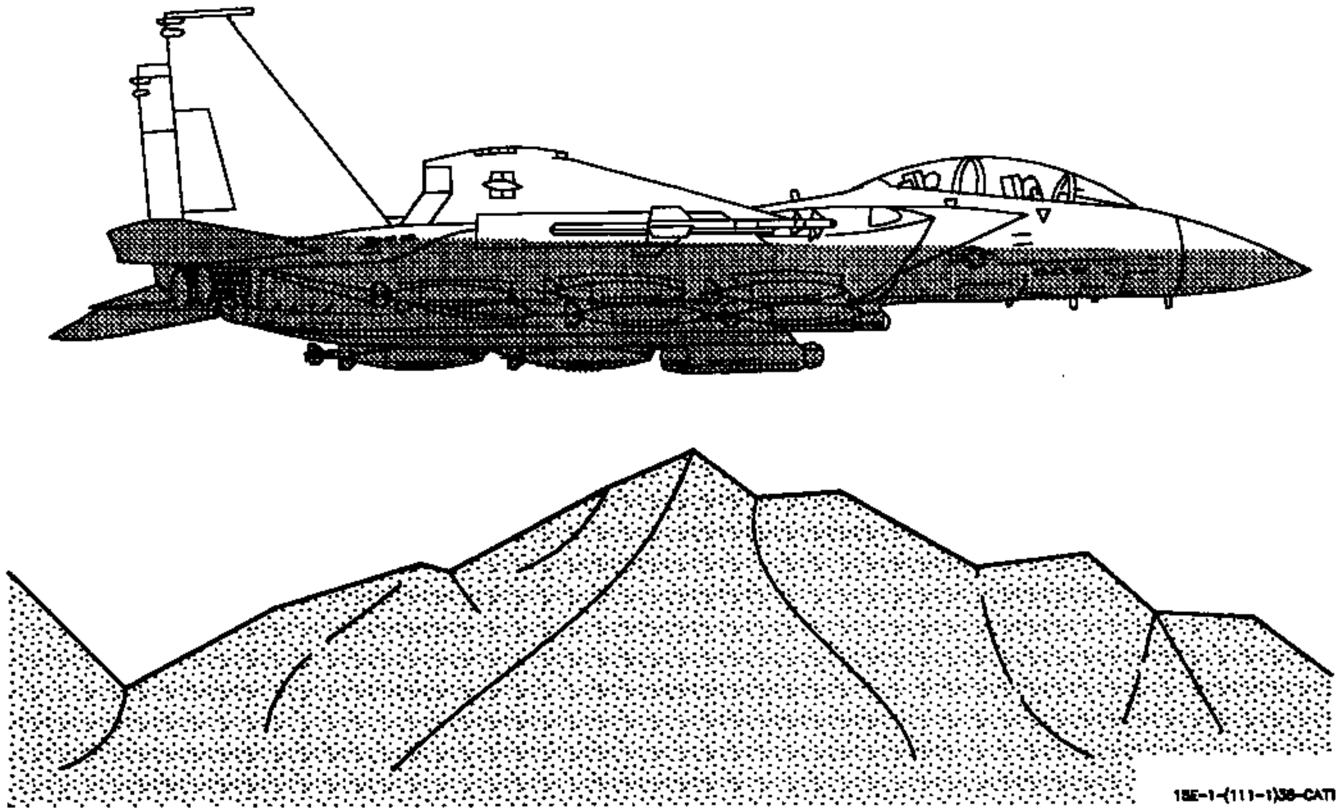
FLIGHT MANUAL



15E-1-(111-1)38-CATI

USAF SERIES
F-15E AIRCRAFT

McDonnell Douglas Aerospace
F33657-86-C-2001
F33657-91-C-2002

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Published under authority of the Secretary of the Air Force.

AIR FORCE 24/06/93 -2205

D 15 APRIL 1993

CURRENT FLIGHT CREW CHECKLIST

TO 1F-15E-1CL-1 15 April 1993

LIST OF EFFECTIVE PAGES

Insert latest changed pages; dispose of superseded pages in accordance with applicable regulations.

Dates of issue for original and changed pages:

Original .... 0 ....15 Apr 93

Total number of pages in this publication is 862 consisting of the following:

Page No.	#Change No.	Page No.	#Change No.	Page No.	#Change No.	Page No.	#Change No.
Title	0	1-28	0	1-71	0	1-114	0
A	0	1-29	0	1-72	0	1-115	0
B	0	1-30	0	1-73	0	1-116	0
C	0	1-31	0	1-74	0	1-117	0
D	0	1-32	0	1-75	0	1-118	0
E blank	0	1-33	0	1-76	0	1-119	0
i	0	1-34	0	1-77	0	1-120	0
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iii	0	1-36	0	1-79	0	1-122	0
iv	0	1-37	0	1-80	0	1-123	0
v	0	1-38	0	1-81	0	1-124	0
vi	0	1-39	0	1-82	0	1-125	0
vii	0	1-40	0	1-83	0	1-126	0
viii	0	1-41	0	1-84	0	1-127	0
ix	0	1-42	0	1-85	0	1-128	0
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1-4	0	1-47	0	1-90	0	1-133	0
1-5	0	1-48	0	1-91	0	1-134	0
1-6	0	1-49	0	1-92	0	1-135	0
1-7	0	1-50	0	1-93	0	1-136	0
1-8	0	1-51	0	1-94	0	1-137	0
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1-25	0	1-68	0	1-111	0	1-154	0
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1-27	0	1-70	0	1-113	0	1-156	0

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Page No.	#Change No.
1-157	0
1-158	0
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Index 3	0
Index 4	0
Index 5	0
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#Zero in this column indicates an original page.

TABLE OF CONTENTS

INTRODUCING THE F-15E

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. This manual provides the best possible operating instructions under most circumstances. 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 TO 0-1-1-4 for a listing of all current flight manuals, safety supplements, operational supplements, and checklists. Also, check the flight manual cover page, the title block of each safety and operational supplement, and all status pages contained in the flight manual or attached to formal safety and operational supplements. Clear up all discrepancies before flight.

ARRANGEMENT. The manual is divided into seven fairly independent sections to simplify reading it straight through or using it as a reference manual.

SAFETY SUPPLEMENTS. Information involving safety will be promptly forwarded to you in a safety supplement. Supplements covering loss of life will get to you within 48 hours by teletype, and supplements covering serious damage to equipment within 10 days by mail. The cover page of the flight manual and the title block of each safety supplement should be checked to determine the effect they may have on existing supplements.

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

CHECKLISTS. The flight manual contains itemized procedures with necessary amplifications. The checklist contains itemized procedures 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 flight crewmember is entitled to personal copies of the flight manual, safety supplements, operational supplements, and checklists. The required quantities should be ordered before you need them to assure their prompt receipt. Check with your publication distribution officer - it is his job to fulfill your TO requests. Basically, you must order the required quantities on the appropriate Numerical Index and Requirement Table (NIRT). TO 00-5-1 and TO 00-5-2 give detailed information for properly ordering these publications. Make sure a system is established at your base to deliver these publications to the flight crews immediately upon receipt.

FLIGHT MANUAL BINDERS. Looseleaf binders and sectionalized tabs are available for use with your manual. They are obtained through local purchase procedures and are listed in the Federal Supply Schedule (FSC Group 75, Office Supplies, Part 1). Check with your supply personnel for assistance in procuring these items.

CHANGE SYMBOL. The change symbol as illustrated by the black line in the margin of this paragraph, indicates text and illustration changes made to the current issue.

NOTE

Throughout the manual, retrofit (TCTO) effectivities are presented in abbreviated form. Refer to the Technical Order Summary at the front of the manual for detailed production/retrofit effectivites.

WARNINGS, CAUTIONS, AND NOTES.

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

WARNING

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

CAUTION

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

NOTE

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

SHALL, SHOULD, MAY, AND WILL.

The following definitions apply to Shall, Will, May and Should found throughout the manual. The word "shall" is used to express a mandatory requirement. The word "should" is used to express nonmandatory provisions. The word "may" is used to express permissiveness. The word "will" is used only to indicate futurity.

ILLUSTRATIONS

The illustrations used throughout Section 1 of the manual are intended to be used as examples. The specific situation may not be exactly as shown.

YOUR RESPONSIBILITY - TO LET US KNOW.

Review conferences with operating personnel and a constant review of accident and flight test reports assure inclusion of the latest data in the manual. 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. Corrections shall be submitted on AF Form 847 and forwarded through your Command Headquarters to: ASC/VFT BLDG 56, 2100 THIRD ST STE 1, WRIGHT-PATTERSON AFB OH 45433-7015.

INTERIM SAFETY/OPERATIONAL SUPPLEMENT SUMMARY

The following list contains the previously cancelled or incorporated Safety/Operational Supplements; the outstanding Safety/Operational Supplements, if any; and the Safety/Operational Supplements incorporated in this issue. In addition, space is provided to list those Operational Supplements received since the latest issue.

NUMBER	PURPOSE	DISPOSITION/ INCORPORATION DATE
1F-15E-1S-1 thru 1F-15E-1SS-43	These supplements have been incorporated/rescinded.	Revision D, 15 April 93

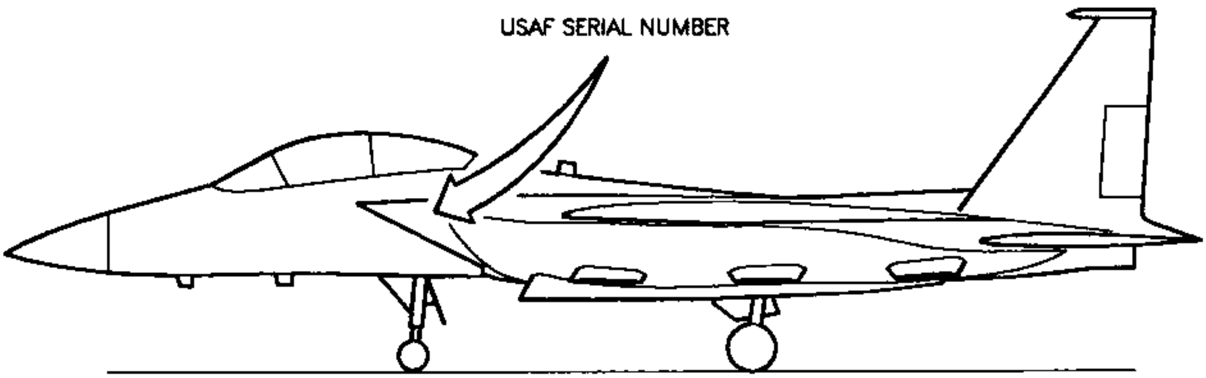
TIME COMPLIANCE TECHNICAL ORDER (TCTO) SUMMARY
This summary lists only those TCTO's which affect this manual.

TCTO	ECP	Title	Production Effectivity	Retrofit Effectivity
1F-15E-501	1851	Expanded AFT FIRE BURN THRU Detection System	87-0201 and up	86-0183 thru 87-0200
1F-15E-506	2018	Pitch, Roll and Yaw Trim Excitation Switchover from Main 28VDC to ESS 28 VDC Bus	87-0181 and up	86-0186 thru 87-0180
1F-15E-561	1975-R1 2390	Installation of Molecular Sieve Oxygen Generating System (MSOGS); MSOGS-ECS Control Panel Lighting Change	90-0233 and up	86-0183 thru 90-0232
1F-15E-616	2297-C	MPCD Power Source Change	89-0497 and up	86-0183 thru 89-0496
1F-15E-638	2239	Provide Quick Cal capability for RMR	90-0239 and up	86-0185 thru 90-0238
1F-15E-640	2218	Replace CRYPTO toggle switch on RICP	90-0250 and up	86-0183 thru 90-0249
1F-15E-654	1670	Installation of P/N 134A600-60 VHSIC Central Computer	90-0261 and up	86-0183 thru 90-0260
1F-15E-655	2405-M	Skid Control Touchdown Protection Enhancement	90-0248 and up	86-0183 thru 90-0247
1F-15E-656	2390	MSOGS-ECS Control Panel Lighting Change	91-0323 and up	90-0233 thru 91-0322

TIME COMPLIANCE TECHNICAL ORDER (TCTO) SUMMARY (Continued)
This summary lists only those TCTO's which affect this manual.

TCTO	ECP	Title	Production Effectivity	Retrofit Effectivity
The following are Engineering Change Proposals (ECP's) which do not have retrofit TCTO's currently assigned.				
	1656	F110 Compatible Fuselage Incorporating BLATS and 9G Capability	86-0184 and up	
	1661-M6	Countermeasures Dispenser Switch	86-0185 and up	
	1873-V	JFS/AMAD/Engine Bay Pneumatic Fire Detection System	86-0185 and up	
	1887-0	CFT Fuel Transfer Pump Monitoring	86-0185 and up	
	1935	Installation of Have Quick II Radio	87-0189 and up	
	2009	Incorporation of Maintenance Diagnostic Panel	88-1667 and up	
	1955	Installation of F100-PW-229 Engines	90-0233 and up	
	1955-S4	Addition of Asymmetric Thrust Departure Prevention System(ATDPS)	90-0233 and up	

BLOCK NUMBERS



BLOCK 41
86-0183 AND 86-0184

BLOCK 42
86-0185 THRU 86-0190

BLOCK 43
87-0169 THRU 87-0189

BLOCK 44
87-0190 THRU 87-0210

BLOCK 45
88-1667 THRU 88-1687

BLOCK 46
88-1688 THRU 88-1708

BLOCK 47
89-0471 THRU 89-0488

BLOCK 48
89-0489 THRU 89-0506

BLOCK 49
90-0227 THRU 90-0244

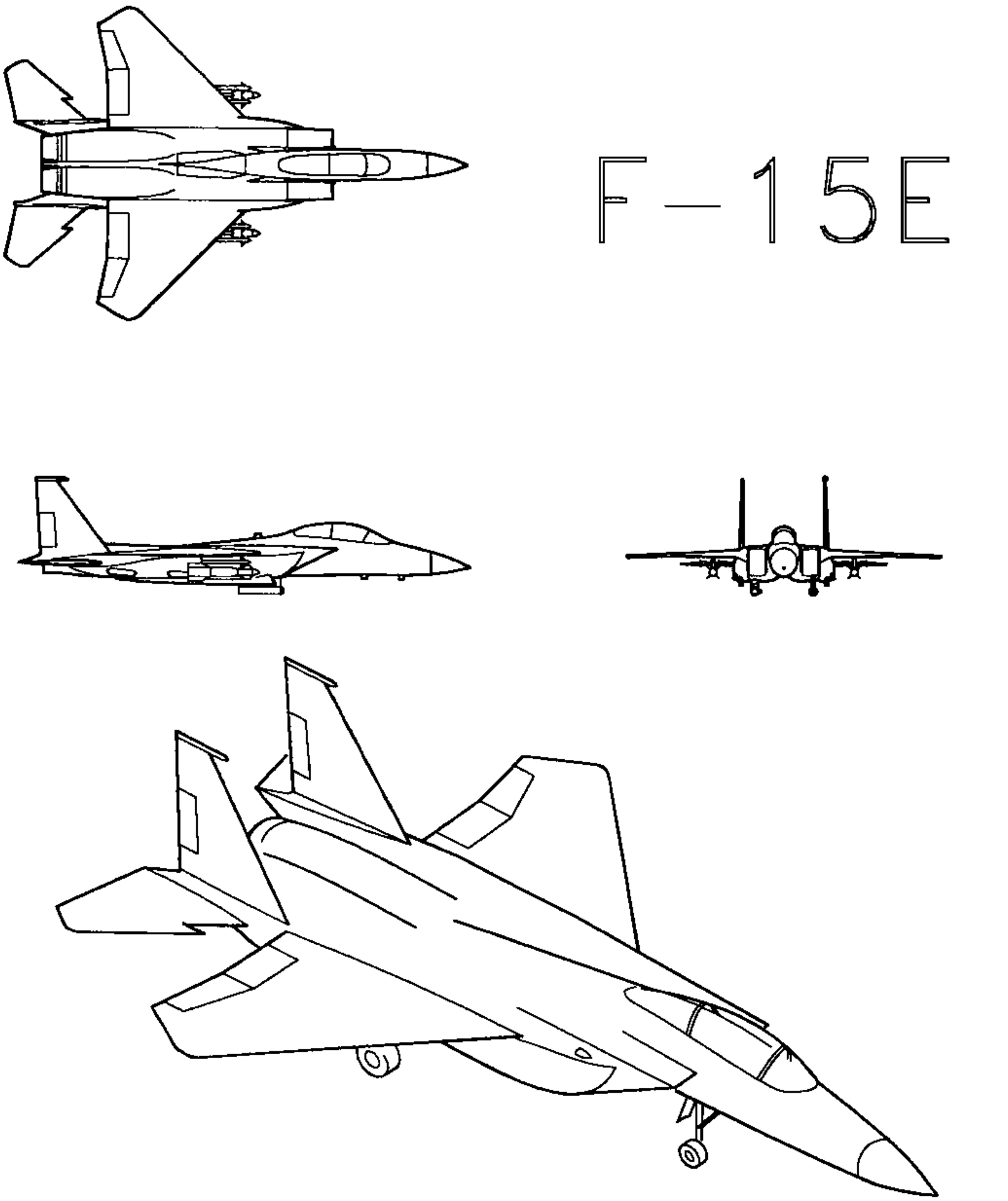
BLOCK 50
90-0245 THRU 90-0262

BLOCK 51
91-0300 THRU 91-0317

BLOCK 52
91-0318 THRU 91-0335

BLOCK 53
91-0600 THRU 91-0605
92-0364 THRU 92-0366

15E-1-(19-1)44-CATI



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SECTION I

DESCRIPTION

TABLE OF CONTENTS

AIRCRAFT

The F-15E is a high-performance, supersonic, all-weather, dual role fighter built by McDonnell Douglas Aerospace. In the air superiority role, its primary weapons are radar guided and infrared homing air-to-air (A/A) missiles and a 20 MM gun. In the interdiction role, the aircraft carries Low Altitude Navigation Targeting Infrared for Night (LANTIRN) targeting and navigation pods on dedicated sensor stations under the left and right engine inlets and can carry a variety of guided and unguided air-to-ground (A/G) weapons. The aircraft is powered by two Pratt and Whitney F-100-PW-**220** or **-229** turbofan engines. Aircraft appearance is characterized by a high-mounted swept-back wing and twin vertical stabilizers. The cockpits are elevated to enhance visibility. The basic aircraft configuration is with conformal fuel tanks (CFT's) and without pods or pylons. CFT's with tangential carriage of A/A and A/G weapons can be removed.

A jet fuel starter (JFS) provides self-starting of the engines. Aircraft systems are designed and located for high maintainability and reliability. Refer to foldout section for general arrangement illustration

DIMENSIONS

The approximate overall dimensions of the aircraft are:

Span — 42 feet, 10 inches
Length — 63 feet, 9 inches
Height — top of vertical tail —18 feet, 8 inches
top of closed canopy — 12 feet
Distance between main landing gear — 9 feet

WEIGHTS

The following weights are approximate to the nearest 500 pounds and shall not be used for computing aircraft performance or for any type operation.

W/O CFTs pounds	Configuration	With CFTs pounds
33,500	Operating weight (basic weight plus crew)	37,500
54,500	Takeoff gross weight (operating weight plus full internal fuel, full centerline fuel tank, ammunition, LANTIRN Pods, wing pylons and four LAU-114 missile racks)	68,000
63,500	Takeoff gross weight as above plus two full external wing fuel tanks	76,500
81,000	Maximum gross weight	81,000

ENGINES

The aircraft is powered by two Pratt and Whitney F100-PW-220 or -229 turbofan engines with afterburners. The **-220** engines are installed on F-15E 86-0183 THRU 90-0232. The **-229** are installed on F-15E 90-0233 AND UP. All further references will be made using "**-220** engines" or "**-229** engines". The **-220** engine is controlled by a full authority digital electronic engine control (DEEC). The **-229** engine is controlled by an improved digital electronic engine control (IDEEC). The DEEC/IDEEC automatically trims to maintain performance as the engine deteriorates. In the remaining text the DEEC/IDEEC will be referred to generically as the DEEC unless specifically referring to either the **-220** engine or the **-229** engine.

ENGINE STARTING SYSTEM

A self contained JFS is used to crank the engines for starting. The JFS is a small jet engine mounted on the central gearbox and along with the Airframe Mounted Accessory Drive (AMAD), provides rotation and initial electrical power for start. The JFS itself is started by accumulated hydraulic pressure. External power is not required during engine start. The JFS provides the only means of engine rotation for start.

ENGINE AIR INDUCTION SYSTEM

The two independent air induction systems consist of three variable ramps, a variable diffuser ramp, and a variable bypass door. Refer to figure 1-1.

Variable Ramps

The variable ramps provide air, at optimum subsonic flow, to the face of the engine fan inlet throughout a wide range of aircraft speeds. Ramp position is controlled by the air inlet controller.

Bypass Door

The bypass door automatically relieves excess pressure in the inlet duct. The air inlet controller positions the bypass door.

Air Inlet Controller

An air inlet controller (AIC), one for each inlet, uses angle of attack, aircraft Mach number and other air data system outputs to automatically schedule the ramps and bypass door throughout the aircraft envelope. The first ramp is locked in the up position until the engine is started.

Inlet Ramp Switch

An inlet ramp switch for each inlet is in the front cockpit on the miscellaneous control panel. The switch is lever locked, and has positions of AUTO and EMERG.

ENGINE AIR INDUCTION SYSTEM

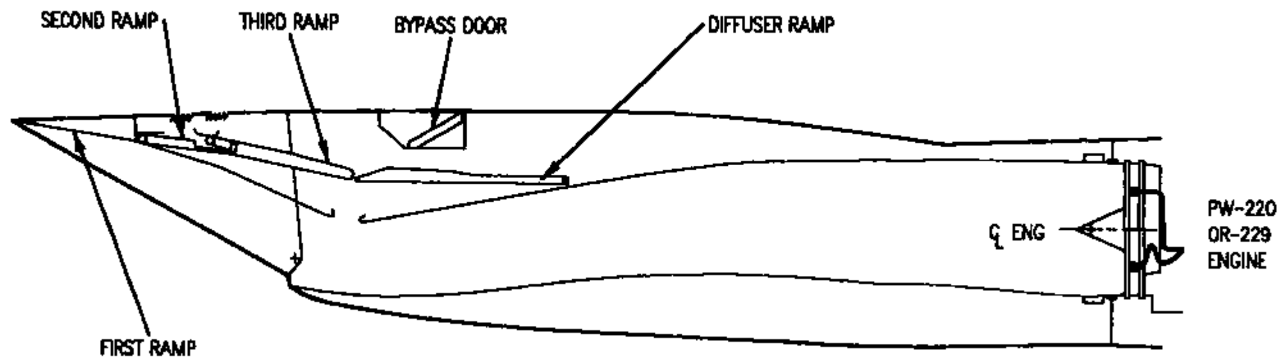


Figure 1-1

15E-1-(5-1)44-CATI

AUTO	The AIC automatically controls the air inlet system. This is the normal position.
EMERG	Removes electrical power from the ramp and bypass door actuators, causing them to move hydraulically to the emergency (ramps locked up and bypass door closed) positions. If hydraulic pressure fails, airloads will force the ramps and bypass door to the emergency position.

NOTE

The internal inlet ramps can take up to 45 seconds to reposition after placing the ramp switch to EMERG

ENGINE OIL SYSTEM

Each engine is equipped with a completely self-contained oil system. Oil is supplied to the main pump element by gravity feed. Return of the engine oil to the pump reservoir is severely limited during 0 or negative g flight. Refer to Servicing Diagram, this section, for oil specifications.

ENGINE FUEL SYSTEM

Refer to foldout section for airplane and engine fuel system illustration.

IGNITION SYSTEM

The ignition system contains an independent engine mounted generator and four igniter plugs (two for the engine and two for the afterburner). During engine start, moving the throttle from OFF to IDLE causes the engine igniter plugs to discharge. Ignition then remains continuous during engine operation. When the throttle is moved into afterburner, afterburner ignition is activated for approximately 1.5 seconds for **-220** or 3.5 seconds for **-229**. Ignition is automatically recycled, up to three times, in the event of a no-light or blowout, without retarding the throttle to MIL.

ENGINE CONTROL SYSTEM

The engine control consists primarily of a hydromechanical main fuel control (MFC), afterburner fuel control (AFC) and a full authority DEEC.

The engine control uses a digital primary control (PRI) with a backup hydrometrical secondary control (SEC). The secondary mode can be achieved either by an automatic primary mode fault action or by the pilot manually selecting OFF on the cockpit ENG CONTR switch. During SEC mode operation, A/B is inhibited and engine thrust is limited to 70-80% MIL power in primary mode. The pilot can attempt to restore primary mode operation by cycling the ENG CONTR switch; if the fault that caused the transfer has cleared, the engine will return to primary mode.

Digital Electronic Engine Control -220 ENGINES

The DEEC contains the engine operating schedules for automatic control from IDLE to MAX A/B, and is powered by the engine alternator. The DEEC schedules engine and afterburner fuel flows, compressor inlet variable vanes (CIVV), rear compressor variable vanes (RCVV), start bleed position, anti-ice and nozzle position. The DEEC controls engine performance by scheduling engine fuel flow to control airflow and nozzle position to control engine pressure ratio (EPR). EPR is the ratio between engine exhaust pressure and engine inlet pressure. By controlling airflow and EPR the engine performance is maintained consistent for a new or deteriorated engine until the FTIT limit is reached. If the DEEC detects a failure that prevents it from safely controlling the engine it will automatically switch to the secondary mode, the same as ENG CONTR switch OFF. In this mode afterburner operation is inhibited, thrust is limited, the CIVV are in the fully closed position, the nozzle is closed to the minimum area (less than 5%) and the L or R ENG CONTR caution is displayed. The RCVV, start bleeds and engine fuel flow are scheduled by the MFC. The engine will remain in this mode until the failure clears and the L or R ENG CONTR switch is cycled. The engine can be started with the L or R ENG CONTR switch ON or OFF. The ENG CONTR switch position should not be changed within 90 seconds after advancing the throttle to IDLE. If the start is made with the switches OFF or the DEEC reverts to the secondary mode, ground starting time will be longer.

Improved Digital Electronic Engine Control -229 ENGINES

The IDEEC contains the engine operating schedules for the same automatic control from start through MAX A/B as provided by the -**220** engine. The -**229** IDEEC includes a ground idle thrust (GIT) setting to maintain equivalent -**220** engine taxi performance. GIT is automatically activated with the aircraft on the ground and throttles near idle. Acceleration from ground IDLE to MIL will be approximately 1 second longer than from approach or flight idle.

The -**229** IDEEC also includes transient idle control logic. After a snap decel, engine speed will initially decrease to approximately 79% rpm, while thrust decreases to the requested throttle setting. If the throttle is not advanced for 20 seconds, engine speed will then further decrease and stabilize at a steady-state idle rpm with no additional thrust decrease. This control feature extends engine life and improves bodie (MAX-IDLE-MAX and MIL-IDLE-MIL) response times.

Engine Control Switches

The L and R ENG CONTR (engine control) switches are located in the front cockpit on the engine control panel. The switches have two positions, ON and OFF.

ON	DEEC provides normal engine control.
OFF	Engine control is transferred to secondary mode (hydromechanical MFC). Afterburner inhibited, engine thrust reduced to 70-80% MIL, and exhaust nozzle will remain closed with gear handle down.

Main Fuel Control

The main fuel control (MFC) houses the hydromechanical components that are controlled by the DEEC in the ENG CONTR ON mode. If the DEEC is transferred to the secondary mode or the ENG CONTR switch is OFF, the MFC schedules the engine fuel flow, start bleed position and RCVV position hydromechanically in response to throttle movement, inlet static pressure and engine inlet total temperature.

ENGINE MONITORING SYSTEM

The engine incorporates an engine monitoring system which consists of the DEEC and the engine diagnostic unit (EDU). The DEEC and EDU continuously monitor electrical control components and engine operation to detect engine failures. Abnormal engine operation and either intermittent or hard failures of components are detected and flagged for maintenance. During abnormal engine operation or component failure, the EDU will record engine and aircraft data as an aid to maintenance troubleshooting. The EDU also maintains engine life cycle information. Airframe mounted LEFT or RIGHT ENGINE and L or R ENG MON SYS fail indicators, located on the avionics status panel in the nose wheelwell, are latched if a fault is detected which requires maintenance attention.

AFTERBURNER SYSTEM

-**220** ENGINES
The afterburner has five stages that are progressively selected as the throttle is moved from MIL to MAX. In the upper left corner of the engine envelope stages two thru five may be inhibited.

-**229** ENGINES
The afterburner has 11 segments that are progressively selected as the throttle is advanced from MIL to MAX. The number of selectable afterburner segments is automatically reduced as the aircraft moves towards the upper left corner of the afterburner operating envelope. During snap accelerations the first segment of the afterburner may, depending on flight condition, light at just above IDLE rpm and the succeeding segments will light as speed approaches MIL rpm. When MAX AB is selected, FTIT will increase by as much as 50°C over MIL power FTIT.

-**220** AND -**229** ENGINES
The engine (**-220 or -229**) uses a light-off detector (LOD) to signal the DEEC if a light-off occurs. The DEEC then schedules the AFC fuel flow for the remaining segments. If the LOD does not sense a light-off or a blowout occurs, the DEEC automatically resets the MFC to MIL, terminates afterburner fuel flow and a check of the LOD is performed. If the LOD checks good, the DEEC will automatically attempt up to three more relights. If the afterburner still fails to light, retarding the throttle to MIL or below will reset the DEEC and the system will operate normally when afterburner is reselected. If the LOD checks failed, the DEEC will attempt one relight, bypassing the LOD, using tailpipe pressure to verify an afterburner light-off. Afterburner light-off may take longer and appear to hesitate if the LOD is failed. Afterburner is inhibited in the ENG CONTR OFF mode.

VARIABLE AREA EXHAUST NOZZLE

The engine has a convergent-divergent nozzle system which is continuously variable between minimum and maximum opening. The nozzle is positioned pneumatically by engine bleed air.

Exhaust Nozzle Control

-**220** ENGINES
The nozzle is controlled by throttle position and landing gear handle position. With the gear handle down, throttle in IDLE and the DEEC on, the nozzle will be approximately 80% open. As the throttle is advanced, the nozzle closes to near minimum area. With the landing gear handle up, the nozzle is near minimum area at all times except at MIL or above. At MIL the nozzle indicators will show the nozzles slightly open (5 - 10%). As the throttle is advanced in the afterburner range the nozzles will schedule further open to compensate for increasing afterburner fuel flow. With the DEEC off or in secondary mode, nozzle position will be closed to near the minimum area in flight or on the ground. This will result in higher idle thrust and taxi speeds.

-**229** ENGINES
The exhaust nozzle is controlled by the throttle position and landing gear handle position. With the gear handle down, throttle in IDLE and the IDEEC ON, the nozzle will be approximately 80-100% open. As the throttle is advanced, the nozzles close to near minimum area. With the landing gear handle UP, the nozzle is near minimum area (10%) when the throttle is below MIL. At subsonic speeds with the throttles at MIL, the nozzles will generally be less than 20% open; at supersonic speeds with the throttles at MIL, the nozzles can be as high as 45% open. As the throttle is advanced in the afterburner range, the nozzle will schedule further open to compensate for increasing afterburner fuel flow. With the IDEEC OFF, nozzle position will be closed to near minimum area (≤5%) inflight or on the ground. This results in higher idle thrust and taxi speeds.

WARNING

On aircraft with **PW-229** engines, wait 10 minutes after engine shutdown before performing inlet and exhaust inspection due to the possibility of auto-ignition after shutdown.

ENGINE ANTI-ICE

The engine anti-ice system is comprised of the inlet ice detector and the engine anti-ice valve. The engine anti-ice valve and the inlet ice detector are functionally unrelated. The detector only senses engine inlet ice build up and turns on the INLET ICE caution. The engine heat switch, on the front cockpit ECS panel, controls the engine anti-ice airflow to the engine nose cone and stationary inlet guide vanes and electrically heats the inlet pressure probe. The DEEC will automatically shut off the engines anti-ice when the altitude is above 30,000 feet or the engine inlet temperature is above 15°C (60°F) or throttle is advanced beyond approximately mid-range regardless of switch position.

ANTI-ICE ENG HEAT Switch

The ANTI-ICE ENG HEAT switch is a three-position switch. The functions are described below.

ON	Activates the engine anti-ice system.
OFF	Deactivates the engine anti-ice system.
TEST	Checks detector operation, and turns on the INLET ICE caution.

INLET ICE Caution

The INLET ICE caution indicates an ice build up on the engine inlet ice probe located in the left engine inlet duct. The INLET ICE caution remains on as long as the icing condition exists and will not be extinguished by activating the engine anti-ice system.

ASYMMETRIC THRUST DEPARTURE PREVENTION SYSTEM (ATDPS)

With the higher thrust of the **PW-229** engines, the ATDPS is designed to reduce the possibility of a directional departure due to asymmetric thrust at high calibrated airspeeds. In response to an ENG CONTR caution, while in the critical flight conditions (above 500 knots calibrated airspeed [KCAS] while greater than Mach 1.1), the ATDPS drives both engines to SEC control. In SEC mode the thrust from both engines is equalized. After the aircraft exits the critical region, ATDPS automatically enables PRI operation of both engines. Asymmetric thrust resulting from failures which do not cause an ENG CONTR caution will not be protected by ATDPS.

ATDPS provides protection for all store loadings except for three external tanks without CFTs.

WARNING

An asymmetric thrust condition on aircraft configured without CFTs and with three external tanks, while operating above 630 KCAS at greater than Mach 1.3, may result in structural damage or loss of aircraft.

ENGINE CONTROLS AND INDICATORS

ENGINE MASTER SWITCHES

Two guarded engine master switches are in the front cockpit on the engine control panel. Placing either switch to ON (with electrical power available) opens its corresponding airframe mounted engine fuel shutoff valve and directs power to the fuel transfer pumps. The engine master switch must be ON before the corresponding engine can be coupled to the JFS. Placing the switch OFF decouples the engine from the JFS. If engine control/essential power is not available, placing an engine master switch OFF will not shut off its airframe mounted engine fuel shutoff valve.

VMAX Switch PW-220 ENGINES

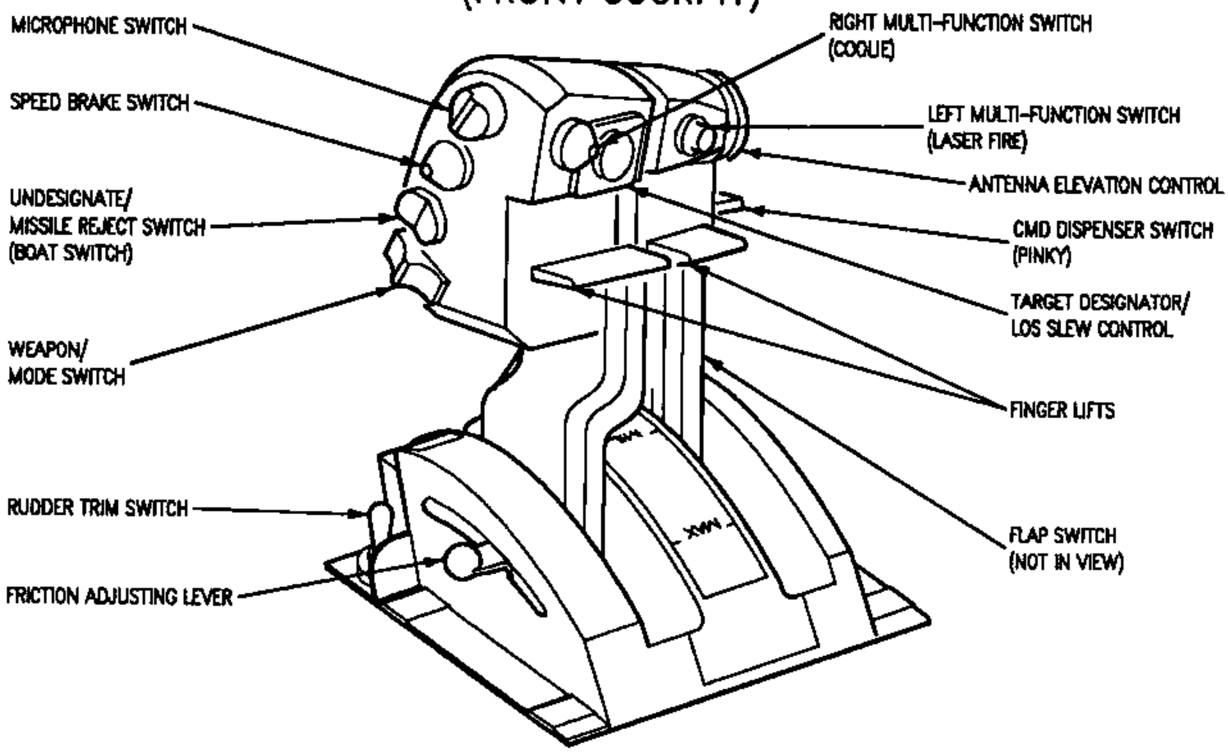
Use of the maximum velocity (VMAX) switch is prohibited in peace time. The VMAX switch is below the front cockpit left canopy sill. The switch has a guard which is wired down. When the wire is broken and the guard raised, the switch may be placed to VMAX which arms the system. With the system armed, the throttle in MAX AB, and airspeed above Mach 1.1, the engine control schedules a 22°C increase in FTIT and a 2% increase in RPM. Main engine and afterburner fuel flow is increased about 4% and thrust is increased about 4. Maximum continuous time in VMAX is 6 minutes. Each use of VMAX must be reported so that a hot section borescope inspection may be performed. Maximum total VMAX time before engine overhaul is 60 minutes.

VMAX Switch PW-229 ENGINES

The **PW-229** does not respond to changes in the VMAX switch position.

THROTTLE QUADRANT

(FRONT COCKPIT)



(REAR COCKPIT)

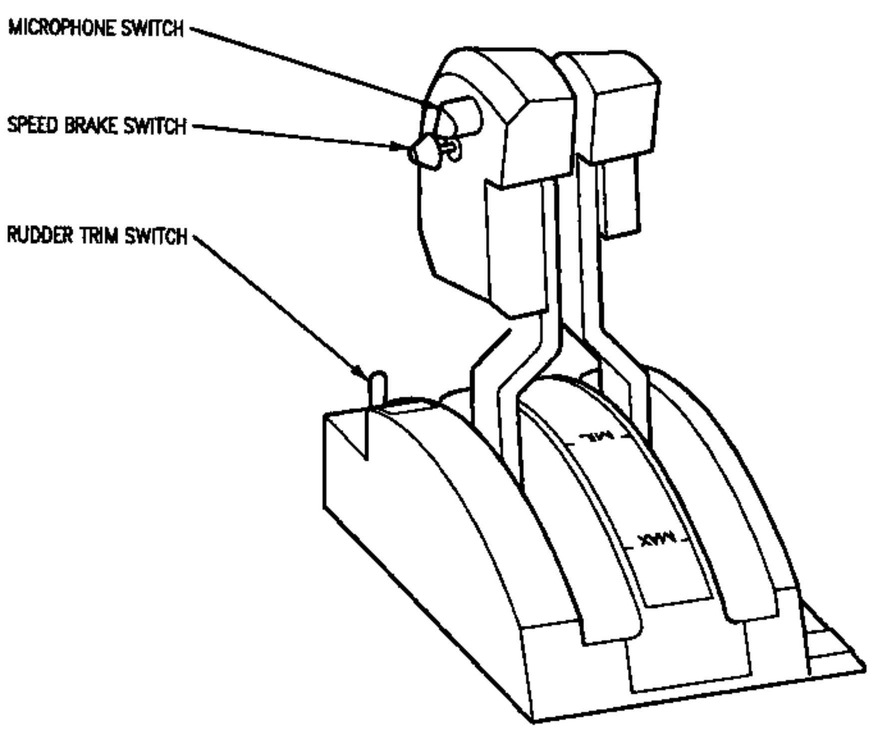


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Figure 1-2

THROTTLE QUADRANTS

The front throttle quadrant contains the front throttles, finger lifts, friction adjusting lever, rudder trim switch and flap switch. Additionally, the throttle grips contain switches to provide various system controls without moving the left hand from the grips. The rear throttle quadrant contains the rear throttles and rudder trim switch. The rear right throttle grip provides control switches for the microphone and speed brake. Refer to figure 1-2. A detailed description of switch functions is in Front Cockpit Controls or Rear Cockpit Controls, this section or in the individual systems in this manual and TO 1F-15E-34-1-1.

Throttles

Movement of the throttle is transmitted by mechanical linkage to the main fuel control. A friction adjusting lever is mounted adjacent to the front cockpit right throttle. Finger lifts on the front cockpit throttles couple the JFS to the engine during starting; they must also be lifted to move the throttles below IDLE and must then be released to move the throttles to OFF. Advancing the throttle from OFF to IDLE (during engine start) opens the main fuel shutoff valve in the fuel control and turns on engine ignition. Movement of the throttles from IDLE to OFF closes the main fuel shutoff valve in the fuel control, stopping fuel flow to the engine. Afterburner light-off is initiated by advancing the throttle forward of the afterburner detent.

ENGINE MONITOR DISPLAY (EMD)

The engine monitor display (EMD) located on the front cockpit (FCP) lower main instrument panel, is the primary source of engine data. The EMD has a left and right liquid crystal display for rpm, temperature, fuel flow, nozzle position, and oil pressure (figure 1-3). During engine starts without external electrical power or when airborne and both main generators are off line and the emergency generator is on line, only rpm and temperature will be displayed until one main generator comes on line. With one main generator on line or external electrical power on, all engine data will be displayed. If the engine data exceeds the range of a parameter, that parameter will

RPM %	Displays compressor rpm from 0 to 110% in 1% increments.
TEMP °C	Displays FTIT from 200 to 1400°C in 10°C increments.
FF PPH	Displays main engine fuel flow from 0 to 99,900 pounds per hour in 100 pph increments.
NOZ POS %	Displays exhaust nozzle position from 0 to 100% open in 10% increments.
OIL PSI	Displays oil pressure from 0 to 100 psi in 5 psi increments.

MPD/MPCD ENGINE DISPLAY

The MPD/MPCD engine display format provides an alternate source for engine data displayed on the EMD by displaying data on selected multi-purpose display/multi-purpose color display (MPD/MPCD). Refer to figure 1-4. The display is selected by pressing the ENG button on the MENU display. If engine data exceeds the range of a parameter the maximum or minimum limit will be displayed on an MPCD. The parameter will be displayed in yellow and boxed. If on the MPD, they are displayed at a greater intensity level and boxed. If any engine data is invalid or no signal is received, OFF will be displayed for that engine parameter. MPD/MPCD engine data displayed with rpm less than or equal to 10% is invalid. EMD data is valid to 0%.

ENGINE MONITOR DISPLAY

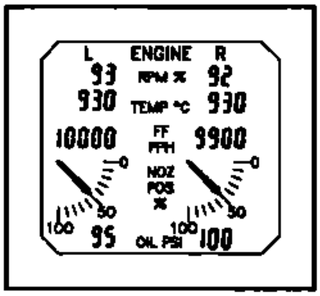

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Figure 1-3

With **PW-229** engines, an additional test is available for the ATDPS. The ATDPS can only be tested during low speed ground operation. When ATDP TEST is selected (from the MPD/MPCD engine display format), switching one engine control to OFF will result in both engines transferring to secondary mode. The engines will return to primary mode only after engine control switches are set to ON and ATDP TEST is deselected.

RPM %	Compressor rpm from 0 to 110% in 1% increments.
TEMP °C	FTIT from 100 to 1375°C in 1°C increments.
FF/PPH	Main engine fuel flow from 0 to 150,000 pph in 10 pph increments.
NOZ POS	Exhaust nozzle position from 0 to 100% open in 1% increments.
OIL PSI	Oil pressure from 0 to 100 psi in 1 psi increments.

ENGINE CAUTION LIGHTS

The ENGINE caution light is in the front cockpit on the caution lights panel and in the rear cockpit on the warning/caution/advisory light panel. The ENGINE caution light, MASTER CAUTION light and MPD/MPCD caution come on when any of the following cautions are activated: L INLET, R INLET, L ENG CONTR, R ENG CONTR, L OIL PRESS, R OIL PRESS, INLET ICE, FIRE SENSOR, FUEL HOT, L BST PUMP, R BST PUMP, L BLEED AIR, R BLEED AIR or with **PW-229** engines, ATDP. The light remains on until the problem is corrected.

ENGINE MONITOR FORMAT

(-220 ENGINES INSTALLED) (-229 ENGINES INSTALLED)

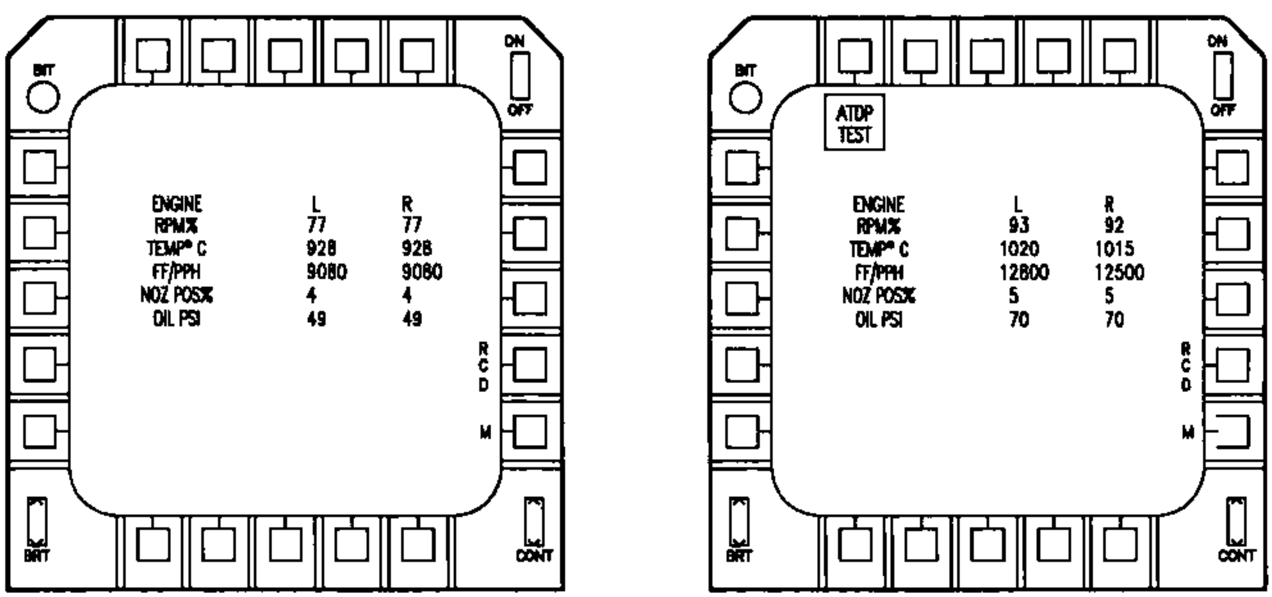

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Figure 1-4

L/R INLET Cautions

The L or R INLET caution comes on with left or right engine inlet controller failure.

L/R Engine Control Cautions

The L or R ENG CONTR caution comes on with left or right DEEC transfer from primary to secondary mode, loss of Mach number signal or afterburner failure (afterburner partially or fully inhibited). Also on aircraft BEFORE 90-0233, if either ENG CONTR switch is OFF, the appropriate ENG CONTR caution is displayed.

L/R OIL Pressure Cautions

The L or R OIL PRESS caution comes on with a low left or right engine oil pressure (less than or equal to 8 psi).

FUEL HOT Caution

The FUEL HOT caution is displayed when the engine fuel inlet temperature is too high

L/R BOOST PUMP Cautions

Two boost pump cautions are used. These cautions are: L BST PMP (for left main boost pump) and R BST PMP (for right main boost pump) and are displayed if the associated boost output pressure is low.

L/R BLEED AIR Cautions

These cautions come on when there is a left/right bleed air leak or overtemperature.

ATDP Caution (-229 ENGINES)

The ATDP caution comes on when system operating mode is other than commanded or when air data is invalid.

NOTE

For -229 engines, the MASTER CAUTION light, ENGINE category light and ATDP caution will come on momentarily during BIT.

FIRE WARNING/EXTINGUISHING SYSTEM

The fire warning and extinguisher system consists of three illuminating pushbutton switches, one fire extinguisher bottle, a discharge/test switch, and fire sensors located in the engine and AMAD compartments, and various warning/caution lights. The system provides engine and AMAD fire warning, emergency engine and JFS shutdown, and selective fire extinguishing. The extinguisher is a gaseous system which provides one-shot, one-compartment extinguishing capability. The gas is non-toxic, non-corrosive and will not damage aircraft components. Electrical power is required to operate the fire warning and extinguisher system. During JFS operation, before the emergency generator comes on the line, only the AMAD system is operative.

FIRE LIGHTS/SYSTEM OPERATION

Three fire lights on the fire warning/extinguishing panel in the front cockpit are combination warning lights and fire extinguisher arming buttons. Two fire warning lights in rear cockpit provide warning of L FIRE and R FIRE but have no extinguisher function. The three lights in the front cockpit are labeled AMAD FIRE PUSH, L ENG FIRE PUSH and R ENG FIRE PUSH. The appropriate fire light(s) comes on when a fire or overheat condition exists.

After first lifting a spring loaded metal guard, pressing the L ENG FIRE PUSH or R ENG FIRE PUSH light shuts off bleed air from, and fuel flow to, the corresponding engine, and arms the extinguisher bottle for release into the selected engine compartment. After the L or R ENG FIRE PUSH light is pressed, the engine decelerates but may continue running at sub-idle rpm for up to 120 seconds until the fuel is consumed downstream of the airframe mounted fuel shutoff valve.

After first lifting a spring loaded metal guard, pressing the AMAD FIRE PUSH light arms the extinguisher bottle for release into the AMAD/JFS compartment but will not prevent normal JFS operation. When arm is selected, approximately 1/8 inch of yellow and black stripes will be visible around the outer edges of the light(s). The fire lights must be pressed again to dearm the extinguisher and restore the selected system to normal operation. On aircraft 87-0201 AND UP, the front cockpit firewarning/extinguisher panel contains left and right AFTERBURNER BURN THRU warning lights. The respective light comes on to indicate a fire. Refer to Voice Warning System, this section, for voice warning associated with FIRE lights.

NOTE

If more than one FIRE PUSH switch is pressed simultaneously, the extinguishing agent is released to each of the areas selected.

FIRE VOICE WARNINGS

-220 ENGINES
The fire voice warning system is activated when either or both engines FTIT exceed 1000°C (overheat), or a fire condition exists.

-229 ENGINES
The fire voice warning system is activated when either or both engines FTIT exceed 1107°C (overheat), or a fire condition exists.

-220 or -229 ENGINES
For an FTIT overtemperature condition the voice warning states: WARNING, OVERTEMP LEFT or WARNING OVERTEMP RIGHT, pauses, then repeats the warning again. For an engine/AMAD fire condition the voice warning states: WARNING, ENGINE FIRE LEFT or WARNING, ENGINE FIRE RIGHT or WARNING, AMAD FIRE, pauses, then repeats the warning again. For a single-point burn through or overtemperature condition in the afterburner section the voice warning states: AB BURN THRU LEFT or AB BURN THRU RIGHT, pauses, then repeats the warning again.

FIRE TEST/EXTINGUISHER SWITCH

A discharge/test switch is located on the fire warning/extinguishing panel in the front cockpit.

OFF	System provides normal fire warning.
DIS-CHARGE	Momentary contact immediately discharges the extinguisher into the selected compartment. If the AMAD circuit was selected, the discharge switch also shuts off fuel flow to the JFS. The switch is lever-locked from OFF to DISCHARGE and is spring loaded to OFF.
TEST	Turns on the three fire lights (only the AMAD light if the JFS is providing electrical power) and the left/right AB BURN THRU lights, indicating the fire sensors are operational. Also turns on rear cockpit lights. Each fire light has four sections with an individual light bulb in each section. The top two bulbs of the AMAD light are associated with the AMAD fire sensor loop and the bottom two bulbs with the JFS fire sensor loop. The top bulbs of the engine fire lights are associated with the forward transponder loop of the corresponding engine, and the bottom two bulbs with the aft transponder loop. Failure of any of the above pairs of lights to come on during test indicates failure of the corresponding sensor loop. Switch is spring loaded to OFF.

FIRE SENSOR CAUTION

Appearance of the FIRE SENSOR caution on the MPD/MPCD indicates one or more fire sensors have failed. The MASTER CAUTION and ENGINE caution also come on.

SECONDARY POWER SYSTEM

The secondary power system provides power for starting the aircraft engines and transmits power from the engine to the aircraft accessories. It consists of an accumulator-powered hydraulic motor, central gearbox, JFS, and left and right AMAD gearboxes.

CENTRAL GEARBOX (CGB)

During JFS start, the CGB provides the mechanical connection between the hydraulic motor and the JFS. After the JFS is started, the CGB then provides the gearing and clutching functions necessary to transmit power from the JFS to the left or right AMAD gearboxes.

AIRFRAME MOUNTED ACCESSORY DRIVE

The left and right AMAD gearboxes are directly connected to their respective engine, utility hydraulic pump, power control (PC) hydraulic pump, and integrated drive generator (IDG). During engine start, power is transmitted from the JFS through the CGB and through the applicable AMAD gearbox to the engine. Once the engine is started, the CGB decouples from the AMAD gearbox and the engine then drives the AMAD gearbox and its associated accessories. The accessories on either AMAD gearbox are sufficient to support the aircraft systems if one engine or its associated AMAD gearbox fails. Refer to figure 1-5.

SECONDARY POWER SYSTEM

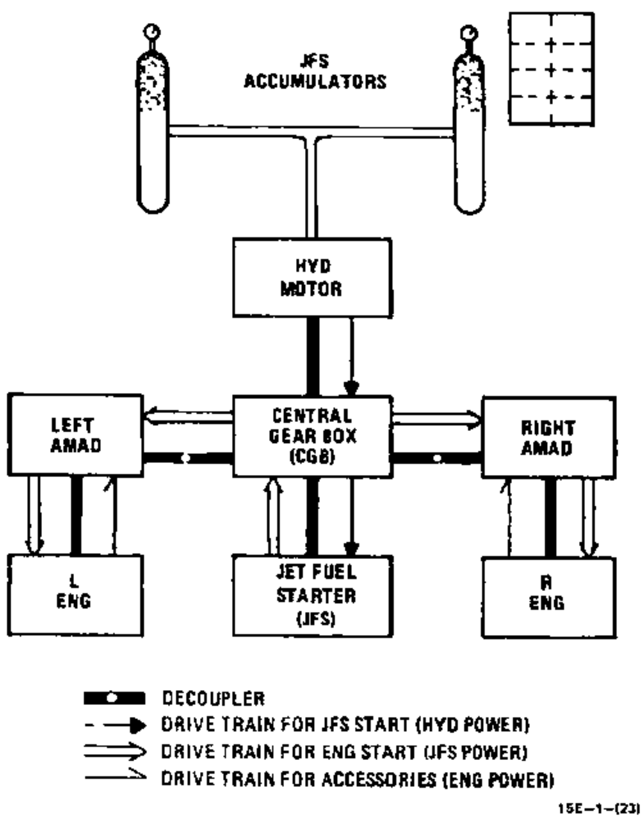


Figure 1-5

JET FUEL STARTER

A JFS, mounted on the central gearbox, is used for engine starting. It can start either engine, but not both simultaneously. JFS operation is controlled by the JFS starter switch and the JFS control handle; fuel is provided by the main aircraft fuel system. JFS ignition and electrical power are provided by the JFS generator (permanent magnet). Starting power to the JFS is provided by a hydraulic motor that is driven by hydraulic pressure accumulators. The accumulators are charged automatically by circuit B of the utility hydraulic system, or manually by hand pump. The JFS automatically shuts down when the second engine reaches between 40 - 50% rpm. The JFS may be used inflight to perform a JFS Assisted Restart, refer to section III.

JFS Starter Switch

The JFS starter switch is in the front cockpit on the right console engine control panel. It has positions of ON and OFF. During engine start, the JFS is automatically shut down after both engines are started; however, it can be shut down at any time by placing the switch OFF.

NOTE

On aircraft 86-0183 THRU 87-0200, a manual JFS shutdown may result in the CAS and MPDP temporarily dropping off line.

JFS Ready Light

The JFS ready light is in the front cockpit on the right console engine control panel. The light indicates the JFS is running. The light goes out when the JFS shuts down.

JFS Control Handle

The JFS control handle is in the front cockpit on the lower right corner of the main instrument panel. Pulling the handle straight out discharges one JFS accumulator. Rotating the handle 45° counterclockwise (CCW) and pulling discharges both accumulators, or the remaining accumulator if one has already been discharged. The handle is spring loaded to return to its normal position.

JFS LOW Caution

The JFS LOW caution is displayed if either JFS accumulator pressure is low.

AIRCRAFT FUEL SYSTEM

Refer to foldout section for airplane and engine fuel system illustration. Fuel is carried internally in four interconnected fuselage tanks, and two internal (wet) wing tanks. External fuel can be carried in three external tanks and two conformal fuel tanks. The external tanks are mounted on the centerline and inboard wing station pylons and are completely interchangeable. CFT's are mounted on the outboard side of each engine nacelle. All tanks may be refueled on the ground through a single pressure refueling point, airborne they can be refueled through the aerial refueling receptacle. External tanks may be individually fueled through external filler points. The internal wing tanks and tank 1 are transfer tanks. Tank 1 consists of one main tank and a right auxiliary tank. The tanks are so arranged that all internal fuel will transfer even if the transfer pumps fail. CFT fuel is transferred by transfer pumps to any internal tank that will accept it. Regulated engine bleed air pressure transfers fuel from the external tanks to any internal tank that will accept it and also provides a positive pressure on all internal fuel tanks. Each CFT is pressurized by a self-contained ram air pressurization and vent system. Float type fuel level control valves control fuel level during refueling or fuel transfer operations. All internal, CFT and external fuel (except engine feed tanks) may be dumped overboard from an outlet at the trailing edge of the right wing tip. All internal fuel tanks are vented through the vent outlets at each wing trailing edge. The external tanks are vented through the vent outlets in their individual pylons. Each CFT is vented through an outlet near the back of the CFT. The fuel quantity indicating system provides fuel quantity, in pounds, of all internal, CFT and external fuel. Refer to Servicing Diagram, this section, for fuel grade and specifications.

SURVIVABILITY

The internal fuel tanks, all of which are located forward of the engines, contain foam for fire/explosion protection. The feed tanks are self-sealing. Fuel lines are routed inside tanks where possible, and most have self-sealing protection when outside the tanks. All CFT compartments incorporate explosion suppression foam slabs for enhanced survivability. Dry bay areas (voids) around fuel cells on the sides and bottom of fuselage fuel tanks are filled with explosion suppression polyether foam.

FUEL TRANSFER SYSTEM

The fuel transfer system provides for internal and external fuel transfer. Internal fuel consists of L and R internal wing tanks, L and R engine feed tanks, right aux tank, and tank 1. External fuel consists of L and R CFT, L and R external wing tanks, and the external centerline tank. Any sustained fuel imbalance greater than 200 pounds between internal wing tanks or 1000 pounds between CFT lasting over 5 minutes should be reported on AFTO Form 781.

Refer to the prohibited maneuvers in Section 5 regarding angle of attack limits with fuel asymmetry over 600 pounds or combined fuel and store asymmetry.

Internal Fuel Transfer

Internal fuel transfer is accomplished by three electric transfer pumps (L and R internal wing tanks and tank 1) and one fuel ejector pump (right aux tank). The electric pumps automatically transfer internal wing and tank 1 fuel to the engine feed tanks when the level control valve(s) in either of the two feed tanks is open. The transfer pumps run continuously when electrical power is applied to the aircraft and an engine master switch is on. However, tank 1 transfer pump will not run unless the slipway switch is in CLOSE even if the FUEL LOW light is on. During normal operation 200 pounds of tank 1 fuel will transfer before the internal wing tanks start transferring. This sequence causes the center of gravity (CG) to move aft. Once the internal wings start feeding, they will simultaneously transfer along with tank 1 to the engine feed tanks. This is true during all engine operations both on the ground or in flight. Although tank 1 fuel quantity is initially higher (approximately 550 ±200 pounds) than either internal wing tank, the transfer rate of tank 1 and the internal wing tanks is designed so that tank 1 and the wing tanks empty within 200 pounds of each other. If the electric transfer pumps fail, fuel from all internal tanks will gravity transfer at a reduced rate to the engine feed tanks. Check valves prevent fuel flow from the feed tanks to the transfer tanks. The fuel ejector pump in the right auxiliary tank automatically transfers fuel to main tank 1 when its transfer pump is operating. If the ejector pump or tank 1 transfer pump fails, fuel will gravity transfer (through the open ejector pump) at a reduced rate as the level of main tank 1 decreases.

External Wing and Centerline Tank Transfer

External wing and centerline fuel is transferred by engine bleed air pressure providing the landing gear handle is UP. External fuel will not transfer with the landing gear handle down or with the slipway switch in OPEN unless the FUEL LOW light comes on. If a complete electrical failure occurs, the external fuel will still transfer. There is no backup provision for the external fuel transfer system. External fuel will normally transfer before the internal tanks start to deplete. External wing tank fuel may not transfer at the same rate or even together, but will normally transfer before centerline fuel. Internal and all external tanks can deplete simultaneously whenever engine fuel consumption exceeds transfer capability.

CFT Transfer

Each CFT contains two transfer pumps, one in the center compartment sump and one in the aft compartment sump. The sumps are connected by a float controlled interconnect valve which isolates the sumps until the aft compartment is almost empty or the aft transfer pump fails. Each CFT also contains an ejector pump that transfers fuel from the forward compartment to the center compartment. The center pump transfers forward/center compartment fuel and the aft pump transfers aft compartment fuel. When the aft compartment fuel level drops below an interconnect float valve level, the interconnect valve opens connecting the two sumps. The CFT transfer pumps run continuously when electrical power is applied to the aircraft, an engine master switch is on, the slipway switch is in CLOSE, CFT is selected on the external transfer switch, and NORMAL is selected on CFT STOP TRANSFER/REFUEL switch. Fuel transfer sequence within the CFT is designed so the CG moves forward as the CFT transfers fuel. Improper fuel sequencing from the CFT may cause the CG to remain or move aft while the CFT transfers fuel. Refer to the CG limitations in Section VI for more details on CG travel with fuel transfer.

External Transfer Switch

The external transfer switch has switch positions of WING/centerline (CTR) and conformal (CONF) TANK. The switch is provided to select the transfer sequence of the external fuel. In flight, all external tanks are pressurized and can transfer fuel. On the ground, since external wing and centerline tanks are depressurized, no fuel will transfer from those tanks. However, the CFTs can transfer fuel on the ground since the CFT transfer pumps operate continuously. Whichever switch position is selected, the opposite tank will not transfer unless the selected tank is empty or the selected tank transfer rate is insufficient to maintain full internal fuel. If the selected transfer sequence doesn't maintain full internal tanks, all the external tanks (wing, centerline, and CFT) will transfer simultaneously until the internal fuel tanks are full. (Internal fuel will deplete by approximately 1100 pounds before the simultaneous transfer occurs.) Once full, the simultaneous transfer will cease until the transfer rate of the selected tank again fails to keep the internal tanks full. For example, with CFTs and without external wing tanks, but the external transfer switch in WING/CTR, cyclic CFT transfer will occur and the cycling will continue until CFTs are empty. This same type of cyclic transfer will occur if the opposite is true; external wing tanks installed, no CFT installed, and external transfer switch in CONF TANK position. On the ground, since external wing and centerline tanks are depressurized, and with CFTs installed, cyclic transfer will maintain the internal tanks full with the external transfer switch in WING/CTR position.

Fuel Control Switches

Three fuel control switches, labeled WING (external wing tanks), CTR (centerline tank), and CONF TANK are on the fuel control panel. All three switches have the same three positions identified below.

NORM	Provides normal transfer and refuel of corresponding tanks.
STOP TRANS	Stops transfer from corresponding tanks, including automatic external transfer, unless FUEL LOW light is on, in which case fuel will transfer regardless of position of this switch.

CAUTION

Selecting STOP TRANS will inhibit auto transfer and could cause the aircraft to exceed aft CG limits.

STOP REFUEL	Prevents filling of the tank(s) selected.

CFT Emergency Transfer Switch

The conformal tank emergency transfer switch, located on the fuel control panel has positions of normal (NORM), L, and R. This switch should be in NORM with or without conformal tanks installed. When operating on the emergency generator only, selecting either L or R will deactivate all aircraft pitot heaters, and activate the selected (L or R) CFT center sump transfer pump. Selecting L or R will deactivate the aircraft pitot heaters even if the CFT's are not installed.

FUEL FEED SYSTEM

There are two separate fuel feed systems, one for each engine. During normal operation, fuel temperature is controlled by fuel recirculation to the internal wing tanks. The internal wing tanks act as a heat exchanger to lower the fuel temperature before it again transfers to the feed tanks. Baffles in the feed tanks provide limited fuel supply for the left and right main boost pumps during negative g or inverted flight. During normal operation, the right main boost pump supplies fuel to the right engine only, and the left main boost pump supplies fuel to the left engine only. Below 1000 pounds total feed tank fuel, feed tanks may not feed simultaneously. The main boost pumps are capable of providing pressurized fuel flow to the engines at all power settings throughout the flight envelope. If either or both main boost pumps fail, or either or both main generators are inoperative, or both main transformer-rectifiers fail, the emergency boost pump is activated and a system of tank interconnect and crossfeed valves allows the remaining operating pump(s) to supply all usable fuel in the feed tanks to both engines. With one main boost pump and the emergency boost pump operating, pressurized fuel is supplied to both engines at all non-afterburner power settings throughout the envelope. With double boost pump failure (any two), the remaining pump is capable of supplying fuel to both engines at all non-afterburner power settings from sea level to 30,000 feet. If both main boost pumps and the emergency boost pump are inoperative, fuel is available to the engines by suction feed only. Under most flight conditions the engine requires pressurized (boosted) fuel to preclude fuel vaporization. Therefore, loss of both main pumps and the emergency boost pump may cause dual engine flameout. During single-engine operation, the feed tank of the inoperative engine will not feed to the operative engine until the fuel level of the good engine feed tank is well below FUEL LOW light activation.

L/R BOOST PUMP Cautions

The L and R POOST PUMP cautions are displayed on the MPD/MPCD if the associated boost output pressure is low.

EMERGENCY BOOST PUMP ON Caution

The EMER BST ON caution, on both the caution light panel and the MPD/MPCD, come on any time the emergency generator is operating and sufficient emergency boost pump output pressure is available.

BOOST SYSTEM MALFUNCTION Caution

The BST SYS MAL caution on both the caution light panel and the MPD/MPCD come on any time the emergency fuel boost pump output is insufficient or the emergency fuel boost pump is being powered by an abnormal source (main generator).

FUEL HOT Caution

The FUEL HOT caution on the caution lights display comes on when the engine fuel inlet temperature requirement is exceeded.

TRANSFER PUMP Caution

The XFER pump caution is displayed on the MPD/MPCD and comes on when a failure of a CFT or a wing fuel transfer pump occurs. There is no differentiation between left or right transfer pump or between internal wing tanks and CFT.

TRANSFER PUMP Voice Warning

Failure of the CFT or wing fuel transfer pump will activate the transfer voice warning. When a failure is detected the voice warning states: "WARNING TRANSFER PUMP", pauses, then repeats the warning.

FUEL TANK PRESSURIZATION AND VENT

The pressurization and vent system provides regulated engine bleed air pressure to all internal tanks to prevent fuel boil-off at altitude and to the external tanks for fuel transfer. The system also provides pressure relief of the fuel tanks during climbs, and vacuum relief of the fuel tanks, as required, during descents. The internal and external tanks are pressurized when the landing gear handle is UP. Internal and external tanks are depressurized when the landing gear handle is DOWN.

The pressurization and vent system is self-contained for each CFT. Each CFT provides regulated ram air pressure (from a flush inlet on the side of the CFT) to all three compartments to maintain positive tank pressures. The system also provides pressure relief of the CFT through the overboard vents during climb and air refueling, and vacuum relief during ground operation.

FUEL QUANTITY INDICATING SYSTEM

The fuel quantity indication system provides readings, in pounds, of usable internal, CFT and external fuel. Refer to figure 1-6. The system components include the fuel quantity indicator, a built-in test (BIT), a BINGO caution display, and an independent FUEL LOW caution light.

Fuel Quantity Indicator

A combination pointer-counter fuel quantity indicator is on the lower right side of the main instrument panel. Refer to figure 1-6. The pointer indicates total internal fuel (with readings multiplied by 1000). The upper counter marked TOTAL LBS indicates total internal fuel plus CFT and external fuel. The two lower counters, marked LEFT and RIGHT, and a selector switch provide individual tank monitoring and a check of the indicator. An OFF flag will be displayed if no electrical power is available. Erroneous fuel indications resulting from fuel slosh will occur during and immediately following maneuvering flight.

Fuel Quantity Selector Knob

FEED	The fuel remaining in the respective engine feed tanks will be displayed.
INT WING	The fuel remaining in the respective internal wing tanks will be displayed.
TANK 1	The fuel remaining in tank 1 will be displayed in the LEFT counter (RIGHT will indicate zero).
EXT WING	The fuel remaining in the respective external wing tanks will be displayed.
EXT CTR	The fuel remaining in the external centerline tank will be displayed in the LEFT counter (RIGHT will indicate zero).
CONF TANK	The fuel remaining in the respective conformal tank will be displayed.
BIT	A spring-loaded position that will drive the internal (pointer) and total (counter) indicators to 6000 pounds, and the LEFT and RIGHT (counters) to 600 pounds indicating the fuel quantity indicator is operating normally.

FUEL LOW Caution

A FUEL LOW caution, on the MPD/MPCD display, warns the aircrew of a low fuel level in one or both engine feed tanks. The FUEL LOW caution is completely independent of the fuel quantity indicating system and is controlled by a sensor in each feed tank. The sensor in the right feed tank is located at the 960 pound level and the sensor in the left feed tank is located at the 540 pound level. If either sensor is exposed (regardless of the combined indicated fuel quantity) the FUEL LOW caution will come on. The caution normally comes on at 1500 ±200 pounds total internal fuel remaining. The FUEL LOW caution may come on with more than 1500 pounds of fuel remaining if fuel transfer falls behind engine fuel consumption because of transfer system failure or sustained high speed afterburner usage. The FUEL LOW caution activates automatic transfer of fuel from the CFT's and external tanks regardless of cockpit fuel switch positions. Transfer will stop as soon as feed tanks refill to the sensor levels and will reactivate when the fuel level again drops below the sensors. FUEL LOW activation will not turn on the tank 1 or CFT transfer pumps if the slipway switch is in OPEN or ORIDE.

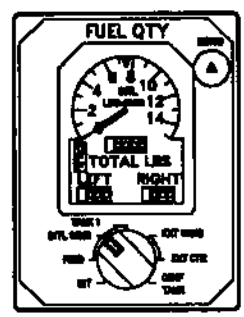
FUEL LOW Voice Warning

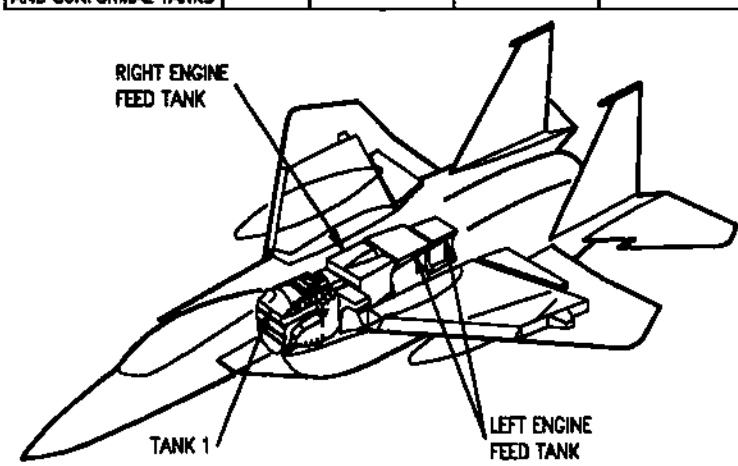
The FUEL LOW voice warning is activated in conjunction with the FUEL LOW caution. When a low fuel condition exists, the voice warning states: "WARNING, FUEL LOW", pauses, then repeats the warning.

FUEL QUANTITIES

(F-15E)

TANK		USABLE FUEL				
		GALLONS	JP-4		JP-8	JP-5
			POUNDS AT 6.5 LB/GAL	POUNDS AT 6.3 LB/GAL	POUNDS AT 6.7 LB/GAL	POUNDS AT 6.8 LB/GAL
TANK 1		604	3,900 ± 150	3,800 ± 150	4,050 ± 150	4,100 ± 150
RIGHT ENG FEED (TANK 2)		234	1,500 ± 100	1,450 ± 100	1,550 ± 100	1,590 ± 100
LEFT ENG FEED (TANK 3)		189	1,250 ± 100	1,150 ± 100	1,250 ± 100	1,290 ± 100
INTERNAL WING TANKS	L	498	3,200 ± 250	3,150 ± 250	3,300 ± 250	3,370 ± 250
	R	498	3,200 ± 250	3,150 ± 250	3,300 ± 250	3,370 ± 250
INTERNAL FUEL LESS CONFORMAL TANKS		2,019	13,100 ± 500	12,700 ± 500	13,550 ± 500	13,750 ± 500
EXTERNAL WING TANKS	L	610	3,950 ± 300	3,800 ± 300	4,100 ± 300	4,150 ± 300
	R	610	3,950 ± 300	3,800 ± 300	4,100 ± 300	4,150 ± 300
INT FUEL PLUS EXT WING TANKS LESS CONFORMAL TANKS		3,239	21,050 ± 850	20,400 ± 850	21,700 ± 850	22,000 ± 850
EXTERNAL ℄ TANK		610	3,950 ± 300	3,800 ± 300	4,100 ± 300	4,150 ± 300
INT FUEL PLUS EXT ℄ TANK LESS CONFORMAL TANKS		2,629	17,100 ± 750	16,550 ± 750	17,600 ± 750	17,900 ± 750
INT FUEL PLUS 3 EXT TANKS LESS CONFORMAL TANKS		3,849	25,000 ± 950	24,250 ± 950	25,800 ± 950	26,150 ± 950
CONFORMAL TANKS	L	728	4,750 ± 300	4,600 ± 300	4,900 ± 300	4,950 ± 300
	R	728	4,750 ± 300	4,600 ± 300	4,900 ± 300	4,950 ± 300
INTERNAL FUEL PLUS CONFORMAL TANKS		3,475	22,600 ± 900	21,900 ± 900	23,300 ± 900	23,650 ± 900
INT FUEL PLUS EXT WING TANKS AND CONFORMAL TANKS		4,695	30,500 ± 1050	29,600 ± 1050	31,450 ± 1050	31,950 ± 1050
INT FUEL PLUS EXT ℄ TANK AND CONFORMAL TANKS		4,085	26,550 ± 950	25,750 ± 950	27,350 ± 950	27,800 ± 950
MAX FUEL LOAD-INT FUEL PLUS 3 EXT TANKS AND CONFORMAL TANKS		5,305	34,500 ± 1150	33,400 ± 1150	35,550 ± 1150	36,100 ± 1150





NOTES

- THE FUEL QUANTITIES, IN POUNDS, ARE ROUNDED OFF TO READABLE VALUES OF COUNTER PORTION OF THE FUEL QUANTITY INDICATOR; THEREFORE, THE ACTUAL GALLONS TIME 6.5, 6.3, 6.7 OR 6.8 WILL NOT NECESSARILY AGREE WITH THE POUNDS COLUMN.
- FUEL WEIGHTS ARE BASED ON JP-5 AT 6.8, JP-8 AT 6.7 AND JP-4 AT 6.5 AND 6.3 POUNDS PER GALLON (DIFFERENCES ARE DUE TO MANUFACTURERS ALLOWABLE TOLERANCES) AND 65 DEGREES FAHRENHEIT.

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Figure 1-6

BINGO FUEL Caution

A BINGO fuel caution on the MPD/MPCD comes on at a preset value, controlled by the aircrew. An adjustable index (bug) on the face of the indicator may be set to any internal fuel quantity by turning the bingo knob. If the bingo index is set above 6000 pounds, the BINGO caution will come on when the BIT check is made. The bingo caution circuit may be used to automatically terminate fuel dumping.

BINGO FUEL Voice Warning

The bingo fuel voice warning is activated in conjunction with the bingo fuel caution. When a bingo fuel condition exists, the voice warning states: "BINGO FUEL", pauses, then repeats the warning.

FUEL DUMP SYSTEM

All fuel except engine feed tank fuel may be dumped by placing the dump switch, on the fuel control panel, to DUMP. With the landing gear handle DOWN, external fuel cannot be dumped since it cannot be transferred to the internal tanks. The fuel dump switch is spring-loaded to the lever-locked NORM position and is electrically held in the DUMP position (with BINGO caution off). When DUMP is selected, a motor-operated dump valve in the right internal wing tank opens. With the dump valve open, the transfer pumps in tank 1 and each internal wing tank force fuel out the right wing dump mast. Conformal fuel tanks and/or external fuel tanks transfer into tank 1 and the wing tanks and is then dumped. Dumping will continue until STOP TRANS is selected or in the case of the external tanks, the landing gear handle is moved to DN. If the tank 1 and internal transfer pumps fail, external fuel passes through a check valve and is dumped. Dumping will continue until:

a. Norm is selected on the dump switch.

b. The BINGO caution comes on, at which time the dump switch automatically returns to NORM terminating fuel dumping.

c. Only feed tank fuel remains. This can occur if the BINGO bug is set below approximately 2700 pounds.

The approximate fuel dumping rates are: right internal wing tank 390 PPM, left internal wing tank 260 PPM, and tank 1, 260 PPM for a total of 910 PPM. The uneven dump rates of the internal wing tanks produce a fuel imbalance (left wing heavy) of approximately 130 pounds per minute up to a maximum of approximately 1100 pounds of wing fuel asymmetry. Wing fuel asymmetry will remain until all the fuel in the internal wing tanks is depleted.

EXTERNAL TANK JETTISON

The external fuel tanks may be jettisoned individually or simultaneously. See Stores Jettison Systems, this section.

AIR REFUELING SYSTEM

The air refueling system has a fixed receptacle, a slipway control switch, a hydraulically operated slipway door, two slipway lights, a receptacle flood-light, a signal amplifier, a READY light, an air refueling release button, an air refuel pressure switch, and an emergency slipway door actuating system. For CG control, a float switch in tank 1 prevents external tank refueling until tank 1 fuel quantity is above approximately 1560 pounds. The CFTs start filling immediately (regardless of tank 1 fuel quantity) with CG being maintained by the sequence in which the CFT compartments are filled. For normal and emergency air refueling procedures refer to F-15 Flight Crew Air Refueling Procedures (TO 1-1C-1-25).

Slipway Switch

The three-position slipway switch is located on the fuel control panel.

CLOSE	Closes the slipway door, turns on tank 1 and CFT transfer pump(s), reestablishes external fuel tank pressurization, and fuel sequencing.
OPEN	Shuts off tank 1 transfer pump, CFT transfer pumps (if operating) opens the slipway door and, providing the slipway door has opened:, a. Depressurizes the external fuel tanks if FUEL LOW light not on. b. Turns on the receptacle lights. c. Turns on the READY light indicating the system is ready for boom engagement.

ORIDE — Accomplishes the same function as in OPEN above plus the following:
a. Allows boom locking, but the tanker disengage feature (both automatic and manual) is lost.
b. The receiver must initiate all disconnects.
c. Bypasses tank 1 float switch and external tanks may be refueled regardless of fuel quaqntity in tank 1.

NOTE

- With the slipway switch in OPEN or ORIDE and the slipway door open, the external tanks are depressurized and descent rate should not exceed 10,000 feet per minute.
- To prevent an undesirable CG condition when using ORIDE position, STOP REFUEL should be selected for the external tanks and CFT until tank 1 fuel quantity is above 1560 pounds.
- FUEL LOW caution activation will not turn on the tank 1 or CFT transfer pump if the slipway switch is in OPEN or ORIDE.

Fuel Control Switches

The three fuel control switches, on the fuel control panel, provide an option of refueling the external/conformal tanks. If the switches are in NORM, the external/conformal tanks will fill during refueling. If any or all switches are in STOP REFUEL, the corresponding external/conformal tank(s) will not fill during refueling.

Air Refuel Pressure Switch

The air refuel pressure switch prevents the aircraft fuel system from becoming over-pressurized during refueling by unlatching the receptacle from the air refueling boom if fuel pressure exceeds approximately 80 psi.

Air Refueling Release Button

The auto acquisition button is used as an air refueling release button. When the button is depressed, the receptacle unlatches from the boom.

Emergency Air Refueling Switch

The slipway door can be opened by placing the emergency air refueling switch to OPEN. Pyrotechnic devices powered by the emergency essential 28 volt dc bus open the door which cannot then be closed in flight. Normal slipway lighting will be available but the READY light will not go out during refueling nor will the boom lock in the receptacle. External fuel tank pressurization can be restored by placing the slipway door switch to CLOSE.

GROUND REFUELING

All internal, CFT and external fuel tanks are pressure fueled through a single point receptacle. However, the external tanks may be fueled through individual filler points. No external power is required for single point refueling.

CFT Manual Precheck Valve

The manual precheck valve, located on the forward end of the CFT, has two positions.

PRECHECK — Prevents ground refueling.

LOCK — Allows ground refueling of the CFT.

CAUTION

If the fuel dump valve(s) were open when electrical power was removed from the aircraft, they will remain open until power is reapplied. Fuel will be dumped during refueling if the dump valve(s) are open.

ELECTRICAL POWER SUPPLY SYSTEM

The electrical power supply system consists of two main AC generators, three transformer-rectifiers, an emergency AC/DC generator, and a power distribution (bus) system. External electrical power can be applied to the bus system on the ground, and the JFS generator provides electrical power to part of the bus system during an engine start without external power. Refer to foldout section for electrical system simplified schematic.

AC ELECTRICAL POWER

Two AC generators are the primary source of electrical power. The two generators are connected for split bus nonsynchronized operation. This means that with both generators operating each generator supplies power independently to certain aircraft buses. If one generator fails, it drops off the line; and at the same time, power from the remaining generator is provided to the buses of the failed (or turned off) generator. Current limiters are provided to prevent a fault in one generator system from shutting down both generators. Either generator is capable of supplying power to the entire system. Each generator is activated automatically when its control switch is in the ON position, and the generator is connected to its buses when voltage and frequency are within prescribed limits (approximately 56% engine rpm). A protection system within the generator control unit protects against damage due to undervoltage, overvoltage, over and under frequency, feeder faults, and generator locked rotor. If a fault or malfunction occurs, the generator control unit removes the affected generator from its buses. Except for an under frequency condition, the control switch of the affected generator must be cycled to bring the generator back on the line after the fault or out-of-tolerance condition clears. If the generator drops off the line due to under frequency and the prescribed frequency is restored, the generator will come back on the line automatically. A generator may be removed from its buses at any time by placing the generator control switch to OFF. Indicator lights, labeled L GEN and R GEN, are on both caution light panels. These lights come on whenever their respective generator drops off the line with power available on the essential 115 VAC bus to illuminate the lights.

Generator Control Switches

Two generator control switches, one for each generator, are on the engine control panel. They are two-position toggle switches with positions of OFF and ON. The switches are lever-lock type and must be raised up before they are moved to a new position.

DC ELECTRICAL POWER

Three transformer-rectifiers (TR) are provided. The outputs of the left and right transformer-rectifiers are connected in parallel; however, protection is provided so that a short on a bus of one TR will not affect the other TR. Also, if either the right or the left TR fails, the other TR will power the entire DC system. A third TR is provided, the essential TR, which operates independently of the other two. No cockpit warning of single TR failure is provided.

EMERGENCY GENERATOR

A utility hydraulic motor-driven emergency AC/DC generator is provided. The emergency electrical system is separate from the primary electrical system. If either or both main generators are inoperative or both the left and right transformer-rectifiers fail, or some combination of faults occur, or if either or both main fuel boost pumps fail, the emergency generator is activated. If only one generator is inoperative or either or both main fuel boost pumps fail, the emergency generator powers the emergency/essential buses only (emergency fuel boost pump, arresting hook, emergency air refueling door open and AFCS/CAS). If both generators are inoperative or both right and left transformer-rectifiers fail, the emergency generator supplies the essential AC/DC buses, the emergency/essential buses and the ground power switch number 1 28 volt dc bus. With the aircraft on the ground and the emergency generator switch in AUTO during engine start without external electrical power, the emergency generator automatically shuts off 30 seconds after first main generator comes on the line. The purpose of shutting down the emergency generator is to limit operation on the ground. The 30 second delay is to allow time to check the emergency generator/emergency boost pump system. For engine start using external power, the emergency generator or emergency boost pump will not operate as long as external power is connected. With the emergency generator switch in AUTO on the ground, except with external power connected, both the EMER BST ON and BST SYS MAL lights come on in situations (single engine taxi, first engine start, etc.) where a main generator is off the line. The lights will go out when the second main generator comes on the line.

Emergency Generator Control Switch

The emergency generator control switch, on the engine control panel, is a three-position toggle switch with positions of AUTO, MAN, and ISOLATE. The switch is electrically held in the ISOLATE position.

AUTO	Provides automatic activation of the emergency generator if either or both main generators are inoperative, both left and right transformer-rectifiers fail, or either or both main fuel boost pumps fail. Also provides automatic shutdown of the emergency generator 30 seconds after the first main generator comes on the line after a ground start without external power. For starts with external power the emergency generator will not operate as long as external power is connected.
MAN	Provides manual activation of the emergency generator.
ISOLATE	Restricts the emergency generator to powering the emergency fuel boost pump, the arresting hook and provides power from the emergency/essential 28 volt dc bus to the emergency air refueling switch to open the slipway door. It also provides power to the ground power switch number 1 28 volt dc bus for operation of the engine monitor display. All power and intercom are removed from the rear cockpit. In the event of a complete electrical failure, an attempt to restore the emergency generator may be made by cycling the switch to ISOLATE and back to MAN.

EMER BST ON/ SYSTEM MALFUNCTION Cautions

The EMER BST ON and BST SYS MAL cautions provide indication of the status of both the emergency fuel boost pump system and the emergency generator system. A single caution or combination of cautions indicate the following:

EMER BST ON	BST SYS MAL	STATUS
ON	OFF	Emergency fuel boost pump pressure normal and pump powered by emergency generator.
OFF	ON	Emergency fuel boost pump failed.
ON	ON	Emergency fuel boost pump pressure normal but powered by abnormal electrical source.

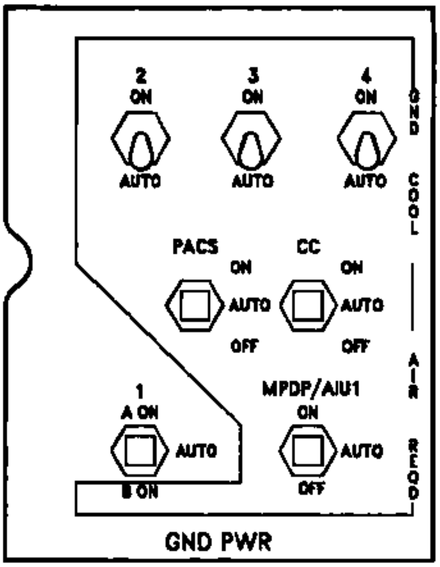
JFS GENERATOR

The JFS generator provides JFS ignition and control, and, with the JFS READY light on, intercom, front utility light, and AMAD fire warning power. These items are powered by the JFS generator until JFS shutdown. If the JFS start switch is used for shutdown, the AMAD fire warning remains powered for a short time during JFS rundown.

EXTERNAL ELECTRICAL POWER

External electrical power may be connected to the aircraft through an external electrical power receptacle near the nose gear wheelwell. The aircraft buses are energized by external power in the same manner as if a main generator were operating. The exceptions to this are those buses which furnish power to systems which do not have on-off control switches and/or require cooling air. Power can be applied to these buses by the use of ground power switches. With external power on the airplane, if the left engine is started first, the complete electrical system automatically switches to internal power when the left generator comes on the line. If the right engine is started first, the right generator, when it comes on the line, energizes only the buses it normally feeds. The buses normally energized by the left generator remain on external power (except those buses energized by the JFS generator) until the external power is removed or the left engine is started and the left generator comes on the line.

GROUND POWER CONTROL PANEL & PLACARD



GND PWR		
SW 1	SW 2	SW 3
HYD PRESS FUEL FLOW ENG MON FUEL QTY IND LDG GR FLAPS EXCDNCE CNTR SPD BK AFCS	AHRS STBY ATT MAD	ADC EAIC AOA VVI IBS VTRS
POS A ALL EXCEPT AFCS POS B ALL		SW 4 ILSR AIU NO. 2 TACAN RMR

15E-1-(33-1)04-CATI

Figure 1-7

External Power Control Switch

The external power control switch, on the engine control panel, controls application of external power to the aircraft electrical buses. An external power monitor will prevent faulty external power from being connected to the aircraft system.

NORM	Allows the aircraft electrical buses to be energized by external power if no aircraft generators are operating.
RESET	Will establish external power if it is not on the line. The RESET position is spring-loaded to NORM.
OFF	Disconnects external power from the aircraft.

Ground Power Switches

Seven ground power switches are provided on the ground power panel (figure 1-7) on the left console. Each controls a group of systems and/or instruments and will prevent unnecessary operation of the systems/instruments on ground power. Switches 2, 3, and 4 have two positions. The CC (central computer) switch, PACS switch, switch 1 and MPDP A1U 1 switch have three positions.

AUTO	System/instrument can only be energized by aircraft generator power.
ON	System/instrument can be energized by external power.
OFF	CC, PACS or MPDP/AIU 1 are de-energized regardless of power source.

CAUTION

Ground cooling air is required except for switch 1 (A or AUTO).

NOTE

With the ECS caution on because of a low avionics cooling air flow condition, all ground power switches become inoperative as a means of applying external power to their applicable equipment. If any of the switches are set to the ON position when a low avionics cooling air condition occurs, the switch(es) will remain in the ON position although the power to their equipment will be shut off.

CIRCUIT BREAKERS

Circuit breakers for the AFCS, pitot heat, speed brake, flaps, landing gear, and nosewheel steering are provided on the lower center instrument panel in the front cockpit. Two circuit breaker panels are in the rear cockpit below the right and left consoles. All other circuit breakers are inaccessible to the flight crew.

HYDRAULIC POWER SUPPLY SYSTEM

Hydraulic power is supplied by three separate systems with each system divided into two or more circuits. Reservoir level sensing (RLS) is employed in all three systems for the purpose of isolating a leak. When a leak develops in a circuit a valve senses the reservoir level and shuts off the affected circuit. Through this method the maximum number of circuits remain operable. Refer to Hydraulic Flow Diagram, section III and the hydraulic systems foldout for a description of what each system powers.

PC SYSTEMS

Both the PC1 pump and PC2 pump operate at a pressure of 3000 psi. Each PC system is divided into a circuit A and a circuit B.

UTILITY SYSTEM

The utility system has a left pump which operates at a pressure of 3000 psi and a right pump which operates at a pressure of 2775 psi. The utility system is divided into a circuit A, circuit B, and a non-RLS circuit.

RESERVOIR LEVEL SENSING

If a leak occurs in any circuit, the reservoir level of that system (PC1, PC2 or utility) drops and circuit A is shut off. If the leak is in circuit B, the reservoir level continues to drop causing circuit A to be restored and circuit B is shut off. In the case of the utility system with a non-RLS circuit leak, circuit A is shut off then restored as circuit B is shut off; however, if flight is continued, a complete utility failure will eventually occur as indicated by zero pressure on the utility hydraulic gage.

HYDRAULIC PRESSURE INDICATORS

Three hydraulic pressure gages on the upper right corner of the instrument panel display PC1, PC2 and utility hydraulic system pressures.

HYDRAULIC SYSTEMS CAUTION LIGHTS

An amber HYD light on the caution light panel and the MASTER CAUTION light come on when any hydraulic systems caution exists. The appropriate caution display: PC1 A, PC1 B, PC2 A, PC2 B, UTL A and UTL B will be displayed on the MPD/MPCD when their respective RLS valve actuates to shut off that circuit. The L PUMP or R PUMP caution is also displayed on the MPD/MPCD when the respective utility hydraulic pump output pressure is low. An indication of a PC pump failure or low pressure is displayed on the MPD/MPCD as PC1 A and PC1 B or PC2 A and PC2 B. Resetting the MASTER CAUTION light will not extinguish the HYD light or the associated caution on the MPD/MPCD.

LANDING GEAR SYSTEM

The gear is electrically controlled and hydraulically operated. While weight is on the gear, the gear cannot be retracted. When the main and nose gear are extended, the forward door(s) will be closed.

LANDING GEAR CONTROL HANDLE

The landing gear is controlled by a wheel shaped handle located on the lower left side of the main instrument panel, and has two positions.

DOWN (DN)	Extends landing gear.
UP	Retracts landing gear.

Landing Gear Warning/UNSAFE Lights and Warning Tone

A red warning light in the front cockpit landing gear control handle and the rear cockpit UNSAFE light on the left lower main instrument panel come on when any landing gear is not locked in the selected position. A low pitch (250 Hz) warning tone will be activated 10 seconds after the landing gear control handle is placed down and will remain activated until all gear are down and locked. The red warning lights will also illuminate due to an unlocked gear door when the landing gear control handle is up. These lights are independent of the three green landing gear position lights. The lights will illuminate and the warning tone will sound whenever the following conditions exist simultaneously: aircraft altitude is below 10,000 feet MSL, airspeed is below 200 KCAS, rate of descent greater than 250 fpm and the gear handle is not down. In addition, the lights will illuminate and a warning tone will sound when the Air Data Computer (ADC) becomes inoperative, regardless of altitude, airspeed, or rate of descent. The warning tone may be silenced by depressing the warning tone silence button adjacent to the landing gear control handle. If the landing gear is up and locked and then the landing gear control circuit power fails (e.g., circuit breaker popped), the warning lights will illuminate; however, the warning tone will not come on.

Landing Gear Position Lights

There are three green landing gear position lights marked NOSE, LEFT, and RIGHT located on the left lower main instrument panel in each cockpit. Each light will illuminate when its respective gear is down and locked.

EMERGENCY LANDING GEAR HANDLE

An EMERG LG handle is located on the left main instrument panel in both cockpits. Emergency gear extension is accomplished by pulling either the front or rear cockpit EMERG LG handle full travel and ensuring the handle is locked in the extend (full travel) position. This bypasses normal hydraulic and electrical controls and hydraulically (JFS accumulator) releases the doors and landing gear. The landing gear then free falls to the down and locked position. The landing gear doors will remain open. The emergency landing gear handle in the forward cockpit can be reset by rotating the handle 45° clockwise and pushing forward. The handle in the rear cockpit must be pulled completely out and locked and once pulled and locked, cannot be reset from the rear seat.

NOSE GEAR STEERING SYSTEM

Nose gear steering (NGS) is a full time mechanically controlled (front and rear cockpit rudder pedals) hydraulically powered (UTL A pressure) system that features dual authority steering ranges consisting of a normal (15° maximum left or right) range and a maneuvering (45° left or right) range. The steering system automatically engages whenever the nose gear strut is compressed by the weight of the aircraft and provides normal steering authority range. The maneuvering range is selected by pressing the NGS button on the front cockpit control stick. The nose gear steering system may be disengaged from either cockpit by pressing and holding the paddle switch on the control stick. With the system disengaged, the nose wheel becomes free swiveling and may be swiveled 360°. When the paddle switch is released, the system will not re-engage if the nose gear has rotated more than approximately 56°. However if the steering is engaged with the nose gear rotated beyond 45°, the nose gear will be immediately driven back to the 45°position. During taxi, when centering action reduces the angle below approximately 45°, the nose gear steering system will re-engage. On takeoff, nose gear steering is disengaged when the nose gear strut extends.

Emergency Steering

Emergency power for the nose gear steering is selected by pulling the front or rear cockpit emergency brake/steering handle located on the lower center of the main instrument panel. Pulling the handle selects JFS hydraulic accumulator pressure to power the nose gear steering. With an emergency brake/steering handle pulled, both nose gear steering ranges are available and cannot be disengaged with the paddle switches. If UTL A is operating, the nose gear steering may not shift to the JFS hydraulic accumulator pressure or may only partially shift which can cause loss of, or reduced steering rate (sluggish) that may appear as loss of steering. Pressing and holding the paddle switch will remove UTL A from the system and ensure that the nose gear steering shifts fully to JFS hydraulic accumulator pressure. If UTL A is available the normal steering system can be restored by resetting the emergency brake/steering handle and releasing the paddle switches. If the JFS LOW caution is on, the emergency steering system is not reliable for taxi since accumulator pressure can no longer be monitored.

Emergency Brake/Steering Handle

For location and use of the emergency/brake steering handle, refer to Emergency Steering and Emergency Brakes narrative this section.

BRAKE SYSTEM

The main landing gear wheels are equipped with hydraulically powered brakes operated by toe action on the rudder pedals. An anti-skid system is incorporated in the normal brake system to provide maximum deceleration with controlled wheel skid. An emergency brake system provides JFS hydraulic accumulator pressure to power the brake system in the event of loss of UTL A which normally powers the system. Anti-skid protection is not available on the emergency brake system. A holding brake relieves the aircrew from maintaining pressure on the brake pedals when the aircraft is stopped for long periods of time.

Anti-Skid System

The anti-skid system is electronically controlled by a three-position switch in the front cockpit on the miscellaneous control panel. An ANTI-SKID caution and the MASTER CAUTION light will come on whenever the landing gear is down and a system failure is detected. A touchdown protection circuit (with anti-skid on) prevents hydraulic pressure from being applied to the brakes until both main wheels spin up. The brake pulser provides main tire skid control in the event anti-skid braking is not available. Skid control effectiveness deteriorates below 30 knots; therefore, heavy braking below 30 knots may result in locked wheels. The pulser may also be selected manually by the anti-skid switch. When the pulser system is activated, applied brake pressure is repeatedly interrupted to the wheel brakes. This provides pulsating braking action which reduces the probability of tire blow-out from locked wheels. This also prevents bringing the aircraft to a complete stop on the brake pulser. After touchdown, the ARI will be disengaged by the anti-skid wheel spin up signal. With the anti-skid switch in OFF or PULSER, the ARI will be disengaged anytime the landing gear handle is down. When the anti-skid is inoperative and for some anti-skid detected malfunctions, the ARI will remain engaged at wheel spin-up, adversely affecting crosswind landing characteristics. Placing the anti-skid switch to OFF or PULSER will ensure ARI disengagement. The MASTER CAUTION light and ANTI-SKID caution do not depend on the position of the landing gear circuit breaker in the front cockpit. However, if the landing gear circuit breaker is pulled or popped, the automatic selection of the brake pulser is disabled and PULSER must be manually selected in order to obtain pulser and disengage ARI.

NORM	The anti-skid is on when the gear is down. However, illumination of the ANTI-SKID caution activates the brake pulser and ARI is disengaged with the gear down.
PULSER	Turns off normal anti-skid protection, turns on the ANTI-SKID caution and MASTER CAUTION, and activates the brake pulser. The ARI is disengaged with the gear handle down.
OFF	Turns off the normal anti-skid and brake pulser systems. Disengages ARI with the gear handle down.

Emergency Brake System

Emergency brake system pressure is supplied by the JFS accumulator and actuated by pulling the emergency brake/steering handle in either cockpit. If UTL B is operating, the accumulator will be continuously replenished. If not, sufficient braking should be available to stop the aircraft. Emergency brakes may feel more sensitive than normal brakes because anti-skid protection is not available. If UTL A pressure is available, the normal brake system can be restored by resetting the emergency brake/steering handle.

Holding Brake

The holding brake is electrically controlled by a two-position toggle switch located in the front cockpit on the lower main instrument panel. The switch is electrically held in the ON position and automatically switches off when a throttle is moved above IDLE, the aircraft is weight off wheels or electrical power is removed. The holding brake 'ON' signal is used by the INS to reenter alignment after interrupted alignment occurs. The holding brake should not be placed to ON while the aircraft is moving but must be ON during AFCS BIT.

ON	Holding brake is on, hydraulic system pressure (3000 psi) is supplied to brakes.
OFF	Holding brake is off, normal brake system operation is restored.

ARRESTING HOOK SYSTEM

A retractable arresting hook is in the underside of the aft fuselage. It is electrically controlled, extended by gravity and a hydraulic dashpot, and retracted by utility hydraulic pressure. It takes a maximum of 2 seconds for the hook to extend and 10 seconds to retract.

Arresting Hook Switch

The arresting hook control switches are two-position switches located on the front and rear cockpit left sub panels.

UP	Hook is retracted.
DOWN	Hook is extended.

ARRESTING HOOK Caution

Any time the arresting hook is not up and locked the MASTER CAUTION and HOOK caution come on.

FLAP SYSTEM

Each wing has a two-position trailing edge flap. The flaps are electrically controlled and hydraulically operated. When the flaps are down, they are protected from structural damage by a blow up airspeed switch. The switch is set to automatically retract the flaps at 250 knots maximum. The flaps will automatically return to the down position at no less than 230 knots, providing the flap control switch is in the down position.

Flap Control Switch

The flap control switch is a two position switch located on the throttle quadrant.

UP	Retracts the flaps.
DOWN (DN)	Extends the flaps.

Flap Position Lights

The flap position lights are on the left sub panel. The YELLOW light indicates the flaps are in transit. A GREEN light indicates the flaps are down.

SPEED BRAKE SYSTEM

A speed brake is located on the upper surface of the center fuselage just aft of the canopy. It is electrically controlled and hydraulically operated. The speed brake can be positioned to any intermediate position between fully retracted and fully extended with AOA below approximately 25 units. If AOA is above 25 units, the speed brake will not extend when selected. If the speed brake is extended, it will automatically retract when AOA increases through 25 units.

NOTE

If the CC detects a failure in the AOA system (AOA FAIL displayed on MPCD), the ground to the speed brake switch is broken and the speed brake, if extended, will retract. If the AOA failure occurs with the speed brake closed, it cannot be extended.

Following automatic retraction of the speed brake, when AOA is reduced, the speed brake will automatically extend provided the speed brake switch is in the OUT position.

Speed Brake Switch

The speed brake switch has three positions and is located on the inboard throttle. The switch will remain in any selected position.

CENTER	Stops the speed brake in any intermediate position.
AFT	Extends the speed brake.
FORWARD	Retracts the speed brake.

The rear cockpit speed brake switch will override any position selected by the front cockpit. It is spring-loaded to the hold (centered) position. When the rear cockpit switch is released to hold, control is returned to the front cockpit.

FLIGHT CONTROL SYSTEM

The aircraft primary flight control surfaces consist of conventional ailerons, twin rudders and stabilators (which are capable of symmetrical or differential movement). Hydraulic actuators are used to position the control surfaces. The inputs to the hydraulic actuators are from a hydromechanical system and an electrical system called the control augmentation system (CAS). The hydromechanical system and the CAS normally work together, but either system alone is capable of providing sufficient aircraft control for flight. Spring cartridges provide simulated aerodynamic forces to the control stick and rudder pedals. The spring cartridges have trim actuators which actually move the neutral positions and thus the control surfaces. Refer to foldout section for the flight control schematic.

Control Stick

The front cockpit control stick consists of a stick grip and force transducer, and contains seven controls: an autopilot/nose gear steering disengage switch (paddle switch), nose gear steering/weapons button, a trigger, a weapon release button, a trim switch, an auto acquisition button and a castle switch. The rear cockpit control stick consists of a stick grip and force transducer and contains four controls: an autopilot/nose gear steering disengage switch (paddle switch), a weapon release button, a trim switch and an air refueling release button. The rear cockpit trigger is non-functional. Refer to figure 1-8. A detailed description of switch functions is in Front Cockpit Controls or Rear Cockpit Controls, this section, or in the description of individual systems in this manual and TO 1F-15E-34-1-1.

Rudder Pedals

The rudder pedals operate conventionally and are adjustable. The rudder pedals are also used for the brakes and nose gear steering.

Rudder Pedal Adjust Knob

Pulling the rudder pedal adjust knob located on the instrument panel releases both rudder pedals. The pedals are then forced aft by spring pressure or pushed forward by foot pressure to achieve the desired adjustment.

NOTE

With the rudder pedal adjust knob extended, aircraft steering or braking is not possible.

T/O Trim Button and Light

The takeoff (T/O) trim button, on the CAS control panel, when pressed, drives the stick and rudder pedals to the takeoff position which, in turn, drives the aileron, rudder and stabilator actuators to the takeoff position. The T/O trim light will then come on. The departure warning tone will sound after the T/O trim button has been pressed and takeoff trim is within limits. The T/O trim light will go out and the tone will cease when the button is released. The stick takeoff position produces a slight nose up trim position which, in turn, drives the pitch trim compensator (PTC) to the full nose up limit of its authority (stabilator leading edge down). This provides maximum nose up stabilator authority for takeoff. The pitch trim compensator will continue to drive the stabilator leading edge down after the button is released.

HYDROMECHANICAL FLIGHT CONTROL SYSTEM

The hydromechanical flight control system uses mechanical linkages and hydraulic actuators to position the flight control surfaces.

CONTROL STICK

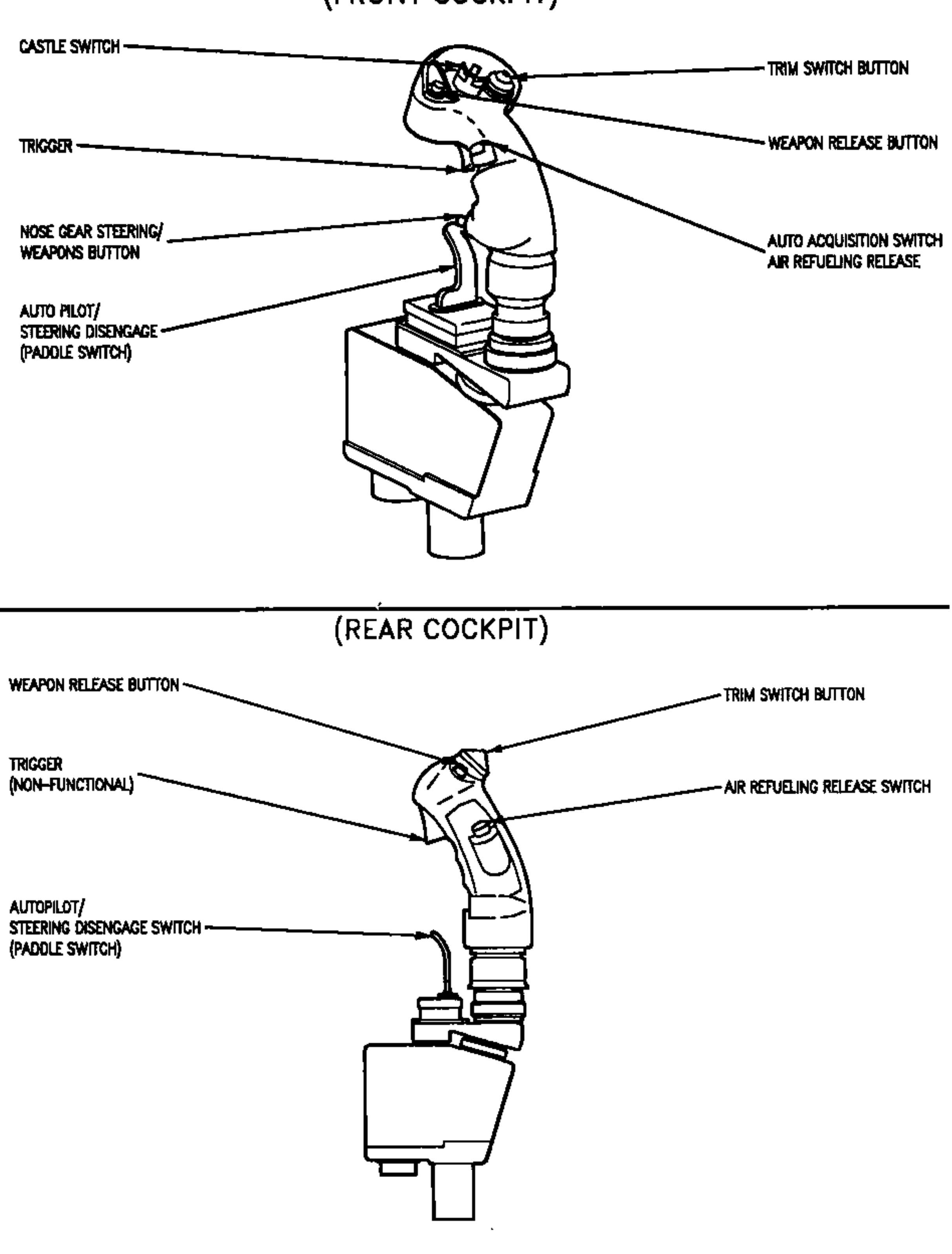


Figure 1-8

LONGITUDINAL CONTROL

Longitudinal stick motion positions the stabilators symmetrically to provide pitch control. The ratio of symmetrical stabilator motion to longitudinal stick motion (pitch ratio) is automatically adjusted for altitude and speed. This provides the same pitch response (constant g) for a given stick deflection regardless of airspeed. The ratio is high (greatest stabilator authority) at low speeds, and low at high speeds at low altitude. If hydraulic pressure is lost, the pitch ratio will drive to an intermediate position and lock. If the mechanical linkage becomes jammed, mechanical longitudinal control is lost; however, the CAS can provide enough stabilator control for moderate flight maneuvers and landing.

Longitudinal Trim/Feel System

The longitudinal control system includes a manual trim and an automatic trim. The manual trim is controlled by the trim button on the stick. The manual trim actuator changes the neutral position of the longitudinal feel spring cartridge to reposition neutral stick position and thus neutral stabilator position. When airborne, the flight control system automatically trims the stabilator without affecting stick position to compensate for changes in trim caused by such things as changing speed, operating flaps or speed brake, or store separations. On the ground, the PTC slowly trims the stabilator to either the extreme forward or aft limit of its authority as the stick is positioned forward or aft of the neutral stick position. This stick positioning can take place by manual stick inputs or by manual trim.

Pitch Ratio Switch

The pitch ratio switch is on the main instrument panel.

AUTO	Provides normal system functions.
EMERG	Removes hydraulic pressure from the hydromechanical pitch control system which causes the pitch ratio and the PTC to drive to a midrange position and lock. Mechanical aileron rudder interconnect (ARI) is also disabled.

Pitch Ratio Indicator

The pitch ratio indicator on the main instrument panel shows the ratio of symmetrical stabilator motion to longitudinal stick motion. For a given stick motion, the stabilators move most at a pitch ratio of 1.0 and least at zero. The ratio should be 1.0 at slow speeds and near zero at Mach 0.9 near sea level. However pitch ratio will increase to 1.0 as speed increases to 1.0 Mach. The indicator will show 0.3 to 0.5 if the pitch ratio switch is placed in EMERG or hydraulic pressure is lost.

PITCH RATIO Caution

The PITCH RATIO caution comes on if hydraulic pressure is lost to the control stick boost/pitch compensator (CSBPC), the pitch ratio switch is in the EMERG position, or the pitch ratio versus airspeed is incorrect below 20,000 feet. However, with the gear down and airspeed above 220 knots the PITCH RATIO caution may come on until the pitch ratio drives to above 0.9. This condition is normal and should be disregarded.

LATERAL CONTROL

Lateral stick motion positions the ailerons, rudders and stabilators to provide roll control. The ratio of aileron/differential stabilator deflection to lateral stick motion (roll ratio) is adjusted automatically for different airspeeds, longitudinal stick position and gear position. Aileron and differential stabilator deflection are washed out to prevent adverse yaw when longitudinal stick deflection is combined with lateral stick deflection. At subsonic speeds, the roll ratio is high; at supersonic speeds the roll ratio is reduced. Additional roll ratio reductions also occur as the stick is moved forward or aft. With the landing gear down, full aileron/differential stabilator is available at any longitudinal stick position. If UTL A and PC2A hydraulic pressures are lost or the roll ratio switch is in EMER, the roll ratio drives to mid-range and locks. A spin recovery aid provides full lateral control authority, regardless of longitudinal stick position, when the yaw rate exceeds 41.5° per second and remains greater than 30° per second for 5 seconds. The spin recovery aid is discontinued (normal control authority) when the yaw rate drops below 30° per second.

Mechanical ARI

The mechanical ARI adjusts the control system such that lateral stick motion results in varying rudder deflection dependent on longitudinal stick position. With the control stick aft of neutral, lateral stick motion causes rudder deflection in the same direction as stick motion. With the control stick forward of neutral, lateral stick motion causes rudder deflection in the opposite direction of the stick motion. With the flaps down, the point where longitudinal stick position causes opposite rudder motion with a lateral input is shifted forward of neutral. This position shift causes the amount of rudder deflection for lateral input to increase with aft stick movement.

The ARI is disengaged at supersonic speeds and on landing. If the anti-skid system detects a malfunction, or the landing gear circuit breaker is OUT, the ARI may remain engaged at wheel spin up, adversely affecting crosswind landing characteristics. Turning the anti-skid switch OFF or PULSER will insure ARI disengagement. If UTL A and PC2A hydraulic pressures are lost or either the pitch or roll ratio switch is in EMER, the ARI is inoperative. If the mechanical system is inoperative, the differential stabilators (through roll CAS) will provide lateral control for moderate maneuvers including landing.

Lateral Trim/Feel System

The aircraft is trimmed laterally using the trim button on the stick. The trim actuator changes the neutral position of the lateral feel spring cartridge to reposition neutral stick position and thus neutral aileron/differential stabilator position.

Roll Ratio Switch

The roll ratio switch is on the miscellaneous control panel.

AUTO	Provides normal system functions.
EMERG	Removes hydraulic pressure from the hydromechanical roll control system which causes the roll ratio to drive to a midrange and lock. Mechanical ARI is also disabled.

ROLL RATIO Caution

The ROLL RATIO caution comes on if hydraulic pressure is lost, the roll ratio switch is in EMERG, the landing gear control handle is DOWN without full roll authority available, or the landing gear control handle is UP with full roll authority continuously commanded (aileron washout disabled) or if roll authority is not commanded to 2/3 of maximum roll authority above Mach 1.5. The ROLL RATIO caution above Mach 1.5 may also indicate the mechanical ARI has not been commanded OFF.

YAW CONTROL

Rudder pedal motion positions the rudders to provide yaw control. If the rudder linkage jams, safety spring cartridges allow the rudder pedals to move to permit nose wheel steering. The rudders are still actuated through the CAS (CAS alone provides only about half rudder deflection). If the nose gear steering jams, similar devices permit rudder operations.

Yaw Trim/Feel System

The aircraft yaw is trimmed using the rudder trim switch on the throttle quadrant. The trim actuator changes the neutral position of the rudder feel spring cartridges to reposition neutral rudder pedal position and also neutral rudder position.

Rudder Travel Limiter

The rudder travel limiter system is completely automatic. When aircraft speed reaches approximately Mach 1.5, rudder pedal movement is mechanically limited. As the airspeed decreases through Mach 1.5, the limiter retracts and full rudder pedal movement is restored.

RUDDER TRAVEL LIMITER Light Caution

The RUDR LMTR caution comes on when the rudder pedal limiter is not engaged above 1.5 Mach or is engaged below 1.5 Mach.

AOA TONE

The gear-down AOA tone is a high pitch (1600 Hz) beeping tone which starts at approximately 30 units AOA. The beep rate increases as AOA increases. The tone may be eliminated by decreasing AOA.

HIGH ANGLE OF ATTACK WARNING

A high angle of attack warning is provided. This gear-up AOA tone is a medium pitch (900 Hz) tone which starts at approximately 28 units AOA, depending on aircraft configuration. The landing gear handle must be up and the external stores configuration must be set correctly in the PACS for the AOA warning to function correctly. The tone (at a 4hz rate) comes on at 28 units AOA. At 30 units AOA a 10Hz (beep) rate is heard, and at 33 units AOA a steady tone will be heard. The AOA must decrease by 1 unit before the warning level transitions to the next lower state. The high AOA warnings pertain to all external stores configurations unless configured with only air-to-air stores. In addition, if the aircraft is loaded exclusively with SUU-20B/A dispensers on stations 2 and/or 8, the above limits are increased by 5 units AOA and consequently the warning tones will be triggered at 33, 35 and 38 units AOA respectively.

NOTE

This high angle of attack warning tone uses the same tones as used by the OWS aural warnings.

DEPARTURE WARNING

With the landing gear up, a medium pitch (900 Hz) beeping tone sounds when the yaw rate reaches 30° per second. As the yaw rate increases the beep rate increases. The tone reaches a maximum beep rate at 60° per second yaw rate. The tone sounds with the T/O trim button depressed and the T/O trim light on. The T/O trim beep rate correlates to approximately 45° per second yaw rate.

AUTOMATIC FLIGHT CONTROL SYSTEM (AFCS)

The AFCS provides roll, pitch, and yaw control augmentation, autopilot modes in roll and pitch axes, and terrain following in the pitch axis. Refer to TO 1F-15E-34-1-1 for terrain following description.

CONTROL AUGMENTATION SYSTEM

Superimposed on the hydromechanical flight control system is a three-channel, three-axis control augmentation system. The CAS responds to electrical signals generated by forces applied to the control stick and to rudder pedal position. These signals modify the control surface deflections commanded by the hydromechanical flight control system to provide the desired flying qualities. The CAS also provides increased damping on all three axes. Since CAS inputs are applied directly to the actuator and the inputs are due to force and require no control stick or rudder motion, with the CAS on, limited aircraft control is retained with the loss of any or all mechanical linkages. The three-channel design turns any axis off when a second like failure occurs. The CAS affects stabilator and rudder position only; the ailerons are not controlled by the CAS. A moderate yaw transient may occur and is normal when yaw CAS is disengaged, reengaged, or the landing gear is lowered.

CAS Caution Display

Three CAS caution displays (CAS YAW, CAS ROLL, and CAS PITCH), on the MPD/MPCD, come on any time their respective axis is disengaged by a failure in the CAS system or the switch is off. These cautions also light the master caution and the FLT CONTR caution on the caution panel. Any time the pitch or yaw CAS disengages, the roll CAS also disengages. A moderate yaw transient may occur and is normal when yaw CAS is disengaged or engaged. If the roll CAS is functioning normally, it can be re-engaged following the loss of pitch CAS. Roll CAS cannot be engaged without an operating yaw CAS. A LAT STK LMT caution indicates that roll commands must be limited to 1/2 lateral stick inputs.

NOTE

CAS YAW and LAT STICK LIMIT cautions may be displayed after a single engine shutdown. This is normal aircraft operation and a YAW CAS reset should be attempted.

CAS Switches

The following three positions are applicable to the roll, pitch, and yaw CAS switches located on the CAS control panel.

ON	Allows normal operation after engagement.
RESET	Engages disconnected axis (provided fault no longer exists). The switch is spring loaded from RESET to ON.
OFF	Disengages applicable axis.

TF Couple Switch

Selecting the TF COUPLE position couples the terrain following system to the autopilot. Selecting OFF deactivates automatic terrain following. Refer to TO 1F-15E-34-1-1 for expanded terrain following operations.

BIT Button

The BIT button is located on the CAS panel. Pressing and holding the BIT button permits initiation of the AFCS BIT when the AFCS pushbutton on the MPD is pressed, the aircraft has weight on wheels and the parking brake is ON. To initiate an AFCS BIT, the operator must press and release the pushbutton on the MPD/MPCD and verify AFCS IN TEST is displayed on the MPD/MPCD. Then release the CONSENT switch to allow BIT to run.

AUTOPILOT FUNCTIONS

The autopilot in the pitch axis provides attitude hold, barometric altitude hold, radar altitude hold or radar altitude select and in the roll axis provides attitude hold, heading hold, tacan steering, navigation steering or ground track steering. Refer to TO 1F-15E-34-1-1 for terrain following description.

Upfront Control (UFC)

The UFC is the primary autopilot mode selection and engagement controller. The basic autopilot mode is selected and engaged using the UFC but before any autopilot mode can be engaged, all three CAS axes, pitch, roll and yaw, must be on.

The UFC menus involved in autopilot engagement and display of system and mode status are menu 1 and the autopilot submenu. See figure 1-9. Menu 1 provides current autopilot status information such as the engagement mode, and whether it has been coupled with the existing steering mode. The autopilot submenu provides the means of coupling the current aircraft steer mode and selecting either the baro or radar altitude hold mode. When the autopilot is engaged the autopilot status (same as menu 1) is displayed centered on the top line. If A/P is not engaged, A/P is displayed centered on this line.

Autopilot Preselection

Autopilot modes of operation may be preselected on the autopilot submenu prior to coupling of the basic autopilot. Any option with an asterisk (steer mode, altitude hold, radar altitude select) will be coupled when the UFC keyboard A/P button is pressed.

NOTE

Operating modes are remembered from the previous sortie. Before coupling the autopilot, review the autopilot submenu for preselections.

Autopilot Engagement - Basic A/P Mode

The basic autopilot is engaged by pressing the A/P key on the UFC keyboard. The autopilot automatically engages pitch attitude hold if pitch is within 0 $\pm 45°$ and heading hold if the bank angle is 0 $\pm 7°$. If the bank angle is greater than $\pm 7°$ and less than $\pm 60°$ roll, attitude hold is engaged until the bank angle is decreased to $\pm 7°$ and then automatically reverts to heading hold.

When the autopilot key is pressed, the UFC autopilot submenu replaces the current display to facilitate steer mode and/or altitude hold engagement selections unless TF is engaged. If automatic terrain following (ATF) is coupled, only the basic autopilot mode is engaged. If an autopilot steer mode was engaged prior to coupling the ATF, the steer mode is retained. Also, if an autopilot steer mode is preselected using the UFC, but not engaged, only the basic autopilot will be engaged upon coupling of ATF. If attitude hold is engaged it appears on menu 1 in the current autopilot mode display as A/P ATT. If heading hold is engaged it is displayed as A/P HDG.

Autopilot Disengagement

The autopilot modes are disengaged by pressing the paddle switch on the control stick, deselecting the mode or engaging a higher priority mode.

Autopilot Coupled With Steer Modes

The autopilot can be coupled with any one of three steer modes, navigation (NAV), ground track (GT), or tacan (TCN). Steer modes are selected from the EHSI display format (figure 1-30). The UFC autopilot submenu, line 2 will show the steer mode currently selected on the HSI and is used to couple the autopilot to the displayed steer mode. If ILST or ILSN is selected on the HSI, the coupling to the steer mode is inhibited since the autopilot cannot be coupled to fly an ILS approach. With the autopilot coupled, ILST and ILSN are removed from the HSI display.

AUTOPILOT DISPLAYS - WITH AP-1R

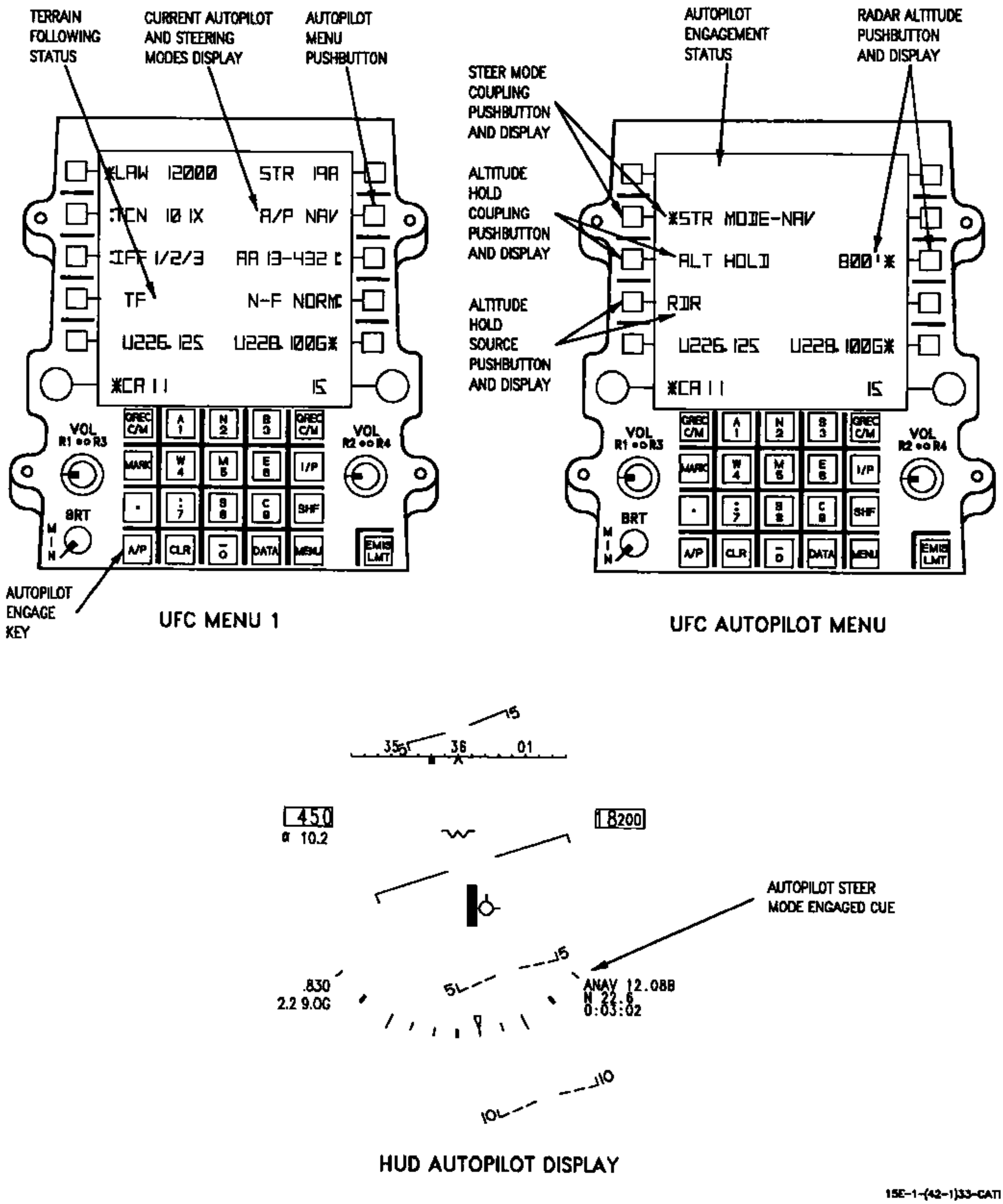
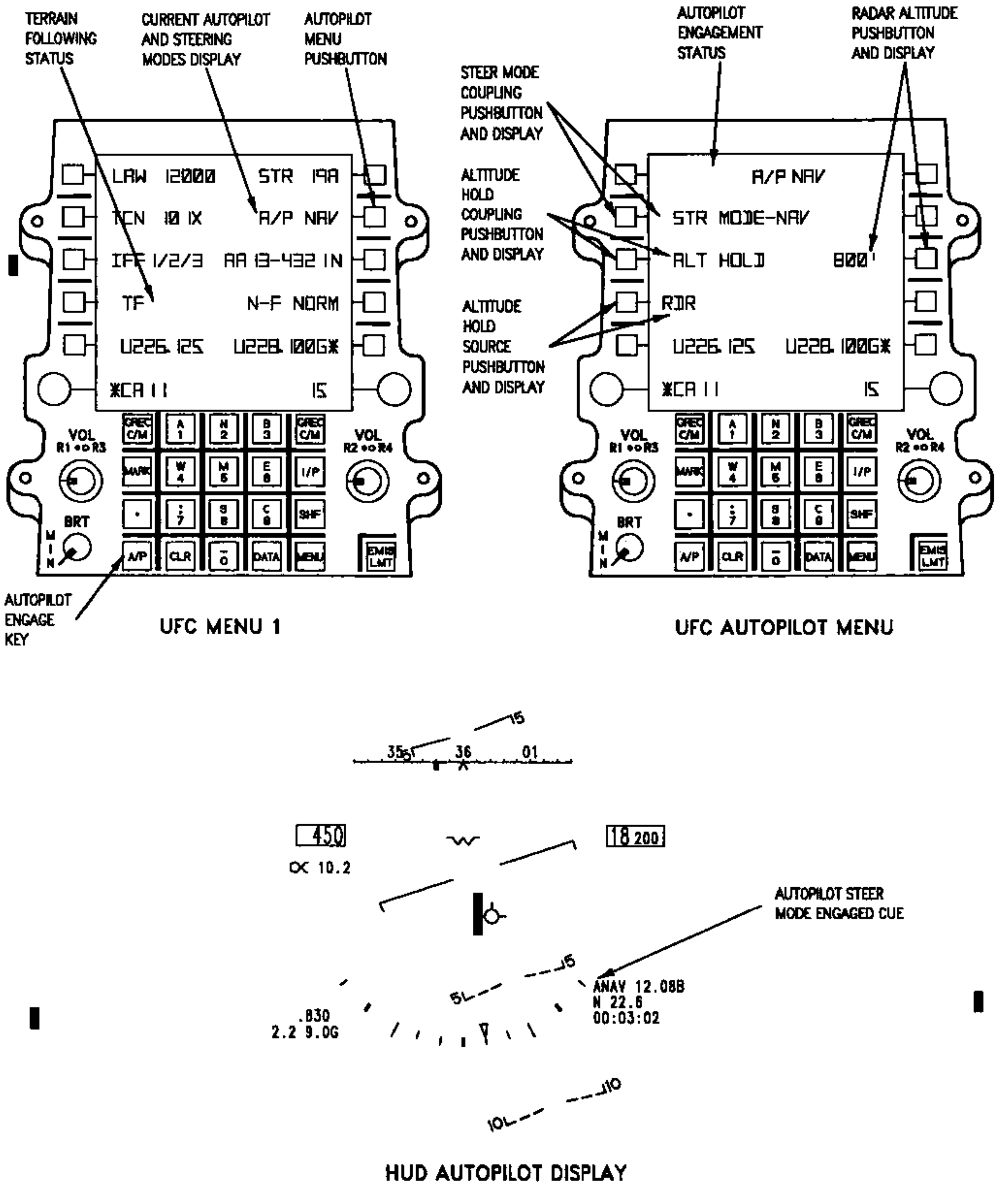


Figure 1-9 (Sheet 1 of 2)

AUTOPILOT DISPLAYS - WITH VHSIC



15E-1-(42-2)44-CATI

Figure 1-9 (Sheet 2)

NOTE

- If either ILS mode is selected on the HSI when the autopilot is coupled, the appropriate steer mode (TCN or NAV) is automatically selected and displayed on both the HSI and the UFC autopilot submenu. For example, if ILSN was selected, the NAV steer mode is automatically selected on the HSI (boxed) when autopilot is coupled.
- The TCN steer mode no longer disengages automatically when flying through the zone of confusion (ZOC). In the ZOC, TACAN steering will parallel the desired course. Once out of the ZOC, TCN steering will intercept and track the desired course.

Assuming that the basic A/P is already engaged, coupling of the selected steer mode is done from the autopilot submenu. Pressing the pushbutton next to the steer mode legend on the UFC displays an asterisk symbol next to the steer mode legend, couples the autopilot to the steer mode displayed, and displays an A/P symbol on the EHSI format. If NAV steer mode has been coupled, the autopilot status is displayed on menu 1 as A/P NAV, indicating that the autopilot is in the NAV steering mode. The two remaining steer modes, tacan and ground track, are selected and coupled with the autopilot in the same manner. In addition, the TCN steer mode provides two display formats: PLAN view and course deviation indicator (CDI). When coupled to a steer mode, an 'A' is displayed on the HUD to the left of the steer mode (figure 1-9).

Altitude Hold

Altitude hold is selected and engaged from the autopilot submenu where it is displayed as ALT HOLD. One of two altitude sources is also displayed, either radar (RDR) or barometric (BARO). To change the altitude source, press the pushbutton next to the displayed source. Assuming the basic autopilot mode is engaged, the mode itself is selected by pressing the pushbutton next to ALT HOLD. An asterisk symbol appears next to ALT HOLD legend when selected.

BARO - With the BARO altitude source displayed on the autopilot submenu display, press the pushbutton next to the ALT HOLD legend to select the mode. ALT HOLD maintains baro altitude at selection. When selected an asterisk symbol appears next to the mode. The mode can be engaged if the vertical velocity is less than 2000 feet per minute (fpm) and disengages at 2000 fpm or greater. The current altitude is held but not displayed on the A/P submenu in baro altitude hold. (Note: with BARO selected, the radar altitude select line (PB 8) is blanked.)

WARNING

At low airspeeds (a function of gross weight and pressure altitude) when either the RDR or BARO altitude hold mode is being used, pitch authority becomes saturated and altitude hold will not be reliable. The system will not automatically trip off until the aircraft exceeds 2000 fpm vertical velocity.

Radar - With radar (RDR) selected as the altitude source, two options are selectable, radar altitude select and radar altitude hold. The primary difference between the two is that a specific altitude is selected via the keyboard for radar altitude select whereas radar altitude hold maintains the altitude at selection. Each is described in the following:

a. Radar altitude select. First enter the desired holding radar altitude using the UFC keyboard. The selected altitude can be any value between 1000 and 50,000 feet in increments of 10 feet. Once displayed on the scratchpad and confirmed as the desired altitude, the selection is transferred to the UFC display, opposite the ALT HOLD legend, by pressing the pushbutton next to the previously selected altitude (PB 8). (Note that any previously selected altitude value is displayed immediately upon selection of the RDR altitude source.) Pressing the pushbutton next to the altitude digital readout a second time displays an asterisk to indicate the digital altitude value has been selected. The actual mode is now selected by pressing the pushbutton next to ALT HOLD. An asterisk next to it indicates the mode is selected. The engagement limits are the same as the disengage limits for radar altitude hold. The aircraft will fly up or down to the selected altitude and automatically level off at that altitude. However, if you are climbing to a radar select altitude and then deselect that altitude, instead of reverting to altitude hold, the aircraft continues climbing to previously selected altitude. When flying up to a selected altitude, the system will try to maintain a 6000 fpm climb schedule. Consequently during heavy gross weight operations, potential stall problems exist.

b. Radar altitude hold. This mode is selected to maintain the existing aircraft radar altitude. The engagement limit is defined as a radar altitude of 400 to 50,000 feet. Selection is accomplished by first noting that the radar altitude select (PB 8) displayed has no asterisk, then press the pushbutton next to ALT HOLD.

NOTE

Radar altitude hold or select will disengage if roll angle exceeds 55°.

The autopilot status on MENU 1 with altitude hold or altitude select engaged and NAV steering selected (on the EHSI) and asterisk (on autopilot submenu) is displayed as A/P NAV/ALT.

Radar altitude hold or select mode will automatically disengage if the aircraft vertical velocity exceeds the following limits:

GEAR UP	
Altitude	VVI
<17,000 feet	8000 fpm
17,000-20,000 feet	Varies linearly between 8000 and 5600 fpm
≥20,000 feet	5600 fpm
GEAR DOWN	4000 fpm

WARNING

The radar altimeter provides no forward looking capability. RDR ALT HOLD mode is not recommended for use over rolling/rugged terrain below 5000 feet above aground level (AGL).

Control Stick Steering

Control stick steering (CSS) during autopilot operation refers to manual control stick inputs in either pitch or roll without disengaging the autopilot. The stick force required for pitch CSS is one pound in attitude hold and 3½ pounds in altitude hold/select. Stick force for roll CSS varies between 1 to 3 pounds, dependent on the autopilot mode. In the ground track steering mode, if CSS is engaged, the bank angle must be reduced to less than ±7° to return to ground track. If the bank angle is greater than or equal to ±7° the autopilot will enter roll attitude hold until the bank angle is reduced. If an autopilot mode is disengaged during CSS the AUTO PLT caution will be displayed on the MPD/MPCD.

Autopilot Caution Displays

Caution displays relating to the autopilot system are the master caution light, the flight control caution light and the specific caution displayed on the appropriate MPD/MPCD in each cockpit. Cautions are triggered as a result of crew action or autopilot system initiation.

There are three ways the autopilot related cautions can be activated by crew action. First is disengagement of the autopilot using the flight control paddle switch; second is an unsuccessful autopilot engagement attempt; and third is to exceed the CSS forces in pitch or roll. These three methods are described below:

a. The flight control stick paddle switch is the control used to disengage the autopilot from the flight control system in all non-terrain following operation. When pressed and disengagement occurs, the MASTER CAUTION, FLT CONTR (flight control) caution light and MPD/MPCD autopilot (AUTO PLT) caution are activated. To extinguish the caution lights, press the MASTER CAUTION light in the cockpit to reset the caution system.

b. If the crew attempts to engage an autopilot mode and the attempt is unsuccessful, the MASTER CAUTION, FLT CONTR caution light and the MPD/MPCD autopilot caution are activated. Unsuccessful coupling also refers to the unsuccessful selection of a steer or altitude hold mode causing the same three caution cues to be activated. In either case all three visual indications will remain on indefinitely until reset by the cockpit MASTER CAUTION reset function.

c. If the crew is using control stick steering during autopilot operation and disengages the autopilot by exceeding the control stick forces in either pitch or roll, the MASTER CAUTION, FLT CONTR caution and the MPD/MPCD cautions are activated.

Any autopilot disengagement not initiated by the crew produces a minimum of three caution indications, MASTER CAUTION, flight control caution and the MPD/MPCD AUTO PLT caution. In most cases, other related cautions will accompany this type of disengagement and will also be displayed.

The caution and warning system has been mechanized to provide caution indications to the crew of multiple autopilot related problems. The first autopilot related problem causes the MASTER CAUTION, flight control caution and the MPD/MPCD AUTO PLT caution to come on. After MASTER CAUTION reset, the crew is alerted to subsequent autopilot problems by the same system. The autopilot MPD/MPCD caution message is also repositioned to the top of the caution list.

CAS FUNCTIONAL FAILURE

CAS functional status is information available to the crew via the AFCS DETAIL BIT display. The data provided is intended as supplementary information as to the current operating mode of the flight control computer. The data may or may not be associated with an AFCS caution, but new information displayed will be accompanied by an AV BIT light. To see the functional failures displayed, first call up the BIT menu, second, press the DETAIL pushbutton, then third, press the AFCS pushbutton on the detailed BIT display. The definition and associated options are as listed below:

PCAS First Fail

One of the three channels of the flight control computer has detected a failure of an element (sensor, servo, switch, etc.) in the pitch axis of its channel. Although pitch CAS is in full normal operation, if a second channel detects a failure of the same element the pitch and roll axes will be shut down with a resulting degradation of pitch and roll handling qualities. Some of the first failures will automatically reset if the computer later determines normal operation, however, other failures are latched out until the PITCH RESET is cycled on the CAS control panel. Autopilot and terrain following remains functional.

CASI Servoloop

The CAS interconnect (CASI) servo provides the harmonization between pitch CAS and the pitch mechanical controls. If a second like failure occurs in this interconnect, pitch and roll CAS will shut down with associated CAS PITCH and CAS ROLL cautions in addition to the CASI SERVOLOOP status. Attempts should first be made to reset roll CAS with the ROLL RESET switch, then pitch CAS with the PITCH RESET switch on the CAS control panel. If pitch CAS is not resettable and CASI SERVOLOOP status remains displayed, pitch CAS can be regained by positioning the pitch ratio switch to EMERGENCY prior to selecting pitch CAS reset.

NOTE

> The combination of pitch CAS disengaged and pitch ratio switch in emergency degrades handling qualities and should be accomplished at a safe altitude, below 300 KCAS level flight condition. A small trim change may occur if pitch CAS is reset and subsequently disengaged.

RCAS First Fail

One of the three channels of the flight control computer has detected a failure of an element (sensor, servo, switch, etc.) in the roll axis of its channel. Although roll CAS is in full operation, if a second channel detects a failure of the same element the roll axes will shut down resulting in degraded roll characteristics. Some of the first failures will automatically reset if the computer later determines normal operation, however, other failures are latched out until the ROLL RESET is cycled on the CAS control panel.

ROLL Limit

A first failure has been detected in the AFCS schedule of roll authority vs airspeed. A second failure of the AFCS air data sensor will result in incorrect scheduling and an associated LAT STK LMT caution. At high airspeeds, above 550 KCAS/Mach 1.0, lateral stick inputs should be limited to one half of full authority.

AOA Fail

This status is displayed in association with a LAT STK LMT caution indicating the AFCS cannot determine the angle of attack. Roll CAS gain is set to zero which may result in degraded roll characteristics. Operations above 600 KCAS are permissible with lateral stick inputs limited to one-half full authority. Do not exceed one half lateral stick authority.

NOTE

The functional failures of roll limit and AOA fail may be set during aircraft maneuvers that mask AOA or pitot-static probes. This is normal operation provided the functional failure and the associated LAT STK LMT caution automatically clear when the aircraft returns to a non-maneuvering flight condition.

YCAS First Fail

One of the three channels of the flight control computer has detected a failure of an element (sensor, servo, switch, etc.) in the yaw axis of its channel. Although yaw CAS is in full operation, if a second channel detects a failure of the same element the roll and yaw axes will disengage resulting in lateral/direction stability degradation. Some of the first failures will automatically reset, however, other failures will be latched out until the YAW RESET is cycled on the CAS control panel.

Spin Recovery Failure

The AFCS provides spin recovery aid by disengaging CAS and selecting full mechanical roll authority if excessive yaw rate is detected. SPIN RECOVERY FAILURE in conjunction with a CAS YAW caution indicates yaw rate cannot be determined by the flight control computer and the spin recovery aid mode is inoperative. SPIN RECOVERY FAILURE status without an associated CAS YAW caution indicates full mechanical roll authority may be incorrectly selected. High AOA handling qualities and spin protection may be degraded. Avoid acrobatic maneuvers.

CAS ARI Off

The flight control system contains two harmonized ARI's The mechanical ARI is scheduled as a function of stick position and the CAS ARI is scheduled as a function of roll rate and AOA. The mechanical ARI disengages at Mach 1.0 and the CAS ARI disengages at Mach 1.5. With the loss of the ability to determine Mach, roll rate, or AOA as a result of failures, the flight control computer disengages CAS ARI and displays CAS ARI OFF status. Although mechanical ARI is not affected by this, some additional aircrew coordination may be required during maneuvers especially above 30 units AOA.

RCP Stick Sensor

If the rear cockpit stick force sensor fails, pitch and/or roll CAS will disengage setting the CAS PITCH and/or CAS ROLL cautions with an associated RCP STICK status. CAS will be resettable, however, the rear cockpit stick force commands to the flight control computer will be inoperative. Stick inputs by the Weapon System Operator (WSO) will result in sluggish performance and a reduction of loads (3.5g's maximum) capability. Only mild maneuvers should be attempted by the backseater.

CAS Rudder Pedal

If the rudder pedal position sensor fails, yaw CAS will disengage setting the CAS YAW caution with an associated CAS RUDDER PEDAL status. Yaw CAS will reset, however, the rudder pedal position sensor will be inoperative. Lateral directional stability will be normal for coordinated flight, but uncoordinated commands will tend to be washed out and should be avoided.

One Rudder CAS

If a rudder servo fails, the servo is disengaged and the CAS gain to the other servo is doubled. Yaw CAS will continue to work normally but total rudder power is reduced. Rolls must be limited to one half stick. Do not exceed Mach 1.0.

Non-hydraulic (NON-HYD) BIT

NON-HYD is displayed on the DETAIL BIT page as a result of AFCS initiated BIT detecting an incompatible state of the aircraft hydraulic pressure switches or the pitch/roll channel assembly (PRCA) thermal switch. Some BIT tests requiring hydraulics will have been bypassed and therefore a full system test has not been accomplished. This status will remain displayed until a full system BIT can be initiated. Check the MPD/MPCD for cautions associated with the hydraulic systems. If all hydraulic systems are normal, proceed with the functional checkout of the flight control system.

BIT Code

A BIT code is displayed as a result of any detected malfunction within the AFCS or associated flight control interface (for example BIT CODE 999A). BIT codes will cycle through all stored values and continuously repeat this process. In flight, BIT codes not associated with other functional failure information will not activate the AV BIT light. However, any stored code will activate the AV BIT light one minute after landing. BIT codes are intended as an aid to maintenance.

NOTE

Initiated BIT will clear all stored BIT codes. Pressing and holding the EDS (emergency disconnect switch/paddle switch) and then pressing and holding the BIT consent switch also clears the stored BIT codes. To aid in aircraft maintenance, the AFCS BIT codes should be recorded before being cleared.

OVERLOAD WARNING SYSTEM (OWS)

For the OWS to program properly, the external stores configuration must be correctly set in the PACS. A 900 Hz tone is heard in the headset to give warning that the maximum allowable g is being approached. The tone is first heard at 85% maximum allowable g or 1 g below the maximum allowable, whichever is lower, and is interrupted at a rate of 4 Hz to produce a beeping sound. At 92% the tone is interrupted at a rate of 10 Hz, until at 100% the voice warning "OVER G, OVER G" is heard. The "OVER G, OVER G" continues until the % of overload falls below 100%. If the overload condition is relieved in the middle of an "OVER G" transmission, the transmission will be completed before the voice warning is discontinued. Inflight, OWS operation may be verified by display of both current g and maximum allowable g on the HUD.

The OWS computes fuel changes at a maximum of 40 pounds per second. Whenever the OWS computed fuel is greater than the aircraft configuration can hold (e.g. tank jettison), the OWS will be inoperative until computations catch up with actual fuel quantity. If AIU 2 fails no OWS computations can be made.

With AP-1R, the OWS will also be inaccurate during weapon delivery. OWS computations are not performed until approximately 1-2 seconds after all selected weapons are expended. Therefore, if heavy weight weapons are being expended, the OWS may sense an over-g condition during recovery maneuvers since the aircraft gross weight may not yet be re-calculated.

With VHSIC software, the OWS recomputation rate has been improved and the time delay and release of the pickle button no longer apply.

Component Malfunctions

Failure of systems which supply data to OWS can cause the OWS to malfunction. Since these systems are also of prime importance for flight, a failure would be apparent to the aircrew (for example, CAS drop-off, ADC BIT, fuel quantity malfunction, current g's unreasonable). If the aircrew detects a malfunction in one of these systems, the OWS should be considered inoperative and the flight manual non-OWS G limits should be observed, even though the HUD G window may still indicate that the OWS is operating.

Certain failures can result in a continuous "over-G" voice warning. Logic was therefore incorporated to shut down the OWS after 30 seconds of accumulated voice warning. Thus the aircrew should be aware that if the voice warning comes on for 30 seconds and then stops, it is not because the system has corrected itself. Checking the HUD in this situation will verify OWS shutdown, and the non-OWS g limits must be observed. The aircrew can verify that the OWS is operational by observing the following:

a. Allowable g's are displayed on the HUD when airborne and current g's are of a reasonable value;
b. The ARMT format on MPD/MPCD displays the actual configuration;
c. The systems supplying information to the OWS are up (no ADC BIT failure, reasonable fuel quantity indications).

MPD/MPCD Display

When the aircraft is g loaded to 85% or more of the design limit, the overload conditions are stored in the CC memory and can be recalled as an information matrix on the MPD/MPCD. The overload conditions include normal acceleration (ACC) in g's , the percent overload (OVL) and overload severity codes for selected components.

Figure 1-10 shows a typical OWS matrix. The matrix is displayed on the MPD/MPCD by selecting OWS from the menu display. The abbreviations used on the display are:

a. ACC - Normal acceleration load factor. This is a two or three digit number with a decimal before the last digit implied (e.g., 92 is read as 9.2 g).

OVERLOAD WARNING SYSTEM SEVERITY CODE DISPLAY

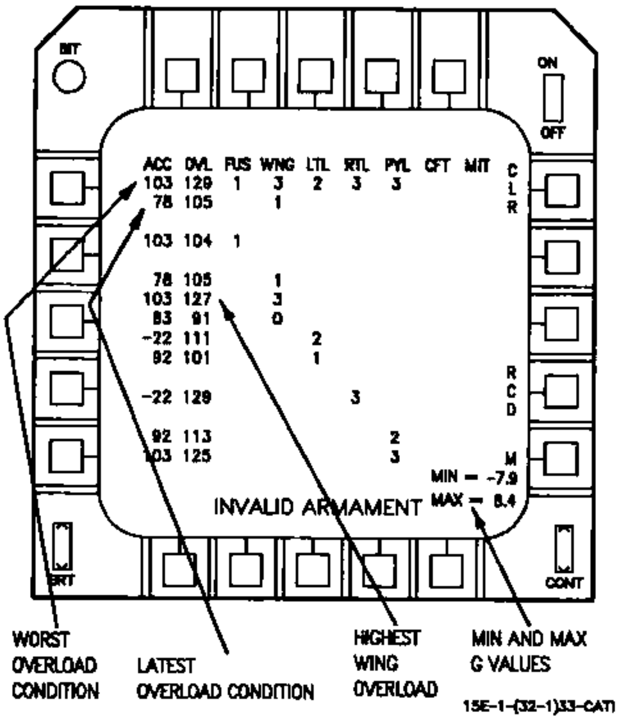


Figure 1-10

b. MIT - Mass items, i.e., engines, AMAD, CGB/JFS, etc.

c. OVL - Percentage of overload expressed as a whole percentage. The percent overload is related to the component severity code as follows:

% OVL	SEVERITY CODE LEVEL
85% - 100%	0
101% - 110%	1
111% - 120%	2
121% - 130%	3
131% - 140%	4
141% and above	5

d. FUS - Fuselage
e. WNG - Wing
f. LTL - Left tail boom
g. RTL - Right tail boom
h. PYL - Pylon
i. CFT - Conformal fuel tanks
j. CLR - Clear function for weight-on-wheels and to clear the OWS matrix from CC memory.
k. RCD - Record function for the video tape recording set (VTRS).
l. MIN/MAX - minimum and maximum g computed by the CC since the last OWS reset occurred. Minimum g can be a negative value. MIN and MAX g values are reset to 1.0 g when an OWS reset is done.

The first line of the display shows the worst (highest) overload condition recorded during the flight. The second line is the latest overload condition encountered. Subsequent lines display overload percentages and severity codes for the listed components. This information is used to determine the required maintenance action. An overload value of exactly 100 will cause a 0 to be displayed, but a value of 100 plus .01 will cause the percent overload value to increase to 101 and cause a 1 to be displayed. All applicable inspections are based on severity codes and not percent overload, which is displayed for information only.

Stored entries are automatically removed from the CC during INS align if no entry exceeds 100%. Overloads over 100% latch indicator 72 on the avionics status panel (ASP) and can only be cleared by selecting CLEAR from the OWS display on the MPD/MPCD and having maintenance personnel reset the ASP in the nose wheelwell. The procedure to clear the matrix is contained in section II.

WARNING /CAUTION /ADVISORY LIGHTS

The red warning lights provide indications of system malfunctions that require immediate crew attention. Except for the gear handle and gear UNSAFE lights, the warning lights are prominently located at or near the top of the instrument panel in both cockpits. The left and right BURN THRU lights are only located in the front cockpit. The caution lights also provide indications of system malfunction which require less than immediate attention. There are two kinds of caution indications, the amber caution lights located on the caution lights panel in the front cockpit and on the warning/caution/advisory lights panel in the rear cockpit, and cautions which are displayed on the MPD's and MPCD's in both cockpits. Only two cautions, the EMER BST ON and the BST SYS MAL, appear as both yellow caution lights and MPD/MPCD cautions. MPD/MPCD cautions are initially displayed on the right MPD in the front cockpit and the right MPCD in the rear cockpit. Depending on the number of cautions displayed, they are presented in three columns written left to right as they occur. The most recent caution will appear at the top of the right column. See figure 1-11. If required, MPD/MPCD cautions can be moved from one display to another. In the front cockpit this is done by simultaneously pressing the MASTER CAUTION light and using the castle switch on the stick to move the cautions, moving the castle switch toward the display where the cautions are desired. To move the cautions in the rear cockpit, press and hold the master caution and click the coolie switch on the appropriate hand controller toward the display where the caution is desired.

NOTE

> When cautions are displayed on the left aft MPCD and the HUD switches to secondary mode, the cautions will be moved to the right aft MPCD. When the HUD is in secondary mode, moving the cautions to the left aft MPCD is inhibited. This prevents cautions from appearing on the WFOV HUD during secondary mode.

CAUTION LIGHTS

There are three yellow caution lights on the caution lights panel in the front cockpit and warning/caution/advisory lights panel in the rear cockpit which are classified as major category caution lights. These lights, ENGINE, FLT CONTR and HYD, provide a prompt that MPD/MPCD cautions from that particular category are being displayed. The MASTER CAUTION light comes on with any of the major category caution lights. The corresponding MPD/MPCD caution will remain on until the problem is corrected. The systems associated with each major category light caution are as follows:

<u>ENGINE</u>

ATDP	
FUEL HOT	INLET ICE
L BST PUMP	R BST PUMP
L INLET	R INLET
L BLEED AIR	R BLEED AIR
L ENG CONTR	R ENG CONTR
L OIL PRESS	R OIL PRESS

<u>FLT CONT</u>

AUTO PLT	CAS PITCH
RUDR LMTR	PITCH RATIO
CAS YAW	ROLL RATIO
CAS ROLL	LAT STK LMT

<u>HYD</u>

L PUMP	R PUMP
PC1A	PC1B
UTL A	UTL B
PC2A	PC2B

With double generator failure and the emergency generator operating, cautions will be displayed only on the MPCD in the front cockpit. These cautions can be removed by moving the front stick castle switch to any position. A second activation of the castle switch restores the cautions to the display. With a CC failure only, cautions are always displayed on any CRT that has the radar display format.

ADVISORY LIGHTS

The advisory lights, which are either green or white, indicate safe and normal conditions and impart information for routine purposes. Individual advisory lights are located throughout the cockpit and are described with their applicable equipment. A list of warning/caution/advisory lights, with causes of their coming on and corrective action to be taken is described in section III.

MASTER CAUTION LIGHTS

The MASTER CAUTION lights, on the upper instrument panel in both cockpits, come on simultaneously when any MPD/MPCD caution comes on. They also come on with all yellow caution lights except the following: PROGRAM, MINIMUM, CHAFF, FLARE, LOCK/SHOOT, AV BIT, LASER ARMED, EMIS LMT and UNARMED/NO ATF. The MASTER CAUTION lights go out when the front cockpit MASTER CAUTION is pressed but, except for the AUTO PLT caution, the caution remains on until the

MPD/MPCD CAUTIONS

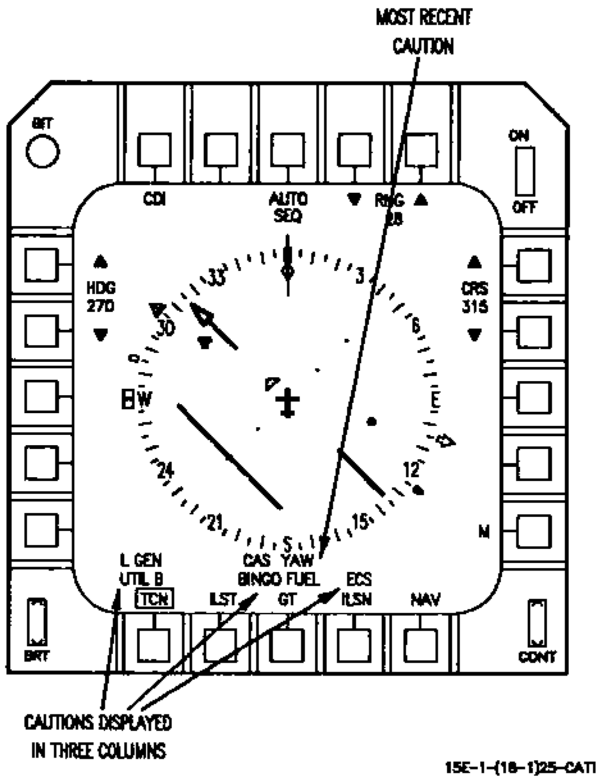


Figure 1-11

malfunction is corrected. Although the MASTER CAUTION lights do not come on with the AV BIT caution, pressing either cockpit MASTER CAUTION light turns off the AV BIT. While it can be used to move MPD/MPCD cautions from one display to another as described above, the rear cockpit MASTER CAUTION cannot be used to turn off the MASTER CAUTION lights and re-set the master caution lights circuit.

AUDIO WARNING SYSTEM

The audio warning system is made up of both audio tones and voice warnings. The weapons lockon tone, TEWS caution and launch tones, ILS audio, and TACAN audio are volume controlled by the RICP for the cockpit and the ICSCP for the rear cockpit. The IFF mode 4 tone is generated by the IFF transponder in response to a valid mode 4 interrogation. The OWS tone is generated by the Multipurpose Display Processor (MPDP) when the aircraft approaches design limit structural overload. When overload is exceeded, the tone is replaced with a voice warning. The unsafe landing warning tone is generated as a function of landing gear position, aircraft altitude, airspeed and rate-of-descent. The AOA stall warning tone is generated when the angle of attack exceeds 28.4 units.

The AFCS enables the departure warning tone when the yaw rate exceeds 30°/second. The beep rate of the tone increases as the yaw rate increases, and the maximum beep rate is reached at a yaw rate of 60°/second. The LANTIRN system produces a 'BINK-BINK' tone to advise the aircrew that automatic terrain following has been selected but is not controlling the aircraft (NO ATF condition) or that the terrain following system is unarmed (no AUTO FLYUP protection provided).

The voice warning system volume cannot be adjusted. The silence button on the ICSCP/RICP is used to silence any voice or tone warning for up to one minute.

The voice warning system activates the following warnings if conditions exist which cause the associated warning lights to come on:

- AB BURN THRU LEFT
- AB BURN THRU RIGHT
- BINGO FUEL
- LOW ALTITUDE
- OBSTACLE AHEAD
- OVER-G
- TF FAILED
- WARNING, AMAD FIRE
- WARNING, FUEL LOW
- WARNING, ENGINE FIRE LEFT
- WARNING, ENGINE FIRE RIGHT
- WARNING, OVERTEMP LEFT
- WARNING, OVERTEMP RIGHT
- WARNING, TRANSFER PUMP

Voice warnings for OBSTACLE AHEAD and TF FAILED continue until the condition causing the voice warning system to activate is corrected. Voice warning for OVER-G continues for a maximum of 30 seconds or until the condition causing the warning is corrected. All other voice warnings repeat twice and do not repeat again unless the condition causing the warning is corrected and subsequently recurs.

Voice warning for the AMAD fire detection system and the FTIT indicators become effective with application of external power, or with JFS operation during first engine start. Voice warning for the engine fire detection system and fuel low level detection system becomes effective with application of external power, or with the emergency generator coming on the line during engine start.

BUILT-IN TEST (BIT) SYSTEM

The BIT system provides the crewmembers with displays of avionic system status. Most information is derived from BIT mechanizations in the avionics sets and from non-avionic BIT's implemented in computer software for other aircraft systems.

Three test methods are used; continuous, periodic and initiated. The continuous method constantly monitors particular signals for presence, value or logic. The periodic method automatically intersperses test signals and replies amongst operating signals in such a manner that they do not interfere with normal equipment operation. The initiated method must be initiated by the crewmember and causes an interruption of normal operation of the designated system for the duration of the test.

Equipment Status Displays

Equipment status displays (BIT, caution, and advisory) provide the aircrew with continuous status of the avionics equipment. The AV BIT caution lights are a cue to check equipment BIT status.

Failure to pass any BIT test causes the appropriate equipment indicator(s) on the ASP in the nose wheelwell to latch, the front and rear cockpit AV BIT caution lights to come on, and if appropriate a system caution is displayed. Pressing the MASTER CAUTION light in either cockpit turns off the AV BIT caution lights. BIT failures will be displayed by pressing the BIT button on the MENU display.

BIT DISPLAY

A MENU selectable BIT display (figure 1-12) contains the status of all BIT tested systems and is selected by pressing PB 20 (BIT) on the main menu. The systems which may be BIT tested are displayed around the outer edge of the BIT display. To select a particular system for BIT, press the PB next to the desired system or combination of systems. The center of the BIT display is divided into two "windows". The upper "in-test" window displays the systems in which an initiated BIT is being performed. The lower "equipment failure" window displays the system(s) that are turned off, not installed or have failed BIT.

Initiated BIT

In addition to displaying the system BIT status the BIT display is used to command an initiated BIT. Those systems identified by the options on the display periphery have initiated BIT capability (figure 1-12). The basic BIT format is altered slightly depending on whether the aircraft is on the ground or airborne. AFCS, DSPL, ADC, EXCS and INS are displayed only when on the ground. AIU, RALT and LANT are removed when in armed TF. The BIT is initiated from either cockpit by pressing the button adjacent to the desired option. When a BIT is initiated the other options are removed and the STOP option is displayed. Pressing STOP button will terminate the BIT in process. If STOP is pressed while an LRU is performing BIT and the LRU remains locked in BIT for 5 seconds or longer, ESCAPE will replace the STOP legend. If ESCAPE is pressed, the BIT routines in the CC are reset so BIT can proceed on other systems. ESCAPE should only be used as a last resort to abort the initiated BIT after STOP has failed. System lockup may occur when ESCAPE is pressed.

BIT may be initiated one at a time or in certain combinations. In the case of AFCS and PACS, additional switchology is required. Selection of AUTO BIT, causes a simultaneous BIT of a majority of the avionic equipment. Refer to AUTO BIT.

AUTO BIT

If the AUTO button is pressed, BIT are initiated in time sequence for systems turned on. Prerequisites for ground AUTO BIT are: the PACS, HUD, and other peripherals must be turned on and the radar timed in (if included). The sequence is initiated by pressing the pushbutton adjacent to AUTO and will take 3.5 to 4 minutes to run if radar is included or 1 minute if radar is OFF. The systems are displayed in the "in-test" window as they perform BIT and are removed when complete. The minimum time any equipment will be displayed is 2 seconds. If a failure

BIT DISPLAY

(TYPICAL)

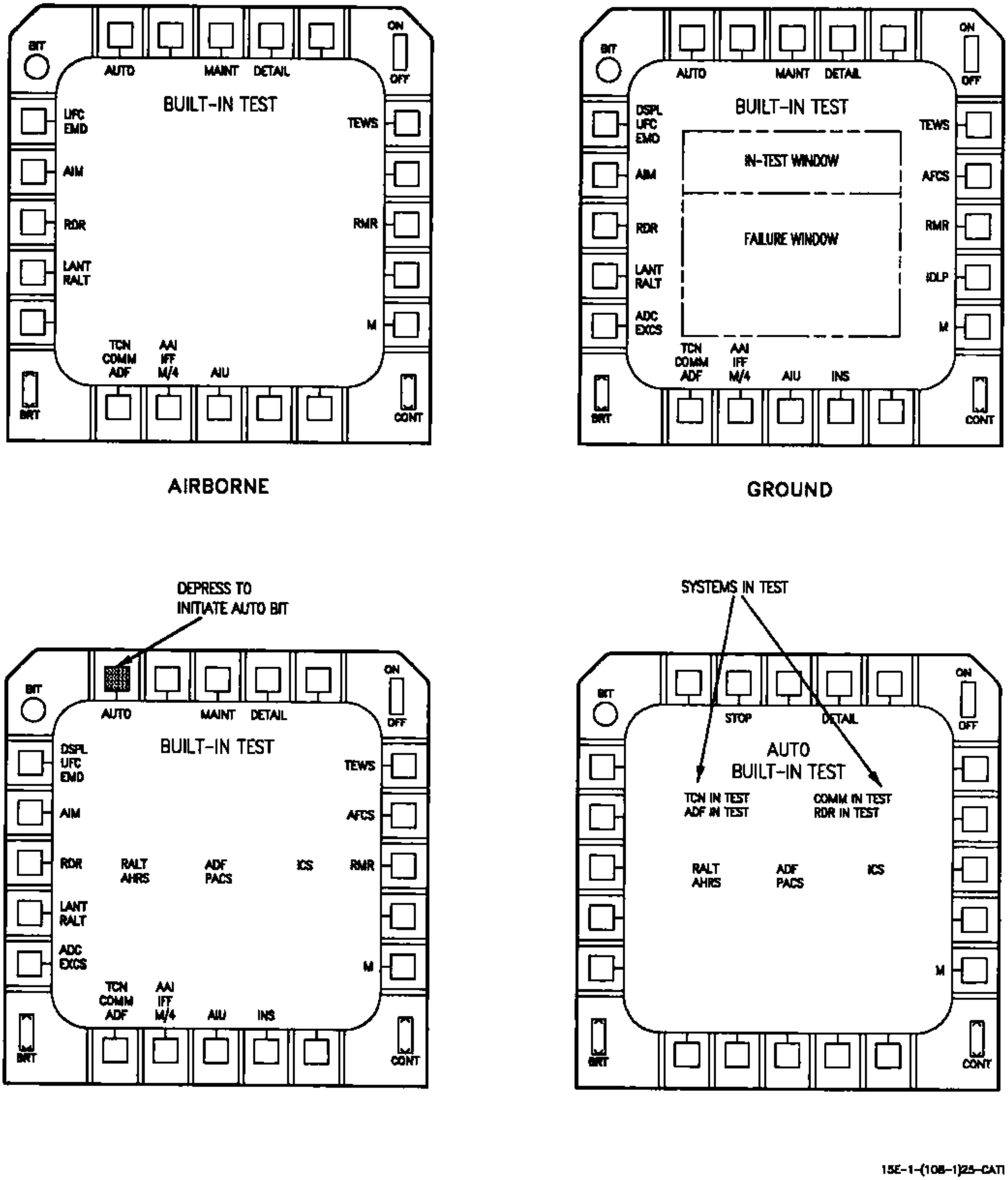


Figure 1-12

is detected, the system is removed from the "in-test" window and is displayed in the "failure" window. When an LRU with an asterisk is displayed as no-go, DETAIL information may be available. If STOP is selected, all systems tests will be terminated, except the radar, ICSCP, and radar altimeter, which will continue to run. The following systems are tested during AUTO BIT:

AAI	IBS
ADC	ICS
ADF	IFF
AIM	M/4
AIU 1A	MPDP
AIU 1B	RALT
AIU 2	RDR
CMD	RMR
COMM	RWR
EMD	TCN
EWW	FWD UFC
EXCS	AFT UFC

EXCS, ADC and MPDP are not tested during AUTO BIT when airborne. The radar altimeter is not tested during AUTO BIT when airborne if the TF radar is turned on (armed TF/Fly-up).

NOTE

With **-229 engines**, the MASTER CAUTION light, ENGINE category light and ATDP caution come on momentarily during AUTO BIT.

FUNCTIONAL/SRU FAILURES

Functional status information is provided on the DETAIL BIT display for the AFCS, target pod, navigation FLIR and terrain following radar. This information is supplementary and may trigger the MASTER CAUTION light. When AFCS, TGT FLIR, NAV FLIR or TF RDR are displayed on any BIT format, check the DETAIL page for functional failure information. Refer to section III for the meaning of AFCS functional failures. Refer to TO 1F-15E-34-1-1 for functional failure meanings for the LANTIRN system.

In addition, shop replaceable unit (SRU) failure data is also available using the DETAIL BIT display, for the following systems/units:

a. MPDP
b. All MPCDs/MPDs
c. HUD
d. Engine monitor display
e. AIU 1 and 2
f. Inertial navigational unit
g. Remote map reader

AFCS PREFLIGHT INITIATED BIT

For the AFCS, the BIT button on the CAS panel in the front cockpit must be pressed and held when BIT is initiated from the BIT display. This prevents inadvertent initiation of BIT on the AFCS for reasons of flight safety. AFCS BIT is terminated by pressing the paddle switch on the control stick or the STOP button on the BIT display. If AFCS BIT is interrupted, the message INCOMPLETE is displayed in the lower display window. Reinitiate AFCS BIT to clear the INCOMPLETE legend. Running a successful AFCS BIT will clear the INCOMPLETE. If the INS is powered, holding brake must be ON to perform AFCS initiated BIT.

CENTRAL COMPUTER (CC)

AP-1R CC

The AP-IR CC is a 256K high speed, stored program, general purpose digital computer that performs mission oriented computation from data received from control panels and subsystems aboard the aircraft. The computations include A/A and A/G steering and weapon delivery, navigation, flight director, and control and display management. Functions of the CC in the various master modes are shown below.

MASTER MODE	CC FUNCTION
A/A	Controls weapon system by selecting radar modes and display format for selected weapon. Provides computation of gunnery lead angles, missile in range conditions, missile launch parameters, allowable steering errors and other parameters for A/A weapon delivery.
A/G	Computes steering commands and positions attack symbology. Provides automatic release with weapon release switch pressed.
NAV	Computes navigational steering data and controls display information to the indicators.

MASTER MODE	CC FUNCTION
INST	Commands specific displays on each display unit to provide basic flight instrument displays. Computes and controls display information for instrument landings.

The CC computations are controlled by the operational flight program stored in the CC memory. Failure detection of the peripheral systems and CC internal operation is done by continual monitoring. Back up system substitution is also accomplished in the central computer. If the computer detects a power loss or failure there is a drastic change in the display formats. In the front cockpit, the left MPD displays the radar A/A format (with A/G format selectable), the MPCD displays ADI, the right MPD displays TEWS, and the HUD shows a backup format. In the rear cockpit, the left MPCD displays ADI, the left MPD has a radar display, the right MPD displays TEWS, and the right MPCD displays TSD.

VERY HIGH SPEED INTEGRATED CIRCUIT (VHSIC) CC

The VHSIC CC has the same form, fit and function of the AP-1R CC. The VHSIC CC has 1.5 M words of bulk memory and the VHSIC circuits provide faster processing speed. Batteries in the VHSIC CC enable it to retain variable data (such as time of day, navigation data, and LANTIRN pod boresight values).

There are numerous display and operating procedures which differ between the two CCs. These differences are annotated by (VHSIC) or (AP-1R) in the affected text and illustrations.

CENTRAL COMPUTER INTERFACE

The central computer is interfaced with the radar, Programmable Armament Control System (PACS), AFCS, Air Data Computer (ADC), Attitude Heading Reference System (AHRS), Multipurpose Display System, Head Up Display (HUD), Signal Data Recorder (SDR), Radar Warning Receiver (RWR), Inertial Navigation Unit (INU), the Engine Diagnostic Unit (EDU), and the ASP. A CC reset is performed by pressing the CC reset button on the front cockpit sensor control panel. The CC reset should be initiated only if a CC problem is suspected.

MISSION NAVIGATOR (MN)

NOTE

If the CC is replaced, an INS precision velocity update (PVU) is required to correct for pointing errors. Refer to section II for update procedures.

The CC maintains a MN routine separate from the INS. The MN integrates PVU corrected velocities for use in weapon delivery modes. It also provides relative target ranges in platform coordinates and allows position updates independent of the INS.

MULTIPLEX (MUX) BUS

Coded messages are transmitted between the CC and remote terminals in both directions on the multiplex bus. The coded messages are in serial digital format. The CC (or MPDP in backup mode) establishes communications on the avionics 1553 mux bus by scheduling all messages. Messages are blocks of data that contain the total information to be transferred. The blocks of data in a message are called words. There are three types of words : command, status and data. The CC (or MPDP in backup mode) gives commands, inspects status and receives/sends data.

AVIONICS INTERFACE UNITS (AIU)

The avionics interface unit set consists of two avionics interface units, AIU no. 1 and AIU no. 2. The AIU set controls, processes, and routes interfacing signals between multiple aircraft systems. Figure 1-13 lists the units and data that are lost if an AIU fails.

The AIU set communicates with the CC by way of the avionics 1553 mux bus. During backup mode, when the CC has failed, the AIU set will communicate with the MPDP. Data which is transferred between the AIU set and the CC is listed below:

a. BIT data - aircraft systems and AIU set
b. Up-front display and control data
c. Aircraft systems discretes, mode, control, and status data
d. Cautions, warnings, and advisories
e. UHF and IFF initialization
f. Memory inspect data

UNITS/DATA LOST WITH AIU FAILURE

Failed AIU	Item Degraded	Effect
AIU1(A)	UHF no. 1 radio	Limited operation. (May be able to transmit on selected frequency under certain conditions)
AIU1(A)	All MPD/MPCD displayed cautions (except LOW ALT and LASER)	No longer displayed
AIU1(A)	TACAN	No operation
AIU1(A)	IFF/RICP (IFF functions)	No operation
AIU1(A)	ADF	No operation
AIU1(A)	UHF2 Cipher	No operation
AIU1(A)	KY-58	No operation
AIU1(A)	EWWS	Limited operation (BIT function lost)
AIU1(A)	PACS (missile caged and missile reject)	No operation
AIU1(B)	Left hand controller	Limited operation (All switch functions lost except for CMD dispenser switch)
AIU1(B)	Fuel flow on MPD/MPCD	No operation (Erroneous fuel flow data displayed)
AIU1(B)	ILS	No operation
AIU1(A) & (B)	Avionics BIT and ASP	No operation
AIU1(A) & (B)	Asymmetric thrust departure function	No operation
AIU2	UHF 2 radio	Limited operation. (May be able to transmit on selected frequency under certain conditions)
AIU2	Right hand controller	No operation
AIU2	AAI	No operation
AIU2	KIR	No operation
AIU2	HF COMM (Not used)	No operation
AIU2	FWD/ REAR sensor control panel	No operation (System control lost)

Figure 1-13 (Sheet 1 of 2)

Figure 1-13

UNITS/DATA LOST WITH AIU FAILURE (Continued)

Failed AIU	Item Degraded	Effect
AIU2	LANTIRN (NAV and Targeting)	No operation
AIU2	OWS	No operation
AIU1(A) and AIU2	Radar altimeter (CARA)	No operation (Erroneous data display)
AIU1(A) and AIU2	Emission limit	No operation
AIU1(A) and AIU2	EMD (BIT data AIU1(A), BIT discretes - AIU2, serial data)	No operation
AIU1(A) and AIU2	ICSCP	Limited operation (No COMM transmit capability)
AIU1(A) and AIU2	Control stick grip	Limited operation (All switch functions lost except weapon release and trigger)
AIU1(A) and AIU2	UFC panel (both)	No operation
AIU1(A) or AIU2	TF function (Requires CARA data from both AIU1(A) and AIU2)	No operation
AIU1(A) and AIU2	LOW ALT warning	No operation
AIU1(B) and AIU2	FWD throttle	Limited operation (All switch functions lost)
AIU1(B) and AIU2	FWD sensor control panel	No operation (System control lost)
AIU1(B) and AIU2	Master modes	No operation
AIU1(B) and AIU2	LASER ARMED warning	No operation

Figure 1-13 (Sheet 2)

DATA TRANSFER MODULE SET (DTMS)

The DTMS consists of the main instrument panel Data Transfer Module Receptacle (DTMR) and the Data Transfer Module (DTM). Mission data is loaded, by the aircrew or operations personnel, on the ground and stored in the module. The module is carried to the aircraft, inserted into the DTM receptacle to initialize mission data.

The DTM READ function transfers mission data for sequence points, tacan stations, list points, HUD titler, crew station display programming, radar display programming, communications, IFF modes and codes, PACS A/G programs (combat or training modes), weapon delivery and PACS weapon loaded data (combat or training modes). With VHSIC, HUD programmed declutter is also provided.

The DTM WRITE function receives mission data from the CC by way of the MPDP for HUD titler, A/A or A/G engagement, NAV (mark point), INS (alignment/terminal errors), OWS (warning data and peak matrix), caution advisories, engine monitor, avionics BIT monitor (radar and other avionics, continuous and initiated), terrain following data and AFCS data.

NOTE

After engine start, the aircrew should clear the CC buffer using the DTM display format so that the event data for the current flight can be stored. After landing, do not clear the CC buffer prior to executing the DTM WRITE function. If the buffer is cleared, all current event data will be lost.

FRONT COCKPIT CONTROLS

The various front cockpit control stick grip and throttle controls used for aircraft control and system operation are shown in figures 1-14 and 1-15.

REAR COCKPIT CONTROLS

The various rear cockpit control stick grip and throttle controls used for aircraft control and system operation are shown in figures 1-16 and 1-17.

HAND CONTROLLERS

The left and right hand controllers (figure 1-18) located on the forward inboard section of the left and right rear cockpit consoles, are used to provide sensor/display control.

CONTROL STICK
(FRONT COCKPIT)

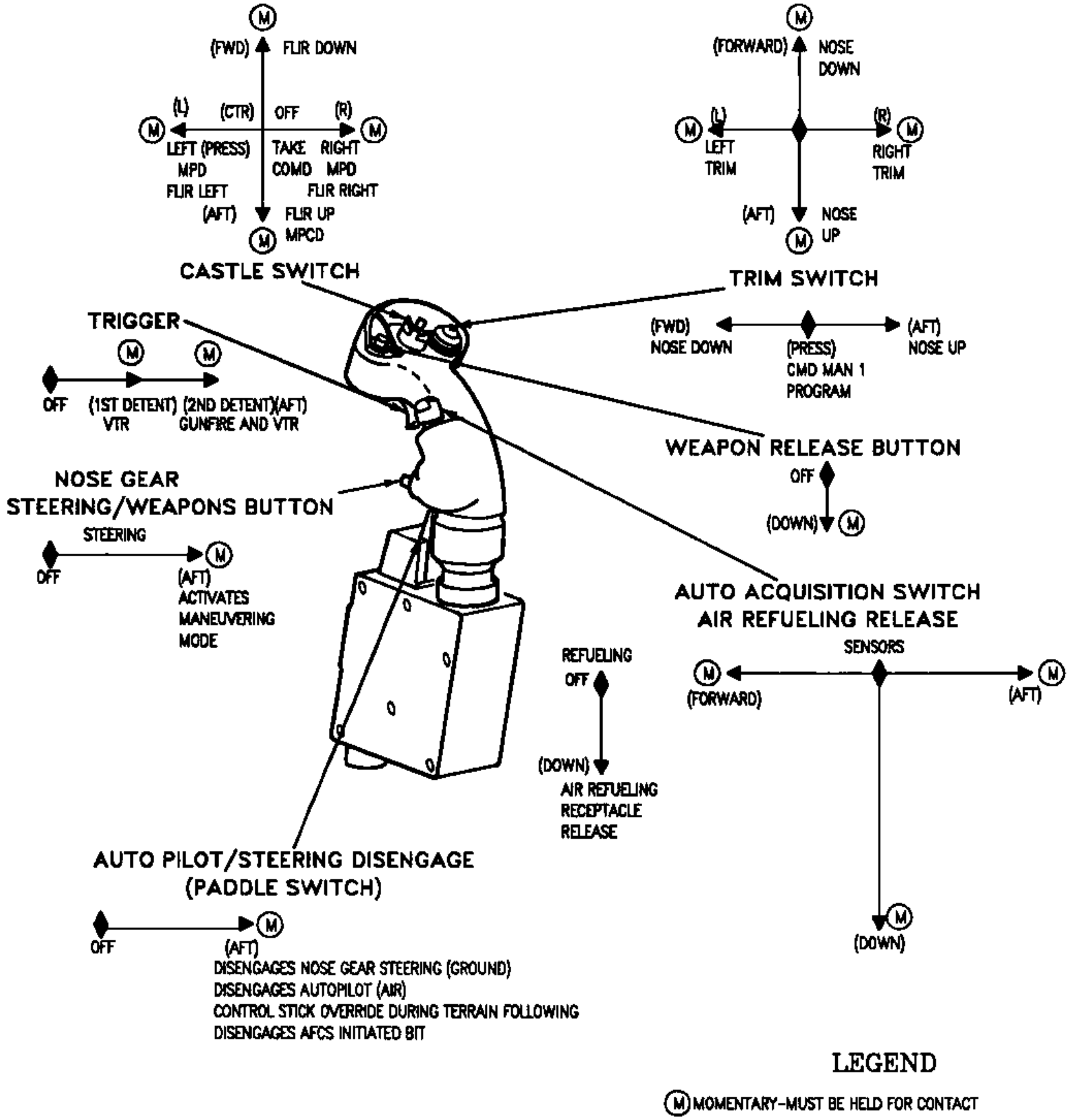


Figure 1-14 (Sheet 1 of 4)

CONTROL STICK (Continued)
(FRONT COCKPIT)

SWITCH	USE	SWITCH POSITION/ACTION				
WEAPON RELEASE BUTTON	WEAPON SYSTEM & VTRS	**PRESSED**				
		WEAPON CONSENT/ RELEASE WITHAUTOMATIC VTRS RECORDING				
CASTLE	DISPLAY SCROLL	**FWD**	**AFT**	**LEFT**	**RIGHT**	**PRESS**
			MPCD	LEFT MPD	RIGHT MPD	
	DISPLAY TAKE COMMAND (PRESS AND RELEASE FIRST)	HUD	MPCD	LEFT MPD	RIGHT MPD	TAKE COMMAND ENABLE
	NAV FLIR (THROTTLE COOLIE DOWN SIMULTANEOUSLY	SNAP LOOK DOWN	SNAP LOOK UP	SNAP LOOK LEFT	SNAP LOOK RIGHT	
	CAUTION CONTROL (MASTER CAUTION LIGHT PRESSED SIMULTANEOUSLY		MPCD	LEFT MPD	RIGHT MPD	
TRIM	FLIGHT CONTROL/ CMD	NOSE DOWN	NOSE UP	LEFT WING DOWN	RIGHT WING DOWN	CMD MANUAL 1 PROGRAM
GUN TRIGGER	GUN/VTRS	**FIRST DETENT**	**SECOND DETENT**	**RELEASE**		
		VTRS RUN	FIRE GUN	STOP GUN/ VTRS		

Figure 1-14 (Sheet 2)

CONTROL STICK *(Continued)*
(FRONT COCKPIT)

<table>
<tr><th rowspan="2">SWITCH</th><th rowspan="2">USE</th><th colspan="4">SWITCH POSITION/ACTION</th></tr>
<tr><th>FORWARD</th><th>AFT</th><th>DOWN</th><th>RELEASE</th></tr>
<tr><td rowspan="8">AUTO ACQUISITION SWITCH</td><td>TARGETING POD</td><td>FOV CHANGE</td><td>RETURN TO CUE</td><td>TRACK/ UNTRACK</td><td></td></tr>
<tr><td>HRM</td><td rowspan="2">SMALLER WINDOW</td><td>1 LARGER WINDOW</td><td rowspan="2">MODE REJECT</td><td></td></tr>
<tr><td>RBM</td><td>LARGER WINDOW</td><td></td></tr>
<tr><td>A/A RADAR</td><td colspan="4">REFER TO TO1F-15E-34-1-1</td></tr>
<tr><td>TSD</td><td>SMALLER CUE FOOT-PRINT</td><td>LARGER CUE FOOT-PRINT</td><td>RETURN TO P.P.MAP</td><td></td></tr>
<tr><td>AIR REFUELING</td><td></td><td></td><td>AIR REFUEL-ING PROBE DISEN-GAGE</td><td></td></tr>
<tr><td>A/G GUIDED WEAPON</td><td colspan="4">REFER TO TO1F-15E-34-1-1</td></tr>
<tr><td>A/G HUD</td><td></td><td>AUTO/ CDIP</td><td></td><td></td></tr>
</table>

Figure 1-14 (Sheet 3)

CONTROL STICK (Continued)
(FRONT COCKPIT)

SWITCH	USE	SWITCH POSITION/ACTION	
NOSEWHEEL STEERING BUTTON		PRESS AND RELEASE	PRESS AND HOLD
	WEIGHT ON WHEELS		MANEUVER MODE NOSE GEAR STEERING
	A/A WEAPONS	REFER TO TO1F-15E-34-1-1	
	A/G GUIDED WEAPON	REFER TO TO1F-15E-34-1-1	
PADDLE SWITCH		PRESS AND RELEASE	PRESS AND HOLD
	AUTO TF	DISENGAGE AUTOPILOT	REVERT TO MANUAL TF, INTERRUPT AP STEER MODES
	ARMED MANUAL TF/UNARMED MANUAL TF	RESET FLYUP	AUTOPILOT DISENGAGE
	WEIGHT ON WHEELS	TERMINATES AFCS BIT	DISENGAGE NOSE GEAR STEERING
	AUTOPILOT	DISENGAGES AUTOPILOT	
1 PATTERN STEERING LINE ENABLE/DISABLE WHEN CURSOR FUNCTION IS TARGET			

Figure 1-14 (Sheet 4)

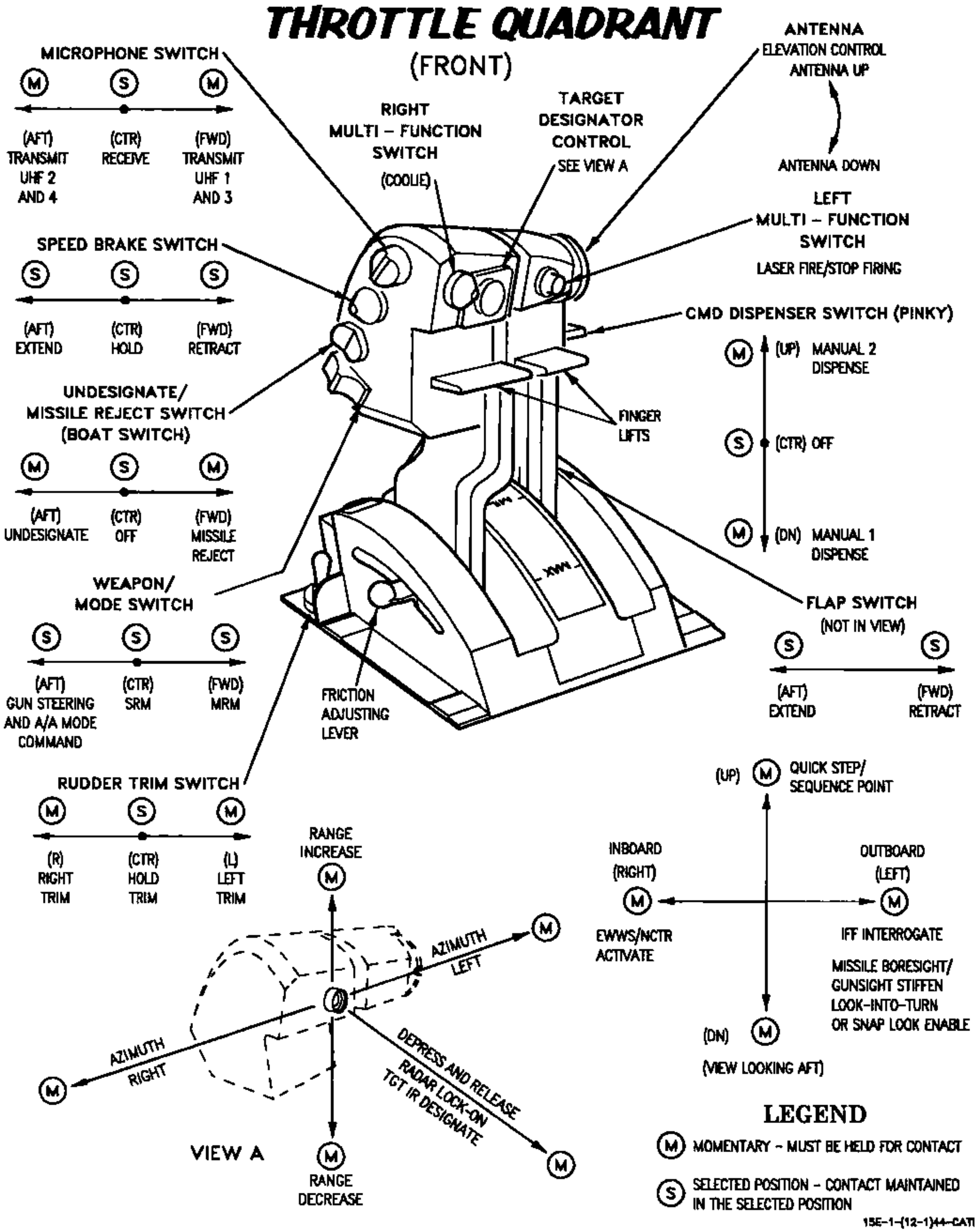


Figure 1-15 (Sheet 1 of 4)

THROTTLE QUADRANT (Continued)
(FRONT)

<table>
<tr><th>SWITCH</th><th>USE</th><th colspan="3">SWITCH POSITION/ACTION</th></tr>
<tr><td rowspan="2">COMMUNICATIONS</td><td rowspan="2">COMM</td><td>FORWARD</td><td colspan="2">AFT</td></tr>
<tr><td>TRANSMIT ON RADIO 1 OR RADIO 3</td><td colspan="2">TRANSMIT ON RADIO 2 OR RADIO 4</td></tr>
<tr><td rowspan="5">BOAT</td><td></td><td>FORWARD</td><td colspan="2">AFT</td></tr>
<tr><td>A/A RADAR</td><td>MISSILE REJECT</td><td colspan="2">TARGET UNDESIGNATE</td></tr>
<tr><td>TARGETING FLIR</td><td></td><td colspan="2">UNDESIGNATE</td></tr>
<tr><td>HRM/RBM/BCN SET</td><td></td><td colspan="2">UNDESIGNATE TARGET/PSL</td></tr>
<tr><td>A/G GUIDED WEAPON</td><td>MISSILE REJECT</td><td colspan="2">TARGET UNDESIGNATE</td></tr>
<tr><td rowspan="2">SPEED BRAKE</td><td rowspan="2"></td><td>FORWARD</td><td>CENTER</td><td>AFT</td></tr>
<tr><td>RETRACT</td><td>HOLD</td><td>EXTEND</td></tr>
<tr><td rowspan="2">WEAPON SELECT SWITCH</td><td rowspan="2">WEAPON SYSTEM SELECT</td><td>FORWARD</td><td>CENTER</td><td>AFT</td></tr>
<tr><td>MRM</td><td>SRM</td><td>AUTO GUNS & A/A MASTER MODE</td></tr>
</table>

Figure 1-15 (Sheet 2)

THROTTLE QUADRANT (Continued)
(FRONT)

<table>
<tr><th>SWITCH</th><th>USE</th><th colspan="4">SWITCH POSITION/ACTION</th></tr>
<tr><td rowspan="6">COOLIE</td><td rowspan="2">TARGETING FLIR
HRM/RBM
BCN/SET
PVU/TSD</td><td>UP</td><td>DOWN</td><td>IN-BOARD</td><td>OUT-BOARD</td></tr>
<tr><td>SE-QUENCE POINT SELECT</td><td rowspan="3">MISSILE BS/ GUN-SIGHT STIFFEN/ LOOK INTO TURN ENABLE</td><td rowspan="3">EWWS/ NCTR ACTI-VATE</td><td rowspan="3">IFF INTER-ROGATE</td></tr>
<tr><td>A/A RADAR</td><td>QUICK STEP</td></tr>
<tr><td>A/A GUN</td><td>LCOS/GDS</td></tr>
<tr><td>A/G GUIDED WEAPON</td><td colspan="4">REFER TO TO1F-15E-34-1-1</td></tr>
<tr><td rowspan="9">TDC</td><td rowspan="2">TARGETING POD</td><td colspan="2">TRANSDUCER</td><td colspan="2">PRESS/RELEASE</td></tr>
<tr><td colspan="2">LOS CONTROL</td><td colspan="2" rowspan="2">DESIGNATION</td></tr>
<tr><td>HRM/RBM</td><td colspan="2">CURSOR CONTROL</td></tr>
<tr><td>A/A RADAR (ACQUISITION SYMBOL CONTROL)</td><td colspan="4">REFER TO TO1F-15E-34-1-1</td></tr>
<tr><td>TSD</td><td colspan="2">RANGE/BEARING LINE CONTROL</td><td colspan="2">CUE COMMAND</td></tr>
<tr><td>A/G GUIDED WEAPON</td><td colspan="4">REFER TO TO1F-15E-34-1-1</td></tr>
<tr><td>NAV/A/G HUD TD DIAMOND</td><td colspan="2">LOS CONTROL</td><td colspan="2">DESIGNATION</td></tr>
<tr><td>NAV POD</td><td colspan="2">ELECTRICAL BORESIGHT SLEW</td><td colspan="2"></td></tr>
</table>

Figure 1-15 (Sheet 3)

THROTTLE QUADRANT (Continued)
(FRONT)

SWITCH	USE	SWITCH POSITION/ACTION	
LASER FIRE BUTTON		PRESS AND RELEASE	
	TARGETING FLIR	LASER FIRE/STOP FIRING	
	HRM/RBM	FREEZE/UNFREEZE	
	A/G GUIDED WEAPONS	REFER TO TO1F-15E-34-1-1	
	HUD	[1] VELOCITY VECTOR CAGE/UNCAGE	
	TSD	TRACK/UNTRACK	
THUMBWHEEL	RADAR	ROTATE	
		ELEVATION RATE CONTROL	
PINKY	COUNTER MEASURES DISPENSER	UP	DOWN
		MANUAL NO. 2	MANUAL NO.1
[1] **Must be 'In Command' of HUD and in A/G, NAV or INST master mode.**			

Figure 1-15 (Sheet 4)

CONTROL STICK
(REAR COCKPIT)

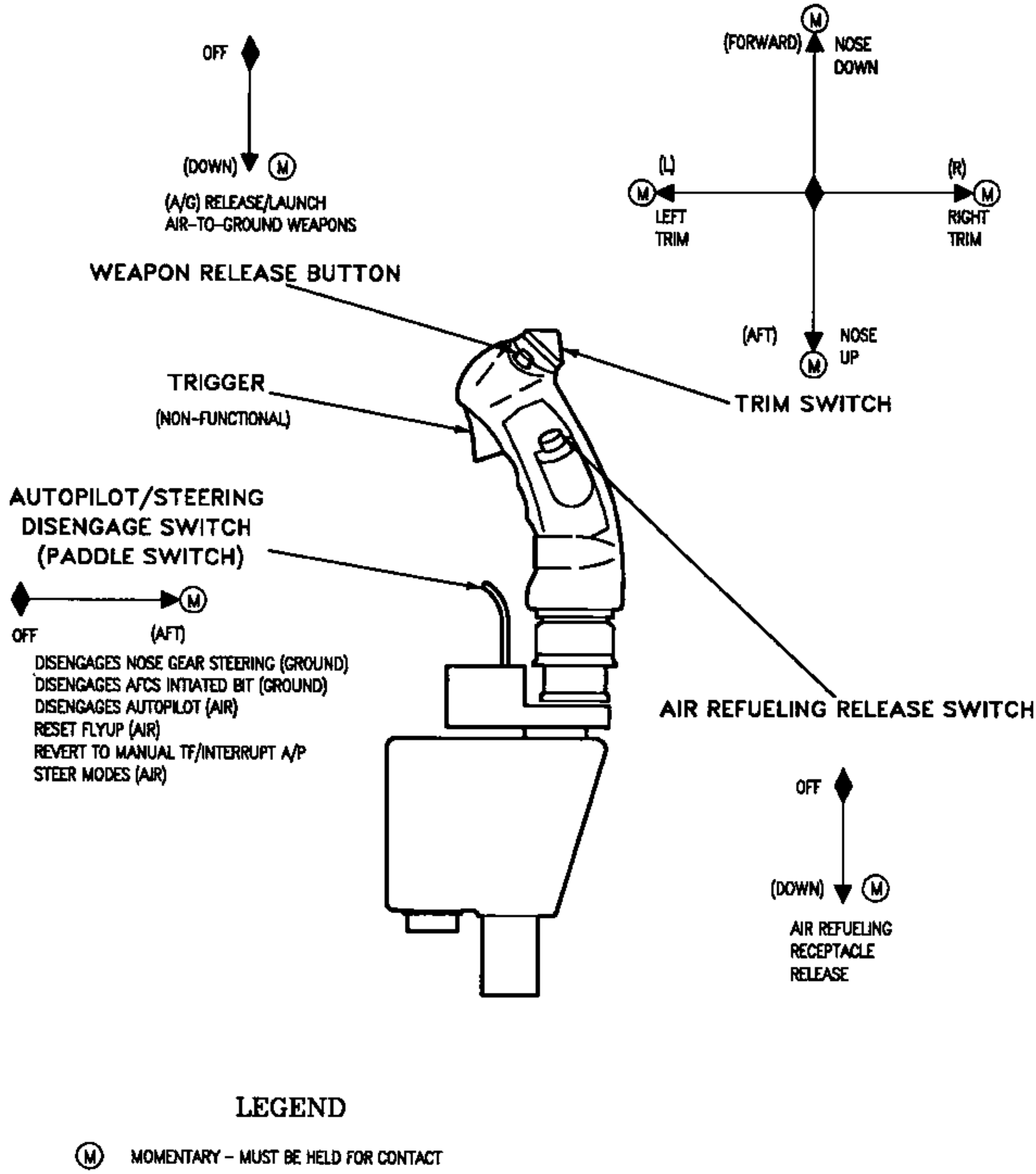


Figure 1-16 (Sheet 1 of 2)

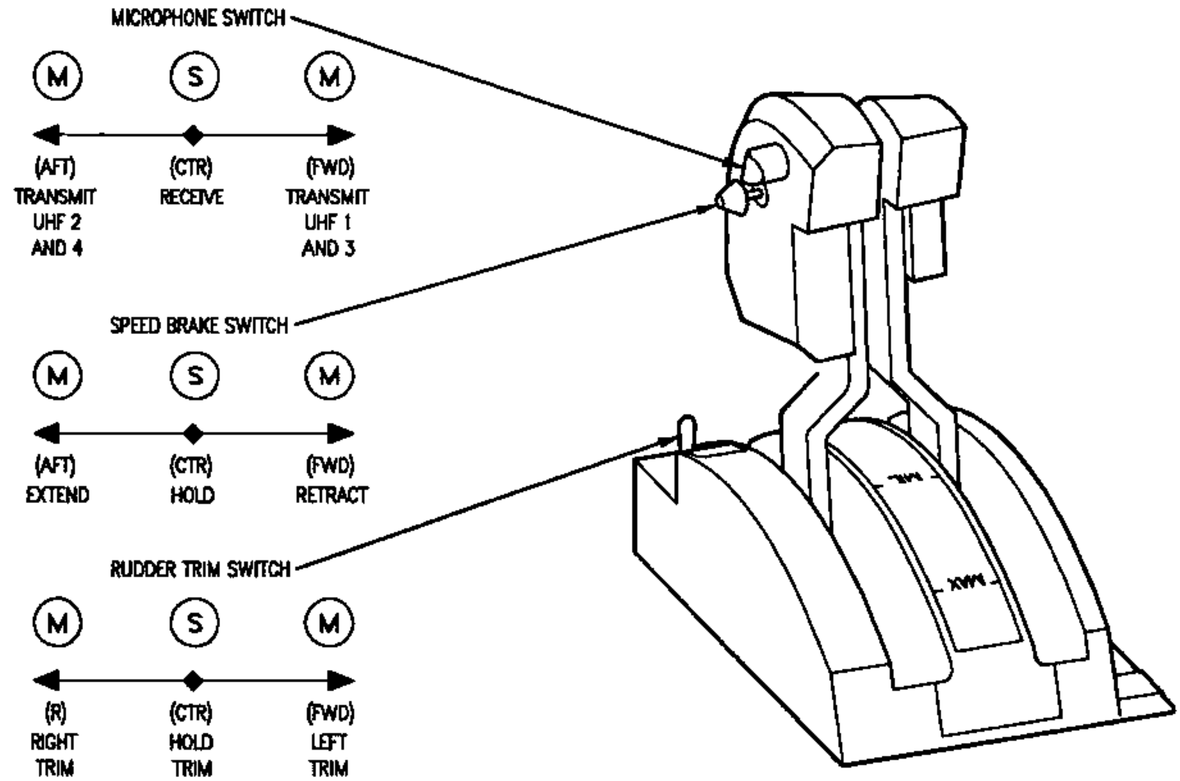
CONTROL STICK *(Continued)*
(REAR COCKPIT)

SWITCH	USE	SWITCH POSITION/ACTION			
		FWD	AFT	LEFT	RIGHT
TRIM	FLIGHT CONTROL TRIM	NOSE UP	NOSE DOWN	LEFT WING DOWN	RIGHT WING DOWN
WEAPON RELEASE BUTTON	WEAPON RELEASE	PRESSED			
	WEAPON SYSTEM	A/G WEAPON RELEASE IF IN A/G MASTER MODE			
	VTRS	PRESSED			
		PROGRAMMED RECORD ENABLE			
AIR REFUELING DISENGAGE		AIR REFUELING PROBE DISENGAGE			
PADDLE SWITCH		PRESS AND RELEASE		PRESS AND HOLD	
	AUTO TF	DISENGAGE AUTOPILOT		REVERT TO MANUAL TF, INTERRUPT AP STEER MODES	
	ARMED MANUAL TF/UNARMED MANUAL TF	RESET FLYUP		AUTOPILOT DISENGAGE	
	WEIGHT ON WHEELS	TERMINATES AFCS BIT		DISENGAGE NOSE GEAR STEERING	
	AUTOPILOT	DISENGAGES AUTOPILOT			

Figure 1-16 (Sheet 2)

THROTTLE QUADRANT

(REAR)



LEGEND

(M) MOMENTARY – MUST BE HELD FOR CONTACT

(S) SELECTED POSITION – CONTACT MAINTAINED IN SELECTED POSITION

15E-1-(12-5)33-CATI

Figure 1-17 (Sheet 1 of 2)

THROTTLE QUADRANT (Continued)

(REAR)

SWITCH	USE	SWITCH POSITION/ACTION		
COMMUNICA-TION	RADIOS	**FORWARD**		**AFT**
		TRANSMIT ON RADIO 1 OR RADIO 3		TRANSMIT ON RADIO 2 OR RADIO 4
SPEED BRAKE	SPEED BRAKE	**FORWARD**	**CENTER (SPRING LOADED)**	**AFT**
		RETRACT	SPEED BRAKE RESPONDS TO FRONT COCKPIT POSITION COMMAND	EXTEND
TRIM	RUDDER TRIM	**RIGHT**	**CENTER**	**LEFT**
		RIGHT TRIM	HOLD TRIM	LEFT TRIM

Figure 1-17 (Sheet 2)

HAND CONTROLLERS

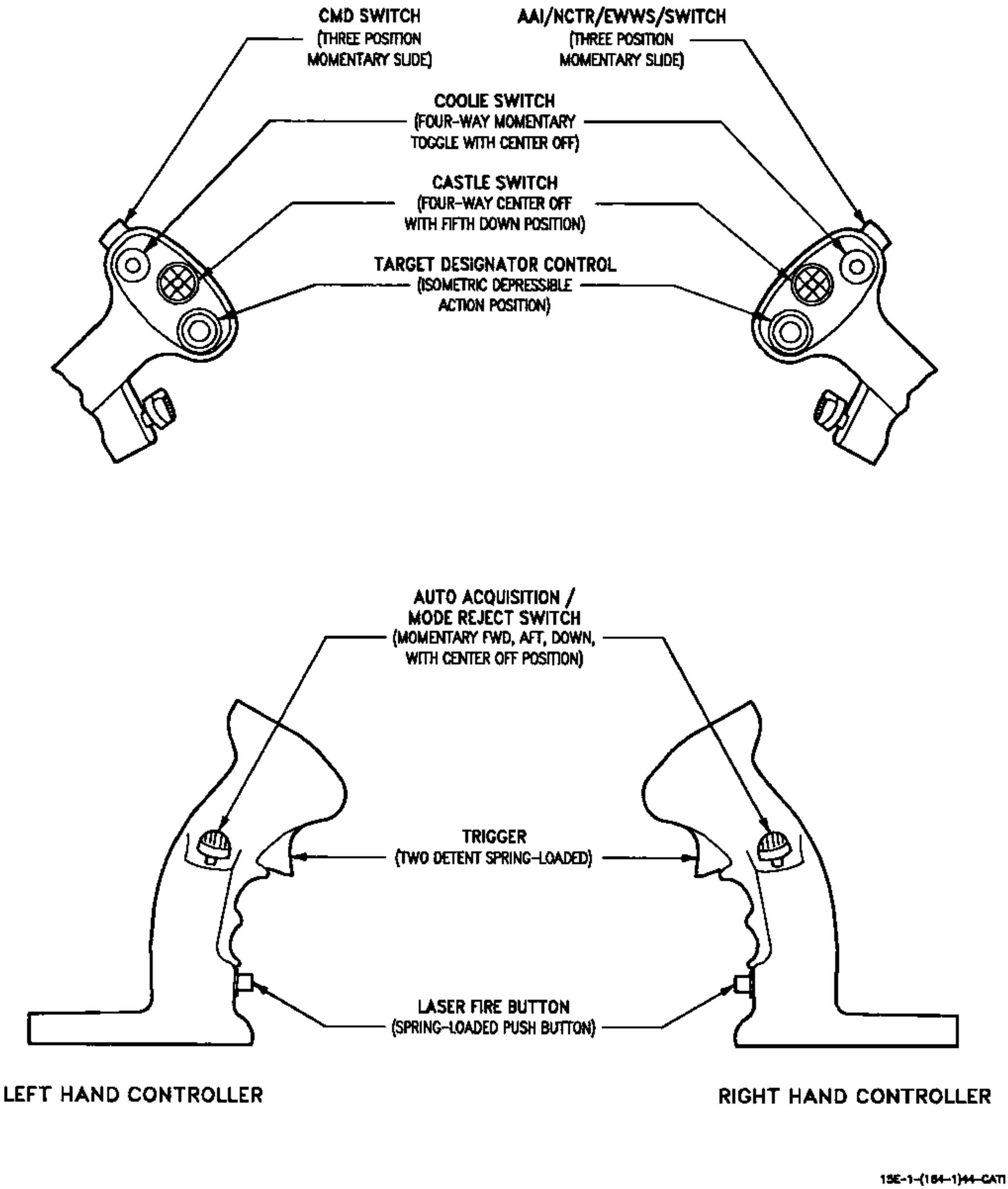


Figure 1-18 (Sheet 1 of 4)

HAND CONTROLLERS (Continued)

(REAR COCKPIT)

SWITCH	USE	SWITCH POSITION/ACTION				
TDC		TRANSDUCER			PRESS AND RELEASE	
	TARGET-ING FLIR	LOS CONTROL				
	HRM	CURSOR CONTROL			[1] EXPAND	
	RBM	CURSOR/[1] EL CONTROL				
	A/A RADAR	ACQUISITION SYMBOL/ [1] EL CONTROL				
	TSD	RANGE/BEARING LINE CONTROL				
	A/G GUIDED WEAPON	REFER TO TO1F-15E-34-1-1				
COOLIE	LEFT/ RIGHT CON-TROLLER	FORWARD	AFT	LEFT	RIGHT	
		SCROLL MPD	SCROLL MPCD	TAKE COMMAND LEFT DISPLAY/ [6] MOVE CAUTIONS	TAKE COMMAND RIGHT DISPLAY/ [6] MOVE CAUTIONS	
RIGHT CON-TROLLER INTERRO-GATE		FORWARD		AFT		
		IFF INTERROGATE		EWWS AND NCTR ACTIVATE		
LEFT CON-TROLLER CMD DISPENSE		FORWARD		AFT		
		MANUAL 1		MANUAL 2 (SEMI-AUTOMATIC)		

Figure 1-18 (Sheet 2)

HAND CONTROLLERS (Continued)
(REAR COCKPIT)

<table>
<tr><th>SWITCH</th><th>USE</th><th colspan="3">SWITCH POSITION/ACTION</th></tr>
<tr><td rowspan="7">TRIGGER</td><td></td><td colspan="2">HALF ACTION</td><td>FULL ACTION</td></tr>
<tr><td>TARGETING POD</td><td colspan="2">TRACK/UNTRACK</td><td>DESIGNATION/ CUE/UPDATE</td></tr>
<tr><td>HRM</td><td colspan="2">EXPAND ENABLE/ PPI RANGE CHANGE ENABLE</td><td>DESIGNATION/ CUE/UPDATE</td></tr>
<tr><td>A/A RADAR</td><td colspan="2">ELEVATION SLEW ENABLE</td><td>TARGET DESIGNATION</td></tr>
<tr><td>RBM/BCN</td><td colspan="2">ELEVATION SLEW ENABLE/PPI RANGE CHANGE ENABLE</td><td>DESIGNATION/ MAP/CUE/UPDATE</td></tr>
<tr><td>TSD</td><td colspan="2">TRACK/UNTRACK</td><td>CUE COMMAND</td></tr>
<tr><td>A/G GUIDED WEAPON</td><td colspan="3">TRACK COMMAND</td></tr>
<tr><td rowspan="6">MODE REJECT/ FOV</td><td></td><td>FORWARD</td><td>AFT</td><td>DOWN</td></tr>
<tr><td>TARGET-ING POD</td><td>NARROW/ WIDE FOV</td><td>RETURN TO CUE</td><td>UNDESIGNATE</td></tr>
<tr><td>HRM/RBM</td><td>SMALLER WINDOW/RANGE [4]</td><td>LARGER WINDOW/ RANGE [2] [4]</td><td>MODE REJECT/ [3] PSL/UN-DESIGNATE</td></tr>
<tr><td>A/A RADAR</td><td>HIGH DATA RATE TWS/RAM</td><td>NORMAL TWS</td><td>MODE REJECT</td></tr>
<tr><td>TSD</td><td>SMALLER CUE FOOTPRINT</td><td>LARGER CUE FOOTPRINT</td><td>RETURN TO PP MAP</td></tr>
<tr><td>A/G GUIDED WEAPON</td><td colspan="3">REFER TO TO1F-15E-34-1-1</td></tr>
</table>

Figure 1-18 (Sheet 3)

HAND CONTROLLERS (Continued)

(REAR COCKPIT)

<table>
<tr><th>SWITCH</th><th>USE</th><th colspan="5">SWITCH POSITION/ACTION</th></tr>
<tr><td rowspan="3">LASER FIRE BUTTON</td><td>TARGETING FLIR</td><td colspan="5">LASER FIRE/STOP FIRE</td></tr>
<tr><td>HRM/RBM</td><td colspan="5">FREEZE/UNFREEZE</td></tr>
<tr><td>A/G GUIDED WEAPON</td><td colspan="5">REFER TO TO1F-15E-34-1-1</td></tr>
<tr><td rowspan="8">CASTLE</td><td></td><td>FORWARD</td><td>AFT</td><td>LEFT</td><td>RIGHT</td><td>PRESS</td></tr>
<tr><td>TARGET POD</td><td>CURSOR BLANK</td><td rowspan="4">TARGET</td><td rowspan="2">CURSOR CUE</td><td rowspan="2">CURSOR UPDATE</td><td rowspan="5">SEQUENCE POINT SELECT</td></tr>
<tr><td>HRM/RBM</td><td rowspan="2">CURSOR MAP</td></tr>
<tr><td>BCN</td><td></td><td></td></tr>
<tr><td>SET</td><td></td><td>CUE</td><td>CURSOR UPDATE</td></tr>
<tr><td>TSD</td><td>DE-CREASES MAP SCALE</td><td>INCREASES MAP SCALE</td><td>ALTER-NATE AC-TUATION SELECTS RADAR CUE OR FLIR CUE</td><td></td></tr>
<tr><td>A/A RADAR</td><td>MRM SEARCH MODE</td><td>SRM SEARCH MODE</td><td>TARGET UN-DESIG-NATE</td><td>MISSILE REJECT</td><td>QUICK STEP</td></tr>
<tr><td>A/G GUIDED WEAPON</td><td colspan="5">REFER TO TO1F-15E-34-1-1</td></tr>
</table>

1. MUST ARM WITH TRIGGER 1/2 ACTION.
2. PATTERN STEERING LINE ENABLE/DISABLE WHEN CURSOR FUNCTION IS TARGET.
3. WHEN CURSOR FUNCTION IS TARGET.
4. CHANGES PPI RANGE WHEN TRIGGER IS AT FIRST DETENT.
5. WHEN CURSOR ACTION IS UPDATE (MN).
6. WITH MASTER CAUTION PRESSED.

Figure 1-18 (Sheet 4)

UPFRONT CONTROLS (UFC)

The upfront controls in the front and rear cockpit are the major interface units for control of avionics subsystems. The UFC consists of 10 function buttons, six 20-character rows of display, four radio volume controls, two rotary switches, a 20-key data entry keyboard, a rotary brightness control knob, and an EMIS LMT pushbutton (figure 1-19).

UFC BIT

The UFC BIT is implemented in three levels; basic self test, initiated BIT and continuous BIT. Basic self test is run each time the unit comes out of the off mode. Initiated BIT is run in response to the BIT initiate discrete input.

The third level of BIT is continuous as performed in normal operation. This method depends on the aircrew observation because of the large number of switches and display segments. Each level of BIT is desensitized such that a single glitch will not cause a no-go indication.

UFC SYSTEM CONTROL

The UFC provides control of the following systems:

a. INS - data entry and display
b. Tacan
c. Auto pilot - attitude hold, altitude hold, radar preset altitude, and steer modes
d. TF
e. IFF/SIF
f. AAI
g. UHF Radios - including ADF and KY-58
h. ILS
i. NAV FLIR
j. Joint Tactical Information Distribution System (JTIDS) mission code (JMC) and JTIDS voice code (JVC) - (Future growth associated with JTIDS)
k. A/G stores delivery bias

Either of the two UFC's controls all systems and each is driven by its own processor (an AIU) with paths to the other AIU. This provides a redundancy when a UFC or processor failure occurs.

The UFC panel alphanumeric pushbutton keys as well as the other pushbuttons are read by the CC. Numbers 0-9 or letters A, N, B, W, M, E, S, C, - (dash), decimal point and colon are available.

0-9 Key	Enters number
SHF (shift) Key	Enables upper case functions on next key pressed
A/P Key	Selects autopilot format and couples autopilot
MARK Key	Marks and selects marked point for display
MENU Key	Selects menu format 1st Push - MENU 1 2nd Push - MENU 2 3rd Push - MENU 1
DATA Key	Selects data display format 1st Push - DATA 1 2nd Push - DATA 2 3rd Push - DATA 1
CLR (clear) Key	Pressing CLR key produces the results show below (dependent on initial UFC condition)

UFC Condition	Result
Empty scratchpad	Blank top 4 rows
Empty scratchpad and top 4 rows blank	Blank all rows
1 digit in scratchpad	Clears selection
2 or more digits in scratchpad	Clears last digit entered in scratchpad
SHF function key pressed	Deactivates SHF function
I/P Key	Initiates IFF identification of position (I/P)

Decimal Point (.) Key	Enters decimal point.
Guard Receiver (GREC) Channel/ Manual (C/M) Key	Left or Right key enables/disables guard receiver or changes between preset channel and manual frequency on appropriate radio.
VOL R1, R2, R3, R4	Volume control for selected radio.
EMIS LMT Key	Limits electronic emissions from the aircraft for passive operations. The low probability of intercept terrain following radar mode is automatically selected if TF radar is active, and other electronic emitters are switched to standby, except CARA which continues to transmit and has to be turned off to terminate transmission. The EMIS LMT light comes on when first selected. With AP-1R, when pushbutton is pressed again the emission limit is deselected and most emitters return to their previous state of operation. However, tacan transmit or receive (T/R) must be reselected, TF must be reset and all IFF modes must be reselected or phasing re-enabled on the UFC. With VHSIC, when the pushbutton is pressed again, the emission light is deselected and affected systems are returned to their previous state of operation.
BRT	Controls brightness of liquid crystal displays (LCD).
Left and Right Rotary/Press Knobs	Pressing knob turns on the radio. Rotating the knobs selects radio channels 1 thru 20 and guard transmitter for appropriate radio. Preset channel may be selected by pressing the channel control knob.

The UFC multifunction buttons are used as the options indicate except buttons 5 and 6 which are dedicated to radios/submenu displays. Buttons are numbered 1 thru 10 beginning at the top left. PB 1 thru 5 are top to bottom on the left. PB 6 thru 10 are bottom to top on the right.

If the UFC display is blank, the actions listed below will restore the display :

a. Press MENU or DATA key to display appropriate menu or data display.

b. Press and release any S1 thru S4 or S7 thru S10 to return top 4 rows to the previously selected submenu. Radio advisory data (rows 5 and 6) return to previously displayed data.

c. Press and release S5 or S6 to return radio advisory data in rows 5 and 6.

UFC DISPLAYS

NOTE

With AP-1R, when making an entry requiring a decimal point, the decimal point must be entered, except for manual UHF frequencies.

Since a large number of system functions have been integrated into the UFC several menus or display formats were developed. These displays are called data displays, menus, and submenus. There are two data displays, two menus and 19 submenus. Regardless of the data or submenu displayed, the radio communication information is always retained. The two data displays (DATA 1, DATA 2), menus (MENU 1, MENU 2), and the submenus pertaining to communications and radio navigation are described in the following paragraphs.

Data 1 Display

This displays current aircraft information. It is selected by pressing the DATA pushbutton on the UFC keyboard (figure 1-19). On this format, pressing PB 1 shows LOS bearing and range to current steerpoint, estimated time enroute/estimated time of arrival (ETE/ETA). The selection will initially power up to display steerpoint bearing and range. The PB may be pressed and released to toggle through the three selections. PB 2, 3 and 4 display calibrated, true and ground speeds respectively. Additionally, PB's 3 and 4 control the display of true airspeed and groundspeed on the HUD and EADI formats (an asterisk is displayed on the UFC when the display is enabled). PB 7 displays either winds or the CC clocktime (must be set each sortie by aircrew). The display will initially power-up to display time at PB 7. With AP-1R, TIME OFF is displayed any time power to the CC is interrupted. With VHSIC, the CC has a battery which keeps the time running (assuming a good battery) and aircrews can re-display time by pressing PB7. Radar (CARA) and baro-corrected altitudes are displayed by PB 8 and 9 respectively. In addition PB 8 controls the display of radar (CARA) altitude on the HUD and EADI formats (an asterisk is displayed on the UFC when display is enabled). PB 10 shows the current steerpoint. Steering can be changed by typing the new point in the scratchpad and entering it by pressing PB 10. Pressing PB 10 with a blank scratchpad calls up one of four point data submenus.

Data 2 Display

Pressing the DATA pushbutton a second time displays the data 2 display (figure 1-19). This display contains NAV data functions which provide the capability to determine what the remaining fuel will be at a selected sequence (steer or target) point, time enroute, and so forth. On the data 2 display, the sequence points are indicated by SP followed by the point number identifier; only steer and target points may be identified as sequence points (SP) on the data 2 display. Target 24, route alpha is the current line of sight point selected. As a result, the 15,000 pounds readout represents the amount of fuel remaining when the aircraft reaches the SP if the aircraft travels at the current aircraft ground speed displayed, 395K, from the aircraft present position direct to SP24.A. Also shown is the calculated ETA to reach SP24.A. Pressing the pushbutton next to the ETA will provide the ETE. If range and bearing to SP24.A is desired, pressing the pushbutton next to the fuel remaining (15,000 lbs) will display the information.

Within the same format a second sequence point, SP25.A, is displayed automatically with data relating to it because it is the next point after the line-of-sight (LOS) point with a time-on-target (TOT) assigned to it. The 12,000 lbs readout is estimated fuel remaining when the aircraft gets to SP25.A. Pressing the pushbutton next to either time-of-arrival (TOA), fuel (12,000 lbs), or command ground (CG) speed will cause TOT to be displayed as shown on figure 1-19. This selection also displays the words FUEL REM in place of the fuel remaining, and CG speed to make the TOT is displayed next to CG. If no TOT has been stored for this point, OFF will appear next to TOT and CG.

Menu 1 Display - WITH AP-1R

Pressing the MENU pushbutton on the keyboard calls up the MENU 1 format (figure 1-20). The information displayed and controlled from menu 1 is described in the following paragraphs.

✳ LAW 12000′	The LAW (12000′ AGL) with the asterisk displayed indicates the system has been enabled with the adjacent pushbutton and the low altitude voice warning and light will be activated if the aircraft first climbs above and then descends below the altitude (AGL) displayed. The LAW altitude is changed by keyboard entry into the scratchpad and pressing the pushbutton next to LAW (based on CARA).
:TCN 101X	The current tacan channel selected and operating is channel 101 mode X. The colon indicates power is on. Tacan channels are changed by keyboard entry of the new channel number into the scratchpad and pressing the pushbutton next to TCN. Turning the TACAN ON/OFF, changing between mode X or Y, and changing operating modes (A/A, TR or REC) is done from the TACAN submenu. Pressing with a clean scratchpad displays the TACAN submenu. Refer to TACAN system.

UFC DATA DISPLAYS

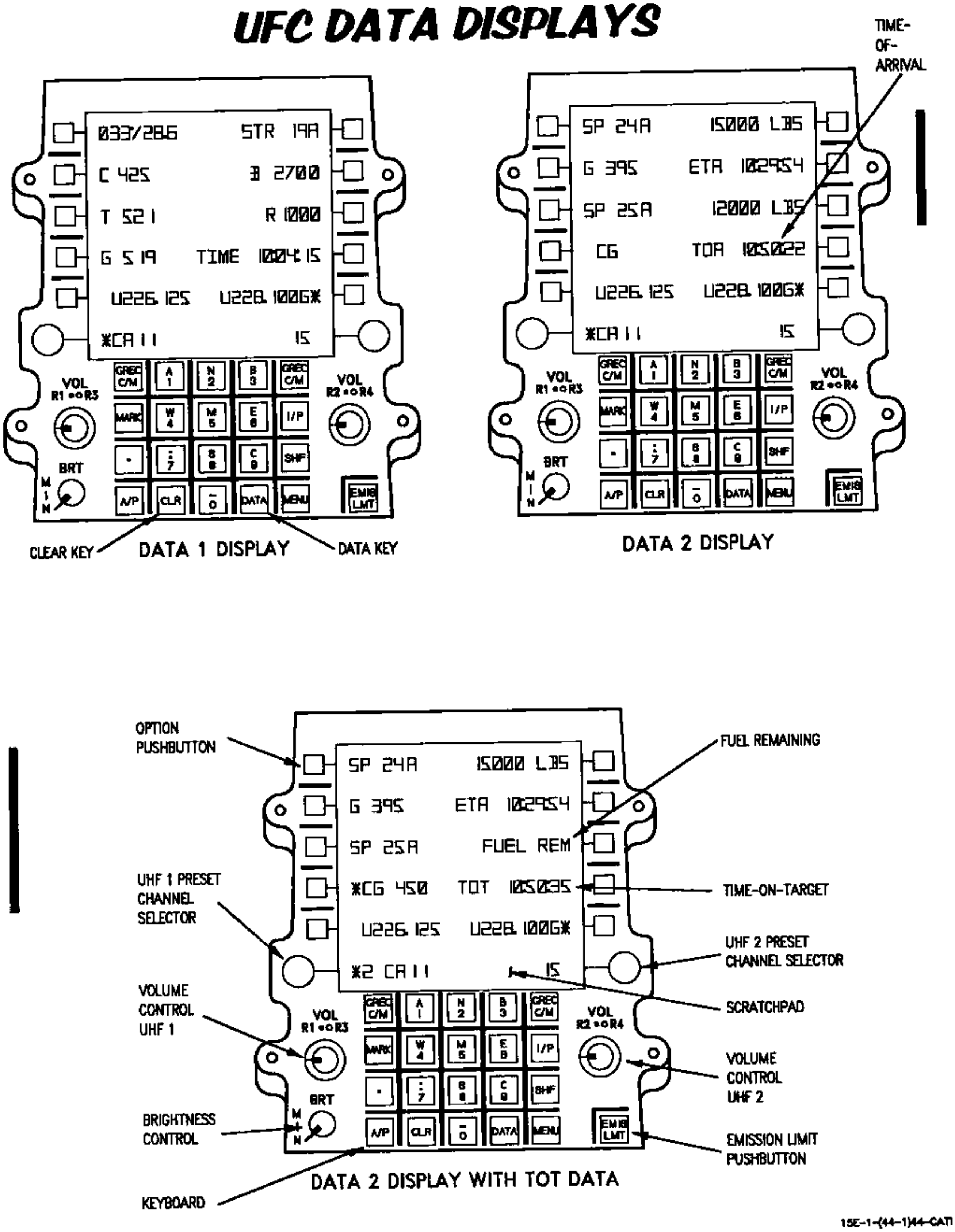
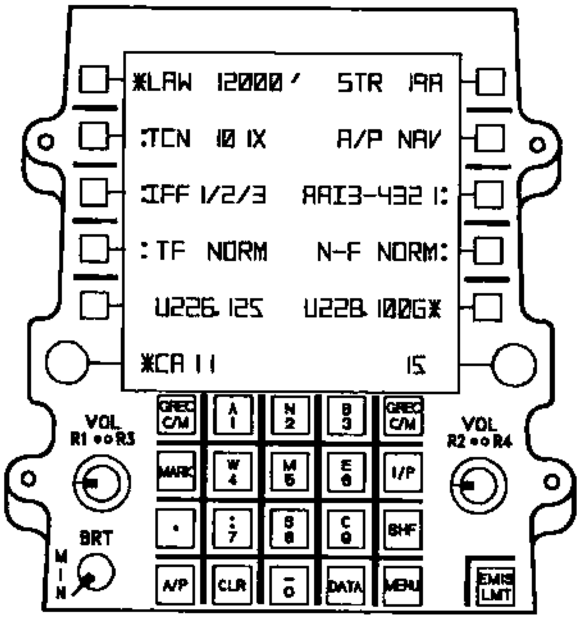
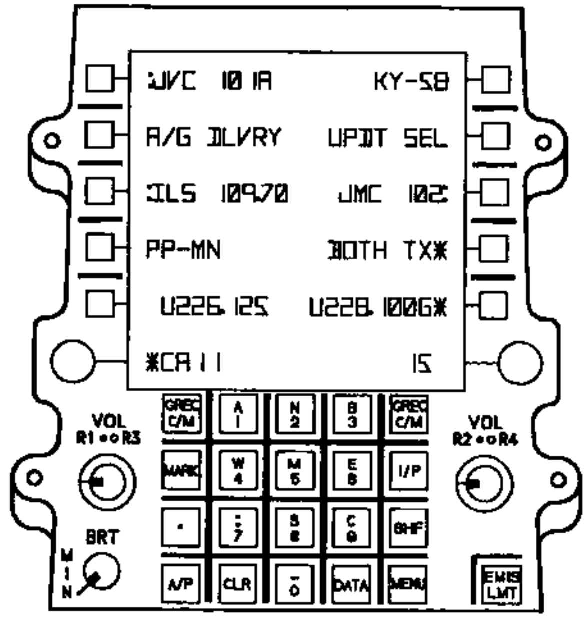


Figure 1-19

UFC MENU DISPLAYS - WITH AP-1R

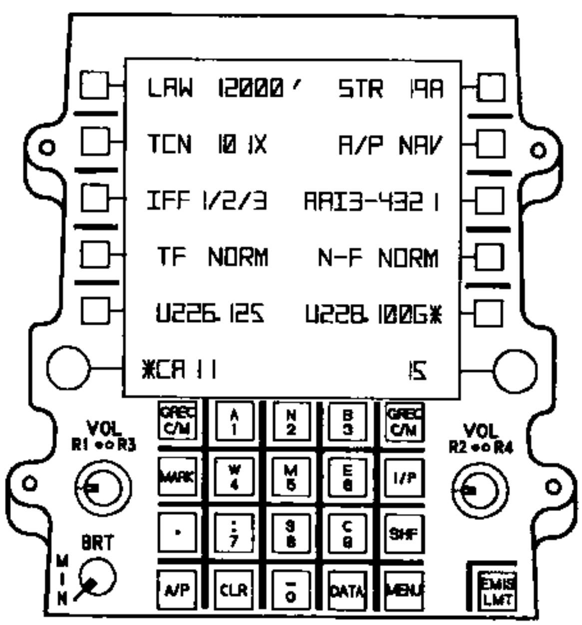


MENU 1 DISPLAY

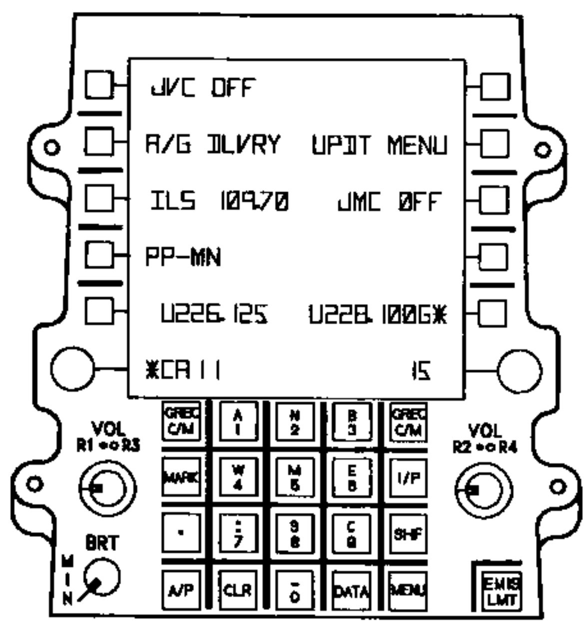


MENU 2 DISPLAY

UFC MENU DISPLAYS - WITH VHSIC



MENU 1 DISPLAY



MENU 2 DISPLAY

15E-1-(41-1)44-CATI

Figure 1-20

AAI 3-4321:	Indicates the current air-to-air interrogation (AAI) mode and code (3-4321). Pressing with a blank scratchpad displays the AAI submenu. AAI modes and codes can be changed from this format using the procedure described under IFF, this section. Refer to TO 1F-15E-34-1-1 for detailed information.
N-F NORM:	Indicates the current NORM mode/power status of the LANTIRN navigation FLIR. Pressing with a blank scratchpad displays the NAV FLIR submenu.
A/P NAV	Indicates autopilot is engaged and current steer mode if any. In this case NAV steer mode. Pressing with a blank scratchpad displays the autopilot submenu.
:IFF 1/2/3	This IFF format indicates that 1/2/3 modes 1, 2, and 3 have been selected for operation. If only mode 3 had been selected, the 1 and 2 would not be displayed. If it is necessary to change mode 3's code, for example, first, press 3 to identify the mode to be changed, second, press SHF (shift) to select the upper case functions of the keyboard, third, select DASH (-), fourth, select the digital code, and fifth, enter the new code by pressing the pushbutton next to IFF. The entered mode and code is displayed for 5 seconds and is then replaced by only the enabled modes without codes. A colon indicates power is on. Modes are selected/deselected from the IFF submenu. IFF phasing selection and programming are also done from the IFF submenu. Refer to identification systems, this section, for more information.
:TF NORM	Displays terrain following (TF) radar status (blank - OFF, N/R - not ready, STBY - standby) or correct TF submodes selected on TF display (NORM, WX, ECCM, LPI or VLC). A colon is displayed if power is on. Refer to TO 1F-15E-34-1-1.
STR 19A	Indicates that current steer (STR) point is number 19 route alpha (A). Steering to a new point is selected by typing the desired point in the scratchpad and pressing this pushbutton. Pressing this pushbutton with a blank scratchpad displays the point-data submenu.

Menu 1 Display - WITH VHSIC

With power removed from the TACAN, IFF, TF radar, NAV FLIR or AAI systems, the system name followed by OFF is displayed on UFC menu 1. Also, if the LAWS or A/P is disabled, the system name followed by OFF is displayed.

Pressing the MENU pushbutton on the keyboard calls up the MENU 1 format (figure 1-20). The information displayed and controlled from menu 1 is described in the following paragraphs.

LAW 12000′	Indicates the system has been enabled and the low altitude voice warning and light will be activated if the aircraft first climbs above and then descends below the altitude (AGL) displayed. The LAW altitude is changed by keyboard entry into the scratchpad and pressing the pushbutton next to LAW (based on CARA).

TCN 101X	The current tacan channel selected and operating is channel 101 mode X. Tacan channels are changed by keyboard entry of the new channel number into the scratchpad and pressing the pushbutton next to TCN. Turning the TACAN ON/OFF and selecting a channel is done using the scratchpad and menu 1. Changing between mode X or Y, and changing operating modes (A/A, TR or REC) is done from the TACAN submenu. Pressing with a clean scratchpad displays the TACAN submenu. Refer to TACAN system.
AAI 3-4321	Displays the current air-to-air interrogation (AAI) mode and code (3-4321). Pressing with a valid scratchpad entry applies power to the AAI system. Pressing with a blank scratchpad displays the AAI submenu. AAI modes and codes can be changed from this format using the procedure described under IFF, this section. Refer to TO 1F-15E-34-1-1 for detailed information.
N-F NORM	Indicates the current NORM mode/power status of the LANTIRN navigation FLIR. Pressing with a blank scratchpad displays the NAV FLIR submenu.
A/P NAV	Indicates autopilot is engaged and current steer mode if any. In this case NAV steer mode. Pressing with a blank scratchpad displays the autopilot submenu.
IFF 1 2 3	This IFF format indicates that modes 1, 2, and 3 have been selected for operation. If only mode 3 had been selected, the 1 and 2 would not be displayed. If it is necessary to change mode 3's code, for example, first, press 3 to identify the mode to be changed, second, press SHF (shift) to select the upper case functions of the keyboard, third, select DASH (-), fourth, select the digital code, and fifth, enter the new code by pressing the pushbutton next to IFF. The entered mode and code is displayed for 5 seconds and is then replaced by only the enabled modes without codes. Modes are selected/deselected from the IFF submenu. IFF phasing selection and programming are also done from the IFF submenu. Refer to identification systems, this section, for more information.
TF NORM	Displays terrain following (TF) radar status (blank - OFF, N/R - not ready, STBY - standby) or correct TF submodes selected on TF display (NORM, WX, ECCM, LPI or VLC). Refer to TO 1F-15E-34-1-1.
STR 19A	Indicates that current steer (STR) point is number 19 route alpha (A). Steering to a new point is selected by typing the desired point in the scratchpad and pressing this pushbutton. Pressing this pushbutton with a blank scratchpad displays the point-data submenu.

Menu 2 Display - WITH AP-1R

Menu 2 display (figure 1-20), is selected by a second pressing of the menu pushbutton. The information displayed is described in the following paragraphs.

JVC 0A JMC 0	JTIDS voice channel and JTIDS mission channel. For entry of JTIDS data. (Provisions only)

A/G DLVRY	Pressing this pushbutton displays the A/G Delivery submenu
: ILS 109.70	Indicates current instrument landing system (ILS) localizer frequency selected, with the colon indicating it is being powered.
PP-MN	Pressing the pushbutton displays the PP keeping submenu (either INS, MN, TCN or A/D; current selection is mission navigator).
KY-58	Pressing this pushbutton displays a KY-58 submenu.
UPDT SEL	Pressing this pushbutton displays an update select submenu.
BOTH TX✳	Pressing the pushbutton displays an asterisk which permits transmission on both radio transmitters, either on the same or different frequencies provided neither radio is in a red mode (secure).

Menu 2 Display - WITH VHSIC

Menu 2 display (figure 1-20), is selected by a second pressing of the menu pushbutton. When power is removed from either UHF 1, UHF 2 or ILS , the words OFF are displayed next to the system name on the UFC. The information displayed is described in the following paragraphs.

JVC OFF	JTIDS voice channel (provisions only)
JMC OFF	JTIDS mission channel. For entry of JTIDS data. (Provisions only)
A/G DLVRY	Pressing this pushbutton displays the A/G Delivery submenu
ILS 109.70	Pressing this pushbutton with an empty scratchpad, applies power to the ILS. With power applied, this line indicates current instrument landing system (ILS) localizer frequency selected .
PP-MN	Pressing the pushbutton displays the PP keeping submenu (either INS, MN, TCN or A/D; current selection is mission navigator).
UPDT MENU	Pressing this pushbutton displays an update select submenu.

Submenus

Menu 1 and menu 2 provide access to submenus (figure 1-21) which contain selection of specific system functions. There are submenus for tacan, tacan programming, IFF, IFF programming, UHF 1, UHF 2, navigation FLIR, navigation FLIR boresight (from NAV FLIR), AAI, autopilot, point data latitude and longitude, UTM, UTM programming, point data range and bearing, direction and range offsets, present position keeping source, HUD titling, A/G delivery, update, and KY-58. Submenus can be selected when the scratchpad is blank by pressing the pushbutton next to the system of interest. For example, to select the IFF submenu, press the pushbutton next to IFF on the menu 1 display. Once displayed, system changes can be selected and made using keyboard entry. To return to either a menu or data display, press either the MENU or DATA pushbutton.

UFC Point Data Submenu - With VHSIC

The UFC point data sequence point mechanization has been modified such that cycling between sequence points is similar to cycling between sequence points on other displays. Also, the capability to change sequence point types and retain the geographic location is available to the aircrew. Specifically, the following sequence point mechanization changes have occurred on all the UFC point data submenus.

Pushbutton 1

a. The order in which sequence points are displayed by pressing PB 1 has been modified to display STR/TGT points and the associated AIM/O/S points in numerical order for a route rather than by sequence point type. MARK point sequencing remains unchanged.

b. After a sequencing point is deleted, the aircrew can press PB 1 to select the next sequence point in numerical order.

c. The capability to change STR or TGT sequence points to TGT or STR points can be accomplished by entering the changed sequence point number and optional letter in the scratchpad, then pressing PB 1. Also, the associated AIM or O/S sequence point will be changed. The sequence point that is changed must be on the same route and of the same numerical order.

d. The BASE point cannot be changed to a STR or TGT.

e. A TGT point cannot be changed to a STR point while the TGT point is designated.

f. The current steer-to-point cannot be deleted.

Pushbutton 7

ELV aappears representing elevation of the sequence point are displayed next to the elevation value on all the UFC point data submenus. When the sequence point elevation is invalid, ELV OFF is displayed.

Pushbutton 9

TOT appears, representing time-on-target for the sequence point selected are displayed next to the TOT value on all the UFC point data submenus.

If the TOT was previously entered, the difference between the scratchpad entered TOT and the current TOT will be added or subtracted from all sequence point TOT's on the route with a TOT.

The delta TOT format is selected by pressing PB 9 on any of the UFC point data submenus, provided a TOT is displayed for the sequence point. If TOT is displayed next to PB 9, the DELTA TOT format is not available to the aircrew. Also, if TOT OFF is displayed next to PB 9, and a TOT is entered, the TOT will only affect the PB sequence point TOT and will not change other TOT's on the route.

From the DELTA TOT format, the aircrew has the ability to enter delta TOT (positive or negative) that will be added or subtracted to all sequence point TOT's on the route with a TOT. Valid delta TOT entries are from 1 to 59 and represent minutes. Any other values are considered invalid and are flashed in the scratchpad if an attempt to enter is made. After the aircrew enters a valid delta TOT, the new sequence point TOT is displayed next to PB 9 on the UFC point data submenu.

The aircrew is still able to adjust an individual sequence point TOT without affecting the other sequence point TOT's from the UFC data 2 display. The TOT option on the UFC data 2 display is available to the aircrew by pressing PB 7.

UFC TACAN Submenu

Pushbutton 1

The aircrew can change the tacan channel by making a valid scratchpad entry at PB 1 or change the tacan band by pressing PB 1 with an empty scratchpad. The tacan channel and band can be changed without power applied to the tacan.

Pushbutton 8

The tacan PROGRAM submenu is now displayed next to PB 8.

Pushbutton 10

Power to the tacan is controlled by alternately pressing PB 10.

UFC TACAN PROGRAM Submenu

Pushbutton 1

The aircrew can change the tacan channel by making a valid scratchpad entry at PB 1 or change the tacan band by pressing PB 1 with a blank scratchpad.

Pushbuttons 2 and 3

The latitude and longitude for the tacan station is displayed next to PB 2 and 3 respectively.

Pushbutton 4

MV is displayed next to the magnetic variation value. When the tacan station magnetic variation has not been entered, MV OFF is displayed.

Pushbutton 7

ELV is displayed next to the elevation value. When the tacan station elevation has not been entered, ELV OFF is displayed.

Pushbutton 8

The tacan PROGRAM submenu selection/deselection is displayed next to PB 8.

Pushbutton 10

The index function is displayed next to PB 10.

TACAN UPDATE Submenu

Pushbutton 1

When power is removed from the tacan, TCN OFF is displayed. The aircrew have the ability to apply power to the tacan by pressing PB 1 with an empty scratchpad. After PB 1 is pressed, power is applied to the tacan and the last selected channel and band are displayed. A valid scratchpad input from the tacan will power the tacan on to the scratchpad entered channel and last selected band.

UFC Present Position Keeping Submenu

Pushbutton 7

MV is displayed next to the magnetic variation value.

KY-58 Submenu

Pushbuttons 1 and 10

When OPR or RV mode is selected, an asterisk is displayed next to PB 1 or 10 respectively.

Pushbuttons 4 and 7

These legends, U1-KY and U2-KY, have changed to clearly indicate which radio is selected for KY-58 operation.

UFC UHF 1 and UHF 2 Submenus

Pushbutton 1

When power is applied to the UHF radio, an asterisk is displayed next to PB 1 on the appropriate UHF submenu. Power can still be applied to the UHF radio by pressing PB 1. Also, the preset channel can be entered by pressing PB 1 with data in the scratchpad.

Pushbutton 2

When power is applied to the ADF, an asterisk is displayed next to PB 2. Power can still be applied to the ADF by pressing PB 2.

Pushbuttons 4 and 7

The KY-58 submenu selection and the BOTH TX function have been relocated from the UFC menu 2 display to both UFC UHF 1 and UHF 2 submenus.

UHF Radio Advisory

Pushbuttons 5 and 6

When the UHF radio is transmitting in manual mode, the U is replaced by a T on both the forward and aft radio advisory.

Channel Selector Knobs

With power removed from the UHF radio, turning the appropriate channel selector knob will power the radio on, select channel mode and increment the channel number.

When the UHF radio is transmitting in channel mode, a T is displayed prior to the channel number on both the forward and rear radio advisory.

Pushbuttons 5 and 6

When power is removed from UHF 1 or 2, the system name followed by the word OFF is displayed on the UFC radio advisory.

Aircrews can now swap scratchpad entries with currently selected channel or manual frequencies by pressing the channel select knob or PB 5 or 6. When the radio is on, entering a manual frequency in the scratchpad and pressing PB 5 or 6 will change the manual frequency to the scratchpad entered manual frequency and display the old manual frequency in the scratchpad. Entering a valid channel number in the scratchpad and pressing the channel selector knob will change the channel number to the scratchpad entered channel number and display the old channel number in the scratchpad. When the radio is off, entering a manual frequency in the scratchpad and pressing PB 5 or 6 will power on the radio (manual mode) to the scratchpad entered manual frequency. Entering a channel number in the scratchpad and pressing the appropriate channel select knob will power the radio on (channel mode) to the scratchpad entered channel number.

UFC MENU/SUBMENU MATRIX - WITH VHSIC

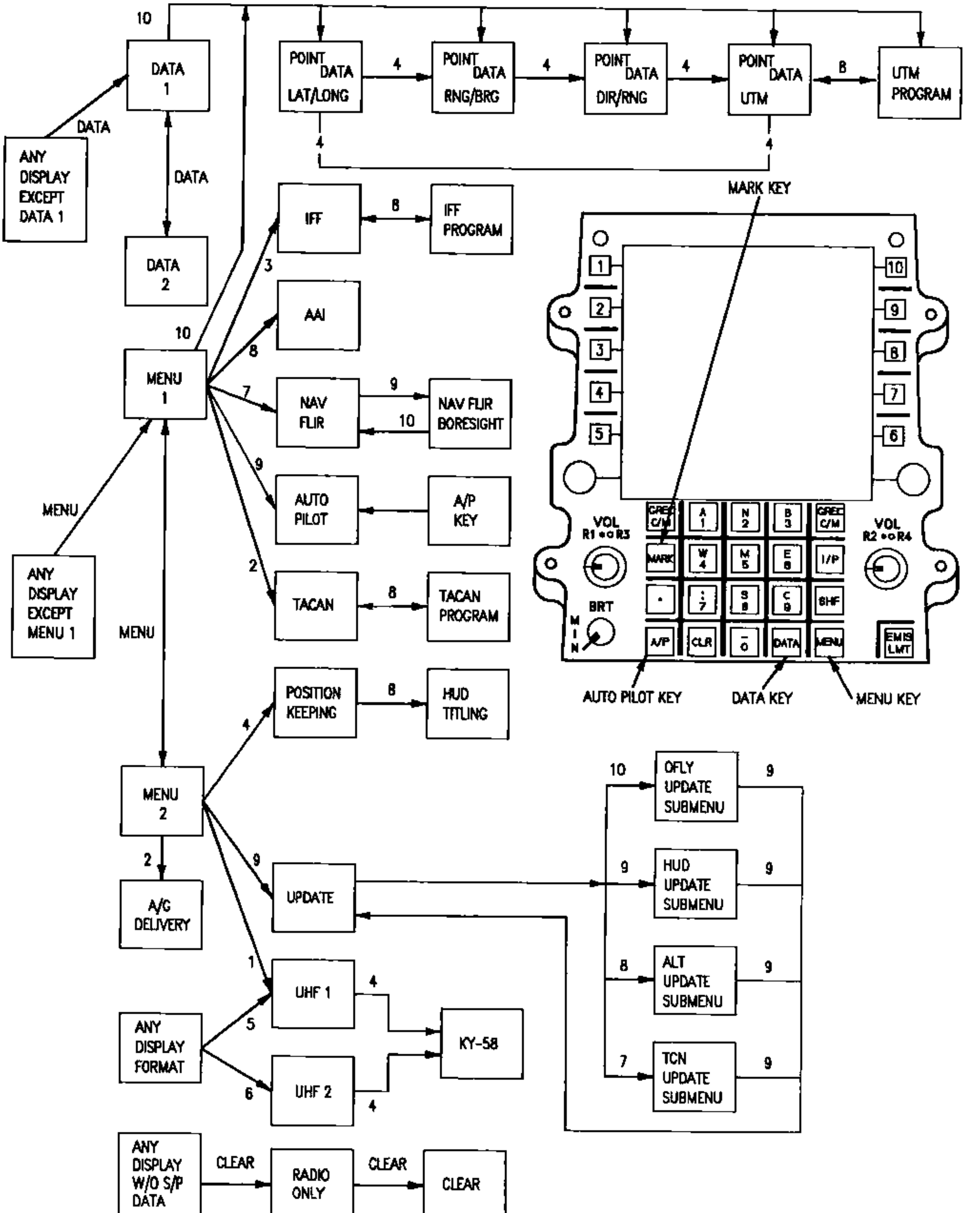
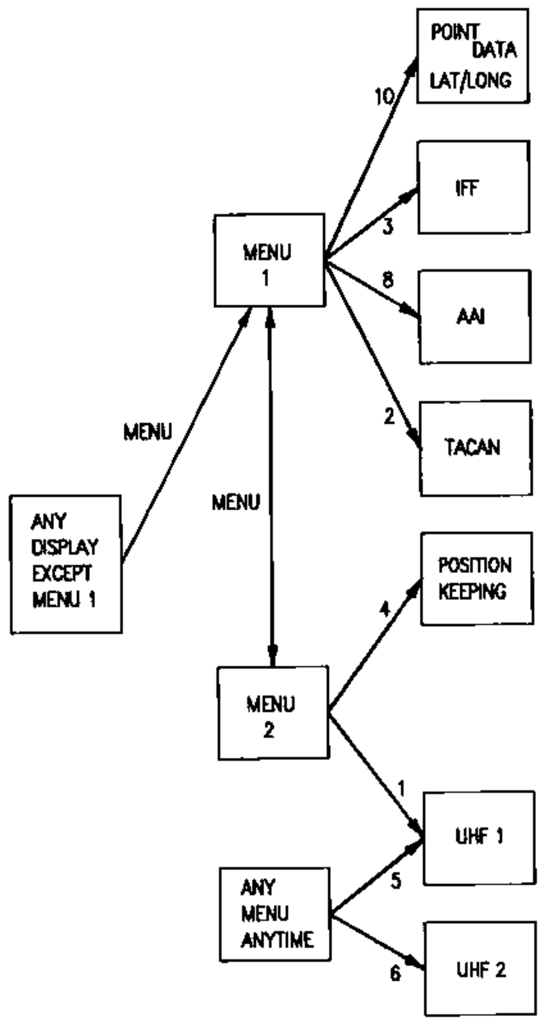


Figure 1-21 (Sheet 1 of 4)

UFC MENU/SUBMENU MATRIX – WITH VHSIC (Continued) (CC INOP)



NOTES:
1. Numbers on the function lines represent multifunction switch actuations necessary to proceed to next menu/submenu.
2. When DATA key is pressed, remain at current menu/submenu.

