indicator — Uncaged.

7. Radar Override Switch — Off (guard closed).
8. Comm/Nav Override Switch — Off (guard closed).
9. Comm & Nav Equipment — As Required.
10. Oxygen Regulator — NORMAL/ 100%/ OFF. Place oxygen emergency/test lever in NORMAL position, diluter lever in 100% position, and supply lever in OFF position.
11. Lighting Controls — OFF.
12. Instrument Hood — Removed or Secured. Check all bungee cords connected.
13. Canopy — Close and Lock.

COCKPIT

NOTE

Ⓕ Steps marked with an asterisk (*) do not apply to rear seat crewmember.

1. Safety Belt, Shoulder Harness, Crew/ Kit Retention Strap, Survival Kit, and Personal Equipment — Attach.

WARNING

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

WARNING

- Failure to install the crew/kit retention strap loop on belt link FIRST may delay or negate man/seat separation during ejection.
- Pull Gold Key after insertion to ensure that it would be retained during ejection.
- Pull up hard on both parachute harness survival kit attach straps to assure full engagement of buckles and to prevent inadvertent release of the survival kit.
- Failure to adjust survival kit straps to achieve a snug fit between the crewmember and kit may result in injury during ejection.

2. Anti-G Suit Hose, Oxygen, and Communication Lead — Connect.

WARNING

Do not disconnect the retention strap from the oxygen hose. The strap gives the straight downward pull required to disconnect the hose during man-seat separation.

CAUTION

To prevent interference with the canopy linkage and possible canopy loss, ensure the anti-g suit hose is installed and aligned parallel to the elbow guard.

NOTE

- To prevent damage to hose between anti-g suit valve and seat, do not position hose behind canopy external crank mechanism.
- The oxygen hose from the mask to the quick-disconnect should be routed under the right shoulder harness strap before connection to the quick-disconnect. This helps keep the shoulder harness clear of the connector and prevents the harness from being snagged between the connector and its mounting plate during seat separation.

3. Zero Delay Lanyard (Unmodified BA-22) — Attach.

Left Console

1. Circuit Breakers — Check.
*2. Rudder Trim Knob — Centered.
3. Radar Mode Selector — OFF.
4. [E-2] (Recon) Mode Selector and Camera Select Switches — OFF.
5. Flap Lever — THUMB SW.
6. Throttles — OFF.
7. Speed Brake Switch — Neutral.
*8. Flap Thumb Switch — UP.
*9. Nose Strut Switch — RETRACT.
*10. [F] Antenna Selector Switch — As Required.
*11. [F] Compass Switch — As Required.
*12. [F] SST-181X Switch — As Required (if installed).

PREFLIGHT CHECK (Continued)

Left Vertical

1. Fuel Shutoff Switches — LEFT and RIGHT (guards closed).
*2. Armament Panel Lights Knob — As Required.
*3. Landing & Taxi Light Switch — OFF.
*4. Landing Gear Alternate Release Handle — Fully Stowed.
*5. AIM-9 Missile Volume Control — Fully Counterclockwise.
*6. Armament and Jettison Switches — OFF and SAFE.
*7. [E] [E-2] [F] External Stores Jettison T-Handle — In; Safety Pin — Installed.
8. Ⓕ (Rear CKPT) Radar Override Switch — Off (guard closed).
9. Ⓕ (Rear CKPT) Comm/Nav Override Switch — Off (guard closed).

Instrument Panel

1. Gear Lever — LG DOWN.
2. Drag Chute Handle — In.
3. Flight Instruments — Check and Set.
*4. Film Magazine/Dust Cover — Locked.
*5. Optical Sight Mode Selector — OFF.

WARNING

Some LCOSS combining glasses have a blue/green tint. Under low ambient light conditions forward visibility through the glass can be significantly reduced.

CAUTION

Power surges when the left generator comes on the line may cause reticle bulb to burn out.

6. Aux Intake Doors Indicator — Barber Pole.
7. Clock — Check and Set.

Pedestal

1. UHF Radio — As Required.
2. [F-2] Transmit Selector Switch — As Required (some aircraft).
3. TACAN — As Required.
4. Ⓕ (Rear CKPT) Ejection Sequence Selector — As Required (T.O. 1F-5F-523); All Others SOLO.

WARNING

- Ⓕ Before T.O. 1F-5F-523, SOLO position is the only authorized selection for flight. Due to possible failure of the power inertia reel to retract shoulder harness, SOLO position allows each crewmember to assume proper position before initiating seat ejection.
- Ⓕ Ensure the ejection sequence selector is firmly seated and the arrow is aligned with the index mark of selected position.

*5. Antenna Selector Switch — As Required (some aircraft).
6. Ⓕ Intercom Knob — As Required.
*7. [F] Control Transfer Panel:
   a. NAV Switch — As Required.
   b. RADAR Switch — As Required.
   c. COMM Switch — As Required.
8. NAV MODE Selector — As Required (some aircraft).
9. Rudder Pedals — Adjust.
10. Brakes — Check.

NOTE

If brake pedals can be depressed to the mechanical stop, reject the aircraft.

*11. Circuit Breakers — Check.

Right Vertical

*1. Cockpit Pressurization and Temperature Controls — As Required.

NOTE

To prevent water entering thru cockpit air inlets, position cabin temperature knob toward HOT.

2. [F-2] (Rear CKPT) UHF 2 Volume Control — As Required (some aircraft).
3. Pitot Heat and Engine Anti-Ice Switches — OFF.
*4. External Fuel Transfer Switches — OFF.

PREFLIGHT CHECK (Continued)

*5. Fuel Boost Pump Switches — LEFT and RIGHT.
*6. Crossfeed Switch — OFF.
*7. Auto Balance Switch — Centered.
8. Canopy Jettison T-handle — In; Safety Pin — Installed.
*9. Battery Switch — BATT.
10. Aux Intake Doors Indicator — Check CLOSE.
*11. Generator Switches — L GEN and R GEN.
12. Compass Switch — As Required (some aircraft).
13. SST-181X Switch — As Required (some aircraft).
14. Antenna Selector Switch — As Required (some aircraft).

Right Console

1. Oxygen System — Check.

SYSTEM

a. Supply Pressure Gage — Check (65-110 psi).
b. Quantity Indicator — Check.
c. Hoses and Connections — Check.

OPERATION

WARNING

It is possible for the oxygen supply lever to stop in an intermediate position between OFF and ON. Push the lever fully ON and check the flow indicator blinker for proper functioning.

a. Supply Lever — ON.
b. Diluter Lever — NORMAL OXYGEN.
c. Emergency Lever — NORMAL.
d. Oxygen and Communications Leads — Connected.
e. Put on mask and check for normal blinker operation.

WARNING

If supply lever on earlier type regulators is at OFF with the diluter lever at NORMAL OXYGEN, the crew breathes only cockpit air. Supply lever must be at ON to prevent hypoxia at altitudes requiring oxygen.

*2. IFF/SIF — STBY.
*3. Fuel and Oxygen Switch — GAGE TEST & QTY CHECK.

NOTE

Failure of indicators to respond indicates static inverter failure.

*4. [F-2] NO. 2 UHF Radio — As Required (some aircraft).
*5. Compass Switch — As Required (some aircraft).
*6. [F-1] [F-2] Control Transfer Panel:
   a. COMM Switch — As Required.
   b. RADAR Switch — As Required.
   c. NAV Switch — As Required.
7. VOR/ILS — As Required (some aircraft).
8. Interior Lights — As Required.
*9. Exterior Lights — As Required.
*10. Rotating Beacon — As Required.
11. Warning Test Switch — TEST.

NOTE

Ⓕ When the test switches in both cockpits are actuated simultaneously, the fire warning lights will illuminate in each cockpit. Gear audible warning signal and AOA lights will not operate in either cockpit.

PREFLIGHT CHECK (Continued)

NOTE

- All four fire warning light bulbs must illuminate during TEST. Failure of any bulb/filament to illuminate may indicate an inoperative fire detector.

12. Circuit Breakers — Check.

BEFORE STARTING ENGINES

1. External Power — Connect (if necessary).
2. Seat — Adjust (if ac power on).
3. Danger Areas Fore and Aft — Clear.

NOTE

When ambient temperature is at or below 55°F (13°C), JP-5 may require ignition system energizing without engine rotation for one 40-second ignition cycle prior to attempting engine start.

STARTING ENGINES

LEFT ENGINE

1. External Air — Apply.
2. At 10% RPM, Start Button — PUSH.
3. Throttle — Advance to IDLE.

CAUTION

- If lightoff does not occur within 5 seconds (15 seconds at or below 0°F (-17.8°C)), retard throttle to OFF and continue motoring for at least 1 minute to purge engine before attempting another start.
- If egt reaches 845°C, retard throttle to OFF, continue motoring for 1 minute to cool engine.

NOTE

An EGT of less than 200°C cannot be read with the EHU-31A/A indicator; therefore, the ON position will be used as the minimum needle position.

4. Engine Instruments — Check Within Limits.
5. Hydraulic Pressure — 2800-3200 psi.
6. Generator Caution Light — Out.

NOTE

If light is on, check idle rpm. If idle rpm is low, advance throttle in an attempt to get generator on line before attempting generator reset.

7. Aux Intake Doors Indicator — Barber Pole.

RIGHT ENGINE

NOTE

Omit this procedure if crossbleed start is to be used.

1. Same as for Left Engine.
2. Aux Intake Doors Indicator — Check OPEN.
3. External Power and Air — Disconnect.

CROSSBLEED START

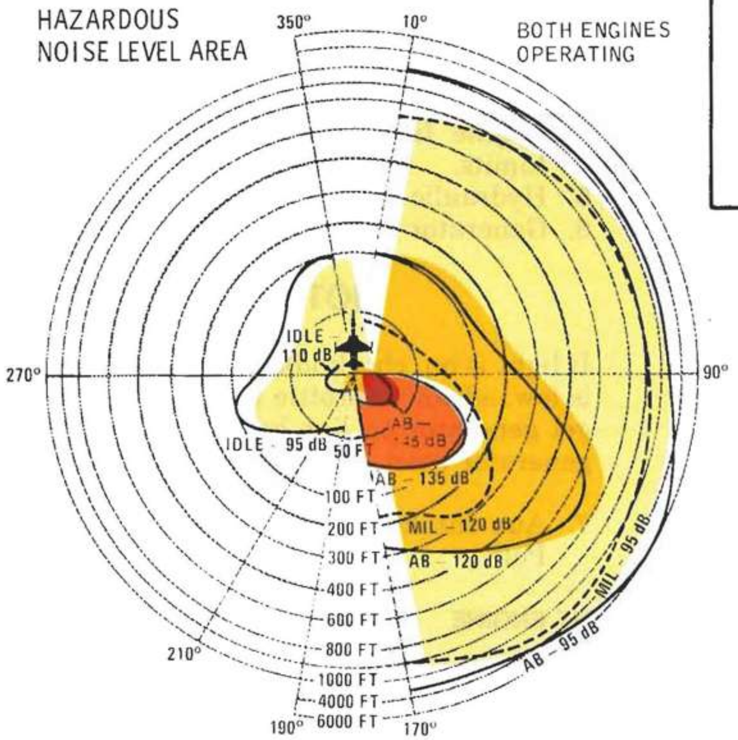
1. External Power and Air — Disconnect.
2. L Engine RPM — 95%.

WARNING

Extreme care should be taken to avoid injury to ramp personnel caused by exhaust gases or blowing equipment since left engine is operating near military power. It is recommended that this procedure be used only in isolated areas.

DANGER AREAS

HAZARDOUS NOISE LEVEL AREA

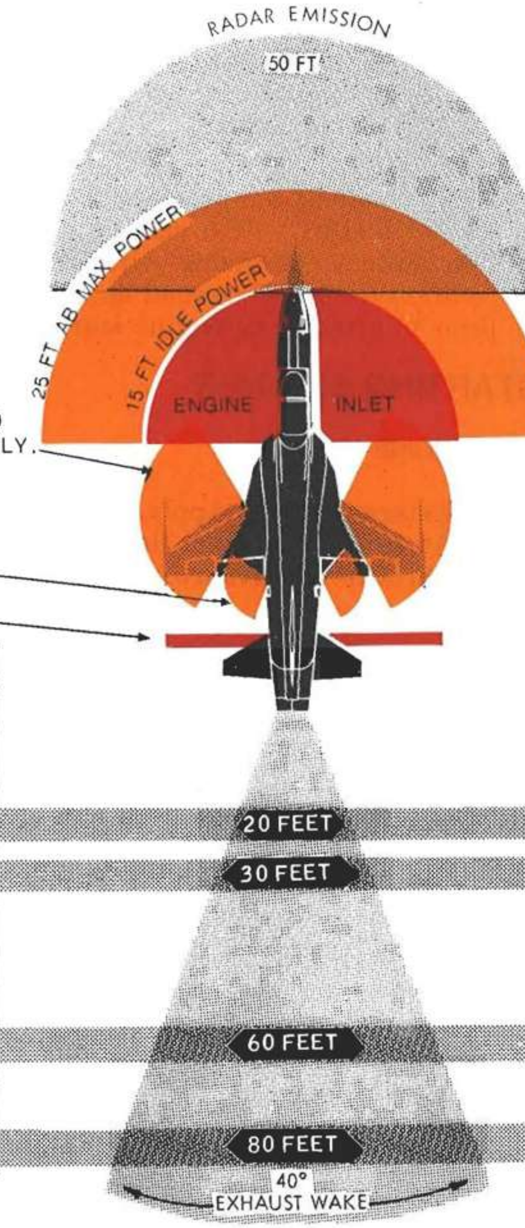


NOISE PROTECTION REQUIREMENTS

DECIBELS	REQUIRED EAR PROTECTION
0-95 dB	No Protection Required
95-120 dB	Ear Muffs or Ear Plugs Required
120-135 dB	Ear Muffs and Ear Plugs Required
135-145 dB	Ear Muffs and Ear Plugs Required Limited Time Exposure
Above 145 dB	Prohibited

Note

- NOISE LEVEL AREAS IDENTICAL ON EACH SIDE OF AIRCRAFT.
- CONTOURS MAY BE ALTERED BY SURROUNDING OBSTACLES.



TIRE AVOIDANCE AREA

AVOID AREA FOR 45 TO 60 MINUTES AFTER AIRCRAFT HAS STOPPED. IF NECESSARY TO APPROACH, DO SO FROM FRONT OR REAR ONLY.

AUXILIARY AIR INTAKE DOORS AREA

5-FOOT RADIUS

ENGINE AREA

ROTATING PLANE OF ENGINE TURBINES

ENGINE EXHAUST TEMPERATURES AND VELOCITY

MAX POWER			MIL POWER			IDLE POWER		
TEMP °F	TEMP °C	VELOCITY (MPH)	TEMP °F	TEMP °C	VELOCITY (MPH)	TEMP °F	TEMP °C	VELOCITY (MPH)
877	469	644	430	221	491	175	79	48
620	327	464	305	152	300	143	62	24
290	143	205	180	82	140	80	27	NEG
210	99	153	158	70	99	NEG		NEG

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Figure 2-1.

STARTING ENGINES (Continued)

3. R Engine Start Button — PUSH.
4. At 10% RPM, R Throttle — IDLE.
5. Engine Instruments — Check Within Limits.
6. L Throttle — Retard to Idle after R Engine is at Idle RPM.
7. Generator Caution Lights — Out.
8. Aux Intake Doors Indicator — Check OPEN.
9. Hydraulic Pressure — 2800-3200 psi.

BEFORE TAXI

*1. Generator Crossover Relay Check — L GEN OFF; then ON.
2. Circuit Breakers — Check.
3. Anti-G Suit Test Button — Press-to-test. Check anti-G suit for proper inflation/deflation.
4. Radar Mode Selector — OFF or STBY.

WARNING

Ensure that radar mode selector is at OFF or STBY to avoid danger to personnel.

CAUTION

During ground operations, do not leave the radar mode selector at OPER, STBY, or TEST for more than 10 minutes to prevent radar malfunction from overheat. If necessary, turn radar off (Ⓕ both cockpits) until immediately prior to takeoff.

5. Speed Brake — In.
   Check that speed brake retracts and horizontal tail trailing edge moves up to check speed brake and horizontal tail interconnect.

WARNING

To avoid injury, insure ground personnel clear before actuating controls.

*6. Flap Thumb Switch — M/AUTO.
   Flaps should extend to full. Verify that horizontal tail trailing edge moves down as flaps extend.

WARNING

Ⓕ If maneuver/auto flaps are selected only in the rear cockpit, uncommanded flap retraction can occur.

*7. Damper Switches — YAW and PITCH.
*8. Pitch Damper Cutoff Switch — Check.
   a. Pitch Damper Cutoff Switch — Actuate.
   b. Pitch Damper Switch — Moves to OFF.
      The cutoff switch disengages the pitch damper only. When cutoff switch is checked on the ground, a small jump in the horizontal tail may be evident.
*9. Pitch Damper Switch — PITCH.
   If the horizontal tail moves when pitch damper is reengaged, a malfunctioning damper is indicated. Disengage pitch damper.
10. Flight Controls — Check.
11. Pitch Trim — Check and Set.

PITCH TRIM INCREMENTS FOR OPTIMUM TAKEOFF PERFORMANCE

	% MAC	INCREMENTS
Ⓔ	Aft of 18	6
	14 to 18	7
	10 to 13	8
	Fwd of 10	9
Ⓕ	Aft of 14	7
	10 to 14	8
	Fwd of 10	9

BEFORE TAXI (Continued)

11. Aileron Trim — Check and Set As Required.
12. Altimeter (AAU-7A/A) — Check.
    After setting in field barometric pressure, check that indicated altitude is within ±75 feet of field elevation.
13. Altimeter (AAU-19/A) — RESET; (AAU-34/A) — ELECT.
    After setting the current field barometric pressure, place the function switch momentarily at STBY (PNEU AAU-34/A). Check that STBY (PNEU) flag is visible and that indicated altitude is within ±75 feet of field elevation. Place the function switch momentarily at RESET (ELECT AAU-34/A). Check that STBY (PNEU) flag is not visible and that indicated altitude is within ±60 feet of field elevation. The altitudes indicated in STBY and RESET (PNEU and ELECT) must be within 75 feet of each other.

CAUTION

Do not rotate the barometric set knob at a rapid rate or exert force to overcome momentary binding. If binding occurs, rotate the setting knob a full turn in the opposite direction and approach the desired setting carefully.

14. Attitude Indicators — Check and Set 3 Degrees Nose Low.
15. Canopy and Seat Safety Pins — Removed and Stowed.
16. (Improved Survival Kit) AUTO/MANUAL Selector — As Required.
17. Wheel Brakes — Apply Heavy Pressure.
    Heavy pressure application to both brake pedals sets automatic brake adjusters and maintains minimum pedal travel for proper braking efficiency.
18. Wheel Chocks — Removed.

TAXI

1. Wheel Brakes — Release.
2. Nosewheel Steering — Engage.
   Check operation at slow taxi speed. Ensure steering mode is terminated when nosewheel steering button is disengaged.

WARNING

If nosewheel steering does not function properly, takeoff should not be attempted, as shimmy damping may not be available. Undamped nosewheel shimmy can induce structural failure of the nose gear strut.

NOTE

If taxi route and conditions permit, momentarily releasing the nosewheel steering button may allow an operational check of the shimmy damper.

3. Flight Instruments — Check.
4. Navigation Equipment — Check.

BEFORE TAKEOFF

*1. Nose Strut Switch — EXTEND.

WARNING

- Failure of nose gear strut to extend (hike) may indicate a nose gear malfunction and takeoff should not be attempted.
- If takeoff is made with nose gear strut dehiked, expect up to 20% increase in airspeed for rotation, and up to 45% increase in takeoff roll.
- Fuel from a leaking centerline tank will migrate through aircraft keel ports to the engines, resulting in fire and/or explosion.

2. Optical Sight Mode Selector — As Required.
3. Radar Mode Selector — As Required.
4. Pins, Belt, Shoulder Harness, and Crew/Kit Retention Strap — Check.
5. GOLD KEY and Zero Delay Lanyard (BA-22) — Attach/Check.
   Ensure gold key and zero delay lanyard are secured.

BEFORE TAKEOFF (Continued)

*6. [E] [E-2] [F] External Stores Jettison Safety Pin — Removed.
*7. Pitot Heat and Engine Anti-Ice Switches — As Required.
*8. IFF/SIF — As Required.
9. Flight Controls — Check.
10. Canopy(ies) — Closed; Light — Out.
11. Caution and Warning Lights — Out.

NOTE

ENGINE ANTI-ICE ON light comes on when engine anti-ice switch is at ENGINE.

*12. Rotating Beacon — As Required.

TAKEOFF

WARNING

Avoid wake turbulence. Allow a minimum of 2 minutes before takeoff behind a large multi-engine aircraft or helicopter. Extend the interval to 4 minutes behind an extremely large aircraft. With effective crosswinds of 5 knots or above, the interval may be reduced, but attempt to remain above and upwind of the preceding aircraft's flight path.

1. Wheel Brakes — Apply.
2. Throttles — MIL.
3. Engine Instruments — Check.
4. Wheel Brakes — Release.
5. Nosewheel Steering — As Required.

WARNING

If nosewheel shimmy occurs, takeoff should be aborted if conditions permit.

CAUTION

Do not exceed 65 knots with nosewheel steering engaged.

6. Throttles — As Required.
   If selected, AB lightoff should occur within approximately 5 seconds.
7. Aft Stick — At 10 Knots Below Takeoff Speed.
   If aft stick is applied earlier, rotation is not immediate. Increased drag due to horizontal tail deflection reduces acceleration and extends the takeoff roll. If aft stick is delayed or if aft movement exceeds 1 second, a longer takeoff roll also results. The shortest takeoff results when rotation occurs just prior to reaching takeoff speed. See the appendix for takeoff speeds.

NOTE

- (F) If aircraft has a CL store exceeding 1000 pounds (without wing stores), increase computed takeoff speed by 5 knots. Aft stick speed is 10 knots less than this adjusted takeoff speed.
- Takeoff speed and full aft stick should be reached before aborting for nonrotation.
- During takeoff with a heavyweight CL store, a noticeable hesitation may occur between nose strut extension and takeoff.
- Takeoff performance charts (Appendix I) are based on full aft stick.

AFTER TAKEOFF

1. Gear — Up.

NOTE

A high-pitched whine may occur as the nose gear starts up.

2. Flap Thumb Switch — As Required.
3. Aux Intake Doors Indicator — Check CLOSE.

CLIMB

*1. External Fuel/Autobalance — As Required.
2. Zero-Delay Lanyard (BA-22) — Disconnect Above 2000 Feet AGL.

WARNING

Ejection above 400 KIAS with zero-delay lanyard connected can cause parachute canopy falure and/or serious injury.

3. Oxygen — NORMAL.
*4. Cockpit Pressurization — Check.
5. Altimeter — As Required.

FUEL BALANCING

Figure 2-2 shows the typical effect on aircraft cg travel of internal fuel consumption with and without fuel balancing.

WARNING

- Ensure that proper switches for fuel balancing have been selected because an aggravated fuel imbalance may occur, resulting in out-of-limit cg.
- Check fuel quantity gage operation before crossfeeding. If a malfunctioning fuel gage is indicated, do not crossfeed.

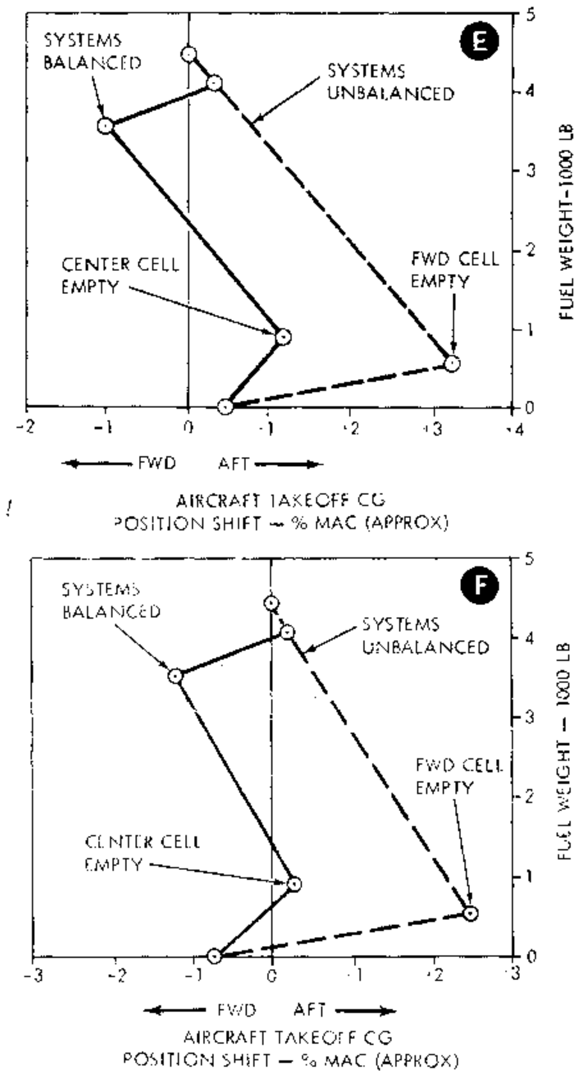
NOTE

Fuel balancing should be delayed until external fuel transfer is complete.

AUTOBALANCING

*1. Fuel and Oxygen Switch — GAGE TEST.
*2. Auto Balance Switch — LEFT LOW or RIGHT LOW (as applicable).

SAMPLE CG TRAVEL DUE TO INTERNAL FUEL CONSUMPTION



Note

- THE AFT (RIGHT) SYSTEM CONTAINS APPROXIMATELY 550 LB (85 GAL) MORE FUEL THAN THE FORWARD (LEFT) SYSTEM. THE TWO SYSTEMS SHOULD BE BALANCED AS SOON AFTER TAKEOFF AS POSSIBLE TO PREVENT AFT CG SHIFT. THIS DIAGRAM ASSUMES THAT INITIAL BALANCING IS PERFORMED BETWEEN 4050-LB AND 3500-LB FUEL LEVELS AND THAT THE TWO SYSTEMS ARE KEPT IN BALANCE UNTIL BOTH SYSTEMS ARE EMPTY.
- THE FUEL QUANTITY INDICATOR SHOULD BE MONITORED TO MAINTAIN THE TWO SYSTEMS WITHIN 200 LB OF EACH OTHER TO ENSURE THAT THE CG REMAINS WITHIN LIMITS.

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Figure 2-2.

FUEL BALANCING (Continued)

NOTE

Switch automatically returns to center position when systems are balanced.

MANUAL BALANCING

*1. Fuel and Oxygen Switch — GAGE TEST.
*2. Crossfeed Switch — CROSSFEED.
*3. Fuel Boost Pump Switch (on low fuel side) — OFF.
*4. Systems Balanced; Boost Pump Switch — LEFT or RIGHT (as applicable).

NOTE

After extended climbs, turn the boost pump on for a minimum of 2 minutes prior to turning crossfeed switch OFF to avoid vapor lock and possible engine flameout.

*5. Crossfeed Switch — OFF.

CRUISE

Perform level-off and operational checks, and check altimeter.

CAUTION

(AAU-19/A, AAU-34/A) If the altitude indications of the primary (RESET/ELECT) and standby (STBY/PNEU) modes vary more than 200 feet below 30,000 feet or 900 feet above 30,000 feet, fly the standby mode only for the remainder of the flight.

NOTE

(AAU-19/A, AAU-34/A) If the altimeter reverts to standby (STBY/PNEU) operation in flight, try to return to the primary (RESET/ELECT) mode by placing the function switch momentarily to RESET (ELECT AAU-34/A). If the altimeter does not reset or reverts to standby mode after a few seconds, continue in the standby mode.

DESCENT

1. Armament Safety Check — Complete.
*2. Canopy Defog, Engine Anti-Ice, and Pitot Heat Switches — As Required. Canopy and windshield defogging should be initiated before descent from altitude in sufficient time to allow heating of transparent surfaces. Failure to do so allows fogging of these surfaces at lower altitudes. Engine anti-ice and pitot heat should be applied for descent into known or suspected icing conditions.
3. Oxygen — Check.
4. Altimeter — Check and Set.

WARNING

- (AAU-19/A, AAU-34/A) Recheck altimeter in primary (RESET/ELECT) and standby (STBY/PNEU) modes in level flight prior to commencing descent. In normal conditions prior to penetration (300 KIAS, 20,000 feet), the maximum allowable error is 200 feet (below 30,000 feet). If differences are exceeded, use standby mode for descent.
- (AAU-19/A, AAU-34/A) If the altimeter internal vibrator is inoperative due to instrument failure or dc power failure, the 100-foot pointer may stick or hang up momentarily when passing thru 0 (12-o'clock position). If the vibrator has failed, the hangup may be cleared by tapping the altimeter case.

5. (F) (Rear CKPT) Ejection Sequence Selector — As Required (T.O. 1F-5F-523); All Others SOLO.

DESCENT (Continued)

6. Zero-Delay Lanyard (BA-22) — As Required.

NOTE

Lanyard should be attached to parachute ripcord handle at start of initial penetration or before reaching 2000 feet AGL. If operational requirements dictate, lanyard may be left disconnected.

*7. Landing and Taxi Light Switch — As Required.

BEFORE LANDING

1. Altimeter — Check and Set.
*2. Manual Crossfeed — Discontinue.
3. Hydraulic Systems — Check Pressure.
4. Shoulder Harness — As Required.
*5. Flap Thumb Switch — M/AUTO.

WARNING

Ⓕ If maneuver/auto flaps are selected only in the rear cockpit, uncommanded flap retraction can occur.

6. Gear — Down.

CAUTION

Ⓕ Failure of the landing gear lever interconnect cable when the gear is lowered from the rear cockpit may result in uncommanded gear retraction on landing. This condition may be prevented by physically checking the front cockpit landing gear lever full down when the gear is lowered from the rear cockpit.

7. Aux Intake Doors Indicator — Check OPEN.
8. Flap and Gear Indicators — Check. Check flaps at full, 3 green lights on; red light in gear lever off.
9. Ⓔ AOA — On Speed.

LANDING

WARNING

Avoid wake turbulence. Allow a minimum of 2 minutes separation before landing behind a large multiengine aircraft or helicopter. The time should be extended to a minimum of 4 minutes behind extremely large aircraft. With an effective crosswind of more than 5 knots, the interval may be reduced, but attempt to remain above and upwind of the preceding aircraft's flight path. Wake turbulence is most dangerous during the approach and flare prior to touchdown with calm or light crosswinds.

NOTE

- It may be necessary to hike the nose gear strut in order to taxi off the runway with the drag chute deployed.
- Taxiing with the nose gear hiked should be kept to a minimum. Avoid sharp turns and high speed taxi with the nose gear hiked, to avoid excessive side loads.

NORMAL LANDING

See figure 2-3 for typical landing pattern procedures. Ⓔ Use AOA as the primary airspeed reference and as an aid to establishing aircraft attitude throughout the final approach. If AOA is inoperative, maintain 145 KIAS (Ⓕ 150) plus weight correction.

CAUTION

Ⓕ Pending recalibration of AOA vane transmitter do not use AOA as the primary attitude/airspeed reference on any approach since on speed indication may provide lower than recommended airspeed on final.

LANDING AND GO-AROUND PATTERN (TYPICAL)

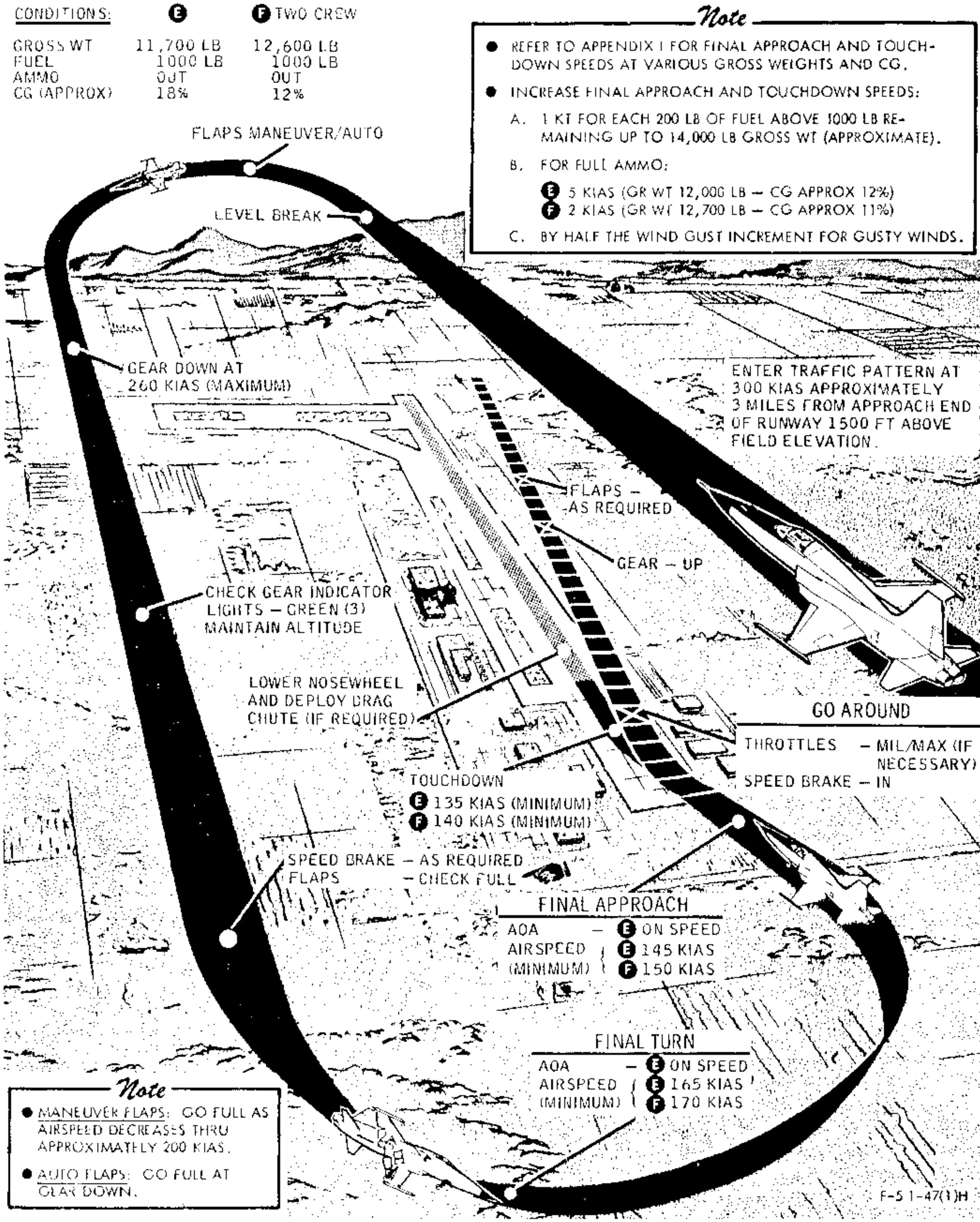


Figure 2-3.

LANDING (Continued)

Accomplish a normal flare to touchdown. After touchdown, lower the nosewheel to the runway (approximately 3 seconds), and apply heavy braking. If runway length and conditions permit, aerodynamic braking may be used to conserve brakes and tires. Aerodynamic braking is achieved by easing the stick back gradually until desired pitch attitude is attained (approximately 12 degrees nose-up). The Ⓕ nosewheel should be lowered to the runway prior to the loss of horizontal tail authority.

CAUTION

Do not exceed 12 degrees pitch. The tailpipe contacts the runway at 15 degrees pitch.

If drag chute is to be used, lower the nosewheel to the runway before deploying the chute. Counteract aircraft yawing with rudder, nosewheel steering, and braking. See section V for landing gear sink rate limitations and the appendix for landing airspeeds and distances.

MINIMUM RUN LANDING

To accomplish a minimum run landing (shortest obtainable stopping distance), execute a normal approach and touchdown, then immediately lower the nosewheel, deploy the drag chute, and apply maximum wheel braking without skidding tires.

HEAVYWEIGHT LANDING

Fly a slightly wider than normal traffic pattern. Control the rate of sink to touchdown, using power as necessary. Full stall landings are not recommended at any gross weight.

CROSSWIND LANDING

Counteract drift by crabbing into the wind, maintaining flight path alignment with the runway. The crab should be held thru touchdown. The wings must be level at touchdown. After touchdown, maintain directional control of the aircraft with rudder. Use care when lowering the nose after touchdown, as premature lowering of the nose can result in a compression of the downwind strut, causing a turn toward the compressed strut. Use of aileron into the wind thruout the landing phase minimizes the strut compression tendency. After nosewheel touchdown, maintain directional control with nosewheel steering and braking. If drag chute is required, lower the nosewheel to the runway before deploying the chute and be prepared to counteract weathervaning tendency with rudder, nosewheel steering, and braking. If directional control cannot be maintained, jettison the drag chute immediately.

MAXIMUM RECOMMENDED 90 DEGREE — CROSSWIND LANDING

GROSS WT (LB)	RUNWAY CONDITION	WIND VELOCITY (KT)	
		W/DRAG CHUTE	W/O DRAG CHUTE
15,500 & Below	Dry	20	35
	Wet	10	20
	Icy	5	10
Above 15,500	Dry	25	35
	Wet	15	25
	Icy	5	10

USE OF WHEEL BRAKES

Take advantage of all available runway to stop the aircraft. Brake application should be a steady increase of pressure. To prevent skidding, extreme care must be exercised when applying wheel brakes immediately after touchdown, at high landing speeds and/or heavy gross weight, or whenever there is considerable lift on the wings. Heavy brake pressure locks the wheels more easily under these conditions. A locked wheel may result in a blown tire. See section VII for braking on a wet, slippery, or icy runway.

CAUTION

To prevent wheel lockup and skidding, do not pump brakes.

LANDING (Continued)

Maximum Braking

For maximum braking, lower the nosewheel to the runway and raise flaps before applying brakes. This improves braking action by increasing the load on the tires and thus increases the frictional force between the tires and the runway.

Overheated Brakes

If brakes overheat during landing and taxi, stop the aircraft on the taxiway. Do not taxi into a crowded parking area. Overheated brakes and wheels shall be cooled before the aircraft is towed or taxied. In extreme overheat cases, heat buildup can cause wheel assembly fuse plug blowout and tire failure. See section V for cooling times.

GO-AROUND

The decision to go around should be made as soon as possible and, when made, the following procedure applies:

a. Throttles — MIL/MAX (if necessary).
b. Speed Brake — In.
c. Gear — Up, When Positive Rate of Climb is Established.
d. Flaps — As Required.

A short, closed-pattern go-around at approximately 12,000 pounds gross weight with launcher rails and five pylons, using two engines and military thrust for climb, requires approximately 200 pounds of fuel. Fuel consumption increases approximately 20 pounds for every 1000-pound increase in weight above 12,000 pounds

TOUCH-AND-GO LANDING

Use normal landing procedures followed by a normal go-around.

WET OR SLIPPERY RUNWAY LANDING

See section VII, Adverse Weather Procedures.

AFTER LANDING

1. Drag Chute — Jettison (if deployed).

CAUTION

Do not allow the chute to collapse as the risers are burned while resting on the hot tail section.

*2. Cabin Pressure Altimeter — Check.
*3. Cockpit Pressurization Switch — RAM DUMP, (prior to opening canopy).
4. Flap Thumb Switch — UP.
5. Speed Brake — Out.
6. Radar Mode Selector — OFF. (Ⓕ both cockpits).

WARNING

Ensure radar is OFF or in STBY to avoid radiation danger to personnel.

*7. Optical Sight Mode Selector — OFF.
*8. Pitot Heat and Engine Anti-Ice Switches — OFF.
*9. Landing and Taxi Light Switch — As Required.
*10. IFF/SIF — OFF.
*11. Rotating Beacon — As Required.
12. Seat and Canopy Safety Pins — Installed (if desired).
13. Pitch Trim — Reset (6 to 7 increments).

ENGINE SHUTDOWN

1. Canopy(ies) — Open.

CAUTION

The canopy seals (Ⓕ both canopies) remain inflated if engines are shut down with canopy locked. Attempts to open canopy with seals inflated may result in damage to canopy drive mechanism.

ENGINE SHUTDOWN (Continued)

*2. Cockpit Pressurization Switch — NORMAL/ [E] [E-2] CABIN PRESS.
3. Wheel Brakes — Hold Until Chocks in Place.
4. All Unguarded Switches (except battery, generators, and fuel boost pumps) — OFF.
5. Seat(s) — Full Up.
*6. Throttles — OFF.
Allow engine rpm to stabilize for 5 to 10 seconds, throttles OFF.
6A. Standby Attitude Indicator — Caged and Locked.
*7. Battery Switch — OFF.

BEFORE LEAVING AIRCRAFT

1. Safety Pins — Installed.

CAUTION

[E] [E-2] [F] Be careful not to actuate the emergency all jettison button when inserting the stores jettison safety pin.

2. Safety Belt — Check.
Attempt to release unmodified safety belt while maintaining forward pressure against the belt. If belt hangs up momentarily or fails to release, enter discrepancy on Form 781.
3. Form 781 — Complete.

INSTRUMENT FLIGHT PROCEDURES

INSTRUMENT TAKEOFF

For an instrument takeoff, perform all normal pretakeoff checks, and turn on pitot heat and engine anti-ice switches if necessary. Takeoff distances should allow for thrust loss when engine anti-ice system is in operation. Check the HSI for proper heading and align the arrow on the pitch trim knob with the reference mark on the attitude indicator case. On a level surface with nose gear strut hiked, this setting should indicate 0 degrees pitch attitude. This setting should give an approximate level flight indication for intermediate altitude level-offs during departures and at normal cruise conditions. Use normal instrument takeoff procedures. Whenever visibility permits, runway features and lights should be used to maintain heading. Increase the pitch attitude to attain an 8-degree nose high attitude indication and allow the aircraft to fly off the runway. When the vertical velocity indicator and altimeter indicate a definite climb, retract the landing gear.

INSTRUMENT CLIMB

Approaching 300 KIAS, retard throttles to MIL. Maintain a climb indication and at least a 1000 fpm climb until reaching recommended climb schedule. A slow airspeed and/or low rate of climb may be required to comply with departure procedures. For this type climb, reduce power below MIL as required. MAX thrust instrument climbs require extremely high pitch angles and are not normally used for instrument departures. If conditions require a MAX thrust climb, maintain climb until approaching recommended climb airspeed/mach; then adjust pitch to maintain climb schedule.

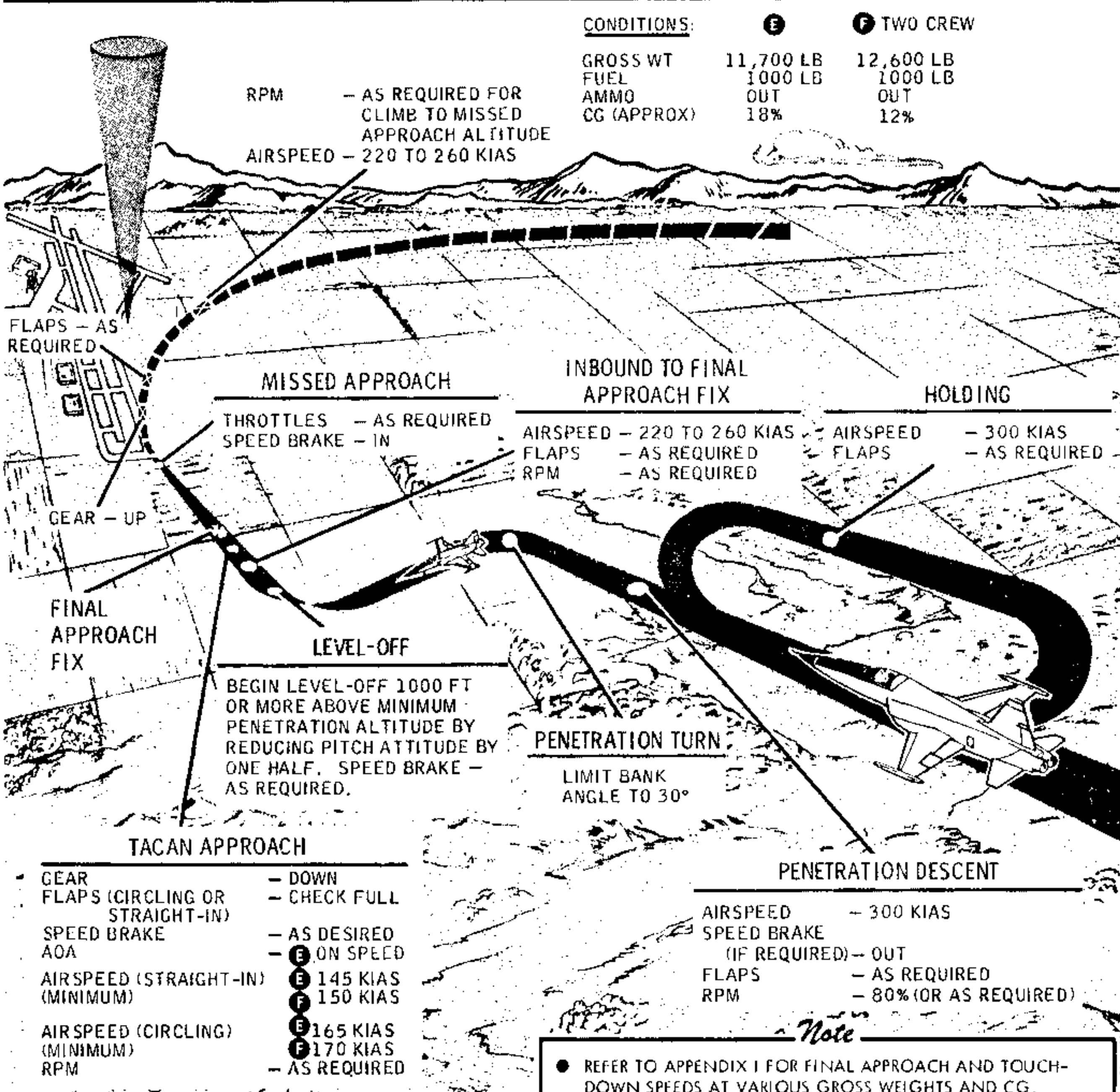
INSTRUMENT APPROACHES

See figures 2-4 and 2-5 for holding pattern. penetration descent, TACAN and radar approach, and missed approach procedures data. See figure 2-6 for VOR penetration, approach, and missed approach, and figure 2-7 for ILS approach and missed approach procedures data.

NIGHT FLYING

To prevent spatial disorientation, the rotating beacon light should be turned off in the vicinity of clouds or before entering a cloud formation. Frequent reference should be made to flight instruments during the landing approach.

TACAN PENETRATION AND APPROACH (TYPICAL)



PENETRATION DESCENT GRADIENTS				
AIRSPEED	300 KIAS	(E) 270 KIAS (F) 275 KIAS	300 KIAS	(E) 270 KIAS (F) 275 KIAS
SPEED BRAKE	IN	IN	OUT	OUT
FLAPS	(M) /FXD	UP	(M) /FXD	(M) /FXD
RPM	80%	IDLE	80%	IDLE
DISTANCE FOR EACH 1000 FEET	2.5 NM	1.4 NM	1.0 NM	0.7 NM

Note

- REFER TO APPENDIX I FOR FINAL APPROACH AND TOUCHDOWN SPEEDS AT VARIOUS GROSS WEIGHTS AND CG.
- INCREASE FINAL APPROACH AND TOUCHDOWN SPEEDS:
  A. 1 KT FOR EACH 200 LB OF FUEL ABOVE 1000 LB REMAINING UP TO 14,000 LB GROSS WT (APPROXIMATE).
  B. FOR FULL AMMO:
  (E) 5 KIAS (GR WT 12,000 LB – CG APPROX 12%)
  (F) 2 KIAS (GR WT 12,700 LB – CG APPROX 11%)
  C. BY HALF THE WIND GUST INCREMENT FOR GUSTY WINDS.
- THE APPROACH SHOWN REQUIRES APPROXIMATELY 200 LB OF FUEL.

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Figure 2-4.

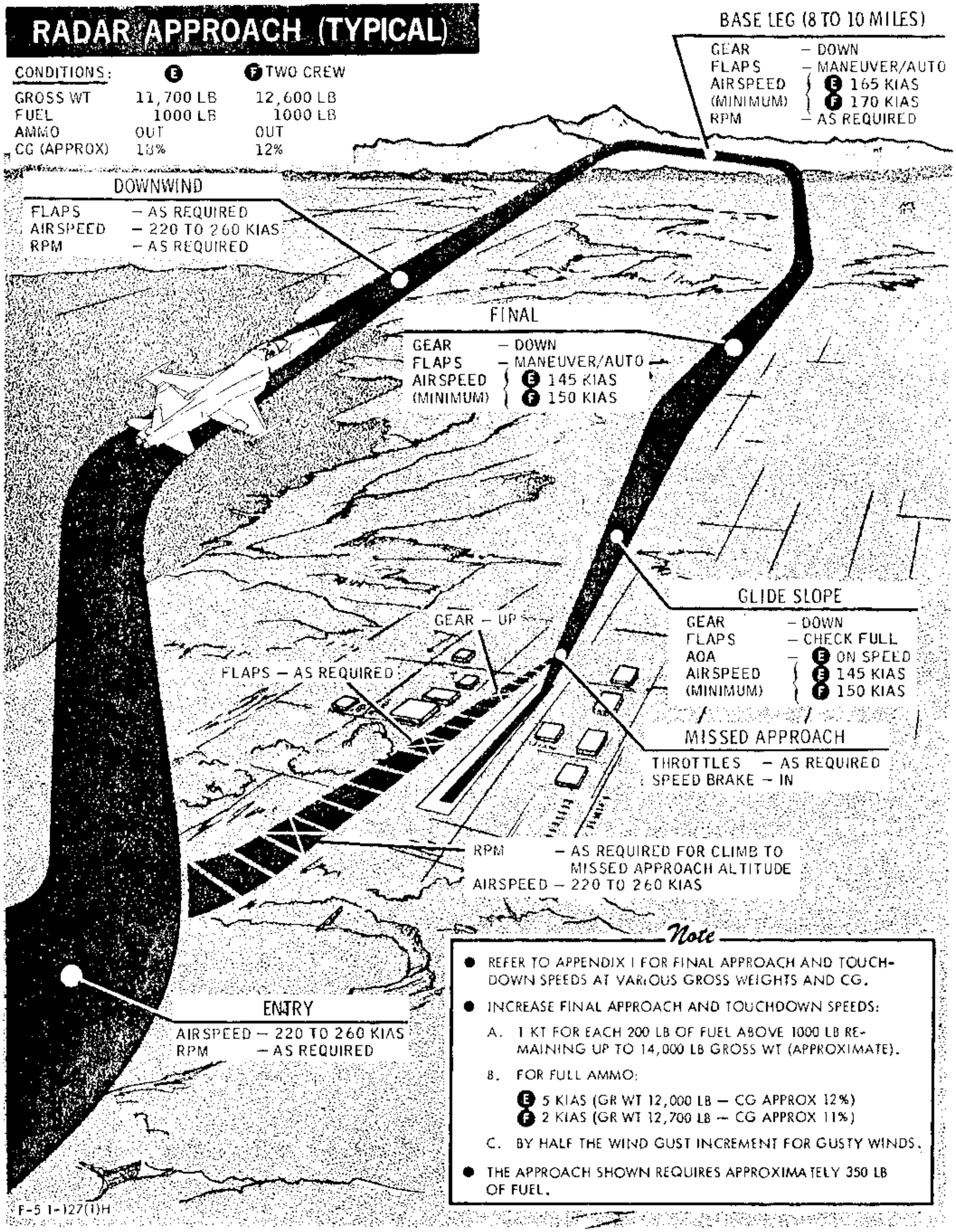
RADAR APPROACH (TYPICAL)
CONDITIONS: E F TWO CREW
GROSS WT 11,700 LB 12,600 LB
FUEL 1000 LB 1000 LB
AMMO OUT OUT
CG (APPROX) 13% 12%
DOWNWIND
FLAPS – AS REQUIRED
AIRSPEED – 220 TO 260 KIAS
RPM – AS REQUIRED
BASE LEG (8 TO 10 MILES)
GEAR – DOWN
FLAPS – MANEUVER/AUTO
AIRSPEED (MINIMUM) E 165 KIAS F 170 KIAS
RPM – AS REQUIRED
FINAL
GEAR – DOWN
FLAPS – MANEUVER/AUTO
AIRSPEED (MINIMUM) E 145 KIAS F 150 KIAS
GLIDE SLOPE
GEAR – DOWN
FLAPS – CHECK FULL
AOA – E ON SPEED
AIRSPEED (MINIMUM) E 145 KIAS F 150 KIAS
GEAR – UP
FLAPS – AS REQUIRED
MISSED APPROACH
THROTTLES – AS REQUIRED
SPEED BRAKE – IN
RPM – AS REQUIRED FOR CLIMB TO MISSED APPROACH ALTITUDE
AIRSPEED – 220 TO 260 KIAS
ENTRY
AIRSPEED – 220 TO 260 KIAS
RPM – AS REQUIRED
Note
• REFER TO APPENDIX I FOR FINAL APPROACH AND TOUCHDOWN SPEEDS AT VARIOUS GROSS WEIGHTS AND CG.
• INCREASE FINAL APPROACH AND TOUCHDOWN SPEEDS:
A. 1 KT FOR EACH 200 LB OF FUEL ABOVE 1000 LB REMAINING UP TO 14,000 LB GROSS WT (APPROXIMATE).
B. FOR FULL AMMO:
E 5 KIAS (GR WT 12,000 LB – CG APPROX 12%)
F 2 KIAS (GR WT 12,700 LB – CG APPROX 11%)
C. BY HALF THE WIND GUST INCREMENT FOR GUSTY WINDS.
• THE APPROACH SHOWN REQUIRES APPROXIMATELY 350 LB OF FUEL.
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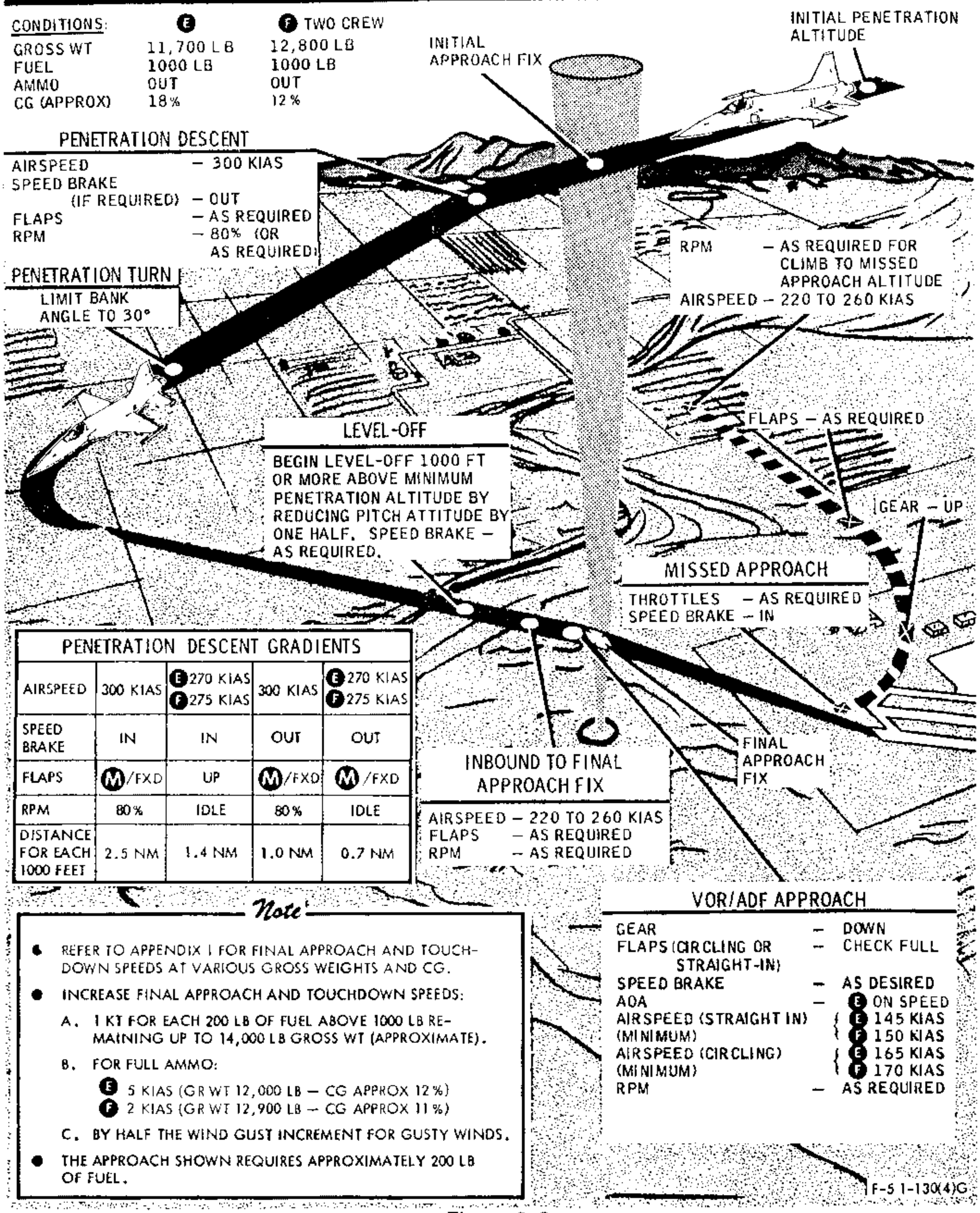
Figure 2-5.

VOR PENETRATION AND APPROACH (TYPICAL)



PENETRATION DESCENT GRADIENTS

AIRSPEED	300 KIAS	(E) 270 KIAS (F) 275 KIAS	300 KIAS	(E) 270 KIAS (F) 275 KIAS
SPEED BRAKE	IN	IN	OUT	OUT
FLAPS	(M)/FXD	UP	(M)/FXD	(M)/FXD
RPM	80%	IDLE	80%	IDLE
DISTANCE FOR EACH 1000 FEET	2.5 NM	1.4 NM	1.0 NM	0.7 NM

Note

- REFER TO APPENDIX I FOR FINAL APPROACH AND TOUCHDOWN SPEEDS AT VARIOUS GROSS WEIGHTS AND CG.
- INCREASE FINAL APPROACH AND TOUCHDOWN SPEEDS:
  - A. 1 KT FOR EACH 200 LB OF FUEL ABOVE 1000 LB REMAINING UP TO 14,000 LB GROSS WT (APPROXIMATE).
  - B. FOR FULL AMMO:
    - (E) 5 KIAS (GR WT 12,000 LB – CG APPROX 12%)
    - (F) 2 KIAS (GR WT 12,900 LB – CG APPROX 11%)
  - C. BY HALF THE WIND GUST INCREMENT FOR GUSTY WINDS.
- THE APPROACH SHOWN REQUIRES APPROXIMATELY 200 LB OF FUEL.

Figure 2-6.

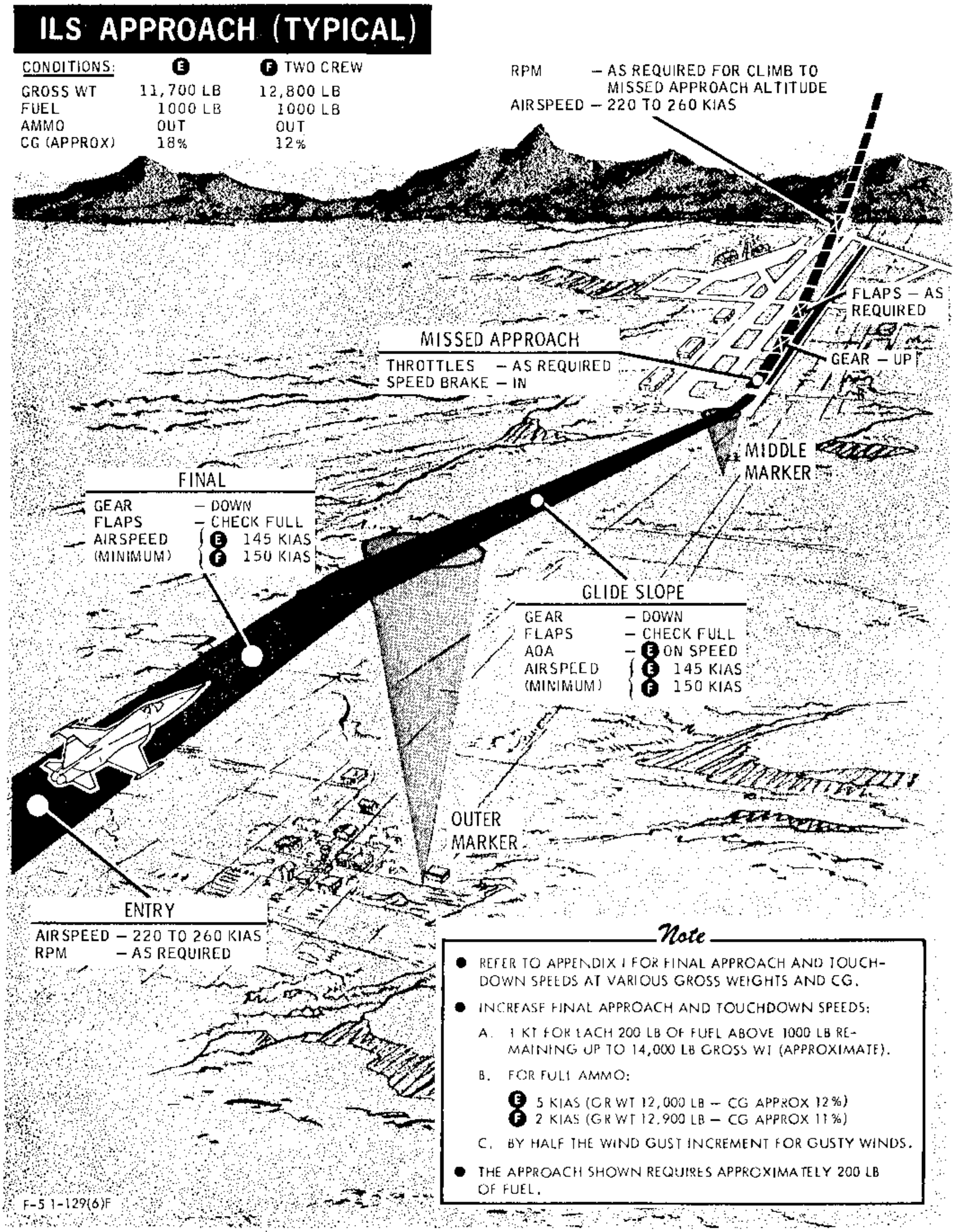

ILS APPROACH (TYPICAL)
CONDITIONS: (E) (F) TWO CREW
GROSS WT 11,700 LB 12,800 LB
FUEL 1000 LB 1000 LB
AMMO OUT OUT
CG (APPROX) 18% 12%
RPM – AS REQUIRED FOR CLIMB TO MISSED APPROACH ALTITUDE
AIRSPEED – 220 TO 260 KIAS
FLAPS – AS REQUIRED
GEAR – UP
MISSED APPROACH
THROTTLES – AS REQUIRED
SPEED BRAKE – IN
MIDDLE MARKER
FINAL
GEAR – DOWN
FLAPS – CHECK FULL
AIRSPEED (MINIMUM) (E) 145 KIAS (F) 150 KIAS
GLIDE SLOPE
GEAR – DOWN
FLAPS – CHECK FULL
AOA – (E) ON SPEED
AIRSPEED (MINIMUM) (E) 145 KIAS (F) 150 KIAS
OUTER MARKER
ENTRY
AIRSPEED – 220 TO 260 KIAS
RPM – AS REQUIRED
Note
● REFER TO APPENDIX I FOR FINAL APPROACH AND TOUCHDOWN SPEEDS AT VARIOUS GROSS WEIGHTS AND CG.
● INCREASE FINAL APPROACH AND TOUCHDOWN SPEEDS:
A. 1 KT FOR EACH 200 LB OF FUEL ABOVE 1000 LB REMAINING UP TO 14,000 LB GROSS WT (APPROXIMATE).
B. FOR FULL AMMO:
(E) 5 KIAS (GR WT 12,000 LB – CG APPROX 12%)
(F) 2 KIAS (GR WT 12,900 LB – CG APPROX 11%)
C. BY HALF THE WIND GUST INCREMENT FOR GUSTY WINDS.
● THE APPROACH SHOWN REQUIRES APPROXIMATELY 200 LB OF FUEL.
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Figure 2-7.

RECON CAMERA OPERATION [E-2]

RECON CAMERA(S) BIT TEST

1. Mode Selector — TEST.
2. INTVL-SEC Switch — TEST 1.
3. Camera Select Switches (4) — ON.
4. BIT INITIATE Button — Press (momentary).
5. FRAMES REMAINING Counters (4) — Count Down 3 to 5 Digits.
6. GO Light (after 4 seconds) — ON.

NOTE

Ignore GO/NO-GO lights during 4-second test interval. If NO-GO light comes on after 4 seconds, repeat BIT test for each individual camera to isolate the defective camera.

CAMERA OPERATION

To Operate Cameras

1. Mode Selector — RMT.

NOTE

The camera remote operate button on the stick grip and the camera operate lights permit headup control and monitoring of the camera system. The CAMR OVERRIDE switch may be used for selective operation of an individual camera or all cameras.

2. INTVL-SEC Switch — As Required.
3. Camera Select Switch(es) — ON (as required).
4. Camera Remote Operate Button — Press and Hold or Mode Selector — OPR.
5. Camera Operate Lights — Monitor. Verify that selected cameras are operating and that interval indications are in accordance with setting.

NOTE

Between flight lines, check FRAMES REMAINING counters to verify film use and film remaining.

To Turn Off Cameras

1. Mode Selector — RMT or OFF.
2. Camera Select Switch(es) — OFF.

To Operate Camera(s) with Camera Override Switch

1. Camera Override Switch — Desired Position.
   FWD — Camera No. 1
   R — Camera No. 2
   L — Camera No. 3
   VERT — Camera No. 4 (or 3 and 4)
   CENTER-PUSH — Operates All Cameras.

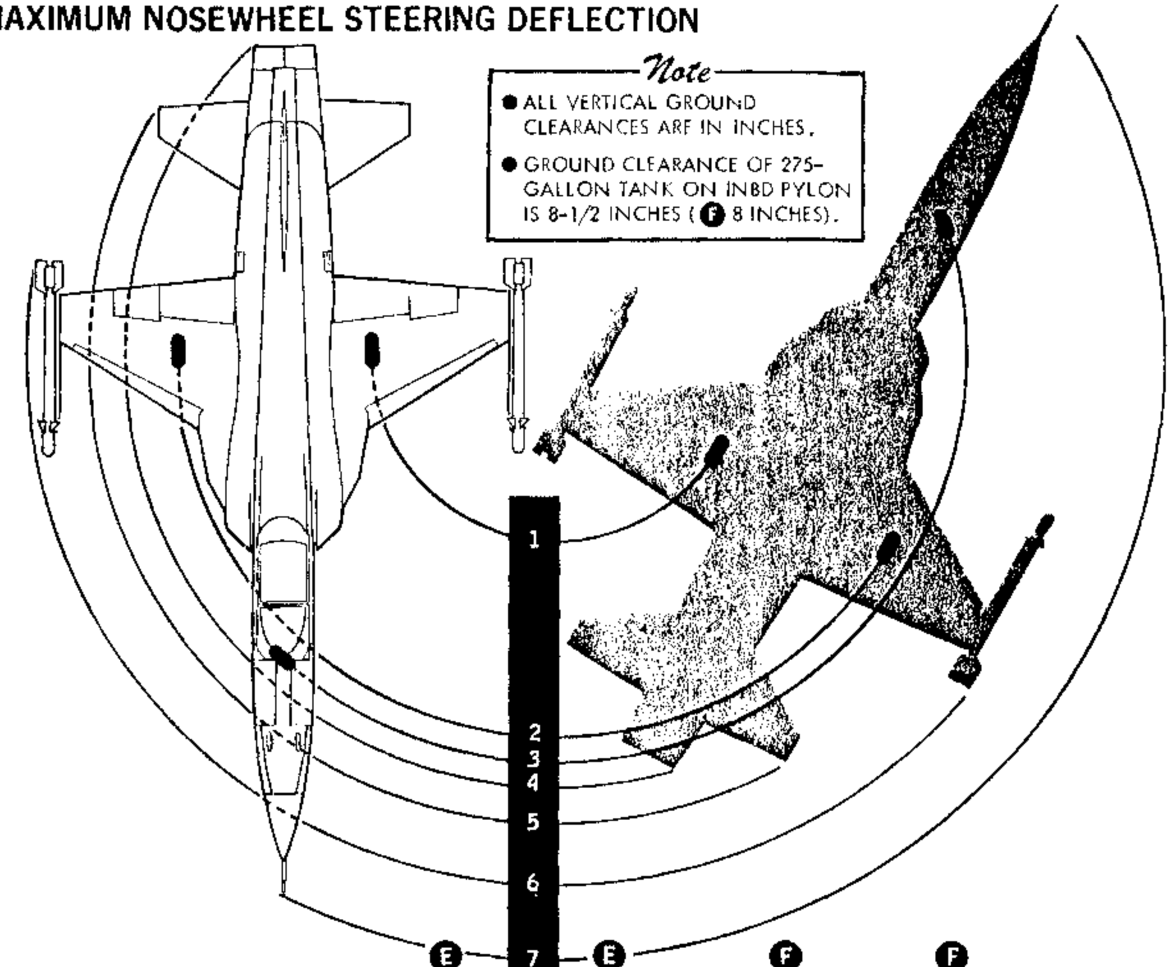
Camera (or cameras) selected operates at runaway (RWY) interval or as rapidly as the shutter and film movement mechanism cycles as long as switch is held in selected position.

To Turn Camera(s) Off After Use of Camera Override Switch

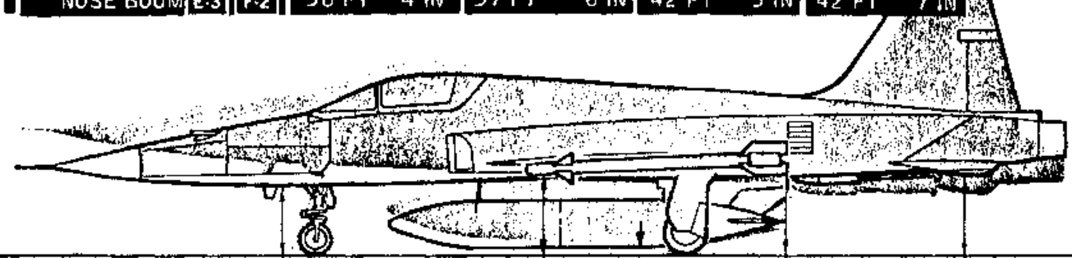
1. Camera Override Switch — Center and Release.

TURNING RADIUS/GROUND CLEARANCE (TYPICAL)

MAXIMUM NOSEWHEEL STEERING DEFLECTION



NOSE STRUT:	E DEHIKED	E HIKED	F DEHIKED	F HIKED
1 LEFT MAIN GEAR	13 FT 8 IN	13 FT 11 IN	18 FT 7 IN	18 FT 9 IN
2 RIGHT MAIN GEAR	26 FT 5 IN	26 FT 7 IN	31 FT 9 IN	31 FT 11 IN
3 NOSE GEAR	26 FT 10 IN	27 FT 0 IN	31 FT 11 IN	32 FT 1 IN
4 TAILPIPE	27 FT 10 IN	28 FT 0 IN	32 FT 10 IN	33 FT 0 IN
5 HORIZONTAL TAIL	30 FT 7 IN	30 FT 10 IN	34 FT 3 IN	34 FT 5 IN
6 MISSILE FIN	34 FT 6 IN	34 FT 8 IN	39 FT 5 IN	39 FT 7 IN
7 NOSE BOOM	36 FT 11 IN	37 FT 1 IN	42 FT 8 IN	42 FT 10 IN
NOSE BOOM (RECON)	36 FT 9 IN	36 FT 11 IN		
NOSE BOOM E-3 F-2	36 FT 4 IN	37 FT 6 IN	42 FT 5 IN	42 FT 7 IN



NOSE STRUT						
E	DEHIKED	38-1/3	46	7-3/4	41	44
E	HIKED	47-3/4	49-1/2	8-3/4	38	37
F	DEHIKED	36-1/3	46-3/4	7-1/2	43-1/4	42-1/4
F	HIKED	50-3/4	49-3/4	8-1/4	40-1/4	33-1/2

F-51-72(1)C

Figure 2-8.

SECTION III
EMERGENCY PROCEDURES

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TABLE OF CONTENTS

TABLE OF CONTENTS

NOTE

- Critical items **(BOLDFACE PRINT)** are those steps of an emergency procedure which must be performed immediately without reference to written checklists. All crewmembers are required to be able to demonstrate correct accomplishment of **BOLDFACE** procedures without reference to checklist.
- To assist the pilot when an emergency occurs, three basic rules are established which apply to most emergencies occurring while airborne and which should be remembered by the pilot.

1. Maintain Aircraft Control.
2. Analyze the Situation and Take Proper Action.
3. Land as Soon as Possible/Practical.

Your emergency procedures checklist is contained in T.O. 1F-5E-1CL-1.

DEFINITIONS

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

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

INCLUDES PROCEDURES THAT COULD BE USED IN TWO OR MORE PHASES OF OPERATION

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PHASES
GROUND
TAKEOFF
IN-FLIGHT
LANDING

CADC/PITOT STATIC MALFUNCTION

Illumination of the AIR DATA COMPUTER caution light on the caution light panel indicates a malfunction or failure of the CADC, although some internal failures can occur that do not result in caution light illumination. Additionally, a blocked or leaking pitot-static system may cause erroneous inputs to the CADC. If CADC failure or false input is detected or suspected, proceed as follows:

1. Pitch Damper Switch — OFF (if necessary).
   Pitch may become excessively sensitive at high airspeed with pitch damper on.
2. AAU-19/A, AAU-34/A Altimeter — Standby (STBY/PNEU) Mode.
3. Flap Lever — FULL (for approach and landing).
   Positioning flap lever at FULL overrides possible erroneous maneuver/auto flap position.

CAUTION

Use of maneuver ([E-3] [F-2] auto or fixed) flap setting with unreliable CADC output may result in unexpected changes in flap position and possible flap overspeed.

4. Engine Aux Door Circuit Breakers — Pull (if desired).
   Pull right and left ac engine aux door circuit breakers (Ⓕ rear cockpit) to preclude the possibility of door cycling and unexpected loss of thrust.

NOTE

If pitot-static malfunction is detected or suspected, AOA indications should be cross-checked frequently during approach and landing.

Inoperative/Unreliable Equipment

a. AAU-19/A, AAU-34/A Altimeter Primary (RESET/ELECT) Mode.
b. Airspeed Indicator.
c. IFF/SIF AIMS Altitude Reporting.
d. Lead Computing Optical Sight System.
e. Stability Augmenter System.
f. Maneuver ([E-3] [F-2] Auto or Fixed) Flaps and Flap Audible Warning.
g. Aux Intake Doors Control.
h. Landing Gear Warning.

AOA/FLAPS FAILURE [E-3] [F-2]

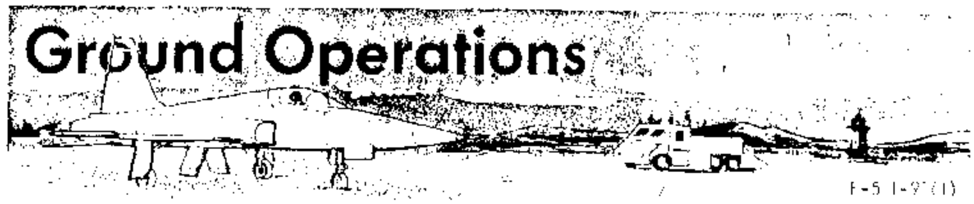
Illumination of the AOA/FLAPS caution light on the caution light panel (figure 3-10) indicates a failure in the AOA switching unit, which results in loss of auto flaps operation. In this condition, the flaps remain in the position attained at the time of failure until another setting is selected on the thumb switch or flap lever.

1. Flap Thumb Switch — As Required.
2. Flap Lever — FULL (for approach and landing).

Inoperative/Unreliable Equipment

a. Auto Flap Setting.

THIS PHASE OF OPERATION IS FROM STARTING ENGINES THRU TAXIING TO TAKEOFF POSITION AND AFTER LANDING ROLL FROM CLEAR OF RUNWAY TO ENGINE SHUTDOWN.



EMERGENCY ENTRANCE

See figure 3-11 for emergency entrance. Unlock the canopy with the canopy external handle. If this fails, pull the canopy jettison external D-handle. If these two means of entrance fail, break into the rear portion of the canopy.

EMERGENCY EXIT ON GROUND

1. Canopy — Unlock (open or jettison, as necessary).
   If the canopy cannot be opened manually, pull the canopy jettison T-handle. If the canopy does not jettison, shut down the engines and break thru the canopy glass with the breaker tool (figure 3-1).

WARNING

The canopy seals remain inflated if engines are shut down with canopy locked, and canopy may not open manually.

2. Throttles — OFF.
3. Safety Belt — Disconnect.
4. Parachute — Remove.
   Removal of the parachute makes it easier to get out of the cockpit. If the parachute is kept on, the survival kit emergency release handle must be pulled (pilot's weight on the seat), and care must be taken not to allow the parachute arming lanyard or the ripcord handle to catch and pull, deploying the parachute.
5. Oxygen Mask/Leads — Remove.
   Removal of the oxygen mask expedites evacuation; however, when egressing thru a fire, consideration should be given to disconnecting the oxygen and communication leads, leaving the mask on.

ENGINE FIRE DURING START

If a fire warning light comes on, or if there are other indications of fire, proceed as follows:

1. Throttles — OFF.

If Engines Fail to Shut Down

2. Fuel Shutoff Switches — CLOSED.

SMOKE, FUMES, OR ODOR IN COCKPIT

Do not take off if smoke, fumes, or unidentified odors are detected. All odors not identifiable should be considered toxic.

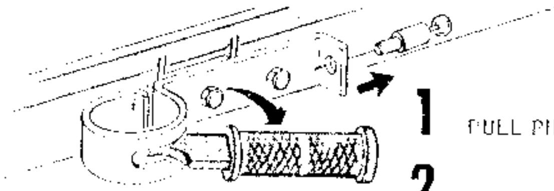
1. Oxygen — 100%.
2. Check For Fire.

If required, see Emergency Exit On Ground procedure, this section.

CANOPY BREAKER TOOL

Note

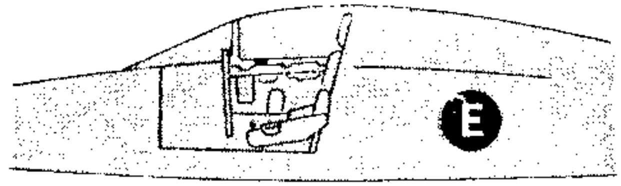
USE ONLY IF ALL OTHER CANOPY RELEASE METHODS FAIL.

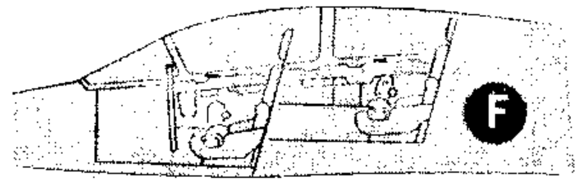


1 PULL PIN.

2 REMOVE TOOL.

3 USE BOTH HANDS ON HANDLE TO BREAK CANOPY WITH POINT OF TOOL.



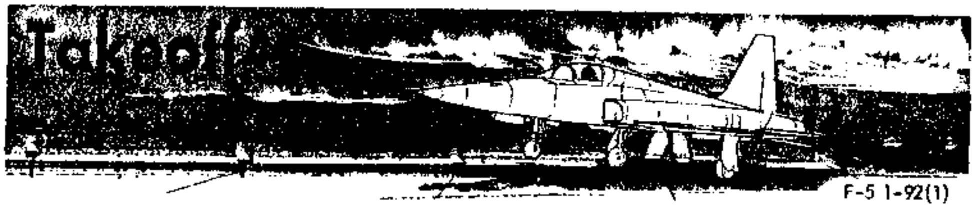


TO BREAK THE CANOPY, GRASP THE CANOPY BREAKER TOOL WITH BOTH HANDS AND USE BODY WEIGHT BEHIND AN ARM SWINGING VERTICAL THRUST. AIM THE POINT OF THE TOOL, CURVED EDGE TOWARD PILOT, TO STRIKE PERPENDICULAR TO THE CANOPY SURFACE. USE THE POINT OF THE TOOL, AS BLADE ALIGNMENT DETERMINES THE DIRECTION OF THE CRACKS. REVERSING THE TOOL TO HAMMER WITH THE BUTT PRODUCES RAGGED AND UNPREDICTABLE CRACKING.

F-5 1-87(20)A

Figure 3-1.

THIS PHASE OF OPERATION IS FROM THE TIME THE THROTTLE IS ADVANCED FOR TAKEOFF UNTIL THE AIRCRAFT IS CLEANED UP AND INITIAL CLIMB ESTABLISHED.



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ABORT/ARRESTMENT

1. **THROTTLES — IDLE.**
2. **CHUTE — DEPLOY.**
3. **HOOK — DOWN.**

WARNING

Jettisoning stores on runway may endanger aircraft and personnel due to possible impact detonation, fire, and collision with landing gear.

CAUTION

- Nosewheel should be on the ground before arrestment.
- Hook should be extended as soon as arrestment need is evident. Early extension is required to permit hook stabilization prior to arrestment.
- Counteract any rollback after arrestment with power rather than braking.

To minimize yaw induced by arrestment, steer straight for the middle of the runway. Arrestment should be perpendicular to the cable. Off center arrestment may result in rapid and unpredictable oscillations. Rudder should be used as the primary directional control until the rudder becomes ineffective. Stop braking before the nosewheel crosses the cable. External stores with less than 8-inch clearance may be damaged crossing over the cable but should not affect the engagement. Arrestment speeds are in section V.

NOTE

- Only arrestment systems listed in section V are certified.
- Possibility of successful engagement of MA-1A barrier is doubtful when carrying external stores or with speed brake extended.

SINGLE-ENGINE TAKEOFF CHARACTERISTICS

If an engine fails and takeoff is continued use MAX thrust until safe ejection altitude is reached. The effect on directional control of loss of an engine is slight and opposite rudder maintains heading. Aft stick should be applied 5 knots before single-engine takeoff speed. However, if available runway permits, increase airspeed as much as possible before attempting takeoff. Stores should be jettisoned unless it is evident that acceleration is more than adequate and the additional weight and drag penalty is acceptable.

Do not raise landing gear until at least 10 knots above single-engine takeoff speed but no later than 210 KIAS. Raising gear too soon may result in aircraft settling to runway.

NOTE

If the left engine is inoperative, normal windmilling rpm should be sufficient to provide hydraulic pressure for gear retraction; however, gear doors may not close completely. If the left engine is frozen and utility hydraulic pressure is zero, the landing gear lever should be left in the LG DOWN position to avoid additional drag caused by gear doors opening.

SINGLE-ENGINE TAKEOFF CHARACTERISTICS (Continued)

Single-engine takeoff speed provides a minimum of 300 feet per minute climb out of ground effect with full flaps and gear down. If close-in obstacle clearance is a consideration, use this speed for initial climb. If obstacle clearance is not a consideration, accelerate as much above the computed single-engine takeoff speed as runway permits. (See appendix for single-engine climb gradient charts.) Aircraft control is critical at this speed and any abrupt control inputs could increase drag and place the aircraft behind the power curve at an altitude where recovery is impossible. The primary concern with either engine failure or fire warning emergencies is acceleration to an airspeed that provides more than adequate aircraft control and thrust/drag ratio, before initiating the climb. The flap thumb switch should be left at M/AUTO during takeoff, acceleration, and climb. Recommended airspeeds for single-engine climb to a safe ejection altitude (2000 feet AGL) with the following conditions are:

RECOMMENDED SINGLE-ENGINE CLIMB SPEEDS

GEAR	FLAPS	KIAS
Down	M	210
	Auto	210
Up	M	260
	Auto	230
Up	Up	290

ENGINE FAILURE/FIRE WARNING DURING TAKEOFF

If Takeoff Is Refused

1. Abort.

NOTE

If the abort was made as a result of an engine fire, place the throttle of the affected engine to OFF once the aircraft is under control. If the fire is confirmed, accomplish the Emergency Exit On The Ground procedure after stopping.

See Abort/Arrestment procedures, this section.

If Takeoff Is Continued

1. THROTTLES — MAX.

WARNING

- Continuing a takeoff on single engine should be attempted only at MAX thrust. No attempt should be made to reduce power on the bad engine due to the possibility of confusion and the necessity of maintaining all available thrust to safe ejection altitude.
- If engine failure occurs after rotation, it may be necessary to lower the nose to the runway; or, if airborne, allow the aircraft to settle back on runway until single-engine takeoff speed is attained. Increase airspeed as much above single-engine takeoff speed as available runway permits before attempting takeoff.

2. STORES — JETTISON (IF NECESSARY).

WARNING

Jettisoning stores on runway may endanger aircraft and personnel due to possible impact detonation, fire, and collision with landing gear.

3. At Safe Ejection Altitude — Perform In-Flight Engine Failure/Fire Warning Procedures.

TIRE FAILURE ON TAKEOFF

If Takeoff Is Refused

1. Abort.

See Abort/Arrestment procedures, this section.

If Takeoff Is Continued

1. **GEAR — DO NOT RETRACT.**

See Landing With Tire Failure, this section.

NOTE

If conditions permit, gear retraction may be considered after visual sighting confirms that damage caused by the tire failure does not preclude raising the gear.

NOSE GEAR

If nose gear tire fails during takeoff and the decision is to abort, make maximum use of nosewheel steering and wheel braking to maintain directional control. Use heavy braking and deploy drag chute to stop.

CAUTION

Nosewheel tire disintegration on takeoff can cause foreign object ingestion in engine.

MAIN GEAR

If a main gear tire fails during takeoff and the decision is to abort, maintain directional control with nosewheel steering and braking. Use brakes and deploy drag chute to stop. The drag created by the failed tire can be equalized by braking the opposite wheel.

NOSEWHEEL SHIMMY

Nosewheel steering should normally be discontinued above 65 KIAS. Some failures of the nosewheel steering actuator or actuator output shaft can preclude nosewheel shimmy damping. If takeoff with a failed damper assembly is attempted, oscillations in nosewheel deflection are induced. These appear as a snaking motion and can result in catastrophic failure of the nose gear strut at speeds as low as 30 knots. Do not attempt takeoff with a nosewheel steering system malfunction. If a shimmy or snaking is encountered on takeoff, an abort should be initiated immediately if conditions permit. The aircraft should be stopped as expeditiously as possible. Dehiking the nose gear strut reduces the possibility of structural failure. Use of full aft stick aids in reducing stopping distance by transferring additional weight to the main wheels, and can reduce nosewheel shimmy.

WARNING

If takeoff must be continued, anticipate possible structural failure of the nose gear strut. See Tire Failure On Takeoff and/or Landing Gear Extension Failure emergency procedures, this section.

CAUTION

Failure to dehike the nose gear strut increases the possibility of structural failure.

NOTE

If the arresting hook is released, the nose gear strut automatically dehikes.

LANDING GEAR RETRACTION FAILURE

If the warning light in the landing gear lever remains on after the lever has been moved to LG UP:

1. Airspeed — Maintain Below 260 KIAS.
2. Gear Alternate Release Handle — Verify Proper Stowage.
3. Nose Strut Switch — Verify Retract Position.
4. Gear Lever — LG DOWN, Then LG UP.

LANDING GEAR RETRACTION FAILURE (Continued)

4. Throttles — MIL.
5. If Light Remains On With Throttles Cycled To MIL — Lower Gear.

If the light goes out, proceed with flight; however, note the discrepancy in Form 781.

EMERGENCY JETTISON

1. Emergency All Jettison Button — PUSH.

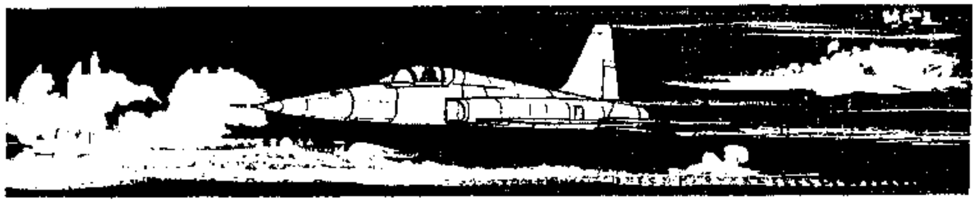
If Stores Fail To Jettison [E] [E-2] [F]

1. External Stores Jettison T-Handle — Pull.

If Stores Fail To Jettison

1. Select Jettison Switch — ALL PYLONS. Pull switch out and down.
2. Select Jettison Button — PUSH.

THIS PHASE OF OPERATION IS FROM THE TERMINATION OF TAKEOFF TO THE INITIATION OF LANDING.



ENGINE FAILURE

1. Throttle (good engine) — As Required.
2. Stores — Jettison (if necessary).
3. Gear — Up.
4. Speed Brake — In.
5. Flaps — As Required.
6. Throttle (failed engine) — OFF.
7. Fuel Balancing — As Required. Autobalance operation should be used, if available.

With Fuel Less Than 400 Lb In Each System

8. Fuel Boost Pump Switches — LEFT and RIGHT.
9. Crossfeed Switch — CROSSFEED.

Inoperative Equipment With Left Engine Failed

a. Speed Brake.
b. Landing Gear Normal Extension.
c. Nosewheel Steering.
d. Stability Augmenter.
e. Gun Gas Deflector and Gun Bay Purge Doors.
f. Normal Braking.

SINGLE-ENGINE FLIGHT CHARACTERISTICS

Single-engine directional control can be maintained at all speeds. Little rudder movement is required because of the close proximity of thrust lines to the centerline of the aircraft. Under high drag and/or maximum gross weight conditions, the aircraft may not maintain altitude on one engine with gear and flaps extended.

WARNING

- Minimum safe single-engine flying speed with gear and flaps up and external stores jettisoned under standard ambient temperature conditions is 190 KIAS (Ⓕ 200 KIAS). Add 1 KIAS for each 1°C above standard ambient temperature conditions. Single-engine maximum thrust provides a minimum rate of climb of 300 fpm out of ground effect under these conditions.
- When performing practice maneuvers to simulate single-engine operation, retard desired engine throttle to IDLE. If single-engine landings, GCA's or low approaches are being simulated, both engines should be used for go-arounds.

NOTE

In single-engine operation, crossfeed is required to obtain all usable fuel.

ENGINE FAILURE AT LOW ALTITUDE

1. **THROTTLES — MAX.**
2. Engine Instruments — Monitor.

If both engines fail at low altitude and with sufficient airspeed, zoom the aircraft to exchange airspeed for altitude and time. Try to airstart immediately upon flameout. Aircraft attitude should not exceed 20 degrees nose-up during zoom. Ejection should be done while aircraft is in a positive climb. If continued airstarts are to be attempted, lower the nose before airspeed drops below 250 KIAS.

ENGINE FAILURE AT LOW ALTITUDE (Continued)

WARNING

With dual engine flameout, battery switch must be at BATT to provide ignition.

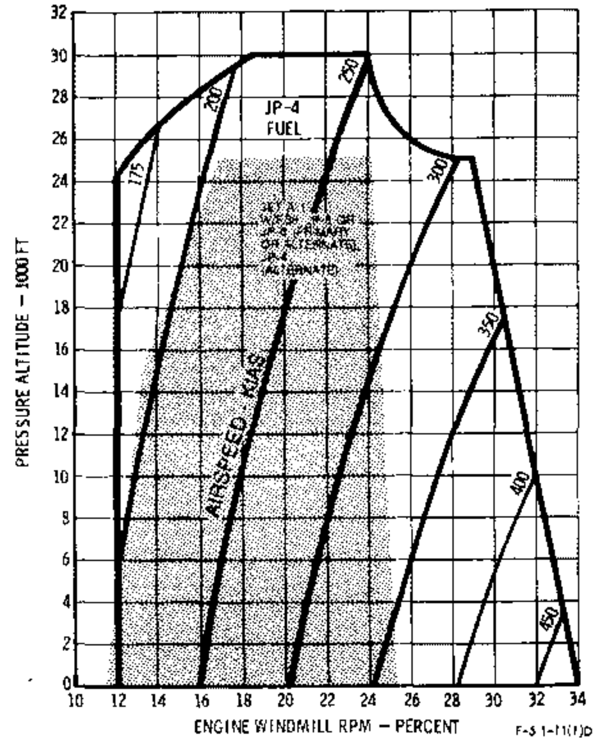
NOTE

- Normally, engine should light off within 10 seconds and accelerate into afterburner. If light off does not occur within 10 seconds, throttle must be left in AB range for an additional 30 seconds to allow for delay in start within the complete ignition cycle (40 seconds).
- If flameout occurs while operating in AB, the throttle must be cycled to MIL and returned to AB to reactivate the ignition cycle and enable the P3 compressor dump system. If the throttle is not cycled out of AB, the start button must be pushed and held to provide continuous ignition while in AB. After engine start, the throttle may be left in AB if desired.
- Momentarily pressing (not holding) the start button before or after selecting AB range will only provide ignition for the time remaining on the first selected ignition cycle. The automatic ignition reset feature is disabled until the ignition timer expires.

AIRSTART

Airstarts can be expected over the range of operating conditions shown in figure 3-2. (See AIRSTART, section I.) The engine design requirements are based on engine windmill speed and pressure altitude and are independent of ambient temperature. Lines of constant indicated airspeed have been superimposed on the basic engine requirements. These are the indicated airspeeds required to achieve corresponding windmill speeds. Airstart attempts at engine windmill speeds below the lower limit normally result in a hung start. The engine lights off, as evidenced by egt rise, but fails to

AIRSTART ENVELOPE



F-5 1-110JD

Figure 3-2.

accelerate up to idle. If airspeed is increased and/or altitude decreased with an engine in a hung start, it may accelerate up to operating speed. Airstart attempts at engine windmill speeds higher than the upper limit normally fail due to the inability of the engine to light off (no egt rise). Combustion may be established by decreasing airspeed and/or decreasing altitude. Since the ignition circuitry is energized for about 40 seconds after pushing the start button, it may be necessary to press the start button again. Use the following procedure.

1. Throttle — OFF.
2. Altitude — Below 30,000 Feet (25,000 feet w/JET A-1 with FSII, JP-8, JP-5, or alternate fuel).
3. Airspeed — 250 KIAS (approximate) (240 KIAS w/JET A-1 with FSII, JP-8, JP-5, or alternate fuel).
4. Fuel Boost Pump Switches — LEFT/RIGHT.
5. Battery Switch — BATT (check).
6. Start and Ignition Circuit Breakers (left console) — Check In.
7. Start Button — PUSH.
8. Throttle — Advance to IDLE.
9. Engine Instruments — Maintain Within Operating Limits.

MAXIMUM GLIDE (BOTH ENGINES WINDMILLING)

DATA BASIS
- DATE: 1 AUGUST 1976
- **FLIGHT TEST**
- GROSS WEIGHT — 13,300 LB
- FLAPS — UP

Note

APPROXIMATE GLIDE DISTANCE FOR EACH 1000 FT AGL:

WITH OR WITHOUT PYLONS — 1.1 NM
WINGTIP MISSILE EFFECT — NEGLIGIBLE

AIRSTART GLIDE SPEED
- BEST AIRSTART GLIDE SPEED WITH:

JP-4 (PRIMARY FUEL)	— 250 KIAS
JP-4 (ALTERNATE FUEL)	— 240 KIAS
JET A-1, JP-8 OR JP-5 (PRIMARY OR ALTERNATE FUEL)	— 240 KIAS

- AIRSPEED DIFFERENCE EFFECT ON DISTANCE — NEGLIGIBLE

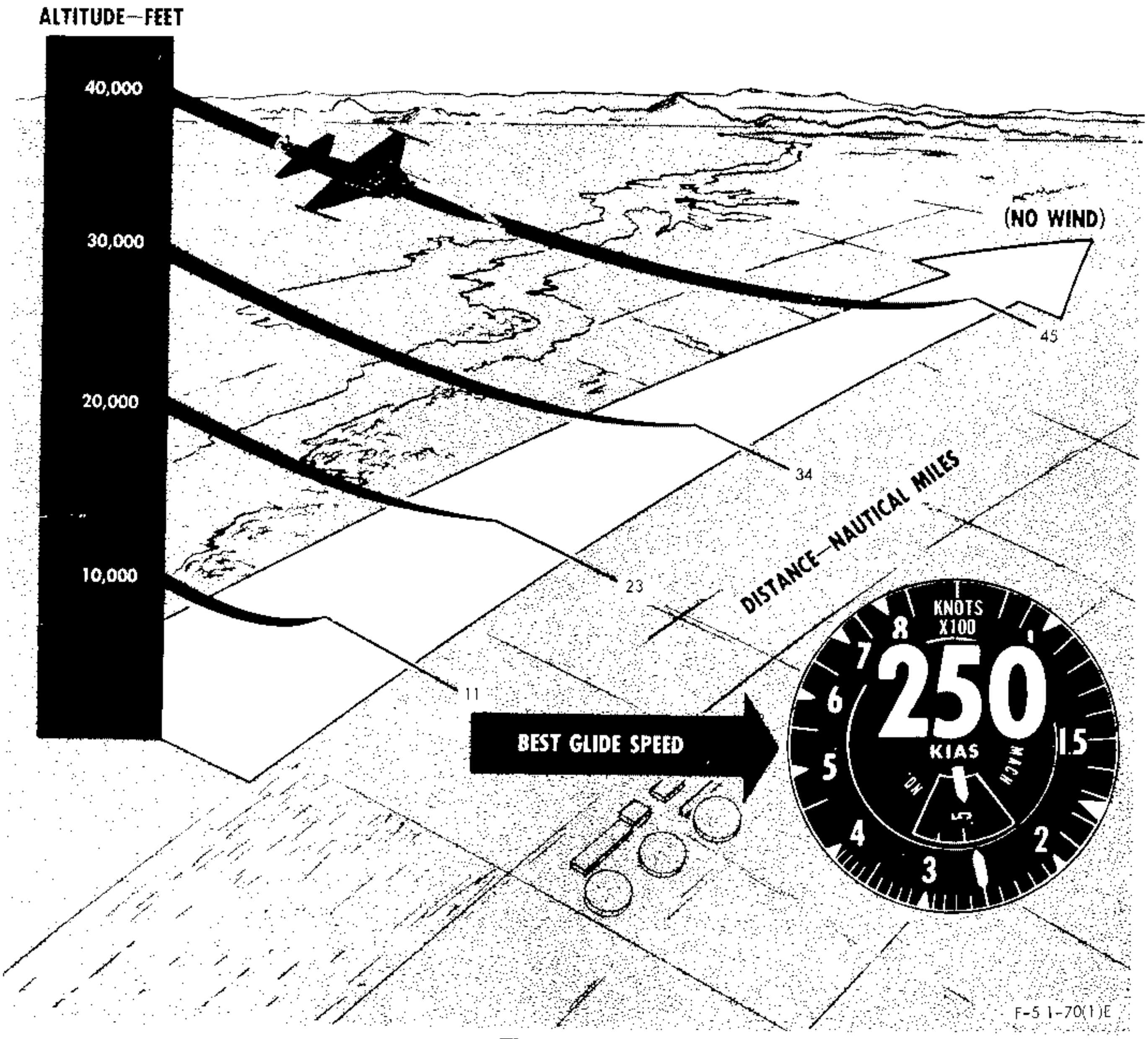


Figure 3-3.

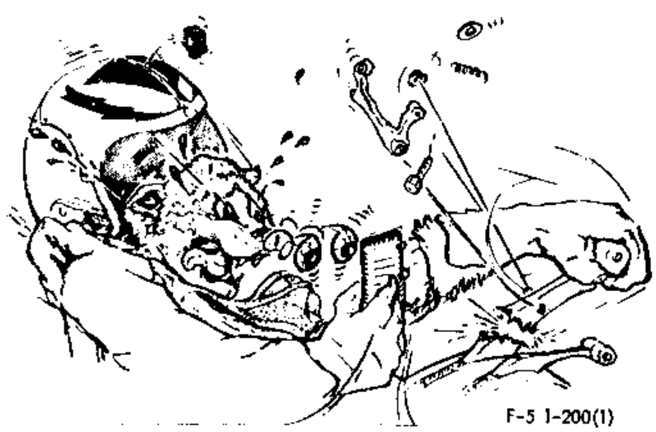
AIRSTART (Continued)

NOTE

- Leave throttle at IDLE for 40 seconds before aborting start.
- If airstart is aborted, check engine ignition circuit breakers before attempting next start.
- If both engines flame out, and conditions permit, left engine start should be attempted first because left engine instruments operate normally as soon as start button is actuated.
- In the case of hung starts, an EGT of less than 200°C cannot be read with the EHU 31A/A indicator.
- If attempted airstart is unsuccessful, increase airspeed approximately 5 to 10 KIAS when using JP-4 or decrease approximately 5 to 10 KIAS when using JET-A1, JP-8 or JP-5 before attempting another airstart.
- Engines require 25 seconds to develop usable thrust from minimum airstart rpm.

ALTERNATE AIRSTART

1. Throttle(s) — OFF (or below MIL).
2. Altitude — Below 30,000 feet (25,000 feet w/JET A-1 with FSII, JP-8, JP-5, or alternate fuel).



F-5 1-200(1)

3. Airspeed — 250 KIAS (approximate) (240 KIAS w/JET A-1 with FSII, JP-8, JP-5, or alternate fuel).
4. Battery Switch — BATT (check).
5. Start and Ignition Circuit Breakers (left console) — Check In.
6. Throttle(s) — MAX.

Engine lights off within 10 seconds and accelerates to MAX.

FIRE WARNING IN FLIGHT (Affected Engine)

1. **THROTTLE — IDLE.**
2. **THROTTLE — OFF IF FIRE WARNING LIGHT REMAINS ON.**

WARNING

- Do not delay placing the throttle to OFF due to possible rapid loss of flight control system from fire damage.
- Close fuel shutoff switch if engine fails to shut down with throttle or if fire warning light remains on.

3. **IF FIRE IS CONFIRMED — EJECT.**

CAUTION

If the fire warning light goes out, check the light by positioning the warning test switch to TEST. If one or both bulbs of the affected fire warning light does not illuminate, it indicates a possible burnthrough of one or more fire sensors. In this case, shut the engine down.

ELECTRICAL FIRE

1. Battery and Generator Switches — OFF.

NOTE

With fuel boost pumps inoperative, engine flameout may occur if above 25,000 feet.

ELECTRICAL FIRE (Continued)

2. All Electrical Equipment — OFF.
3. Battery and Generator Switch(es) — BATT and L GEN/R GEN (as required).

NOTE

Turn on battery and generator(s) and operate only those units necessary for flight and landing.

4. Land As Soon As Practical.

SMOKE, FUMES, OR ODOR IN COCKPIT

All odors not identifiable should be considered toxic. If smoke, fumes, or odor is detected in cockpit:

1. Oxygen — 100%.
2. Check For Fire.
3. Descend to 25,000 Feet or Below.
4. Oxygen Emergency Lever — EMERGENCY.
5. Cockpit Pressurization Switch — RAM DUMP.
6. Ⓕ [E-1] [E-5] Cockpit Pressurization Switch — DEFOG ONLY (after smoke clears).
7. If Smoke Is Severe — Jettison Canopy Below 300 KIAS (if possible).

ENGINE MALFUNCTIONS

OIL PRESSURE

If pressure exceeds limits or a sudden change in pressure of 10 psi or more occurs:

1. Throttle — Reduce (to maintain pressure within limits).
2. Throttle — OFF (if 5 psi minimum pressure cannot be maintained at idle rpm or if engine seizure appears imminent).

CAUTION

Failure of engine rpm indication and loss of oil pressure on the same engine may be an indication of a sheared oil pump shaft. Consideration should be given to shutdown of the affected engine.

NOTE

If the remaining engine requires shutdown the engine previously shut down for oil pressure malfunction may be restarted.

COMPRESSOR STALL

If an engine compressor stalls, proceed as follows:

1. Throttle — Retard (until engine recovers).
2. Increase Airspeed and Advance Throttle Slowly.

NOTE

If engine FOD is suspected, slow throttle advance is necessary to regain sustained engine power.

3. Throttle — OFF (if engine does not recover).

NOTE

- After experiencing a compressor stall, the engine may not recover to the full range of operation. If normal instrument indications can be achieved for a given power setting, the engine should not be shut down unless other circumstances dictate.
- If the engine is shut down, an airstart may be attempted as applicable.
- Rapidly retarding the throttle to IDLE and immediately pushing the engine start button may permit the engine to recover and prevent complete flameout.

ENGINE MALFUNCTIONS (Continued)

NOZZLE FAILURE

If nozzle failure occurs in closed range, excessive EGT is possible. If this condition occurs, follow the engine overtemperature procedure. If a nozzle fails in the open position, low EGT results. The affected engine operates from IDLE to MIL, but with a lower thrust output. Afterburner may not be available. Depending on the severity of either condition, consideration should be given to recovering the aircraft in accordance with single engine landing procedures. After landing, monitor EGT.

OVERSPEED OR OVERTEMPERATURE

If engine rpm exceeds 103% or EGT exceeds 675°C during stabilized engine operation:

1. Throttle — Retard (until indication within limits).

LOSS OF CANOPY

If The Canopy Is Lost Or Jettisoned

1. Slow Aircraft to 300 KIAS or Less.

WARNING

(Improved Ejection Seat) After canopy is lost or jettisoned, inadvertent ejection seat drogue chute deployment is possible. Chute deployment could cause an immediate out-of-control condition.

NOTE

Wind blast effect may be sufficient to cause circuit breakers to pop in the upper aft cockpit area. These circuit breakers are inaccessible during flight, and the resultant loss of associated electrical equipment may significantly affect normal aircraft operation.

ELECTRICAL SYSTEM FAILURE

AC/COMPLETE ELECTRICAL FAILURE

Operate only systems necessary for flight and landing. Conserve battery power.

1. Throttle(s) — Retard (if above 25,000 feet).
2. Altitude — 25,000 Feet or Below.
3. Electrical Loads — Reduce.
4. Battery Switch — BATT (check).
5. Generator Switch(es) — Reset, Then L GEN/R GEN.
   Hold switch(es) at reset momentarily before placing at L GEN/R GEN.
6. Crossfeed — As Required.
7. Circuit Breakers — Check.
8. Land As Soon As Possible.

NOTE

- In the event of single generator failure and failure of the remaining generator to pick up the load (power transfer failure), see electrical systems diagram.
- With fuel boost pump inoperative, remain below 25,000 feet. Although flight at reduced power can usually be sustained at altitudes up to 25,000 feet, fly at the lowest practical altitude for terrain clearance and range requirements.
- Illumination of a generator caution light and a respective fuel pressure light may indicate failure of remaining generator to pick up total load.

The Following Are Inoperative With Complete Electrical Failure

a. Flight and Engine Instruments. EXCEPTION: The Tachometers, Airspeed Indicator and the Altimeter (in STBY/PNEU) remain operative. The Standby Attitude Indicator is operative for 9 minutes after electrical failure.
b. Communications and Navigation Equipment.
c. Speed Brake and Flaps.

ELECTRICAL SYSTEM FAILURE (Continued)

d. Landing Gear Normal Extension.
e. Landing Gear Indicator Lights.
f. Nosewheel Steering.
g. Fuel Boost Pumps.
h. Engine Ignition System.
i. Emergency All and Select Jettison Controls.
j. Anti-ice Systems.
k. External Fuel (unless selected prior to failure).
l. Stability Augmenter System.
m. Pitch and Aileron Trim.
n. Arresting Hook Extension.
o. Canopy Seals May Not Deflate.

DC OVERLOAD (F) E-1 E-3

If the DC OVERLOAD caution light (figure 3-10) comes on in flight, use the following procedures:

1. Nonessential DC Equipment — Turn Off (in increments).
2. Battery Switch — Cycle OFF/BATT (after each dc equipment reduction). Light should go off when dc is sufficiently reduced.

If Light Remains On

If DC OVERLOAD caution light remains on after all possible dc reductions, the overload detector may have malfunctioned, or the battery may be charging excessively. Proceed as follows:

1. Essential DC Equipment — As Required.
2. Land As Soon As Practical.

FUEL AUTOBALANCE SYSTEM MALFUNCTION

If fuel autobalance system malfunction occurs (switch failed in LEFT LOW or RIGHT LOW position), proceed as follows:

1. Auto Balance Switch — Center (manually).
2. Fuel balancing — Use manual balancing procedures (as required).

If Auto Balance Switch Cannot be Moved

1. Altitude — 25,000 Feet or Below.
2. Crossfeed Switch — CROSSFEED.
3. Fuel Boost Pump (on low fuel side) — OFF.

NOTE

- Accomplishing this procedure turns off the fuel boost pump of the low fuel side, thus initiating gravity feed. With this failure mode, the manual system does not override the automatic system until actuation of the fuel low caution signal. At that point, the auto balancing system is bypassed and the manual balancing system operates. When the systems are balanced, terminate manual fuel balancing.
- Flight with reduced power at lowest practical altitude for terrain clearance and emergency requirements further assures continued stable engine operation with boost pumps inoperative.

4. Land As Soon As Practical.

HYDRAULIC SYSTEMS FAILURE

There are three different types of hydraulic system malfunctions which may be encountered: low pressure, high pressure, and hydraulic fluid overtemperature. A low-pressure condition of 1500 psi or less is indicated by illumination of the respective hydraulic caution light. A high-pressure condition in excess of 3200 psi has no warning indication; it can be detected only by monitoring the hydraulic pressure indicators. A high-pressure condition may cause a hydraulic fluid overtemperature condition. Hydraulic fluid overtemperature will also cause the respective hydraulic system caution light to illuminate [T.O. 1F-5-941]. To determine which condition (low-pressure or fluid overtemperature) caused the caution light to illuminate, the respective hydraulic pressure indicator must be checked. If hydraulic pressure is in the normal range or higher, illumination of the caution light is caused by hy-

HYDRAULIC SYSTEMS FAILURE (Continued)

draulic fluid overtemperature. A hydraulic fluid overtemperature condition or a pressure not within limits may cause subsequent failure of flight control components. An excessively high hydraulic pressure and a hydraulic fluid overtemperature condition will usually occur together; however, it is possible to have one without the other.

DUAL SYSTEM FAILURE

If Flight Control Becomes Impossible

1. Eject.

SINGLE SYSTEM FAILURE

If Utility or Flight Hydraulic Caution Light Illuminates

1. Hydraulic Pressure Indicators — Check.

With Hydraulic Pressure Low

1. Monitor Both Systems.
2. Pitch and Yaw Damper Switches — OFF (utility only).
3. Land As Soon As:
   Possible — Both Systems.
   Practical — One System.

With Hydraulic Pressure Normal or High

A steady-state hydraulic pressure higher than 3200 psi or indication of hydraulic fluid over-temperature in either system must be considered a system malfunction, proceed as follows:

1. Land As Soon As Possible.
2. Retard Throttle of Affected Engine to IDLE.
3. Pitch and Yaw Damper Switches — OFF (Utility Only)
4. Minimize Flight Control Movement.
5. Land From a Straight In Approach.
6. Clear of Runway, Shut Down Affected Engine.

HYDRAULIC SYSTEMS FAILURE (Continued)

With a Flight Control Malfunction (sluggish controls)

If a high hydraulic pressure reading or indication of hydraulic fluid overtemperature in either system is accompanied by sluggish flight controls or other symptoms of a flight control system malfunction, proceed as follows:

1. Shut Down Affected Engine.
2. Minimize Flight Control Movements.
3. Land As Soon As Possible.
4. Land From a Straight In Approach.
5. If Control Becomes Difficult or Impossible — Eject.

Inoperative Equipment With Utility Hydraulic System Failure

a. Landing Gear Normal Extension.
b. Nosewheel Steering.
c. Normal Brakes.
d. Speed Brake.
e. Stability Augmenter.
f. Gun Gas Deflector and Gun Bay Purge Doors.

AIRFRAME GEARBOX FAILURE

A gearbox failure is indicated by simultaneous illumination of the generator and hydraulic caution lights for the same engine.

If Gearbox Fails

1. Throttle (affected engine) — OFF (if vibration exists).

Gearbox failure to shift is indicated when either generator caution light comes on when accelerating thru the 68% to 72% shift range.

If Gearbox Fails to Shift

1. Throttle — Reduce RPM (to range that sustains generator operation).
2. Generator Switch — RESET, Then L GEN/R GEN, if necessary.
3. Throttle — Maintain RPM (in range sustaining generator operation until starting final approach, then use as necessary to effect a safe landing).

TRIM MALFUNCTION

PITCH TRIM FAILURE

Pitch trim may fail completely or in only one direction. Exercise caution to preclude activation of pitch trim to an extreme position from which it cannot be returned. A controllability check should be accomplished at a safe altitude in a landing configuration.

1. Airspeed — Adjust (as necessary to minimize stick forces).
2. Pitch Trim — Set As Required.
3. Flaps — As Required.
   The flap/horizontal tail interconnect allows some horizontal tail movement with normal pitch trim inoperative.
4. Landing Approach — Straight In (if possible).

RUNAWAY TRIM

1. Trim Control — Actuate in Opposite Direction.

TRIM MALFUNCTION (Continued)

If Runaway Trim Is Not Corrected.

2. TRIM CONTROL Circuit Breaker (left console circuit breaker panel; Ⓕ front cockpit) — Pull.

PITCH DAMPER FAILURE (With External Tanks)

1. Airspeed — Reduce Below 0.75 IMN.

Ⓔ Normal operation of the stability augmenter system becomes more critical when external tanks are carried on inboard wing stations, particularly in the absence of outboard stores without full ammunition ballast.

CONTROLLABILITY CHECK

1. Altitude — 15,000 feet AGL (if practical).
2. Landing Configuration — Establish.

NOTE

Minimize flap movement if flap damage is known or suspected.

3. Airspeed — Reduce. Airspeed should be reduced to determine the acceptable approach and landing characteristics (no slower than normal approach speed).
4. Gear and Flaps — Landing Configuration (as determined).
5. Do Not Change Aircraft Configuration.
6. Landing Approach — Straight In. Plan to fly a power-on, straight in approach requiring minimum flare. Fly final approach no slower than acceptable airspeed determined in step 3.
7. Touchdown — At or Above Determined Airspeed.

ERECT POSTSTALL GYRATION RECOVERY

Poststall gyration (PSG) is characterized by uncommanded motion about all three axes at angles of attack (AOA) above stall. The motion may be abrupt or relatively smooth and mild. For earlier aircraft, the dominant characteristic is an uncommanded yaw excursion at stall, followed quickly by roll oscillations. On those aircraft modified for improved handling qualities ([E-3] [F-2]), the dominant characteristic at stall is a wing drop, followed quickly by roll oscillations. These motions tend to further increase the angle of attack. Exaggerated full aft stick rudder rolls can drive AOA above stall. Uncommanded yaw excursions may continue after rudder is neutralized and result in a PSG. When uncommanded motion is sensed, aft stick pressure should be relaxed to reduce AOA. If relaxing aft stick pressure does not immediately recover the aircraft, take the following action:

1. STICK — FORWARD AS REQUIRED.

WARNING

- If stick position forward of trim does not produce immediate recovery indications, full forward stick should be applied without delay. Delay in application of adequate forward stick may result in spin entry.
- If the stick is trimmed aft, more forward stick pressure is required for PSG recovery.

2. Ailerons and Rudder — Neutral.

WARNING

Failure to relax forward stick on recovery may cause the aircraft to enter an inverted PSG or inverted spin.

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ERECT POSTSTALL GYRATION RECOVERY (Continued)

NOTE

- Recovery is indicated when the aircraft responds to forward stick and airspeed increases toward 130 KIAS. Once recovery is indicated, relax forward stick to prevent an overshoot to negative g.
- During more severe PSGs, one or both engines may flame out. The probability of flameouts is increased with engines at MIL or MAX power.

If an erect spin is recognized, maintain full forward stick and proceed with the erect spin recovery procedures.

ERECT SPIN RECOVERY

Initially, the spin is probably oscillatory about all axes. Spin rotation may be slow, and roll oscillations may mask the yawing to the extent that determination of spin direction is difficult. Full forward stick may be sufficient to recover the airplane during this initial part of the spin. However, as the spin develops, it may transition from the oscillatory mode, which may be recoverable, to a flat spin from which recovery is very unlikely. Therefore, immediately upon recognition of spin direction, the following spin recovery controls should be applied:

1. **STICK — FULL FORWARD.**
2. **AILERON — FULL IN DIRECTION OF SPIN.**

WARNING

If full aileron deflection (thru the spring stop) in the direction of the spin is not maintained thruout the recovery, the spin recovery may be prolonged or prevented. Only half aileron deflection is available at the spring stop. Both hands may be required to force the stick past the spring stop.

3. **RUDDER — FULL OPPOSITE.**
4. Flaps — Maneuver/AUTO.

WARNING

Do not sacrifice forward stick or recovery aileron to select maneuver/auto flaps. Failure to maintain primary recovery controls may prolong or prevent recovery.

5. Neutralize Controls After Recovery. Do not change gear and speed brake positions during recovery.

WARNING

- The pitch-over during recovery from an erect spin is abrupt. Smooth aft stick is required to prevent an overshoot to negative g.
- Deployment of drag chute for spin recovery purposes is not recommended.

NOTE

Recovery from an erect spin is slow and may require several turns. As the airspeed increases to approximately 130 knots, the nose abruptly pitches down and yaw rate ceases. There will likely be some residual rolling immediately following spin recovery.

INVERTED POSTSTALL GYRATION/ INVERTED PITCH HANGUP/ INVERTED SPIN RECOVERY

An inverted poststall gyration is characterized by violent, disorienting oscillations about all three axes following an inverted stall. Maneuver flaps and/or aft CG tend to promote an inverted PSG entry. Following the PSG the aircraft may enter one of two possible inverted spin modes. The inverted oscillatory spin is the most likely mode. It is characterized by severe oscillations about all three axes and is similar to the PSG. Flight experience has also shown that it is possible to enter an inverted flat spin

INVERTED POSTSTALL GYRATION/ INVERTED PITCH HANGUP/ INVERTED SPIN RECOVERY (Continued)

mode. This mode is characterized by a predominant smooth yaw rate with some pitch and roll motion. If the IPH, inverted PSG, or either of the inverted spin modes is encountered accomplish the following:

1. **FLAPS — UP.**
2. **STICK — AFT AS REQUIRED.**
3. **AILERONS AND RUDDER — NEUTRAL.**

WARNING

- Failure to raise the flaps during an IPH recovery attempt makes recovery unlikely.
- Avoid aileron and rudder deflection until positive-g flight and airspeed above the stall are regained. These controls can induce transition to an upright (erect) PSG/spin.

If recovery does not occur and inverted spin entry is indicated, if a turn needle is available, determine the direction of spin rotation. Maintain stick position and:

4. Rudder — Full Opposite Direction of Spin (turn needle).

WARNING

- The aircraft always recovers from the inverted PSG/oscillatory spin but some additional negative pitch oscillations (typically 1 to 3) may be encountered prior to recovery. If recovery is initiated at airspeeds below approximately 100 KIAS, some delay may be encountered before effectiveness of flight control surfaces is regained.
- Recovery from the inverted flat spin mode is unlikely.
- Deployment of the drag chute for spin recovery purposes is not recommended.
- If considerable aft stick is used to recover from the inverted PSG/spin, the aircraft can very quickly transition to an extreme positive AOA upon recovery to a positive g flight. This could lead to an erect PSG/spin.
- If control is not regained from an erect or inverted spin by 10,000 feet AGL (Ⓕ 10,000 feet AGL solo; 15,000 feet AGL dual) eject.

NOTE

If the aircraft does not recover to positive-g flight after flaps are UP, smooth aft stick should be applied as necessary to regain positive-g flight.

EJECTION VS FORCED LANDING

Ejection is preferable to landing on an unprepared surface. Landing with both engines flamed-out will not be attempted.

EJECTION (GENERAL)

The ejection seats (Standard and Improved) provide safe escape with either the BA-22 or BA-25 parachute. Variables that can reduce survival chances are: altitude, airspeed, pitch and bank angles, sink rate, g-loads, human reaction times, etc. In most situations, ejection at higher altitudes (approximately 10,000 feet AGL) at reduced airspeed compensates for these variables and allows more time to overcome any ejection difficulties. See figures 3-5 thru 3-9 for post-ejection sequence and ejection altitude versus sink rate, bank angle, and dive angle for both type ejection seats.

EJECTION (GENERAL) (Continued)

SEAT/PARACHUTE CAPABILITY

The emergency MINIMUM ejection conditions, based on a level attitude with zero sink rate are:

Standard Seat

BA-22 and BA-25 parachutes with 0.25-second delay opening or BA-22 parachute with zero-delay lanyard attached.	Ground Level at 120 KIAS
BA-22 parachute zero-delay lanyard NOT attached (1-second delay opening).	100 Feet AGL

Improved Seat

BA-22 and BA-25 parachutes with 0.25-second delay opening or BA-22 parachute zero-delay lanyard attached.	Ground Level at 50 KIAS

The emergency MAXIMUM ejection airspeeds from sea level thru 14,000 feet for either type seat/parachute are:

BA-22 and BA-25 parachutes with 0.25-second delay opening.	500 KIAS
BA-22 parachute with zero-delay lanyard attached.	400 KIAS
BA-22 parachute equipped with zero-delay lanyard but NOT attached (1-second delay opening).	550 KIAS

WARNING

- Ejection above 400 KIAS with the zero-delay lanyard attached can cause parachute canopy failure and/or personnel injury.
- Ejection above maximum airspeeds listed for each parachute configuration can cause failure of the parachute canopy and/or personnel injury.

NOTE

When using a BA-22 parachute which has not been modified with a survival kit auto-release cable, the survival kit must be deployed manually.

EJECTION ALTITUDE

Chances for survival are better if ejection occurs above 2000 feet AGL flying straight and level at a low airspeed. When the aircraft is controllable at higher altitudes, trade excess airspeed and excess altitude for time to accomplish before ejection procedures. When below 2000 feet AGL, trade airspeed for altitude in a zoom maneuver and eject before climb rate reaches zero. Under uncontrolled conditions (spins, dives, etc,) eject at least 10,000 feet AGL (Ⓕ 10,000 feet AGL solo; 15,000 feet AGL dual) whenever possible.

WARNING

- If the aircraft becomes uncontrollable below 10,000 feet AGL (Ⓕ 10,000 feet AGL solo; 15,000 feet AGL dual) eject immediately since any delay reduces your chances for successful ejection.

EJECTION (GENERAL) (Continued)

WARNING

- Do not delay ejection below 2000 feet above the terrain for any reason that may commit you to an unsafe ejection or a dangerous flameout landing. Accident statistics show a decrease in successful ejections as altitude decreases below 2000 feet AGL.
- No safety factor is provided for equipment malfunction. Since survival from an extremely low altitude ejection depends on the aircraft sink rate, attitude, and altitude, the decision to eject under these conditions must be left to the pilot. Factors such as g-loads, high sink rate, and, while at low altitudes, aircraft attitudes other than level or slightly nose high decrease survival chances. The emergency minimum of 120 KIAS for Standard seat or 50 KIAS for Improved seat at ground level is given only to show that zero altitude ejection can be accomplished. It must not be used as a basis for delaying ejection when above 2000 feet AGL.

BEFORE EJECTION

Prior to ejection at low altitudes, attempt to level the wings and zoom the aircraft. If at high altitude, set up a speed and configuration that obtain maximum glide distance or recommended speed for engine airstart.

WARNING

- Engines require 25 seconds to develop usable thrust from minimum airstart rpm.
- Eject before the start of any sink rate. If a high sink rate occurs, eject immediately.

Under controlled conditions, attempt to slow the aircraft as much as practical prior to ejection by trading airspeed for altitude. Ejection should be accomplished while in a positive rate-of-climb with the aircraft attitude approximately 20 degrees nose up. Also, if a positive rate-of-climb cannot be achieved, level flight ejection should be accomplished immediately to avoid ejection with a sink rate.

WARNING

- If the aircraft is not controllable, ejection must be accomplished at whatever speed exists, as this offers the only opportunity of survival. At sea level, wind blast and deceleration exert medium forces on the body up to approximately 450 KIAS, severe forces causing flailing and skin injuries between 450 and 600 KIAS, and excessive forces above 600 KIAS. As altitude increases, the speed ranges of the injury-producing forces are a function of the mach number.
- For controlled ejection at 2000 or more feet above terrain, the zero-delay lanyard should be disconnected to reduce chances of seat-parachute-man involvement.
- Connection of the zero-delay lanyard should not be attempted after deciding to eject, the disadvantage of time lost in connection is greater than any advantage gained.
- Ejection above 400 KIAS with zero-delay lanyard connected can cause parachute canopy failure and/or serious injury.

EJECTION

See figure 3-4 for ejection procedures.

EJECTION

BEFORE EJECTION

IF TIME AND CONDITIONS PERMIT

(F) 1. NOTIFY OTHER CREWMEMBER OF DECISION TO EJECT.

(F) 2. VERBALLY VERIFY SETTING OF EJECTION SEQUENCE SELECTOR.

WARNING

IF SELECTOR IS AT NORMAL OR DUAL, ENSURE LEGBRACES IN BOTH COCKPITS ARE RAISED BEFORE EJECTION.

3. IFF TO EMER, UHF TO GUARD; TRANSMIT MAYDAY, GIVING POSITION AND INTENTIONS.
4. TURN AIRCRAFT TOWARD UNINHABITED AREA.
5. ATTAIN PROPER AIRSPEED, ALTITUDE AND ATTITUDE.
6. STOW LOOSE GEAR AND (F) INSTRUMENT HOOD.
7. (HIGH ALTITUDE) ACTUATE EMERGENCY OXYGEN CYLINDER.
8. LOCATOR BEACON ACTUATOR TAB – AS REQUIRED.
9. (SURVIVAL KIT) AUTO/MANUAL SELECTOR – AS REQUIRED.
10. SHOULDER HARNESS – LOCK. THIS ASSURES POSITIVE LOCKING OF HARNESS.
11. LOWER HELMET VISOR; TIGHTEN CHIN STRAP, SAFETY BELT AND SURVIVAL KIT STRAPS.
12. (UNMODIFIED BA-22) ZERO-DELAY LANYARD – CHECK.

EJECTION

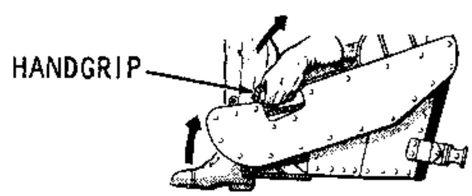
WARNING

- ASSUME PROPER POSITION: SIT ERECT, HEAD FIRMLY AGAINST HEADREST, FEET BACK AGAINST SEAT. PLACE ELBOWS CLOSE TO BODY WITHIN ELBOW GUARDS TO PROTECT ELBOWS WHEN LEGBRACES ARE RAISED AND DURING EJECTION.
- PROPER POSITION COULD BE IMPOSSIBLE TO ASSUME IF SEAT IS TOO HIGH.
- (F) TO PREVENT POSSIBLE INJURY FROM FRONT SEAT ROCKET BLAST, REAR CREWMEMBER SHOULD EJECT FIRST IF ALTITUDE PERMITS. FOR SEQUENCED EJECTION, ENSURE LEGBRACES OF EACH SEAT ARE RAISED BEFORE SQUEEZING TRIGGER.

1. HANDGRIPS — RAISE.

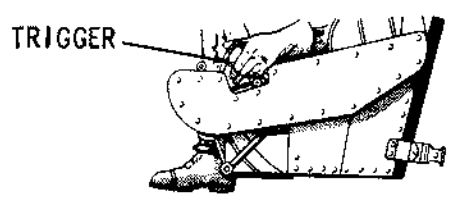
USING ONE OR BOTH GRIPS, RAISE LEGBRACES UNTIL LOCKED AND TRIGGERS ARE EXPOSED.

AFTER TCTO 1F-5E-631 OR TCTO 1F-5F-534 RAISING THE HANDGRIPS WILL RAISE THE LEGBRACES, RETRACT THE SHOULDER HARNESS, JETTISON THE CANOPY AND EJECT THE SEAT.



2. TRIGGERS — SQUEEZE.

SQUEEZING ONE OR BOTH TRIGGERS JETTISONS CANOPY AND EJECTS SEAT. SEAT EJECTS THRU CANOPY IF CANOPY FAILS TO JETTISON.



AFTER EJECTION

IMMEDIATELY AFTER EJECTION

1. SAFETY BELT – ATTEMPT TO OPEN MANUALLY.

WARNING

- IF SAFETY BELT MANUALLY OPENED, ALL FOLLOWING AUTOMATIC FEATURES ARE LOST.

AFTER SAFETY BELT IS OPENED

2. ATTEMPT TO SEPARATE FROM SEAT.
   AS SOON AS BELT OPENS, A DETERMINED EFFORT MUST BE MADE TO SEPARATE FROM SEAT TO OBTAIN FULL CHUTE DEPLOYMENT AT MAXIMUM TERRAIN CLEARANCE. THIS IS EXTREMELY IMPORTANT FOR LOW ALTITUDE EJECTIONS.
3. (ABOVE 14,000 FT) PARACHUTE ARMING LANYARD – PULL.
4. (BELOW 14,000 FT) PARACHUTE RIPCORD HANDLE – PULL.

AFTER CHUTE STABILIZES

5. SURVIVAL KIT – DEPLOY, AS REQUIRED.
6. (IF OVER WATER) LIFE VEST – INFLATE BEFORE ENTERING WATER.

AFTER CHUTE STABILIZATION AND KIT DEPLOYMENT, THE FOUR-LINE RELEASE SHOULD BE MADE IF OSCILLATIONS PERSIST. THE RESULTING INCREASE IN HORIZONTAL VELOCITY IS REDUCED BY FACING INTO THE WIND. RELEASE CANOPY AS SOON AS PRACTICAL AFTER LANDING.

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Figure 3-4.

EJECTION SEQUENCE STANDARD SEAT

Note

- TIME FROM TRIGGER SQUEEZE TO FULL PARACHUTE DEPLOYMENT FOR PARACHUTES WITH 0.25-SECOND DELAY OR ZERO DELAY (LANYARD ATTACHED) IS 3.6 - 4.8 SECONDS, OR 4.6 - 5.8 SECONDS FOR 1-SECOND DELAY (ZERO-DELAY LANYARD STOWED), AT AN EJECTION AIRSPEED OF 150 KIAS.
- VARIABLES SUCH AS LOWER AIRSPEEDS AND THE ATTITUDE OF THE CREWMEMBER AT TIME OF PACK OPENING CAN INCREASE PARACHUTE DEPLOYMENT TIME.

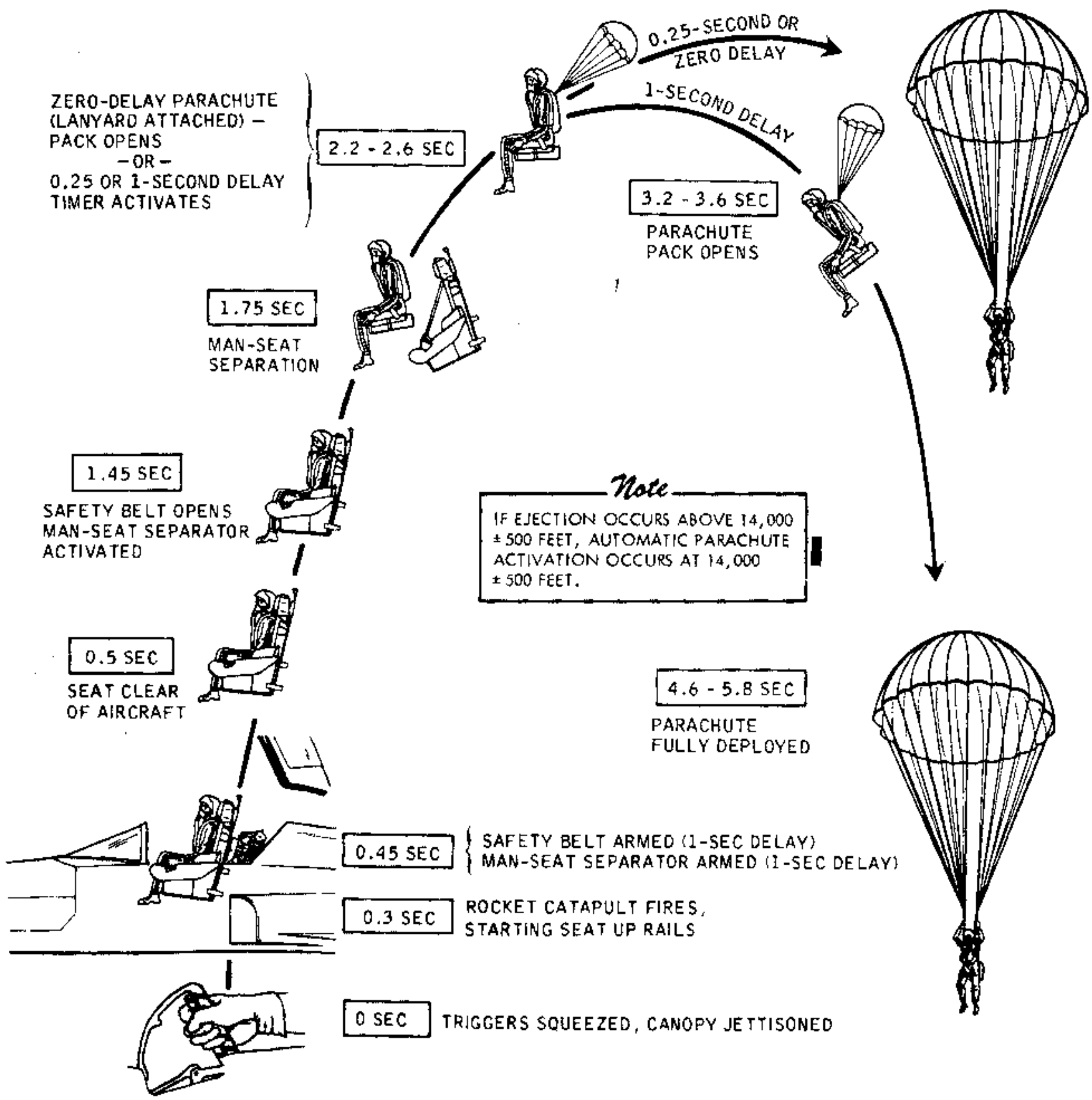


Figure 3-5.

EJECTION SEQUENCE

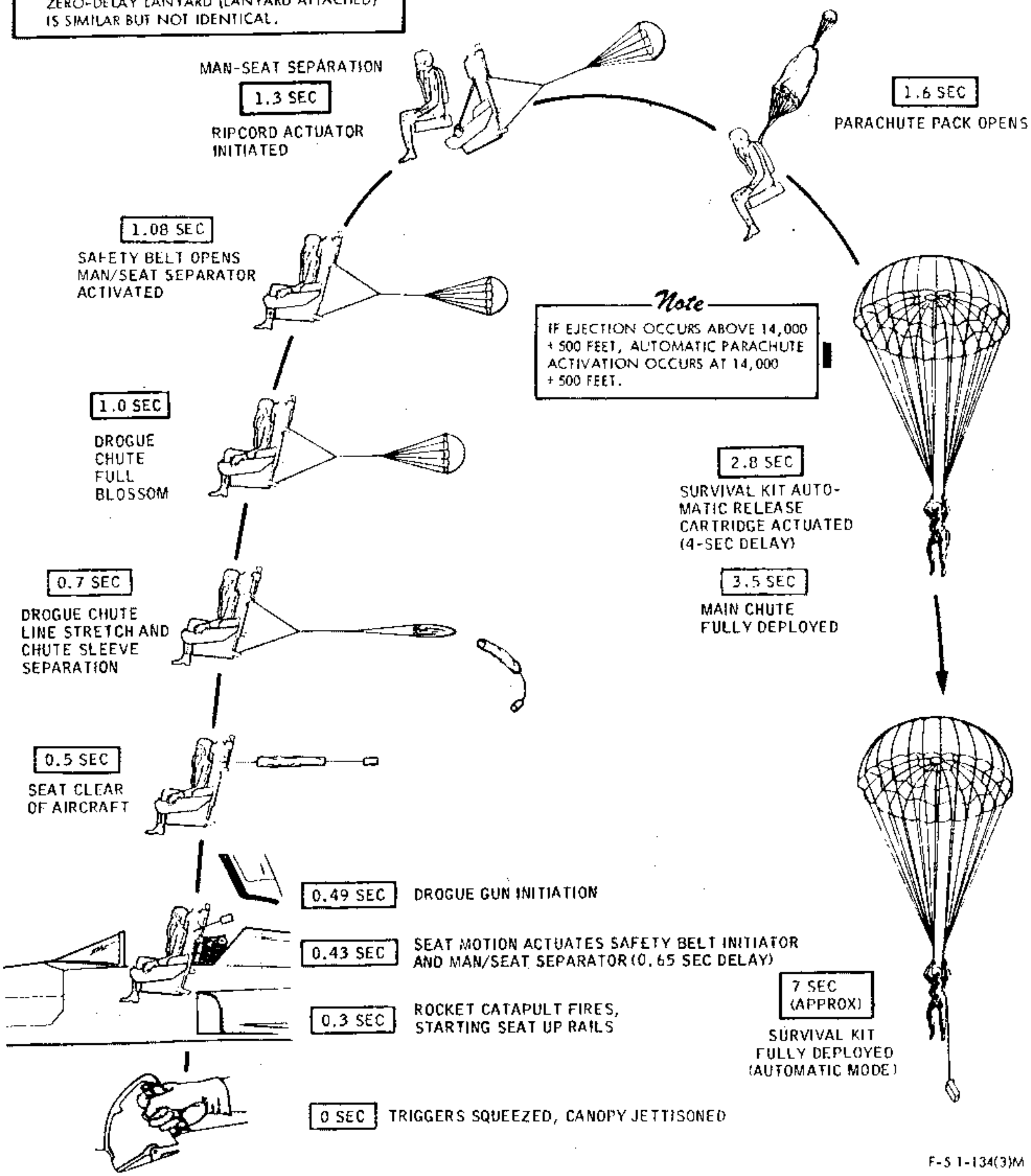
IMPROVED SEAT

Note

- PARACHUTE WITH 0.25-SECOND DELAY SHOWN.
- PERFORMANCE FOR PARACHUTE EQUIPPED WITH ZERO-DELAY LANYARD (LANYARD ATTACHED) IS SIMILAR BUT NOT IDENTICAL.

Note

- TIME FROM TRIGGER SQUEEZE TO FULL PARACHUTE DEPLOYMENT IS 3.5 SECONDS (APPROX) AT AN EJECTION AIRSPEED OF 150 KNOTS. VARIABLES SUCH AS LOWER AIRSPEEDS AND THE ATTITUDE OF THE PILOT AT TIME OF PACK OPENING CAN INCREASE PARACHUTE DEPLOYMENT TIME.
- TIME TO FULL PARACHUTE DEPLOYMENT IS SAME FOR BOTH SEATS.



Note

IF EJECTION OCCURS ABOVE 14,000 + 500 FEET, AUTOMATIC PARACHUTE ACTIVATION OCCURS AT 14,000 + 500 FEET.

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Figure 3-6.

EJECTION ALTITUDE VS SINK RATE & DIVE/BANK ANGLE

STANDARD SEAT

Note

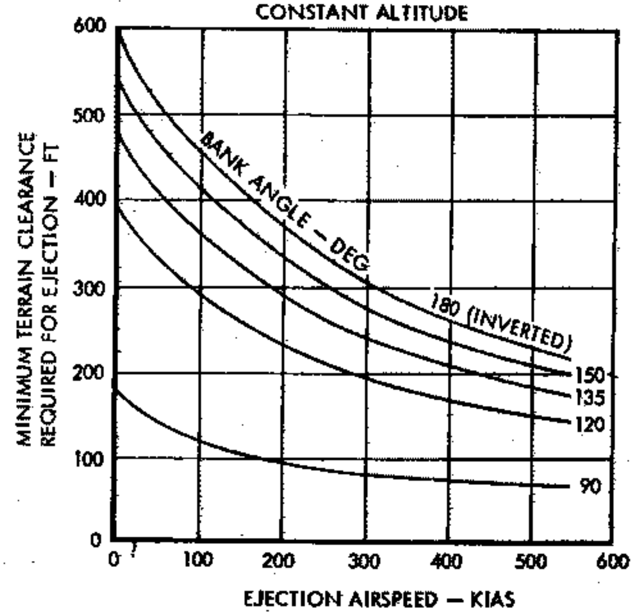
- SEAT EQUIPPED WITH BA-22 PARACHUTE WITH ZERO-DELAY LANYARD, M-38 ROCKET CATAPULT, AND 3.6 TO 4.8-SECOND SYSTEM (TRIGGER SQUEEZE TO FULL PARACHUTE DEPLOYMENT).
- PERFORMANCE FOR BA-22 AND BA-25 PARACHUTES WITH 0.25-SECOND DELAY IS SIMILAR BUT NOT IDENTICAL.

WARNING

- THE MINIMUM EJECTION ALTITUDES SHOW SEAT CAPABILITY BUT PROVIDE NO SAFETY FACTOR FOR EQUIPMENT MALFUNCTION OR DELAY IN SEPARATING FROM THE SEAT.
- EJECTIONS BELOW BANK ANGLE OR DIVE ANGLE LINES ARE UNSAFE FOR GIVEN CONDITIONS.
- THE MINIMUM EJECTION ALTITUDES SHALL NOT BE USED AS THE BASIS FOR DELAYING EJECTION WHEN ABOVE 2000 FEET TERRAIN CLEARANCE.
- EJECTION AT AIRSPEEDS ABOVE 400 KIAS WITH ZERO-DELAY LANYARD ATTACHED CAN CAUSE PARACHUTE CANOPY FAILURE AND/OR PERSONNEL INJURY.

CONDITIONS

CONSTANT ALTITUDE



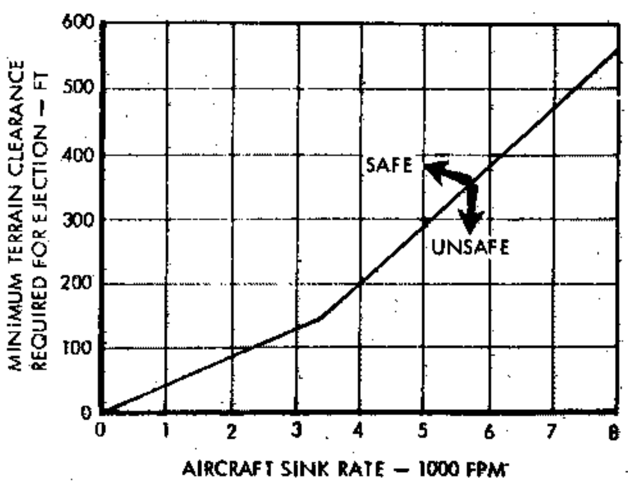
Note

BANK ANGLES UP TO 60° ARE SAFE FOR EJECTION AT ALL AIRSPEEDS WITHIN THE EJECTION ENVELOPE.