15E-1-(243-2)40-CATI

Figure 1-21 (Sheet 2)

UFC MENU/SUBMENU MATRIX - WITH AP-1R

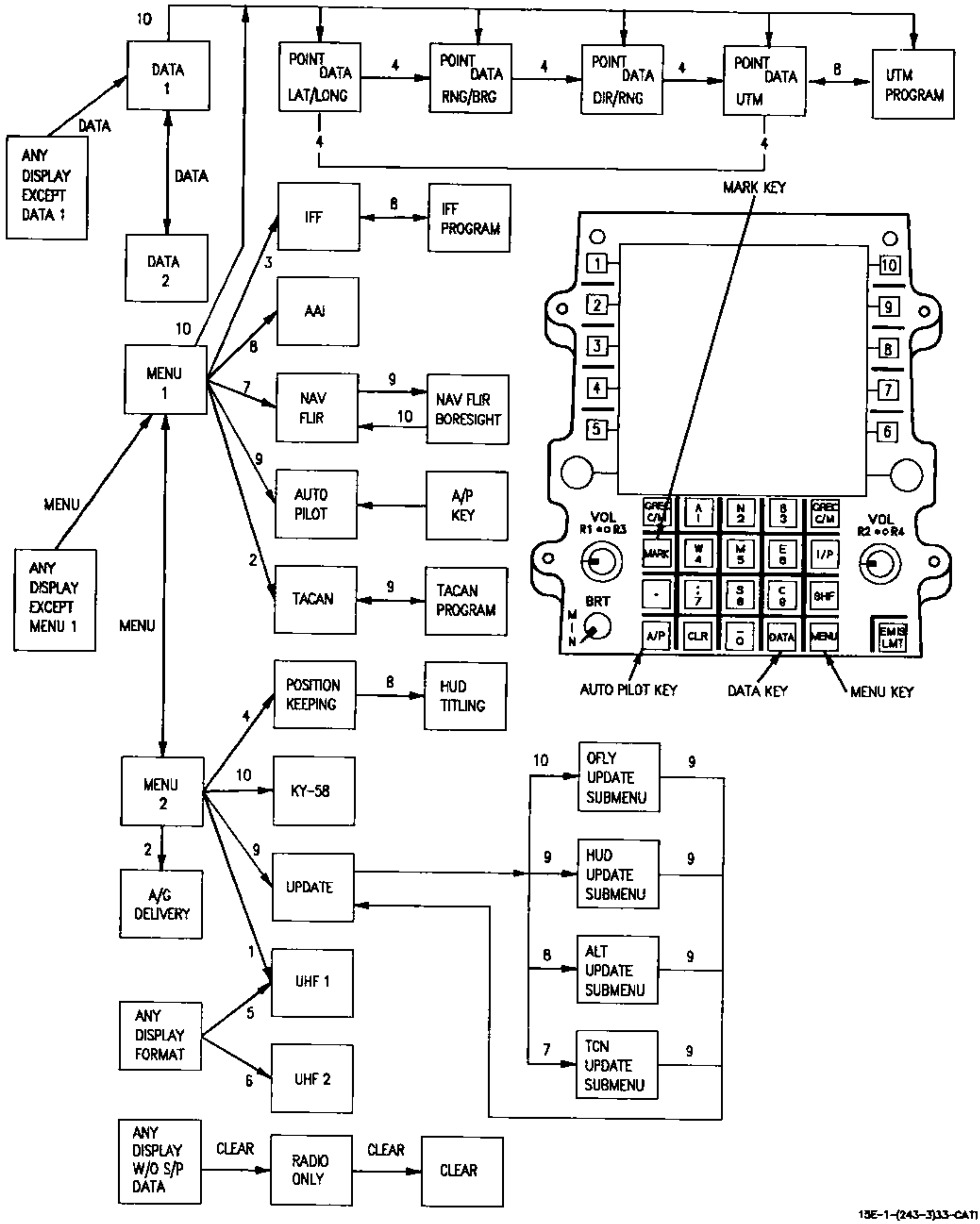
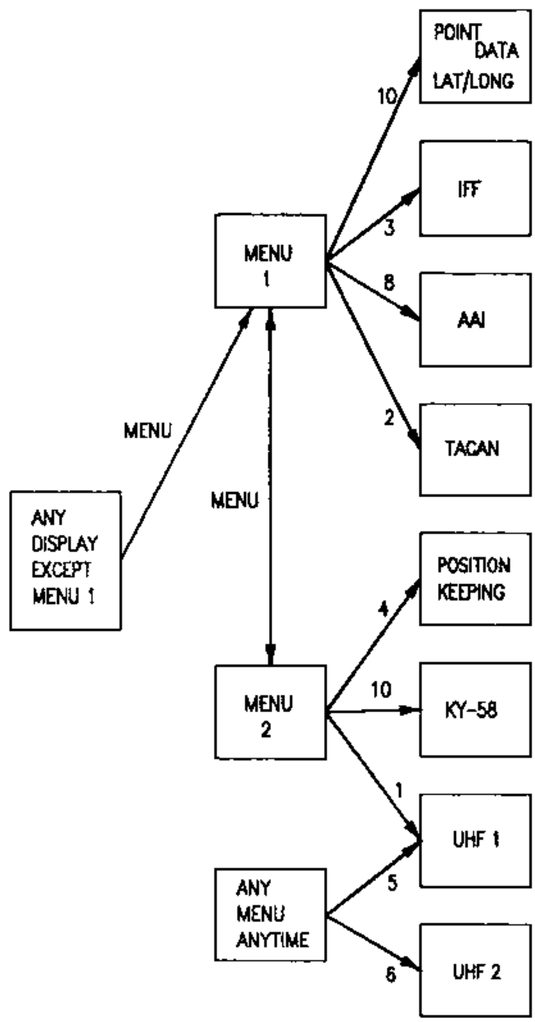


Figure 1-21 (Sheet 3)

UFC MENU/SUBMENU MATRIX – WITH AP-1R (Continued) (CC INOP)



NOTES:

1. Numbers on the function lines represent multifunction switch actuations necessary to proceed to next menu/submenu.
2. When DATA key is pressed, remain at current menu/submenu.

15E-1-(243-4)40-CATI

Figure 1-21 (Sheet 4)

HEAD-UP DISPLAY (HUD)

The HUD control panel, (figure 1-22) is located on the main console. The holographic combiner displays projected raster (video) and stroke (symbols) imagery in a total field of view which measures 21° in elevation and 28° in azimuth. The HUD displays navigation, FLIR video, flight control and weapon delivery information.

HUD CONTROLS

Symbol Brightness (SYM BRT) Control

The SYM BRT control is a rotary knob. Clockwise rotation applies power to the HUD. This control adjusts brightness of the HUD stroke symbology only. Raster video imagery is not affected. A detented OFF position removes power from the HUD.

Symbol (SYM) Declutter Switch

WITH AP-1R, the SYM switch is a three-position, toggle switch which removes and restores symbol information from the HUD. REJ 1 and REJ 2 provide identical declutter functions. Selecting REJ 1 or REJ 2 for all master modes removes the heading scale, command heading, command velocity, pitch ladder, and Bank scale (provided TF radar is off). In air-to-air master modes the target locator line, the off boresight angle and velocity vector are removed. The NORM position restores all information.

WITH VHSIC, the symbol declutter switch remains functional, however programming of the HUD declutter is provided.

DAY/AUTO/NIGHT Switch

The DAY/AUTO /NIGHT switch is a three-position, toggle switch which provides the pilot with a means to select appropriate raster and stroke imagery brightness levels for daytime or nighttime missions. The DAY position allows for the full range of the stroke symbology and raster video. The AUTO position provides automatic brightness adjustment of stroke symbology only based on ambient brightness data.

NOTE

The AUTO position does not provide adequate illumination at night.

The NIGHT position limits the brightness range of the stroke symbology and raster video to be compatible with night operations.

BIT Indicator

In normal operation, the BIT indicator is black. The BIT indicator is white when the HUD has failed. The BIT indicator resets when HUD power is cycled off and back on, or after a successful initiated BIT. If the fault condition still exists after either of the above, the BIT indicator will set white after approximately 60 seconds. When power is removed from the HUD, the BIT indicator holds at its last setting.

Test Button

When the momentary action pushbutton, located above the BIT indicator is pressed and held, an internally generated 18° X 28° FOV raster test pattern is displayed.

Video Brightness (VID BRT) Control

This rotary control fine adjusts the intensity of both the raster-generated video imagery and the stroke-generated symbology. This control ,usually left at the 12 o'clock position, is used to make the darkest shade of gray truly black.

Video Contrast (VID CONT) Control

This rotary control adjusts the contrast level (shades of gray) of the raster generated video. Stroke generated symbology is not affected. When the CONT control is ON, NAV FLIR imagery is processed for display on the HUD. A detented OFF position removes raster generated video from the HUD and restores NAV data in stroke.

Master Mode Buttons

Four master mode buttons are available: NAV, A/A, A/G and INST. When any of these buttons are pressed, the light comes on to indicate that particular mode is selected. Only one master mode can be selected at a time.

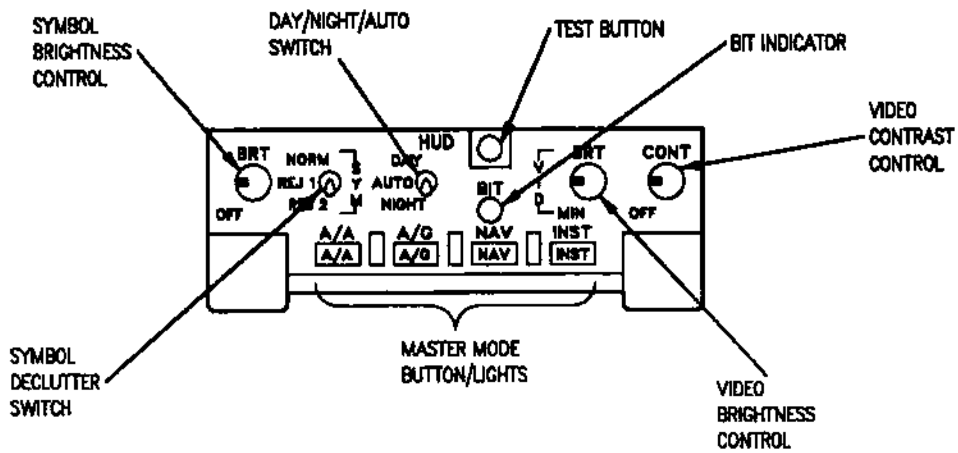
SYSTEM POWER UP

Once aircraft electrical power is applied the HUD is turned on via the SYM BRT control and the raster via the VID CONT control.

HUD SYMBOLS

In this description, the following operational categories of HUD symbology are considered. Refer to figure 1-23.

HUD CONTROL PANEL



15E-1-(245-1)44-CATI

Figure 1-22

a. HUD nav, flight, and weapon delivery symbols that are common to most master modes (except A/G) and positioned depending on the weapon mode and sensor device selected.

b. HUD window displays, alphanumeric data with fixed locations.

Calibrated airspeed and barometric altitude data are displayed in digital format to remove graphics clutter and provide a direct readout of the data. Additionally, the crew can select true airspeed (T) or groundspeed (G) data and select radar (R) altitude for display. These selections are obtained through the UFC data 1 display.

Velocity Vector

The velocity vector displays the instantaneous aircraft flight path with respect to the earth. It is a small airplane symbol. The wings of the symbol always remain parallel to the wings of the aircraft. The vertical relationship between the waterline symbol (when displayed) and the velocity vector indicates true AOA. Velocity vector azimuth displacement from HUD centerline indicates that drift (or a crab angle) is present. The vector symbol is limited to 8.5° radius of motion centered on the HUD. The velocity vector flashes if the data to the CC is degraded or the velocity vector is caged or limited.

The velocity vector may be caged by pressing the laser fire button on the throttle if in command of the HUD and in INST or NAV mode. Caging the velocity vector permits the velocity vector-referenced information (pitch ladder and steering information) to be retained near the center of the HUD when there are large yaw and/or crosswind angles.

Command Velocity

An analog command velocity wiper is displayed left of HUD window 1. The symbol rotates up and down from a horizontal position to indicate the difference between current aircraft speed and command velocity. The symbol rotation is limited from -80° to +80°, where 1° represents 1 knot of velocity. A positive angle signifies more velocity (forward throttle). The command velocity is based on groundspeed or true airspeed if selected on the UFC. Otherwise, command velocity is based on calibrated airspeed. If the command velocity source is invalid, this symbol is not displayed.

Ghost Velocity Vector

When the velocity vector is caged, a ghost velocity vector is displayed at the true velocity vector position. The symbol is presented during snap look and look into turn (NAV FLIR) operations. The pitch ladder

HUD SYMBOLS

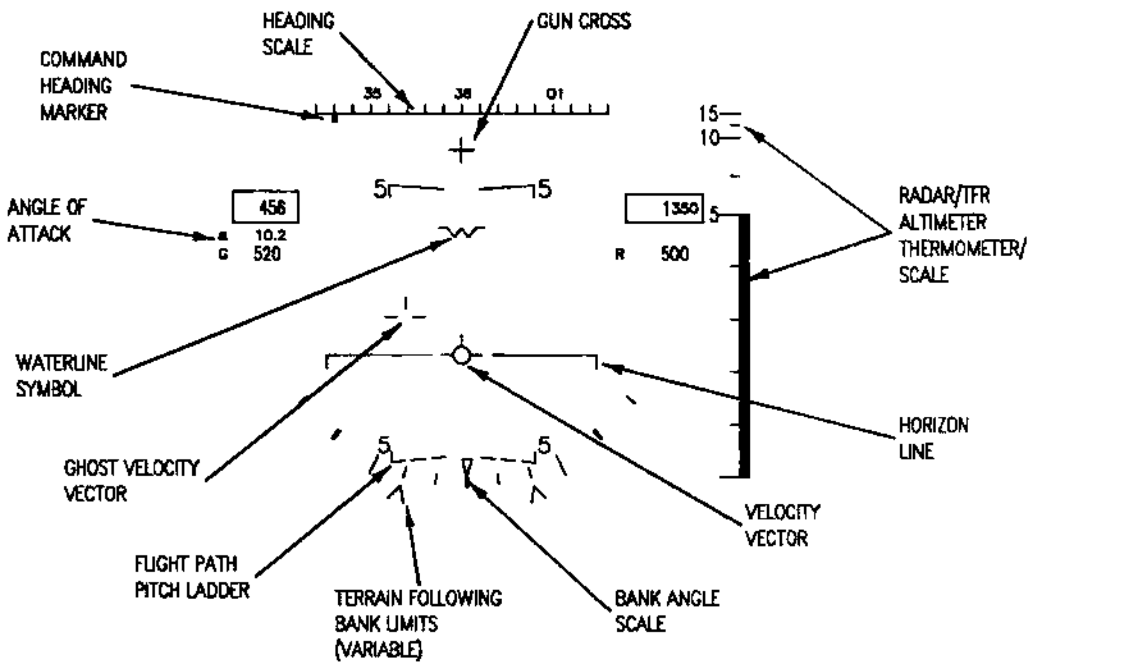


Figure 1-23

and steering information are referenced to the caged position. The ghost velocity vector flashes when within 1.5° of the edge of the HUD.

Flight Path Pitch Ladder

The vertical flight path angle of the aircraft is indicated by the position of the flight path pitch ladder relative to the position of the velocity vector. The aircraft pitch attitude is indicated by the position of the aircraft waterline reference with respect to the pitch ladder about the stabilized wings of the velocity vector. The horizon line and the flight path pitch angle lines are displayed for each 5° between ±85°. Positive pitch lines are solid and negative pitch lines are dashed. The tabs at the end of each segment point toward the horizon. Each line has a number which maintains its orientation relative to the pitch ladder. The pitch lines themselves are angled (point) toward the horizon at an angle one-half the angle of pitch that the line represents. For example, the 40° positive pitch line angles 20° toward the horizon. The 90° dive point is indicated by a circle with an X enclosed. The 90° climb point is indicated by a circle.

The flight path pitch ladder is normally displayed in a position referenced to the velocity vector to provide flight path information. When the velocity vector becomes HUD-limited, the flight ladder does not transition back to the aircraft waterline symbol. The pitch ladder will always be referenced to the valid velocity vector while maintaining the artificial horizon on the horizon. If the velocity vector is not displayed, the pitch ladder is referenced to the aircraft waterline in azimuth and displays best available pitch referenced to the horizon. This transition may take up to 2 seconds.

The horizon bar is longer than other lines in the pitch scale and has tabs at each end that point toward the ground.

Heading Scale

The heading scale moves horizontally against a fixed caret index indicating aircraft magnetic heading from 0° through 360°. The two digit display is expressed in degrees x 10; e.g., 10° is displayed 01 and 250° is displayed 25.

The command heading marker (when displayed) moves against the scale and if the marker is limited, a digital readout of command heading is displayed at the end of the scale.

Bank Angle Scale

With AP-1R, bank angle scale is always displayed in NAV and INST master modes. With VHSIC, bank angle scale is always displayed in NAV and INST master modes unless selected programmed for declutter in REJ 1 or 2. With terrain following ON, a bank angle scale with tic marks (0°, 10°, 20°, 30°, 45°, and 60°) is displayed at the bottom of the HUD except with guided weapons aboard. The 0°and 45° tic marks are single length, double width. The 30° and 60° tic marks are double length, single width. Terrain following bank angle limit carets are displayed against the scale. These limits are variable, however, which is indicated by positionable TF limit caret markers.

Waterline Symbol

An aircraft waterline position is indicated on the HUD by the display of a flying W symbol. The pitch ladder provides aircraft pitch attitude information when it is compared with the waterline symbol. If the velocity vector is not displayed, the pitch ladder slides to its waterline-referenced position in azimuth.

Gun Cross

The gun cross is fixed 2° above waterline in the azimuth center of the HUD and appears when the master arm switch is in ARM. The symbol indicates the projectile conversion point (without AOA or ballistic drop corrections) at the 2250-foot gun harmonization range. The symbol is also the position of the gun reticle pipper at zero mils depression (zero sight line). The gun cross is removed from the display by selecting the master arm switch SAFE position.

Reticle

The primary A/G reticle consists of a 50-mil circle, a 2-mil pipper (aim dot), and a range bar (analog bar) when radar A/G range is available. The reticle is displayed in all A/G attack modes when the CC and HUD are operable. The reticle is positioned in azimuth to one of several points, depending on the delivery mode selected.

a. To the velocity vector (Auto mode).
b. To the computed weapon impact point (CDIP mode).
c. To the HUD depression angle set by the pilot (Direct and Manual modes via the UFC).
d. To weapon boresight (when an EO guided weapon is selected).

Reticle Range Bar

When the CC receives valid laser and/or radar range data, the reticle range bar is displayed around the inside perimeter of the 50-mil reticle circle. When AUTO is displayed on the UFC, the display priority is laser range (if valid) or radar A/G range (AGR) if laser invalid. If LAS or AGR is displayed on the UFC then the displayed choice is used. The range bar, which rotates clockwise with increasing range, displays slant range from 0 to 23,000 feet. The range bar is limited to less than two revolutions around the perimeter of the reticle and contains an index to indicate the magnitude of the range displayed. The first revolution displays slant range from 0 to 12,000 feet and the second revolution displays slant range from 12,000 to 23,000 feet.

Break X

In A/G master mode, the break X is displayed when the aircraft dive angle is greater than 3° and the aircraft is projected to pull out below a specified altitude. The pull out maneuver is a constant pull to attain 4g's in 2 seconds. When radar altitude is the best available source, the break X is displayed when the aircraft will pull out below 200 feet. If barometric is the best available altitude source, then the break X is displayed when the aircraft will pull out below 400 feet. The barometric altitude of the nearest steer point is used to estimate the ground altitude. If the aircraft is in terrain following mode, the BREAK X is displayed at 75% of the selected set clearance if the set clearance is 200 feet or less (e.g., 150 feet for 200 set clearance or 75% of 400 if baro). In CDIP gun, the break X is displayed when the aircraft will pull out below ground level. If the aircraft is in a dive of 20° or greater, the break X is displayed at 200 feet or 400 feet projected pull out altitude even if in terrain following or CDIP gun.

In A/A master mode, the break X is displayed in MRM, SRM or VI modes when the aircrew has penetrated the indicated Rmin range. The symbol flashes in all modes unless an AIM-7 time-of-flight (TOF) countdown is in progress. In this case, the break X remains steady until TOF reaches zero. The ASE circle and steering dot are removed from the display when the break X is displayed in missile modes, but remain on the display in the VI mode.

NOTE

In CDIP gun with pitch angles between -3° and -20°, 0 feet is used as minimum ground clearance altitude.

HUD WINDOWS

Figure 1-24 shows the location of the various windows. Windows 8, 9, and 12 are not fixed; they move dynamically as required. Windows 8 and 9 follow the location of the velocity vector. Window 12 follows the position of the range caret in the HUD radar range scale. When more than one item is commanded for display, the item highest in the list is displayed.

HUD Window 1

Aircraft calibrated airspeed is displayed. If the speed is invalid, OFF is displayed.

HUD Window 2

Aircraft AOA to the nearest tenth of a unit is displayed below the aircraft calibrated airspeed readout at all times.

HUD Window 2A

Aircraft true airspeed or groundspeed is displayed, preceded by T or G as selected on the UFC. If the selected airspeed source is invalid, the letter identifier and OFF is displayed.

HUD Window 3

This window displays the terrain following left turn obstacle (OBST) caution. The right turn caution is displayed in opposing window 15.

HUD Window 4

This window displays IN CMD legend when the pilot has command of the HUD.

HUD Window 5

Emergency Cue

The emergency cue (E) is displayed when the radar is in emergency mode.

Gun Rounds

The gun rounds display is a function of the number of rounds set on the weapon load display minus any rounds fired.

Missile Count

The type of missile loaded on the aircraft is identified by the PACS. With MRM selected, the display consists of M (MRM selected), the count of MRM's available for launch (STBY or RDY), and the type in priority for launch (A for AIM-120A; F or M for the AIM-7).

With SRM selected, the display is S (SRM selected), the total count of SRM's available for launch (in a STBY or RDY status), and the type in priority for launch: J for AIM-9P/P-1; P for AIM-9P-2/P-3; and L or M for those missiles respectively.

The off missile cue is displayed if the attack develops to a point where another on-board missile is in-envelope for a shot at the target. Refer to HUD AIM-7, AIM-9 and AIM-120A Symbols. Refer to TO 1F-15E-34-1-1.

HUD Window 6

Aircraft Mach number is displayed in all modes when the landing gear is up.

HUD Window 7

Target Mach

The target Mach number is displayed only in the visual ident (VI) mode.

Current G/Allowable G

The HUD displays both current and maximum allowable g. Allowable g is displayed for existing flight conditions, aircraft configuration, gross weight, and changes automatically as these factors change. Current g is displayed on the left and maximum allowable g on the right. The g data is not displayed with the landing gear down unless the CC is inoperative. In CC NOGO, only current g is displayed.

Overload Warning System (OWS) Inoperative

The OWOFF cue is displayed when the OWS system fails, or when airborne with an invalid armament condition.

Invalid Armament (INVARM) Cue

This cue is displayed only with Weight on Wheels (WOW) when the PACS senses an unidentifiable store on the aircraft, or if the aircrew programs a store mode that is not in the PACS inventory.

In such a case, OWS processing is disabled. If in flight, an invalid armament cue causes the OWOFF cue to be displayed.

HUD Window 8

Several different warnings concerning the Terrain Following (TF) system may be displayed.

HUD Window 9

Several cautions and information cues concerning the TF and Nav FLIR (NF) systems can be displayed.

HUD Window 10

The selected radar range scale is displayed when the radar is in a track mode.

HUD Window 11

One-half the selected range scale (displayed in window 10) is displayed in window 11.

HUD Window 12

The opening or closing range rate (Vc) in knots between the aircraft and A/A target is displayed when the radar is in track.

HUD Window 12A

If the command heading bug is limited (outside the displayed 30° scale), a digital readout of the command heading is displayed at the appropriate side of the scale.

HUD Window 13

The aircraft barometric altitude is displayed. The thousands and ten thousands digits are larger than the hundreds, tens, and units digits, except below 1000 feet, when all the digits are the large size.

If the barometric altitude is invalid, OFF is displayed.

HUD Window 14

ADC vertical velocity in feet per minute to the nearest 100 feet per minute is displayed in the NAV/INST master modes when the gear is down. Descents are indicated by negative signs preceding the numerical readout.

If the vertical velocity data is invalid, VV OFF is displayed.

When in A/G or A/A master mode, or in NAV/INST master mode with the gear handle up, SNIFF, TSNIFF or FLOOD is displayed when radar is in SNIFF mode or training SNIFF or FLOOD mode respectively. An R displayed at the far right of window 14 indicates mode rejects are being sent to the radar

HUD Window 14A

The aircraft radar altitude is displayed preceded by the letter "R" (if selected on the UFC, if not selected this window will be blanked). If the radar altitude is not valid, OFF preceded by "R" is displayed

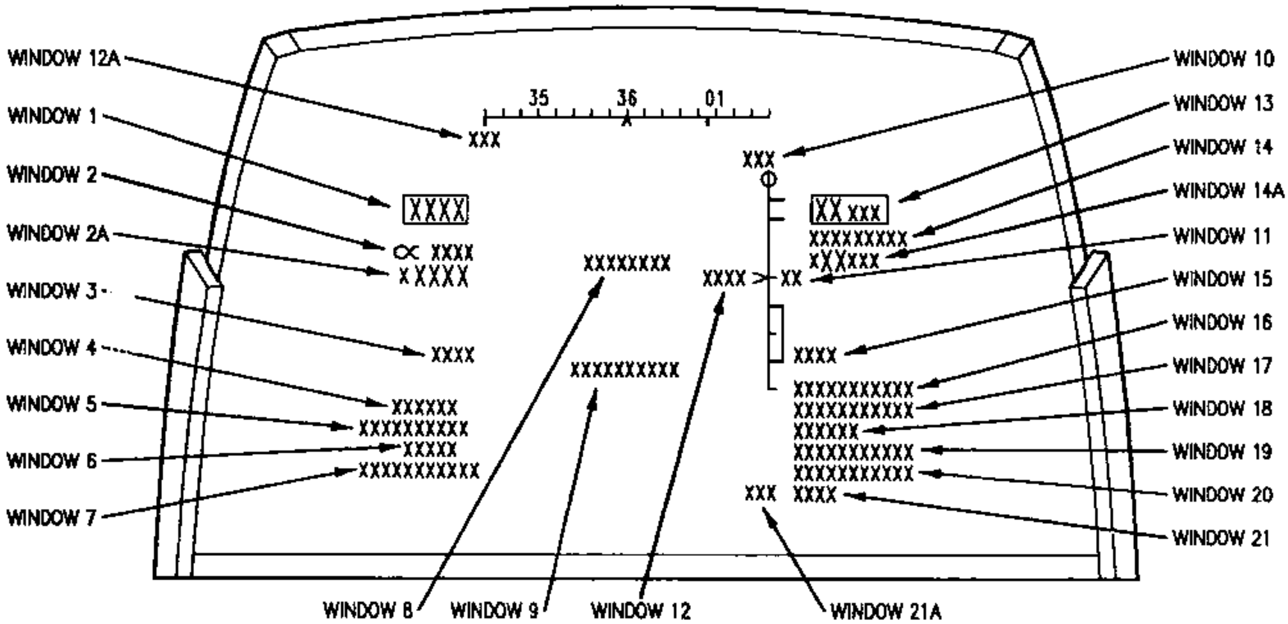
HUD Window 15

This window displays the terrain following right turn OBST caution.

HUD Window 16

INS alignment cues are displayed as required. Refer to applicable paragraphs in this section. Also displays primary designated target (PDT) altitude.

HUD FORMATS - WITH VHSIC



HEAD-UP DISPLAY

LEGEND

1. TRUE AIR OR GROUND SPEED IS SELECTED ON THE UP-FRONT CONTROL X = G OR T DEPENDING ON SELECTED SPEED.
2. DISPLAYED IN ALL MASTER MODES/GEAR UP OR DOWN.
3. XXX CAN BE ANY OF THE EIGHT MISSILE CUES.
4. NOT DISPLAYED WITH GEAR DOWN.
5. ONLY WITH WEIGHT-ON-WHEELS AND INVALID WEAPONS ID IN PACS.
6. NOT DISPLAYED WITH GEAR DOWN UNLESS IN CC NO-GO. IN CC NO-GO, ONLY CURRENT G IS DISPLAYED.
7. VALID INS OR AFCS ON 88-1667 AND UP, GEAR UP WITH OWS OFF.
8. DISPLAYED IF RADAR NOT IN VI TRACK AND ONE OF THE BELOW CONDITIONS EXIST
   A. CAU, INS AND AFCS NOT VALID; INVALID ARMAMENT; WEIGHT-OFF-WHEELS.
   B. VALID ARMAMENT; OWS INVALID; WEIGHT-ON-WHEELS.
   C. VALID ARMAMENT; WEIGHT-OFF-WHEELS; LDG GEAR HANDLE UP; OWS INVALID AND CAU, INS AND AFCS NOT VALID.
9. DISPLAYED WHEN COMMAND HEADING CUE IS OUTSIDE OF HEADING SCALE LIMITS.
10. RADAR ALTITUDE DISPLAY IS SELECTED ON UP-FRONT CONTROL.
11. VERTICAL VELOCITY DISPLAYED IN NAV/INST MASTER MODE WITH GEAR DOWN ONLY WITH PRIORITY OVER RADAR CUES.
12. THE FOLLOWING COMBINATIONS ARE POSSIBLE:
    NAV DEGD.
    IFA, IFA X.X, IFA OK, SH NO TAXI, SH HOLD, SH XX.X, SH OK,
    GC NO TAXI, GC PP REQ, GC HOLD, GC XX.X, GC OK.
    OK=ALIGNMENT FINISHED, PP REQ=A PRESENT POSITION ENTRY IS REQUIRED. NO TAXI=AIRCRAFT SHOULD NOT BE TAXIED.
    HOLD = ALIGNMENT IS ON HOLD. XX.X=ALIGNMENT QUALITY.
13. DESTINATION CODE: BASE 1 THRU 99.01C: MARK 1 THRU 10
14. A/G MASTER MODE WITH NO TARGET DESIGNATED, XXX=NAV OCTCN (DEFAULT), NAV MASTER MODE: XXX=NAV, TCN OR GT.
15. DELETED
16. FOR AIM-7WH, ZZZ=HOH OR DCY: FOR ANY MRM, ZZZ=SML, MED OR LRG DEPENDS ON TARGET TYPE SELECTION ON ARMT FORMAT. OFF MISSILE CUE HAS PRIORITY OVER TARGET TYPE CUE.
17. AIRSPEED MAY FLASH.
18. DELETED
19. R CAN BE DISPLAYED W/SNIFF OR TSNIFF
20. DISPLAY TRNG IN HUD WINDOW 21 IN ALL MASTER MODES WHEN PACS IS IN TRAINING MODE.
21. ATGT (WITHOUT SEQUENCE POINT AND ROUTE LETTER) WILL BE DISPLAYED WHEN A PREPLANNED TARGET IS NOT DESIGNATED.
22. THIS DATA CAN BE REMOVED THRU THE HUD DECLUTTER PROGRAMMING MENU.

15E-1-(244-1)33-CATI

Figure 1-24 (Sheet 1 of 14)

HUD FORMATS – WITH VHSIC *(Continued)*

SYMBOLS – ALL MASTER MODES

		MASTER MODES: A/A				MASTER MODES: NAV/INST					MASTER MODES: A/G							ALL MODES			
Symbol (positions 1 2 3 4 5 6 7 8 9 10 11)		MRM	SRM	GUN	VIS-IDENT	NAV	TACAN	ILS-NAV	ILS-TCN	GND TRK	CDIP	CDIP/GUN	AUTO	AUTO LADD	GUIDED	DIRECT	MANUAL	CC NO-GO	SYM REJ 1	SYM REJ 2	SEE NOTES
1 2 3 4 5 6 7 8 9 10 11	WINDOW 1																				
1 0 4 5	CALIBRATED AIRSPEED	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
O F F	SPEED INVALID	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
1 2 3 4 5 6 7 8 9 10 11	WINDOW 2																				
α 2 0 . 1	ANGLE-OF-ATTACK	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				2, 22
1 2 3 4 5 6 7 8 9 10 11	WINDOW 2A																				
G 1 0 4 5	GROUND SPEED	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				1
T 1 0 4 5	TRUE AIRSPEED	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
X O F F	SPEED INVALID	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
1 2 3 4 5 6 7 8 9 10 11	WINDOW 3																				
O B S T	WARNING (TF LEFT TURN)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
1 2 3 4 5 6 7 8 9 10 11	WINDOW 4																				
I N C M D	IN COMMAND					X	X	X	X	X	X	X	X	X	X	X	X				
1 2 3 4 5 6 7 8 9 10 11	WINDOW 5																				
E	RADAR EMERGENCY MODE CUE	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
7 0 0	ROUNDS REMAINING			X	X							X									
M 4 A	AIM-120A (AIM-120 COUNT)	X			X																
M 4 F	AIM-7F (AIM-7 COUNT)	X			X																
M 4 M	AIM-7M (AIM-7 COUNT)	X			X																
M 4 H	AIM-7MH (AIM-7 COUNT)	X			X																
S 4 J	AIM-9J (AIM-9 COUNT)		X		X																
S 4 P	AIM-9P (AIM-9 COUNT)		X		X																
S 4 L	AIM-9L (AIM-9 COUNT)		X		X																
S 4 M	AIM-9M (AIM-9 COUNT)		X		X																
X X X	OFF MISSILE CUE	X	X	X	X																3
Z Z Z	TARGET TYPE CUE	X																			15
1 2 3 4 5 6 7 8 9 10 11	WINDOW 6																				
. 9 0 0	MACH	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				4, 22
1 2 3 4 5 6 7 8 9 10 11	WINDOW 7																				
I N V A R M	INVALID WEAPON	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				5
T M 1 . 5	TARGET MACH				X																
– 4 . 5 9 . 0 G	CURRENT G, MAX ALLOWABLE G	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			6, 22
– 4 . 5 G O W O F F	OWS OFF	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X				7
O W O F F	OWS OFF	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				8

15E-1-(244-2)40-CATI

Figure 1-24 (Sheet 2)

HUD FORMATS - WITH VHSIC (Continued)

SYMBOLS - ALL MASTER MODES

Window characters (1 2 3 4 5 6 7 8 9 10 11)	Symbol	MRM	SRM	GUN	VIS-IDENT	NAV	TACAN	ILS-NAV	ILS-TCN	GND TRK	CDIP	CDIP/GUN	AUTO	AUTO LADD	GUIDED	DIRECT	MANUAL	CC NO-GO	SYM REJ 1	SYM REJ 2	SEE NOTES
		A/A				NAV/INST					A/G							ALL MODES			
1 2 3 4 5 6 7 8 9 10 11	WINDOW 8																				
F L Y U P	TF WARNINGS	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
U N A R M E D	↓	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
N O A T F	↓	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
T F F A I L	↓	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
O B S T A C L E	↓	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
G L I M I T	↓	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
T F L O W	↓	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
1 2 3 4 5 6 7 8 9 10 11	WINDOW 9																				
R O L L	TF CAUTIONS AND N-F INFO DIVE ANGLE	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
T U R N R A T E	↓	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
T U R N A C C E L	↓	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
D I V E A N G L E	↓	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
I N S L I M I T	↓	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
A I R S P E E D	↓	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			16
N O T E R R A I N	↓	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
E C C M	↓	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
N – F B R S T	↓	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
N – F L O S	↓	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
1 2 3 4 5 6 7 8 9 10 11	WINDOW 10																				
1 6 0	RADAR RANGE SCALE	X	X	X	X																
1 2 3 4 5 6 7 8 9 10 11	WINDOW 11																				
8 0	HALF RADAR RANGE SCALE	X	X	X	X																
1 2 3 4 5 6 7 8 9 10 11	WINDOW 12																				
1 1 5 0	RANGE RATE, +-KTS	X	X	X	X																
1 2 3 4 5 6 7 8 9 10 11	WINDOW 12A																				
2 7 0	LIMITED COMMAND HEADING	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				9
1 2 3 4 5 6 7 8 9 10 11	WINDOW 13																				
4 6 3 5 0 O F F	BARO ALTITUDE INVALID	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
1 2 3 4 5 6 7 8 9 10 11	WINDOW 14																				
V V 2 5 4 0 0	VERTICAL VELOCITY					X	X	X	X	X								X			11
V V O F F	VERTICAL VELOCITY OFF					X	X	X	X	X								X			
S N I F F	RADAR SPECIAL MODE	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
T S N I F F	RADAR SPECIAL MODE	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
R	REJECT SENT TO RADAR	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
F L O O D	RADAR SPECIAL MODE	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				17
1 2 3 4 5 6 7 8 9 10 11	WINDOW 14A																				
R 1 5 0 0 0	RADAR ALTITUDE	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			10
R O F F	INVALID	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
1 2 3 4 5 6 7 8 9 10 11	WINDOW 15																				
O B S T	WARNING (TF RIGHT TURN)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			

15E-1-(244-3)33-CATI

Figure 1-24 (Sheet 3)

HUD FORMATS – WITH VHSIC *(Continued)*

SYMBOLS – ALL MASTER MODES

		MASTER MODES																ALL MODES			
		A/A				NAV/INST					A/G										
		MRM	SRM	GUN	VIS-IDENT	NAV	TACAN	ILS-NAV	ILS-TCN	GND TRK	CDIP	CDIP/GUN	AUTO	AUTO LADD	GUIDED	DIRECT	MANUAL	CC NO-GO	SYM REJ 1	SYM REJ 2	SEE NOTES
1 2 3 4 5 6 7 8 9 10 11	WINDOW 16																				12
G C O K	GYRO COMPASS ALIGN MODE	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
I F A P P R E Q	IN-FLIGHT ALIGN MODE	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
S H N O T A X I	STORED HEADING	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
	ALIGN MODE	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
H O L D		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
X X . X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
N A V D E G D	DEGRADED NAV MODE	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
X X – X	PDT ALTITUDE	X	X	X	X																
1 7 L	LEFT ASPECT ANGLE	X	X	X	X																
0 1 R	RIGHT ASPECT ANGLE	X	X	X	X																
T	TAIL ASPECT ANGLE	X	X	X	X																
H	HEAD ASPECT ANGLE	X	X	X	X																
U N C	UNCAGE (SRM)		X																		
1 2 3 4 5 6 7 8 9 10 11	WINDOW 17																				
J A M	RADAR JAM CODE	X	X	X	X																
H O J	RADAR HOJ CODE	X	X	X	X																
A O J	RADAR AOJ CODE	X	X	X	X																
M E M	TRACK MEMORY	X	X	X	X																
N O Z O N E	NO ZONE	X	X																		
B A D T R K	BAD TRACK	X																			
T G T 9 9 .	PREPLANNED TARGET										X		X	X	X	X					
T G T	NON-PLANNED TARGET										X		X	X	X	X					13
N A V 9 9 . 0 7 C	NAV STEER MODE					X					X	X	X	X	X	X	X	X			22
T C N 1 0 3 X	TACAN STEER MODE						X				X	X	X	X	X	X	X	X			22
I L S N 9 9 . 0 7 C	ILS-NAV STEER MODE							X										X			22
I L S T 1 1 2 . 5	ILS-TACAN STEER MODE								X									X			22
G T 9 9 . 0 7 C	GROUND TRACK STEER MODE									X											22
A X X X 9 9 . 0 7 C	AUTO PILOT SELECTED					X	X			X	X	X	X	X	X	X	X				14
A T G T X X . X	AUTO PILOT NAV STEERING AND TARGET DESIGNATED										X	X	X	X	X	X	X				21
1 2 3 4 5 6 7 8 9 10 11	WINDOW 18																				
R 1 5 0 . 1	RADAR RANGE	X	X	X	X																
G 1 9 . 6	A/G RANGE										X	X	X	X	X						
N 9 8 0 . 7	NAV RANGE					X		X		X	X	X	X	X	X	X	X	X			22
T 2 0 6 . 3	TACAN RANGE	X	X	X	X		X		X		X	X	X	X	X	X		X			22
1 2 3 4 5 6 7 8 9 10 11	WINDOW 19																				
3 5 S E C	AIM-120 TIME-TO-ACTIVE	X																			
A # # S E C	AIM-120 TIME-TO-INTERCEPT	X																			
T # # S E C	AIM-7 TIME-OF-FLIGHT	X																			
1 : 1 5 T B U R S T	TIME-TO-BURST (NUCLEAR)										X	X	X	X	X	X	X				
1 : 1 5 T I M P C T	TIME-TO-IMPACT										X	X	X	X	X	X	X				
1 0 : 1 5 T P U L L	TIME-TO-PULL												X	X							
1 0 : 1 5 T R E L	TIME-TO-RELEASE										X	X	X	X	X						
1 0 : 1 5 T T G T	TIME-TO-TARGET										X	X	X	X	X	X					
1 1 : 3 0 : 1 5	NAV, TCN TIME-TO-GO					X	X	X	X												22

15E-1-(244-4)40-CATI

Figure 1-24 (Sheet 4)

HUD SYMBOLS – WITH VHSIC (Continued)

SYMBOLS – ALL MASTER MODES

		MASTER MODES																ALL MODES			
		A/A				NAV/INST					A/G										
		MRM	SRM	GUN	VIS-IDENT	NAV	TACAN	ILS-NAV	ILS-TCN	GND TRK	CDIP	CDIP/GUN	AUTO	AUTO LADD	GUIDED	DIRECT	MANUAL	CC NO-GO	SYM REJ 1	SYM REJ 2	SEE NOTES
1 2 3 4 5 6 7 8 9 10 11	WINDOW 20																				
A # / # # SEC	AIM-120 MIN/MAX TOF	X																			
T # / # # SEC	AIM-7 MIN/MAX TOF	X					X	X	X												
LSG/LSG	LOSING	X																			
XXX/XXX	LOST	X																			
CSET 270	COURSE SET (ILS/TACAN)						X	X	X												22
MKR	ILS MARKER BEACON							X	X									X			
CDIP	CDIP DELIVERY MODE										X										
GUN	CDIP GUN MODE											X									
AUTO	AUTO DELIVERY MODE												X								
LADD	AUTO LADD DELIVERY MODE													X							
GUIDED	GUIDED DELIVERY MODE														X						
DIRECT	DIRECT DELIVERY MODE															X					
MANUAL	MANUAL DELIVERY MODE																X				
LAS	LASER HAT SENSOR										X	X	X	X	X	X	X				19
LAS X	EXTRAPOLATE										X	X	X	X	X	X	X				
RALT	CARA HAT SENSOR										X	X	X	X	X	X	X				
RALT X	EXTRAPOLATE										X	X	X	X	X	X	X				
BARO	SYSTEM ALTITUDE HAT SENSOR										X	X	X	X	X	X	X				
AGR	RADAR HAT SENSOR										X	X	X	X	X	X	X				
AGR X	EXTRAPOLATE										X	X	X	X	X	X	X				
1 2 3 4 5 6 7 8 9 10 11	WINDOW 21																				
TRNG	PACS TRAINING WINDOW	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			18
1 2 3 4 5 6 7 8 9 10 11	WINDOW 21A																				
DUD	DUD										X	X	X	X	X	X	X				

15E-1-(244-5)40-CATI

Figure 1-24 (Sheet 5)

HUD FORMATS – WITH VHSIC *(Continued)*

SYMBOLS – ALL MASTER MODES

HUD SYMBOLOGY	MASTER MODES																ALL MODES		
	A/A				NAV/INST					A/G									
	MRM	SRM	GUN	VIS-IDENT	NAV	TACAN	ILS-NAV	ILS-TCN	GND TRK	CDIP	CDIP/GUN	AUTO	AUTO LADD	GUIDED	DIRECT	MANUAL	CC NO-GO	SYM REJ 1	SYM REJ 2
SHOOT CUE	X	X																	
PITCH STEERING 1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
BANK STEERING					X	X	X	X	X			X					X		
AIRCRAFT WATERLINE SYMBOL 2	X	X		X	X	X	X	X	X								X		
VELOCITY VECTOR 3	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
GHOST VELOCITY VECTOR 4	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
HEADING SCALE	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
PITCH LADDER	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
RANGE SCALE	X	X	X	X															
GUN CROSS	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
R MIN, R MAX 1	X	X																	
R MAX 2 , RTR	X																		
ASE CIRCLE	X	X		X															
RETICLE RANGE BAR		X	X	X						X	X	X	X	X	X	X			
DYNAMIC SEEKER RANGE	X																		
A/A GUN RETICLE			X																
LAG LINE			X																
BULLET TIME-OF-FLIGHT			X																
STEERING DOT	X	X		X															
A/A TGT DESIGNATOR BOX	X	X	X	X	X	X	X	X	X										
BREAK X	X	X		X						X	X	X	X	X	X	X			
FOV/REF CIRCLE	X	X															X		
AIM-9L/M SEEKER POSITION		X												X					
VERT SCAN LINE	X	X	X	X															
SUPER SEARCH CIRCLE	X	X	X	X															
4 DEG BORESIGHT REF CIRCLE	X	X	X	X															
DISPLAYED IMPACT LINE										X									
PULL-UP CUE										X		X	X	X	X				
AZIMUTH STEERING LINE												X	X	X					
RELEASE CUE												X	X						

15E-1-(244-6)33-CATI

Figure 1-24 (Sheet 6)

HUD FORMATS – WITH VHSIC (Continued)

SYMBOLS – ALL MASTER MODES

HUD SYMBOLOGY	MASTER MODES																ALL MODES		
	A/A				NAV/INST					A/G									
	MRM	SRM	GUN	VIS-IDENT	NAV	TACAN	ILS-NAV	ILS-TCN	GND TRK	CDIP	CDIP/GUN	AUTO	AUTO LADD	GUIDED	DIRECT	MANUAL	CC NO-GO	SYM REJ 1	SYM REJ 2
COMMAND HEADING CUE	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
A/G TGT DESIGNATOR DIAMOND										X		X	X	X	X				
BANK SCALE AND POINTER					X	X	X	X	X			X	X			X	X	X	X
A/G GUN RETICLE										X	X	X	X	X	X	X			
NAV LOS DESIGNATOR					X	X	X	X	X	X	X	X	X	X					
RADAR ALTIMETER SCALE 5	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
ELEVATION STEERING LINE												X	X						
LASER CUE	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
TCN/ILS HUD CDI						X	X	X											
ILS GLIDESLOPE							X	X											
GBU-15 RANGE DATA														X					
ANGLE OF ATTACK	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
COMMAND VELOCITY	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			

NOTES

1 A/A OR A/G MASTER MODE – TF PITCH STEERING ONLY WHEN TF IS SELECTED.
NAV/INST MASTER MODE – TF PITCH STEERING IF TF SELECTED, ILS PITCH STEERING WHEN ILSN OR ILST IS SELECTED.

2 – AIRCRAFT SYMBOL WILL BE DISPLAYED IN A/A GUN MODE IF
(A) SYMBOL REJECT IS NOT SELECTED AND
(B) VELOCITY VECTOR IS HUD LIMITED.

3 – REJECT IN A/A MASTER MODE ONLY.

4 DISPLAYED WHEN VELOCITY VECTOR IS CAGED ON FLIR IN LOOK-INTO TURN. REJECT IN A/A MASTER MODE ONLY.

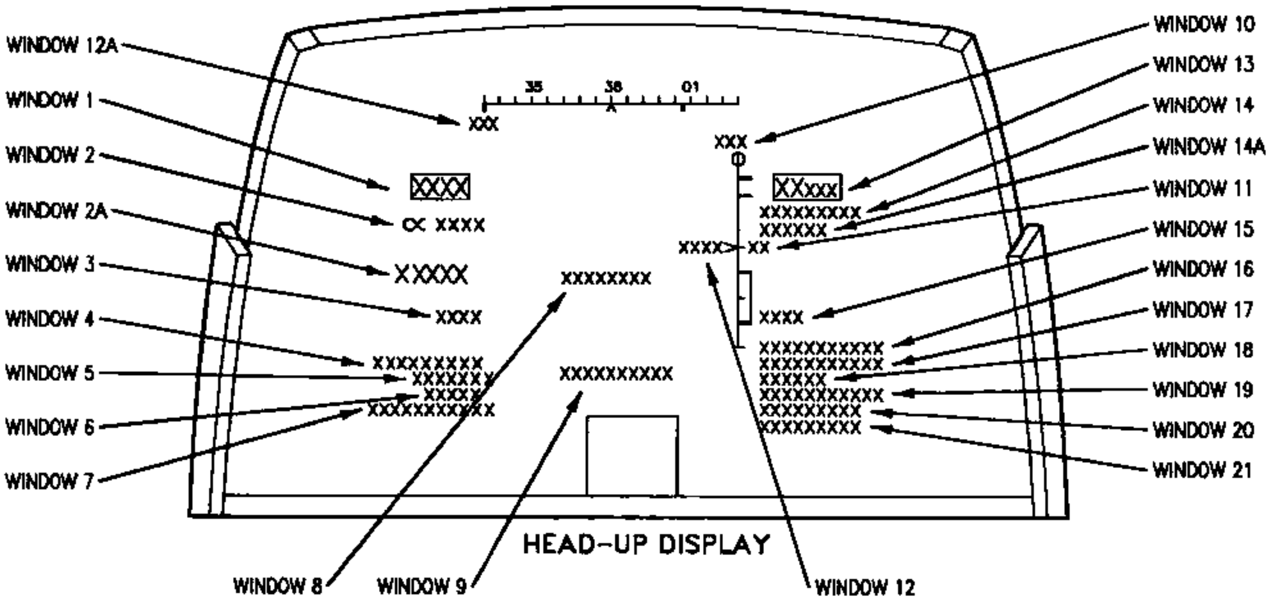
5 DISPLAYED WHEN CARA IS ON AND RADAR ALTIMETER IS ≤ 1500' AGL.

15E-1-(244-7)38-CATI

Figure 1-24 (Sheet 7)

HUD FORMAT - WITH AP-1R

WINDOWS – ALL MASTER MODES



LEGEND

1. TRUE AIR OR GROUND SPEED IS SELECTED ON THE UP-FRONT CONTROL X = G OR T DEPENDING ON SELECTED SPEED.
2. DISPLAYED IN ALL MASTER MODES/GEAR UP OR DOWN.
3. XXX CAN BE ANY OF THE EIGHT MISSILE CUES.
4. NOT DISPLAYED WITH GEAR DOWN.
5. ONLY WITH WEIGHT-ON-WHEELS AND INVALID WEAPONS ID IN PACS.
6. NOT DISPLAYED WITH GEAR DOWN UNLESS IN CC NO-GO. IN CC NO-GO, ONLY CURRENT G IS DISPLAYED.
7. VALID INS OR AFCS ON 88-1667 AND UP, GEAR UP WITH OWS OFF.
8. DISPLAYED IF RADAR NOT IN VI TRACK AND ONE OF THE BELOW CONDITIONS EXIST
   - A. CAU, INS AND AFCS NOT VALID; INVALID ARMAMENT; WEIGHT-OFF-WHEELS.
   - B. VALID ARMAMENT; OWS INVALID; WEIGHT-ON-WHEELS.
   - C. VALID ARMAMENT; WEIGHT-OFF-WHEELS; LDG GEAR HANDLE UP; OWS INVALID AND CAU, INS AND AFCS NOT VALID.
9. DISPLAYED WHEN COMMAND HEADING CUE IS OUTSIDE OF HEADING SCALE LIMITS.
10. RADAR ALTITUDE DISPLAY IS SELECTED ON UP-FRONT CONTROL.
11. VERTICAL VELOCITY DISPLAYED IN NAV/INST MASTER MODE WITH GEAR DOWN ONLY WITH PRIORITY OVER RADAR CUES.
12. THE FOLLOWING COMBINATIONS ARE POSSIBLE:
    NAV DEGD.
    IFA, IFA X.X, IFA OK, SH NO TAXI, SH HOLD, SH XX.X, SH OK, GC NO TAXI, GC PP REQ, GC HOLD, GC XX.X, GC OK.
    OK=ALIGNMENT FINISHED, PP REQ=A PRESENT POSITION ENTRY IS REQUIRED. NO TAXI=AIRCRAFT SHOULD NOT BE TAXIED, HOLD = ALIGNMENT IS ON HOLD. XX.X=ALIGNMENT QUALITY.
13. DESTINATION CODE: BASE 1 THRU 99.01C; MARK 1 THRU 10
14. A/G MASTER MODE WITH NO TARGET DESIGNATED, XXX=NAV DCTCN (DEFAULT), NAV MASTER MODE: XXX=NAV, TCN OR GT.
15. FOR AIM-7WH, ZZZ=HOH OR DCY: FOR ANY MRM, ZZZ=SML, MED OR LRG DEPENDS ON TARGET TYPE SELECTION ON ARMT FORMAT. OFF MISSILE CUE HAS PRIORITY OVER TARGET TYPE CUE.
16. AIRSPEED MAY FLASH.
17. R CAN BE DISPLAYED W/SNIFF OR TSNIFF
18. DISPLAY TRNG IN HUD WINDOW 21 IN ALL MASTER MODES WHEN PACS IS IN TRAINING MODE.
19. HEIGHTH ABOVE TARGET (HAT) SENSOR CURRENTLY IN USE FOR A/G DELIVERY. "X" INDICATES EXTRAPOLATING RANGE.

15E-1-(244-8)33-CATI

Figure 1-24 (Sheet 8)

HUD FORMATS - WITH AP-1R (Continued)

SYMBOLS - ALL MASTER MODES

		MASTER MODES A/A				NAV/INST					A/G							ALL MODES			
		MRM	SRM	GUN	VIS-IDENT	NAV	TACAN	ILS-NAV	ILS-TCN	GND TRK	CDIP	CDIP/GUN	AUTO	AUTO LADD	GUIDED	DIRECT	MANUAL	CC NO-GO	SYM REJ 1	SYM REJ 2	SEE NOTES
1 2 3 4 5 6 7 8 9 10 11	WINDOW 1																				
1 0 4 5	CALIBRATED AIRSPEED	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
0 F F	SPEED INVALID	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
1 2 3 4 5 6 7 8 9 10 11	WINDOW 2																				
∝ 2 0 . 1	ANGLE-OF-ATTACK	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				2
1 2 3 4 5 6 7 8 9 10 11	WINDOW 2A																				
G 1 0 4 5	GROUND SPEED	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				1
T 1 0 4 5	TRUE AIRSPEED	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
X 0 F F	SPEED INVALID	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
1 2 3 4 5 6 7 8 9 10 11	WINDOW 3																				
O B S T	WARNING (TF LEFT TURN)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
1 2 3 4 5 6 7 8 9 10 11	WINDOW 4																				
I N C M D	IN COMMAND					X	X	X	X	X											
1 2 3 4 5 6 7 8 9 10 11	WINDOW 5																				
E	RADAR EMERENCY MODE CUE	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
7 0 0	ROUNDS REMAINING			X	X							X									
M 4 A	AIM-120A (AIM-120 COUNT)	X			X																
M 4 F	AIM-7F (AIM-7 COUNT)	X			X																
M 4 M	AIM-7M (AIM-7 COUNT)	X			X																
M 4 H	AIM-7MH (AIM-7 COUNT)	X			X																
S 4 J	AIM-9J (AIM-9 COUNT)		X		X																
S 4 P	AIM-9P (AIM-9 COUNT)		X		X																
S 4 L	AIM-9L (AIM-9 COUNT)		X		X																
S 4 M	AIM-9M (AIM-9 COUNT)		X		X																
X X X	OFF-MISSILE CUE	X	X	X	X																3
Z Z Z	TARGET TYPE CUE	X																			15
1 2 3 4 5 6 7 8 9 10 11	WINDOW 6																				
0 . 9 0 0	MACH	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				4
1 2 3 4 5 6 7 8 9 10 11	WINDOW 7																				
I N V A R M	INVALID WEAPON	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				5
T M 1 . 5	TARGET MACH				X																
- 4 . 5 9 . 0 G	CURRENT G, MAX ALLOWABLE G	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			6
- 4 . 5 G O W O F F	OWS OFF	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X				7
O W O F F	OWS OFF	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				8

15E-1-(244-6)33-CATI

Figure 1-24 (Sheet 9)

HUD FORMATS – WITH AP-1R *(Continued)*

SYMBOLS – ALL MASTER MODES

		MASTER MODES																ALL MODES			
		A/A				NAV/INST					A/G										
		MRM	SRM	GUN	VIS-IDENT	NAV	TACAN	ILS-NAV	ILS-TCN	GND TRK	CDIP	CDIP/GUN	AUTO	AUTO LADD	GUIDED	DIRECT	MANUAL	CC NO-GO	SYM REJ 1	SYM REJ 2	SEE NOTES
1 2 3 4 5 6 7 8 9 10 11	WINDOW 8																				
FLY UP	TF WARNINGS	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
UNARMED	↓	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
TF FAIL	↓	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
OBSTACLE	↓	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
G LIMIT	↓	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
TF LOW	↓	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
1 2 3 4 5 6 7 8 9 10 11	WINDOW 9																				
ROLL	TF CAUTIONS AND	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			16
TURN RATE	N-F INFO	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
TURN ACCEL	DIVE ANGLE	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
DIV ANGLE	↓	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
INS LIMIT	↓	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
AIRSPEED	↓	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
NO TERRAIN	↓	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
ECCM	↓	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
N-F BRST	↓	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
N-F LOS	↓	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
1 2 3 4 5 6 7 8 9 10 11	WINDOW 10																				
160	RADAR RANGE SCALE	X	X	X	X																
1 2 3 4 5 6 7 8 9 10 11	WINDOW 11																				
80	HALF RADAR RANGE SCALE	X	X	X	X																
1 2 3 4 5 6 7 8 9 10 11	WINDOW 12																				
1150	RANGE RATE, +-KTS	X	X	X	X																
1 2 3 4 5 6 7 8 9 10 11	WINDOW 12A																				
270	LIMITED COMMAND HEADING	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				9
1 2 3 4 5 6 7 8 9 10 11	WINDOW 13																				
46350	BARO ALTITUDE	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
OFF	INVALID																				
1 2 3 4 5 6 7 8 9 10 11	WINDOW 14																				
VV 25400	VERTICAL VELOCITY					X	X	X	X	X								X			11
VV OFF	VERTICAL VELOCITY OFF					X	X	X	X	X								X			
SNIFF	RADAR SPECIAL MODE	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
TSNIFF	RADAR SPECIAL MODE	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
R	REJECT SENT TO RADAR	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				17
FLOOD	RADAR SPECIAL MODE	X	X	X	X												X				
1 2 3 4 5 6 7 8 9 10 11	WINDOW 14A																				
R 15000	RADAR ALTITUDE	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			10
R OFF	INVALID	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
1 2 3 4 5 6 7 8 9 10 11	WINDOW 15																				
OBST	WARNING (TF RIGHT TURN)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			

15E-1-(244-10)33-CATI

Figure 1-24 (Sheet 10)

HUD FORMATS – WITH AP-1R (Continued)

SYMBOLS – ALL MASTER MODES

		MASTER MODES																ALL MODES			
		A/A				NAV/INST					A/G										
		MRM	SRM	GUN	VIS-IDENT	NAV	TACAN	ILS-NAV	ILS-TCN	GND TRK	CDIP	CDIP/GUN	AUTO	AUTO LADD	GUIDED	DIRECT	MANUAL	CC NO-GO	SYM REJ 1	SYM REJ 2	SEE NOTES
1 2 3 4 5 6 7 8 9 10 11	WINDOW 16																				⟨12⟩
G C 0 K	GYRO COMPASS ALIGN MODE	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
I F A P P R E Q	IN-FLIGHT ALIGN MODE	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
S H N O T A X I	STORED HEADING ALIGN MODE	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
H O L D		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
X X . X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
N A V D E G D	DEGRADED NAV MODE	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X				
A X X – X	PDT ALTITUDE	X	X	X	X																
1 2 3 4 5 6 7 8 9 10 11	WINDOW 17																				
J A M	RADER JAM CODE	X	X	X	X																
H O J	RADER HOJ CODE	X	X	X	X																
A O J	RADER AOJ CODE	X	X	X	X																
M E M	TRACK MEMORY	X	X	X	X																
N O Z O N E	NO ZONE	X	X																		
B A D T R K	BAD TRACK	X																			
T G T 9 9 .	PREPLANNED TARGET										X		X	X	X						
T G T	NON-PLANNED TARGET										X		X	X	X	X					⟨13⟩
N A V 9 9 . 0 7 C	NAV STEER MODE					X					X	X	X	X	X	X	X	X			
T C N 1 0 3 X	TACAN STEER MODE						X				X	X	X	X	X	X	X	X			
I L S N 9 9 . 0 7 C	ILS-NAV STEER MODE							X										X			
I L S T 1 1 2 . 5	ILS-TACAN STEER MODE								X									X			
G T 9 9 . 0 7 C	GROUND TRACK STEER MODE									X											
A X X X 9 9 . 0 7 C	AUTO PILOT SELECTED					X	X			X	X	X	X	X	X	X	X				⟨14⟩
1 2 3 4 5 6 7 8 9 10 11	WINDOW 18																				
R 1 5 0 . 1	RADER RANGE	X	X	X	X																
G 1 9 . 6	A/G RANGE										X	X	X	X	X						
N 9 8 0 . 7	NAV RANGE					X		X		X	X	X	X	X	X	X	X	X			
T 2 0 6 . 3	TACAN RANGE	X	X	X	X		X		X		X	X	X	X	X	X		X			
1 2 3 4 5 6 7 8 9 10 11	WINDOW 19																				
3 5 S E C	MRM TIME-TO-GO	X	X	X	X																
L O S I N G	MRM LOSTNGE	X	X	X	X																
1 : 1 5 T B U R S T	TIME-TO-BURST (NUCLEAR)										X	X	X	X	X	X	X				
1 : 1 5 T I M P C T	TIME-TO-IMPACT										X	X	X	X	X	X	X				
1 0 : 1 5 T P U L L	TIME-TO-PULL												X	X							
1 0 : 1 5 T R E L	TIME-TO-RELEASE										X	X	X	X	X						
1 0 : 1 5 T T G T	TIME-TO-TARGET										X	X	X	X	X	X					
0 1 : 3 0 : 1 5	NAV, TCN TIME-TO-GO					X	X	X	X												
1 2 3 4 5 6 7 8 9 10 11	WINDOW 20																				
C S E T 2 7 0	COURSE SET (ILS/TACAN)						X	X	X												
M K R	ILS MARKER BEACON							X	X									X			
U N C	UNCAGE (SRM)		X																		

15E-1-(244-11)33-CATI

Figure 1-24 (Sheet 11)

HUD FORMATS – WITH AP–1R *(Continued)*

SYMBOLS – ALL MASTER MODES

		MASTER MODES																ALL MODES			
		A/A				NAV/INST					A/G										
		MRM	SRM	GUN	VIS-IDENT	NAV	TACAN	ILS-NAV	ILS-TCN	GND TRK	CDIP	CDIP/GUN	AUTO	AUTO LADD	GUIDED	DIRECT	MANUAL	CC NO-GO	SYM REJ 1	SYM REJ 2	SEE NOTES
1 2 3 4 5 6 7 8 9 10 11	WINDOW 20																				
1 7 L	LEFT ASPECT ANGLE	X	X	X	X																
0 1 R	RIGHT ASPECT ANGLE	X	X	X	X																
T	TAIL ASPECT ANGLE	X	X	X	X																
H	HEAD ASPECT ANGLE	X	X	X	X																
C D I P	CDIP DELIVERY MODE										X										
G U N	CDIP GUN MODE											X									
A U T O	AUTO DELIVERY MODE												X								
L A D D	AUTO LADD DELIVERY MODE													X							
G U I D E D	GUIDED DELIVERY MODE														X						
D I R E C T	DIRECT DELIVERY MODE															X					
M A N U A L	MANUAL DELIVERY MODE																X				19
L A S	LASER HAT SENSOR										X	X	X	X	X	X	X				
L A S X	EXTRAPOLATE										X	X	X	X	X	X	X				
A G R	RADAR HAT SENSOR										X	X	X	X	X	X	X				
A G R X	EXTRAPOLATE										X	X	X	X	X	X	X				
R A L T	CARA HAT SENSOR										X	X	X	X	X	X	X				
R A L T X	EXTRAPOLATE										X	X	X	X	X	X	X				
B A R O	SYSTEM ALTITUDE HAT SENSOR										X	X	X	X	X	X	X				
1 2 3 4 5 6 7 8 9 10 11	WINDOW 21																				18
T R N G	PACS TRAINING MODE	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			

15E-1-(244-12)33-CATI

Figure 1-24 (Sheet 12)

HUD FORMATS - WITH AP-1R (Continued)

SYMBOLS - ALL MASTER MODES

HUD SYMBOLOGY	MASTER MODES																ALL MODES		
	A/A				NAV/INST					A/G									
	MRM	SRM	GUN	VIS-IDENT	NAV	TACAN	ILS-NAV	ILS-TCN	GND TRK	CDIP	CDIP/GUN	AUTO	AUTO LADD	GUIDED	DIRECT	MANUAL	CC NO-GO	SYM REJ 1	SYM REJ 2
SHOOT CUE	X	X																	
PITCH STEERING [1]	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
BANK STEERING					X	X	X	X	X			X					X		
AIRCRAFT WATERLINE SYMBOL [2]	X	X		X	X	X	X	X	X								X		
VELOCITY VECTOR [3]	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
GHOST VELOCITY VECTOR [4]	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
HEADING SCALE	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
PITCH LADDER	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
RANGE SCALE	X	X	X	X															
GUN CROSS	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
R MIN, R MAX 1	X	X																	
R MAX 2 , RTR	X																		
ASE CIRCLE	X	X		X															
RETICLE RANGE BAR		X	X	X						X	X	X	X	X	X	X			
DYNAMIC SEEKER RANGE	X																		
A/A GUN RETICLE			X																
LAG LINE			X																
BULLET TIME-OF-FLIGHT			X																
STEERING DOT	X	X		X															
A/A TGT DESIGNATOR BOX	X	X	X	X															
BREAK X	X	X		X						X	X	X	X	X	X	X			
FOV/REF CIRCLE	X	X															X		
AIM-9L/M SEEKER POSITION		X												X					
VERT SCAN LINE	X	X	X	X															
SUPER SEARCH CIRCLE	X	X	X	X															
4 DEG BORESIGHT REF CIRCLE	X	X	X	X															
DISPLAYED IMPACT LINE										X									
PULL-UP CUE										X		X	X	X	X				
AZIMUTH STEERING LINE												X	X	X					
RELEASE CUE												X	X						

15E-1-(244-13)33-CATI

Figure 1-24 (Sheet 13)

HUD FORMATS – WITH AP-1R (Continued)

SYMBOLS – ALL MASTER MODES

HUD SYMBOLOGY	MASTER MODES: A/A MRM	SRM	GUN	VIS-IDENT	NAV/INST: NAV	TACAN	ILS-NAV	ILS-TCN	GND TRK	A/G: CDIP	CDIP/GUN	AUTO	AUTO LADD	GUIDED	DIRECT	MANUAL	ALL MODES: CC NO-GO	SYM REJ 1	SYM REJ 2
COMMAND HEADING CUE	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
A/G TGT DESIGNATOR DIAMOND										X		X	X	X	X				
BANK SCALE AND POINTER					X	X	X	X	X			X	X			X	X	X	X
A/G GUN RETICLE										X	X	X	X	X	X	X			
NAV LOS DESIGNATOR					X	X	X	X	X	X	X	X	X	X					
RADAR ALTIMETER SCALE 5					X	X	X	X	X	X	X	X	X	X	X	X	X		
ELEVATION STEERING LINE												X	X						
LASER CUE	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
TCN/ILS HUD CDI						X	X	X											
ILS GLIDESLOPE							X	X											
GBU-15 RANGE DATA														X					
ANGLE OF ATTACK	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
COMMAND VELOCITY	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			

NOTES

1 A/A OR A/G MASTER MODE – TF PITCH STEERING ONLY WHEN TF IS SELECTED.
NAV/INST MASTER MODE – TF PITCH STEERING IF TF SELECTED, ILS PITCH STEERING WHEN ILSN OR ILST IS SELECTED.

2 – AIRCRAFT SYMBOL WILL BE DISPLAYED IN A/A GUN MODE IF
(A) SYMBOL REJECT IS NOT SELECTED AND
(B) VELOCITY VECTOR IS HUD LIMITED.

3 – REJECT IN A/A MASTER MODE ONLY.

4 DISPLAYED WHEN VELOCITY VECTOR IS CAGED ON FLIR IN LOOK-INTO TURN. REJECT IN A/A MASTER MODE ONLY.

5 WHEN TF IS SELECTED ONLY.

15E-1-(244-1)33-CATI

Figure 1-24 (Sheet 14)

HUD Window 17

Radar Jam Codes

The jam codes, when displayed, override all other window 17 displays. Refer to TO 1F-15E-34-1-1-1.

Track Memory (MEM)

Refer to A/A Radar Displays, TO 1F-15E-34-1-1.

No Zone

Refer to A/A Radar Displays and to AIM-7 Missile, TO 1F-15E-34-1-1-1.

Bad Track (BAD TRK)

This cue is displayed when the radar track quality is judged to be poor based on an inconsistent number of target updates (hits). Since the cue is not range dependent, it is designed to give an earlier indication of a degrading track than the MEM cue.

NAV Steer Displays

These cues are applicable to A/G target selection and to the NAV/INST master mode. Refer to applicable paragraphs in this section.

HUD Window 18

Range Displays

Window 18 always displays range data. A prefix letter identifies the display as R (radar), T (tacan), N (Nav), or G (A/G) designated range. Ranges are displayed with a resolution of 0.1 NM to a maximum of 999.9 NM. The maximum radar range displayed is 160 NM.

HUD Window 19

MRM Time of Flight

The MRM prelaunch TOF cue is steady and appears in radar track when target range is between Rmax1 and Rmin. The value is the predicted MRM TOF and is continuously updated as range and angle conditions change. The postlaunch TOF, a function of target position and velocity data, provides an accurate display of the required illumination period. The indications are as follows:

Target does not maneuver.	Flashing TOF counts down in real time.
Target maneuvers, staying in range.	Flashing TOF countdown adjusted for target maneuvers.
Lost missile, target has maneuvered to or beyond missile limit	LOST is displayed for 15 seconds.
Flood Launch	Flashing TOF counts down in real time.

Nav/Tacan Time To Go (Tgo)

In the NAV/INST master mode, the Tgo displays pertain to the NAV/TCN range displays shown in window 18.

A/G Attack Mode Tgo

The A/G Tgo values pertain to the A/G range data of window 18, and the A/G weapon delivery modes displayed in window 20.

HUD Window 20

ILS Cues

Various cues are displayed for the ILS in the NAV/INST master modes. Refer to applicable paragraphs in this section.

CSET cue

In NAV/INST master modes, CSET XXX will flash for 10 seconds when entering TCN, ILST or ILSN steer modes. The flashing of the cue is independent of the previously selected mode. Also, the cue will not flash or appear on the NAV/INST HUD when the course select value is changed on the HSI.

Uncage (UNC)

UNC is displayed when the NGS button is pressed an odd number of times to permit SRM seeker uncage (IR lockon). An even number of button depressions removes UNC from the HUD, breaks IR lockon, and returns the SRM seeker to the missile boresight or to the (AIM-9L/M) radar antenna LOS.

Target Aspect Angle

Target aspect angle is displayed for the designated A/A target.

A/G Delivery Mode

A cue denoting the selected A/G weapon delivery mode is displayed for each delivery mode. In addition, a cue denoting the sensor currently in use to calculate the height above target (HAT) is displayed.

HUD Window 21

This window displays TRNG cue when PACS is in a training mode.

HUD DISPLAY PROGRAMMING (REJECT 1 AND 2) - WITH VHSIC

Programming the HUD symbology can be done using menu 2 on the MPD/MPCD. HUD PROG is displayed next to PB 17 on menu 2. The HUD symbols are programmable for two reject levels (1 and 2) and for all the master modes. NAV and INST master modes cannot be programmed separately.

In order to program the HUD symbology, the aircrew selects HUD PROG from menu 2. Once selected, the HUD PROG display initializes to the master mode and reject level currently selected on the HUD control panel. Also if the pilot changes the master mode or reject level on the HUD control panel, the HUD PROG display will also change to reflect the new master mode or reject level. The aircrew can then select the symbology which will be displayed on the HUD and verify the selections using the HUD or the HUD repeater display. Symbols which are boxed are displayed on the HUD and the current master mode and reject level are displayed at the center of the display.

The aircrew can also program the HUD symbology independent of the master mode and reject level selected on the HUD control panel. This allows either crewmember to change the HUD programming options in flight without affecting the current master mode. Pressing PB 13 toggles to the next reject level and PB 14 toggles to the next master mode.

A list of the symbols displayed with default selected are shown in master mode HUD programming tables under master mode programming, this section.

HUD MRM MODE

See HUD AIM-7 or AIM-120A Mode Symbols, refer to TO 1F-15E-34-1-1.

HUD SRM MODE

See HUD AIM-9 Mode Symbols, refer to TO 1F-15E-34-1-1.

HUD GUN MODE

See HUD GUN Mode Symbols, refer to TO 1F-15E-34-1-1.

HUD BACK-UP MODE

When the CC has failed and the MPDP has taken control of the mux bus and the displays, the HUD is in back-up mode. In back-up mode the HUD display format always appears in the gear-up position even if the gear is down. INS provides pitch and bank data and radar provides altitude data. The HUD format will only be displayed on the HUD (no repeater display).

MULTIPURPOSE DISPLAY PROCESSOR

The MPDP is a multiple processor symbol generator that simultaneously drives eight displays. The eight displays include four MPD's, three MPCD's, and the HUD. The MPDP generates and overlays symbology (graphic symbols and alphanumerics) onto the MPD and MPCD by raster and/or stroke methods. A separate display channel drives each display individually. Display output data generated by the MPDP may consist of either stroke written symbology (only), monochrome and color rasters, or hybrid with monochromatic raster symbology.

The primary functions of the MPDP include:

a. Produce stroke symbology and background video information for displays on the MPCD's, MPD's, HUD, and video tape recorder (VTR).

b. Convert analog voltage signals from the OWS into digital values for transmission to the CC.

c. Data communications for the DTM.

d. Backup bus controller (CC no-go condition exists) for avionics 1553 mux bus.

e. Bus controller for JTIDS 1553 mux bus (not used).

f. BIT controller for HUD, MPCD, and MPD.

g. Primary display (HUD, MPD, and MPCD) controller when CC no-go exists.

h. Process discrete data from:
1. Radar
2. Radar warning receiver (RWR)
3. Electronic warfare warning set (EWWS)
4. Fuel quantity and acceleration data (for OWS function)
5. LANTIRN NAV and targeting pods (video)
6. Remote map reader (video)
7. Weapon stations (video).

i. Sends discrete data to:
1. BIT discretes to AIU no. 1 and ASP
2. OWS
3. NAV targeting pod (weapon video).

The MPDP produces symbology for the HUD, MPD, and MPCD. It also does video processing for the MPD and MPCD. It initiates and controls data transfer with the HUD, MPD, and MPCD and communicates with the CC using the displays 1553 mux bus.

The central computer, in normal mode, is the primary display controller for the multipurpose display system. The MPDP general processor (GP) section becomes the primary display controller during backup mode (CC no-go exists).

The MPDP transfers serial data to and from the DTM. When transfer is complete the MPDP communicates the DTM data to the CC through the displays 1553 mux bus. The DTM is preprogrammed with flight operational data for a specific flight or mission. The DTM also has the ability to receive and store flight data from the MPDP.

The MPDP converts all displays to composite video for the VTR. This video can be any display format or a split screen format (a pair of display formats recorded side by side).

The MPDP provides control of the avionics 1553 mux bus when the CC is not operational. The MPDP receives a CC no-go from the CC and automatically takes command of the avionics 1553 mux bus. During this backup mode condition, the MPDP communicates with eight systems.

a. Inertial navigation set
b. Remote map reader
c. Radar system
d. Left and right engines
e. Flight control computer
f. Radar warning receiver system
g. LANTIRN system
h. Avionics interface unit set
i. The MPDP also provides normal communications with the MPD, MPCD, and HUD.

MULTI-PURPOSE DISPLAYS/MULTI-PURPOSE COLOR DISPLAYS

There are two MPD's in each cockpit, and one MPCD in the front cockpit and two MPCD's in the rear cockpit. The MPD's display system data, sensor video and weapon information in monochromatic format. The MPD's have 20 peripheral pushbuttons by which the crew can control weapons systems, sensors and data to be displayed. Legends are positioned adjacent to each pushbutton to advise the crew of the modes and options selectable for operation of the onboard radar, FLIR, navigation, and weapon systems. The exact content of data in the display formats is software programmable. The MPCD's display monochromatic or multicolor presentation of sensor and weapon video overlaid with symbology, advisory readouts and navigation data. Color coding of display data aids in quick interpretation of complex formats such as HSI and ADI. Color presentation of navigational maps also contributes to easy and accurate assessment of the tactical situation. The MPCDs also have 20 peripheral pushbuttons which provide control in the same manner as the MPD. Each MPD/MPCD has a power switch, a brightness switch, a contrast switch and a BIT indicator. Refer to figure 1-25.

Pushbuttons

There are twenty pushbuttons on each MPD/MPCD numbered 1 thru 20 counterclockwise from the upper button on the left side of the display to the left button on the top of the display.

Power Switch

A two position rocker switch provides electrical power to the MPD/MPCD's. When powering up the aircraft, the aircrew must turn on the MPD and MPCD's. However, if the aircrew experiences a brief power interrupt inflight, the MPD/MPCD displays will automatically come up without reselecting the power rocker switch.

Brightness Switch

A two-position, spring-loaded-to-center rocker switch provides a non-linear adjustment of stroke written symbol luminance or brightness. On the MPD the switch controls black level. On the MPCD this switch controls brightness and raster contrast. Backlighted arrow symbols on this rocker switch indicate an increase or decrease in CRT display brightness.

NOTE

If color distortions or blotches are displayed, reduce the brightness control.

Contrast Switch

A two-position, spring-loaded-to-center rocker switch provides adjustment of raster contrast, also called shade of gray. On the MPD's the switch adjusts both raster contrast and stroke brightness.

BIT Indicator

A magnetically controlled BIT ball rolls over to indicate white when MPD/MPCD has failed. In normal operation, the BIT ball is seen as black. When power is removed from the MPD/MPCD, the BIT ball will hold at its last setting. The BIT ball will reset automatically when the failure is corrected.

POWER UP OPERATION

Once electrical power is available, the individual MPD/MPCD must be turned on with the power switch. The display format that was being presented at aircraft shutdown will be initialized on each MPD/MPCD as shown on the MPD in figure 1-25. The letter M or M2 is displayed adjacent to the pushbutton in the lower right hand corner of each display unit. It is used to call up the menu 1 or menu 2 display. When power is turned on, the MPD/MPCD's will come up at a 50% default brightness level and will be fully active. Default brightness level is a function of the DAY/NIGHT switch setting on the interior lights control panel. Pressing the pushbutton adjacent to the M results in the menu display shown on the MPD in figure 1-25.

MENU DISPLAY

The menu displays can be selected by pressing the lower right hand pushbutton on any display. This pushbutton will always be labeled M or M2 From the menu display (figure 1-25) the individual system formats are selected by pressing the appropriate pushbutton adjacent to the system legend. Any format can be presented on any display unit except the air-to-ground radar format which is not selectable (legend not displayed) on a color display unit. Pressing the lower right hand pushbutton will alternate between the two menu displays. The menu 1 display has 18 separate display selections to choose from and one that permits display programming. Use of the various displays are described in other parts of this manual where the affected system(s) is covered.

NOTE

The A/G radar display is not available on the MPCD. WPN1/WPN2 display is only available when an EO or IR weapon is loaded.

The menu display options are as follows:

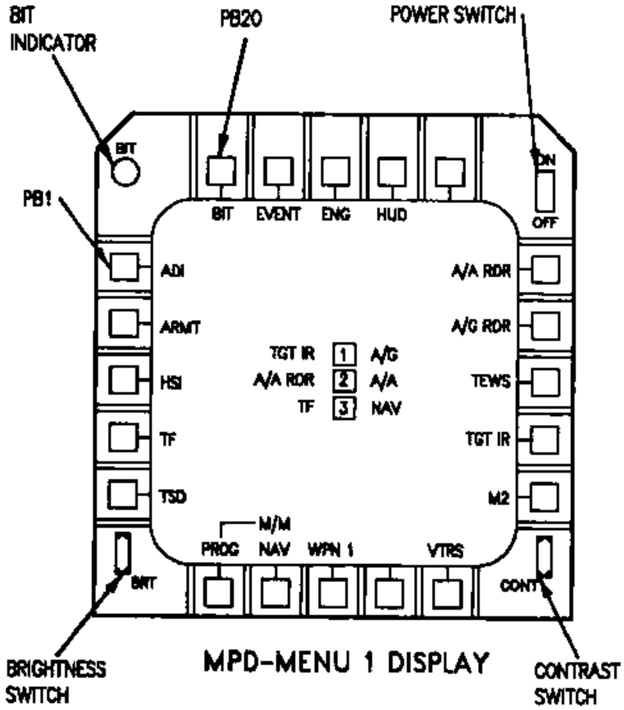
MENU 1

PROG M/M	Program master mode
NAV	NAV master mode
WPN1	Weapon video from GBU-15, AGM-65
WPN2	Weapon video from a second A/G guided weapon, if installed
VTRS	Video Tape Recording System
M2	Menu 2
TGT IR	LANTIRN Targeting FLIR
TEWS	Tactical Electronic Warfare System
A/G RDR	Air-to-ground radar map
A/A RDR	Air-to-Air Radar
HUD	Head Up Display
ENG	Engine Parameters
EVENT	A/G Event Data
BIT	Built-In Test
ADI	Attitude Director Indicator
ARMT	Armament
HSI	Horizontal Situation Indicator
TF	Terrain Following
TSD	Tactical Situation Display

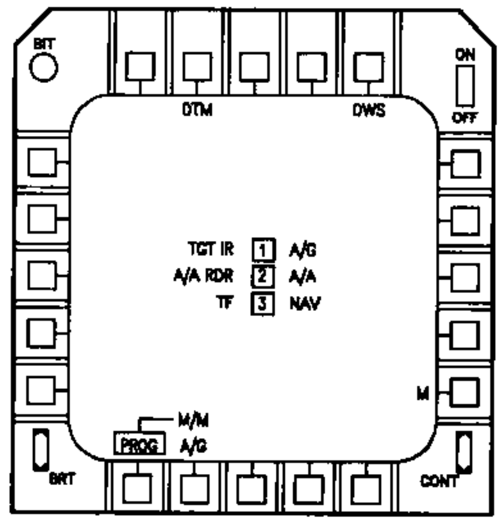
MENU 2

PROG M/M	Program master mode
A/G	Air-to-Ground master mode
M	Menu 1
OWS	Overload Warning System
HUD PROG (VHSIC)	HUD symbol program declutter
DTM	Data Transfer Module

MPD - WITH AP-1R

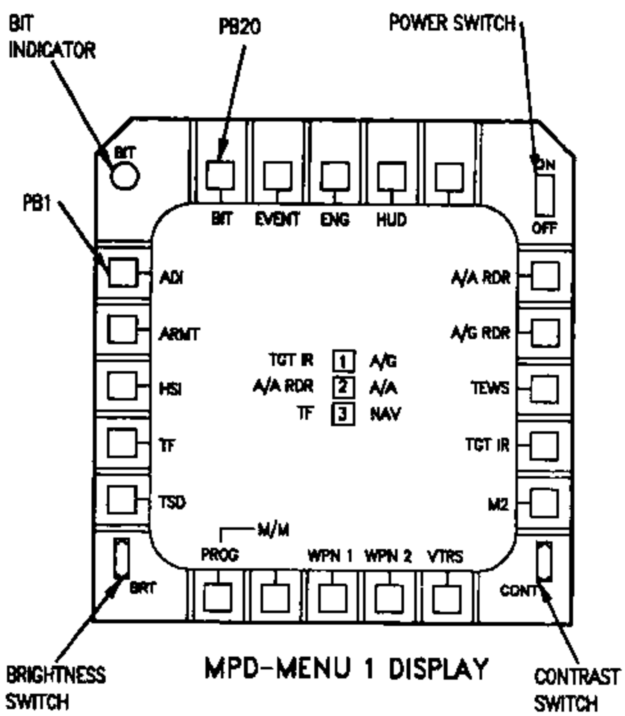


MPD-MENU 1 DISPLAY

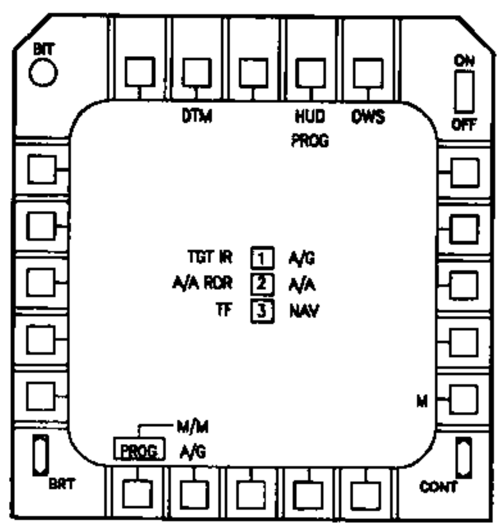


MPD-MENU 2 DISPLAY

MPD - WITH VHSIC



MPD-MENU 1 DISPLAY



MPD-MENU 2 DISPLAY

15E-1-(37-1)33-CATI

Figure 1-25

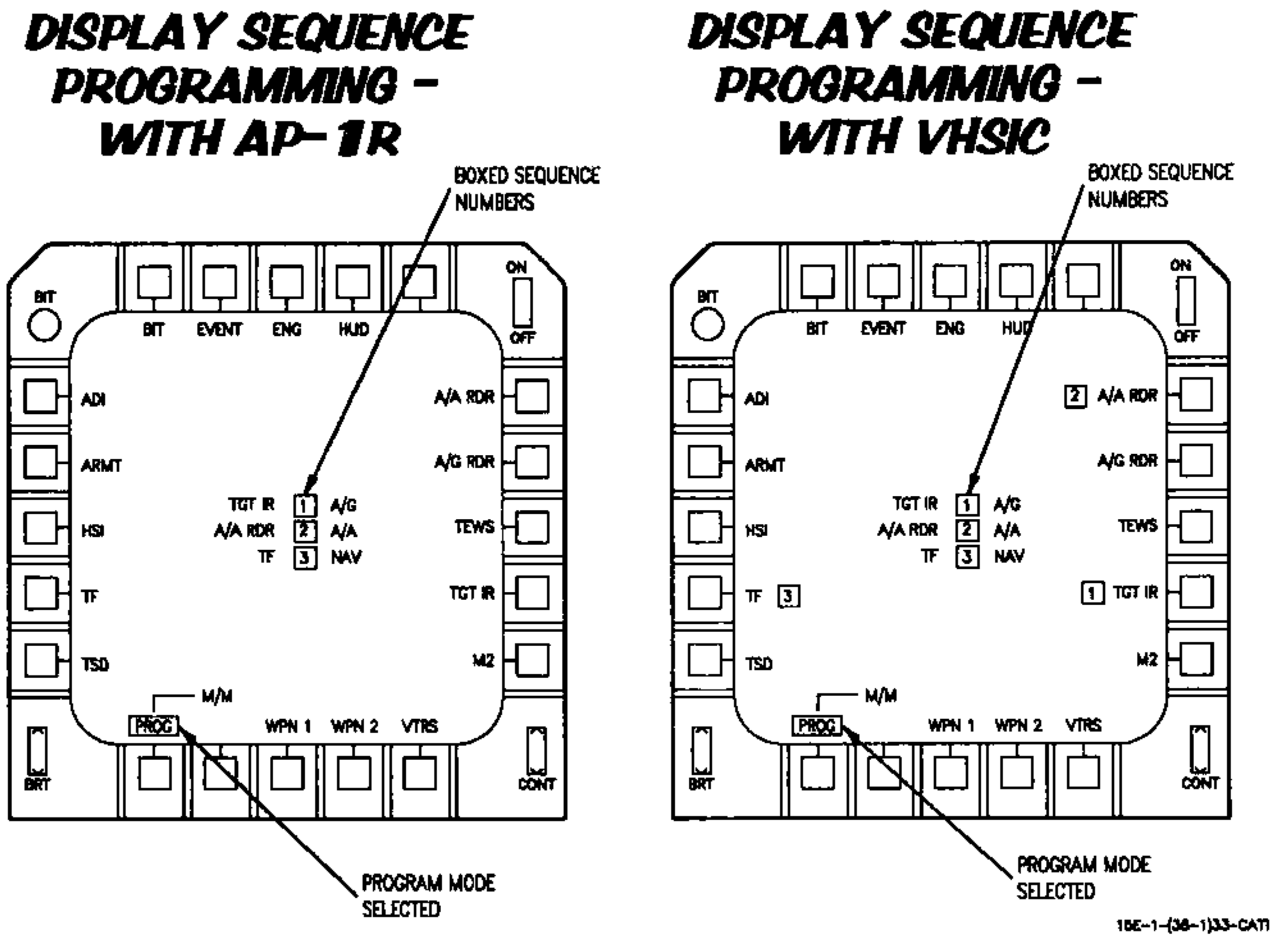


Figure 1-26

Display Sequence Programming

To simplify operation, each MPD/MPCD can be programmed to provide hands-on access for up to three display formats. The pilot and/or WSO can then address a specific display with a switch integrated into the stick grip for the pilot, and a similar switch integrated into each hand controller for the WSO. To program the displays, first select the menu display, then press the program (PROG) pushbutton (PB 6). A box appears around PROG. Refer to figure 1-26. Then select the display formats in the order desired. When selected, the boxed sequence number is displayed in the center of the screen with the format name to the left. When master modes are assigned to a format, the master mode abbreviation is displayed to the right of the sequence number. The program numbers are assigned in the order the pushbuttons are pressed. For example, A/A RDR was selected first, A/G RDR second, and HSI third. With this accomplished, the display formats can now be displayed in the order selected through the HOTAS controls. To exit the program mode, press PB 6 or scroll to one of the programmed displays. The box around PROG will be removed. To reprogram a particular display, reselect program, deselect the undesired display format, and select the one desired. Also, it is not necessary to program all seven head down displays. To sequence or scroll through the displays in the cockpit, toggle the castle switch toward the desired display Refer to figure 1-27. Each time the switch is toggled toward a display, it will scroll to the next programmed display format. The first aft movement of the front cockpit castle switch will present the ADI on the front cockpit MPCD. Quick access to the front cockpit ADI may not be possible with PACS nuclear display. Refer to TO 1F-15E-25-1. The rear cockpit four way coolie switch on the left hand controller controls the left MPD/MPCD, the right hand controller coolie switch controls the right MPD/MPCD. Moving the switch in a forward (or upward) direction will scroll through the display program on the inboard MPD. Moving it aft (or downward) scrolls through the display program on the outboard MPCD. Operation is the same for the left display or the right display. Program display rotation is summarized in figure 1-27. Note that the forward cockpit operation is independent from the rear and vice versa.

MASTER MODE PROGRAMMING

To simplify operation and reduce crew workload, a method of programming the displays as a function of master mode has been implemented. By selecting a master mode, as shown in figure 1-28, A/A, A/G, NAV, and INST, a specific set of display formats can be displayed. Three of these master modes are programmable by the crewmembers while the fourth, INST, is preprogrammed and cannot be changed by the crewmembers.

Programming the displays as a function of master mode is shown in figure 1-28. Note that a display format cannot be programmed to a master mode until that display format has been assigned a display sequence number. To program the displays, first select PROG on the menu display. Then select the master mode to be programmed, A/A, A/G or NAV. This is accomplished by alternate depressions of the display pushbutton under the legend M/M on the MPD/MPCD. Finally, press the pushbutton adjacent to the system display format desired. The master mode now appears next to the selected display format. The display formats on the top and bottom rows of the menu format can be programmed to one master mode. Those on the left and right sides can be programmed to three master modes. Also note that each master mode can be assigned to only one display format at a time. Each MPD/MPCD can be programmed using this procedure.

HUD Programmed Declutter - WITH VHSIC

Figure 1-29 shows the symbols and description of the HUD symbology and whether the symbol is contained in the default set of symbols.

There are several exceptions for removal of symbology from the HUD, listed below :

a. The RALT scale and bank scale can be selected for removal from the HUD. However, in TF the RALT scale and bank scale are always displayed regardless of programming and master mode selections.

b. The bank bar can be selected for removal in NAV/INST master mode. However, it will not be removed in ILST or ILSN.

c. If NAV data is selected for removal from the HUD, the pilot can use the coolie switch (outboard) on the throttle to recall the steer mode and range data.

d. If OWS is selected for removal from the HUD and an invalid maximum g condition occurs, OWOFF is automatically displayed on the HUD.

The aircrew can use the DTM to load two customized HUD programs (REJECT 1 and REJECT 2) for each master mode. A display of HUD PROG is also seen on the DTM READ IN PROGRESS menu.

PROGRAMMED DISPLAY ROTATION

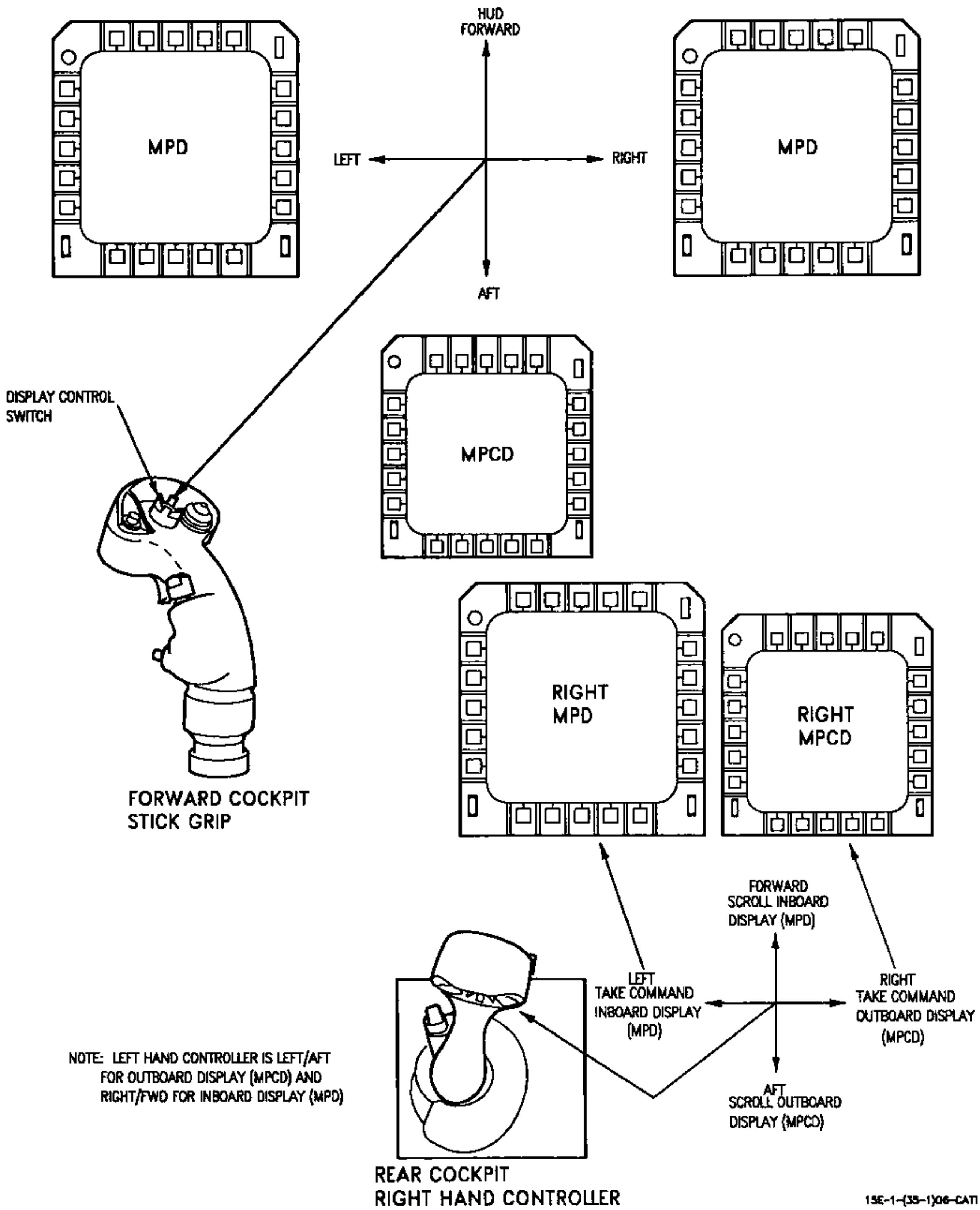
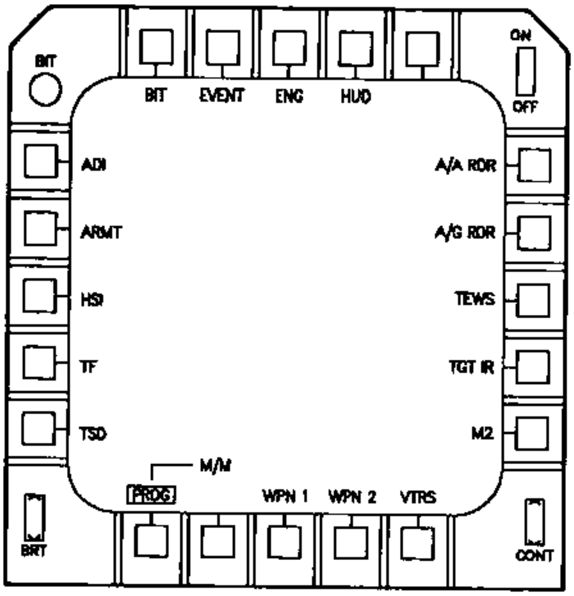
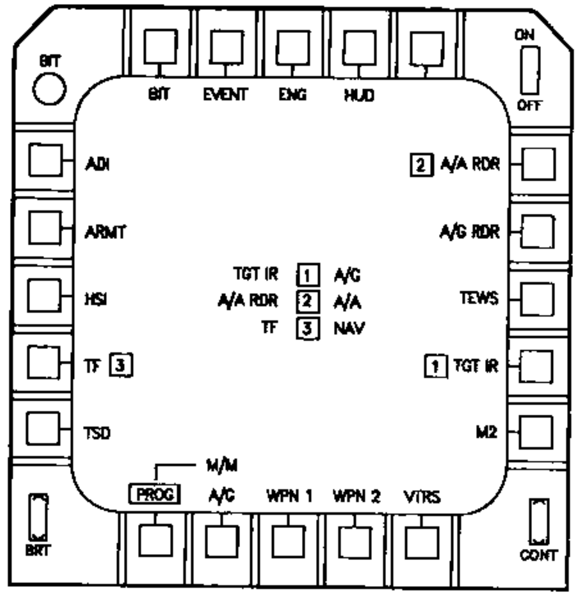


Figure 1-27

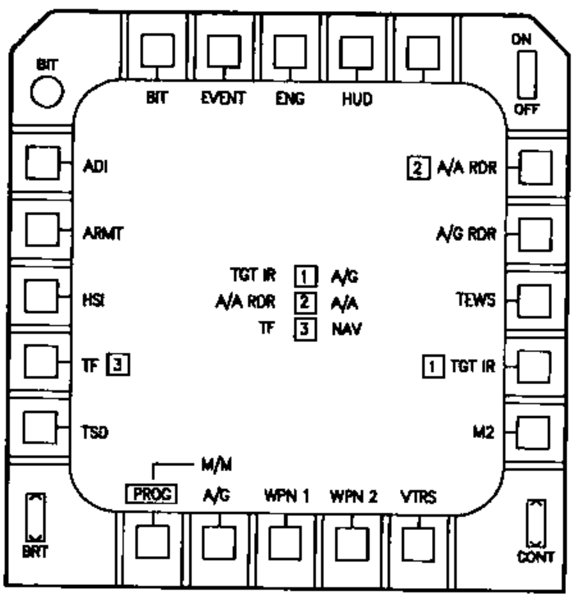
MASTER MODE PROGRAMMING - WITH VHSIC



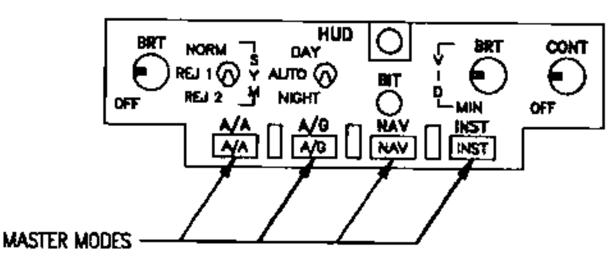
SELECT PROGRAM



SELECT MASTER MODE



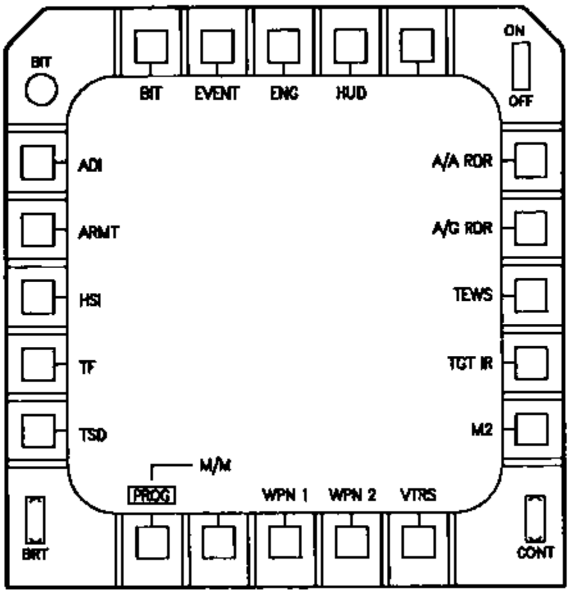
SELECT SYSTEM DISPLAY FORMAT



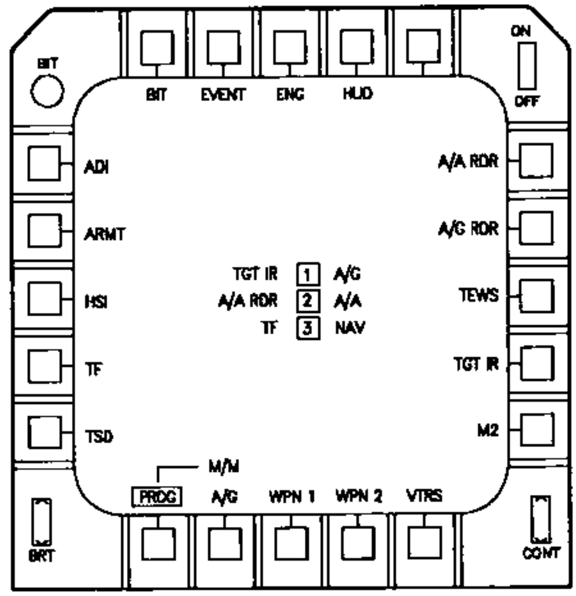
15E-1-(36-1)33-CATI

Figure 1-28 (Sheet 1 of 2)

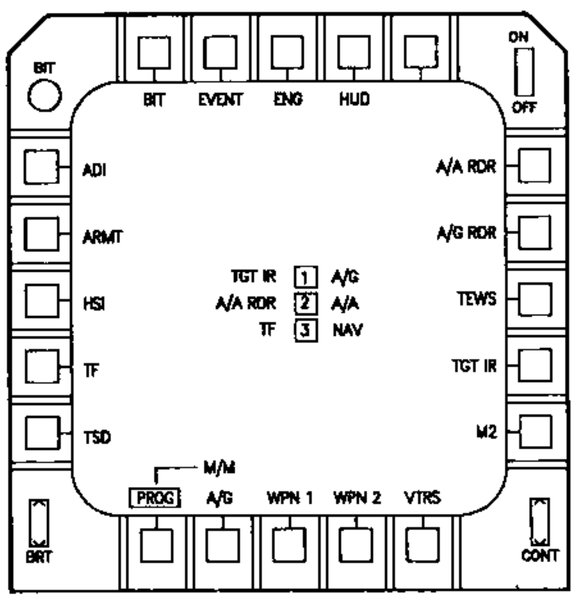
MASTER MODE PROGRAMMING - WITH AP-1R



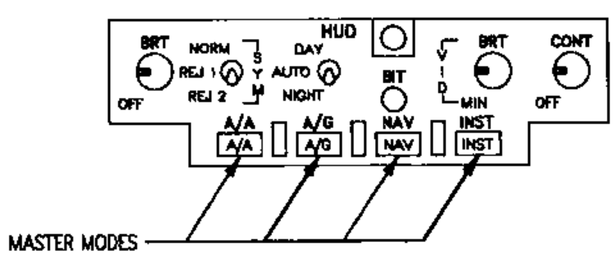
SELECT PROGRAM



SELECT MASTER MODE



SELECT SYSTEM DISPLAY FORMAT



15E-1-(36-2)33-CATI

Figure 1-28 (Sheet 2)

HUD PROGRAMMING

A/A MASTER MODE

PB	SYMBOL LEGEND	DEFAULT SYMBOL		DESCRIPTION
		BOXED	UN-BOXED	
1	TGT LOC LINE		X	Target locator line, off boresight angle, degrees before break lock
2	TGT IR LOS	X		Target pod line of sight
3	ASPECT ANGLE	X		Analog aspect line
4	RDR RNG SCALE	X		Radar range scale, scale range, half range, radar range caret, closing rate, SRM/MRM launch zones
5	TGT ALT ASPECT	X		Digital target altitude and digital target aspect
6	HDG SCALE		X	Heading scale, magnetic heading, command heading, digital command heading
7	PITCH LAD		X	Flight path pitch ladder
9	NAV DATA	X		Navigation data block (windows 17-20), steer-to-point/range/time
10	RALT SCALE	X		CARA altitude scale and set clearance marker
16	WATERLINE	X		Aircraft waterline
17	OWS	X		Current and maximum allowable g
18	MACH	X		Aircraft Mach number
19	AOA	X		Angle of attack
20	CMD VEL		X	Analog command velocity

Figure 1-29 (Sheet 1 of 3)

HUD PROGRAMMING (Continued)
A/G MASTER MODE

PB	SYMBOL LEGEND	DEFAULT SYMBOL		DESCRIPTION
		BOXED	UN-BOXED	
1	NAV LOS	X		Navigation line of sight
2	TGT IR LOS	X		Target pod line of sight
3	RETICLE RANGE BAR	X		Reticle analog range scale and range index
4	WPN RNG SCALE	X		Weapon range scale, weapon range caret, optimum range marker, T_{max} range marker, T_{min} range marker
5	BANK STEER	X		Bank steering bar
6	HDG SCALE		X	Heading scale, magnetic heading, command heading, digital command heading
7	PITCH LAD		X	Flight path pitch ladder
9	NAV DATA	X		Navigation data block (windows 17-20), steer-to-point/range/time
10	RALT SCALE	X		CARA altitude scale and set clearance marker
17	OWS	X		Current and maximum allowable g
18	MACH	X		Aircraft Mach number
19	AOA	X		Angle of attack
20	CMD VEL		X	Analog command velocity

Figure 1-29 (Sheet 2)

HUD PROGRAMMING (Continued)
NAV/INST MASTER MODE

PB	SYMBOL LEGEND	DEFAULT SYMBOL		DESCRIPTION
		BOXED	UN-BOXED	
1	TGT LOC LINE	X		Target locator line, off boresight angle
2	TGT IR LOS	X		Target pod line of sight
3	A/A TD BOX	X		A/A target designation line of sight
5	BANK STEER	X		Bank steering bar (not removed in ILST or ILSN)
6	HDG SCALE		X	Heading scale, magnetic heading, command heading, digital command heading
7	PITCH LAD		X	Flight path pitch ladder
8	BANK SCALE		X	Bank angle scale and pointer
9	NAV DATA	X		Navigation data block (windows 17-20), steer-to-point/range/time
10	RALT SCALE	X		CARA altitude scale and set clearance marker
16	WATERLINE	X		Aircraft waterline
17	OWS	X		Current and maximum allowable g
18	MACH	X		Aircraft Mach number
19	AOA and VVI	X		Angle of attack and vertical velocity
20	CMD VEL		X	Analog command velocity

Figure 1-29 (Sheet 3)

Instrument Master Mode

The preprogrammed set of display formats associated with the instrument master mode provides a one-step procedure to rapidly call up the A/A radar (left MPD), attitude director indicator (ADI) (MPCD), and the horizontal situation indicator (HSI) (right MPD) in the cockpit. In the rear cockpit, the left MPCD displays HSI format, the right MPCD displays ADI format and the MPD's continue to display previous selection.

TAKE COMMAND OPERATION

A method of take command of operation without the need to have a separate take-command control panel in either cockpit is provided. Refer to figure 1-30. Command can be taken from but cannot be given to the other cockpit. The front cockpit can have command of one display but the rear cockpit can have command of two displays (one on each side). The following display formats have take command capability.

TSD	Tactical Situation Display
A/A	Air-to-Air Radar
A/G	Air-to-Ground Radar
TGT IR	Targeting FLIR
WPN1	Weapon 1
WPN2	Weapon 2
HUD	Head Up display (Front cockpit only)

Take command is initiated in the front cockpit by means of the stick grip castle switch and is accomplished by first pressing the switch and releasing it. Then move the switch, within 2 seconds, in the direction of the HUD or MPD/MPCD which displays the format the crewmember desires to command. Vertical bars are presented at the bottom of the display format on the MPD/MPCD to indicate take command has been accomplished. Command of the HUD is indicated by the IN CMD cue displayed in window 4. Take command is initiated in the rear cockpit from the left and right hand controllers by the four way coolie switches. Moving the switch on the left hand controller to the left takes command of the format on the left hand MPCD and to the right takes command of the format on the left hand MPD. Moving the switch on the right hand controller to the left takes command of the right MPD and to the right takes command of the right MPCD. To minimize the need for the crew to converse about who is in command of a given system, visual cues are provided within the display format. In figure 1-28, a typical radar search display is shown. The display format on the left shows a solid cursor plus command lines between the display options. This indicates to the crewmember with this display format in his cockpit that he has command of the radar. The display on the right has a dashed cursor and no lines between options indicating that the crewmember doesn't have command of the radar.

If a crewmember is attempting to take command of a system the other crewmember is active on (for example, moving the acquisition symbol), a SYSTEM IN USE message will be presented on the display he is attempting to command. If command of the display is indeed required, a second command request within 5 seconds will be honored. Command of a display format remains until that format is commanded on another display or that display is used to take command of another format. When scrolling off of a commanded display format, command of that display format is retained. The hands on throttle and stick (HOTAS) controls of that format are non-functional while it is out of view. Control function and command are provided when the display format is recalled.

NOTE

Command cannot be taken for A/G radar if in radar A/A priority mode or the aircraft is within 15 seconds of time to release.

TAKE COMMAND FORMATS

NOTES:

1. TAKE COMMAND CONTROL INDICATED BY SOLID CURSOR OR FOOTPRINT AND LINES DIVIDING OPTIONS ACROSS BOTTOM OF DISPLAY.
2. ABSENCE OF LINES BETWEEN OPTIONS AND A DASHED CURSOR OR FOOTPRINT INDICATES CREWMEMBER DOES NOT HAVE COMMAND OF DISPLAY.
3. THESE TAKE COMMAND FORMATS ARE SHOWN WITH AP-1R INSTALLED.

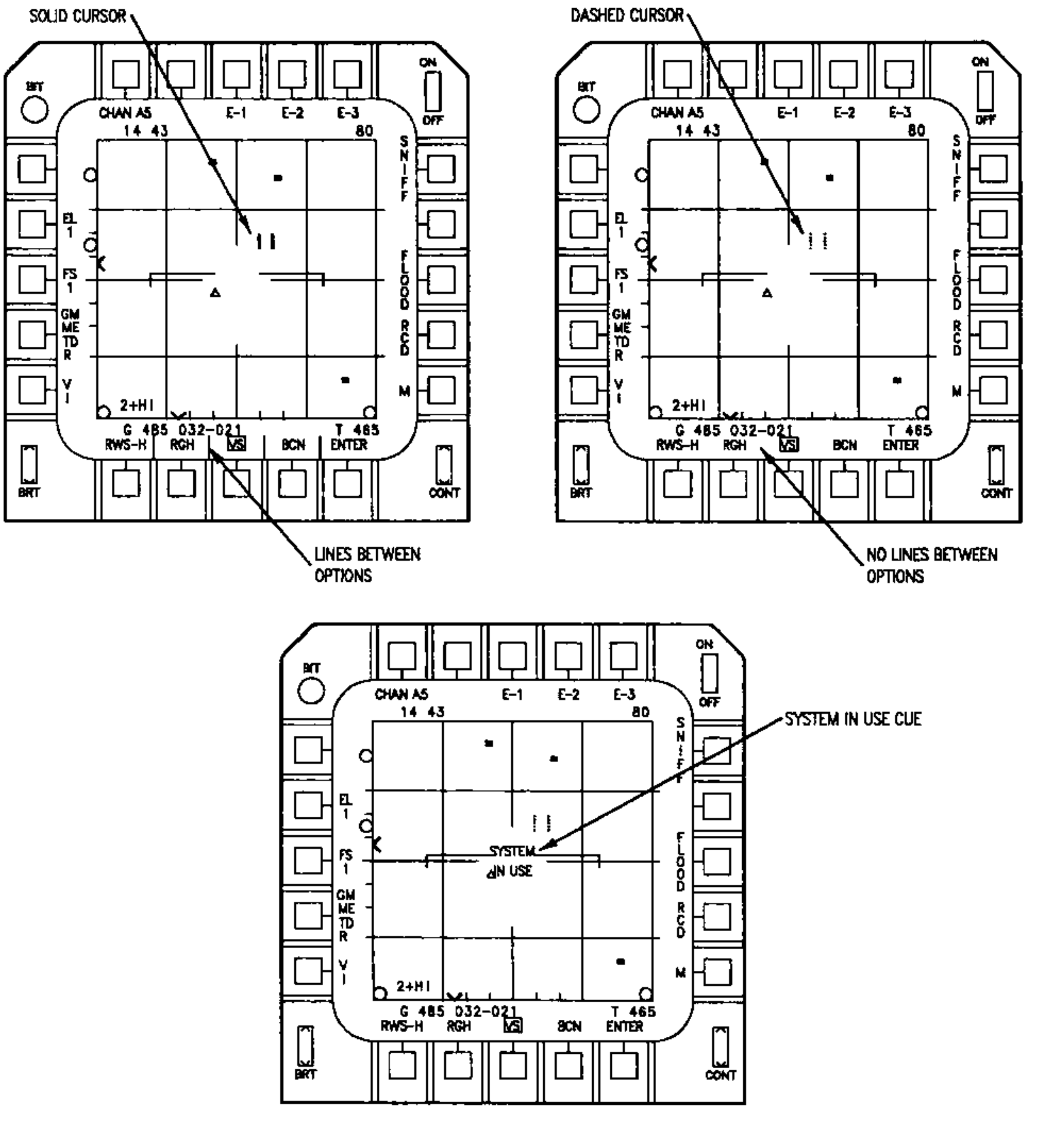


Figure 1-30

INSTRUMENTS

Refer to foldout section for front and rear cockpit instrument panel illustrations For information about instruments that are an integral part of a system, refer to applicable paragraphs in this section.

VERTICAL VELOCITY INDICATOR (VVI)

The vertical velocity indicator (in both cockpits) is driven by electrical signals from the air data computer. A window on the instrument will display an OFF flag if electrical power is lost or the display is not valid.

STANDBY ATTITUDE INDICATOR

The standby attitude indicator (in both cockpits) is a self-contained electrically driven gyro-horizon type instrument. The OFF flag appears if there is a power loss to the indicator or the gyro is caged. The gyro is caged by pulling the knob. Do not turn the knob to lock the gyro in the caged position. The gyro cages to 0° pitch and roll regardless of airplane attitude. The caged position is approximately 4° nose up from the normal ground attitude and the gyro will precess 4° nose down after uncaging. Power should be applied to the instrument for at least 1 minute before caging. The indicator displays roll through 360°. Pitch display is limited by mechanical stops at 90° climb and 78° dive. As the aircraft climbs or dives, the pitch attitude changes smoothly until the stop is reached when the gyro tumbles 180° in roll.

STANDBY AIRSPEED INDICATOR

The standby airspeed indicator (in both cockpits) operates directly from pitot-static pressures. It has a fixed scale of 60 to 850 knots and a rotation pointer.

STANDBY ALTIMETER

The standby altimeter (in both cockpits) operates directly from a static pressure source. The barometric pressure in inches of mercury is set on both altimeters; however the baro altitude displayed on the HUD, ADI and UFC is based on the cockpit altimeter baro setting only. On some aircraft, the thousand digit moves progressively with the pointer rotation, rather than when the pointer transits the 9 to 0 range only.

STANDBY MAGNETIC COMPASS

A conventional aircraft magnetic compass is mounted on the canopy arch in the front cockpit only.

ANGLE-OF-ATTACK (AOA) INDICATOR

The AOA indicator, in the front cockpit only, is driven by electrical signals from the probe and displays indicated AOA in units from 0 to 45. A T-shaped index mark is set at approximate optimum landing approach AOA (20 to 22 units). A window on the face of the instrument displays an OFF flag if electrical power is lost, there is invalid data from the ADC or a failure within the indicator. A triangular index mark is positioned full scale and is inoperative.

RADAR ALTIMETER

The radar altimeter indicates clearance over land and water from 0 to 50,000 feet. Radar altitude is utilized by the AFCS, LANTIRN navigation pod and the CC for terrain following and low altitude warning (LAW). Radar altitude is displayed on the TF display and is selectively displayed on the HUD, EADI and UFC. A radar altitude scale (thermometer) is also displayed on the HUD and EADI during TF. Refer to TO 1F-15E-34-1-1 for a detailed operational description of TF. The radar altimeter is controlled by the radar altimeter switch on the sensor control panel (SCP).

Radar Altimeter Switch

The RDR ALT switch on the sensor control panel on the left console in the front cockpit has three positions:

OFF	Radar altimeter is deactivated. If LAW is enabled, the LAW warnings are activated. If TF is enabled, TF FAIL warning is activated.
ON	Radar altimeter is activated.
OVERRIDE	Radar altimeter is deactivated. If LAW is enabled, the LAW warnings are activated. If auto TF or manual TF with automatic flyup is coupled, TF FAIL warning is activated. If manual TF is engaged with manual flyup, a signal is sent to the terrain following system that radar altitude is not available.

WARNING

RDR ALT OVERRIDE is selectable for emergency situations only during manual TF with FLYUP ENABLE off. To ensure the greatest protection against low altitude conditions, the OVERRIDE position should not be used.

HUD Display

With the radar altimeter turned on, radar altitude is displayed in window 14A of the HUD provided radar altitude is selected on the UFC data 1 format. The display includes radar altitude rounded to the nearest 10 feet. An "R" appears to the left of the readout indicating the altitude is radar. Should the altitude source become invalid, OFF is displayed in place of radar altitude. During CC failure, radar altitude is displayed on the HUD and EADI since barometric altitude is not available.

Low Altitude Warning

NOTE

With VHSIC, if the LAW is enabled on the ground, the aircraft must first climb above the preset altitude to trigger the warning.

When LAW is enabled on the UFC menu 1, audio and visual warnings are activated when the aircraft descends below the selected LAW altitude on menu 1. The warnings are removed when either the aircraft climbs 20 feet above the selected LAW altitude, the LAW function is disabled on the UFC menu 1, or the LAW altitude is changed to below the present radar altitude. If LAW is enabled and the radar altimeter fails, the LAW warnings are activated. If LAW is enabled, radar altitude is less than 5000 feet, aircraft attitude is less than 50° of roll and less than 20° of pitch, and the radar altimeter breaks track, the LAW warnings will be activated. The warnings are removed for these cases when either the fail condition corrects itself or the LAW function is disabled on the UFC menu 1.

Low Altitude Voice Warning

The 'LOW ALTITUDE' voice warning repeats twice when the aircraft descends below the selected LAW altitude and resets when the LAW condition is removed. This voice warning is a function of LAW only. It is not used by the TF system.

Low Altitude Warning Light

A red low altitude warning light, labeled LOW ALT, is located on the upper instrument panel in both cockpits. The LOW ALT light comes on when a LAW condition is encountered and remains on until the LAW condition is removed. This warning light is also used by the TF system to indicate a set clearance warning.

Up-Front Control

The UFC is used to set the LAW altitude, to enable the LAW function, and to select CARA altitude for display on the HUD and ADI. Baro altitude is always displayed boxed in the upper right corner of the HUD and ADI and also at PB 9 on UFC Data 1. The present LAW altitude, in feet, is displayed at PB 1 on UFC menu 1. To set a different LAW altitude, the desired LAW altitude is entered in the UFC scratchpad using the UFC keyboard. After verifying the correct altitude in the scratchpad, the upper left pushbutton adjacent to the LAW readout is pressed to change the LAW altitude to that in the scratchpad. Alternately pressing the upper left pushbutton with the scratchpad blank enables and disables the LAW function. Pressing PB 8 on UFC Data 1 displays CARA altitude on the HUD and ADI in addition to baro. When selected, an "R" with the CARA readout will be displayed below the baro altitude on the HUD and ADI.

Terrain Following

Radar altitude is used by the TF system to monitor proximity to the selected set clearance. When TF is enabled and either the LANTIRN NAV Pod or the AFCS detects the radar altitude approaching or below 75% of the TF set clearance, a SET CLEARANCE warning is activated. A manual or automatic fly-up is initiated and the red LOW ALT warning light comes on. No voice warning is activated for the set clearance warning condition. If the radar altimeter fails, is turned off or breaks track during TF, the TF fail warnings will be activated and an automatic or manual fly-up is initiated. The RDR ALT OVERRIDE switch position is available for emergency use only during manual TF with FLYUP ENABLE off. This switch position powers off the radar altimeter and sends a signal to the AFCS that radar altitude is not available. The AFCS during RDR ALT OVERRIDE does not perform its low altitude monitoring logic. For maximum protection from TF low altitude conditions, the OVERRIDE position should not be used. Refer to TO 1F-15E-34-1-1 for a detailed description of terrain following.

ATTITUDE DIRECTOR INDICATOR (ADI)

The ADI (figure 1-31) can be displayed on any MPD/MPCD and consists of the items indicated. The attitude sphere displays pitch and bank. The pitch markings on the sphere are in graduations of 5°, the bank markings begin at 10° increments up to 30°, then 45° and 60°. Signals are received from the INS or AHRS system. The primary attitude source is the INS. The pitch and bank steering bars are driven by signals from the CC. The bank steering bar provides command steering information to intercept tacan radials and navigation computer destinations. The ADI displays vertical velocity under the altitude window if gear is down. It is displayed as descending (−) or ascending (+). Angle of attack is displayed under the airspeed window when the landing gear is down. Command velocity (CV) is displayed if valid and landing gear is up, under the airspeed window. The units of CV are KCAS unless TAS or GS are selected on UFC Data 1. For example, if PB 4 (on Data 1) is selected (asterisk) then CV is in knots GS. The CV reference point is displayed next to the CV. It is displayed as a function of entering data into the upfront control for time-over-target purposes. When ILST or ILSN steer modes are selected on the HSI, ILS data is also displayed on the ADI (figure 1-32).

ADI Invalid Displays

The major indication of attitude display problems is an X written across the attitude sphere. The word OFF written by the attitude source indicates the INS/AHRS is invalid. If the turn rate and/or inclinometer information is invalid, the word OFF is written adjacent to the data. If the heading source is invalid, OFF is written in the middle of the heading scale. If airspeed information is invalid, the word OFF is displayed in the airspeed window. If vertical velocity is invalid OFF is written adjacent to it. If the selected source of altitude information is invalid, OFF is written in the altitude window.

HORIZONTAL SITUATION INDICATOR (HSI)

The HSI can be displayed on any MPD/MPCD when selected from the MPD/MPCD main menu. When the MPCD is used, the data is color coded as follows:

a. TACAN data is green
b. INS data is blue
c. Heading data is orange
d. All other information is white.

The HSI (figure 1-31) provides a horizontal or plan view of the aircraft with respect to the navigation situation. The aircraft symbol in the center of the HSI is the airplane superimposed on the compass rose. The compass card rotates so that the aircraft heading is always under the top of the lubber line. Command heading and course selection function, plus the steering modes of TCN (PLAN or CDI), GT, ILST, ILSN and NAV are provided by using the display pushbutton. A selection for disabling/enabling automatic destination sequencing is available on the HSI format. The legend "AUTO SEQ" is displayed below PB 18 and is boxed when auto-sequencing is enabled. The selection is automatically enabled when power to the CC is cycled and the aircraft is on the ground. Data associated with ILS operation is also displayed, but only when ILSN/ILST is selected. Additional symbols which are displayed on the HSI are:

RANGE SCALE	There are five range scales (10, 20, 40, 80 and 160 nautical miles, NM). The range represents the distance from the aircraft symbol to the perimeter of the compass rose. The navigation steer point and/or selected tacan station is presented so that their position with respect with current heading can be seen and easily interpreted.
TACAN AND INS NAV DATA	Two data blocks provide bearing, distance, and estimated time enroute (ETE) information about the selected tacan or NAV sequence point selected. The display also includes the tacan channel mode X or Y, or sequence point number.

HEADING MARKER	The marker is moved around by command heading selections made by the operator in all modes except NAV and GT. In NAV the marker is positioned to the command heading to fly for the steer point selected. In GT the marker is positioned to the command heading to fly to maintain a constant ground track.
BEARING POINTERS	Two bearing pointers are displayed, one for INS nav bearing and one for tacan station bearing. The two pointers are shaped and color coded when displayed on the color CRT.
ADF BEARING	A small lollypop symbol indicates the bearing of the transmitted signal. No symbol indicates ADF function is not selected. Selection of ADF is made on the UFC.

NAVIGATION/STEERING MODES

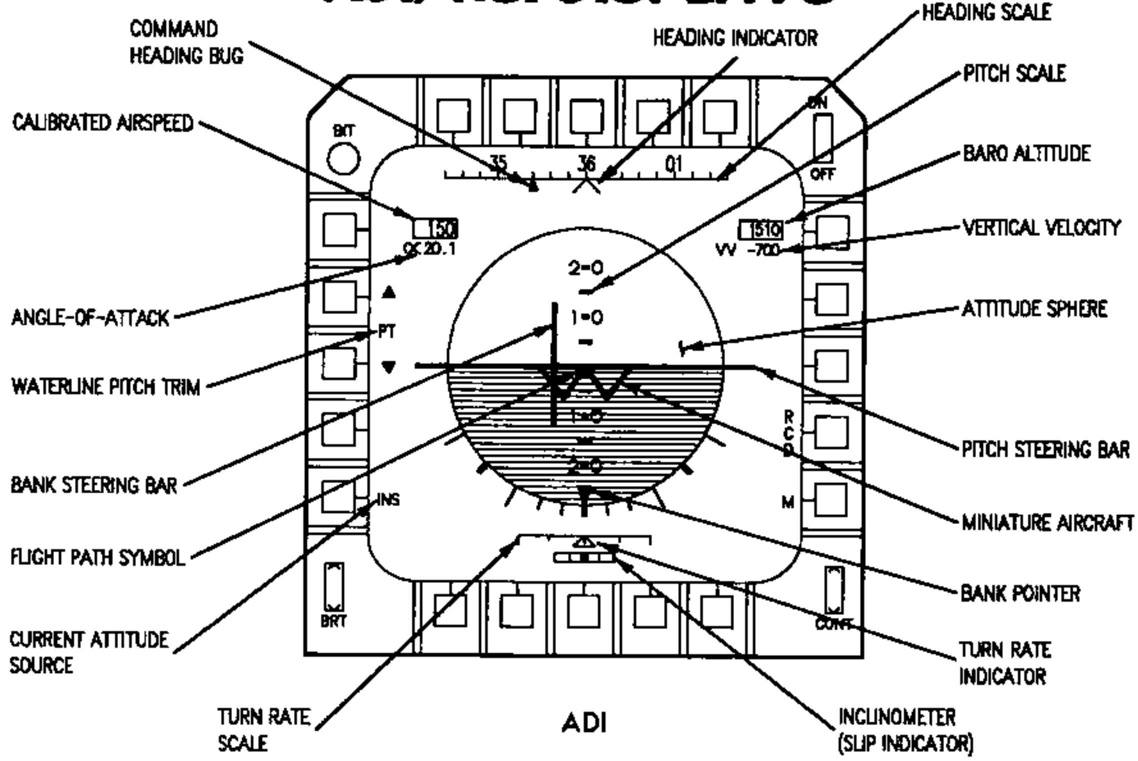
There are five steering modes listed at the bottom of the HSI display. They are TCN, ILST, GT, ILSN, and NAV, and are selected by pressing the desired mode pushbutton. The mode selected becomes boxed.

If the auto pilot has been coupled, the two ILS steer modes are removed from the display and auto-pilot (A/P) is written on the display. A coupled ILS is not selectable.

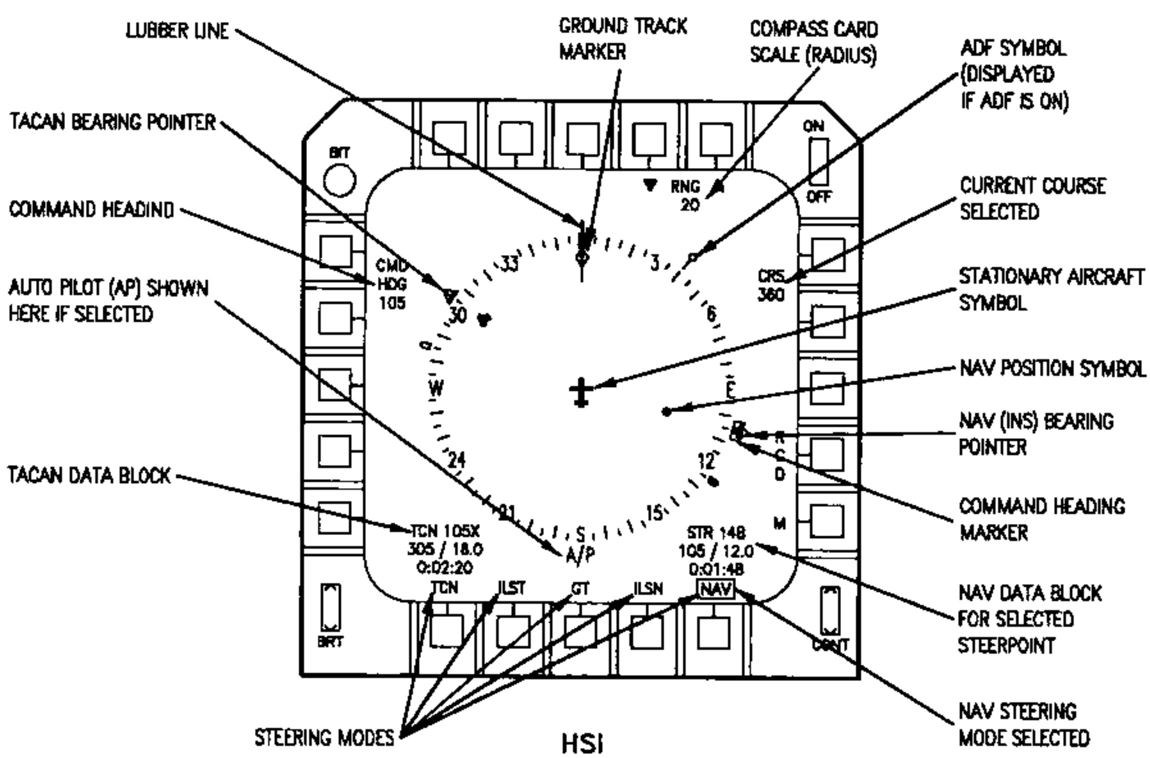
Tacan Steering Mode

The display format with TCN selected is shown in Figure 1-32, sheets 1 and 2. There are two display options available with TCN selected: course deviation indicator (CDI) or PLAN. The current selection is shown at PB 20 and pressing PB 20 will alternate between the two options.

ADI/HSI DISPLAYS



ADI



HSI

15E-1-(48-1)25-CATI

Figure 1-31

With CDI selected (figure 1-32, sheet 1), a white set course pointer and course deviation indicator are drawn on the display. The set course pointer is drawn through the center of the aircraft symbol according to the course value shown between PB 14 and PB 15. The TO/FROM indicator is drawn adjacent to the aircraft symbol, and the course deviation indicator is drawn on the course deviation scale with full deflection being 10° of displacement.

With PLAN selected (sheet 2), a green set course arrow is drawn through the center of the tacan station symbol according to the course value shown between PB 14 and PB 15. There is no TO/FROM indicator and no course deviation indicator. If the selected range scale is too small to show the tacan position, the tacan position symbol and the set course arrow are removed. All other features of the HSI display format are the same for either CDI or PLAN. The course set pushbuttons (PB 14 decrement, PB 15 increment) are used to select the desired inbound or outbound radial to fly. The course can also be set by entering the value in the UFC scratchpad and transferring it to the HSI by pressing either PB 14 or PB 15. Since the tacan channels and modes are selected with the UFC, additional information is provided on the HSI display format to indicate tacan status. When the tacan system is off, OFF is written in large red letters in the tacan data block and above the TCN steer mode cue, and all tacan indications such as the station position symbol, set course arrow, set course pointer, CDI, bearing pointer and TO/FROM indicator are removed.

ILST/ILSN Steering Modes

Selecting ILST or ILSN mode displays the format shown in figure 1-32, sheets 3 and 4. The CDI displays localizer deviation and the tacan TO-FROM indicator is removed. The course point indicates the selected inbound course to the localizer. The course set pushbutton (or UFC scratchpad) can be used to change the inbound course. The heading set pushbutton or UFC scratchpad can be used to move the heading marker.

GROUND TRACK Steering Mode

Selecting GT mode presents the HSI format shown on figure 1-32, sheet 5. The desired ground track is selected using the course set pushbutton or UFC scratchpad. The course pointer and CDI will not be displayed.

NAVIGATION Steering Mode

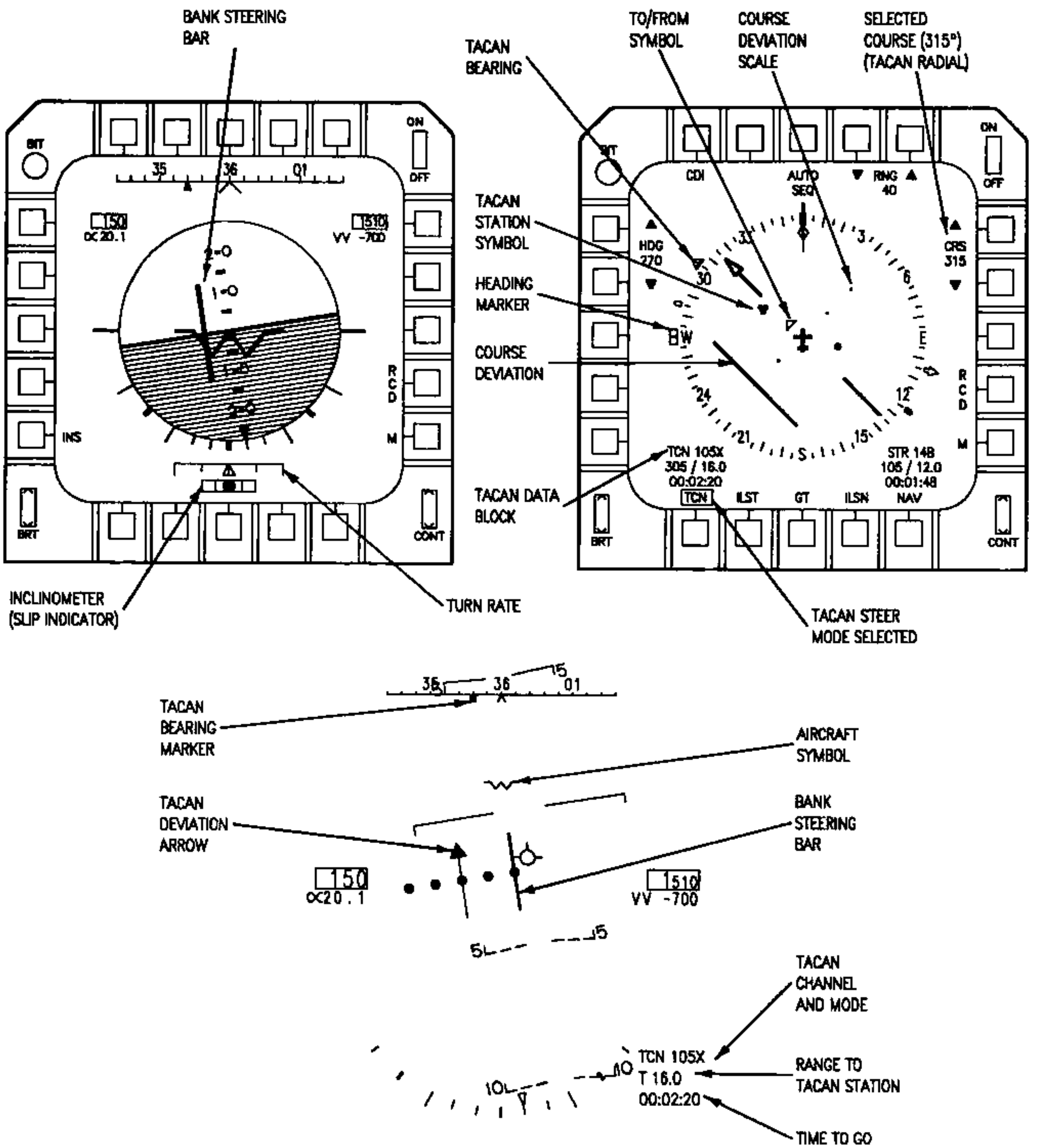
Selecting NAV mode displays the bearing and heading to fly to get the steer point selected. As shown on figure 1-32, sheet 6, the heading marker moves to indicate the heading to fly. Command heading is also printed in the command heading window on the left side of the display. Course window displays ground track. Bearing, distance, and time-to-arrive are displayed in the lower right hand data block.

NOTE

When selecting the NAV STEER mode with AUTO TF engaged, the aircraft may begin an immediate turn.

STEERING DISPLAY

(TACAN MODE / CDI)
GEAR DOWN



15E-1-(185-1)25-CATI

Figure 1-32 (Sheet 1 of 6)

STEERING DISPLAY

(TACAN MODE / PLAN VIEW)
GEAR DOWN

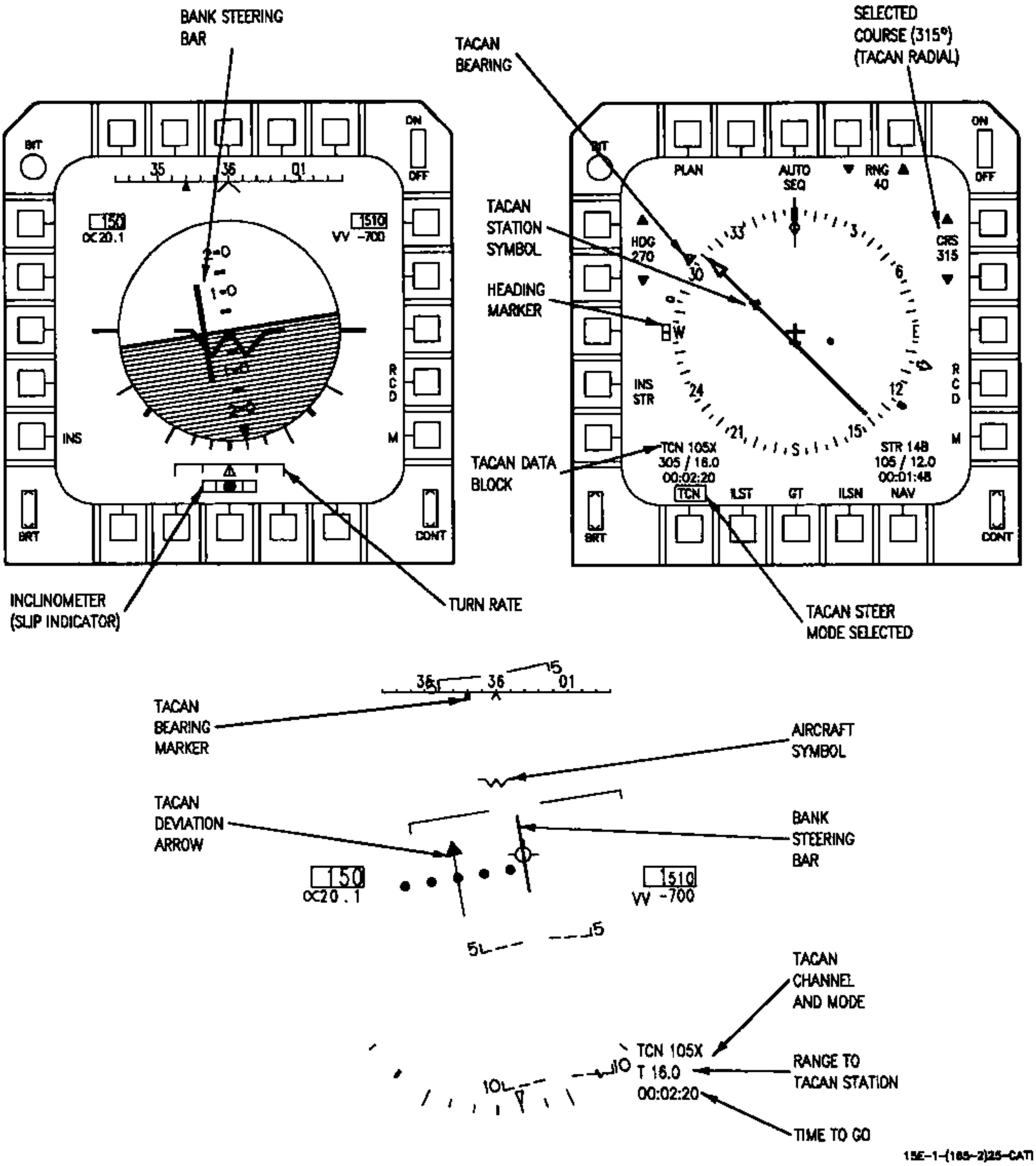


Figure 1-32 (Sheet 2)

STEERING DISPLAYS

(ILS TACAN MODE)

GEAR UP

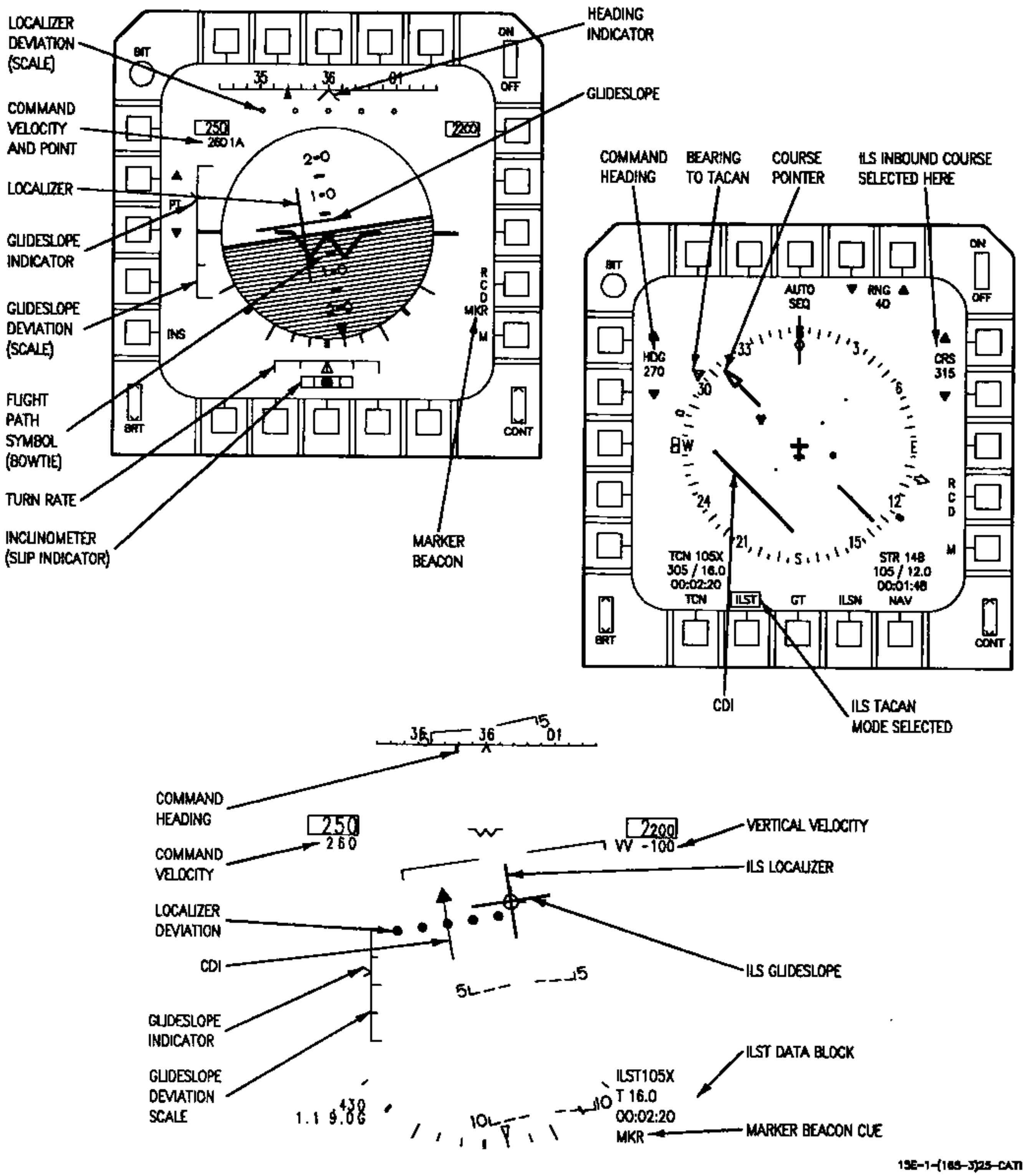
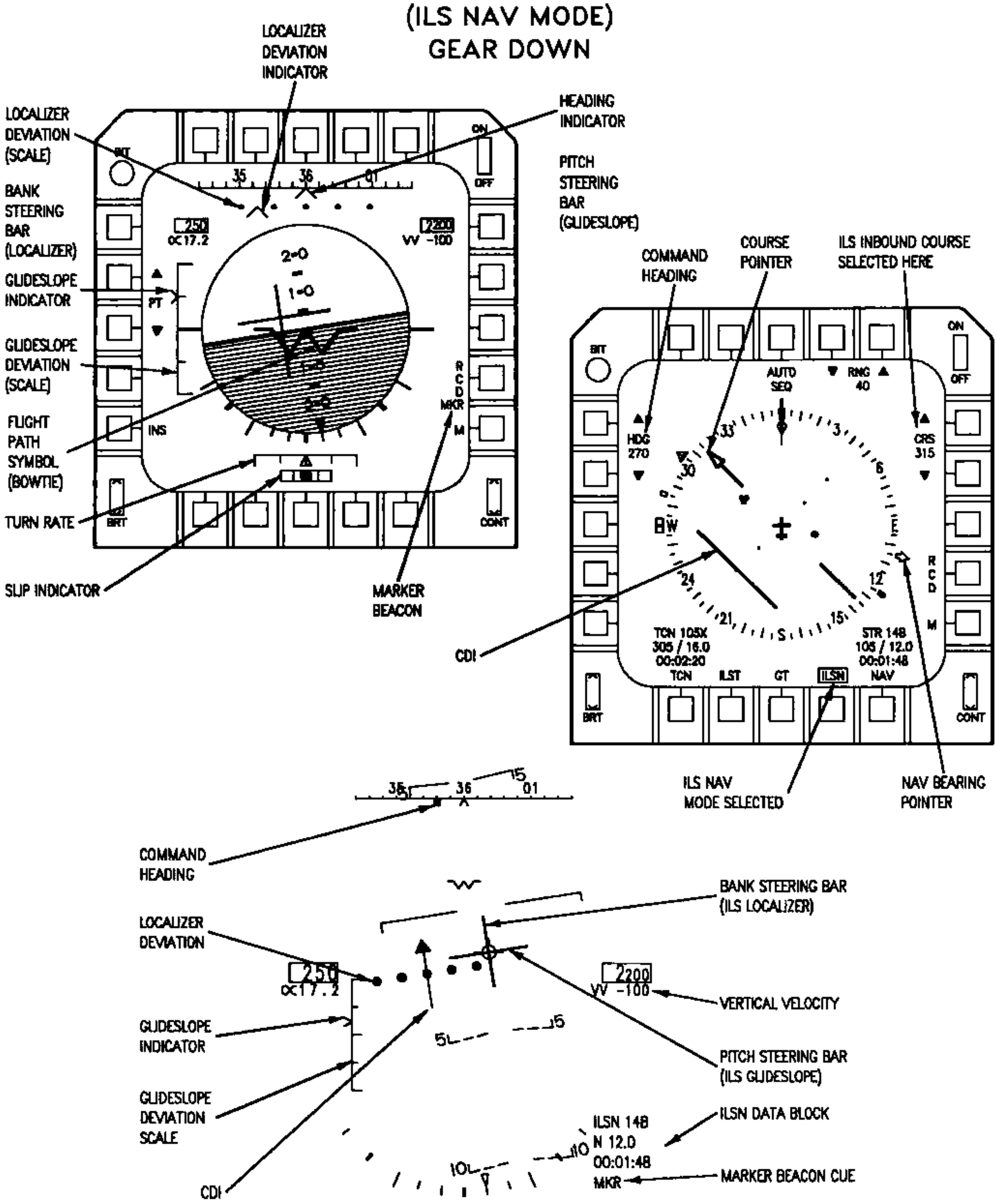


Figure 1-32 (Sheet 3)

STEERING DISPLAYS

(ILS NAV MODE)
GEAR DOWN



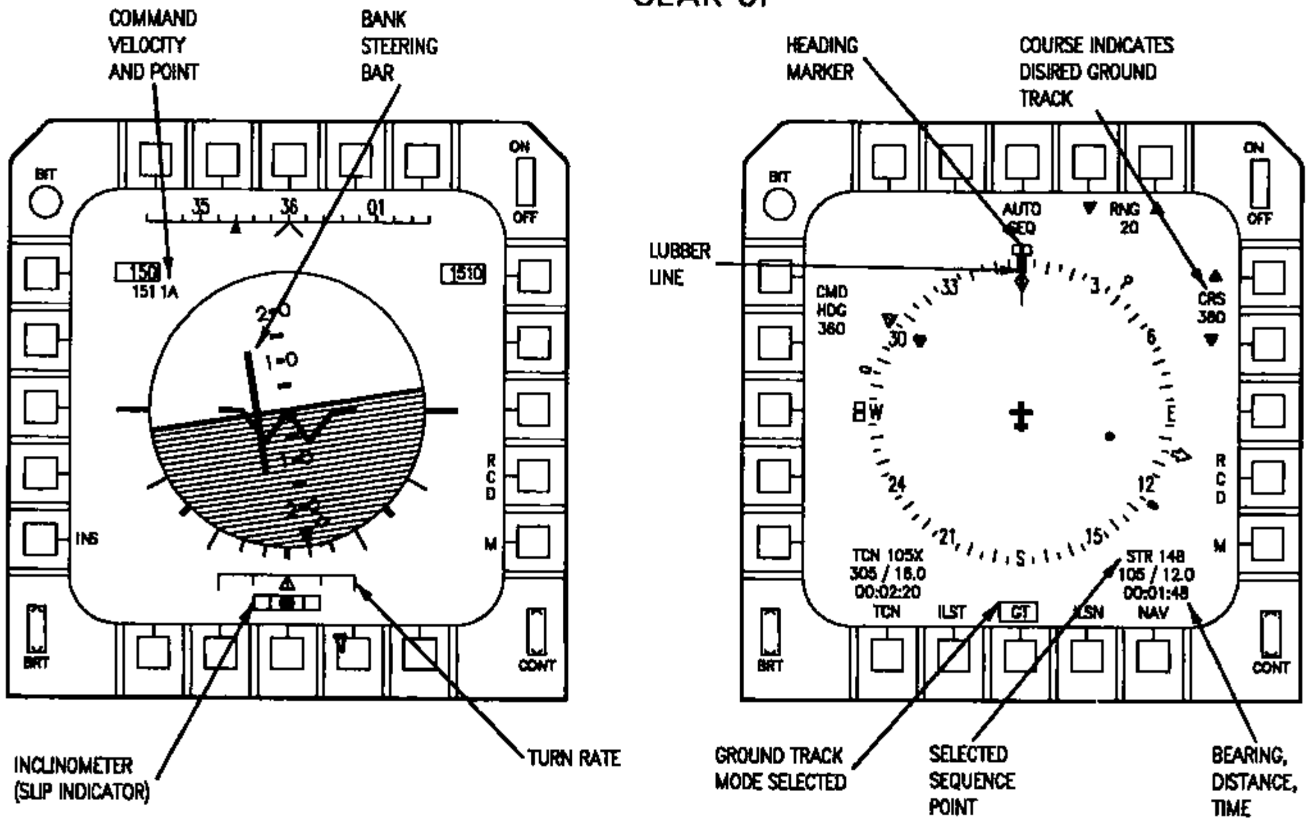
15E-1-(165-4)25-CATI

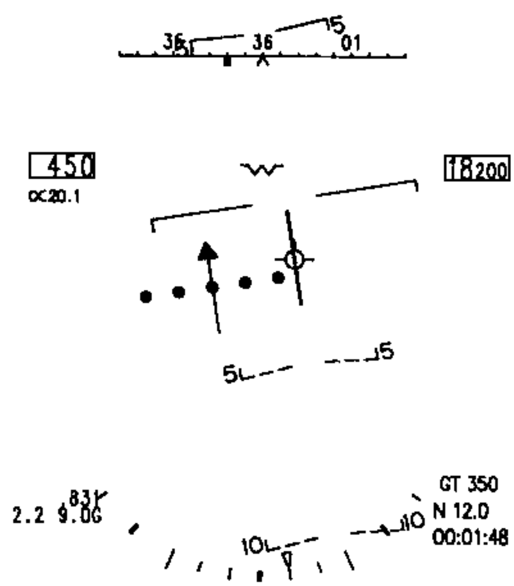
Figure 1-32 (Sheet 4)

STEERING DISPLAYS

(GROUND TRACK MODE)

GEAR UP



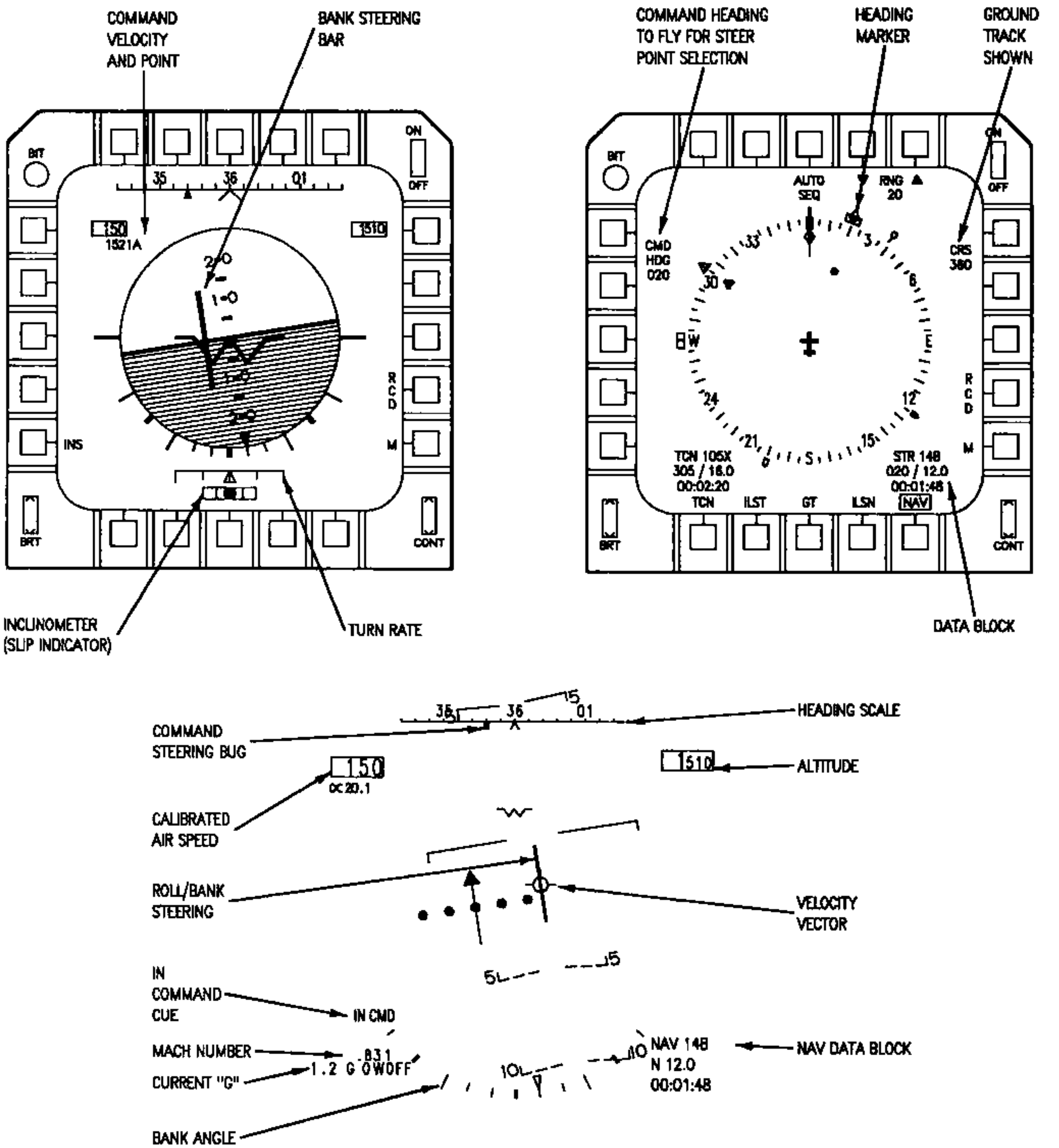


15E-1-(165-5)25-CATI

Figure 1-32 (Sheet 5)

STEERING DISPLAY

(NAV MODE)
GEAR UP



15E-1-(165-6)25-CATI

Figure 1-32 (Sheet 6)

NAVIGATION DISPLAYS

HUD NAVIGATION DISPLAYS

The HUD displays the following aircraft parameters in all modes: magnetic heading, airspeed, altitude, velocity vector, pitch scale, aircraft symbol, and (in air-to-air modes) aircraft Mach. The aircraft load factor to the nearest tenth of a g is displayed in all modes and this reading is limited to 9 g. The HUD displays both current and maximum allowable g for existing flight conditions, aircraft configuration, and gross weight. Current g is displayed on the left and maximum allowable g is displayed on the right. The maximum allowable display changes automatically as flight conditions and gross weight changes. If the overload warning system fails, the g display reverts to displaying only the current g and OWOFF will appear on the display next to the current g. The aircraft is also equipped with a provision to cage the velocity vector symbol. When the NAV master mode is initially selected, the velocity vector is positioned at the correct position. Flashing of the velocity vector indicates that the symbols actual position is out of the HUD field of view. Pressing and releasing the laser fire button on the throttle, with command of the HUD, centers the velocity vector and pitch scale in azimuth. A subsequent depression again frees the symbols in drift. The heading, bank scale, velocity vector (in A/A mode), target locator line and pitch scales symbology can be removed by placing the HUD symbol switch on the HUD control panel to the reject 1 position. In addition to the flight parameters, the HUD displays navigational data if the avionics system is in the NAV mode. The NAV mode is selected by positioning the weapon select switch on the throttles to any position other than gun and pressing the NAV master mode pushbutton in the front cockpit. In NAV (navigation) mode, in addition to the flight parameters, the HUD displays bank steering to the destination selected, time-to-go and range to destination, steering mode selected, and nav destination selected. In TCN (tacan) mode, the HUD displays are the same as in NAV mode except that the bank steering displayed is to the selected tacan radial, the time-to-go and range displayed is to the tacan station, and destination is not displayed. In ILS/NAV and ILS/TCN (instrument landing set) modes, in addition to the flight parameters, the HUD displays the following: bank and pitch steering bars for approach and landing on runway destination, time-to-go and range to destination (in ILS/NAV) or tacan station (in ILS/TCN), the steering mode selected, and the glideslope deviation scale and pointer for glideslope steering. Time-to-go is displayed to the nearest second with a maximum reading of 99. Also with ILSN or ILST steer mode selected, when the aircraft passes over the outer marker or middle marker beacon, MKR will be displayed on the HUD. Range to the nearest tenth of a NM is displayed on the HUD for any mode selected on the steering mode panel. In all modes, AOA data in cockpit units is displayed on the HUD. When gear is down, all the HUD window symbols (the bank scale, course deviation indicator (ILS), ILS glideslope) on the HUD display are lowered to reduce pilot look angles from the velocity vector to the displays.

Airspeed and altitude parameters are displayed in digital formats. The crewmembers have the option of selecting either true (T) airspeed, or groundspeed (G) for display. Either T or G is displayed next to the digital display. Calibrated airspeed is always displayed and does not need to be selected from the UFC. Baro-corrected altitude is also always displayed. Radar altitude can be selected for display using the UFC. These selections are made from the UFC data 1 menu and are displayed in digital format. A bank scale is at the bottom of the HUD display and is graduated into 10° segments up to 30° then 15° segments up to 60°. If the command heading is beyond the 30° scale displayed, a digital readout of the heading appears at the end of the scale.

During terrain following mode, radar altitude is displayed as a thermometer scale with the selected terrain clearance displayed as an accented tic mark on the right side of the scale. A rectangular box symbol provides pitch command steering information referenced to the velocity vector and is displayed when manual TF is selected. TF warning cues are displayed above the velocity vector when a problem arises. TF caution cues are displayed below the velocity vector. If auto TF is selected the command signal is changed to a pitch command bar.

UFC NAVIGATION DISPLAYS

Navigation displays consisting of sequence point coordinates, elevation, range and bearing, offset data, and INS update data are contained on several submenus and are accessed from the menu and data displays on the upfront control. These submenus are used to verify data loaded into the aircraft via the DTM, provide steering and timing data for route navigation and target attack, and to enter or change data for navigation and target attack. Route navigation and steering are described in TO 1F-15E-34-1-1.

In order to enter or change a specific item on the UFC, the appropriate submenu must be accessed. Procedures to enter or change data is included in section II, UFC Procedures.

SEQUENCE POINTS

Sequence points are a set of geographical points which can be overflown or used for sensor cuing during a mission. All points are stored as latitude/longitude and converted for display as lat/long.

These points are divided into the following categories.

LIST	DTM loaded points which are used to generate steer, aim, target, and target offset points. The system can store a total of 99 list points.
STEER	Points used to build the basic route to be flown. Combined steer and target points cannot exceed 100 (all routes, A, B, and C). Displayed as the point number and route letter (17A).
AIM	Always associated with a steer point, up to seven aim points per steer point. Displayed as the steer point number plus a decimal, tenth, and route letter (17.1A). The system can store up to 100 combined aim and offset points in all three routes.
TARGET	Displayed as a point number followed by a decimal and route letter (18.B). Combined target and steer points cannot exceed 100. Target data may also be displayed in direction/range north and east of offset or range/bearing from offset point in special circumstances. Along with STEER points, TARGET points comprise the route.
OFFSET	Usually associated with a target point, displayed as the target number, decimal, hundredths, and route letter (18.01B). The system can store up to seven offsets per target, maximum of 100 combined offset and aim points in all three routes. Point data also displayed in direction/range north and east of target or range/bearing from target.
MARK	Mark points are entered by an overfly mark, radar mark, or an automatic overfly mark at weapon release; data displayed includes time of day. They are displayed as the mark sequence number displayed above a "V" .
BASE	The base point is normally the unit home station, is displayed as B and should agree with the PP coordinates during INS alignment.

NOTE

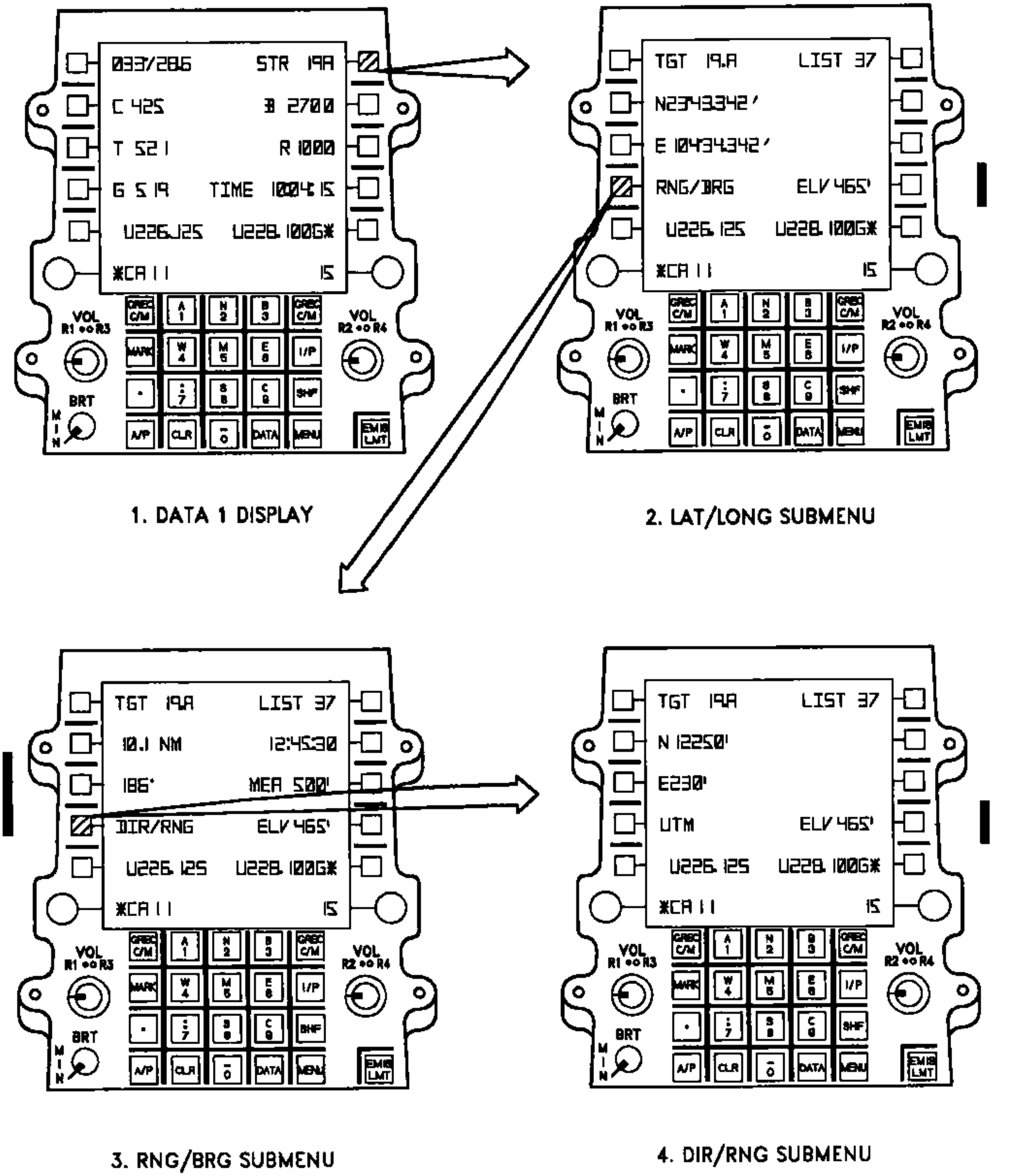
When changing sequence point numbers, the route letter does not need to be entered if the new point is in the same route (A, B, or C) as the old point.

DATA 1 DISPLAY

The data 1 display (figure 1-33) contains current aircraft information. Constant monitoring of calibrated airspeed, true airspeed and groundspeed as well as baro-corrected and radar altitudes is now possible on Data 1 display.

The steerpoint bearing/range and ETE/ETA have been combined and moved to PB 1. The selection is automatically set to steerpoint bearing/range at CC power-up. Pressing and releasing PB 1 toggles through the three selections.

DATA 1 DISPLAY/SUBMENUS



15E-1-(27-1)44-CATI

Figure 1-33 (Sheet 1 of 3)

DATA 1 DISPLAY/SUBMENUS (CONTINUED)

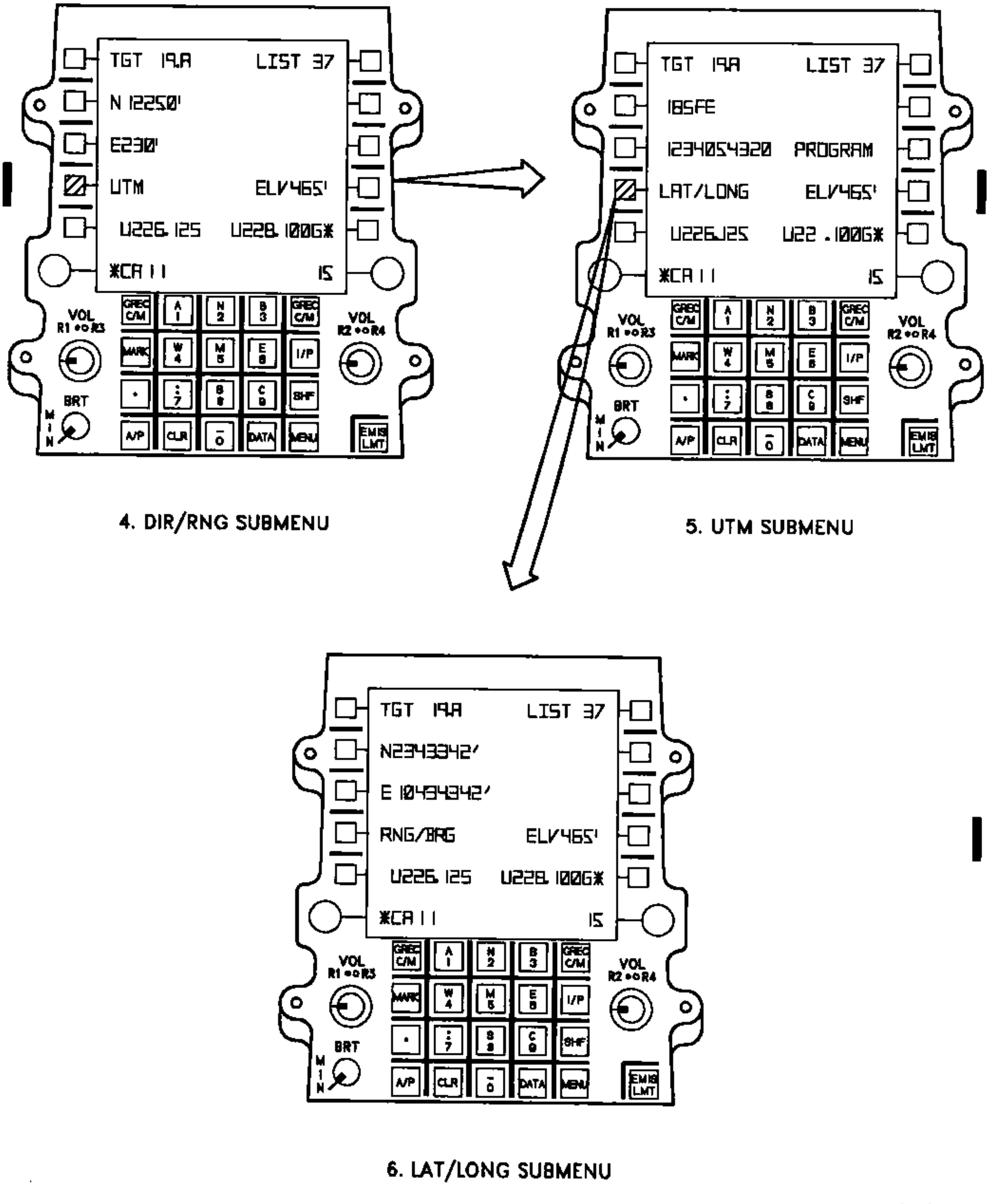
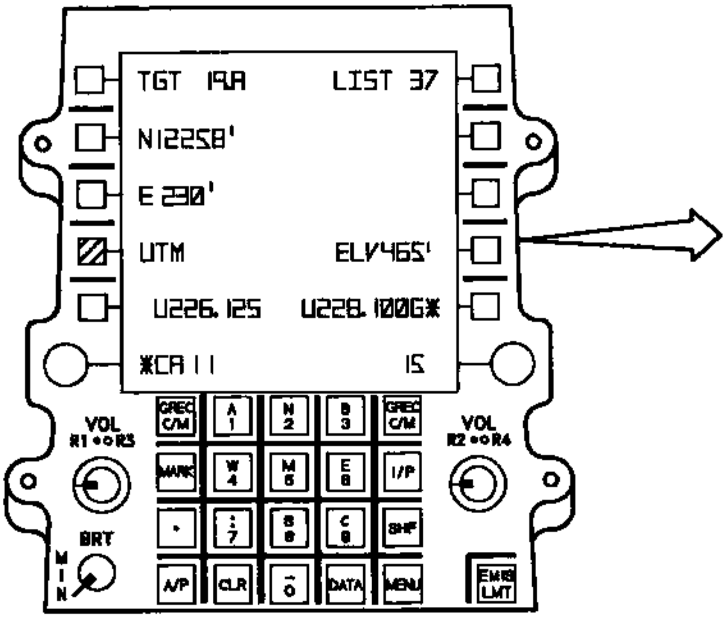
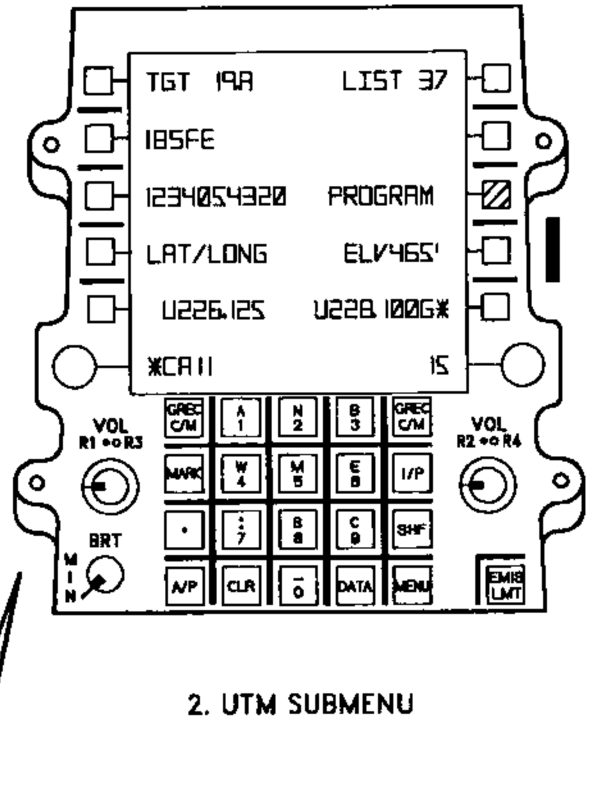


Figure 1-33 (Sheet 2)

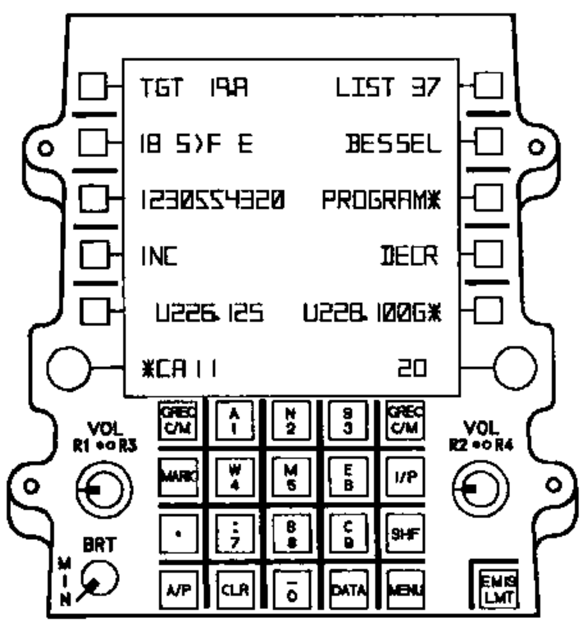
DATA 1 DISPLAY/SUBMENUS (CONTINUED)



1. DIR/RNG SUBMENU



2. UTM SUBMENU



3. UTM PROGRAMMING SUBMENU

15E-1-(27-3)25-CATI

Figure 1-33 (Sheet 3)

Calibrated airspeed is constantly displayed next to PB 2. True airspeed is constantly displayed next PB 3. Pressing and releasing PB 3 toggles the display of true airspeed on the HUD and EADI formats (an asterisk is displayed next to PB 3 when selection is enabled). PB 4 provides the same function for the display of groundspeed. Both of these selections may be toggled off to remove the second velocity source display from the HUD and EADI; but both selections cannot be on at the same time. Selecting the source that is not currently displayed automatically de-selects the displayed one.

PB 5 and PB 6 remain unchanged. PB 5 and 6 display UHF channel information.

PB 7 alternates display of winds and TOD. The selection is automatically set to TOD when CC is powered-up. Pressing and releasing PB 7 with no data displayed in the scratchpad toggles the selection between time and winds except when TIME OFF is displayed; in that case, the time display will show last valid known time and start counting.

PB 8 displays radar (CARA) altitude. Pressing and releasing PB 8 toggles the display of radar altitude on the HUD and EADI formats (an asterisk is displayed next to PB 8 when selection is enabled).

PB 9 constantly displays baro-corrected altitude.

PB 10 continues to display the selected steerpoint. On the data 1 display, all navigation points are preceded by STR. The specific type of point is determined by the use of a decimal and/or digits after the decimal as shown previously.

Point Data Submenus

The point data latitude/longitude submenu is accessed by pressing the button adjacent to the current steer point number (figure 1-33). Sequence point type, lat/long, elevation, and minimum enroute altitude (MEA) and TOT may be changed.

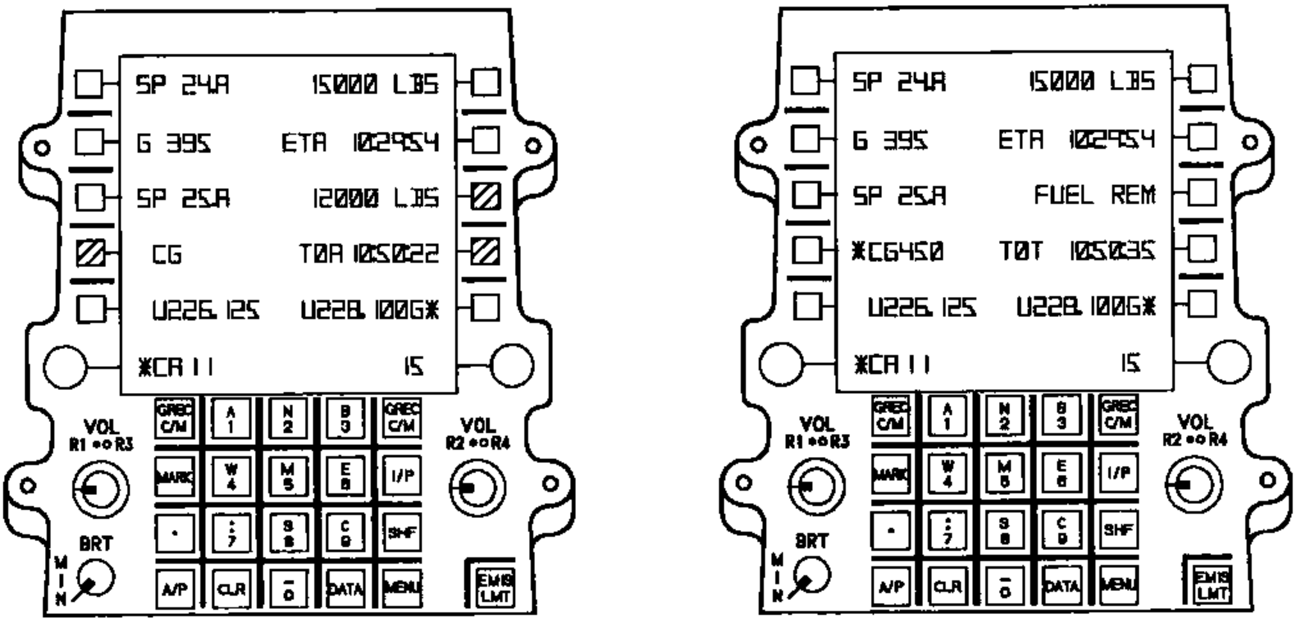
The RNG/BRG submenu is available from the lat/long submenu only if there are offsets stored for a target or target offset point. Press RNG/BRG to enter the range/bearing submenu. On this display, the following items may be changed: current range to the point in NM and tenths of a NM, true bearing to the point, TOT to the point (not available for aim, mark, or offset points), and point elevation.

Pressing the button next to DIR/RNG on the range/bearing submenu selects the direction/range submenu. The DIR/RNG submenu is available only if there are offsets stored for a target or target offset point. Direction N, S, E, or W and range in feet to the point shown may be changed. To return to the data 1 display at any time from the submenus, press the data button once.

To convert to UTM geographical coordinates from lat/long coordinates, the crewmember presses the button adjacent to UTM. This calls up the point data UTM submenu, figure 1-33. 18SFE represents the UTM grid zone and 10,000 meter squared block; the x and y coordinates are 1234054320. The number 1234054320 represents 12,340 meters in the eastern direction, and 54,320 meters in the northern direction. If data to the nearest meter is not available, the aircrew is not required to enter all five digits for each of the east and north coordinates. The aircrew must enter an even number of digits; the first half of the entry is defined as the east coordinate, and the second half is the north coordinate. For example, if the aircrew enters 123456, then east = 12,300 meters and north = 45,600 meters offset from the corner of the grid zone. A quick means is provided to return the lat/long coordinates; simply press the button adjacent to LAT/LONG.

The UTM PROGRAMMING submenu (figure 1-33, sheet 3) allows the aircrew to select a new spheroid or to change the UTM 10,000 meter squared block identifier. The UTM programming submenu is selected from the point data UTM submenu by pressing the button adjacent to PROGRAM. For the UTM coordinate system, the globe is divided into a number of large oval shaped sections called spheroids. To select a new spheroid, press the button adjacent to BESSEL. Successive depressions rotate through the seven spheroid options: Bessel, WGS, International (INTL), Clarke 66, Clarke 80, Everest, and Australian National (AUST NAT). To change the 10,000 meter squared block, first, press the button adjacent to 18>S F E until the caret is pointing at the letter which you wish to change. Next, press and hold either the increment (INC) or decrement (DECR) button until the desired letter of the alphabet is displayed. This procedure is repeated until the three desired characters are displayed. Note that the letters I and O are not used. Programming is exited by pressing the pushbutton adjacent to PROGRAM. Display will return to the UTM Program Submenu.

DATA 2 DISPLAY



1. DATA 2

2. COMMAND GS

15E-1-(25-1)04-CATI

Figure 1-34

DATA 2 DISPLAY

The data 2 display (figure 1-34) provides time, ground speed, and fuel information pertaining to two selected points in the selected navigation route sequence. Pressing the button next to 15000 LBS (fuel remaining at SP 24.A) cycles range and bearing direct from A/C position to line-of-sight SP 24.A, and back to fuel remaining. Pressing the button next to ETA (estimated time of arrival at SP 24.A) cycles to ETE (estimated time enroute) to 24.A and back to ETA. The 12000 LBS shows the fuel remaining at SP 25.A if the route is flown at the command ground speed (CG) direct to the line-of-sight point (24.A) then following the route to the look ahead (end) point 25.A. TOA is the time of arrival at SP 25.A at the CG. Pressing either CG, fuel or TOA changes the display as shown in display 2. If there is no TOT stored for SP 25.A, OFF is displayed next to CG and TOT. A TOT may be entered on this display. The line-of-sight sequence point (SP 24.A) and the look ahead sequence point (SP 25.A) can be incremented by pressing the adjacent button or changed using the scratchpad.

MENU 1 DISPLAY

The menu 1 display (figure 1-35) is a basic avionic system status display. However it can be used to change steer points, to access the point data submenu, to access the tacan, NAV FLIR, AAI, IFF, and A/P submenus, or change the TF set clearance or LAW altitude.

MENU 2 DISPLAY

The menu 2 display (figure 1-36) contains control features for the ILS and (WITH AP-IR) the secure speech system which are explained under those system descriptions elsewhere in section I. It also allows access to the A/G Delivery submenu, present position source submenu, update submenu, and the HUD titling submenu (Refer to Video Tape Recorder System, this section).

MENU 1 DISPLAY – WITH AP-1R | **MENU 1 DISPLAY – WITH VHSIC**

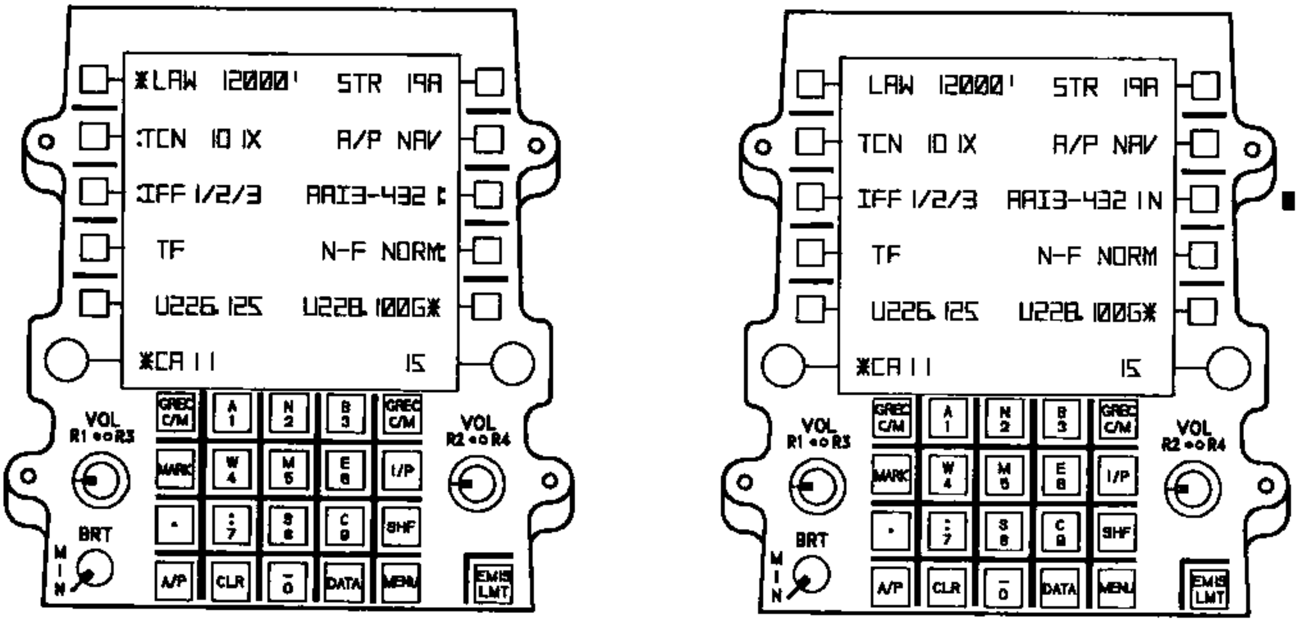


Figure 1-35

Present Position Keeping Source Submenu

NOTE

> With VHSIC, if MN is selected as the PP keeping source, the INS cannot be updated.

To select the PP keeping source submenu, press the button next to PP-MN; the display appears as shown in figure 1-36. Either pilot or WSO may select the desired PP source and change the aircraft present position latitude and longitude.

Entering a new latitude and longitude to the INS should not be done without the INS, CC and UFC turned on and evaluation of the INS stored PP at turn-on. When a new PP is entered the new values should be accurate to 600 feet (0.1 arc minute). Present position entered during alignment should be the actual location of the aircraft. PP corrections made after the aircraft has moved should be done by update after transition to NAV. The front cockpit UFC will automatically initialize to the PP source submenu when going from INS OFF to GC align, if the cockpit UFC is not on a submenu.

Update Select Submenu

Pressing the button adjacent to UPDT SEL selects the update select submenu as shown in figure 1-36, display 3. This display allows the aircrew to update the MN present position and system altitude independently. It also provides the ability to select the following update submenus: Overfly (OFLY), HUD, altitude (ALT) and tacan (TCN).

When the HUD update submenu is selected, the current steer-to-point is displayed next to PB 1. The aircrew can select a different steer-to-point using the UFC scratchpad. When the HUD update submenu is selected, the update source defaults to MN. N/S and E/W represent the starting format for performing a HUD update. The aircrew can select either INS or MN as the update source at PB 10. To perform an update, NAV/INST must be selected and pilot must be in command of the HUD. After the aircrew slews the HUD LOS symbol, the CC calculates position errors for INS and MN. The errors displayed on the

UFC are associated with the update source. The aircrew can cycle between sources to view the errors for each update source. When INS is the update source, the INS and MN are updated. When MN is the update source, only the MN is updated (INS cannot be updated). After the position errors are entered, the HUD update submenu returns to the starting format. The displayed steer-to-point is inhibited from automatic sequencing until the aircrew exits the UFC update select submenu.

When the TACAN update select submenu is selected the current TACAN station and band are displayed next to PB 1. The aircrew can select a different tacan station using the UFC scratchpad or by pressing and releasing PB 1. When selected, the tacan update submenu defaults to MN update source. Position errors are displayed constantly on the UFC TCN update submenu. The aircrew can select the INS or MN as the update source at PB 10. The errors can be entered in any master mode and command of the HUD is not required. When the errors are entered with the INS as the update source, the INS and MN are updated. When the errors are entered with the MN as the update source, only the MN is updated. The aircrew also has the ability to return to the UFC update select submenu.

When the overfly update submenu is selected, the current steer-to-point is displayed next to PB 1. The aircrew can select a different steer-to-point using the UFC scratchpad. When the OFLY update submenu is selected, the update source defaults to MN. N/S, E/W and H/L represent the starting format to perform an OFLY update. The aircrew has the ability to select INS, MN or ALT as the update source. After the aircrew presses PB 8 on the UFC to freeze the errors, the CC calculates errors for INS, MN and ALT. The errors displayed on the UFC are associated with the displayed update source. The aircrew can cycle between update sources to view the errors for each source. When ALT is the update source, the steer-to-point elevation and system altitude are displayed next to PB 2 and PB 3 respectively. If INS is the update source, the INS , MN and system altitude are all updated when the errors are entered. If MN is the selected source when the errors are entered, the MN and system altitude are both updated. If ALT is the selected update source when the errors are entered, only the system altitude is updated. After the errors are entered, the UFC OFLY update menu returns to the starting format and the PB 1 steer-to-point sequences to the next steer-to-point provided AUTO SEQ is selected on HSI. The aircrew also has the option to return to the UFC update select submenu.

When the ALT update submenu is selected, the current steer-to-point is displayed next to PB 1. The aircrew can select a different steer-to-point using the UFC scratchpad. The altitude of the current steer-to-point is displayed next to PB 2 and current system altitude is displayed next to PB 3. H/L represents the starting format to perform an altitude update. The aircrew has the ability to update the system altitude over known surfaces from the UFC ALT update submenu. The aircrew enters the elevation of the known surface next to PB 2. The altitude update is performed over that known surface. After the aircrew freezes the errors (pressing PB 8), the CC calculates the system altitude error. The UFC displays system altitude error associated with the PB 1 displayed reference. Switching the PB 1 displayed reference after the altitude error is calculated causes the original format to be displayed. After the system altitude error is entered, the UFC ALT update menu returns to the starting format and PB 1 displayed steer-to-point will sequence to the next steer-to-point provided the update was done to the steer-to-point and not the known surface and AUTO SEQ is selected on HSI. The aircrew also has the option to return to the update select submenu.

The ability to reset mission navigator present position and system altitude independently is provided only from the UPDT SEL submenu. Selecting PB 1 will display MN RESET (or INV, if invalid) for 5 seconds indicating the MN has been reset to the INS present position. Similarly, pressing PB 2 will display SYS and the CC provided system altitude (or INV, if invalid) for 5 seconds, indicating that the system altitude was reset to baro-corrected altitude.

Listed below are some general notes to remember when performing an update :

a. If an INS position update is required, INS must be selected as the PP-keeping source (UFC Menu 2, PB 4)

b. 2With INS selected at PB 10 as the update source, then INS, MN and ALT (if applicable) are updated. Similarly, if MN is selected, then MN and ALT are updated.

c. Once calculated, errors for INS, MN and ALT (if applicable) can be inspected by toggling PB 10.

d. To clear displayed errors without accepting them, both aircrew must exit the update format by selecting UPDT SEL (WITH AP-1R) or UPDT MENU (WITH VHSIC), DATA or MENU.

e. Auto-sequencing is inhibited while any update submenu is selected, including the UPDT SEL (WITH AP-1R) or UPDT MENU (WITH VHSIC) submenu. Exception: after OFLY errors have been entered, the UFC OFLY update page will return to the starting format and the PB 1 displayed steer-to point will sequence to the next steer-to point provided "AUTO SEQ" is boxed on the HSI and the auto-sequencing conditions are satisfied.

f. When entering an update format from the UPDT SEL (WITH AP-1R) or UPDT MENU (WITH VHSIC) submenu, the PB 10 update source defaults to MN.

BACK-UP MODE DISPLAYS

In the event of a CC failure, the MPDP will assume control of the mux bus and the displays. Some of the displays shown in back-up mode are hybrid combinations of displays available during normal operation. The HUD will only display the CC back-up mode (picture) format. The possible display formats supported for the seven MPD/MPCD include the following: EADI, TEWS, TF, TSD, radar (A/A or A/G). Each of the formats used in backup mode is simplified from the format available in primary mode. Refer to Figure 1-37 for formats displayed in backup mode. The first display listed is the initial format of that particular display. The other formats listed can be scrolled for display. The displays available in the various formats in backup mode are shown in figure 1-38.

A display format may be shown on several units at once. When this occurs, the format is identical in appearance on all of the selected display units. Switch inputs from one of the display units shall affect all appearances of that display format.

In back-up mode (with normal power available), the cautions/advisories will always overlay the radar display format. If the radar display format is not being displayed, the cautions/advisories will not be displayed. The MASTER CAUTION light will come on to indicate to the aircrew that the caution/advisory data is available on the radar display format. Radar data is not occluded when overlaid by caution/advisory data.

In the emergency-power back-up mode, the cautions/advisories are always displayed on the cockpit MPCD and portions of the ADI data are occluded to provide easy readability of the cautions/advisories. The cautions/advisories can be turned off but will reappear when a new caution/advisory occurs.

ADI BACK-UP MODE DISPLAY

The ADI back-up mode display combines data from the normal ADI and HSI displays into a hybrid format. Refer to figure 1-39. The ADI continues to display aircraft attitude with pitch and bank steering bars, aircraft symbol, ground speed, vertical velocity and radar altitude. In addition, the ADI also displays compass heading scale, course setting and the four steer modes available in back-up mode (NAV, TCN, ILST and ILSN). If in emergency power back-up mode, only NAV steer mode is available.

TF BACK-UP MODE DISPLAY

The TF display in back-up mode displays TF video and selected ground clearance. The TF mode is fixed at NORMAL (or LPI if in emission limit), the ride is fixed at HARD and the frequency is fixed at 4.

TSD BACK-UP MODE DISPLAY

The TSD in back-up mode enables the RMR video in normal (not inverted), track-up, no-zoom mode. Display range is adjustable and present position can be up-dated. This format can be selected on either or both of the rear cockpit MPCD.

MENU 2 DISPLAY/SUBMENUS - WITH VHSIC

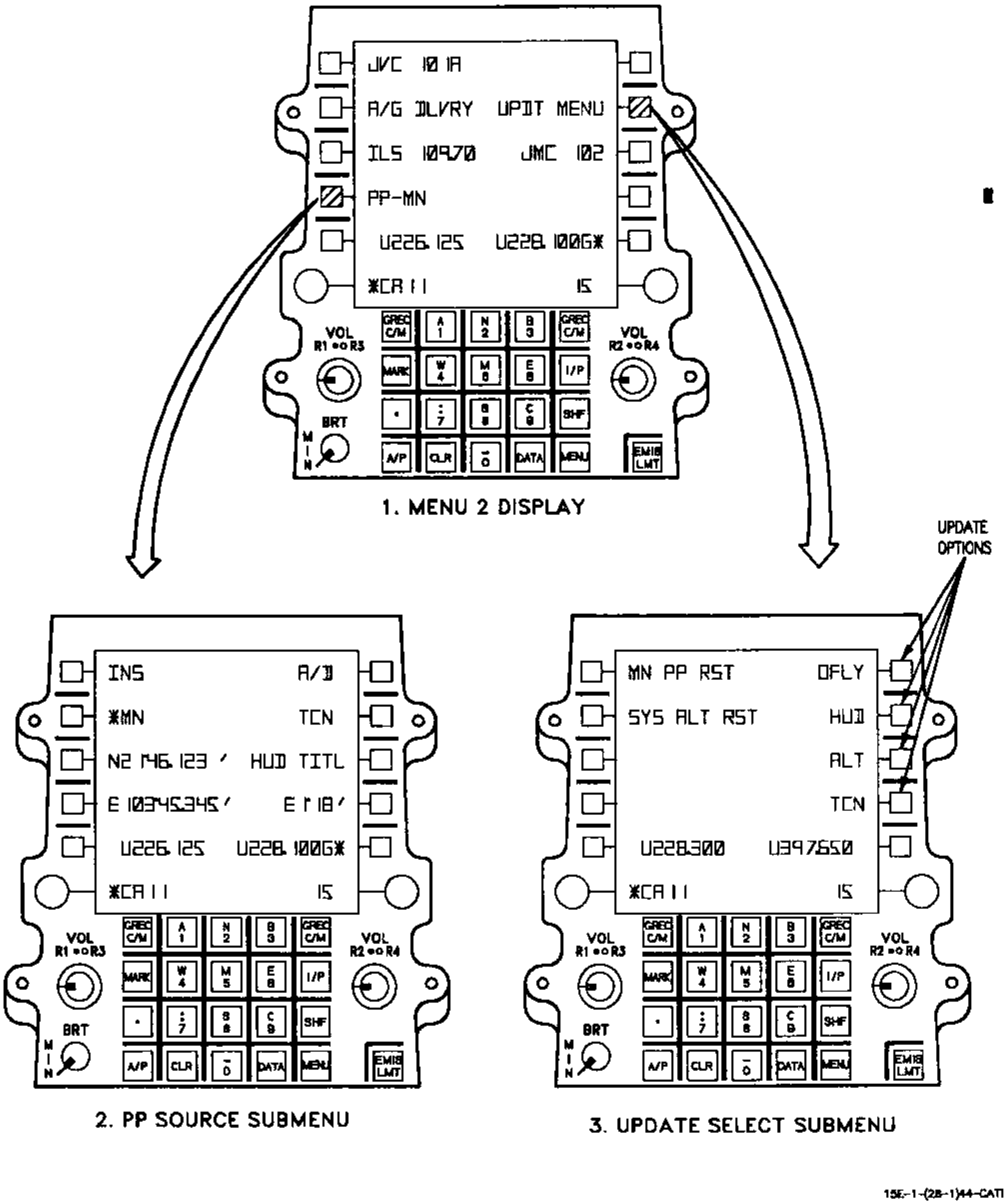
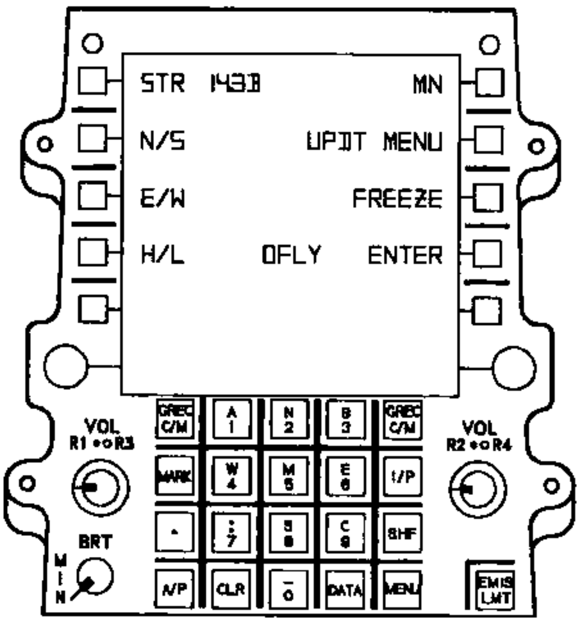
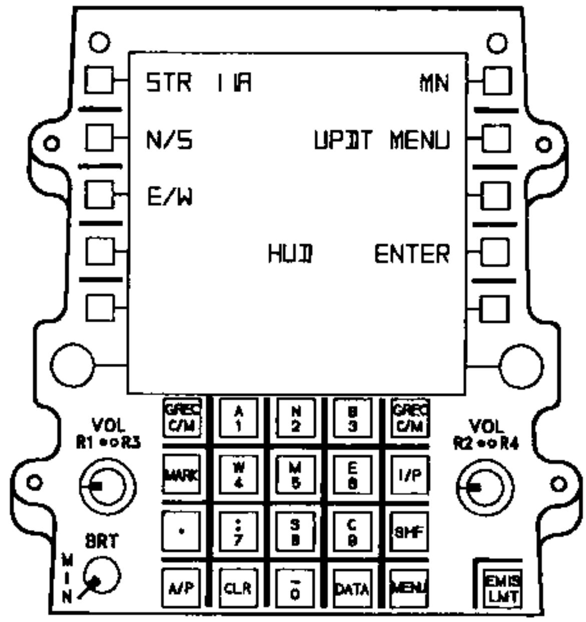


Figure 1-36 (Sheet 1 of 4)

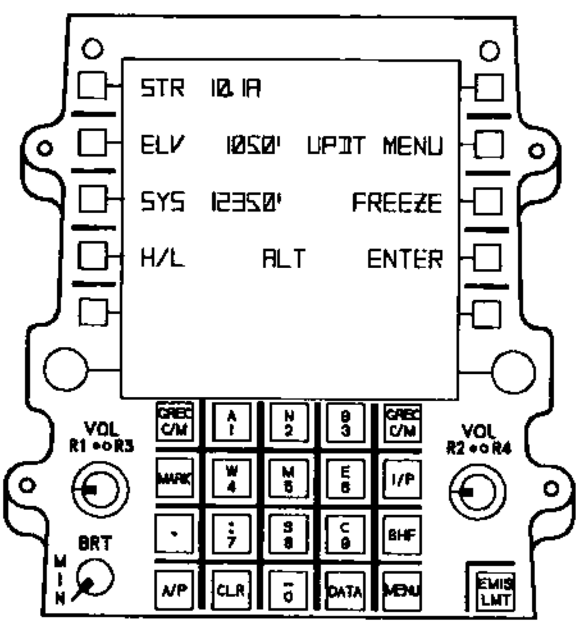
MENU 2 DISPLAY/SUBMENUS - WITH VHSIC (Continued)



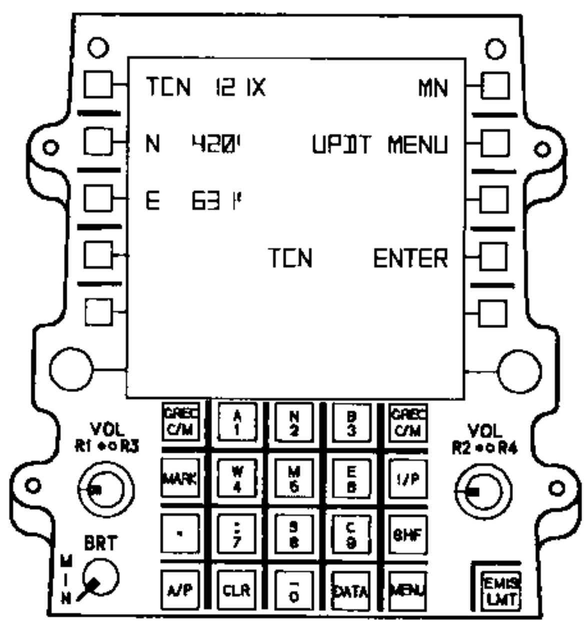
OVERFLY UPDATE SUBMENU



HUD UPDATE SUBMENU



ALTITUDE UPDATE SUBMENU



TACAN UPDATE SUBMENU

15E-1-(28-2)33-CATI

Figure 1-36 (Sheet 2)

MENU 2 DISPLAY/SUBMENUS - WITH AP-1R

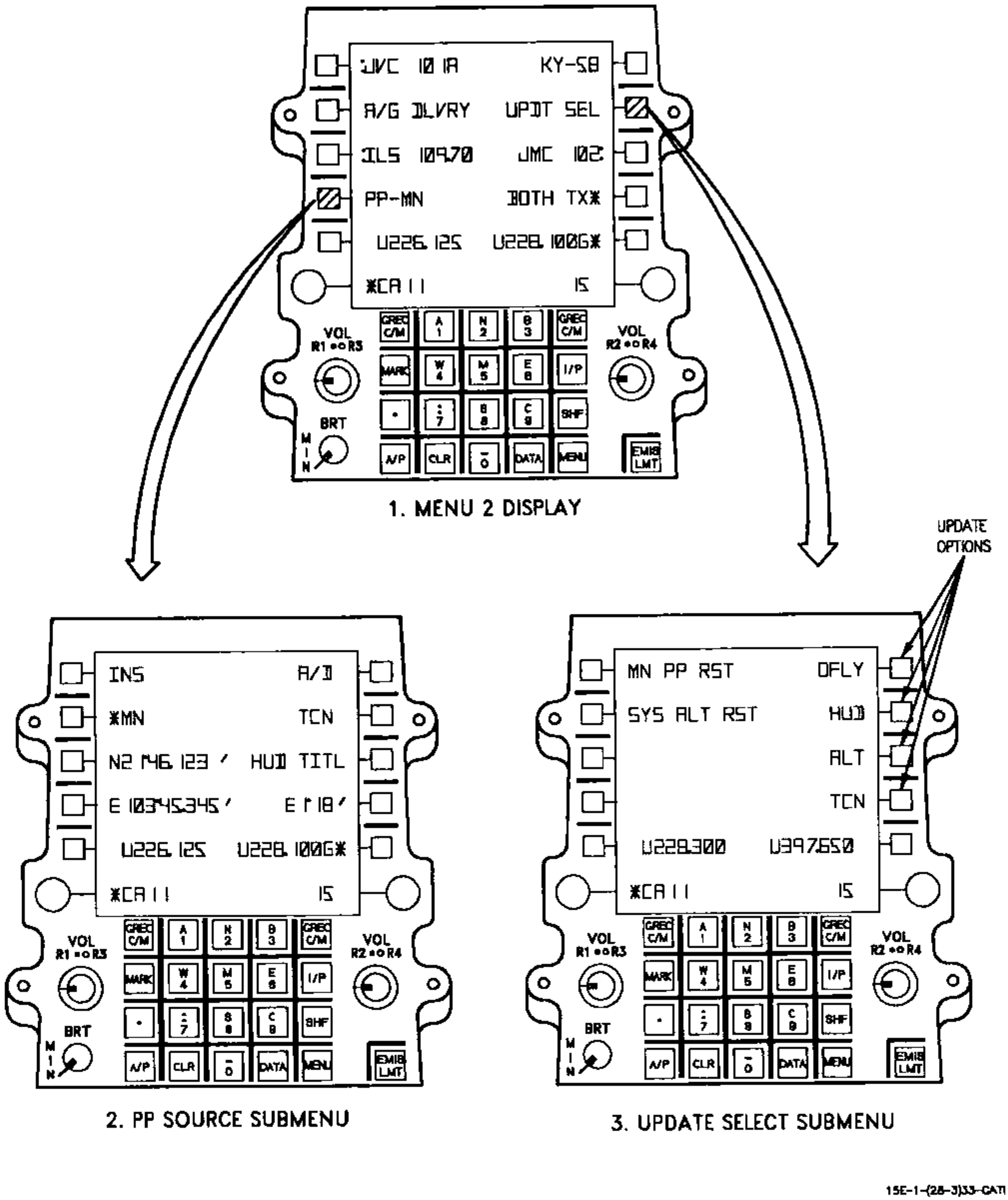
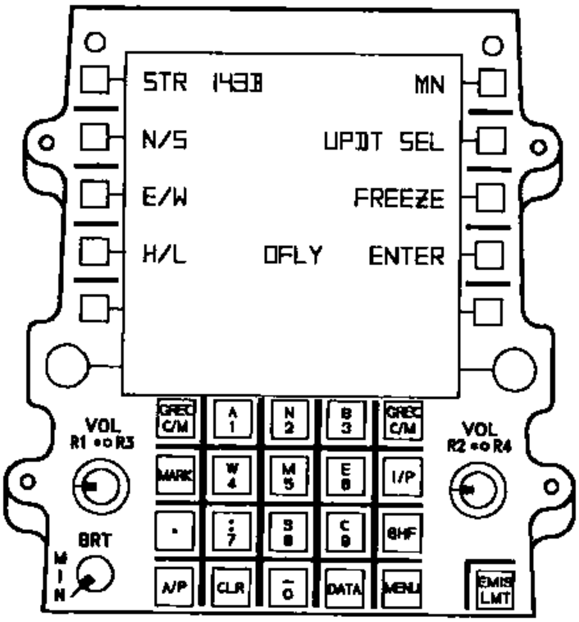
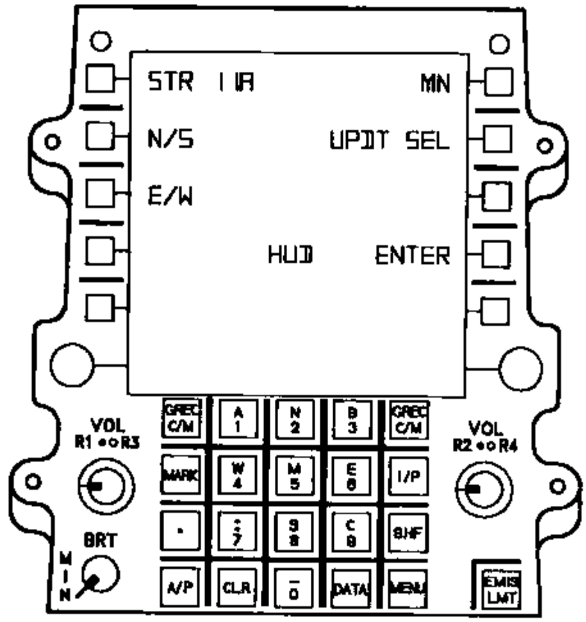


Figure 1-36 (Sheet 3)

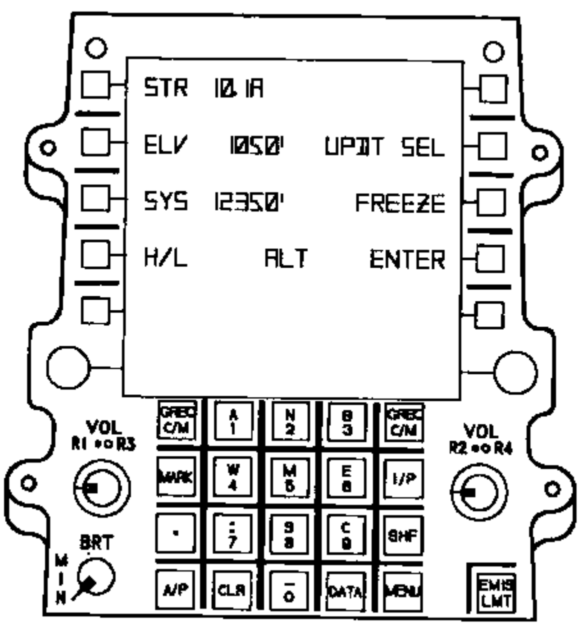
MENU 2 DISPLAY/SUBMENUS - WITH AP-1R (Continued)



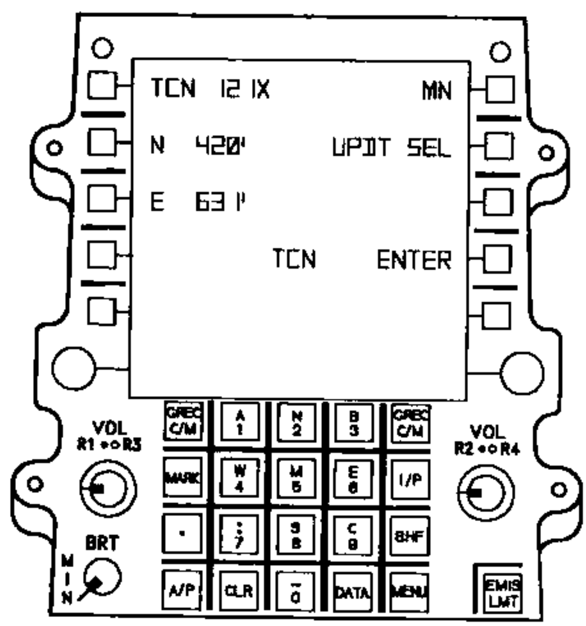
OVERFLY UPDATE SUBMENU



HUD UPDATE SUBMENU



ALTITUDE UPDATE SUBMENU



TACAN UPDATE SUBMENU

15E-1-(28-4)33-CATI

Figure 1-36 (Sheet 4)

BACK-UP MODE (CC FAILED) DISPLAYS

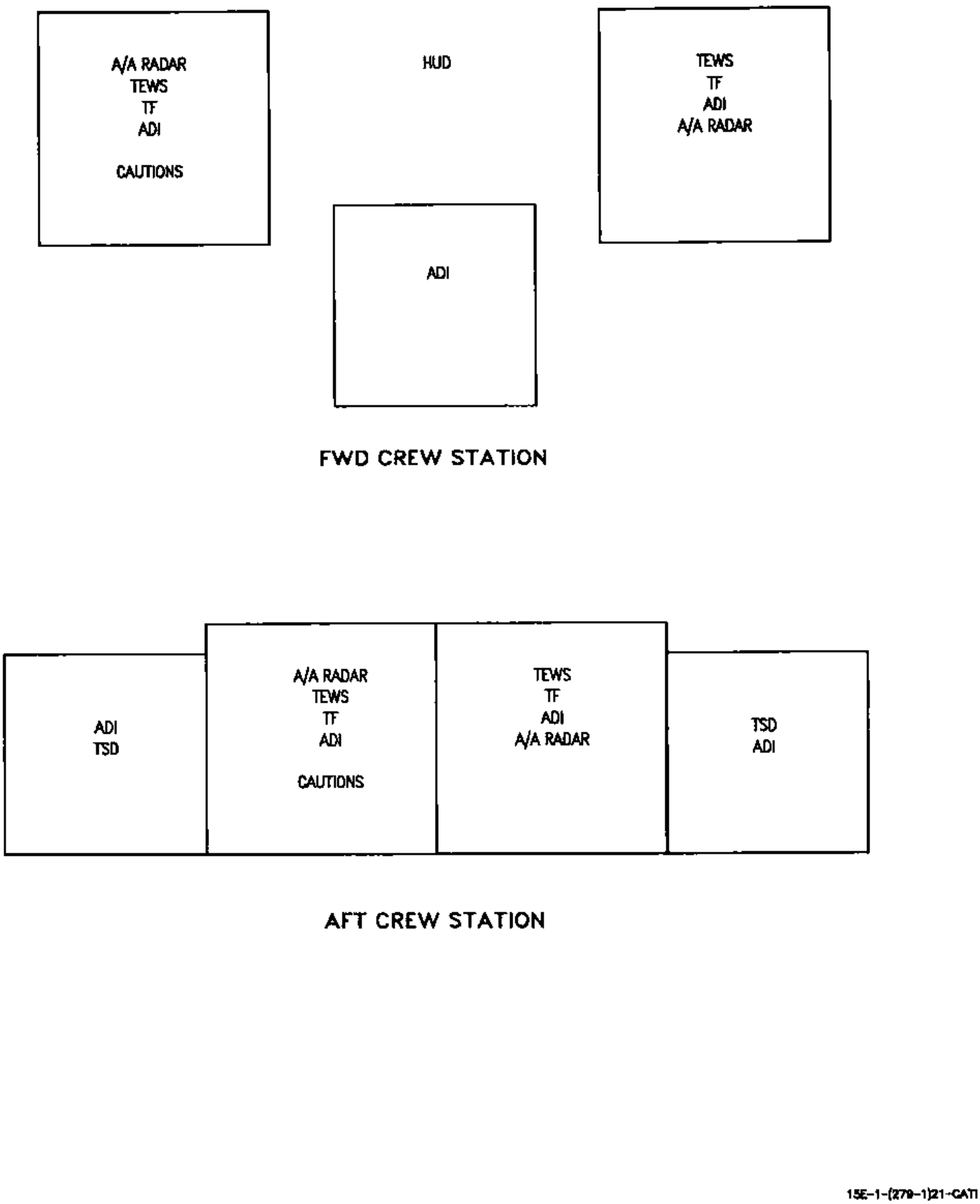


Figure 1-37

BACKUP MODE

AVAILABLE DISPLAYS AND FUNCTIONS

Display Format	Displays and Functions Not Available	Displays and Functions Available	Commanded Operating Parameters
ADI	Angle-of-attack Pitch trim adjust Command heading Attitude source display On demand record Calibrated airspeed - (OFF displayed in this window) Barometric altitude - (OFF displayed in this window) Master menu select Commanded speeds	Steer mode selections Steer point data block Tacan data block Course select options Tacan/ILS	N/A
A/A Radar	SNIFF AUTO GUN VI BCN NCTR	A/G radar display Range Channel selection Search Non-designated track while scan (NDTWS) Vertical scan Single target track (STT) High data rate track while scan (HDTWS) Designated track while scan (DTWS)	FS = 0 EL = 4 RWS I = Interleaved GMTR = AUTO Azimuth scan = Full
A/G Radar	PVU HRM BCN No cursor functions No IPVU SNIFF Steer points	A/A radar display Range Channel selection	Mode = RBM Brightness = 8 Azimuth scan = FULL Gain Control = 3
TEWS	Ownship emissions not provided to the RWR	All RWR symbology, Complete RWR processing logic Ownship headings, Attitude not provided to the RWR	N/A

Figure 1-38 (Sheet 1 of 5)

Figure 1-38

BACKUP MODE (Continued)
AVAILABLE DISPLAYS AND FUNCTIONS

Display Format	Displays and Functions Not Available	Displays and Functions Available	Commanded Operating Parameters
TSD	No target related functions No cursor functions	All primary RMR status cues Map scale INS position update	
HUD	Calibrated airspeed - (OFF displayed in this window) True airspeed Selected speed invalid Angle-of-attack Command velocity Rounds remaining AIM-120 count AIM-7 count AIM-9 count OFF- missile cue Invalid weapon Target Mach Current g Maximum allowable g OWS OFF N-F BRST Radar range scale Half radar range scale Range rate Command heading Baro altitude - (OFF displayed in this window) Selected altitude invalid Vertical velocity off IFA not initialized Gyro compass alignment Inflight align mode Stored heading align Degraded NAV mode Radar JAM code Radar HOJ code	Magnetic heading Ground speed Radar altitude Vertical velocity Velocity vector Pitch ladder Bank scale Gun cross Waterline symbol MRM reference circle Current g loading Pitch/bank steering bars Selected steer mode Steer point range ILS localizer raw data ILS glideslope raw data Tacan CDI data Manual mode A/G gun reticle TF FAIL OBSTACLE g limit TF low Turn rate Turn acceleration DIVE Unarmed INS limit Airspeed No terrain ECCM	N/A

Figure 1-38 (Sheet 2)

BACKUP MODE (Continued)
AVAILABLE DISPLAYS AND FUNCTIONS

Display Format	Displays and Functions Not Available	Displays and Functions Available	Commanded Operating Parameters
HUD (cont)	Radar AOJ code Track memory No zone Figure-of-merit Preplanned target Non-planned target Autopilot selected Ground track steer mode Radar special mode Radar range A/G range MRM TOF MRM lost Time-to-burst (nuclear) Time-to-impact Time-to-pull Time-to-release Time-to-target NAV, tacan time-to go Course set Uncage (SRM) Aspect angle Direct delivery mode Guided delivery mode Auto LADD delivery mode Auto delivery mode CDIP gun mode CDIP delivery mode Shoot cue Rmin, Rmax1 Rmax2, Rne ASE circle Reticle range bar Dynamic seeker range A/A gun reticle Lag line Bullet TOF Steering dot A/A target designator box Break away cue FOV/REF circle AIM/AGM-65 seeker position	N-F LOS TF altitude scale ILS-tacan steer mode ILS marker beacon Manual delivery mode Ghost velocity vector Taacan/ ILS HUD CDI ILS glideslope	N/A

Figure 1-38 (Sheet 3)

BACKUP MODE (Continued)
AVAILABLE DISPLAYS AND FUNCTIONS

Display Format	Displays and Functions Not Available	Displays and Functions Available	Commanded Operating Parameters
HUD (cont)	Super search circle 4° boresight reference circle Displayed impact line Pull-up cue Azimuth steering line Release cue A/G target designator diamond Bank scale and pointer NAV LOS designator Radar altimeter scale Elevation steering line Laser cue GBU-15 range data		
TF	ECCM (manual) Weather mode LPI (Except by way of emission limit) Very low clearance TF warnings/cautions Bank indicator Pitch bank steering Altitude speed	TF Off/Stby/Oper TF set clearance (except 100 feet) Armed fly-up	TF radar frequency = 4 TF submode = Normal TF ride = HARD TF control mode = MANUAL MEA = 30,000
ADI (with Manual TF selected)	AOA Pitch trim adjust Command heading Attitude source display On demand record Master menu select Calibrated true airspeed Barometric altitude Commanded speeds	All display functions are available Pitch steering bar Radar altitude scale TF warnings/cautions	N/A

Figure 1-38 (Sheet 4)

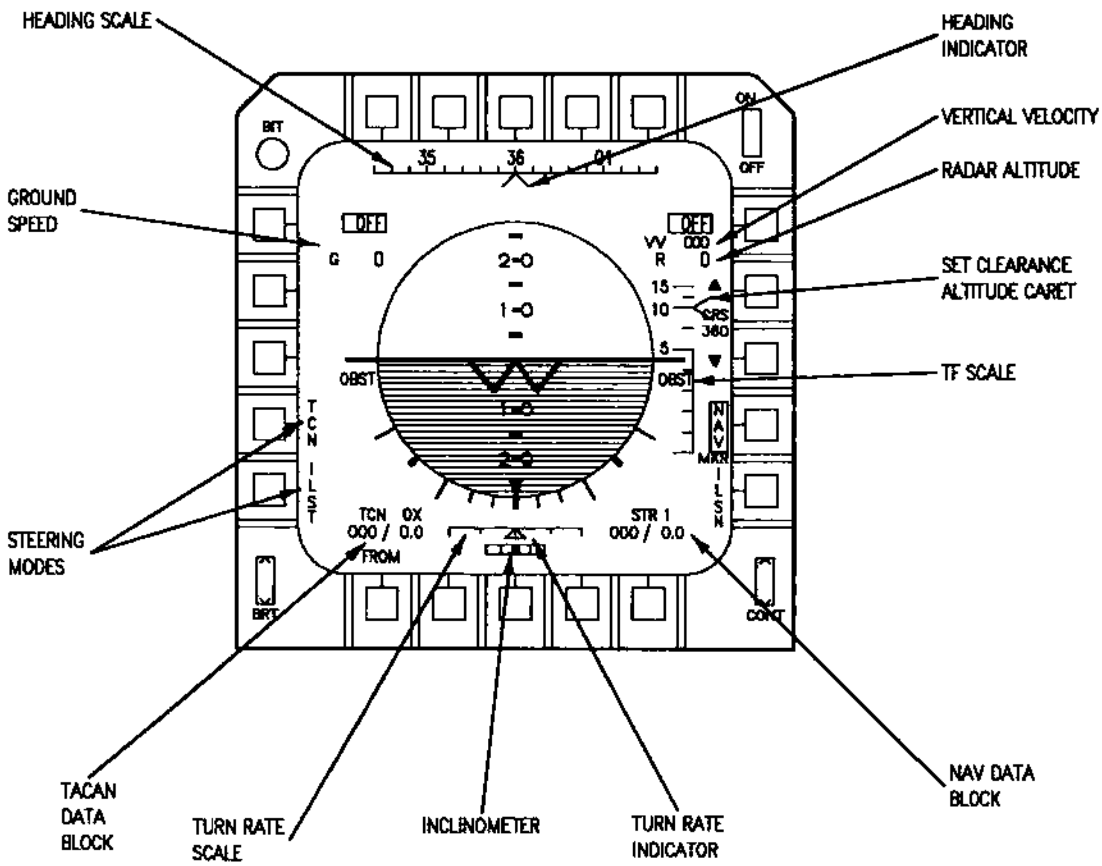
BACKUP MODE (Continued)
AVAILABLE DISPLAYS AND FUNCTIONS

Display Format	Displays and Functions Not Available	Displays and Functions Available	Commanded Operating Parameters
UFC	Data 1 menu Data 2 menu Tacan programming sub-menu IFF programming sub-menu NAV/FLIR submenu NAV/FLIR boresight submenu Autopilot submenu Point data universal transverse mercator sub-menu Point data range/bearing submenu Point data direction/range submenu Point data universal transverse mercator sub-menu HUD titling submenu Present position update submenu	Radia/comm functions Tacan/ILS functions KY-58 functions AAI functions IFF functions MENU 1 - Steer point MENU 1 - TF status MENU 1 - NAV FLIR status MENU 2 - Present position source Point data sub-menu Steer point latitude/longitude data Present position keeping source sub-menu - Aircraft current latitude/longitude Present position keeping source sub-menu - Aircraft current magnetic variation A/G depression angle display and entry	N/A
Weapons data (HUD)	AIM-120	A/G Manual AIM-9 Boresight AIM-7 Flood Gun Fixed cross	N/A
Cautions		Fully displayed on radar display formats for backup supported systems	

Figure 1-38 (Sheet 5)

ADI - BACKUP MODE

NAV STEER MODE SELECTED



15E-1-(253-1)25-CATI

Figure 1-39 (Sheet 1 of 3)

ADI - BACKUP MODE

TACAN STEER MODE SELECTED

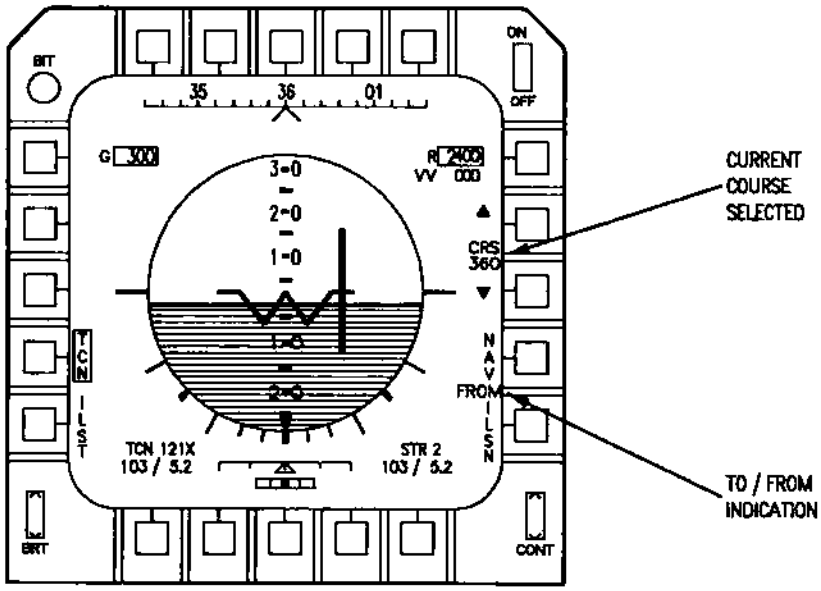
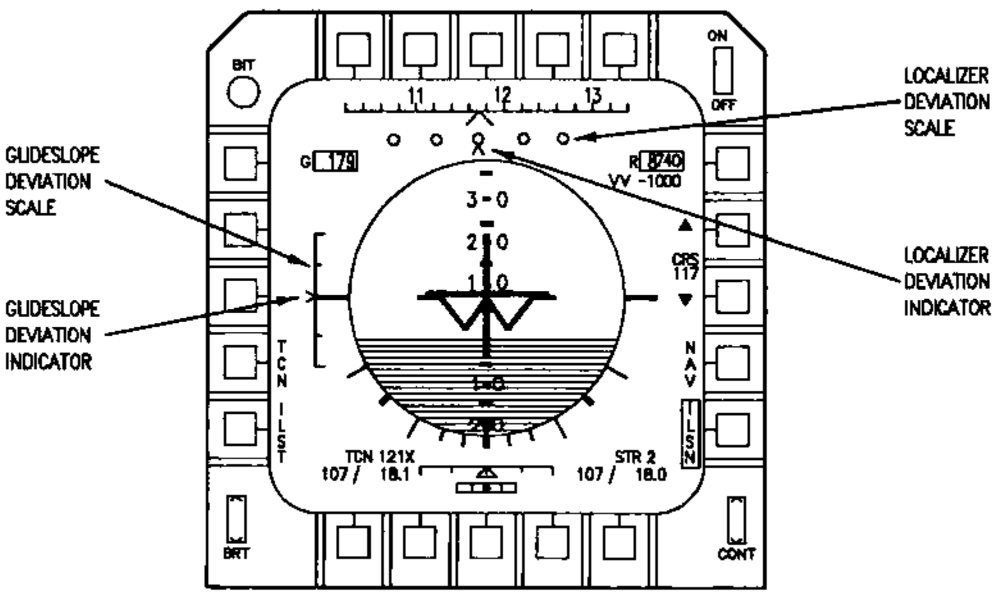


Figure 1-39 (Sheet 2)

ADI - BACKUP MODE

ILS STEER MODE SELECTED



15E-1-(253-3)44-CATI

Figure 1-39 (Sheet 3)

TACTICAL SITUATION DISPLAY (TSD)

The TSD is a presentation of aircraft position with respect to a planned mission route superimposed over a moving map format. Its primary function is to provide planned navigation information and sensor positioning control to the crew. The TSD is selectable on either the MPD or MPCD from the MENU display (figure 1-40).

The best display for its presentation will be on the MPCD so that the advantages of having the moving map in color can be realized. Two primary operational uses of this display are navigation (position awareness) and sensor cueing operation.

TSD NAVIGATION

The navigation function is the display of the aircraft present position, based on the current present position keeping source at UFC Menu 2, PB 4, relative to a planned route which is programmed into the system by means of the DTM or the UFC.

There are several different navigation symbols displayed on the TSD.

SEQUENCE POINTS

There is no specific TSD symbol for this term but it is frequently used in describing the F-15E navigation system. It is a generic term used to define a set of geographical points. These points are loaded into the system using latitude, longitude and altitude (LAT, LONG, and ELEV), with the exception of MARK points, which use latitude, longitude and time. These points can be overflown or used for sensor cueing. They are divided into the following six groups:

List Points

This term refers to DTM loaded geographical points (LAT, LONG, and ELEV) that are used in turn to generate the other navigation points used in the system (steer points, target points, and target offsets). The system is capable of storing 99 list points (1 thru 99).

Base Point

The base point is usually the unit home station and is displayed as B.

Steer Points

These points are defined geographical points (LAT, LONG and ELEV) that comprise the route to be flown. They are displayed on the TSD as circles with a whole number identification assigned to each one. They are loaded into the system via the DTM or manually selected through the UFC. Navigation steering provided on the displays (HUD, ADI, HSI, etc.) is based on the steering point displayed on the UFC. Automatic sequencing of these points is provided as the route is flown if auto-sequencing is selected on the HSI.

Aim Points

These are geographical points associated with a steer point, displayed as square symbols, and identified with its steer point number plus a decimal e.g., 3.1, 4.1, etc. No more than seven aim points can be referenced to any one steer point. The geographical points they represent are used to enhance off-route sensor cueing and position updates. There is capacity in the system for up to 99 aim points. Automatic sequencing of these points is not available.

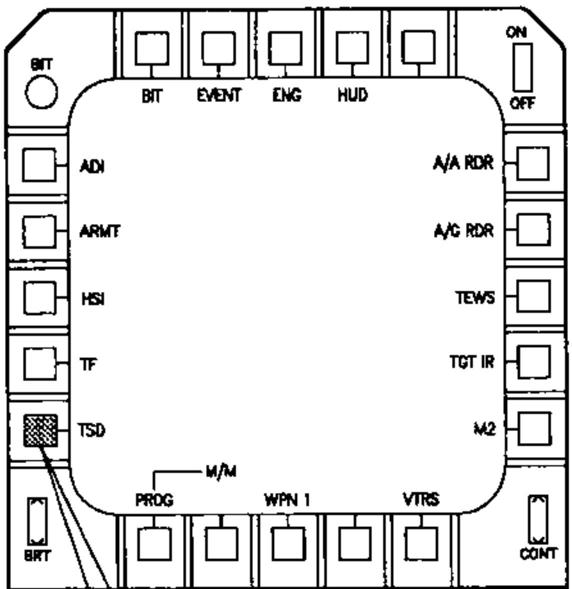
Target Points

Target points are displayed as triangle symbols on the TSD. Target points are stored with steer points whose combined total will not exceed 99. Their ID numbers are whole numbers followed by a decimal, e.g., 2., 17., etc. When in A/G master mode and steering to a target point, that point becomes designated. Automatic sequencing is available for target points provided they are undesignated.

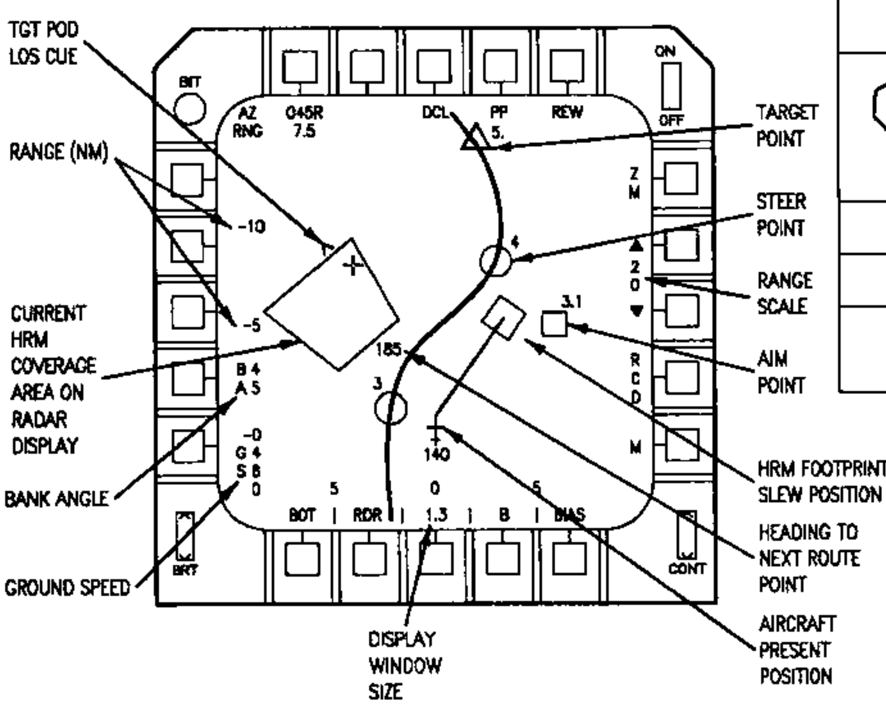
Target Offset Points

Target offset points are used as points to which target points are referenced. They are displayed on the TSD as a broken triangle and identified with its target point whole number plus a decimal number in hundredths e.g., 3.01, 3.02, 3.03 etc. No more than seven target O/S points can be referenced to any one target point. Automatic sequencing of these points is not available.

TSD DISPLAY



MENU DISPLAY



TYPICAL DISPLAY FORMAT

TSD DISPLAY SYMBOLOGY	
	STEER POINT 1
	AIM POINT 1.1
	TARGET 1.
	OFFSET POINT 1.01
	CURSOR
B	BASE
	FLIR LOS/PT TRACK/ACTIVE FLIR COVERAGE
	RADAR LOS/PT TRACK/ACTIVE RADAR COVERAGE
140	AIRCRAFT PRESENT POSITION WITH GROUND TRACK READOUT
	ANTENNA AZIMUTH SCAN PATTERN IN RBM
	FLIR ACTIVE LOS
	MARK POINT
	A/A TARGET SYMBOL (STT/PDT)

15E-1-(168-1)21-CATI

Figure 1-40

Mark Points

Mark points are displayed on the TSD as an extended V shaped symbol at the time of the mark occurrence. Mark points are identified as a whole number above a V. These points are loaded by either performing an overfly mark via the UFC, a radar mark via the A/G radar display or an automatic overfly mark when the weapon release button is pressed.

REMOTE MAP READER (RMR)

The RMR in the rear cockpit, right console, generates a color moving map video signal from aeronautical chart data reproduced on 35 millimeter filmstrips. The video signal is combined with situational overlays within the display system processors and portrayed on the MPCD as the TSD. See figure 1-40. The RMR consists of the following:

Access Door	Provides access to the film cassette. Opening the door rewinds the cassette.
Release Lever	Raising this lever releases the film cassette.
Film Cassette	The 35 mm film cassette is installed by the WSO; cassettes can be changed in flight.
BIT Indicator	The indicator shows white with a system failure.

The RMR calibrates itself upon initial power-up. On aircraft 90-0238 AND UP, a recalibration can be done by rewinding, removing and reinstalling the cassette, either inflight or on the ground.

CAUTION

Remote map reader film can not be stored in temperatures of 140°F and 70% humidity or above. If temperatures are expected to reach this limit, remove cassette from aircraft.

NOTE

- When film cassette is removed, the cassette installation/removal lever must be left in the removed position unless another tape is installed immediately. Vibration could cause the leader strip to be sucked into RMR and prevent loading of a cassette.
- If an initiated or automatic BIT is run on the RMR while the RMR is in REWIND, an erroneous failure of the RMR is displayed.

DISPLAY FORMAT OPTIONS

The TSD format has a number of display options to facilitate its use for navigation. The operator must be in command of the display format to select options. They are selected via HOTAS controls or pushbuttons from the options displayed on the format and are described below (refer to figure 1-40).

Scale Select

There are four display scales and four corresponding map scales available on the TSD, 10, 20, 40 and 80 NM. Refer to figure 1-41 for the corresponding map scales and chart types. The RMR film cassette stores a large area of coverage for each chart type. PB 13 will decrease the display scale and PB 14 will increase it. The selected display scale value appears between those two pushbuttons. WITH VHSIC, the castle switch on the hand controllers can also be used to select map scales. Aft on the castle switch increases map scale range and forward decreases scale range. Range tic marks are displayed on both the left and bottom of the display. The tic marks are centered around the aircraft symbol and provide the crew with a simple reference to estimate the location of a given point on the map. Refer to figure 1-41, where the 20 NM scale has been selected. The corresponding chart type is the Tactical Pilotage Chart (TPC) and the map scale is 1:500,000. The aircraft symbol is at the bottom of the display and the range tic marks show 15 NM ahead of the aircraft and 5 NM behind. The tic marks are labeled at 0, 5 and 10 NM, with the 0 NM mark aligned with the aircraft symbol. The range marks also show 10 NM to either side, labeled at 5 NM on each side.

Zoom

The zoom (ZM) option magnifies the display scale and chart image by a factor of 10/7. The zoom feature is selected with PB 15 and the label ZM is boxed when selected. The display scales provided with zoom are:

Display Scale	Expanded Map Scale
10 NM	7 NM
20 NM	14 NM
40 NM	28 NM
80 NM	56 NM

Figure 1-41 depicts a display with zoom selected. Note that the map scale value between PB 13 and PB 14 shows 14, rather than 20, which was the display scale prior to selecting ZM.

Aircraft Symbol Position

Two positions of the aircraft symbol are available, bottom (BOT) and center (CTR). Selection of either option is made with PB 6, and the current selection is displayed. With BOT selected, 3/4 of the display is in front of the aircraft symbol. With CTR selected, 1/2 of the display is in front. Refer to figure 1-42.

Route Select

Any one of the three mission routes (A, B or C) can be selected for display by stepping from one route to the next with PB 9, and the current route is labeled at PB 9. Refer to figure 1-42.

Turn Radius Select

The actual ground track of the planned aircraft route can be displayed by crew selection of planned bank angle and ground speed. The route line connecting the mission steer and target points will have a turn radius curve originating from the point behind and extending to the next two points ahead of the aircraft symbol. The heading to next route point after the current steerpoint is displayed above and to the right of the current steerpoint. The heading is only displayed when the current mission route is displayed on the TSD and look-ahead mode is not selected. In look-ahead mode, the selected steer or target point is referenced instead of the aircraft symbol. The current selections of planned bank angle and ground speed are shown at the left edge of the display format. Display and selection of bank angle (BA) is made at PB 4; values of 30°, 45° and 60° are available. Display and selection of GS is made at PB 5; values of 360, 420, 480, 540, 600 and 0 knots are available. If a ground speed of 0 is selected, the route points will be connected with straight lines and the bank angle selection is removed. Turn radius select is available on all TSD scales.

Look Ahead

The look ahead option allows the crew to sequentially step through the steer and target points of the displayed mission route. Look ahead can be selected with PB 17 or by pressing up on the coolie switch (front cockpit) or pressing the castle switch (rear cockpit). Selection of the look ahead option commands the display format to 10 NM scale and north-up orientation, with the stepped-to route point displayed in the center and its sequence point number shown at PB 17. WITH VSHIC, the sensor cue range and bearing line originate from the direction of the aircraft. The range and bearing line are oriented back to the aircraft's position, relative to the sensor cue postion. The aircraft symbol is removed. The display can be returned to the usual present position format by pressing down on the auto acq switch (frint cockpit) or down on the mode reject switch (rear cockpit). Refer to figure 1-43.

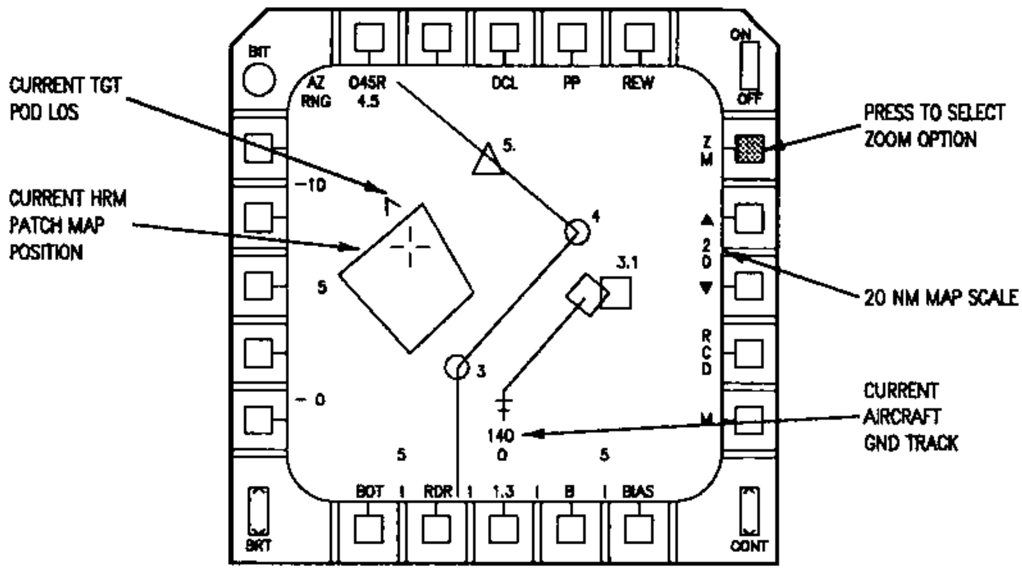
Declutter

The declutter (DCL) option removes most of the symbology drawn over the chart image to improve readability of the displayed chart. The declutter feature is selected with PB 18, and the label DCL is boxed when selected. Selection of declutter removes the following symbology: sequence points and route lines, range scales and the active sensor cues (HRM window and FLIR arrow). Refer to figure 1-42.

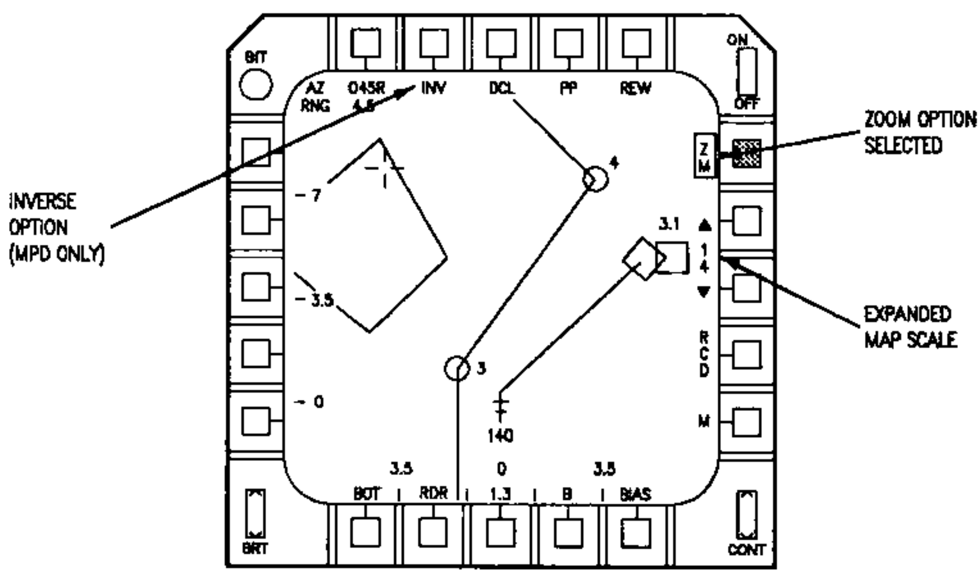
Inverse Option

The inverse video (INV) option is available only when the TSD is shown on an MPD. It provides improved viewing of the map during night operations and improves the readability of the color charts when shown on a monochrome display. The inverse feature is selected with PB 19, and the label INV is boxed when selected. The effect is similar to viewing a photograph negative, where the gray scale from light to dark of the normal image is reversed. Refer to figure 1-41.

TSD MOVING MAP DISPLAY



TYPICAL TSD DISPLAY



EXPANDED TSD DISPLAY

DISPLAY SCALE	MAP SCALE	CHART TYPE	APPROXIMATE COVERAGE (NM^2)
80	1:2,000,000	JNC	650,000
40	1:1,000,000	ONC	160,000
20	1:500,000	TPC	40,000
10	1:250,000	JOG	10,000

MAP SCALES

15E-1-(225-1)44-CATI

Figure 1-41

Rewind

The rewind (REW) option is used to rewind the RMR film cassette. The film cassette must be rewound completely before it can be removed from the RMR. The rewind feature is selected with PB 16, and the label REW is boxed when selected. During rewind, the message RMR NOT READY appears on the TSD. After film rewind is complete, the message FILM REWOUND is displayed. Refer to figure 1-42.

RMR Video Alignment

The system bias (BIAS) option is used to null out any system bias and video alignment error in the chart image from the RMR. The video alignment feature is selected with PB 10, and the label BIAS is boxed when selected. In this mode, a video test frame and center X are displayed and the crew uses the TDC to move the test frame until it is centered with the center X, thus storing this position offset or bias by exiting the bias mode. Refer to figure 1-43.

DISPLAY FORMAT ADVISORIES

There are several cues and advisories to the crew that can appear on the TSD. These messages inform the operator about system status and chart availability. Refer to figure 1-42.

Scale Not Available

This advisory is displayed when the chart type corresponding to the display scale is not available for the commanded position. The commanded position is covered by some other chart type, and the display scale should be changed to obtain the appropriate chart, generally to a larger scale.

Map Not Available

This advisory is displayed when there is no chart coverage in any scale for the commanded position. An RMR film cassette containing the appropriate coverage should be loaded, if available.

RMR Not Ready

This advisory is displayed during rewind or RMR video calibration, or if the film cassette access door is open.

Film Rewound

This advisory is displayed when the film cassette is completely rewound and ready for removal from the RMR.

Invalid PP

This advisory is displayed if the aircraft present position data is invalid.

Sequence Point Error

If an invalid sequence point is selected with the UFC, the cue ERROR is displayed at PB 17 for five seconds, after which the display returns to the previous sequence point number. Refer to figure 1-43.

A/A Target

The A/A target cue symbol is displayed on the TSD to indicate the aspect, range and relative bearing of the primary A/A target designated from any track mode of the A/A radar. The symbol is displayed in red on the MPCD. Refer to figure 1-43.

TSD SENSOR POSITIONING

The sensor positioning function is the display and control of A/G radar HRM and TGT pod IR line of sight and footprint size. From the TSD, range and azimuth of either sensor cue point is controlled with the TDC and displayed in the upper left corner of the format. Various sensor options can be selected from the display pushbuttons or through HOTAS controls. The operator must be in command of the display format. Refer to figure 1-44, sheet 1. More detailed information on operation of the A/G radar and TGT pod is contained in TO 1F-15E-34-1-1.

Sensor Selection

Either A/G radar HRM (RDR) or TGT pod IR (FLR) can be selected as the sensor of interest for slewing and control from the TSD. With AP-1R, selection is made by pressing PB 7 or by pressing the castle switch (rear cockpit) forward for RDR or aft for FLR. With VHSIC, selection is made by pressing PB7 or by cycling the castle switch (rear cockpit) left between RDR or FLR. There is no HOTAS selection. The current sensor selection is displayed at PB 7. Refer to figure 1-44, sheet 1.

TGT Pod IR Arrow

This arrow symbol is the TGT Pod IR cue and it represents the range and bearing of the current TGT pod line-of-sight (LOS). If the TGT pod IR is selected as the sensor of interest, the TGT pod IR arrow cue also appears at the end of the TSD control range and bearing line, and FLR is displayed at PB 7. Refer to figure 1-40, sheet 2.

HRM Display Window

This variable size symbol is the A/G radar HRM cue and it represents the range and bearing, patch map size and radar cursor location in the patch map of the current HRM, if any. If the A/G radar HRM is selected as the sensor of interest, an appropriately sized window outline is displayed centered around the end of the TSD control range and bearing line. RDR is displayed at PB 7 and the selected HRM display window size is displayed at PB 8. Four window sizes are available from the TSD: 1.3, 3.3, 4.7 and 10 NM. Window size can be changed by pressing the auto acq switch (front cockpit) forward for a smaller footprint or aft for a larger footprint. In the rear cockpit, press the mode reject switch forward for a smaller footprint or aft for a larger footprint. Refer to figure 1-44, sheet 1.

HRM Limit Cue

A large X symbol is displayed within the TSD control HRM display window cue whenever the range and bearing are not suitable for map processing. This HRM limit cue is displayed under any of the below conditions :

a. Any display window corner within 8° of the velocity vector

b. Any display window corner outside radar gimbal limits (60°)

c. Display window position outside maximum range for its size

d. Display window position inside minimum range for its size

e. Display window position not within absolute HRM limits

If minimum or maximum range limits for the selected display window size are the cause for the limit cue, the large X is drawn the size of a display window that would met the limits, and not the size of the selected display window. Refer to figure 1-44, sheet 2.

Range and Bearing Track Mode

Positioning either sensor cue at the end of the range and bearing line to track a desired point on the moving map display is accomplished by engaging the range and bearing track mode. This mode maintains the sensor cue in a ground stabilized point track using INS inputs. Range and bearing track mode can be engaged or disengaged by pressing the laser fire button (front cockpit) or by pressing trigger half action (rear cockpit). When track mode is engaged a small dot is displayed at the end of TSD control range and bearing line. Refer to figure 1-44, sheets 1 and 2.

Sensor Cueing

The position of the range and bearing line, and its associated sensor cue for the selected system, is controlled with the TDC. Pressing and releasing the TDC (front cockpit) or pressing trigger full action (rear cockpit) commands the TGT pod to be cued (in wide field of view) or the HRM map to be processed (in the selected display window size) at the position shown on the TSD.

Radar Advisories

If an HRM is commanded from the TSD and the radar system cannot respond to the command, an appropriate message is displayed to the crew. If the radar is in use for some other purpose such as A/A modes or A/G radar in command at some other display, the message RADAR IN USE is displayed. If the radar is not operating or is not able to transmit, the message RADAR NOT OPERATING is displayed.

TSD SELECTIONS

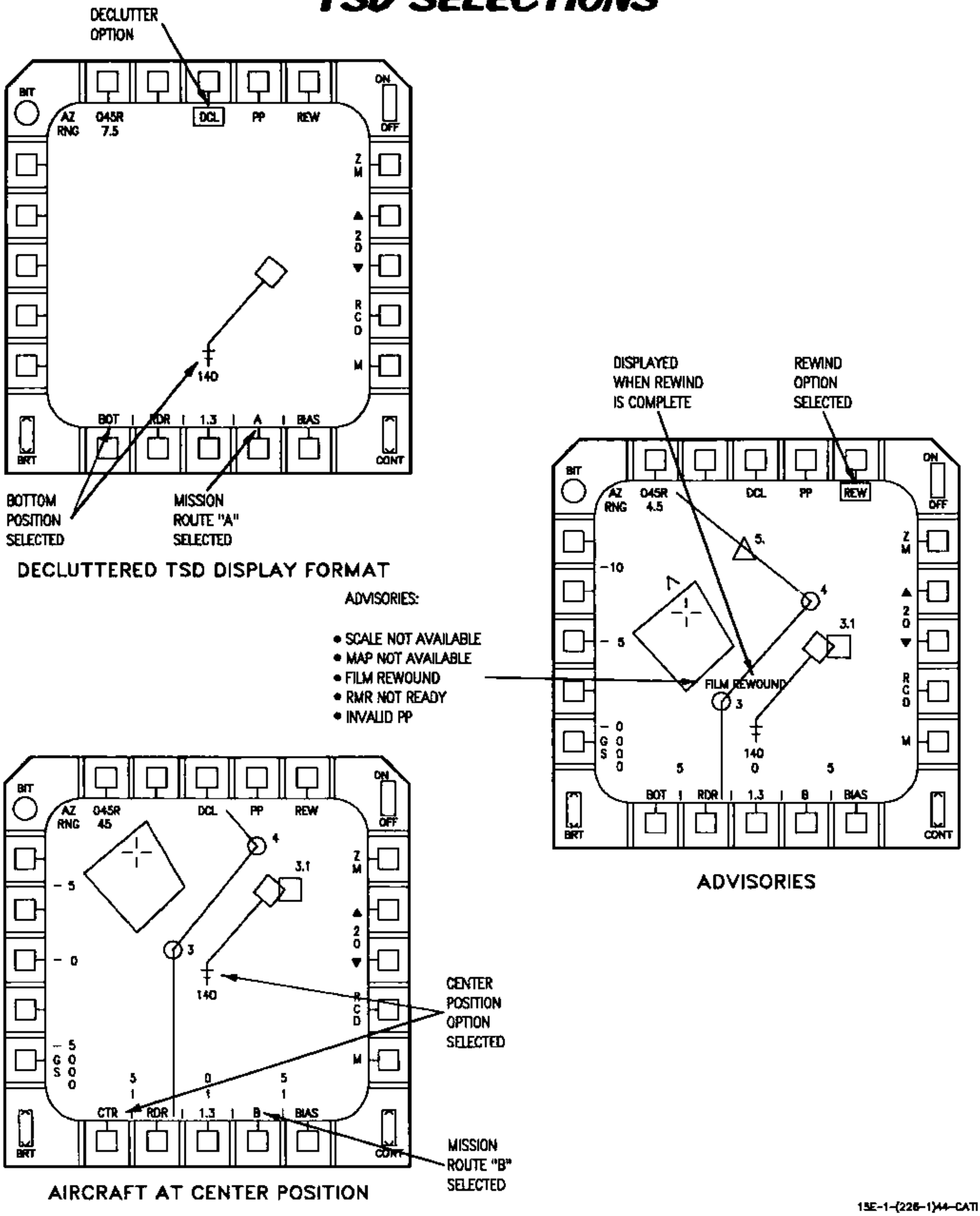
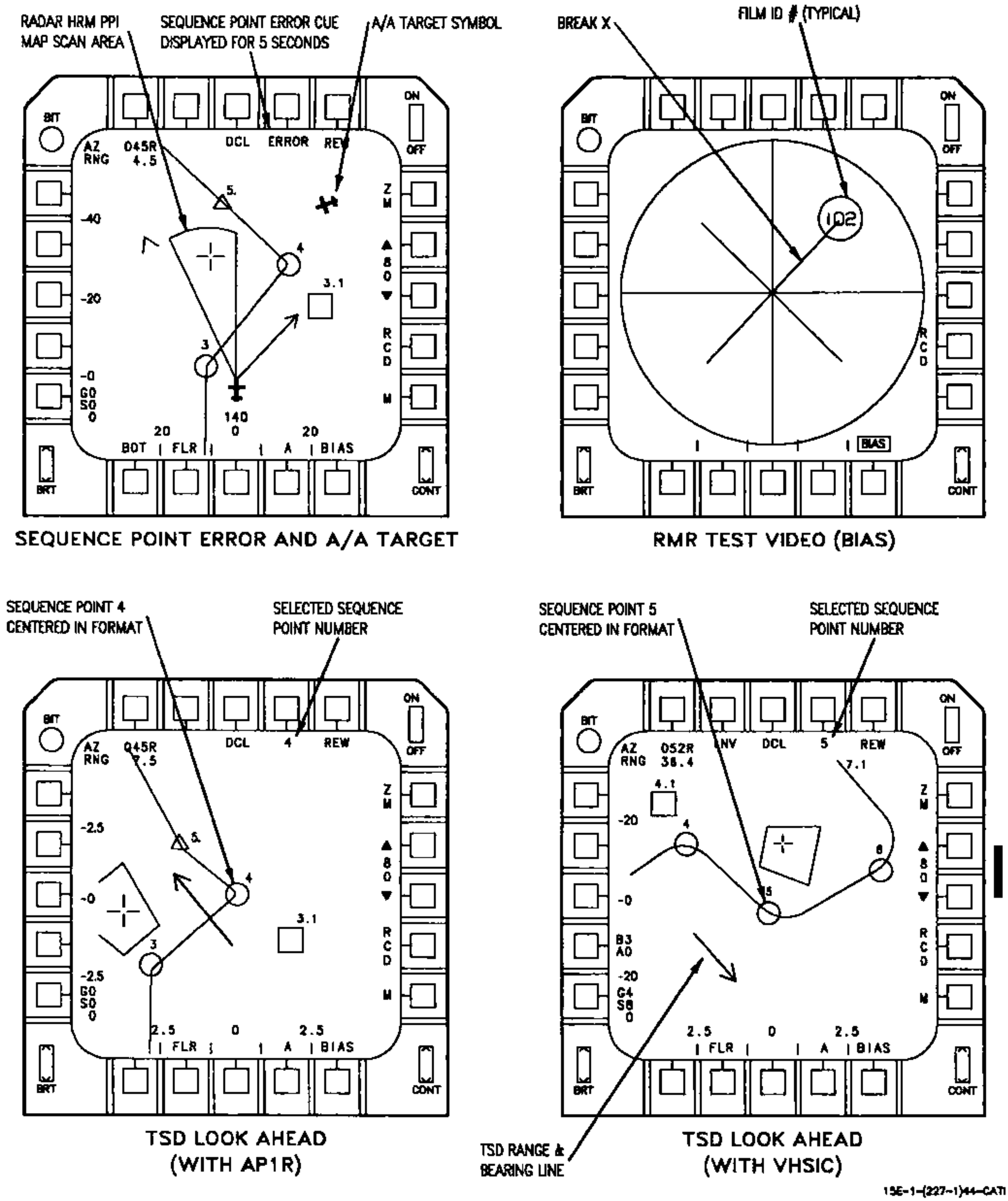


Figure 1-42

TSD ADVISORIES AND SYMBOLS



SEQUENCE POINT ERROR AND A/A TARGET

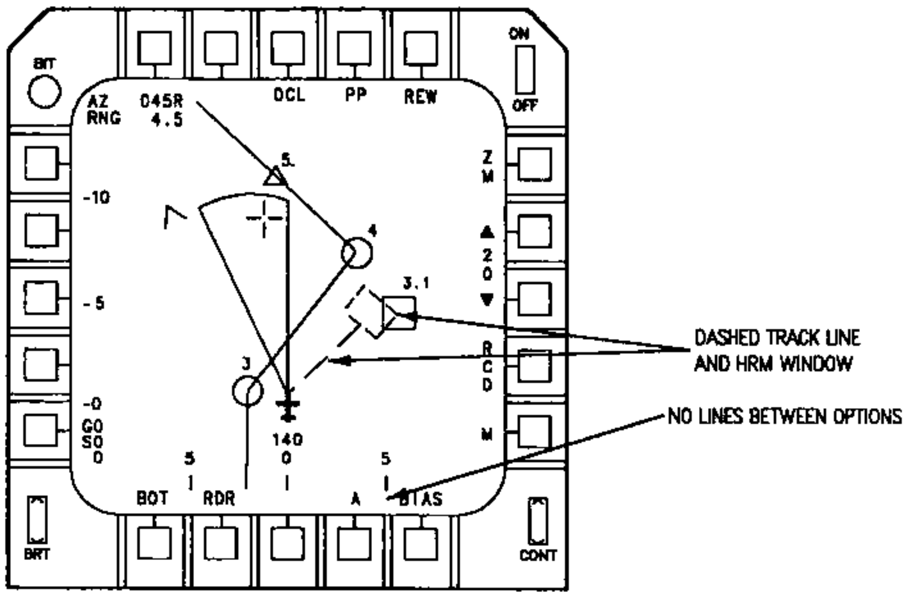
RMR TEST VIDEO (BIAS)

TSD LOOK AHEAD (WITH AP1R)

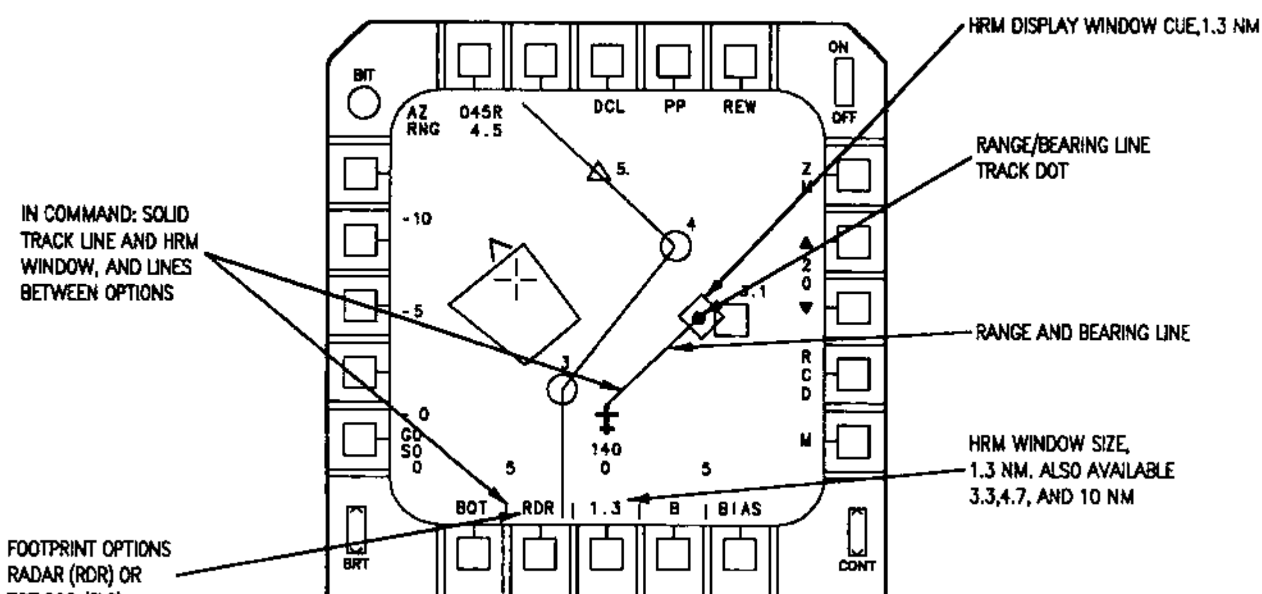
TSD LOOK AHEAD (WITH VHSIC)

Figure 1-43

SENSOR POSITIONING



BEFORE TAKE COMMAND

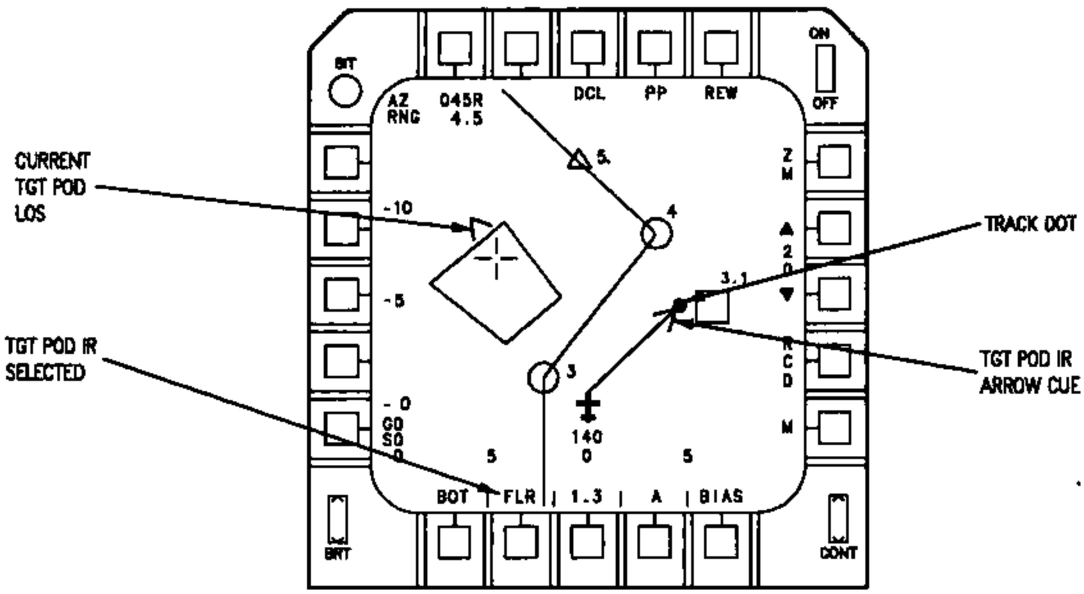


RADAR FOOTPRINT SELECTION

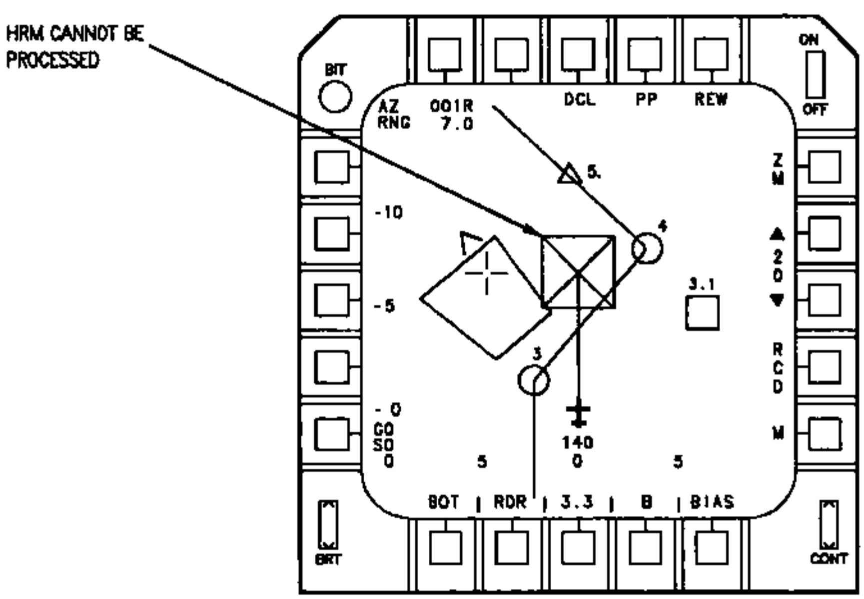
15E-1-(228-1)44-CATI

Figure 1-44 (Sheet 1 of 3)

SENSOR POSITIONING (Continued)



FLIR CUE

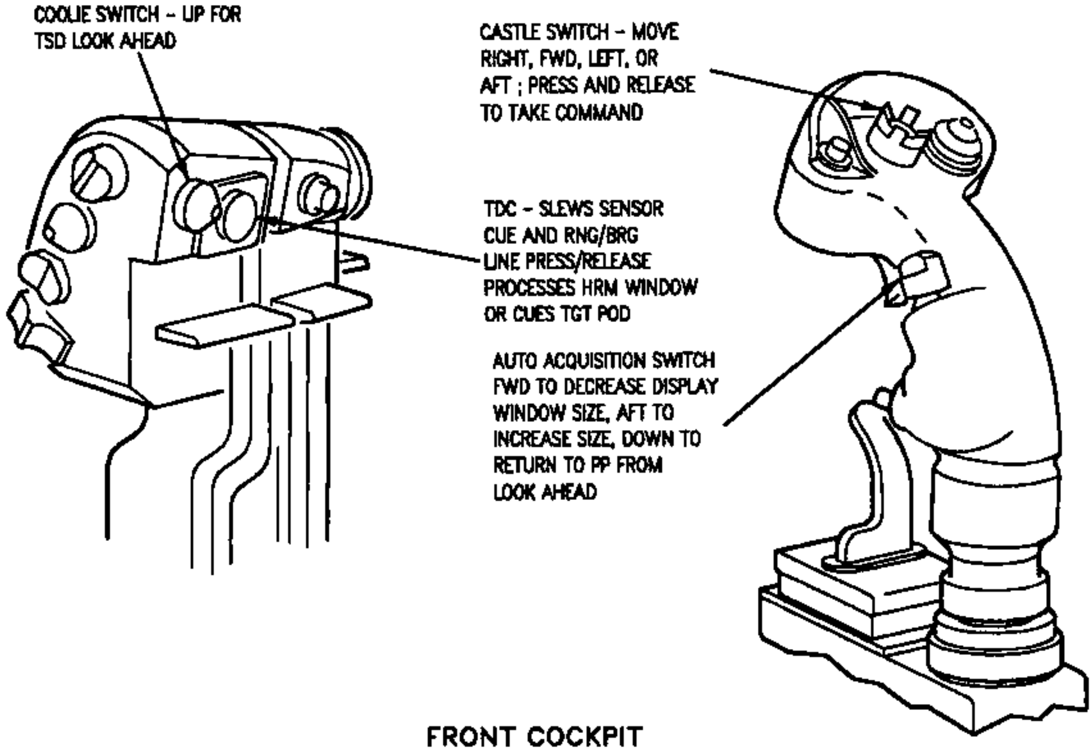


HRM LIMIT CUE

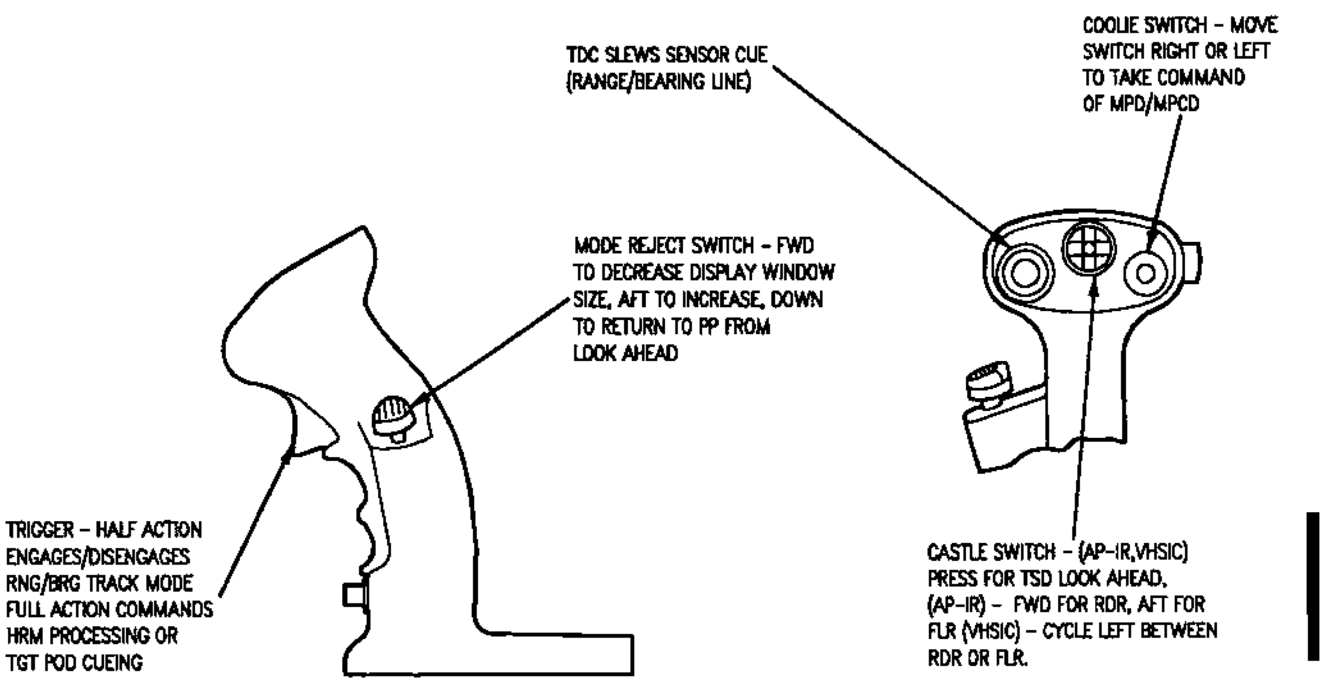
15E-1-(226-2)44-CATI

Figure 1-44 (Sheet 2)

SENSOR POSITIONING (Continued)



FRONT COCKPIT



REAR COCKPIT
RIGHT CONTROLLER

15E-1-(228-3)44-CATI

Figure 1-44 (Sheet 3)

INTERCOM SYSTEM

The intercom system (ICS) provides communication between the two crewmembers, and between the crewmembers and the ground crew. An external receptacle and volume control are installed on the aircraft exterior for the ground crew. The exterior volume control knob controls intercom volume to the ground crew headset.

INTERCOM CONTROLS

Controls for the intercom are on the remote intercommunications control panel in front cockpit and the intercommunications set control panel in the rear cockpit. These controls are the ICS volume control knob and the intercom function selector switch.

ICS Volume Control Knob

The ICS volume control knob adjusts the intercom audio volume level for the crewmember's headset.

Intercom Function Selector Switch

This switch, labeled MIC, has positions of RAD ORIDE, ON and OFF. It is not spring-loaded to return to ON position.

RAD ORIDE	Selecting radio override will attenuate the radio communications in favor of intercom communication; however, the voice warning messages are not overridden, and the following warning tones are not overridden: yaw rate, angle of attack, unsafe landing gear, over g, and TEWS launch.
ON	Selecting ON provides direct communication from the cockpit in which it is selected with the other cockpit and/or the ground crew.
OFF	Selecting OFF turns off the microphone for intercom purposes; however, the crewmember can still transmit on the radio and normal side tone is provided.

UHF COMMUNICATIONS SYSTEM

The UHF communications system provides an air-to-air and air-to-ground communications, automatic direction finding (ADF), and monitoring of guard (emergency frequency). The system consists of two separate receiver-transmitters (UHF 1 and UHF 2) with their associated controls and indicators. Both radios have provisions for a speech unit (KY-58) for secure communications. Both receiver-transmitters transmit on manually selected frequencies or on 20 preset frequencies within the 225.000 to 399.975 MHz frequency range. The UHF radios can operate in Have Quick mode (anti-jam). The radios can be operated from ground power without cooling air; however, transmissions should be minimized.

NOTE

If an annoying noise is received by one crewman whose UHF receiver is tuned to a low UHF frequency (230 to 260 MHz) while the second crewman is transmitting at a high UHF frequency on the other radio, the noise can be eliminated by placing the UHF 1 antenna selector switch to UPPER.

UHF CONTROLS AND INDICATORS

The UHF 1 and UHF 2 radios are operated by controls on the intercommunications set control panel, the remote intercommunications control panel, the microphone switch on the throttles, the foot operated switches on the rear cockpit floor, and the upfront control.

INTERCOMMUNICATIONS SET CONTROL PANEL

The intercommunications set control panel is on the left console in the rear cockpit. Controls on the panel associated with the UHF radios are the voice warning silence pushbutton, the tone selector switch and the intercom function selector switch.

REMOTE INTERCOMMUNICATIONS CONTROL PANEL

The remote intercommunications control panel is on the left console in the front cockpit. Controls associated with the UHF radios are the voice warning silence pushbutton, the UHF antenna selector switch, the VHF antenna selector switch, the tone selector switch, and the intercom function selector switch.

Voice Warning Silence Pushbutton

Pressing this pushbutton silences the voice warnings and the aural tones in progress for 1 minute. If still present after 1 minute, the warnings will be heard again.

UHF Antenna Selector Switch

The UHF antenna selector switch has positions of UPPER, LOWER and AUTO. Placing the switch to UPPER selects the upper antenna for UHF 1 radio and putting the switch to LOWER selects the lower antenna for UHF 1 radio. Placing the switch to AUTO (automatic) causes the UHF 1 radio to automatically select the antenna with the best signal. The UHF 2 radio always transmits and receives on the lower antenna.

VHF Antenna Selector Switch

This switch is presently inoperative.

Tone Selector Switch

The tone selector switch has positions of UHF 1 and UHF 2. The crewmember can transmit tone on the UHF 1 or UHF 2 by selecting either position.

Intercom Function Selector Switch

This switch is described in the Intercom System paragraphs, this section.

MICROPHONE SWITCH

A three-position microphone switch is on the inboard throttle control handle in each cockpit for UHF transmission. It is spring-loaded to the center, receive position. Pushing the switch forward enables transmission on radios 1 and 3. Pushing the switch aft enables transmission on radios 2 and 4. There are two foot-operated, push to transmit pushbuttons on the rear cockpit floor. The left pushbutton controls transmissions on UHF 1, the right pushbutton controls transmission on UHF 2.

NOTE

With the microphone button held or stuck open (hot mic), the crewmember with the hot mic cannot hear any intercom or radio transmission.

OPERATION OF UHF RADIOS

When aircraft power is activated the selections on UHF 1 and UHF 2 radios from the previous flight are displayed on the UFC. The asterisk symbol displayed next to the preset channel number or the manual frequency indicates the radio is turned on. In the example, UHF 1 channel 11 with cipher (C) and anti-jam (A) functions are selected, and UHF 2 manual frequency (228.100) had been previously selected (see figure 1-45, sheet 1). To confirm the operating status of UHF 1 press the pushbutton next to the UHF 1 digital readout to call up the UHF 1 submenu. Absence of an asterisk, adjacent to U1, or an asterisk in row 5 or 6 indicates the radio is off. Pressing the pushbutton next to U1 applies power to the system and the asterisk symbol is displayed. The volume control for UHF 1 is on the left side of the UFC and labeled R1. R3 is reserved for JTIDS. The volume control for UHF 2 is on the right side. R4 is provided as a spare. Turning the left channel selector selects a preset channel for UHF 1 operation. The right channel selector controls UHF 2 preset channel. Pressing the channel selector knob cycles between radios 1 (UHF) and 3 (JTIDS provisions) or 2 (UHF) and 4 (spare).

NOTE

If an incremental channel change results in a two-channel change of the UHF radio, the aircrew should initiate AIU BIT. When AIU BIT is complete, the UHF channel select knob on the UFC will again function properly.

Selection Of Guard

After the selected radio is powered, press and release the shift (SHF) pushbutton key. Next, press the guard receiver (GREC) pushbutton key. The letter G appears next to the manual frequency readout (figure 1-46) indicating that the guard receiver is now active with that UHF radio. The process is repeated to deselect the guard receiver. To transmit on guard the preset channel selected must be rotated until the letter G appears adjacent to the channel selector. The guard transmit/receive function is available with either UHF radio. Selection of GUARD overrides the KY-58 or manual frequency selection.

Selecting The Displayed Manual Frequencies

As shown on figure 1-46, the asterisk indicates that preset channel 11 has been selected for UHF 1. To select the manual frequency displayed (226.125), press the C/M pushbutton key. C/M stands for channel and manual. The asterisk will move to the manual frequency indicating that it is now selected for transmit/receive on UHF 1. Pressing C/M again will toggle to channel mode.

Keying In A Manual Frequency

Press the desired numeric pushbutton keys so that the frequency is displayed in the scratchpad. The decimal is not required. Then press either the UHF 1 or UHF 2 pushbutton opposite the current manual frequency being displayed. The two manual frequencies will swap display locations as shown in figure 1-45, so that if necessary, it is easy to return to the original manual frequency. To accomplish this, press the display pushbutton a second time.

UHF 1 AND UHF 2 SUBMENUS

A separate submenu display is provided for UHF 1 and UHF 2. Selection of UHF 1 submenu (figure 1-46) is accomplished by pressing the pushbutton adjacent to the displayed frequency with a blank scratchpad. UHF 2 submenu is selected for display in a similar manner by pressing the pushbutton adjacent to the displayed frequency. This may be done from any menu or submenu. This format permits the programming of the preset channels (1 thru 20), selection of cipher and anti-jam modes, ADF function plus selection of have quick (HQ) functions. To change channel 11's preset frequency of 228.000, key in the new frequency, confirm it in the scratchpad and press the pushbutton opposite the old frequency readout. The new frequency will now be displayed.

SECURE SPEECH SYSTEM (KY-58)

The KY-58 secure speech system is used for ciphering (coding) or deciphering (decoding) audio routed through the UHF 1 and UHF 2 receiver-transmitters. The controls for the system are on the intercommunications set control panel, the remote intercommunications control panel, and on the UFC. The KY-58 control, located on both the above control panels, is the cipher text selector switch.

Cipher Text Selector Switch

This switch has positions of ONLY and NORM.

ONLY	The radio can receive only the ciphered text and not clear text radio communications.
NORM	Permits reception of both cipher text and clear text radio communications.

UPFRONT CONTROL

To select the KY-58 submenu (figure 1-47), press the KY-58 pushbutton on the menu 2 display (WITH AP-1R) or UHF-1/UHF-2 submenu display (WITH VHSIC) with a blank scratchpad. To activate the KY-58 system, press the pushbutton adjacent to OPR or RV. A colon (WITH AP-1R) or an asterisk (WITH VSHIC) appears to indicate the system is activated. At this time the other mode is automatically deselected. If it is desired to select a different fill variable number (1 to 6), enter the number on the keyboard and press the fill pushbutton. With RV selected the new variable number is provided to the KY-58 system. If CIPHER is displayed on the UFC, press the pushbutton and PLAIN is displayed. If CIPHER is selected, then BB (baseband) cannot be selected, DP (diphase) is automatically selected. Only one radio (UHF 1 or UHF 2) can be enabled at one time. The enabled radio will have an asterisk displayed next to its symbol (WITH AP-1R - U1/U2 or WITH VHSIC - U1-KY/U2-KY). If it is desired to enable DELAY mode, press the pushbutton adjacent to DELAY. It is enabled if OPR or RV is selected.

UHF OPERATION DISPLAYS - WITH VHSIC

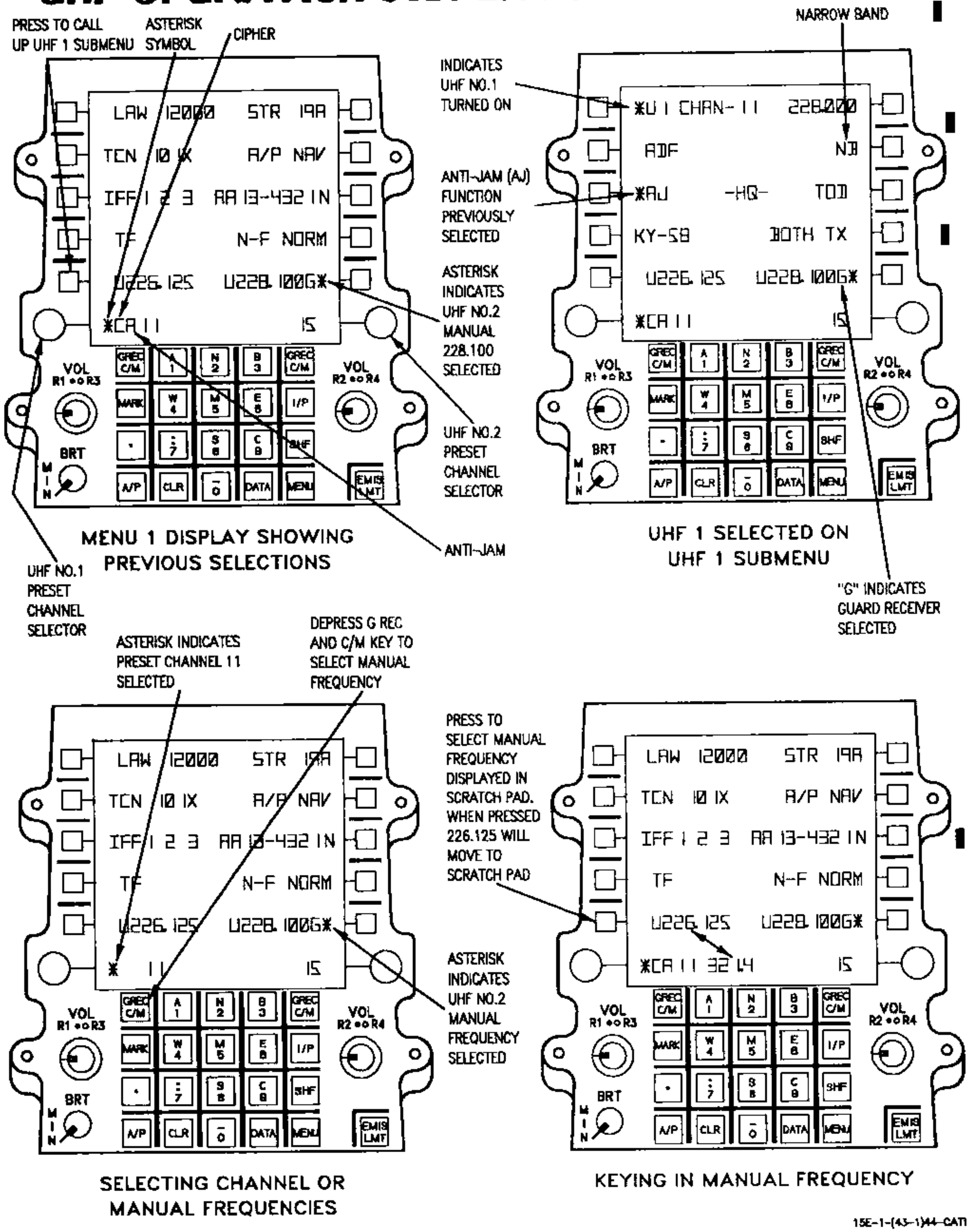


Figure 1-45 (Sheet 1 of 2)

UHF OPERATION DISPLAYS - WITH AP-1R

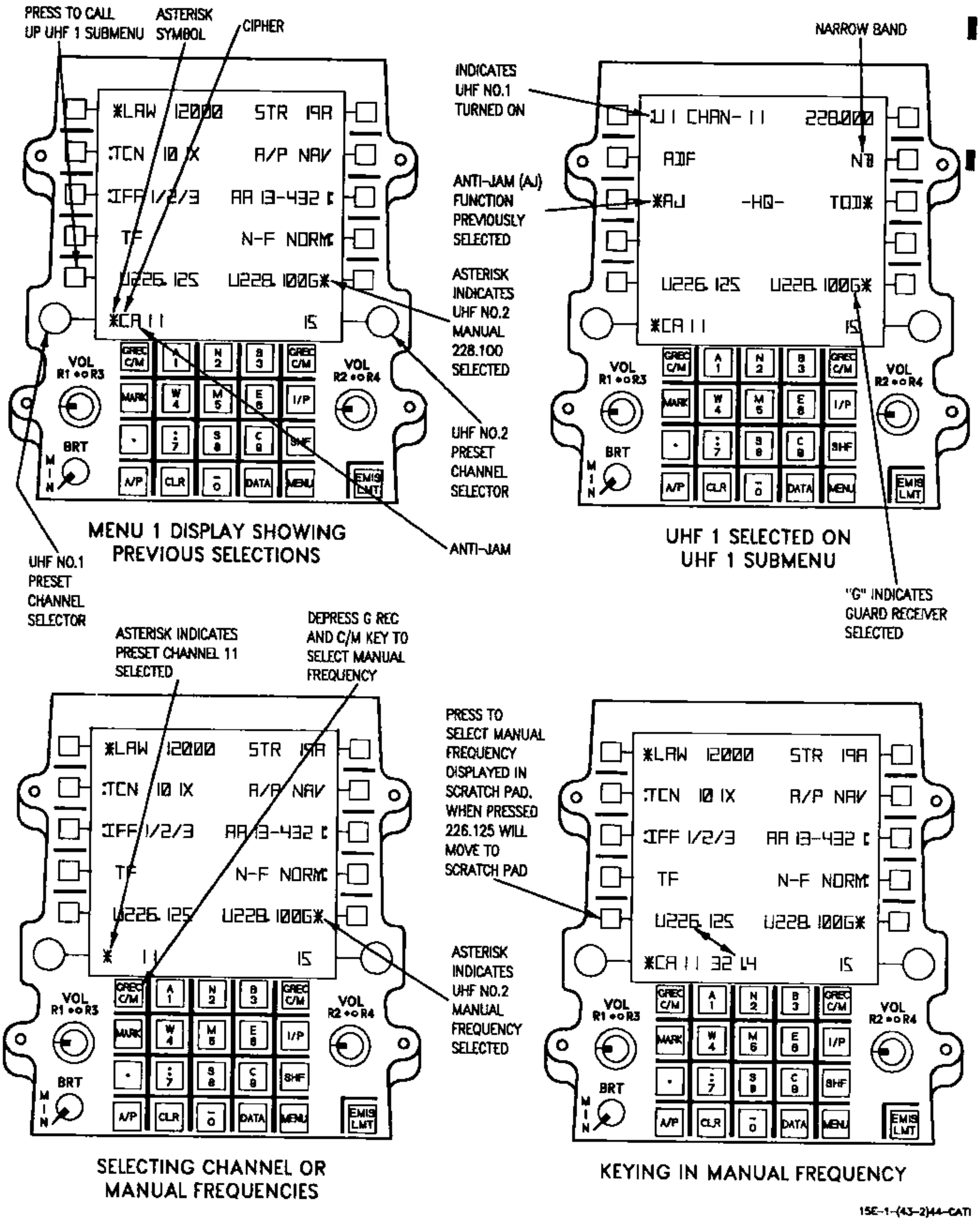
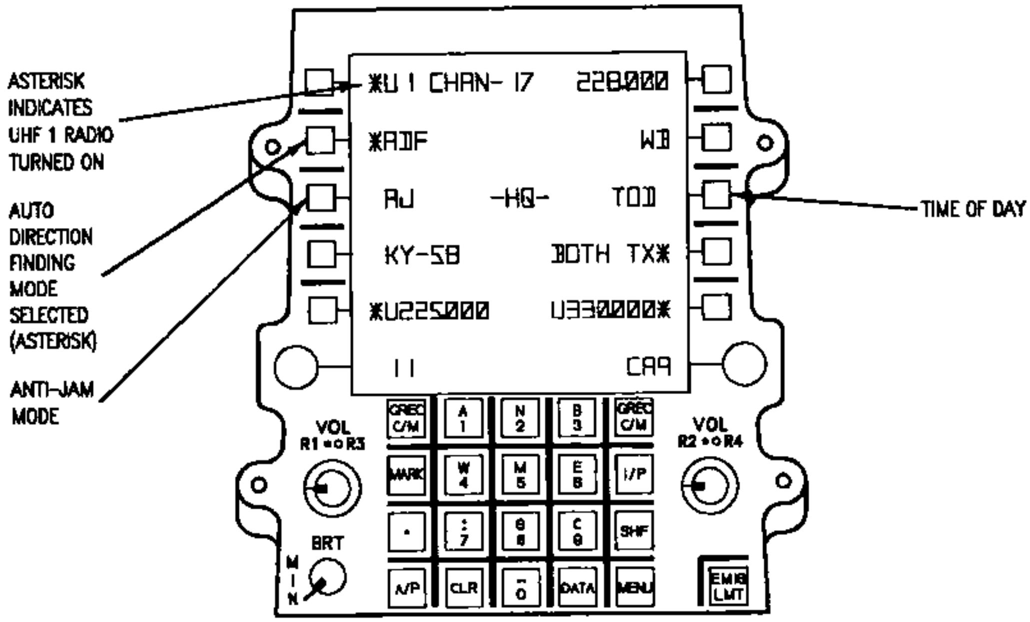
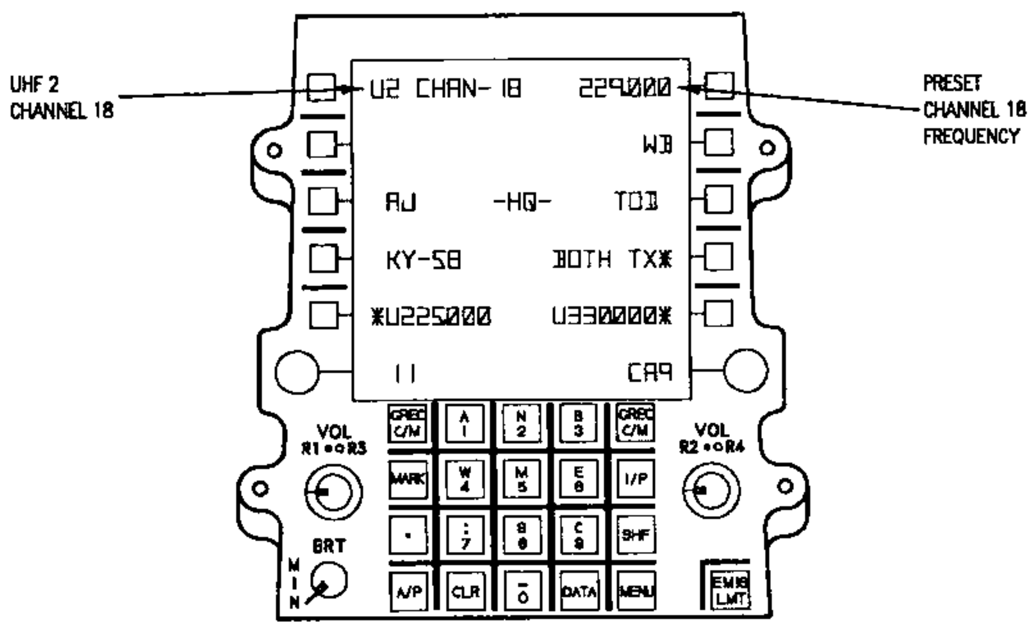


Figure 1-45 (Sheet 2)

UHF SUBMENUS - WITH VHSIC



UHF 1 SUBMENU

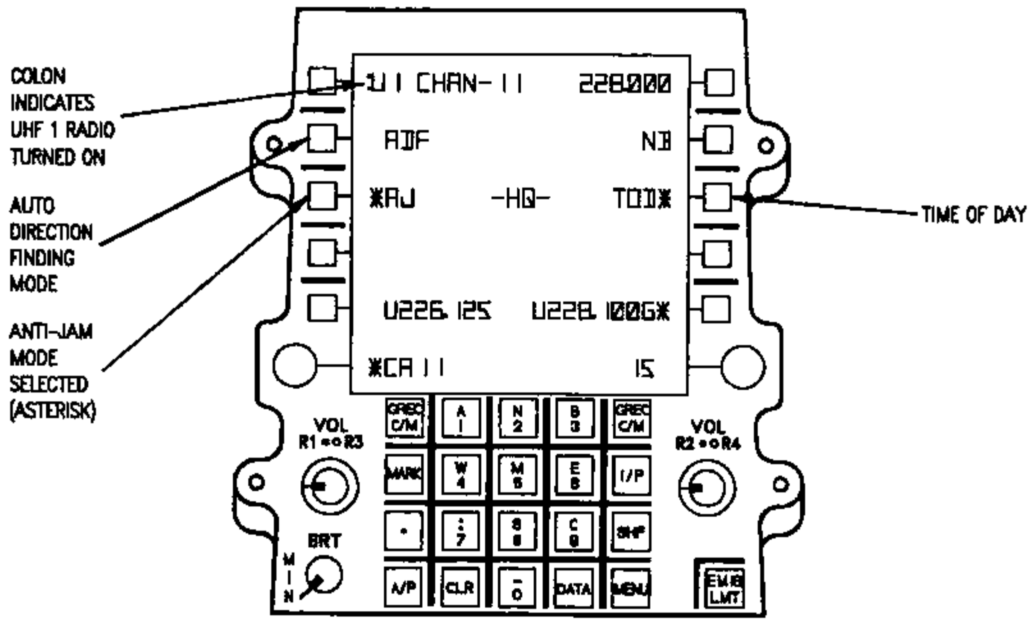


UHF 2 SUBMENU

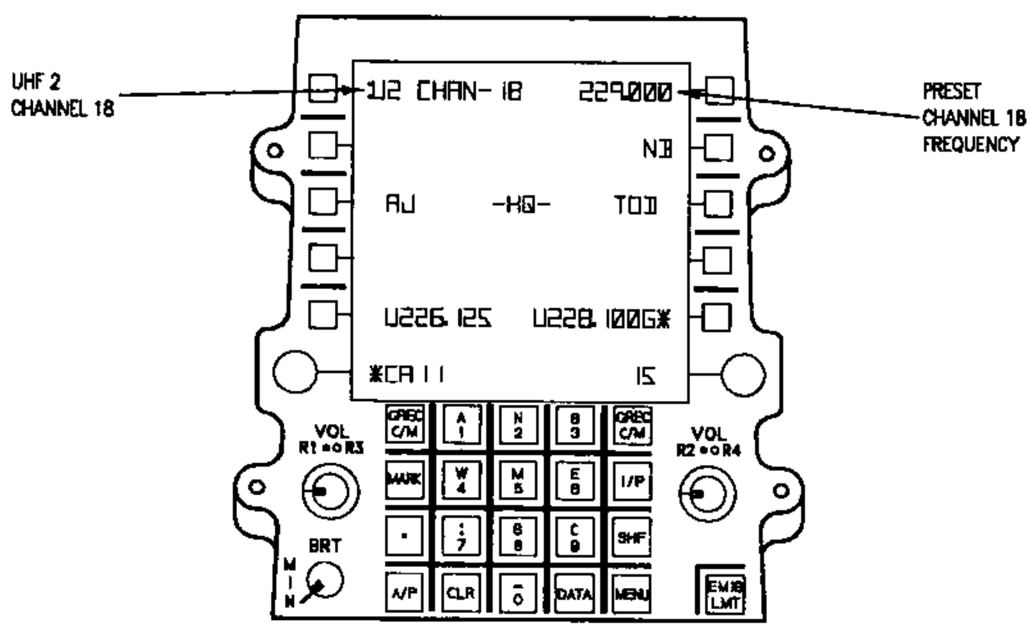
15E-1-(50-1)44-CATI

Figure 1-46 (Sheet 1 of 2)

UHF SUBMENUS -WITH AP-1R



UHF 1 SUBMENU

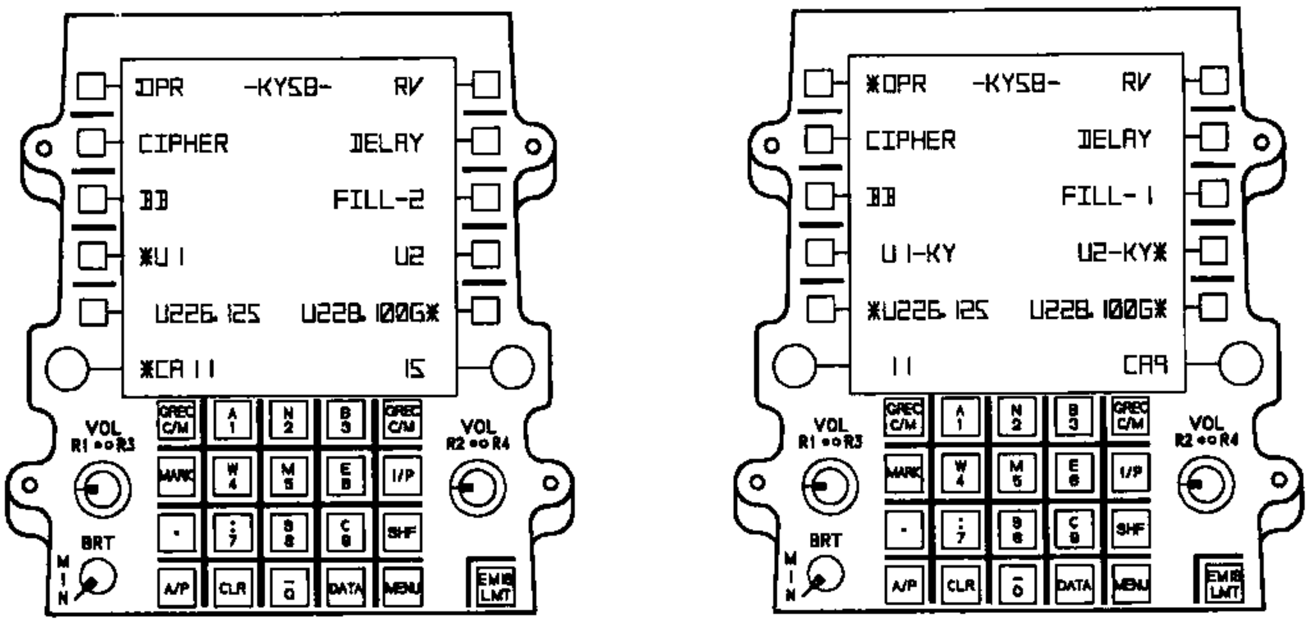


UHF 2 SUBMENU

15E-1-(50-2)44-CATI

Figure 1-46 (Sheet 2)

KY-58 SUBMENU DISPLAY - WITH AP-1R | **KY-58 SUBMENU DISPLAY - WITH VHSIC**



15E-1-(47-1)33-CATI

Figure 1-47

HAVE QUICK SYSTEM

The Have Quick radio uses a frequency hopping method to change the channel or frequency selected many times a second. To operate in the anti-jammodes, all radios in a particular net must have the same word-of-day (WOD), time-of-day (TOD), net number, and the same frequencies stored in allocated preset channel locations. Description of the Have Quick system is based on training net operation. For training nets, channel 20 is used to store WOD and channels 14 thru 20 are used to store the preset frequencies.

The radios contain a clock, memory circuits, and a real time code generator. This added circuitry allows the radio to change frequencies many times a second. The WOD sets up the pattern for hopping the frequencies stored in the memory. A TOD signal from the anti-jam net control station synchronizes the radio clock to the other radios in the net. The clock times the operation of the real time code generator. When anti-jam modes are selected, signals are sent which activate the real time code generator and the anti-jam mode is placed in operation. With anti-jam selected, the radios are commanded to narrow band (NB).

WORD-OF-DAY

The WOD is normally entered prior to flight, but it is possible to enter it in flight. The WOD defines the frequency hopping pattern for the day for the radio.

TIME-OF-DAY

The TOD entry is normally performed before flight, but can be done in flight after the radio is turned on. TOD synchronizes the Have Quick radio to the net control station and the other radios in the net. After the radio is turned on it accepts the first TOD signal it receives on any channel or frequency in use. To ensure that the radio is operating in the correct net, request a TOD from the net control station, or request a TOD from another station in the net which has previously received TOD from the net control station. The TOD is heard in the headset as a short burst of varying tones followed by a steady tone. The steady tone lasts as long as the station keeps the sending transmitter in the tone setting. If anti-jam communication is attempted with an invalid TOD the received signal is not readable and it is necessary to request another TOD transmission.

HAVE QUICK II SYSTEM

A HAVE QUICK II radio operates in the basic HAVE QUICK mode. It also provides the additional capabilities of multiple word-of-day (MWOD) and all associated frequencies can be loaded at one time. When in the HAVE QUICK II mode, the MWODs and frequencies are stored in radio memory. Channel 20 is used for setting the radio to the proper mode.

MULTIPLE-WORD-OF-DAY

All WOD's which make a MWOD have their own unique date code attached to them which corresponds to the day of the month the WOD is to be used. A date code can be any number between 301.000 thru 331.000. The first day of the month equals 301.00 and the last day (ie. 31) equals 331.000. If the radio is turned off, no WOD's or frequencies are lost. They are permanently stored in the radio until they are intentionally erased or changed. However, it must be identified to the radio which one of the up to six WOD's is to be used. With the exception of channel 20, which is required to initialize MWOD function, all preset channels are available for use. The radio also has the capability to automatically changeover from one day's WOD to the next with no action required by the aircrew.

WORD-OF-DAY

WOD's are normally entered before flight but can also be entered during flight. They can be loaded into either or both UHF radios. Since multiple WOD's can be entered, a date code associated with each new WOD, is used to specify the day of the month. The date is required to uniquely identify the appropriate WOD when reinitializing at midnight. Once the WOD information has been entered, today's date must be entered to set the radio's clock so it can select the correct WOD for use.

TIME-OF-DAY

The TOD starts the HAVE QUICK radio's clock and synchronizes all radios on the same net, allowing communication in anti-jam mode. When the radio is initially powered up, it accepts the first TOD signal it receives on any frequency or channel in use. You can get the TOD from a remote signal generator or from another aircraft. When the TOD is received from another aircraft, only those receiving it at the same time will be able to communicate in the anti-jam mode, as they will be out of sync with other HAVE QUICK users. When received, the TOD is heard as a short burst of varying tones followed by a steady tone.

IDENTIFICATION FRIEND OR FOE (IFF) SYSTEM

IFF TRANSPONDER SET

The IFF transponder set provides automatic identifications of the airplane in which it is installed when challenged by surface or airborne interrogator sets, and provides momentary identification of position (I/P) upon request. The modes provided are mode 1, mode 2, mode 3/A, mode 4, and mode C. Modes 1, 2, and 3/A are selective identification feature (SIF) modes. Mode 4 is used for highest confidence identification (crypto), and mode C is used for altitude reporting. The codes for modes 1 and 3/A can be set in the cockpit. Mode 2 is set using the control box in door 3R. Mode 4 is keyed in door 3R by maintenance personnel using the KIK. Mode 2 cannot be changed in flight. Mode 4 can be changed between 4A and 4B in flight or can be zeroized.

TRANSPONDER CONTROLS

Controls for the IFF are located on the remote intercom control panel in the front cockpit and the UFC. The controls consist of the mode 4 selector switch, the mode 4 reply switch, the master switch, the IFF antenna selector switch, and the mode 4 crypto switch.

Mode 4 Selector Switch

The mode 4 selector switch is a lever-lock switch with positions of B, A and OUT.

B	Enables mode 4/B reply.
A	Enables mode 4/A reply.
OUT	Disables all mode 4 replies.

Mode 4 Reply Switch

LIGHT	When the mode 4 system replies to valid interrogation being transmitted above a minimum threshold rate, the REPLY light illuminates.
AUDIO REC	Allows audio tone when valid interrogations are received. The light operation works as described in LIGHT above.
OFF	Disables the mode 4 AUDIO REC and LIGHT functions and turns the system off.

Master Switch

LOW	System operates with reduced sensitivity. Mode reception is reduced; however, mode 4 response to a valid interrogation is normal.
NORM	System operates at full sensitivity.
EMERG	Selects normal sensitivity emergency IFF operation. Allows the system to respond to interrogations in modes 1, 2, 3A, C and 4.

Mode 4 Crypto Switch

The crypto switch in the cockpit is a spring-loaded, return-to-norm switch with positions of HOLD, NORM and ZERO. The crypto switch in the rear cockpit is spring loaded to NORM from both HOLD and ZERO positions.

HOLD	Stores the mode 4 crypto codes in memory. Prevents automatic zeroing of the crypto codes at power shutdown.
NORM	Permits normal operation of the crypto codes and automatic zeroing of the crypto codes at power shutdown.
ZERO	Sets the code settings back to zero. Seat ejection also zeroes the codes automatically.

NOTE

The crypto codes can be stored in non-volatile memory for the next flight by selecting HOLD. However, the HOLD command resets each flight based on the position of the landing gear handle. Therefore, if the crypto switch is set to the HOLD position before moving the landing gear handle to DOWN, the HOLD command will be ignored and the crypto codes will be lost when power is removed after landing.

IFF Antenna Selector Switch

The antenna selector switch is on the left console next to the ICSCP.

UPPER	Selects upper antenna
LOWER	Selects lower antenna
BOTH	Provides automatic antenna selection

IFF MODE 4 CAUTION

NOTE

On this aircraft an IFF mode 4 reply fault is indicated by an IFF MODE 4 caution appearing on the MPD/MPCD and the MASTER CAUTION light coming on.

The IFF MODE 4 caution on the MPD/MPCD can be caused by failure to respond to a valid interrogation, zeroized code, or internal component failure.

NOTE

The logic in the mode 4 system is such that while the reply LIGHT is on (plus a small time delay after it goes out), the operation of the IFF MODE 4 caution is inhibited. Therefore, in a high density interrogation environment, it may be desirable to place the MODE 4 LIGHT/ AUDIO RECEIVE SWITCH to LIGHT or AUDIO REC to minimize the effects of spurious signals or system overloads mixed in with valid responses.

IDENTIFICATION OF POSITION (IP)

Pressing the I/P pushbutton on the UFC enables the IFF system to transmit momentary identification of position when interrogated on modes 1, 2, and 3. The response is continued for 15 to 30 seconds after the pushbutton is released.

IFF EMERGENCY OPERATION

Upon ejection from the cockpit, the IFF emergency mode automatically becomes active if mode 1, 2, 3A, or C is enabled.

IFF SUBMENU

The IFF submenu is selected and displayed from the UFC menu 1 format. Pressing the pushbutton next to IFF with a blank scratchpad calls up the IFF submenu (figure 1-48). From this display the various functions, modes, codes, and programming of the IFF can be done. For example, mode C is enabled or disabled from this submenu. From this display mode 1 code can be selected and deselected. Also the IFF can be programmed to operate at specific modes and codes as a function of the time. This is referred to as phasing (PH). Phasing permits the selection of up to 13 mission segments for automatic change of IFF operation based on TOD information and is expected to be based on authentication procedures for a given theater of operation. Phasing can be programmed by the DTM. Note that the IFF operation here refers to all IFF modes and codes including mode C. The programming option, when selected, permits changing of the phasing program.

To enable or disable an IFF mode, press the mode pushbutton next to the displayed mode. If the mode was previously enabled it will become disabled, if it was previously disabled it will become enabled. An asterisk appears next to all enabled modes. To change the codes for mode 1, type the code on the keyboard and enter by pressing the mode 1 pushbutton. The largest values for the first and second digits of the code are 7 and 3. To change the codes for mode 3, type the codes on the keyboard and enter by pressing the mode 3 pushbutton. The largest value for any code digit is 7. Trailing zeros are not required.

To enter the phase programming mode, press the PROGRAM pushbutton. An asterisk appears next to the PROGRAM display. The UFC displays a 1 for the phase and the prestored associated data (modes/ codes and time). To select a different phase number for monitoring or programming, press the phase (PH) pushbutton and the number will increment by one each time it is pressed and released. The prestored phase numbers are incremented in sequential order. The UFC will display the new phase number and its associated data (modes/codes and time).

To remove the indicated phase from the phases, type a zero (0) phase number on the keyboard and enter by pressing the PH pushbutton. The current phase number remains displayed but the modes 1, 2, 3 and C and time are zeroed. PROGRAM and IFF remain displayed. To enable or disable a mode for the displayed phase, press the mode pushbutton next to the displayed mode (mode 1, 2, 3, C). If the mode was previously enabled it will become disabled, if it was previously disabled it will become enabled. An asterisk appears next to all enabled modes. The enable modes are stored in memory for the displayed phase.

To exit the programming mode, press the PROGRAM pushbutton. The display will revert to the IFF submenu. Phasing is enabled by pressing the PH pushbutton.

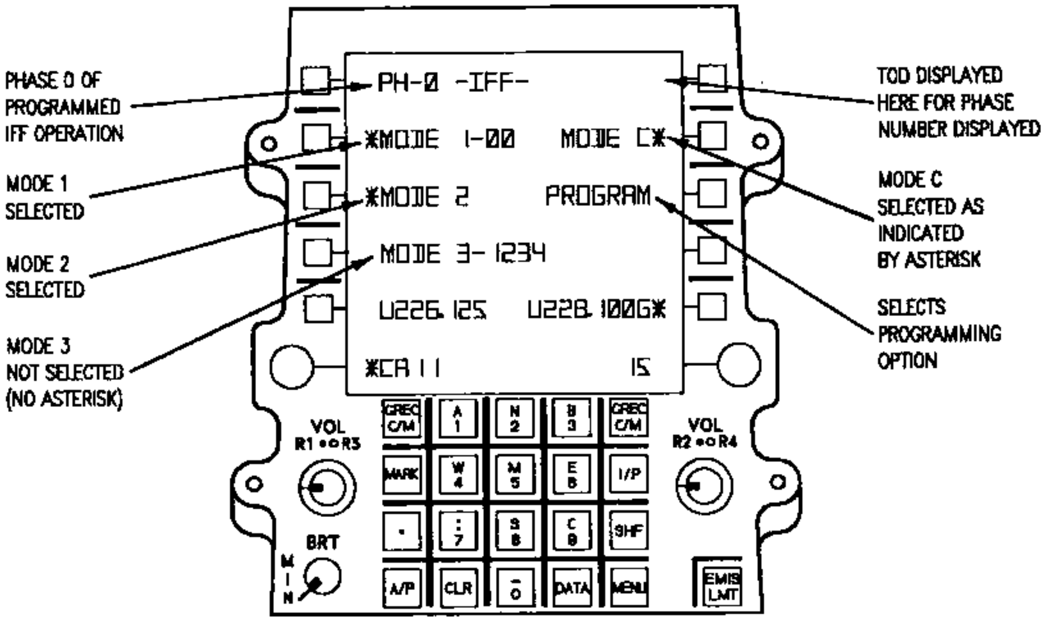
IFF INTERROGATOR SET

The UFC contains the controls for providing Air-to-Air Interrogation (AAI) target identification. Refer to TO 1F-15E-34-1-1 for description of the AAI system.

AIR DATA COMPUTER (ADC)

The ADC is a digital computer which receives inputs from the pitot-static system, the AOA probes, the left total temperature probe, the standby altimeter setting knob, the nose landing gear door switch, and the flap switch. The ADC corrects these inputs for sensor error as required, computes various parameters from this data and furnishes required parameters to aircraft equipment and cockpit displays (refer to figure

IFF SUBMENU



15E-1-(48-1)-25-CATI

Figure 1-48

1-49). The ADC performs validity checks on critical data received by the using equipment or display and actuates appropriate cautions or warnings if the data is invalid. Operation of the ADC is entirely automatic and no controls are available to the aircrew.

NOTE

The CC's system altitude recognizes the standby altimeter setting at CC power-up. Any changes to that setting are not recognized unless the CC is reset or a system altitude reset is performed.

PITOT-STATIC SYSTEM

The pitot-static system (figure 1-50) employs multiple pitot and static sources for redundancy and to provide each inlet controller with conditions peculiar to its inlet during asymmetric conditions. There is an airstream pitot-static mast on each side of the forward fuselage and a pitot mast and flush static port in each inlet duct.

Pitot Heat Switch

The pitot heat switch is on the front cockpit ECS panel on the right console. Two circuit breakers are available to the pilot.

ON	Provides electrical power to the heating elements of all four pitot-static probes.
OFF	Pitot heat off.

ANGLE-OF-ATTACK PROBES

The AOA probes, on each side of the forward fuselage, measure local AOA and furnish this data to the ADC, the respective engine inlet controller, the AFCS, and the cockpit AOA indicator. Heaters to prevent ice formation are automatically energized when airborne. No controls are available to the aircrew. The probes remain hot for some time after flight and contact should be avoided.

AIR DATA COMPUTER

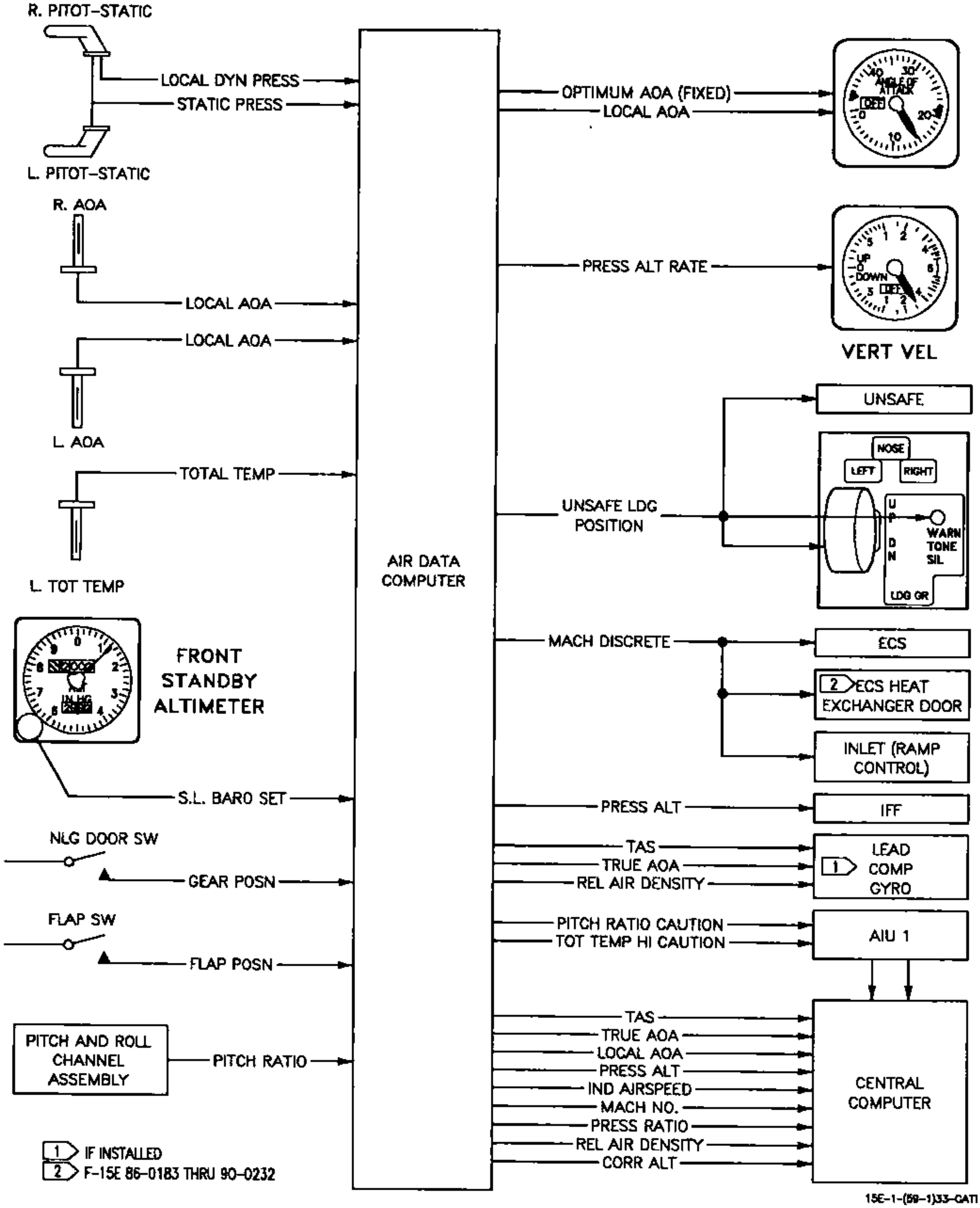


Figure 1-49

PITOT-STATIC SYSTEM

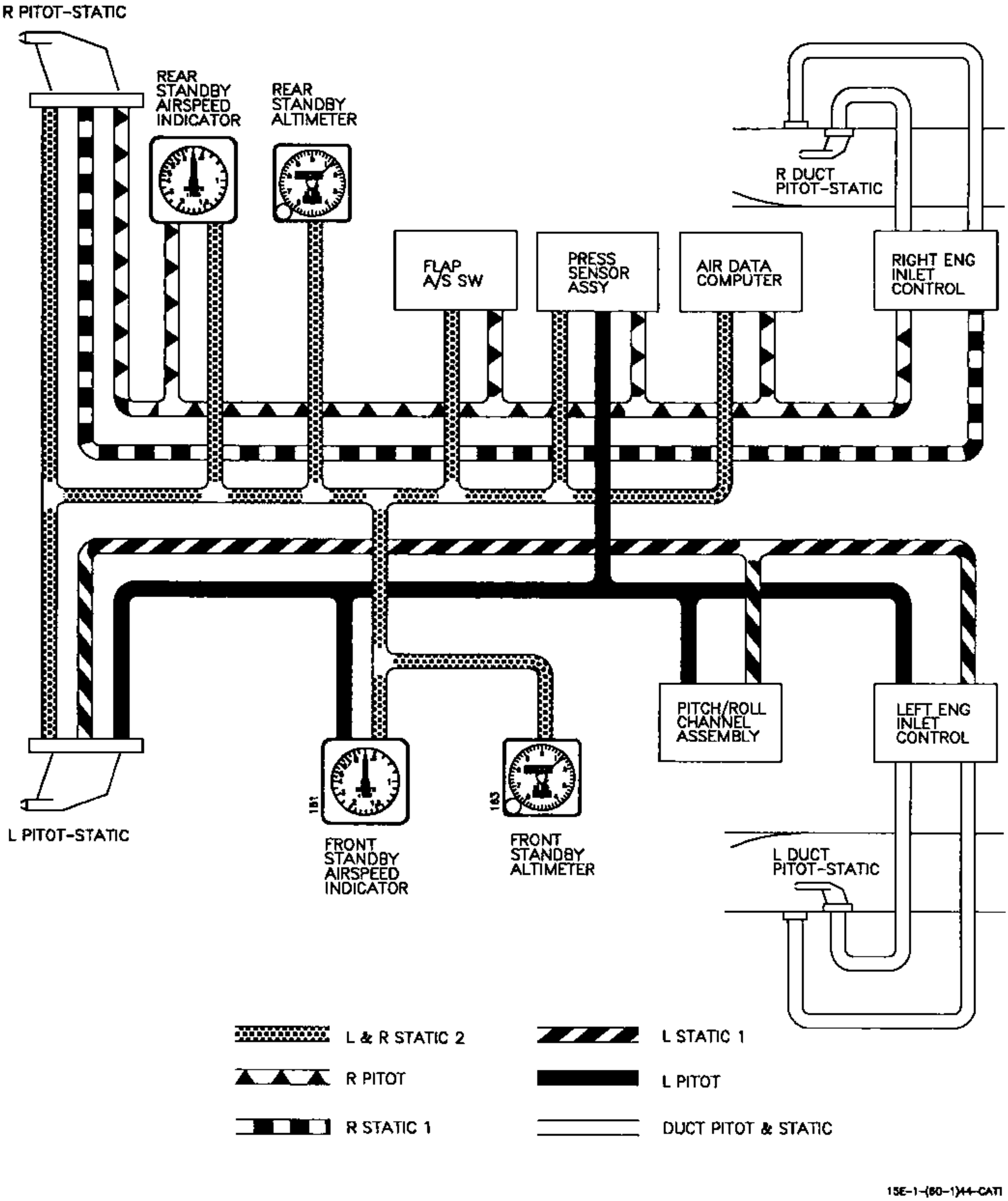


Figure 1-50

TOTAL TEMPERATURE PROBE

Total temperature probes, on the left and right forward fuselage, furnish temperature information to their respective engine air inlet controllers. The left probe furnishes temperature information to the air data computer.

TOTAL TEMPERATURE HIGH Caution

The TOT TEMP HI caution comes on when the sensed duct temperature is high enough to cause critical engine inlet heating. Such temperatures are the result of ram rise at high Mach number.

INERTIAL NAVIGATION SYSTEM (INS)

The INS is a self-contained, fully automatic ring laser gyro (RLG) system which supplies the primary attitude reference for the aircraft and provides continuous present position (PP) monitoring. In addition, the INS provides aircraft attitude, heading, velocity, and acceleration information to the LANTIRN, radar, AFCS and CC.

NOTE

> The PP entered should be the actual aircraft location. Further corrections after the aircraft has moved should be done by update after transition to NAV.

INERTIAL SENSOR ASSEMBLY (ISA)

The primary component of the INS is the ISA, which contains three complete RLG's, (roll, pitch, and yaw), three accelerometers, a high voltage power supply, and a calibration memory/temperature multiplexer. The sensors provide output signals of angular rates and linear accelerations with respect to an orthogonal set of axes.

Ring Laser Gyro

The RLG is a key element of the INS. It is a rate-integrating gyro which does not use a spinning mass like a conventional gyroscope. The RLG detects and measures angular rotation by measuring the effective frequency difference between two contrarotating (one clockwise, one counterclockwise) laser beams in a ceramic block. As the two laser beams travel simultaneously around the cavity, mirrors reflect each beam around the enclosed path. When the gyro is at rest, the two beams have the same frequency because the optical path is the same in both directions. However, when the gyro is subjected to an angular turning rate about an axis perpendicular to the plane of the two beams, one beam sees a greater path length and the other beam sees a shorter length. The two resonant frequencies effectively change to adjust to the longer or shorter optical path; the effective frequency differential is directly proportional to the angular turning rate.

INERTIAL NAVIGATION DIGITAL COMPUTER

The inertial computer contains all circuits necessary for gyro and accelerometer signal processing and for computing North/South, East/West, and vertical velocities and accelerations; X, Y and Z velocities and accelerations; body rates; body angle and linear accelerations; and pitch, roll, magnetic heading and true heading. It also contains the necessary circuits for calculation of wander angle, inertial altitude, latitude, and longitude and computes platform correction signals for gyro compass and stored heading alignments. A Kalman filter is implemented to model errors in velocity, position, and calibration to provide enhanced alignment and inflight performance. The computer also performs BIT functions and provides computer mode control.

INS Performance Monitor

The INS performance monitor (stored at shutdown) maintains a history of recent alignment and navigation data. Navigation data is stored in two configurations: pure inertial (no updates) and aided inertial (updates included). Data is stored on the basis of a complete flight defined by:

a. Nose gear up limit switch closed for takeoff.
b. Ground speed less than 80 knots for landing.
c. INS mode transition from align to NAV.

Data storage includes, but is not limited to: type and time of alignment; flight data for last 12 flights; time in NAV; initial latitude and longitude; final latitude and longitude; and inertial cumulative error.

To have complete performance monitor data, an on-ground visual overfly update at the end of flight is required prior to INS shutdown.

The INS also has continuous/periodic BITs, initiated BIT, and power-up tests to monitor system performance.

INS MODE KNOB

The INS mode knob is located on the sensor control panel (figure 1-51) and controls the following functions:

OFF — Removes power from the INS.

STORE — Selects the stored heading (SH) alignment mode and uses gyrocompass alignment parameters which were stored at the time of the last system shut-off for rapid INS alignment. PP source submenu is called up on the pilot's UFC when SH is selected. The aircraft must not have been moved since the last shutdown. SH alignment is complete approximately 40 seconds after turn-on and should achieve approximately GC align accuracy. The accuracy is directly affected by the INS accuracy of the previous flight and error rate at the time of the last system shutdown. Alignment complete is indicated by SH OK in HUD window 16 and on the A/G radar precision velocity update (PVU) display.

If STORE is selected and the INS has determined that stored heading alignment is not available (GC had not been performed; or groundspeed of previous flight >3 knots or error rate of previous flight was >1 NM/HR) the INS will automatically switch to GC align mode.

GC — Selects the gyrocompass (GC) mode which is the most accurate mode of INS alignment. PP source submenu is called up on pilot's UFC when GC selected. Full GC alignment requires approximately 4 minutes. Alignment complete is indicated by GC OK in HUD window 16 and on the PVU display.

NAV — This is the primary navigation mode. The INS solves the navigation problem by sensing aircraft accelerations, applying appropriate corrections and determining aircraft velocity and position. Steering to destination is computed in the CC based on inertially derived present position. The knob must be pulled up before it can be rotated out of NAV.

If the mode switch is positioned directly from OFF to NAV, the INS will perform a GC alignment and after align complete is reached the INS will automatically transition to the NAV mode.

GYROCOMPASS AND STORED HEADING ALIGNMENT AND NAV

There are several displays on the HUD and PVU display during INS alignment that indicate system align status. The display will reflect the INS operation. This may differ from the switch selection on the sensor control panel. See figure 1-51.

GC PP REQ
SH PP REQ — Present position update required. Displayed for GC or SH alignment if last shutdown position differs from the INS stored base location by more than 2 NM. When displayed the pilot or WSO must insert new PP on UFC PP source submenu. INS alignment is continuing using the stored base location while PP REQ is displayed.

NOTE

The PP can be entered more than once during an alignment cycle, the PP should reference the aircraft base location. Once the aircraft leaves the base location, changes should be done by update in the NAV mode. If a new PP is entered during a GC alignment, the INS may restart a full GC alignment (restart the 4-minute sequence) at the time the PP is entered depending on the time in the alignment cycle that the entry is made. If a new PP is entered during a SH alignment or align HOLD, the INS will automatically switch to GC alignment mode and restart the alignment.

GC NO TAXI
SH NO TAXI — NO TAXI is displayed for approximately 60 seconds after GC or STORE is selected until INS attitude is valid (figure 1-52). During this time the aircraft should not be moved. Movement during this time will require the INS to be turned off (2 seconds minimum), back on and then restart alignment.

NOTE

NAV may be selected at any time after NO TAXI is removed, but degraded accuracy should be expected if NAV is selected before GC, IFA or SH OK is displayed.

GC XX.X
SH XX.X
IFA XX.X — INS alignment quality is indicated by a numerical countdown from 15.9 in GC, SH or IFA. This display indicates the accuracy of alignment. It does not indicate the expected accuracy at the end of flight. A full GC should result in an indication of approximately 1.0; a complete SH should result in an indication of SH OK. SH quality is directly affected by previous alignment accuracy.

GC HOLD — Displayed if INS senses motion while GC or SH alignment is in progress. This indicates that the INS is retaining the existing alignment quality until the aircraft motion stops and the holding brake is engaged or until the aircraft takes off. If the holding brake is engaged and the INS detects no motion, the system will resume a GC alignment and GC XX.X will be displayed as above.

NOTE

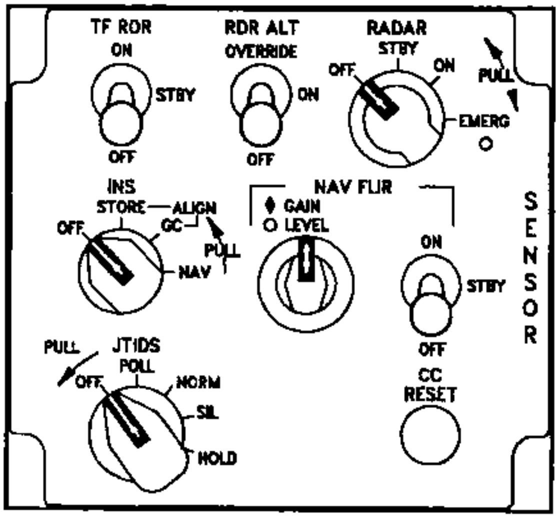
- If new PP is entered when INS is in a HOLD mode the INS will switch to GC alignment and restart the alignment.
- If the aircraft takes off with GC HOLD displayed, the GC HOLD is removed with nose gear up and the INS automatically enters the NAV mode; degraded accuracy should be expected.
- If the aircraft is stopped but the holding brake is not engaged, the INS will not reenter the GC mode; degraded accuracy should be expected.

GC OK
SH OK
IFA OK — Indicates which align mode was done and that the INS alignment is complete; displayed until NAV selected or takeoff.

The GC indicates the INS is in the gyrocompass align mode; the SH indicates the INS is in the stored heading align mode; and IFA indicates the INS is in the inflight align mode. IFA mode requires position and/or velocity updates. IFA also requires initialization of data by the CC at the start of IFA selection. OK, PP REQ, NO TAXI, HOLD, and XX.X (align quality) are displayed in one HUD window based on the following priorities order: 1-OK, 2-PP REQ, 3-NO TAXI, 4-HOLD, 5-XX.X.

During alignment when the INS mode knob is positioned to GC or SH, the present position submenu is automatically called up on the pilot's UFC. The present position stored in the INS and being used for

SENSOR CONTROL PANEL



15E-1-(24-1)-CATI-19

Figure 1-51

alignment will be displayed. If the PP is correct no action is required. If the PP is not correct the aircrew should enter the correct PP. The new entered PP should be accurate to 600 feet. Depending on the time in the GC alignment that the new PP is entered, the alignment may start over. If a new PP is entered from SH, the INS will automatically switch to the GC alignment mode.

NAV DEGD — Displayed on the HUD indicates the INS is in a degraded navigation mode caused by transition to NAV via mode knob, early exit of IFA, or INS automatic transition without alignment being completed. Aided alignment (position and velocity updates) can be performed during NAV to improve navigation accuracy.

NOTE

If an IFA is being performed, the IFA and associated display will replace NAV DEGD if displayed.

INS UPDATES

NOTE

If the INU has been replaced, an INS precision velocity update (PVU) is required to reduce pointing errors.

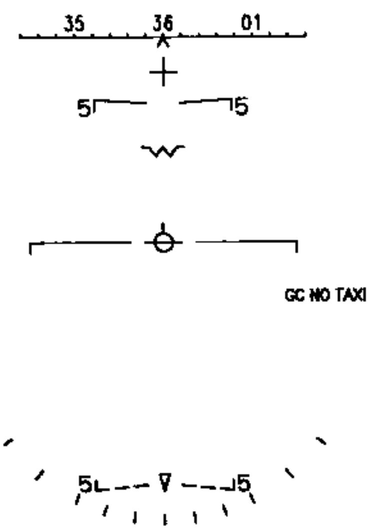
Updates to the INS should be done during IFA alignment or done to improve the accuracy of the INS when it has drifted off or when NAV DEGD is indicated. Updates should be done only with source data that is correct and more accurate than the INS. Updating the INS with bad data will induce more error and INS may not be able to recover.

When the INS updates are performed, the INS uses a Kalman filter using inputs from the CC. The INS compares the data received such as the source of update, error, the variance of the error and the correlation of the error. The INS determines if the error is reasonable in reference to recent INS operation and previous updates. Based on CC inputs, the INS will accept a smaller or larger portion of an update based on the quality of the update and the update source.

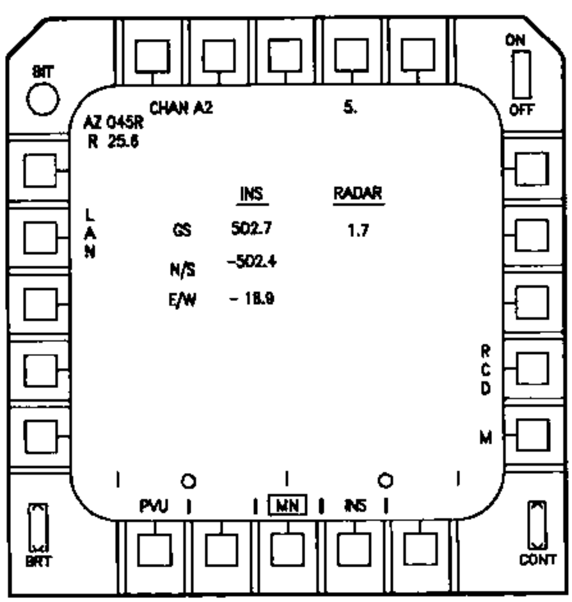
Whenever an INS velocity update is done using the PVU mode, the system attempts to identify any fixed pointing errors. Were these pointing errors not compensated for, velocity errors on the order of 1 to 3 knots would be induced whenever the PVU mode was used to update the mission navigator velocities. Subsequent HRM maps would contain position errors, typically 400 feet or more. Thus, using a system that has had an INS PVU velocity update will result in the most accurate cueing and target designation off of HRM maps.

Pointing errors exist mainly due to slight internal misalignments in the radar, radar antenna or in the IMU, or slight misalignments inherent in their installation. Unit specifications and boresight techniques keep the individual errors to a minimum, but the cumulative effect of only 2 milliradians can cause the magnitude of error mentioned above.

GYROCOMPASS ALIGNMENT DISPLAYS



HUD DISPLAY



A/G PVU RADAR DISPLAY

15E-1-(187-1)21-CATI

Figure 1-52

When the INS PVU is done, the estimated azimuth and elevation pointing errors are stored in non-volatile memory in the CC. Assuming that an adequate update was done, the estimated errors will be representative of the current system until either the INS or radar antenna is changed or reinstalled, or until the CC is changed or reloaded.

Updating the INS velocities with the PVU mode is different from updating the MN velocities or from updating the INS or MN position. In those cases, the update occurs all at once. The INS PVU is an ongoing process initiated by the aircrew that will continue until manually stopped. In theory, the longer that the update process continues, the more accurate the update. In practice, 3 to 5 minute updates will suffice.

In order for the INS Kalman filter to adequately identify all the error contributions, the heading, attitude and velocity of the aircraft should be changed during the update. An update done during continuous straight and level flight at a constant speed should be avoided since the system would have no chance to identify the system pointing errors. While there is no perfect update profile, one that contains 90° to 180° heading changes, some combination of climbs, dives, accelerations and decelerations, as well as periods of straight and level flight will work best. Keep in mind that the PVU mode performs best during maneuvers under 3 g's.

PRECISION VELOCITY UPDATES

There are three PVU modes available to the aircrew: MN, INS, and IFA. The MN and INS modes have a LAND/SEA option available on the display format; the IFA mode does not have this option.

When the radar is in the PVU mode, it is trying to determine the aircraft ground speed by measuring the velocity of the aircraft relative to the surface. If the surface is moving (large bodies of water with significant currents) this measurement will not be the actual ground speed of the aircraft. The LAND/SEA option gives the aircrew the ability to limit the detrimental effects of water currents on the accuracy of the weapon system. To effectively use this capability, the aircrew must understand the limitations of the PVU over water. The primary limitation is that the radar cannot determine the portion of the sensed velocity produced by the water currents. Consequently, the PVU could induce errors to the weapon system if not performed judiciously. The following is a summary of the function of the LAND/SEA selection in the various PVU modes.

MN PVU

The effects of surface motion on the accuracy of an MN PVU is the most significant of the three modes. For MN PVUs, the LAND/SEA option is non-functional. The aircrew may select either option but the PVU will still function as though LAND were selected. Accepting an MN PVU which was performed over water will not isolate the effect of the currents and could degrade the accuracy of the weapon system.

INS PVU

This is the only PVU mode that functions differently based on the selection of the LAND or SEA option. When LAND is selected, the INS updates all of its biases and also determines the angular boresight errors between the INS and the radar antenna. When SEA is selected, the INS still updates all of its biases but the pointing error calculations are suspended. If angular boresight air correction factors are stored in the CC from a previous INS PVU, the radar will continue to use them. The LAND/SEA option can be selected either before starting the INS PVU or while the PVU is in progress.

IFA

The LAND/SEA option is not available in the IFA mode. To do an alignment, the INS only needs an approximate ground speed. A better ground speed yields a better alignment, but a slight error will not prevent the INS from aligning.

PVU Techniques

Keep in mind that the radar is pointing in front of and to the side of the aircraft during a PVU. Refer to figure 1-53. For an MN PVU, the radar uses six antenna positions: 45° left and right, 35° down; 35° left and right, 10° down; and 0° azimuth, 10° and 35° down. Data is combined from all antenna positions to determine velocity. MN PVUs are only kept for 5 minutes.

For an INS PVU, the radar uses the same six antenna positions as the MN PVU, plus: 35° left and right, 35° down. For an INS PVU the INS processes data from each of the eight antenna positions. An INS PVU is permanent. If operating in coastal areas, the radar could be getting its measurements from the water surface even if the aircraft is over land. At 2000 feet

PRECISION VELOCITY UPDATES

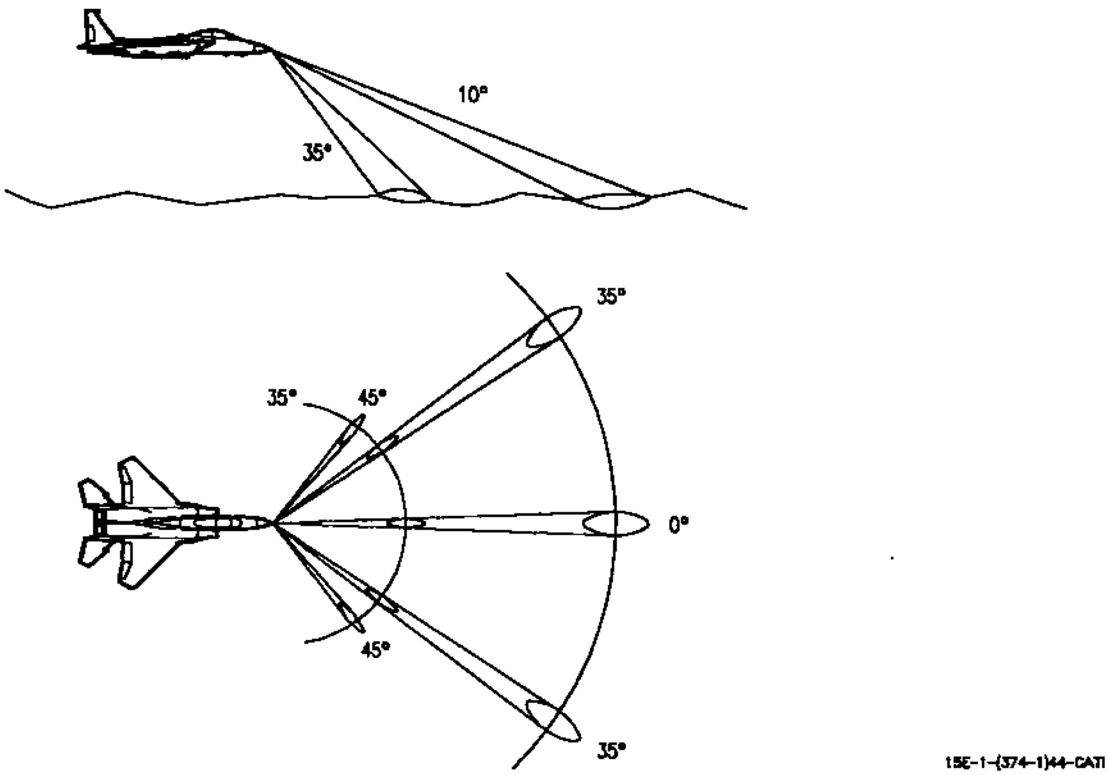


Figure 1-53

AGL, the radar is pointing almost 2 NM in front of the aircraft and 1.5 NM to either side. At higher altitudes, the problem is exaggerated.

For an MN PVU:

a. LAND/SEA option is non-functional.
b. Complete the PVU over land.
c. Currents could induce errors and degrade system performance.
d. Monitor proximity to shore to guard against illuminating the water when the aircraft is over land.

For an INS PVU:

a. Attempt to complete the PVU over land.
b. Select SEA immediately if illuminating over water.
c. Select LAND if illuminating over land.
d. Expect degraded radar mapping performance after INS (SEA) PVU if INS PVU over land not previously completed.
e. Monitor proximity to shore to guard against illuminating the water when the aircraft is over land.

ATTITUDE HEADING REFERENCE SET (AHRS)

The attitude heading reference set supplies aircraft magnetic heading to various avionic systems. The AHRS is also the standby system which provides attitude (roll and pitch) information if the primary (INS) system fails. AHRS attitude is displayed when AHRS is selected on the ADI.

AHRS INTERFACE

The INS provides roll and pitch data to the radar set. The AHRS is informed by the INS of INS attitude validity. If INS attitude is invalid, the AHRS sends attitude information to the radar set. The AHRS provides the CC with magnetic heading at all times and informs the computer when the AHRS is in the slaved mode of operation. The AHRS supplies magnetic heading to the HSI to position the compass card when AHRS is selected.

NOTE

When INS is aligned and operating, the CC determines the best available heading source. In this event the INS retains control of the compass card on the HSI and the card cannot be manually slewed.

COMPASS CONTROL PANEL

The compass control panel, on the right console, provides the necessary controls to operate the gyromagnetic compass system. These controls are the sync indicator meter, push to sync knob, fast erect pushbutton, hemisphere switch, latitude control knob, and the mode selector knob.

Sync Indicator Meter

The sync indicator meter indicates the direction (plus or minus) between the AHRS directional gyro and the magnetic azimuth detector, in the slaved mode.

Push To Sync Knob

The push to sync knob is a combination push to sync and push to turn (set heading) knob. When the knob is pressed and the mode selector knob is in SLAVED, the AHRS provides fast synchronization of the gyro stabilized magnetic heading output to the magnetic azimuth detector. When the mode selector knob is in DG (directional gyro) and AHRS is selected on the ADI, pressing and rotating the push to sync knob will slew the AHRS heading output through 360° of rotation (on the compass card) while the heading on the HUD remains steady.

Fast Erect Pushbutton

Depressing the fast erect pushbutton causes the AHRS pitch and roll erection loops to revert to the fast erection rate. If the aircraft is in unaccelerated flight and there is an obvious disagreement between the attitude indicator and the visually verified attitude of the aircraft, go to straight-and-level unaccelerated flight and momentarily press the fast erect pushbutton to re-erect the gyro for correct attitude sensing. During the fast erect condition the AHRS will indicate invalid BIT outputs, and level, unaccelerated flight must be maintained until a correct attitude is obtained.

Hemisphere Switch

The hemisphere switch selects the northern (N) or southern (S) hemisphere for operation of AHRS.

Latitude Control Knob

The latitude control knob manually inserts present position latitude, in DG and slaved mode, so that the AHRS can determine the correction needed for gyro drift due to the earths rotation.

Mode Selector Knob

The mode selector knob is a three-position rotary knob with positions of COMP (compass), DG, and SLAVED. The SLAVED mode is normally used. In the SLAVED mode, directional gyro sensed heading is continuously corrected to the heading sensed by the magnetic azimuth detector and the result is transmitted to other aircraft systems. The COMP mode is usually selected only when there is a gyro malfunction. In the COMP mode, the reading sensed by the magnetic azimuth detector is transmitted to other aircraft systems. The DG mode is used in latitudes higher than 70° or where the earth magnetic field is appreciably distorted. In the DG mode, the directional gyro heading is transmitted to other aircraft systems. When the DG mode is initially selected, the aircraft magnetic heading must be set into the system with the PUSH TO SYNC knob. The system then uses this reference for subsequent heading indications. In the SLAVED and DG modes, apparent drift compensation is inserted with the hemisphere (N-S) switch and the latitude control knob. When in either of these modes, ensure that the hemisphere and latitude settings correspond with the actual latitude.

COMP	Heading sensed from the magnetic azimuth detector.
DG	Heading sensed from the directional gyro.
SLAVED	Heading sensed from the directional gyro continuously corrected by the magnetic azimuth detector.

TACAN (TACTICAL AIR NAVIGATION) SYSTEM

The tacan system functions to give precise air-to-ground bearing and distance information at ranges up to approximately 300 miles (depending on aircraft altitude) from an associated ground or shipboard transmitting station. It determines the identity of the transmitting station and indicates the dependability of the transmitted signal. Tacan information except in A/A mode is presented on the HSI, the ADI, and the HUD. In A/A mode, both distance and bearing are received if cooperating aircraft (such as refueling tanker aircraft) have bearing transmission capability.

When operating in conjunction with aircraft having air-to-air capability, the A/A mode provides line of sight distance between two aircraft operating their tacan sets 63 channels apart. Up to five aircraft can determine line of sight distance from a sixth lead aircraft in the A/A mode, provided their tacan sets are set 63 channels apart from the lead aircraft. The limit of operation is four times the distance between the lead aircraft and the nearest aircraft. The lead aircraft will indicate distance from one of the other five, but it cannot readily determine which one. Before operating in the A/A mode, the frequencies used by each aircraft must be coordinated.

TACAN CONTROLS

The controls for tacan operation are on the intercommunications set control panel, the remote intercommunications control panel, and the UFC. The tacan volume control on the ICSCP/RICP adjusts the volume level of the tacan station identification audio tone. Operation of the tacan system is done using the upfront control.

Tacan Submenu

The tacan submenu is selected and displayed from menu 1. When displayed, all the tacan functions are presented as shown in figure 1-54. For example, tacan channel 101 is shown as the current channel selected and the system is being powered as indicated by the colon symbol adjacent to TCN. The asterisk symbol indicates the system currently has the transmit/receive (T-R) mode selected.

To change the tacan channel number, type the new number on the keyboard and check it in the scratchpad, then enter it by pressing the pushbutton next to TCN display. To select a tacan mode (A/A, T-R, REC), press the pushbutton next to the respective display. An asterisk appears next to the selected mode. To change the channel mode from Y to X or X to Y, press the pushbutton next to the X or Y currently being displayed. Return to menu 1 is accomplished by pressing the MENU key. As noted in the figure, tacan has a program sub-menu that permits indexing of 12 tacan stations for navigation updating and present position keeping purposes.

Tacan Channel Programming

The UFC provides for storing 12 tacan stations for navigation update purposes, using latitude, longitude, altitude and magnetic variation. This submenu, as shown in figure 1-54, is selected by pressing the pushbutton adjacent to PROGRAM on the tacan submenu. In most cases these stations will be programmed into the data transfer module. To select a different tacan channel number for the displayed index number, enter the channel number on the keyboard and enter it by pressing the pushbutton next to the TCN display. To select a different index number (stored number for the station), increment the number by one by pressing the pushbutton next to the INDEX display. This provides the new index number and associated data in memory for display on the UFC. To change the latitude of the tacan station, first press the SHF (shift) key on the UFC and then N or S. Type in the latitude value, including leading zeroes. Then enter the latitude by pressing the latitude pushbutton (below the INDEX pushbutton). A new longitude is entered the same way except the SHF key must be pressed and then either the W or E key is pressed.

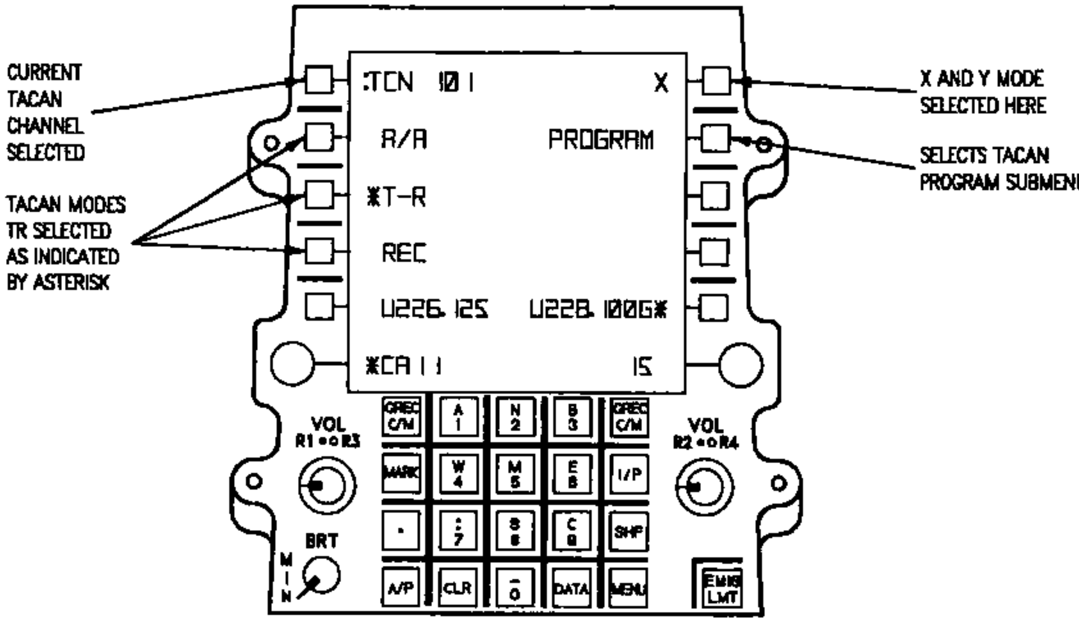
NOTE

> When programming channel and index numbers, index numbers should be changed before the channel numbers. Failure to use this sequence could result in an incorrect channel number being entered into an index number.

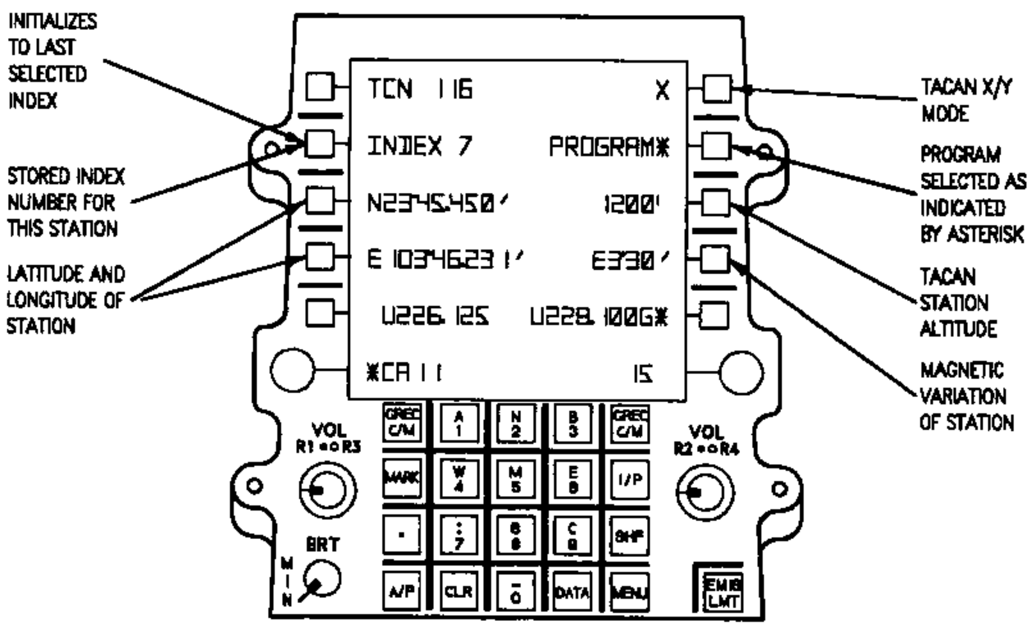
To change the magnetic variation (MV), press the SHF key then the E or W key. Type in the MV value and leading zeroes. Enter new MV by pressing the pushbutton second from the bottom on the right side of the UFC.

To change the altitude of the tacan station, type the altitude value on the keyboard and enter by pressing the pushbutton just above the MV pushbutton. This new altitude is stored in memory for the tacan station. To change the channel mode from Y to X or X to Y, press the pushbutton next to the X or Y currently being displayed.

TACAN SUBMENU DISPLAYS - WITH AP-1R



TACAN SUBMENU DISPLAY

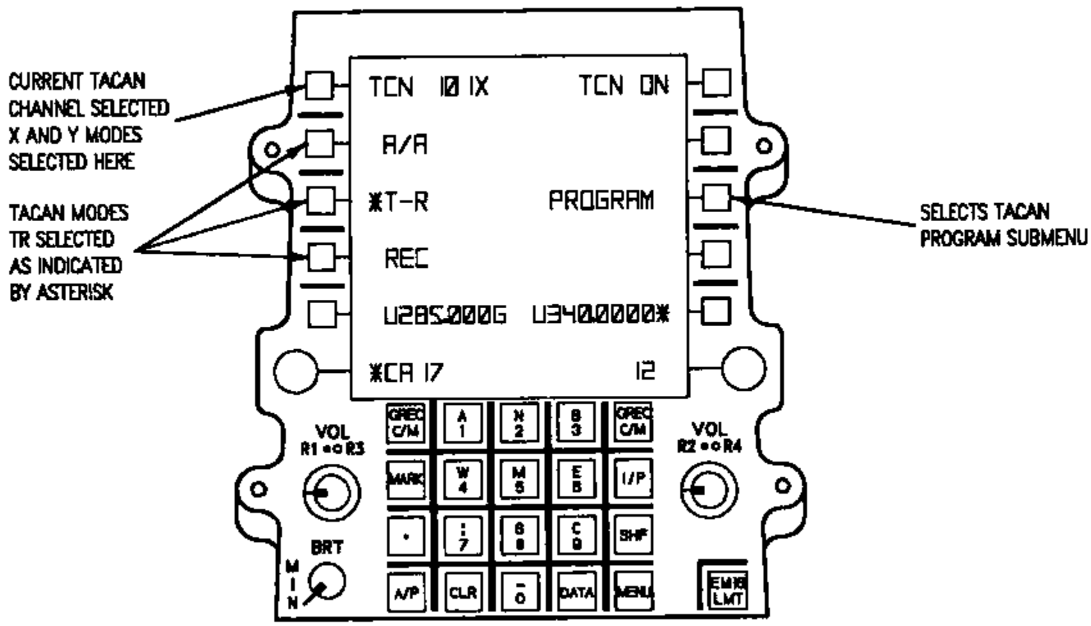


TACAN PROGRAM SUBMENU DISPLAY

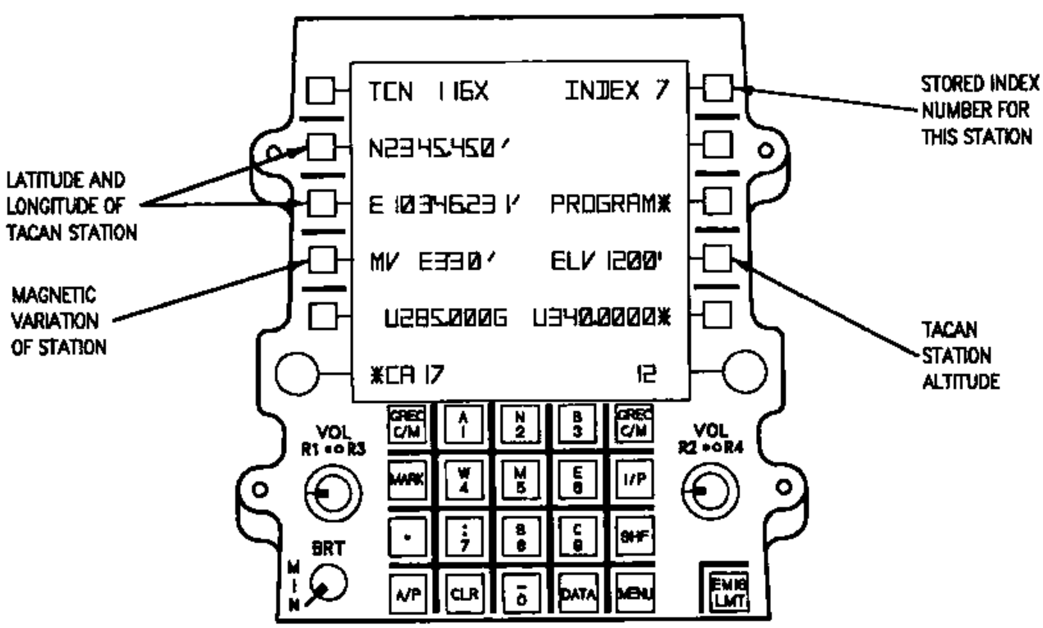
15E-1-(45-1)44-CATI

Figure 1-54 (Sheet 1 of 2)

TACAN SUBMENU DISPLAYS - WITH VHSIC



TACAN SUBMENU DISPLAY



TACAN PROGRAM SUBMENU DISPLAY

15E-1-(43-2)44-CATI

Figure 1-54 (Sheet 2)

INSTRUMENT LANDING SYSTEM (ILS)

The ILS provides the capability for the aircraft to make a precision landing approach and descent. The localizer frequency range is 108.10 to 111.95 MHz. The localizer frequency is entered and selected on the menu 2 display on the UFC (see figure 1-36). The decimal point does not need to be entered thru the UFC scratchpad. The localizer morse code identification can be heard in the headset. The marker beacon receiver operates on a fixed frequency of 75MHz. In addition to localizer and glideslope information, ILS-T provides range information to the selected TACAN station and ILS-N provides range information to the selected steerpoint. ILSN or ILST appears on the HUD (see figure 1-55).

NOTE

ILST and ILSN are not available when TF is on.

Raw data scales on the HUD and ADI show the position of the glideslope and localizer relative to the position of the aircraft (see figure 1-55). The HSI only indicates the position of the localizer. This data will always be displayed (or indicated OFF) in either ILS mode. The HUD and ADI also display command steering for both localizer and glideslope. If localizer information is valid, the bank steering command is displayed. The pitch steering command is displayed only after glideslope information is valid and the aircraft captures the glideslope center. If the aircraft subsequently loses the glideslope signal (either by flying too far off the glideslope or by a dropout in the received signal), the pitch steering commands are removed until the aircraft recaptures glideslope center. After selecting ILS-T or ILS-N, CSET flashes on the HUD for 10 seconds to remind the aircrew to set the final approach course. While overflying a marker beacon, MKR is displayed on the HUD and ADI. The MKR cue flashes the code of the marker beacon (two dashes/second for the outer marker, alternating dots and dashes for the middle marker, and six dots/second for the inner marker).

WARNING

Cross check raw data cues during any ILS approach.

NOTE

- The ILS pitch steering bar is optimized for a 3° glideslope. If flying a 2.5° glideslope, the command steering will position the aircraft about 1/2 dot below glideslope at decision height.
- The ILS steering adjusts it's commands based on the elapsed time since glideslope capture. This results in smaller correction commands as the aircraft gets closer to the runway where the steering sensitivity increases. If the glideslope is captured late or if there is any interruption of ILS validity after glideslope capture, the steering may overcorrect and cause S turns during the approach.

ILS Volume Control Knob

The ILS volume control knob on the intercom control panel adjusts the volume level of the localizer station identification audio.

VIDEO TAPE RECORDER SET (VTRS)

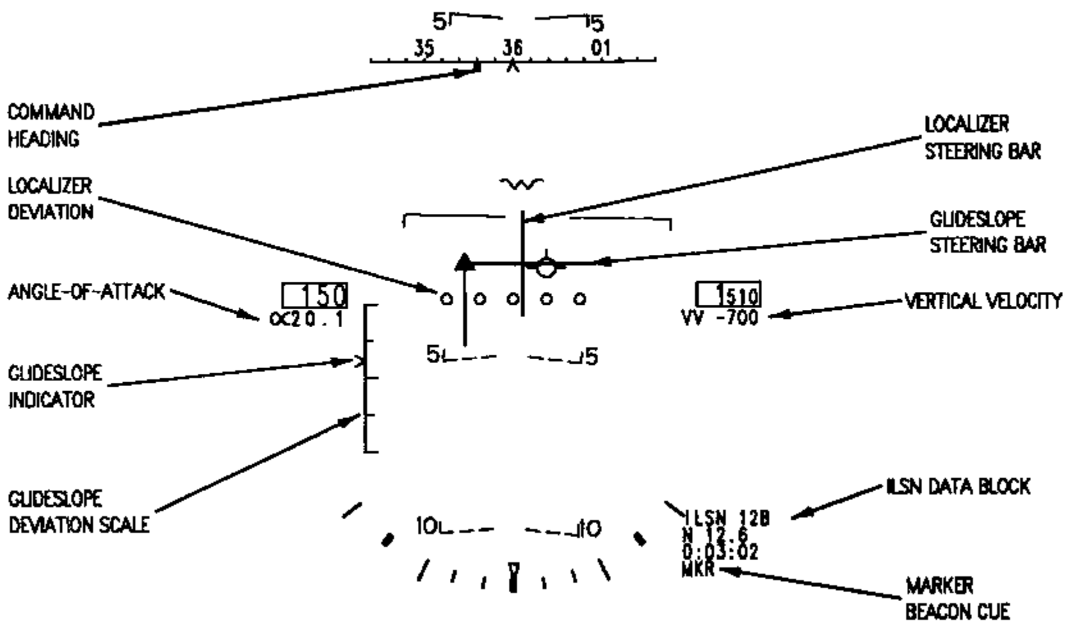
The VTRS is installed to record individual MPD, MPCD, and HUD displays. There are two video taping options available, non-programmed recording and programmed recording. In both cases the crew interface with the VTRS includes the VTRS control panel, one or more of the MPD/MPCD's, the HUD, and the control stick trigger switch.

VTRS CONTROL PANEL

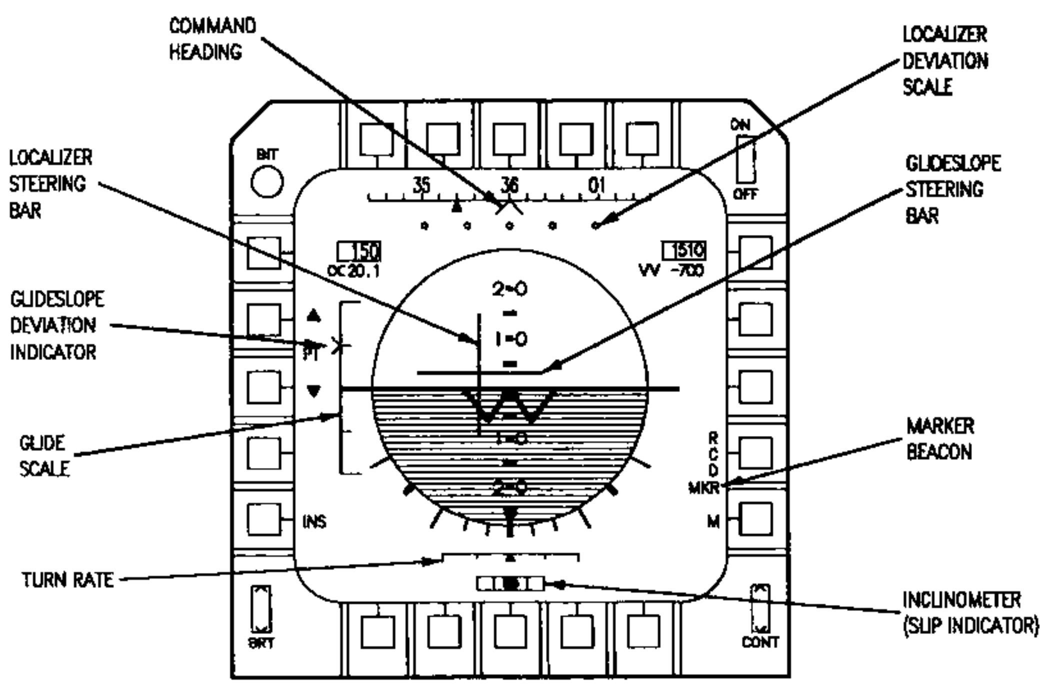
The controls for the VTRS are on the VTRS control panel on the right console of the front cockpit. A description of the controls follows:

ILS DISPLAYS

GEAR DOWN



HUD WITH ILS NAV STEERING FORMAT



ADI WITH ILS FORMAT

15E-1-(34-1)44-CATI

Figure 1-55

Record Switch

This switch has positions of enable and unthread.

ENABLE	Enables the VTRS to record if the INS is turned on.
UNTHREAD	If the INS is on, selecting unthread unthreads the video tape. The VTRS automatically unthreads when the INS is turned off (takes approximately 15 seconds to unthread).

Minutes Remaining Counter

This indicates minutes of video tape remaining. The counter is reset by pressing and turning the reset knob.

VTRS ADVISORY LIGHTS

These consist of the RCD (record) and EOT (end of tape) lights.

RCD	Illuminates green when recording is in progress only positive indication of operation.
EOT	Illuminates white to indicate end of tape or no tape in recorder.

NON-PROGRAMMED RECORDING

For non-programmed recording ensure that RECORD ENABLE is selected on the VTRS control panel. Then either crewmember presses the MPD/MPCD pushbutton next to the RCD cue on the display. This initiates recording of the display of interest. Two displays can be recorded at the same time using non-programmed recording, but there are exceptions.

Record Cue

When recording is not commanded, RCD is displayed adjacent to the MPD pushbutton. Pressing this pushbutton will initiate non-programmed recording of that display. The same pushbutton is pressed to stop recording. For the HUD, the pilot presses the flight stick trigger to the first detent to initiate non-programmed recording. The RCD cue will not be displayed on the PACS, BIT, DTM, VTRS, and menu displays. To initiate non-programmed recording of these display formats, they must be called up on a display which has recording already in progress. The non-programmed RCD cue is available on the following display formats:

A/A RADAR	TGT IR
A/G RADAR	WPN1
ADI	WPN2
HSI	OWS
TF	ENGINE
TSD	HUD REPEATER
TEWS	

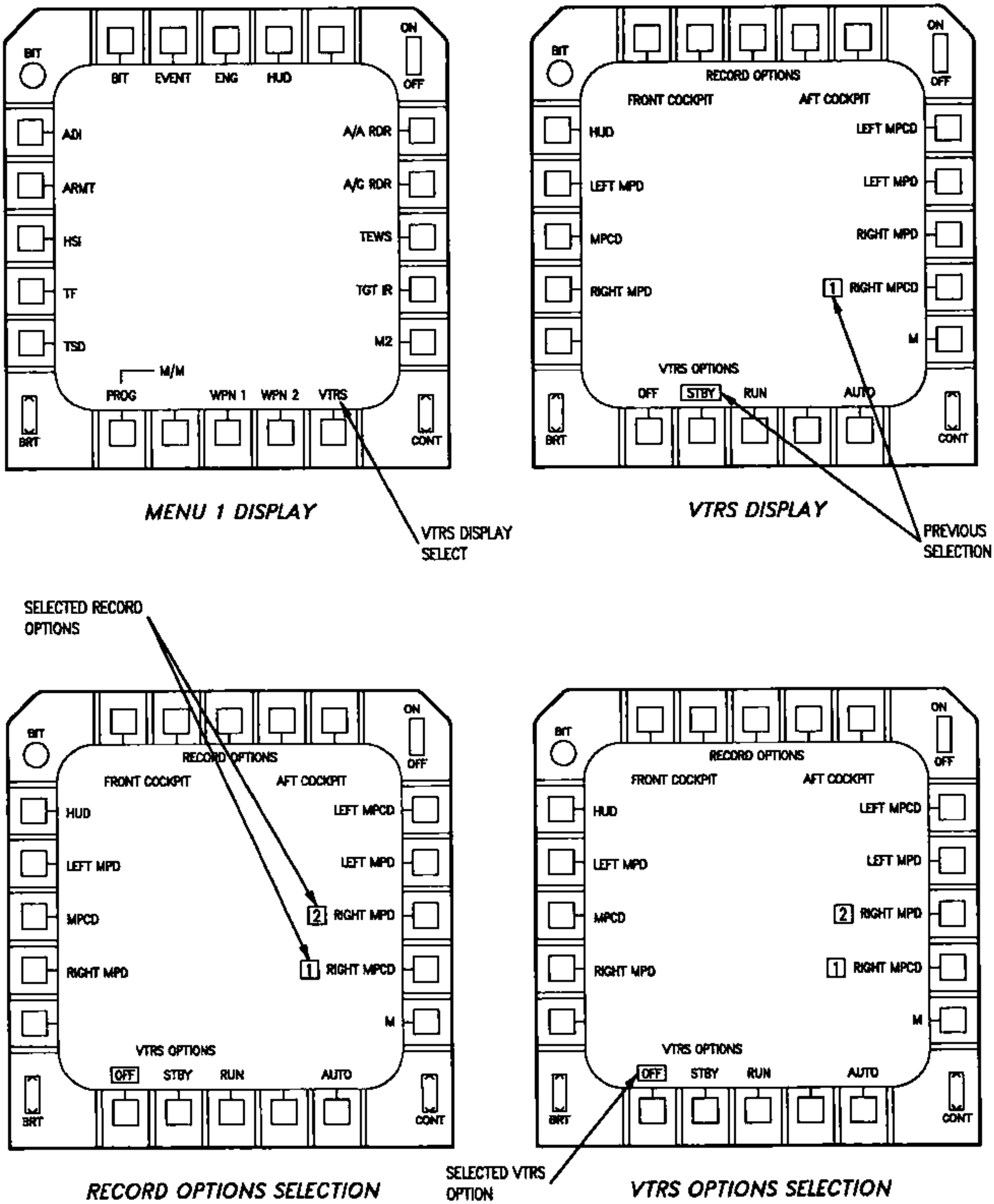
Non-Programmed Recording In Progress Cue

The CC clock time is displayed adjacent to the record pushbutton whenever non-programmed recording is in progress for that display. The PACS, BIT, DTM, VTRS, MENU and display formats do not display this cue. Nevertheless, these five display formats will be recorded if they are called up on an MPD or MPCD with recording in progress.

PROGRAMMED RECORDING

If the crewmembers know in advance which cockpit display(s) they wish to record, they can program the VTRS through a VTRS display menu to record particular display(s) before the fact. This is called programmed recording. Because programmed recording occurs automatically, the workload of the crewmembers is reduced. Another advantage of programmed recording is that after the program is entered, the recording procedure can be controlled with HOTAS functions. The aircrew procedures for programmed recording are described in the following paragraphs.

PROGRAMMED RECORDING DISPLAYS - WITH VHSIC



15E-1-(40-1)33-CATI

Figure 1-56 (Sheet 1 of 2)

PROGRAMMED RECORDING DISPLAYS - WITH AP-1R

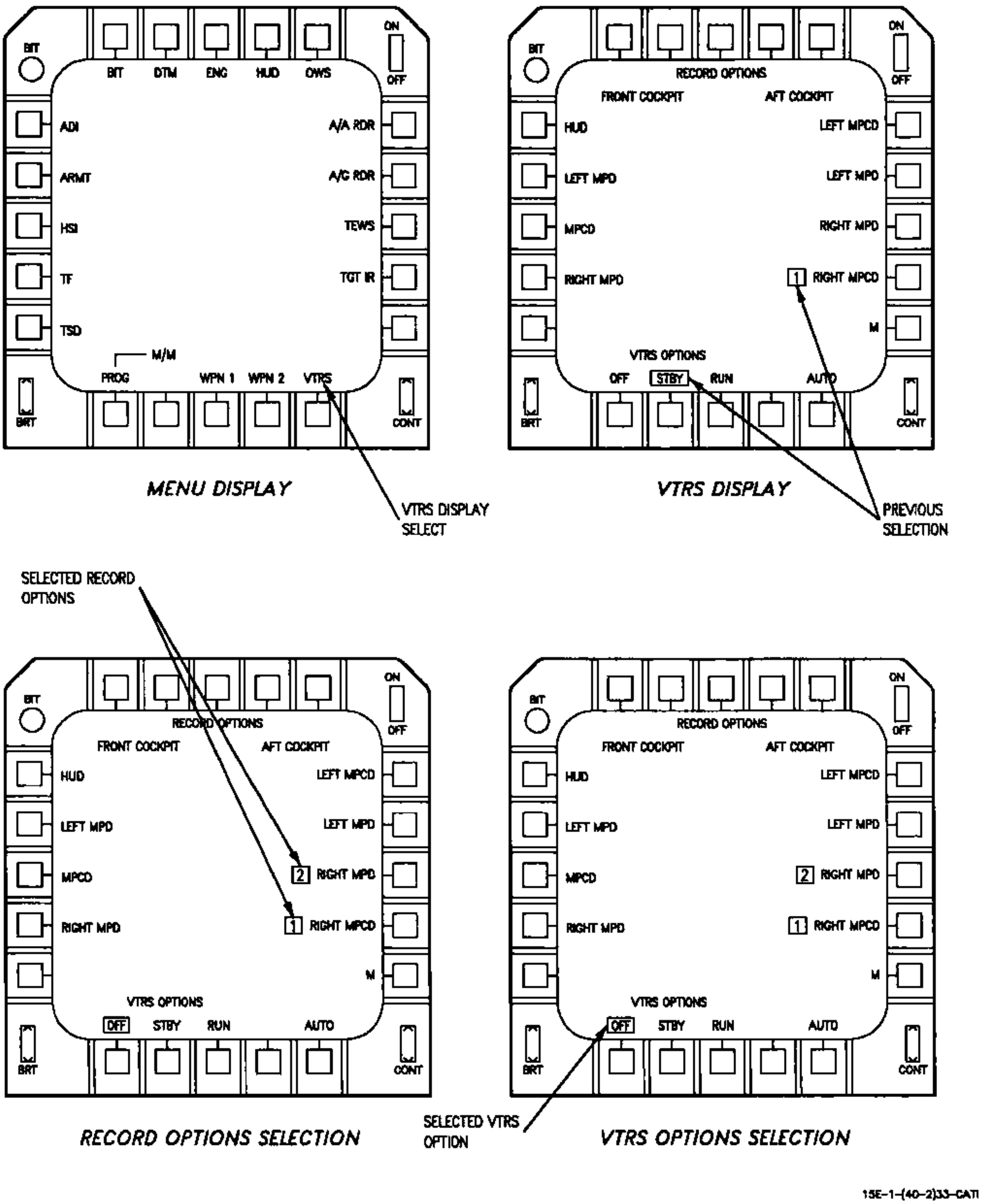


Figure 1-56 (Sheet 2)

VTRS Selection

Pressing the MPD or MPCD pushbutton adjacent to M calls up the menu display shown in figure 1-56.

Pressing the VTRS pushbutton selects the VTRS display shown in figure 1-51. The VTRS display will indicate those selections which were selected the previous time this display was called up. For example, if the rear cockpit right-hand MPCD was previously selected and the VTRS was set in the standby (STBY) mode, the resultant display would look like figure 1-56.

Record Options and Priorities

The crewmember can select or deselect any two of the eight available record options by pressing the pushbutton adjacent to the desired option. Also note that the options are separated for front cockpit and rear cockpit. A boxed priority number 1 appears adjacent to the first record option selection, and a boxed priority number 2 appears adjacent to the second record option selection, as shown in figure 1-56. This procedure is referred to as programmed recording. No recording will actually occur at this point because OFF has been selected as the VTRS Option. To deselect a record option, the crew member simply presses the adjacent pushbutton, and the boxed priority number is removed. If the number 1 priority record option is deselected, the number 2 priority record option will automatically be reassigned number 1 priority, and the boxed priority number will change accordingly. If two record options have already been selected, any attempt to select a third record option will be ignored by the system.

Split-Screen Video

VTRS has the capability to record split-screen video for the majority of display format pairs. For split-screen video to occur, the displays must be synchronized, i.e., the displays must be refreshed at the same rate. Some of the display formats are ineligible for split-screen video due to incompatible synchronization rates. If any two of the following formats are selected, only the first one selected will be recorded:

TSD	TGT FLIR
WPN1	TF E^2
WPN2	NAV FLIR (on HUD or HUD Repeater)

The end result of a split-screen video recording is a display with 50% horizontal video compression, and full-size vertical video. That is, both displays are regular height, but their width is compressed by one-half.

VTRS Options

The three VTRS Options are displayed on the bottom of the VTRS display: OFF, STBY, and RUN. Each VTRS option can be selected by pressing the corresponding pushbutton. In addition, the central computer will automatically select the OFF VTRS option, as shown in figure 1-56 whenever no record options have been selected. If a crewmember attempts to select either STBY or RUN without first selecting a record option, then a cue is displayed in the center of the VTRS display. When no record options have been selected, OFF is the only available VTRS option. The cue is automatically removed after the crewmember selects a record option. The STBY OPTION enables the AUTO function, if selected. With STBY selected, recording of programmed displays occurs when the weapon release (pickle) button is pressed. In the A/A master mode, the displays will be recorded for missile TOF plus 5 seconds. In the A/G master mode, they will be recorded from weapon consent through weapon release plus 10 seconds. The RUN option initiates recording of the programmed display(s).

Auto Function

The VTRS AUTO function may be selected or deselected independent of the three VTRS Options previously discussed. The AUTO function is boxed when selected. By pressing the adjacent pushbutton, the box is removed and the AUTO function is deselected. When the AUTO function is selected by a crewmember, the VTRS will automatically record the HUD whenever predetermined conditions exist. That is, the AUTO function will interrupt recording of programmed or non-programmed displays, and will automatically record the HUD. When the predetermined conditions no longer exist, the VTRS will revert to recording the previously selected display(s). One predetermined condition is the selection of the gun (using the weapon select switch) together with a radar-detected target within 10 NM of the aircraft. The other predetermined conditions involve A/A missile launch commanded by the weapon release pushbutton. The duration of the AUTO recording equals the missile TOF plus 5 seconds.

HUD Recording In Progress Cue

The CC clock time cue is displayed in the lower left corner of the HUD to indicate recording in progress.

Programmed Recording in Progress Cue

In general, the CC clock time is displayed on the right side of the MPD/MPCD when programmed recording is in progress. Also, an asterisk is displayed above and below the clock time. The asterisks are displayed to distinguish programmed recording from non-programmed recording. For the PACS, BIT, MENU, VTRS and DTM displays, the clock time cue will not be displayed. However, if programmed recording is in progress on a particular MPD and one of these displays is called up, then the recorder will record the PACS, BIT or DTM format on the programmed MPD(s).

Weapon Consent Cue

A small tick mark placed on the left edge of the recording. Identical in appearance to the weapon release tick mark but separated positionally. The weapon consent cue is present while the pickle button is pressed or the trigger is held in full action.

Weapon Release Cue

A small tick mark is displayed on the left edge of the recording to mark the time of weapon release. The duration of this cue is 1 second. The purpose of the weapon release cue is to help the crewmember search his video tape recordings after flight, freezing the playback machine at the time of weapon release.

Voice Communications and Aural Tones

In order to aid correlation of inflight occurrences with post flight review of the video tape recording, voice communications to and from the crewmembers are recorded on the audio track of the VTRS. Likewise, aural tones voice warnings, weapon consent and weapon release tones are recorded.

LIGHTING EQUIPMENT

EXTERIOR LIGHTING

Exterior lights are controlled from either the exterior lights control panel or the miscellaneous control panel, both on the left console in the front cockpit.

Position Lights

The position lights include a green light on the forward edge of the right wing tip, a red light on the forward edge of the left wing tip, and a white light just below the tip of the left vertical tail fin. The position lights are controlled by a knob on the exterior lights control panel labeled POSITION. With the anti-collision lights on, the position lights automatically go to steady full brilliance, regardless of the position of the position lights knob.

OFF	Lights are off.
1 - 5	Guide numbers for varying brightness from off to full bright.
BRT	Lights are at full brightness.
FLASH	The lights will flash at full brightness.

Anti-Collision Lights

There are three red anti-collision lights; one on the leading edge of each wing just outboard of the air intake and another just below the tip of the right vertical tail fin. The anti-collision lights are controlled by a single toggle switch on the exterior lights control panel labeled ANTI-COLLISION. The switch positions are OFF and ON.

Formation Lights

Six green electroluminescent formation lights are provided. Two lights are on the wingtips behind the position lights, one light on each side of the forward fuselage just forward of the cockpit, and one light on each side the aft fuselage just aft of the wing trailing edge. The formation lights are controlled by a single knob on the exterior lights control panel labeled FORMATION.

OFF	Lights are off.
1 - 5	Guide numbers for varying brightness from off to full bright.
BRT	The lights are at full brightness.

Vertical Tail Flood Lights

Two vertical tail flood lights are installed on the right and left aft fuselage to illuminate the vertical tails during night join-ups and formation flying. They are controlled by a single switch on the exterior lights control panel.

OFF	Lights are off.
DIM	Lights are on in a dimmed condition.
BRT	Lights are at full brightness.

Landing and Taxi Lights

The landing and taxi lights are on the nose gear strut. They are controlled by a toggle switch on the miscellaneous control panel. The lights are off, regardless of switch position, when the landing gear handle is in the up position.

OFF	Lights are off.
LDG LIGHT	If the landing gear handle is down, the landing light is turned on.
TAXI LIGHT	If the landing gear handle is down, the taxi light is turned on.

INTERIOR LIGHTING

Except for the utility floodlights and UFC display lighting, all the controls for interior lights are on the interior lights control panel on the right console in each cockpit.

Upfront Control Display Lighting

The UFC Liquid Crystal Display (LCD) consists of six display rows. A brightness (BRT) control provides a full range of adjustment for night utilization. Backlighting is not required because the LCD is a reflective type display.

Instrument Lighting

Integral lighting is provided for all instruments and panels on the front cockpit instrument panel including the MPDs, MPCD, UFC, circuit breaker panels and the HUD. Integral lighting is also provided to the radio call, emergency hook and emergency vent panels. Instrument lighting is provided to the front cockpit standby compass whenever the STBY COMP switch is ON. Rear cockpit integral instrument lighting is provided for all instruments and panels on the rear instrument panel including the MPDs and MPCDs. Integral lighting is also provided to the UFC, the command selector valve panel, the emergency hook panel and the radio call panel. The lights are controlled by the instrument panel lights knob in either cockpit, labeled INST PNL, which provides variable lighting between positions OFF and BRT.

Console Lighting

The console lights are controlled by the CONSOLE knob in either cockpit which provide variable lighting between positions OFF and BRT.

Storm/Flood Lighting

Four storm/flood lights are provided in the front cockpit and two in the rear cockpit for secondary lighting. The front cockpit has a light above each console and two above the main instrument panel. The rear cockpit has one light above each console. The lights in each cockpit are controlled by the storm/flood lights knob labeled STORM FLOOD, which provides variable lighting between OFF and BRT. In either cockpit, if the warning/caution/advisory lights are in the dimmed condition, moving the storm/flood lights knob to full BRT causes the warning/caution/advisory lights to revert to full intensity, regardless of the position of the WARNING CAUTION control knob.

Utility Flood Lights

A portable utility flood light is provided in each cockpit and is normally stowed on a bracket above the right console. An alligator clip attached to the light may be used to fasten the light to various locations in the cockpit at the crewmember's discretion. The utility light in the front cockpit is the only cockpit light designed to illuminate the cockpit which operates from JFS generator power.

Standby Compass Light

Lighting for the front cockpit standby compass is controlled by the STBY COMP switch and the INST PNL knob. With the STBY COMP switch ON, variable lighting is provided between positions OFF and BRT of the INST PNL knob. In the rear cockpit, although a STBY COMP switch is provided, there is no standby compass installed.

Chart Lights

A chart light is provided in the front cockpit on the canopy bow and in the rear cockpit above the right console. The lights, which illuminate maps and other documents on the crewmember's knee board, are mounted by adjustable positioning joints. The lights are controlled by the CHART LT knob in either cockpit, which provides variable lighting between positions OFF and BRT.

Display Lighting Switch

A DISPLAY switch is provided in each cockpit which controls the maximum illumination level for the MPD/MPCD displays. The positions are DAY and NIGHT.

Warning/Caution Lights Control Knob

A control is provided in each cockpit on the interior lights control panel to independently switch the warning/caution/advisory lights from bright intensity (day mode) to the low intensity range (night mode), and then to vary the brightness within the low intensity night mode. The control is labeled WARNING CAUTION and is variable between the OFF position and BRT (bright), with a momentary RESET position at the maximum clockwise position. Variable lighting is provided for the night mode whenever the INST PNL knob is not OFF, the STORM FLOOD lights knob is not full BRT, and the WARNING CAUTION knob is set to RESET and then varied between OFF and BRT. The dimmed night lights revert back to the bright day mode when main aircraft power is interrupted, INST PNL lights are turned OFF, or the STORM FLOOD lights are full BRT. The MASTER CAUTION light is also dimmed in the night mode, but intensity cannot be varied.

In the day mode, this control also permits the pilot to vary the intensity of the LOCK/SHOOT lights on the canopy bow. In this mode and in a high ambient light environment, the pilot should be aware that the LOCK/SHOOT lights can be set too dim to be seen. Also, when the pilot selects the low intensity night mode, the LOCK/SHOOT lights are disabled.

Lights Test Switch

A lights test switch, labeled LT TEST, is provided to test the warning/caution/advisory lights. If in the low intensity night mode, the lights will test at the dimmed setting, as controlled by the WARNING CAUTION control knob.

OFF	Removes power from lights test circuit
ON	Serviceable warning/ caution/ advisory lights (including rear cockpit LEFT/RIGHT ENGINE FIRE lights) will come on (except T/O TRIM).

NOTE

During twilight operations, with the warning/cautions dimmed, the FIRE light may be difficult to see.

LIQUID OXYGEN SYSTEM (LOX) (F-15E 86-0183 THRU 90-0232 BEFORE TO 1F-15E-561)

NORMAL OXYGEN SUPPLY

The normal system pressure is 70 psi with a usable pressure range of 55 to 90 psi. When the system is not operating (aircrew not using system oxygen) the allowable pressure range is 55 to 120 psi. The pressure should remain within these limits until the converter is depleted.

OXYGEN LOW Caution

The OXY LOW caution is displayed when oxygen quantity is below 4 liters. The caution also comes on when the oxygen quantity test button in either cockpit pressed when the oxygen quantity gage pointer drops below 4 liters.

EMERGENCY OXYGEN SUPPLY

A 10 minute supply of oxygen is furnished by a gaseous oxygen storage bottle on the left rear of each ejection seat. The supply is activated automatically on ejection, or is activated manually by pulling the emergency oxygen green ring just forward of the bottle on the left seat arm rest.

OXYGEN REGULATOR

The oxygen regulator, on the front and rear cockpit right consoles, automatically controls the pressure and flow rate of normal oxygen based on demand and cockpit altitude.

Supply Lever

A two-position lever on the right corner of each regulator panel, controls the flow of oxygen from the regulator.

ON	The proper mix of cockpit air and oxygen is supplied to the mask.
OFF	Breathing is not possible with the mask on.

Diluter Lever

A two-position diluter lever, in the center of each regulator, controls the mixture of air and oxygen.

100%	Pure oxygen is delivered.
NORMAL	The scheduled mixture of air and oxygen is delivered.

Emergency Lever

A three-position emergency lever is on the lower left corner of each regulator panel.

EMERGENCY	Continuous positive pressure oxygen is delivered to the mask.
NORMAL	Normal operation is provided.
TEST MASK	Positive oxygen pressure is supplied.

Oxygen Flow Indicator

The oxygen flow indicator on each regulator panel alternately shows white for flow and black for no-flow with each breath under normal conditions. Continuous black indicates no air/oxygen is being furnished and continuous white indicates a leak in the system.

Oxygen Pressure Gage

The oxygen pressure gage on each regulator panel indicates oxygen delivery to the regulator. The normal indication is approximately 70 psi.

OXYGEN QUANTITY GAGE

The oxygen quantity gage is on the front and rear cockpit ECS panel.

Oxygen Quantity Gage Test Button

The oxygen quantity gage test button, on the front and rear cockpit ECS panel, tests the operation of the gage and the OXY LOW caution. Depressing the test button causes the gage needle to rotate from the present quantity indication to 0. As the needle passes below 4 liters the OXY LOW caution should come on. Upon release of the test button, the gage needle should rotate from 0 to an indication of the present quantity. The OXY LOW caution should go out as the needle passes above 4 liters.

OXYGEN HOSE STOWAGE FITTING

An oxygen hose stowage fitting is provided in the front and rear cockpit above and outboard of the right console. The oxygen hose should be stowed in this fitting at all times when not in use to prevent hose contamination and damage to the console by a flailing hose.

MOLECULAR SIEVE OXYGEN GENERATING SYSTEM (MSOGS) (F-15E 90-0233 AND UP AND F-15E 86-0183 THRU 90-0232 AFTER TO 1F-15E-561)

The MSOGS provides a continuously available supply of breathing gas for the aircrew. MSOGS uses engine bleed air that is cooled by the ECS, and filters out the nitrogen and other pollutants to provide oxygen enriched breathing gas. The MSOGS primary air source is from the high pressure water separator, and the secondary source is from the anti-fog valve inlet line. A source control valve and temperature sensor automatically selects the air source based on available pressure and temperature. If a total ECS failure/shutdown occurs, ram air cools the engine bleed air from the secondary source. This secondary source provides preconditioned air to MSOGS as long as bleed air is available from either engine.

MSOGS consists of an oxygen concentrator (the molecular sieve filter) and an integral, self-charging Backup Oxygen Supply (BOS). Each crewmember has a panel mounted oxygen breathing regulator, similar in function to the LOX regulator. The breathing gas is continuously sampled by a MSOGS monitor/controller to insure that the oxygen concentration of the output gas is above acceptable levels. Electrical power for MSOGS is supplied from the aircraft Essential bus

MSOGS CONCENTRATOR

The MSOGS concentrator contains dual beds of molecular sieve materials. Pressurized air from either source is cycled through the beds by an electrically driven valve. Nitrogen is removed and dumped overboard while the remaining output of oxygen rich breathing gas is supplied to the aircrew. The concentrator contains a three-way valve that normally allows oxygen enriched breathing gas flow but will automatically switch to the BOS during a system failure.

NOTE

> The MSOGS is not specifically designed to filter out all possible contaminates that can be introduced into the ECS. Contaminates such as hydraulic fumes can also can be introduced through the ECS by other aircraft system failures.

The concentrator monitor/controller controls BOS fill operation, checks control valve operation and performs power-up and continuous BIT. It also measure the oxygen concentration of the product gas and activates a caution signal if below acceptable breathing levels.

Backup Oxygen System

When fully charged, the BOS provides at least 16 man-minutes (8 minutes per crew member) of oxygen enriched breathing gas. It is used in case of concentrator failure, loss of both bleed air sources or loss of electrical power. The BOS is automatically recharged whenever MSOGS is producing at least 93% oxygen enriched gas and adequate inlet pressure is available to the concentrator. When charged, the BOS is the breathing gas source if the oxygen system is used on the ground prior to engine start. A BOS check can be performed to monitor BOS pressure and system operation. BOS cannot be manually selected other than by the BOS check. An empty BOS will not begin to charge unless the oxygen regulator gauge is reading approximately 28 psi or greater. Selection of anti-fog HOT may boost the MSOGS pressure enough to initiate BOS charging if desired during cold weather ground idle operation.

MSOGS BIT

Power-up BIT

Power-up BIT is a self test of the MSOGS system that is automatically performed when electrical power is on the aircraft, adequate pressure is available to the concentrator, and the front cockpit regulator is turned on. The power-up BIT lasts approximately 3 minutes. When successfully completed, the green OXY BIT light on the right console in both cockpits will come on. On 90-0233 THRU 91-0317, the light may be reset by pressing the OXY BIT button/light in the front cockpit only. On 91-0318 AND UP, the light may be reset by pressing and releasing the OXY BIT button/light two times in the front cockpit only. If power-up BIT fails, the OXYGEN caution and MASTER CAUTION lights will come on. Power-up BIT can be restarted by turning the front cockpit regulator OFF (more than 1 second) and back ON.

Continuous BIT

The monitor controller performs continuous monitoring of the oxygen concentration, conducts periodic checks of other system parameters, and verifies BOS charging capability. The minimum acceptable oxygen concentration is 34% at sea level and increases as cabin altitude increases up to approximately 94% oxygen. The monitor/controller checks for two types of failures: critical and non-critical.

Critical failures are:

a. Low product gas oxygen concentration.
b. Low concentrator outlet pressure
c. Concentrator outlet, BOS and cabin pressure sensor faults
d. Sensor accuracy faults
e. Software faults

Critical failure during continuous BIT will automatically switch the system to BOS and activate the OXYGEN caution and MASTER CAUTION lights .

Non-critical failures are monitored but do not require any aircrew actions. Non-critical failures that require maintenance action, such as dirty filters, will trip BIT indicators on the MSOGS concentrator and the Avionics Status Panel. The OXYGEN caution and MASTER CAUTION lights will not go on for non-critical failures.

BOS Check

The BOS check provides the aircrew the capability to check the BOS pressure, the caution circuitry, and the concentrator three way valve operation. On 90-0233 THRU 91-0322, pressing and holding the OXY BIT button in the front cockpit will toggle the concentrator three way valve allowing BOS gas to be supplied to the regulator and BOS pressure to be read on the regulator gauge. On 91-0323 AND UP, pressing and releasing the OXY BIT button in the front cockpit will toggle the concentrator three way valve allowing BOS gas to be supplied to the regulator and BOS pressure to be read on the regulator gauge. After BOS pressure is read on 90-0233 THRU 91-0322, releasing the OXY BIT button/light, or on 91-0323 AND UP, pressing and releasing the OXY BIT button/light a second time returns the gauge to normal system operation. During this check, the OXYGEN caution and MASTER CAUTION lights will come on. The BOS check should be performed prior to taxi. The pressure reading may be as high as 450 psi when fully charged. Once the OXY BIT button is released, several breaths are required before the gauge will read the normal concentrator operating range (10-60 psi).

BREATHING REGULATOR

The MSOGS regulator is a diluter-demand, g-compensated oxygen regulator similar to the standard CRU-73/A. Modifications were made to provide positive pressure breathing as a function of g-forces (PBG). The PBG function is activated via a pressure signal from the anti-g valve.

Supply/Mode Control Lever

A three position lever located on the right side of the regulator panel controls the flow of breathing gas to the crew member.

OFF	Electrical power is removed. No breathing gas is provided to the crewmember.
ON (Front cockpit only)	Provides electrical power to the concentrator. Supplies breathing gas to the crewmember on demand and positive pressure breathing as a function of altitude.
PBG	Same function as "ON" plus providing positive pressure breathing as a function of G. This position is mechanically locked out until compatible life support equipment (Combat Edge) is fielded.

CAUTION

Do not lift the regulator toggle switch when switching between OFF and ON. Damage to the regulator switch will result.

Diluter Lever

A two position lever, located in the center of the regulator panel, controls the mixture of MSOGS gas and ambient cabin air.

100%	No dilution of MSOGS breathing gas is provided.
NORMAL	MSOGS gas and cabin air are mixed as a function of altitude

Emergency Lever

A three position lever located on the lower left of the regulator panel.

EMERGENCY	Provides continuous positive pressure to the mask as well as the same regulator functions operation provided in NORMAL.
NORMAL	Provides normal breathing gas flow on demand.
TEST-MASK	Spring loaded, momentary position that must be held to provide positive pressure to test mask seal.

Flow Indicator

The flow indicator on each regulator panel alternately shows white for flow and black for no-flow with each breath under normal conditions. Continuous black indicates no air/MSOGS gas flow is being furnished and continuous white indicates a leak in the system.

Pressure Gauge

The pressure gauge indicates the inlet supply pressure to the regulator. After power-up, the normal pressure is 10 to 60 psi, as indicated by the green band on the face of the gauge. The pressure will fluctuate with the breathing cycle. If the concentrator is not electrically powered, or the BOS system is the source of the breathing gas, the pressure gauge indicates the gas pressure of the BOS. This pressure depends on the length of time BOS is in use, and is a relative indication of BOS quantity. A fully charged BOS will indicate approximately 450 psi on the gauge. Breathing from the BOS is possible with BOS pressure as low as 20 psi.

ENVIRONMENTAL CONTROL SYSTEM (ECS)

The ECS provides conditioned air and pressurization, for the cockpit and avionics, windshield anti-fog and anti-ice, anti-G, canopy seal, and fuel pressurization. The ECS uses engine bleed air from both engines for normal operation. Cooling for the avionics, with the air source knob OFF or the cockpit temperature switch OFF, automatically switches to ram air. Ram air cooling is automatically supplied to the avionics whenever compressor inlet duct pressure drops. See foldout section for the ECS schematic.

ECS vents and louvers are located on the center instrument panel and along the canopy rails in both cockpits.

AIR SOURCE KNOB

The air source knob, on the air conditioning control panel on the right console, selects the engine bleed air source for the ECS system.

BOTH	Supplies bleed air from both engines.
L ENG	Shuts off bleed air from the right engine.
R ENG	Shuts off bleed air from the left engine.
OFF	Shuts off bleed air from both engines.

CAUTION

Selection of OFF on the air source knob or cabin temperature control switch will switch avionics from normal cooling to ram air cooling. Overheat damage to the avionics may occur. Monitor the ECS caution on the MPD/MPCD.

AIR FLOW SELECTOR SWITCH

The air flow selector switch allows three cockpit flow selections.

MAX	Maximum air flow
NORM	Normal air flow
MIN	Minimum air flow

Flow selection is at the discretion of the aircrew. The change in flow from MIN to MAX is not always perceptible to the aircrew.

BLEED AIR CAUTIONS

The L and/or R BLEED AIR caution is displayed on the MPD/MPCD when a bleed air leak is detected between the engine and the primary heat exchanger.

COCKPIT PRESSURIZATION

Control of the pressure schedule by the cockpit pressure regulator is automatic. Refer to figure 1-57 for the cockpit pressure schedule.

COCKPIT PRESSURE ALTIMETER

The pressure altitude of the cockpit is indicated on a 0-50,000 foot pressure altimeter on the right main instrument panel.

COCKPIT TEMPERATURE CONTROL

Cockpit temperature is controlled by the cockpit temperature control knob and switch on the air conditioning control panel.

COCKPIT PRESSURE SCHEDULE

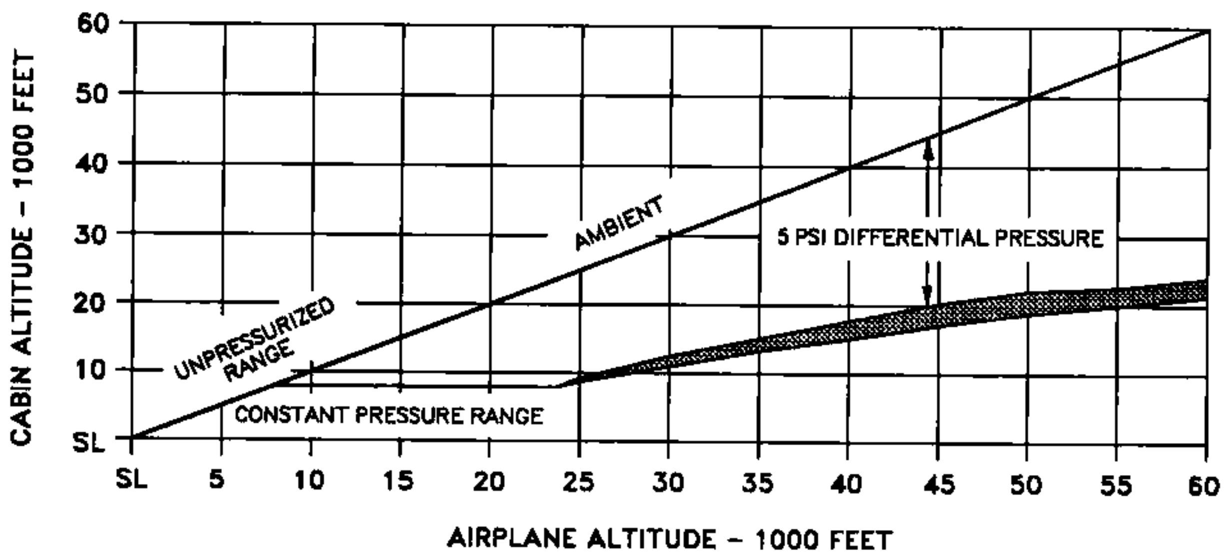


Figure 1-57

AUTO	Cockpit temperature is automatically maintained at the temperature selected on the control knob.
MANUAL	Cockpit temperature may be manually changed with the control knob but is not automatically maintained.
OFF	a. Turns off ECS air to the cockpit, avionics, and windshield anti-fog. b. Avionics cooling automatically switches to ram air. c. The canopy seal, fuel pressurization, radar waveguide, anti-g and windshield anti-ice continue to operate.

AVIONICS PRESSURIZATION AND TEMPERATURE

The pressurization and temperature control of the avionics system is automatic.

ECS CAUTION

The ECS caution warns of overtemperature or low air flow of the avionics cooling air. With the ECS operating normally, the ECS caution may come on during low speed flight, particularly at high power settings, or during idle descents. When the ECS caution comes on during single engine operation on the ground, selected avionics equipment will automatically be turned off.

DISPLAY FLOW LOW CAUTION

The DISPLAY FLOW LOW caution warns of inadequate cooling air flow to the cockpit displays. Caution lights are located in both the forward and aft cockpits. In the forward cockpit, the DSPL FLO LO light is located on the right subpanel. In the aft cockpit, the DISPLAY FLOW LOW light can be found above the right MPD.

A differential pressure switch monitors the difference between cabin pressure and display cooling line pressure. If the differential pressure drops below a required value, the cockpit display cooling flow is assumed low and the caution will illuminate. The caution light will remain on until adequate differential pressure is restored.

EMERGENCY VENT CONTROL

The emergency vent handle on the right main instrument sub panel, when turned 45° CCW electrically dumps cabin pressure. Extension of the handle shuts off ECS air to the cockpit, diverts all ECS cooling air to the avionics and allows ram air to enter the cockpit.

The amount of cockpit ram air flow is controlled by how far the handle is extended. At full travel the handle is locked. If the handle is pushed in and rotated clockwise (CW), normal ECS operation is restored.

ANTI-G SYSTEM

The anti-g system is automatic and delivers cooled bleed air to the anti-g suit. The airflow into the suits is proportional to the g force experienced. A manual inflation button in the valve allows the aircrew to inflate the suit for checking the system. The system incorporates an automatic pressure relief valve.

WINDSHIELD ANTI-FOG

Windshield anti-fog air is supplied when cockpit air conditioning is operating. The anti-fog air temperature may be regulated by the pilot with the anti-fog advisory lights switch. If the emergency vent handle is turned 45° CCW and pulled, windshield anti-fog hot air is automatically selected.

Anti-Fog Switch

The anti-fog switch allows the pilot to select a range of temperatures for anti-fog air. The switch is electrically held in the HOT or COLD position and automatically resets to NORMAL when electrical power is lost.

NORMAL	Anti-fog air is supplied at normal temperature.
HOT	Anti-fog air is hotter than normal.
COLD	Anti-fog air temperature is controlled by the cockpit temperature control knob and may be varied from colder than normal to hotter than normal.

The position of this switch is at the pilot's discretion for his own comfort. If the switch is in the COLD position and a condition where windshield fogging is anticipated, select HOT.

WINDSHIELD ANTI-ICE SWITCH

The windshield anti-ice switch on the ECS panel controls hot airflow from the primary heat exchanger to the windshield exterior anti-ice nozzle.

ON	Activates the windshield anti-ice system
OFF	Deactivates the windshield anti-ice system.

CAUTION

Use of the windshield anti-ice system under non-icing conditions may damage the windshield.

WINDSHIELD HOT Caution Light

The WINDSHLD HOT caution light comes on when windshield anti-ice air temperature is excessive. It does not detect the temperature of the windshield and may not warn of impending windshield damage.

BOARDING STEPS

A boarding steps position indicator on the left canted bulkhead will display UP when the steps are retracted and DOWN when the steps are extended. The retractable boarding steps are released by pressing one of two release buttons. One release button is located inside the top kick-in step and another release button is located on the retractable step door. Pressing either button allows the steps to free fall to the down position. See figure 2-2.

CANOPY SYSTEM

The cockpit area is enclosed by a clamshell type canopy and an impact resistant windshield. Refer to foldout section for ejection seat illustration. The main components of the canopy system are a hydraulic actuator which provides manual and powered operation of the canopy, a locking mechanism, and a pyrotechnic canopy remover for emergency jettison. Latches on the canopy frame and along the lower edge of the canopy engage fittings on the cockpit sill structure to lock the canopy to the fuselage. An inflatable seal, installed around the edge of the canopy frame, retains cockpit pressure when the canopy is locked.

NORMAL CANOPY SYSTEM

For normal canopy operation, an internal canopy control handle (figure 1-58) is provided on the right side of the cockpit under the canopy sill in both cockpits. For operation of the canopy from outside the aircraft, an external canopy control handle is located on the left side of the aircraft below the canopy. The external canopy control handle duplicates operation of the internal canopy control handle. Canopy may not fully close with hydraulic pressure if ambient temperature is below 0°F. In this case, and after attempting to close the canopy mechanically, the pilot may assist the canopy in fully closing. With canopy down on the sills, and the internal control handle set to DOWN, grab hold of the two handles on the forward arch of the canopy and shove the canopy forward. Once the canopy moves fully forward, the control handle may be moved to the LOCKED position after waiting 10 seconds. An accumulator provides hydraulic power for powered operation of the canopy (2-1/2 to 3 cycles) when utility hydraulic pressure is not on the aircraft. Accumulator may not fully close the canopy if the ambient temperature is outside the 30°F thru 110°F range. A hand pump is installed in the nose wheelwell to operate the canopy with hydraulic pressure off the aircraft and accumulator hydraulic pressure depleted. The canopy can be operated without accumulator pressure by moving the external canopy control handle or one of the internal canopy handles to the UP or DN position, as desired, and then operating the hand pump in the nose wheelwell. For ground egress with accumulator hydraulic pressure depleted, the canopy can be opened by placing the internal canopy control handle to UP and then pushing up on the canopy. A nitrogen charge in the canopy actuator aids in opening the canopy manually. The internal and external canopy control handles are used to lock the canopy mechanically by placing the handle to LOCKED from the DN position, once the canopy is fully closed.

Internal Canopy Control Handle

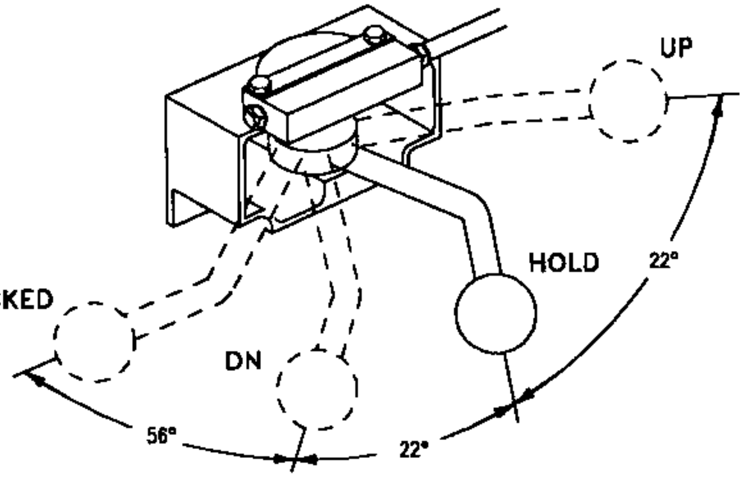
The canopy control handle has four positions: LOCKED, DN, HOLD and UP. The front and rear handles are interconnected and follow each other in position when one handle is moved.

LOCKED	Causes a hydraulic block, therefore it is necessary to have the canopy against the windscreen before placing the handle in LOCKED. Placing the handle to the LOCKED position mechanically locks the canopy.
UP	Raises canopy to maximum open position. If selected from the LOCKED position, the canopy will first unlock, then move 1.5 inches aft before rising.
DN	Lowers canopy full down, then forward against the windscreen.
HOLD	Creates a hydraulic lock and stops the canopy at any point in the open or close cycle. This position may be used when the canopy is to be left open for an extended period.

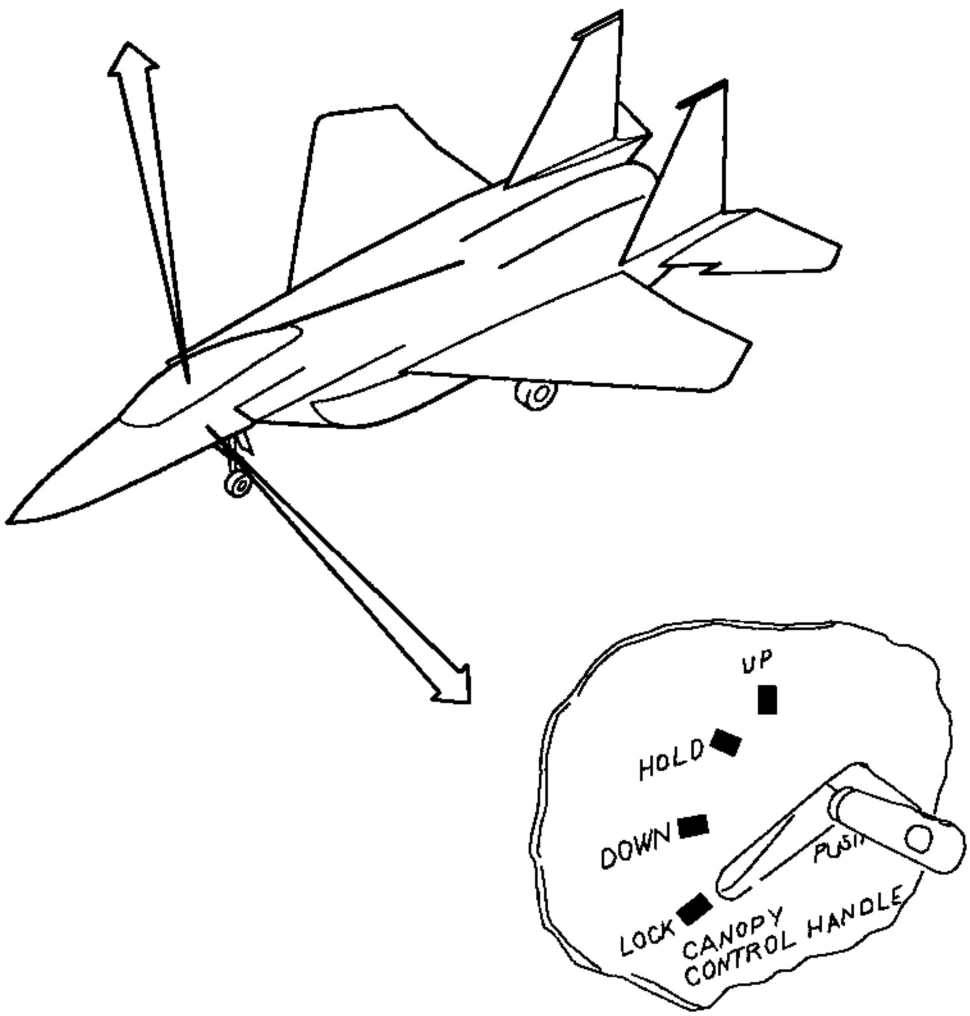
External Canopy Control Handle

The external canopy control handle (figure 1-58) is normally stowed flush with the fuselage on the left side of the aircraft below the canopy. When the handle retaining pushbutton is pushed, the handle springs outboard approximately 2 inches from the fuselage. After rotating the handle full aft to the UP position, canopy will move slightly aft and start opening. To stop the canopy at any point in its opening travel rotate the handle slightly forward from the full aft position to the HOLD position. To close the canopy rotate the handle forward to the DOWN position. The LOCKED position mechanically locks the canopy and produces a hydraulic block in the canopy system. The handle is stowed flush with the fuselage by manually pushing inboard until the retaining latch is engaged.

CANOPY CONTROL HANDLES



INTERNAL CANOPY CONTROL HANDLE



EXTERNAL CANOPY CONTROL HANDLE

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Figure 1-58

CANOPY UNLOCKED Warning Lights

The CANOPY UNLOCKED warning light on the upper right of the instrument panel in each cockpit comes on whenever the canopy is unlocked or the canopy actuated initiator lanyard is disconnected.

Canopy Actuated Initiator Firing Indicator

The canopy actuated initiator firing indicator is located on the bulkhead in back of the seat in the front cockpit. The indicator is a gray cylinder-like housing containing an orange spiral spring which extends when the canopy actuated initiator is fired. Refer to foldout section for ejection seat illustration.

EMERGENCY CANOPY SYSTEM

For canopy jettison, a pyrotechnic canopy remover operates independently of the normal canopy system. The canopy remover, behind the front seat, is designed to safely jettison the canopy only from the closed and LOCKED position. When the ejection control handle, or either an internal or external canopy jettison handle is pulled, the remover mechanically unlocks and jettisons the canopy. Improperly placed or unsecured items near the canopy remover may actuate the canopy jettison bellcrank causing loss of the canopy.

Internal Canopy Jettison Handle

A black and yellow striped canopy jettison handle is located under the left canopy sill just aft of the instrument panel in both cockpits. Depressing an unlock button on the inboard side of the handle, and pulling the handle aft fires the canopy jettison system. The handle, once pulled to the fired position, is locked in the fired position where it remains locked until the handle and initiator are replaced.

External Canopy Jettison Handle

The external canopy jettison handle is a T-handle located within an access door just below and forward of the external canopy control handle, and is used to jettison the canopy from outside the aircraft (refer to airplane entry/aircrew extraction, section III). After pushing a release button to open the access door, the handle and its lanyard is played out 8 feet from the aircraft and then pulled. This fires the external canopy jettison system.

EJECTION SEAT SYSTEM

An ejection seat is installed in each cockpit and a sequencing system is provided which allows for selection of various single or dual ejection options. See command selector valve below. Once ejection is initiated, whether dual or single, each ejection seat is a fully automatic catapult rocket system. Three ejection modes are automatically selected. Refer to figure 1-59. Mode 1 is a low speed mode during which the parachute is deployed almost immediately after the seat departs the aircraft; Mode 2 is a high speed mode during which a drogue chute is first deployed to slow the seat, followed by the deployment of the parachute; Mode 3 is a high altitude mode in which the sequence of events is the same as mode 2 except that man-seat separation and deployment of the parachute is delayed until a safe altitude is reached.

Controls are provided to adjust seat height and lock shoulder harness. Refer to foldout section for ejection seat illustration. The ejection seat is equipped with primary and redundant ejection systems and a canopy breaker. The primary and redundant systems are isolated and independent of each other. Both ejection systems are initiated simultaneously when an ejection control handle is pulled. However, a built-in delay in the redundant system allows the primary system to work before the redundant system starts. The time delay prevents any interference of primary and redundant system ejection sequencing. Also, if the primary system fails prior to canopy jettison, the redundant system will jettison the canopy and eject the seat. If both the primary and redundant system fail to jettison the canopy, the redundant system will still fire the seat catapults and with the addition of the seat mounted canopy breaker, provide through the canopy ejection. The redundant system will eject the seat regardless of canopy position (open, closed or in-between).

CAUTION

If the canopy actuated disconnect lanyard becomes disconnected and an ejection is later attempted for any reason, the primary mode ejection sequence will fail after canopy separation. This will result in a short time delay (2 seconds for front seat and 1.5 seconds for rear seat).

On aircraft with SEAWARS installed, an automatic backup method is incorporated to release the parachute canopy when landing in sea water. SEAWARS consist of two releases mounted outboard of the Koch connectors on the parachute risers. Each release contains an electronics package (sensor), battery, cartridge, and canopy release fitting. Immersion in sea water activates the sensors which mechanically release the parachute risers from the aircrew's restraint harness. With SEAWARS installed, the normal procedures for connecting and releasing the Koch fitting are the same.

Command Selector Valve

A command selector valve is provided in the rear cockpit to select the desired ejection sequence to be initiated from the rear cockpit, or provide for single ejection for solo flight. Positioning is accomplished by pulling full aft then turning to the desired position. To release from aft initiate, pull then turn clockwise. Solo position requires use of a collar. Refer to foldout section for ejection seat system performance. The redundant system by-passes the command selector valve. However a built-in delay allows the primary system to work before the redundant system starts.

NORM (vertical)	Single rear seat ejection when initiated from the rear cockpit. Dual ejection (rear seat first) when initiated from the front cockpit.
AFT INITIATION (horizontal)	Dual ejection (rear seat first) when initiated from either seat.
SOLO (45° CCW)	Ejection from the front seat is immediate. The aft seat will also eject after the forward crewmember has ejected. However, if a failure occurs in the front seat primary system, the aft seat will be ejected by the redundant system first followed by ejection of the forward crewmember.

WARNING

If a failure occurs in the primary system the front seat will not eject unless the forward crewmember initiates his own ejection.

There are potential failure modes which will result in ejection of the forward crewmember first, by the primary mode, followed by ejection of the aft crewmember, by the redundant system. This situation is not optimum since injury to the rear seat occupant can occur; but it does provide for a means of escape that was not previously available.

Seat Adjust Switch

The seat adjust switch is in each cockpit on the left side of the cockpit above the console. The switch has the three positions of UP and DN and is spring-loaded to the center off position. Maximum vertical seat travel is 5 inches. The seat adjustment actuator does not cut off power to the electric motor at either limit of travel. Release the seat adjust switch when the seat reaches an upper or lower limit to prevent damage to the actuator motor.

Ejection Control Handles

There are two ejection control handles, one mounted on each forward upper side of the seat. The controls are interconnected so that actuation of either control initiates ejection. The ejection control pull force is approximately 45 pounds. Handles need only to be raised approximately 2 inches (25°), as measured from the forward edge of the control handles, to initiate ejection. Handle over-center locks at approximately 4 inches (45°) of travel.

Ejection Controls Safety Lever

The ejection controls safety lever is located immediately aft of the left ejection control handle. With the safety lever rotated up and forward both ejection control handles are mechanically locked, and a yellow and black checkerboard placard is displayed to the seat occupant reading EJECTION CONTROLS LOCKED. With the safety lever rotated aft and down, the ejection control handles are unlocked and a black and white placard is displayed reading EJECTION CONTROLS ARMED.

Shoulder Harness Inertia Reel

Shoulder harness restraint is provided by a dual strap shoulder harness inertia reel mounted in the seat below the headrest pads. Automatic locking of the inertia reel occurs when the reel senses excessive rate of strap payout. Manual locking and unlocking of the reel is controlled by the shoulder harness lock/unlock handle.

Shoulder Harness Lock/Unlock Handle

The inertia reel control handle on the left arm rest of the seat is spring tensioned and has two positions.

LOCKED	The inertia reel prevents the reel straps from being extended, and ratchets any slack in the straps back into the reel. This prevents the crewmember from leaning forward without first unlocking the reel.
UNLOCKED	The reel allows the crewmember to lean forward. The inertia portion of the reel will automatically lock the reel when it senses excessive rate of strap pay out. Once the reel has locked automatically, the locked condition must be released by cycling the control lever to locked and back to unlocked.

Restraint Release System

The crewmember is held in the ejection seat by a lap belt and the shoulder harness straps. In addition, two survival kit retaining straps connect the torso harness to the survival kit stored under the rigid seat pan. These straps are not intended for crewmember restraint. During ejection, the lap belt, inertia reel straps and seat pan release are automatically released by the recovery sequencer prior to seat-man separation.

Emergency Manual Chute Handle

The emergency manual chute handle is on the right arm rest aft of the ejection control handle. With the seat in the launch rails, the handle is locked and cannot be pulled out of its stowed position. Once the seat is clear of the launch rails the handle can be used to ballistically deploy the recovery parachute and to release the harness restraints. The handle must be pulled full travel (approximately 6 inches) to ensure that the harness restraints release.

Battery Window

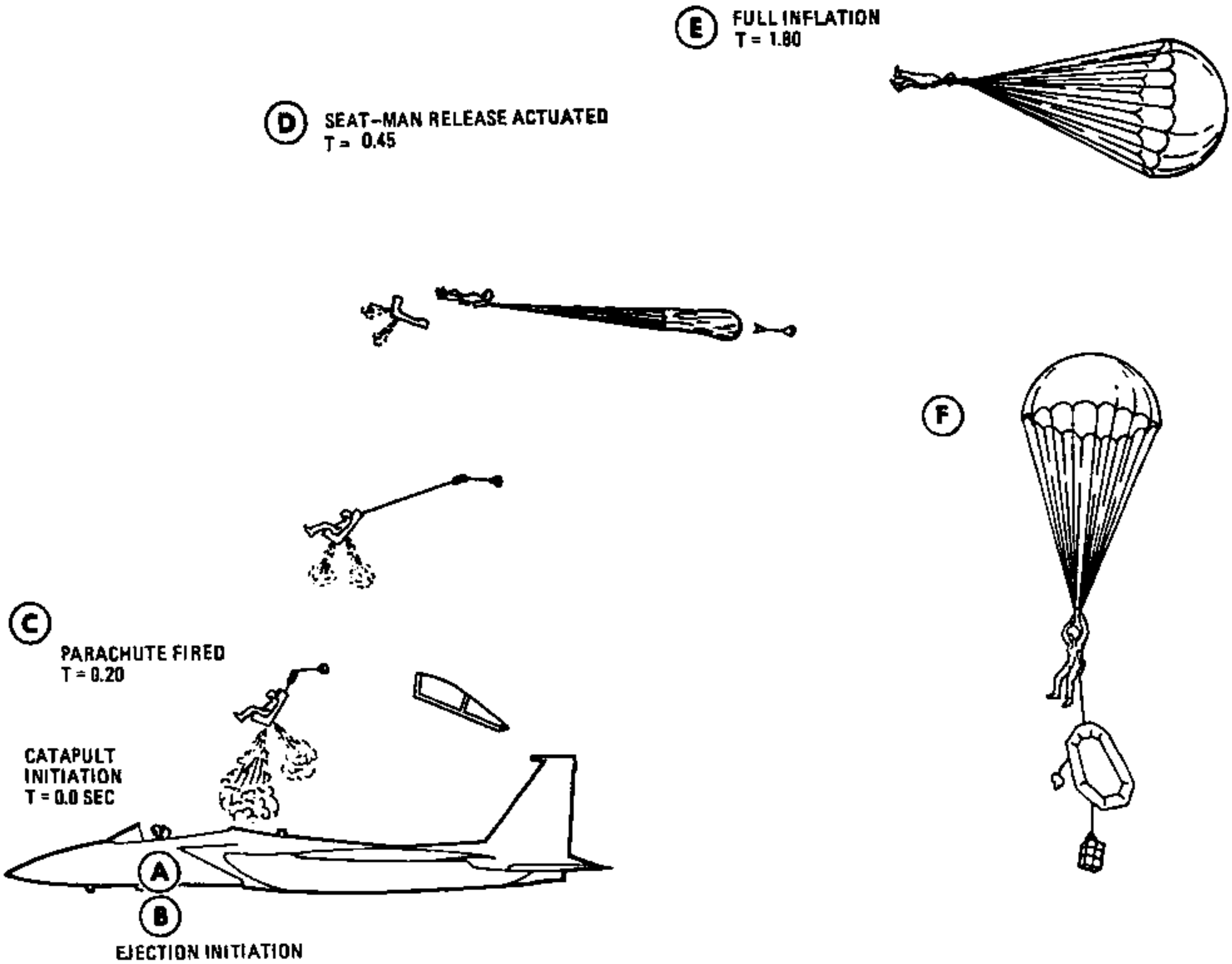
A battery window, a small circular hole on the right side of the seat forward of the seat rail, gives indication of the status of the seat sequencing system battery. If the battery is activated, a red plunger will puncture the white window.

Survival Kit

The survival kit consists of a fabric case which houses a life raft, rucksack, and an auxiliary container. The life raft and rucksack are attached to the survival kit case by a dropline. The auxiliary container, which is for storage of items to be retained with the crewman, is secured inside the survival kit. An AN/URT-33C radio beacon is installed in the kit. The survival kit stows in the seat bucket beneath the rigid seat pan. The pan pivots for withdrawal of the kit during seat-man separation. The kit is attached to the crewmember's harness by attachment fittings on the kit retaining straps. A survival kit auto/manual deployment selector, located on the inside of the forward right thigh support of the kit, permits the crewmember to select either manual or automatic deployment of the kit.

ACES II EJECTION SEQUENCES

MODE 1 OPERATION 150 KNOTS



(A) EJECTION CONTROL HANDLE PULLED TO ACTUATE SEAT–MOUNTED GAS INITIATOR AND:
- POWERED INERTIA REEL RETRACTS SHOULDER STRAPS
- CANOPY REMOVER FIRES.
- CANOPY JETTISONS AND PULLS LANYARD TO FIRE CANOPY ACTUATED INITIATOR.
- IFF SWITCH ACTUATED.

NOTE

IN A DUAL EJECTION; THERE IS A 0.4 SECOND DELAY BETWEEN REAR AND FRONT SEAT CATAPULT INITIATION

(B) ROCKET CATAPULT FIRES, SEAT MOVES UP RAILS AND:
- RECOVERY SEQUENCER POWER SUPPLY ENERGIZED.
- COMMUNICATIONS AND SHIPS OXYGEN LINES DISCONNECT.
- EMERGENCY OXYGEN IS TRIPPED.
- RECOVERY SEQUENCER SWITCH TRIPPED BY STRIKER PLATE.
- STAPAC PITCH CONTROL SYSTEM INITIATED.

(C) PARACHUTE DEPLOYMENT MORTAR FIRES AS SEAT CLEARS AIRCRAFT.

(D) RECOVERY SEQUENCER INITIATES HARNESS RELEASE ACTUATOR AND:
A. LAP BELT AND SHOULDER HARNESS STRAPS RELEASE FROM SEAT STRUCTURE.
B. PILOT IS SEPARATED FROM SEAT.
C. RADIO BEACON INITIATED (IF AUTO SELECTED).

(E) PARACHUTE FULLY INFLATED

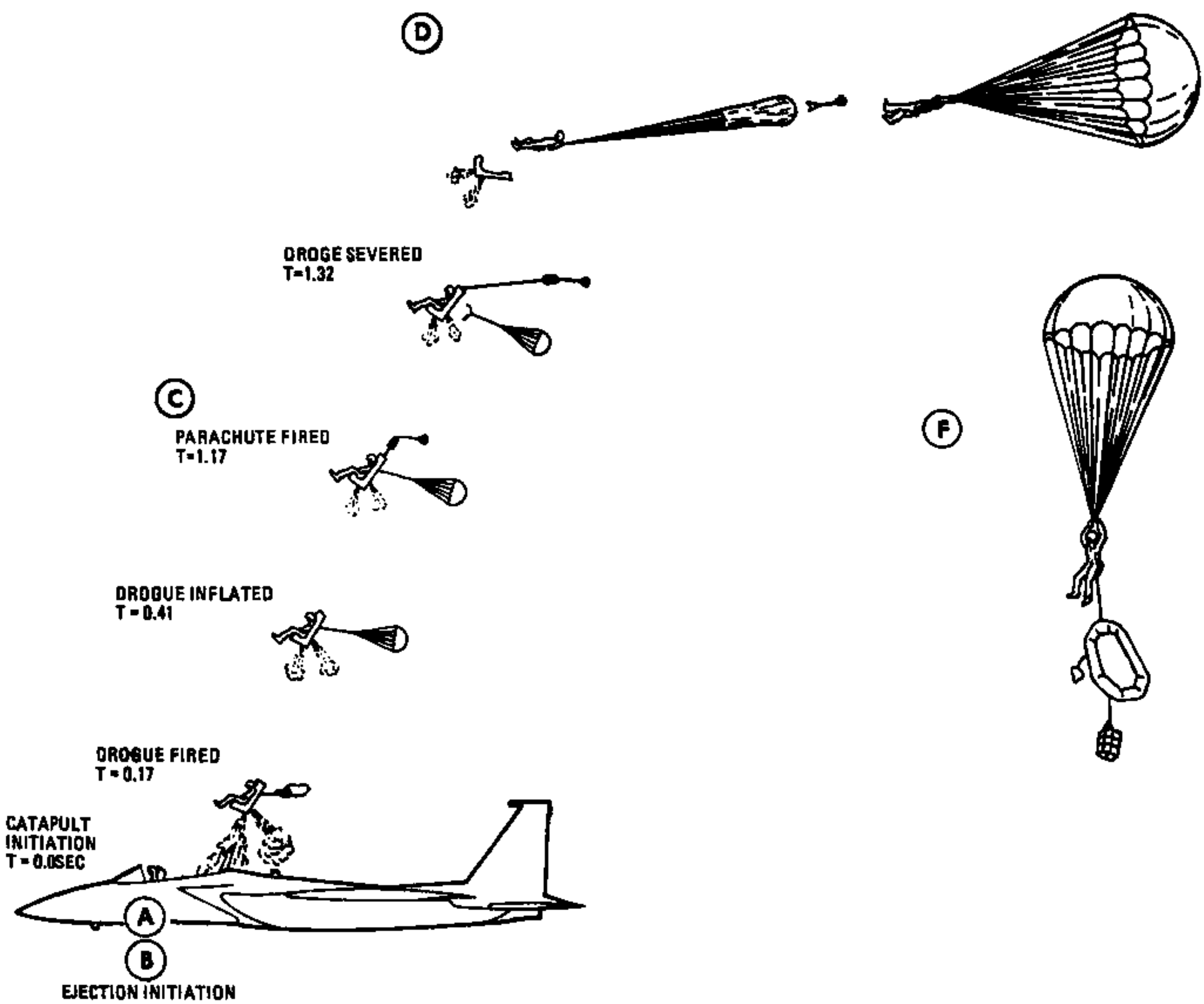
(F) SURVIVAL KIT DEPLOYED (PROVIDED AUTO SELECTED ON DEPLOYMENT SELECTOR

15E-1-(53-11A

Figure 1-59 (Sheet 1 of 2)

EJECTION SEQUENCES

MODE 2 OPERATION 600 KNOTS



NOTE

- TIMES INDICATED ARE AFTER CATAPULT FIRING. TO DETERMINE TOTAL TIME, A TIME FACTOR FOR THE PERIOD BETWEEN EJECTION HANDLE INITIATION AND CATAPULT FIRING MUST BE ADDED TO THE FIGURES SHOWN. THIS TIME INTERVAL REPRESENTS ESSENTIALLY THE TIME IT TAKES TO REMOVE THE CANOPY AFTER THE EJECTION HANDLE IS PULLED, AND IS APPROXIMATELY 0.3 SECONDS AT ZERO AIRSPEED AND BECOMES SLIGHTLY LESS AS AIRSPEED INCREASES. THERE IS AN ADDITIONAL DELAY OF 0.4 SECONDS BETWEEN REAR AND FRONT SEAT FIRING FOR DUAL EJECTION.
- IN MODE 3, WHICH IS DESIGNED FOR HIGH ALTITUDE CONDITIONS, THE DROGUE IS DEPLOYED AS IN MODE 2, BUT MAN–SEAT SEPARATION AND DEPLOYMENT OF THE PARACHUTE ARE DELAYED UNTIL THE PROPER ALTITUDE IS ENCOUNTERED.

OPERATING MODE ENVELOPES

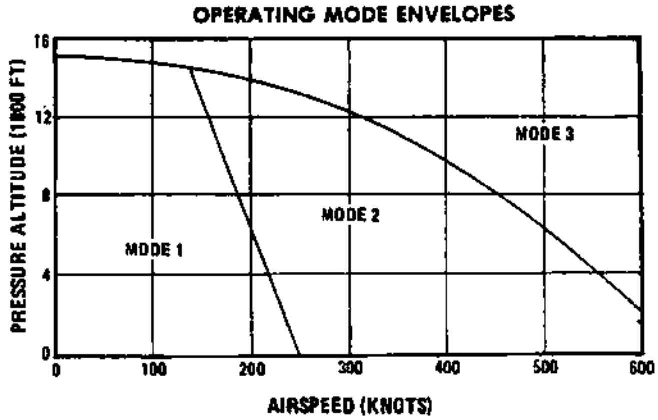


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Figure 1-59 (Sheet 2)

A (Forward)	The kit automatically deploys after man-seat separation.
M (Aft)	To deploy the kit after man-seat separation the survival kit release handle on the right rear of the kit must be pulled.

AN/URT-33C Radio Beacon Selector Switch

Access to the radio beacon auto/manual selector is gained through a cutout in the front of the seat pan. The selector is a rocker switch. When the left arm (as viewed by the seat occupant) is pressed, MAN is selected. When the right arm is pressed, AUTO is selected.

MAN	Radio beacon will not activate at man-seat separation.
AUTO	Radio beacon activates at man-seat separation.

STORES JETTISON SYSTEMS

There are two methods used to jettison stores from the aircraft: emergency jettison and selective jettison. Emergency jettison is provided by the emergency jettison button. Selective jettison is provided by the select jettison knob/button (A/A, A/G and COMBAT positions only) in conjunction with the MPD/MPCD.

WARNING

Emergency jettison of any stores or selective jettison (A/G or COMBAT) of A/G stores may release stores at a Minimum Release Interval (MRI) less than the MRI programmed for normal weapon release, possibly causing store-to-store and/or store-to-aircraft collision.

Regardless of master arm switch position, when either the emergency jettison or select jettison button (in COMBAT, A/A or A/G position only) is pressed, all arming solenoids are automatically deenergized before jettison and all stores are jettisoned unarmed.

JETTISON AND RELEASE SAFETY SWITCHES

Landing Gear Control Handle

When the landing gear handle is down, the selective jettison controls are deenergized unless the armament safety switch is in the OVERRIDE position. This control has no function in the emergency jettison control circuit.

Armament Safety Switch

The armament safety switch is located on the left console outboard of the anti-g valve. The OVERRIDE position of the armament safety switch bypasses the landing gear handle interlock. Aircraft power must be applied to maintain the OVERRIDE position. This control has no function in the emergency jettison control circuit.

SAFE	Normal circuitry is used.
OVERRIDE	The switch is solenoid held until electrical power is removed, the landing gear handle is placed UP, or the switch is placed in SAFE.

EMERGENCY JETTISON BUTTON

The emergency jettison button is located on the center of the front instrument panel to the left of the MPCD. This button, when pressed, simultaneously jettisons all carted pylons (stations 2, 5, and 8) and all carted stores (CFT stations 1 thru 6) and all MRMs. Although the button is spring-loaded to the normal position, a means is provided to determine that the button is not stuck in the jettison position. In the normal position only the color black on the inside lip of the button guard can be seen above the button. If the button is stuck in the jettison position, yellow color can be seen in the switch guard below the black color.

CAUTION

The emergency jettison button is hot when electrical power is on the aircraft.

SELECT JETTISON KNOB/BUTTON

When pressed, the select jettison button jettisons stores depending on the knob positions described below:

OFF	Removes power from the selective jettison button.
COMBAT	Selective jettison button first press initiates combat jettison program 1. Second press initiates combat jettison program 2.
A/A	Selects air-to-air selective jettison.
A/G	Selects air-to-ground selective jettison.
ALTN REL	Used for nuclear weapons release. This is not a jettison position. Refer to TO 1F-15E-25-1.
MAN RET	This is not a jettison position. Refer to TO 1F-15E-34-1-1.
MAN FF	This is not a jettison position. Refer to TO 1F-15E-34-1-1.

AIRCRAFT SERVICING DIAGRAM

The aircraft servicing diagram is shown in figure 1-60.

PROGRAMMABLE ARMAMENT CONTROL SET

Refer to TO 1F-15E-34-1-1 for description and operation of the PACS.

TACTICAL ELECTRONIC WARFARE SYSTEM (TEWS)

Refer to TO 1F-15E-34-1-1-1 for description of the TEWS or CMD data.

INTERFERENCE BLANKER SYSTEM (IBS)

The interference blanker system prevents or reduces electromagnetic interference between TEWS and other aircraft systems which utilize radio frequency (rf) transmitters and receivers.

RADAR SYSTEM

Refer to TO 1F-15E-34-1-1 for description and operation of the Radar System.

LANTIRN NAVIGATION POD

Refer to TO 1F-15E-34-1-1 for description and operation of the LANTIRN navigation pod.

LANTIRN TARGETING POD

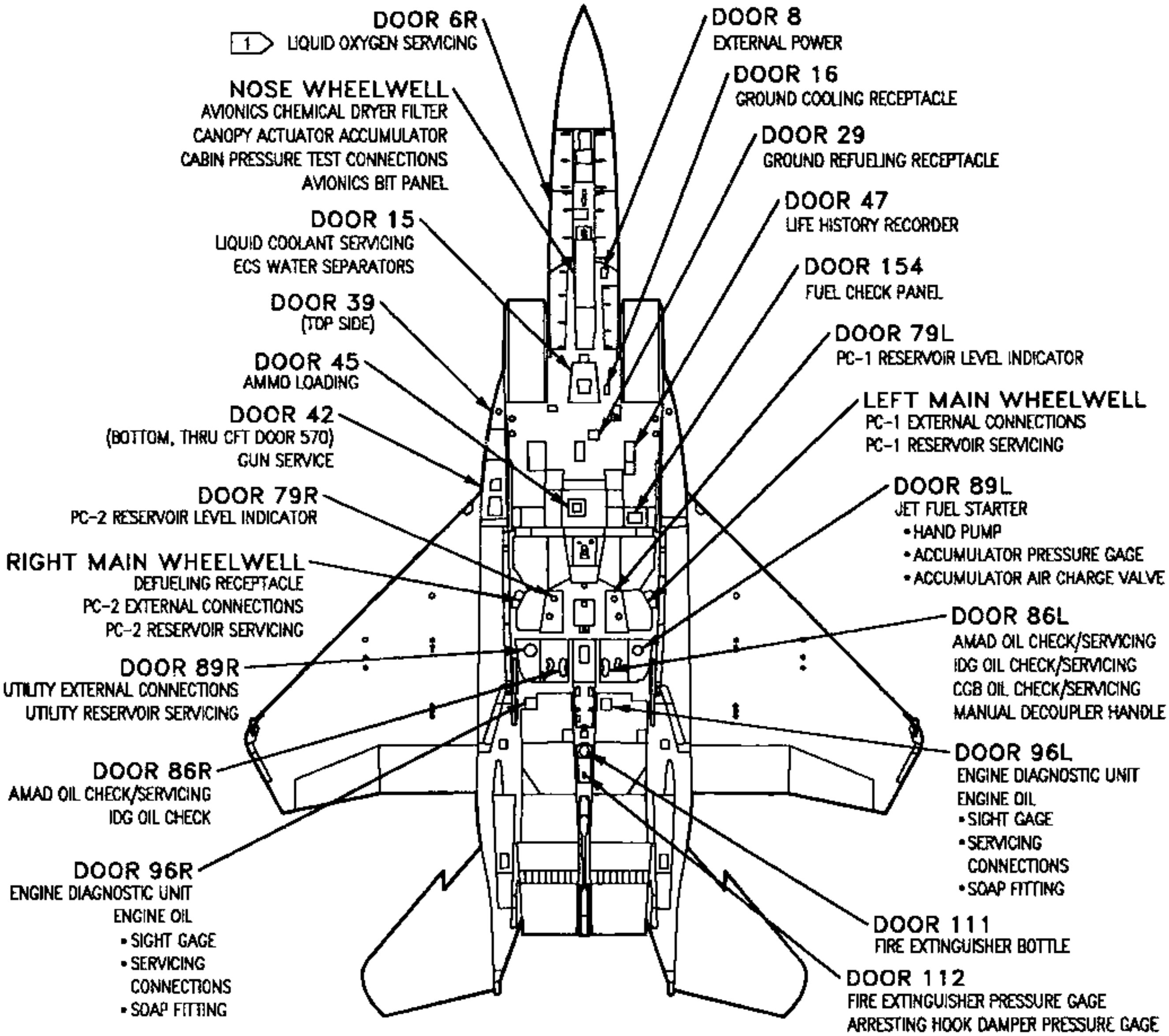
Refer to TO 1F-15E-34-1-1 for description and operation of the LANTIRN targeting pod.

WEAPON SYSTEMS

Refer to TO 1F-15E-34-1-1 for a detailed and operational description of the following systems.

a. Aircraft Weapons Capabilities
b. AAI System
c. Stores Jettison System - Combat Programming
d. Weapon Employment
e. Suspension Equipment
f. Combat Weapons
g. Training Weapons

SERVICING DIAGRAM



SPECIFICATIONS		USAF	NATO
FUEL	PRIMARY	MIL-T-5624,JP-4	
	ALTERNATE (REFER TO SECTION V)	MIL-T-5624, JP-5 MIL-T-83133, JP-8	F-43 F-44 F-34 F-35
EXTERNAL ELECTRICAL POWER	115±15 VAC, 400±30 Hz	A/M 32A-60A ONLY	
HYDRAULIC FLUID		MIL-H-5606 MIL-H-83282	H-515 H-537
1 OXYGEN	LIQUID	MIL-O-27210	

SPECIFICATIONS		USAF	NATO
OIL	TURBINE ENGINE CENTRAL GEAR BOX INTERGRATED DRIVE GENERATOR AMAD	MIL-L-7808 (NO ALTERNATE)	O-148
NITROGEN	GASEOUS	BB-N-411 GRADE A, TYPE I OR II	
OIL	M61A1 GUN	MIL-L-46000	
EXTINGUISHING AGENT	FIRE EXTINGUISHER BOTTLE	HALON-1301	

1 F-15E 86-0183 THRU 90-0232 WITH LOX

15E-1-(58-1)33-CATI

Figure 1-60

SECTION II

NORMAL PROCEDURES

TABLE OF CONTENTS

PREPARATION FOR FLIGHT

WEIGHT AND BALANCE

For maximum gross weight limitations, refer to section V, Operating Limitations. For weight and balance information refer to the individual aircraft's DD Form 365-4 (FORM F), section V, Operating Limitations and the handbook of Weight and Balance Data, TO 1-1B-40.

NOTE

Some aircrew procedures are separated into front cockpit and rear cockpit. Other procedures are combined and are coded for applicable crewmember action. Items coded (BOTH) are applicable to both the pilot and weapon system officer. Items coded (W) are applicable to the weapon system officer. Items coded (P) are applicable to the pilot only. Items not coded, (blank) may be applicable to either.

PREFLIGHT CHECK

1. Check Form 781 for aircraft status and release.

NOTE

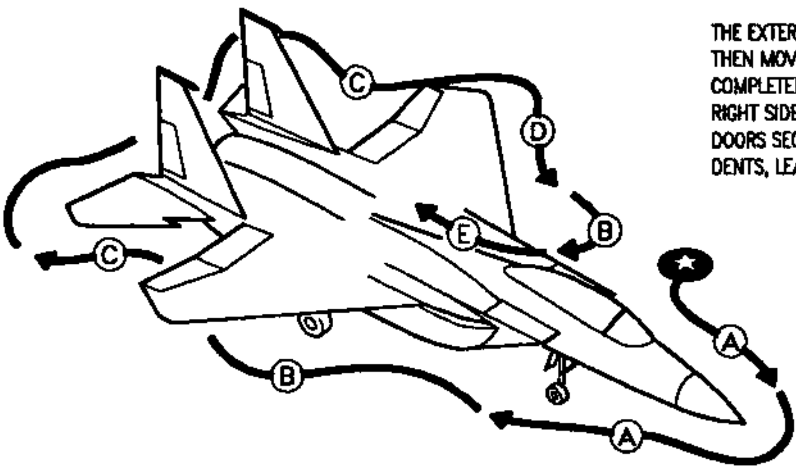
If aircraft forms indicate the CC has been reprogrammed or replacement of the radar power supply (610), radar antenna (031), INU or the CC, an INS precision velocity update (PVU) is required to reduce pointing errors.

2. Takeoff and landing data - COMPUTE (if required)

EXTERIOR INSPECTION

1. Check general condition. Refer to figure 2-1. Check aircraft exterior for abnormalities which could affect flight (e.g., cracks or leaks). Check all sensors (AOA, pitot/static, inlet ice, total temperature). The ground intercom compartment door will be open. The hydraulic and JFS accumulator circular access panels (4) may be open for after start servicing. Check all other doors and panels closed and fastened. Check intakes clear of foreign objects. Check all external/internal inlet ramps in up position. Check tires for condition and inflation. Check gear struts for extension. Check landing gear pins (3), arresting hook pin, and canopy strut removed.

EXTERIOR INSPECTION



THE EXTERIOR INSPECTION STARTS AT THE COCKPIT STEPS THEN MOVES FORWARD AND AROUND THE AIRCRAFT. IT IS COMPLETED AT THE TOP OF THE FUSELAGE. THE LEFT AND RIGHT SIDES ARE THE SAME AND LISTED ONCE. CHECK DOORS SECURE. BE ALERT FOR LOOSE FASTENERS, CRACKS DENTS, LEAKS AND OTHER GENERAL DISCREPANCIES.

WARNING

MAKE SURE -229 ENGINES HAVE BEEN SHUTDOWN FOR 10 MINUTES BEFORE DOING INSPECTION

(A) NOSE

1 UNDERSIDE

A. NLG TIRE, WHEEL AND STRUT CONDITION
B. NLG DOORS & LINKAGE SECURE, GROUND LOCK REMOVED
C. ANTENNA CONDITION

2 FORWARD FUSELAGE

A. PITOT-STATIC PROBE CONDITION (2)
B. AOA PROBE SECURE CONDITION (2)
C. ENGINE INTAKE DUCT CLEAR (2)
D. CFT LOCKOUT CHECKED (2)

(B) CENTER FUSELAGE AND WING

1 WING

A. EXTERNAL STORES & PYLONS SECURE
B. NAVIGATION & FORMATION LIGHTS CONDITION
C. AILERON & FLAP CONDITION
D. FUEL DUMP/VENT MAST CONDITION

(C) AFT FUSELAGE

1 GENERAL AREA

A. ARRESTING HOOK
B. STABILATOR CONDITION
C. RUDDER CONDITION
D. ANTENNA COVER CONDITION (VERTICAL STABILIZER)
E. NAVIGATION & FORMATION LIGHTS CONDITION
F. ENGINE EXHAUST AREA CONDITION

(D) UNDERSIDE OF FUSELAGE

1 GENERAL AREA

A. Q STORES & PYLON SECURE
B. CFT
C. LANTIRN PODS

2 MAIN GEAR AND WHEELWELL

A. WHEEL, TIRE AND STRUT CONDITION
B. DOORS AND LINKAGE SECURE
C. GROUND LOCK REMOVED

(E) TOP OF FUSELAGE

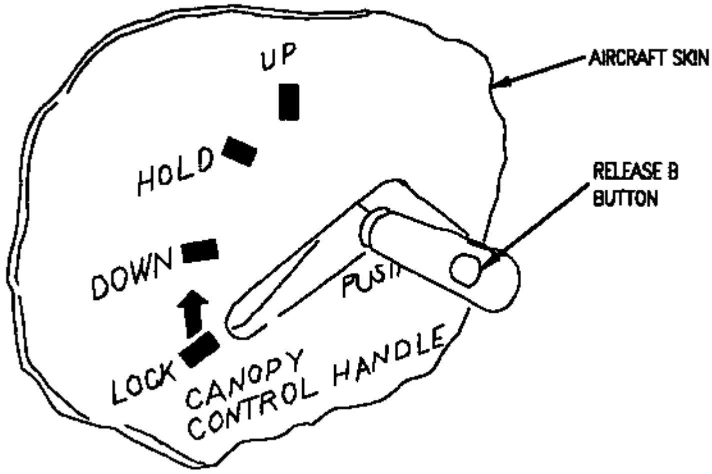
1 GENERAL AREA

A. SECONDARY HEAT EXCHANGER
B. EXHAUST COVER REMOVED

15E-1-(8-1)33-CATI

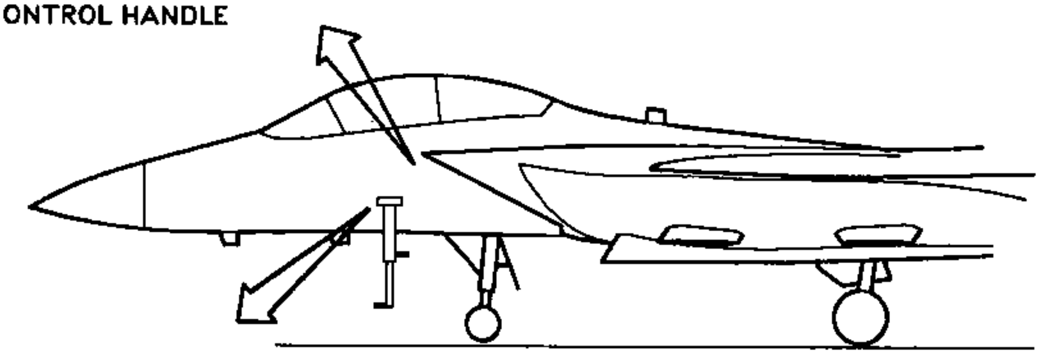
Figure 2-1

COCKPIT ENTRY



EXTERNAL CANOPY
CONTROL HANDLE

1. EXTEND CANOPY EXTERNAL CONTROL HANDLE BY PUSHING RELEASE BUTTON IN CENTER OF HANDLE.
2. TO RAISE CANOPY, ROTATE HANDLE AFT.
3. TO LOWER CANOPY, ROTATE HANDLE FWD.



CAUTION	STEP RELEASE BUTTON FLUSH WHEN LATCHED
FREE FALLING STEPS LOWER BY HAND	

THE RETRACTABLE STEPS ARE RELEASED BY PRESSING THE RELEASE BUTTON INSIDE THE TOP KICK-IN STEP, OR ON THE RETRACTABLE STEP DOOR, AFTER PRESSING THE BUTTON, THE STEPS ARE LOWERED BY HAND.

WARNING

HAVE ALL PERSONNEL CLEAR AREA BENEATH THE LADDER BEFORE DEPRESSING BUTTON.

15E-1-(52-1)44-CATI

Figure 2-2

BEFORE ENTERING FRONT COCKPIT

Refer to foldout section for ejection seat illustration.

1. Canopy initiator indicator - NOT FIRED
2. Ejection controls safety lever - LOCKED
3. Safety pins - REMOVED
   a. Canopy jettison handle pin
   b. Ejection seat safety pins (2)
4. Radio beacon auto/manual selector - AS DESIRED
5. Auto/manual seat kit deployment selector - AUTO
6. Emergency manual chute handle - FULLY DOWN
7. Seat hoses disconnect coupling - CHECK SECURE
8. Battery window - NO RED PIN SHOWING
9. Both pitot tubes - NO OBSTRUCTIONS
10. Emergency O_2 bottle indicator - CHECK FULL

For Solo Flight -

1. Command selector valve - SECURED IN SOLO POSITION
2. Rear cockpit - SECURED
   a. Ejection controls safety lever - LOCKED
   b. Aft radio beacon/radio selector - MANUAL
   c. Solo flight tie down strap - INSTALLED
   d. Map case cover - SECURED
   e. TGT FLIR - OFF
   f. Emergency landing gear handle - IN
   g. Emergency brake/steering handle - IN
   h. Circuit breakers - IN
   i. Arresting hook switch - UP
   j. Oxygen supply lever - OFF
   k. TEWS - AS REQUIRED
   l. CMD - AS REQUIRED
   m. RMR - CHECK INSTALLED OR INSERT
   n. Oxygen hose - SECURED TO STOWAGE FITTING
   o. Utility light - SECURED TO STOWAGE FITTING
   p. Canopy initiator - LANYARD ATTACHED, PIN REMOVED

FRONT COCKPIT INTERIOR CHECK

A thorough cockpit interior preflight shall be accomplished before each flight. The design features of the aircraft greatly simplify this task. Switch positions designated AS DESIRED allow pilot preference in switch/control positioning. AS REQUIRED indicates those switches that will differ with mission requirements. If no specific requirement exists, pilot preference may be used. Those avionics switches designated AS DESIRED or AS REQUIRED should be OFF for start.

CAUTION

Do not place any item on the glare shield, as scratching the windshield is probable.

1. Interior check - COMPLETE
   a. Harness and personal equipment leads - FASTEN
      Attach parachute risers to harness buckles. Attach survival kit and ensure straps are snug within the limits of personal comfort. Secure and firmly adjust lap belt. Connect oxygen, anti-g suit and communication leads. Check operation of shoulder harness locking mechanism.

WARNING

- After connecting the parachute risers to the harness, lift the locking lever on each Koch fitting and verify the actuating lever is full up and snug against the inner part of the locking lever. If the actuating lever will not seat properly, disconnect the release and use a different harness.
- Failure to adjust the survival kit straps to achieve a snug fit between the crewmember and kit may result in injury during ejection.
- Failure to properly stow/secure all loose articles may result in entanglement with cockpit controls, including ejection handles, which could cause inadvertent ejection.

Left Console -

a. Ground power panel - ALL SWITCHES AS DESIRED
b. Armament safety switch - SAFE
c. Emergency air refueling switch guard - DOWN

d. Integrated communications controls - AS DESIRED
   (1) Volume knobs - AS DESIRED
   (2) Crypto switch - NORM
   (3) MIC switch - ON
   (4) UHF antenna switch - AUTO
   (5) Cipher text switch - AS REQUIRED
   (6) Mode 4 selector switch - AS REQUIRED
   (7) Mode 4 reply switch - AS DESIRED
   (8) IFF master switch - AS REQUIRED
e. EWWS enable switch - OFF, GUARD DOWN
f. IFF antenna switch - BOTH
g. Sensor control panel - ALL SWITCHES OFF
h. Exterior lights panel - ALL SWITCHES AS REQUIRED
i. Flyup enable switch - ARMED, GUARD DOWN

WARNING

The red cover guard on the flyup enable switch can be down with the switch in either position. Make sure the switch is in the proper position.

j. NCTR enable switch - AS REQUIRED
k. V-MAX switch - COVER CLOSED AND SAFETY WIRED
l. Flap switch - UP
m. Friction lever - AS DESIRED
n. Throttles - OFF
o. Fuel control panel - SET
   (1) Fuel dump switch - NORM
   (2) Wing switch - AS REQUIRED
   (3) Center switch - AS REQUIRED
   (4) Conformal tank switch - STOP TRANS
   (5) Slipway switch - CLOSE
   (6) Conformal tank emergency transfer switch - AS REQUIRED
   (7) External transfer switch - WING/CTR (AS DESIRED with CFTs)
p. Nuclear consent switch - SAFE (COVER FULLY CLOSED)
q. CAS switches - ON
r. TF COUPLE switch - OFF
s. Miscellaneous control panel - SET
   (1) Anti-skid switch - NORM
   (2) Inlet ramp switches - AS REQUIRED
   (3) Roll ratio switch - AUTO
   (4) Landing/taxi light switch - OFF
t. Canopy jettison handle - FORWARD
u. Emergency landing gear handle - IN
v. Arresting hook switch - UP

Instrument Panel -

a. Landing gear handle - DOWN
b. Pitch ratio switch - AUTO
c. Master arm switch - SAFE
d. Select jettison knob - OFF, BUTTON NOT PRESSED
e. Fire lights - NOT PRESSED
f. Fire test/extinguisher switch - OFF
g. HUD control panel - AS REQUIRED
h. Emergency jettison button - NOT PRESSED
i. Emergency brake/steer handle - IN
j. Rudder pedals - ADJUST

WARNING

To prevent injury to lower leg, make sure feet are on rudders before pulling the rudder adjust knob.

k. DTM - INSERTED
l. Circuit breakers - IN
m. JFS handle - IN
n. Holding brake switch - OFF

Right Console -

a. Emergency vent handle - IN AND VERTICAL
b. (LOX) Oxygen system - CHECK AND SET
   Pressure - 55 to 120 psi
   Regulator - CHECK
   (1) Oxygen supply lever - FULLY ON
       It is possible for the oxygen supply lever to stop at an intermediate position between OFF and ON. Assure the lever is all the way ON.
   (2) Emergency lever - NORMAL
   (3) MASK - ON
       Breath normally for three cycles and check flow indicator operation. Hold breath, all flow should stop and the indicator should show no flow (black). A white indicator indicates a leak which must be corrected before flight.
   Indicator - CHECK
   (4) Diluter lever - 100%

(5) Emergency lever - EMERGENCY
(6) Oxygen flow - CHECK (Return diluter and emergency levers to NORM)
Connections - CHECK
Emergency Oxygen - CHECKED
(7) Pressure - CHECK
(8) Actuating ring - STOWED and CHECKED

b. (MSOGS) Oxygen system - CHECK AND SET
Pressure - 20 to 450 psi
If MSOGS BOS pressure is below 20 psi, breathing may be restricted
Regulator - CHECK
(1) Oxygen supply lever - FULLY ON
(If breathing from BOS is required) It is possible for the oxygen supply lever to stop at an intermediate position between OFF and ON. Make sure the lever is all the way ON. If BOS is empty, select NORM on diluter level during engine start. Selection of 100% may result in a brief period of breathing supply restriction during MSOGS power-up BIT.
(2) Emergency lever - NORMAL
(3) Diluter lever - NORM
(4) MASK - ON
Breathe normally for three cycles and check flow indicator operation. Hold breath, all flow should stop and the indicator should show no flow (black). A white indicator indicates a leak which must be corrected before flight. If BOS is available, aircrew may breathe BOS gas mixed with cabin air. If no BOS gas is available, aircrew may breathe cabin air through the regulator with moderate restriction.
Indicator - CHECK, if BOS > 20 psi
(5) Diluter level - 100%
(6) Emergency lever - EMERGENCY
(7) Oxygen flow - CHECK
Connections - CHECK
Emergency Oxygen Bottle - CHECK
(8) Pressure - CHECK
(9) Actuating ring - STOWED and CHECKED

CAUTION

Do not lift the regulator toggle switch when switching regulator from OFF to ON or ON to OFF. Damage to the regulator switch will result.

c. Anti-ice switches - SET
(1) Engine heat switch - OFF
(2) Pitot heat and windshield switches - OFF

d. Engine control panel - SET
(1) Generator switches - ON
(2) Emergency generator switch - AUTO
(3) ENG CONTR switches - ON
(4) JFS starter switch - ON
(5) Engine master switches - ON
(6) EXT PWR switch - AS REQUIRED

e. Air conditioning control panel - SET
(1) Temperature control switch - AUTO
(2) Air source knob - BOTH
(3) Air flow selector switch - NORM
(4) Cockpit temperature control knob - AS DESIRED

f. Interior lights controls - AS DESIRED

g. Compass control panel - AS REQUIRED
(1) Latitude - SET
(2) Hemisphere - SET

h. Video tape record switch - UNTHREAD

After Front Cockpit Check Is Complete -

VERIFY:

VERIFY items are those items which, if not correctly positioned, could cause a safety hazard and/or system damage.

1. Emergency air refueling switch - NORM (GUARD DOWN)
2. Throttles - OFF
3. Formation lights - OFF
4. Emergency landing gear handle - IN
5. Arresting hook switch - UP
6. Landing gear handle - DOWN
7. Master arm switch - SAFE
8. Emergency jettison button - NOT PRESSED
9. Emergency brake/steer handle - IN
10. Emergency vent handle - IN AND VERTICAL
11. Engine control switches - ON
12. Anti-ice switches - SET
    a. Engine heat switch - OFF
    b. Pitot heat and windshield switches - OFF

13. Avionics - OFF (RADAR, HUD, INS, TF RADAR, NAV FLIR)

STARTING ENGINES

Normal engine start procedure does not use external power. With the JFS running, power is available to operate the AMAD fire warning system, the intercom system between the aircrew and the ground, and the front cockpit (FCP) utility light. Engine RPM and FTIT indications on the EMD are inoperative until the emergency generator comes on line at 15-17% RPM during engine start. The rest of the engine instruments are inoperative until a main generator comes on at 56-58% RPM during first engine start.

With **PW-229** engines the ENGINE category light will come on and remain lit until the second engine starts and no engine faults exist. With external electrical power or during the second engine start, the ENGINE category light will be on until the IDEEC is powered up by the engine alternator at about 10% RPM. It will come on again momentarily, between 15-29% RPM, indicating that the IDEEC is automatically performing a self test. If the engine is started with the ENG CONTR switch in OFF, the ENGINE category light stays on throughout the start cycle, indicating the engine is in SEC mode. After engines are started, the engine anti-ice switch should be set as required for ambient conditions.

Because a JFS accumulator was discharged to start the JFS, the JFS LOW caution will come on when power is available to display the caution. It will go out when accumulators are recharged by a running engine.

When the fingerlift is raised, the JFS will engage and accelerate the engine. JFS engagement is indicated by an audible decrease in JFS whine when the JFS clutch engages. JFS whine decrease is followed immediately by an increase to a higher pitch than before engagement. Engine rotation is apparent within approximately 5 seconds. If electrical power is not available, rotation can be felt and heard. If electrical power is available, RPM increase can be seen on the EMD. The JFS will continue to smoothly accelerate engine rotation without hesitation until light-off occurs or steady-state windmill (23-30%) is reached. A normal start is indicated by RPM acceleration occurring before initial FTIT movement.

Monitor engine indications on the EMD and compare against the operating limitations listed in section V.

After first engine start, the JFS automatically decouples from that engine and is ready for the second engine start. After second engine start, the JFS shuts down automatically.

The following procedure is applicable to either engine. The right engine is normally started first to permit checking utility hydraulic pressure with only the right pump operating.

JFS START

1. Engine master switches - CHECK ON
2. JFS switch - CHECK ON
3. JFS handle - PULL AND RELEASE

NOTE

If JFS does not start, starter switch should be set OFF. Wait 30 seconds after cycling switch before trying second start so JFS can decelerate, and start sequence relay deenergize. Failure to wait 30 seconds may result in a JFS no start.

4. Starter READY light - ON (within 10 sec; 15 sec if temperature below −18°C/0°F)
5. Fire extinguisher switch - TEST. Observe the AMAD fire warning light on and voice warning activated.

ENGINE START

CAUTION

To prevent possible failure of the CGB shear section the ENG CONTR switch position should not be changed during a start. The switch may be positioned to the desired setting 90 seconds after advancing the throttle to IDLE.

1. Finger lift - RAISE AND RELEASE
   This engages the JFS to the engine.
2. EMD RPM display - OBSERVE INDICATING
3. Fire extinguisher switch - TEST
   Check all fire lights on and voice warnings activated.
4. Throttle - IDLE (20% RPM)
5. Engine instruments - CHECK
   Engine limits are contained in section V.

CAUTION

Abort the start if no oil pressure occurs within one minute.

6. JFS deceleration - CONFIRM
7. Warnings and caution lights - TEST (Check AB BURN THRU warning lights)
8. UHF #2 - ON
9. EMER BST ON caution - OBSERVE ON

   The EMER BST ON caution comes on after first generator comes on line to indicate both emergency generator and emergency boost pump are operating properly. Thirty seconds after the main generator comes on the line, the BST SYS MAL caution also comes on as the emergency generator cuts off. This indicates that the emergency fuel boost pump is now operating off an abnormal power source. When the second main generator comes on the line, both EMER BST ON and BST SYS MAL cautions go out.

NOTE

If automatic avionics shutdown occurs due to low ECS cooling airflow only UHF #2 will be available, All major caution lights will be inoperable. In addition, the right engine ramp may move to the full up position. Start other engine as soon as possible to obtain sufficient ECS airflow. If two engine operation is not possible, single engine operation at 73 - 78% RPM will provide sufficient ECS airflow.

10. Total fuel quantity - CHECK
11. Hydraulic caution light - CHECK
12. Slipway door - CHECK (if AAR is planned)
13. Other engine - START

NOTE

- Some **PW-220** and **PW-229** engines exhibit low frequency vibrations which are non-damaging to both the airframe and engines. The vibrations should disappear if engine RPM is either increased or decreased by 5%.
- At idle RPM the left engine fuel flows displayed on the EMD and MPD/MPCD may oscillate between 200 and 1600 pph, may momentarily drop to zero, and may differ between EMD and MPD/MPCD displays. The fuel flow displays should all stabilize when the left engine RPM is increased above idle.

14. Engine instruments - CHECK
15. JFS - CONFIRM OFF; JFS SWITCH ON
16. ECS - CHECK

    Ensure ECS caution off and airflow present.

WARNING

If access to door 10L or 10R is required by maintenance personnel, both engines must be shut down to prevent possible inlet ramp activation which could cause ramp/door collision with resulting personnel injury.

BEFORE TAXIING (FRONT COCKPIT)

1. Canopy - CLOSE IF DESIRED (WAIT 10 SEC BEFORE LOCKING)

WARNING

The ejection seat will fire with the canopy in any position from full closed to full open. However to reduce the possibility of injury, the canopy should be closed prior to ejecting.

CAUTION

- Make sure canopy has completed movement and wait 10 seconds before moving handle to LOCKED position. If there is a heavy load when attempting to place the handle in LOCKED, recycle the handle to DN and again perform locking procedure. Make sure canopy unlock light is on with handle in DN and goes out with handle in LOCKED. Make sure the handle is full forward.
- Canopy may not fully close with hydraulic pressure if the ambient temperature is below 0°F. In this case and

after attempting to close the canopy mechanically, the pilot may force the canopy closed. With the canopy down on the sills and the internal canopy control handle set to DOWN position, grab hold of the two handles on the forward arch of the canopy and shove the canopy forward. Once the canopy moves fully forward the control handle can be set to LOCKED position.

2. MPDs/MPCDs - ON
3. HUD - ON
4. DTM - TRANSFER AS REQUIRED
5. CC buffer - CLEAR
6. Brakes - CHECK
7. Holding Brake - ON
8. Sensor control panel - SET
   a. NAV FLIR power switch - AS REQUIRED
   b. Radar power switch - AS REQUIRED
   c. Radar altimeter power switch - AS REQUIRED
   d. TF radar power switch - AS REQUIRED
   e. INS - ALIGN (see INS alignment procedures)
      INS may be switched to NAV after OK (approximately 4 minutes for GC, 40 seconds for SH)
9. Flight Controls - CHECK (CAS OFF)
   a. AFCS BIT codes - CLEAR
      Press and release BIT button on CAS panel while pressing paddle switch.
   b. AFCS BIT — NOT IN TEST
   c. CAS PITCH, CAS ROLL, CAS YAW - OFF
   d. Antiskid - CHECK NORM
   e. Stick full aft and left - Observe stabilator trailing edge up (left further up than right) rudder left, left aileron up, right aileron down.

NOTE

Observe that the rudders travel smoothly and follow stick movement during each leg.

   f. Stick full left and full forward - Observe right stabilator leading edge moves into view and rudders move right (ailerons should not move)
   g. Stick full forward and full right - Observe left aileron moves down and right aileron moves up, rudders move left, and left stabilator leading edge in view.
   h. Stick full right and full aft - Observe stabilator trailing edge moves to full up (right higher than left) and rudder moves right (ailerons should not move).
   i. Rudder - Check (if desired). Hold stick neutral and paddle switch pressed. Move rudder pedals left and right and observe 1/2 rudder travel (15°).

NOTE

During flight control check, stabilator chatter may be noted. This is characterized by airframe vibrations during the flight control stick movement. Vibrations are normal if they stop within 3 to 4 seconds after flight control movement has stopped.

10. Flight Controls - CHECK (CAS ON)
   a. Set yaw, roll, pitch to ON/RESET on the CAS panel.

NOTE

Six seconds of programmed rudder oscillation may be noticed after each ground engagement of Yaw CAS. This is normal AFCS operation.

   b. Verify CAS PITCH, CAS ROLL, CAS YAW cautions - OUT
   c. Pitch ratio switch - EMERG (Observe 0.3 to 0.5 PITCH RATIO)
   d. T/O Trim button - PUSH UNTIL DEPARTURE WARNING TONE BEEPS
   e. Pitch ratio switch - AUTO (Observe 0.9 to 1.0 pitch ratio)
   f. Stick full aft and hold - Verify stabilator training edge travels up rapidly with stick application until full aft stick is reached.
   g. Stick full aft and left - Observe stabilator trailing edge up (left further up than right) rudder left, left aileron up, right aileron down.

NOTE

Observe that the rudders travel smoothly and follow stick movement during each leg.

   h. Stick full left and slowly full forward - Observe right stabilator leading edge moves into view and rudders move right (ailerons should not move)

i. Stick full forward and full right - Observe left aileron moves down and right aileron moves up, rudders move left, and left stabilator leading edge in view.

j. Stick full right and slowly full aft - Observe stabilator trailing edge moves to full up (right higher than left) and rudder moves right (ailerons should not move).

k. Rudder - Check. Hold stick neutral and paddle switch pressed. Move rudder pedals left and right and observe full rudder travel (30°).

l. With stick and rudder pedals neutral, verify the flight control surfaces are at takeoff trim position.

m. Select MENU/BIT/DETAIL/AFCS on MPD/MPCD. Verify no BIT codes or failures. If CAS will not stay on - ABORT.

NOTE

Cycling the stick and rudder pedals several times with CAS ON will improve the chances of executing a clean AFCS BIT.

11. Pitch Trim Compensator - CHECK (If desired)
    (1) Stick full forward and hold —Verify stabilator trailing edge travels down rapidly with stick application until full stick is reached, then more slowly as the pitch trim compensator runs to full travel. Observe stabilator inboard leading edge tips just visible above wing trailing edge.
    (2) Stick full aft and hold —Verify stabilator trailing edge travels up rapidly with stick application until full aft stick is reached, then move more slowly as the pitch trim compensator runs to full travel.
12. Trim - CHECK AND SET
    a. Trim pitch, roll, and yaw off neutral
    b. T/O TRIM button - PUSH
    Lateral stick and rudders should drive to center and longitudinal stick to takeoff position. The departure warning tone should beep.
    c. T/O trim light - ON
    d. T/O trim button - RELEASE
13. AFCS preflight BIT (PBIT) - INITIATE

WARNING

AFCS BIT will cycle the controls and the control surfaces. Flight and ground crew must stay clear of the flight control system while AFCS BIT is IN TEST. Ground crew should observe stabilators during first 30 seconds of PBIT. If any motion is detected, suspect a bad stabilator actuator valve.

NOTE

- Flight crew must stay clear of rudder pedals and stick. Do not cycle the speed brake or flaps while AFCS BIT is IN TEST. Interference will cause incorrect BIT results.

- Any BIT code occurring during a Preflight BIT run is considered acceptable for flight provided this code does not reappear on a subsequent BIT run. All BIT codes even if they clear on subsequent BIT runs should be reported for tracking purposes.

    a. Select MENU/BIT on MPD/MPCD, press and hold BIT button on CAS panel then press and release AFCS button on MPD/MPCD. When AFCS IN TEST is displayed on MPD/MPCD, release BIT button on CAS panel.
    b. AFCS remains IN TEST until complete, holding brake is released, paddle switch is pressed, or STOP button is pressed.
    c. AFCS BIT requires approximately 2 minutes to complete. If INCOMPLETE is displayed on MPD/MPCD, wait at least 15 seconds and reinitiate BIT.
    d. Steps 14 thru 22 may be performed during AFCS BIT.
14. Engine control switches - CHECK (90 seconds after engine start)
    a. **(PW-220 Engine)** Engine control transfer - CHECK
        (1) L ENG CONTR switch - OFF
        Check L engine reverts to secondary mode (nozzle closes) and L ENG CONTR caution is displayed.

(2) L ENG CONTR switch - ON
Check L engine reverts to primary mode (nozzle opens) and L ENG CONTR caution is not displayed.
(3) Repeat steps (1) and (2) for right engine control switch replacing L with R.

a. (**PW-229** Engine) ATDP test - INITIATE
(1) Press and release ATDP TEST on MPD/MPCD engine display - CHECK TEST LEGEND BOXED, NO ATDP CAUTION
(2) L ENG CONTR switch - OFF
Check both engines revert to secondary mode (nozzles close). L and R ENG CONTR cautions are displayed. MASTER CAUTION and ENGINE category lights on.
(3) L ENG CONTR switch - ON
Verify both engines remain in SEC mode
(4) Press and release ATDP TEST - CHECK LEGEND BOX REMOVED, L AND R ENG CONTR CAUTIONS NO LONGER DISPLAYED, NO ATDP CAUTION, ENGINES REVERT TO PRIMARY MODE (NOZZLES OPEN)
(5) Repeat steps 1 thru 4 for R ENG CONTR switch.

15. Avionics - AS REQUIRED
16. Oxygen - CHECK
17. Fuel quantity gage - CHECK
    a. Tank quantity - CHECK
    b. BIT - CHECK
    c. BINGO bug - SET
18. CFT switch - NORM
19. Bleed air - CHECK
20. PACS - PROGRAM AS REQUIRED

CAUTION

For the OWS to program properly and prevent possible aircraft over-G the external store configuration, including external tanks, must be set in the PACS.

21. OWS severity codes - CHECK CLEARED
22. MPD/MPCD - PROGRAM AS DESIRED
23. Master Modes - PROGRAM (if desired)

Once AFCS preflight BIT complete:

24. CAS - ON
25. AFCS - CHECK BIT CODES
    a. Verify AFCS contains no BIT codes or functional failures.
26. Radar STBY BIT - INITIATE
    a. Ground (GBIT) indication - CONFIRM
    b. Previous matrix - CHECK
27. Radar power switch - ON
28. Auto BIT - INITIATE (AS REQUIRED). When MPD/MPCD have test pattern displayed, ensure the indicated total fuel reading is within 800 pounds of the fuel gauge. Failure of this check indicates an unreliable OWS.

When RADAR IN TEST appears on BIT page:

29. Radar Track Test and Operate BIT - INITIATE
30. Flaps - DOWN
31. Speed brake - CYCLE
32. JFS LOW caution - OUT
33. INS mode knob - NAV (when aligned)
34. MPD individual display maintenance BIT - CHECK (if required)
35. AAI BIT - INITIATE (if required)
    AAI system does not always time-out before being checked during AUTO BIT. Therefore a system specific BIT is recommended to ensure proper operation.
    a. MODE 3 - 0000
    b. Scope - 40 nm MINIMUM
36. Avionics/BIT - CHECK BIT FOR CODES
37. Cautions/Warnings - CHECK OFF
38. Standby attitude indicator - CAGED THEN UNCAGED
39. Anti-g suit - CHECK
40. Altimeter - SET AND CHECK
    a. HUD and Altimeter should agree within ±60 feet.

NOTE

If the altimeter is not within tolerance, the aircraft may be flown provided that the altimeter checks within ±75 feet of field elevation. The ±75 feet of field elevation is an operational restriction and does not necessarily reflect instrument tolerances.

41. AVTRS/VTR - PROGRAM/ENABLE
42. Radar - PROGRAM/VERIFY WEAPON MODES (MRM/SRM)
43. UFC - SELECT AND PROGRAM AS REQUIRED

44. (MSOGS) BOS - CHECK
    a. OXY BIT button - PRESS AND HOLD
        (1) Verify BOS pressure (20-450 psi)
        (2) Observe OXYGEN caution and MASTER CAUTION
    b. OXY BIT button - RELEASE
    OXYGEN caution and MASTER CAUTION should go off. Several breaths are required before the pressure gage returns to the normal concentrator operating range of 10-60 psi.

BEFORE ENTERING REAR COCKPIT

Refer to foldout section for ejection seat illustration.

1. Canopy initiator - LANYARD ATTACHED, PIN REMOVED
2. Ejection controls safety lever - LOCKED
3. Safety pins - REMOVED
    a. Canopy jettison handle pin
    b. Ejection seat safety pins (2)
4. Radio beacon auto/manual selector - AS DESIRED
5. Auto/manual seat kit deployment selector - AUTO
6. Emergency manual chute handle- FULLY DOWN
7. Seat hoses disconnect coupling - CHECK SECURE
8. Battery window - NO RED PIN SHOWING
9. Both pitot tubes - NO OBSTRUCTIONS
10. Emergency O_2 bottle indicator - CHECK FULL

REAR COCKPIT INTERIOR CHECK

A thorough cockpit interior preflight shall be accomplished before each flight. The design features of the aircraft greatly simplify this task. Switch positions designated AS DESIRED allow aircrew preference in switch/control positioning. AS REQUIRED indicates those switches that will differ with mission requirements. If no specific requirement exists, aircrew preference may be used. Normally, those avionics switches designated AS DESIRED or AS REQUIRED should be OFF for start.

1. Interior check - COMPLETE
    a. Harness and personal equipment leads - FASTEN
    Attach parachute risers to harness buckles. Attach survival kit and ensure straps are snug within the limits of personal comfort. Connect oxygen, G suit, and communication leads. Check operation of shoulder harness locking mechanism.

WARNING

- After connecting the parachute risers to the harness, lift the locking lever on each Koch fitting and verify the actuating lever is full up and snug against the inner part of the locking lever. If the actuating lever will not seat, disconnect the release and use a different harness.
- Failure to adjust the survival kit straps to achieve a snug fit between the crew member and kit may result in injury during ejection.
- Failure to properly stow/secure all loose articles may result in entanglement with cockpit controls, including ejection handles, which could cause inadvertent ejection.

Left Console -

a. Intercomm set control panel - SET
    (1) Volume knobs - AS DESIRED
    (2) Crypto switch - NORM
    (3) MIC switch - ON
    (4) Cipher text switch - AS REQUIRED
    (5) Tone switch - OFF
b. EW control panel - SET AS REQUIRED
c. Sensor control panel - SET
    (1) TGT FLIR power switch - OFF
    (2) LASER switch - SAFE
d. Nuclear consent switch - SAFE (COVER FULLY CLOSED)
e. Canopy jettison handle - FORWARD

Instrument panel -

a. Emergency landing gear handle - IN
b. Arresting hook switch - UP
c. Emergency brake/steer handle - IN
d. Rudder pedals - ADJUST

WARNING

To prevent injury to lower leg, make sure feet are on rudders before pulling the adjust knob.

Right Console -

a. Command selector valve - NORM (VERTICAL)

b. **(LOX)**
Oxygen system - CHECK AND SET
Pressure - 55 to 120 psi
Regulator - CHECK
(1) Oxygen supply lever - FULLY ON
It is possible for the oxygen supply lever to stop at an intermediate position between OFF and ON. Assure the lever is all the way ON.
(2) Emergency lever - NORMAL
(3) MASK - ON
Breath normally for 3 cycles and check flow indicator operation. Hold breath, all flow should stop and the indicator should show no flow (black). A white indicator indicates a leak which must be corrected before flight.
Indicator - CHECK
(4) Diluter lever - 100%
(5) Emergency lever - EMERGENCY
(6) Oxygen flow - CHECK (Return Diluter and Emergency levers to NORM)
Connections - CHECK
Emergency Oxygen - CHECKED
(7) Pressure - CHECK
(8) Actuating ring - STOWED and CHECKED

c. **(MSOGS)**
Oxygen system - CHECK AND SET
Pressure - 20 to 450 psi
If MSOGS BOS pressure is below 20 psi, breathing may be restricted
Regulator - CHECK
(1) Oxygen supply lever - FULLY ON (If breathing from BOS is required)
It is possible for the oxygen supply lever to stop at an intermediate position between OFF and ON. Assure the lever is all the way ON. If BOS is empty, select NORM on diluter lever during engine start. Selection of 100% may result in a brief period of breathing supply restriction during MSOGS power-up BIT.
(2) Emergency lever - NORMAL
(3) Diluter lever - NORM
(4) MASK - ON
Breathe normally for 3 cycles and check flow indicator operation. Hold breath, all flow should stop and the indicator should show no flow (black). A white indicator indicates a leak which must be corrected before flight. If BOS is available, aircrew may breathe BOS gas mixed with cabin air. If no BOS is available, aircrew may breathe the cabin air through the regulator with moderate restriction.
Indicator - CHECK, if BOS > 20 psi
(5) Diluter level - 100%
(6) Emergency lever - EMERGENCY
(7) Oxygen flow - CHECK
Connections - CHECK
Emergency Oxygen Bottle - CHECK
(8) Pressure - CHECK
(9) Actuating ring - STOWED and CHECKED

CAUTION

Do not lift the regulator toggle switch when switching regulator from OFF to ON or ON to OFF. Damage to the regulator switch will result.

d. TEWS control panel - SET
(1) ICS switch - OFF
(2) RWR switch - OFF
(3) EWWS switch - OFF

e. Countermeasures dispenser control panel - SET
(1) Mode switch - OFF
(2) Flare switch - NORM (COVER DOWN)

f. RMR - CHECK CASSETTE INSTALLED/INSERT

g. Circuit breakers - IN

h. Interior lights controls - AS DESIRED

After Rear Cockpit Check Is Complete -

VERIFY:

VERIFY items are those items which, if not correctly positioned, could cause a safety hazard and/or system damage.

1. Arresting hook switch - UP
2. Landing gear handle - DOWN
3. Emergency brake/steer handle - IN
4. Avionics - OFF (TGT FLIR and TEWS)

BEFORE TAXIING (REAR COCKPIT)

1. Warning and caution lights - TEST
2. MPD's/MPCD's - ON
3. DTM - TRANSFER (AS REQUIRED)
4. CC buffer - CLEAR
5. INS - INSERT PP, CONFIRM ALIGN
6. Avionics - AS REQUIRED
7. Sensor control panel - SET
   a. TGT FLIR - AS REQUIRED
   b. LASER switch - SAFE
8. Avionics systems - CHECK/PROGRAM, INSERT/VERIFY UFC MISSION DATA, INITIATE BIT AS REQUIRED

NOTE

If RMR is in REWIND, do not run initiated or AUTO BIT on the RMR.

9. Radar - PROGRAM/VERIFY WEAPON MODES (MRM, SRM)
10. PACS - PROGRAM AS REQUIRED

CAUTION

For the OWS to program properly, the external store configuration, including external tanks, must be programmed in the PACS.

11. Oxygen - CHECK
12. Anti-g suit - CHECK OPERATION
13. Standby attitude indicator - CAGE THEN UNCAGE
14. Altimeter - SET AND CHECK
    a. Altimeter should agree with HUD altimeter within ±60 feet.

NOTE

If the altimeter is not within tolerance, the aircraft may be flown provided that the altimeter checks within ±75 feet of field elevation. The ±75 feet of field elevation is an operational restriction and does not necessarily reflect instrument tolerances.

TAXIING

As the throttles are moved out of idle, confirm that the holding brake switch goes OFF and that the holding brake is released. As aircraft starts to roll, apply brakes to check operation. When clear, actuate nose gear steering in both directions to ensure proper operation. During taxi, check all flight instruments. At high gross weights, make all turns at minimum practicable speed and maximum practicable radius. At low gross weight, taxi speed requires continual attention due to excess thrust at IDLE.

CAUTION

Nose gear damage can result during turns at high gross weight when using asymmetric thrust and/or asymmetric braking. At heavy gross weights, avoid abrupt nose gear steering inputs. Make turns at minimum practical speed and maximum practical radius, and avoid operations on rough and uneven taxiways or runways; failure to do so may result in tire damage.

1. (P) Inlet ramp switches - AS REQUIRED
2. (P) Holding brake - OFF
3. (P) Brakes - CHECK
4. (P) Nose gear steering - CHECK
5. (BOTH) Flight instruments - CHECK

If taxiing is required before INS alignment is complete and the aircraft is stationary again before takeoff, place the holding brake ON to continue the alignment.

CAUTION

To prevent a skid and possible tire failure, the aircraft must be completely stopped before placing the holding brake ON.

BEFORE TAKEOFF

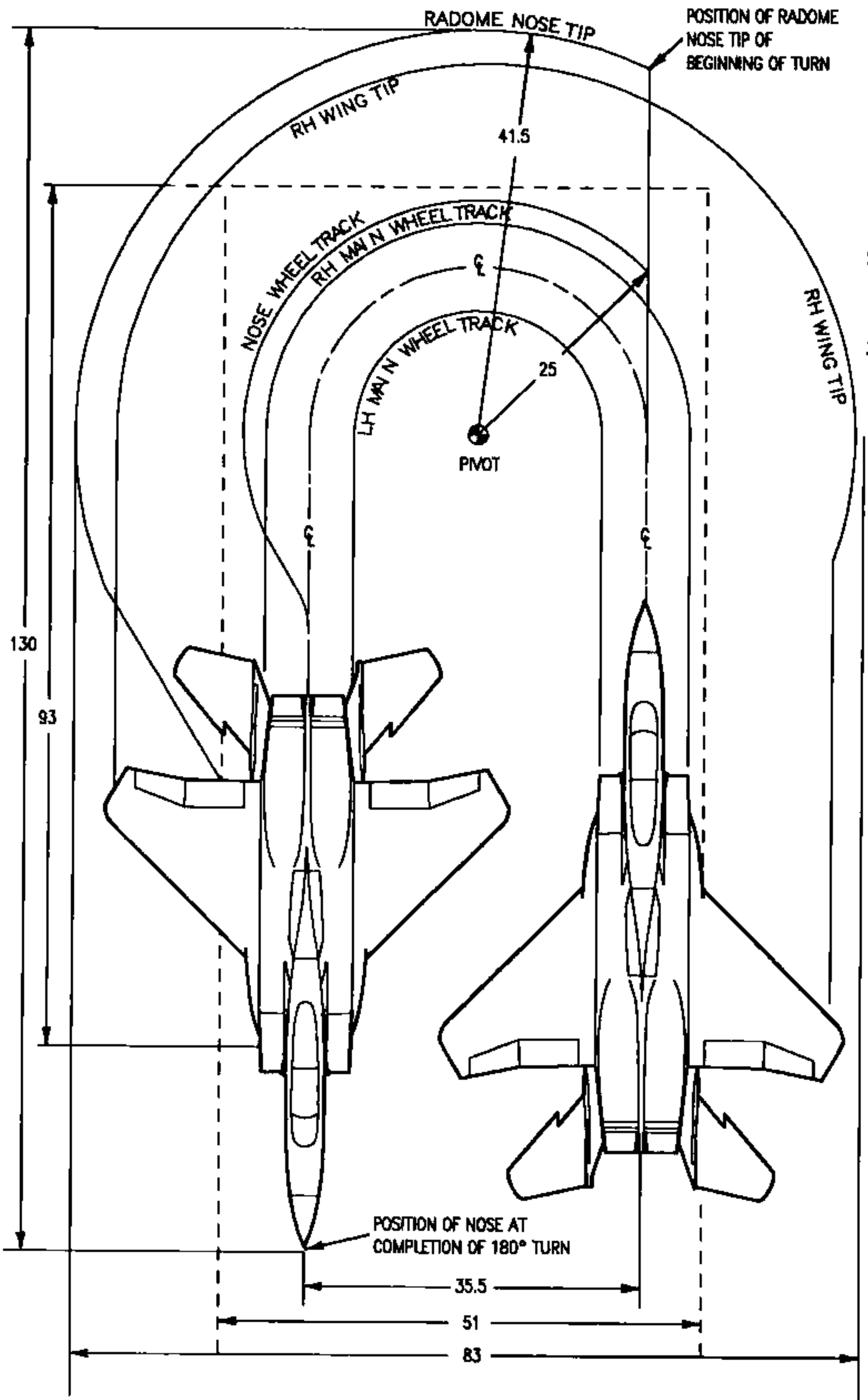
1. (P) Inlet ramp switches - CONFIRM AUTO
2. (BOTH) Confirm all loose items are stowed
3. (BOTH) Harness - CHECK
   Ensure all buckles, straps, and fittings secure and properly adjusted.
4. (BOTH) Ejection control safety lever - ARMED
5. (W) Command select valve - AS BRIEFED
6. (BOTH) Flight controls - CHECK FREE
7. (BOTH) Flaps - CHECK DOWN
8. (P) T/O trim - CHECK
   If the aircraft is manually trimmed nose down from takeoff trim, nosewheel lift-off speed may be increased.
9. (BOTH) Canopy - CHECK CLOSED AND LOCKED
10. IFF - ON,
11. (P) Radar - ON
12. (W) TGT Pod - STBY, CONFIRM STOWED
13. (P) PITOT HEAT/ENG HEAT - ON AS REQUIRED

CAUTION

Do not turn the ENG HEAT switch ON unless flying in conditions susceptible to icing. Once clear of icing conditions, turn the ENG HEAT switch OFF.

14. (BOTH) Warnings, cautions, BIT lights, and circuit breakers - CHECK
15. (P) Holding brake - OFF
16. (P) INS - NAV
17. UFC - SELECT PP keeping source AS DESIRED
18. Mission navigator - RESET (if desired)
19. System altitude - RESET (if desired)

TAXI TURNING RADIUS



NOTES

1. TURN RADIUS DEPICTS GEOMETRIC TURN RADIUS AND DOES NOT INCLUDE A NOSE WHEEL SLIP ANGLE. ACTUAL TURN RADIUS WILL BE LARGER DEPENDING UPON SURFACE CONDITION AND TAXI SPEED.
2. OVERALL DIMENSIONS INCLUDES TWO FEET CLEARANCE BETWEEN WHEEL TRACKS AND PAVEMENT EDGES.
3. ALL DIMENSIONS ARE IN FEET.

——— DENOTES CLEAR AREA REQUIRED.

- - - DENOTES EDGE OF PAVEMENT.

Figure 2-3

TAKEOFF

Advance engines to 80% for **PW-220** engines or 82% for **PW-229** engines (some aircraft creep may occur) and check instruments. When ready for takeoff, release brakes and advance throttles to MIL or MAX as desired. Monitor engine instruments for proper operation, assuring that nozzles remain at or below 30% at MIL power for both the **PW-220** and **PW-229** engines.

NORMAL TAKEOFFS

For normal takeoffs, smoothly move the stick to approximately one-half aft stick at rotation speed to establish approximately 10° pitch attitude.

Applying aft stick at a speed lower than rotation speed may result in nose wheel bouncing. Excessive aft stick can lead to high pitch rate. Retract gear and flaps when airborne.

MAXIMUM PERFORMANCE TAKEOFFS

For maximum performance takeoffs (minimum ground roll), move the stick full aft at 10 knots below the nose wheel lift-off speed in figure A3-11 (with **PW-220** engine) or B3-11 (with **PW-229** engine) and rotate to 12° pitch attitude. Nose wheel lift-off speed and takeoff speed is increased for heavy gross weights and/or forward center of gravity. Additional aft stick will compensate for these effects, but rotation rates could be unacceptably high, leading to over-rotation. Retract gear and flaps when airborne.

AFTERBURNER OPERATION

During normal afterburner operation, observe exhaust nozzles open progressively with each afterburner segment; thrust and fuel flow increase proportionately. As throttles are advanced from minimum to maximum afterburner, the increase in thrust is fairly smooth and continuous.

CLIMB TECHNIQUES

PW-220 Engines

MIL Power - For drag index of 40 or less, climb at 350 KCAS to 0.88 Mach, then maintain Mach to cruise altitude. For indexes between 40 and 100, use 330 KCAS/0.83 Mach. Greater than 100, use 310 KCAS/ 0.74 Mach.

MAX Power - For drag index of 60 or less, climb at 350 knots to 0.95 Mach. If Mach increases above 0.95 at 40° pitch attitude, hold 40° and allow the Mach to increase. (Mach will rise only slightly before returning to 0.95.) For drag index greater than 60, climb at 350 KCAS to 0.92 Mach, then maintain 0.92 Mach.

PW-229 Engines

MIL Power - For drag index of 60 or less, climb at 350 KCAS to 0.90 Mach, then maintain Mach to cruise altitude. For indexes greater than 60, use 300 KCAS/ 0.75 Mach.

MAX Power - For drag index of 60 or less, climb at 350 knots to 0.95 Mach. If Mach increases above 0.95 at 40° pitch attitude, hold 40° and allow the Mach to increase. (Mach will rise only slightly before returning to 0.95.) For drag index greater than 60, climb at 350 KCAS to 0.90 Mach, then maintain 0.90 Mach.

INFLIGHT

Continually monitor aircraft systems operation throughout the flight. Periodically check attitude of ADI vs standby Attitude Indicator. Frequently check engine instruments (EMD), cabin pressure, oxygen system operation, fuel quantity (internal vs. total), and fuel transfer.

NOTE

Some **PW-220** and **PW-229** engines exhibit low frequency vibrations which are non-damaging to both the airframe and engines. The vibrations should disappear if engine RPM is either increased or decreased by 5%.

Optimum cruise and maximum endurance should be found in the performance data section and is attained by flying the correct Mach number for configuration and altitude. If the performance charts are not available and accuracy is not a significant factor, 14 units AOA may be used for long range cruise at or below 25,000 feet and 14.5 units AOA above 25,000 feet. For maximum endurance, 18 units AOA may be used at or below 25,000 feet and 17 units AOA above 25,000 feet.

NOTE

The higher thrust of the **PW-229** engines may result in inadvertent non-afterburning supersonic flight when in level flight at or above 20,000 feet.

ASYMMETRIC THRUST

(**PW-229** ENGINES) The ATDPS does not protect from pilot commanded throttle movements that could result in thrust asymmetries. Therefore, do not perform asymmetric throttle movements in afterburner when operating above 500 KCAS while greater than 1.1 Mach. When selecting afterburner at these flight conditions, make sure both nozzles open before proceeding to higher throttle settings.

FUEL MONITORING

With three external tanks installed, fuel transfer should be checked by selecting stop transfer on external wing tanks and observing fuel transfer from the centerline tank. When centerline transfer is confirmed the external wing tank switch should be returned to normal.

CAUTION

To prevent fuel pump damage/failure, the CFT transfer switch must be placed in the STOP TRANS position when all CFT fuel has been transferred.

After all external fuel tanks (wing, centerline, and CFT) are empty and the internal wing tanks start feeding, a check should be made to ensure that a differential of 750 pounds is not being exceeded between tank 1 and each internal wing tank. The transfer rate should be periodically monitored until tank 1 and the internal wing tanks are empty.

During low altitude/high speed flight, fuel consumption can be as high as 184,800 PPH (3,080 pounds per minute) with **PW-220** engines and 196,000 PPH (3,267 pounds per minute) with **PW-229** engines and may exceed fuel transfer capability. This will cause premature reduction of feed tank fuel level. Maneuvering and acceleration can cause fuel gage errors resulting in a fuel state over 1,000 pounds less than gage indication. To avoid dangerously low fuel states as a result of these factors, maintain situation awareness, make more frequent fuel checks, and closely monitor feed tank fuel quantity.

With external tanks installed, an asymmetric external fuel imbalance may occur. Compare the internal fuel pointer with the total counter for indications of trapped external fuel. During sustained cruise power an external wing tank may not transfer fuel until after the other external wing tank is empty. The aircraft may be safely flown below 30 units AOA with an asymmetric load as great as one full external wing tank.

TERRAIN FOLLOWING CHECK

Successful AFCS, LANT/RALT, and AIU BITs are assumed. Verify during LANT/RALT BIT the OBST warning is displayed and the voice warning is activated. Conduct checks above 370 KCAS/400 GS at a safe altitude, over level terrain if practical.

1. TF display - SET
   a. SCP - 1,000 FEET
   b. TF mode, ride, and frequency - AS REQUIRED
2. CARA - VERIFY ON
3. LAWS - VERIFY ON
   a. LAWS - SET ABOVE CURRENT AGL ALTITUDE
   b. Voice warning and light - VERIFY ON
   c. LAWS - SET AS REQUIRED
4. Flyup enable switch - VERIFY ON
5. TF radar power switch - ON
   a. MTF box - COMMANDS DIVE
   b. TF display - OWL, ZCL, raw/synthetic video - PRESENT
   c. NORM, ECCM, WX, LPI, and VLC modes - CHECK AS REQUIRED
6. Roll between 45° and 60° for more than 2 seconds.
   a. ROLL caution - DISPLAYED
   b. MTF box - REMOVED
7. Roll wings level
   a. Roll caution - OFF
   b. MTF box - RETURNS AFTER 2 SECONDS
8. MODE A FLYUP - VERIFY using one of the three following methods:

   TF Couple Method

   a. Paddle switch - PRESS AND HOLD
      (1) UNARMED/NO ATF light and BINK BINK tone - VERIFY ON
   b. Roll between the dynamic bank angle limit and 60°
   c. TF couple switch - COUPLE

d. Paddle switch - RELEASE
   (1) Wings level flyup - VERIFY
   (2) TF FAIL light and voice warning - VERIFY ON
e. Once back in bank angle limits, Paddle switch - PRESS AND RELEASE
   (1) ATF pitch steering bar - VERIFY DISPLAYED
f. TF couple switch - AS DESIRED

CARA Method

a. Roll between 10° and the dynamic bank angle limits
b. CARA - OFF
   (1) Wings level flyup - VERIFY
   (2) MTF box - COMMANDS CLIMB
   (3) TF FAIL light and voice warning - VERIFY ON
c. Paddle switch- PRESS AND HOLD
   (1) UNARMED/NO ATF light - VERIFY ON
d. CARA - ON and WAIT FOR TIME IN
e. After CARA time-in
   (1) BINK BINK tone - VERIFY ON
   (2) TF FAIL light and voice warning - VERIFY OFF
f. Paddle switch - RELEASE
   (1) UNARMED/NO ATF light - VERIFY OFF

75% Set Clearance Method
(Use this method only when over known flat terrain)

a. Fly a shallow dive with velocity vector below the MTF box
b. Roll between 10° and the dynamic bank angle limit
c. At 750 feet AGL, wings level flyup - VERIFY
   (1) TF FAIL light and voice warning - VERIFY ON
   (2) MTF box - COMMANDS CLIMB
d. Paddle switch - PRESS AND RELEASE
   (1) BINK BINK tone - VERIFY ON
   (2) TF FAIL and voice warning - VERIFY OFF

9. FLYUP ENABLE switch - AS DESIRED

If ATF is desired, perform step 10; if not, proceed to step 11.