BANK ANGLE

CONDITIONS

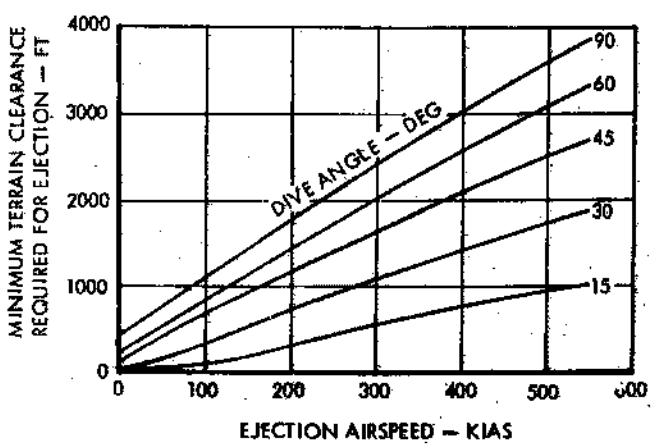
ZERO-DELAY LANYARD ATTACHED
AIRSPEED AT EJECTION — 150 KNOTS
WINGS LEVEL — SLIGHT NOSE UP ATTITUDE
2-SECOND REACTION TIME



SINK RATE

CONDITIONS

WINGS LEVEL
2-SECOND REACTION TIME



DIVE ANGLE

F-5 1-139(1)G

Figure 3-7.

EJECTION ALTITUDE VS BANK/DIVE ANGLE

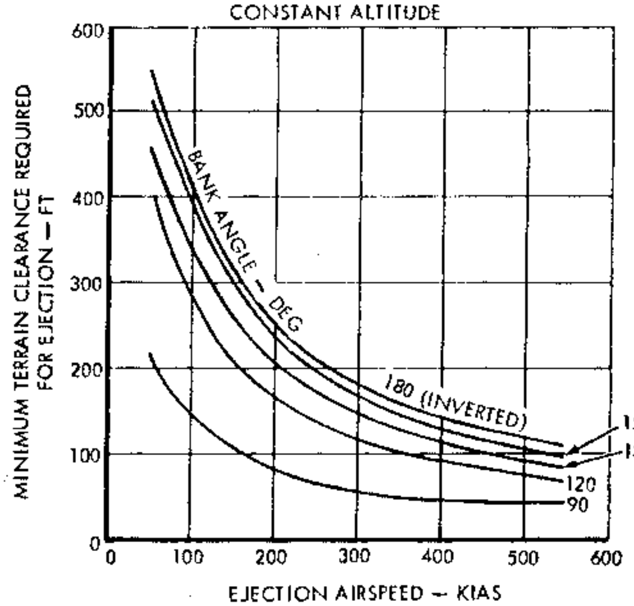
IMPROVED SEAT

WARNING

- THE MINIMUM EJECTION ALTITUDES SHOW SEAT CAPABILITY BUT PROVIDE NO SAFETY FACTOR FOR EQUIPMENT MALFUNCTION OR DELAY IN SEPARATING FROM THE SEAT.
- EJECTIONS BELOW BANK ANGLE OR DIVE ANGLE LINES ARE UNSAFE FOR GIVEN CONDITIONS.
- THE MINIMUM EJECTION ALTITUDES SHALL NOT BE USED AS THE BASIS FOR DELAYING EJECTION WHEN ABOVE 2000 FEET TERRAIN CLEARANCE.
- (BA-22 PARACHUTE) EJECTION AT AIRSPEEDS ABOVE 400 KIAS WITH ZERO-DELAY LANYARD ATTACHED CAN CAUSE PARACHUTE CANOPY FAILURE AND/OR PERSONNEL INJURY.

CONDITIONS

CONSTANT ALTITUDE



BANK ANGLE

Note

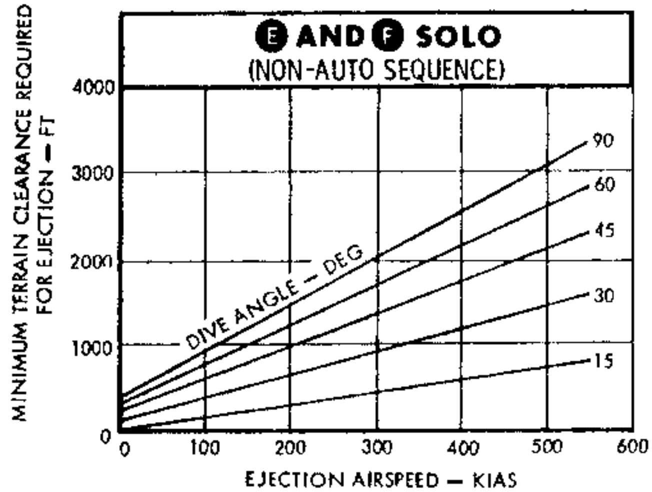
BANK ANGLES UP TO 60° ARE SAFE FOR EJECTION AT ALL AIRSPEEDS WITHIN THE EJECTION ENVELOPE.

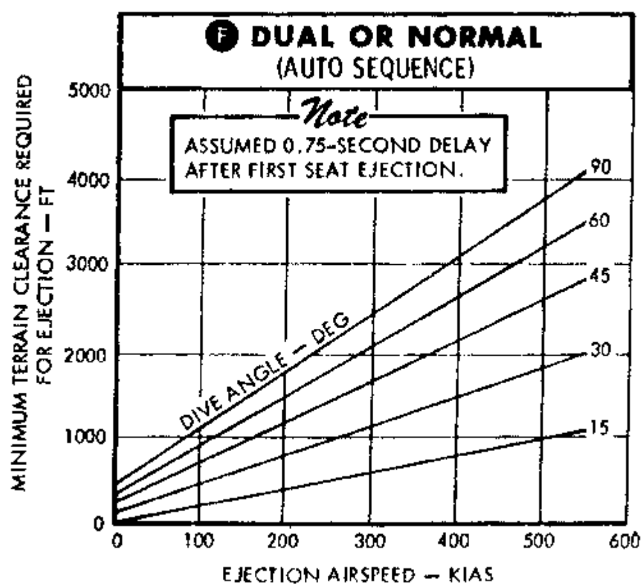
Note

- SEAT EQUIPPED WITH BA-22 OR BA-25 PARACHUTE WITH 0.25-SECOND DELAY, M-38 OR CKU-7A ROCKET CATAPULT, AND 3.5-SECOND SYSTEM (TRIGGER SQUEEZE TO FULL PARACHUTE DEPLOYMENT).
- PERFORMANCE FOR BA-22 PARACHUTE WITH ZERO-DELAY LANYARD (LANYARD ATTACHED) IS SIMILAR BUT NOT IDENTICAL.

CONDITIONS

WINGS LEVEL
2-SECOND REACTION TIME





DIVE ANGLE

F-5 1-139(2)K

Figure 3-8.

EJECTION ALTITUDE VS SINK RATE

IMPROVED SEAT

Note

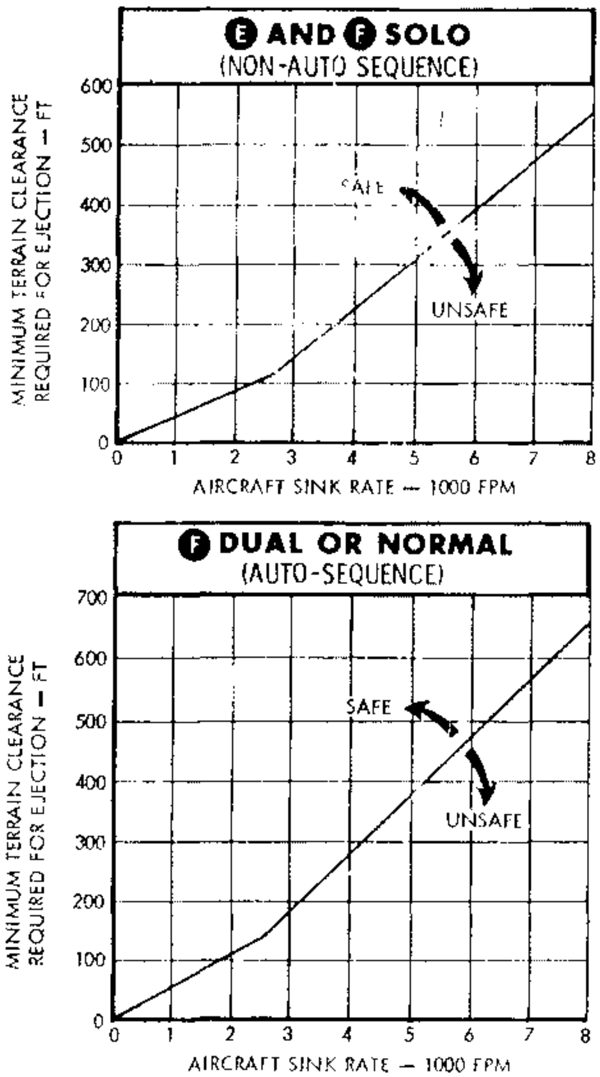
- SEAT EQUIPPED WITH BA-22 OR BA-25 PARACHUTE WITH 0.25-SECOND DELAY, M-38 OR CKU-7A ROCKET CATAPULT, AND 3.5-SECOND SYSTEM (TRIGGER SQUEEZE TO FULL PARACHUTE DEPLOYMENT).
- PERFORMANCE FOR BA-22 PARACHUTE WITH ZERO-DELAY LANYARD (LANYARD ATTACHED) IS SIMILAR BUT NOT IDENTICAL.
- (F) REAR SEAT EJECTS FIRST, FOLLOWED IN 0.75 SECOND BY FRONT SEAT (AUTO-SEQUENCE EJECTION).

WARNING

- THE MINIMUM EJECTION ALTITUDES SHOW SEAT CAPABILITY BUT PROVIDE NO SAFETY FACTOR FOR EQUIPMENT MALFUNCTION OR DELAY IN SEPARATING FROM THE SEAT.
- THE MINIMUM EJECTION ALTITUDES SHALL NOT BE USED AS THE BASIS FOR DELAYING EJECTION WHEN ABOVE 2000 FEET TERRAIN CLEARANCE.

CONDITIONS

AIRSPEED AT EJECTION — 150 KIAS
WINGS LEVEL — SLIGHT NOSE-UP ATTITUDE
2-SECOND REACTION TIME

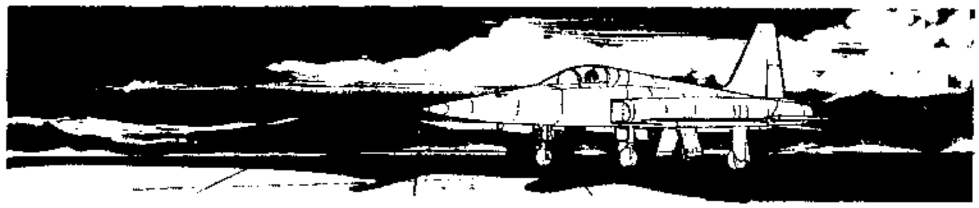


SINK RATE

F-5 1-140(1)K

Figure 3-9.

THIS PHASE OF OPERATION IS FROM THE INITIATION OF THE LANDING PROCEDURE THRU THE LANDING ROLL.



DRAG CHUTE FAILURE

If the drag chute fails to deploy on landing, and the decision is made to go around, use the following procedure:

1. Drag Chute — Jettison.
2. Go Around.
   See Go-around procedures in section II.

SINGLE-ENGINE APPROACH

Delay lowering landing gear until just before glide path. MAX thrust should be used on single-engine approaches if necessary.

WARNING

Expend or jettison stores before entering the landing pattern, if necessary.

SINGLE-ENGINE LANDING

1. Flap Thumb Switch — M/AUTO.
2. Gear — Down.

NOTE

With a failed left engine, windmilling rpm may be sufficient to allow normal extension of landing gear. However, if gear does not extend, use alternate release system to extend gear. Nosewheel steering and normal braking are not available.

3. Airspeed — Increase 10 KIAS Above Normal Until Landing Assured.
4. (E) AOA Indicator — 14.0 Units on Final Approach.
5. (F) AOA Indicator — Do Not Use.
6. Drag Chute — As Required.

SINGLE-ENGINE MISSED APPROACH

Use MAX thrust for single-engine missed approach. Landing gear should be retracted as soon as 10 knots above safe single-engine takeoff speed is attained and climb is established. Keep flaps in maneuver/auto and accelerate in MAX thrust. Climb at 260 KIAS [E-3] [F-2] 230 KIAS) with landing gear up or 210 KIAS with landing gear down. See appendix I for single-engine maximum thrust climb gradient at 50-foot obstacle clearance speed.

WING FLAP ASYMMETRY

If lateral rolling and yawing is experienced during operation of the wing flaps, suspect an asymmetrical wing flap condition. Leading edge flap asymmetry should not present a control problem as little rolling and yawing effect is induced if the aircraft is not at a high angle of attack. Proceed as follows:

1. Flap Thumb Switch/Lever — Return to Previous Setting.

If Lateral Rolling and Yawing Continues

2. Gear — Down (if required).
   To allow full aileron control.

NOTE [E-3] [F-2]

Extending landing gear with flaps in AUTO setting causes flaps to go to full. If full flaps are not desired, select a setting other than AUTO prior to extending landing gear.

WING FLAP ASYMMETRY (Continued)

3. Controllability — Check (if time permits).
   Controllability check should be made at a safe altitude to determine safe minimum airspeeds to use in landing pattern.
4. Airspeed — Increase by 20 KIAS the Final Approach and Touchdown Airspeeds.

NO-FLAP LANDING

If a landing is to be made with the wing flaps retracted, use the normal landing procedure modified as follows:

1. Pattern — Fly Wider Than Normal.
2. Airspeed — Increase by 10 KIAS the Final Turn, Final Approach, and Touchdown Airspeeds.
3. Ⓔ AOA Indicator — 16.4 Units on Final Approach.
4. Ⓕ AOA Indicator — Do Not Use.

NOTE

Landing distance increases approximately 15% due to higher touchdown speed and less effective aerodynamic braking.

LANDING GEAR ALTERNATE EXTENSION

1. Airspeed [illegible] 2 0 [illegible]IAS or Less.
2. Gear Lever — LG DOWN.
3. Gear Alternate Release Handle — Pull.
   Pull handle out (approximately 10 inches) and hold until gear unlocks; then stow.
4. Gear Indicators — Check.
   Gear extension could take up to 35 seconds.

If Nose Gear Fails to Extend

5. Gear Lever — LG UP.
6. Gear Alternate Release Handle — Pull.
   If nose gear remains up, cycle the gear lever down then up and actuate the alternate release handle again.
7. Gear Lever — LG DOWN.

NOTE

- If the main gear fails to extend fully, yawing the aircraft, rocking wings, and pulling positive g's aid the extension.
- Nosewheel steering is not available.
- Stop straight ahead on the runway and have the landing gear safety pins installed.

If Alternate Extension Fails

If alternate extension fails to extend landing gear, the landing gear door selector valve may have failed, indicated by excessive handle forces and failure of handle to fully extend. The landing gear does not extend because trapped hydraulic pressure from the utility hydraulic system holds the gear doors and uplocks in the gear up position. Dissipating the pressure allows the gear to extend. To dissipate hydraulic pressure and extend the landing gear:

1. Throttle (left engin[illegible] FF.
2. Gear Lever — Check at LG DOWN.
3. Control Stick — Rapid Lateral Stick Movements (until utility hydraulic pressure depleted).
4. Gear Alternate Release Handle — Pull.
   Pull handle out fully while pressure is depleted until gear unlocks; then stow.
5. Gear Lever — LG UP, Then LG DOWN (cycle rapidly).
6. Gear Indicators — Check.
7. Left Engine — Restart.

NOTE

If gear indicates unsafe after utility hydraulic pressure builds up, gear does not remain down because the gear selector valve has failed or the landing gear control circuit has malfunctioned.

LANDING GEAR ALTERNATE EXTENSION (Continued)

If Gear Remains Unsafe

8. Battery and Generator Switches — OFF (if required).
9. Gear Alternate Release Handle — Pull. Hold until gear unlocks, then stow.
10. Battery and Generator Switches — BATT and L GEN/R GEN.
11. Gear Indicators — Check.

LANDING GEAR EXTENSION FAILURE

Unsafe cockpit gear indications should not be the only factor in the determination of an unsafe gear condition. Gear position should be determined by chase aircraft or other visual means. Ⓕ In the absence of visual confirmation any gear that indicates down in either cockpit is down and locked based upon the independent warning systems for each cockpit indicator. If all gear are fully down (verified) but one or more are indicating unsafe, stop straight ahead on the runway and have the gear safety pins installed. If time and conditions permit, take the following actions to reduce gross weight and minimize fire hazard:

a. Expend excess fuel.
b. Jettison armament. Retain empty pylon tank(s), empty SUU-20 or MXU-648 using select jettison system.

A landing with gear up or unsafe requires careful consideration before deciding whether to attempt a landing or eject. The following table indicates that for a particular gear condition, a landing is considered feasible, or ejection is the best course of action. Disregard gear door position.

GEAR CONDITION*		RECOMMENDED ACTION
NOSE	MAIN	
UP	BOTH DOWN	LAND
UP	BOTH UP	EJECT (unless carrying empty CL tank, empty SUU-20, MXU-648; empty or loaded with soft non-flammable material, empty symmetrical wing tanks, or with clean no pylon configuration.)
UP	ONE DOWN	EJECT
DOWN	BOTH UP	EJECT
DOWN	ONE DOWN	EJECT

*Actual Landing Gear Position (not indication)

Use normal approach speeds for all configurations. Use normal touchdown speeds for all configurations except when landing with all gear up. Minimize sink rate at touchdown but maintain a normal landing attitude to avoid excessive slam-down.

WARNING

- Landing in lieu of ejection for gear conditions recommending ejection is considered more hazardous.
- Pilot injury may result if belly landing is attempted without empty tank(s), empty SUU-20 or MXU-648 to cushion shock of nose slam-down.
- Recommendation to land pre-supposses that a favorable runway environment exists.

LANDING WITH NOSE GEAR UP OR UNSAFE

With both main gear extended and nose gear up or unsafe:

1. Shoulder Harness — LOCK.
2. Survival Kit — Disconnect. Pull kit emergency release handle.
3. Landing Pattern — Normal.
4. Throttles — IDLE at Touchdown.
5. Nose — Gently Lower to Runway.

LANDING GEAR EXTENSION FAILURE (Continued)

NOTE

If nose gear is up, position throttles OFF when nose contacts runway.

6. Drag Chute — Deploy.
7. Wheel Brakes — As Required.

NOTE

Do not use brakes if a safe stop can be made without them when the nose gear is down but indicating unsafe.

8. Battery Switch — OFF.

BELLY LANDING

Without Empty Pylon Tank(s) and/or Empty SUU-20, or MXU-648

1. Eject.

With Empty Pylon Tank(s) and/or Empty SUU-20, or MXU-648

1. Gear — Up.
2. Shoulder Harness — LOCK.
3. Survival Kit — Disconnect.
   Pull kit emergency release handle.
4. Landing Pattern — Normal.
5. Throttles — OFF at Touchdown.
6. Drag Chute — Deploy When Aircraft is on Runway.
7. Battery Switch — OFF.

With No Pylons Installed

This procedure should be used only under favorable conditions of the runway environment.

1. Gear — UP.
2. Shoulder Harness — LOCK.
3. Survival Kit — Disconnect.
   Pull kit emergency release handle.
4. Speed Brake — Open.

NOTE

After landing, the speed brake may grind down beyond the actuator attach point. When this occurs, expect the nose to drop suddenly accompanied by increased noise, vibration, and deceleration.

5. Flap Thumb Switch — M/AUTO.
   Fly a power on approach requiring minimum flare.
6. Landing Pattern — Normal.
7. Airspeed — Increase Touchdown Speed 10 KIAS.
8. Throttles — OFF at touchdown.
9. Drag Chute — Deploy When Aircraft is on Runway.
10. Battery Switch — OFF.

LANDING WITH ONE OR BOTH MAIN GEAR NOT EXTENDED

If all attempts to have both main gear extended are unsuccessful with nose gear up or down and all gear cannot be retracted:

1. Eject.

If Landing Must be Attempted

1. Shoulder Harness — LOCK.
2. Survival Kit — Disconnect.
   Pull kit emergency release handle.
3. Landing Pattern — Normal.
4. Throttles — IDLE at Touchdown.

NOTE

With one main gear extended, touch down in center of runway; use aileron to hold wings level, nosewheel steering (if nose gear down), and brake on extended gear to maintain directional control.

5. Drag Chute — Deploy.
6. Throttles — OFF.
7. Battery Switch — OFF.

LANDING WITH TIRE FAILURE

NOSE GEAR

When landing is to be made with the nose gea tire flat, expend excess fuel, fire out ammunition, jettison CL store, if practicable to obtain a more favorable aft CG position before landing. Fly a normal traffic pattern. After touchdown, hold nosewheel off runway as long as

LANDING WITH TIRE FAILURE (Continued)

possible. When nosewheel touches down, engage nosewheel steering and deploy drag chute. Make maximum use of rudder, nosewheel steering, and wheel braking to maintain directional control.

MAIN GEAR

When landing with a flat main gear tire is anticipated, expend excess fuel before landing. External stores should be jettisoned but empty pylon fuel tank(s) retained. Fly a normal traffic pattern and land on the side of the runway away from the failed tire. When it is unknown which tire is failed, touch down in the center of the runway. After touchdown, lower nosewheel to runway, engage nosewheel steering, deploy drag chute, and use a combination of rudder, nosewheel steering, and braking to maintain directional control.

NOTE

When landing with a failed tire, have the arresting cable(s) removed or land beyond approach-end cable(s).

DITCHING

Ditch only as a last resort. If unable to eject:

1. Distress Procedure — Radio, IFF/SIF.
2. Oxygen — 100%.
3. Stores — Jettison.
4. Personal Equipment Leads — Disconnect (all except oxygen hose).
5. Shoulder Harness — LOCK.
6. Gear — Up.
7. Speed Brake — Out.
8. Flap Lever — FULL.
9. Canopy(ies) — Jettison.
10. Normal Approach.
11. Throttles — OFF at Touchdown.
12. When Forward Motion Stops — Open Safety Belt and Disconnect Oxygen Hose.

ARRESTMENT

See Abort/Arrestment, this section, for midfield and departure-end engagements.

APPROACH-END ENGAGEMENT

1. Landing Configuration — Establish.
2. Hook — Down.
3. Ⓔ AOA — On Speed.
4. Touchdown — 500 Feet (minimum) Before Cable in Center of Runway.
5. Nose — Lower to Runway.
6. Chute — Deploy.
7. Braking — Discontinue (before nosewheel crosses cable).

After Engagement

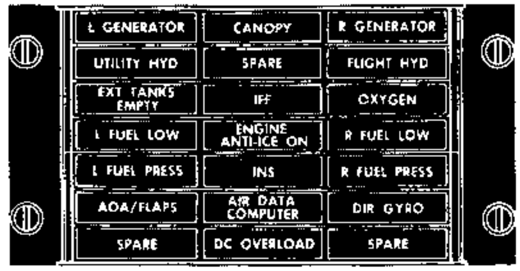
8. Throttles — As Required (to control rollback).

CAUTION

Approach end engagements result in aircraft damage to fuselage skin and horizontal tail.

WARNING & CAUTION LIGHT ANALYSIS (TYPICAL)

LIGHT	CONDITION	CORRECTIVE ACTION
 FIRE REAR F	ENGINE COMPARTMENT FIRE OR OVERHEAT CONDITION.	SEE FIRE WARNING PROCEDURES, THIS SECTION.
 MASTER CAUTION REAR F	ONE OR MORE LIGHTS ON CAUTION LIGHT PANEL ON.	CHECK CAUTION LIGHTS ON PANEL AND RESET MASTER CAUTION LIGHT.
	ARRESTING HOOK DOWN.	LAND PAST APPROACH-END BARRIER UNLESS APPROACH-END ENGAGEMENT IS INTENTIONAL.



CAUTION LIGHT	CONDITION	CORRECTIVE ACTION
AIR DATA COMPUTER	CADC OUTPUTS UNRELIABLE.	SEE CADC/PITOT-STATIC MALFUNCTION.
AOA/FLAPS E-3 F-2	AOA SWITCHING UNIT FAILURE.	SEE AOA FLAP FAILURE.
CANOPY	CANOPY UNLOCKED (F ONE OR BOTH).	LOCK CANOPY.
DC OVERLOAD	DC SYSTEM OVERLOADED.	SEE ELECTRICAL SYSTEM FAILURE DC OVERLOAD.
DIR GYRO	SYSTEM NOT INSTALLED.	————
ENGINE ANTI-ICE ON	ANTI-ICE SYSTEM OPERATING.	ADVISORY.
EXT TANKS EMPTY	EXTERNAL TANKS EMPTY.	ADVISORY.
FLIGHT HYD	FLIGHT HYD PRESS 1500 PSI OR LESS, OR HYD FLUID OVERTEMP	SEE HYDRAULIC SYSTEM FAILURE.
IFF	MODE IV INCORRECTLY COMPARING CODED INTERROGATIONS.	SELECT ANOTHER MODE TO OBTAIN IFF IDENTIFICATION.
INS	SYSTEM NOT INSTALLED.	————
L FUEL LOW	USABLE FUEL REMAINING IN LEFT SYSTEM 400 LB OR LESS.	CHECK FUEL BALANCE
L FUEL PRESS	LEFT SYSTEM FUEL PRESSURE 6.5 PSI OR LESS.	CHECK BOOST PUMPS ON, REDUCE RPM, DESCEND TO 25,000 FEET OR BELOW, AND MONITOR FUEL FLOW.
L GENERATOR	LEFT GENERATOR NOT OPERATING.	TURN ON OR RESET LEFT GENERATOR.
OXYGEN	OXYGEN REMAINING 0.5 LITER OR LESS, OR PRESSURE 40 PSI OR LESS	DESCEND TO A SAFE ALTITUDE AND MONITOR SUPPLY PRESSURE.
R FUEL LOW	USABLE FUEL REMAINING IN RIGHT SYSTEM 400 LB OR LESS.	CHECK FUEL BALANCE
R FUEL PRESS	RIGHT SYSTEM FUEL PRESSURE 6.5 PSI OR LESS.	CHECK BOOST PUMPS ON, REDUCE RPM, DESCEND TO 25,000 FEET OR BELOW, AND MONITOR FUEL FLOW.
R GENERATOR	RIGHT GENERATOR NOT OPERATING.	TURN ON OR RESET RIGHT GENERATOR.
UTILITY HYD	FLIGHT HYD PRESS 1500 PSI OR LESS, OR HYD FLUID OVERTEMP	SEE HYDRAULIC SYSTEMS FAILURE.

REAR F

FUEL SYSTEM INDICATOR LIGHTS

INDICATOR LIGHT	CONDITION
CENTERLINE ON	EXT FUEL CL TRANSFER SWITCH ON.
CROSSFEED ON	CROSSFEED SWITCH ON OR AUTOBALANCE SWITCH AT LEFT OR RIGHT LOW.
LEFT BOOST OFF	LEFT BOOST PUMP SWITCH OFF OR AUTOBALANCE SWITCH AT LEFT LOW.
PYLONS ON	EXT FUEL PYLONS TRANSFER SWITCH ON.
RIGHT BOOST OFF	RIGHT BOOST PUMP SWITCH OFF OR AUTOBALANCE SWITCH AT RIGHT LOW.
TIPS ON	INOPERATIVE

F-5 1-106(1)H

Figure 3-10.

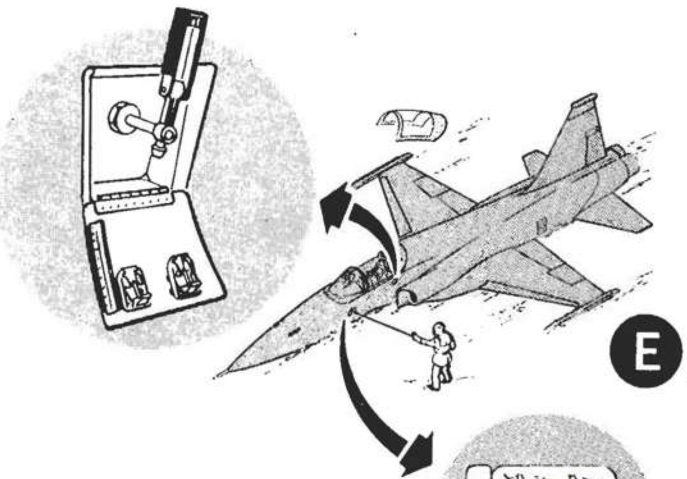
EMERGENCY ENTRANCE

NORMAL ENTRANCE (LEFT SIDE OF FUSELAGE)

1. PUSH TWO LATCHES TO OPEN DOOR.
2. PULL HANDLES OUT UNTIL ENGAGED.

> *Note*
> A MODERATE FORCE IS REQUIRED TO ROTATE HANDLES.

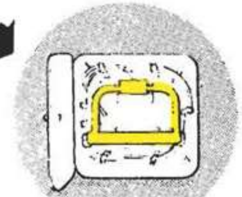
3. ROTATE HANDLES FULLY CLOCKWISE TO UNLOCK AND RAISE CANOPIES TO FULL OPEN.

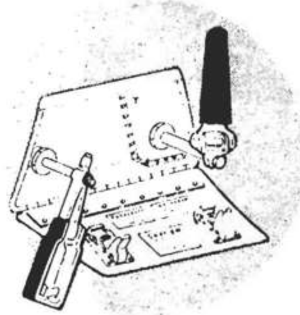


CANOPY JETTISON ENTRANCE
(EITHER SIDE OF FUSELAGE)

WARNING Do not use this method when residual fuel is around cockpit area.

1. PUSH LATCH TO OPEN DOOR.
2. PULL D-HANDLE OUT TO FULL LENGTH (APPROXIMATELY 6 FEET).



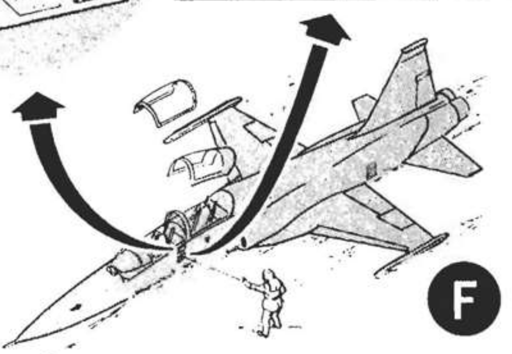


> *Note* (F)
> BOTH CANOPIES ARE JETTISONED WHEN EMERGENCY D-HANDLE IS PULLED.

IF UNABLE TO OPEN CANOPY

1. BREAK CANOPY BEHIND CREWMEMBER WITH AX OR SIMILAR IMPLEMENT.

> *Note*
> SPRAYING CANOPY WITH CO_2 CAUSES GLASS TO BECOME BRITTLE AND EASY TO BREAK.

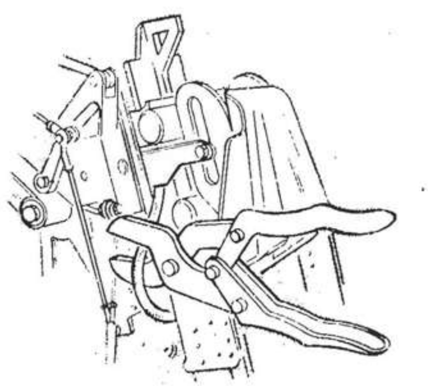


AFTER ACCESS TO COCKPIT IS GAINED

WARNING
- Inadvertent seat jettison is possible if handgrips are raised.
- To avoid initiation of ejection system, cut catapult and drogue gun initiator hose on seat ((F) both seats) before attempting to rescue crewmember(s).

STANDARD SEAT

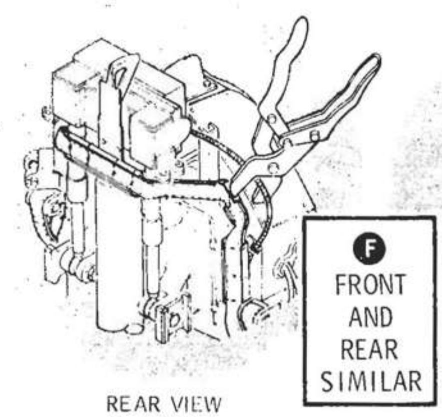
1. CUT CATAPULT HOSE, USING WISS BULLDOG SHEARS NO. 5 OR BOLT CUTTER.



F-5 1-82(1)F CATAPULT HOSE

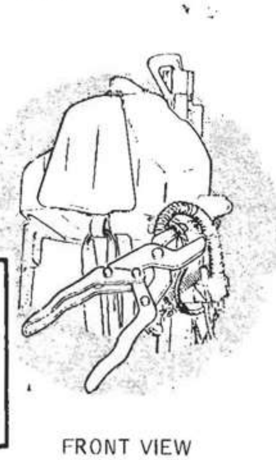
IMPROVED SEAT

1. CUT CATAPULT HOSE AT "CUT HERE" PLACARD, USING WISS BULLDOG SHEARS NO. 5 OR SHEAR-TYPE BOLT CUTTER.
2. CUT DROGUE GUN INITIATOR HOSE ON PILOT'S LEFT SIDE OF SEAT.



REAR VIEW

(F) FRONT AND REAR SIMILAR



FRONT VIEW

Figure 3-11.

SECTION IV

CREW DUTIES

F-5E 1-64

(This section does not apply.)

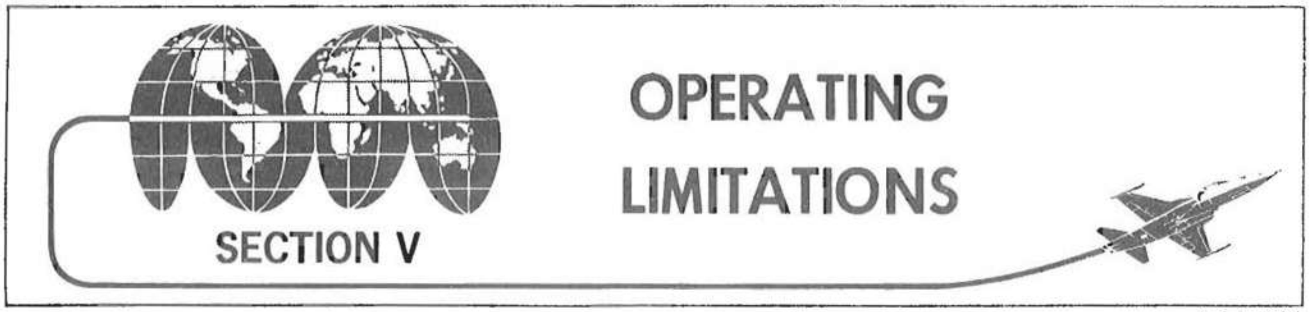


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TABLE OF CONTENTS

INSTRUMENT MARKINGS

Instrument markings are shown in figure 5-1. These markings are not necessarily repeated elsewhere in the text.

ENGINE LIMITATIONS

The engine transient and steady state operating envelope lies outside the aircraft 1.0 g flight envelope shown in Flight Envelope MAX Thrust chart in Section VI except in the low-speed, high-altitude portion of the flight envelope. At speeds from approximately 0.4 to 0.85 IMN and between 30,000 feet altitude and the maximum altitude, the engine transient and the aircraft 1.0 g flight envelope coincide. The engines are capable of steady-state operation with any aircraft maneuvers within the aircraft envelope for any atmosphere. The engines are also capable of any engine transient within the envelope with the aircraft in 1.0 g flight. However, combinations of severe aircraft maneuvers and engine nonafterburning to afterburning transients can cause an engine to stall or flame out. Other engine operating limitations are shown in figure 5-2.

NOTE

During maneuvering flight at high altitude and high angles of attack in heavy buffet, throttle movement from below MIL to MAX may result in engine compressor stall and/or flameout.

AUX INTAKE DOOR FAILURE DURING GROUND OPERATION

With the aux intake doors indicator showing barber pole or CLOSE during ground operations, engine operation is restricted to IDLE or MAX, to prevent overheating. Occasional transients are permissible for taxiing.

AIRCRAFT SYSTEMS AIRSPEED LIMITATIONS

Limiting airspeeds for operation of aircraft systems are shown in figure 5-3.

INSTRUMENT MARKINGS (TYPICAL)

EHU-31/A EHU-31A/A

EXHAUST GAS TEMPERATURE

- 140°C MINIMUM
- 325°C TO 650°C CONTINUOUS OPERATION
- 685°C MAXIMUM
- 925°C MAXIMUM DURING START AND ACCELERATION
- 675°C TO 685°C ALLOWABLE UNDER LIMITED CONDITIONS

Note

EGT MARKINGS BASED ON ANY AUTHORIZED FUEL (SEE SERVICING DIAGRAM).

HYDRAULIC PRESSURE

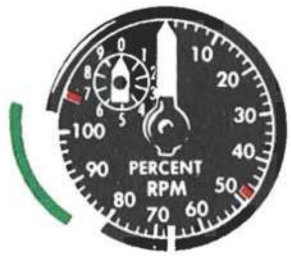
- 1500 PSI MINIMUM
- 2800 TO 3200 PSI NORMAL RANGE
- 3200 PSI MAXIMUM

ACCELEROMETER

- -3.0 G'S MINIMUM
- +7.33 G'S MAXIMUM

OIL PRESSURE

- 5 PSI MINIMUM
- 20 TO 55 PSI NORMAL OPERATING RANGE
- 55 TO 100 PSI



ENGINE TACHOMETER

- 49% RPM IDLE MINIMUM
- 80% TO 103% RPM CONTINUOUS
- 107% RPM MAXIMUM DURING ENGINE TRANSIENT (SEE RPM NOTE 3 ON FIGURE 5-2.)

AIRSPEED-MACH INDICATOR

- MAXIMUM ALLOWABLE LANDING GEAR EXTENSION AIRSPEED 260 KIAS
- ▲ MAXIMUM ALLOWABLE INDICATED AIRSPEED WHICH IS EQUIVALENT TO 710 KEAS

F-5 1-48(1)B

SOLID BLACK PLATE (+3 COLORS)

Figure 5-1.

ENGINE OPERATING LIMITATIONS

CONDITION (STEADY-STATE)	❸ RPM %	EGT – °C	NOZZLE POSITION %	OIL PRESS PSI	DURATION MINUTES
GROUND START	10 (MIN)	❶	———	INDICATION	———
IDLE	49-52	———	70-80	5-20	———
MAX CONTINUOUS *	90-103	650	———	20-55	NO LIMIT
MIL	❹ 90-103	❷ 665-675	0-16	20-55	30
MAX	❹ 90-103	❷ 665-675	50-80	20-55	15
FLUCTUATION LIMITS (ALL POWER SETTINGS)	±1	±7.5	±3	±2	———

* MAX CONTINUOUS IS THE POWER SETTING RPM AND EGT AT WHICH THE ENGINE CAN RUN CONTINUOUSLY.

Note

TAKEOFF SHOULD NOT BE ATTEMPTED UNLESS ENGINE RPM AT MIL OR MAX FALLS WITHIN THE FOLLOWING LIMITS:

OAT °C	% RPM
0 AND HIGHER	101 ± 2
-26 TO 0	98 ± 3
-42 TO -26	95 ± 3
-43 AND BELOW	92 + 3/-2

OTHER LIMITATIONS

EGT:

❶ 845°C – ABORT START. IF 925°C IS EXCEEDED, DO NOT RESTART UNTIL ENGINE HOT SECTION HAS BEEN INSPECTED FOR DAMAGE.

❷ DURING AIRCRAFT MANEUVERS INVOLVING RAPID RAM AIR TEMPERATURE CHANGES SUCH AS ENCOUNTERED DURING CLIMBS, DIVES, ACCELERATIONS, ETC, EGT MAY INCREASE ABOVE 675°C. THIS IS ACCEPTABLE PROVIDING EGT RETURNS WITHIN STEADY-STATE LIMITS (665°TO 675°C) ONCE STABILIZED LEVEL FLIGHT IS ESTABLISHED. HOWEVER, EGT SHOULD NOT EXCEED 685°C DURING THESE MANEUVERS. AT LOW COMPRESSOR INLET AIR TEMPERATURE (BELOW -25°C), MIL AND MAX EGT DROP BELOW 665°C.

3. AT LOW COMPRESSOR AIR INLET TEMPERATURES, MIL AND AB EGT CUT BACK BELOW OPERATING LIMITS.

RPM:

1. RPM VARIES AS A FUNCTION OF COMPRESSOR INLET TEMPERATURE.
2. FLIGHT IDLE RPM EQUAL TO OR HIGHER THAN GROUND STEADY STATE.

❸ DURING ENGINE TRANSIENTS – RPM MAY MOMENTARILY EXCEED STEADY-STATE VALUES (UP TO 107%), BUT SHALL NOT EXCEED 103% FOR MORE THAN 1 SECOND.

❹ RPM OF ENGINES SHALL BE WITHIN 2% OF EACH OTHER AT MIL OR AB POWER WHEN THE RPM ARE BETWEEN 99% AND 103% AND SHALL BE WITHIN 3% OF EACH OTHER WHEN THE RPM ARE LESS THAN 99% IN MIL OR AB POWER.

OIL PRESSURE:

1. DURING COLD WEATHER STARTS, PRESSURE CAN EXCEED 55 PSI. TO EXPEDITE OIL WARMUP, ENGINE MAY BE OPERATED AT MIL POWER. IF PRESSURE DOES NOT RETURN TO OPERATING LIMITS WITHIN 6 MINUTES AFTER ENGINE START, SHUT DOWN ENGINE.
2. IF A SUDDEN CHANGE OF 10 PSI OR GREATER PRESSURE INDICATION OCCURS AT ANY STABILIZED RPM, SHUT DOWN ENGINE IF SEIZURE INDICATED.

ENGINE TRANSIENTS:

1. FOLLOWING RAPID THROTTLE MOVEMENT, ENGINE INSTRUMENTS SHOULD STABILIZE WITHIN FLUCTUATION RANGE WITHIN 10 SECONDS.
2. ENGINES ON WHICH THE NOZZLE IS FULLY OPEN AT MAX POWER SHOW A FUEL FLOW CUTBACK TO KEEP EGT WITHIN LIMITS. THESE ENGINES TAKE APPROXIMATELY 5 SECONDS LONGER FOR EGT TO RETURN WITHIN LIMITS. TO PREVENT AB BLOWOUT WHILE RETARDING THROTTLE IN AFTERBURNER RANGE, MAINTAIN AN EGT OF 620°C OR HIGHER. IF EGT INDICATES BELOW 620°C, RETARD THROTTLE SLOWLY UNTIL NOZZLE MOVEMENT INDICATES A DECREASE (CLOSING), THEN RESUME THROTTLE MOVEMENT.

F-5 1-53(1)G

Figure 5-2.

AIRCRAFT SYSTEMS AIRSPEED LIMITATIONS

SYSTEM OR CONDITION	MAXIMUM SPEED	REMARKS
Canopy open, ground operation	50 KIAS	
Deploy drag chute	180 KIAS	Nosewheel must be on ground.
Flap system Cruise/Fixed Maneuver/Auto Full	(whichever is less) 550 KIAS/0.95 IMN 550 KIAS/0.95 IMN 330 KIAS/0.85 IMN	
Hook arrestment speed BAK-9 BAK-12 (conventional) BAK-12 (dual) Dual mode Single mode BAK-14 (cable raising device) 61QSII (with interconnect) MA-1A (modified) *M-21 15,000 lb (gross weight) 26,000 lb (gross weight) E-28 15,000 lb (gross weight) 26,000 lb (gross weight) E-5 (standard chain) 15,000 lb (gross weight) 26,000 lb (gross weight) E-5 (heavy chain) 15,000 lb (gross weight) 26,000 lb (gross weight) *Advise controlling agency of aircraft gross weight.	 160 knots 160 knots DO NOT ENGAGE 144 knots See remarks 160 knots 125 knots 125 knots 115 knots 135 knots 125 knots 135 knots 140 knots 130 knots 140 knots	**NOTE** • The arresting hook system is an emergency system. Limiting speeds do not mean that arrestment should be avoided at any speed when emergency arrestment is required. • The BAK-14 does not modify engagement speeds of the BAK-9, BAK-12 (conventional, and dual or single modes), or 61QSII (with equivalent interconnects) arrestment systems. If runway is equipped with a BAK-14 device, request tower raise cable for arrestment use. Raising the BAK-14 requires up to 7-1/2 seconds to be fully up and locked.
Landing gear extended or gear doors open	260 KIAS	
Landing lights failure to retract	300 KIAS	
Nosewheel steering engaged	65 KIAS	

Figure 5-3.

PROHIBITED MANEUVERS

a. Intentional spins.
b. [F] [F-1] Exceeding 29 units AOA.
c. Exceeding 20 units AOA with centerline stores installed or with asymmetric pylon stores, regardless of flap position.
d. Rudder rolls shall be limited to one full roll (360 degrees).
e. The following are structural limits and require AFTO Form 781 entry, if inadvertently exceeded.
   (1) Continuous 360-degree rolls with more than half aileron (halfway to spring stop).
   (2) Exceeding negative 2.0 g with speed brake extended.
   (3) Exceeding aileron spring stop except for spin recovery and emergencies.
   (4) Entering 360-degree full deflection (to spring stop) abrupt aileron rolls at load factors greater than 5.0 g without pylon stores or 1.0 g with pylon stores.
   (5) Abrupt full deflection rudder reversals with empty 275-gallon centerline tank.
   (6) Abrupt full deflection rudder reversals at airspeeds in excess of 400 KIAS with a 150-gallon centerline tank (empty or with any fuel).
   (7) Abrupt aileron or rudder inputs with 275-gallon fuel tanks on inboard wing stations.

OTHER OPERATING LIMITATIONS

ENGINE OIL SYSTEM LIMITATIONS

Due to engine oil supply and pressure requirements, engine operation is restricted to the following:

Zero oil pressure — 60 seconds

CAUTION

Maintain a close check of oil pressure during maneuvering flight, particularly when negative-g or rolling maneuvers are performed. During these conditions of flight, oil venting occurs. Excessive loss of oil may be indicated by oil pressure fluctuations.

FUEL SYSTEM LIMITATIONS

a. With less than 650 pounds in either system:
   (1) Dive angles in excess of normal descents with high power settings can result in flameouts.
   (2) At fuel flow rates in excess of 6000 pph per engine, crossfeeding should be discontinued.
b. Engine operation with fuel boost pumps inoperative at altitudes above 25,000 feet or fuel flow above 9800 pph can result in engine flameout.
c. Sustained 0-g flight at high engine power settings can cause engine fuel starvation.
d. Negative-g flight should be avoided with less than 650 pounds of fuel in either system; or during crossfeed; or during gravity feed fuel operation. Negative-g operating limitations are shown in figure 5-4. Operation is not recommended in the shaded area due to possible fuel starvation.

ALTERNATE FUEL LIMITATIONS

JP-4 (when JET A-1 w/FSII, JP-8, or JP-5 is primary fuel):

a. RPM may be affected but should remain within normal limits.
b. Airstart and afterburner relight envelope are degraded. Use JET A-1 w/FSII, JP-8, or JP-5 and alternate fuel airstart envelope.

LEGEND	
CBU	CBU-24, -49, -52, -58, -71 Series
GBU-10(FF)	GBU-10F/B (LGB Folding Fin)
GBU-12(FF)	GBU-12E/B (LGB Folding Fin) BDU-50 A/B
GBU-12(HS)	GBU-12/B, A/B (LGB High Speed), BDU-50 A/B
GBU-12(LS)	GBU-12A/B (LGB Low Speed), BDU-50 A/B
LAU	LAU-3, -60, -68 Series
M129	M129E2
MER	BRU-27/A
MK-82	MK-82LD, MK-82SE BDU-50/B, A/B
SUU-20	SUU-20 Series
SUU-25	SUU-25 Series

SAMPLE PROBLEM

Assume a combat mission requirement for an F-5E [T.O. 1F-5E-594] to carry 4 MK-82LD bombs on the wing pylons, a centerline pylon 275-gallon fuel tank, wingtip AIM-9J missiles, and full 20mm ammunition.

Use of Authorized Configurations for Takeoff Charts

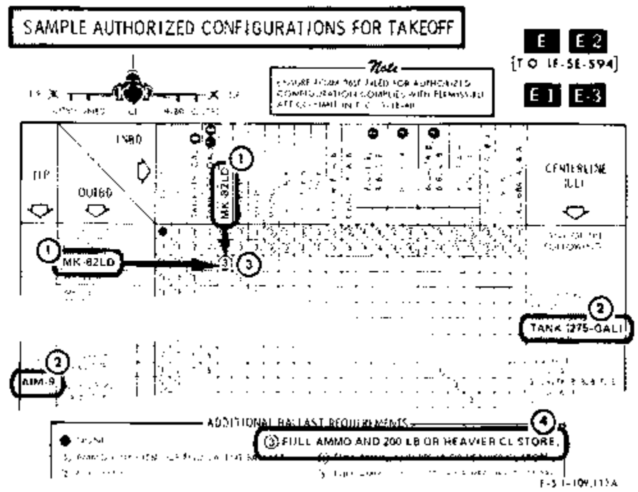
To determine if the given stores loading is authorized, use Authorized Configurations for Takeoff [E] [E-2] [T.O. 1F-5E-594] and [E-1] [E-3] chart (figure 5-5, sheets 1 and 2).

① Enter the chart with the planned load for the inboard and outboard stations.

② Check the tip and centerline columns to verify these stores are authorized in combination with the wing pylon stores.

③ Where the outboard MK-82LD line intersects the inboard MK-82LD line, note the ③ dot marker.

④ The ③ dot marker indicates additional ballast requirements of full ammo and 200 lb or heavier centerline store.



Use of In-Flight Carriage & Sequencing Limitations Charts

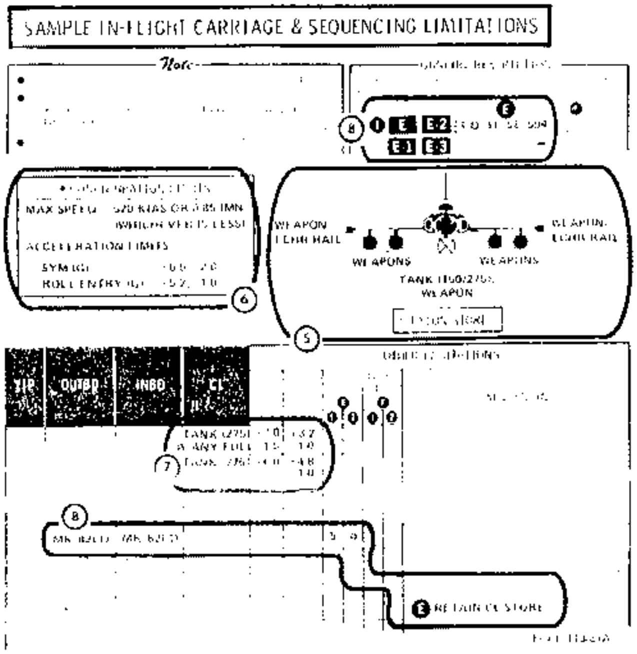
For this sample problem, assume that the inboard MK-82LD are released before the outboard MK-82LD. The centerline tank is jettisoned prior to making an air-to-air attack and the AIM-9 missiles are launched. For single station release of stores, retain all limitations of the symmetrical configuration until opposite station store is released. Enroute to the target with all stations loaded, use the first In-Flight Carriage & Sequencing Limitations chart for 5 pylon stores (figure 5-9, sheet 1).

⑤ Aircraft symbol shows weapons on inboard and outboard pylons, weapons on tips and a tank on centerline.

⑥ Note the basic configuration limits for maximum speed and acceleration.

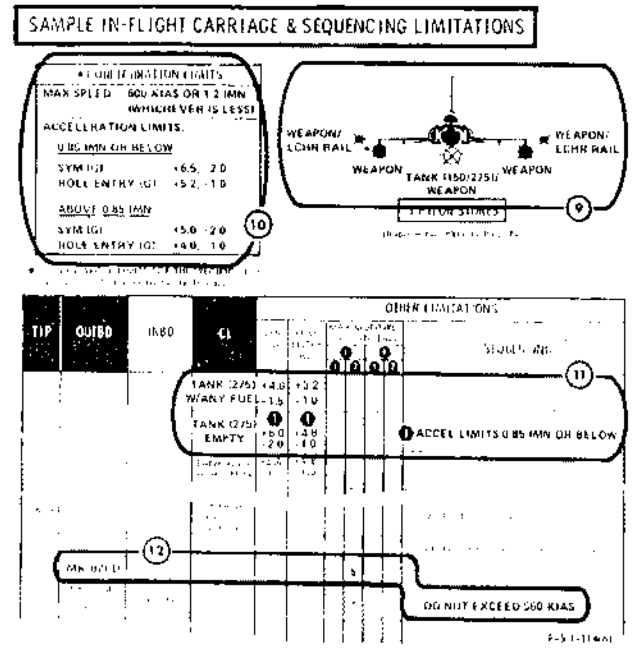
⑦ To find sequencing and other limitations peculiar to this configuration which might modify the basic configuration limits, scan down the station columns. Under the CL column, tank (275) w/any fuel and tank (275) empty are listed, note the modified acceleration limits under sym(g) and roll entry (g) subcolumns.

⑧ Under OUTBD and INBD columns listing MK-82LD, note the gunfire restriction of 5 seconds for dot ❶ marker gunfire subcolumn, and retain CL store under the sequencing subcolumn. The dot ❶ marker indicates aircraft configuration [T.O. 1F-5E-594], is used for this sample.



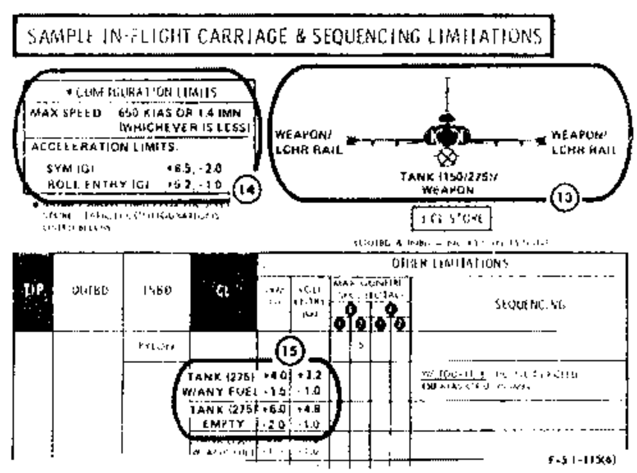
To establish limitations after the inboard MK-82LD are released, proceed to the In-Flight Carriage & Sequencing limitations for 3 pylon stores (figure 5-9, sheet 10).

- (9) Aircraft symbol shows weapons on outboard pylons, weapons on tips, and a tank on centerline.
- (10) Note the basic configuration limits for maximum speed and acceleration. Note that acceleration limits are given for speeds above 0.85 IMN and at 0.85 IMN and below.
- (11) Under the CL column, tank (275) w/any fuel and tank (275) empty are listed. Note the modified acceleration limits under sym(g) and roll entry(g) subcolumns. The black hexagon one symbols indicate the airspeed at which the empty tank sym(g) and roll entry(g) are applicable.
- (12) Under OUTBD column listing MK-82LD, note the modified maximum speed under the sequencing subcolumn. Gunfire is not limited in this configuration.



After all MK-82LD are released, proceed to the In-Flight Carriage & Sequencing Limitations for 1 centerline store (figure 5-9, sheet 19).

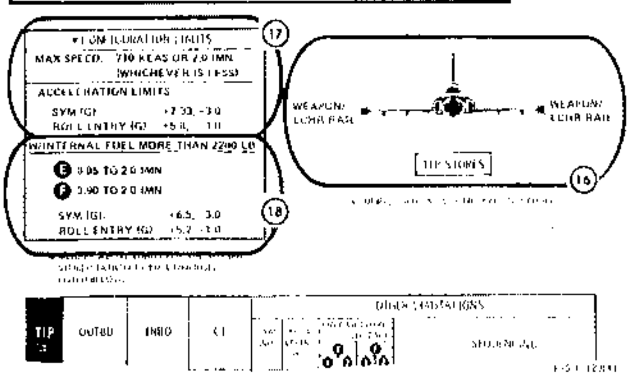
- (13) Aircraft symbol shows weapons on tips and a tank on centerline.
- (14) Note the basic configuration limits for maximum speed and acceleration.
- (15) Under CL column listing tank (275) w/any fuel and tank (275) empty, note the modified acceleration limits under sym(g) and roll entry(g) subcolumns. The W/TDU-11/B limitation under the sequencing subcolumn does not apply to this configuration.



After the centerline tank is jettisoned, proceed to the In-Flight Carriage & Sequencing Limitations for tip stores (figure 5-9, sheet 21).

(16) Aircraft symbol shows clean pylons and weapons on tips.
(17) Note the basic configuration limits for maximum speed and acceleration.
(18) Note the (E) acceleration limits at speeds above 0.95 IMN with internal fuel more than 2200 lb.

SAMPLE IN-FLIGHT CARRIAGE & SEQUENCING LIMITATIONS

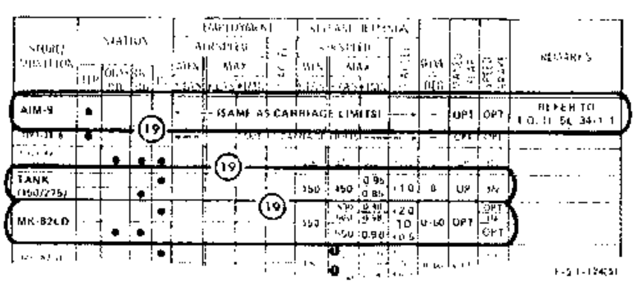


Use of Employment/Release/Jettison Limits Charts

To find employment, release or jettison limitations, use Employment/Release/Jettison Limits chart (figure 5-10, sheets 1 and 2).

(19) Enter the chart with store/munition and read across to find limitations.

SAMPLE EMPLOYMENT/RELEASE/JETTISON LIMITS



CENTER OF GRAVITY LIMITATIONS

Stores must be expended in the recommended sequence to keep the cg within limits. T.O. 1-1B-40 should be consulted before flight in order to be fully aware of cg travel vs gross weight and to determine the consequences of expending stores in other than the recommended sequence.

BALLAST REQUIREMENTS

The following criteria establish the basic ballast requirements to maintain cg within limits. In all cases, T.O. 1-1B-40 of each aircraft is used to determine the exact ballast requirements for the various loading configurations.

NOSE BALLAST [E] [E-2] [Before T.O. 1F-5E-594]

Aircraft not modified by T.O. 1F-5E-594, when configured with or without stores on pylons and with less than full load of 20mm ammunition, shall require and maintain a minimum of 100 rounds of 20mm ammunition; or a full load of 20mm links, or equivalent ballast.

NOSE BALLAST [E] [E-2] [T.O. 1F-5E-594] and [E-1] [E-3]

In addition to the fixed nose ballast, additional variable nose ballast must be installed when inboard pylon fuel tanks are carried.

TAIL BALLAST (F)

The external tail ballast is variable in that it consists of four removable pieces ([F-1] [F-2], four removable and one permanently installed piece). Tail ballast may be removed to maintain c.g. forward of 12%. See figure 5-7, sheets 1 and 2, and figure 5-8 sheets 1 and 2 for variable external tail ballast requirements.

DART TARGET SYSTEM LIMITATIONS

TARGET FLIGHT CONDITION	AIRSPEED	ACCELERATION
Stowed (Cruise & Climb)	310 KIAS (MAX)	0 to +1.5 G
Launch	190 to 220 KIAS	+1.0 G
In Tow	Below 325 KIAS	0 to +3.0 G
	325 to 350 KIAS	0 to +4.0 G
	350 to 450 KIAS or 0.85 IMN (MAX) (whichever is less)	0 to +5.0 G

WARNING

With 150-gallon fuel tank on right pylon, do not fire wingtip missiles or release tank when dart target is stowed.

NOTE

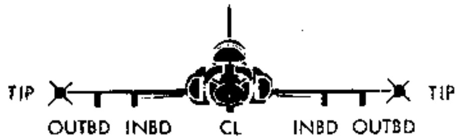
Ⓔ With 150-gallon fuel tank on right pylon, do not fire guns until tank is empty.

AUTHORIZED CONFIGURATIONS FOR TAKEOFF

E E-2

[T.O. 1F-5E-594]

E-1 E-3



Note

ENSURE FORM 365-4 FILED FOR AUTHORIZED CONFIGURATION COMPLIES WITH PERMISSIBLE AFT CG LIMIT IN T.O. 1-1B-40.

TIP	OUTBD ↓ / INBD →	NO PYLON	PYLON	TANK (150 GAL) ❽	TANK (275 GAL) ❶❽	MK-82 LD	MK-82 SE	MK-36	M129E2	CBU-24 B/B	CBU-49 B/B	CBU-52 B/B	CBU-58/B, A/B	CBU-71/B, A/B	BLU-1/B, B/B, C/B ❼ (U)	BLU-1/B, B/B, C/B ❼ (F)	BLU-27/B ❼ (U)	BLU-27/B ❼ (F)	BLU-27A/B, B/B, C/B ❼ (U)	BLU-27A/B, B/B, C/B ❼ (F)	BLU-32A/B, B/B, C/B (U)	BLU-32A/B, B/B, C/B (F)	LAU-3/A, A/A, B/A	LAU-60/A	LAU-68A/A, B/A	CENTERLINE (CL)
LCHR RAILS AIM-9	NO PYLON	●	①	②	②	③	③	③	③	③	③	③	③	③	④	④	④	④	④	④	③	③	③	③	③	(ANY OF THE FOLLOWING) NO PYLON PYLON TANK (150 GAL) TANK (275 GAL) MK-82 LD MK-82 SE MK-84 LD MK-36 M129E2 CBU-24B/B CBU-49B/B CBU-52B/B CBU-58/B, A/B CBU-71/B, A/B BLU-1/B, B/B, C/B (U) & (F) BLU-27/B (U) & (F) BLU-27A/B, B/B, C/B (U) & (F) BLU-32A/B, B/B, C/B (U) & (F) SUU-20/A (M), A/A, B/A
	PYLON	①	①	②	②	③	③	③	③	③	③	③	③	③	④	④	④	④	④	④	③	③	③	③	③	
	MK-82 LD	①	①	③	③	③																				
	MK-82 SE	①	②	③	③		③																			
	MK-36	①	②	③	③			③																		
	M129E2	①	①						③																	
	CBU-24 B/B	①	①							③																
	CBU-49 B/B	①	①								③															
	CBU-52 B/B	①	①									③														
	CBU-58/B, A/B	①	①										③													
	CBU-71/B, A/B	①	①											③												
	BLU-1/B, B/B, C/B (U)	②	②												④											
	BLU-1/B, B/B, C/B (F)	①	②													④										
	BLU-27/B (U)	②	②	⑤	⑤												④									
	BLU-27/B (F)	①	②	⑤	⑤													④								
	BLU-27A/B, B/B, C/B (U)	②	②	⑤	⑤														④							
	BLU-27A/B, B/B, C/B (F)	①	②	⑤	⑤															④						
	BLU-32A/B, B/B, C/B (U)	①	①																		③					
	BLU-32A/B, B/B, C/B (F)	①	②																			③				
	LAU-3/A, A/A, B/A	②	②	⑤	⑤																		③			
	LAU-60/A	②	②	⑤	⑤																			③		
	LAU-68A/A, B/A	②	②																						③	
	SUU-25A/A, C/A, E/A	②	②																							
	NO PYLON	●	①	②	②																					BRU-27/A (MER): EMPTY
	PYLON	●	①	②	②																					
	MK-82 LD	①	①	②	②																					
	MK-82 SE	①	①	②	②																					
	NO PYLON	①	①	②	②																					BRU-27/A (MER): 2 TO 5 MK-82 LD OR SE
	PYLON	①	①	②	②																					
	MK-82 LD	②	②																							BRU-27/A (MER): 2 TO 5 MK-82 LD
	MK-82 SE	②	②																							BRU-27/A (MER): 2 TO 5 MK-82 SE
	MK-82 LD	②	②	②	②																					BRU-27/A (MER): 5 MK-82 LD
	MK-82 SE	②	②	②	②																					BRU-27/A (MER): 5 MK-82 SE

OTHER CONFIGURATION LIMITATIONS

- ALL AIM-9 MISSILES (CAPTIVE OR LIVE) EXCEPT THE AIM-9 ICT, SHALL HAVE WING AND ROLLERON ASSEMBLIES INSTALLED. AIM-9 ICT SHALL HAVE FLAT PLATE WINGS.
- TAKEOFF WITH AN ASYMMETRIC WING PYLON/LAUNCHER CONFIGURATION IS PROHIBITED, EXCEPT AS INDICATED IN NOTES ❷ THRU ❻
- STORES SHALL BE IDENTICAL IN MODEL DESIGNATION, EXCEPT AS INDICATED IN NOTES ❹ AND ❻ (EXAMPLE: LAU-3/A CANNOT BE MIXED WITH LAU-3A/A). WITH INBD PYLON FUEL TANKS, OUTBD PYLON WEAPONS SHALL BE IDENTICAL.

F-5 1-109(5)K

Figure 5-5 (Sheet 1).

AUTHORIZED CONFIGURATIONS FOR TAKEOFF (Continued)

E **E-2** [T.O. 1F-5E-594] **E-1** **E-3**

TIP	OUTBD \ INBD	NO PYLON	PYLON	TANK (150 GAL) ❽	TANK (275 GAL) ❼❽	MK-83 LD	M117	GBU-12/B, A/B (HS)	GBU-12E/B (FF)	MXU-648 ❶	CENTERLINE (CL)
LCHR RAILS AIM-9	NO PYLON	●	①	②	②			②	②		NO PYLON PYLON TANK (150 GAL) TANK (275 GAL) GBU-10F/B (FF) GBU-12E/B (FF)
	PYLON	①	①	②	②			②	②		
	GBU-12/B, A/B (HS)	①	①	②	②			②			
	GBU-12A/B (LS)	①	①	②	②						
	GBU-12E/B (FF)	①	①	②	②				②		
AIM-9	NO PYLON	●	①			②	②				NO PYLON PYLON TANK (150 GAL) TANK (275 GAL) MK-83 LD M117
	PYLON	①	①			②	②				
	M117	②	②				②				
LCHR RAILS	TDU-10/B ❷	②									RMU-10/A TOW REEL
AIM-9	TDU-10/B ❸			②							
TDU-11/B AIM-9 ❹	NO PYLON	●									NO PYLON PYLON TANK (275 GAL)
AIM-9 (CAPTIVE OR LIVE) ❺	NO PYLON	●									
	PYLON		●								
AIS POD AIM-9 ❻	NO PYLON	●									NO PYLON PYLON TANK (150 GAL) TANK (275 GAL)
LCHR RAILS AIM-9	NO PYLON			②	②						MXU-648
	PYLON			②	②						
	NO PYLON									②	TANK (150 GAL) TANK (275 GAL)
	PYLON									②	

Note

❶ AIM-9 REQUIRED ON TIP LCHR RAILS.

❷ LEFT OUTBD PYLON ONLY; OTHER WING STATIONS – NO PYLON.

❸ LEFT OUTBD PYLON ONLY; TANK (150 GAL) ON RIGHT INBD PYLON ONLY; OTHER WING STATIONS – NO PYLON.

❹ TDU-11/B ON LEFT TIP LCHR RAIL; AIM-9 ON RIGHT RAIL.

❺ MAY BE CARRIED ON EITHER TIP LCHR RAIL WITH OPPOSITE RAIL EMPTY.

❻ AIS POD ON EITHER TIP LCHR RAIL WITH AIM-9 ON OPPOSITE RAIL; OR AIS POD ON EITHER TIP LCHR RAIL WITH OPPOSITE RAIL EMPTY.

❼ WITH OUTBD NO PYLON/PYLON, AIM-9 REQUIRED ON TIP LCHR RAILS WHEN CL 275-GAL TANK WITH FUEL OR MK-84 IS CARRIED.

❽ VARIABLE NOSE BALLAST REQUIRED.

ADDITIONAL BALLAST REQUIREMENTS

● NONE.	③ FULL AMMO AND 200 LB OR HEAVIER CL STORE.
① AMMO LINKS (560) OR EQUIVALENT BALLAST.	④ FULL AMMO AND 800 LB OR HEAVIER CL STORE.
② FULL AMMO (560 ROUNDS).	⑤ FULL AMMO AND 1100 LB OR HEAVIER CL STORE.

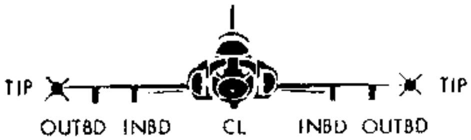
F-5 1-109(7)G

Figure 5-5 (Sheet 2).

AUTHORIZED CONFIGURATIONS FOR TAKEOFF

E **E-2**

[BEFORE T.O. 1F-5E-594]



> ***Note***
>
> ENSURE FORM 365-4 FILED FOR AUTHORIZED CONFIGURATION COMPLIES WITH PERMISSIBLE AFT CG LIMIT IN T.O. 1-1B-40.

TIP	OUTBD \ INBD	NO PYLON	PYLON	TANK (150 GAL)	TANK (275 GAL) ❶	MK-82 LD	MK-82 SE	MK-36	M129E2	CBU-24 B/B	CBU-49 B/B	CBU-52 B/B	CBU-58/B, A/B	CBU-71/B, A/B	BLU-32A/B, B/B, C/B (U)	BLU-32A/B, B/B, C/B (F)	LAU-3/A, A/A, B/A	LAU-60/A	LAU-68A/A, B/A	CENTERLINE (CL)
LCHR RAILS AIM-9	NO PYLON	●	①	①	①	②	②	②	②	②	②	②	②	②	②	②	②	②	②	(ANY OF THE FOLLOWING) NO PYLON PYLON TANK (150 GAL) TANK (275 GAL) MK-82 LD MK-82 SE MK-84 LD MK-36 M129E2 CBU-24B/B CBU-49B/B CBU-52B/B CBU-58/B, A/B CBU-71/B, A/B BLU-1/B, B/B, C/B (U) & (F) BLU-27/B (U) & (F) BLU-27A/B, B/B, C/B (U) & (F) BLU-32A/B, B/B, C/B (U) & (F) SUU-20/A (M), A/A, B/A
	PYLON	●	①	①	①	②	②	②	②	②	②	②	②	②	②	②	②	②	②	
	MK-82 LD	①	①		②	②														
	MK-82 SE	①	①				②													
	MK-36	①	①					②												
	M129E2	①	①						②											
	CBU-24 B/B	①	①							②										
	CBU-49 B/B	①	①								②									
	CBU-52 B/B	①	①									②								
	CBU-58/B, A/B	①	①										②							
	CBU-71/B, A/B	①	①											②						
	BLU-1/B, B/B, C/B (U)	①	①																	
	BLU-1/B, B/B, C/B (F)	①	①																	
	BLU-27/B (U)	①	①																	
	BLU-27/B (F)	①	①																	
	BLU-27A/B, B/B, C/B (U)	①	①																	
	BLU-27A/B, B/B, C/B (F)	①	①																	
	BLU-32A/B, B/B, C/B (U)	①	①												②					
	BLU-32A/B, B/B, C/B (F)	①	①													②				
	LAU-3/A, A/A, B/A	①	①														②			
	LAU-60/A	①	①															②		
	LAU-68A/A, B/A	①	①																②	
	SUU-25A/A, C/A, E/A	①	①																	
	NO PYLON	●	①	①	①															BRU-27/A (MER): EMPTY OR 2 TO 5 MK-82 LD OR SE
	PYLON	●	①	①	①															
	MK-82 LD	①	①	①	①															BRU-27/A (MER): EMPTY OR 5 MK-82 LD
	MK-82 SE	①	①	①	①															BRU-27/A (MER): EMPTY OR 5 MK-82 SE

OTHER CONFIGURATION LIMITATIONS

- ALL AIM-9 MISSILES (CAPTIVE OR LIVE) EXCEPT THE AIM-9 ICT, SHALL HAVE WING AND ROLLERON ASSEMBLIES INSTALLED. AIM-9 ICT SHALL HAVE FLAT PLATE WINGS.
- TAKEOFF WITH AN ASYMMETRIC WING PYLON/LAUNCHER CONFIGURATION IS PROHIBITED, EXCEPT AS INDICATED IN NOTES ❷ THRU ❻.
- STORES SHALL BE IDENTICAL IN MODEL DESIGNATION, EXCEPT AS INDICATED IN NOTES ❹ AND ❻ (EXAMPLE: LAU-3/A CANNOT BE MIXED WITH LAU-3A/A). WITH INBD PYLON FUEL TANKS, OUTBD PYLON WEAPONS SHALL BE IDENTICAL.

F-5 1-109(1)N

Figure 5-6 (Sheet 1).

AUTHORIZED CONFIGURATIONS FOR TAKEOFF (Continued)

E E-2 [BEFORE T.O. 1F-5E-594]

TIP	OUTBD \ INBD	NO PYLON	PYLON	TANK (150 GAL)	TANK (275 GAL) ❶	GBU-12/B, A/B (HS)	GBU-12E/B (FF)	MXU-648 ❶	CENTERLINE (CL)
LCHR RAILS AIM-9	NO PYLON	●	①	①	①	②	②		NO PYLON PYLON TANK (150 GAL) TANK (275 GAL) GBU-10F/B (FF) GBU-12E/B (FF)
LCHR RAILS AIM-9	PYLON	●	①	①	①	②	②		NO PYLON PYLON TANK (150 GAL) TANK (275 GAL) GBU-10F/B (FF) GBU-12E/B (FF)
LCHR RAILS AIM-9	GBU-12/B, A/B (HS)	①	①			②			NO PYLON PYLON TANK (150 GAL) TANK (275 GAL) GBU-10F/B (FF) GBU-12E/B (FF)
LCHR RAILS AIM-9	GBU-12A, B (LS)	①	①						NO PYLON PYLON TANK (150 GAL) TANK (275 GAL) GBU-10F/B (FF) GBU-12E/B (FF)
LCHR RAILS AIM-9	GBU-12E/B (FF)	①	①				②		NO PYLON PYLON TANK (150 GAL) TANK (275 GAL) GBU-10F/B (FF) GBU-12E/B (FF)
LCHR RAILS	TDU-10/B ❷	①							RMU-10/A TOW REEL
AIM-9	TDU-10/B ❸			①					RMU-10/A TOW REEL
TDU-11/B AIM-9 ❹	NO PYLON	●							NO PYLON PYLON TANK (275 GAL)
AIM-9 (CAPTIVE OR LIVE) ❺	NO PYLON	●							NO PYLON PYLON TANK (275 GAL)
AIM-9 (CAPTIVE OR LIVE) ❺	PYLON		●						NO PYLON PYLON TANK (275 GAL)
AIS POD AIM-9 ❻	NO PYLON	●							NO PYLON PYLON TANK (150 GAL) TANK (275 GAL)
LCHR RAILS AIM-9	NO PYLON			①	①				MXU-648
LCHR RAILS AIM-9	PYLON			①	①				MXU-648
LCHR RAILS AIM-9	NO PYLON							①	TANK (150 GAL) TANK (275 GAL)
LCHR RAILS AIM-9	PYLON							①	TANK (150 GAL) TANK (275 GAL)

Note

❶ AIM-9 REQUIRED ON TIP LCHR RAILS.

❷ LEFT OUTBD PYLON ONLY; OTHER WING STATIONS – NO PYLON.

❸ LEFT OUTBD PYLON ONLY; TANK (150 GAL) ON RIGHT INBD PYLON ONLY; OTHER WING STATIONS – NO PYLON.

❹ TDU-11/B ON LEFT TIP LCHR RAIL; AIM-9 ON RIGHT RAIL.

❺ MAY BE CARRIED ON EITHER TIP LCHR RAIL WITH OPPOSITE RAIL EMPTY.

❻ AIS POD ON EITHER TIP LCHR RAIL WITH AIM-9 ON OPPOSITE RAIL; OR AIS POD ON EITHER TIP LCHR RAIL WITH OPPOSITE RAIL EMPTY.

ADDITIONAL BALLAST REQUIREMENTS

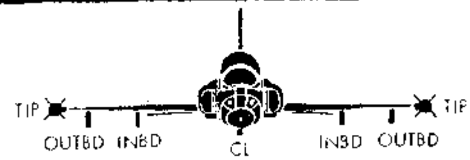
- ● NONE.
- ① FULL AMMO (560 ROUNDS).
- ② FULL AMMO AND 200 LB OR HEAVIER CL STORE.

F-5 109(8)F

Figure 5-6 (Sheet 2).

AUTHORIZED CONFIGURATIONS FOR TAKEOFF

ONE CREW **F**



Note

ENSURE FORM F(DD365-4) FILED FOR AUTHORIZED CONFIGURATION COMPLIES WITH PERMISSIBLE AFT CG LIMIT IN T.O. 1-1B-40

TIP ⇩	OUTBD ⇩ (INBD ⇨)		NO PYLON	PYLON	TANK (150 GAL)	TANK (275 GAL) ❶	MK-82 LD	MK-82 SE	MK-36	M129E2	CBU-24B/B	CBU-49B/B	CBU-52B/B	CBU-58/B, A/B	CBU-71/B, A/B	BLU-32A/B, B/B, C/B (U)	BLU-32A/B, B/B, C/B (F)	LAU-3/A, A/A, B/A	LAU-60/A	LAU-68A/A, B/A	CENTERLINE (CL) ⇩
LCHR RAILS AIM-9	NO PYLON		(6)	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	(ANY OF THE FOLLOWING)
	PYLON		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	(7)	(7)	●	
	MK-82 LD		●	●	(2)	(2)	●														NO PYLON PYLON TANK (150 GAL) TANK (275 GAL) MK-82 LD MK-82 SE MK-84 LD MK-36 M129E2 CBU-24B/B CBU-49B/B CBU-52B/B CBU-58/B, A/B CBU-71/B, A/B BLU-1/B, B/B, C/B (U) & (F) BLU-27/B (U) & (F) BLU-27A/B, B/B, C/B (U) & (F) BLU-32A/B, B/B, C/B (U) & (F) SUU-20/A (M), A/A, B/A ❼
	MK-82 SE		●	●	(2)	(2)		●													
	MK-36		●	●	(2)	(2)			(2)												
	M129E2		●	●						●											
	CBU-24B/B		●	●							(2)										
	CBU-49B/B		●	●								(2)									
	CBU-52B/B		●	●									(2)								
	CBU-58/B, A/B		●	●										(2)							
	CBU-71/B, A/B		●	●											(2)						
	BLU-1/B, B/B, C/B	(U)	●	●																	
		(F)	●	●																	
	BLU-27/B	(U)	●	●	(5)	(5)															
		(F)	●	●	(5)	(5)															
	BLU-27A/B, B/B, C/B	(U)	●	●	(5)	(5)															
		(F)	●	●	(5)	(5)															
	BLU-32A/B, B/B, C/B	(U)	●	●												(2)					
		(F)	●	●													●				
	LAU-3/A, A/A, B/A		●	●	(3)	(3)												●			
	LAU-60/A		●	●	(3)	(3)													●		
	LAU-68A/A, B/A		●	●																●	
	SUU-25A/A, C/A, F/A		●	●																	
	NO PYLON		(6)	●	●	●															SUU-20/A (M): EMPTY TO 5 MK-82 LD OR SE
	PYLON		●	●	●	●															
	MK-82 LD		●	●	●	●															SUU-20/A (M): 5 MK-82 LD
	MK-82 SE		●	●	●	●															SUU-20/A (M): 5 MK-82 SE
	MK-82 LD		●	●	(2)	●															SUU-20/A (M): EMPTY
	MK-82 SE		●	●	(2)	(2)															
AIM-9	NO PYLON		(7)																		NO PYLON
LCHR RAILS	NO PYLON		(8)																		

OTHER CONFIGURATION LIMITATIONS

- ALL AIM-9 MISSILES (CAPTIVE OR LIVE) EXCEPT THE AIM-9 ICT, SHALL HAVE WING AND ROLLERON ASSEMBLIES INSTALLED. AIM-9 ICT SHALL HAVE FLAT PLATE WINGS.
- TAKEOFF WITH AN ASYMMETRIC WING PYLON/LAUNCHER CONFIGURATION IS PROHIBITED, EXCEPT AS INDICATED IN NOTES ❷ THRU ❻.
- STORES SHALL BE IDENTICAL IN MODEL DESIGNATION, EXCEPT AS INDICATED IN NOTES ❹ AND ❺ (EXAMPLE: LAU-3/A CANNOT BE MIXED WITH LAU-3A/A). WITH INBD PYLON FUEL TANKS, OUTBD PYLON WEAPONS SHALL BE IDENTICAL.

F-5 1-109(2)M

Figure 5-7 (Sheet 1).

AUTHORIZED CONFIGURATIONS FOR TAKEOFF (Continued)

ONE CREW

F

TIP	OUTBD / INBD	NO PYLON	PYLON	TANK (150 GAL)	TANK (275 GAL) ❶	MK-83 LD	M117	GBU-12 B,A/B (HS)	GBU-12E/B (FF)	MXU-648 ❶	CENTERLINE (CL)
LCHR RAILS AIM-9	NO PYLON	⑥	●	●	●			●	●		NO PYLON PYLON TANK (150 GAL) TANK (275 GAL) GBU-10F/B (FF) GBU-12E/B (FF)
	PYLON	●	●	●	●			●	●		
	GBU-12 B,A/B (HS)	●	●	④	④			●			
	GBU-12A/B (LS)	●	●	④	④						
	GBU-12E/B (FF)	●	●	④	④				●		
AIM-9	NO PYLON	⑥	●			●	●				NO PYLON PYLON TANK (150 GAL) TANK (275 GAL) MK-83 LD M117
	PYLON	●	●			①	●				
	M117	●	●				②				
LCHR RAIL	TDU-10/B ❷	●									RMU-10/A TOW REEL
AIM-9	TDU-10/B ❸			●							
TDU-11/B AIM-9 ❹	NO PYLON	⑥									NO PYLON PYLON TANK (275 GAL)
AIM-9 (CAPTIVE CARRIED) ❺	NO PYLON	⑥									
	PYLON		●								
AIS POD AIM-9 ❻	NO PYLON	●									NO PYLON PYLON TANK (150 GAL) TANK (275 GAL)
LCHR RAILS AIM-9	NO PYLON			●	●						MXU-648
	PYLON			●	●						
	NO PYLON									⑦	TANK (150 GAL) TANK (275 GAL)
	PYLON									⑦	

Note

❶ AIM-9 REQUIRED ON TIP LCHR RAILS.
❷ LEFT OUTBD PYLON ONLY, OTHER WING STATIONS – NO PYLON.
❸ LEFT OUTBD PYLON ONLY, TANK (150 GAL) ON RIGHT INBD PYLON ONLY, OTHER WING STATIONS – NO PYLON.
❹ TDU-11/B ON LEFT TIP LCHR RAIL, AIM-9 ON RIGHT RAIL.
❺ MAY BE CARRIED ON EITHER TIP LCHR RAIL WITH OPPOSITE RAIL EMPTY.
❻ AIS POD ON EITHER TIP LCHR RAIL WITH AIM-9 ON OPPOSITE RAIL; OR AIS POD ON EITHER TIP LCHR RAIL WITH OPPOSITE RAIL EMPTY.
❼ SUU-20 ADAPTER REQUIRED

ADDITIONAL BALLAST REQUIREMENTS

● NONE
① AMMO LINKS (140) OR EQUIVALENT BALLAST.
② FULL AMMO (140 ROUNDS).
③ FULL AMMO AND 600 LB OR HEAVIER CL STORE.
④ FULL AMMO AND 1100 LB OR HEAVIER CL STORE.
⑤ FULL AMMO AND 1800 LB OR HEAVIER CL STORE.
⑥ EXTERNAL TAIL BALLAST INSTALLED (EXCEPT ⑦ & ⑧) (4 REMOVABLE PIECES).
⑦ EXTERNAL TAIL BALLAST (4 REMOVABLE PIECES) OPTIONAL.
⑧ EXTERNAL TAIL BALLAST (2 OF 4 REMOVABLE PIECES) INSTALLED AND 2 OF 4 REMOVABLE PIECES OPTIONAL.

F-5 1-109(9)E

Figure 5-7 (Sheet 2).

AUTHORIZED CONFIGURATIONS FOR TAKEOFF — TWO CREW (F)

Note

▌ENSURE FORM F(DD365-4) FILED FOR AUTHORIZED CONFIGURATION COMPLIES WITH PERMISSIBLE AFT CG LIMIT IN T.O. 1-1B-40.

TIP	OUTBD ↓ / INBD →	NO PYLON	PYLON	TANK (150 GAL)	TANK (275 GAL) ❶	MK-82 LD	MK-82 SE	MK-36	M129E2	CBU-24 B/B	CBU-49 B/B	CBU-52 B/B	CBU-58/B, A/B	CBU-71/B, A/B	BLU-32A/B, B/B, C/B (U)	BLU-32A/B, B/B, C/B (F)	LAU-3/A, A/A, B/A	LAU-60/A	LAU-68A/A, B/A	CENTERLINE (CL)
LCHR RAILS AIM-9	NO PYLON	④	⑤	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	(ANY OF THE FOLLOWING)
	PYLON	⑤	⑤	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
	MK-82 LD	●	●	●	②	●														NO PYLON PYLON TANK (150 GAL) TANK (275 GAL) MK-82 LD MK-82 SE MK-84 LD MK-36 M129E2 CBU-24B/B CBU-49B/B CBU-52B/B CBU-58/B, A/B CBU-71/B, A/B BLU-1/B, B/B, C/B (U) & (F) BLU-27/B (U) & (F) BLU-27A/B, B/B, C/B (U) & (F) BLU-32A/B, B/B, C/B (U) & (F) SUU-20 A (M), A/A, B/A ❼
	MK-82 SE	●	●	②	②		●													
	MK-36	●	●	②	②			●												
	M129E2	●	●						●											
	CBU-24B/B	●	●							●										
	CBU-49B/B	●	●								●									
	CBU-52B/B	●	●									●								
	CBU-58/B, A/B	●	●										●							
	CBU-71/B, A/B	●	●											●						
	BLU-1/B, B/B, C/B (U)	●	●																	
	BLU-1/B, B/B, C/B (F)	●	●																	
	BLU-27/B (U)	●	●	③	③															
	BLU-27/B (F)	●	●	③	③															
	BLU-27A/B, B/B, C/B (U)	●	●	③	③															
	BLU-27A/B, B/B, C/B (F)	●	●	③	③															
	BLU-32A/B, B/B, C/B (U)	●	●												●					
	BLU-32A/B, B/B, C/B (F)	●	●													●				
	LAU-3/A, A/A, B/A	●	●	②	②												●			
	LAU-60/A	●	●	②	②													●		
	LAU-68A/A, B/A	●	●																●	
	SUU-25A/A, C/A, E/A	●	●																	
	NO PYLON	④	⑤	●	●															BRU-27/A (MER): EMPTY TO 5 MK-82 LD OR SE
	PYLON	⑤	⑤	●	●															BRU-27/A (MER): EMPTY TO 5 MK-82 LD OR SE
	MK-82 LD	●	●	●	●															BRU-27/A (MER): 5 MK-82 LD
	MK-82 SE	●	●	●	●															BRU-27/A (MER): 5 MK-82 SE
	MK-82 LD	●	●	●	●															BRU-27/A (MER): EMPTY
	MK-82 SE	●	●	●	●															BRU-27/A (MER): EMPTY
AIM-9	NO PYLON	⑤																		NO PYLON
LCHR RAILS	NO PYLON	⑥																		NO PYLON

OTHER CONFIGURATION LIMITATIONS

- ALL AIM-9 MISSILES (CAPTIVE OR LIVE) EXCEPT THE AIM-9 ICT, SHALL HAVE WING AND ROLLERON ASSEMBLIES INSTALLED. AIM-9 ICT SHALL HAVE FLAT PLATE WINGS.
- TAKEOFF WITH AN ASYMMETRIC WING PYLON/LAUNCHER CONFIGURATION IS PROHIBITED, EXCEPT AS INDICATED IN NOTES ❷ THRU ❻.
- STORES SHALL BE IDENTICAL IN MODEL DESIGNATION, EXCEPT AS INDICATED IN NOTES ❹ AND ❻ (EXAMPLE: LAU-3/A CANNOT BE MIXED WITH LAU-3A/A). WITH INBD PYLON FUEL TANKS, OUTBD PYLON WEAPONS SHALL BE IDENTICAL.

F-5 1-11(1)M

Figure 5-8 (Sheet 1).

AUTHORIZED CONFIGURATIONS FOR TAKEOFF (Continued)

F

TWO CREW

TIP	OUTBD \ INBD	NO PYLON	PYLON	TANK (150 GAL)	TANK (275 GAL) ❶	MK-83 LD	M117	GBU-12/B, A/B (HS)	GBU-12E/B (FF)	MXU-648 ❼	CENTERLINE (CL)
LCHR RAILS AIM-9	NO PYLON	(4)	(5)	●	●			●	●		NO PYLON PYLON TANK (150 GAL) TANK (275 GAL) GBU-10F/B (FF) GBU-12E/B (FF)
	PYLON	(5)	(5)	●	●			●	●		
	GBU-12, B, A/B (HS)	●	●	(2)	(2)			●			
	GBU-12A, B (LS)	●	●	(2)	(2)						
	GBU-12E B (FF)	●	●	(2)	(2)				●		
AIM-9	NO PYLON	(4)	(5)			●	●				NO PYLON PYLON TANK (150 GAL) TANK (275 GAL) MK-83 LD M117
	PYLON	(5)	(5)			●	●				
	M117	●	●				(1)				
LCHR RAILS	TDU-10, B ❷	●									RMU-10/A TOW REEL
AIM-9	TDU-10, B ❸			●							
TDU-11 B AIM-9 ❹	NO PYLON	(4)									NO PYLON PYLON TANK (275 GAL)
AIM-9 CAPTIVE OR LIVE ❺	NO PYLON	(4)									
	PYLON		(5)								
AIS POD AIM-9 ❻	NO PYLON	●									NO PYLON PYLON TANK (150 GAL) TANK (275 GAL)
LCHR RAILS AIM-9	NO PYLON			●	●						MXU-648
	PYLON			●	●						
	NO PYLON									(2)	TANK (150 GAL) TANK (275 GAL)
	PYLON									(2)	

Note

❶ AIM-9 REQUIRED ON TIP LCHR RAILS.
❷ LEFT OUTBD PYLON ONLY; OTHER WING STATIONS – NO PYLON.
❸ LEFT OUTBD PYLON ONLY; TANK (150 GAL) ON RIGHT INBD PYLON ONLY, OTHER WING STATIONS – NO PYLON.
❹ TDU-11/B ON LEFT TIP LCHR RAIL, AIM-9 ON RIGHT RAIL.
❺ MAY BE CARRIED ON EITHER TIP LCHR RAIL WITH OPPOSITE RAIL EMPTY.
❻ AIS POD ON EITHER TIP LCHR RAIL WITH AIM-9 ON OPPOSITE RAIL; OR AIS POD ON EITHER TIP LCHR RAIL WITH OPPOSITE RAIL EMPTY.
❼ SUU-20 ADAPTER REQUIRED

ADDITIONAL BALLAST REQUIREMENTS

● NONE
(1) AMMO LINKS (140) OR EQUIVALENT BALLAST
(2) FULL AMMO (140 ROUNDS)
(3) FULL AMMO AND 1100 LB OR HEAVIER CL STORE
(4) EXTERNAL TAIL BALLAST INSTALLED (EXCEPT (5) & (6)) (4 REMOVABLE PIECES)
(5) EXTERNAL TAIL BALLAST (4 REMOVABLE PIECES) OPTIONAL PROVIDED AFT CG LIMIT IN T.O. 1-1B-40 IS NOT EXCEEDED.
(6) EXTERNAL TAIL BALLAST (2 OF 4 REMOVABLE PIECES) INSTALLED AND 2 OF 4 REMOVABLE PIECES OPTIONAL.

F-5 1-110(1)P

Figure 5-8 (Sheet 2).

IN-FLIGHT CARRIAGE & SEQUENCING LIMITATIONS

Note

- FOR WEAPON DELIVERY DATA, REFER TO T.O. 1F-5E-34-1-1.
- RETAINING EMPTY ACCESSORY (BOMB RACK, DISPENSERS, OR ROCKET LAUNCHERS) DOES NOT CHANGE STATION CONFIGURATIONS.
- LAUNCH: INDICATES FIRING MISSILES FROM LAUNCHER RAILS.
- RELEASE: INDICATES DROPPING STORES FROM PYLONS, INCLUDING ROCKET LAUNCHERS AND FLARE DISPENSERS.
- STORES ON 4 WING PYLONS: RECOMMEND RELEASE OF INBD STORES FIRST BECAUSE LIMITATIONS ON OUTBD STORES ARE LESS RESTRICTIVE THAN INBD STORES.
- STORES ON 2 WING PYLONS: LIMITATIONS LESS RESTRICTIVE WITH STORES ON OUTBD PYLONS.

GUNFIRE RESTRICTIONS

MAX GUNFIRE — SEC (TOTAL) SUBCOLUMN HEADING NUMBERED DOT MARKERS APPLY AS FOLLOWS.

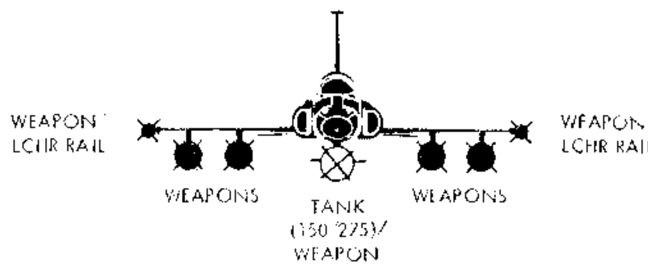
	Ⓔ	Ⓕ
❶	E E-2 [T.O. 1F-5E-594] E-1 E-3	❶ ONE CREW
❷	E E-2 [BEFORE T.O. 1F-5E-594]	❷ TWO CREW

✱ CONFIGURATION LIMITS

MAX SPEED: 520 KIAS OR 0.85 IMN (WHICHEVER IS LESS).

ACCELERATION LIMITS:
SYM (G): +6.5, -2.0
ROLL ENTRY (G): +5.2, -1.0

✱ MODIFY ABOVE LIMITS FOR THE SPECIFIC STORE-STATION CONFIGURATIONS LISTED BELOW.



5 PYLON STORES

TIP	OUTBD	INBD	CL	OTHER LIMITATIONS						
				SYM (G)	ROLL ENTRY (G)	MAX GUNFIRE-SEC. (TOTAL)				SEQUENCING
						Ⓔ		Ⓕ		
						❶	❷	❶	❷	
			TANK (275) W/ANY FUEL	+4.0 -1.5	+3.2 -1.0					
			TANK (275) EMPTY	+6.0 -2.0	+4.8 -1.0					
			TANK (150) W/WO FUEL	+6.0 -1.5	+4.8 -1.0					
			MK-84 LD GBU-10 (FF)	+5.0 -2.0	+4.0 -1.0					
			M129	+5.0 -1.0	+4.0 0					
	MK-82 LD	MK-82 LD				5	0			
	MK-82 SE	MK-82 SE				2	0			
	LAU	LAU								❷ RETAIN CL STORE.
	MK-36	MK-36				2	0	0		
	M129	M129		+5.0 -1.0	+4.0 0	2	0			

(CONTINUED ON NEXT PAGE)

F-5 1-113(1)N

Figure 5-9 (Sheet 1).

IN-FLIGHT CARRIAGE & SEQUENCING LIMITATIONS

* CONFIGURATION LIMITS	
MAX SPEED:	520 KIAS OR 0.85 IMN (WHICHEVER IS LESS).
ACCELERATION LIMITS:	
SYM (G):	+6.5, -2.0
ROLL ENTRY (G):	+5.2, -1.0

* MODIFY ABOVE LIMITS FOR THE SPECIFIC STORE-STATION CONFIGURATIONS LISTED BELOW.

5 PYLON STORES

(CONTINUED FROM PREVIOUS PAGE)

TIP	OUTBD	INBD	CL	OTHER LIMITATIONS: SYM (G)	ROLL ENTRY (G)	MAX GUNFIRE-SEC. (TOTAL) (E) (1)	(E) (2)	(F) (1)	(F) (2)	SEQUENCING	
	BLU-27/B	BLU-27/B				0				(E) TIP LCHR RAILS W/MK-84 LD OR TANK W/FUEL: DO NOT RELEASE OUTBD STORE BEFORE INBD.	(E) RETAIN CL STORE.
	BLU-1 (U)	BLU-1 (U)				0					
	BLU-1 (F)	BLU-1 (F)				2					
	BLU-27A/B, B/B, C/B (U)	BLU-27A/B, B/B, C/B (U)				0					
	BLU-27A/B, B/B, C/B (F)	BLU-27A/B, B/B, C/B (F)				2					
	BLU-32 (U)	BLU-32 (U)				2	0	0		TIP LCHR RAILS: DO NOT RELEASE OUTBD BLU-32 ABOVE 400 KIAS OR 0.80 IMN.	
	BLU-32 (F)	BLU-32 (F)				5	0				
	CBU	CBU				2	0	0		AIM-9 W/MK-84 LD OR TANK W/FUEL: DO NOT RELEASE INBD CBU ABOVE 400 KIAS OR 0.85 IMN. (E) RETAIN CL STORE.	
	GBU-12 (FF)	GBU-12 (FF)				5	2			TIP LCHR RAILS: DO NOT RELEASE OUTBD GBU ABOVE 500 KIAS OR 0.80 IMN. E E-2 [BEFORE T.O. 1F-5E-594] RETAIN CL STORE.	
	GBU-12 (HS)	GBU-12 (HS)									
AIM-9	M117	M117				0		2		DO NOT LAUNCH AIM-9's BEFORE RELEASING WING STORES.	

F-5 1-113(2)K

Figure 5-9 (Sheet 2).

IN-FLIGHT CARRIAGE & SEQUENCING LIMITATIONS

* CONFIGURATION LIMITS		
	TANK(S) (275) W/ANY FUEL	INBD TANKS EMPTY
MAX SPEED (WHICHEVER IS LESS):	450 KIAS OR 0.80 IMN	520 KIAS OR 0.85 IMN
ACCELERATION LIMITS:	SYM (G): +4.0, -1.5 ROLL ENTRY (G): +3.2, -1.0	SYM (G): +5.0, -1.5 ROLL ENTRY (G): +4.0, -1.0

* MODIFY ABOVE LIMITS FOR THE SPECIFIC STORE-STATION CONFIGURATIONS LISTED BELOW:

5 PYLON STORES

TIP	OUTBD	INBD	CL	OTHER LIMITATIONS: SYM (G)	ROLL ENTRY (G)	MAX GUNFIRE-SEC. (TOTAL) (E) (1)	(E) (2)	(F) (1)	(F) (2)	SEQUENCING
ALL CONFIGURATIONS W/TANKS (275)										● DO NOT LAUNCH AIM-9's BEFORE RELEASING INBD TANKS. ● DO NOT RELEASE INBD TANKS W/FUEL BEFORE RELEASING OUTBD WEAPONS.
AIM-9			M129	+5.0 -1.0	+4.0 0					
AIM-9	MK-82	TANK (275) W/ANY FUEL	MER W/ BOMBS			0	0	(1)		(1) (F) 1 CREW WITH MK-82 SE: EITHER DO NOT FIRE GUN OR DO NOT RELEASE BOMBS FROM MER.
AIM-9	MK-82	TANK (275) EMPTY	MER W/ BOMBS			2	0			
AIM-9	MK-82	TANK (275) W/ANY FUEL	MER EMPTY			2	0			
AIM-9	MK-82	TANK (275) EMPTY	MER EMPTY			2	2			
AIM-9	GBU-12 (FF, HS, LS)	TANK (275) W/ANY FUEL				0		0	0	(F) 1 CREW; RETAIN CL STORE.
AIM-9	GBU-12 (FF, HS, LS)	TANK (275) EMPTY				5				
AIM-9	MK-82	TANK (275) W/ANY FUEL				2	0	0	0	(E) RETAIN CL STORE.
AIM-9	MK-82	TANK (275) EMPTY				5	2			(E) RETAIN CL STORE.
AIM-9	MK-36	TANK (275) W/ANY FUEL				2	0	0	0	(E) RETAIN CL STORE.
AIM-9	MK-36	TANK (275) EMPTY				5	2			(E) RETAIN CL STORE.

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F-5 1-117(1)H

Figure 5-9 (Sheet 3).

IN-FLIGHT CARRIAGE & SEQUENCING LIMITATIONS

* CONFIGURATION LIMITS		
	TANK(S) (275) W/ANY FUEL	INBD TANKS EMPTY
MAX SPEED (WHICHEVER IS LESS):	450 KIAS OR 0.80 IMN	520 KIAS OR 0.85 IMN
ACCELERATION LIMITS:	SYM (G): +4.0, -1.5 ROLL ENTRY (G): +3.2, -1.0	SYM (G): +5.0, -1.5 ROLL ENTRY (G): +4.0, -1.0

* MODIFY ABOVE LIMITS FOR THE SPECIFIC STORE-STATION CONFIGURATIONS LISTED BELOW:

5 PYLON STORES

(CONTINUED FROM PREVIOUS PAGE)

TIP	OUTBD	INBD	CL	OTHER LIMITATIONS: SYM (G)	ROLL ENTRY (G)	MAX GUNFIRE-SEC. (TOTAL) E ❶	E ❷	F ❶	F ❷	SEQUENCING
ALL CONFIGURATIONS W/TANKS (275)										● DO NOT LAUNCH AIM-9's BEFORE RELEASING INBD TANKS. ● DO NOT RELEASE INBD TANKS/W FUEL BEFORE RELEASING OUTBD WEAPON.
AIM-9	LAU-3/60	TANK (275) W/ANY FUEL				2	0	0	0	E & F 1 CREW: RETAIN CL STORE.
AIM-9	LAU-3/60	TANK (275) EMPTY				5	2	0		E & F 1 CREW: RETAIN CL STORE.
AIM-9	BLU-27	TANK (275) W/ANY FUEL				0			0	RETAIN CL STORE.
AIM-9	BLU-27	TANK (275) EMPTY				2				RETAIN CL STORE.

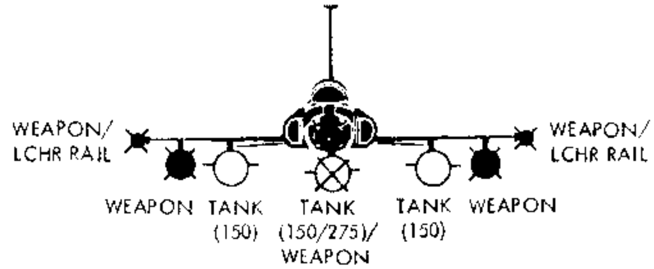
F-5 1-117(2)G

Figure 5-9 (Sheet 4).

IN-FLIGHT CARRIAGE & SEQUENCING LIMITATIONS

* CONFIGURATION LIMITS	
MAX SPEED:	520 KIAS OR 0.85 IMN (WHICHEVER IS LESS).
ACCELERATION LIMITS:	
SYM (G):	+6.0, -1.5
ROLL ENTRY (G):	+4.8, -1.0

* MODIFY ABOVE LIMITS FOR THE SPECIFIC STORE-STATION CONFIGURATIONS LISTED BELOW.



5 PYLON STORES

TIP	OUTBD	INBD	CL	SYM (G)	ROLL ENTRY (G)	MAX GUNFIRE-SEC. (TOTAL) (E) (1)	(E) (2)	(F) (1)	(F) (2)	SEQUENCING
			TANK (275) W/ANY FUEL	+4.0 -1.5	+3.2 -1.0					
			MK-84 LD GBU-10 (FF)	+5.0 -1.5	+4.0 -1.0					
			M129	+5.0 -1.0	+4.0 0					
LCHR RAILS		TANK (150) W/ANY FUEL								DO NOT RELEASE OUTBD WEAPONS ABOVE 400 KIAS OR 0.80 IMN.
	GBU-12 (FF, HS, LS)	TANK (150) W/ANY FUEL				0		0	0	(F) 1 CREW: RETAIN CL STORE.
		TANK (150) EMPTY				5				
	MK-82	TANK (150) W/ANY FUEL	MER W/ BOMBS	+5.0 -1.5	+4.0 -1.0	0	0	(1)		(1) (F) 1 CREW: EITHER DO NOT FIRE GUN OR DO NOT RELEASE BOMBS FROM MER.
		TANK (150) EMPTY				2	0			
		TANK (150) W/ANY FUEL	MER EMPTY			2	0			
		TANK (150) EMPTY				2	2			
	MK-82 LD	TANK (150) W/ANY FUEL				2	0	0		(E) RETAIN CL STORE.
		TANK (150) EMPTY				5	2			

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Figure 5-9 (Sheet 5).

F-5 1-118(1)H

IN-FLIGHT CARRIAGE & SEQUENCING LIMITATIONS

* CONFIGURATION LIMITS	
MAX SPEED:	520 KIAS OR 0.85 IMN (WHICHEVER IS LESS).
ACCELERATION LIMITS:	
SYM (G):	-6.0, -1.5
ROLL ENTRY (G):	+4.8, -1.0

* MODIFY ABOVE LIMITS FOR THE SPECIFIC STORE-STATION CONFIGURATIONS LISTED BELOW.

5 PYLON STORES

(CONTINUED FROM PREVIOUS PAGE)

TIP	OUTBD	INBD	CL	OTHER LIMITATIONS						
				SYM (G)	ROLL ENTRY (G)	MAX GUNFIRE-SEC. (TOTAL) (E)		(F)		SEQUENCING
						(1)	(2)	(1)	(2)	
	MK-82 SE MK-36	TANK (150) W/ANY FUEL				2	0	0	0	(E) RETAIN CL STORE.
	MK-82 SE MK-36	TANK (150) EMPTY				5	2			
	LAU-3/60	TANK (150) W/ANY FUEL				2	0	0	0	(E) AND (F) 1 CREW: RETAIN CL STORE.
		TANK (150) EMPTY				5	2	0		
	BLU-27	TANK (150) W/ANY FUEL				0			0	RETAIN CL STORE.
		TANK (150) EMPTY				2				

F-5 1-116(2)C

Figure 5-9 (Sheet 6).

IN-FLIGHT CARRIAGE & SEQUENCING LIMITATIONS

* CONFIGURATION LIMITS	
MAX SPEED:	520 KIAS OR 0.85 IMN (WHICHEVER IS LESS).
ACCELERATION LIMITS:	
SYM (G):	+6.5, -2.0
ROLL ENTRY (G):	+5.2, -1.0

* MODIFY ABOVE LIMITS FOR THE SPECIFIC STORE-STATION CONFIGURATIONS LISTED BELOW.

4 PYLON STORES

(CL – NO PYLON/PYLON)

TIP	OUTBD	INBD	CL	SYM (G)	ROLL ENTRY (G)	MAX GUNFIRE-SEC. (TOTAL) E 1	E 2	F 1	F 2	SEQUENCING
	GBU-12 (FF) GBU-12 (HS)	GBU-12 (FF) GBU-12 (HS)				5				TIP LCHR RAILS: DO NOT RELEASE OUTBD GBU ABOVE 500 KIAS OR 0.80 IMN.
	M129	M129		+5.0 -1.0	+4.0 0					
	MK-36 CBU	MK-36 CBU						0		
	BLU-32 (U) BLU-32 (F)	BLU-32 (U) BLU-32 (F)						0		TIP LCHR RAILS: DO NOT RELEASE OUTBD BLU-32 ABOVE 400 KIAS OR 0.80 IMN.
AIM-9	M117	M117				0		2		DO NOT LAUNCH AIM-9's BEFORE RELEASING WING STORES.

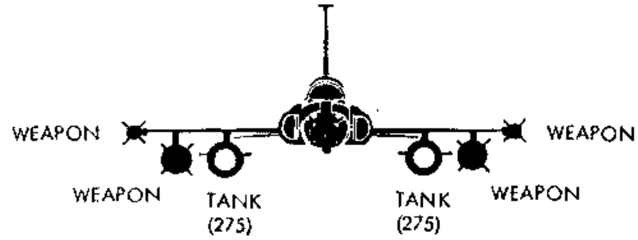
F-5 1-122(2)G

Figure 5-9 (Sheet 7).

IN-FLIGHT CARRIAGE & SEQUENCING LIMITATIONS

* CONFIGURATION LIMITS		
	INBD TANKS W/ANY FUEL	INBD TANKS EMPTY
MAX SPEED (WHICHEVER IS LESS):	450 KIAS OR 0.80 IMN	520 KIAS OR 0.85 IMN
ACCELERATION LIMITS:	SYM (G): +4.0, -1.5 ROLL ENTRY (G): +3.2, -1.0	SYM (G): +5.0, -1.5 ROLL ENTRY (G): +4.0, -1.0

* MODIFY ABOVE LIMITS FOR THE SPECIFIC STORE-STATION CONFIGURATIONS LISTED BELOW:



4 PYLON STORES

(CL – NO PYLON/PYLON)

TIP	OUTBD	INBD	CL	SYM (G)	ROLL ENTRY (G)	MAX GUNFIRE-SEC. (TOTAL) (E) (1)	(E) (2)	(F) (1)	(F) (2)	SEQUENCING
ALL CONFIGURATIONS W/TANKS (275)										● DO NOT LAUNCH AIM-9's BEFORE RELEASING INBD TANKS. ● DO NOT RELEASE INBD TANKS/W FUEL BEFORE RELEASING OUTBD WEAPON.
AIM-9	GBU-12 (FF,HS,LS)	TANK (275) W/ANY FUEL				0			0	
AIM-9	GBU-12 (FF,HS,LS)	TANK (275) EMPTY				5				
AIM-9	MK-82 / MK-36	TANK (275) W/ANY FUEL						0	0	
AIM-9	LAU-3/60	TANK (275) W/ANY FUEL							0	

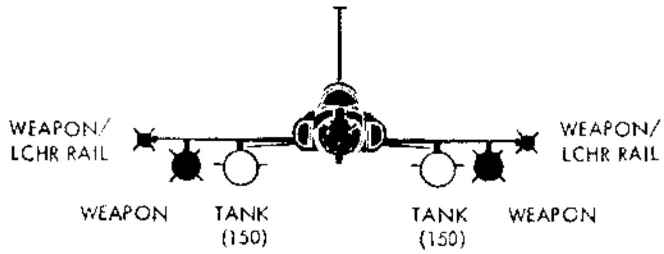
F-5 1-197(1)C

Figure 5-9 (Sheet 8).

IN-FLIGHT CARRIAGE & SEQUENCING LIMITATIONS

✱CONFIGURATION LIMITS	
MAX SPEED:	520 KIAS OR 0.85 IMN (WHICHEVER IS LESS).
ACCELERATION LIMITS:	
SYM (G):	+6.0, -1.5
ROLL ENTRY (G):	+4.8, -1.0

✱ MODIFY ABOVE LIMITS FOR THE SPECIFIC STORE-STATION CONFIGURATIONS LISTED BELOW.



4 PYLON STORES

(CL — NO PYLON/PYLON)

TIP	OUTBD	INBD	CL	OTHER LIMITATIONS SYM (G)	ROLL ENTRY (G)	MAX GUNFIRE-SEC. (TOTAL) E 1	E 2	F 1	F 2	SEQUENCING
LCHR RAILS		TANK (150) W/ANY FUEL								DO NOT RELEASE OUTBD WEAPONS ABOVE 400 KIAS OR 0.80 IMN.
	GBU-12 (FF, HS, LS)	TANK (150) W/ANY FUEL				0			0	
		TANK (150) EMPTY				5				
	MK-82 LD	TANK (150) W/ANY FUEL						0		
	MK-82 SE / MK-36	TANK (150) W/ANY FUEL						0	0	
	LAU-3/60	TANK (150) W/ANY FUEL							0	

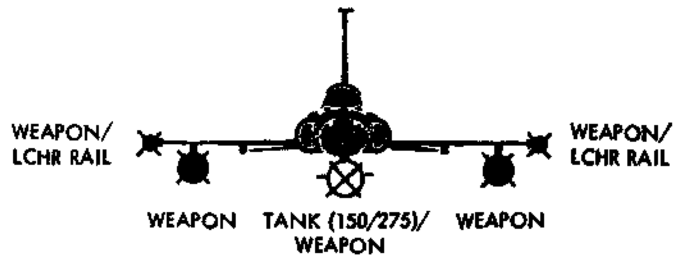
F-5 1-183(1)D

Figure 5-9 (Sheet 9).

IN-FLIGHT CARRIAGE & SEQUENCING LIMITATIONS

* CONFIGURATION LIMITS	
MAX SPEED:	600 KIAS OR 1.2 IMN (WHICHEVER IS LESS)
ACCELERATION LIMITS:	
0.85 IMN OR BELOW:	
SYM (G):	+6.5, -2.0
ROLL ENTRY (G):	+5.2, -1.0
ABOVE 0.85 IMN:	
SYM (G):	+5.0, -2.0
ROLL ENTRY (G):	+4.0, -1.0

* MODIFY ABOVE LIMITS FOR THE SPECIFIC STORE-STATION CONFIGURATIONS LISTED BELOW.



3 PYLON STORES

(INBD – NO PYLON/PYLON)

TIP	OUTBD	INBD	CL	OTHER LIMITATIONS: SYM (G)	ROLL ENTRY (G)	MAX GUNFIRE-SEC. (TOTAL) E 1	E 2	F 1	F 2	SEQUENCING
			TANK (275) W/ANY FUEL	+4.0 -1.5	+3.2 -1.0					
			TANK (275) EMPTY	(1) +6.0 -2.0	(1) +4.8 -1.0					(1) ACCEL LIMITS 0.85 IMN OR BELOW.
			TANK (150) W/WO FUEL	+6.0 -1.5	+4.8 -1.0					
			MK-84 LD	+5.0 -2.0	+4.0 -1.0					
			GBU-10 (FF)							
			M129	+5.0 -1.0	+4.0 0					DO NOT EXCEED 0.90 IMN.
			BLU							
			CBU							DO NOT EXCEED 1.02 IMN.
	MK-82		MER W/ BOMBS	+5.0 -2.0	+4.0 -1.0	5	5			DO NOT EXCEED 560 KIAS.
			MER EMPTY				5			
AIM-9	CBU		MK-84 LD OR TANK (150/275) W/FUEL				5			DO NOT EXCEED 400 KIAS OR 0.85 IMN.
							5			DO NOT EXCEED 520 KIAS OR 0.85 IMN.
	MK-82 LD						5			DO NOT EXCEED 560 KIAS.
	MK-82 SE / MK-36	PYLON				5	5			
	MK-82 SE / MK-36	NO PYLON					5			

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F-5 1-114(1)L

Figure 5-9 (Sheet 10).

IN-FLIGHT CARRIAGE & SEQUENCING LIMITATIONS

* CONFIGURATION LIMITS	
MAX SPEED:	600 KIAS OR 1.2 IMN (WHICHEVER IS LESS)
ACCELERATION LIMITS:	
0.85 IMN OR BELOW:	
SYM (G):	+6.5, -2.0
ROLL ENTRY (G):	+5.2, -1.0
ABOVE 0.85 IMN:	
SYM (G):	+5.0, -2.0
ROLL ENTRY (G):	+4.0, -1.0

* MODIFY ABOVE LIMITS FOR THE SPECIFIC STORE-STATION CONFIGURATIONS LISTED BELOW.

3 PYLON STORES

(INBD — NO PYLON/PYLON)

(CONTINUED FROM PREVIOUS PAGE)

TIP	OUTBD	INBD	CL	OTHER LIMITATIONS: SYM (G)	ROLL ENTRY (G)	MAX GUNFIRE-SEC. (TOTAL) E ①	E ②	F ①	F ②	SEQUENCING	
	GBU-12 (FF, HS, LS)						5				
	M129			+5.0 -1.0	+4.0 0		5			DO NOT EXCEED 520 KIAS OR 0.85 IMN.	
	BLU-1 (F)	PYLON				5	5			—	
	BLU-27 (F)	PYLON				5	5			—	
	BLU-32 (F)	PYLON				5	5			—	
	BLU-1 (F)	NO PYLON					5			—	
	BLU-27 (F)	NO PYLON					5			—	
	BLU-32 (F)	NO PYLON					5			—	
	BLU-1 (U)					5	5			—	
	BLU-27 (U)					5	5			—	
	BLU-32 (U)						5			—	
	SUU-25					5	5			—	
	LAU					5	5			—	
AIM-9	M117		TANK (150/275) W/ANY FUEL			5				DO NOT EXCEED 400 KIAS OR 0.85 IMN.	DO NOT LAUNCH AIM-9's BEFORE RELEASING WING STORES.
AIM-9	M117					5				DO NOT EXCEED 520 KIAS OR 0.85 IMN.	DO NOT LAUNCH AIM-9's BEFORE RELEASING WING STORES.

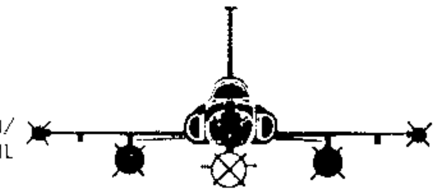
F-5 1-114(2)G

Figure 5-9 (Sheet 11).

IN-FLIGHT CARRIAGE & SEQUENCING LIMITATIONS

* CONFIGURATION LIMITS
MAX SPEED: 600 KIAS OR 1.2 IMN (WHICHEVER IS LESS)
ACCELERATION LIMITS: 0.85 IMN OR BELOW: SYM (G): +6.5, -2.0 ROLL ENTRY (G): +5.2, -1.0 ABOVE 0.85 IMN: SYM (G): +5.0, -2.0 ROLL ENTRY (G): +4.0, -1.0

* MODIFY ABOVE LIMITS FOR THE SPECIFIC STORE-STATION CONFIGURATIONS LISTED BELOW.



3 PYLON STORES

(OUTBD – NO PYLON/PYLON)

TIP	OUTBD	INBD	CL	OTHER LIMITATIONS: SYM (G)	ROLL ENTRY (G)	MAX GUNFIRE-SEC. (TOTAL) (E) (1)	(E) (2)	(F) (1)	(F) (2)	SEQUENCING	
			TANK (275) W/ANY FUEL	+4.0 -1.5	+3.2 -1.0						
			TANK (275) EMPTY	(1) +6.0 -2.0	(1) +4.8 -1.0					(1) ACCEL. LIMITS 0.85 IMN OR BELOW.	
			TANK (150) W/WO FUEL	+6.0 -1.5	+4.8 -1.0						
			MK-84 LD GBU-10 (FF)	+5.0 -2.0	+4.0 -1.0						
			M129	+5.0 -1.0	+4.0 0					DO NOT EXCEED 0.90 IMN.	
			BLU								
			CBU							DO NOT EXCEED 1.02 IMN.	
		MK-82 MK-36				5	0			DO NOT EXCEED 560 KIAS.	(E) RETAIN CL STORE.
		M129		+5.0 -1.5	+4.0 0	5	0			DO NOT EXCEED 520 KIAS OR 0.85 IMN.	
		CBU				5	0				
		LAU-68				5	0				
	PYLON	LAU-3/60				2	0	0			
	NO PYLON	LAU-3/60				2	0				
AIM-9		GBU-12 (FF,HS)				5	2			DO NOT LAUNCH AIM-9's ABOVE 500 KIAS OR 0.80 IMN.	E E-2 [BEFORE T.O. 1F-5E-594] RETAIN CL STORE.
LCHR RAILS		GBU-12 (FF,HS)				5	2			DO NOT EXCEED 500 KIAS OR 0.80 IMN.	

(CONTINUED ON NEXT PAGE)

F-5 1-116(1)H

Figure 5-9 (Sheet 12).

IN-FLIGHT CARRIAGE & SEQUENCING LIMITATIONS

* CONFIGURATION LIMITS	
MAX SPEED:	600 KIAS OR 1.2 IMN (WHICHEVER IS LESS)
ACCELERATION LIMITS:	
0.85 IMN OR BELOW:	
SYM (G):	+6.5, -2.0
ROLL ENTRY (G):	+5.2, -1.0
ABOVE 0.85 IMN:	
SYM (G):	+5.0, -2.0
ROLL ENTRY (G):	+4.0, -1.0

* MODIFY ABOVE LIMITS FOR THE SPECIFIC STORE-STATION CONFIGURATIONS LISTED BELOW.

3 PYLON STORES

(OUTBD — NO PYLON/PYLON)

(CONTINUED FROM PREVIOUS PAGE)

TIP	OUTBD	INBD	CL	SYM (G)	ROLL ENTRY (G)	MAX GUNFIRE-SEC. (TOTAL) E ❶	E ❷	F ❶	F ❷	SEQUENCING
		BLU-27A/B, B/B, C/B								RETAIN CL STORE.
		BLU-1 (U)				2				DO NOT EXCEED 520 KIAS OR 0.85 IMN.
		BLU-27/B (F)								
	PYLON	BLU-1 (F)				2				AIM-9 W/MK-84 LD OR 275 GAL TANK W/ANY FUEL: DO NOT LAUNCH AIM-9'S.
	NO PYLON	BLU-1 (F)				5				
	PYLON	BLU-27/B (U)				0				
	NO PYLON	BLU-27/B (U)				2				
	PYLON	BLU-32 (U)				2	0			W/AIM-9: DO NOT EXCEED 520 KIAS OR 0.85 IMN AND DO NOT LAUNCH AIM-9'S ABOVE 400 KIAS OR 0.80 IMN.
	NO PYLON	BLU-32 (U)				5	0			W/TIP LCHR RAILS: DO NOT EXCEED 400 KIAS OR 0.80 IMN.
		BLU-32 (F)				5	0			E RETAIN CL STORE.
AIM-9		MXU-648		+3.0 0	+2.4 +0.5	0	0	0	0	RETAIN CL STORE. DO NOT EXCEED 450 OR 0.80 IMN. DO NOT LAUNCH AIM-9'S.
AIM-9		MK-83 LD				2				DO NOT EXCEED 520 KIAS OR 0.85 IMN.
AIM-9		M117								DO NOT LAUNCH AIM-9'S BEFORE RELEASING WING STORES.

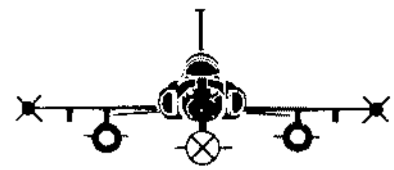
F-5 1-116(2)F

Figure 5-9 (Sheet 13).

IN-FLIGHT CARRIAGE & SEQUENCING LIMITATIONS

* CONFIGURATION LIMITS		
	TANK(S) (275) W/ANY FUEL	INBD TANKS EMPTY
MAX SPEED (WHICHEVER IS LESS):	450 KIAS OR 0.80 IMN	520 KIAS OR 0.85 IMN
ACCELERATION LIMITS:	SYM (G): +4.0, -1.5 ROLL ENTRY (G): +3.2, -1.0	SYM (G): +5.0, -1.5 ROLL ENTRY (G): +4.0, -1.0

* MODIFY ABOVE LIMITS FOR THE SPECIFIC STORE-STATION CONFIGURATIONS LISTED BELOW:



3 PYLON STORES

(OUTBD — NO PYLON/PYLON)

TIP	OUTBD	INBD	CL	OTHER LIMITATIONS: SYM (G)	ROLL ENTRY (G)	MAX GUNFIRE-SEC. (TOTAL) E 1	E 2	F 1	F 2	SEQUENCING
AIM-9	ALL CONFIGURATIONS W/TANKS (275) →									DO NOT LAUNCH AIM-9s BEFORE RELEASING INBD TANKS.
AIM-9			EXCEPT MER				2			
AIM-9			M129	+5.0 -1.0	+4.0 0					
AIM-9			MXU-648	+3.0 0	+2.4 +0.5	0	0			
AIM-9		TANK (275) W/ANY FUEL	MER W/ BOMBS			2	0			
AIM-9		TANK (275) EMPTY	MER W/ BOMBS			2	2			
AIM-9		TANK (275) W/ANY FUEL	MER EMPTY			5	2			
AIM-9		TANK (275) EMPTY	MER EMPTY				2			

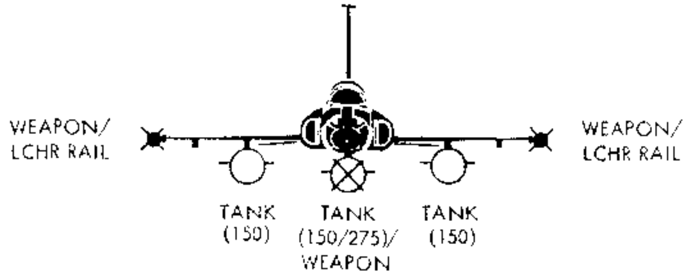
F-5 1-119(1)J

Figure 5-9 (Sheet 14).

IN-FLIGHT CARRIAGE & SEQUENCING LIMITATIONS

* CONFIGURATION LIMITS	
MAX SPEED:	560 KIAS OR 1.2 IMN (WHICHEVER IS LESS)
ACCELERATION LIMITS:	
0.85 IMN OR BELOW:	
SYM (G):	+6.0, -1.5
ROLL ENTRY (G):	+4.8, -1.0
ABOVE 0.85 IMN:	
SYM (G):	+5.0, -1.5
ROLL ENTRY (G):	+4.0, -1.0

* MODIFY ABOVE LIMITS FOR THE SPECIFIC STORE-STATION CONFIGURATIONS LISTED BELOW.



3 PYLON STORES

(OUTBD — NO PYLON/PYLON)

TIP	OUTBD	INBD	CL	OTHER LIMITATIONS: SYM (G)	ROLL ENTRY (G)	MAX GUNFIRE-SEC. (TOTAL) E 1	E 2	F 1	F 2	SEQUENCING
			TANK (275) W/ANY FUEL	+4.0 -1.5	+3.2 -1.0					
			MK-84 LD / GBU-10 (FF)	+5.0 -1.5	+4.0 -1.0					
			M129	+5.0 -1.0	+4.0 0					DO NOT EXCEED 0.90 IMN.
			BLU							
			CBU							DO NOT EXCEED 1.02 IMN.
			MXU-648	+3.0 0	+2.4 +0.5	0	0			DO NOT EXCEED 520 KIAS OR 0.85 IMN.
		TANK (150) W/WO FUEL	EXCEPT MER				2			
LCHR RAILS		TANK (150) W/ANY FUEL					2			DO NOT EXCEED 400 KIAS OR 0.80 IMN.
		TANK (150) EMPTY					2			DO NOT EXCEED 520 KIAS OR 0.85 IMN.
		TANK (150) W/ANY FUEL	MER W/ BOMBS	+5.0 -1.5	+4.0 -1.0	2	0			
		TANK (150) EMPTY				2	2			
		TANK (150) W/ANY FUEL	MER EMPTY			5	2			
		TANK (150) EMPTY					2			

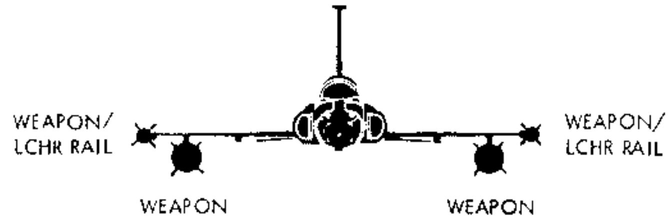
F-5 1-120(1)J

Figure 5-9 (Sheet 15).

IN-FLIGHT CARRIAGE & SEQUENCING LIMITATIONS

* CONFIGURATION LIMITS	
MAX SPEED:	600 KIAS OR 1.2 IMN (WHICHEVER IS LESS)
ACCELERATION LIMITS: 0.85 IMN OR BELOW:	
SYM (G):	+6.5, -2.0
ROLL ENTRY (G):	+5.2, -1.0
ABOVE 0.85 IMN:	
SYM (G):	+5.0, -2.0
ROLL ENTRY (G):	+4.0, -1.0

* MODIFY ABOVE LIMITS FOR THE SPECIFIC STORE-STATION CONFIGURATIONS LISTED BELOW.



2 PYLON STORES

(CL & INBD — NO PYLON/PYLON)

TIP	OUTBD	INBD	CL	OTHER LIMITATIONS: SYM (G)	ROLL ENTRY (G)	MAX GUNFIRE-SEC. (TOTAL) E ①	E ②	F ①	F ②	SEQUENCING
	MK-82 LD						5			DO NOT EXCEED 560 KIAS.
	MK-82 SE	PYLON				5	5			
	MK-36									
	MK-82 SE	NO PYLON					5			
	MK-36									
	GBU (FF, HS, LS)						5			
	M129			+5.0 -1.0	+4.0 0		5			DO NOT EXCEED 520 KIAS OR 0.85 IMN.
	CBU						5			
	LAU					5	5			
	SUU-25									
	BLU-1 (U)									
	BLU-27 (U)									
	BLU-1 (F)	PYLON				5	5			
	BLU-27 (F)									
	BLU-32 (F)									
	BLU-1 (F)	NO PYLON					5			
	BLU-27 (F)									
	BLU-32 (F)									
	BLU-32 (U)						5			
AIM-9	M117					5				DO NOT EXCEED 520 KIAS OR 0.85 IMN. DO NOT LAUNCH AIM-9's BEFORE RELEASING WING STORES.

F-5 1-180(1)E

Figure 5-9 (Sheet 16).

IN-FLIGHT CARRIAGE & SEQUENCING LIMITATIONS

* CONFIGURATION LIMITS	
MAX SPEED:	600 KIAS OR 1.2 IMN (WHICHEVER IS LESS)
ACCELERATION LIMITS:	
0.85 IMN OR BELOW:	
SYM (G):	+6.5, -2.0
ROLL ENTRY (G):	+5.2, -1.0
ABOVE 0.85 IMN:	
SYM (G):	+5.0, -2.0
ROLL ENTRY (G):	+4.0, -1.0

* MODIFY ABOVE LIMITS FOR THE SPECIFIC STORE-STATION CONFIGURATIONS LISTED BELOW.

2 PYLON STORES

(CL & OUTBD – NO PYLON/PYLON)

TIP	OUTBD	INBD	CL	SYM (G)	ROLL ENTRY (G)	MAX GUNFIRE-SEC. (TOTAL) E 1	E 2	F 1	F 2	SEQUENCING
AIM-9		GBU-12 (FF,HS)				5				DO NOT LAUNCH AIM-9's ABOVE 500 KIAS OR 0.80 IMN.
LCHR RAILS		GBU-12 (FF,HS)				5				DO NOT EXCEED 500 KIAS OR 0.80 IMN.
AIM-9		BLU-32								DO NOT EXCEED 520 KIAS OR 0.85 IMN. DO NOT LAUNCH AIM-9's ABOVE 400 KIAS OR 0.80 IMN.
LCHR RAILS		BLU-32								DO NOT EXCEED 400 KIAS OR 0.80 IMN.
		MK-82								DO NOT EXCEED 560 KIAS.
		MK-36								
		M129		+5.0 -1.0	+4.0 0					DO NOT EXCEED 520 KIAS OR 0.85 IMN.
		CBU								
		LAU-68								
	PYLON	LAU-3/60						0		
	NO PYLON	LAU-3/60								
AIM-9		MK-83 LD				2				DO NOT EXCEED 520 KIAS OR 0.85 IMN. DO NOT LAUNCH AIM-9's BEFORE RELEASING WING STORES.
		M117								

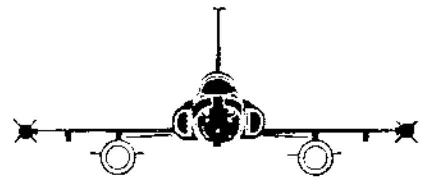
F-5 1-186(1)E

Figure 5-9 (Sheet 17).

IN-FLIGHT CARRIAGE & SEQUENCING LIMITATIONS

* CONFIGURATION LIMITS	
MAX SPEED:	560 KIAS OR 1.2 IMN (WHICHEVER IS LESS)
ACCELERATION LIMITS:	
0.85 IMN OR BELOW:	
SYM (G):	+6.0, -1.5
ROLL ENTRY (G):	+4.8, -1.0
ABOVE 0.85 IMN:	
SYM (G):	+5.0, -1.5
ROLL ENTRY (G):	+4.0, -1.0

* MODIFY ABOVE LIMITS FOR THE SPECIFIC STORE-STATION CONFIGURATIONS LISTED BELOW.



2 PYLON STORES

(CL & OUTBD — NO PYLON/PYLON)

TIP	OUTBD	INBD	CL	OTHER LIMITATIONS: SYM (G)	ROLL ENTRY (G)	MAX GUNFIRE-SEC. (TOTAL) E ❶	E ❷	F ❶	F ❷	SEQUENCING	
AIM-9		TANK (275) W/ANY FUEL		+4.0 -1.5	+3.2 -1.0		2			DO NOT EXCEED 450 KIAS OR 0.80 IMN.	DO NOT LAUNCH AIM-9'S BEFORE RELEASING INBD TANKS.
		TANK (275) EMPTY		+5.0 -1.5	+4.0 -1.0		2			DO NOT EXCEED 520 KIAS OR 0.85 IMN.	
		TANK (150) W/WO FUEL					2				
LCHR RAILS		TANK (150) W/ANY FUEL					2			DO NOT EXCEED 400 KIAS OR 0.80 IMN.	
		TANK (150) EMPTY					2			DO NOT EXCEED 520 KIAS OR 0.85 IMN.	

F-5 1-181(1)E

Figure 5-9 (Sheet 18).

IN-FLIGHT CARRIAGE & SEQUENCING LIMITATIONS

✱ CONFIGURATION LIMITS	
MAX SPEED:	650 KIAS OR 1.4 IMN (WHICHEVER IS LESS).
ACCELERATION LIMITS:	
SYM (G):	+6.5, -2.0
ROLL ENTRY (G):	+5.2, -1.0

✱ MODIFY ABOVE LIMITS FOR THE SPECIFIC STORE-STATION CONFIGURATIONS LISTED BELOW.

1 CL STORE

(OUTBD & INBD — NO PYLON/PYLON)

TIP	OUTBD	INBD	CL	OTHER LIMITATIONS: SYM (G)	ROLL ENTRY (G)	MAX GUNFIRE-SEC. (TOTAL) E ❶	E ❷	F ❶	F ❷	SEQUENCING
		PYLON					5			
			TANK (275) W/ANY FUEL	+4.0 -1.5	+3.2 -1.0					W/ TDU-11/B: DO NOT EXCEED 450 KIAS OR 0.95 IMN.
			TANK (275) EMPTY	+6.0 -2.0	+4.8 -1.0					
			TANK (150) W/ANY FUEL	+6.0 -1.5	+4.8 -1.0					
			TANK (150) EMPTY	+6.0 -1.5	+4.8 -1.0					SYM(G) LIMIT: +7.0, -1.5 BELOW 600 KIAS OR 1.4 IMN.
			MK-84 LD GBU-10 (FF)	+5.0 -2.0	+4.0 -1.0					DO NOT EXCEED 1.3 IMN.
			SUU-20							
			MK-82							DO NOT EXCEED 1.2 IMN.
			GBU-12 (FF)							
			MK-36							
			M129	+5.0 -1.0	+4.0 0					DO NOT EXCEED 600 KIAS OR 0.90 IMN.
			BLU							
			CBU							DO NOT EXCEED 1.02 IMN.
			MER W/ BOMBS	+5.0 -2.0	+4.0 -1.0		5			DO NOT EXCEED 600 KIAS OR 1.2 IMN.
			MER EMPTY				5			

(CONTINUED ON NEXT PAGE)

F-5 1-115(1)N

Figure 5-9 (Sheet 19).

IN-FLIGHT CARRIAGE & SEQUENCING LIMITATIONS

* CONFIGURATION LIMITS	
MAX SPEED:	650 KIAS OR 1.4 IMN (WHICHEVER IS LESS).
ACCELERATION LIMITS:	
SYM (G):	+6.5, -2.0
ROLL ENTRY (G):	+5.2, -1.0

* MODIFY ABOVE LIMITS FOR THE SPECIFIC STORE-STATION CONFIGURATIONS LISTED BELOW.

1 CL STORE

(CONTINUED FROM PREVIOUS PAGE)

TIP	OUTBD	INBD	CL	OTHER LIMITATIONS: SYM (G)	ROLL ENTRY (G)	MAX GUNFIRE-SEC. (TOTAL) E 1	E 2	F 1	F 2	SEQUENCING
			MK-83 LD	+6.0 -2.0	+4.8 -1.0					DO NOT EXCEED 1.3 IMN.
			M117							DO NOT EXCEED 600 KIAS.
AIS POD			TANK (275) W/ANY FUEL	+4.0 -1.5	+3.2 -1.0					DO NOT EXCEED 450 KIAS OR 0.8 IMN.
			TANK (275) EMPTY	+6.0 -2.0	+4.8 -1.0					
			TANK (150) W/ANY FUEL	+6.0 -1.5	+4.8 -1.0					DO NOT EXCEED 450 KIAS OR 0.8 IMN.
			TANK (150) EMPTY	+6.0 -1.5	+4.8 -1.0					SYM (G) LIMIT: +7.0 BELOW 600 KIAS OR 1.4 IMN.

F-5 1-115(2)A

Figure 5-9 (Sheet 20).

IN-FLIGHT CARRIAGE & SEQUENCING LIMITATIONS

*** CONFIGURATION LIMITS**

MAX SPEED: 710 KEAS OR 2.0 IMN (WHICHEVER IS LESS)

ACCELERATION LIMITS:
- SYM (G): +7.33, -3.0
- ROLL ENTRY (G): +5.8, -1.0

W/INTERNAL FUEL MORE THAN 2200 LB:
- (E) 0.95 TO 2.0 IMN
- (F) 0.90 TO 2.0 IMN
- SYM (G): +6.5, -3.0
- ROLL ENTRY (G): +5.2, -1.0

* MODIFY ABOVE LIMITS FOR THE SPECIFIC STORE-STATION CONFIGURATIONS LISTED BELOW.

TIP STORES

(OUTBD, INBD, & CL — NO PYLON/PYLON)

TIP	OUTBD	INBD	CL	OTHER LIMITATIONS						
				SYM (G)	ROLL ENTRY (G)	MAX GUNFIRE-SEC. (TOTAL) (E)		(F)		SEQUENCING
						(1)	(2)	(1)	(2)	
		PYLON					5			

F-5 1-123(1)E

Figure 5-9 (Sheet 21).

EMPLOYMENT/RELEASE/JETTISON LIMITS

CAUTION

- THE EMPLOYMENT/RELEASE/JETTISON LIMITS FOR ANY ONE STORE SHALL NOT EXCEED CONFIGURATION CARRIAGE LIMITS.
- LANDING GEAR SHOULD BE UP FOR ALL STORES RELEASE/JETTISON IN FLIGHT.

STORE/ MUNITION	STATION TIP	STATION OUT-BD	STATION IN-BD	STATION CL	EMPLOYMENT AIRSPEED MIN KIAS	EMPLOYMENT AIRSPEED MAX KIAS	EMPLOYMENT AIRSPEED MAX *IMN	EMPLOYMENT G ACCEL	RELEASE-JETTISON AIRSPEED MIN KIAS	RELEASE-JETTISON AIRSPEED MAX KIAS	RELEASE-JETTISON AIRSPEED MAX *IMN	RELEASE-JETTISON G ACCEL	DIVE ∠ DEG	MANUV/AUTO FLAP	SPEED BRAKE	REMARKS
AIM-9	●				(SAME AS CARRIAGE LIMITS)								—	OPT	OPT	REFER TO T.O. 1F-5E-34-1-1
TDU-11/B	●				(SAME AS CARRIAGE LIMITS)								—	OPT	OPT	
PYLON (EMPTY)		●	●	●					250	375	0.85	+1.0	0	UP	IN	
TANK (150/275)				●					150	450	0.95	+1.0	0	UP	IN	
			●								0.85					
MK-82 LD				●					150	530	0.90	+2.0 TO +0.5	0-60	OPT	OPT	
										600	0.98				IN	
		●	●							550	0.90				OPT	
MK-82 SE/ MK-36				●					150	(1) 450	0.90	+2.0 TO +0.5	0-60	OPT	IN	
		●	●							(1) 450	0.90				OPT	
MER										375	0.85	+1.0	0	UP	IN	LOADED OR EMPTY
MK-82 LD				●	150	550	0.90	+2.0 TO +0.5					0-60	OPT	IN	
MK-82 SE						(1) 450										
MK-83 LD				●					200	500	0.90	+1.5 TO +0.5	0-60	OPT	OPT	
										600	0.98			OPT	IN	
			●							520	0.85			OPT	OPT	
MK-84 LD				●						520	0.95	+1.5 TO +0.5	0-60	OPT	OPT	
										640					IN	
M117				●					200	500	0.90	+1.5 TO +0.5	0-60	OPT	OPT	
										600	0.98			OPT	IN	
		●	●							520	0.85			OPT	OPT	
M129E2		●	●	●					170	400	0.85	+1.5 TO +0.5	0-45	UP	IN	
CBU				●					200	500	0.90	+2.0 TO +0.5	0-60	OPT	OPT	
										600	0.98				IN	
		●	●							520	0.85				OPT	
LAU		●	●						170	400 / 360	0.85	+1.0	0	UP	IN	FULL / EMPTY
2.75 FFAR						(2) 520	0.85	+1.5 +0.5					0-60	OPT	OPT	

*WHICHEVER IS LESS.

F-5 1-124(4)C

Figure 5-10 (Sheet 1).

EMPLOYMENT/RELEASE/JETTISON LIMITS (CONTD)

STORE/ MUNITION	STATION TIP	STATION OUT-BD	STATION IN-BD	STATION CL	EMPLOYMENT AIRSPEED MIN KIAS	EMPLOYMENT AIRSPEED MAX KIAS	EMPLOYMENT AIRSPEED MAX *IMN	EMPLOYMENT G ACCEL	RELEASE-JETTISON AIRSPEED MIN KIAS	RELEASE-JETTISON AIRSPEED MAX KIAS	RELEASE-JETTISON AIRSPEED MAX *IMN	RELEASE-JETTISON G ACCEL	DIVE ∠ DEG	FLAPS	SPEED BRAKE	REMARKS
SUU-20				●					150	400	0.85	+1.0	0	UP	IN	
2.75 FFAR						550	0.90	+1.5 +0.5					0-60	OPT	IN	SINGLE OR RIPPLE FIRE ONLY
BDU-33/ MK-106								+4.0 +0.5							OPT	
SUU-25		●							170	400	0.85	+1.0	0	UP	IN	LOADED OR EMPTY
FLARE/ MARKER					300	500	0.85	1.0								
GBU-10 (FF)				●						520	0.95	+2.0 TO +0.5	0-60	OPT	OPT	
										640					IN	
GBU-12 (FF)				●					150	530	0.90	+1.5 TO +0.5	0-60	OPT	OPT	
										600	0.98				IN	
GBU-12 (FF,HS)		●	●						200	550	0.90	+1.5 TO +0.5	0-60	OPT	OPT	
GBU-12 (LS)		●														
BLU				●					200	500	0.90	+1.5 TO +0.5	0-60	OPT	OPT	FINNED
										560					IN	
		●	●							❸ 500	0.85				OPT	
				●					200	500	0.90	+1.5 TO +0.5	0-30	OPT	OPT	UNFINNED
										540					IN	
		●	●							❸ 500	0.85	+1.5 TO +0.87	0-30	UP	OPT	
TDU-10/B		●			190	220	—	+1.0					0	MAN/ AUTO	IN	REFER TO T.O. 1F-5E-34-1-1

* WHICHEVER IS LESS.

❶ MAX SPEED 350 KIAS FOR FIN OPEN RELEASE (ARMED) WITH FINS MODE 0, 1, AND 2 INSTALLED.

Note

FIN MODS 0, 1, AND 2 ARE ATTACHED TO BOMB BODY WITH A SNAP RING AND GARTER SPRING AND DO NOT HAVE SETSCREW ACCESS HOLES IN FINS.

❷ MAX SPEED SALVO FIRING LAU-3/60:

475 KIAS W/STABILITY AUGMENTER ON.
425 KIAS W/STABILITY AUGMENTER OFF.

❸ WITH OUTBD BLU AND INBD TANKS, MAXIMUM RELEASE-JETTISON SPEED IS 475 KIAS OR 0.85 IMN (WHICHEVER IS LOWER), +0.87 TO +1.5-G ACCEL.

F-5 1-12553(C)

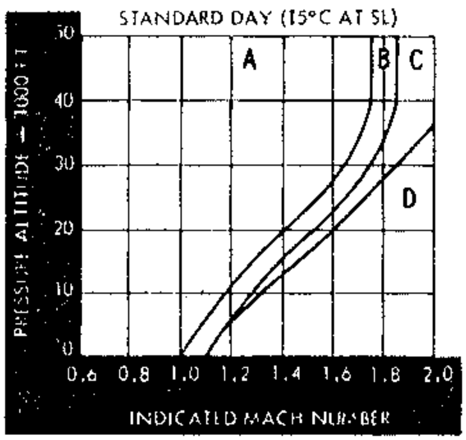
Figure 5-10 (Sheet 2).

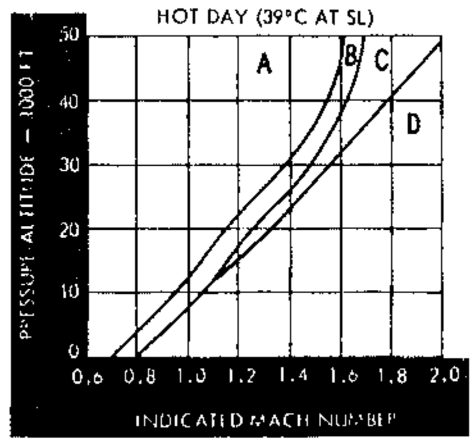
WINGTIP MISSILE LIMITATION WITH MK 8 MOD 1 OR 2 WARHEAD

AIM-9B/E/J/N/P series missiles equipped with a MK 8 MOD 1 or 2 warhead are sensitive to air friction heat buildup, which may cause low order warhead detonation. The airspeed/altitude region restrictions and limitations are shown in figure 5-11.

WINGTIP MISSILE WARHEAD LIMITATION

WITH MK 8 MOD 1 OR 2 WARHEAD





AREA A	NO RESTRICTION.
AREA B	REPEATED EXCURSIONS OF NO MORE THAN 10 MINUTES EACH ARE PERMITTED.
AREA C	REPEATED EXCURSIONS OF NO MORE THAN 5 MINUTES EACH ARE PERMITTED.
AREA D	AVOID.

CAUTION

- IF LIMITATIONS OF AREAS B, C, AND D ARE EXCEEDED, THE WARHEAD SHOULD BE DESTROYED BY JETTISONING THE MISSILE.
- IF JETTISON OF MISSILE IS NOT POSSIBLE, LANDING IS WITH THE RISK OF LOW ORDER WARHEAD DETONATION.

Note

INSPECTION OF WARHEAD REQUIRED IF MISSILE RETURNED AFTER FLIGHT WITHIN AREAS B AND C.

F-5 1-201(2)

Figure 5-11.

SECTION VI
FLIGHT CHARACTERISTICS

F-5 1-80(1)

TABLE OF CONTENTS

GENERAL FLIGHT CHARACTERISTICS

NOTE

The term *earlier aircraft* as used within this section refers to [E] [E-1] [E-2] [F] and [F-1] configurations, equipped with the maneuver flap system. Use of the term *later aircraft* indicates [E-3] and [F-2] configurations, equipped with the auto flap system and modified for improved handling qualities with the shark nose radome and wing leading edge extension.

The aircraft is a high-performance, multipurpose tactical fighter with a primary mission of air superiority in the aerial combat maneuvering (ACM) environment. Leading and trailing edge flaps are used to increase wing lift, delay buffet onset and generally improve the maneuver capability of the aircraft. On earlier aircraft, maneuver flaps should be selected when initiating a maneuver above 1-g flight and the flaps retracted in less than 1-g flight. On later aircraft, auto flaps should be selected to provide the optimum flap position for existing airspeed and angle-of-attack (AOA). Maneuver flaps should be retracted when accelerating, to reduce drag. With auto flaps, check that flaps have automatically retracted.

The two-axis (pitch and yaw) stability augmenter system provides improved flight characteristics. The aircraft can be maneuvered throughout the flight envelope with the augmenters disengaged with minimal degradation of flying qualities.

The aircraft can maneuver to the structural limiting g-load above 360 KIAS. Below 360 KIAS, the aircraft is aerodynamically lift-limited rather than structurally limited, and maximum lift capability is attained near stall AOA. For earlier aircraft, stall occurs at approximately 24 units AOA and is characterized primarily by wing rock and/or uncommanded yaw oscillations. For later aircraft, stall occurs at approximately 27 to 28 units AOA, and the dominant characteristic is wing rock and/or wing drop. For all aircraft, full aft stick in most cases produces AOAs above stall with a resultant increase in drag. In general, buffet onset (13 to 14 units AOA without flaps, 15 to 17 units AOA with flaps) can be used as a guide to indicate when maximum sustained level turn performance is attained.

Maneuvering and handling qualities are degraded at lower airspeeds; therefore, a minimum of 300 KIAS should be maintained except for instrument approaches, maximum range descents, landings, and tactical maneuvering. The objective for establishing a minimum airspeed is to maintain a satisfactory energy state (i.e., g available) that provides desired recovery response if an undesirable flight parameter is encountered below 15,000 ft. AGL.

CONTROL EFFECTIVENESS

PITCH

The horizontal tail provides satisfactory pitch control above 100 KIAS, but control decreases rapidly below 100 KIAS. In the 0.90 to 0.95 mach region with the clean aircraft, or near the limiting mach number with stores, pitch sensitivity is increased. This increased pitch sensitivity can produce g overshoots and may make the aircraft more difficult to trim, especially with the pitch damper off.

WARNING

Rapid aft stick inputs may result in the generation of high pitch rates that can drive the AOA beyond stall where PSG or spin entry is possible.

CAUTION

G-limit overshoot may occur as a result of abrupt control input.

NOTE

Rapid aft stick input causes pitch change rate up to eight units AOA per second. Abrupt aft stick input causes pitch change rate greater than eight units AOA per second.

For earlier aircraft, use of maneuver flaps increases pitch sensitivity and lack of precise aircraft control is apparent in pushovers to zero or negative-g flight conditions. This could lead to a negative-g overshoot giving the appearance of a runaway nose-down trim. Positive corrective action must be taken to stop the motion or the aircraft may enter into an inverted pitch hangup (IPH). IPH is a natural aircraft tendency to hangup at a negative g and is discussed under Inverted Pitch Hangup. When attempting to accelerate near zero g, the flaps should be raised to reduce drag and the IPH tendency. On later aircraft with auto flaps selected and the flaps positioned down, increased pitch sensitivity and lack of precise aircraft control is also evident in pushovers to zero or negative-g flight, and can lead to mild negative-g overshoot and the appearance of excessive nose-down trim. With fixed flaps selected, the negative-g overshoot is exaggerated since the flaps do not automatically retract, and may give the appearance of runaway nose-down trim. With either flap system automatic shifting of the flaps causes pitch trim changes, which are most apparent above 0.90 IMN. Pitch trim changes also occur with speed brake movement, and may either be nose-up or nose-down, depending on airspeed and altitude.

ROLL/YAW

Ailerons provide effective roll control below approximately 20 units AOA. Use of aileron (to the spring stop) produces high roll rates, particularly in the 0.80 to 0.95 Mach region, and can result in significant g increase due to roll coupling (see ROLL ENTRY G). Above approximately 20 units AOA, roll control with aileron is less effective because adverse sideslip is produced which tends to counter the commanded aileron input. In order to reduce this effect a proper blend of rudder with aileron is required. The addition of rudder also results in yaw rate which can couple with roll rate to further increase the angle of attack. This phenomenon is termed roll/yaw coupling.

The rudder may be used throughout the flight envelope. It provides good roll control particularly at low airspeed and/or high AOA conditions. However, if the aircraft is flown to an AOA above stall, roll hesitations or oscillations develop. At or near zero g the rudder yaws but does not roll the aircraft; as negative g increases, the aircraft rolls opposite to the rudder input. The yaw stability augmenter reduces the effects of turbulence and aids in precise control of the aircraft.

During rolling maneuvers roll/yaw coupling causes the AOA to increase above the roll entry AOA. Aggressive rudder rolls performed with partial/full sustained rudder can produce AOAs above stall; and when accompanied by a nose up pitch command the AOA can be driven well above stall.

WARNING

PSG/spin entry may occur as a result of nose up pitch commands applied during aggressive or sustained rudder rolls.

NOTE

A large rudder roll rate may mask a rapidly increasing yaw rate.

ROLL ENTRY G

The same phenomenon, roll/yaw coupling, which causes AOA to increase results in an increase in g. For this reason roll entry g is established to avoid exceeding the maximum g limit during a rolling maneuver. Roll entry g should not be interpreted as the maximum permissible load factor during a rolling maneuver. Normally, the load factor increases during a roll depending on angle-of-attack, roll rate, etc. Roll entry g levels are established by determining the g level at which a maximum rate, 360-degree roll (aileron to the spring stop) can be initiated without exceeding the maximum allowable load factor. For example, an aircraft with an empty centerline fuel tank may enter a maximum rate rolling maneuver with 4.8 g established and be assured that 6.0 g will not be exceeded, provided no aft stick is applied during the maneuver. The maximum allowable load factor differs with aircraft configuration and, therefore, various roll entry g levels have been established (see section V).

Exceeding the aileron spring stop at the maximum allowable roll entry g causes the maximum g limit to be exceeded. Rolling maneuvers can be initiated at g levels above the established roll entry g if less than a maximum rate roll is performed; however, some g increase occurs during the maneuver. Because of roll coupling, use care when applying abrupt aileron-plus-rudder in the same direction because g limit may be exceeded.

HIGH PITCH ATTITUDE/LOW AIRSPEED

When performing less than 75 degrees pitch attitude/low airspeed maneuvers, such as straight-ahead zooms, the aircraft can be maneuvered well below 1 g stall speed. With the controls trimmed to maintain the climb, no additional flight control input is required for recovery. The aircraft pitches toward the horizon at approximately zero g until a diving attitude is achieved and flying speed is regained. If the trim is forward or if forward stick is applied during recovery from a zoom, the aircraft may pitch over and enter an inverted PSG or inverted spin. At pitch attitudes greater than 75 degrees, the recommended vertical recovery is a coordinated roll to the nearest horizon, maintain aft stick to bring the nose below the horizon and, as airspeed is regained, recover from inverted flight.

NOTE

For aircraft equipped with manuever flaps, recommend flaps be raised to avoid IPH.

It is important that this vertical recovery be initiated prior to reaching 100 KIAS during the zoom. If recovery is delayed and airspeed decreases below 100 KIAS, pitch control is not sufficient to control the aircraft, particularly if airspeed approaches zero. Aircraft recovery from high-pitch attitude zooms to near-zero airspeed typically occurs in one of three ways:

(1) If the pitch attitude has rotated past the nose-up vertical position, the

nose falls through to an inverted wings-level attitude.

(2) If the pitch attitude has not reached the nose-up vertical, the aircraft pitches forward and overrotates through the nose-down vertical position to an inverted flight condition, or:

(3) Regardless of pitch attitude with respect to nose-up vertical, if the aircraft falls off on one wing, it may roll to inverted flight.

Regardless of the type of recovery, the aircraft typically ends up in inverted flight at low airspeed. Airspeed increases slowly while inverted and full aft stick is not effective in rotating the aircraft to a nose-down pitch attitude for recovery until airspeed increases above approximately 100 KIAS. While inverted the aircraft may yaw and roll and enter an IPH, an inverted PSG, or inverted spin. The inverted PSG or inverted spin can be a violent, disorienting maneuver, but may be recoverable if sufficient altitude is available (see INVERTED PSG/SPIN). The aircraft remains in a 1 to 2 negative g condition while oscillating about all axes until recovery is accomplished.

WARNING

Initiate recovery prior to 100 KIAS during zooms in which pitch attitude exceeds approximately 75 degrees. If this pitch attitude is not decreased and airspeed is allowed to approach zero (allowing the aircraft to tail slide) before recovery is attempted, sufficient pitch control is not available for immediate recovery and inverted PSG/spin entry is highly probable.

ERECT STALLS/POSTSTALL GYRATIONS/SPINS Ⓔ

GENERAL

The aircraft in the clean configuration resist departure from controlled flight, particularly when the cg is forward and maneuver/ auto flaps are selected. Clean aircraft stall for all flap positions occurs at approximately 24-26 units AOA in earlier aircraft, and 27-28 units AOA in later aircraft with IHQ modifications. Stall normally occurs prior to reaching full aft stick. See figure 6-1, sheets 1 and 2 for stall speeds of earlier and later configuration aircraft.

Stalls [E] [E-1] [E-2]

With maneuver flaps (earlier aircraft), buffet onset occurs at approximately 15-17 units AOA. The initial buffet is of light-to-moderate intensity and gradually increases as AOA is increased toward stall. One-g stalls with maneuver flaps are characterized by a slight nose drop and onset of wing rock. If the stick is brought to full aft and held, the wing rock continues and AOA may exceed 30 units (maximum readable on AOA gauge). As stall AOA is attained in accelerated stalls, the wing rock is accompanied by a decreased capability to maintain a g-level or turn rate. In accelerated stalls above 250 KIAS, minimum flap deflection is provided with maneuver flaps selected and the wing rock may be initiated by a mild nose slice which usually causes the aircraft to roll out of turn. Precise aircraft control is regained immediately upon relaxing aft stick pressure to reduce AOA below stall which, in turn, terminates the wing rock. If the stall and/or full aft stick is maintained, the wing rock is sustained and frequency of the wing rock is increased over that observed in the 1-g stalls. With flaps up, buffet onset occurs at approximately 13-14 units AOA and buffet intensity does not increase significantly as AOA is increased toward stall. Stalls with flaps up are generally characterized by a mild nose slice followed by wing rock. These post-stall motions are mild in 1-g stalls and the motions become more abrupt in accelerated stalls. However, as with maneuver flaps, the stall is easily terminated by relaxing aft stick pressure. With cruise flaps, stall characteristics are essentially the same as those observed with flaps up.

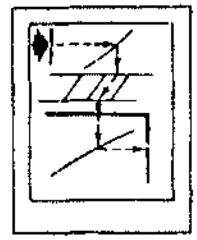
Stalls [E-3]

With auto flaps (later aircraft), buffet onset occurs at approximately 15-17 units AOA. The initial buffet is of light-to-moderate intensity and gradually increases as AOA is increased to-

STALL SPEED CHART

FLAPS AND/OR GEAR UP OR DOWN

E E-1 E-2 F F-1



DATA BASIS
- FLIGHT TEST
- ALL CONFIGURATIONS
- IDLE THRUST

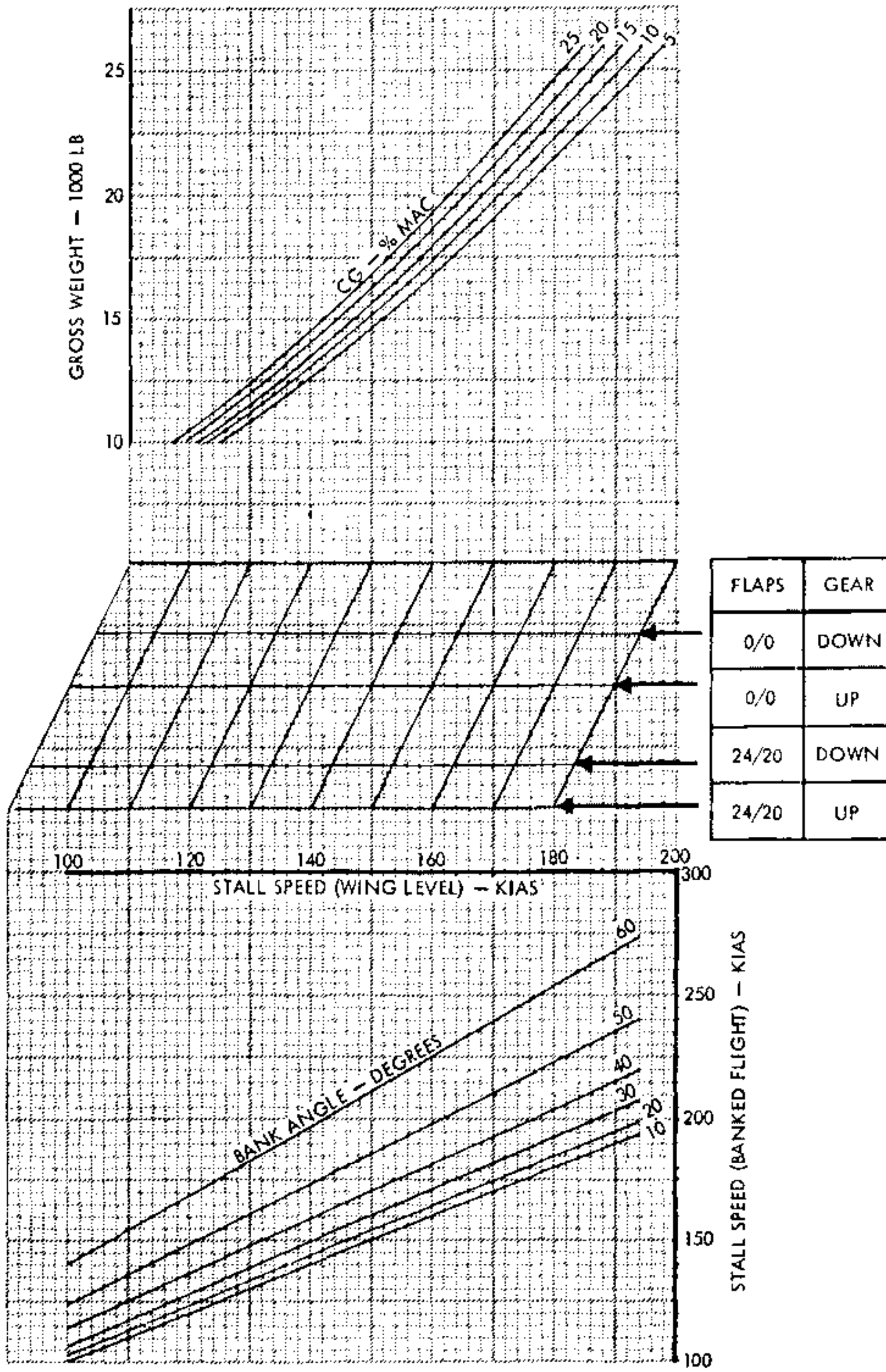


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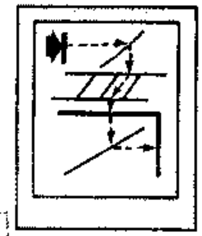
Figure 6-1 (Sheet 1).

STALL SPEED CHART

FLAPS AND/OR GEAR UP OR DOWN



E-3

F-2

DATA BASIS
- FLIGHT TEST
- ALL CONFIGURATIONS
- IDLE THRUST

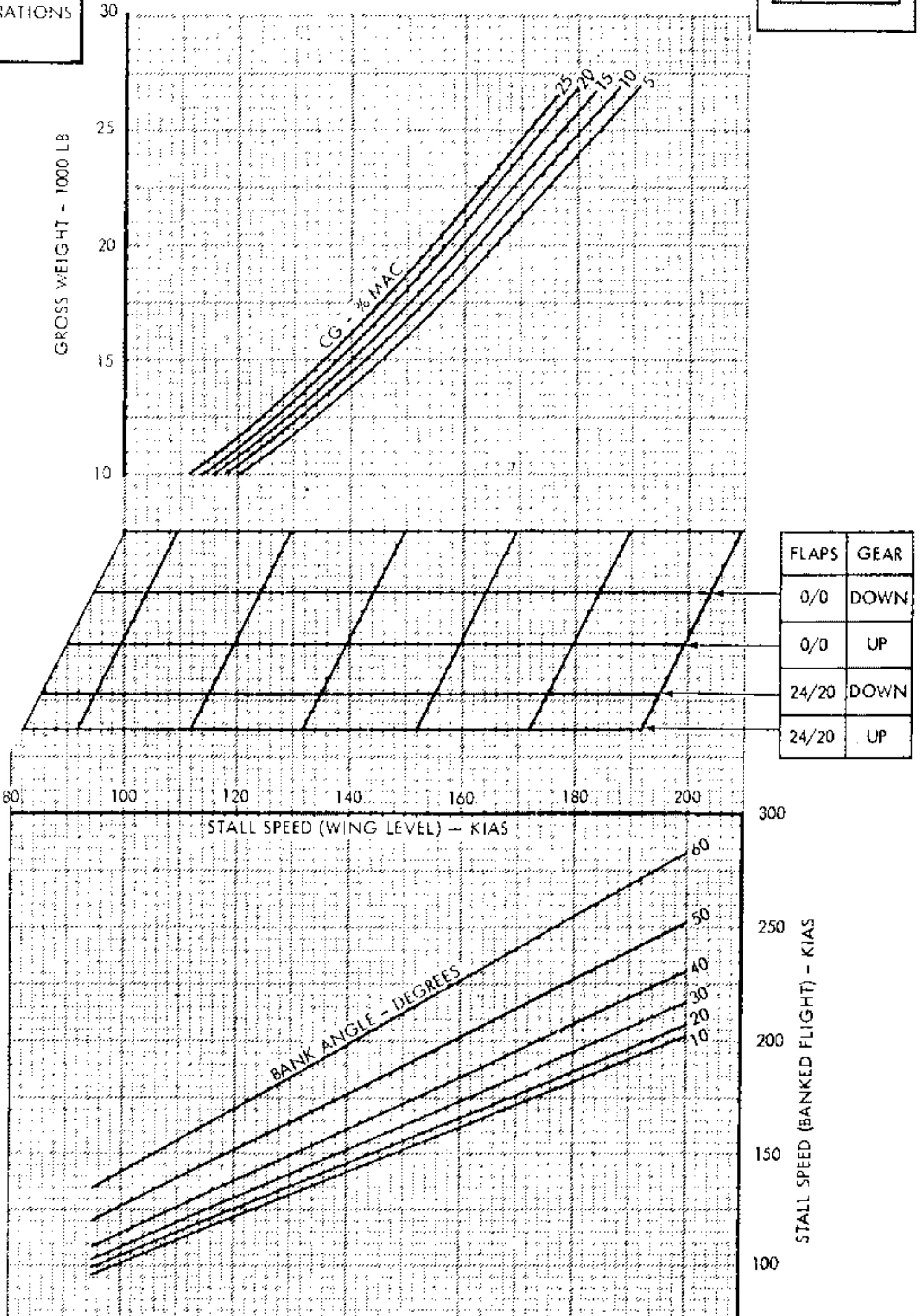


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Figure 6-1 (Sheet 2).

ward stall. One-g stalls with auto flaps are characterized by a random wing drop. If the stick is brought full aft and held, a wing rock may develop and cause AOA to exceed 30 units (maximum readable on AOA indicator). As stall AOA is attained in accelerated stalls, the wing rock is accompanied by a decreased capability to maintain a g-level or turn rate. Precise aircraft control is regained immediately upon relaxing aft stick pressure to reduce AOA below stall and terminate the wing rock. If full aft stick is maintained, the wing rock is sustained with no increase in frequency over that observed in the 1-g stalls.

With flaps up, buffet onset occurs at approximately 13-14 units AOA and buffet intensity does not increase significantly as AOA is increased toward stall. Stalls with flaps up are also characterized by a random wing drop. Post-stall motions are mild in 1-g stalls and the motions become more abrupt in accelerated stalls. However, as with auto flaps, the stall is easily terminated by relaxing aft stick pressure.

With fixed flaps below approximately 32,000 feet (12°/8°) stall characteristics are essentially the same as those observed with auto flaps. Above approximately 32,000 feet (0°/8°) stall characteristics are the same as those observed with flaps up.

Stalls Ⓔ

As the cg moves aft, less aft stick movement is required to reach stall AOA (regardless of flap position) and consequently, application of full aft stick with aft cg provides more of a rotation capability beyond stall AOA. With sustained full aft stick the aircraft motions (primarily wing rock) will prevent precise aircraft control and the turning performance is reduced from that obtained at AOAs below stall. If pitch control is applied abruptly to full aft stick from below stall AOA, the aircraft can achieve AOAs significantly in excess of 30 units and a PSG or spin entry may result.

WARNING

> Application of full aft stick at near maximum rate from below stall AOA may result in PSG or spin entry.

POSTSTALL GYRATIONS Ⓔ

A poststall gyration (PSG) is continued uncontrolled aircraft motions about all three axes at AOAs above stall. These motions may be abrupt or relatively smooth and mild. The uncontrolled motions of the PSG are continued yaw, pitch, and roll oscillations, and the inability to immediately reduce AOA below stall with release of aft stick pressure.

Flight experience has shown that the clean aircraft can be maneuvered beyond the stall AOA with little likelihood of entering a PSG. Use of maneuver/auto flaps and/or cg's forward of the aft limit increase resistance to PSG entry. Certain critical combinations of abrupt or sustained (full or near full) rudder (or full crossed controls) in conjunction with nose up pitch commands can produce PSGs or spins. PSGs or spins are most likely to occur when these control inputs are applied near stall AOA during decelerating turns, particularly within the 190 KIAS to 250 KIAS regime with the pitch attitude near or above the horizon. At higher speeds, aerodynamic stability inhibits PSG/Spin entry. Below approximately 190 KIAS, the control surfaces lack sufficient authority to make PSG/Spin entry probable. When rudder is applied in conjunction with aft stick, the aircraft yaws and rolls in the direction of rudder and simultaneously pitches to a high AOA resulting in a rapid deceleration. When stall AOA is exceeded, uncommanded roll hesitations or oscillations are usually apparent. These roll hesitations or oscillations are the best, and in some cases the only, indication of impending loss of control and should be immediately countered by relaxing aft stick pressure. If the stick is trimmed aft, relaxing the stick to a trimmed position may not be sufficient to recover the aircraft. Positive forward pressure is required. A maneuver of this type, if prolonged, can produce sufficient AOA and yaw rate at low airspeed such that recovery to below stall may not be obtained by neutralizing rudder and aileron and relaxing aft stick pressure.

Allowing a PSG to continue allows yaw rate to increase and the motion may then transition to a spin. Therefore, it is imperative that if recovery is not immediately achieved, forward stick (full forward, as required) be applied to reduce AOA and terminate the PSG. With the stick trimmed aft, more forward stick pressure is required. If this recovery action is promptly applied, spin entry is highly unlikely.

Initial aircraft response to forward stick may be slow and the AOA may not appear to be decreasing significantly. Probably the best indication that recovery is occurring is that airspeed is increasing toward 130 KIAS (rather than oscillating below 110 KIAS). A slight decrease in g, or a lightening in the seat may be noted as the aircraft pitches over on recovery. As the airspeed increases through approximately 130 KIAS, a strong pitchover occurs, indicating a successful recovery. Rolling during recovery may occur because of residual sideslip but this subsides and may be controlled with aileron. Aircraft pitch attitude upon recovery may be very nose low. Altitude loss during the PSG varies but could be as much as 4000 feet. Because of the low airspeed and low pitch attitude at recovery, approximately 5000 to 7000 feet may be required for the dive pullout to regain level flight.

If forward stick is maintained after recovery, particularly with maneuver flaps selected, the aircraft pitches to negative AOA and may enter an IPH or inverted PSG spin. Once recovery from the erect PSG has been established, aft stick should be applied smoothly to maintain or regain positive g flight and prevent entry into the IPH or inverted PSG/spin.

WARNING

Failure to relax forward stick on recovery from an erect PSG may cause the aircraft to enter an inverted PSG or inverted spin.

SPINS Ⓔ

If PSG recovery controls are not applied, or delayed until ineffective, the aircraft may enter an erect spin. The most critical airspeed region for spin entry is between 190 and 250 KIAS. In this airspeed region, there is sufficient flight control authority to generate AOA in association with yaw to initiate a spin entry. Flight tests show that below 190 KIAS, horizontal tail authority cannot generate enough AOA to generate spin entry. Above 250 KIAS, misapplication of flight controls could result in spin entry but likelihood is remote. During the development phase between PSG and the spin, yaw rate increases and the direction of spin rotation becomes apparent. Initially, the spin is more than likely oscillatory, but may transition to a flat spin. The oscillatory spin is characterized by roll and pitch oscillations, pitch attitude approximately 30 degrees nose low, and a turn rate of approximately six seconds per turn. The flat spin is characterized by pitch attitude increasing toward, or on the horizon, and little, if any, pitch and roll motion and a turn rate of approximately four seconds per turn.

Altitude loss is approximately 1700 to 2500 feet per turn in the oscillatory spin and approximately 1500 feet per turn in the flat spin. Airspeed during the oscillatory spin may be oscillating below approximately 110 KIAS (as in the PSG), but is probably pegged near zero during the flat spin. Recovery from the oscillatory spin is possible but highly unlikely from the flat spin. The oscillatory spin may transition to the flat spin, even with proper spin recovery controls applied. Apply spin recovery controls as soon as the direction of spin is determined to obtain the best chance for spin recovery (see section III for erect spin recovery procedures). Spin recovery may be improved somewhat by selecting maneuver/auto flaps if the spin was entered with flaps up. The benefit is limited compared to proper application of spin recovery controls. Do not sacrifice spin recovery controls in order to select maneuver/auto flaps for spin recovery.

If recovery from the oscillatory spin is occurring, early recovery indications are not immediately obvious, as noted in the PSG recovery. Pitch attitude gradually transitions to an increasing nose-low attitude and average indicated airspeed should begin to gradually increase. As airspeed increases through approximately 130 KIAS, a strong pitchover occurs, much like the recovery from the PSG, indicating that recovery has occurred. Spin recovery probably requires a minimum of two turns and 4000 feet altitude loss, not including dive pullout. Pitch attitude upon recovery is nose-low (similar to that obtained in the PSG recovery) and 5000 to 7000 feet of altitude loss is required for the dive pullout to regain level flight.

If forward stick is maintained after recovery, the aircraft may pitch inverted and enter an inverted PSG/spin as described in the erect PSG section. When recovery is effected, smoothly apply aft stick to maintain or regain positive g flight.

WARNING

Failure to relax forward stick after recovery from an erect spin may cause the aircraft to enter an inverted PSG or inverted spin.

ERECT STALLS/POSTSTALL GYRATIONS/SPINS Ⓕ

GENERAL

Later aircraft [F-2] exhibit improved lateral-directional stability at high AOA. However, longitudinal stability is reduced in the region beyond stall. Rapid aft stick inputs or sustained full rudder maneuvering can quickly drive AOA well beyond stall and may result in PSG or spin entry. Earlier aircraft [F] [F-1] resist departure from controlled flight below 29 units AOA. Stability deteriorates with increasing AOA above 29 units. Therefore, the aircraft is less resistant to departure from controlled flight above 29 units and becomes susceptible at more extreme AOAs which are more easily obtained with an aft cg.

STALLS Ⓕ

Clean aircraft stall occurs at approximately 24-27 units AOA for all flap positions (see figure 6-1 for stall speeds), and usually occurs prior to reaching full aft stick.

With maneuver/auto flaps, buffet onset occurs at approximately 15-17 units AOA. The initial buffet is of light-to-moderate intensity and gradually increases as AOA is increased toward stall. With flaps up, buffet onset occurs at approximately 13-14 units AOA and buffet intensity does not increase significantly as AOA is increased toward stall. One-g stalls are characterized by a slight nose drop and onset of wing rock. As stall AOA is attained in accelerated stalls, the wing rock is accompanied by a decreased capability to maintain a g-level or turn rate. The onset of wing rock during accelerated entries is more abrupt and frequency of oscillation is faster than during one-g stalls. Wing rock is terminated immediately upon relaxing aft stick pressure to reduce AOA below stall.

Less aft stick is required to generate stall AOA for relatively aft cg's (regardless of flap position) and, consequently, full aft stick provides more of a rotation capability at the aft cg's. The aircraft is capable of generating high pitch rates from below stall AOA with aft stick inputs at less than maximum rate. This can drive AOA beyond stall and may result in PSG or spin entry. Sustained full aft stick generally does not cause the aircraft to exceed 29 units AOA unless the aircraft is at an aft cg or full aft stick was abruptly applied. With an aft cg, wing rock and yaw excursions increase in magnitude, AOA increases well above 29 units, and PSG or spin entry may occur. Application of abrupt full aft stick from below stall AOA can achieve AOAs significantly in excess of 29 units and may result in PSG or spin entry.

WARNING

- Prolonged full aft stick with an aft cg after stall or application of sustained full aft stick at maximum rate below stall AOA may result in PSG or spin entry.
- Rapid aft stick inputs initiated from any AOA with nominal cg's can cause high pitch rates which may drive the aircraft to above stall AOA and generate departure with no departure warning cues.

POSTSTALL GYRATIONS Ⓕ

A poststall gyration (PSG) is continued uncontrolled aircraft motions at AOAs above stall. These motions may be abrupt or relatively smooth and mild. The uncontrolled motions of the PSG are continued yaw excursions, roll ocillations, and the inability to immediately reduce AOA below stall with release of aft stick pressure.

Flight experience with the clean aircraft has shown that sustained or abrupt aft stick (see STALLS) or full or near full rudder in conjunction with nose up pitch commands can produce PSGs or spins. PSGs or spins are most likely to occur when these control inputs are applied near stall AOA during decelerating turns, particularly within the 190 KIAS to 250 KIAS regime with the pitch attitude near or above the horizon. At higher speeds, aerodynamic stability inhibits PSG/Spin entry. Below approximately 190 KIAS, the control surfaces lack sufficient authority to make PSG/Spin entry probable. When rudder is applied in conjunction with aft stick, the aircraft yaws and rolls in the direction of rudder and simultaneously pitches to a high AOA resulting in a rapid deceleration. When stall AOA is exceeded, uncommanded roll hesitations or oscillations are usually apparent. These roll hesitations or oscillations are the best, and in some cases the only, indication of impending loss of control and should be immediately countered by relaxing aft stick pressure. If the stick is trimmed aft, relaxing the stick to a trimmed position may not be sufficient to recover the aircraft. Positive forward pressure is required. A maneuver of this type can produce sufficient AOA (well above 29 units) and yaw rate at low airspeed such that PSG or spin entry may occur. With cg's near the aft limit, these higher AOAs are more easily obtained. Maneuver/auto flaps increase the roll-yaw stability of the aircraft and increase its resistance to PSG entry. Flaps up allows a higher initial yaw rate to be established with rudder inputs than if maneuver/auto flaps are used.

WARNING

Maneuvering flight at high AOA should only be performed using maneuver/auto flaps. Use of maneuver/auto flaps increases the aircraft's resistance to PSG/spin entry.

Allowing a PSG to continue allows yaw rate to increase and the motion may then transition to a spin. Therefore, it is imperative that forward stick (full forward, as required) be applied immediately to reduce AOA and terminate the PSG. With the stick trimmed aft, more forward stick pressure is required. If this recovery action is delayed, spin entry may occur.

Initial aircraft response to forward stick may be slow and AOA may not appear to be decreasing significantly. Probably the best indication that recovery is occurring is that airspeed is increasing toward 130 KIAS (rather than oscillating below 110 KIAS). A slight decrease in g, or a lightening in the seat may be noted as the aircraft pitches over on recovery. As the airspeed increases through approximately 130 KIAS, a strong pitchover occurs, indicating a successful recovery. Rolling during recovery may occur because of residual sideslip but subsides and may be controlled with aileron. Aircraft pitch attitude upon recovery may be very nose-low. Altitude loss during the PSG varies but could be as much as 4000 feet. Because of the low airspeed and low pitch attitude at recovery, approximately 5000 to 7000 feet may be required for the dive pullout to regain level flight.

If forward stick is maintained after recovery, particularly with maneuver flaps selected, the aircraft pitches to negative AOA and may enter an IPH or inverted PSG/spin. Once recovery from the erect PSG has been established, aft stick should be applied smoothly to maintain or regain positive g flight and prevent entry into the IPH or inverted PSG/spin.

WARNING

Failure to relax forward stick on recovery from an erect PSG may cause the aircraft to enter an inverted PSG or inverted spin.

SPINS (F)

If PSG recovery controls are not applied, or delayed until ineffective, the aircraft may enter an erect spin. The most critical airspeed region for spin entry is between 190 and 250 KIAS. In this airspeed region, there is sufficient flight control authority to generate AOA in association with yaw to initiate a spin entry. Flight tests show that below 190 KIAS, horizontal tail authority cannot generate enough AOA to generate spin entry. Above 250 KIAS, misapplication of flight controls could result in spin entry but likelihood is remote. During the development phase between the PSG and the spin, yaw rate increases and the direction of spin rotation becomes apparent. Initially, the spin is more than likely oscillatory, but may transition to a flat spin. The oscillatory spin is characterized by roll and pitch oscillations and an airspeed oscillating below 110 KIAS. The flat spin is characterized by pitch attitude increasing toward or on the horizon, and little (if any) pitch and roll motion and near zero airspeed. Altitude loss is approximately 1700 to 2500 feet per turn with a turn rate of 6 to 7 seconds per turn in the oscillatory spin and approximately 1500 feet per turn with a turn rate of 5 seconds in the flat spin. Airspeed during the oscillatory spin may be oscillating below approximately 100 KIAS (as in the PSG), but is probably pegged near zero during the flat spin. Recovery from the oscillatory spin is possible but highly unlikely from the flat spin. However, the oscillatory spin may transition to the flat spin, even with proper spin recovery controls applied. Apply spin recovery controls as soon as the direction of spin is determined to obtain the best chance for spin recovery (see section III for erect spin recovery procedures). Flight test results indicate that spin recovery may be improved somewhat by selecting maneuver/auto flaps if the spin was entered with flaps up. The benefit is limited compared to proper application of spin recovery controls. Do not sacrifice spin recovery controls in order to select maneuver/auto flaps for spin recovery.

If recovery from the oscillatory spin is occurring, early recovery indications are not immediately obvious, as noted in the PSG recovery. Pitch attitude gradually transitions to an increasing nose-low attitude and average indicated airspeed should begin to gradually increase. As airspeed increases through approximately 130 KIAS, a strong pitchover occurs, much like the recovery from the PSG, indicating that recovery has occurred. Spin recovery probably requires a minimum of two turns and 4500 feet altitude loss, not including dive pullout. Pitch attitude upon recovery is nose-low (similar to that obtained in the PSG recovery) and 5000 to 7000 feet of altitude loss is required for the dive pullout to regain level flight.

If forward stick is maintained after recovery, the aircraft may pitch inverted and enter an inverted PSG/spin as described in the erect PSG section. When recovery is effected, smoothly apply aft stick to maintain or regain positive g flight.

WARNING

Failure to relax forward stick after recovery from an erect spin may cause the aircraft to enter an inverted PSG or inverted spin.

INVERTED FLIGHT CHARACTERISTICS

INVERTED PITCH HANGUP (IPH)

Inverted pitch hangup (IPH) is the tendency for the aircraft to stabilize or hang at negative g (AOA generally pegged at zero units) if aft stick is not applied to maintain positive-g flight. When flown at negative g near zero units AOA, the aircraft exhibits a tendency to tuck to a slightly more negative g and stabilize hands off. The IPH tendency exists for all configurations and airspeeds, but is more prevalent below 300 KIAS with maneuver flaps and a relative aft cg condition with the pitch trim less than +3 units. The IPH can be encountered from normal inverted flight or from various erect maneuvers, such as improper vertical recovery. If recovery from the IPH is not accomplished, divergent roll oscillations or an inverted spiral may develop. If the inverted spiral is allowed to progress, an inverted PSG/spin results.

NOTE

Flight data indicates that the altitude required to recover to level flight from an IPH is dependent on IPH entry airspeed. For example, IPH entry at 150 KIAS may require 2500 feet for recovery and IPH entry at 100 KIAS may require 5000 feet for recovery. Altitude required for recovery should not be used as a basis for delaying ejection if the aircraft is below recommended ejection altitude for out-of-control flight.

INVERTED PSG/SPIN

An inverted PSG is characterized by violent, disorienting oscillations about all three axes following an inverted stall. The inverted PSG may be encountered following an extended IPH. It may also be encountered following erect PSG or spin recovery, from improper vertical recoveries, or from rudder rolls to inverted flight. In these three cases, the inverted PSG is probably not preceded by the IPH. Maneuver/FXD flaps and/or aft cg tend to promote an inverted PSG entry. Following the PSG it may be possible to enter an inverted spin mode. The most likely mode is characterized by severe oscillations about all three axes, similar to the inverted PSG, and is the oscillatory inverted spin. Flight experience has also shown that it is possible to enter an inverted flat spin mode. This mode is characterized by a predominant smooth yaw rate with some pitch and roll motion. The inverted PSG/oscillatory spin is recoverable if sufficient altitude is available but recovery from the inverted flat spin is unlikely. (See section III for Inverted PSG/IPH/Inverted Spin recovery procedures.)

Altitude loss during inverted PSG/oscillatory spin recovery varies, but is at least 3500 feet and may exceed 6000 feet (not including dive pullout). For recovery when using maneuver/FXD flaps, flaps up should be selected first, primarily because of added pitch stability provided at negative g with flaps up. When using auto flaps, the flaps automatically shift to flaps up at negative g. Then, apply smooth aft stick as necessary to regain positive g flight. The best indication of recovery from the inverted PSG/oscillatory spin is the decrease of negative g and the onset of positive g. The aircraft always recovers from the inverted PSG/oscillatory spin if sufficient altitude is available, but some additional negative pitch oscillations (typically 1 to 3) may occur after recovery has been initiated.

If considerable aft stick (or full aft stick) is maintained after recovery, the aircraft may quickly transition to an extreme positive AOA on recovery and, dependent on other aircraft motions (primarily yaw rate), entry into an erect PSG or spin is possible. Aileron and rudder should not be used to aid recovery from the inverted PSG/spin because:

(1) A sustained turn direction is difficult to determine because of the extremely oscillatory and disorienting aircraft motions, and
(2) Aileron or rudder may cause the aircraft to transition quickly to an upright (erect) PSG or spin from which recovery is more difficult.

STORE EFFECTS

CENTERLINE STORES

Resistance to departure from controlled flight is significantly reduced if centerline stores are carried. With centerline stores, the aircraft is susceptible to PSGs and spins if AOA exceeds 20 units. The aircraft is more susceptible to PSGs and spins with flaps up. Do not exceed 20 units AOA when centerline stores are carried regardless of flap position.

Carriage of centerline stores (excluding pylon only) causes an aerodynamic effect which reduces the yaw stability. Approach-to-stall characteristics with centerline stores are essentially the same as that obtained with the clean aircraft. However, if stall AOA is attained or exceeded, the aircraft can exhibit large excursions about all three axes and poststall gyrations are significantly more abrupt and oscillatory than with the clean aircraft. The poststall motions are more exaggerated with large stores than with small stores (i.e., 275-gallon tank versus SUU-20 dispenser). During 1-g stalls with centerline stores, earlier

aircraft have a tendency to exhibit a pure nose-slice (yaw) followed by roll oscillations; later aircraft have a tendency to exhibit the roll oscillations only. These poststall motions are relatively mild in 1-g stalls and can generally be terminated by releasing aft stick pressure to reduce AOA to below stall. Accelerated stalls in earlier aircraft are characterized by an abrupt nose-slice followed by very rapid roll and yaw oscillations; later aircraft exhibit very rapid roll and yaw oscillations without the nose-slice. Resulting side forces are apparent to the pilot. The AOA also abruptly increases to beyond 30 units. Normal PSG recovery procedures should effect a satisfactory recovery if applied soon enough. If releasing aft stick does not produce a pitch response, full forward stick should be applied immediately. If PSG recovery controls are not applied immediately, spin entry may occur rapidly. The initial turn rate during the spin may be very slow and difficult to recognize because of the large pitch and roll oscillations. However, as soon as the turn direction is recognized, normal spin recovery controls should be applied immediately. Altitude loss per turn during the spin is approximately the same as with the clean aircraft but recovery from either the PSG or spin with a centerline store may be slower than with the clean aircraft.

When wing stores are carried in conjunction with a centerline store, stall/poststall characteristics are similar to those described under CENTERLINE STORES. However, because of the increased roll and yaw inertia due to the wing stores, the poststall roll/yaw oscillations take longer to develop, but also take longer to stop. Following stall AOA, the poststall motion is primarily in yaw with significantly less rolling tendency (due to the increased roll inertia) than with centerline stores only. Therefore, to preclude PSG/spin entry, do not exceed 20 units AOA when centerline stores are carried.

SYMMETRIC WING STORES

With symmetric wing stores, several distinct aircraft characteristics occur. Power changes produce noticeable pitch changes. These pitch changes are more pronounced for heavy store loading and/or as the cg moves toward the aft limit. Use of speed brakes, especially at high speed, low altitude, also causes pitch changes. Pitch control becomes more sensitive with speed brakes extended. With flaps down, pushovers to negative g can result in a slight negative g overshoot. The amount of overshoot is a function of stick rate and is greatest at 220 KIAS. Salvo of 4 or 5 firebombs or simultaneous release of outboard firebombs at high airspeeds and less than 1 g causes an abrupt instantaneous pitch response. There is no change to aircraft flight path and the aircraft returns to the prerelease flight conditions without pilot actions.

ASYMMETRIC STORES

A single AIM-9 missile is not restricted as an asymmetrical configuration. Aileron or rudder trim requirements to compensate for the single missile are negligible. During erect stalls, either 1-g or accelerated, there are no noticeable rolling tendencies due to the missile nor are there any erect poststall characteristics unique to the single missile. Inverted characteristics are affected to the extent that the inverted spiral is generally biased in the direction of the missile. There are no unique characteristics in the inverted PSG/oscillatory spin or recovery modes due to the single missile.

An asymmetric pylon store loading is very susceptible to PSG/spin entry if 20 units AOA is exceeded. Therefore, do not exceed 20 units if an asymmetric pylon store loading exists.

Aircraft flight characteristics with asymmetric pylon store loadings are affected primarily by weight imbalance. These effects are more noticeable at lower airspeeds or during maneuvering flight. At low AOA, rudder trim is sufficient to trim out yaw produced by asymmetric loads. Available aileron trim may be exceeded and have to be supported by stick forces at low speeds. If possible, the asymmetric pylon stores should be jettisoned prior to landing. However, if landing is attempted, a flat straight in approach, with little flare, should be made to accomplish a smooth touchdown. Be alert for possible wing drop during roundout. The approach and landing should be carefully planned and executed, considering the runway length, crosswind and increased approach speed. During landing roll with asymmetric pylon stores, caution should be used when braking because the aircraft has a tendency to turn away from the store-loaded wing.

High AOA characteristics with asymmetric pylon stores are very noticeable to the pilot. During the approach to a stall, there is a steadily increasing rolling tendency into the heavy wing and there may be insufficient aileron to counter the roll. Coordinated rudder, however, controls the roll. As stall AOA is reached (approximately 24 units AOA in earlier aircraft; approximately 27-28 units AOA in later aircraft), the aircraft motions change abruptly, and the aircraft yaws and rolls strongly away from the heavy wing. If the aircraft is maintained in a stall, the yaw continues, the AOA increases, and the aircraft may progress into a spin (earlier Ⓔ aircraft, highly oscillatory spin). These motions are most abrupt in accelerated stalls, increasing the likelihood of spin entry. With earlier Ⓔ aircraft the asymmetry tends to keep the spin oscillatory, but the flat spin mode may also be encountered. Turn rates during the spin are similar to that of the clean aircraft. Altitude loss per turn is increased slightly over that of the clean aircraft. With spin recovery control applied, recovery is very slow with light asymmetries, and may be nonexistent with heavy asymmetries. Therefore, to preclude PSG/spin entry with asymmetric pylon stores, do not exceed 20 units AOA. With earlier [F] [F-1] aircraft, the spin probably is flat but may initially exhibit more roll oscillations than during a flat spin with the clean aircraft. Turn rates during the spin are faster than those of the clean aircraft flat spin, approximately 4 seconds per turn. Spin recovery is highly unlikely with any asymmetric pylon loading. Therefore, to preclude PSG/spin entry with asymmetric pylon stores, do not exceed 20 units AOA.

EXTERNAL STORE JETTISON

Do not jettison external stores while aircraft is out of control.

DRAG CHUTE

Do not use the drag chute as a spin recovery device because of the following undetermined factors:

(1) Deployment
(2) Effectiveness
(3) Ejection seat-to-chute clearance
(4) Structural failure.

AIRCRAFT CONFIGURATION EFFECTS

Gear position, speed brake position, stability augmenter status, and engine power setting (symmetric or asymmetric) have no significant effect on stall/poststall characteristics.

ENGINE OPERATING CHARACTERISTICS

If a PSG/spin is encountered with the engines at high power setting (above approximately 95 percent RPM) flameout of one or both engines is probable. If both engines flameout, generator dropout occurs at approximately 43 percent RPM leaving only battery power available. As engine RPM decays, any flight control movement rapidly depletes the hydraulic pressure.

AOA INDICATOR

The AOA indicator provides accurate information up to the stall. However, above the stall, AOA indications become oscillatory and unreliable because of sideslip oscillations. AOAs obtained during erect PSGs and spins are significantly greater than 30 units and the AOA indicator generally is pegged at the maximum reading. However, sideslip oscillations during the PSG or spin may cause the AOA indicator to intermittently, and erroneously read less than 30 units. Erroneous indications below 30 units may lead to premature release of PSG or spin recovery controls, therefore, the AOA indicator should not be used to provide an indicaton of PSG/spin recovery.

DIVE RECOVERY

Steep dives at high speeds at low altitudes should be avoided because of the large altitude loss during recovery. (See figure 6-2.) Should a high-speed, steep dive be entered at low altitude, the speed brake should be extended immediately. Use of speed brake does not restrict g attainable.

HIGH MACH DIVES

Maximum Mach Dives Ⓔ

The maximum mach number profile is defined by the maximum mach dive shown in figure 6-3 for a standard day. The dive is initiated by a pushover from 40,000 feet and 1.58 mach at MAX thrust and is based upon a constant 0 g load factor, held until recovery. At 27,000 feet, mach 1.74, and a dive angle of 31 degrees, reduce thrust to MIL and start a 4 g pullout (use approximately 2 seconds to build g from 0 to 4.0). Recovery to level flight should be completed at approximately 21,000 feet at mach 1.5, having lost 6000 feet from the start of the recovery.

Maximum Mach Dives Ⓕ

The maximum mach number profile is defined by the maximum mach dive shown in figure 6-4 for a standard day. The dive is initiated by a pushover from 43,000 feet and 1.41 mach at MAX thrust and is based upon a constant zero g load factor, held until recovery. At 26,000 feet, mach 1.69, and a dive angle of 38 degrees, reduce thrust to MIL and start a 4 g pullout (use approximately 2 seconds to build g from 0 to 4.0). Recovery to level flight should be completed at approximately 18,000 feet at mach 1.40 having lost 8000 feet from the start of the recovery.

Shallow Dive Ⓔ

The limit speed is more easily attained by pushing over at MAX thrust into a shallow dive from 29,000 feet at mach 1.5 (see figure 6-3). Continue a gradual pushover until 16 degrees is reached at approximately 17,500 feet. With 16 degrees dive angle, mach 1.5, and 17,500 feet, start a 4 g pullout, using approximately 2 seconds to build to 4 g. Recovery should be completed at 15,000 feet, having lost 2500 feet in the pullout.

Shallow Dive Ⓕ

The limit speed is more easily attained by pushing over at MAX thrust into a shallow dive from 32,500 feet at mach 1.5 (see figure 6-4). Continue a gradual pushover until 19 degrees is reached at approximately 17,500 feet. With 19 degrees dive angle, mach 1.5, and 17,500 feet, start a 4 g pullout, using approximately 2 seconds to build to 4 g. Recovery should be completed at 15,000 feet, having lost 2500 feet in the pullout.

FLIGHT ENVELOPES

The flight envelopes are shown in figure 6-5, sheets 1 and 2. Maximum thrust is maintained in the dive to the start of pullout at which time the thrust of both engines is reduced to military thrust. The lift limits are based on maximum lift conditions at the prevailing mach numbers.

DIVE RECOVERY CHART

EXAMPLE:

IF 4.0-G PULLOUT FROM A 30° DIVE AT 600 KIAS IS STARTED AT 25,000 FT, THE ALTITUDE LOST DURING DIVE RECOVERY WILL BE 3800 FT.

(1) ENTER CHART WITH KIAS AT START OF PULLOUT — 600 KT.

(2) PROCEED RIGHT TO ALTITUDE PULLOUT STARTED — 25,000 FT.

(3) THEN DOWN TO DIVE ANGLE — 30 DEG.

(4) PROJECT RIGHT AND INTERSECT:

(5) DIVE RECOVERY LOAD FACTOR — 4.0 G.

(6) READ ALTITUDE LOSS DURING PULLOUT — 3800 FT.

Note

IF KTAS IS KNOWN, ENTER CHART WITH KTAS AT START OF PULLOUT, PROCEED UP TO THE DIVE ANGLE, AND REPEAT STEPS (4), (5), AND (6).

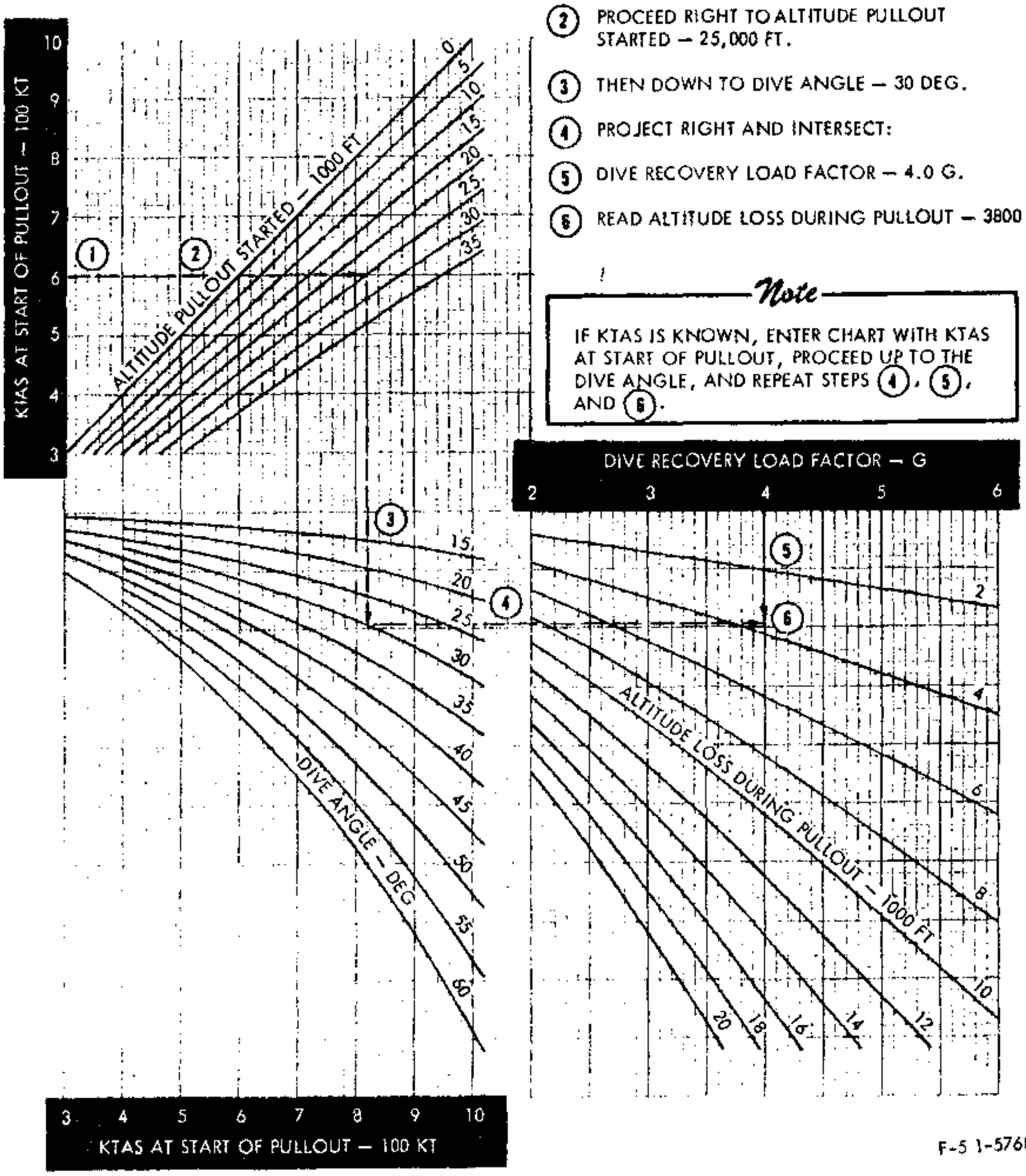


Figure 6-2.

HIGH MACH DIVES

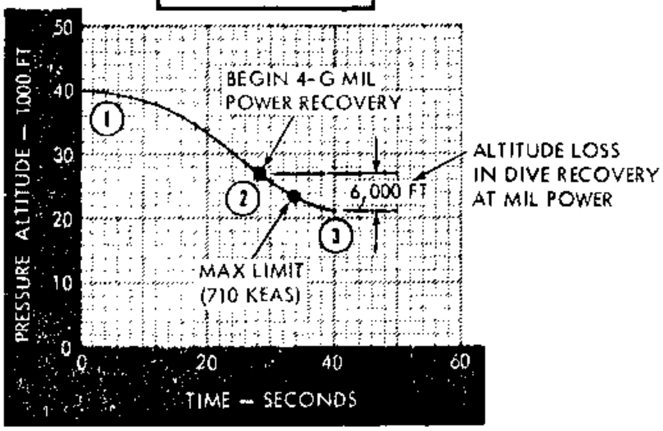
E

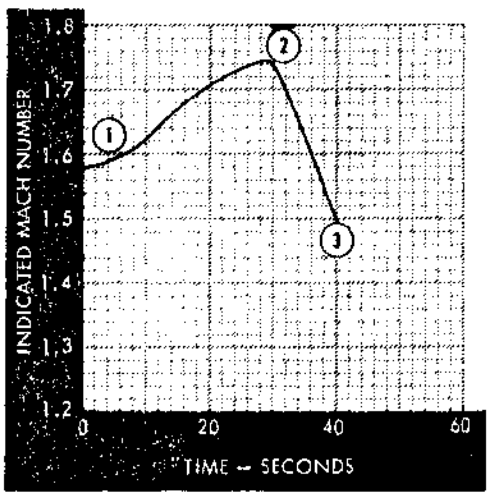
STANDARD DAY — GROSS WEIGHT — 13,300 POUNDS

DATA BASIS: **FLIGHT TEST**

TIP LAUNCHER RAILS

MAX MACH DIVE





Note

1. BEGIN ZERO-G MAXIMUM THRUST DIVE ENTRY.
2. ATTAIN 31° DIVE ANGLE. REDUCE THRUST TO MIL AND BEGIN 4-G DIVE RECOVERY AT 27,000 FT.
3. END DIVE RECOVERY IN LEVEL FLIGHT ATTITUDE.

WARNING

INITIATE DIVE RECOVERY AT 27,000 FEET MINIMUM TO PREVENT EXCEEDING STRUCTURAL LIMIT.

TYPICAL SHALLOW DIVE AT 1.5 MACH

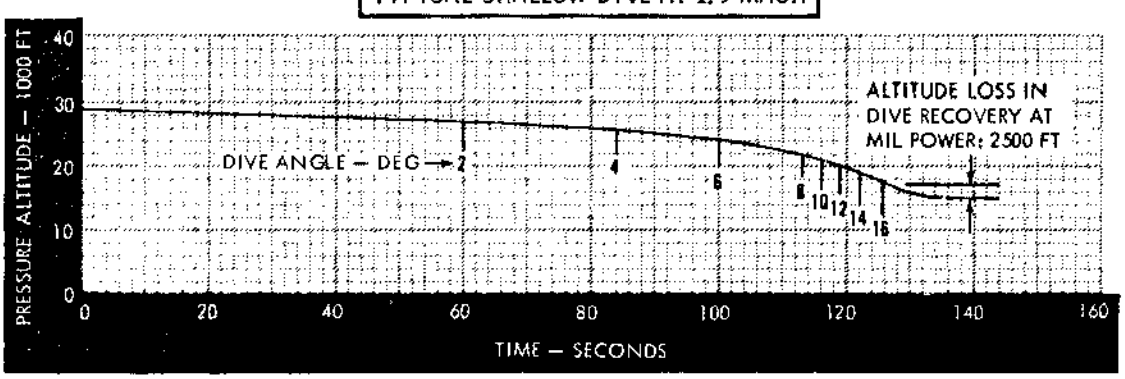


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Figure 6-3.

HIGH MACH DIVES

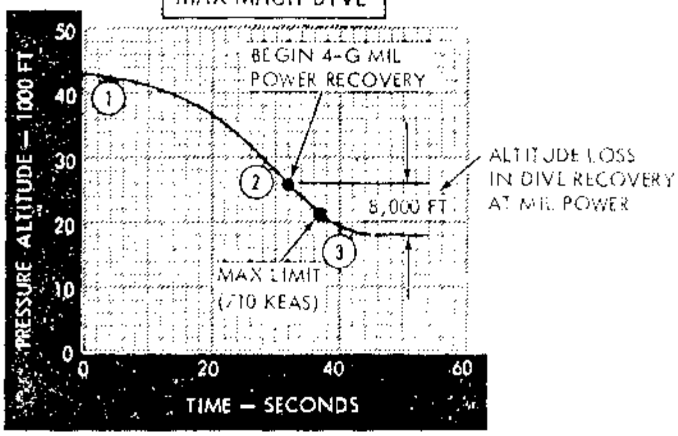
F

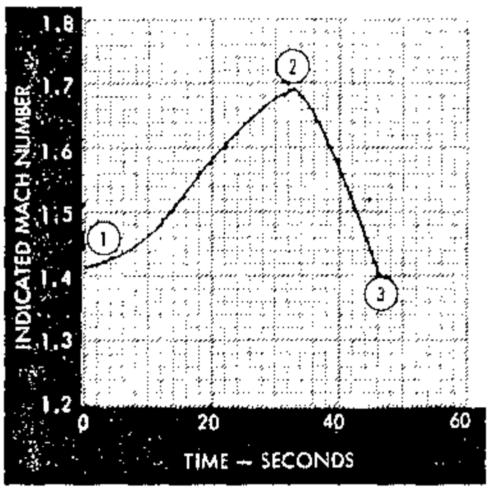
STANDARD DAY — GROSS WEIGHT 13, 800 POUNDS

DATA BASIS: **FLIGHT TEST**

TIP LAUNCHER RAILS

MAX MACH DIVE





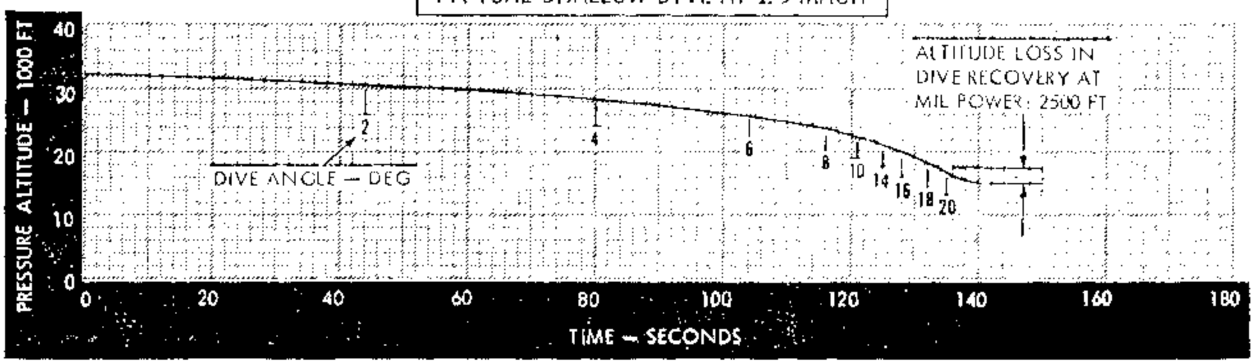
Note

1. BEGIN ZERO-G MAXIMUM THRUST DIVE ENTRY.
2. ATTAIN 35° DIVE ANGLE. REDUCE THRUST TO MIL AND BEGIN 4-G DIVE RECOVERY AT 26,000 FT.
3. END DIVE RECOVERY IN LEVEL FLIGHT ATTITUDE.

WARNING

INITIATE DIVE RECOVERY AT 26,000 FEET MINIMUM TO PREVENT EXCEEDING STRUCTURAL LIMIT.

TYPICAL SHALLOW DIVE AT 1.5 MACH

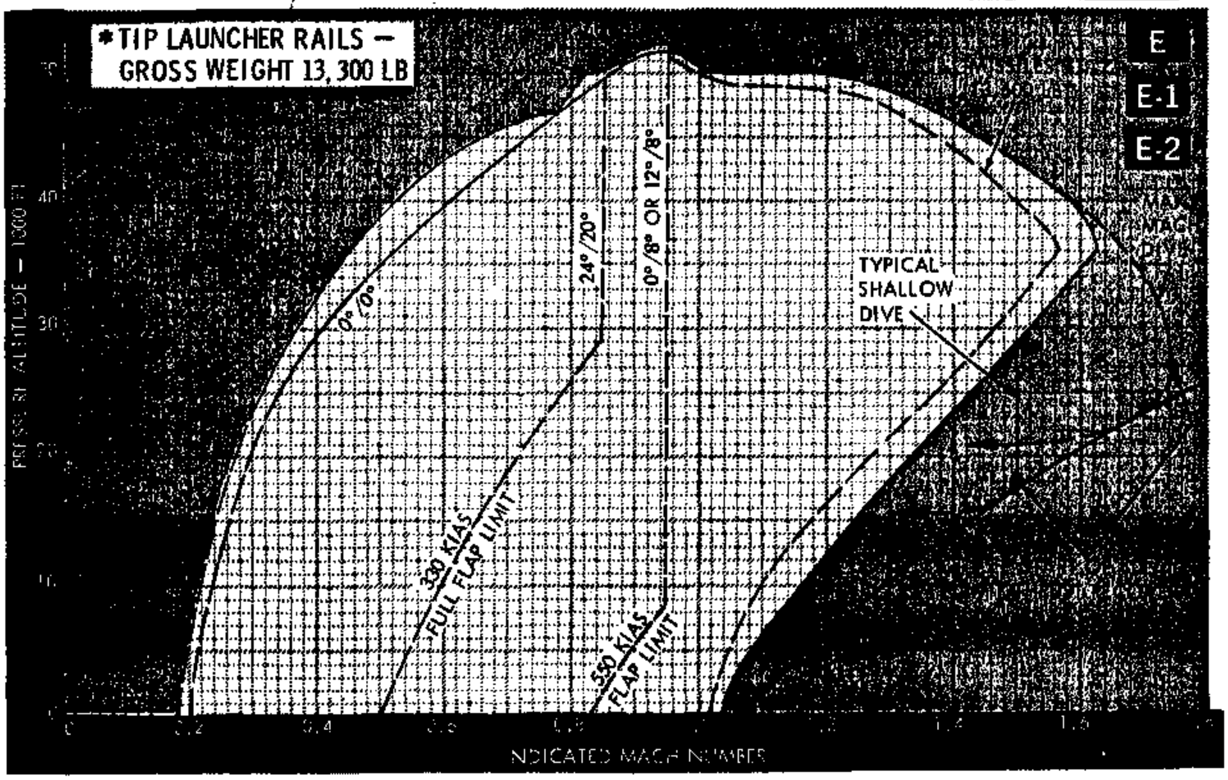


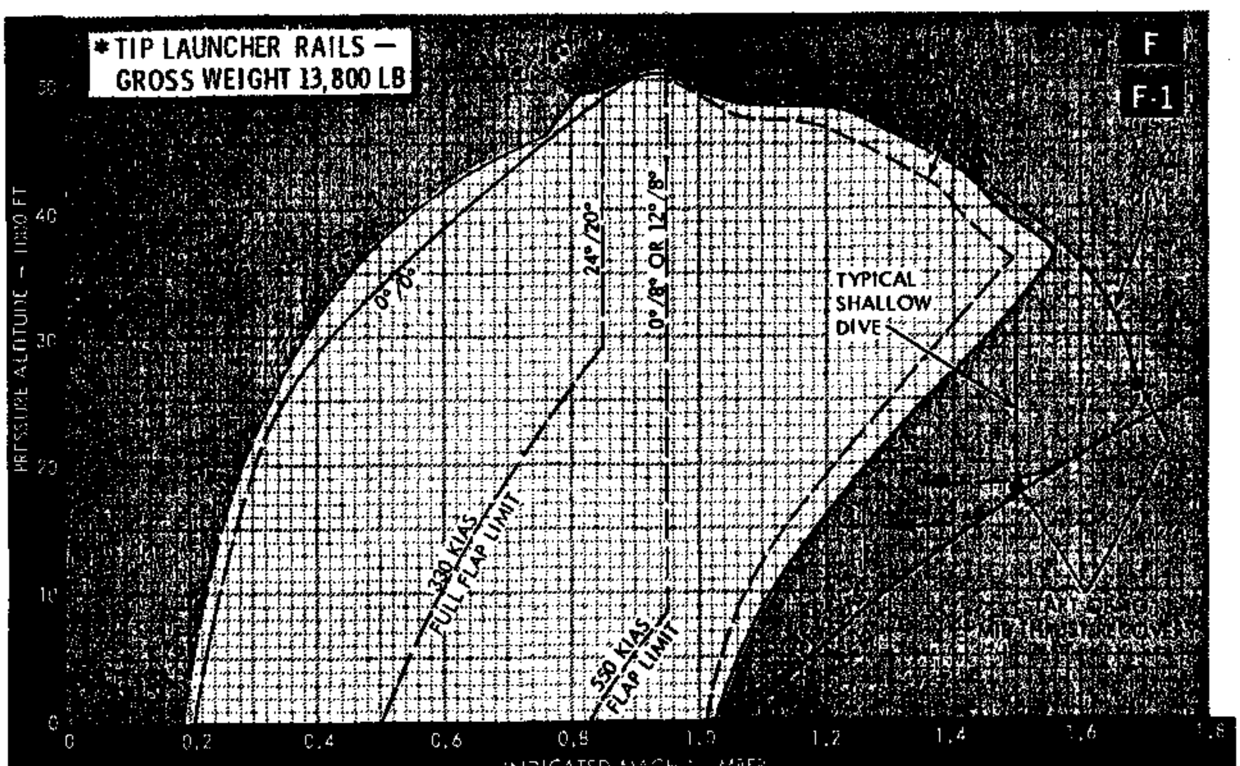
F-5 1-583(2)B

Figure 6-4.

FLIGHT ENVELOPE MAX THRUST

Note
CHART DATA BASED ON STANDARD DAY AND 1-G CONDITIONS.





*EXCEPT AS NOTED

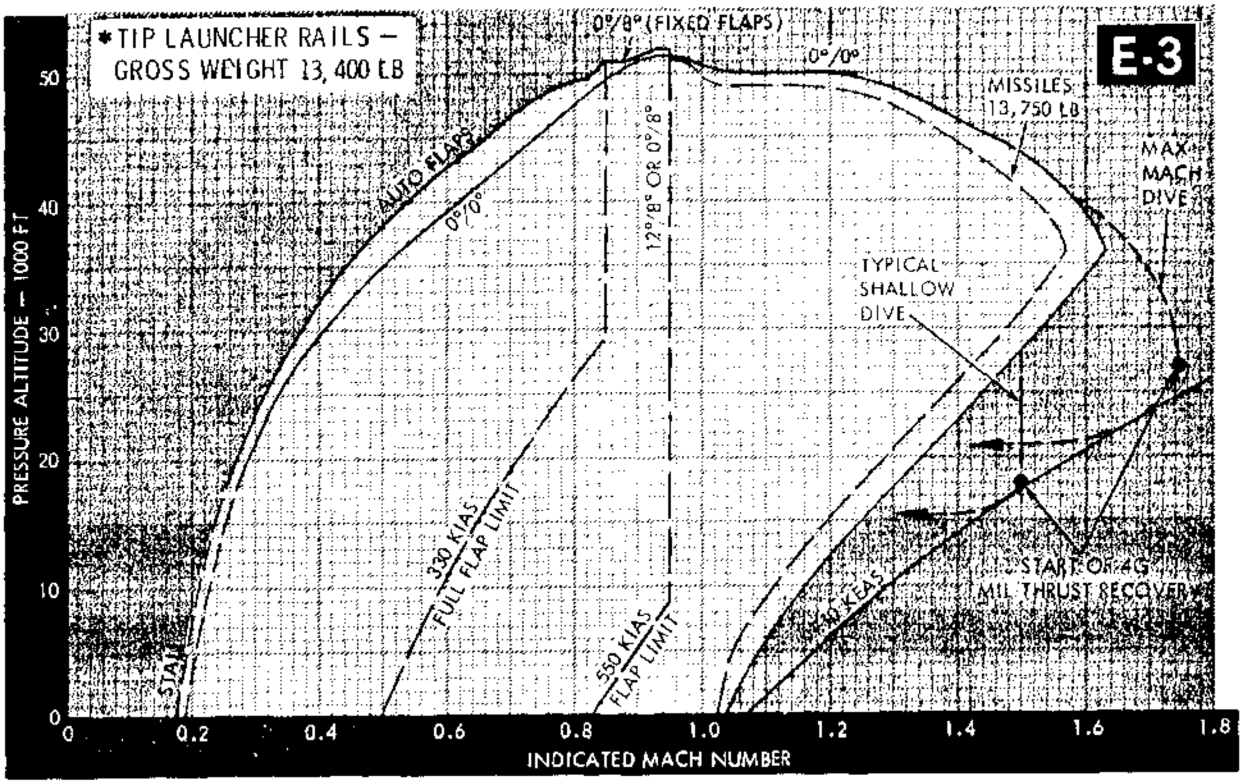
F-5 1-536(1)E

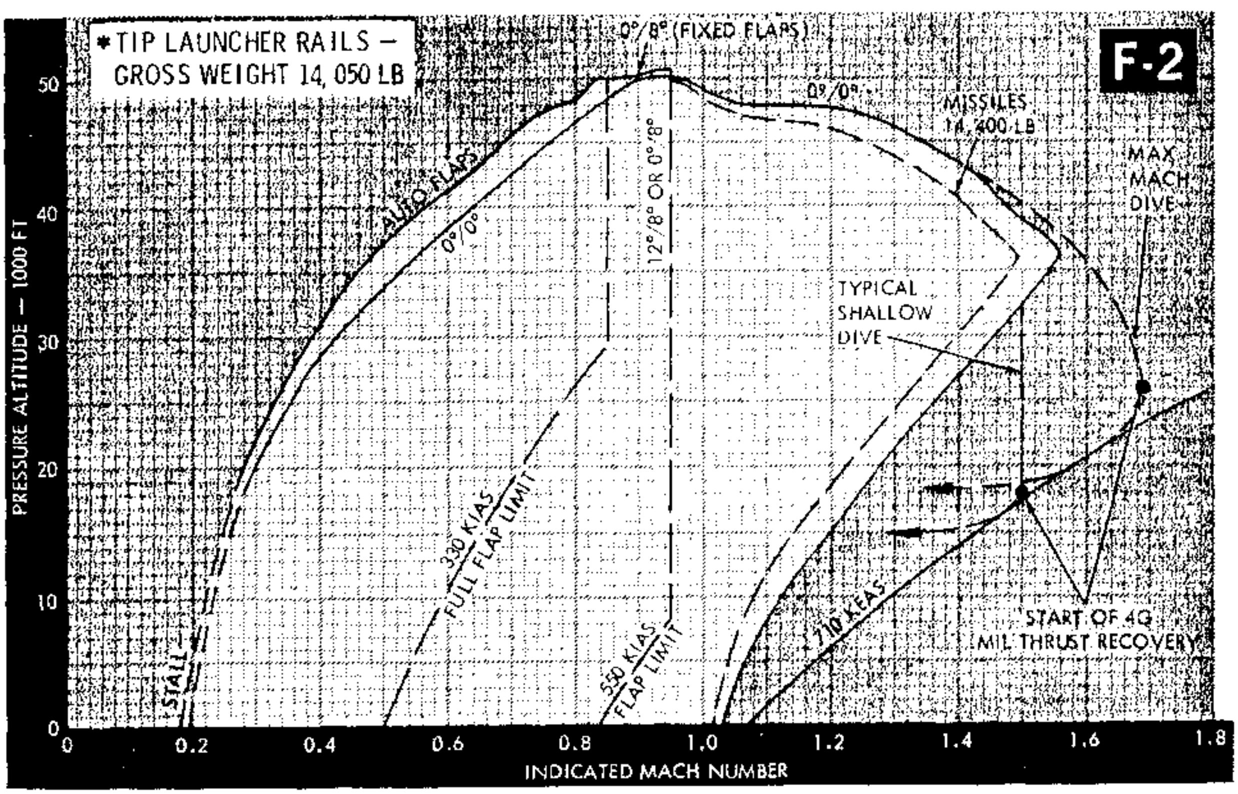
Figure 6-5 (Sheet 1).

FLIGHT ENVELOPE MAX THRUST

Note

CHART DATA BASED ON STANDARD DAY AND 1-G CONDITIONS.





* EXCEPT AS NOTED

Figure 6-5 (Sheet 2).

ADVERSE WEATHER OPERATION

SECTION VII

F-5 1-81(1)

TABLE OF CONTENTS

INTRODUCTION

This section contains discussion, explanation, operational peculiarities, and procedures which affect operation of the aircraft in extreme weather and climatic conditions. Normal instrument flight procedures are covered in section II.

ICE AND RAIN

ICING CONDITIONS

Each aircraft is provided with engine anti-ice, pitot heat, AOA vane heat, and canopy and windshield defog for adverse weather operation. Icing conditions which may be encountered are trace, light, moderate, and severe. Moderate and severe icing, particularly, can cause rapid buildup of ice on aircraft surfaces, greatly affecting performance. Short duration climbs and descents may be made thru light icing conditions.

WARNING

The aircraft should not be flown in moderate or severe icing conditions. If any icing is encountered, leave the area of icing conditions as soon as possible. If flight in icing conditions results in ice accumulation on the aircraft, enter this fact in the Form 781; engines must be inspected for ice ingestion damage when this occurs.

Ice accumulation on the engine inlet duct lips may cause engine damage. The entry of ice into an engine may cause a jar, vibration, or noise in the engine and damage the inlet guide vanes and first-stage compressor blades. Instrument indications may remain normal even though damage and loss of thrust have occurred.

When icing conditions are anticipated, the pitot heat and engine anti-ice switches should be turned on and the canopy defog knob turned to full increase.

NOTE

To ensure effective anti-icing, maintain at least 80% rpm. Canopy and windshield defog systems will operate at any engine rpm.

WET OR SLIPPERY RUNWAY

Takeoff

On icy or wet runways, the aircraft may skid during MIL power runup even though the brakes are locked. It may be necessary to run up one engine at a time, and to start the takeoff roll at less than MIL power.

Landing

Normal landing procedures should be used. Landing ground roll distances are significantly increased on a wet or slippery runway. After nosewheel is lowered, apply brakes carefully. Avoid locking the brakes. Hydroplaning and/or tire skidding on a wet or icy runway increases stopping distance and can easily result in loss of directional control. Taxi carefully, as nosewheel steering can be relatively ineffective on a wet or slippery runway.

CAUTION

- Painted areas on runways, taxiways, and ramps are significantly more slippery than unpainted areas.
- When conditions of snow or ice exist, approach ends of runways are usually more slippery than any other areas due to the melting and refreezing of ice and snow at this location.

RUNWAY CONDITION READING (RCR) WET RUNWAYS

The Runway Condition Reading (RCR) is an indication of the expected braking performance of the aircraft. All charts involving stopping distance are based on an RCR value of 23 for a dry pavement condition. Wet runway surfaces increase the stopping distance.

CAUTION

RCR values can only provide an approximation of the required stopping distance for the aircraft. Wet RCR values are valid only when hydroplaning does not occur. If hydroplaning occurs, it is not possible to predict the actual stopping distance.

The rubber buildup on the touchdown areas of the runway reduces the braking efficiency of the aircraft. The ground roll approximated by the RCR charts after applications of the RCR correction factor is based on that portion of the runway between the two touchdown areas. In situations where the estimated landing roll includes the touchdown area at the opposite end of the runway, speed should be reduced as much as possible before entering this area, since less traction for braking can be expected. The depth of the water may vary at different locations on the runway. Water depth on runway surfaces is influenced by the drainage characteristics and texture of the pavement surface.

HYDROPLANING FACTORS

Hydroplaning is a phenomenon with many variables. If hydroplaning is expected during landing, use drag chute or aerodynamic braking to slow aircraft as much as possible before applying wheel brakes. Hydroplaning may occur above 85 KIAS. Certain factors should be considered when planning a takeoff or landing on a wet or damp runway.

1. Tires approaching the wear limits are more likely to hydroplane than new tires. Also, if the tire pressures are low, hydroplaning occurs at a lower speed.
2. Avoid immediate application of the wheel brakes after touchdown to allow full wheel spin up. When using wheel brakes, be prepared to immediately release and reapply the brakes upon first indication of skidding or unusual yaw.
3. Crosswind components above the maximum safe velocities cause the aircraft to drift laterally if hydroplaning occurs.

4. The advantages of delayed landing or proceeding to an alternate airfield should be considered when hydroplaning potential is high.

ENGINE ICING

Engine inlet guide vane icing may occur when ambient temperature is below 40°F and visible moisture is present. Under these conditions and when icing conditions are anticipated, the engine anti-ice switch should be immediately placed in the ENGINE position. This action ensures continuing anti-ice action.

NOTE

To ensure effective anti-icing, maintain at least 80% rpm when engine anti-icing system is turned ON.

TURBULENCE AND THUNDERSTORMS

Flight in turbulent air, hailstorms, and thunderstorms should be avoided because of the high probability of damage to airframe and components from impact ice, hail, and lightning. If entry into adverse weather cannot be avoided, turn on engine anti-ice and pitot heat prior to penetration.

TURBULENT AIR PENETRATION PROCEDURES

CAUTION

Flight thru thunderstorms or extreme turbulence must be avoided whenever possible. Maximum use of weather forecast and radar facilities to help avoid thunderstorms and turbulence is essential.

If flight thru these areas cannot be avoided, the following procedures should be followed:

1. Airspeed — Establish 300 KIAS and trim for level flight. Severe turbulence causes large and rapid variations in airspeed. Do not change thrust except for extreme airspeed variations.
2. Attitude — Attitude is the primary reference in extreme turbulence. Pitch and bank should be controlled by reference to the attitude indicator. Do not change trim. Maintain control as near neutral as possible to avoid overcontrolling. Do not use sudden or extreme control inputs. Extreme gusts cause large attitude changes, but smooth and moderate use of the horizontal tail reestablishes the desired attitude.
3. Altitude — Severe vertical gusts may cause appreciable altitude variations. Allow altitude to vary. Sacrifice altitude to maintain attitude. Do not chase altitude and vertical velocity indications.

PENETRATION SPEED

If flight thru turbulent air is unavoidable, the recommended best penetration speed is 300 KIAS.

WARNING

Flying in turbulence or hail may result in engine inlet duct airflow distortion. This distortion can result in engine surge and possible flameout.

COLD WEATHER OPERATION

WARNING

When the cockpit is cold-soaked below -20°F for extended periods, probability of proper operation of the ejection seat rocket is reduced. Parking aircraft in heated hangar or preheating cockpit is mandatory.

Most cold weather operation difficulties are encountered on the ground. The following instructions are to be used with the normal procedures in section II when cold weather aircraft operation is necessary.

BEFORE ENTERING AIRCRAFT

Remove protective covers and duct plugs; check to see that surfaces, ducts, struts, drains, canopy rails, and vents are free of snow, ice, and frost. Brush off light snow and frost. Remove ice and encrusted snow, either by a direct flow of air from a portable ground heater or by using deicing fluid. Remove light frost from the windshield and canopy with a clean soft rag.

WARNING

- Takeoff distance and climb performance can be seriously degraded by snow and ice accumulation. The roughness and distribution of the ice and snow can vary stall speeds and characteristics dangerously. Loss of an engine on takeoff is serious enough without the added and avoidable hazard of ice and snow on the aircraft. Ice and snow must be removed before flight is attempted.
- Ensure that water does not accumulate in control hinge areas or other critical areas where refreezing may cause damage or binding.

CAUTION

To avoid damage to aircraft surfaces, do not permit ice to be chipped or scraped away.

Check the fuel system vents on the vertical stabilizer for freedom from ice. Inspect aircraft carefully for fuel and hydraulic leaks caused by contraction of fittings or by shrinkage of packings.

Inspect area behind aircraft to ensure that water or snow will not be blown onto personnel and equipment during engine start.

ENTERING AIRCRAFT

While wearing bulky arctic clothing, strapping-in may be difficult. Entering the cockpit with parachute on is easier than trying to slip into the parachute harness after it has been attached to the survival kit in the cockpit. The survival kit straps should be let out fully before entering the cockpit. The crew chief's assistance is required to fasten these straps to the parachute harness.

WARNING

- Entry into the cockpit using the pullout built-in steps is difficult when wearing cold weather flying gear. Use extreme caution while entering.
- Keep oxygen mask well clear of face until after engine start and cockpit warms. Even so, the exhalation valve may have frozen and could require forceful warm breath to free the stuck valve.

ENGINE START

Use external power for starting to conserve the battery. For JP-4 fuel, no preheat or special starting procedures are required. At or below 0°F (-17.8°C), JP-8 fuel may require engine main fuel control preheat to obtain starts. Increased start times can be expected. When ambient temperature is at or below 55°F (13°C), JP-5 may require ignition system-energizing without engine rotation for one 40second ignition cycle prior to attempting engine start. Turn on cockpit heat and canopy defog system, as required, immediately after engine start. Use the following engine start procedure only when starting difficulties are encountered during cold weather:

1. Throttle — Advance to IDLE.
2. External air — Apply.
3. Start button (at first indication of RPM) — PUSH.

WARMUP AND GROUND CHECK

After engine start, oil pressure indications above 55 psi is observed. As the oil warms up, pressure should reduce to within operating limits. If oil pressure does not return to operating limits within 6 minutes after engine start, the engine should be shut down. Slightly lower idle speeds are to be expected with cold engines and a small advance of throttles may be necessary to place the generators on the line. When engines are sufficiently warmed up, check flight controls, speed brake, and aileron trim for proper operation. Cycle flight controls 4 to 6 times. Check hydraulic pressure, control reaction, and operation of all instruments.

TAXIING

Nosewheel steering effectiveness is reduced when taxiing on ice and hard packed snow. A combination of nosewheel steering and wheel braking should be used for directional control. The nosewheel skids sideways easily, increasing the possibility of tire damage. To ensure positive engagement of nosewheel steering, depress control button firmly when wearing heavy flying gloves. It is suggested that alternate fingers be used for this function since constant pressure with one could lead to frostbite. If conditions permit, taxi with one engine at idle and the other at high rpm (70% to 80%) to provide more heat for the cockpit and for canopy and windshield defrosting. However, reduced speeds generally are necessary when taxiing over the uneven snow and ice covered surfaces common in low temperature environments. Increase the normal interval between aircraft, both to ensure a safe stopping distance and to prevent icing of aircraft surfaces from melted snow and ice caused by the jet blast of the preceding aircraft. Minimize taxi time to conserve fuel and reduce the amount of ice fog generated by the engines. If bare spots exist thru the snow, skidding onto them should be avoided.

WARNING

Make sure all instruments have warmed up sufficiently to ensure normal operation. Check for sluggish instruments while taxiing.

TAKEOFF

Due to increased thrust available at low ambient temperatures on icy or wet runways, the aircraft may skid during MIL power runup even though the brakes are locked. It may be necessary to run up one engine at a time and start the takeoff roll at less than MIL power.

SCRAMBLE TAKEOFF

When the temperature is 32°F or below and operational requirements dictate, it is permissible to take off when a decreasing indication in oil pressure has been established and pressure indications have decreased to 95 psi or below. If operating at military power or in afterburner, the oil pressure should decrease to normal operating limits within approximately 6 minutes. If the pressure does not return to normal within the time limit, the throttle should be retarded as required to decrease the pressure to an acceptable limit. If lowering the power setting does not decrease the oil pressure within limits, shut down engine.

LANDING

Use minimum run landing techniques. When landing on runways that have patches of dry surface, avoid locking the wheels. If the aircraft starts to skid, release brakes until recovery from skid is accomplished.

CAUTION

After touchdown and deployment of drag chute, prepare for tendency of the aircraft to veer toward either side of runway. In cold environment, main landing gear struts may not compress equal amounts, causing aircraft to track to side of lower strut. Nosewheel steering is ineffective during high-speed portion of landing roll on icy runway.

ENGINE SHUTDOWN

Use normal engine shutdown procedure.

BEFORE LEAVING AIRCRAFT

The canopy should be fully closed on aircraft parked outdoors to prevent the entry of blowing snow caused by operation of other aircraft or from natural conditions.

HOT WEATHER AND DESERT OPERATION

Operation in hot weather and desert requires that precautions be taken to protect the aircraft from damage caused by high temperatures, dust, and sand. Care must be taken to prevent the entrance of sand into aircraft parts and systems such as the engines, fuel system, pitot-static system, etc. All filters should be checked more frequently than under normal conditions. Plastic and rubber segments of the aircraft should be protected both from high temperatures and from blowing sand. Canopy covers should be left off to prevent sand from accumulating between the cover and the canopy and acting as an abrasive on the plastic canopy. With a canopy closed, cockpit damage may result when ambient temperature is above 110°F. Canopy should be opened in advance of flight to reduce cockpit temperature for comfort. Desert and hot weather operation requires that, in addition to normal procedures, the following precautions be observed.

ENTERING AIRCRAFT

During preflight inspection and upon entering aircraft, it is recommended that light flying gloves be worn since aircraft surfaces are extremely hot in high ambient temperatures.

NOTE

Full fuel load of JP-4 at high ambient temperatures may indicate as low as approximately 4100 pounds.

AFTER ENGINE START

To prevent formation of frost and fog after engines have been started and canopy has been closed in high humidity conditions, operate the canopy defog system at highest flow possible and set cockpit temperature as high as possible (consistent with pilot's comfort).

TAKEOFF

1. Use normal takeoff technique.
2. Be alert for gusts and wind shifts near the ground.
3. Anticipate longer takeoff distance and reduced climb performance due to higher density altitudes associated with hot weather.

NOTE

Hot weather takeoff with high gross weights results in excessive differences between normal takeoff speed and single-engine takeoff speed.

INFLIGHT

The canopy defog system should be operated at the highest flow possible and set cockpit temperature as high as possible (consistent with pilot's comfort) for 10 minutes prior to descent from high altitude flight to provide an airflow over the transparent surfaces and prevent the formation of frost or fog during descent.

APPROACH AND LANDING

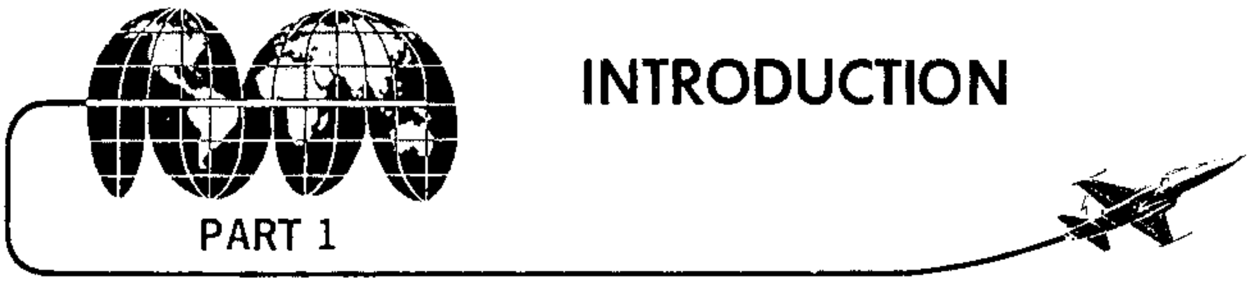
1. Monitor airspeed closely to ensure that recommended approach and touchdown airspeeds are maintained; high ambient temperatures cause ground speed to be higher than normal.
2. Anticipate a long landing roll due to higher ground speed at touchdown.

APPENDIX I

PERFORMANCE DATA

TABLE OF CONTENTS

F-5E 1-7B



INTRODUCTION

PART 1

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TABLE OF CONTENTS

Page numbers underlined denote charts.

INTRODUCTION

The appendix contains the performance data required for planning missions. Data are divided into parts 1 thru 10 in sequence for mission planning. Part 9 contains data for Dart target tow missions. Part 10 details the mission planning process. Each part explains the use of the charts. The charts are in graph form, using drag index to identify store loadings. Single-engine performance is shown for a drag index range of 0 to 120.

NOTE

- Where performance differences require, charts are provided for both Ⓔ and Ⓕ aircraft. However, all sample problems are based on the Ⓔ. Computations pertinent to the Ⓕ may be made by using the sample problem procedures and data derived from the Ⓕ performance charts.
- Performance charts, when different for aircraft incorporating improved handling modifications (shark nose, LEX) and autoflaps are identified in the chart title by [E-3] and/or [F-2].

PERFORMANCE DATA BASIS

Performance data are based on flight test data. All altitudes are mean sea level (MSL) unless otherwise noted. Airspeeds are in knots indicated airspeed and indicated mach number to provide a direct cockpit readout. The differences between calibrated airspeed (KCAS) and indicated airspeed (KIAS) are negligible, as are the differences between true mach number (TMN) and indicated mach number (IMN). Charts are for US standard atmosphere conditions. Ambient temperature corrections are provided where temperature effects are significant. Weights are based on JP-4 fuel at 6.5 pounds per US gallon. Engine fuel consumption rates are increased 5% to account for variations in service aircraft. Parts 2 and 7 correct the data for the effect of cg position. Each chart contains a miniature guide box in the upper right corner with chase-thru guidelines for reference. All performance charts are based on JP-4 fuel.

NOTE

Performance charts are applicable for use with other kerosene type fuel at 6.7 pounds per US gallon.

DRAG INDEX SYSTEM

The drag index system presents performance for a number of store loadings on one chart. Drag numbers are given for the basic aircraft, accessory equipment, wingtip stores, centerline stores, and wing stores. Stores are assigned a drag number depending on size, shape, and location on the aircraft. The sum of the drag numbers is the drag index. Drag index determines the aircraft performance for the configuration. In the performance charts, the drag index is, at times, not in numerical order with respect to the other drag indexes on the same chart due to the effect of wingtip stores on drag due to lift. Performance should be interpolated in the charts for intermediate values of drag index unless otherwise stated.

DRAG NUMBER CHART

Drag numbers are in FA1-1. Note that the drag numbers for wing stores depend on the type of stores on the adjacent pylons. Drag numbers at the intersection of the outboard and inboard wing stations represent the total of the combination of these stations and are based on symmetrical store loading. When store loading changes, as when the empty tank is dropped or rockets are fired, the drag numbers of the remaining items must be read from FA1-1 and recalculated to determine the drag index for the new store configuration.

WEIGHT DATA

Weight data in FA1-2 (Sheets 1 and 2) provide average aircraft gross weight and weights of fuel, tanks, ammunition, pylons, accessories, stores, and training equipment. The gross weight listed is the weight of a typical aircraft. Refer to T.O. 1-1B-40 for actual gross weight. Trapped fuel is included in the external tank weight.

VARIABLE NOSE BALLAST Ⓔ

If flight operations are primarily without wing pylon fuel tanks, tank variable ballast should be removed from the nose when the tanks are removed to insure that maximum performance characteristics are met. The aircraft can be flown with the variable ballast without wing pylon fuel tanks; however, performance degradations should be expected due to the increased ballast weight and as much as 1.4% forward cg movement.

EXTERNAL VARIABLE TAIL BALLAST Ⓕ

Variable tail ballast may be retained with two crew and wing pylons only to improve performance characteristics provided the aft cg limit is not exceeded. Refer to T.O. 1-1B-40 to determine aft cg limit. See Authorized Configuration for Takeoff, section V.

USE OF DRAG NUMBER AND WEIGHT DATA CHARTS

Use of FA1-1 and FA1-2 (Sheets 1 and 2) to determine drag indexes and store weights during a mission is shown below. Assume an F-5E with a 275-gallon fuel tank on the centerline, a MK-82LD bomb on each inboard and outboard wing station, and an AIM-9J missile on each wingtip. Determine drag index and store weights for takeoff.

	Drag No.	Weight (Lb)
Basic aircraft Ⓔ	2	—
Stores:		
Centerline fuel tank and pylon	32	2174
Inboard MK-82LD bombs and outboard MK-82LD bombs with pylons	70	2624
AIM-9J missiles	16	340
Drag index and total store weight	120	5138

As the mission is flown and stores are expended, the drag index of the aircraft and the store weights change. Referring again to FA1-1 and FA1-2 (Sheets 1 and 2), the following is determined:

1. After the outboard, inboard MK-82LDs and centerline tank are dropped:

	Drag No.	Weight (Lb)
Basic aircraft Ⓔ	2	—
Stores:		
Centerline pylon	14	170
Inboard and outboard pylons	53	500
AIM-9J missiles	16	340
Drag index and total store weight	85	1010

2. After AIM-9J missiles are fired:

	Drag No.	Weight (Lb)
Basic aircraft Ⓔ	2	—
Stores:		
Centerline pylon	14	170
Inboard and outboard pylons	53	500
Wingtip launchers	1	—
Drag index and total store weight	70	670

AIRCRAFT TAKEOFF GROSS WEIGHT AND CG POSITION (APPROXIMATE) CHART

The Aircraft Takeoff Gross Weight and CG Position Charts (FA1-3, sheets 1 thru 5) determine the approximate takeoff and cg position as affected by pylons, stores, wingtip missiles, ammunition, and ballast. Sheet 1, which is used for [E] and [E-2] aircraft [Before T.O. 1F-5E-594], does not provide an inboard pylon fuel tank correction grid but does require peculiar ammunition loading and firing restrictions to compensate for carriage of inboard pylon fuel tanks (see section V). Sheet 2 provides an additional correction grid for installation of variable ballast in the nose section of modified [E] and [E-2] aircraft [T.O. 1F-5E-594] to compensate for carriage of inboard pylon 150-gallon or 275-gallon fuel tanks. Sheet 3 reflects the heavier average gross weight and cg change of [E-1] and [E-3] aircraft. Sheet 4 provides similar data for the [F], including correction grids for variable external tail ballast and the weight and moment of the additional pilot. Sheet 5 reflects the heavier average gross weight and cg change of [F-1] and [F-2] aircraft.

NOTE

- Cumulative external store and pylon weights exceeding the chart fan grid require reference to T.O. 1-1B-40 for cg position calculation. (Approximation calculations are inaccurate beyond provided grid.)
- Refer to T.O. 1-1B-40 for actual aircraft takeoff weight and cg data.

USE

The charts are entered at the index point representing the aircraft average gross weight with pilot, full internal fuel, tip launcher rails, and no ammo. Each chart is divided into grids for various store loading combinations that require corrections to ascertain the particular configuration cg position. Grid A in each chart provides a cg position plot for cumulative weight of the outboard, inboard, and centerline pylons, in that order. The remaining grids of each chart provide correction factors to the cg position for wingtip missiles, ammunition, ballast, and Ⓕ rear seat weight (sheet 3).

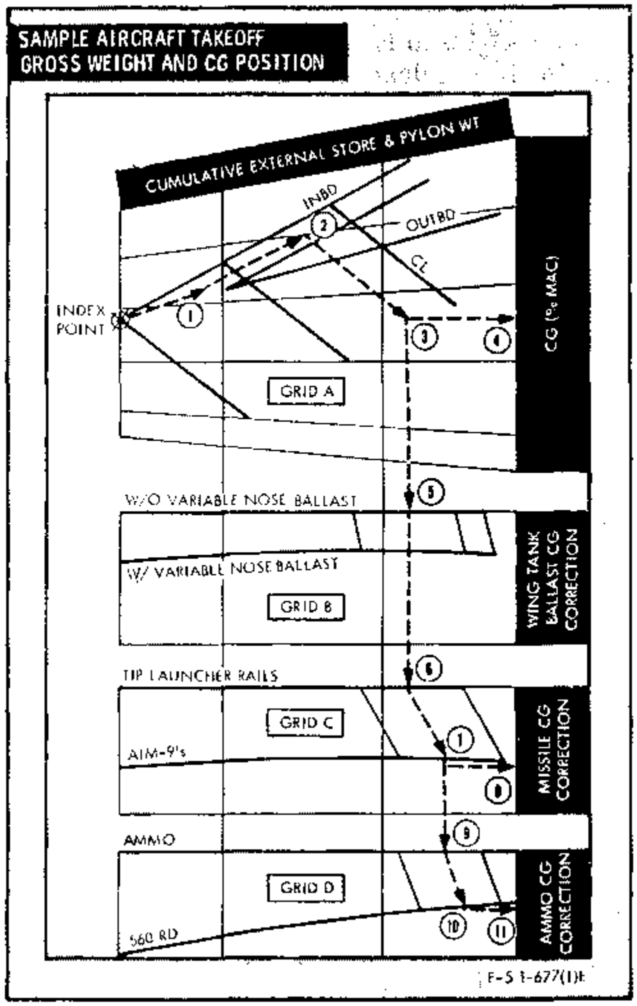
SAMPLE PROBLEM

NOTE

The weight of the aircraft, stores, and equipment in the examples are not actual weights. They are used for sample problem purposes only.

Given:

A. [E] [E-2] Average gross weight [T.O. 1F-5E-594] with launcher rails, internal fuel, oil, and pilot is 15,050 lb.
B. Weight of outboard pylon plus MK-82LD bomb is 659 lb. Total weight of both outboard wing stations equals 1318 lb.
C. Weight of inboard pylon plus MK-82LD bomb is 653 lb. Total weight of both inboard wing stations equals 1306 lb.
D. Weight of centerline pylon plus full 275-gallon tank is 2174 lb.



E. Weight of two AIM-9J missiles is 340 lb.
F. Weight of a full load of 20mm ammunition is 394 lb.

Calculate:

A. Approximate takeoff cg position.
B. Use Aircraft Takeoff Gross Weight and CG Position chart FA1-3, sheet 2.
   ① From the Index Point (15,050 lb) marked x on Grid A, proceed right along the line marked OUTBD until a weight value of 1318 lb is obtained from scale at top of chart (intersected by vertical guidelines).

NOTE

If pylons are not installed, cg position is read to the right by paralleling the unmarked chart grid lines.

② From point ① continue right paralleling the nearest INBD line until a cumulative total external store and pylon weight of 2624 lb is obtained (1318 lb + 1306 lb).

③ From point ② project a line downward parallel to the nearest CL line until a cumulative total external store and pylon weight of 4798 lb is obtained (1318 lb + 1306 lb + 2174 lb).

④ Following guidelines to the right from point ③ (which is the approximate takeoff cg of the aircraft without ammunition or missiles), read cg of 16.0% MAC for a gross weight of 19,848 lb (15,050 lb + 4798 lb).

⑤ Return to point ③ and proceed down, following the nearest vertical guideline to Grid B w/o variable nose ballast curve. Since wing fuel tanks are not carried, no correction is required for additional ballast.

⑥ From point ⑤ proceed down, following the nearest guideline to Grid C Tip Launcher Rails Only curve. The launcher rails configuration does not require correction factors for cg position or gross weight (data basis for Index point).

⑦ From point ⑥ contour guidelines to the AIM-9 missile curve. Note added weight of 342 lb for AIM-9 missiles (340 lb for AIM-9J, see FA1-2).

⑧ Proceed right and read CG correction factor of +0.5% MAC for missile weight.

⑨ Return to point ⑦ and proceed down following the nearest guideline to Grid D Ammunition.

⑩ From point ⑨ contour guidelines to the 560 rounds curve. Note added weight of 394 lb for full load of 20mm ammunition.

⑪ Proceed right and read CG correction factor of −4% MAC for ammunition weight.

Thus:

Takeoff Gross Wt (19,848 + 340 lb + 394 lb) = 20,582 lb

Takeoff CG Position (16% + 0.5% − 4.0%) = 12.5% MAC

ALTIMETER AND AIRSPEED INSTALLATION ERROR CORRECTION

Altimeter and airspeed installation error corrections are presented in FA1-4, sheets 1 and 2. These corrections are valid for flaps and gear up or down and for all store configurations. Enter charts with KCAS and true pressure altitude and read corrections to altitude in feet in upper chart and to airspeed in lower chart. To obtain indicated pressure altitude, add altimeter installation error correction to true pressure altitude. KIAS is obtained by adding airspeed installation error correction to KCAS.

MACH NUMBER INSTALLATION ERROR CORRECTION

Indicated mach number may be read as true mach number. Installation error is negligible; therefore, a chart for correction is not required.

COMPRESSIBILITY CORRECTION TO CALIBRATED AIRSPEED

The difference between KCAS and KEAS is the compressibility correction shown in FA1-5 (KEAS = KCAS − airspeed compressibility correction).

AIRSPEED CONVERSION

Chart FA1-6 converts between KCAS, true mach number, and true airspeed. Enter the chart with KCAS and move upward to the pressure altitude. Read true mach number on the left scale and true airspeed for standard atmosphere between the sloping speed lines whose scale is at the sea level pressure altitude line. To correct true airspeed for off-standard temperatures, move horizontally from the intersection of KCAS and pressure altitude to the sea level pressure altitude line, then down to the ambient temperature and read the corrected true airspeed on the scale at the right.

STANDARD ATMOSPHERE TABLE

US standard atmosphere is tabulated at 1000-foot increments between −2000 and 65,000 feet altitude in FA1-7. Sea level values are listed in the top of the chart for use with the ratios shown in the table. As an example of the use of the chart, find the equivalent airspeed in knots in standard atmosphere corresponding to 0.85 mach number at 30,000 feet pressure altitude. At 30,000 feet read $a/a_0 = 0.8909$, read $1/\sqrt{\sigma} = 1.6349$, and at the top of the chart read $a_0 = 661.47$ knots

Then: $a = a_0 \times a/a_0 = 661.47 \times 0.8909$
$= 589.3$ knots.

KTAS = mach $\times$ a = 0.85×589.3
$= 500.9$ knots.

KEAS = KTAS $\div (1/\sqrt{\sigma}) = 500.9 \div 1.6349$
$= 306.4$ knots.

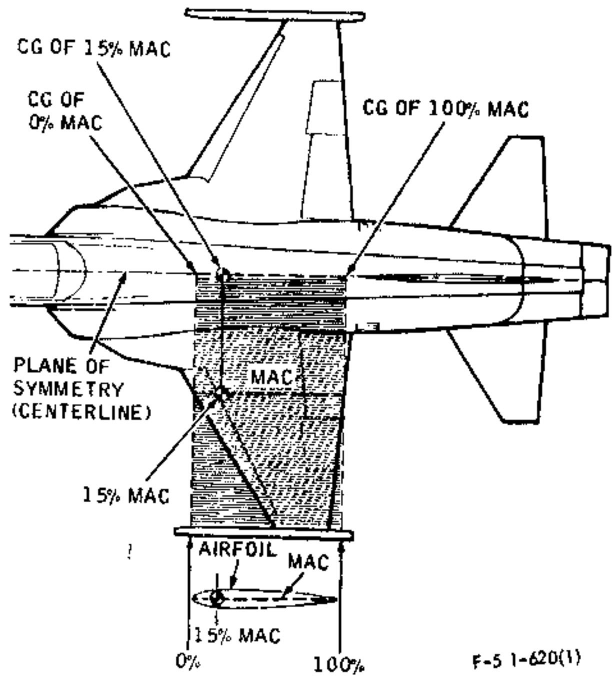
STANDARD UNITS CONVERSION

Linear scales for converting units of temperature, distance, and speed from one measurement system to another are provided in FA1-8. Additional conversion factors for volume, pressure, and weight are listed at the bottom of the chart.

MEAN AERODYNAMIC CHORD

The mean aerodynamic chord (MAC) is the chord of an imaginary rectangular wing which has force vectors identical with those of the actual wing. This chord is used as a reference for the forces and moments acting on the aircraft. The following illustration depicts the location of the MAC on the aircraft. The aircraft center-of-gravity position is a point on the plane of symmetry (centerline) behind the leading edge of the MAC equal to a percentage of the length of the MAC. The illustration shows a cg position of 15% MAC.

MEAN AERODYNAMIC CHORD



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RUNWAY WIND COMPONENTS

The runway wind components chart of FA1-9 converts surface wind velocities into components parallel to and across the runway. The headwind or tailwind component is used to compute takeoff and landing distances, and the crosswind component is used to determine the feasibility of operations.

DRAG NUMBERS

Code

1. WINGTIP STORE DRAG NUMBER INCLUDES TIP LCHR RAIL.
2. PYLON STORE DRAG NUMBER INCLUDES PYLON.
3. DRAG NUMBER WITH J-HOOKS INSTALLED OR AFTER PYLON JETTISON:

CL	1	(2) INBD	2	(2) OUTBD	2

(U) UNFINNED (F) FINNED (W/O) WITHOUT

BASIC AIRCRAFT	E	F
W/O TIP LCHR RAILS	2	8
E2 W/RECON NOSE	6	-

WINGTIP STATIONS (1)	
(2) TIP LCHR RAILS (ONLY)	1
(2) L TIP LCHR RAIL WITH AFT FAIRING REMOVED + R TIP LCHR RAIL	3
(2) AIM-9B SERIES (OR CAPTIVE)	18
(2) AIM-9E/J/N/P SERIES (OR CAPTIVE)	16
(1) AIM-9B SERIES (OR CAPTIVE) + (1) TIP LCHR RAIL	10
(1) AIM-9E/J/N/P SERIES (OR CAPTIVE) + (1) TIP LCHR RAIL	9
(1) TDU-11/B + (1) AIM-9B/E/J/N/P SERIES	19
(1) TDU-11/B + (1) TIP LCHR RAIL	12
(1) AIS POD + (1) AIM-9B SERIES	17
(1) AIS POD + (1) AIM-9E/J/N/P SERIES	16
(1) AIS POD + (1) TIP LCHR RAIL	9

CENTERLINE STATION (2)		
NO PYLON (3)		0
PYLON		14
150-GAL FUEL TANK		22
WRM 150-GAL FUEL TANK		25
275-GAL FUEL TANK		32
M129E2		28
BLU-1/B, B/B, C/B; -27B, A/B, B/B, C/B	U	22
	F	27
BLU-32A/B, B/B, C/B	U	20
	F	24
CBU-24B/B;-49B/B;-52B/B;-58/B,A/B; -71/B,A/B		23
MK-36		21
MK-82 LD		17
MK-82 SE		21
BRU-27/A MER	5 MK-82 LD OR SE	88
	4 MK-82 LD OR SE	65
	3 MK-82 LD OR SE	61
	2 MK-82 LD OR SE	57
	EMPTY	44
MK-83 LD		19
MK-84 LD		25

CENTERLINE STATION (2) (cont.)			F *
GBU-10F/B (LGB FF)		32	
GBU-12E/B (LGB FF)		24	
M117		19	
MXU-648		22	
SUU-20/A (M) OR -20A/A	LOADED (BDU-33 SERIES)	51	58
	LOADED (MK-106)	53	60
	EMPTY	39	46
SUU-20B/A	LOADED (BDU-33 SERIES)	49	56
	LOADED (MK-106)	51	58
	EMPTY	37	44

* INCLUDES DISPENSER ADAPTER ASSEMBLY.

OUTBOARD STATIONS (2) / INBOARD STATIONS (2)	NO PYLON (3)	PYLON	150-GAL FUEL TANK	WRM 150-GAL FUEL TANK	275-GAL FUEL TANK	MK-82 LD	MK-82 SE	MK-83 LD	M117	GBU-12/B, A/B (LGB HS)	GBU-12E/B (LGB FF)	MK-36	M129E2	CBU-24B/B;-49B/B;-52B/B;-58/B,A/B;-71/B,A/B	BLU-1/B, B/B, C/B; -27/B, A/B, B/B, C/B (F ONLY) U	BLU-1/B ... F	BLU-32A/B, B/B, C/B U	BLU-32A/B ... F	LAU-3/A, A/A, B/A; -60/A NOSE CONE ONLY	LAU-3 NOSE AND TAIL CONE	LAU-3 W/O EITHER CONE (UNFIRED)	LAU-3 W/O EITHER CONE (FIRED)	LAU-68A/A, B/A UNFIRED	LAU-68A/A, B/A FIRED	MXU-648
NO PYLON (3)	0	27	48	54	70	33	43	40	53	48	45	43	58	64	44	54	39	47	56	38	147	94	29	46	44
PYLON	27	53	74	80	97	60	70	67	80	75	72	70	85	91	71	81	65	73	83	65	174	121	56	73	71
MK-82 LD	34	61	86	92	109	70																			
MK-82 SE	44	71	96	102	119		90																		
M117	44	71							108																
MK-36	44	71	96	102	119							90													
M129E2	59	86											128												
CBU-24B/B;-49B/B;-52B/B;-58/B,A/B;-71/B,A/B	56	83												131											
BLU-1/B, B/B, C/B; -27/B, A/B, B/B, C/B U	46	72	118	124	142										111										
BLU-1/B, B/B, C/B; -27/B, A/B, B/B, C/B F	55	82	128	134	151											130									
BLU-32A/B, B/B, C/B U	40	67															89								
BLU-32A/B, B/B, C/B F	48	75																105							
LAU-3/A, A/A, B/A; -60/A NOSE CONE ONLY	57	84	122	128	147														123						
LAU-3/A ... NOSE AND TAIL CONE	39	66	104	110	129															87					
LAU-3/A ... W/O EITHER CONE (UNFIRED)	148	175	213	219	238																305				
LAU-3/A ... W/O EITHER CONE (FIRED)	95	122	160	166	185																	199			
LAU-68/A, B/A UNFIRED	30	57																					62		
LAU-68/A, B/A FIRED	47	74																						96	
SUU-25A/A	121	148																							
SUU-25C/A, E/A	76	103																							
GBU-12/B, A/B (LGB HS)	51	78	103	109	126					105															
GBU-12A/B (LGB LS)	57	84	111	117	134																				
GBU-12E/B (LGB FF)	48	75	100	106	123						99														

F-51-619(1)L

FA1-1.

WEIGHT DATA

AIRCRAFT—AVERAGE GROSS WEIGHT (LB)

WITH TIP LAUNCHER RAILS:	JP-4	JET A-1 OR JP-8
E E-2 W/O BALLAST	14,950	15,090
E E-2 W/BALLAST [T.O. 1F-5E-594]	15,050	15,190
E-1 E-3 W/BALLAST	15,170	15,310
F W/VARIABLE TAIL BALLAST *	15,650	15,790
F-1 F-2 W/VARIABLE TAIL BALLAST *	15,860	16,000

* WITHOUT TAIL BALLAST INSTALLED, SUBTRACT 140 LB.

Note

- AVERAGE GROSS WEIGHT INCLUDES PILOT WITH PARACHUTE AND FLIGHT GEAR (240 LB) (ONE CREW ONLY F), AND FULL INTERNAL FUEL AND OIL (NO AMMO.)
- REFER TO T.O. 1-1B-40 FOR INDIVIDUAL AIRCRAFT WEIGHT.

ACCESSORIES

PYLONS:	WT-LB
(1) CL	170
(1) INBD	122
(1) OUTBD	128

LAUNCHERS:		WT-LB
(1) LAU-3/A, -3A/A, -3B/A, OR -60/A	EMPTY	74
	FULL	469 *
(1) LAU-68A/A, B/A	EMPTY	71
	FULL	215 *

* MAY VARY WITH TYPE WARHEADS LOADED.

BOMB RACK:	WT-LB
(1) BRU-27/A MER	200

DISPENSERS:		WT-LB
(1) SUU-20/A (M) (EMPTY)		320
(1) SUU-20A/A (EMPTY)		325
(1) SUU-20B/A (EMPTY)		270
F SUU-20 ADAPTER		47
(1) SUU-25A/A	EMPTY	160
	FULL	400 **
(1) SUU-25C/A, E/A	EMPTY	262
	FULL	497 **

** MAY VARY WITH TYPE FLARE/MARKERS LOADED.

AIS POD:	WT-LB
(1) ASQ-T11(P-3 POD)	126
(1) ASQ-T13(P4), ASQ-T17(P4A), ASQ-T20(P4AX)	123
(1) ASQ-T21(HAIS)	124

BAGGAGE/CARGO POD:		WT-LB
(1) MXU-648 W/REMOVABLE TAILCONE	EMPTY	130
	FULL	430
W/FIXED TAILCONE	EMPTY	98
	FULL	398

AMMO

	WT-LB
E (560) ROUNDS 20MM (FULL LOAD)	394
F (140) ROUNDS 20MM (FULL LOAD)	98
(1) ROUND 20MM	0.7

MISSILES, ROCKETS, BOMBS AND FLARES

MISSILES:	WT-LB		WT-LB
(1) AIM-9B, B-1	165	(1) AIM-9B-2, B-3 OR ICT	178
(1) AIM-9E, E-1	171	(1) AIM-9E-2, E-3 OR ICT	184
(1) AIM-9J, J-1	170	(1) AIM-9J-2, J-3 OR ICT	183
(1) AIM-9N, N-1	170	(1) AIM-9N-2, N-3 OR ICT	183
(1) AIM-9P, P-1	166	(1) AIM-9P-2, P-3 OR ICT	179

ROCKETS:		WT-LB
(1) 2.75-INCH FFAR	MK 1, MK 5 WARHEAD	18
	M151, M156, WDU-4 WARHEAD	21
(1) TDU-11/B TARGET ROCKET		215

BOMBS:		WT-LB
(1) MK-82 LD		531
(1) MK-82 SE		570
(1) MK-83 LD		985
(1) MK-84 LD		1970
(1) M117		824
(1) GBU-10F/B (LGB FF)		2083
(1) GBU-12/B, A/B (LGB HS)		605
(1) GBU-12A/B (LGB LS)		619
(1) GBU-12E/B (LGB FF)		610
(1) MK-36 DESTRUCTOR		572
(1) M129E2 LEAFLET		203
(1) CBU-24B/B OR -49B/B		822
(1) CBU-52B/B		785
(1) CBU-58/B, A/B, OR -71/B, A/B		818
(1) BLU-1/B, B/B, OR C/B	FINNED	717
	UNFINNED	702
(1) BLU-27/B	FINNED	854
	UNFINNED	839
(1) BLU-27A/B, B/B, OR C/B	FINNED	797
	UNFINNED	782
(1) BLU-32A/B, B/B, OR C/B	FINNED	597
	UNFINNED	582
(1) BDU-33 SERIES PRACTICE		24
(1) MK-106 PRACTICE		5

FLARES/MARKERS:	WT-LB
(1) MK-24 MOD 4	27
(1) LUU-1/B OR -5/B	27
(1) LUU-2/B	30

TOW TARGET EQUIPMENT

	WT-LB
(1) RMU-10/A TOW REEL POD (INCLUDES 2300 FT OF 11/64 TOW CABLE)	475
(1) TARGET CARRIER ASSEMBLY	270
(1) TDU-10/B DART TARGET	197

F-5 1-618(1)U

FA1-2 (Sheet 1).

WEIGHT DATA (CONTINUED)

DATA BASIS

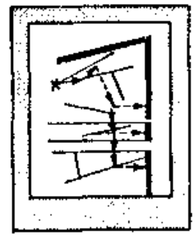
- CAPACITIES CALIBRATED FOR STANDARD DAY CONDITION.
- SINGLE-POINT REFUELING — LEVEL RAMP ATTITUDE.
- FUEL DENSITY:
  - JP-4 — 6.5 LB/US GAL
  - JET A-1 OR JP-8 — 6.7 LB/US GAL
  - JP-5 — 6.8 LB/US GAL

	TANKS AND FUEL	FULLY SERVICED POUNDS JP-4	FULLY SERVICED POUNDS JET A-1 JP-8	FULLY SERVICED POUNDS JP-5	USABLE POUNDS JP-4	USABLE POUNDS JET A-1 JP-8	USABLE POUNDS JP-5	EMPTY TANK * WT-LB
	INTERNAL FUEL							
	TOTAL	4537	4676	4746	4400	4536	4604	——
	INTERNAL FUEL	[T.O. 1F-5-921]						
	TOTAL	4647	4790	4862	4511	4650	4719	——
	EXTERNAL FUEL							
275-GAL TANKS	CL W/275 GALS	1788	1843	1870	1775	1829	1856	229
275-GAL TANKS	2 INBDS, EACH W/275 GALS	3575	3685	3740	3549	3658	3713	454
275-GAL TANKS	CL W/260 GALS	1703	1755	1782	1690	1742	1768	229
275-GAL TANKS	2 INBDS, EACH W/260 GALS	3406	3511	3563	3380	3484	3536	454
150-GAL TANKS	CL W/150 GALS	988	1018	1034	975	1005	1020	148
150-GAL TANKS	2 INBDS, EACH W/150 GALS	1976	2037	2067	1950	2010	2040	306
	MAXIMUM FUEL							
275-GAL TANKS	INTERNAL & 3 EXTERNAL TANKS, EACH W/275 GALS	9900	10,204	10,356	9724	10,023	10,173	
275-GAL TANKS	INTERNAL & 3 EXTERNAL TANKS, EACH W/260 GALS	9646	9942	10,091	9470	9762	9908	
150-GAL TANKS	INTERNAL & 3 EXTERNAL TANKS, EACH W/150 GALS	7501	7731	7847	7325	7551	7664	
	MAXIMUM FUEL	[T.O. 1F-5-921]						
275-GAL TANKS	INTERNAL & 3 EXTERNAL TANKS, EACH W/275 GALS	10,010	10,318	10,472	9834	10,137	10,288	
275-GAL TANKS	INTERNAL & 3 EXTERNAL TANKS, EACH W/260 GALS	9756	10,056	10,207	9581	9875	10,023	
150-GAL TANKS	INTERNAL & 3 EXTERNAL TANKS, EACH W/150 GALS	7611	7845	7963	7436	7664	7779	

* EMPTY TANK WEIGHT INCLUDES UNUSABLE FUEL (ALL FUELS):
275-GAL TANK 10 LB 150-GAL TANK 13 LB

F-5 1-132(1)

FA1-2 (Sheet 2).



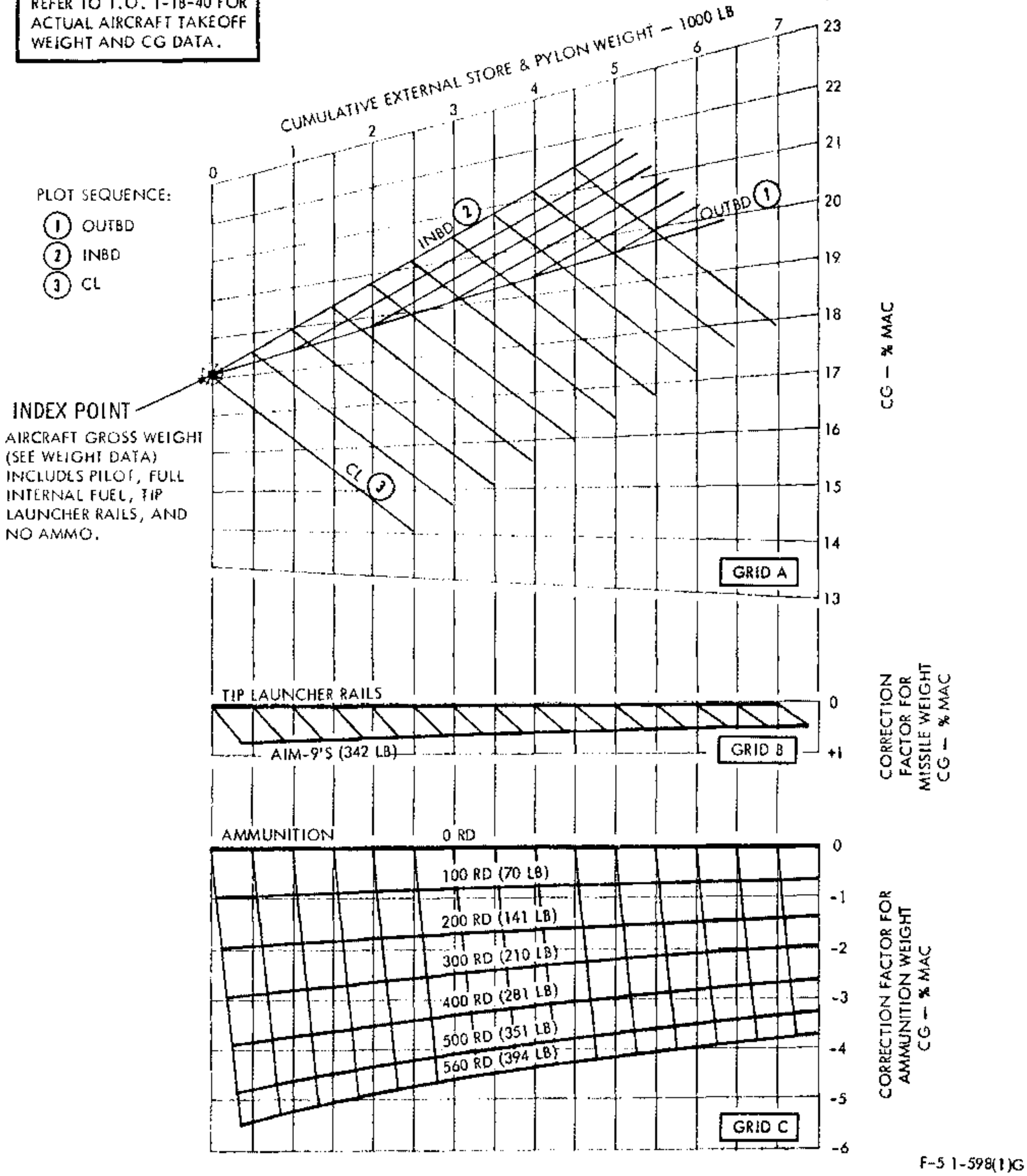
E
E-2

AIRCRAFT TAKEOFF GROSS WEIGHT AND CG POSITION

APPROXIMATE

[BEFORE T.O. 1F-5E-594]

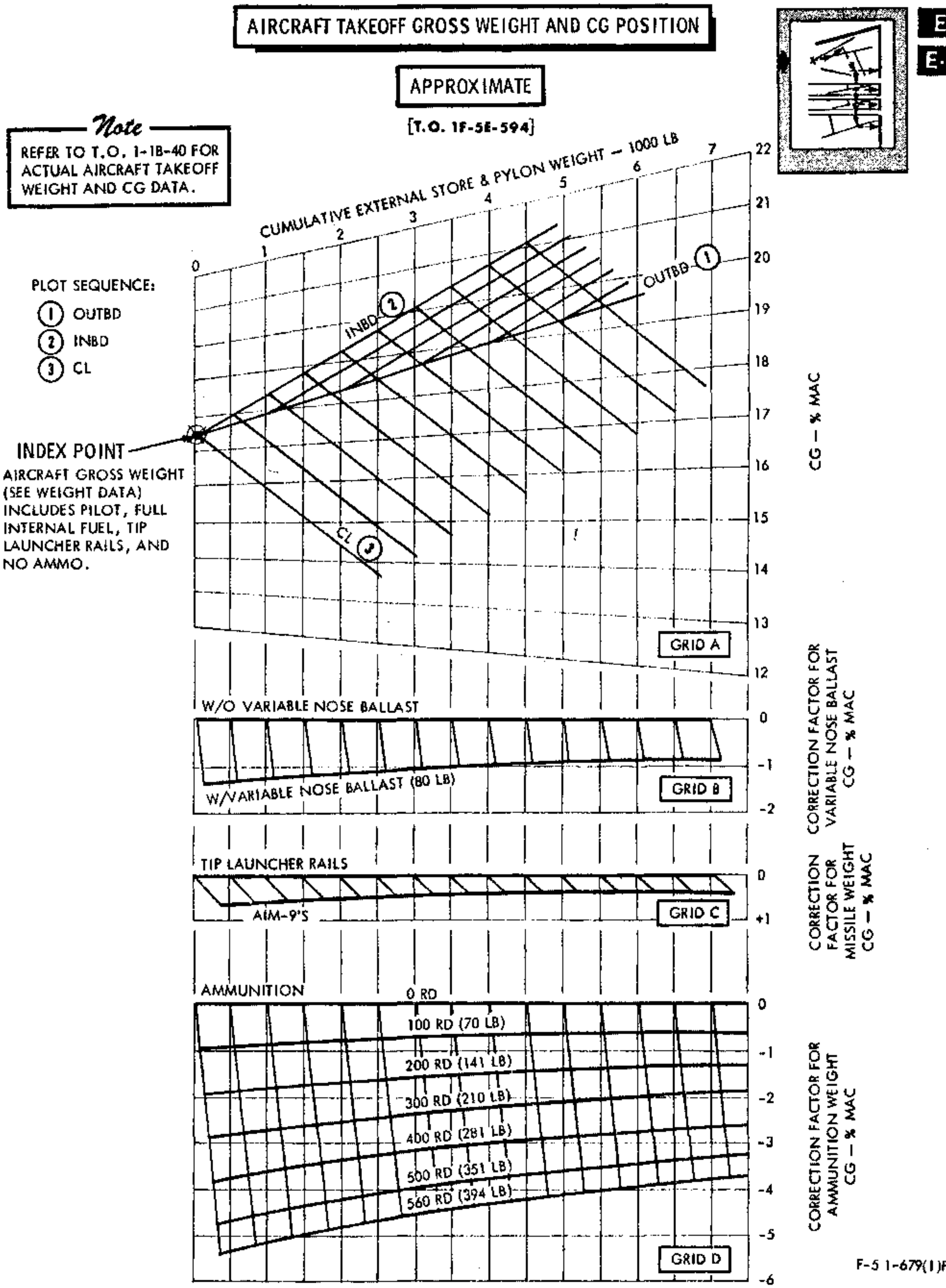
Note
REFER TO T.O. 1-1B-40 FOR ACTUAL AIRCRAFT TAKEOFF WEIGHT AND CG DATA.



FA1-3 (Sheet 1).

E

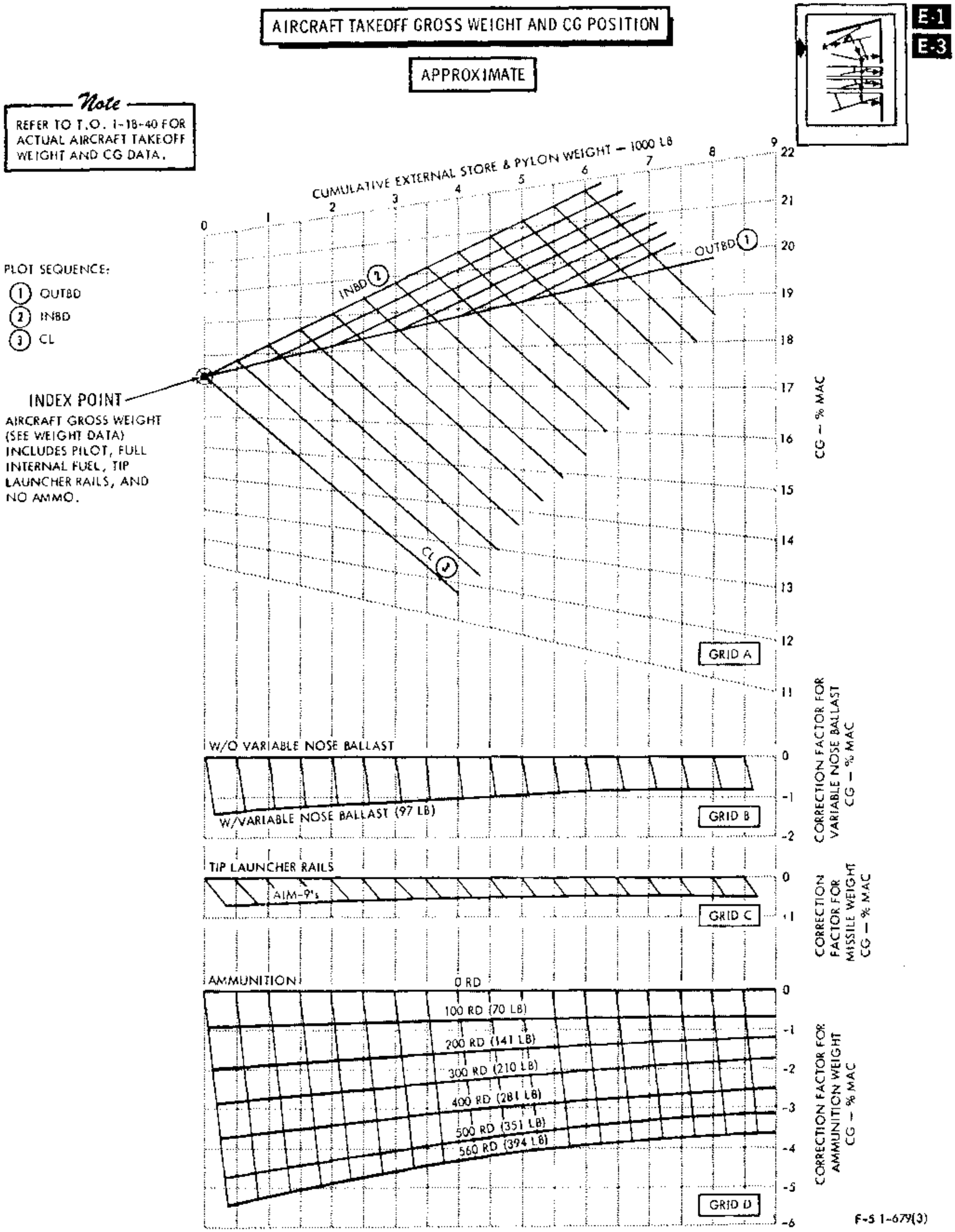
E-2



FA1-3 (Sheet 2).

AIRCRAFT TAKEOFF GROSS WEIGHT AND CG POSITION

APPROXIMATE



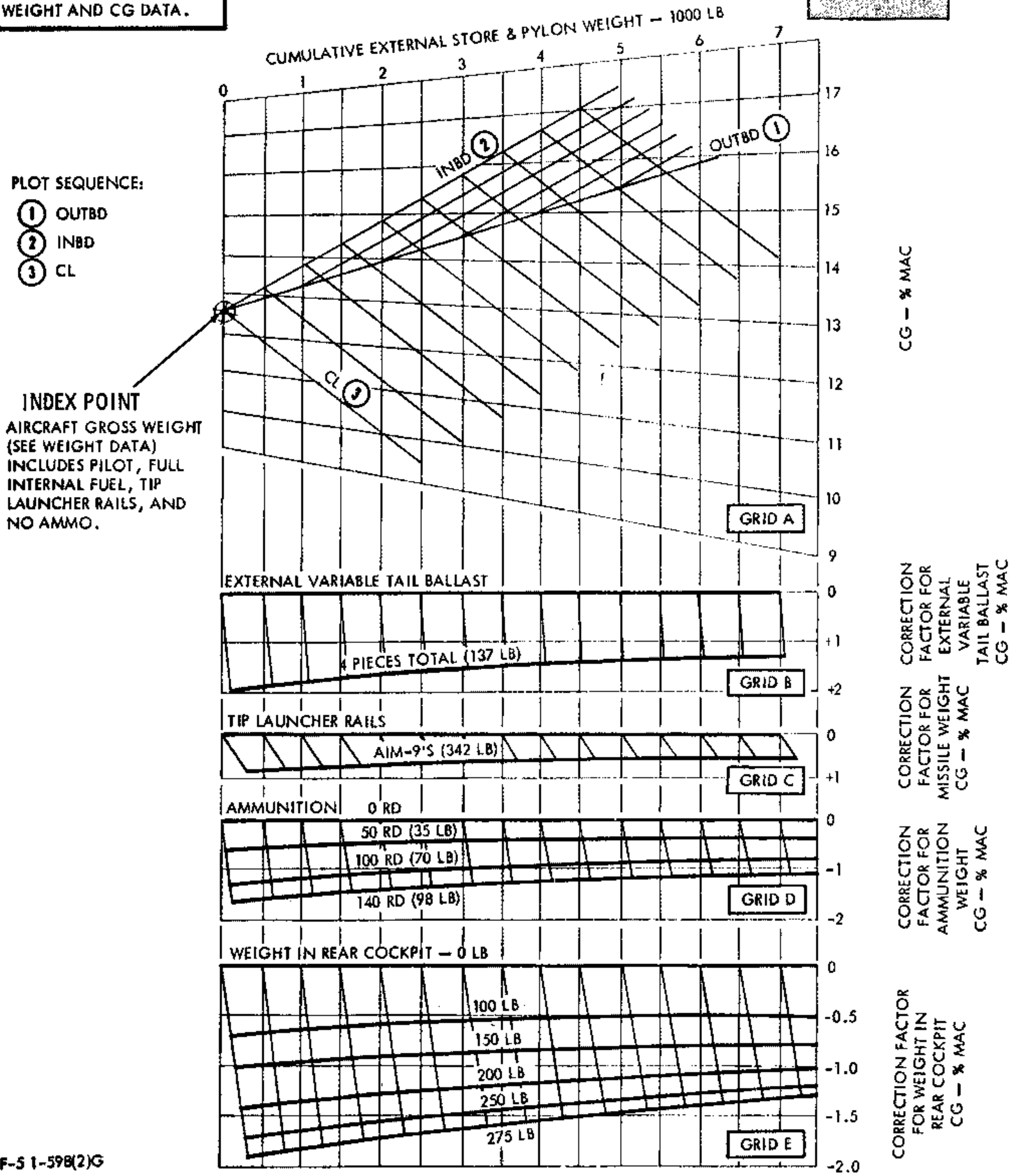
FA1-3 (Sheet 3).

AIRCRAFT TAKEOFF GROSS WEIGHT AND CG POSITION

APPROXIMATE

Note

REFER TO T.O. 1-1B-40 FOR ACTUAL AIRCRAFT TAKEOFF WEIGHT AND CG DATA.



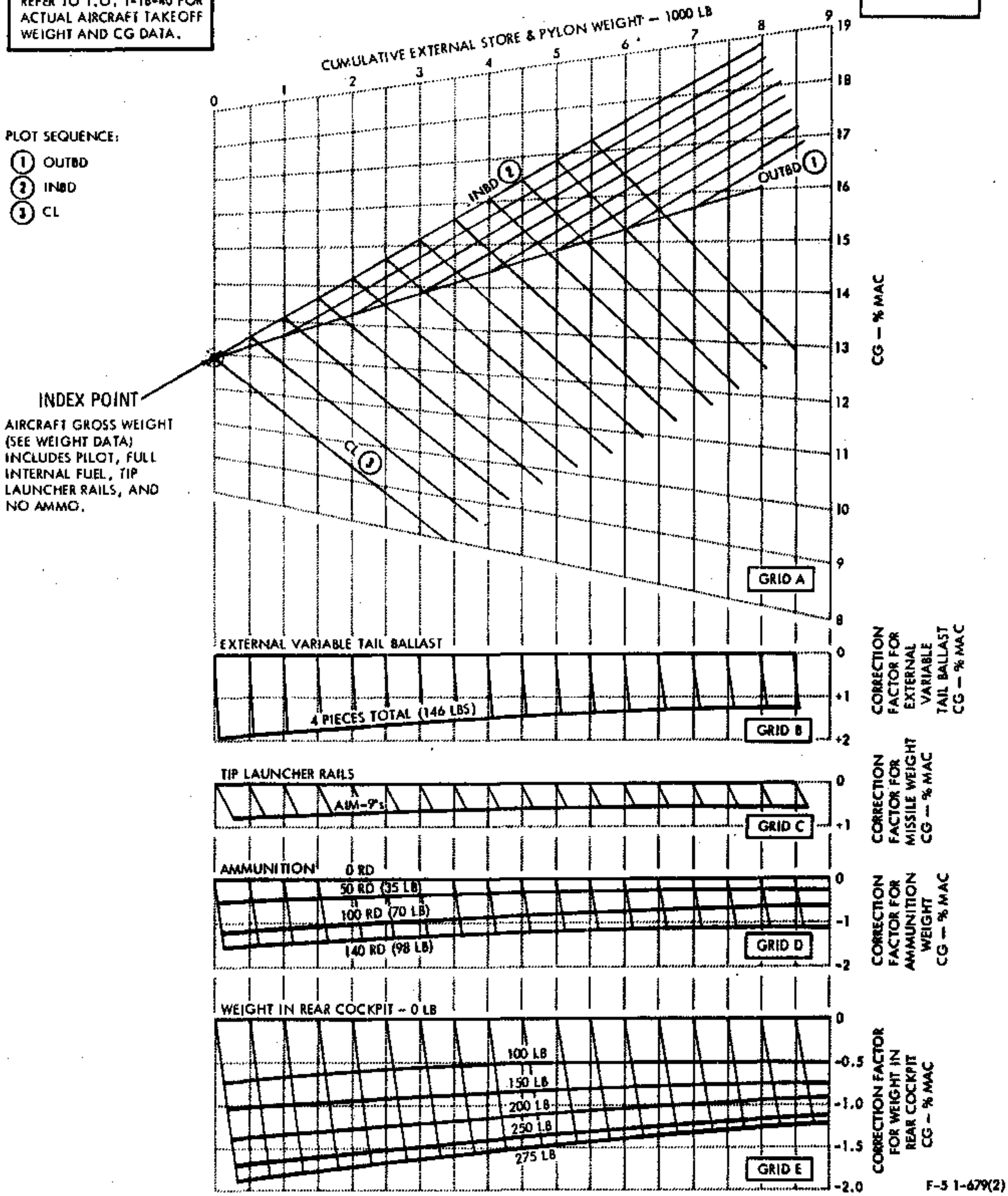
FA1-3 (Sheet 4).

AIRCRAFT TAKEOFF GROSS WEIGHT AND CG POSITION

APPROXIMATE

Note

REFER TO T.O. 1-1B-40 FOR ACTUAL AIRCRAFT TAKEOFF WEIGHT AND CG DATA.



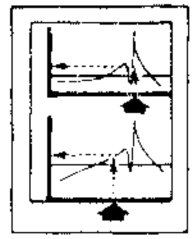
FA1-3 (Sheet 5).

MODEL: F-5E/F
DATE: 1 DECEMBER 1977
DATA BASIS: **FLIGHT TEST**
ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

ALTIMETER AND AIRSPEED INSTALLATION ERROR CORRECTION

ALL CONFIGURATIONS

GEAR AND FLAPS UP OR DOWN

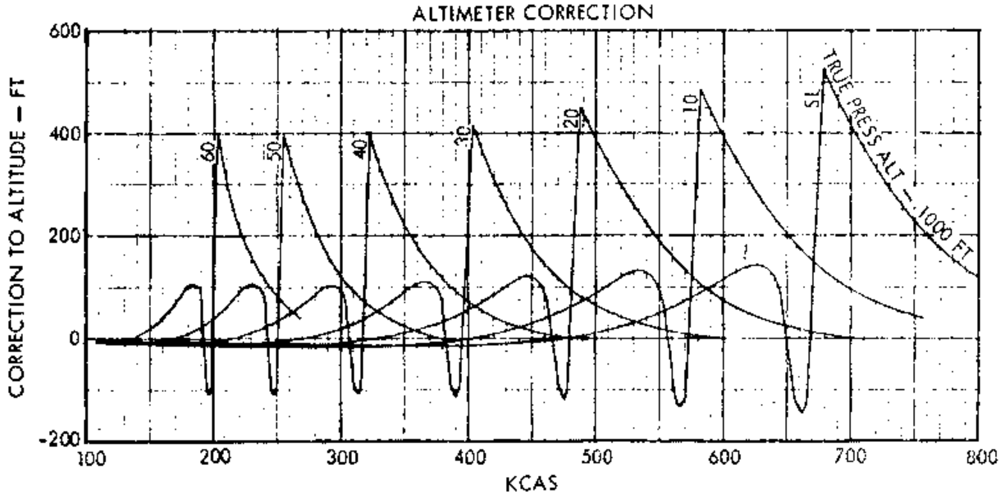


E
E-1
E-2
F
F-1

Note

- CORRECTION APPLICABLE TO AAU-7A/A, AAU-19/A IN STBY MODE ONLY, AND AAU-34/A IN PNEU MODE ONLY.
- ADD CORRECTION TO OBTAIN INDICATED PRESSURE ALTITUDE.