10. TF couple switch - COUPLE
    a. MTF box changes to ATF bar.
11. Monitor ATF or MTF letdown.
    a. (ATF only) Verify aircraft follows ATF bar
    b. Verify pitch steering is appropriate based on synthetic video and ZCL.
12. Stepdown - AS REQUIRED
    a. LAWS - SET at 90% of desired SCP
    b. SCP, mode, ride, and frequency - AS REQUIRED

INSTRUMENT FLIGHT PROCEDURES

GENERAL

The HUD is the primary indicator for instrument flight.

RECOMMENDED AIRSPEEDS

The holding, penetration, and downwind airspeed for instrument approach may vary from those recommended. At normal approach gross weight, acceleration and high residual thrust characteristics of turbofan engines, combined with low aerodynamic drag, make precise speed control difficult. The recommended technique during instrument approach is to select a power setting which allows the aircraft to stabilize at the approximate recommended airspeed.

Holding

The recommended holding airspeed is 250 knots.

Penetration

Normally, after power is set (approximately 72%), lower nose to approximately 10° and allow airspeed to increase slowly to 300 knots. The speed brake can be used if a higher descent rate is required. Approaching final approach fix, slow to 200-250 knots and lower gear and flaps.

INSTRUMENT APPROACHES

In the pattern, select a power setting that will maintain 200 to 250 knots. Approaching final, lower gear and flaps, and slow the aircraft. Maintain on-speed AOA on final. The speed brake can be used to control descent and airspeed. On GCA final, the velocity vector can be used to indicate glideslope. If a 2 1/2° glideslope is used, holding 2 1/2° flight path angle with the velocity vector provides a good basis from which corrections, if required, can be made.

On an ILS approach, use of the bank steering bar in the ILS mode is not recommended until approximately aligned with the final approach heading. Bank steering information on the HUD and ADI automatically switches from 30° maximum bank angle to the final approach mode of 15° maximum bank angle when the glideslope is intercepted. If the glideslope is intercepted with a considerable difference between aircraft heading and final approach course, a 15° bank angle may not be sufficient to align the aircraft on final approach. When an ILS mode is selected, CSET flashes on the HUD for 10 seconds to remind the pilot to set the final approach course. Interception of the center of the glideslope and automatic shift to approach mode is indicated by the appearance of glideslope indications on the HUD and ADI. Glideslope and localizer information is displayed on the ADI.

WARNING

HUD ILS command guidance is mechanized for a 3° glideslope. If other than a 3° glideslope is being flown, the generated glideslope commands will place the aircraft approximately 1/2 dot off the glide path. Therefore, during any ILS approach, crosscheck generated steering commands with raw glideslope data.

Use the best available range information. ILST normally provides the most accurate range information if the tacan station is suitably located. ILSN mode provides range to the coordinates entered for the STEER TO destination.

On final approach, steer the velocity vector to the flight director cross. Velocity vector position on the pitch scale may be used to reduce the effect of an overly sensitive flight director cross (out of HUD limit). A flashing (caged) velocity vector may be used but it will not indicate the actual azimuth of the flight path.

MISSED APPROACH/GO AROUND

Advance power as required and retract speed brake. Retract gear and flaps when climb is established. Accelerate to 200-250 knots if another approach is planned. If climbing out of the pattern, a higher airspeed may be used.

WARNING

Do not exceed 250 knots until out of the low altitude environment. This will ensure that turn radius does not exceed TERPS obstacle clearance criteria.

DESCENT CHECK

Descents from high altitude may cause windshield fogging. The hot position should be selected before descent if fogging is anticipated.

1. (P) Master arm switch - SAFE
2. (W) Counter Measures Dispenser mode switch - OFF
3. (BOTH) Altimeters - SET AND CHECK
4. (W) TGT POD switch - STBY/OFF
5. (P) TF radar power switch - AS REQUIRED
6. (P) PITOT HEAT/ENG HEAT - ON AS REQUIRED

CAUTION

Do not turn the ENG HEAT switch ON unless flying in conditions susceptible to icing. Once clear of the icing conditions, turn the ENG HEAT switch OFF.

BEFORE LANDING

1. (BOTH) Landing gear - DOWN AND VERIFY
2. (BOTH) Flaps - AS REQUIRED
3. (P) Hydraulics - CHECK
4. (P) Landing light - ON
5. (P) ANTI-SKID - NORM
6. (P) Holding brake - OFF

WARNING

Landing with holding brake on (engaged) will cause loss of control when struts compress and throttle is placed in IDLE.

LANDING TECHNIQUE

The aircraft can accommodate several different landing techniques, however, the procedures described are recommended.

NORMAL LANDING

Approaching the break, set power to maintain altitude and airspeed (300 knots minimum). The speed brake may be used as required. On downwind, below 250 knots, lower gear and flaps.

During base turn, reduce speed to arrive on final at on-speed AOA (20-22 units). If faster than on-speed, the aircraft will float for a considerable distance. If slower than on-speed, minor buffet may be noticed. With center of gravity near the aft limit, final approach should be flown no slower than on-speed AOA.

At the flare point, smoothly retard the throttles to IDLE and reduce rate of descent. Ground effect will cushion the aircraft, and touchdown may be difficult to recognize. Raising the nose too high in the flare will cause ballooning, and possibly a hard landing and tail/engine ground contact. For high gross weights, fly on-speed AOA, but delay reducing power until well into the flare (refer to section VI). After touchdown, maintain directional control with rudder and raise the nose to approximately 12° pitch attitude to achieve optimum aerodynamic braking. With center of gravity near the aft limit, the stick feels light and the aircraft requires very little aft stick to flare or to hold the nose up during aerobraking. At aft center of gravity, use caution to avoid possible tail strike due to over-rotation. For any CG condition, aerobraking is highly effective at airspeeds above 90 knots and significantly reduces the possibility of hot brakes, excessive tire wear, and blown tires. Therefore, aerobraking should be accomplished first followed by normal braking. Flaps should remain down during a normal, dry runway landing to provide increased aerodynamic drag and normal nose fall through at the crossover point between aerobrake and wheel brake effectiveness. Pitch attitudes less than 12 - 13 ° will be less effective and result in a longer landing roll.

CAUTION

- Limit pitch attitude to 15° to avoid dragging the tail. The aircraft symbol (W on the HUD) will flash at 13°. Do not rely on the HUD repeater display for correct pitch attitude.
- The aircraft can sustain a flaps up aerobrake for a considerable distance. Unless the nose is lowered to the runway and wheel braking initiated, stopping distance will be greatly increased.

NOTE

Upon touchdown, **PW-229** engines will transition to ground idle thrust. However, the associated engine speed reduction will not be apparent until approximately 20 seconds after throttles are moved to idle.

During the aerobrake, monitor ground speed and runway remaining to determine the effectiveness of the aerobrake. If stopping distance is critical, lower the nose immediately and commence maximum anti-skid braking. In any case lower the nose of the aircraft not later than 80-90 knots and apply brakes as required to be at an appropriate taxi speed before turning off the runway. At high gross weights, or forward CG, the nose will begin to fall at proportionally higher airspeeds (refer to section VI). Due to a high idle thrust, the aircraft may not decelerate after the nosewheel is on the ground unless braking is used. Optimum braking is achieved in a three point attitude with maximum pressure on both brake pedals. Differential braking may reduce braking effectiveness and increase stopping distance. At aft center of gravity, if forward stick is not used to bring the nose down, expect the nose to stay up significantly longer during aerobraking. Due to high idle thrust, the aircraft may not decelerate after the nose wheel is on the ground unless braking is used.

WARNING

With low gross weight (less than 2,000 lbs of fuel), use caution in turns and avoid excessive speed. Weight-off-wheels switch may break contact and cause loss of brakes.

CROSSWIND LANDING

Landing is not recommended if the 90° crosswind component exceeds 30 knots. Fly a normal pattern adjusted to avoid excessively steep or shallow base turns. On final, establish a wings-level crab to counteract drift and maintain the flight path straight down the runway. It may be necessary to adjust power or delay throttle reduction in the flare to avoid abrupt sink rates or counteract the effects of turbulence. In gusty or turbulent conditions, use normal on-speed AOA; however, AOA deviations are more critical.

Hold the crab through touchdown. After touchdown, maintain ground track with rudder. Use aileron into the wind to maintain a wings-level attitude. After touchdown, if the crosswind component exceeds 25 knots, do not increase pitch attitude to greater than 10°. If directional control becomes difficult, lower the nose and brake in a three-point attitude. See Wind Components Chart, figure A1-12 or B1-12.

NOTE

When landing with an asymmetric load, it is desirable to place the heavy wing into the wind.

MINIMUM RUN LANDING

When stopping distance is critical, fly final at 23 units AOA, and use a flatter approach angle (1 ½° - 2°). Precise control of the touchdown point can be achieved using the velocity vector. If runway is dry and gross weight is 45,000 pounds or less, lower nose after touchdown and commence maximum anti-skid braking. Maximum anti-skid braking is achieved by applying maximum pedal pressure. If gross weight is greater than 45,000 pounds, use aerobraking technique. For wet/icy runway conditions, refer to Section VII.

NO FLAP LANDING

No flap landings require no special technique. Approach speed is slightly faster at on-speed AOA and the aircraft is more sensitive in pitch. Allow for higher pitch attitude and slower deceleration on final.

CAUTION

The aircraft can sustain a flaps up aerobrake for a considerable distance. Unless the nose is lowered to the runway and wheel braking initiated, stopping distance will be greatly increased.

GO AROUND

Advance power as required and retract speed brake. Retract gear and flaps when climb is established. Accelerate to 200-250 knots if another approach is planned. If climbing out of the pattern, a higher airspeed may be used.

AFTER LANDING

1. (BOTH) Ejection controls safety lever - LOCKED
2. (W) Command Selector valve - NORMAL
3. (P) (BEFORE TO1F-15E-655) ANTI-SKID - OFF BELOW 30 KNOTS
4. (P) Speed brake - IN
5. (P) Flaps - UP
6. IFF modes - DESELECT
7. Mode 4 crypto switch - HOLD MOMENTARILY AND RETURN TO NORM
8. (P) Radar power knob - STBY
9. (P) TF radar - OFF
10. (P) Trim - T/O
11. (P) Landing/taxi light - AS REQUIRED
12. (P) Formation lights - OFF
13. (P) Pitot heat and windshield switches - OFF
14. (P) ENG HEAT - AS REQUIRED
15. Mode 4 selector switch - OUT
16. INS - UPDATE (if position known)

SINGLE-ENGINE TAXI

1. (BOTH) Avionics - AS REQUIRED
2. MPDs/MPCDs - AS REQUIRED
   The right display in each cockpit should be left on to monitor cautions.
3. UHF #2 - VERIFY ON
4. (P) Either throttle - OFF
5. (P) Corresponding engine master switch - OFF
   Placing the engine master switch OFF resets the automatic avionics shutdown system.

NOTE

Automatic avionics shutdown may occur due to low ECS cooling airflow at idle RPM. Single engine RPM at 73 - 78% should provide sufficient airflow.

HOT REFUELING

Stop short of the refueling area for tanks/stores safety check. If suspected hot brake or other unsafe condition exists, do not enter refueling area. Consider all available methods of escape should a fire or other emergency occur. Taxiing clear, ground egress, and static ejection are some of the options available. Follow ground crew directions into the refueling area, and establish communications with the ground crew. If you suspect a malfunction stop refueling. Do not transmit on UHF except in an emergency. After refueling complete and when cleared by ground crew, taxi clear of the area. Do not use high power in congested areas.

Before Refueling -

1. After landing checklist - COMPLETE
2. (P) Holding brake - ON
3. (BOTH) Avionics - AS REQUIRED
4. (P) Anti-collision lights - OFF
5. (P) Slipway switch - OPEN

NOTE

Either engine may be shut down for hot refueling. In actual combat situations, both engines may be left running.

6. (P) MPDP/AIU 1 - OFF 5 SEC THEN ON
7. Either throttle - AS DIRECTED
8. (P) Inoperative engine master switch - OFF
9. UHF#2 - VERIFY ON

NOTE

Automatic avionics shutdown may occur during refueling due to low ECS cooling airflow. The most notable indication will be blanking of the right displays. Single engine rpm at 73 - 78% should provide sufficient airflow for avionics cooling. Make sure UHF #2 continues to operate if auto shutdown occurs. The operative engine ramp may extend full up with automatic avionics shutdown.

10. (BOTH) Canopy - CLOSED
    Hot refueling with the canopy closed provides maximum protection in the event of a fire.
11. (BOTH) Fuel quantity - NOTE

During Refueling -

12. (BOTH) Keep hands visible to refueling supervisor. Be prepared to shut down engine and evacuate aircraft or taxi clear of area as directed by ground crew if an emergency occurs.

After Refueling -

13. Fuel quantity indicator - CHECK AND NOTE TOTAL QUANTITY
14. (P) Slipway switch - CLOSED
15. (P) External lights - AS REQUIRED
16. (BOTH) Avionics - AS REQUIRED

ENGINE SHUTDOWN

1. (P) Slipway switch - OPEN (if required)
2. (P) OWS matrix - CHECK
3. INS - UPDATE
4. (P) Video recorder - UNTHREAD
5. (BOTH) LANTIRN pods - OFF
6. (P) INS - OFF (obtain mission data)
7. DTM - WRITE (if desired)
8. (BOTH) Avionics - OFF (AAI, ILS, TACAN, SENSORS, HUD, TEWS, RADAR)
   Turn avionics OFF, including systems controlled on the UFC, before shutting down engines to prevent false BIT warnings on the status panel.
9. (BOTH) MSOGS - OFF

NOTE

If MSOGS is not turned off prior to engine shutdown, the system will register a fault requiring corrective maintenance action prior to next flight.

10. (P) Throttles - OFF
    (15 seconds after INS OFF)

Wait 15 seconds after INS shutoff to allow the VTR to unthread. Prior to engine shutdown with **PW-220** engines, if maintenance requests and local safety conditions permit, scavenge the engine oil system by advancing the throttle(s) to 75-78% rpm and stabilize for 5-10 seconds. Place the throttle(s) to IDLE and stabilize for 1-2 seconds and then return to cutoff. Before the emergency generator drops off the line, ensure that the L and R GEN OUT caution lights and the landing gear indicator lights come on. Illumination of these lights indicates that the generator failure circuit is functioning and the emergency generator is supplying both AC and DC essential power.

WARNING

Wait 10 minutes after **PW-229** engine shutdown before inspecting engine inlets and exhausts due to possibility of auto-ignition after shutdown.

CAUTION

With **PW-229** engines, shutdowns with less than 5 minutes stabilization at IDLE prior to shutdown increase the likelihood of post shutdown auto-ignition.

OWS MATRIX DISPLAY

To display the OWS matrix -

1. From MENU 2, OWS menu - SELECT

To clear the OWS matrix -

2. CLEAR pushbutton - PRESS (CLEAR boxed) Ensure maintenance personnel toggle OWS reset switch on the ASP and reset ASP 72.

WARNING

To prevent injury, do not clear maintenance personnel to enter the nose wheelwell unless one engine is shut down.

3. Matrix cleared - CHECK (CLEAR unboxed and ASP 72 black)

UFC PROCEDURES

DATA FORMATS

Numerous different types of data may be entered on the UFC for navigation. In most cases, data is entered by first selecting the appropriate menu display, data display, or submenu; typing the data into the scratch pad; and pressing the UFC button adjacent to the data to be changed or entered.

SEQUENCE Points

Sequence point types include steer, target, aim, offset, mark, and base and are entered in basically the same manner. However, the aircrew must pay attention to the use of the decimal point, tenths and hundredths digits, and route letter identifiers.

a. For steer point 18A, type 18, shift (SHF), A, press sequence point button.
b. For target point 17.B, type 17, decimal, SHF, B, press sequence point button.
c. For aim point 18.1A, type 18, decimal, 1, SHF, A, press sequence point button.
d. For offset point 17.01B, type 17, decimal, 01, SHF, B, press sequence point button.
e. For base point, type B, press sequence point button.

When changing navigation point numbers, the route letter identifier needs to be entered only if it is different from the current display letter. Entering a zero for a point, when in Point Data submenu, removes that point from the mission route unless it is your current steer to point.

Latitude/Longitude

To enter a point latitude and longitude, type the hemisphere, degrees, minutes, and thousandths of minutes. When the hemisphere key (N, S, E, or W) is pressed, the degree symbol, minutes symbol, decimal, and entered letter are displayed on the scratchpad. Leading zeros must be included if the latitude degrees are less than two digits or the longitude degrees are less than three digits.

a. For 38°45.6 north latitude, type SHF, N, 38456, press latitude button.
b. For 90°22.1 east longitude, type SHF, E, 090221, press longitude button.

UTM Spheroid, Grid, and Coordinates

UTM coordinates are changed/entered on the UTM or program submenu; the spheroid grid are changed on the UTM program submenu. Grid numbers can be changed on the UTM submenu.

For UTM coordinates 18S 6897064356

a. Press UTM COORDINATE BUTTON.
b. To change the UTM spheroid, press the button adjacent to the current spheriod to cycle through until the desired spheriod is displayed.
c. To change the UTM grid number to 18, type 18, press grid number button.

d. To change the UTM grid letter, press the button adjacent to the grid identifier until the letter to be changed is preceded by a caret, then press the INCR or DECR button to obtain the desired letter.
e. Type 6897064356, press UTM coordinate button.

Point Elevation

Navigation point elevation is entered in feet above or below (−)MSL.

a. For 1250 feet MSL, type 1250, press elevation button.

Point MEA

The MEA for any point along the route may be entered from 400 to 30,000 feet.

a. For 1000 feet, type 1000, press MEA button.

Range/Bearing

Type offset range in NM and tenths.

a. For 10.1 NM, type 10, decimal, 1, press range button.

Type offset bearing in degrees true.

a. For 35° true bearing, type 035, press bearing button.

Direction/Range

Type offset direction/range in cardinal direction and feet.

a. For 15,250 feet north, type SHF, N, 15250, press N/S button.

Time

Current time or route times are entered in hours, minutes, and seconds.

a. To enter 16 hours, 35 minutes, 15 seconds, type 163515, press time button.

Magnetic Variation (if INS invalid)

Magnetic variation is entered in degrees and minutes east or west. The degree symbol appears in the scratchpad when E or W is pressed.

a. To enter a mag var of W3°30', type SHF, W, 0033, press mag var button.

Wind Direction and Speed

Wind direction (bearing) is entered in degrees true and speed in knots on the Data 1 Format.

a. For wind 185° true and 45 knots, type 185, SHF, dash, 045, press wind button.

DATA ENTRY/DISPLAY (BOTH)

Mission data must be entered from the appropriate display on the UFC; some data can be entered/changed on more than one display. As data is typed on the UFC keyboard it appears in the scratchpad. When the appropriate button is pressed to enter the data, the new data is displayed next to the button and the scratchpad is blank.

Present Position

Present position entry is required during INS alignment if HUD window 16 displays PP REQ. Present position also should be entered if the PP display on the UFC after INS turn-on is incorrect. When entered the PP becomes the base point.

1. Menu 2 display - SELECT
2. PP INS source submenu - SELECT
3. Type present latitude.
4. Latitude button - PRESS
5. Type present longitude.
6. Longitude button - PRESS

Magnetic Variation (Mag Var)

Magnetic variation is not required as an input to the INS for its alignment or navigation operation. INS provides mag var from a stored mag var table based on the latitude and longitude of the aircraft. Mag var accuracy is dependent on aircraft location. During normal operation the CC uses mag var from the INS. If the INS has failed, the CC will use the last known good mag var. If the INS has failed and/or air data is selected, then mag var can be entered via the UFC for use by the CC.

1. Menu 2 display - SELECT
2. PP INS source submenu - SELECT
3. Type present position mag var.
4. Mag var button - PRESS

Sequence Point Number

1. Data 1/Menu 1 display - SELECT
2. Type new mission point number and letter.
3. Mission point button - PRESS

Sequence Point Lat/Long

1. Data 1/Menu 1 display - SELECT
2. Point data submenu - SELECT
3. Coordinate button - PRESS UNTIL LAT/LONG SUBMENU APPEARS
4. Type point latitude
5. Latitude button - PRESS
6. Type point longitude
7. Longitude button - PRESS

Sequence Point Elevation

1. Data 1/Menu 1 display - SELECT
2. Point data submenu - SELECT
3. Type mission point elevation
4. Mission point elevation button - PRESS

Sequence Point MEA

1. Data 1/Menu 1 display - SELECT
2. Point data submenu - SELECT
3. Type mission point MEA
4. Mission point MEA button - PRESS

Sequence Point UTM's

1. Data 1/Menu 1 display - SELECT
2. Point data submenu - SELECT
3. Coordinate button - PRESS UNTIL UTM DISPLAY APPEARS

To change UTM coordinates:

4. Type point UTM coordinates
5. UTM coordinate button - PRESS

To change UTM spheroid:

4. Program button - PRESS
5. Spheroid button - PRESS UNTIL DESIRED SPHEROID APPEARS

To change UTM grid number:

4. Type new UTM grid number
5. Grid identifier button - PRESS

To change UTM grid letter:

4. Program button - PRESS
5. Grid identifier button - PRESS UNTIL CARET PRECEDES LETTER TO BE CHANGED
6. INCR or DECR button - PRESS TO DISPLAY DESIRED LETTER
7. Repeat steps 5 and 6 for other grid letters to be changed.

Offset Data

1. Data 1/Menu 1 display - SELECT
2. Point data submenu - SELECT
3. Coordinate button - PRESS UNTIL RNG/BRG IS DISPLAYED
4. RNG/BRG button - PRESS

To change offset range/bearing data:

5. Type range from offset point to target
6. Range button - PRESS
7. Type true bearing from offset point to target
8. Bearing button - PRESS

To change direction/range data:

5. DIR/RNG button - PRESS
6. Type N/S distance from offset point to target.
7. N/S button - PRESS
8. Type E/W distance from offset point to target
9. E/W button - PRESS

Tacan Data

Twelve tacan stations may be stored in addition to the mission points. The data is used for tacan navigation or updates.

1. Menu 1 display - SELECT
2. Tacan submenu - SELECT
3. Program button - PRESS
   Program submenu appears with the selected tacan channel number, its index number, and coordinates.
4. Press index button to increment 1 thru 12 to the desired index number or type and enter the INDEX number.
5. Type desired tacan channel number.
6. TCN button - PRESS
7. Type tacan station latitude
8. Latitude button - PRESS
9. Type tacan station longitude
10. Longitude button - PRESS
11. Type tacan station mag var

12. Mag var button - PRESS
13. Type tacan station elevation
14. Elevation button - PRESS
15. Press mode button to select either X or Y channel system
16. Repeat steps 4 thru 15 for each of 12 programmed tacan stations

NOTE

When programming channel and index numbers, index numbers should be changed before the channel numbers. Failure to use this sequence could result in an incorrect channel number being entered into an index number.

HUD Titling (TITL)

HUD titling data is entered for identification of the video tape recorder and signal data recorder outputs. HUD titling can be done manually using the HUD TITL submenu or automatically using the DTM. In either case, to verify or modify the data, do the following:

1. Menu 2 display - SELECT
2. PP source submenu - SELECT
3. HUD TITL submenu - SELECT
4. Verify data is correct. If corrections are required, continue as shown.
5. Type month and date.
   a. To enter the date of June 30, type 06, SHF, dash, 30.
6. Month-day button - PRESS
7. Type year.
   a. To enter the year 1989, type 89.
8. Year button - PRESS
9. Type mission number.
   a. To enter the mission number 5, type 05.
10. Mission (MSN) button - PRESS
11. Type aircraft tail number.
   a. To enter aircraft tail number 86-0183, type 86, SHF, dash, 0183.
12. A/C button - PRESS
13. Type wing number.
   a. To type wing number 131, type 0131.
14. WNG button - PRESS
15. Type local use data.
   a. Local 1 and 2 (LOC-1, LOC-2) are four-digit numbers for local use (gun number or squadron). Type digits.
16. LOC-1 or LOC-2 button - PRESS

INS PROCEDURES

INS ALIGNMENTS

During the selected ground alignment mode, present position should be entered only when the aircraft is not moving and with the holding brake applied.

During INS alignment, displays called out as appearing in HUD window 16 also appear on the radar A/G PVU display if selected on an MPD/MPCD. INS mode knob position is selected by the pilot; all other alignment steps may be accomplished by either crewmember.

Normal GC Alignment (Switch OFF to GC)

1. (P)INS mode knob - GC
   After approximately 7 seconds, HUD displays GC PP REQ or GC NO TAXI. If the pilot's UFC is not displaying a submenu, the PP submenu is automatically selected on the UFC for the pilot evaluation of the PP being used for INS alignment. If the PP is acceptable no input is required. If PP REQ is displayed a new PP must be entered. GC PP REQ remains until a new PP is entered or the system transitions to NAV. INS attitude stabilization requires approximately 30 seconds and is accomplished while either PP REQ or NO TAXI is displayed.

NOTE

The PP entered should be the aircraft location and both latitude and longitude must be re-entered (even if only one required corrections). Position corrections after the aircraft has moved should be done by update after transition to NAV but may result in poor performance. Therefore, it is vitally important that PP is entered correctly when aligning.

2. Present position - INPUT NEW PP IF REQUIRED
3. GC NO TAXI - displayed for 60 seconds on HUD window 16.
4. HUD window 16 - GC 15.9 (After approximately 30 seconds dependent on other priority displays.)
   The display of GC 15.9 in place of NO TAXI indicates that attitude has stabilized. Alignment quality number (15.9) decrease indicates

alignment accuracy improvement. The aircraft may be taxied and flown at this time, however, degraded accuracy should be expected.

NOTE

Taxiing is allowed with GC selected. GC HOLD is displayed while the aircraft is in motion. To continue the alignment, the holding brake must be turned ON after the aircraft is stopped and the INS detects no aircraft motion; GC HOLD will be replaced with GC XX.X (alignment quality).

5. HUD window 16 - GC OK (After approximately 4 minutes)
   Display of GC OK indicates GC alignment complete.
6. (P)INS mode knob - NAV

SH Alignment

1. (P)INS mode knob - STORE
   After approximately 7 seconds, HUD displays SH PP REQ or SH NO TAXI. The PP submenu is automatically selected on the pilot's UFC (if not in submenu) for the pilot's evaluation of the PP being used for INS alignment. If PP REQ is displayed or if the pilot determines the INS PP is incorrect, the present position must be entered and the INS will not display SH but will display GC and will enter a full GC alignment. INS attitude stabilization requires approximately 30 seconds and is accomplished while either PP REQ or NO TAXI is displayed.
2. HUD window 16 - SH NO TAXI

NOTE

If the aircraft is moved with STORE selected, GC HOLD is displayed while the aircraft is in motion. The INS will discard the SH alignment and continue a GC alignment if the aircraft is stopped and the holding brake turned ON and the INS detects no aircraft motion; GC HOLD will be replaced with GC XX.X (alignment quality).

3. HUD window 16 - SH OK
   SH OK should be displayed in approximately 40 seconds because the SH alignment time of 40 seconds is run concurrent with the attitude stabilization time of 30 seconds. SH OK indicates SH alignment complete.
4. (P)INS mode knob - NAV
   The INS mode switch should be switched to NAV prior to movement of the aircraft.

Direct Transition GC Alignment (OFF to NAV)

1. (P)INS mode knob - NAV
   After approximately 7 seconds, HUD displays GC PP REQ or GC NO TAXI. The PP submenu is automatically selected on the pilot's UFC (if not in a submenu) for the pilot evaluation of the PP being used for INS alignment. If the PP is acceptable no input is required. If PP REQ is displayed a new PP must be entered. GC PP REQ remains until a new PP is entered or transitions to NAV. INS attitude stabilization requires approximately 30 seconds and is accomplished while either PP REQ or NO TAXI is displayed.

NOTE

The PP entered should be the aircraft location. Further corrections after the aircraft has moved should be done by update after transition to NAV.

2. Present position - INPUT NEW PP IF REQUIRED
3. GC NO TAXI - displayed for 60 seconds on HUD window 16.
4. HUD window 16 - GC 15.9 (After approximately 40 seconds dependent on other priority displays.)
   The display of GC 15.9 in place of NO TAXI indicates that attitude has stabilized. Alignment quality number (15.9) decrease indicates alignment accuracy improvement. The aircraft may be taxied and flown at this time, however, degraded accuracy should be expected.

NOTE

Taxiing is allowed with GC selected. GC HOLD is displayed while the aircraft is in motion. To continue the alignment, the holding brake must be turned ON after the aircraft is stopped and the INS detects no aircraft motion; GC HOLD will be replaced with GC alignment quality.

5. HUD window 16 - Blank (After approximately 4 minutes)
   Indicates GC OK and transition to NAV.

PERFORMANCE MONITOR DATA

To insure complete INS performance monitor data is stored, an on-ground visual overfly update must be performed at the end of flight. The update may be performed at any location on the ground. At the aircraft shutdown location, the INS should be turned off with the mode switch. The performance monitor data can be reviewed for the current flight by turning the INS off, and after 10 seconds turning the INS back to GC. The data can be displayed on the MPD as follows:

1. Push PB 11 for master menu
2. Push PB 20 for BIT menu
3. Push PB 18 for maintenance menu
4. Push PB 9 for INS 1st flight data
5. Push PB 13 for each of the second through twelfth flight

Data displayed for the most recent flight is as follows:

a. Initial latitude and longitude
b. Type of ground alignment; time in align and IFA if appropriate
c. Final aided latitude and longitude
d. Time in Nav
e. Final unaided latitude
f. Final unaided longitude
g. Groundspeed
h. RER (Radial Error Rate)
i. CEP (Circular Error Probable) and number of flights in CEP calculation (max of 12)
j. In spec or maintenance, check recommendation.

Data which may be displayed for second through twelfth last flight is as follows:

a. Type of ground alignment and time in align
b. Groundspeed
c. RER
d. CEP (Same for all flights stored) and number of flights in CEP calculation (max of 12).

UPDATE PROCEDURES

INS and/or mission navigator (MN) present position may be updated by comparison with tacan data (TCN update), visual position (OFLY or HUD updates), radar ground target position (RBM or HRM update) or target pod line of sight data (LANTIRN update). Also a provision for altitude only updates is included.

Following an update procedure, the distance from the INS or MN present position to the tacan, HUD, overfly, radar, or target pod derived position is shown on the update format. If the distances are ≤ 3000 feet, they are shown in feet N/S and E/W. If greater than 3000 feet, the distances are shown in nautical miles to the nearest tenth. The difference data can be either accepted or rejected.

System altitude updates can be accomplished with the overfly, altitude-only or target pod formats. Altitude error data is always displayed in feet. System altitude is also updated if the INS or MN present position (PP) is updated with these formats.

With all update formats, if INS PP is updated, then so is MN PP and system altitude, if applicable. INS-PP keeping must be used for an INS update. If MN PP-keeping is selected, INS update errors will be invalid (INV).

1. UFC Menu 2 display - SELECT
2. UPDT SEL - SELECT
3. Select desired update mode
   a. OFLY
   b. HUD
   c. ALT
   d. TCN

Tacan Update

4. TCN - SELECT
5. Ensure desired tacan channel number and system (X or Y) is selected.
6. Desired update source (INS or MN) - SELECT
7. To accept the update, ENTER button - PRESS
8. To reject the update, exit the update submenu or perform another update.

Overfly Freeze Update

An INS overfly freeze update done on the ground after landing is done to store complete performance data. The update can be done anytime/place where present position is known.

4. OFLY - SELECT
5. When directly over the point to be updated (selected at PB 1), FREEZE button - PRESS
6. Desired update source (INS or MN) - SELECT
7. To accept the update, ENTER button - PRESS
8. To reject the update, exit the update submenu or perform another update.

HUD Update (P)

4. HUD - SELECT
5. NAV (or INST) master mode - SELECT
6. Take command of HUD
7. Press and hold the TDC to slew line-of-sight symbol over visual update point (update point selected at PB 1).
8. Toggle PB 10 to desired source for update (INS or MN)
9. To accept the update, ENTER button - PRESS
10. To reject the update, exit the update submenu or perform another update

Altitude Update

An altitude-only update can be performed using two methods - overflying a steer-to point with a known elevation or overflying a known surface elevation (lake, ocean or plain). If the surface (SURF) format is to be used, PB 1 is toggled to display "SURF" and then the surface elevation is entered at PB 2. CC provided system altitude is displayed at PB 3 for both formats.

4. ALT - SELECT

Steer-to Format

5. When directly over the point to be updated (selected at PB 1), FREEZE button - PRESS
6. To accept the update, ENTER button - PRESS
7. To reject the update, exit the update submenu or perform another update.

SURF Format

5. Toggle PB 1- SURF displayed
6. Enter surface elevation at PB 2 via UFC scratchpad
7. When over surface, FREEZE button - PRESS
8. To accept the update, ENTER button - PRESS
9. To reject the update, exit the update submenu or perform another update

LANTIRN Update

1. Take command of FLIR display on MPD/MPCD
2. PB 17 - VERIFY CORRECT SEQUENCE POINT NUMBER DISPLAY
3. Cursor UPDT function - SELECT
4. MN, INS or ALT update (PB 16) - SELECT
5. Slew cursor over update point, position errors and command track displayed
6. Fire Laser
7. Accept by full action TDC (P) or Trigger (W)

Real Beam Map (RBM) Update

1. Take command of RBM display
2. PB 17 - VERIFY CORRECT SEQUENCE POINT NUMBER
3. Cursor UPDT function - SELECT
4. Mission Navigator or INS update (PB16) - SELECT
5. Slew cursor over update point, position errors displayed
6. Accept or deselect update

High Resolution Map (HRM) Update

1. Take command of HRM display
2. PB 17 - VERIFY CORRECT SEQUENCE POINT NUMBER
3. Cursor UPDT function - SELECT
4. Mission Navigator or INS update (PB16) - SELECT
5. Slew cursor over update point, position errors displayed
6. Accept or deselect update

PVU Update

NOTE

If the INU, CC or radar antenna has been replaced or the CC program has been reloaded, an INS PVU is required to correct for pointing errors. This should be done as early in the flight as practical.

1. Take command of radar A/G display
2. PVU - SELECT
   MN is boxed.

If MN PVU update required

3. Wait for errors to appear and stabilize.
4. Accept update by pressing the TDC (P) or selecting full action (FA) on the trigger (W).

NOTE

MN PVU update is zeroed out after 5 minutes.

If INS PVU update required

3. INS (PB 9) - SELECT
   MN is unboxed and INS is boxed.
4. Wait for errors to appear.
5. To initiate INS PVU, press the TDC (P) or select FA on the trigger (W).
6. Perform gentle climbs, dives, accelerations, decelerations and turns at less than 45° bank, for approximately 2 minutes.
7. To accept update when complete or to exit mode, MN - SELECT
   INS is unboxed.

EXTERNAL POWER START

(Following cockpit interior check)

If external power is to be used more than 2 minutes before starting engines, ensure the number 1 ground power switch is in A ON, CC and PACS switches are OFF, and all other ground power switches are in AUTO. If cooling air is available, avionics may be on as desired.

1. (P) External power switch - RESET

NOTE

If finger lifts are raised with electrical power on the aircraft and engine master switches ON, an engine will engage without command as the JFS starts.

2. (P) Holding brake - ON
3. (BOTH) MPD's/MPCD's/HUD - ON (if cooling air available)
4. (P) Fire extinguisher switch - TEST
5. (BOTH) Warning and caution lights - TEST

JFS START (P)

1. Engine master switches - CHECK ON
2. JFS switch - CHECK ON
3. JFS handle - PULL AND RELEASE

WARNING

If the JFS does not start, the starter switch should be placed OFF. Wait 30 seconds after cycling the switch to allow the start sequence relay to disengage and the JFS to decelerate before trying a second start. Failure to wait 30 seconds may result in a JFS no start.

4. JFS READY light - ON (within 10 seconds)

ENGINE START (P)

1. Right throttle finger lift - RAISE AND RELEASE
2. Right throttle - IDLE (20% RPM)
3. (BOTH) Engine instruments - CHECK
4. JFS deceleration - CONFIRM
5. External power - DISCONNECT
6. EMER BST ON and BST SYS MAL cautions - OBSERVE ON
   The EMER BST ON caution does not come on with external power applied. When external power is disconnected the EMER BST ON caution and BST SYS MAL caution come on immediately. This condition is normal and both lights will go out after the second main generator comes on the line. To check the emergency generator/emergency boost pump system, cycle the emergency generator switch to MAN and then back to AUTO. The BST

SYS MAL caution goes off and the EMER BST ON caution remains on while the switch is in MAN.

7. Left engine - START (steps 1 thru 3)
8. JFS - CONFIRM OFF; JFS SWITCH ON
9. ECS - CHECK Ensure ECS caution is off and airflow is present.
10. Inlet ramp switches - AS REQUIRED
11. Engine anti-ice switch - AS REQUIRED
12. Engine control switches - CYCLE (engine and ENG CONTR cautions OFF)

Confirm nozzle operation with the ground crew

BEFORE TAXI

1. Continue with normal procedures.

SCRAMBLE

COCKPIT SETUP

NOTE

All aircraft maintenance, loading of fuel, weapons and stores should be done prior to performing the INS GC alignment to get the best STOR alignment results.

1. (BOTH) Complete the Before Flight procedures through Before Taxiing.
2. (P) When the INS has aligned in GC (GC OK), INS mode knob - OFF. If the aircraft is not moved the INS is ready for a stored heading alignment.
3. (BOTH) Do Engine Shutdown procedure.

NOTE

Leave UHF radio and individual displays on.

4. (BOTH) Ejection controls safety lever - LOCKED
5. (BOTH) Avionics switches - ON (EXCEPT RADAR, TEWS, NAV and TGT PODS and INS)
6. (P) Pitot Heat - ON
7. Do not move the aircraft.

JFS/ENGINE START

1. Use normal procedures.

BEFORE TAXIING

1. (BOTH) Multi purpose display switches - ON
2. (P) INS mode knob - STORE

Best INS performance is obtained by selecting NAV immediately after SH OK is displayed. However if PP is not correct or 'GC PP REQ' is displayed on HUD, a full GC alignment is required.

3. Present position - CHECK
4. For GC alignment, enter PP and perform full GC alignment (approximately 4 minutes)
5. (BOTH) Communications and navigation equipment - CHECK
6. (P) Radar - ON
7. (BOTH) Altimeters - SET AND CHECK
8. (P) CAS - RESET
9. (P) INS mode knob - NAV (SH OK)
10. (BOTH) Flight controls - CHECK FREE
11. (BOTH) Flaps - CHECK DOWN
12. IFF - AS REQUIRED
13. (P) T/O trim - CHECK
    If the aircraft is manually trimmed nose down from takeoff trim, nosewheel lift-off speed may be increased.
14. (BOTH) Standby attitude indicator - UNCAGE
15. Canopy - CLOSE, WAIT 10 SEC, THEN LOCK

CAUTION

- Make sure canopy has completed movement and wait 10 seconds before moving handle to LOCKED position. If there is heavy load when attempting to place the handle in LOCKED, recycle handle to DN and again perform locking procedure. Make sure canopy unlock light is on with handle DN and goes out with handle LOCKED. Make sure the handle is full forward.
- Canopy may not fully close with hydraulic pressure if the ambient temperature is below 0° F. In this case and after attempting to close the canopy mechanically, the pilot may force the canopy closed. With the canopy down on the sills and the internal canopy control handle set to DOWN position, grab hold of the two handles on the forward arch of the canopy and shove the canopy forward. Once the canopy moves fully forward the control handle can be set to LOCKED position.

16. (BOTH) Warnings, cautions, BIT lights, and circuit breakers - CHECK
17. (BOTH) Personal equipment and harness - CHECK
18. (BOTH) Weapons - CHECK

BEFORE TAKEOFF

1. (BOTH) Ejection controls safety lever - ARMED
2. TEWS - CONFIRM ON

QUICK TURN (BOTH)

1. After landing checks - COMPLETE
2. Communication with groundcrew - ESTABLISH (if required)
3. Engine shutdown - COMPLETE (if required)
4. Aircraft setup - COMPLETE (if required)
5. Consider cumulative brake heating effect.

WARNING

After an abort or full stop taxi back landing, consider the cumulative heating effect on the brakes in the event the second takeoff results in an abort.

SECTION III

EMERGENCY PROCEDURES AND ABNORMAL OPERATION

TABLE OF CONTENTS

This section covers the operation of the aircraft during emergency/abnormal conditions. It includes a discussion of problem indications and corrective actions as well as procedural steps when applicable. Adherence to these guidelines will insure maximum safety for the aircrew and/or aircraft. The situations covered are representative of the most probable malfunctions. However, multiple emergencies, weather or other factors, may require modification of the recommended procedures. Accomplish only those steps required to correct or manage the problem. When dealing with emergency/abnormal conditions, it is essential that you determine the most correct course of action, using sound judgment, common sense and a full understanding of the applicable system(s). When practical, advise other concerned agencies (i.e., flight lead, tower, etc.) of the problem and intended course of action. The following rules are basic to all emergency/abnormal conditions. You should thoroughly understand and apply them.

1. MAINTAIN AIRCRAFT CONTROL
2. ANALYZE THE SITUATION AND TAKE THE PROPER ACTION
3. LAND AS SOON AS PRACTICABLE

During any inflight emergency, when structural damage or any other failure is known or suspected that may adversely affect aircraft handling characteristics, perform a Controllability Check.

Retain the canopy during all emergencies that could result in crash or fire such as crash landing, aborted takeoff, or arresting gear engagement. The protection the canopy affords you during such emergencies far outweighs the isolated risk of entrapment due to canopy malfunction or overturn. During ground egress, consider normal canopy opening procedures first to preclude the possibility of a static seat ejection.

WARNINGS/CAUTIONS/ADVISORIES

DISPLAY	CAUSE	CORRECTIVE ACTION/REMARKS
RED WARNING LIGHTS		
AI	Air intercept threat	Information
AMAD FIRE	Fire condition	Refer to emergency procedure (Front cockpit only)*
L BURN THRU R BURN THRU	Abrupt temperature change in AB section	Retard throttles out of AB range (Front cockpit only)
CANOPY UNLOCKED	Canopy unlocked or canopy actuated initiator lanyard disconnected	GROUND: Relock canopy or connect lanyard AIR: Airspeed - 250 KNOTS Cockpit pressure - DUMP (below 25,000 feet) Canopy control handle - FULL FORWARD
FIRE	Excessive temperature in indicated area	Refer to emergency procedures
Landing Gear Handle	Gear up and aircraft in landing regime, gear not in selected position, no control power, or ADC failed	Climb or Refer to emergency procedures*
LOW ALT (LOW ALTITUDE)	Aircraft has descended below 75% of set clearance plane value or AFCS system determines or predicts you will reach less than 75% of ground clearance if action not taken	Climb to proper altitude and check system for problems
LOW ALT	Aircraft has descended below LAW altitude selected in UFC menu 1	Climb above LAW altitude
OBST	Obstacle in flight path requiring more than 2g to clear	Climb or turn
SAM	Missile threat	Information
TF FAIL	Terrain following failed	Do not rely on terrain following indications
UNSAFE	Gear up and aircraft in landing regime, gear not in selected position, no control power, or ADC failed	Information (Rear cockpit only)
BST SYS MAL	Emergency boost pump logic malfunction	Refer to emergency procedure*
* ADDITIONAL INFORMATION AVAILABLE IN THIS SECTION		

WARNINGS/CAUTIONS/ADVISORIES (Continued)

DISPLAY	CAUSE	CORRECTIVE ACTION/REMARKS
YELLOW CAUTION LIGHTS (CAUTION LIGHT PANEL)		
AV BIT	Avionics BIT failure	Check BIT display on MPD/MPCD If FLT CONTR caution also on - Refer to LAT STK LMT caution*
CHAFF	Flashing: Dispensing chaff Steady: Chaff dispenser empty	Information
DISPL FLO LO	Inadequate cooling air flow to cockpit displays	Refer to emergency procedure*
EMER BST ON	Emergency boost pump supplying pressure	Check BST SYS MAL caution out/off
ENGINE	Engine systems failure	Check MPD/MPCD cautions
FLARE	Flashing: Dispensing flares Steady: Flare dispenser empty	Information
UNARMED/ NO ATF	Flyup enable switch ON	Information (Rear cockpit only)
FLT CONTR	Flight control system failure	Check MPD/MPCD cautions
FUEL LOW	Left feed tank below 540 pounds and/or Right feed tank below 960 pounds	Use minimum power - Check all tanks
L GEN	Left/right generator failure	Refer to emergency procedure*
R GEN		
HYD	Hydraulic systems failure	Check MPD/MPCD cautions
MINIMUM	Dispensable stores at predetermined level	Information
NUCLEAR	Nuclear armament malfunction	Check armament display
1 OXYGEN	Oxygen concentration is below acceptable limits	Refer to MSOGS Emergency Procedures
EMIS LMT	EMIS LMT switch ON	Information
FLAPS	Flaps in transit	Information

NOTES

*ADDITIONAL INFORMATION AVAILABLE IN THIS SECTION

1 F-15E 90-0233 AND UP; ALSO F-15E 86-0183 THRU 90-232 AFTER TO 1F-15E-561

WARNINGS/CAUTIONS/ADVISORIES (Continued)

DISPLAY	CAUSE	CORRECTIVE ACTION/REMARKS
YELLOW CAUTION LIGHTS (CAUTION LIGHTS PANEL) (cont)		
LASER ARMED	Target pod laser armed	Information (Front cockpit only)
LOCK/SHOOT	Steady: Radar locked on Flashing: Shoot cue	Information (Canopy bow)
MASTER CAUTION	One or more cautions displayed	Check caution lights and MPD/MPCD
HUD WARNINGS (TF)		
FLYUP	FLYUP initiated	Recover aircraft to safe altitude and determine cause of flyup
UNARMED	Malfunctions preclude auto flyup	Determine cause of flyup fault
NO ATF	ATF not available	Recover aircraft to safe altitude. Determine cause of failure.
TF FAIL	Terrain following failed	Recover aircraft to safe altitude. Determine cause of failure.
OBSTACLE	Obstacle requiring more than 2.0g is in aircraft flight path	Climb or turn away from obstacle
G-LIMIT	Flyup command greater than 2.1g	Climb to zero g command. Recover at safe altitude. Determine cause of failure.
TF LOW	Below 75% of selected terrain clearance or predicted to descend below 75% of selected clearance	Climb and recover aircraft to safe altitude. Determine cause of descending below set clearance.
HUD CAUTIONS (TF)		
ROLL	Roll angle exceeding 45° in TF mode	Decrease roll angle below 45°
TURN RATE	TF mode turn rate exceeded	Reduce turn rate
TURN ACCEL	TF mode turn acceleration limit exceeded	Reduce turn acceleration
DIVE	Dive angle $\geq$15°	Reduce dive angle to $<$15°
INS LIMIT	Drift, pitch or vector angle exceeded	Reduce exceeded limit
AIRSPEED	Airspeed too slow to accomplish flyup maneuver or exceeding TF radar limit($<$370 KCAS/400GS or 0.9 Mach)	Adjust speed accordingly

WARNINGS/CAUTIONS/ADVISORIES (Continued)

DISPLAY	CAUSE	CORRECTIVE ACTION/REMARKS
HUD CAUTIONS (cont)		
NO TERRAIN	TF radar cannot determine terrain altitude	Information. Continue following TF commands.
ECCM	Jamming interfering with TF radar	Select TF Radar ECCM mode if appropriate
N-F LOS	NAV FLIR LOS out of tolerance	Use NAV FLIR only with extreme caution
N-F BRST	NAV FLIR in boresight mode	Forward TDC may be used to slew NAV FLIR video
MPD/MPCD CAUTIONS		
ANTI-SKID	Anti-skid inoperative or OFF	Refer to emergency procedure*
ATTITUDE	Unreliable attitude source	Check standby attitude indicator* Select operable mode
AUTO PLT	Auto pilot malfunction and /or mode disengagement	Information
BINGO FUEL	Fuel at preset amount	Information
CAUTION	Caution lights are no longer functional	Information, cautions are not being displayed
L BLEED AIR R BLEED AIR	Left/right bleed air leak or overtemperature	Refer to emergency procedure*
BST SYS MAL	Emergency boost pump logic malfunction	Refer to emergency procedure*
L BST PUMP R BST PUMP	Left/right boost pump failure	Refer to emergency procedure*
CAS PITCH	Control augmentation system inoperative or disengaged in mode shown	CAS pitch - RESET
CAS ROLL		CAS roll - RESET
CAS YAW		CAS yaw - RESET/CAS roll - RESET
ECS	Environmental control system flow low or high temperature	Refer to emergency procedure*
* ADDITIONAL INFORMATION AVAILABLE IN THIS SECTION		

WARNINGS/CAUTIONS/ADVISORIES (Continued)

DISPLAY	CAUSE	CORRECTIVE ACTION/REMARKS
MPD/MPCD CAUTIONS (CONT)		
L ENG CONTR R ENG CONTR	Left/right DEEC failed, DEEC Mach number failure, AB full or partially inhibited. Or on aircraft before 90-0233, switch OFF	Refer to emergency procedure*
EMER BST ON	Emergency boost pump supplying pressure	Check BST SYS MAL caution off/out
FIRE SENSOR	Failed fire/temperature sensor	Information
FUEL HOT	Engine fuel temperature	Throttles - ADVANCE AS FEASIBLE TO A NON-A/B POWER SETTING Ground: If light does not go out within five minutes - ABORT
HOOK	Hook unlocked	Slow and cycle hook
IFF MODE 4	Mode 4 OUT/zeroized or not responding	Check mode 4 not in OUT Check proper A or B code
INLET ICE	Ice buildup in left engine inlet	Anti-ice engine heat switch - ON
L INLET R INLET	Left/right engine inlet control failure	Refer to emergency procedure *
JFS LOW	JFS accumulator pressure low	JFS start/emergency gear/brakes/steering may be inoperative*
LAT STK LMT	AFCS failure	Do not exceed 1/2 lateral stick Refer to LAT STK LMT caution*
NAV POD HOT	Navigation pod overtemperature	Turn OFF NAV FLIR and TF RDR*
L OIL PRESS R OIL PRESS	Left/right oil pressure low	Check oil pressure
OXY LOW	4 liters oxygen remaining	Below 1/2 liter - Descend below 10,000 feet MSL
PITCH RATIO	CSBPC failure, pitch ratio failure or EMERG selected	Pitch ratio switch - EMERG*
*ADDITIONAL INFORMATION AVAILABLE IN THIS SECTION		

WARNINGS/CAUTIONS/ADVISORIES (Continued)

DISPLAY	CAUSE	CORRECTIVE ACTION/REMARKS
MPD/MPCD CAUTIONS (CONT)		
PC1 A PC1 B PC2 A PC2 B	Designated RLS valve has actuated to shut off subsystem Simultaneous PC1 A and B or PC2 A and B indicates PC pump failure	Refer to Hydraulic Flow Diagram for systems affected*
L PUMP R PUMP	Left/right utility pump pressure low	Information
ROLL RATIO	Roll ratio incorrect or EMERG selected	Roll ratio switch - EMERG*
RUDR LMTR	Rudder limiter not scheduling properly	No high speed large rudder input Verify rudder available before landing
TGT POD HOT	Target pod overtemperature	Turn OFF Pod*
TOT TEMP HI	Critical inlet temperature (3 minute limit)	Reduce airspeed
UTL A UTL B	Designated RLS valve has actuated to shut off system	Refer to Hydraulic Flow Diagram for systems affected* If UTL A and PC 2 failure - Refer to emergency procedure*
WNDSHLD HOT	Anti-ice air hot	Windshield anti-ice switch - OFF
XFER PUMP	Wing or CFT fuel transfer pump inoperative	Monitor wing and CFT fuel transfer*
2 ATDP	Asymmetric thrust departure prevention system inoperative or ADC unreliable	Information
GREEN ADVISORY LIGHTS		
AUTO TF	Auto terrain following selected	Information (Rear cockpit only)
FLAP	Flaps are down	Information
LEFT	Left main gear down and locked	Information
MASTER ARM	Master arm switch in ARM	Information (Rear cockpit only)

NOTES

*ADDITIONAL INFORMATION AVAILABLE IN THIS SECTION

2 F-15E 90-0233 AND UP

WARNINGS/CAUTIONS/ADVISORIES (Continued)

DISPLAY	CAUSE	CORRECTIVE ACTION/REMARKS
GREEN ADVISORY LIGHTS (Cont)		
NOSE	Nose gear down and locked	Information
PROGRAM	Countermeasure dispenser in semi-auto mode and stored dispense program awaiting action	Information
RIGHT	Right main gear down and locked	Information
RCD	Recorder function commanded and record enabled	Information
READY (JFS)	JFS ready for engine engagement	Information
READY (AR)	Air refueling system ready	Information
T/O TRIM	Trim is takeoff position	Information
WHITE ADVISORY LIGHTS		
A/A	Air-to-air master mode selected	Information
A/G	Air-to-ground master mode selected	Information
EOT	VTR tape expended	Information
INST	Instrument master mode selected	Information
NAV	Navigation master mode selected	Information
REPLY	IFF responding to mode 4 interrogation	Information

START/GROUND OPERATIONS

JFS FAILS TO ENGAGE OR ABNORMAL ENGAGEMENT/DISENGAGEMENT

Failure to engage is indicated by no decrease in JFS whine after the fingerlift is raised. This may be caused by the throttle not being full off, dirty switch contacts, master switch not on, an electrical malfunction, or low CGB servicing. If the normal starting sequence has been interrupted (one engine shut down for some reason), it may be necessary to cycle the engine master switch to reset the control circuits. Once the JFS has engaged (JFS whine decreased), any abnormal sound or other indication requires immediate JFS shutdown. These can include no JFS whine increase, no engine rotation, rpm hangup, or JFS disengagement. If the JFS fails to decelerate after either engine start, shut down the JFS and both engines. This may indicate AMAD lubrication pump failure.

If JFS fails to engage -

1. Throttle - ENSURE FULL OFF
2. Engine master switch - CYCLE
3. Fingerlift - RAISE AND RELEASE

If still no engagement -

4. Engine master switch - OFF
5. JFS switch - OFF
6. Do not attempt another start

If engagement/disengagement is abnormal -

1. Throttle - OFF
2. Engine master switch - OFF
3. JFS switch - OFF
4. Do not attempt another start

JFS READY LIGHT DOES NOT COME ON

If the JFS ready light does not come on within 10 seconds, and -

a. The JFS sounds normal.
b. The AMAD fire light tests normally, then the JFS light is inoperative, and the start may be continued (The JFS READY light is required to monitor inflight JFS air start).

If the above cues are not present or JFS did not start on the first accumulator:

a. JFS switch - CYCLE
b. Have ground crew check JFS system.

If no abnormality is found and 30 seconds has elapsed, another JFS start may be attempted.

ABNORMAL ENGINE START

FAILS TO START

If no indication of light - off 30 seconds (-220 engines) or 20 seconds (-229 engines) after throttle advanced to IDLE -

1. Throttle - OFF

If another start attempt desired -

2. Engine - WINDMILL FOR 10 SECONDS
3. Throttle - IDLE

If another start attempt not desired -

2. Engine master switch - OFF
3. JFS - OFF
4. Complete engine shutdown procedure

FAILS TO ACCELERATE NORMALLY

If both rpm and FTIT appear to stop increasing during the start sequence -

1. Throttle - OFF
2. Engine master switch - OFF
3. JFS switch - OFF
4. Complete engine shutdown procedure

HOT START

-220 ENGINES

If one of the following conditions occur during -220 engine start, the starting FTIT limit of 680°C may be exceeded:

- Rpm acceleration simultaneous with or after initial FTIT movement.
- FTIT above 500°C with rpm below 40%
- FTIT rises rapidly thru 580°C

- Rpm stops increasing then decreases while FTIT is stable or increases.

-229 ENGINES

If one of the following conditions occur during -229 engine start, the starting FTIT limit of 800°C may be exceeded:

- Rpm acceleration simultaneous with or after initial FTIT movement.
- FTIT rises rapidly thru 750°C
- Rpm stops increasing then decreases while FTIT is stable or increasing

If starting FTIT of the -220 or -229 engine is exceeded, allowing the engine to windmill after shutdown will assist cooling.

1. Throttle - OFF

If FTIT starting limit not exceeded -

2. Engine - WINDMILL (10 seconds after FTIT indicates 200°C).
   The JFS can be engaged when rpm is below 30%.
3. Air source knob - SELECT ENGINE TO BE STARTED
4. Throttle - IDLE
5. Air source knob - BOTH (idle rpm)

If FTIT exceeded starting limit -

2. Engine - WINDMILL (if practical)
3. Engine master switch - OFF
4. JFS switch - OFF
5. Complete engine shutdown procedure

AUTO-ACCELERATION ABOVE IDLE

If auto-acceleration occurs

1. Throttle - OFF
2. Fire warning light - PUSH
3. Engine master switch - OFF
4. JFS switch - OFF
5. Abort mission

FIRE DURING START

1. Fire warning light - PUSH
2. Throttle(s) - OFF
3. Fire extinguisher - DISCHARGE
4. Engine master switches - OFF
5. JFS switch - OFF

AMAD FIRE DURING START

AMAD fire may be recognized by illumination of the AMAD fire light, voice warning "Warning, AMAD Fire," or by ground crew notification. Extinguisher actuation will discharge the fire extinguisher into the AMAD compartment and automatically shut down the JFS. If this action does not suffice, ground fire extinguishers may be required. If fire light is on (steady light):

1. AMAD light - PUSH
2. Fire extinguisher - DISCHARGE
3. Throttles - OFF
4. Engine master switches - OFF
5. JFS switch - OFF

ASYMMETRIC THRUST DEPARTURE PREVENTION SYSTEM (ATDPS) MALFUNCTION

Any of the following conditions during the ATDP pre-taxi check indicates a potential ATDPS malfunction :

a. Both engines do not revert to SEC mode when either engine control switch is set to OFF
b. Both engines do not remain in SEC mode when the engine control switch is set to back to ON
c. Both engines do not revert to primary mode when ATDP TEST is unboxed

An ATDP caution at any time during ground operations indicates that an ATDPS malfunction exists.

WARNING

The ATDP caution may indicate that the engines are interconnected at all times. This results in both engines reverting to secondary mode if either engine experiences an ENG CONTR caution. Neither engine can be reset to primary mode.

If an ATDPS malfunction exists -

1. CC - RESET
2. MPDP/AIU 1 switch - CYCLE

If malfunction clears -

3. ATDP test - PERFORM

If ATDPS malfunction or ATDP caution persists -

4. Abort mission

EMERGENCY GENERATOR NOT ON LINE ON START

On internal power starts, the emergency generator should come on line within 30 seconds after raising fingerlift for first engine start. This is indicated by an increasing rpm indication on the engine monitor display. The emergency generator does not power the emergency boost pump during first engine start; therefore, the EMER BST ON caution will not illuminate until the first main generator comes on line. The emergency generator should remain on the line for 30 seconds after the first main generator is on line. There is a remote possibility of the emergency generator dropping off line prematurely. If this occurs before a main generator comes on line, the rpm and FTIT indications go blank. Regard a BST SYS MAL caution less than 30 seconds after the first main generator comes on line as an indication that the emergency generator has dropped off line prematurely.

If emergency generator not on line 30 seconds after raising fingerlift -

1. Emergency generator switch - CYCLE THRU ISOLATE

If emergency generator still does not come on line -

2. Engine master switches - OFF
3. JFS - OFF
4. Abort

If emergency generator prematurely drops off line -

1. Throttle(s) - OFF
2. Engine master switch(es) - OFF
   Have maintenance investigate malfunction

ECS MALFUNCTIONS

DUAL ENGINE OPERATION (ECS CAUTION ON)

An ECS caution during engine ground operation is an abnormal condition. Make sure that the cockpit temperature control switch is in the AUTO position and that the air source knob is at BOTH. If the caution cannot be cleared, the ECS is not operating properly and avionics may suffer heat damage. Shutting down either engine will provide automatic avionics shutdown to protect the avionics equipment from overheat. In the event the automatic avionics shutdown does not occur, turning off all avionics except UHF will protect this equipment.

1. Temperature Control Switch - AUTO
2. Air Source Knob - BOTH

If the ECS caution remains on after 1 minute -

3. Isolate the bleed source by rotating air source knob (L, R, BOTH) while ground crew checks exhaust ports.
4. Throttle of operating source - ADVANCE TO 77%
5. Nonessential avionics (not required for displays) - OFF
6. Throttle of non-operating source - CYCLE, IDLE TO 78% RPM
7. Air source knob - CYCLE (L, R, BOTH)

If the ECS caution remains on after 10 minutes -

8. Either throttle - OFF

Automatic avionics shutdown will occur at this time -

9. Abort Mission

If automatic avionics shutdown does not occur -

10. Avionics (except UHF) - OFF
11. Remaining engine - SHUTDOWN (as soon as practical)

SINGLE ENGINE OPERATION (AUTOMATIC AVIONICS SHUTDOWN)

During single engine operation inadequate avionics cooling airflow is possible. When inadequate cooling is detected, an immediate automatic avionics shutdown occurs. The only indication of this condition will be blank displays.

Automatic avionics shutdown disables the following avionics:

- HUD
- RMR
- MPDP
- RADAR
- ADC
- JTIDS (when available)
- EWWS
- AIU #1
- AFCS Flight Control Computer
- ILS
- CC
- IBS
- PACS
- RWR Low Band Receiver/Processor
- RWR Power Supply
- AHRS
- Left and Right Air Inlet Controller
- VTRS
- UHF #1
- MPDs
- MPCDs

The MASTER CAUTION light and major category light are shutdown as a result of the automatic avionics shutdown of AIU #1.

Advancing the throttle to increase single engine RPM to 73% should provide adequate airflow to avionics and normal avionics operation will resume in two minutes. If either throttle is advanced above approximately 78% rpm, ECS cooling airflow could actually be reduced due to automatic ignition temperature control (AIT), this will also cause an automatic avionics shutdown. If normal operation does not resume, it may be necessary to start the second engine.

1. Single engine RPM - INCREASE (to 73%)

If avionics remain shutdown after two minutes -

2. Abort mission

DISPLAY FLOW LOW CAUTION

During dual engine operation, a Display Flow Low caution is an abnormal condition and indicates low cooling air flow to the cockpit displays. Turning off all non-essential displays will help protect them from heat damage.

During single engine operation, a slight increase in RPM above IDLE (to 73%) may be required to extinguish the light with ECS operating normally

1. Non-essential displays - OFF
2. Abort Mission

INS PROBLEMS

EXCESSIVE GROUNDSPEED/POSITION ERROR

If groundspeed and present position/update errors are excessive prior to take-off and the INS has been in GC align for 4 minutes, consider changing the aircraft heading 90±20° and continue alignment. If this does not improve the errors or is not possible , another alignment may be attempted. Generally, groundspeed error of 6 knots or more, and/or positional error of 2 miles or more, are considered excessive for normal operations. Lesser errors may be considered excessive for certain missions. The INS should be off for at least 5 seconds prior to another alignment. Allow the INS to remain in the GC mode as long as possible. After INS has been in GC for 4 minutes, the accuracy can be improved by changing the aircraft heading 90±20° and continuing the alignment. If possible, monitor the ground speed and present position for at least one minute to assess accuracy.

GROUND EGRESS

WARNING

Crew members must coordinate the type of escape to be used before initiating ground egress or ejection.

If time is extremely critical, consider ground ejection. The emergency evacuation procedures are identical to normal egress. Exercise care to avoid catching personal equipment on the canopy rail hooks. If canopy jettison is required, remain in the seat to minimize possibility of injury as the canopy departs. The boarding ladder may be extended by foot pressure on a button inside the upper foot well. Although other egress means are available, depending on the urgency and critical nature of the situation, egress via the boarding ladder is the safest method. The fastest egress is made by hanging from the canopy rail and dropping. Egress by this method may result in injury.

1. Ejection controls safety lever - LOCKED
2. Shoulder harness - RELEASE
3. Lap belt - RELEASE
4. Survival kit straps - RELEASE
5. G-suit - DISCONNECT
6. Canopy - OPEN

NOTE

The canopy may not depart the aircraft if it is jettisoned with the canopy unlocked.

If manual canopy operation is required -

7. Canopy control handle - UP
8. Canopy - PUSH

AIRPLANE ENTRY / AIRCREW EXTRACTION

WARNING

IF LEFT ENGINE IS RUNNING, APPROACH AIRPLANE ONLY IF SECURED BY AN ADEQUATE RESTRAINING LINE.

NORMAL ENTRY

1. PUSH HANDLE RELEASE BUTTON ON NORMAL CONTROL HANDLE. ALLOWING THE HANDLE TO SPRING OUT.
2. ROTATE THE HANDLE FULLY AFT, THE CANOPY WILL UNLOCK AND OPEN.

MANUAL ENTRY

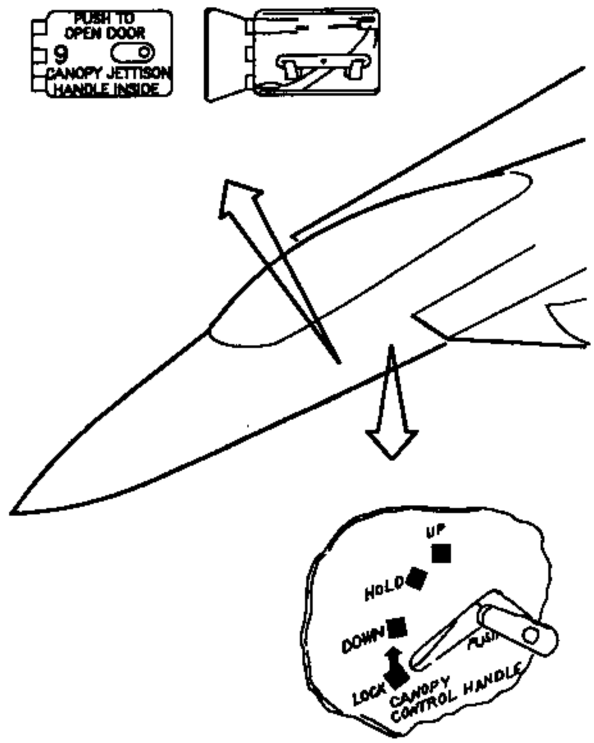
1. ENSURE NORMAL CONTROL HANDLE IS OUT AND ROTATED FULL AFT.
2. LIFT CANOPY AND INSTALL SAFETY STRUT.

CAUTION

DAMAGE TO CANOPY SHEAR BOLT WILL RESULT IF CANOPY IS LIFTED TOO HIGH.

EMERGENCY ENTRY

1. PRESS BUTTON TO OPEN DOOR 9, AND REMOVE T-HANDLE.
2. TO JETTISON CANOPY, PULL T-HANDLE TO FULL LENGTH (APPROXIMATELY 8 FEET) AND YANK HARD.



EXTRACTION – EJECTION SEAT

WARNING

DO NOT ACTUATE EITHER EJECTION SEAT FIRING HANDLE, ROTATE THE EJECTION CONTROLS SAFETY LEVER FORWARD AND UP AGAINST THE LEFT EJECTION FIRING HANDLE TO SAFETY THE SEAT.

1. EJECTION CONTROLS SAFETY LEVER FORWARD TO LOCKED POSITION.
2. RELEASE LAP BELT.
3. RELEASE LEFT AND RIGHT SURVIVAL KIT BUCKLES.
4. RELEASE LEFT AND RIGHT PARACHUTE HARNESS STRAPS.
5. OPEN FACE MASK, IF REQUIRED.

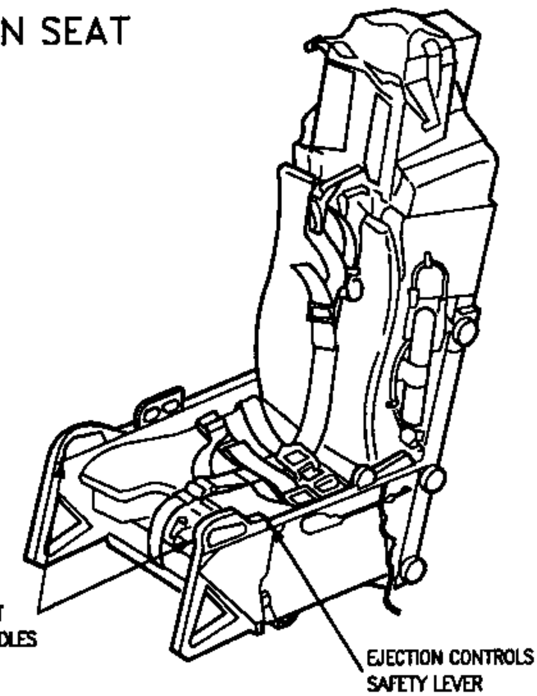


Figure 3-1

TAKEOFF

ABORT

The decision to abort or continue takeoff depends on many factors, most of which relate to a specific takeoff situation. Considerations should include, but are not limited to, the following:

a. Runway factors: Runway remaining, surface condition (wet, dry, etc.), type and/or number of arresting gear available, obstructions alongside or at the departure end, wind direction and velocity, weather and visibility.
b. Aircraft factors: Weight, stores aboard, nature of the emergency, velocity at decision point, and importance of getting airborne.
c. Stopping factors: Maximum braking (see Minimum Run Landing, section II), speed brake, hook, jettisoning stores, engine shutdown.

Consider aborting after airborne where sufficient runway is available. Normally, with the short takeoff distances of the aircraft, abort is not a problem, but an early decision will provide the most favorable circumstances.

1. Throttles - IDLE
2. Brakes - APPLY
   If aborting with a blown main tire or if a main tire blows during abort, place the anti-skid switch to PULSER and use braking on the good tire.
3. Hook - AS REQUIRED

If hot brakes are suspected -

4. Use Brake Overheat procedure.

EXTERNAL STORES JETTISON

Two means exist to jettison external stores: the emergency jettison button on the center of the front instrument panel and the select jettison knob/button on the armament control panel in the front cockpit.

WARNING

- The emergency jettison button jettisons pylons on stations 2, 5, and 8 and all CFT stores (A/A and A/G). When airborne, the possibility exists of wing station missile/store/pylon collision with CFT mounted stores and subsequent missile/store/pylon collision with the aircraft. Ground jettisoning may result in the store/pylon striking the ground before the pylon aft pivots release. Under these conditions, the wing mounted pylon stores will probably rotate horizontally, and will strike the landing gear if the rotation is in that direction. The centerline pylon will almost certainly strike the landing gear.
- A/G stores on CFT stations must be jettisoned before A/G stores on wing stations to ensure safe separation.
- With selective jettison, stores could jettison at 60-80 msec, which could be less than recommended interval.

CAUTION

If centerline or inboard release is required with the landing gear down, damage may occur to the aircraft.

ENGINE FIRE ON TAKEOFF

If you decide to discontinue takeoff -

1. Abort.
2. Fire warning light - PUSH

If warning light remains on -

3. Throttle - OFF
4. Fire extinguisher - DISCHARGE

If you decide to continue takeoff -

1. Climb to safe altitude and follow Engine Fire Inflight procedures.

PITCH RATIO FAILURE

If takeoff is made with the CAS ON, it is unlikely that pitch ratio failure will cause any control difficulty, and takeoff may be continued. The PITCH RATIO caution may be the only noticeable indication of failure. However, if the failure occurs with CAS OFF, longitudinal stick forces may be considerably higher than normal, and late nosewheel liftoff will likely result. In this case, aborting the takeoff is preferred if conditions permit. If takeoff is continued with CAS OFF, maneuver conservatively since the ARI is inoperative.

ENGINE FAILURE ON TAKEOFF

Depending on the type of failure and aircraft conditions, MIL power may be sufficient to sustain flight. The aircraft accelerates better at a reduced AOA. If afterburner is required, use only that necessary to maintain safe flight.

If decision is made to continue takeoff, input one-half aft stick at the rotation speed and rotate to a 10° pitch attitude. Delaying rotation in this way results in increased single engine rate of climb at takeoff. With CFTs, figures A3-12 thru A3-16 (**PW-220** engines) or figures B3-12 thru B3-16 (**PW-229** engines) should also be checked to determine if adequate single engine rate of climb is available at this takeoff speed. If available runway permits, the takeoff speed may be increased somewhat by delaying rotation until either runway limitations or tire limit speeds dictate rotation. This will result in correspondingly increased ground roll distance. Due to loss of thrust during MIL PWR takeoff, delay retracting gear until a positive rate of climb is established.

An engine failure introduces a large thrust asymmetry that can degrade directional control and result in large lateral excursions from the desired ground track. Factors affecting directional control include power setting, temperature, pressure altitude, gross weight, and runway surface condition. Power setting, temperature, and pressure altitude all affect the thrust level of the operating engine and therefore the magnitude of the thrust asymmetry. Thrust asymmetry associated with **PW-229** engines will be larger than that for **PW-220** engines at the same power setting. Gross weight determines the tire reaction available for nose-wheel steering. Lighter airplanes will have less nose-wheel steering capability than heavier ones. Wet and icy runway surfaces will further degrade steering control.

Prompt action to counter the thrust asymmetry (applying opposite rudder pedal) or to reduce it (retarding throttles) is necessary to avoid excessive lateral excursions. The effects of thrust asymmetries will be largest at low speeds (less than 100 KCAS) where directional control due to the combination of flight control system effectiveness and nose-wheel steering is lowest. Abort the takeoff if large lateral excursions occur.

If takeoff is discontinued -

1. Abort

If takeoff is continued -

1. Throttle(s) - AS REQUIRED
2. Climb to a safe altitude and investigate.

ASYMMETRIC THRUST DEPARTURE PREVENTION SYSTEM (ATDPS) FAILURE (PW-229 Engines)

WARNING

When the ATDP caution is ON, any subsequent failure which results in an ENG CONTR caution (refer to Engine Control Malfunction) on one engine will result in a sudden loss of thrust on both engines. In this event, neither engine can be reset to primary mode for the duration of the flight.

AFTERBURNER FAILURE

The engine has an automatic afterburner recycle capability using the light-off detector. If the afterburner does not light satisfactorily or a blowout occurs, the DEEC will automatically resequence the afterburner ignition system a maximum of three times in approximately 12 seconds providing the throttle remains above MIL. If the afterburner does not light during these attempts, the throttle must be retarded to MIL or below before further attempting to light the afterburner.

If the ENG CONTR caution is on, afterburner operation may be prevented or may be limited to only the first and second segment for **PW-220** engines or first eight segments for **PW-229** engines. If the DEEC has transferred to secondary mode, afterburner operation is prevented and only 80 to 85% of MIL thrust is available. Cycling the engine control switch may return the engine to normal operation. The engine control switch may be cycled ON-OFF-ON at MIL or below. If the ENG CONTR caution goes off, the engine will operate normally. However, if there is a malfunction in the afterburner control, the ENG CONTR caution may come on again when afterburner is reselected. Refer to Engine Control Malfunction.

BLOWN TIRE DURING TAKEOFF

Tire failure is very difficult to recognize and may not be noticed in the cockpit. If a failure is suspected, or confirmed, and:

If takeoff is discontinued -

1. Abort
2. Anti-skid - PULSER

If takeoff is continued -

1. Gear/flaps - DO NOT RETRACT

NOTE

Flaps automatically retract at 250 knots maximum and extend at no less than 230 knots .

2. Refer to Landing with Known Blown Main Tire.

LANDING GEAR FAILS TO RETRACT

If the warning light in the landing gear handle stays on after the handle is placed up or comes on in flight, the gear or gear doors are not correctly sequenced. This is typically caused by a failed limit switch or a mechanical binding in the gear or door linkage. If the cause of the warning light is a failed switch, no amount of gear recycling will correct the problem. But if the cause is a mechanical binding, it is possible that cycling the gear will correct the problem. However, if after two unsuccessful attempts at gear retraction, it is improbable that further attempts will succeed.

1. Reduce airspeed below 250 knots
2. Landing gear circuit breaker - CHECK
3. Landing gear handle - LOWER

If the gear comes down normally

4. Landing gear handle - UP

If gear handle light is still on -

5. Landing gear handle - LOWER
6. Reduce weight.
7. Land as soon as practical.

INFLIGHT

HYDRAULIC FAILURE

Refer to hydraulic flow diagram (figure 3-2) and BIT panel for systems affected.

A failure of a single hydraulic system is not considered a critical item because of dual systems and reservoir level sensing (RLS) incorporated in the hydraulic system design. Although not considered critical, proper treatment of the situation is warranted, as with any emergency, due to the possibility of subsequent failures which may compound the problem. With UTL A failure, if time and conditions warrant, an approach-end arrestment is recommended. For multiple hydraulic failures, the pilot must refer to the Hydraulic Flow Diagram, this section, to determine systems affected and corrective action required. UTL A and PC1 B, or a UTL B and PC2 B failure will cause a split flap condition if the flaps are extended.

HYDRAULIC FLOW DIAGRAM

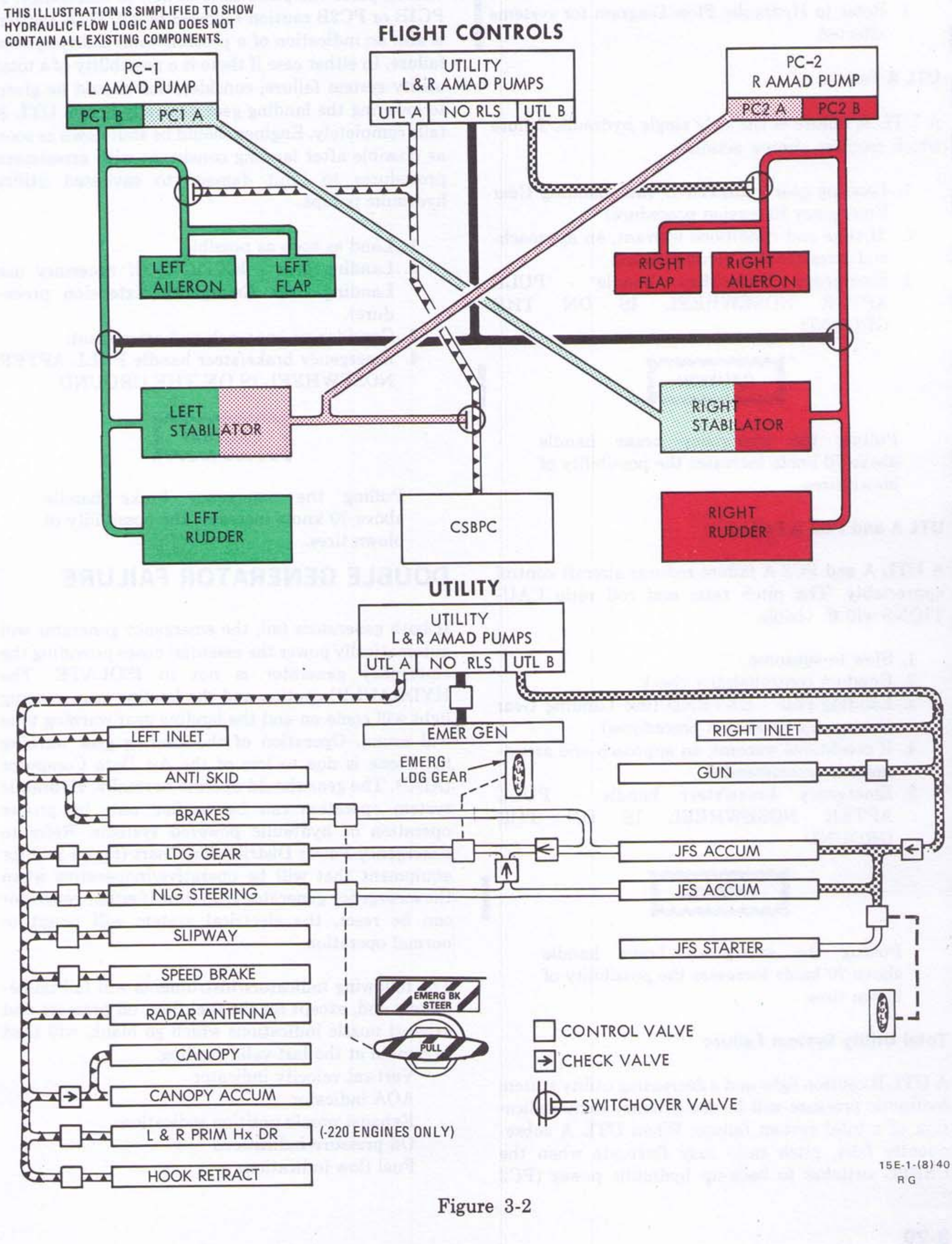


Figure 3-2

Single/Dual Failure (Except UTL A)

1. Refer to Hydraulic Flow Diagram for systems affected.

UTL A Failure

A UTL A failure is the only single hydraulic failure which requires aircrew action.

1. Landing gear - EXTEND (use Landing Gear Emergency Extension procedure)
2. If time and conditions warrant, an approach-end arrestment is recommended.
3. Emergency brake/steer handle - PULL AFTER NOSEWHEEL IS ON THE GROUND

CAUTION

Pulling the emergency brake handle above 70 knots increases the possibility of blown tires.

UTL A and PC2 A Failure

A UTL A and PC2 A failure reduces aircraft control appreciably. The pitch ratio and roll ratio CAUTIONS will be visible.

1. Slow to subsonic.
2. Conduct controllability check.
3. Landing gear - EXTEND (use Landing Gear Emergency Extension procedures)
4. If conditions warrant, an approach-end arrestment is recommended.
5. Emergency brake/steer handle - PULL AFTER NOSEWHEEL IS ON THE GROUND

CAUTION

Pulling the emergency brake handle above 70 knots increases the possibility of blown tires.

Total Utility System Failure

A UTL B caution light and a decreasing utility system hydraulic pressure will be the primary early indication of a total system failure. When UTL A subsequently fails, pitch ratio may fluctuate when the CSBPC switches to back-up hydraulic power (PC2 A). If this fluctuation produces undesirable flight effects, place the pitch ratio switch to emergency. A PC1B or PC2B caution followed by a UTL A caution is also an indication of a possible total utility system failure. In either case if there is a possibility of a total utility system failure, consideration should be given to lowering the landing gear normally before UTL A fails completely. Engines should be shut down as soon as possible after landing consistent with arrestment procedures to limit damage to cavitated utility hydraulic pumps.

1. Land as soon as possible.
2. Landing gear - EXTEND (if necessary use Landing Gear Emergency Extension procedure).
3. Consider an approach-end arrestment.
4. Emergency brake/steer handle PULL AFTER NOSEWHEEL IS ON THE GROUND

CAUTION

Pulling the emergency brake handle above 70 knots increases the possibility of blown tires.

DOUBLE GENERATOR FAILURE

If both generators fail, the emergency generator will automatically power the essential buses providing the emergency generator is not in ISOLATE. The HYDRAULIC caution and the landing gear warning light will come on and the landing gear warning tone will sound. Operation of the landing gear warning light/tone is due to loss of the Air Data Computer (ADC). The gear should operate normally. Hydraulic system operation can be verified only by proper operation of hydraulic powered systems. Refer to Emergency Power Distribution Chart (figure 3-5) for equipment that will be operative/inoperative when the emergency generator is on line. If either generator can be reset, the electrical system will revert to normal operation.

The following indicators/instruments will fail immediately and, except for the fuel flow, oil pressure and exhaust nozzle indications which go blank, will tend to remain at the last valid reading:

Vertical velocity indicator
AOA indicator
Exhaust nozzle position indications
Oil pressure indications
Fuel flow indications

Oxygen quantity indicators
PC1 hydraulic pressure indicator
PC2 hydraulic pressure indicator
Utility hydraulic pressure indicator

The only display powered by the emergency generator is the front MPCD which will display ADI format and cautions. With double generator failure and the emergency generator operating, cautions are displayed only on the MPCD in the cockpit. These cautions can be removed by pressing the castle switch on the cockpit control stick to any position. A second activation of the castle switch restores the cautions to the display. If double generator failure occurs at night, all instrument and console lights will fail and the flood lights (utility and storm) must be used for cockpit illumination. Partial failure of the left main generator may also result in failure of the instrument and console lights; power can be restored in this case by turning the left generator switch off.

NOTE

On aircraft before 89-0072, if a dual generator failure occurs, the front cockpit MPCD may not receive enough power to operate and consequently the ADI display will be lost. If this occurs, use the standby flight instruments which will still be operational.

1. EMER BST ON caution - CHECK ON
   If the EMER BST ON caution is not on, cycle the emergency generator switch to ISOLATE and back to MAN. If the emergency generator does not power the emergency/essential buses, engine rpm and FTIT indications will go blank. Operation of the engines can be confirmed by advancing the throttle and noting thrust response.

NOTE

In ISOLATE mode, rear cockpit power and intercom are lost. WSO should be advised prior to initiating ISOLATE mode. Weight-on-wheels idle thrust will be greater than normal.

2. Main generator switches - CYCLE

If main generators still failed and emergency generator is inoperative -

3. Follow Both Main Fuel Boost Pumps and Emergency Boost Pump Inoperative (Total Boost Pump Failure) procedure.
   All internal transfer pumps will be inoperative and fuel will gravity transfer to the feed tanks.
4. Follow Oxygen Caution procedure (**MSOGS** installed).

WARNING

With both main generators inoperative, the nozzles will stay full closed with the landing gear down, and idle thrust will be substantially higher than normal.

NOTE

Feed tank fuel cannot be monitored. Flameout due to fuel starvation may occur with prolonged use of high power settings. With total electrical failure, the standby attitude indicator will display an OFF flag but is reliable for 9 minutes after loss of electrical power.

GENERATOR FAILURE

A generator failure is indicated by a L GEN OUT or R GEN OUT caution. The emergency generator will come on and power the emergency boost pump and the EMER BST ON caution will come on. If the BST SYS MAL caution comes on, the emergency generator has probably failed. Normal flight electrical loads (except TEWS pods) can be handled by one generator. Check hydraulic warning lights and gages for indication of AMAD failure. Check engine instruments for indication of stall/stagnation or flameout.

1. Generator switch - CYCLE

If generator still failed -

2. Generator switch - OFF

CENTRAL COMPUTER FAILURE

If a central computer (CC) failure occurs or is suspected, attempt to rest the CC. If the CC has failed, the MPDP becomes the backup bus controller.

WARNING

With a CC failure, the ATDPS will not provide protection against departure, regardless of ADC status. Additionally, status of connection between engines is unknown with a CC or AIU failure. In this case, an augmentor failure or transfer to SEC mode may cause a sudden loss of thrust on both engines.

Available Functions with CC Failure

COMM, IFF AAI, EWWS	Normal
TACAN/ILS	Normal (ADI format)
TEWS	Degraded
A/A RADAR	Search, TWS-ND, STT, Vert scan, Designated TWS
A/G RADAR	RBM
Basic aircraft performance	ADI Format
CAUTIONS	Fully displayed for supported systems. With CC failure only, cautions are always displayed on any MPD/MPCD that has the radar display format
NAV	TSD display format PP lat/long (UFC) Two steer points maintained Update of INS (Overfly only)
TF	Manual TF with selectable set clearance TF displays supported
NAV FLIR	Video provided to HUD status on UFC
Weapon employment	AIM-9, Boresight AIM-7, Flood AIM-120, None GUN, Fixed Cross

DISPLAY FORMAT CHANGES WITH CC FAILURE

The display formats that are available with CC failure have some of the information from the standard formats, and, in some cases, the formats are supplemented with additional information. The changes in backup formats are described in the following paragraphs. Refer to Section 1 for additional information.

Backup ADI Display Format

Since the HSI format cannot be displayed, some of its selections, such as steer modes and course select, are included in the backup ADI format. Display items which are not available include : angle-of-attack, pitch trim adjust, command heading marker, attitude source display, record option, master menu select, calibrated/true airspeed, barometric altitude and commanded speeds. Display items added to the backup ADI format are steer mode selections, steer point data block, tacan data block and course select options.

The backup ADI format displays ILS data similar to the normal format but calibrated airspeed and baro altitude are not displayed with CC failure. However, ground speed and radar altitude are both available. If ILST is selected, the ILS data is unchanged. The ADI receives localizer and glideslope raw data to position the pitch/bank steering bars.

Backup HUD Display Format

With a CC failure, the preprogrammed HUD declutter function is not available.

With a CC failure the following information is available on the HUD.

a. Magnetic heading
b. Pitch ladder
c. Vertical velocity
d. Groundspeed
e. Bank scale
f. Velocity vector
g. Radar altitude
h. Gun cross
i. Waterline symbol
j. MRM reference circle
k. Current g loading
l. Pitch/bank steering bars
m. Selected steer mode
n. Steer point range

When ILST or ILSN steer modes are selected ILS localizer and glideslope raw data is displayed on the HUD. If ILST steer mode is selected, the tacan channel is also displayed. No AOA information is displayed but localizer deviation is displayed normally.

Backup TSD Format

On the backup TSD format two selectable parameters remain : map scale selection and INS position update. The aircraft present position symbol remains but no cursor or target related functions remain. The remaining update function is for overfly only.

UFC Display Format

With a CC failure, all radio/comm, tacan, ILS, KY-58, AAI and IFF functions, except programming, remain operable. Menu 1 information concerning steer point, TF and NAV FLIR status is available. Data is also available on the point data submenu, menu 2 present position source, plus current aircraft latitude/longitude and current magnetic variation.

MULTIPURPOSE DISPLAY PROCESSOR (MPDP) FAILURE

If one of the four power supplies in the MPDP fail the following functions are lost -

Power supply A failure

a. FWD MPCD
b. Right aft MPD
c. Displays 1553 Bus A (fwd MPCD, fwd left MPD, aft left MPCD, aft right MPD)
d. GP I/O (backup mode capability)
e. 1553 Avionic Bus
f. SGP Bus A (fwd MPCD, fwd left MPD, aft left MPCD, aft right MPD; in backup mode - lose fwd MPCD, aft MPD)
g. JTIDS 1553 Bus
h. Radar

Power supply B failure

a. Aft right MPCD
b. Fwd right MPD
c. EWWS, OWS, RWR
d. 1553 displays Bus B (HUD, fwd right MPD, aft left MPD, aft right MPCD)
e. SGP Bus B (HUD, fwd right MPD, aft left MPD, aft right MPCD)

Power supply C failure

a. Aft left MPCD
b. HUD backup mode
c. 1553 displays Bus B (HUD, fwd right MPD, aft left MPD, aft right MPCD)
d. Radar
e. Fwd left MPD

Power supply D failure
1553 displays Bus A (fwd MPCD, fwd left MPD, aft left MPCD, aft right MPD)

a. VTR
b. Aft left MPD
c. HUD (primary)
d. TEST PATTERN (Initiated BIT)

NOTE

In the event of a power supply C or D failure, removing power from the CC will result in a six display backup mode of operation.

If a total MPDP failure occurs all systems which require an MPD/MPCD or HUD to be displayed (i.e. radar, INS, PACS) are lost. The EMD and the standby instruments are still functional.

NOTE

If several front and rear cockpit displays go blank or display STANDBY, a recycle of power to MPDP should return the system to normal operation.

AVIONICS INTERFACE UNIT FAILURE

1. MPDP/AIU-1 switch (GND PWR panel) - CYCLE

The following systems/data are affected if AIU 1 fails -

UHF 1 radio	Inoperative
Left hand controller	Inoperative
Cautions (except LOW ALT, LASER ARMED)	Not displayed
Fuel flow on MPD/MPCD	No data
Avionics BIT and ASP	Inoperative
ILS	No data/operation
TACAN	No data/operation
IFF	Inoperative
ADF	No data
EWWS	Inoperative
KY-58	Inoperative
Seat ejection auto beacon	Inoperative
Voice Warning	No engine overtemp LT/RT
F-15E 90-0233 AND UP, ATDP	Inoperative

The following systems/data are affected if AIU 2 fails -

UHF 2 radio	Inoperative
Right hand controller (aft)	Inoperative
AAI	Inoperative
KIR	Inoperative
HF communication	Inoperative
Aft sensor control panel	No system control
TGTFLIR gain/level	defaults to AUTO
LANTIRN (nav and targeting)	Presence not sensed by OWS
Voice Warning	No engine overtemp LT/RT
UHF 2 radio	Inoperative
OWS	Inoperative

The following systems/data are affected if AIU 1 and AIU 2 fail -

Radar altimeter (CARA)	No data
Intercom set control panel	No comm control
Fwd throttle and stick	No HOTAS functions
Fwd sensor control panel	No system control
Upfront controls (both)	Inoperative
Master modes	Selection fixed
LOW ALT and LASER ARMED warning	Indication lost
Voice Warning	Inoperative

EMERGENCY POWER DISTRIBUTION

EMERGENCY GENERATOR OPERATING
SWITCH IN AUTO OR MAN

L GEN OUT   R GEN OUT

INOPERATIVE EQUIPMENT

ENGINE-
- AB BURN THRU DETECTION
- CFT AFT TRANSFER PUMPS
- ENGINE ANTI-ICE
- ENGINE OIL PRESSURE INDICATIONS
- FUEL FLOW INDICATORS
- FUEL TRANSFER PUMPS
- ICE DETECTOR
- L&R BOOST PUMPS
- L&R DUCT TEMP PROBE HEATERS
- L&R ENG INLET CONTROLLERS
- L&R TOTAL TEMP PROBE HEATERS
- NOZZLE POSITION INDICATIONS
- ASYMMETRIC THRUST DEPARTURE PREVENTION SYSTEM (With PW-229 Engines Installed)

FLIGHT INSTRUMENTS-
- ANGLE OF ATTACK INDICATOR
- VERTICAL VELOCITY INDICATORS

NAVIGATION EQUIPMENT-
- ADF
- ATTITUDE HEADING REFERENCE SYSTEM
- IFF INTERROGATOR
- ILS
- KY-58
- STANDBY COMPASS LIGHT
- TACAN
- UHF R/T NO.2

OTHER-
- AIR DATA COMPUTER
- AIU NO.2
- ANTI-COLLISION LIGHTS
- CENTRAL COMPUTER
- CONSOLE LIGHTS
- FORMATION LIGHTS
- HUD
- INSTRUMENT LIGHTS
- IRE (IFF REPLY EVALUATOR)
- JETTISON (USING A/G SELECT AND SELECT JETTISON CONTROLS)
- KIR (INTERROGATOR COMPUTER)
- KIT (TRANSPONDER COMPUTER)
- LANTIRN POD
- LANDING & TAXI LIGHTS
- MPCD (REAR)
- MPD'S (ALL)
- OVERLOAD WARNING
- OXYGEN QUANTITY GAGE (LOX)
- PC-1 HYD PRESS INDICATOR
- PC-2 HYD PRESS INDICATOR
- PITCH RATIO INDICATOR
- POSITION LIGHTS
- RADAR
- RADAR ALTIMETER
- RMR
- SEAT ADJUST
- TEW (RWR, EWWS, ICS)
- TIS
- UTILITY HYD PRESS IND
- UTILITY FLOOD LIGHT (REAR CKPT)
- VERTICAL TAIL LIGHTS
- VTRS
- WPN NORM RELEASE/LAUNCH
- WINDSHIELD ANTI-ICE SYSTEM

Figure 3-3 (Sheet 1 of 3)

EMERGENCY POWER DISTRIBUTION

EMERGENCY GENERATOR OPERATING

SWITCH IN AUTO OR MAN

L GEN OUT **R GEN OUT**

OPERATIVE EQUIPMENT

ENGINE-

AMAD FIRE DETECTION SYS
AMAD FIRE EXTINGUISHER SYS
BLEED AIR LEAK DETECTOR
EMER FUEL BOOST PUMP
1 ENG AND A/B IGNITION
ENG FIRE EXTINGUISHER SYSTEM
ENG FIRE DETECTION SYSTEM
ENG RPM INDICATION
FTIT INDICATION
FUEL DUMP (EXT TANKS ONLY)
FUEL LOW AND BINGO LIGHTS
1 FUEL PRESS AND VENT
FUEL QUANTITY INDICATORS
L & R ENG FUEL SHUTOFF VALVES
SELECTED CFT CENTER TRANSFER PUMP

FLIGHT INSTRUMENTS

1 STANDBY AIRSPEED
1 STANDBY ALTIMETER
STANDBY ATTITUDE INDICATOR

NAVIGATION EQUIPMENT-

INTERCOM
2 IFF TRANSPONDER
INS
UHF R/T NO.1

OTHER-

AERIAL REFUELING
AERIAL REFUELING FLOOD LIGHTS
AFCS/CAS
AIU NO.1
AN/ALE-45 CMD
ANTENNA SELECT
ANTI-SKID
ARRESTING HOOK
CHART LIGHTS
EMERGENCY JETTISON POWER (EMERG JETT BUTTON)
ENVIRONMENTAL CONTROL SYSTEM
FLAPS
ICSCP/RICP
LANDING GEAR
LANDING GEAR POSITION INDICATORS
MASTER CAUTION RESET
MPCD-FRONT (EADI FORMAT ONLY)
MPDP
MSOGS (If Installed)
NOSEWHEEL STEERING
PITCH RATIO
PULSER BRAKE SYSTEM
SPEEDBRAKE
STORM/FLOOD LIGHTS
TRIM (AIL/RUD/STAB)
UP-FRONT CONTROLS
UTILITY FLOOD LIGHT (FRONT CKPT)
VOICE WARNING SYSTEM
WARNING/CAUTION/ADVISORY LIGHTS
WARNING/CAUTION/ADVISORY LIGHTS TEST

Figure 3-3 (Sheet 2)

EMERGENCY POWER DISTRIBUTION

EMERGENCY GENERATOR OPERATING

SWITCH IN ISOLATE

L GEN OUT | R GEN OUT

OPERATIVE EQUIPMENT

- AERIAL REFUELING (DEGRADED OPERATION)
- ARRESTING HOOK
- EMER BST ON CAUTION LIGHT
- EMER FUEL BOOST PUMP
- [1] EMERGENCY NOSEWHEEL STEERING
- [1] ENG AND A/B IGNITION
- ENG RPM AND FTIT INDICATIONS
- [1] FUEL PRESS AND VENT
- [1] STANDBY AIRSPEED
- [1] STANDBY ALTIMETER

NOTE

[1] ALTHOUGH OPERATIVE, ITEMS ARE NOT POWERED BY THE EMERGENCY GENERATOR

[2] WHEN ANY MODES ARE SELECTED, THE IFF TRANSPONDER WILL SQUAWK EMERGENCY (ONLY WITH WEIGHT OFF WHEELS)

Figure 3-3 (Sheet 3)

FUEL TRANSFER SYSTEM MALFUNCTION

The primary indication of a fuel transfer system malfunction is the fuel gage. Other indications include premature FUEL LOW caution, BINGO caution, wing low tendency and appropriate voice warnings.

CAUTION

No caution is generated for a tank 1 transfer fail.

INTERNAL TANK(S) FAIL TO TRANSFER

If tank 1 transfer pump has failed a differential greater than approximately 750 pounds between tank 1 and the internal wing tanks will be observed. If this occurs, the fuel in tank 1 should be considered trapped and as the wing tanks empty aircraft CG will shift forward, ending up near the design limit of the aircraft. If feed tank fuel quantity begins to drop with fuel remaining in either internal wing tank , a wing tank transfer pump has probably failed. If any or all transfer pumps fail, the fuel in the affected tanks will gravity transfer to the feed tanks when tanks with operating transfer pumps are empty and the fuel level (height) in the feed tanks drops below the level of fuel in the affected tank(s). Gravity transfer may be confirmed by observing the simultaneous decrease of fuel quantities in the affected tank(s) and feed tanks. Gravity transfer may not occur until after FUEL LOW caution comes on and very low feed tank quantities are reached (300 to 400 pounds in each tank). Gravity transfer will not completely refill the feed tanks, and may not keep up with feed tank usage, depending on total fuel quantity and pitch attitude. At fuel flow rates above 3,500 pounds per hour per engine, gravity transfer will not keep up with engine demand from the feed tanks. If transfer pump failure is suspected:

1. Throttles - RETARD (less than 3,500 pph/engine)

For tank 1 transfer failure -

2. Slipway switch - CHECK CLOSED

If slipway switch closed-

3. Stay below 30 units AOA.
4. Maintain approximately 250 knots for cruise and plan for a minimum fuel descent.
5. Land as soon as practical.

EXTERNAL TANK FAILS TO TRANSFER

With wing tanks installed, if the external fuel tanks fail to transfer completely or if STOP TRANS is selected due to an emergency and any external tank, including the centerline, is partially full, the aircraft may exceed the aft CG limit as internal fuel decreases due to fuel moving aft in the external tanks. Cycling the external tank switch or slipway door, may restore transfer. If the landing gear is cycled under these conditions, it may fail to retract due to WOW switch malfunction. Ensure fuel on board will allow flight to a suitable landing base with the gear down if transfer is not restored. If not, it may be necessary to jettison the tanks for controllability or range considerations. Landing with up to a full tank on one side will normally present no problem, but perform a Controllability Check when practical. With pitch CAS inoperative, the CG shift due to movement of trapped fuel in external tanks can degrade aircraft handling characteristics.

1. External transfer switch - WING/CTR
2. External tank fuel control switches - CYCLE
3. Landing gear circuit breaker - IN
4. Slipway switch - CYCLE
5. Throttle(s) - MIL

If external tank still fails to transfer or STOP TRANS is selected -

6. Maintain minimum 250 knots
7. Use minimum pitch angles for maneuvering
8. Jettison external tanks if required

If partially full external tanks are retained -

9. Maintain 18 units AOA on final.

CFT FAILS TO TRANSFER

CFT fuel transfer failure is indicated by voice warning, "WARNING, TRANSFER PUMP", the TRANSFER PUMP caution and can be verified by reference to the fuel quantity indicator. There is no provision for transfer of CFT fuel if both transfer pumps on one side fail. If both pumps on one side fail, it may be desirable to stop CFT transfer to maintain balance. If only one CFT pump fails, it may be difficult at low fuel flows, using the fuel quantity gage, to determine which side has failed. To confirm if a CFT pump has failed, the MPD caution can be deleted by momentarily placing the CFT switch to STOP TRANS. If the caution is not removed from the MPD, the failed pump is not in the CFT. Refer to Internal Tank(s) Fail To Transfer procedure.

If both main generators fail, all CFT transfer pumps automatically shut off. If fuel is not critical, do not transfer CFT fuel. If fuel is critical, CFT fuel can be transferred using the CFT emergency transfer switch. The landing gear handle must be up to prevent fuel from transferring to the other CFT. Wait until internal fuel decreases about 1000 pounds then select L or R. When internal tanks are full, place the switch to NORM. Wait until internal fuel again decreases about 1000 pounds, then select L or R as required to maintain fuel balance. Repeat until the CFT's are empty.

1. Conformal fuel tank switch - CYCLE
2. Slipway switch - CYCLE

If both generators fail and fuel critical -

3. Landing gear handle - UP

After internal fuel decreases about 1000 pounds -

4. Conformal tank emergency transfer switch - L or R

When internal tanks full -

5. Conformal tank emergency transfer switch - NORM
6. Repeat steps 1 thru 3 for opposite CFT

EMERGENCY FUEL TRANSFER/DUMP (EXTERNAL TANKS), GEAR DOWN

Fuel in external tanks cannot be transferred and/or dumped unless the landing gear handle is up or the fuel low level system is activated. If it is necessary to transfer or dump fuel with the gear down, the following procedure will permit external fuel transfer/dump without raising the landing gear.

1. Emergency landing gear handle - PULL
2. Landing gear handle - UP
3. Fuel gauge - MONITOR
4. Fuel dump switch - DUMP (if required)
5. Landing gear handle - DOWN (when dumping completed)
6. Emergency landing gear handle - RESET

FUEL BOOST PUMPS INOPERATIVE

There are various combinations of indications to warn of a single or multiple fuel boost pump failure. A single boost pump failure is indicated by a L or R BST PUMP caution on or a BST SYS MAL caution on or a BST SYS MAL caution on without an EMER BST ON caution. A multiple failure is indicated by two or more of the above cautions on. Total electrical failure including the emergency generator causes total boost pump failure without the usual cautions. With total boost pump failure, fuel is available to the engine by gravity feed only and fuel vaporization with resulting flameout of one or both engines is probable. Flameout is most likely to occur during the first 30 seconds of gravity feed operation and is more probable above 15,000 feet and/or at low power settings.

Fuel vaporization is caused by a combination of loss of boost pump pressure, and high altitude (low ambient pressure) or high fuel temperature. Fuel temperature is increased by electrical, AMAD, and hydraulic systems heat being transferred to the fuel in the heat exchangers. The probability of fuel vaporization can be decreased by reducing fuel temperature and descending to a lower altitude. Increased fuel flow is the most effective method of reducing fuel temperature. Reducing electrical load aids in reducing fuel temperature, but this effect is delayed. The primary consideration is to ensure that at least one engine continues to operate.

SINGLE OR DOUBLE (ANY TWO) FUEL BOOST PUMP FAILURE

With only one boost pump operating, prudence dictates that the aircraft be operated at the lowest practical altitude below 30,000 feet and at a higher (but not afterburner) power setting.

1. Maintain MIL power or below
2. Land as soon as practical

BOTH MAIN FUEL BOOST PUMPS AND EMERGENCY BOOST PUMP INOPERATIVE (TOTAL BOOST PUMP FAILURE)

1. Descend to minimum practical altitude using maximum practical power on at least one engine (not afterburner).

   If the situation permits, maintain high power settings for at least 3 minutes to cool the fuel, and descend with both throttles at military power. As the descent becomes more restricted by weather, airspeed, etc., maintain one throttle at military while retarding the other as necessary toward IDLE. If the retarded engine operates at IDLE and additional power reduction is required, you can then retard the advanced throttle as required. Use of the speed brake should be considered.

2. Reduce electrical load to the minimum practical
3. Maintain split throttles until established in traffic pattern

   Maintain one engine at as high a power setting as possible until the throttle must be retarded to permit landing.

INFLIGHT FUEL LEAK

Prompt action is required to isolate the source of the leak to minimize fuel loss and fire hazard. If the leak can be associated with one engine bay, feed tank, or side of the aircraft, then the fire warning light for the engine on that side should be pressed to close the airframe fuel shutoff valve. Placing the throttle OFF will not isolate leaks upstream of the engine fuel control. If the leak is upstream of the airframe fuel shutoff valve, fuel loss may be reduced by stopping external fuel transfer and shutting off the fuel transfer and fuel boost pumps. The transfer and main boost pumps can be shut off by turning both main generators OFF. The external tank transfer can be stopped by selected STOP TRANS. Monitor feed tank fuel quantities and turn the main generators ON and/or turn the refuel/transfer switches to NORMAL as required to prevent feed tank depletion. Failure of some fuel system components can cause loss of all fuel in a few minutes. Consider increasing airspeed (without afterburner) to maximize range by using fuel which would otherwise be lost.

WARNING

Afterburner may ignite leaking fuel.

NOTE

Checking the fuel flow gages may help to determine associated engine bay.

If leak can be associated with one engine bay -

1. Fire warning light - PRESS
2. Throttle - OFF

If source of leak cannot be determined -

1. Either fire warning light - PRESS
2. Throttle - OFF

If leak continues -

3. Fire warning light - RESET
4. Engine - RESTART
5. Other engine fire warning light - PUSH
6. Other engine throttle - OFF

If leak continues and flight to emergency landing site not assured -

7. External tank/conformal tank fuel control switches - STOP TRANSFER
8. Fire warning light - RESET
9. Engine - RESTART
10. Emergency generator switch - MAN (EMER BST ON caution on and BST SYS MAL caution off)
11. Both main generator switches - OFF
12. Fuel gage - MONITOR FEED TANKS
13. Main generator switches - ON AS REQUIRED FOR FUEL TRANSFER AND FOR LANDING
14. External tank switches - ON AS REQUIRED

After landing -

15. Shutdown engines using fire warning lights, engine master switches, and throttles.

UNCOMMANDED FUEL VENTING

Fuel flowing unintentionally from the dump mast(s) in flight is, in all probability, due to abnormal venting caused by fuel transfer system and/or fuel pressurization/vent system failures (the probability of a spontaneous dump system failure is extremely low). If fuel dump is selected with abnormal venting, the internal fuel tanks could overpressurize and rupture. Cycling the fuel dump switch may also increase the fuel loss rate. Therefore, the fuel dump switch should not be cycled in an attempt to correct uncommanded fuel venting (cycling the switch is acceptable if normal fuel dumping does not stop when the switch is moved from DUMP to NORM). Feed tank fuel cannot be dumped or vented. Turning the air source knob to OFF may reduce the fuel loss rate if fuel pressurization malfunctions are contributing to the venting flow.

CAUTION

If fuel dump is selected during abnormal venting, the internal fuel tanks could over-pressurize and rupture.

1. Fuel dump switch - NORM
2. External tank/conformal tank fuel control switches - STOP TRANSFER
   If any external tank is partially full, the aircraft may exceed the aft CG limit at light internal fuel weights due to fuel moving aft in the external tanks. In this case, it may be necessary to jettison the external tanks.
3. Slipway switch - OPEN
4. Air source knob - OFF (below 25,000 feet)
   Expect a possible ECS light once the air source knob is turned off.

NOTE

The supply of bleed air to the MSOGS concentrator is shut off when the air source knob is turned off. If the BOS is charged, it will automatically provide oxygen enriched breathing gas to the regulators. If the BOS is not charged or becomes depleted, descend below 10,000 feet MSL. Consider using the emergency oxygen bottle.

If fuel venting continues and flight to an emergency landing site requires more than feed tank fuel -

5. Emergency generator switch - MAN
   The EMER BST ON caution should come on and the BST SYS MAL caution should remain off.
6. Main generator switches - OFF
   If the BST SYS MAL caution is on when both generator switches are turned OFF, double engine flameout may occur due to lack of boost pump pressure.
7. Fuel gage - MONITOR FEED TANK
   Feed tanks may be refilled by turning on a main generator thus activating transfer pumps, or by allowing fuel to gravity feed from internal wing tanks.

When feed tank fuel is sufficient for flight to an emergency landing site -

8. Main generator switches - ON

ECS CAUTION

An ECS caution indicates low airflow or overtemperature of the avionics cooling air. In either case, avionics damage due to heat is the primary concern. Very low or high engine rpm can degrade ECS operation; therefore, maintain moderate airspeeds and rpm if the ECS caution is on. Shut down the radar first as it is very heat sensitive and reduces the cooling air available for other systems. Turn off non-essential avionics for their own protection. Avionics that cannot be turned off (AHRS, xfmr rectifiers, IFF, AIC, ADC, signal data recorder, etc.) will continue to be heat damaged. Turning the emergency vent handle dumps cockpit pressurization. Pulling the handle diverts ECS cockpit air to the avionics and allows ram flow to enter the cockpit as a function of handle extension. Turning the cockpit temperature control switch OFF will switch avionics cooling to ram air. The ECS caution will continue to monitor avionics cooling air flow and temperature. Optimum ram air cooling is obtained at 400 knots and 15,000 feet.

ECS turbine bearing disintegration and failure generally causes a high pitched whine that increases in pitch as engine rpm rises (starting about 80%). It can be accompanied by vibration in the floor area, an ECS light, and/or smoke and fumes. The only way to shut the ECS turbine down is by placing the cabin temperature control switch or air source knob to OFF.

NOTE

When landing with an illuminated ECS light, an automatic avionics shutdown may occur upon touchdown or during landing rollout. If so, the HUD and cockpit displays will blank, UHF 1 will be inoperative. Aerobrake using backup visual references.

1. Maintain 250-450 knots (75-85% rpm)

If caution remains on -

2. Non-essential avionics - OFF
3. Emergency vent handle - TURN AND PULL (below 25,000 feet)

If caution still remains on -

4. Cabin temperature control switch - OFF

DISPLAY FLOW LOW CAUTION

A DISPLAY FLOW LOW caution indicates low cooling air flow to the cockpit displays. The cockpit displays include the UFCs, HUD, RMR, MPDs, and MPCDs. The primary concern in this case is damage to the displays due to overheat. Turning Internal Countermeasures Set off will increase cooling supply pressure to the cockpit displays. Non-essential displays should be turned off for their own protection. The RMR and MPCDs are the most heat sensitive displays and have no overheat protective circuitry and therefore should be turned off as soon possible. The MPDs have overheat protection which will cycle the units off and on during periods of extreme overheat. The HUD is the most reliable display and has limited overheat protection circuitry which will turn itself off upon impending heat damage. The HUD will remain off until turned on again by the pilot. If cabin airflow is normal, it can be assumed that some cooling air flow is available to the displays. As a minimum, the HUD, UFCs, and the aft cockpit R/H MPD should remain on. This will provide the pilot with flight information and allow the Weapons Systems Operator to monitor fault indications. Also, turning the emergency vent handle below 25,000 feet will lower cabin pressure, and therefore increase display cooling flow.

SINGLE ENGINE OPERATION

During single engine low or high rpm operation, ECS performance will be degraded and a DISPLAY FLOW LOW caution may come on with the ECS operating normally. Display cooling is marginal but is adequate for short term operations. Optimum cooling is achieved by operating at 80-82% rpm below 40,000 feet.

1. Internal Countermeasures Set - OFF (as soon as practical)

If caution remains on -

2. Non-essential displays - OFF
3. Emergency vent handle - TURN (below 25,000 feet)
4. Maintain 80-82% rpm below 40,000 feet

EXTREME COCKPIT TEMPERATURE

If temperature control cannot be maintained in AUTO -

1. TEMP switch - MANUAL
2. Adjust temperature control

If this fails and temperature becomes excessive -

3. Emergency vent handle- PULL
4. Observe caution at altitude and consider descent

If temperature hot and altitude low -

5. Consider a climb to cooler air and/or deceleration to slower speed.

OXYGEN CAUTION (MSOGS Installed) (F-15E 90-0233 AND UP; ALSO F-15E 86-0183 THRU 90-0232 AFTER TO 1F-15E-561)

An OXYGEN caution indicates a low Partial Pressure of Oxygen (PPO_2) , a low concentrator outlet pressure, or incorrect internal BIT answers. The gauge indicates the BOS pressure available, and may be as high as 450 PSI. The BOS is automatically engaged whenever the OXYGEN caution light comes on. If a low MSOGS concentration occurs and an automatic switchover to BOS does not occur, activation of the emergency oxygen bottle should be considered to enable a safe descent. The pilot can also press and hold the OXY BIT button/light to switch to BOS (however, MSOGS will revert out of BOS when the OXY BIT button/light is released).

If OXYGEN caution comes on -

1. Oxygen pressure gage - CHECK

If BOS is not available or when BOS pressure falls below 50 psi -

2. Descend below 10,000 feet MSL.
3. Consider using the emergency oxygen bottle.

SMOKE, FUMES, OR FIRE IN COCKPIT

Consider all unidentified odors in the cockpit as toxic. Do not confuse condensation from the air conditioning system with smoke. The most probable source of visible smoke or fumes in the cockpit is from the engine or residual oil in the ECS ducts which can enter the cockpit through the ECS system via the center pedestal air outlet and/or cabin defog outlets. This smoke is blue grey in color, has a characteristic pungent odor, and may cause the eyes to sting. This odor may be noticed during engine run-up (if accomplished), during takeoff roll and occasionally during supersonic flight. Severe cases of smoke may indicate a potential engine oil system problem. If possible retard throttles to the lowest thrust possible and monitor engine oil pressure indicators. Refer to Oil System malfunction if oil pressure problem is indicated.

Another possible source of smoke or fumes is an electrical malfunction or overheat in equipment located in the cockpit. In the event of electrical short or overload condition, this equipment may generate electrical smoke (usually white or grey in color) but should not cause an open fire since cockpit equipment uses very little electrical current. Cockpit electrical wiring insulation may smolder and create smoke, but will not erupt into a seriously damaging fire. There are no fuel or hydraulic lines passing through or near the cockpit area, hence, the possibility of cockpit fire is remote. Both main generators may be turned off after emergency boost system operation is confirmed.

If smoke or fumes detected -

1. Oxygen regulator - 100% AND EMERGENCY
   Placing the diluter lever to 100% and the emergency lever to EMERGENCY will provide oxygen under positive pressure. This will prevent smoke and fumes from entering the mask even if the mask leaks.

WARNING

The emergency oxygen supply (bailout bottle) does not supply sufficient oxygen flow for normal breathing unless the oxygen supply hose is disconnected from the CRU-60/P. This action would permit smoke and fumes to enter the mask.

NOTE

Severe smoke may indicate an oil system problem. Retard the throttles as low as possible and monitor engine oil pressure indicators .

If required -

2. Emergency vent handle - TURN AND PULL (below 25,000 feet)

If engine oil smoke suspected -

3. Throttles - RETARD (as low a setting as possible)
4. Monitor oil pressure indicator and refer to Oil System malfunction.

If electrical smoke confirmed -

3. Non-essential electrical equipment - OFF
4. Land as soon as practical

If cockpit visibility restricted -

5. Canopy - JETTISON

WARNING

If the cockpit is the source of the smoke or fumes, canopy jettison may cause an eruption of flames around the pilot.

If electrical fire/smoke persists -

6. Emergency generator switch - MAN
   The EMER BST ON caution should come on and the BST SYS MAL caution should remain off.
   If the BST SYS MAL caution is on when both generator switches are turned OFF, double engine flameout may occur due to lack of boost pump pressure.
7. Both main generator switches - OFF

If electrical fire still persists -

8. Emergency generator switch - ISOLATE

NOTE

In ISOLATE mode, rear cockpit power and intercom are lost and the MSOGS system will not generate oxygen (the system will revert to BOS). WSO should be advised prior to initiating ISOLATE mode.

9. Follow Oxygen Caution procedure (MSOGS installed)

If fire is intolerable -

10. Eject.

LOSS OF CABIN PRESSURE

Loss of cabin pressure can occur rapidly or develop slowly for no apparent reason and can be verified by the cabin pressure altimeter. This procedure is to be used when a suspected cabin pressure problem is experienced.

1. Oxygen pressure regulator - 100%
2. Descend to lowest practical altitude (25,000 feet maximum)
3. Land as soon as practical.

ENGINE FIRE INFLIGHT

If a fire light comes on, or a voice warning "Warning, Engine Fire, Left (or Right)" is heard, or indications of an engine/aft fuselage fire are observed, perform this procedure. A fire in the afterburner section or in the vicinity of the nozzle will not cause a FIRE light to come on, the L (R) BURN THRU light will come on and the "AB Burn Thru, Left (Right)" voice warning will be heard. If an afterburner/nozzle burn through occurs, reducing the throttle to IDLE should extinguish the fire within 30 seconds. If the initial throttle reduction causes the light to go out or fire indications to cease and the fire detection system tests good, restrict thrust on the affected engine. If a fire light is accompanied by other indications of a fire (e.g., smoke, control difficulties, bleed air light, hydraulic or electrical anomalies), complete the procedure. With indications of explosion or catastrophic failure, do not delay completing engine shutdown steps. This may terminate fuel to the fire before it becomes self sustaining. Once the light has been pushed and the fuel shut off, do not depress the light again unless engine restart is necessary. If the fire extinguisher is used successfully, do not consider restarting the engine unless absolutely necessary.

1. Throttle(s) - IDLE

If warning light goes off or fire out -

2. Fire warning system - TEST
3. Monitor other fire indications closely

If warning light remains on or fire persists -

2. Fire warning light - PUSH
3. Throttle - OFF
4. Fire extinguisher - DISCHARGE

If fire persists -

5. Eject

AFTERBURNER BURN THRU

If a fire occurs in the afterburner section, the left or right afterburner burn through lights will come on and the voice warning will be heard.

1. Throttles - RETARD TO MIL OR BELOW

AMAD FIRE INFLIGHT

The most likely cause of an AMAD fire light in flight is the generators. If indications of a fire (AMAD Fire Light and "Warning, AMAD Fire" voice warning) exist, check electrical indications as well. Turning off a generator may remedy the situation.

1. Throttles - REDUCE

If fire warning light goes out -

2. Fire warning system - TEST
3. Monitor other fire indications closely
4. Discontinue mission

If fire warning light remains on -

2. AMAD light - PUSH
3. Fire extinguisher - DISCHARGE

If fire warning light still remains on -

4. Emergency generator switch - MANUAL
   The EMER BST ON caution should come on and the BST SYS MAL caution should remain off. If the BST SYS MAL caution is on when both generator switches are turned OFF, double engine flameout may occur due to lack of boost pump pressure.

5. Affected generator switch - OFF

If unable to determine which generator is affected -

6. Both generator switches - OFF (one at a time to isolate source)

If fire persists -

7. Eject

AMAD FAILURE

AMAD failure is indicated by the simultaneous loss of the PC system, the utility pump, and the generator on the same side. If this occurs:

1. Throttle - IDLE
2. Refer to Electrical and Hydraulic Failures.

If double AMAD failure occurs -

3. Eject

   If double AMAD failure occurs, total hydraulic and electrical power are lost and aircraft control is impossible.

SINGLE ENGINE STALL/STAGNATION

Engine stalls are the result of a disruption of airflow across one or more fan/compressor blades. Although many conditions affect compressor airflow (i.e., aircraft maneuvering, ice, DEEC, afterburner backpressure, etc.) most will not exceed the designed stall margin of the engine. The DEEC includes logic to detect and automatically recover most engine stalls without pilot action.

However, the fan bypass duct provides a convenient passage for pressure disturbances created in the afterburner section to travel directly forward to the fan/compressor. If the engine nozzle does not position properly when operating the afterburner, pressure pulses can be transmitted forward to the fan/compressor causing the blade(s) to exceed the stall limit. Hence, most stalls will be associated with use of the afterburner. High altitude/slow flight and maneuvering all increase the sensitivity to stall because they increase airflow disturbances to the face of the engine.

Stalls may also be caused by an anti-ice valve failed in the open position at higher power settings (greater than 85%). If an engine stall occurs, retard the throttle to mid-range or below and make sure the ENG HEAT switch is OFF. If the switch was ON when the stall occurred, the mission may be continued with the ENG HEAT switch OFF, if conditions permit. However, if subsequent stalls occur, follow normal stall recovery procedures and restrict throttle movement to mid-range and below (less than 85%).

Stalls normally produce an audible pop, bang or thud, but may occur without audible warning. Engine instruments may not indicate anything unusual, but rpm rollback, increased FTIT and nozzle opening may be noted for more severe stalls at MIL or above. Generally the stall will be self-clearing; however, quickly retarding the throttles to MIL (IDLE if a non-afterburning stall) will aid recovery.

In the unlikely event that the fan/compressor stall does not self-clear, the disturbed airflow will propagate through the compressor, resulting in a stagnation. Unstable burning then occurs in the combustion chamber causing higher than normal temperatures and rpm decreasing to sub-idle (less than 60%). To clear this condition, the engine must be shutdown and restarted.

If a stagnation develops, it will be characterized by rising FTIT and decreasing rpm with no change in throttle position. FTIT may exceed 1000°C (**PW-220** engines) or 1107°C (**PW-229** engines) or stabilize at some lower level in response to trim commands from the DEEC to prevent overtemperature. FTIT above 1000°C (**PW-220** engines) or 1107°C (**PW-229** engines) will result in engine damage. To prevent catastrophic engine damage, immediate corrective action should be taken. It is possible that a stagnated engine may also display a fire plume trailing the aircraft if the throttle is not placed to OFF. This plume may persist until the throttle is placed to OFF and the stagnation cleared. A GEN OUT caution and EMER BST ON caution may be the first indication of engine stagnation. With a single engine stagnation and no other anomaly, the GEN OUT and EMER BST ON should be the only cautions on before engine shutdown.

Post stagnation engine operation is keyed to FTIT. If 1000°C (**PW-220** engines) or 1107°C (**PW-229** engines) was not exceeded, normal engine operating limits apply. If an engine overtemp warning was activated during the stagnation (FTIT ≥1000°C for **PW-220** engines, FTIT ≥1107°C for **PW-229** engines), the engine may be started to provide redundant hydraulic and electric power, but should be left at IDLE (**PW-220** engines) or below 80%(**PW-229** engines) unless additional thrust is required to ensure safe recovery. After a stagnation has cleared, engine parameters at MIL will initially be lower until the DEEC can retrim the engine.

SINGLE ENGINE STALL/STAGNATION

1. Throttle - CHOP TO IDLE (MIL if in AB)
   If afterburner stall does not clear at MIL, chop the throttle to IDLE.
2. ENG HEAT switch - CHECK OFF

If RPM is less than 60% and no response to throttle movement, or if FTIT continues to rise -

3. Throttle - OFF
4. Perform restart.

With PW-220 engines, if FTIT exceeded 1000° -

5. Throttle - LEAVE AT IDLE (if practical)

With PW-229 engines, if engine overtemp warning activated (1107°C) -

5. Throttle - SET AT 80% RPM OR LESS (if practical)

SINGLE ENGINE OPERATION

If the engine will not start, best cruise may be approximated by a climb at 250 knots until rate of climb stops. Accelerate to 0.6 Mach (**PW-220** engines) or 0.65Mach (**PW-229** engines) in MIL. Cruise climb as fuel weight decreases.

During single engine operation at low power settings, the low ECS airflow affects the output from the MSOGS concentrator, which may result in some breathing restriction during inhalation. Increase engine RPM slightly to correct the breathing restriction.

DOUBLE ENGINE STALL/STAGNATION/FAILURE

Three conditions can cause double engine flameout: all boost pumps inoperative, empty feed tanks or mechanical failure of both engines. If both main boost pumps and the emergency boost pump are not operating, restart is possible only within a severely restricted flight envelope. If altitude permits, immediately lower the nose to maintain 350 knots. Check rpm and FTIT to determine whether the engines are flamed out or stagnated. If the flameouts were caused by temporary fuel starvation, they may restart. If the engines are stagnated, they must be shut down and restarted. Shut down the right engine first unless the engine overtemp warning is activated (1000°C for **PW-220** engines, 1107°C for **PW-229** engines). If the overtemp warning is activated, shutdown the engine with the lower FTIT.

During a double engine out situation, regardless of airspeed, altitude or cause, attempt a spooldown restart; however, the primary task is to maintain enough hydraulic power for aircraft control while getting at least one engine producing normal power. A single engine at about 18% or both engines at 12%, will provide enough hydraulic power for flight control and emergency generator operation. An airspeed of 350 knots will normally maintain 12% rpm or greater. At low speed, a momentary steep dive may be required to rapidly attain 350 knots; however, a shallow dive (10° or less) will maintain 350 knots and 12% rpm. Once steady state rpm is established, excessive airspeed/dive angle reduces time available for restart. If sufficient rpm is not maintained to fully power the emergency generator system, the emergency generator output may degrade to powering only the ISOLATE functions. In this case, RPM and FTIT will still be available. If this occurs, increase airspeed to increase engine rpm and cycle the emergency generator switch to ISOLATE and back to MAN to restore full emergency generator power. The JFS, when engaged, will provide sufficient hydraulic power for flight control and emergency generator operation permitting a minimum rate of descent glide at 210 knots.

During a double engine stagnation, allow one engine to remain in stagnation while commencing a restart on the other engine. Prolonged overtemperature increases damage and reduces the probability of successful restart of that engine; therefore, shut down the second engine and commence a restart as soon as a restart is indicated on the first engine.

Eject before losing flight control. Imminent loss of control is indicated by loss of the emergency generator and/or control transients as the first PC system drops to 0.

DOUBLE ENGINE STALL/STAGNATION

1. Both throttles - CHOP TO IDLE (MIL if in AB)

If afterburner stall does not clear at MIL, chop throttle(s) to IDLE.

2. ENG HEAT switch - CHECK OFF

If RPM on both engines is less than 60% and no response to throttle movement, or if FTIT on both engines continues to rise -

3. Throttle (right engine) - OFF WHILE ESTABLISHING 350 KNOTS

   If FTIT exceeds 1000°C , shut down engine with lower FTIT.

4. Perform Restart procedure

   If optimum restart parameters are not met by the time rpm decreases through 30%, place the throttle to midrange regardless of FTIT, airspeed or altitude.

5. At rpm increase on engine being started or if restart unsuccessful, shut down other engine.
6. Other engine - RESTART

If above restart attempts fail -

7. JFS assisted restart - PERFORM (if conditions permit)

RESTART (PW-220 Engines)

Ignition and fuel are continuously supplied when the throttles are at IDLE or above. If an engine does flameout and auto start does not occur, it is unlikely that a start can be accomplished as cycling the throttles through OFF does not recycle either ignition circuits or fuel flow. Therefore, restarts are generally required only because an engine has been shut down for some reason. Restarts may be made with rpm as low as 12% (fuel flow and/or ignition may not be available below approximately 12%); however, for optimum restart capability, place the throttle in midrange when the following conditions are met: a. RPM between 30% and 50%. b. FTIT below 800°C.

Normally the fastest restart is accomplished by placing the throttle to midrange as rpm unwinds (spooldown restart) rather than waiting for rpm to stabilize (windmill restart), or attempting a JFS assisted restart. Advancing the throttle at a minimum 30% when rpm is decreasing should allow time for a relight before rpm drops to 12%. There is a high probability of hot starts, hung starts or no lights below 250 knots (primary mode) or 275 knots (secondary mode). If airspeed is insufficient and rpm drops below 12%, airspeeds up to 450 knots may be required to regain 12%.

CAUTION

If a restart is planned, maintain engine rpm above 0%. The engine may thermally seize if the engine rpm is allowed to drop to 0%. If this occurs, the engine will not rotate even with high airspeeds or engagement of the JFS.

If the rpm drops below 12%, the DEEC may transfer to and lock up in SEC. A normal SEC mode windmill restart can be made; however, engine control switch cycling (i.e. ON-OFF-ON) will not restore the primary ENG CONTR mode.

Restart indications are practically the same as during ground start. Initially, both rpm and FTIT increase. FTIT may reverse several times, but rpm should continue to increase.

Restart at or near minimum recommended airspeeds above 35,000 feet may be characterized by very slow rpm and FTIT increases and/or fluctuations during engine acceleration to idle. Up to two minutes may be required to achieve a successful restart. During this period there will be no response to throttle movement above idle and the DEEC will inhibit pilot inputs until a stabilized flight idle has been established. If fluctuations occur, the restart can normally be completed without re-initiation by accelerating or decelerating toward 300 knots and/or decreasing altitude.

An unsuccessful restart is indicated by a steady decrease in rpm trend (rpm begins to decrease), or by FTIT increasing through 800°C with rpm hung or decreasing. If either of these conditions occur and a start with the ENG CONTR switch ON is unsuccessful, consider a secondary mode (SEC) start (ENG CONTR switch OFF). If the control system senses a condition which could prevent safe operation in the primary mode, an automatic transfer to SEC will occur and a SEC start will result regardless of the ENG CONTR switch position. The start procedure for either a primary or secondary start is the same; however, a higher airspeed is required for SEC start. Momentary fluctuations of RPM and FTIT may be observed in SEC mode (typically for less than 10 seconds) during the engine acceleration to idle. Restart time for a SEC start will range from about 30 seconds at sea level to as much as 60 seconds above 30,000 feet.

CAUTION

During SEC restarts, FTIT should be closely monitored because SEC fuel flow is hydromechanically controlled independent of RPM and FTIT.

RESTART (PW-229 engines)

Ignition and fuel are continuously supplied when the throttles are at IDLE or above. If an engine does flameout and auto start does not occur, cycle the throttle to OFF and then back to mid-range as soon as restart conditions are met. Restarts are generally required only because an engine has been shut down for some reason. Restarts may be made with rpm as low as 12% (fuel flow and/or ignition may not be available below approximately 12%); however, for optimum restart capability, place the throttle in mid-range when the following conditions are met:

1. RPM between 30% and 50%.
2. FTIT below 800°C.

Normally the fastest restart is accomplished by placing the throttle to midrange as rpm unwinds (spooldown restart) rather than waiting for rpm to stabilize (windmill restart), or attempting a JFS assisted restart. Advancing the throttle at a minimum 30% when rpm is decreasing should allow time for a relight before rpm drops to 12%. There is a high probability of hot starts, hung starts or no lights at the conditions listed below :

*Below 250 knots from 0 to 30,000 feet in primary mode

*Below 275 knots, above 30,000 feet in primary mode

*Below 275 knots from 0 to 30,000 in secondary mode

*At any airspeed above 30,000 feet and in secondary mode.

If airspeed is insufficient and rpm drops below 12%, airspeeds up to 450 knots maybe required to regain 12%.

CAUTION

If a restart is planned, maintain engine rpm above 0%. The engine may thermally seize if the engine rpm is allowed to drop to 0%. If this occurs, the engine will not rotate even with high airspeeds or engagement of the JFS.

During restart, there will be no response to throttle movement above IDLE and the IDEEC will inhibit pilot inputs until a stabilized flight idle has been established.

Stabilizing or increasing rpm is normally the first indication of light-off during restart. The fuel manifold drain port on the pressurizing and dump valve is capped, resulting in normal light-off time of 5 seconds or less after advancing throttle to mid-range. However, RPM and FTIT turn around are slow, making light-off subtle and difficult to detect. This condition should not be confused with a hung start. For PRI restarts below 30,000 feet MSL, if light-off is not indicated in 20 seconds, place the throttle to OFF and attempt a restart in SEC.

IDEEC overtemperature protection logic attempts to limit FTIT during start to 870°C, which may result in decreasing, hung or slowly increasing RPM. If a hung start occurs below 30,000 feet MSL (stabilized FTIT 870°C or less, RPM hung and definitely stabilized below 60%), increase airspeed to a maximum of 400 knots/0.9 Mach. If the hung start persists, attempt a restart in SEC.

Above 30,000 feet MSL, the restart should be initiated by moving the throttle to mid-range at 50% RPM regardless of FTIT or airspeed to increase the probability of light-off. If unable to move the throttle to mid-range at 50%, do so at as high an RPM as possible and always by 30%. Obtain 400 knots/0.9 Mach by diving or using the good engine to minimize RPM spooldown rate, and quickly decrease altitude to less than 30,000 feet MSL. If light-off indications are not noted within 20 seconds after advancing the throttle, or if FTIT exceeds 870°C (hot start), move the throttle to OFF and reinitiate a PRI restart. If a hung start occurs (RPM stable with FTIT stable at 870°C or less), keep the throttle at mid-range until below 30,000 feet MSL, then reinitiate a PRI restart.

If the control system senses a condition which could prevent safe operation in the primary mode, an automatic transfer to SEC mode will occur and a SEC start may result regardless of the ENG CONTR switch position. The start procedure for either a primary or secondary start is the same; however, a higher airspeed is required for SEC start.

Windmill restarts at 25,000 feet MSL and above with alternate fuels may result in no lights. If light-off indications are not noted within 20 seconds, move the throttle to OFF, descend and hold airspeed to maintain 12% RPM, and reinitiate the restart when below 25,000 feet MSL.

During a SEC start, 60 to 70 seconds are required for light-off and acceleration to mid-range from the time the throttle is advanced from OFF. If a SEC spooldown restart is initiated below 20,000 feet with RPM in the 40 to 50% range, as much as 30 seconds may be required to see positive RPM response. Do not confuse this slow response with a no-light.

CAUTION

During SEC restarts, FTIT should be closely monitored because SEC fuel flow is hydromechanically controlled independent of RPM and FTIT.

Higher altitude/lower RPM (30-40%) SEC spooldown restarts will show normal positive RPM indications within 20 seconds after throttle advancement from OFF. Restarts initiated at higher RPM in general will typically accelerate slowly in the 40-50% RPM range.

NOTE

ENG CONTR switch position should not be changed within 90 seconds after initiating a start (advancing throttle from OFF).

JFS ASSISTED RESTART

JFS airstart capability has been incorporated for assistance in engine restarting. This capability is intended for use when encountering engine stall/stagnations after all other restart options have been attempted or rejected as being impractical. The probability of a successful JFS airstart and engine engagement will be enhanced if the aircraft is within the envelope depicted in figure 3-4. Additionally, the centerline pylon should be jettisoned if at all possible. If the centerline pylon will not jettison, it may be necessary to descend to lower altitudes to achieve a JFS airstart. In all cases, proper consideration to the safe ejection envelope should be made prior to attempting the JFS airstart procedure. During restart attempts, ensure that at least one engine is rotating (even in stagnation) at or above 18% rpm to provide sufficient hydraulic power for the emergency generator and flight controls.

WARNING

When doing a JFS assisted restart, the engine display format on the MPD/MPCD may freeze if power is lost to the DEEC/IDEEC. The EMD will continue to correctly display engine parameters and should be used in this case.

If a JFS assisted restart is desired:

1. Throttle - OFF
2. Centerline pylon - JETTISON (if required)
   If both engines are below minimum rpm for generators (approximately 56%) or both main generators are inoperative, the centerline pylon can only be jettisoned by pressing the emergency jettison button.
3. JFS switch - CHECK ON

After at least one engine is below 40% rpm -

4. JFS handle - PULL AND RELEASE
   Use single accumulator for inflight JFS starts. If both accumulators are discharged simultaneously the JFS may accelerate too rapidly and fail to start.

WARNING

If the JFS does not start, the starter switch should be placed OFF. Wait 30 seconds after cycling the switch to allow the start sequence relay to disengage and the JFS to decelerate before trying a second start. Failure to wait 30 seconds may result in a JFS no start.

5. JFS ready light - CHECK ON (within 10 seconds)

After engine is below 30% RPM -

CAUTION

To preclude a possible CGB shear section failure, do not move the engine control switch until the engine achieves idle.

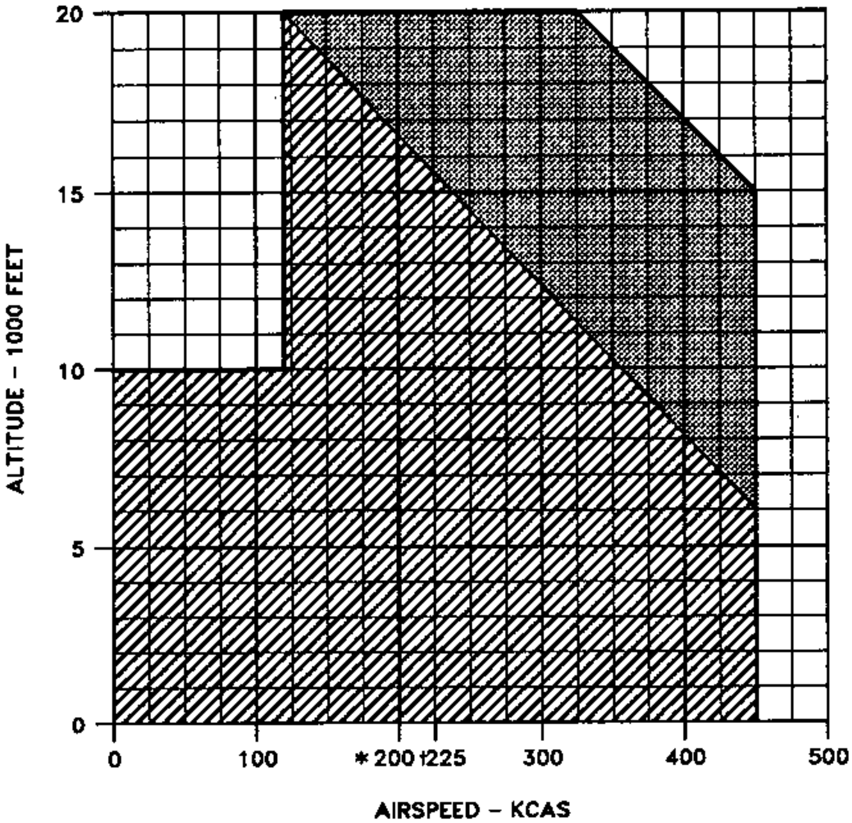
6. Finger lift - RAISE AND RELEASE
   Attempts to engage the JFS above 30% RPM may shear the CGB shaft. Once the JFS is engaged, sufficient hydraulic pressure to the flight controls should be available to permit a controlled minimum rate of descent glide (approximately 210 knots).

7. Throttle - MID RANGE (after engine reaches steady state motoring speed of 26 to 29% RPM)

8. Other engine - START (if applicable)

9. JFS - CONFIRM OFF

INFLIGHT JFS STARTING ENVELOPE-



LEGEND


CLEAN CENTERLINE ONLY.


CLEAN CENTERLINE OR CENTERLINE PYLON INSTALLED (WITH OR WITHOUT STORES).

* WITH -220 ENGINES, JFS ASSISTED ENGINE START NOT RECOMMENDED BELOW 200 KNOTS DUE TO POSSIBLE MAIN ENGINE HOT START.

† WITH -229 ENGINES, JFS ASSISTED ENGINE START NOT RECOMMENDED BELOW 225 KNOTS DUE TO POSSIBLE MAIN ENGINE HOT START.

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Figure 3-4

AIR INLET SYSTEM MALFUNCTION

INLET LIGHT ON

An illuminated caution light indicates either an AIC failure, ramp position error or a diffuser ramp that did not lock or unlock at the appropriate Mach number. Airspeed should be reduced below Mach +1.0 and if above Mach 0.95 accelerations are limited to +4.0 g to -1.0 g.

NOTE

> The internal inlet ramps can take up to 45 seconds to reposition after setting the RAMP switch to EMERG. Failure to decelerate below 1.0 Mach within 45 seconds may lead to a compressor stall on the affected engine.

1. Inlet ramp switch - EMERG
2. Throttle - MIL (if above Mach 1.0)
3. Limit aircraft accels to +4.0g to -1.0g (if above .95 Mach).
4. Reduce and maintain airspeed below Mach 1.0.

ROLL RATIO and RUDR LMTR CAUTION ON -

If the engine RPM does not decrease as the throttle is moved to idle, and ROLL RATIO (and possibly RUDR LMTR) caution is displayed, an AIC malfunction has probably occurred resulting in a false high Mach signal to the engine.

1. Determine if engine RPM respond to throttle movement.

If RPM does not respond to throttle movement -

2. Reduce and/or maintain airspeed below Mach 1.0.
3. ENG CONTR switch - OFF
4. Refer to Engine Control Malfunction procedures.

If RPM responds to throttle movement -

2. Refer to Flight Control Malfunction procedures.

ENGINE CONTROL MALFUNCTION

The ENG CONTR caution will come on as a result of a failure of the Mach number signal, failure of an electrical signal used for afterburner control, or if the DEEC has transferred from primary to secondary control due to DEEC failure detection or power loss. If the ENG CONTR caution is ON and corresponding INLET caution is OFF, a fault inhibiting afterburner or a control mode transfer from primary to secondary is probable. When the engine is in secondary control mode, the nozzle is closed, afterburner operation is prevented, only 70-80% of normal MIL thrust is available and both approach idle and ground idle (**PW-229**) thrust are disabled which increases taxi speed. Cycling the ENG CONTR switch may return the engine to normal operation. Cycling the ENG CONTR switch from OFF to ON above 40,000 feet may cause an engine stall.

When the ENG CONTR caution is ON and not clearable through cycling the ENG CONTR switch, the engine may still be operating in primary control mode. This condition may provide improved operation over secondary control mode. If the ENG CONTR caution is ON and engine operation is stable and follows throttle commands, keep the ENG CONTR switch in ON to keep IDEEC control features active. The features include higher MIL thrust, lower approach and landing thrust, faster thrust response, stall recovery, closed loop limit protection, and partial or full afterburner operation.

PW-220 ENGINES

If supersonic -

1. Throttles - MIL
2. Slow to subsonic.

If subsonic -

1. Throttle - 80%-85% RPM
2. ENG CONTR switch - CYCLE ON-OFF-ON

If engine operation unsatisfactory -

3. ENG CONTR switch - OFF
4. Land as soon as practical.
   Gear down idle thrust will be greater than normal.

After landing -

5. Shutdown engine to reduce taxi speed (if required).

PW-229 ENGINES

If supersonic -

1. Throttles - MIL
2. Slow to subsonic.

If subsonic and above 40,000 feet

1. Throttle - MINIMIZE MOVEMENT
2. Descend below 40,000 feet.

If subsonic and below 40,000 feet

1. Throttle - 80%-85% RPM
2. ENG CONTR switch - CYCLE ON-OFF-ON

If engine operation unsatisfactory -

3. ENG CONTR switch - OFF
4. Land as soon as practical.
   Gear down idle thrust will be greater than normal.

After landing -

5. Shutdown the engine to reduce taxi speed (if required).

ENGINE FAILS TO RESPOND TO THROTTLE COMMANDS

Failure modes exist which may result in no engine response to throttle commands. If the engine is stuck at near MIL or above, turning the engine control switch off will reduce the thrust level to 70-80%MIL. If the engine is stuck above IDLE, engine thrust may produce unacceptably high airspeeds for approach and excessive landing rollout distances. Shutdown of the non-responsive engine may be required, but should be delayed until the desired airspeed cannot be achieved through the use of differential power or until preparing for the landing approach. Engine shutdown for the approach should be accomplished at a speed and altitude which allows a smooth transition to single engine flight. Refer to SINGLE ENGINE PROCEDURE. If engine shutdown is required but cannot be accomplished with the throttle, the engine fire button should be pushed. Engine pops, fireballs from the exhaust and an FTIT overtemp are possible for a short time after engine flameout as residual fuel in the fuel lines passes through the engine fuel control. Attempting to restart an engine that did not shutdown with the throttle will most likely result in a hot start.

A broken throttle cable may allow engine power to be advanced but not retarded. With **PW-229 engines** above 550 KCAS while greater than 1.1 Mach, asymmetric thrust caused by an engine that does not respond to throttle commands may result in loss of directional control and permanent structural damage or aircraft loss. When reducing power in this region, a small throttle change accompanied by corresponding changes in fuel flow and nozzle position will indicate that the engines are responding properly prior to making a larger power reduction. If an engine does not respond when accomplishing this check, setting the engine control switch off will cause the ATDPS to command both engines to SEC mode if the aircraft is in a critical region, allowing the aircraft to safely exit the region.

If engine is stuck at near MIL or above -

1. ENG CONTR switch - OFF
2. Refer to Single Engine Operation

Prior to landing with an engine stuck above IDLE -

3. Throttle - OFF
4. Engine fire light - PUSH (if required)

ATDP SYSTEM CAUTION (PW-229 ENGINES)

An ATDP caution resulting from invalid air data indicates that ATDP is inoperative.

An ATDP caution subsonic indicates ATDP has failed with the engines interconnected. With both engines in the secondary mode, turning off the CC or AIU #1 may allow one or both engines to regain primary operation. Consider the systems/functions lost versus the thrust gained before following this course of action.

An ATDP caution supersonic generally indicates ATDP is inoperative.

WARNING

- With an inoperative ATDP system, asymmetric thrust above 500 KCAS while greater than 1.1 Mach may result in permanent structural damage or aircraft loss.
- With ATDP failed to the interconnected state, the engines are interconnected at all times. This results in both engines reverting to secondary mode if either engine experiences an ENG CONTR caution. Neither engine can be reset to primary mode.

NOZZLE FAILURE

The cockpit nozzle indication is nozzle control unit commands, not actual nozzle position. It is possible for the nozzle to fail open or closed and still have normal cockpit indications. Engine stall when selecting afterburner may be an indication of a nozzle failed closed. A loss of thrust and lower than normal FTIT at MIL may be an indication of a nozzle failed open. If nozzle malfunction is indicated, leave the ENG CONTR switch ON. Do not use MIL or afterburner unless required to maintain flight. Gear down idle thrust will be greater than normal with the nozzle full closed.

OIL SYSTEM MALFUNCTION

Engine oil system malfunctions include over or under pressure, and excessive fluctuations. If the oil pressure stays below 8 psi but above 0 psi and appreciable time at altitude is expected, consider engine shutdown. If oil pressure stays at 0 psi or above 100 psi and the other engine is operating normally, the engine should be shut down without delay to limit damage. If the engine is left running and vibration or other indications of possible engine seizure occur, shut down the engine and make a single-engine landing.

If oil pressure is out of normal range -

1. Throttle - IDLE

If oil pressure below 8 psi or pegged at 100 psi -

1. Throttle - OFF (conditions permitting)

EMER BST ON AND/OR BST SYS MAL CAUTION

The EMER BST ON and BST SYS MAL cautions provide indication of the status of both the emergency fuel boost pump system and the emergency generator system. A single caution or combination of cautions require the following aircrew actions:

EMER BST ON	BST SYS MAL	AIRCREW ACTION
ON	OFF	Refer to generator failure or boost pump failure as applicable.
OFF	ON	Follow applicable boost pump failure procedure.
ON	ON	Do not turn main generators OFF or place emergency generator switch to ISOLATE as this may fail the emergency boost pump.

BLEED AIR CAUTION

Bleed air malfunctions have the potential for developing into serious situations. Depending on the location of the hot air leak, various indications can result, causing pilot confusion and misinterpretation. Therefore, prompt action is required by the pilot.

While operating at low power settings near idle with a single air source selected, the low ECS airflow affects the output from the MSOGS concentrator, which may result in some breathing restriction during inhalation. Increase engine RPM slightly to correct the breathing restriction.

If left or right bleed air caution comes on -

1. Air source knob - OPPOSITE SOURCE

If caution remains on -

2. Throttle - IDLE

If both cautions come on -

1. Air source knob - OFF (below 25,000 feet)

NOTE

The supply of bleed air to the MSOGS concentrator is shut off when the air source knob is turned off. If the BOS is charged, it will automatically provide oxygen enriched breathing gas to the regulators. If the BOS is not charged, or becomes depleted, descend below 10,000 feet Consider using the emergency oxygen bottle.

FLIGHT CONTROL SYSTEM MALFUNCTION

The CAS is a highly reliable, three channel fail-operate/fail-safe system which continuously self-checks its operation. If the system senses failures in two channels of the same CAS axis, it will drop itself off line. If a flight control system anomaly is apparent, but adequate aircraft control can be maintained, do not disengage the CAS as it may be responsible for maintaining controlled flight. If it were to be disengaged, not only would aircraft control be jeopardized, but it may not be possible to reengage. If the CAS fails and cannot be reset, handling qualities are satisfactory for most mission tasks. If the pitch CAS fails while supersonic above 600 knots, pilot induced oscillations (PIO) may occur. If the malfunction involves both the CAS and the mechanical system, handling qualities may be severely degraded. If the pitch CAS fails while the aircraft has an aft center of gravity, the aircraft may be unstable above 450 KCAS, especially if loaded with external wing tanks. If the aircraft becomes unstable under these conditions, maintain control by using short, quick, pulse-like longitudinal stick inputs. Perform a Controllability Check, if practical, before landing. If the malfunction is in roll ratio, evaluate handling qualities at approach speed with the roll ratio switch in both AUTO and EMERG. If the malfunction is in pitch ratio, EMERG should only be tried if the pitch CAS is still on line or the airspeed is below 300 KCAS with the pitch ratio below 0.3. On aircraft with aft cg, selecting pitch ratio EMERG with the pitch CAS off and airspeeds above 300KCAS may cause uncontrollable pitch ups. Handling qualities may be considerably different at approach speeds than at higher speeds. If selecting EMERG does not noticeably improve controllability, land with the switch in AUTO. If landing with pitch ratio EMERG and pitch CAS OFF, fly a flat 18 unit AOA approach.

Failure of the PRCA - ARI interconnect cable can cause out of control roll oscillations especially at high gross weights. Such a failure results in more rudder movements than desired with lateral stick movement. Failure of the interconnect cable would be indicated by the rudders deflecting in the same direction as the stick, regardless of the fore/aft position of the stick. Inflight failure will cause roll oscillations at high gross weights and noticeable yaw excursions at low fuel states. This malfunction can be corrected by disengaging the ARI (roll ratio switch - Emergency).

NOTE

Placing either ratio switch to EMERG will fail the aileron-rudder interconnect (ARI), and will remove pitch and/or roll compensations provided by the ratio changer. Selection of the emergency pitch system will also disable pitch trim compensation. Handling qualities are adequate for recovery.

PITCH CAS FAILURE WITH AFT CG

With A/G stores aboard, the aircraft aft cg could be at or near the aft limit under one or more of the following conditions :

NOTE

Aircraft with wing tanks/stores or **-229** engines are more susceptible to aft cg conditions.

a. Low internal fuel state with the extent of aft cg travel dependent on external store configuration.

b. CFT transfer problem resulting in more fuel in the aft and center compartments.

c. Hung stores on center or aft CFT stations.

d. Fuel transferred from internal tanks prior to CFT fuel transfer selection.

If pitch CAS failure occurs with cg near the aft limit, handling qualities will be significantly degraded at low altitudes. Short, quick, pulse-like longitudinal stick inputs are required to keep pitch motions from diverging. Smooth, slow stick motions are not recommended due to the probability of increasing the pitch oscillations, leading to possible over-g and loss of control.

If pitch CAS fails and cannot be reset :

1. Slow to below 450 KCAS (0.7 Mach) by smoothly retarding the throttles. Avoid use of speed brake above 0.7 Mach.

WARNING

Use of the speed brake will cause an abrupt pitch down. At speeds above 0.7 Mach the pitch down may be uncontrollable and can be large enough to cause a severe PIO.

2. If aircraft pitch response is still too sensitive, continue decelerating to 300 KCAS and verify pitch control is acceptable. Extending the speedbrake below 0.7 Mach will improve longitudinal stability.
3. If the pilot workload is still excessive for adequate control, longitudinal stability can be increased by jettisoning wing tanks or wing mounted A/G stores. These actions should be sufficient to move the cg forward and provide acceptable handling qualities. In the event that adequate control is still not maintained, selectively release the aft CFT stores or jettison the CFT mounted A/G stores.

WARNING

If the center or aft CFT stations hang, aircraft control may be significantly degraded to the point of being uncontrollable.

If pitch CAS failure occurs while at low altitude during auto terrain following -

4. Auto flyup will command a very aggressive pullup. Depending on gross weight, center of gravity and airspeed conditions, this pullup could over-g the aircraft. To preclude a violent PIO, the recommended action is to initially 'freeze' the stick slightly aft of neutral until clear of the ground then attempt to regain pitch control by using short, quick, pulse-like stick inputs to stop unstable pitch movements from diverging.

PITCH SYSTEM MALFUNCTION

WARNING

With CFT's installed, if pitch CAS drops off line with the pitch ratio switch in EMERG, or pitch CAS is off line and the pitch ratio switch is placed in EMERG, a pitch up will occur which could rapidly over-g the aircraft before corrective action can be taken. This can occur as much as 10 -15 seconds after the pitch CAS drops off and/or the pitch ratio switch is in EMERG.

1. Slow to approximately 300 knots

If pitch ratio below 0.3 or if aircraft still difficult to control -

2. Pitch ratio switch - EMERG
3. Pitch ratio indicator - OBSERVE 0.3 to 0.5

If pitch ratio EMERG and pitch CAS OFF -

4. Fly a flat 18 unit AOA approach

NOTE

Reduced stabilator authority, with pitch ratio in EMERG, will prevent normal aerodynamic braking after landing. The nose will fall through at a higher airspeed. Limited aerodynamic braking may necessitate applying wheel brakes early.

ROLL SYSTEM MALFUNCTION

1. Roll ratio switch - EMERG

WARNING

- Destructive structural loads caused by excessive pitch and yaw excursions can occur during supersonic loaded rolls when the roll ratio light is on at Mach 1.5 or above with the roll ratio switch in AUTO. Until the roll ratio switch is placed in EMERG, avoid high lateral roll rates above Mach 1.5 at negative or high positive g.

WARNING

Loss of roll control authority has occurred above 18 units AOA with a large lateral asymmetry (2,000 lb. class weapon- AIM-9 and AIM-7 on the same side) and roll CAS off with roll ratio in EMERG. Avoid exceeding 18 units AOA under these conditions.

RUDDER SYSTEM MALFUNCTIONS

Two different rudder control system malfunctions are possible; failure/jamming of the rudder control cables or failure of a rudder actuator. If the rudder control cable is broken or jammed, flight control inputs which cause rudder movement will probably result in irreversible deflection of one or both rudders. Rudder trim will appear to correct the problem if rudder deflection is small; however, subsequent rudder inputs will aggravate the out-of-trim condition. Failure of a rudder actuator may cause the corresponding rudder to drive to a fully deflected position and remain there. This condition may be visually confirmed through use of mirrors, chase, etc. In either of these failures, the aircraft is controllable as long as the CAS remains on.

WARNING

If a rudder malfunction is apparent, do not turn the CAS off as this may cause loss of aircraft control.

If CAS disengages, a single fully deflected rudder may be counteracted with rudder and aileron; however, depending on the degree of dual rudder deflection, sufficient control may not be available to counteract the effects of a broken/jammed rudder cable. Avoid all unnecessary turns to prevent increasing the amount of irreversible deflection. Avoid unnecessary g loading since aircraft control will be reduced as AOA increases. Consider use of asymmetrical thrust to aid in reducing yaw effects. If possible turn in direction of failed rudder.

LAT STK LMT CAUTION

A LAT STK LMT caution on the MPD/MPCD may be an indication that the AOA has failed (AOA is invalid, static or pitot pressure is invalid) or left or right rudder CAS servo is inoperative or spin recovery aid circuitry is inoperative or the roll limit has functionally failed. In this case, more than 1/2 lateral stick may cause departure or structural failure.

1. Do not exceed 1/2 lateral stick until BIT display check.
2. Check AFCS DETAIL BIT display on MPD/MPCD.
3. Refer to AFCS Functional Status Summary.
4. CAS switches - RESET

NOTE

LAT STICK LIMIT and CAS YAW cautions may be displayed after a single engine shutdown. This is normal aircraft operation and the pilot should attempt a YAW CAS reset.

RUNAWAY TRIM

Sufficient control is available to land the aircraft from a runaway trim in any direction. Unless other flight control malfunctions are evident, leave pitch and roll ratio switches in AUTO.

1. Slow to below 250 knots.
2. Pitch and roll ratio - AUTO
   Unless other Flt Contr Malf.

If a runaway trim condition cannot be controlled with the normal trim controls -

3. Takeoff trim button - PRESS
   Trim returns to a near neutral position.

If required, remove power from trim actuators (in a neutral position if possible) -

4. AFCS ESS AC circuit breaker(s) - PULL
   This removes power from the trim actuators while leaving the rest of the flight control system operational (upper AFCS ESS AC circuit breaker is for pitch trim, and the lower AFCS ESS AC circuit breaker is for both roll and yaw trim).

AFCS FUNCTIONAL STATUS SUMMARY

FUNCTIONAL STATUS	INDICATIONS	CREW ACTIONS	COMMENTS
PCAS FIRST FAIL	AV BIT LIGHT ON	●RESET AV BIT ●CALL UP BIT PAGE ●SELECT PCAS RESET TO POSSIBLY CLEAR FIRST FAIL ●IF RESET FAILS WITH CFT STORES AND WING TANKS, SLOW TO 450 KCAS OR LESS	FLIGHT CONTROL SYSTEM REMAINS FUNCTIONAL. IF IN TF, IT REMAINS FUNCTIONAL.
PCAS DISENGAGE	MASTER CAUTION ON FLIGHT CONTROL CATEGORY LIGHT ON CAS PITCH CAUTION MESSAGE ON MPD/MPCD CAS ROLL CAUTION MESSAGE ON MPD/MPCD PITCH HANDLING QUALITIES DEGRADED NO AUTO PILOT MODES FLYUP COMMANDED IF IN ARMED MANUAL OR ATF NO AUTOMATIC ROLL TO WINGS LEVEL	●RESET MASTER CAUTION ●ATTEMPT RESET OF ... —CAS ROLL —CAS PITCH IF RESET FAILS: —STAY BELOW 600 KCAS —STAY BELOW 400 KCAS WHEN CONFIGURED WITH CFT STORES AND WING TANKS ●CALL UP BIT PAGE AND CHECK IF CASI-SERVOLOOP HAS FAILED —IF PCAS NO RESET, SELECT PITCH RATIO EMERG AND REFER TO CASI SERVOLOOP STATUS. ●RECOVER FROM FLYUP AND ASSESS PROBLEM	

AFCS FUNCTIONAL STATUS SUMMARY (Continued)

FUNCTIONAL STATUS	INDICATIONS	CREW ACTIONS	COMMENTS
RCAS FIRST FAIL	AV BIT LIGHT ON	●RESET AV BIT ●CALL UP BIT PAGE AND DETERMINE PROBLEM ●SELECT RCAS RESET TO POSSIBLY CLEAR FIRST FAIL	FLIGHT CONTROL SYSTEM REMAINS FULLY FUNCTIONAL.
RCAS DISENGAGE	MASTER CAUTION ON FLIGHT CONTROL CATEGORY LIGHT ON CAS ROLL CAUTION MESSAGE ON MPD/MPCD AUTO PLT caution if autopilot previously engaged POSSIBLE DEGRADED ROLL RESPONSE NO AUTOPILOT MODES (EXCEPT ATF)	●RESET MASTER CAUTION ●ATTEMPT RESET OF RCAS IF RESET FAILS —STAY BELOW 600 KCAS	DEGRADED ROLL DAMPING AND ROLL RESPONSE. NO ROLL AUTOPILOT, NO ROLL RATE LIMITING, ONLY 1/2 DIFFERENTIAL STABILATOR AVAILABLE.
YCAS FIRST FAIL	AV BIT LIGHT ON	●RESET AV BIT ●CALL UP BIT PAGE ●SELECT YAW CAS RESET TO POSSIBLY CLEAR FIRST FAIL	FLIGHT CONTROL SYSTEM REMAINS FUNCTIONAL.
YCAS DISENGAGE	MASTER CAUTION ON FLIGHT CONTROL CATEGORY LIGHT ON CAS YAW AND ROLL MESSAGE ON MPD/MPCD LATERAL/DIRECTIONAL STABILITY DEGRADED NO AUTO PILOT MODES (EXCEPT ATF)	●RESET MASTER CAUTION ●ATTEMPT RESET OF... —CAS YAW —CAS ROLL IF RESET FAILS —STAY BELOW 600 KCAS/ 1.0M	

AFCS FUNCTIONAL STATUS SUMMARY (Continued)

FUNCTIONAL STATUS	INDICATIONS	CREW ACTIONS	COMMENTS
SPIN RECOVERY	FIRST FAIL AV BIT LIGHT ON	●RESET AV BIT ●CALL UP BIT PAGE ●LIMIT LATERAL STICK INPUTS TO 1/2	IF SPIN RECOVERY IS LISTED BUT NOT CAS YAW, OR FULL MECHANICAL ROLL AUTHORITY INCORRECTLY SELECTED. SPIN RECOVERY AID MAY NOT BE AVAILABLE. HIGH ANGLE-OF-ATTACK HANDLING QUALITIES MAY BE DEGRADED. IF RESET FAILS AND BOTH SPIN RECOVERY AND CAS YAW ARE DISPLAYED, FULL MECHANICAL AUTHORITY IS NOT SELECTED IN SPIN.
SPIN RECOVERY WITH YAW CAS DISENGAGE	MASTER CAUTION ON CAS YAW CAUTION MESSAGE ON MPD/MPCD	●RESET MASTER CAUTION ●ATTEMPT RESET OF CAS YAW ●CALL UP BIT PAGE ●IF IN A SPIN, PUT GEAR DOWN TO GET FULL AUTHORITY ●REDUCE MANEUVERS TO "YCAS DISENGAGE" LIMITS. ●LIMIT LATERAL STICK INPUTS TO 1/2 EXCEPT FOR SPIN RECOVERY.	
CAS ARI-(2ND FAIL)	AV BIT LIGHT ON	●RESET AV BIT ●CALL UP BIT PAGE ●REQUIRES COORDINATED FLIGHT CONTROL INPUTS .	POSSIBLE TO HAVE RELATED FAIL INDICATIONS, I.E., ● AOA FAIL ● ROLL LIMIT
ROLL LIMIT	AV BIT LIGHT ON	●RESET AV BIT ●CALL UP BIT PAGE ●IF >550 KCAS/1.0M, LIMIT TO 1/2 STICK INPUTS	LATERAL ROLL AUTHORITY MAY BE INCORRECT. PITCH RATIO MAY BE INCORRECT.
ROLL LIMIT WITH LATERAL STICK LIMIT CAUTION	MASTER CAUTION ON FLIGHT CONTROL CATEGORY LIGHT ON LATERAL STICK LIMIT MESSAGE ON MPD/MPCD	●RESET MASTER CAUTION ●LIMIT LATERAL STICK INPUTS TO 1/2	
AOA FAIL	MASTER CAUTION ON FLIGHT CONTROL CATEGORY LIGHT ON LATERAL STICK LIMIT MESSAGE ON MPD/MPCD SPEEDBRAKE RETRACTS (IF EXTENDED)	●RESET MASTER CAUTION ●LIMIT LATERAL STICK INPUTS TO 1/2	

AFCS FUNCTIONAL STATUS SUMMARY (Continued)

FUNCTIONAL STATUS	INDICATIONS	CREW ACTIONS	COMMENTS
CASI SERVOLOOP	AV BIT LIGHT ON MASTER CAUTION ON FLIGHT CONTROL CATEGORY LIGHT ON CAS PITCH CAUTION MESSAGE ON MPD/MPCD CAS ROLL CAUTION MESSAGE ON MPD/MPCD	●RESET MASTER CAUTION ●ATTEMPT RESET OF —ROLL CAS —PITCH CAS ●IF PITCH CAS NO RESET, CALL UP BIT PAGE ●IF CASI SERVOLOOP DISPLAYED, SELECT PITCH RATIO EMERG WHEN STRAIGHT AND LEVEL BELOW 300 KCAS. EXPECT G TRANSIENT FROM -1/2 TO +1.0G/SEC. IF AFT CG EXITS, EXPECT POSSIBLE OVER-G. ●THEN, ATTEMPT RESET OF PITCH CAS	CASI SERVOLOOP FAIL WILL SHOW UP WITH PITCH CAS FAIL, ROLL CAS FAIL.
R/C/P STICK	AV BIT LIGHT ON MASTER CAUTION ON FLIGHT CONTROL CATEGORY LIGHT ON CAS PITCH CAUTION MESSAGE ON MPD/MPCD CAS ROLL CAUTION MESSAGE ON MPD/MPCD	●RESET MASTER CAUTION ●RESET ROLL AND PITCH CAS ●CALL UP BIT PAGE AND DETERMINE FAILURE ●TURN CAS OFF TO IMPROVE RESPONSE, IF ONLY AFT STICK INPUTS ARE REQUIRED.	RCP STICK FORCE SENSOR HAS FAILED. RCP STICK INPUTS RESULTS IN REDUCED PERFORMANCE AND REDUCES RCP G CAPABILITY TO 3.5G MAXIMUM.
CAS RUDDER PEDAL	AV BIT LIGHT ON MASTER CAUTION ON FLIGHT CONTROL CATEGORY LIGHT ON CAS YAW CAUTION MESSAGE ON MPD/MPCD	●RESET MASTER CAUTION ●ATTEMPT RESET OF YAW AND ROLL CAS ●CALL UP BIT PAGE AND DETERMINE FAILURE	RUDDER PEDAL POSITION SENSOR HAS FAILED. LARGER PEDAL INPUTS REQUIRED TO OVERCOME CAS FOR EQUIVALENT RESPONSE. NORMAL MECHANICAL PLUS DAMPENING IS AVAILABLE.
ONE RUDDER CAS	AV BIT LIGHT ON MASTER CAUTION ON FLIGHT CONTROL CATEGORY LIGHT ON LATERAL STICK LIMIT MESSAGE ON MPD/MPCD	●RESET MASTER CAUTION ●CALL UP BIT PAGE AND DETERMINE FAILURE ●LIMIT LATERAL STICK INPUTS TO 1/2 ●ATTEMPT YAW AND ROLL CAS RESET ●LIMIT FLIGHT TO BELOW 1.0M	RUDDER SERVO HAS FAILED. CAS GAIN IS DOUBLED TO REMAINING RUDDER. TOTAL RUDDER POWER REDUCED.

CANOPY UNLOCKED INFLIGHT/LOSS OF CANOPY

CANOPY UNLOCKED

The CANOPY UNLOCKED caution indicates that either the canopy locking mechanism has moved to the unlocked position or the canopy actuated initiator lanyard has become disconnected. The following procedures are recommended:

1. Slow to below 250 knots
2. Emergency vent handle - TURN (below 25,000 feet)
3. Canopy control handle - FULL FORWARD

CANOPY LOST

Air-to-ground communication may be possible up to about 400 knots, but airspeed should be reduced as much as practical and precautions taken to remain within the cockpit confines to prevent injury from the slipstream. Severe problems may be encountered by the WSO. Rapidly slowing below 200 knots and reducing altitude enables intercockpit communication and reduces the wind effects on the WSO. The WSO can attain the lowest slipstream profile by lowering the seat full down, grasping the lower instrument panel with the left hand and leaning full forward while using the right hand for helmet/mask retention. If necessary, select COLD MIC to prevent noise interference with pilot's radio.

1. Slow to lowest practical airspeed (200 knots maximum)
2. Descend to lowest practical altitude
3. Land as soon as practical

BOARDING STEPS EXTENDED

Malfunction of the lock-up mechanism can allow the boarding steps to extend in flight. Normally there is no indication, except that the position indicator will indicate DOWN. At high speed, some buffet may be present. The boarding steps have extended in flight at speeds as high as Mach 2 with no adverse effect. However, if the steps fail structurally, pieces will probably enter the left engine inlet. For this reason, if the steps extend, reduce airspeed as soon as practical.

ADC FAILURE

Operation of the ADC is entirely automatic, and no control over the system is available to the pilot.

The primary indications of ADC failure are failure/freezing (with associated OFF indications) of the vertical velocity, warning light in the landing gear handle, and when airborne, landing gear warning tone. However, partial failure of the ADC may not show all these indications.. Due to various systems interface, any or all of the following systems may malfunction or be unreliable if the ADC fails. These are :

a. ECS
b. Inlets
c. Pitch ratio
d. Altitude hold
e. Total temp
f. IFF mode C
g. Navigation/Attack steering
h. HUD (except pitch ladder and heading scale)

With PW-229 engines, the ATDP caution is another possible indication of ADC failure. Also, the ATDPS is inoperative with a failed ADC.

NOTE

Loss of ADC information to the inlet controller may cause internal ramp component fluctuation with associated vibration and utility hydraulic fluctuation with no visible ramp movement.

Pilot action during ADC system malfunction should be based on timely recovery using the standby instruments for flight. Indications of subsequent loss or partial recovery of any of the above secondary systems may be experienced as a result of the aircraft transiting various flight regimes. Cross-check the primary and secondary ADI instruments. If a large discrepancy exists, check AFCS detail BIT functional status.

INS FAILURE

If the INS fails, the ATTITUDE caution is displayed. If the INS is the selected data source, OFF is displayed next to INS and an X is displayed on the ADI attitude ball. Master caution and the AV BIT caution will also come on. Select the attitude source that is still valid and monitor the standby attitude indicator.

AIR DATA (A/D) MODE

The A/D mode is a backup to the primary INS mode. If the INS fails, the CC automatically switches to the A/D navigation mode. The CC uses true airspeed, wind velocity, and magnetic heading to derive aircraft position and compute steering to destination. INS computation of inertially derived aircraft velocity and position is not disturbed by selection of the A/D mode. Wind and magnetic variation may be entered in the UFC. The A/G radar PVU display may be selected and PVU updates entered to update the INS. The most accurate PP update methods are radar high resolution map (HRM), LANTIRN and OVERFLY updates.

The A/D mode may be manually selected from the PP source submenu on the UFC if large errors appear in the INS present position, wind, and ground speed.

INS INFLIGHT ALIGNMENT (IFA)

This INS mode takes 20 minutes and requires continuous PVU updates and three position updates to reach specification level accuracies. Prior to doing the IFA operation, the aircraft should be flown straight and level for 1 to 2 minutes, then upgrade the AHRS by doing a fast erect and sync operation.

If the INS attitude fails, PP errors will also normally increase. The INS may be realigned to reset the attitude and to regain PP accuracy.

Both attitude and PP accuracy are improved as the length of an inflight alignment increases. The aircraft does not need to be flown straight and level during an IFA; some maneuvering in fact helps the system analyze the problems and increase alignment accuracy. Aircraft maneuvers should be limited to ±45° of pitch and ±60° of bank.

The INS mode knob must be turned OFF, then directly to NAV. The INS enters a standby mode until IFA is selected on the radar A/G PVU display; the INS enters the IFA mode and receives AHRS attitude, heading, best available true airspeed and MN position. In the PVU mode, the radar automatically accomplishes periodic updates and displays the errors on the MPD/MPCD, along with IFA alignment quality (starting at 15.9). The displayed errors are accepted and updates sent to the INS by (WSO) pressing the appropriate hand controller trigger to the second detent and releasing or (pilot) pressing and releasing the TDC on the throttle. Along with the PVU updates, HRM/RBM and LANTIRN position updates increase IFA accuracy.

NOTE

During IFA, if position update is done using the radar antenna (RBM/HRM), the radar is taken out of the PVU mode and the IFA display is also removed. The IFA does continue and NAV DEGRADED is displayed if updates are continued. Eventually the NAV DEGRADED is removed (approximately 20 minutes).

Precondition the AHRS

1. Maintain straight and level unaccelerated flight.
2. AHRS control panel sync knob - PRESS
3. AHRS control panel fast erect button - PRESS
4. Wait approximately 30 seconds before performing alignment.

Alignment

1. INS mode knob - OFF FOR 5 SECONDS, THEN NAV
2. IFA mode - SELECT
   The INS is in a standby mode until the IFA mode is selected on the A/G radar PVU display. The CC then sends the best available navigation data to the INS for initialization.
3. HUD window 16 - IFA 15.9
   Once the INS is in the IFA mode and accepting PVU updates, the INS alignment quality begins to countdown. The aircraft maneuvers should be limited to ±45° of pitch and ±60° of bank during the IFA. The INS requires three position updates during the 20 minutes preferably two high accuracy updates (LANTIRN/OVERFLY).
4. PVU error data - ACCEPT
   Perform some maneuvers while doing steps 4 and 5, heading changes, gentle S turns, climb/dive, level accelerations.
5. Position update - 3 to 5 high accuracy updates during 20 minutes
6. HUD window 16 - IFA OK
   It will take approximately 20 minutes to accomplish a full IFA. Accuracy is increased by other INS updates (HRM/RBM/LANTIRN) during the IFA. The aircrew may stop the IFA at any time after IFA 15.9.
7. IFA mode - DESELECT
   The aircrew may stop the IFA at any time the accuracy is considered sufficient for mission

requirements. The INS remains in the IFA mode until deselected on the A/G radar PVU display. If the IFA is not allowed to continue until reaching IFA OK, the INS will indicate NAV DEGD.

HEADING ERROR

Magnetic heading is available on the HUD, ADI, HSI TSD and standby compass (front cockpit only). The CC supplies a best available heading to each of these formats (except standby compass) and automatically selects the most accurate magnetic heading source. There are two heading sources available to the CC - INS and AHRS. With a valid INS, displayed heading source is the INS. If the INS fails, the CC automatically provides AHRS heading to the displays, provided AHRS is valid. No indications are present on the HUD, ADI, HSI or TSD if this transition occurs. Typically an INS failure is accompanied by an ATTITUDE caution on the MPD/MPCD and an AV BIT light with the associated INS caution on the BIT equipment status display. Changing the attitude source (PB4) on the ADI does not affect the source of displayed heading.

If INS fails -

1. Check AHRS mode selector - SLAVE
2. Magnetic variation - ENTER
3. Maintain straight and level unaccelerated flight
4. AHRS SYNC button - PRESS
5. AHRS fast erect button - PRESS
6. Monitor headings by cross checking with the standby compass.

If both the INS and AHRS are invalid, OFF replaces the heading scale on the ADI and HUD and the lubber line is removed from the HSI.

If both heading sources fail -

1. AHRS mode selector - COMP or DG
   If the AHRS platform has not failed, DG may be used. If this mode is inoperative, the COMP position allows direct readout of the magnetic azimuth detector, and the HSI behaves similar to the standby compass (good only in straight and level flight). In either COMP or DG, the CC does not use any AHRS inputs.
2. Magnetic variation - ENTER
   The HUD should display correct magnetic heading.

If AHRS DG mode is used -

3. Select AHRS on ADI
4. HSI heading - SET TO STANDBY COMPASS
   Press and rotate the AHRS SYNC knob to set HSI heading. Make sure the latitude and hemisphere settings are correct.

LANTIRN OVERTEMPERATURE CONDITION

If the navigation or targeting pod develops an overheat condition, a NAV POD HOT or TGT POD HOT caution is displayed on the MPD/MPCD in both cockpits and will remain on for the duration of the flight. The caution display also causes the MASTER CAUTION light in the cockpit to come on.

1. TGT FLIR or NAV FLIR and TF RDR power switch(es) - OFF

If overheat condition returns -

2. LANTIRN pod(s) - TURN OFF

OUT-OF-CONTROL RECOVERY

The aircraft is out of control when it does not properly respond to aircrew flight control inputs. An example of this is attempting to perform a slow speed, nose high reversal in one direction and the aircraft will not roll in that direction. An out-of-control situation will progress to a departure if the situation is not corrected by smoothly neutralizing controls to reduce AOA or yaw rate. A departure is characterized by an uncommanded flight path change such as a nose slice, roll away from lateral input, or excessive yaw rates. The departure warning tone may sound indicating high yaw rate and is the best indication of an impending spin. If a continuous warning tone is heard and the controls are not neutral, it is imperative that the controls be neutralized immediately in a smooth manner. This action should recover the aircraft from all departures.

Abrupt neutralization of longitudinal controls while out-of-control or in a departure, where high yaw rates are present, may aggravate the situation and induce a spin. Releasing all rudder and stick pressure (hands off) once the controls are at or near neutral will result in neutral controls if trimmed near 1g.

If the controls are not neutralized at the first indication of departure or when the departure warning tone begins, a spin may develop. Spins are typified by a high yaw rate accompanied by a high rate departure warning tone. The turn needle will be steady and fully deflected in the direction of spin. For recovery from a positive g spin, maintain neutral longitudinal stick and apply full lateral stick with the yaw the same direction as the turn needle. Rudder is not needed but, if used, must be against the yaw, opposite the direction of the turn needle. Neutralize all controls when the aircraft recovers from the spin and allow large residual motion to subside. Spin recovery is indicated by departure warning tone stopping, sustained nose low attitude, increasing airspeed, and AOA decreasing from greater than 45 units.

An auto-roll is a rudder roll caused by rudder deflections with neutral cockpit controls. The aircraft may slowly self-recover; however, for a rapid recovery from a positive g auto-roll, apply full rudder against the roll. Do not use aileron to stop the roll as this input may induce a spin. If unsure of the roll direction, use the ADI to determining roll direction. Do not use the turn needle as it oscillates during rolls. The departure warning tone may not sound. Neutral controls will recover the aircraft from all negative g conditions including spins and auto-rolls; however, rudder with the roll will produce a faster recovery from a negative g auto-roll.

Do not move the throttles unless in afterburner. If in afterburner, reduce power to MIL.

NOTE

Record all departures and spins on AFTO Form 781. Include aircraft configuration, flight parameters, wing/CFT fuel and any other significant information.

1. Controls - SMOOTHLY NEUTRALIZE AND RELEASE

   Abrupt neutralization of longitudinal control during a departure where high roll and yaw rates are present may temporarily aggravate the out-of-control situation and induce a spin. If controls are neutralized at the first indication of departure (large uncommanded roll or yaw), the aircraft will recover quickly. Opposite rudder may be used to counter roll rates; however, lateral stick inputs should be avoided.

2. Speedbrake - RETRACT

WARNING

If speedbrake fails to retract when AOA is greater than 32 units, lateral stability is significantly decreased and may result in a departure and subsequent spin. If the speedbrake remains extended during a spin, additional departure may result when excessive AOA is used during the recovery.

If aircraft is not recovering, an auto roll is possible -

3. Rudder - OPPOSITE ROLL

WARNING

Aileron against the roll can induce a spin.

If aircraft is still not recovering, an upright spin is most probable -

4. Longitudinal stick - CENTERED
5. Lateral Stick - FULL IN DIRECTION OF YAW (turn needle)
6. Aircraft recovers (tone ceases) - CONTROLS NEUTRAL

WARNING

If the departure warning tone malfunctions and stops prior to 30 degrees per second (i.e., yaw rate gyro failure), neutralizing controls may result in yaw acceleration and a redeveloped spin. Use other indications of spin recovery in conjunction with the departure warning tone.

If recovery is not apparent by 10,000 feet AGL -

7. Eject

EJECTION

Ejection can be accomplished at ground level between zero and 600 knots airspeed with wings level and no sink rate. Appreciable forces are exerted on the body when ejection is performed at airspeeds above 450 knots. Above 600 knots, ejection is extremely hazardous due to excessive wind blast forces. In primary mode the seat will not fire unless the canopy has separated. However in backup mode, the seat whether inflight or on the ground, will fire regardless of canopy position (full open to full closed) and will fire through the canopy if the canopy fails to separate. The selection of backup mode is automatic, based on the ejection system sensing a failure of primary mode. Minimum ejection altitudes for various flight conditions and attitudes are shown in the ejection seat performance charts in the foldout section.

- Time and circumstances permitting, the pilot will alert the WSO to prepare for ejection and then direct individual ejections or initiate ejection for both crewmembers, as briefed.

- WSO initiated ejection of the pilot shall be limited to immediate ejection situations when so directed by the pilot or when the pilot is incapacitated. The pilot should consider the experience level of the WSO, the degree of training/proficiency, and meticulously brief on ejection signals (with or without intercom) and the exact circumstances under which the WSO will eject the crew.

NOTE

- Refer to foldout section for ejection seat performance charts.

- The following procedure in no way precludes either occupant from initiating ejection at any time he determines that circumstances warrant such action.

IMMEDIATE EJECTION

- Alert other crewmember

- If at low altitude, attempt to trade airspeed for altitude and to eject wings level with zero sink rate

- Assume proper ejection position

1. Ejection control handles - PULL
   Grasp the handles and pull so that the handles will rotate up and toward the back of the seat.

NOTE

Although actuation of either handle is sufficient to initiate ejection, both handles should be grasped, if possible, to prevent arm flailing. Continue holding the handles until man-seat separation. Be prepared to release the handles at man-seat separation since the handles will not detach from the seat.

CONTROLLED EJECTION

If time and conditions permit (before assuming the proper ejection position), attempt to achieve optimum ejection parameters listed below.

- 5,000-10,000 feet (AGL), 150-250 knots

- Eject no lower than 2,000 feet (AGL)

- Tighten lap belt, helmet chin strap and oxygen mask

- Lower helmet visor

- Stow loose equipment

- Throttles - IDLE

- Speedbrake - AS REQUIRED

- Aft seat ejection first

1. Command selector valve - NORMAL
2. RCP ejection control handles - PULL
3. FCP ejection control handles - PULL

WARNING

- If dual sequence ejection is commanded and a failure of the rear cockpit primary mode exists, this could cause ejection of the forward seat first by the primary system followed by the rear seat by the redundant system. Serious injury will result to the rear crewmember.
- Minimum altitudes are dependent upon dive angle, airspeed and bank angle. Recommended minimums are 10,000 feet (AGL) if out of control or 2,000 feet (AGL) in controlled flight.
- Failure to install the solo flight collar when required will result in a 0.4 second delay in front seat ejection.
- If the emergency oxygen green ring is pulled while still in the cockpit, the aircraft oxygen hose must be disconnected from the CRU-60P connector or the emergency oxygen will vent into the aircraft system.
- If dual ejection is initiated without alerting the other crewmember, incapacitation on ejection may occur due to improper body position.
- If fire/smoke is the cause for ejection, a dual ejection should be made. Individual ejection by the WSO could incapacitate the pilot from intense heat and fire caused by windblast and draft effects of a jettisoned canopy.

NOTE

Although actuation of either handle is sufficient to initiate ejection, both handles should be grasped, if possible, to prevent arm flailing. Continue holding the handles until man-seat separation. Be prepared to release the handles at man-seat separation since the handles will not detach from the seat.

CANOPY SEPARATION FAILURE AND EJECTION SEAT FAILS TO FIRE

If the canopy does not jettison and seat does not fire

1. Ejection control handle(s)- PULL HANDLE AGAIN SHARPLY
   The redundant system takes approximately 2 seconds to function.

If canopy still does not separate -

2. Remain in ejection position (arms inboard) and ready to grasp the ejection control handle(s)
3. Canopy jettison handle - PRESS UNLOCK BUTTON AND PULL

If canopy still fails to separate -

4. Canopy control handle - UP

If canopy still fails to separate -

5. Canopy - PULL AFT AND PUSH OPEN

DESCENT AND MANUAL SURVIVAL EQUIPMENT DEPLOYMENT

If emergency oxygen fails to release automatically upon ejection -

1. Oxygen release ring - PULL (on rear of left armrest)

After parachute deployment -

2. Face mask - REMOVE AND DISCARD

If survival kit does not deploy -

3. Kit handle - GRASP WITH RIGHT HAND AND PULL
   Life raft inflation is initiated by gravity when the drop line is fully extended after kit opening.

WARNING

If the survival kit is deployed after landing in water, a snatch pull on the drop line (near CO_2 bottle) is required to inflate the life raft.

MANUAL MAN-SEAT SEPARATION

WARNING

The following procedures bypass the highly reliable automatic system and should only be used as a last resort.

If below 15,000 feet (MSL) and harness release actuator fails to operate -

1. Emergency manual chute handle - PULL WHEN CLEAR OF AIRCRAFT

WARNING

- The emergency manual chute handle must be pulled to its full travel to assure restraint release.
- If parachute container does not separate the crewmember from the seat, the crew member may be attached to the seat by the parachute risers.

NOTE

Initial travel of the emergency chute handle deploys the personnel parachute. Additional travel of the handle is required to release the lap belt, inertia reel and seat pan. Full travel of the handle is approximately 7 inches.

If chute deploys but automatic man-seat separation fails -

2. Emergency manual chute handle - CONTINUE PULLING
3. LAP BELT - MANUALLY OPEN

LANDING

CONTROLLABILITY CHECK

If handling characteristics for recovery are suspect, perform a controllability check. If recovery is possible, plan to fly the final approach at the AOA determined in the controllability check and delay reducing power until well into the flare.

1. Attain a safe altitude.
2. Reduce gross weight to minimum practicable.
3. Establish landing configuration.
   Use of flaps is not recommended if structural damage to the wing is suspected.
4. Slow aircraft to no less than on-speed AOA (20-22 units)
   Slow only to that AOA/speed which allows acceptable handling characteristics.

If recovery is possible -

5. Maintain landing configuration and fly straight-in approach no slower than AOA found in step 4.
6. Delay reducing power until well into the flare

SINGLE-ENGINE OPERATION

Single-engine operation provides adequate power for flight. Since loss of electric and hydraulic redundancy is the major concern, make every attempt, consistent with safety and prudence, to have the ailing engine running, even at idle. Otherwise, normal procedures should be followed, making appropriate allowance for reduced thrust. Reduce gross weight as practicable; plan ahead to avoid situations requiring high thrust levels. A windmilling engine can cause repeated flight control transients, reduced control sensitivity, momentary split flaps and CAS disengagements as the hydraulic switchover valves operate. Audible noises may be heard as switchover valves operate. After PC pressure has decreased to near zero, the transients will cease and the CAS may be reset and flap operation will be normal. Monitor hydraulic pressure as windmill rpm sufficient to cause transients may occur with the tachometer indicating 0%. To prevent repeated switchover valve cycling, avoid stabilized flight where engine windmilling conditions produce hydraulic pressure fluctuations between 800-2000 psi.

If landing single engine with an ECS caution, automatic avionics shutdown will occur upon touchdown. UHF 1 will be inoperative, along with the HUD and the MPDs/MPCDs. Aerobrake using backup visual references. If the ECS caution is not illuminated and power is below 73%, expect automatic avionics shutdown during landing rollout.

FLAP MALFUNCTIONS

If a split-flap situation occurs and the flaps cannot be retracted, fly a wider than normal pattern using normal AOA and airspeeds. Sufficient control will be available either CAS-ON or CAS-OFF under most configurations, but a controllability check should be performed if doubt exists. With CAS-ON, only a slight rolling tendency will be noticed. CAS-OFF, the tendency is more pronounced, but not severe. UTL A and PC1 B, or a UTL B and PC2 B failure will cause a split flap if the flaps are extended.

LANDING GEAR UNSAFE

If one or both main gear indicate unsafe, but all gear are visually confirmed to have extended and appear to be locked, leave the gear handle down and, if conditions warrant, an approach-end arrestment is recommended. If the nose gear indicates unsafe, but is visually confirmed to have extended and appears to be locked, leave the gear handle down and make a normal landing. In either case, the anti-skid should be OFF/PULSER. Yawing the aircraft or pulling g loading may assist in obtaining a locked indication.

If all three gear extend without any of the three gear down indicators (green lights) on and the gear is visually confirmed down, a circuit breaker(s) is probably popped. In this situation, test the lights. If any of the three lights test good, anti-skid is not available but there will be no warning light. If the lights do not test good, anti-skid should be available (but warning of failure may not be). Because of the uncertainty of the status of the anti-skid system in these cases, the anti-skid switch should be placed to OFF/PULSER.

If you are unable to visually confirm gear status or one or more gear have failed to extend, refer to Landing Gear Emergency Extension.

1. Obtain visual confirmation of gear status (if practical)

If gear not visually confirmed down -

2. Use Landing Gear Emergency Extension procedure

If gear visually confirmed down -

2. Anti-skid - OFF/PULSER

If one or both main gear indicate unsafe -

3. If conditions warrant, an approach-end arrestment is recommended.

If nose gear indicates unsafe -

3. Make normal landing

LANDING GEAR EMERGENCY EXTENSION

Failure of the gear to extend may be caused by loss of UTL A hydraulic pressure, mechanical or electrical failure of a system component, or physical jamming of the gear. Pulling the emergency landing gear handle (far enough out to lock) bypasses the normal electrical and hydraulic controls and ports JFS accumulator pressure to open the gear doors and unlock the landing gear. The landing gear, aided by air loads, then free falls to down and locked. Providing no component or UTL A failure exists, resetting the emergency landing gear handle with the normal handle DOWN will restore pressure to the extend side of the gear actuator, close the landing gear doors and allow the JFS accumulator to recharge.

If failure to extend is due to a mechanical jam, repeated cycling with the normal system may be the only method to dislodge the object causing the jam. If normal hydraulic and electrical power are available and completion of the following steps does not successfully extend all landing gear, restore normal system operation by pushing the emergency landing gear handle in and ensuring the circuit breaker is in. Attempt to extend the landing gear normally several times. Pause 10 seconds between each movement of the control handle and pull g during the extension cycle. If this fails, refer to Landing With Abnormal Gear Configuration.

1. Airspeed - BELOW 250 KNOTS
2. Landing gear handle - DOWN
3. Emergency landing gear handle - PULL
   Yawing the aircraft and slowing to below 200 knots may aid in obtaining gear down indications.
4. Emergency landing gear handle - RESET

If any gear fails to extend -

5. Landing gear control circuit breaker - PULL, WAIT AT LEAST 30 SECONDS
6. Landing gear control circuit breaker - RESET

If any gear still fails to extend (normal electrical and hydraulic power available) -

7. Attempt normal gear extension several times (pause 10 seconds between each handle movement)

If gear still fails to extend or cannot be visually confirmed down -

8. Refer to Landing Gear Emergency - Landing, figure 3-3.

If any gear retracts -

5. Emergency landing gear handle - PULL (DO NOT RESET)

LANDING WITH ABNORMAL GEAR CONFIGURATION

Before attempting to land with an abnormal gear configuration, consider arresting gear limitations, crosswinds, other weather factors and runway/ overrun condition. If conditions are not favorable - eject. If conditions favor landing, refer to the specific gear configurations shown in Figure 3-5, Landing Gear Emergency - Landing.

When landing with an abnormal gear configuration, fly 18 units AOA with a flat approach, plan on landing on runway centerline and attempt to land 800 to 1,200 feet prior to the cable (if an arrested landing is desired) or in the normal touchdown zone if arrestment is not planned. If an arrestment is planned, enough fuel should be reserved to allow for at least one missed arrestment, go-around and another attempt.

A concern when landing with abnormal gear configurations is that the damaged gear, external stores, or a stabilator will catch the arresting cable causing loss of directional control and collateral damage to the aircraft. For this reason, approach end arrestment is not recommended when the main landing gear wheel and brake stack are both missing or the main gear is partially broken off (stub strut). When landing with a damaged or missing main landing gear wheel and tire, but an intact brake stack, an approach end arrestment is recommended. The brake stack will pass over the cable and allow a successful approach end arrestment. The aileron should be used to keep the wings level and reduce the weight on the abnormal gear. Refer to Landing Gear Emergency - Landing Chart.

If landing with one main gear up, be prepared to counter wing dip on landing with aileron. Some power may be necessary to hold the non-gear wing up. Attempt to engage the arresting gear in a wings level altitude. If the arrestment is unsuccessful, a go-around should be initiated if fuel and conditions permit. If a go-around is not possible, the anti-skid switch must be placed to PULSER to restore braking on the extended main gear. This braking, in conjunction with nose gear steering, may assist in maintaining directional control. If landing with missing landing gear wheel (stub strut), refer to Landing Gear Emergency - Landing chart.

LANDING GEAR EMERGENCY-LANDING

BEFORE LANDING CONSIDERATIONS -

1. JETTISON ARMAMENT AND CHAFF/FLARES (CONSIDER RETAINING RACKS)
   IF GEAR HANDLE IS DOWN, SELECT ARMAMENT OVERRIDE TO USE SELECTIVE JETTISON
2. DUMP OR BURN EXCESS FUEL
3. RETAIN EMPTY DROP TANKS (DEPRESSURIZE - OPEN SLIPWAY)
   IF FUEL LOW LIGHT ON, PLACING THE AIR SOURCE KNOB OFF IS THE ONLY MEANS TO DEPRESSURIZE THE TANKS
4. FLAPS - DOWN
5. FLY 18 UNITS AOA WITH FLAT APPROACH
6. FOR PLANNED ARRESTMENT, LAND 800 - 1200 FEET PRIOR TO CABLE
7. LAND ON RUNWAY CENTERLINE

LANDING NOT RECOMMENDED

ONE MAIN - NO NOSE

- RETRACT GEAR AND REFER TO ALL GEAR UP

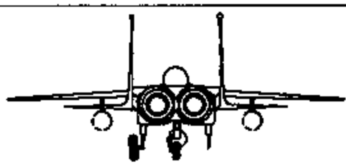
IF GEAR WILL NOT RETRACT -

- RECOMMENDED EJECT

ARRESTMENT NOT RECOMMENDED

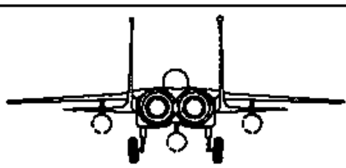
ALL GEAR UP

- 170 KNOTS TOUCHDOWN SPEED
- LOWER, REMOVE, OR LAND PAST CABLE



STUB MAIN GEAR

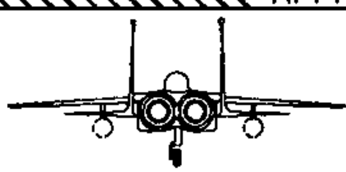
- LOWER, REMOVE, OR LAND PAST CABLE
- ANTI-SKID OFF
- LAND ON SIDE OF RUNWAY TOWARD GOOD GEAR
- HOLD WINGS LEVEL AS LONG AS POSSIBLE
- USE NOSEWHEEL STEERING AND GOOD BRAKE TO MAINTAIN TRACK



BOTH MAIN - NO NOSE/STUB NOSE

- DO NOT SHUT DOWN ENGINES UNTIL STOPPED
- LOWER, REMOVE, OR LAND PAST CABLE

APPROACH END ARRESTMENT RECOMMENDED

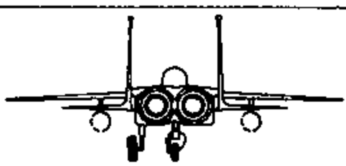


NO MAIN - NOSE DOWN

- JETTISON CENTERLINE TANK
- BE PREPARED TO COUNTER WING DIP
- SAVE FUEL FOR REATTEMPT IF MISSED

IF ARRESTMENT NOT PRACTICAL -

- DO NOT SHUT DOWN ENGINES UNTIL STOPPED



ONE MAIN - NOSE DOWN

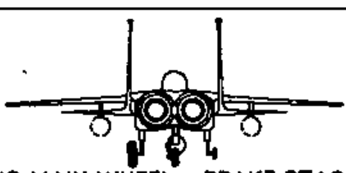
- ANTI-SKID - OFF/PULSER
- SAVE FUEL FOR REATTEMPT, IF MISSED
- BE PREPARED TO COUNTER WING DIP

IF ARRESTMENT NOT PRACTICAL -

- RETRACT GEAR AND REFER TO ALL GEAR UP

IF GEAR WILL NOT RETRACT (ARRESTMENT NOT POSSIBLE) -

- REFER TO STUB MAIN GEAR



NO MAIN WHEEL - BRAKE STACK INTACT

- ANTI-SKID - OFF/PULSER
- SAVE FUEL FOR REATTEMPT, IF MISSED
- BE PREPARED TO COUNTER WING DIP

IF ARRESTMENT NOT PRACTICAL -

- LAND ON SIDE OF RUNWAY TOWARD GOOD GEAR
- HOLD WINGS LEVEL AS LONG AS POSSIBLE
- USE NOSEWHEEL STEERING AND GOOD BRAKE TO MAINTAIN TRACK

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Figure 3-5

APPROACH END ARRESTMENT

Anticipate a missed engagement. Consider the type of emergency, availability of backup arresting gear, runway condition and length, weather, fuel state, and any other pertinent factors in determining the proper action in event of a missed engagement. With all gear down, touch down at least 800 feet from the arresting gear to allow enough time to lower the nosewheel to the runway before engagement.

CAUTION

- Above 35,000 pounds, an arrestment with the nosewheel in the air may result in nose gear failure and extensive aircraft damage.
- When attempting cable engagements, either approach or departure-end, with runway centerline lights installed, a 90° slightly off-center cable engagement is recommended due to possible hook bounce and missed engagement. With a blown nose tire, runway centerline lights may cause damage and subsequent loss of control.

Throttles must be at idle before engagement. After engagement, control arresting gear recoil using power to control rollback and light braking when stopped and await instruction. Refer to figure 3-6 for engagement limitations.

1. Reduce landing weight.
2. Hook - DOWN
3. Inertia reel - LOCKED
4. Lower nose immediately after touchdown.
5. Throttles - IDLE
6. Stick - NEUTRALIZE AFTER NOSEWHEEL IS FIRMLY ON THE GROUND
   Cable could strike stabilator and or engine nozzle if control stick is not neutralized.
7. Engage arresting gear in the center with brakes off.
   Engagements up to 1/4 cable length off-center produce only minor yawing motions which are easily controlled with nosewheel steering.

DEPARTURE END ARRESTMENT

If there is any doubt about your ability to stop the aircraft on the remaining runway, lower the tail hook. Stopping short of the arresting gear will only require raising the hook, but rolling over arresting gear when it is needed may cause serious damage and/or injury. Engage as close to center as possible, without brakes, and aligned with the runway. Place the hook down at least 2000 feet before the arresting gear, and reduce speed as much as possible.

After engagement, once forward motion has stopped, control arresting gear recoil using power to control rollback and light braking when stopped and await instructions.

CAUTION

When attempting cable engagements, either approach or departure-end, with runway centerline lights installed, a 90° slightly off-center cable engagement is recommended due to possible hook bounce and missed engagement. With a blown nose tire, runway centerline lights may cause wheel damage and subsequent loss of directional control.

1. Hook - DOWN
2. Engage arresting gear squarely with brakes off, throttles idle, and in a three-point attitude.
   Engagements up to 1/4 cable length off-center produce only minor yawing motions which are easily controlled with nosewheel steering.

ARRESTMENT GEAR DATA

MAXIMUM ENGAGEMENT GROUNDSPEEDS

SYSTEM	AIRCRAFT GROSS WEIGHT - POUNDS			
	BELOW 50,000	50,000 TO 60,000	60,000 TO 68,000	68,000 TO 81,000
BAK-9	135 KNOTS	130 KNOTS	120 KNOTS	113 KNOTS
BAK-12/BAK-14	145 KNOTS	145 KNOTS	140 KNOTS	138 KNOTS
BAK-12/BAK-14 Dual or extended runout	160 KNOTS	160 KNOTS	140 KNOTS	138 KNOTS
BAK-13	150 KNOTS	145KNOTS	143 KNOTS	142 KNOTS

NOTES

- USE STANDARD BAK-12 LIMITATIONS UNLESS YOU POSITIVELY DETERMINE THAT BAK-12 DUAL OR EXTENDED RUNOUT IS INSTALLED
- AVOID HARD BRAKING AND/OR ABRUPT STEERING INPUTS DURING ARRESTMENT
- MAXIMUM ENGAGEMENT SPEEDS ARE VALID ONLY WITH IDLE THRUST, AIRCRAFT IN A THREE POINT ATTITUDE, AND ENGAGEMENT ON CENTER
- FOR ARRESTMENT WITH GEAR OTHER THAN THOSE LISTED, ENGAGE AT THE LOWEST POSSIBLE WEIGHT AND SPEED
- ENGAGEMENTS MAY BE MADE AT SPEEDS SLIGHTLY HIGHER THAN THOSE SHOWN BUT THERE IS THEN A POSSIBILITY OF HOOK FAILURE OR STRUCTURAL DAMAGE
- A BAK-14 SYSTEM CAN REQUIRE UP TO 7 1/2 SECONDS FROM ACTIVATION TO FULLY UP AND LOCKED, CONTROLLER REACTION TIME WILL INCREASE THIS TIME

Figure 3-6

ANTI-SKID MALFUNCTION

An ANTI-SKID caution, either in flight or on the ground, should be interpreted as a potential loss of the normal braking system. Therefore, continued operation should be with the anti-skid switch OFF or PULSER (as required). The pulser brake system will activate automatically when the ANTI-SKID caution comes on. If the system does not automatically activate, it can be selected by placing the anti-skid switch to PULSER. When the system is activated, the ARI is disengaged with the gear handle down. Pulser operation can be confirmed by applying brake pedal and feeling the oscillatory brake pressure relief. Limit use of the pulser system to slowing the aircraft from landing speed down to taxi speed. Turn the anti-skid switch OFF when slowed to a comfortable taxi speed. The intensity of brake pressure relief appears to increase as speed decreases even though the pulser brake cycle rate is constant. If runway length is insufficient for aerobraking followed by non-anti-skid wheel braking, plan an approach-end arrestment.

If the ANTI-SKID caution comes on inflight or on the ground:

1. Anti-skid switch - PULSER
   During pulser operation, pedal pressure over that required for safe deceleration may cause excessive tire wear.

For taxi -

2. Anti-skid switch - OFF
   Aircraft creeps and cannot be completely stopped with pulser brakes.

LOSS OF BRAKES

Loss of normal brakes may be caused by a defective anti-skid system, faulty brakes, improper strut servicing (causing loss of WOW signal) or UTL A hydraulic pressure loss. Malfunction of the anti-skid system may not illuminate the anti-skid light, however, failures may be recognized by no apparent braking action. In any case, it is important to remember when assessing the status of brakes, that very little deceleration will be sensed by the pilot at speeds above 100 knots regardless of whether the anti-skid system has failed. Therefore, aerodynamic braking should be accomplished first during the landing roll, followed by braking action as required. If loss of brakes is determined, turn the anti-skid switch to PULSER at high speed or OFF at taxi speed. If braking is not restored, pulling the emergency brake/steering handle provides an alternate power source for brakes/steering and bypasses the anti-skid/pulser system. Sufficient accumulator pressure is available to safely stop the aircraft. Repeated brake applications deplete the system faster than a smooth steady application. If UTL B is operating, the JFS accumulator will remain charged. If the JFS LOW caution is on, the emergency brake system is not reliable for taxi since accumulator pressure can no longer be monitored. Do not pull the emergency brake/steering handle in flight as the nosewheel will follow rudder commands, and touchdown protection is lost. If UTL A is available normal operation can be restored by pushing in the emergency brake/steering handle and releasing the paddle switch. When brake failure occurs during landing roll, consider lowering the tail hook before attempting to restore braking. While taxiing, if stopping distance is critical, use the emergency brake/steering handle first.

If loss of brakes occurs -

1. HOOK - DOWN (if applicable)
2. Brakes - RELEASE
3. Anti-skid switch - OFF OR PULSER (as required)
4. Brakes - REAPPLY
   Place the anti-skid switch to OFF at taxi speed.

If braking is not restored -

5. Brakes - RELEASE
   Completely remove both feet from brake pedals.
6. Emergency brake/steering handle - PULL
   Pulling the emergency brake above 70 knots increases the possibility of blown tires.
7. Paddle switch - HOLD PRESSED
   Holding the paddle switch pressed will ensure that the nose gear steering shifts to the JFS accumulator pressure.
8. Brakes - REAPPLY
   To avoid blowing tires, light brake pedal pressure should be applied initially to develop a feel for effective braking.

SPEED BRAKE FAILURE

If either a hydraulic or electrical failure occurs, the speed brake will be closed by air pressure. If the speed brake will not retract, pulling the SPD BK circuit breaker will remove electrical and hydraulic power and allow air load closure.

1. Speed brake circuit breaker - PULL

LOSS OF DIRECTIONAL CONTROL

Directional control problems with the nose gear on the ground may be caused by a blown tire, nose gear shimmy, defective nose gear steering, defective anti-skid, overextended strut, or a faulty brake. For a known blown tire or brake loss refer to the appropriate emergency procedure. If the cause of the directional control problem cannot be determined, time spent in fault isolation may worsen the situation. In this case, a single procedure (pulling the emergency brake/steering handle) is recommended. Use of this procedure provides an alternate source for powered braking/steering and disables the anti-skid and pulser system(s), thereby accommodating all of the various failure modes which may have caused the directional control problem.

1. Brakes - RELEASE
2. Emergency brake/steer handle - PULL
   Because the anti-skid has been removed, be prepared for a possible wheel lockup and a subsequent blown tire(s).
3. Paddle switch - HOLD PRESSED
   This ensures that the nose gear steering will shift to JFS hydraulic accumulator pressure.

If departing a prepared surface -

4. Throttles - OFF (conditions permitting)

BLOWN TIRES

Selecting PULSER prevents continuous loss of brake pressure due to skid sensing on the blown tire and allows braking on the good tire. If both main tires are blown, be prepared to counter any skid with timely nose gear steering inputs in the direction of the skid. The skid potential increases as speed decreases due to loss of vertical tails and rudders effectiveness. Overcorrection, no input at all, or initial inputs away from the skid may result in loss of directional control. Maneuvering mode of nose gear steering may be needed for adequate control.

At high speed, lateral stick can be used to maintain a wings level attitude and relieve some of the load on the blown tire. The anti-skid switch should be placed from PULSER to OFF when slowed to taxi speed. Stop straight ahead if possible and shut down as soon as fire equipment is available. Do not taxi unless an emergency situation exists.

When landing with a known blown main tire, an approach-end arrestment should be considered to avoid the possible braking/directional control problems discussed above. Landing on the runway centerline is recommended regardless of arrestment options. The anti-skid switch should be placed to PULSER before landing. Maneuver conservatively since ARI is disengaged with gear down and PULSER selected.

If a main tire blows on landing rollout, consider a modified or departure-end arrestment.

If the nose tire is blown, the possibility of engine FOD due to rubber being thrown from the nose wheel exists. Hold the nosewheel off as long as practicable (below 70 knots), and insure engines are at IDLE when nosewheel touchdown occurs.

LANDING WITH KNOWN BLOWN MAIN TIRE

1. Anti-skid switch - PULSER (before landing)
2. Consider approach-end arrestment.

BLOWN MAIN TIRE DURING LANDING ROLLOUT

1. Hook - AS REQUIRED
2. Anti-skid switch - PULSER
3. Use braking on good tire as required.

HOT BRAKES

Brake overheat (hot brakes) occurs when the kinetic energy absorbed by either wheel brake exceeds 23 million foot pounds. Depending on the severity of the stop, brake energies above this limit can result in blown tires/fire. Tire deflation due to wheel thermal fuse plug activation generally occur within 20 minutes of initial brake application. Fires are usually fueled by wheel and brake contaminates and are easily extinquished. However, if extreme overheat occurs (brake energies in excess of 48 million foot pounds), hydraulic fluid fires are possible due to the deterioration of seals within the brake assembly. Brake overheat should be considered :

a. when brakes are applied at speeds in excess of 100 knots
b. when brakes are dragging during taxi
c. when successive stops from airspeeds in excess of normal taxi speeds are made within one hour of each other.

Refer to Section V, figure 5-5, for brake energy determination.

If brake overheat is suspected:

1. Notify tower that hot brakes exist.
2. Taxi aircraft to closest safe location
   Use brakes only as needed to stop or turn.
3. Turn aircraft into the wind.
4. Holding brake - DO NOT USE
5. Wheels - CHOCKED
6. Brakes - RELEASE
7. Shutdown engines after firefighting equipment arrives.

WARNING

With **PW-220 engines,** fuel draining overboard after engine shutdown can contact a hot wheel and cause a fire. Engine shutdown before arrival of firefighting equipment should be avoided when hot brakes exist.

8. If necessary to egress aircraft, move away from aircraft along nose line.

WARNING

When hot brakes exist, stay clear of an area extending at least 300 feet in a 45° cone around the axle on both sides of the wheel until brakes have cooled or until thermal release plugs have deflated the tires.

COCKPIT PRESSURIZATION MALFUNCTION

Cabin pressurization malfunctions may be detected by discomfort in the ears and can be verified by the cabin pressure altimeter. On the ground, if the cabin pressure altimeter does not agree with the actual field elevation, perform the following before opening the canopy:

1. Emergency vent handle - TURN

CAUTION

If the cockpit pressure altitude is lower than actual field elevation, the canopy may separate from the aircraft if the canopy is opened before cockpit pressure is dumped.

POST SHUTDOWN FIRE

The possibility of a post shutdown auto-ignition exists with the **PW-229** engines. Ignition may be indicated by a mild bang and may be followed by smoke, fumes or even a small fire in the combustion turbine area. This does not cause damage to the engine or airvcraft; however, avoid engine exhaust and inlet areas for 10 minutes following shutdown as a safety precaution.

CAUTION

Oil scavange shutdowns or shutdowns with less than 5 minutes stabilization time at IDLE power prior to shutdown increase the liklihood of post shutdown auto-ignition and should bne avoided when possible.

If post shutdown fire occurs -

1. Motor with JFS for approximately 1 minute.

SECTION IV

CREW DUTIES

GENERAL AIRCREW RESPONSIBILITIES

The safe operation of the aircraft is the responsibility of both aircrew members. The flight manual and checklist is based on a definite division of responsibilities between cockpits. Each aircrew member should have a thorough working knowledge of Aircraft Systems, Normal/Emergency Procedures, Operating Limitations, and Aircraft Flight Characteristics.

CREWMEMBER IN COMMAND OF AIRCRAFT

The primary responsibility of the crewmember in command of the aircraft is to ensure mission accomplishment within acceptable safety limits. Specific responsibilities are:

a. Conduct adequate integral aircrew briefings to ensure definite division of responsibility during flight.
b. Accomplish Normal/Emergency Procedures as outlined in this manual.
c. Operation of the aircraft within published operating and structural design limitations.
d. Ensure use of abbreviated checklist on all flights.

CREWMEMBER IN CONTROL OF AIRCRAFT

The crewmember actually in control of the aircraft is responsible for flying the aircraft and operating auxiliary equipment under his control in accordance with this manual. Those procedures requiring immediate response will be accomplished as required; however, aircrew member not in control of the aircraft will be required to read the procedure from the checklist when time and circumstances permit. The crewmember in control of the aircraft will call for checklist items when required during flight profile.

CREWMEMBER NOT IN CONTROL OF AIRCRAFT

The crewmember not in control of the aircraft shares overall responsibility for the safe accomplishment of the mission. In addition, he is responsible for operating auxiliary equipment under his control in accordance with this manual. Specifically, his responsibilities are:

a. Perform navigational duties as required.
b. Assist other aircrew member in monitoring flight progress.
c. Assist other aircrew member in monitoring aircraft systems and detecting system malfunctions.
d. Initiate required inflight checklist items when not called for by crewmember in control of aircraft.
e. Monitor instruments during all climbs and descents and advise the other crewmember of any deviations from established flight parameters.
f. Clear the flight area whenever possible.

SECTION V

OPERATING LIMITATIONS

TABLE OF CONTENTS

GENERAL

All aircraft/system limitations that must be observed during normal operation are covered herein. Some limitations that are characteristic only of a special phase of operation (emergency procedures, flight through turbulent air, etc.) are not covered here; however, they are contained along with the discussion of the operation in question.

NOTE

All references to airspeed quoted in knots refer to calibrated airspeed.

CREW REQUIREMENTS

The minimum crew for safe flight in F-15E aircraft is one.

INSTRUMENT MARKINGS

Instrument markings are shown in figure 5-1.

ENGINE LIMITATIONS

Refer to figure 5-2.

PRIMARY FUEL

The primary fuel is JP-4. F-40 is the NATO equivalent fuel. However, NATO F-40 may not contain corrosion inhibitor at some locations. Operation without corrosion inhibitor should be restricted to 10 consecutive hours.

ALTERNATE FUEL

The aircraft may be operated on JP-8, NATO F-34, NATO F-35, JP-5, NATO F-43, NATO F-44, or commercial JET A or JET A-1 and JET B. Except for freeze point and possible icing and corrosion inhibitor differences, JET B and JP-4 are equivalent and the same operating limitations apply.

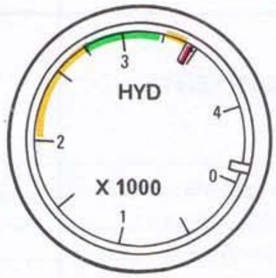
NOTE

Alternate fuels are much more prone to leak than JP-4. Guidelines provided in TO 1-1-3 should be used to evaluate leaks when they occur.

Operating and throttle handling limitations for approved alternate fuels are the same as for primary fuels except: Ground starts with temperature below −20°C (−4°F) with alternate fuel may produce more smoke and require a longer time for engine light-off. Ground starts should not be attempted with fuel temperature below −40°C (−40°F). When using alternate fuels, hot starts may occur during spool-down airstarts at airspeeds less than 350 knots for altitudes above 30,000 feet. Alternate fuel airstarts may require longer engine light-off times.

Alternate fuels may be intermixed in any proportion with primary fuels during ground or air refueling operations. No change in operating limitations, retrim not required. Most alternate fuels are heavier, refer to Fuel Quantities in section I.

- 2750 – 3250 PSI – NORMAL, (NO DEMAND ON SYSTEM)
- 2000 – 2750 NORMAL WITH RAPID CONTROL MOVEMENT
- 3250 – 3400 IF PRESSURE EXCEEDS 3250 STEADY STATE, AN ENTRY MUST BE LOGGED ON FORM 781.
- 3400 MAXIMUM



HYDRAULIC PRESSURE

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Figure 5-1

Due to alternate fuel freeze points, fuel in external tanks may not transfer after sustained operation (5 minutes or longer) below 200 knots above 25,000 feet or 250 knots above 45,000 feet.

NATO F-34 and NATO F-44 may not contain corrosion inhibitor and NATO F-35, NATO F-43, JET A-1 and JET B may not contain icing or corrosion inhibitors. Restrict operation without icing inhibitor to one flight. Restrict operation without corrosion inhibitor to 10 consecutive hours.

Refer to TO 42B1-1-14 for additional fuel usage data.

F100-PW-220 ENGINE LIMITATIONS

GROUND

CONDITION	FTIT°C	RPM%	OIL PSI	REMARKS
START	680	-	-	NOTE 5
IDLE	-	-	15-80	NOTE 5
MILITARY/AB	960	94	30-80	NOTES 2, 5, 6, 8 AND 9
TRANSIENT	970	94	30-80	NOTES 2, 5, 8 AND 10
FLUCTUATION	±10	±1	±10	NOTES 2, 3, 4 AND 6

FLIGHT

CONDITION	FTIT°C	RPM%	OIL PSI	REMARKS
AIRSTART	800	-	-	
IDLE	-	-	15-80	
MILITARY/AB	970	96	30-80	NOTES 1, 2 AND 7
TRANSIENT	990	96	30-80	NOTES 2, AND 11
FLUCTUATION	±10	±1	±10	NOTES 2, 3, 4 AND 6

NOTES

1. Use of VMAX switch is prohibited.
2. FTIT and RPM limitations include fluctuations.
3. In phase fluctuation of more than one instrument, or short term cyclic fluctuations accompanied by thrust surges, indicate engine control problems.
4. Nozzle fluctuations are limited to ±2% at military power and above. Fluctuations are not permitted below military power.
5. Any oil pressure from 0 to 100 (pegged) PSI is acceptable during start and initial operation for a period not exceeding 1 minute after reaching idle.
6. Oil pressure fluctuations of ±10PSI are acceptable if the average is within limits.
7. At less than 0g, oil pressure may drop as low as 0 PSI.
8. For engine operation at military or above, oil pressure must increase 15 PSI minimum above idle oil pressure.
9. Engine nozzle position is limited to 30% open or less at military power.
10. Maximum temperature limited to 30 seconds.
11. Maximum temperature limited to 10 seconds.

Figure 5-2 (Sheet 1 of 2)

F100-PW-229 ENGINE LIMITATIONS

GROUND

CONDITION	FTIT°C	RPM%	OIL PSI	REMARKS
START	800	-	-	NOTE 4
IDLE	625	-	15-80	NOTE 4
MILITARY/AB	1070	97	30-80	NOTES 1, 4, 5, 7 AND 8
TRANSIENT	1090	98	30-80	NOTES 1, 4, 7 AND 9
FLUCTUATION	±10	±1	IDLE ±5 ABOVE IDLE ±10	NOTES 1, 2, 3 AND 5

FLIGHT

CONDITION	FTIT°C	RPM%	OIL PSI	REMARKS
AIRSTART	870	-	-	
IDLE	-	-	15-80	
MILITARY/AB	1070	97	30-80	NOTES 1 AND 6
TRANSIENT	1090	98	30-80	NOTES 1 AND 10
FLUCTUATION	±10	±1	IDLE ±5 ABOVE IDLE ±10	NOTES 1, 2, 3 AND 5

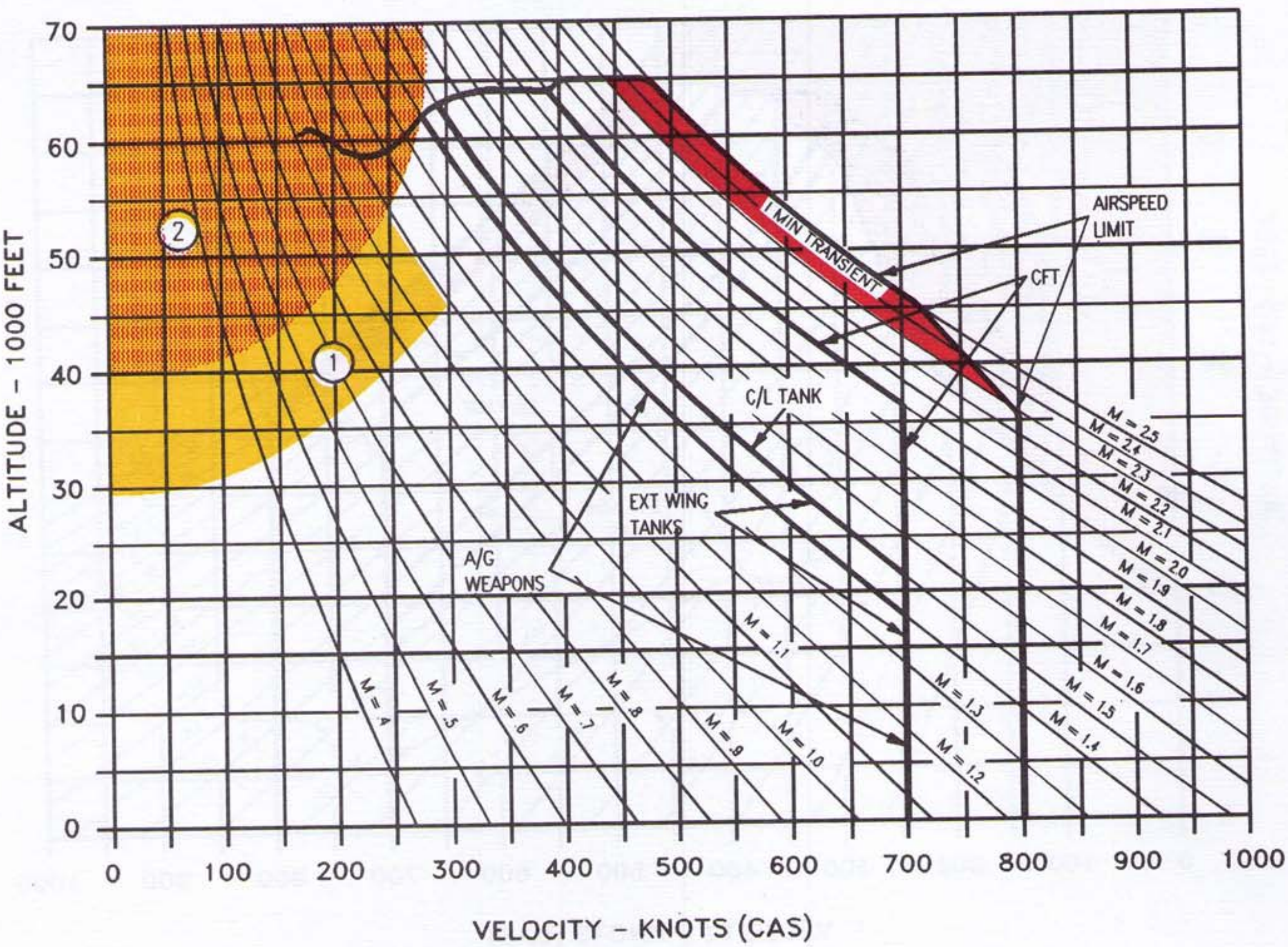
NOTES

1. FTIT and RPM limitations include fluctuations.
2. In phase fluctuation of more than one instrument, or short term cyclic fluctuations accompanied by thrust surges, indicate engine control problems.
3. Nozzle fluctuations are limited to ±2% at military power and above. Fluctuations are not permitted below military power.
4. Any oil pressure from 0 to 100 (pegged) PSI is acceptable during start and initial operation for a period not exceeding 1 minute after reaching idle.
5. Oil pressure fluctuations of ±10PSI are acceptable if the average is within limits.
6. At less than 0g, oil pressure may drop as low as 0 PSI.
7. For engine operation at military or above, oil pressure must increase 15 PSI minimum above idle oil pressure.
8. Engine nozzle position is limited to 30% open or less at military power.
9. Maximum temperature limited to 30 seconds.
10. Maximum temperature limited to 10 seconds.

Figure 5-2 (Sheet 2)

AIRSPEED AND AFTERBURNER OPERATING ENVELOPE

F100-PW-220 ENGINE



NOTES

THE DEEC AUTOMATICALLY LIMITS AFTERBURNER OPERATION TO ALLOW UNRESTRICTED THROTTLE MOVEMENT THROUGHOUT THE FLIGHT ENVELOPE.

REGION 1 - DEEC LIMITS INITIATION OF AFTERBURNER SEGMENTS TO 1 THRU 4. SEGMENT 5 BLOCKED.

REGION 2 - DEEC LIMITS AFTERBURNER SEGMENT TO SEGMENT 1 OR BLOCKS SEGMENT SEQUENCING.

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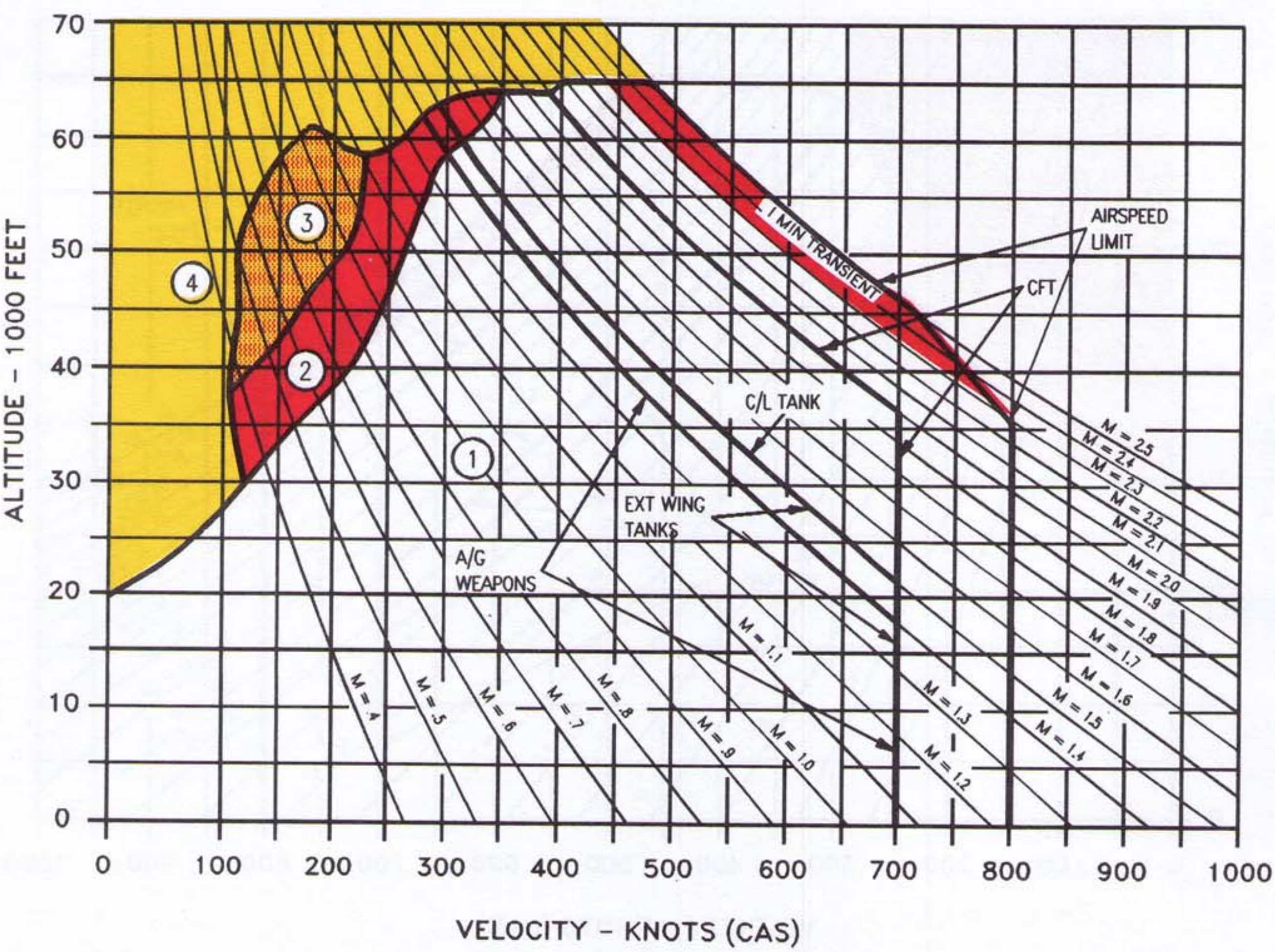
Figure 5-3 (Sheet 1 of 2)

AIRSPEED AND AFTERBURNER OPERATING ENVELOPE (Continued)

F100-PW-229 ENGINE



NOTES

- F-15E AIRCRAFT EQUIPPED WITH F100-PW-229 ENGINES ARE RESTRICTED TO 700 KCAS OR MACH 1.2, WHICHEVER IS MOST RESTRICTIVE. AFTER COMPLIANCE WITH TCTO 2J-F100-229-(II)-517 ON BOTH ENGINES, AIRCRAFT ARE CLEARED TO NORMAL OPERATING ENVELOPE.
- THROTTLE MOVEMENT IS UNRESTRICTED THROUGHOUT THE AIRCRAFT FLIGHT ENVELOPE
  REGION 1: UNLIMITED OPERATION OF ALL 11 AFTERBURNER SEGMENTS
  REGION 2: IDEEC AUTOMATICALLY SCHEDULES SEGMENTS 1 THROUGH 10
  REGION 3: IDEEC AUTOMATICALLY SCHEDULES SEGMENTS 1 THROUGH 8
  REGION 4: AFTERBURNER INITIATION AND SEQUENCING AUTOMATICALLY INHIBITED

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Figure 5-3 (Sheet 2)

SYSTEMS LIMITATIONS

	AIRSPEED	LOAD FACTOR
LANDING GEAR EXTENSION/RETRACTION OR FLIGHT WITH GEAR EXTENDED (Minimize Sideslip)	300 KCAS (AIR-TO-AIR WITH OR WITHOUT CFT OR MISSILES, WITHOUT LANTIRN PODS) 250 KCAS (ANY CONFIGURATION)	1.25g 2.0g
FLAPS DOWN	250 KNOTS	0.0 to +4.0g Load factor
INLETS EMERGENCY POSITION	Above 0.95 MACH	-1.0 to +4.0g
CANOPY OPEN (INCLUDING WIND)	60 KNOTS	N/A
TIRES	NOSE - 210 KNOTS MAIN - 227 KNOTS	N/A N/A

SYSTEMS

JET FUEL STARTER

Maximum 10 seconds (15 seconds if temperature below 0° F) between JFS start initiation and READY light.

Starter engagement time shall not exceed 90 seconds except, if a hot start occurs, the time may be extended to 150 seconds.

Minimum 10 seconds between first engine at idle speed and engagement for second engine start to allow for JFS stabilization. If the engine engagement time exceeds 90 seconds, wait 20 seconds before again engaging or shutting down the JFS. This allows engine RPM to drop below JFS RPM, eliminating the possibility of a "crash" start.

FLIGHT CONTROLS

To insure the flight control hydraulic fluid is sufficiently warm before takeoff, observe the listed warm up times for the corresponding temperature range.

Temperature	Time (minutes)
+4°C (+40°F) AND UP	No restriction
-4°C (+25°F) to +3°C (39°F)	5
-18°C (0°F) to -5°C (+24°F)	8
-32°C (-26°F) to -19°C (-9°F)	10
-46°C (-50°F) to -33°C (-27°F)	12

LANTIRN PODS

During Terrain Following, airspeed should be maintained above 370 KCAS and 400 knots GS and below 0.9 Mach (590 KCAS) to avoid TF algorithm inaccuracies.

Figure 5-4

AIRSPEED LIMITATIONS

Maximum airspeeds are shown in figure 5-3. Additional limitations may be imposed by external stores. Limiting airspeed for operation of various aircraft systems are shown in figure 5-4.

SYSTEMS RESTRICTIONS

JFS LIMITATIONS

JFS limitations are shown on figure 5-4.

BRAKES

The brakes are limited in the amount of energy they can absorb and dissipate in the form of heat without damage. A measure of the amount of heat absorbed by the brakes is the kinetic energy expended, measured in millions of foot-pounds. The amount of heat added to the brakes for each braking effort during a landing rollout or taxiing is cumulative and is a function of the speed of the aircraft and its gross weight at the time the brakes are applied. The heat generated in the brakes is transferred to the wheel and tire and (depending on the severity of the stop) can cause the tire pressure to rise to dangerous levels. Thermal fuse plugs within the wheel are designed to prevent wheel explosion by relieving pressure from the tire when the wheels attains a particular temperature.

Brake energy zones for flaps-speedbrake extended landings are provided in figure 5-5. Brake overheat occurs when the energy absorbed by an individual brake exceeds normal zone limits. In the caution zone fuse plug release is possible. In the danger zone, fuse plug release is expected, wheel/brake damage may occur, and brake fires are possible. In the extreme danger zone brake energies exceed all tested conditions and wheel/brake damage is certain. The brake energy limit chart should be used whenever a takeoff is aborted, for flaps-up landings, or when the pilot suspects that the combination of gross weight, IAS, and the number of stops and decelerations will result in brake energies in the caution or danger zones. As stated before, the effects of brake usage/heat buildup are cumulative. The amount of cooling time required after the aircraft operations stated above must be determined to allow sufficient rotor/stator cooling to avoid heat damage to the brakes. The aircraft must not be operated until the prescribed cooling time has elapsed.

HOLDING BRAKE

To avoid brake damage, the holding brake should not be set when cumulative per brake energy exceeds 16.6 million foot pounds.

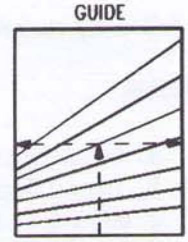
EXTERNAL FUEL TRANSFER

An adverse cg condition may develop if STOP TRANS is selected while fuel remains in the external tanks. This condition develops as internal fuel continues to feed while fuel moves in the external tanks. With pitch CAS off, external fuel transfer should not be stopped except in an emergency.

NEGATIVE G FLIGHT

Negative g flight is limited to 10 seconds at all power settings.

BRAKE ENERGY LIMITS



NOTES:
1. SUBTRACT 60 PERCENT OF THE HEADWIND COMPONENTS FROM THE INDICATED AIRSPEED. THE FULL TAILWIND COMPONENT MUST BE ADDED.
2. CHART ASSUMES BOTH LEFT AND RIGHT BRAKE ABSORB EQUAL ENERGY. ACTUAL DISTRIBUTION MAY VARY.
3. SUCCESSIVE STOPS OCURRING WITHIN ONE HOUR OF EACH OTHER SHALL BE CONSIDERED CUMULATIVE AND THE RESULTING BRAKE ENERGIES SHALL BE ADDED TOGETHER WHEN DETERMINING BRAKE OPERATING ZONE.

CONDITIONS:
FLAPS 30°
SPEEDBRAKE EXTENDED
5000 FT - 90 DEG F

DATE: 15 AUGUST 1989
DATA BASIS: **ESTIMATED**

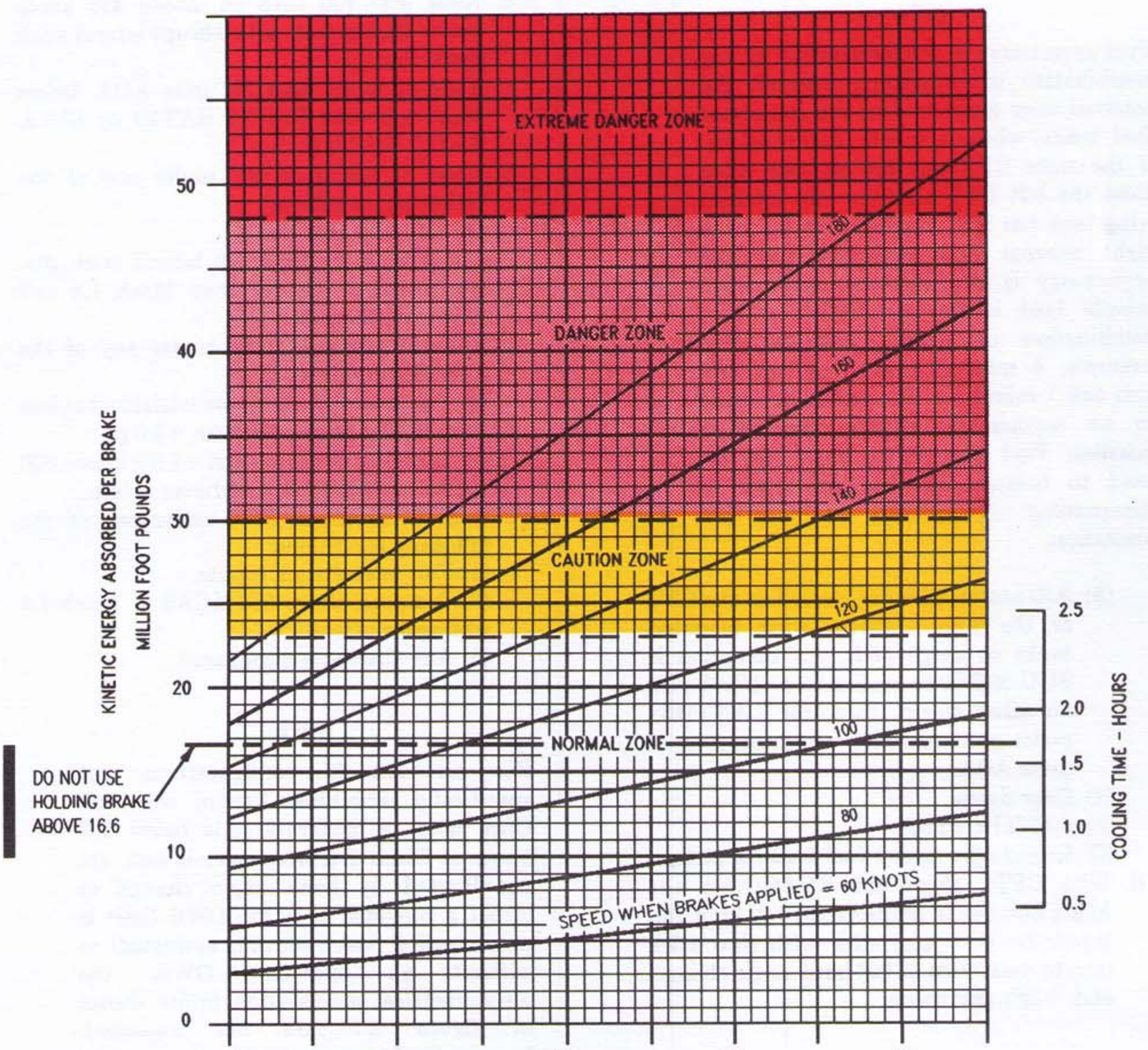


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Figure 5-5

PROHIBITED MANEUVERS

The following maneuvers are prohibited.

GENERAL

a. Intentional spins.
b. Zero g flight, except transient.
c. AOA over 30 units with any of the following:
   (1) Fuel asymmetry (wing & CFT) over 600 pounds.
   (2) Fuel asymmetry over 200 pounds when the asymmetric missile load is 3 or more.

NOTE

Fuel asymmetry is the summation of any combination of imbalance between the internal wing tanks and/or the conformal fuel tanks, when installed. For example, if the right CFT has 400 pounds more than the left CFT and the left internal wing tank has 200 pounds more than the right internal wing tank, the net fuel asymmetry is 200 pounds. Asymmetric missile load is the summation of any combination of missile loadings. For example, 4 missiles (any type) on one side and 1 missile on the other side result in an asymmetric missile load of 3 missiles. Fuel asymmetry shall not be used to balance missile asymmetry in determining compliance with this limitation.

   (3) A/G stores, whether carried on the CFT or the wing stations, wing mounted tanks or cargo pods. An exception is SUU-20B/A on stations 2 and/or 8 with no other stores (including LANTIRN pods) aboard, which are limited to 35 units AOA.
   (4) Gear down.
   (5) LANTIRN pods.
   (6) Inoperative tank 1 fuel transfer pump.
d. With CFTs, above 600 KCAS when the Mach number is greater than 1.3, limit roll inputs to ½ lateral stick with slow stick inputs, maximum of 90° bank angle change, and +3g's maximum.
e. With **PW-229** ENGINES and ATDPS inoperative, do not fly above 500 KCAS when greater than Mach 1.1 with AB selected.
f. With **PW-229** ENGINES, due to possible departure, no pilot-commanded asymmetric throttle movements above 500 KCAS when greater than Mach 1.1 because ATDPS does not protect against pilot-commanded asymmetric thrust.

ROLLS

a. Full lateral stick inputs in less than 1 second with LANTIRN pods.
b. Rolls with roll CAS on, above 475 knots below 12,000 feet, with abrupt lateral stick deflection.
c. Rolls at more than 20 units AOA, below Mach 1.0 with PITCH RATIO or ROLL RATIO light ON.
d. Rolls in excess of 90° under any of the following conditions:
   (1) Landing gear down.
   (2) With more than 1/2 lateral stick displacement at greater than Mach 1.8 and above 40,000 feet.
e. Rolls in excess of 180° under any of the following conditions:
   (1) Full lateral stick inputs initialized at less than +1.0 g or greater than +3.0 g.
   (2) Initiated at other than +1.0 g above 500 KCAS or Mach 1.4, whichever is less.
f. Rolls in excess of 360° under any of the following conditions:
   (1) Full lateral stick inputs.
   (2) Airspeed above 550 KCAS or Mach 1.4 whichever is less.
   (3) Any CAS axis disengaged.

NOTE

For all aircraft configurations not specifically prohibited herein, with full CAS, mild to moderate rolls below 550 knots or Mach 1.4, whichever is less, are not limited by bank angle change or initial g provided that the OWS limit is not exceeded (voice warning activated) or without an operative OWS, the unsymmetrical acceleration limits shown in figure 5-7 are not exceeded. Longitudinal control coordination may be required to prevent g excursions outside these limits during the roll.

WITHOUT OPERATIVE OWS

a. With wing-mounted tanks, cargo pods, or A/G stores:
   (1) Rolls over 360°.
   (2) Rolls over 180° started at other than +1.0g.
   (3) Rolls at less than 0.0 g above 600 knots.

b. More than 1/2 lateral stick with full or partially full CFTs, full or partially full wing-mounted tanks, cargo pods, or A/G stores or, above Mach 1.0, with empty wing-mounted tanks.

CAS OFF

a. Operation above 600 KCAS or Mach 1.0 with any CAS axis OFF or inoperative.

b. Operation above 450 KCAS with pitch CAS off or inoperative when carrying any A/G stores on the CFT's and wing tanks unless the CFT's are completely full or completely empty.

TERRAIN FOLLOWING RESTRICTIONS

a. Minimum set clearance for manual terrain following (MTF) in mountainous terrain in instrument meteorological conditions (IMC) is 500 feet.

NOTE

"Mountainous terrain" is defined as a vertical change that exceeds 900 feet per nautical mile, (which equates to a 15% slope change). This restriction only applies along the anticipated aircraft flight path.

b. Terrain following is prohibited with a degraded INS attitude platform or TF attitude fail or after performing an in-flight alignment.

c. Airspeed should be maintained above 370 KCAS and 400 knots GS to avoid TF algorithm inaccuracies. Terrain Following above 0.9 Mach (590 KCAS) is prohibited due to the potential for lower fuselage structural cracking and degradation in LANTIRN pod cooling. .

d. If armed manual terrain following or automatic terrain following is engaged, the aircrew must make sure the aircraft remains within system limits for flyup protection.

GROSS WEIGHT LIMITATIONS

The aircraft is designed for a maximum allowable gross weight of 81,000 pounds for flight/ground operations and landing .

WARNING

Configurations with missiles, A/G stores, and fully fueled CFTs and external tanks could exceed the aircraft maximum allowable gross weight.

The maximum allowable landing sink rate versus gross weight is shown in figure 5-6.

CAUTION

At heavy gross weight, avoid abrupt nose gear steering inputs and make turns at minimum practical speed and maximum practical radius. Avoid operations on rough and uneven taxiways or runways. Failure to do so may result in tire damage.

CENTER OF GRAVITY LIMITATIONS

During ground operations below 76,000 pounds gross weight, the forward cg limit is 22% MAC (gear down). Add 0.5% mean aerodynamic center (MAC) for each 2,000 pounds above 76,000 pounds gross weight.

Longitudinal cg may be adversely affected by failure of internal transfer tanks to feed properly. With a malfunctioning tank 1 transfer system and the wing tanks feeding normally, the aircraft cg will shift forward until the wing tanks run dry and tank 1 starts to gravity feed. This forward cg condition will increase aircraft departure susceptibility. Aft cg limits are dependent on the number of LANTIRN pods, if wing tanks are loaded and specific store configurations.

CAUTION

If A/G stores on the center and aft CFT stations are not expended during a mission, and/or the configuration includes stores or tanks on stations 2, 5 and/or 8, the aircraft could be near the aft cg limit at low internal fuel states. In this case, handling qualities will be degraded and care will need to be taken on approach and landing (see Sections 2 and 6).

NOTE

- Refer to figure 3-1 of TO 1F-15E-5 for specific stores configuration aft cg limits.
- Stores on station 5 do not change aft cg limits.

ACCELERATION LIMITATIONS

With the OWS operative, the maximum allowable acceleration is continuously displayed on the HUD. OWS tones indicate proximity to the maximum allowable g (85% and 92% of design limit load) and OWS voice warning indicates that the maximum allowable g is exceeded, see figure 5-7.

With the OWS inoperative, the maximum accelerations allowed for flight in smooth or moderately turbulent air are as shown in figure 5-7. Separate plots are provided for symmetrical maneuvers (maneuvers without any roll rate) and unsymmetrical maneuvers (maneuvers with an accompanying roll rate such as rolling pullouts, etc.).

Maximum acceleration may be reduced by limitations applicable to a specific store as shown on the External Stores Limitations chart.

EXTERNAL STORES LIMITATIONS

LANTIRN navigation and targeting pod operating envelopes and flight restrictions are shown in figure 5-8.

For airspeed, and Mach number limits, basic aircraft limit (BAL) refers to the limits shown in figure 5-3 for the specific aircraft configuration. For acceleration limits with OWS, BAL refers to the limit shown on the HUD and indicated by the voice warning. External store limits other than BAL are not programmed in the OWS. Where only a positive g limit is shown, the negative g limit is the OWS limit. For acceleration limits without OWS, BAL refers to the acceleration limits shown in Figure 5-7 for the specific aircraft configuration.

Only the external stores configuration shown in the External Stores Limitation chart (figure 5-9) may be loaded and carried. Additional stores will be added to the chart upon completion of flight testing of stores configurations.

CAUTION

- Flares should not be carried in the left outboard magazine CMD station or in the outer row on the left inboard magazine CMD station when the LANTIRN targeting pod is installed.
- Bomb-to-bomb or bomb-to-aircraft contact has occurred with ripple release from fully loaded CFT stations.

NOTE

- Conformal fuel tanks must be installed when the LANTIRN pods are carried.
- Firing of the 20mm gun is authorized. Inspect the AN/ALQ-135 ICS Control Oscillator boxes (in the gun bay) for external damage after each 10,000 rounds are fired.