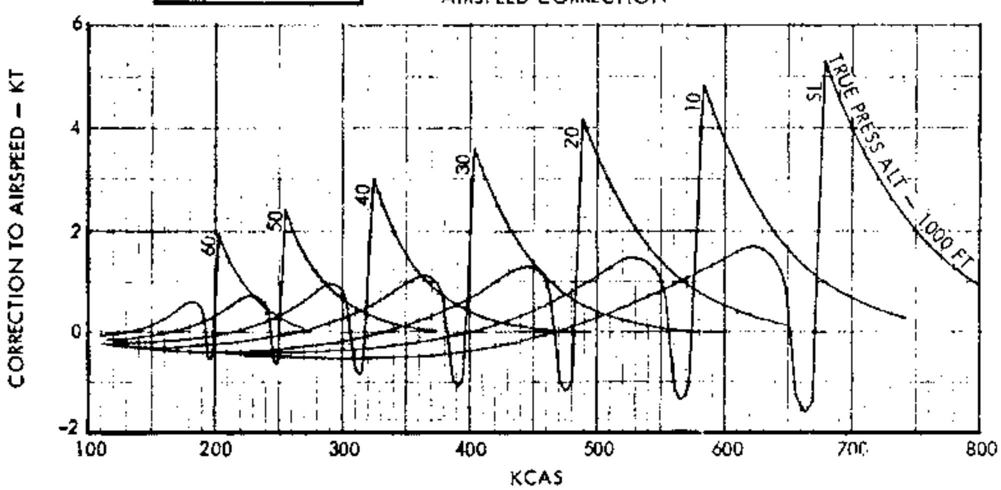
ALTIMETER CORRECTION



Note

ADD CORRECTION TO OBTAIN KIAS.

AIRSPEED CORRECTION



F-5 1-537(1)C

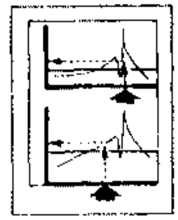
FA1-4 (Sheet 1).

MODEL: F-5E/F
DATE: 1 MARCH 1982
DATA BASIS: **FLIGHT TEST**

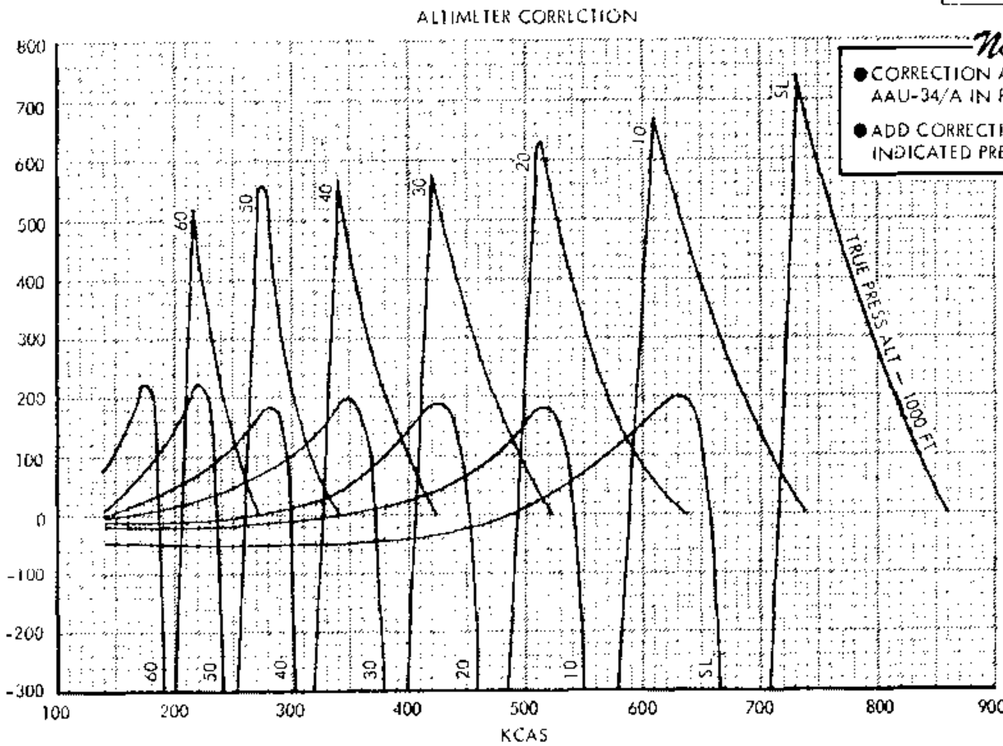
ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

ALTIMETER AND AIRSPEED INSTALLATION ERROR CORRECTION

ALL CONFIGURATIONS
GEAR AND FLAPS UP OR DOWN

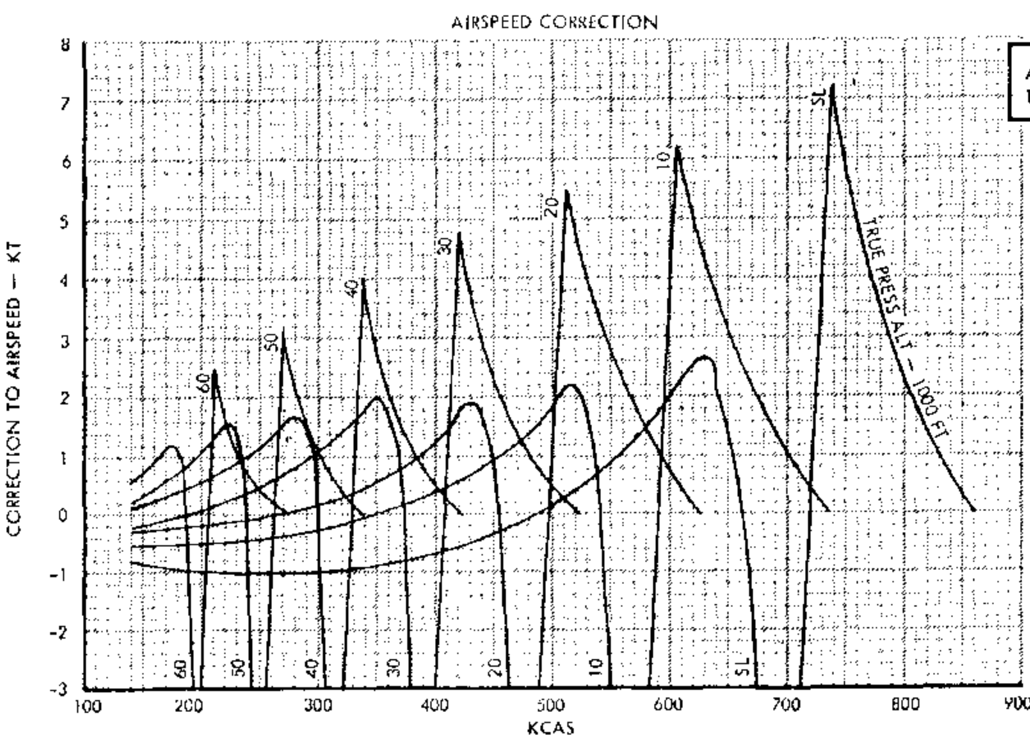


E-3
F-2



Note

- CORRECTION APPLICABLE TO AAU-34/A IN PNEU MODE ONLY.
- ADD CORRECTION TO OBTAIN INDICATED PRESSURE ALTITUDE.



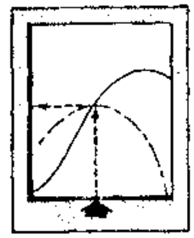
Note

ADD CORRECTION TO OBTAIN KIAS.

F-5 1-537(4)

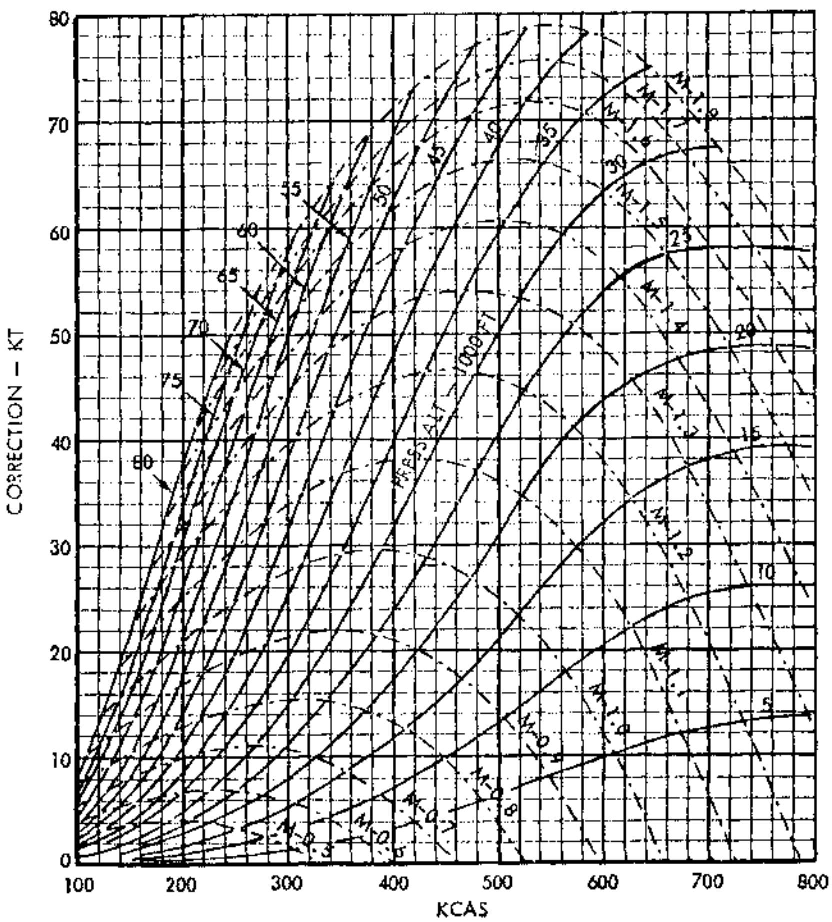
FA1-4 (Sheet 2).

COMPRESSIBILITY CORRECTION
TO CALIBRATED AIRSPEED



Note

SUBTRACT COMPRESSIBILITY CORRECTION FROM KCAS TO OBTAIN KEAS.

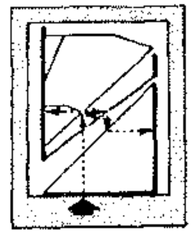


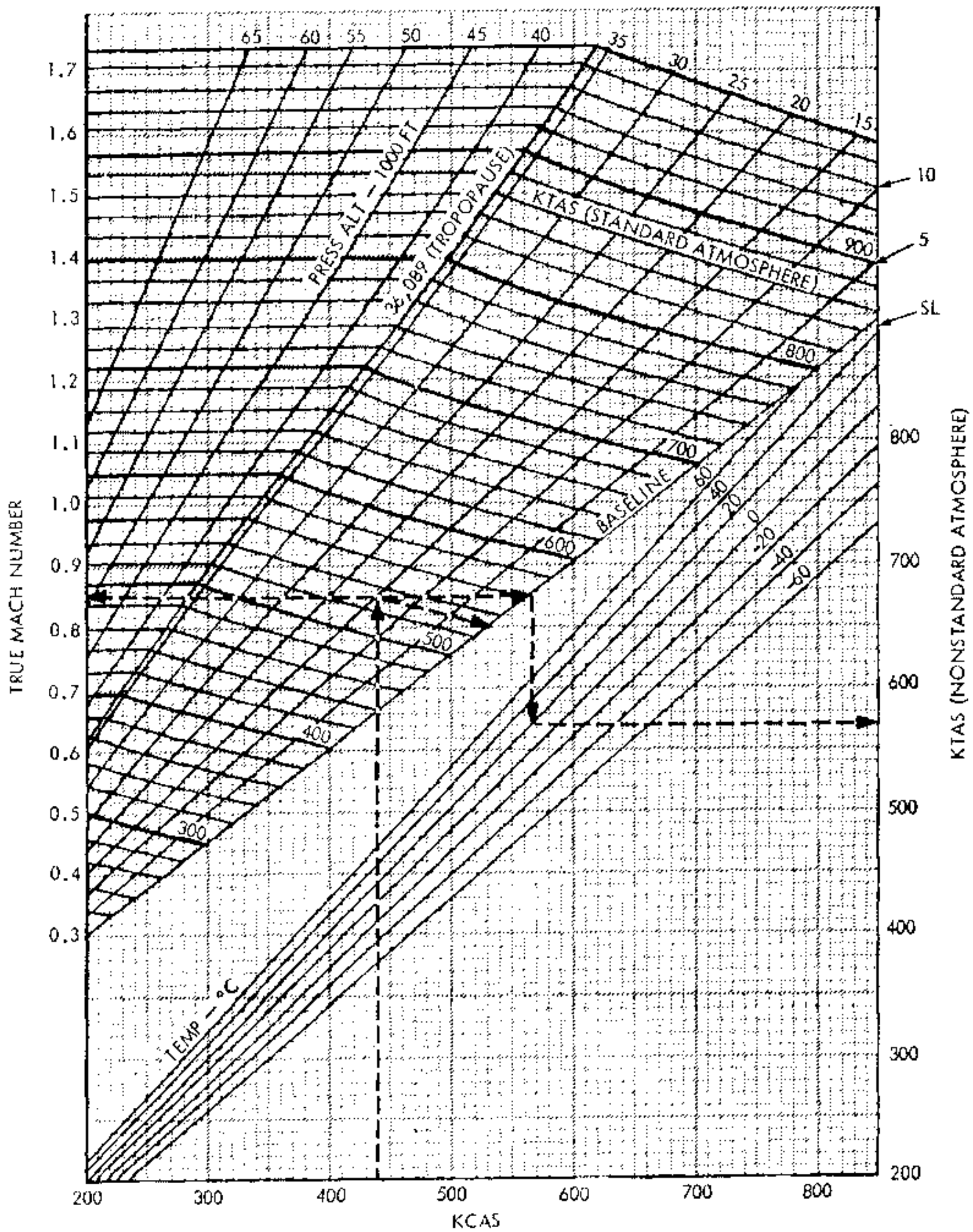
F-5E 1-443B

FA1-5.

EXAMPLE:
KCAS = 440
PRESS ALT = 15,000 FT
TMN = 0.85
KTAS (STD DAY) - 535
KTAS (AT 20°C) - 570

AIRSPEED CONVERSION





F-5 1-541(1)A

FA1-6.

STANDARD ATMOSPHERE TABLE

STANDARD SEA LEVEL AIR:

T = 59°F (15°C)

P = 29.921 IN. OF HG

W = 0.076475 LB/CU FT ρ_o = 0.0023769 SLUGS/CU FT

1 IN. OF HG = 70.732 LB/SQ FT = 0.4912 LB/SQ IN.

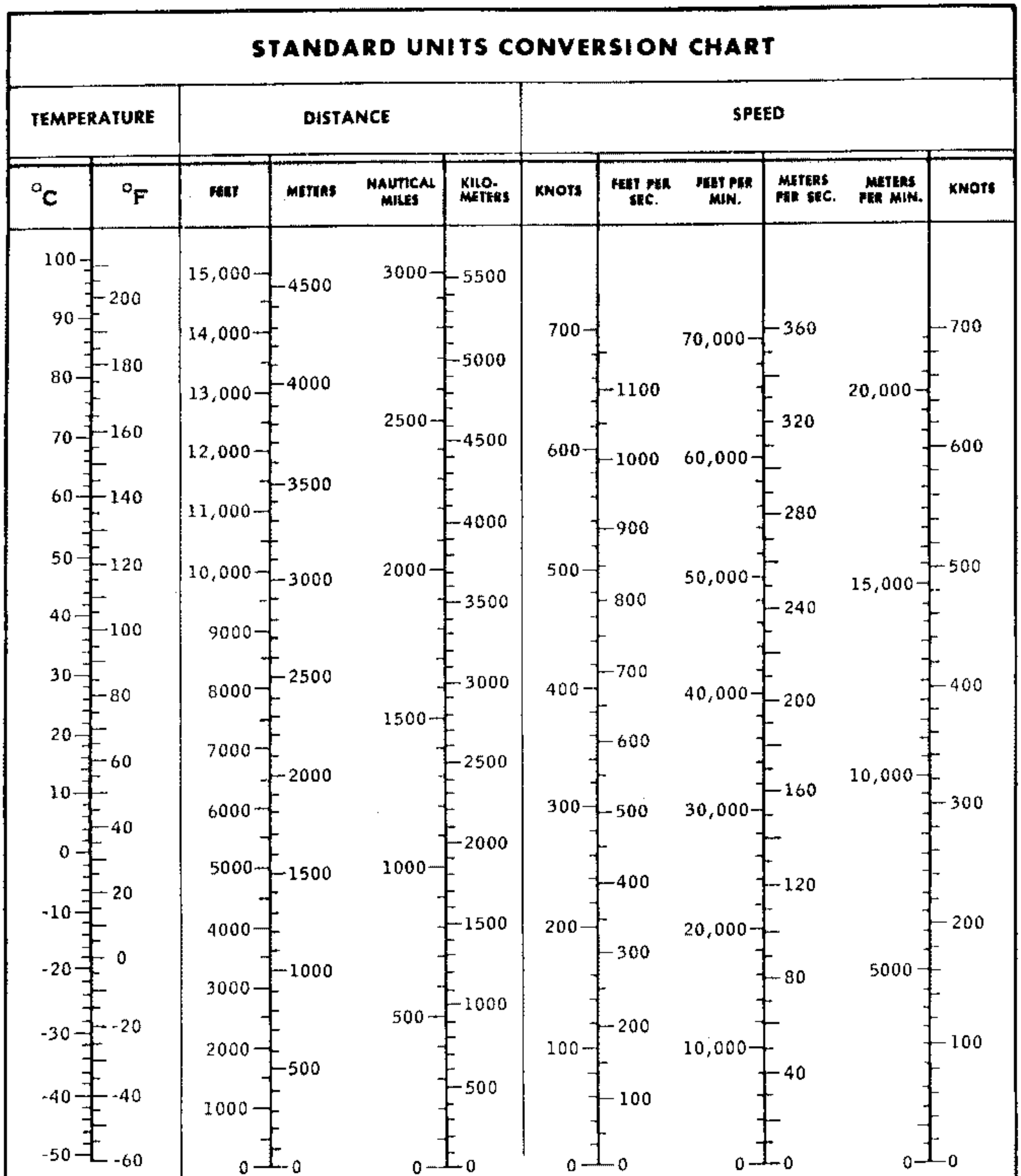
a_o = 1116.44 FT/SEC = 661.47 KT

US STANDARD ATMOSPHERE

ALTITUDE FEET	DENSITY RATIO $\rho/\rho_o = \sigma$	$1/\sqrt{\sigma}$	TEMPERATURE DEG. F	TEMPERATURE DEG. C	SPEED OF SOUND RATIO a/a_o	PRESSURE IN. OF HG	PRESSURE RATIO $P/P_o = \delta$
−2000	1.0598	0.9714	66.132	18.962	1.0064	32.15	1.0744
−1000	1.0296	0.9855	62.566	16.981	1.0030	31.02	1.0367
0	1.0000	1.0000	59.000	15.000	1.0000	29.92	1.0000
1000	0.9711	1.0148	55.434	13.019	0.9966	28.86	0.9644
2000	0.9428	1.0299	51.868	11.038	0.9931	27.82	0.9298
3000	0.9151	1.0454	48.302	9.057	0.9896	26.82	0.8962
4000	0.8881	1.0611	44.735	7.075	0.9862	25.84	0.8637
5000	0.8617	1.0773	41.169	5.094	0.9827	24.90	0.8320
6000	0.8359	1.0938	37.603	3.113	0.9792	23.98	0.8014
7000	0.8106	1.1107	34.037	1.132	0.9756	23.09	0.7716
8000	0.7860	1.1279	30.471	−0.849	0.9721	22.22	0.7428
9000	0.7620	1.1456	26.905	−2.831	0.9686	21.39	0.7148
10,000	0.7385	1.1637	23.338	−4.812	0.9650	20.58	0.6877
11,000	0.7156	1.1822	19.772	−6.793	0.9614	19.79	0.6614
12,000	0.6932	1.2011	16.206	−8.774	0.9579	19.03	0.6360
13,000	0.6713	1.2205	12.640	−10.756	0.9543	18.29	0.6113
14,000	0.6500	1.2403	9.074	−12.737	0.9507	17.58	0.5875
15,000	0.6292	1.2606	5.508	−14.718	0.9470	16.89	0.5643
16,000	0.6090	1.2815	1.941	−16.699	0.9434	16.22	0.5420
17,000	0.5892	1.3028	−1.625	−18.681	0.9397	15.57	0.5203
18,000	0.5699	1.3246	−5.191	−20.662	0.9361	14.94	0.4994
19,000	0.5511	1.3470	−8.757	−22.643	0.9324	14.34	0.4791
20,000	0.5328	1.3700	−12.323	−24.624	0.9287	13.75	0.4595
21,000	0.5150	1.3935	−15.889	−26.605	0.9250	13.18	0.4406
22,000	0.4976	1.4176	−19.456	−28.587	0.9213	12.64	0.4223
23,000	0.4807	1.4424	−23.022	−30.568	0.9175	12.11	0.4046
24,000	0.4642	1.4678	−26.588	−32.549	0.9138	11.60	0.3876
25,000	0.4481	1.4938	−30.154	−34.530	0.9100	11.10	0.3711
26,000	0.4325	1.5206	−33.720	−36.511	0.9062	10.63	0.3552
27,000	0.4173	1.5480	−37.286	−38.492	0.9024	10.17	0.3398
28,000	0.4025	1.5762	−40.852	−40.473	0.8986	9.725	0.3250
29,000	0.3881	1.6052	−44.419	−42.455	0.8948	9.297	0.3107
30,000	0.3741	1.6349	−47.985	−44.436	0.8909	8.885	0.2970
31,000	0.3605	1.6654	−51.551	−46.417	0.8871	8.488	0.2837
32,000	0.3473	1.6968	−55.117	−48.398	0.8832	8.106	0.2709
33,000	0.3345	1.7291	−58.683	−50.379	0.8793	7.737	0.2586
34,000	0.3220	1.7623	−62.249	−52.361	0.8754	7.382	0.2467
35,000	0.3099	1.7964	−65.816	−54.342	0.8714	7.041	0.2353
36,000	0.2981	1.8315	−69.382	−56.323	0.8675	6.712	0.2243
37,000	0.2844	1.8753	−69.700	−56.500	0.8671	6.397	0.2138
38,000	0.2710	1.9209	−69.700	−56.500	0.8671	6.097	0.2038
39,000	0.2583	1.9677	−69.700	−56.500	0.8671	5.811	0.1942
40,000	0.2462	2.0155	−69.700	−56.500	0.8671	5.538	0.1851
41,000	0.2346	2.0645	−69.700	−56.500	0.8671	5.278	0.1764
42,000	0.2236	2.1148	−69.700	−56.500	0.8671	5.030	0.1681
43,000	0.2131	2.1662	−69.700	−56.500	0.8671	4.794	0.1602
44,000	0.2031	2.2189	−69.700	−56.500	0.8671	4.569	0.1527
45,000	0.1936	2.2728	−69.700	−56.500	0.8671	4.355	0.1455
46,000	0.1845	2.3281	−69.700	−56.500	0.8671	4.151	0.1387
47,000	0.1758	2.3848	−69.700	−56.500	0.8671	3.956	0.1322
48,000	0.1676	2.4428	−69.700	−56.500	0.8671	3.770	0.1260
49,000	0.1597	2.5022	−69.700	−56.500	0.8671	3.593	0.1201
50,000	0.1522	2.5630	−69.700	−56.500	0.8671	3.425	0.1145
51,000	0.1451	2.6254	−69.700	−56.500	0.8671	3.264	0.1091
52,000	0.1383	2.6892	−69.700	−56.500	0.8671	3.111	0.1040
53,000	0.1318	2.7546	−69.700	−56.500	0.8671	2.965	0.09909
54,000	0.1256	2.8216	−69.700	−56.500	0.8671	2.826	0.09444
55,000	0.1197	2.8903	−69.700	−56.500	0.8671	2.693	0.09001
56,000	0.1141	2.9606	−69.700	−56.500	0.8671	2.567	0.08578
57,000	0.1087	3.0326	−69.700	−56.500	0.8671	2.446	0.08176
58,000	0.1036	3.1063	−69.700	−56.500	0.8671	2.331	0.07792
59,000	0.09877	3.1819	−69.700	−56.500	0.8671	2.222	0.07426
60,000	0.09414	3.2593	−69.700	−56.500	0.8671	2.118	0.07078
61,000	0.08972	3.3386	−69.700	−56.500	0.8671	2.018	0.06746
62,000	0.08551	3.4198	−69.700	−56.500	0.8671	1.924	0.06429
63,000	0.08150	3.5029	−69.700	−56.500	0.8671	1.833	0.06127
64,000	0.07767	3.5881	−69.700	−56.500	0.8671	1.747	0.05840
65,000	0.07403	3.6754	−69.700	−56.500	0.8671	1.665	0.05566

F-5 1-508(1)A

FA1-7.



TEMPERATURE CONVERSION

$°F = \frac{9}{5}\ °C + 32°$

$°C = \frac{5}{9}(°F - 32°)$

US GALLONS = LITERS X 0.264

IMPERIAL GALLONS = LITERS X 0.220

INCHES OF MERCURY = MILLIBARS X 0.0295

POUNDS = KILOGRAMS X 2.20

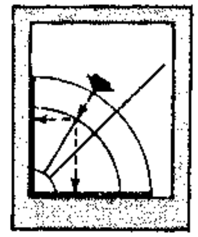
F-5 1-505(1)A

FA1-8.

MODEL: F-5E/F
DATE: 1 MARCH 1978
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

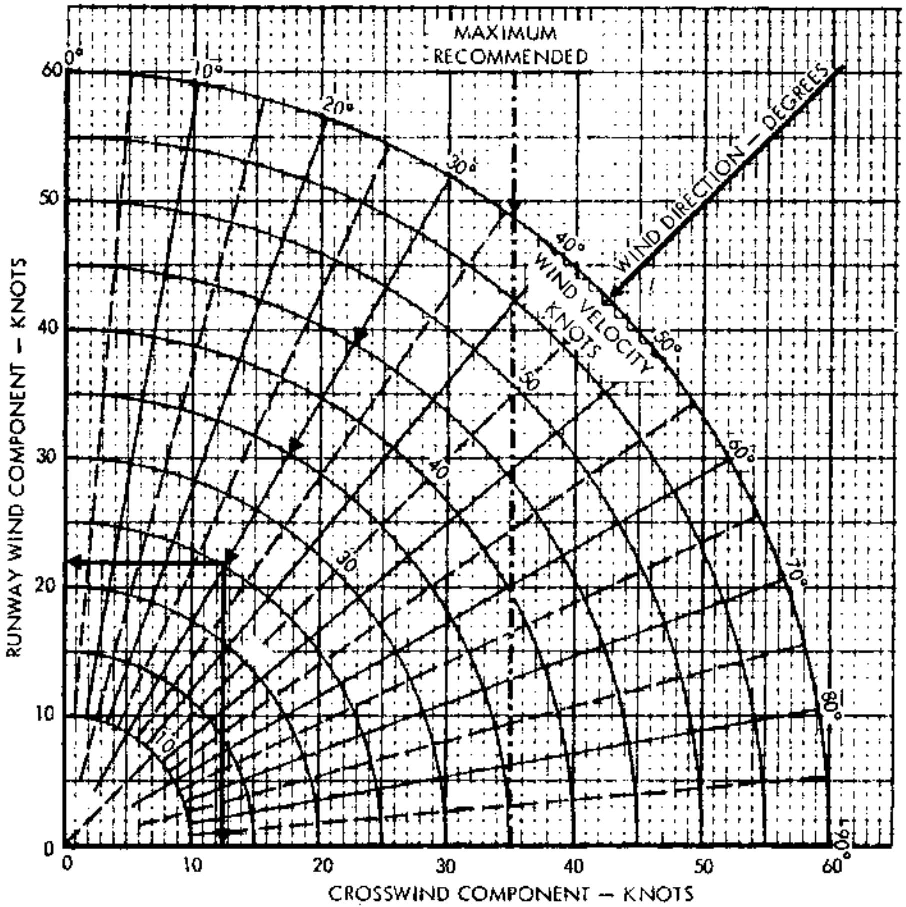
RUNWAY WIND COMPONENTS



Note

ENTER CHART WITH STEADY WIND TO DETERMINE HEADWIND OR TAILWIND COMPONENT AND WITH MAXIMUM GUST VELOCITY TO DETERMINE CROSSWIND COMPONENT.

EXAMPLE:
RELATIVE WIND DIRECTION = 030°
RELATIVE WIND VELOCITY = 25 KT
RUNWAY WIND COMPONENT = 22 KT
CROSSWIND COMPONENT = 12.5 KT



MAXIMUM RECOMMENDED 90° – CROSSWIND LANDING			
GROSS WEIGHT (LB)	RUNWAY CONDITION	W/DRAG CHUTE	W/O DRAG CHUTE
		WIND VELOCITY (KT)	WIND VELOCITY (KT)
15,500 & BELOW	DRY WET ICY	20 10 5	35 20 10
ABOVE 15,500	DRY WET ICY	25 15 5	35 25 10

F-5 1-555(20)A

FA1-9

PART 2

TAKEOFF

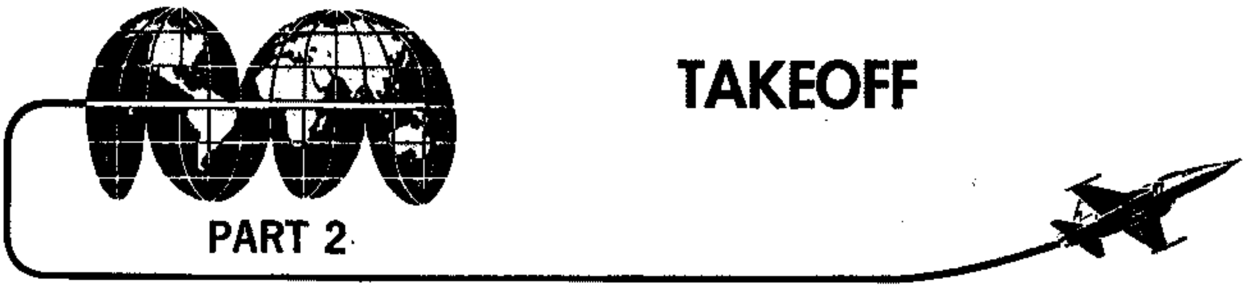


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TABLE OF CONTENTS

Page numbers underlined denote charts.

TAKEOFF PERFORMANCE CHARTS (GENERAL)

Takeoff charts are used to determine takeoff performance under normal or emergency operating conditions. The charts present takeoff speeds and distances based on two-engine operation for dry, hard-surfaced runways using takeoff procedures in section II. Data are based on full flaps, hiked position of the nosegear strut, and auxiliary intake doors open. The charts apply to all loading configurations when the data is corrected for the effect of cg position. The effect of cg position is to increase baseline speed and distances for actual cg forward of 15% MAC and to decrease the speeds and distances for cg aft of 15% MAC.

AFT STICK, TAKEOFF, AND OBSTACLE CLEARANCE SPEED CHART

The Aft Stick, Takeoff, and Obstacle Clearance Speed chart is presented in FA2-2. The chart provides for various takeoff gross weight and cg positions and is intended for use with maximum thrust, minimum AB, or military thrust. Obstacle clearance speed is based on maximum thrust. Aft stick speed is 10 knots less than takeoff speed. Fuel flow values for ground taxi (57% rpm) and static military thrust runup are shown on the chart. The estimated fuel required for ground operation is subtracted from initial gross weight to obtain takeoff gross weight. Obstacle clearance speed is at least 20% higher than power-off stall speed, as compared to at least 10% higher at takeoff, and is obtained while maintaining an accelerating-climbing flight path at a constant angle of attack.

NOTE

Ⓕ If aircraft has a centerline store exceeding 1000 pounds (without wing stores), increase charted takeoff speed by 5 knots. Aft stick speed is 10 knots less than this adjusted takeoff speed.

DEFINITIONS

AFT STICK SPEED: The speed during takeoff ground run at which the stick is moved aft for aircraft rotation to takeoff attitude.

TAKEOFF SPEED: Speed at which main gear lifts from runway.

OBSTACLE CLEARANCE SPEED: Speed necessary to obtain clearance distance.

USE

Enter the upper chart with takeoff gross weight and proceed up to the cg position, then left and read takeoff speed. To obtain aft stick speed, subtract 10 KIAS from the takeoff speed. To obtain obstacle clearance speed enter the lower chart with takeoff gross weight and cg and read the obstacle clearance speed.

SAMPLE PROBLEM

Given:
A. Takeoff gross weight: 18,000 lb.
B. CG position: 12% MAC.

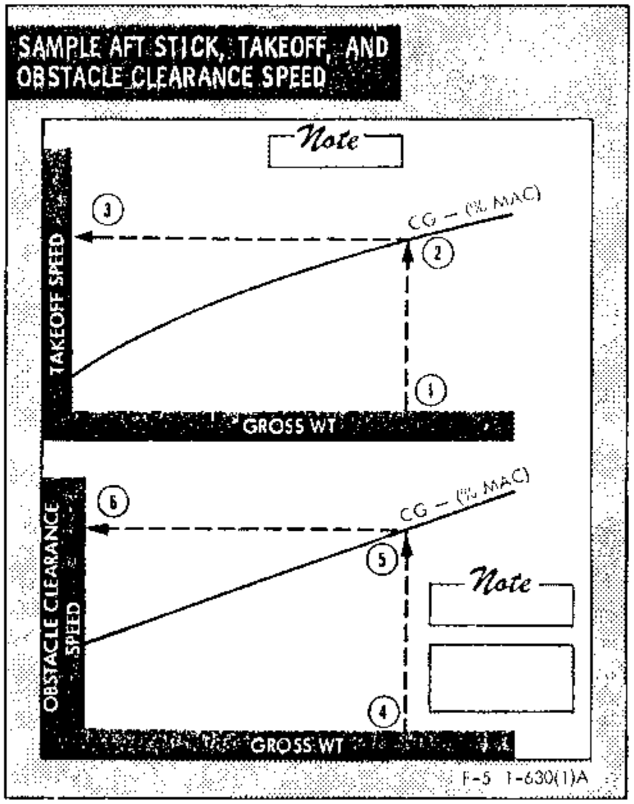
Calculate:
A. Aft Stick, Takeoff, and Obstacle Clearance Speeds.
B. Use Aft Stick, Takeoff, and Obstacle Clearance Speed chart FA2-2. Enter upper chart.

①	Gross Wt	18,000 lb.
②	CG	12%MAC
③	Takeoff Speed	167 KIAS

C. Refer to note on chart for determining aft stick speed.
Thus: Takeoff Speed — 10 KIAS = Aft Stick Speed.
167 KIAS — 10 KIAS = 157 KIAS

D. Enter lower chart.

④	Gross weight	18,000 lb.
⑤	CG	12%MAC
⑥	Obstacle clearance speed	183 KIAS



TIRE LIMIT SPEED CHART

The tire limit speed is 230 knots ground speed. The Tire Limit Speed chart (FA2-3) provides the tire limit speed in KIAS as a function of runway temperature and pressure altitude for zero wind. Wind velocity is added or subtracted to obtain corrected KIAS. Indicated takeoff (or landing) airspeed should never exceed the tire limit speed corrected for wind velocity.

DEFINITION

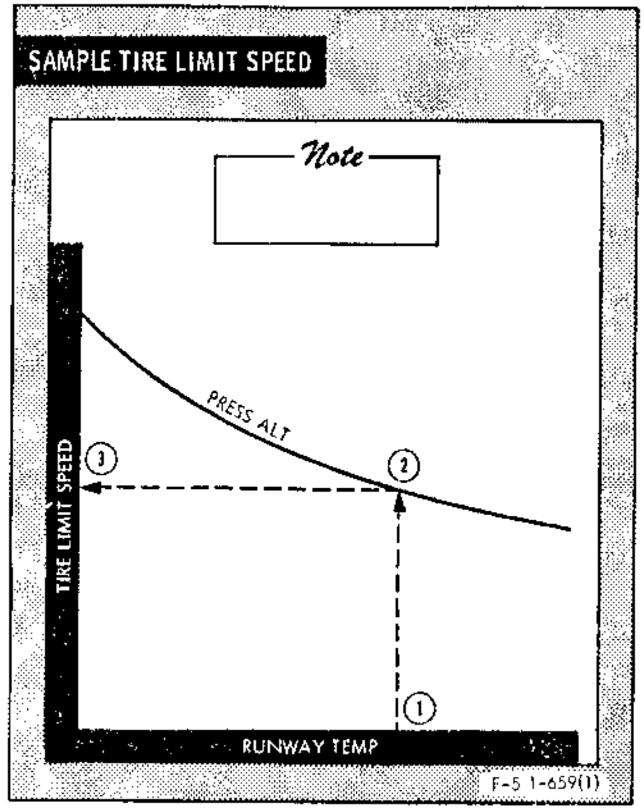
TIRE LIMIT SPEED: Maximum indicated airspeed allowable for safe operation of tires.

USE

Enter the chart with runway temperature, proceed up to the pressure altitude, then left to read zero wind tire limit speed. To correct for wind effect, add headwind or subtract tailwind velocity to obtain indicated airspeed.

SAMPLE PROBLEM

Given:
A. Runway temperature: +15°C.
B. Runway pressure altitude: Sea Level.
C. Headwind: 10 kt.



Calculate:
A. Tire limit speed.
B. Use Tire Limit Speed chart FA2-3.
 ① Runway Temp +15°C
 ② Press Alt Sea level
 ③ Tire Limit Speed (zero wind) 230 KIAS
C. Refer to note on chart for wind effect.

Thus:

Tire Limit Speed (zero wind) + Headwind = Tire Limit Speed (KIAS).
230 kt + 10 kt = 240 KIAS

TAKEOFF FACTOR CHART

The Takeoff Factor chart for maximum, minimum afterburner, or military thrust (FA2-4) combines runway temperature, pressure altitude, and engine thrust into one quantity, called takeoff factor. The effect of engine anti-ice may also be included in the takeoff factor, if required. Takeoff factor is used to define takeoff distance, critical field length, refusal speed and distance, critical engine failure speed, single-engine takeoff speed, 50-foot obstacle clearance distance, and a single-engine climb gradient.

USE

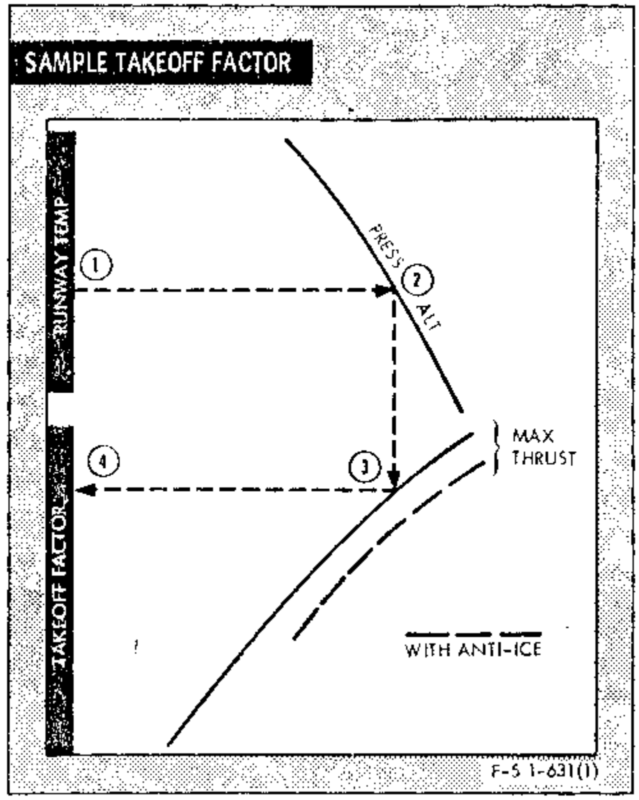
Enter the chart with the runway temperature and proceed right to the pressure altitude. At the intersection of temperature and altitude curves, proceed down to the desired thrust setting curve and then left to read the takeoff factor to the left. If anti-ice is required, the thrust setting line for anti-ice (indicated by dashed lines) is used in place of the corresponding solid thrust line.

SAMPLE PROBLEM

Given:
A. Runway temperature: +15°C.
B. Runway pressure altitude: Sea Level.
C. Maximum thrust takeoff without anti-ice.

Calculate:
A. Takeoff factor.
B. Use Takeoff Factor chart FA2-4.

①	Runway Temp	+15°C
②	Press Alt	Sea Level
③	Max Thrust (w/o anti-ice)	
④	Takeoff Factor	12.0



TAKEOFF GROUND RUN CHART

Takeoff ground run is presented in FA2-5 as a function of takeoff factor. Corrections are provided in the chart for wind, cg position, and runway slope. If the chart is entered with a combination of a takeoff factor from 4 to 8 and an aircraft gross weight of 19,600 lb to 26,000 lb, the takeoff speed in figure FA2-2 must be corrected by the speed correction indicated in figure FA2-5. This additional speed is needed to overcome a thrust limited condition to attain a minimum of 300 fpm climb capability. If the aircraft cg is 20% or more (aft), add the speed correction to the takeoff speed derived from figure FA2-2. If the aircraft cg is 20% or less (fwd), decrease the speed correction by 1 knot per 1% cg less than 20%, but never less than the correction speed. For example, if the speed correction is 8 knots and the cg is 15%, the correction should be reduced by 5 knots. Therefore, the adjusted speed correction is 3 knots. However, if the cg is 12% or less, the speed correction is 0 knots.

DEFINITIONS

TAKEOFF GROUND RUN: Ground run in feet from brake release to takeoff speed.

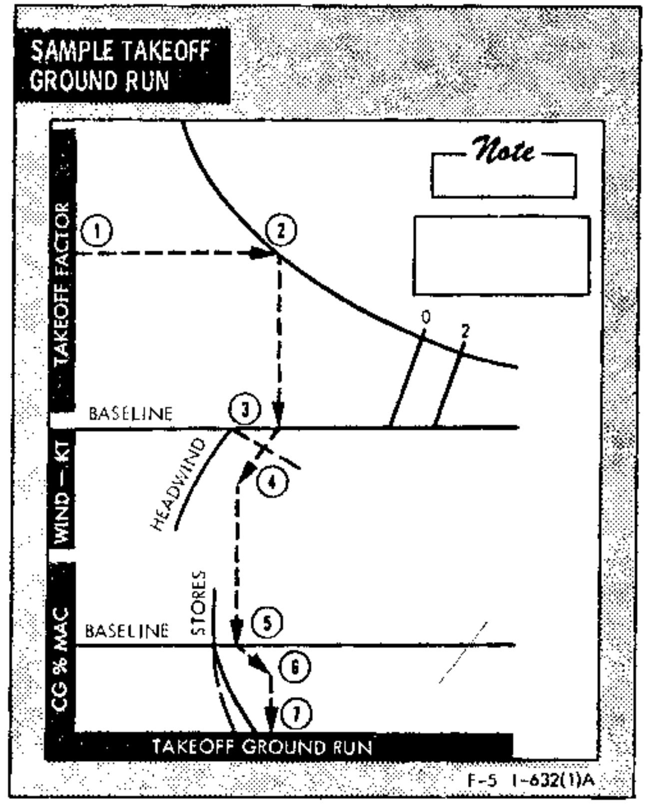
RUNWAY SLOPE: Expressed in percent (uphill or downhill), runway slope is the change in runway height divided by the runway length multiplied by 100.

USE

Enter the chart with takeoff factor and proceed right to takeoff gross weight. If the plot with the gross weight curve falls within the speed correction area, an increase in takeoff speed may be required. From this point, proceed down to the wind baseline. Contour the guidelines for headwind or tailwind to the wind velocity (if zero-wind conditions prevail, proceed directly thru) then continue down to the cg baseline. Contour the guidelines up or down for aft or forward cg, respectively, to the aircraft cg position. Dashed cg correction guidelines for no-stores configurations are provided for cg positions forward of 17% MAC. From this point, proceed down to read the required takeoff ground run. If the cg position is 15% MAC, proceed directly vertical thru the cg correction portion of the chart to obtain takeoff ground run. If an uphill runway slope correction is necessary, add the appropriate correction (see note on chart) to the ground run to obtain actual takeoff ground run.

SAMPLE PROBLEM

Given:
A. Takeoff factor: 12.0
B. Takeoff gross weight: 18,000 lb.
C. CG position: 12% MAC.
D. Headwind: 10 kt.
E. Runway slope: 1% uphill.



Calculate:
A. Takeoff ground run.
B. Use Takeoff Ground Run chart FA2-5.

①	Takeoff Factor	12.0
②	Gross Wt (Takeoff airspeed correction for cg position of 12% MAC not required)	18,000 lb
③	Baseline	—
④	Headwind	10 kt
⑤	Baseline	—
⑥	CG	12% MAC
⑦	Takeoff Ground Run	2600 ft
	Correction for 1% uphill slope (see note on chart)	+130 ft
	Corrected Takeoff Ground Run	2730 ft

TOTAL OBSTACLE CLEARANCE DISTANCE CHART

The total 50-foot Obstacle Clearance Distance chart is presented in FA2-6 as a function of takeoff ground run corrected for headwind or tailwind, as appropriate, and cg position. Total obstacle clearance distance data is based on the use of maximum thrust only.

DEFINITION

TOTAL OBSTACLE CLEARANCE DISTANCE: Horizontal distance from brake release to 50-foot height when accelerating between takeoff and obstacle clearance speeds.

USE

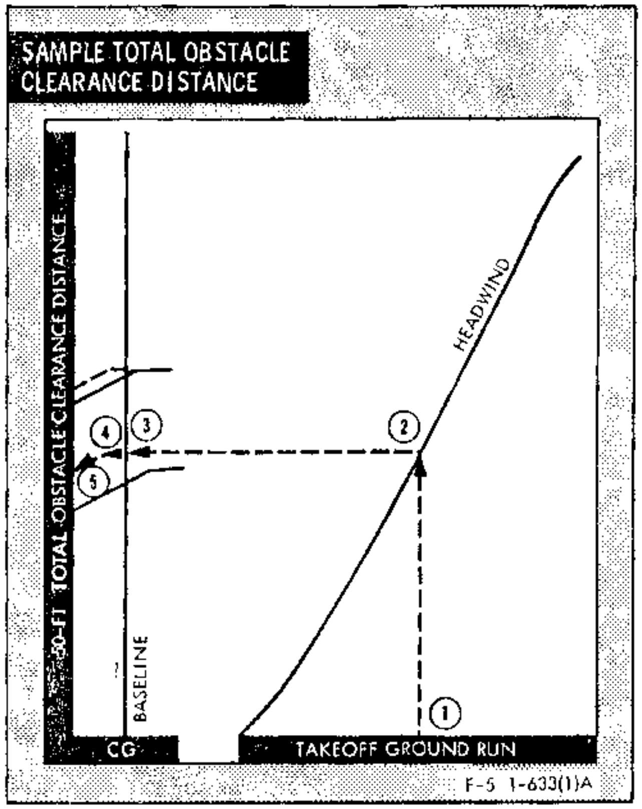
Enter with takeoff ground run corrected for wind, cg position, and runway slope and proceed up to the wind curve, then left to the baseline. Contour the nearest guideline to the cg position and at this point project left and read 50-foot obstacle clearance distance. The dashed guidelines within the cg plotting grid are to be used for no-stores configurations which enter this area of the chart, instead of the solid guidelines which represent store configurations. If the cg position is 15%, proceed directly from the baseline to read total obstacle clearance distance.

SAMPLE PROBLEM

Given:
A. Corrected takeoff ground run: 2730 ft.
B. Headwind: 10 kt.
C. CG position (with stores): 12% MAC

Calculate:
A. 50-foot total obstacle clearance distance.
B. Use Total Obstacle Clearance Distance chart FA2-6.

①	Takeoff Ground Run	2730 ft
②	Headwind	10 kt
③	Baseline	—
④	CG	12%MAC
⑤	50-foot Total Obstacle Clearance Distance	3950 ft



MINIMUM SAFE SINGLE-ENGINE TAKEOFF SPEED CHART

The Minimum Safe Single-Engine Takeoff Speed chart for maximum thrust is presented in FA2-7. The chart provides minimum safe single-engine takeoff speed as a function of maximum thrust takeoff factor, pressure altitude, gross weight, and cg position. The single-engine takeoff speed should be compared with tire limit speed to assure safe operation of the aircraft.

Maximum gross weight takeoff capability can be obtained by reading up from Maximum Gross Weight Capability dashed curves into the gross weight lines, starting with applicable cg. The intersection of this line with one coming from the takeoff thrust factor pressure altitude grid determines the desired maximum gross weight capability for 300 fpm rate of climb. The required speeds for this performance provide minimum drag.

DEFINITION

MINIMUM SAFE SINGLE-ENGINE TAKEOFF SPEED: Minimum speed out of ground effect, at which the aircraft can maintain a 300 fpm rate of climb with one engine inoperative while in the takeoff configuration.

USE

Enter the chart with maximum thrust takeoff factor and proceed up to the pressure altitude, then right to the gross weight. From this point, move down to the cg position and then proceed left to the second set of gross weight curves. At this intersection, move down and read the single-engine takeoff speed.

WARNING

If gross weight or cg curves cannot be intersected, safe single-engine takeoff cannot be made.

NOTE

Obtain at least the higher of either the minimum safe single-engine speed or the obstacle clearance speed (for two-engine operation) as soon as possible after a takeoff with both engines operating.

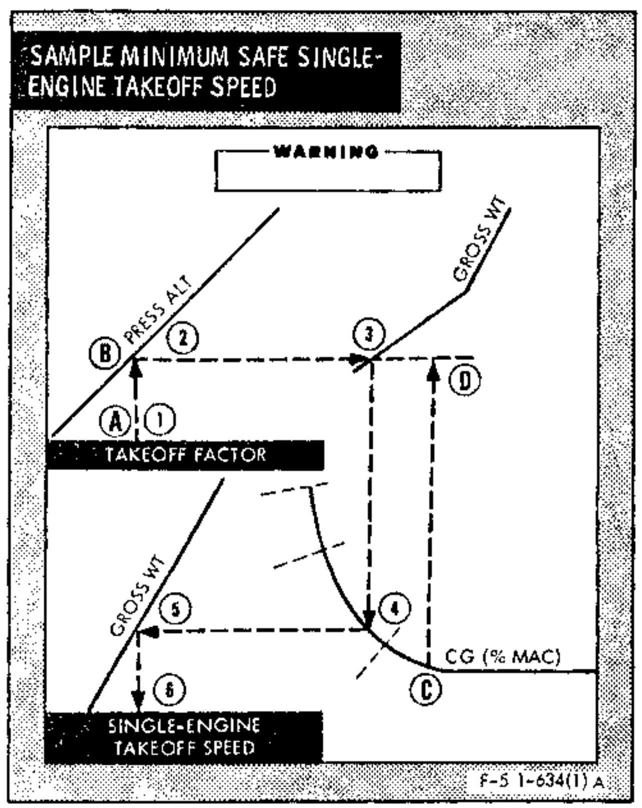
To obtain maximum gross weight takeoff capability, determine the desired maximum takeoff thrust factor, pressure altitude, and aircraft cg and gross weight. Enter the Minimum Safe Single-Engine Takeoff Speed chart with the maximum thrust takeoff factor and pressure altitude, then construct a line thru the gross weight curves. Reenter the chart at the Maximum Gross Weight Capability (dashed lines) within the cg position curves with the estimated gross weight and cg. Proceed upward to intersect the constructed horizontal line. If the gross weight at this point and the estimated gross weight are the same: this is the maximum gross weight for takeoff. If the gross weight of the estimated configuration exceeds the gross weight plotted at the intersection point, a single engine takeoff at that gross weight cannot be accomplished. The chart must be reentered with a different authorized configuration gross weight/cg until a coincidental or slightly lower maximum gross weight is determined.

SAMPLE PROBLEM

Given:
A. Takeoff factor (maximum thrust): 12.
B. Runway pressure altitude: Sea Level
C. Takeoff gross weight (with stores): 18,000 lb.
D. CG position: 12% MAC.

Calculate:
A. Minimum safe single-engine takeoff speed.
B. Use Minimum Safe Single-Engine Takeoff Speed chart, FA2-7.

①	Takeoff Factor (max thrust)	12.0
②	Press Alt	Sea Level
③	Gross Wt	18,000 lb
④	CG	12% MAC
⑤	Gross Wt	18,000 lb
⑥	Single-Engine Takeoff Speed	171 KIAS



C. Maximum gross weight capability. Use FA2-7.

Ⓐ	Takeoff Factor (max thrust)	12.0
Ⓑ	Press Alt	Sea Level
Ⓒ	Gross Wt and CG (Estimated)	21,000 lb/ 10% MAC
Ⓓ	Gross Wt (Calculated)	19,600 lb

The estimated gross weight and the calculated gross weight are not equal: therefore, chart must be reentered with different weight/cg configuration until this requirement is satisfied.

Ⓒ	Gross Wt and CG (Estimated)	20,000 lb/ 10% MAC
Ⓓ	Gross Wt (Calculated)	20,000 lb

SINGLE ENGINE CLIMB GRADIENT CHART

The Single-Engine Climb Gradient at Obstacle Clearance Speed charts for landing gear down and up with full flaps at maximum thrust are presented in FA2-8 and FA2-9, respectively. The charts provide single-engine rate of climb and the climb gradient in feet-per-nautical mile, or percent, as a function of maximum thrust takeoff factor, pressure altitude, and gross weight. Gross weight is limited to conditions under which the aircraft can maintain a 300 feet-per-minute rate of climb at 50-foot obstacle clearance speed. It is possible to improve aircraft performance by flying slightly faster than obstacle speed to reduce drag. For example, maximum gross weight capability for 300 fpm climb rate with single engine will be improved significantly by doing so, as indicated on the Minimum Safe Single-Engine Takeoff Speed Charts.

DEFINITIONS

CLIMB GRADIENT: The slope of the flight path as it increases in altitude from the point of liftoff from the runway in relationship to the horizontal distance flown over the ground. For example, a 10% climb gradient represents 100 feet increase in altitude for each 1000 feet of horizontal distance flown along the flight path or 608 feet increase for every nautical mile (6076 ft X 10% = 608 ft).

SINGLE-ENGINE CLIMB GRADIENT: The climb gradient, out of ground effect, in feet-per-nautical mile or percent that the aircraft can climb with one engine at maximum thrust and the other engine windmilling.

USE

Enter the appropriate chart with maximum thrust takeoff factor and proceed up to the pressure altitude, then right to the gross weight. From this point move down to the cg correction baseline for the rate of climb. For cg position more than 15% MAC, contour the upper guidelines of the grid; for cg position less than 15% MAC, contour the lower guidelines of the grid. If cg position is 15% MAC, proceed appropriately directly thru the baseline and move down to the cg curve and then left to the baseline. For tailwind conditions, contour the nearest guideline to the tailwind velocity. At this point of intersection, proceed left and read the climb gradient in percent and/or feet-per-nautical mile. For zero and headwind conditions, proceed left directly from the baseline to obtain climb gradient. To obtain climb gradient in the event of single-engine go-around during a landing approach, enter the appropriate chart with the maximum thrust takeoff factor, pressure altitude, and landing gross weight.

WARNING

If gross weight curve cannot be intersected, single engine climb cannot be made at obstacle clearance speed. Reenter Minimum Single-Engine Takeoff Speed chart. If gross weight and cg curve can be intersected, a 300 fpm rate of climb can be made and the resulting minimum safe single-engine takeoff speed would be higher than the obstacle clearance speed and should be used as the minimum airspeed.

SAMPLE PROBLEM

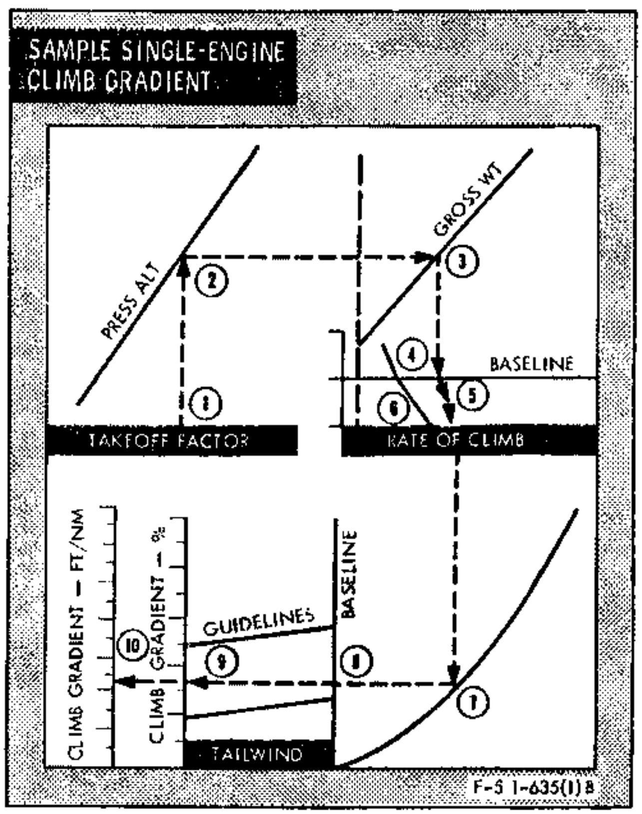
Given:

A. Single-engine climb, maximum thrust, full flaps, and gear down.
B. Takeoff factor: 12.0
C. Runway pressure altitude: Sea Level.
D. Takeoff gross weight (with stores): 18,000 lb.
E. CG position: 12% MAC.
F. No wind.

Calculate:

A. Single-engine rate of climb and climb gradient at 50-foot obstacle clearance speed.
B. Use Single-Engine Climb Gradient at Obstacle Clearance Speed chart, Gear Down, FA2-8.

①	Takeoff Factor (max thrust)	12.0
②	Press Alt	Sea Level
③	Gross Wt	18,000 lb
④	Baseline	15% MAC
⑤	CG	12% MAC
⑥	Rate of climb	450 fpm
⑦	CG curve	12% MAC
⑧	Baseline	—
⑨	Climb Gradient (%)	2.5%
⑩	Climb Gradient ft/nm	150 ft/nm



CRITICAL FIELD LENGTH CHARTS

The Critical Field Length charts for no drag chute and with drag chute are contained in FA2-10 and FA2-11, respectively. Distances shown in the charts are based on maximum thrust acceleration to engine failure and continuous brake application during stopping phase. The aft stick speed line in both charts represents the condition at which critical engine failure speed is the same as maximum thrust two-engine aft stick speed. A calculated takeoff factor that intersects a given takeoff gross weight in the No Drag Chute chart and fails to intersect the same takeoff gross weight curve in the With Drag Chute chart, indicates that with drag chute the aft stick speed is the limiting factor for critical engine failure speed. The braking friction required to provide consistent minimum stopping distances on a dry, hard-surfaced runway is designated as heavy braking and corresponds to a runway condition reading (RCR) of 23. This is the baseline condition used in the charts. The charts apply takeoff factor, gross weight, wind, cg position, and RCR correction curves to obtain critical field length. In addition, a correction for runway slope (see note on chart) is provided. In the With Drag Chute chart, the chute is assumed deployed at any speed for abort.

DEFINITION

CRITICAL FIELD LENGTH: Total distance required for the aircraft to accelerate on both engines to the critical engine failure speed, experience an engine failure, and then either continue the takeoff or stop.

RUNWAY CONDITION READING (RCR): A number that indicates the degree of braking friction available on the runway surface (obtainable from base operations).

NOTE

Approximate RCR value for a wet, hard-surfaced runway could vary anywhere from 12 without standing water to 7 with standing water.

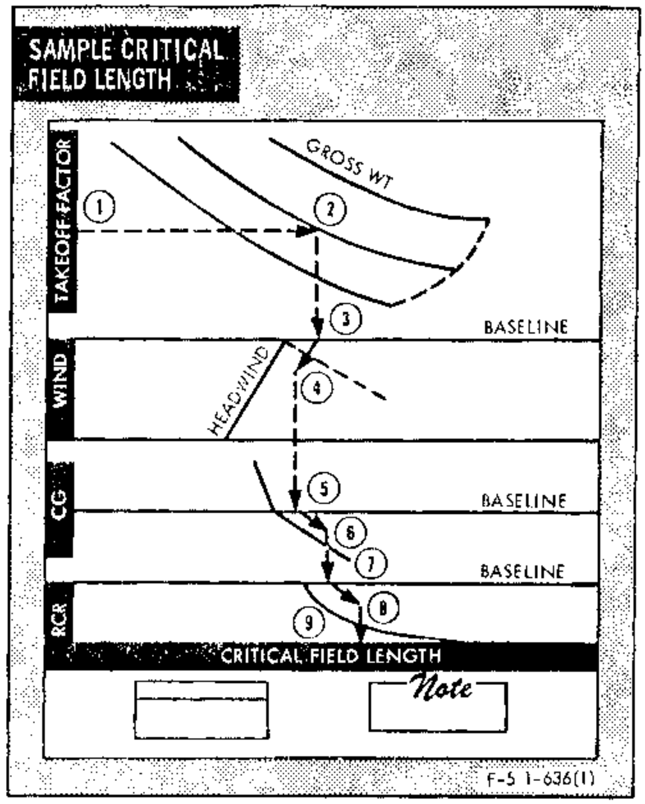
USE

Enter appropriate chart with takeoff factor, proceed right to gross weight and then down to the wind baseline. Contour the guidelines for headwind or tailwind to the wind velocity (if no wind, proceed down from baseline) and then down to the cg correction baseline. For cg positions more than 15% MAC, it is necessary to contour the upper guidelines of the grid; for cg positions less than 15% MAC, contour the lower guidelines of the grid prior to proceeding down to the RCR baseline. If the cg position is 15% MAC, proceed directly thru the cg correction portion of the chart to the RCR baseline. Contour the guidelines to the RCR and then continue down to read critical field length. If operating from a dry, hard-surfaced runway, proceed directly thru the RCR correction portion of the chart. If a runway slope correction is necessary, add or subtract the appropriate distance (see note on chart) to or from the previously read critical field length to obtain critical field length corrected for runway slope.

SAMPLE PROBLEM

Given:

A. Maximum thrust takeoff and no drag chute condition for abort.
B. Takeoff factor: 12.0
C. Takeoff gross weight (with stores): 18,000 lb.
D. Runway headwind: 10 kt.
E. CG position: 12% MAC.
F. Runway surface: Wet, hard-surfaced (RCR 12).
G. Runway slope: 1% uphill.



Calculate:

A. Critical field length.
B. Use Critical Field Length chart, No Drag Chute, FA2-10.

①	Takeoff Factor	12.0
②	Gross Wt	18,000 lb
③	Baseline	—
④	Headwind	10 kt
⑤	Baseline	—
⑥	CG	12%
⑦	Baseline (RCR 23; Dry, Hard-Surfaced Runway)	4950 ft
⑧	RCR for Wet, Hard-Surfaced Runway (see reference on chart)	12
⑨	Critical Field Length	5450 ft
	Correction for 1% uphill slope	+273 ft
	Corrected Critical Field Length	5723 ft

CRITICAL ENGINE FAILURE OR REFUSAL SPEED CHARTS

Critical Engine Failure or Refusal Speed charts are presented in FA2-12 thru FA2-14. FA2-12 is based on maximum or military thrust without drag chute and is used to determine critical engine failure and refusal speeds. FA2-13 is based on maximum thrust with drag chute and is used to determine critical engine failure and refusal speeds. FA2-14 is based on military thrust with drag chute and is used to determine refusal speed. Takeoff factor, gross weight, and runway length are used to determine refusal speed. Takeoff factor, gross weight, and critical field length obtained from FA2-10 or FA2-11 are used to determine critical engine failure speed. The computed critical engine failure speed is always higher with the use of drag chute than without the use of drag chute because of shorter stopping distance resulting from additional deceleration with deployment of drag chute. Initial entry into the charts is made with a critical field length for dry, hard-surfaced runway conditions; as the corrections provided for RCR change the speed from that for a dry, hard-surfaced runway to that for the surface condition corresponding to the RCR of interest. An RCR of 23 is used as the baseline condition as this corresponds to the braking friction required to provide consistent minimum stopping distances on a dry, hard-surfaced runway. In the use of drag chute chart, the chute is assumed deployed at any speed for abort.

NOTE

The RCR Correction curves for Refusal Speed and Critical Engine Failure Speed are to be used only to correct for surface conditions not applicable to a dry, hard-surfaced runway; for example, wet or icy surface.

DEFINITION

CRITICAL ENGINE FAILURE SPEED: Speed at which an engine failure permits acceleration to takeoff in the same distance required to decelerate the aircraft to a stop.

REFUSAL SPEED: Maximum speed to which the aircraft can accelerate with two-engine thrust and then stop in the remaining runway length.

USE

Enter appropriate chart with takeoff factor and move up to gross weight. Proceed right to the known value of actual runway length, and then down to the RCR baseline for refusal speed. Contour the guidelines to the RCR value, and then proceed down to the refusal speed. Critical engine failure speed is determined by using FA2-12 or FA2-13 and is read in the same manner as refusal speed except that the critical field length (obtained from FA2-10 or FA2-11) is used in place of the actual field length and the RCR correction for critical engine failure speed is used in place of the RCR correction for refusal speed. The value of critical field length used in the chart is always for dry, hard-surfaced runway conditions. Wind correction is obtained from note on chart.

SAMPLE PROBLEM

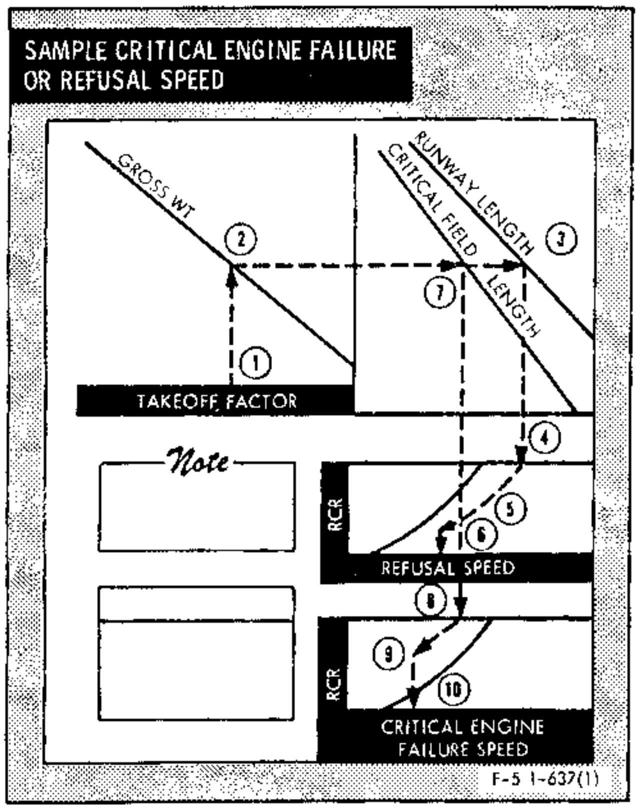
Given:

A. Maximum thrust takeoff and no drag chute condition for abort.
B. Takeoff factor: 12.0
C. Takeoff gross weight (with stores): 18,000 lb.
D. Runway length: 10,000 ft.
E. Runway surface: Wet, Hard-Surfaced (RCR 12).
F. Critical field length for dry, hard-surfaced runway (RCR 23) from FA2-10: 4950 ft.
G. Runway headwind: 10 kt.
H. Runway slope: 1% uphill.

Calculate:

A. Critical engine failure speed and refusal speed.
B. Use Critical Engine Failure or Refusal Speed chart, No Drag Chute, FA2-12.

①	Takeoff Factor	12.0
②	Gross Wt	18,000 lb
③	Runway Length	10,000 ft
④	Baseline (RCR 23)	—



⑤ RCR for Wet, Hard-Surfaced Runway (see reference on chart) 12
⑥ Refusal Speed 155 KIAS
Correction for headwind (see note on chart) +10 kt
Corrected Refusal Speed (for wet, hard-surfaced runway and headwind) 165 KIAS

C. Reenter chart at step ② and plot for critical engine failure speed.
⑦ Critical Field Length (from FA2-10, for dry, hard-surfaced runway) 4950 ft
Correction for 1% uphill slope (from FA2-10) +248 ft
Corrected Critical Field Length 5198 ft
⑧ Baseline (RCR 23) —
⑨ RCR for Wet, Hard-Surfaced Runway (see reference on chart) 12
⑩ Critical Engine Failure Speed 107 KIAS
Correction for headwind (see note on chart) 10 kt
Corrected Critical Engine Failure Speed (for wet, hard-surfaced runway and headwind) 117 KIAS

DECISION SPEED CHART

The Decision Speed chart is presented in FA2-15. The chart provides minimum decision speed as a function of takeoff factor, gross weight and runway length. Corrections are provided in the chart for headwind or tailwind and cg position.

DEFINITION

DECISION SPEED: The minimum speed at which the aircraft can experience an engine failure and still accelerate to takeoff speed in the remaining runway.

USE

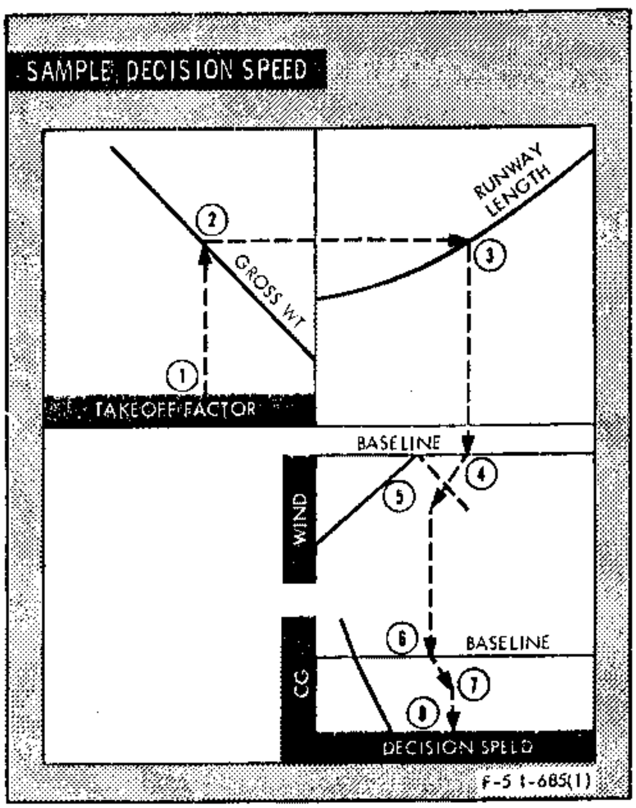
Enter the chart with takeoff factor and proceed up to the gross weight. Proceed right to actual runway length, and then down to the wind baseline. Contour the guidelines for headwind or tailwind to the wind velocity (if no wind, proceed directly thru) then continue down to the cg baseline. Contour the guidelines up or down for aft or forward cg, respectively, to the aircraft cg position. If cg position is 15% MAC, proceed directly down thru the cg correction portion of the chart to obtain decision speed.

SAMPLE PROBLEM

Given:
A. Takeoff factor: 12.0
B. Gross weight: 18,000 lb.
C. CG position: 12% MAC.
D. Runway length: 4,000 ft.
E. Runway headwind: 10 kt.

Calculate:
A. Decision speed.
B. Use Decision Speed chart, FA2-15.

①	Takeoff factor	12.0
②	Gross Wt	18,000 lb
③	Runway Length	4,000 ft
④	Baseline	—
⑤	Headwind	10 kt
⑥	Baseline	—
⑦	CG	12% MAC
⑧	Decision Speed	140 KIAS



VELOCITY DURING TAKEOFF GROUND RUN CHART

The Velocity During Takeoff Ground Run chart (FA2-16) is used to determine speed/distance traveled during takeoff ground run. In particular, it is used to determine the acceleration check speed.

DEFINITIONS

GO/NO-GO SPEED: Same as Critical Engine Failure Speed for category 1 and 2 abort situations. For category 3 (critical engine failure speed exceeds refusal speed), decision speed is used as GO/NO-GO speed.

REFUSAL DISTANCE: Distance required to accelerate from brake release to refusal speed.

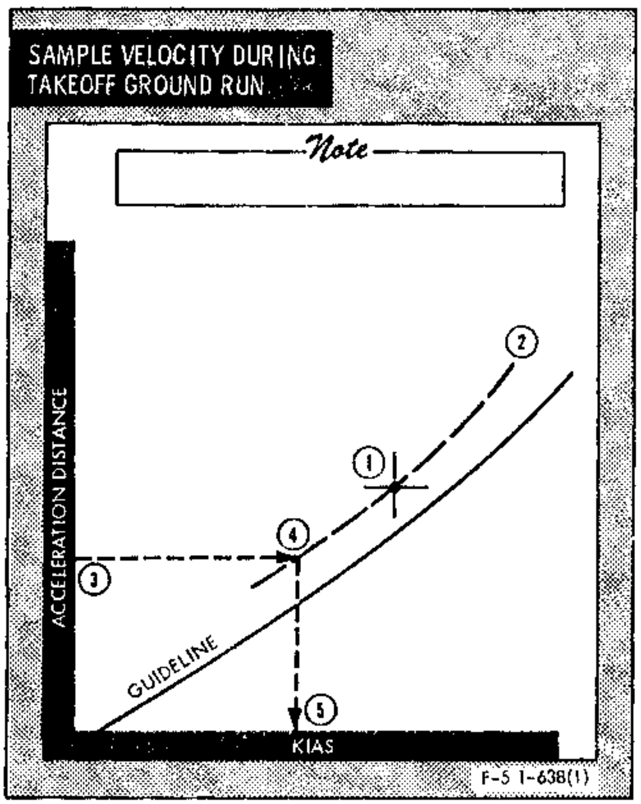
USE

Establish a point on the chart at takeoff speed and corrected takeoff ground run as determined from FA2-2 and FA2-5. Construct a line thru the point contouring the nearest guideline. This line represents normal speed-distance relationship during takeoff. If takeoff distance is 3000 feet or greater, enter the chart at the 2000-foot distance and read the speed at that point on the normal acceleration line. If takeoff distance is less than 3000 feet, check speed at the 1000-foot distance. This is the normal acceleration speed at that distance. To determine acceleration tolerance, subtract 3 knots for each 1000 feet of runway in excess of normal critical field length or 10 knots, whichever is less, for normal acceleration speed. This corrected speed is the acceleration check speed at the 2000-foot (or 1000-foot) marker. The critical engine failure speed is used as GO/NO-GO for category 1 and 2 abort situations. The decision speed is used as GO/NO-GO speed for category 3. (Abort categories are discussed in detail following the sample problem.)

SAMPLE PROBLEM

Given:

A. Maximum thrust takeoff and no drag chute.
B. Takeoff gross weight (with stores): 18,000 lb.
C. CG: 12% MAC.
D. Runway pressure altitude: Sea Level.
E. Runway surface. Wet, hard-surfaced (RCR 12).
F. Runway length: 10,000 ft.
G. Runway slope: 1% uphill.
H. Runway headwind: 10 kt.
I. Takeoff factor: 12
J. Takeoff speed: 167 KIAS.
K. Takeoff ground run (corrected for headwind, cg, and uphill runway): 2730 ft.
L. Critical field length: 5723 ft.
M. Critical engine failure speed: 117 KIAS.



Calculate:

A. Acceleration check speed at the 1000-foot marker.
B. Use Velocity During Takeoff Ground Run chart FA2-16.
   ① Establish Point on Chart (defined by takeoff speed of 167 KIAS and takeoff ground run of 2730 ft.)
   ② Construct Contour Line thru Point — — — —
C. Determine normal acceleration speed:
   ③ Acceleration distance: 1000 ft
   ④ Intersect Constructed Contour Line —
   ⑤ Normal Acceleration Speed 102 KIAS
D. To determine acceleration tolerance, subtract 3 knots for each 1000 feet of runway in excess of critical field length or 10 knots, whichever is less, from normal acceleration speed.

   Thus:

$$\frac{\text{Runway Length} - \text{Critical Field Length}}{1000} \times 3$$

= Acceleration Tolerance

$$\frac{10{,}000 - 5723}{1000} \times 3 = 12.83$$

therefore, use 10 KIAS

E. Acceleration check speed at 1000-foot marker:
   Thus:

   102 KIAS (normal acceleration speed)
   −10 KIAS (acceleration tolerance)
   92 KIAS

F. If acceleration is acceptable at 1000 feet, continue takeoff, using the critical engine failure speed as GO/NO-GO speed. This is a category 1 abort condition.

ABORT TAKEOFF CHARTS (GENERAL)

MAXIMUM THRUST

The abort takeoff charts contained in FA2-7 thru FA2-16 provide the means of planning for a GO/NO-GO decision if an engine fails during takeoff. This discussion of the GO/NO-GO concept illustrates the factors which influence the decision to stop or go if an engine fails. The principal factor affecting an aborted takeoff is the relationship of actual runway length to critical field length, which falls into three categories; within each category, the speed at which engine fails further affects the stop or go decision as follows:

Category 1.

Runway Length Greater Than Critical Field Length. (Refusal Speed Exceeds Critical Engine Failure Speed) (FA2-1).

a. If engine failure occurs before GO/NO-GO speed, aircraft should be stopped; runway length is always sufficient for stopping.
b. If engine failure occurs between GO/NO-GO and refusal speeds, takeoff can be continued or aborted in the remaining distance. The decision to take off or abort depends on operational factors such as aircraft loading, length and condition of overruns, traffic pattern obstructions, and terrain clearance.
c. If an engine fails after refusal speed, continue takeoff. Sufficient runway for takeoff is always available.

Category 2.

Runway Length Same as Critical Field Length. (Refusal Speed Equals Critical Engine Failure Speed.)

Refusal speed and GO/NO-GO speed are the same; therefore aircraft must be stopped if engine failure occurs before the speed and should continue takeoff if engine failure occurs after the speed. Runway is adequate for either condition.

Category 3.

Runway Length Less Than Critical Field Length. (Refusal Speed Less Than Critical Engine Failure Speed.)

This is the most critical category. Decision speed must be used and carefully evaluated as follows:

a. If engine failure occurs between refusal speed and decision speed, aircraft must be stopped. Barrier engagement can be expected.
b. If engine failure occurs after decision speed, continue takeoff. Sufficient runway for takeoff is always available.

When the drag chute is used, distances plotted in the abort charts for stopping on the runway are based on deployment at any speed.

MILITARY THRUST

In the event of an engine failure during a military thrust takeoff, attempting to obtain an AB light on the good engine and continue the takeoff is not recommended. Therefore, a military thrust takeoff should not be attempted unless there is sufficient runway length to stop the aircraft if an engine failure occurs before takeoff speed.

WARNING

Military thrust takeoff is not recommended unless takeoff speed is less than military thrust refusal speed.

If an engine failure occurs before takeoff speed, the aircraft should be stopped; runway length is always sufficient for stopping.

CRITICAL OBSTACLE CLEARANCE DISTANCE WITH ENGINE FAILURE DURING TAKEOFF

When carrying external stores, the following procedures may be used to evaluate critical obstacle clearance capability in the event of engine failure during takeoff in which the failure occurs at the critical engine failure speed (most critical speed). Pylons stores are jettisoned and single-engine takeoff is accomplished when obstacle clearance speed is obtained.

USE

After using Velocity During Takeoff Ground Run chart (FA2-16) to determine normal acceleration check speed, reenter chart to obtain critical obstacle clearance distance with engine failure on takeoff. Use the following procedures:

a. Reenter FA2-16 at the constructed point (Point A) representing two-engine takeoff speed and distance (with stores) and the constructed contour line Ⓑ thru this point. Plot the critical engine failure speed (with stores) Ⓒ on the constructed contour line (Point Ⓓ). This point is the acceleration distance to engine failure.
b. Plot critical field length and safe single-engine takeoff speed (with stores) (Point Ⓕ). This would be the point for single-engine takeoff with stores.
c. Construct a straight line Ⓖ between points Ⓓ and Ⓕ. On this line plot obstacle clearance speed (determined for aircraft weight with stores jettisoned) (Point Ⓘ). This is the distance from brake release to the point where stores are jettisoned and liftoff is accomplished, as read from the acceleration distance scale, Ⓙ.
d. Enter the Single-Engine Climb Gradient charts (FA2-8 and FA2-9) to determine the horizontal distance required from single-engine takeoff to clear a given obstacle.

SAMPLE PROBLEM

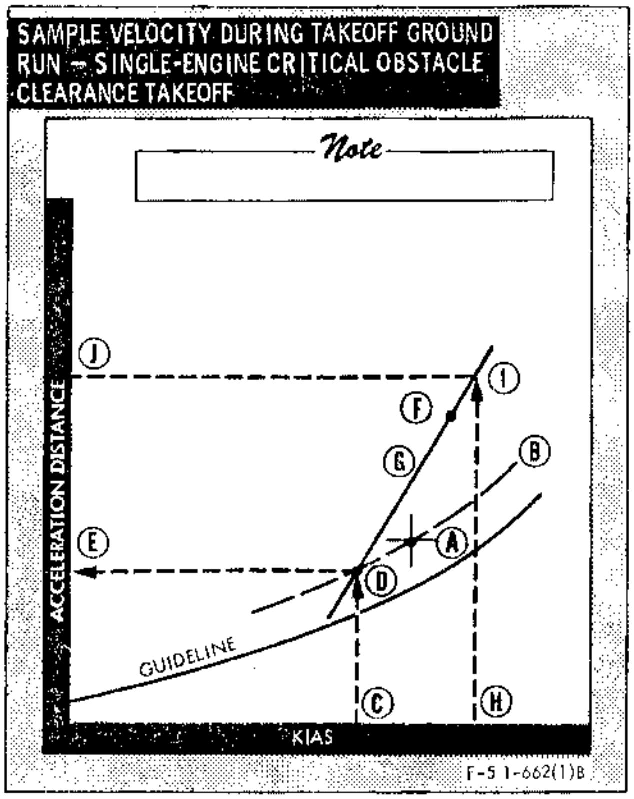
Determine the horizontal distance from brake release to clear a 250-foot obstacle with engine failure occurring at critical engine failure speed.

Given:
A. Takeoff gross weight (with stores): 18,000 lb.
B. CG: 12% MAC.
C. Runway pressure altitude: Sea Level.
D. Takeoff factor: 12.0
E. Runway surface: wet, hard-surfaced (RCR 12).
F. Runway length: 10,000 ft.
G. Runway temperature: +15°C.
H. Runway slope: 1% uphill.
I. Runway headwind: 10 KIAS.
J. Takeoff speed (two-engine): 167 KIAS.
K. Takeoff distance (two engine): 2730 ft.
L. Critical field length (no drag chute): 5723 ft.
M. Critical engine failure speed (no drag chute): 117 KIAS.
N. Safe single-engine takeoff speed (FA2-7): 171 KIAS.
O. Takeoff gross weight (stores jettisoned): 16,500 lb.
P. CG (stores jettisoned): 12% MAC.
Q. Obstacle clearance speed (stores jettisoned) (FA2-2): 176 KIAS.
R. Single-engine climb gradient, gear down (FA2-8): 5.5%.
S. Horizontal distance to 50 ft obstacle, gear down (50 ÷ 0.055) = 909 ft.
T. Horizontal distance to 200 ft obstacle, gear up (200 ÷ 0.055) = 3636 ft.
U. Single-engine climb gradient, gear up (FA2-9): 9.6%.
V. Horizontal distance to climb 200 ft, gear up (200 ÷ 0.096) = 2083 ft.

Calculate:
A. Total distance from brake release to clear 250 ft obstacle (gear up or down) = Ground Run Distance from Brake Release to Stores Jettison and Liftoff + Horizontal Distances to 50 Ft Altitude (gear down) + Horizontal Distance to Climb 200 Ft (gear up or down).

B. Use Velocity During Takeoff Ground Run chart, FA2-16.

(A)	Point Previously Established by Takeoff Speed (167 KIAS) and Takeoff Ground Run (2730 ft) (two engines, with stores)	+
(B)	Contour Line Constructed Thru Point	—
(C)	Critical Engine Failure Speed	117 KIAS



(D)	Intersect Constructed Contour Line	—
(E)	Acceleration Distance to Engine Failure (with stores)	1300 ft
(F)	Establish Point Defined by Critical Field Length (with stores) and Safe Single-Engine Takeoff Speed (with stores)	5723 ft and 171 KIAS
(G)	Construct Line thru (D) and (F)	—
(H)	Obstacle Clearance Speed (stores jettisoned)	176 KIAS
(I)	Intersect Line (D)(F)	
(J)	Ground Distance From Brake Release to Stores Jettison and Liftoff	6150 ft

C. Use Single-Engine Climb Gradient chart data (FA2-8 and FA2-9) and calculations in given data, above:

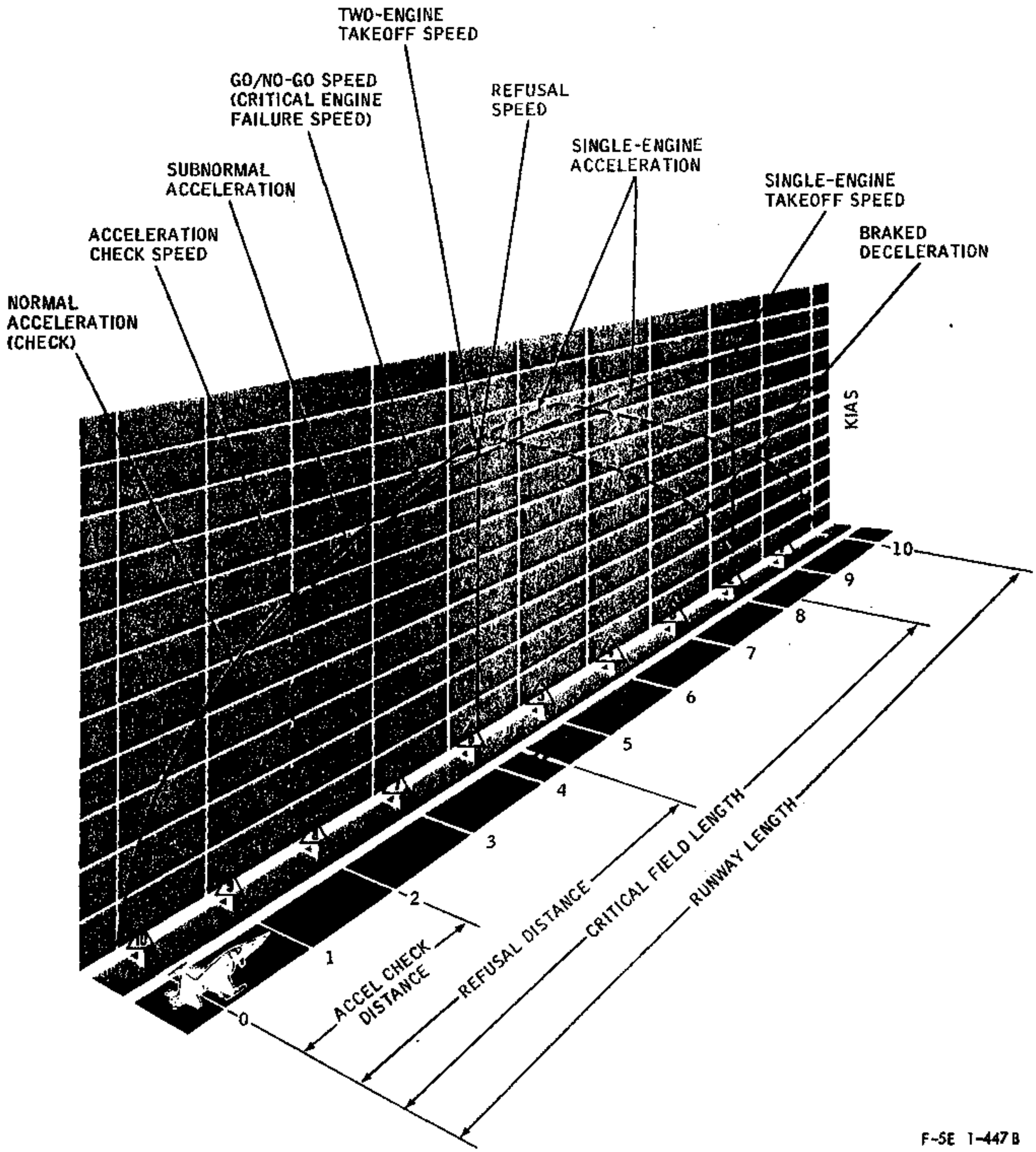
Thus:
Total distance from Brake Release to Clear 250 ft Obstacle (gear down): 6150 ft + 909 ft + 3636 ft = 10,695 ft

If climb to 250 ft altitude is with gear up:

Thus:
Total Distance from Brake Release to Clear 250 ft Obstacle (gear up): 6150 ft + 909 ft + 2083 ft = 9142 ft

TAKEOFF/ABORT CRITERIA

(GO/NO-GO CONCEPT)



FA2-1.

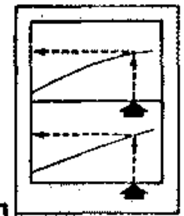
MODEL: F-5E/F
DATE: 1 AUGUST 1976
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

AFT STICK, TAKEOFF, AND OBSTACLE CLEARANCE SPEED

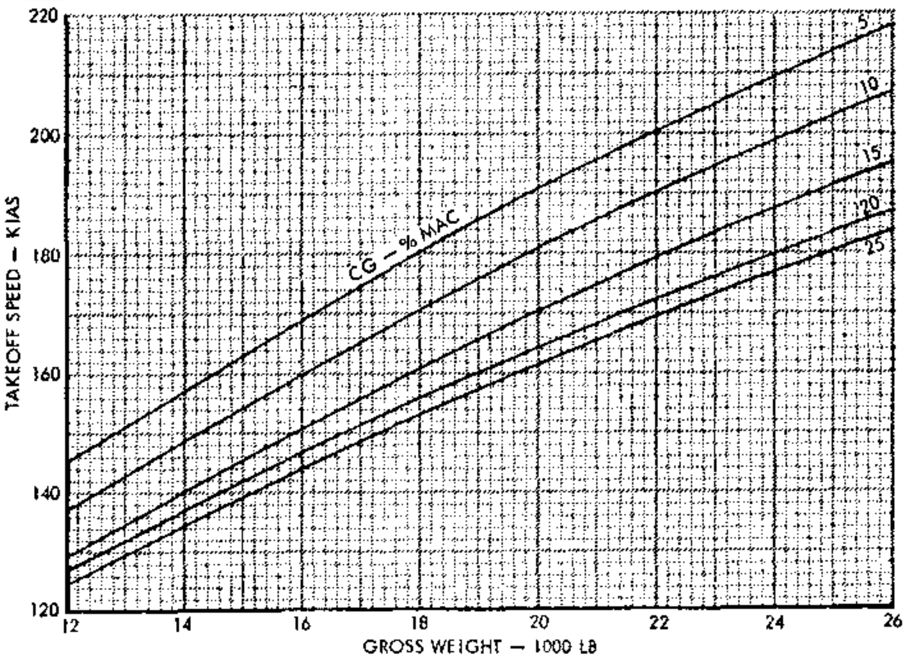
MAXIMUM, MINIMUM AB, OR MILITARY THRUST

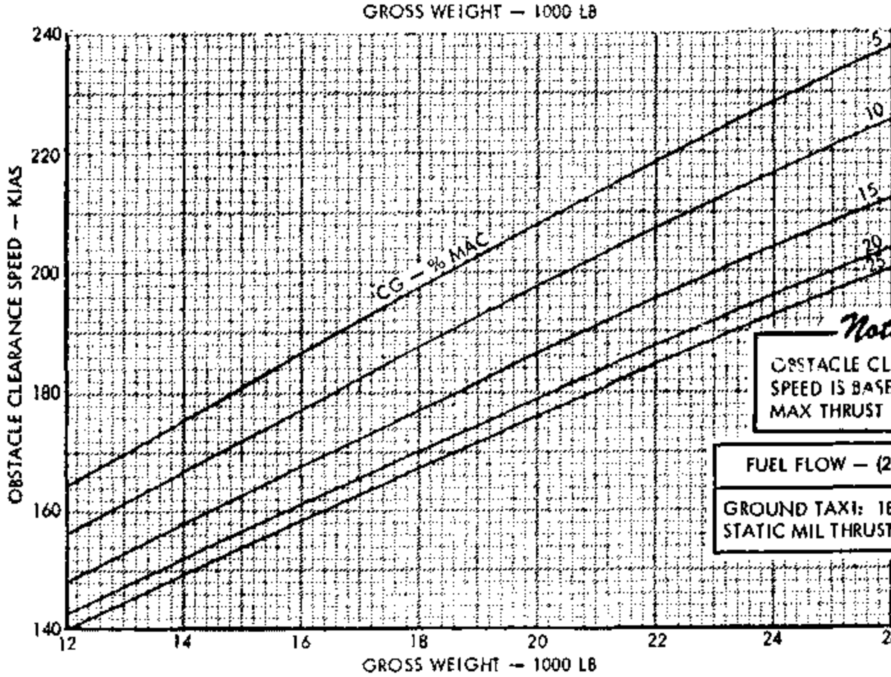
FULL FLAPS



Note

- (F) FOR CONFIGURATIONS WITH CL STORE MORE THAN 1000 LB AND NO WING STORES, INCREASE TAKEOFF SPEED 5 KIAS.
- AFT STICK SPEED IS 10 KNOTS LESS THAN TAKEOFF SPEED.
- SEE TAKEOFF GROUND RUN CHART FOR INCREASED TAKEOFF SPEED CORRECTION REQUIRED FOR HEAVYWEIGHT TAKEOFF WITH TAKEOFF FACTOR 8 OR LESS.





Note

OBSTACLE CLEARANCE SPEED IS BASED ON MAX THRUST ONLY.

FUEL FLOW — (2) ENGINES
GROUND TAXI: 18 LB/MIN STATIC MIL THRUST: 119 LB/MIN

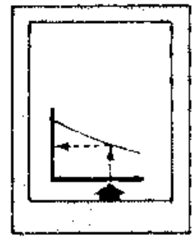
F-5 1-507(20)

FA2-2.

MODEL: F-5E/F
DATE: 1 AUGUST 1984
DATA BASIS: **FLIGHT TEST**

ENGINES: (2)J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

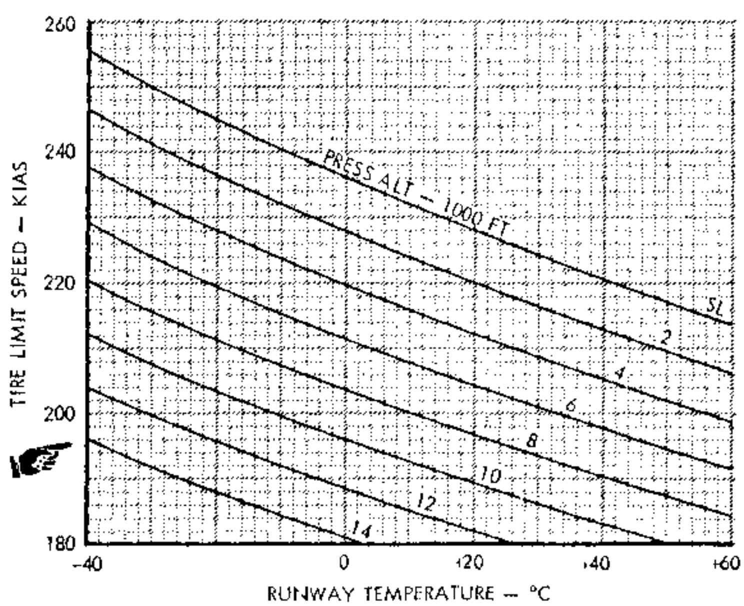
TIRE LIMIT SPEED



Note

- TO CORRECT FOR WIND EFFECT, ADD HEADWIND OR SUBTRACT TAILWIND TO OBTAIN CORRECTED KIAS.
- TIRES MOLD-MARKED 217 KNOTS ARE APPROVED FOR 230 KNOTS.

230 KNOTS GROUND SPEED



F-5 1-506(20)A

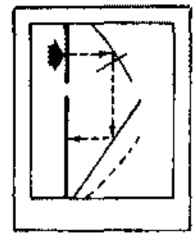
FA2-3.

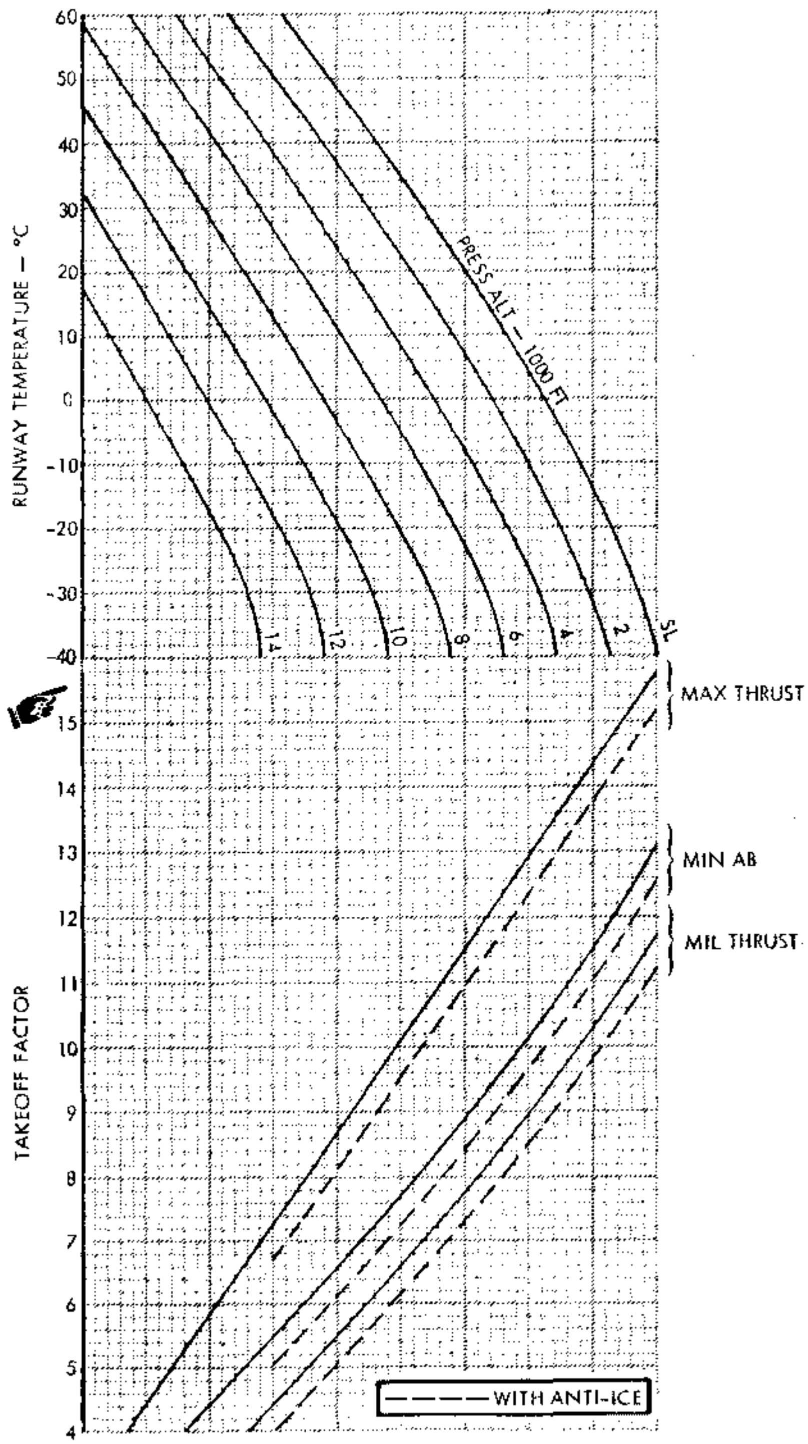
MODEL: F-5E/F
DATE: 1 AUGUST 1984
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

TAKEOFF FACTOR

MAXIMUM, MINIMUM AB
OR MILITARY THRUST





F-5 1-543(20)A

FA2-4.

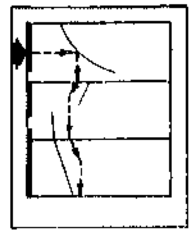
MODEL: F-5E/F
DATE: 1 AUGUST 1976
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

TAKEOFF GROUND RUN

MAXIMUM, MINIMUM AB, OR MILITARY THRUST

FULL FLAPS



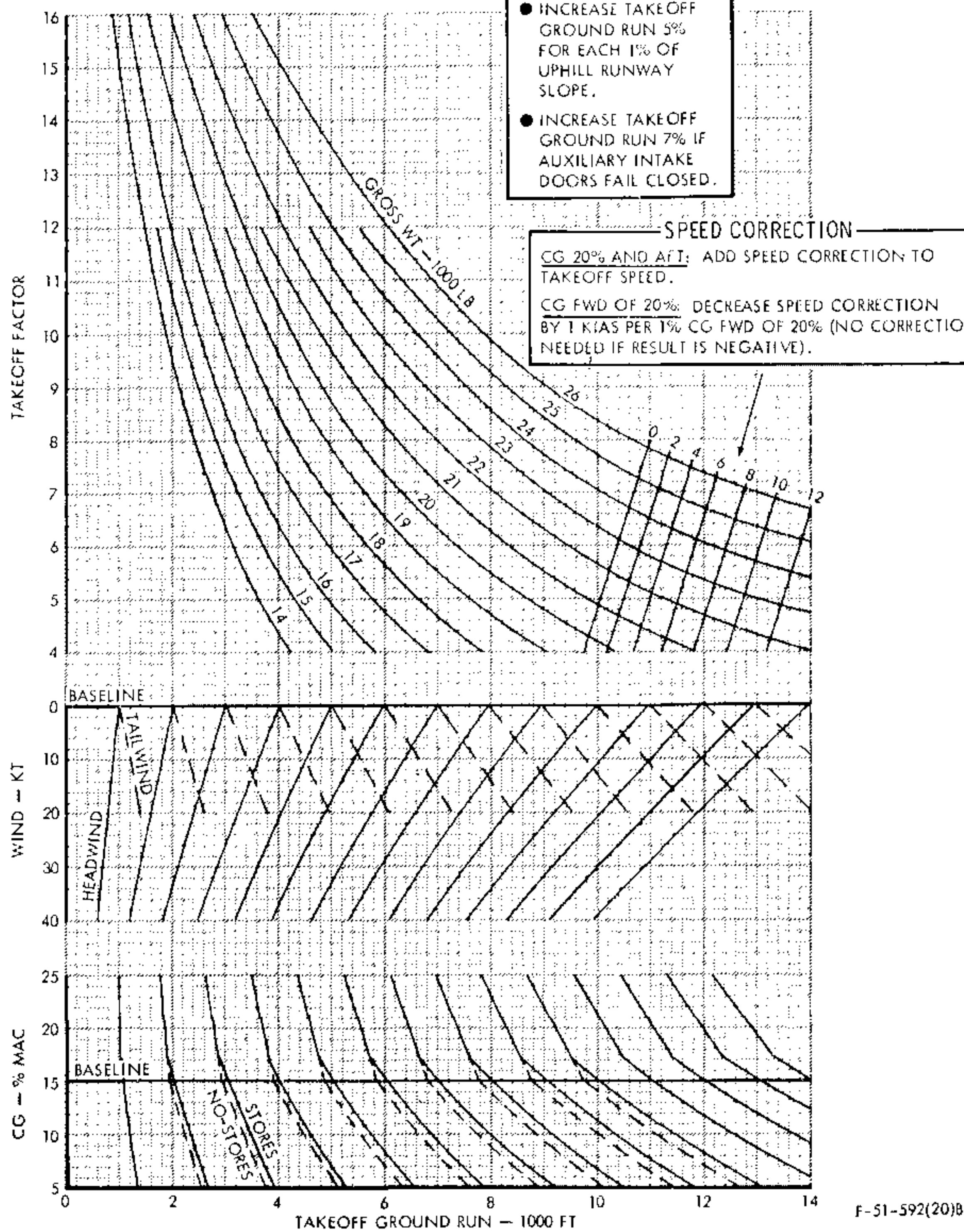
Note

- INCREASE TAKEOFF GROUND RUN 5% FOR EACH 1% OF UPHILL RUNWAY SLOPE.
- INCREASE TAKEOFF GROUND RUN 7% IF AUXILIARY INTAKE DOORS FAIL CLOSED.

SPEED CORRECTION

CG 20% AND AFT: ADD SPEED CORRECTION TO TAKEOFF SPEED.

CG FWD OF 20%: DECREASE SPEED CORRECTION BY 1 KIAS PER 1% CG FWD OF 20% (NO CORRECTION NEEDED IF RESULT IS NEGATIVE).



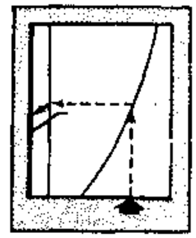
FA2-5.

MODEL: F-5E/F
DATE: 1 AUGUST 1976
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

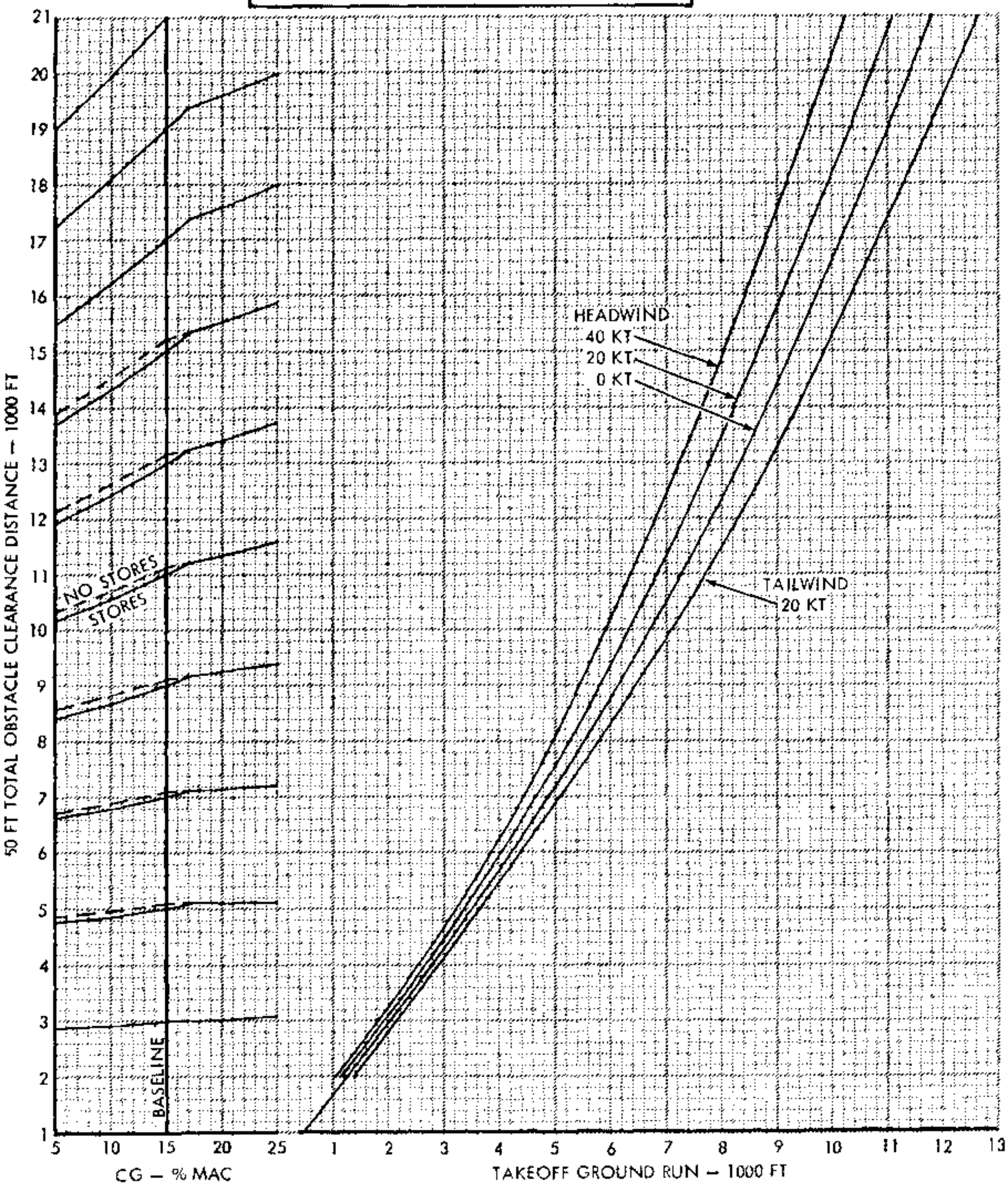
TOTAL OBSTACLE CLEARANCE DISTANCE

MAXIMUM THRUST
FULL FLAPS



Note

ENTER WITH TAKEOFF GROUND RUN CORRECTED FOR WIND, CG, AND RUNWAY SLOPE FROM TAKEOFF GROUND RUN CHART.



F-5 1-551(20)

FA2-6.

MODEL: F-5E/F
DATE: 1 DECEMBER 1976
DATA BASIS: FLIGHT TEST

ENGINES: (2)J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

MINIMUM SAFE SINGLE-ENGINE TAKEOFF SPEED

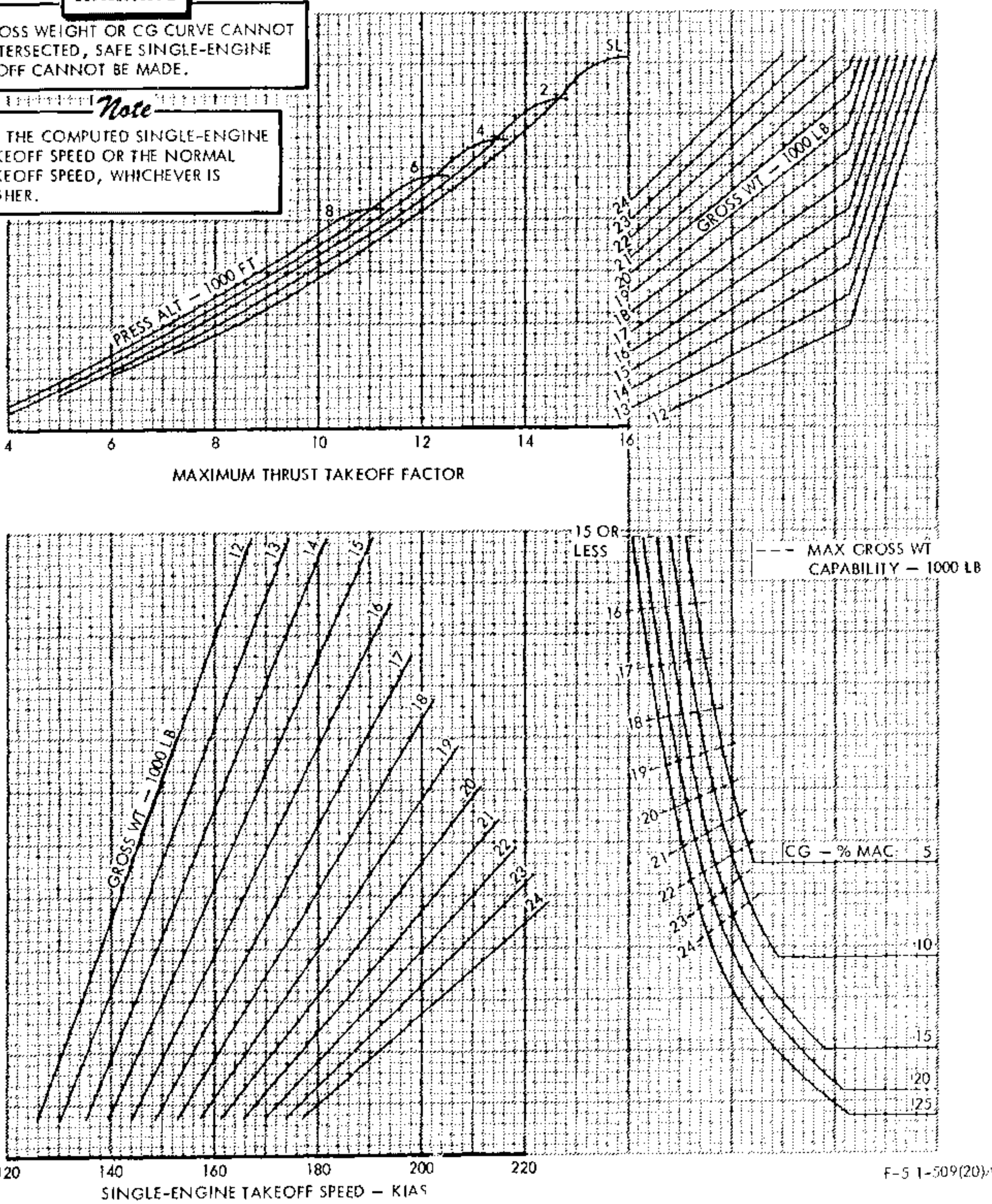
MAXIMUM THRUST
FULL FLAPS
GEAR DOWN

WARNING

IF GROSS WEIGHT OR CG CURVE CANNOT BE INTERSECTED, SAFE SINGLE-ENGINE TAKEOFF CANNOT BE MADE.

Note

USE THE COMPUTED SINGLE-ENGINE TAKEOFF SPEED OR THE NORMAL TAKEOFF SPEED, WHICHEVER IS HIGHER.



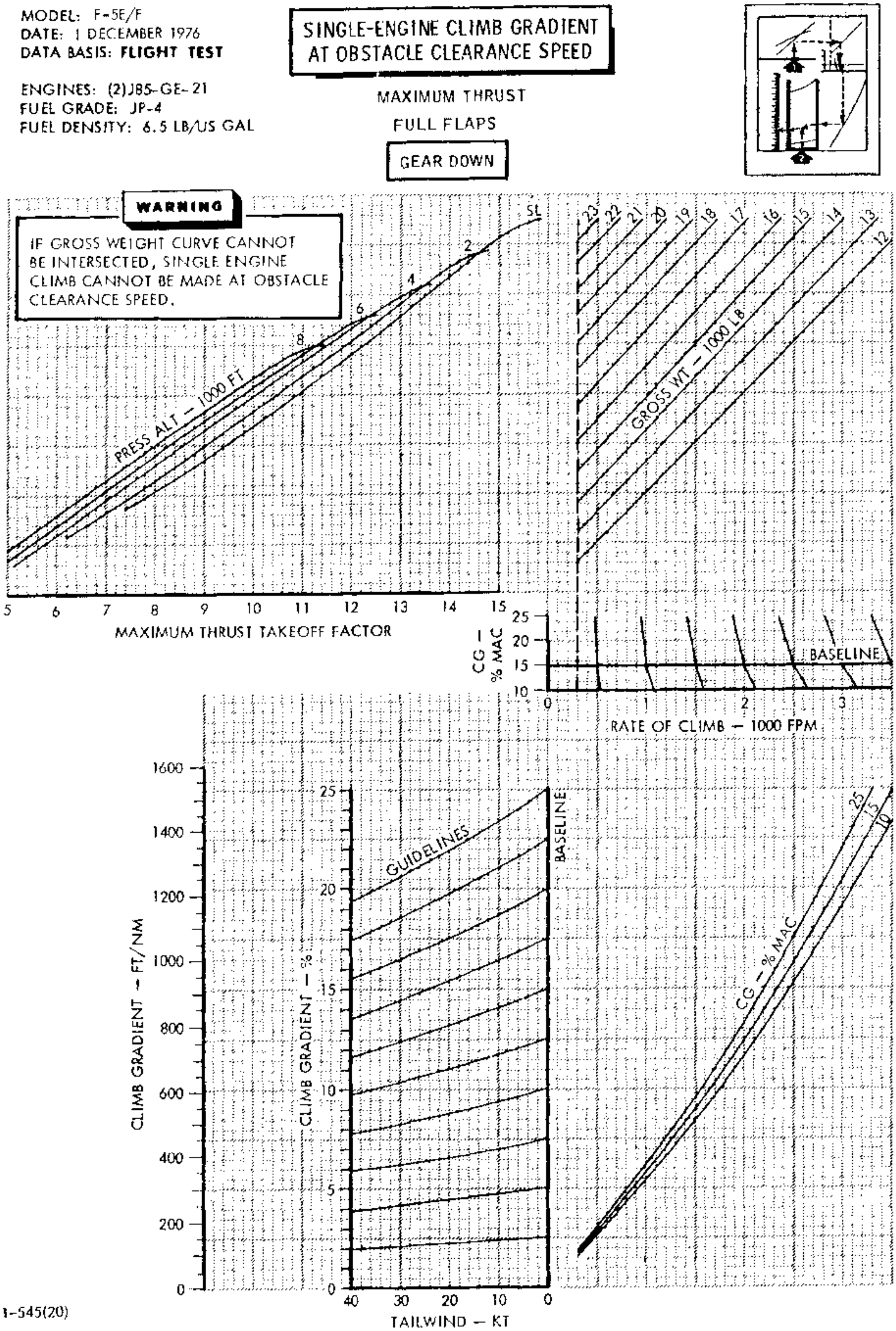
FA2-7.

MODEL: F-5E/F
DATE: 1 DECEMBER 1976
DATA BASIS: **FLIGHT TEST**

ENGINES: (2)J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

SINGLE-ENGINE CLIMB GRADIENT AT OBSTACLE CLEARANCE SPEED

MAXIMUM THRUST
FULL FLAPS
GEAR DOWN



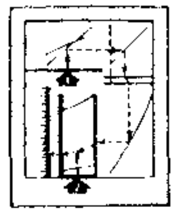
F-5 1-545(20)

FA2-8.

MODEL: F-5E/F
DATE: 1 APRIL 1977
DATA BASIS: **FLIGHT TEST**

ENGINES: (2)J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

SINGLE-ENGINE CLIMB GRADIENT AT OBSTACLE CLEARANCE SPEED



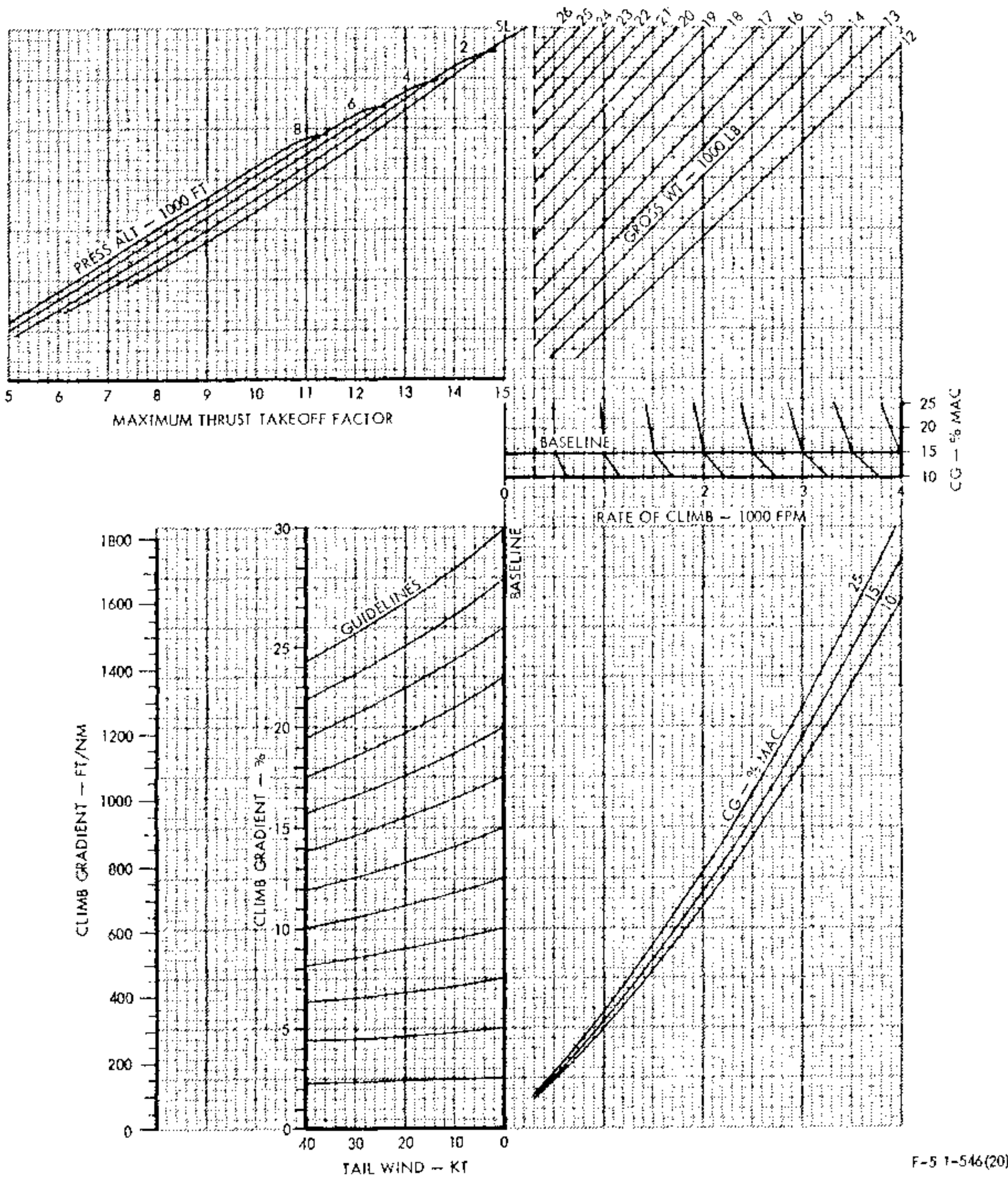
MAXIMUM THRUST

FULL FLAPS

GEAR UP

WARNING

IF GROSS WEIGHT CURVE CANNOT BE INTERSECTED, SINGLE ENGINE CLIMB CANNOT BE MADE AT OBSTACLE CLEARANCE SPEED.



F-5 1-546(20)

FA2-9.

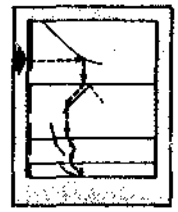
MODEL: F-5E/F
DATE: 1 DECEMBER 1976
DATA BASIS: **FLIGHT TEST**

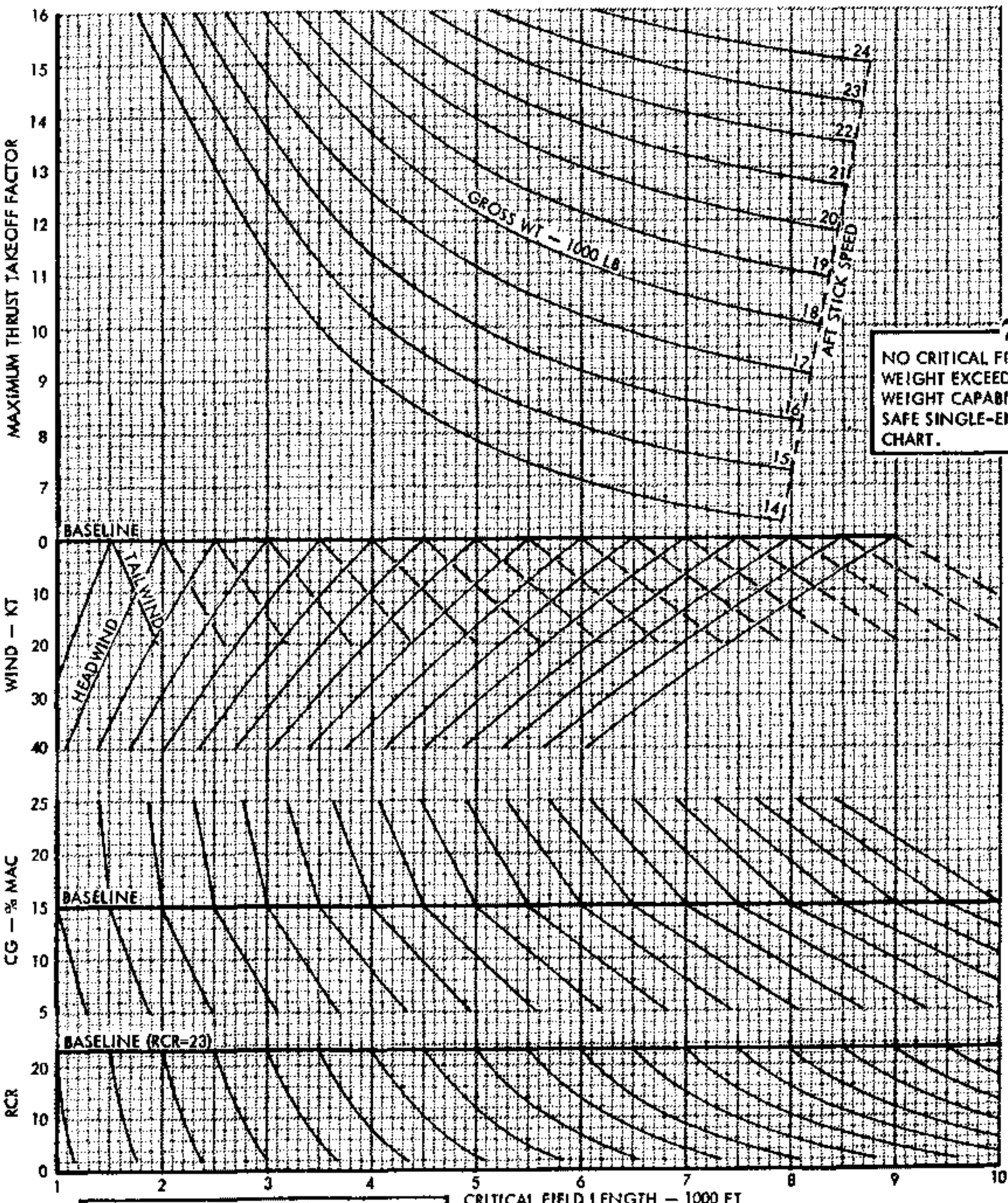
ENGINES: (2)J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

CRITICAL FIELD LENGTH

MAXIMUM THRUST
FULL FLAPS

NO DRAG CHUTE





Note

NO CRITICAL FIELD LENGTH IF GROSS WEIGHT EXCEEDS MAXIMUM GROSS WEIGHT CAPABILITY FROM MINIMUM SAFE SINGLE-ENGINE TAKEOFF SPEED CHART.

APPROXIMATE RCR VALUES FOR HARD-SURFACED RUNWAY CONDITIONS	
CONDITION	RCR
DRY	23
WET	12
WET (STANDING WATER)	7
ICY	5
ICY (GLAZED)	2

Note

INCREASE CRITICAL FIELD LENGTH 5% FOR EACH 1% OF UPHILL RUNWAY SLOPE.

F-5 1-547(20)

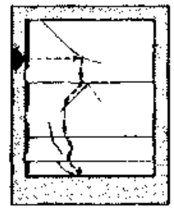
FA2-10.

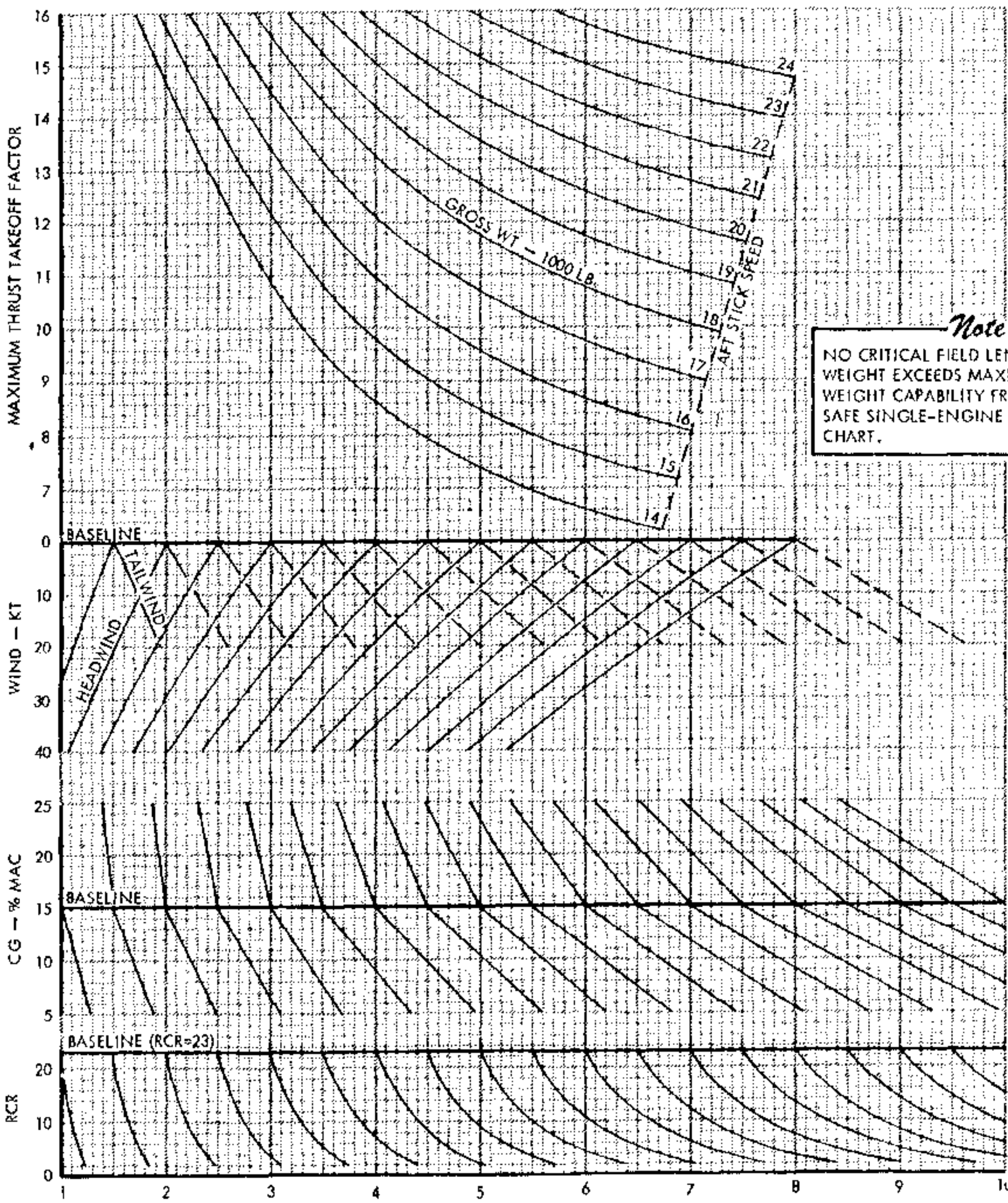
MODEL: F-5E/F
DATE: 1 DECEMBER 1976
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

CRITICAL FIELD LENGTH

MAXIMUM THRUST
FULL FLAPS
WITH DRAG CHUTE





Note

NO CRITICAL FIELD LENGTH IF GROSS WEIGHT EXCEEDS MAXIMUM GROSS WEIGHT CAPABILITY FROM MINIMUM SAFE SINGLE-ENGINE TAKEOFF SPEED CHART.

APPROXIMATE RCR VALUES FOR HARD-SURFACED RUNWAY CONDITIONS	
CONDITION	RCR
DRY	23
WET	12
WET (STANDING WATER)	7
ICY	5
ICY (GLAZED)	2

Note

INCREASE CRITICAL FIELD LENGTH 5% FOR EACH 1% OF UPHILL RUNWAY SLOPE.

F-5 1-54B(20)

FA2-11.

MODEL: F-5E/F
DATE: 1 DECEMBER 1976
DATA BASIS: **FLIGHT TEST**

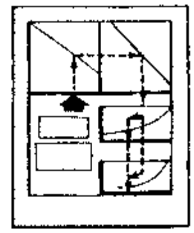
ENGINES: (2)J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

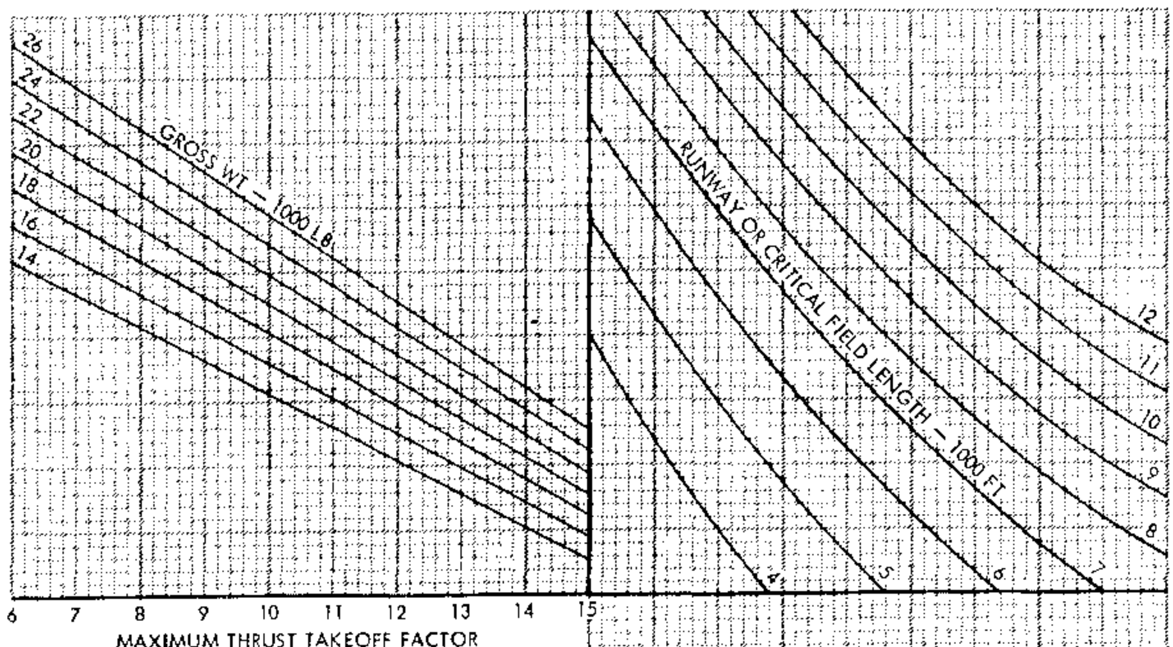
CRITICAL ENGINE FAILURE OR REFUSAL SPEED

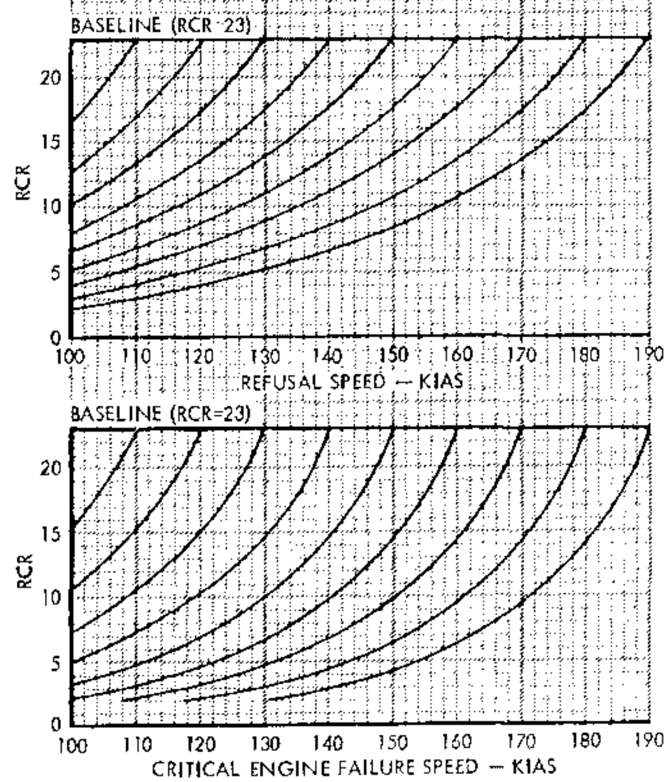
MAXIMUM THRUST

FULL FLAPS

NO DRAG CHUTE







Note

- RUNWAY LENGTH IS USED TO OBTAIN REFUSAL SPEED.
- MILITARY THRUST REFUSAL SPEED MAY BE OBTAINED BY ENTERING CHART WITH MILITARY THRUST TAKEOFF FACTOR AND ADDING 10 KIAS TO THE REFUSAL SPEED.
- CRITICAL FIELD LENGTH FOR DRY HARD-SURFACED RUNWAY IS USED TO OBTAIN CRITICAL ENGINE FAILURE SPEED.
- ADD HEADWIND TO OR SUBTRACT TAILWIND FROM SPEED.

APPROXIMATE RCR VALUES FOR HARD-SURFACED RUNWAY CONDITIONS	
CONDITION	RCR
DRY	23
WET	12
WET (STANDING WATER)	7
ICY	5
ICY (GLAZED)	2

F-5 1-549(20)A

FA2-12.

MODEL: F-5E/F
DATE: 1 DECEMBER 1976
DATA BASIS: **FLIGHT TEST**

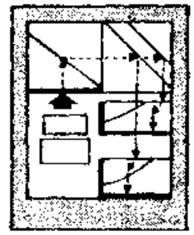
ENGINES: (2)J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

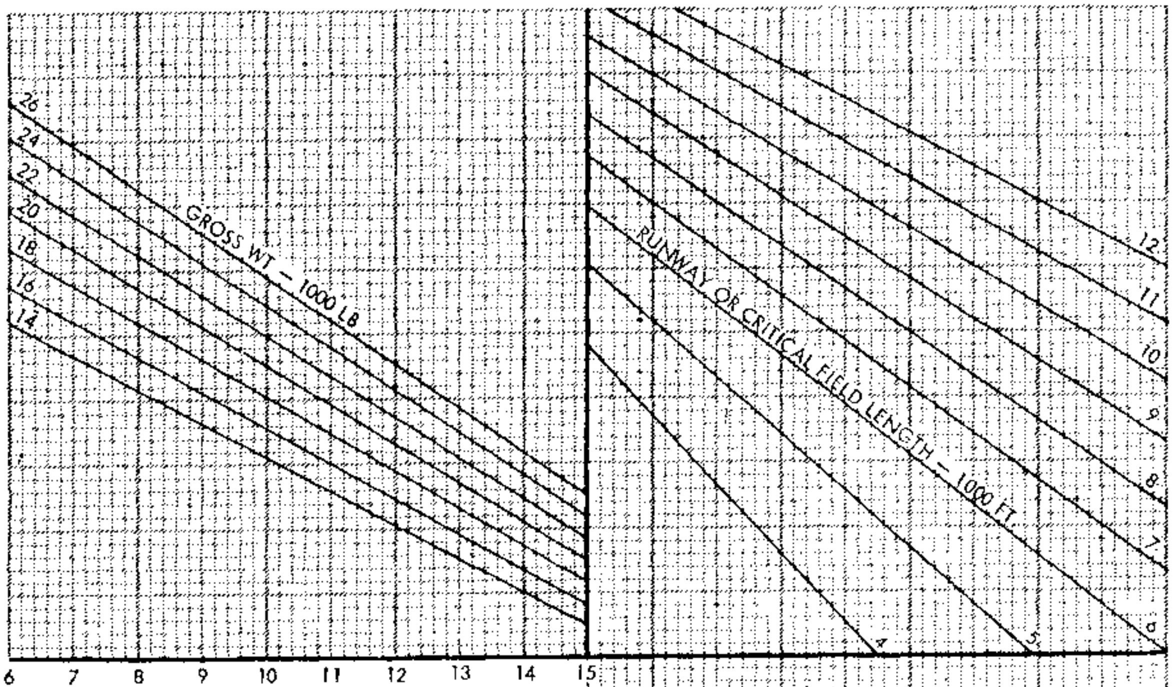
CRITICAL ENGINE FAILURE OR REFUSAL SPEED

MAXIMUM THRUST

FULL FLAPS

WITH DRAG CHUTE

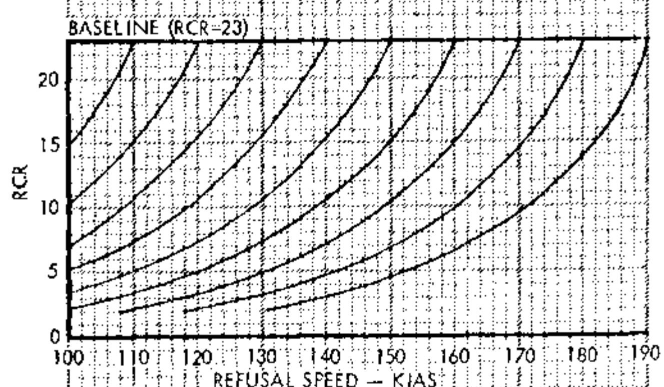


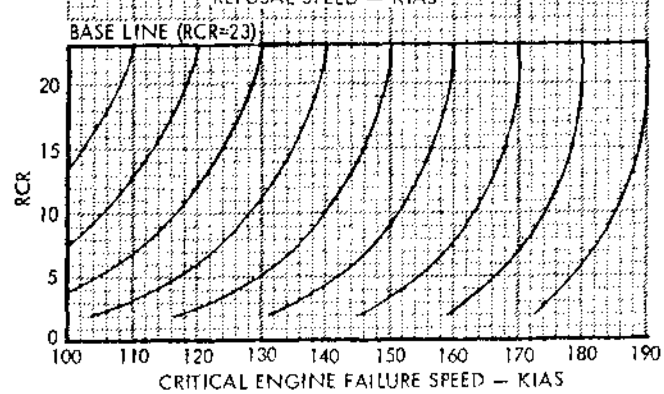


Note

- RUNWAY LENGTH USED TO OBTAIN REFUSAL SPEED.
- CRITICAL FIELD LENGTH FOR DRY HARD-SURFACED RUNWAY IS USED TO OBTAIN CRITICAL ENGINE FAILURE SPEED.
- ADD HEADWIND TO OR SUBTRACT TAILWIND FROM SPEED.

APPROXIMATE RCR VALUES FOR HARD-SURFACED RUNWAY CONDITIONS	
CONDITION	RCR
DRY	23
WET	12
WET (STANDING WATER)	7
ICY	5
ICY (GLAZED)	2





F-5 1-550(20)

FA2-13.