ALLOWABLE LANDING SINK RATE

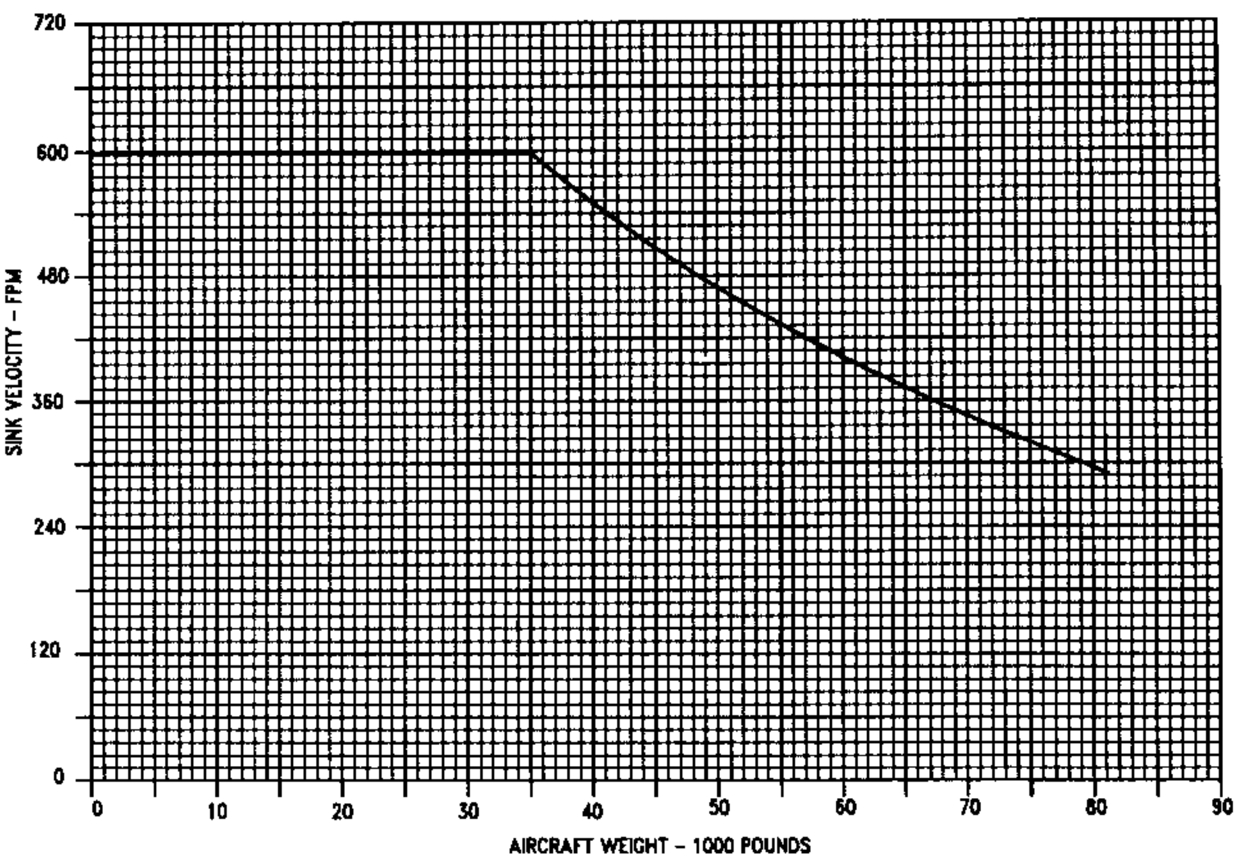


Figure 5-6

ACCELERATION LIMITATIONS
OVERLOAD WARNING SYSTEM INOPERATIVE
SYMMETRICAL MANEUVERING

NOTES

1. Negative Load Factor varies linearly from −3Gs at 750 KCAS to −1G at 800 KCAS
2. Airspeed limits with CFTs and/or A/G Stores is 700 KCAS; with Tanks is 660 KCAS.
3. See External Store Limitations For Additional Acceleration Limits
4. Load factor limits apply with or without
   - Aim 7
   - Aim 9
   - Aim 120
   - Centerline fuel tank

CONFIGURATION	Wing Tanks or Wing A/G Stores/Pods	CFT	CFT A/G Stores
A (1)	with M < 1.0 or without	without	
B	with M > 1.0	without	
C	with < 600 KCAS or without	with	
D	with > 600 KCAS	with	
E	with < 600 KCAS or without	with	with
F	with > 600 KCAS	with	with

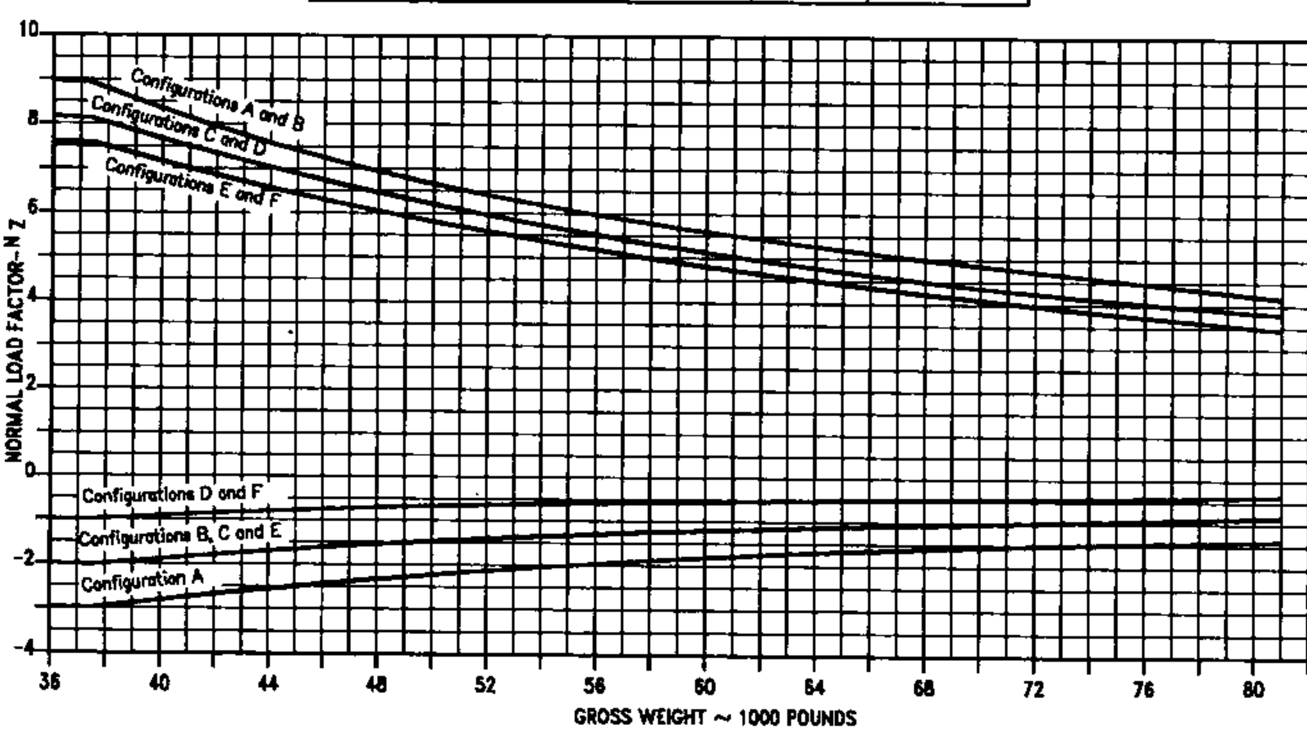


Figure 5-7 (Sheet 1 of 2)

ACCELERATION LIMITATIONS OVERLOAD WARNING SYSTEM INOPERATIVE ASYMMETRICAL MANEUVERING

NOTE

1. Full stick with tanks Empty; 1/2 stick with tank fuel or Air-To-Ground stores.
2. Configuration has 1/2 stick capability.
3. Configuration has FULL stick capability; with wing tanks, 1/2 stick M > 1.0.
4. See External Store Limitations For Additional Acceleration Limits.
5. Load factor limits apply with or without
   - Aim 7
   - Aim 9
   - Aim 120
   - Centerline Fuel Tank

CONFIGURATION	Wing Tanks or Wing A/G Stores/Pods	CFT	CFT A/G Stores
A ⟨1⟩	with M < 1.0 or without	without	
B ⟨2⟩	with M > 1.0	without	
C ⟨2⟩	with < 600 KCAS or without	with	
D ⟨2⟩	with > 600 KCAS	with	
E ⟨3⟩	with Empty < 600 KCAS or without	with Empty	
F ⟨3⟩	with Empty > 600 KCAS	with Empty	
G ⟨2⟩	with < 600 KCAS or without	with	with
H ⟨2⟩	with > 600 KCAS	with	with

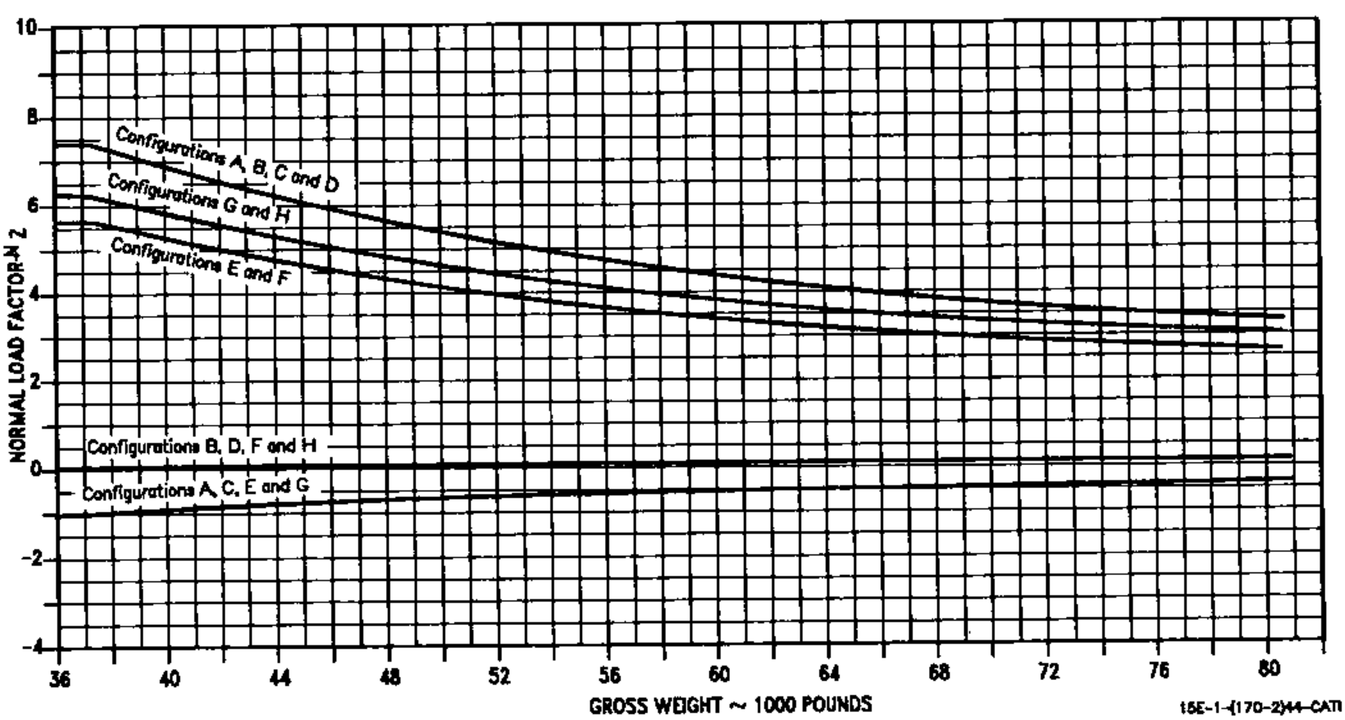


Figure 5-7 (Sheet 2)

LANTIRN POD CARRIAGE AND OPERATING ENVELOPES

NAVIGATION POD AND/OR TARGETING POD

NOTE

CFT'S MUST BE INSTALLED.

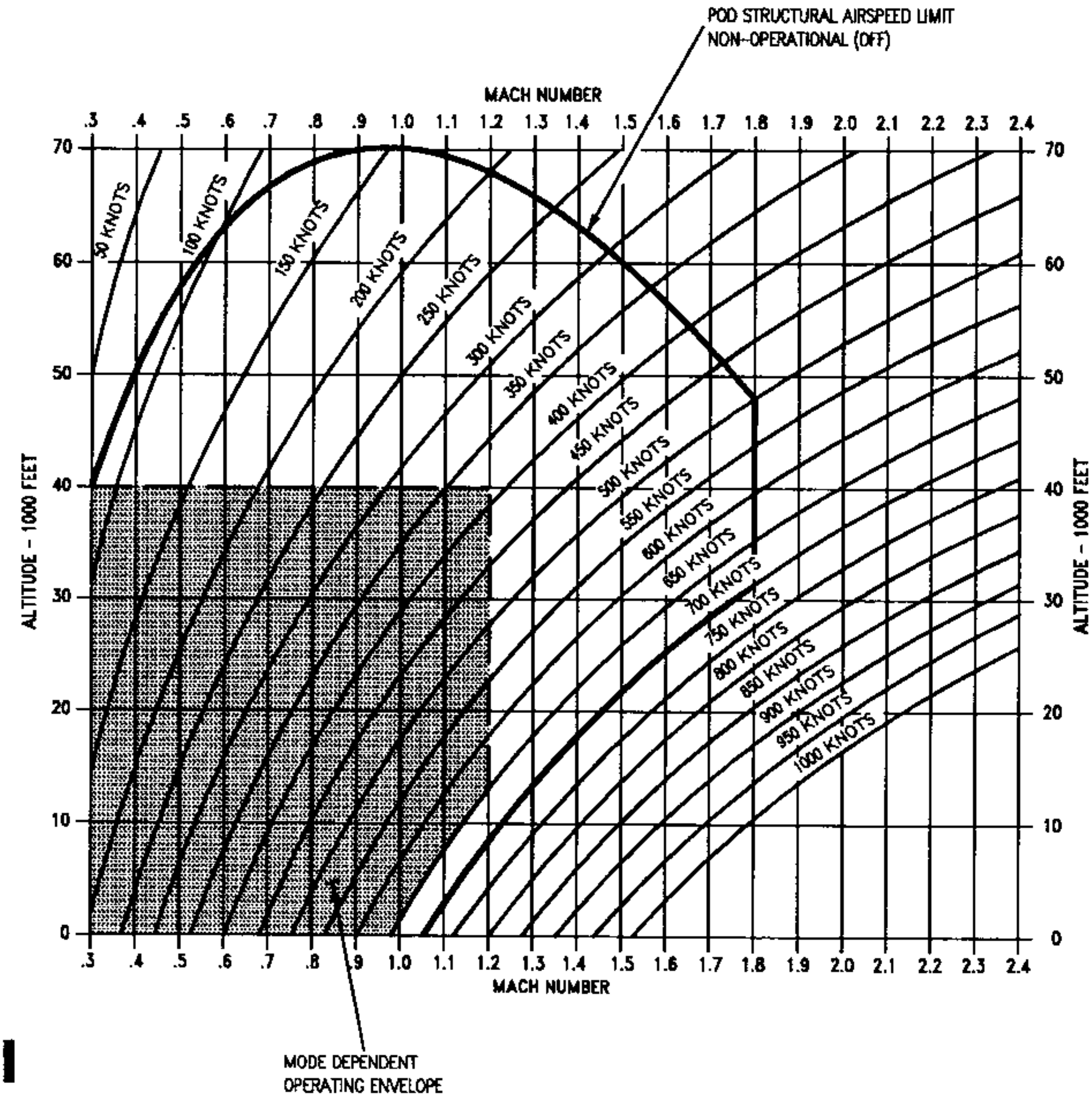


Figure 5-8 (Sheet 1 of 3)

LANTIRN POD CARRIAGE AND OPERATING ENVELOPES *(Continued)*

SINGLE POD INSTALLED

NOTES

- CFT'S MUST BE INSTALLED.

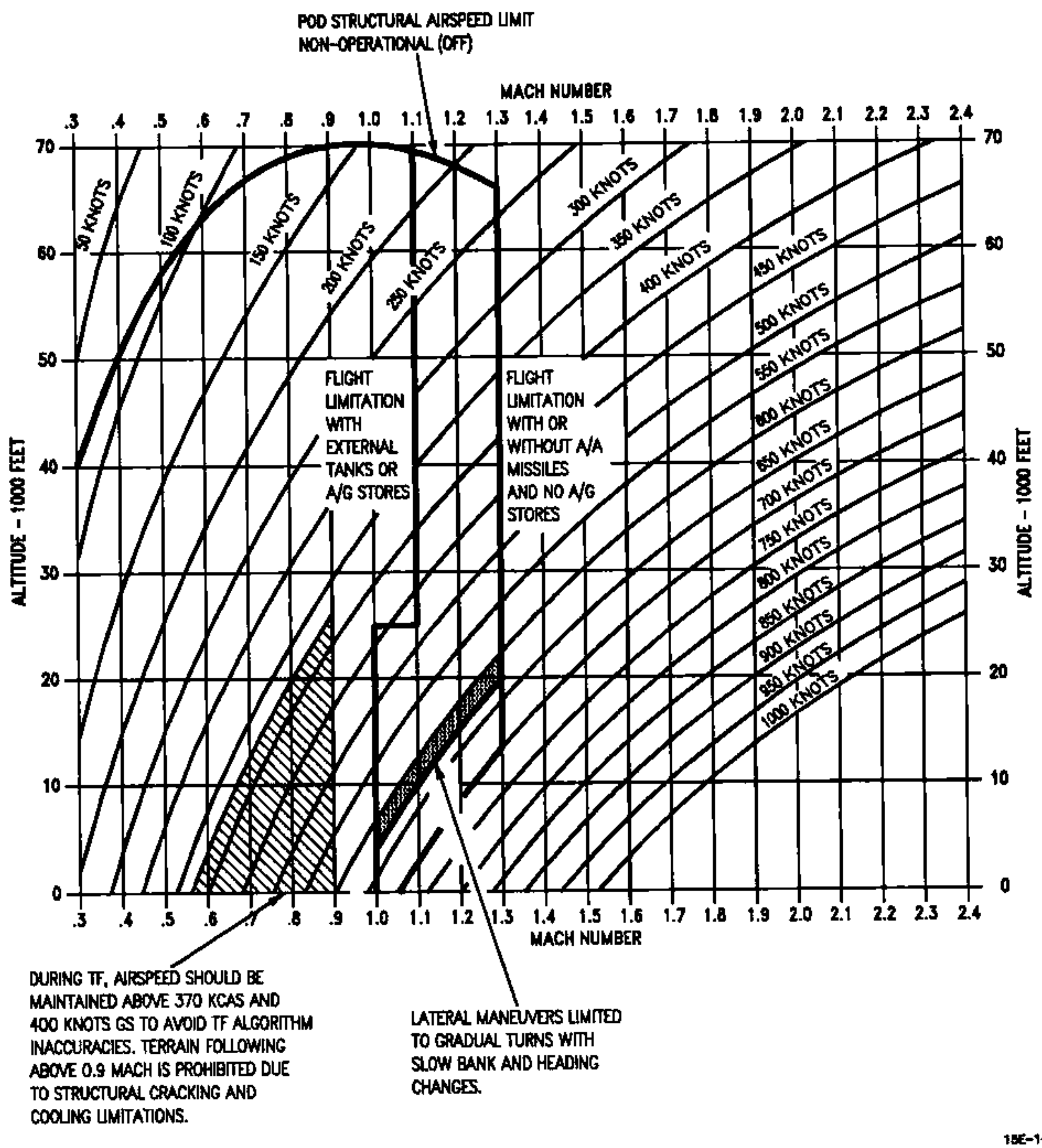


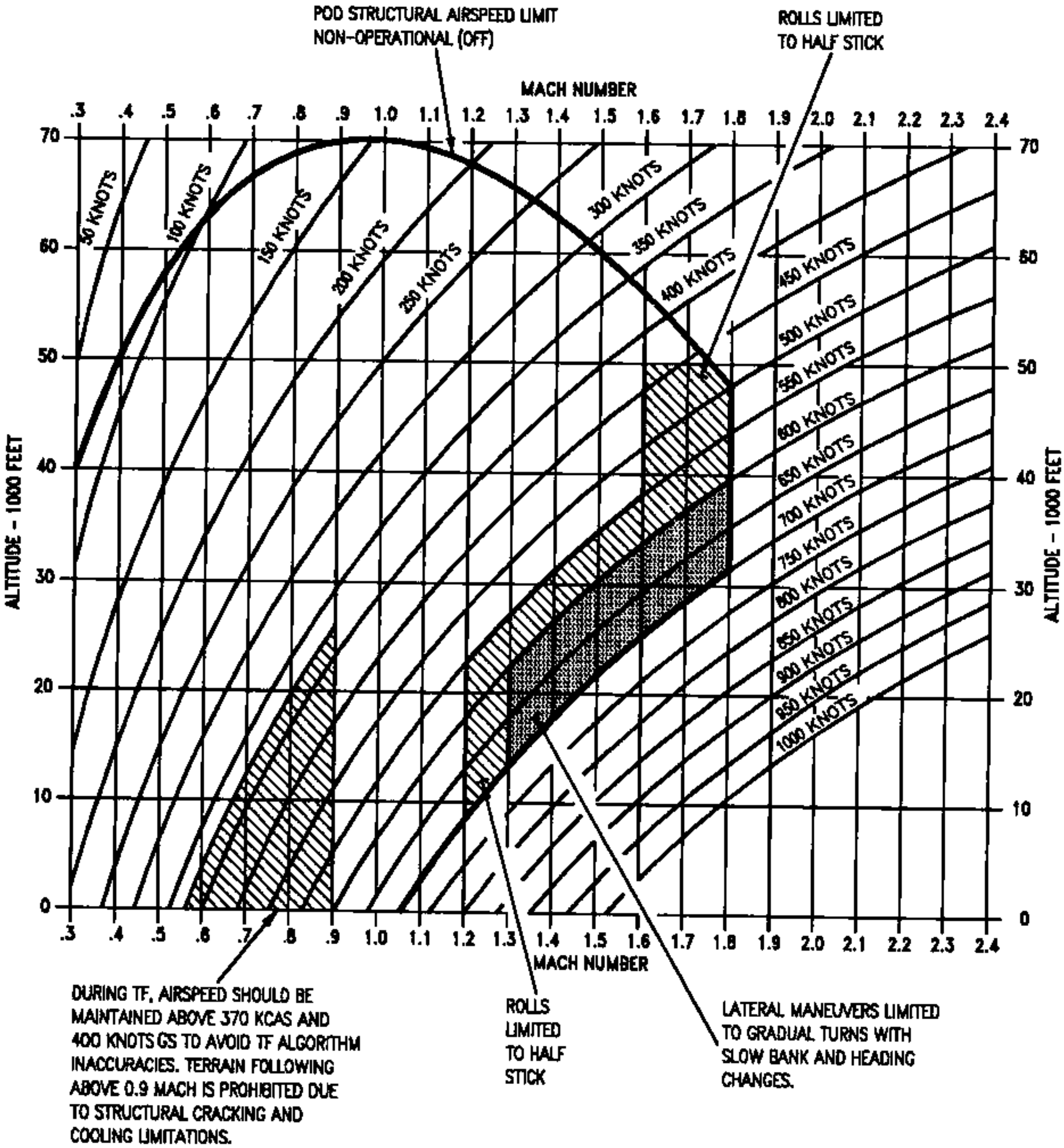
Figure 5-8 (Sheet 2)

LANTIRN POD CARRIAGE AND OPERATING ENVELOPES *(Continued)*

BOTH PODS INSTALLED

NOTES

- CFT'S MUST BE INSTALLED.

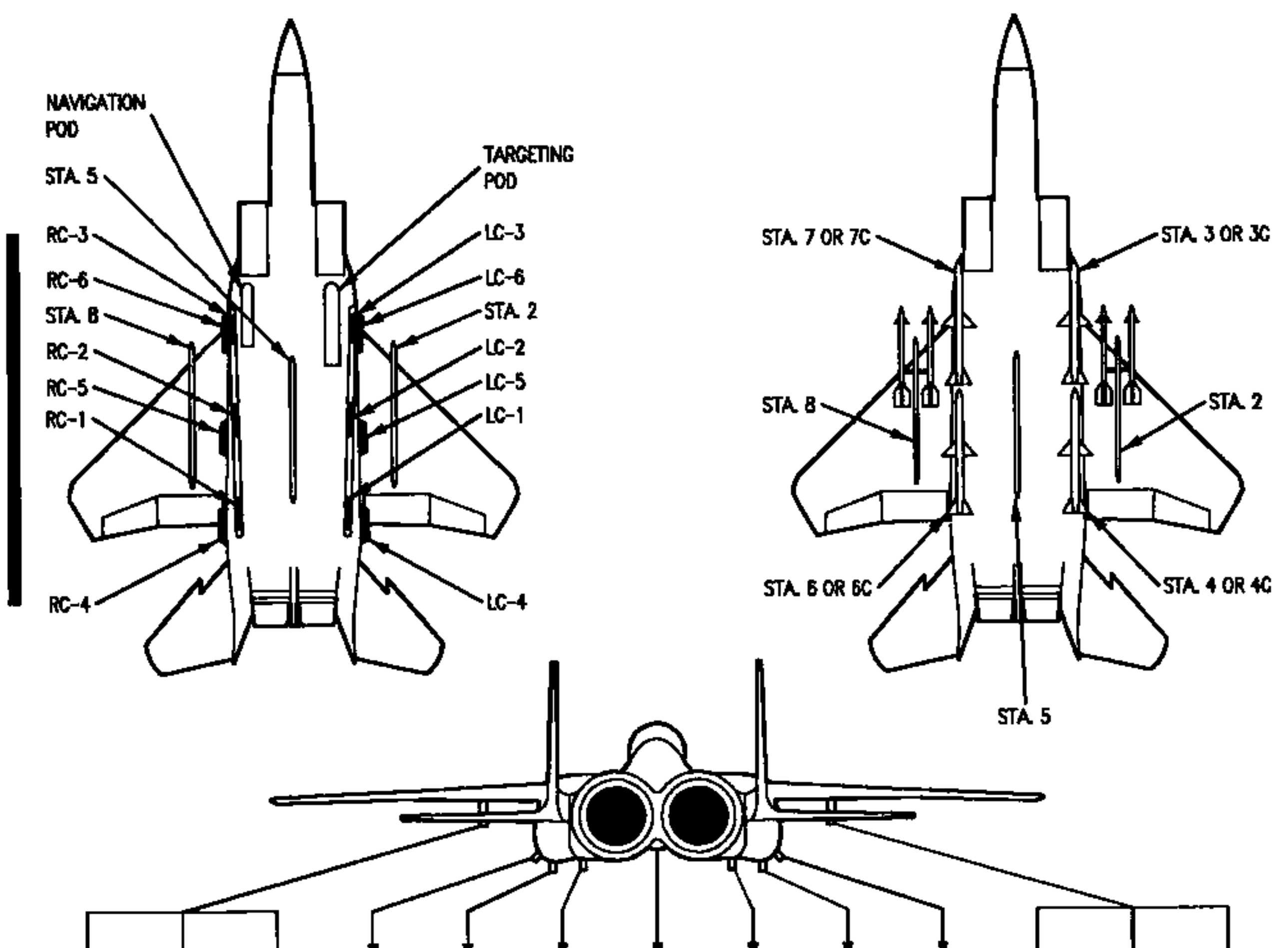


15E-1-(168-3)44-CATI

Figure 5-8 (Sheet 3)

EXTERNAL STORES LIMITATIONS

EXTERNAL STORES STATION IDENTIFICATION



			LEFT CFT OUTBD STORE STATION	LEFT CFT INBD STORE STATION	LANTIRN TGT POD		LANTIRN NAV POD	RIGHT CFT INBD STORE STATION	RIGHT CFT OUTBD STORE STATION			
2A (MISSILE)	2	2B (MISSILE)	6 (FWD)	3 (FWD)		5		3 (FWD)	6 (FWD)	8A (MISSILE)	8	8B (MISSILE)
			5 (CTR)	2 (CTR)				2 (CTR)	5 (CTR)			
			4 (AFT)	1 (AFT)				1 (AFT)	4 (AFT)			
				MISSILE				MISSILE				
				3C (FWD)				7C (FWD)				
				4C (AFT)				6C (AFT)				

15E-1-(235-1)44-CATI

Figure 5-9 (Sheet 1 of 21)

EXTERNAL STORES LIMITATIONS

RELEASE AND DOWNLOADING SEQUENCE

1. With all stations loaded and selected, the release sequence is :
   LC-1/RC-1
   STATION 5
   LC-3/RC-3
   LC-4/RC-4
   LC-6/RC-6
   LC-5/RC-5
   LC-2/RC-2
   STATION 2
   STATION 8
2. Any station with A/G stores (2, LC, 5, RC, 8) may be deselected provided the aircrew makes sure all CFT A/G stores are released before the adjacent wing A/G stores are released.
3. Partial store configurations (downloads) are authorized and are obtained by deleting stores from CFT's and/or other stations in the proper release sequence.
4. If CFT stores are not fully loaded (symmetrically or asymmetrically) and all stations are selected, the PACS will always release the first loaded station on the left CFT (in CFT release sequence), then the first loaded station on the right CFT (in CFT release sequence), then station 5. The PACS will always continue to release the first loaded station on the left CFT (in CFT release sequence), then the first loaded station on the right CFT (in CFT release sequence) until either the left or right CFT is empty. Once a CFT is empty, the PACS will release the other CFT's loaded station(s) (in CFT release sequence). The PACS will release the wing stations last.
5. Partial store configurations should be distributed to minimize weight asymmetry and adverse cg affects. Attempt to load A/A missiles on stations 2/8 symmetrically. Consideration should be given to the weight asymmetry of the internal gun.

MIXED LOADS

1. Each store configuration is shown in figure 5-9 as a separate line number.
2. Mixed loads of different A/G stores (i.e., MK-82 and MK-84), different store types (i.e., MK-82 AIR and MK-82SE) and different store models (i.e., A/B and C/B) are not authorized unless depicted as a separate line number. This restriction applies to all aircraft stations.
3. Mixed loads of A/A adapters, launchers and missiles, Airborne Instrument Set (AIS) pods, Gulf Range Drone Control Upgrade System (GRDCUS) pods and Captive Air Training Missiles (CATM) are optional on stations 2A, 2B, 8A and 8B with all line numbers unless otherwise noted.
4. Hardback beacon pods are optional on stations 2, LC2, 5, RC2 and 8. with all line numbers unless otherwise noted.
5. CFT mounted A/A missiles are optional with all stations 2, 5 and 8 stores unless otherwise noted.
6. Fuel tanks are optional on stations 2, 5 and 8 or in place of stores on stations 2, 5 and 8 for all line numbers unless otherwise noted. Asymmetrical fuel tank carriage is not authorized.
7. LANTIRN pods are optional with all line numbers unless otherwise noted.
8. Captive, inert and training store versions are authorized unless otherwise noted.
9. Most restrictive limits apply when carrying mixed loads.

OTHER RESTRICTIONS

1. Smooth stick inputs and no rolling maneuvers allowed for carriage above 600 KCAS/1.2 Mach with asymmetric CFT configurations.
2. Mirror image loadings are authorized for all asymmetric line numbers unless otherwise noted.
3. With CFT mounted A/G stores, limit unsymmetric maneuvers above 25 units AOA to +3g.
4. Empty centerline pylons should be carted, jettison limit is 300 KCAS/0.70 Mach.
5. Do not roll the aircraft until at least one second after weapon release.

GENERAL REMARKS

1. CFT A/A or A/G stores station loading is shown by listing authorized station number in L/R CFT columns. Refer to sheet 1 for CFT stores station identification.
2. All authorized external store limits are with CFTs installed.

Figure 5-9 (Sheet 2)

3. Minimum release interval applies only to bombs released from the same side of the aircraft. When performing ripple single release from both sides of the aircraft, divide the minimum release interval by 2.

JETTISON

1. Emergency jettison limits have not been flight tested and are not provided. During emergency jettison the PACS sends a release pulse every 60-80 msec (35±5 on, then 35±5 off) in a sequence that is different from the authorized stores release sequence. Store-to-store and store-to-aircraft collisions may occur.
2. Unless otherwise noted, jettison limits are applicable only for jettison of the store (pylon not attached) in the release sequence authorized in note 1 under Release and Downloading Sequence. The PACS sends a release pulse every 60-80 msec during selective jettison in A/G, combat or MAN FF and 200-260 msec in MAN RET.

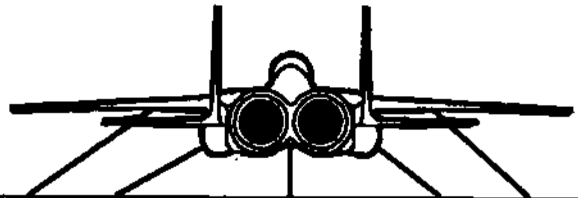
CAUTION

Use of emergency or a jettison mode with a ripple interval less than the stores minimum release interval may cause store-to-store or store-to-aircraft collision.

Figure 5-9 (Sheet 3)

EXTERNAL STORES LIMITATIONS

FUEL TANKS
LANTIRN PODS
TRAVEL PODS



STORE	LINE NUMBER	SUSPENSION	STATION LOADING									MAXIMUM KCAS OR IMN OR WHICHEVER IS LESS		
			2	L CFT OUT BD	L CFT INBD	LTP	5	LNP	R CFT INBD	R CFT OUT BD	8	CARRIAGE	EMPLOYMENT	JETTISON
610 GALLON FUEL TANK	101	SUU-73/A				OPT	○	OPT				660 1.5 ②	NA	625 1.25 ①
	102	SUU-59C/A BRU-47/A	○								○	660 1.5		600 0.95
LANTIRN PODS	103	ADU-577/A				●						See Remarks		NA
		ADU-576/A						●						

Figure 5-9 (Sheet 4)

EXTERNAL STORES LIMITATIONS

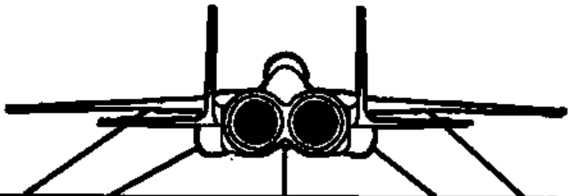
NA - NOT APPLICABLE
NE - NOT ESTABLISHED
BAL - BASIC AIRCRAFT LIMITS
LTP - LANTIRN TARGETING POD
LNP - LANTIRN NAVIGATION POD

LINE NUMBER	ACCELERATION-G CARRIAGE SYM	ACCELERATION-G CARRIAGE UNSYM	ACCELERATION-G EMPLOYMENT	ACCELERATION-G JETTISON	DELIVERY ANGLE	STORES CONFIGURATION WEIGHT-LBS (WEIGHTS INCLUDE SUSPENSION EQUIPMENT)	REMARKS
101	BAL	BAL	NA	+0.8 to +1.2	NA	Empty - 636 Full - 4601	① With both LANTIRN pods. With no pods, jettison limit is 660/1.5M. With single pod, jettison limits are 1.0M below 25,000 ft MSL or 1.1M above 25,000 ft MSL. ② Mach is limited to 1.0 below 25,000 ft MSL and 1.1 above 25,000 ft MSL for single LANTIRN pod carriage. • Ejector pitch valve settings should be -1 fwd and -1 aft.
102						Empty - 1382 Full - 9312	
103	See Remarks			NA		(LTP) 621 (LNP) 520	• Single Navigation or Targeting pod carriage is authorized. • Conformal fuel tanks must be installed when LANTIRN pods are carried. • LANTIRN pods are subject to carriage limits in Figure 5-8. • LANTIRN adapters cannot be flown without pods attached. • Auto or manual TF is prohibited when carrying AN/ASQ-T17 or AN/ASQ-T25 ACMI pods and GRDCUS pods unless the internal pod radar altimeter is disconnected. **WARNING** Do not fire the "Tactical" (not eye safe) LASER within 2000 feet of another aircraft. Reflected energy may cause eye damage. Never lase inhabited areas. **CAUTION** Until -049 TE configured target pods are received, the operation of the target pod laser above 20,000 feet is limited to essential test and tactical operations.

Figure 5-9 (Sheet 5)

EXTERNAL STORES LIMITATIONS

FUEL TANKS
LANTIRN PODS
TRAVEL PODS



STORE	LINE NUMBER	SUSPENSION	STATION LOADING									MAXIMUM KCAS OR IMN OR WHICHEVER IS LESS		
			2	L CFT		LTP	5	LNP	R CFT		8			
				OUT BD	INBD				INBD	OUT BD		CARRIAGE	EMPLOYMENT	JETTISON
MXU-648 A/A-10, -30, -50 TRAVEL POD	104	SUU-59C/A BRU-47/A (Sta 2 & 8) SUU-73/A BRU-47/A (Centerline) BRU-47/A (LC2 & RC2)	●		2	OPT	●	OPT	2		●	550 0.95	N/A	N/A

Figure 5-9 (Sheet 6)

EXTERNAL STORES LIMITATIONS

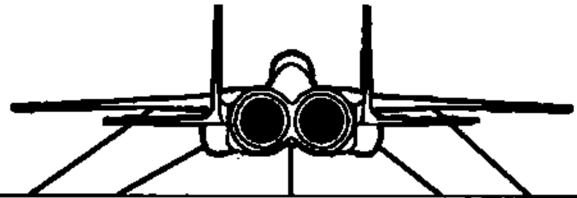
NA - NOT APPLICABLE
NE - NOT ESTABLISHED
BAL - BASIC AIRCRAFT LIMITS
LTP - LANTIRN TARGETING POD
LNP - LANTIRN NAVIGATION POD

LINE NUMBER	ACCELERATION-G				DELIVERY ANGLE	STORES CONFIGURATION WEIGHT-LBS (WEIGHTS INCLUDE SUSPENSION EQUIPMENT)	REMARKS
	CARRIAGE		EMPLOYMENT	JETTISON			
	SYM	UNSYM					
104	-1.0 to +5.0	0.0 to +3.0	N/A	N/A		(Empty) CFT (-10 Pod) 130 (-30,-50 Pod) 98 Sta 2 or 8 (-10 Pod) 501 (-30,-50 Pod) 469 Sta 5 (-10 Pod) 446 (-30,-50 Pod) 414	● Travel pods may be carried in any combination on stations 2, 5, 8, LC2 or RC2. ● Maximum cargo weight 300 pounds per pod. ● Maximum roll rate 120°/sec (½ lateral stick). ● Do not cart BRU-47/A or pylons, travel pods are non-jettisonable.

Figure 5-9 (Sheet 7)

EXTERNAL STORES LIMITATIONS

ACMI PODS
INSTRUMENTATION
PODS



STORE	LINE NUMBER	SUSPENSION	STATION LOADING 2	L CFT OUT BD	L CFT INBD	LTP	5	LNP	R CFT INBD	R CFT OUT BD	8	MAXIMUM KCAS OR IMN OR WHICHEVER IS LESS: CARRIAGE	EMPLOYMENT	JETTISON
AIS PODS AN/ASQ T-17, T-20, T-21, T-25 GRDCUS SHOOTER POD	105	SUU-59C/A BRU-47/A ADU-407/A LAU-114/A or ADU-552/A LAU-128/A	●			OPT		OPT			●	BAL	NA	600 0.95 ①
G, E, I & J BAND HARD-BACK BEA-CON POD	106	SUU-59C/A BRU-47/A (Sta 2 & 8) SUU-73/A BRU-47/A (Centerline)	●		2		●		2		●			NA

Figure 5-9 (Sheet 8)

EXTERNAL STORES LIMITATIONS

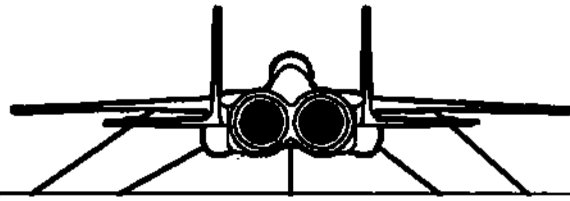
NA - NOT APPLICABLE
NE - NOT ESTABLISHED
BAL - BASIC AIRCRAFT LIMITS
LTP - LANTIRN TARGETING POD
LNP - LANTIRN NAVIGATION POD

LINE NUMBER	ACCELERATION-G				DELIVERY ANGLE	STORES CONFIGURATION WEIGHT-LBS (WEIGHTS INCLUDE SUSPENSION EQUIPMENT)	REMARKS
	CARRIAGE		EMPLOYMENT	JETTISON			
	SYM	UNSYM					
105	BAL	BAL	NA	+0.5 to +2.0 ①	NA	(AIS) 973 (GRDCUS) 978	① Limit is for pylon jettison only and is prohibited with CFT stores aboard. ● Simultaneous operations of both the aircraft radar altimeter (CARA) and the T-17, T-25 or GRDCUS radar altimeter may result in radio frequency interference. ● Only one AIS pod authorized, preferred loading is 2A but may be loaded on 2A, 2B, 8A or 8B.
106				NA		(Sta 2 & 8) 444 (Centerline) 389	● The Hardback Beacon Pod must be configured with sway brace pads. ● Do not cart the BRU-47/A, Hardback Beacon Pods are non-jettisonable. ● Only one pod authorized but may be loaded on 2, 5, 8, LC2 or RC2.

Figure 5-9 (Sheet 9)

EXTERNAL STORES LIMITATIONS

MISSILES



STORE	LINE NUMBER	SUSPENSION	STATION LOADING 2	L CFT OUT BD	L CFT INBD	LTP	5	LNP	R CFT INBD	R CFT OUT BD	8	MAXIMUM KCAS OR IMN OR WHICHEVER IS LESS CARRIAGE	EMPLOYMENT	JETTISON
AIM-7F/M CATM-7F-3 CATM-7F CATM-7M	301	LAU-106A/A			3C 4C	OPT		OPT	7C 6C			660 1.4	660 1.4	600 0.95
AIM-9P/L/M CATM-9 P/L/M	302	SUU-59C/A BRU-47/A ADU-407/A LAU-114/A OR ADU-552/A LAU-128/A										BAL	BAL	600 0.95 (1)
AIM-120A CATM-120A	303	SUU-59C/A, BRU-47/A, ADU-552/A, LAU-128/A												
AGM-65 A/B/D/G, T-MISSILE, TGM-65 A/B/D/G	304	SUU-59C/A BRU-47/A LAU-117/A, (V)1/A										660 1.4	660 1.4	600 0.95
		SUU-59C/A BRU-47/A ADU-578/A LAU-88/A, A/A												300 0.70 (1)

Figure 5-9 (Sheet 10)

EXTERNAL STORES LIMITATIONS

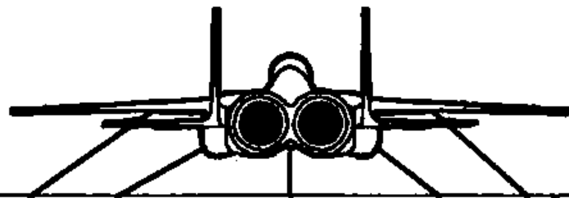
NA - NOT APPLICABLE
NE - NOT ESTABLISHED
BAL - BASIC AIRCRAFT LIMITS
LTP - LANTIRN TARGETING POD
LNP - LANTIRN NAVIGATION POD

LINE NUMBER	ACCELERATION-G				DELIVERY ANGLE	STORES CONFIGURATION WEIGHT-LBS WEIGHTS INCLUDE SUSPENSION EQUIPMENT	REMARKS
	CARRIAGE		EMPLOYMENT	JETTISON			
	SYM	UNSYM					
301	BAL	BAL	-0.5 to +7.2	+0.5 to +3.0	N/A	2040	● CATM carriage with/without wings and fins is authorized.
302			-0.5 to +7.3	+0.5 to +2.0 (1)		1688	(1) Jettison limit is for pylon jettison only and is prohibited with CFT stores aboard. ● Mixed loads of AIM-9s and AIM-120s, are authorized. ● Single AIM-9 or CATM-9 should be loaded on 2A or 2B (2B preferred). ● CATM-9P/L/M optional configurations: (1) Canards only (2) Wings/rollerons only (3) Canards and wings minus rollerons (4) Without canards or wings
303						2553	**NOTE** Performing an AIM-120 BIT check with the AN/ALQ-135 operating (jamming) may cause AIM-120 degradation. ● Mixed loads of AIM-9s and AIM-120s, are authorized. ● Carriage is authorized with or without missile wings or control surfaces. Employment is not authorized without missile wings or control surfaces.
304	-2.0 to +6.0	-1.0 to +4.8	+0.5 to +3.0	+0.8 to +1.2	-45° to +5°	(AGM-65A/B) 1934 (AGM-65D) 1982 (AGM-65G) 2342	(1) Jettison limit is for pylon jettison only and is prohibited with CFT stores aboard. ● ADU-578/A required when carrying A/A missile launcher adapters (ADU-407 or ADU-552). ● Any download of LAU-88, regardless of LAU-88 release sequence is authorized. ● Ejector pitch valve settings for LAU-117 are -1 fwd and -1 aft. ● Dual launches are not authorized. ● AGM-65G not authorized on LAU-88/A, A/A. ● When flying through visible moisture, without the dome cover in place, the maximum airspeed is 350 KCAS or 0.53 Mach whichever is less, to prevent damage to guidance window unit.
				+0.8 to +1.2 (1)		(AGM-65A/B) 4654 (AGM-65D) 4798	

Figure 5-9 (Sheet 11)

EXTERNAL STORES LIMITATIONS

GP BOMBS
LASER GUIDED
BOMBS



STORE	LINE NUMBER	SUSPENSION	STATION LOADING 2	L CFT OUT BD	L CFT INBD	LTP	5	LNP	R CFT INBD	R CFT OUT BD	8	MAXIMUM KCAS OR IMN OR WHICHEVER IS LESS: CARRIAGE	EMPLOYMENT	JETTISON
MK-82 LDGP OR AIR BDU-50B BDU-50A/B (BSU-49/B fin)	501	BRU-46/A (OUTBD) BRU-47/A (INBD)		6 5 4	3 2 1	OPT		OPT	3 2 1	6 5 4		660 1.4	600 0.95	600 0.95
MK-82 SNAKEYE BDU-50/B BDU-50A/B (MK-15 fin)													500 0.85 ①	500 0.85 ①
MK-84 LDGP MK-84 AIR	502	BRU-47/A (CFT) SUU-59C/A BRU-47/A (Sta 2 & 8) SUU-73/A BRU-47/A (Centerline)	[bomb symbol]		2		[bomb symbol]		2		[bomb symbol]		600 0.95	600 0.95
	503		[bomb symbol]		2		[bomb symbol]		3 1		[bomb symbol]			
	504		[bomb symbol]		3 1		[bomb symbol]		3 1		[bomb symbol]		525 0.85 ②	525 0.85 ②
GBU-10 C/B D/B E/B G/B H/B J/B	505	BRU-47/A (CFT) SUU-73/A BRU-47/A (Centerline) SUU-59C/A BRU-47/A (Sta 2 & 8)			2		[bomb symbol]		2				660 1.4	660 1.4
	506		[bomb symbol]		2		[bomb symbol]		2		[bomb symbol]		600 0.95	600 0.95

Figure 5-9 (Sheet 12)

EXTERNAL STORES LIMITATIONS

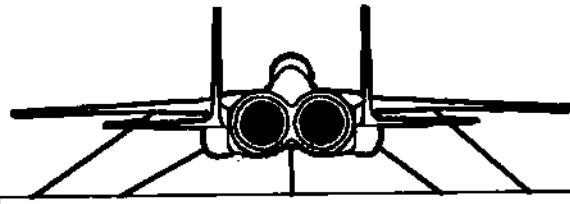
NA - NOT APPLICABLE
NE - NOT ESTABLISHED
BAL - BASIC AIRCRAFT LIMITS
LTP - LANTIRN TARGETING POD
LNP - LANTIRN NAVIGATION POD

LINE NUMBER	ACCELERATION-G CARRIAGE SYM	ACCELERATION-G CARRIAGE UNSYM	ACCELERATION-G EMPLOYMENT	ACCELERATION-G JETTISON	DELIVERY ANGLE	STORES CONFIGURATION WEIGHT-LBS WEIGHTS INCLUDE SUSPENSION EQUIPMENT	REMARKS
501	-2.0 to +6.0	-1.0 to +4.8	+0.5 to +5.0	+0.8 to +1.2	-45° to +45° UN-RETARDED -20° to +20° RETARDED	(LDGP) 6060 (AIR) 6480	(1) High Drag configuration. In Low drag configuration employment/jettison limit is 600 KCAS/0.95M. ● MK-82 LDGP, MK-82 AIR and MK-82 Snakeye (LD) minimum ripple interval is 60 MSEC. MK-82 SE (HD) minimum ripple interval is 200 MSEC. ● Ejector pitch valve settings should be -1 fwd and -2 aft.
						6600	
502		0.0 to +4.8	+0.5 to +6.0		-45° to +45°	(LDGP) 10,908 (AIR) 11,108	(2) Line 504 employment and jettison limits are 600 KCAS/0.95M if LANTIRN pods are not carried. ● Ejector pitch valve settings should be -1 fwd and -3 aft. ● Minimum ripple interval is 60 MSEC. ● MK-84 on stations 2, 5, and 8 are optional and may be substituted with symmetric carriage of fuel tanks. ● Line 503 mirror image carriage not authorized. ● Line 504 could exceed weight limits.
503						(LDGP) 12,878 (AIR) 13,118	
504						(LDGP) 14,848 (AIR) 15,128	
505	-1.0 to +5.0	0.0 to +3.0	+0.5 to +5.0			6517	● Minimum ripple interval is 80 MSEC. ● The ejector feet on GBU-10G/B, H/B and J/B stations must contact the bomb through the 5/8 inch ejector foot adapter. ● Ejector pitch valve settings should be -1 fwd and -2 aft for stations LC2, RC2, and station 5. Use -1 fwd and -3 aft for stations 2 and 8. ● Line number 506, A/A missiles may not be carried on stations 2 and 8. GRDCUS and AIS Pods/CATMs without canards and wings may be carried. ● GBU-10 on stations 2, 5 and 8 are optional.
506						11,393	

Figure 5-9 (Sheet 13)

EXTERNAL STORES LIMITATIONS

PGM
LASER GUIDED
BOMBS



STORE	LINE NUMBER	SUSPENSION	STATION LOADING									MAXIMUM KCAS OR IMN OR WHICHEVER IS LESS		
			2	L CFT OUT BD	L CFT INBD	LTP	5	LNP	R CFT INBD	R CFT OUT BD	8	CARRIAGE	EMPLOYMENT	JETTISON
GBU-12B/B C/B D/B	507	BRU-46/A (OUTBD) BRU-47/A (INBD) (CFT) SUU-73/A BRU-47/A (Centerline) SUU-59C/A BRU-47/A (Sta 2 & 8)	●	6 4	3 1	OPT	●	OPT	3 1	6 4	●	525 0.90	525 0.90	525 0.90
	508		●	6	3		●		3	6	●	575 0.95	575 0.95	575 0.95
GBU-15 TV(MK-84) IR(MK-84) TV(BLU-109) IR(BLU-109)	509	SUU-59C/A BRU-47/A	●								●	650 1.4	570 1.4	600 0.95 ①
AN/AXQ-14 DLP		SUU-73/A BRU-47/A					●						NA	300 0.70
GBU-24/B GBU-24A/B	510	SUU-59C/A BRU-47/A (Sta 2 & 8) SUU-73/A BRU-47/A (Centerline)	●				●				●	660 1.4	500 0.85 (Sta 2 & 8) 600 0.95 (Sta 5)	500 0.85 (Sta 2 & 8) 600 0.95 (Sta 5)

Figure 5-9 (Sheet 14)

EXTERNAL STORES LIMITATIONS

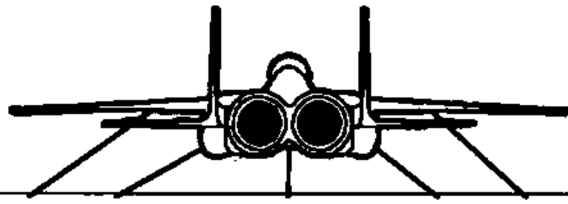
NA - NOT APPLICABLE
NE - NOT ESTABLISHED
BAL - BASIC AIRCRAFT LIMITS
LTP - LANTIRN TARGETING POD
LNP - LANTIRN NAVIGATION POD

LINE NUMBER	ACCELERATION-G CARRIAGE SYM	ACCELERATION-G CARRIAGE UNSYM	ACCELERATION-G EMPLOYMENT	ACCELERATION-G JETTISON	DELIVERY ANGLE	STORES CONFIGURATION WEIGHT-LBS WEIGHTS INCLUDE SUSPENSION EQUIPMENT	REMARKS
507	-2.0 to +5.5	-1.0 to +4.4	+0.5 to +5.5	+0.8 to +1.2	-45° to +45°	7768	● GBU-12 are optional on stations 2, 5 and 8. ● Minimum ripple interval is 80 msec. ● Ejector pitch valve settings should be -1 fwd and -3 aft. ● GBU-12 may not be carried on stations 2 and 8 with AIM/CATM missiles with canards and wings. GRDCUS and AIS Pods/CATMs without canards and wings may be carried.
508						5328	
509	-2.0 to +6.0	-1.0 to +4.8	+0.5 to +1.5	+0.8 to +1.2 ①	+10 to -15°	5746	① GBU-15 Trainer carriage and jettison is authorized. Trainers should be carried minus control surfaces, wings, and strakes. Normal jettison limits apply. Do not cart BRU-47. ● MK-84 versions use only the long chord wing (LCW) configuration. ● BLU-109 versions use only the short chord wing (SCW) configuration. ● Ejector pitch valve settings should be -1 fwd and -2 aft. ● AN/AXQ-14 data link pod is optional. Do not cart BRU-47/A on station 5. Jettison only with pylon attached. ● AIM-120 missiles may not be carried on stations 2 and 8 in conjunction with GBU-15. ● AIM-9 missile may not be carried on stations 2 and 8 in conjuntion with GBU-15 LCW. GBU-15 SCW must be employed or jettisoned prior to AIM-9 launch (same station).
			NA		NA	766	
510			+0.5 to +6.0	+0.8 to +1.2	-45° to +45°	(GBU-24/B) 8003 (GBU-24A/B) 8102	● Minimum ripple interval is 80 MSEC. ● Ejector pitch valve settings should be -1 fwd and -3 aft. ● LAU-114/128 missile launchers may not be carried on stations 2 & 8 in conjunction with GBU-24s. ● GBU-24 on stations 2, 5 and 8 are optional.

Figure 5-9 (Sheet 15)

EXTERNAL STORES LIMITATIONS

PGM
LASER GUIDED
BOMBS



STORE	LINE NUMBER	SUSPENSION	STATION LOADING									MAXIMUM KCAS OR IMN OR WHICHEVER IS LESS		
			2	L CFT		LTP	5	LNP	R CFT		8			
				OUT BD	INBD				INBD	OUT BD		CARRIAGE	EMPLOYMENT	JETTISON
GBU-28/B	511	SUU-59C/A BRU-47/A				OPT		OPT				600 1.2	375 0.95	375 0.95

Figure 5-9 (Sheet 16)

EXTERNAL STORES LIMITATIONS

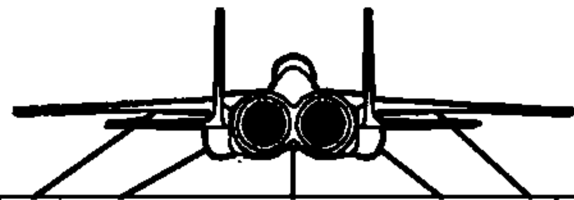
NA - NOT APPLICABLE
NE - NOT ESTABLISHED
BAL - BASIC AIRCRAFT LIMITS
LTP - LANTIRN TARGETING POD
LNP - LANTIRN NAVIGATION POD

LINE NUMBER	ACCELERATION-G				DELIVERY ANGLE	STORES CONFIGURATION WEIGHT-LBS WEIGHTS INCLUDE SUSPENSION EQUIPMENT	REMARKS
	CARRIAGE		EMPLOYMENT	JETTISON			
	SYM	UNSYM					
511	0.0 to +5.0	+1.0 to +4.0	+0.8 to +1.2	+0.8 to +1.2	-10° to +10°	9,894	●Takeoff with an asymmetric GBU-28 is prohibited. ● Ejector pitch valve settings should be -1 fwd and -3 aft. ●GBU-28 must be employed or jettisoned prior to AIM-9 launch (same station). ●Inoperative OWS limits apply. ●The ejector feet on GBU-28 stations must contact the bomb through the 5/8 inch ejector foot adapter. ●With asymmetrically loaded GBU-28, loss of roll control authority may occur above 18 units AOA. ●Landing limits for crosswinds opposite an asymmetrically loaded GBU-28 : CAS ON - 10 knots, CAS OFF - Not Recommended ●Avoid abrupt lateral stick inputs. Do not exceed 1/2 lateral stick deflection while airborne. ●No more than one asymmetric missile allowed on same side as GBU-28 (AIM-7, AIM-9 or AIM-120).

Figure 5-9 (Sheet 17)

EXTERNAL STORES LIMITATIONS

CLUSTER BOMB UNITS/ DISPENSERS



STORE	LINE NUMBER	SUSPENSION	STATION LOADING									MAXIMUM KCAS OR IMN OR WHICHEVER IS LESS		
			2	L CFT OUT BD	L CFT INBD	LTP	5	LNP	R CFT INBD	R CFT OUT BD	8	CARRIAGE	EMPLOYMENT	JETTISON
SUU-20B/A with BDU-33B/B or BDU-33 D/B Practice Bomb	701	SUU-59C/A BRU-47/A	▲			OPT		OPT			▲	600 0.95	600 0.95	450 0.90 ①
SUU-20B/A with MK-106 Practice Bomb	702													
CBU-52B/B, CBU-58/B, A/B CBU-71/B, A/B	703	BRU-46/A (Outbd) BRU-47/A (Inbd)		6 5 4	3 2 1				3 2 1	6 5 4		600 1.2		600 0.95
	704	BRU-47/A			3 2 1				3 2 1					
CBU-87/B, A/B, B/B CBU-89/B	705	BRU-46/A (Outbd) BRU-47/A (Inbd)		6 5 4	3 2 1				3 2 1	6 5 4		660 1.4		
	706	BRU-47/A			3 2 1				3 2 1					
MK-20 Mod 3, Mod 4	707	BRU-46/A (Outbd) BRU-47/A (Inbd)		6 5 4	3 2 1				3 2 1	6 5 4				

Figure 5-9 (Sheet 18)

EXTERNAL STORES LIMITATIONS

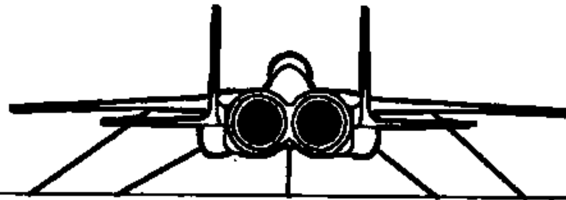
NA - NOT APPLICABLE
NE - NOT ESTABLISHED
BAL - BASIC AIRCRAFT LIMITS
LTP - LANTIRN TARGETING POD
LNP - LANTIRN NAVIGATION POD

LINE NUMBER	ACCELERATION-G CARRIAGE SYM	ACCELERATION-G CARRIAGE UNSYM	ACCELERATION-G EMPLOYMENT	ACCELERATION-G JETTISON	DELIVERY ANGLE	STORES CONFIGURATION WEIGHT-LBS WEIGHTS INCLUDE SUSPENSION EQUIPMENT	REMARKS
701	-2.0 to +6.5	-1.0 to +4.8	+0.7 to +5.0	+0.8 to +2.0 (1)	-45° to +45°	Empty 1294 Full 1570	(1) Do not cart BRU-47/A on stations 2 and/or 8. Jettisonable only with pylon attached. ● Mixed loads of BDU-33 and MK-106 practice bombs are permitted. ● Minimum ripple interval is 250 MSEC.
702					-20° to +45°	Empty 1294 Full 1354	
703	-2.0 to +6.0		+0.5 to +6.0	+0.8 to +1.2	-45° to +45°	(CBU-52) 9420 (CBU-58, 71) 9720	● Line 703, wing fuel tanks not authorized. ● Minimum ripple interval is 90 MSEC. ● Ejector pitch valve settings should be -1 fwd and -3 aft.
704						(CBU-52) 4710 (CBU-58, 71) 4860	
705						(CBU-87) 11,400 (CBU-89) 8472	● Line 705, wing fuel tanks not authorized. ● Minimum ripple interval is 80 MSEC. ● Ejector pitch valve settings should be -1 fwd and -3 aft.
706						(CBU-87) 5700 (CBU-89) 4236	
707						5880	● Minimum ripple interval is 100 MSEC. ● Ejector pitch valve settings should be -1 fwd and -2 aft.

Figure 5-9 (Sheet 19)

EXTERNAL STORES LIMITATIONS

MISCELLANEOUS



STORE	LINE NUMBER	SUSPENSION	STATION LOADING									MAXIMUM KCAS OR IMN OR WHICHEVER IS LESS		
			2	L CFT		LTP	5	LNP	R CFT		8			
				OUT BD	INBD				INBD	OUT BD		CARRIAGE	EMPLOYMENT	JETTISON
BLU-107/B	901	BRU-46/A (OUTBD) BRU-47/A (INBD)		6 5 4	3 2 1	OPT		OPT	3 2 1	6 5 4		600 1.2	600 0.95	600 0.95
BDU-38/B B-61 MODS -3, -4, -10	902	BRU-47/A-5N (CFT) SUU-73/A BRU-47/A-5N (Centerline)	●		2		●		2		●	660 1.4	660 1.4	660 1.4
TMU-28/B	903	SUU-59C/A BRU-47/A	○								○		600 0.95	600 0.95
MC-1	904	BRU-46/A (OUTBD) BRU-47/A (INBD)		6 5 4	3 2 1				3 2 1	6 5 4				
	905	BRU-47A			3 2 1				3 2 1					
MC-1 (M1A1 Fuze Extenders)	906	BRU-46/A (OUTBD) BRU-47/A (INBD)		6 4	3 1				3 1	6 4				
	907	BRU-47A			3 1				3 1					

Figure 5-9 (Sheet 20)

EXTERNAL STORES LIMITATIONS

NA - NOT APPLICABLE
NE - NOT ESTABLISHED
BAL - BASIC AIRCRAFT LIMITS
LTP - LANTIRN TARGETING POD
LNP - LANTIRN NAVIGATION POD

LINE NUMBER	ACCELERATION-G				DELIVERY ANGLE	STORES CONFIGURATION WEIGHT-LBS WEIGHTS INCLUDE SUSPENSION EQUIPMENT	REMARKS
	CARRIAGE		EMPLOYMENT	JETTISON			
	SYM	UNSYM					
901	-2.0 to +6.0	-1.0 to +4.8	+0.7 to +1.3	+0.8 to +1.2	-10° to +10°	5928	● Ejector pitch valve settings should be -1 fwd and -1 aft. ● Minimum ripple interval is 200 MSEC.
902			+0.5 to +6.0		-10° to +40°	3605 3755	● Ejector pitch valve settings should be -1 fwd and -1 aft. ● Only DELAY setting (H) is authorized for the B-61. ● Minimum employment airspeeds are: 240 KCAS/0.42 Mach (freefall), 330 KCAS/0.42 Mach (retard). ● To employ a B61-10, a B61-4 must be programmed into the PACS.
903			+1.0 to +5.0	+0.8 to +4.0	-5° to +5°	Empty 1876 Full 4612	● Ejector pitch valve pitch settings should be -1 fwd and -3 aft. ● All four fins (with reinforced riveting) must be attached to the TMU-28. ● Maximum roll rate is 60deg/sec with no abrupt stick inputs. ● Non OWS limits apply. **CAUTION** TMU-28/B should be jettisoned immediately after use with the nozzle (boom) in the down position. Retracting the nozzle or delaying jettison may result in aircraft contamination from residual liquid.
904			+0.5 to +6.0	+0.8 to +1.2	-45° to +45°	8016	● Line 904, wing fuel tanks are not authorized. ● Minimum ripple interval is 100 MSEC. ● Ejector pitch valve settings should be -1 fwd and -2 aft.
905						4008	
906						5344	● Line 906, wing fuel tanks are not authorized. ● Minimum ripple interval is 60 MSEC. ● Ejector pitch valve settings should be -1 fwd and -2 aft.
907						2672	

Figure 5-9 (Sheet 21)

SECTION VI

FLIGHT CHARACTERISTICS

TABLE OF CONTENTS

GENERAL HANDLING QUALITIES

The original design of the flight control system was to provide uniform handling qualities throughout the entire flight envelope. However, due to the growth of the F-15E, the flight control system is no longer capable of providing uniform handling qualities. As a result, handling qualities vary with aircraft load, weight, center-of-gravity (cg), and automatic flight control system (AFCS) failures. First this section discusses the handling qualities of an aircraft with no CFT's, LANTIRN pods or external stores at nominal weight and cg conditions. Then this section discusses the effect of configuration and weight changes on those handling qualities.

LONGITUDINAL CHARACTERISTICS

The normal mode of operation of the flight control system is PITCH CAS ON and PITCH RATIO AUTO. With PITCH CAS ON and PITCH RATIO AUTO, the stick force required to maintain a desired g does not change with airspeed, thrust, or configuration changes. In addition, the stick force per g requirement remains constant throughout the flight envelope.

The Pitch Trim Compensator (PTC) provides the capability of automatically trimming the aircraft. This feature does not trim off control forces; instead, it trims to maintain the desired stick force selected by the pilot with manual trim. For example, if trimmed for hands-off, 1 g level flight, the aircraft will tend to remain in 1 g level flight regardless of thrust, airspeed, or configuration changes. There is some delay in the PTC particularly when rolling out of a turn. In this case, the nose will tend to rise requiring some forward stick force, even if the aircraft was not trimmed in the turn. Do not retrim immediately since most of the nose-up tendency will disappear in a very short time.

Manual trim is normally required in only two instances. The first is after takeoff to counter a nose up tendency created by the PTC bias which is intentionally established when takeoff trim is selected. This bias is required to ensure sufficient stabilator authority to rotate the aircraft during the takeoff roll. Without this bias, takeoff rotation may be significantly delayed. The second situation requiring manual trim is when the landing gear handle is down. With the gear handle down, the aircraft will no longer tend to hold 1 g flight. This characteristic provides a speed cue to the pilot. As the aircraft slows down, manual trim is used to zero out the stick forces for the desired airspeed or angle of attack (AOA).

The design of the Control Augmentation System (CAS) is such that the stick force per g remains relatively constant throughout the entire flight envelope. There are some cases when this rule does not hold true. For example, when decelerating through Mach 1 at high g loadings, the CAS is unable to maintain the g level. During this transition period there is an approximate 1 to 1.5 g transonic pitch up tendency as the aircraft decelerates. In addition when operating at high altitude and high Mach, the stick force per g requirements increase.

The carriage of CFTs increases the pitch response and maneuverability of the aircraft. The CFTs also increase nose up pitch sensitivity and at high AOA, reduce the nose down pitch response. During takeoff, smooth aft stick is needed for rotation, especially with three external tanks. During maneuvering flight, CFTs increase the maximum AOA capability by about 4 units. During landing approaches, aircraft with CFTs have light buffet cues at 20 to 21 units. It may be necessary to refer to AOA indicators to prevent AOA overshoots during pattern and flare.

The carriage of either external stores or LANTIRN pods reduces the dynamic longitudinal stability. In these situations, even though adequate handling qualities are maintained, abrupt pitch inputs will not dampen out immediately.

With the gear handle up and AOA greater than 23 units, the CAS will intentionally not hold 1 g flight. This feature, referred to as the stall inhibitor, forces the pilot to hold large stick deflections at high angles of attack. As a result tactile feedback is provided to the pilot of an impending high AOA condition. Handling qualities are improved if the pilot does not trim above 23 units.

LATERAL-DIRECTIONAL CHARACTERISTICS

The normal mode of AFCS operation is YAW and ROLL CAS ON and ROLL RATIO AUTO. The design is such that roll maneuvers can be accomplished through lateral stick only, i.e., no rudder coordination is necessary. Coordination is provided by the Aileron Rudder Interconnect (ARI) such that when the stick is near full aft, lateral stick input causes rudder deflection in the direction of lateral input. With forward stick, the rudder deflection will be opposite to lateral input.

Full lateral stick produces a high roll rate through most of the flight envelope. Continuous full-stick rolls can result in aircraft pitch and yaw excursions. These rolls can cause high structural loads and possible loss of control due to inertial coupling. This tendency is greatest with negative or high positive g loads and above 500 KCAS or Mach 1.4. Lateral stick forces are light, and initial roll acceleration is high, particularly during low altitude, high speed subsonic flight. There is a tendency to over control at these conditions.

Rolling maneuvers performed with large lateral stick inputs at supersonic speeds may result in large uncomfortable yaw excursions.

An alternate approach to rolling the aircraft is to use rudder only. This method is less effective than lateral stick in achieving maximum roll rate below 30 CPUs. Above 30 CPUs AOA, the use of rudder alone is the most efficient means of maneuvering the aircraft. When lateral stick is used above 30 CPUs adverse flight characteristics will result. The first indication of these characteristics are roll hesitations and roll ratcheting around 27 CPU. Around 35 CPU, uncommanded rolls and roll reversals can be expected when lateral stick is used. Above 35 CPU the detrimental effects of lateral control inputs are reduced.

WARNING

Use of lateral stick for maneuvering above 30 CPU could result in departures. These departures are characterized as uncommanded rolls and roll reversals. If this type of motion is experienced, smoothly neutralize the control inputs to recover the aircraft.

When CFTs are down-loaded, the adverse characteristics associated with lateral stick inputs above 30 CPUs are less.

NOTE

Use of lateral stick for maneuvering above 30 CPUs could result in a departure. Above 30 CPU maneuver with rudder pedals while keeping lateral stick neutral.

The LANTIRN pods and external centerline tank significantly reduce the lateral-directional (roll-yaw) stability of the aircraft. With CFTs, LANTIRN pods, and external centerline tank loaded, rolling departures resulting from abrupt lateral stick inputs may occur at less than 30 units AOA.

External stores generally will degrade roll response. More time is required to attain or stop a given roll rate, particularly at high AOA. Generally, there will be larger yaw excursions during rolls.

CONFIGURATION IMPACTS ON HANDLING QUALITIES

FLIGHT WITH CENTER OF GRAVITY AT LIMITS

The distribution of fuel among the fuselage tanks, CFT compartments, and external tanks will affect the aircraft cg position. For specific external stores configurations, fuel distribution may result in cg excursions beyond the accepted limits. Figures 6-1 and 6-2 illustrate the static cg travel for the F-15E configured with F100-**PW-220** engines and loaded with typical air-to-air and air-to-ground stores. The cg travel curves for the F100-**PW-229** configured aircraft will be different due to the weight difference of the engines and ballast requirements. As denoted in figures 6-1 and 6-2, the F100-**PW-229** engines increase the aircraft weight by 1,200 lbs and shift the cg aft approximately 0.8%.

The points designated by the numbers on the cg travel illustrations correspond to fuel states that can be observed in the cockpit. (The points are described in the notes on the illustrations.) The solid lines on the illustrations denote the predicted static cg travel based on typical tank selections (i.e., external fuel tanks first, then CFTs, and internal tanks last) with proper fuel sequencing from all of the tanks. The dashed lines on the illustrations denote a possible cg travel during maneuvering flight. The difference in the cg travel is the result of degraded performance of the CFT aft compartment transfer system. There are three contributors to this degraded transfer performance: (1) forward/center compartment transfer into the aft compartment through the sump vent hole; (2) unavailability of aft compartment fuel at high AOA/fuel angles due to forward location of the aft compartment pump; (3) transfer of forward fuel into the center compartment by gravity transfer and ejector pump. The effect of this fuel transfer situation may occur at any indicated CFT quantity. The situation described above is aggravated by aggressive aircraft maneuvering particularly at high AOA combined with both normal and level acceleration. The resulting fuel angle will contribute to the problem by temporarily trapping fuel in the aft compartment of the CFT, which will then transfer out when the aircraft levels off. Since the fuel gauge shows only the total CFT fuel quantity, monitoring is impossible.

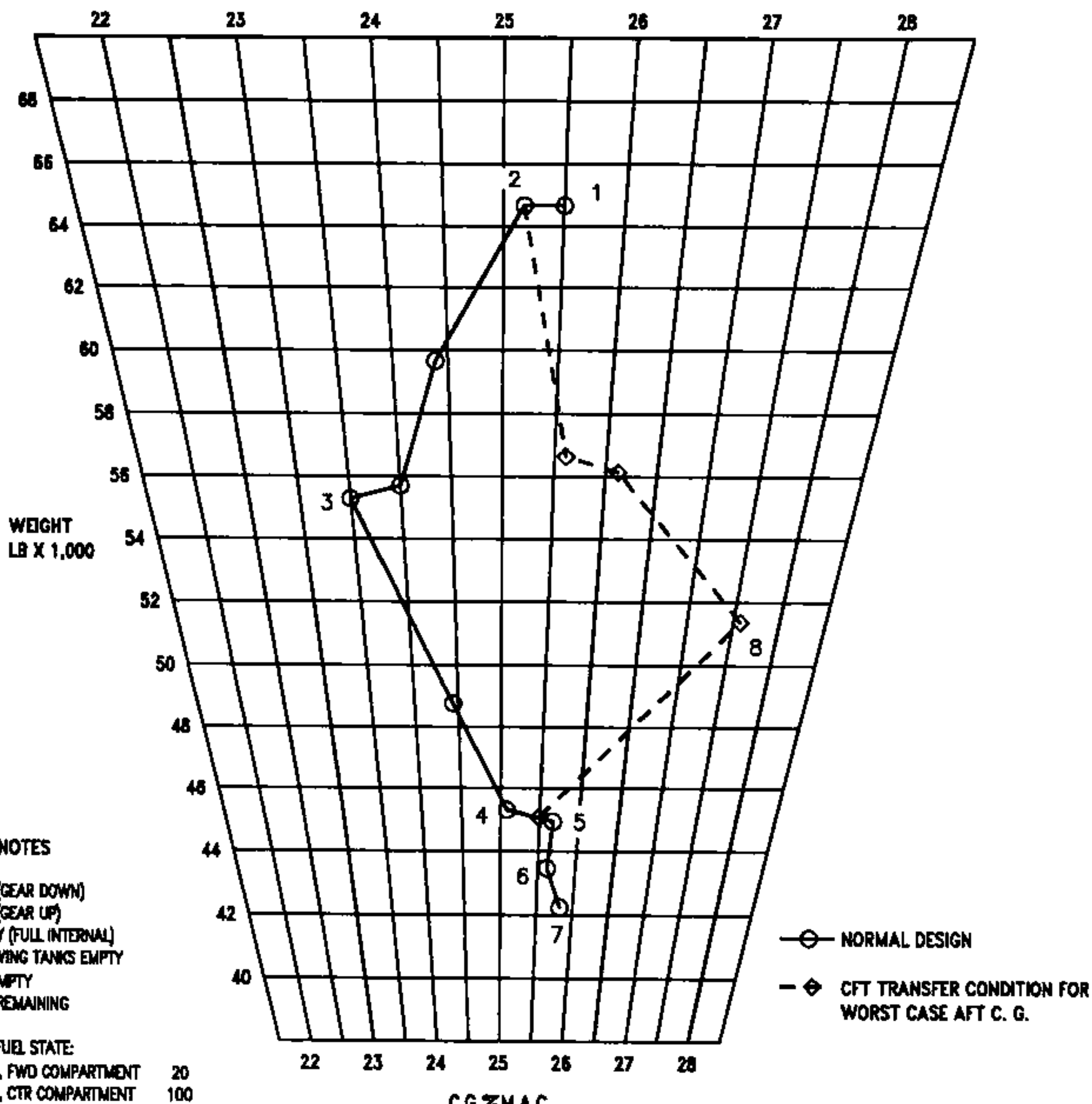
CG TRAVEL DUE TO FUEL CONSUMPTION

AIR-TO-AIR MISSION

F-15E WITH - 220 ENGINES, (JP-4) + CFT + LANTIRN PODS + (4) AIM-7 + (4) AIM-9

NOTE:

-229 ENGINES INCREASE WEIGHT APPROXIMATELY 1,200 LBS AND SHIFT CG AFT APPROXIMATELY 0.8%



NOTES

1. FULL FUEL (GEAR DOWN)
2. FULL FUEL (GEAR UP)
3. CFTS EMPTY (FULL INTERNAL)
4. INTERNAL WING TANKS EMPTY
5. TANK #1 EMPTY
6. 1,100 LBS REMAINING
7. EMPTY
8. MOST AFT FUEL STATE:

CFTS, FWD COMPARTMENT	20
CFTS, CTR COMPARTMENT	100
CFTS, AFT COMPARTMENT	1,266
TANK #1	1,814
WING TANKS	2,937
ALL OTHER TANKS	2,906
FUEL TOTAL	9,043

15E-1-(369-1)44-CATI

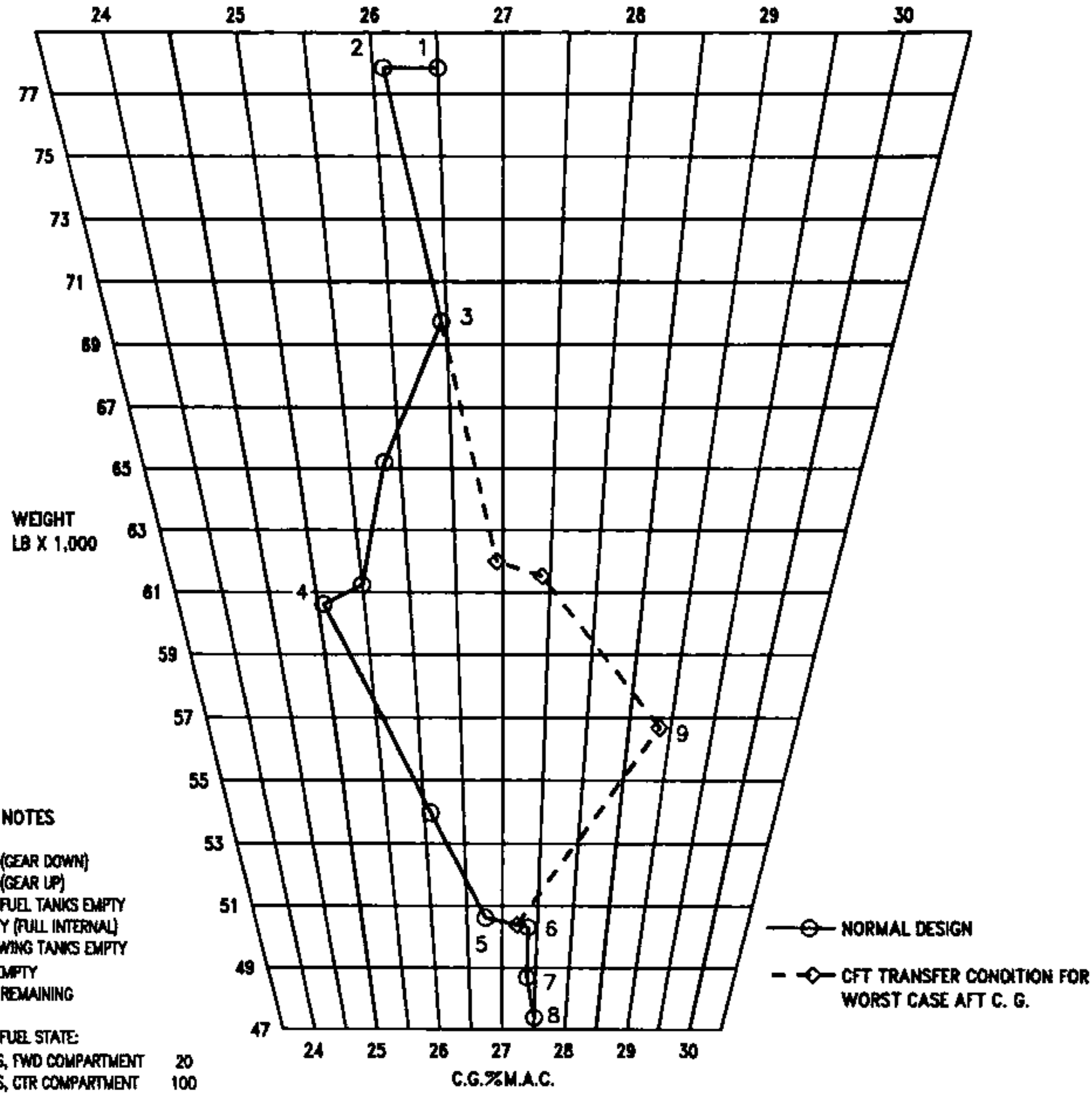
Figure 6-1

CG TRAVEL DUE TO FUEL CONSUMPTION

AIR-TO-GROUND MISSION

F-15E WITH - 220 ENGINES, (JP-4) + CFT + LANTIRN PODS
+ (2) EXTERNAL TANKS + (12) MK-82 + (4) AIM-9

NOTE:
-229 ENGINES INCREASE WEIGHT APPROXIMATELY
1,200 LBS AND SHIFT CG AFT APPROXIMATELY 0.8%



NOTES

1. FULL FUEL (GEAR DOWN)
2. FULL FUEL (GEAR UP)
3. EXTERNAL FUEL TANKS EMPTY
4. CFTS EMPTY (FULL INTERNAL)
5. INTERNAL WING TANKS EMPTY
6. TANK #1 EMPTY
7. 1,100 LBS REMAINING
8. EMPTY
9. MOST AFT FUEL STATE:

CFTS, FWD COMPARTMENT	20
CFTS, CTR COMPARTMENT	100
CFTS, AFT COMPARTMENT	1,266
TANK #1	1,814
WING TANKS	2,937
ALL OTHER TANKS	2,906
FUEL TOTAL	9,043

15E-1-(370-1)44-CATI

Figure 6-2

Any CFT fuel sequencing problem that results in more fuel in the center and aft compartments than planned, or any fuel left in the CFTs that accumulates in the aft compartments, moves the cg aft. The amount of cg travel depends on the amount of fuel. With A/G store loads and CFT fuel sequencing problems, the aircraft may be near the aft limit until the CFTs are emptied. If fuel remains in the CFT while internal fuel is used, reduce pitch attitude until CFT fuel is transferred. Transfer normally requires only 1-2 minutes.

There are several modes of operation of the fuel system from which an aft cg shift is likely to result. The first is the selection of wing/center externals without actually carrying external tanks. In this situation the fuel will transfer from tank 1 until 3,300 lbs of fuel remains, at which point the CFTs will begin to transfer. The second is the failure to select CFTs after transfer of external tank(s) is completed. This results in the same condition as in the first case. The third is the selection of CFT STOP TRANS with less than full CFTs, which will result in the remaining CFT fuel redistributing incorrectly among the compartments due to gravity flow.

WARNING

An aft cg is likely when the following operations occur: (1) Selection of wing/center externals without carrying external tanks, (2) failure to select CFTs after transfer of externals, and (3) selection of CFT STOP TRANS with fuel remaining in the CFTs.

Aft cg's may cause small oscillations in non-maneuvering flight. These pitch oscillations may reach $\pm 1/2°$. The aft cg may also cause increased pitch sensitivity during precision tasks such as air refueling and fingertip formation. If PIO's are encountered, reduce airspeed below 400KCAS. If the pitch CAS fails when configured with A/G stores and wing tanks, the airplane may be uncontrollable above 450 KCAS. Landings with an aft cg require lighter than normal force to flare and aerobrake. Large stick forces or motions may cause ballooning or tail strikes.

If the situation requires high speed with the maximum allowable CFT store loading and wing tanks, the AV BIT light may indicate a CAS failure. If this light comes on, check the BIT PAGE to see if there is a Pitch CAS problem. If so, slow to 450 KCAS or less.

Fuel sloshing will aggravate aft cg instability problems. If the Pitch CAS fails with these critical loadings, avoid sustained climbs steeper than 8 degrees or steady state flight at more than 16 units AOA. Jettison of wing stores may be required.

In addition to CFT transfer sequence problems, other fuel system failures can result in movement of the cg either forward or aft. A tank 1 pump failure can lead to a forward cg. Although this doesn't increase pitch sensitivity, it can lead to departures because the aircraft can settle in the departure susceptibility region during high AOA maneuvering. This is why tank 1 should be monitored for a failure prior to engaging in high AOA maneuvers.

FLIGHT AT HEAVY GROSS WEIGHTS

Although there is less pitch damping at heavy gross weights, the handling qualities of the aircraft are not significantly degraded. Due to the control augmentation system, a heavy gross weight aircraft will be as responsive as a light weight aircraft. With this responsiveness, the pilot can put the aircraft in a high AOA high sink rate condition with little warning.

This weight masking effect is of particular concern during traffic patterns and landing. For this reason, a wide pattern or straight-in approach is recommended. Fly final approach at on-speed AOA, but delay reducing power until well into the flare to prevent an excessive sink rate. Expect the nose to drop at significantly higher airspeeds during aerobraking.

Although the control system will often mask weight effects the aircraft response to control inputs may be initially slowed by high inertias with partially-full to full CFTs. Longitudinally, the higher inertias will always be partially offset by the increased pitch response caused by the aerodynamic effects of the CFTs. Aircraft flying qualities during aerial refueling and formation flying are good, although higher power settings will be required for these maneuvers than with an aircraft without CFT's. The closed loop stability of the terrain following system is such that aircraft ride quality may be degraded when terrain following at heavy gross weights.

FLIGHT WITH ASYMMETRIC LOADS

During takeoff roll, an aircraft with a heavy wing will tend to turn toward the heavy side. Some opposite rudder will be required to counter the inertia of the heavy wing. On rotation, the airplane will tend to roll into the heavy wing requiring some opposite lateral stick. Avoid abrupt pitch changes as the aircraft is rotated for takeoff.

Required control inputs with asymmetric loads change significantly with AOA. At low AOAs and high speeds, some lateral stick away from the heavy wing is required. Some rudder away from the heavy side may also be required. However, as AOA is increased to beyond 30 units, the airplane will tend to yaw and roll away from the heavy wing. The resulting sideslip angle will require lateral stick towards the heavy wing to stop the roll. Rudder pedal towards the heavy wing may also be needed to stop the yaw rate. The tendency for the airplane to yaw away from the heavy wing will eventually overpower the control surfaces at high AOA. Motions in yaw are difficult to detect and may be more readily identified by an uncommanded rolling motion. The end result will be the airplane will depart in yaw and roll and eventually spin away from the heavy side if AOA is not reduced.

Yawing moment due to asymmetric drag also has some effect but is usually much smaller than the effects due to weight asymmetry. The presence of a centerline tank, because of its destabilizing effect on lateral-directional stability, will further aggravate the departure tendencies at high AOA. High AOAs, high subsonic Mach, and higher altitudes tend to amplify the characteristics created by the asymmetry.

Lateral asymmetries as great as one full external wing tank may be safely flown to 30 units AOA. Above 30 units, little capability remains to control yaw and roll due to the asymmetry. If the critical AOA for any given asymmetric loading is exceeded, the airplane will yaw and roll in the direction opposite the heavy wing. At higher AOA, this motion can be quite rapid.

In addition to increased departure susceptibility, lateral asymmetry also degrades recovery characteristics. As the asymmetry increases, the recovery is delayed. Control can be regained by reducing AOA and increasing speed.

Landing may be made with asymmetric loading if turns are shallow and a flat approach is flown. Fly final approach at on-speed AOA, but delay reducing power until well into the flare. Avoid a large or abrupt flare. With a large asymmetric load, avoid crosswinds from the light wing side in excess of 15 knots. When in doubt, perform a controllability check before landing.

Lateral asymmetries have a pronounced effect on roll performance during negative g flight. Loss of roll control authority during negative g flight is possible with large lateral asymmetries (greater than 10,000 ft-lbs). This can occur during negative g flight with as little as -0.8g's.

LOW-ALTITUDE HIGH-SPEED FLIGHT

The aircraft is susceptible to wind gusts during low altitude high-speed flight due to low wing loading/ high wing lift characteristics. In areas of very heavy turbulence, such as found in mountainous desert terrain, flight above about 0.8 Mach may induce abrupt vertical motions. Minor lateral/directional motion will occur. None of these disturbances significantly alter the flight path. Flight with external stores increases the wing loading and reduces the effects of gusts.

SLOW SPEED FLIGHT

The aircraft exhibits no unusual slow speed flight characteristics. With symmetrical loads, the handling qualities remain acceptable until there is insufficient airflow over the wings and control surfaces to provide adequate lift or control. In many cases, at very slow speed, full aft stick and/or a pegged vertical velocity indicator may be the only sign(s) of a low energy 1 g stalled condition.

With asymmetrical loads, maintain a minimum of 300 KCAS except during low-speed tactical maneuvers, maximum range descents, holding, or instrument approaches and landings. This minimum airspeed provides reasonable handling qualities and adequate maneuvering margins for terrain and collision avoidance.

NEGATIVE G FLIGHT CHARACTERISTICS

Aircraft response to roll and yaw control inputs at negative load factors can be extremely disorienting. Abrupt rudder or cross controls can result in pilot induced out-of-control situations.

During negative g maneuvers, pitch sensitivity increases. Large aileron inputs cause the aircraft to roll out from under you with the disorienting and uncomfortable effect of being lifted out of the seat and thrown about the cockpit.

Rudder response at various angles of attack under negative g conditions can cause adverse effects. At positive g, left rudder input produces left roll. However, as positive g is reduced, rudder input produces more and more yaw induced sideslip and has less effect on generating roll. As AOA becomes negative (between 0 and -0.5 g) rudder inputs will result in extreme sideslip angles causing the aircraft to fly sideways, resulting in high cockpit lateral g's.

At load factors beyond about -0.5 g, rudder input will cause a roll in the opposite direction and will be accompanied by high pitch rate and pitch angle changes. This condition is extremely disorienting due to the combined effect of negative and lateral g and severe pitch and roll oscillations. Avoid abrupt manual rudder inputs at negative load factors. If this situation is encountered, neutralizing or releasing the controls will recover the aircraft.

The combined effect of aileron and manual rudder input at negative g can be even more dynamic. With forward stick, ailerons easily overcome any opposite direction rolling movement. If cross controls are applied, inertial coupling can produce extremely rapid and disorienting oscillatory rolls (in the direction of aileron input) in excess of 200 deg/sec. Cross control rolls should be avoided. If this situation is encountered, neutralizing or releasing the controls will recover the aircraft.

TERRAIN FOLLOWING AND AUTOPILOT FLIGHT CHARACTERISTICS

Except under certain conditions, Terrain Following (Manual or Auto), and Autopilot provide stable flight characteristics throughout most of the flight envelope.

When carrying LANTIRN pods in turbulence, the aircraft exhibits a side-to-side oscillation. If the ride quality is objectionable, the oscillation can be reduced by slowing down.

At gross weight above 68,000 pounds, a longitudinal oscillation is possible when aggressively following the manual Terrain Following (TF) pitch steering cue over rough terrain.

External store configurations with three external tanks or with an aft cg degrade TF ride quality. This degradation is more noticeable when combined with speeds below 400 KCAS. In ATF, the velocity vector will consistently overshoot the pitch command bar resulting in a jerky ride even over relatively smooth terrain. At speeds below 400 KCAS, these oscillations may reach ±0.7g with a period of 3 seconds. This oscillation does not cause significant flight path or set clearance plane deviation, but it may cause aircrew discomfort. Even if this occurs, there is no degradation of the ATF system. The best way to reduce the oscillation is to increase airspeed. There is no sustained oscillation in manual TF. However, the increased pitch sensitivity with an aft cg makes it easy to over-control the aircraft when aggressively following the pitch command box. The stick will feel very light during manual TF around 370 KCAS. This increases the chance of developing a PIO. Manual TF at all speeds is prone to PIO.

External store configurations with external wing tanks or with an aft cg also degrade autopilot flight characteristics. In these configurations, ATTITUDE HOLD and BARO ALTITUDE HOLD autopilot will tend to porpoise in pitch at all altitudes. The magnitude of the porpoising increases at higher altitudes.

Fly-ups at low speeds and heavy gross weights will rapidly cause high AOA and very slow speed. The pilot must ensure a proper power setting for all fly-ups and must actively limit the AOA. In this situation, the pilot will notice a pronounced dig-in at the start of the fly-up resulting in a large pitch rate with relatively little change in flight path angle.

Fly-ups caused by a Pitch CAS failure at high speed with an aft cg may over g the aircraft unless the pilot takes immediate corrective action. An unusually rapid g onset rate is the best cue to the pilot than an over g is imminent.

With Pitch CAS failure, the TF system will command a fly-up but will be unable to command a roll or maintain wings level because of the simultaneous loss of Roll CAS. If the airplane has an asymmetric load in this situation, the airplane will tend to roll in the direction of the heavy wing.

WARNING

- If a pitch CAS failure occurs while terrain following with large asymmetric loadings, the aircraft will rapidly roll towards the heavy wing with minimum climbing. If the fly-up occurs starting from a turn in the direction of the heavy wing, the airplane will quickly roll beyond a 90 degree bank. The pilot must take control of the aircraft for a successful fly-up.
- ATF flight above 19,000 ft-lbs asymmetry should be avoided due to the lack of autopilot roll attitude hold control authority available to maintain wings level flight.

Pitch commands in TF Weather Mode will be more abrupt over rough terrain because the TF radar commands pitch inputs based on terrain within 15,000 feet of the aircraft instead of the normal 36,000 feet. Workload in Manual TF while flying in the weather, especially in turbulence or over rough terrain, may be so high as to make it impossible for the pilot to perform any other tasks besides following the pitch command box. In all situations, ATF provides a lower workload than Manual TF.

STALLS

1 G STALLS

Light buffet begins at approximately 15 units AOA, increases in intensity to 23 units, then remains fairly constant. External stores decrease buffet onset AOA and increase the buffet level. Required aft stick force increases with increasing AOA (CAS ON or OFF). Some wing rock and yaw oscillations occur above 30 units AOA. This is accentuated in the centerline tank configurations. With full aft stick, AOA stabilizes at 38 units or above with airspeed 100 knots or less. (This varies with cg position, with aft cg giving higher AOA).

As AOA increases above 30 units, lateral stick becomes less effective in generating roll. Approaching the stall, the rudder is more effective than lateral stick for roll control. At stall (full aft stick) neither lateral stick nor rudder are very effective. The vertical velocity indicator will probably be pegged in a descent. Recovery from a stall is immediate when the stick is moved forward. With CFTs, less nose down pitch response will result in a delayed stall recovery. If lateral stick inputs are not removed before the stick is moved forward to recover from a stall, a departure could be induced. Stick motion with any sideslip present will induce a roll.

ACCELERATED STALLS

Accelerated stall characteristics are heavy buffet with moderate yaw and roll oscillations averaging less than 10 degrees of sideslip and 20 degrees of bank. All buffet and yaw/roll activity diminishes rapidly as airspeed bleeds off. With external stores buffet onset is earlier and buffet level is greater. Airspeed bleed-off tends to be more rapid.

NEGATIVE AOA STALLS

In a level flight negative g stall, AOA is below zero units. The last few inches of forward stick travel does not change AOA, and moving the stick back from the forward stop does not produce any response during the first few inches of stick motion. Positive aft stick force may be required to eliminate negative g and recover to normal flight. Negligible roll-yaw activity with no buffet occurs at a negative g stall. External stores have little effect.

LANDING CONFIGURATION STALLS

With gear and flaps down, stall characteristics are much the same as in the 1 g stall; however, buffet begins at about 23 units AOA. External stores decrease buffet onset AOA and increase buffet level. The roll and yaw motions, buffet, and indicated airspeed are similar to the 1 g stall. Any lateral control input above 35 units AOA can produce excessive adverse yaw (apparent flight control reversal due to full aileron authority being available), and a spin may rapidly develop.

OUT-OF-CONTROL FLIGHT CHARACTERISTICS

The F-15E has not been formally flight tested for departure and spin susceptibility. However, a limited high AOA test program was conducted to assess the impact of CFTs on flying qualities. During this testing, departure characteristics in the form of roll hesitation, roll reversal and uncommanded rolls were experienced. The spin characteristics of the F-15E are estimated based on F-15A and F-15C flight test data and wind tunnel analysis. It is assumed that an F-15E without CFTs will respond like an F-15A/C. The impact of the CFTs and the dual canopy on spin susceptibility has not been determined.

A departure from controlled flight is characterized by an uncommanded flight path change such as a nose slice, roll away from a lateral input, or excessive yaw rate. An out-of-control condition exists when the aircraft is not responding properly to pilot inputs.

Although departures occur in the yaw axis, motion in that axis is difficult to detect. The departure may be more readily identified by an uncommanded rolling motion. Loss of directional stability and subsequent rolling departures may be encountered when attempting high sideslip maneuvers, especially with cross-control, even with the CAS ON.

A roll away from lateral input, nose slice, or excessive yaw rate (and the accompanying departure warning tone) are usually the first indications of a departure.

WARNING

The departure warning tone should not be used as an indication of maximum performance. Continued maneuvering with the departure tone may lead to a departure spin.

At the first indication of departure, smoothly neutralizing the controls will normally quickly recover the aircraft to controlled flight. With any loading, introducing or holding lateral stick at or near longitudinal center can lead to an autoroll or a spin. With lateral asymmetries, a spin can result if the aircraft is not recovered properly.

Engine stagnation requiring shutdown and restart is possible in an out-of-control maneuver. Dual engine stagnation has occurred during extremely violent, forced departures. Engine stagnation has also occurred at very slow airspeed and high AOA. At these conditions, engine stagnation progressed to AB blowout and engine stall. At throttle settings of MIL or less, no engine anomaly has occurred during stall, vertical stall, or tail slide.

Report all departures, spins, and autorolls on AFTO Form 781. Include aircraft configuration, flight parameters, wing/CFT fuel, and any other significant information.

CAUSES OF DEPARTURES

There are several reasons for loss of directional control in an F-15E. These factors are : lateral asymmetry, reduced directional stability, aileron schedule, inappropriate lateral control inputs, cross control and asymmetric thrust. Combinations of these factors will increase the likelihood of departure.

Lateral Asymmetry

Lateral weight asymmetry is measured by summing the moments about the aircraft centerline. Each moment is a product of the distance from the centerline in feet and the weight of the differential fuel or store in pounds. Figure 6-3 provides lateral distance (moment arm) to weapon and fuel stations and Figure A1-1 (**PW-220** engines) or figure B1-1 (**PW-229** engines) provides specific store and missile weights. The lateral weight asymmetry for any loading can be computed from these charts. For example, the contribution of an AIM-9L missile on Station 2A is 2,126 ft-lbs (10.9 feet x 195 pounds), while 600 pounds internal wing fuel imbalance contributes 4,500 ft-lbs (7.5 feet x 600 pounds). The aircraft without CFT's is 1,850 ft-lbs right side heavy, primarily due to the 20 MM gun and its support equipment. Therefore, if an asymmetric store loading is carried, the aircraft weight asymmetry can be minimized if a majority of the store weight is on the left. For example, if there are two AIM-7's on the left side of the aircraft, with no other missiles loaded, an installed gun and the aircraft has a 200 pound left side heavy internal wing fuel imbalance, the aircraft is 4495 foot-pounds left side heavy. Because of the gun, the same 2 AIM-7's loaded on the right side with a right side heavy internal wing fuel imbalance results in 8195 foot-pounds right side heavy, an area where the aircraft is extremely susceptible to departure. Therefore, asymmetric missile loadings combined with even small fuel imbalances can further aggravate the problem. This is especially true for right side loadings.

Departure susceptibility (Figure 6-4) is most affected by lateral cg position (internal wing fuel and/or stores, tanks, or missiles imbalance). The aircraft is very departure resistant below 5,000 ft-lbs of asymmetry. It is spin resistant below 7,000 ft-lbs with a centerline tank installed and below 10,000 ft-lbs without a centerline tank. Spin recovery has been demonstrated up to 10,000 ft-lbs of asymmetry.

As AOA is increased above 30 units, more rudder toward the heavy wing is required to counter yaw away from the heavy wing. Whether the rudders are deflected by the pedals or the ARI, both rudder pedal and lateral stick are required toward the heavy wing as dihedral effect at high AOA causes the heavy wing to rise. If AOA continues to increase above 37 CPUs, the rudders will no longer be able to counter the yawing moment and the aircraft will depart away from the heavy wing.

LATERAL ASYMMETRY CONTRIBUTIONS

Weapon/Store	Store Station	Weight (Pounds)	Moment Arm (Feet)	Lateral Asymmetry (Foot-Pounds)
Gun plus associated hardware (with/without ammunition)		509	3.5	1782
Wing Pylon (SUU-59C/A)	2 or 8	371	9.6	3560
Outboard Launchers LAU-114 (With Adapter) LAU-128 (With Adapter)	 2A or 8B 2A or 8B	 52 (79) 82 (106)	 10.4 10.4	 541 (822) 853 (1102)
Inboard Launchers LAU-114 (With Adapter) LAU-128 (With Adapter)	 2B or 8A 2B or 8A	 52 (79) 82 (106)	 8.8 8.8	 458 (695) 722 (933)
AIM-120/A	2A or 8B 2B or 8A 3 or 7 4 or 6	338	10.9 8.3 4.9 4.6	3684 2805 1656 1555
AIM-7F/M	3 or 7 4 or 6 CFT Stations	510	4.9 4.6 6.3	2500 2346 3213
AIM-9L/M/P	2B or 8A 2A or 8B	195	8.3 10.9	1619 2126
ACMI Pod	2B or 8A 2A or 8B	160	8.3 10.9	1328 1744
LANTIRN Navigation Pod		520	3.9	2030
LANTIRN Targeting Pod		621	3.9	2420
Internal Wing Fuel			7.5	7.5 x Fuel Imbalance
External Wing Fuel			9.6	9.6 x Fuel Imbalance
CFT Fuel			5.6	5.6 x Fuel Imbalance
NOTE Basic aircraft asymmetry is 50 foot pounds right side heavy without the gun.				

Figure 6-3

HIGH ANGLE OF ATTACK DEPARTURE/SPIN SUSCEPTIBILITY SUMMARY (Above 30 units AOA)

Lateral Asymmetry (Foot-Pounds)	Departure (All Loadings)	Spin	
		Without centerline tank	With centerline tank only
0 to 5,000	Resistant	Extremely resistant	Resistant
5,001 to 6,999	Susceptible	Resistant	Resistant
7,000 to 10,000	Extremely Susceptible	Resistant	Susceptible

DEFINITIONS	
Extremely susceptible to departure	Departure from controlled flight will generally occur with the normal application of pitch control alone or with small roll and yaw control inputs. This can occur almost instantly.
Susceptible to departure	Departure from controlled flight will generally occur with the application or brief (about 1 second) misapplication of pitch, roll or yaw controls that may be anticipated in operational use.
Resistant to departure	Departure from controlled flight will only occur with a large and reasonably sustained (more than 3 seconds) misapplication of pitch, roll or yaw controls.
Extremely resistant to departure	Departure from controlled flight can only occur after an abrupt and inordinately sustained (over 15 seconds) application of gross, abnormal, pro-departure controls.

Notes :
- This table applies to altitudes above approximately 20,000 feet.
- Departure resistance is increased considerably at lower altitudes.
- The aircraft can become directionally unstable at high AOA (approximately 40-44 units) with sideslip (yaw angle) present.

Figure 6-4

Lateral weight asymmetries greater than 5,000 ft-lbs tend to provide enough sideslip to make departure inevitable, and the departure will be without warning. With external stores, tanks, and/or pods loaded, the yaw and roll acceleration may become uncontrollable at a lower AOA. The aircraft is considered susceptible to departure with lateral asymmetries above 5,000 ft-lbs and extremely susceptible with greater than 7,000 ft-lbs.

Abrupt entries into high AOA regions will result in a departure and loss of control without warning. If full aft stick is maintained during or after a 1 g stall or abrupt pullup, the aircraft will depart (with the departure warning tones as the first warning) with a very pronounced roll away from the heavy wing with a descending spiral being likely. During a slow entry approach to a stall with asymmetric loads, the ever increasing amount of lateral stick or rudder to control heading and bank angles should serve as ample warning that loss of control is imminent. Control must be smoothly neutralized immediately following the departure to effect recovery. The most significant effect on recovery capability is the amount of time between departure and neutralized controls. Longitudinally centered lateral stick against the roll will result in a spin. If not promptly recovered from a departure, an aircraft with large lateral asymmetries will quickly enter a spin.

Departures with asymmetric loads will take longer to recover due to the higher yaw rates involved. With 7,000 to 10,000 ft-lbs of asymmetry, recovery may be significantly delayed, with several peaks in AOA and yaw rate, and 1-1/2 to 2 rolls during the departure.

Reduced Directional Stability

The aircraft exhibits reduced directionally stability in the 37-44 units AOA region. The true area is 40-44 units AOA but because of mechanical lag in the AOA gauge, the airplane may already be in this region even though the gauge is reading as low as 37 units AOA. For that reason, the aircraft should be assumed to be in the area of directional instability when the AOA gauge is between 37 and 44 units AOA. With flight in this region, sideslip generated from lateral-directional inputs or Dutch Roll oscillations can immediately lead to a departure.

The aircraft has a larger AOA region of directional instability when external stores are carried. When equipped with the centerline tank, the aircraft has reduced lateral-directional stability and increased departure susceptibility over that of the aircraft without CFT's.

The combination of CFTs, LANTIRN pods, and centerline tank results in greatly reduced lateral-directional stability and greatly increased departure susceptibility. When equipped with these items, the departure regime is much larger. Care must be taken to avoid abrupt lateral stick inputs and to neutralize controls if roll reversal occurs.

WARNING

With centerline tank loadings, departures have occurred with rapid lateral inputs below 30 units AOA.

External stores (except missiles) and external wing tanks reduce aircraft resistance to departure. Store inertia reduces roll response so that more time is required to attain or stop a given roll rate, particularly at high AOA. Less aft stick will be required to obtain high angles of attack. This makes departures more likely due to the increased chance of being at high angles of attack while being near longitudinal center and applying large or abrupt lateral stick inputs. These stores have a 30 unit AOA limit. If rapid stick inputs are used, departures may occur below 30 units AOA. Once a departure has occurred, store(s) loadings with bombs or external tanks will require significantly more altitude to attain flying speed during recovery from post stall gyrations than is required with only A/A missiles installed or without CFT's installed. Jettison of stores is not recommended due to the possibility of store-to-aircraft collisions. The likelihood of departure is decreased by neutralizing controls if the aircraft rolls away from a lateral input.

If the speed brake fails to auto-retract, an extended speedbrake above 32 units AOA significantly decreases lateral stability and may result in a departure and subsequent spin; and if left extended during recovery, may result in additional departures when excessive AOA is attained.

Aileron Schedule

Aileron deflection is mechanically scheduled based on lateral stick input and on average stabilator position through the Pitch Roll Channel Assembly. Basically, near longitudinal center, full lateral stick inputs result in full aileron deflection. However; with aft stick, full lateral stick inputs will not result in full aileron deflection. In this way, the flight control system tries to reduce the amount of aileron deflection available at high AOA. With gear down or in the spin recovery mode, full aileron will be available at any stick position. Since AOA lags stick input, it is possible to be at a high AOA with the stick near longitudinal center.

WARNING

Lateral stick inputs applied near longitudinal center while at high AOA may result in a departure.

Heavyweight operations are more susceptible to departure than lightweight operations. The increased departure susceptibility is largely due to the destabilizing influence of external stores and tanks that are loaded for heavyweight operations. However, heavier weight aircraft have higher trim AOA than lighter weight aircraft. This makes departure more likely due to the increased chance of being at high AOA when near longitudinal center while applying large or abrupt lateral stick inputs. Heavier weight aircraft will require more altitude to recover in the event of a departure.

CFT equipped aircraft are able to generate more AOA at any given stick position than the aircraft without CFT's. This results in less aft stick required to reach AOA regions of departure susceptibility. Because of this, it is easier to unintentionally achieve full aileron deflection from lateral stick inputs at high AOA which may result in departures or spins. Wait until AOA is reduced to initiate large lateral inputs. AOA reduction will take longer in the CFT equipped aircraft.

Lateral - Directional Control Inputs

The region of departure susceptibility increases with the addition of external stores, tanks, and/or pods. Also, any rolling motion will be accompanied by a larger amount of sideslip buildup with loadings that include pods, tanks, and/or stores. In these cases, abrupt lateral stick or rudder inputs can initiate a departure due to the excessive sideslip buildup. To avoid departures, avoid rapid lateral-directional control inputs. Lateral input against the yaw in high sideslip rolling maneuvers will result in a spin if the input is prolonged (due to the adverse yaw created by aileron inputs). With centerline tank loadings, departures may occur with rapid lateral control inputs below 30 units AOA.

Cross Control

In level flight, loss of directional stability and subsequent rolling or slicing departures may be encountered when attempting high sideslip maneuvers with extensive cross control inputs (lateral stick opposite rudder) even with the CAS ON. These departures may be preceded by an apparent increase in sideslip with a constant rudder pedal input. The likelihood of a departure from cross control inputs increases with increasing sideslip. Such departures are more likely to be encountered with external fuel tanks or LANTIRN pods installed.

Due to the ARI schedule, cross control inputs may result from rapid fore-aft longitudinal movement with constant lateral input. As the point of directional instability is reached during high AOA maneuvering with cross control inputs applied, the AOA and yaw rates will increase rapidly and uncontrollably. Aggressive forward stick inputs to control AOA while holding opposite aileron will aggravate the departure. Controls should be smoothly neutralized at the first indication of a departure. Prior to recovery, avoid side-to-side lateral stick inputs.

Asymmetric Thrust

Asymmetric thrust departures are characterized by rapid uncommanded sideslip. At high dynamic pressures, this sideslip can result in exceeding aircraft structural design limits, aircraft structural damage, and loss of the aircraft.

Large asymmetric thrust resulting from a single engine SEC transfer or single engine AB inhibit can result in a departure because of excessive sideslip buildup. The F100-**PW-220** engines do not generate enough thrust to induce an asymmetric thrust departure within the level flight envelope. The F100-**PW-229** engines generate enough thrust such that a single engine failure (SEC transfer or AB inhibit) increases departure susceptibility over the F100-**PW-220** engines.

All F100-**PW-229** equipped aircraft have the Automatic Thrust Departure Prevention System (ATDPS). If the ATDPS fails to operate correctly when entering the ATDPS enable region, asymmetric thrust may result in permanent structural damage or aircraft loss (see Section III). The ATDPS does not provide protection for loadings with three external tanks without CFTs.

WARNING

- An asymmetric thrust condition on aircraft configured without CFTs and with three external tanks, while operating above 630 KCAS and greater than Mach 1.3, may result in structural damage or loss of aircraft.
- With an ATDPS failure, asymmetric thrust may result in structural damage or aircraft loss.

The ATDPS does not protect against pilot commanded throttle movements that could result in thrust asymmetries. Therefore, do not perform asymmetric throttle movements in afterburner when operating above 500 KCAS while greater than Mach 1.1. When selecting afterburner at these flight conditions, make sure both nozzles open before proceeding to higher throttle settings.

OUT OF CONTROL FLIGHT MODES

Highly Oscillatory Erect Spin

The highly oscillatory erect spin mode will exhibit average AOA in excess of cockpit gauge range (70-80 units), with average yaw rates of 60 deg to 90 deg/sec. Oscillations of +20 deg/sec yaw rate are typical. Neutralizing the controls during a highly oscillatory spin usually results in a recovery in as little as 1 to 1-1/2 turns but may take as much as 3-1/2 turns.

Recovery usually take an altitude loss of approximately 2,500 to 4,000 feet but may take as much as 7,000 feet. The highly oscillatory spin could progress to a flat spin.

Applying aileron (lateral stick) in the direction of the spin (i.e., anti-spin) will recover the aircraft almost immediately and prevent a flat spin entry in all cases. Application of aileron (lateral stick) opposite the spin (i.e., pro-spin) will accelerate the yaw, and a flat spin can develop rapidly.

Flat Erect Spin

The flat spin mode will exhibit average angles of attack in excess of the cockpit gauge range (70-90 units) with average yaw rates of 75 deg to 135 deg/sec. Periods of high (i.e. 3 to 4 g) 'eyeballs out' longitudinal g forces will be experienced. These spins are uncomfortable and disorienting due to high yaw rates and g forces. The flat spin is often very steady with no oscillations apparent to the pilot; however, in some cases, mild oscillations may be present. When a flat spin has developed, recovery is no longer possible with neutral controls. Nearly full aileron/differential stabilator deflections in the spin direction have little effect on spin recovery. Recovery will not be immediately apparent and will require approximately two to four turns, with at least 3,000 to 6,000 feet or altitude loss (approximately 10 to 20 seconds) to stop the rotation. Full aileron deflection, which is required for satisfactory recovery, is made available by the spin recovery mode of the flight control system. This mode allows the pilot to use full aileron deflection five seconds after the yaw rate exceeds 41.5 deg/sec, regardless of fore/aft stick position. Normal aileron control is restored when yaw rate is reduced to less than 30 deg/sec. Full aileron deflection is available with the stick at longitudinal neutral regardless of yaw rate due to aileron scheduling. Yaw rate reduction (i.e., recovery) is smooth and quite slow, and may not be apparent for sometime. With application of aileron (lateral stick) opposite the spin direction (i.e., pro-spin), the yaw rate will accelerate and 'eyeballs out' g force may reach 4 to 5 g's. With the aileron (lateral stick) again applied in the direction of the spin (anti-spin), yaw rate will decrease but will take longer to stop due to the prior misapplication of controls. In all cases, recovery may not be apparent for some time.

Low Rate Erect Spin

Slow speed entries will likely result in a low rate spin mode. The aircraft will be in excess of the cockpit gauge range, but the average value of 60 to 65 units will be lower than that of the other erect spin modes. Oscillations of + 12 units in AOA are typical. Average yaw rate will be between 45 deg and 60 deg/sec, usually with oscillation of +10 deg/sec. As a result, the departure tone beep rate may not be consistent during the spin (Figure 6-5). Delaying recovery controls or inadvertently applying pro-spin controls can cause the aircraft to progress into a high rate spin mode. Applying full lateral stick in the direction of the spin will normally recover the aircraft quickly. Occasionally, the amplitude of the spin oscillations will reduce and the low-rate spin will become very smooth. Should this occur, aircraft recovery will be slowed. If the aircraft is in the low rate spin mode, and is not recovering with full antispin controls (especially with yaw rate gyro failure), the landing gear may be lowered. This results in a control system change which insures full anti-spin aileron deflection is available with full lateral stick regardless of longitudinal stick position, even if the spin recovery mode has not been initiated. Flaps should not be extended during spins as they may increase the number of turns for recovery. Again, recovery from the spin may not be apparent for some time after appropriate recovery controls are applied.

Inverted Spin

The inverted spin can be caused by full lateral stick or full rudder deflection at the full forward stick position (i.e., inverted spin). The spin direction is in the direction of rudder deflection. The inverted spin is generally stabilized at -55 to -60 units AOA, with 40 deg to 45 deg/sec yaw rate. No buffet or roll/yaw oscillations exist. After neutralizing the controls, the aircraft will normally recover from the spin in approximately 1-1/2 turns with 4,000 feet altitude loss. The recovery may not be apparent for some time.

Positive G Autoroll

Typically autoroll entry conditions are: 200 to 300 KCAS, 20 to 30 units AOA, rolling with rudder alone, and then easing the stick forward. During a positive g autoroll, roll and yaw will be in the same direction. The turn needle will fluctuate from side to side and cannot be used to determine the direction. The roll direction should be obvious: however, if in doubt, use the ADI. The departure warning may or may not sound since the yaw rate will be slightly above or below 30 deg/sec, the point at which the tone begins (Figure 6-5). Neutralizing the controls and rudder application opposite the rolling motion will terminate

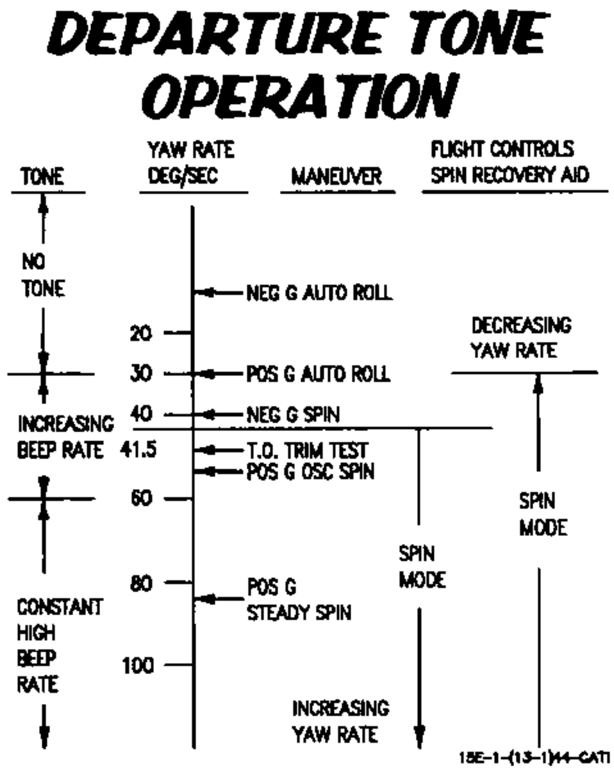


Figure 6-5

the maneuver. The more rudder is applied, the faster the recovery. When the roll stops, a negative g pitch-over will occur. The severity of the negative g pitch-over is a function of the rate of recovery and is worse if PITCH CAS is OFF. An abrupt application of rudder may cause negative g pitch-over as great as 4 negative g's. To minimize negative g pitch-over and aid in pilot orientation, slowly apply rudder to the deflection required to stop the roll. Aileron against the roll in an autoroll is a pro-spin input which can induce a spin.

Negative G Autoroll

During negative g autorolls, yaw and roll will be in opposite directions. Negative g autorolls are normally entered at negative g and sustained by maintaining forward stick. A negative g autoroll normally exhibits slow roll and yaw rates, and the departure warning tone will not sound. Neutralizing the controls is sufficient to terminate the maneuver. Neutral controls and rudder application with the rolling motion will speed the recovery. If the stick was sufficiently forward during entry, considerable aft stick may be required to reduce the negative g during both the maneuver and the recovery. Negative g autorolls can be extremely disorienting.

Uncommanded Roll

During stabilized flight at 32-35 units AOA, typically between 250 KCAS and 325 KCAS, the aircraft may make an uncommanded roll to the right. The roll rate is usually slow but may be as high as 60 deg/sec. Decreasing AOA or smoothly neutralizing controls at the first indication of uncommanded motion will recover the aircraft to controlled flight. This uncommanded roll occurs at a higher AOA and exhibits a lower roll rate than an autoroll, and can be entered without rudder input.

HANDLING QUALITIES WITH FLIGHT CONTROL SYSTEM MALFUNCTIONS

The design of the AFCS is such that adequate but degraded flying qualities are provided for most mission tasks when operating with the AFCS in a failure mode. These modes consist of CAS OFF for the electronic system (upon detection of two failures within the same axis) and PITCH and/or ROLL RATIO selected to EMERG for the mechanical system.

PITCH CAS OFF, PITCH RATIO AUTO

With PITCH CAS OFF and PITCH RATIO AUTO, the aircraft feels less solid in pitch (less pitch damping) making precise maneuvers more difficult. When configured with external stores there will be a noticeable increase in pitch sensitivity such that formation flight and air refueling may be difficult. The automatic trim will be less effective, causing larger trim transients during airspeed or configuration changes, or when rolling out of turns.

Stabilator authority is slightly less at all speeds, resulting in higher stick forces at high g and less available g's at full aft stick. At higher altitude, this reduction can be as much as 2 g's. Below 10,000 feet, the reduction in available g is negligible. During takeoffs and landings, the nose feels heavier and some mild pitch oscillations may occur. Because of the reduced stabilator effectiveness, the nose cannot be raised as early during takeoff roll or held up as long during landing. This is not the case with A/G store loadings at an aft cg. With A/G stores and aft cg, the stick feels light and the aircraft requires very little aft stick to flare or to hold the nose up during aerobraking. Use caution to avoid possible tail-strike due to over-rotation. Expect the nose to stay up significantly longer during aerobraking.

Supersonic, or above 600 knots, or transonic between 0.8 and 1.0 Mach, pitch control will be very sensitive and PIOs may occur, particularly at higher gross weight and with external fuel tanks. If the aircraft is stable and a PIO occurs, release the stick and reduce speed. Pitch oscillations that are caused by an aft cg location (i.e., an unstable aircraft) may also occur at these conditions. If the cause of the pitch oscillations is unknown, recover the aircraft using small, quick pulse-like stick inputs.

If a Pitch CAS failure occurs with an A/G store or ferry loading and the cg is near the aft limit, handling qualities will be significantly degraded, especially at speeds above 400 KCAS when below 10,000 feet MSL. If the situation requires high speed with the maximum allowable CFT store loading and wing tanks, an AV BIT light may indicate a CAS failure. If this light illuminates, check the BIT PAGE to see if there is a Pitch CAS problem. If so, slow to 450 KCAS or less.

WARNING

With first failure of pitch CAS the AV BIT light comes on. If a CAS problem exists and aircraft is configured with the maximum allowable CFT stores and wing tanks, slow to 450 KCAS or less.

With an A/G store or ferry loading the aircraft may be longitudinally unstable above 400 KCAS and below 10,000 feet MSL. Pitch oscillations with a period between 2 and 8 seconds may develop. To maintain control of a longitudinally unstable aircraft, the pilot must stay in the loop using small quick, pulse-like stick inputs to arrest the pitch motion. Smooth slow stick motions are not recommended due to the likelihood of aggravating the oscillations. Releasing the stick could result in divergent oscillations.

WARNING

If pitch CAS fails above 450 KCAS, the aircraft may become uncontrollable with maximum allowable load of some A/G stores on the CFTs, wing tanks, with fuel in the CFTs or low internal fuel states.

Controllability will be greatly improved if the aircraft is slowed (by throttle reduction only) to below 300 KCAS. Do not use the speedbrake to slow to 300 KCAS because it will cause an abrupt pitch down that may induce a more severe pitch oscillation. Once below 300 KCAS, extending the speedbrake will improve longitudinal stability.

WARNING

Extending the speedbrake above Mach 0.7 with a possible aft cg may result in an uncontrollable abrupt pitch down.

If the Pitch CAS fails with the above critical loadings, avoid sustained climbs steeper than 8 degrees or steady state flight at more than 16 units AOA. Jettison of wing stores may be required to maintain aircraft control.

Inflight refueling with A/G stores can be safely accomplished with a failed pitch CAS, although the workload is significantly higher than with PITCH CAS ON. Pitch sensitivity will be higher with external wing tanks and A/G stores loaded. Small, quick, pulse-like pitch control inputs are required to keep the aircraft in the desired refueling position. If workload is excessive, consider jettisoning the wing tanks or wing stores prior to refueling. The recommended condition for refueling is between 250 and 300 KCAS and between 20,000 and 30,000 feet. Below 250 KCAS or above 30,000 feet, fore and aft positioning workload is high because of the power required. Above 300 KCAS or below 20,000 feet, pitch workload is high because of increased pitch sensitivity.

PITCH CAS ON, PITCH RATIO EMERG

With PITCH CAS ON and PITCH RATIO EMERG, very little degradation in handling qualities will be noticed. Maximum stabilator deflection is reduced at low speed. The greatest danger in this condition is the severely degraded handling qualities if pitch CAS were to drop off.

PITCH CAS OFF, PITCH RATIO EMERG

With pitch CAS OFF and PITCH RATIO EMERG, longitudinal stick forces are very high at low speed, and pitch control is very sensitive at high subsonic speed. Automatic trim is not available. Available AOA and g are severely reduced at both supersonic and low speed.

With CFTs and/or wing stores (A/G or tanks), a large nose-up transient will occur as the automatic stabilator trim is driven to a fixed position as a result of a pitch CAS failure combined with PITCH RATIO EMERG. The recommended pilot actions are to use forward stick as soon as it is noticed and slow to below 250 KCAS. Delaying the forward stick input could result in difficulty maintaining aircraft control. The speed and severity of the transient will depend on the airspeed, configuration, gross weight, and center of gravity. The transient could, but may not, occur immediately. Depending on the conditions, the transient may not begin until 10-15 seconds after the PITCH CAS OFF and the PITCH RATIO EMERG.

WARNING

> Pitch CAS failure combined with PITCH RATIO EMERG results in a nose-up transient. With no pilot intervention at high subsonic speeds and low fuel states, the load factor during the transient could reach 9 g's when configured with A/G and wing stores.

During landing, stick forces are very high, pitch response is slow, and flare capability is greatly reduced. Control is adequate for landing, but avoid high sink rate at slow speed. An approach at 18 units AOA or less provides sufficient flare capability for landing. Maximum available AOA is approximately 21 units at touchdown.

YAW/ROLL CAS OFF, ROLL RATIO AUTO

With the YAW or ROLL CAS OFF and ROLL RATIO AUTO, artificial dampening of the Dutch Roll (coupled roll-yaw motion) is lost. Dutch Roll damping is greatly reduced, particularly at approach speed. Roll can produce uncommanded yaw, especially when rolling out of a turn. Initial roll acceleration is reduced, but the maximum roll rate can be greater than with CAS ON. Because of the reduced initial roll acceleration, the tendency to over control in roll at high speed is reduced. During landing, the airplane will tend to wallow and some rudder may be necessary for coordinated flight.

YAW/ROLL CAS ON, ROLL RATIO EMERG

With YAW and ROLL CAS ON and ROLL RATIO EMERG, roll response will be slightly degraded at most flight conditions. Since the ARI is inoperative, some adverse yaw will result when rolling at high AOA. Roll and yaw control during landing will be slightly degraded, particularly in the presence of a crosswind.

YAW /ROLL CAS OFF, ROLL RATIO EMERG

With YAW or ROLL CAS OFF and ROLL RATIO EMERG, roll rate is reduced at all speeds. Since there is no ARI, roll response is very sluggish and lateral stick forces are high, particularly at low speed. Approach and landing in crosswind, turbulence, or with an asymmetric load is difficult.

WARNING

> Loss of roll control authority has occurred above 18 units AOA with a large lateral asymmetry (2,000 lb. class weapon- AIM-9 and AIM-7 on the same side) and ROLL CAS OFF with ROLL RATIO EMERG. Avoid exceeding 18 units AOA under these conditions.

SECTION VII

ADVERSE WEATHER OPERATION

TABLE OF CONTENTS

This section provides for operation in adverse weather. Section II of this manual provides normal instrument flight procedures. These procedures differ from, or are in addition to, those contained in section II.

TURBULENCE AND THUNDERSTORMS

Avoid areas of icing, turbulence, hail, or thunderstorms, when possible, due to the increased danger of engine stagnation. If these areas cannot be avoided, turn on the engine anti-icing system before weather penetration. Monitor FTIT gages continuously during weather penetration. Increasing FTIT is an indication of engine icing. The INLET ICE caution warns of icing conditions in the engine inlet. When possible, anticipate icing and turn on the anti-icing system to warm the engine inlet guide vanes.

PENETRATION

The aircraft structure is capable, subsonic, of withstanding the accelerations and gust loadings associated with the largest thunderstorms. The aircraft is stable and comparatively easy to control in severe turbulence if speed is not high. Severe damage may be caused by hail and lightning. Hail damage to the speed brake is increased significantly if the speed brake is extended.

PENETRATION AIRSPEED

Optimum thunderstorm penetration speed is 300 knots or best cruise, whichever is lower. Optimum thunderstorm penetration speed is a compromise between pilot comfort, controllability, structural stress, and engine inlet air distortion. At high speed, aircrew discomfort and structural stress are greater. At slow speed, controllability is reduced and inlet airflow distortion due to turbulence may cause compressor stall and/or engine stagnation.

THUNDERSTORM PENETRATION

Place the windshield anti-ice switch ON at the first sign of ice or before entering known icing conditions. Establish recommended penetration speed. Perform or check the following:

1. Throttle - ADJUST TO MAINTAIN DESIRED PENETRATION SPEED
2. Pitot heat switch - ON

CAUTION

Do not turn the ENG HEAT switch ON unless flying in conditions susceptible to icing. Once clear of the icing conditions, turn the ENG HEAT switch OFF.

3. Windshield anti-ice switch - ON
4. Lower seat.

If night penetration -

5. Storm flood switch - BRT
6. Instrument lights - BRT
7. Console lights - BRT
8. Anti-collision lights - OFF

IN THE STORM

Maintain a normal instrument scan with added emphasis on the EADI and power setting. Attempt to maintain attitude and accept altitude, AOA, and airspeed fluctuations. Ice or hail may damage the pitot tubes or AOA probe.

SNOW, ICE, RAIN AND SLUSH

TAXIING

CAUTION

Do not turn the ENG HEAT switch ON unless flying in conditions susceptible to icing. Once clear of the icing conditions, turn the ENG HEAT switch OFF.

Painted areas on runways, taxiways, and ramps are significantly slipperier than nonpainted areas. When painted areas are wet, braking may be negligible. Painted areas may serve as condensation surfaces and it is possible to have wet, frosty, or icy conditions on these areas when the overall weather is dry. With snow or ice, the approach end of the runway is usually slipperier than other areas due to melting and refreezing. There is sufficient braking effectiveness to overcome residual thrust at the very slow taxi speed required on slippery surfaces. Use care to avoid imprudent taxi speed since the braking required to quickly reduce taxi speed may cause skidding. Use of the groundspeed indicator to properly manage taxi speed is recommended. Avoid hard turns on snow or ice-covered taxiways. Expect the nose to overshoot the desired position and skid sideways when using the maneuvering nosewheel steering mode. If the nosewheel skids, straighten the nosewheel and again initiate the turn. The windshield anti-ice switch may be used momentarily to clear ice or moisture from the windshield. Inlet lip and engine face icing can occur when the ambient temperature is between 10°C (50°F) and −20°C (−4°F) and the dew point is within 0° to 3°C (5°F) of ambient temperature. If a half inch or more ice build-up is observed on the leading edge of the inlet variable ramp, mission abort should be considered. Ice ingestion from the lip or engine face even with engine anti-ice ON, can cause engine FOD and slight loss of power. Inlet lip and engine face ice build-up during taxi can be minimized during icing conditions by observing the following: Before engine start, insure the ground surface directly below and just forward of the inlet face is clear of snow, slush and water whenever the ambient temperature is below 10°C (50°F). After engine start, turn on engine anti-ice if either visible moisture is present or the dew point is within 3°C (5°F) of ambient temperature with the ambient temperature between 10°C (50°F) and −20°C (−4°F). While taxiing, avoid stopping where inlets are above areas covered by snow, slush or water. Prior to takeoff, minimize engine operation above IDLE power with ambient temperature between 2°C (36°F) and 10°C (50°F). In this temperature range and at IDLE power, water droplets in the airstream will remain above freezing. Above IDLE power, the temperature decrease thru the inlet duct is such that water will freeze on impact causing ice formation. After landing, single engine taxi during icing conditions is recommended to prevent exposure of both engines, to possible ice FOD. If taxiing single-engine with power below 78%, expect automatic avionics shutdown. Do not turn the ENG HEAT switch OFF until engine shutdown.

TAKEOFF

Do not attempt takeoff with ice or snow on the aircraft.

INFLIGHT

CAUTION

Do not turn the ENG HEAT switch ON unless flying in conditions susceptible to icing. Once clear of the icing conditions, turn the ENG HEAT switch OFF.

There is always a possibility of engine and/or airframe icing in instrument conditions. Icing is most likely when takeoff is made into low clouds with temperature near freezing. Flight operations are normally above serious icing levels and the aircraft's high performance will usually enable you to move out of dangerous areas quickly. When icing is encountered, take immediate action to avoid further accumulation. Flight through ice and/or rain requires no special technique; however, engine and windshield anti-ice systems do require attention. Turn on the ENG HEAT when icing is anticipated. Do not wait until the INLET ICE caution comes on since this indicates that ice has already formed in the inlets. The L and/or R INLET caution may come on in icing conditions below 1.33 Mach due to ice blockage of the duct static port. When icing conditions no longer exist, turning the ENG HEAT off reduces FTIT and increases engine life. Momentary application of windshield anti-ice may be used to clear precipitation from the windshield during the approach.

NOTE

Icing of the AOA probes may cause pitch and roll CAS to disengage. The speed brake may also retract due to erroneous AOA information.

LANDING

When stopping distance is critical, fly final approach as slow as possible up to 23 units AOA. Precise control of airspeed and touchdown point is critical. Use of speed brake may assist in airspeed control and decreased landing roll. The velocity vector, airspeed, and AOA on the HUD can be used as aids. On a wet runway, anticipate hydroplaning. If the runway is slippery, and there is sufficient runway remaining, raising the flaps will allow aerobraking to lower speeds, thereby reducing the braking required to slow to taxi speed. Landing roll can also be reduced by shutting down one engine after touchdown when committed to stop. During single-engine operations at idle, expect automatic avionics shutdown. Aerobrake until full aft stick is achieved. Hold full aft stick until the nose drops. With a crosswind, do not jeopardize directional control by attempting to aerodynamic brake to very low airspeeds. If conditions prevent a normal aerodynamic braking attitude, consider lowering the nose and commencing maximum anti-skid braking. Maximum wheel braking is obtained with the brake pedals fully depressed; therefore, use as much pedal force as possible (not just enough to get anti-skid cycling) without jeopardizing your ability to maintain directional control. Failure to hold the pedals fully depressed may extend the landing roll. Consider departure and barrier if required.

HYDROPLANING

Operation on wet or flooded runways may produce three conditions under which tire traction may be reduced to an insignificant value.

DYNAMIC HYDROPLANING

As the tire velocity is increased, the hydrodynamic pressure acting on the leading portion of the tire footprint will increase to a value sufficient to support the vertical load acting on the tire. The speed at which this occurs is called total hydroplaning speed. Any increase in ground speed above this critical value lifts the tire completely off the runway, leaving the tire supported by the fluid alone. Since the fluid cushion is incapable of sustaining any appreciable shear forces, braking and side force coefficients drop to near zero. The total hydroplaning speed is equal to nine times the square root of tire pressure. Since tire pressure is set for takeoff gross weight, total hydroplaning speed will depend on takeoff gross weight. The table below indicates the total hydroplaning speed for typical gross weights.

T/O GROSS WEIGHT (LBS)	TOTAL HYDRO-PLANING SPEED (KTS)
Up to 45,000	132
45,001 to 55,000	146
55,001 to 81,000	160

VISCOUS HYDROPLANING

Viscous hydroplaning occurs due to the inability of the tire to penetrate the very thin film found under damp runway conditions. This condition is aggravated when more viscous fluid such as oil, fuel, rubber deposits and/or dust are present. The condition is improved on a coarse textured runway. Viscous hydroplaning occurs at medium to high speeds with rolling or skidding tires. The speed at which it occurs is not dependent on tire pressure.

REVERTED RUBBER HYDROPLANING

Occurs after a locked-wheel skid has started on a wet runway. Enough heat may be produced to turn the trapped water to steam. The steam will heat the rubber sufficiently to revert it to its natural state and will seal the tire grooves. The tire then rides on a cushion of steam which greatly reduces the friction coefficient and may continue to do so to very low speeds.

AFTER LANDING

Ensure windshield anti-ice switch is OFF. Single engine taxi is recommended on slippery surfaces. Expect automatic avionics shutdown during single-engine taxi below 78% RPM. Use extra care when turning from runway to taxiway as transition from a relatively dry to a slippery surface can cause rotational skids. A rotational skid is insidious and will likely result in a ground loop if it starts. Slow nearly to a stop before attempting a turn under these conditions.

COLD WEATHER OPERATION

The following paragraphs contain the necessary information for safe and efficient operation during cold weather. As a general rule, cold weather is defined as outside air temperature below 0° F. However, each system discussed here has its own temperature limitations. Therefore, this section should be referenced any time the outside air temperature drops below 0° F.

BEFORE ENTERING COCKPIT

CAUTION

Do not turn the ENG HEAT switch ON unless flying in conditions susceptible to icing. Once clear of the icing conditions, turn the ENG HEAT switch OFF.

The entire aircraft must be free of snow, ice, and frost. These are a major flight hazard and result in a loss of lift and increased stall speed. They must be removed before flight. Do not chip or scrape away ice as damage to aircraft may result.

1. Shock struts, pitot tube, fuel vents, and actuating cylinders are free of ice or dirt.
2. Fuel drain cocks free of ice.
3. All exterior covers removed.
4. JFS accumulators - 2900 PSI MINIMUM - 4000 PSI (MIL-H-83282 hydraulic fluid below −29°C (−20°F))

INTERIOR CHECK

In temperatures below 0°C (32°F), difficulty may be experienced when connecting the oxygen mask hose to the T-connector. Apply a small amount of heat to the T-connector to alleviate this problem. If the oxygen mask is not fastened, keep it well clear of the face to prevent freezing of the valves.

CANOPY CLOSURE

Canopy may not fully close with hydraulic pressure if ambient temperature is below 0°F. This condition may warrant pilot assistance. With canopy down on sills, and the internal control handle set to the "DOWN" position, grasp the two handles on the forward arch and push the canopy forward. Once the canopy moves fully forward, the control handle may be moved to the "LOCKED" position.

STARTING JFS

With the hydraulic system serviced with MIL-H-5606 hydraulic fluid, normal JFS starts may be made if the temperature is above −35°C (−31°F). Between −35°C (−31°F) and −40°C (−40°F), use double bottle starts. Below −40°C (−40°F), preheating is required.

With the hydraulic system serviced with MIL-H-83282 hydraulic fluid, normal JFS starts may be made if the temperature is above −29°C (−20°F). Between −29°C (−20°F) and −40°C (−40°F), use double bottle starts. Below −40°C (−40°F), preheating is required.

STARTING ENGINES

At temperatures below −18°C (0°F), allow the JFS to run for 1 minute prior to engaging an engine. If ambient temperature is below −30°C (−22°F), insure that gear pins are in until aircraft hydraulic and electrical power are available.

BEFORE TAXIING

NOTE

Warm up of fluids can be speeded up by cycling the controls.

Operate all flight controls and the speedbrake through several cycles. Turn on the windshield anti-ice, if required. Cycle the ENG CONTR at least twice to prevent sluggish nozzle movement which may cause compressor stall at afterburner initiation. At temperatures below −40°C (−40°F), avionics may require up to 30 minutes warm-up before operating normally. Turn on ENG HEAT if visible moisture is present and ambient temperature is between +10°C (+50°F) and −20°C (−4°F). Do not wait until the INLET ICE caution comes on. Use of ENG HEAT is not time limited and does not degrade engine thrust significantly. Expect idle RPM to be around 55%. Idle oil pressure may be below 15 psi. This is acceptable for taxi.

TAXIING

Avoid taxiing in deep or rutted snow since frozen brakes will likely result. Increase space between aircraft while taxiing at sub-freezing temperatures to insure safe stopping distance and to prevent icing of aircraft surfaces by melted snow and ice blown by the jet blast of preceding aircraft. The high idle thrust can produce high taxi speeds. Control taxi speeds to avoid high-speed stops or turns on slippery taxiways.

TAKEOFF

Below −20°C (−4°F), MIL RPM may be as low as 87% and FTIT may be as low as 810°C.

AFTER LANDING

Single engine taxi is recommended for easier control of taxi speed. Expect automatic avionics shutdown at single-engine operation below 78% RPM. Idle thrust is high, and remains essentially constant as temperature decreases. When wearing bulky arctic survival clothing and winter flying gloves, rapid egress from the cockpit by disconnecting the torso harness will be impeded due to the inability to see the connectors and degraded sense of touch.

BEFORE LEAVING AIRCRAFT

Leave canopy open, weather permitting, to permit circulation. This decreases windshield and canopy frosting. Check that protective covers are installed. Engine intake duct covers should not be installed until two hours after engine shutdown to prevent condensation from puddling and freezing, preventing subsequent engine rotation.

HOT WEATHER/DESERT OPERATION

PREFLIGHT

During preflight, ensure that the aircraft is relatively free of sand. Sand adheres to oiled areas (wheels, flight controls and hinges) and fuel leaks.

When boarding the aircraft, use caution when touching hot metal surfaces in the cockpit.

ENGINE START

During start be alert to the possibility of AMAD fires.

Keep JFS run time (non-engaged and engaged) to a minimum. Consider shutting down the JFS to work maintenance problems between engine starts.

GROUND OPERATIONS

High ambient temperatures may cause ECS cautions to be displayed. Advancing one engine to 73-78% should extinguish the caution in about 30 seconds. If the caution remains on, call maintenance and comply with the ECS Malfunction procedures in the checklist.

Do not operate the engines in a sand or dust storm (if avoidable). If engine operation is required, consider locking the ramps up to minimize sand ingestion.

INFLIGHT

Avoid prolonged flight in blowing sand or dust. Flight in these conditions will cause damage to the canopy, LANTIRN Nav and Targeting Pod windows and any EO/IR weapon seekers.

High ambient temperatures will reduce aircraft engine performance significantly. Speed is severely reduced under these conditions, particularly with high drag indexes. When operating with alternate fuels, the possibility of HOT FUEL cautions at low power settings exists.

POSTFLIGHT

If possible, park the aircraft crosswind. Engine covers and other inlet covers should be installed to prevent blowing sand from being deposited inside the inlets.

Cockpit instrumentation should be covered to prevent damage due to exposure to high temperatures. Canopies should be closed or covered to prevent blowing sand or dust from entering the cockpit.

VOLCANIC ASH OPERATION

GROUND OPERATIONS

Modified ground operations on an airfield which has experienced volcanic ash fallout are required even after cleanup is complete.

For preflight, carefully inspect the following areas for volcanic dust:

- ECS ram inlet ducts
- Engine intakes
- LG strut chrome surface
- Pitot static probes
- AOA probes
- Total temperature probes

After engine start, keep ground operation time/thrust to a minimum and run air-conditioning at full cold setting, if practical. Do not use anti-ice unless required.

Taxi at a safe speed considering surface conditions, slope, thrust and gross weight. Perform a rolling takeoff, if possible, since volcanic ash, especially when wet, reduces Runway Condition Reading (RCR).

Consider increasing the interval between takeoffs to allow clouds of suspended ash to clear.

After landing, consider shutting down both engines and have aircraft towed to the parking area, or consider taxiing on one engine.

Use RCR of 18 for dry volcanic ash and 10 for wet volcanic ash if actual RCR value is unknown.

INFLIGHT OPERATIONS

Flight in a volcanic ash environment is extremely hazardous. Airborne radar does not detect ash clouds which visually are easily mistaken for normal clouds.

Some indications of volcanic ash cloud penetration are:

- Acid odor
- Canopy opacity
- Engine exhaust torching
- Engine surges/malfunctions
- Erroneous airspeed indications/fluctuations
- FTIT rise
- St. Elmo's fire
- Volcanic ash entering cockpit

When volcanic ash cloud penetration is detected, reduce thrust and maintain minimum thrust required to sustain flight, exit the volcanic ash environment, and land as soon as practical. Do not use anti-ice unless required.

Engine operation above 80% rpm while ingesting volcanic ash may cause build up of melted ash on turbine hardware and possible engine stalls. If possible, keep rpm at 80% or less until clear of ash.

APPENDIX A

PERFORMANCE DATA WITH F100-PW-220 ENGINES

NOTE

All performance data is based on U.S. standard day and sea level altitude. The data must be adjusted for any difference in altitude or temperature.

PART 1

INTRODUCTION

TABLE OF CONTENTS

Charts

NOTE

All performance data are based on JP-4 fuel and are also applicable for JP-8 fuel.

DRAG INDEX SYSTEM

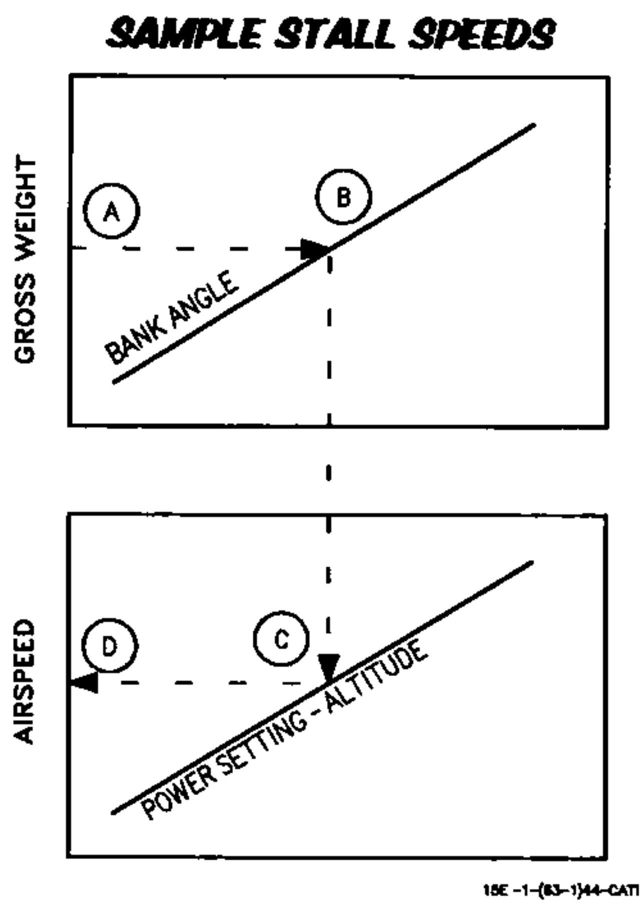
Most of the charts use the drag index system to effectively present the many combinations of weight/ drag effects on performance. The Airplane Loading chart (figure A1-1) contains the drag number and weight of each externally carried store. The weight and drag number for external store suspension equipment are listed separately. The drag index for a specific configuration may be found by multiplying the number of stores carried by its drag number, and adding the drag number of the applicable suspension equipment. The total drag index may then be used to enter the planning data charts. The F-15E Gross Weights and CG Location (%MAC) chart (figure A1-2) contains the weight and % CG for certain "typical" load configurations. Charts applicable for all loads and configuration are labeled ALL DRAG INDEXES. Charts labeled INDIVIDUAL DRAG INDEXES contain data for a range of drag numbers; i.e., individual curves/columns for a specific drag number. Supersonic data is not compatible to the drag index system; therefore, each chart is labeled for a specific configuration.

STALL SPEEDS CHARTS

The Stall Speeds charts (figures A1-4 thru A1-7) present stall speeds for various combinations of gross weight, bank angle, power setting and altitude. The data is based on having the gear and flaps down (figures A1-4, A1-5) or gear and flaps up (figures A1-6, A1-7).

USE

Enter the appropriate chart with the applicable gross weight and proceed horizontally to the right to intersect the applicable bank angle. From this intersection, descend vertically and intersect the applicable altitude curve. Then project horizontally left to read the stall speed.



Sample Problem

Configuration: Flaps Down, Gear Down, Maximum Thrust

A. Gross weight	40,000 Lb
B. Bank angle	15°
C. Altitude	10,000 Ft
D. Stall speed	107 Kt

AIRSPEED CONVERSION

The Airspeed Conversion charts, (figures A1-8 and A1-9) provide a means of converting calibrated airspeed to true Mach number and true airspeed.

INDICATED AIRSPEED

Indicated airspeed (IAS) is the uncorrected airspeed read directly from the indicator.

CALIBRATED AIRSPEED

Calibrated airspeed (CAS) is indicated airspeed corrected for static source error.

EQUIVALENT AIRSPEED

Equivalent airspeed (EAS) is calibrated airspeed corrected for compressibility. There is no provision made for reading equivalent airspeed.

TRUE AIRSPEED

True airspeed (TAS) is equivalent airspeed corrected for density altitude. Refer to the Airspeed Conversion charts (figures A1-8 and A1-9).

AIRSPEED POSITION ERROR CORRECTION CHART

Under normal conditions, the air data computer compensates for the static source position error. If an air data computer malfunction occurs, the primary airspeed/Mach indicator becomes inoperative and airspeed is read from the standby indicator. The indicated airspeed read on this indicator may be corrected to calibrated airspeed by utilizing the Airspeed Position Error Correction chart (figure A1-10).

USE

Enter the appropriate chart with the indicated airspeed read from the standby indicator. In the flaps down, gear down configuration at 10,000 feet and below read the calibrated airspeed from the tabulated chart. In the flaps up, gear up configuration, enter the chart with the indicated airspeed and project vertically up to the appropriate altitude reflector curve. From this point, project horizontally left to read the calibrated airspeed.

Sample Problem

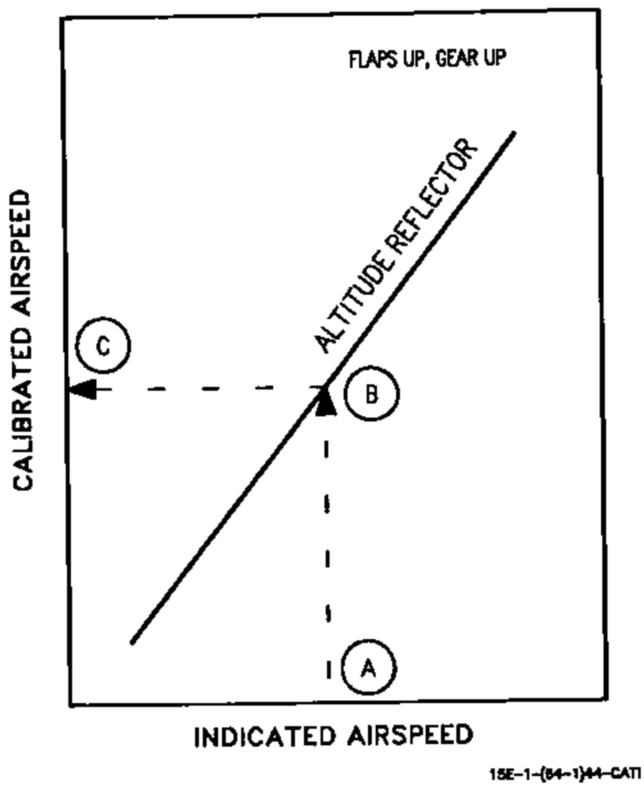
Configuration: Flaps Up, Gear Up

A. Indicated airspeed	300 Kt
B. Altitude reflector line	40,000 Ft
C. Calibrated airspeed	312 Kt

Configuration: Flaps Down, Gear Down (10,000 Ft and below)

A. Indicated airspeed	200 Kt
B. Gross weight	40,000 Lb
C. Calibrated airspeed	198.5 Kt

SAMPLE AIRSPEEDS POSITION ERROR CORRECTION



ALTIMETER POSITION ERROR CORRECTION CHART

Under normal conditions, the ADC compensates for the static source position error. If an ADC malfunction occurs, the primary altitude indicator becomes inoperative and altitude is read from the standby indicator. The indicated altitude read on this indicator may be corrected to calibrated altitude by utilizing the Altimeter Position Error Correction chart (figure A1-11).

USE

Enter the appropriate chart with indicated airspeed. In the flaps retracted, gear up configuration project horizontally right to the assigned altitude reflector. From this point, project vertically up to the reflector line. From this point, project horizontally left to read the ΔH altitude correction. In the full flaps, gear down configuration project vertically up to the appropriate gross weight curve. From this point project horizontally left to read the ΔH altitude correction. In either case apply the ΔH altitude correction to the altimeter and fly indicated altitude.

Sample Problem

Configuration: Flaps up, Gear Up

A. Indicated airspeed	400 Kt
B. Assigned altitude	55,000 Ft
C. Reflector line	
D. ΔH correction	+375 Ft
E. Indicated altitude necessary to maintain assigned altitude (B+D)	55,375 Ft

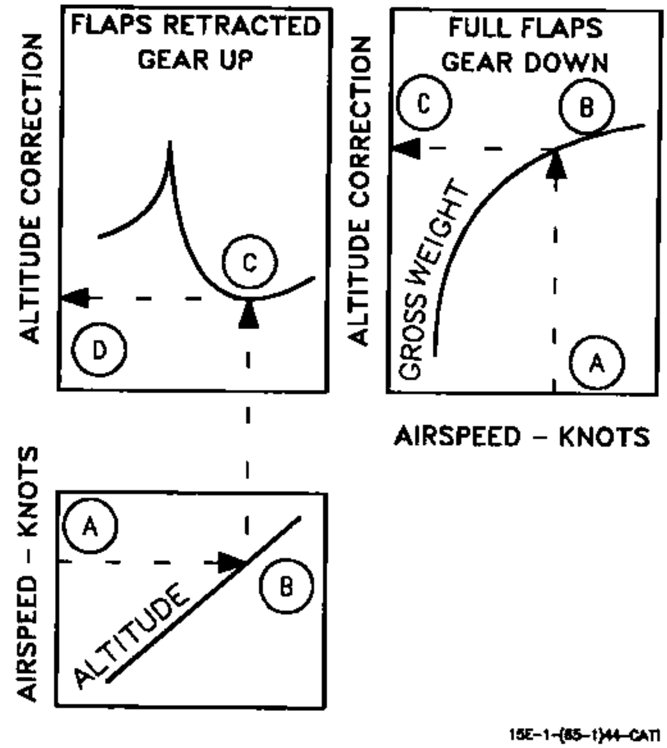
Configuration: Flaps Down, Gear Down

A. Indicated airspeed	155 Kt
B. Gross weight	40,000 Lb
C. ΔH correction	+60 Ft

WIND COMPONENTS CHART

A standard Wind Components chart (figure A1-12) is included. It is used primarily for breaking a forecast wind down into crosswind and headwind components for takeoff computations. It may, however, be used whenever wind component information is desired. It is not to be used as a ground controllability chart.

SAMPLE ALTIMETER POSITION ERROR CORRECTION



USE

Determine the effective wind velocity by adding one-half the gust velocity (incremental wind factor) to the steady state velocity; e.g., reported wind 050/30 G40, effective wind is 050/35. Reduce the reported wind direction to a relative bearing by determining the wind direction and runway heading. Enter the chart with the relative bearing. Move along the relative bearing to intercept the effective wind speed arc. From this point, descend vertically down to read the crosswind component. From the intersection of bearing and wind speed, project horizontally left to read headwind component.

Sample Problem

Reported wind 050/35, runway heading 030.

A. Relative bearing	20°
B. Intersect windspeed arc	35 Kt
C. Crosswind component	12 Kt
D. Headwind component	33 Kt

STATION LOADING

NOTE

- FOR PRECISE AIRPLANE BASIC WEIGHT, REFER TO WEIGHT AND BALANCE DATA HANDBOOK, TO 1-1B-40, FOR THE PARTICULAR AIRPLANE
- THE TERMS 'BASIC' AND 'CLEAN' AIRCRAFT (AS USED IN THESE APPENDIXES) REFER TO AN F-15E AIRCRAFT WITH CONFORMAL FUEL TANKS, BUT WITHOUT PYLONS OR LANTIRN PODS INSTALLED

CONFIGURATION DRAG

ITEM	WEIGHT (POUNDS)	DRAG NUMBER (WITH CFT A/G STORES)	DRAG NUMBER (W/O CFT A/G STORES)
F-15E , Without CFT's	33,500	-	-
Full Internal Fuel	12,915	-	-
Aircrew	215 (each)	-	-
Two -4 CFTs (F-15E Production Model)	E 4367 F 13714	20.1	20.1
LANTIRN Navigation Pod (AN/AAQ-13) and Adapter (ADU-576/A)	520	9.5	8.3
LANTIRN Targeting Pod (AN/AAQ-14) and Adapter (ADU-577/A)	621	7.4	6.5

ITEM	WEIGHT PER ITEM (POUNDS)	DRAG NUMBER WITHOUT CFT		DRAG NUMBER WITH CFT			
		CENTER-LINE STATION	OTHER STATIONS	CENTER-LINE STATION	WING STATIONS	CFT STATIONS WITHOUT BOMBS/ TANKS ON WING STATIONS	CFT STATIONS WITH BOMBS/ TANKS ON WING STATIONS
Air-to-Air Missiles							
AIM-7F, -7M	510	-	1.8	-	-	2.3	2.3
AIM-9L, 9M	195	-	2.1	-	2.1	-	-
AIM-9P/P-1	170	-	2.1	-	2.1	-	-
AIM-9P-2/P-3	180	-	2.1	-	2.1	-	-
AIM-120A	338	-	1.3	-	2.3	1.7	1.7
CATM-9L/M-1	195	-	2.1	-	2.1	-	-
Air-to-Ground Missiles							
AGM-65A, B	481	-	3.7	-	3.7	-	-
AGM-65D	485	-	3.7	-	3.7	-	-
AGM-65G	687	-	3.7	-	3.7	-	-
AGM-130A, B	2962	-	TBD	-	TBD	-	-

Figure A1-1 (Sheet 1 of 4)

STATION LOADING (CONT)

ITEM	WEIGHT PER ITEM (POUNDS)	DRAG NUMBER WITHOUT CFT		DRAG NUMBER WITH CFT			
		CENTER-LINE STATION	OTHER STATIONS	CENTER-LINE STATION	WING STATIONS	CFT STATIONS WITHOUT BOMBS/ TANKS ON WING STATIONS	CFT STATIONS WITH BOMBS/ TANKS ON WING STATIONS
Pylons, Launchers and Adapters							
SUU-73/A Center-line Pylon with BRU-47/A	316	3.3	-	3.3	-	-	-
SUU-59C/A Wing Pylon with BRU-47/A	371	-	3.3	-	3.3	-	-
LAU-128/A Launcher and AIM-9/AIM-120 Adapter (ADU-552/A)	111	-	1.1	-	1.1	-	-
LAU-88A/A Launcher (Triple Rail) and AGM-65 Adapter (ADU-578/A)	573	-	9.6	-	9.6	-	-
LAU-117/A Launcher (Single Rail) for AGM-65	135	-	1.4	-	1.4	-	-
LAU-114/A Launcher and AIM-9 Adapter (ADU-407/A)	79	-	1.2	-	1.2	-	-
General Purpose Weapons							
MK-82 LDGP	505	-	-	-	-	0.8	0.9
MK-82 SE	550	-	-	-	-	1.4	1.5
MK-82 AIR (With BSU-49 Fin)	540	-	-	-	-	1.1	1.2
MK-84 LDGP	1970	3.0	2.1	3.0	2.3	2.8	3.0
MK-84 AIR (With BSU-50 Fin)	2010	5.4	3.9	5.4	4.2	5.1	5.6
Special Weapons							
B61	751	2.5	1.8	2.5	1.8	1.8	2.0

Figure A1-1 (Sheet 2)

STATION LOADING (CONT)

ITEM	WEIGHT PER ITEM (POUNDS)	DRAG NUMBER WITHOUT CFT		DRAG NUMBER WITH CFT			
		CENTER-LINE STATION	OTHER STATIONS	CENTER-LINE STATION	WING STATIONS	CFT STATIONS WITHOUT BOMBS/ TANKS ON WING STATIONS	CFT STATIONS WITH BOMBS/ TANKS ON WING STATIONS
Guided Weapons							
GBU-10A/B	2053	10.5	7.5	10.5	7.5	9.8	10.7
GBU-10C/B, D/B	2081	10.5	7.5	10.5	7.5	9.8	10.7
GBU-12B/B, C/B	610	-	-	-	-	3.9	4.3
GBU-15(V)-4/B	2502	-	5.6	-	5.6	-	-
GBU-24/B	2323	7.8	5.6	7.8	5.6	5.6	6.2
GBU-28/B	4576	-	7.5 (est)	-	7.5 (est)	-	-
Dispensers/Rockets							
CBU-52B/B	785	-	-	-	-	4.6	5.0
CBU-58/B	810	-	-	-	-	4.6	5.0
CBU-71/B	810	-	-	-	-	4.6	5.0
CBU-87/B (TMD)	950	-	-	-	-	2.9	3.2
CBU-89/B (TMD)	706	-	-	-	-	2.9	3.2
MK-20 Rockeye	486	-	-	-	-	1.5	1.6
TMU-28/B Spray Tank	E 567 F 1935	-	3.0	-	3.0	-	-
Miscellaneous Stores							
610 Gallon Fuel Tank	E 320 F 4285	12.2	5.5	12.2	6.0	-	-
610 Gallon Fuel Tank (With Bombs on Inboard CFT Station)	E 320 F 4285	-	-	12.2	8.2	-	-
610 Gallon Fuel Tank (With Bombs on Outboard CFT Station)	E 320 F 4285	-	-	12.2	12.3	-	-
SUU-20B/A Practice Dispenser	E 276	5.0	3.6	5.0	3.9	3.9	3.9
MK-106 PB (Incl)	F 306	4.2	3.0	4.2	3.3	3.3	3.3
BDU-33 PB (Incl)	F 414	4.2	3.0	4.2	3.3	3.3	3.3
BDU-48 PB (Incl)	F 336	4.2	3.0	4.2	3.3	3.3	3.3

E - Empty F - Full PB - Practice Bomb

Figure A1-1 (Sheet 3)

STATION LOADING (CONT)

ITEM	WEIGHT PER ITEM (POUNDS)	DRAG NUMBER WITHOUT CFT		DRAG NUMBER WITH CFT			
		CENTER-LINE STATION	OTHER STATIONS	CENTER-LINE STATION	WING STATIONS	CFT STATIONS WITHOUT BOMBS/ TANKS ON WING STATIONS	CFT STATIONS WITH BOMBS/ TANKS ON WING STATIONS
BDU-38 (B61 Training Shape)	751	2.6	1.8	2.5	1.8	1.8	2.0
AN/AXQ-14 Data Link Pod (for GBU-15)	450	4.6	-	4.6	-	-	-
P-4A/AX AIS Pod	160	-	2.1	-	2.1	-	-
AN/ASQ-T17 AIS Pod	122	-	2.1	-	2.1	-	-
AN/ASQ-T20 AIS Pod	123	-	2.1	-	2.1	-	-
AN/ASQ-T21 AIS Pod	124	-	2.1	-	2.1	-	-
AN/ASQ-T25 AIS Pod	122	-	2.1	-	2.1	-	-
BLU-107 Durandal	494	-	-	-	-	1.2	1.4
MXU-648A/A-50 Cargo Pod	E 98 F 398	3.6	3.6	3.6	3.6	-	-
MC-1 (M1A1 Fuze Extenders)	668					3.0	3.0
Ammunition							
(512 Live Rounds)	289	-	-	-	-	-	-
(Spent Cartridges)	136	-	-	-	-	-	-

E - Empty F- Full

Figure A1-1 (Sheet 4)

F-15E GROSS WEIGHTS (LBS) AND CG LOCATION (%MAC) PW-220 ENGINES

STORE	#	FULL FUEL		CFT EMPTY		3200 LBS REMAINING		COMMENTS
		WEIGHT	CG	WEIGHT	CG	WEIGHT	CG	
MK-20	12	68315	26.2	58965	24.8	49042	26.6	
	8	66371	25.9	57021	24.4	47098	26.2	
	4	64427	25.4	55077	23.7	45154	25.4	
MK-82 SE	12	69083	26.4	59733	25.0	49810	26.9	
	8	66883	24.3	57533	22.5	47610	23.8	
	4	64683	23.7	55333	21.8	45410	23.0	
MK-82 AIR	12	68963	26.4	59613	25.0	49690	26.8	
	8	66803	24.2	57453	22.4	47530	23.8	
	4	64643	23.7	55293	21.8	45370	23.1	
MK-82 LDGP	12	68543	26.2	59193	24.7	49270	26.5	
	8	66523	25.9	57173	24.4	47250	26.2	
	4	64503	25.4	55153	23.7	45230	25.4	
MK-84 AIR	4	70523	25.3	61173	23.8	51250	25.3	STA 2, 8, LC/RC 2
	2	66503	25.5	57153	23.9	47230	25.5	LC/RC 2
MK-84 LDGP	4	70363	25.2	61013	23.7	51090	25.2	STA 2, 8, LC/RC 2
	2	66423	25.4	57073	23.8	47150	25.5	LC/RC 2
GBU-10C/B	4	69603	25.5	60253	23.9	50330	25.5	STA 2, 8, LC/RC 2 NO AIM-9
	2	66645	25.5	57295	23.9	47372	25.5	LC/RC 2
GBU-10G/B	4	69603	25.5	60253	23.9	50330	25.5	STA 2, 8, LC/RC 2 NO AIM-9
	2	66645	25.5	57295	23.9	47372	25.5	LC/RC 2
GBU-12	8	67363	26.0	58013	24.5	48090	26.2	
	4	64923	25.6	55573	24.0	45650	25.8	
GBU-24/B	3	68224	24.7	58874	23.0	48951	24.4	STA 2, 5, 8 NO AIM-9 or AIM-120
GBU-24A/B	3	68323	24.7	58973	23.0	49050	24.4	STA 2, 5, 8 NO AIM-9 or AIM-120
GBU-28/B	2	71635	24.7	62285	23.1	52362	24.5	STA 2 & 8

Figure A1-2 (Sheet 1 of 2)

F-15E GROSS WEIGHTS (LBS) AND CG LOCATION (%MAC) PW-220 ENGINES (CONT)

STORE	#	FULL FUEL		CFT EMPTY		3200 LBS REMAINING		COMMENTS
		WEIGHT	CG	WEIGHT	CG	WEIGHT	CG	
CBU-52	12	71903	26.7	62553	25.4	52630	27.2	
	8	68763	26.4	59413	25.0	49490	26.8	
	4	65623	25.6	56273	23.9	46350	25.7	
CBU-58 CBU-71	12	72203	26.7	62853	25.4	52930	27.2	
	8	68963	26.4	59613	25.0	49690	26.8	
	4	65723	25.6	56373	23.9	46450	25.7	
CBU-87	12	73883	27.2	64533	26.0	54610	27.8	
	8	70083	26.7	60733	25.4	50810	27.3	
	4	66283	25.7	56933	24.2	47010	25.9	
CBU-89	12	70955	26.7	61605	25.4	51682	27.2	
	8	68131	26.3	58781	24.9	48858	26.7	
	4	65307	25.5	55957	23.9	46034	25.6	
MC-1	12	71183	26.7	61833	25.4	51910	27.2	
	8	68283	26.3	58933	24.9	49010	26.7	
	4	65383	25.5	56033	23.9	46110	25.6	

NOTES

1. CENTER OF GRAVITY DATA BASED ON F-15E 88-1688.
2. AIRCRAFT CONFIGURATION IS: FULL OF FUEL (INTERNAL AND CFT), 2 x LANTIRN PODS, 4 x AIM-9L, NO GUN AMMO AND LIGHTWEIGHT CREW (170 LBS).
3. CG LOCATIONS ARE FOR GEAR UP. ADD 0.3% MAC FOR GEAR DOWN ABOVE 70,000 POUNDS. BELOW 70,000 POUNDS ADD 0.4% TO MAC.
4. CENTER OF GRAVITY TRACK IS FAIRLY LINEAR BETWEEN POINTS SHOWN.
5. AS FUEL IS BURNED FROM 3200 LBS REMAINING TO 2700 LBS REMAINING, CG MOVES AFT 0.6% MAC. FROM 2700 LBS TO BINGO, CG REMAINS CONSTANT.
6. ADD 0.6% MAC FOR EACH LANTIRN POD REMOVED AND SUBTRACT 621 LBS IF TARGETING POD REMOVED AND 520 LBS IF NAV POD REMOVED.
7. ADD 0.05% MAC AND SUBTRACT 195 LBS FOR EACH AIM-9 REMOVED.
8. WITH CENTERLINE TANK, SUBTRACT 0.5% MAC AND ADD 4600 LBS. AFTER CENTERLINE TANK FUEL IS BURNED, CG TRACK IS AS DESCRIBED ABOVE.
9. ABOVE DATA ASSUMES NORMAL RELEASE SEQUENCE OF STORES FROM BOTH CFT'S SIMULTANEOUSLY. IF CONFIGURATION HAS MORE THAN 1 STORE PER CFT, AND IF ONE CFT IS FULLY DOWNLOADED BEFORE THE OTHER, THE ABOVE DATA DOES NOT APPLY.
10. SUBTRACT 0.2% MAC AND ADD 289 LBS IF FULL LOAD OF GUN AMMO IS CARRIED.
11. SUBTRACT 0.3% MAC AND ADD 90 LBS IF HEAVYWEIGHT CREW (215).
12. SUBTRACT 600 LBS IF NO ICS (CG IS UNCHANGED).

Figure A1-2 (Sheet 2)

STANDARD ATMOSPHERE TABLE

STANDARD SEA LEVEL AIR:
T = 59°F (15°C)
P = 29.921 IN. OF HG

W = 0.076475 LB/CU FT = 0.0023769 SLUGS/CU FT
1 IN. OF HG = 70.732 LB/SQ FT = 0.4912 LB/SQ IN
α_o = 116.5 FT/SEC = 661.5 KNOTS

U.S. STANDARD ATMOSPHERE, 1966

ALTITUDE FEET	DENSITY RATIO ρ/ρ_o	$1/\sqrt{\sigma}$	AIR TEMPERATURE		SPEED OF SOUND RATIO α/α_o	PRESSURE	
			DEG. F	DEG. C		IN. OF HG	RATIO $P/P_o = \delta$
-2.000	1.0598	0.9714	66.132	18.962	1.0068	32.15	1.0745
-1.000	1.0296	0.9855	62.566	16.981	1.0034	31.02	1.0368
0	1.0000	1.0000	59.000	15.000	1.0000	29.92	1.0000
1.000	0.9711	1.0148	55.434	13.019	0.9966	28.86	0.9644
2.000	0.9482	1.0299	51.868	11.038	0.9931	27.82	0.9298
3.000	0.9151	1.0454	48.302	9.057	0.9896	26.82	0.8962
4.000	0.8881	1.0611	44.735	7.075	0.9862	25.84	0.8637
5.000	0.8617	1.0773	41.169	5.094	0.9827	24.90	0.8320
6.000	0.8359	1.0938	37.603	3.113	0.9792	23.98	0.8014
7.000	0.8106	1.1107	34.037	1.132	0.9756	23.09	0.7716
8.000	0.7860	1.1279	30.471	-0.849	0.9721	22.22	0.7428
9.000	0.7620	1.1456	26.905	-2.831	0.9686	21.39	0.7148
10.000	0.7385	1.1637	23.338	-4.812	0.9650	20.58	0.6877
11.000	0.7156	1.1822	19.772	-6.793	0.9614	19.79	0.6614
12.000	0.6932	1.2011	16.206	-8.74	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	16.83	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	0.9827	13.75	0.4593
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

Figure A1-3 (Sheet 1 of 2)

STANDARD ATMOSPHERE TABLE

STANDARD SEA LEVEL AIR:
T = 59°F (15°C)
P = 29.921 IN. OF HG

W = 0.076475 LB/CU FT = 0.0023769 SLUGS/CU FT
1 IN. OF HG = 70.732 LB/SQ FT = 0.4912 LB/SQ IN
α_0 = 116.5 FT/SEC = 661.5 KNOTS

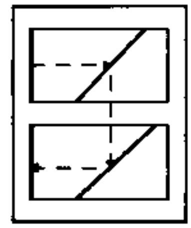
U.S. STANDARD ATMOSPHERE, 1966

ALTITUDE FEET	DENSITY RATIO ρ/ρ_o	$1/\sqrt{\sigma}$	AIR TEMPERATURE		SPEED OF SOUND RATIO α/α_o	PRESSURE	
			DEG. F	DEG. C		IN. OF HG	RATIO $P/P_o = \delta$
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

Figure A1-3 (Sheet 2)

STALL SPEEDS

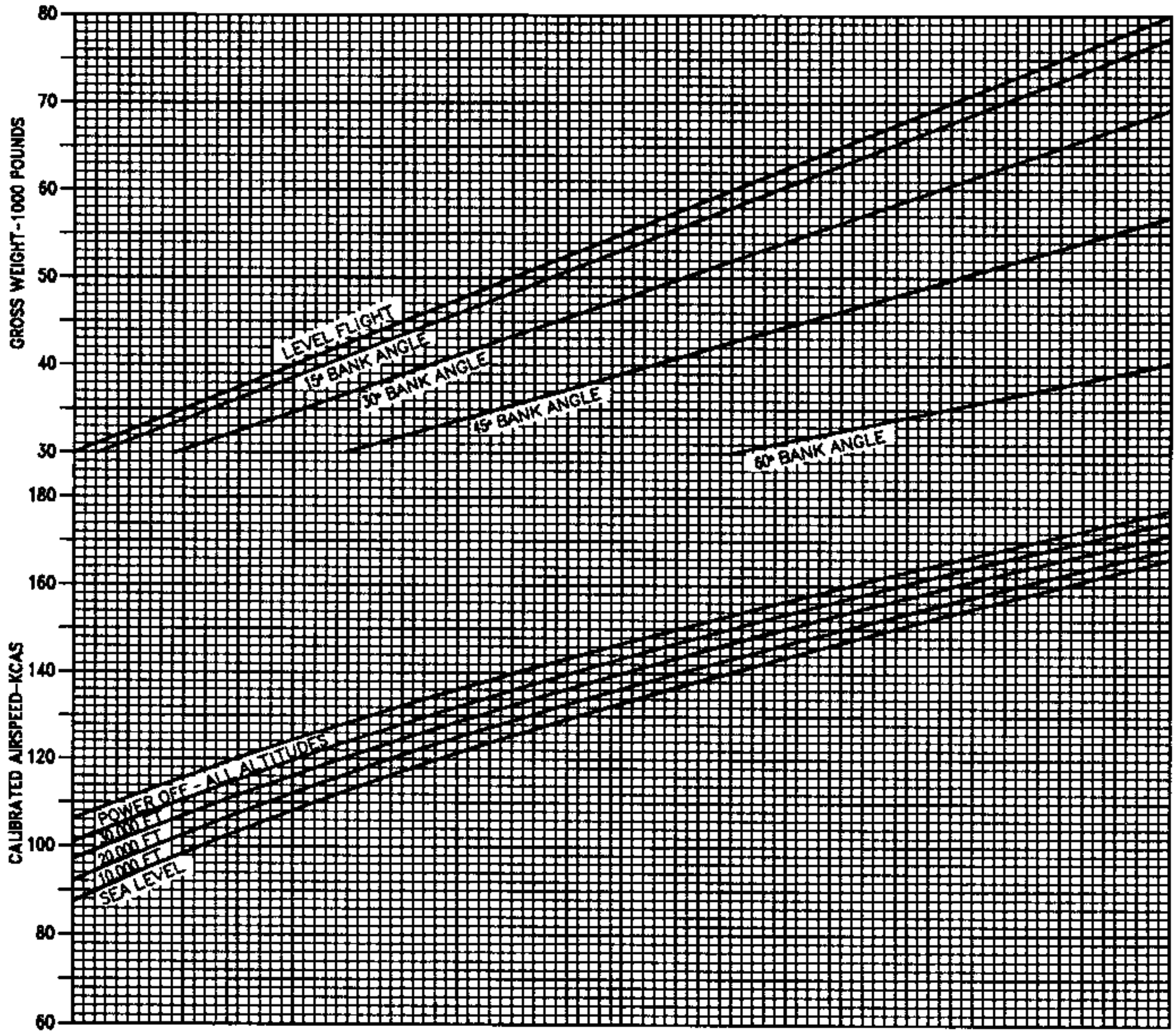
MILITARY THRUST



AIRPLANE CONFIGURATION
GEAR AND FLAPS DOWN
ALL DRAG INDEXES

REMARKS
U.S. STANDARD DAY, 1966
ENGINE(S): (2) F100-PW-220

DATE: 15 JUNE 1988
DATA BASIS: FLIGHT TEST



15E-1-(67-1)44-CATI

Figure A1-4

STALL SPEEDS

MAXIMUM THRUST

AIRPLANE CONFIGURATION
GEAR AND FLAPS DOWN
ALL DRAG INDEXES

REMARKS
U.S. STANDARD DAY, 1966
ENGINE(S): (2) F100-PW-220

DATE: 15 JUNE 1988
DATA BASIS: FLIGHT TEST

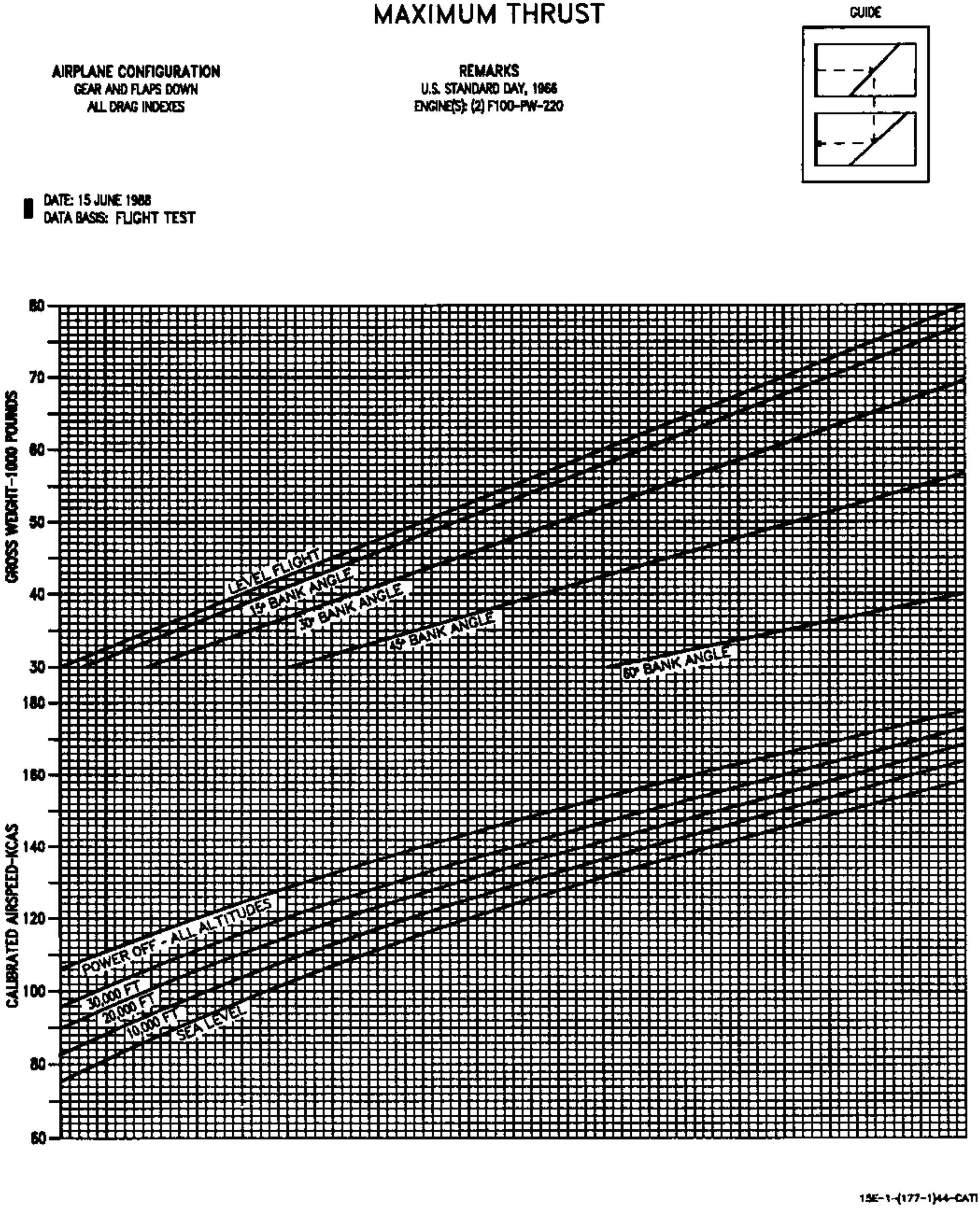


Figure A1-5

STALL SPEEDS

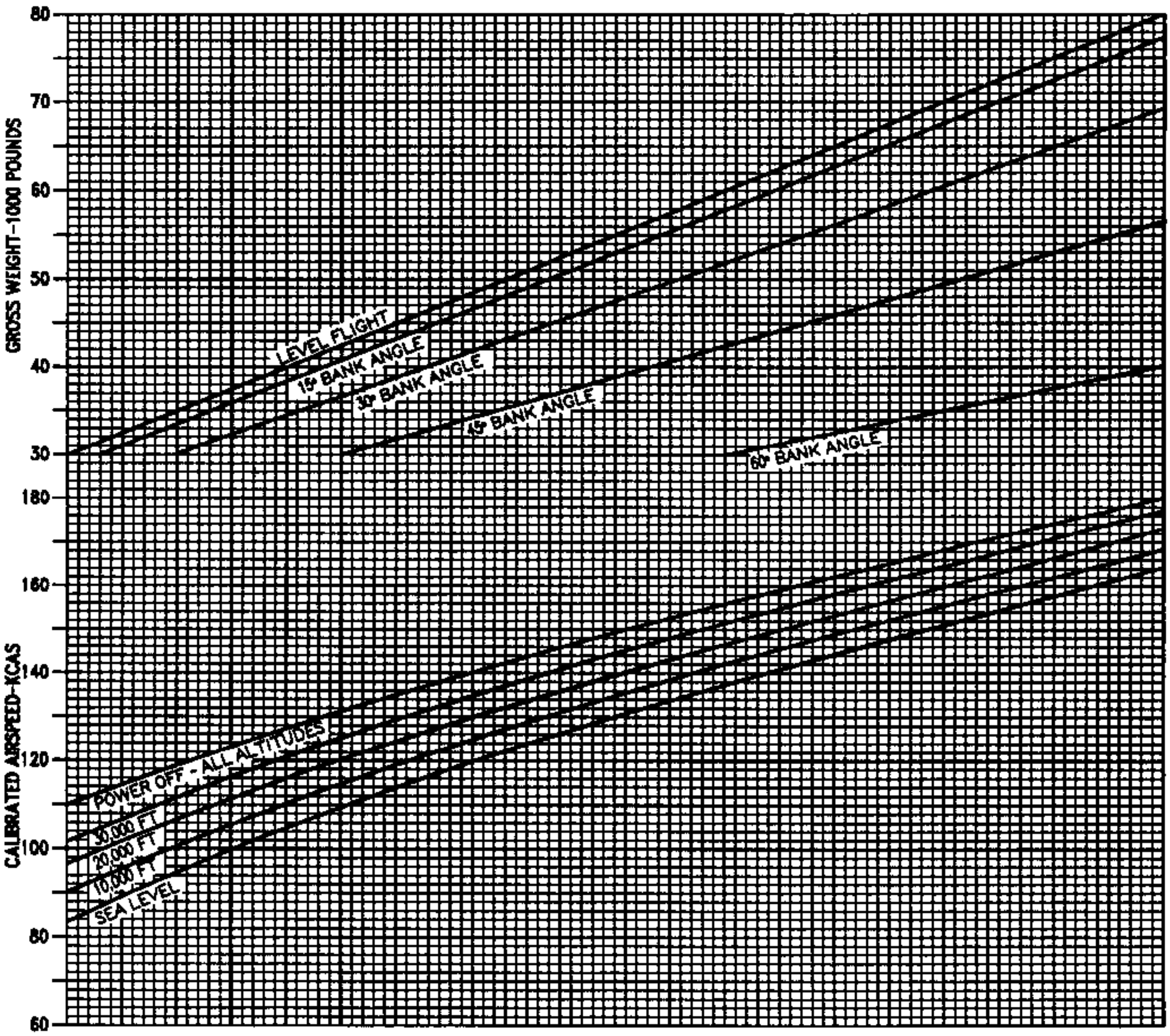
MILITARY THRUST

AIRPLANE CONFIGURATION
GEAR AND FLAPS UP
ALL DRAG INDEXES

REMARKS
U.S. STANDARD DAY, 1966
ENGINE(S): (2) F100-PW-220

GUIDE

DATE: 15 JUNE 1988
DATA BASIS: FLIGHT TEST



15E-1-(88-1)44-CATI

Figure A1-6

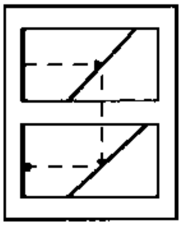
STALL SPEEDS

MAXIMUM THRUST

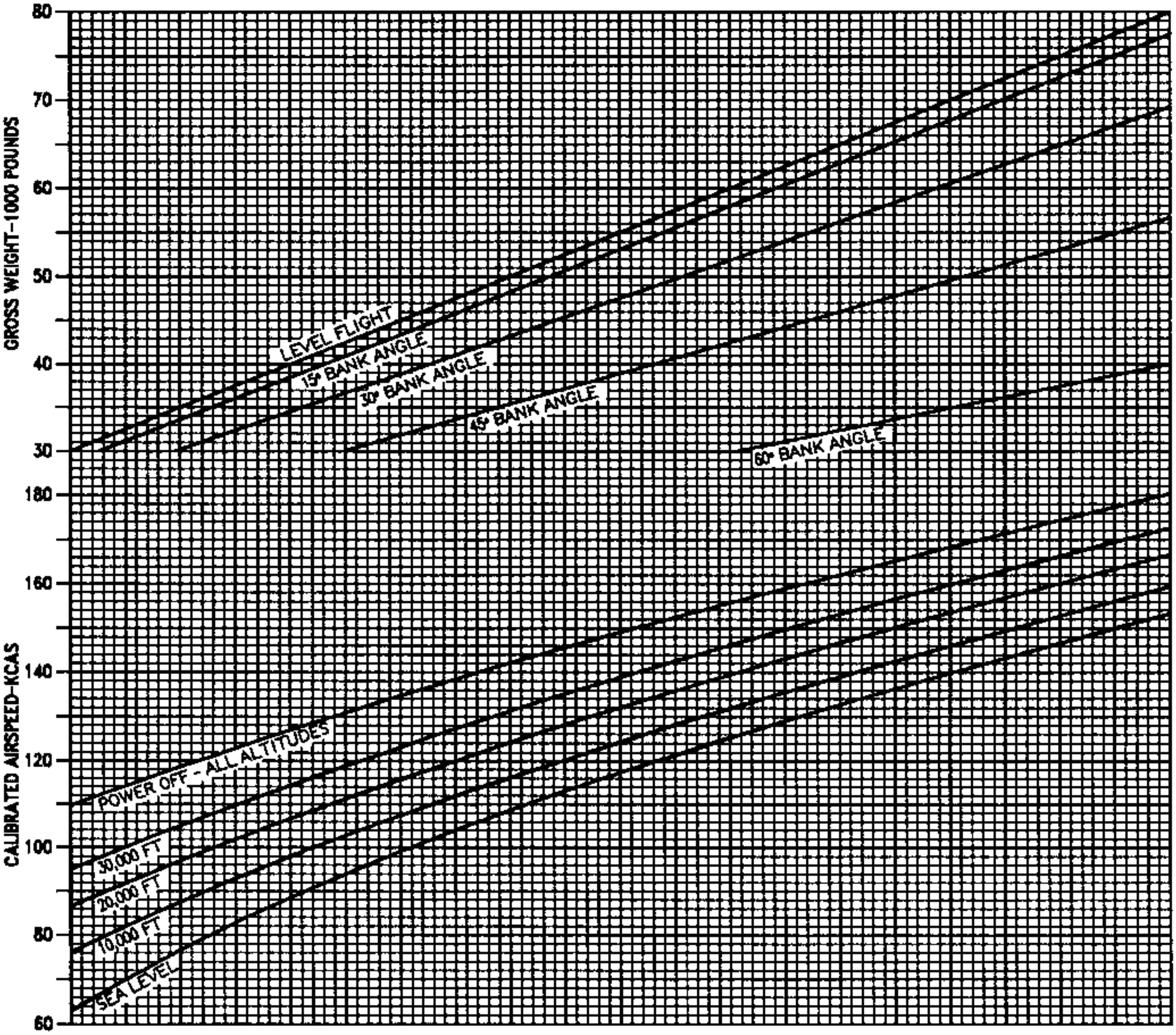
AIRPLANE CONFIGURATION
GEAR AND FLAPS UP
ALL DRAG INDEXES

REMARKS
U.S. STANDARD DAY, 1966
ENGINE(S): (2) F100-PW-220

GUIDE



DATE: 15 JUNE 1988
DATA BASIS: FLIGHT TEST

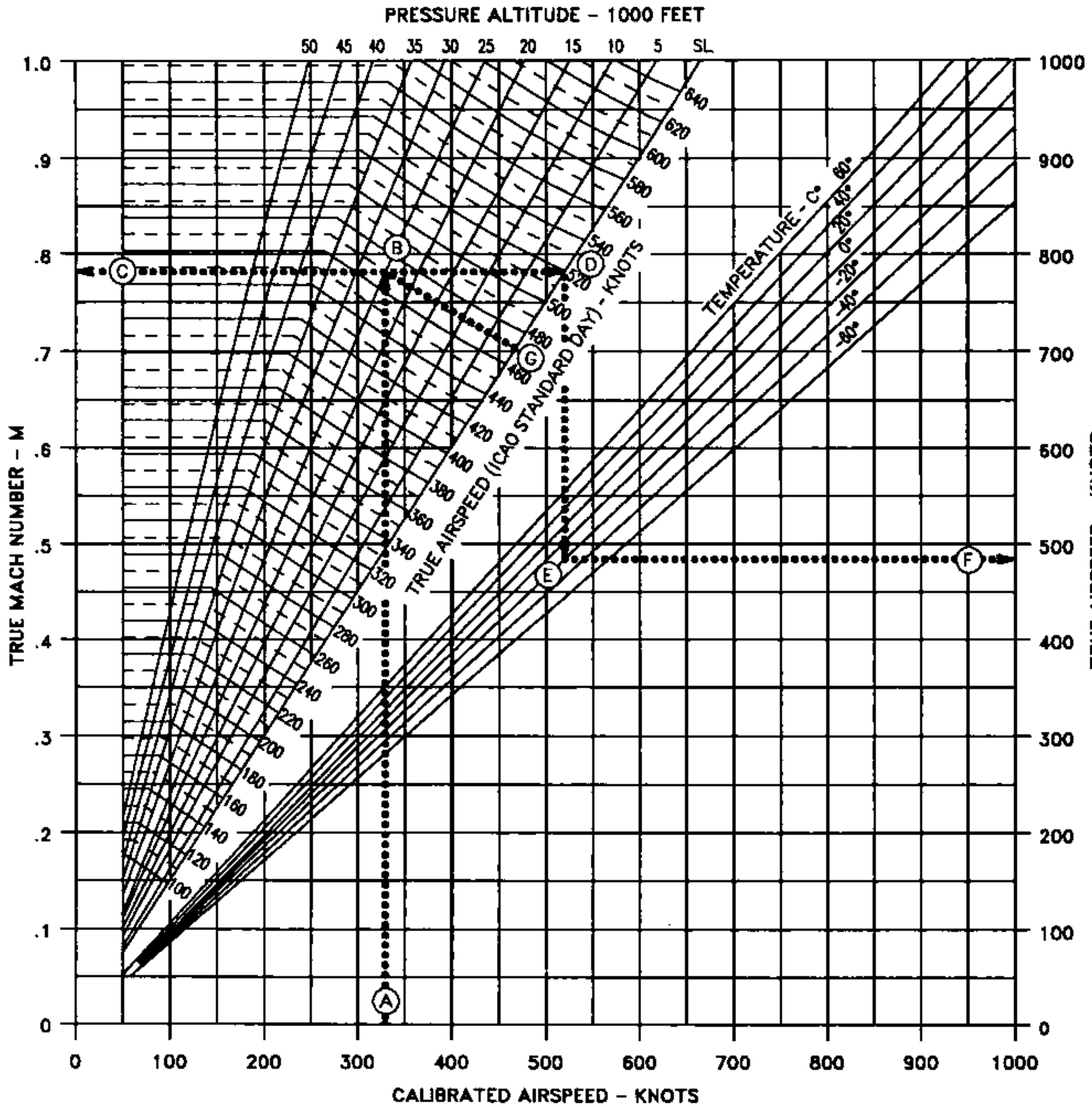


15E-1-(176-1)44-CATI

Figure A1-7

AIRSPEED CONVERSION

LOW MACH



EXAMPLE

A = CAS = 300 KNOTS
B = ALTITUDE = 25,000 FEET
C = MACH = .782
D = SEA LEVEL LINE
E = TEMPERATURE = -20°C
F = TAS = 486 KNOTS
G = TAS (STANDARD DAY) = 472 KNOTS

15E-1-(69-1)44-CATI

Figure A1-8

AIRSPEED CONVERSION

HIGH MACH

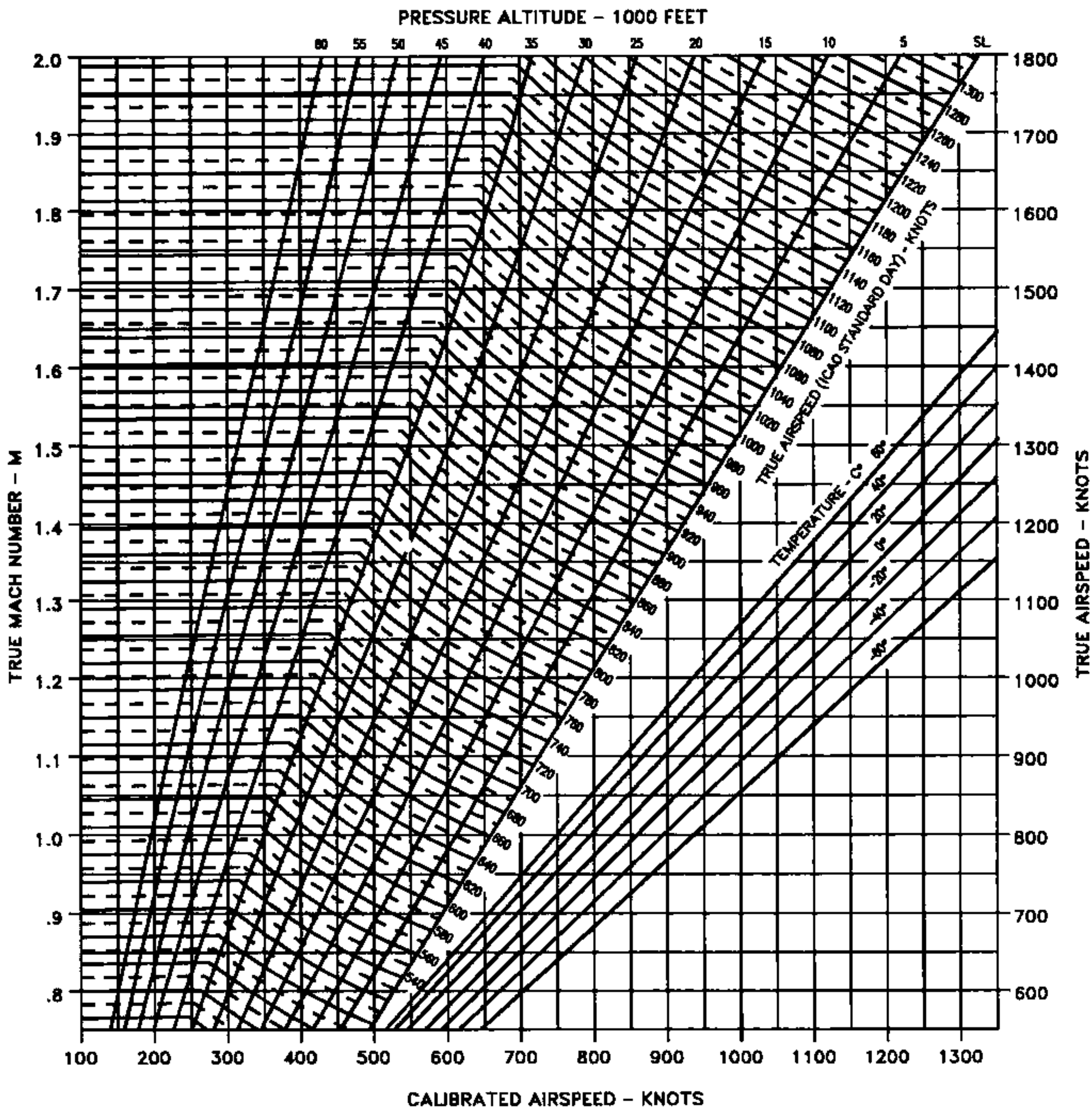


Figure A1-9

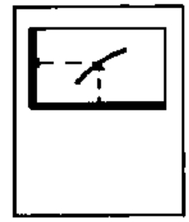
AIRSPEED POSITION ERROR CORRECTION

1G FLIGHT

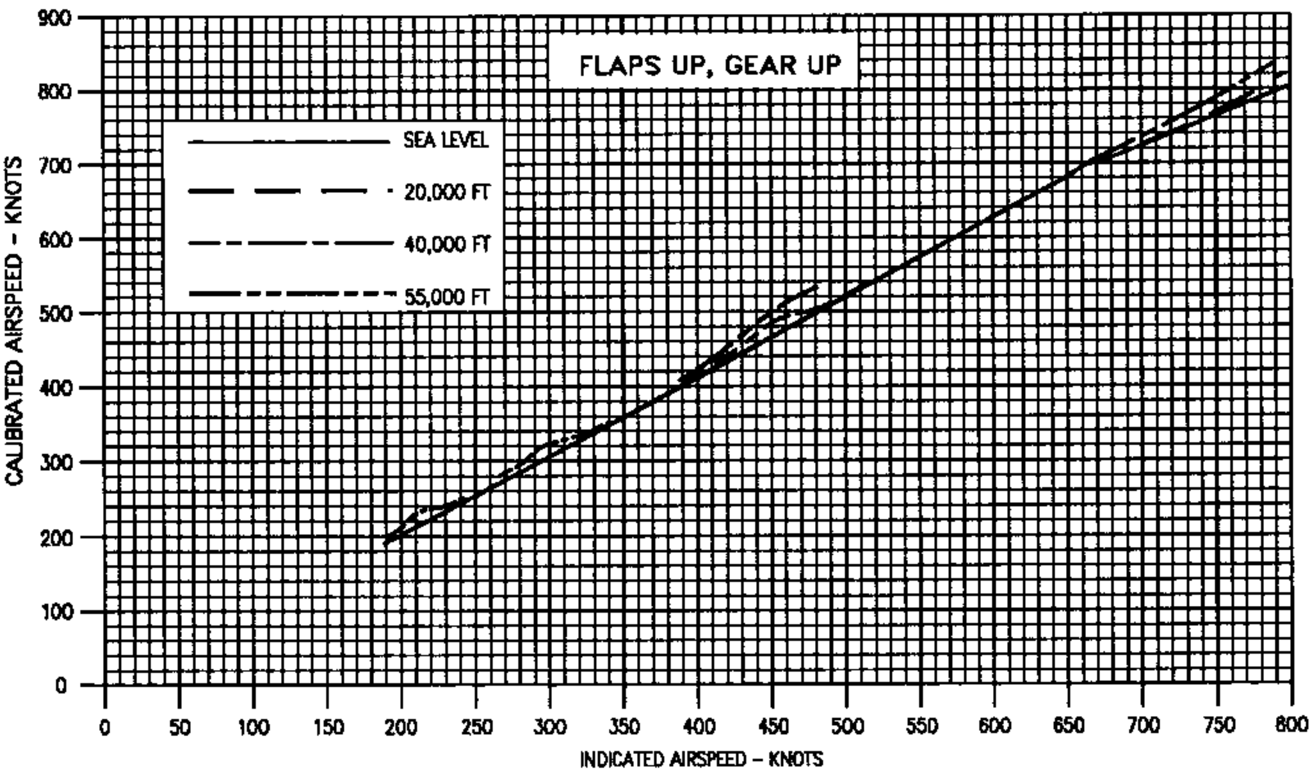
AIRPLANE CONFIGURATION
FLAPS AND GEAR AS NOTED

REMARKS
U.S. STANDARD DAY, 1966

GUIDE



DATE: 15 MARCH 1991
DATA BASIS: ESTIMATED



FLAPS DOWN, GEAR DOWN

10,000 FT AND BELOW

	CALIBRATED AIRSPEED - KTS		
INDICATED AIRSPEED - KTS	GW 30,000	GW 40,000	GW 50,000
140	137	-	-
160	158	157	-
180	178.5	178	177
200	198.5	198.5	198
220	219	218.5	218.5
240	239	238	239

15E-1-(71-1)44-CATI

Figure A1-10

ALTIMETER POSITION ERROR CORRECTION

STANDBY ALTIMETER ONLY

AIRPLANE CONFIGURATION
GEAR AND FLAPS AS NOTED
ALL DRAG INDEXES

REMARKS
U.S. STANDARD DAY, 1966

NOTE
ASSIGNED ALTITUDE + Δ H = INDICATED ALTITUDE, FLY INDICATED ALTITUDE.

DATE: 15 JUNE 1989
DATA BASIS: FLIGHT TEST

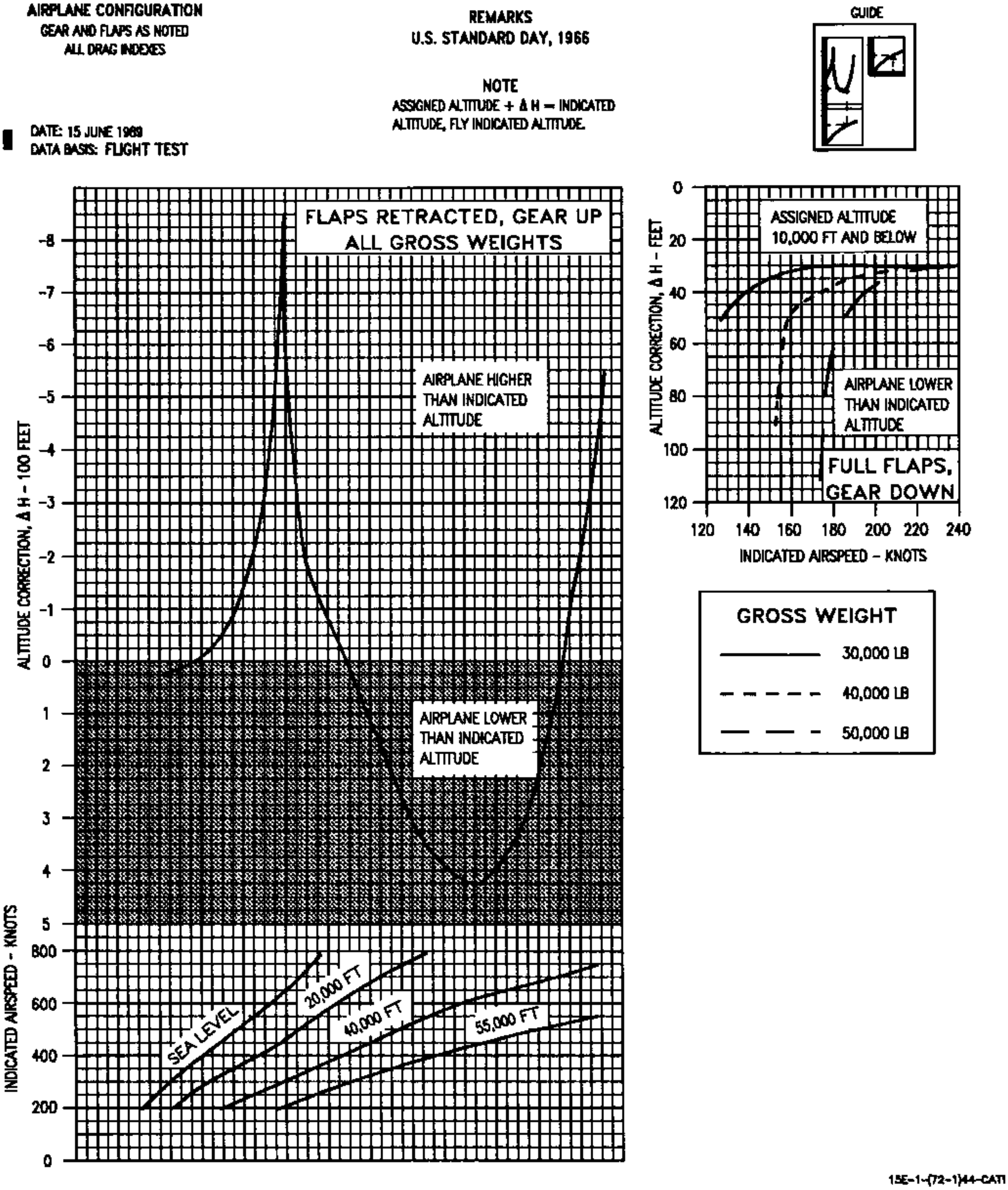
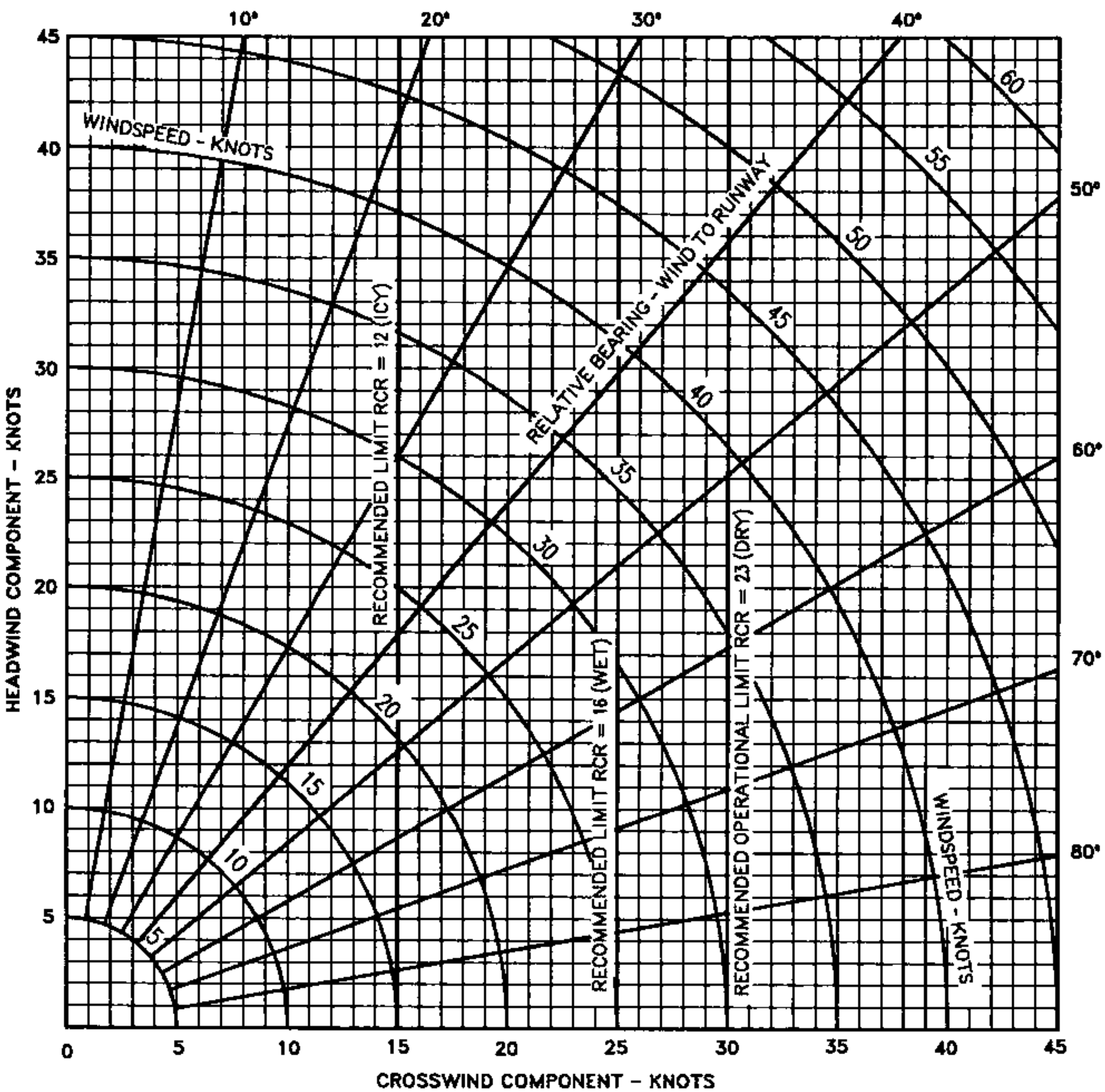


Figure A1-11

WIND COMPONENTS

- DETERMINE THE EFFECTIVE WIND VELOCITY BY ADDING ONE-HALF THE GUST VELOCITY (INCREMENTAL WIND FACTOR) TO THE STEADY STATE VELOCITY: E.G. REPORTED WIND 050/30 G40, EFFECTIVE WIND IS 050/35.
- CROSSWIND LIMITS FOR RCR VALUES, 12-16 AND 16-23 MAY BE OBTAINED BY INTERPOLATING BETWEEN THE LIMITS SHOWN.



15E-1-(73-1)16-CATI

Figure A1-12

PART 2

ENGINE DATA

This part not applicable.

PART 3

TAKEOFF

TABLE OF CONTENTS

Charts

DENSITY RATIO CHART

This chart (figures A3-1) provides a means of obtaining a single factor (density ratio) that may be used to represent a combination of temperature and pressure altitude. Density ratio must be determined before the Minimum Go Speed and Maximum Abort Speed charts can be utilized.

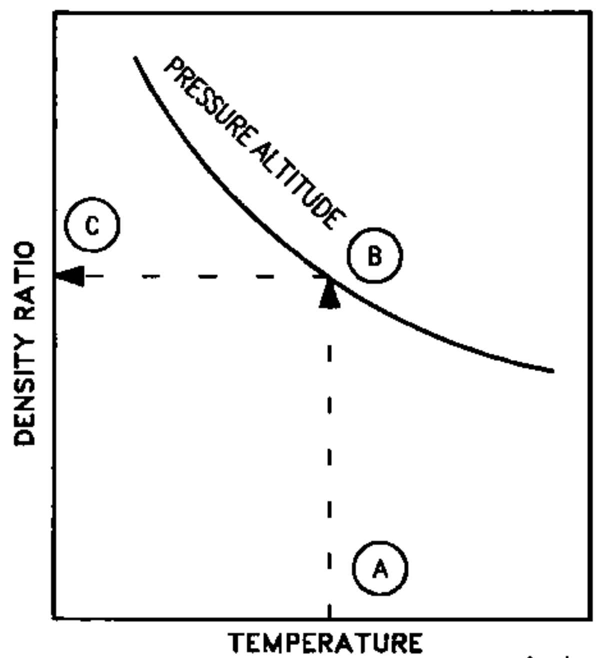
USE

Enter the chart with existing temperature, and project vertically to intersect the applicable pressure altitude curve. From this point, project horizontally to the left scale to read density ratio.

Sample Problem

A. Temperature	60°F
B. Pressure Altitude	2000 Ft
C. Density ratio	0.93

SAMPLE DENSITY RATIO



15E-1-(74-1)44-CATI

MINIMUM GO SPEED CHART

These charts (figures A3-2, A3-6) provide the means of determining the minimum speed at which the aircraft can experience an engine failure and still take off under existing conditions of temperature, pressure altitude, gross weight, and the runway length remaining. Separate plots are provided for maximum and military thrust conditions, and for aircraft with and without CFT's installed. The data is based on an engine failure occurring at the minimum go speed and allows for a 3-second decision period with one engine operating at its initial thrust setting. In the case of a military thrust takeoff, an additional 3-second period is allowed for advancing the operating engine throttle to maximum thrust.

These charts address only the ability of the aircraft to takeoff on the remaining runway following an engine failure, not the additional issue of directional controllability on the runway. An engine failure rapidly produces a thrust asymmetry which can induce large lateral excursions if corrective action is not taken promptly. The effects of the thrust asymmetry are largest at low speeds where the combination of flight control system effectiveness and nose-wheel steering control is lowest. The effects of thrust asymmetry are dependent on power setting, temperature, pressure altitude, gross weight, and runway surface condition. Directional control at speeds below 100 KCAS even on a dry runway may be insufficient to maintain acceptable lateral placement on the runway. Abort the takeoff if large lateral excursions occur. Directional controllability problems due to thrust asymmetry should be countered by applying opposite rudder pedal and/or reduce the thrust level.

WARNING

If an engine is lost above the maximum abort speed but below the minimum go speed, the pilot can neither abort nor take off safely on the runway length remaining without considering such factors as reducing gross weight or engaging the overrun end arrestment cable. Refer to Engine Failure During Takeoff, section III.

USE

Enter the applicable plot with the prevailing density ratio, and project horizontally to the available runway length grid line. Parallel the nearest guideline up or down to intersect the baseline. From this point descend vertically to intersect the applicable takeoff gross weight curve, then horizontally to read minimum go speed. If this projected line lies entirely to the right of the gross weight curve single engine failure can be tolerated at any speed between zero and the highest speed shown with the ground roll being within the available runway length. If the above projected line lies entirely to the left of the gross weight curve, single engine failure takeoff cannot be accomplished with the available runway length. With CFTs, the recommended rotation speeds are given in figure 3-10. Without CFTs, with an engine failure before nose rotation at high gross weights, , the ground roll will be shortened if aft stick is relaxed until 10 to 15 knots below takeoff speed. This situation will be obvious to the pilot.

Sample Problem

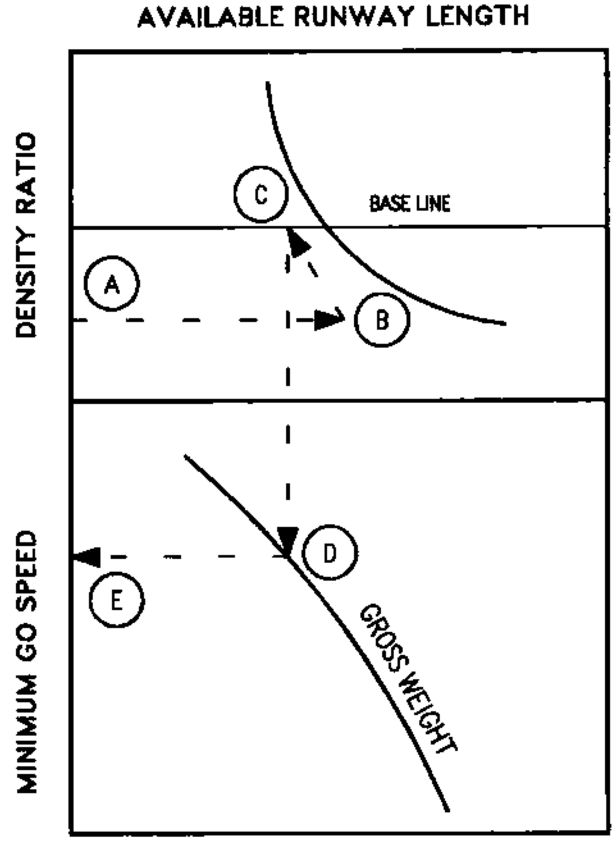
Maximum Thrust Takeoff With CFT (with fuel tanks or A/G stores on wing pylons)

A. Density ratio	0.90
B. Available runway length	9000 Ft
C. Parallel guideline to base-line	
D. Takeoff gross weight	75,000 Lb
E. Minimum go speed	172 KCAS

NOTE

This problem assumes maximum thrust on operating engine within 6 seconds after engine failure. The minimum go speed for a maximum thrust takeoff will be less than that for a military thrust takeoff due to the greater acceleration with maximum thrust up to and including the 3-second decision time.

SAMPLE MINIMUM GO SPEED



15E-1-(75-1)44-CATI

MAXIMUM ABORT SPEED CHART

NOTE

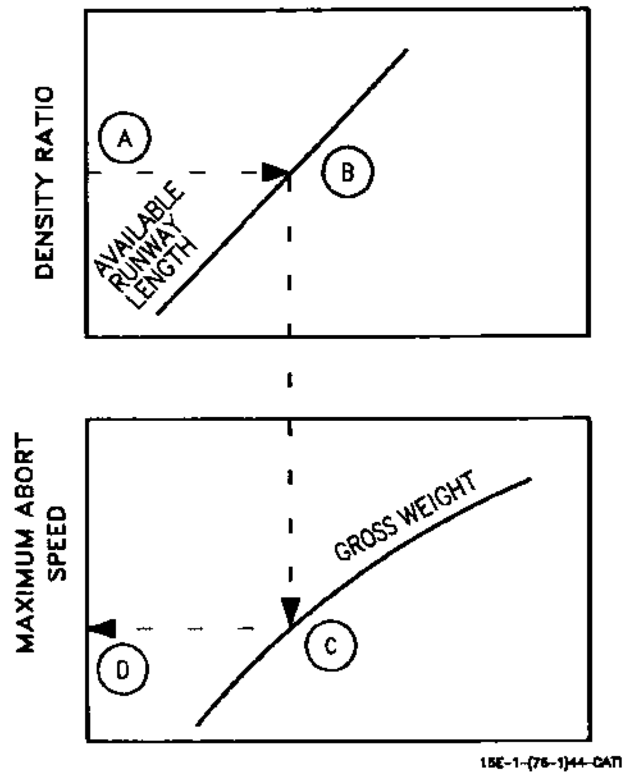
- The maximum abort speed chart does not include the capability of any arrestment gear which may be installed, and takes into account only aircraft stopping performance for the given field conditions.
- Lower weight aircraft are often shown to have lower maximum abort speeds than higher weight aircraft due to the greater acceleration of the lighter aircraft during the abort decision period used in the calculations.

These charts (figures A3-3 and A3-7) provide a means of determining the maximum speed at which an abort may be started and the aircraft stopped within the remaining runway length. Separate plots are provided for maximum and military thrust, and for aircraft with and without CFT's installed. Separate plots are also included for dry, wet, and icy runways. Allowances included in this data are based on a 3-second decision period (with both engines operating at the initial thrust setting) followed by a 2-second period to apply wheel brakes and a 5-second period to reach idle thrust (these two abort procedures are initiated simultaneously).

USE

Enter applicable plot with the prevailing density ratio, and project horizontally to intersect the available runway length curve. From this point, descend further to intersect the computed takeoff gross weight, then horizontally to read the corresponding maximum abort speed.

SAMPLE MAXIMUM ABORT SPEED



Sample Problem

Maximum Thrust Takeoff, Hard Dry Runway, With CFT (with fuel tanks or A/G stores on wing pylons)

A. Density ratio	0.90
B. Available runway length	9000 Ft
C. Gross weight	75,000 Lb
D. Maximum abort speed	125 KCAS

TAKEOFF DISTANCE CHARTS

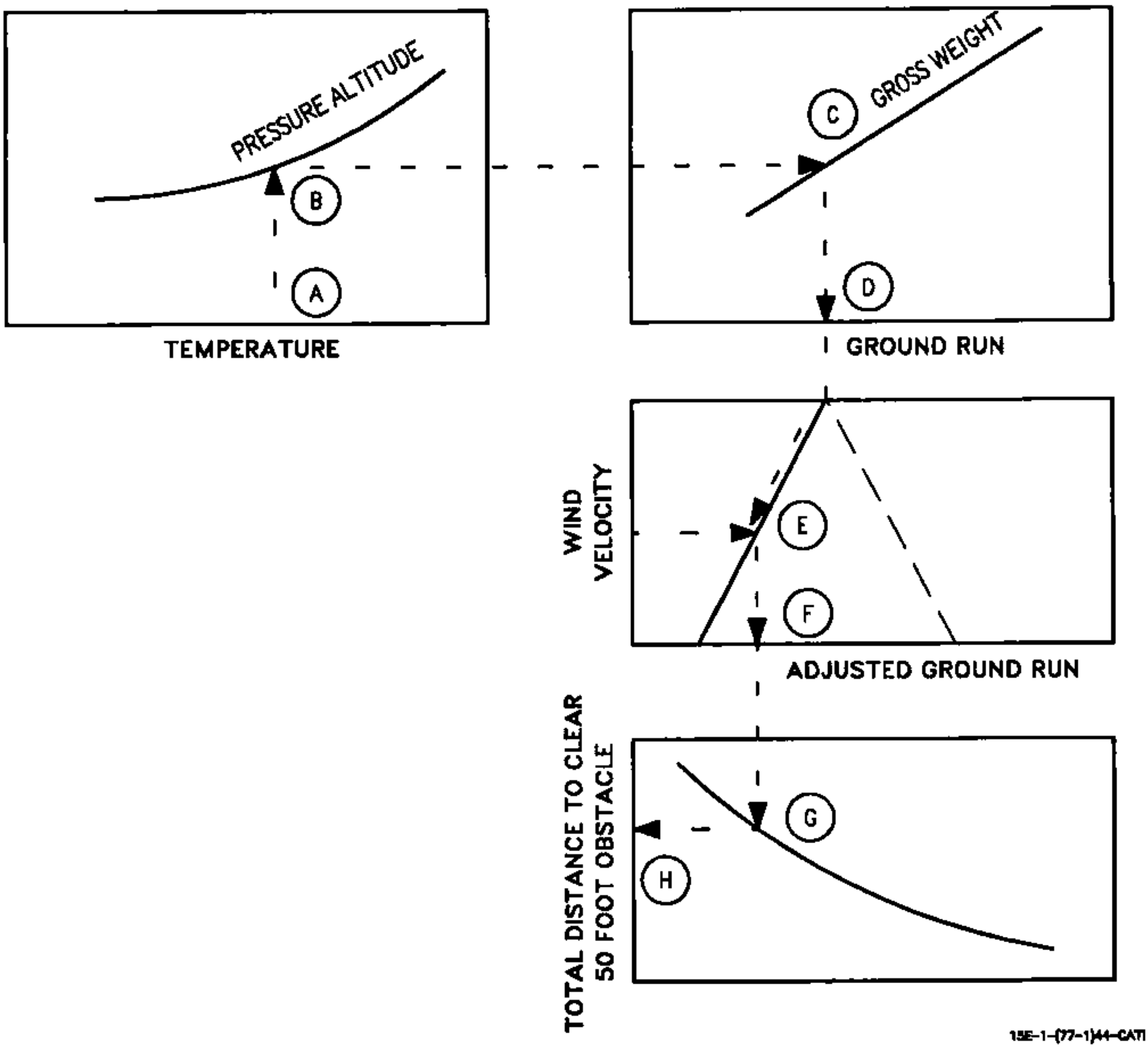
These charts (figures A3-4, A3-5, A3-8, A3-9) are used to determine the no wind ground run distance, wind adjusted ground run and the total distance required to clear a 50-foot obstacle. Separate charts are provided for maximum and military thrust, and for aircraft with and without CFT's installed. The without CFT charts (figures A3-8, A3-9) are based on CG's representative of each gross weight. With CFTs, the CG's used for each gross weight are noted on the chart. Takeoff distances will be reduced for aft CG's and increased for forward CG's.

The notes regarding CG effect on ground roll on the takeoff charts are based on conservative performance estimates based on data generated at typical weight, altitude, and temperature conditions.

USE

Enter the chart with existing temperature and project vertically to intersect the applicable pressure altitude curve. From that point, proceed horizontally to the right and intersect the takeoff weight line. Then descend vertically to read no wind ground run distance. Parallel the appropriate wind guideline (headwind or tailwind) to intersect the takeoff wind velocity. From this point project vertically down to read the ground run adjusted for wind effects. To find the total distance required to clear a 50-foot obstacle, continue downward to the reflector line and project horizontally to the left scale.

SAMPLE TAKEOFF DISTANCE



Sample Problem

Maximum Thrust With CFT (with fuel tanks or A/G stores on wing pylons)

A. Temperature	20°C
B. Pressure altitude	2000 Ft
C. Gross weight	75,000 Lb
A. Temperature	20°C
D. No wind Ground run distance	4050 Ft
E. Effective headwind	25 Kt
F. Ground run (wind corrected)	3100 Ft
G. Intersect reflector line	
H. Total distance required to clear 50-foot obstacle	5400 Ft

NOSEWHEEL LIFTOFF SPEED/TAKEOFF SPEED CHART

These charts (figures A3-10 and A3-11) are used to determine nosewheel liftoff speed and aircraft takeoff speed for various gross weights in either maximum or military thrust for aircraft with and without CFTs installed

With CFTs installed, rotation speeds along with the corresponding nosewheel liftoff and takeoff speeds are presented for standard two-engine takeoffs as a function of CG and gross weight. At the indicated rotation speed one-half aft stick should be applied and the aircraft rotated to 12°. Rotation speeds increase at forward CGs to prevent nosewheel bouncing. Rotation speeds are also presented for continued takeoffs after an engine failure during ground roll. For continued takeoffs one-half aft stick should be applied at the rotation speed, but the aircraft should only be rotated to 10° for improved acceleration.

Without CFTs, the speeds are based on CGs representative of each gross weight. The chart provides data for either a normal or maximum performance takeoff. A normal takeoff is accomplished by applying 1/2 aft stick over a period of 1 second as the aircraft is accelerating through 120 knots, and then holding 10° of pitch throughout the takeoff roll. A maximum performance takeoff is accomplished by applying full aft stick at a low speed and when the nose rotates, holding 12° of pitch throughout the takeoff roll. Aircraft rotation will be more rapid with the maximum performance takeoff technique. Rotation speeds are also presented for continued takeoffs after an engine failure during ground roll. For continued takeoffs one-half aft stick should be applied at the rotation speed, with a 10° pitch attitude held throughout the takeoff roll.

The difference in nosewheel lift-off speeds between military and maximum thrust are due to the thrust effects on pitching moment. The differences in takeoff speeds are due to the thrust support in lift and the time required to rotate the aircraft to takeoff attitude.

SINGLE ENGINE RATE OF CLIMB

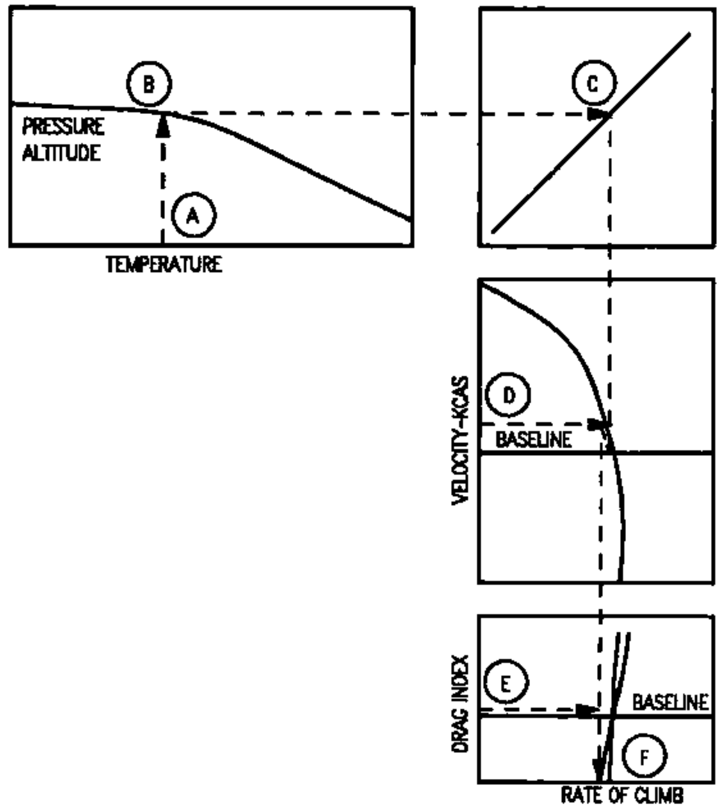
These charts (figures A3-12 thru A3-16) provide the means of determining single engine rate of climb for takeoff planning purposes for existing conditions of temperature, pressure altitude, gross weight, airspeed, and Drag Index. Separate plots are provided for gross weights from 60,000 lb to 81,000 lb. The data are for one engine operating at maximum A/B thrust and the other engine windmilling. Out-of-ground-effects aero data were used in construction of these charts. Gear and flaps are extended.

These charts can be used to determine if single engine rate of climb is adequate at the single engine takeoff speeds obtained from figure A3-10 for the continued takeoff technique. The change in rate of climb due to increasing or decreasing takeoff speed can also be determined.

USE

Enter the applicable chart with existing temperature and project vertically to intersect the applicable pressure altitude curve. From this point, project horizontally to the right and intersect the applicable with or without wing stores line. Then descend vertically to intersect the baseline velocity of 210 KCAS. Parallel the guidelines to intersect the takeoff velocity in question. From this point descend vertically to intersect the baseline Drag Index. Parallel the appropriate velocity guideline to intersect the takeoff Drag Index. Descend vertically again to read the single engine rate of climb.

SAMPLE SINGLE ENGINE RATE OF CLIMB



15E-1-(224-1)04-CATI

Sample Problem

Gross Weight 75,000 Lb

A. Temperature	5°C
B. Pressure Altitude	Sea Level
C. Wing Tanks or A/G Weapons Installed	
D. Takeoff Velocity	204 KCAS
E. Drag Index	100
F. Single Engine Rate of Climb	+1200 ft/min

DENSITY RATIO

AIRPLANE CONFIGURATION
ALL DRAG INDEXES

DATE: 15 JUNE 1989
DATA BASIS: FLIGHT TEST

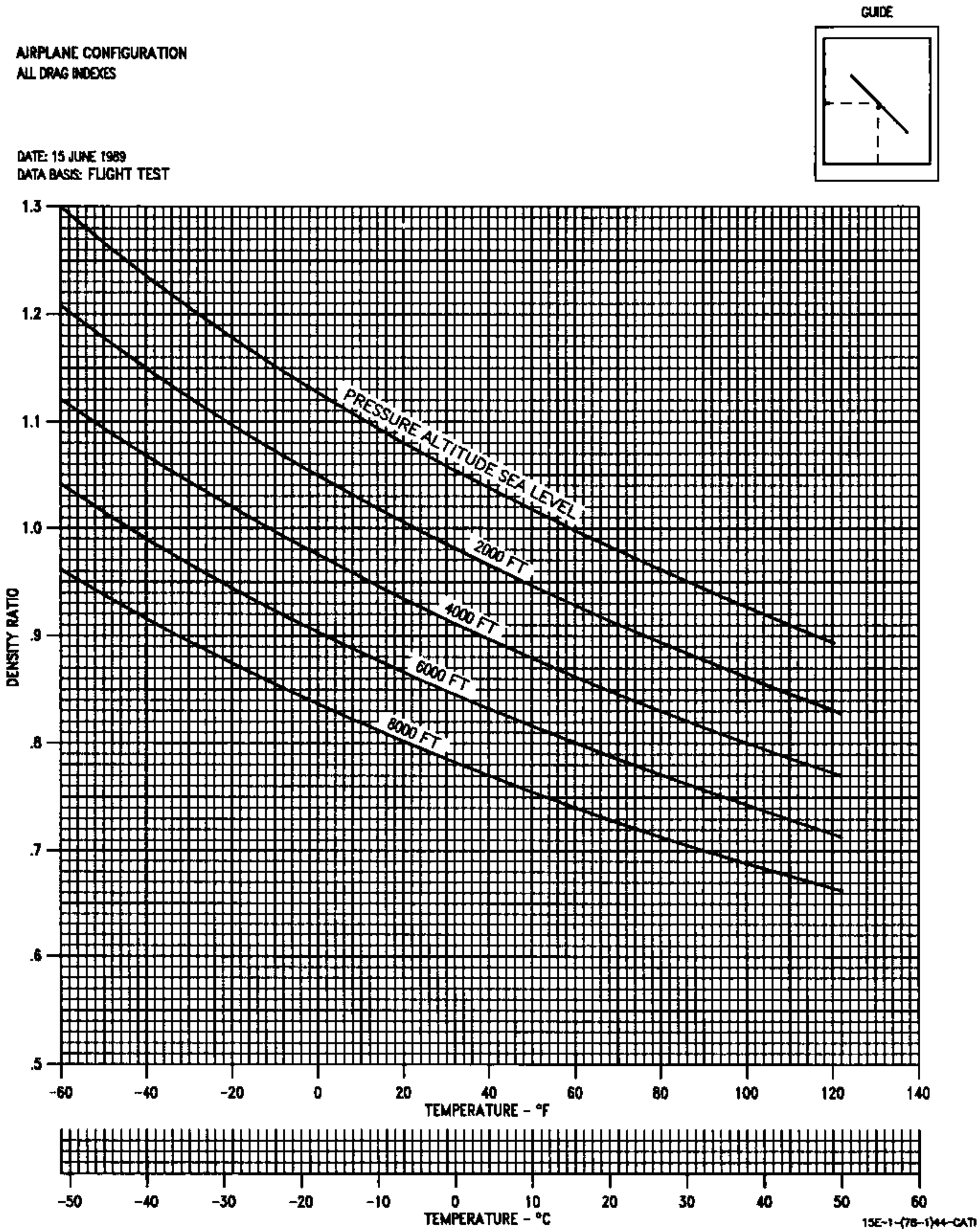
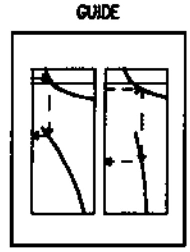


Figure A3-1

MINIMUM GO SPEEDS

WITH CFT
(WITH SINGLE ENGINE FAILURE)



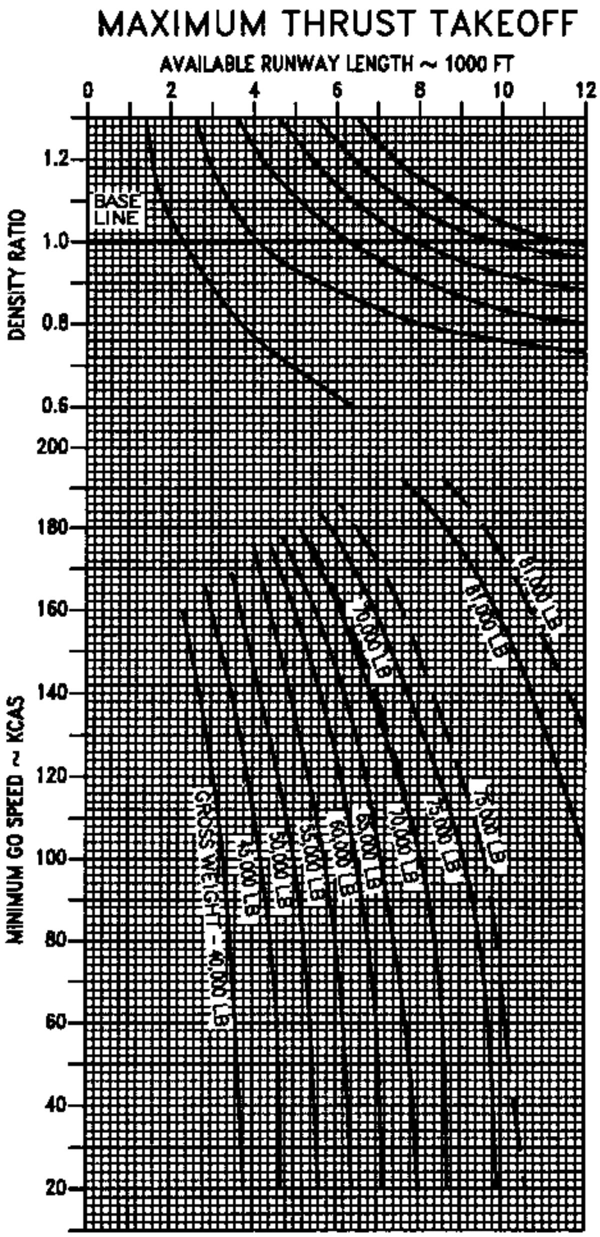
AIRPLANE CONFIGURATION
GEAR AND FLAPS DOWN
ALL DRAG INDEXES

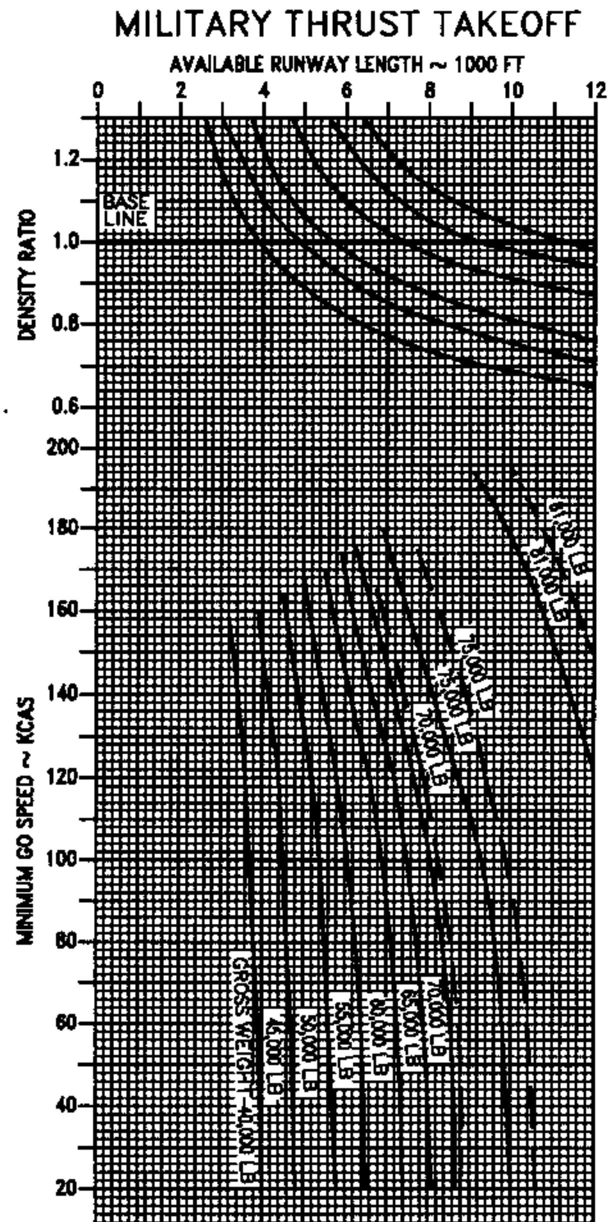
REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

NOTE

- FOLLOWING ENGINE FAILURE WITH MILITARY THRUST, THE AFTERBURNER IS IGNITED ON THE OPERATING ENGINE.
- HALF AFT STICK APPLIED AT THE ROTATION SPEED FROM FIG A3-10 AND A 10 DEGREE PITCH ATTITUDE HELD AFTER ROTATION.
- DASHED LINES TO BE USED WHEN CARRYING AIR-TO-GROUND WEAPONS OR FUEL TANKS ON WING STATIONS.
- SOLID LINES TO BE USED WHEN CARRYING NO STORES OR ONLY AIR-TO-AIR WEAPONS ON WING STATIONS.

DATE: 15 JUNE 1988
DATA BASIS: FLIGHT TEST





15E-1-(79-1)44-CATI

Figure A3-2

MAXIMUM ABORT SPEED

WITH CFT
MAXIMUM THRUST
HARD DRY RUNWAY

AIRPLANE CONFIGURATION
FLAPS AND GEAR DOWN
ALL DRAG INDEXES

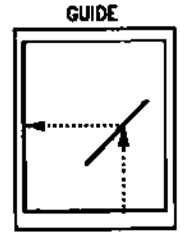
REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

DATE: 15 JUNE 1992
DATA BASIS: ESTIMATED

NOTE

- DATA IS FOR NO-WIND CONDITION. ADD HEADWIND OR SUBTRACT TAILWIND TO DETERMINE ACTUAL MAXIMUM ABORT SPEED.
- HALF AFT STICK APPLIED AT THE ROTATION SPEED FROM FIG A3-10 AND A 12 DEGREE PITCH ATTITUDE HELD AFTER ROTATION UNTIL ALTERED BY ABORT PROCEDURES.

GUIDE



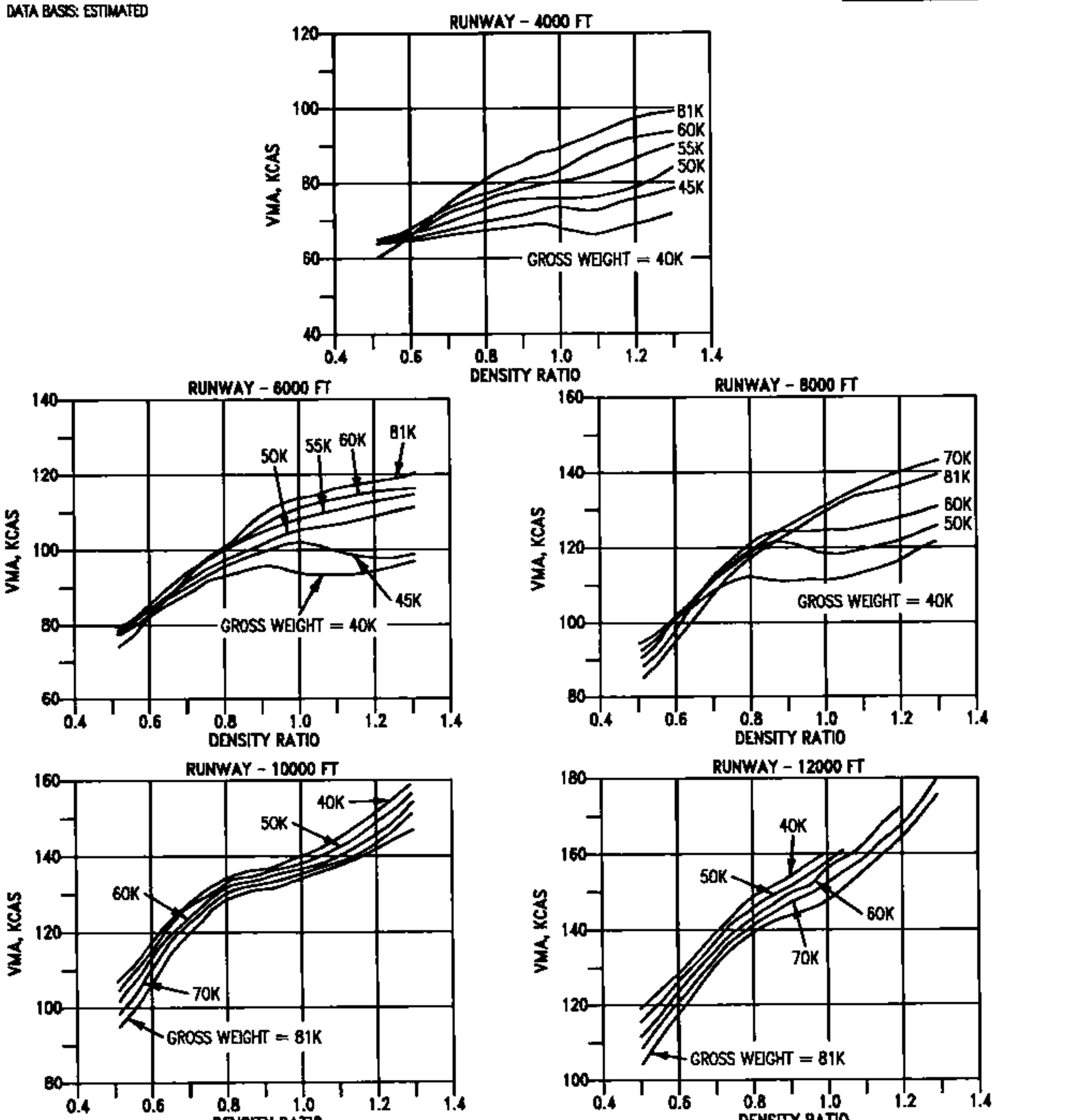


Figure A3-3 (Sheet 1 of 6)

MAXIMUM ABORT SPEED

WITH CFT
MILITARY THRUST
HARD DRY RUNWAY

AIRPLANE CONFIGURATION
FLAPS AND GEAR DOWN
ALL DRAG INDEXES

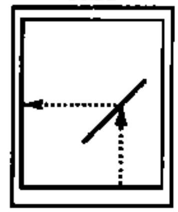
REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

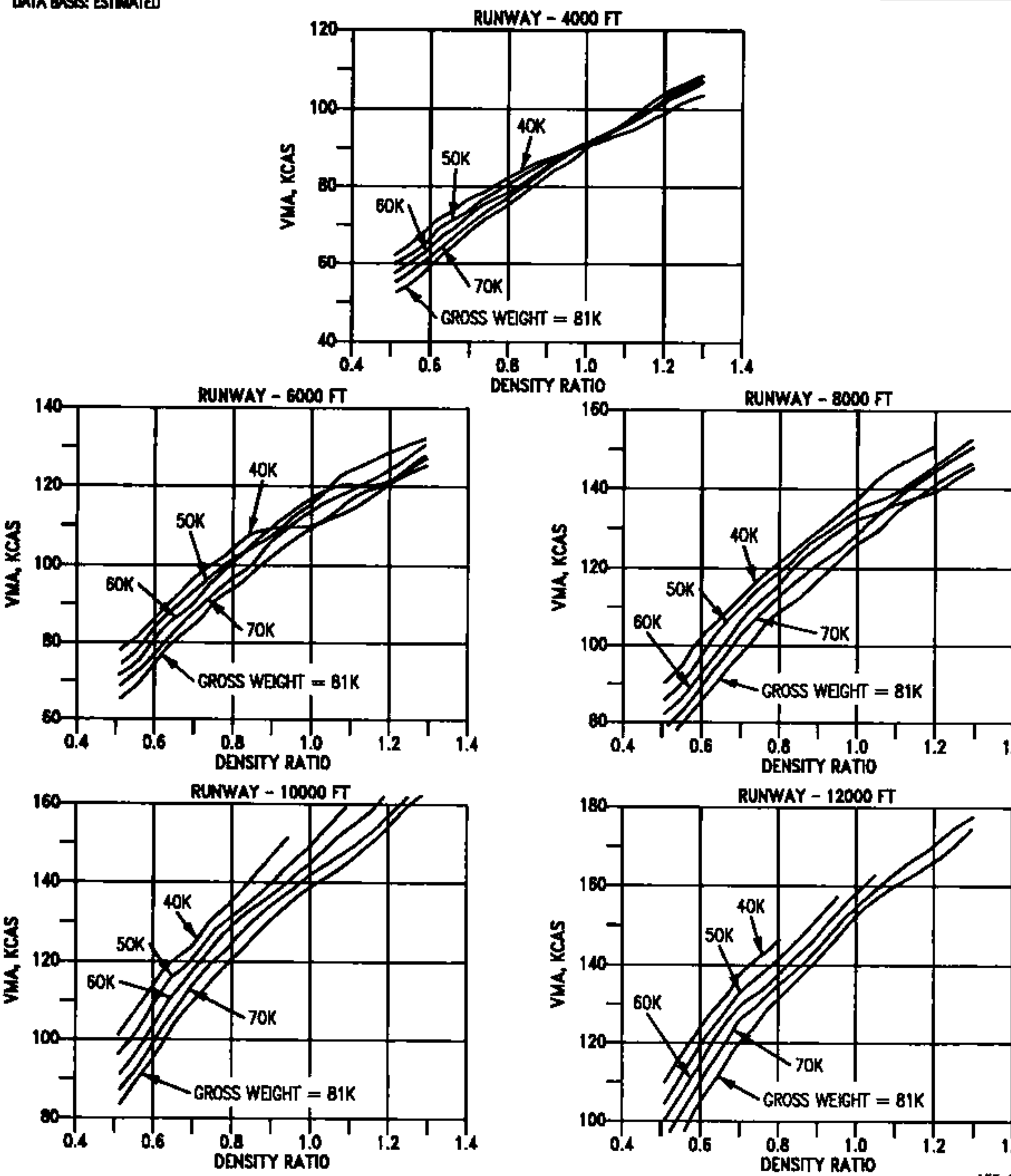
DATE: 15 JUNE 1992
DATA BASIS: ESTIMATED

NOTE

- DATA IS FOR NO-WIND CONDITION. ADD HEADWIND OR SUBTRACT TAILWIND TO DETERMINE ACTUAL MAXIMUM ABORT SPEED.
- HALF AFT STICK APPLIED AT THE ROTATION SPEED FROM FIG A3-10 AND A 12 DEGREE PITCH ATTITUDE HELD AFTER ROTATION UNTIL ALTERED BY ABORT PROCEDURES.

GUIDE





15E-1-(80-2)38-CATI

Figure A3-3 (Sheet 2)

MAXIMUM ABORT SPEED

WITH CFT
MAXIMUM THRUST
HARD WET RUNWAY

AIRPLANE CONFIGURATION
FLAPS AND GEAR DOWN
ALL DRAG INDEXES

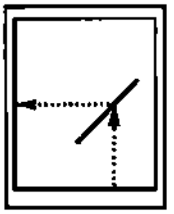
REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

DATE:15 JUNE 1992
DATA BASIS: ESTIMATED

NOTE

- DATA IS FOR NO-WIND CONDITION. ADD HEADWIND OR SUBTRACT TAILWIND TO DETERMINE ACTUAL MAXIMUM ABORT SPEED.
- HALF AFT STICK APPLIED AT THE ROTATION SPEED FROM FIG A3-10 AND A 12 DEGREE PITCH ATTITUDE HELD AFTER ROTATION UNTIL ALTERED BY ABORT PROCEDURES.

GUIDE



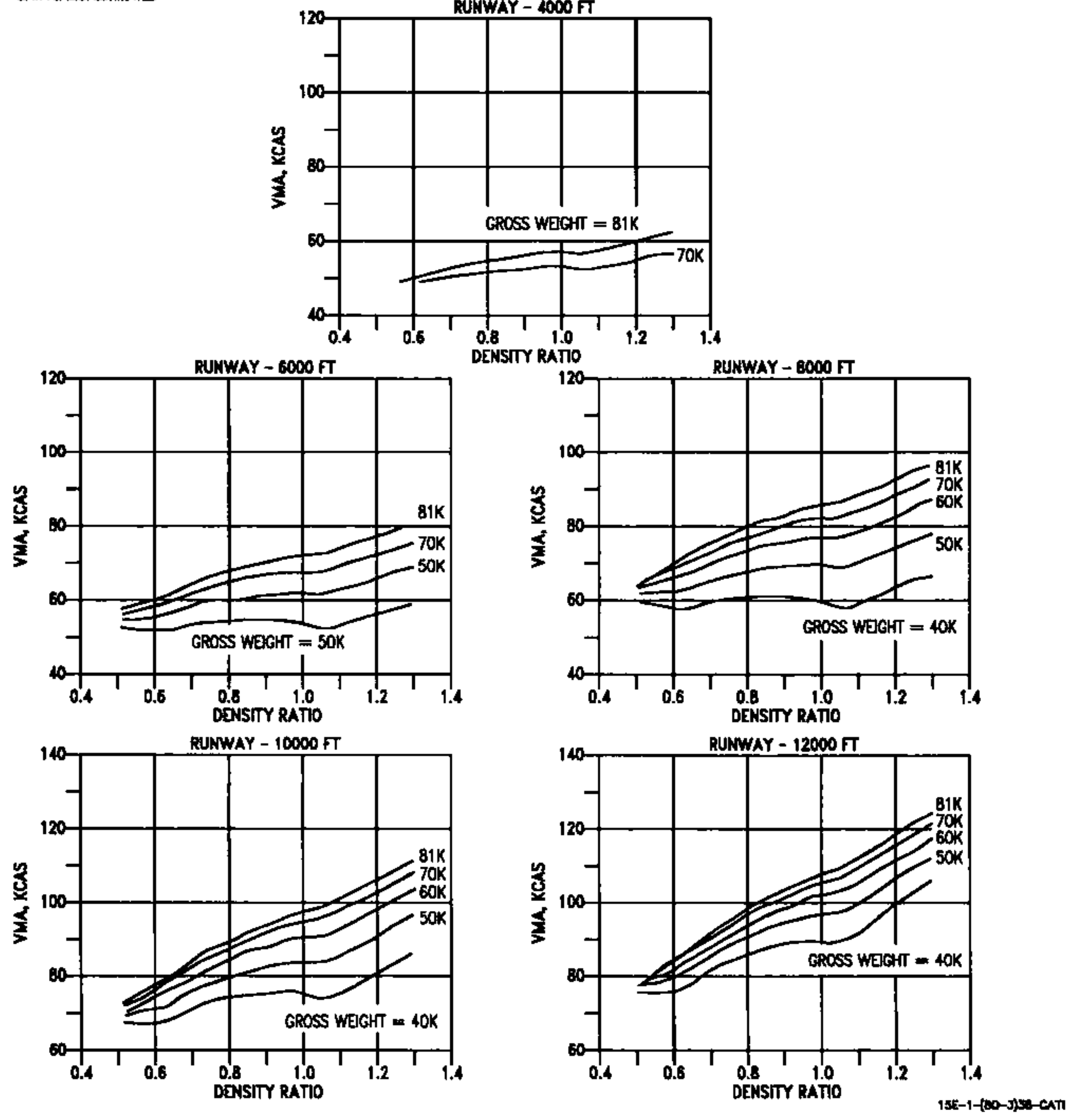


Figure A3-3 (Sheet 3)

MAXIMUM ABORT SPEED

WITH CFT
MILITARY THRUST
HARD WET RUNWAY

AIRPLANE CONFIGURATION
FLAPS AND GEAR DOWN
ALL DRAG INDEXES

REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

DATE: 15 JUNE 1992
DATA BASIS: ESTIMATED

NOTE

- DATA IS FOR NO-WIND CONDITION. ADD HEADWIND OR SUBTRACT TAILWIND TO DETERMINE ACTUAL MAXIMUM ABORT SPEED.
- HALF AFT STICK APPLIED AT THE ROTATION SPEED FROM FIG A3-10 AND A 12 DEGREE PITCH ATTITUDE HELD AFTER ROTATION UNTIL ALTERED BY ABORT PROCEDURES.

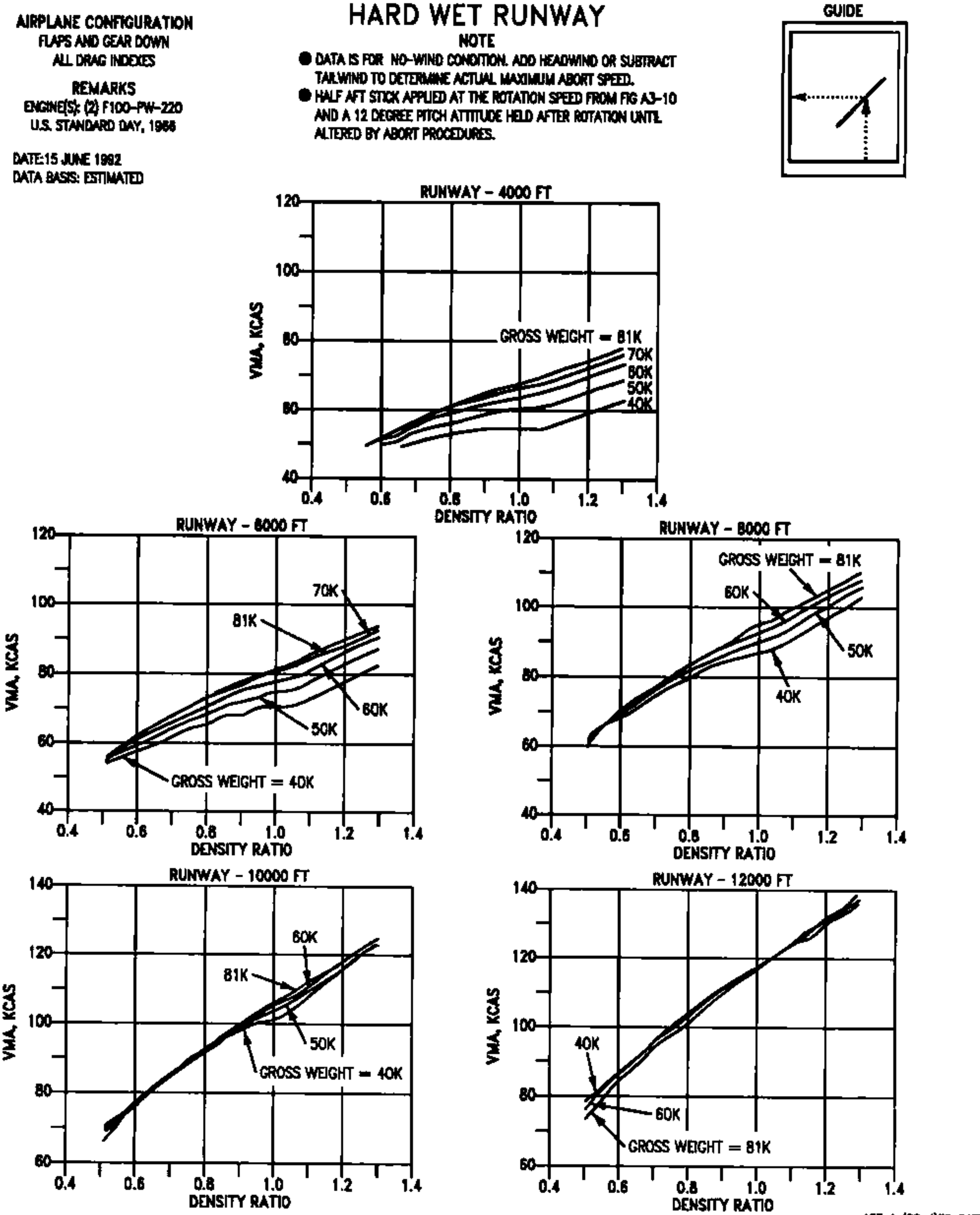


Figure A3-3 (Sheet 4)

MAXIMUM ABORT SPEED
WITH CFT
MAXIMUM THRUST
HARD ICY RUNWAY

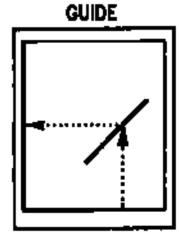
AIRPLANE CONFIGURATION
FLAPS AND GEAR DOWN
ALL DRAG INDEXES

REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

DATE:15 JUNE 1992
DATA BASIS: ESTIMATED

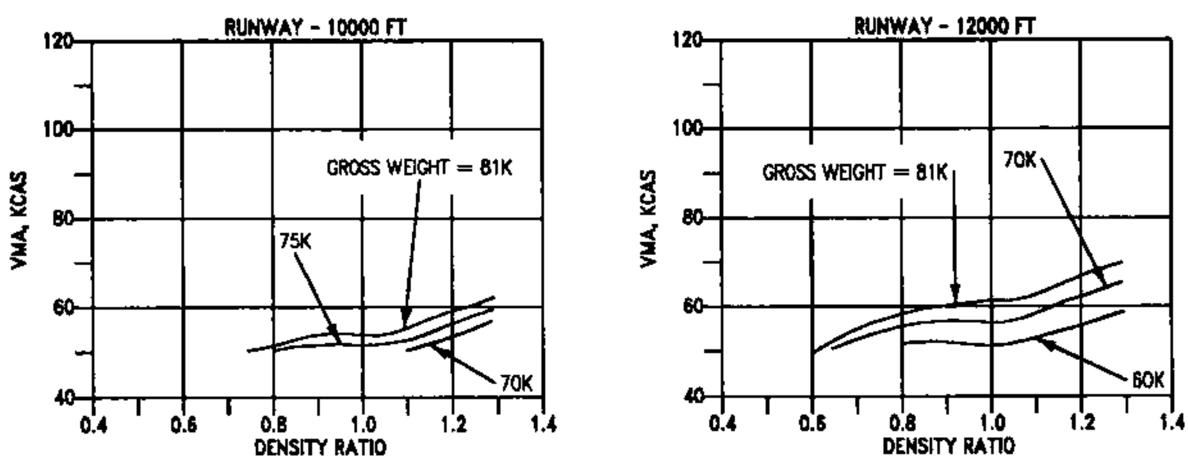
NOTE

- DATA IS FOR NO-WIND CONDITION. ADD HEADWIND OR SUBTRACT TAILWIND TO DETERMINE ACTUAL MAXIMUM ABORT SPEED.
- HALF AFT STICK APPLIED AT THE ROTATION SPEED FROM FIG A3-10 AND A 12 DEGREE PITCH ATTITUDE HELD AFTER ROTATION UNTIL ALTERED BY ABORT PROCEDURES.



CAUTION

ON RUNWAYS OF 4000 TO 8000 FEET TAKEOFF CANNOT BE ABORTED ON ICY RUNWAY USING BRAKING ALONE.



15E-1-(80-5)38-CATI

Figure A3-3 (Sheet 5)

MAXIMUM ABORT SPEED
WITH CFT
MILITARY THRUST
HARD ICY RUNWAY

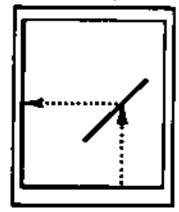
AIRPLANE CONFIGURATION
FLAPS AND GEAR DOWN
ALL DRAG INDEXES

REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

DATE: 15 JUNE 1992
DATA BASIS: ESTIMATED

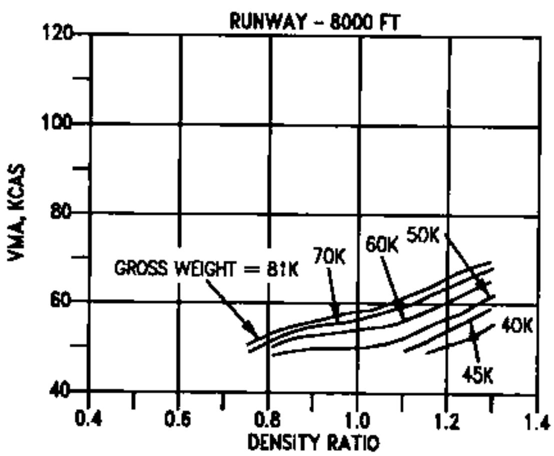
NOTE
- DATA IS FOR NO-WIND CONDITION. ADD HEADWIND OR SUBTRACT TAILWIND TO DETERMINE ACTUAL MAXIMUM ABORT SPEED.
- HALF AFT STICK APPLIED AT THE ROTATION SPEED FROM FIG A3-10 AND A 12 DEGREE PITCH ATTITUDE HELD AFTER ROTATION UNTIL ALTERED BY ABORT PROCEDURES.

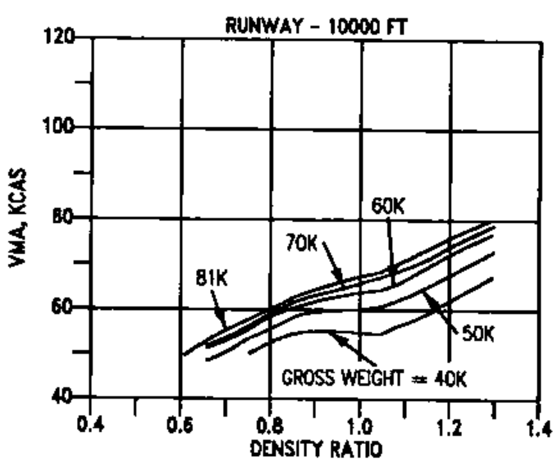
GUIDE

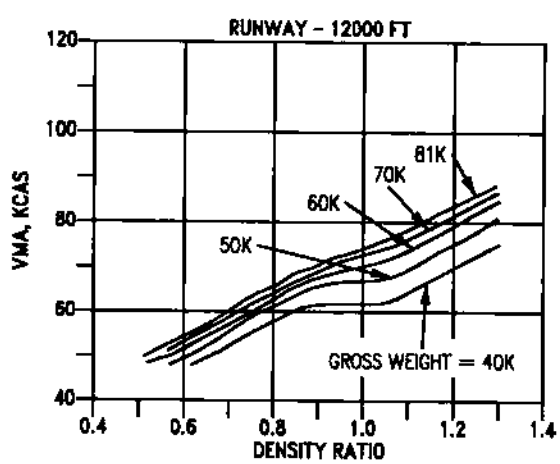


CAUTION

"TAKEOFF CANNOT BE ABORTED ON ICY RUNWAY USING BRAKING ALONE."







15E-1-(80-6)38-CAT

Figure A3-3 (Sheet 6)

TAKEOFF DISTANCE

WITH CFT
MAXIMUM THRUST
HARD DRY RUNWAY

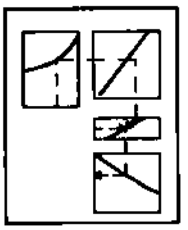
AIRPLANE CONFIGURATION
FLAPS AND GEAR DOWN
ALL DRAG INDEXES

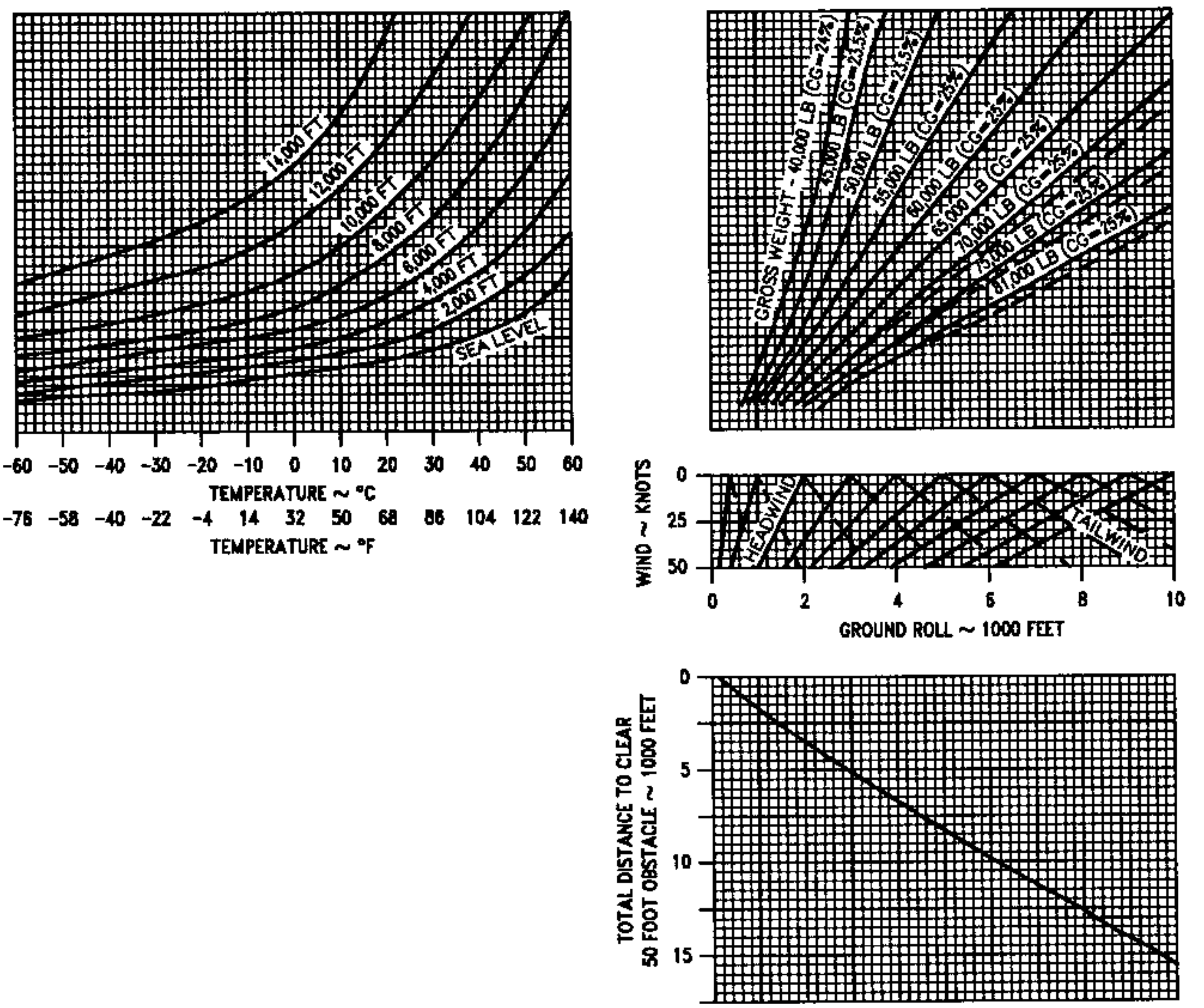
DATE: 15 JUNE 1988
DATA BASIS: ESTIMATED

REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

NOTE

- THIS DATA BASED ON HALF AFT STICK APPLIED AT THE ROTATION SPEED FROM FIG A3-10 AND A 12 DEGREE PITCH ATTITUDE HELD AFTER ROTATION.
- DASHED LINES TO BE USED WHEN CARRYING AIR-TO-GROUND WEAPONS OR FUEL TANKS ON THE WING STATIONS.
- SOLID LINES TO BE USED WHEN NO STORES OTHER THEN AIR-TO-AIR WEAPONS ARE INSTALLED ON THE WING STATIONS.
- FOR EVERY 1% CG SHIFT FORWARD OF THE REFERENCE CG, INCREASE THE ZERO WIND GROUND ROLL DISTANCE BY 5%. FOR EVERY 1% CG SHIFT AFT OF THE REFERENCE CG, DECREASE THE ZERO WIND GROUND ROLL DISTANCE BY 1%. THEN APPLY WIND EFFECTS AND DETERMINE DISTANCE TO 50 FT. USING NORMAL PROCEDURES.





15E-1-(112-1)04-CATI

Figure A3-4

TAKEOFF DISTANCE

WITH CFT
MILITARY THRUST
HARD DRY RUNWAY

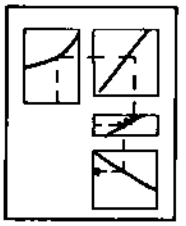
AIRPLANE CONFIGURATION
FULL FLAPS,GEAR DOWN
ALL DRAG INDEXES

DATE: 15 JUNE 1988
DATA BASIS: ESTIMATED

REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

NOTE

- THIS DATA BASED ON HALF AFT STICK APPLIED AT THE ROTATION SPEED FROM FIG A3-10 AND A 12 DEGREE PITCH ATTITUDE HELD AFTER ROTATION.
- DASHED LINES TO BE USED WHEN CARRYING AIR-TO-GROUND WEAPONS OR FUEL TANKS ON THE WING STATIONS.
- SOLID LINES TO BE USED WHEN NO STORES OTHER THEN AIR-TO-AIR WEAPONS ARE INSTALLED ON THE WING STATIONS.
- FOR EVERY 1% CG SHIFT FORWARD OF THE REFERENCE CG, INCREASE THE ZERO WIND GROUND ROLL DISTANCE BY 3%. FOR EVERY 1% CG SHIFT AFT OF THE REFERENCE CG, DECREASE THE ZERO WIND GROUND ROLL DISTANCE BY 1%. THEN APPLY WIND EFFECTS AND DETERMINE DISTANCE TO 50 FT. USING NORMAL PROCEDURES.



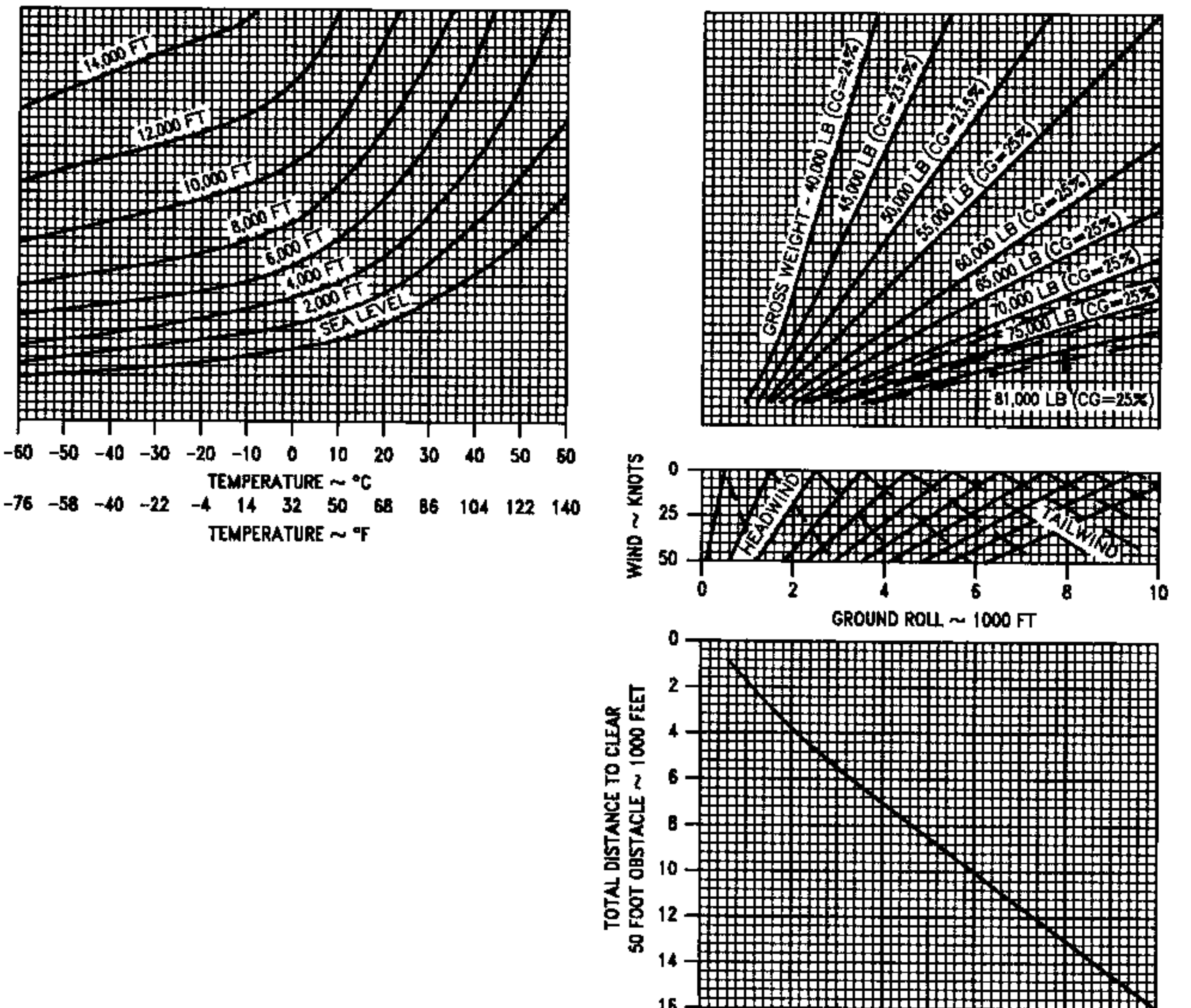


Figure A3-5

MINIMUM GO SPEED

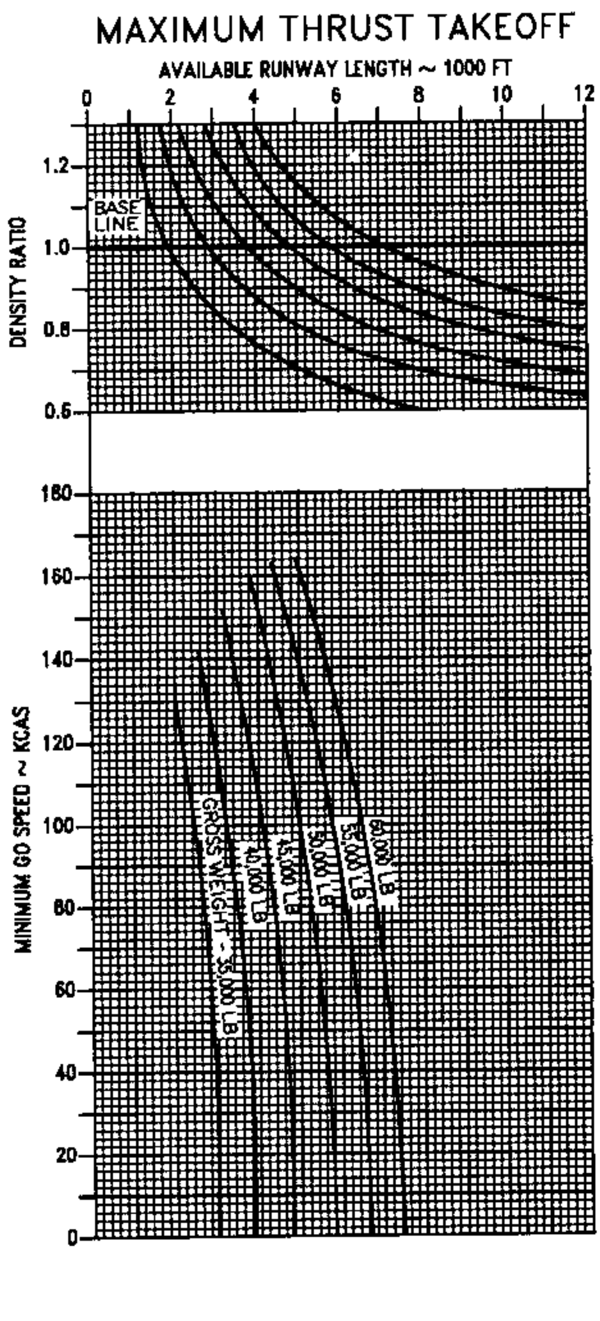
WITHOUT CFT
(WITH SINGLE ENGINE FAILURE)

AIRPLANE CONFIGURATION
GEAR AND FLAPS DOWN
ALL DRAG INDEXES

REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

NOTE
- FOLLOWING ENGINE FAILURE WITH MILITARY THRUST, THE AFTERBURNER IS IGNITED ON THE OPERATING ENGINE.
- HALF AFT STICK APPLIED AT THE ROTATION SPEED FROM FIG A3-11 AND A 10 DEGREE PITCH ATTITUDE HELD AFTER ROTATION.

DATE: 15 NOV 1988
DATA BASIS: ESTIMATED



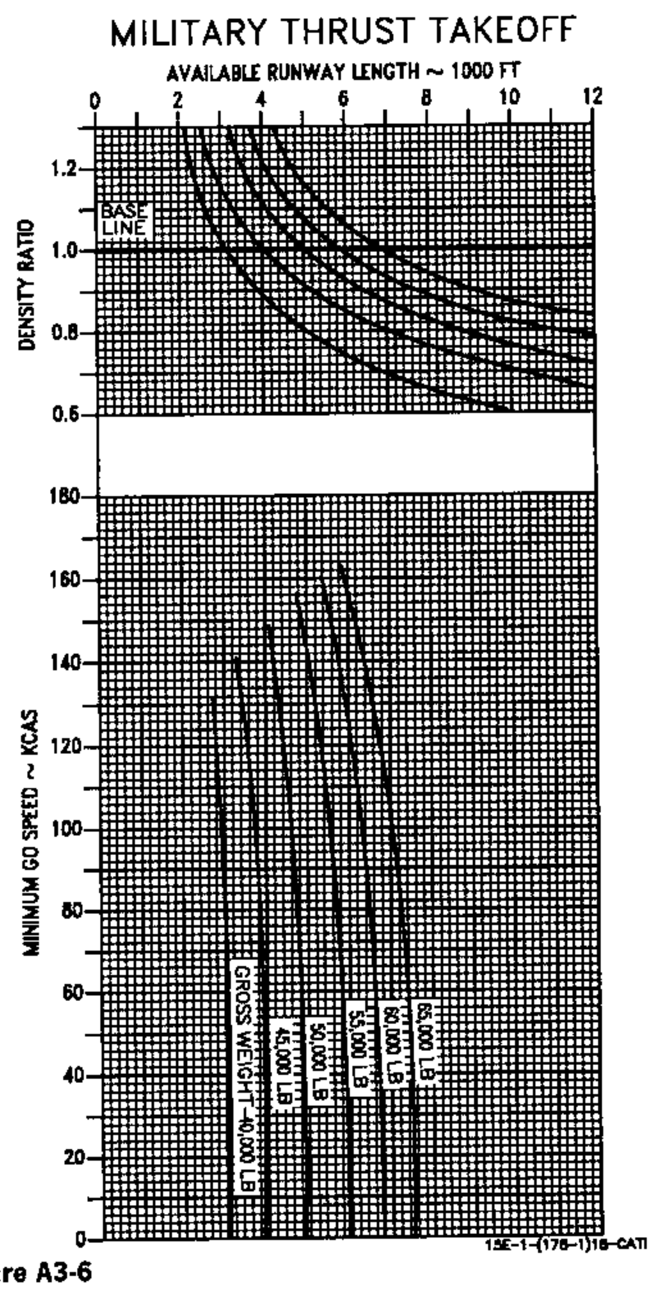


Figure A3-6

MAXIMUM ABORT SPEED

WITHOUT CFT
MAXIMUM THRUST
HARD DRY RUNWAY

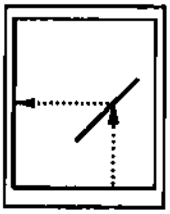
AIRPLANE CONFIGURATION
FLAPS AND GEAR DOWN
ALL DRAG INDEXES

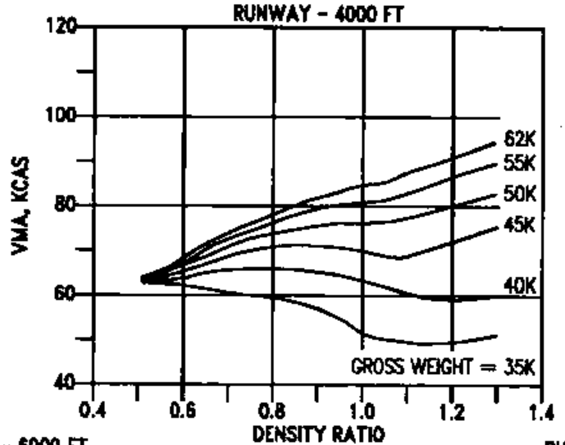
REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

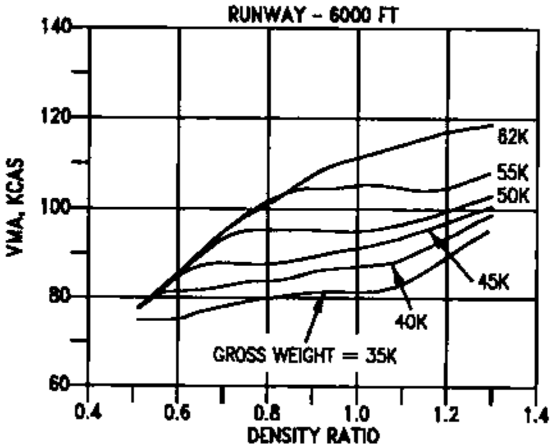
DATE: 15 JUNE 1992
DATA BASIS: ESTIMATED

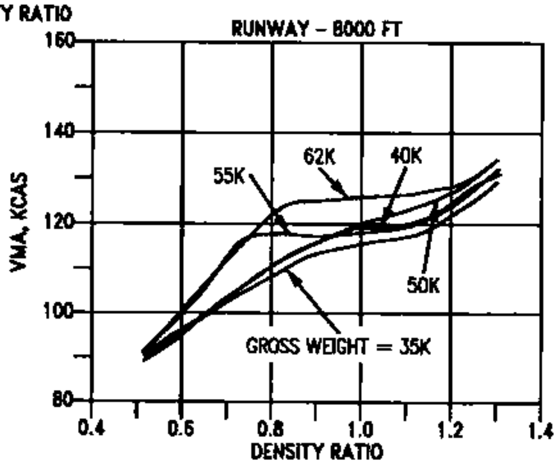
NOTE

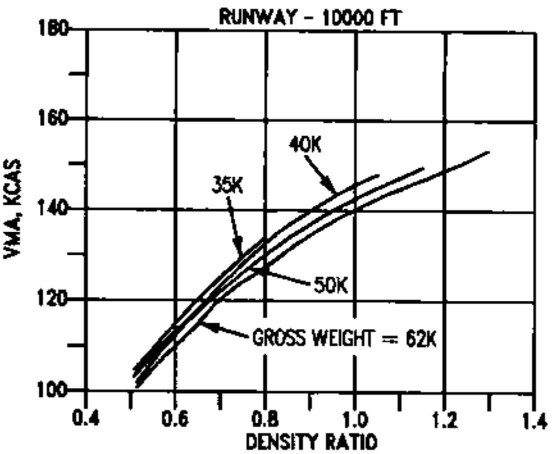
- DATA IS FOR NO-WIND CONDITION. ADD HEADWIND OR SUBTRACT TAILWIND TO DETERMINE ACTUAL MAXIMUM ABORT SPEED.
- FULL AFT STICK APPLIED AT LOW SPEED AND A 12 DEGREE PITCH ATTITUDE HELD AFTER ROTATION UNTIL ALTERED BY ABORT PROCEDURES.

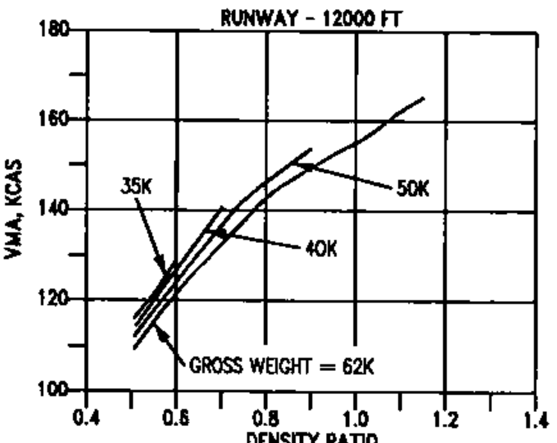












15E-1-(179-1)38-CATI

Figure A3-7 (Sheet 1 of 6)

MAXIMUM ABORT SPEED

WITHOUT CFT
MILITARY THRUST
HARD DRY RUNWAY

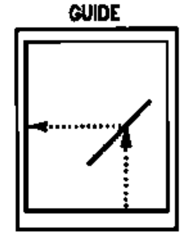
AIRPLANE CONFIGURATION
FLAPS AND GEAR DOWN
ALL DRAG INDEXES

REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

DATE: 15 JUNE 1992
DATA BASIS: ESTIMATED

NOTE

- DATA IS FOR NO-WIND CONDITION. ADD HEADWIND OR SUBTRACT TAILWIND TO DETERMINE ACTUAL MAXIMUM ABORT SPEED.
- FULL AFT STICK APPLIED AT LOW SPEED AND A 12 DEGREE PITCH ATTITUDE HELD AFTER ROTATION UNTIL ALTERED BY ABORT PROCEDURES.



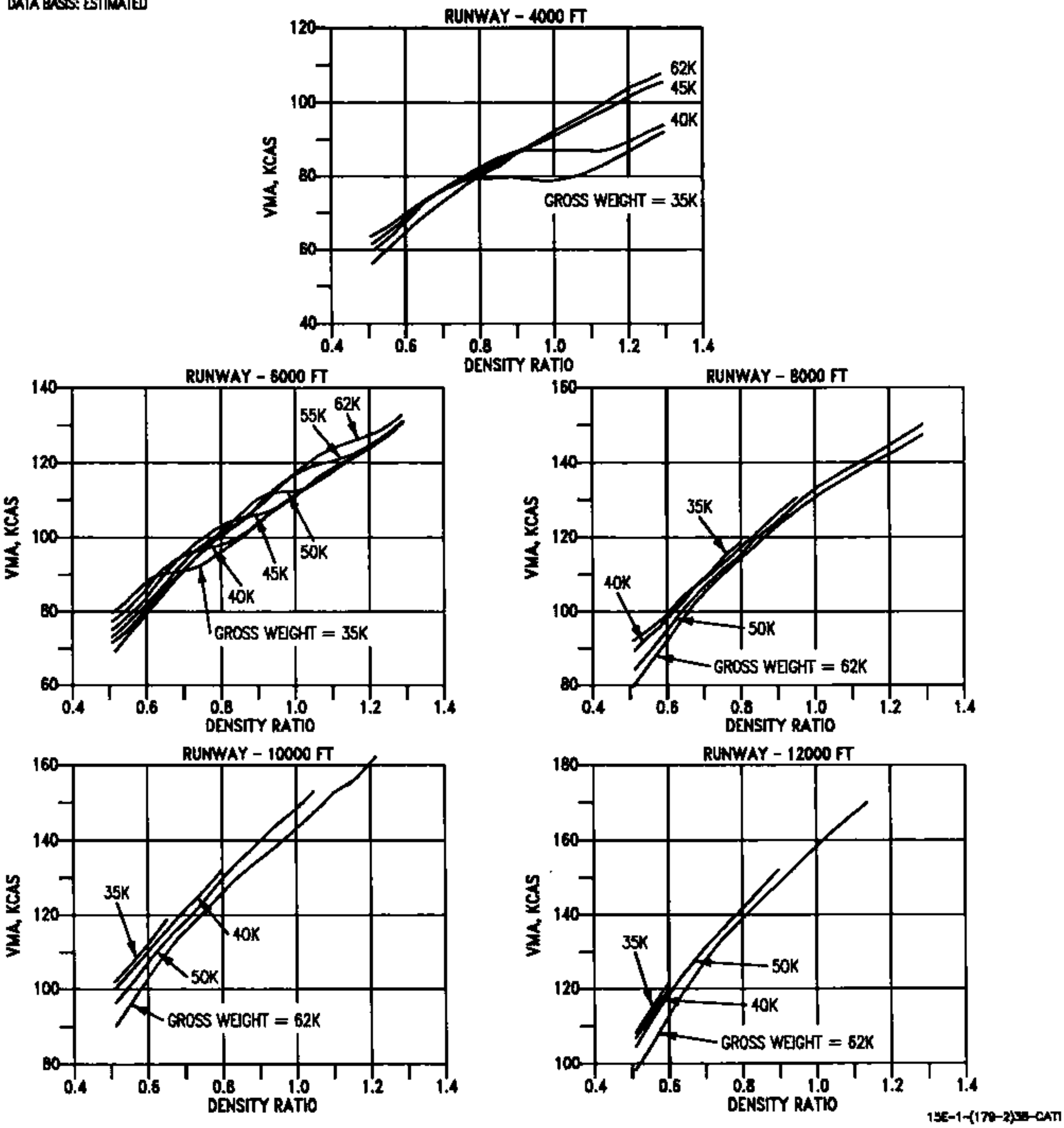


Figure A3-7 (Sheet 2)

MAXIMUM ABORT SPEED

WITHOUT CFT
MAXIMUM THRUST
HARD WET RUNWAY

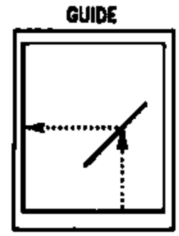
AIRPLANE CONFIGURATION
FLAPS AND GEAR DOWN
ALL DRAG INDEXES

REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

DATE: 15 JUNE 1992
DATA BASIS: ESTIMATED

NOTE

- DATA IS FOR NO-WIND CONDITION. ADD HEADWIND OR SUBTRACT TAILWIND TO DETERMINE ACTUAL MAXIMUM ABORT SPEED.
- FULL AFT STICK APPLIED AT LOW SPEED AND A 12 DEGREE PITCH ATTITUDE HELD AFTER ROTATION UNTIL ALTERED BY ABORT PROCEDURES.



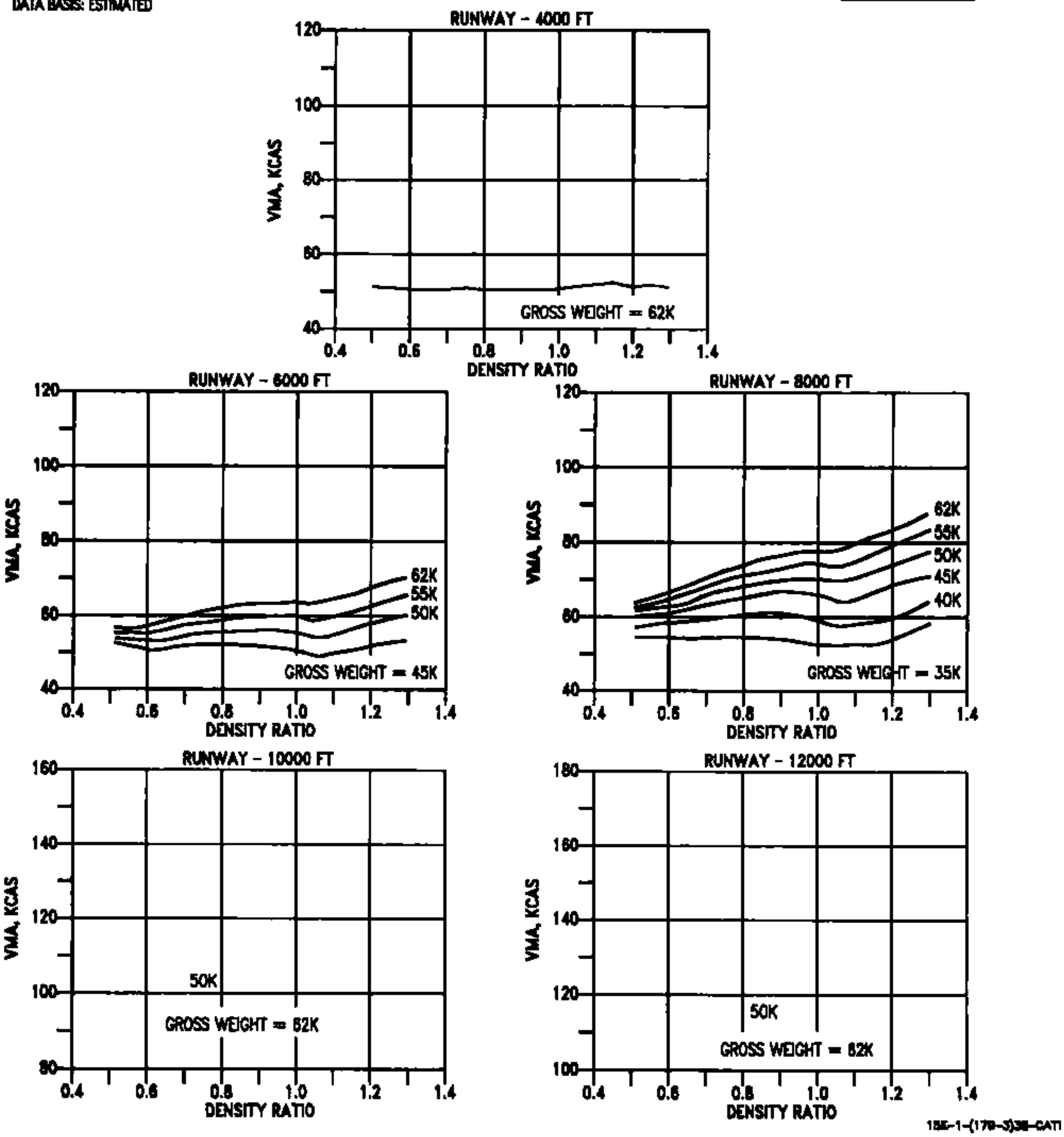


Figure A3-7 (Sheet 3)

MAXIMUM ABORT SPEED

WITHOUT CFT
MILITARY THRUST
HARD WET RUNWAY

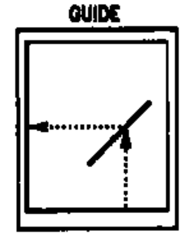
AIRPLANE CONFIGURATION
FLAPS AND GEAR DOWN
ALL DRAG INDEXES

REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

DATE: 15 JUNE 1992
DATA BASIS: ESTIMATED

NOTE

- DATA IS FOR NO-WIND CONDITION. ADD HEADWIND OR SUBTRACT TAILWIND TO DETERMINE ACTUAL MAXIMUM ABORT SPEED.
- FULL AFT STICK APPLIED AT LOW SPEED AND A 12 DEGREE PITCH ATTITUDE HELD AFTER ROTATION UNTIL ALTERED BY ABORT PROCEDURES.



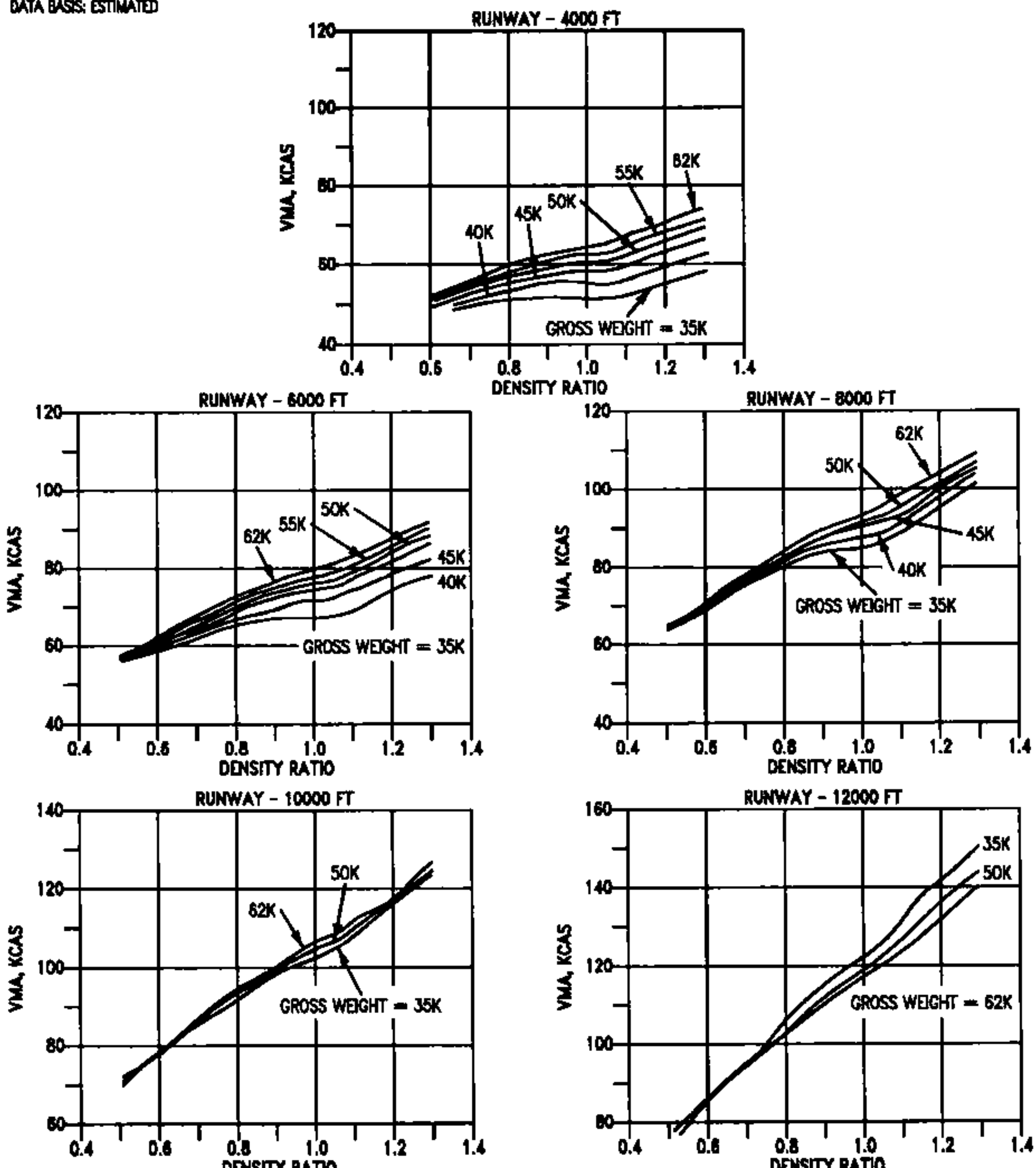


Figure A3-7 (Sheet 4)

MAXIMUM ABORT SPEED

WITHOUT CFT
MAXIMUM THRUST
HARD ICY RUNWAY

AIRPLANE CONFIGURATION
FLAPS AND GEAR DOWN
ALL DRAG INDEXES

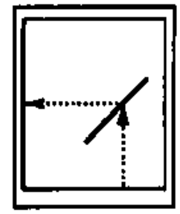
REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

DATE:15 JUNE 1992
DATA BASIS: ESTIMATED

NOTE

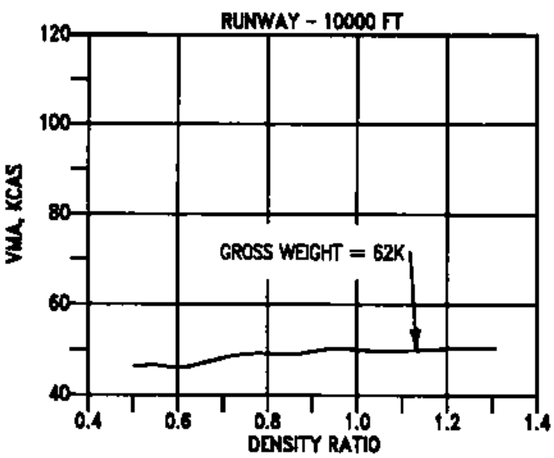
- DATA IS FOR NO-WIND CONDITION. ADD HEADWIND OR SUBTRACT TAILWIND TO DETERMINE ACTUAL MAXIMUM ABORT SPEED.
- HALF AFT STICK APPLIED AT THE ROTATION SPEED FROM FIG A3-10 AND A 12 DEGREE PITCH ATTITUDE HELD AFTER ROTATION UNTIL ALTERED BY ABORT PROCEDURES.

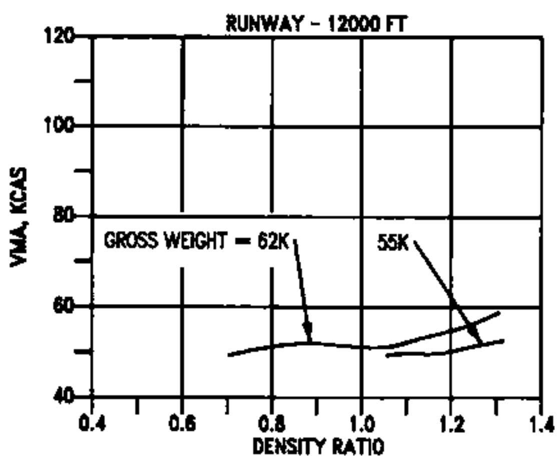
GUIDE



CAUTION

ON RUNWAYS OF 4000 TO 8000 FEET TAKEOFF CANNOT BE ABORTED ON ICY RUNWAY USING BRAKING ALONE.





15E-1-(179-5)38-CATI

Figure A3-7 (Sheet 5)

MAXIMUM ABORT SPEED

WITHOUT CFT
MILITARY THRUST
HARD ICY RUNWAY

AIRPLANE CONFIGURATION
FLAPS AND GEAR DOWN
ALL DRAG INDEXES

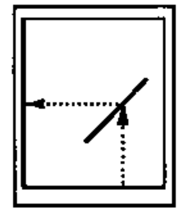
REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

DATE: 15 JUNE 1992
DATA BASIS: ESTIMATED

NOTE

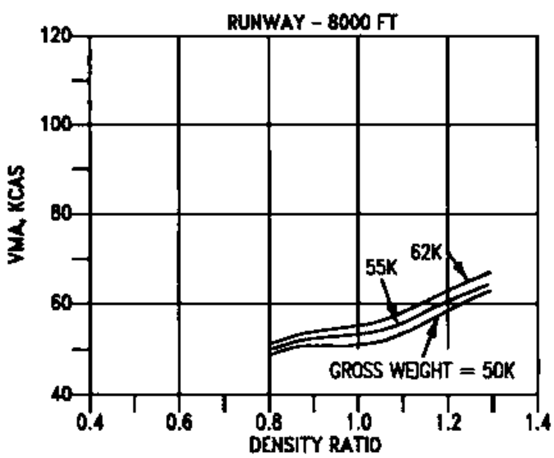
- DATA IS FOR NO-WIND CONDITION. ADD HEADWIND OR SUBTRACT TAILWIND TO DETERMINE ACTUAL MAXIMUM ABORT SPEED.
- FULL AFT STICK APPLIED AT LOW SPEED AND A 12 DEGREE PITCH ATTITUDE HELD AFTER ROTATION UNTIL ALTERED BY ABORT PROCEDURES.

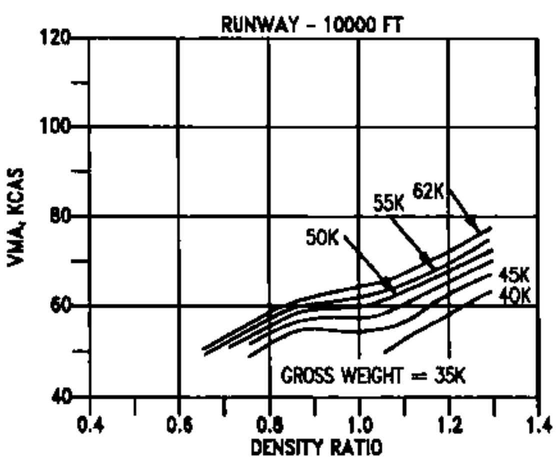
GUIDE

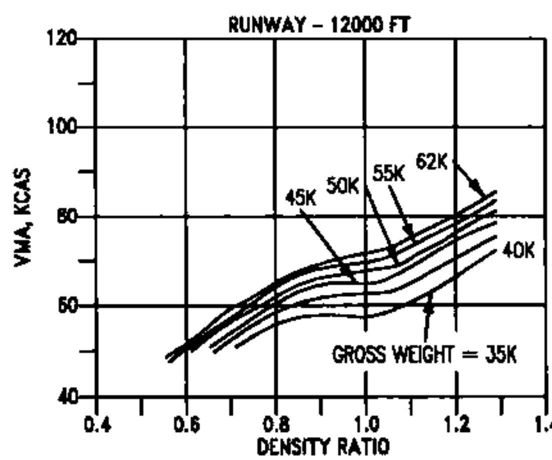


CAUTION

"TAKEOFF CANNOT BE ABORTED ON ICY RUNWAY USING BRAKING ALONE."







15E-1-(179-8)36-CATI

Figure A3-7 (Sheet 6)

TAKEOFF DISTANCE

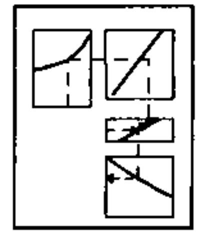
WITHOUT CFT
MAXIMUM THRUST
HARD DRY RUNWAY

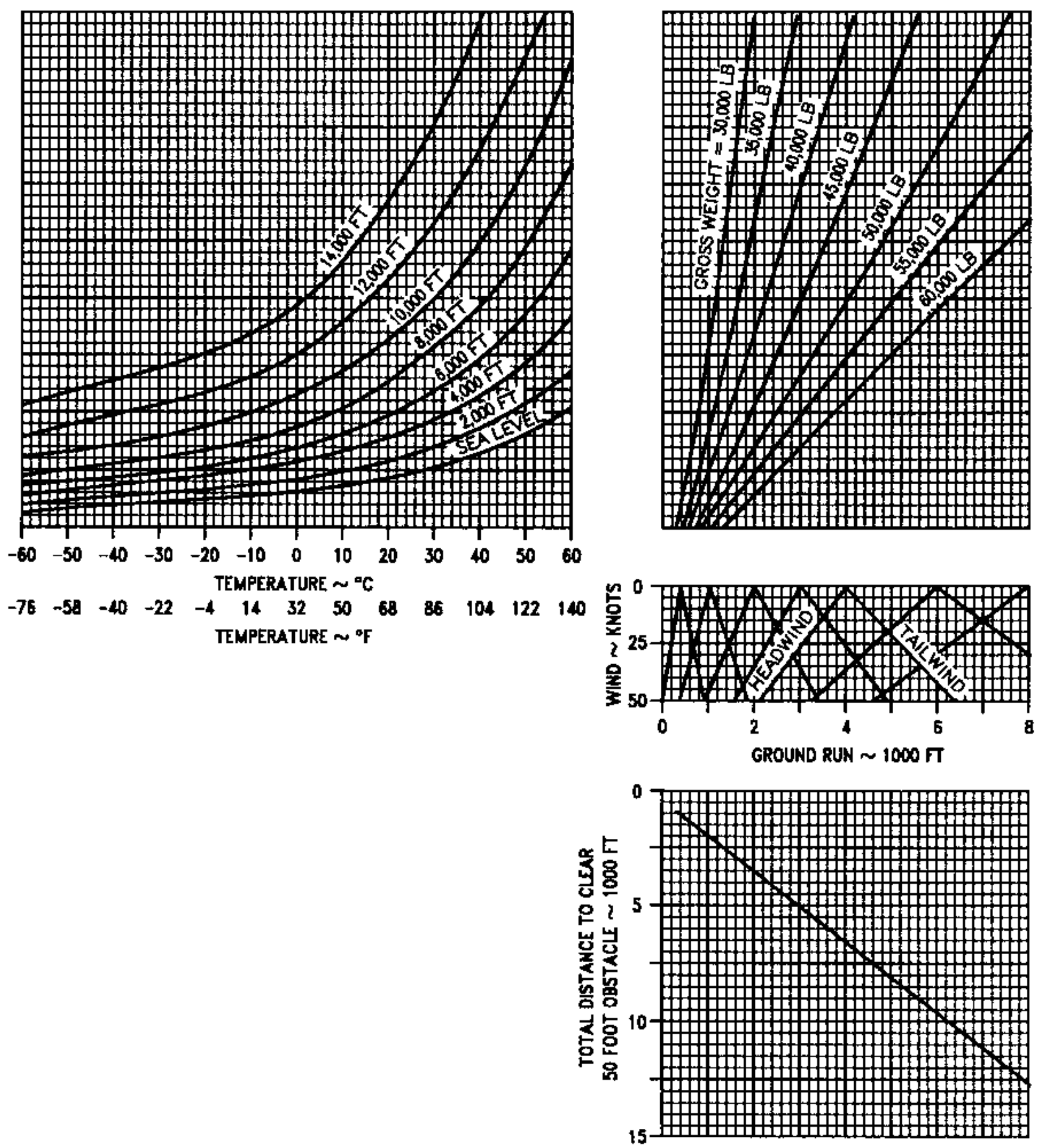
AIRPLANE CONFIGURATION
FULL FLAPS, GEAR DOWN
ALL DRAG INDEXES

DATE: 1 AUGUST 1986
DATA BASIS: ESTIMATED

REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

NOTE
THESE DATA BASED ON MAXIMUM PERFORMANCE TAKEOFF PROCEDURES: FULL AFT STICK APPLIED AT LOW SPEED AND A 12 DEGREE ATTITUDE IS HELD AFTER ROTATION.





15E-1-(115-1)05-CATI

Figure A3-8

TAKEOFF DISTANCE

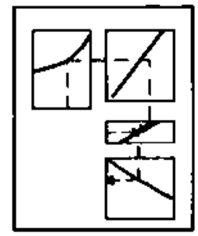
WITHOUT CFT
MILITARY THRUST
HARD DRY RUNWAY

AIRPLANE CONFIGURATION
FULL FLAPS, GEAR DOWN
ALL DRAG INDEXES

DATE: 1 AUGUST 1986
DATA BASIS: ESTIMATED

REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

NOTE
THESE DATA BASED ON MAXIMUM PERFORMANCE TAKEOFF PROCEDURES: FULL AFT STICK APPLIED AT LOW SPEED AND A 12 DEGREE ATTITUDE IS HELD AFTER ROTATION.



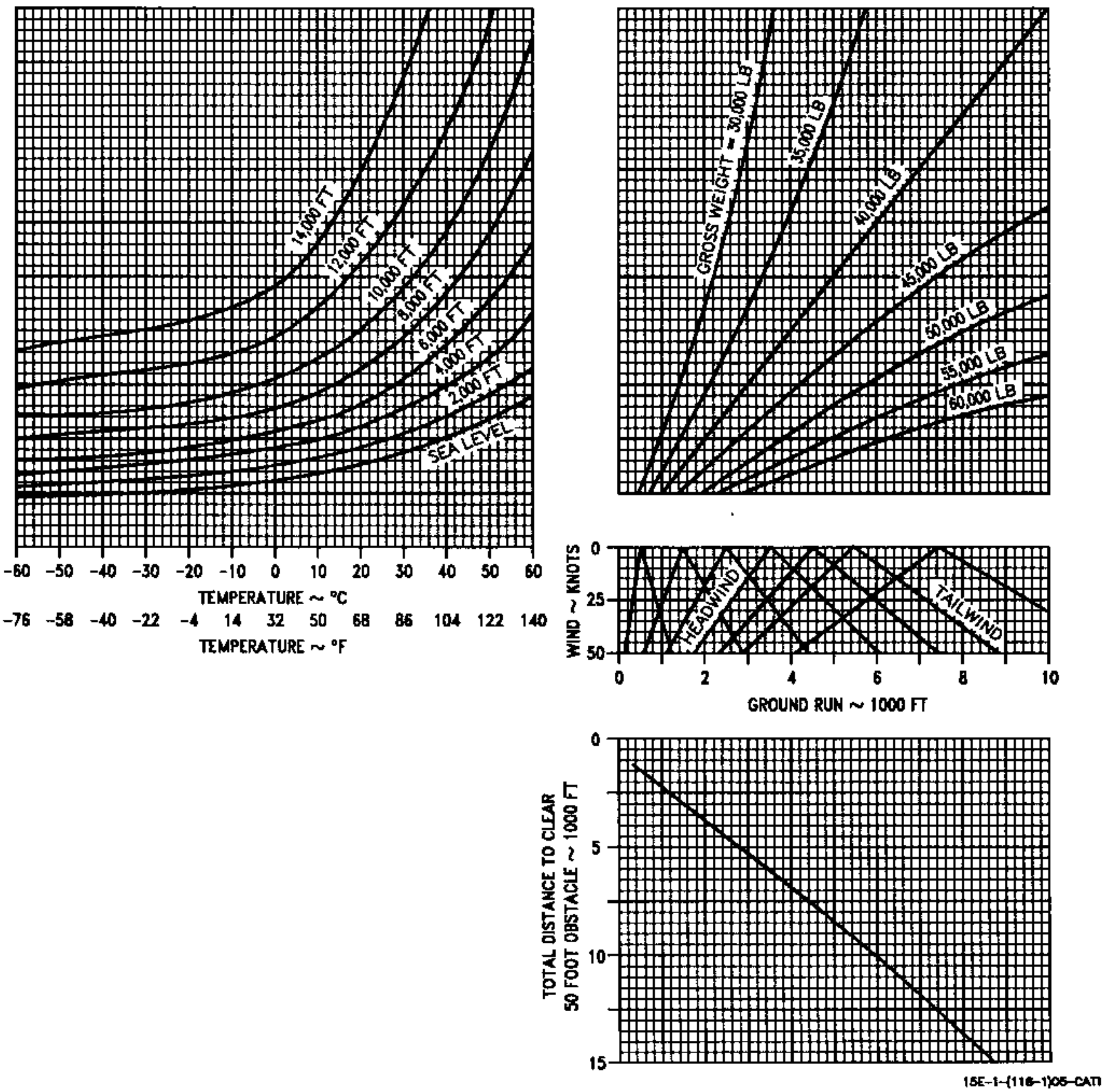


Figure A3-9

ROTATION SPEED/NOSEWHEEL LIFT-OFF SPEED/ TAKEOFF SPEED

WITH CFT

AIRPLANE CONFIGURATION
FULL FLAPS, GEAR DOWN
ALL DRAG INDEXES

REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

NORMAL TAKEOFF

ONE-HALF AFT STICK APPLIED OVER A PERIOD OF 1 SECOND STARTING AT THE ROTATION SPEED LISTED BELOW AND 12° ATTITUDE HELD AFTER ROTATION.

DATE: 15 JUNE 1988
DATA BASIS: ESTIMATED

GROSS WEIGHT-LB	CG (-%)	ROTATION/NOSEWHEEL LIFT-OFF/TAKEOFF SPEEDS (KCAS)	
		MAXIMUM THRUST	MILITARY THRUST
40,000	28	—	—
	26	110 / 124 / 149	115 / 123 / 141
	24	110 / 128 / 152	115 / 125 / 143
	22	110 / 130 / 154	120 / 130 / 146
45,000	28	—	—
	26	115 / 130 / 154	120 / 127 / 144
	24	115 / 132 / 156	120 / 129 / 146
	23.5	115 / 133 / 156	120 / 129 / 146
	22	118 / 137 / 159	125 / 134 / 150
50,000	28	—	—
	26	120 / 134 / 158	125 / 132 / 148
	24	120 / 136 / 159	125 / 134 / 150
	23.5	120 / 137 / 160	125 / 134 / 150
	22	125 / 142 / 163	130 / 139 / 154
55,000	28	—	—
	26	125 / 138 / 161	130 / 137 / 155
	25	125 / 139 / 162	130 / 138 / 155
	24	125 / 141 / 163	135 / 142 / 156
	22	—	—
60,000	28	—	—
	26	130 / 143 / 165	135 / 141 / 163
	25	130 / 144 / 166	135 / 142 / 163
	24	133 / 148 / 169	140 / 147 / 163
	22	—	—
65,000	28	140 / 150 / 171	145 / 150 / 169
	26	140 / 152 / 172	145 / 151 / 170
	25	140 / 154 / 173	145 / 151 / 170
	24	145 / 159 / 177	150 / 156 / 170
	22	—	—
70,000	28	155 / 164 / 183	155 / 159 / 180
	26	155 / 166 / 184	155 / 160 / 181
	25	155 / 167 / 185	155 / 161 / 181
	24	160 / 172 / 190	160 / 166 / 182
	22	—	—
75,000	28	160 / 169 / 187	160 / 164 / 186
	26	160 / 171 / 189	160 / 165 / 188
	25	160 / 173 / 190	160 / 166 / 188
	24	165 / 177 / 194	165 / 171 / 189
	22	—	—
81,000	28	167 / 176 / 192	167 / 171 / 194
	26	167 / 177 / 194	167 / 171 / 195
	25	167 / 179 / 195	167 / 172 / 196
	24	172 / 184 / 199	172 / 177 / 197
	22	—	—

15E-1-(114-1)04-CATI

Figure A3-10 (Sheet 1 of 2)

SINGLE ENGINE ROTATION SPEED/NOSEWHEEL LIFT-OFF SPEED/ TAKEOFF SPEED

WITH CFT

AIRPLANE CONFIGURATION
FULL FLAPS, GEAR DOWN
ALL DRAG INDEXES
ALL CG LOCATIONS

REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

NOTE
NOSEWHEEL BOUNCING MAY OCCUR DURING ONE-ENGINE-OUT TAKEOFF AT GROSS WEIGHTS OF 65,000 LBS AND LESS.

DATE: 15 JUNE 1988
DATA BASIS: ESTIMATED

CONTINUED (SINGLE ENGINE) TAKEOFF

ONE-HALF AFT STICK APPLIED OVER A PERIOD OF 1 SECOND STARTING AT THE ROTATION SPEED LISTED BELOW AND 10° ATTITUDE HELD AFTER ROTATION.

GROSS WEIGHT-LB	ROTATION/NOSEWHEEL LIFT-OFF/TAKEOFF SPEEDS (KCAS)	
	MAXIMUM THRUST	
40,000	170 / 171 / 177	TO BE USED WHEN NO STORES OTHER THAN AIR-TO-AIR WEAPONS ARE INSTALLED ON THE WING STATIONS.
45,000	180 / 181 / 187	
50,000	185 / 186 / 192	
55,000	190 / 191 / 196	
60,000	190 / 191 / 196	
65,000	190 / 192 / 197	
70,000	190 / 192 / 197	
75,000	190 / 192 / 199	
81,000	190 / 192 / 207	
70,000	190 / 192 / 198	TO BE USED WHEN CARRYING AIR-TO-GROUND WEAPONS OR FUEL TANKS ON THE WING STATIONS.
75,000	190 / 193 / 204	
81,000	190 / 193 / 213	

15E-1-(114-2)04-CATI

Figure A3-10 (Sheet 2)

NOSEWHEEL LIFT-OFF SPEED/TAKEOFF SPEED

WITHOUT CFT

AIRPLANE CONFIGURATION
FULL FLAPS, GEAR DOWN
ALL DRAG INDEXES

REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

DATE: 1 AUGUST 1986
DATA BASIS: ESTIMATED

NORMAL TAKEOFF

ONE-HALF AFT STICK APPLIED OVER A PERIOD OF
1 SECOND STARTING AT 120 KNOTS AND 10°
ATTITUDE HELD AFTER ROTATION

GROSS WEIGHT – LB	NOSEWHEEL LIFT-OFF/TAKEOFF SPEEDS (KCAS)	
	MAXIMUM THRUST	MILITARY THRUST
30,000	129/143	124/135
35,000	134/150	128/141
40,000	136/153	129/142
45,000	137/155	130/148
50,000	139/158	133/161
55,000	150/166	144/169
60,000	158/173	161/177

MAXIMUM PERFORMANCE TAKEOFF

FULL AFT STICK APPLIED AT LOW SPEED AND
12° ATTITUDE HELD AFTER ROTATION

GROSS WEIGHT – LB	NOSEWHEEL LIFT-OFF/TAKEOFF SPEEDS (KCAS)	
	MAXIMUM THRUST	MILITARY THRUST
30,000	83/110	94/108
35,000	91/121	102/119
40,000	102/131	110/129
45,000	115/142	119/139
50,000	127/151	129/148
55,000	138/159	140/157
60,000	147/166	148/165

15E-1-(117-1)04

Figure A3-11 (Sheet 1 of 2)

SINGLE ENGINE ROTATION SPEED/NOSEWHEEL LIFT-OFF SPEED/ TAKEOFF SPEED

AIRPLANE CONFIGURATION
FULL FLAPS, GEAR DOWN
ALL DRAG INDEXES
ALL CG LOCATIONS

WITHOUT CFT

REMARKS
ENGINES: (2) F100-PW-220
U.S. STANDARD DAY, 1966

DATE: 1 FEBRUARY 1989
DATA BASIS: ESTIMATED

CONTINUED (SINGLE ENGINE) TAKEOFF

ONE-HALF AFT STICK APPLIED OVER A PERIOD OF 1 SECOND STARTING AT THE ROTATION SPEED LISTED BELOW AND 10° ATTITUDE HELD AFTER ROTATION

GROSS WEIGHT - LB	ROTATION/NOSEWHEEL LIFT-OFF/TAKEOFF SPEEDS (KCAS)
	MAXIMUM THRUST
35000	160/163/169
40000	170/173/179
45000	180/183/188
50000	185/189/195
55000	190/194/199
60000	190/194/200

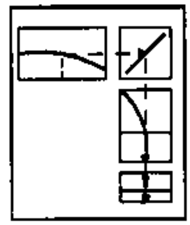
15E-1-(117-2)04

Figure A3-11 (Sheet 2)

SINGLE-ENGINE RATE OF CLIMB

GROSS WEIGHT – 60,000 POUNDS
WITH CFT
OUT OF GROUND EFFECT
MAXIMUM THRUST

GUIDE



AIRPLANE CONFIGURATION
FLAPS AND GEAR DOWN
SPEEDBRAKE RETRACTED

REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

DATE: 15 JUNE 1988
DATA BASIS: ESTIMATED

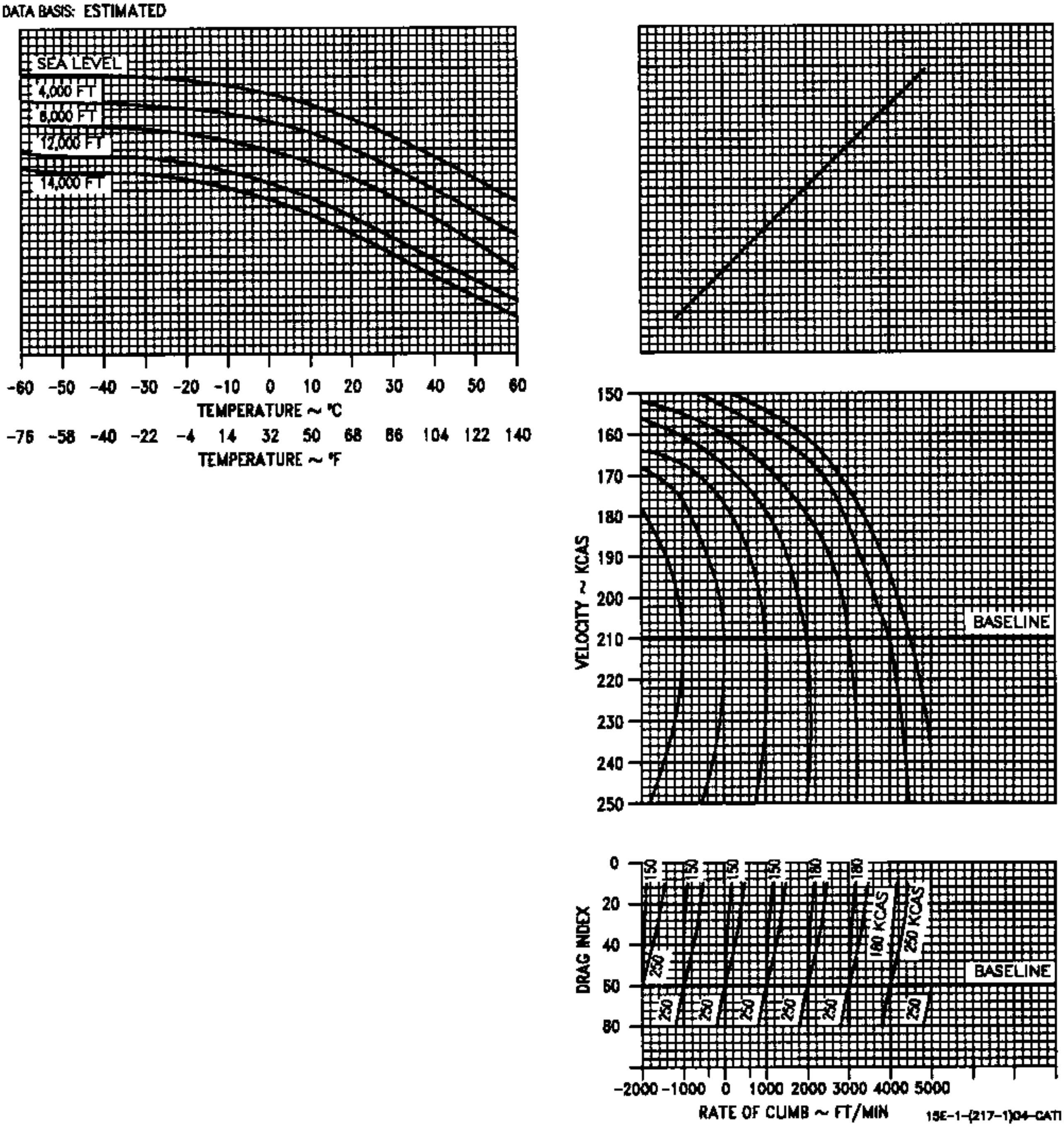


Figure A3-12

SINGLE-ENGINE RATE OF CLIMB

GROSS WEIGHT – 65,000 POUNDS
WITH CFT
OUT OF GROUND EFFECT
MAXIMUM THRUST

AIRPLANE CONFIGURATION
FLAPS AND GEAR DOWN
SPEEDBRAKE RETRACTED

REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

DATE: 15 JUNE 1988
DATA BASIS: ESTIMATED

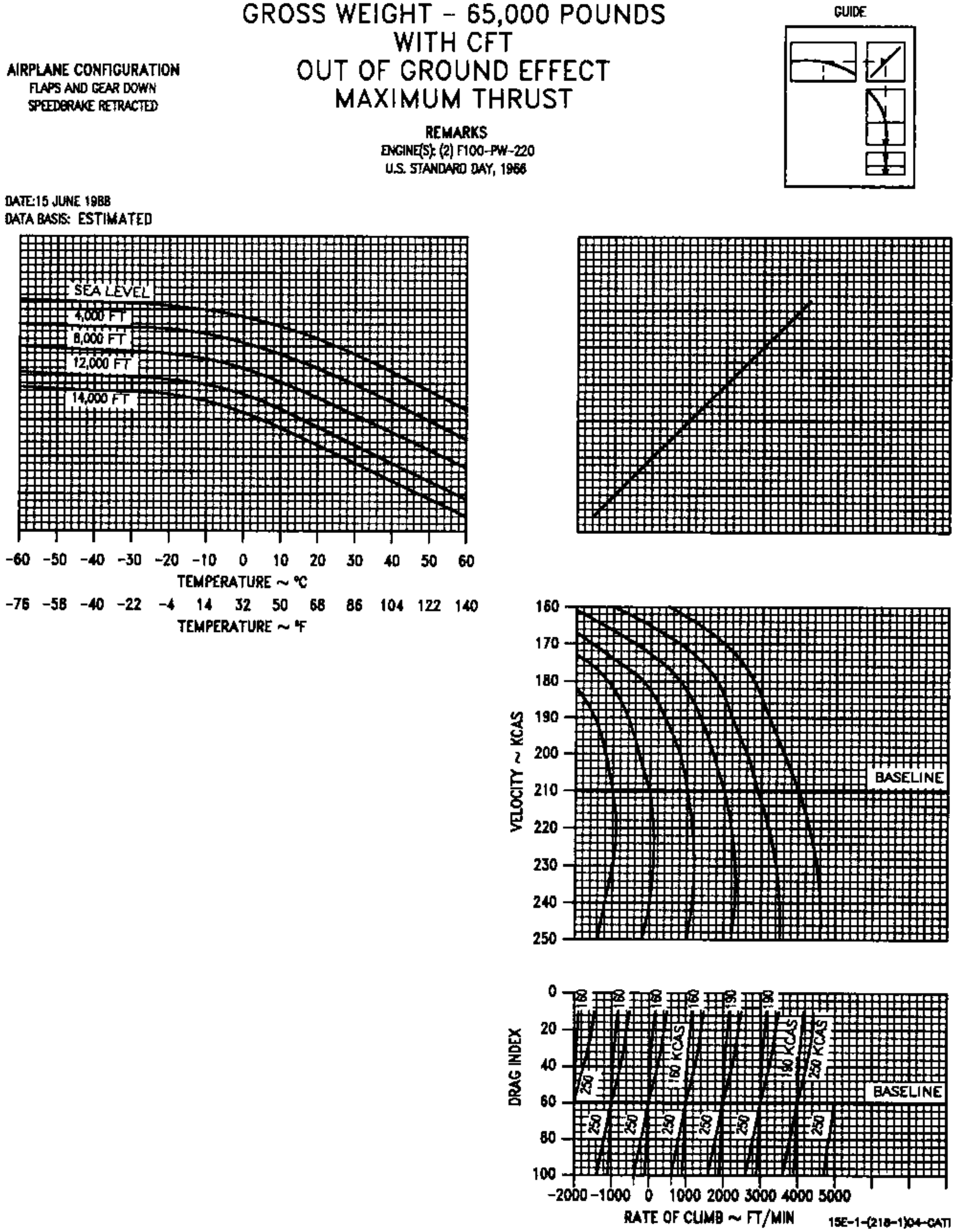


Figure A3-13

SINGLE-ENGINE RATE OF CLIMB

GROSS WEIGHT – 70,000 POUNDS
WITH CFT
OUT OF GROUND EFFECTS
MAXIMUM THRUST

AIRPLANE CONFIGURATION
FLAPS AND GEAR DOWN
SPEEDBRAKE RETRACTED

REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

NOTE
- DASHED LINES TO BE USED WHEN CARRYING AIR-TO-GROUND WEAPONS OR FUEL TANKS ON THE WING STATIONS.
- SOLID LINES TO BE USED WHEN NO STORES OTHER THAN AIR-TO-AIR WEAPONS ARE INSTALLED ON THE WING STATIONS.

DATE: 15 JUNE 1988
DATA BASIS: ESTIMATED

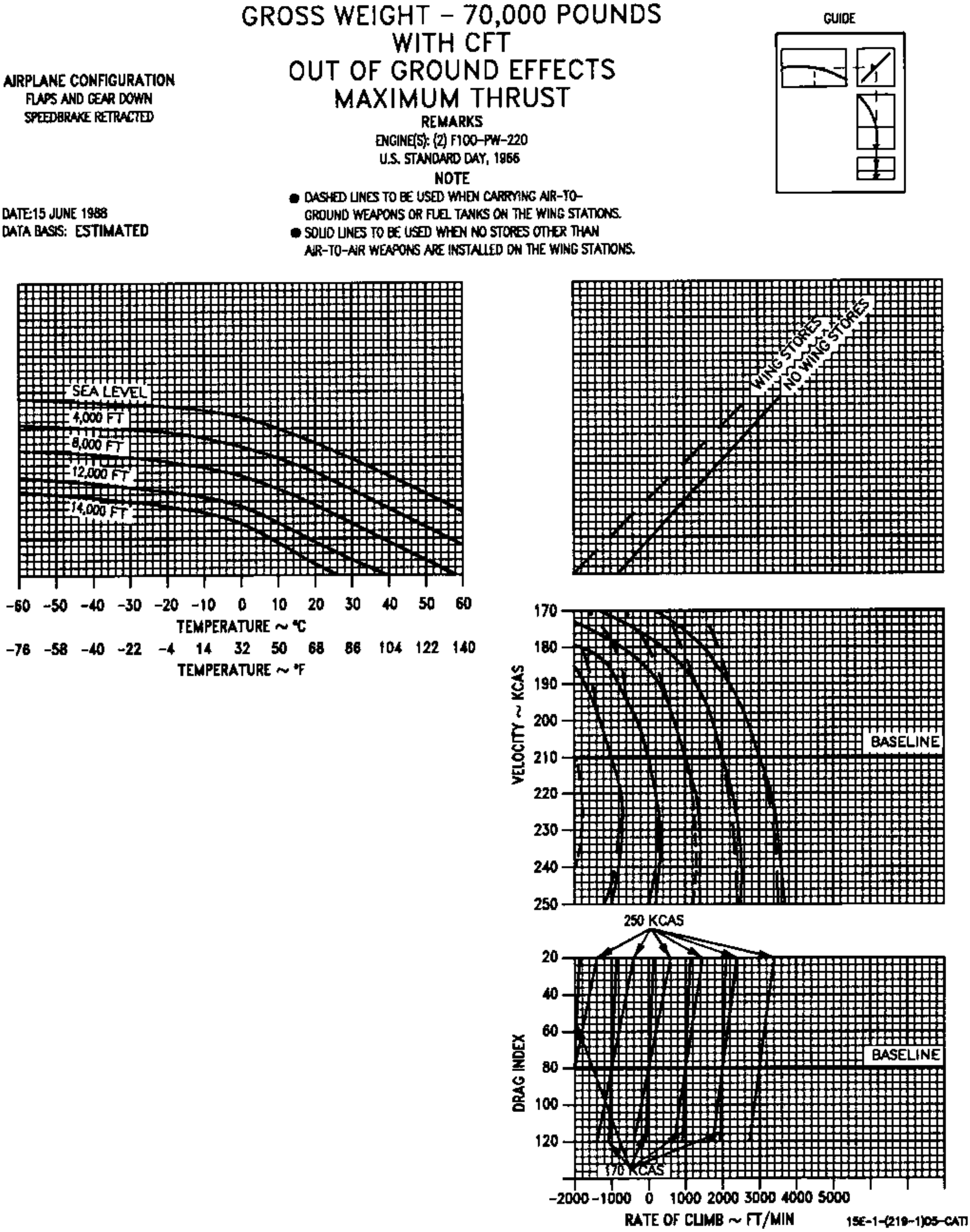


Figure A3-14

SINGLE-ENGINE RATE OF CLIMB

GROSS WEIGHT – 75,000 POUNDS
WITH CFT
OUT OF GROUND EFFECT
MAXIMUM THRUST

AIRPLANE CONFIGURATION
FLAPS AND GEAR DOWN
SPEEDBRAKE RETRACTED

REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

NOTE
- DASHED LINES TO BE USED WHEN CARRYING AIR-TO-GROUND WEAPONS OR FUEL TANKS ON THE WING STATIONS.
- SOLID LINES TO BE USED WHEN NO STORES OTHER THAN AIR-TO-AIR WEAPONS ARE INSTALLED ON THE WING STATIONS.

DATE: 15 JUNE 1988
DATA BASIS: ESTIMATED

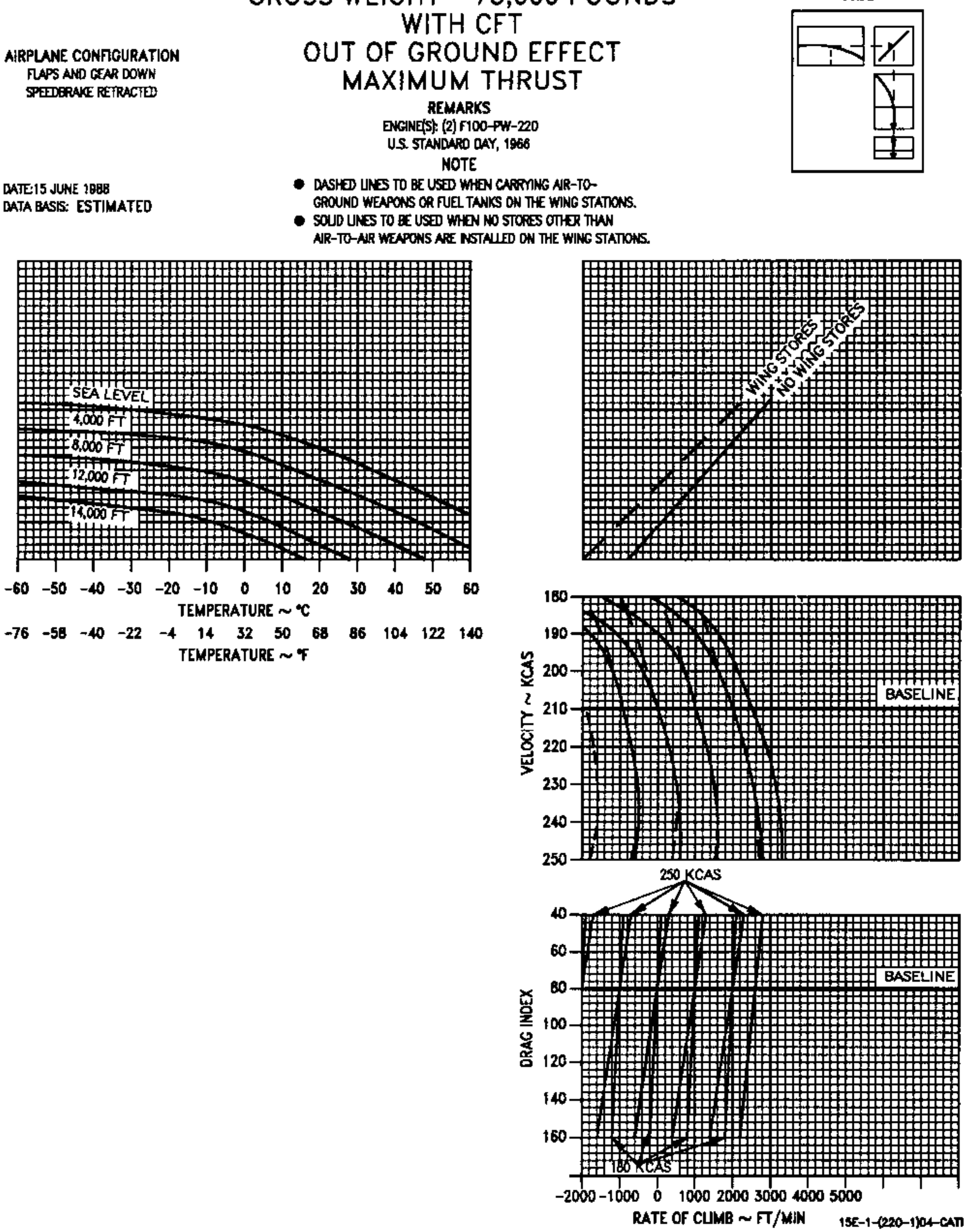


Figure A3-15

SINGLE-ENGINE RATE OF CLIMB

GROSS WEIGHT – 81,000 POUNDS
WITH CFT
OUT OF GROUND EFFECT
MAXIMUM THRUST

AIRPLANE CONFIGURATION
FLAPS AND GEAR DOWN
SPEEDBRAKE RETRACTED

REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

DATE: 15 JUNE 1988
DATA BASIS: ESTIMATED

NOTE

- DASHED LINES TO BE USED WHEN CARRYING AIR-TO-GROUND WEAPONS OR FUEL TANKS ON THE WING STATIONS.
- SOLID LINES TO BE USED WHEN NO STORES OTHER THAN AIR-TO-AIR WEAPONS ARE INSTALLED ON THE WING STATIONS.

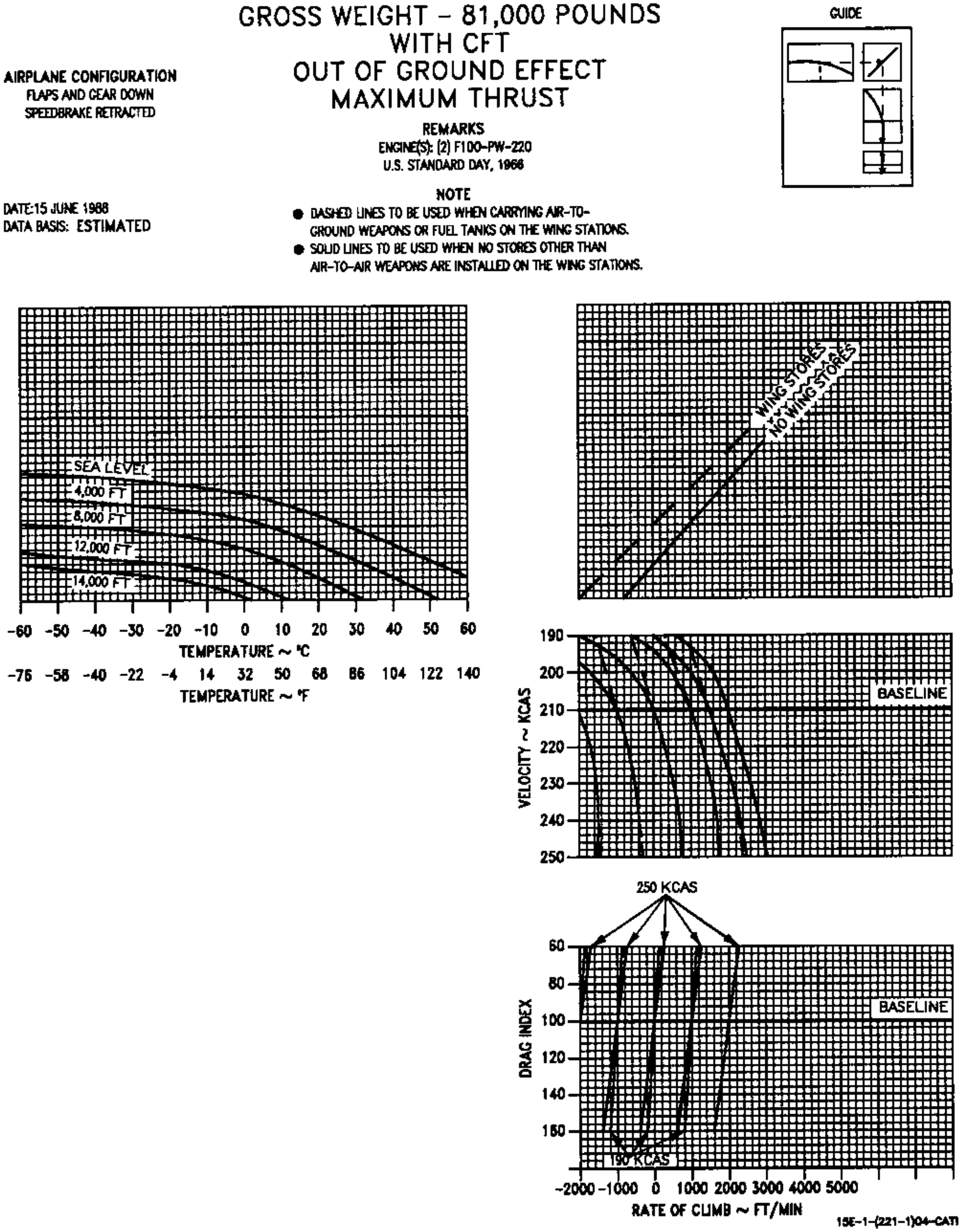


Figure A3-16

PART 4

CLIMB

TABLE OF CONTENTS

Charts

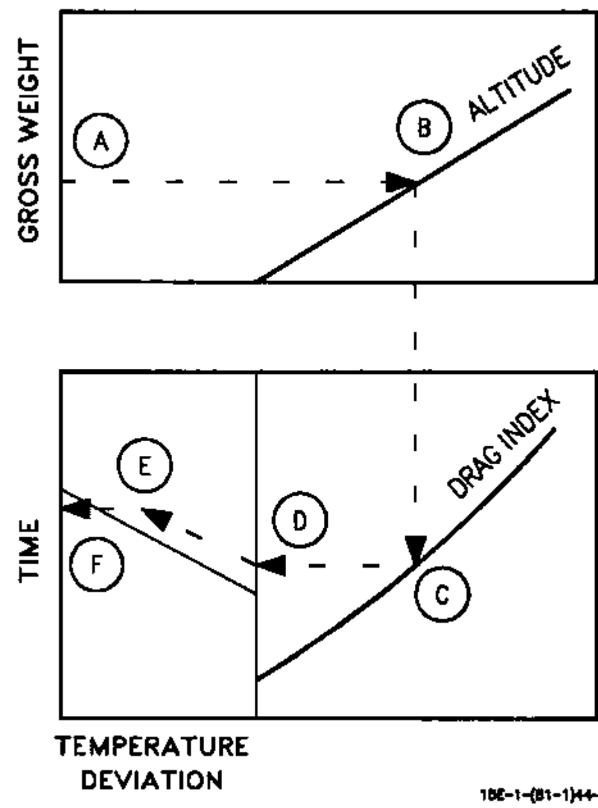
CLIMB CHARTS

The Climb charts (figures A4-1 thru A4-6) are used to determine time, fuel used, and distance covered while in the climb. Each chart is based on a military or maximum thrust climb for individual drag index configurations. The climb speed schedule and pre-climb data are noted on each chart.

USE

The method of presenting data on the time, fuel and distance charts is identical, and the use of all three charts will be undertaken simultaneously here. Enter the charts with the initial climb gross weight and project horizontally right to intersect the assigned cruise altitude or the optimum cruise altitude for the computed drag index, then vertically down to intersect the applicable drag index curve. From this point project horizontally left to the temperature baseline and parallel the nearest temperature guideline to read time, fuel or distance. Time, fuel or distance required to accelerate to climb speed must be added to the chart values.

SAMPLE CLIMB



15E-1-(81-1)44-CATI

Sample Problem

Military Thrust

A. Gross weight	60,000 Lb
B. Cruise altitude	20,000 Ft
C. Drag Index	120
D. Temperature baseline	
E. Temperature deviation	+10°C
F. Time	6.0 Min
G. Fuel (from Fuel Required To Climb Chart)	1700 Lb
H. Distance (from Distance Required to Climb Chart)	35 NM

COMBAT CEILING CHARTS

These charts (figures A4-7 and A4-8) present the military and maximum thrust subsonic combat ceiling for both single engine and normal two engine operation. The variable of gross weight and pressure altitude are taken into consideration for a range of drag indexes.

USE

Enter the applicable graph with estimated gross weight at end of climb. Project vertically up to intersect applicable configuration curve, then horizontally to the left to read combat ceiling.

Sample Problem

Combat Ceiling - Maximum Thrust - (2) Engines

Configuration: -4 CFTs + (4) AIM-7F missiles

A. Gross weight at end of climb	55,000 Lb
B. Drag index	18.6
C. Combat ceiling	49,700 Ft

TIME TO CLIMB

MILITARY THRUST

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

NOTES

- CLIMB SPEED SCHEDULE FOR DRAG INDEXES UP TO 40 IS 350 KCAS UNTIL INTERCEPTION OF .88 MACH, THEN MAINTAINING MACH TO CRUISE ALTITUDE. FOR DRAG INDEXES BETWEEN 40 AND 100, USE 330 KCAS/.83 MACH. GREATER THAN 100, USE 310 KCAS/.74 MACH.
- TIME FROM BRAKE RELEASE TO INITIAL CLIMB SPEED IS 1.0 MINUTES MILITARY THRUST TAKEOFF AND 0.5 MINUTES MAX THRUST TAKEOFF.

DATE: 15 JUNE 1988
DATA BASIS: FLIGHT TEST

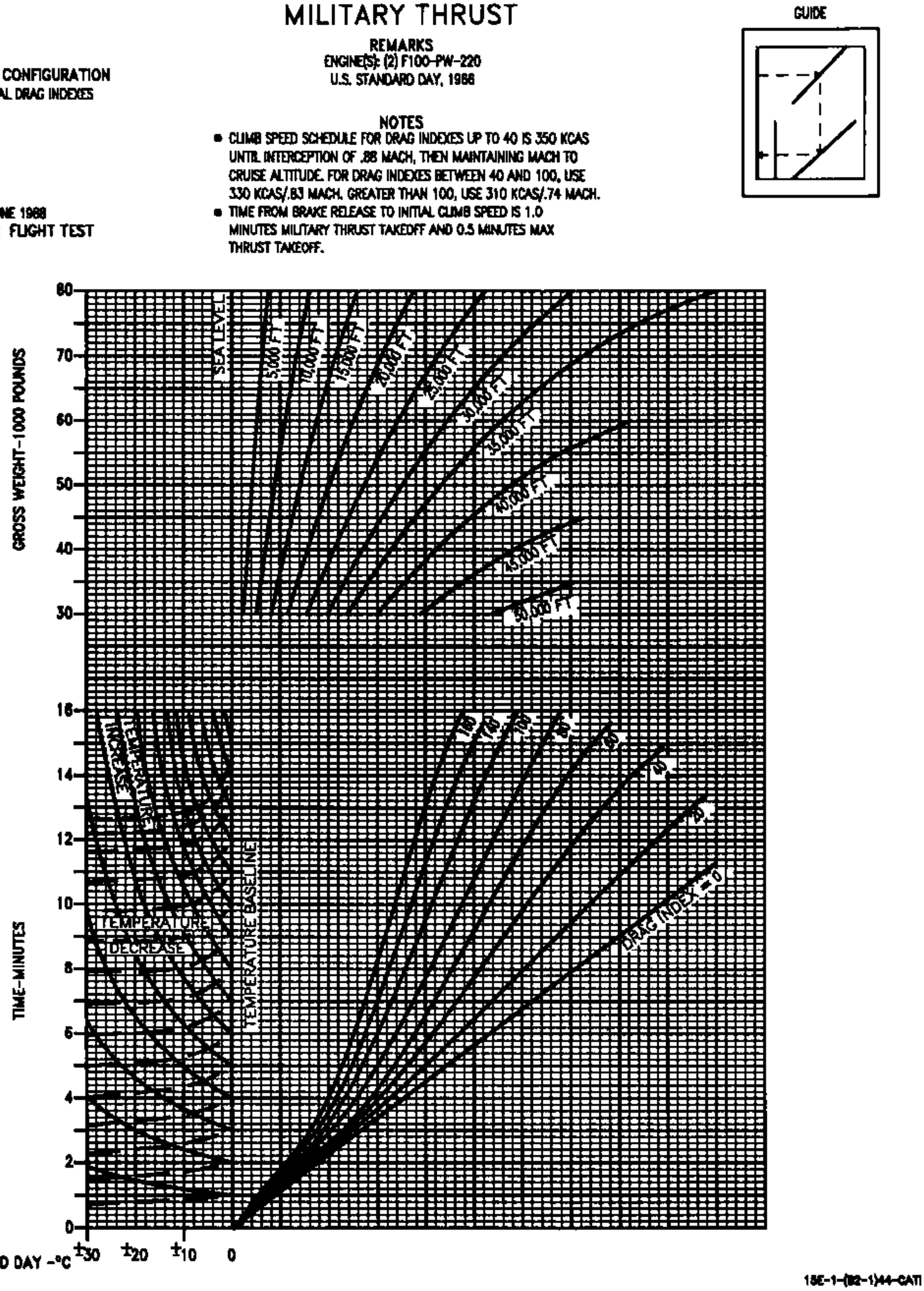


Figure A4-1

FUEL REQUIRED TO CLIMB

MILITARY THRUST

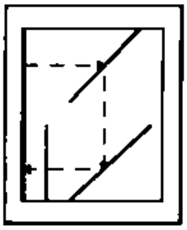
AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

DATE: 15 JUNE 1988
DATA BASIS: FLIGHT TEST

REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

NOTES
- CLIMB SPEED SCHEDULE FOR DRAG INDEXES UP TO 40 IS 350 KCAS UNTIL INTERCEPTION OF .88 MACH, THEN MAINTAINING MACH TO CRUISE ALTITUDE. FOR DRAG INDEXES BETWEEN 40 AND 100, USE 330 KCAS/.83 MACH. GREATER THAN 100, USE 310 KCAS/.74 MACH.
- PRETAKEOFF FUEL CONSUMPTION IS AS FOLLOWS: START- 32 LB/ENG; MIL RUNUP- 82 LB/ENG; TAXI 23 LB/MIN/ENG.
- FUEL REQUIRED FROM BRAKE RELEASE TO INITIAL CLIMB SPEED IS 300 POUNDS MILITARY THRUST AND 560 POUNDS MAXIMUM THRUST.

GUIDE



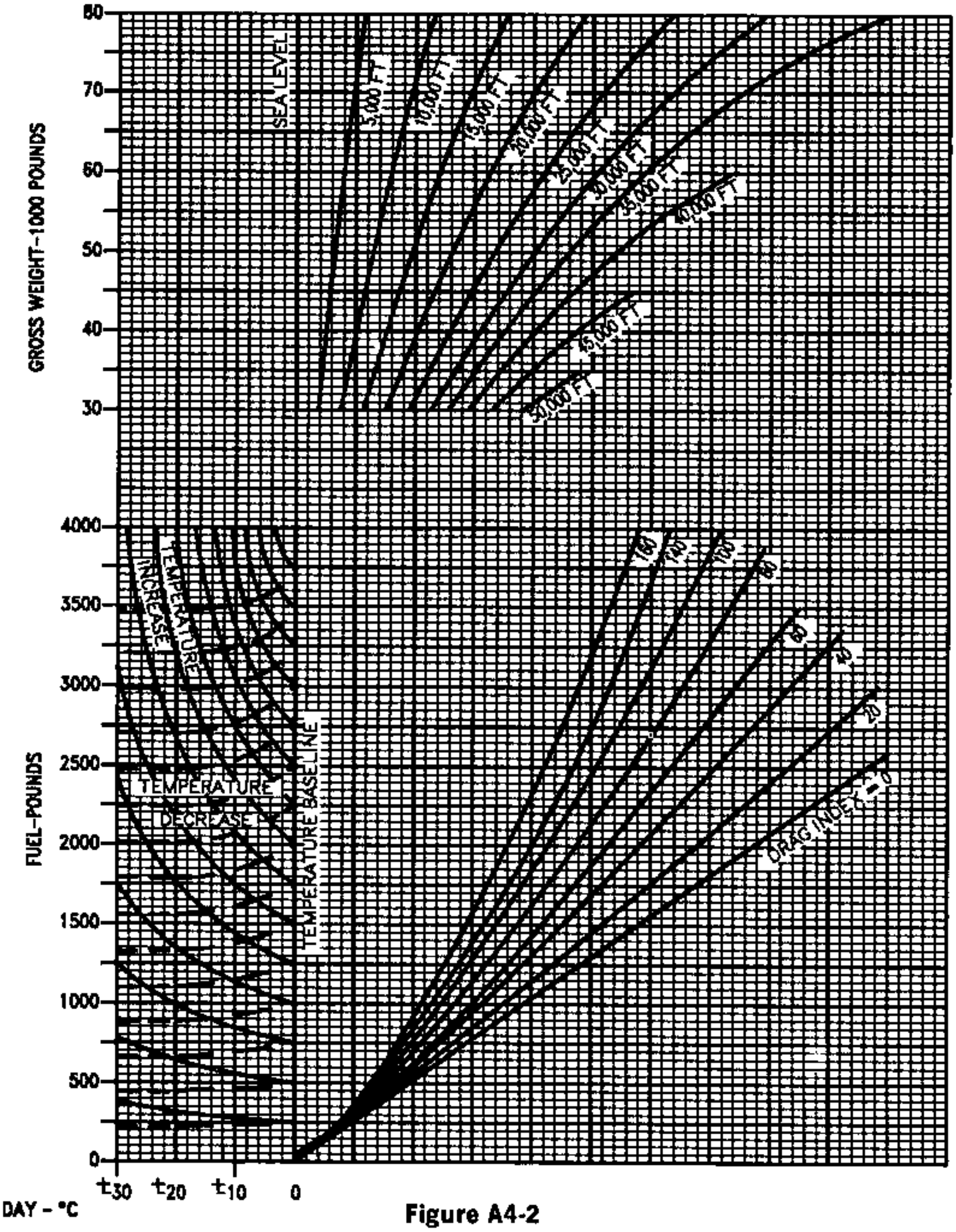


Figure A4-2

15E-1-(83-1)44-CATI

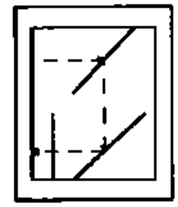
DISTANCE REQUIRED TO CLIMB

MILITARY THRUST

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

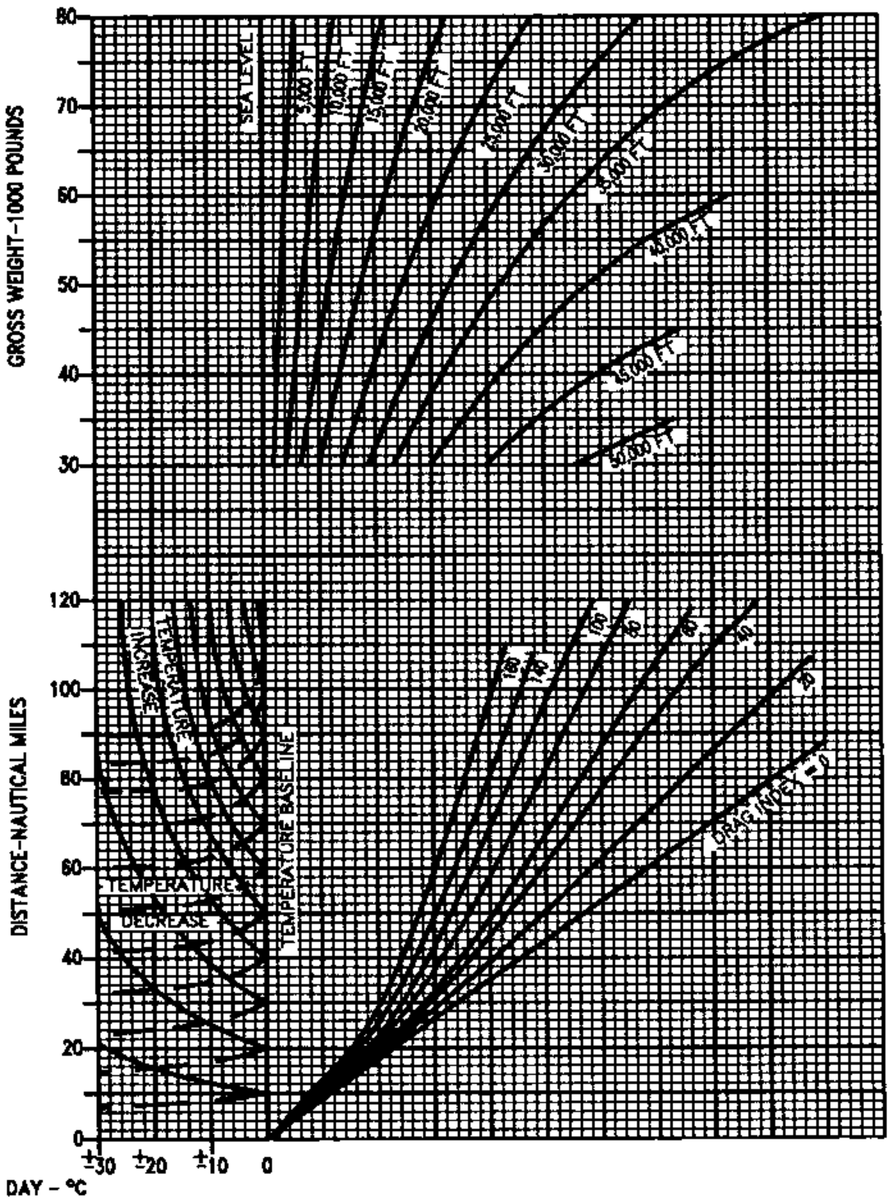
REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

GUIDE



DATE: 15 JUNE 1988
DATA BASIS: FLIGHT TEST

NOTES
- CLIMB SPEED SCHEDULE FOR DRAG INDEXES UP TO 40 IS 350 KCAS UNTIL INTERCEPTION OF .88 MACH, THEN MAINTAINING MACH TO CRUISE ALTITUDE. FOR DRAG INDEXES BETWEEN 40 AND 100, USE 330 KCAS/.83 MACH. GREATER THAN 100, USE 310 KCAS/.74 MACH.
- DISTANCE FROM BRAKE RELEASE TO INITIAL CLIMB SPEED IS 2.0 NAUTICAL MILES MILITARY THRUST TAKEOFF AND 1.0 NAUTICAL MILES MAXIMUM THRUST TAKEOFF.



15E-1-(84-1)44-CATI

Figure A4-3

TIME TO CLIMB

MAXIMUM THRUST

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

DATE: 15 JUNE 1988
DATA BASIS: FLIGHT TEST

REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

NOTES
- TIME FROM BRAKE RELEASE TO INITIAL CLIMB SPEED IS 1.0 MINUTES MILITARY THRUST TAKEOFF AND 0.5 MINUTES MAX THRUST TAKEOFF.
- CLIMB SPEED SCHEDULE FOR DRAG INDEX OF 60 OR LESS IS 350 KCAS UNTIL INTERSECTION OF .95 MACH. FOR HIGHER DRAG INDEXES, USE 350 KCAS/.92 MACH.

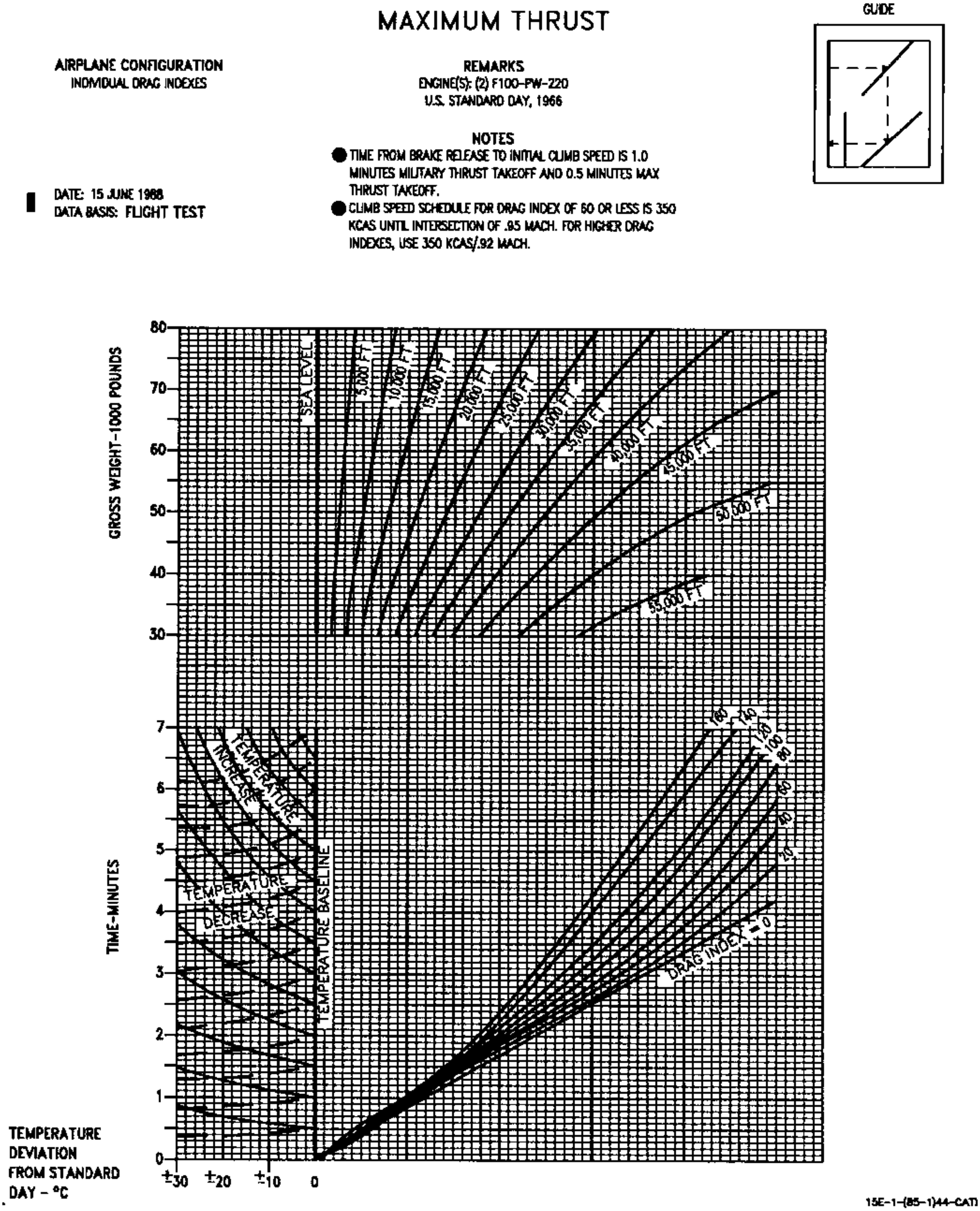


Figure A4-4

FUEL REQUIRED TO CLIMB

MAXIMUM THRUST

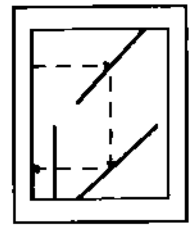
AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

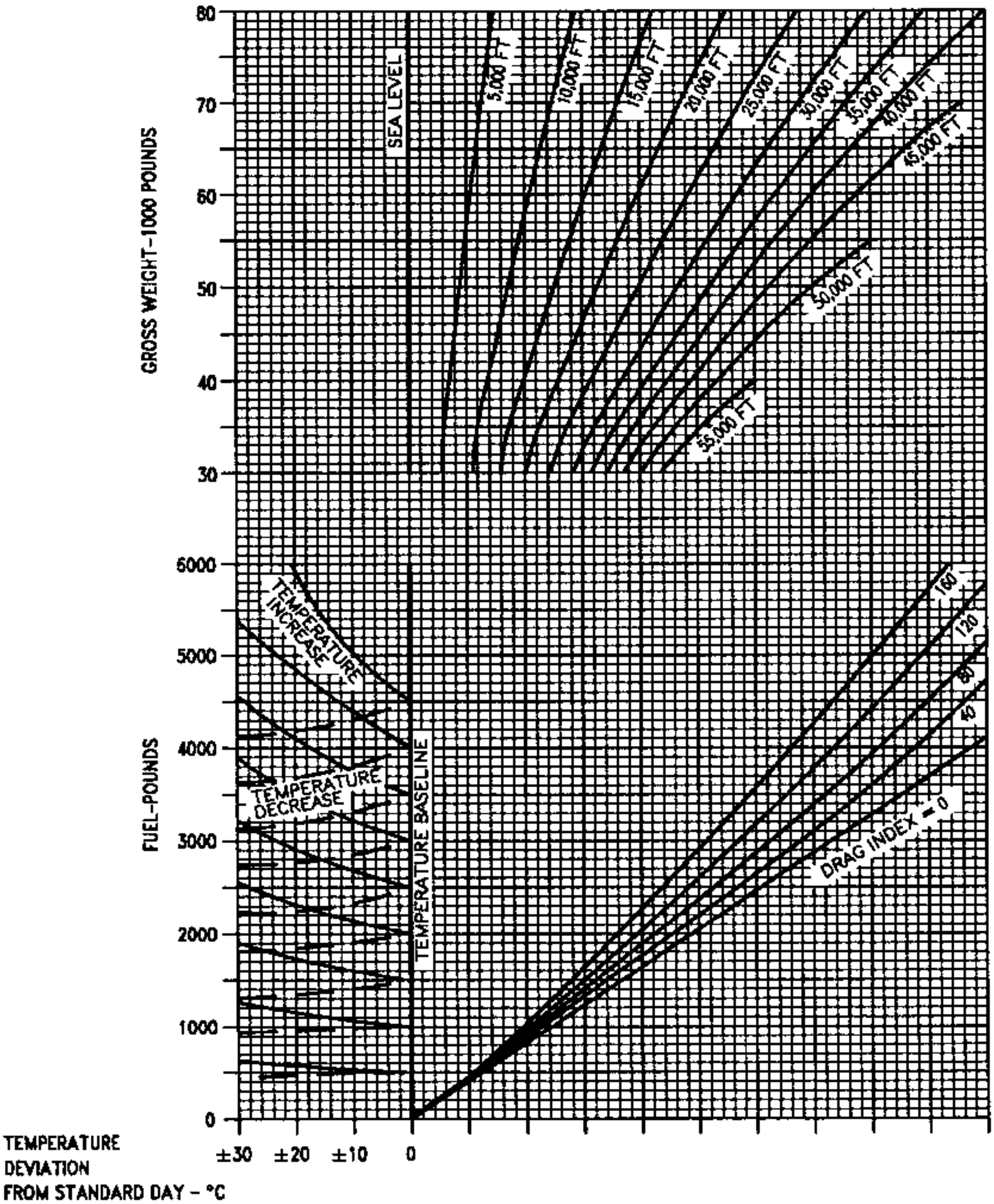
DATE: 15 JUNE 1988
DATA BASIS: FLIGHT TEST

REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

NOTE

- CLIMB SPEED SCHEDULE FOR DRAG INDEXES OF UP TO 60 IS 350 KCAS UNTIL INTERSECTION OF .95 MACH. FOR HIGHER DRAG INDEXES, USE 350 KCAS/.92 MACH.
- FUEL REQUIRED FROM BRAKE RELEASE TO INITIAL CLIMB SPEED IS 300 POUNDS MILITARY THRUST AND 550 POUNDS MAXIMUM THRUST.
- PRETAKEOFF FUEL CONSUMPTION IS AS FOLLOWS: START- 32 LB/ENG; MIL RUNUP- 82 LB/ENG; TAXI 23 LB/MIN/ENG.



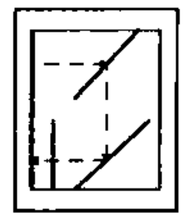


15E-1-(88-1)44-CATI

Figure A4-5

DISTANCE REQUIRED TO CLIMB

MAXIMUM THRUST



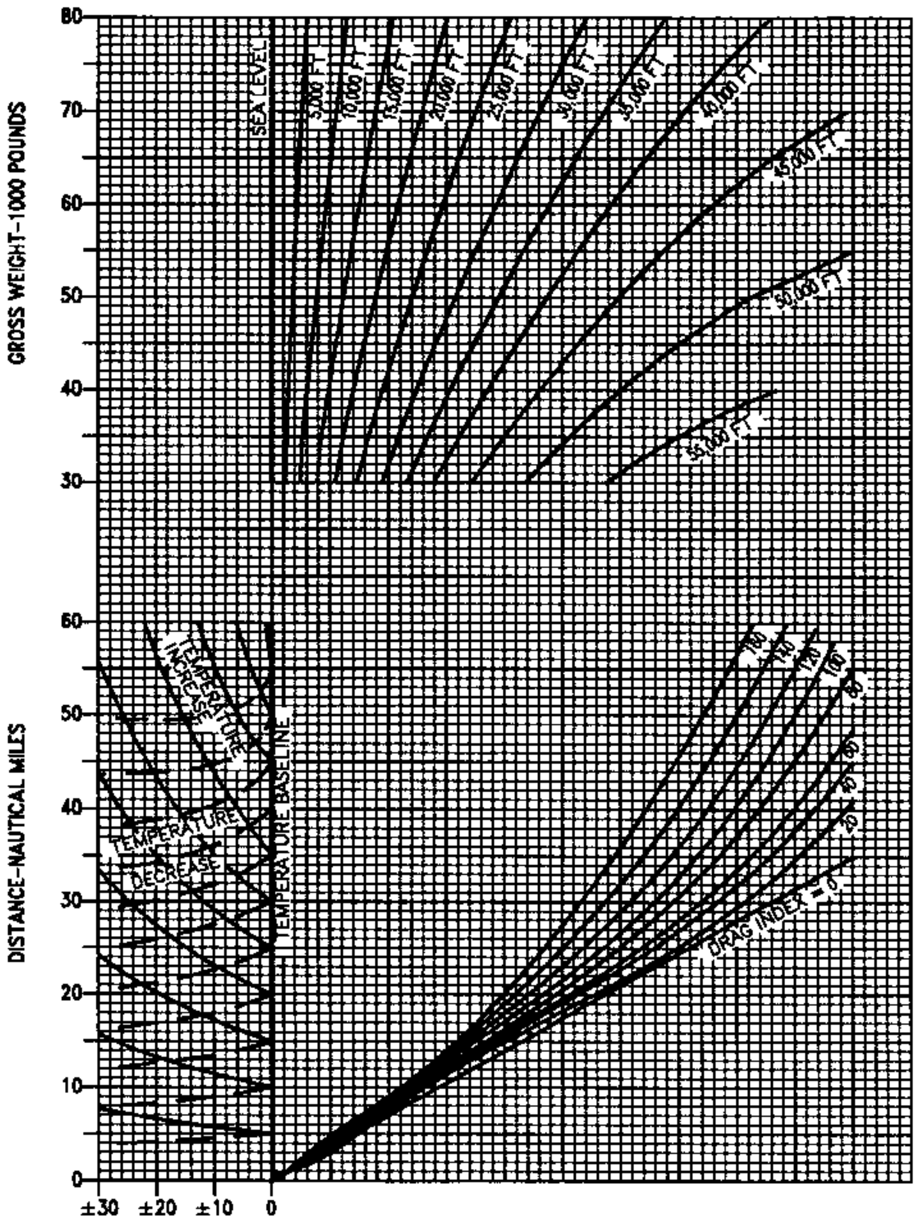
AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

NOTES

- DISTANCE FROM BRAKE RELEASE TO INITIAL CLIMB SPEED IS 2.0 NAUTICAL MILES MILITARY THRUST TAKEOFF AND 1.0 NAUTICAL MILES MAXIMUM THRUST TAKEOFF.
- CLIMB SPEED SCHEDULE FOR DRAG INDEX OF 60 OR LESS IS 350 KCAS UNTIL INTERSECTION OF .95 MACH. FOR HIGHER DRAG INDEXES, USE 350 KCAS/.92 MACH.

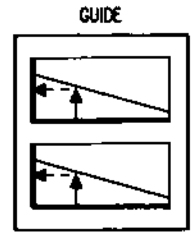
DATE: 15 JUNE 1988
DATA BASIS: FLIGHT TEST



15E-1-(87-1)44-CATI

Figure A4-6

COMBAT CEILING

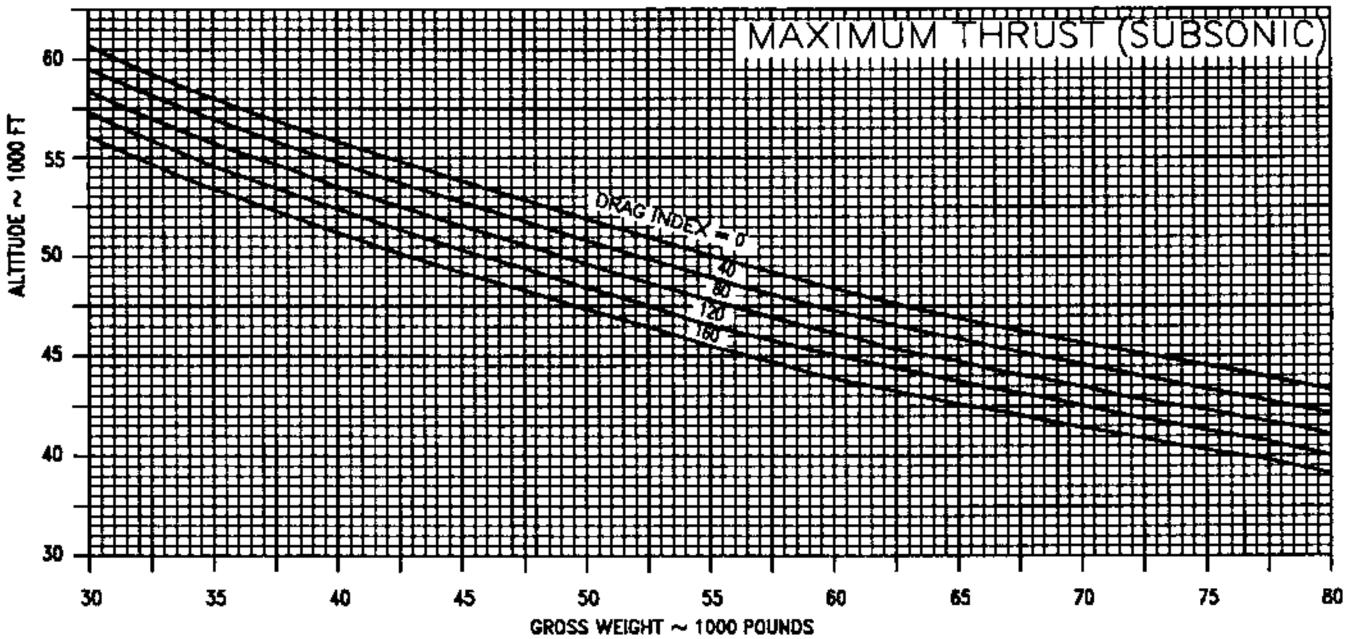


AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

DATE: 15 JUNE 1988
DATA BASIS: FLIGHT TEST

REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

NOTE
COMBAT CEILING IS THE PRESSURE ALTITUDE AT WHICH THE AIRCRAFT CAN CLIMB AT A MAXIMUM RATE OF 500 FEET PER MINUTE.



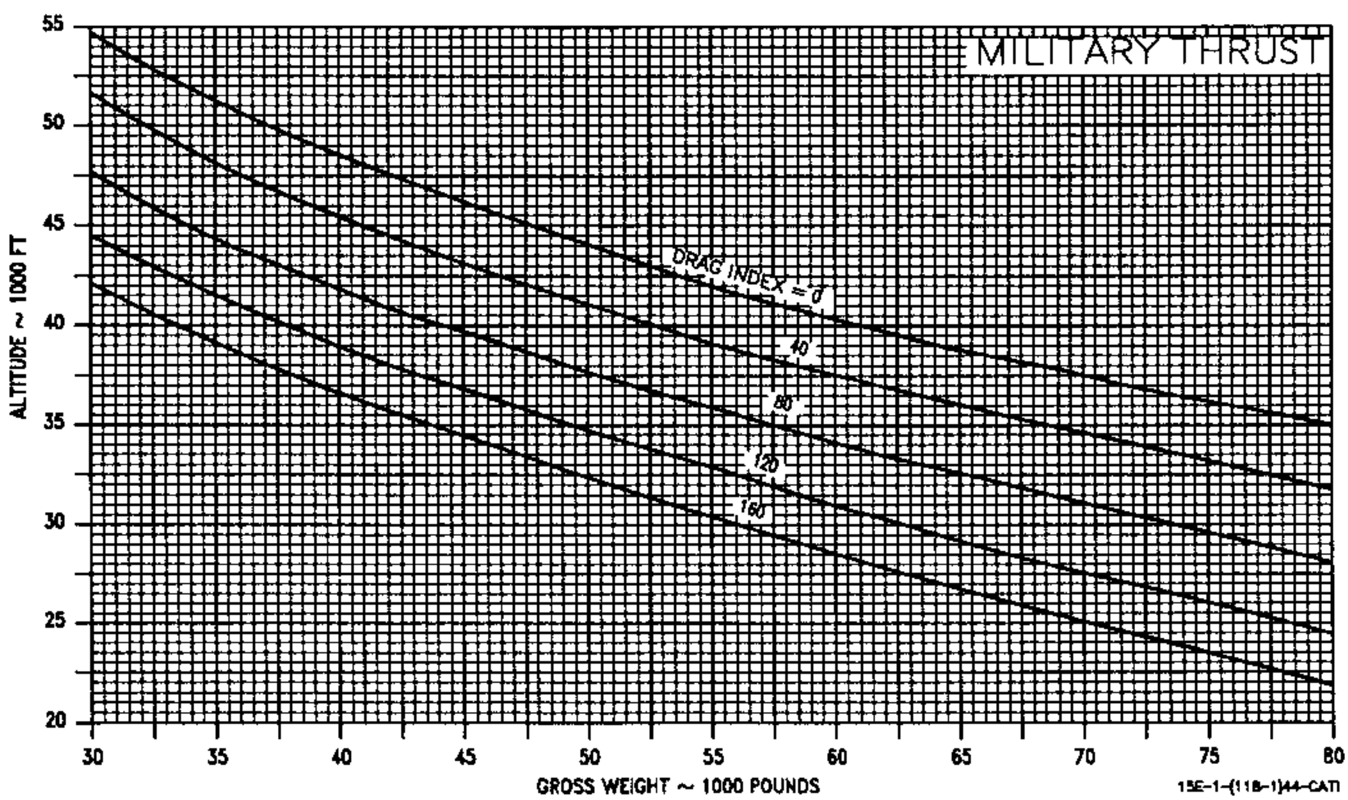
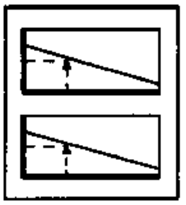


Figure A4-7

COMBAT CEILING

ONE ENGINE OPERATING



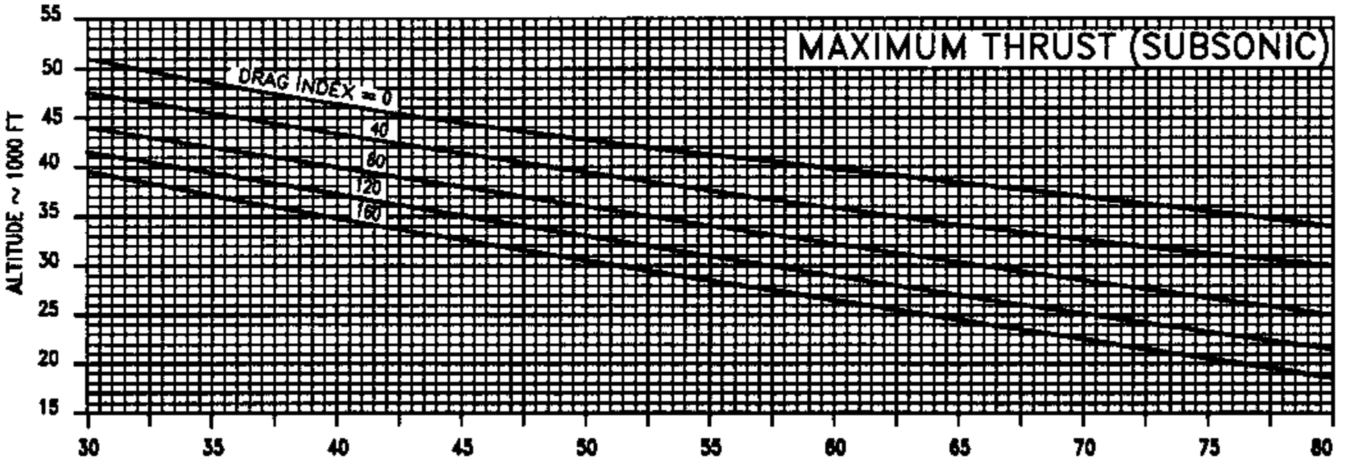
AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

DATE:15 JUNE 1988
DATA BASIS: FLIGHT TEST

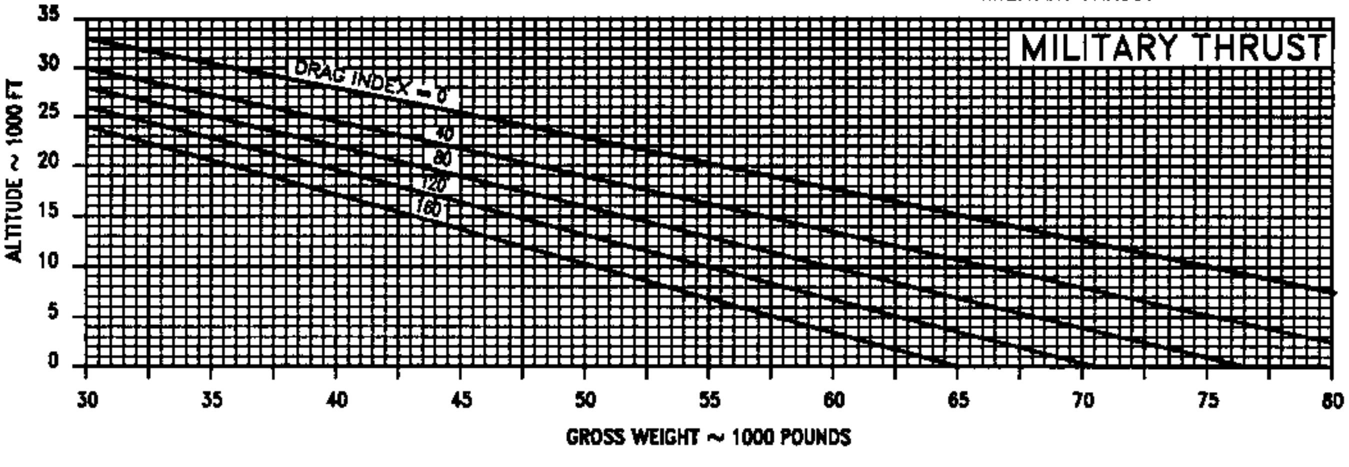
REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

NOTE

- COMBAT CEILING IS THE PRESSURE ALTITUDE AT WHICH THE AIRCRAFT CAN CLIMB AT A MAXIMUM RATE OF 500 FEET PER MINUTE.
- INOPERATIVE ENGINE WINDMILLING.



MILITARY THRUST



15E-1-(119-1)44-CATI

Figure A4-8

PART 5

RANGE

TABLE OF CONTENTS

Charts

OPTIMUM LONG RANGE CRUISE

These charts (figures A5-1 and A5-2) present cruise data for twin-engine and single engine operation. These charts depict cruise altitude, specific range (nautical miles per pound) and cruise Mach number for various gross weights and drag indexes.

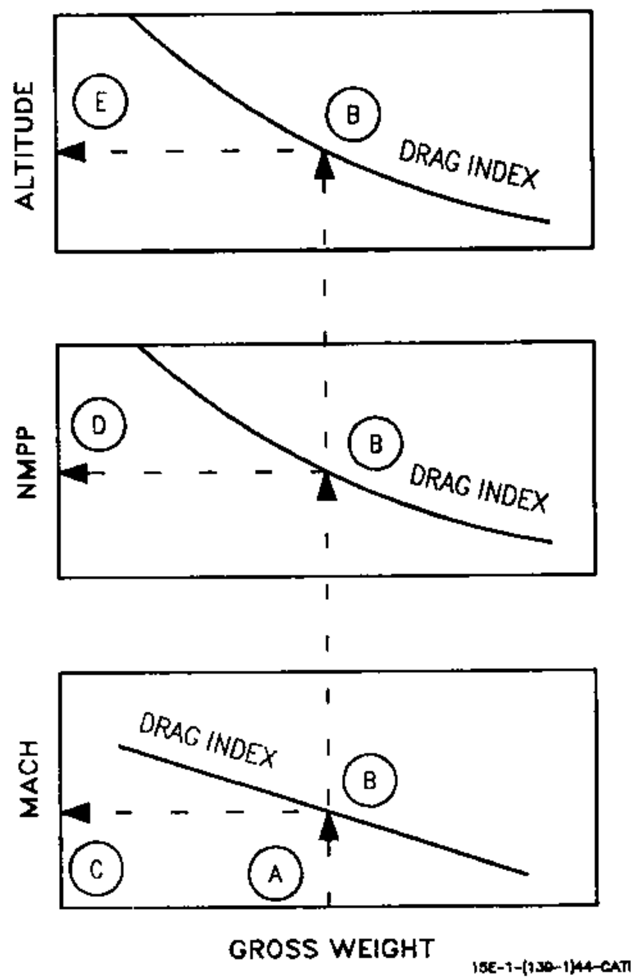
USE

Enter the chart with the applicable gross weight and project vertically up to intersect the appropriate drag index curves in each plot. From the intersection of the appropriate drag index curve, reflect horizontally left and read cruise Mach number, specific range in nautical miles per pound and cruise altitude.

Sample Problem

A. Gross weight	60,000 Lb
B. Drag index	120
C. Mach number	0.765 Mach
D. Specific range	0.051 NMPP
E. Cruise altitude	31,200 Ft

SAMPLE OPTIMUM LONG RANGE CRUISE



CONSTANT ALTITUDE/LONG RANGE CRUISE

These charts (figures A5-3 thru A5-12) present the necessary planning data to set up optimum cruise schedules for normal two-engine operation at a constant altitude. The charts depict specific range (nautical miles per pound of fuel) for various Mach numbers, gross weights and individual drag indexes at altitudes of sea level thru 45,000 feet in increments of 5000 feet. The recommended procedure is to use an average gross weight for a given leg of the mission. One way to find the average gross weight is to divide the mission into weight segments. With this method, readjust the cruise schedule each time a given amount of fuel is used. Subtract one-half of the fuel weight allotted for the first leg from the initial cruise gross weight. The remainder is the average gross weight for the leg. It is possible to obtain instantaneous data if desired.

USE

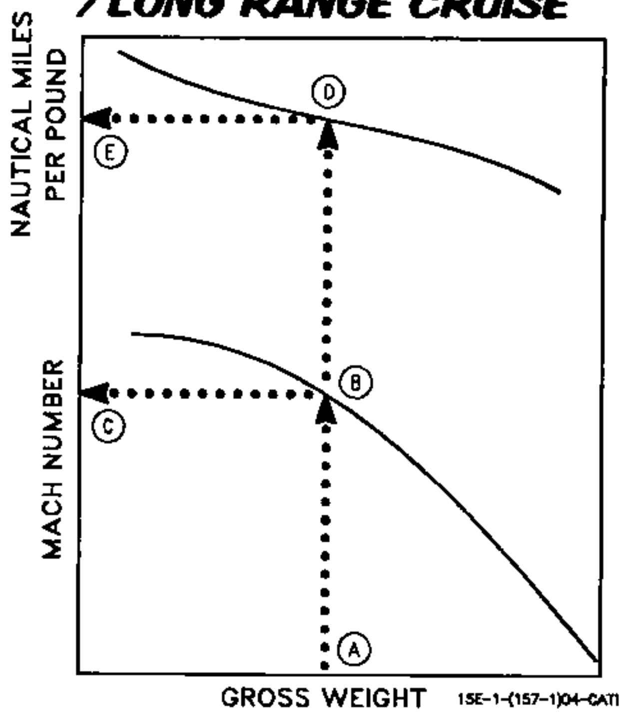
Enter the chart with the desired gross weight and project vertically upward to intersect the appropriate drag index curve, then horizontally to the left to determine optimum cruise Mach number. From the optimum airspeed-gross weight intersection project vertically up to intersect the appropriate drag index curve, then horizontally left to determine the specific range. These charts are applicable for any temperature day. Use following paragraph to determine true airspeed and total fuel flow.

Sample Problem

Configuration - -4 CFT + (4)AIM-7F Missiles, Altitude - 30,000 feet

A. Gross weight	55,000 Lb
B. Drag index	18.6
C. Cruise Mach number	0.850
D. Drag index	18.6
E. Specific range	0.078 NMPP

SAMPLE CONSTANT ALTITUDE /LONG RANGE CRUISE



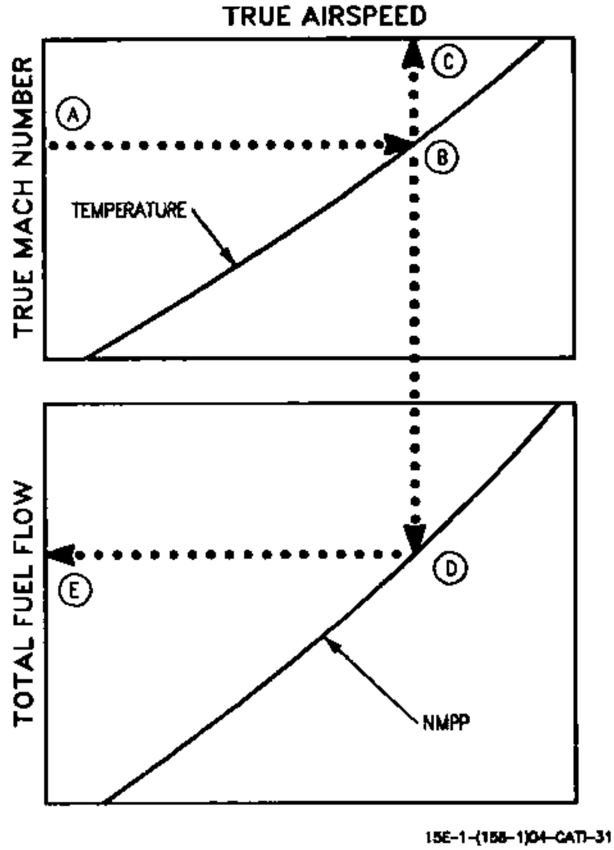
CONSTANT ALTITUDE CRUISE CHARTS

This chart (A5-13) presents the necessary planning data to set up optimum cruise schedules for normal two engine operation at a constant altitude at various flight-level temperatures.

USE

Enter the left side of the chart with the optimum cruise Mach number and project horizontally right to intersect the predicted flight-level temperature. Then, project vertically up to obtain the corresponding true airspeed. Project vertically down to intersect the interpolated specific range, then project horizontally left to obtain total fuel flow required in pounds per hour.

SAMPLE CONSTANT ALTITUDE CRUISE



Sample Problem

Configuration - -4 CFT + (4) AIM-7F Missiles, Altitude - 30,000 feet, Temperature - −40°C

A. True Mach number	0.855
B. Temperature	−40°C
C. True airspeed	510 KTAS
D. Specific range	0.078 NMPP
E. Total fuel flow	6600 PPH

LOW ALTITUDE CRUISE TABLES

These tables (figures A5-14 thru A5-23) present total fuel flow values for various combinations of cruise airspeed and drag index at altitudes of Sea Level, 5000, 10,000, 15,000 and 20,000 feet. Also included for each altitude are the total fuel flow values and resultant V_{max} (maximum attainable TAS) for a MIL thrust setting. Separate tables are provided for gross weights of 35,000 thru 80,000 pounds. Fuel flow values are tabulated for U.S. Standard Day; however, correction factors are given for non-standard temperatures. The standard day temperature is listed with the altitude. If the actual temperature at a particular altitude differs from the standard day temperature, refer to the TEMP. EFFECTS column to determine the appropriate temperature correction factor.

USE

After selecting the applicable table for gross weight and altitude, determine the equivalent standard day true airspeed by dividing the desired true airspeed by the non-standard day temperature correction factor obtained from the appropriate TEMP. EFFECTS column. Enter the table with the equivalent standard day true airspeed and project horizontally to the applicable drag index column and read total fuel flow for a standard day. To obtain the total fuel flow at the desired true airspeed, multiply the total fuel flow for a standard day by the nonstandard day temperature correction factor.

Sample Problem

Gross weight 35,000 lbs, 15,000 ft (−15°C)

A. Desired airspeed	535 KTAS
B. Drag Index	20
C. Nonstandard day temperature	0°C
D. Correction factor	1.029
E. Equivalent standard day true airspeed (A ÷ D)	520 Kt
F. Standard day total fuel flow	9894 PPH
G. Total fuel flow at desired true airspeed (F X D)	10181 PPH
H. Standard day V_{max}	614.2 KTAS
J. Standard day Mil. Pwr. total fuel flow	18,716 PPH

HIGH ALTITUDE CRUISE TABLES

These tables (figures A5-24 thru A5-33) present total fuel flow values for various combinations of cruise airspeed and drag index at altitudes of 25,000 feet thru 45,000 feet in 5000 foot increments. Also included for each altitude are the total fuel flow values and resultant V_{max} (maximum attainable TAS) for a MIL thrust setting. Separate charts are provided for gross weights of 35,000 thru 80,000 pounds. Fuel flow values are tabulated for U.S. Standard Day; however, correction factors are given for nonstandard temperatures. The standard day temperature is listed with the altitude. If the actual temperature at a particular altitude differs from the standard day temperature, refer to the TEMP. EFFECTS column to determine the appropriate temperature correction factor.

USE

After selecting the applicable table for gross weight and altitude, determine the equivalent standard day true airspeed by dividing the desired true airspeed by the nonstandard day temperature correction factor obtained from the appropriate TEMP EFFECTS column. Enter the table with the equivalent standard day true airspeed and project horizontally to the applicable drag index column and read total fuel flow for a standard day. To obtain the total fuel flow at the desired true airspeed, multiply the total fuel flow for a standard day by the nonstandard day temperature correction factor.

CONSTANT ALTITUDE CRUISE - LANDING GEAR EXTENDED

This chart (figure A5-34) presents data to set up constant altitude cruise schedules when landing gear cannot be retracted. The chart contains specific range (nautical miles per pound of fuel) data for various combinations of gross weight, drag index, and altitude for a cruise speed of 250 KCAS.

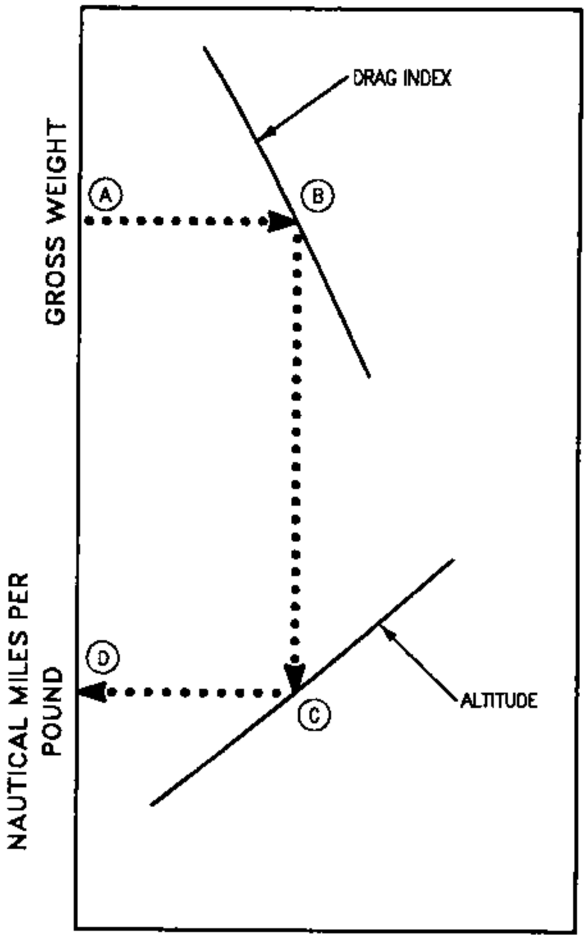
USE

Enter the chart at the gross weight scale and project horizontally right to intersect with the applicable drag index. From this point, project downward to intersect with the desired cruise altitude and project horizontally left to read the specific range.

Sample Problem

A. Gross weight	40,000 Lb
B. Drag index (external stores)	30
Drag index (all gear extended)	90
Total drag index	120
C. Altitude	10,000 Ft
D. Specific range	0.046 NMPP

SAMPLE CONSTANT ALTITUDE CRUISE, LANDING GEAR EXTENDED



15E-1-(155-1)04-CATI

OPTIMUM LONG RANGE CRUISE

MILITARY THRUST

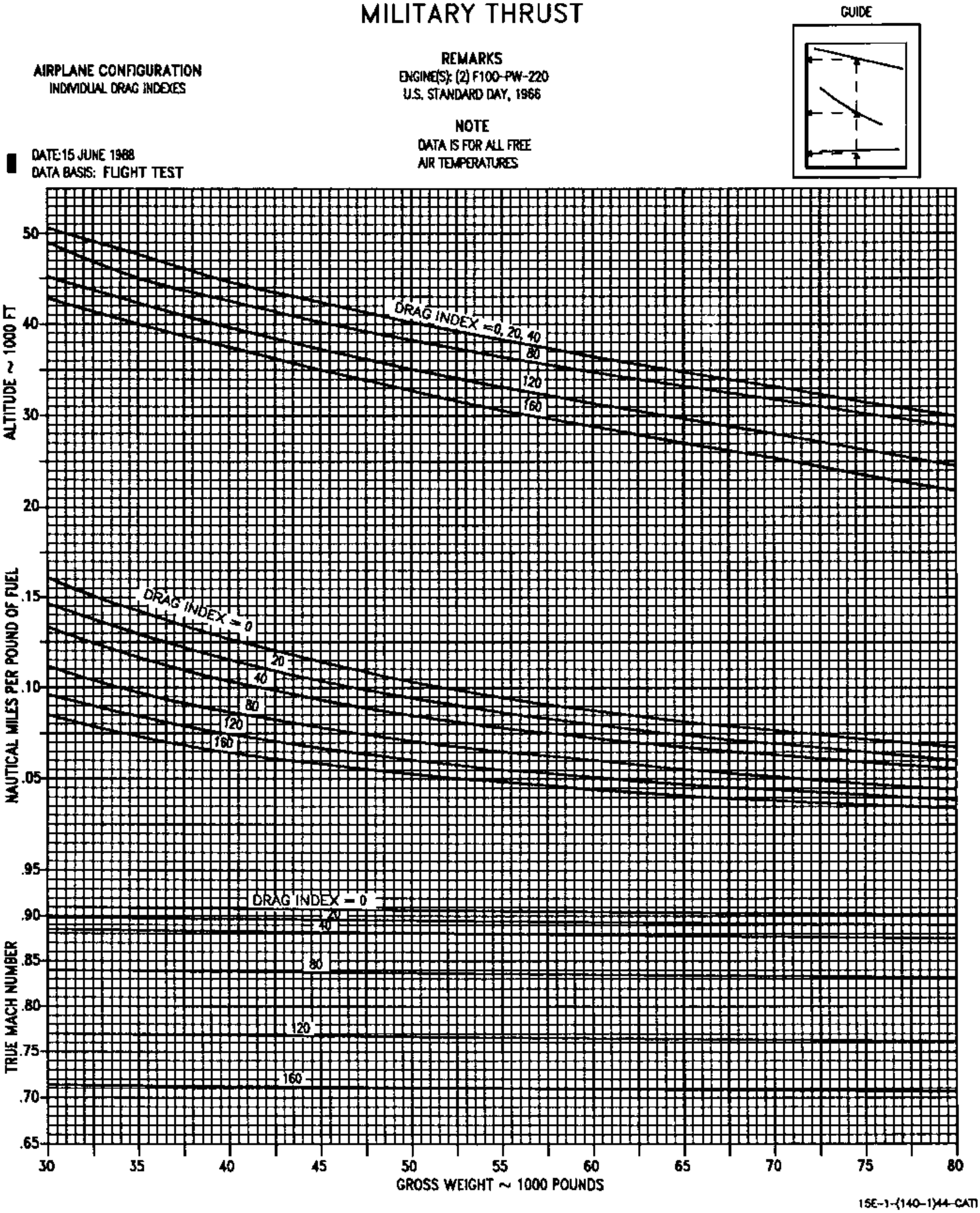


Figure A5-1

OPTIMUM LONG RANGE CRUISE

ONE ENGINE OPERATING

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

GUIDE

DATE: 15 JUNE 1988
DATA BASIS: FLIGHT TEST

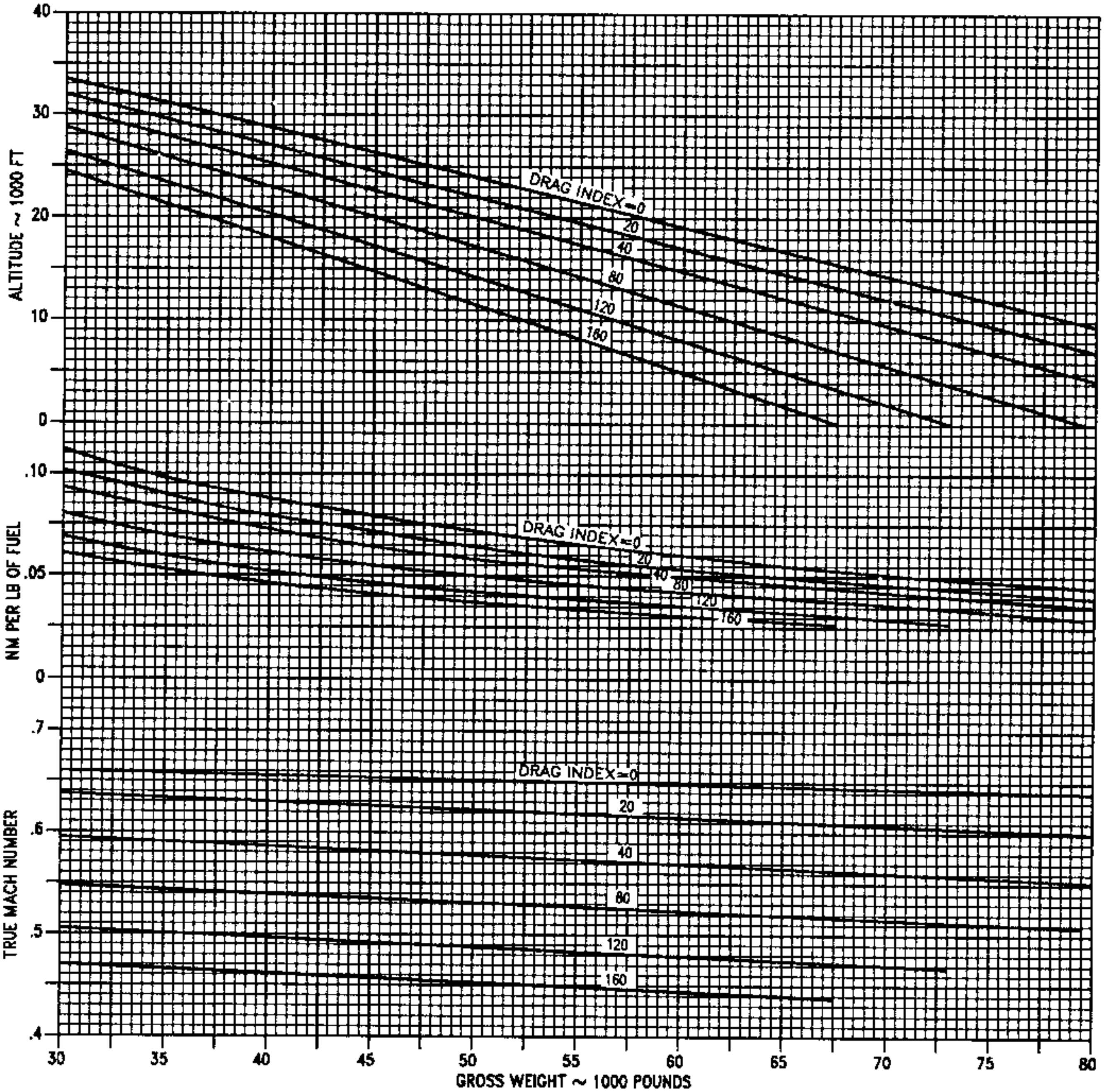


Figure A5-2

CONSTANT ALTITUDE/LONG RANGE CRUISE
SEA LEVEL

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

SPECIFIC RANGE, TRUE MACH NUMBER

REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

GUIDE

DATE: 15 JUNE 1988
DATA BASIS: FLIGHT TEST

NOTE
DATA IS FOR ALL FREE AIR TEMPERATURES

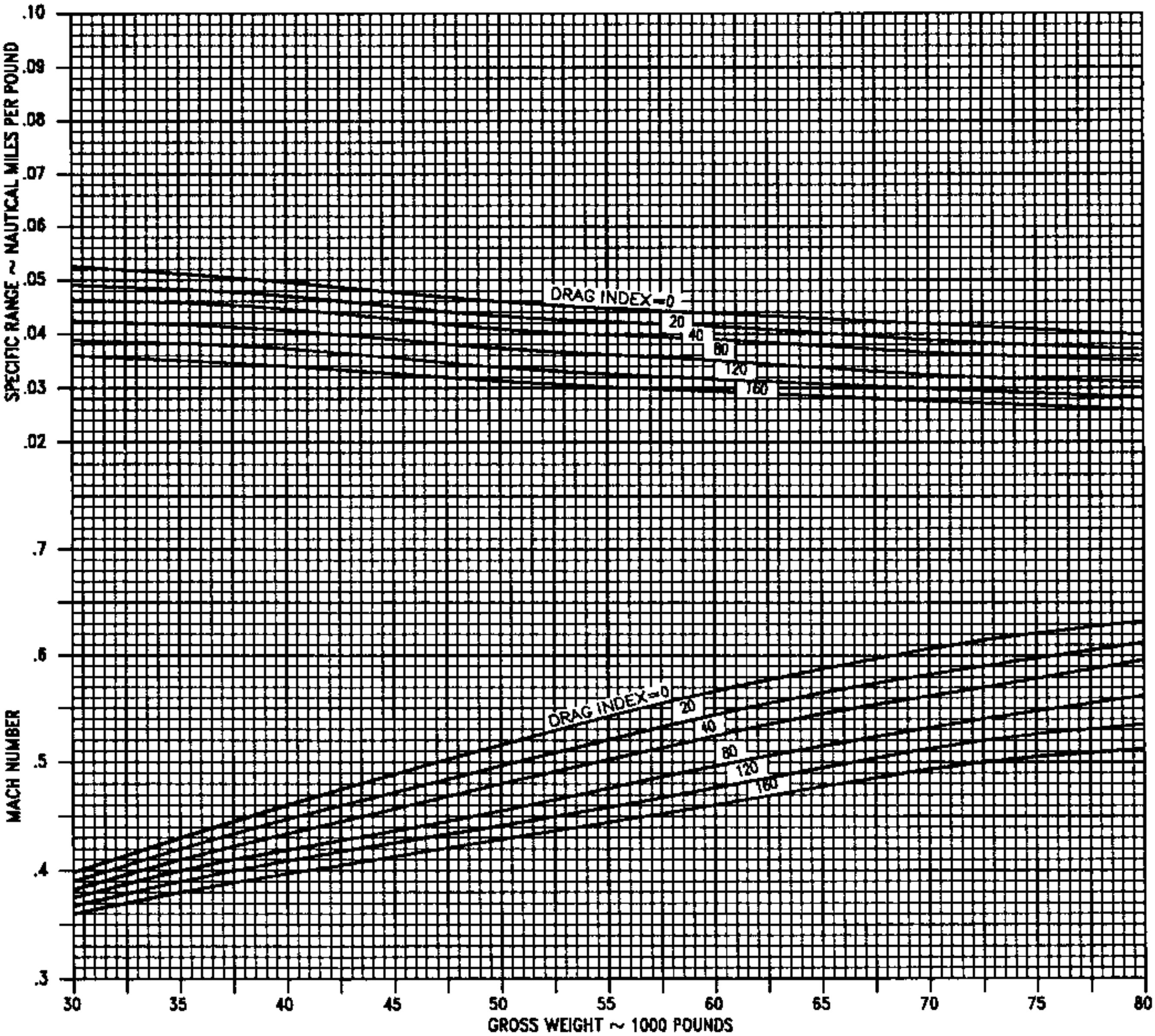


Figure A5-3

CONSTANT ALTITUDE/LONG RANGE CRUISE 5,000 FEET

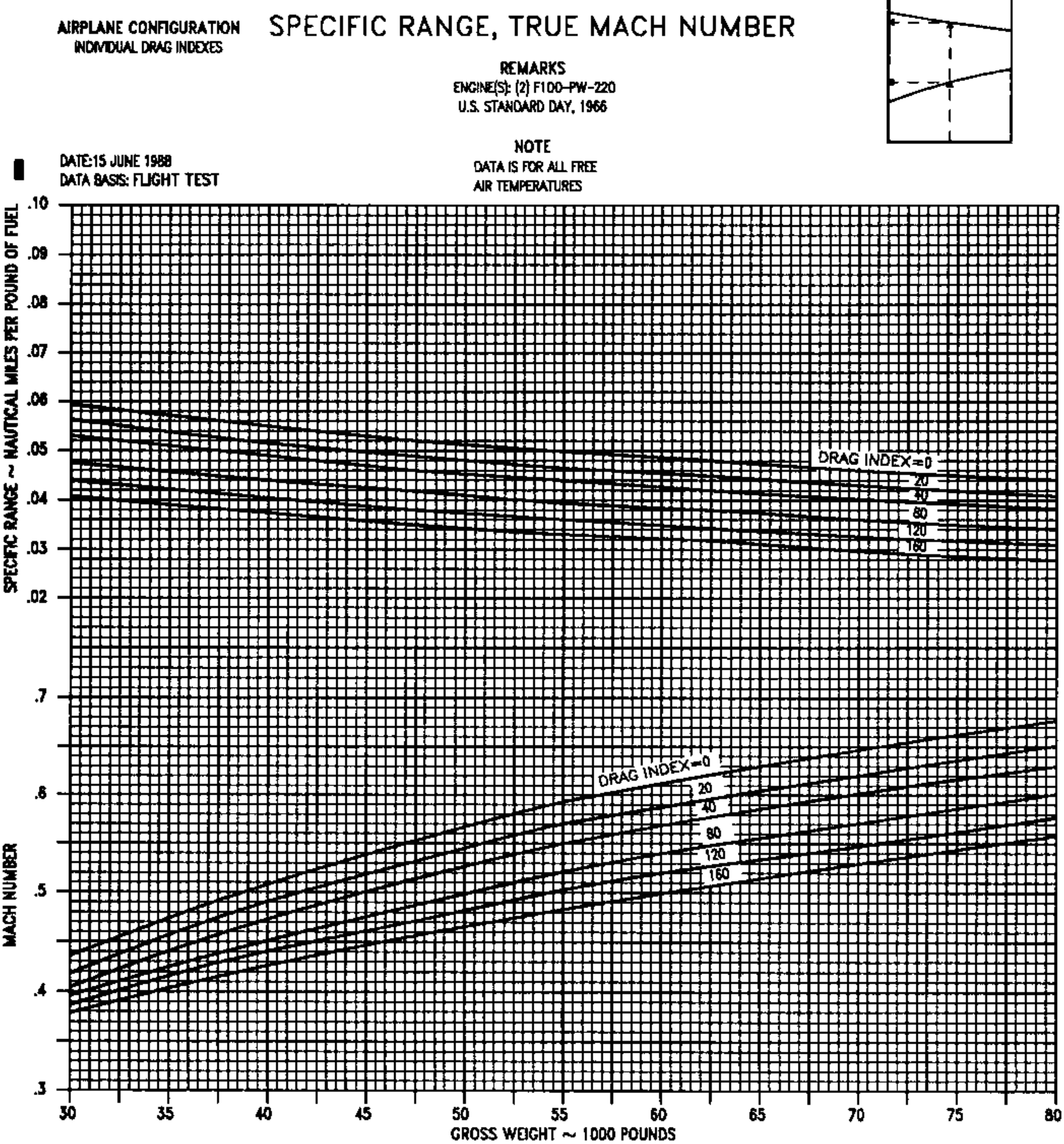


Figure A5-4

CONSTANT ALTITUDE/LONG RANGE CRUISE 10,000 FEET

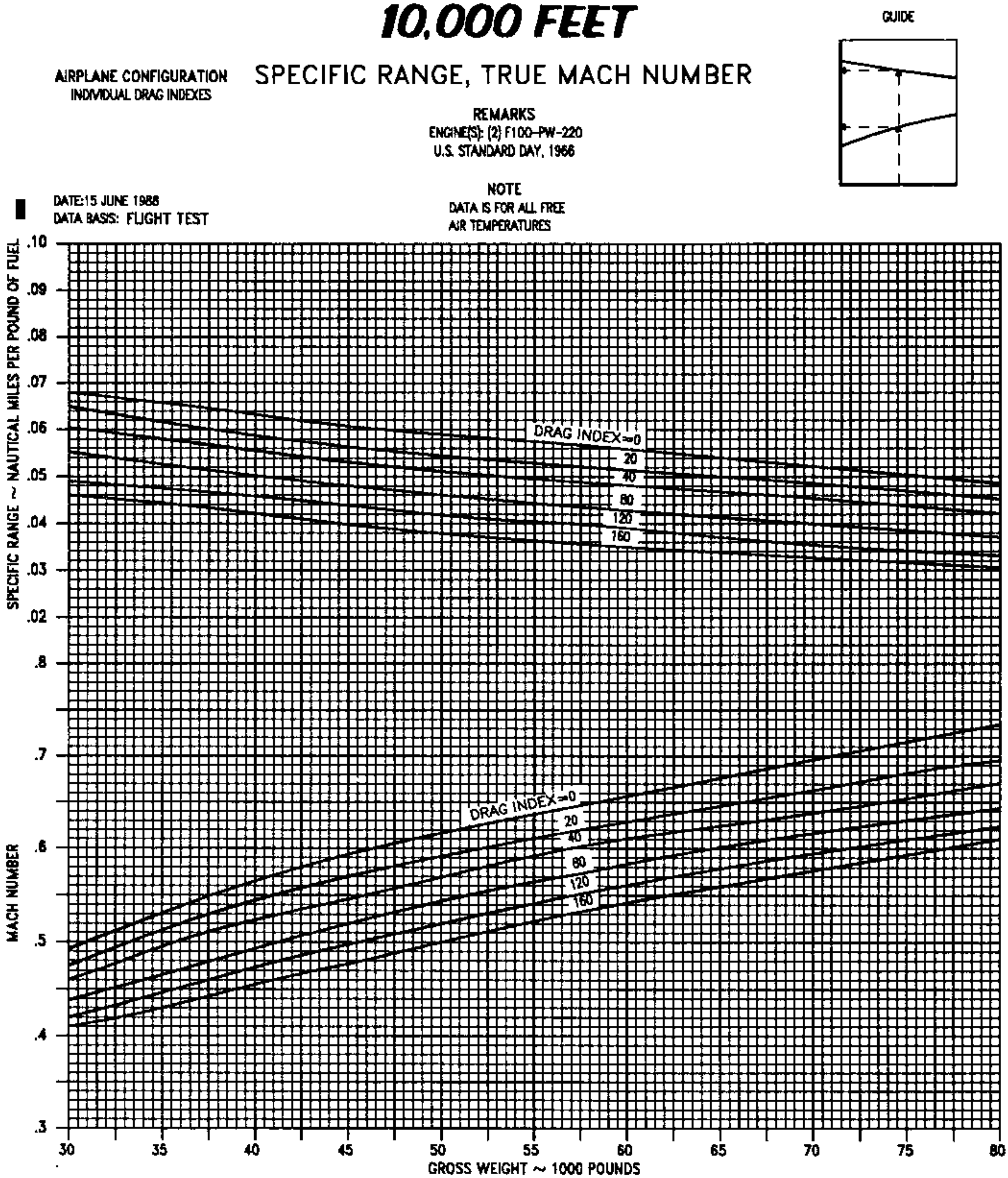
SPECIFIC RANGE, TRUE MACH NUMBER

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

DATE: 15 JUNE 1988
DATA BASIS: FLIGHT TEST

NOTE
DATA IS FOR ALL FREE AIR TEMPERATURES



15E-1-(145-1)44-CATI

Figure A5-5

CONSTANT ALTITUDE/LONG RANGE CRUISE 15,000 FEET

SPECIFIC RANGE, TRUE MACH NUMBER

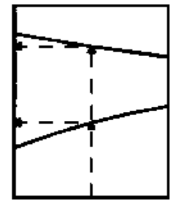
AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

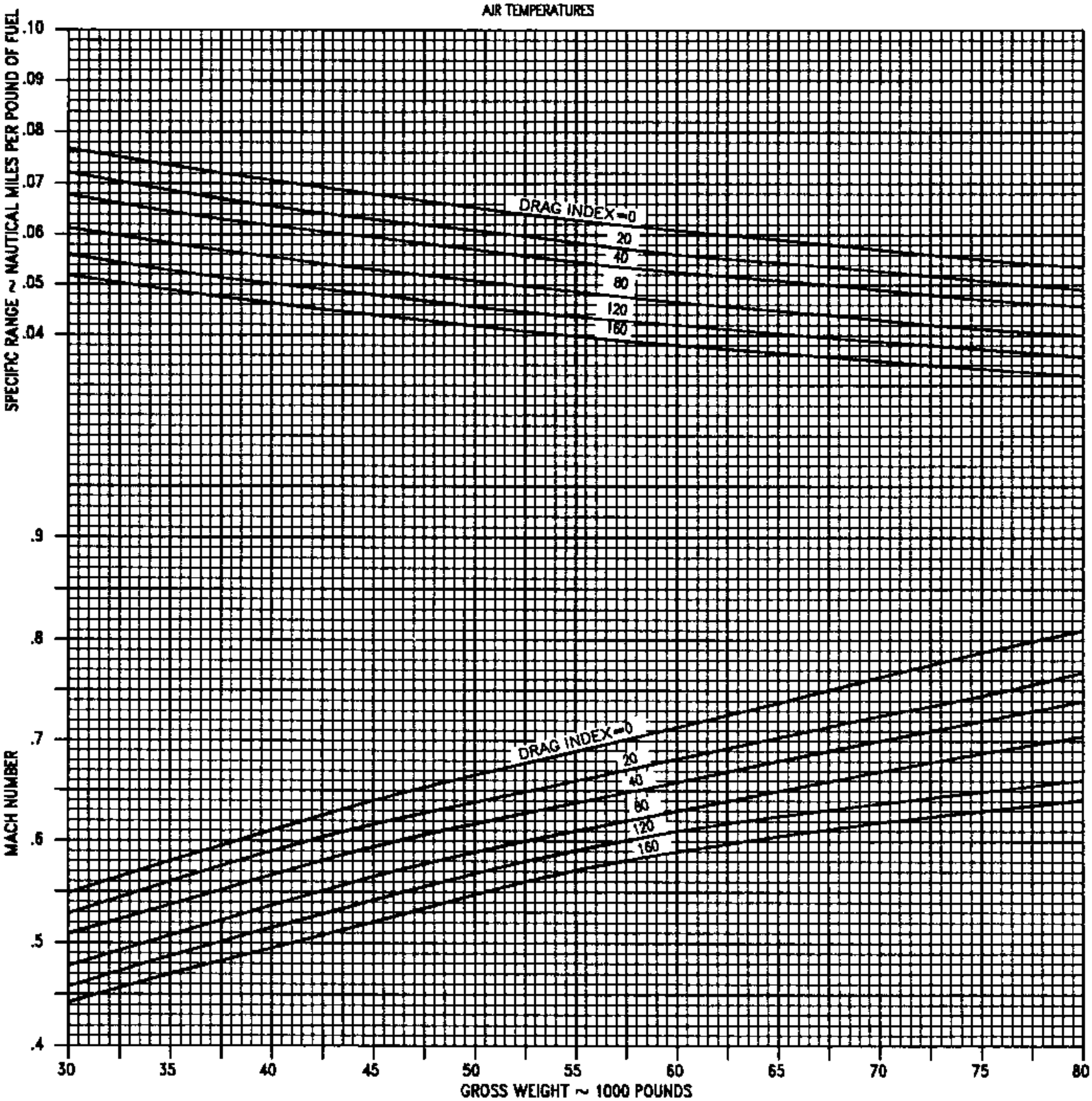
REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

DATE: 15 JUNE 1988
DATA BASIS: FLIGHT TEST

NOTE
DATA IS FOR ALL FREE AIR TEMPERATURES

GUIDE





15E-1-(148-1)44-CATI

Figure A5-6

CONSTANT ALTITUDE/LONG RANGE CRUISE
20,000 FEET

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

SPECIFIC RANGE, TRUE MACH NUMBER

REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

NOTE
DATA IS FOR ALL FREE AIR TEMPERATURES

DATE: 15 JUNE 1988
DATA BASIS: FLIGHT TEST

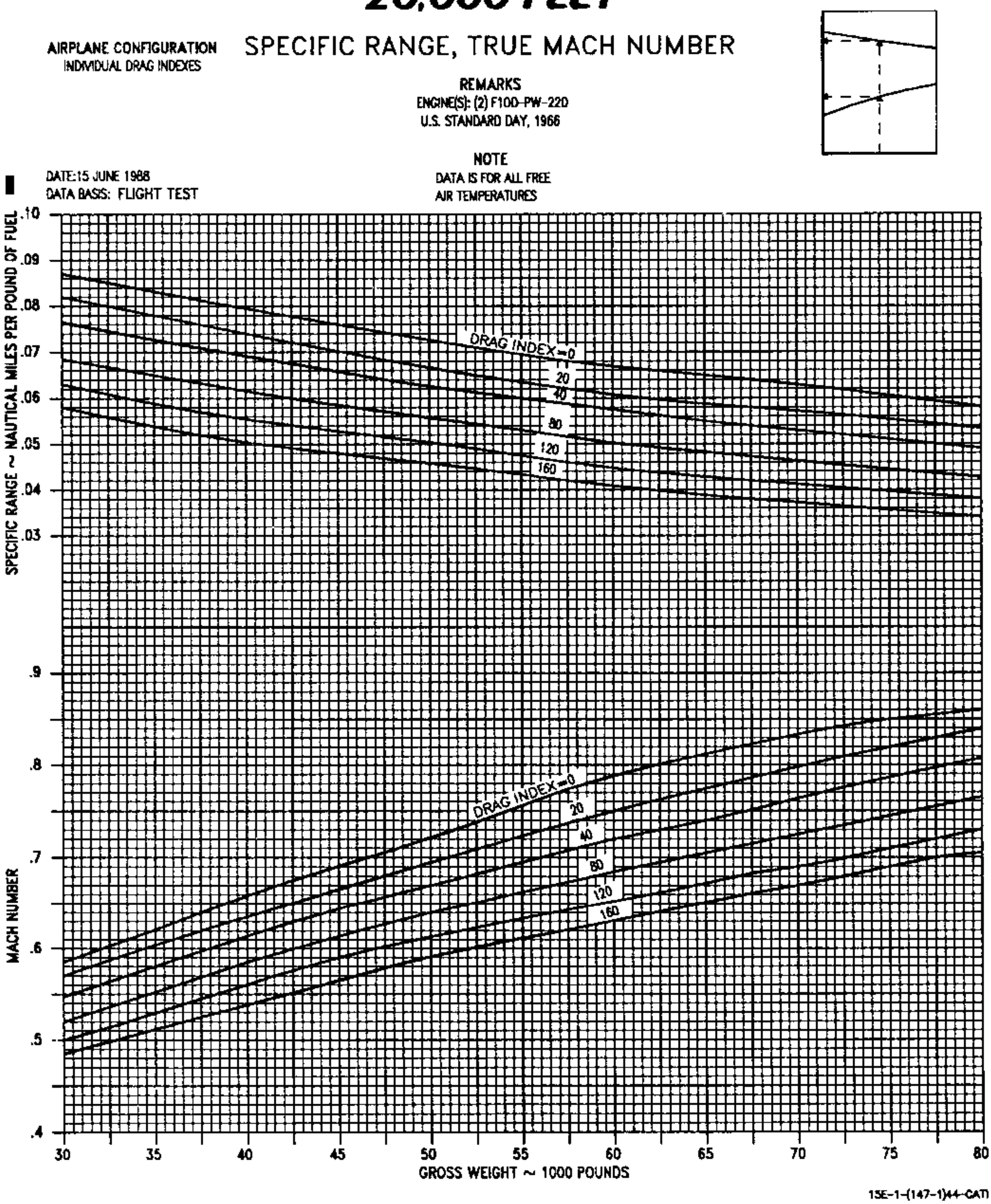


Figure A5-7

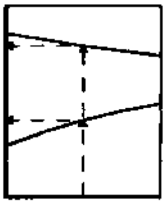
CONSTANT ALTITUDE/LONG RANGE CRUISE
25,000 FEET

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

SPECIFIC RANGE, TRUE MACH NUMBER

REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

GUIDE



DATE: 15 JUNE 1988
DATA BASIS: FLIGHT TEST

NOTE
DATA IS FOR ALL FREE AIR TEMPERATURES

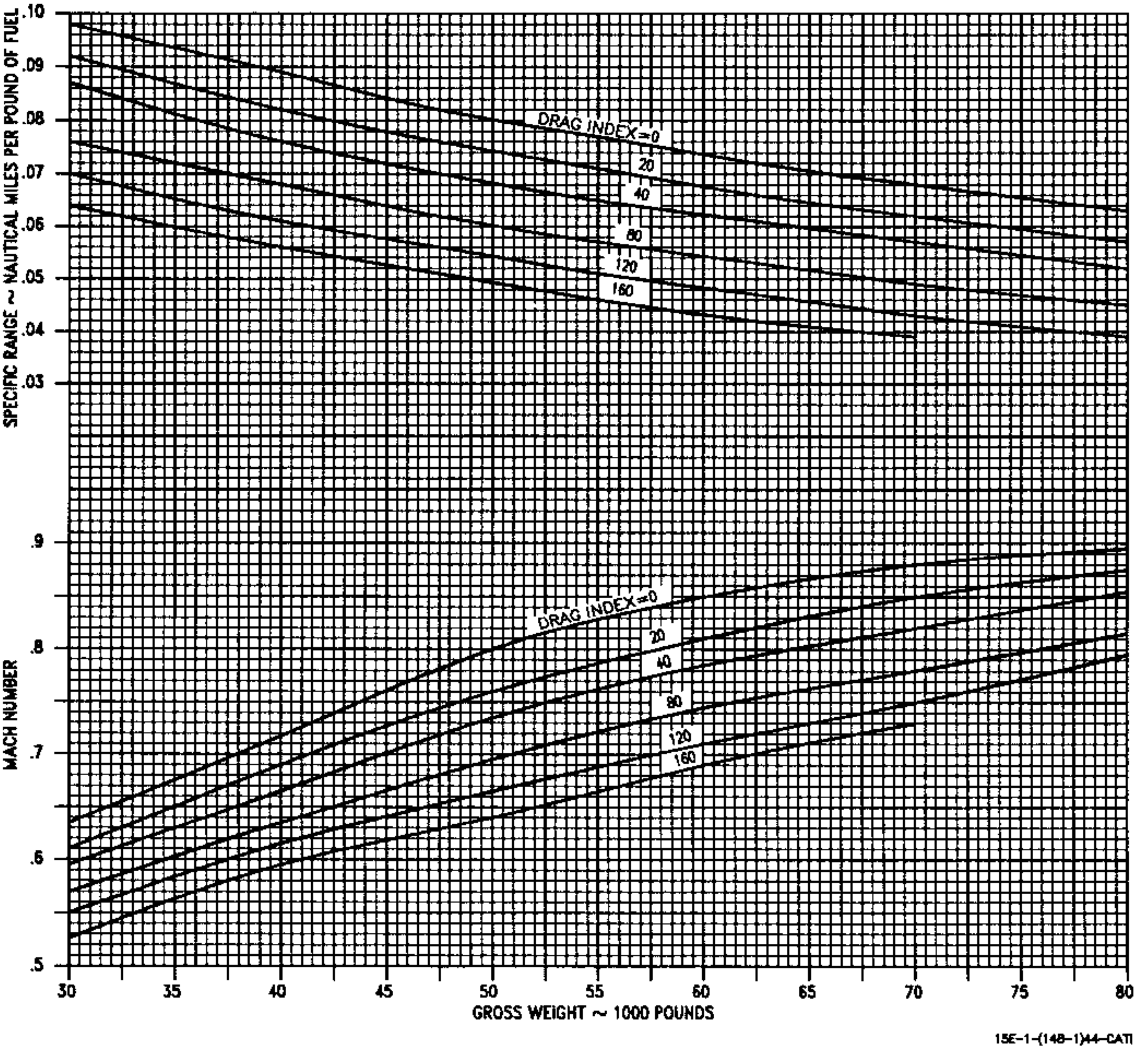


Figure A5-8

CONSTANT ALTITUDE/LONG RANGE CRUISE 30,000 FEET

SPECIFIC RANGE, TRUE MACH NUMBER

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

NOTE
DATA IS FOR ALL FREE AIR TEMPERATURES

DATE: 15 JUNE 1988
DATA BASIS: FLIGHT TEST

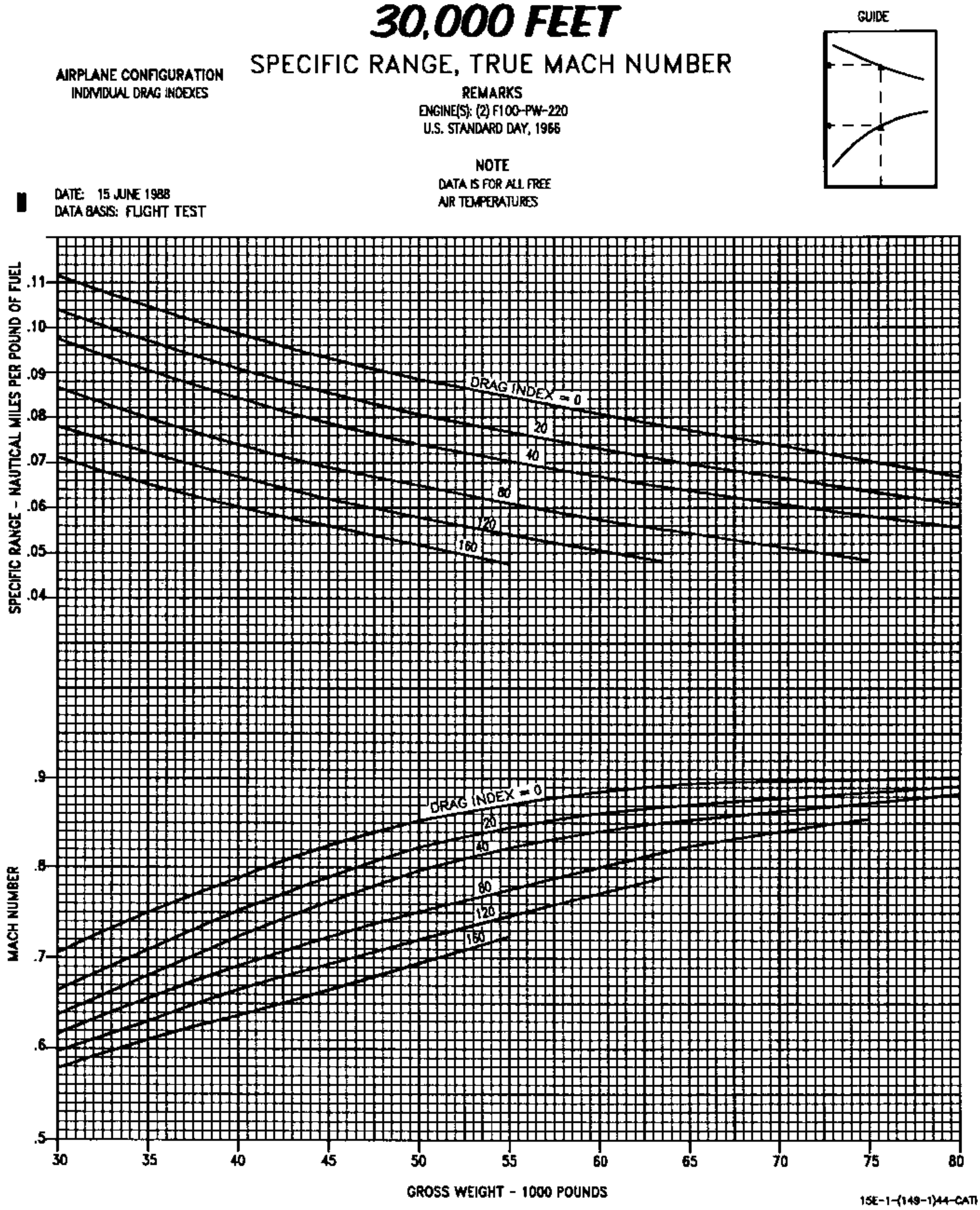


Figure A5-9

CONSTANT ALTITUDE/LONG RANGE CRUISE
35,000 FEET

SPECIFIC RANGE, TRUE MACH NUMBER

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

NOTE
DATA IS FOR ALL FREE AIR TEMPERATURES

DATE: 15 JUNE 1988
DATA BASIS: FLIGHT TEST

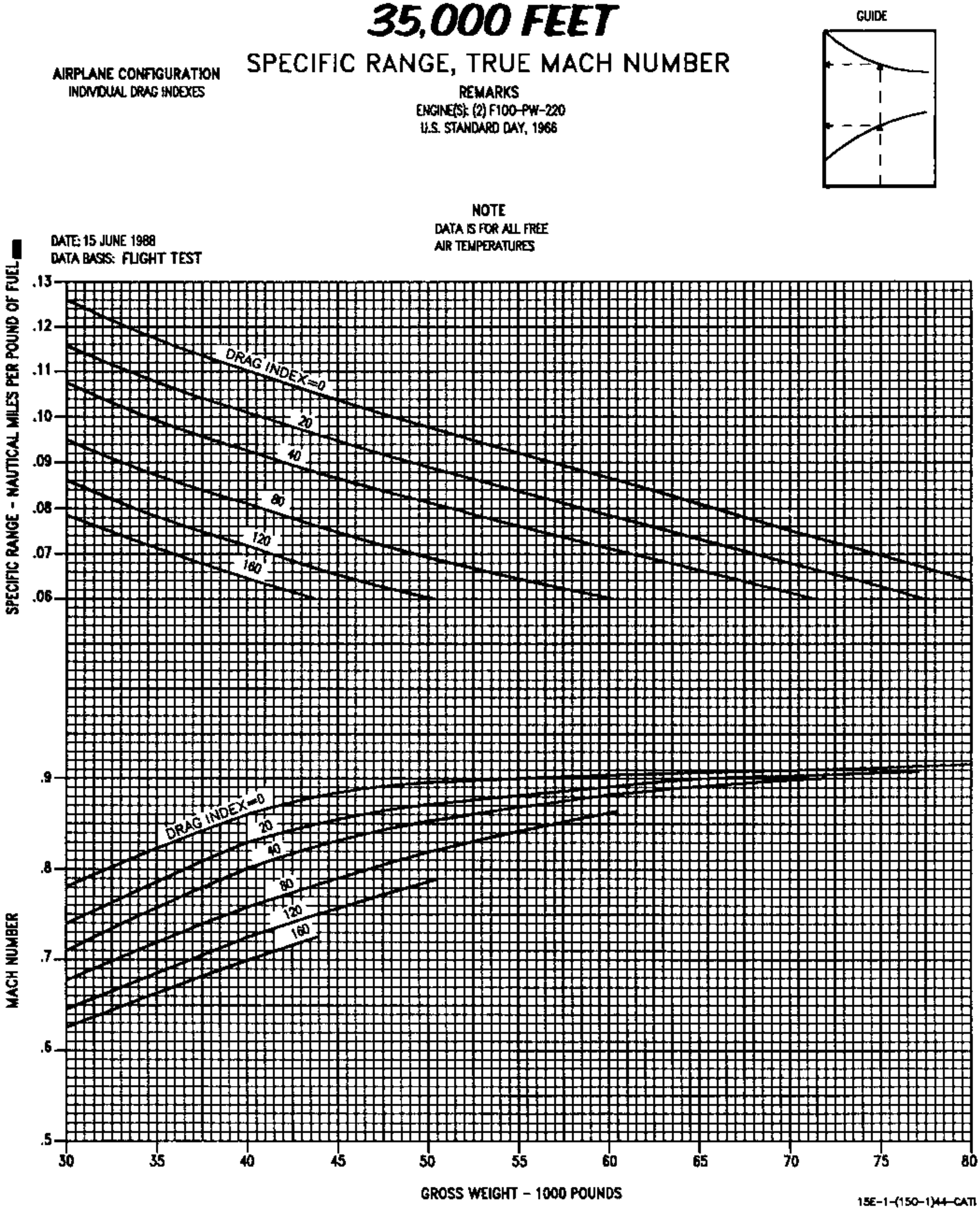


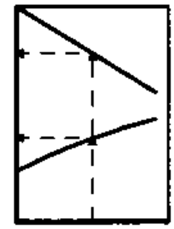
Figure A5-10

CONSTANT ALTITUDE/LONG RANGE CRUISE 40,000 FEET

SPECIFIC RANGE, TRUE MACH NUMBER

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966



DATE: 15 JUNE 1988
DATA BASIS: FLIGHT TEST

NOTE
DATA IS FOR ALL FREE AIR TEMPERATURES

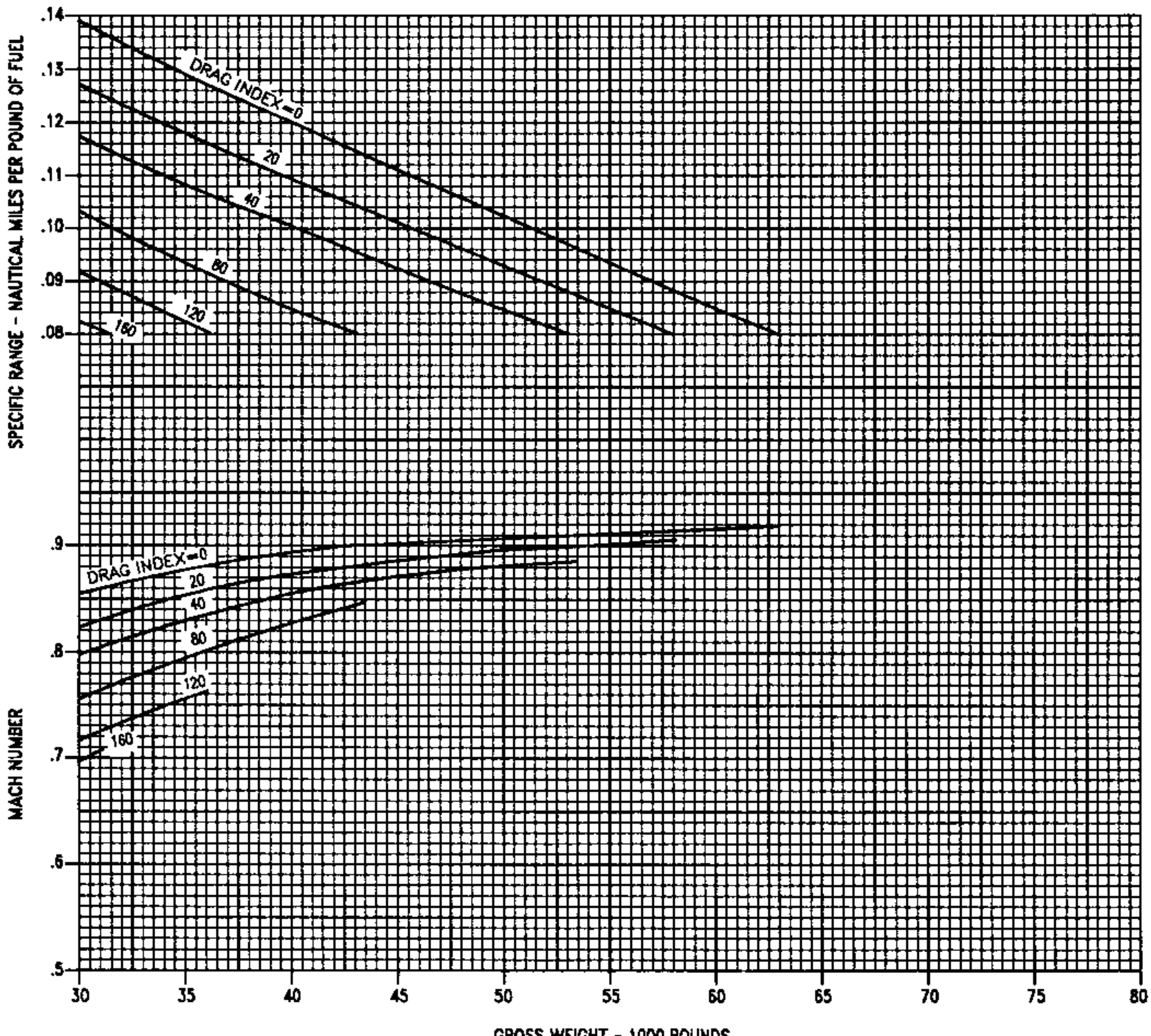


Figure A5-11

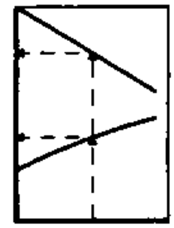
CONSTANT ALTITUDE/LONG RANGE CRUISE
45,000 FEET

SPECIFIC RANGE, TRUE MACH NUMBER

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

GUIDE



NOTE
DATA IS FOR ALL FREE AIR TEMPERATURES

DATE: 15 JUNE 1988
DATA BASIS: FLIGHT TEST

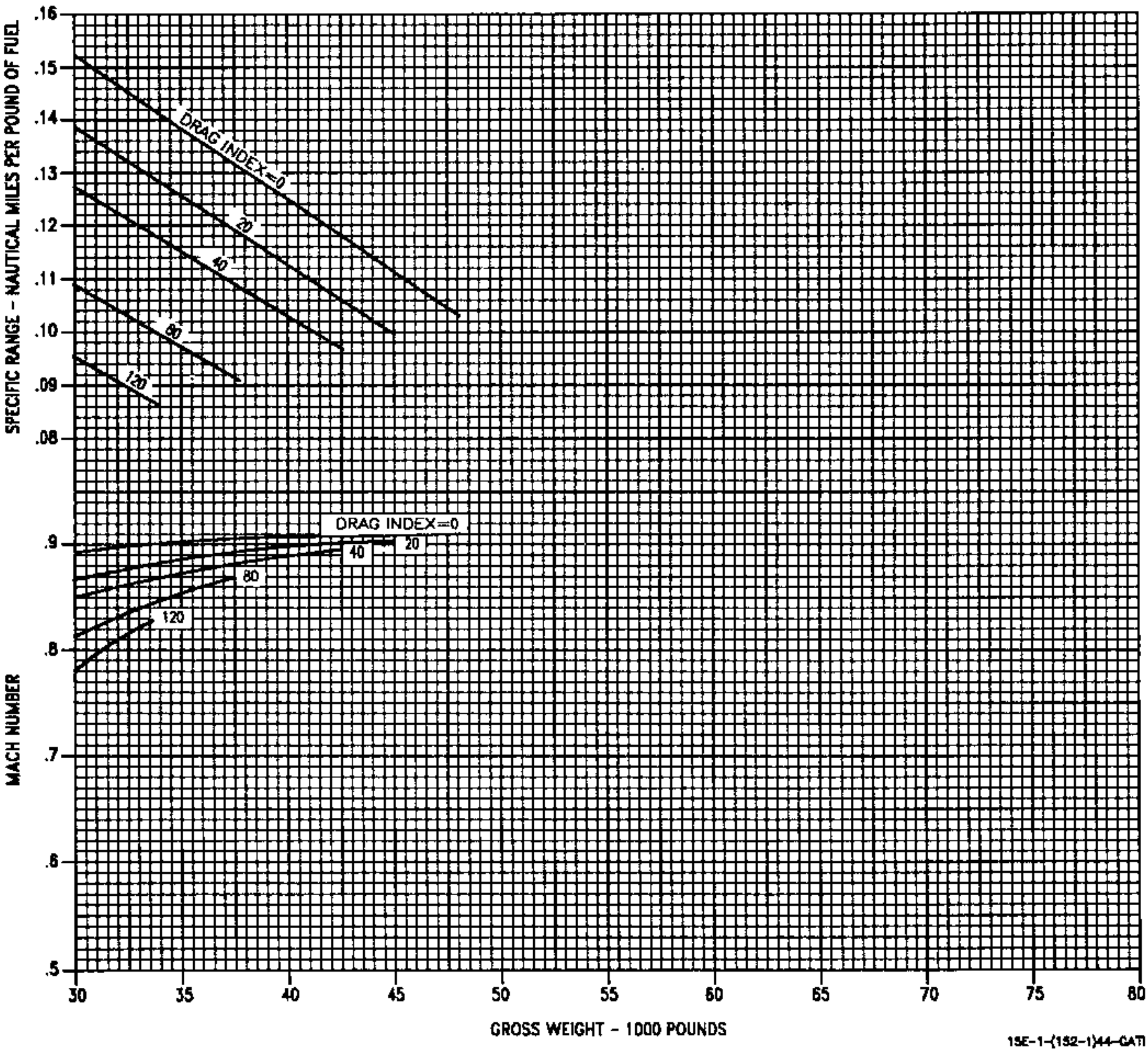
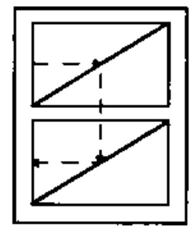


Figure A5-12

CONSTANT ALTITUDE CRUISE

TRUE AIRSPEED AND FUEL FLOW



AIRPLANE CONFIGURATION
ALL DRAG INDEXES

REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

DATE: 15 JUNE 1988
DATA BASIS: FLIGHT TEST

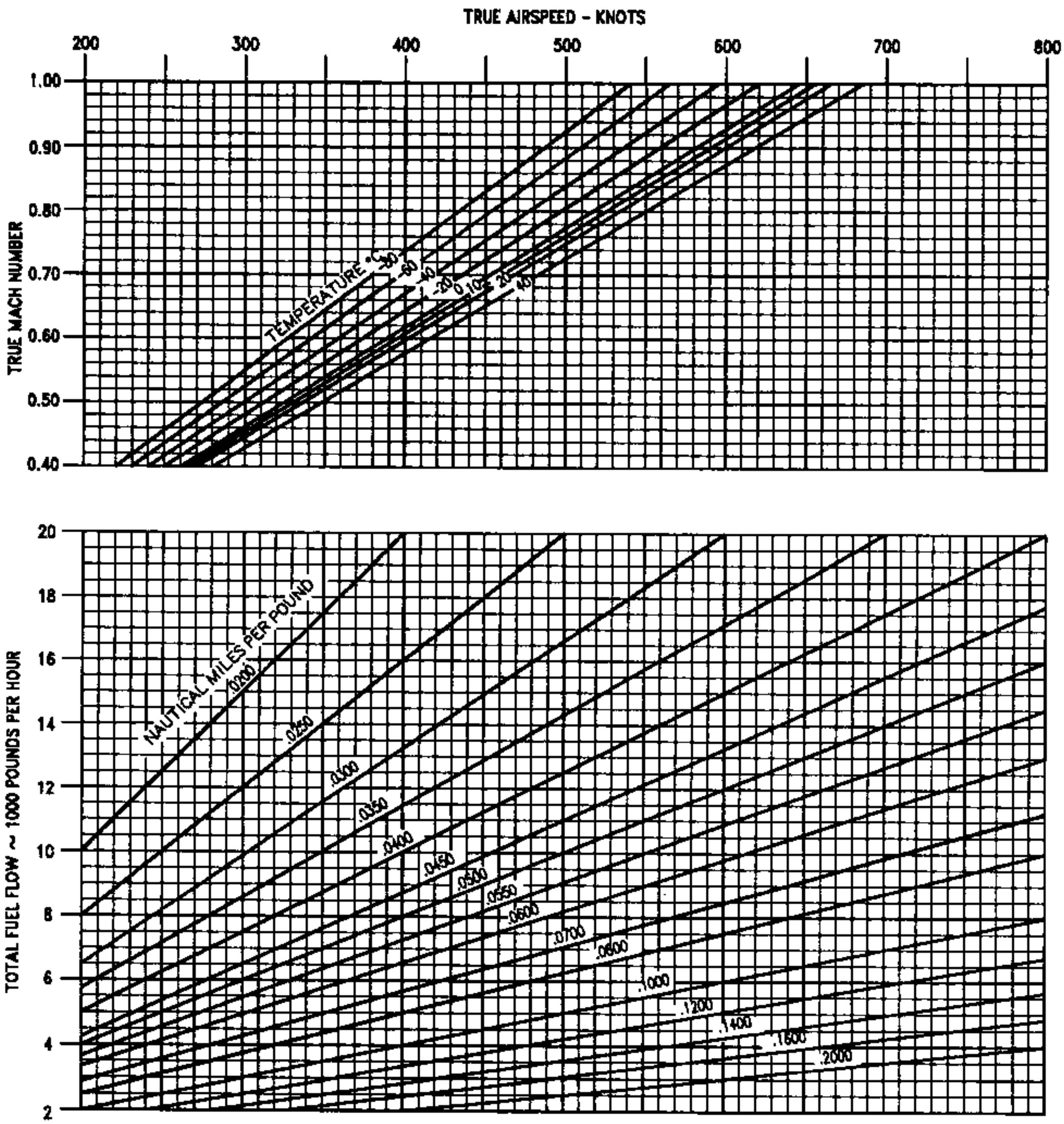


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Figure A5-13

LOW ALTITUDE CRUISE

GROSS WEIGHT 35,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-220

DATE: 15 JUNE 1988
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

	KTAS	DRAG INDEX									ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS		
		0	20	40	60	80	100	120	140	160		CRUISE	MIL	V_{MAX}
SEA LEVEL (15°C)	360	7698	8339	8981	9642	10312	10982	11652	12350	13102	-40	.899	1.520	.975
	400	9013	9830	10682	11534	12386	13317	14271	15226	16196	-20	.937	1.330	.986
	440	10545	11629	12714	13873	15081	16289	17551	18823	20098	0	.974	1.140	.997
	480	12270	13641	15153	16671	18248	19845	21459	23086		20	1.009	.960	1.000
	520	14175	16073	17996	19999	22011	24038				40	1.042	.810	.999
	560	16497	18918	21440	23994									
	600	20162	23518											
	MIL	27165	26683	26270	25963	25643	25341	25023	24736	24485				
	V_{MAX}	639.2	617.1	598.2	574.9	552.4	531.1	511.2	493.6	478.1				
5,000 FEET (5°C)	360	6564	7121	7663	8219	8776	9334	9891	10528	11168	-40	.916	1.400	.976
	400	7874	8372	9085	9797	10536	11357	12177	12998	13848	-20	.954	1.225	.987
	440	8955	9868	10782	11809	12840	13883	14954	16026	17151	0	.991	1.050	.998
	480	10414	11617	12909	14209	15554	16902	18362	19822	21289	20	1.027	.885	1.000
	520	12046	13656	15298	16974	18776	20614				40	1.061	.735	.998
	560	14114	16212	18407	20758									
	600	17699	20851											
	MIL	24312	24053	23708	23402	23013	22616	22260	21948	21675				
	V_{MAX}	637.4	618.7	597.8	580.0	559.0	537.6	518.2	499.6	483.3				
10,000 FEET (-5°C)	360	5630	6073	6546	7030	7515	7999	8511	9037	9562	-40	.932	1.300	.977
	400	6507	7131	7755	8379	9044	9721	10398	11100	11822	-20	.972	1.130	.992
	440	7613	8406	9225	10082	10940	11841	12751	13677	14648	0	1.009	.960	1.001
	480	8841	9899	10990	12116	13269	14459	15683	16947	18254	20	1.046	.800	1.003
	520	10273	11646	13081	14548	16084	17677	19311			40	1.081	.650	1.005
	560	12077	13912	15841	17873	20002								
	600	15484	18399											
	MIL	21726	21419	21046	20749	20421	20020	19619	19302	19105				
	V_{MAX}	633.5	617.8	597.5	580.0	562.8	542.8	522.8	504.8	488.5				

Figure A5-14 (Sheet 1 of 2)

LOW ALTITUDE CRUISE
GROSS WEIGHT 35,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-220

DATE: 15 JUNE 1988
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

	KTAS	DRAG INDEX									ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS		
		0	20	40	60	80	100	120	140	160		CRUISE	MIL	V_{MAX}
15,000 FEET (-15°C)	360	4900	5285	5687	6090	6492	6910	7344	7777	8211	-40	.950	1.225	.985
	400	5638	6157	6676	7212	7771	8331	8899	9488	10077	-20	.990	1.045	.997
	440	6533	7191	7893	8603	9329	10082	10834	11640	12450	0	1.029	.880	1.007
	480	7530	8433	9341	10309	11281	12305	13343	14488	15638	20	1.066	.725	1.012
	520	8730	9894	11128	12399	13704	15137	16590			40	1.101	.560	1.017
	560	10414	12018	13687	15508	17376								
	600	13727	16293											
	MIL	19013	18716	18296	17956	17679	17496	17303	17117	16962				
	V_{MAX}	628.0	614.2	595.1	577.1	561.4	544.8	527.3	510.4	494.7				
20,000 FEET (-25°C)	360	4304	4635	4965	5296	5641	5999	6357	6715	7089	-40	.969	1.145	.992
	400	4898	5324	5756	6220	6684	7152	7645	8138	8637	-20	1.010	.965	1.003
	440	5607	6169	6761	7354	7982	8611	9270	9944	10639	0	1.049	.810	1.012
	480	6423	7180	7957	8758	9593	10450	11358	12283	13337	20	1.087..	655	1.017
	520	7416	8414	9452	10550	11691	12888	14230			40	1.123	.500	1.023
	560	9049	10507	12041	13684	15456								
	600	12371	14566											
	MIL	16591	16389	16157	15872	15766	15631	15506	15380	15257				
	V_{MAX}	622.5	609.6	594.0	571.6	561.9	548.5	533.1	517.7	502.5				

Figure A5-14 (Sheet 2)

LOW ALTITUDE CRUISE
GROSS WEIGHT 40,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-220

DATE: 15 JUNE 1988
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

	KTAS	DRAG INDEX								
		0	20	40	60	80	100	120	140	160
SEA LEVEL (15°C)	360	7780	8418	9056	9716	10382	11048	11715	12416	13163
	400	9069	9885	10733	11581	12430	13360	14310	15261	16228
	440	10577	11657	12738	13895	15098	16301	17559	18826	20096
	480	12296	13663	15172	16685	18258	19850	21457	23079	
	520	14178	16071	17988	19986	21993	24014			
	560	16501	18916	21431	23980					
	600	20132	23480							
	MIL	27175	26691	26275	25965	25645	25345	25027	24739	24486
	V_{MAX}	639.7	617.5	596.4	575.1	552.5	531.3	511.5	493.8	478.2
5,000 FEET (5°C)	360	6690	7224	7765	8318	8871	9424	9987	10623	11259
	400	7750	8448	9156	9864	10609	11425	12241	13056	13904
	440	9014	9923	10836	11862	12887	13928	14994	16061	17184
	480	10446	11647	12934	14230	15570	16914	18369	19824	21285
	520	12073	13677	15314	16985	18782	20614			
	560	14118	16209	18398	20743					
	600	17680	20823							
	MIL	24315	24056	23711	23407	23017	22620	22261	21948	21676
	V_{MAX}	637.5	618.9	598.0	580.3	559.2	537.8	518.2	499.6	483.4
10,000 FEET (-5°C)	360	5759	6199	6679	7159	7639	8120	8637	9158	9679
	400	6611	7230	7850	8470	9139	9811	10483	11186	11902
	440	7689	8477	9297	10149	11002	11902	12807	13732	14697
	480	8899	9956	11042	12165	13313	14500	15718	16980	18280
	520	10307	11675	13107	14570	16099	17687	19315		
	560	12103	13933	15857	17883	20004				
	600	15464	18368							
	MIL	21730	21423	21050	20752	20422	20018	19618	19302	19102
	V_{MAX}	633.7	618.0	597.8	580.2	562.8	542.7	522.8	504.8	488.3

	ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS		
		CRUISE	MIL	V_{MAX}
SEA LEVEL (15°C)	-40	.899	1.520	.975
	-20	.937	1.330	.986
	0	.974	1.140	.997
	20	1.009	.960	1.000
	40	1.042	.810	.999
5,000 FEET (5°C)	-40	.916	1.400	.976
	-20	.954	1.225	.987
	0	.991	1.050	.998
	20	1.027	.885	1.000
	40	1.061	.735	.998
10,000 FEET (-5°C)	-40	.932	1.300	.977
	-20	.972	1.130	.992
	0	1.009	.960	1.001
	20	1.046	.800	1.003
	40	1.081	.650	1.005

Figure A5-15 (Sheet 1 of 2)

LOW ALTITUDE CRUISE
GROSS WEIGHT 40,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-220

DATE: 15 JUNE 1988
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

	KTAS	DRAG INDEX									ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS		
		0	20	40	60	80	100	120	140	160		CRUISE	MIL	V_{MAX}
15,000 FEET (-15°C)	360	5060	5455	5853	6252	6650	7076	7505	7934	8363	-40	.950	1.225	.985
	400	5768	6283	6798	7338	7893	8448	9018	9603	10187	-20	.990	1.045	.997
	440	6628	7262	7987	8692	9419	10167	10916	11721	12525	0	1.029	.880	1.007
	480	7601	8504	9411	10375	11345	12363	13402	14540	15686	20	1.066	.725	1.012
	520	8790	9953	11182	12449	13753	15179	16626			40	1.101	.560	1.017
	560	10439	12037	13700	15515	17377								
	600	13757	16316											
	MIL	19016	18718	18293	17955	17679	17494	17299	17113	16958				
	V_{MAX}	628.2	614.3	595.0	577.0	561.4	544.6	526.9	510.0	494.3				

	KTAS	0	20	40	60	80	100	120	140	160	ACTUAL OAT DEG. C	CRUISE	MIL	V_{MAX}
20,000 FEET (-26°C)	360	4515	4841	5168	5498	5851	6205	6558	6917	7294	-40	.969	1.145	.992
	400	5057	5479	5921	6380	6839	7313	7801	8289	8795	-20	1.010	.965	1.003
	440	5728	6297	6885	7481	8104	8727	9389	10058	10759	0	1.049	.810	1.012
	480	6523	7275	8053	8849	9684	10536	11444	12363	13422	20	1.087	.655	1.017
	520	7492	8490	9526	10618	11757	12957	14291			40	1.123	.500	1.023
	560	9114	10570	12099	13741	15505								
	600	12379	14564											
	MIL	16588	16387	16155	15870	15762	15628	15502	15374	15250				
	V_{MAX}	622.4	609.5	593.8	571.5	561.6	548.1	532.6	516.9	501.7				

Figure A5-15 (Sheet 2)

LOW ALTITUDE CRUISE
GROSS WEIGHT 45,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-220

DATE: 15 JUNE 1988
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

	KTAS	DRAG INDEX									ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS		
		0	20	40	60	80	100	120	140	160		CRUISE	MIL	V_{MAX}
SEA LEVEL (15°C)	360	7886	8520	9154	9814	10476	11138	11801	12508	13251	-40	.899	1.520	.975
	400	9143	9959	10803	11647	12491	13424	14369	15315	16280	-20	.937	1.330	.986
	440	10635	11711	12787	13945	15143	16342	17597	18858	20124	0	.974	1.140	.997
	480	12329	13691	15198	16706	18275	19861	21464	23081		20	1.009	.960	1.000
	520	14198	16088	18000	19992	21993	24008				40	1.042	.810	.999
	560	16505	18914	21423	23966									
	600	20118	23459											
	MIL	27182	26694	26278	25967	25648	25347	25028	24739	24487				
	V_{MAX}	639.9	617.6	596.6	575.2	552.7	531.5	511.5	493.8	476.2				
5,000 FEET (5°C)	360	6819	7349	7890	8439	8988	9538	10112	10744	11375	-40	.916	1.400	.976
	400	7841	8539	9243	9947	10699	11510	12321	13135	13978	-20	.954	1.225	.987
	440	9082	9986	10903	11923	12944	13981	15043	16104	17225	0	.991	1.050	.998
	480	10499	11700	12982	14274	15609	16950	18399	19849	21304	20	1.027	.885	1.000
	520	12108	13707	15340	17006	18799	20624				40	1.061	.735	.998
	560	14139	16226	18409	20747									
	600	17661	20795											
	MIL	24317	24059	23715	23411	23017	22618	22260	21948	21673				
	V_{MAX}	637.7	619.1	598.2	580.5	559.2	537.7	518.2	499.6	483.2				
10,000 FEET (-5°C)	360	5912	6362	6838	7315	7791	8276	8792	9309	9826	-40	.932	1.300	.977
	400	6736	7351	7967	8588	9256	9923	10591	11296	12007	-20	.972	1.130	.992
	440	7778	8562	9384	10231	11079	11979	12879	13803	14763	0	1.009	.960	1.001
	480	8963	10020	11102	12222	13365	14549	15762	17020	18315	20	1.046	.800	1.003
	520	10363	11725	13154	14613	16137	17721	19342			40	1.081	.650	1.005
	560	12135	13962	15881	17902	20017								
	600	15484	18382											
	MIL	21733	21426	21049	20752	20421	20016	19613	19297	19098				
	V_{MAX}	633.8	618.1	597.7	580.1	562.8	542.6	522.5	504.4	487.9				

Figure A5-16 (Sheet 1 of 2)

LOW ALTITUDE CRUISE

GROSS WEIGHT 45,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-220

DATE: 15 JUNE 1988
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

	KTAS	DRAG INDEX									ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS		
		0	20	40	60	80	100	120	140	160		CRUISE	MIL	V_{MAX}
15,000 FEET (-15°C)	360	5261	5656	6050	6445	6850	7275	7699	8124	8556	-40	.950	1.225	.985
	400	5924	6434	6945	7493	8043	8593	9166	9746	10326	-20	.990	1.045	.997
	440	6744	7402	8103	8803	9532	10274	11026	11826	12625	0	1.029	.880	1.007
	480	7694	8592	9500	10458	11428	12441	13482	14615	15756	20	1.066	.725	1.012
	520	8858	10019	11242	12506	13810	15229	16671			40	1.101	.560	1.017
	560	10489	12083	13739	15551	17406								
	600	13790	16343											
	MIL	19014	18717	18290	17953	17676	17489	17294	17106	16952				
	V_{MAX}	628.1	614.3	594.9	576.9	561.1	544.2	526.5	509.4	493.5				
20,000 FEET (-25°C)	360	4765	5088	5412	5759	6110	6460	6810	7182	7555	-40	.969	1.145	.992
	400	5248	5666	6119	6574	7029	7509	7992	8475	8990	-20	1.010	.965	1.003
	440	5875	6452	7035	7635	8253	8876	9539	10203	10911	0	1.049	.810	1.012
	480	6644	7391	8170	8961	9799	10644	11556	12484	13538	20	1.087	.655	1.017
	520	7582	8581	9617	10704	11842	13047	14374			40	1.123	.500	1.023
	560	9187	10640	12165	13808	15563								
	600	12431	14611											
	MIL	16584	16383	16149	15869	15758	15623	15495	15366	15241				
	V_{MAX}	622.1	609.3	593.4	571.3	561.2	547.5	531.7	515.9	500.5				

Figure A5-16 (Sheet 2)

LOW ALTITUDE CRUISE

GROSS WEIGHT 50,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-220

DATE: 15 JUNE 1988
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

	KTAS	DRAG INDEX								
		0	20	40	60	80	100	120	140	160
SEA LEVEL (15°C)	360	8010	8639	9273	9930	10588	11246	11904	12619	13358
	400	9226	10042	10882	11722	12582	13499	14440	15381	16345
	440	10695	11767	12839	13998	15192	16385	17638	18894	20156
	480	12373	13734	15237	16739	18304	19885	21483	23094	
	520	14231	16118	18027	20013	22009	24019			
	560	16515	18919	21422	23958					
	600	20104	23437							
	MIL	27186	26697	26282	25969	25648	25346	25027	24739	24485
	V_{MAX}	640.1	617.8	596.8	575.4	552.7	531.4	511.5	493.7	478.1
5,000 FEET (5°C)	360	6969	7495	8038	8583	9128	9673	10263	10890	11517
	400	7947	8647	9347	10047	10810	11616	12423	13236	14074
	440	9168	10069	10991	12007	13022	14058	15115	16172	17292
	480	10559	11761	13038	14328	15657	16998	18441	19885	21335
	520	12152	13746	15375	17035	18824	20644			
	560	14174	16257	18437	20768					
	600	17656	20781							
	MIL	24319	24061	23717	23410	23015	22616	22257	21942	21668
	V_{MAX}	637.9	619.3	598.3	580.5	559.1	537.6	518.0	499.2	482.9
10,000 FEET (-5°C)	360	6091	6553	7025	7497	7970	8465	8977	9490	10002
	400	6883	7493	8104	8733	9396	10059	10724	11430	12137
	440	7894	8674	9500	10343	11192	12087	12982	13908	14863
	480	9051	10111	11187	12308	13445	14629	15836	17094	18383
	520	10428	11785	13211	14669	16186	17766	19383		
	560	12179	14002	15917	17933	20041				
	600	15520	18414							
	MIL	21733	21425	21047	20751	20418	20007	19603	19291	19090
	V_{MAX}	633.8	618.1	597.6	580.1	562.6	542.2	522.1	503.9	487.3

	ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS		
		CRUISE	MIL	V_{MAX}
SEA LEVEL (15°C)	-40	.899	1.520	.975
	-20	.937	1.330	.986
	0	.974	1.140	.997
	20	1.009	.960	1.000
	40	1.042	.810	.999
5,000 FEET (5°C)	-40	.916	1.400	.976
	-20	.954	1.225	.987
	0	.991	1.050	.998
	20	1.027	.885	1.000
	40	1.061	.735	.998
10,000 FEET (-5°C)	-40	.932	1.300	.977
	-20	.972	1.130	.992
	0	1.009	.960	1.001
	20	1.046	.800	1.003
	40	1.081	.650	1.005

Figure A5-17 (Sheet 1 of 2)

LOW ALTITUDE CRUISE

GROSS WEIGHT 50,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-220

DATE: 15 JUNE 1988
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

	KTAS	DRAG INDEX									ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS		
		0	20	40	60	80	100	120	140	160		CRUISE	MIL	V_{MAX}
15,000 FEET (-15°C)	360	5497	5887	6278	6668	7086	7506	7927	8347	8786	-40	.950	1.225	.985
	400	6105	6611	7128	7674	8220	8768	9343	9918	10493	-20	.990	1.045	.997
	440	6884	7549	8245	8941	9673	10411	11168	11962	12756	0	1.029	.880	1.007
	480	7815	8708	9618	10571	11541	12549	13596	14722	15861	20	1.066	.725	1.012
	520	8950	10113	11331	12593	13900	15313	16750			40	1.101	.560	1.017
	560	10546	12135	13785	15595	17444								
	600	13841	16390											
	MIL	19011	18715	18282	17945	17671	17483	17285	17097	16944				
	V_{MAX}	627.9	614.2	594.5	576.5	560.7	543.6	525.6	508.6	492.5				

	KTAS	0	20	40	60	80	100	120	140	160	ACTUAL OAT DEG. C	CRUISE	MIL	V_{MAX}
20,000 FEET (-25°C)	360	5048	5371	5715	6065	6415	6765	7134	7507	7880	-40	.969	1.145	.992
	400	5469	5900	6350	6800	7261	7740	8218	8707	9223	-20	1.010	.965	1.003
	440	6055	6634	7212	7818	8431	9061	9719	10377	11097	0	1.049	.810	1.012
	480	6793	7535	8317	9105	9946	10796	11703	12646	13693	20	1.087	.655	1.017
	520	7700	8703	9741	10821	11960	13175	14495			40	1.123	.500	1.023
	560	9278	10730	12253	13898	15645								
	600	12488	14660											
	MIL	16576	16378	16140	15866	15751	15616	15485	15354	15228				
	V_{MAX}	621.6	608.9	592.8	571.0	560.6	546.7	530.6	514.5	499.0				

Figure A5-17 (Sheet 2)

LOW ALTITUDE CRUISE
GROSS WEIGHT 55,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-220

DATE: 15 JUNE 1988
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

SEA LEVEL (15°C)

KTAS	DRAG INDEX 0	20	40	60	80	100	120	140	160
360	8150	8776	9411	10065	10718	11372	12026	12751	13485
400	9335	10153	10989	11824	12668	13604	14540	15476	16441
440	10782	11849	12916	14079	15268	16456	17707	18959	20217
480	12434	13797	15294	16792	18354	19931	21524	23130	
520	14265	16149	18054	20035	22025	24030			
560	16551	18951	21448	23976					
600	20091	23416							
MIL	27189	26700	26285	25968	25646	25345	25025	24735	24481
V_{MAX}	640.2	617.9	596.9	575.3	552.6	531.3	511.4	493.5	477.9

ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS CRUISE	MIL	V_{MAX}
-40	.899	1.520	.975
-20	.937	1.330	.986
0	.974	1.140	.997
20	1.009	.960	1.000
40	1.042	.810	.999

5,000 FEET (5°C)

KTAS	DRAG INDEX 0	20	40	60	80	100	120	140	160
360	7141	7666	8207	8748	9289	9830	10439	11062	11684
400	8084	8780	9476	10172	10949	11751	12552	13365	14199
440	9271	10167	11096	12107	13118	14153	15204	16256	17377
480	10638	11843	13115	14402	15726	17067	18504	19942	21387
520	12219	13807	15433	17088	18877	20690			
560	14208	16288	18464	20789					
600	17678	20796							
MIL	24321	24060	23716	23409	23012	22611	22249	21935	21659
V_{MAX}	638.0	619.2	598.3	580.4	559.0	537.3	517.5	498.8	482.4

ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS CRUISE	MIL	V_{MAX}
-40	.916	1.400	.976
-20	.954	1.225	.987
0	.991	1.050	.998
20	1.027	.885	1.000
40	1.061	.735	.998

10,000 FEET (-5°C)

KTAS	DRAG INDEX 0	20	40	60	80	100	120	140	160
360	6304	6771	7239	7707	8176	8684	9192	9700	10207
400	7052	7659	8266	8904	9562	10221	10892	11594	12296
440	8026	8801	9632	10471	11323	12213	13103	14031	14981
480	9151	10213	11284	12404	13536	14720	15921	17178	18461
520	10511	11863	13288	14744	16255	17834	19443		
560	12241	14062	15976	17989	20090				
600	15556	18446							
MIL	21731	21424	21044	20747	20409	19998	19590	19280	19079
V_{MAX}	633.7	618.0	597.4	579.9	562.2	541.7	521.4	503.0	486.4

ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS CRUISE	MIL	V_{MAX}
-40	.932	1.300	.977
-20	.972	1.130	.992
0	1.009	.960	1.001
20	1.046	.800	1.003
40	1.081	.650	1.005

Figure A5-18 (Sheet 1 of 2)

LOW ALTITUDE CRUISE
GROSS WEIGHT 55,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-220

DATE: 15 JUNE 1988
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

	KTAS	DRAG INDEX									ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS		
		0	20	40	60	80	100	120	140	160		CRUISE	MIL	V_{MAX}
15,000 FEET (-15°C)	360	5763	6152	6541	6948	7367	7786	8205	8634	9075	-40	.950	1.225	.985
	400	6312	6814	7342	7884	8425	8979	9549	10119	10703	-20	.990	1.045	.997
	440	7047	7720	8411	9106	9839	10572	11336	12125	12917	0	1.029	.880	1.007
	480	7950	8838	9751	10699	11670	12672	13728	14848	15983	20	1.066	.725	1.012
	520	9054	10219	11430	12691	14002	15408	16841			40	1.101	.560	1.017
	560	10626	12212	13855	15665	17508								
	600	13906	16452											
	MIL	19006	18707	18273	17936	17665	17474	17274	17083	16933				
	V_{MAX}	627.6	613.8	594.0	576.0	560.1	542.8	524.6	507.3	491.2				

	KTAS	0	20	40	60	80	100	120	140	160	ACTUAL OAT DEG. C	CRUISE	MIL	V_{MAX}
20,000 FEET (-25°C)	360	5368	5711	6061	6410	6760	7127	7500	7872	8245	-40	.969	1.145	.992
	400	5721	6168	6615	7063	7537	8012	8487	8993	9504	-20	1.010	.965	1.003
	440	6268	6841	7420	8028	8636	9276	9929	10599	11315	0	1.049	.810	1.012
	480	6964	7708	8488	9282	10116	10974	11875	12838	13878	20	1.087	.655	1.017
	520	7833	8840	9881	10955	12095	13324	14636			40	1.123	.500	1.023
	560	9379	10830	12350	13999									
	600	12638	14809											
	MIL	16566	16367	16123	15863	15744	15607	15474	15339	15212				
	V_{MAX}	621.0	608.2	591.7	570.8	559.9	545.5	529.1	512.6	497.0				

Figure A5-18 (Sheet 2)

LOW ALTITUDE CRUISE

GROSS WEIGHT 60,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-220

DATE: 15 JUNE 1988
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

SEA LEVEL (15°C)

KTAS	DRAG INDEX 0	20	40	60	80	100	120	140	160	ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS CRUISE	MIL	VMAX
360	8312	8934	9572	10222	10871	11521	12180	12910	13639	-40	.899	1.520	.975
400	9453	10273	11104	11936	12788	13719	14650	15582	16547	-20	.937	1.330	.986
440	10870	11933	12996	14164	15348	16535	17782	19028	20283	0	.974	1.140	.997
480	12495	13859	15352	16845	18405	19976	21565	23166		20	1.009	.960	1.000
520	14325	16204	18105	20080	22065	24064				40	1.042	.810	.999
560	16587	18983	21474	23999									
600	20105	23424											
MIL	27193	26702	26284	25966	25645	25342	25019	24729	24475				
VMAX	640.4	618.0	596.9	575.2	552.5	531.2	511.0	493.2	477.5				

5,000 FEET (5°C)

KTAS	DRAG INDEX 0	20	40	60	80	100	120	140	160	ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS CRUISE	MIL	VMAX
360	7334	7862	8399	8936	9472	10023	10641	11258	11876	-40	.916	1.400	.976
400	8237	8929	9620	10312	11105	11902	12699	13513	14341	-20	.954	1.225	.987
440	9385	10277	11216	12222	13228	14262	15309	16356	17480	0	.991	1.050	.998
480	10726	11936	13203	14489	15808	17150	18582	20014	21453	20	1.027	.885	1.000
520	12285	13868	15491	17141	18929	20737				40	1.061	.735	.998
560	14266	16343	18517	20835									
600	17700	20812											
MIL	24321	24058	23715	23407	23005	22602	22241	21924	21647				
VMAX	638.0	619.1	598.2	580.3	558.6	536.8	517.1	498.1	481.7				

10,000 FEET (-5°C)

KTAS	DRAG INDEX 0	20	40	60	80	100	120	140	160	ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS CRUISE	MIL	VMAX
360	6553	7017	7480	7944	8429	8932	9435	9938	10451	-40	.932	1.300	.977
400	7248	7850	8453	9102	9755	10409	11088	11785	12482	-20	.972	1.130	.992
440	8172	8947	9781	10614	11470	12355	13239	14172	15116	0	1.009	.960	1.001
480	9268	10334	11400	12522	13649	14834	16030	17288	18566	20	1.046	.800	1.003
520	10607	11957	13378	14833	16339	17918	19520			40	1.081	.650	1.005
560	12304	14123	16035	18045	20140								
600	15628	18519											
MIL	21729	21421	21037	20740	20400	19982	19572	19268	19065				
VMAX	633.6	617.9	597.0	579.5	561.7	540.9	520.5	501.9	485.2				

Figure A5-19 (Sheet 1 of 2)

LOW ALTITUDE CRUISE

GROSS WEIGHT 60,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-220

DATE: 15 JUNE 1988
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

	KTAS	DRAG INDEX								
		0	20	40	60	80	100	120	140	160
15,000 FEET (-15°C)	360	6062	6450	6849	7268	7686	8104	8528	8968	9409
	400	6544	7047	7584	8120	8657	9219	9784	10349	10949
	440	7230	7912	8599	9300	10028	10755	11528	12312	13122
	480	8102	8985	9903	10845	11820	12817	13864	14998	16131
	520	9176	10344	11550	12811	14129	15529	16958		
	560	10715	12298	13936	15746					
	600	13983	16527							
	MIL	19000	18699	18261	17925	17657	17462	17259	17068	16918
	V_{MAX}	627.3	613.4	593.3	575.4	559.4	541.7	523.3	505.9	489.4

ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS		
	CRUISE	MIL	V_{MAX}
-40	.950	1.225	.985
-20	.990	1.045	.997
0	1.029	.880	1.007
20	1.066	.725	1.012
40	1.101	.560	1.017

	KTAS	0	20	40	60	80	100	120	140	160
20,000 FEET (-25°C)	360	5760	6109	6458	6806	7177	7548	7920	8292	8693
	400	6021	6470	6918	7384	7860	8336	8832	9344	9857
	440	6507	7076	7663	8266	8874	9521	10169	10856	11567
	480	7155	7905	8680	9481	10310	11177	12072	13058	14091
	520	7990	8993	10038	11116	12250	13495	14800		
	560	9486	10938	12455	14109					
	600	12791	14960							
	MIL	16550	16354	16105	15860	15736	15595	15459	15321	15192
	V_{MAX}	620.0	607.3	590.4	570.5	559.1	544.0	527.4	510.4	494.6

ACTUAL OAT DEG. C	CRUISE	MIL	V_{MAX}
-40	.969	1.145	.992
-20	1.010	.965	1.003
0	1.049	.810	1.012
20	1.087	.655	1.017
40	1.123	.500	1.023

Figure A5-19 (Sheet 2)

LOW ALTITUDE CRUISE
GROSS WEIGHT 65,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-220

DATE: 15 JUNE 1988
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

	KTAS	DRAG INDEX 0	20	40	60	80	100	120	140	160
SEA LEVEL (15°C)	360	8496	9113	9755	10401	11046	11692	12367	13092	13816
	400	9589	10413	11240	12067	12930	13857	14784	15711	16678
	440	10985	12043	13101	14276	15454	16642	17883	19125	20377
	480	12585	13954	15441	16929	18488	20053	21638	23233	
	520	14393	16267	18186	20135	22115	24108			
	560	16623	19015	21500	24019					
	600	20128	23440							
	MIL	27194	26700	26283	25964	25641	25336	25013	24722	24466
	V_{MAX}	640.5	617.9	596.8	575.0	552.3	530.7	510.6	492.7	477.0

ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS CRUISE	MIL	V_{MAX}
-40	.899	1.520	.975
-20	.937	1.330	.986
0	.974	1.140	.997
20	1.009	.960	1.000
40	1.042	.810	.999

	KTAS	DRAG INDEX 0	20	40	60	80	100	120	140	160
5,000 FEET (5°C)	360	7548	8080	8612	9145	9678	10255	10868	11480	12094
	400	8405	9092	9779	10487	11279	12071	12863	13679	14503
	440	9522	10410	11361	12362	13363	14397	15439	16488	17608
	480	10831	12047	13309	14593	15907	17251	18677	20104	21538
	520	12379	13956	15577	17221	19010	20812			
	560	14332	16407	18581	20892					
	600	17728	20834							
	MIL	24320	24055	23713	23401	22996	22593	22227	21910	21633
	V_{MAX}	637.9	618.9	598.1	580.0	558.1	536.3	516.2	497.3	480.8

ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS CRUISE	MIL	V_{MAX}
-40	.916	1.400	.976
-20	.954	1.225	.987
0	.991	1.050	.998
20	1.027	.885	1.000
40	1.061	.735	.998

	KTAS	DRAG INDEX 0	20	40	60	80	100	120	140	160
10,000 FEET (-5°C)	360	6830	7293	7756	8224	8726	9229	9731	10234	10767
	400	7464	8062	8673	9322	9971	10620	11307	12000	12692
	440	8344	9128	9957	10786	11648	12527	13407	14346	15285
	480	9412	10473	11537	12658	13779	14967	16157	17418	18689
	520	10719	12069	13485	14940	16439	18018			
	560	12400	14214	16126	18135	20222				
	600	15703	18595							
	MIL	21726	21416	21029	20733	20385	19964	19548	19251	19048
	V_{MAX}	633.5	617.6	596.5	579.0	561.0	540.0	519.3	500.6	483.8

ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS CRUISE	MIL	V_{MAX}
-40	.932	1.300	.977
-20	.972	1.130	.992
0	1.009	.960	1.001
20	1.046	.800	1.003
40	1.081	.650	1.005

Figure A5-20 (Sheet 1 of 2)

LOW ALTITUDE CRUISE
GROSS WEIGHT 65,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-220

DATE: 15 JUNE 1988
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

	KTAS	DRAG INDEX									ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS		
		0	20	40	60	80	100	120	140	160		CRUISE	MIL	V_{MAX}
15,000 FEET (-15°C)	360	6392	6787	7204	7622	8040	8460	8900	9340	9780	-40	.950	1.225	.985
	400	6802	7322	7856	8390	8934	9496	10057	10626	11241	-20	.990	1.045	.997
	440	7444	8126	8807	9516	10239	10967	11745	12522	13354	0	1.029	.880	1.007
	480	8281	9159	10083	11020	11999	12990	14071	15178	16310	20	1.066	.725	1.012
	520	9316	10489	11694	12950	14276	15669	17094			40	1.101	.560	1.017
	560	10825	12406	14048	15850									
	600	14105	16653											
	MIL	18992	18681	18244	17912	17647	17448	17242	17045	16900				
	V_{MAX}	626.8	612.8	592.4	574.8	558.5	540.5	521.7	503.8	487.2				

	KTAS	0	20	40	60	80	100	120	140	160	ACTUAL OAT DEG. C	CRUISE	MIL	V_{MAX}
20,000 FEET (-25°C)	360	6230	6578	6933	7304	7674	8045	8426	8827	9229	-40	.969	1.145	.992
	400	6356	6805	7265	7742	8219	8706	9220	9733	10258	-20	1.010	.965	1.003
	440	6773	7337	7936	8534	9155	9797	10441	11146	11851	0	1.049	.810	1.012
	480	7368	8124	8894	9704	10527	11405	12293	13307	14334	20	1.087	.655	1.017
	520	8179	9177	10227	11310	12437	13703	15001			40	1.123	.500	1.023
	560	9627	11080	12596	14259									
	600	13035	15208											
	MIL	16533	16335	16082	15857	15724	15580	15441	15299	15166				
	V_{MAX}	619.0	606.0	588.9	570.2	558.1	542.3	525.2	507.7	491.4				

Figure A5-20 (Sheet 2)

LOW ALTITUDE CRUISE
GROSS WEIGHT 70,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-220

DATE: 15 JUNE 1988
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

	KTAS	DRAG INDEX									ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS		
		0	20	40	60	80	100	120	140	160		CRUISE	MIL	V_{MAX}
SEA LEVEL (15°C)	360	8696	9315	9956	10597	11238	11880	12573	13293	14013	-40	.899	1.520	.975
	400	9747	10570	11393	12215	13092	14014	14936	15858	16827	-20	.937	1.330	.986
	440	11101	12156	13218	14392	15566	16755	17991	19227	20477	0	.974	1.140	.997
	480	12675	14049	15531	17014	18572	20132	21713	23303		20	1.009	.960	1.000
	520	14462	16330	18226	20190	22166	24153				40	1.042	.810	.999
	560	16690	19079	21558	24071									
	600	20151	23456											
	MIL	27192	26698	26281	25961	25635	25329	25004	24711	24456				
	V_{MAX}	640.4	617.8	596.7	574.8	551.8	530.3	510.1	492.1	476.3				

	KTAS	0	20	40	60	80	100	120	140	160	ACTUAL OAT DEG. C	CRUISE	MIL	V_{MAX}
5,000 FEET (5°C)	360	7791	8320	8849	9378	9907	10513	11122	11730	12339	-40	.916	1.400	.976
	400	8598	9281	9964	10696	11483	12271	13058	13876	14695	-20	.954	1.225	.987
	440	9687	10550	11514	12510	13506	14541	15577	16631	17746	0	.991	1.050	.998
	480	10948	12171	13428	14712	16020	17369	18790	20212		20	1.027	.885	1.000
	520	12477	14049	15668	17307	19098	20895				40	1.061	.735	.998
	560	14398	16471	18644	20949									
	600	17811	20916											
	MIL	24313	24052	23706	23394	22986	22577	22211	21893	21614				
	V_{MAX}	637.9	618.6	597.7	579.6	557.6	535.5	515.3	496.3	479.6				

	KTAS	0	20	40	60	80	100	120	140	160	ACTUAL OAT DEG. C	CRUISE	MIL	V_{MAX}
10,000 FEET (-5°C)	360	7133	7596	8059	8552	9054	9556	10058	10578	11117	-40	.932	1.300	.977
	400	7701	8295	8921	9565	10209	10865	11551	12238	12926	-20	.972	1.130	.992
	440	8532	9327	10151	10975	11843	12717	13604	14537	15470	0	1.009	.960	1.001
	480	9569	10625	11692	12808	13931	15115	16300	17565	18830	20	1.046	.800	1.003
	520	10845	12197	13607	15064	16558	18137				40	1.081	.650	1.005
	560	12499	14308	16219	18229	20309								
	600	15790	18678											
	MIL	21721	21411	21020	20722	20368	19941	19518	19232	19026				
	V_{MAX}	633.2	617.4	596.0	578.4	560.1	538.9	517.8	499.0	482.0				

Figure A5-21 (Sheet 1 of 2)

LOW ALTITUDE CRUISE

GROSS WEIGHT 70,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-220

DATE: 15 JUNE 1988
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

	KTAS	DRAG INDEX								
		0	20	40	60	80	100	120	140	160
15,000 FEET (-15°C)	360	6767	7184	7601	8018	8436	8875	9314	9753	10192
	400	7092	7627	8161	8695	9257	9819	10381	10981	11597
	440	7684	8361	9038	9755	10473	11214	11987	12760	13616
	480	8474	9347	10278	11210	12194	13179	14276	15377	16508
	520	9468	10647	11853	13103	14440	15828			
	560	10945	12525	14173	15968					
	600	14228	16779							
	MIL	18977	18658	18226	17898	17635	17431	17216	17016	16878
	V_{MAX}	626.1	611.6	591.5	574.0	557.4	538.9	519.8	501.4	484.6

ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS		
	CRUISE	MIL	V_{MAX}
-40	.950	1.225	.985
-20	.990	1.045	.997
0	1.029	.880	1.007
20	1.066	.725	1.012
40	1.101	.560	1.017

	KTAS	0	20	40	60	80	100	120	140	160
20,000 FEET (-25°C)	360	6791	7158	7527	7897	8266	8663	9063	9463	9863
	400	6715	7170	7649	8127	8609	9123	9638	10153	10726
	440	7065	7650	8251	8856	9501	10146	10828	11536	12255
	480	7604	8368	9137	9955	10782	11664	12574	13593	14613
	520	8384	9377	10433	11521	12641	13930	15221		
	560	9776	11231	12747	14421					
	600	13282	15458							
	MIL	16512	16314	16061	15853	15712	15582	15420	15270	15094
	V_{MAX}	617.6	604.6	587.5	569.8	556.9	540.0	522.5	504.1	486.7

ACTUAL OAT DEG. C	CRUISE	MIL	V_{MAX}
-40	.969	1.145	.992
-20	1.010	.965	1.003
0	1.049	.810	1.012
20	1.087	.655	1.017
40	1.123	.500	1.023

Figure A5-21 (Sheet 2)

LOW ALTITUDE CRUISE
GROSS WEIGHT 75,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-220

DATE: 15 JUNE 1988
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

SEA LEVEL (15°C)

KTAS	DRAG INDEX 0	20	40	60	80	100	120	140	160
360	8914	9538	10175	10811	11448	12085	12799	13514	14230
400	9919	10737	11556	12375	13266	14183	15100	16025	16992
440	11244	12293	13366	14535	15704	16894	18125	19356	20604
480	12783	14162	15639	17120	18674	20229	21806	23390	
520	14560	16422	18318	20276	22246	24227			
560	16758	19145	21618	24126					
600	20175	23473							
MIL	27190	26695	26279	25955	25629	25321	24992	24700	24442
V_{MAX}	640.3	617.7	596.6	574.4	551.4	529.7	509.3	491.3	475.5

ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS CRUISE	MIL	V_{MAX}
-40	.899	1.520	.975
-20	.937	1.330	.986
0	.974	1.140	.997
20	1.009	.960	1.000
40	1.042	.810	.999

5,000 FEET (5°C)

KTAS	DRAG INDEX 0	20	40	60	80	100	120	140	160
360	8062	8590	9118	9646	10213	10821	11428	12036	12645
400	8808	9487	10166	10923	11705	12488	13278	14092	14905
440	9837	10716	11696	12687	13684	14715	15747	16808	17918
480	11080	12311	13562	14847	16150	17503	18918	20335	
520	12588	14155	15773	17411	19200	20990			
560	14493	16565	18740	21038					
600	17694	20997							
MIL	24317	24047	23699	23386	22973	22561	22192	21872	21592
V_{MAX}	637.7	618.3	597.3	579.1	556.8	534.6	514.1	495.1	478.3

ACTUAL OAT DEG. C	CRUISE	MIL	V_{MAX}
-40	.916	1.400	.976
-20	.954	1.225	.987
0	.991	1.050	.998
20	1.027	.885	1.000
40	1.061	.735	.998

10,000 FEET (-5°C)

KTAS	DRAG INDEX 0	20	40	60	80	100	120	140	160
360	7463	7926	8407	8909	9410	9912	10421	10960	11498
400	7959	8553	9193	9833	10473	11141	11823	12505	13200
440	8734	9541	10359	11184	12053	12923	13818	14746	15674
480	9751	10801	11873	12984	14111	15289	16479	17738	
520	10985	12339	13743	15201	16689	18270			
560	12615	14418	16330	18340					
600	15907	18792							
MIL	21716	21403	21009	20712	20347	19915	19484	19208	19001
V_{MAX}	632.9	617.0	595.3	577.8	559.1	537.6	516.1	497.0	480.0

ACTUAL OAT DEG. C	CRUISE	MIL	V_{MAX}
-40	.932	1.300	.977
-20	.972	1.130	.992
0	1.009	.960	1.001
20	1.046	.800	1.003
40	1.081	.650	1.005

Figure A5-22 (Sheet 1 of 2)

LOW ALTITUDE CRUISE
GROSS WEIGHT 75,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-220

DATE: 15 JUNE 1988
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

	KTAS	DRAG INDEX								
		0	20	40	60	80	100	120	140	160
15,000 FEET (-15°C)	360	7230	7646	8062	8482	8920	9358	9796	10235	10721
	400	7422	7957	8492	9043	9606	10169	10749	11365	11982
	440	7952	8625	9312	10025	10738	11493	12260	13046	13913
	480	8685	9567	10493	11431	12410	13411	14506	15605	16732
	520	9645	10830	12039	13282	14632	16018			
	560	11085	12665	14319	16107					
	600	14392	16951							
	MIL	18959	18632	18206	17883	17621	17411	17190	16993	16852
	V_{MAX}	625.2	610.4	590.4	573.2	556.1	537.1	517.0	498.5	481.4
20,000 FEET (-25°C)	360	7394	7763	8133	8520	8920	9321	9721	10150	10603
	400	7142	7620	8098	8578	9093	9608	10123	10694	11268
	440	7371	7976	8580	9212	9860	10518	11229	11940	12718
	480	7881	8640	9422	10233	11076	11952	12899	13912	14925
	520	8604	9605	10655	11751	12898	14181			
	560	9942	11390	12907	14592					
	600	13610	15795							
	MIL	16488	16286	16040	15848	15697	15540	15388	15236	15007
	V_{MAX}	616.2	602.7	586.1	569.4	555.6	537.2	518.6	500.0	481.1

	ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS		
		CRUISE	MIL	V_{MAX}
15,000 FEET (-15°C)	-40	.950	1.225	.985
	-20	.990	1.045	.997
	0	1.029	.880	1.007
	20	1.066	.725	1.012
	40	1.101	.560	1.017
20,000 FEET (-25°C)	-40	.969	1.145	.992
	-20	1.010	.965	1.003
	0	1.049	.810	1.012
	20	1.087	.655	1.017
	40	1.123	.500	1.023

Figure A5-22 (Sheet 2)

LOW ALTITUDE CRUISE

GROSS WEIGHT 80,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-220

DATE: 15 JUNE 1988
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

	KTAS	DRAG INDEX 0	20	40	60	80	100	120	140	160
SEA LEVEL (15°C)	360	9154	9785	10418	11051	11684	12344	13055	13766	14476
	400	10117	10931	11745	12560	13468	14381	15293	16223	17185
	440	11389	12435	13518	14683	15847	17040	18266	19492	20738
	480	12901	14289	15761	17242	18792	20341	21915	23494	
	520	14661	16517	18412	20365	22330	24306			
	560	16827	19211	21678	24181					
	600	20241	23534							
	MIL	27187	26692	26271	25949	25622	25309	24979	24685	24427
	V_{MAX}	640.1	617.5	596.2	574.0	550.9	528.9	508.5	490.4	474.5
5,000 FEET (5°C)	360	8354	8882	9410	9941	10547	11154	11761	12368	12993
	400	9033	9707	10390	11167	11944	12722	13517	14325	15133
	440	10016	10902	11888	12874	13873	14899	15925	16994	18098
	480	11225	12466	13713	14998	16296	17657	19066	20478	
	520	12717	14278	15896	17541	19323	21108			
	560	14590	16662	18839	21131					
	600	17977	21079							
	MIL	24315	24041	23691	23373	22957	22539	22169	21848	21566
	V_{MAX}	637.5	617.9	596.8	578.5	556.0	533.4	512.8	493.6	476.8
10,000 FEET (-5°C)	360	7820	8292	8793	9294	9796	10297	10834	11372	11910
	400	8240	8858	9498	10139	10786	11469	12151	12834	13554
	440	8968	9782	10597	11431	12295	13160	14065	14988	15912
	480	9939	10985	12061	13166	14299	15472	16669	17922	
	520	11143	12499	13898	15360	16850	18426			
	560	12747	14543	16457	18470					
	600	16024	18905							
	MIL	21706	21391	20997	20699	20321	19883	19442	19181	18972
	V_{MAX}	632.5	616.3	594.6	577.0	557.8	536.0	514.0	494.8	477.6

	ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS CRUISE	MIL	V_{MAX}
SEA LEVEL (15°C)	-40	.899	1.520	.975
	-20	.937	1.330	.986
	0	.974	1.140	.997
	20	1.009	.960	1.000
	40	1.042	.810	.999
5,000 FEET (5°C)	-40	.916	1.400	.976
	-20	.954	1.225	.987
	0	.991	1.050	.998
	20	1.027	.885	1.000
	40	1.061	.735	.998
10,000 FEET (-5°C)	-40	.932	1.300	.977
	-20	.972	1.130	.992
	0	1.009	.960	1.001
	20	1.046	.800	1.003
	40	1.081	.650	1.005

Figure A5-23 (Sheet 1 of 2)

LOW ALTITUDE CRUISE
GROSS WEIGHT 80,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-220

DATE: 15 JUNE 1988
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

	KTAS	DRAG INDEX								
		0	20	40	60	80	100	120	140	160
15,000 FEET (-15°C)	360	7767	8181	8606	9043	9480	9917	10367	10851	11336
	400	7783	8319	8861	9425	9989	10553	11170	11787	12405
	440	8242	8915	9620	10332	11057	11823	12589	13416	14281
	480	8922	9814	10735	11681	12654	13677	14765	15866	
	520	9838	11020	12232	13469	14832	16217			
	560	11238	12817	14481	16264					
	600	14562	17130							
	MIL	18935	18598	18186	17864	17604	17381	17158	16966	16822
	V_{MAX}	624.2	608.9	589.3	572.2	554.6	534.4	514.1	495.3	477.8

ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS		
	CRUISE	MIL	V_{MAX}
-40	.950	1.225	.985
-20	.990	1.045	.997
0	1.029	.880	1.007
20	1.066	.725	1.012
40	1.101	.560	1.017

	KTAS	DRAG INDEX								
		0	20	40	60	80	100	120	140	160
20,000 FEET (-25°C)	360	8212	8599	8994	9389	9784	10215	10663	11110	11557
	400	7641	8120	8603	9118	9634	10150	10725	11301	11876
	440	7740	8347	8964	9616	10267	10967	11681	12427	13236
	480	8180	8939	9742	10554	11422	12297	13297	14308	
	520	8855	9866	10910	12014	13193	14469			
	560	10122	11571	13080	14778					
	600	13939	16132							
	MIL	16458	16256	16020	15839	15680	15511	15351	15197	14862
	V_{MAX}	614.3	600.7	584.7	568.5	554.0	533.7	514.1	495.1	471.8

ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS		
	CRUISE	MIL	V_{MAX}
-40	.969	1.145	.992
-20	1.010	.965	1.003
0	1.049	.810	1.012
20	1.087	.655	1.017
40	1.123	.500	1.023

Figure A5-23 (Sheet 2)

HIGH ALTITUDE CRUISE
GROSS WEIGHT 35,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-220

DATE: 15 JUNE 1988
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

	KTAS	DRAG INDEX 0	20	40	60	80	100	120	140	160	ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS CRUISE	MIL	V_{MAX}
25,000 FEET (-35°C)	360	3832	4102	4371	4661	4953	5245	5540	5850	6160	-80	.900	1.480	.959
	400	4274	4626	5008	5389	5775	6179	6583	6996	7429	-60	.945	1.250	.978
	440	4816	5310	5803	6318	6839	7376	7929	8498	9111	-40	.988	1.035	.996
	480	5486	6120	6787	7461	8162	8895	9664	10504	11375	-20	1.030	.880	1.007
	520	6331	7196	8098	9036	10016	11095	12226			0	1.070	.720	1.016
	560	7938	9269	10671	12193									
	600	11674	13495											
	MIL	14698	14548	14349	14033	13843	13619	13411	13182	12953				
	V_{MAX}	617.9	605.4	591.2	570.1	559.2	546.3	532.8	516.9	501.0				

	KTAS	0	20	40	60	80	100	120	140	160	ACTUAL OAT DEG. C	CRUISE	MIL	V_{MAX}
30,000 FEET (-44°C)	360	3476	3713	3952	4192	4435	4688	4942	5195	5462	-80	.919	1.025	.936
	400	3778	4089	4399	4719	5047	5374	5717	6066	6415	-60	.966	1.010	.978
	440	4195	4602	5024	5451	5890	6338	6807	7309	7823	-40	1.010	.955	1.001
	480	4716	5260	5811	6385	6979	7616	8293	8993	9749	-20	1.052	.785	1.006
	520	5439	6169	6943	7756	8609	9541	10564			0	1.043	.610	1.011
	560	6977	8170	9434										
	600	10962	12626											
	MIL	12731	12638	12513	12043	12025	11692	11387	11045	10669				
	V_{MAX}	612.3	600.0	586.3	556.6	555.8	541.9	529.1	512.8	494.9				

	KTAS	0	20	40	60	80	100	120	140	160	ACTUAL OAT DEG. C	CRUISE	MIL	V_{MAX}
35,000 FEET (-54°C)	360	3293	3491	3698	3906	4114	4333	4557	4782	5014	-80	.940	.930	.943
	400	3444	3704	3972	4240	4519	4803	5089	5409	5729	-60	.987	.980	.988
	440	3720	4067	4414	4774	5135	5533	5939	6377	6825	-40	1.032	.915	1.010
	480	4112	4563	5034	5522	6040	6594	7170	7794		-20	1.075	.740	1.016
	520	4707	5353	6023	6722	7493	8352				0	1.117	.570	1.023
	560	6347	7342	8546										
	600	10293												
	MIL	10560	10292	10003	9352	9304	9023	8761	8421	8074				
	V_{MAX}	603.0	588.1	572.8	543.1	540.7	526.9	513.1	492.9	472.3				

Figure A5-24 (Sheet 1 of 2)

HIGH ALTITUDE CRUISE
GROSS WEIGHT 35,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-220

DATE: 15 JUNE 1988
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

	KTAS	DRAG INDEX								
		0	20	40	60	80	100	120	140	160
40,000 FEET (-57°C)	360	3484	3664	3844	4030	4234	4439	4644	4862	5082
	400	3364	3587	3816	4046	4304	4564	4831	5115	5400
	440	3444	3730	4021	4332	4660	5008	5372	5746	
	480	3684	4055	4442	4849	5288	5748	6240		
	520	4119	4649	5198	5783	6469				
	560	5877	6538	7585						
	600									
	MIL	8166	7991	7714	7376	7179	6918	6586	6162	5852
	V_{MAX}	591.1	577.1	561.2	542.8	531.1	515.4	490.7	458.9	426.4

ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS		
	CRUISE	MIL	V_{MAX}
-80	.944	.915	.945
-60	.992	.985	.992
-40	1.037	.930	1.019
-20	1.081	.765	1.033
0	1.122	.600	1.046

	KTAS	0	20	40	60	80	100	120	140	160
45,000 FEET (-57°C)	360	4911	5080	5250	5420	5589				
	400	3696	3912	4139	4366	4601				
	440	3414	3683	3960	4258	4560				
	480	3436	3770	4119	4485	4889				
	520	3766	4203	4674	5218					
	560	5311	6065							
	600									
	MIL	6242	6058	5888	5683	5420	2276	2276	2276	2276
	V_{MAX}	573.6	560.1	547.7	531.3	508.3				

ACTUAL OAT DEG. C	CRUISE	MIL	V_{MAX}
-80	.944	.915	.946
-60	.992	.985	.993
-40	1.037	.930	1.016
-20	1.081	.765	1.027
0	1.122	.600	1.037

Figure A5-24 (Sheet 2)

HIGH ALTITUDE CRUISE

GROSS WEIGHT 40,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-220

DATE: 15 JUNE 1988
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

25,000 FEET (-35°C)

KTAS	DRAG INDEX 0	20	40	60	80	100	120	140	160
360	4091	4359	4646	4936	5227	5518	5826	6134	6442
400	4472	4838	5215	5593	5986	6385	6784	7206	7635
440	4984	5473	5965	6481	6996	7539	8088	8667	9273
480	5618	6254	6915	7591	8286	9025	9788	10638	11504
520	6437	7298	8200	9137	10111	11193	12325		
560	8030	9362	10763	12285					
600	11737	13559							
MIL	14690	14542	14343	14032	13831	13609	13397	13163	12929
V_{MAX}	617.3	604.9	590.8	570.1	558.5	545.7	531.8	515.6	499.3

ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS CRUISE	MIL	V_{MAX}
-80	.900	1.480	.959
-60	.945	1.250	.978
-40	.988	1.035	.996
-20	1.030	.880	1.007
0	1.070	.720	1.016

30,000 FEET (-44°C)

KTAS	DRAG INDEX 0	20	40	60	80	100	120	140	160
360	3815	4054	4294	4542	4796	5049	5303	5577	5851
400	4046	4356	4671	4997	5323	5660	6007	6354	6732
440	4408	4816	5238	5661	6104	6546	7035	7531	8060
480	4884	5430	5983	6552	7158	7789	8476	9182	9934
520	5574	6308	7081	7890	8744	9692	10710		
560	7102	8293	9555						
600	11156								
MIL	12722	12627	12495	12041	11995	11670	11360	10984	10581
V_{MAX}	611.2	598.7	585.1	556.5	554.6	541.0	527.8	509.9	490.7

ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS CRUISE	MIL	V_{MAX}
-80	.919	1.025	.936
-60	.966	1.010	.978
-40	1.010	.955	1.001
-20	1.052	.785	1.006
0	1.043	.610	1.011

35,000 FEET (-54°C)

KTAS	DRAG INDEX 0	20	40	60	80	100	120	140	160
360	3792	3999	4209	4433	4657	4881	5126	5379	5633
400	3781	4051	4321	4608	4894	5194	5516	5839	6182
440	3988	4345	4701	5061	5449	5864	6281	6728	7184
480	4334	4789	5256	5759	6280	6840	7434	8051	
520	4880	5523	6193	6894	7691	8644			
560	6619	7621	8682						
600									
MIL	10498	10235	9927	9349	9258	8966	8662	8299	7895
V_{MAX}	599.5	584.9	569.4	543.0	538.5	524.1	507.2	485.6	461.6

ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS CRUISE	MIL	V_{MAX}
-80	.940	.930	.943
-60	.987	.980	.988
-40	1.032	.915	1.010
-20	1.075	.740	1.016
0	1.117	.570	1.023

Figure A5-25 (Sheet 1 of 2)

HIGH ALTITUDE CRUISE

GROSS WEIGHT 40,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-220

DATE: 15 JUNE 1988
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

	KTAS	DRAG INDEX									ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS		
		0	20	40	60	80	100	120	140	160		CRUISE	MIL	V_{MAX}
40,000 FEET (-57°C)	360	4505	4709	4925	5142	5362	5578	5794			-80	.944	.915	.946
	400	3921	4164	4425	4687	4968	5254	5543			-60	.992	.985	.992
	440	3787	4092	4417	4750	5113	5483	5868			-40	1.037	.930	1.019
	480	3966	4352	4765	5203	5659	6159				-20	1.081	.765	1.033
	520	4375	4908	5464	6094	6775					0	1.122	.600	1.046
	560	6070	6989											
	600													
	MIL	8089	7884	7601	7373	7080	6737	6129	2806	2806				
	V_{MAX}	584.1	570.4	555.2	542.7	525.2	501.9	455.5						

	KTAS	0	20	40	60	80	100	120	140	160	ACTUAL OAT DEG. C	CRUISE	MIL	V_{MAX}
45,000 FEET (-57°C)	360	6965	7131	7297	7464						-80	.944	.915	.946
	400	5018	5249	5480	5710						-60	.992	.985	.993
	440	4127	4429	4746	5061						-40	1.037	.930	1.016
	480	3882	4250	4636	5051						-20	1.081	.765	1.027
	520	4151	4624	5182							0	1.122	.600	1.037
	560	5953												
	600													
	MIL	6087	5932	5751	5398	2276	2276	2276	2276	2276				
	V_{MAX}	562.3	550.9	536.8	508.1									

Figure A5-25 (Sheet 2)

HIGH ALTITUDE CRUISE
GROSS WEIGHT 45,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-220

DATE: 15 JUNE 1988
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

	KTAS	DRAG INDEX									ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS		
		0	20	40	60	80	100	120	140	160		CRUISE	MIL	V_{MAX}
25,000 FEET (-35°C)	360	4392	4682	4972	5262	5555	5863	6171	6479	6797	-80	.900	1.480	.959
	400	4713	5086	5458	5839	6233	6628	7034	7457	7880	-60	.945	1.250	.978
	440	5183	5668	6165	6676	7193	7736	8278	8873	9474	-40	.988	1.035	.996
	480	5777	6415	7071	7749	8439	9187	9950	10808	11673	-20	1.030	.880	1.007
	520	6567	7421	8325	9264	10244	11320	12453			0	1.070	.720	1.016
	560	8136	9468	10867	12389									
	600	11859	13687											
	MIL	14681	14533	14330	14031	13818	13595	13375	13137	12895				
	V_{MAX}	616.5	604.1	589.9	570.0	557.7	544.9	530.3	513.8	497.0				
30,000 FEET (-44°C)	360	4244	4489	4742	4995	5247	5517	5790	6063	6344	-80	.919	1.025	.936
	400	4356	4673	5000	5327	5667	6015	6363	6744	7135	-60	.966	1.010	.978
	440	4656	5071	5488	5918	6356	6816	7306	7807	8345	-40	1.010	.955	1.001
	480	5093	5633	6189	6752	7374	8014	8701	9418	10162	-20	1.052	.785	1.006
	520	5736	6477	7253	8057	8913	9882	10896			0	1.043	.610	1.011
	560	7240	8429	9709										
	600	11401												
	MIL	12711	12614	12462	12040	11958	11625	11318	10894	10464				
	V_{MAX}	609.6	596.9	582.9	556.4	553.0	539.2	525.8	505.6	485.1				
35,000 FEET (-54°C)	360	4402	4624	4846	5084	5335	5586	5839	6108	6378	-80	.940	.930	.943
	400	4209	4490	4778	5065	5389	5713	6047	6401	6754	-60	.987	.980	.988
	440	4300	4658	5023	5411	5821	6250	6702	7163		-40	1.032	.915	1.010
	480	4592	5054	5533	6038	6579	7138	7747			-20	1.075	.740	1.016
	520	5092	5738	6407	7106	7937					0	1.117	.570	1.023
	560	6911	7959	9242										
	600													
	MIL	10421	10162	9832	9346	9201	8881	8523	8045	7560				
	V_{MAX}	595.3	580.8	565.1	542.8	535.7	519.9	499.0	470.6	436.7				

Figure A5-26 (Sheet 1 of 2)

HIGH ALTITUDE CRUISE

GROSS WEIGHT 45,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-220

DATE: 15 JUNE 1988
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

	KTAS	DRAG INDEX									ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS		
		0	20	40	60	80	100	120	140	160		CRUISE	MIL	V_{MAX}
40,000 FEET (-57°C)	360	6274	6488	6702	6916	7129					-80	.944	.915	.945
	400	4665	4944	5230	5517	5812					-60	.992	.985	.992
	440	4260	4597	4948	5323	5706					-40	1.037	.930	1.019
	480	4277	4697	5137	5597	6105					-20	1.081	.765	1.033
	520	4688	5237	5827	6509						0	1.122	.600	1.046
	560	6634	7578											
	600													
	MIL	7972	7726	7489	7223	6877	2806	2806	2806	2806				
	V_{MAX}	575.8	561.9	549.1	533.8	512.4								
45,000 FEET (-57°C)	360	9502	9661								-80	.944	.915	.946
	400	6952	7181								-60	.992	.985	.993
	440	5241	5560								-40	1.037	.930	1.016
	480	4546	4968								-20	1.081	.765	1.027
	520	4654	5225								0	1.122	.600	1.037
	560													
	600													
	MIL	5953	5817	2276	2276	2276	2276	2276	2276	2276				
	V_{MAX}	552.4	542.2											

Figure A5-26 (Sheet 2)

HIGH ALTITUDE CRUISE

GROSS WEIGHT 50,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-220

DATE: 15 JUNE 1988
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

	KTAS	DRAG INDEX									ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS		
		0	20	40	60	80	100	120	140	160		CRUISE	MIL	V_{MAX}
25,000 FEET (-35°C)	360	4772	5061	5350	5648	5955	6262	6569	6894	7226	-80	.900	1.480	.959
	400	5005	5379	5756	6152	6547	6948	7372	7795	8230	-60	.945	1.250	.978
	440	5415	5894	6399	6904	7430	7967	8523	9118	9713	-40	.988	1.035	.996
	480	5962	6604	7255	7937	8630	9381	10163	11014	11878	-20	1.030	.880	1.007
	520	6721	7573	8478	9421	10411	11480	12617			0	1.070	.720	1.016
	560	8247	9574	10975	12499									
	600	12019	13858											
	MIL	14667	14520	14312	14031	13803	13578	13346	13104	12850				
	V_{MAX}	615.3	603.0	588.7	570.0	556.9	543.9	528.3	511.5	493.9				

	KTAS	0	20	40	60	80	100	120	140	160	ACTUAL OAT DEG. C	CRUISE	MIL	V_{MAX}
30,000 FEET (-44°C)	360	4806	5057	5311	5583	5856	6128	6415	6722	7028	-80	.919	1.025	.936
	400	4709	5038	5368	5712	6062	6413	6802	7196	7593	-60	.966	1.010	.978
	440	4950	5371	5798	6238	6687	7180	7673	8212	8753	-40	1.010	.955	1.001
	480	5336	5874	6431	7012	7630	8288	8968	9700		-20	1.052	.785	1.006
	520	5926	6676	7455	8266	9115	10110	11121			0	1.043	.610	1.011
	560	7388	8580	9884										
	600	11700												
	MIL	12694	12597	12423	12038	11916	11575	11223	10777	10295				
	V_{MAX}	607.5	594.6	580.2	556.3	551.3	537.1	521.3	500.0	477.1				

	KTAS	0	20	40	60	80	100	120	140	160	ACTUAL OAT DEG. C	CRUISE	MIL	V_{MAX}
35,000 FEET (-54°C)	360	5433	5683	5942	6210	6479	6752	7018	7288		-80	.940	.930	.943
	400	4773	5061	5386	5711	6047	6402	6756	7119		-60	.987	.980	.988
	440	4651	5021	5413	5828	6264	6721	7189			-40	1.032	.915	1.010
	480	4876	5346	5860	6393	6954	7562	8181			-20	1.075	.740	1.016
	520	5344	5993	6668	7403	8235					0	1.117	.570	1.023
	560	7283	8379	9684										
	600													
	MIL	10328	10066	9728	9343	9122	8779	8219	7384	4196				
	V_{MAX}	589.9	575.6	560.4	542.7	531.8	514.2	480.9	423.5					

Figure A5-27 (Sheet 1 of 2)

HIGH ALTITUDE CRUISE
GROSS WEIGHT 50,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-220

DATE: 15 JUNE 1988
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

	KTAS	DRAG INDEX									ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS		
		0	20	40	60	80	100	120	140	160		CRUISE	MIL	V_{MAX}
40,000 FEET (-57°C)	360	8296	8505	8715	8925						-80	.944	.915	.945
	400	5909	6204	6499	6794						-60	.992	.985	.992
	440	4961	5340	5727	6126						-40	1.037	.930	1.019
	480	4712	5162	5631	6151						-20	1.081	.765	1.033
	520	5060	5638	6321							0	1.122	.600	1.046
	560	7261												
	600													
	MIL	7809	7580	7387	6955	2806	2806	2806	2806	2806				
	V_{MAX}	566.4	554.0	543.5	517.8									
45,000 FEET (-57°C)	360	12227									-80	.944	.915	.946
	400	9153									-60	.992	.985	.993
	440	6892									-40	1.037	.930	1.016
	480	5601									-20	1.081	.765	1.027
	520	5404									0	1.122	.600	1.037
	560													
	600													
	MIL	5810	2276	2276	2276	2276	2276	2276	2276	2276				
	V_{MAX}	541.6												

Figure A5-27 (Sheet 2)

HIGH ALTITUDE CRUISE
GROSS WEIGHT 55,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-220

DATE: 15 JUNE 1988
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

	KTAS	DRAG INDEX									ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS		
		0	20	40	60	80	100	120	140	160		CRUISE	MIL	V_{MAX}
25,000 FEET (-35°C)	360	5234	5524	5829	6135	6441	6754	7086	7417	7749	-80	.900	1.480	.959
	400	5334	5709	6106	6503	6902	7327	7752	8183	8658	-60	.945	1.250	.978
	440	5679	6168	6669	7175	7707	8239	8818	9407	10028	-40	.988	1.035	.996
	480	6176	6821	7475	8154	8861	9608	10411	11255	12121	-20	1.030	.880	1.007
	520	6903	7761	8660	9607	10611	11677	12815			0	1.070	.720	1.016
	560	8390	9715	11119	12647									
	600	12243	14100											
	MIL	14650	14502	14288	14030	13782	13555	13308	13057	12790				
	V_{MAX}	613.9	601.5	587.1	569.9	555.7	542.6	525.7	508.2	489.7				
30,000 FEET (-44°C)	360	5466	5735	6004	6274	6576	6879	7183	7493	7818	-80	.919	1.025	.936
	400	5175	5507	5859	6210	6576	6970	7365	7778	8205	-60	.966	1.010	.978
	440	5271	5697	6141	6585	7080	7577	8111	8657	9217	-40	1.010	.955	1.001
	480	5610	6156	6710	7316	7938	8613	9310	10040		-20	1.052	.785	1.006
	520	6155	6904	7688	8508	9390	10377				0	1.043	.610	1.011
	560	7561	8758	10088										
	600	12082												
	MIL	12672	12575	12379	12035	11867	11507	11096	10595	10023				
	V_{MAX}	604.5	591.8	577.3	556.2	549.2	534.2	515.2	491.4	461.9				
35,000 FEET (-54°C)	360	7105	7370	7635	7899	8165	8430				-80	.940	.930	.943
	400	5398	5723	6058	6412	6769	7137				-60	.987	.980	.988
	440	5096	5502	5921	6371	6834	7311				-40	1.032	.915	1.010
	480	5175	5681	6206	6775	7374	8002				-20	1.075	.740	1.016
	520	5638	6296	6989	7790	8628					0	1.117	.570	1.023
	560	7743	8902											
	600													
	MIL	10208	9924	9615	9338	8964	8450	4196	4196	4196				
	V_{MAX}	583.4	569.2	555.3	542.4	524.0	494.6							

Figure A5-28 (Sheet 1 of 2)

HIGH ALTITUDE CRUISE
GROSS WEIGHT 55,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-220

DATE: 15 JUNE 1988
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

	KTAS	DRAG INDEX								
		0	20	40	60	80	100	120	140	160
40,000 FEET (-57°C)	360	10646	10853	11059						
	400	7799	8088	8377						
	440	5954	6350	6750						
	480	5303	5796	6324						
	520	5515	6188	6903						
	560									
	600									
	MIL	7648	7454	7045	2806	2806	2806	2806	2806	2806
	V_{MAX}	557.7	547.2	523.1						

ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS		
	CRUISE	MIL	V_{MAX}
-80	.944	.915	.945
-60	.992	.985	.992
-40	1.037	.930	1.019
-20	1.081	.765	1.033
0	1.122	.600	1.046

Figure A5-28 (Sheet 2)

HIGH ALTITUDE CRUISE

GROSS WEIGHT 60,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-220

DATE: 15 JUNE 1988
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

	KTAS	DRAG INDEX								
		0	20	40	60	80	100	120	140	160
25,000 FEET (-35°C)	360	5813	6118	6423	6733	7063	7394	7724	8071	8443
	400	5686	6084	6482	6881	7308	7738	8167	8644	9121
	440	5972	6477	6982	7511	8047	8609	9202	9805	10466
	480	6426	7065	7726	8399	9126	9863	10696	11536	12400
	520	7107	7972	8869	9817	10838	11913	13042		
	560	8540	9865	11273	12807					
	600	12491								
	MIL	14629	14476	14258	14016	13759	13529	13257	12987	12715
	V_{MAX}	612.1	599.8	585.0	569.1	554.3	541.0	522.1	503.4	484.5
30,000 FEET (-44°C)	360	6480	6781	7082	7383	7705	8029	8352	8676	9000
	400	5746	6097	6450	6845	7240	7643	8072	8501	8936
	440	5625	6072	6520	7012	7514	8047	8597	9160	
	480	5901	6462	7049	7670	8336	9018	9758		
	520	6410	7162	7944	8774	9694	10679			
	560	7764	8962	10323						
	600	12533								
	MIL	12644	12546	12332	12033	11804	11416	10919	10203	9523
	V_{MAX}	600.8	588.5	574.1	556.1	546.6	530.5	506.8	472.7	431.2
35,000 FEET (-54°C)	360	8981	9244	9508	9771	10034				
	400	6489	6845	7215	7577	7943				
	440	5689	6118	6583	7053	7543				
	480	5551	6079	6648	7241	7877				
	520	5971	6658	7406	8253					
	560	8298	9477							
	600									
	MIL	10075	9785	9497	9174	8712	4196	4196	4196	4196
	V_{MAX}	576.0	563.0	550.0	534.4	510.2				

	ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS		
		CRUISE	MIL	V_{MAX}
25,000 FEET (-35°C)	-80	.900	1.480	.959
	-60	.946	1.250	.978
	-40	.986	1.035	.996
	-20	1.030	.880	1.007
	0	1.070	.720	1.016
30,000 FEET (-44°C)	-80	.919	1.025	.936
	-60	.966	1.010	.978
	-40	1.010	.955	1.001
	-20	1.052	.785	1.006
	0	1.043	.610	1.011
35,000 FEET (-54°C)	-80	.940	.930	.943
	-60	.987	.980	.988
	-40	1.032	.915	1.010
	-20	1.075	.740	1.016
	0	1.117	.570	1.023

Figure A5-29 (Sheet 1 of 2)

HIGH ALTITUDE CRUISE

GROSS WEIGHT 60,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-220

DATE: 15 JUNE 1988
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

	KTAS	DRAG INDEX								
		0	20	40	60	80	100	120	140	160
40,000 FEET (-57°C)	380	13440	13643							
	400	9811	10095							
	440	7289	7691							
	480	6133	6669							
	520	6142	6869							
	560									
	600									
	MIL	7504	7141	2806	2806	2806	2806	2806	2806	2806
	V_{MAX}	549.9	528.9							

ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS		
	CRUISE	MIL	V_{MAX}
-80	.944	.915	.945
-60	.992	.985	.992
-40	1.037	.930	1.019
-20	1.081	.765	1.033
0	1.122	.600	1.046

Figure A5-29 (Sheet 2)

HIGH ALTITUDE CRUISE
GROSS WEIGHT 65,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-220

DATE: 15 JUNE 1988
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

ALTITUDE	KTAS	DRAG INDEX 0	20	40	60	80	100	120	140	160
25,000 FEET (-35°C)	360	6437	6744	7071	7397	7723	8066	8434	8802	9170
	400	6159	6557	6962	7389	7816	8257	8735	9212	9705
	440	6299	6807	7329	7868	8415	9012	9608	10261	10928
	480	6703	7340	8007	8688	9420	10186	11016	11860	
	520	7333	8206	9112	10053	11092	12177			
	560	8685	10009	11420	12960					
	600	12793								
	MIL	14603	14440	14217	13987	13731	13490	13193	12903	12607
	V_{MAX}	610.0	597.4	582.3	567.5	552.7	538.3	517.7	497.6	477.4
30,000 FEET (-44°C)	360	8064	8380	8698	9016	9334	9651	9969		
	400	6351	6738	7137	7536	7967	8400	8834		
	440	6079	6530	7026	7532	8071	8625	9193		
	480	6207	6774	7402	8049	8739	9464	10212		
	520	6680	7445	8240	9072	10040	11030			
	560	8006	9207	10606						
	600									
	MIL	12613	12482	12279	12029	11716	11306	10535	5308	5308
	V_{MAX}	596.8	584.2	570.5	556.0	542.9	525.2	488.5		
35,000 FEET (-54°C)	360	11115	11374	11633	11893					
	400	8018	8377	8736	9095					
	440	6446	6917	7408	7902					
	480	6034	6607	7205	7849					
	520	6379	7094	7942	8809					
	560	8904								
	600									
	MIL	9910	9652	9381	8886	4196	4196	4196	4196	4196
	V_{MAX}	568.6	557.0	544.5	520.2					

ALTITUDE	ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS CRUISE	MIL	V_{MAX}
25,000 FEET (-35°C)	-80	.900	1.480	.959
	-60	.945	1.250	.978
	-40	.988	1.035	.996
	-20	1.030	.880	1.007
	0	1.070	.720	1.016
30,000 FEET (-44°C)	-80	.919	1.025	.936
	-60	.966	1.010	.978
	-40	1.010	.955	1.001
	-20	1.052	.785	1.006
	0	1.043	.610	1.011
35,000 FEET (-54°C)	-80	.940	.930	.943
	-60	.987	.980	.988
	-40	1.032	.915	1.010
	-20	1.075	.740	1.016
	0	1.117	.570	1.023

Figure A5-30 (Sheet 1 of 2)

HIGH ALTITUDE CRUISE
GROSS WEIGHT 65,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-220

DATE: 15 JUNE 1988
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

	KTAS	DRAG INDEX								
		0	20	40	60	80	100	120	140	160
40,000 FEET (-57°C)	360	16049								
	400	12140								
	440	9157								
	480	7333								
	520	6945								
	560									
	600									
	MIL	7128	2806	2806	2806	2806	2806	2806	2806	2806
	V_{MAX}	528.1								

ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS		
	CRUISE	MIL	V_{MAX}
-80	.944	.915	.945
-60	.992	.985	.992
-40	1.037	.930	1.019
-20	1.081	.765	1.033
0	1.122	.600	1.046

Figure A5-30 (Sheet 2)

HIGH ALTITUDE CRUISE
GROSS WEIGHT 70,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-220

DATE: 15 JUNE 1988
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

	KTAS	DRAG INDEX 0	20	40	60	80	100	120	140	160
25,000 FEET (-35°C)	360	7398	7723	8065	8432	8799	9167	9549	9947	10345
	400	6698	7112	7540	7967	8426	8904	9382	9892	10416
	440	6661	7178	7721	8264	8857	9458	10099	10769	11442
	480	7008	7667	8340	9060	9798	10622	11459	12322	
	520	7582	8463	9377	10334	11373	12471			
	560	8867	10191	11608	13156					
	600	13169								
	MIL	14575	14400	14181	13954	13690	13422	13118	12777	12365
	V_{MAX}	607.8	594.7	579.9	565.6	550.4	533.5	512.3	488.8	462.2

ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS CRUISE	MIL	V_{MAX}
-80	.900	1.480	.959
-60	.945	1.250	.978
-40	.988	1.035	.996
-20	1.030	.880	1.007
0	1.070	.720	1.016

	KTAS	DRAG INDEX 0	20	40	60	80	100	120	140	160
30,000 FEET (-44°C)	360	9917	10233	10550	10867	11185	11502			
	400	7293	7700	8128	8556	8996	9430			
	440	6594	7101	7609	8159	8716	9291			
	480	6557	7168	7803	8496	9208	9964			
	520	6980	7770	8598	9496	10486				
	560	8292	9499	10947						
	600									
	MIL	12578	12411	12221	12025	11553	10947	5308	5308	5308
	V_{MAX}	592.1	579.4	566.6	555.8	536.2	508.1			

ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS CRUISE	MIL	V_{MAX}
-80	.919	1.025	.936
-60	.966	1.010	.978
-40	1.010	.955	1.001
-20	1.052	.785	1.006
0	1.043	.610	1.011

	KTAS	DRAG INDEX 0	20	40	60	80	100	120	140	160
35,000 FEET (-54°C)	360	13502	13752	14007						
	400	9907	10264	10621						
	440	7521	8015	8508						
	480	6655	7266	7918						
	520	6828	7636	8513						
	560	9545								
	600									
	MIL	9769	9506	9114	4196	4196	4196	4196	4196	4196
	V_{MAX}	562.3	550.4	531.4						

ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS CRUISE	MIL	V_{MAX}
-80	.940	.930	.943
-60	.987	.980	.988
-40	1.032	.915	1.010
-20	1.075	.740	1.016
0	1.117	.570	1.023

Figure A5-31

HIGH ALTITUDE CRUISE
GROSS WEIGHT 75,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-220

DATE: 15 JUNE 1988
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

	KTAS	DRAG INDEX									ACTUAL OAT DEG. C	TEMP. EFFECTS FACTORS		
		0	20	40	60	80	100	120	140	160		CRUISE	MIL	V_{MAX}
25,000 FEET (-35°C)	360	8684	9042	9405	9794	10182	10571	10972	11348	11736	-80	.900	1.480	.959
	400	7338	7767	8203	8683	9162	9652	10178	10705	11233	-60	.945	1.250	.978
	440	7072	7616	8161	8746	9350	9980	10653	11328		-40	.988	1.035	.996
	480	7301	7981	8673	9419	10200	11044	11902			-20	1.030	.880	1.007
	520	7857	8731	9656	10637	11674	12781				0	1.070	.720	1.016
	560	9075	10400	11824	13383									
	600	13588												
	MIL	14542	14356	14146	13916	13640	13343	12985	12558	11971				
	V_{MAX}	604.8	591.7	577.5	563.4	547.5	528.0	503.2	474.4	437.4				

	KTAS	0	20	40	60	80	100	120	140	160	ACTUAL OAT DEG. C	CRUISE	MIL	V_{MAX}
30,000 FEET (-44°C)	360	11941	12253	12566	12878	13190					-80	.919	1.025	.936
	400	8519	8952	9391	9829	10268					-60	.966	1.010	.978
	440	7295	7818	8380	8944	9535					-40	1.010	.955	1.001
	480	6983	7624	8307	9011	9774					-20	1.052	.785	1.006
	520	7327	8135	8988	9967	10981					0	1.043	.610	1.011
	560	8622	9887	11366										
	600													
	MIL	12521	12344	12166	11850	11351	5308	5308	5308	5308				
	V_{MAX}	586.8	574.9	562.9	548.5	527.4								

	KTAS	0	20	40	60	80	100	120	140	160	ACTUAL OAT DEG. C	CRUISE	MIL	V_{MAX}
35,000 FEET (-54°C)	360	16325	16572								-80	.940	.930	.943
	400	11882	12234								-60	.987	.980	.988
	440	8841	9336								-40	1.032	.915	1.010
	480	7459	8121								-20	1.075	.740	1.016
	520	7425	8310								0	1.117	.570	1.023
	560													
	600													
	MIL	9629	9357	4196	4196	4196	4196	4196	4196	4196				
	V_{MAX}	555.9	543.4											

Figure A5-32

HIGH ALTITUDE CRUISE
GROSS WEIGHT 80,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-220

DATE: 15 JUNE 1988
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

	KTAS	DRAG INDEX								
		0	20	40	60	80	100	120	140	160
25,000 FEET (-35°C)	360	10510	10913	11284	11671	12057	12444	12831	13217	
	400	7975	8432	8908	9384	9892	10415	10938	11470	
	440	7566	8114	8699	9306	9937	10614	11292	11985	
	480	7645	8330	9062	9814	10654	11507	12386		
	520	8145	9041	9975	10998	12067				
	560	9317	10647	12083	13654					
	600	14135								
	MIL	14499	14306	14113	13868	13579	13224	12781	12016	7173
	V_{MAX}	601.4	588.3	575.2	560.6	543.9	519.8	489.1	440.3	

ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS CRUISE	MIL	V_{MAX}
-80	.900	1.480	.959
-60	.945	1.250	.978
-40	.988	1.035	.996
-20	1.030	.880	1.007
0	1.070	.720	1.016

	KTAS	0	20	40	60	80	100	120	140	160
30,000 FEET (-44°C)	360	14182	14489	14796	15103	15410				
	400	10267	10698	11128	11559	11990				
	440	8033	8600	9180	9777	10368				
	480	7487	8163	8875	9634	10407				
	520	7709	8552	9468	10482					
	560	8995	10350							
	600									
	MIL	12444	12276	12104	11831	10747	5308	5308	5308	5308
	V_{MAX}	581.7	570.3	559.1	539.4	498.6				

ACTUAL OAT DEG. C	CRUISE	MIL	V_{MAX}
-80	.919	1.025	.936
-60	.966	1.010	.978
-40	1.010	.955	1.001
-20	1.052	.785	1.006
0	1.043	.610	1.011

	KTAS	0	20	40	60	80	100	120	140	160
35,000 FEET (-54°C)	360	18897								
	400	14103								
	440	10578								
	480	8563								
	520	8162								
	560									
	600									
	MIL	9448	4196	4196	4196	4196	4196	4196	4196	4196
	V_{MAX}	547.8								

ACTUAL OAT DEG. C	CRUISE	MIL	V_{MAX}
-80	.940	.930	.943
-60	.987	.980	.988
-40	1.032	.915	1.010
-20	1.075	.740	1.016
0	1.117	.570	1.023

Figure A5-33

CONSTANT ALTITUDE CRUISE

LANDING GEAR EXTENDED
CRUISE SPEED–250 KCAS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

DATE: 15 JUNE 1988
DATA BASIS: FLIGHT TEST

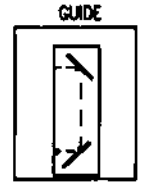
REMARKS

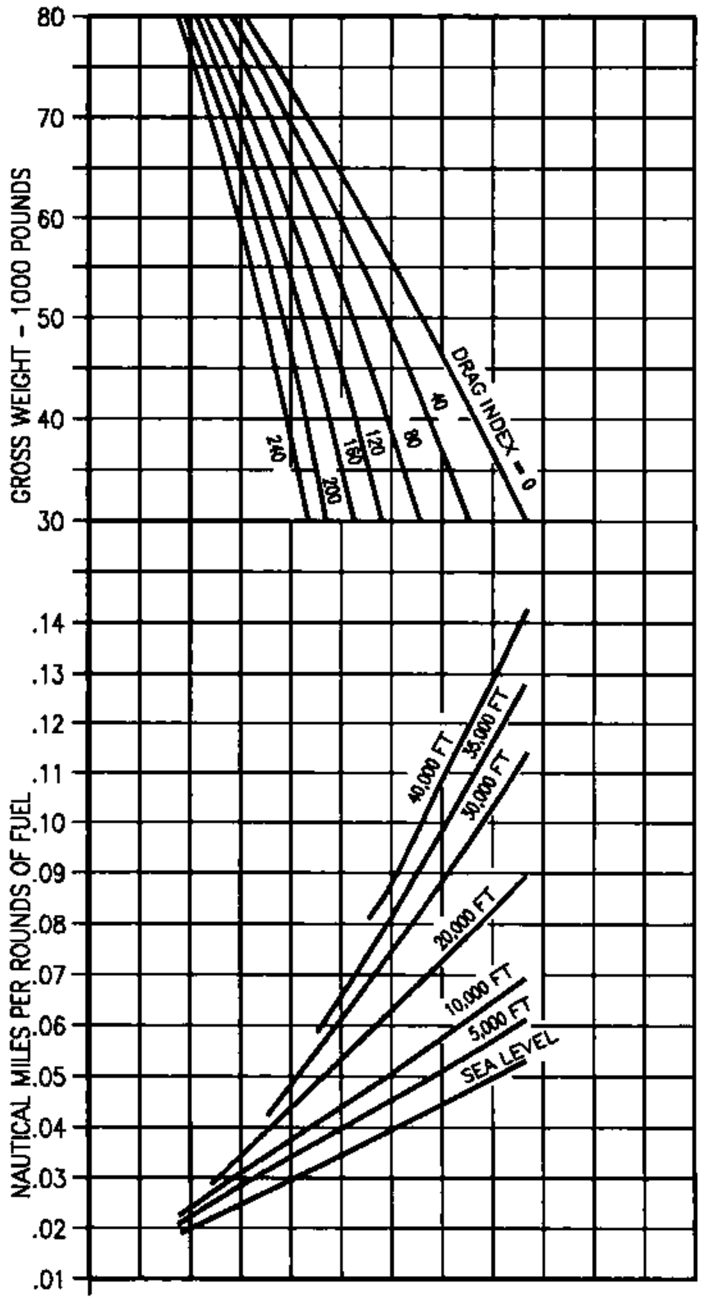
ENGINE(S): (2) F100-PW-220

DATA APPLICABLE FOR ANY TEMPERATURE

NOTE

- LANDING GEAR DRAG MUST ALSO BE INCLUDED WHEN CALCULATING TOTAL DRAG INDEX
- DI = 40 FOR NOSE GEAR DI = 25 FOR EACH MAIN GEAR
- SPEED RESTRICTED TO 250 KCAS WITH GEAR EXTENDED





15E-1-(154-1)44-CATI

Figure A5-34

PART 6

ENDURANCE

TABLE OF CONTENTS

MAXIMUM ENDURANCE CHARTS

These charts (figures A6-1 and A6-2) present optimum endurance altitude and maximum endurance specifics (fuel flow and Mach number) for various combinations of effective gross weight and altitude.