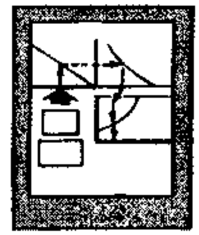
MODEL: F-5E/F
DATE: 1 APRIL 1978
DATA BASIS: **FLIGHT TEST**

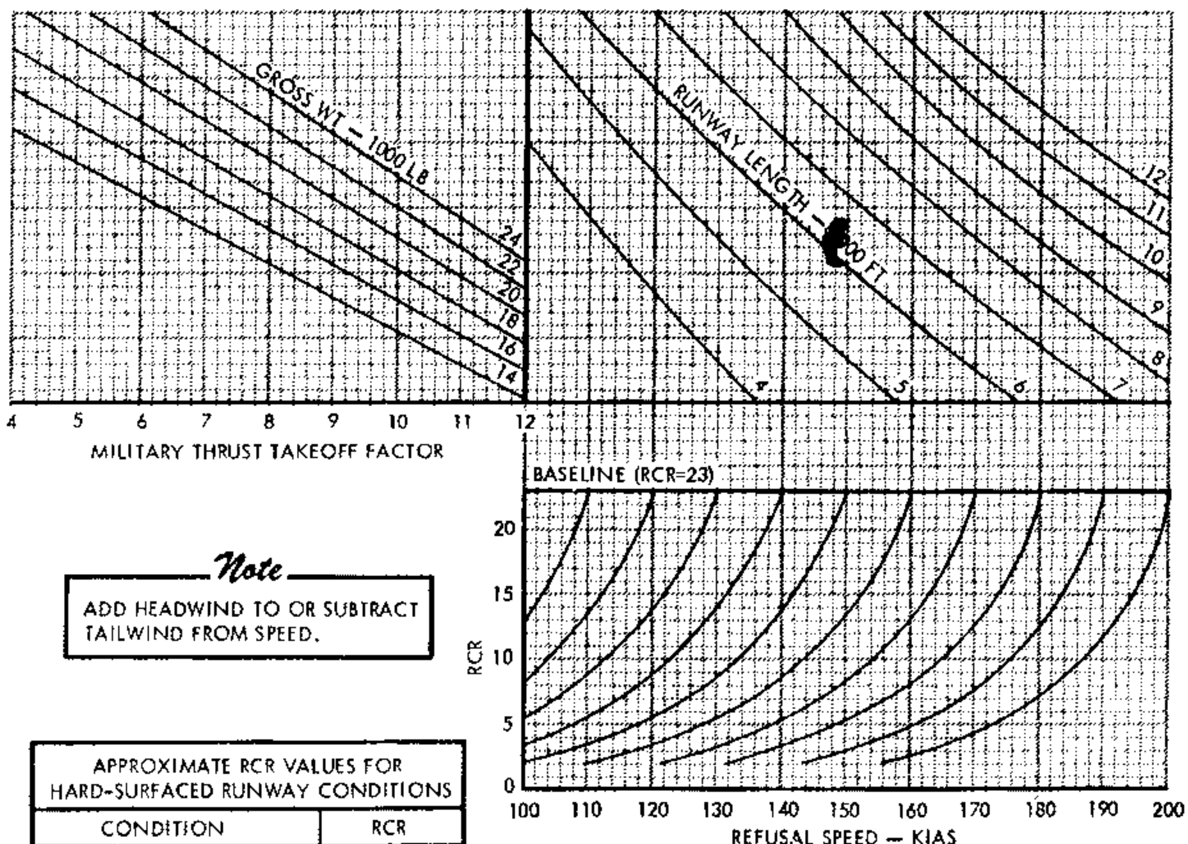
ENGINES: (2)J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

REFUSAL SPEED

MILITARY THRUST
FULL FLAPS

WITH DRAG CHUTE





Note

ADD HEADWIND TO OR SUBTRACT TAILWIND FROM SPEED.

APPROXIMATE RCR VALUES FOR HARD-SURFACED RUNWAY CONDITIONS	
CONDITION	RCR
DRY	23
WET	12
WET (STANDING WATER)	7
ICY	5
ICY (GLAZED)	2

F-5 1-683(1)B

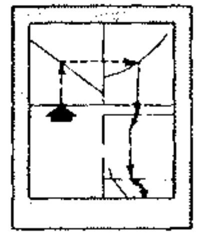
FA2-14.

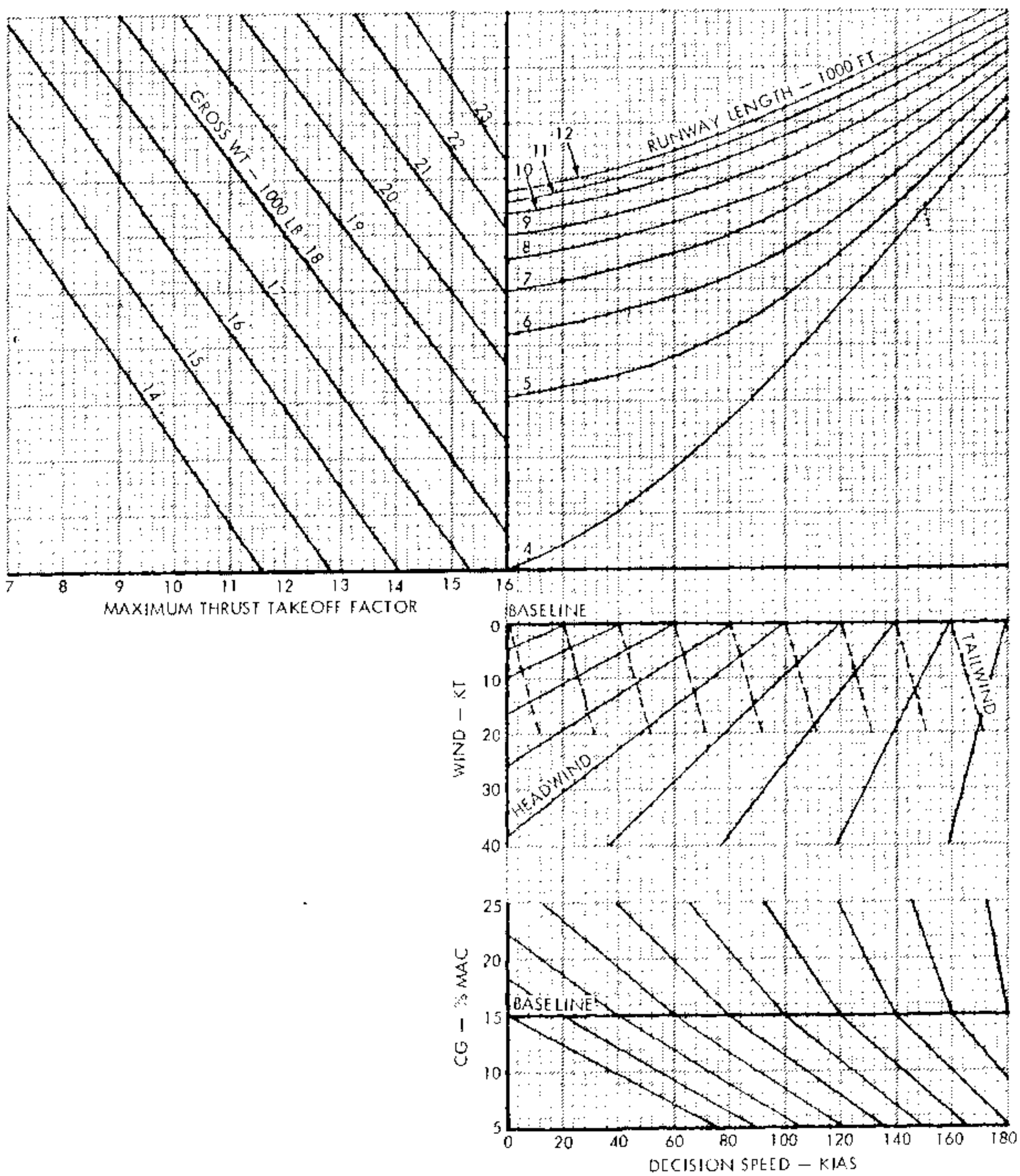
MODEL: F-5E/F
DATE: 1 AUGUST 1981
DATA BASIS: **FLIGHT TEST**

ENGINES: (2)J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

DECISION SPEED

MAXIMUM THRUST
FULL FLAPS
GEAR DOWN





F-5 E-684(1)A

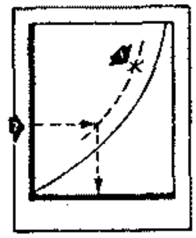
FA2-15.

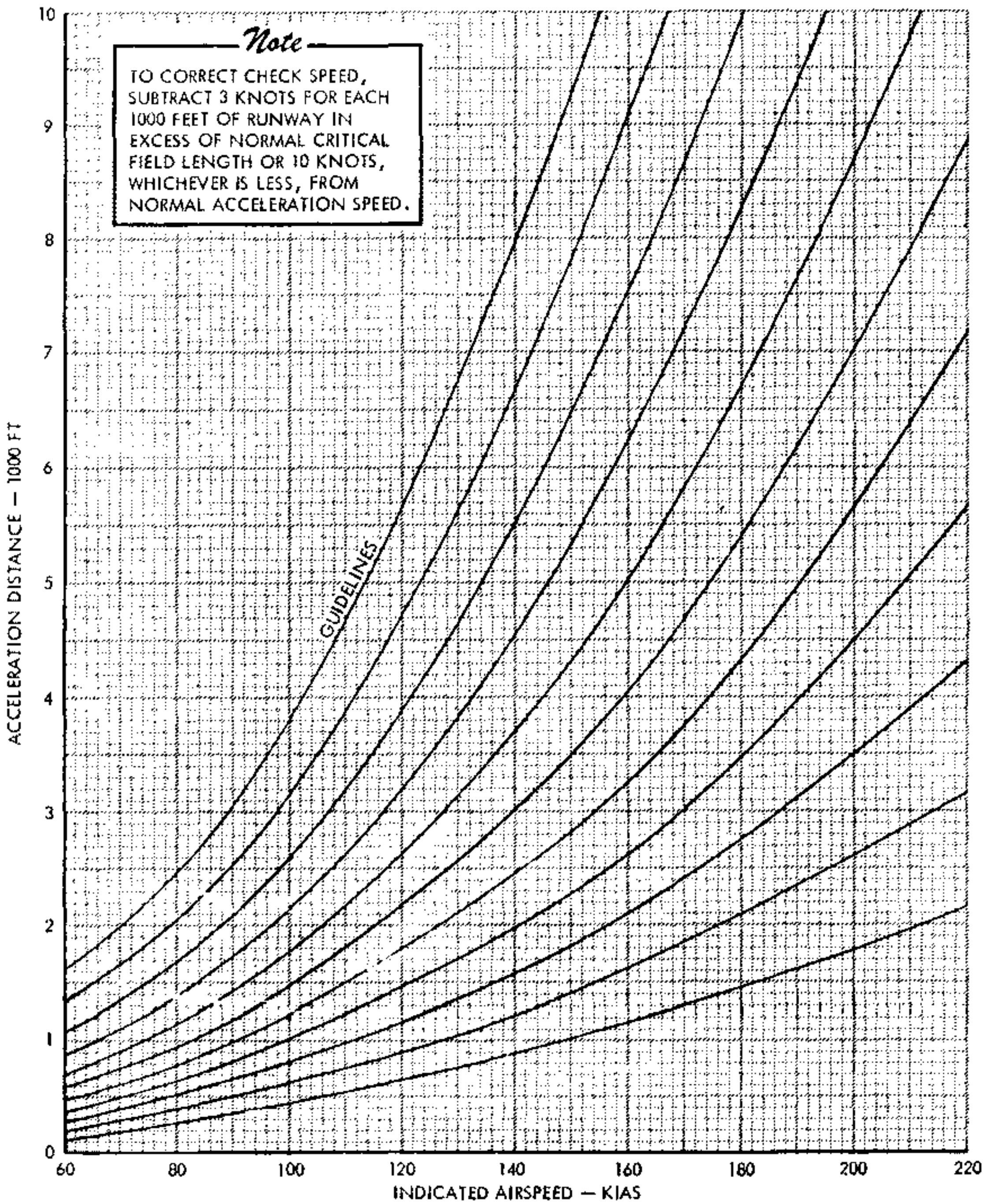
MODEL: F-5E/F
DATE: 1 DECEMBER 1976
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

VELOCITY DURING TAKEOFF GROUND RUN

MAXIMUM, MINIMUM AB, OR MILITARY THRUST
DRY, HARD-SURFACED RUNWAY
FULL FLAPS





F-5 1-568(20) B

FA2-16.

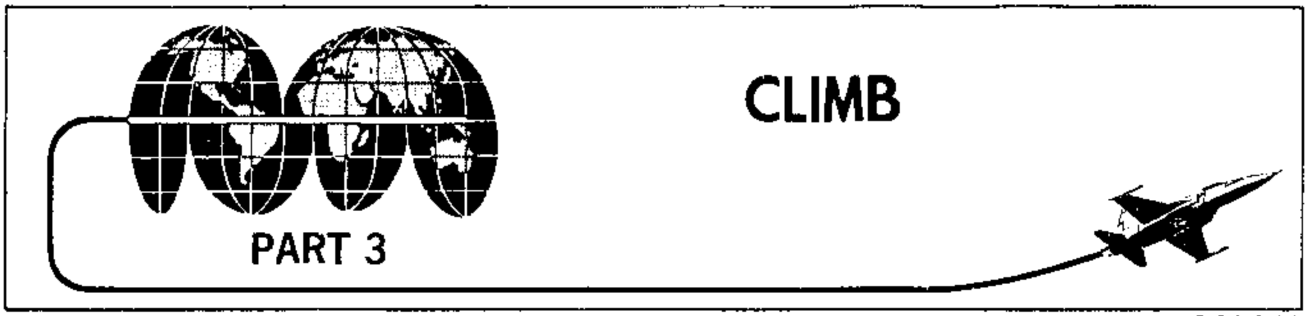


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TABLE OF CONTENTS

Page numbers underlined denote charts.

CLIMB CHARTS (GENERAL)

Climb charts provide aircraft climb performance, including time, distance, and fuel required to climb for various drag indexes. The time, distance, and fuel required to climb from sea level to altitude are presented for all gross weights and drag indexes of 0 to 400 for both maximum and military thrust. The climb speed schedules are based on providing minimum time to climb with maximum thrust and maximum range with military thrust. Data for single-engine maximum thrust climb for drag indexes of 0 to 120 are also provided. The single-engine climb speed schedules are based on providing maximum range with maximum thrust.

TIME, FUEL, AND DISTANCE FROM BRAKE RELEASE TO CLIMB SPEED CHART

The Time, Fuel, and Distance from Brake Release to Climb Speed chart (FA3-1) presents the time, fuel and distance required to take off and accelerate to best climb speed. The data on the left side of the chart are based on taking off and accelerating with maximum thrust to the climb speed schedule for a maximum thrust climb. The data on the right side of the chart are based on taking off with maximum thrust and accelerating with maximum thrust to 300 KIAS, then continuing with military thrust acceleration to the climb speed schedule for a military thrust climb. Less time, distance, and fuel are required for the higher drag index because the climb speeds are lower. The climb speed schedules are tabulated on sheet 1 of the climb performance charts. Fuel flow values for ground taxi (idle rpm) and static military thrust runup conditions are shown at the bottom of the chart. The fuel estimated for ground operation (taxi and runup) plus the fuel required to take off and accelerate to climb speed are subtracted from the aircraft takeoff gross weight to obtain the gross weight at the start of initial climb.

USE

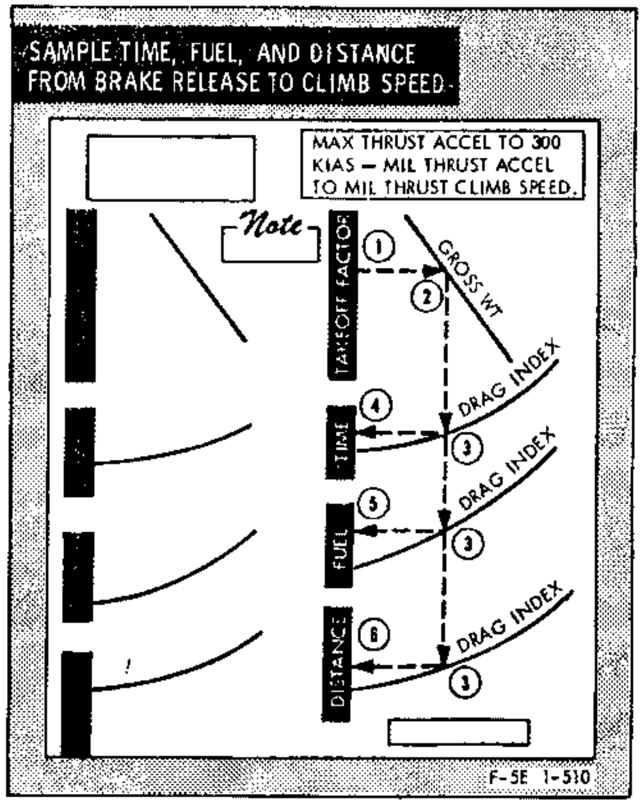
Enter appropriate acceleration portion of FA3-1 with takeoff factor and proceed right to the gross weight at start of takeoff. At the point of intersection with the weight curve (interpolate as necessary), project down thru all the drag index curves of the time, fuel, and distance scales. At each point of intersection with the desired drag index, proceed left and read time, fuel, and distance, respectively.

SAMPLE PROBLEM

Given:
A. Takeoff factor: 11.6.
B. Takeoff gross weight (with stores): 20,300 lb.
C. Configuration drag index: 120.

Calculate:
A. Time, fuel, and distance required for maximum thrust takeoff and acceleration to 300 KIAS, then military thrust acceleration to best military thrust climb speed schedule.
B. Use Time, Fuel, and Distance from Brake Release to Climb Speed chart FA3-1.

①	Takeoff Factor (max thrust)	11.6
②	Gross Wt	20,290 lb
③	Drag Index	120
④	Time	1.1 min
⑤	Fuel	310 lb
⑥	Distance	3 nm



MAXIMUM AND MILITARY THRUST CLIMB CHARTS

The charts for Maximum Thrust Climb are contained in FA3-2 thru FA3-3; those for Military Thrust Climb are contained in FA3-4 thru FA3-5. Maximum Thrust Climb for single-engine is contained in FA3-6. Each Climb Chart consists of two sheets. Sheet 1 is used to find fuel used as a function of sea level gross weight, pressure altitude, drag index, and temperature. Sheet 2 is used to find time to climb and distance traveled as a function of sea level gross weight, pressure altitude, drag index, and temperature. The temperature correction scale on each sheet of the charts corrects for non-standard day conditions.

The recommended climb schedule for various drag indexes is shown in tabular form on each sheet 1 of the maximum and military thrust climb charts. The maximum thrust with two engines charts provide the minimum time to climb; the military thrust with two engines and the maximum thrust with single engine charts provide the minimum fuel to climb. The constant KIAS climb speed portion of the schedule provides an increasing mach number to the airspeed transition altitude (KIAS to altitude). At the airspeed transition altitude, climb speed is then established at a constant mach number, which is maintained until desired cruise altitude is reached (IMN to level-off). Use 0°/0° flaps for climb with maximum or military thrust.

If the climb starts at sea level, enter the climb performance with sea level gross weight and move to the right to the end climb altitude, then down to the drag index value, and left to the temperature baseline. Continue thru the temperature correction grid if standard day temperature is used. If a temperature correction is required, contour the nearest guideline to the desired temperature variation, then proceed left to the fuel, time, or distance scale and read the value.

If the climb begins at an altitude other than sea level, the fuel required to climb from one altitude to another is the fuel required from sea level to the higher altitude less the fuel required from sea level to the lower altitude. Time and distance are found in the same manner.

The fuel, time, and distance values should be read for a gross weight adjusted to sea level for the purpose of entering the climb charts. This weight is heavier than the start climb gross weight by the amount of fuel required to climb from sea level to the start climb altitude. To determine the adjusted sea level gross weight, enter the sea level gross weight scale of the appropriate climb chart with the aircraft weight at the start climb altitude and read the fuel used for this gross weight. Add this value to the start climb gross weight at altitude to obtain the adjusted sea level gross weight.

USE

Enter sheet 1 with the sea level gross weight and proceed right to the pressure altitude. Proceed down to the drag index and then left to the baseline of the temperature scale. If temperature is standard, proceed across; if not, contour the guideline for hotter or colder temperature variation and then proceed across to read fuel used.

Enter sheet 2 with the sea level gross weight and move right to the pressure altitude. Proceed down thru the drag index of the time portion of the chart and continue down to the drag index of the distance portion of the chart. At each point of intersection of the drag index, project left and read time and distance, respectively.

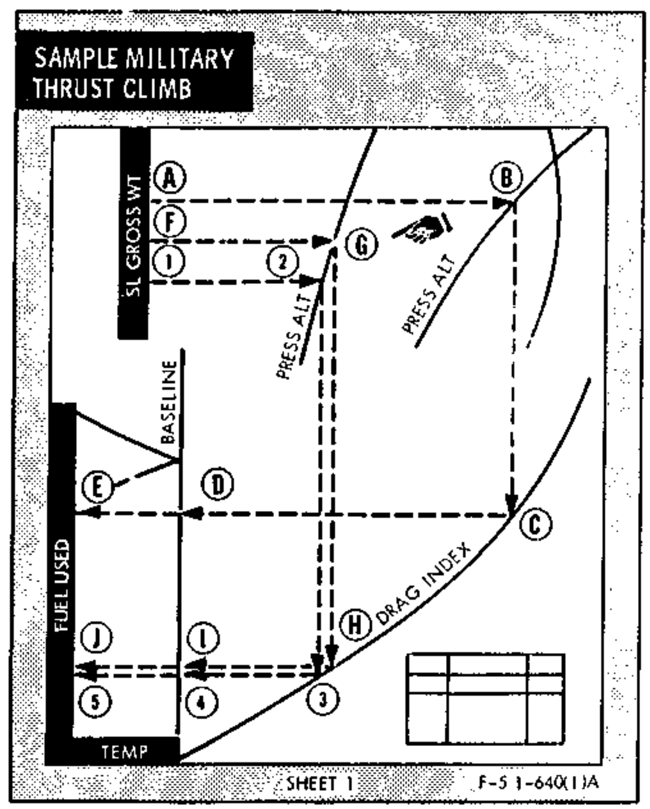
SAMPLE PROBLEM

Given:

A. Takeoff field elevation (above sea level): 1000 ft.
B. Start climb gross weight: 19,980 lb.
C. Military thrust climb to: 30,000 ft.
D. Configuration drag index: 120.
E. Standard day temperature at all altitudes.

Calculate:

A. Fuel, time, and distance required for a climb from 1000 ft field elevation to 30,000 ft pressure altitude.



B. Use Military Thrust Climb, Fuel Used, Drag Index 0 to 200 chart FA3-4, sheet 1.
   ① Start climb Gross Wt 19,980 lb
   ② Press Alt (field elevation) 1000 ft
   ③ Drag Index 120
   ④ Baseline (std day temp) —
   ⑤ Fuel Used 35 lb

C. Since the climb begins at an altitude other than sea level (chart data based on sea level conditions), determine adjusted sea level gross weight.

D. Start Climb Gross weight (at field elevation) + Fuel Used = Adjusted Sea Level Gross Weight.
   Thus: 19,980 lb + 35 lb = 20,015 lb

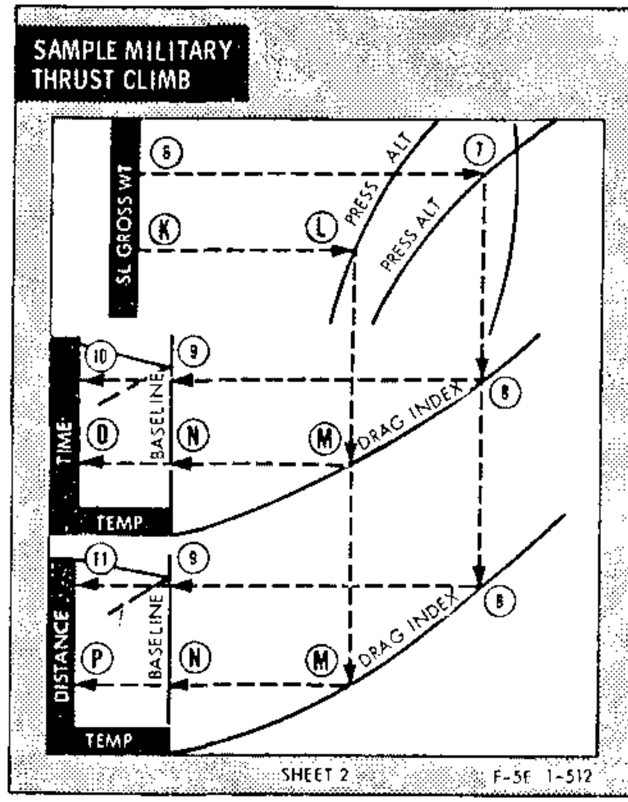
E. Reenter FA3-4, sheet 1, to determine fuel used from sea level to the higher altitude for the adjusted sea level gross weight.
   Ⓐ Adjusted SL Gross Wt 20,015 lb
   Ⓑ Press Alt (cruise alt) 30,000 ft
   Ⓒ Drag Index 120
   Ⓓ Baseline (std day temp) —
   Ⓔ Fuel Used 1200 lb

F. Reenter FA3-4, sheet 1, to determine fuel used from sea level to the lower altitude for adjusted sea level gross weight.
   Ⓕ Adjusted SL Gross Wt 20,015 lb
   Ⓖ Press Alt (field elevation) 1000 ft
   Ⓗ Drag Index 120
   Ⓘ Baseline (std day temp) —
   Ⓙ Fuel Used 35 lb

G. Fuel Used (30,000 ft) — Fuel Used (1000 ft) = Fuel Required to Climb from 1000 to 30,000 ft.
   Thus: 1200 lb — 35 lb = 1165 lb

H. Use Military Thrust Climb, Time to Climb and Distance Traveled, Drag Index 0 to 200 chart FA3-4, sheet 2.

I. Using the adjusted sea level gross weight calculated in sheet 1, determine time and distance to climb from sea level to the higher altitude.



   ⑥ Adjust SL Gross Wt 20,015 lb
   ⑦ Press Alt 30,000 ft
   ⑧ Drag Index 120
   ⑨ Baseline (std day temp) —
   ⑩ Time 14.7 min
   ⑪ Distance 102 nm

J. Reenter FA3-4, sheet 2, to determine time and distance to climb from sea level to the lower altitude.
   Ⓚ Adjusted SL Gross Wt 20,015 lb
   Ⓛ Press Alt 1000 ft
   Ⓜ Drag Index 120
   Ⓝ Baseline (std day temp) —
   Ⓞ Time 0.3 min
   Ⓟ Distance 2 nm

K. Time (30,000 ft) — Time (1000 ft) = Time Required to Climb from 1000 to 32,000 ft.
   Thus: 14.7 min — 0.3 min = 14.4 min

L. Distance (30,000 ft) — Distance (1000 ft) = Distance Required to Climb from 1000 to 30,000 ft.
   Thus: 102 nm — 2 nm = 100 nm

COMBAT CEILING CHART

The Combat Ceiling chart (rate of climb = 500 fpm) for maximum and military thrust is presented in FA3-7. The chart determines the combat ceiling for a standard day as a function of gross weight and drag index with flaps up. The combat ceiling is based on the actual gross weight at altitude and use of the appropriate climb speed schedule.

USE

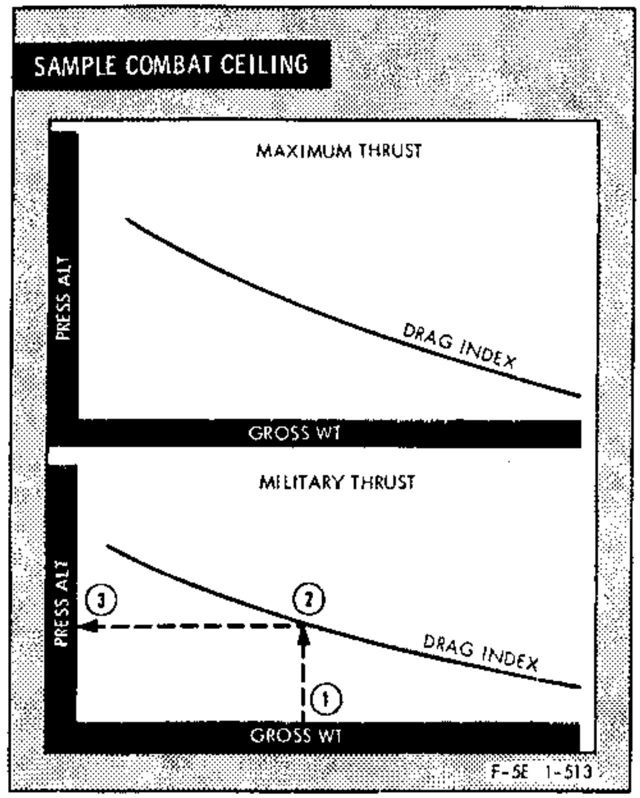
Enter either the maximum thrust or military thrust portion of the chart with gross weight and proceed up to the drag index. From this point move left and read pressure altitude (combat ceiling).

SAMPLE PROBLEM

Given:
A. Gross weight (at altitude): 18,600 lb.
B. Standard day condition at altitude.
C. Drag Index: 120
D. Military thrust.

Calculate:
A. Combat ceiling.
B. Used Combat Ceiling, Military Thrust, chart FA3-7.

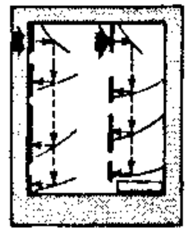
①	Gross Wt	18,600 lb
②	Drag Index	120
③	Press Alt	32,000 ft



MODEL: F-5E/F
DATE: 1 MARCH 1978
DATA BASIS: FLIGHT TEST

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

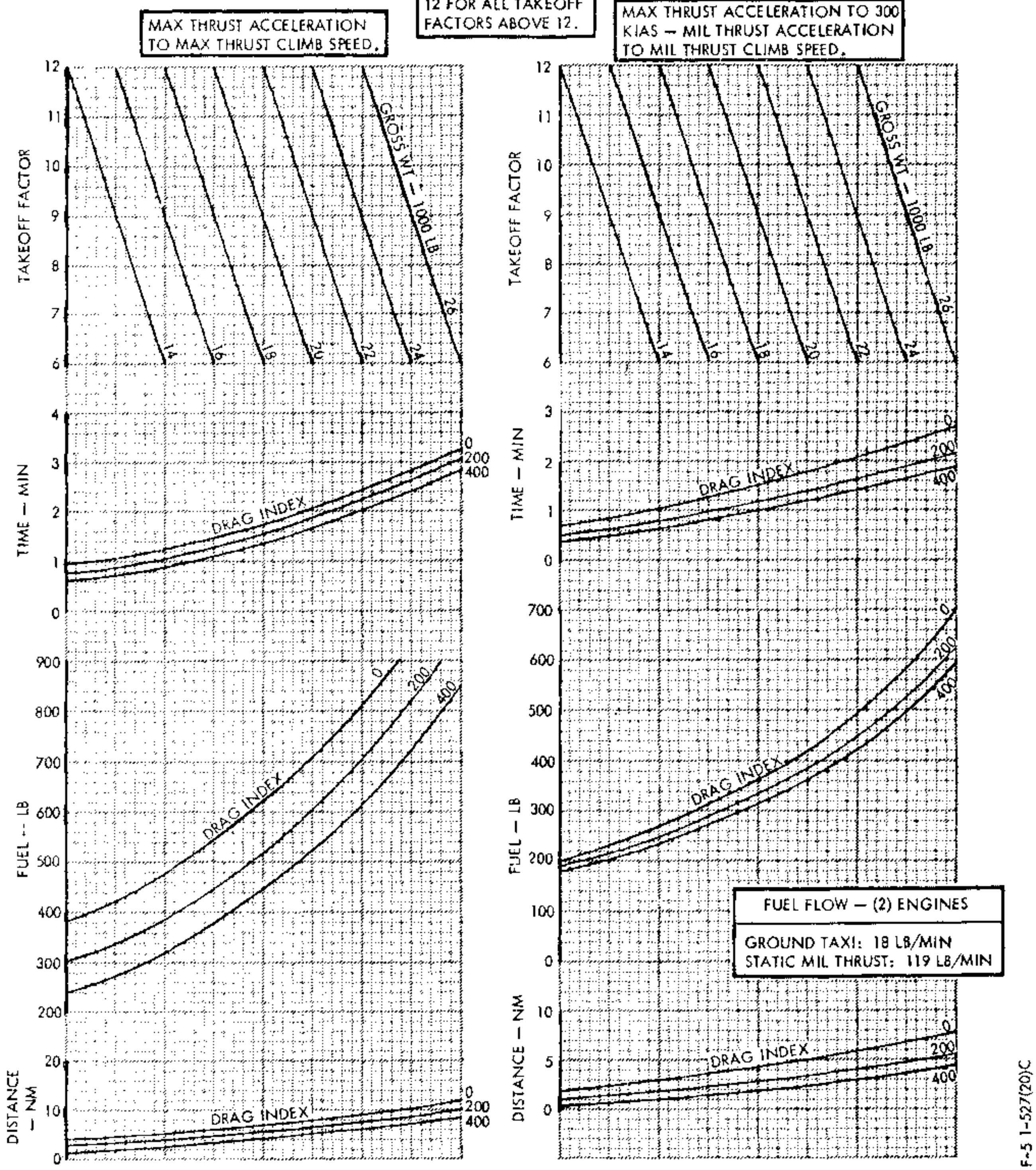
TIME, FUEL, AND DISTANCE FROM BRAKE RELEASE TO CLIMB SPEED



MAXIMUM THRUST TAKEOFF

Note

USE TAKEOFF FACTOR 12 FOR ALL TAKEOFF FACTORS ABOVE 12.



FA3-1.

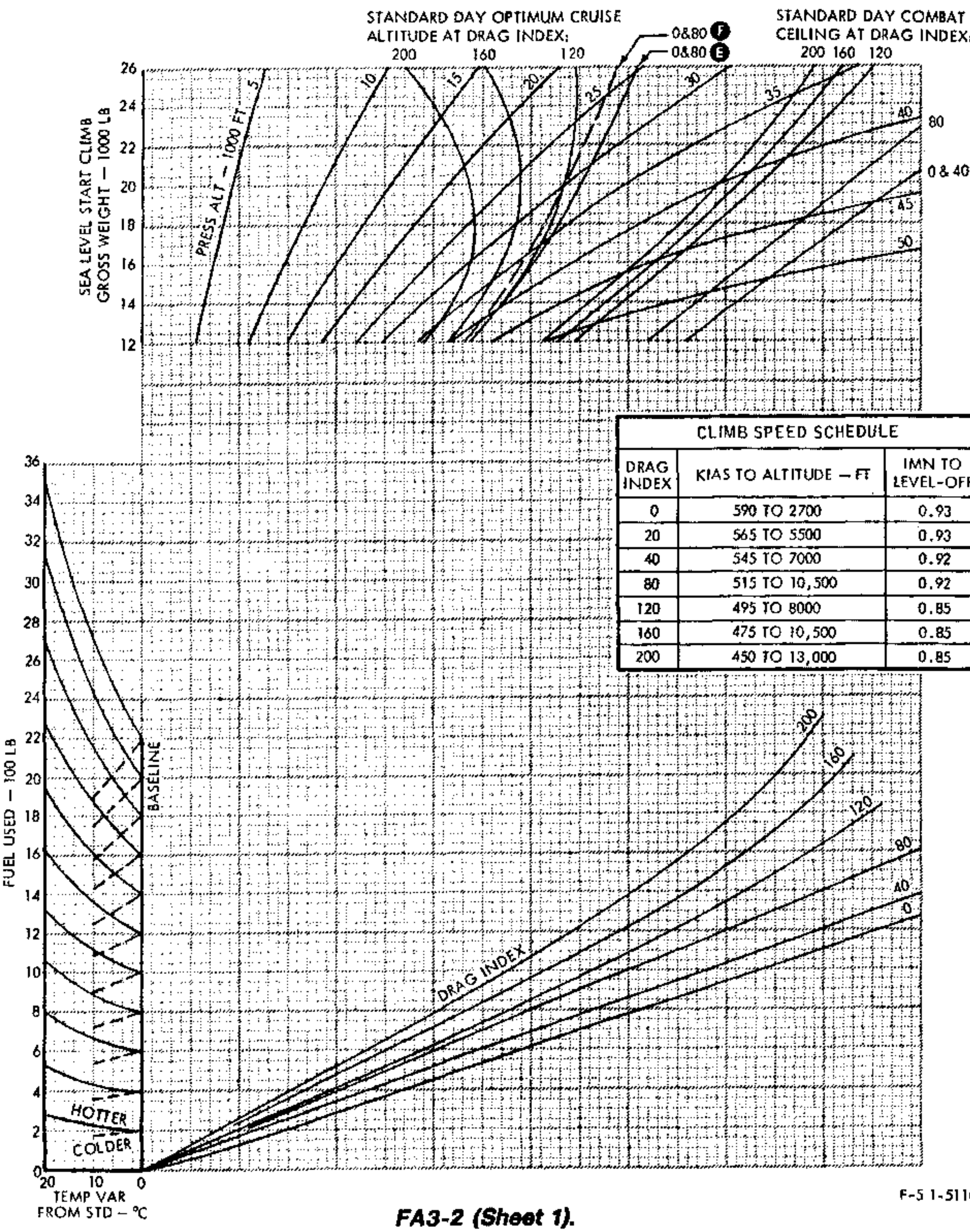
MODEL: F-5E/F
DATE: 1 MARCH 1978
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

MAXIMUM THRUST CLIMB (FLAPS UP)

FUEL USED

DRAG INDEX 0 TO 200



CLIMB SPEED SCHEDULE		
DRAG INDEX	KIAS TO ALTITUDE – FT	IMN TO LEVEL-OFF
0	590 TO 2700	0.93
20	565 TO 5500	0.93
40	545 TO 7000	0.92
80	515 TO 10,500	0.92
120	495 TO 8000	0.85
160	475 TO 10,500	0.85
200	450 TO 13,000	0.85

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FA3-2 (Sheet 1).

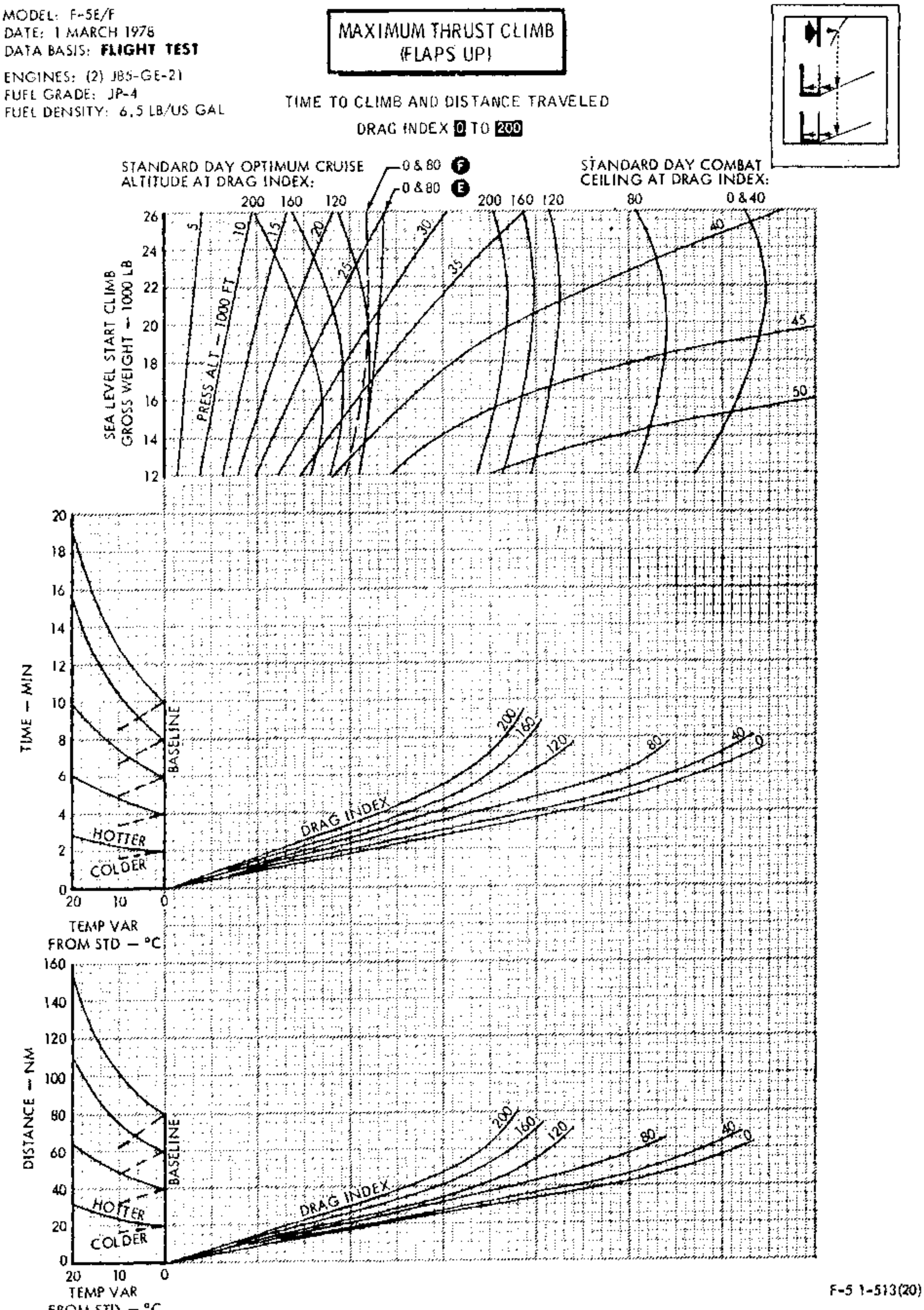
MODEL: F-5E/F
DATE: 1 MARCH 1978
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

MAXIMUM THRUST CLIMB (FLAPS UP)

TIME TO CLIMB AND DISTANCE TRAVELED

DRAG INDEX 0 TO 200



FA3-2 (Sheet 2).

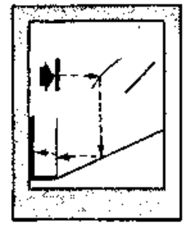
MODEL: F-5E/F
DATE: 1 MARCH 1976
DATA BASIS: **FLIGHT TEST**

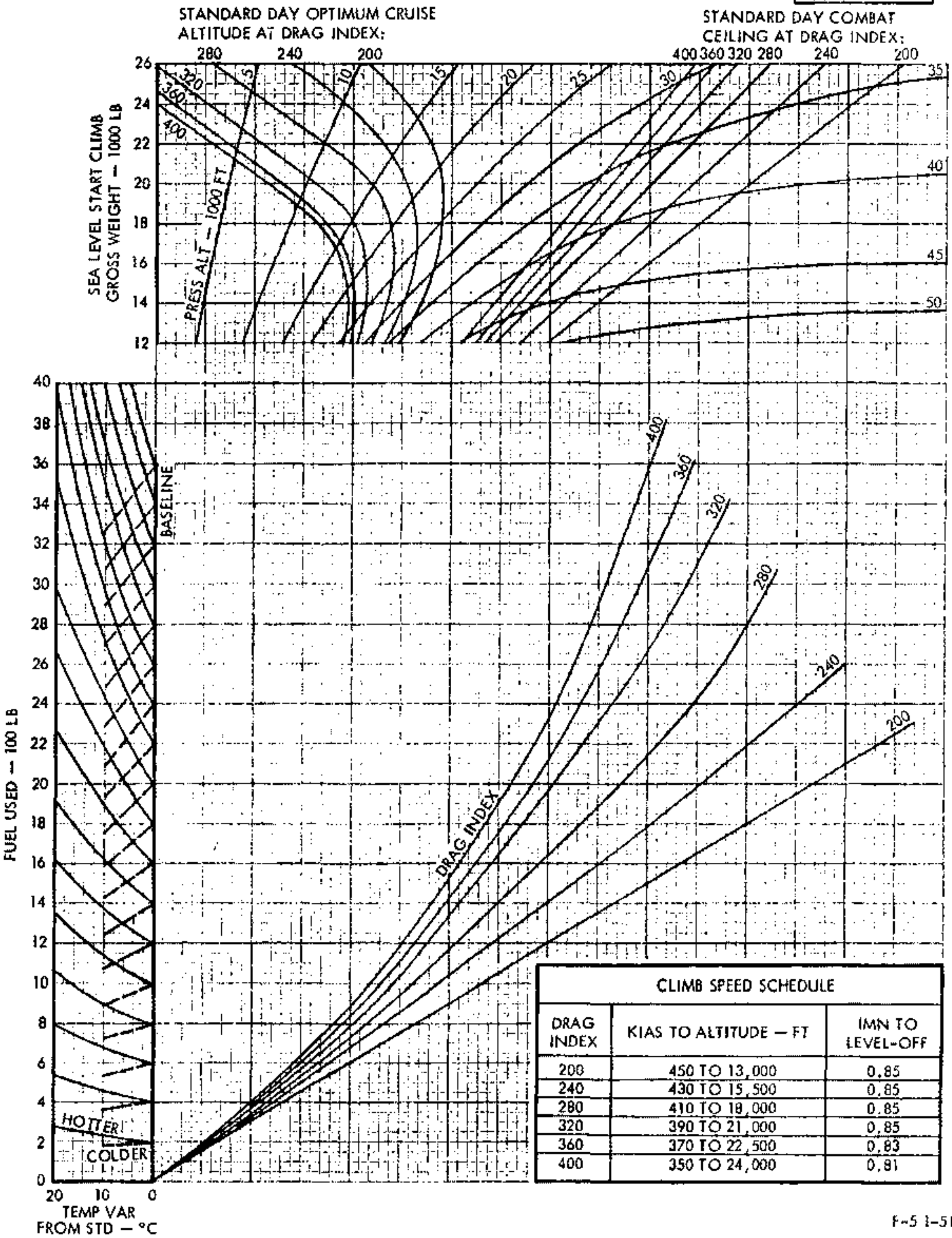
ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

MAXIMUM THRUST CLIMB (FLAPS UP)

FUEL USED

DRAG INDEX 200 TO 400





CLIMB SPEED SCHEDULE		
DRAG INDEX	KIAS TO ALTITUDE — FT	IMN TO LEVEL-OFF
200	450 TO 13,000	0.85
240	430 TO 15,500	0.85
280	410 TO 18,000	0.85
320	390 TO 21,000	0.85
360	370 TO 22,500	0.83
400	350 TO 24,000	0.81

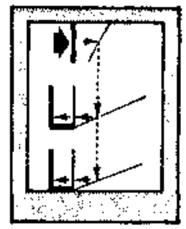
FA3-3 (Sheet 1).

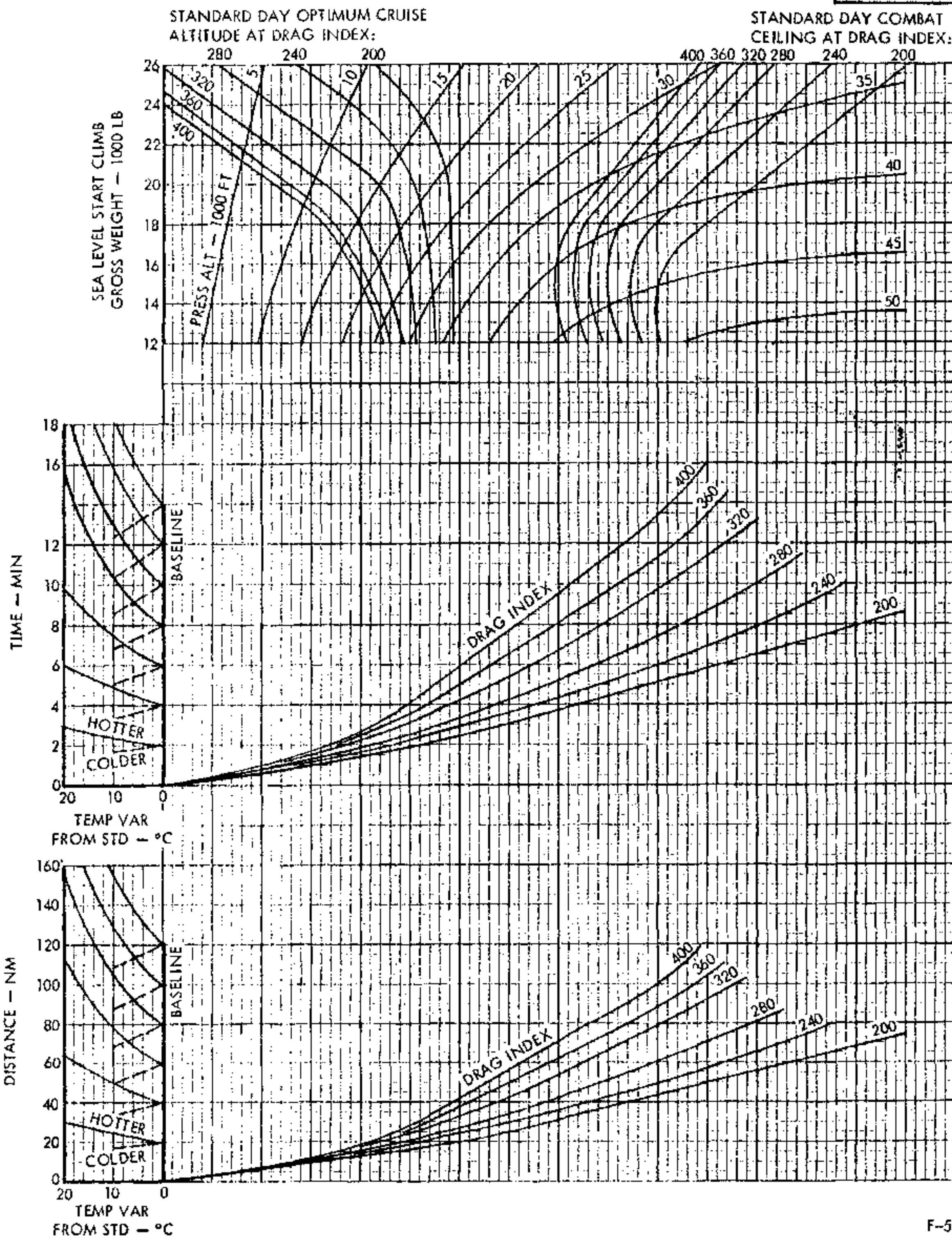
MODEL: F-5E/F
DATE: 1 MARCH 1976
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

MAXIMUM THRUST CLIMB (FLAPS UP)

TIME TO CLIMB AND DISTANCE TRAVELED
DRAG INDEX 200 TO 400





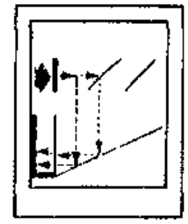
FA3-3 (Sheet 2).

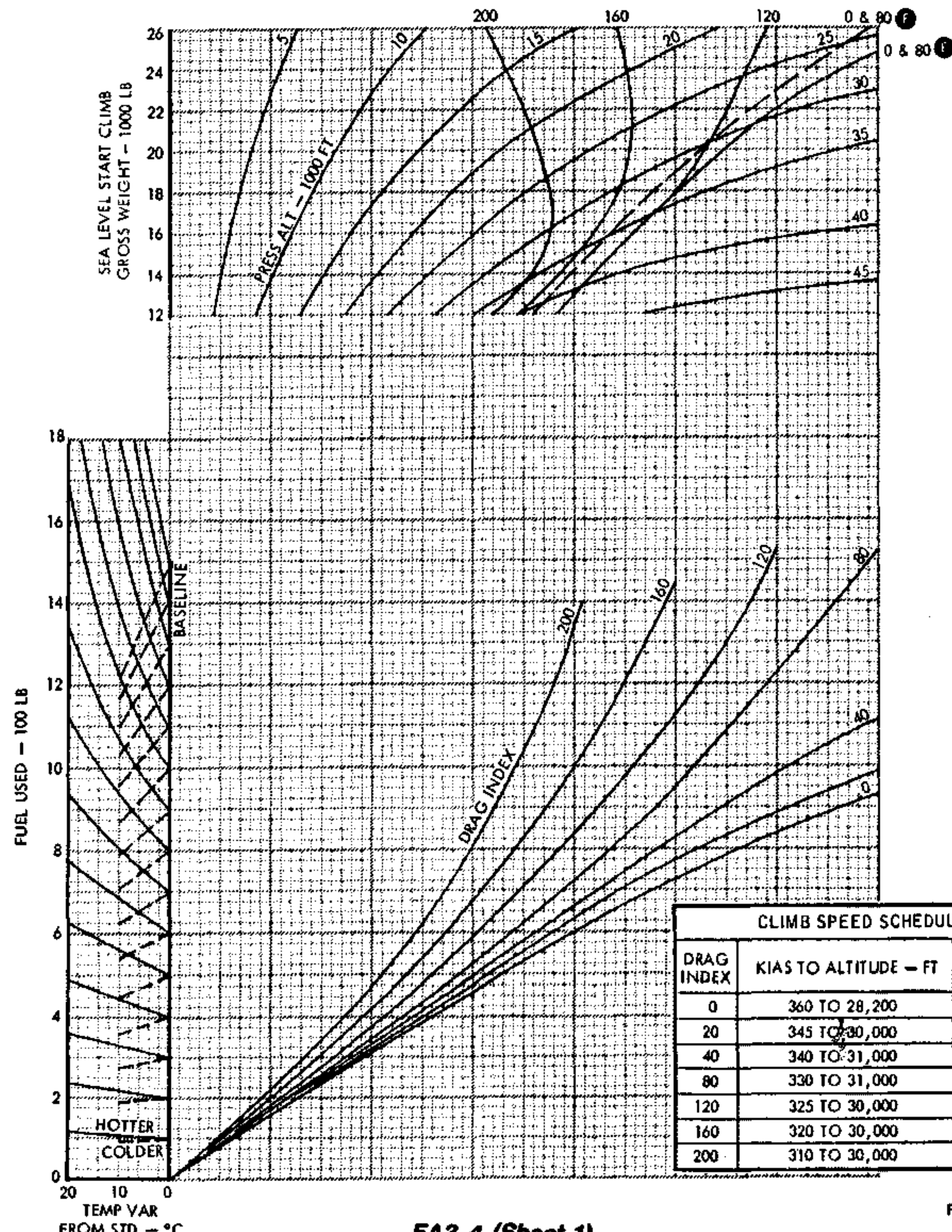
MODEL: F-5E/F
DATE: 1 MARCH 1978
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

MILITARY THRUST CLIMB (FLAPS UP)

FUEL USED
DRAG INDEX 0 TO 200





CLIMB SPEED SCHEDULE		
DRAG INDEX	KIAS TO ALTITUDE – FT	IMN TO LEVEL-OFF
0	360 TO 28,200	0.90
20	345 TO 30,000	0.90
40	340 TO 31,000	0.90
80	330 TO 31,000	0.88
120	325 TO 30,000	0.85
160	320 TO 30,000	0.83
200	310 TO 30,000	0.82

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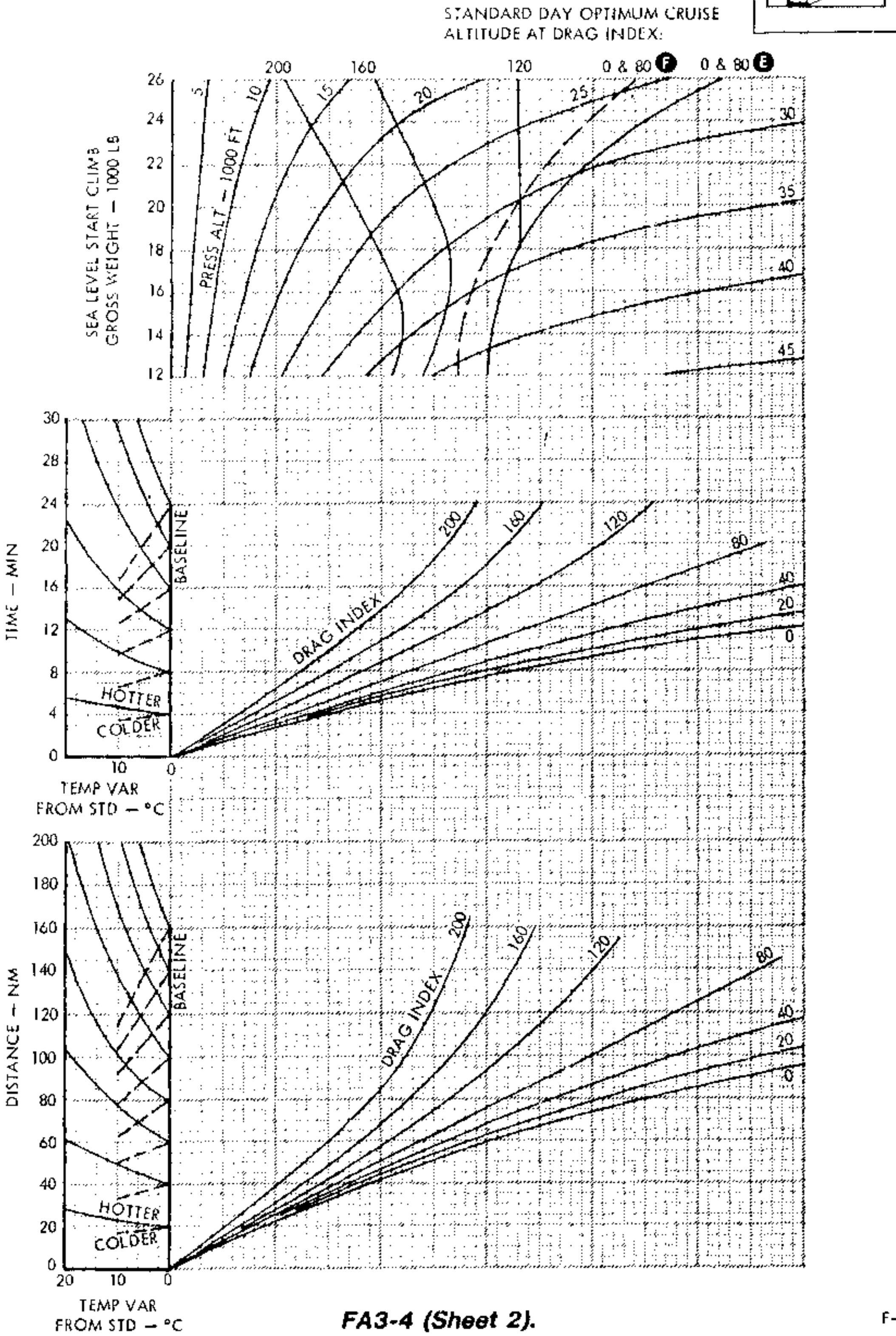
FA3-4 (Sheet 1).

MODEL: F-5E/F
DATE: 1 MARCH 1978
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

MILITARY THRUST CLIMB (FLAPS UP)

TIME TO CLIMB AND DISTANCE TRAVELED
DRAG INDEX 0 TO 200



FA3-4 (Sheet 2).

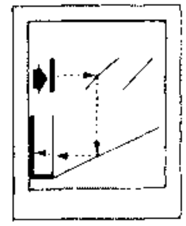
F-5 1-523(20)

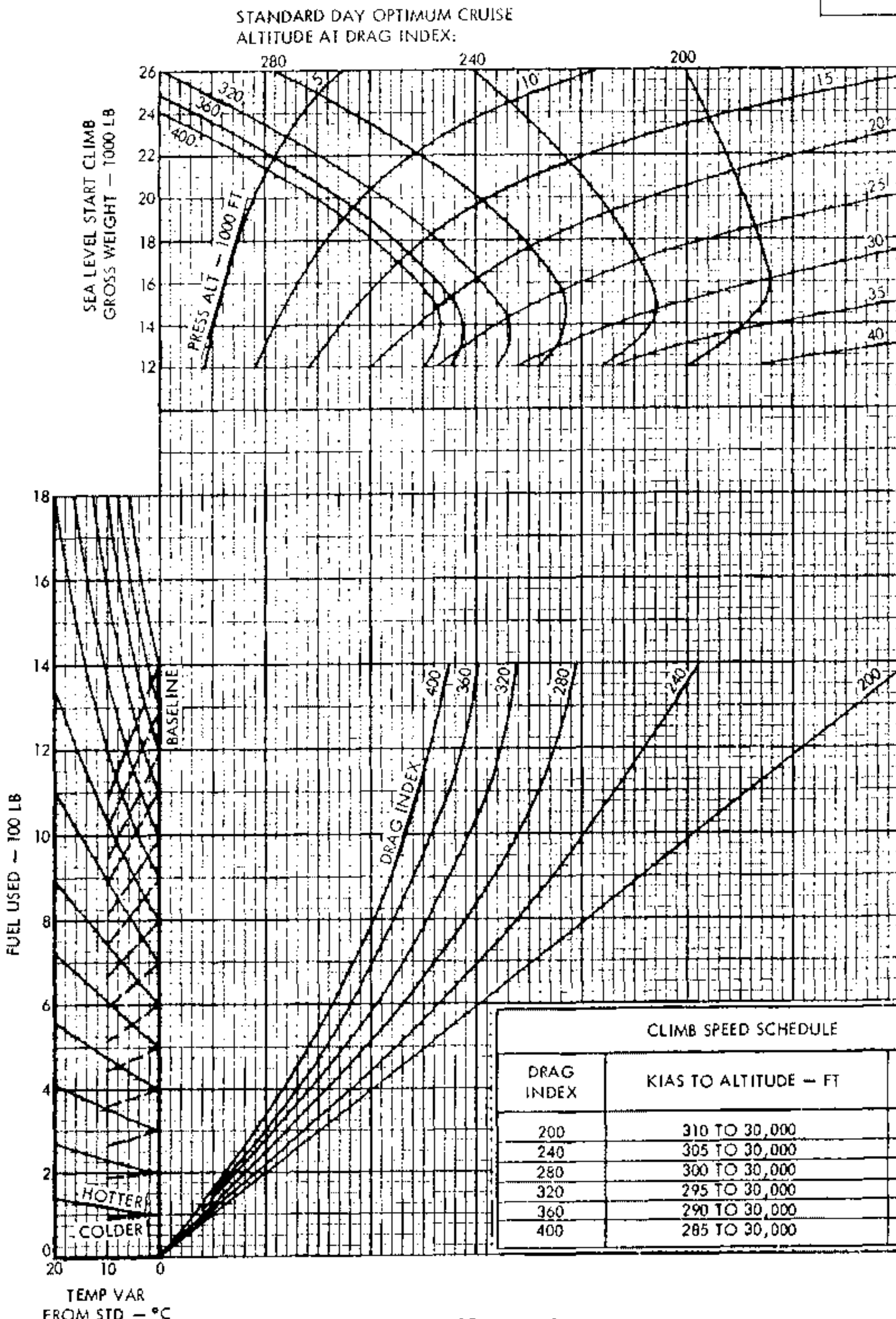
MODEL: F-5E/F
DATE: 1 MARCH 1976
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

MILITARY THRUST CLIMB (FLAPS UP)

FUEL USED
DRAG INDEX 200 TO 400





CLIMB SPEED SCHEDULE		
DRAG INDEX	KIAS TO ALTITUDE — FT	IMN TO LEVEL OFF
200	310 TO 30,000	0.82
240	305 TO 30,000	0.81
280	300 TO 30,000	0.79
320	295 TO 30,000	0.78
360	290 TO 30,000	0.77
400	285 TO 30,000	0.76

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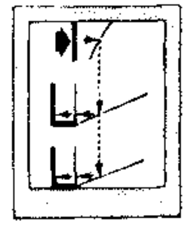
FA3-5 (Sheet 1).

MODEL: F-5E/F
DATE: 1 AUGUST 1976
DATA BASIS: **FLIGHT TEST**

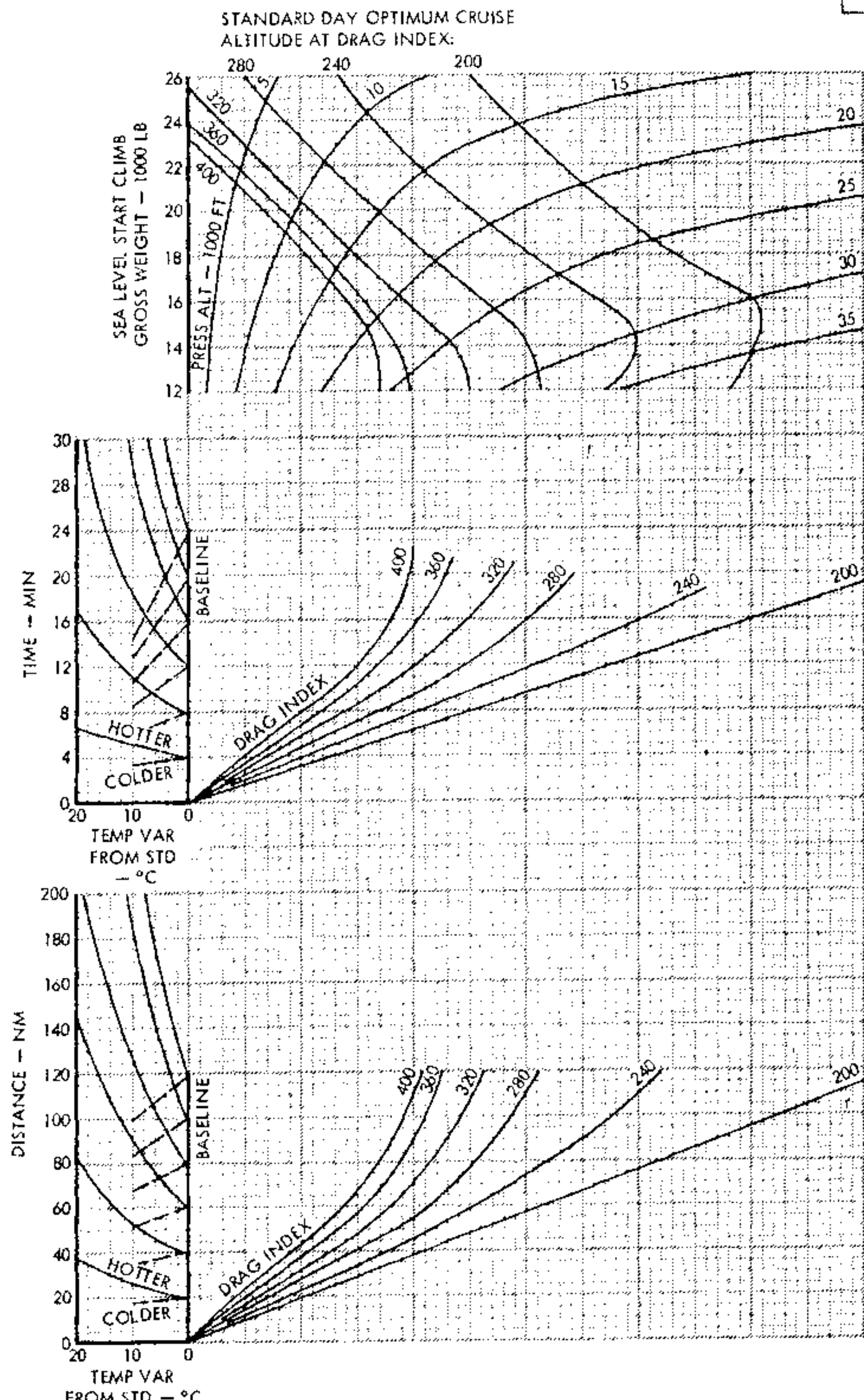
ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

MILITARY THRUST CLIMB (FLAPS UP)



TIME TO CLIMB AND DISTANCE TRAVELED

DRAG INDEX 200 TO 400



F-5 1-525(20)

FA3-5 (Sheet 2).

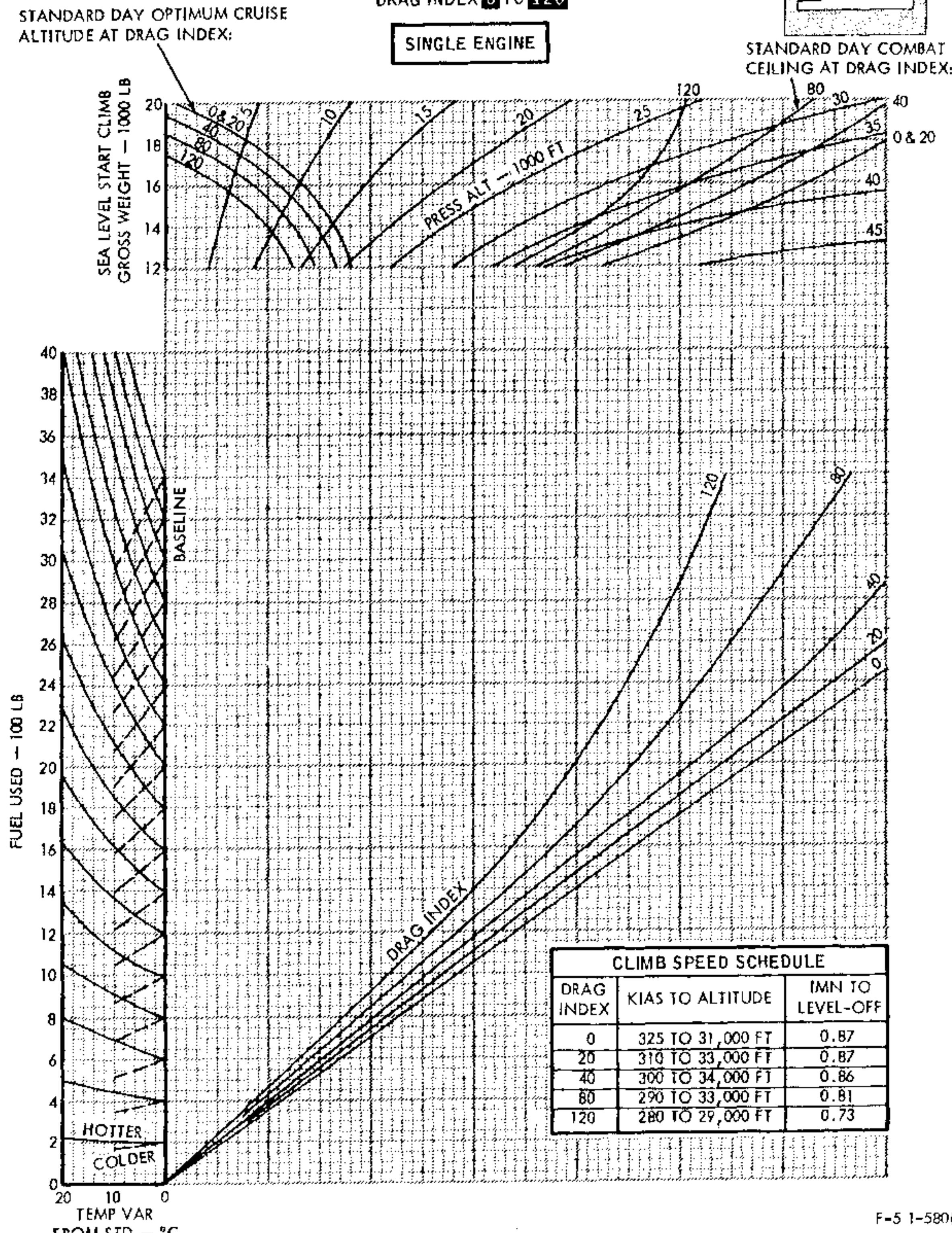
MODEL: F-5E/F
DATE: 1 AUGUST 1976
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

MAXIMUM THRUST CLIMB (FLAPS UP)

FUEL USED
DRAG INDEX 0 TO 120

SINGLE ENGINE



CLIMB SPEED SCHEDULE		
DRAG INDEX	KIAS TO ALTITUDE	IMN TO LEVEL-OFF
0	325 TO 31,000 FT	0.87
20	310 TO 33,000 FT	0.87
40	300 TO 34,000 FT	0.86
80	290 TO 33,000 FT	0.81
120	280 TO 29,000 FT	0.73

F-5 1-580(20)

FA3-6 (Sheet 1).

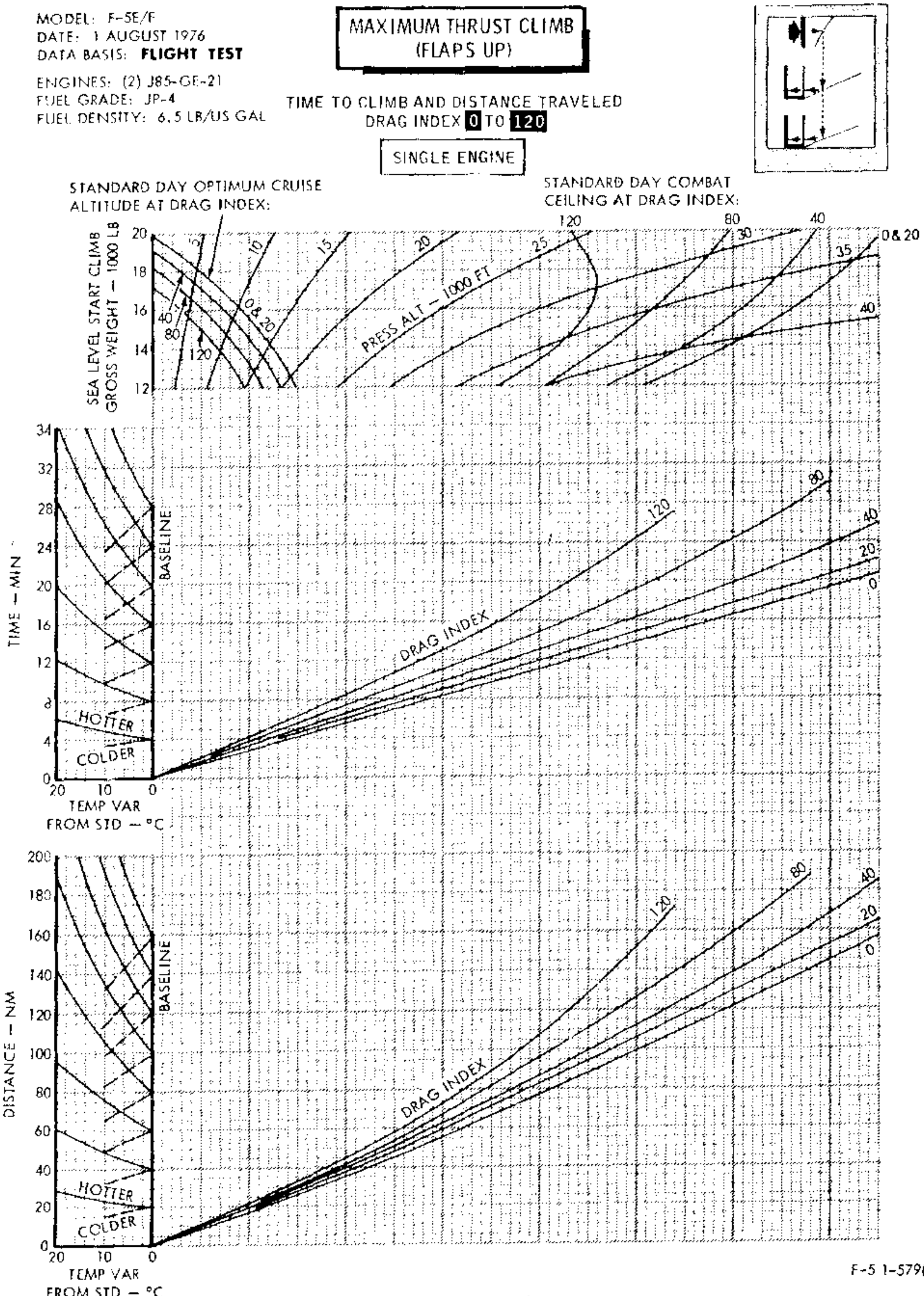
MODEL: F-5E/F
DATE: 1 AUGUST 1976
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

MAXIMUM THRUST CLIMB (FLAPS UP)

TIME TO CLIMB AND DISTANCE TRAVELED
DRAG INDEX 0 TO 120

SINGLE ENGINE



F-5 1-579(20)

FA3-6 (Sheet 2).

MODEL: F-5E/F
DATE: 1 MAY 1981
DATA BASIS: **FLIGHT TEST**

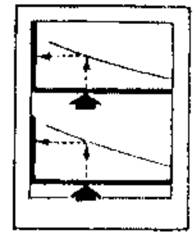
ENGINES: (2)J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

COMBAT CEILING

STANDARD DAY

FLAPS UP

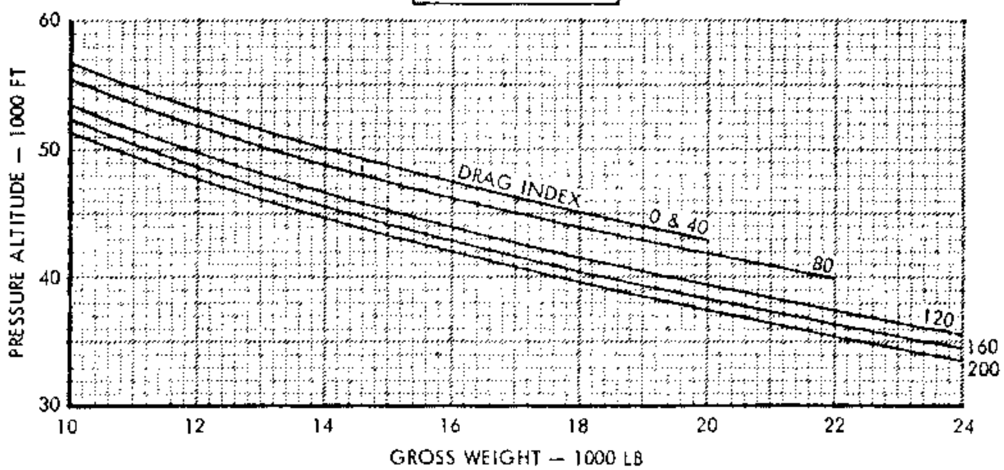
DRAG INDEX 0 TO 200



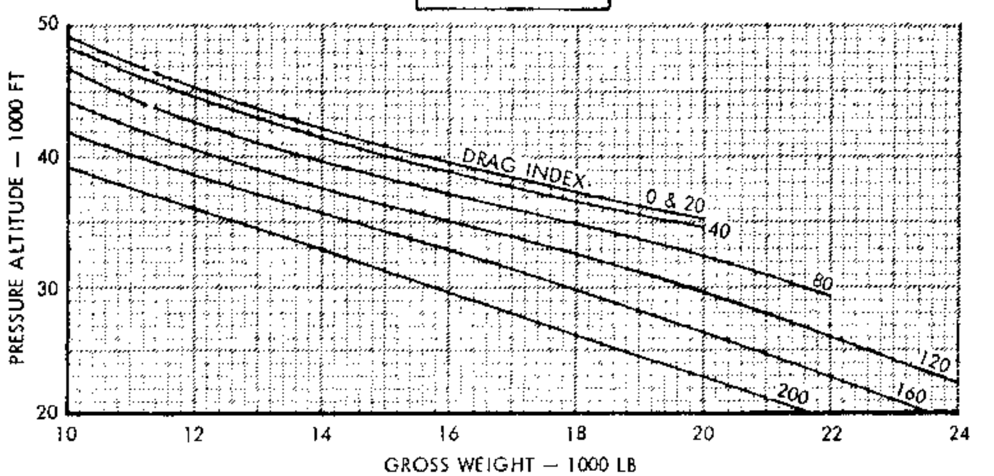
Note

TO INCREASE CEILING BY 500 FT, USE CRUISE/FIXED FLAPS AND REDUCE CLIMB SPEED 0.03 MACH.

MAXIMUM THRUST

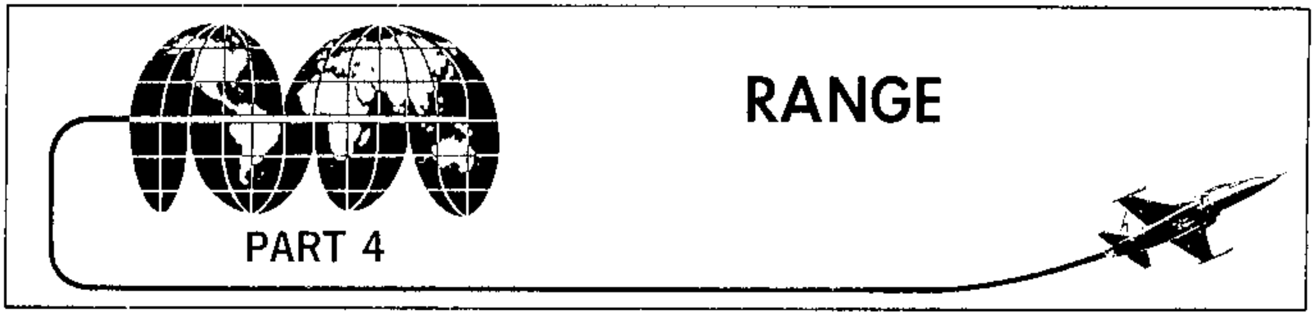


MILITARY THRUST



F-5 1-519(20)A

FA3-7.



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Page numbers underlined denote charts.

RANGE CHARTS (GENERAL)

The range charts determine the optimum conditions for aircraft operation during cruise in order to obtain the maximum distance per pound of fuel, or conversely, to determine the feasibility of operation under a given set of conditions.

OPTIMUM CRUISE ALTITUDE FOR SHORT RANGE MISSIONS

For a short range mission, the cruise altitude may optimize at a lower altitude than is required for a long range mission. The Optimum Cruise Altitude for Short Range Missions chart (FA4-1) presents the cruise altitude for short range missions as a function of climb-plus-cruise-plus-descent distance. The cruise altitude optimizes slightly higher than shown if a maximum range descent on course is used, and slightly lower if the descent is made over the destination. If the intersection of the drag index and mission range distance plot falls outside the dashed Use Optimum Cruise Altitude line, obtain optimum cruise altitude from FA4-2 or FA4-3, as appropriate.

USE

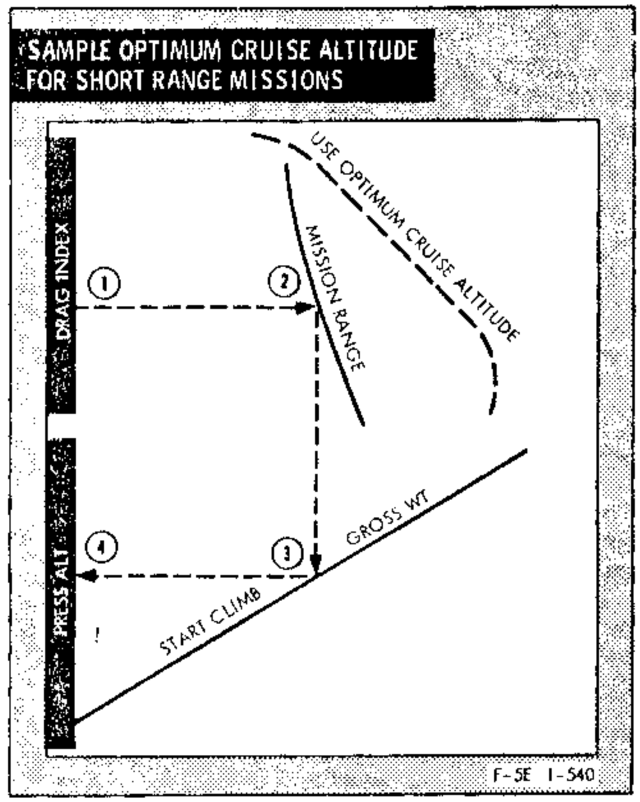
Enter chart with drag index and proceed right to the desired mission range distance, then down to the start climb gross weight. From this point, proceed left to read pressure altitude for cruise.

SAMPLE PROBLEM

Given:
A. Configuration drag index: 120.
B. Mission range distance: 100 nm.
C. Start climb gross weight: 19,980 lb.

Calculate:
A. Optimum cruise altitude.
B. Use Optimum Cruise Altitude for Short Range Missions chart FA4-1.

①	Drag Index	120
②	Mission Range	100 nm
③	Start Climb Gross Wt	19,980 lb
④	Pressure Alt	17,000 ft



OPTIMUM CRUISE ALTITUDE CHARTS

The Optimum Cruise Altitude charts for standard and nonstandard day (+10°C and +20°C) for two-engine operation are presented in FA4-2 and FA4-3, respectively. Similar charts for single-engine operation are presented in FA4-4 and FA4-5. These charts provide the optimum cruise altitudes for maximum range cruise as a function of the gross weight at altitude and the drag index.

USE

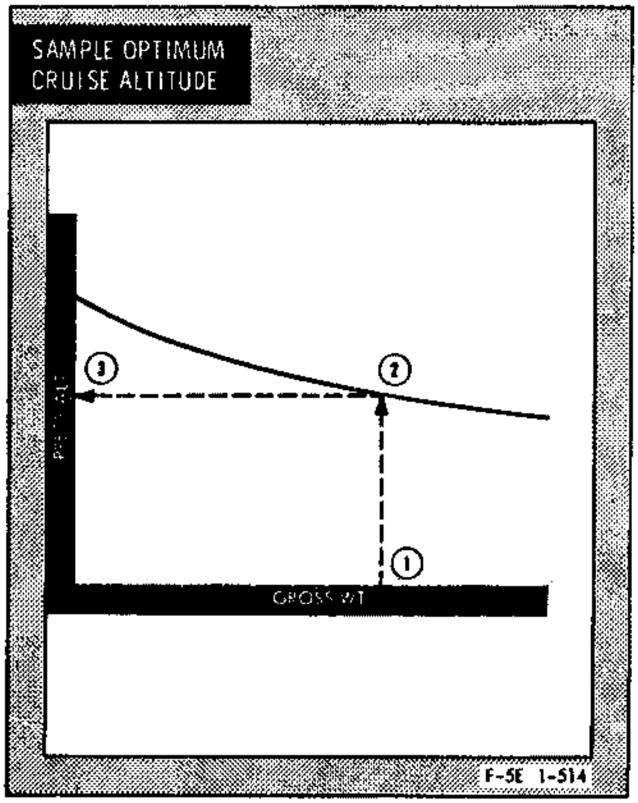
Enter the appropriate chart with gross weight and proceed up to the drag index, then left and read the optimum cruise pressure altitude.

SAMPLE PROBLEM

Given:
A. Gross weight at altitude: 18,755 lb.
B. Drag index: 120

C. Two-engine operation.
D. Standard day

Calculate:
A. Optimum cruise altitude.
B. Use Optimum Cruise Altitude chart FA4-2.
   ① Gross Wt 18,755 lb
   ② Drag Index 120
   ③ Press Alt 30,250 ft



CONSTANT ALTITUDE CRUISE CHARTS

The Constant Altitude Cruise charts for two-engine operation (FA4-6, sheets 1 and 2) and for single-engine operation (FA4-7, sheets 1 and 2) provide cruise data based on long range cruise mach number. Long range cruise mach number is that speed faster than maximum range cruise mach number which provides 99% of the maximum cruise range. Flaps are up for cruise.

Sheet 1 provides optimum indicated cruise mach number as a function of average gross weight, pressure altitude, and drag index. The remainder of the chart is an aid in obtaining values of true airspeed or groundspeed and time as a function of the indicated mach number, temperature, and ground distance. Sheet 2 provides specific range (nautical miles-per-pound of fuel) as a function of average gross weight, pressure altitude, and drag index. Fuel flow and fuel required may be obtained from the remainder of the chart as a function of specific range, true airspeed, and time. The values of true airspeed and time are obtained from sheet 1.

The Constant Altitude Cruise charts should be used for mission planning when optimum range capability is desired, and the Nautical Miles Per Pound of Fuel charts (FA4-8 and FA4-9) should be used when other than optimum cruise mach numbers are required.

USE

Enter sheet 1 with average gross weight, proceed right to cruise pressure altitude, down to drag index, then left and read optimum indicated mach number. At this value of mach number, proceed right to the temperature baseline, and parallel the nearest guideline to the temperature applicable to the cruise altitude. Continue right from this point to the zero wind line, and at this position read the true airspeed on the scale at the bottom of the chart. Correct the airspeed to groundspeed by moving left (for headwind) or right (for tailwind) by the amount of the wind, and read the ground speed on the same scale at the bottom of the chart. Move up at the correct value of groundspeed to the ground distance curve applicable to cruise (interpolate, if necessary), then left and read time to cruise.

Enter sheet 2 with average gross weight, move right to cruise altitude and down to drag index. Move left and read nautical miles-per-pound of fuel (specific range). At this value of specific range, proceed right to the true airspeed curve (interpolate, if necessary), then proceed up, noting the values of fuel flow, and continue up to the time required for cruise obtained from sheet 1. From this point, move left and read fuel required.

ALTERNATE USE

A. If fuel available for cruise is known, rather than cruise distance, time has to be obtained from sheet 2 and used in sheet 1 to obtain the distance.

Thus:

1. Enter sheet 1 as previously described and proceed to obtain true airspeed (zero wind).
2. Enter sheet 2 as previously described and chase-thru to obtain fuel flow point of intersection, which is the extension of the vertical upward line from the true airspeed point of intersection. Project a horizontal line from the fuel required scale (fuel available), and project a vertical line from the fuel flow point of intersection. Where the two projected lines intersect, read time in minutes.
3. Reenter sheet 1 at the true airspeed point of intersection previously plotted, and move left or right to the appropriate headwind or tailwind value. Note groundspeed, and project a vertical line upward thru the ground distance curves. Also project a line horizontally right from the time value found in sheet 2, and at the intersection of these two lines read ground distance.

B. Distance can also be computed, rather than read from sheet 1, if the specific range (nautical miles-per-pound of fuel) obtained in sheet 2 is multiplied by the fuel available for cruise.

NOTE

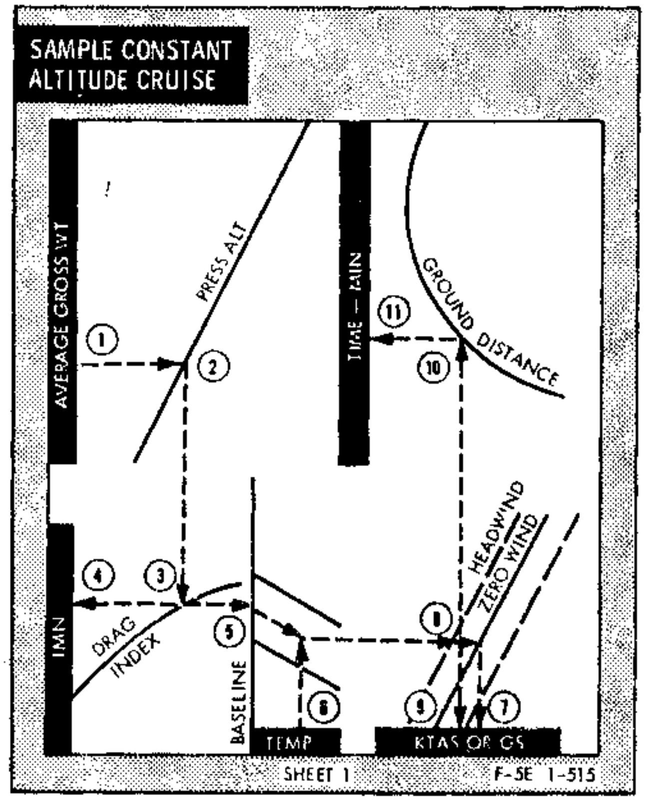
Computation results in air distance. Obtain ground distance by correcting for headwind or tailwind.

C. When the average gross weight is not known initially, it may be necessary to run thru the charts once to obtain a value of cruise fuel based on the start cruise weight and then reread the charts using the start cruise weight reduced by half of the fuel found for cruise.

SAMPLE PROBLEM

Given:

A. Gross weight (average): 17,755 lb.
B. Cruise pressure altitude: 32,000 ft.
C. Drag index: 120
D. Temperature (at altitude): -48.4°C.
E. Headwind: 25 kt.
F. Ground distance: 300 nm.



Calculate:

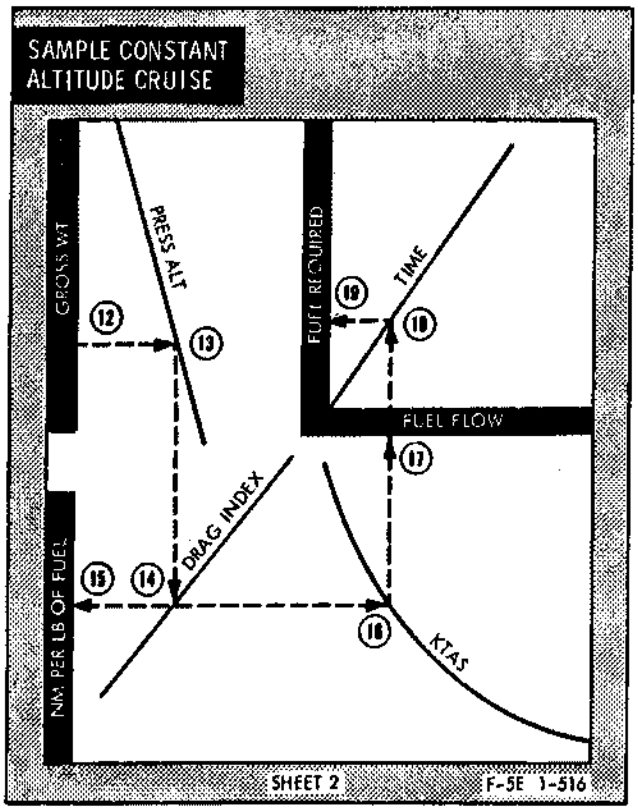
A. Indicated mach number, true airspeed, ground speed, time, specific range, fuel flow, and fuel required.
B. Use Constant Altitude Cruise chart FA4-6, sheet 1.

①	Gross Wt (avg)	17,755 lb
②	Press Alt	32,000 ft
③	Drag Index	120
④	IMN	0.86
⑤	Baseline	—
⑥	Temp (std day)	-48.4°C
⑦	True Airspeed (zero wind)	510 KTAS

(8)	Headwind	25 kt
(9)	Groundspeed	485 kt
(10)	Ground Distance	300 nm
(11)	Time	37 min

C. Use Constant Altitude Cruise Chart FA4-6, sheet 2.

(12)	Gross Wt (avg)	17,755 lb
(13)	Press Alt	32,000 ft
(14)	Drag Index	120
(15)	NM/LB of Fue (specific range)	0.15
(16)	True Airspeed	510 KTAS
(17)	Fuel Flow	3400 pph
(18)	Time	37 min
(19)	Fuel Required	2100 lb



NAUTICAL MILES PER POUND OF FUEL CHARTS (GENERAL)

The Nautical Miles Per Pound of Fuel charts provide cruise data throughout the speed range from approximately maximum endurance to 0.95 mach. Charts are provided for two-engine and single-engine operation. These charts are used when the cruise mach number is other than optimum long range speed.

The Nautical Miles Per Pound of Fuel charts for two-engine operation consist of three charts (FA4-8 sheets 1 thru 3). Sheet 1 is used to obtain a reference number which, when used in sheet 2, provides specific range for the particular conditions of the flight. In sheet 3, cruise mach number and temperature define true airspeed which, when combined with specific range, provides fuel flow per engine. The single-engine charts (FA4-9 sheets 1 thru 3) are identical in format and are used in the same manner as the two-engine charts.

USE

Enter sheet 1 with the average cruise gross weight, right to the pressure altitude, and then down thru the indicated mach number scale directly to the baseline. From this point of intersection with the baseline, contour the guideline either to the left or to the right to the desired cruise indicated mach number projected down from the indicated mach number scale. At this point of intersection, proceed right with a projected line thru the reference number grid plot. Enter the upper right portion of the chart with indicated mach number and move right to the appropriate drag index, then proceed down to intersect the horizontal projection which was plotted previously thru the reference number grid. At this intersection, read the value of reference number for use with sheet 2.

Enter sheet 2 with the indicated mach number and proceed right to the reference number curve for the reference number value obtained in sheet 1; (interpolate, if necessary). From this intersection move up to the pressure altitude and then right and read nautical miles-per-pound. Enter sheet 3 with the nautical miles-per-pound and project a line to the right. Next, enter with indicated mach number and proceed right to the temperature curve applicable to the cruise pressure altitude. From this point, project up to the horizontal line previously projected, and read fuel flow per engine. True airspeed, if desired, can be read at the intersection of the vertical with the KTAS scale. A reference table is provided on the chart for temperature vs pressure altitude based on a standard day.

SAMPLE PROBLEM

Given:
A. Gross weight (average): 17,775 lb
B. Desired cruise mach number: 0.9 IMN.
C. Drag index: 120
D. Cruise pressure altitude: 32,000 ft.
E. Temperature (at altitude): -48.4°C.

Calculate:
A. Reference number, nautical miles-per-pound of fuel, fuel flow, and true airspeed.
B. Use Nautical Miles Per Pound of Fuel, Indicated Mach Number and Reference Number chart FA4-8, sheet 1.

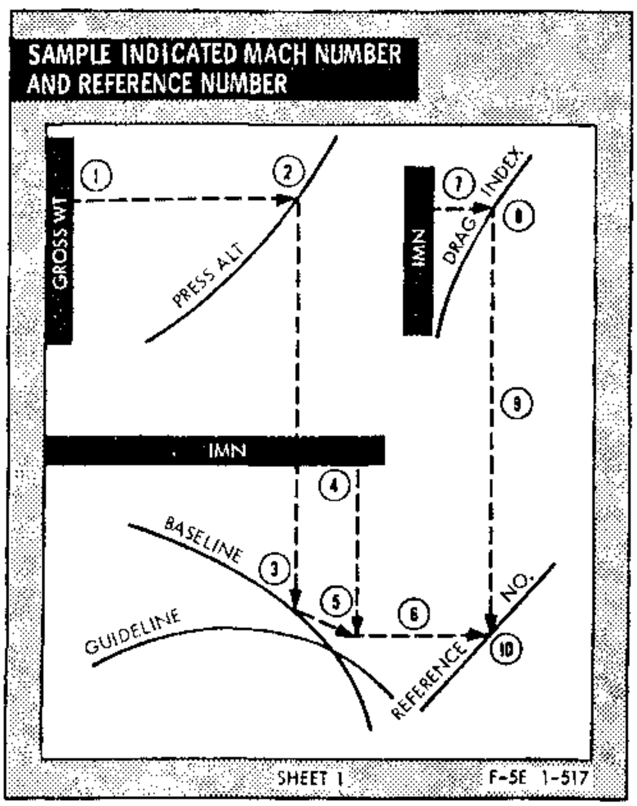
①	Gross Wt (avg)	17,755 lb
②	Press Alt	32,000 ft
③	Baseline	—
④	IMN (desired cruise)	0.9
⑤	Intersect Guideline Contour	—
⑥	Projected Line (thru reference number grid)	—
⑦	IMN	0.9
⑧	Drag Index	120
⑨	Projected Line (thru reference number grid)	—
⑩	Reference number	9.2

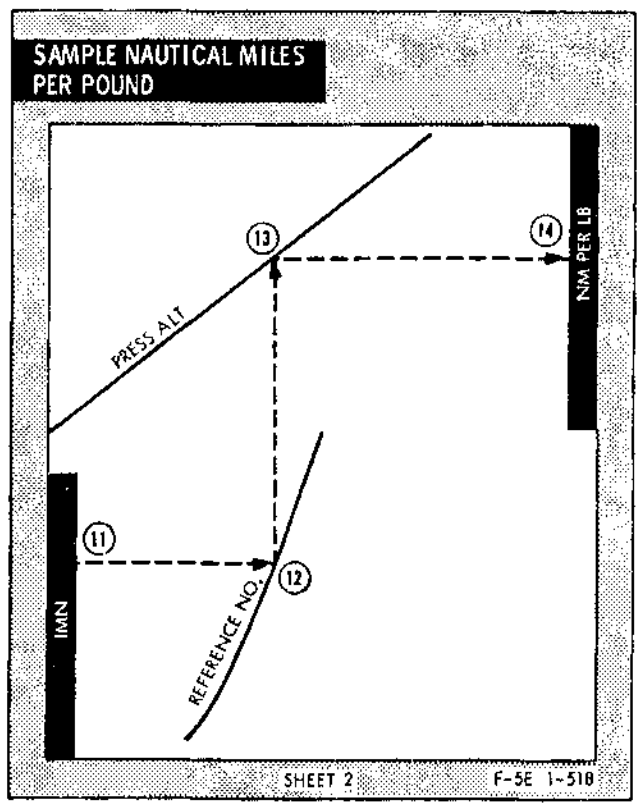
C. Use Nautical Miles Per Pound of Fuel, Nautical Miles Per Pound chart FA4-8, sheet 2.

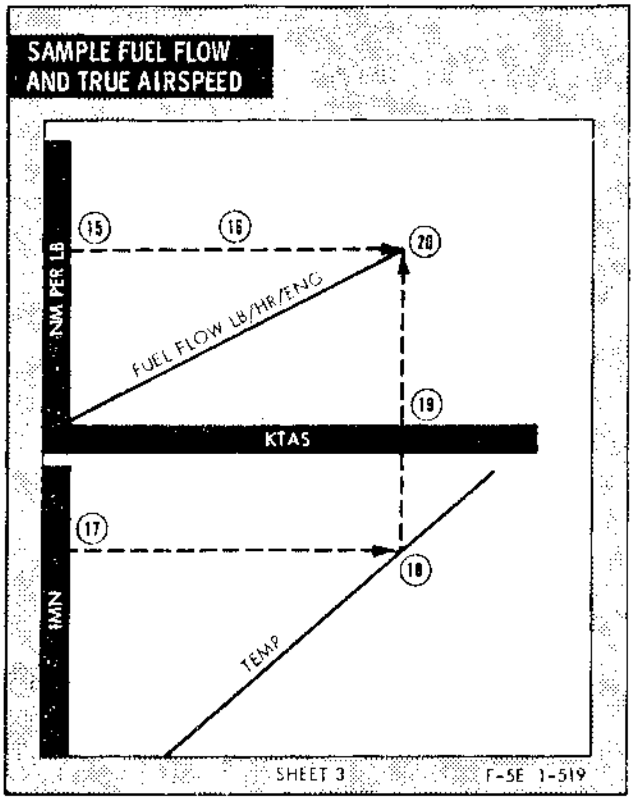
⑪	IMN	0.9
⑫	Reference number	9.2
⑬	Press Alt	32,000 ft
⑭	NM/LB (of fuel)	0.15

D. Use Nautical Miles Per Pound of Fuel, Fuel Flow and True Airspeed chart, FA4-8, sheet 3.

⑮	NM/LB (of fuel)	0.15
⑯	Projected Line (thru fuel flow grid)	—
⑰	IMN	0.9
⑱	Temp (std day)	-48.4°C
⑲	True Airspeed	525 KTAS
⑳	Fuel Flow (per engine)	1780 pph







DIVERSION RANGE CHARTS

Diversion range charts for two-engine and single-engine operation are presented as flight profile type charts in figure FA4-10, sheets 1 thru 6. The charts for single-engine operation provide for cruise without and with partial AB power. Partial AB profile provides a higher cruise altitude and should be used if required for terrain clearance. Each diversion range chart provides the maximum range obtainable for two optional return profiles with from 600 to 1400 pounds of available fuel remaining. The range pertains to an aircraft with AIM-9 missiles and five pylons and is based on having 300 pounds of fuel remaining for approach and landing after descent is completed. A climb speed schedule and recommended long range cruise indicated mach number are tabulated on each chart. Climb-cruise and descent-cruise guidelines on the charts show the flight path, that provides the maximum range for the return procedure used. Initial points to the right of the climb guidelines require climb to and cruise at optimum altitude.

The two types of diversion range flight profile procedures shown on each chart are:

TWO ENGINE

Profile 1.

a. Climb on course at MIL thrust to optimum altitude. If at optimum altitude, no climb is required.
b. Cruise at optimum altitude to base.
c. Descent after arrival over base: 300 KIAS, 80% RPM, maneuver (E-3 F-2 fixed) flaps, speed brake OUT.

Profile 2.

a. Climb on course at MIL thrust to optimum altitude. If at optimum altitude, no climb is required.
b. Cruise at optimum altitude.
c. Maximum range, descent on course: 270 (Ⓕ 275) KIAS, IDLE RPM, flaps up, speed brake IN.

SINGLE ENGINE (W/O AFTERBURNER)

Profile 1.

a. Descend on course at MIL power at 270 (Ⓕ 275) KIAS to base or optimum cruise altitude. If at optimum altitude, no descent required.
b. Cruise at optimum altitude to base.
c. Descent after arrival over base.

Profile 2.

a. Climb at MIL power to optimum cruise altitude or descend on course at MIL power at 270 (Ⓕ 275) KIAS. If at optimum altitude, no climb or descent required.
b. Cruise at optimum altitude (if required).
c. Maximum range descent on course to base.

NOTE

Maximum range descent at: 270 (Ⓕ 275) KIAS, IDLE rpm, flaps up, and speed brake IN.

SINGLE ENGINE (PARTIAL AFTERBURNER)

Profile 1.

a. Climb at MAX thrust, or descend on course at MIL power to optimum cruise altitude. If at optimum altitude, no climb or descent required.
b. Cruise at optimum altitude to base.
c. Descend after arrival over base.

Profile 2.

a. Climb at MAX thrust or descend on course at MIL power to optimum cruise altitude. If at optimum altitude, no descent required.
b. Cruise at optimum altitude (if required).
c. Maximum range descent on course to base.

NOTE

- Cruise at optimum altitude with modulated afterburner to maintain altitude.
- Maximum range descent at: 270 (Ⓕ 275) KIAS, IDLE rpm, flaps up, and speed brake IN.

USE

If a penetration descent after arrival over base is desired, use profile 1. If there is insufficient fuel for profile 1, then profile 2 may be used to obtain extra range. The chart may be entered at the initial altitude with either the fuel on board (to determine the range available) or with the distance to be flown (to determine the fuel required).

To determine range, enter the appropriate profile chart with initial altitude, move horizontally right to the pounds of fuel remaining curve, and then vertically down to read the air distance. To determine the optimum cruise altitude for two-engine operation, start at this intersection and move up parallel to the nearest climb path guideline to intersect the nearest optimum cruise altitude. To determine optimum cruise altitude for single-engine operation, start at the intersection and move up or down parallel to the nearest guideline to intersect the nearest optimum cruise altitude. Single-engine operation may require either up or down movement, depending upon initial altitude.

NOTE

- Maximum range can be obtained only by climb or descent to optimum altitude.
- If the intersection plot of the initial altitude and fuel remaining curve coincides on the optimum cruise altitude, remain at the altitude for cruise.

Cruise indicated mach number in each chart is given in the column next to the altitude scale. For profile 2, the range at which to begin the maximum range descent to base is determined by reading the air distance at the intersection of the cruise altitude line with the descent line.

To determine the fuel required for a given distance to return to base, enter the chart with initial altitude, and move horizontally right to a point of intersection with the distance to base. At this point, read the fuel required, then proceed parallel to the nearest climb or descent path guideline to determine the optimum cruise altitude.

SAMPLE PROBLEM

Given:

A. Configuration with wingtip missiles, five empty pylons, and two engines operating.
B. Initial altitude: 10,000 ft.
C. Distance to base: 150 nm
D. Fuel remaining: 1150 lb

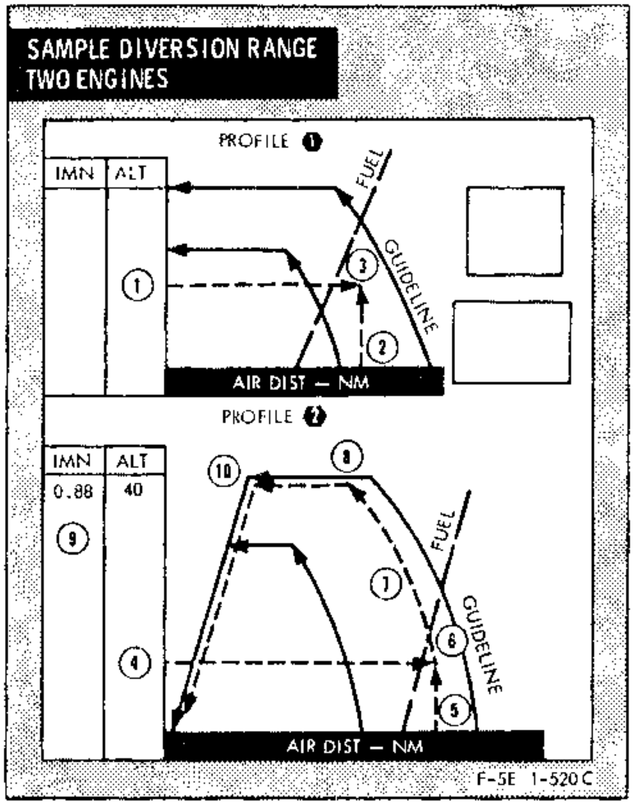
Calculate:

A. Diversion range flight profile.
B. Use Diversion Range chart FA4-10, sheet 1 enter Profile 1.

①	Initial Alt	10,000 ft
②	Dist	150 nm
③	Fuel Required	1330 lb

C. Since fuel required for 150 nm at 10,000 ft is 1330 lb, Profile 1 will not allow a safe return to base.
D. Enter Profile 2 of same chart.

④	Initial Alt	10,000 ft
⑤	Dist	150 nm
⑥	Fuel Required	1100 lb



E. Since fuel required in this profile is 50 lb less than fuel remaining, continue with profile requirements.

⑦	Contour Guideline	—
⑧	Optimum Alt	40,000 ft
⑨	Cruise Airspeed	0.88 IMN
⑩	Start Descent	46 nm

NOTE

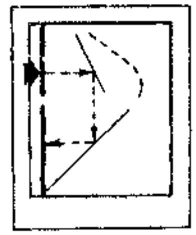
Refer to note and profile instructions on chart for climb and descent; airspeed; power; flap and speed brake position; fuel and distance credit.

MODEL: F-5E/F
DATE: 1 AUGUST 1981
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

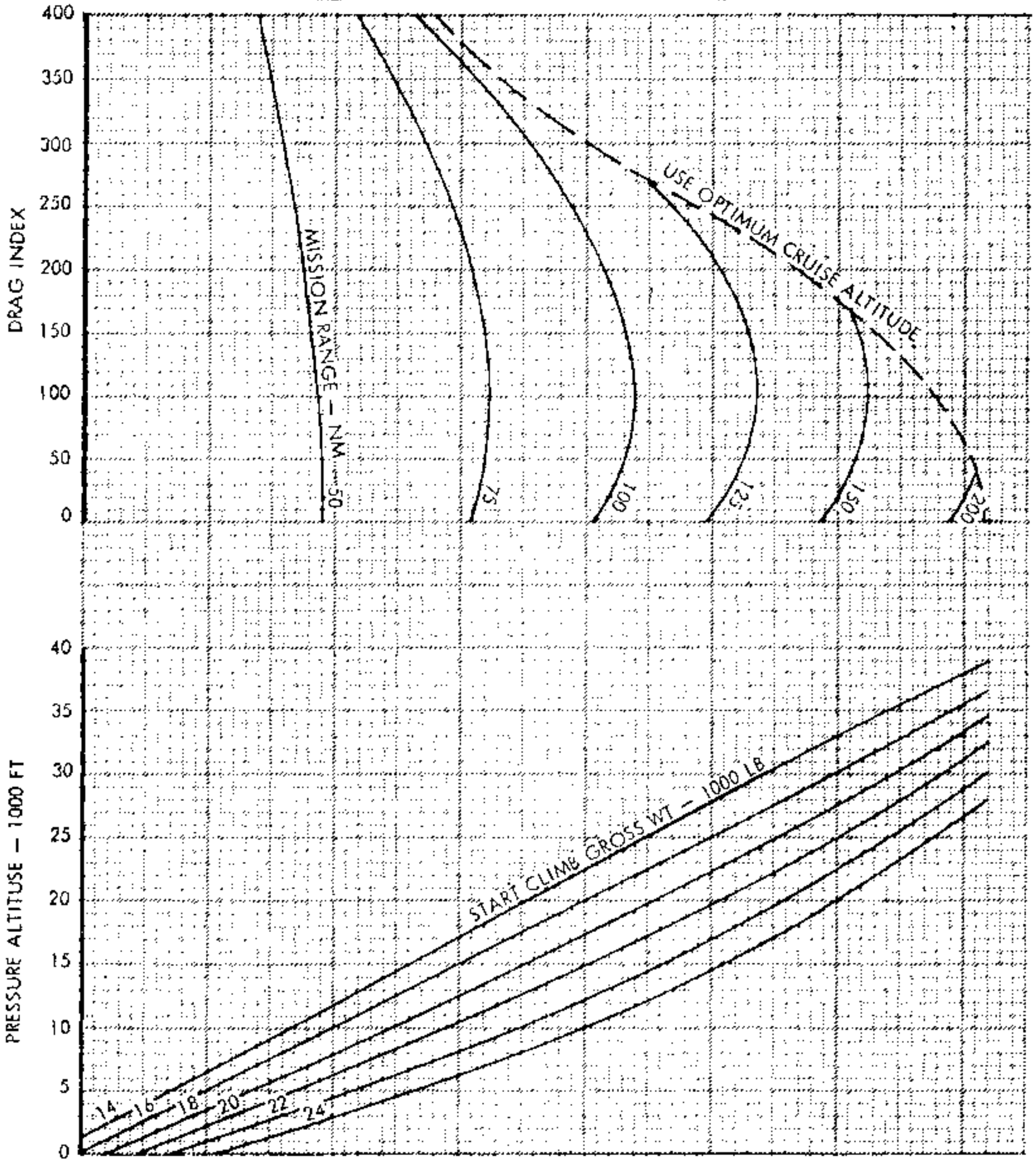
OPTIMUM CRUISE ALTITUDE FOR SHORT-RANGE MISSIONS (FLAPS UP)

STANDARD DAY



CONDITIONS

- MILITARY THRUST CLIMB.
- LONG-RANGE CRUISE IMN.
- PENETRATION DESCENT ON COURSE WITH SPEED BRAKE OUT.



F-5 1-595(20)A

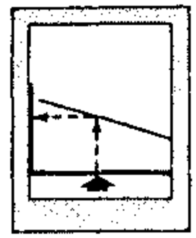
FA4-1.

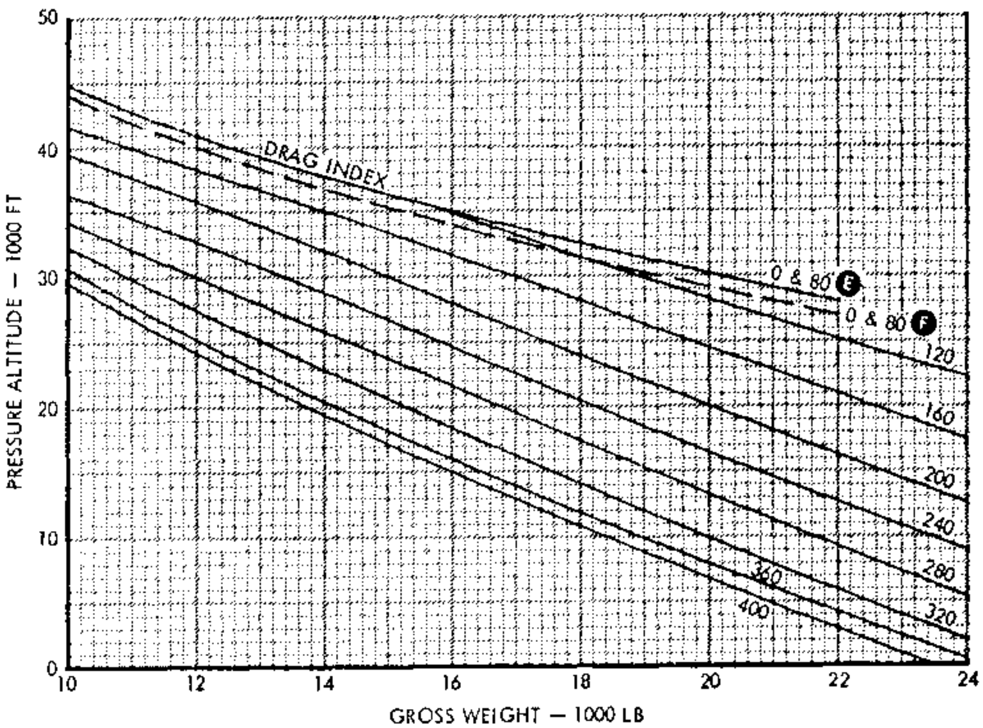
MODEL: F-5E/F
DATE: 1 MARCH 1978
DATA BASIS: **FLIGHT TEST**

ENGINES: (2)J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

OPTIMUM CRUISE ALTITUDE (FLAPS UP)

STANDARD DAY





F-5 1-574(20)

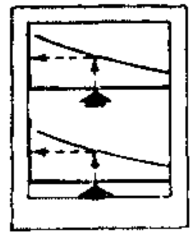
FA4-2.

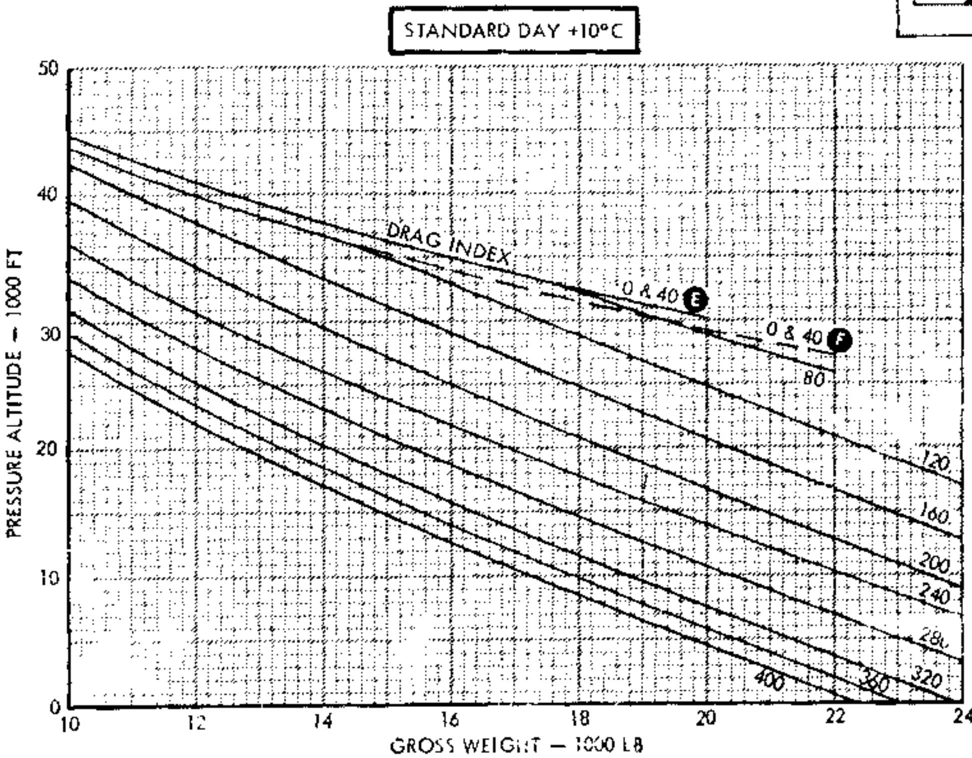
MODEL: F-5E/F
DATE: 1 MARCH 1978
DATA BASIS: **FLIGHT TEST**

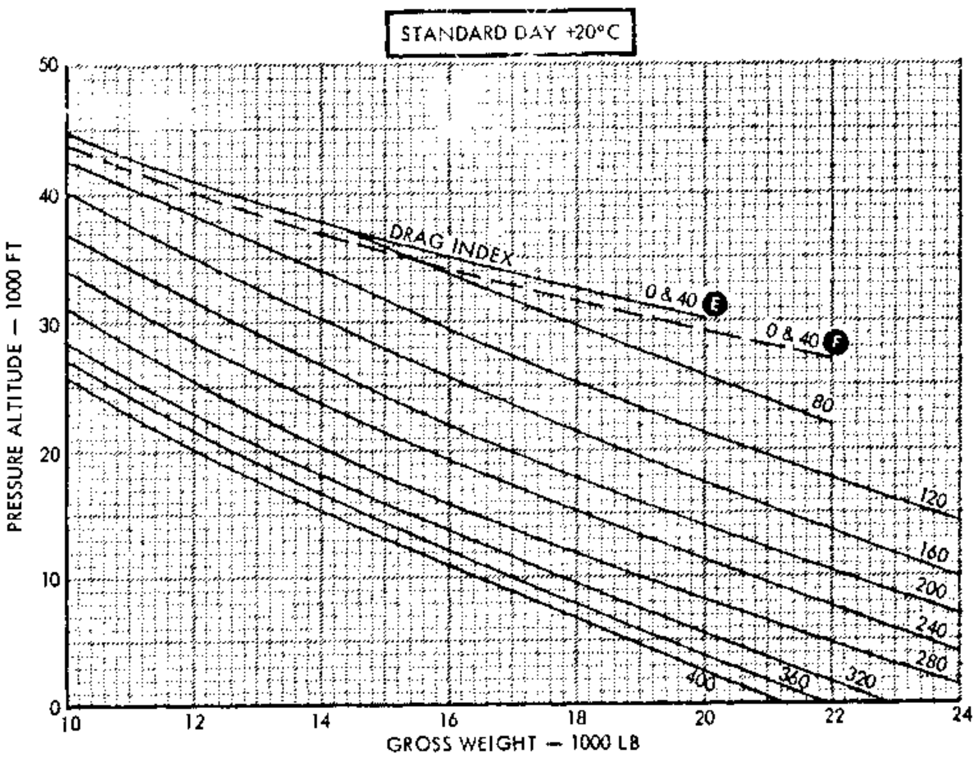
ENGINES: (2)J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

OPTIMUM CRUISE ALTITUDE (FLAPS UP)

NONSTANDARD DAY







F-5 1-596(20)A

FA4-3.

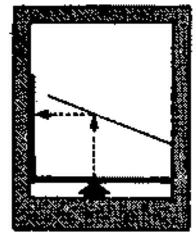
MODEL: F-5E/F
DATE: 1 MARCH 1976
DATA BASIS: **FLIGHT TEST**

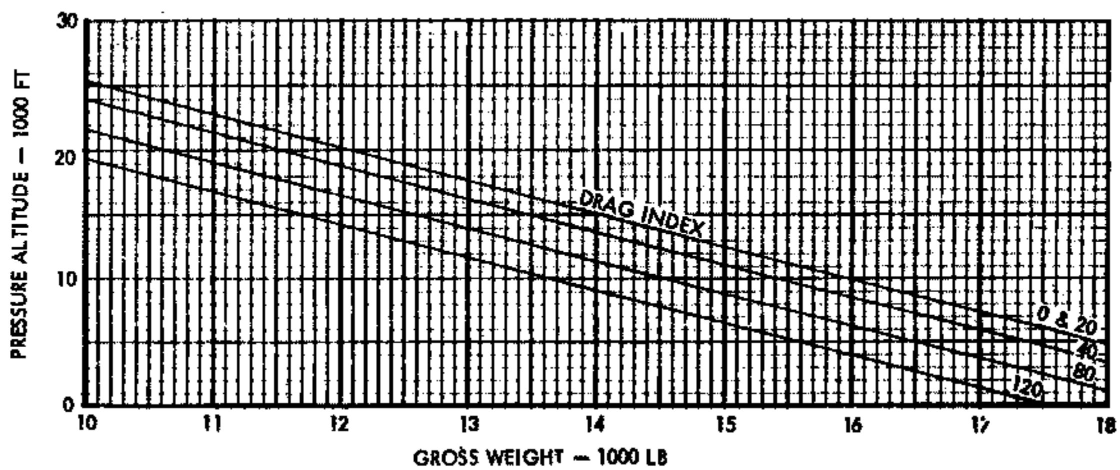
ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

OPTIMUM CRUISE ALTITUDE (FLAPS UP)

STANDARD DAY

SINGLE ENGINE





FA4-4.

F-5 1-575(20)

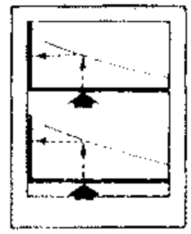
MODEL: F-5E/F
DATE: 1 MARCH 1976
DATA BASIS: **FLIGHT TEST**

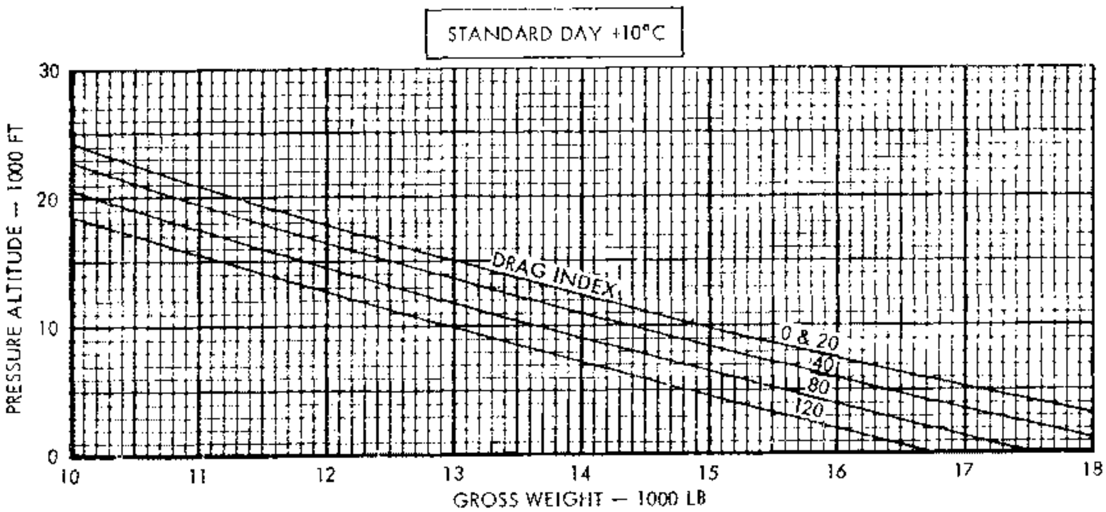
ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

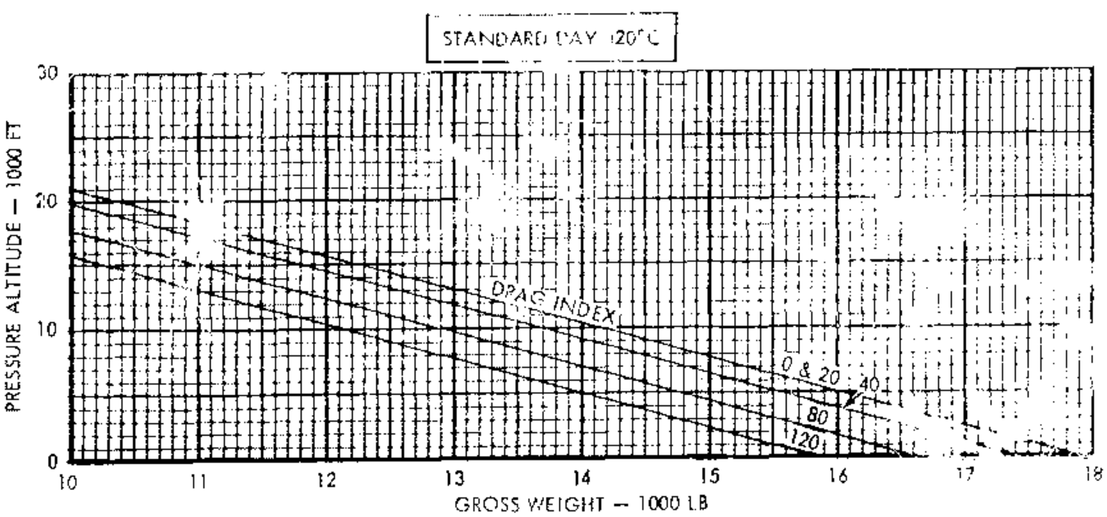
OPTIMUM CRUISE ALTITUDE (FLAPS UP)

NONSTANDARD DAY

SINGLE ENGINE







F-5 1-597(20)

FA4-5.

MODEL: F-5E/F
DATE: 1 MARCH 1976
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

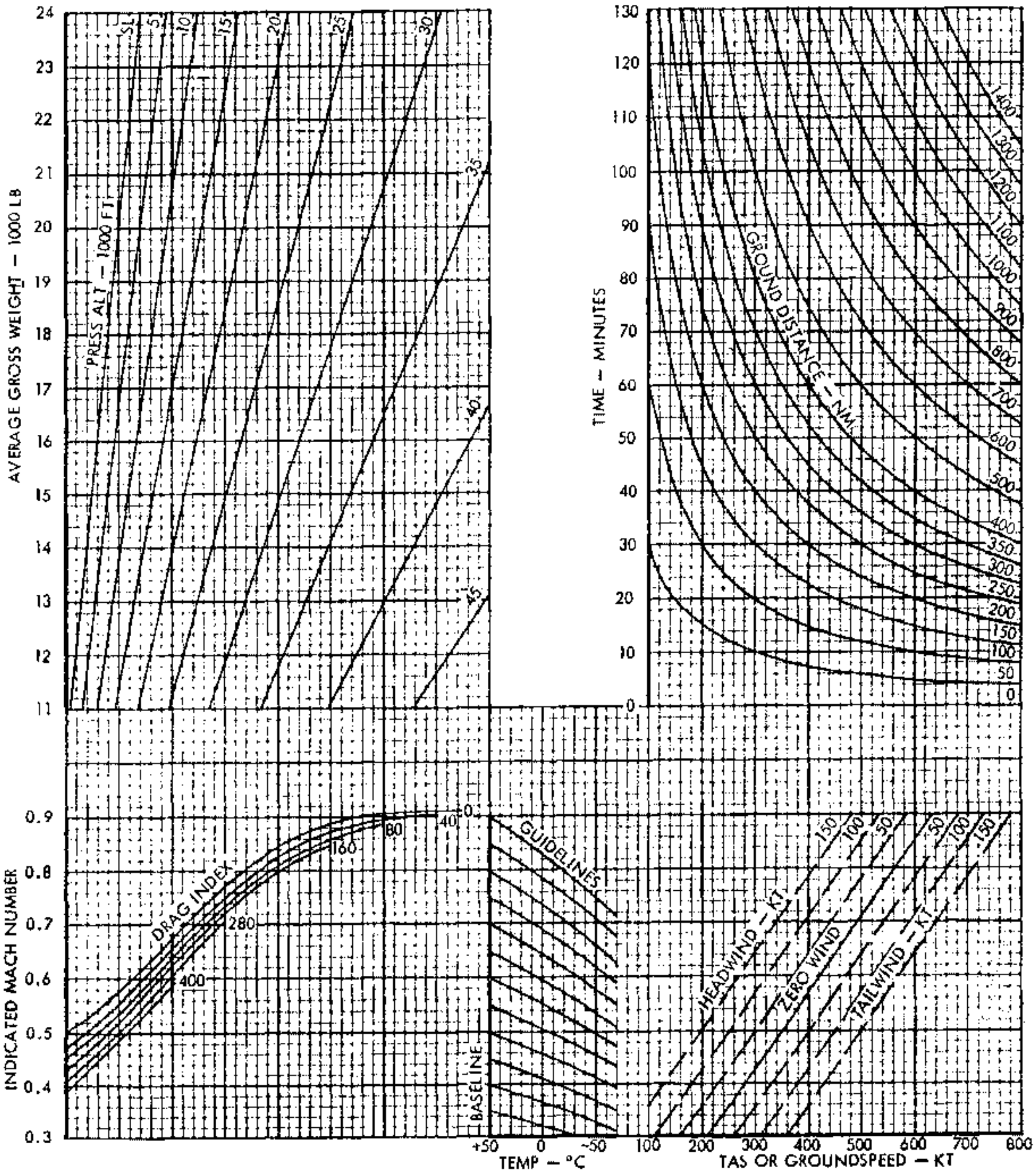
Note

FOR MAX RANGE, REDUCE CRUISE MACH BY 0.03.

CONSTANT ALTITUDE CRUISE (FLAPS UP)

LONG RANGE SPEED
INDICATED MACH NUMBER, TRUE AIRSPEED
GROUNDSPEED, AND TIME

DRAG INDEX 0 TO 400



STANDARD DAY									
ALT — 1000 FT	SL	5	10	15	20	25	30	35	36, 089 & ABOVE
TEMP — °C	15.0	5.1	-4.8	-14.7	-24.6	-34.5	-44.4	-54.3	-56.5

SPEED
——— GROUND OR AIR
— — GROUND

F-5 1-528(20)

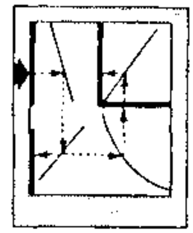
FA4-6. (Sheet 1)

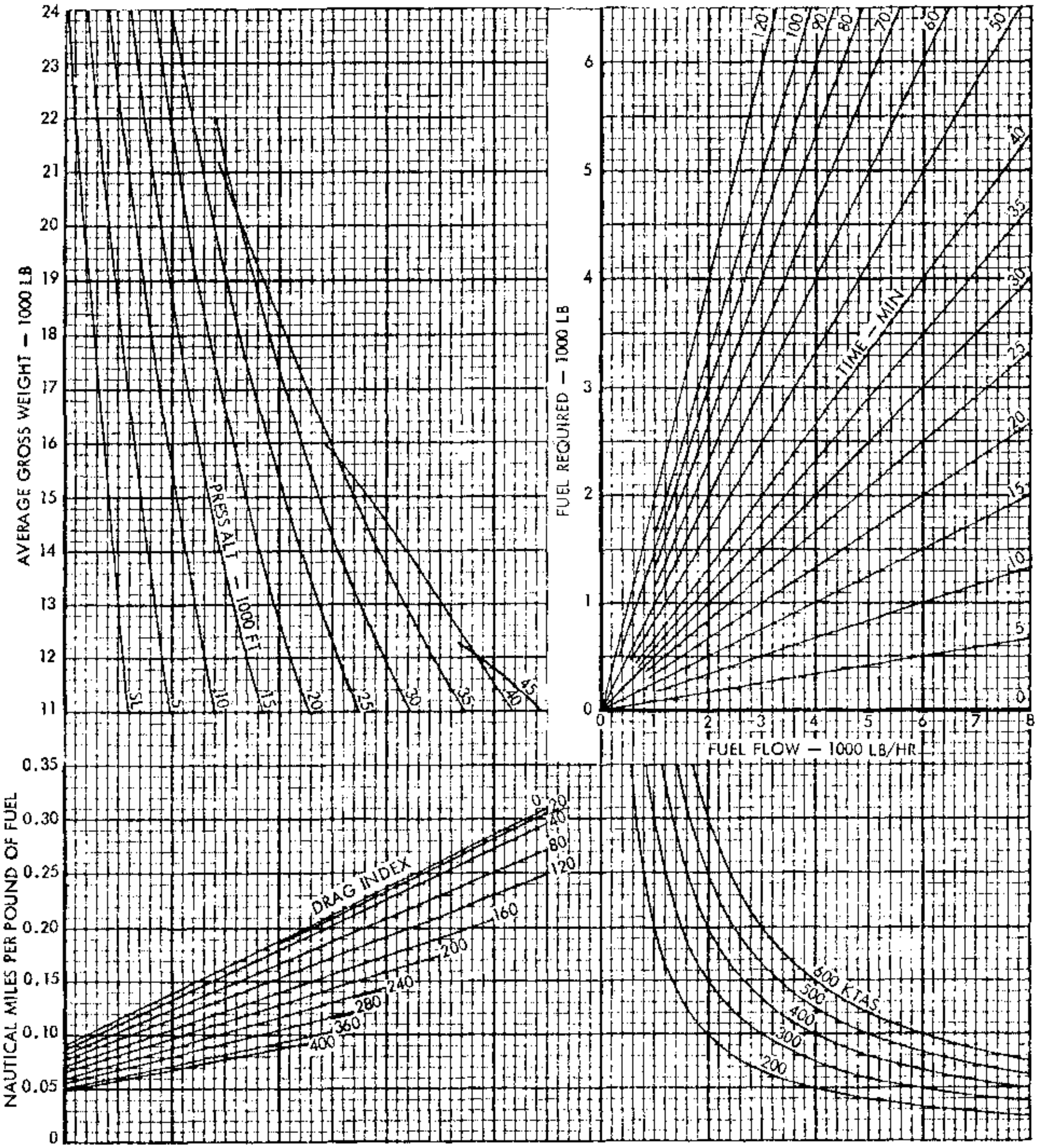
MODEL: F-5E/F
DATE: 1 MARCH 1976
DATA BASIS: **FLIGHT TEST**
ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

CONSTANT ALTITUDE CRUISE
(FLAPS UP)

LONG RANGE SPEED
SPECIFIC RANGE, FUEL FLOW,
AND FUEL REQUIRED

DRAG INDEX 0 TO 400





FA4-6. (Sheet 2)

MODEL: F-5E/F
DATE: 1 MARCH 1976
DATA BASIS: **FLIGHT TEST**

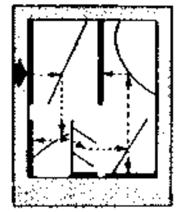
ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

CONSTANT ALTITUDE CRUISE (FLAPS UP)

LONG RANGE SPEED

INDICATED MACH NUMBER, TRUE AIRSPEED, GROUNDSPEED, AND TIME

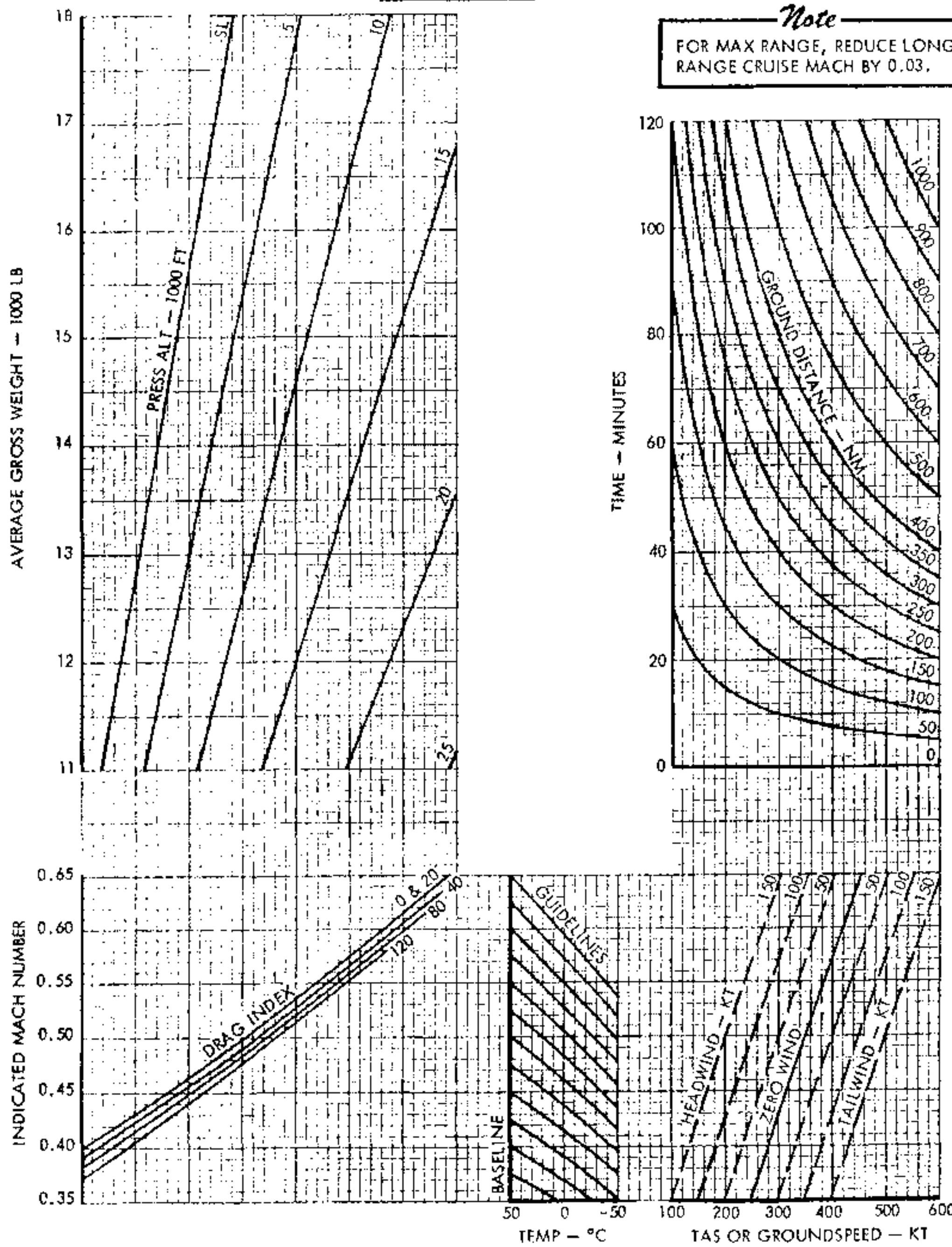
DRAG INDEX 0 TO 120



SINGLE ENGINE

Note

FOR MAX RANGE, REDUCE LONG RANGE CRUISE MACH BY 0.03.



STANDARD DAY									
ALT — 1000 FT	SL	5	10	15	20	25	30	35	36,089 & ABOVE
TEMP — °C	15.0	5.1	-4.8	-14.7	-24.6	-34.5	-44.4	-54.3	-56.5

SPEED
—— GROUND OR AIR
— — GROUND

F-5 1-577(20)

FA4-7. (Sheet 1)

MODEL: F-5E/F
DATE: 1 MARCH 1976
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

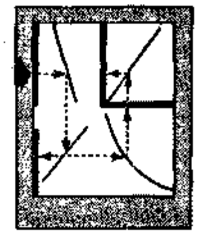
CONSTANT ALTITUDE CRUISE (FLAPS UP)

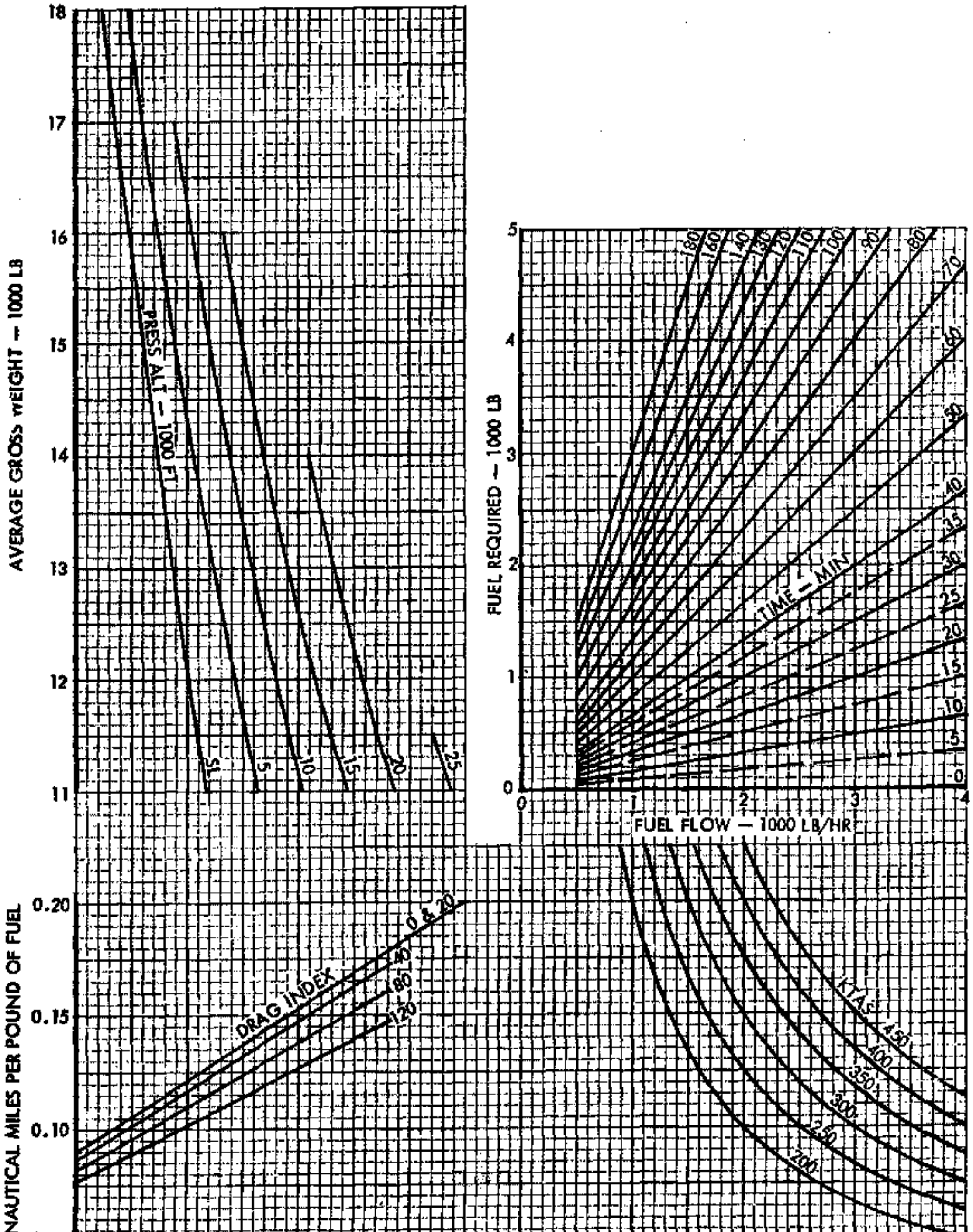
LONG RANGE SPEED

SPECIFIC RANGE, FUEL FLOW, AND FUEL REQUIRED

DRAG INDEX 0 TO 120

SINGLE ENGINE





F-5 1-578(20)

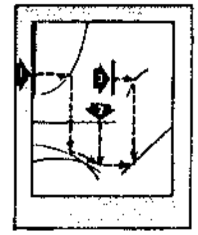
FA4-7. (Sheet 2)

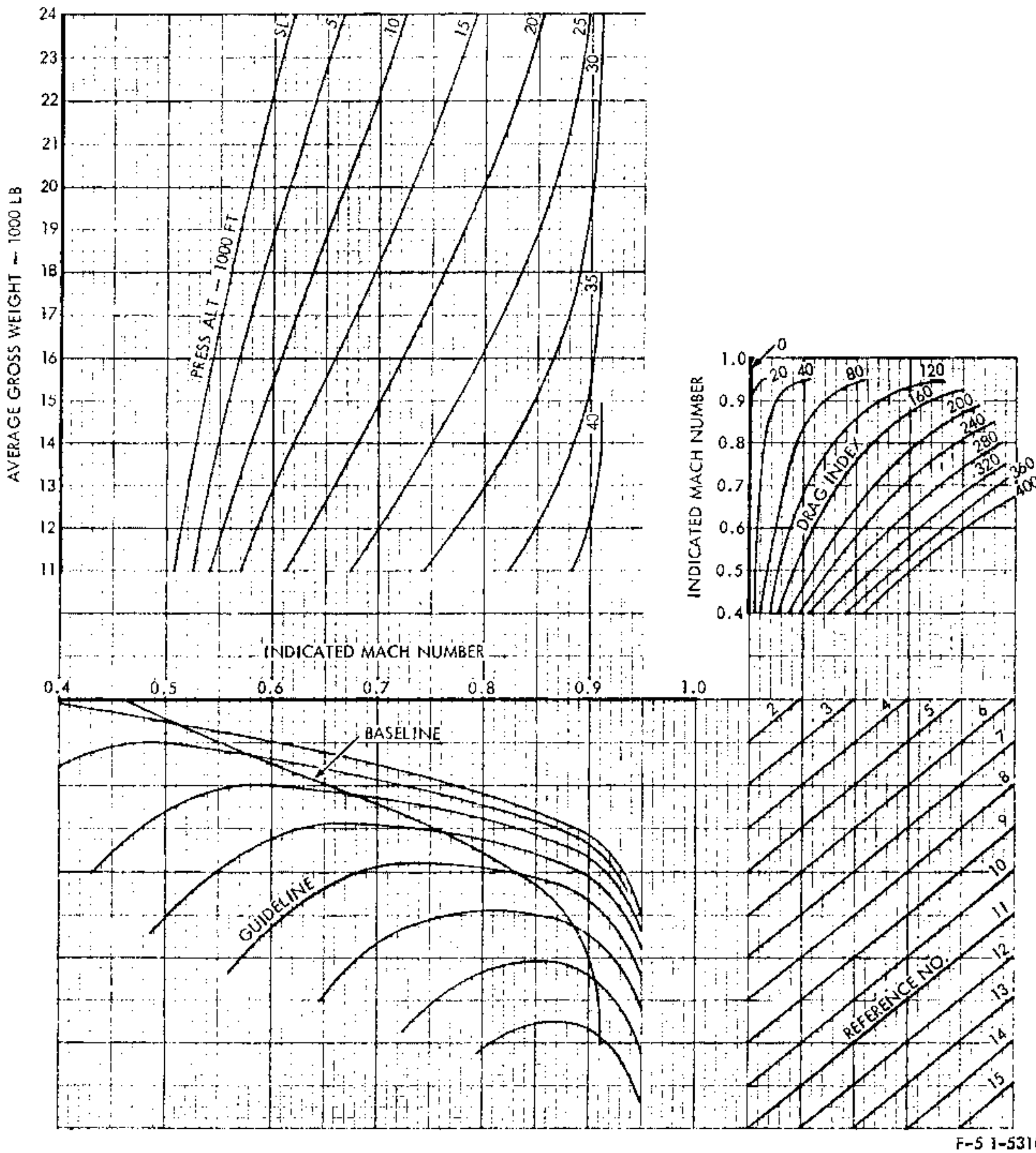
MODEL: F-5E/F
DATE: 1 MARCH 1976
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

NAUTICAL MILES PER POUND OF FUEL (FLAPS UP)

INDICATED MACH NUMBER
AND
REFERENCE NUMBER





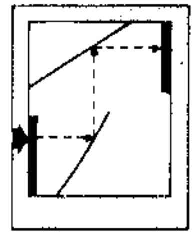
FA4-8. (Sheet 1)

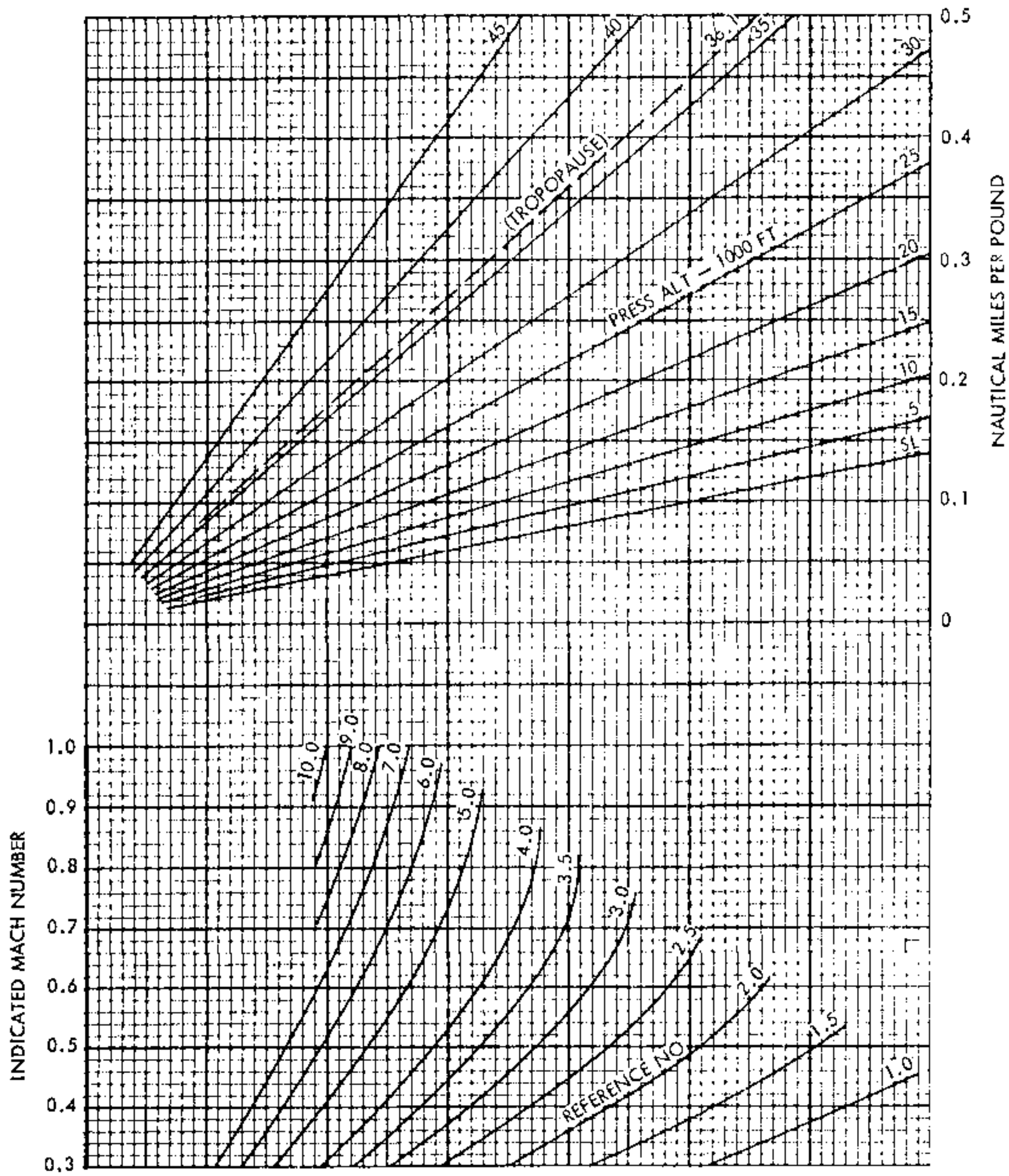
MODEL: F-5E/F
DATE: 1 MARCH 1976
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

NAUTICAL MILES PER POUND OF FUEL
(FLAPS UP)

NAUTICAL MILES PER POUND





F-5 1-533(20)

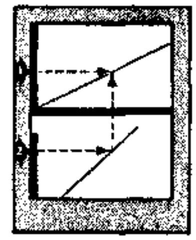
FA4-8. (Sheet 2)

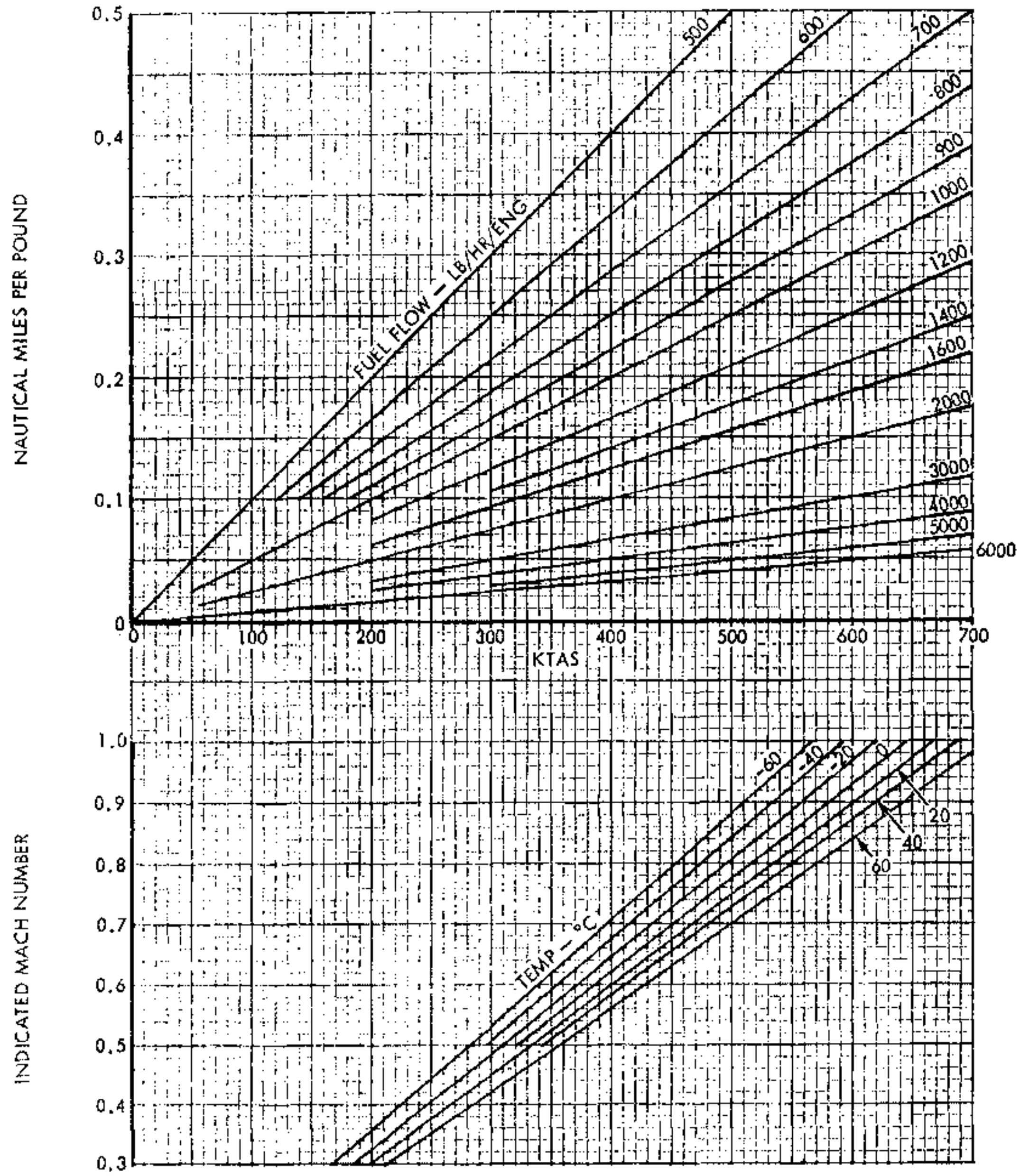
MODEL: F-5E/F
DATE: 1 MARCH 1976
DATA BASIS: **FLIGHT TEST**

ENGINES: (2)J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

NAUTICAL MILES PER POUND OF FUEL

FUEL FLOW AND TRUE AIRSPEED





STANDARD DAY									
ALT — 1000 FT	SL	5	10	15	20	25	30	35	36,089 & ABOVE
TEMP — °C	15.0	5.1	-4.8	-14.7	-24.6	-34.5	-44.4	-54.3	-56.5

F-5 1-534(20)

FA4-8. (Sheet 3)

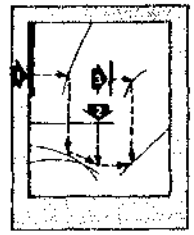
MODEL: F-5E/F
DATE: 1 MARCH 1976
DATA BASIS: **FLIGHT TEST**

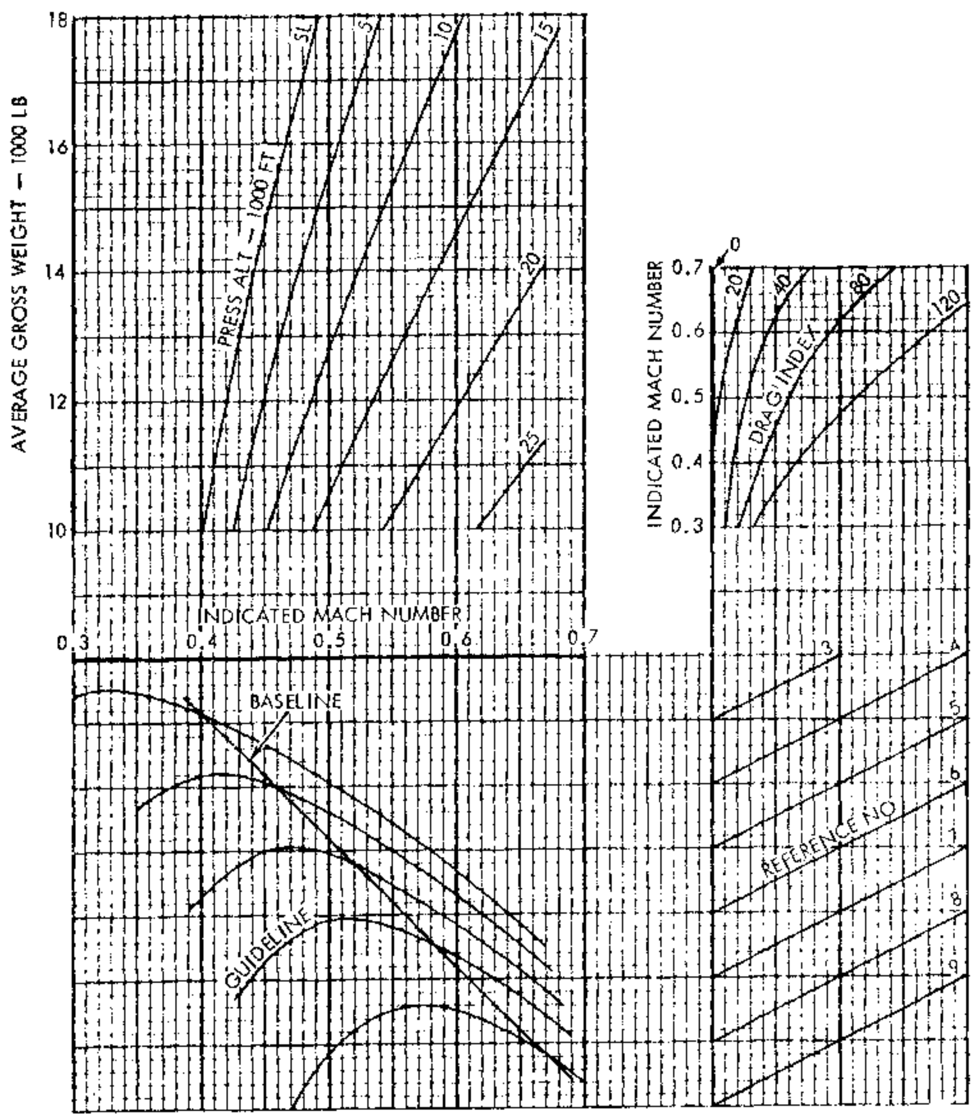
ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

NAUTICAL MILES PER POUND OF FUEL
(FLAPS UP)

INDICATED MACH NUMBER AND REFERENCE NUMBER

SINGLE ENGINE





F-5 1-591(20)

FA4-9. (Sheet 1)

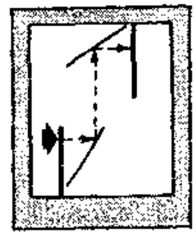
MODEL: F-5E/F
DATE: 1 MARCH 1976
DATA BASIS: **FLIGHT TEST**

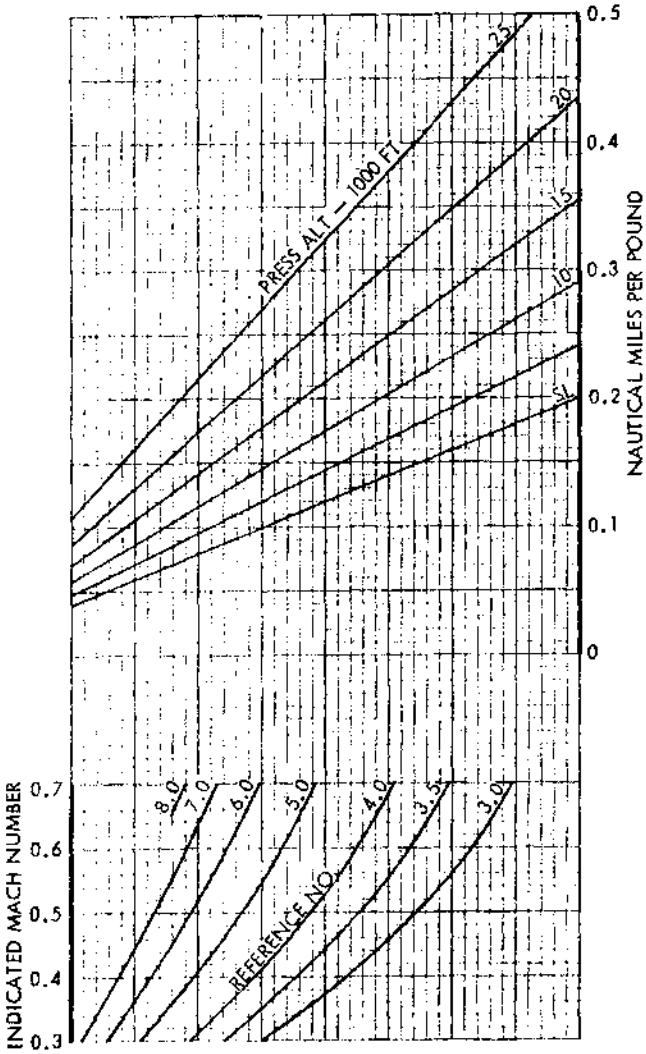
ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

NAUTICAL MILES PER POUND OF FUEL
(FLAPS UP)

NAUTICAL MILES PER POUND

SINGLE ENGINE





F-5 1-518(20)

FA4-9. (Sheet 2)

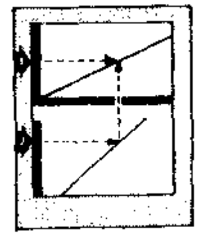
MODEL: F-5E/F
DATE: 1 MARCH 1976
DATA BASIS: **FLIGHT TEST**

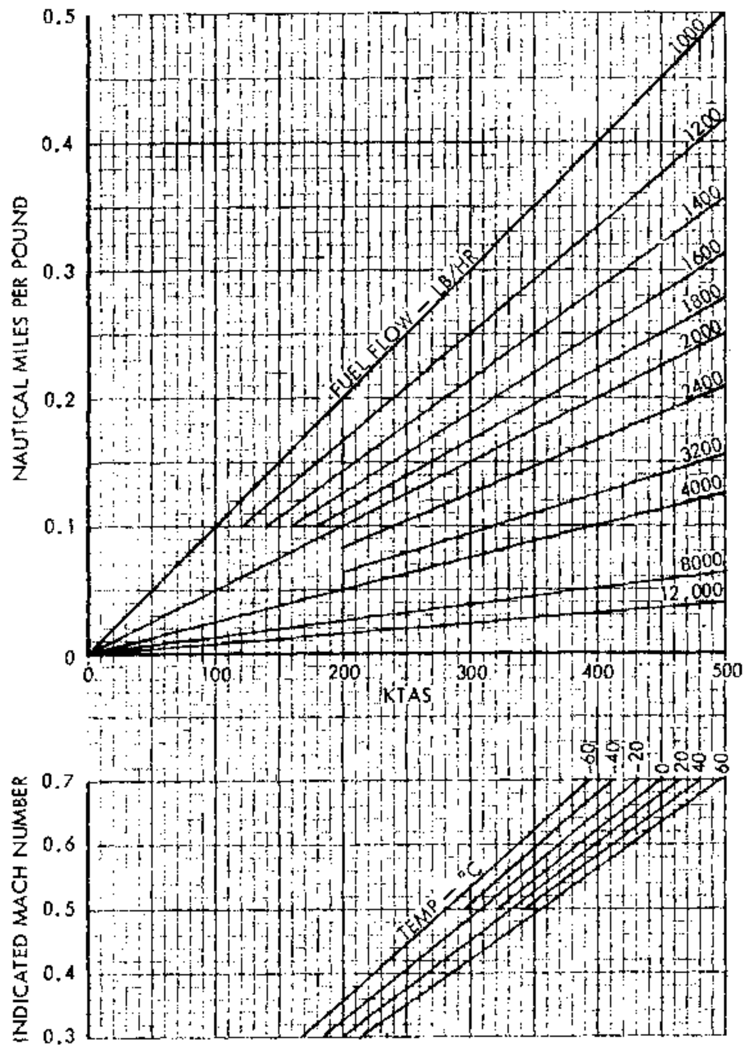
ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

NAUTICAL MILES PER POUND OF FUEL

FUEL FLOW AND TRUE AIRSPEED

SINGLE ENGINE





STANDARD DAY									
ALT — 1000 FT	SL	5	10	15	20	25	30	35	36,089 & ABOVE
TEMP — °C	15.0	5.1	-4.8	-14.7	-24.6	-34.5	-44.4	-54.3	-56.5

F-5 1-569(20)

FA4-9. (Sheet 3)

DIVERSION RANGE

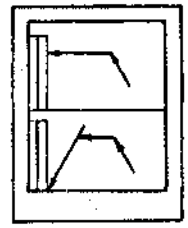
MODEL: F-5E
DATE: 1 DECEMBER 1976
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

TO ARRIVE AT DESTINATION WITH
300 LB OF FUEL REMAINING

AIM-9 + (5) PYLONS

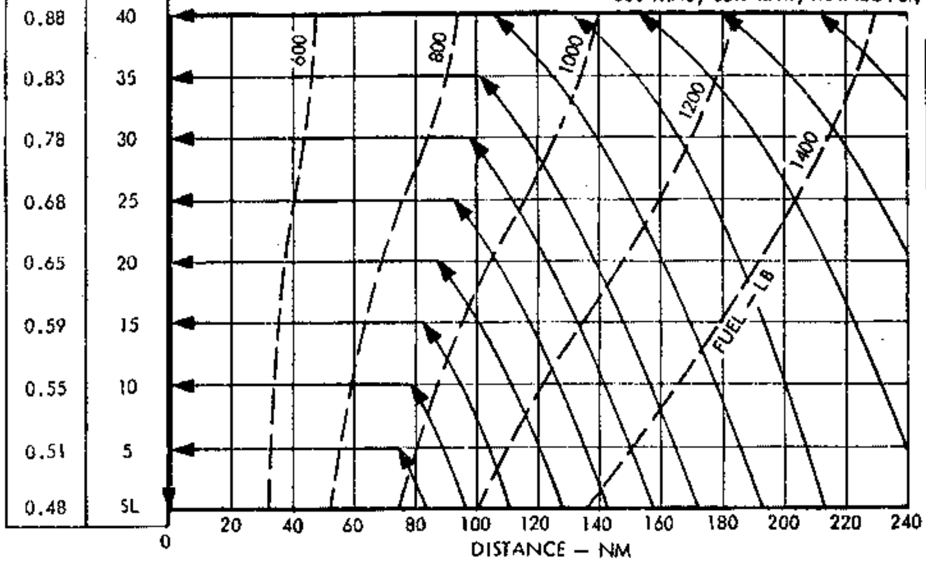
STANDARD DAY ZERO WIND



E

TWO ENGINES

PROFILE 1: USE OPTIMUM ALTITUDE UNTIL OVER BASE. DESCEND AT 300 KIAS, 80% RPM, MANEUVER/FIXED FLAPS, SPD BK 45°.



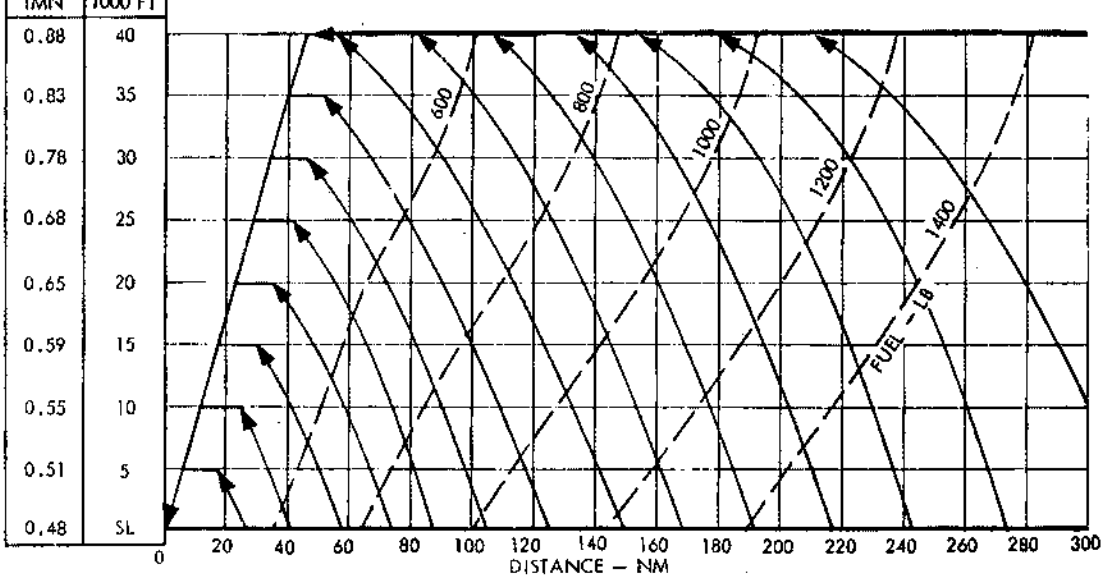
LEGEND

- ——— CLIMB-CRUISE FLIGHT PATH GUIDELINES
- — — — FUEL REQUIRED OR REMAINING

Note

- CLIMB AT 330 KIAS OR 0.88 IMN, WHICHEVER IS LOWER, WITH MILITARY THRUST.
- CLIMB AND CRUISE WITH FLAPS UP.
- WITH MORE THAN 1400 POUNDS OF FUEL, CRUISE AT 0.88 IMN, 38,000 FT. INCREASE RANGE BY 20 NM FOR EACH 100 LB OF FUEL ABOVE 1400 LB.

PROFILE 2: USE OPTIMUM ALTITUDE AND DESCEND ON COURSE AT MAX RANGE DESCENT: 270 KIAS, IDLE RPM, FLAPS UP, SPD BK-IN.



PROFILE 1: FUEL IS INCLUDED FOR CLIMB TO OPTIMUM ALTITUDE AND PENETRATION DESCENT AT DESTINATION. NO DISTANCE CREDIT FOR DESCENT TO DESTINATION.

PROFILE 2: FUEL IS INCLUDED FOR CLIMB TO OPTIMUM ALTITUDE AND MAXIMUM RANGE DESCENT TO DESTINATION; RANGE INCLUDES DISTANCE FOR ON-COURSE DESCENT TO DESTINATION.

F-5 1-589(1)E

FA4-10 (Sheet 1).

MODEL: F-5F
DATE: 1 AUGUST 1977
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

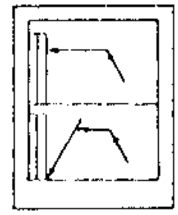
DIVERSION RANGE

TO ARRIVE AT DESTINATION WITH 300 LB OF FUEL REMAINING

AIM-9 + (5) PYLONS

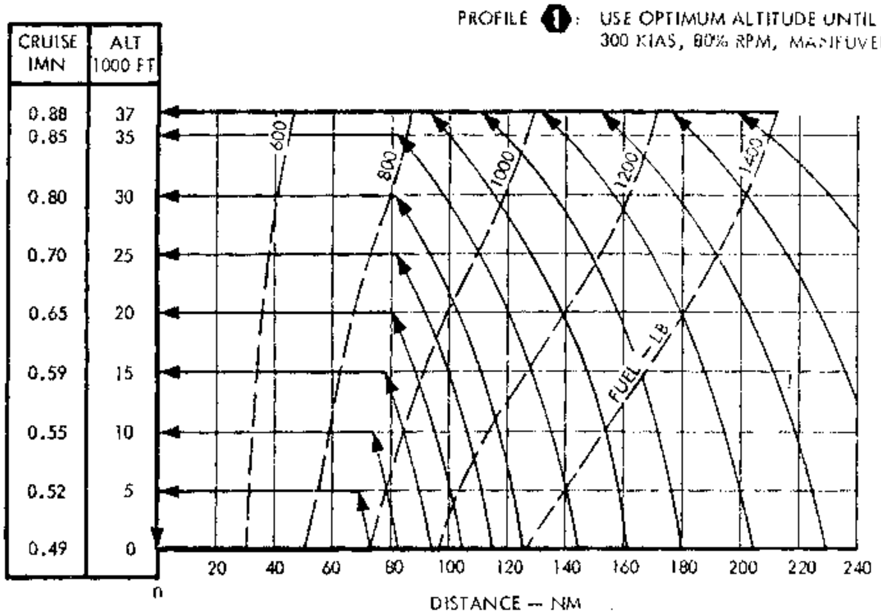
STANDARD DAY ZERO WIND

TWO ENGINES



F

PROFILE ❶: USE OPTIMUM ALTITUDE UNTIL OVER BASE. DESCEND AT 300 KIAS, 80% RPM, MANEUVER/FIXED FLAPS, SPD BK 45°

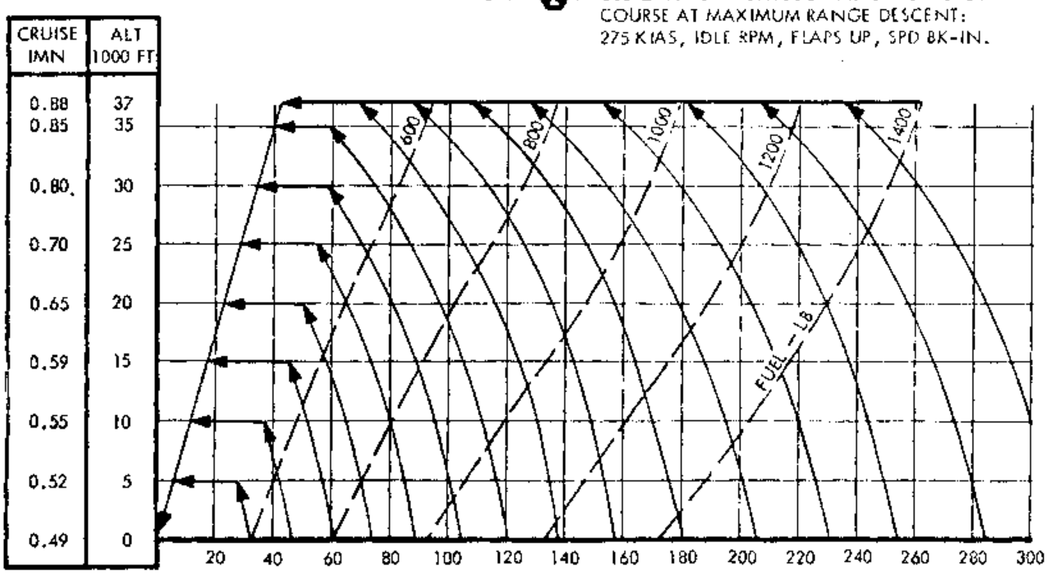


LEGEND
——— CLIMB-CRUISE FLIGHT PATH GUIDELINES
– – – FUEL REQUIRED OR REMAINING

Note

- CLIMB AT 330 KIAS OR 0.88 IMN, WITCHEVER IS LOWER, WITH MILITARY THRUST.
- CLIMB AND CRUISE WITH FLAPS UP.
- WITH MORE THAN 1400 POUNDS OF FUEL, CRUISE AT 0.87 IMN, 35,000 FT. INCREASE RANGE BY 20 NM FOR EACH 100 LB OF FUEL ABOVE 1400 LB.

PROFILE ❷: USE OPTIMUM ALTITUDE AND DESCEND ON COURSE AT MAXIMUM RANGE DESCENT: 275 KIAS, IDLE RPM, FLAPS UP, SPD BK-IN.



PROFILE ❶: FUEL IS INCLUDED FOR CLIMB TO OPTIMUM ALTITUDE AND PENETRATION DESCENT AT DESTINATION. NO DISTANCE CREDIT FOR DESCENT TO DESTINATION.

PROFILE ❷: FUEL IS INCLUDED FOR CLIMB TO OPTIMUM ALTITUDE AND MAXIMUM RANGE DESCENT TO DESTINATION. RANGE INCLUDES DISTANCE FOR ON-COURSE DESCENT TO DESTINATION.

F-5 1-589(2)E

FA4-10 (Sheet 2).

MODEL: F-5E
DATE: 1 AUGUST 1977
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

DIVERSION RANGE

TO ARRIVE AT DESTINATION WITH 300 LB OF FUEL REMAINING

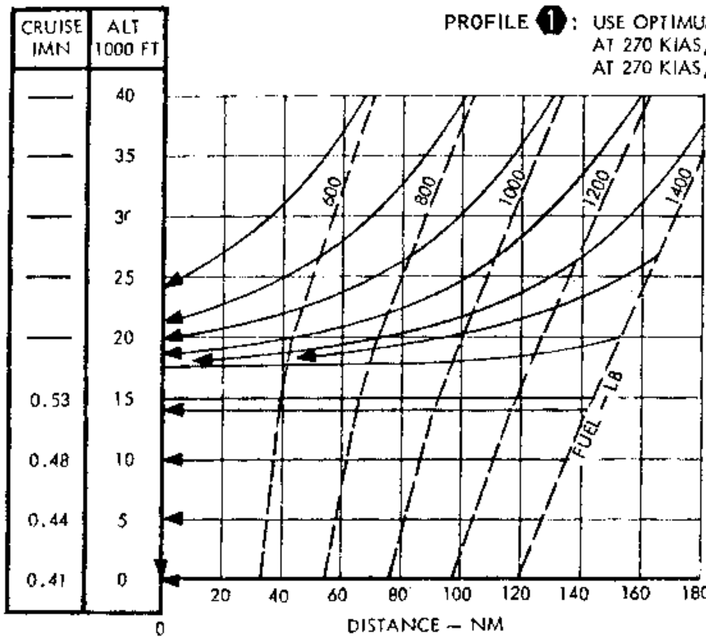
AIM-9 + (5) PYLONS

STANDARD DAY ZERO WIND

SINGLE ENGINE – WITHOUT AB

E

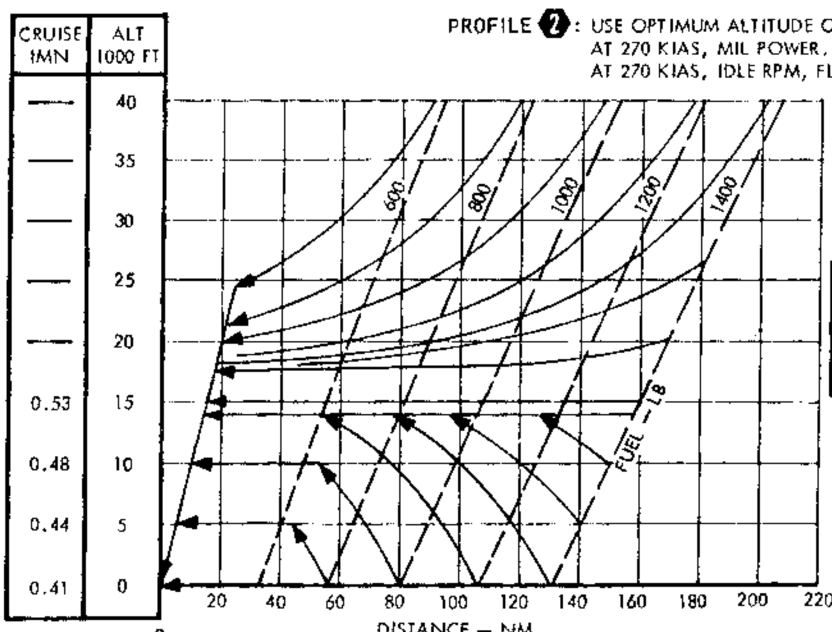
PROFILE 1: USE OPTIMUM ALTITUDE OR DESCEND (IF REQUIRED) AT 270 KIAS, MIL POWER. FINAL DESCENT OVER BASE AT 270 KIAS, IDLE RPM, FLAPS UP, SPD BK-IN.



Note

- CLIMB (IF REQUIRED) AT 245 KIAS WITH MIL THRUST.
- IF MIL POWER TIME LIMITATION OF 30 MIN IS EXCEEDED, USE MAXIMUM CONTINUOUS POWER (EGT = 650° C).
- CLIMB AND CRUISE WITH FLAPS UP.
- WITH MORE THAN 1400 LB OF FUEL, CRUISE AT 0.54 IMN, 12,000 FT. INCREASE RANGE BY 10 NM FOR EACH 100 LB OF FUEL ABOVE 1400 LB.
- WITH EITHER FUEL SYSTEM BELOW APPROXIMATELY 400 LB, MANUAL CROSSFEED IS REQUIRED TO OBTAIN ALL USABLE FUEL.

PROFILE 2: USE OPTIMUM ALTITUDE OR DESCEND (IF REQUIRED) AT 270 KIAS, MIL POWER. FINAL DESCENT ON COURSE AT 270 KIAS, IDLE RPM, FLAPS UP, SPD BK-IN.



LEGEND
- DESCENT OR CLIMB-CRUISE FLIGHT PATH GUIDELINE
- FUEL REQUIRED OR REMAINING

PROFILE 1: FUEL IS INCLUDED FOR DESCENT TO OPTIMUM ALTITUDE AND DESCENT AT DESTINATION. NO DISTANCE CREDIT FOR DESCENT TO DESTINATION.

PROFILE 2: FUEL IS INCLUDED FOR CLIMB OR DESCENT TO OPTIMUM ALTITUDE AND MAXIMUM RANGE DESCENT TO DESTINATION; RANGE INCLUDES DISTANCE FOR ON-COURSE DESCENT TO DESTINATION.

F-5 1-587(1)F

FA4-10 (Sheet 3).

MODEL: F-5F
DATE: 1 AUGUST 1977
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

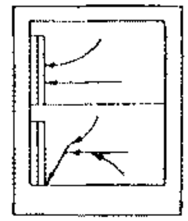
DIVERSION RANGE

TO ARRIVE AT DESTINATION WITH 300 LB OF FUEL REMAINING

AIM-9 + (5) PYLONS

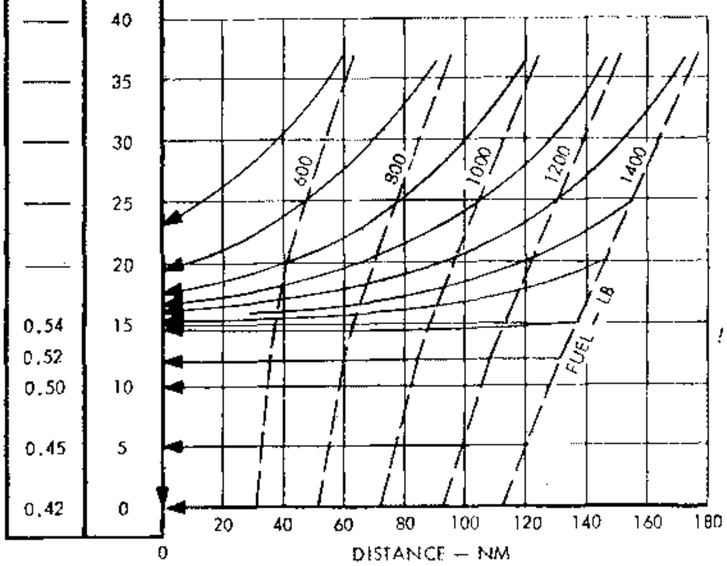
STANDARD DAY ZERO WIND

SINGLE ENGINE – WITHOUT AB



F

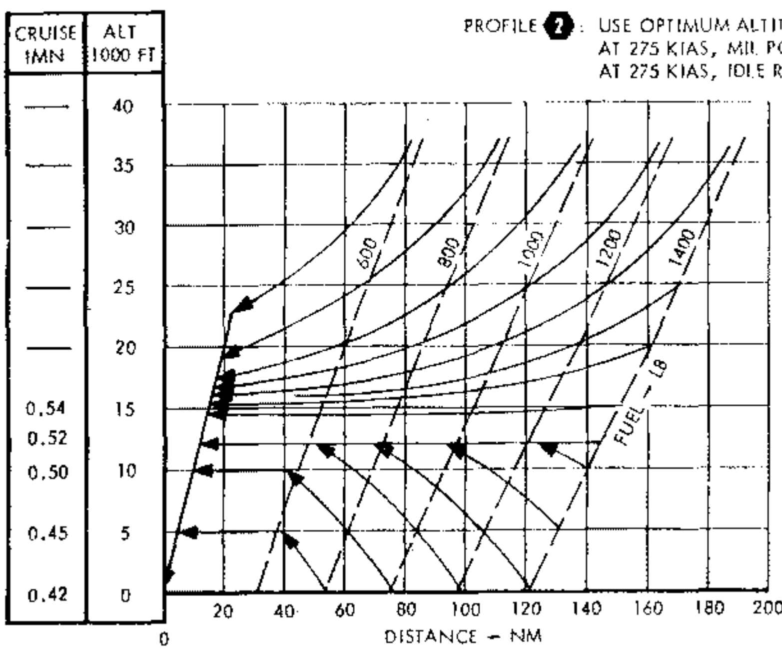
PROFILE 1: USE OPTIMUM ALTITUDE OR DESCEND (IF REQUIRED) AT 275 KIAS, MIL POWER. FINAL DESCENT OVER BASE AT 275 KIAS, IDLE RPM, FLAPS UP, SPD BK-IN.



Note

- CLIMB (IF REQUIRED) AT 245 KIAS WITH MIL THRUST.
- IF MIL POWER TIME LIMITATION OF 30 MIN IS EXCEEDED, USE MAXIMUM CONTINUOUS POWER (EGT ~ 650° C).
- CLIMB AND CRUISE WITH FLAPS UP.
- WITH MORE THAN 1400 LB OF FUEL, CRUISE AT 0.52 IMN, 10,000 FT. INCREASE RANGE BY 10 NM FOR EACH 100 LB OF FUEL ABOVE 1400 LB.
- WITH EITHER FUEL SYSTEM BELOW APPROXIMATELY 400 LB, MANUAL CROSSFEED IS REQUIRED TO OBTAIN ALL USABLE FUEL.

PROFILE 2: USE OPTIMUM ALTITUDE OR DESCEND (IF REQUIRED) AT 275 KIAS, MIL POWER. FINAL DESCENT ON COURSE AT 275 KIAS, IDLE RPM, FLAPS UP, SPD BK-IN.



LEGEND
- ——— DESCENT OR CLIMB-CRUISE FLIGHT PATH GUIDELINE
- – – – FUEL REQUIRED OR REMAINING

PROFILE 1: FUEL IS INCLUDED FOR DESCENT TO OPTIMUM ALTITUDE AND DESCENT AT DESTINATION. NO DISTANCE CREDIT FOR DESCENT TO DESTINATION.

PROFILE 2: FUEL IS INCLUDED FOR CLIMB OR DESCENT TO OPTIMUM ALTITUDE AND MAXIMUM RANGE DESCENT TO DESTINATION; RANGE INCLUDES DISTANCE FOR ON-COURSE DESCENT TO DESTINATION.

F-5 1-567(2)E

FA4-10 (Sheet 4).

MODEL: F-5E
DATE: 1 AUGUST 1977
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

DIVERSION RANGE

TO ARRIVE AT DESTINATION WITH 300 LB OF FUEL REMAINING

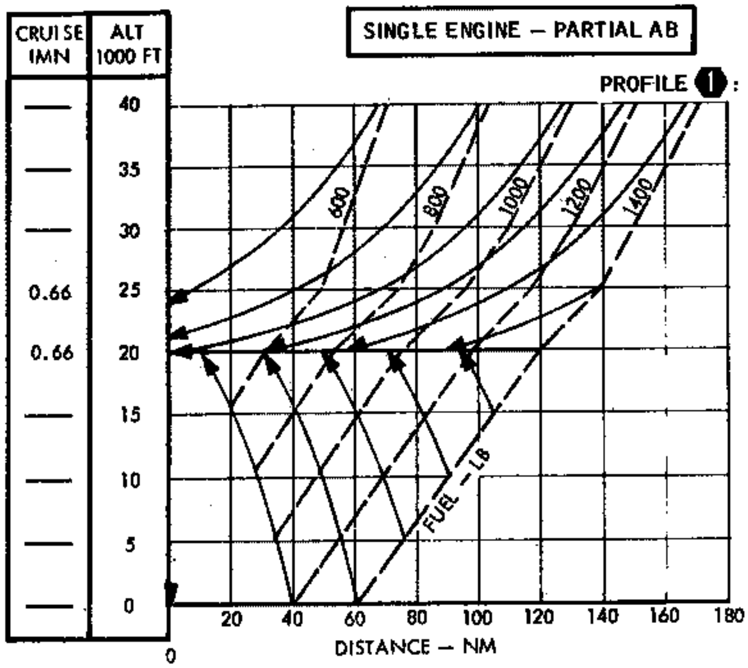
AIM-9 + (5) PYLONS

STANDARD DAY ZERO WIND

SINGLE ENGINE — PARTIAL AB

E

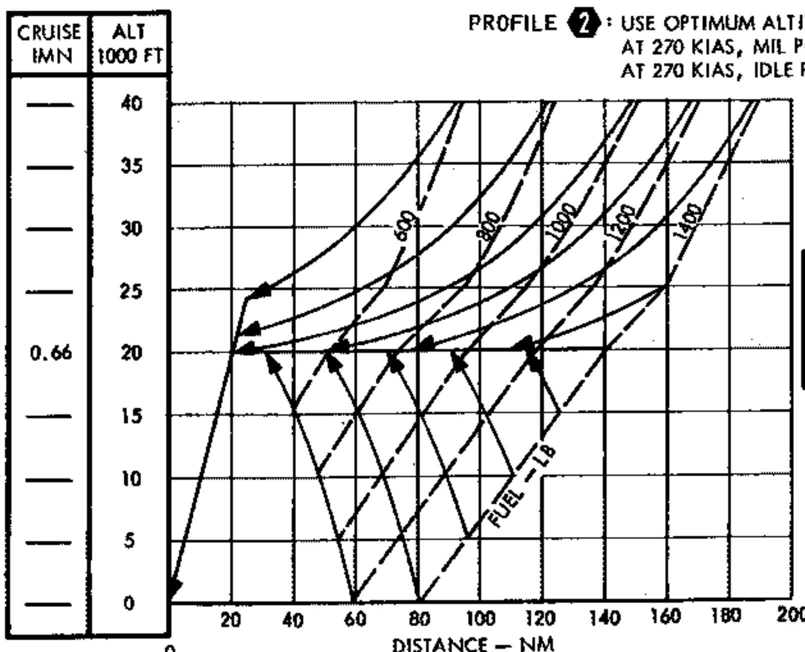
PROFILE 1: USE OPTIMUM ALTITUDE OR DESCEND (IF REQUIRED) AT 270 KIAS, MIL POWER. FINAL DESCENT OVER BASE AT 270 KIAS, IDLE RPM, FLAPS UP, SPD BK — IN.



Note

- CLIMB (IF REQUIRED) AT 290 KIAS WITH MAX THRUST.
- CLIMB AND CRUISE WITH FLAPS UP.
- WITH MORE THAN 1400 LB OF FUEL, CRUISE AT 0.64 IMN, 20,000 FT. INCREASE RANGE BY 10 NM FOR EACH 100 LB OF FUEL ABOVE 1400 LB.
- PARTIAL AB TIME LIMITATION IS 15 MIN.
- WITH EITHER FUEL SYSTEM BELOW APPROXIMATELY 400 LB, MANUAL CROSSFEED IS REQURIED TO OBTAIN ALL USABLE FUEL.

PROFILE 2: USE OPTIMUM ALTITUDE OR DESCEND (IF REQUIRED) AT 270 KIAS, MIL POWER. FINAL DESCENT ON COURSE AT 270 KIAS, IDLE RPM, FLAPS UP, SPD BK-IN.



LEGEND
- —— DESCENT OR CLIMB-CRUISE FLIGHT PATH GUIDELINE
- – – – FUEL REQUIRED OR REMAINING

F-5 1-585(1)F

PROFILE 1: FUEL IS INCLUDED FOR CLIMB OR DESCENT TO OPTIMUM ALTITUDE AND DESCENT AT DESTINATION. NO DISTANCE CREDIT FOR DESCENT TO DESTINATION.

PROFILE 2: FUEL IS INCLUDED FOR CLIMB OR DESCENT TO OPTIMUM ALTITUDE AND MAXIMUM RANGE DESCENT TO DESTINATION; RANGE INCLUDES DISTANCE FOR ON-COURSE DESCENT TO DESTINATION.

FA4-10 (Sheet 5).

MODEL: F-5F
DATE: 1 AUGUST 1977
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

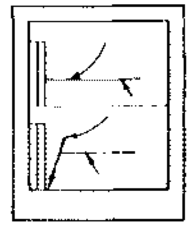
DIVERSION RANGE

TO ARRIVE AT DESTINATION WITH 300 LB OF FUEL REMAINING

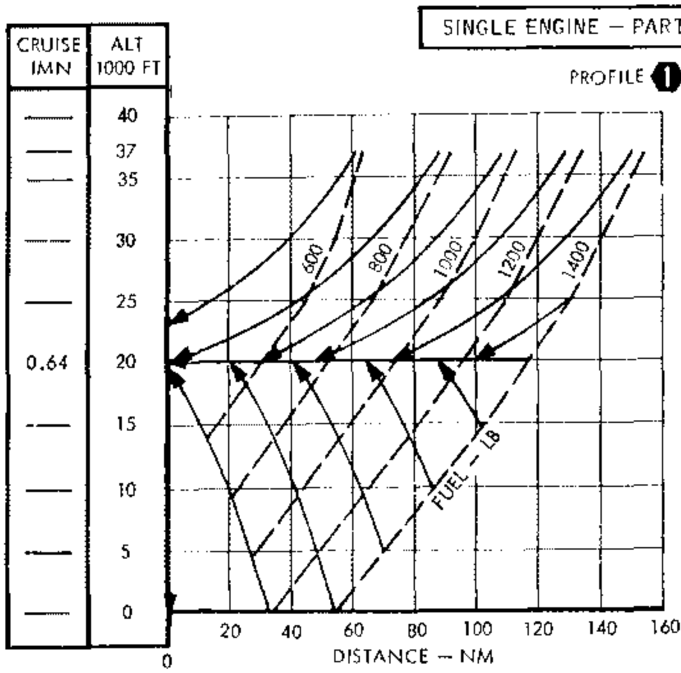
AIM-9 + (5) PYLONS

STANDARD DAY ZERO WIND

SINGLE ENGINE — PARTIAL AB



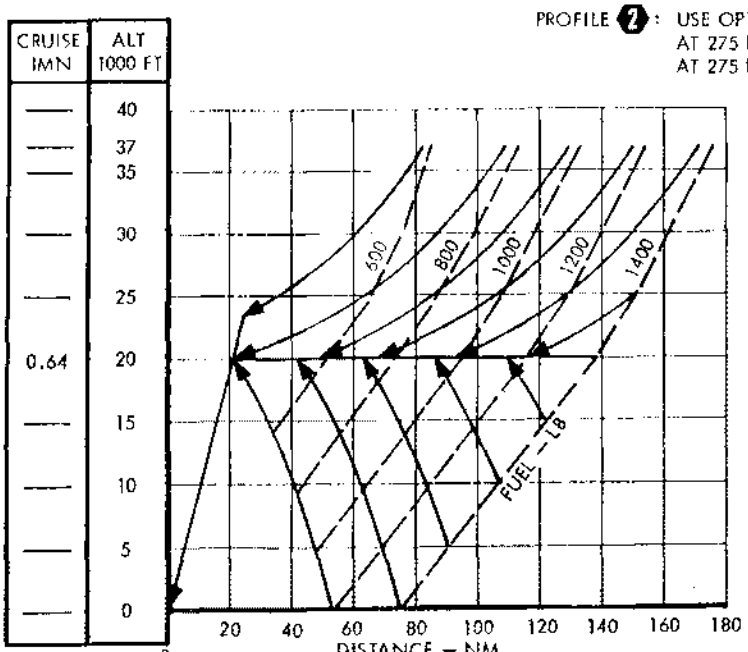
PROFILE 1: USE OPTIMUM ALTITUDE OR DESCEND (IF REQUIRED) AT 275 KIAS, MIL POWER. FINAL DESCENT OVER BASE AT 275 KIAS, IDLE RPM, FLAPS UP, SPD BK-IN.



Note

- CLIMB (IF REQUIRED) AT 290 KIAS WITH MAX THRUST.
- CLIMB AND CRUISE WITH FLAPS UP.
- WITH MORE THAN 1400 LB OF FUEL, CRUISE AT 0.62 IMN, 20,000 FT. INCREASE RANGE BY 10 NM FOR EACH 100 LB OF FUEL ABOVE 1400 LB.
- PARTIAL AB TIME LIMITATION IS 15 MIN.
- WITH EITHER FUEL SYSTEM BELOW APPROXIMATELY 400 LB, MANUAL CROSSFEED IS REQUIRED TO OBTAIN ALL USABLE FUEL.

PROFILE 2: USE OPTIMUM ALTITUDE OR DESCEND (IF REQUIRED) AT 275 KIAS, MIL POWER. FINAL DESCENT ON COURSE AT 275 KIAS, IDLE RPM, FLAPS UP, SPD BK-IN.



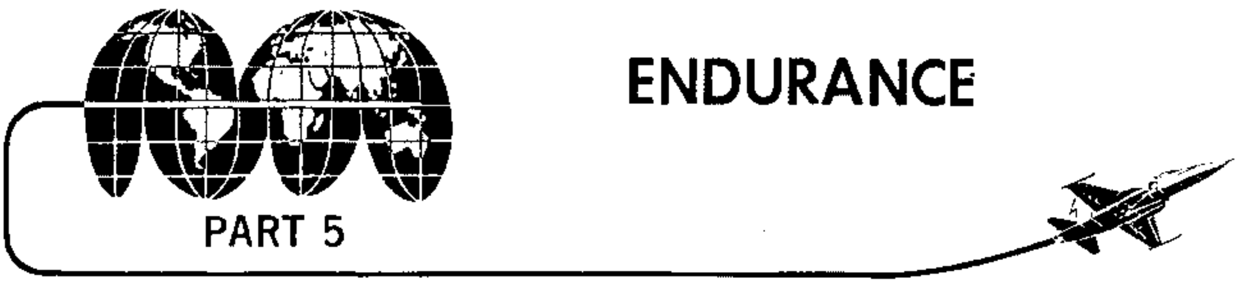
LEGEND
- ——— DESCENT OR CLIMB-CRUISE FLIGHT PATH GUIDELINES
- — — — FUEL REQUIRED OR REMAINING

PROFILE 1: FUEL IS INCLUDED FOR CLIMB OR DESCENT TO OPTIMUM ALTITUDE AND DESCENT AT DESTINATION. NO DISTANCE CREDIT FOR DESCENT TO DESTINATION.

PROFILE 2: FUEL IS INCLUDED FOR CLIMB OR DESCENT TO OPTIMUM ALTITUDE AND MAXIMUM RANGE DESCENT TO DESTINATION; RANGE INCLUDES DISTANCE FOR ON-COURSE DESCENT TO DESTINATION.

F-5 1-585(2)E

FA4-10 (Sheet 6).



ENDURANCE

PART 5

F-5E 1-80

TABLE OF CONTENTS

ENDURANCE CHARTS

Endurance charts determine the optimum mach number and fuel required to loiter at a given altitude for a specific period of time. A correction grid to gross weight for bank angle and a temperature correction grid (hotter-than-standard conditions) to fuel flow are provided for optional use.

NOTE

The effects of temperature for colder-than-standard day conditions are considered negligible. Use standard day (baseline) for temperatures below standard day.

The altitude for maximum loiter time is defined in the charts by the drag index curves titled Optimum Maximum Endurance Altitude contained in the gross weight grid. The endurance charts for two-engine operation provide data for drag indices of 0 thru 400. The single-engine endurance chart provides data for drag indices of 0 thru 120. The data on the endurance charts (FA5-1 and FA5-2) are based on flaps up below a drag index of 80 and on cruise/fixed flaps at a drag index of 80 and above. On aircraft equipped with auto flaps ([E-3] [F-2]) the CADC may command two possible positions with fixed flaps selected: 0°/8° above 30,000 feet MSL, or 12°/8° below 30,000 feet MSL (±2000 feet). For [E-3] [F-2] loiter above 30,000 feet use chart FA5-1; for [E-3] [F-2] loiter below 30,000 feet use charts FA5-3 or FA5-4.

USE

Enter the appropriate two-engine or single-engine chart (FA5-1 thru FA5-4) with gross weight. If the loiter period requires turning flight, gross weight should be corrected for bank angle. To use the bank angle correction grid, enter with gross weight and contour the nearest guideline to the right while simultaneously entering the bank angle scale with desired degree of bank angle and projecting up. At the point of intersection of the two projections, proceed left and read gross weight corrected for bank angle.

Gross weight (corrected for bank angle, if required) is then projected right from the gross weight scale of the chart to the pressure altitude. If maximum loiter time is desired, stop momentarily at the optimum maximum endurance altitude drag index curve (interpolate, if necessary). Mark this position location on the chart for further use.

From the point of intersection with pressure altitude, proceed up to the configuration drag index in the upper left grid of the chart, then left to read the indicated mach number for loiter. Return to the plotted point intersection of the gross weight and pressure altitude and proceed down to the drag index at the lower left portion of the chart, then right to the gross weight curve. From this point proceed up to the baseline of the temperature correction grid (standard day). For hotter-than-standard day condition, contour the guidelines to the temperature increase. (If no increase is required, proceed directly thru.) Fuel flow can be read while proceeding up to the desired loiter time. Project right to read fuel required for loiter.

If loiter fuel is already known, project left from the fuel required scale and simultaneously intersect the vertical plot projected from the temperature grid to read loiter time.

For loiter times of long duration (more than 10 minutes) greater accuracy requires use of average gross weight during loiter to calculate the fuel required. To obtain average loiter weight, the fuel required to loiter must first be determined based on gross weight at start or end of loiter and then is recalculated based on start or end gross weight, decreased or increased, respectively, by half the calculated loiter fuel.

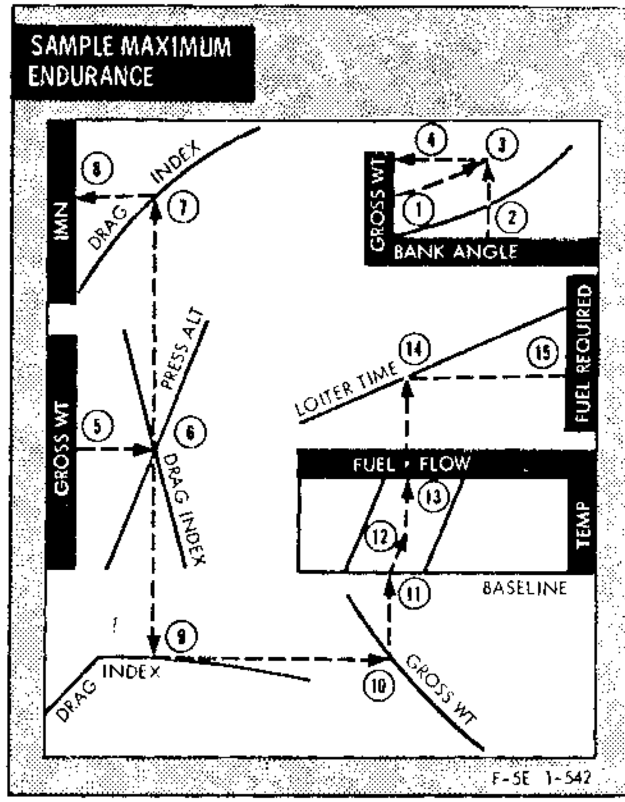
SAMPLE PROBLEM

Given:

A. End cruise gross weight: 15,900 lb.
B. Desired two-engine loiter time with bank angle of 20 degrees: 10 minutes.
C. Loiter pressure altitude: 25,000 ft.
D. Drag index: 120.
E. Temperature (at altitude): 10°C hotter-than-standard.
F. Configuration [E] aircraft.

Calculate:

A. Indicated mach number and fuel required to 10-minute loiter.



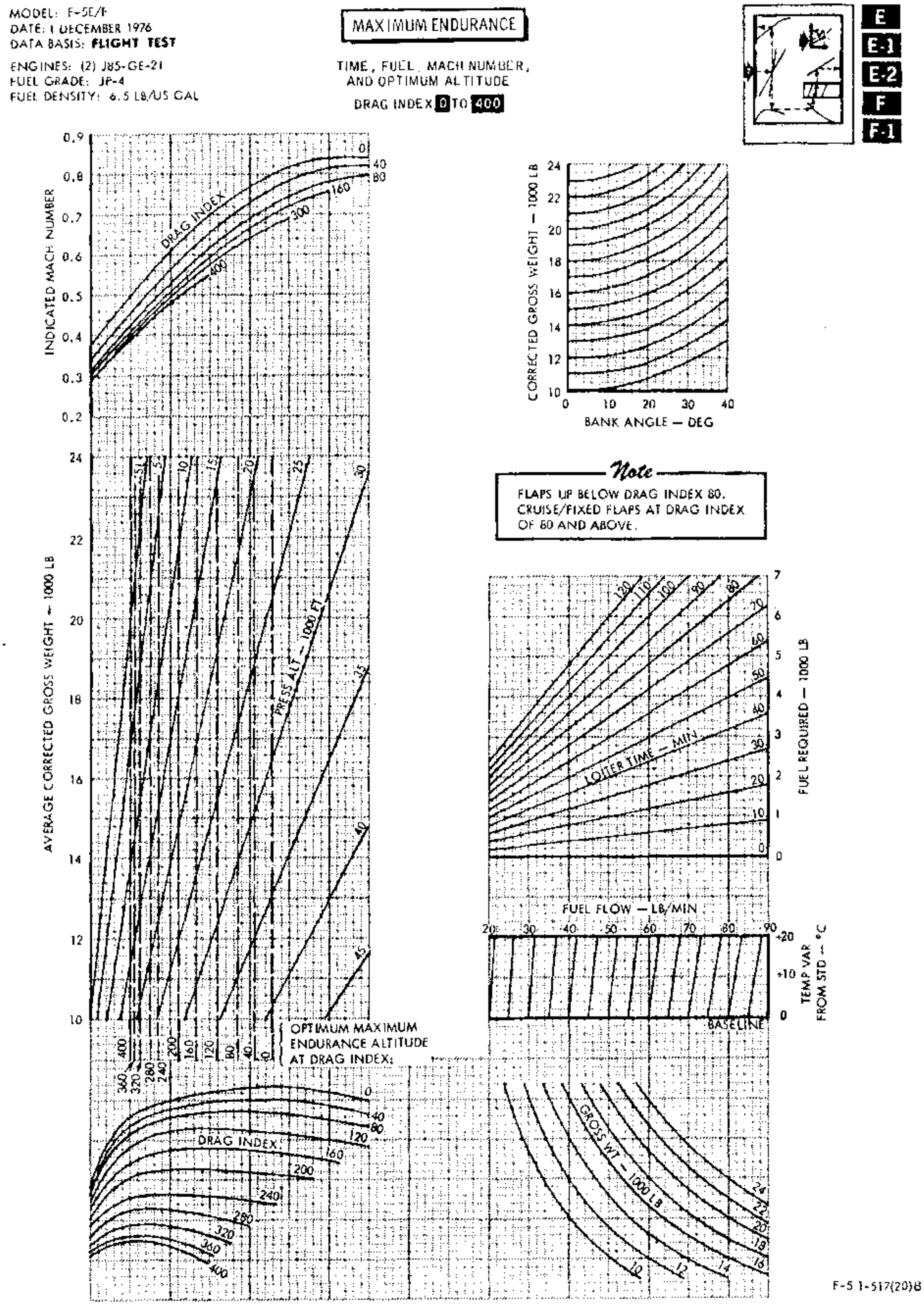
B. Use Maximum Endurance — Time, Fuel Mach Number, and Optimum Altitude — Drag Index 0 to 400 chart FA5-1.

①	Gross Wt	15,900 lb
②	Bank Angle	20 deg
③	Intersection	—
④	Gross Wt (corrected)	17,000 lb
⑤	Gross Wt (corrected)	17,000 lb
⑥	Press Alt	25,000 ft
⑦	Drag Index	120

NOTE

If optimum maximum endurance altitude is desired, intersect optimum maximum endurance altitude at 120 drag index (interpolate) and continue plot in similar manner.

⑧	IMN	0.65
⑨	Drag index	120
⑩	Gross Wt (corrected)	17,000 lb
⑪	Baseline	—
⑫	Temp	10°C (hotter)
⑬	Fuel Flow	48.5 lb/min
⑭	Loiter Time	10 min
⑮	Fuel Required	470 lb


MODEL: F-5E/F
DATE: 1 DECEMBER 1976
DATA BASIS: FLIGHT TEST
ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL
MAXIMUM ENDURANCE
TIME, FUEL, MACH NUMBER, AND OPTIMUM ALTITUDE
DRAG INDEX 0 TO 400
E
E-1
E-2
F
F-1
INDICATED MACH NUMBER
DRAG INDEX
AVERAGE CORRECTED GROSS WEIGHT — 1000 LB
PRESS ALT — 1000 FT
OPTIMUM MAXIMUM ENDURANCE ALTITUDE AT DRAG INDEX:
CORRECTED GROSS WEIGHT — 1000 LB
BANK ANGLE — DEG
Note
FLAPS UP BELOW DRAG INDEX 80.
CRUISE/FIXED FLAPS AT DRAG INDEX OF 80 AND ABOVE.
LOITER TIME — MIN
FUEL REQUIRED — 1000 LB
FUEL FLOW — LB/MIN
TEMP VAR FROM STD — °C
BASELINE
GROSS WT — 1000 LB
F-5 1-517(20)B

FA5-1.

MODEL: F-5E/F
DATE: 1 DECEMBER 1976
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

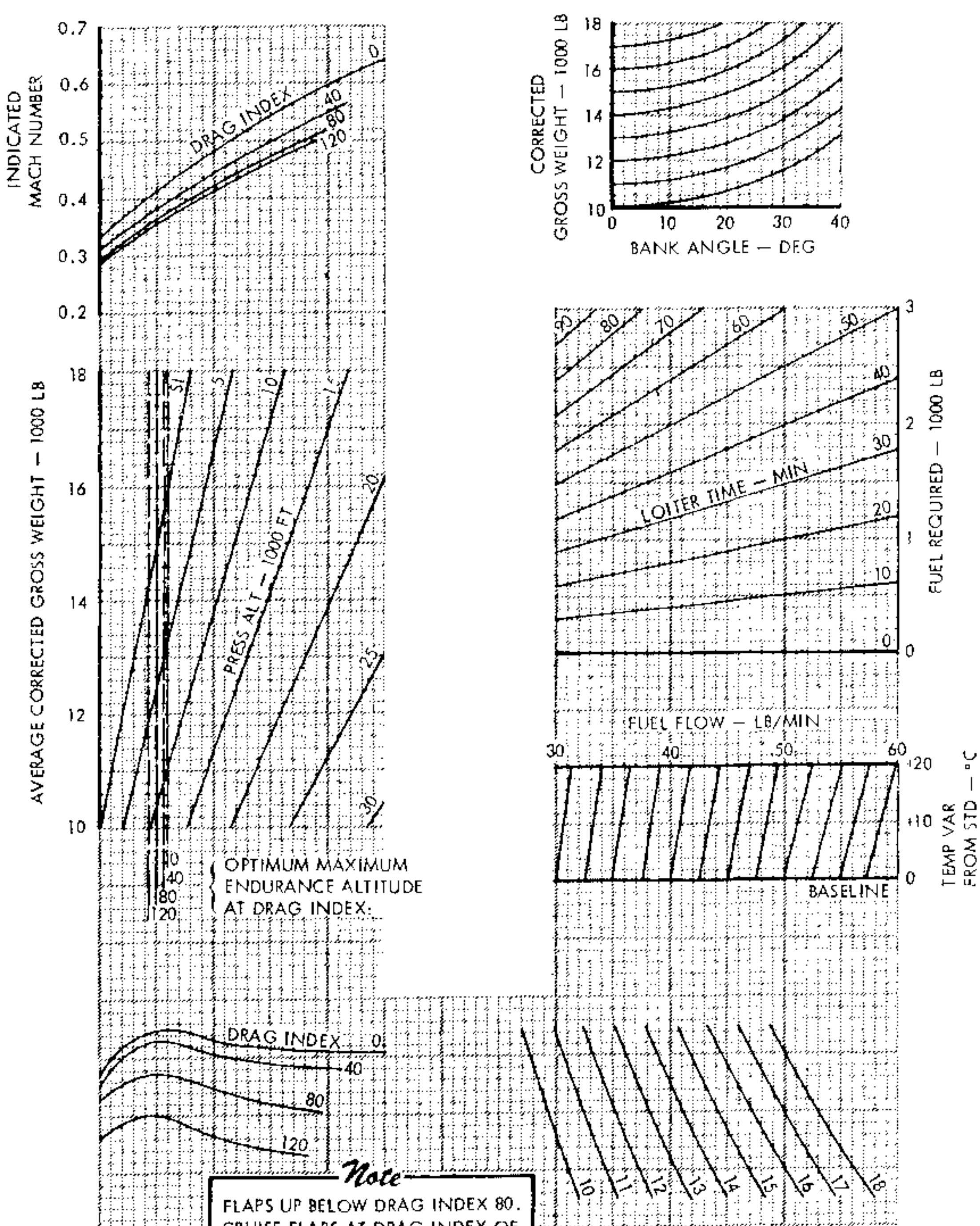
MAXIMUM ENDURANCE

TIME, FUEL, MACH NUMBER, AND OPTIMUM ALTITUDE

DRAG INDEX 0 TO 120

SINGLE ENGINE

E
E-1
E-2
F
F-1



Note

FLAPS UP BELOW DRAG INDEX 80. CRUISE FLAPS AT DRAG INDEX OF 80 AND ABOVE.

F-5 1-584(20)A

FA5-2.

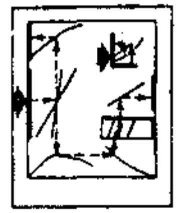
MODEL: F-5E/F
DATE: 1 MARCH 1982
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

MAXIMUM ENDURANCE BELOW 30,000 FEET (FIXED FLAPS)

TIME, FUEL, MACH NUMBER, AND OPTIMUM ALTITUDE

DRAG INDEX 0 TO 400

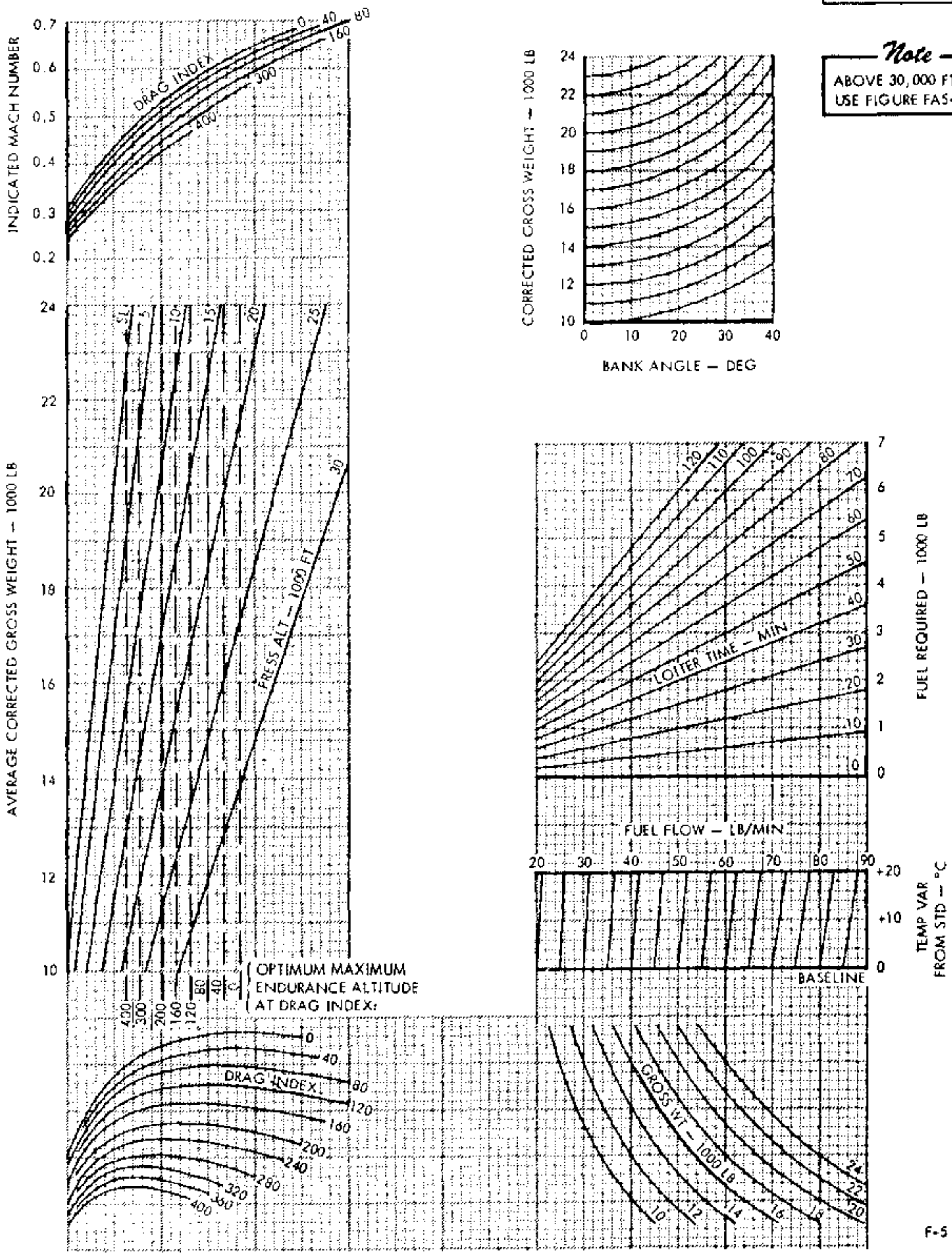


E-3

F-2

Note

ABOVE 30,000 FT USE FIGURE FA5-1.



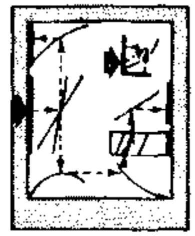
F-5 1-517(5)A

FA5-3.

MODEL: F-5E/F
DATE: 1 MARCH 1982
DATA BASIS: FLIGHT TEST

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

MAXIMUM ENDURANCE BELOW 30,000 FEET (FIXED FLAPS)

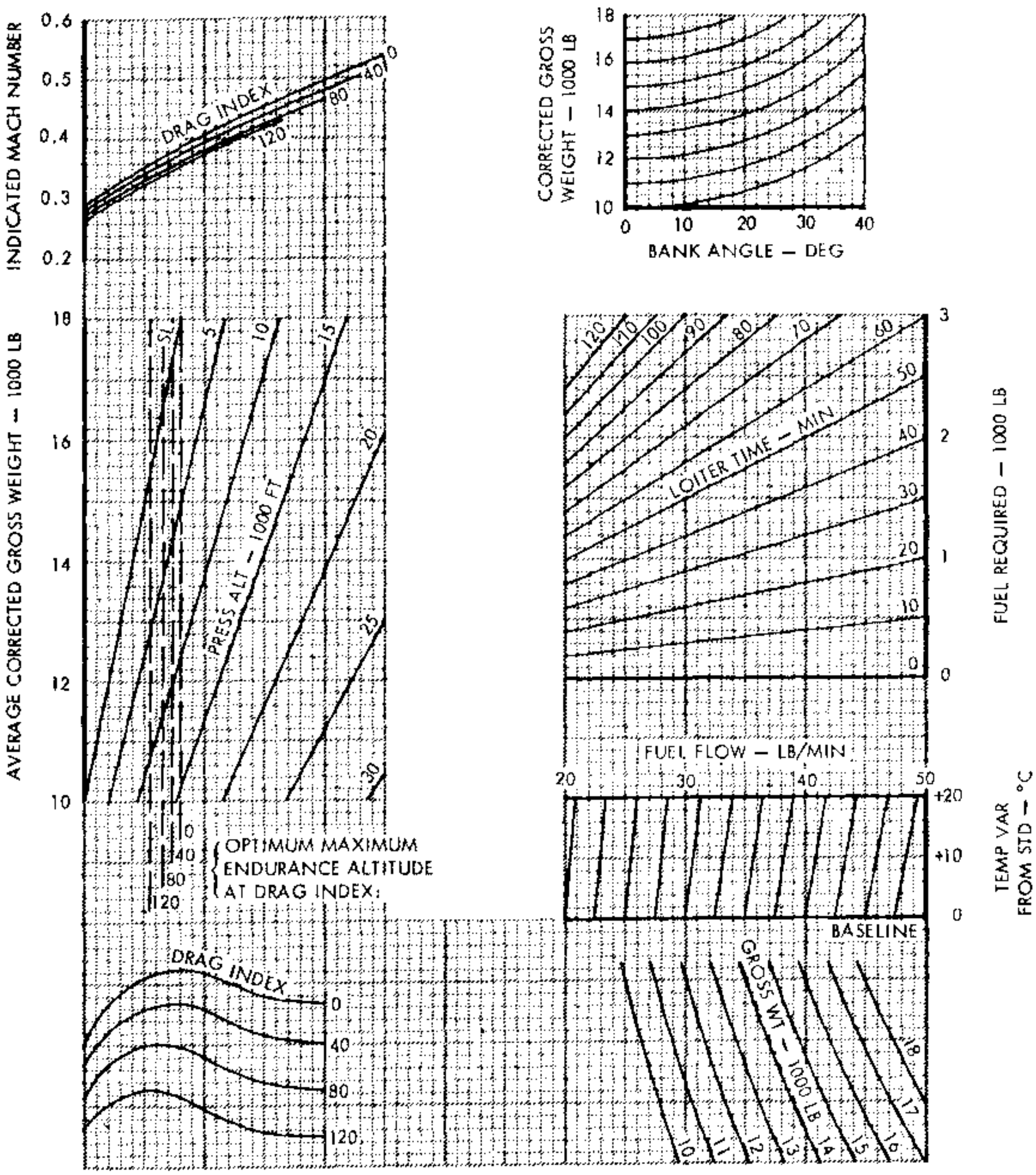


E-3
F-2

TIME, FUEL, MACH NUMBER AND OPTIMUM ALTITUDE

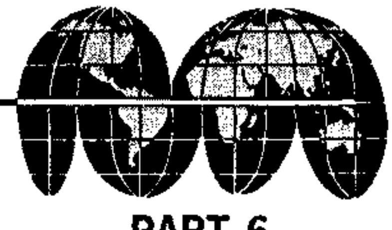
DRAG INDEX 0 TO 120

SINGLE ENGINE



F-5 1-584 (5)

FA5-4.



DESCENT

PART 6

F-5 1-101(1)

TABLE OF CONTENTS

Page numbers underlined denote charts.

MAXIMUM RANGE DESCENT CHART

The Maximum Range Descent chart (FA6-1) provides fuel, time, and distance to descend from altitude with flaps up and speed brake in at idle rpm. These data cover an altitude range from approximately 45,000 feet pressure altitude to sea level at a constant 270 KIAS (Ⓕ 275 KIAS) for drag indexes of 0 to 400 and for all gross weights.

USE

Enter chart at initial descent pressure altitude and proceed up to the value of drag index configuration (interpolation required for values between drag index curves on graphs). Read, fuel, time, and distance required for descent at the left of each plotted drag index. To determine fuel, time, and distance required to descend from a higher altitude to a lower altitude, take the difference between the values read at the two altitudes.

PENETRATION DESCENT CHARTS

The Penetration Descent charts (FA6-2 thru FA6-4) provide fuel, time, and distance to descend from altitude with maneuver/fixed flaps at 80% rpm with the speed brakes positioned at 0, 30 (with centerline tank), and 45 degrees. These data cover an altitude range from approximately 45,000 feet pressure altitude to sea level at a constant 300 KIAS for drag indexes of 0 to 400 (0 to 300 with speed brake at 45 degrees) and for all gross weights.

USE

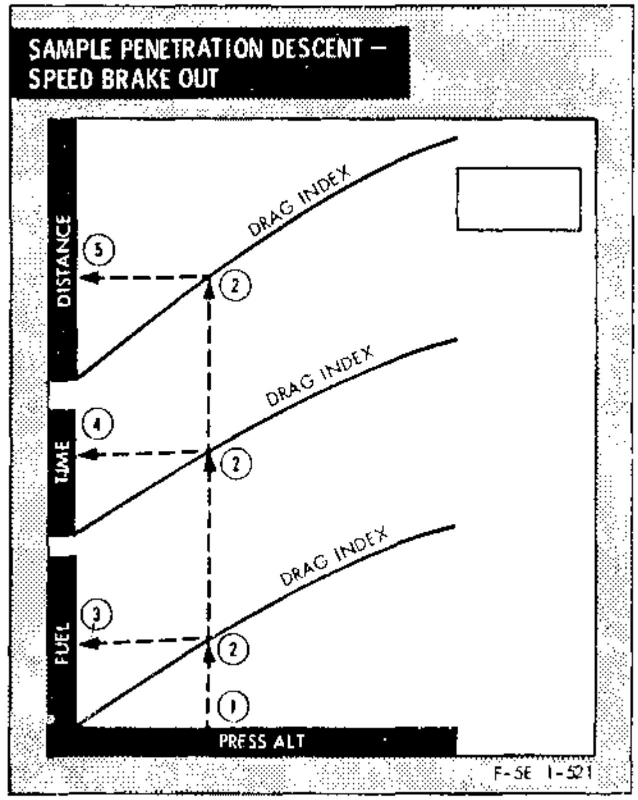
Use of the Penetration Descent charts is the same as that for the Maximum Range Descent chart except for the constant penetration speed of 300 KIAS.

SAMPLE PROBLEM

Given:
A. Configuration drag index: 100.
B. Cruise altitude: 15,000 ft.

Calculate:
A. Fuel, time, and distance required for penetration descent with speed brake at 45 degrees, 300 KIAS, from cruise altitude to sea level.
B. Use Penetration Descent, 80% RPM, chart FA6-4.

①	Press Alt	15,000 ft
②	Drag Index	100
③	Fuel	58 lb
④	Time	2.2 min
⑤	Distance	12.3 nm



MODEL: F-5E/F
DATE: 1 JULY 1975
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

MAXIMUM RANGE DESCENT

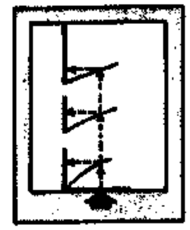
IDLE RPM

SPEED BRAKE IN FLAPS UP

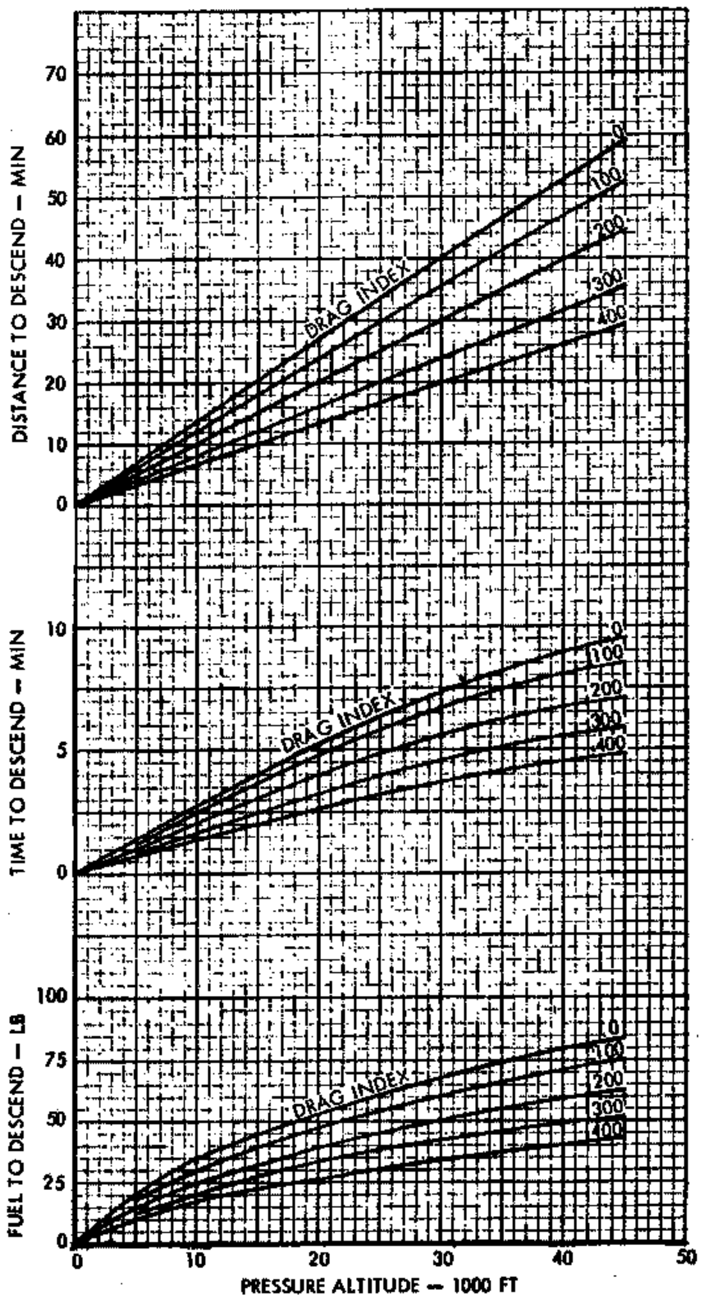
STANDARD DAY

DRAG INDEX 0 TO 400

ALL GROSS WEIGHTS



DESCENT SPEED SCHEDULE
(E) 270 KIAS
(F) 275 KIAS



F-5 1-552(20)B

FA6-1.

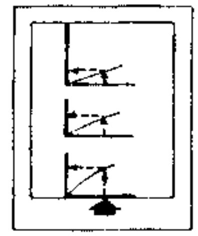
MODEL: F-5E/F
DATE: 1 AUGUST 1983
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

PENETRATION DESCENT

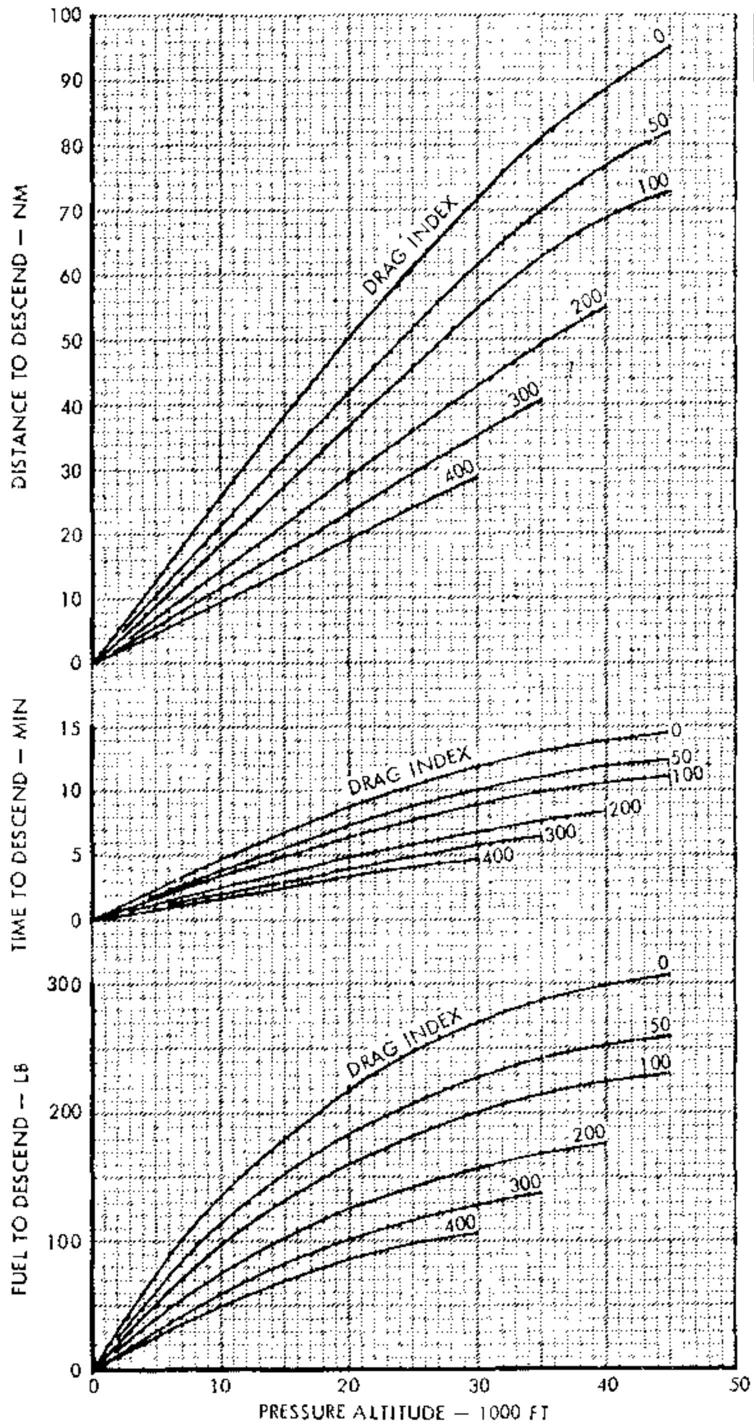
80% RPM

SPEED BRAKE IN   MANEUVER/FIXED FLAPS



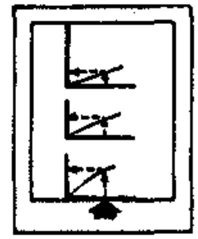
STANDARD DAY
DRAG INDEX 0 TO 400
ALL GROSS WEIGHTS

DESCENT SPEED SCHEDULE — 300 KIAS



F-5 1-553(20)B

FA6-2.



MODEL: F-5E/F
DATE: 1 AUGUST 1983
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

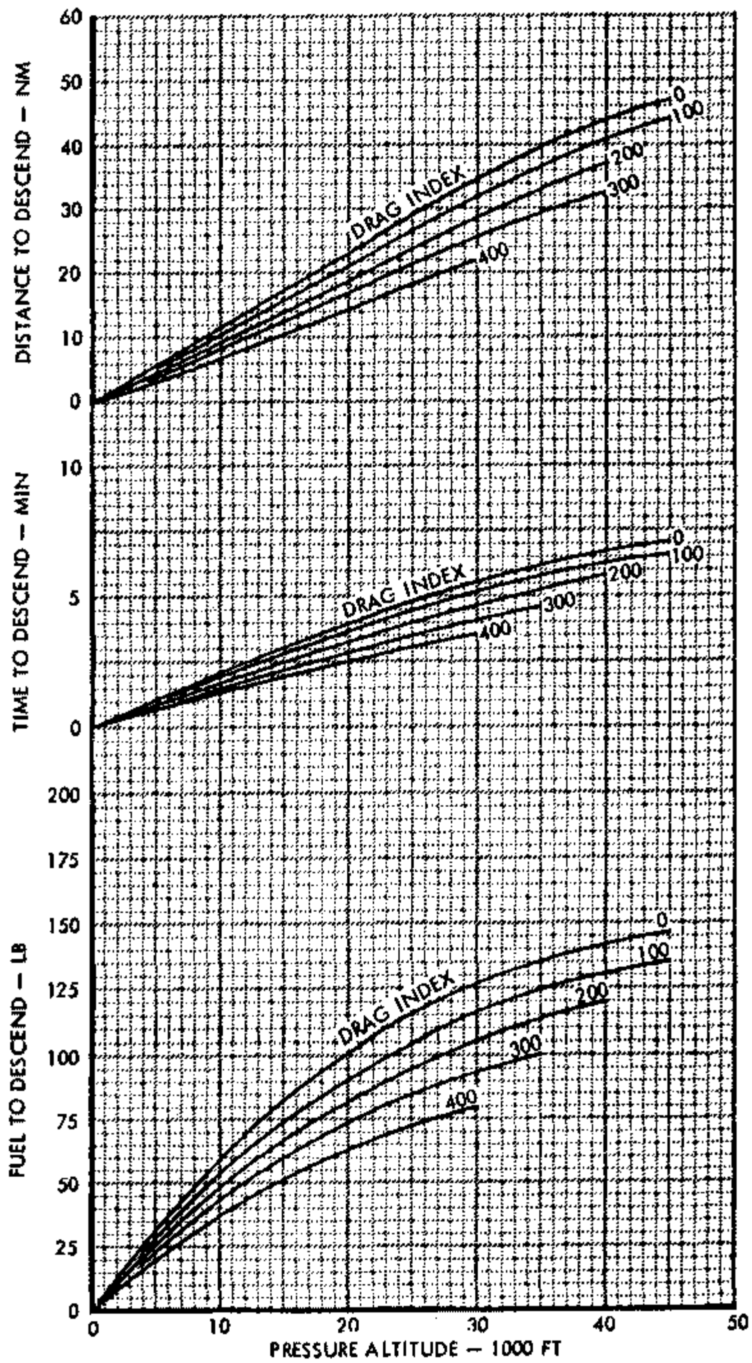
PENETRATION DESCENT

80% RPM

SPEED BRAKE 30° CL TANK MANEUVER/FIXED FLAPS

STANDARD DAY
DRAG INDEX 0 TO 400
ALL GROSS WEIGHTS

DESCENT SPEED SCHEDULE — 300 KIAS



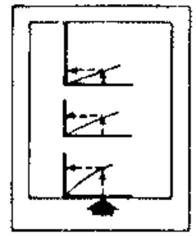
F-5 1-594(20)B

FA6-3.

MODEL: F-5E/F
DATE: 1 AUGUST 1983
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

PENETRATION DESCENT

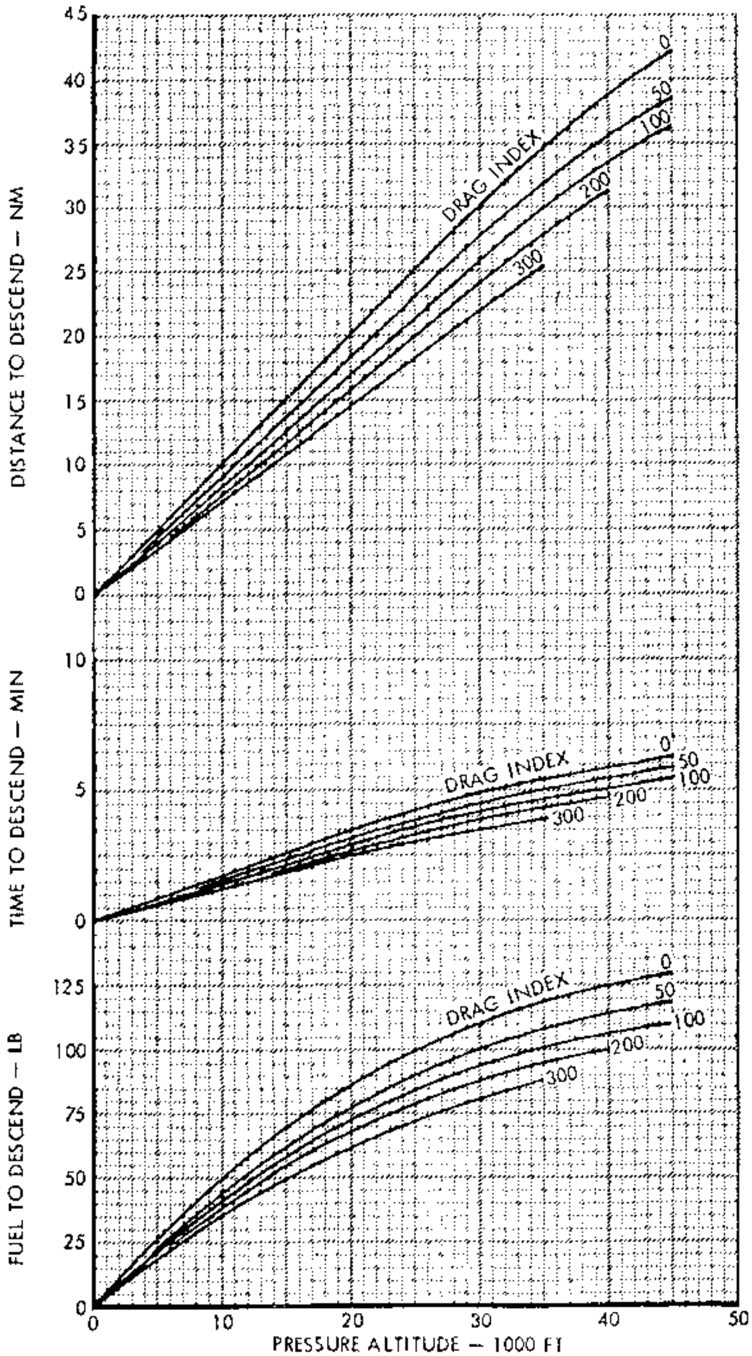


80% RPM

SPEED BRAKE 45° MANEUVER/FIXED FLAPS

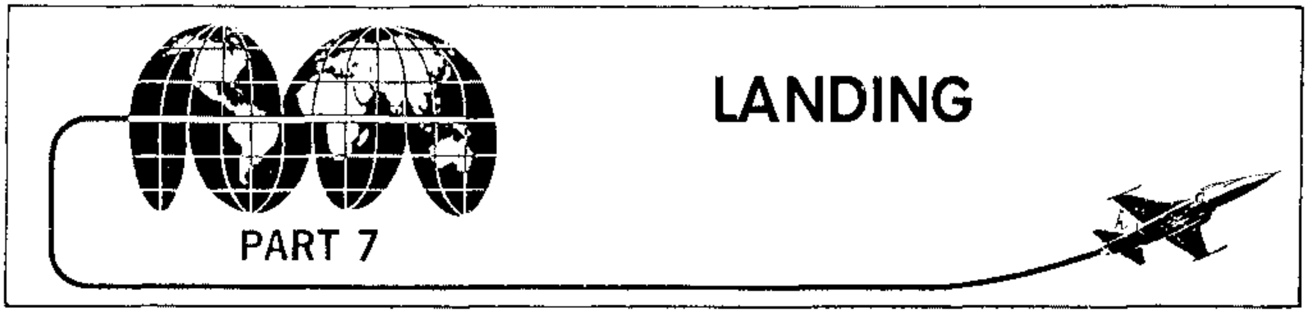
STANDARD DAY
DRAG INDEX 0 TO 300
ALL GROSS WEIGHTS

DESCENT SPEED SCHEDULE – 300 KIAS



F-5 1-554(20)B

FA6-4.



F-5E 1-82

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Page numbers underlined denote charts.

LANDING CHARTS (GENERAL)

Landing charts determine normal final approach speed, total distance from a 50-foot obstacle, touchdown speed, ground roll distance, and minimum distance from touchdown to hook engagement. The Landing Ground Roll and Total Distance charts are based on a cg position of 15% MAC with provisions to show effect on landing distance of drag chute use. All data is based on full flap configuration.

NOTE

Refer to part 1 of this appendix for Runway Wind Components chart.

LANDING SPEED SCHEDULE CHART

The Landing Speed Schedule chart (FA7-1, sheets 1 and 2) presents final approach and touchdown speeds as a function of gross weight and cg position. The AOA indexer Ⓔ should be used as the primary reference for normal landings. Disregard the indexer for single-engine landings.

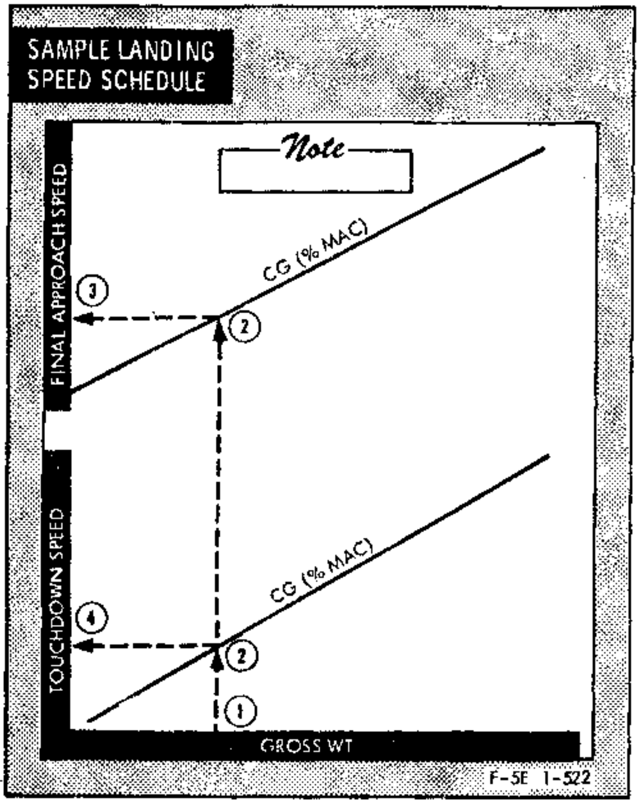
USE

Enter FA7-1 with gross weight and proceed vertically up to cg position (% MAC) on touchdown speed and final approach speed scales of the chart. At each point of intersection of the cg curves, proceed horizontally left and read values of final approach and touchdown speeds, respectively.

SAMPLE PROBLEM

Given:

A. Landing gross weight: 12,100 lb.
B. CG position: 19% MAC.



Calculate:

A. Final approach and touchdown speeds.
B. Use Landing Speed Schedule chart FA7-1.

①	Gross Wt	12,100 lb
②	CG	19%
③	Final Approach Speed	147 KIAS
④	Touchdown Speed	137 KIAS

LANDING DISTANCE CHARTS

Two Landing Distance charts (FA7-2 and FA7-3) (without and with drag chute) present ground roll distance and total distance from 50-foot obstacle as a function of runway temperature, pressure altitude, gross weight, and wind velocity for a cg position of 15% MAC. Total landing distance is based on passing over the 50-foot obstacle at final approach speed on a 3-degree flight path angle followed by a landing flare and touchdown at computed touchdown speed with zero rate of sink.

The flare initiation height tends to increase with landing weight. Ground roll distance is based on heavy braking throughout ground roll on a dry, hard-surfaced runway following a 3-second free roll period to allow the nose to fall thru, and another second for brake application. Ground roll distance, using the drag chute and heavy braking is based on deployment of the drag chute up to 180 KIAS. The chute handle is assumed to be pulled at the nosewheel down point, with full deployment following in 2 seconds. Shorter stopping distances can be achieved by use of maximum braking.

USE

Enter appropriate chart with runway temperature, proceed up to pressure altitude, and then right to gross weight. From this point proceed downward to the baseline (zero-wind line). Move down contouring the appropriate guideline (headwind or tailwind) to wind velocity, then vertically down and read ground roll distance. Continue down to the zero, headwind, or tailwind velocity curve and then left to read total distance from 50-foot obstacle.

SAMPLE PROBLEM

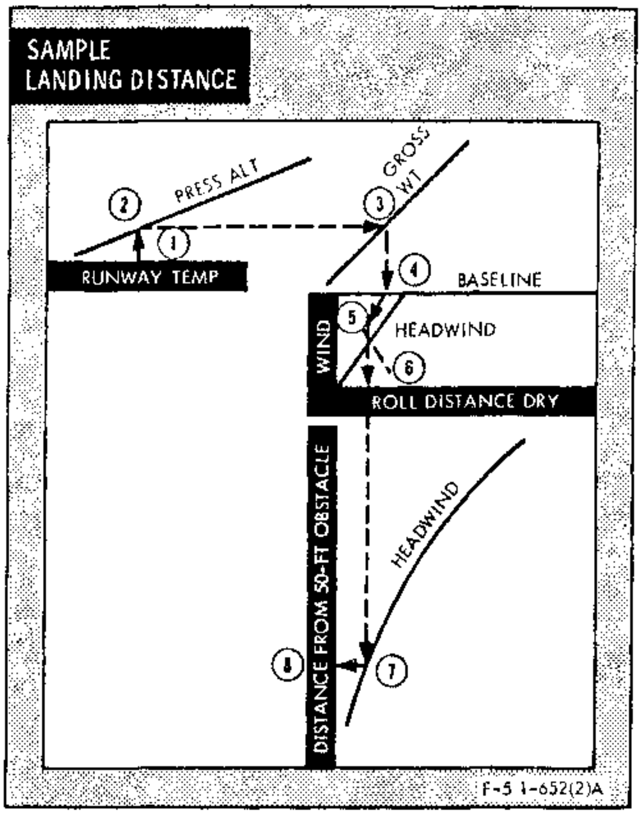
Given:

A. Runway temperature: +13°C.
B. Runway pressure altitude: 1000 ft.
C. Landing gross weight: 12,100 lb.
D. Headwind: 20 kt.
E. No drag chute.

Calculate:

A. Ground roll distance and total distance from 50-foot obstacle.
B. Use Landing Distance, Full Flaps, CG 15% MAC, No Drag Chute chart FA7-2.

①	Runway Temp	+13°C
②	Press Alt	1000 ft
③	Gross Wt	12,100 lb
④	Baseline	—
⑤	Headwind	20 kt
⑥	Ground Roll Distance	2750 ft
⑦	Headwind	20 kt
⑧	Total Distance (from 50-ft obstacle)	4300 ft



EFFECT OF RUNWAY CONDITIONS (RCR) ON GROUND ROLL DISTANCE CHARTS

The Effect of Runway Conditions (RCR) on Ground Roll Distance charts for use without and with drag chute are presented in FA7-4 and FA7-5, respectively. The charts correct the landing ground roll distance for changes in braking efficiency caused by variations in runway surface conditions. An RCR of 23 represents heavy braking action on a dry, hard-surfaced runway. An RCR less than 23 represents a decrease in braking efficiency.

USE

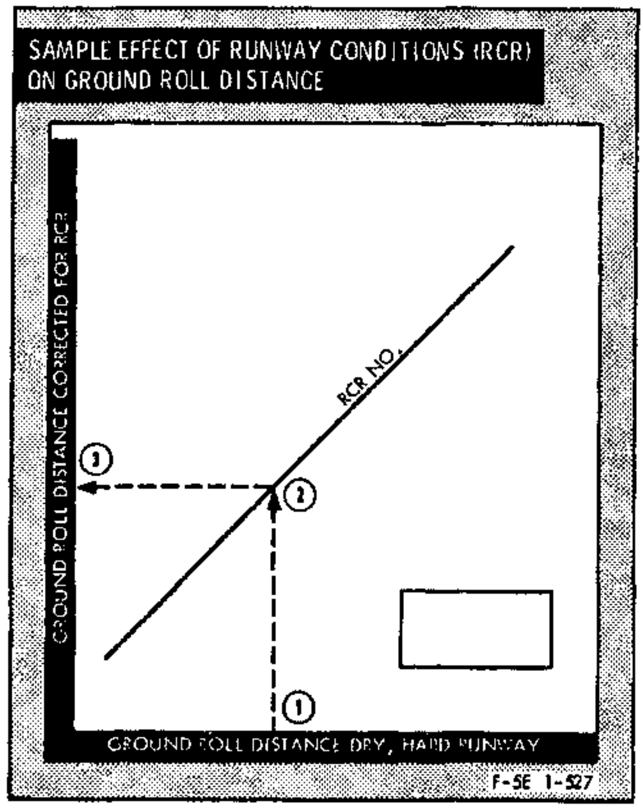
Enter appropriate chart with ground roll distance for dry, hard-surfaced runway and proceed vertically upward to RCR number. Then proceed horizontally left to read corrected ground roll distance.

SAMPLE PROBLEM

Given:
A. Ground roll distance (dry, hard-surfaced runway): 2750 ft.
B. RCR: 12
C. No drag chute.

Calculate:
A. Ground roll distance corrected for RCR.
B. Use Effect of Runway Conditions (RCR) on Ground Roll Distance chart FA7-4.

①	Ground Roll Distance	2750 ft
②	RCR	12
③	Ground Roll Distance Corrected for RCR	4300 ft



ARRESTING HOOK ENGAGEMENT CHARTS (GENERAL)

The arresting hook engagement speeds are based on a maximum hook load limit of 57,000 pounds. The distance required to decelerate from the normal touchdown speed to the hook limit speed is shown for hook engagement speeds of 160 knots and 125 knots. The 160-knot engagement speed is to be used with the BAK-9, BAK-12 (conventional or single mode), and 61QSII arresting cables and the 125-knot engagement speed is to be used with any authorized arresting barrier (except heavyweight with M-21 barrier). These distances are based on normal landing speeds and techniques.

MINIMUM DISTANCE FROM TOUCHDOWN TO HOOK ENGAGEMENT CHARTS

The Distance from Touchdown to Hook Engagement charts for 160-knot and 125-knot engagement speeds (FA7-6 and FA7-7) present the minimum distance required to lower the nosewheel to the runway, apply brakes, and decelerate from the recommended landing speed at touchdown to the recommended hook engagement speed for a cg position of 15% MAC. This distance is a function of runway temperature, pressure altitude, and gross weight. Corrections are provided in the chart for headwind or tailwind and RCR.

USE

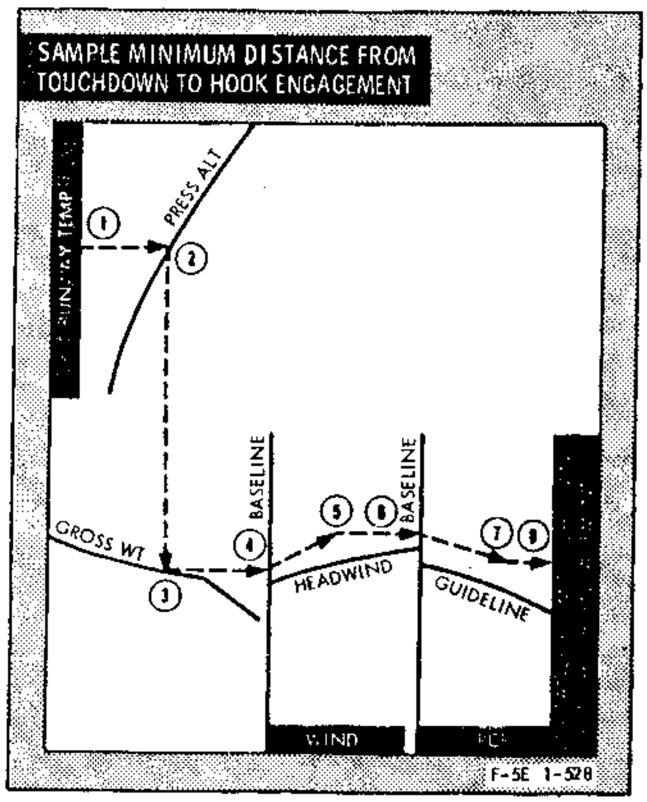
Enter appropriate chart with runway temperature and proceed right to pressure altitude. From this point, proceed down to the landing gross weight, then right to the wind correction baseline. Contour the guidelines for either headwind or tailwind to the wind velocity (if no wind, proceed directly thru). From this point proceed right to the RCR correction baseline. Contour the guidelines, as appropriate, to the RCR value for the runway condition (if runway is dry, hard-surfaced proceed directly thru) and proceed right to read distance from touchdown to hook engagement.

SAMPLE PROBLEM

Given:
A. Runway temperature: +15°C.
B. Runway pressure altitude: 1000 ft.
C. Gross weight: 13,000 lb.
D. Headwind: 20 kt.
E. RCR: 12.
F. Hook engagement speed: 125 kt.

Calculate:
A. Distance from touchdown to hook engagement.
B. Use Minimum Distance from Touchdown to Hook Engagement, 125-knot Hook Engagement Speed, No Drag Chute, CG 15% MAC chart FA7-7.

①	Runway Temp	+15°C
②	Press Alt	1000 ft
③	Gross Wt	13,000 lb
④	Baseline	—
⑤	Headwind	20 kt
⑥	Baseline	—
⑦	RCR	12
⑧	Distance from Touchdown to Hook Engagement (cg 15%)	650 ft

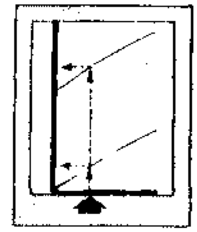


MODEL: F-5E
DATE: 1 MARCH 1976
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

LANDING SPEED SCHEDULE

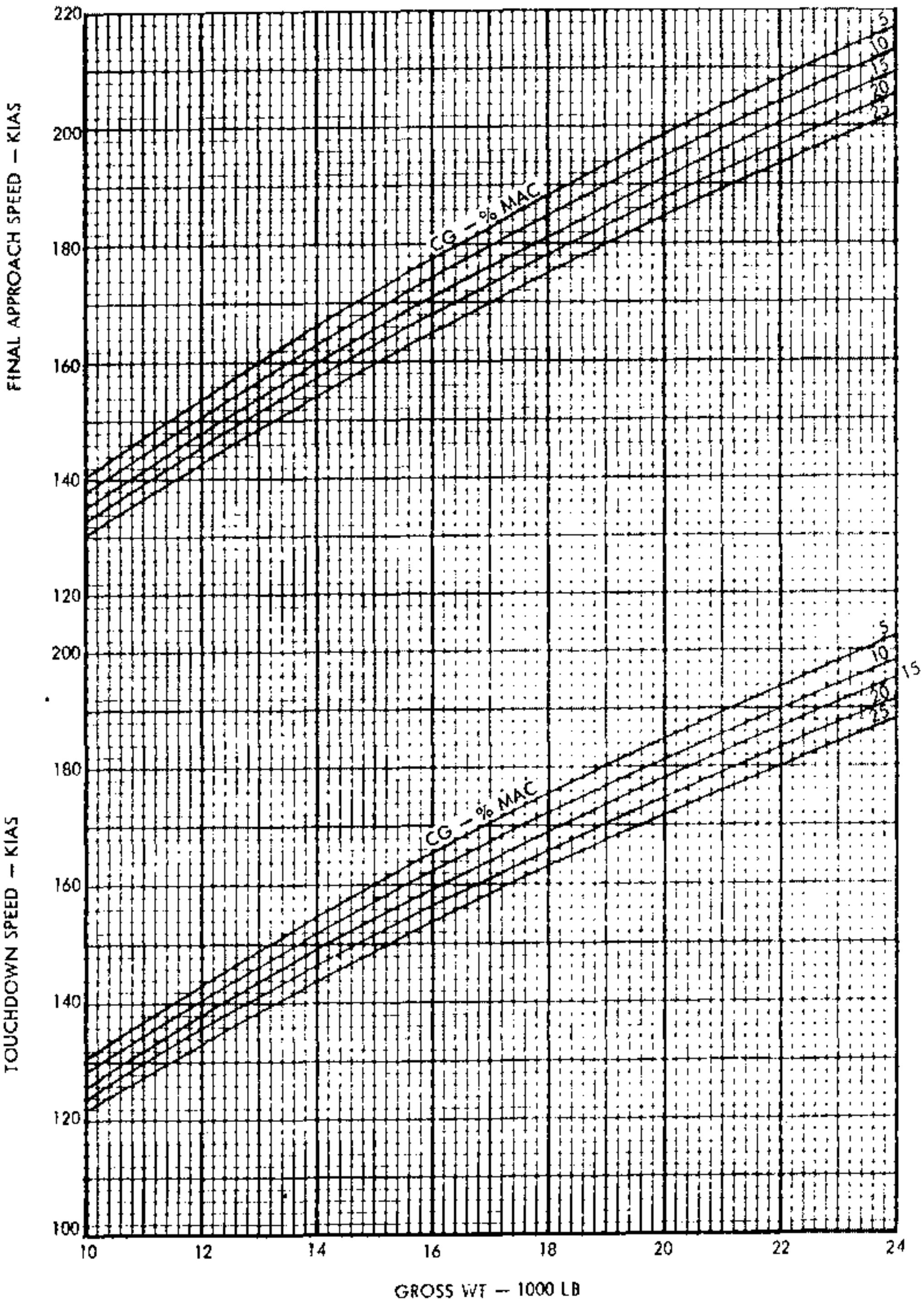
FULL FLAPS



E

Note

THRESHOLD SPEED (50-FOOT OBSTACLE) IS EQUAL TO FINAL APPROACH SPEED.



F-5 1-502(20)B

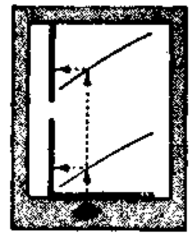
FA7-1 (Sheet 1).

MODEL: F-5F
DATE: 1 AUGUST 1976
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

LANDING SPEED SCHEDULE

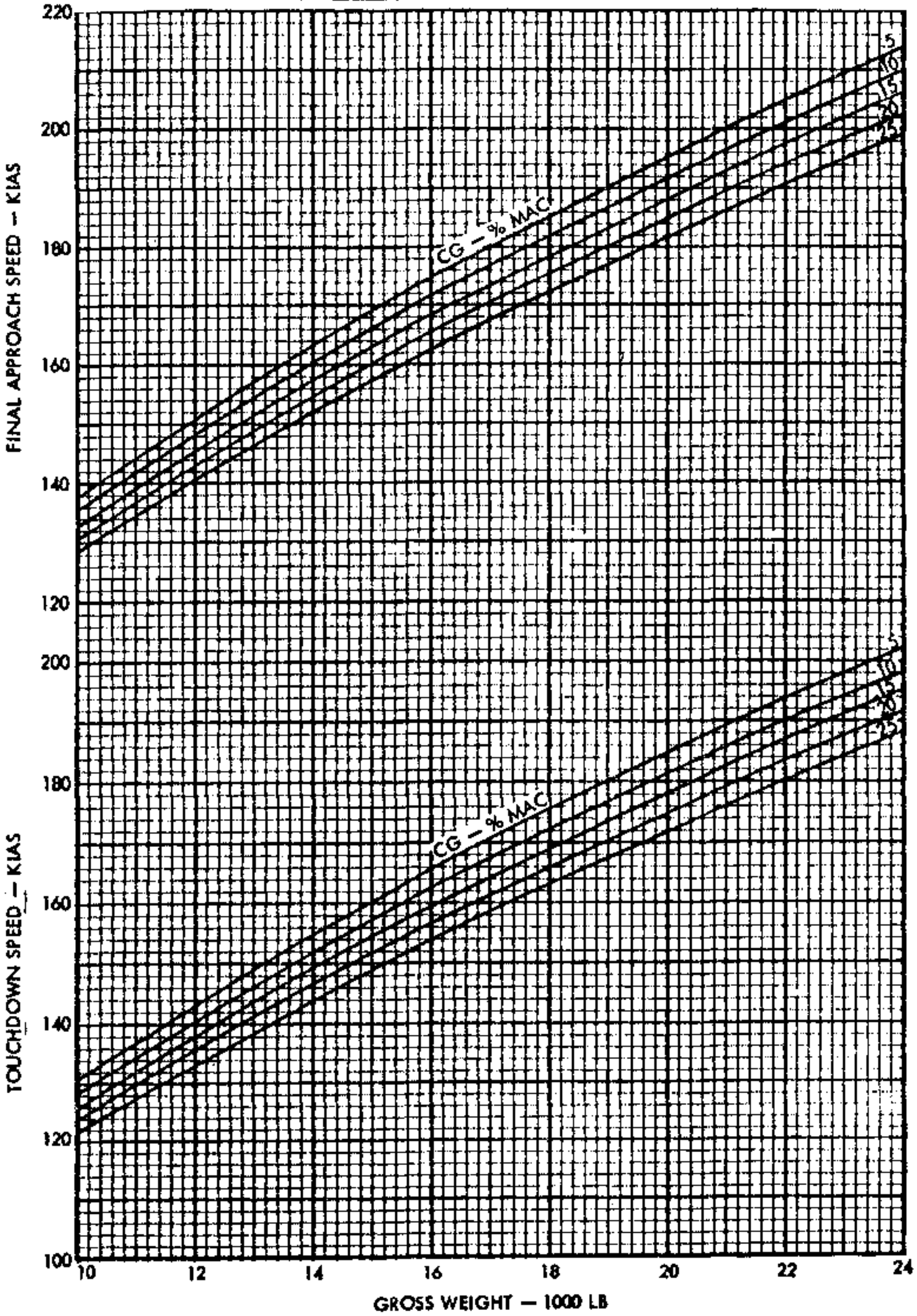
FULL FLAPS



F

Note

THRESHOLD SPEED (50-FOOT OBSTACLE) IS EQUAL TO FINAL APPROACH SPEED.



F-5 1-502(21)

FA7-1 (Sheet 2).

MODEL: F-5E/F
DATE: 1 AUGUST 1984
DATA BASIS: **FLIGHT TEST**

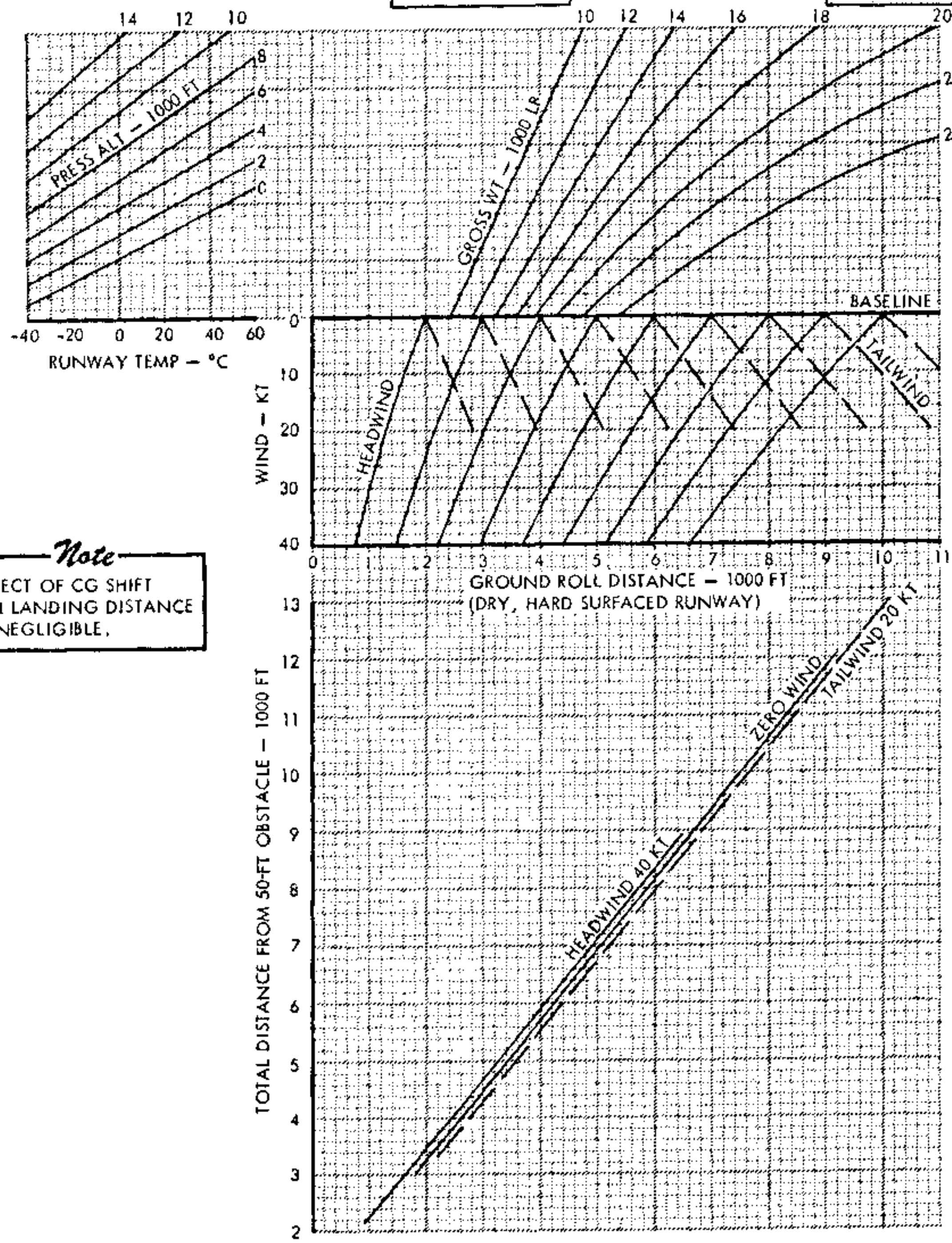
ENGINES: (2)J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

LANDING DISTANCE

MAJOR CHANGE

FULL FLAPS
CG 15% MAC

NO DRAG CHUTE



Note

EFFECT OF CG SHIFT ON LANDING DISTANCE IS NEGLIGIBLE.

F-5 1-500(20)C

FA7-2.

MODEL: F-5E/F
DATE: 1 AUGUST 1984
DATA BASIS: FLIGHT TEST

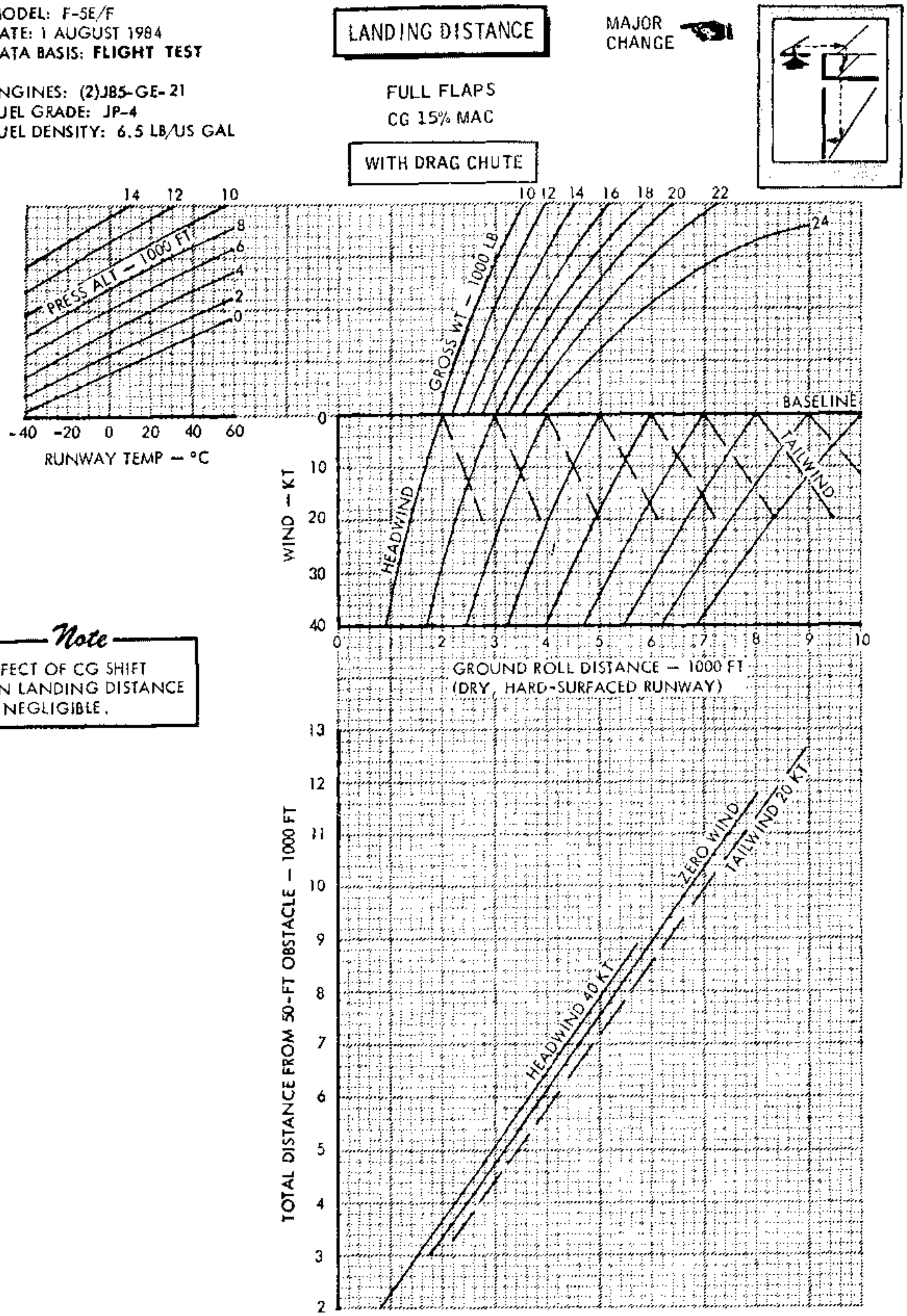
ENGINES: (2)J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

LANDING DISTANCE

FULL FLAPS
CG 15% MAC

WITH DRAG CHUTE

MAJOR CHANGE



Note

EFFECT OF CG SHIFT ON LANDING DISTANCE IS NEGLIGIBLE.

F-5 1-501(20)B

FA7-3.

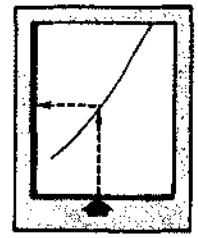
MODEL: F-5E/F
DATE: 1 AUGUST 1980
DATA BASIS: FLIGHT TEST

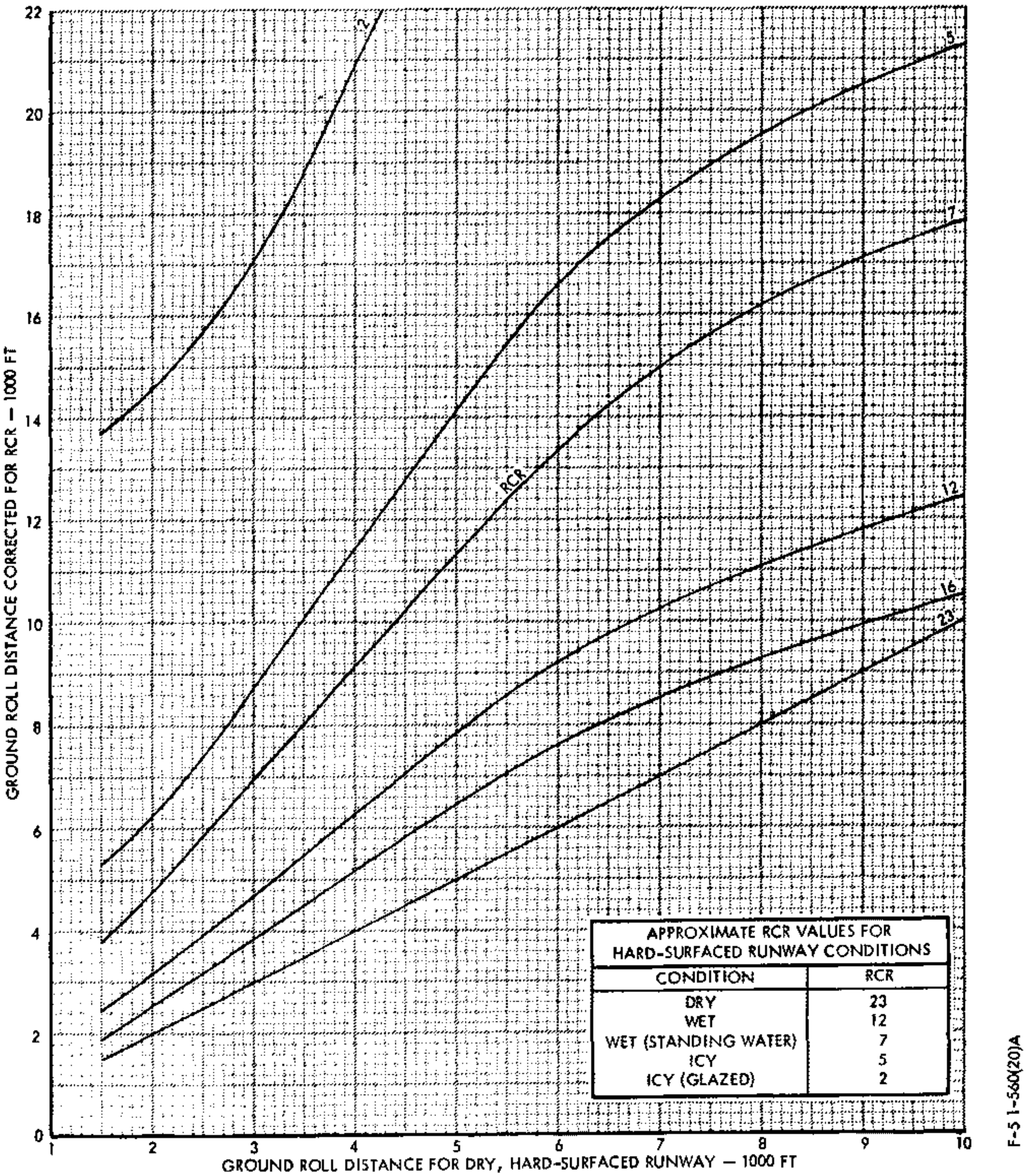
ENGINES: (2)J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

EFFECT OF RUNWAY CONDITIONS (RCR) ON GROUND ROLL DISTANCE

FULL FLAPS

NO DRAG CHUTE





APPROXIMATE RCR VALUES FOR HARD-SURFACED RUNWAY CONDITIONS	
CONDITION	RCR
DRY	23
WET	12
WET (STANDING WATER)	7
ICY	5
ICY (GLAZED)	2

FA7-4.

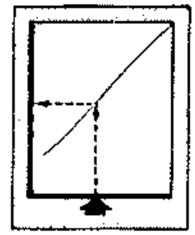
MODEL: F-5E/F
DATE: 1 AUGUST 1980
DATA BASIS: **FLIGHT TEST**

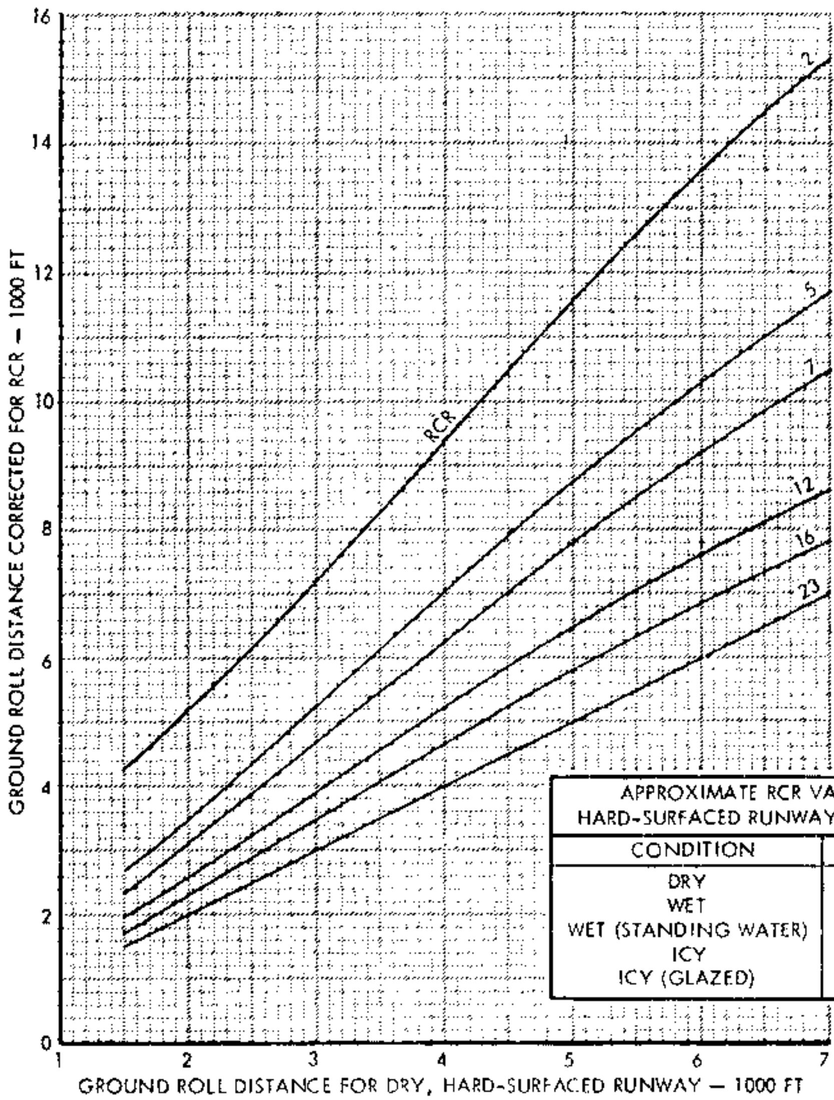
ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

EFFECT OF RUNWAY CONDITIONS (RCR) ON GROUND ROLL DISTANCE

FULL FLAPS

WITH DRAG CHUTE





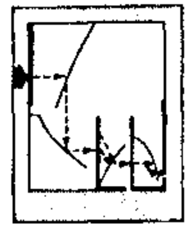
APPROXIMATE RCR VALUES FOR HARD-SURFACED RUNWAY CONDITIONS	
CONDITION	RCR
DRY	23
WET	12
WET (STANDING WATER)	7
ICY	5
ICY (GLAZED)	2

F-5 1-561(20)A

FA7-5.

MODEL: F-5E/F
DATE: 1 AUGUST 1977
DATA BASIS: **FLIGHT TEST**
ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

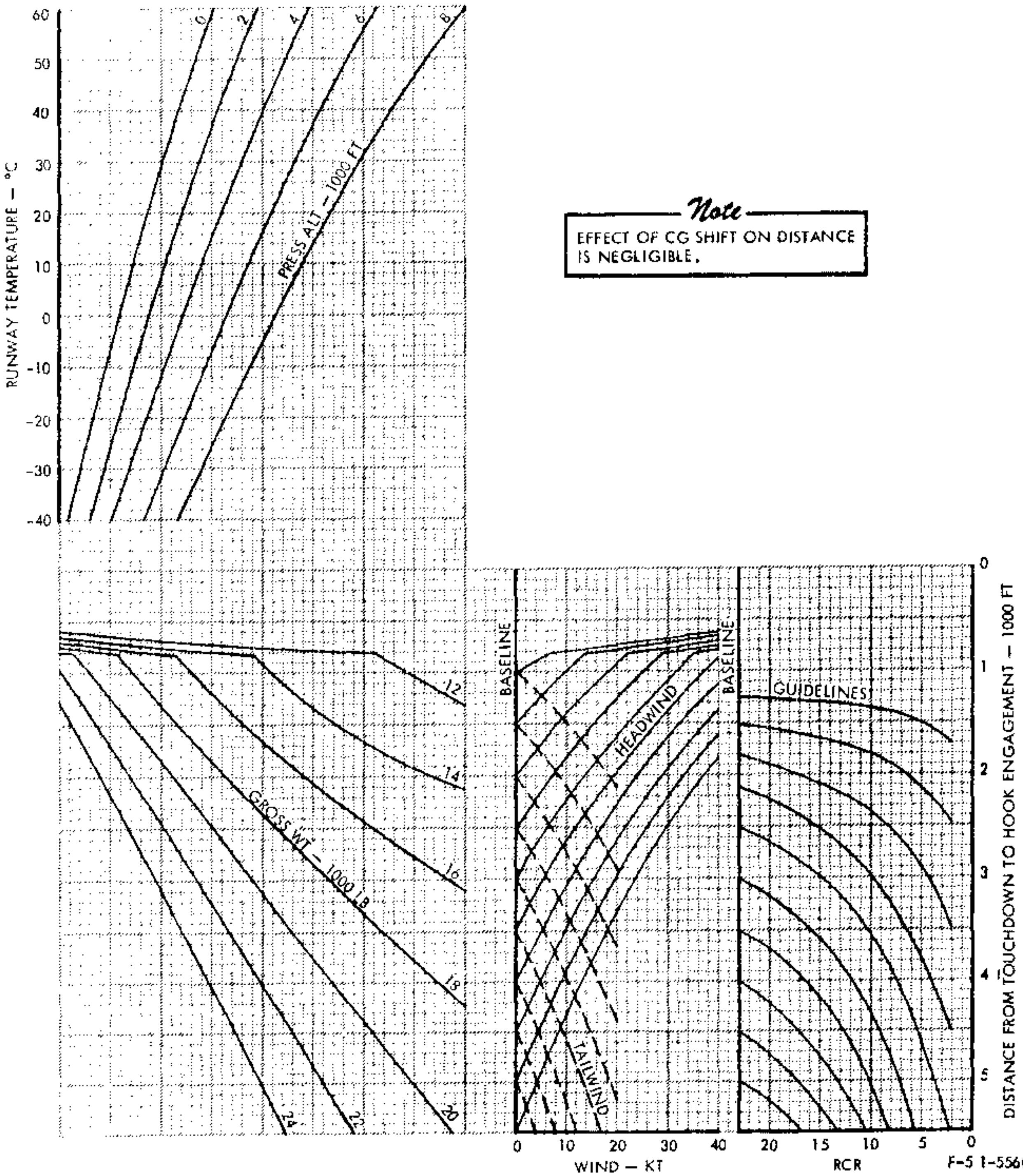
MINIMUM DISTANCE FROM TOUCHDOWN TO HOOK ENGAGEMENT (BASED ON RECOMMENDED TOUCHDOWN SPEED)



160-KNOT HOOK ENGAGEMENT SPEED

NO DRAG CHUTE

CG = 15% MAC



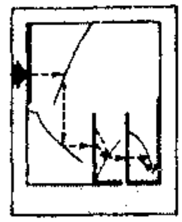
Note
EFFECT OF CG SHIFT ON DISTANCE IS NEGLIGIBLE.