USE (ALTITUDE AND BANK ANGLE CHART)

Enter the Altitude and Bank Angle chart with the average gross weight. If bank angles are to be considered, follow the gross weight curve until it intersects the bank angle to be used, then project horizontally right to obtain effective gross weight. (If bank angles are not to be considered, enter the chart at the effective gross weight scale.) From this point proceed horizontally right to intersect the applicable drag index curve, then project vertically down to read optimum endurance altitude.

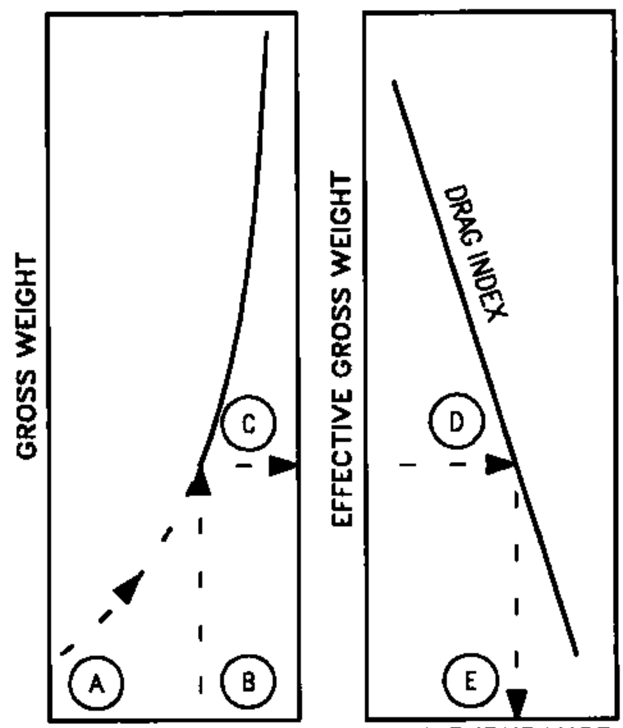
Sample Problem

Altitude and Bank Angle

A. Gross weight	60,000Lb
B. Bank angle	20°
C. Effective gross weight	63,800 Lb
D. Drag index	120
E. Optimum endurance altitude	18,000 Ft

SAMPLE MAXIMUM ENDURANCE

ALTITUDE AND BANK ANGLE



15E-1-(88-1)44-CATI

USE (FUEL FLOW AND MACH NUMBER CHART)

Enter the fuel flow and Mach number plots on the Fuel Flow and Mach Number chart with the effective gross weight, then horizontally to intersect the optimum endurance altitude curve. From this point, project vertically down to intersect the applicable drag index curve, then horizontally to read fuel flow or true Mach number.

Sample Problem

Fuel Flow

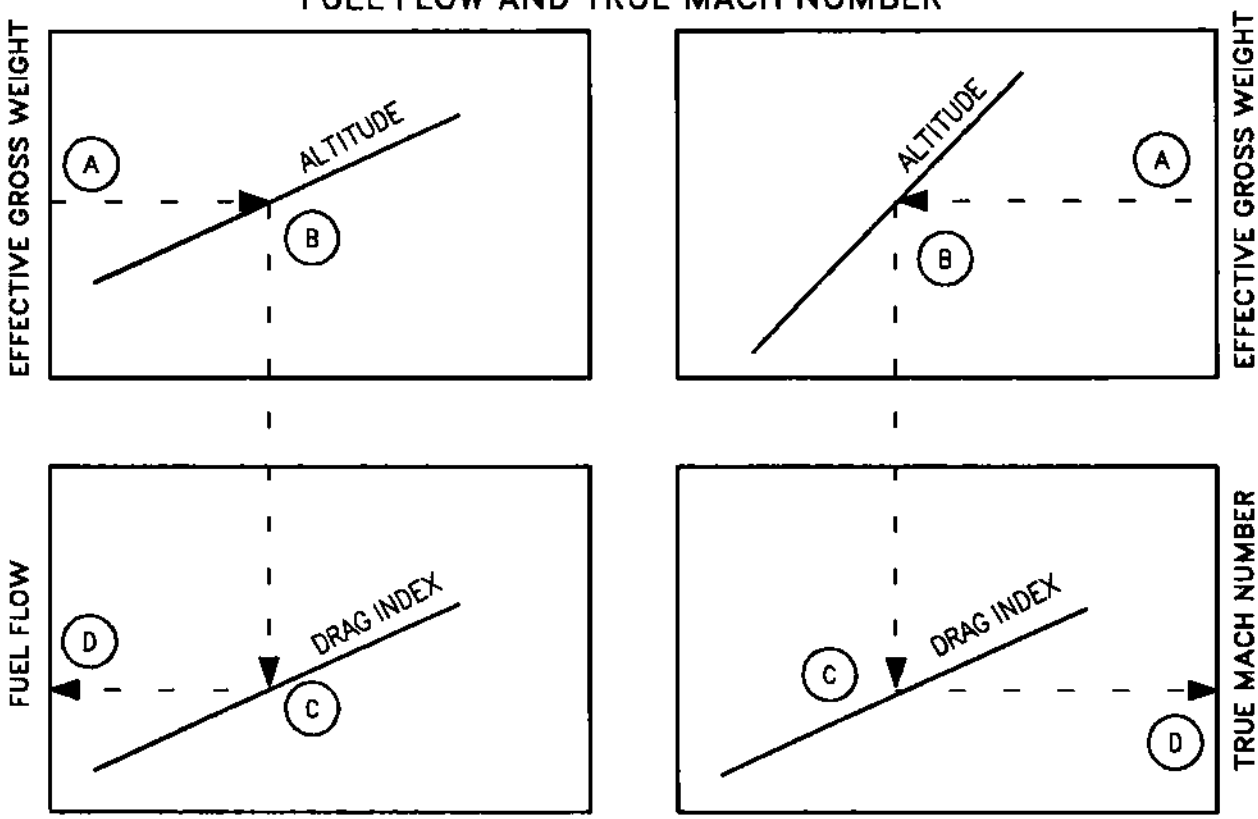
A. Effective gross weight	63,800 Lb
B. Endurance altitude	18,000 Ft
C. Drag index	120
D. Fuel flow	8050 PPH

Mach Number

A. Effective gross weight	63,800 Lb
B. Endurance altitude	18,000 Ft
C. Drag index	120
D. True Mach number	0.589

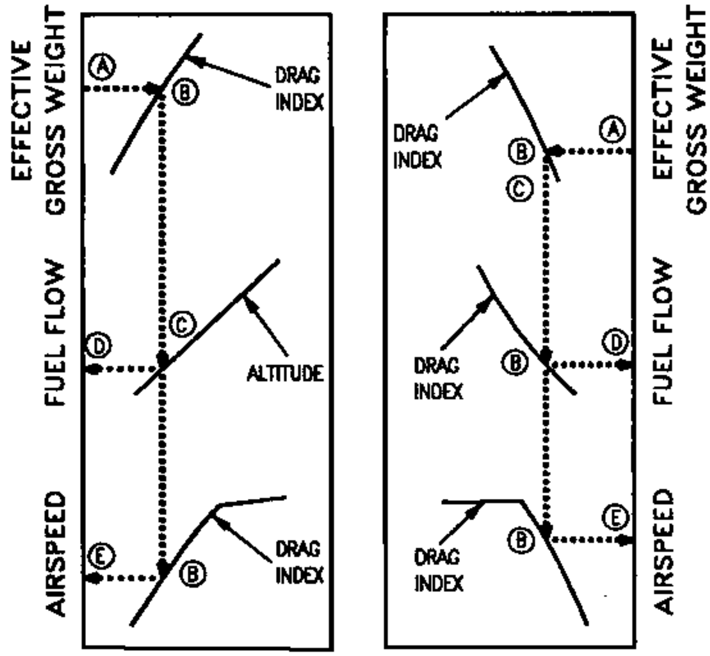
SAMPLE MAXIMUM ENDURANCE

FUEL FLOW AND TRUE MACH NUMBER



15E-1-(89-1)44-CATI

SAMPLE ENDURANCE, LANDING GEAR EXTENDED



15E-1-(158-1)04-CATI

ENDURANCE-LANDING GEAR EXTENDED

This chart (figure A6-3) presents constant altitude endurance and maximum endurance specifics (fuel flow, calibrated airspeed, and altitude) for various combinations of gross weight and drag index.

USE

If bank angles are to be considered, utilize the method described in the previous problem to determine the effective gross weight. To obtain constant altitude endurance specifics, enter the left side of the chart at the effective gross weight scale. From this point, proceed horizontally right to intersect the applicable drag index curve, then project downward to intersect with the desired altitude. From this point, project horizontally left to read the fuel flow. To obtain the calibrated airspeed, project downward from the altitude-fuel flow intersection to intersect with the applicable drag index curves on the airspeed chart, project horizontally left from this point to read the calibrated airspeed.

To obtain maximum endurance specifics, the right side of the chart is used. Enter the chart at the effective gross weight and project horizontally left to intersect with the applicable drag index curve. From this point, project downward to read the maximum endurance altitude from the horizontal scale. Project further downward to intersect with the applicable drag index curve and project horizontally right to read the fuel flow or the calibrated airspeed.

Sample Problem

Constant Altitude Endurance

A. Effective gross weight	42,500 Lb
B. Drag index (external stores)	30
Drag index (all gear extended)	90
Total drag index	120
C. Altitude	10,000 Ft
D. Fuel flow	5,400 PPH
E. Airspeed	203 KCAS

Maximum Endurance

A. Effective gross weight	42,500 Lb
B. Drag index	120
C. Altitude	28,000 Ft
D. Fuel flow	5,600 PPH
E. Airspeed	204 KCAS

MAXIMUM ENDURANCE

ALTITUDE AND BANK ANGLE

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

DATE:15 JUNE 1988
DATA BASIS: FLIGHT TEST

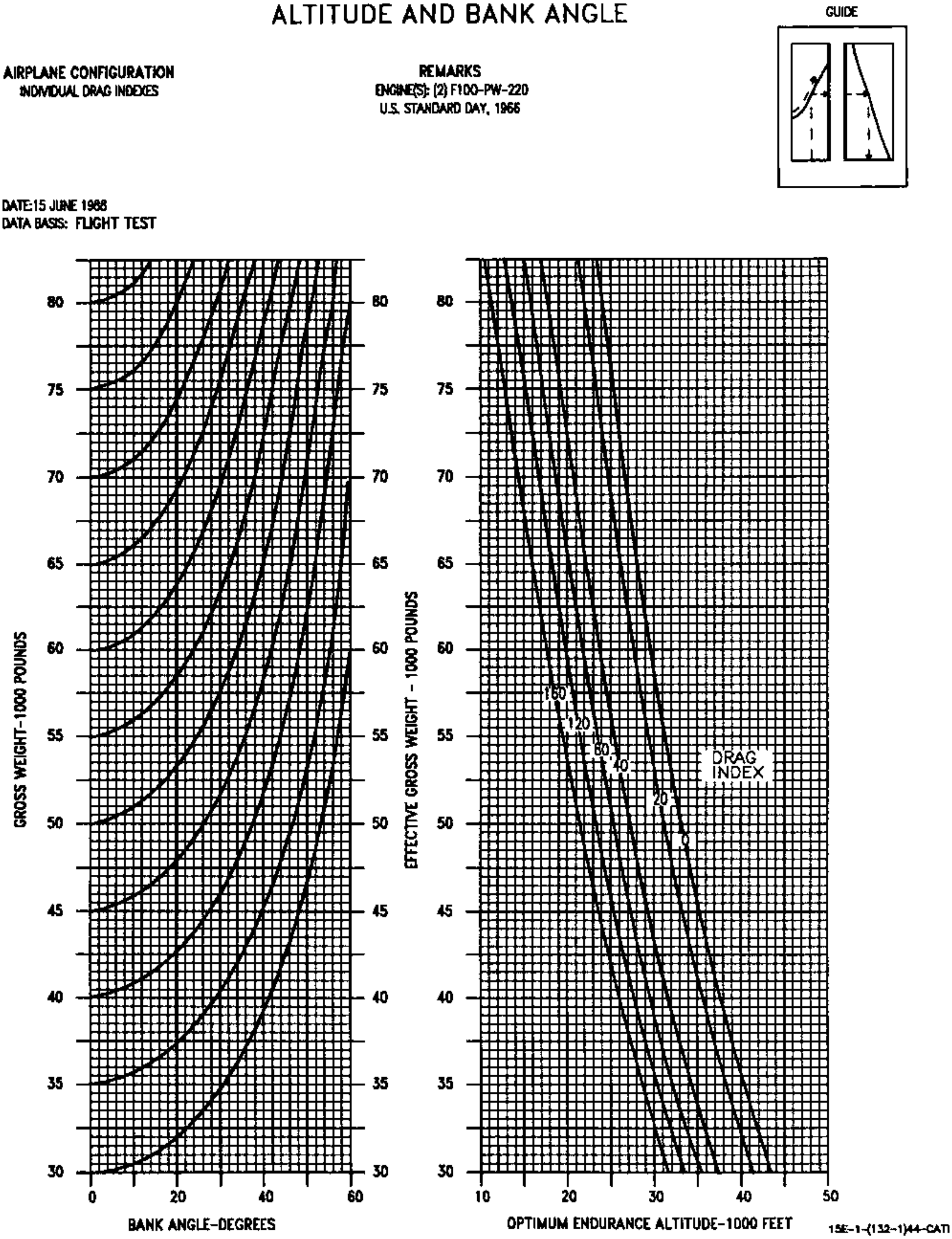


Figure A6-1

MAXIMUM ENDURANCE

FUEL FLOW AND TRUE MACH NUMBER

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

DATE: 15 JUNE 1988
DATA BASIS: FLIGHT TEST

REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

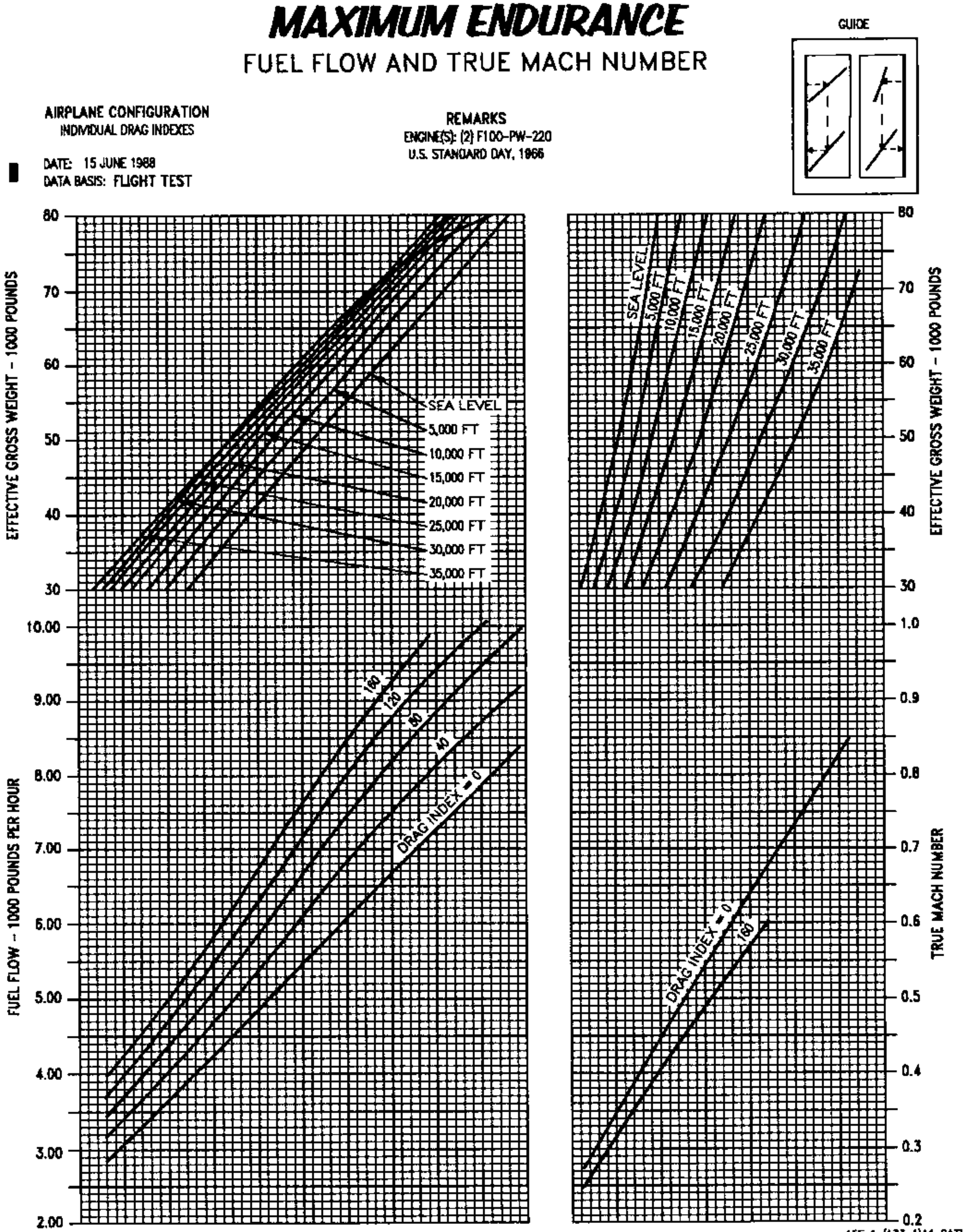


Figure A6-2

ENDURANCE

LANDING GEAR EXTENDED

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES
FLAPS RETRACTED

DATE: 15 JUNE 1988
DATA BASIS: FLIGHT TEST

REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

NOTE
- LANDING GEAR DRAG MUST ALSO BE INCLUDED WHEN CALCULATING TOTAL DRAG INDEX.
- DI=40 NOSE GEAR DI=25 FOR EACH MAIN GEAR.
- SPEEDS RESTRICTED TO 250 KCAS WITH GEAR EXTENDED.
- USE FIGURE A6-1 TO DETERMINE EFFECTIVE GROSS WEIGHT FOR A BANKED TURN.

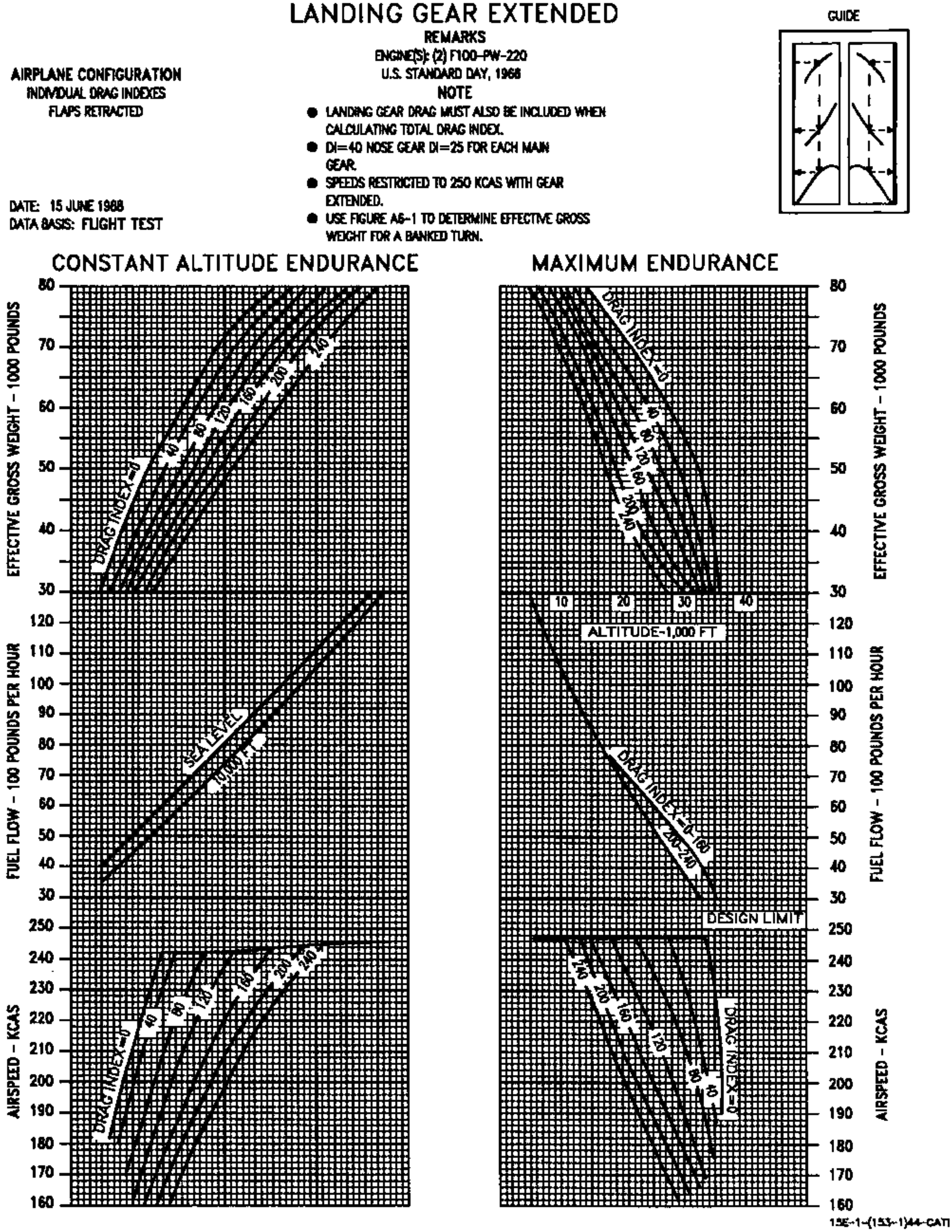


Figure A6-3

PART 7

DESCENT

DESCENT CHARTS

The Descent charts (figures A7-1 thru A7-5) present distance, time, total fuel used and Mach number in the descent. Incremental data may be obtained for distance, time and fuel by subtracting data corresponding to level-off altitude from the data for the original cruising altitude.

USE

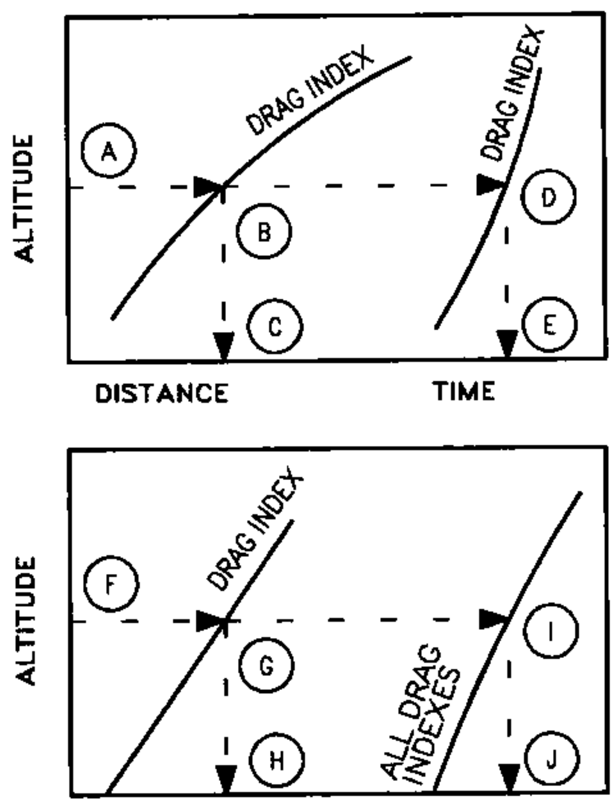
Enter the upper plot of the appropriate chart at the cruising altitude, project horizontally right to intersect both series of drag index curves. From the altitude - drag index intersection in the first series, project vertically down to read distance. From the altitude - drag index intersection in the second series, project vertically down to read time to descend. Enter the lower plot at the cruising altitude and project horizontally right to intersect the applicable drag index curve on the fuel graph. Continue horizontally right and intersect the curve on the Mach number graph. From the altitude - drag index intersection on the fuel graph, descend vertically and read total fuel used in the descent. From the intersection on the Mach number graph, project vertically down to read true Mach number.

Sample Problem

Maximum Range Descent, 220 KCAS, Idle Thrust, Speed Brake Retracted, F-15 without CFT

A. Altitude	30,000 Ft
B. Drag index	40
C. Distance	55 NM
D. Drag index	40
E. Time required	11.7 Min
F. Altitude	30,000 Ft
G. Drag index	40
H. Total fuel used	395 Lb
I. Drag reflector	
J. True Mach number	0.59 Mach

SAMPLE DESCENT



15E-1-(80-1)44-CATI

DESCENT

WITH CFT
MAXIMUM RANGE
220 KCAS - IDLE THRUST

AIRPLANE CONFIGURATION
SPEED BRAKE RETRACTED

REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

DATE: 15 JUNE 1988
DATA BASIS: ESTIMATED

NOTE
DO NOT INCLUDE CFT OR CFT PYLON DRAG WHEN CALCULATING DRAG INDEX.

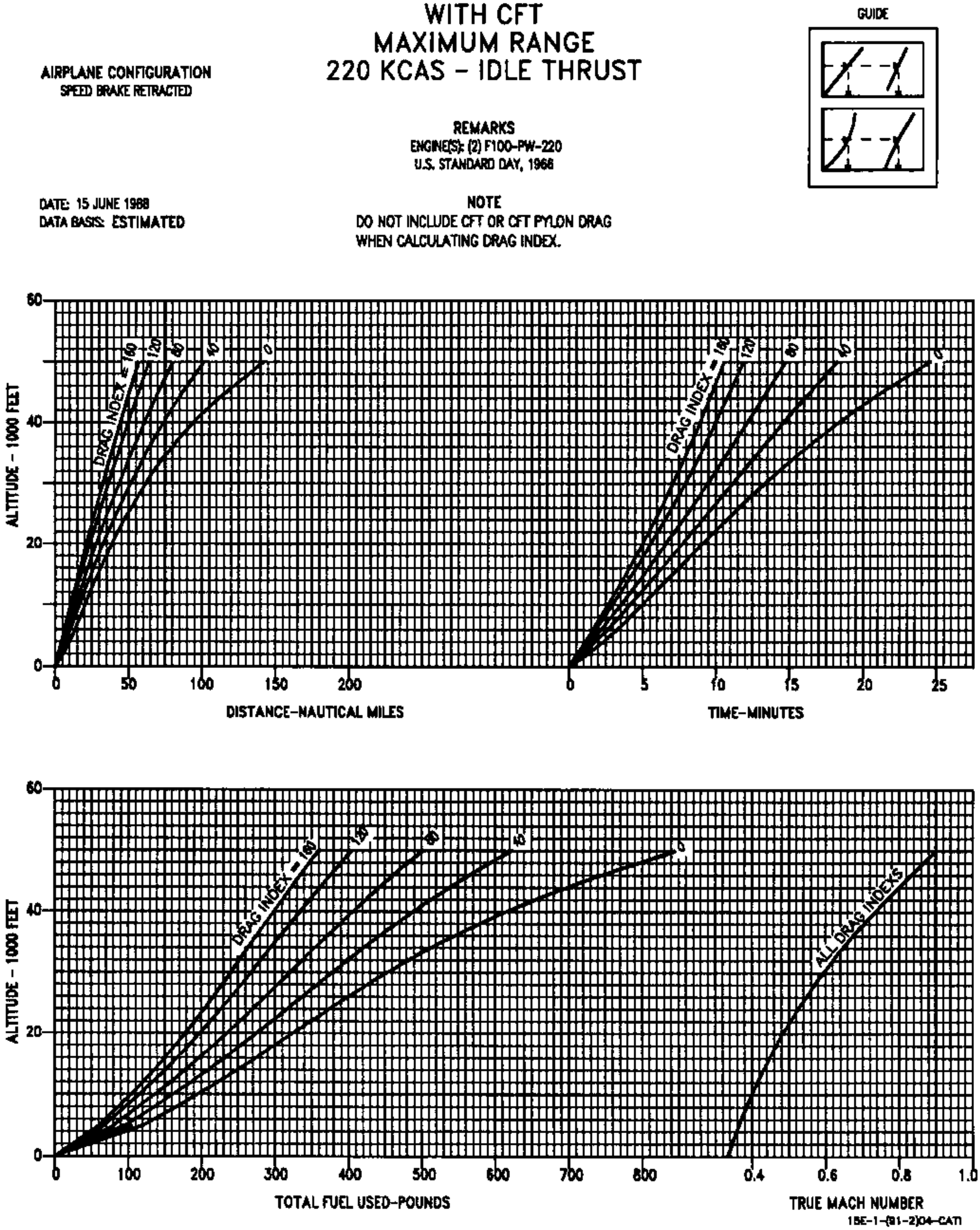
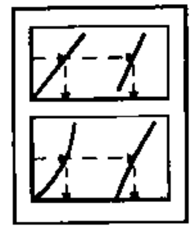


Figure A7-1

DESCENT

WITH CFT
MAXIMUM RANGE
300 KCAS - IDLE THRUST

GUIDE

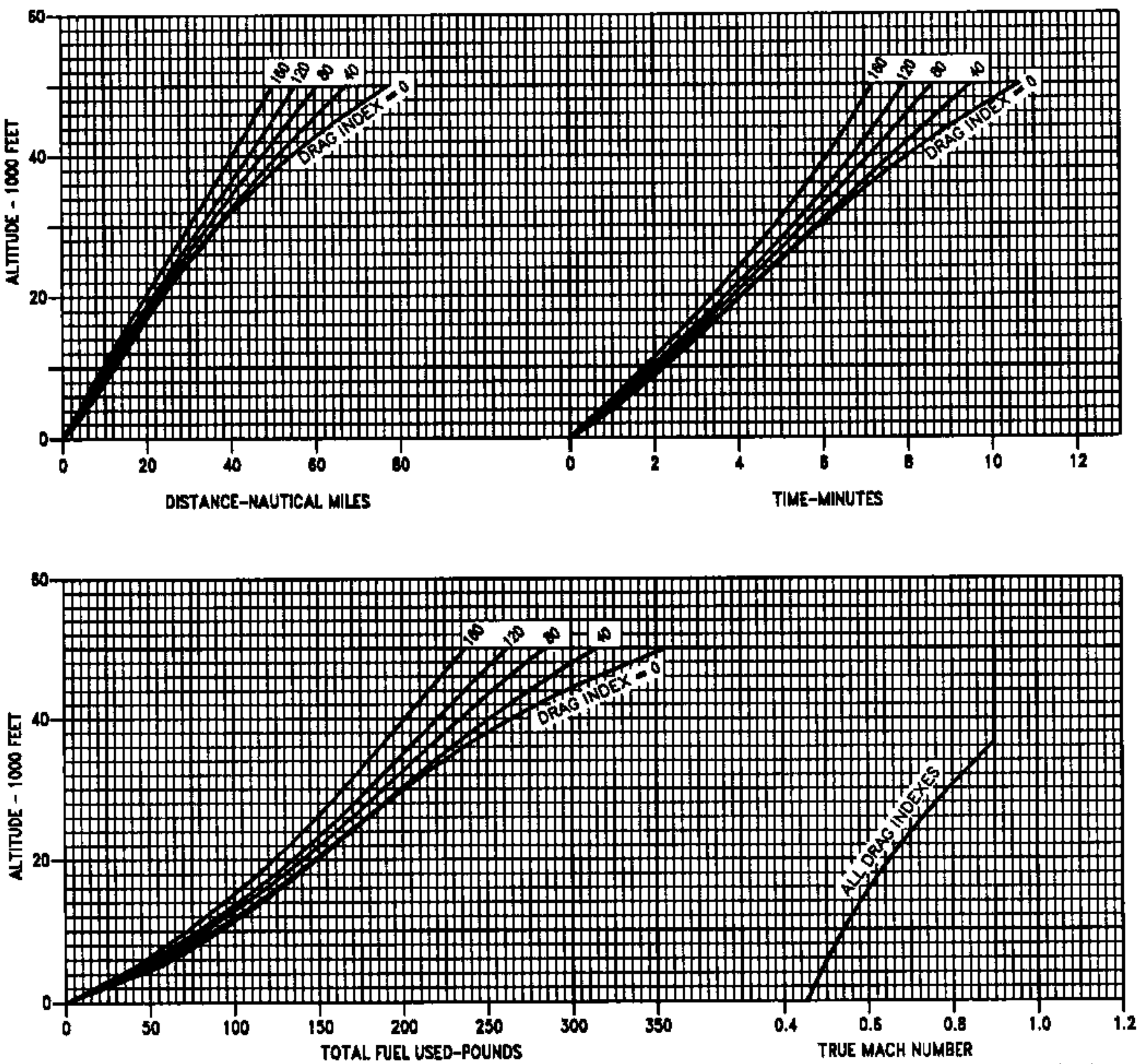


AIRPLANE CONFIGURATION
SPEED BRAKE RETRACTED

REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

DATE: 15 JUNE 1988
DATA BASIS: ESTIMATED

NOTE
DO NOT INCLUDE CFT OR CFT PYLON DRAG
WHEN CALCULATING DRAG INDEX.



15E-1-(82-1)36-CATI

Figure A7-2

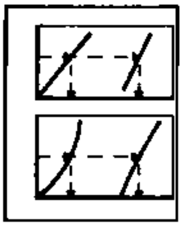
DESCENT

WITHOUT CFT
MAXIMUM RANGE
220 KCAS - IDLE THRUST

AIRPLANE CONFIGURATION
SPEED BRAKE RETRACTED

REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

GUIDE



DATE: 15 JUNE 1988
DATA BASIS: ESTIMATED

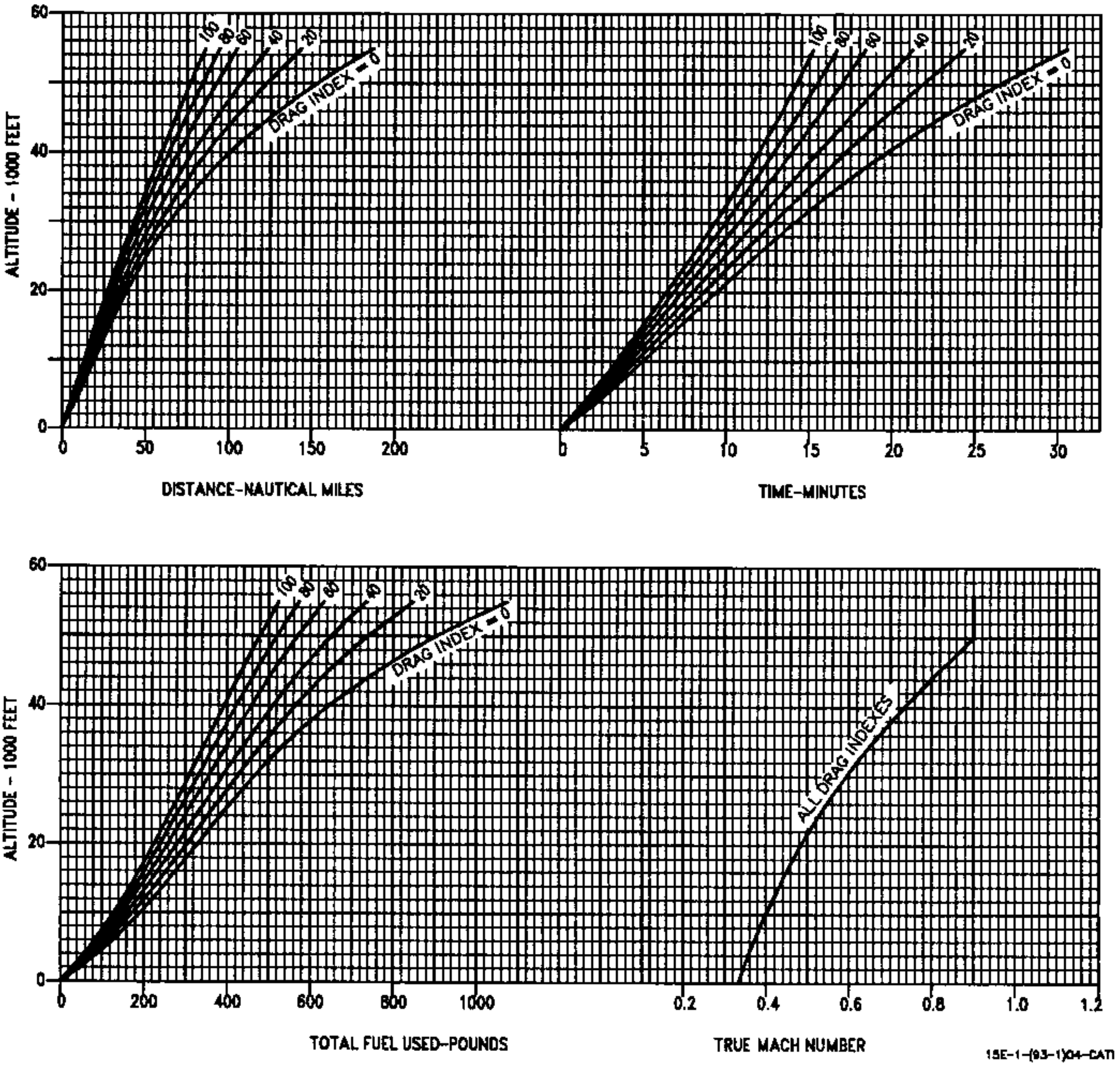


Figure A7-3

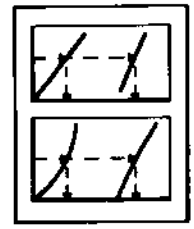
DESCENT

WITHOUT CFT
MAXIMUM RANGE
300 KCAS - IDLE THRUST

AIRPLANE CONFIGURATION
SPEED BRAKE RETRACTED

REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

DATE: 15 JUNE 1988
DATA BASIS: ESTIMATED



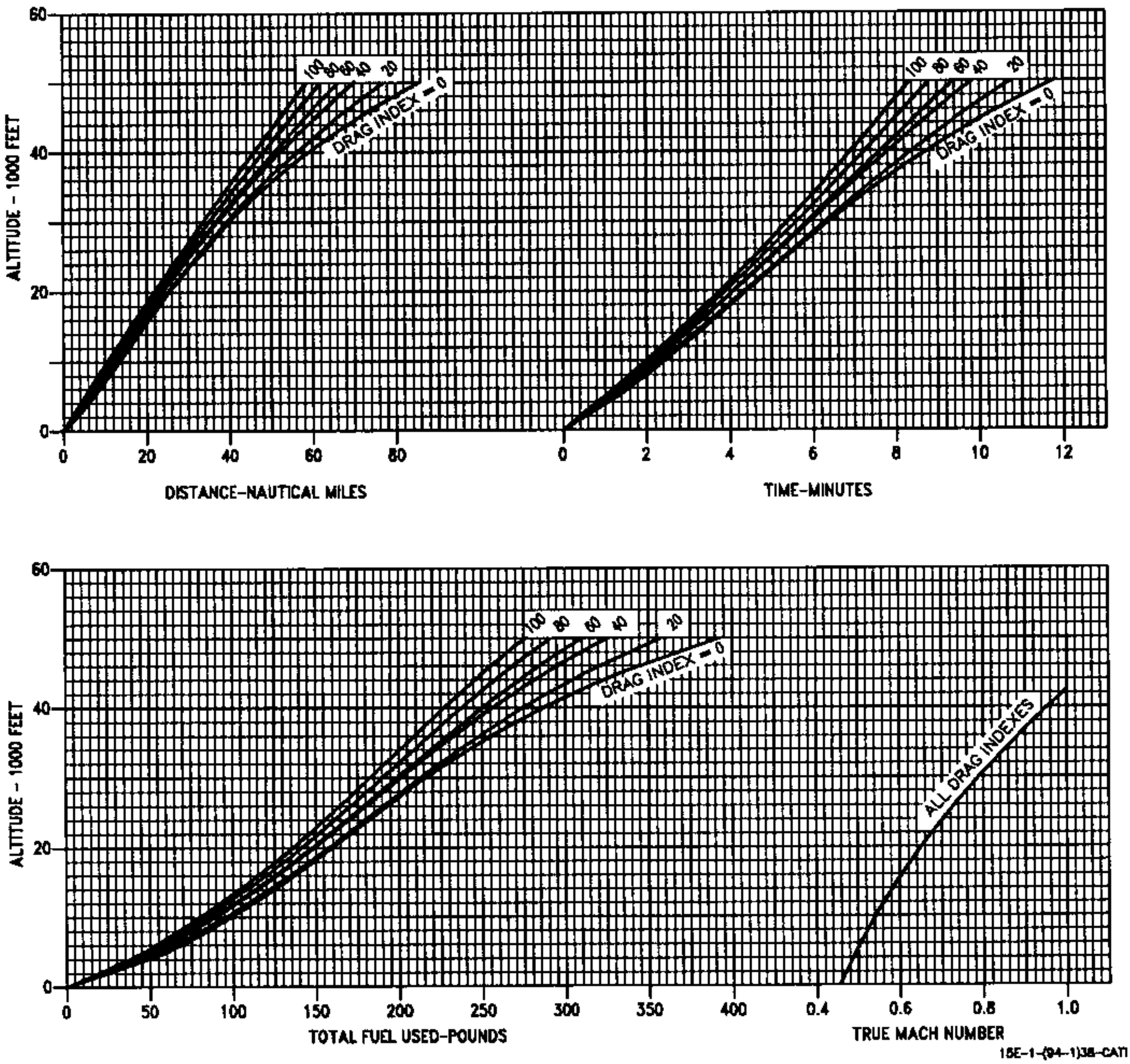


Figure A7-4

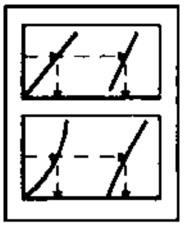
DESCENT

WITH OR WITHOUT CFT
MAXIMUM RANGE
220 KCAS - IDLE THRUST

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES
SPEED BRAKE EXTENDED

REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

GUIDE



DATE: 15 JUNE 1988
DATA BASIS: ESTIMATED

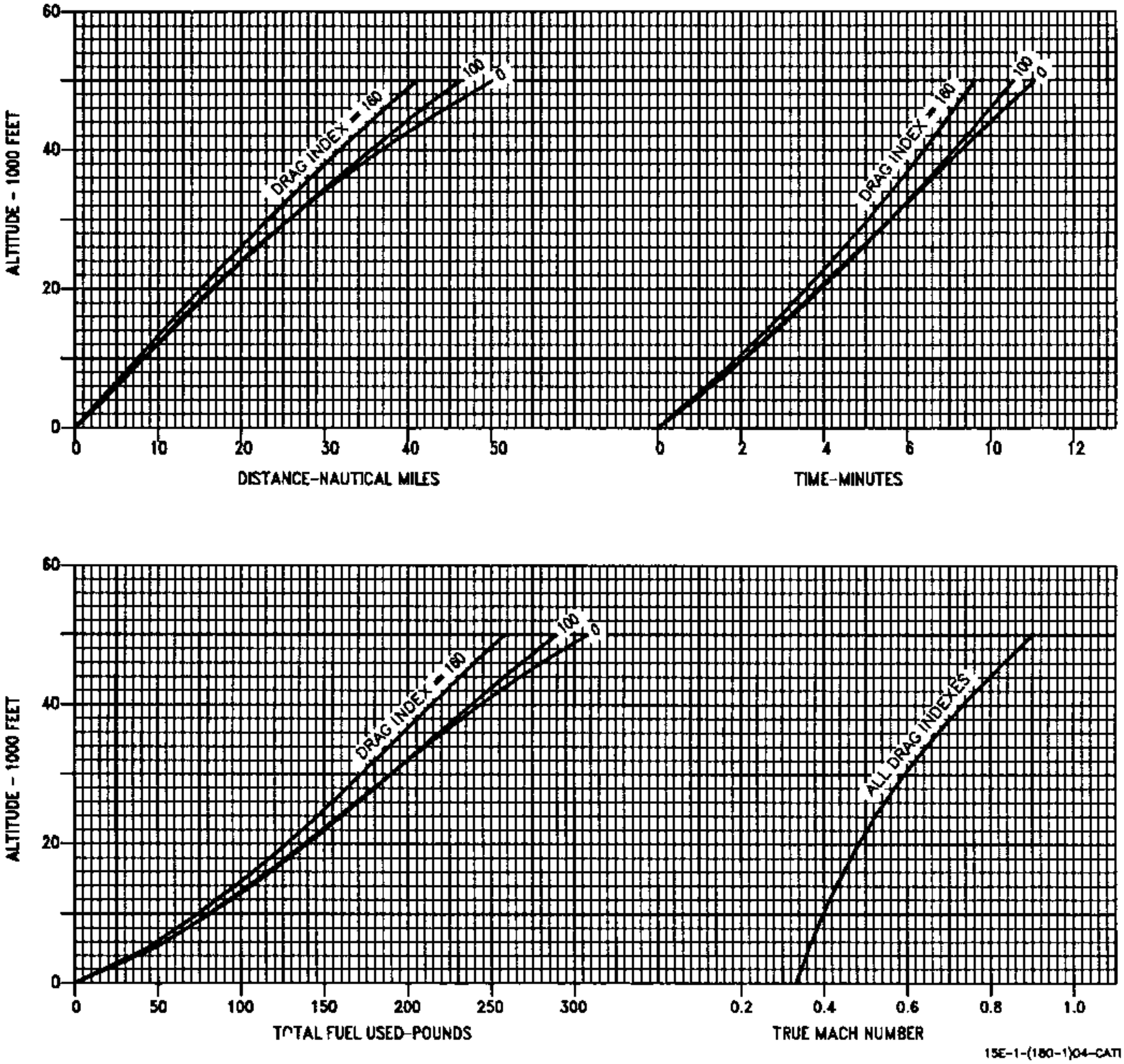


Figure A7-5

PART 8

APPROACH AND LANDING

TABLE OF CONTENTS

Charts

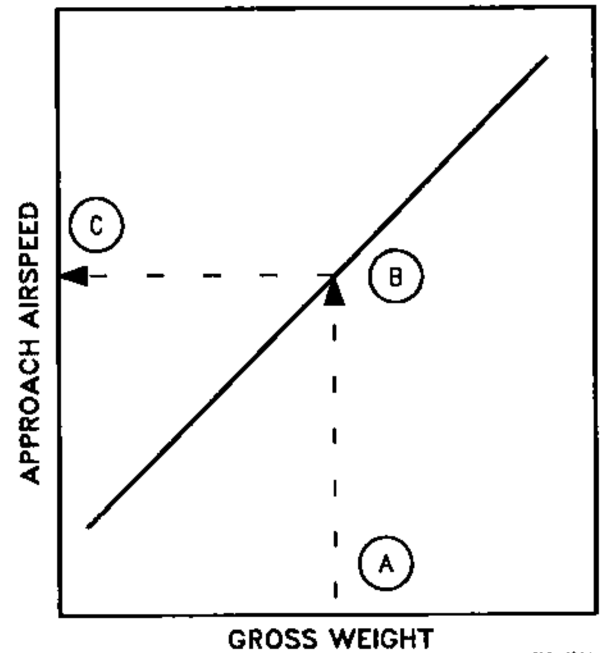
LANDING APPROACH SPEED CHART

The Landing Approach Speed chart (figure A8-1) provides recommended approach speed for various gross weights of the aircraft. The data is plotted for flaps either up or down.

USE

Enter the chart at the estimated landing gross weight and project vertically up to the appropriate flap reflector line. From this point, project horizontally left to read recommended approach speed.

SAMPLE APPROACH SPEED



15E-1-(95-1)44-CATI

Sample Problem

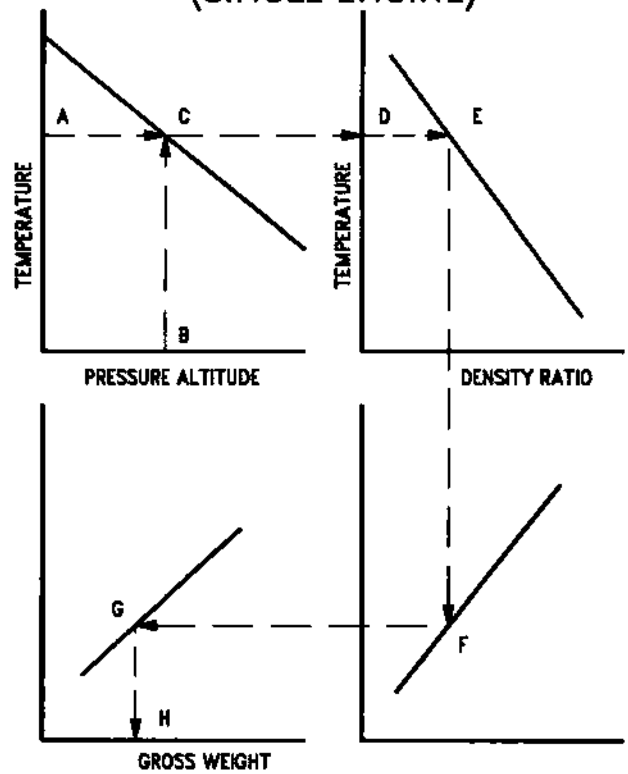
Configuration: Flaps Down

A. Estimated landing gross weight	50,000 Lb
B. Flaps down reflector line	
C. Landing approach speed	174.1 Kt

MAXIMUM APPROACH GROSS WEIGHT

The Maximum Approach Gross Weight chart (figure A8-2) provides the maximum gross weight at which the aircraft can peform a single engine maximum power climb after experiencing an engine failure. The data presented are based on the requirement that the aircraft be able to climb at a rate of 500 ft/min at approach speed at the existing ambient temperature and pressure altitude.

SAMPLE MAXIMUM APPROACH GROSS WEIGHT
(SINGLE ENGINE)



15E-1-(230-1)03-CATI

USE

Enter the chart at the existing ambient temperature and ambient pressure. Project horizontally right at the existing ambient temperature and project vertically up at the existing ambient pressure. The intersection of the two projections represents existing conditions with respect to a standard day. From this point, project horizontally right to the existing ambient pressure altitude and then descend vertically to determine the appropriate density ratio. Continue descending vertically to intersect existing ambient temperature. From this point, project horizontally left to the effective Drag Index and then descend vertically to read gross weight.

Sample Problem

A. Temperature	21°C
B. Pressure Altitude	2000 Ft
C. Type Day	STD +10°C
D. Temperature	21°C
E. Pressure Altitude	2000 Ft
F. Type Day Reflector	STD +10°C
G. Drag Index Reflector	190
H. Gross Weight	77,500 Lb

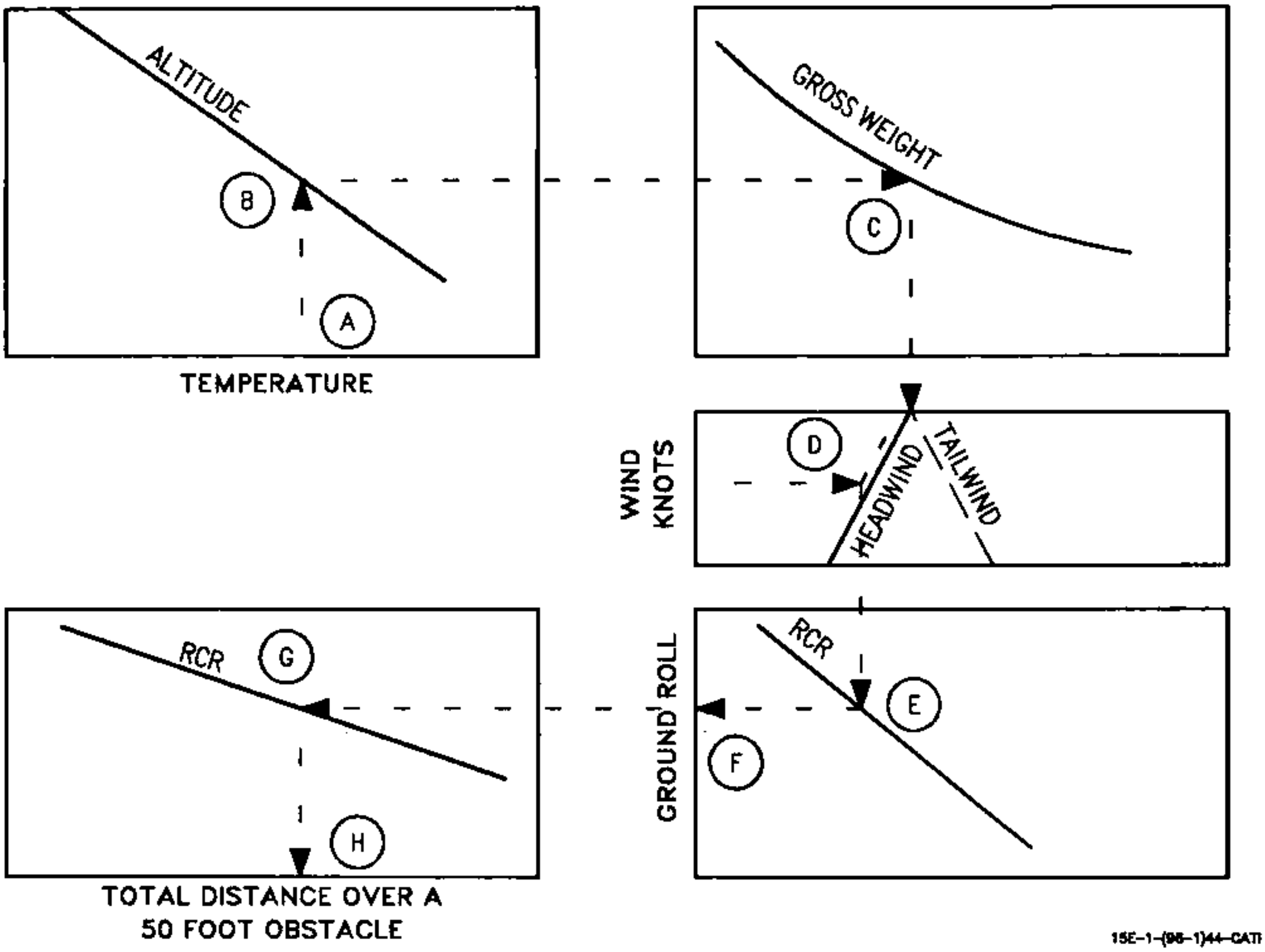
LANDING DISTANCE CHART

These charts (figures A8-3 thru A8-5) provide landing roll distance information. One chart provides data for a normal landing using aerodynamic braking. The other provides data for a landing roll utilizing the technique of lowering the nose immediately after touchdown and applying maximum anti-skid braking. The variables of temperature, altitude, gross weight, effective wind, and runway condition are taken into consideration.

USE

Enter the chart with the runway temperature and project vertically up to the applicable pressure altitude. From this point, proceed horizontally right to the landing gross weight, then descend vertically to the wind baseline. Parallel the nearest guideline down to the effective headwind or tailwind for the appropriate runway condition. From this point, project

SAMPLE LANDING DISTANCE



vertically down to the appropriate runway condition reflector, then horizontally left to read ground roll. Continue further left to the appropriate runway condition reflector, then vertically down to read total distance required when landing over a 50 foot obstacle.

Sample Problem

Normal Landing - Aerodynamic Braking

A. Temperature	20°C
B. Pressure altitude	2000 Ft
C. Gross weight	40,000 Lb
D. Effective headwind (DRY)	15 Kt
E. RCR reflector (DRY)	23
F. Landing distance	4500 Ft
G. RCR Reflector (DRY)	
H. Total distance required over a 50-foot obstacle	5600 Ft

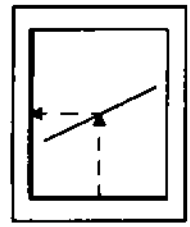
LANDING APPROACH SPEED

WITH OR WITHOUT CFT

AIRPLANE CONFIGURATION
ALL DRAG INDEXES
21 UNITS AOA

REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

DATE: 15 JUNE 1988
DATA BASIS: FLIGHT TEST



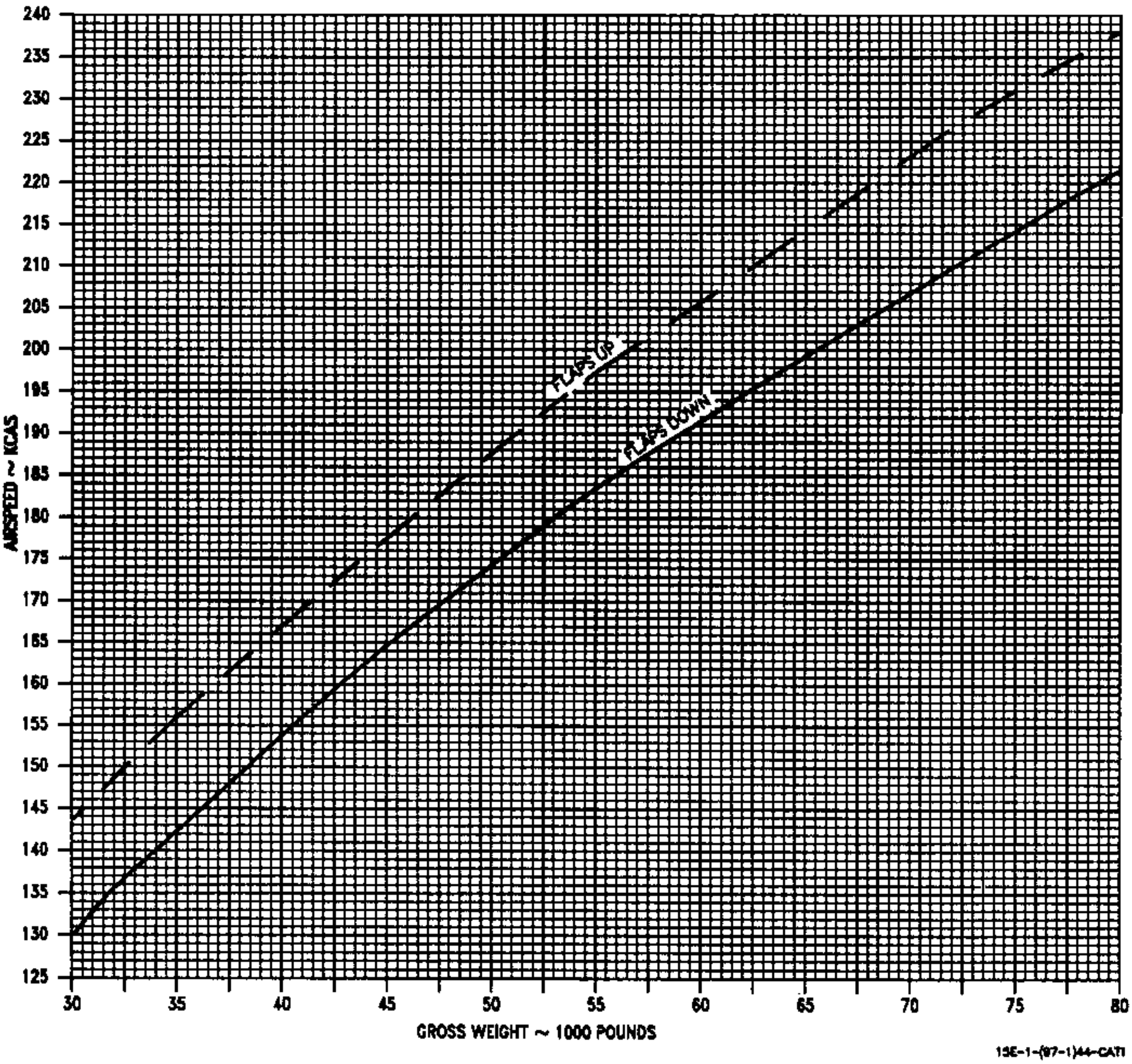


Figure A8-1

MAXIMUM APPROACH GROSS WEIGHT

SINGLE ENGINE OPERATING

AIRPLANE CONFIGURATION
GEAR AND FLAPS EXTENDED
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

NOTE
- LANDING GEAR DRAG MUST ALSO BE INCLUDED WHEN CALCULATING TOTAL DRAG INDEX
- DI=40 NOSE GEAR, DI=25 FOR EACH MAIN GEAR
- INOPERATIVE ENGINE WINDMILLING
- SPEEDBRAKE RETRACTED

DATE: 15 JUNE 1988
DATA BASIS: ESTIMATED

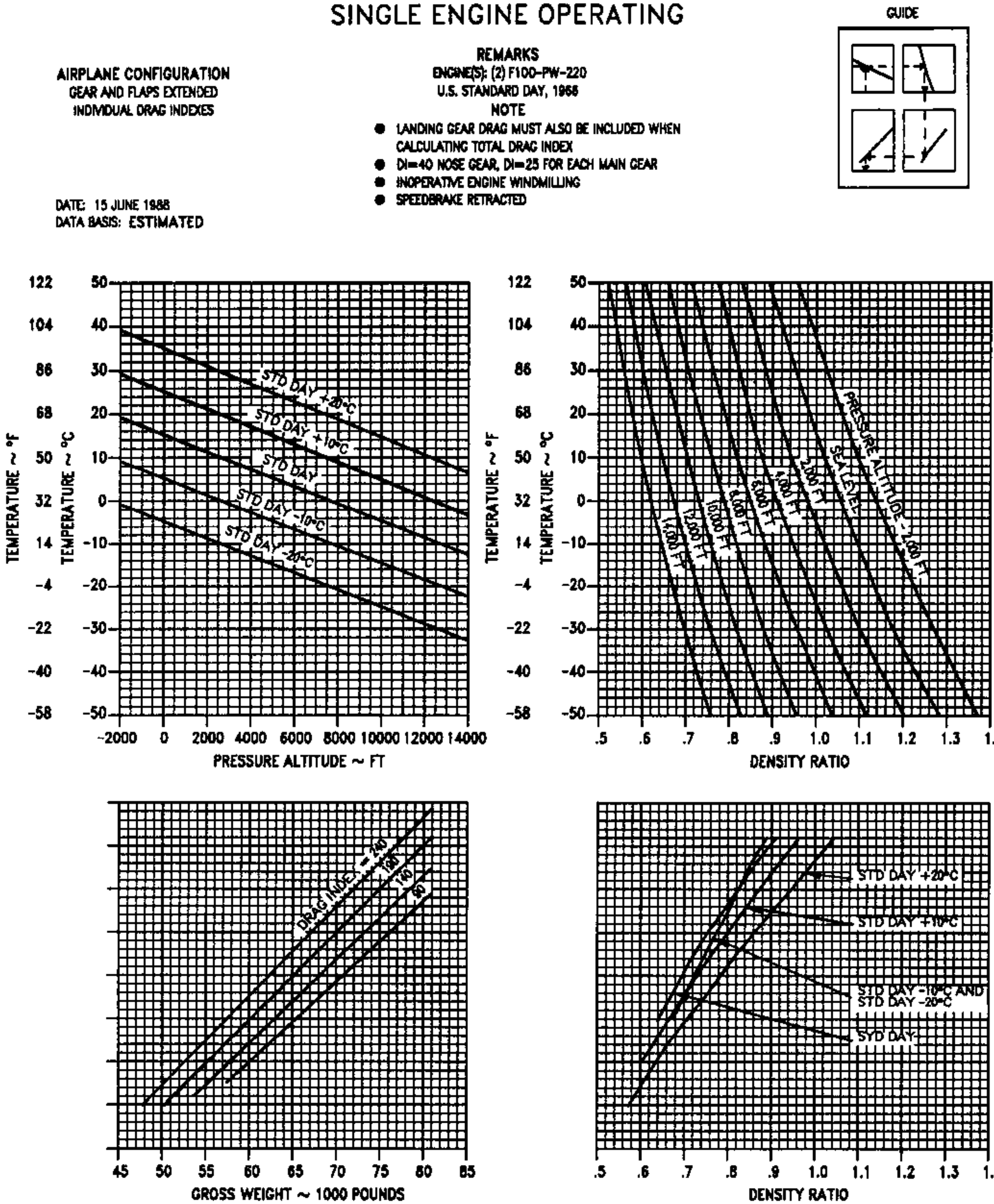


Figure A8-2

LANDING DISTANCE

WITH OR WITHOUT CFT
AERODYNAMIC BRAKING
IDLE THRUST
GROSS WEIGHT 35,000 TO 55,000 POUNDS

AIRPLANE CONFIGURATION
FLAPS DOWN GEAR DOWN
ALL DRAG INDEXES

REMARKS
ENGINE(S): (2) F100-PW-220

NOTE
- DATA IS BASED ON THE USE OF AERODYNAMIC BRAKING BY RAISING THE NOSE TO A 12° PITCH ATTITUDE AFTER TOUCHDOWN AND MAINTAINING AS LONG AS POSSIBLE.
- SPEED BRAKE IS EXTENDED AT TOUCHDOWN.

DATE: 15 JUNE 1988
DATA BASIS: ESTIMATED

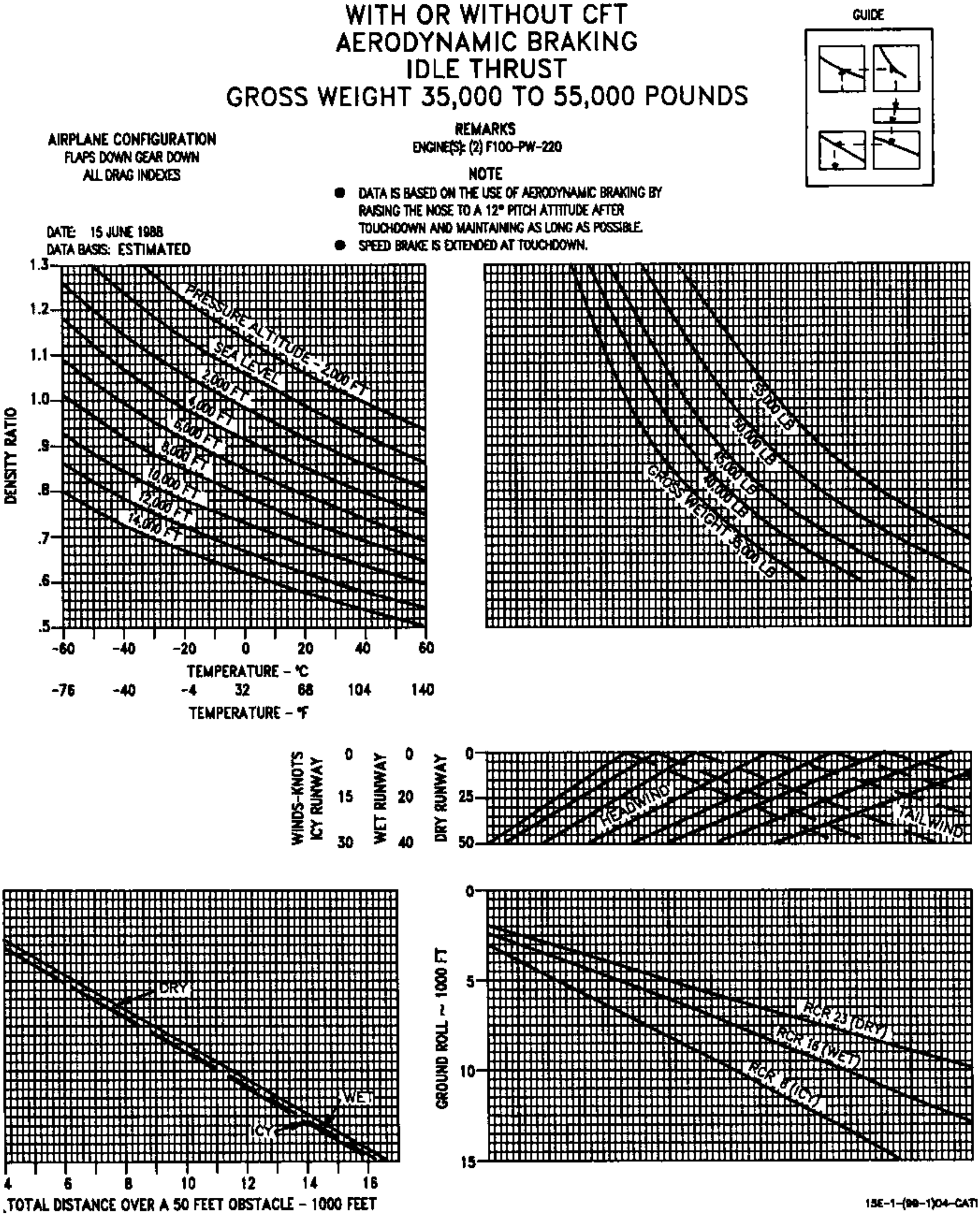


Figure A8-3

LANDING DISTANCE

WITH OR WITHOUT CFT
AERODYNAMIC BRAKING
IDLE THRUST
GROSS WEIGHT 55,000 TO 80,000 POUNDS

AIRPLANE CONFIGURATION
FLAPS DOWN
GEAR DOWN
ALL DRAG INDEXES

DATE: 15 JUNE 1988
DATA BASIS: ESTIMATED

REMARKS
ENGINE(S): (2) F100-PW-220

NOTE

- DATA IS BASED ON THE USE OF AERODYNAMIC BRAKING BY RAISING THE NOSE TO A 12° PITCH ATTITUDE AFTER TOUCHDOWN AND MAINTAINING AS LONG AS POSSIBLE.
- SPEED BRAKE IS EXTENDED AT TOUCHDOWN.

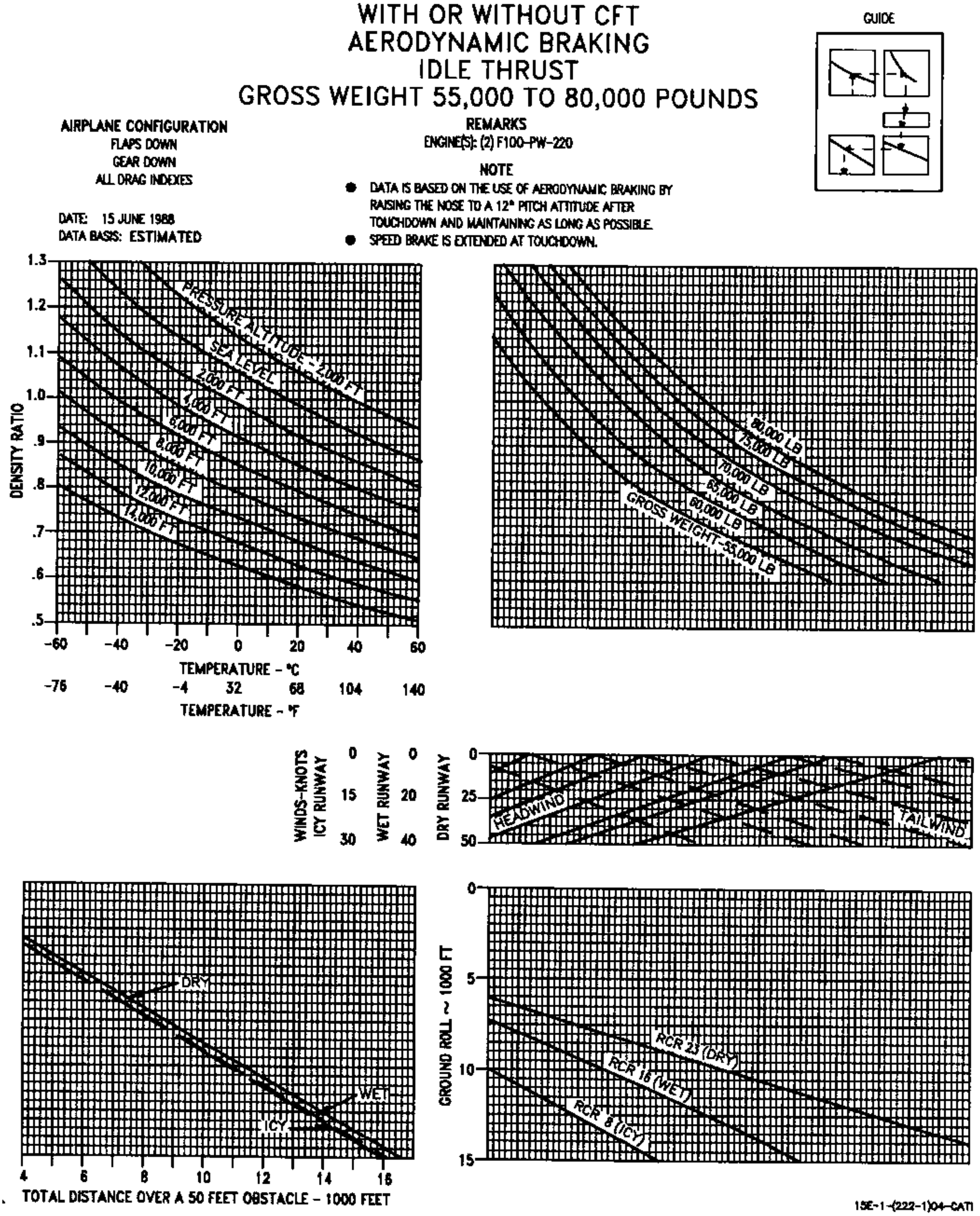


Figure A8-4

LANDING DISTANCE

WITH OR WITHOUT CFT
MAXIMUM ANTI-SKID BRAKING
IDLE THRUST

GUIDE

AIRPLANE CONFIGURATION
FLAPS DOWN GEAR DOWN
ALL DRAG INDEXES

DATE: 15 JUNE 1988
DATA BASIS: ESTIMATED

REMARKS
ENGINE(S): (2) F100-PW-220

NOTE

- DATA IS BASED ON LOWERING THE NOSE IMMEDIATELY AFTER TOUCHDOWN AND APPLYING MAXIMUM ANTI-SKID BRAKING.
- SPEED BRAKE IS EXTENDED AT TOUCHDOWN.

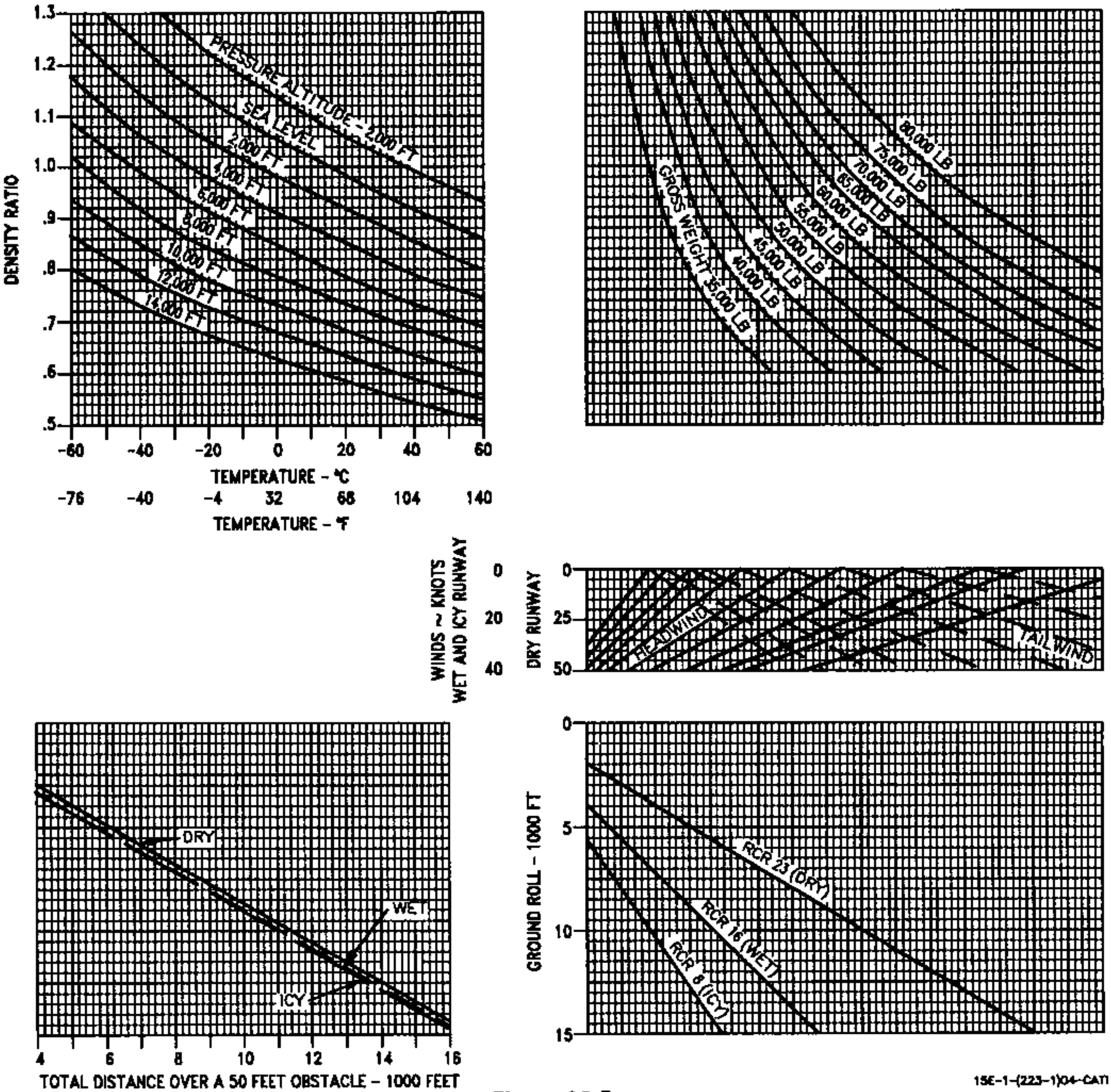


Figure A8-5

PART 9

COMBAT PERFORMANCE

TABLE OF CONTENTS

Charts

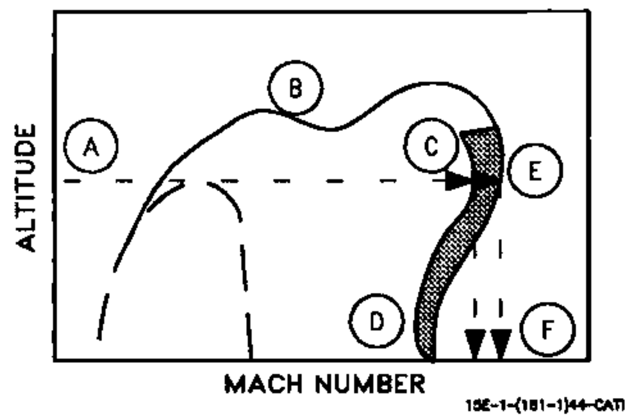
LEVEL FLIGHT ENVELOPE

These charts (figures A9-1 thru A9-14) present the aircraft level flight speed envelope for various configurations and average combat gross weights. Parameters of the envelopes extend from the maximum lift coefficient to maximum thrust Mach number at 0g acceleration throughout the altitude range. For each configuration, envelopes are presented for a standard day and standard day ±10°C. In addition to the maximum attainable Mach number at 0g acceleration, each standard day curve indicates Mach number at .03g acceleration. Figure A9-14 shows the relationship between maximum Mach number and Vmax for a selected configuration.

USE

Enter the chart with the desired combat altitude and project horizontally to intersect the applicable standard day .03g and 0g acceleration power curves. From these points, proceed vertically down to read the .03g Mach number and the maximum attainable Mach number in level flight.

SAMPLE LEVEL FLIGHT ENVELOPE



Sample Problem

Configuration: -4 CFT + (4) AIM-7 + (4) AIM-9; 52,500 Pounds Gross Weight.

A. Combat altitude	35,000 Ft
B. Curve	Std Day
C. .03g Acceleration Curve	
D. .03g Acceleration Mach number	1.44
E. 0g Acceleration curve	
F. 0g Acceleration Mach number	1.52

MAXIMUM SPEED-LEVEL FLIGHT

This chart (figure A9-15 and A9-16) presents level flight maximum speed at military power for drag indexes from 0 to 160 for gross weight with 50% internal fuel remaining. The maximum speeds are listed by Mach/KCAS at 0g acceleration and 0.03g (0.5 knots per second) acceleration for various altitudes. For a given altitude, maximum speeds are provided for standard temperature, and ten degrees above and below standard temperature.

USE

Enter chart at nearest computed drag index and read maximum speeds for 0g and 0.03g accelerations at selected altitude with applicable temperature. For most accurate results, use standard interpolation techniques to determine maximum speeds.

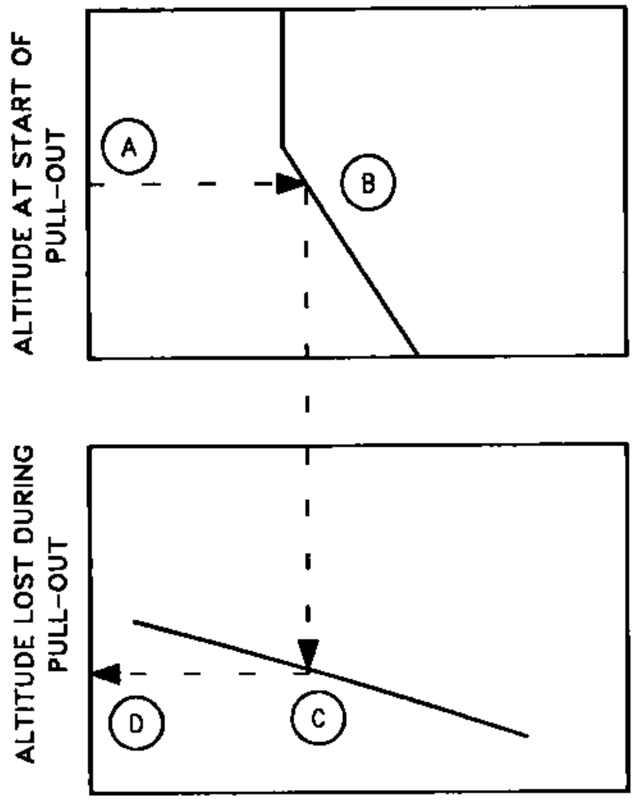
Sample Problem

A. Drag index	40
B. Altitude	30,000 Ft
C. Temperature	-44.4°C
D. Maximum speed - 0g KCAS	0.99 Mach/383
E. Maximum speed - 0.03g KCAS	0.96Mach/374

DIVE RECOVERY CHARTS

These charts, (figures A9-17 thru A9-19) present the airplanes dive recovery capability for various speeds (subsonic and supersonic), altitudes, and dive angles. The supersonic chart (figure A9-18) includes airplane structural limit curves to determine the maximum dive angle that can be achieved without exceeding the structural limit speed during dive recovery. Figure A9-20 (Sheet 1) presents emergency pullout data for gross weights of 40,000 to 45,000 pounds for dive angles of 30°, 60° and 90°using full aft stick or 12g's (below 350 KCAS) or 10.3g's (above 350 KCAS) to wing rock with power settings of maximum afterburner below initial airspeeds of 350 knots or idle power above 350 KCAS. Figure A9-20 (Sheet 2) presents emergency pullout data for gross weights of 50,000 to 55,000 pounds. The low speed recovery procedure is the same as for the low gross weight chart, but the procedures for above 500 KCAS are somewhat different. Between 350 KCAS and 500 KCAS, idle power is selected immediately while at the same time applying full aft stick or 10g's to wing rock. At airspeeds above 500 KCAS, idle power is selected immediately while at the same time applying 8g's. Figure A9-20 (Sheets 3 and 4) present emergency pullout data for gross weights of 65,000 and 70,000 pounds. The low speed recovery procedure is the same as for the low gross weight chart, but the procedures for above 500 KCAS are somewhat different. Between 350 KCAS and 500 KCAS, idle power is selected immediately while at the same time applying full aft stick or 8.7g's (at 65,000 pounds) or 8g's (at 70,000 pounds) to wing rock. At airspeeds above 500 KCAS, idle power is selected immediately while at the same time applying 6.8g's (at 65,000 pounds) or 6.3g's (at 70,000 pounds) to wing rock. An important procedural difference to note for the heavier gross weight emergency pullout is the CAS should be ON.

SAMPLE DIVE RECOVERY



15E-1-(236-1)44-CATI

USE

Enter the applicable chart with the altitude at the start of the pullout and project horizontally right to intersect the curve for the Mach number at the start of the pullout. From this point, project vertically down to intersect the dive angle at the start of pullout, then horizontally left to read altitude lost during pullout.

Sample Problem

Configuration: (4) AIM-9 Launchers; Supersonic

A. Altitude at start of pull out	40,000 Ft
B. Mach number at start of pullout	1.5
C. Dive angle at start of pullout	70°
D. Altitude loss during pull-out	11,800 Ft

LOW ALTITUDE COMBAT PERFORMANCE CHART

This table (figure A9-21) presents specific fuel flow values (pounds per minute) for maximum thrust operation at constant calibrated airspeeds of 300, 400, 500, 600, and 700 knots. The data are for altitudes of sea level, 5000 and 10,000 feet. Fuel flow values are computed for U.S. Standard Day; however, correction factors are given for nonstandard day temperatures. The standard day temperature is listed with the altitude. If the actual temperature at a particular altitude differs from the standard day temperature, refer to the TEMP. EFFECTS column to determine the appropriate temperature correction factor.

USE

Enter the table with the desired altitude and calibrated airspeed and project horizontally right to the specific fuel flow column to read specific fuel flow for a standard day. To obtain the specific fuel flow for a nonstandard day, mulitply the specific fuel flow for a standard day by the nonstandard day temperature correction factor obtained from the TEMP. EFFECTS column.

Sample Problem

A. Desired altitude	**5000 Ft**
B. Desired constant airspeed	600 KCAS
C. Specific fuel flow for a standard day	2113 Lb/Min
D. Nonstandard day temperature	0°C
E. Nonstandard day temperature correction factor	1.03
F. Nonstandard day specific fuel flow (C X E)	2176 Lb/Min

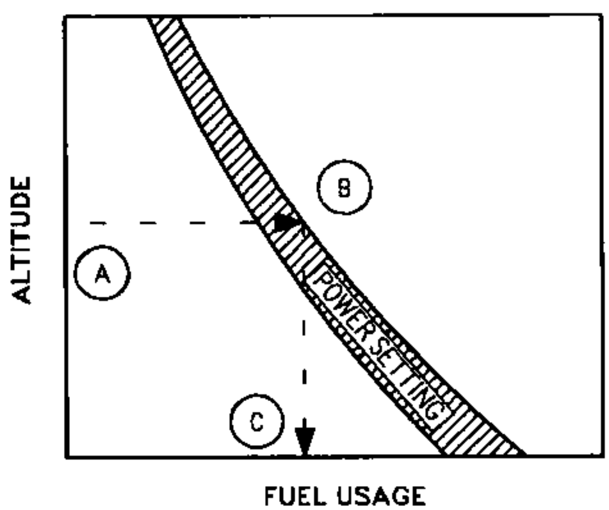
COMBAT FUEL MANAGEMENT CHART

This chart (figure A9-22) presents a relative comparison between engine power setting and fuel usage in pounds per minute. The chart emphasizes the effect of power setting on combat fuel management. Data presented are for engine power settings of military power, mid-range afterburner and maximum afterburner at altitudes from sea level to 40,000 feet and airspeeds between Mach 0.8 and Mach 1.1.

USE

Enter the chart at the desired altitude and project horizontally right to the selected Mach/engine power setting. From this point project vertically down to read fuel usage in pounds per minute.

SAMPLE COMBAT FUEL MANAGEMENT



15E-1-(237-1)44-CATI

Sample Problem

A. Desired altitude	25,000 Ft
B. Mach/power setting	0.9/Max AB
C. Fuel usage	1020 PPM

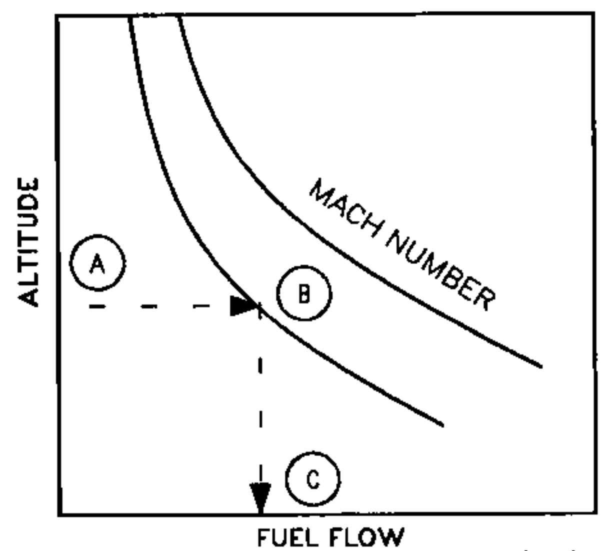
COMBAT FUEL FLOW CHART

These charts (figures A9-23 thru A9-27) present a relative comparison between high airspeeds at stabilized level flight and fuel flow in pounds per minute. Data presented are for two non-CFT configurations and seven CFT configurations, based on F100-PW-220 engines.

USE

Enter the chart at the desired altitude and project horizontally right to the selected Mach number curve. From this point project vertically down to read fuel flow in pounds per minute.

SAMPLE COMBAT FUEL FLOW



15E-1-(238-1)44-CATI

Sample Problem

Configuration: -4 CFT + (4) AIM-7 + (4) AIM-9

A. Desired altitude	30,000 Ft
B. Mach number	1.1
C. Fuel flow	660 PPM

OVERLOAD WARNING SYSTEM SYMMETRICAL ALLOWABLE LOAD FACTOR CHARTS

These charts (Figures A9-28 thru A9-39) present the overload warning system symmetrical allowable load factor capability for various Mach numbers, altitudes, and airplane gross weights.

USE

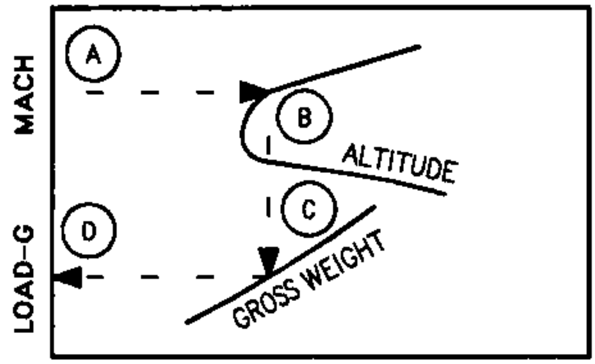
Enter the chart (Figures A9-28 or A9-29) with the desired Mach number and project horizontally to the desired altitude. From this point, descend vertically to the applicable gross weight then project horizontally left to read the airplane symmetrical allowable load factor given by OWS. When CFT's are installed, enter the applicable CFT/Aircraft interface charts based on CFT fuel quantity (Figures A9-28 thru A9-37) with the desired Mach number and project horizontally to the desired altitude. From this point, descend vertically to the applicable aircraft gross weight, then project horizontally left to read the CFT/airplane symmetrical allowable load factor. The combined allowable load factor is the less of the two (airplane and CFT/airplane interface).

Sample Problem

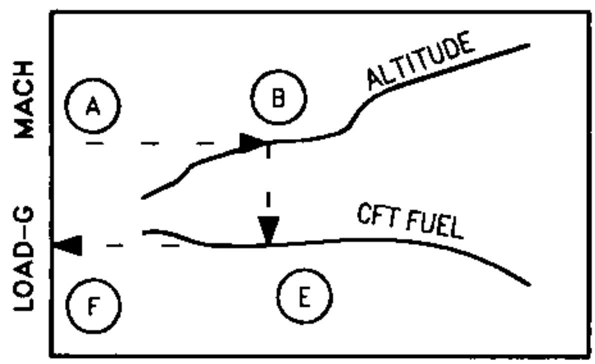
Configuration: Full CFTS

A. Mach number	0.8
B. Altitude	Sea Level
C. Gross Weight	45,000 Lb
D. Airplane Symmetrical Load Factor	8.6 g
E. CFT fuel/CFT	4875 Lb
F. CFT/Airplane interface symmetrical allowable load factor	8.0 g
G. Combined Symmetrical allowable load factor	8.0 g

SAMPLE OVERLOAD WARNING SYSTEM SYMMETRICAL ALLOWABLE LOAD FACTORS



WITHOUT CFT'S



CFT/AIRPLANE INTERFACE

15E-1-(266-1)44-CATI

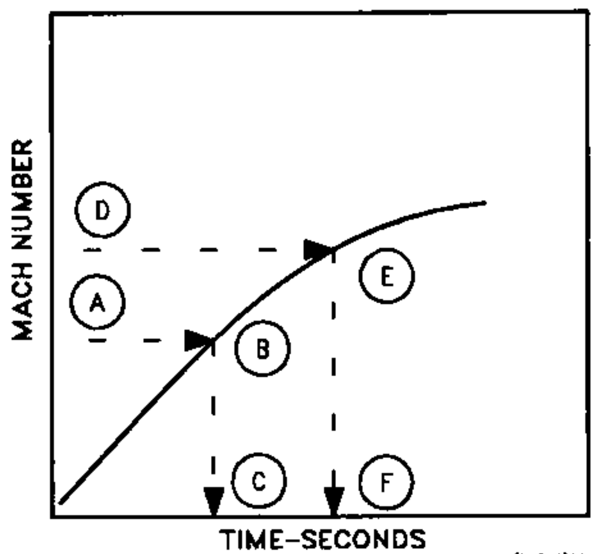
LEVEL FLIGHT ACCELERATION CHARTS

These charts (figures A9-40 thru A9-48) are used to determine time to accelerate in level flight between two Mach numbers. The curves are presented for various configurations with initial gross weights. Each chart shows maximum and military thrust accelerations at 10,000 feet and maximum thrust acceleration at 40,000 feet. The curves are presented for a standard day and standard day ±10°C. The origin for each curve is 250 KCAS and .03g acceleration points are indicated on each curve.

USE

Enter applicable configuration chart with initial Mach number and altitude, and project horizontally to appropriate thrust/standard day curve. Project vertically down to initial Mach time reference. Enter chart again with final Mach number, project horizontally to the same curve, and project vertically down to the final Mach time reference. To determine time to accelerate, subtract initial Mach number time reference from final Mach number time reference.

SAMPLE LEVEL FLIGHT ACCELERATION



15E-1-(240-1)44-CATI

Sample Problem

Configruation: -4 CFT + (4) AIM-7 + (40 AIM-9; 58,100 Pounds Initial Gross Weight: Maximum Thrust, Altitude 10,000 Feet.

A. Initial Mach number	0.8 Mach
B. Maximum thrust/ standard day curve	STD −10° C
C. Initial Mach number time reference	21 Seconds
D. Final Mach number	0.9 Mach
E. Maximum thrust/ standard day curve	STD −10° C
F. Final Mach number time reference	27 Seconds
G. Time to accelerate (F. minus C.)	6 Seconds

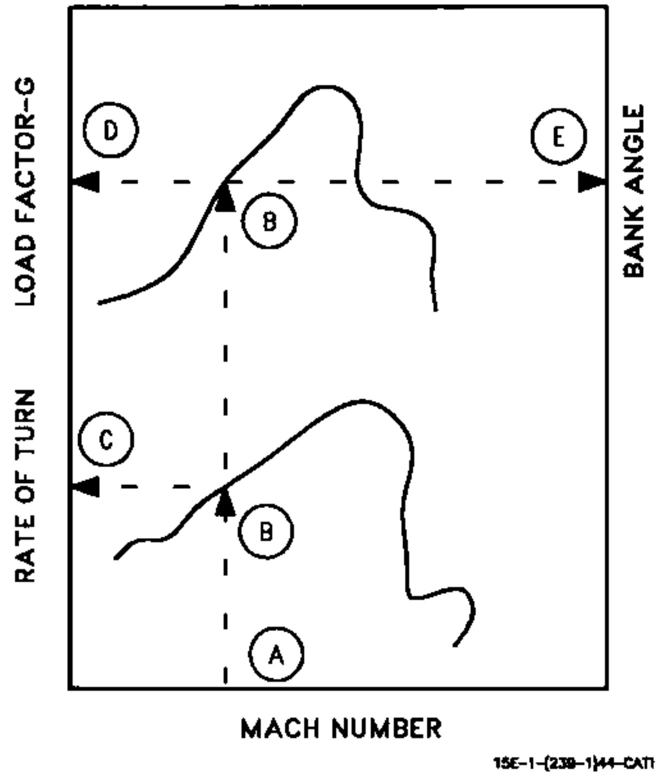
SUSTAINED LEVEL TURNS

These charts (figures A9-49 thru A9-57) present the maximum sustained level rate of turn and corresponding maximum sustained load factor for a given Mach number and altitude. The charts are based on maximum thrust for various aircraft configurations. Bank angles are shown for corresponding load factors, and a formula is provided to calculate radius of turn.

USE

Enter chart with Mach number and project vertically up to applicable rate of turn and load factor altitude curves. Project horizontally left from rate of turn altitude curve to maximum sustained rate of turn. Project horizontally left from load factor altitude curve to the maximum sustained load factor corresponding to the maximum sustainable turn rate. Project horizontally right from the load factor altitude curve to bank angle corresponding to the maximum sustained load factor.

SAMPLE SUSTAINED LEVEL TURNS



Sample Problem

Configuration: -4 CFT + (4) AIM-7 + (4) AIM-9
52,500 Pounds Gross Weight

A. Mach number	0.9
B. Altitude	40,000 Ft
C. Maximum sustained turn rate	2.9°/SEC
D. Maximum sustained load factor	1.7g
E. Bank angle	53°

LEVEL FLIGHT ENVELOPE

GROSS WEIGHT – 39,500 POUNDS
MAXIMUM THRUST

AIRPLANE CONFIGURATION
CLEAN AIRPLANE

REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

NOTE
CAPABILITY REMAINING: MAXIMUM SPEEDS, ACCELERATION OF 0 AND 0.03g; CEILINGS AND LOW SPEED, RATE OF CLIMB OF 500 FEET PER MINUTE. a/g = 0.03 REPRESENTS AN ACCELERATION OF 0.5 KNOTS/SEC

DATE: 15 APRIL 1990
DATA BASIS: FLIGHT TEST

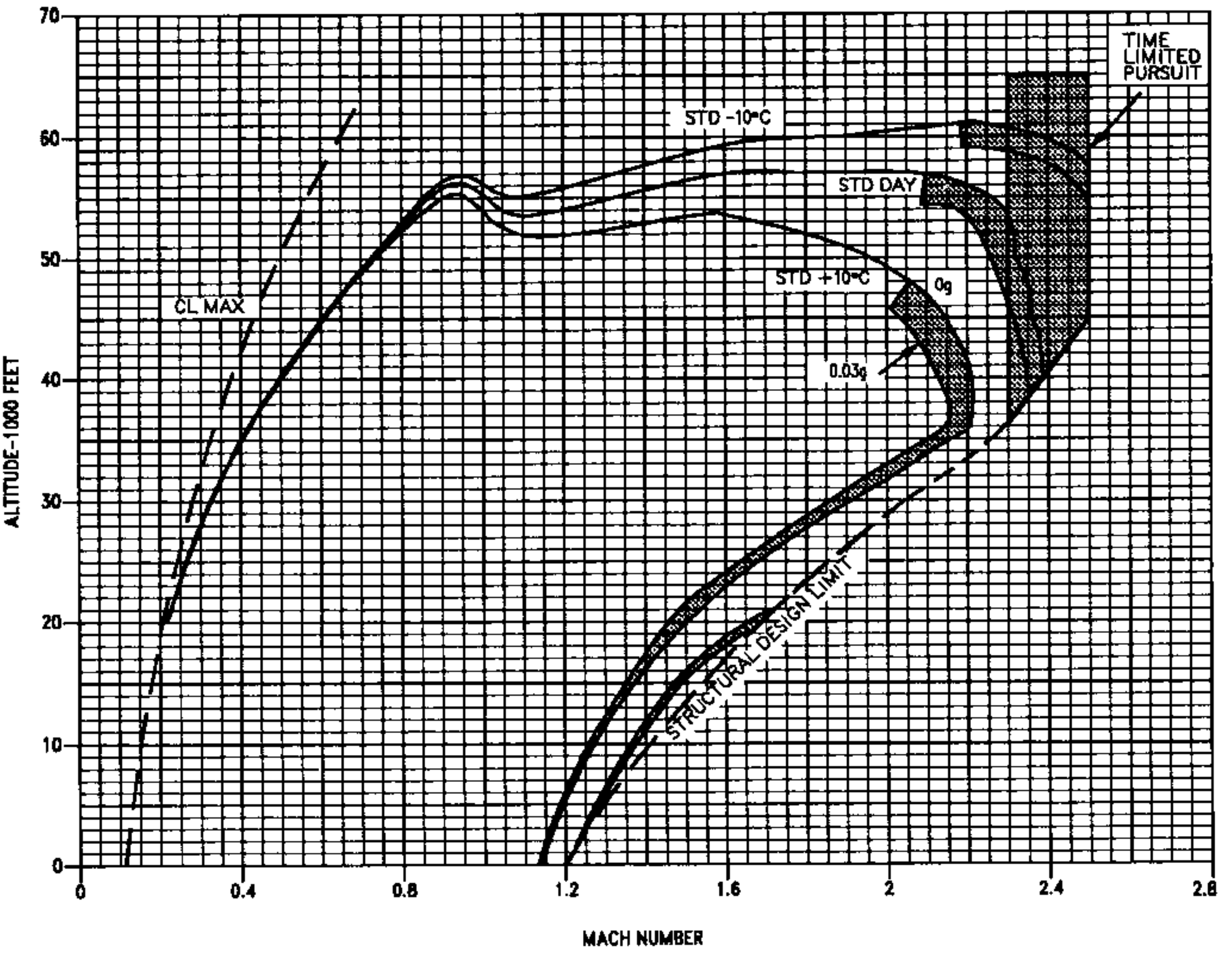


Figure A9-1

LEVEL FLIGHT ENVELOPE

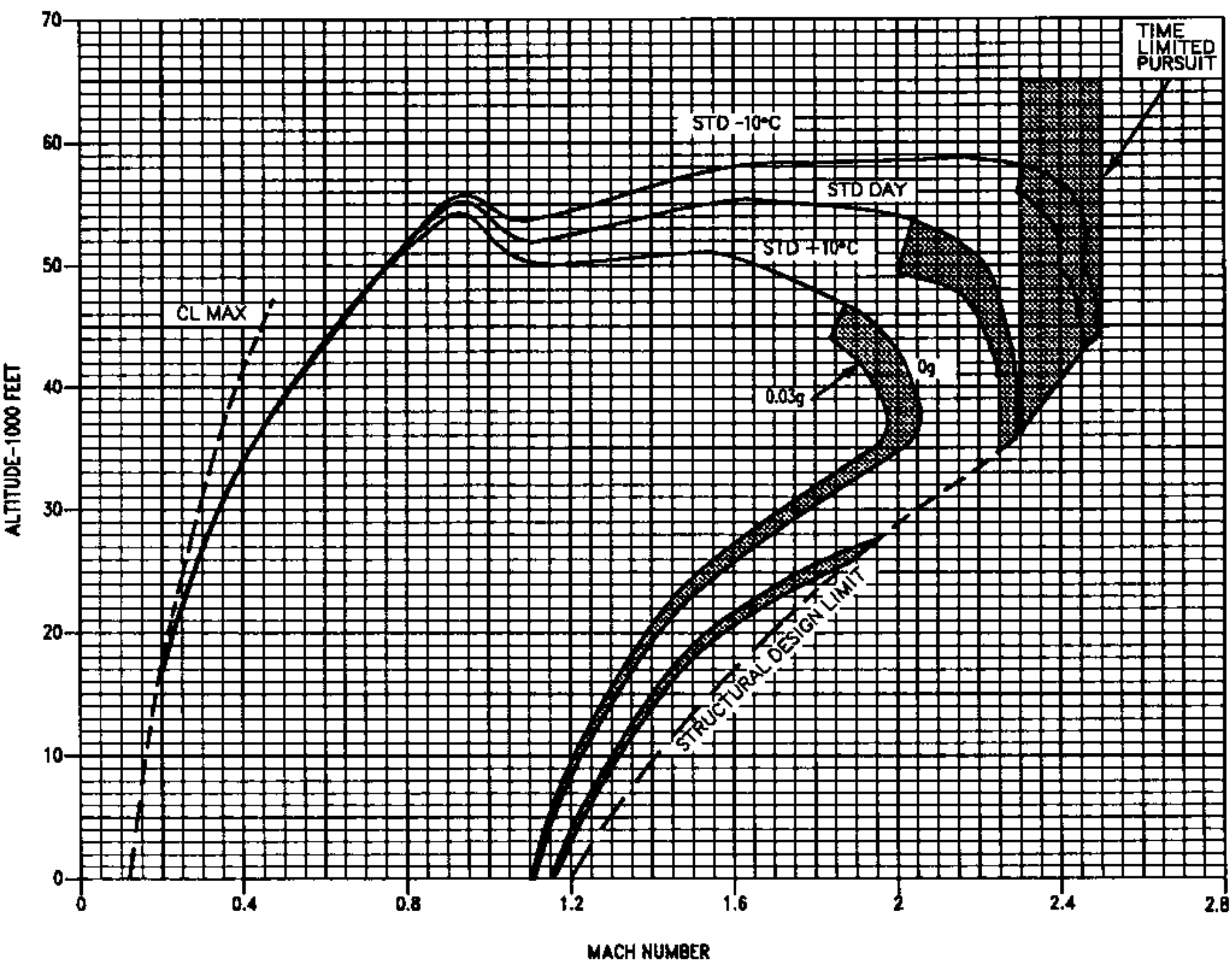
GROSS WEIGHT – 41,500 POUNDS
MAXIMUM THRUST

AIRPLANE CONFIGURATION
(4)AIM-7

REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

NOTE
CAPABILITY REMAINING: MAXIMUM SPEEDS, ACCELERATION OF 0 AND 0.03g; CEILINGS AND LOW SPEED, RATE OF CLIMB OF 500 FEET PER MINUTE. a/g = 0.03 REPRESENTS AN ACCELERATION OF 0.5 KNOTS/SEC

DATE:15 APRIL 1990
DATA BASIS: FLIGHT TEST



15E-1-(135-1)18-CATI

Figure A9-2

LEVEL FLIGHT ENVELOPE

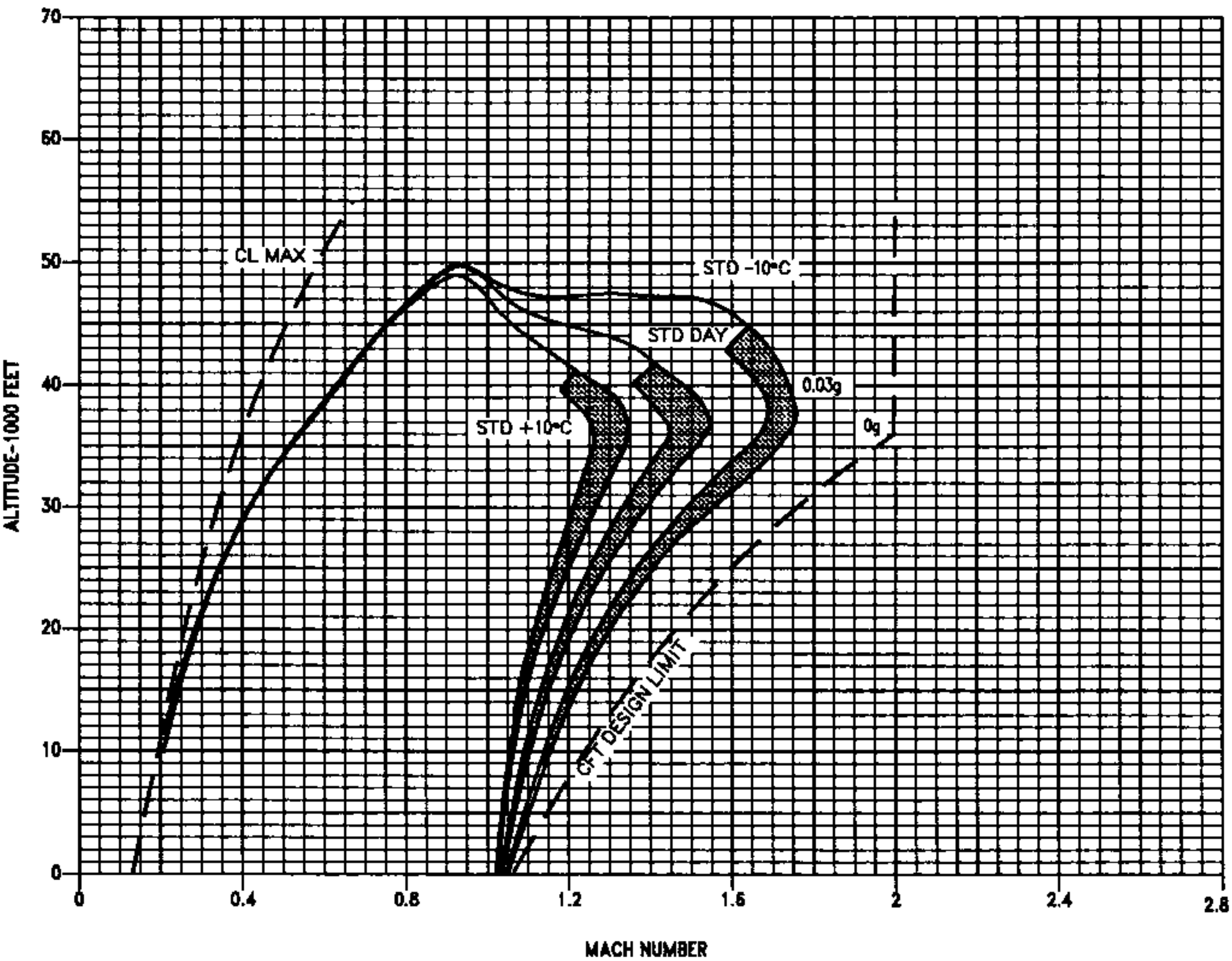
GROSS WEIGHT – 52,500 POUNDS
MAXIMUM THRUST

AIRPLANE CONFIGURATION
-4CFT, (4)AIM-9, (4)AIM-7

REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

NOTE
CAPABILITY REMAINING: MAXIMUM SPEEDS, ACCELERATION OF 0 AND 0.03g; CEILINGS AND LOW SPEED, RATE OF CLIMB OF 500 FEET PER MINUTE. a/g = 0.03 REPRESENTS AN ACCELERATION OF 0.5 KNOTS/SEC

DATE: 15 APRIL 1990
DATA BASIS: (STORES) ESTIMATED
(AIRCRAFT/CFT) FLIGHT TEST



15E-1-(136-1)16-CATI

Figure A9-3

LEVEL FLIGHT ENVELOPE

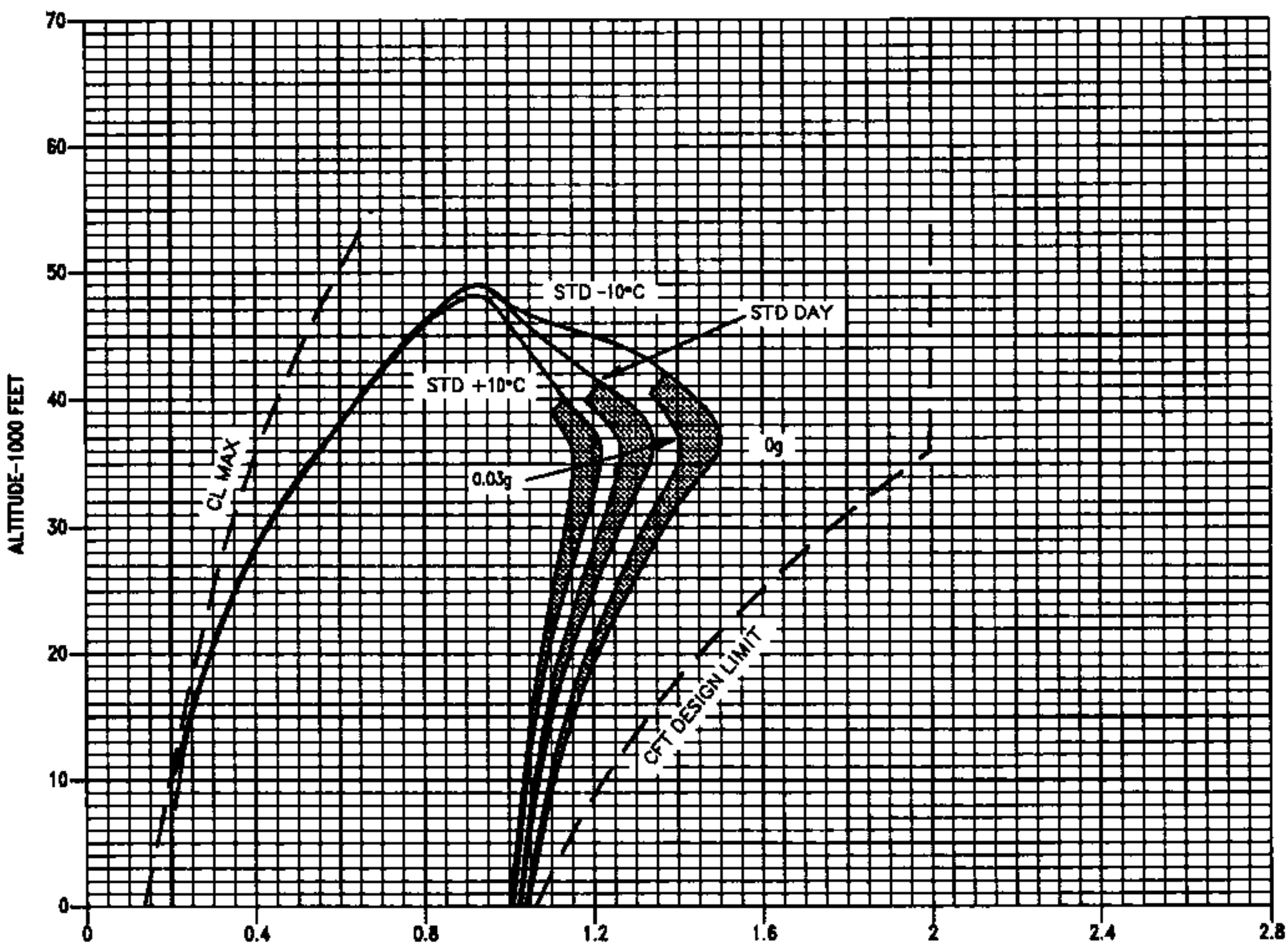
GROSS WEIGHT – 53,700 POUNDS
MAXIMUM THRUST

AIRPLANE CONFIGURATION
-4CFT, LANTIRN, (4)AIM-9,
(4)AIM-7

REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

NOTE
CAPABILITY REMAINING: MAXIMUM SPEEDS, ACCELERATION OF 0 AND 0.03g; CEILINGS AND LOW SPEED, RATE OF CLIMB OF 500 FEET PER MINUTE. a/g = 0.03 REPRESENTS AN ACCELERATION OF 0.5 KNOTS/SEC

DATE: 15 APRIL 1990
DATA BASIS: (STORES) ESTIMATED
(AIRCRAFT/CFT) FLIGHT TEST



15E-1-(137-1)16-CATI

Figure A9-4

LEVEL FLIGHT ENVELOPE

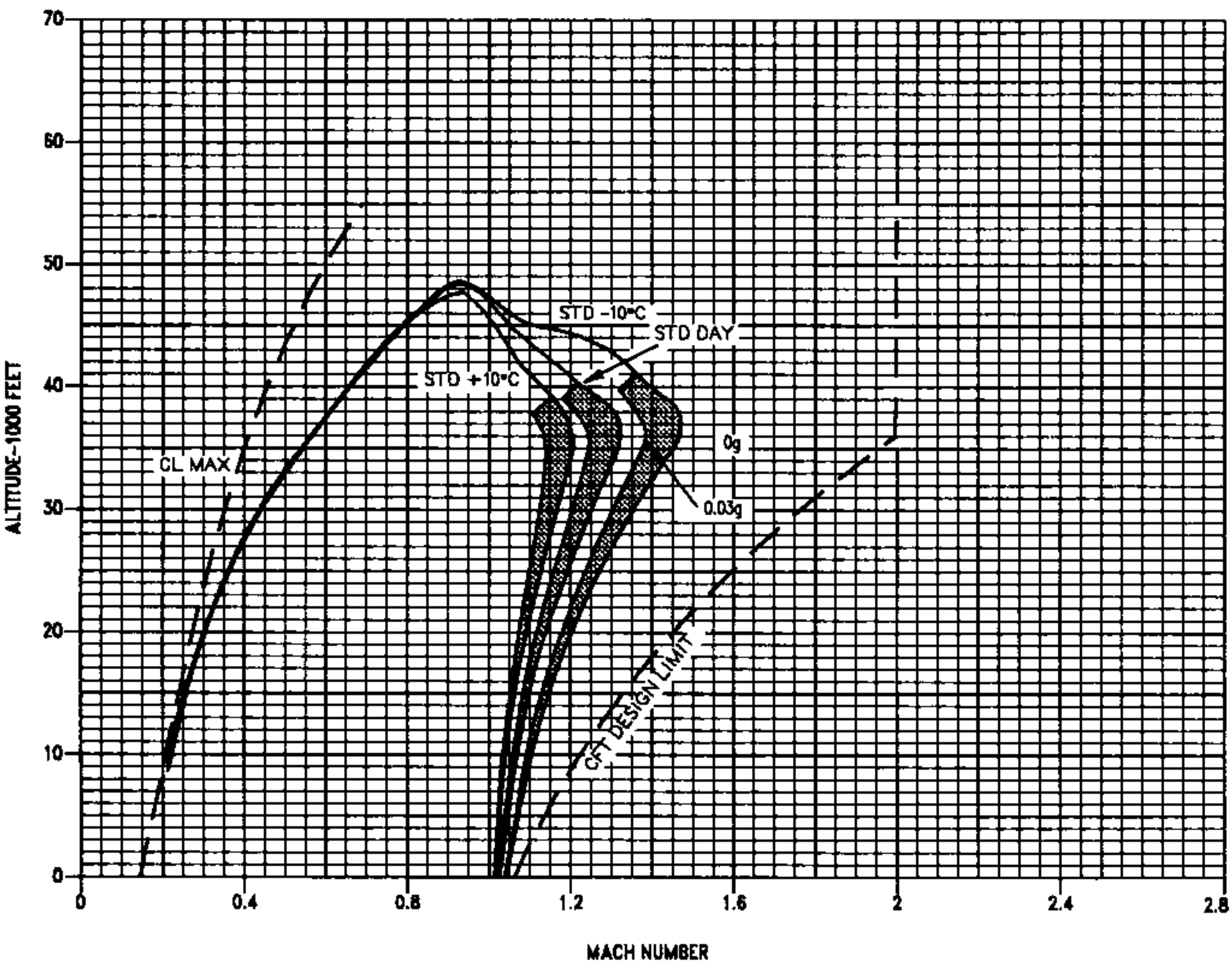
GROSS WEIGHT – 55,600 POUNDS
MAXIMUM THRUST

AIRPLANE CONFIGURATION
-4CFT, LANTIRN, (4)AIM-9,
(2)MK-84

REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

NOTE
CAPABILITY REMAINING: MAXIMUM SPEEDS, ACCELERATION OF 0 AND 0.03g, CEILINGS AND LOW SPEED, RATE OF CLIMB OF 500 FEET PER MINUTE. a/g = 0.03 REPRESENTS AN ACCELERATION OF 0.5 KNOTS/SEC.

DATE: 15 APRIL 1990
DATA BASIS: (STORES) ESTIMATED
(AIRCRAFT/CFT) FLIGHT TEST



15E-1-(138-1)16-CATI

Figure A9-5

LEVEL FLIGHT ENVELOPE

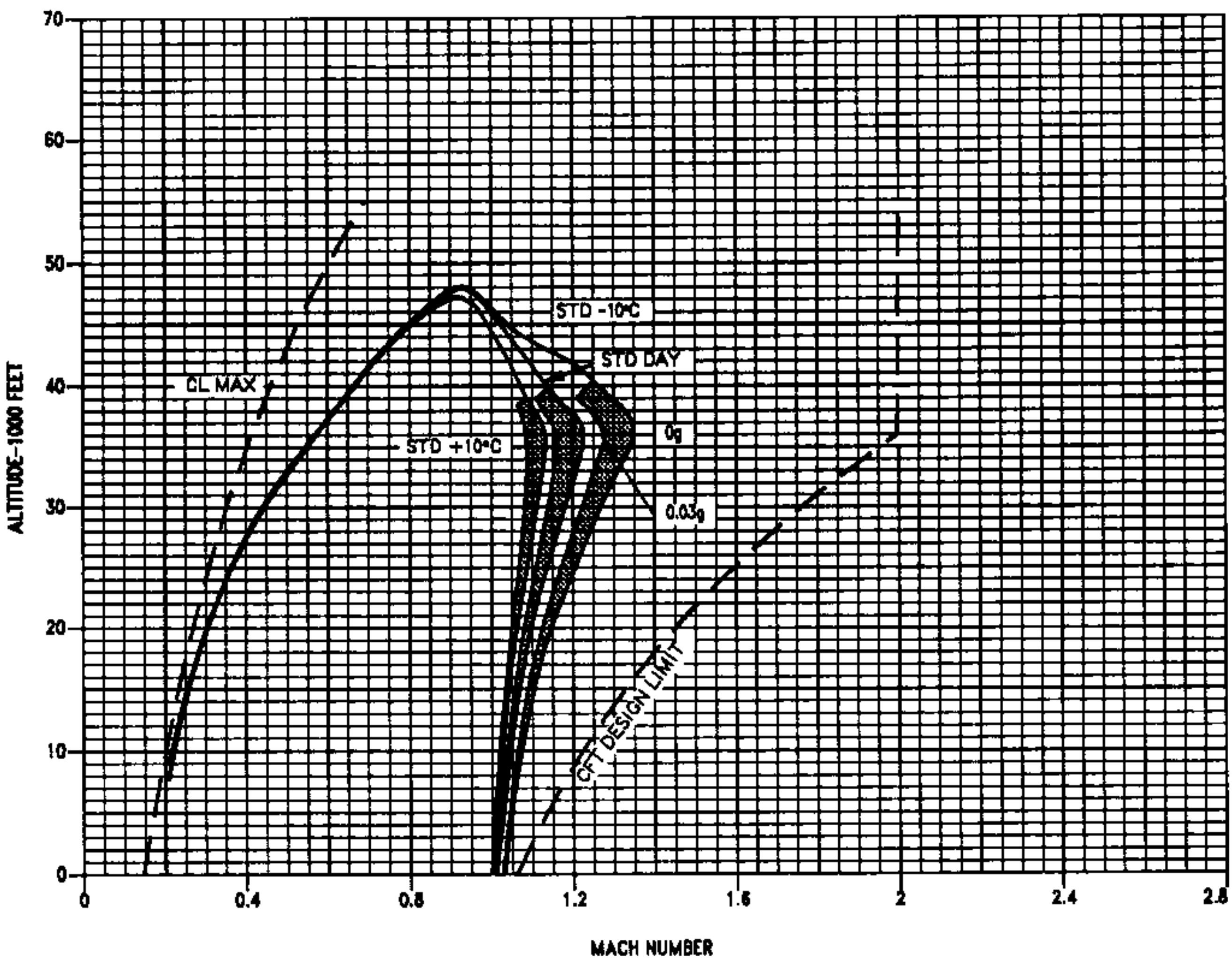
GROSS WEIGHT – 55,900 POUNDS
MAXIMUM THRUST

AIRPLANE CONFIGURATION
-4CFT, LANTIRN, (4)AIM-9,
(6)CBU-89

REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

NOTE
CAPABILITY REMAINING: MAXIMUM SPEEDS, ACCELERATION OF 0 AND 0.03g; CEILINGS AND LOW SPEED, RATE OF CLIMB OF 500 FEET PER MINUTE. a/g = 0.03 REPRESENTS AN ACCELERATION OF 0.5 KNOTS/SEC

DATE: 15 APRIL 1990
DATA BASIS: (STORES) ESTIMATED
(AIRCRAFT/CFT) FLIGHT TEST



15E-1-(159-1)10-CATI

Figure A9-6

LEVEL FLIGHT ENVELOPE

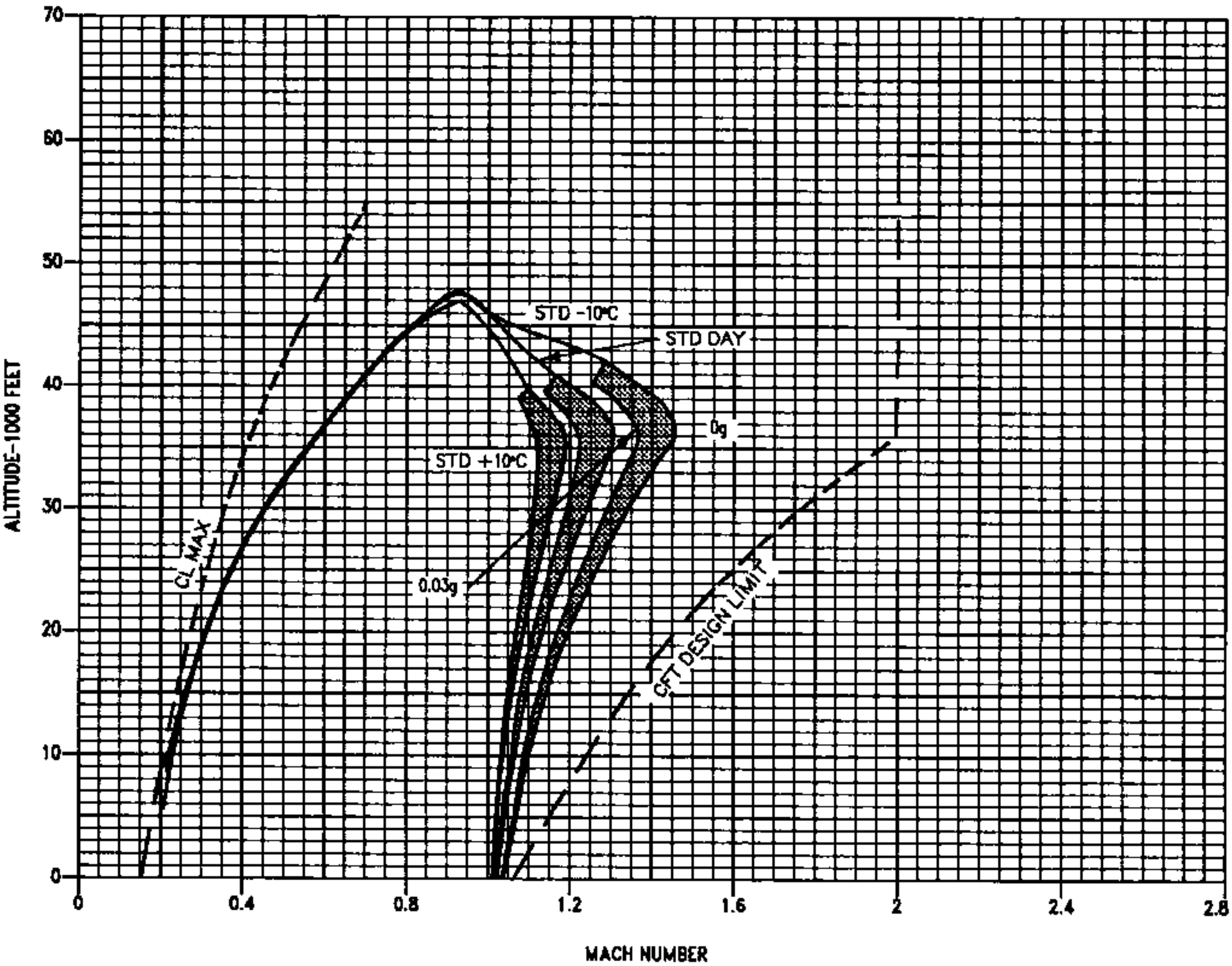
GROSS WEIGHT – 57,700 POUNDS
MAXIMUM THRUST

AIRPLANE CONFIGURATION
–4CFT, LANTIRN, (4)AIM-9,
(12)MK-82

REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

NOTE
CAPABILITY REMAINING: MAXIMUM SPEEDS, ACCELERATION OF 0 AND 0.03g; CEILINGS AND LOW SPEED, RATE OF CLIMB OF 500 FEET PER MINUTE. a/g = 0.03 REPRESENTS AN ACCELERATION OF 0.5 KNOTS/SEC

DATE:15 APRIL 1990
DATA BASIS: (STORES) ESTIMATED
(AIRCRAFT/CFT) FLIGHT TEST



15E-1-(171-1)16-CATI

Figure A9-7

LEVEL FLIGHT ENVELOPE

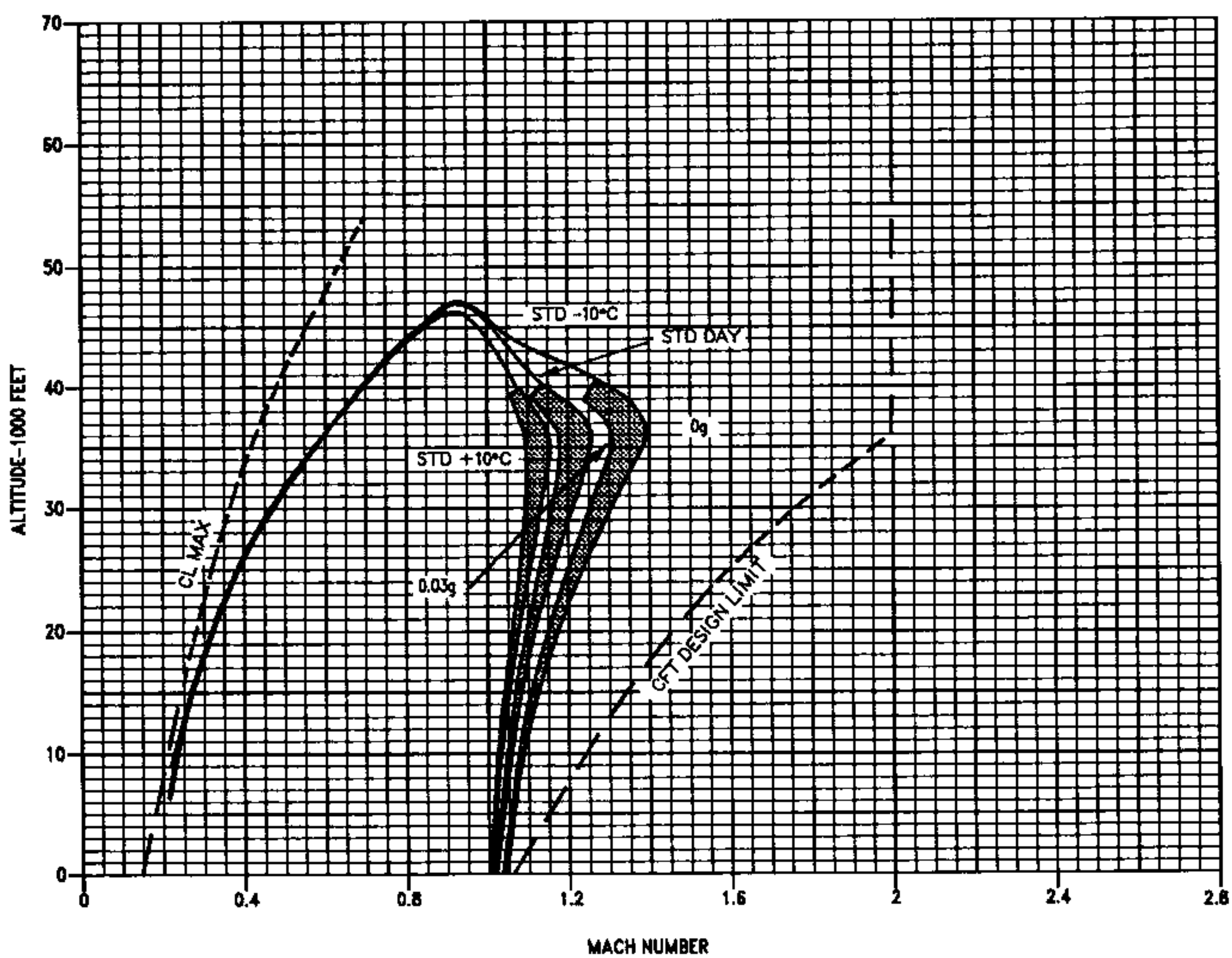
GROSS WEIGHT – 59,500 POUNDS
MAXIMUM THRUST

AIRPLANE CONFIGURATION
-4CFT, LANTIRN, (4)AIM-9,
(4)MK-84

REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

NOTE
CAPABILITY REMAINING: MAXIMUM SPEEDS, ACCELERATION OF 0 AND 0.03g; CEILINGS AND LOW SPEED, RATE OF CLIMB OF 500 FEET PER MINUTE. a/g = 0.03 REPRESENTS AN ACCELERATION OF 0.5 KNOTS/SEC

DATE: 15 APRIL 1990
DATA BASIS: (STORES) ESTIMATED
(AIRCRAFT/CFT) FLIGHT TEST



15E-1-(172-1)16-CATI

Figure A9-8

LEVEL FLIGHT ENVELOPE

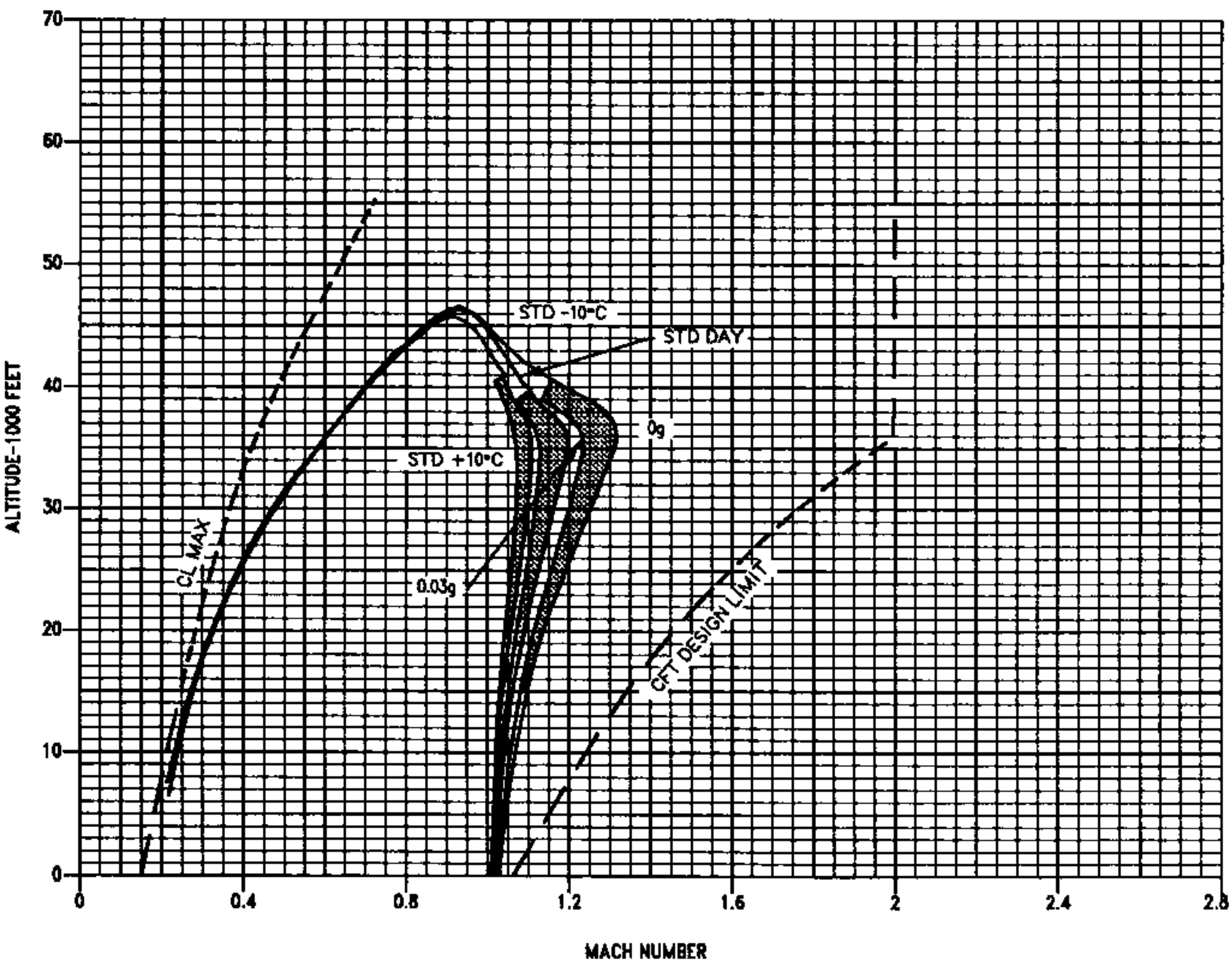
GROSS WEIGHT – 60,300 POUNDS
MAXIMUM THRUST

AIRPLANE CONFIGURATION
-4CFT, LANTIRN, CL TANK,
(4)AIM-9, (12)MK-82

REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

NOTE
CAPABILITY REMAINING: MAXIMUM SPEEDS, ACCELERATION OF 0 AND 0.03g; CEILINGS AND LOW SPEED, RATE OF CLIMB OF 500 FEET PER MINUTE. a/g = 0.03 REPRESENTS AN ACCELERATION OF 0.5 KNOTS/SEC

DATE:15 APRIL 1990
DATA BASIS: (STORES) ESTIMATED
(AIRCRAFT/CFT) FLIGHT TEST



15E-1-(173-1)16-CATI

Figure A9-9

LEVEL FLIGHT ENVELOPE

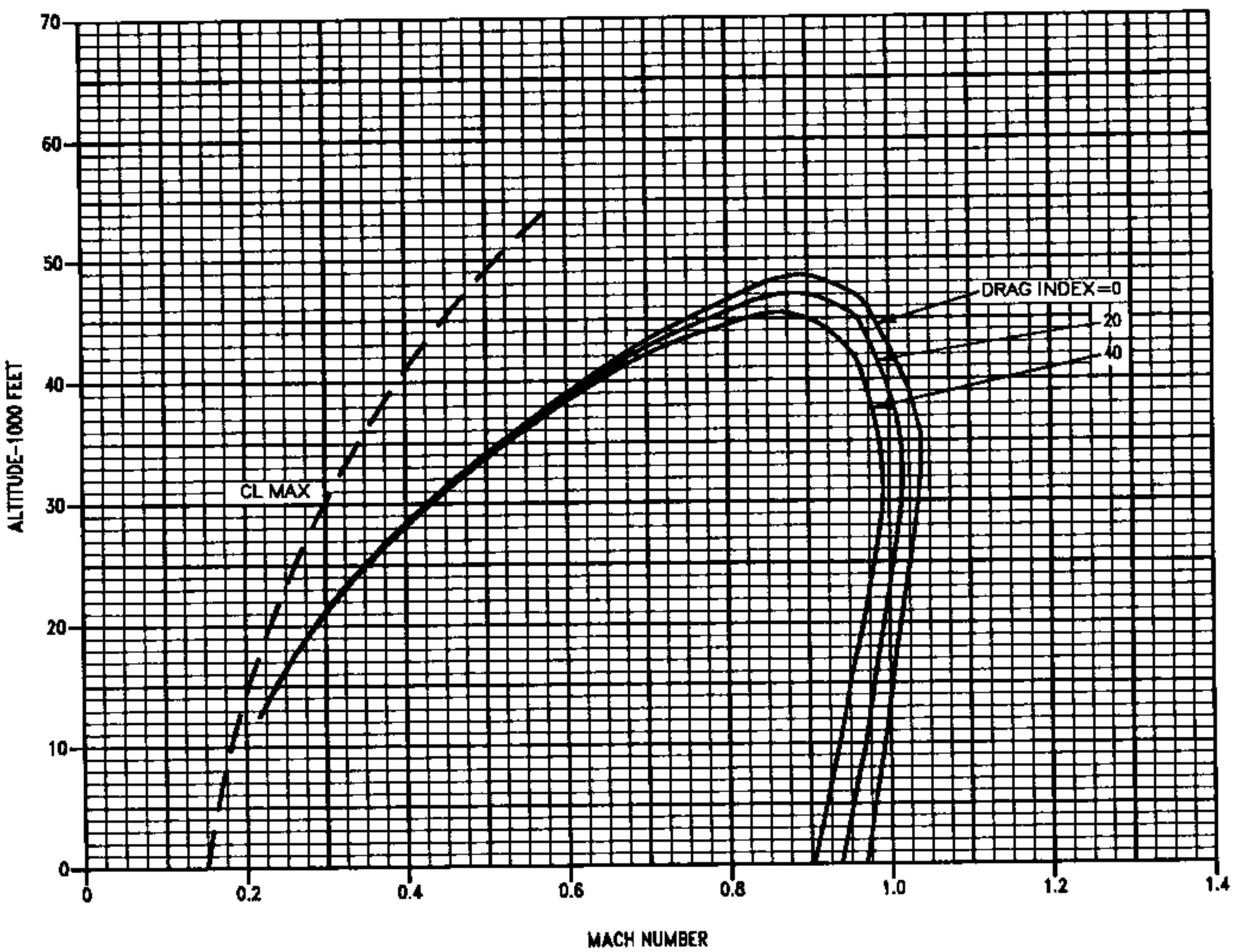
MILITARY THRUST
GROSS WEIGHT – 40,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

DATE:15 JUNE 1986
DATA BASIS: ESTIMATED

REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

NOTE
- CAPABILITY REMAINING: MAXIMUM SPEEDS, ACCELERATION OF 0g; CEILINGS AND LOW SPEED, RATE OF CLIMB OF 500 FEET PER MINUTE.
- CFT DRAG MUST BE INCLUDED WHEN TOTAL DRAG INDEX IS CALCULATED.



15E-1-(242-1)04-CATI

Figure A9-10

LEVEL FLIGHT ENVELOPE

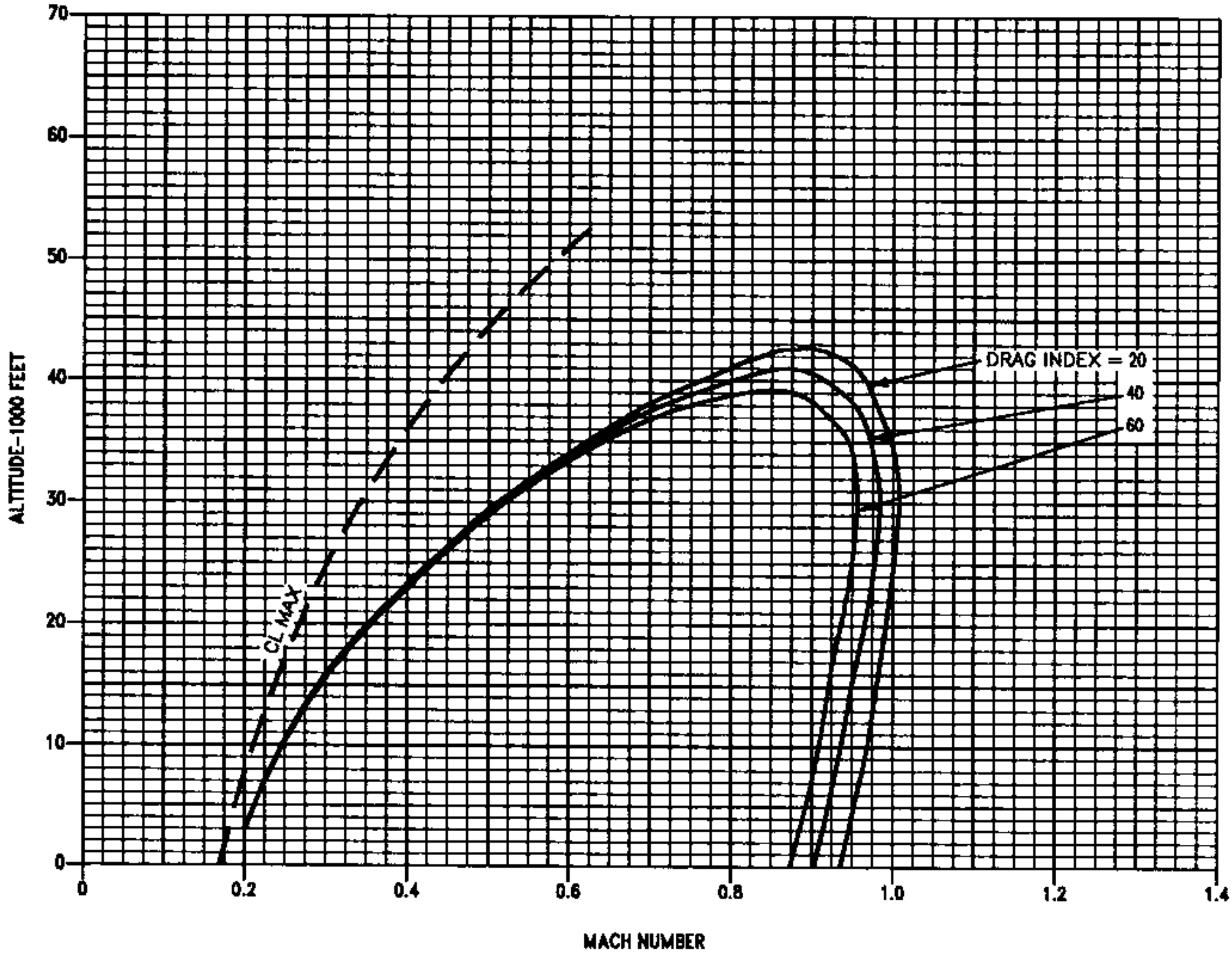
MILITARY THRUST
GROSS WEIGHT – 50,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

NOTES
- CAPABILITY REMAINING: MAXIMUM SPEEDS, ACCELERATION OF 0g; CEILINGS AND LOW SPEED, RATE OF CLIMB OF 500 FEET PER MINUTE.
- CFT DRAG MUST BE INCLUDED WHEN TOTAL DRAG INDEX IS CALCULATED.

DATE: 15 JUNE 1988
DATA BASIS: ESTIMATED



15E-1-(162-1)04-CATI

Figure A9-11

LEVEL FLIGHT ENVELOPE

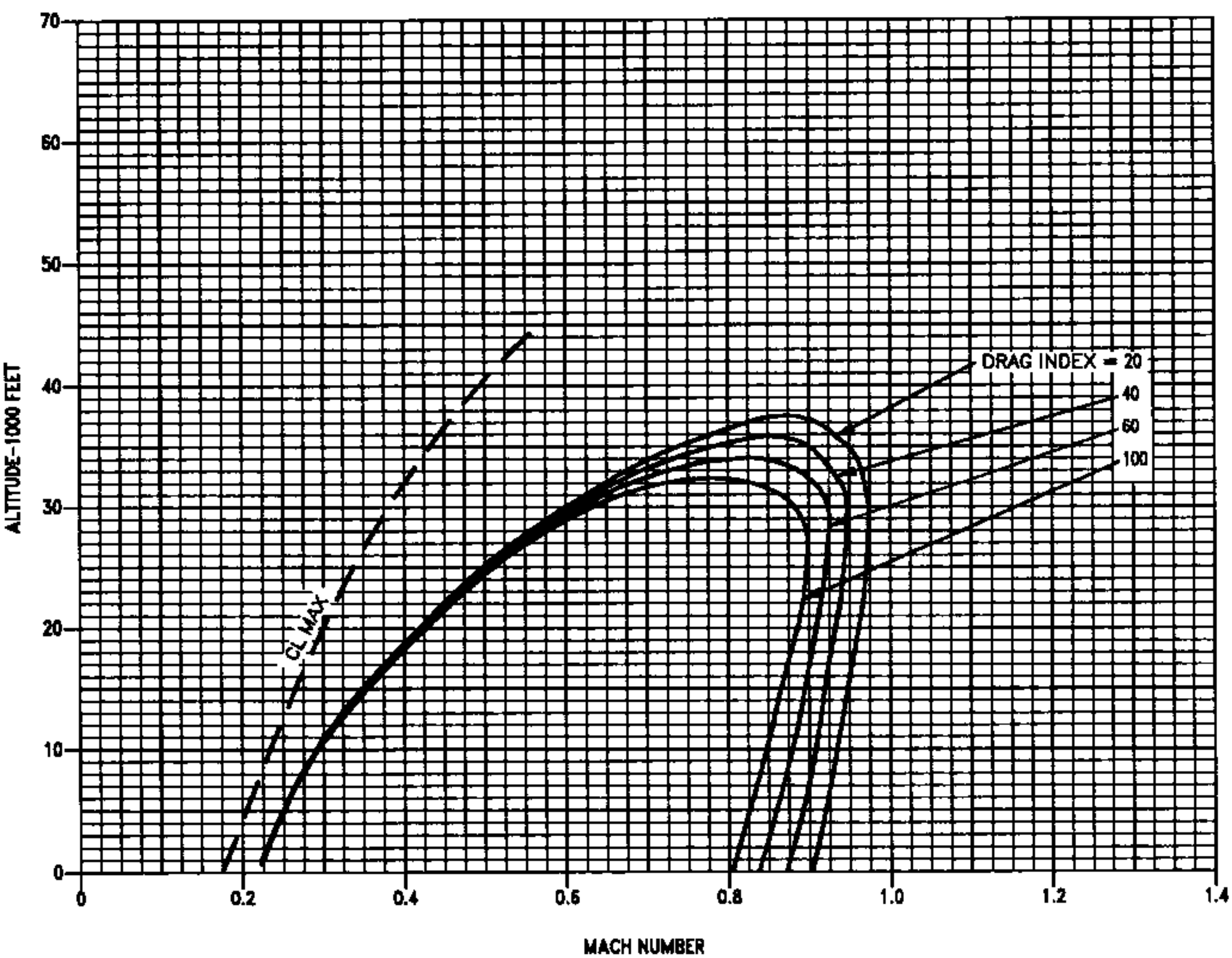
MILITARY THRUST
GROSS WEIGHT – 60,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

DATE: 15 JUNE 1988
DATA BASIS: ESTIMATED

REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

NOTES
- CAPABILITY REMAINING: MAXIMUM SPEEDS, ACCELERATION OF 0g; CEILINGS AND LOW SPEED, RATE OF CLIMB OF 500 FEET PER MINUTE.
- CFT DRAG MUST BE INCLUDED WHEN TOTAL DRAG INDEX IS CALCULATED



15E-1-(174-1)04-CATI

Figure A9-12

LEVEL FLIGHT ENVELOPE

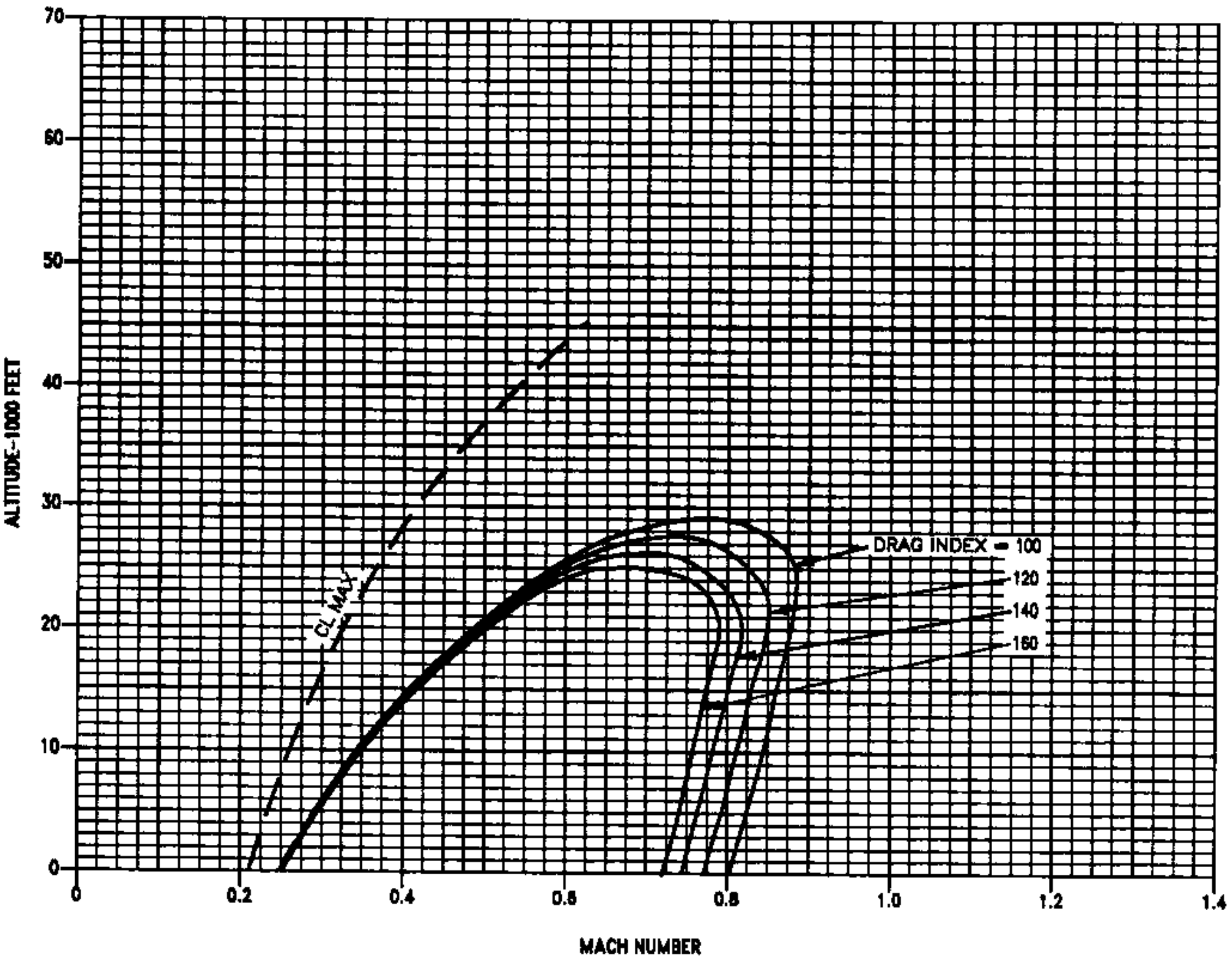
MILITARY THRUST
GROSS WEIGHT - 70,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

NOTES
- CAPABILITY REMAINING: MAXIMUM SPEEDS, ACCELERATION OF 0g; CEILINGS AND LOW SPEED, RATE OF CLIMB OF 500 FEET PER MINUTE.
- CFT DRAG MUST BE INCLUDED WHEN TOTAL DRAG INDEX IS CALCULATED.

DATE: 15 JUNE 1988
DATA BASIS: ESTIMATED



15E-1-(175-1)04-CATI

Figure A9-13

LEVEL FLIGHT ENVELOPE

GROSS WEIGHT - 41,500 POUNDS

AIRPLANE CONFIGURATION
(4)AIM-7

REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

NOTE
CAPABILITY REMAINING: MAXIMUM SPEEDS, ACCELERATION OF 0g; CEILINGS AND LOW SPEED, RATE OF CLIMB OF 500 FEET PER MINUTE.

DATE: 15 APRIL 1990
DATA BASIS: FLIGHT TEST

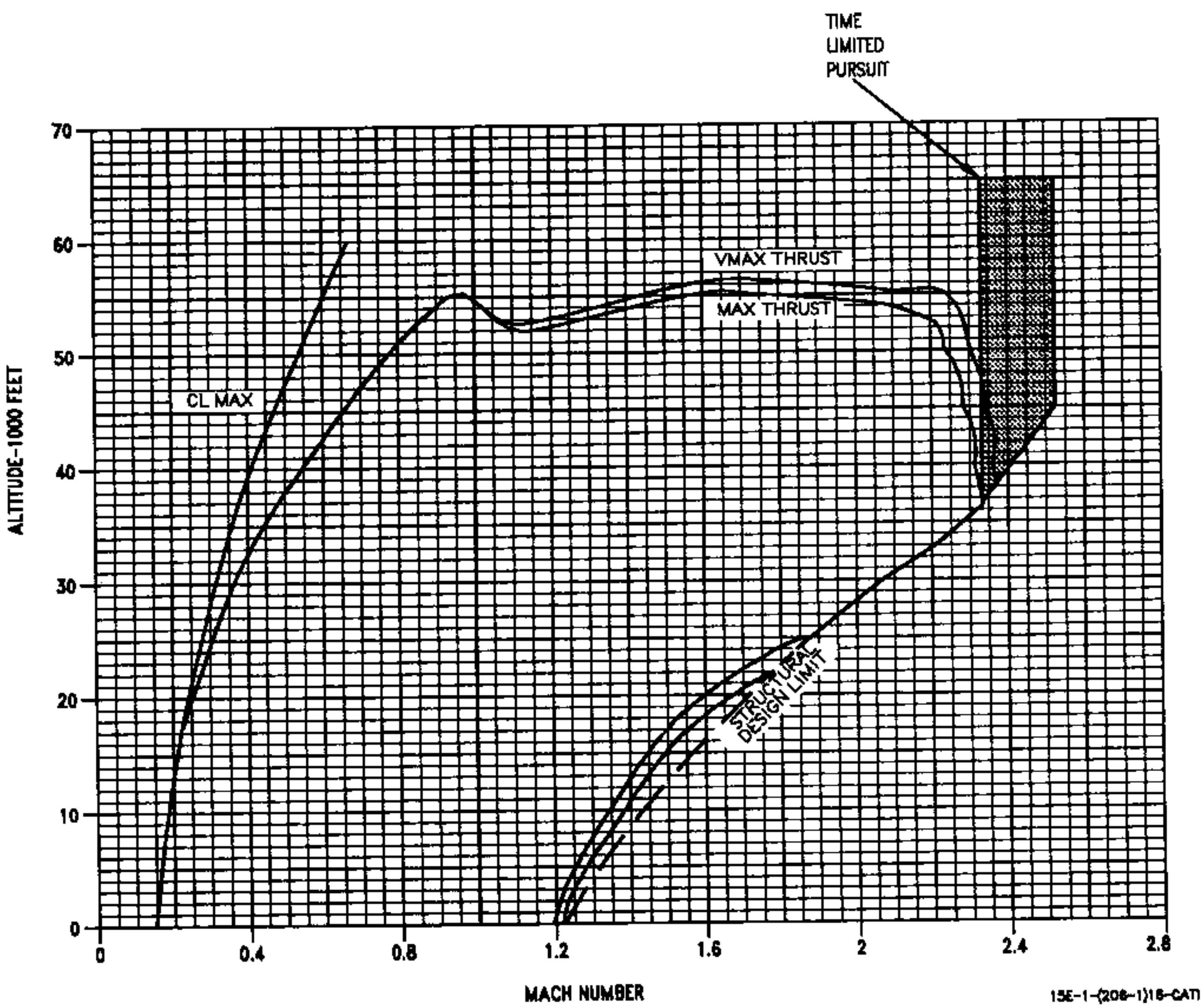


Figure A9-14

MAXIMUM SPEED - LEVEL FLIGHT

MILITARY POWER - DRAG INDEX 0 TO 60

REMARKS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

ENGINES: (2) F100-PW-220
U.S.STANDARD DAY, 1966

DATE: 15 JUNE 1988
DATA BASIS: FLIGHT TEST

NOTE

- CFT DRAG MUST BE INCLUDED WHEN TOTAL DRAG INDEX IS CALCULATED
- a/g=0.03 REPRESENTS AN ACCELERATION OF 0.5 KNOTS/SEC

		MAXIMUM SPEED MACH/KCAS							
		GROSS WEIGHT=40,000 POUNDS				GROSS WEIGHT=50,000 POUNDS			
DRAG INDEX		0	0	20	20	40	40	60	60
ALTITUDE (FT)	TEMP °C	a/g=0.0	a/g=0.03	a/g=0.0	a/g=0.03	a/g=0.0	a/g=0.03	a/g=0.0	a/g=0.03
S.L.	5.0	0.99/651	0.98/648	0.96/633	0.95/629	0.93/612	0.92/605	0.90/594	0.89/586
	15.0	0.97/641	0.96/636	0.93/618	0.93/612	0.90/598	0.89/589	0.87/576	0.86/566
	25.0	0.95/630	0.94/623	0.91/604	0.90/598	0.88/581	0.86/569	0.84/554	0.82/541
5000	-4.9	1.00/610	0.99/607	0.97/596	0.96/591	0.94/576	0.93/569	0.91/559	0.90/553
	5.1	0.98/602	0.98/599	0.95/584	0.94/578	0.92/564	0.91/556	0.89/547	0.88/537
	15.1	0.97/592	0.96/586	0.93/569	0.92/562	0.90/550	0.88/539	0.86/528	0.84/516
10000	-14.8	1.01/570	1.00/567	0.99/558	0.98/554	0.96/541	0.95/534	0.93/524	0.92/517
	-4.8	0.99/562	0.99/558	0.97/548	0.96/542	0.94/529	0.92/521	0.91/513	0.90/505
	5.2	0.98/554	0.97/549	0.95/536	0.94/528	0.92/517	0.90/508	0.89/499	0.86/486
20000	-34.6	1.03/490	1.02/485	1.01/479	1.00/475	0.98/467	0.97/461	0.95/449	0.94/444
	-24.6	1.01/482	1.00/477	0.99/471	0.98/466	0.97/458	0.95/447	0.94/442	0.92/433
	-14.6	1.00/475	1.00/470	0.98/464	0.96/457	0.94/446	0.92/436	0.92/432	0.90/422
30000	-54.4	1.05/412	1.03/404	1.02/401	1.01/393	0.99/385	0.97/375	0.95/368	0.94/361
	-44.4	1.04/407	1.02/400	1.02/397	1.00/391	0.99/383	0.96/374	0.95/368	0.91/312
	-34.4	1.02/398	1.00/392	1.00/389	0.98/382	0.97/375	0.94/364	0.94/364	0.91/352
35000	-64.3	1.04/368	1.02/358	1.02/356	0.99/347	0.97/339	0.94/327	0.95/330	0.91/312
	-54.3	1.04/366	1.02/357	1.02/356	0.99/348	0.97/339	0.94/328	0.95/330	0.91/312
	-44.3	1.02/360	1.01/353	1.00/352	0.98/344	0.97/337	0.94.326	0.95/329	0.90/312
40000	-66.5	1.02/320	0.99/309	1.00/311	0.97/300	0.95/295	—	0.90/278	—
	-56.5	1.02/319	0.99/309	1.00/311	0.97/300	0.95/295	—	0.91/278	—
	-46.5	1.01/315	0.98/306	0.99/307	0.96/298	0.94/292	—	0.90/278	—

Figure A9-15

MAXIMUM SPEED - LEVEL FLIGHT

MILITARY POWER - DRAG INDEX 80 TO 160

REMARKS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

ENGINES: (2) F100-PW-220
U.S.STANDARD DAY, 1966

DATE: 15 JUNE 1988
DATA BASIS: **FLIGHT TEST**

NOTE

- CFT DRAG MUST BE INCLUDED WHEN TOTAL DRAG INDEX IS CALCULATED
- a/g=0.03 REPRESENTS AN ACCELERATION OF 0.5 KNOTS/SEC

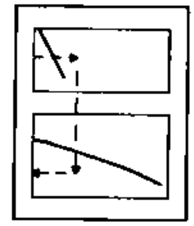
		MAXIMUM SPEED MACH/KCAS									
		GROSS WEIGHT=60,000 POUNDS				GROSS WEIGHT=70,000 POUNDS					
DRAG INDEX		80	80	100	100	120	120	140	140	160	160
ALTITUDE (FT)	TEMP °C	a/g=0.0	a/g=0.03	a/g=0.0	a/g=0.03	a/g=0.0	a/g=0.03	a/g=0.0	a/g=0.03	a/g=0.0	a/g=0.03
S.L.	5.0	0.87/573	0.85/561	0.83/551	0.81/538	0.80/531	0.78/514	0.77/512	0.75/496	0.75/495	0.73/480
	15.0	0.84/553	0.81/539	0.80/532	0.78/517	0.77/510	0.75/493	0.74/492	0.72/476	0.72/477	0.70/460
	25.0	0.80/529	0.77/512	0.77/507	0.74/491	0.74/487	0.71/468	0.71/470	0.68/452	0.69/455	0.66/436
5000	-4.9	0.89/543	0.87/531	0.86/524	0.84/511	0.83/505	0.80/488	0.80/488	0.77/469	0.77/470	0.74/453
	5.1	0.86/526	0.84/510	0.83/505	0.80/489	0.79/484	0.76/464	0.76/466	0.73/447	0.74/450	0.71/431
	15.1	0.83/505	0.80/489	0.80/485	0.77/467	0.76/463	0.73/442	0.73/446	0.70/426	0.71/431	0.67/410
10000	-14.8	0.91/510	0.89/499	0.88/494	0.85/480	0.85/475	0.81/455	0.82/457	0.78/438	0.79/441	0.75/422
	-4.8	0.88/496	0.86/481	0.85/477	0.82/459	0.81/455	0.77/433	0.78/438	0.75/417	0.76/423	0.72/402
	5.2	0.85/478	0.82/457	0.81/456	0.78/436	0.78/435	0.73/410	0.75/418	0.71/395	0.72/403	0.68/380
20000	-34.6	0.93/439	0.91/430	0.91/429	0.89/417	0.88/414	0.83/389	0.85/399	0.79/370	0.82/383	0.75/350
	-24.6	0.91/429	0.88/415	0.89/417	0.85/399	0.85/399	0.80/373	0.82/384	0.76/353	0.79/370	0.72/335
	-14.6	0.89/417	0.85/397	0.86.401	0.81/378	0.81.379	0.74/345	0.78/363	0.71/327	0.75/348	0.67/309
30000	-54.4	0.93/359	0.87/331	0.90/347	—	—	—	—	—	—	—
	-44.4	0.93/359	0.87/332	0.90/348	—	—	—	—	—	—	—
	-34.4	0.91/350	0.83/317	0.88/336	—	—	—	—	—	—	—
35000	-64.3	0.88/304	—	—	—	—	—	—	—	—	—
	-54.3	0.89/305	—	—	—	—	—	—	—	—	—
	-44.3	0.89/304	—	—	—	—	—	—	—	—	—
40000	-66.5	—	—	—	—	—	—	—	—	—	—
	-56.5	—	—	—	—	—	—	—	—	—	—
	-46.5	—	—	—	—	—	—	—	—	—	—

Figure A9-16

DIVE RECOVERY-6.0 G PULL-OUT

SUBSONIC-SPEEDBRAKE RETRACTED
GROSS WEIGHT 37,400 POUNDS-MAX POWER

GUIDE



AIRPLANE CONFIGURATION
(2) WING PYLONS,
(4) LAU-128 LAUNCHERS,
CENTERLINE 610 GAL FUEL TANK

REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

NOTE
PULL-OUT BASED ON 2.0 g PER SECOND ACCELERATION BUILDUP TO MAXIMUM USABLE STABILATOR LIMIT OR 6.0 g WHICHEVER OCCURS FIRST.

DATE: 15 JUNE 1988
DATA BASIS: ESTIMATED

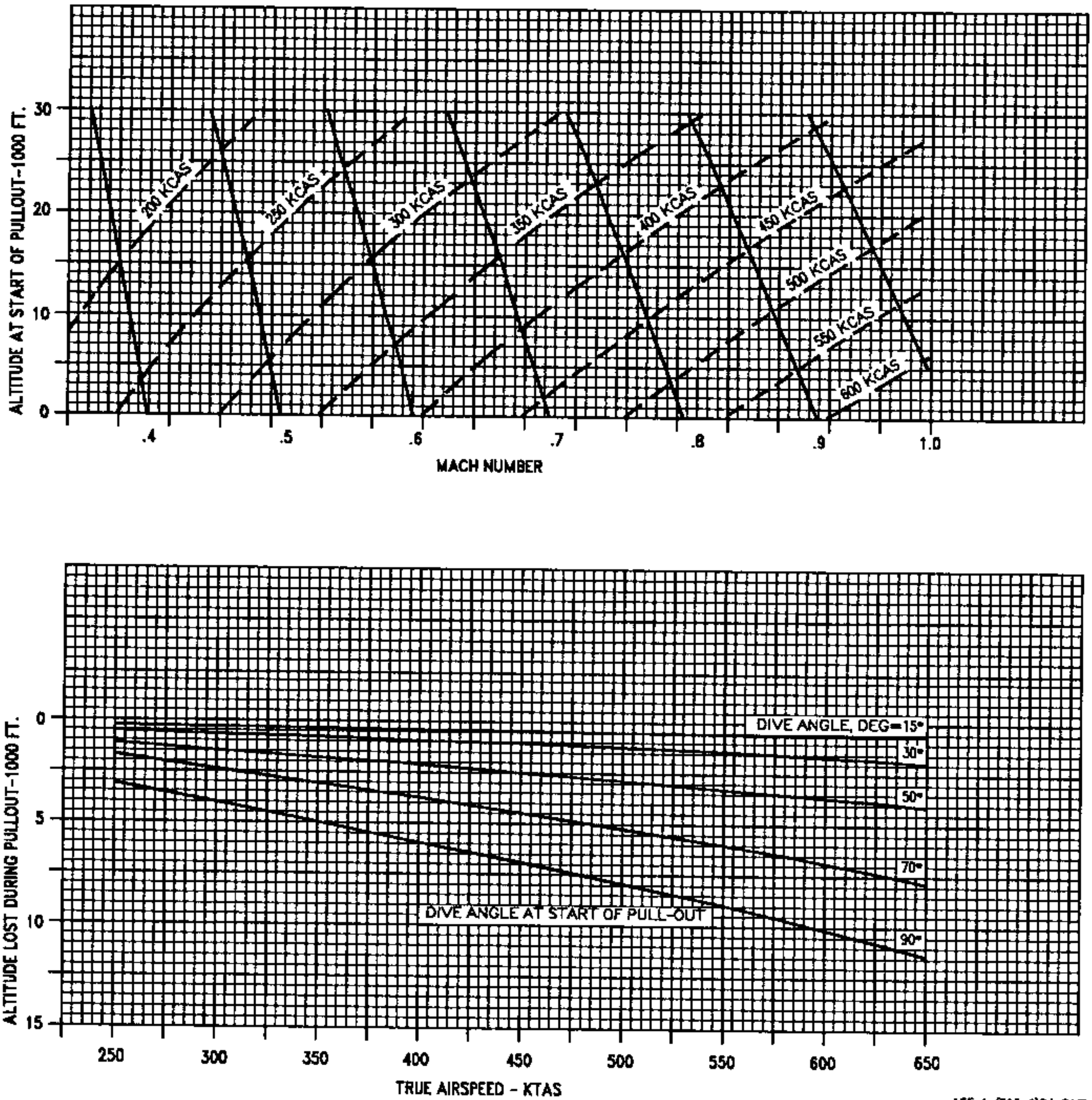
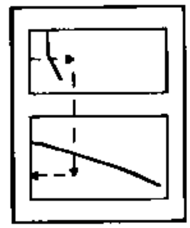


Figure A9-17

DIVE RECOVERY-6.0 G PULL-OUT

SUPERSONIC-SPEEDBRAKE RETRACTED
GROSS WEIGHT 37,400 POUNDS-MAX POWER

GUIDE

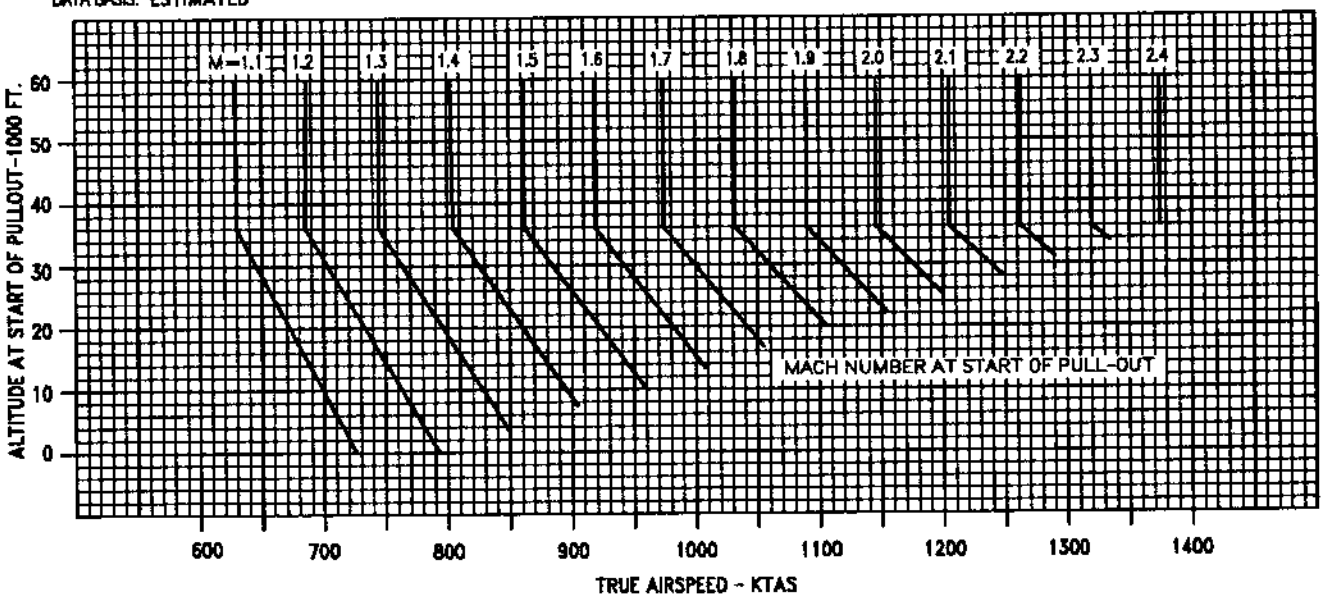


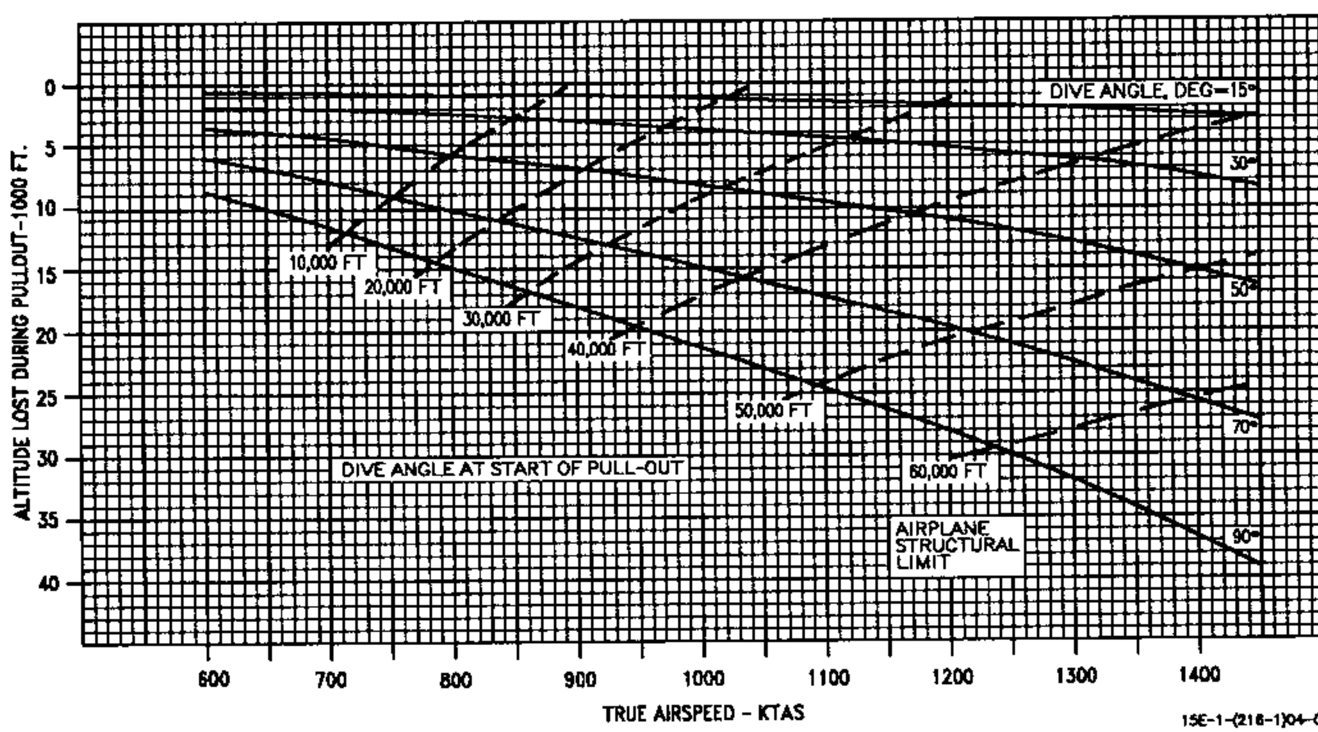
AIRPLANE CONFIGURATION
(2) WING PYLONS,
(4) LAU-128 LAUNCHERS

REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

NOTE
PULL-OUT BASED ON 2.0 g PER SECOND ACCELERATION BUILDUP TO MAXIMUM USABLE STABILATOR LIMIT OR 6.0 g WHICHEVER OCCURS FIRST.