FA7-6.

MODEL: F-5E/F
DATE: 1 AUGUST 1977
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

MINIMUM DISTANCE FROM TOUCHDOWN TO HOOK ENGAGEMENT (BASED ON RECOMMENDED TOUCHDOWN SPEED)



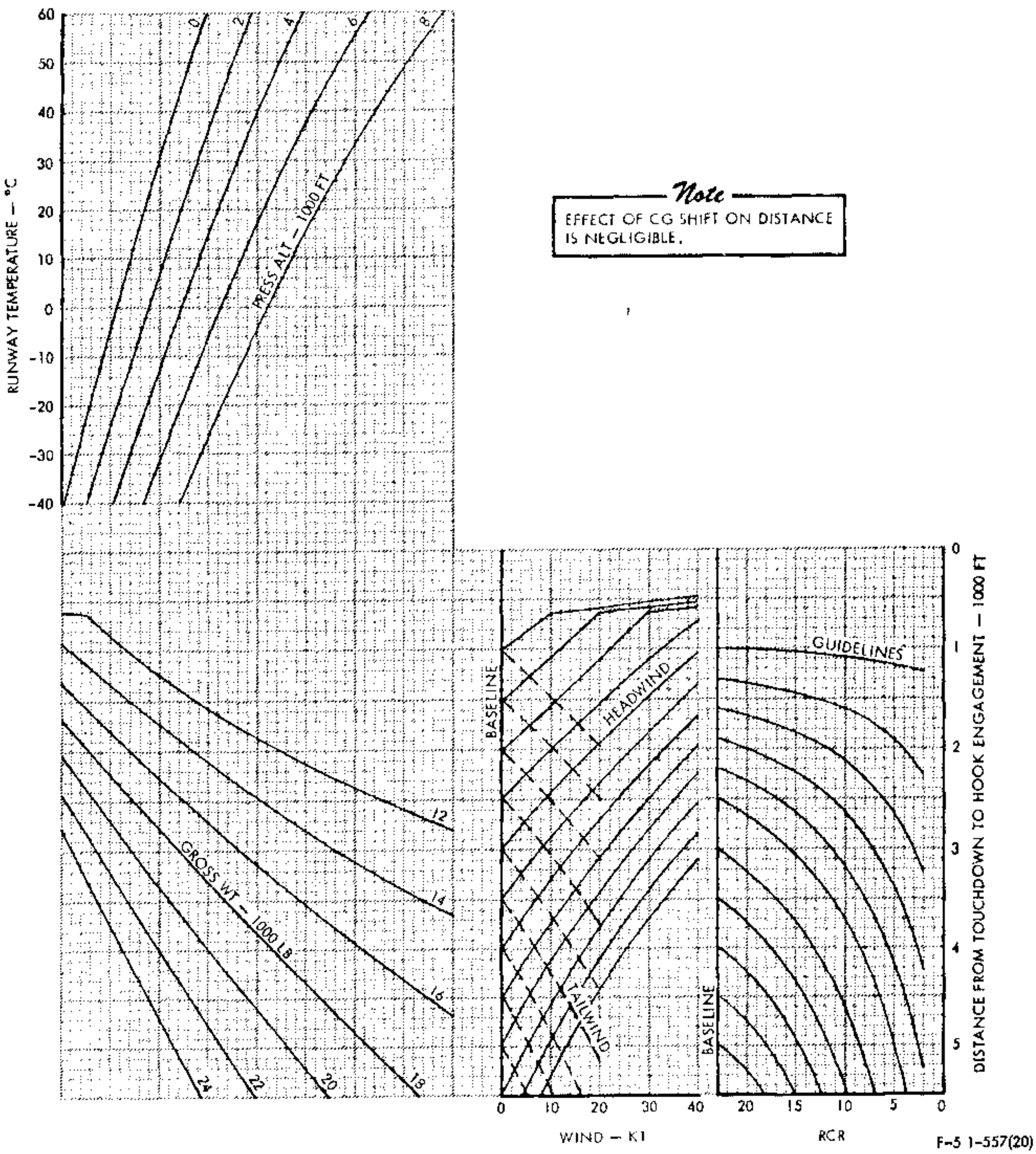
125-KNOT HOOK ENGAGEMENT SPEED

NO DRAG CHUTE

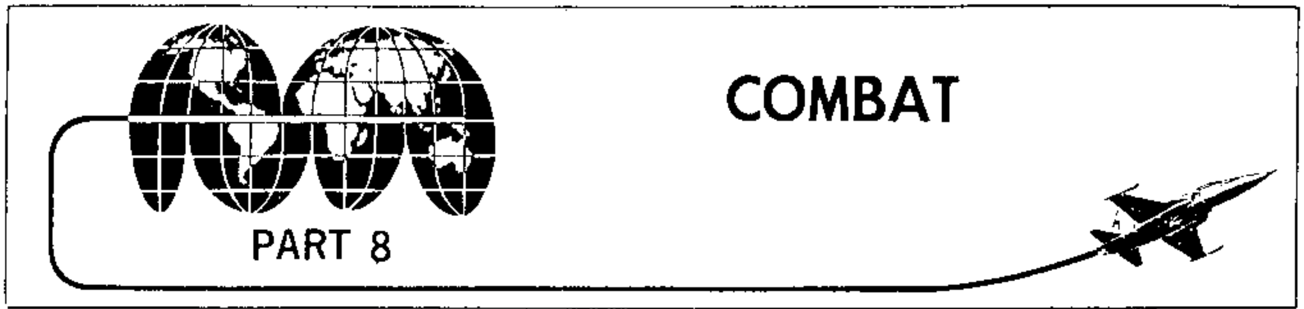
CG = 15% MAC

Note

EFFECT OF CG SHIFT ON DISTANCE IS NEGLIGIBLE.



FA7-7.



F-5E 1-83

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Page numbers underlined denote charts.

COMBAT PERFORMANCE CHARTS (GENERAL)

The combat performance charts provide data for use during maneuvering flight at low altitude, high altitude, supersonic climb, and level flight with maximum and military thrust and the use of maneuver/auto flaps. Turn performance data are presented for accelerating, decelerating, and steady state conditions.

COMBAT FUEL ALLOWANCE CHART

The Combat Fuel Allowance chart (FA8-1) for maximum or military thrust determines total fuel flow for two engines in pounds per minute as a function of pressure altitude and mach number.

USE

Enter appropriate thrust chart with pressure altitude and proceed right to indicated mach number. Move down and read fuel flow in pounds per minute.

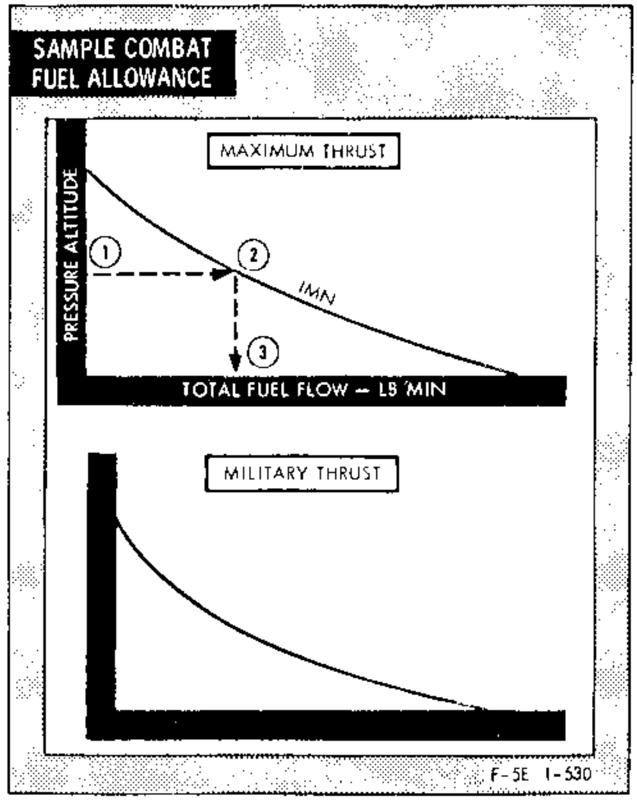
SAMPLE PROBLEM

Given:
A. Pressure altitude: 26,000 ft.
B. Airspeed: 1.2 IMN.
C. Maximum thrust.
D. Combat duration: 3 min.

Calculate:
A. Fuel flow and fuel used during combat.
B. Use Combat Fuel Allowance, Maximum Thrust, chart FA8-1.

①	Press Alt	26,000 ft
②	Airspeed	1.2 IMN
③	Fuel Flow	290 lb/min

C. Fuel flow (290 lb/min) X Time (3 min) = Total Fuel Used.
Thus: 290 lb/min X 3 min = 870 lb.



LEVEL FLIGHT ACCELERATION AT LOW ALTITUDE CHARTS

Level Flight Acceleration at Low Altitude for maximum and military thrust is shown in FA8-2 and FA8-3. The time, distance, and fuel required to accelerate from 0.5 IMN are presented as a function of drag index, initial gross weight, final desired indicated mach number, and ambient temperature. Maximum thrust covers a drag index range of 0 thru 400. Military thrust covers the range of 0 thru 200 because of the low acceleration obtained at high drag index numbers.

USE

Enter appropriate chart with initial gross weight (operating weight) and proceed right to terminal (desired) indicated mach number. From this point proceed down to the baseline (standard temperature) of the temperature portion of the chart and then parallel the guidelines for hotter or colder (if necessary) temperature to the temperature in degrees above or below standard.

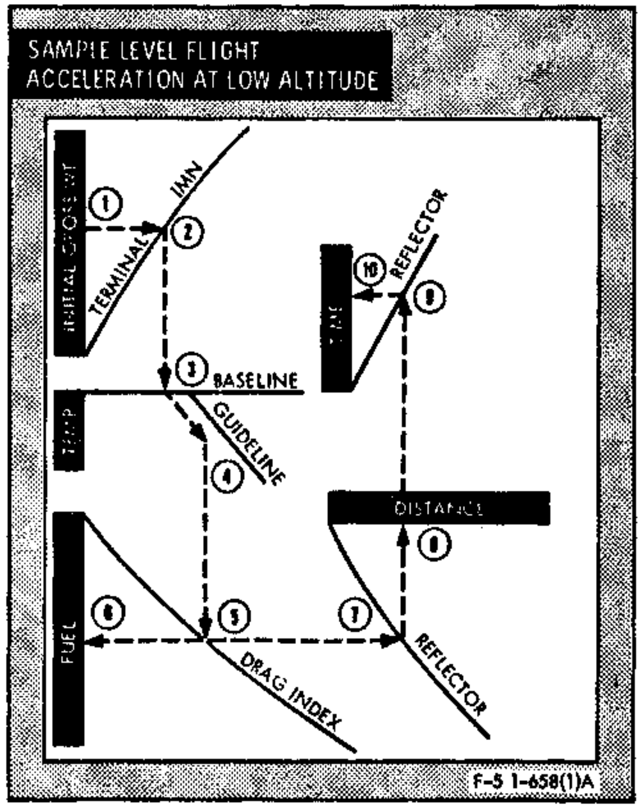
From this point, again proceed down to the drag index curve and left to read fuel required. Return to the drag index point of intersection and proceed right to the distance guideline and then up, noting the distance, to the time guideline. At this point move left and read time in minutes.

SAMPLE PROBLEM

Given:
A. Pressure altitude: 3000 ft.
B. Maximum thrust.
C. Accelerate from 0.5 IMN to 0.85 IMN.
D. Initial gross weight: 14,800 lb.
E. Temperature: 10°C hotter-than-standard.
F. Drag index: 85.

Calculate:
A. Fuel, distance, and time.
B. Use Level Flight Acceleration at Low Altitude, Maximum Thrust, Initial Mach 0.5, Drag Index 0 to 400 chart, FA8-2.

①	Initial Gross Wt	14,800 lb
②	Terminal IMN	0.85
③	Baseline (std temp)	—
④	Temp	10°C (hotter)
⑤	Drag Index	85
⑥	Fuel	230 lb
⑦	Reflector	—
⑧	Distance	3.6 nm
⑨	Reflector	—
⑩	Time	0.5 min



LEVEL FLIGHT ACCELERATION AT 36,000 FEET (HIGH ALTITUDE) CHARTS

Level Flight Acceleration at 36,000 feet is shown in FA8-4, sheets 1 and 2, thru FA8-7, sheets 1 and 2. The time, distance, and fuel required to accelerate from an initial speed of 0.8 mach number are presented as a function of initial gross weight (operating weight), final desired indicated mach number, and temperature. Data is shown for maximum thrust at 36,000 feet with two wingtip configurations and two wingtip with centerline 275-gallon fuel tank configurations. Dashed lines crossing the constant mach number lines in the upper (initial weight) portion of the charts indicate approximately the maximum speed (M_{Max} less 0.02) to which the aircraft with various numbers of pylons can accelerate in a reasonable length of time.

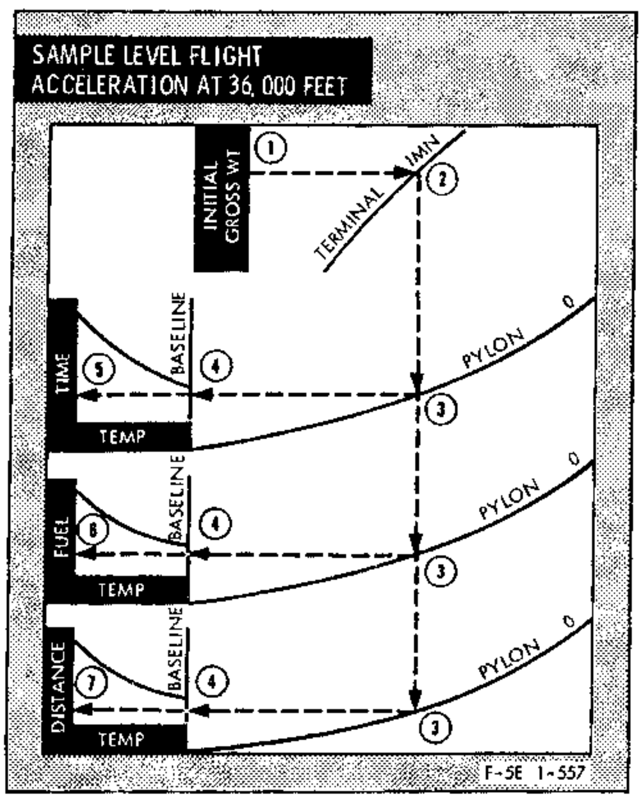
USE

Enter appropriate chart with initial gross weight and proceed right to terminal (final) mach number and then project downward completely thru the time, fuel, and distance portions of the chart. At each point of intersection of the curves representing proper pylon configuration, proceed left to the baseline of each temperature scale (standard temperature). If temperature is standard, proceed horizontally across; if not, contour the guideline for temperature variation to the temperature in degrees above or below standard. Continue left to read: time — min, fuel — lb, and distance — nm, respectively.

SAMPLE PROBLEM

Given:

A. Pressure altitude: 36,000 ft.
B. Maximum thrust.
C. Accelerate from 0.8 IMN to 1.4 IMN.
D. (2) AIM-9 missiles, (0) pylons.
E. Initial gross weight: 14,200 lb.
F. Temperature (at altitude): Std.



Calculate:

A. Time, fuel, and distance required.
B. Use Level Flight Acceleration at 36,000 Feet chart FA8-5, sheet 1.

①	Initial Gross Wt	14,200 lb
②	Terminal IMN	1.4
③	Pylon	0
④	Baseline	—
⑤	Time	3 min
⑥	Fuel	610 lb
⑦	Distance	34 nm

SUPERSONIC ZOOM CLIMB CHART

The Supersonic Zoom Climb chart, FA8-8 sheets 1 and 2, in conjunction with the Level Flight Acceleration at 36,000 Feet chart, is the most efficient means of attaining supersonic flight at or above 45,000 feet. By accelerating to 1.4/1.5 IMN at 36,000 feet and making a zoom (decelerating) climb to 45,000 feet, time, fuel, and distance are saved as compared to:

1. Climbing subsonically to 45,000 feet and accelerating at altitude, or;
2. Accelerating to the target mach (1.2) at 36,000 feet and climbing at 1.2.

Zoom climb speed profiles are shown in figure FA8-8, sheets 1 and 2 for start climb speed from 1.2 to 1.5 mach for the wingtip missiles configuration only, at one-half internal fuel.

Zoom climb at maximum thrust is performed by pulling the aircraft up at a steady 1.5 G until a climb angle of about 30 degrees is reached. This angle is held until the airspeed decreases to approximately 150 KIAS, then a pushover is made to maintain approximately 100 KIAS over the top. If 1.2 G is pulled during the zoom, the aircraft achieves altitude at a slightly higher mach number but the time required is considerably longer.

USE

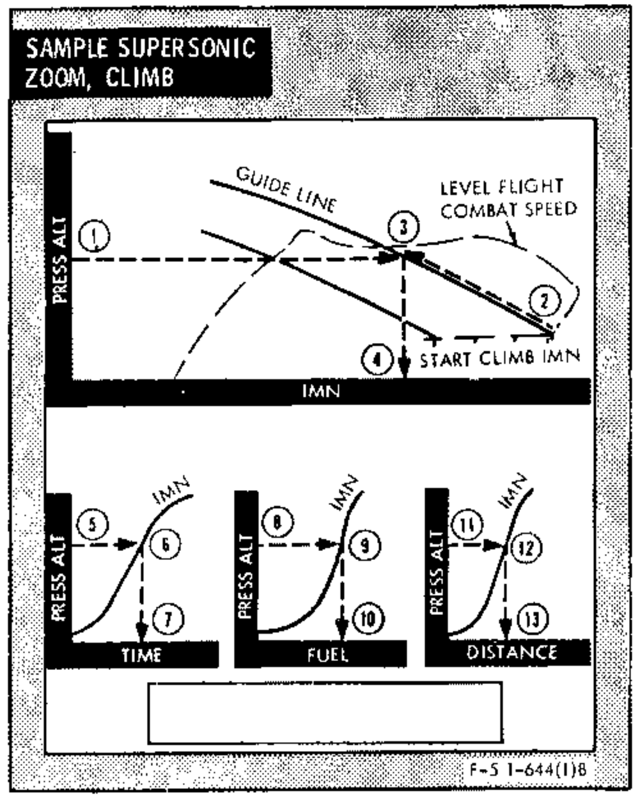
The charts may be used for determining a variety of data such as: start climb speed versus end climb speed and pressure altitude, time, fuel and distance for climb, level flight combat speed, and approximate climb angle required to achieve desired pressure altitude at the end climb speed.

Enter the upper chart with desired pressure altitude and proceed right while simultaneously entering with start climb IMN and proceed up the guideline until intersection is made with the pressure altitude and down to read the end climb IMN. Note the approximate climb angles required at the various pressure altitudes. Check that the end climb IMN and pressure altitude fall within the level flight combat speed envelope.

To determine time for climb, enter lower left chart with desired pressure altitude and proceed right to start climb IMN reflector and down to read time in seconds.

To determine fuel for climb, enter lower center chart with desired pressure altitude and proceed right to start climb IMN reflector and down to read fuel in pounds.

To determine distance for climb, enter lower right chart with desired pressure altitude and proceed right to start climb IMN reflector and down to read distance in nautical miles.



SAMPLE PROBLEM

Given:

A. Aircraft configuration: (2) AIM-9 missiles, one-half internal fuel.
B. Start climb airspeed: 1.5 IMN.
C. Desired pressure altitude: 45,000 ft.

Calculate:

A. Mach number at 45,000 ft and the fuel, distance, and time required to zoom climb from 36,100 ft to 45,000 ft.
B. Use Supersonic Zoom Climb Chart FA8-8, sheet 1. Enter upper chart with desired pressure altitude of 45,000 ft.

①	Press Alt	45,000 ft
②	Start Climb IMN	1.5
③	Intersect	—
④	IMN (at altitude)	1.25

C. To obtain time for climb enter lower left chart with desired pressure altitude of 45,000 ft.

⑤	Press Alt	45,000 ft
⑥	Start Climb IMN	1.5
⑦	Time	35 seconds

D. To obtain fuel for climb enter lower center chart with desired pressure altitude of 45,000 ft.

⑧	Press Alt	45,000 ft
⑨	Start Climb IMN	1.5
⑩	Fuel	118 lb

E. To obtain distance for climb enter lower right chart with desired pressure altitude of 45,000 ft.

⑪	Pressure Alt	45,000 ft
⑫	Start Climb IMN	1.5
⑬	Distance	7.5 nm

LEVEL FLIGHT COMBAT SPEED CHARTS

Level flight (1.0g) combat speeds are presented in two separate charts (FA8-9, sheet 1 thru 4, and FA8-10, sheets 1 thru 4), with maneuver/auto flaps and flaps up, for a launcher rail only configuration. The speed envelopes are shown as a function of pressure altitude versus mach number based on the aircraft gross weights stated at the top of each chart. The charts utilizing maneuver/auto flaps show the region where each flap position is operating, the airspeed at which the flaps shift position, the flap limit speed for that particular position, and the level flight combat ceiling with maximum or military thrust power. The flaps up charts show the flight envelope with flaps-up flight and include a supersonic region for standard and nonstandard day temperatures.

USE

The charts may be used for determining a variety of data such as: pressure altitude versus mach, power required, flap positions shift and limit speeds, level flight combat ceilings, and minimum flying speeds.

Maneuver Flaps

Enter with desired pressure altitude and proceed right while simultaneously entering with mach and proceeding up until intersection is made with the pressure altitude. Note the region of intersection and determine flap position and power required.

To determine flap autoshift mach number, enter with desired altitude and proceed right to the desired flap position autoshift speed curve and down to read mach number.

To determine flap autoshift pressure altitude, enter with desired mach number and proceed up to the desired thrust power setting and left to read ceiling.

To determine minimum flying speed, enter with desired pressure altitude and proceed right to the appropriate thrust power setting and down to read mach number.

Flaps Up

The use of the flaps-up chart is the same as for the maneuver/auto flap chart with the exception of the higher mach envelopes; which are depicted for standard and nonstandard day temperatures.

SAMPLE PROBLEM

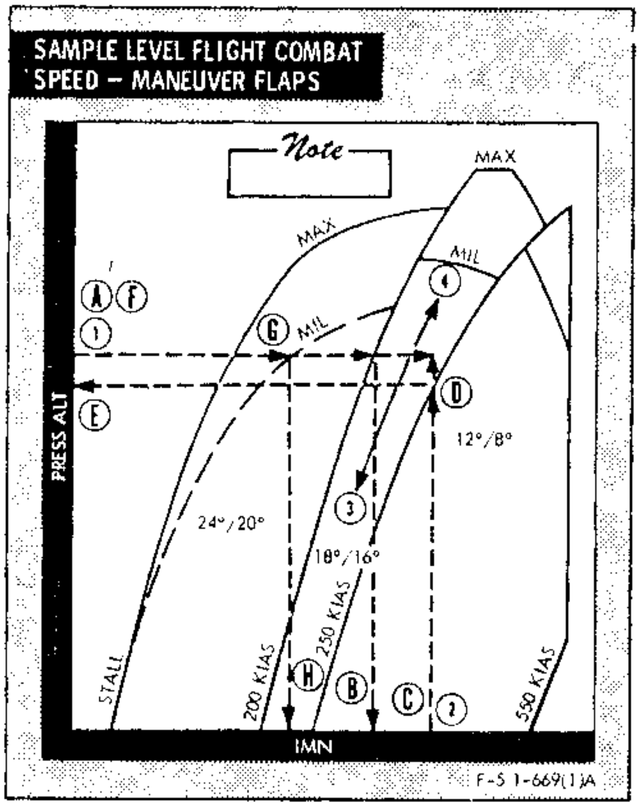
Given:

A. Aircraft with launcher rails only; gross weight: 13,300 lb. (E configuration).
B. Maneuver flaps.
C. Pressure altitude: 30,000 ft.
D. Airspeed: 0.6 IMN.

Calculate:

A. Flap position and thrust power required.
B. Use Level Flight Combat Speed, Maneuver Flaps Chart FA8-9, sheet 1.

(1)	Press Alt	30,000 ft
(2)	IMN	0.6
(3)	Flap Position	18°/16°
(4)	Power Required	MIL



SAMPLE LEVEL FLIGHT COMBAT SPEED – MANEUVER FLAPS

C. Flap autoshift speed.

(A)	Press Alt	30,000 ft
(B)	Flap autoshift from 24°/20° to 18°/16°	0.54 IMN

D. Flap autoshift altitude for 18°/16°.

(C)	IMN	0.6
(D)	Intersect	--
(E)	Press Alt (autoshift 18°/16°)	24,500 ft

E. Minimum Safe Flying Speed.

(F)	Press Alt	30,000 ft
(G)	Minimum Power Required	MIL
(H)	IMN (minimum)	0.44

TURN PERFORMANCE — RADIUS CHARTS

The Turn Performance — Radius charts for a typical air-to-ground support low-level mission present turn radius versus mach number with half the total quantity of fuel on board. The charts provide the ability to determine lateral obstacle clearance capability or optimum turn capability during weapons delivery phase of the mission. Turn performance at sea level is shown in FA8-11, sheets 1 thru 4; at 5000 feet in FA8-12, sheets 1 thru 4. The charts show the minimum turn radii obtainable under sustained conditions (level flight, constant speed) at military or maximum thrust and at the transient maximum lift condition for flap settings of UP, CRUISE, or MANEUVER (E-3 F-2 UP or AUTO). See section I for description of flap shift schedule with maneuver or auto flap selected on the flap thumb switch.

USE

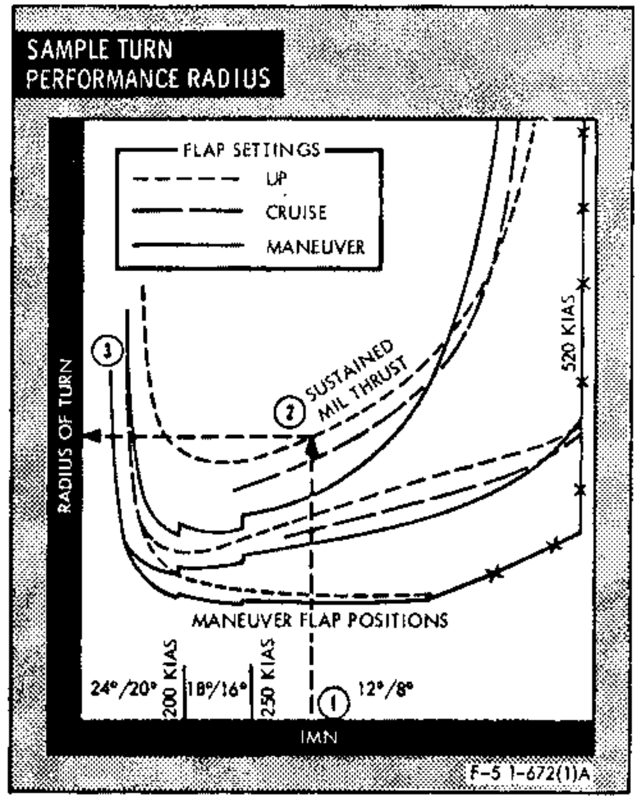
Enter the chart with indicated mach number and proceed up to the curve representing the maximum lift or thrust condition and flap setting of interest. Then proceed horizontally left and read the radius of turn.

SAMPLE PROBLEM

Given:
A. Aircraft Configuration E-1 : (2) AIM-9 Missiles, CL Tank, and (4) MK-82LD Bombs.
B. Pressure altitude: 5000 Ft.
C. Airspeed: 0.5 IMN.
D. Military thrust (sustained).
E. Flap setting: MANEUVER.

Calculate:
A. Radius of turn required.
B. Use Turn Performance — Radius — 5000 feet chart FA8-12, sheet 1.

①	IMN	0.5
②	Sustained MIL Thrust (MANEUVER flap setting)	—



NOTE

Maneuver flap position is 12°/8°.

③	Radius of Turn	4900 ft

TURN PERFORMANCE — TURN RATE, TURN RADIUS, AND LOAD FACTOR CHARTS

The Turn Performance — Turn Rate, Turn Radius, and Load Factor charts provide for a typical air-to-air combat configuration consisting of two AIM-9 missiles, full 20mm ammunition, and one-half internal fuel at altitudes of 5000 feet (FA8-13, sheets 1 and 2), 15,000 ft (FA8-14, sheets 1 and 2), and 30,000 feet (FA8-15, sheets 1 and 2). In addition to providing best combat turn performance for these altitudes, the charts also indicate the flap position operating regimes within the data envelope.

USE

The charts are of the multi-entry type. An explanation of chart terminology and general use is as follows.

On each chart a line, identified as SUSTAINED, representing sustained flight conditions (level flight, constant speed) shows the maximum turn rate obtainable with maximum thrust as a function of mach number. Additionally, a background fan grid, consisting of load factor and turn radius parameters, is shown to provide supplementary information. It can be seen that the speed for maximum turn rate is considerably faster than that for minimum turn radius.

A second line on the chart, identified as MAX LIFT, shows the maximum instantaneous turn performance obtainable by trading off altitude or airspeed to realize the maximum lift capability of the aircraft. This lift capability is limited to 7.33G for this configuration. At maximum lift, at a particular altitude, the airspeed providing the maximum possible instantaneous turn performance is called the corner speed. This corner speed is shown on each chart in the upper left area at the intersection of the maximum lift line with the 7.33G limit line.

Any point lying on the SUSTAINED line represents a condition of drag equal to maximum thrust. All of the thrust available is required to turn in level unaccelerated flight at the particular mach number of interest. This is the condition of ZERO P_s or specific power. Any point below the SUSTAINED line represents a more shallow turn where excess thrust is available for use in either accelerating to a higher mach number at constant altitude or for climbing to a higher altitude at the same mach number. This is called a region of POSITIVE P_s. Any point lying between the SUSTAINED line and the MAX LIFT line (or 7.33G line) represents a turn condition of increased magnitude, where the drag exceeds thrust and negative rate of climb (descent) or a decreasing speed is developed during the turn. This is a region of NEGATIVE P_s.

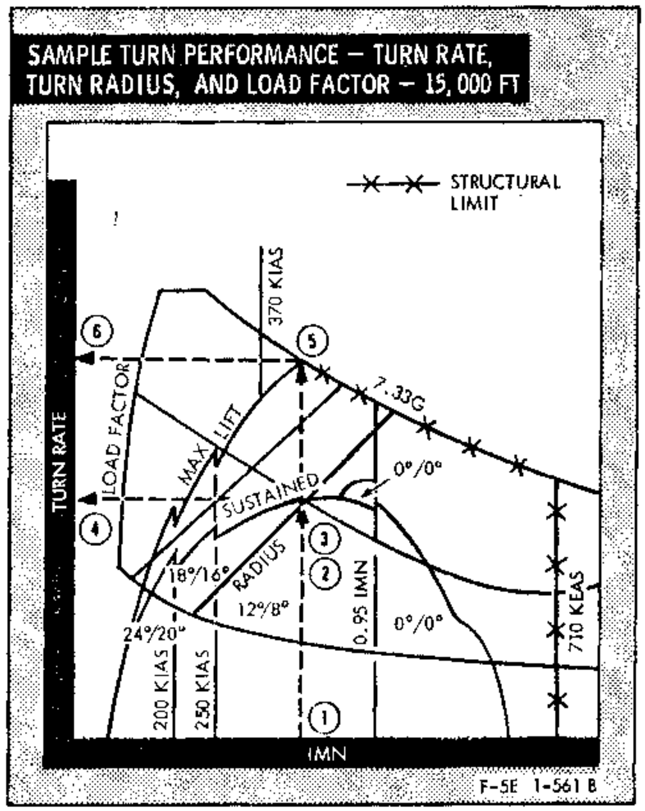
DEFINITION

SPECIFIC POWER (P_s): Available excess power which can be used to either climb or accelerate to another speed.

SAMPLE PROBLEM

Given:

A. Aircraft configuration: (2) AIM-9 missiles, full ammo, one-half internal fuel.
B. Maximum thrust.
C. Pressure altitude: 15,000 ft.



Calculate:

A. Final sustained turn rate, turn radius, and load factor at 0.75 mach. In addition, find corresponding values for a 7.33G load factor limit at 0.75 mach.
B. Use Turn Performance Turn Rate, Turn Radius, and Load Factor — 15,000 Feet chart FA8-14, sheet 1.

①	IMN	0.75
②	Sustained Turn Radius	4700 ft
③	Sustained Load Factor	4.3 G
④	Sustained Turn Rate	9.9 deg/sec

C. At 0.75 mach and 7.33G load factor limit:
   ⑤ Instantaneous Turn Radius 2700 ft
   ⑥ Instantaneous Turn Rate 17 deg/sec

TURN PERFORMANCE — SPECIFIC EXCESS POWER AND TURN RATE CHARTS

The specific Excess Power (P_s) and Turn Rate charts for an airspeed of 0.6 IMN (FA8-16, sheets 1 and 2) and 0.9 IMN (FA8-17, sheets 1 and 2) allow a study of the effect of trading off available excess thrust (P_s) for a change in speed, rate of climb, or load factor to produce a more desirable flight condition.

USE

The charts are of the multi-entry type. An explanation of the theory and use of the charts is as follows. With any aircraft, a certain amount of thrust is required to maintain level unaccelerated flight. Any excess engine thrust available can be used to increase altitude, speed, or load factor. Specific power, P_s, is a term which defines the available excess power which can be used to either climb or accelerate to another speed. It represents thrust minus drag times speed (giving excess power) divided by weight (giving specific excess power, or power per pound of weight). Think of it as:

$$P_s = \frac{\text{Thrust} - \text{Drag}}{\text{Weight}} \times \text{Speed (fps)}$$

in terms of climb capability. Now if P_s is divided by speed, a dimensionless term is obtained which represents the longitudinal acceleration in G's. Think of it as:

$$\frac{P_s}{\text{Speed}} = \frac{\text{Thrust} - \text{Drag}}{\text{Weight}} = \text{Longitudinal Acceleration (G) in terms of acceleration capability.}$$

In level, 1.0-G (normal acceleration) flight, drag is low and P_s is at its maximum positive value.

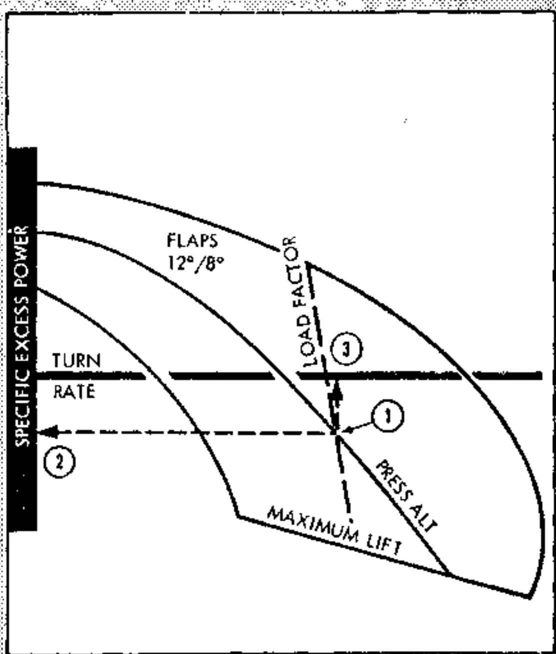
During a sustained turn, the aircraft is allowed to bank until drag builds up to match available thrust, and the condition of ZERO P_s is achieved. All of the longitudinal acceleration capability has been traded for normal acceleration capability (load factor) for which a certain turn rate has been obtained.

When maximum available load factor is pulled, drag exceeds thrust and the condition of NEGATIVE P_s is achieved. Here, maximum longitudinal deceleration is obtained, which is desirable when trying to force an adversary on your tail to overshoot. Charts of P_s versus turn rate are shown in FA8-16, sheets 1 and 2, and FA8-17, sheets 1 and 2, for mach number of 0.6 and 0.9, respectively.

An inspection of FA8-16, sheet 1, for an altitude of 15,000 feet indicates a zero turn rate at 1.0-G load factor at the extreme left of the chart. At this condition, with maximum thrust, a rate of climb of 240 fps (P_s = 240 fps) is available for maneuvering or to perform a level flight acceleration to a higher speed. If a climbing turn is initiated at 0.6 mach, the rate of climb will diminish to 190 fps at 2.0G and to zero at 3.3G (P_s = 0 fps). At zero P_s, the aircraft is in a sustained turn (level flight, constant speed) at 9.1 degrees per second. If the aircraft is forced into a steep turn at 0.6 mach, speed can be maintained as the load factor is increased further until the maximum lift condition is reached at 5.2G and a turn rate of 14.8 degrees per second. By maintaining the high load factor at this point, the large negative P_s value of -870 fps can be used to create a high deceleration in speed.

It is useful to note that FA8-16 and FA8-17 have data in common with FA8-13 thru FA8-15. For instance, the line for 15,000 feet and 0.6 mach on FA8-16 corresponds to the line for the same conditions on FA8-14. Thus, for the same conditions, P_s values can be obtained from FA8-16 for use with FA8-14.

SAMPLE TURN PERFORMANCE – SPECIFIC POWER AND TURN RATE – 0.6 MACH



SAMPLE PROBLEM

Given:

A. Aircraft configuration: (2) AIM-9 missiles, one-half internal fuel.
B. Maximum thrust.
C. Initial mach: 0.6 IMN.
D. Pressure altitude: 15,000 ft.

Calculate:

A. Specific excess power and turn rate with 4.0-G load factor.
B. Use Turn Performance, Specific Power and Turn Rate — 0.6 Mach chart FA8-16, sheet 1.

①	Press Alt and Load Factor	15,000 ft and 4.0 G
②	Specific Excess Power	-225 ft/sec
③	Instantaneous Turn Rate	11.2 deg/sec

EFFECT OF PYLONS ON COMBAT PERFORMANCE

The following shows effect of increased drag and gross weight due to the addition of pylons.

MAXIMUM SPEED

At 36,000 feet — 4% loss per pylon.
At 20,000 feet — 3% loss per pylon.
At 5,000 feet — 1 1/2% per pylon.

NOTE

- Ⓔ At 36,000 feet and with 1/2 fuel capacity, the aircraft maximum speed with launcher rails decreases from 1.63 mach without pylons to 1.29 mach with 5 pylons. The addition of missiles on wingtips decreases these speeds to 1.57 mach without pylons and 1.23 with 5 pylons.
- Ⓕ At 36,000 feet and with 1/2 fuel capacity, the aircraft maximum speed with launcher rails decreases from 1.56 mach without pylons to 1.21 mach with five pylons. The addition of missiles on wingtips decreases these speeds to 1.50 mach without pylons and 1.14 with five pylons.

LEVEL FLIGHT ACCELERATION AT 36,000 FEET

See charts FA8-4 and FA8-5.

SUSTAINED TURN RATE (DEGREES PER SECOND)

A 2% loss per pylon at all altitudes.

TURN RATE AT MAXIMUM LIFT (DEGREES PER SECOND)

A 1% loss per pylon at all altitudes.

SPECIFIC EXCESS POWER AT 0.9 IMN (FEET PER SECOND)

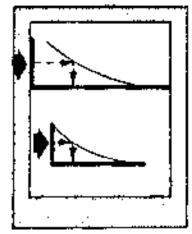
A 4% loss per pylon at all altitudes.

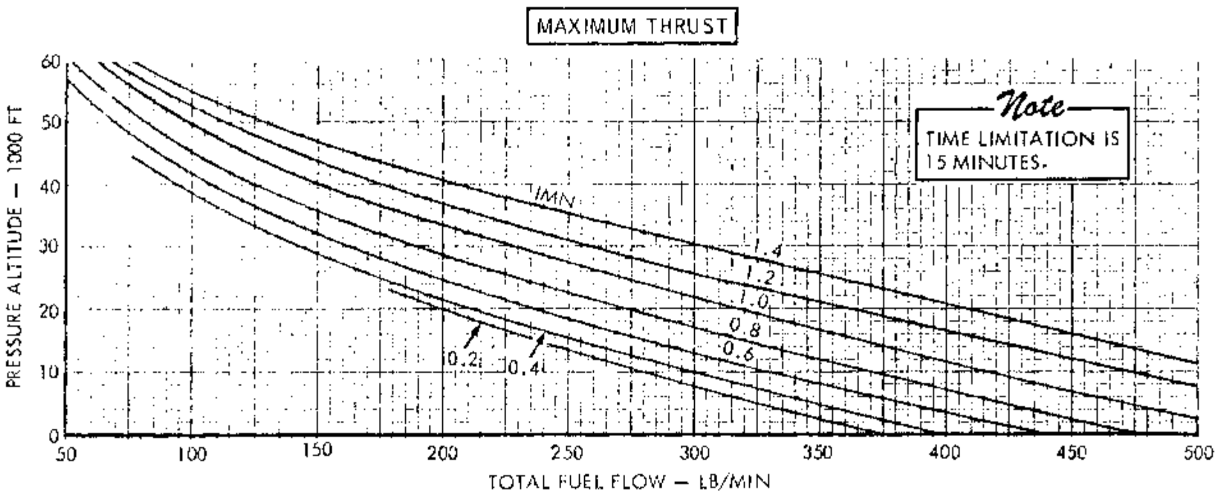
MODEL: F-5E/F
DATE: 1 MARCH 1976
DATA BASIS: **FLIGHT TEST**

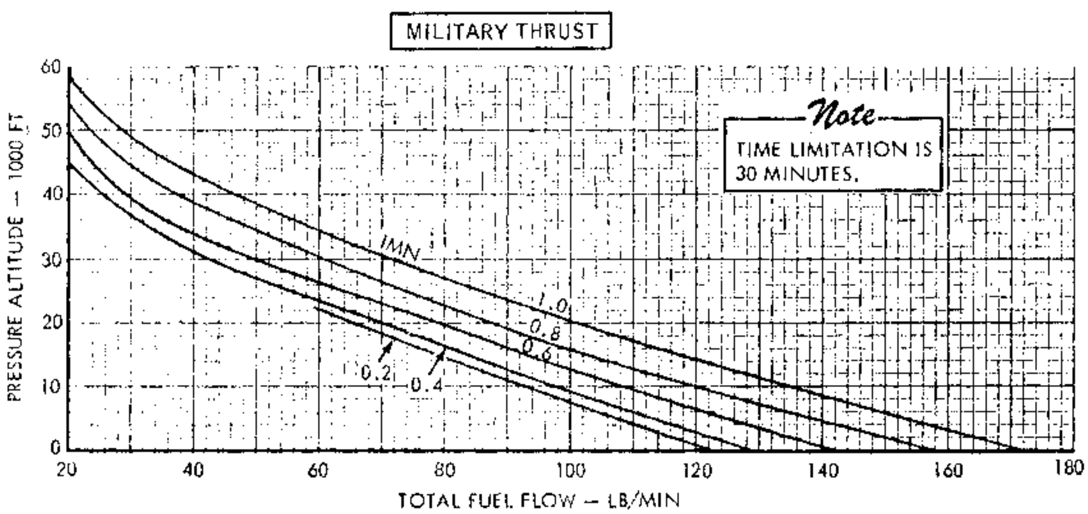
ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

COMBAT FUEL ALLOWANCE

STANDARD DAY







F-5 1-521(20)

FA8-1.

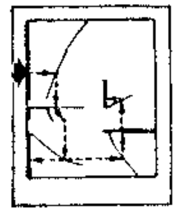
MODEL: F-5E/F
DATE: 1 NOVEMBER 1978
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

LEVEL FLIGHT ACCELERATION AT LOW ALTITUDE (FLAPS UP)

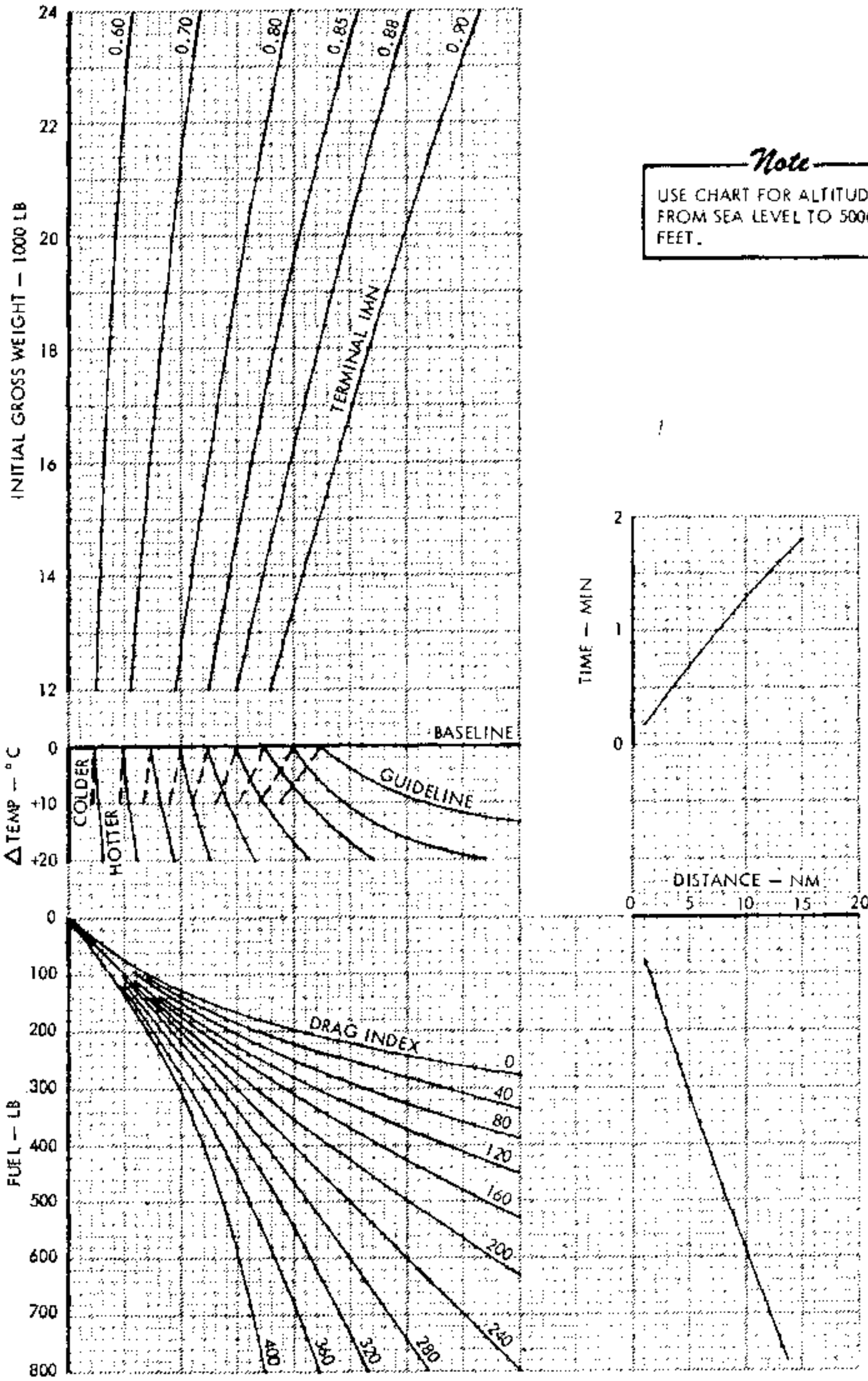
MAXIMUM THRUST
INITIAL MACH 0.5

DRAG INDEX 0 TO 400



Note

USE CHART FOR ALTITUDES FROM SEA LEVEL TO 5000 FEET.



F-5 1-567(20)B

FA8-2.

MODEL: F-5E/F
DATE: 1 AUGUST 1978
DATA BASIS: **FLIGHT TEST**

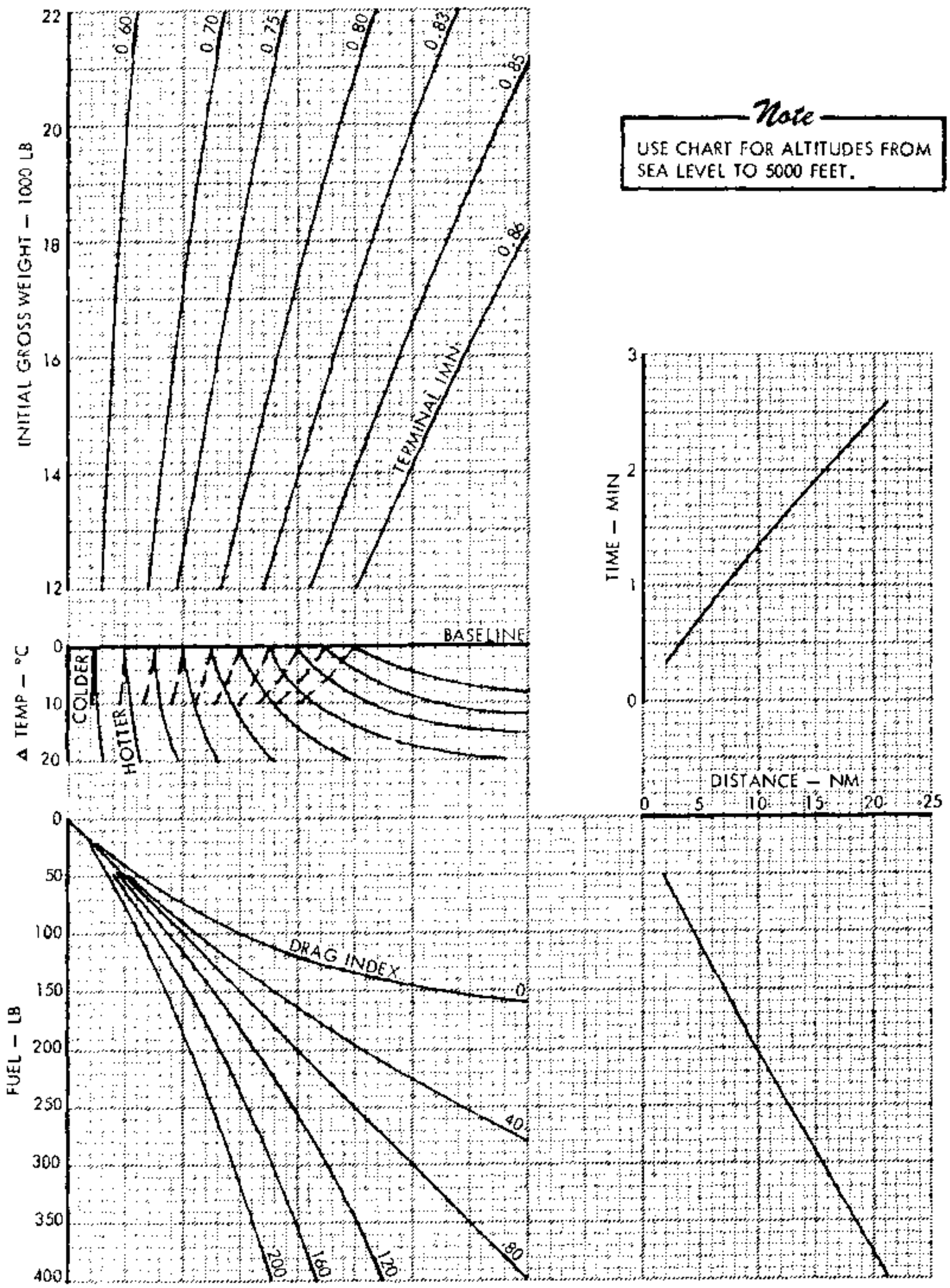
ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

LEVEL FLIGHT ACCELERATION AT LOW ALTITUDE (FLAPS UP)

MILITARY THRUST

INITIAL MACH 0.5

DRAG INDEX 0 TO 200

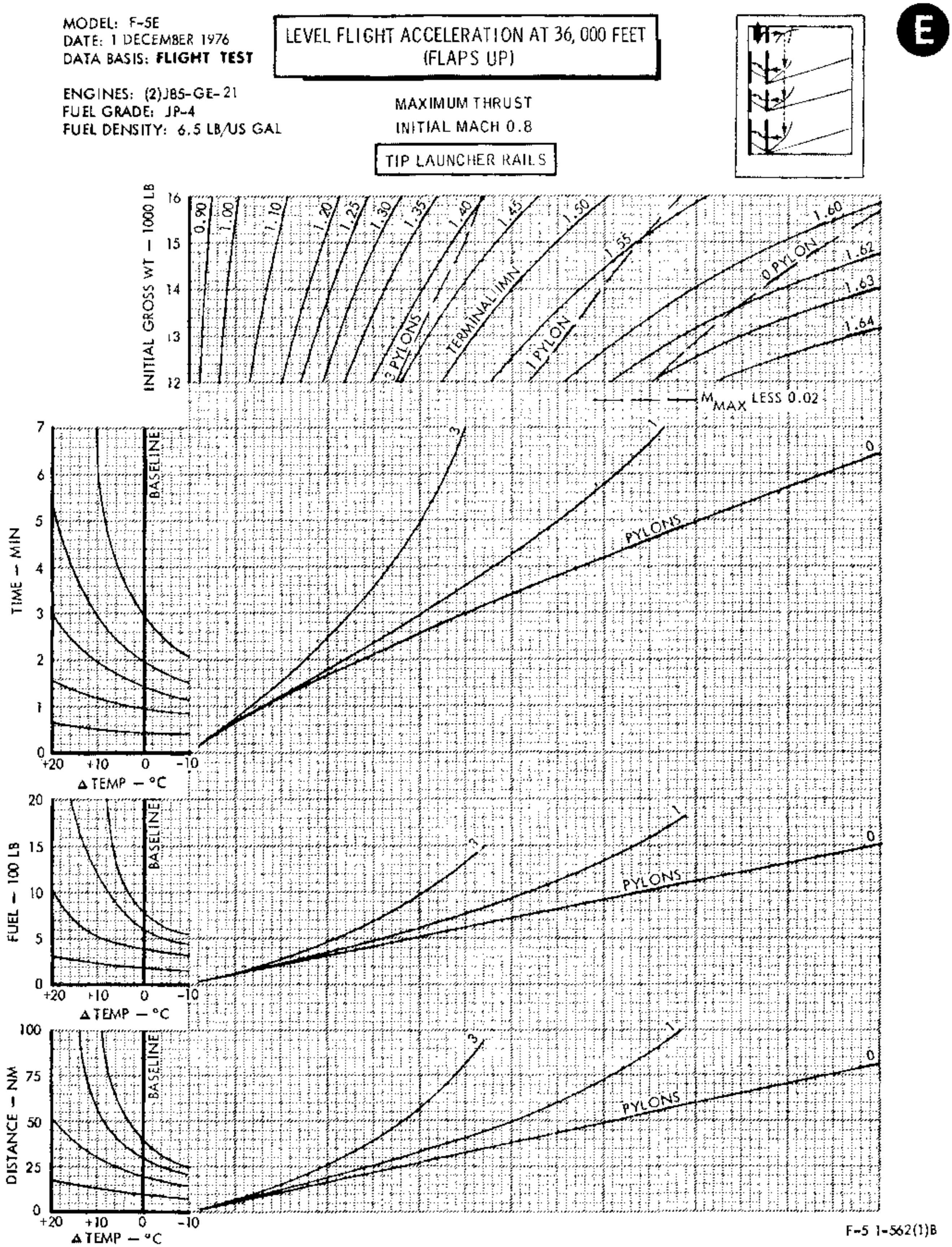


Note

USE CHART FOR ALTITUDES FROM SEA LEVEL TO 5000 FEET.

F-5 1-566(20)B

FA8-3.


MODEL: F-5E
DATE: 1 DECEMBER 1976
DATA BASIS: FLIGHT TEST
ENGINES: (2)J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL
LEVEL FLIGHT ACCELERATION AT 36,000 FEET (FLAPS UP)
MAXIMUM THRUST
INITIAL MACH 0.8
TIP LAUNCHER RAILS
E
INITIAL GROSS WT — 1000 LB
0.90
1.00
1.10
1.20
1.25
1.30
1.35
1.40
1.45
1.50
1.55
1.60
1.62
1.63
1.64
3 PYLONS
TERMINAL IMN
1 PYLON
0 PYLON
M MAX LESS 0.02
TIME — MIN
FUEL — 100 LB
DISTANCE — NM
BASELINE
PYLONS
Δ TEMP — °C
F-5 1-562(1)B

FA8-4 (Sheet 1).

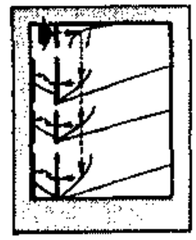
MODEL: F-5F
DATE: 1 DECEMBER 1976
DATA BASIS: **FLIGHT TEST**

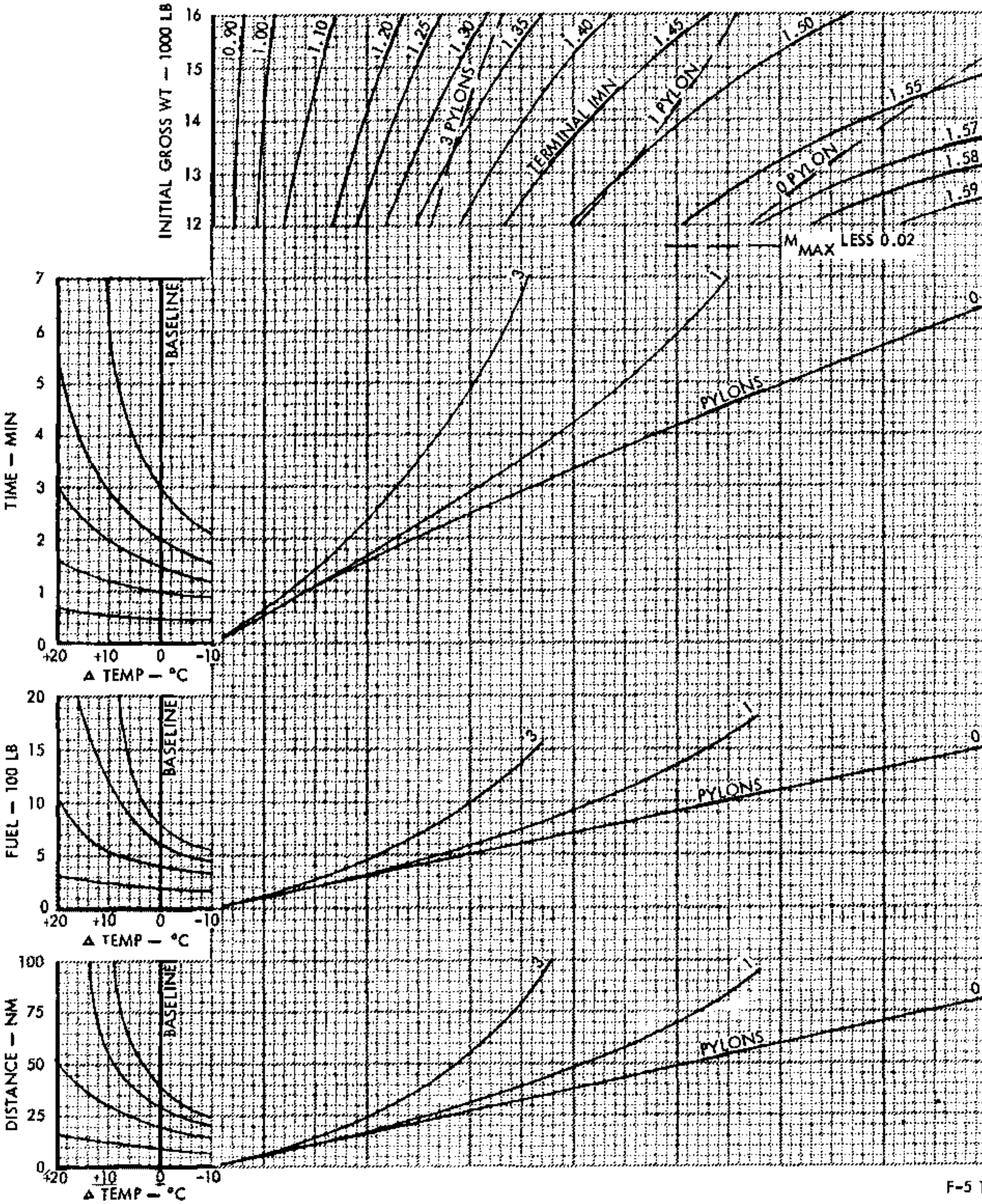
LEVEL FLIGHT ACCELERATION AT 36,000 FEET (FLAPS UP)

ENGINES: (2)J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

MAXIMUM THRUST
INITIAL MACH 0.8

TIP LAUNCHER RAILS





F-5 1-562(2)8

FA8-4 (Sheet 2).

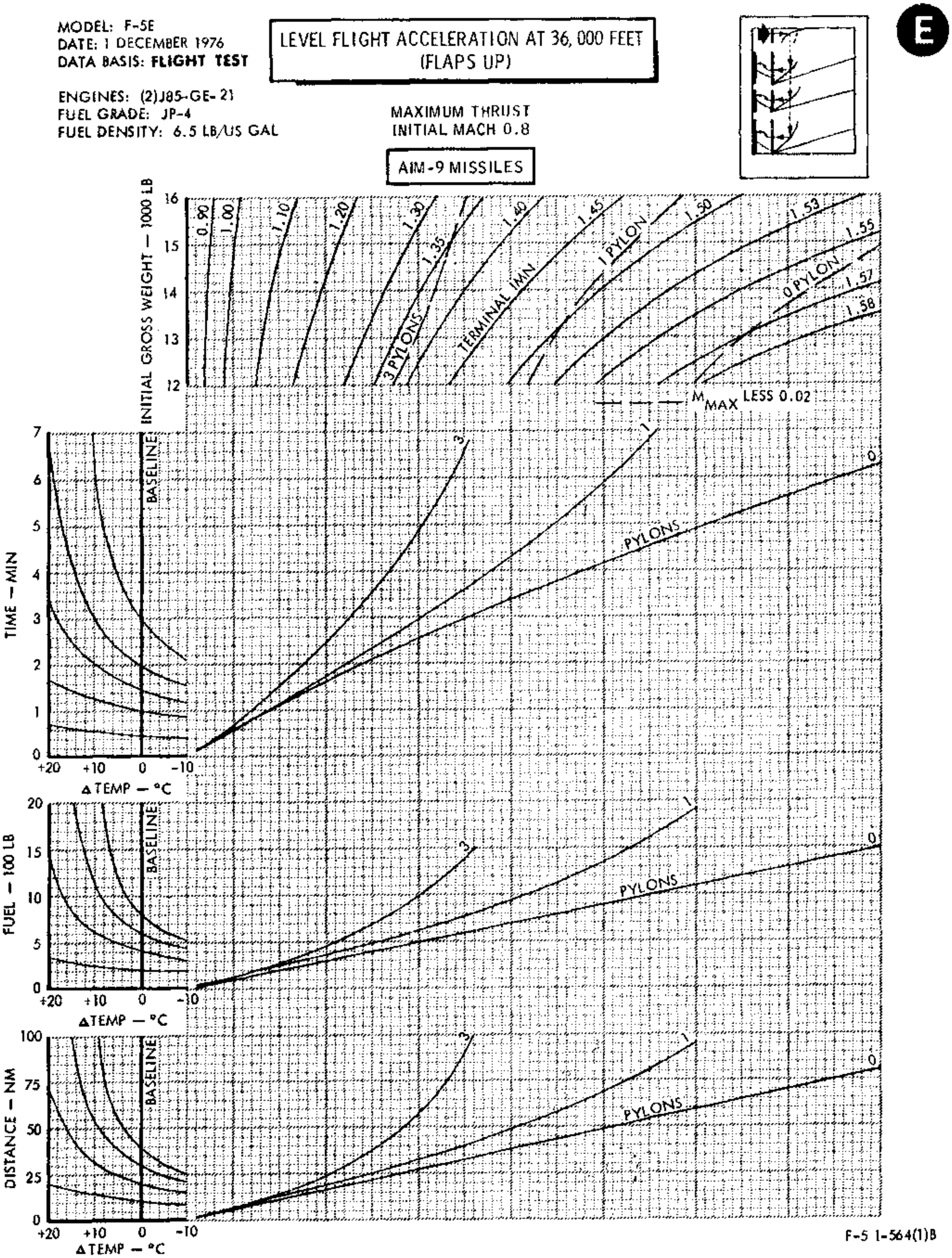
MODEL: F-5E
DATE: 1 DECEMBER 1976
DATA BASIS: **FLIGHT TEST**

ENGINES: (2)J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

LEVEL FLIGHT ACCELERATION AT 36,000 FEET (FLAPS UP)

MAXIMUM THRUST
INITIAL MACH 0.8

AIM-9 MISSILES



FA8-5 (Sheet 1).

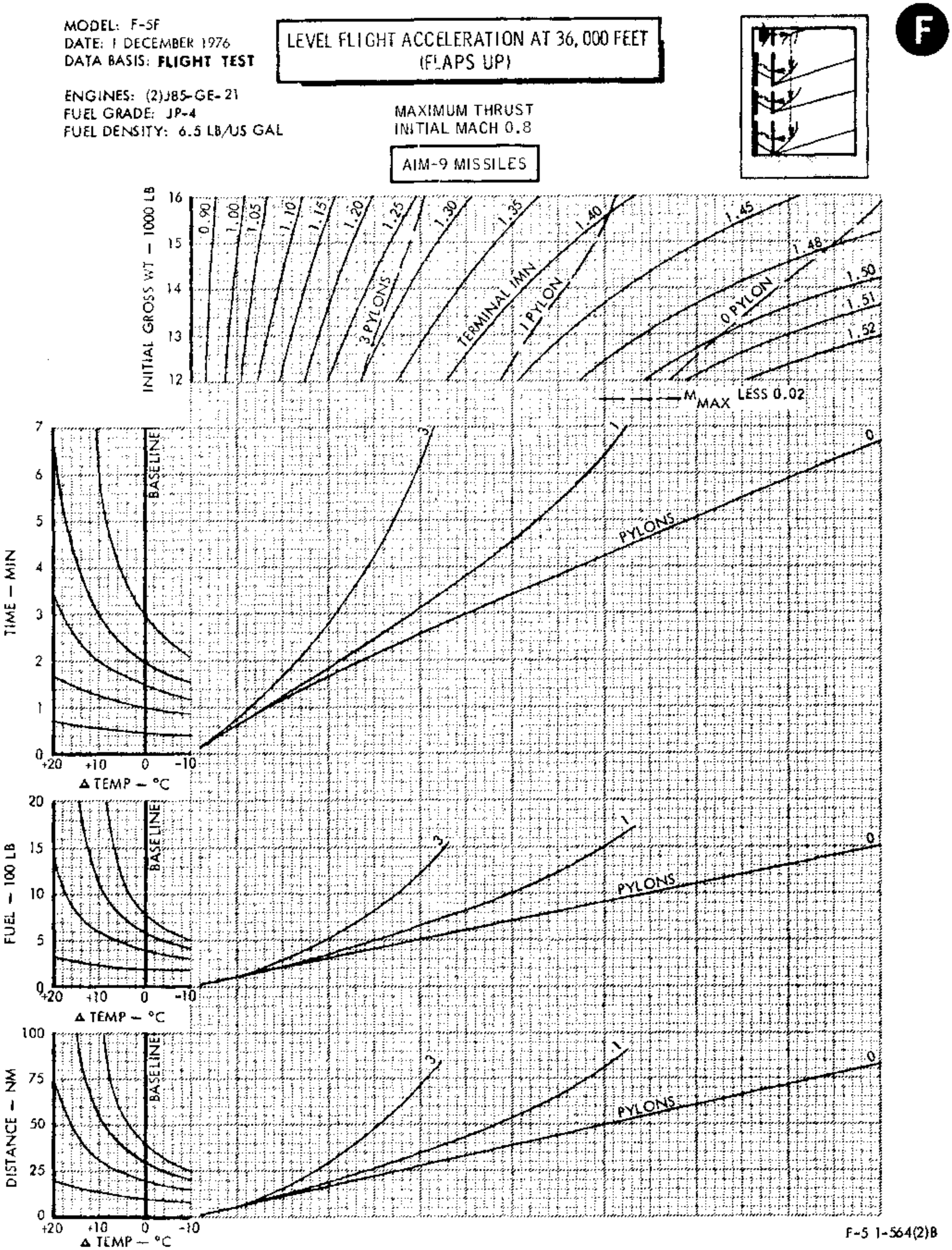
MODEL: F-5F
DATE: 1 DECEMBER 1976
DATA BASIS: FLIGHT TEST

ENGINES: (2)J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

LEVEL FLIGHT ACCELERATION AT 36,000 FEET (FLAPS UP)

MAXIMUM THRUST
INITIAL MACH 0.8

AIM-9 MISSILES



FA8-5 (Sheet 2).

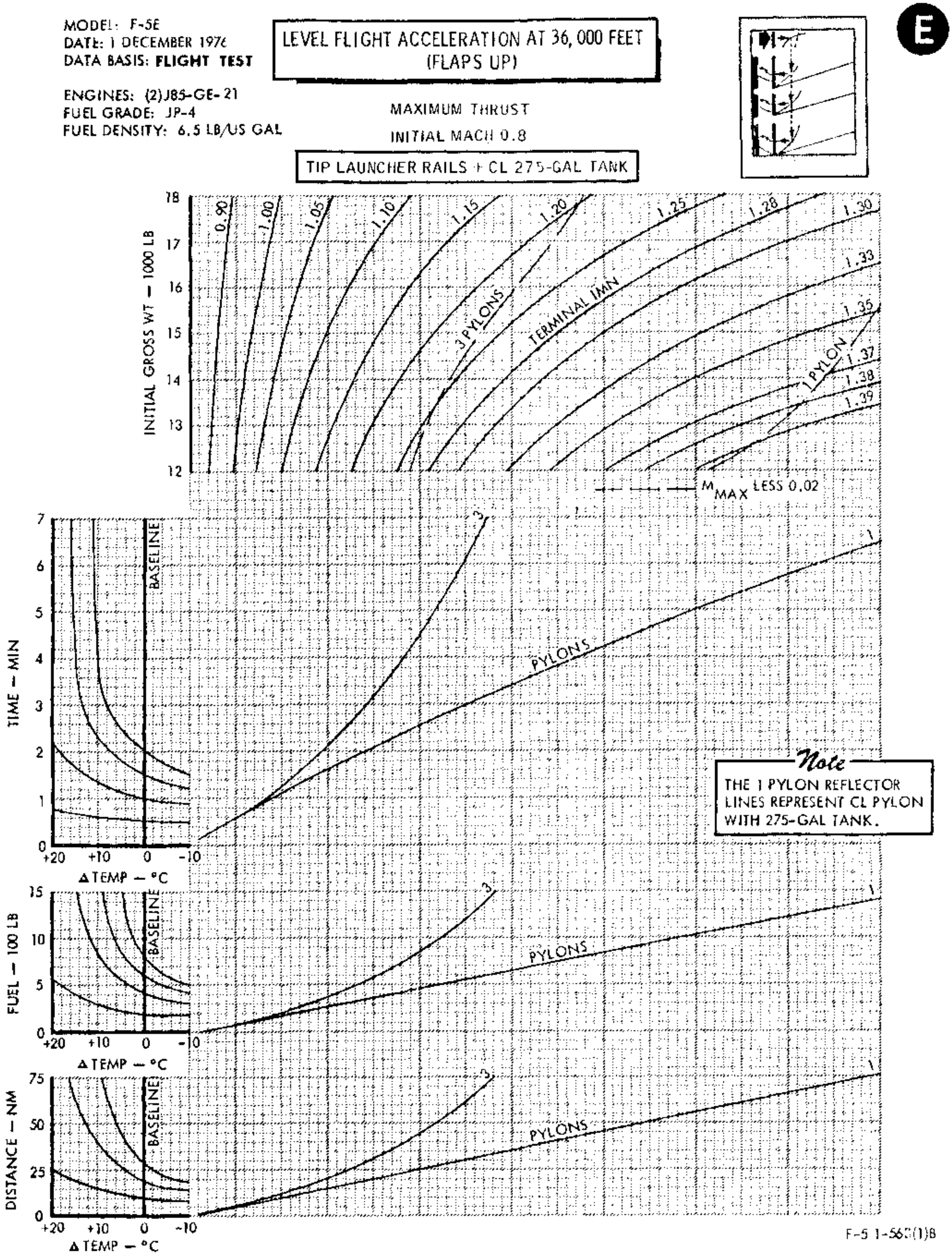
MODEL: F-5E
DATE: 1 DECEMBER 1976
DATA BASIS: FLIGHT TEST

ENGINES: (2)J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

LEVEL FLIGHT ACCELERATION AT 36,000 FEET (FLAPS UP)

MAXIMUM THRUST
INITIAL MACH 0.8

TIP LAUNCHER RAILS + CL 275-GAL TANK



FA8-6 (Sheet 1).

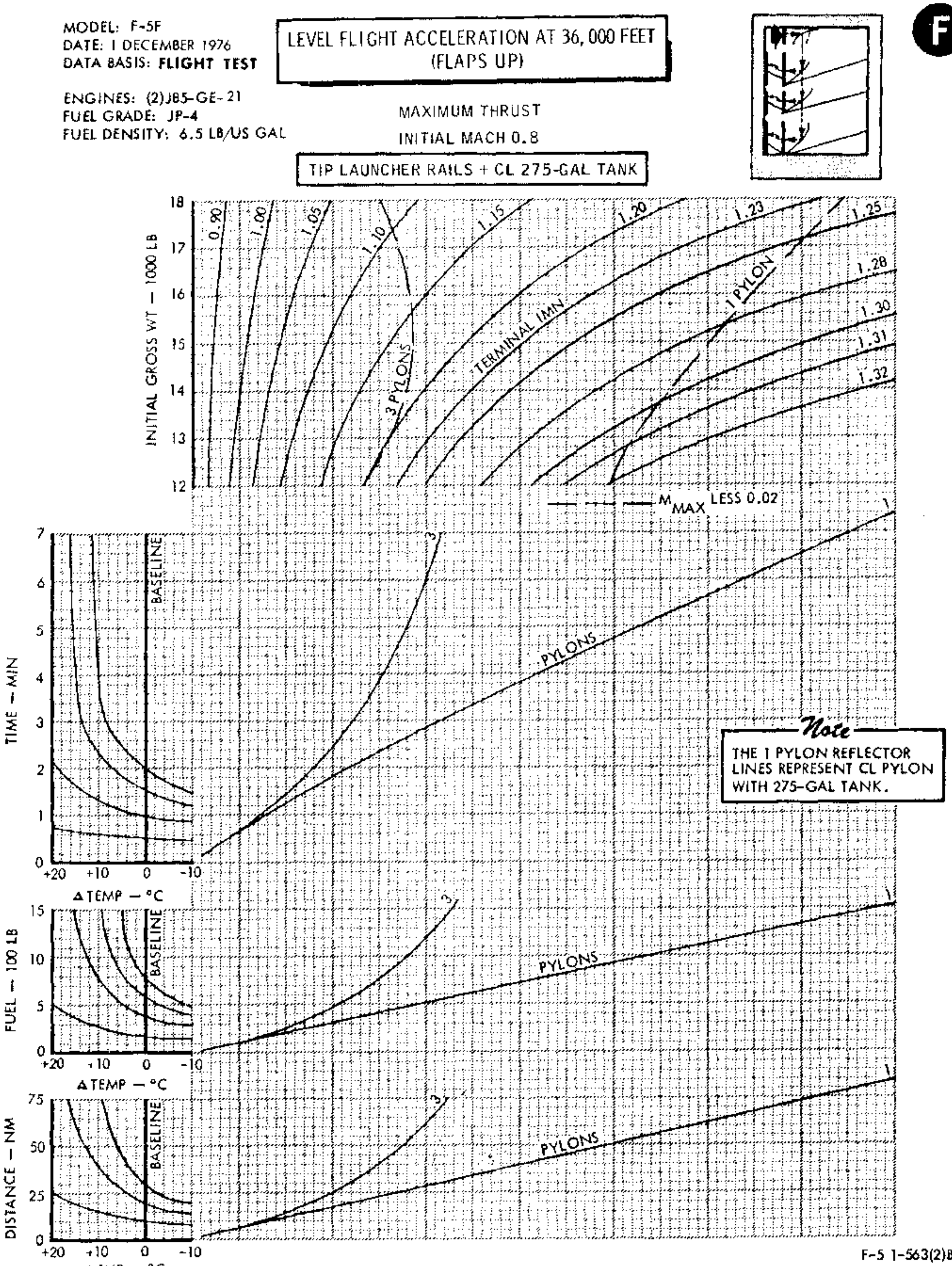
MODEL: F-5F
DATE: 1 DECEMBER 1976
DATA BASIS: FLIGHT TEST

ENGINES: (2)J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

LEVEL FLIGHT ACCELERATION AT 36,000 FEET (FLAPS UP)

MAXIMUM THRUST
INITIAL MACH 0.8

TIP LAUNCHER RAILS + CL 275-GAL TANK



Note: THE 1 PYLON REFLECTOR LINES REPRESENT CL PYLON WITH 275-GAL TANK.

FA8-6 (Sheet 2).

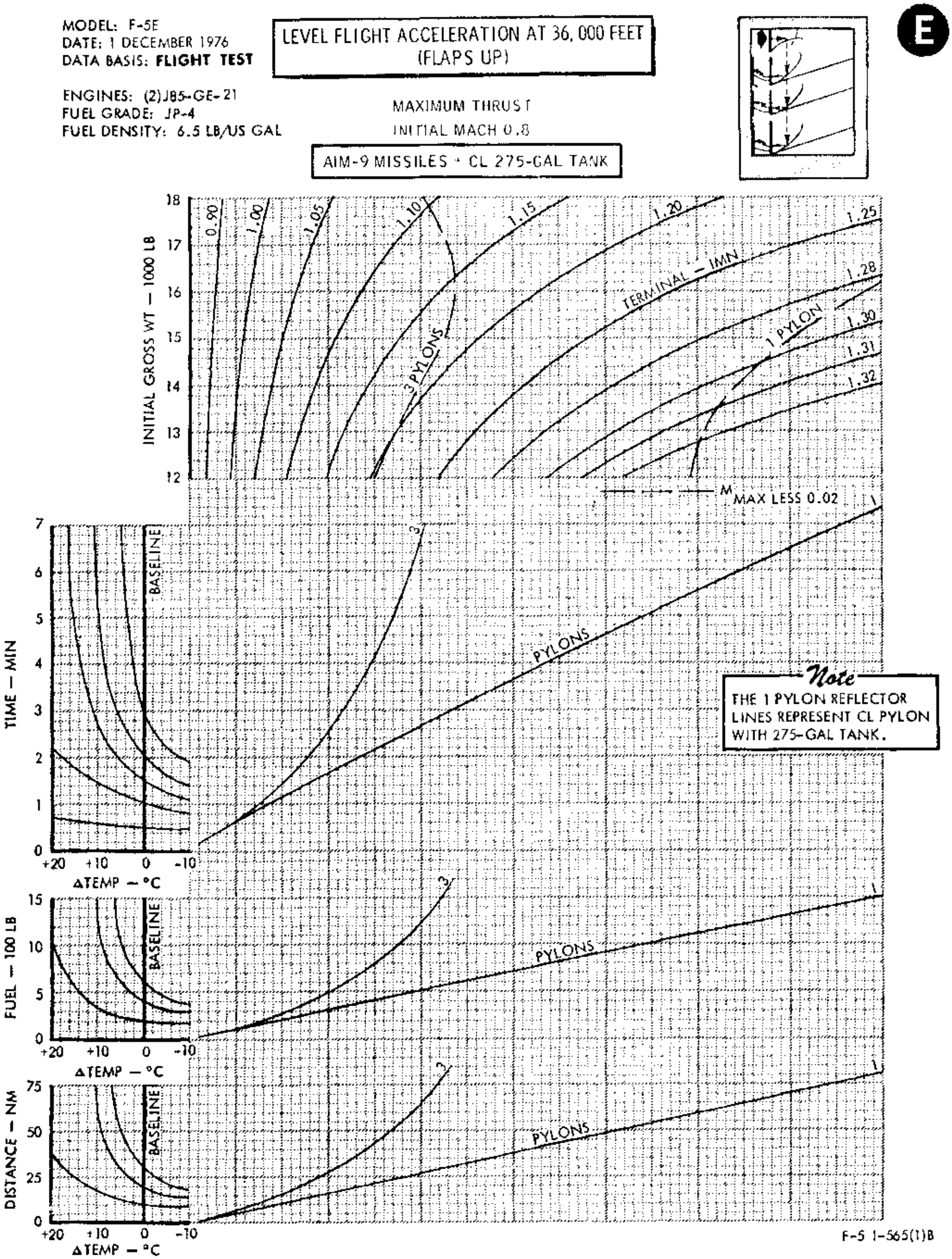
MODEL: F-5E
DATE: 1 DECEMBER 1976
DATA BASIS: **FLIGHT TEST**

ENGINES: (2)J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

LEVEL FLIGHT ACCELERATION AT 36,000 FEET (FLAPS UP)

MAXIMUM THRUST
INITIAL MACH 0.8

AIM-9 MISSILES + CL 275-GAL TANK



FA8-7 (Sheet 1).

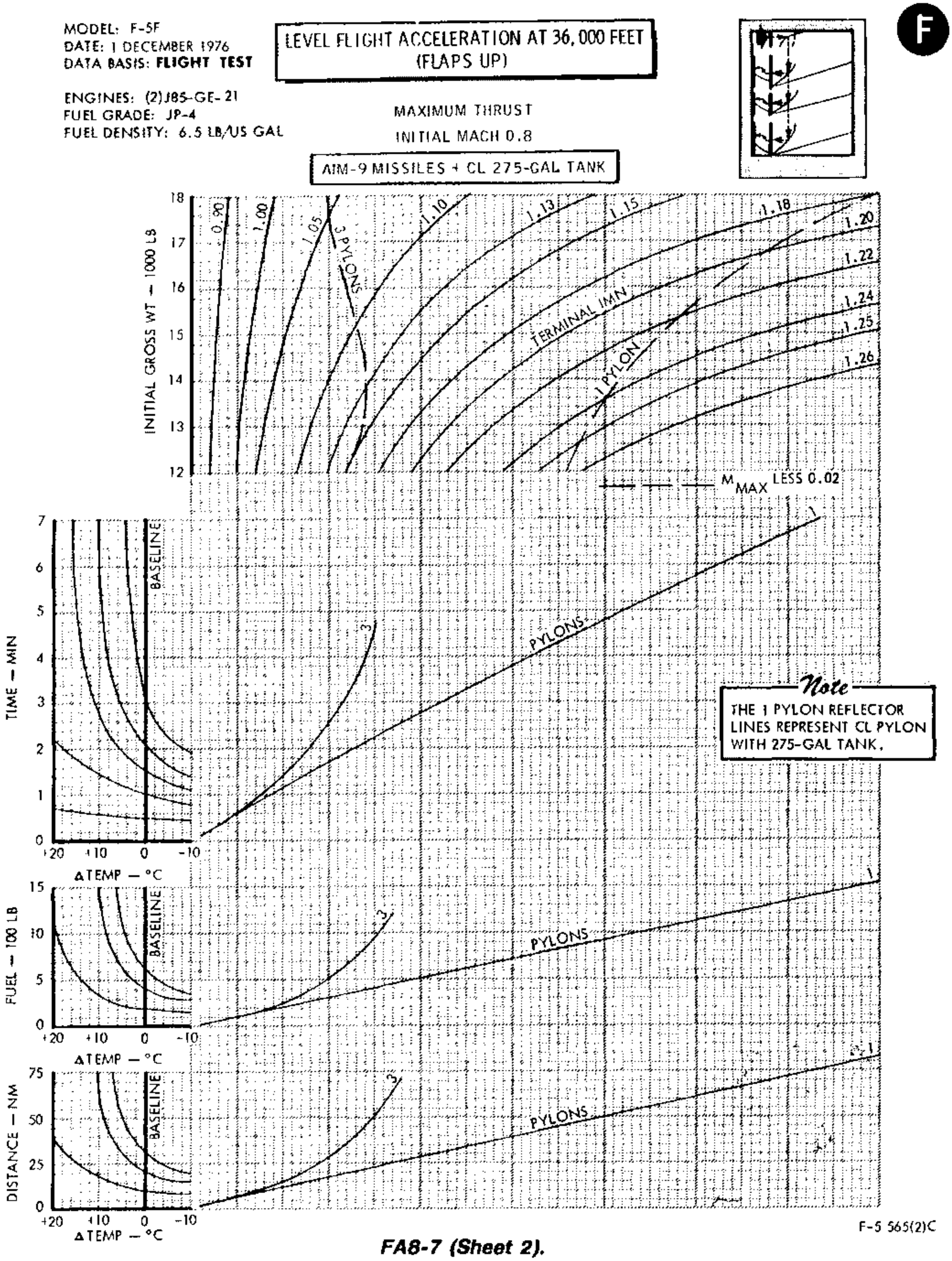
MODEL: F-5F
DATE: 1 DECEMBER 1976
DATA BASIS: **FLIGHT TEST**

ENGINES: (2)J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

LEVEL FLIGHT ACCELERATION AT 36,000 FEET (FLAPS UP)

MAXIMUM THRUST
INITIAL MACH 0.8

AIM-9 MISSILES + CL 275-GAL TANK



Note

THE 1 PYLON REFLECTOR LINES REPRESENT CL PYLON WITH 275-GAL TANK.

FA8-7 (Sheet 2).

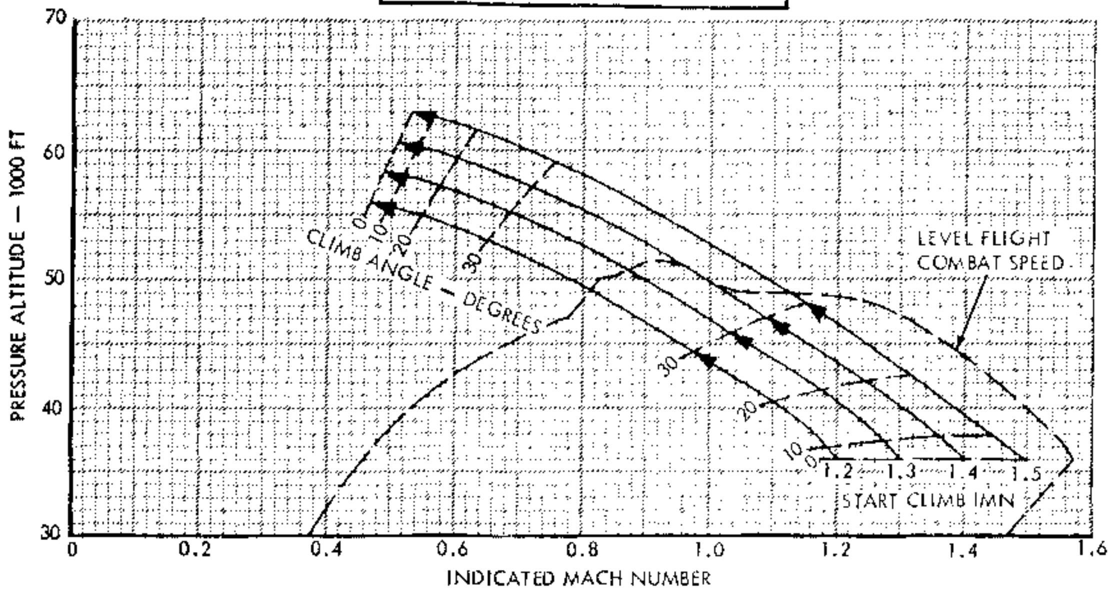
MODEL: F-5E
DATE: 1 DECEMBER 1978
DATA BASIS: FLIGHT TEST

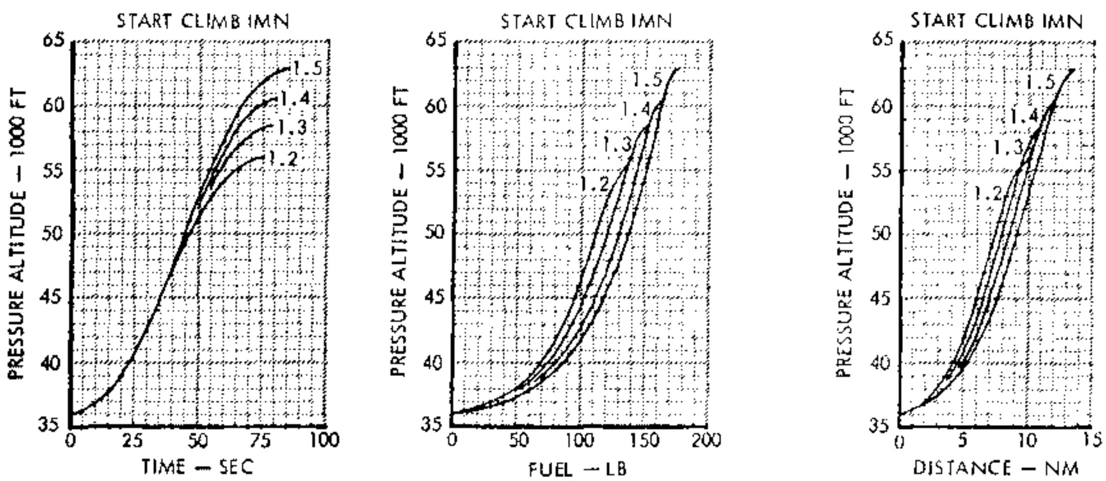
ENGINES: (2)J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

SUPERSONIC ZOOM CLIMB FROM 36,100 FT

MAXIMUM THRUST
STANDARD DAY
(2) AIM-9 MISSILES
GROSS WEIGHT 13,600 LB

FLAP SETTINGS
ABOVE 0.95 IMN — UP
BELOW 0.95 IMN — MANEUVER/AUTO





Note

- START ZOOM CLIMB WITH A STEADY 1.5G PULLUP TO A MAXIMUM CLIMB ANGLE OF 30°.
- INITIATE RECOVERY AS THE DESIRED END ALTITUDE IS APPROACHED.
- FOR MAXIMUM ALTITUDE ZOOM HOLD CLIMB ANGLE OF 30° TO 150 KIAS, THEN MAKE A 0.5G PUSHOVER.

F-5 1-599(1)C

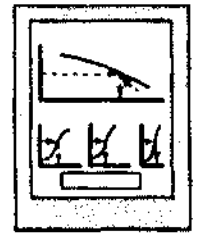
FA8-8 (Sheet 1).

MODEL: F-5F
DATE: 1 DECEMBER 1978
DATA BASIS: FLIGHT TEST

ENGINES: (2)J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

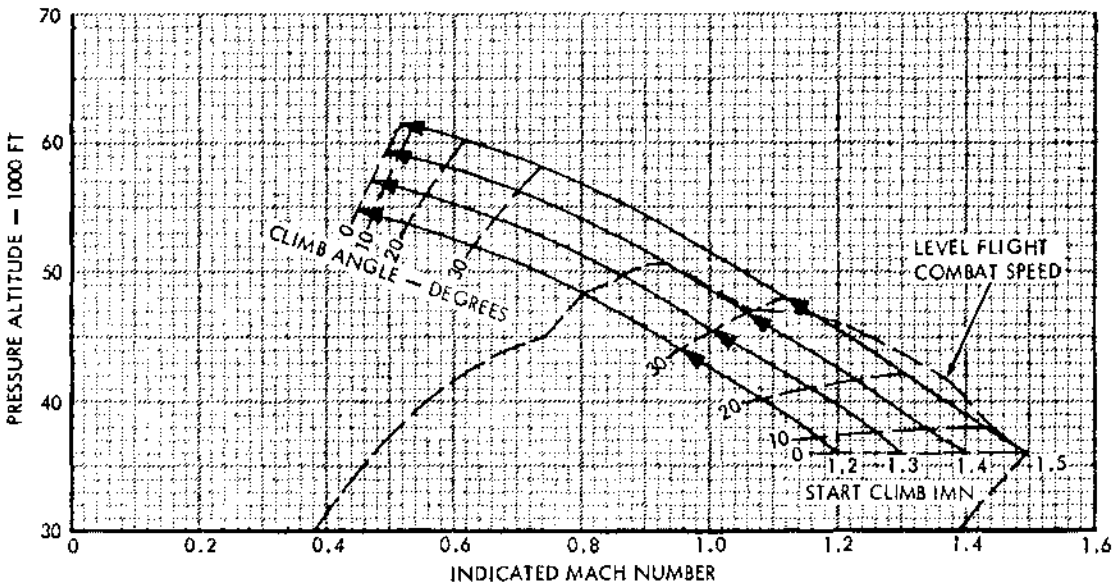
SUPERSONIC ZOOM CLIMB FROM 36,100 FT

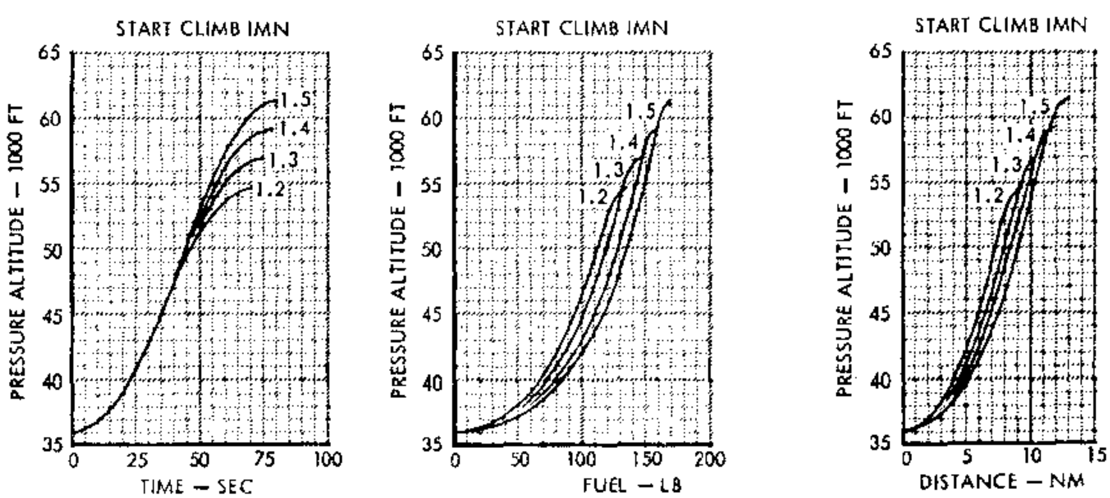
MAXIMUM THRUST
STANDARD DAY
(2) AIM-9 MISSILES
GROSS WEIGHT 14,150 LB



F

FLAP SETTINGS
ABOVE 0.95 IMN — UP
BELOW 0.95 IMN — MANEUVER/AUTO





Note

- START ZOOM CLIMB WITH A STEADY 1.5G PULLUP TO A MAXIMUM CLIMB ANGLE OF 30°.
- INITIATE RECOVERY AS THE DESIRED END ALTITUDE IS APPROACHED.
- FOR MAXIMUM ALTITUDE ZOOM HOLD CLIMB ANGLE OF 30° TO 150 KIAS, THEN MAKE A 0.5G PUSHOVER.

F-5 1-599(2)C

FA8-8 (Sheet 2).

MODEL: F-5E
DATE: 1 AUGUST 1976
DATA BASIS: **FLIGHT TEST**

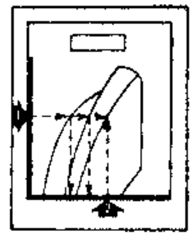
ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

LEVEL FLIGHT COMBAT SPEED

TIP LAUNCHER RAILS

GROSS WEIGHT 13,300 POUNDS

MANEUVER FLAPS



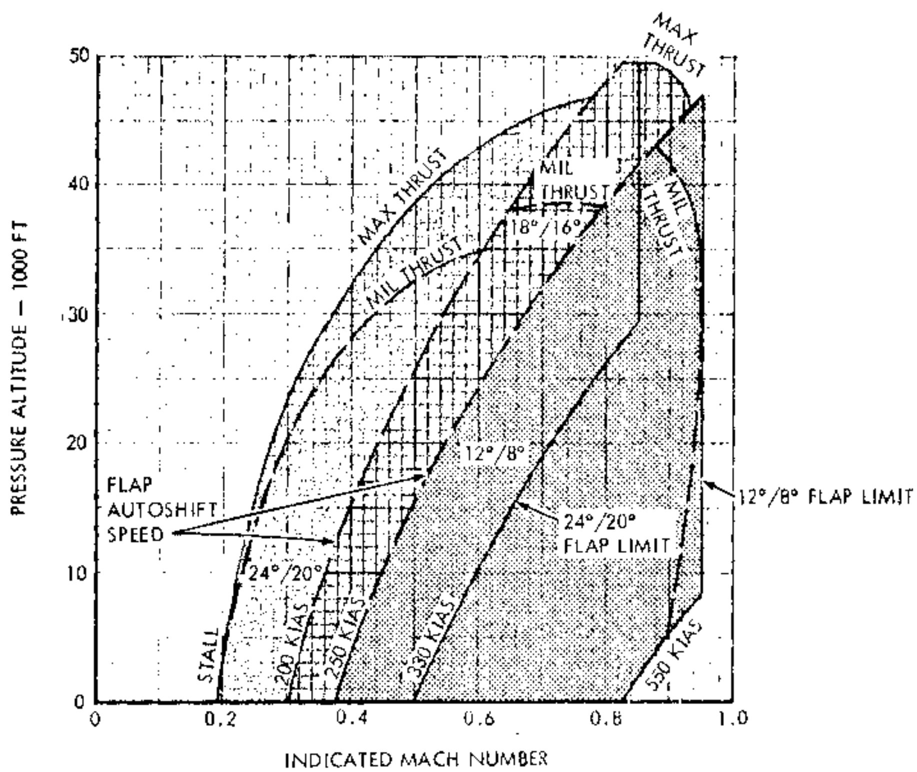
E

E-1

E-2

Note

CHART DATA BASED ON STANDARD DAY CONDITIONS.



F-5 1-539(1)C

FA8-9 (Sheet 1).

MODEL: F-5E
DATE: 1 MARCH 1982
DATA BASIS: **FLIGHT TEST**

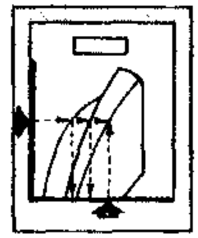
ENGINES: (2)J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

LEVEL FLIGHT COMBAT SPEED

TIP LAUNCHER RAILS

GROSS WEIGHT 13,400 POUNDS

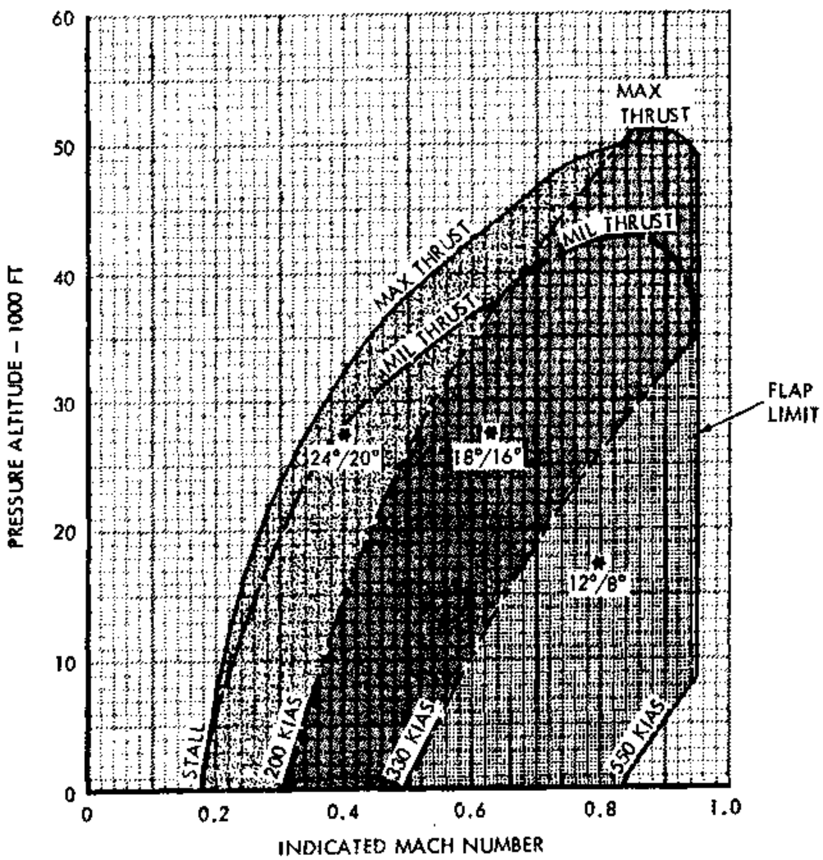
AUTO FLAPS
(BELOW 0.95 IMN)



E-3

Note

- CHART DATA BASED ON STANDARD DAY CONDITIONS.
- SEE SECTION 1 FOR AUTO-FLAP SHIFT SCHEDULE.



*:MAXIMUM AUTO FLAP POSITION AVAILABLE

F-5 1-539(13)

FA8-9 (Sheet 2).

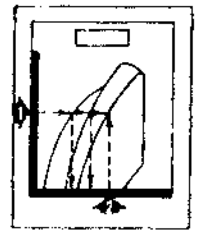
MODEL: F-5F
DATE: 1 AUGUST 1976
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

LEVEL FLIGHT COMBAT SPEED

TIP LAUNCHER RAILS
GROSS WEIGHT 13,800 POUNDS

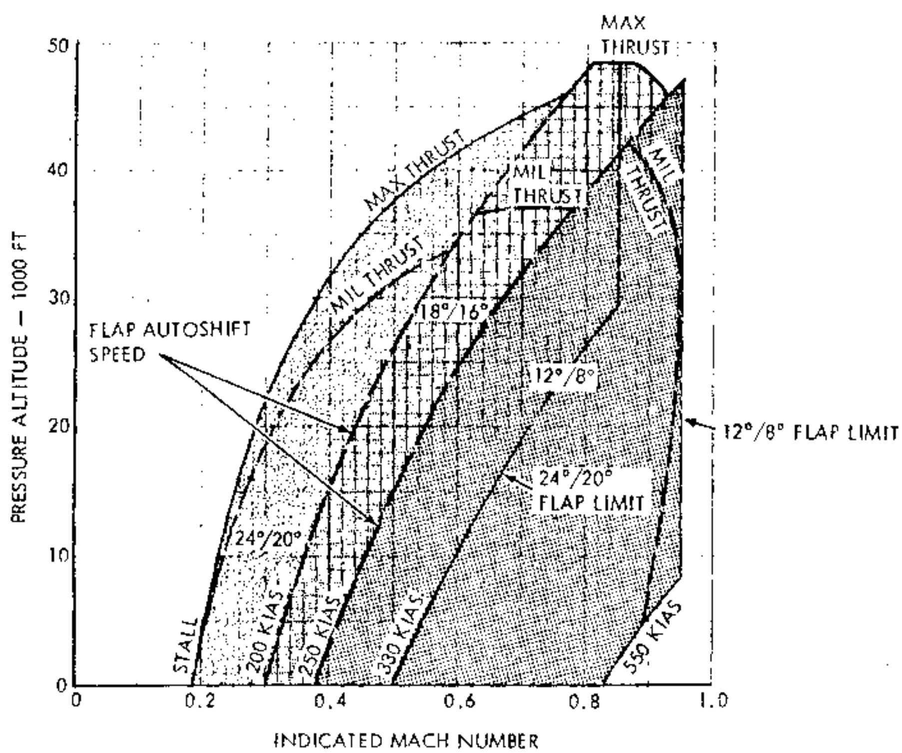
MANEUVER FLAPS



F
F-1

Note

CHART DATA BASED ON STANDARD DAY CONDITIONS.



F-5 1-539(2)C

FA8-9 (Sheet 3).

MODEL: F-5F
DATE: 1 MARCH 1982
DATA BASIS: FLIGHT TEST

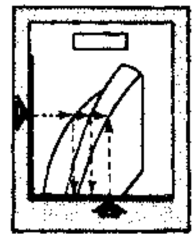
ENGINES: (2)J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

LEVEL FLIGHT COMBAT SPEED

TIP LAUNCHER RAILS

GROSS WEIGHT 14,050 POUNDS

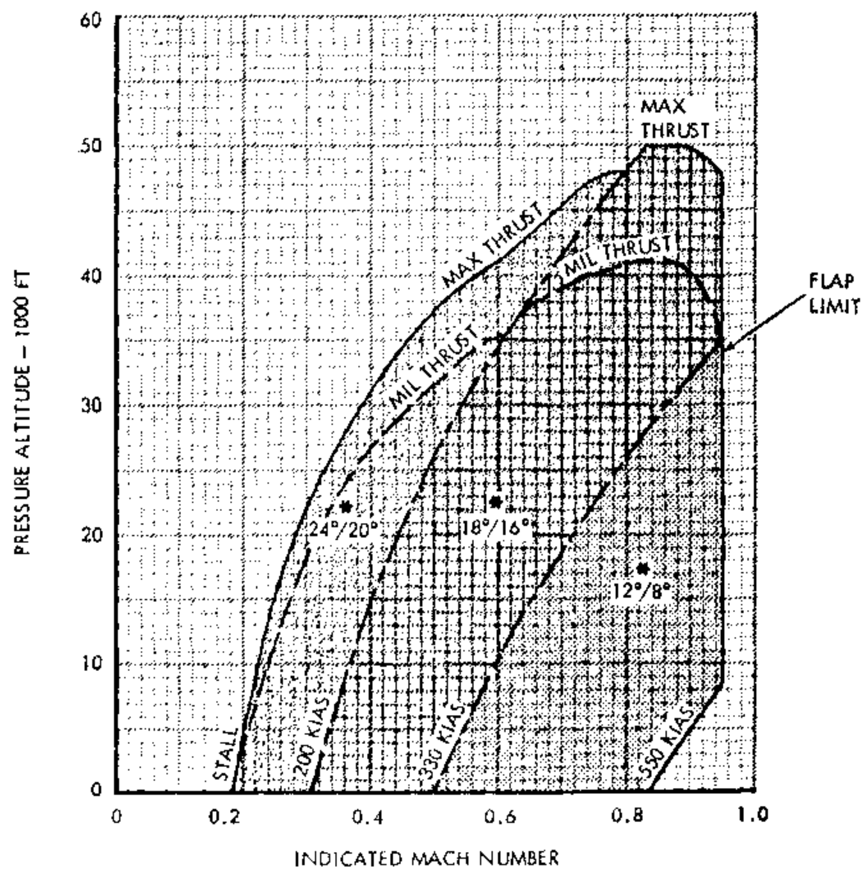
AUTO FLAPS
(BELOW 0.95 IMN)



F-2

Note

- CHART DATA BASED ON STANDARD DAY CONDITIONS.
- SEE SECTION I FOR AUTO-FLAP SHIFT SCHEDULE.



* MAXIMUM AUTO FLAP POSITION AVAILABLE

F-5 1-539(12)

FA8-9 (Sheet 4).

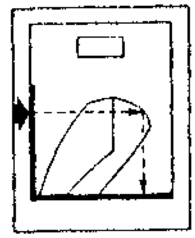
MODEL: F-5E
DATE: 1 AUGUST 1976
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

LEVEL FLIGHT COMBAT SPEED

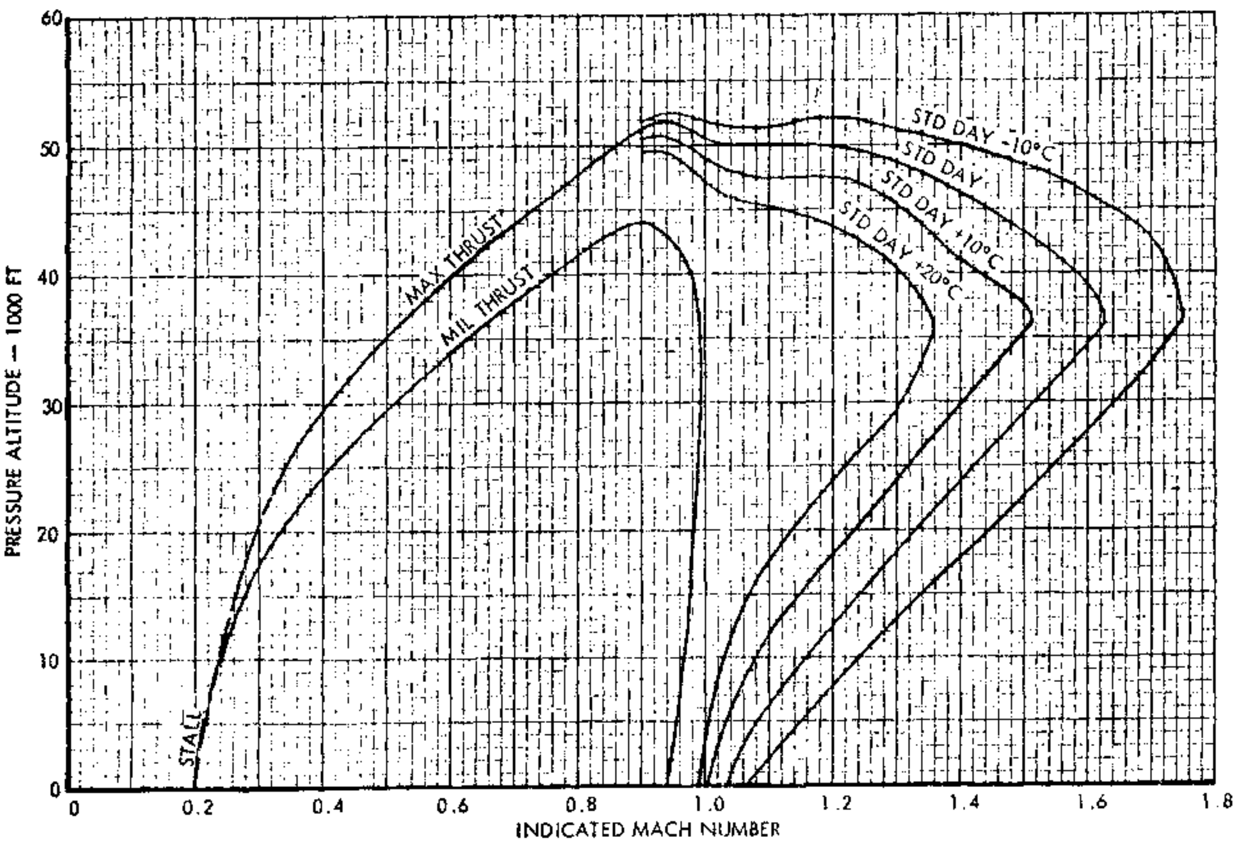
TIP LAUNCHER RAILS
GROSS WEIGHT 13,300 POUNDS

FLAPS UP



E **E-1** **E-2**

Note
CHART DATA BELOW 0.90 IMN BASED ON STANDARD DAY CONDITIONS.



F-5 1-535(1)D

FA8-10 (Sheet 1).

MODEL: F-5E
DATE: 1 MARCH 1982
DATA BASIS: FLIGHT TEST

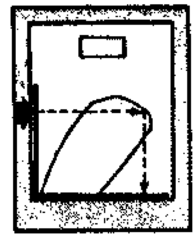
ENGINES: (2)J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

LEVEL FLIGHT COMBAT SPEED

TIP LAUNCHER RAILS

GROSS WEIGHT 13,400 POUNDS

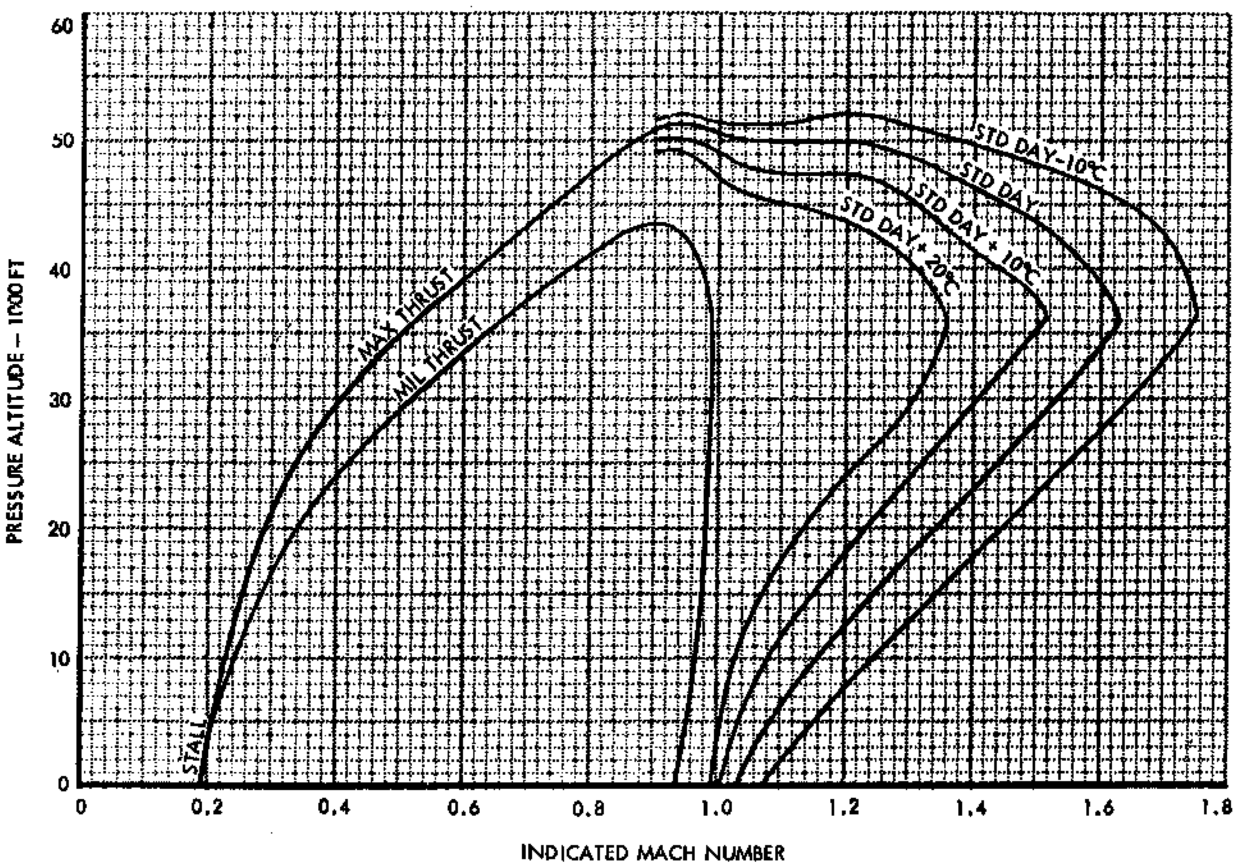
FLAPS UP



E-3

Note

CHART DATA BELOW 0.90 IMN BASED ON STANDARD DAY CONDITIONS.



F-5 1-535(13)

FA8-10 (Sheet 2).

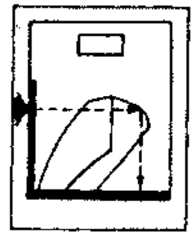
MODEL: F-5F
DATE: 1 AUGUST 1976
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

LEVEL FLIGHT COMBAT SPEED

TIP LAUNCHER RAILS
GROSS WEIGHT 13,800 POUNDS

FLAPS UP

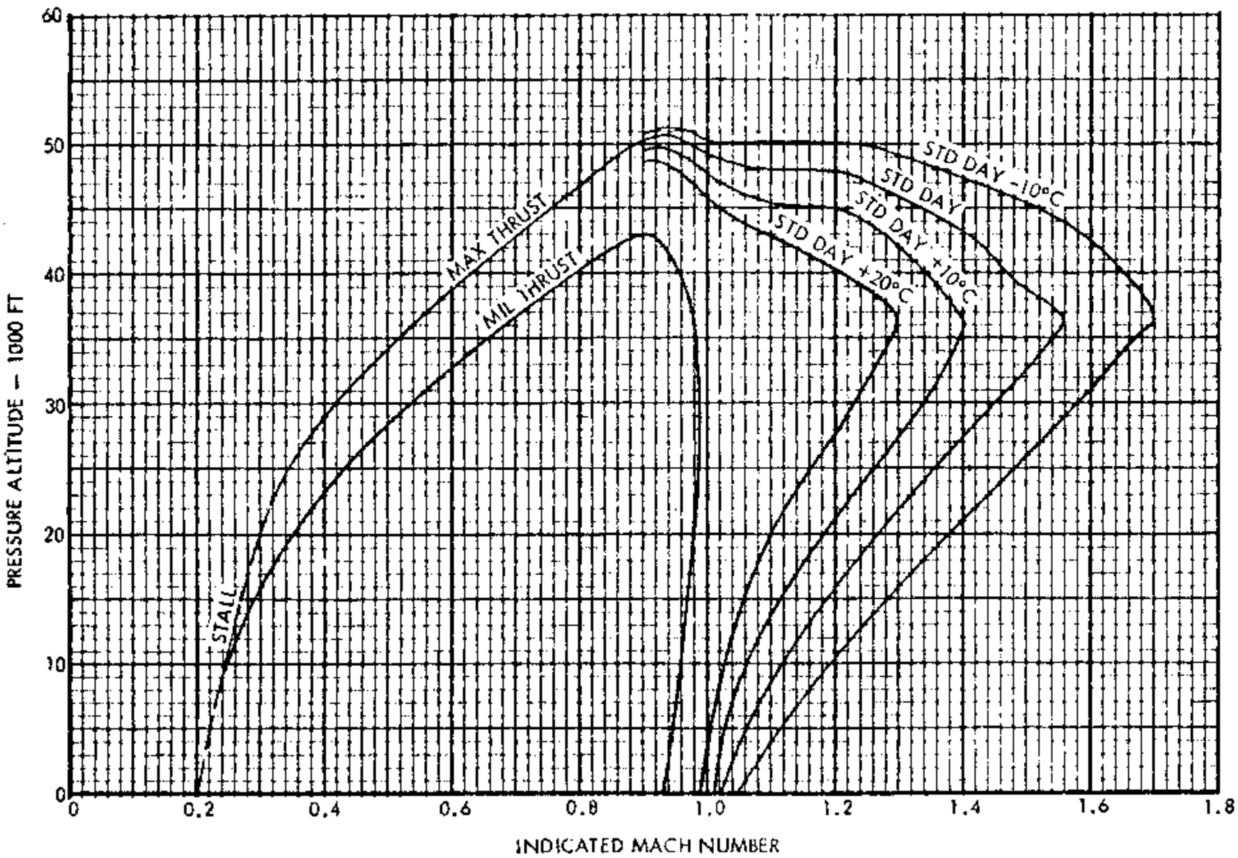


F

F-1

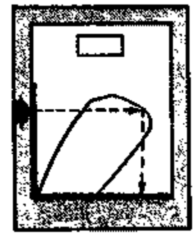
Note

CHART DATA BELOW 0.90 IMN BASED ON STANDARD DAY CONDITIONS.



F-5 1-535(2)D

FA8-10 (Sheet 3).



F-2

MODEL: F-5F
DATE: 1 MARCH 1982
DATA BASIS: FLIGHT TEST

ENGINES: (2)J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

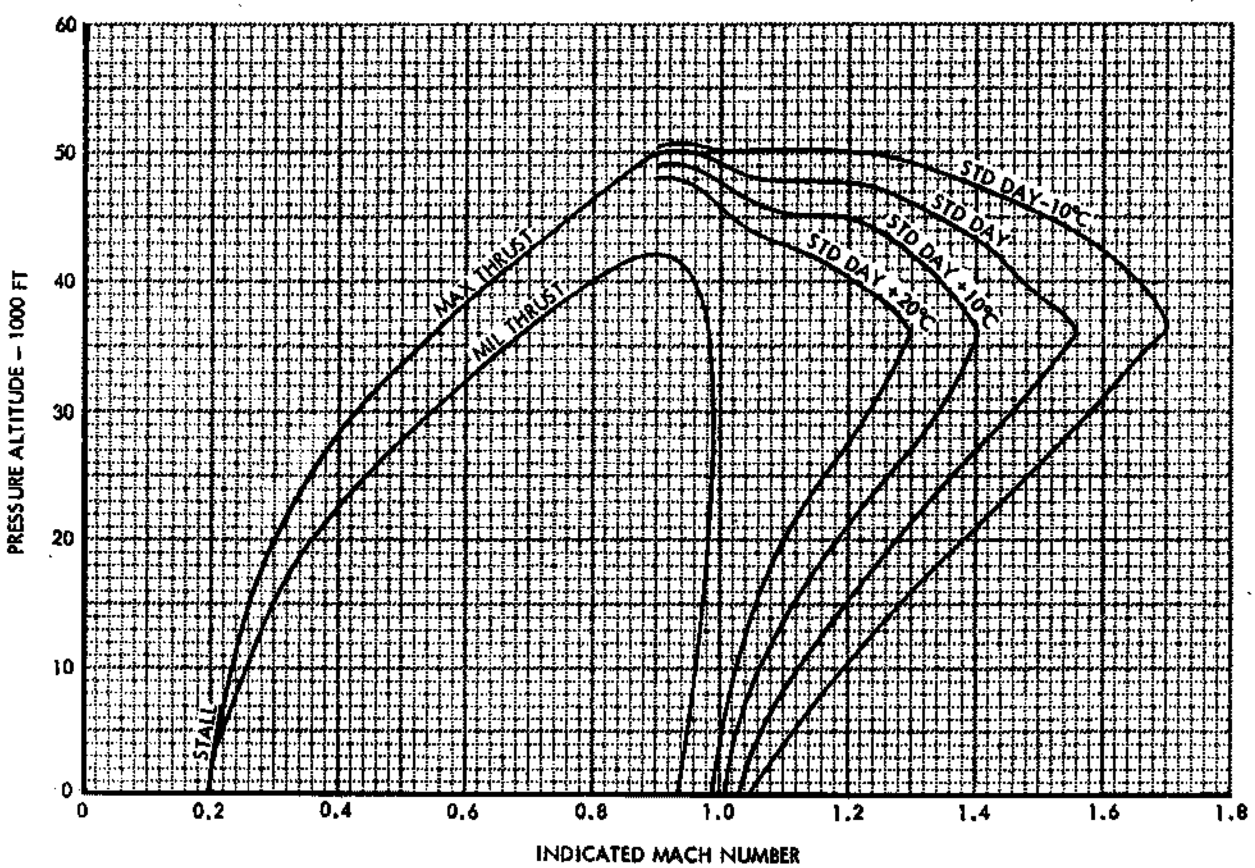
LEVEL FLIGHT COMBAT SPEED

TIP LAUNCHER RAILS
GROSS WEIGHT 14,050 POUNDS

FLAPS UP

Note

CHART DATA BELOW 0.90 IMN BASED ON STANDARD DAY CONDITIONS.



F-5 1-535(12)

FA8-10 (Sheet 4).

MODEL: F-5E
DATE: 1 APRIL 1977
DATA BASIS: **FLIGHT TEST**

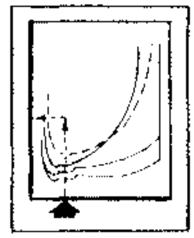
ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

TURN PERFORMANCE

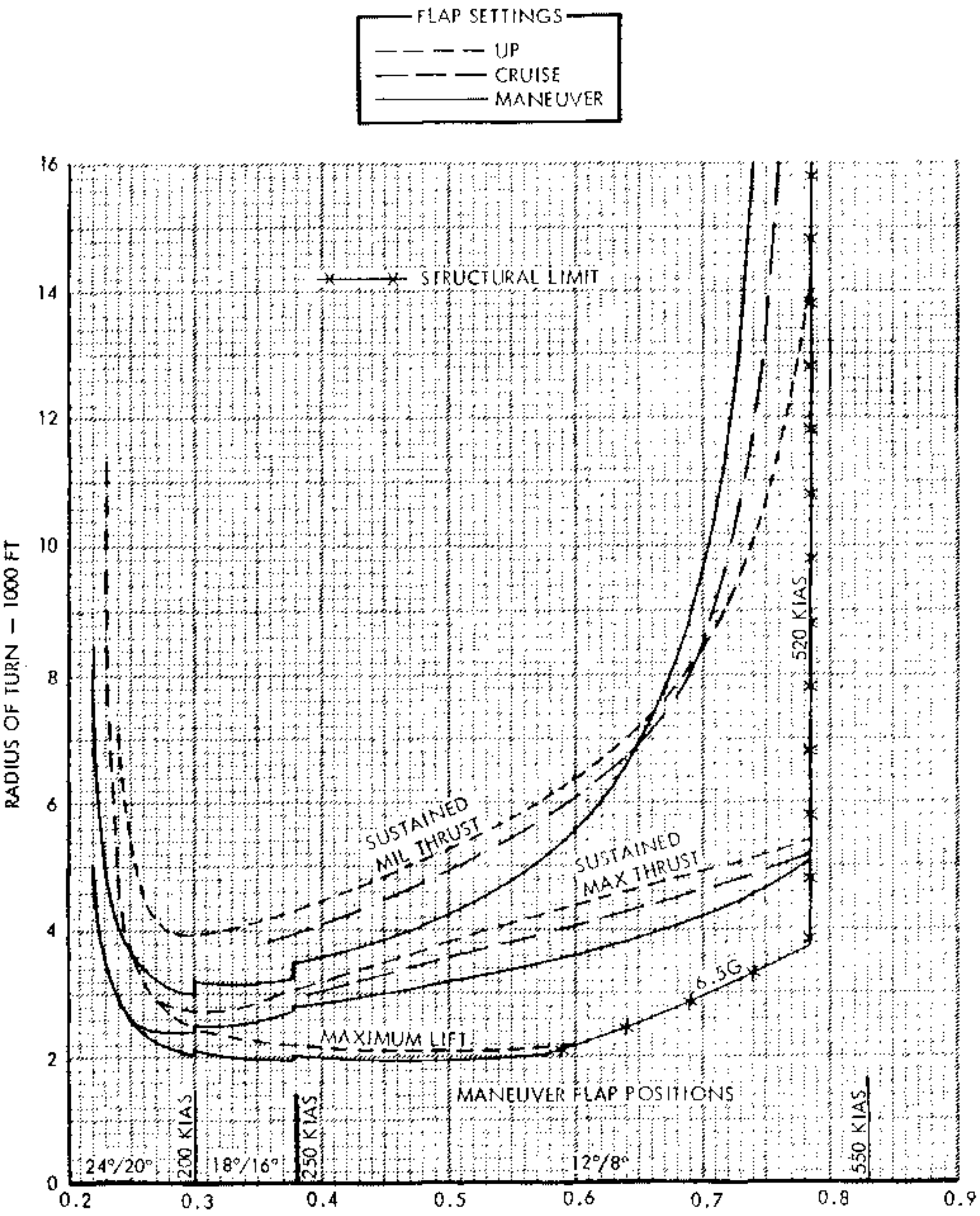
RADIUS
STANDARD DAY

(2) AIM-9 MISSILES, CL TANK, AND (4) MK-82 BOMBS
GROSS WEIGHT 17,500 POUNDS

SEA LEVEL



E
E-1
E-2



F-5 1-603(1)C

FA8-11 (Sheet 1).

MODEL: F-5E
DATE: 1 MARCH 1982
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

TURN PERFORMANCE

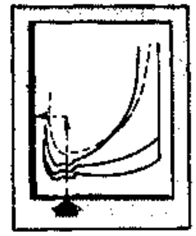
RADIUS

STANDARD DAY

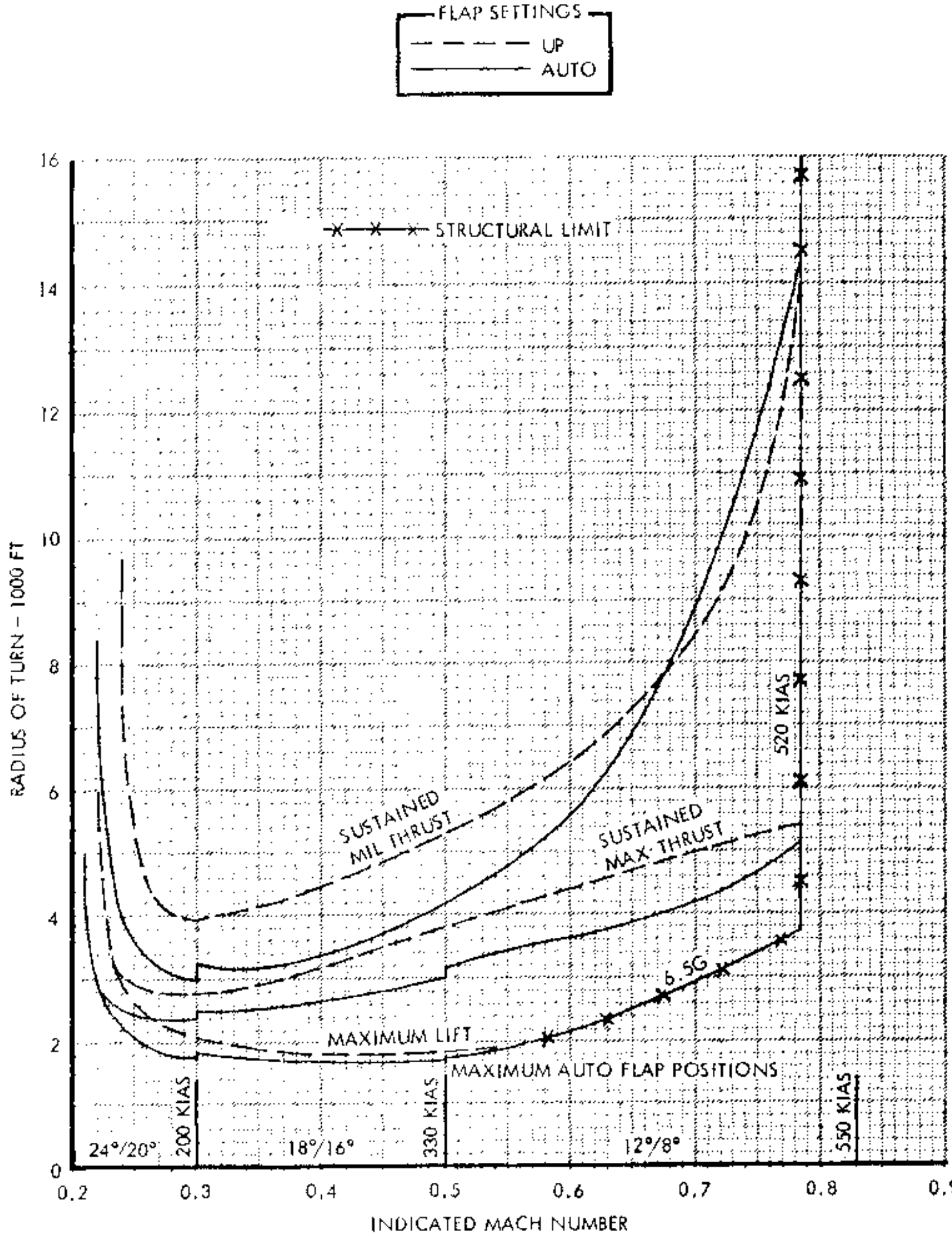
(2) AIM-9 MISSILES, CL TANK, AND (4) MK-82 BOMBS

GROSS WEIGHT 17,600 POUNDS

SEA LEVEL



E-3



F-5 1-603(12)

FA8-11 (Sheet 2).

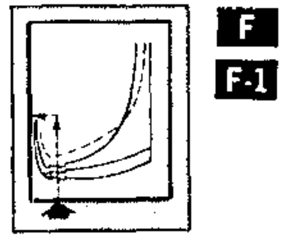
MODEL: F-5F
DATE: 1 APRIL 1977
DATA BASIS: FLIGHT TEST

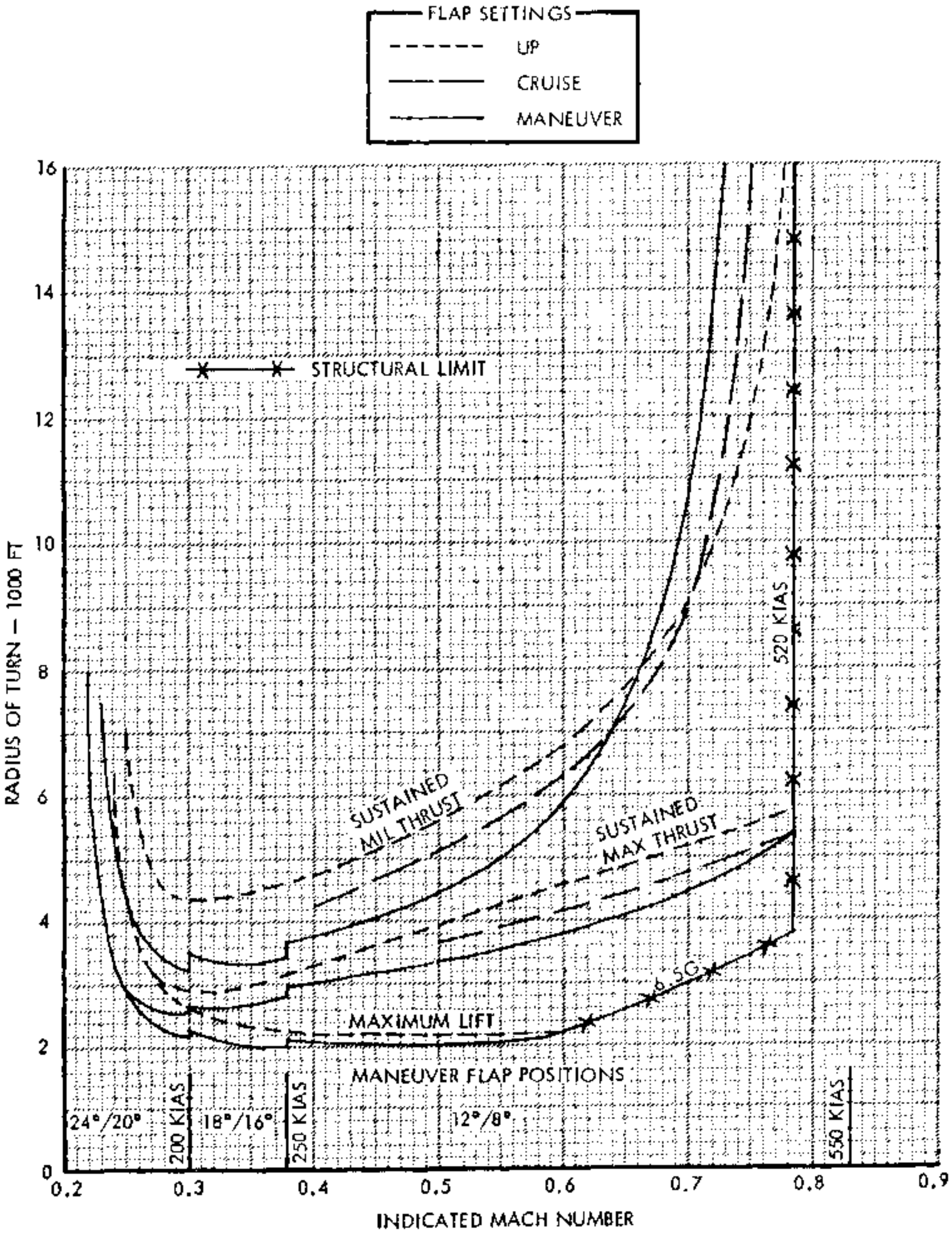
ENGINES: (2)J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

TURN PERFORMANCE

RADIUS
STANDARD DAY
(2) AIM-9 MISSILES, CL TANK, AND (4) MK-82 BOMBS
GROSS WEIGHT 18,100 POUNDS

SEA LEVEL





F-5 1-603(2)C

FA8-11 (Sheet 3).

MODEL: F-5F
DATE: 1 MARCH 1982
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

TURN PERFORMANCE

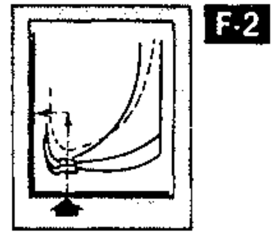
RADIUS

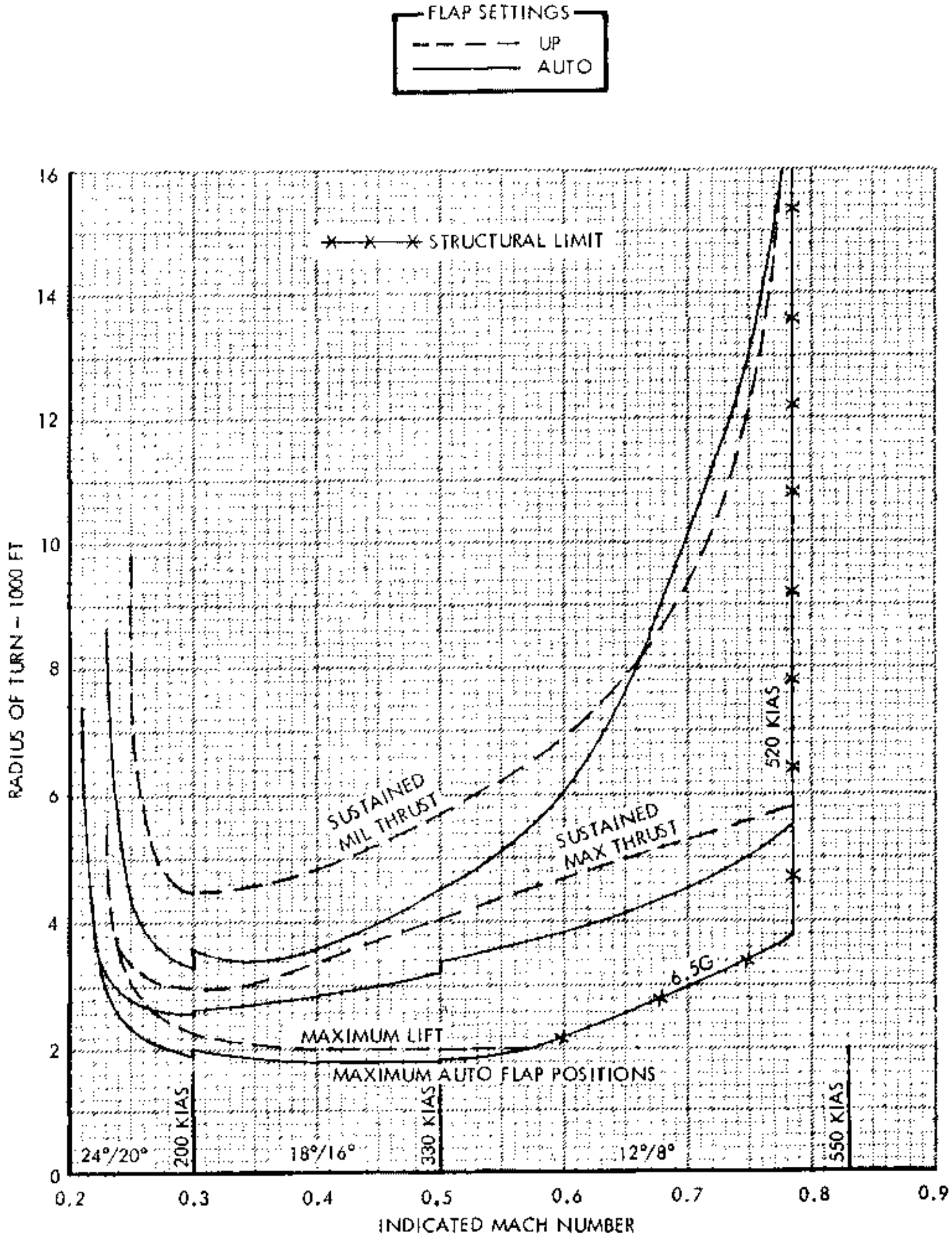
STANDARD DAY

(2) AIM-9 MISSILES, CL TANK, AND (4) MK-82 BOMBS

GROSS WEIGHT 18,250 POUNDS

SEA LEVEL





F-5 1-603(13)

FA8-11 (Sheet 4).

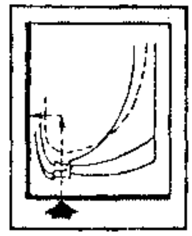
MODEL: F-5E
DATE: 1 APRIL 1977
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

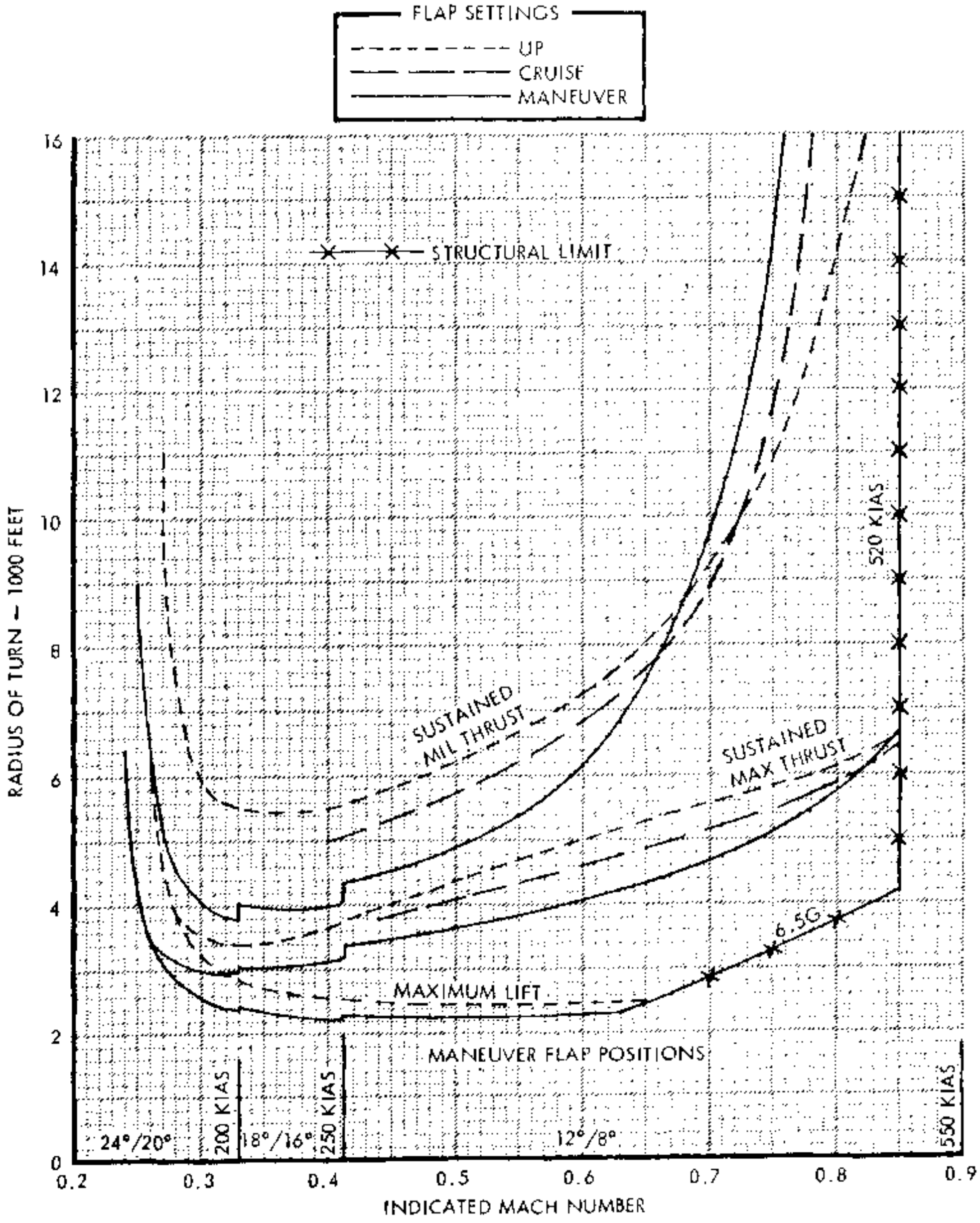
TURN PERFORMANCE

RADIUS
STANDARD DAY
(2) AIM-9 MISSILES, CL TANK, AND (4) MK-82 BOMBS
GROSS WEIGHT 17,500 POUNDS

5000 FEET



E
E-1
E-2



F 5 1-604(1)C

FA8-12 (Sheet 1).

MODEL: F-5E
DATE: 1 MARCH 1982
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

TURN PERFORMANCE

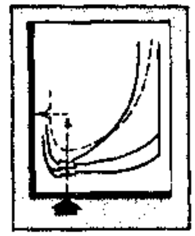
RADIUS

STANDARD DAY

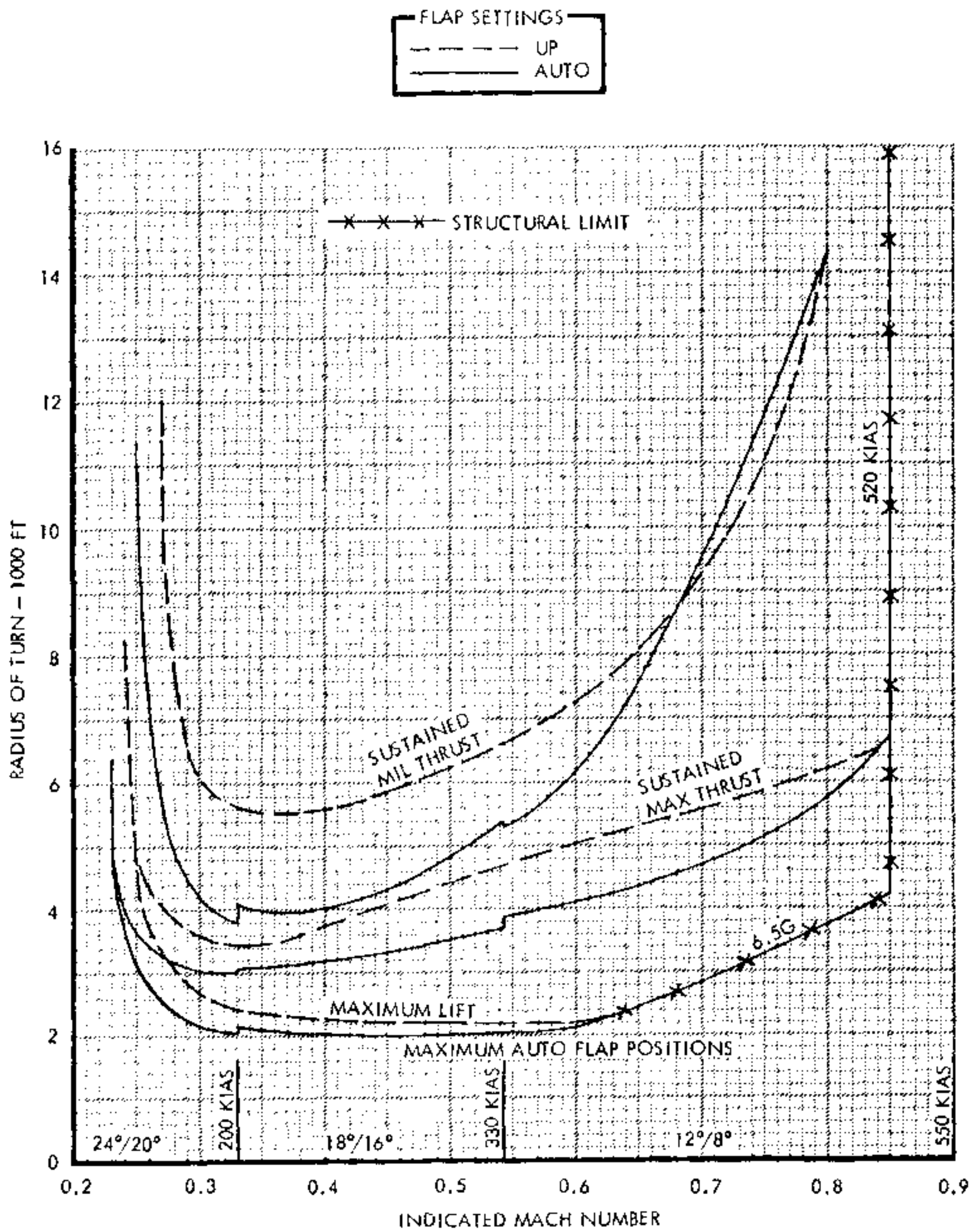
(2) AIM-9 MISSILES, CL TANK, AND (4) MK-82 BOMBS

GROSS WEIGHT 17,600 POUNDS

5000 FEET



E-3



F-5 1-604(12)

FA8-12 (Sheet 2).

MODEL: F-5F
DATE: 1 APRIL 1977
DATA BASIS: **FLIGHT TEST**

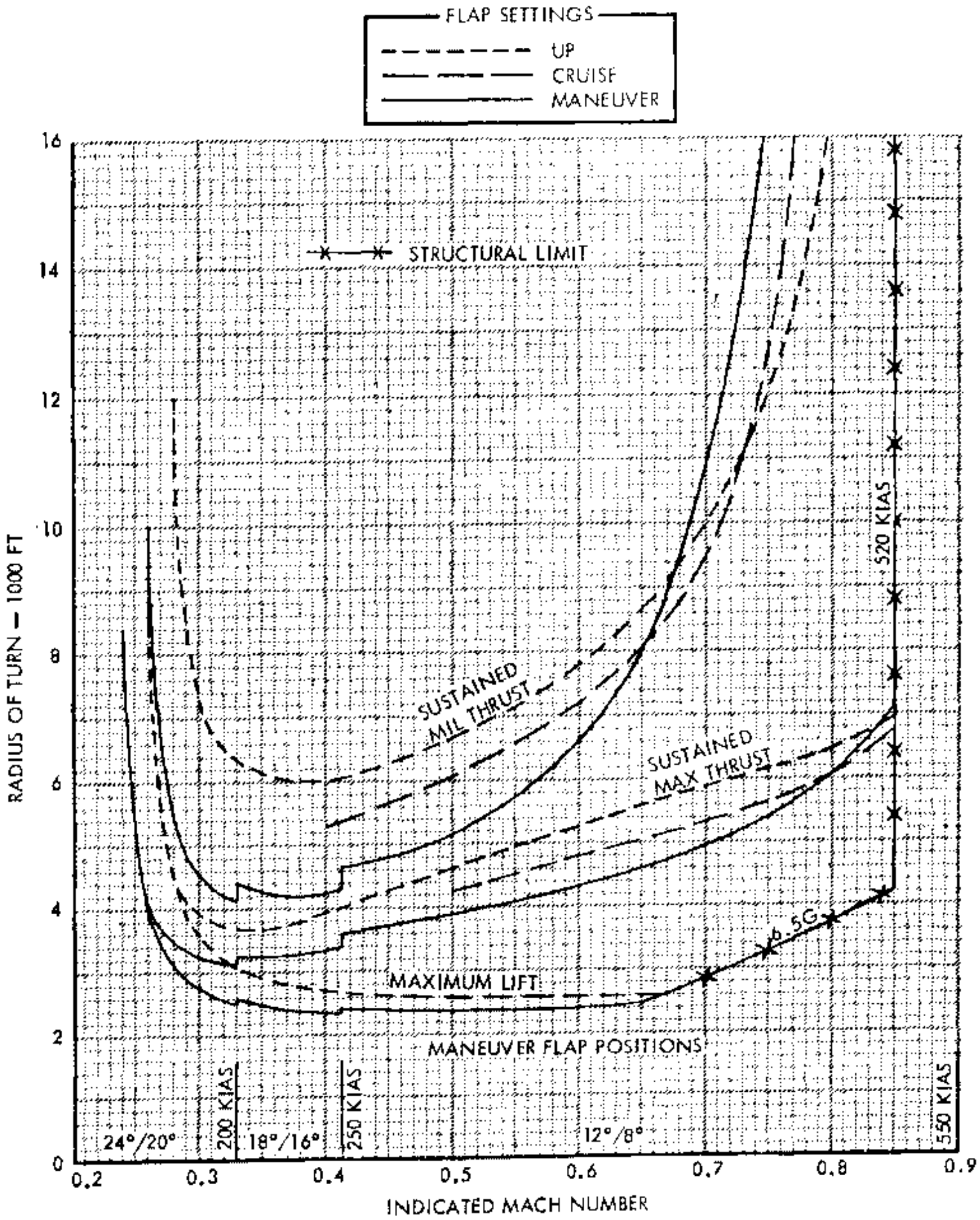
ENGINES: (2)J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

TURN PERFORMANCE

RADIUS
STANDARD DAY
(2) AIM-9 MISSILES, CL TANK, AND (4) MK-82 BOMBS
GROSS WEIGHT 18,100 POUNDS

5000 FEET

F
F-1



F-5 1-604(2)E

FA8-12 (Sheet 3).

MODEL: F-5F
DATE: 1 MARCH 1982
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

TURN PERFORMANCE

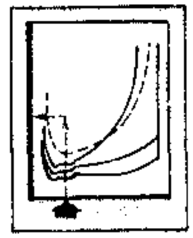
RADIUS

STANDARD DAY

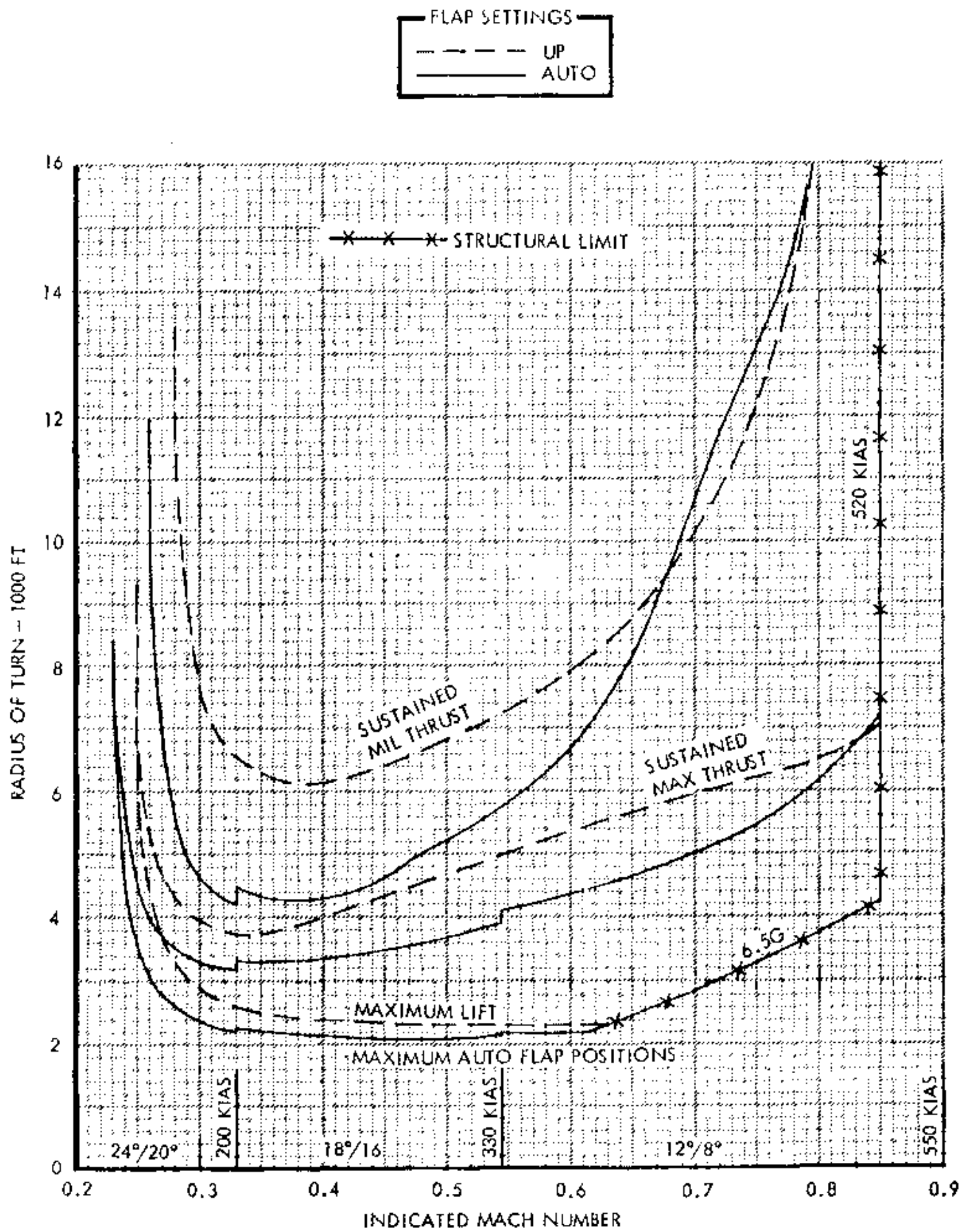
(2) AIM-9 MISSILES, CL TANK,
AND (4) MK-82 BOMBS

GROSS WEIGHT 18,250 POUNDS

5000 FEET



F-2



F-5 1-604(13)

FA8-12 (Sheet 4).

MODEL: F-5E
DATE: 1 AUGUST 1976
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

TURN PERFORMANCE

TURN RATE, TURN RADIUS, AND LOAD FACTOR

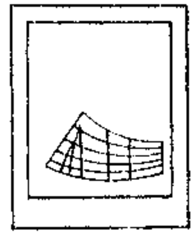
MAXIMUM THRUST

STANDARD DAY

(2) AIM-9 MISSILES

GROSS WEIGHT 13,600 POUNDS

5000 FEET

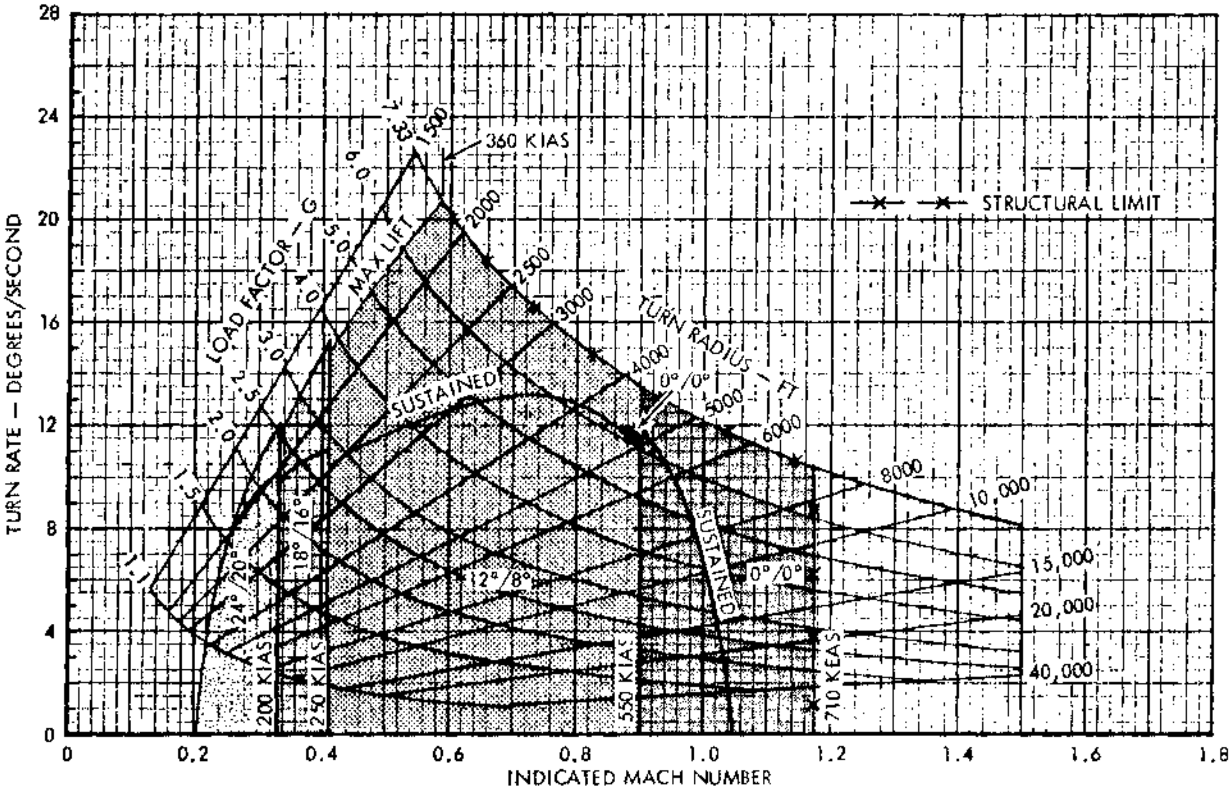


MULTIPLE ENTRY

E

E-1

E-2



F-5 1-600(1)D

FA8-13 (Sheet 1).

MODEL: F-5E
DATE: 1 MARCH 1982
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

TURN PERFORMANCE

TURN RATE, TURN RADIUS, AND LOAD FACTOR

MAXIMUM THRUST

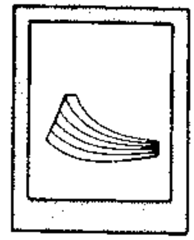
STANDARD DAY

(2) AIM-9 MISSILES

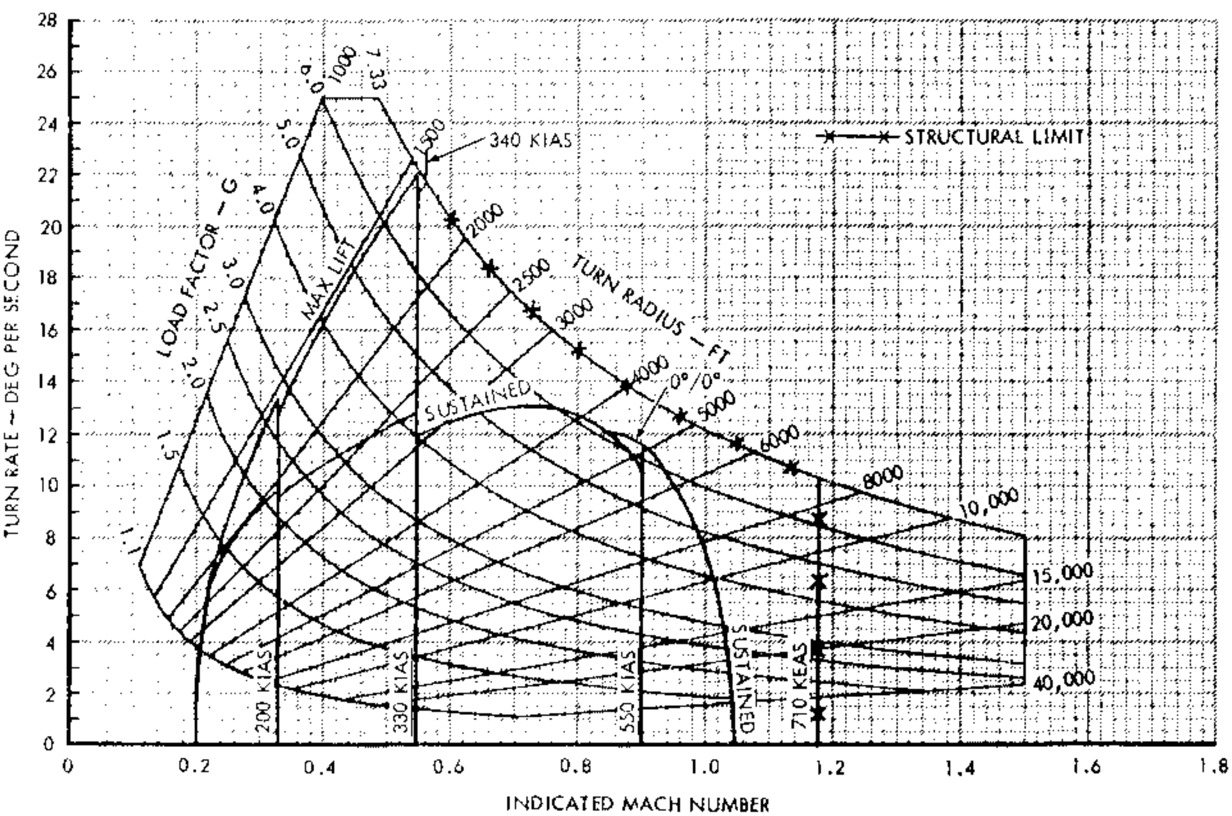
GROSS WEIGHT 13,750 POUNDS

5000 FEET

AUTO FLAPS



E-3



F-5 1-600(12)

FA8-13 (Sheet 2).

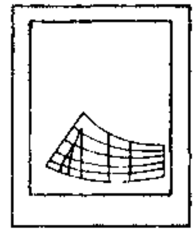
MODEL: F-5F
DATE: 1 AUGUST 1976
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

TURN PERFORMANCE

TURN RATE, TURN RADIUS,
AND LOAD FACTOR
MAXIMUM THRUST
STANDARD DAY
(2) AIM-9 MISSILES
GROSS WEIGHT 14,150 POUNDS

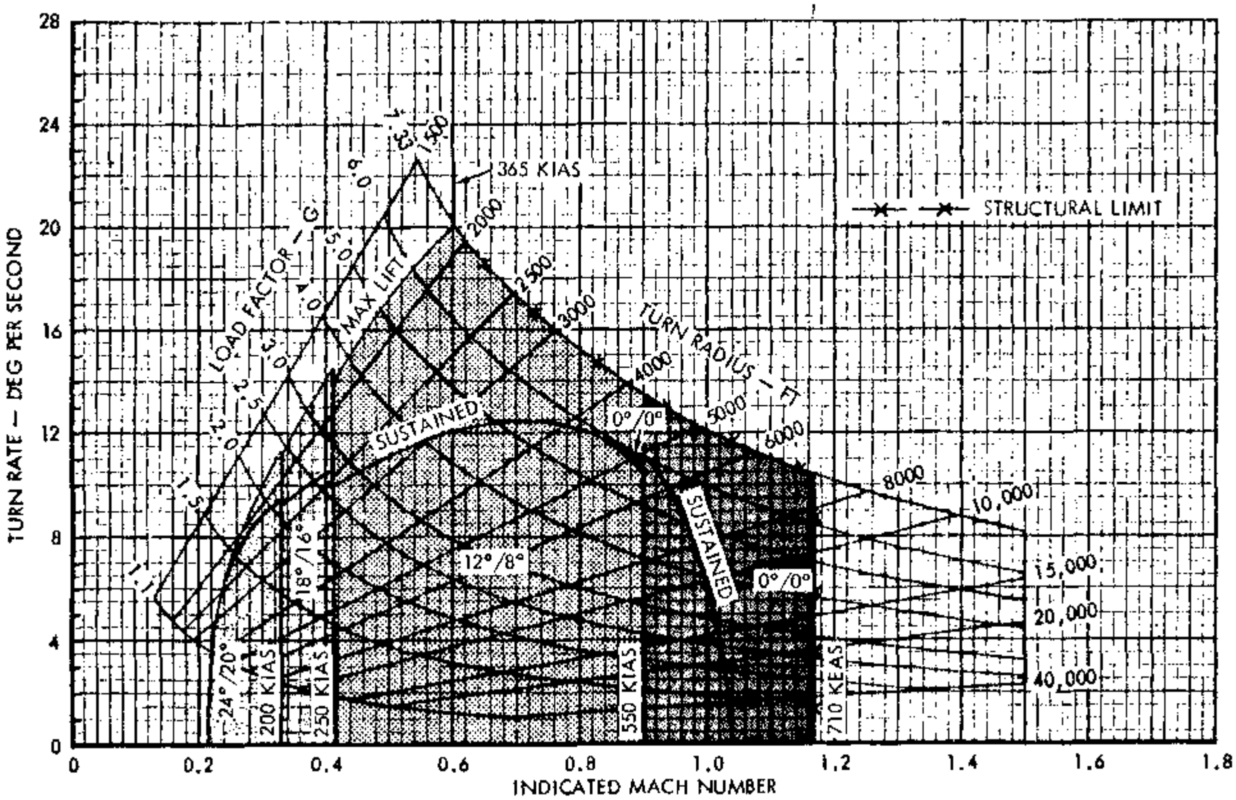
5000 FEET



MULTIPLE ENTRY

F

F-1



F-5 1-600(2)D

FA8-13 (Sheet 3).

MODEL: F-5F
DATE: 1 MARCH 1982
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

TURN PERFORMANCE

TURN RATE, TURN RADIUS, AND LOAD FACTOR

MAXIMUM THRUST

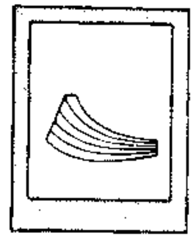
STANDARD DAY

(2) AIM-9 MISSILES

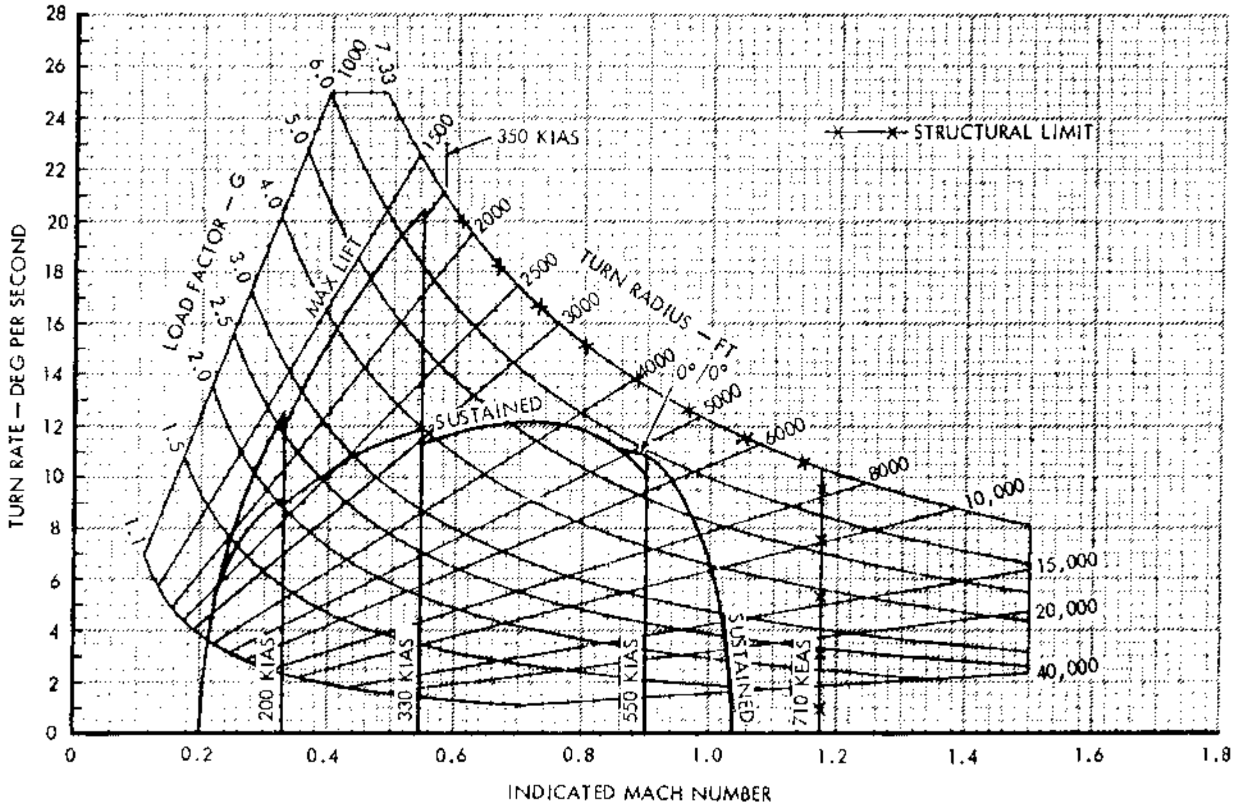
GROSS WEIGHT 14,400 POUNDS

5000 FEET

AUTO FLAPS



F-2



F-5 1-600(13)

FA8-13 (Sheet 4).

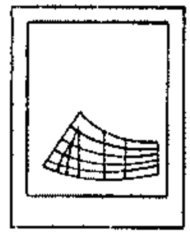
MODEL: F-5E
DATE: 1 AUGUST 1976
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

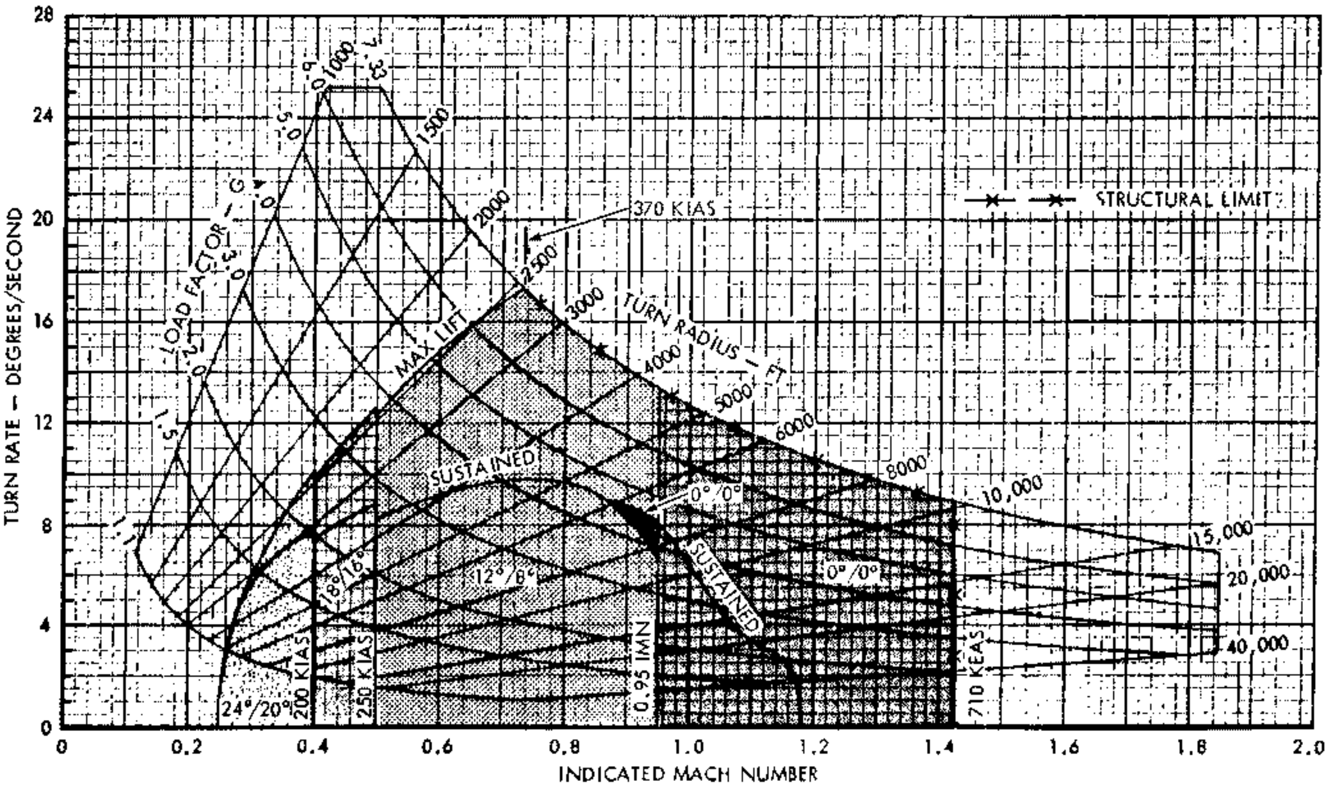
TURN PERFORMANCE

TURN RATE, TURN RADIUS, AND LOAD FACTOR
MAXIMUM THRUST
STANDARD DAY
(2) AIM-9 MISSILES
GROSS WEIGHT 13,600 POUNDS

15,000 FEET


MULTIPLE ENTRY

E
E-1
E-2



F-5 1-601(1)D

FA8-14 (Sheet 1).

MODEL: F-5E
DATE: 1 MARCH 1982
DATA BASIS: **FLIGHT TEST**

ENGINES: (2)J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

TURN PERFORMANCE

TURN RATE, TURN RADIUS, AND LOAD FACTOR

MAXIMUM THRUST

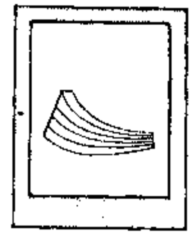
STANDARD DAY

(2) AIM-9 MISSILES

GROSS WEIGHT 13,750 POUNDS

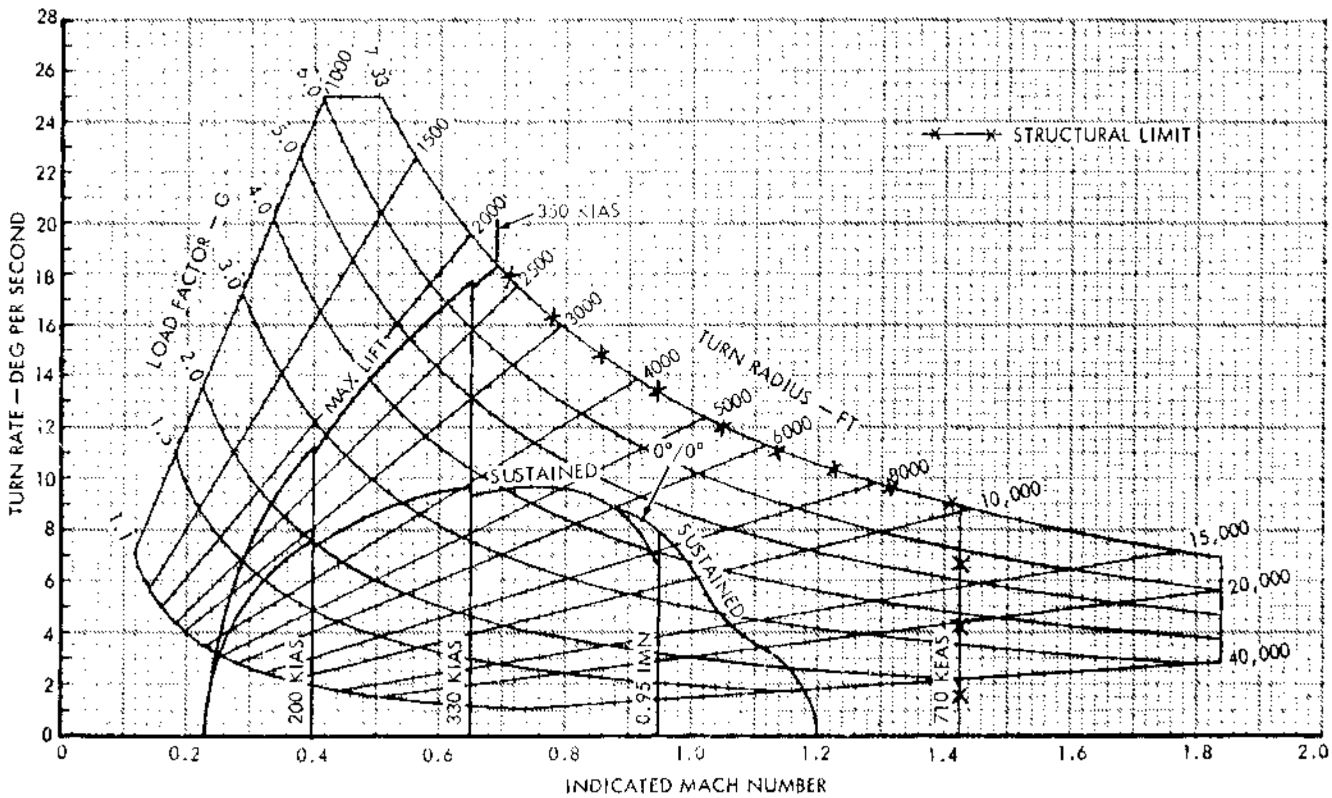
15,000 FEET

AUTO FLAPS



MULTIPLE ENTRY

E-3



F-5 1-601(12)A

FA8-14 (Sheet 2).

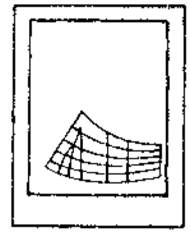
MODEL: F-5F
DATE: 1 AUGUST 1976
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

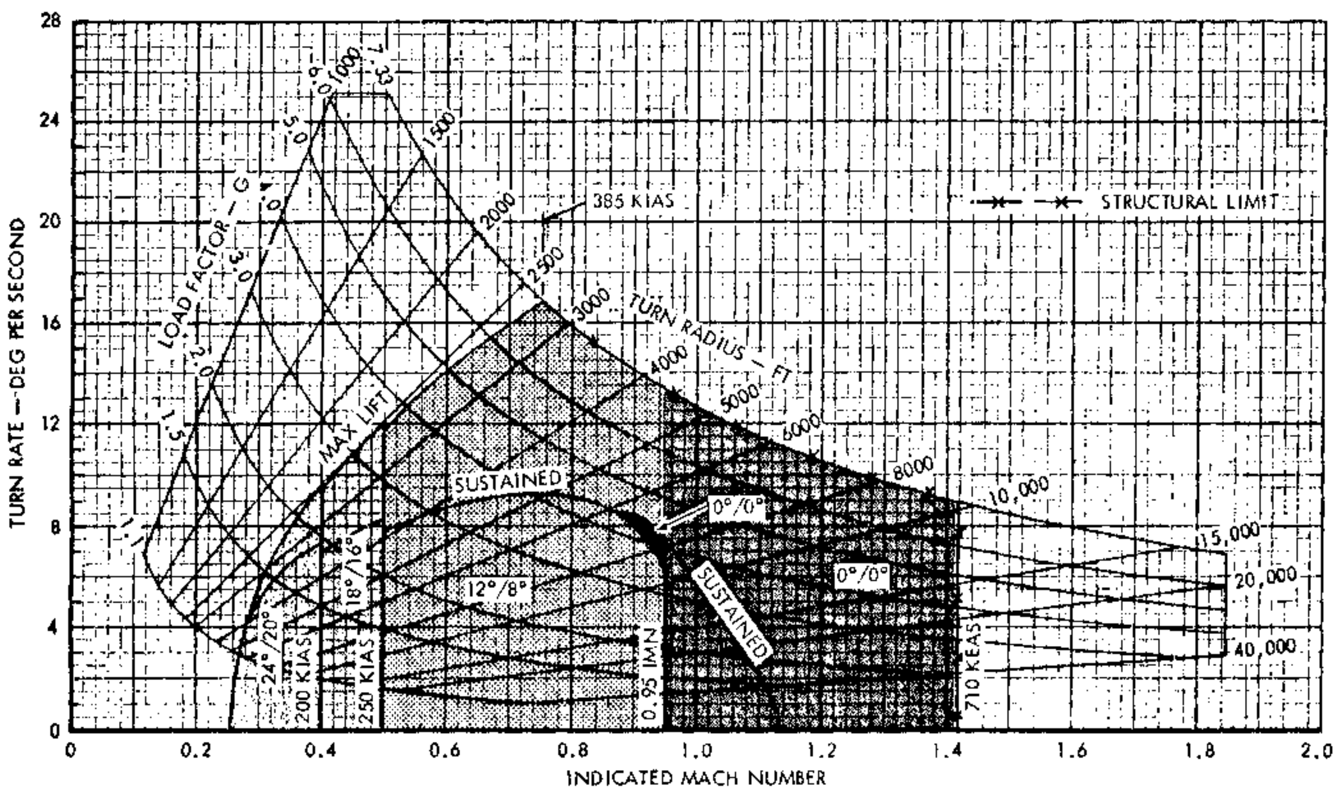
TURN PERFORMANCE

TURN RATE, TURN RADIUS, AND LOAD FACTOR
MAXIMUM THRUST
STANDARD DAY
(2) AIM-9 MISSILES
GROSS WEIGHT 14,150 POUNDS

15,000 FEET



F
F-1



F-5 1-601(2)D

FA8-14 (Sheet 3).

MODEL: F-5F
DATE: 1 MARCH 1982
DATA BASIS: **FLIGHT TEST**

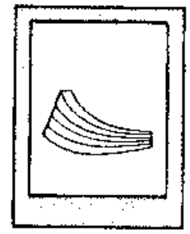
ENGINES: (2)J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

TURN PERFORMANCE

TURN RATE, TURN RADIUS, AND LOAD FACTOR
MAXIMUM THRUST
STANDARD DAY
(2) AIM-9 MISSILES
GROSS WEIGHT 14,400 POUNDS

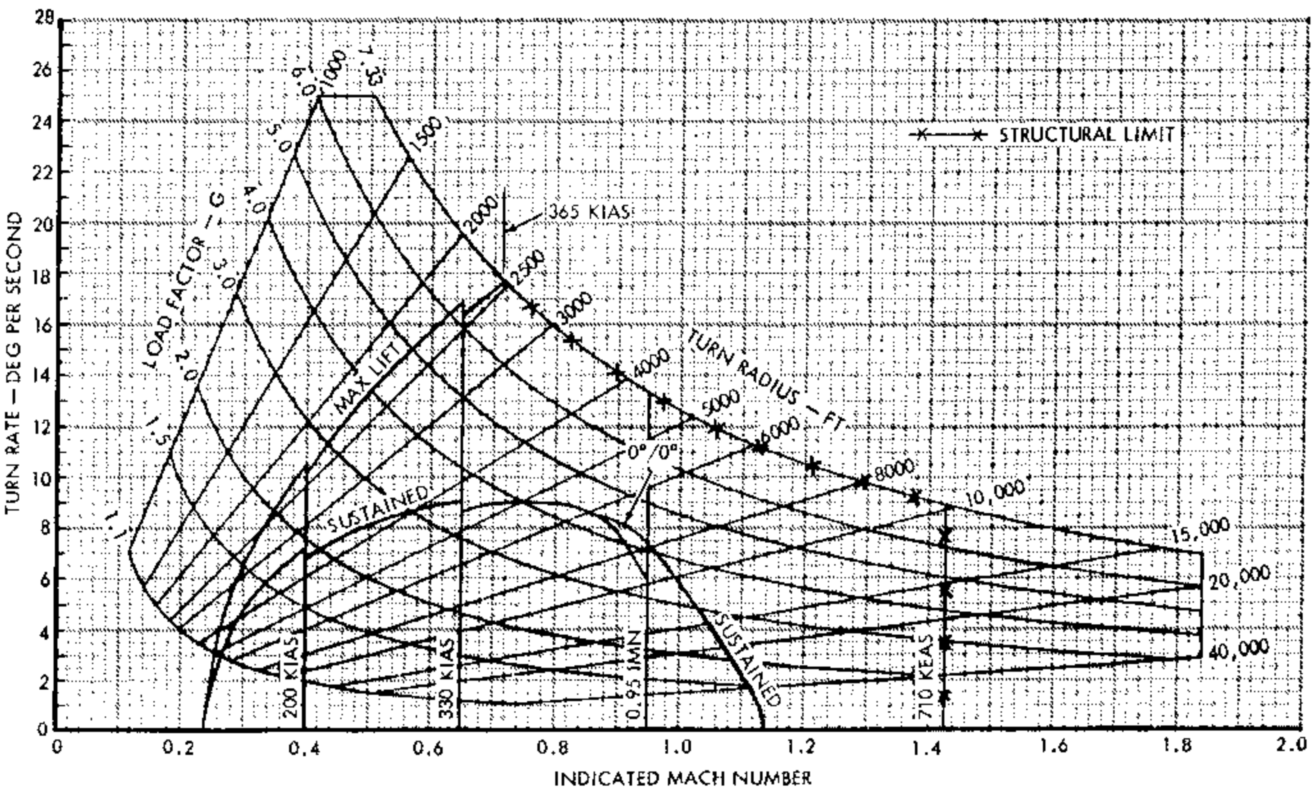
15,000 FEET

AUTO FLAPS



MULTIPLE ENTRY

F-2



FA8-14 (Sheet 4).

F-5 1-601(13)

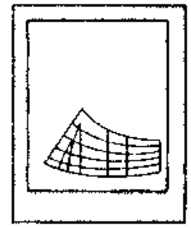
MODEL: F-5E
DATE: 1 AUGUST 1976
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

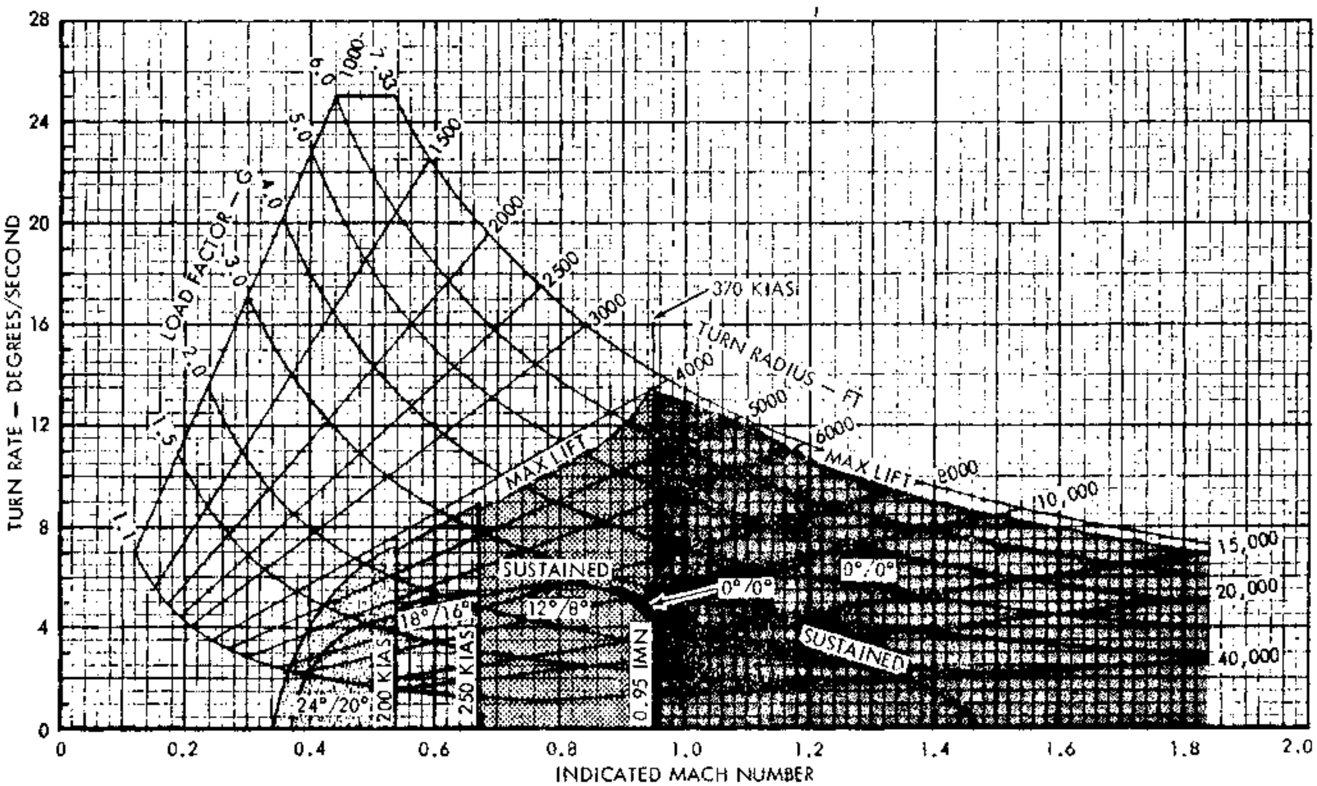
TURN PERFORMANCE

TURN RATE, TURN RADIUS, AND LOAD FACTOR
MAXIMUM THRUST
STANDARD DAY
(2) AIM-9 MISSILES
GROSS WEIGHT 13,600 POUNDS

30,000 FEET



E **E-1** **E-2**



FA8-15 (Sheet 1).

F-5 1-602(1)D

MODEL: F-5E
DATE: 1 MARCH 1982
DATA BASIS: FLIGHT TEST

ENGINES: (2)J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

TURN PERFORMANCE

TURN RATE, TURN RADIUS, AND LOAD FACTOR

MAXIMUM THRUST

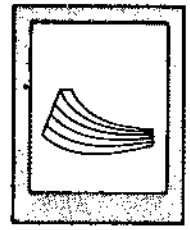
STANDARD DAY

(2) AIM-9 MISSILES

GROSS WEIGHT 13,750 POUNDS

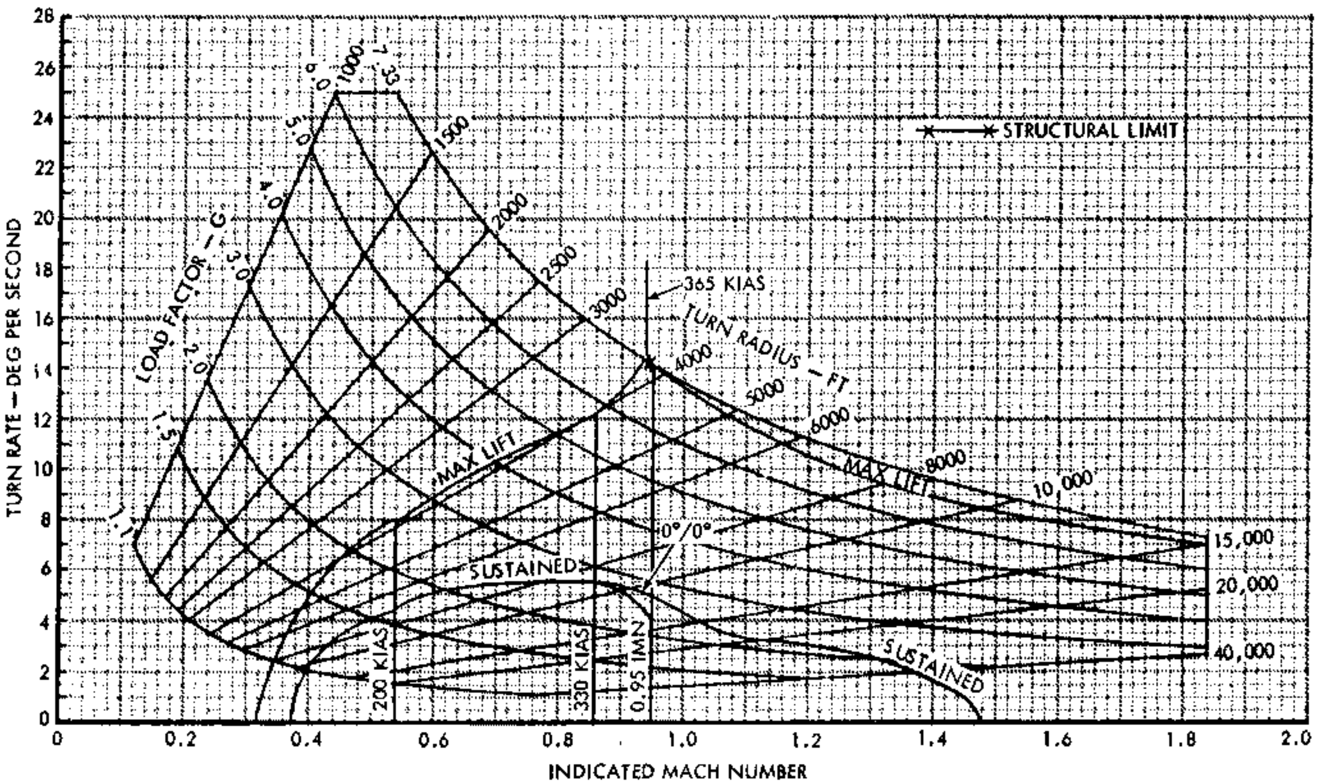
30,000 FEET

AUTO FLAPS



MULTIPLE ENTRY

E-3



FA8-15 (Sheet 2).

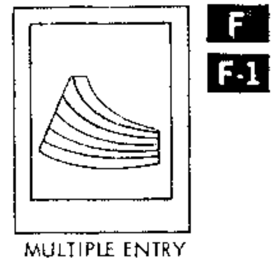
F-5 1-602(12)

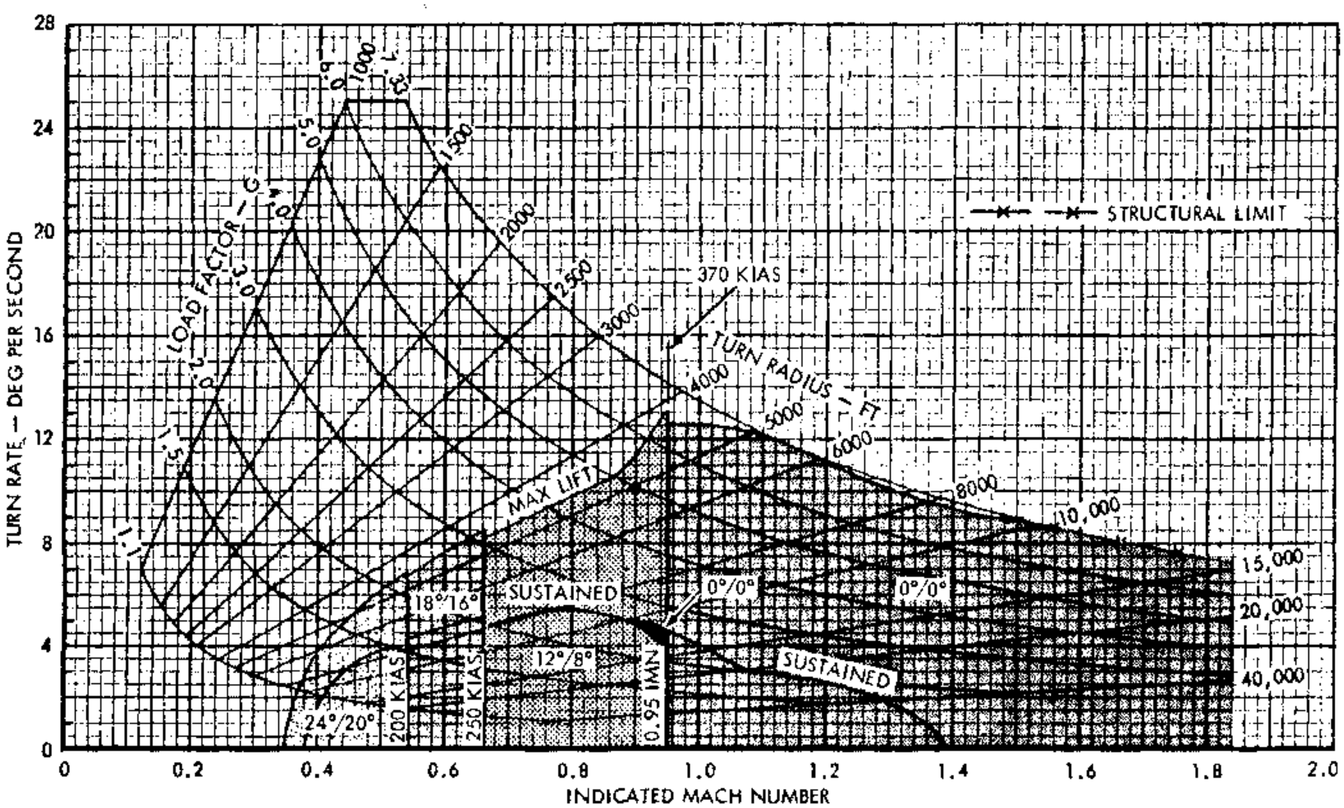
MODEL: F-5F
DATE: 1 AUGUST 1976
DATA BASIS: **FLIGHT TEST**
ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

TURN PERFORMANCE

TURN RATE, TURN RADIUS AND LOAD FACTOR
MAXIMUM THRUST
STANDARD DAY
(2) AIM-9 MISSILES
GROSS WEIGHT 14,150 POUNDS

30,000 FEET





F-5 1-602(2)D

FA8-15 (Sheet 3).

MODEL: F-5F
DATE: 1 MARCH 1982
DATA BASIS: FLIGHT TEST

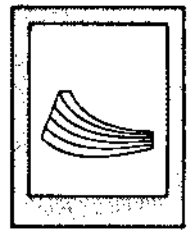
ENGINES: (2)J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

TURN PERFORMANCE

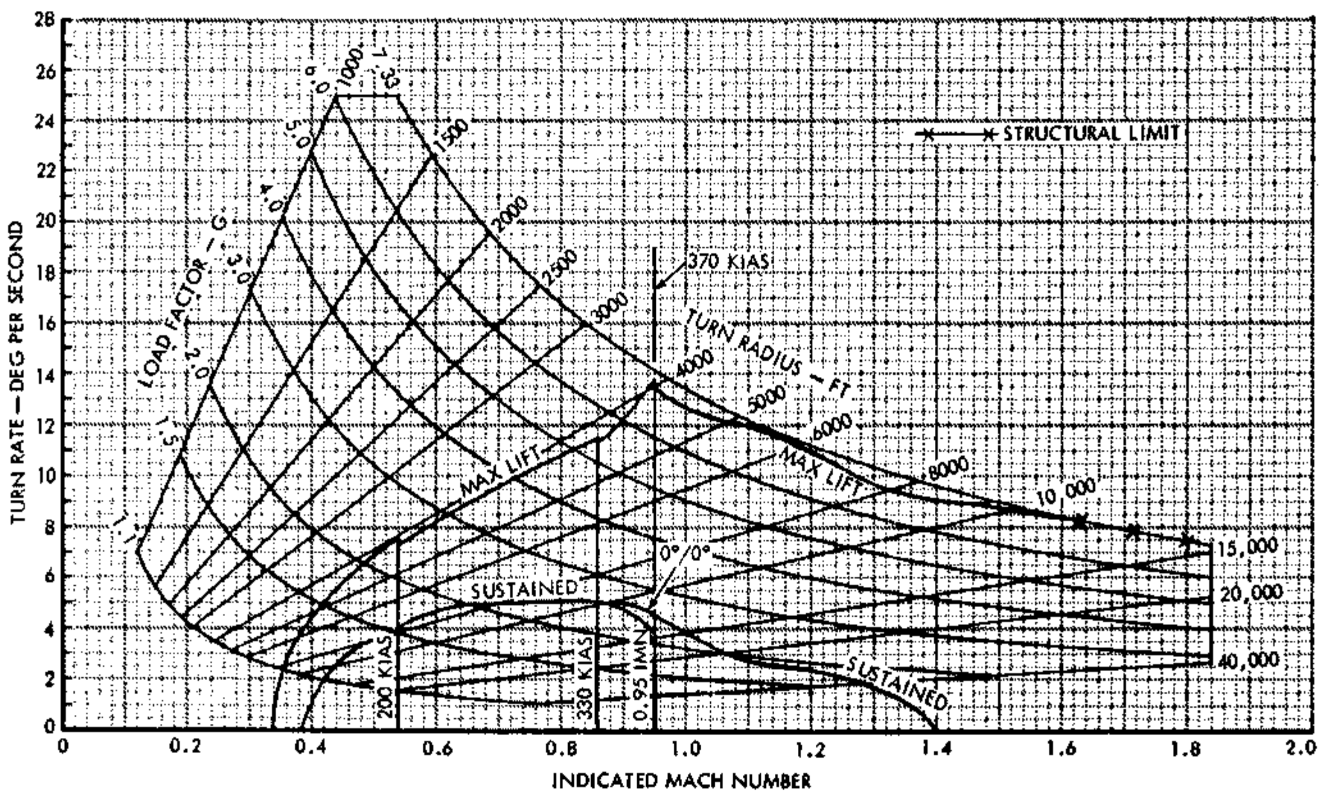
TURN RATE, TURN RADIUS, AND LOAD FACTOR
MAXIMUM THRUST
STANDARD DAY
(2) AIM-9 MISSILES
GROSS WEIGHT 14,400 POUNDS

30,000 FEET

AUTO FLAPS


MULTIPLE ENTRY

F-2



F-5 1-602(13)

FA8-15 (Sheet 4).

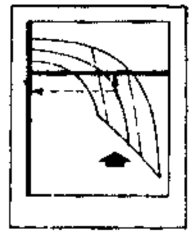
MODEL: F-5E
DATE: 1 AUGUST 1976
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

TURN PERFORMANCE

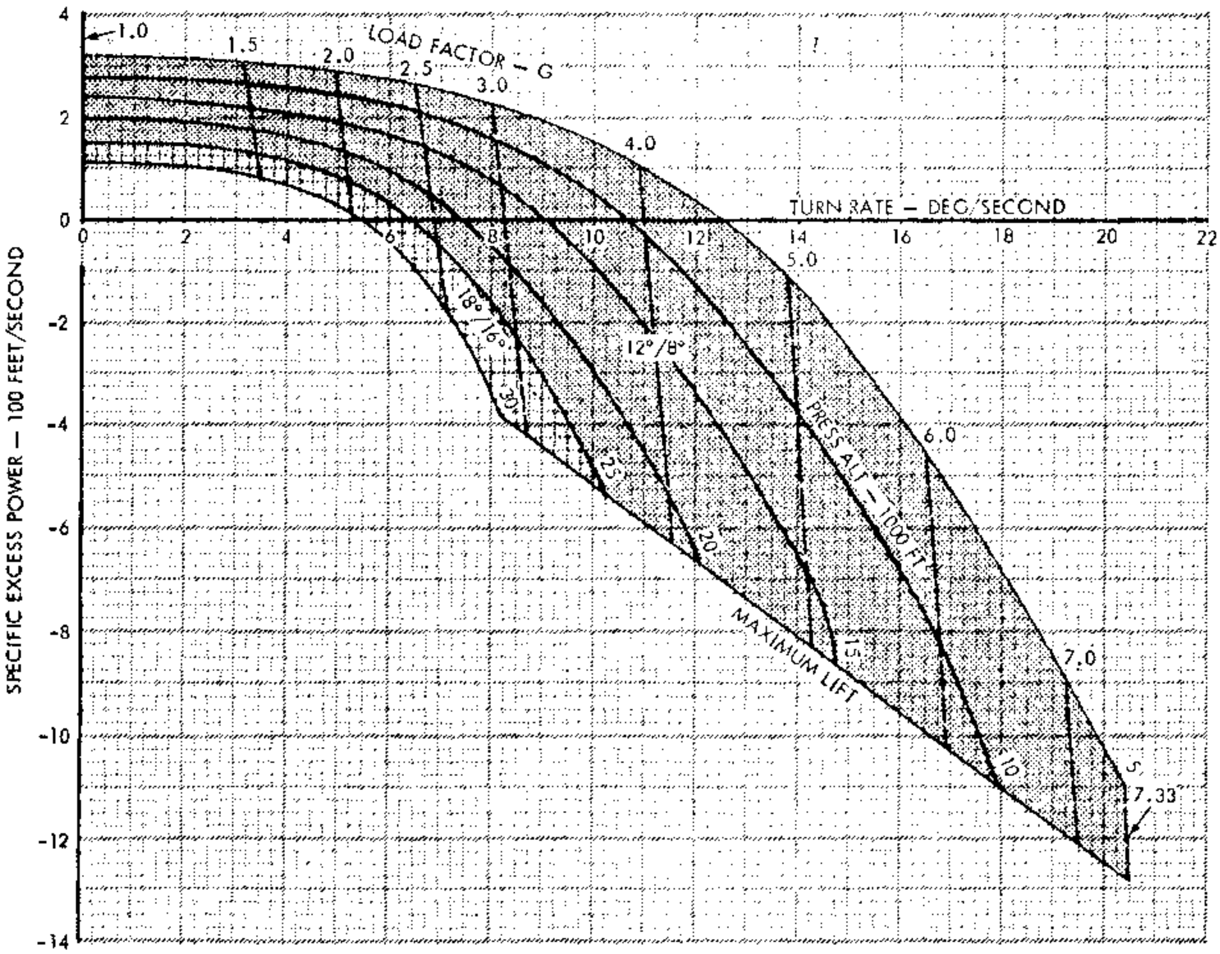
SPECIFIC EXCESS POWER AND TURN RATE
MAXIMUM THRUST
STANDARD DAY
(2) AIM-9 MISSILES
GROSS WEIGHT 13,600 POUNDS

0.6 IMN



E
E-1
E-2

MANEUVER FLAPS



FA8-16 (Sheet 1).

F-5 1-605(1)D

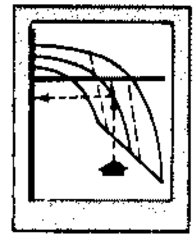
MODEL: F-5E
DATE: 1 MARCH 1982
DATA BASIS: **FLIGHT TEST**

ENGINES: (2)J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

TURN PERFORMANCE

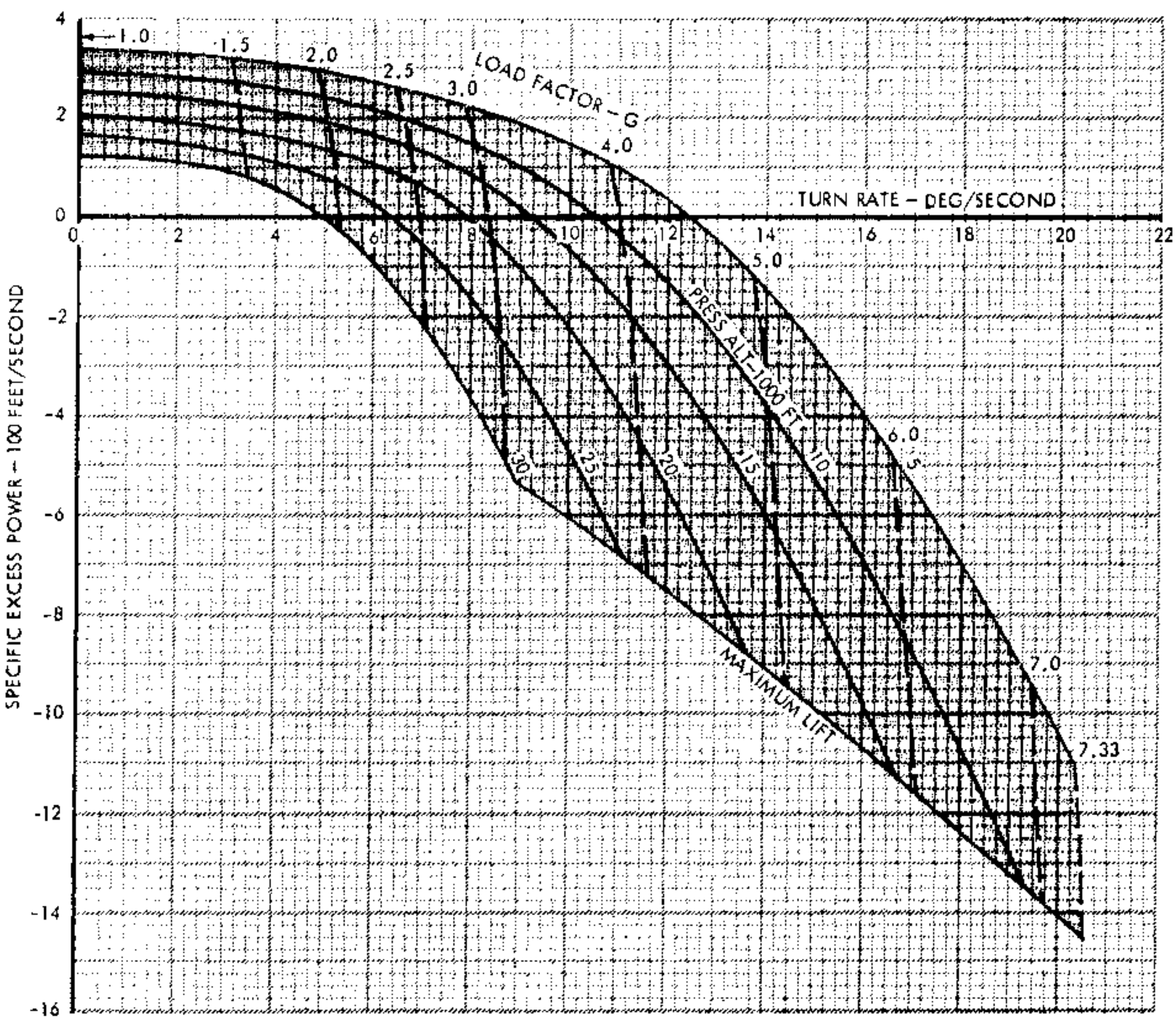
SPECIFIC EXCESS POWER AND TURN RATE
MAXIMUM THRUST
STANDARD DAY
(2) AIM-9 MISSILES
GROSS WEIGHT 13,750 POUNDS

E-3



0.6 IMN

AUTO FLAPS



FA8-16 (Sheet 2).

F-5 1-605(12)

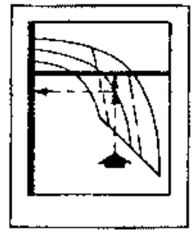
MODEL: F-5F
DATE: 1 AUGUST 1976
DATA BASIS: **FLIGHT TEST**

ENGINES: (2)J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

TURN PERFORMANCE

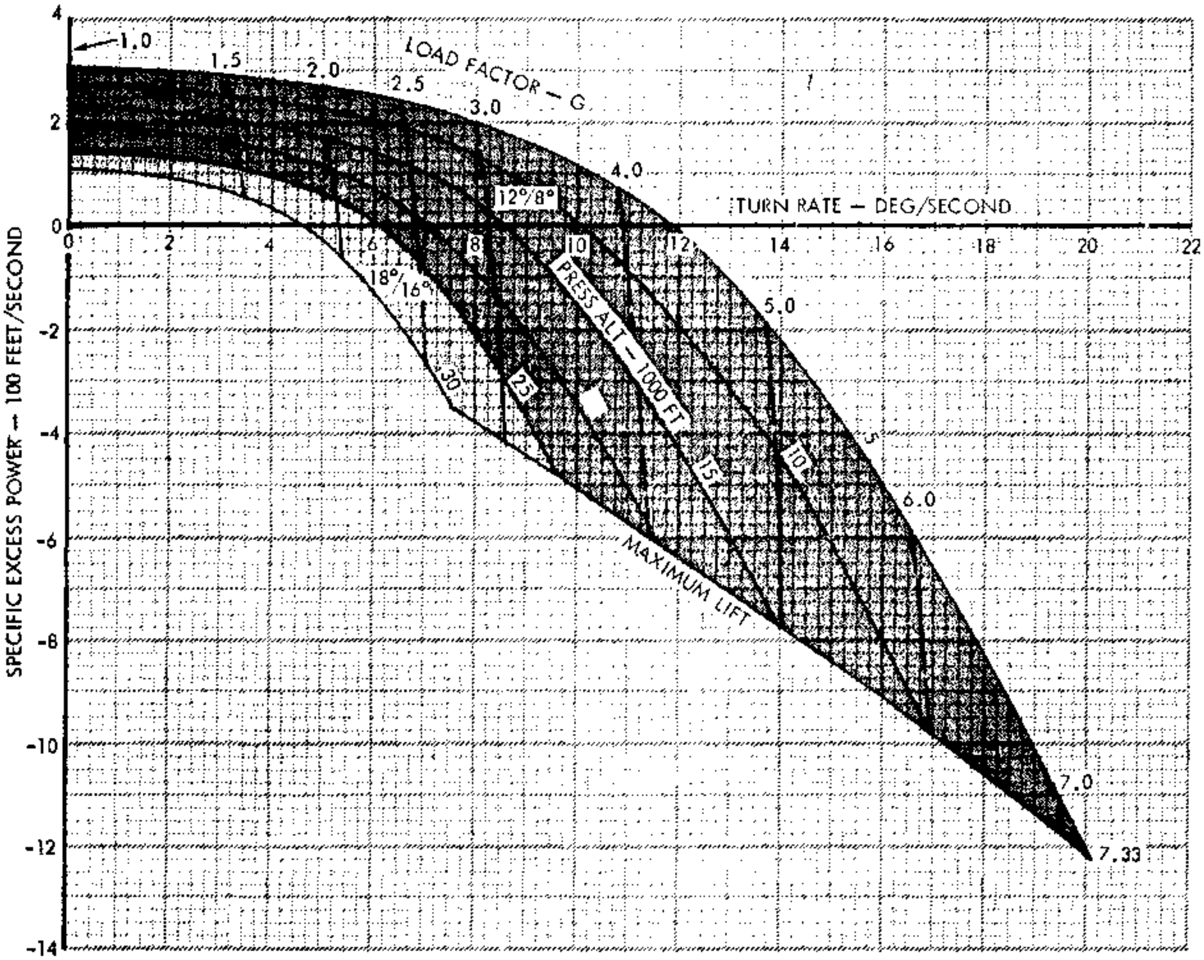
SPECIFIC EXCESS POWER AND TURN RATE
MAXIMUM THRUST
STANDARD DAY
(2) AIM-9 MISSILES
GROSS WEIGHT 14,150 POUNDS

0.6 IMN



F
F-1

MANEUVER FLAPS



F-5 1-605(2)D

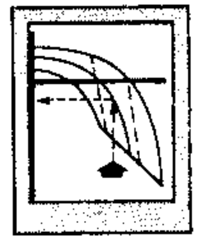
FA8-16 (Sheet 3).

MODEL: F-5F
DATE: 1 MARCH 1982
DATA BASIS: **FLIGHT TEST**

ENGINES: (2)J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

TURN PERFORMANCE

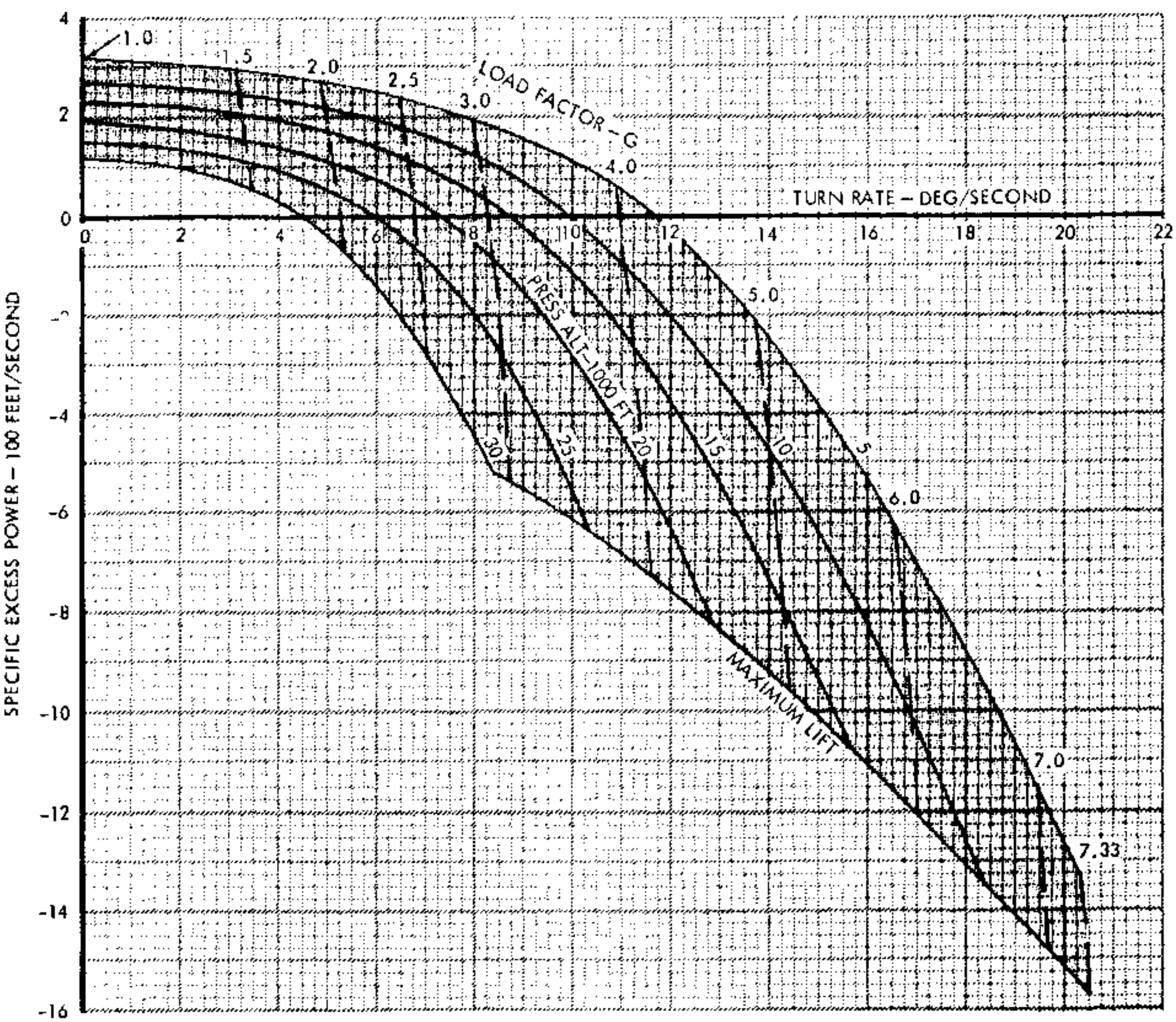
SPECIFIC EXCESS POWER AND TURN RATE
MAXIMUM THRUST
STANDARD DAY
(2) AIM-9 MISSILES
GROSS WEIGHT – 14,400 POUNDS



F-2

0.6 IMN

AUTO FLAPS



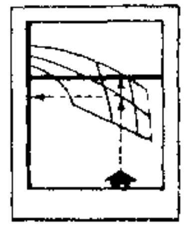
F-5 1-605(13)

FA8-16 (Sheet 4).

MODEL: F-5E
DATE: 1 AUGUST 1976
DATA BASIS: **FLIGHT TEST**
ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

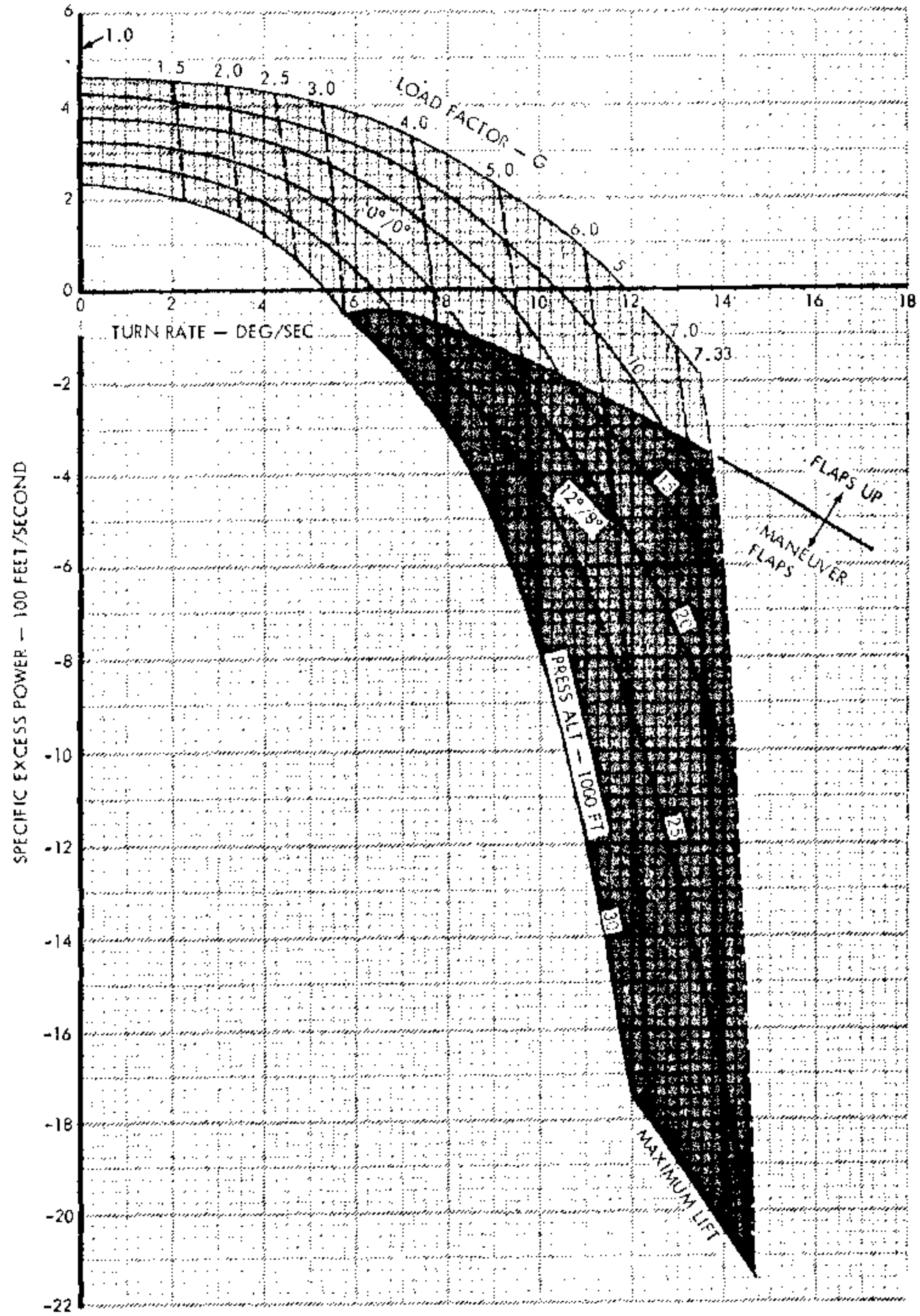
TURN PERFORMANCE

SPECIFIC EXCESS POWER AND TURN RATE
MAXIMUM THRUST
STANDARD DAY
(2) AIM-9 MISSILES
GROSS WEIGHT 13,600 POUNDS



E
E-1
E-2

0.9 IMN

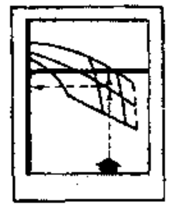


F-5 1-606(1)C

FA8-17 (Sheet 1).

MODEL: F-5E
DATE: 1 MARCH 1982
DATA BASIS: FLIGHT TEST

ENGINES: (2)J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL



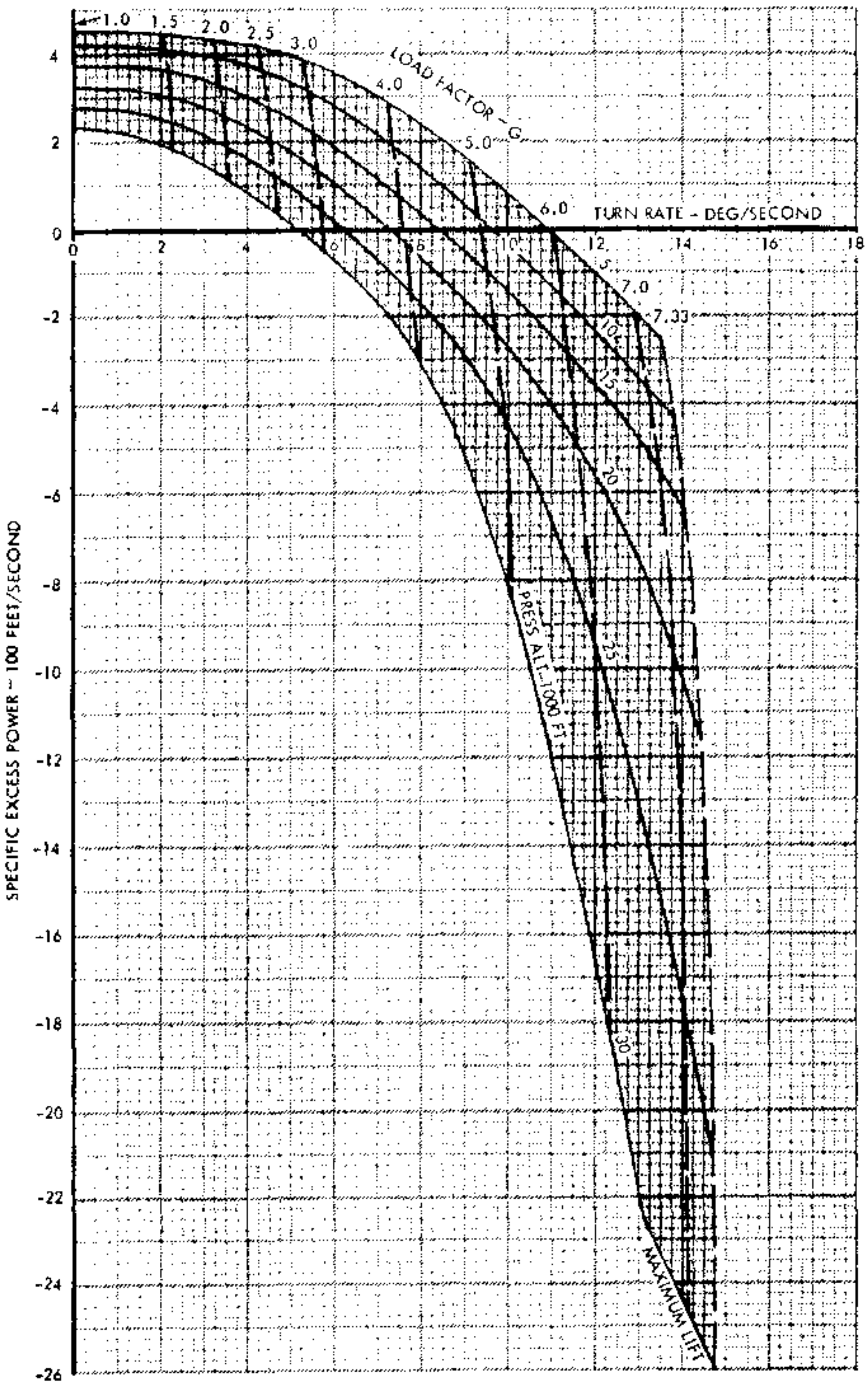
E-3

TURN PERFORMANCE

SPECIFIC EXCESS POWER AND TURN RATE
MAXIMUM THRUST
STANDARD DAY
(2) AIM-9 MISSILES
GROSS WEIGHT 13,750 POUNDS

0.9 IMN

AUTO FLAPS



F-5 1-606(12)

FA8-17 (Sheet 2).

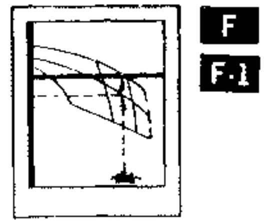
MODEL: F-5F
DATE: 1 AUGUST 1976
DATA BASIS: **FLIGHT TEST**

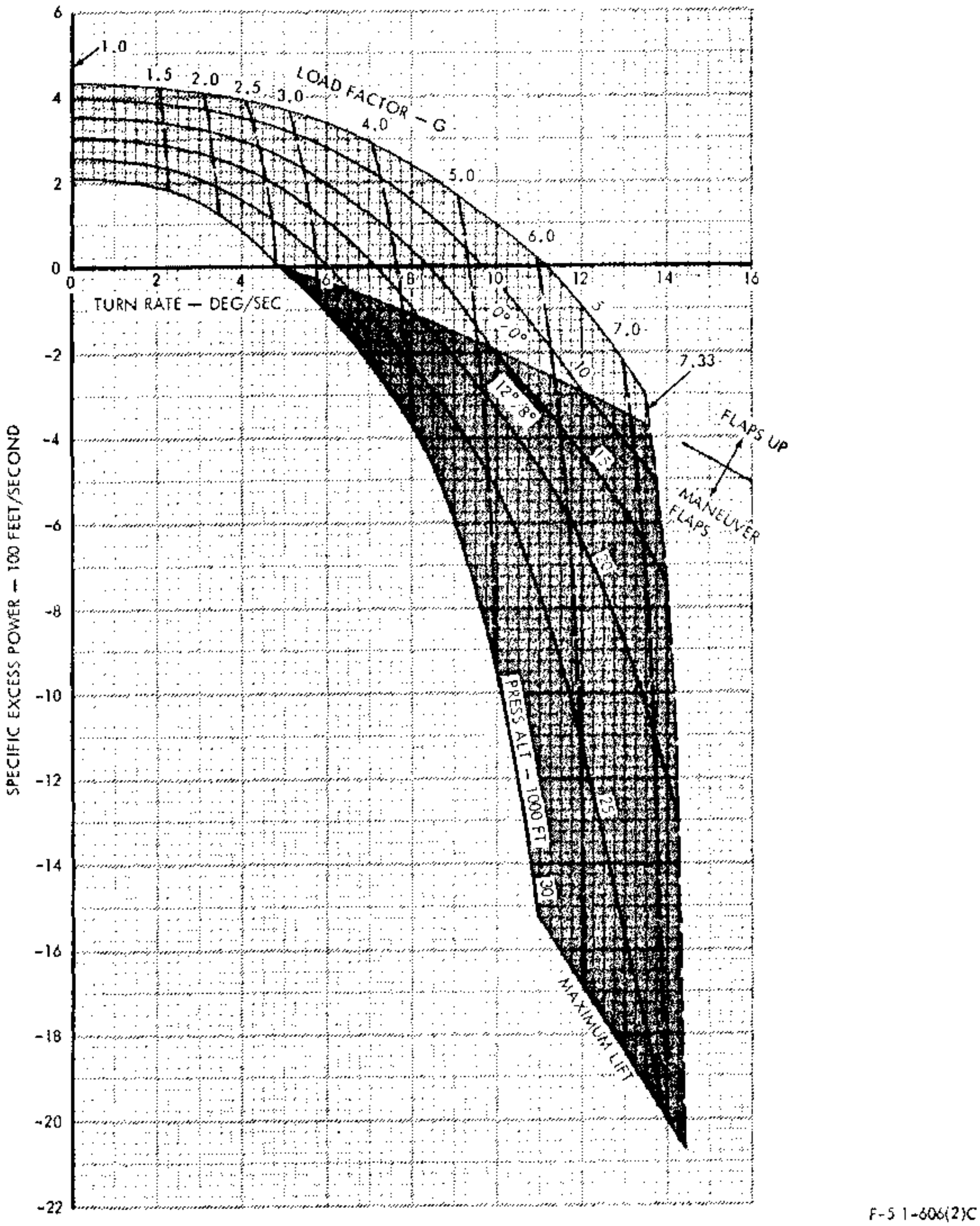
ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

TURN PERFORMANCE

SPECIFIC EXCESS POWER AND TURN RATE
MAXIMUM THRUST
STANDARD DAY
(2) AIM-9 MISSILES
GROSS WEIGHT 14,150 POUNDS

0.9 IMN





FA8-17 (Sheet 3).

MODEL: F-5F
DATE: 1 MARCH 1982
DATA BASIS: FLIGHT TEST

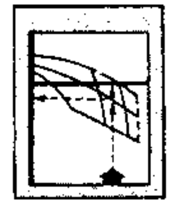
ENGINES: (2)J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

TURN PERFORMANCE

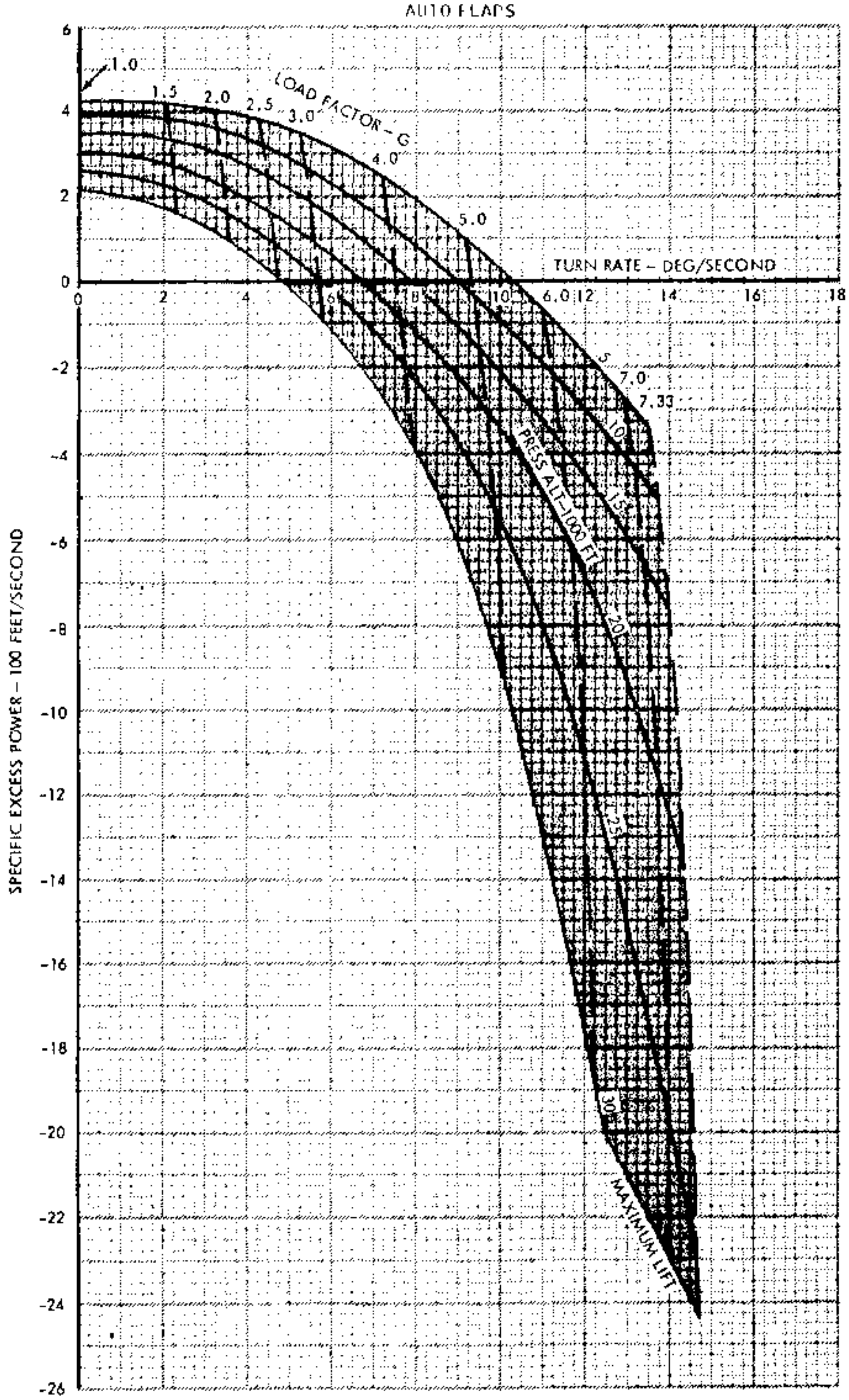
SPECIFIC EXCESS POWER AND TURN RATE
MAXIMUM THRUST
STANDARD DAY
(2) AIM-9 MISSILES
GROSS WEIGHT 14,400 POUNDS

0.9 IMN

AUTO FLAPS



F-2



F-5 1-606(13)

FA8-17 (Sheet 4).

DART TARGET TOW

PART 9

F-5E 1-84

TABLE OF CONTENTS

Page numbers underlined denote charts.

DART TARGET PERFORMANCE DATA (GENERAL)

The tabular charts in this part provide performance data for aircraft equipped with the Dart tow target (A/A37U-15 Tow Target System). Additional Dart target information included with the normal procedures in section II of T.O. 1F-5E-34-1-1 is required for complete performance coverage. The tabular charts in this part provide for the determination of single-engine takeoff speed and two-engine climb, level acceleration, and cruise. Use of a drag number is not required; the drag number is incorporated into the chart data. Takeoff data in part 2 is used initially to compute aft stick speed, takeoff speed, and ground roll distance. To obtain corrected takeoff data for the Dart target configuration, add 15 knots to aft stick speeds and 25 knots to takeoff speeds and increase the takeoff ground roll distance by 40 percent. High rates of rotation or extreme nose high attitudes during takeoff may result in the target striking the ground.

MINIMUM SAFE SINGLE-ENGINE TAKEOFF SPEED CHART

The Minimum Safe Single-Engine Takeoff Speed chart (FA9-1, sheets 1 and 2) provides the minimum takeoff speed required for a safe single-engine maximum thrust takeoff (with or without inboard pylon fuel tank) in the event of engine failure with the Dart target stowed. The chart parameters are runway temperature and runway pressure altitude. Using maximum power on the operating engine, the listed speed provides a rate of climb of 100 feet per minute with gear down, flaps at FULL position, and the target stowed. Accelerate to 10 knots above safe single-engine takeoff speed before the landing gear is retracted. If an engine fails after gear retraction, maximum power single-engine thrust is sufficient to sustain flight for all conditions shown in the chart. The best airspeed in this situation is 210 to 220 KIAS. Keep flaps in maneuver/auto setting to increase lift and minimize drag

MILITARY THRUST CLIMB CHART

Military Thrust Climb chart (FA9-2) provides fuel, range and time required to climb to a specified altitude with the target stowed, in tow, or after the target has been dropped. The target stowed and target in tow charts are based on a climb at 305 KIAS with flaps up and a start climb gross weight of 16,000 pounds. The target dropped chart is based on a climb at 345 KIAS with flaps up and a start climb gross weight of 14,000 pounds. Each chart contains a correction factor (change per 1000 pounds %) to be used when the aircraft gross weight varies from the data basis.

TARGET LAUNCH AND REEL OUT

A minimum of 3000 feet AGL must be attained before target launch. Optimum launch speed is 200 KIAS. The optimum reel out speed is 200 to 220 KIAS in straight and level flight with maneuver/auto flaps until cable is fully reeled out (approximately 2 minutes).

LEVEL FLIGHT ACCELERATION CHART

The Level Flight Acceleration chart (FA9-3) with target in tow (with or without external fuel tank) provides the fuel, range, and time required for military thrust acceleration from 200 to 300 KIAS with flaps up. A variable percentage change factor at specific altitudes and for gross weights above or below the data basis gross weight is used to compute the fuel, range, and time for acceleration.

LEVEL FLIGHT CRUISE CHARTS

Level Flight Cruise charts provide cruise airspeed and maximum range data at specific altitudes without inboard pylon fuel tank (FA9-4) or with 150-gal inboard pylon fuel tank (FA9-5) for the aircraft with target stowed, in tow, and after target drop. Airspeed is presented in both mach and KIAS, with flaps up. Range is determined as a function of nautical miles-per-pound. Time is determined as a function of minutes-per-pound for the specified altitudes. A percentage of change factor is applied to nautical miles-per-pound or minutes-per-pound, as applicable, to allow for other than the data basis gross weight used in each chart. The chart for target in tow provides for both maximum range and maximum time. The charts for target stowed and target dropped provide for maximum range only.

ENGINE FAILURE WITH TARGET IN TOW

If engine failure occurs with the target in tow, the recommended minimum airspeeds, service ceilings, and gross weights are as follows:

Minimum Airspeed (KIAS)	Service Ceiling (ft) (Std Temp + 20°C)		Gross Weight (lb)	
	W/Tank	No Tank	W/Tank	No Tank
Ⓔ 270	11,000	13,000	17,300	15,800
Ⓕ 275	9,000	11,000	17,900	16,300

WARNING

Single-engine MIL thrust will not sustain flight at any altitude.

NOTE

Empty pylon fuel tank may be jettisoned to reduce drag.

TARGET DROP

Maintain 1500 feet above terrain to cut cable and drop target. Use cruise/fixed flaps and adjust speed according to target condition as follows:

Target Damage	Airspeed (Approximate KIAS)
Undamaged	Up to 300
Moderate to Heavy	200
Severe	Drop on range. Do not attempt to return target to base.

Refer to T.O. 1F-5E-34-1-1 for complete Tow Target Procedures.

MODEL: F-5E
DATE: 1 SEPTEMBER 1979
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

DART TARGET
MINIMUM SAFE SINGLE-ENGINE TAKEOFF SPEED

E

MAXIMUM THRUST
GEAR DOWN
FULL FLAPS

NO EXTERNAL FUEL TANK

GROSS WT – 16,800 LB
CG – 14% MAC

PRESS ALT – FT		TAKEOFF SPEED – KIAS			
		SL	2000	4000	6000
RUNWAY TEMP – °C	+11 (AND COLDER)	182	182	182	182
	+12	182	182	182	186
	+13	182	182	182	—
	+20	182	182	182	—
	+21	182	182	186	—
	+22	182	182	—	—
	+30	182	182	—	—
	+31	182	186	—	—
	+32	182	—	—	—
	+39	182	—	—	—
	+40	186	—	—	—

INBD 150-GAL FUEL TANK

GROSS WT – 18,300 LB
CG – 16% MAC

PRESS ALT – FT		TAKEOFF SPEED – KIAS			
		SL	2000	4000	6000
RUNWAY TEMP – °C	0 (AND COLDER)	186	186	186	186
	+2	186	186	186	195
	+3	186	186	186	—
	+12	186	186	186	—
	+13	186	186	195	—
	+14	186	186	—	—
	+22	186	186	—	—
	+23	186	195	—	—
	+24	186	—	—	—
	+31	186	—	—	—
	+32	195	—	—	—

Note

WHERE BLANKS (-) OCCUR IN THE TABLE, SINGLE-ENGINE TAKEOFF IS IMPOSSIBLE.

FA9-1 (Sheet 1).

F-5 1-570(1)J

F

MODEL: F-5F
DATE: 1 SEPTEMBER 1979
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

DART TARGET
MINIMUM SAFE SINGLE-ENGINE TAKEOFF SPEED

MAXIMUM THRUST

GEAR DOWN
FULL FLAPS

NO EXTERNAL FUEL TANK

GROSS WT – 17,300 LB
CG – 14% MAC

RUNWAY TEMP – °C \ PRESS ALT – FT	TAKEOFF SPEED – KIAS SL	2000	4000	6000
+7 (AND COLDER)	185	185	185	185
+8	185	185	185	188
+9	185	185	185	—
+17	185	185	185	—
+18	185	185	188	—
+19	185	185	—	—
+26	185	185	—	—
+27	185	188	—	—
+28	185	—	—	—
+35	185	—	—	—
+36	188	—	—	—

INBD 150-GAL FUEL TANK

GROSS WT – 18,900 LB
CG – 16% MAC

RUNWAY TEMP – °C \ PRESS ALT – FT	TAKEOFF SPEED – KIAS SL	2000	4000	6000
-5 (AND COLDER)	190	190	190	190
-4	190	190	190	197
-3	190	190	190	—
+6	190	190	190	—
+7	190	190	197	—
+8	190	190	—	—
+17	190	190	—	—
+18	190	197	—	—
+19	190	—	—	—
+26	190	—	—	—
+27	197	—	—	—

Note

WHERE BLANKS (-) OCCUR IN THE TABLE, SINGLE-ENGINE TAKEOFF IS IMPOSSIBLE.

F-5 1-570(2)G

FA9-1 (Sheet 2).

MODEL: F-5E/F
DATE: 1 AUGUST 1977
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

DART TARGET MILITARY THRUST CLIMB

UEL, RANGE, AND TIME

W/WO EXTERNAL FUEL TANK.

TARGET STOWED

FLAPS UP
305 KIAS

START CLIMB GROSS WEIGHT — 16,000 LB

SEA LEVEL TO: (FT)	FUEL (LB)	RANGE (NM)	TIME (MIN)	*CHANGE PER 1000 LB (%)
5000	117	5	0.9	9
10,000	242	11	2.1	10
15,000	381	20	3.5	11
20,000	537	32	5.3	13
25,000	719	48	7.7	16
30,000	950	75	11.2	18

*FUEL, RANGE, AND TIME:
INCREASE ABOVE / DECREASE BELOW } 16,000 LB

CAUTION

REDUCE AIRSPEED IF VIBRATION OCCURS.

TARGET IN TOW

FLAPS UP
305 KIAS

AVERAGE CLIMB GROSS WEIGHT — 16,000 LB

3000 FT TO: (FT)	FUEL (LB)	RANGE (NM)	TIME (MIN)	*CHANGE PER 1000 LB (%)
5000	55	3	0.5	11
10,000	203	10	1.8	12
15,000	375	21	3.6	13
20,000	585	37	6.0	15
25,000	868	63	9.7	21

*FUEL, RANGE, AND TIME:
INCREASE ABOVE / DECREASE BELOW } 16,000 LB

TARGET DROPPED

FLAPS UP
345 KIAS

AVERAGE CLIMB GROSS WEIGHT — 14,000 LB

SEA LEVEL TO: (FT)	FUEL (LB)	RANGE (NM)	TIME (MIN)	*CHANGE PER 1000 LB (%)
5000	83	4	0.6	8
10,000	170	9	1.4	9
15,000	259	15	2.3	9
20,000	352	22	3.3	9
25,000	447	32	4.5	10
30,000	544	43	5.9	10

*FUEL, RANGE, AND TIME:
INCREASE ABOVE / DECREASE BELOW } 14,000 LB

F-5 1-571(2)E

FA9-2.

MODEL: F-5E/F
DATE: 1 APRIL 1978
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

DART TARGET LEVEL FLIGHT ACCELERATION

MILITARY THRUST
GEAR UP
FLAPS UP

TARGET IN TOW

NO EXTERNAL FUEL TANK

ACCELERATION FROM 200 TO 300 KIAS				
GROSS WEIGHT - 16,000 LB				
ALTITUDE (FT)	FUEL (LB)	RANGE (NM)	TIME (MIN)	*CHANGE PER 1000 LB (%)
3000	69	2	0.6	17
5000	75	3	0.7	18
10,000	100	5	1.0	25
15,000	150	9	1.7	48

*FUEL, RANGE, AND TIME:
INCREASE ABOVE / DECREASE BELOW 16,000 LB

INBD 150-GAL FUEL TANK

ACCELERATION FROM 200 TO 300 KIAS				
GROSS WEIGHT - 17,000 LB				
ALTITUDE (FT)	FUEL (LB)	RANGE (NM)	TIME (MIN)	*CHANGE PER 1000 LB (%)
3000	74	3	0.6	16
5000	82	3	0.7	17
10,000	110	5	1.1	24
15,000	170	10	2.0	47

*FUEL, RANGE, AND TIME:
INCREASE ABOVE / DECREASE BELOW 17,000 LB

F-5 1-572(2)D

FA9-3.

MODEL: F-5E/F
DATE: 1 AUGUST 1977
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

DART TARGET LEVEL FLIGHT CRUISE

MAXIMUM RANGE, TIME, AND AIRSPEED
FLAPS UP
NO EXTERNAL FUEL TANK

TARGET IN TOW

GROSS WEIGHT – 15,000 LB				
ALTITUDE (FT)	MAXIMUM RANGE			*CHANGE PER 1000 LB (%)
	MACH	KIAS	NM/LB	
10,000	0.51	282	0.092	5
15,000	0.59	300	0.099	4
20,000	0.65	300	0.108	4
25,000	0.73	305	0.120	3
ALTITUDE (FT)	MAXIMUM TIME			*CHANGE PER 1000 LB (%)
	MACH	KIAS	MIN/LB	
10,000	0.46	255	0.0176	7
15,000	0.51	255	0.0175	7
20,000	0.57	260	0.0173	7
25,000	0.63	260	0.0174	7

*NM/LB AND MIN/LB:
INCREASE BELOW / DECREASE ABOVE } 15,000 LB

TARGET STOWED

GROSS WEIGHT – 15,000 LB				
ALTITUDE (FT)	MAXIMUM RANGE			*CHANGE PER 1000 LB (%)
	MACH	KIAS	NM/LB	
10,000	0.52	290	0.105	5
15,000	0.59	300	0.112	4
20,000	0.65	300	0.122	4
25,000	0.72	300	0.134	4
30,000	0.79	300	0.146	4

*NM/LB:
INCREASE BELOW / DECREASE ABOVE } 15,000 LB

TARGET DROPPED

GROSS WEIGHT – 14,000 LB				
ALTITUDE (FT)	MAXIMUM RANGE			*CHANGE PER 1000 LB (%)
	MACH	KIAS	NM/LB	
10,000	0.57	315	0.132	3
15,000	0.63	320	0.143	4
20,000	0.69	320	0.159	4
25,000	0.74	310	0.172	4
30,000	0.80	305	0.188	5

*NM/LB:
INCREASE BELOW / DECREASE ABOVE } 14,000 LB

F-5 1-573(2)D

FA9-4.

MODEL: F-5E/F
DATE: 1 APRIL 1978
DATA BASIS: FLIGHT TEST

ENGINES: (2) J85-GE-21
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

DART TARGET LEVEL FLIGHT CRUISE

MAXIMUM RANGE, TIME, AND AIRSPEED

FLAPS UP

INBD 150-GAL FUEL TANK

TARGET IN TOW

GROSS WEIGHT — 16,000 LB				
ALTITUDE (FT)	MAXIMUM RANGE			*CHANGE PER 1000 LB (%)
	MACH	KIAS	NM/LB	
10,000	0.53	295	0.090	4
15,000	0.59	300	0.097	4
20,000	0.66	305	0.105	4
25,000	0.73	305	0.115	3
ALTITUDE (FT)	MAXIMUM TIME			*CHANGE PER 1000 LB (%)
	MACH	KIAS	MIN/LB	
10,000	0.49	270	0.0169	7
15,000	0.54	275	0.0168	7
20,000	0.60	275	0.0166	7
25,000	0.66	275	0.0167	7

*NM/LB AND MIN/LB:
INCREASE BELOW / DECREASE ABOVE } 16,000 LB

TARGET STOWED

GROSS WEIGHT — 16,000 LB				
ALTITUDE (FT)	MAXIMUM RANGE			*CHANGE PER 1000 LB (%)
	MACH	KIAS	NM/LB	
10,000	0.53	295	0.099	4
15,000	0.59	300	0.107	4
20,000	0.66	305	0.117	4
25,000	0.73	305	0.127	3
30,000	0.82	310	0.142	3

*NM/LB:
INCREASE BELOW / DECREASE ABOVE } 16,000 LB

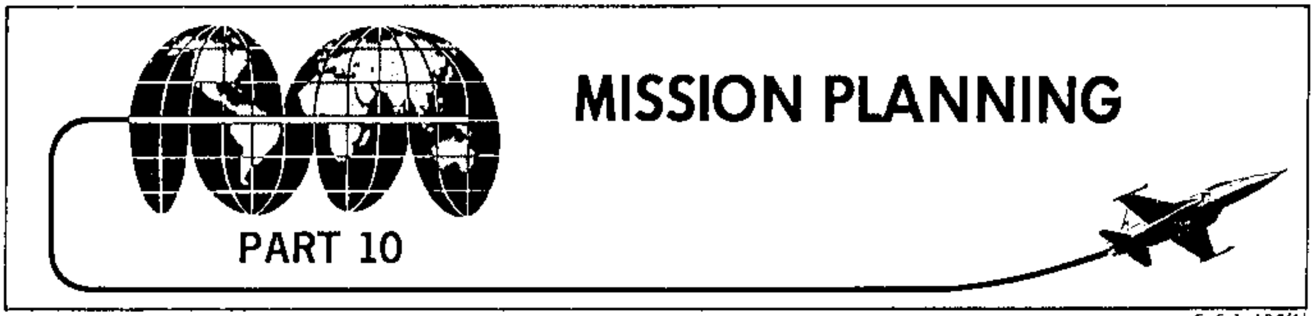
TARGET DROPPED

GROSS WEIGHT — 15,000 LB				
ALTITUDE (FT)	MAXIMUM RANGE			*CHANGE PER 1000 LB (%)
	MACH	KIAS	NM/LB	
10,000	0.56	310	0.129	3
15,000	0.60	305	0.139	4
20,000	0.69	320	0.152	4
25,000	0.77	325	0.166	3
30,000	0.86	330	0.186	4

*NM/LB:
INCREASE BELOW / DECREASE ABOVE } 15,000 LB

F-5 1-681(2)C

FA9-5.



F-5 1-105(1)

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Page numbers underlined denote charts.

PURPOSE OF MISSION PLANNING

The purpose of mission planning is to obtain optimum performance for any specific mission. Optimum performance varies, for example, from maximum time on station to maximum radius with no time on station. Exact requirements vary, depending upon the type of mission to be flown. The use of parts 1 thru 8 is illustrated in this part by means of sample problems.

MISSION PLANNING SAMPLE PROBLEM

NOTE

The following problem is an exercise in the use of the performance charts. It is not intended to reflect actual or proposed tactical missions.

SAMPLE PROBLEM

The problem is to determine the maximum target radius available for an F-5E (configuration [E] after [T.O. 1F-5E-594]) with wingtip missiles, four MK-82LD bombs on the wing pylons, a 275-gallon external fuel tank on the centerline pylon, and 560 rounds of 20mm ammunition. For simplicity, no descents are included in the problem. Takeoff is made with maximum thrust followed by a military thrust climb on course to optimum cruise altitude. Cruise is at constant altitude at long range speed.

NOTE

The centerline store must be retained until inboard MK-82LD bombs are released (see section V, Inflight Carriage and Sequencing Limitations).

At the target area, a 5-minute sea level combat fuel allowance is calculated with military thrust at 0.8 mach number. After bombs, missiles, centerline store, and ammunition are expended, a military thrust climb to optimum cruise altitude and a constant altitude long-range cruise speed cruise to the base are calculated, allowing a 600-pound fuel reserve at altitude over the base for descent and landing. Zero wind and standard day conditions are assumed throughout the mission except for takeoff and landing.

Supplemental Data

a. The loaded gross weight with (2) AIM-9J missiles, 560 rounds of 20mm ammunition, (4) MK-82LD bombs, (1) 275-gallon centerline fuel tank, (5) pylons, and full internal fuel is 20,582 pounds. Tabulating the weight data from FA1-2 results in the following:

	WT-LB
F-5E with Launcher Rails	15,050
(2) AIM-9J Missiles	340
(4) MK-82LD Bombs	2124
(1) 275-gal CL Tank (full fuel)	2004
(5) Pylons (170 + 244 + 256)	670
560 Rounds of 20mm Ammunition (with links)	394
Total Gross Weight	20,582

b. Usable fuel load is 6175 pounds. Aircraft weight with zero fuel and without four MK-82LD bombs, 314 pounds of ammunition, the 275-gallon pylon tank, and the two AIM-9J missiles is 11,400 lb.

General Comments

a. This type of mission cannot be solved directly as none of the conditions at the maximum radius point, such as fuel used, gross weight, or radius, is known. The problem must be worked from the beginning and the end of the mission, starting with the takeoff weight and empty weight (zero fuel) and working toward the weight at the start of combat. When the radius from takeoff to combat equals the radius from combat back to the base, the problem is solved.

b. As the outbound weight and drag are greater than the weight and drag during the return to base, more fuel is required to reach the combat zone than to return. Therefore, as a starting point, assume that 51 percent of the total fuel has been used when combat begins. This determines the aircraft weight at this point and both the outbound and return radii can be computed. By comparing the two radii, the combat weight can be adjusted and the computations revised until the mission is balanced. The fuel used during combat and during the climb to cruise altitude after combat is hardly affected by small adjustments in the combat weight; therefore, the problem of adjusting the two radii to match is quickly resolved.

c. As the maximum radius of this aircraft is considerably in excess of the distance shown in FA4-1, this mission is not in the short range category for planning purposes.

Takeoff and Accelerate

The mission is now worked from takeoff to the combat zone. Drag Index at takeoff from FA1-1:

Basic Aircraft Configuration	2
(2) AIM-9J Missiles	16
(1) CL 275 gal Tank	32
(2) MK-82LD Bombs (inboard)	70
(2) MK-82LD Bombs (outboard)	
Drag Index	120

Takeoff factor is 12 (FA2-4) for standard day at Sea Level. Takeoff time, fuel and distance (FA3-1) required before reaching MIL thrust climb:

Taxi Fuel Flow	18 lb/min
Estimated Taxi Time	5 min
Taxi Fuel Allowance (5 × 18)	90 lb
Static Mil Thrust Runup Time	1 min
Engine Runup Fuel Allowance	119 lb

Total Takeoff Allowance

Gross Weight at Brake Release	20,582 − (90 + 119) = 20,373 lb
Time to Accelerate to Mil Climb Speed	1.1 min
Fuel	315 lb
Distance	3 nm
Start Climb Weight	20,373 − 315 = 20,058 lb

Climb to Optimum Cruise Altitude

Referring to FA3-4 sheets 1 and 2:

Start Climb Weight	20,058 lb
Drag Index	120
Fuel to Climb	1170 lb
Time to Climb	15 min
Distance to Climb	105 nm
Weight at End of Climb	18,888 lb
Altitude at End of of Climb (FA4-2)	30,000 ft

Determination of Gross Weight at Start of Combat

Total usable fuel for the mission is 6175 lb. Total fuel used before start of combat: 6175 × 0.51 = 3149 lb. Therefore, with 51% of the fuel used the gross weight at start of combat is: 20,582 − 3149 = 17,433 lb.

Cruise to Start of Combat

Cruise Altitude	30,000 ft
Weight at Start of Cruise	18,888 lb
Weight at End of Cruise (estimated for start of combat)	17,433 lb
Fuel for Cruise (18,888 − 17,433)	1455
Average Cruise Weight	18,161 lb
Drag Index	120
Specific Range (FA4-6, sheet 2)	0.150 nm/lb fuel
Cruise Range (0.15 × 1455)	218 nm
Cruise Mach Number (Limited by Configuration)	0.85 mach
Cruise Time (FA4-6, sheet 1)	26 min

Change in Gross Weight During Combat

For the purpose of obtaining the fuel used during 5 minutes of combat at 0.8 mach at military thrust at sea level, use FA8-1.

Combat Altitude	Sea level
Combat Speed	0.80 IMN
Combat Fuel Flow	158 lb/min
Fuel Used in 5 Min	158 × 5 = 790 lb
Bomb Weight	2124 lb
Ammunition Weight	314 lb
(2) AIM-9J Missiles	340 lb
Empty Centerline Tank	229 lb
Weight Loss During Combat	790 + 2124 + 314 + 340 + 229 = 3797
Estimated Weight at End of Combat	17,433 − 3797 = 13,636 lb

Total Outbound Distance at Start of Combat

	Distance nm	Time min
Takeoff and Acceleration	3	7.1
Climb to Cruise Altitude	105	15
Cruise at 30,000 ft to Start of Combat	218	26
Total Outbound Distance and Time to Combat	326	48.1

Climb to Optimum Altitude and Cruise to Base

The mission must now be worked from empty weight (zero fuel) back toward end of combat. The drag index after combat and for the remainder of the mission is:

Basic Aircraft Configuration	2
(2) Launcher Rails	1
(2) Outboard Pylons	53
(2) Inboard Pylons	
(1) Centerline Pylon	14
Drag Index	70

Weight with zero fuel and without four MK-82LD bombs, 314 pounds of 20mm ammunition, external fuel tank, and two AIM-9J missiles is 11,400 pounds.

Weight over base at end of cruise:	11,400 + 600 = 12,000 lb

The return climb and cruise to base can now be calculated.

Start climb weight at end of combat: 13,636 pounds.

Using FA3-4, sheets 1 and 2, climb to 39,000 feet.

Drag Index	70
Fuel to Climb	725 lb
Time	9.8 min
Distance	72 nm
Start Cruise Weight (13,636 − 725)	12,911 lb
Cruise Altitude (FA4-1)	39,000 ft
End Cruise Weight	12,000 lb
Average Cruise Weight	12,456 lb
Specific Range (FA4-6, sheet 2)	0.240 nm/lb of fuel
Cruise Fuel	911 lb
Cruise Range (911 × 0.240)	219 nm
Cruise Time	26.2 min
Total Range to Base (219 + 72)	291 nm

Balancing the Mission

Using the estimated combat weight of 17,433 lb, the ranges out and back are:

Range Out	326 nm
Range Back	291 nm
Difference	35 nm

In order to balance the mission, combat weight must be increased to decrease the range out and increase the range back. An average value of the fuel used during cruise is (0.15 + 0.240) ÷2 = 0.2 nm/lb, or 5.0 lb per nm. The combat weight must be increased only sufficiently to account for half of the 35 nm difference.

Fuel for 18 nm 18 × 5.0 = 90 lb

The cruise to combat weight range leg must be shortened and the inbound leg must be lengthened for the effect of 90 lb fuel change.

Therefore:

Outbound

Change of Range	.15 × 90 = 13 nm
Cruise Range	218 − 13 = 205 nm
Total Range	326 − 13 = 313 nm

Inbound

Change of Range	0.240 × 90 = 22 nm
Cruise Range	219 + 22 = 241 nm
Total Range	291 + 22 = 313 nm

The mission is now balanced and the mission radius is 313 nm. A final adjustment of the time to cruise would result in the following values:

Outbound Range	205 nm
Cruise Time	24.6 min
Inbound Range	241 nm
Cruise Time	28.6 min

A summary of the balanced mission is shown in FA10-1.

Alternate Method of Balancing Mission

An alternate method of balancing a mission of this type, where it is required to determine the maximum range of the aircraft, is to solve a very simple equation, which states that the total range outbound is equal to the total range inbound. Referring to the Sample Mission Planning Chart in FA10-1, most of the fuel and range values for the various phases of the mission are readily calculated by knowing the ground rules or the particular conditions of the flight plan pertaining to these phases. For instance, the range during cruise while using fuel from a certain pylon tank is determined by the quantity of fuel available in that tank. When the chart shown in FA10-1 is filled in with all the parts of the mission that can be determined from the ground rules, there will be one outbound cruise phase just prior to combat and one inbound cruise phase (in this case, the entire inbound cruise leg) whose distances are unknown. These two cruise legs must now be determined so that the total distance outbound is equal to the total distance inbound. The fuel available for these two cruise legs is that amount of the total mission fuel remaining after all the other mission phases are determined, and is found as follows:

Known Amount of Fuel Used:

Start, Taxi, Takeoff	524
Climb	1170
Combat	790
Climb-Cruise to Base	725
Reserve	600
	3809 lb

Total Mission Usable Fuel = 6175 lb

Fuel Available for the Two Unknown Cruise Legs (6175 − 3809) = 2366 lb

SAMPLE MISSION PLANNING LOG HI-LO-HI INTERDICTION

PHASE OF MISSION	POWER SETTING	✱ FUEL USED – LB	TIME	DISTANCE	POSITION	TOTAL GROSS WEIGHT – LB	TOTAL TIME	TOTAL DISTANCE	AIRSPEED	ALTITUDE – FT
						20,582	0	0	——	SL
5-MIN TAXI 1-MIN RUNUP TAKEOFF & ACCELERATE	IDLE MIL MAX – MIL	524	7.1	3	START				——	
					END	20,058	7.1	3	325 KIAS	SL
CLIMB TO 30,000 FT	MIL	1170	15	105	START				325 KIAS	
					END	18,888	22.1	108	325 KIAS	30,000
CRUISE AT 30,000 FT	0.85 IMN	1365	24.6	205	START				501 KTAS	
					END	17,523	46.7	313	501 KTAS	30,000
COMBAT AT SEA LEVEL 0.80 IMN	MIL	790	5	0	START				529 KIAS	SL
					END	16,733	51.7	313	529 KIAS	SL
RELEASE BOMBS & TANK FIRE AMMO & MISSILES	——	[3007]	0	0	START				——	
					END	13,726	51.7	313	——	SL
CLIMB FROM SEA LEVEL TO 39,000 FT	MIL	725	9.8	72	START				335 KIAS	
					END	13,001	61.5	241	335 KIAS	39,000
CRUISE AT LONG RANGE SPEED AT 39,000 FT	0.88 IMN	1001	28.6	241	START				505 KTAS	
					END	12,000	90.1	0	505 KTAS	39,000
LANDING FUEL RESERVES	——	600	0	0	START				——	
					END	11,400	90.1	0	——	SL

✱ USABLE FUEL WEIGHT

INTERNAL	4400 LB
CL PYLON TANK	1775 LB
TOTAL	6175 LB

[ ] STORE WEIGHT ONLY

DATA BASIS
- STANDARD DAY
- ZERO WIND CONDITIONS
- PYLON FUEL TANK DROPPED WHEN EMPTY

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FA10-1.

Although 2366 lb of fuel is available for the two cruise legs, it is not yet known how this fuel is divided between the two legs as to balance the mission. For this reason, the average cruise weight used to determine the specific range for each of the two cruise legs will have to be estimated for the first try and may have to be slightly adjusted in a second calculation if a more accurate value of specific range is required. Assume that 60% of available fuel is used outbound (1420 lb).

Data for the two unknown cruise legs are as follows:

Average Cruise Weight Outbound:
$18{,}888 - (1420 \div 2) = 18{,}178$

Cruise Specific Range Outbound
(FA4-6, sheet 2) = 0.150 nm/lb

Average Cruise Weight Inbound:
$12{,}000 + (946 \div 2) = 12{,}473$

Cruise Specific Range Inbound
(FA4-6, sheet 2) = 0.240 nm/lb

Total Known Distance Outbound:

Taxi, Takeoff	3
Climb	105
	108 nm

Total Known Distance Inbound = 72 nm

To set up the equation used to balance the mission:

Let X = pounds of fuel available for the outbound cruise leg

2366 − X = pounds of fuel available for the inbound cruise leg

0.150 X = outbound cruise leg in nm

0.240 (2366 − X) = inbound cruise leg in nm

The equation to balance the mission is now written and solved as follows:

Total Distance Outbound = Total Distance Inbound.

Outbound Cruise Leg + 108 nm = Inbound Cruise Leg + 72 nm

$0.15X + 108 = 0.240\,(2366 - X) + 72$

$0.15X + 108 = (568 - 0.240X) + 72$

$0.15X + 0.240X = (568 + 72) - 108$

$0.390X = 532$

X = 1364 lb of fuel for outbound cruise leg

2366 + X = 1002 lb of fuel for inbound cruise leg

0.15×1364 = 205 nm outbound cruise leg

0.24×1002 = 241 nm inbound cruise leg

To check the results of equation:

$205 + 108 = 241 + 72$

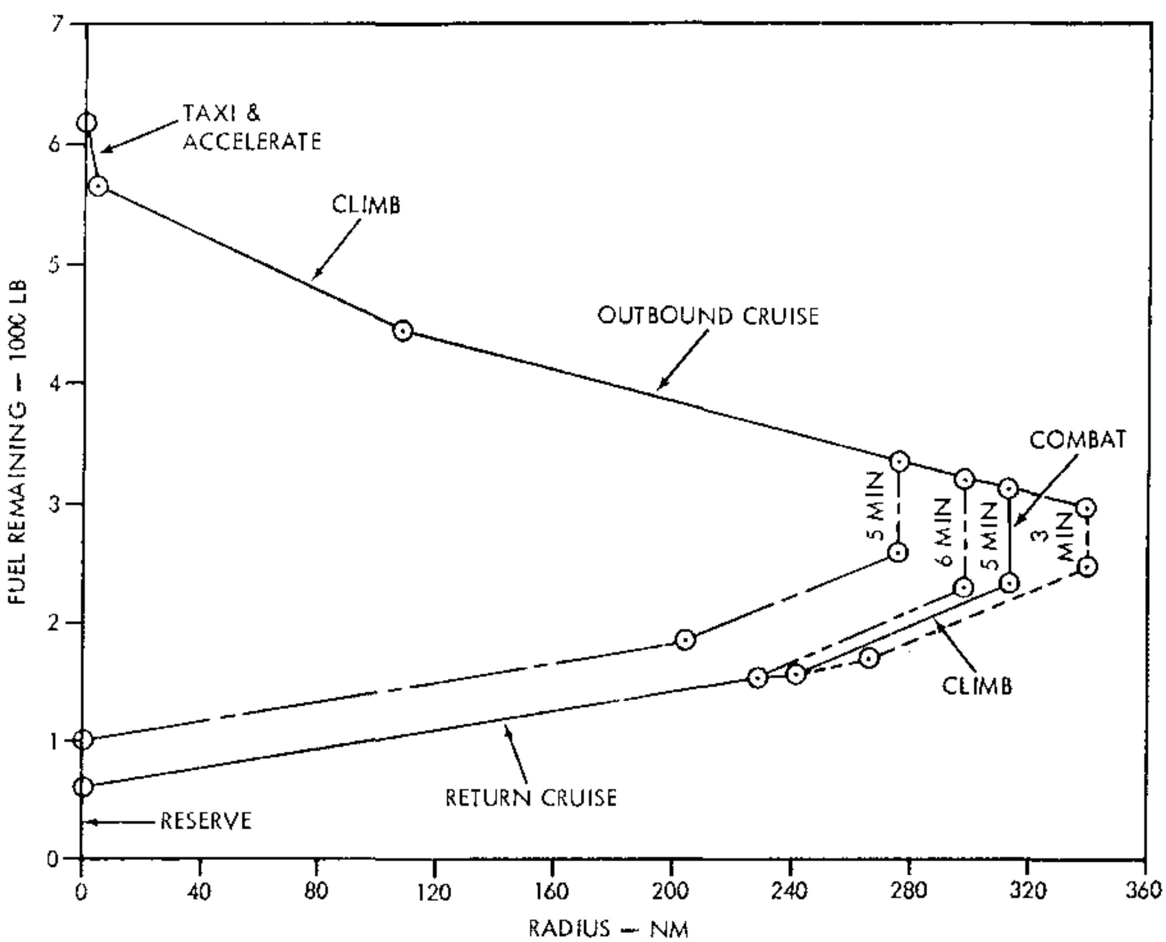
313 nm = 313 nm

GRAPHIC SOLUTION OF MISSION

Figure FA10-2 graphically illustrates the sample mission illustrated in FA10-1 and can be used to study the effects of various modifications on the radius of any similar mission. The solid lines are a plot of fuel remaining versus mission radius in the sample mission. If the slopes of the return climb and cruise lines are maintained, these lines may be shifted with changes in combat fuel or landing fuel and the resulting mission radius determined with reasonable accuracy. The dashed lines show the effects of changes in the mission.

HI-LO-HI INTERDICTION PROFILE

(4) MK-82 LD
(2) AIM-9J MISSILES
(1) CL 275-GAL TANK



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FA10-2.

TAKEOFF AND LANDING DATA CARD

The following example illustrates the preparation of the takeoff and landing data card. Takeoff and landing data are obtained from parts 2 and 7, respectively, and the fuel allowance for taxi is obtained from the fuel flow rates tabulated on FA3-1. The takeoff weight is the gross weight with full fuel less the fuel allowance for taxi and engine runup at military power. The landing weight immediately after takeoff with two engines operating and with stores, and for single-engine after stores are jettisoned is the takeoff weight less an average fuel allowance of 300 lb for takeoff and go-around.

For the purpose of the sample problem, the conditions and calculations are as follows:

Gross Weight (Full Fuel)	20,582 lb and cg 13% MAC
Gross Weight (Pylon Stores Jettisoned)	16,454 lb and cg 14% MAC
Runway Pressure Altitude	Sea Level
Runway Temperature	10°C
Wind	10 kt from 60°
Runway Length	11,000 ft
Runway Slope	1% uphill
RCR (Wet Runway)	12
Drag Chute Option	No chute
Flap Position	FULL

The takeoff calculations are as follows:

Taxi Fuel Allowance	18 lb/min × 5 = 90 lb fuel
Engine Runup at MIL	119 lb/min × 1 = 119 lb fuel
Takeoff Gross Weight (With Stores)	20,582 – (90 + 119) = 20,373 lb
Headwind Component (FA1-9)	5 kt
Takeoff Speed (FA2-2)	177 KIAS
Aft Stick Speed (FA2-2)	167 KIAS
Takeoff Factor (FA2-4)	12.4
Takeoff Ground Run (5 kt Headwind, 1% uphill) (FA2-5):	3200 + 160 = 3360 ft
Takeoff Gross Weight (Pylon Stores Jettisoned)	16,454 – (90 + 119) = 16,245 lb

Minimum Safe Single-Engine Takeoff Speed:

(Stores Jettisoned) (FA2-7)	154 KIAS
(With Stores) (FA2-7)	206 KIAS

Critical Field Length (With Stores):

No Drag Chute, 5 kt Headwind, RCR = 23, 1% uphill (FA2-10):	7800 + 390 = 8190 ft
RCR = 12, 1% uphill (FA2-10):	8700 + 435 = 9135 ft

Critical Engine Failure Speed:

No Drag Chute, 5 kt Headwind, RCR = 12 (FA2-12):	141 + 5 = 146 KIAS

Refusal Speed:

No Drag Chute, 5 kt Headwind, RCR = 12 (FA2-12):	160 + 5 = 165 KIAS

Decision Speed:

5 kt Headwind (FA2-15)	135 KIAS

Normal Acceleration Speed at 2000 ft (FA2-16)	140 KIAS
Acceleration Tolerance:	$\frac{11{,}000 - 8190}{1000} \times 3 = 8$ KIAS
Check speed at 2000 ft marker:	140 − 8 = 132 KIAS

The landing conditions are as follows:

	After Takeoff and Go-Around	After Jettisoning Pylon Stores	Final Landing
Ldg Gr Wt	20,073 lb	15,945 lb	12,000 lb
C.G. (% MAC)	13	14	18
Press Alt	SL	SL	SL
Temperature	+10	+10	+10
Headwind	5 kt	5 kt	20 kt
Rwy Length	11,000 ft	11,000 ft	11,000 ft
RCR	12	12	12
Drag Chute	No Chute/ Chute	No Chute/ Chute	No Chute/ Chute
Flaps	FULL	FULL	FULL

The landing calculations are as follows:

Approach Speed (FA7-1, sheet 1)	193 KIAS	171 KIAS	146 KIAS
Touchdown (FA7-1, sheet 1)	180 KIAS	160 KIAS	137 KIAS

Landing Ground Roll, No Drag Chute:

FA7-2	5100 ft	4200 ft	2600 ft
RCR	12	12	12
FA7-4	8100 ft	6600 ft	4100 ft

Landing Ground Roll With Drag Chute:

FA7-3	3600 ft	3000 ft	1900 ft
RCR	12	12	12
FA7-5	4700 ft	3900 ft	2450 ft

Minimum Distance from Touchdown to 125 KT Hook Engagement:

No Drag Chute			
RCR	12	12	12
FA7-7	3700 ft	2200 ft	650 ft

TAKEOFF AND LANDING DATA CARD

CONDITIONS

	TAKEOFF	LANDING
GROSS WEIGHT & CG	20,373 LB 13%	12,000 LB 18%
RUNWAY LENGTH	11,000 FT	11,000 FT
RUNWAY PRESSURE ALTITUDE	SL	SL
RUNWAY SLOPE	UPHILL 1%	——— %
RUNWAY TEMPERATURE	+10°C	+10°C
RUNWAY WIND COMPONENT	HEADWIND 5 KT	HEADWIND 20 KT
DRAG CHUTE OPTION	NO CHUTE	CHUTE OR NO CHUTE
RCR	12	12

TAKEOFF

ACCELERATION CHECK SPEED & MARKER	132 KIAS	2000 FT
CRITICAL ENGINE FAILURE SPEED	146 KIAS	
DECISION SPEED	135 KIAS	
AFT STICK SPEED	167 KIAS	
TAKEOFF SPEED & GROUND RUN DISTANCE	177 KIAS	3360 FT
MINIMUM SAFE SINGLE-ENGINE SPEED:		
WITH STORES	206 KIAS	
NO STORES (OR JETTISONED)	154 KIAS	

LANDING

	AFTER TAKEOFF & GO-AROUND		FINAL LANDING
	TWO ENGINES (W/STORES)	SINGLE ENGINE (W/O STORES)	
GROSS WEIGHT & CG	20,073 LB 13%	15,945 LB 14%	12,000 LB 18%
FINAL APPROACH SPEED	193 KIAS	171 KIAS	146 KIAS
TOUCHDOWN SPEED	180 KIAS	160 KIAS	137 KIAS
MAX HOOK ENGAGEMENT SPEED	125 KT	125 KT	125 KT
LANDING GROUND ROLL:			
WITH DRAG CHUTE	4700 FT	3900 FT	2450 FT
NO DRAG CHUTE	8100 FT	6600 FT	4100 FT
DISTANCE FROM TOUCHDOWN TO HOOK ENGAGEMENT	3700 FT	2200 FT	650 FT

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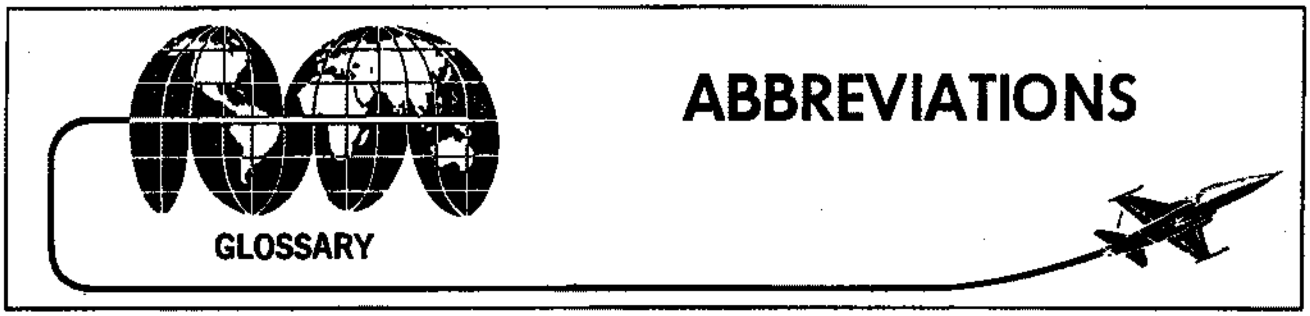
FA10-3.



ABBREVIATIONS

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Abbreviation	Word
A	
AB	Afterburner
AC ac	Alternating Current
ACCL	Acceleration
ACQ	Acquisition
ADF	Automatic Direction Finder
ADI	Attitude Director Indicator
AGL	Above Ground Level
AHRS	Attitude and Heading Reference System
ALT	Altitude
AMMO	Ammunition
AOA	Angle of Attack
ARR HK	Arresting Hook
ATT	Attitude
AUG	Augmenter
AUX	Auxiliary
B	
BARR	Barrier
BATT	Battery
BIT	Built-in-Test
BRG	Bearing
BRT	Bright
C	
CADC	Central Air Data Computer
CAMR	Camera
CAS	Calibrated Airspeed
CCW	Counterclockwise
CDI	Course Deviation Indicator
CG cg	Center of Gravity
CHAN	Channel
CI	Control-Indicator
CKPT	Cockpit
CLR	Clear
C/L, CL	Centerline
COMM	Communications
COMP	Compass
CONT	Control
CONT'D	Continued
CR	Cruise
CRS	Course
CW	Clockwise
D	
dB	Decibel
DC dc	Direct Current
DEG/ SECOND	Degrees per second
DEV	Deviation
DF	Direction Finding
DIR	Direct
DIST	Distance
E	
E	East
ECP	Engineering Change Proposal
EGT	Exhaust Gas Temperature
ELEC	Electric (also electrical, electronic)
EMER	Emergency
ENG	Engine
ERR	Error
ETA	Estimated Time of Arrival
EX-G	Excess G (acceleration of gravity)
EXT	External
F	
F	Finned
FCR	Fire Control Radar
FF	Folding Fin
FLT	Flight

Abbreviation	Word
FORM	Formation
FPM fpm	Feet per minute
FPS fps	Feet per second
FSII	Fuel System Icing-Inhibitor
FWD	Forward

G

Abbreviation	Word
G	Gravity (load factor)
GAL	Gallon (US)
GC	Gyro Compass
GCA	Ground Controlled Approach
GCU	Generator Control Unit
GEN	Generator
GS	Groundspeed (knots). Speed relative to ground.
GW, GR WT	Gross Weight

H

Abbreviation	Word
HDG	Heading
HS	High Speed
HSI	Horizontal Situation Indicator
HTR	Heater
HYD	Hydraulic
Hz	Hertz

I

Abbreviation	Word
IAS	Indicated Air Speed
ICT	Inert Captive Trainer
IFF	Identification Friend/Foe
IFR	Instrument Flight Rules
IHQ	Improved Handling Qualities (LEX, Shark Nose)
ILS	Instrument Landing System
IMC	Instrument Meteorological Conditions
IMN	Indicated Mach Number
IN in	Inch(es)
INBD	Inboard
IND	Indicator
IN RNG	In Range
INTERCOM	Intercommunication(s)
INTVL-SEC	Interval-Seconds

J

Abbreviation	Word
JASU	Jet Assist Starting Unit
JETT	Jettison

K

Abbreviation	Word
KCAS	Knots Calibrated Airspeed
KEAS	Knots Equivalent Airspeed
kHz	Kilohertz
KIAS	Knots Indicated Airspeed
KT	Knot(s)
KTAS	Knots True Airspeed

L

Abbreviation	Word
L	Left
LAU, LCHR	Launcher
LB lb	Pound
LB/HR	Pounds per hour
LB/HR/ENG	Pounds per hour per engine
LB/MIN	Pounds per minute
LCOSS	Lead Computing Optical Sight System
LDG	Landing
LE	Leading Edge
LEX	Leading Edge Extension
LG, LDG GR	Landing Gear
LK ON	Lock-On
LOC	Localizer
LS	Low Speed
LTD	Limited

M

Abbreviation	Word
MAC	Mean Aerodynamic Chord
Mach	Speed Relative to Speed of Sound
MAG	Magnetic
MAN	Maneuvering
MAX	Maximum
MHz	Megahertz
MIC	Microphone
MIL	Military
MIN	Minimum/Minute
Mmax	Maximum Mach number
MK	Mark
MON	Monitor
MSL	Mean Sea Level

N

Abbreviation	Word
N	North
NAV	Navigation
NM nm	Nautical Mile(s)

Abbreviation	Word
NM/LB nm/lb	Nautical miles per pound
NO.	Number
NORM	Normal
NTM	Northrop Technical Manual

O

Abbreviation	Word
OBS	Obstacle
OPR	Operate
OUTBD	Outboard
OXY	Oxygen

P

Abbreviation	Word
PPH	Pounds per hour
PRI	Primary
PRESS	Pressure
Ps	Specific excess power
PSR	Photo Scale Reciprocal
PWR	Power

Q

Abbreviation	Word
QTY	Quantity

R

Abbreviation	Word
R	Right
RAD	Radiation
RADAR	Radio Detection and Ranging
RCR	Runway Condition Reading
RD	Round (of ammunition)
REC	Receive
RECON	Reconnaissance
REF	Reference
REL	Relative
RKT	Rocket
RMT	Remote
RNG	Range
RWY	Runway

S

Abbreviation	Word
S	South
SAS	Stability Augmenter System
SEC	Secondary
SIF	Selective Identification Feature
SL	Sea level
SPD	Speed
SPD BK	Speed Brake
STAB	Stability
STBY	Standby
STD	Standard
SW	Switch
SYS	System(s)

T

Abbreviation	Word
TAC	Tactical
TACAN	Tactical Air Navigation
TAS	True Airspeed
TCTO	Time Compliance Technical Order
TE	Trailing Edge
TEMP	Temperature
TGT	Target
TMN	True Mach Number

U

Abbreviation	Word
U	Unfinned
UHF	Ultrahigh Frequency
UNLTD	Unlimited

V

Abbreviation	Word
VAC vac	Volts Alternating Current
VAR	Variation
VDC vdc	Volts Direct Current
VEL	Velocity
VEN	Variable Exhaust Nozzle
VERT	Vertical
VOL	Volume
VV	Vertical Velocity

W

Abbreviation	Word
W	West
W/	With
W/O	Without
WPN	Weapon
WT	Weight

X

Abbreviation	Word
XFMR-RECT	Transformer-Rectifier
XMTR	Transmitter

SCIENTIFIC & MATHEMATICAL SYMBOLS

ΔTEMP	Temperature correction
a	Speed of sound in ambient air
a_o	Speed of sound at sea level
P	Ambient air pressure
P_o	Air pressure at sea level
δ(Delta)	Relative air pressure, P/P_o
ρ(Rho)	Ambient air density
ρ_o	Air density at sea level
σ(Sigma)	Relative air density, ρ/ρ_o

ALPHABETICAL INDEX

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