DATE: 15 JUNE 1988
DATA BASIS: ESTIMATED





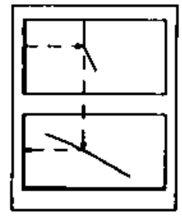
15E-1-(218-1)04-CATI

Figure A9-18

DIVE RECOVERY-6.0G PULL-OUT

SUBSONIC-SPEEDBRAKE RETRACTED
GROSS WEIGHT-45,000 POUNDS

GUIDE

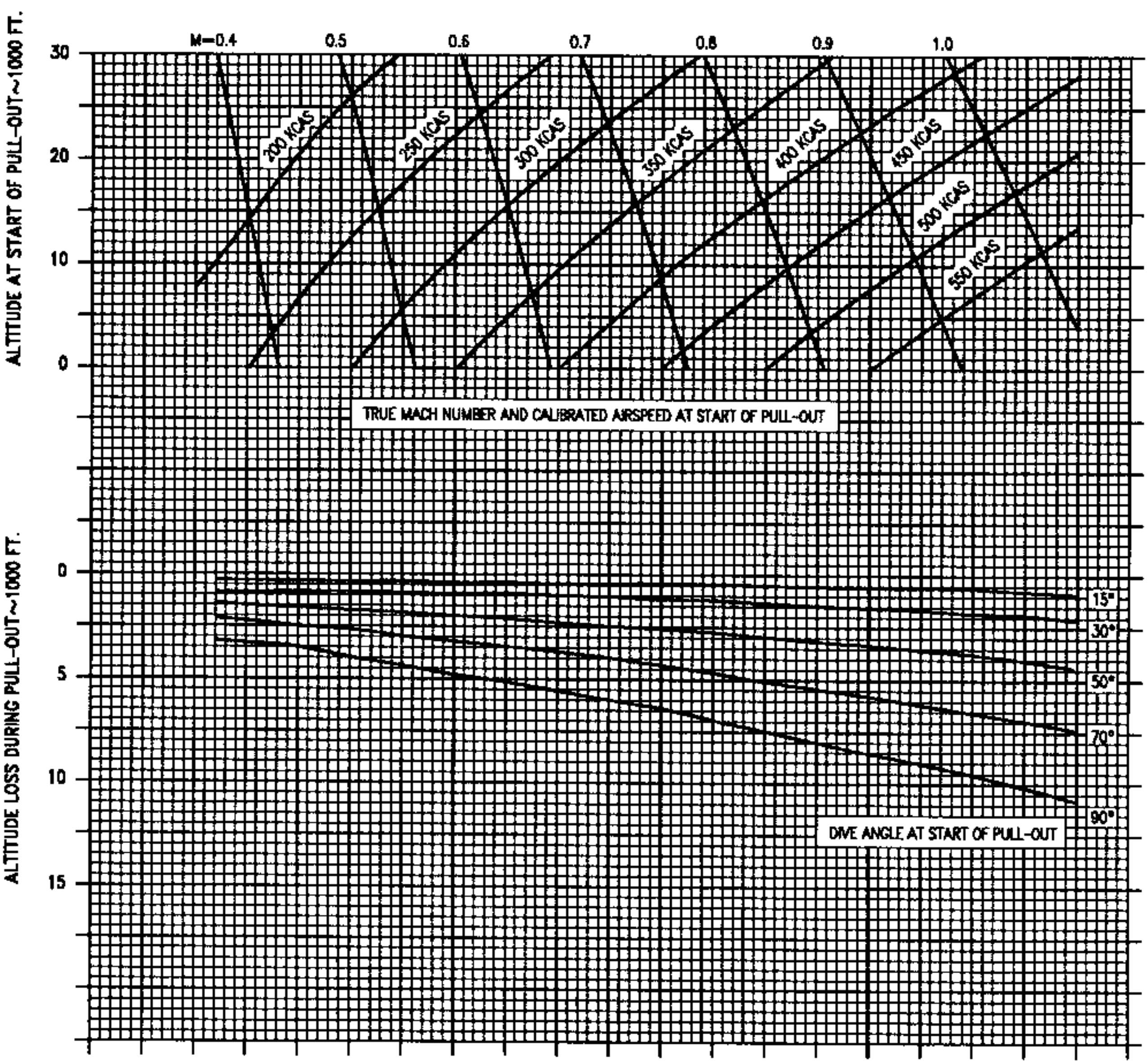


AIRPLANE CONFIGURATION
(4)AIM-7+(2)WING PYLONS
+(4)LAUNCHERS/ADAPTERS
+(4)AIM-9

REMARKS
ENGINE: (2)F100-PW-220
U.S. STANDARD DAY, 1966

NOTE
- ALTITUDE LOSS WITH MAXIMUM THRUST IS ESSENTIALLY THE SAME WITH MILITARY THRUST
- PULL-OUT BASED ON 2.0G PER SECOND ACCELERATION BUILDUP TO MAXIMUM USABLE NORMAL FORCE STABILATOR LIMIT OR 6.0G, WHICHEVER OCCURS FIRST

DATE: 15 MARCH 1991
DATA BASIS: ESTIMATED



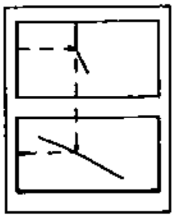
15E-1-(278-1)21-CATI

Figure A9-19 (Sheet 1 of 7)

DIVE RECOVERY-6.0G PULL-OUT

SUPERSONIC-SPEEDBRAKE RETRACTED
GROSS WEIGHT-45,000 POUNDS

GUIDE

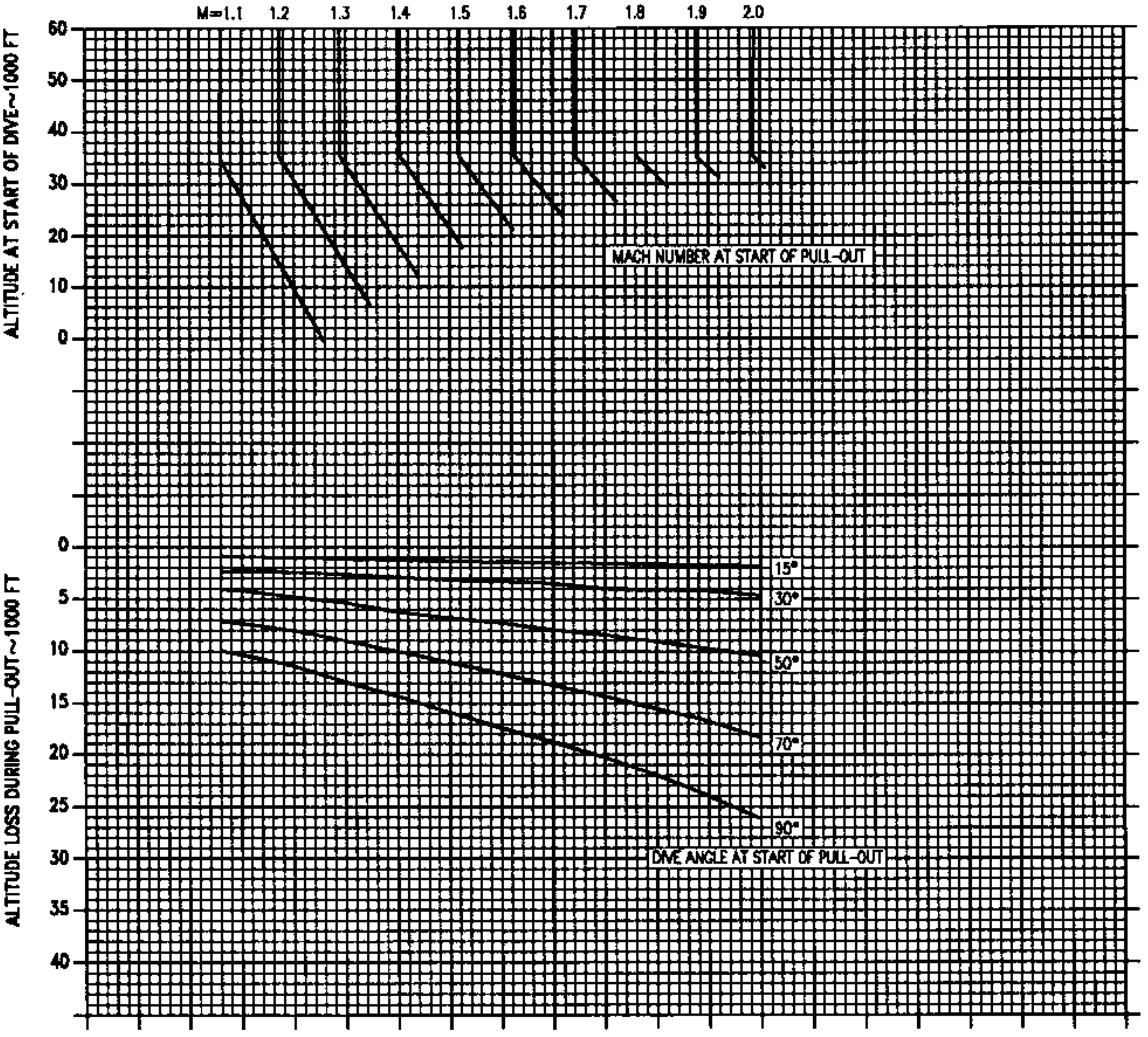


AIRPLANE CONFIGURATION
(4)AIM-7+(2)WING PYLONS
+(4)LAUNCHERS/ADAPTERS
+(4)AIM-9

REMARKS
ENGINE: (2)F100-PW-220
U.S. STANDARD DAY, 1966

NOTE
- ALTITUDE LOSS WITH MAXIMUM THRUST IS ESSENTIALLY THE SAME WITH MILITARY THRUST
- PULL-OUT BASED ON 2.0G PER SECOND ACCELERATION BUILDUP TO MAXIMUM USABLE NORMAL FORCE STABILATOR LIMIT OR 6.0G, WHICHEVER OCCURS FIRST

DATE: 15 MARCH 1991
DATA BASIS: ESTIMATED



15E-1-(278-2)21-CATI

Figure A9-19 (Sheet 2)

DIVE RECOVERY-6.0G PULL-OUT

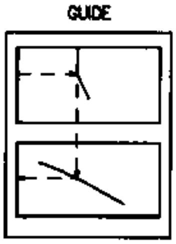
SUBSONIC-SPEEDBRAKE RETRACTED
GROSS WEIGHT-55,000 POUNDS

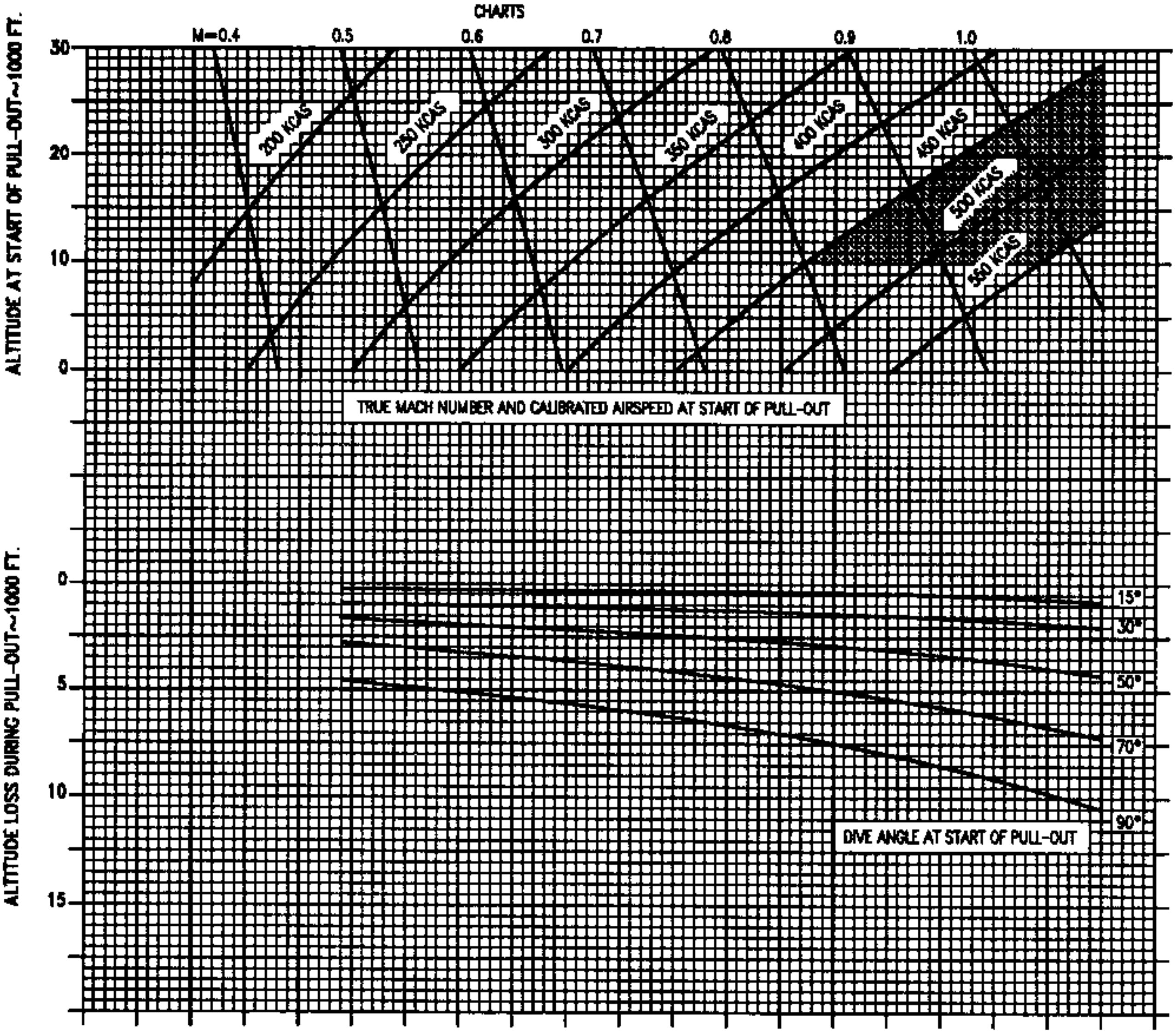
AIRPLANE CONFIGURATION
-4CFT+(4)AIM-7
+(2)WING PYLONS
+(4)LAUNCHERS/ADAPTERS
+(4)AIM-9

DATE: 15 MARCH 1991
DATA BASIS: ESTIMATED

REMARKS
ENGINE: (2)F100-PW-220
U.S. STANDARD DAY, 1966

NOTE
- ALTITUDE LOSS WITH MAXIMUM THRUST IS ESSENTIALLY THE SAME WITH MILITARY THRUST
- PULL-OUT BASED ON 2.0G PER SECOND ACCELERATION BUILDUP TO MAXIMUM USABLE NORMAL FORCE STABILATOR LIMIT OR 6.0G, WHICHEVER OCCURS FIRST
- SHADED AREA INDICATES POSSIBLE STRUCTURAL OVERLOAD AT 6G's. RECOVERIES IN THIS REGION SHOULD BE LIMITED TO Nz ALLOWABLE BASED ON OVERLOAD WARNING SYSTEM OR OWS INOPERATIVE CHARTS





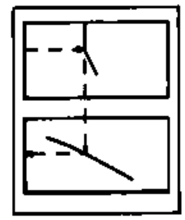
15E-1-(276-3)21-CATI

Figure A9-19 (Sheet 3)

DIVE RECOVERY-6.0G PULL-OUT

SUPERSONIC-SPEEDBRAKE RETRACTED
GROSS WEIGHT-55,000 POUNDS

GUIDE

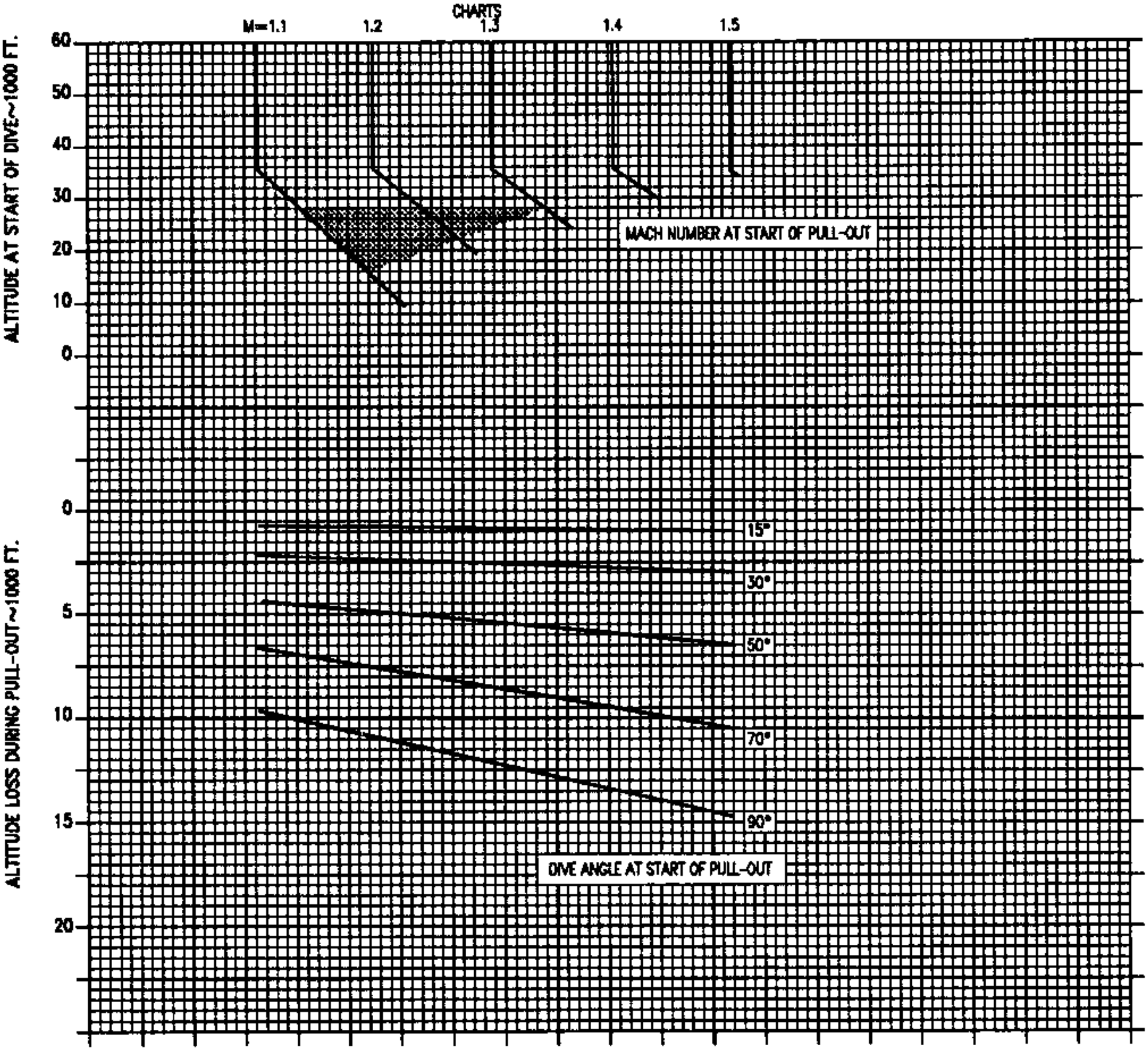


AIRPLANE CONFIGURATION
-4CFT+(4)AIM-7
+(2)WING PYLONS
+(4)LAUNCHERS/ADAPTERS
+(4)AIM-9

DATE: 15 MARCH 1991
DATA BASIS: ESTIMATED

REMARKS
ENGINE: (2)F100-PW-220
U.S. STANDARD DAY, 1966

NOTE
- ALTITUDE LOSS WITH MAXIMUM THRUST IS ESSENTIALLY THE SAME WITH MILITARY THRUST
- PULL-OUT BASED ON 2.0G PER SECOND ACCELERATION BUILDUP TO MAXIMUM USABLE NORMAL FORCE STABILATOR LIMIT OR 6.0G, WHICHEVER OCCURS FIRST
- SHADED AREA INDICATES POSSIBLE STRUCTURAL OVERLOAD AT 6G's. RECOVERIES IN THIS REGION SHOULD BE LIMITED TO Nz ALLOWABLE BASED ON OVERLOAD WARNING SYSTEM OR OWS INOPERATIVE CHARTS



15E-1-(278-4)21-CATI

Figure A9-19 (Sheet 4)

DIVE RECOVERY-6.0G PULL-OUT

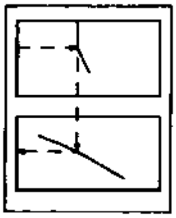
SUBSONIC-SPEEDBRAKE RETRACTED
GROSS WEIGHT-65,000 POUNDS

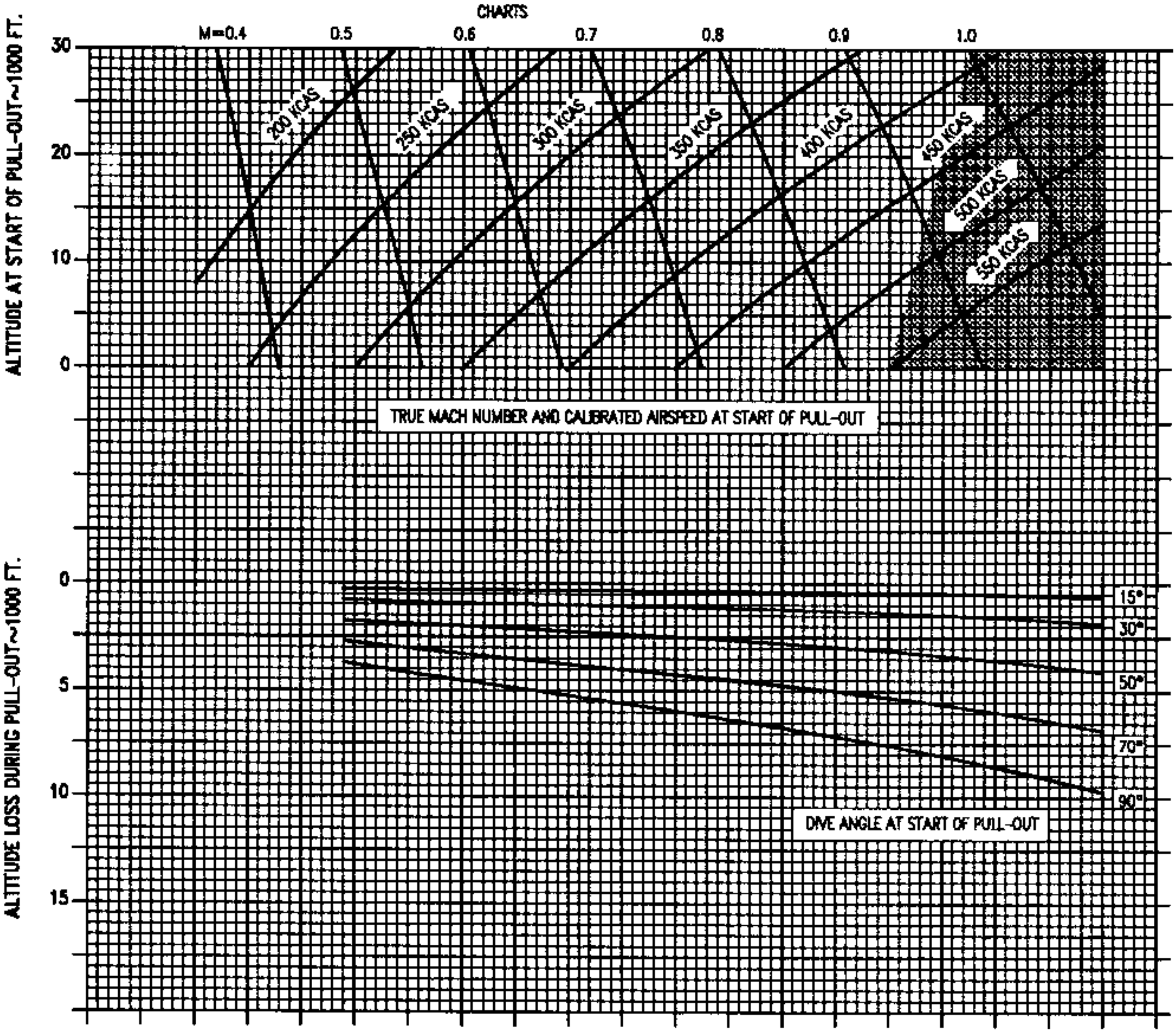
AIRPLANE CONFIGURATION
-4CFT+LANTIRN PODS
+(12)MK-82+(2)WING PYLONS
+(4)LAUNCHERS/ADAPTERS
+(4)AIM-9

DATE: 15 MARCH 1991
DATA BASIS: ESTIMATED

REMARKS
ENGINE: (2)F100-PW-220
U.S. STANDARD DAY, 1966

NOTE
- ALTITUDE LOSS WITH MAXIMUM THRUST IS ESSENTIALLY THE SAME WITH MILITARY THRUST
- PULL-OUT BASED ON 2.0G PER SECOND ACCELERATION BUILDUP TO MAXIMUM USABLE NORMAL FORCE STABILATOR LIMIT OR 6.0G, WHICHEVER OCCURS FIRST
- SHADED AREA INDICATES POSSIBLE STRUCTURAL OVERLOAD AT 6G's. RECOVERIES IN THIS REGION SHOULD BE LIMITED TO Nz ALLOWABLE BASED ON OVERLOAD WARNING SYSTEM OR OWS INOPERATIVE CHARTS



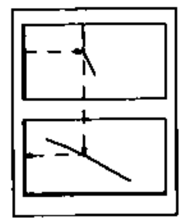


15E-1-(278-5)21-CATI

Figure A9-19 (Sheet 5)

DIVE RECOVERY-6.0G PULL-OUT

SUPERSONIC-SPEEDBRAKE RETRACTED
GROSS WEIGHT-65,000 POUNDS

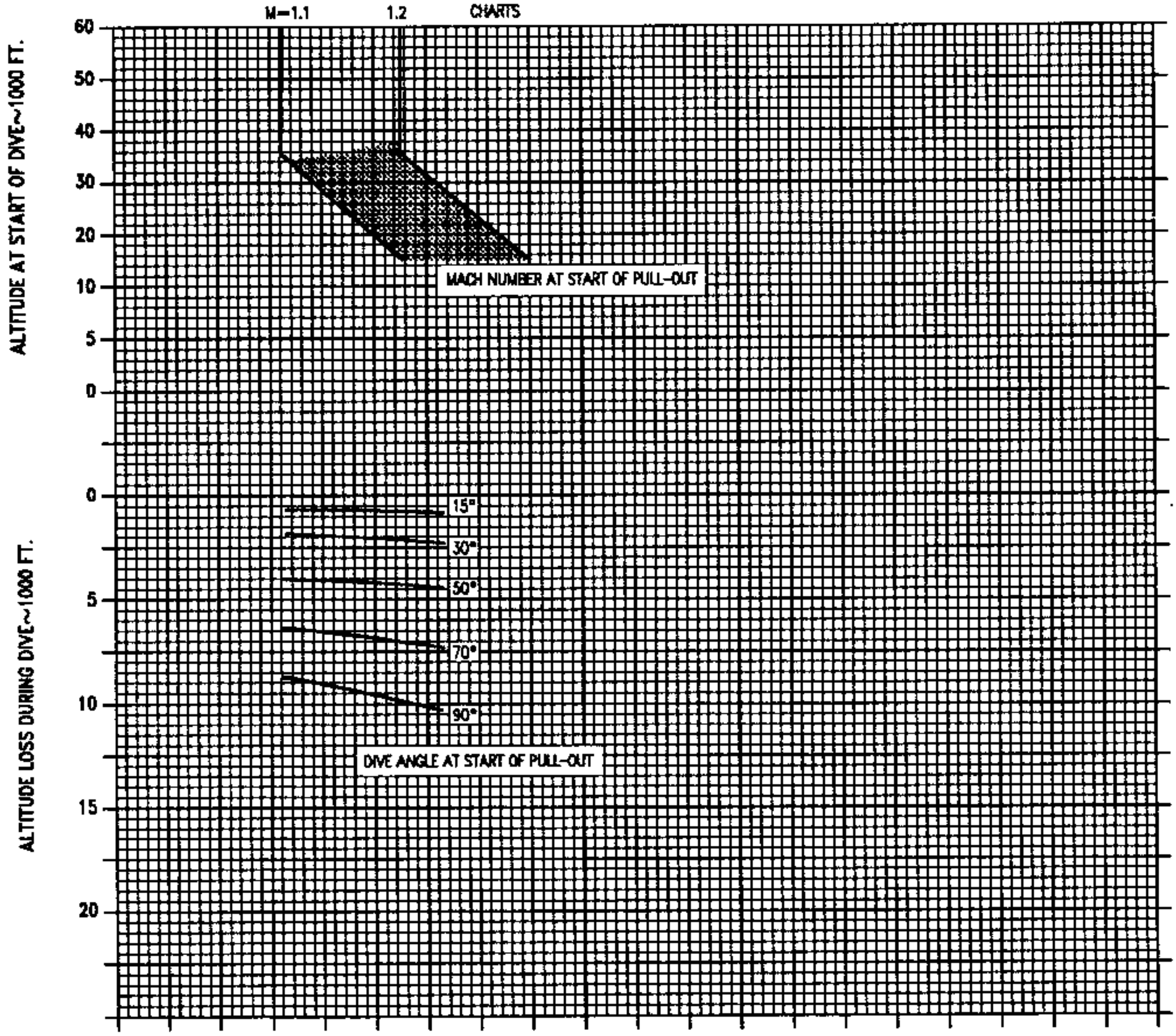


AIRPLANE CONFIGURATION
-4CTF+LANTIRN PODS
+(12)MK-82+(2)WING PYLONS
+(4)LAUNCHERS/ADAPTERS
+(4)AIM-9

REMARKS
ENGINE: (2)F100-PW-220
U.S. STANDARD DAY, 1966

NOTE
- ALTITUDE LOSS WITH MAXIMUM THRUST IS ESSENTIALLY THE SAME WITH MILITARY THRUST
- PULL-OUT BASED ON 2.0G PER SECOND ACCELERATION BUILDUP TO MAXIMUM USABLE NORMAL FORCE STABILATOR LIMIT OR 6.0G, WHICHEVER OCCURS FIRST
- SHADED AREA INDICATES POSSIBLE STRUCTURAL OVERLOAD AT 6G's. RECOVERIES IN THIS REGION SHOULD BE LIMITED TO Nz ALLOWABLE BASED ON OVERLOAD WARNING SYSTEM OR OWS INOPERATIVE CHARTS

DATE: 15 MARCH 1991
DATA BASIS: ESTIMATED



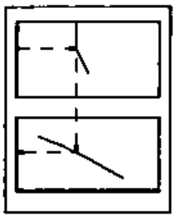
15E-1-(278-6)21-CATI

Figure A9-19 (Sheet 6)

DIVE RECOVERY-6.0G PULL-OUT

SUBSONIC-SPEEDBRAKE RETRACTED
GROSS WEIGHT-70,000 POUNDS

GUIDE

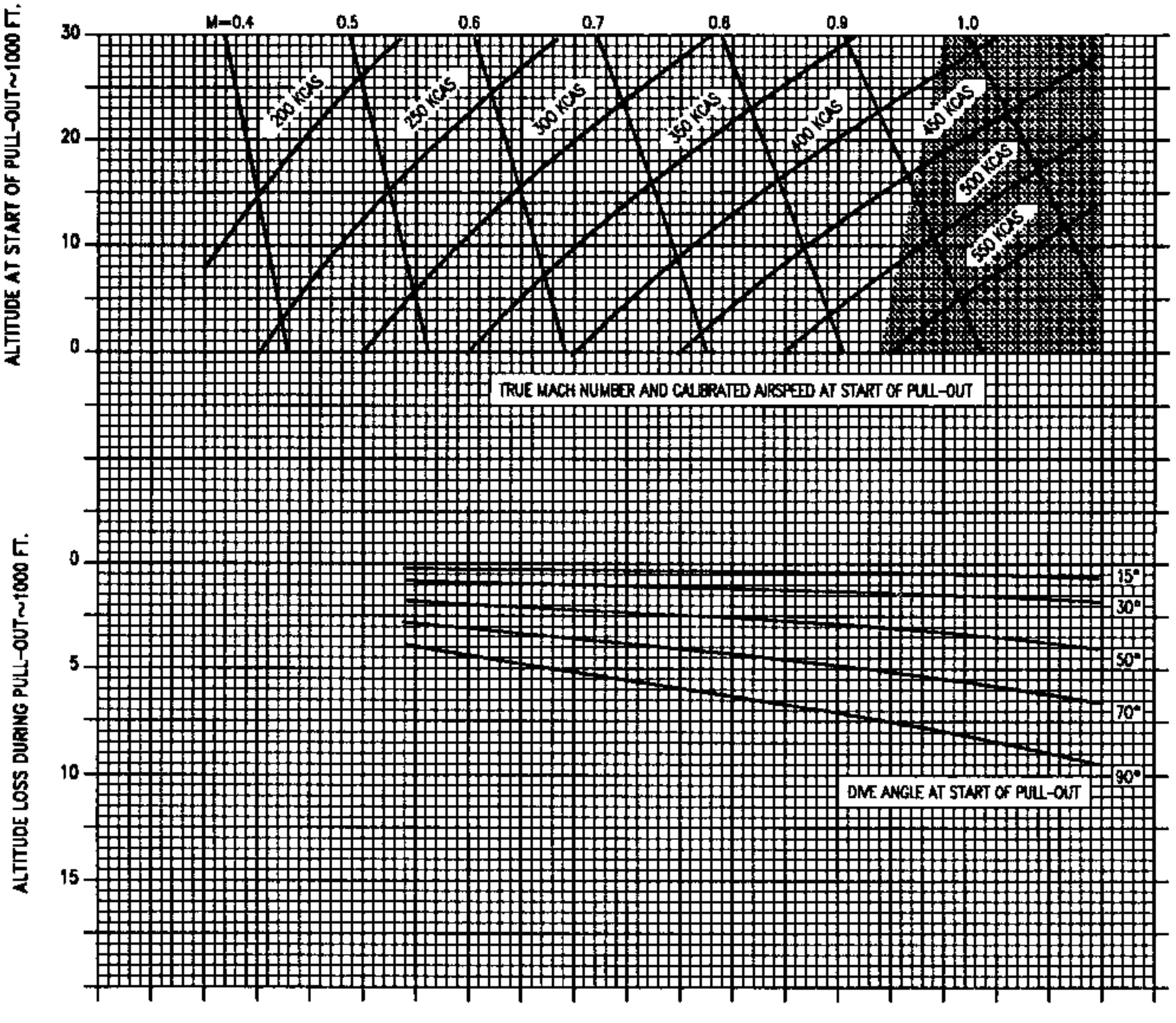


AIRPLANE CONFIGURATION
-4CFT+LANTIRN PODS
+(12)MK-82+(2)WING PYLONS
+(4)LAUNCHERS/ADAPTERS
+(4)AIM-9+CENTERLINE PYLON/TANK

DATE: 15 MARCH 1991
DATA BASIS: ESTIMATED

REMARKS
ENGINE: (2)F100-PW-220
U.S. STANDARD DAY, 1966

NOTE
- ALTITUDE LOSS WITH MAXIMUM THRUST IS ESSENTIALLY THE SAME WITH MILITARY THRUST
- PULL-OUT BASED ON 2.0G PER SECOND ACCELERATION BUILDUP TO MAXIMUM USABLE NORMAL FORCE STABILATOR LIMIT OR 6.0G, WHICHEVER OCCURS FIRST
- SHADED AREA INDICATES POSSIBLE STRUCTURAL OVERLOAD AT 6G's. RECOVERIES IN THIS REGION SHOULD BE LIMITED TO Nz ALLOWABLE BASED ON OVERLOAD WARNING SYSTEM OR OWS INOPERATIVE CHARTS



15E-1-(278-7)21-CATI

Figure A9-19 (Sheet 7)

DIVE RECOVERY-EMERGENCY PULL-OUT

GROSS WEIGHT OF 40,000 TO 45,000 POUNDS
APPLICABLE ONLY FOR
RECOVERIES BELOW 10,000 FEET

AIRPLANE CONFIGURATION
(4)AIM-7+(2)WING PYLONS
+(4)LAUNCHERS/ADAPTERS
+(4)AIM-9

REMARKS
ENGINE: (2)F100-PW-220
U.S. STANDARD DAY, 1966

NOTE
- RETRACT SPEEDBRAKE AT AIRSPEEDS BELOW 350 KCAS, EXTEND ABOVE 350 KCAS
- CAS ON OR OFF

DATE: 15 MARCH 1991
DATA BASIS: ESTIMATED

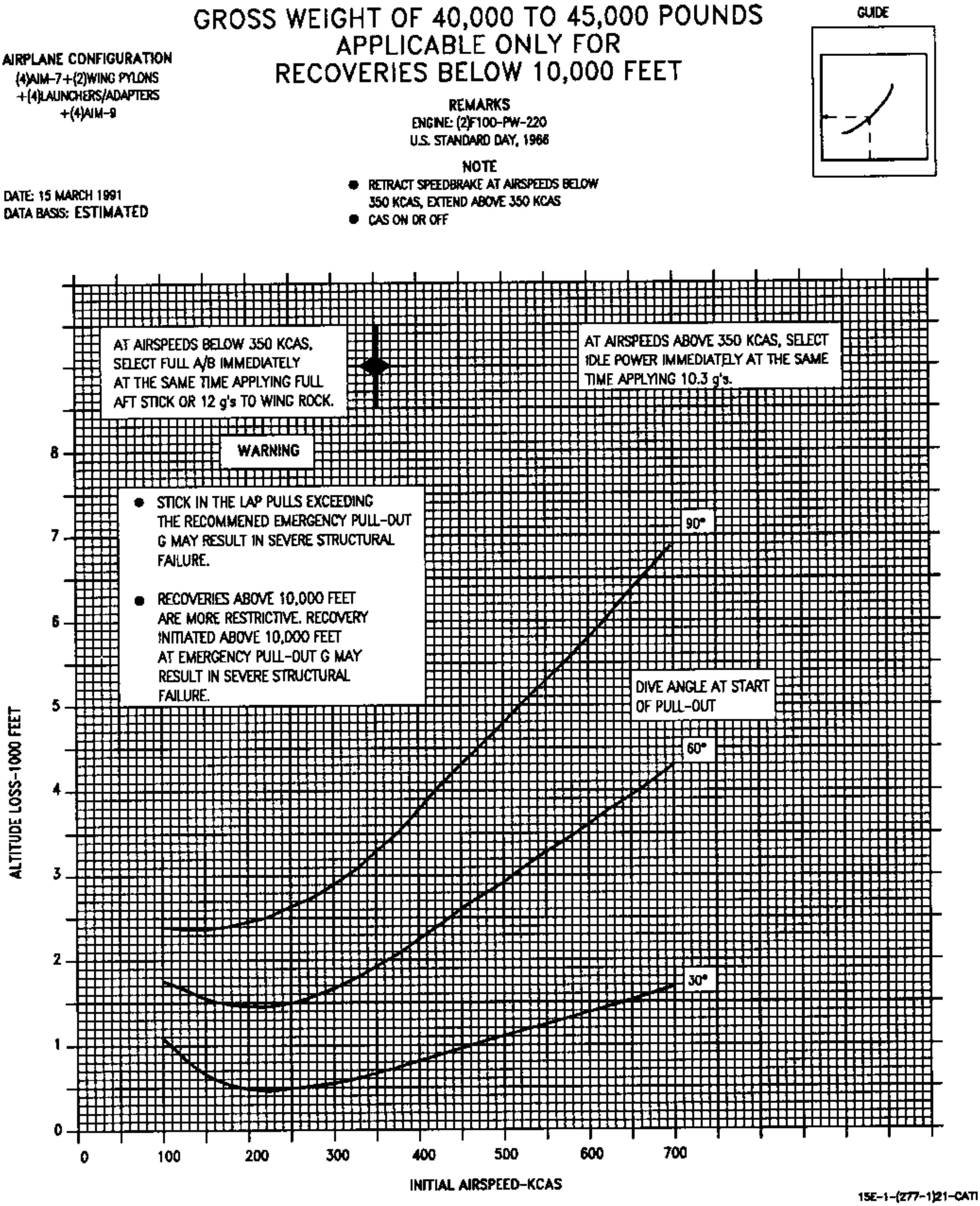


Figure A9-20 (Sheet 1 of 4)

DIVE RECOVERY-EMERGENCY PULL-OUT

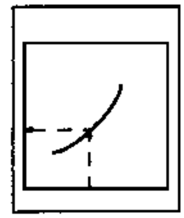
GROSS WEIGHT OF 50,000 TO 55,000 POUNDS
APPLICABLE ONLY FOR
RECOVERIES BELOW 10,000 FEET

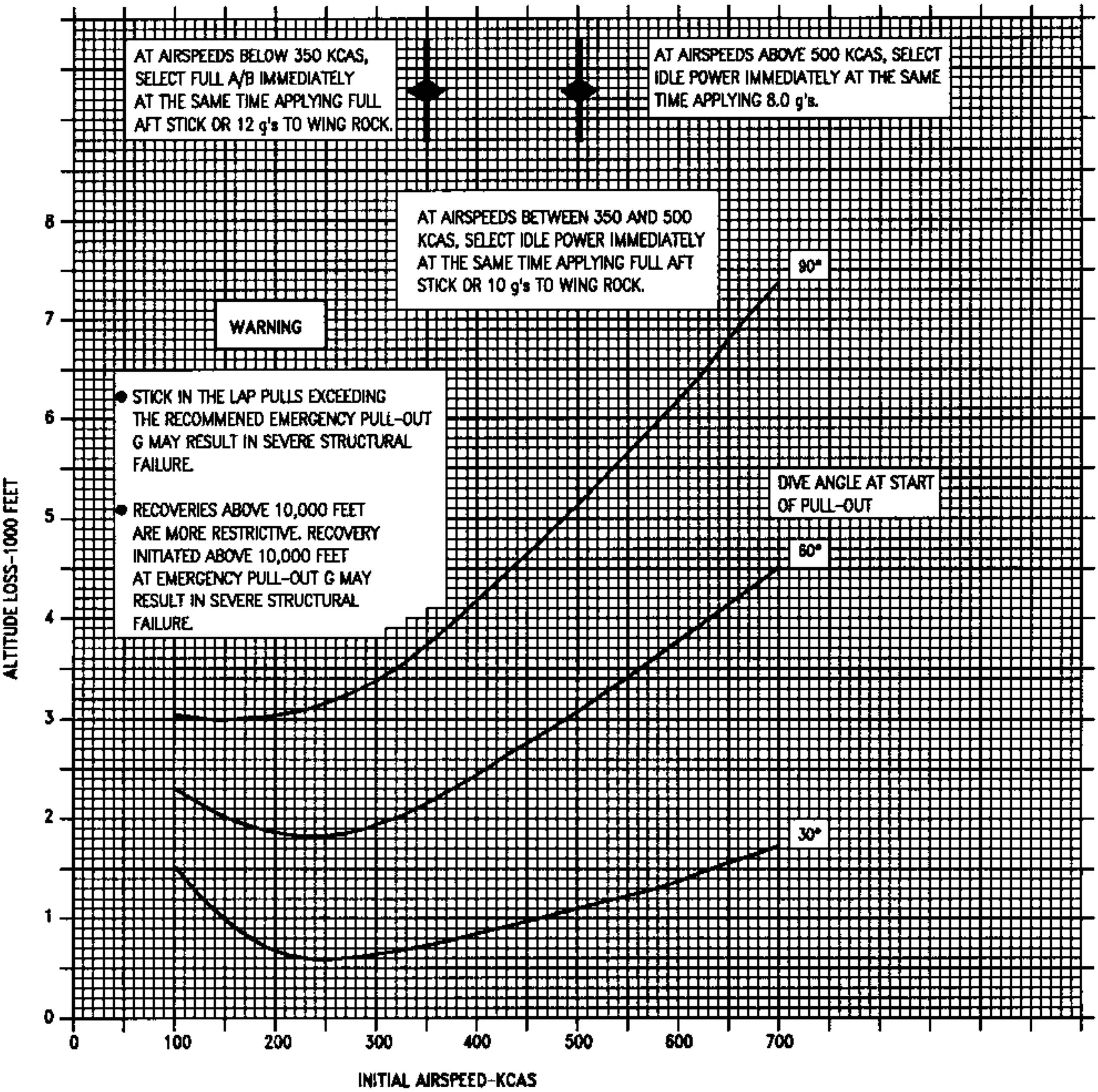
AIRPLANE CONFIGURATION
-4CFT+(4)AIM-7+(2)WING PYLONS
+(4)LAUNCHERS/ADAPTERS
+(4)AIM-9

REMARKS
ENGINE: (2)F100-PW-220
U.S. STANDARD DAY, 1966

NOTE
- RETRACT SPEEDBRAKE AT AIRSPEEDS BELOW 350 KCAS, EXTEND ABOVE 350 KCAS
- CAS ON OR OFF

DATE: 15 MARCH 1991
DATA BASIS: ESTIMATED





15E-1-(277-2)25-CATI

Figure A9-20 (Sheet 2)

DIVE RECOVERY-EMERGENCY PULL-OUT

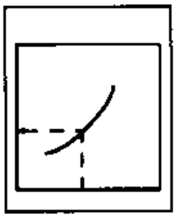
GROSS WEIGHT OF 65,000 POUNDS
APPLICABLE ONLY FOR
RECOVERIES BELOW 10,000 FEET

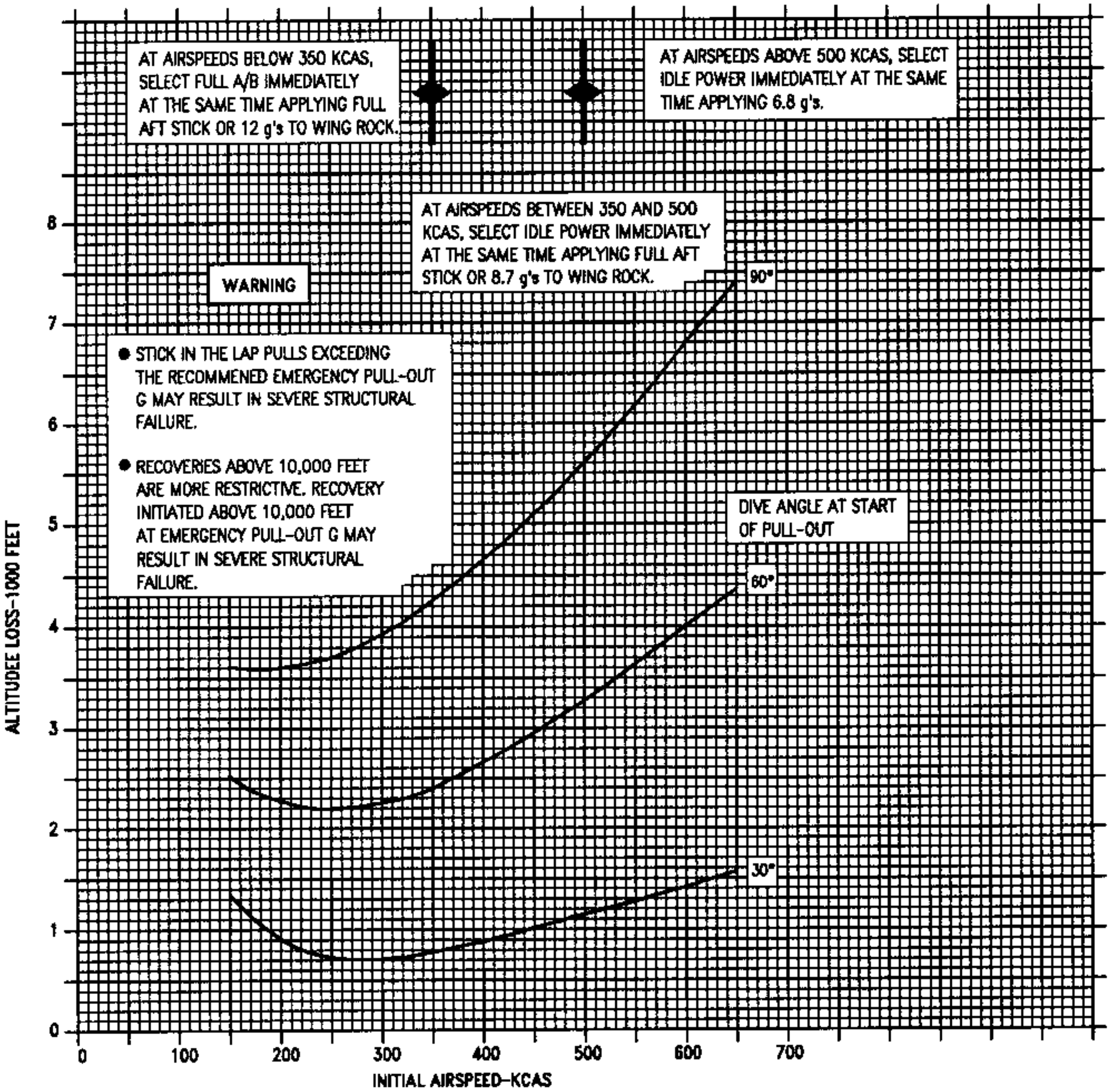
AIRPLANE CONFIGURATION
-4CFT+LANTIRN PODS+(12)MK-82
+(2)WING PYLONS
+(4)LAUNCHERS/ADAPTERS
+(4)AIM-9

REMARKS
ENGINE: (2)F100-PW-220
U.S. STANDARD DAY, 1966

NOTE
- RETRACT SPEEDBRAKE AT AIRSPEEDS BELOW 350 KCAS, EXTEND ABOVE 350 KCAS
- CAS ON

DATE: 15 MARCH 1991
DATA BASIS: ESTIMATED





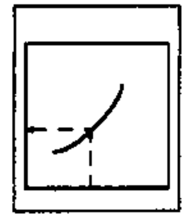
15E-1-(277-3)21-CATI

Figure A9-20 (Sheet 3)

DIVE RECOVER-EMERGENCY PULL-OUT

GROSS WEIGHT OF 70,000 POUNDS APPLICABLE ONLY FOR RECOVERIES BELOW 10,000 FEET

GUIDE

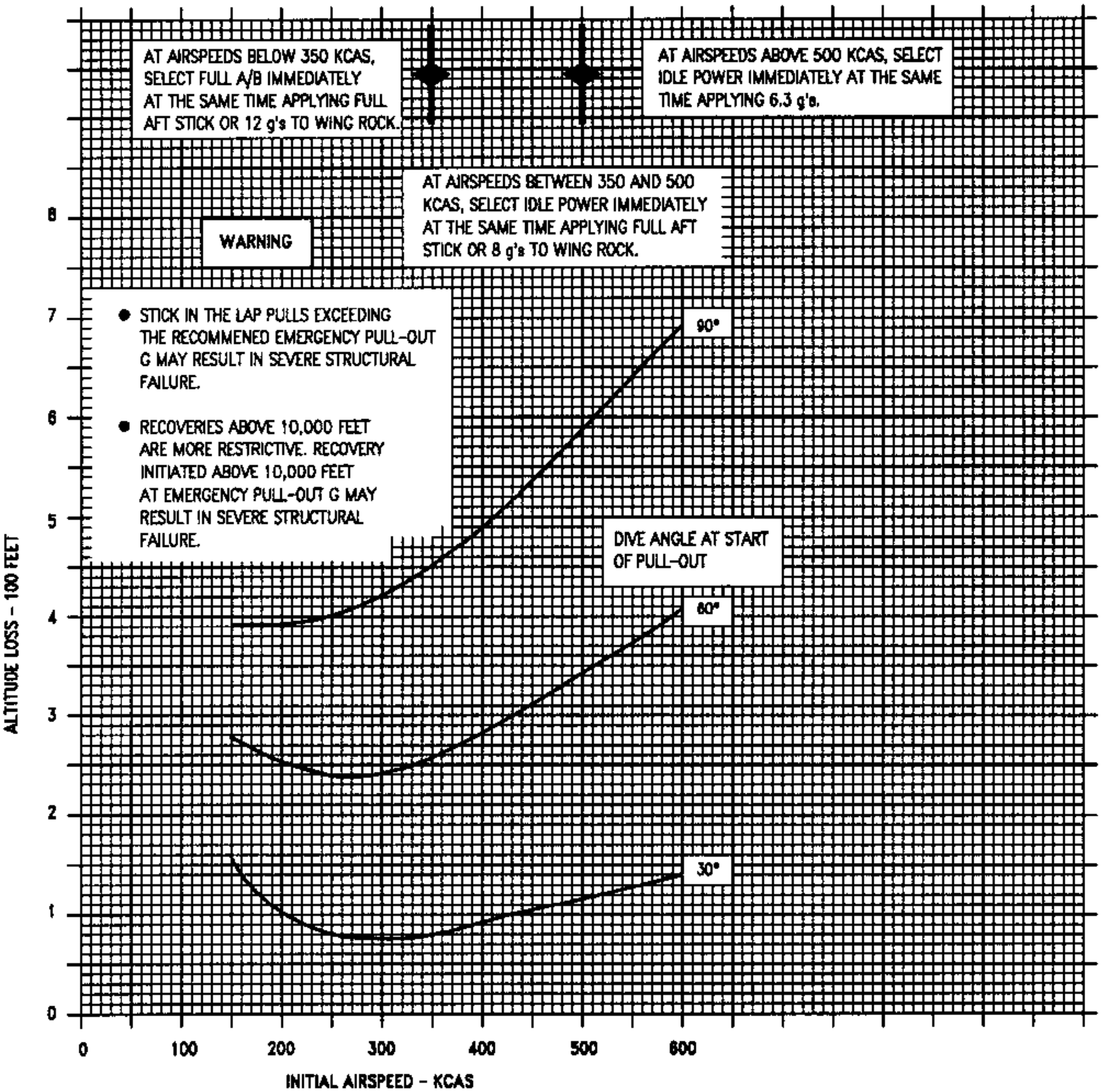


AIRPLANE CONFIGURATION
-4CFT+LANTIRN PODS+
(12)MK-82+(2)WING PYLONS
+(4)LAUNCHERS/ADAPTERS+
(4)AIM-9+CENTER LINE PYLON/TANK

REMARKS
ENGINE: (2)F100-PW-220
U.S. STANDARD DAY, 1966

DATE: 15 MARCH 1991
DATA BASIS: ESTIMATED

NOTE
- RETRACT SPEEDBRAKE AT AIRSPEEDS BELOW 350 KCAS, EXTEND ABOVE 350 KCAS
- CAS ON



15E-1-(277-4)21-CATI

Figure A9-20 (Sheet 4)

LOW ALTITUDE COMBAT PERFORMANCE

MAXIMUM THRUST

AIRPLANE CONFIGURATION
ALL DRAG INDEXES

REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

DATE:15 JUNE 1988
DATA BASIS: FLIGHT TEST

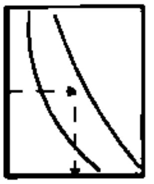
	CONSTANT KCAS	SPECIFIC FUEL FLOW–LB/MIN	TEMPERATURE EFFECTS ACTUAL OAT DEG C	TEMPERATURE EFFECTS CORRECTION FACTOR
SEA LEVEL (15°C)	300	1793	-40	1.19
	400	1936	-20	1.17
	500	2103	0	1.07
	600	2196	20	.98
	700	2526	40	.90
5000 FEET (5.1°C)	300	1579	-40	1.21
	400	1724	-20	1.14
	500	1901	0	1.03
	600	2113	20	.94
	700	2341	40	.86
10,000 FEET (-4.8°C)	300	1388	-40	1.18
	400	1540	-20	1.08
	500	1722	0	.97
	600	1934	20	.88
	700	2208	40	.81

15E-1-(206-1)44-CATI

Figure A9-21

COMBAT FUEL MANAGEMENT

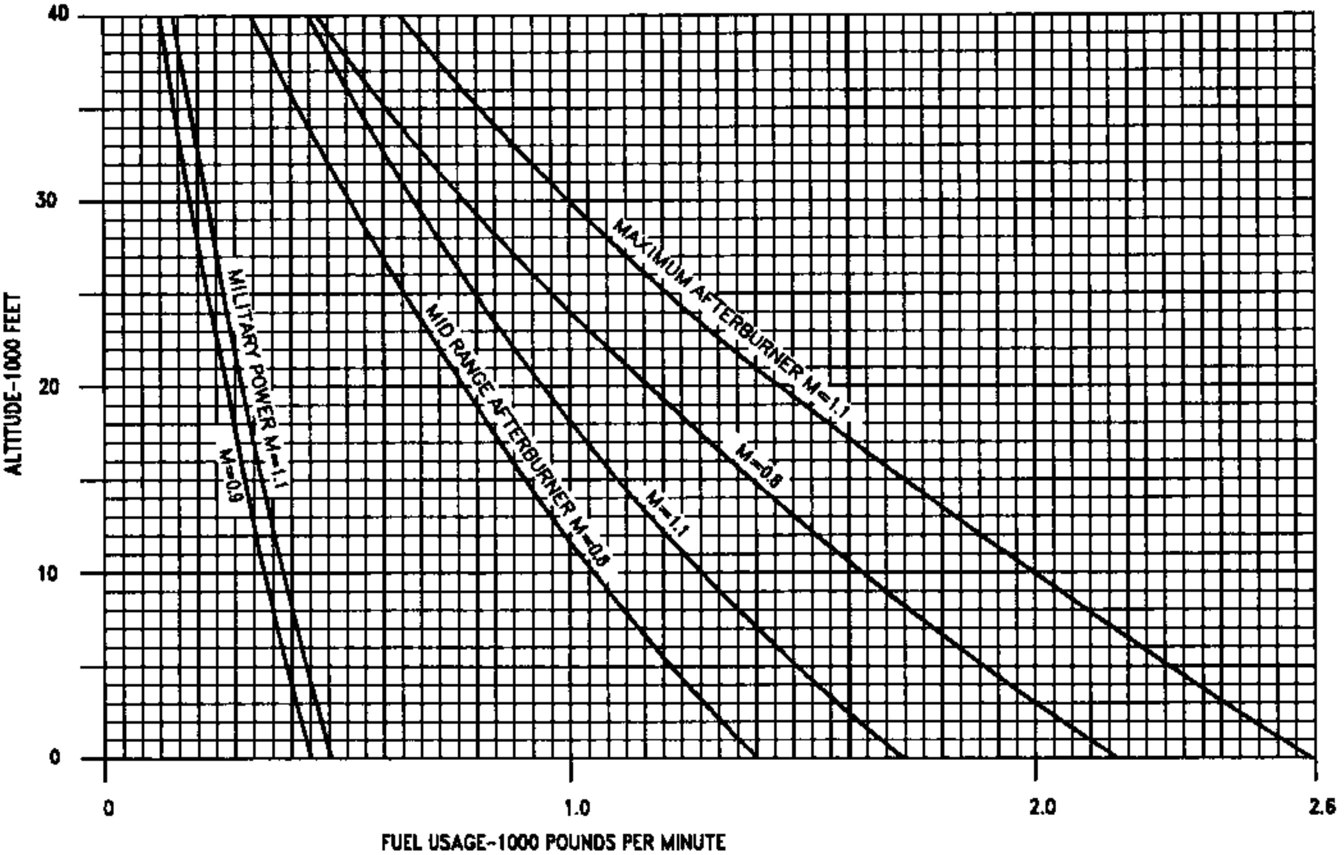
GUIDE



AIRPLANE CONFIGURATION
ALL DRAG INDEXES

REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

DATE: 15 APRIL 1990
DATA BASIS: FLIGHT TEST



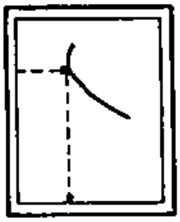
15E-1-(204-1)44-CATI

Figure A9-22

COMBAT FUEL FLOW

STABILIZED LEVEL FLIGHT

GUIDE



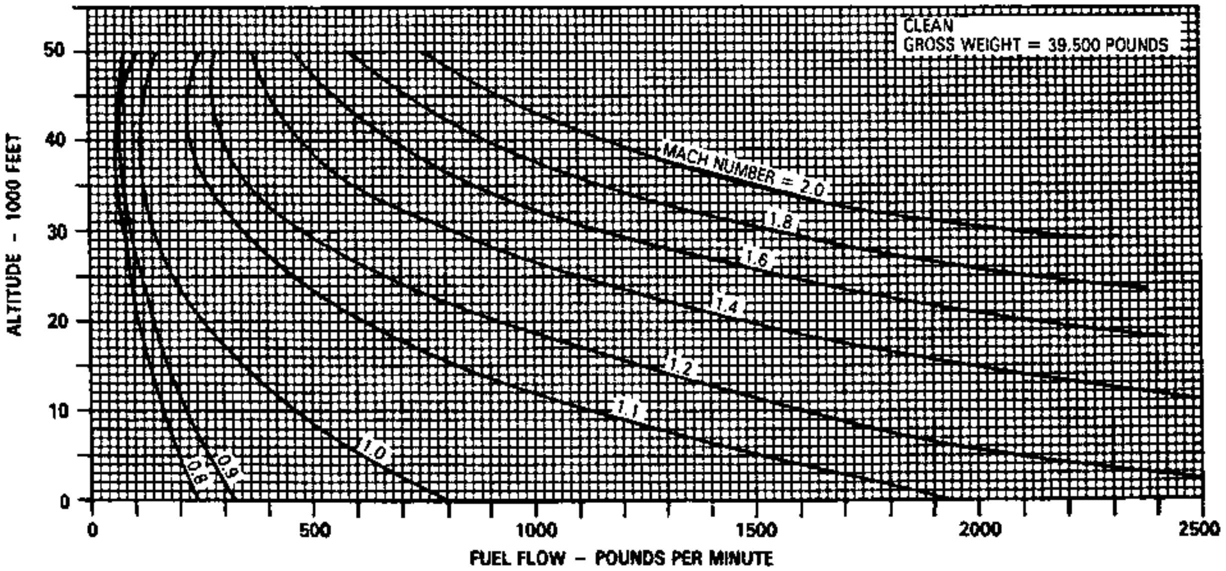
AIRPLANE CONFIGURATION

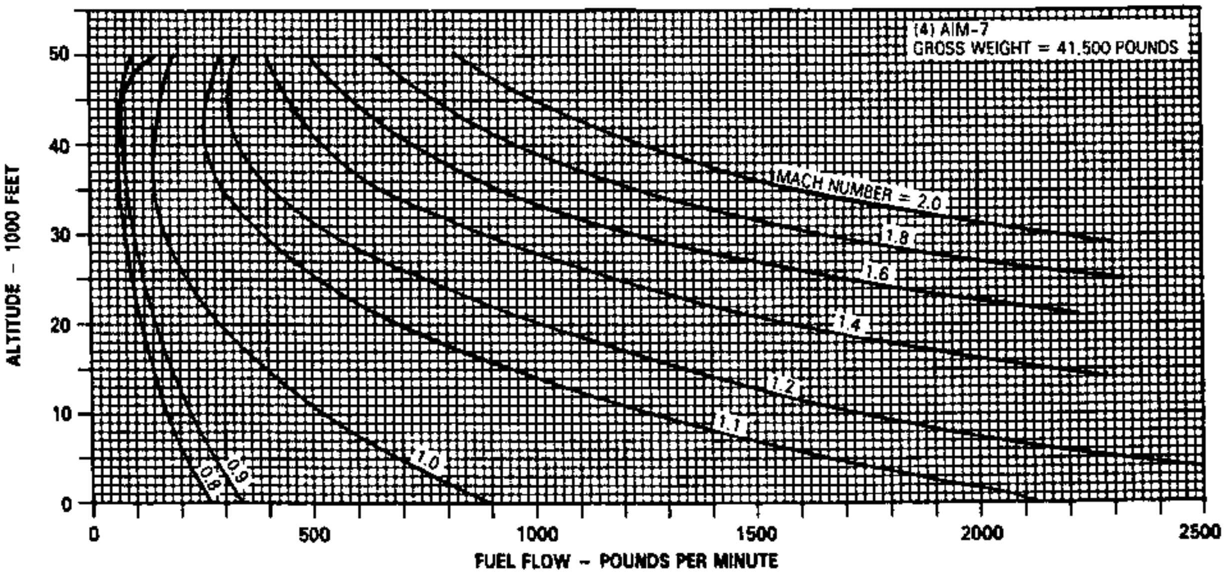
F-15E

REMARKS

ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

DATE: 15 APRIL 1990
DATA BASIS: FLIGHT TEST





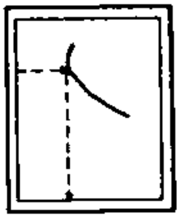
15E-1-(203)16

Figure A9-23

COMBAT FUEL FLOW

STABILIZED LEVEL FLIGHT

GUIDE



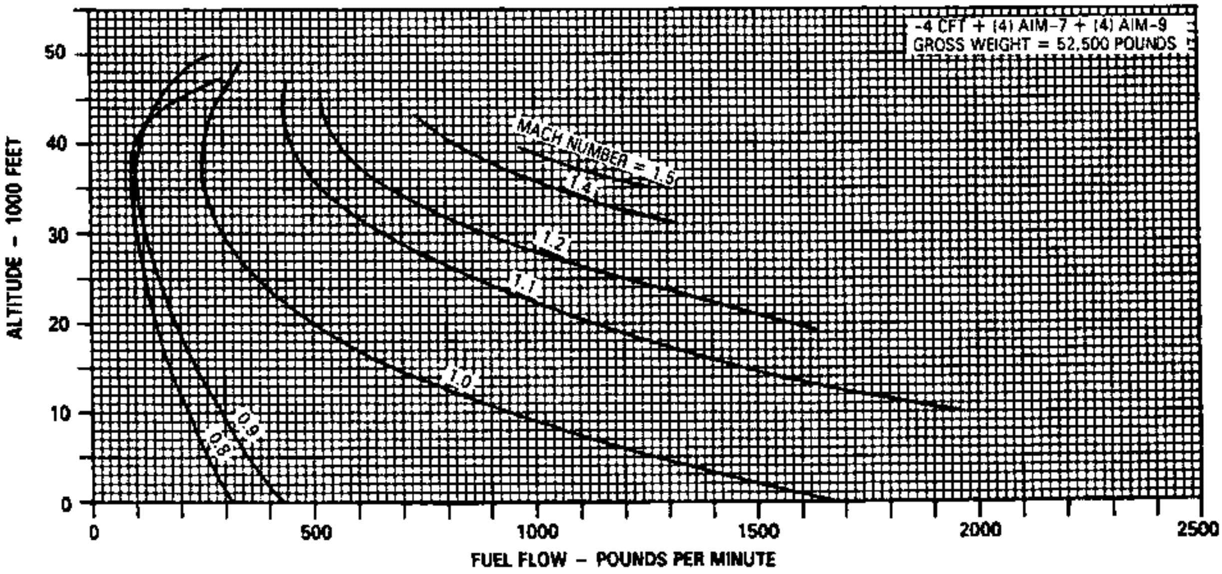
AIRPLANE CONFIGURATION

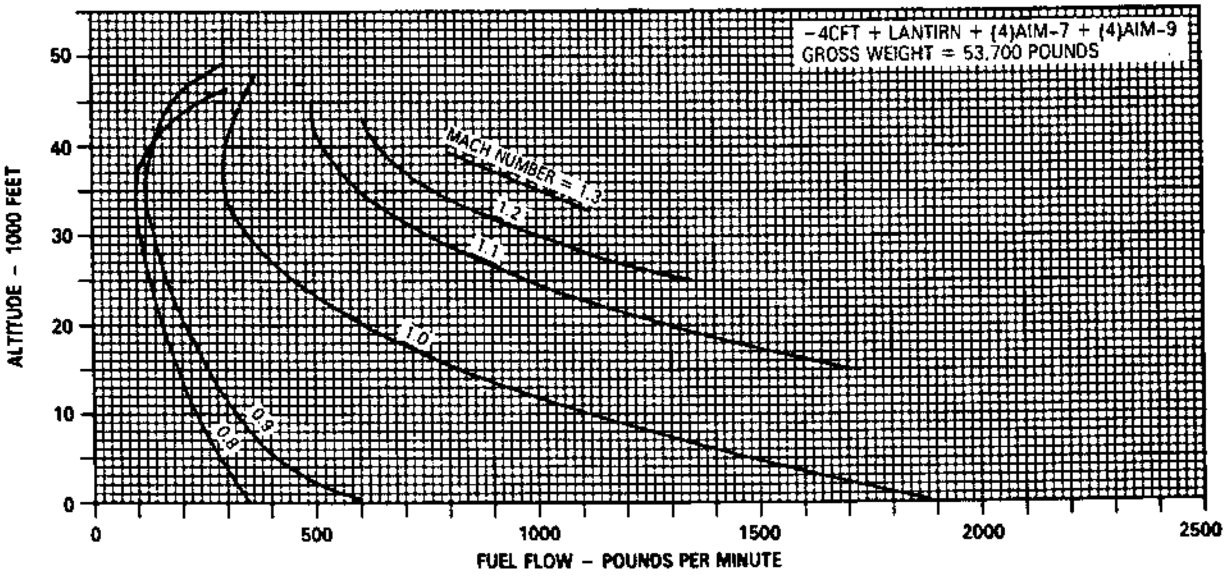
F-15E

REMARKS

ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

DATE: 15 APRIL 1990
DATA BASIS: (STORES) ESTIMATED
(AIRCRAFT/CFT) FLIGHT TEST





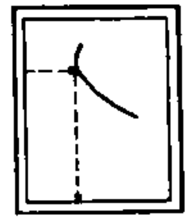
15E-1-(202)16

Figure A9-24

COMBAT FUEL FLOW

STABILIZED LEVEL FLIGHT

GUIDE



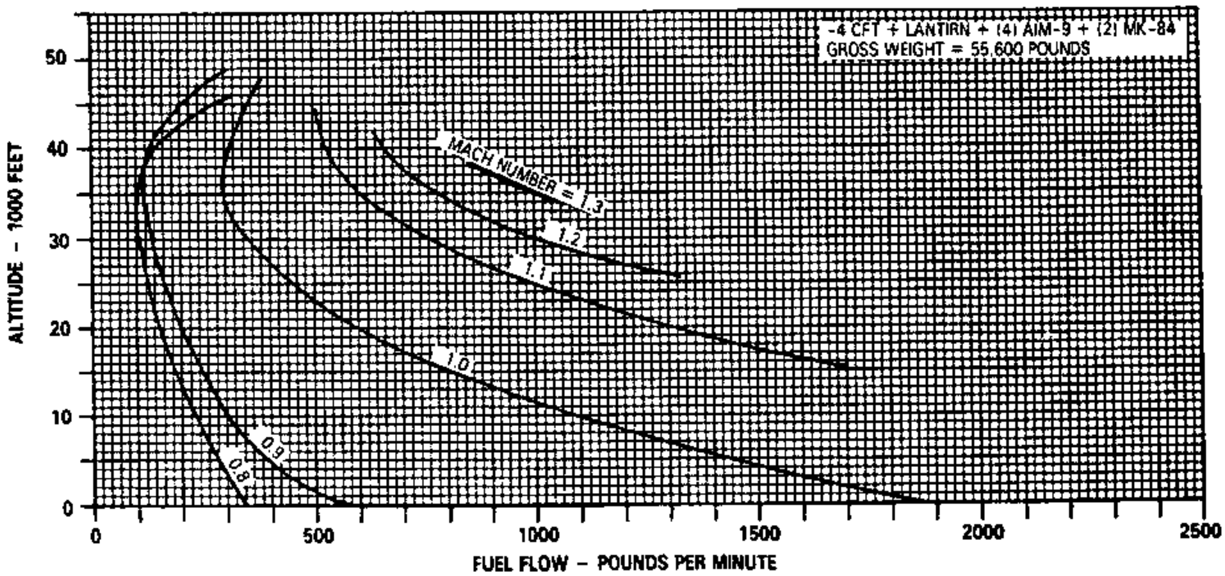
AIRPLANE CONFIGURATION

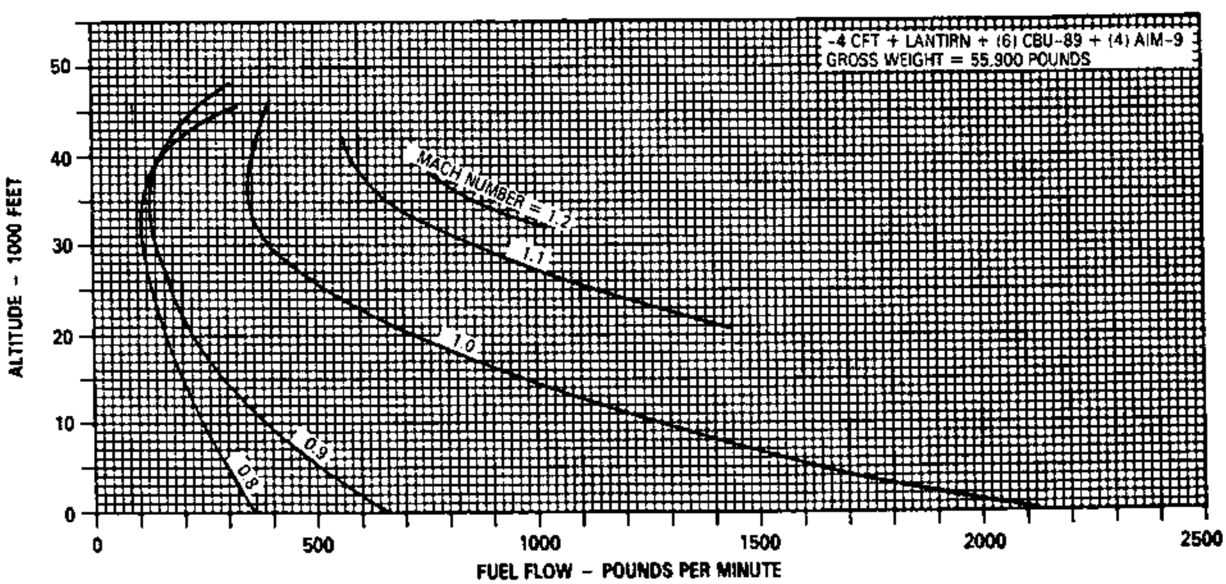
F-15E

REMARKS

ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

DATE: 15 APRIL 1990
DATA BASIS: (STORES) ESTIMATED
(AIRCRAFT/CFT) FLIGHT TEST





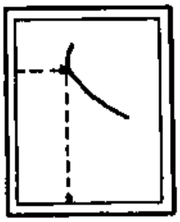
15E-1-(201)16

Figure A9-25

COMBAT FUEL FLOW

STABILIZED LEVEL FLIGHT

GUIDE



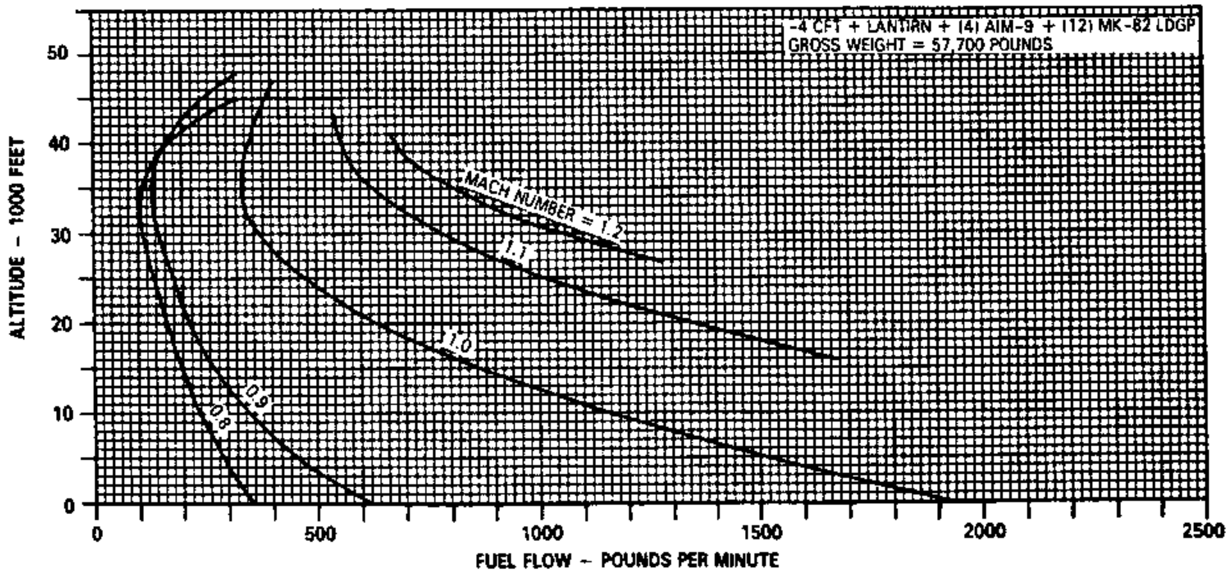
AIRPLANE CONFIGURATION

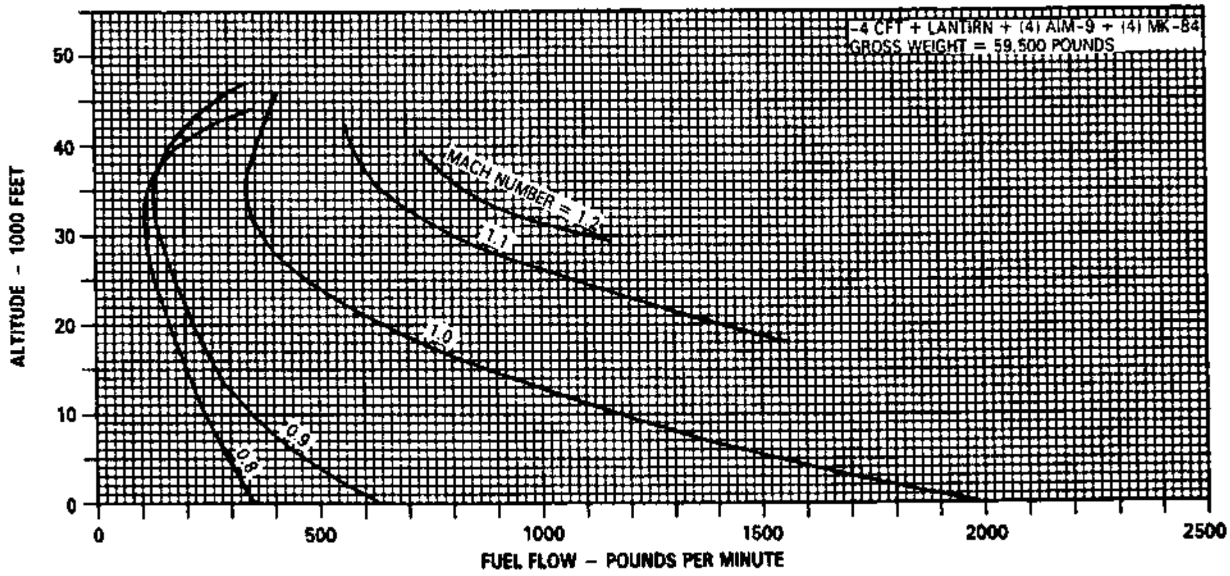
F-15E

REMARKS

ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

DATE: 15 APRIL 1990
DATA BASIS: (STORES) ESTIMATED
(AIRCRAFT/CFT) FLIGHT TEST





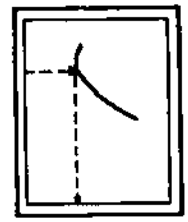
15E-1-(199)16

Figure A9-26

COMBAT FUEL FLOW

STABILIZED LEVEL FLIGHT

GUIDE



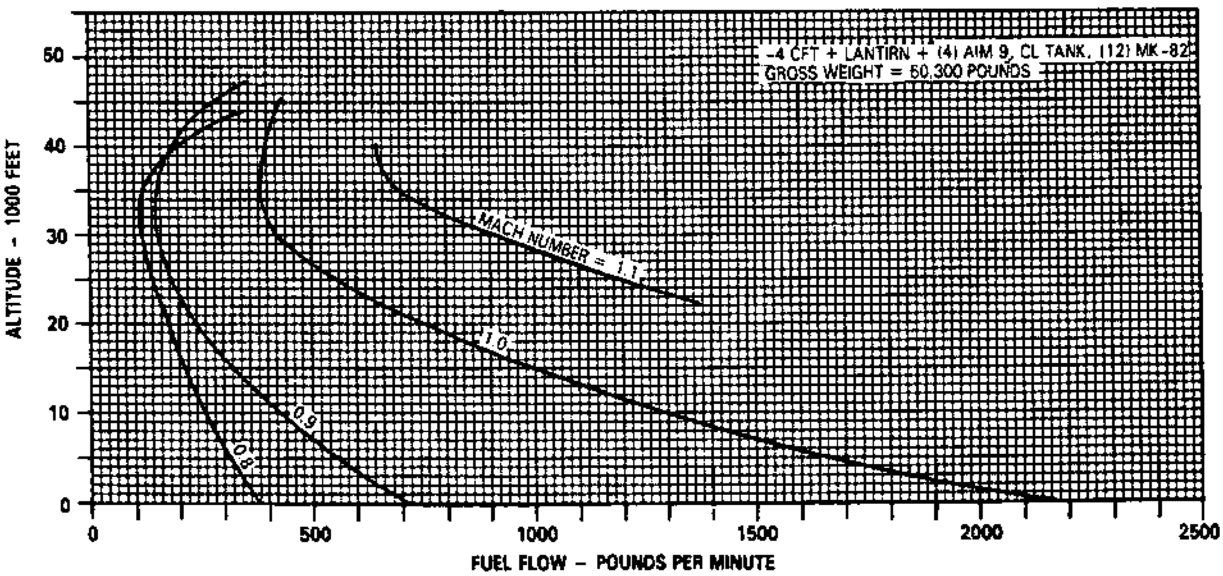
AIRPLANE CONFIGURATION

F-15E

REMARKS

ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

DATE: 15 APRIL 1990
DATA BASIS: (STORES) ESTIMATED
(AIRCRAFT/CFT) FLIGHT TEST



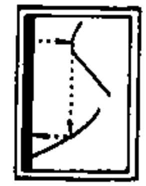
15E-1-(200)16

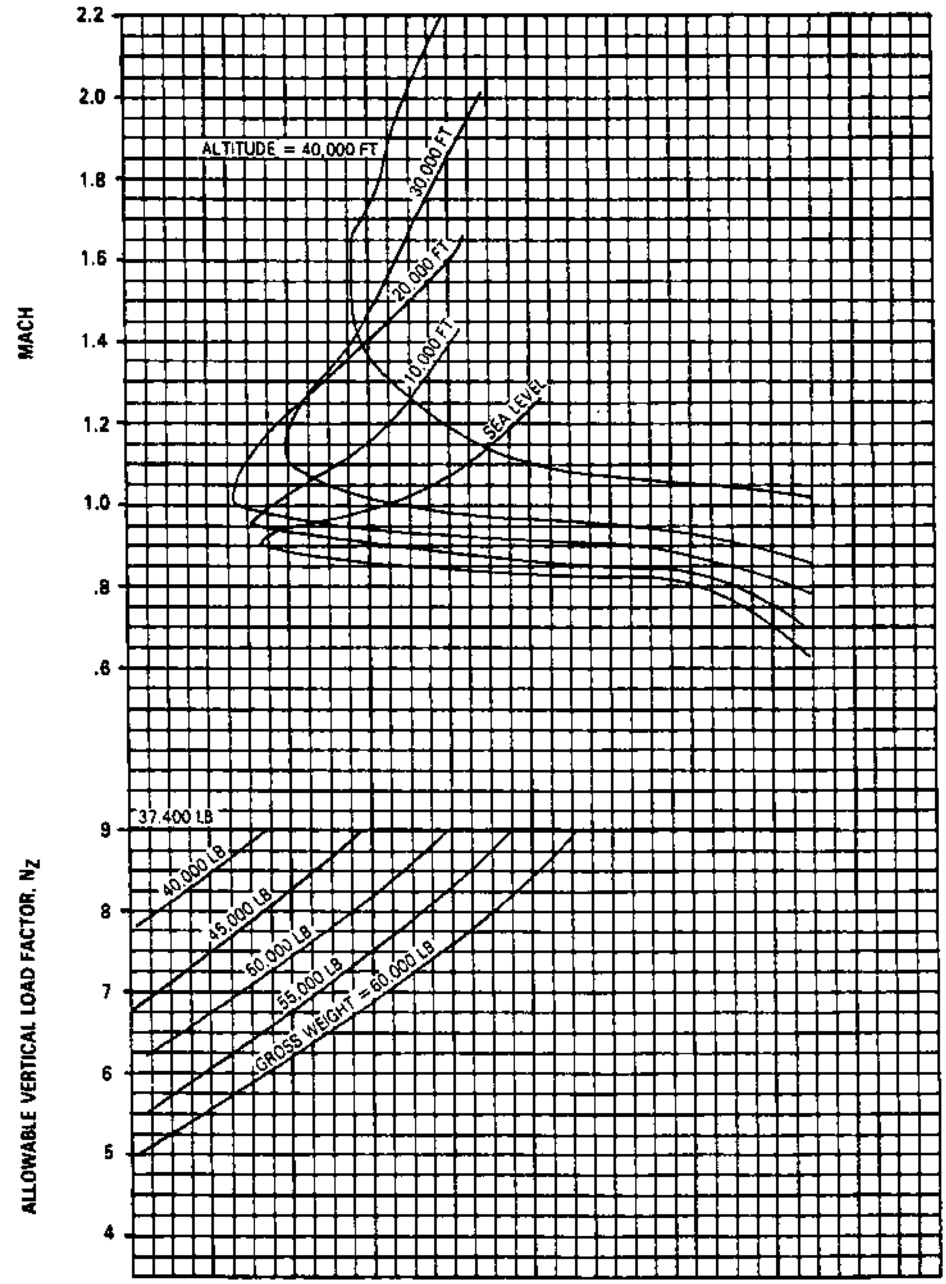
Figure A9-27

OVERLOAD WARNING SYSTEM SYMMETRICAL ALLOWABLE LOAD FACTORS

NOTE

1. NO WING TANKS OR STORES
2. CFT NOT INSTALLED





15E-1-(256)18

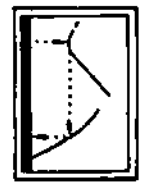
Figure A9-28

OVERLOAD WARNING SYSTEM SYMMETRICAL ALLOWABLE LOAD FACTORS - CFT/AIRCRAFT INTERFACE

TANKS OR STORES ON WING STATIONS 2 AND 8

NOTE

1. CFT NOT INSTALLED



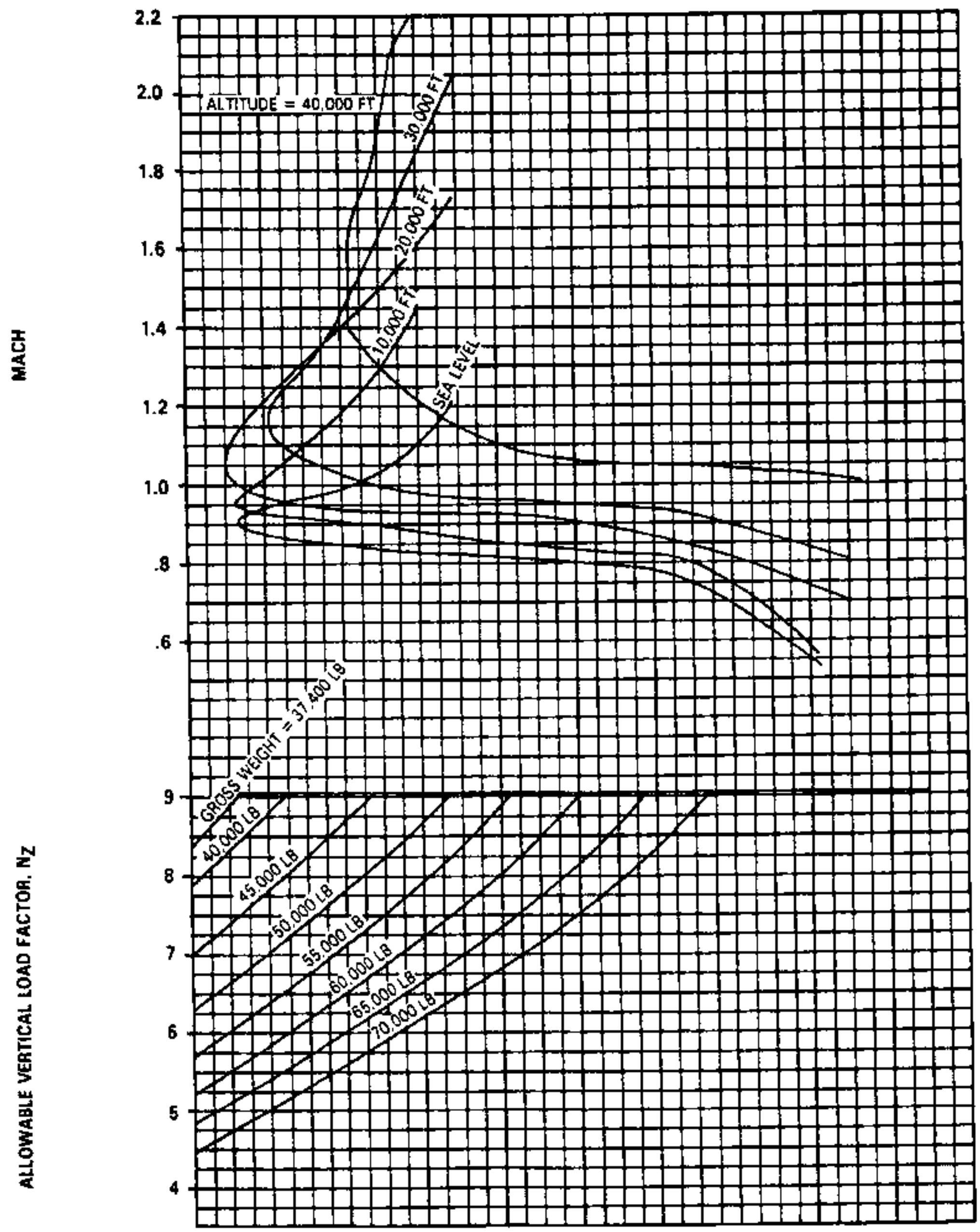
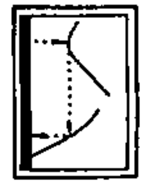


Figure A9-29

OVERLOAD WARNING SYSTEM SYMMETRICAL ALLOWABLE LOAD FACTORS - CFT/AIRCRAFT INTERFACE

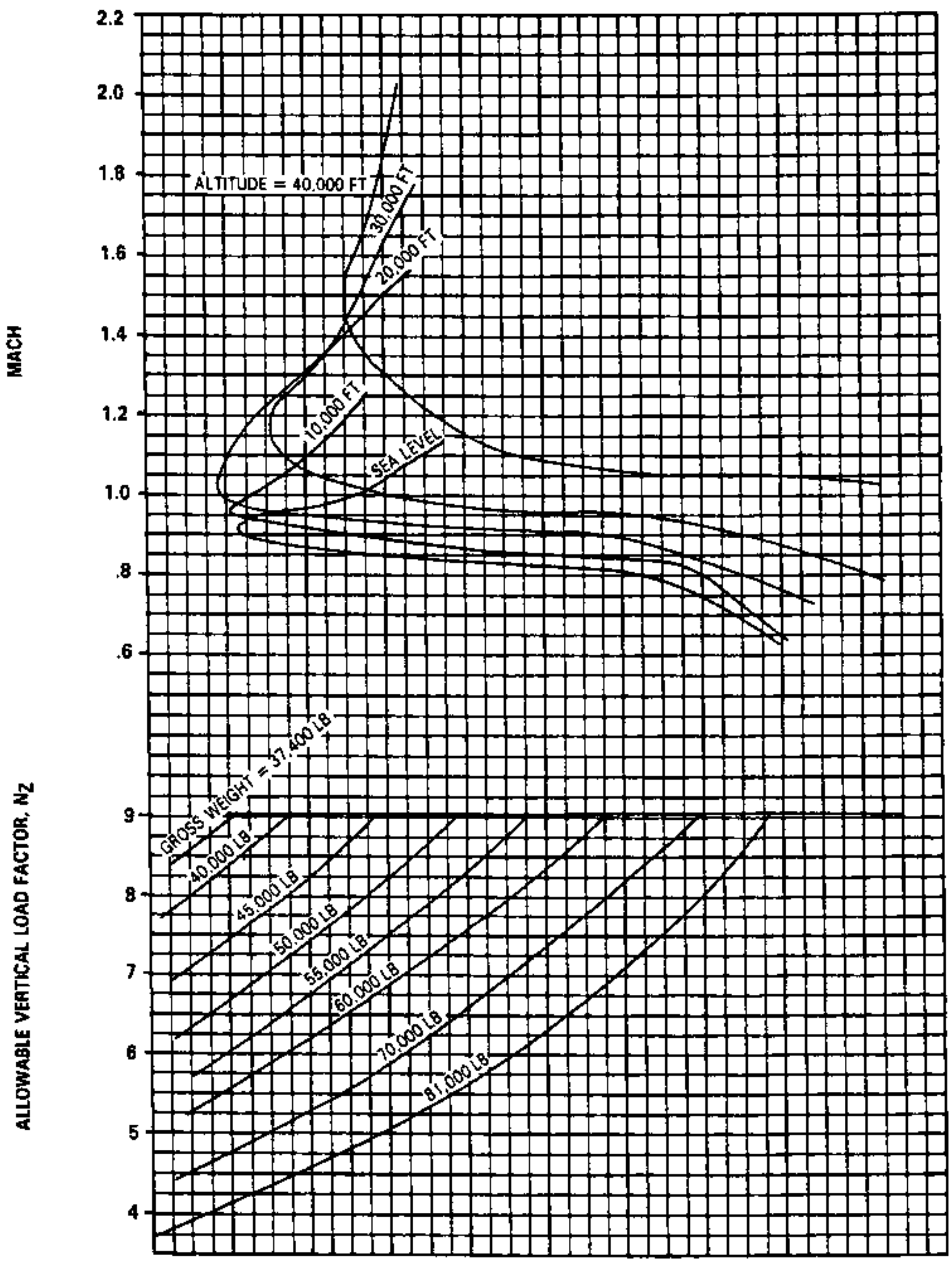
CFT STORE STATIONS CLEAN

GUIDE



NOTE

1. NO WING TANKS OR STORES
2. BASED ON CFT WEIGHT = 2106 LB + FUEL PER SIDE



15E-1-(258)1B

Figure A9-30

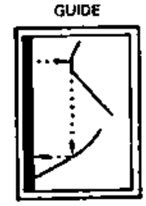
OVERLOAD WARNING SYSTEM SYMMETRICAL ALLOWABLE LOAD FACTORS - CFT/AIRCRAFT INTERFACE

TANKS OR STORES ON WING STATIONS 2 AND 8

CFT STORE STATIONS CLEAN

NOTE

1. BASED ON CFT WEIGHT = 2106 LB + FUEL PER SIDE



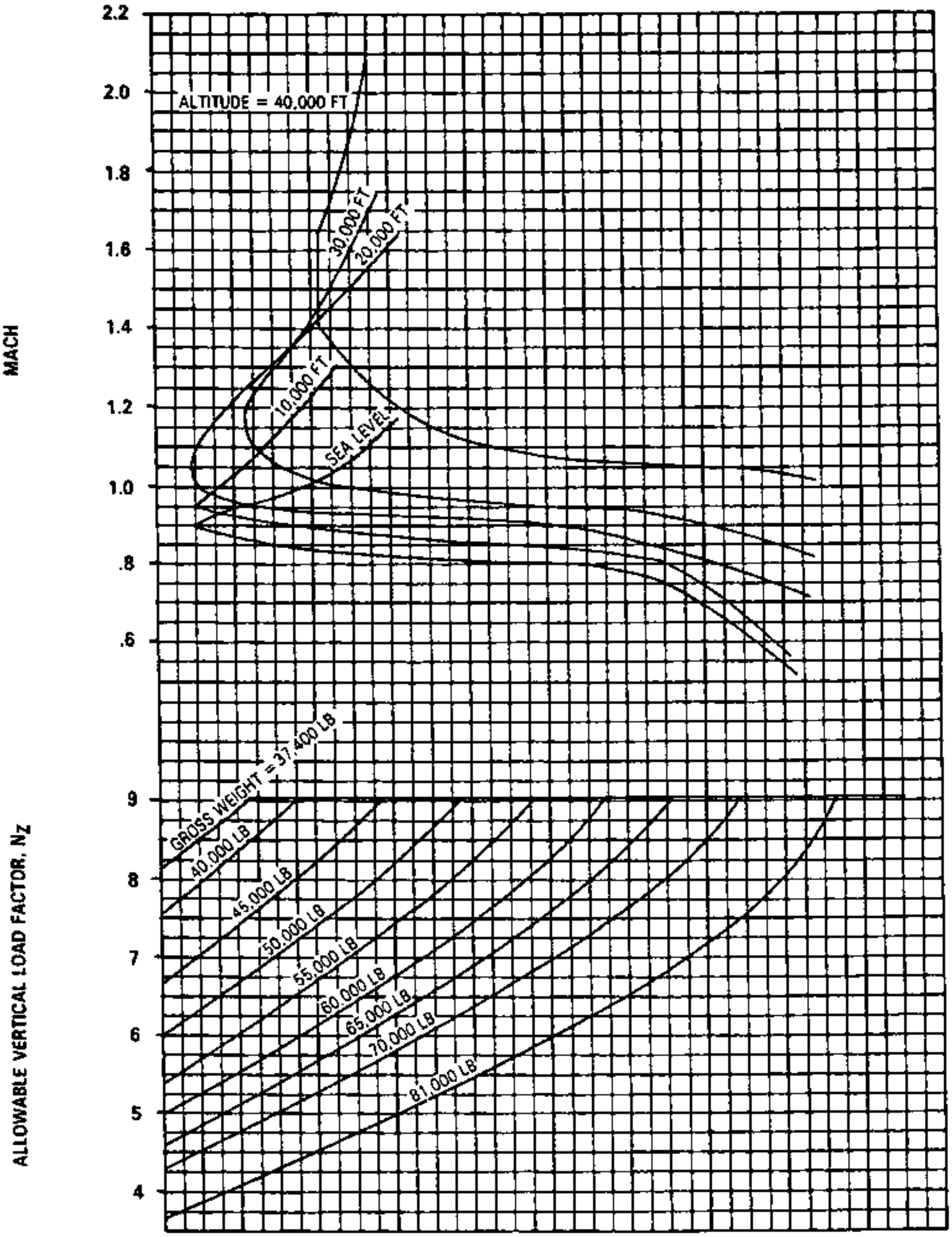


Figure A9-31

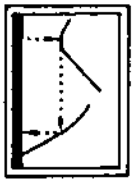
OVERLOAD WARNING SYSTEM SYMMETRICAL ALLOWABLE LOAD FACTORS - CFT/AIRCRAFT INTERFACE

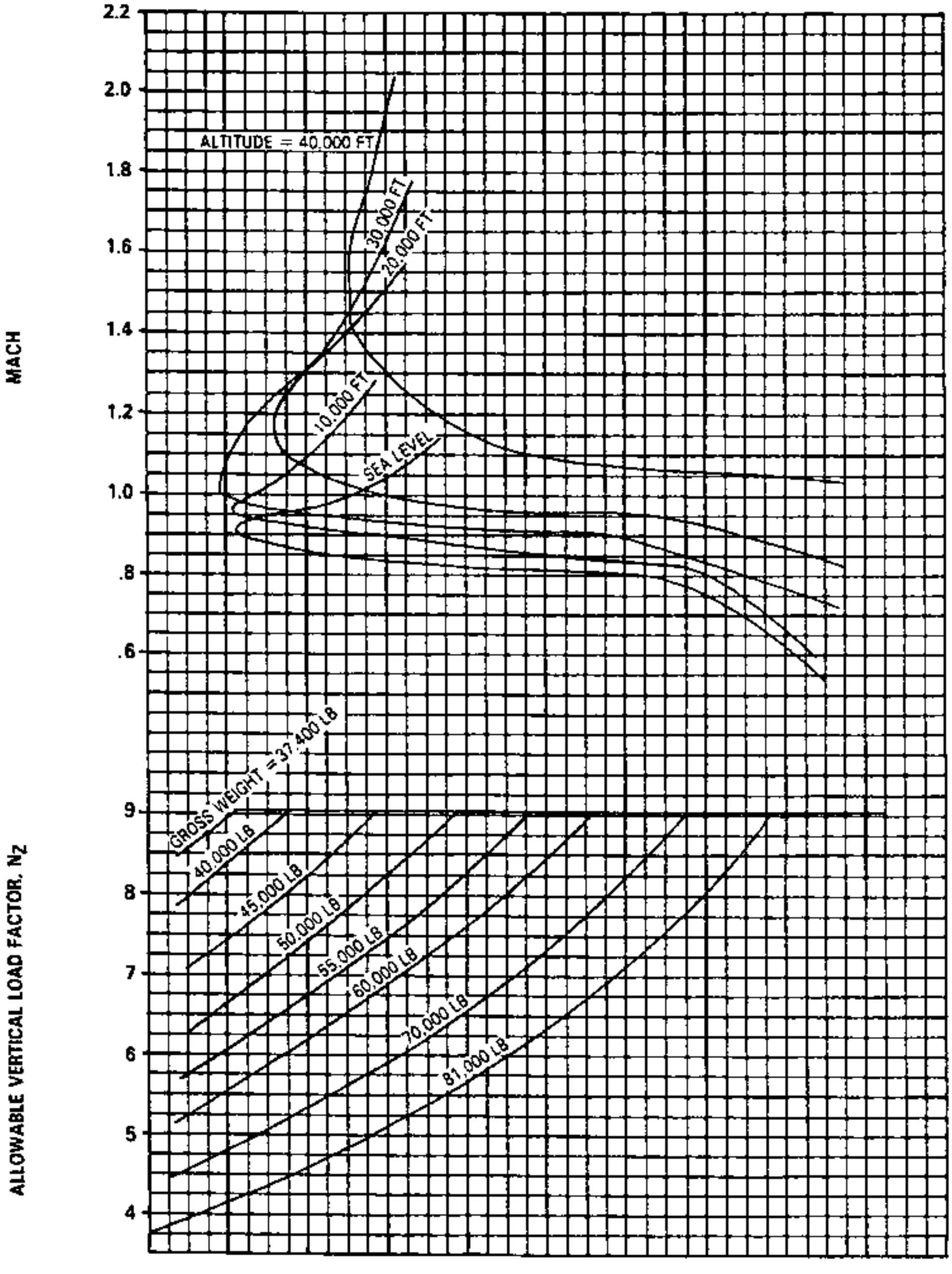
AIM-7 MISSILES ON CFT STORE STATIONS

NOTE

1. NO WING TANKS OR STORES
2. BASED ON CFT WEIGHT = 3126 LB + FUEL PER SIDE

GUIDE





15E-1-(260)1B

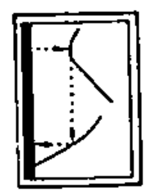
Figure A9-32

OVERLOAD WARNING SYSTEM SYMMETRICAL ALLOWABLE LOAD FACTORS - CFT/AIRCRAFT INTERFACE

AIM-7 MISSILES ON CFT STORE STATIONS TANKS OR STORES ON WING STATIONS 2 AND 8

NOTE

1. BASED ON CFT WEIGHT = 3126 LB + FUEL PER SIDE



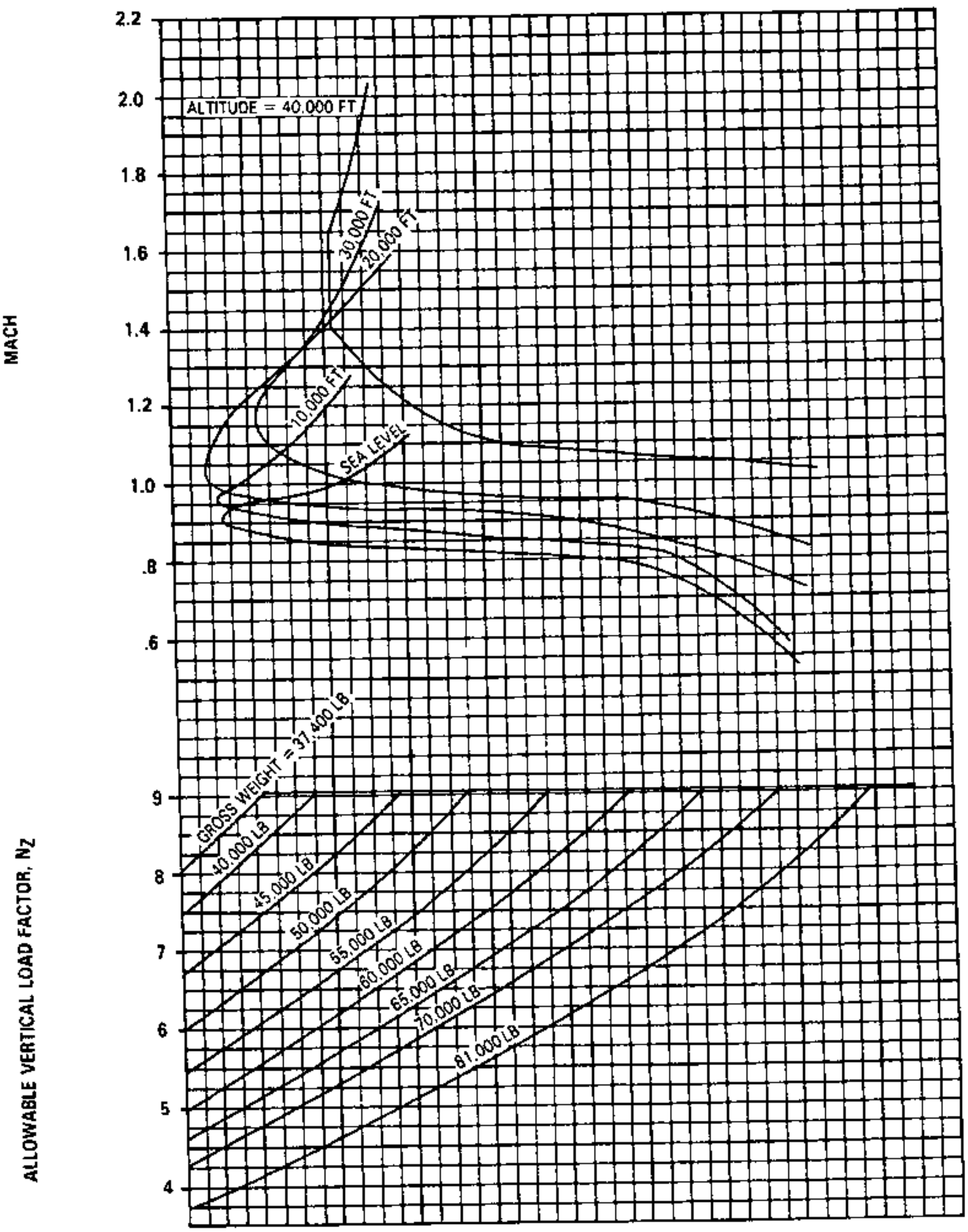


Figure A9-33

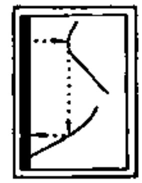
OVERLOAD WARNING SYSTEM SYMMETRICAL ALLOWABLE LOAD FACTORS - CFT/AIRCRAFT INTERFACE

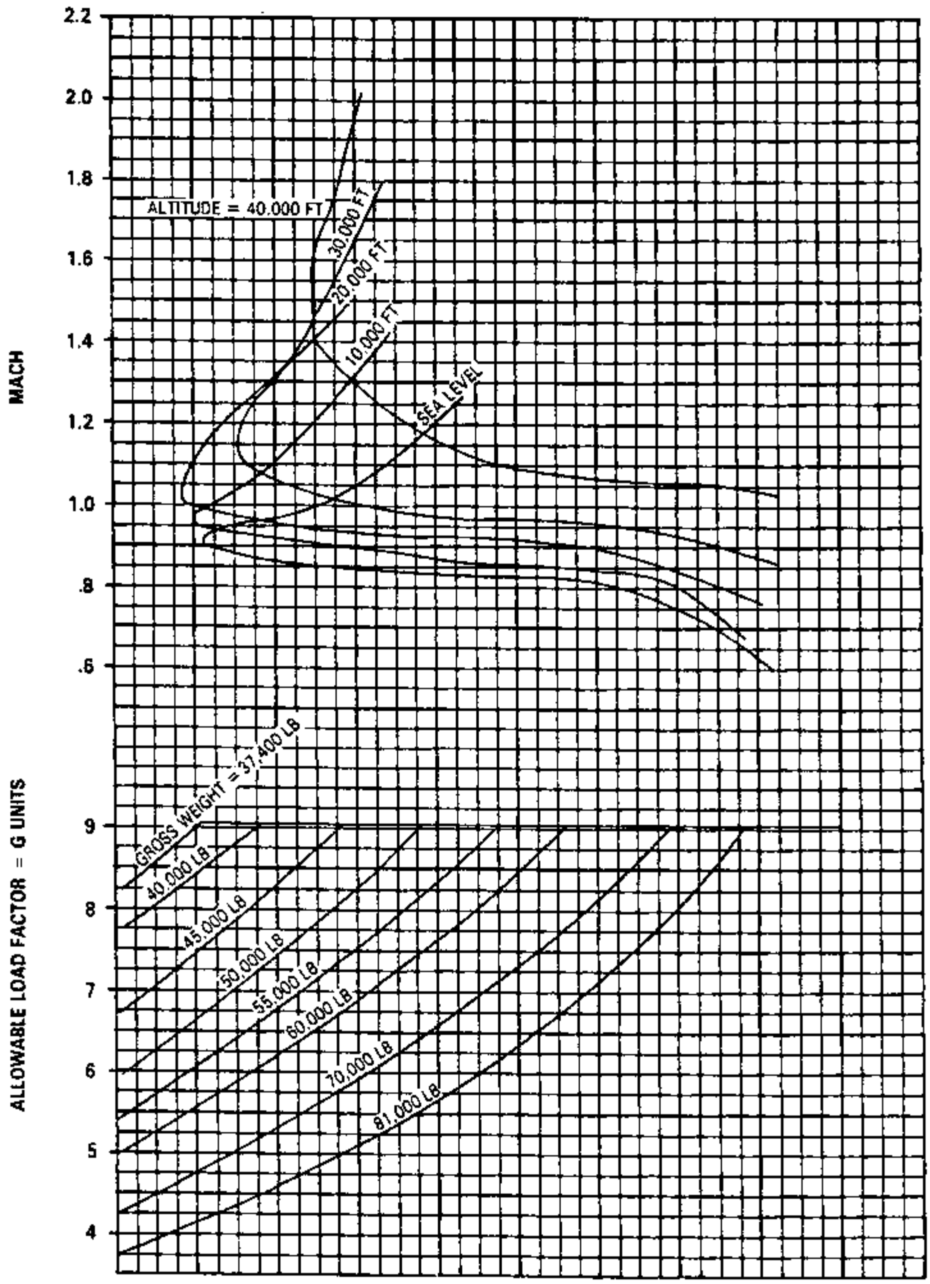
STORE ON CENTER INBOARD CFT STORE STATION

NOTE

1. NO WING TANKS OR STORES
2. EXTERNAL STORES LIMITATIONS MAY BE MORE RESTRICTIVE
3. BASED ON CFT WEIGHT = 4406 LB + FUEL PER SIDE

GUIDE





15E-1-1262118

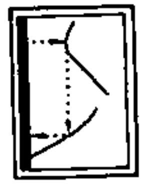
Figure A9-34

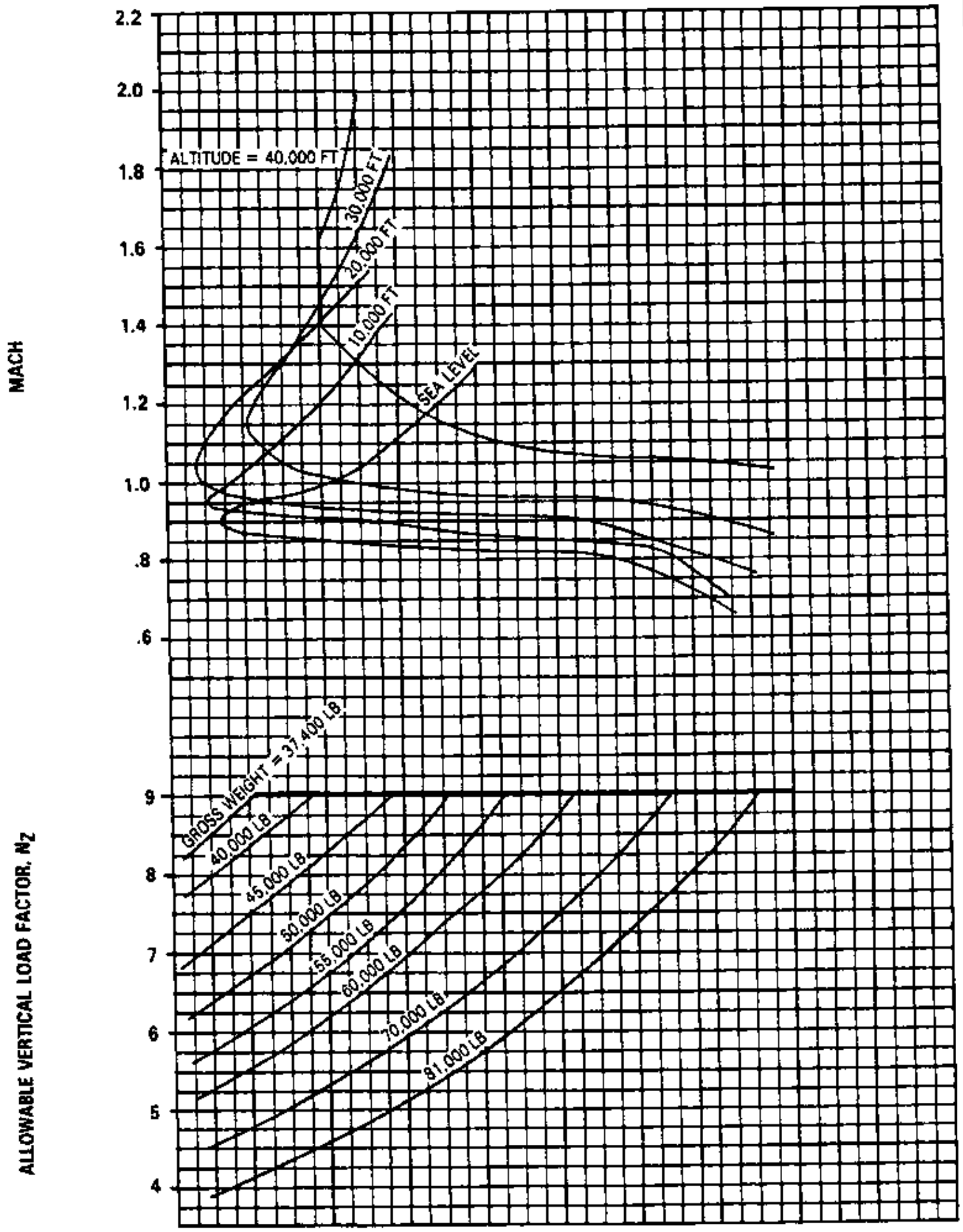
OVERLOAD WARNING SYSTEM SYMMETRICAL ALLOWABLE LOAD FACTORS - CFT/AIRCRAFT INTERFACE

TANKS OR STORES ON WING STATIONS 2 AND 8 STORE ON CENTER INBOARD CFT STORE STATION

NOTE

1. EXTERNAL STORES LIMITATIONS MAY BE MORE RESTRICTIVE
2. BASED ON CFT WEIGHT = 4406 LB + FUEL PER SIDE





15E-1-(263)18

Figure A9-35

OVERLOAD WARNING SYSTEM SYMMETRICAL ALLOWABLE LOAD FACTORS - CFT/AIRCRAFT INTERFACE

STORES ON FWD AND AFT INBOARD CFT STORE STATIONS

NOTE

1. NO WING TANKS OR STORES
2. EXTERNAL STORES LIMITATIONS MAY BE MORE RESTRICTIVE
3. BASED ON CFT WEIGHT = 6306 LB + FUEL PER SIDE

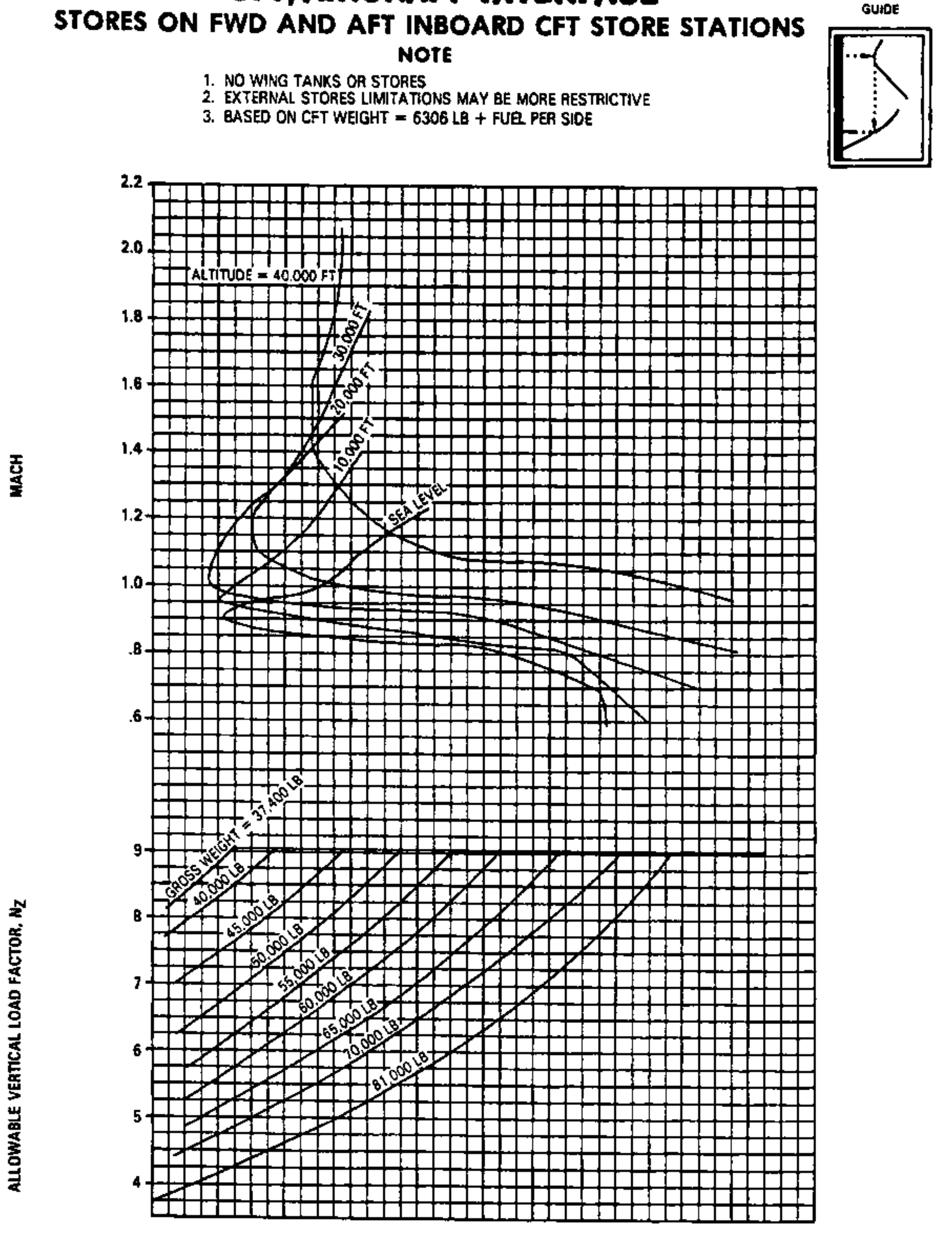


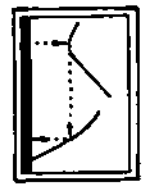
Figure A9-36

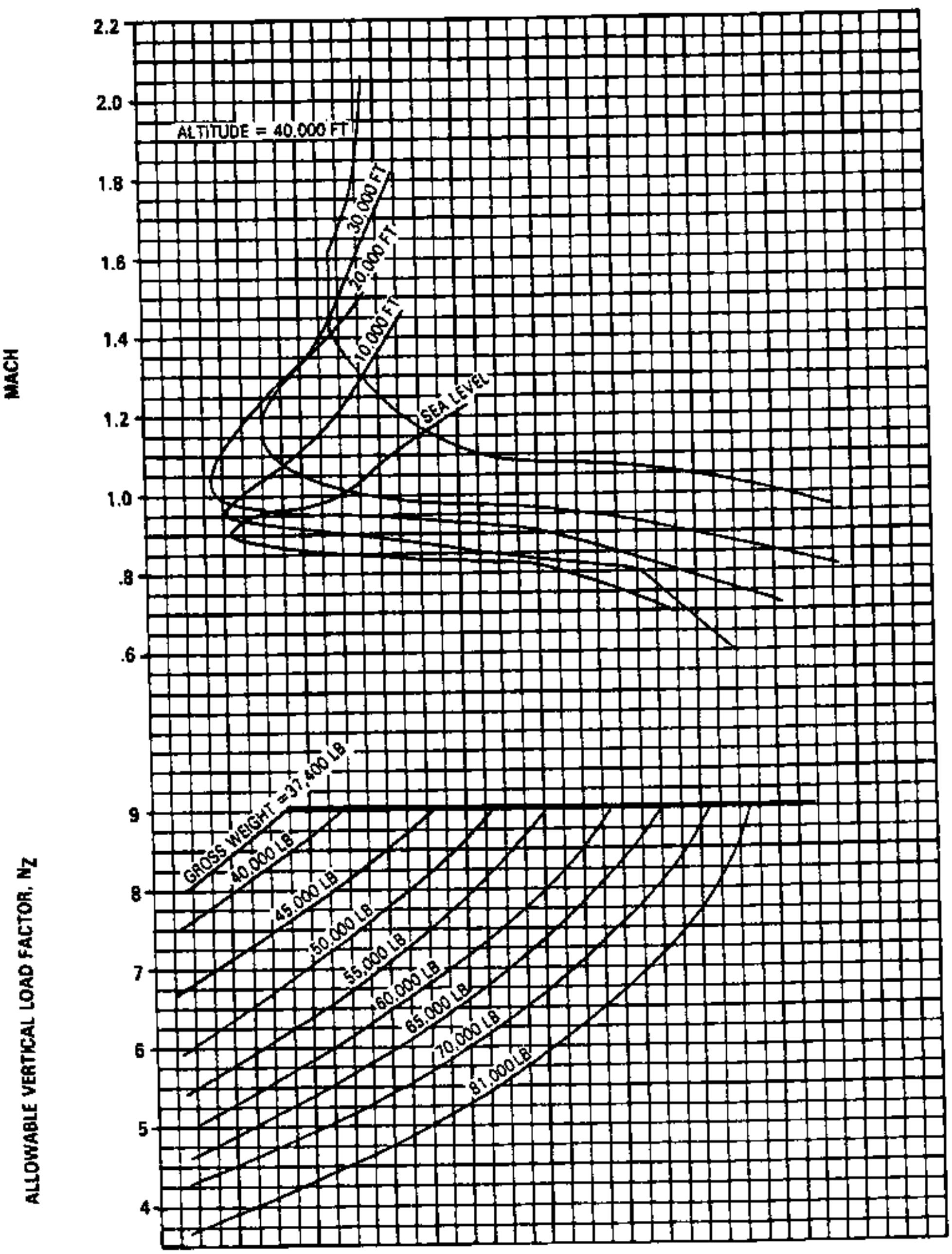
OVERLOAD WARNING SYSTEM SYMMETRICAL ALLOWABLE LOAD FACTORS - CFT/AIRCRAFT INTERFACE

TANKS OR STORES ON WING STATIONS 2 AND 8 STORES ON FWD AND AFT INBOARD CFT STORE STATIONS

NOTE

1. EXTERNAL STORES LIMITATIONS MAY BE MORE RESTRICTIVE
2. BASED ON CFT WEIGHT = 6306 LB + FUEL PER SIDE



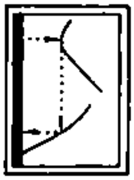


15E-1-(265)1B

Figure A9-37

OVERLOAD WARNING SYSTEM SYMMETRICAL ALLOWABLE LOAD FACTORS - CFT/AIRCRAFT INTERFACE

STORES ON ALL CFT STORE STATIONS



NOTE

1. NO WING TANKS OR STORES
2. EXTERNAL STORES LIMITATIONS MAY BE MORE RESTRICTIVE
3. BASED ON CFT WEIGHT = 7806 LB + FUEL PER SIDE

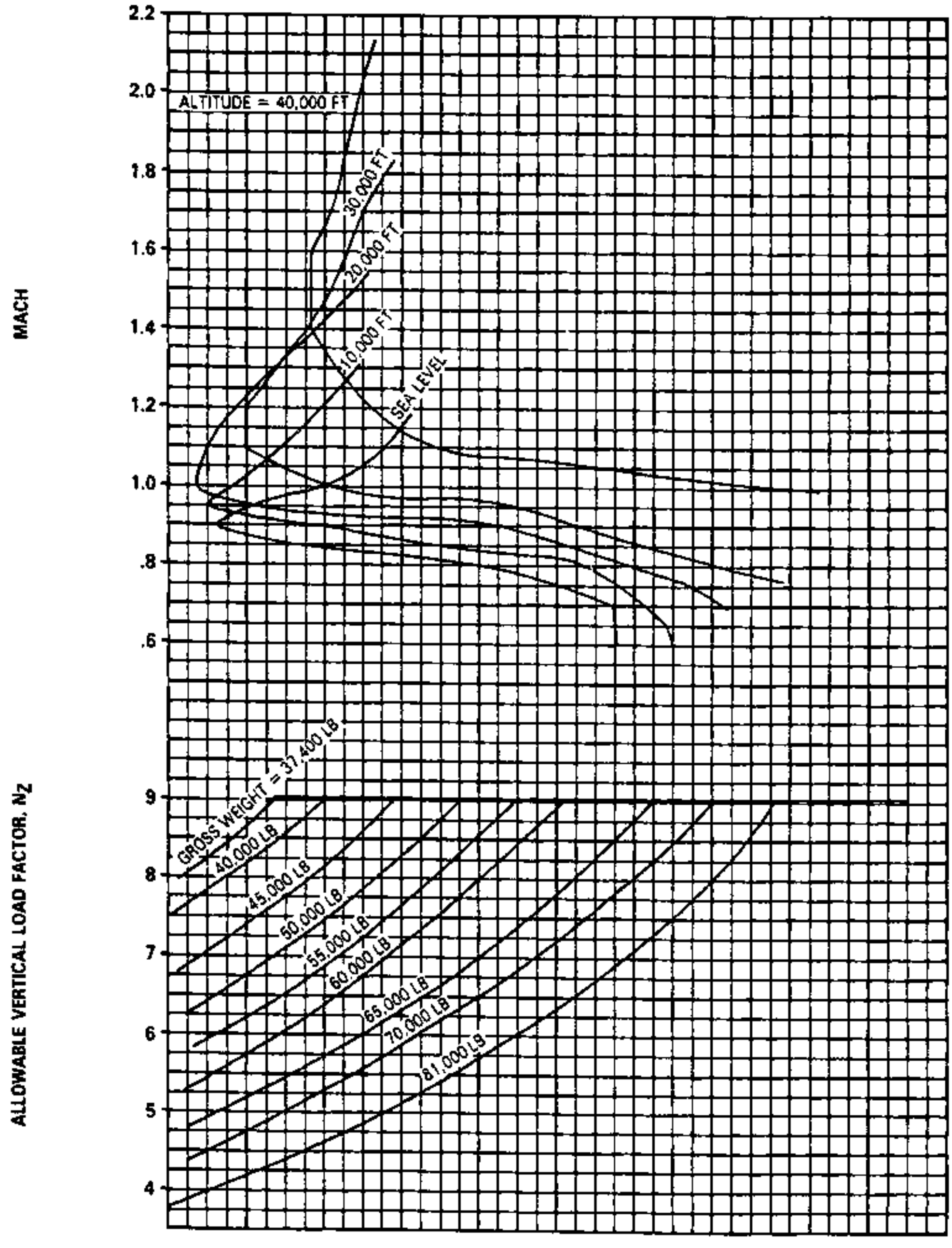


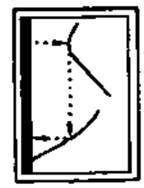
Figure A9-38

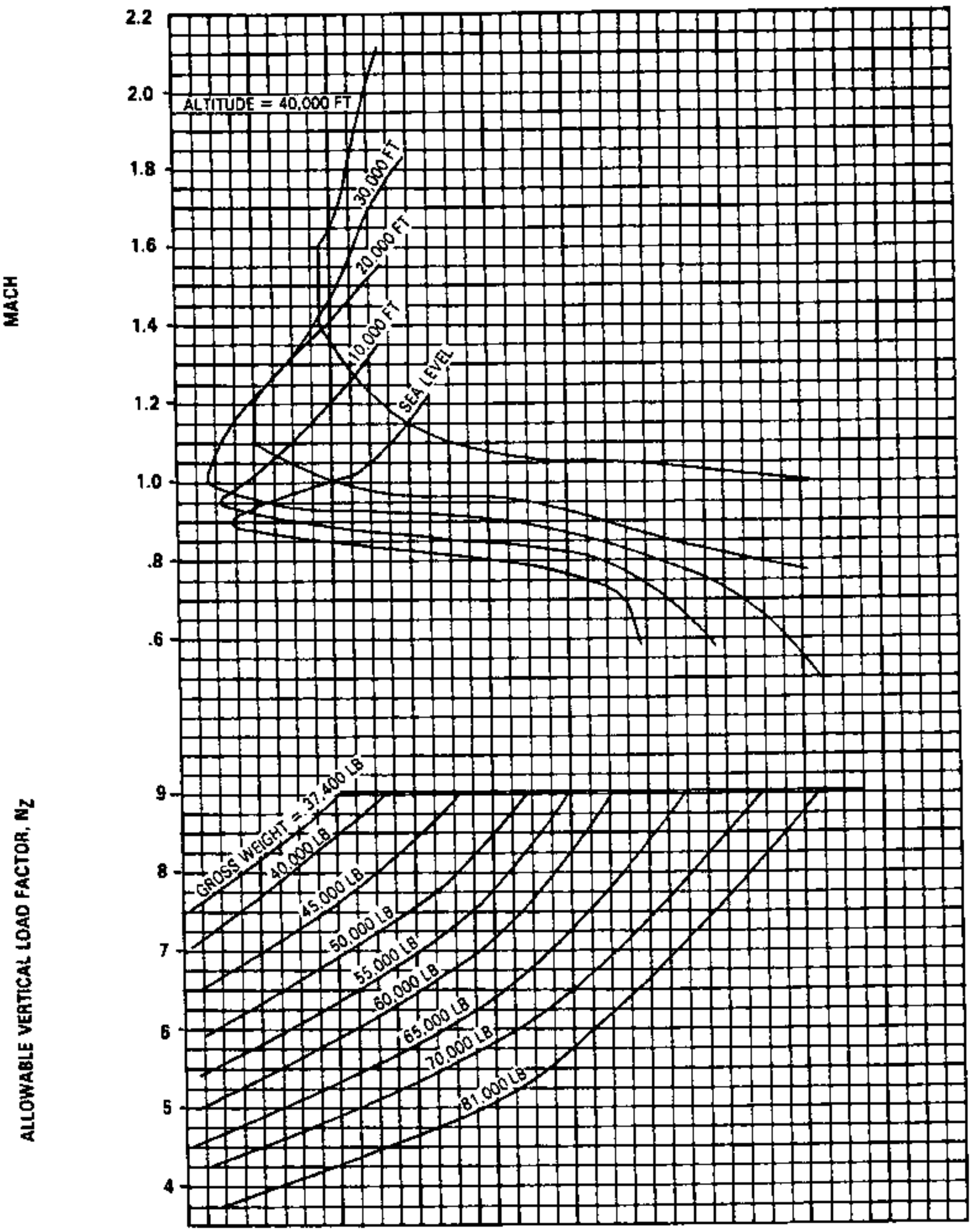
OVERLOAD WARNING SYSTEM SYMMETRICAL ALLOWABLE LOAD FACTORS - CFT/AIRCRAFT INTERFACE

TANKS OR STORES ON WING STATIONS 2 AND 8 STORES ON ALL CFT STORE STATIONS

NOTE

1. EXTERNAL STORES LIMITATIONS MAY BE MORE RESTRICTIVE
2. BASED ON CFT WEIGHT = 7806 LB + FUEL PER SIDE





15E-1-(267)18

Figure A9-39

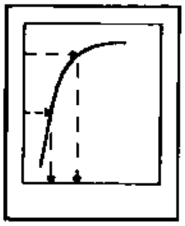
LEVEL FLIGHT ACCELERATION

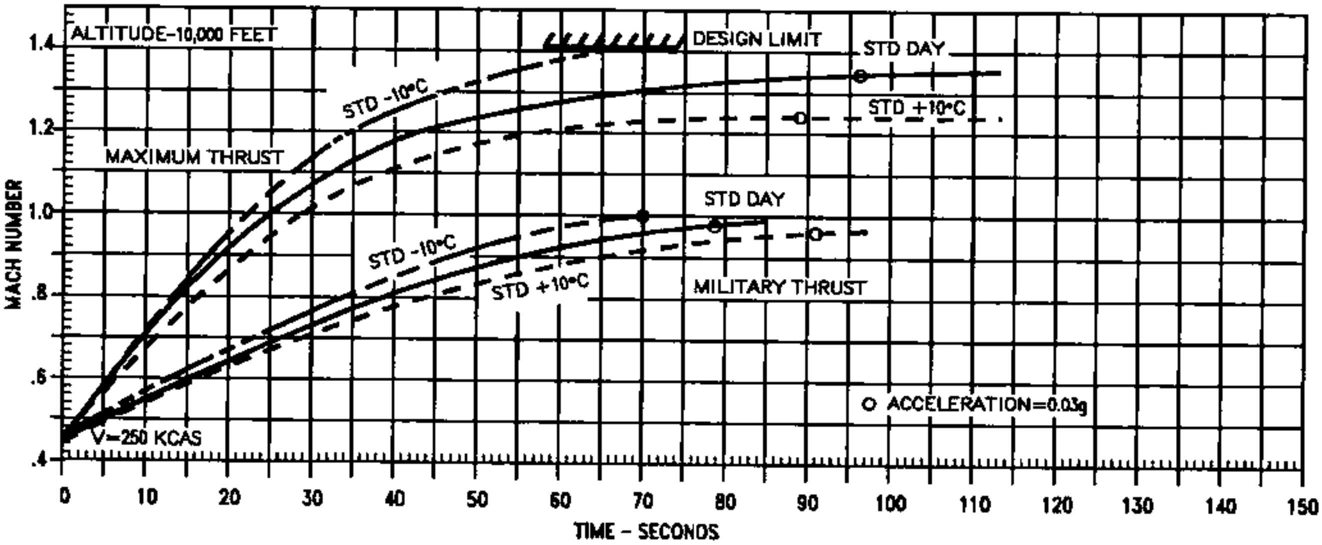
INITIAL GROSS WEIGHT – 42,800 POUNDS

AIRPLANE CONFIGURATION
CLEAN

REMARKS
ENGINE(S): (2) F100-PW-220
1g LOAD FACTOR

DATE: 15 APRIL 1990
DATA BASIS: FLIGHT TEST





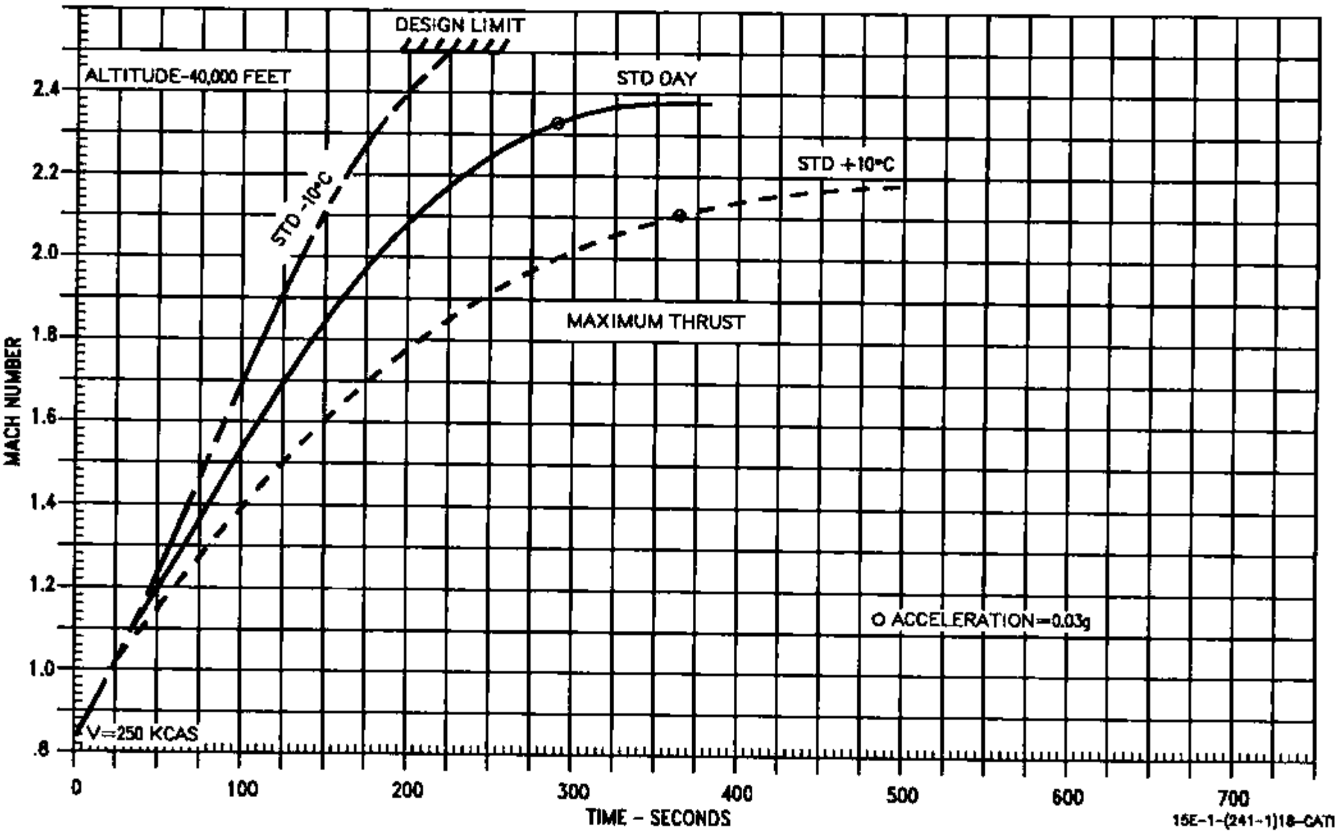
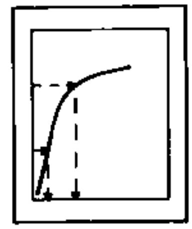


Figure A9-40

LEVEL FLIGHT ACCELERATION

INITIAL GROSS WEIGHT – 44,800 POUNDS

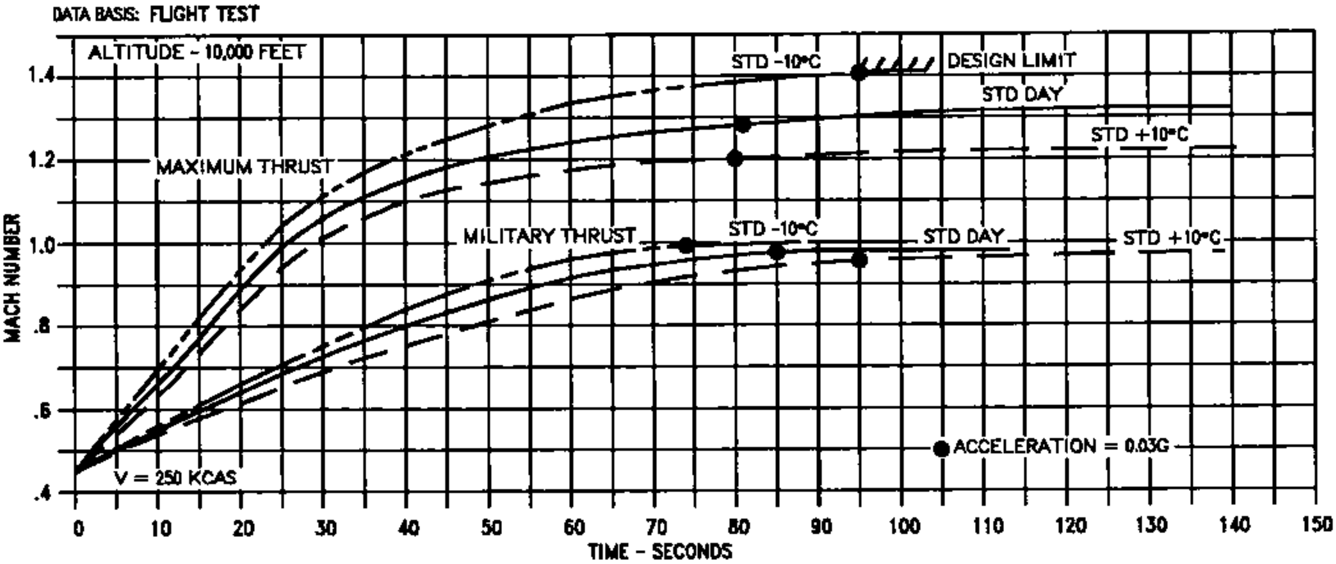
GUIDE

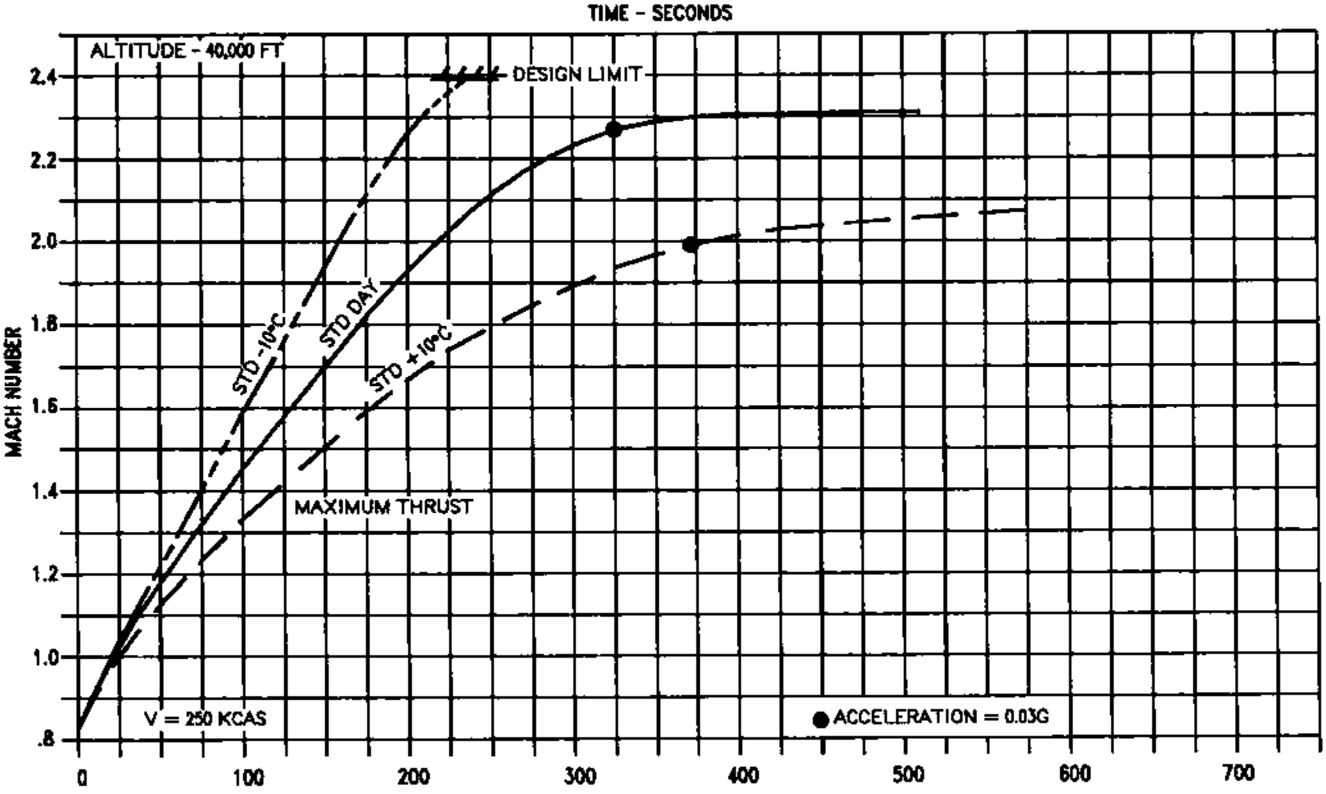


AIRPLANE CONFIGURATION
(4) AIM-7

REMARKS
ENGINE(S): (2) F100-PW-220
1g LOAD FACTOR

DATE: 15 APRIL 1990
DATA BASIS: FLIGHT TEST





15E-1-(197-1)44-CATI

Figure A9-41

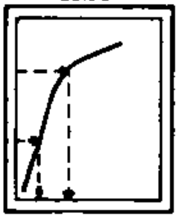
LEVEL FLIGHT ACCELERATION

INITIAL GROSS WEIGHT - 58,100 POUNDS

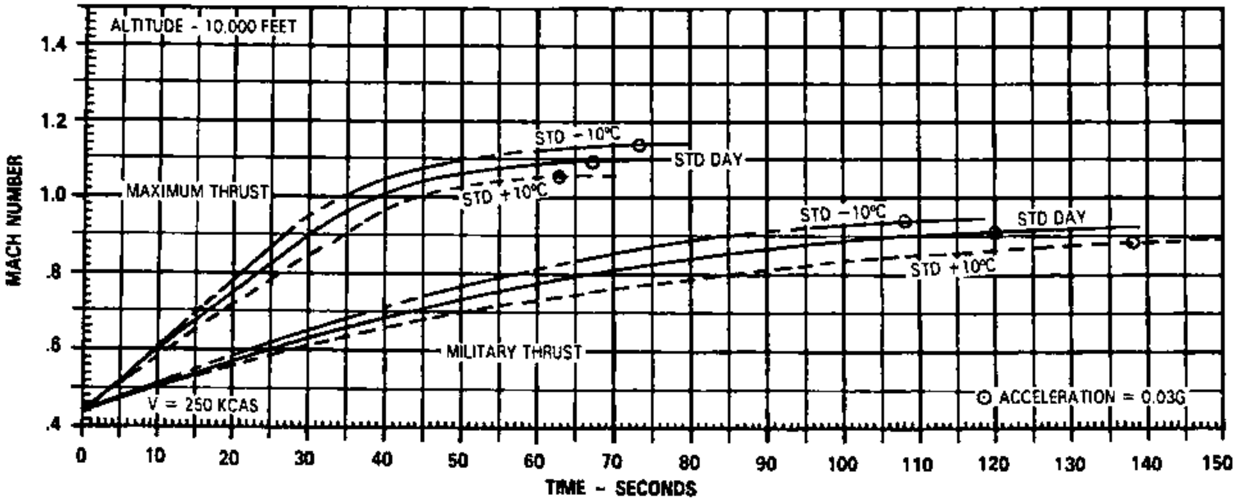
AIRPLANE CONFIGURATION
-4 CFT
(4) AIM-9, (4) AIM-7

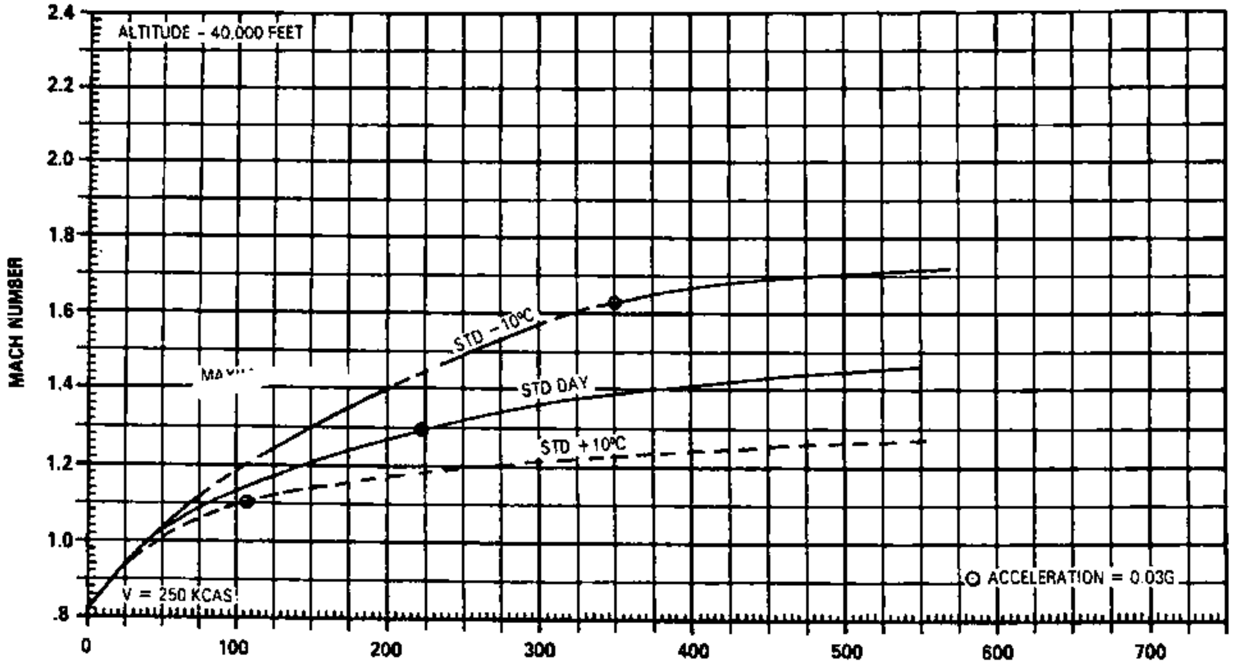
REMARKS
ENGINE(S): (2)F100-PW-220
1g LOAD FACTOR

GUIDE



DATE: 15 APRIL 1990
DATA BASIS: (STORES) ESTIMATED
(AIRCRAFT/CFT) FLIGHT TEST





15E-1-(196)18

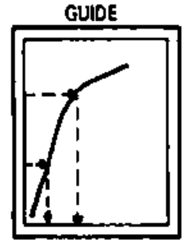
Figure A9-42

LEVEL FLIGHT ACCELERATION
GROSS WEIGHT - 59,300 POUNDS

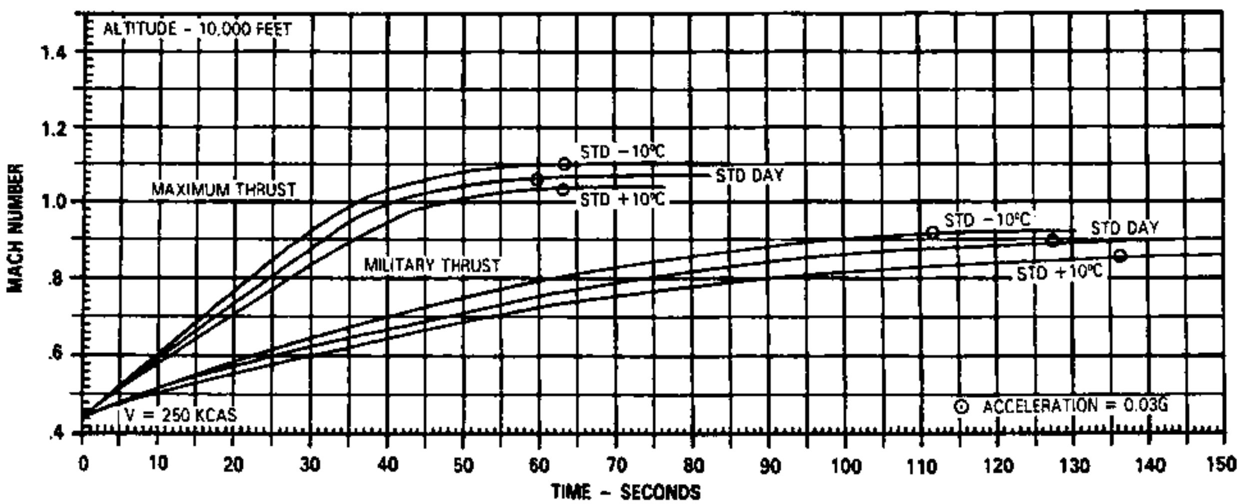
AIRPLANE CONFIGURATION
-4 CFT
LANTIRN
(4) AIM-7, (4) AIM-9

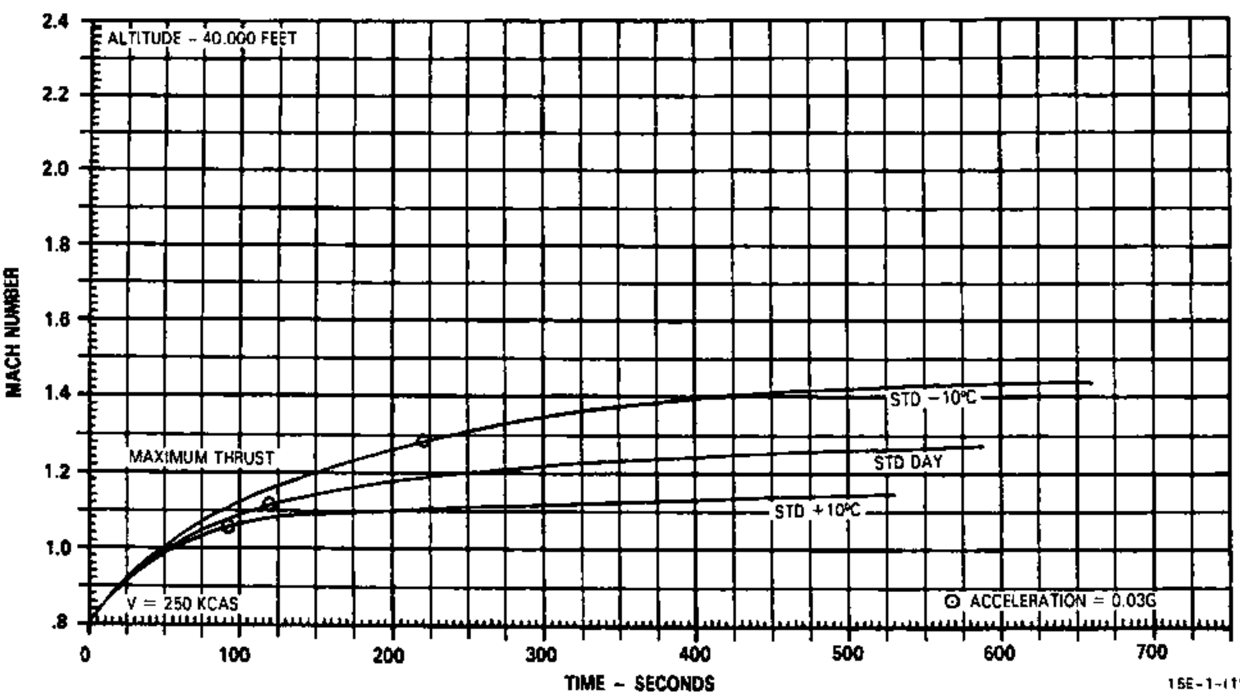
REMARKS
ENGINE(S): (2)F100-PW-220
1g LOAD FACTOR

GUIDE



DATE: 15 APRIL 1990
DATA BASIS: **(STORES) ESTIMATED**
(AIRCRAFT/CFT) FLIGHT TEST





15E-1-(195)18

Figure A9-43

LEVEL FLIGHT ACCELERATION

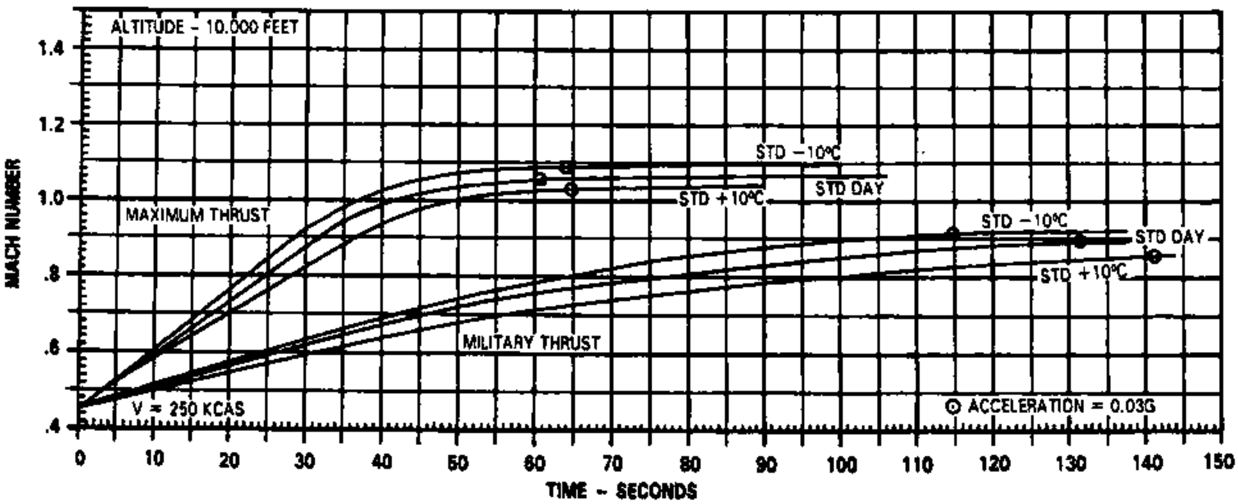
GROSS WEIGHT - 61,200 POUNDS

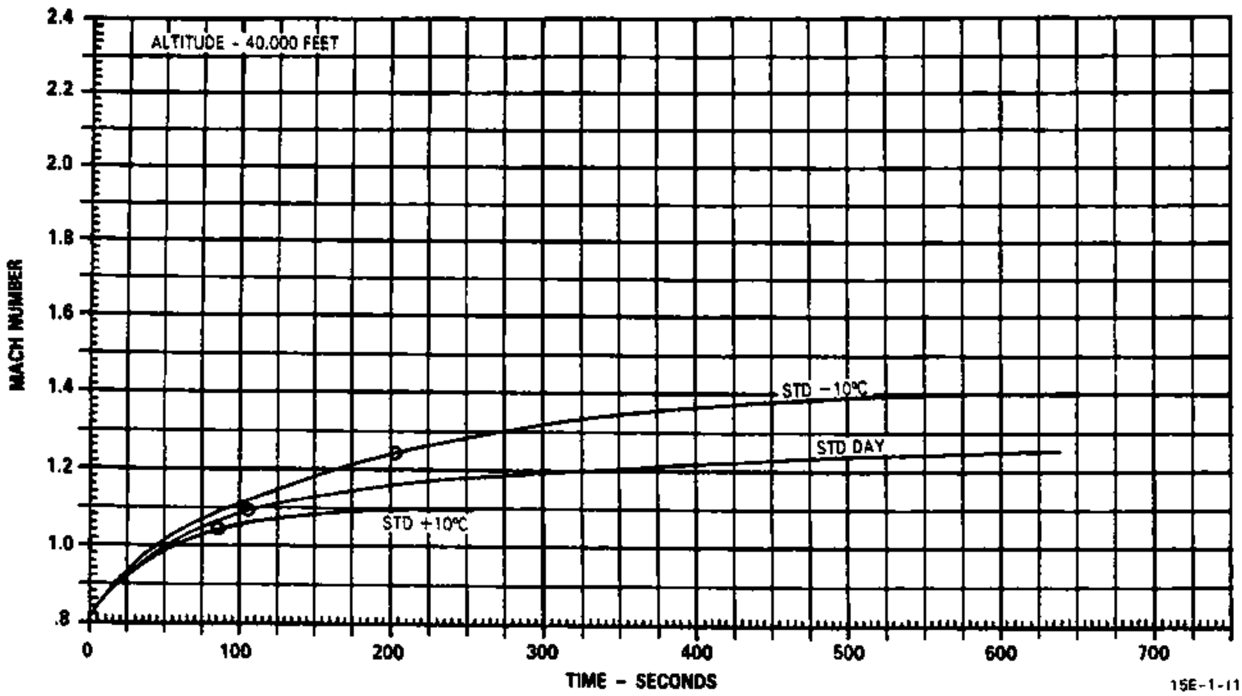
AIRPLANE CONFIGURATION
-4 CFT
LANTIRN
(4) AIM-9, (2) MK-84

REMARKS
ENGINE(S): (2)F100-PW-220
1g LOAD FACTOR

GUIDE

DATE: 15 APRIL 1990
DATA BASIS: (STORES) ESTIMATED
(AIRCRAFT/CFT) FLIGHT TEST





15E-1-1194118

Figure A9-44

LEVEL FLIGHT ACCELERATION

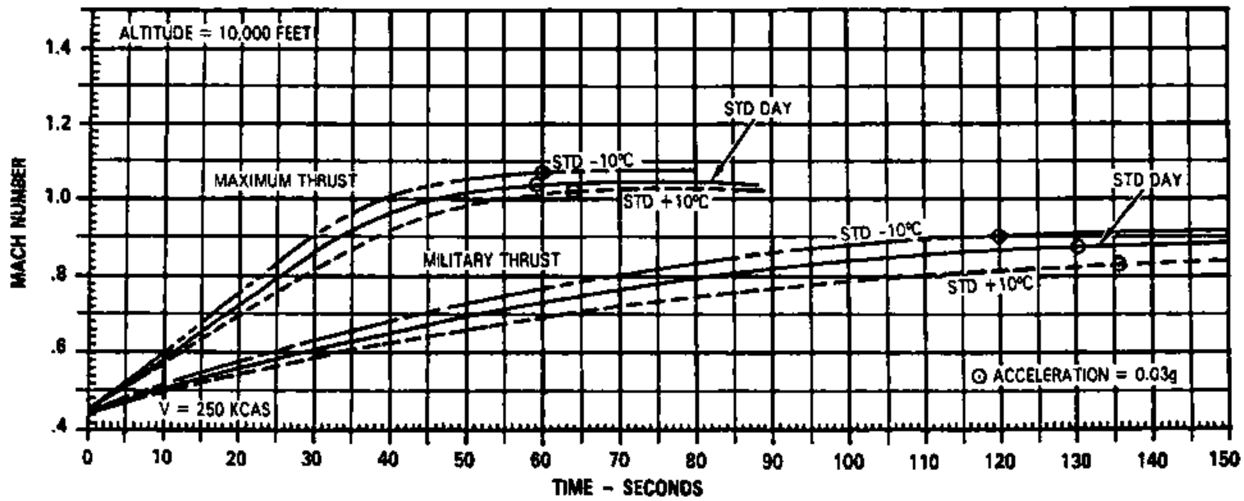
INITIAL GROSS WEIGHT - 61,500 POUNDS

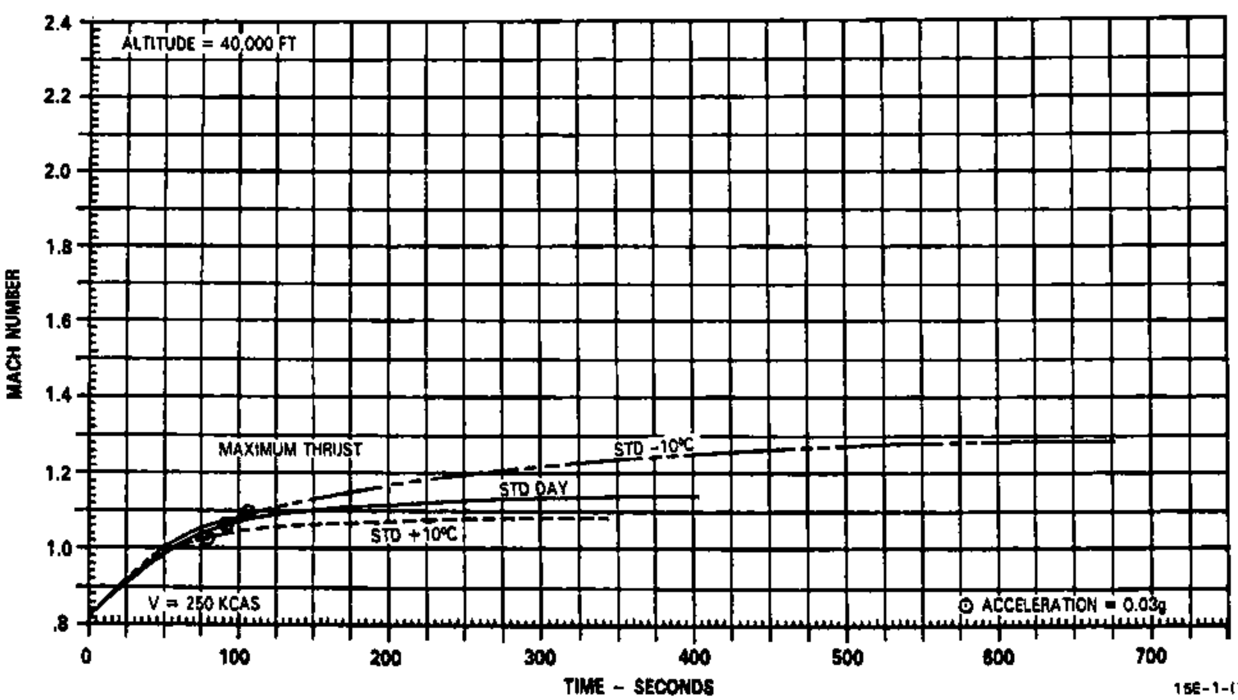
AIRPLANE CONFIGURATION
-4 CFT
(4) AIM-9, (6) CBU-89

REMARKS
ENGINE(S): (2) F100-PW-220
1g LOAD FACTOR

GUIDE

DATE: 15 APRIL 1990
DATA BASIS **(STORES) ESTIMATED**
(AIRCRAFT/CFT) FLIGHT TEST





15E-1-(181)1

Figure A9-45

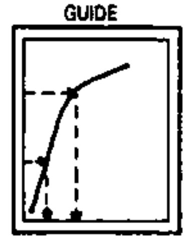
LEVEL FLIGHT ACCELERATION

INITIAL GROSS WEIGHT - 63,300 POUNDS

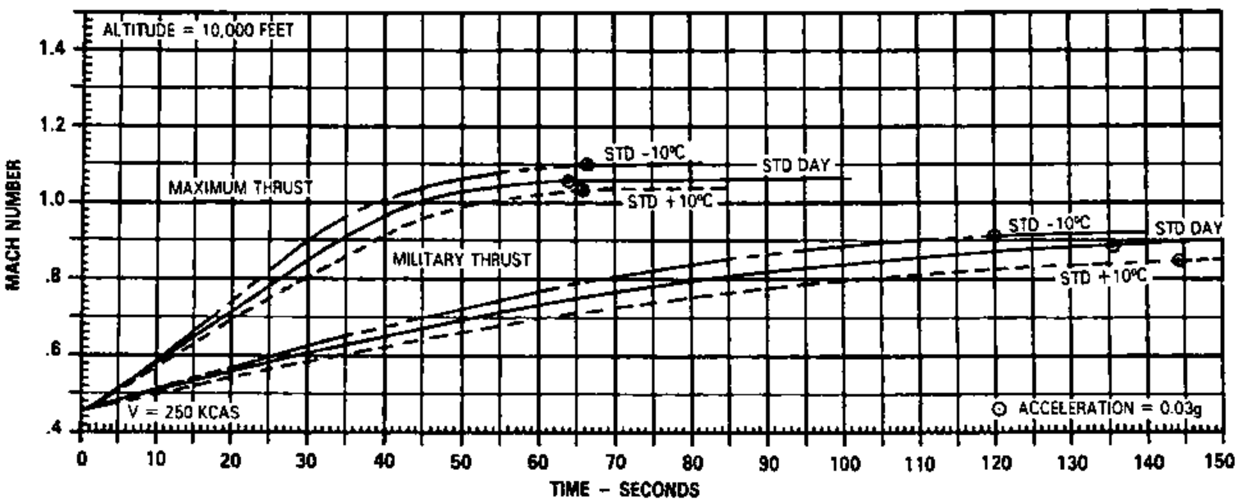
AIRPLANE CONFIGURATION
-4 CFT
LANTIRN
(4) AIM-9, (12) MK-82

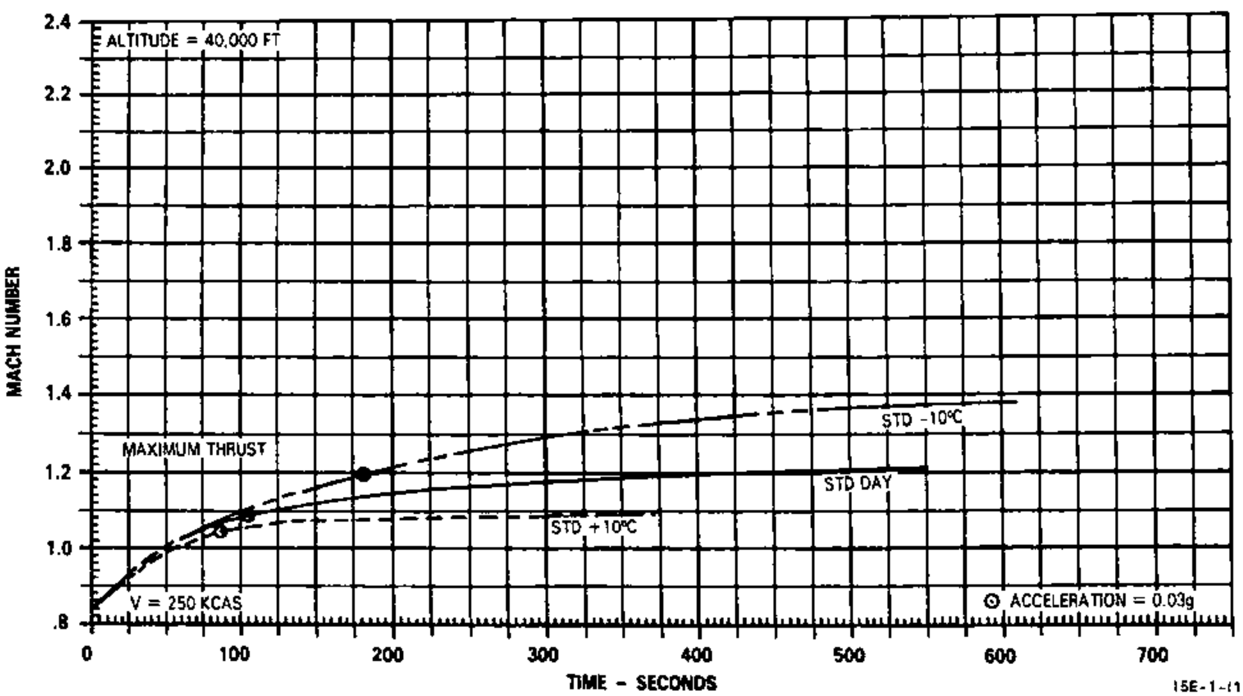
REMARKS
ENGINE(S): (2) F100-PW-220
1g LOAD FACTOR

GUIDE



DATE: 15 APRIL 1990
DATA BASIS (STORES) ESTIMATED
(AIRCRAFT/CFT) FLIGHT TEST





15E-1-(182)19

Figure A9-46

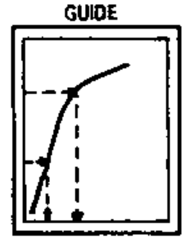
LEVEL FLIGHT ACCELERATION

INITIAL GROSS WEIGHT - 65,100 POUNDS

AIRPLANE CONFIGURATION
-4 CFT
LANTIRN
(4) AIM-9, (4) MK-84

REMARKS
ENGINE(S): (2) F100-PW-220
1g LOAD FACTOR

GUIDE



DATE: 15 APRIL 1990
DATA BASIS: **(STORES) ESTIMATED**
(AIRCRAFT/CFT) FLIGHT TEST

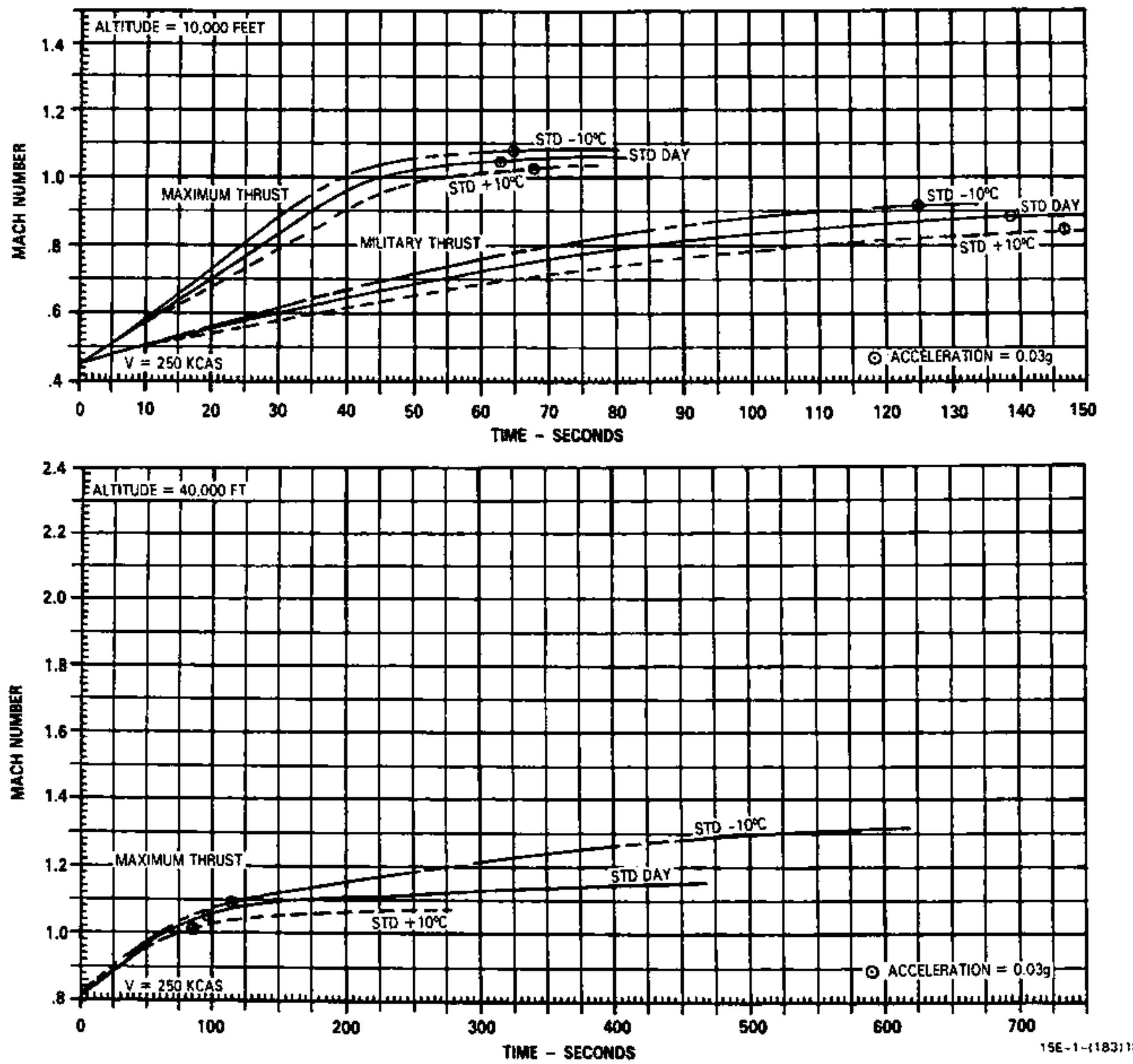


Figure A9-47

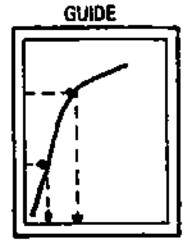
LEVEL FLIGHT ACCELERATION

INITIAL GROSS WEIGHT - 66,900 POUNDS

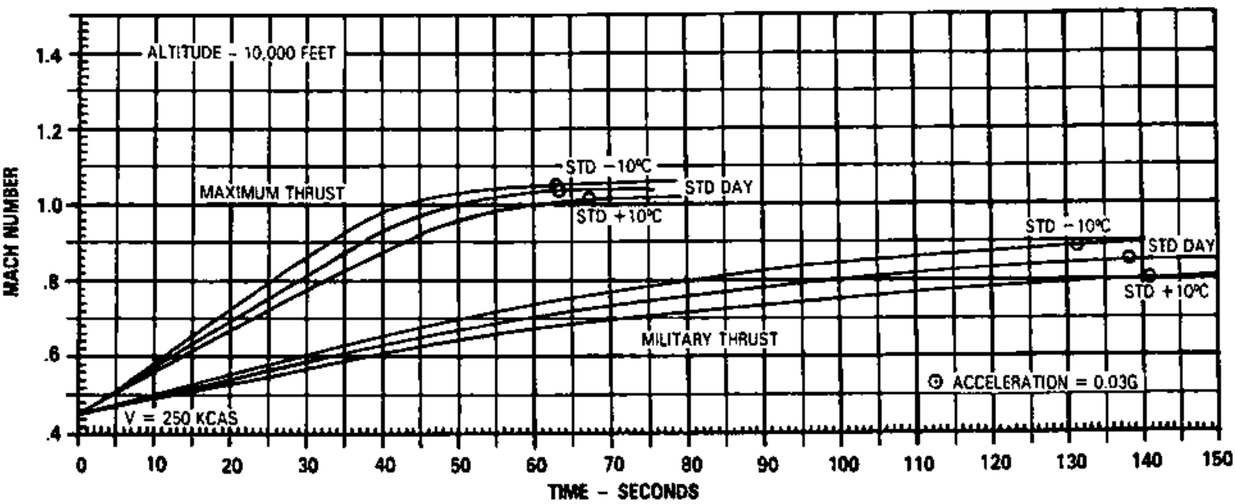
AIRPLANE CONFIGURATION
-4 CFT
LANTIRN
CL TANK
(4) AIM-9, (12) MK-82

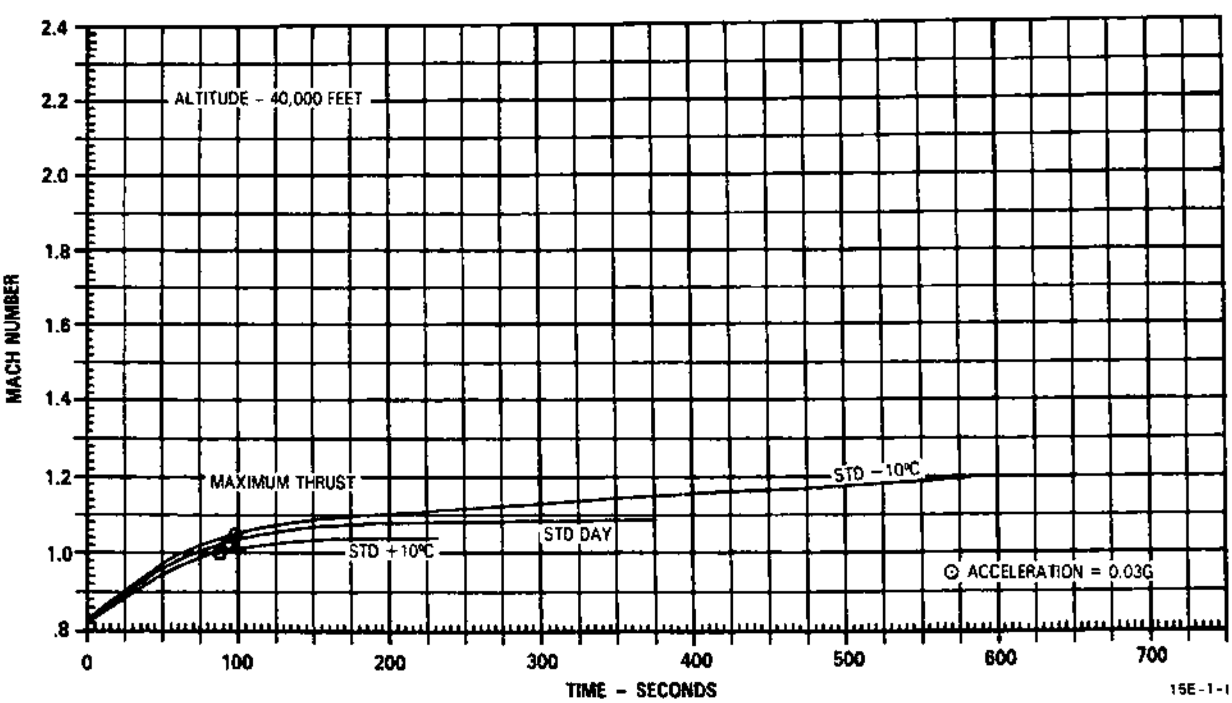
REMARKS
ENGINE(S): (2)F100-PW-220
1g LOAD FACTOR

GUIDE



DATE: 15 APRIL 1990
DATA BASIS: (STORES) ESTIMATED
(AIRCRAFT/CFT) FLIGHT TEST





15E-1-(184)18

Figure A9-48

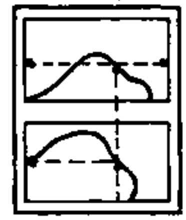
SUSTAINED LEVEL TURNS

GROSS WEIGHT - 39,500 POUNDS
MAXIMUM THRUST

AIRPLANE CONFIGURATION
F-15E CLEAN

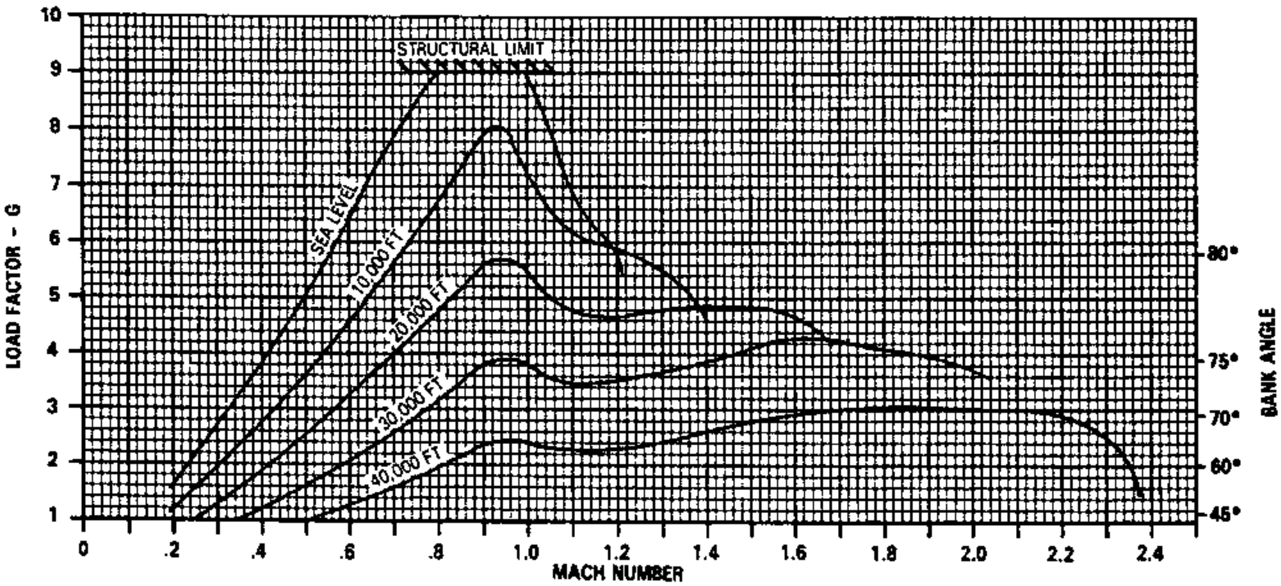
REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

GUIDE



NOTE
MAXIMUM CAPABILITY MAY BE REDUCED BY OVERLOAD WARNING SYSTEM.

DATE: 15 APRIL 1990
DATA BASIS: FLIGHT TEST



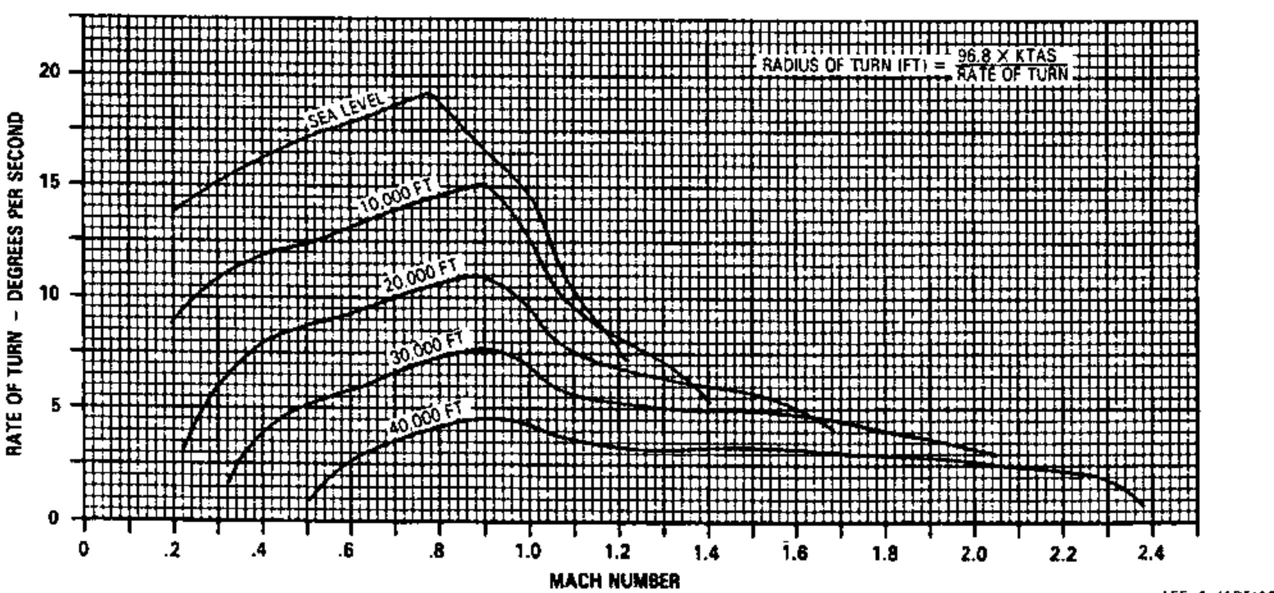


Figure A9-49

SUSTAINED LEVEL TURNS

GROSS WEIGHT - 41,500 POUNDS

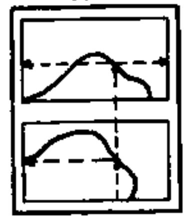
MAXIMUM THRUST

AIRPLANE CONFIGURATION
(4) AIM-7

REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

NOTE
MAXIMUM CAPABILITY MAY BE REDUCED BY OVERLOAD WARNING SYSTEM.

DATE: 15 APRIL 1990
DATA BASIS: (STORES) ESTIMATED
(AIRCRAFT/CFT) FLIGHT TEST



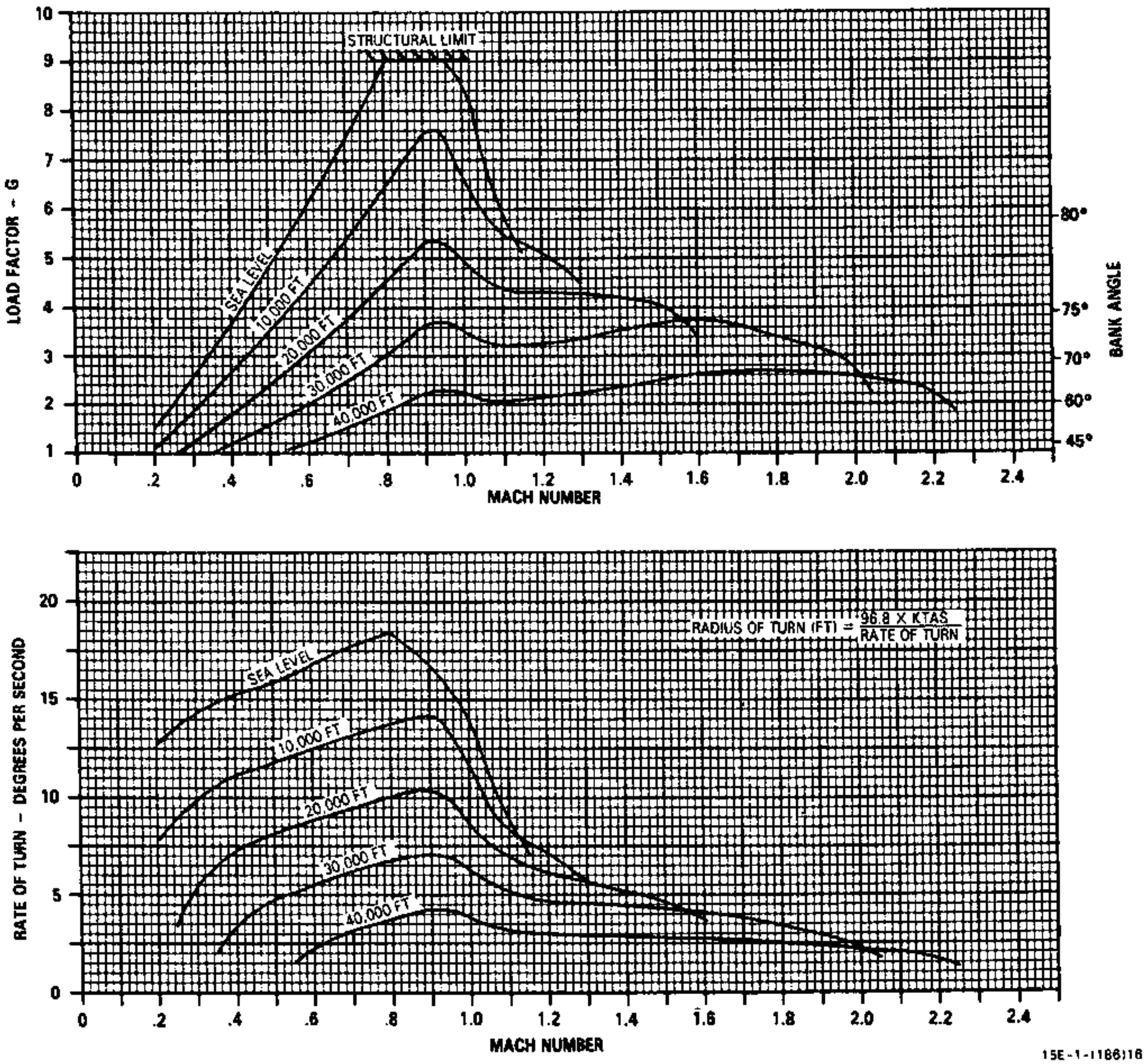


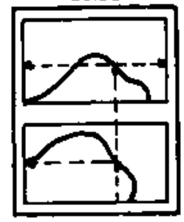
Figure A9-50

SUSTAINED LEVEL TURNS
GROSS WEIGHT - 52,500 POUNDS
MAXIMUM THRUST

AIRPLANE CONFIGURATION
-4 CFT
(4) AIM-7, (4) AIM-9

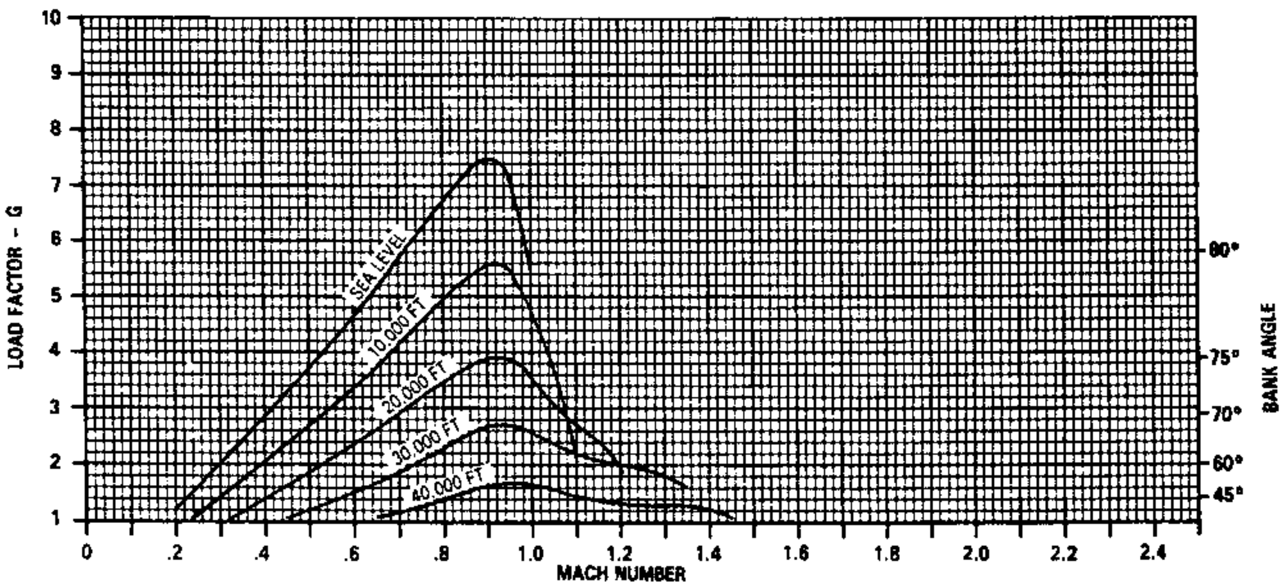
REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

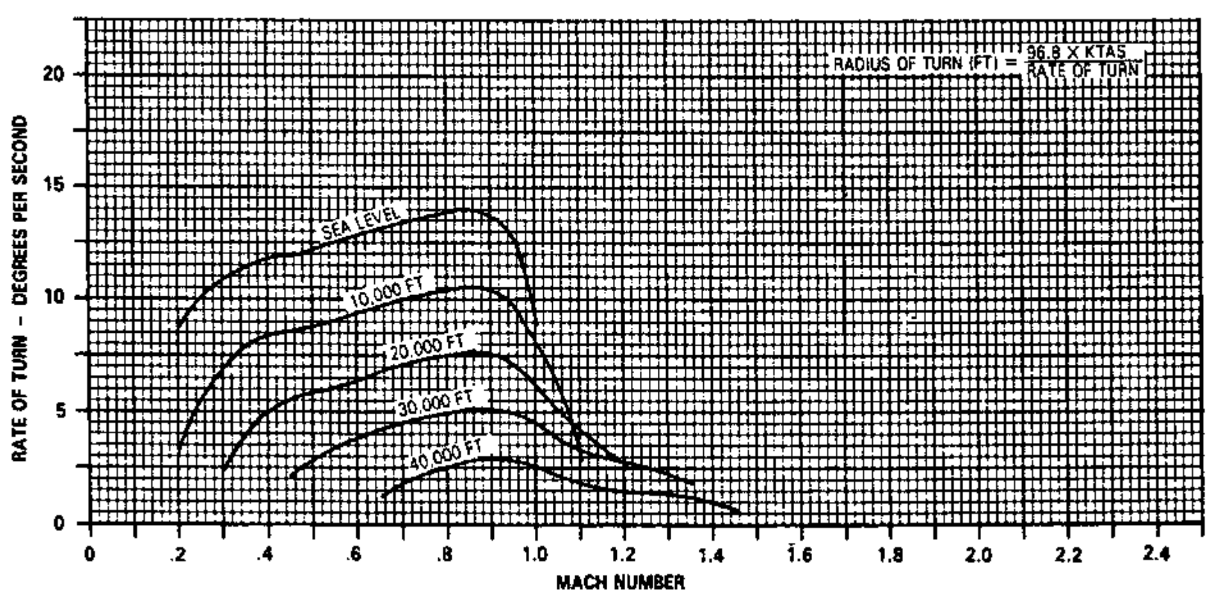
GUIDE



NOTE
MAXIMUM CAPABILITY MAY BE REDUCED BY OVERLOAD WARNING SYSTEM.

DATE: 15 APRIL 1990
DATA BASIS: (STORES) ESTIMATED
(AIRCRAFT/CFT) FLIGHT TEST





15E-1-(187)16

Figure A9-51

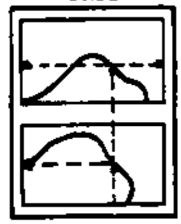
SUSTAINED LEVEL TURNS

GROSS WEIGHT - 53,700 POUNDS
MAXIMUM THRUST

AIRPLANE CONFIGURATION
-4 CFT
LANTIRN
(4) AIM-7, (4) AIM-9

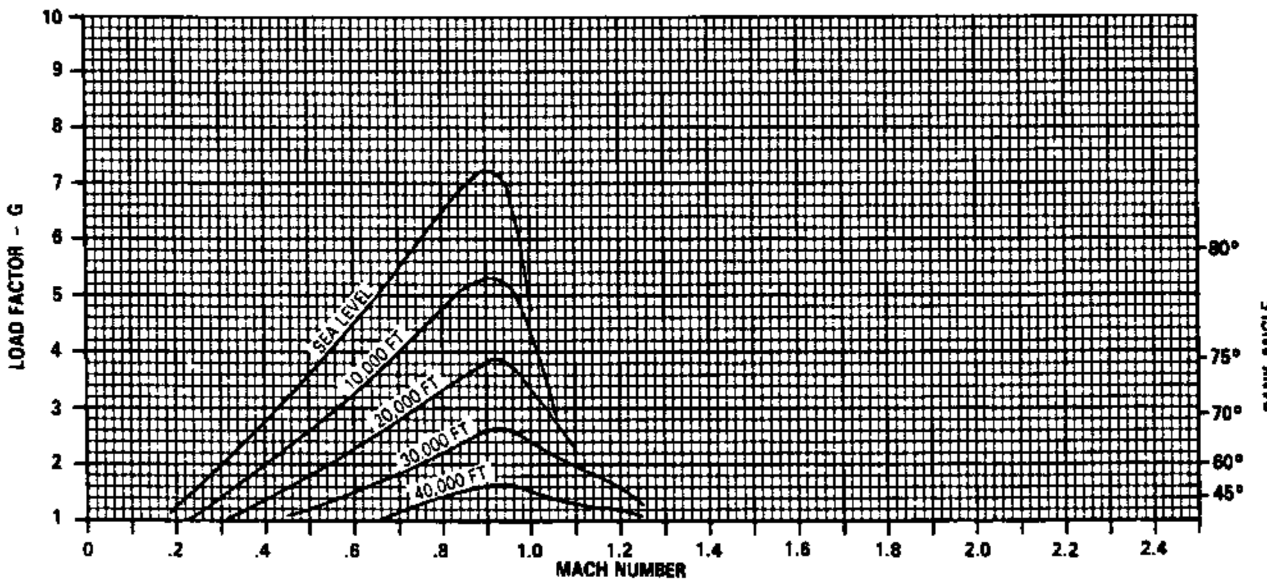
REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

GUIDE



NOTE
MAXIMUM CAPABILITY MAY BE REDUCED BY OVERLOAD WARNING SYSTEM.

DATE: 15 APRIL 1990
DATA BASIS: (STORES) ESTIMATED
(AIRCRAFT/CFT) FLIGHT TEST



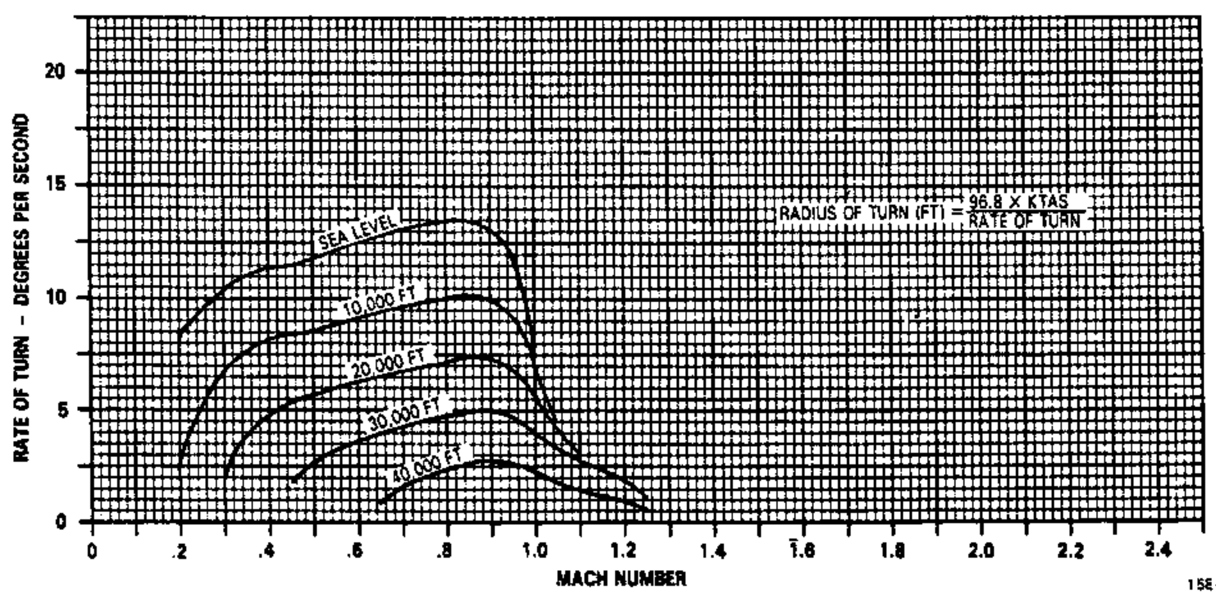
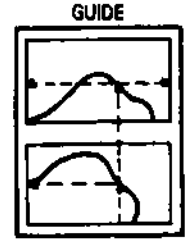


Figure A9-52

SUSTAINED LEVEL TURNS

GROSS WEIGHT - 55,600 POUNDS
MAXIMUM THRUST



AIRPLANE CONFIGURATION

-4 CFT
LANTIRN
(4) AIM-9, (2) MK-84

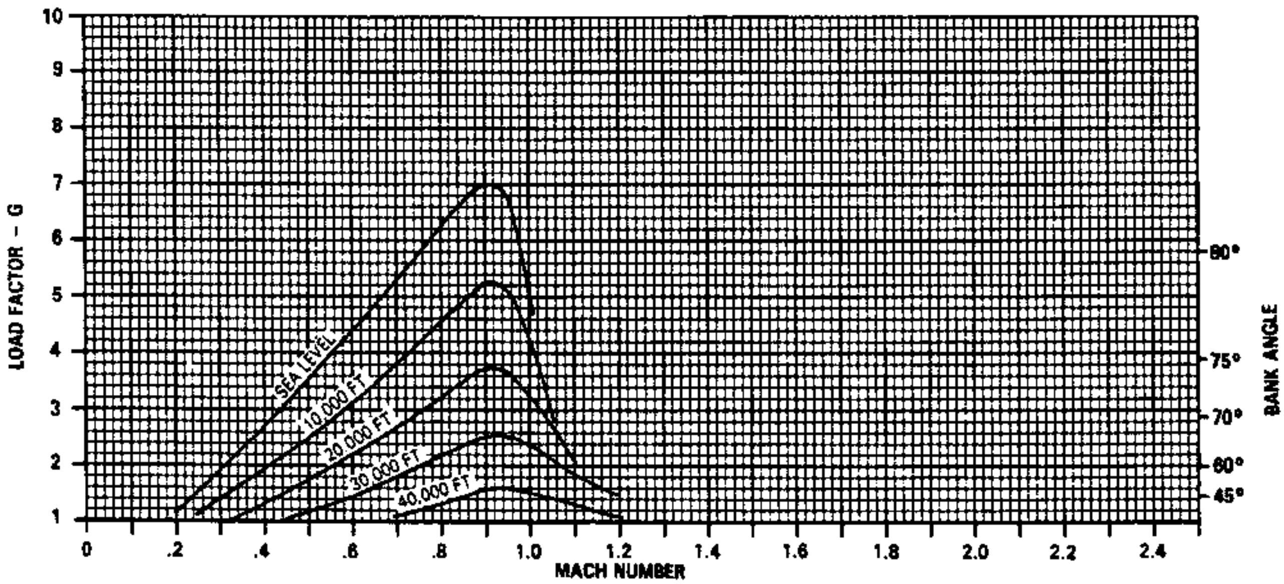
REMARKS

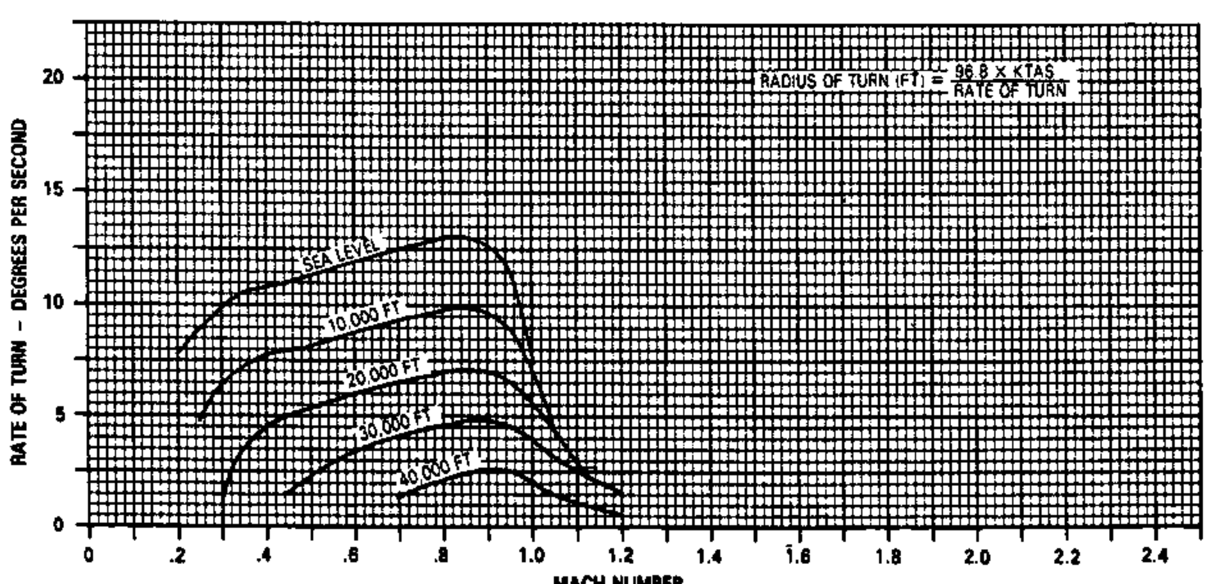
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

NOTE

MAXIMUM CAPABILITY MAY BE REDUCED BY OVERLOAD WARNING SYSTEM.

DATE: 15 APRIL 1990
DATA BASIS: (STORES) ESTIMATED
(AIRCRAFT/CFT) FLIGHT TEST





15E-1-(189)18

Figure A9-53

SUSTAINED LEVEL TURNS

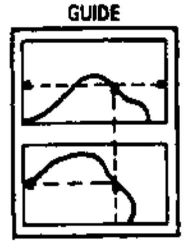
GROSS WEIGHT - 55,900 POUNDS
MAXIMUM THRUST

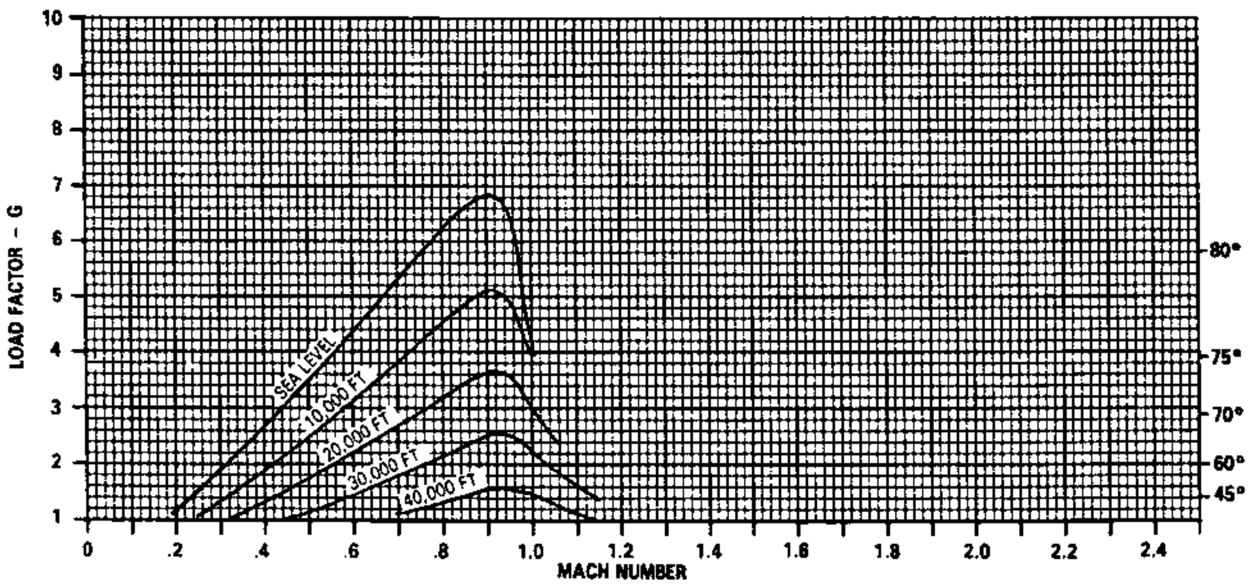
AIRPLANE CONFIGURATION
-4 CFT
LANTIRN
(4) AIM-9, (6) CBU-89

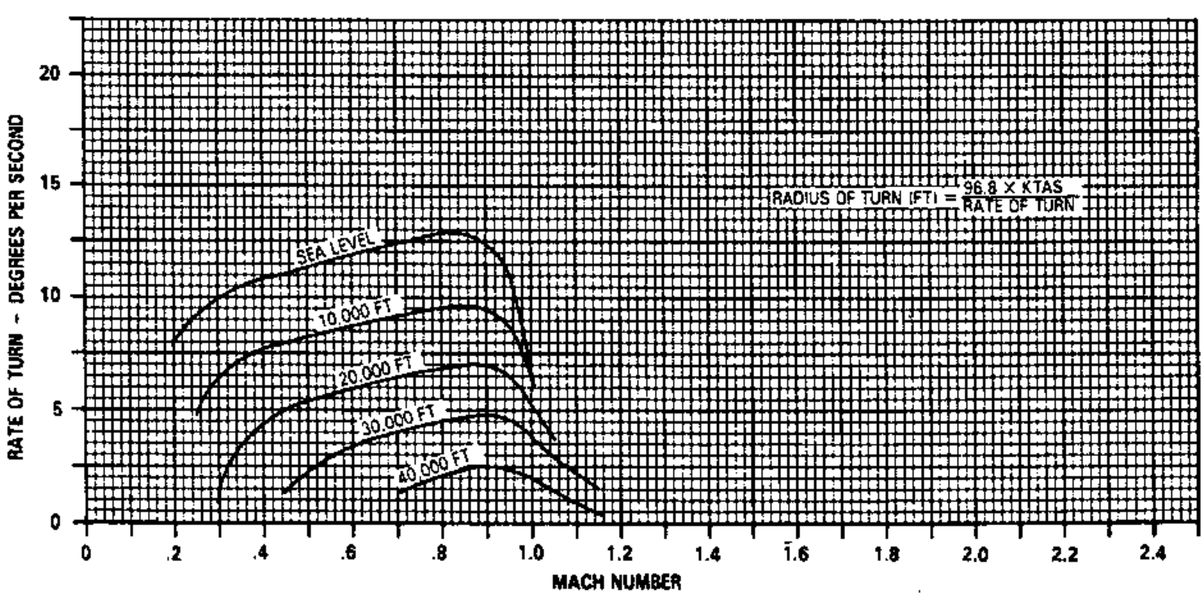
REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

NOTE
MAXIMUM CAPABILITY MAY BE REDUCED BY OVERLOAD WARNING SYSTEM.

DATE: 15 APRIL 1990
DATA BASIS: (STORES) ESTIMATED
(AIRCRAFT/CFT) FLIGHT TEST







15E-1-(190)16

Figure A9-54

SUSTAINED LEVEL TURNS

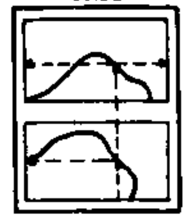
GROSS WEIGHT - 57,700 POUNDS

MAXIMUM THRUST

AIRPLANE CONFIGURATION
-4 CFT
LANTIRN
(4) AIM-9, (12) MK 82

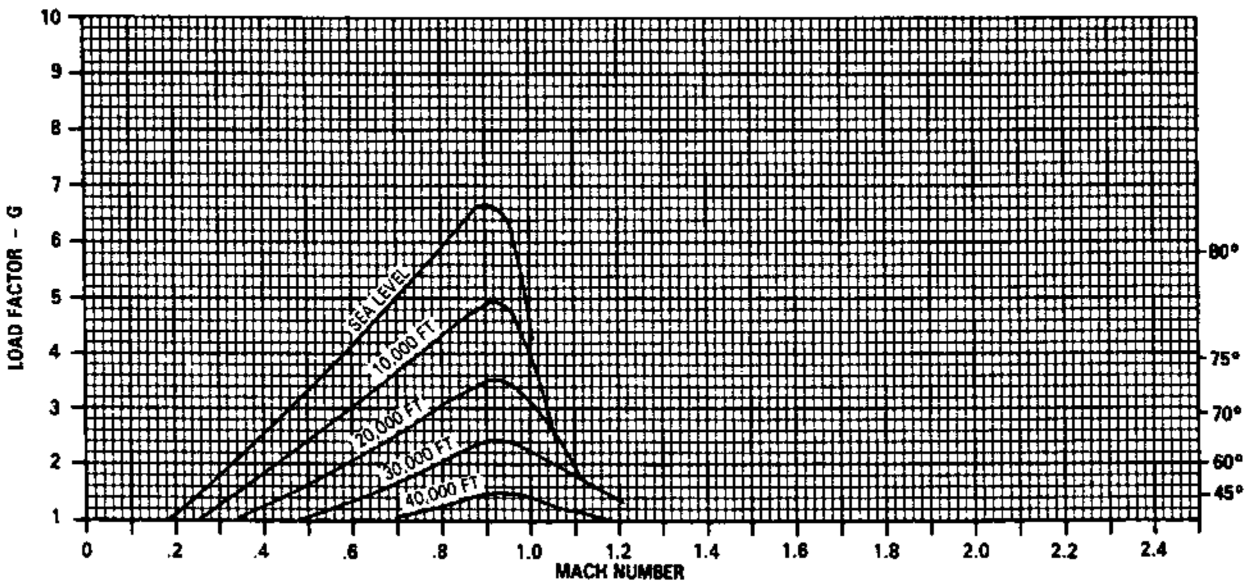
REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

GUIDE



NOTE
MAXIMUM CAPABILITY MAY BE REDUCED BY OVERLOAD WARNING SYSTEM.

DATE: 15 APRIL 1990
DATA BASIS: (STORES) ESTIMATED
(AIRCRAFT/CFT) FLIGHT TEST



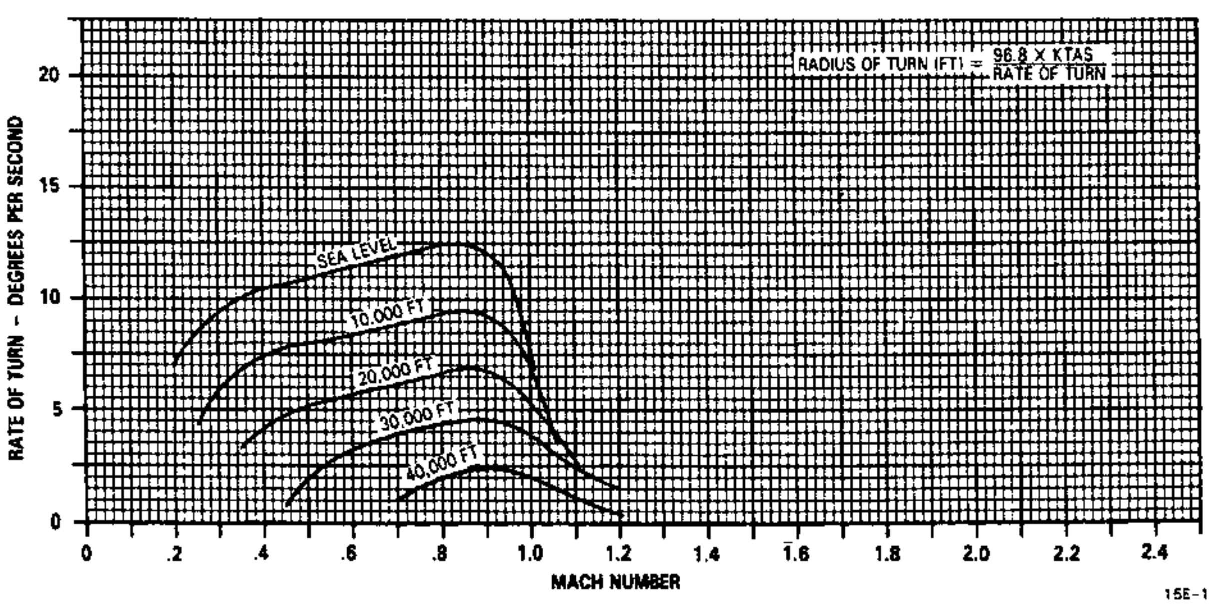
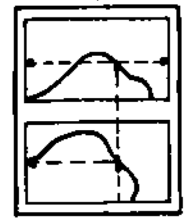


Figure A9-55

SUSTAINED LEVEL TURNS

GROSS WEIGHT - 59,500 POUNDS
MAXIMUM THRUST



AIRPLANE CONFIGURATION
-4 CFT
LANTIRN
(4) AIM-9, (4) MK-84

REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

NOTE
MAXIMUM CAPABILITY MAY BE REDUCED BY OVERLOAD WARNING SYSTEM.

DATE: 15 APRIL 1990
DATA BASIS: (STORES) ESTIMATED
(AIRCRAFT/CFT) FLIGHT TEST

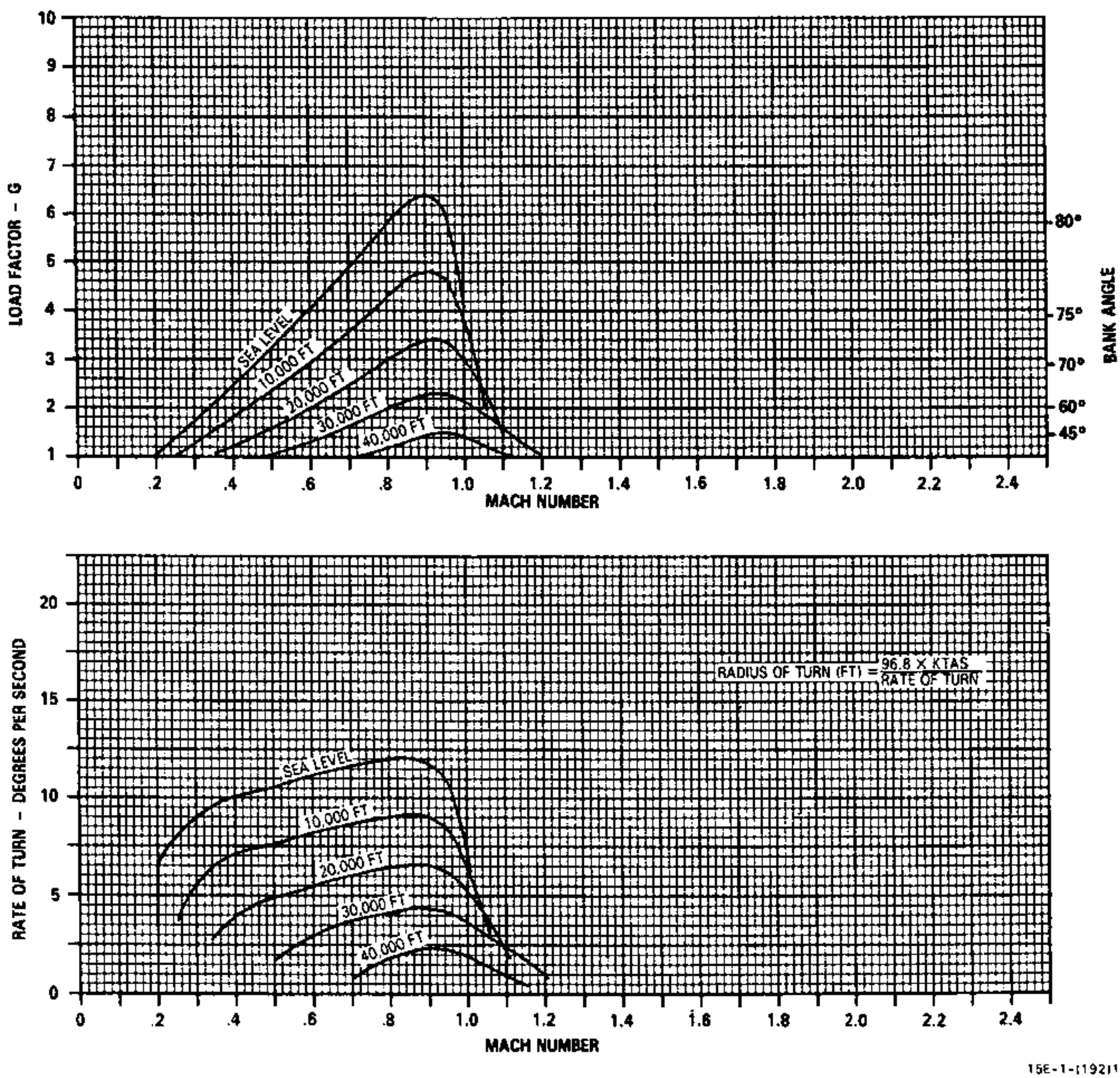


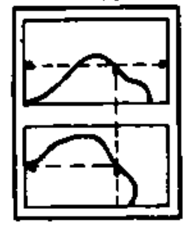
Figure A9-56

SUSTAINED LEVEL TURNS

GROSS WEIGHT - 60,300 POUNDS

MAXIMUM THRUST

GUIDE

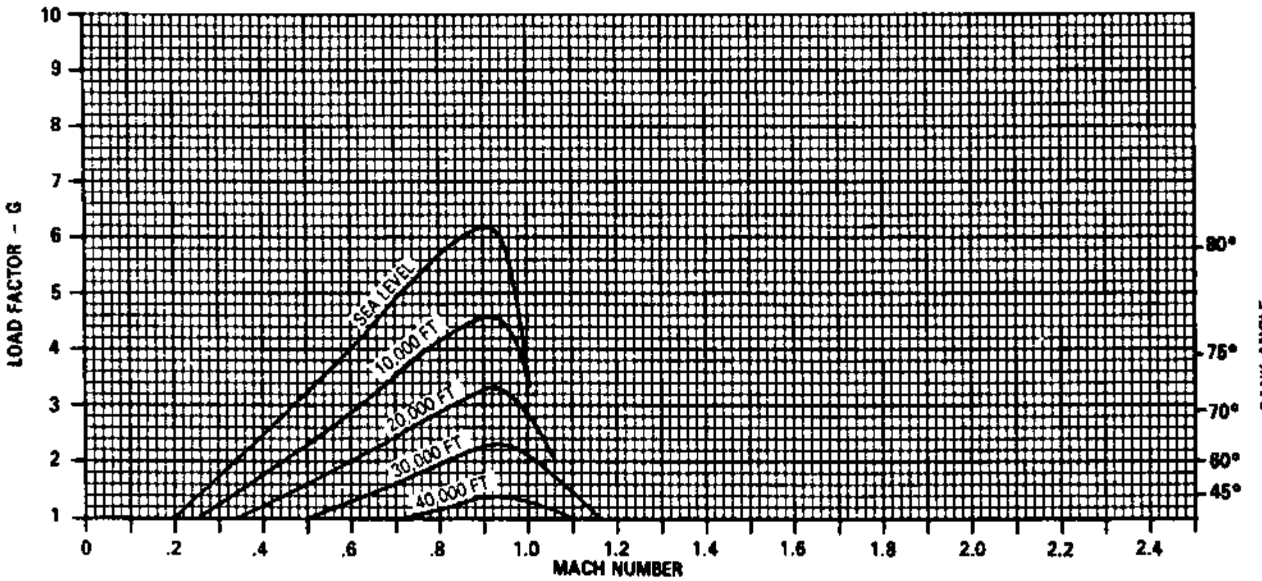


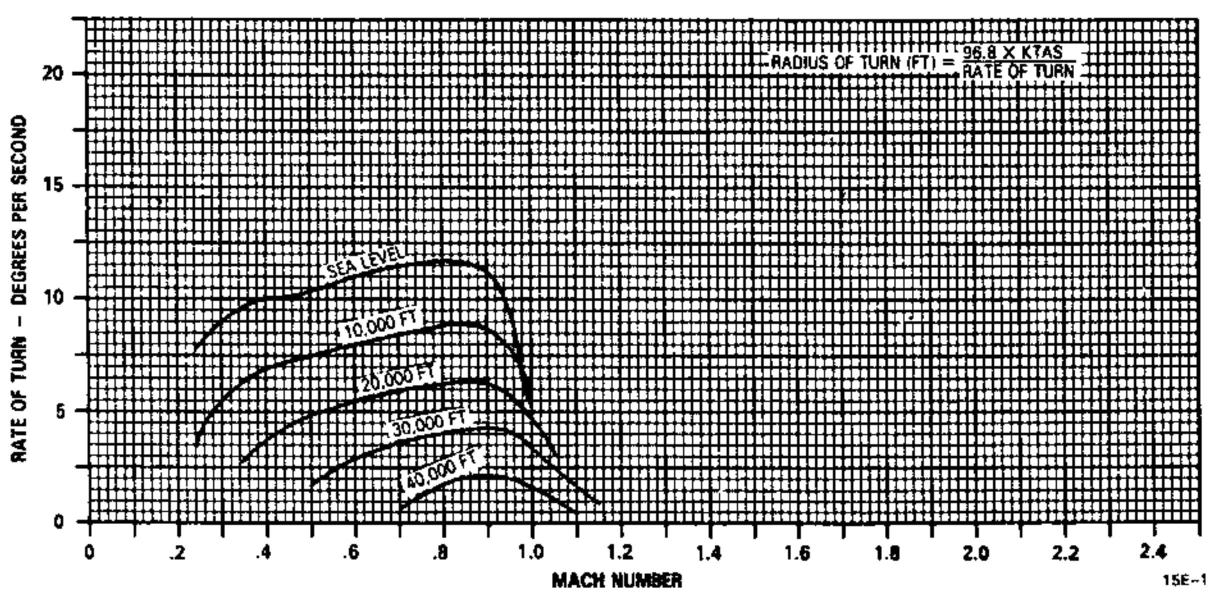
AIRPLANE CONFIGURATION
-4 CFT
LANTIRN
CL TANK
(4) AIM-9, (12) MK-82

REMARKS
ENGINE(S): (2) F100-PW-220
U.S. STANDARD DAY, 1966

NOTE
MAXIMUM CAPABILITY MAY BE REDUCED BY OVERLOAD WARNING SYSTEM.

DATE: 15 APRIL 1990
DATA BASIS: (STORES) ESTIMATED
(AIRCRAFT/CFT) FLIGHT TEST





15E-1-(193)16

Figure A9-57

APPENDIX B

PERFORMANCE DATA WITH F100-PW-229 ENGINES

NOTE

All performance data is based on U.S. standard day and sea level altitude. The data must be adjusted for any difference in altitude or temperature.

PART 1

INTRODUCTION

TABLE OF CONTENTS

Charts

NOTE

- All performance data are based on JP-4 fuel and are also applicable for JP-8 fuel.
- Performance charts for the PW-229 engines are currently being developed. The references to figures have been retained even if the chart is not available. The actual charts will be added as they become available.

DRAG INDEX SYSTEM

Most of the charts use the drag index system to effectively present the many combinations of weight/drag effects on performance. The Airplane Loading chart (figure B1-1) contains the drag number and weight of each externally carried store. The weight and drag number for external store suspension equipment are listed separately. The drag index for a specific configuration may be found by multiplying the number of stores carried by its drag number, and adding the drag number of the applicable suspension equipment. The total drag index may then be used to enter the planning data charts. The F-15E Gross Weights and CG Location (%MAC) chart (figure B1-2) contains the weight and % CG for certain "typical" load configurations. Charts applicable for all loads and configuration are labeled ALL DRAG INDEXES. Charts labeled INDIVIDUAL DRAG INDEXES contain data for a range of drag numbers; i.e., individual curves/columns for a specific drag number. Supersonic data is not compatible to the drag index system; therefore, each chart is labeled for a specific configuration.

STALL SPEEDS CHARTS

The Stall Speeds charts (figures B1-4 thru B1-7) present stall speeds for various combinations of gross weight, bank angle, power setting and altitude. The data is based on having the gear and flaps down (figures B1-4, B1-5) or gear and flaps up (figures B1-6, B1-7).

USE

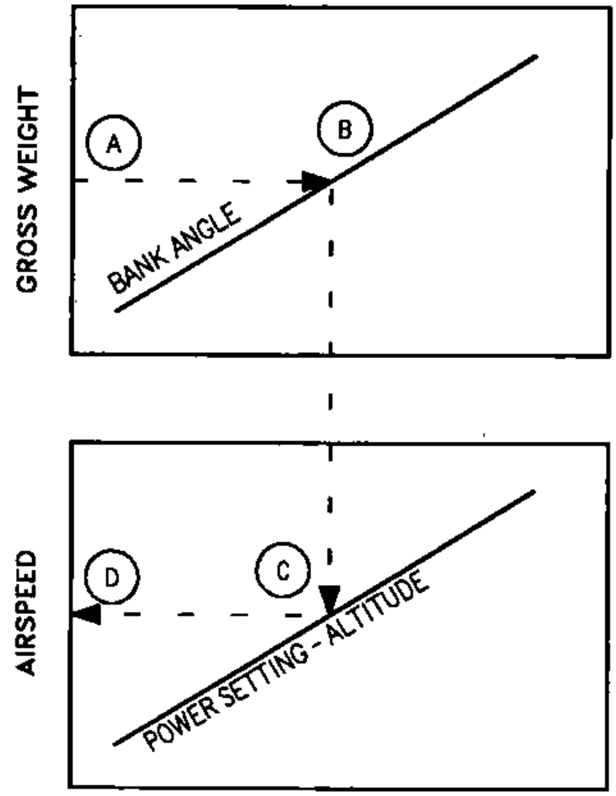
Enter the appropriate chart with the applicable gross weight and proceed horizontally to the right to intersect the applicable bank angle. From this intersection, descend vertically and intersect the applicable altitude curve. Then project horizontally left to read the stall speed.

Sample Problem

Configuration: Flaps Down, Gear Down, Maximum Thrust

A. Gross weight	40,000 Lb
B. Bank angle	15°
C. Altitude	10,000 Ft
D. Stall speed	107 Kt

SAMPLE STALL SPEEDS



15E-1-(63-1)44-CATI

AIRSPEED CONVERSION

The Airspeed Conversion charts, (figures B1-8 and B1-9) provide a means of converting calibrated airspeed to true Mach number and true airspeed.

INDICATED AIRSPEED

Indicated airspeed (IAS) is the uncorrected airspeed read directly from the indicator.

CALIBRATED AIRSPEED

Calibrated airspeed (CAS) is indicated airspeed corrected for static source error.

EQUIVALENT AIRSPEED

Equivalent airspeed (EAS) is calibrated airspeed corrected for compressibility. There is no provision made for reading equivalent airspeed.

TRUE AIRSPEED

True airspeed (TAS) is equivalent airspeed corrected for density altitude. Refer to the Airspeed Conversion charts (figures B1-8 and B1-9).

AIRSPEED POSITION ERROR CORRECTION CHART

Under normal conditions, the air data computer compensates for the static source position error. If an air data computer malfunction occurs, the primary airspeed/Mach indicator becomes inoperative and airspeed is read from the standby indicator. The indicated airspeed read on this indicator may be corrected to calibrated airspeed by utilizing the Airspeed Position Error Correction chart (figure B1-10).

USE

Enter the appropriate chart with the indicated airspeed read from the standby indicator. In the flaps down, gear down configuration at 10,000 feet and below read the calibrated airspeed from the tabulated chart. In the flaps up, gear up configuration, enter the chart with the indicated airspeed and project vertically up to the appropriate altitude reflector curve. From this point, project horizontally left to read the calibrated airspeed.

Sample Problem

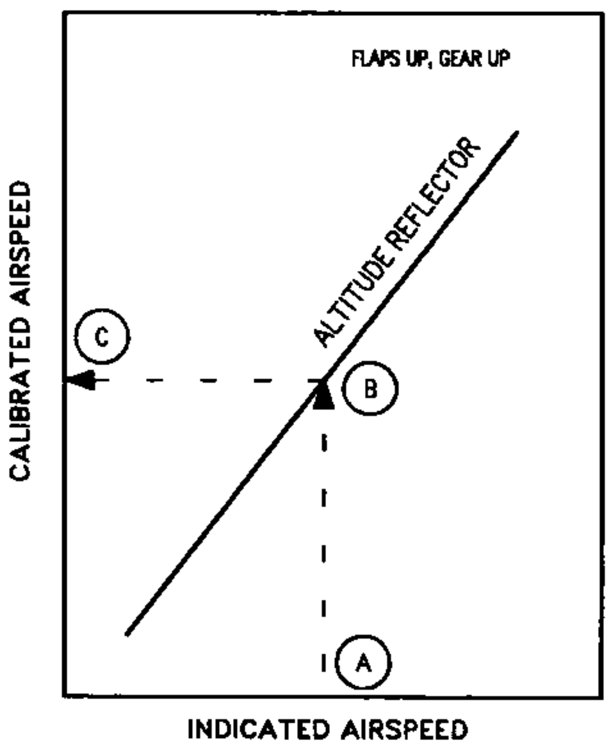
Configuration: Flaps Up, Gear Up

A. Indicated airspeed	300 Kt
B. Altitude reflector line	40,000 Ft
C. Calibrated airspeed	312 Kt

Configuration: Flaps Down, Gear Down (10,000 Ft and below)

A. Indicated airspeed	200 Kt
B. Gross weight	40,000 Lb
C. Calibrated airspeed	198.5 Kt

SAMPLE AIRSPEEDS POSITION ERROR CORRECTION



15E-1-(64-1)44-CATI

ALTIMETER POSITION ERROR CORRECTION CHART

Under normal conditions, the ADC compensates for the static source position error. If an ADC malfunction occurs, the primary altitude indicator becomes inoperative and altitude is read from the standby indicator. The indicated altitude read on this indicator may be corrected to calibrated altitude by utilizing the Altimeter Position Error Correction chart (figure B1-11).

USE

Enter the appropriate chart with indicated airspeed. In the flaps retracted, gear up configuration project horizontally right to the assigned altitude reflector. From this point, project vertically up to the reflector line. From this point, project horizontally left to read the ΔH altitude correction. In the full flaps, gear down configuration project vertically up to the appropriate gross weight curve. From this point project horizontally left to read the ΔH altitude correction. In either case apply the ΔH altitude correction to the altimeter and fly indicated altitude.

Sample Problem

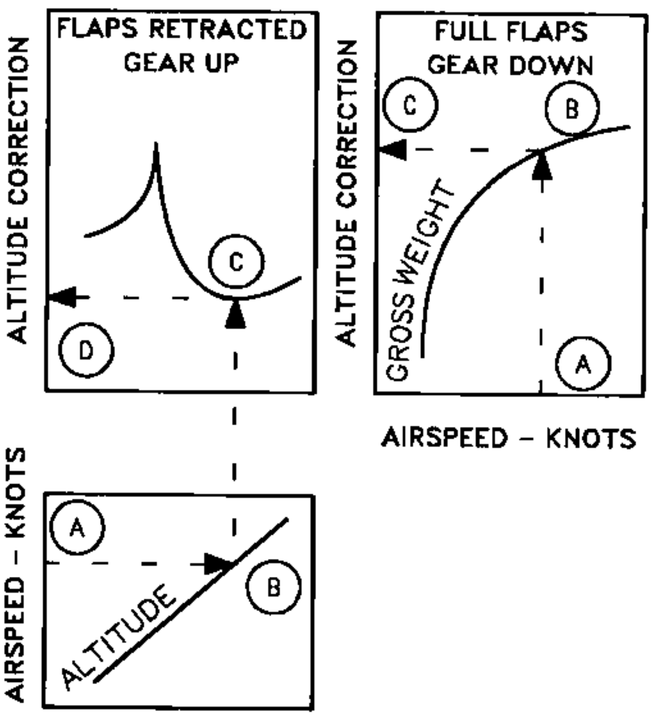
Configuration: Flaps up, Gear Up

A. Indicated airspeed	400 Kt
B. Assigned altitude	55,000 Ft
C. Reflector line	
D. ΔH correction	+375 Ft
E. Indicated altitude necessary to maintain assigned altitude (B+D)	55,375 Ft

Configuration: Flaps Down, Gear Down

A. Indicated airspeed	155 Kt
B. Gross weight	40,000 Lb
C. ΔH correction	+60 Ft

SAMPLE ALTIMETER POSITION ERROR CORRECTION



15E-1-(85-1)44-CATI

WIND COMPONENTS CHART

A standard Wind Components chart (figure B1-12) is included. It is used primarily for breaking a forecast wind down into crosswind and headwind components for takeoff computations. It may, however, be used whenever wind component information is desired. It is not to be used as a ground controllability chart.

USE

Determine the effective wind velocity by adding one-half the gust velocity (incremental wind factor) to the steady state velocity; e.g., reported wind 050/30 G40, effective wind is 050/35. Reduce the reported wind direction to a relative bearing by determining the wind direction and runway heading. Enter the chart with the relative bearing. Move along the relative bearing to intercept the effective wind speed arc. From this point, descend vertically down to read the crosswind component. From the intersection of bearing and wind speed, project horizontally left to read headwind component.

Sample Problem

Reported wind 050/35, runway heading 030.

A. Relative bearing	20°
B. Intersect windspeed arc	35 Kt
C. Crosswind component	12 Kt
D. Headwind component	33 Kt

STATION LOADING

NOTE

- FOR PRECISE AIRPLANE BASIC WEIGHT, REFER TO WEIGHT AND BALANCE DATA HANDBOOK, TO 1-1B-40, FOR THE PARTICULAR AIRPLANE
- THE TERMS 'BASIC' AND 'CLEAN' AIRCRAFT (AS USED IN THESE APPENDIXES) REFER TO AN F-15E AIRCRAFT WITH CONFORMAL FUEL TANKS, BUT WITHOUT PYLONS OR LANTIRN PODS INSTALLED

CONFIGURATION DRAG

ITEM	WEIGHT (POUNDS)	DRAG NUMBER (WITH CFT MOUNTED A/G STORES)	DRAG NUMBER (W/O CFT MOUNTED A/G STORES)
F-15E Without CFT's	34,600	-	-
Full internal fuel	12,915	-	-
Aircrew	215 (each)	-	-
Two -5 CFTs (F-15E Production Model)	E 4,386 F 13,738	21.3	21.3
LANTIRN Navigation Pod (AN/AAQ-13) and Adapter (ADU-576/A)	520	9.5	8.3
LANTIRN Targeting Pod (AN/AAQ-14) and Adapter (ADU-577/A)	621	7.4	6.5

ITEM	WEIGHT PER ITEM (POUNDS)	DRAG NUMBER WITHOUT CFT		DRAG NUMBER WITH CFT			
		CENTER-LINE STATION	OTHER STATIONS	CENTER-LINE STATION	WING STATIONS	CFT STATIONS WITHOUT BOMBS/ TANKS ON WING STATIONS	CFT STATIONS WITH BOMBS/ TANKS ON WING STATIONS
A/A Missiles							
AIM-7F, -7M	510	-	1.8	-	-	2.3	2.3
AIM-9L, 9M	195	-	2.1	-	2.1	-	-
AIM-9P/P-1	170	-	2.1	-	2.1	-	-
AIM-9P-2/P-3	180	-	2.1	-	2.1	-	-
AIM-120A	338	-	1.3	-	2.3	1.7	1.7
CATM-9L/M-1	195	-	2.1	-	2.1	-	-
A/G Missiles							
AGM-65A, B	481	-	3.7	-	3.7	-	-
AGM-65D	485	-	3.7		3.7	-	-
AGM-65G	687	-	3.7	-	3.7	-	-
AGM-130A, B	2962	-	TBD	-	TBD	-	-

Figure B1-1 (Sheet 1 of 4)

STATION LOADING (CONT)

ITEM	WEIGHT PER ITEM (POUNDS)	DRAG NUMBER WITHOUT CFT		DRAG NUMBER WITH CFT			
		CENTER-LINE STATION	OTHER STATIONS	CENTER-LINE STATION	WING STATIONS	CFT STATIONS WITHOUT BOMBS/ TANKS ON WING STATIONS	CFT STATIONS WITH BOMBS/ TANKS ON WING STATIONS
Pylons, Launchers and Adapters							
SUU-73/A Center-line Pylon with BRU-47/A	316	3.3	-	3.3	-	-	-
SUU-59C/A Wing Pylon with BRU-47/A	371	-	3.3	-	3.3	-	-
LAU-128/A Launcher and AIM-9/AIM-120 Adapter (ADU-552/A)	111	-	1.1	-	1.1	-	-
LAU-88A/A Launcher (Triple Rail) and AGM-65 Adapter (ADU-578/A)	573	-	9.6	-	9.6	-	-
LAU-117/A Launcher (Single Rail) for AGM-65	135	-	1.4	-	1.4	-	-
LAU-114/A Launcher and AIM-9 Adapter (ADU-407/A)	79	-	1.2	-	1.2	-	-
General Purpose Weapons							
MK-82 LDGP	505	-	-	-	-	0.8	0.9
MK-82 SE	550	-	-	-	-	1.4	1.5
MK-82 AIR (With BSU-49 Fin)	540	-	-	-	-	1.1	1.2
MK-84 LDGP	1970	3.0	2.1	3.0	2.3	2.8	3.0
MK-84 AIR (With BSU-50 Fin)	2010	5.4	3.9	5.4	4.2	5.1	5.6

Figure B1-1 (Sheet 2)

STATION LOADING (CONT)

ITEM	WEIGHT PER ITEM (POUNDS)	DRAG NUMBER WITHOUT CFT: CENTER-LINE STATION	DRAG NUMBER WITHOUT CFT: OTHER STATIONS	DRAG NUMBER WITH CFT: CENTER-LINE STATION	DRAG NUMBER WITH CFT: WING STATIONS	DRAG NUMBER WITH CFT: CFT STATIONS WITHOUT BOMBS/ TANKS ON WING STATIONS	DRAG NUMBER WITH CFT: CFT STATIONS WITH BOMBS/ TANKS ON WING STATIONS
Guided Weapons							
GBU-10A/B	2053	10.5	7.5	10.5	7.5	9.8	10.7
GBU-10C/B, D/B	2081	10.5	7.5	10.5	7.5	9.8	10.7
GBU-12B/B, C/B	610	-	-	-	-	3.9	4.3
GBU-15(V)-4/B	2502	-	5.6	-	5.6	-	-
GBU-24/B	2323	7.8	5.6	7.8	5.6	5.6	6.2
GBU-28/B	4576	-	7.5 (est)	-	7.5 (est)	-	-
Dispensers/Rockets							
CBU-52B/B	785	-	-	-	-	4.6	5.0
CBU-58/B	810	-	-	-	-	4.6	5.0
CBU-71/B	810	-	-	-	-	4.6	5.0
CBU-87/B (TMD)	950	-	-	-	-	2.9	3.2
CBU-89/B (TMD)	706	-	-	-	-	2.9	3.2
MK-20 Rockeye	486	-	-	-	-	1.5	1.6
TMU-28/B Spray Tank	E 567 F 1935	-	3.0	-	3.0	-	-
Special Weapons							
B61	751	2.5	1.8	2.5	1.8	1.8	2.0
Miscellaneous Stores							
610 Gallon Fuel Tank	E 320 F 4285	12.2	5.5	12.2	6.0	-	-
610 Gallon Fuel Tank (With Bombs on Inboard CFT Station)	E 320 F 4285	-	-	12.2	8.2	-	-
610 Gallon Fuel Tank (With Bombs on Outboard CFT Station)	E 320 F 4285	-	-	12.2	12.3	-	-
SUU-20B/A Practice Dispenser (Empty)	276	5.0	3.6	5.0	3.9	3.9	3.9
MK-106 PB (Incl)	F 306	4.2	3.0	4.2	3.3	3.3	3.3
BDU-33 PB (Incl)	F 414	4.2	3.0	4.2	3.3	3.3	3.3
BDU-48 PB (Incl)	F 336	4.2	3.0	4.2	3.3	3.3	3.3

E - Empty F - Full PB - Practice Bomb

Figure B1-1 (Sheet 3)

STATION LOADING (CONT)

ITEM	WEIGHT PER ITEM (POUNDS)	DRAG NUMBER WITHOUT CFT		DRAG NUMBER WITH CFT			
		CENTER-LINE STATION	OTHER STATIONS	CENTER-LINE STATION	WING STATIONS	CFT STATIONS WITHOUT BOMBS/ TANKS ON WING STATIONS	CFT STATIONS WITH BOMBS/ TANKS ON WING STATIONS
BDU-38 (B61 Training Shape)	751	2.6	1.8	2.5	1.8	1.8	2.0
AN/AXQ-14 Data Link Pod (for GBU-15)	450	4.6	-	4.6	-	-	-
P-4A/AX AIS Pod	160	-	2.1	-	2.1	-	-
AN/ASQ-T17 AIS Pod	122	-	2.1	-	2.1	-	-
AN/ASQ-T20 AIS Pod	123	-	2.1	-	2.1	-	-
AN/ASQ-T21 AIS Pod	124	-	2.1	-	2.1	-	-
AN/ASQ-T25 AIS Pod	122	-	2.1	-	2.1	-	-
BLU-107 Durandal	494	-	-	-	-	1.2	1.4
MXU-648A/A-50 Cargo Pod	E 98 F 398	3.6	3.6	3.6	3.6	-	-
Ammunition							
(512 Live Rounds)	289	-	-	-	-	-	-
(Spent Cartridges)	136	-	-	-	-	-	-

E - Empty F- Full

Figure B1-1 (Sheet 4)

F-15E GROSS WEIGHTS (LBS) AND CG LOCATION (%MAC) PW-229 ENGINES

DATA BASIS: ESTIMATED

STORE	#	FULL FUEL		CFT EMPTY		3200 LBS REMAINING		COMMENTS
		WEIGHT	CG	WEIGHT	CG	WEIGHT	CG	
MK-82 SE	12	70250	27.0	60848	25.7	51132	27.5	
	8	68050	24.8	58648	23.2	48932	24.6	
	4	65850	24.3	56448	22.5	46732	23.9	
MK-82 AIR	12	70130	26.9	60728	25.6	51012	27.4	
	8	67970	24.8	58568	23.1	48852	24.6	
	4	65810	24.3	56408	22.5	46692	23.9	
MK-82 LDGP	12	69710	26.7	60308	25.4	50592	27.2	
	8	67690	26.5	58288	25.1	48572	26.9	
	4	65670	25.9	56268	24.4	46552	26.2	
MK-84 AIR	4	71690	25.8	62288	24.4	52572	26.0	STA 2, 8, LC/RC 2
	2	67670	26.0	58268	24.5	48552	26.2	LC/RC 2
MK-84 LDGP	4	71530	25.7	62128	24.3	52412	25.9	STA 2, 8, LC/RC 2
	2	67590	26.0	58188	24.5	48472	26.2	LC/RC 2
GBU-10C/B	4	70770	26.0	61368	24.6	51652	26.2	STA 2, 8, LC/RC 2 NO AIM-9
	2	66608	26.3	57206	24.8	47490	26.6	LC/RC 2
GBU-10G/B	4	70770	26.0	61368	24.6	51652	26.2	STA 2, 8, LC/RC 2 NO AIM-9
	2	66608	26.3	57206	24.8	47490	26.6	LC/RC 2
GBU-24/B	3	69391	25.2	59989	23.7	50273	25.2	STA 2, 5, 8, NO AIM-9 or AIM-120
GBU-24A/B	3	69490	25.2	60088	23.7	50371	25.2	STA 2, 5, 8, NO AIM-9 or AIM-120
GBU-12	8	68530	26.5	59128	25.1	49412	26.9	
	4	66090	26.2	56688	24.7	46972	26.5	
CBU-52	12	73070	27.2	63668	26.0	53952	27.8	
	8	69930	26.9	60528	25.6	50812	27.4	
	4	66790	26.1	57388	24.6	47672	26.4	

Figure B1-2 (Sheet 1 of 2)

F-15E GROSS WEIGHTS (LBS) AND CG LOCATION (%MAC) PW-229 ENGINES (CONT)

DATA BASIS: ESTIMATED

STORE	#	FULL FUEL		CFT EMPTY		3200 LBS REMAINING		COMMENTS
		WEIGHT	CG	WEIGHT	CG	WEIGHT	CG	
CBU-58 CBU-71	12	73370	27.2	63968	26.0	54252	27.8	
	8	70130	26.9	60728	25.6	51012	27.4	
	4	66890	26.1	57488	24.6	47772	26.4	
CBU-87	12	75050	27.6	65648	26.6	55932	28.4	
	8	71250	27.2	61848	26.0	52132	27.9	
	4	67450	26.3	58048	24.9	48332	26.6	
CBU-89	12	72122	27.2	62720	26.0	53004	27.8	
	8	69298	26.8	59896	25.5	50180	27.4	
	4	66474	26.1	57072	24.6	47356	26.4	
MK-20	12	69482	26.7	60080	25.4	50364	27.2	
	8	67538	26.5	58136	25.1	48420	26.9	
	4	65594	26.0	56192	24.4	46476	26.2	
GBU-28/B	2	72802	25.2	63400	23.8	53684	25.2	STA 2 & 8
MC-1	12	72350	27.2	62948	26.0	53232	27.8	
	8	69450	26.9	60048	25.5	50332	27.4	
	4	66550	26.1	57148	24.6	47432	26.4	

NOTES

1. CENTER OF GRAVITY DATA BASED ON F-15E 90-0233.
2. AIRCRAFT CONFIGURATION IS: FULL OF FUEL (INTERNAL AND CFT), 2 x LANTIRN PODS, 4 x AIM-9L, NO GUN AMMO AND LIGHTWEIGHT CREW (170 LBS).
3. CG LOCATIONS ARE FOR GEAR UP. ADD 0.3% MAC FOR GEAR DOWN ABOVE 70,000 POUNDS. BELOW 70,000 POUNDS ADD 0.4% TO MAC.
4. CENTER OF GRAVITY TRACK IS FAIRLY LINEAR BETWEEN POINTS SHOWN.
5. AS FUEL IS BURNED FROM 3200 LBS REMAINING TO 2700 LBS REMAINING, CG MOVES AFT 0.6% MAC. FROM 2700 LBS TO BINGO, CG REMAINS CONSTANT.
6. ADD 0.6% MAC FOR EACH LANTIRN POD REMOVED AND SUBTRACT 621 LBS IF TARGETING POD REMOVED AND 520 LBS IF NAV POD REMOVED.
7. ADD 0.05% MAC AND SUBTRACT 195 LBS FOR EACH AIM-9 REMOVED.
8. WITH CENTERLINE TANK, SUBTRACT 0.5% MAC AND ADD 4600 LBS. AFTER CENTERLINE TANK FUEL IS BURNED, CG TRACK IS AS DESCRIBED ABOVE.
9. ABOVE DATA ASSUMES NORMAL RELEASE SEQUENCE OF STORES FROM BOTH CFT'S SIMULTANEOUSLY. IF CONFIGURATION HAS MORE THAN 1 STORE PER CFT, AND IF ONE CFT IS FULLY DOWNLOADED BEFORE THE OTHER, THE ABOVE DATA DOES NOT APPLY.
10. SUBTRACT 0.2% MAC AND ADD 289 LBS IF FULL LOAD OF GUN AMMO IS CARRIED.
11. SUBTRACT 0.3% MAC AND ADD 90 LBS IF HEAVYWEIGHT CREW (215).
12. SUBTRACT 600 LBS IF NO ICS (CG IS UNCHANGED).

Figure B1-2 (Sheet 2)

STANDARD ATMOSPHERE TABLE

STANDARD SEA LEVEL AIR:	W = 0.076475 LB/CU FT = 0.0023769 SLUGS/CU FT
T = 59°F (15°C)	1 IN. OF HG = 70.732 LB/SQ FT = 0.4912 LB/SQ IN
P = 29.921 IN. OF HG	α_0 = 116.5 FT/SEC = 661.5 KNOTS

U.S. STANDARD ATMOSPHERE, 1966

ALTITUDE FEET	DENSITY RATIO ρ/ρ_o	$1/\sqrt{\sigma}$	AIR TEMPERATURE		SPEED OF SOUND RATIO α/α_o	PRESSURE	
			DEG. F	DEG.C		IN. OF HG	RATIO $P/P_o = \delta$
-2.000	1.0598	0.9714	66.132	18.962	1.0068	32.15	1.0745
-1.000	1.0296	0.9855	62.566	16.981	1.0034	31.02	1.0368
0	1.0000	1.0000	59.000	15.000	1.0000	29.92	1.0000
1.000	0.9711	1.0148	55.434	13.019	0.9966	28.86	0.9644
2.000	0.9482	1.0299	51.868	11.038	0.9931	27.82	0.9298
3.000	0.9151	1.0454	48.302	9.057	0.9896	26.82	0.8962
4.000	0.8881	1.0611	44.735	7.075	0.9862	25.84	0.8637
5.000	0.8617	1.0773	41.169	5.094	0.9827	24.90	0.8320
6.000	0.8359	1.0938	37.603	3.113	0.9792	23.98	0.8014
7.000	0.8106	1.1107	34.037	1.132	0.9756	23.09	0.7716
8.000	0.7860	1.1279	30.471	-0.849	0.9721	22.22	0.7428
9.000	0.7620	1.1456	26.905	-2.831	0.9686	21.39	0.7148
10.000	0.7385	1.1637	23.338	-4.812	0.9650	20.58	0.6877
11.000	0.7156	1.1822	19.772	-6.793	0.9614	19.79	0.6614
12.000	0.6932	1.2011	16.206	-8.74	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	16.83	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	0.9827	13.75	0.4593
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

Figure B1-3 (Sheet 1 of 2)

STANDARD ATMOSPHERE TABLE

STANDARD SEA LEVEL AIR:
T = 59°F (15°C)
P = 29.921 IN. OF HG

W = 0.076475 LB/CU FT = 0.0023769 SLUGS/CU FT
1 IN. OF HG = 70.732 LB/SQ FT = 0.4912 LB/SQ IN
α_0 = 116.5 FT/SEC = 661.5 KNOTS

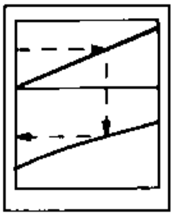
U.S. STANDARD ATMOSPHERE, 1966

ALTITUDE FEET	DENSITY RATIO ρ/ρ_o	$1/\sqrt{\sigma}$	AIR TEMPERATURE		SPEED OF SOUND RATIO α/α_o	PRESSURE	
			DEG. F	DEG.C		IN. OF HG	RATIO $P/P_o = \delta$
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

Figure B1-3 (Sheet 2)

STALL SPEEDS

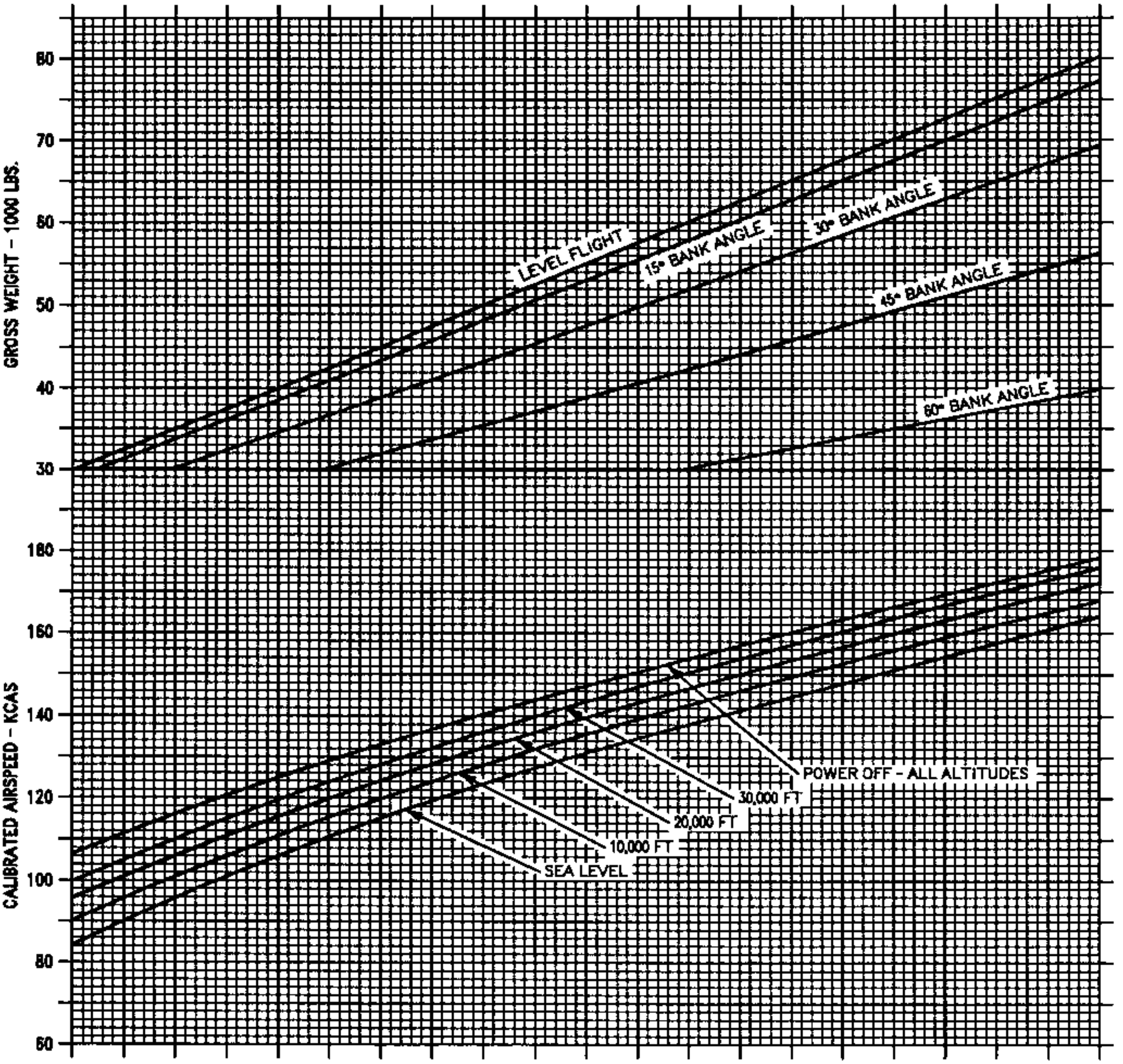
MILITARY THRUST



AIRPLANE CONFIGURATION
GEAR AND FLAPS DOWN
ALL DRAG INDEXES

REMARKS
ENGINE(S): (2)F100-PW-229
U.S. STANDARD DAY, 1966

DATE: 15 JULY 1988
DATA BASIS: ESTIMATED



15E-1-(337-1)38-CATI

Figure B1-4

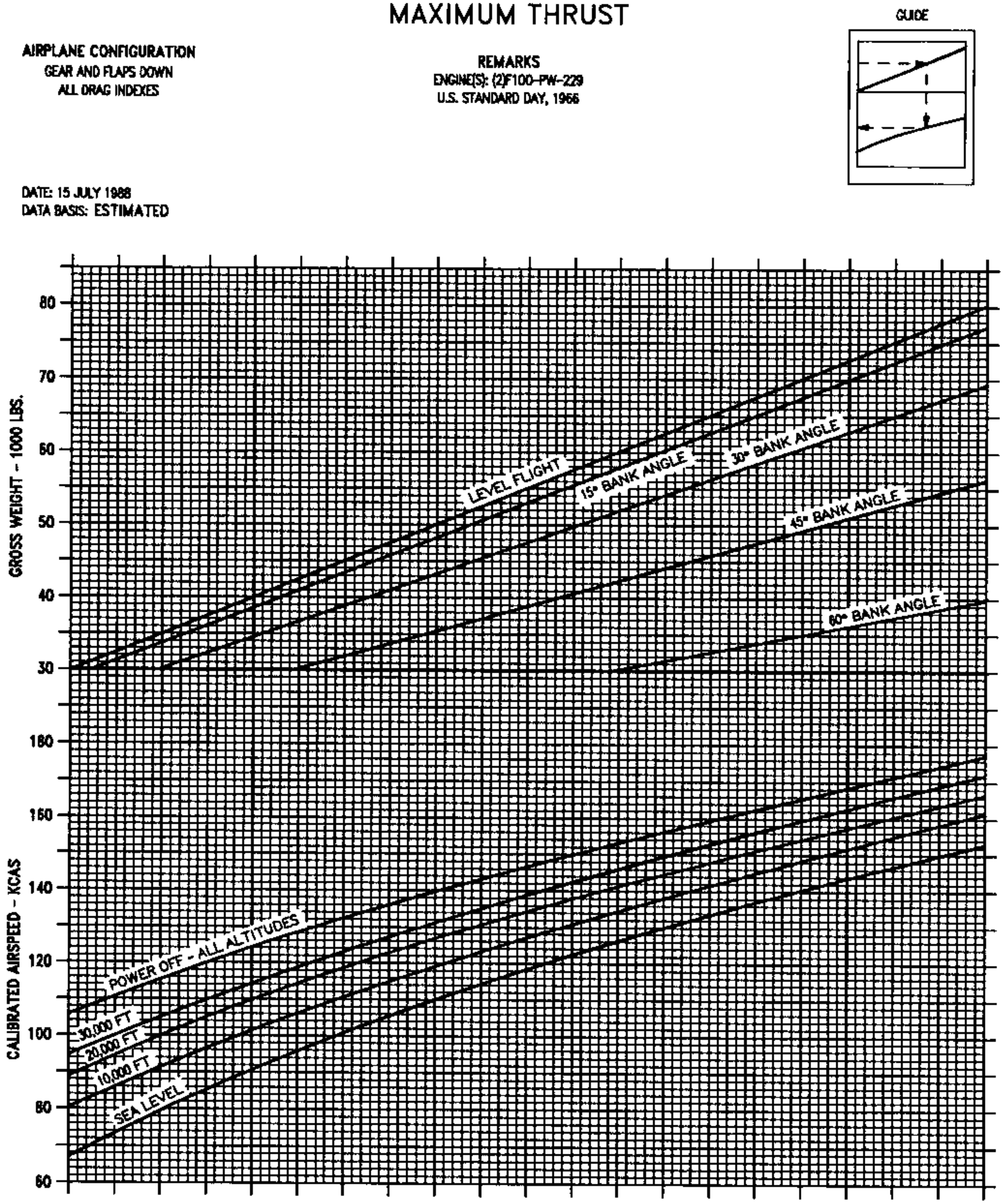
STALL SPEEDS

MAXIMUM THRUST

AIRPLANE CONFIGURATION
GEAR AND FLAPS DOWN
ALL DRAG INDEXES

REMARKS
ENGINE(S): (2)F100-PW-229
U.S. STANDARD DAY, 1966

DATE: 15 JULY 1988
DATA BASIS: ESTIMATED



15E-1-(338-1)38-CATI

Figure B1-5

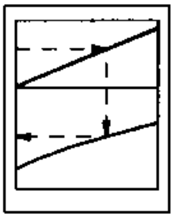
STALL SPEEDS

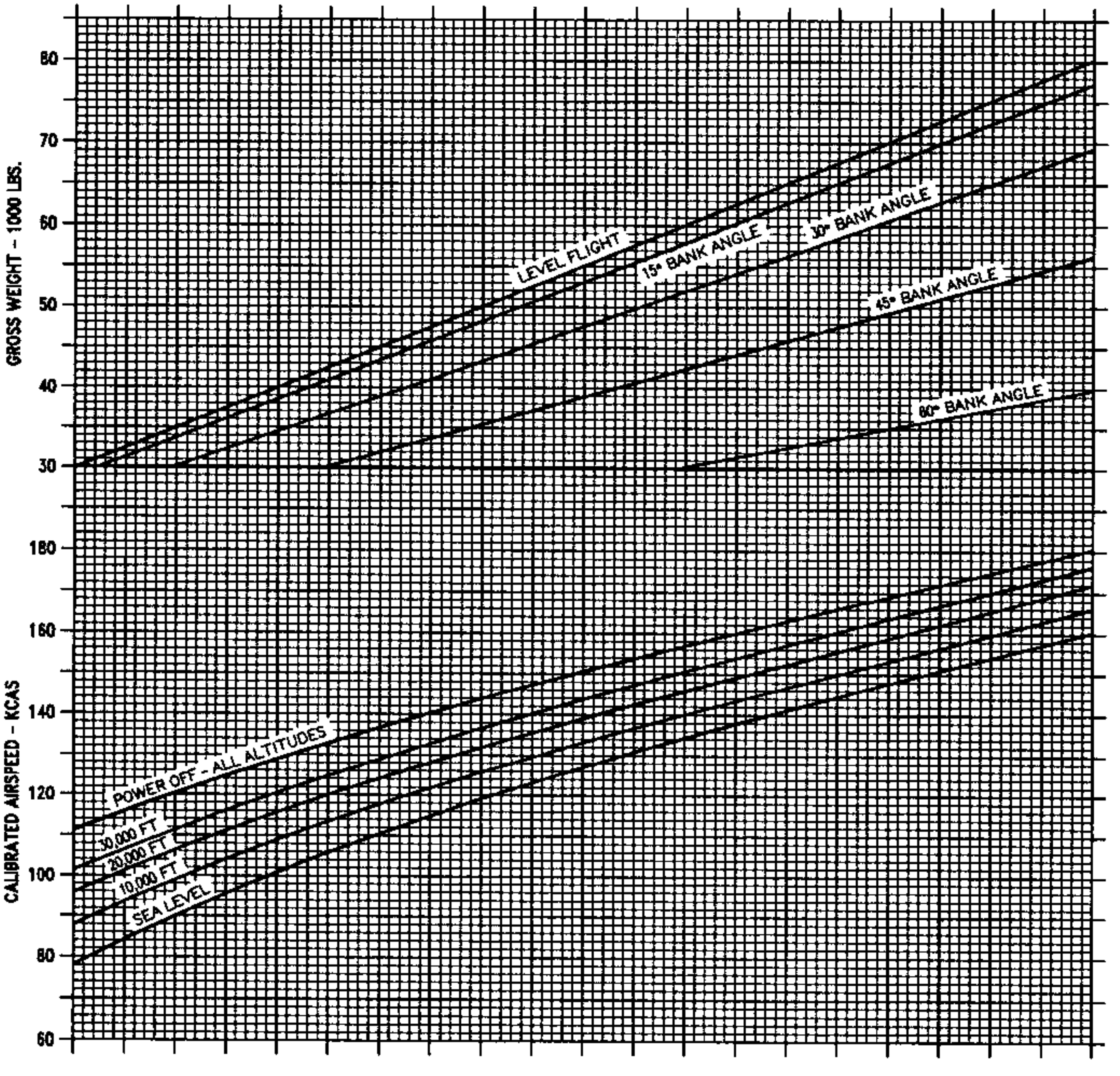
MILITARY THRUST

AIRPLANE CONFIGURATION
GEAR AND FLAPS UP
ALL DRAG INDEXES

REMARKS
ENGINE(S): (2)F100-PW-229
U.S. STANDARD DAY, 1966

DATE: 15 JULY 1988
DATA BASIS: ESTIMATED





15E-1-(339-1)38-CATI

Figure B1-6

STALL SPEEDS

MAXIMUM THRUST

AIRPLANE CONFIGURATION
GEAR AND FLAPS UP
ALL DRAG INDEXES

REMARKS
ENGINE(S): (2)F100-PW-229
U.S. STANDARD DAY, 1966

DATE: 15 JULY 1988
DATA BASIS: ESTIMATED

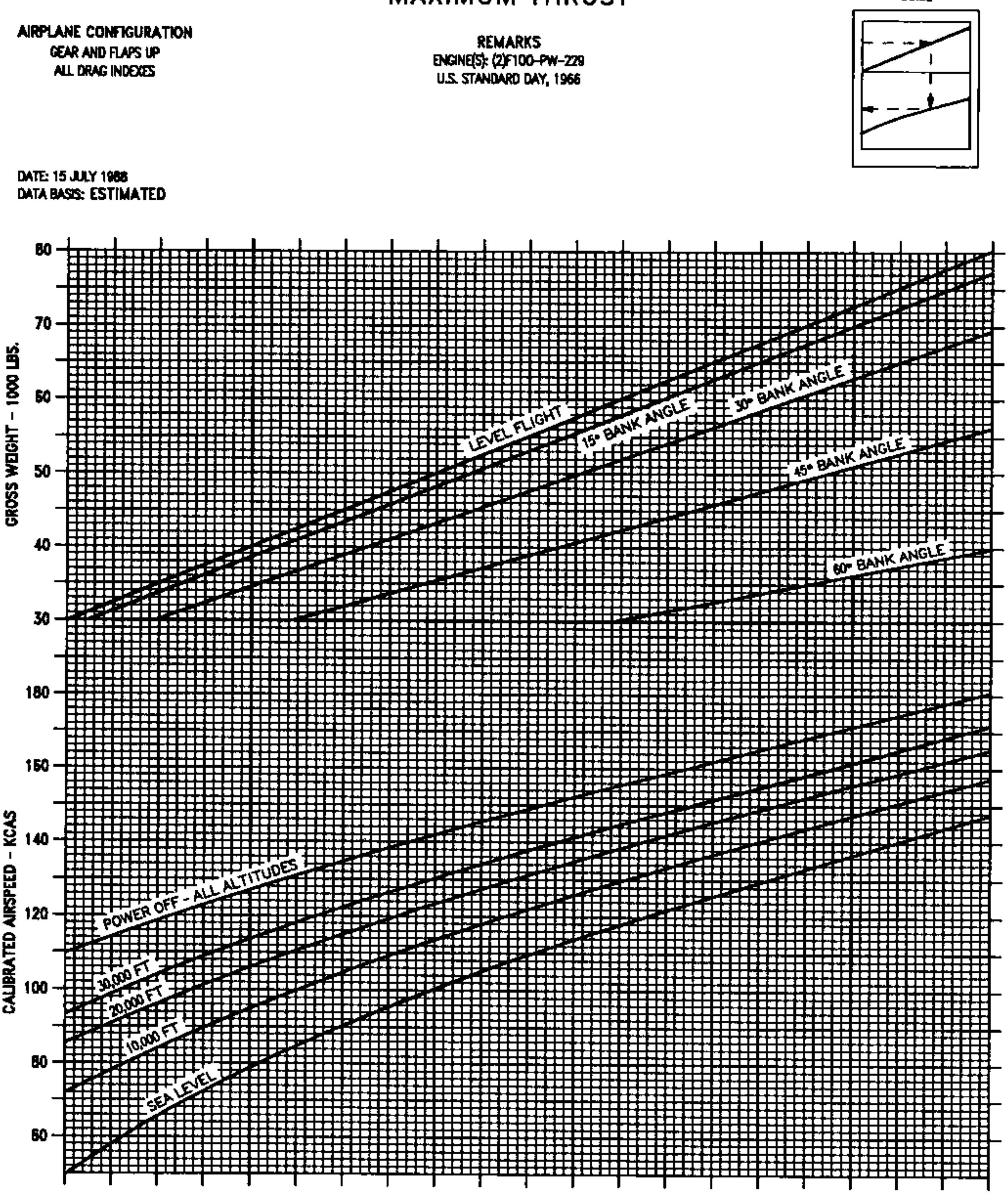
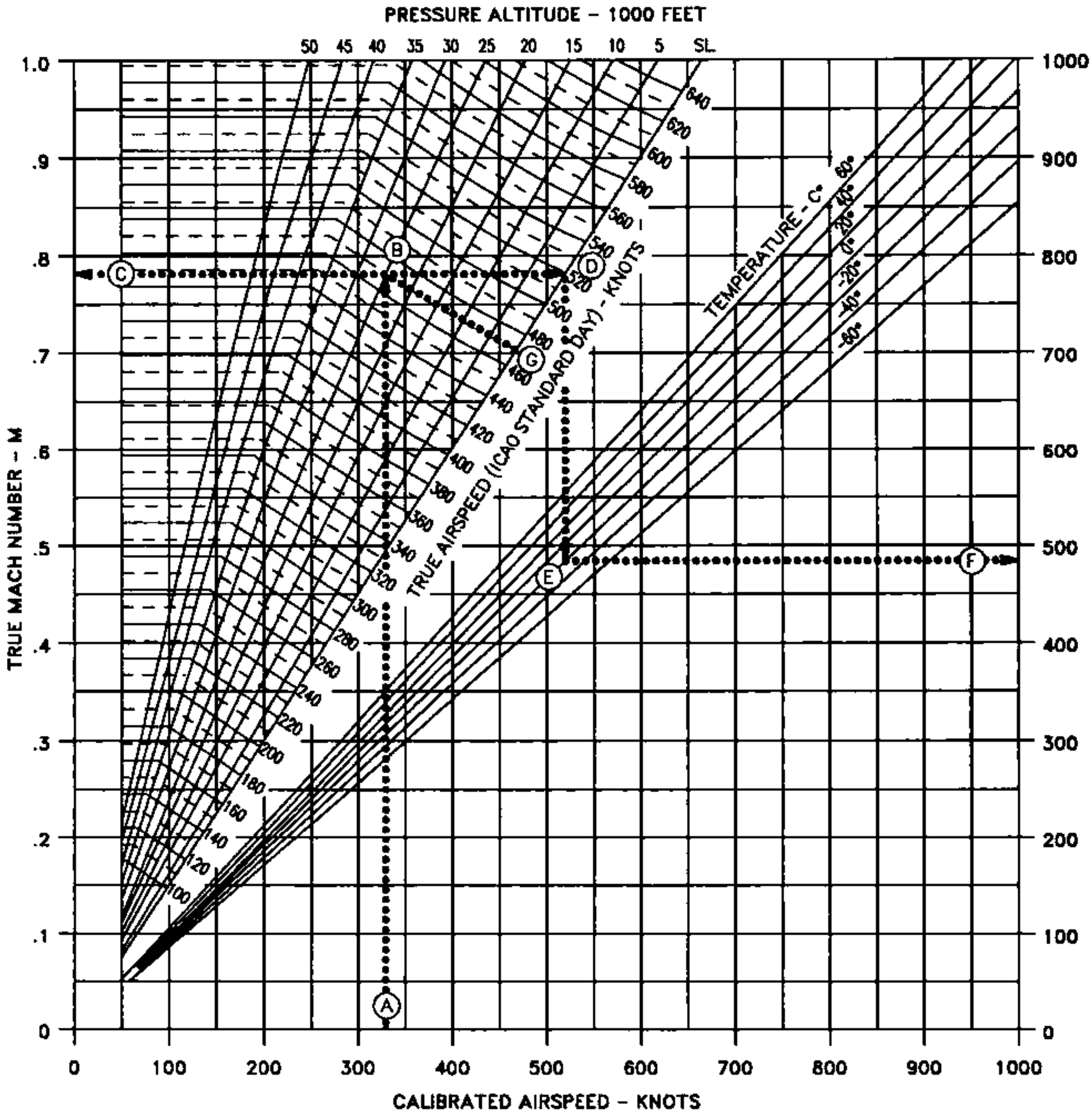


Figure B1-7

AIRSPEED CONVERSION

LOW MACH



EXAMPLE

A = CAS = 300 KNOTS
B = ALTITUDE = 25,000 FEET
C = MACH = .782
D = SEA LEVEL LINE
E = TEMPERATURE = -20°C
F = TAS = 486 KNOTS
G = TAS (STANDARD DAY) = 472 KNOTS

15E-1-(80-1)44-CATI

Figure B1-8

AIRSPEED CONVERSION

HIGH MACH

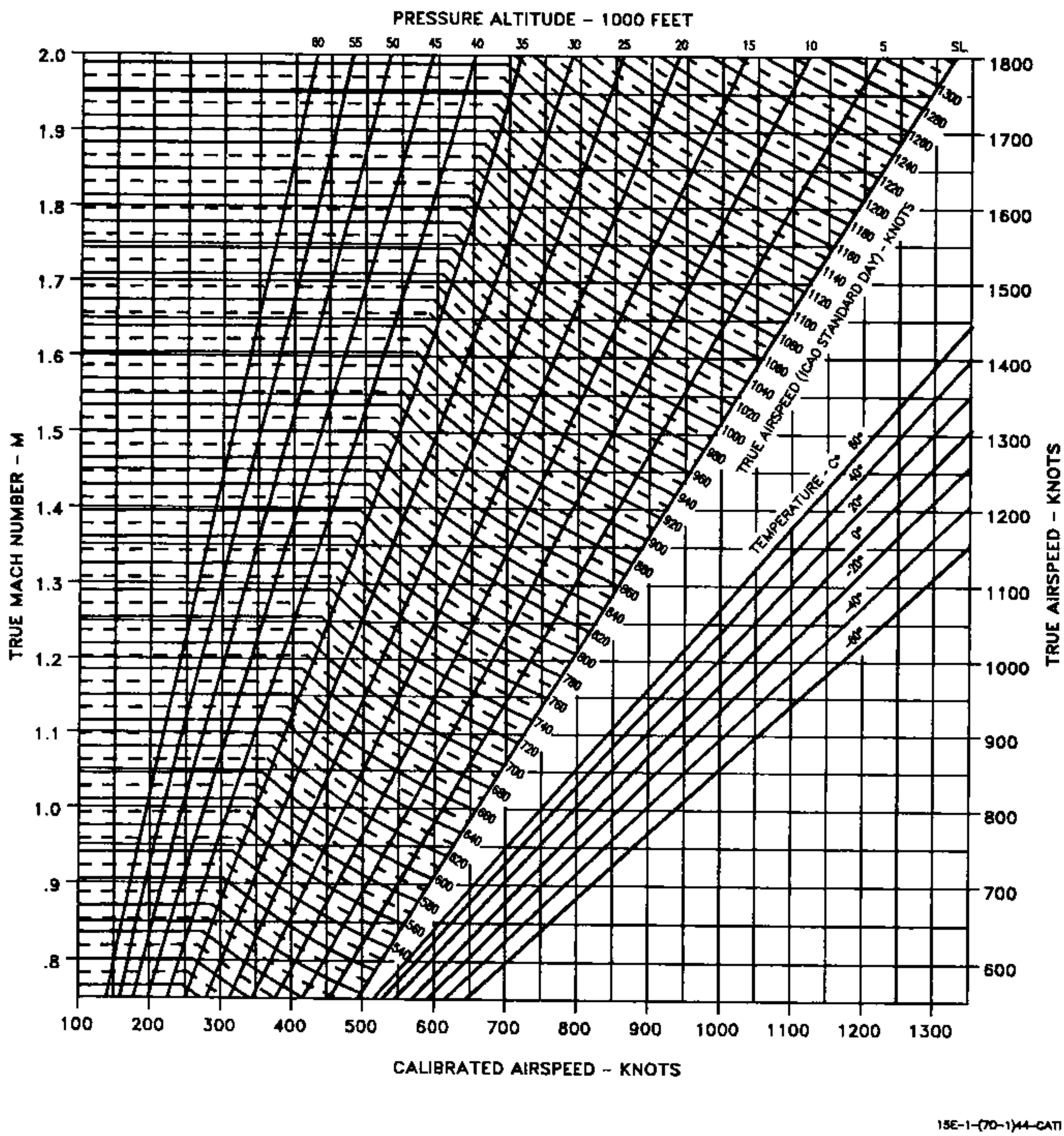
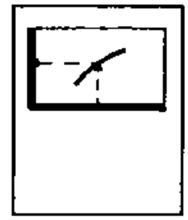


Figure B1-9

AIRSPEED POSITION ERROR CORRECTION

1G FLIGHT

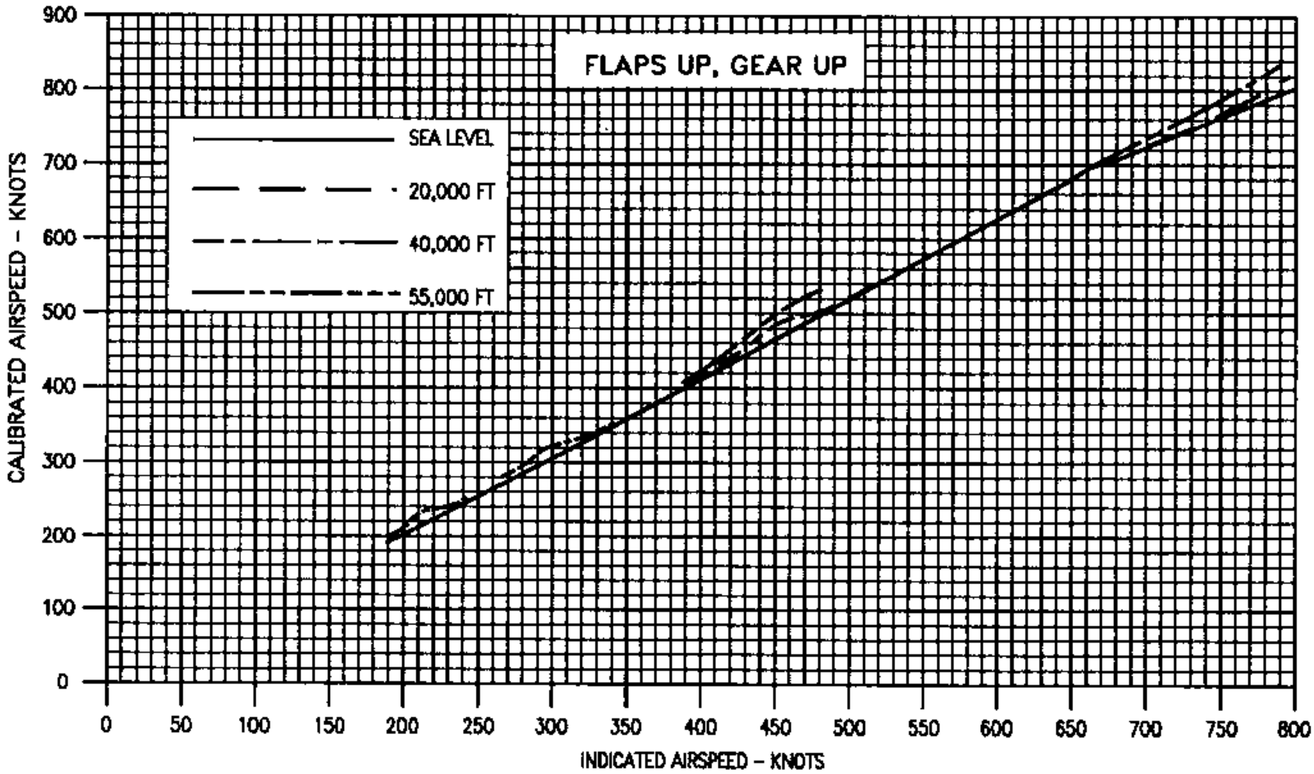
GUIDE



AIRPLANE CONFIGURATION
FLAPS AND GEAR AS NOTED

REMARKS
U.S. STANDARD DAY, 1966

DATE: 15 MARCH 1991
DATA BASIS: ESTIMATED



FLAPS DOWN, GEAR DOWN

10,000 FT AND BELOW

	CALIBRATED AIRSPEED - KTS		
INDICATED AIRSPEED - KTS	GW 30,000	GW 40,000	GW 50,000
140	137	-	-
160	158	157	-
180	178.5	178	177
200	198.5	198.5	198
220	219	218.5	218.5
240	239	238	239

15E-1-(71-1)44-CATI

Figure B1-10

ALTIMETER POSITION ERROR CORRECTION

STANDBY ALTIMETER ONLY

AIRPLANE CONFIGURATION
GEAR AND FLAPS AS NOTED
ALL DRAG INDEXES

REMARKS
U.S. STANDARD DAY, 1966

NOTE
ASSIGNED ALTITUDE + Δ H = INDICATED ALTITUDE, FLY INDICATED ALTITUDE.

DATE: 15 JUNE 1989
DATA BASIS: FLIGHT TEST

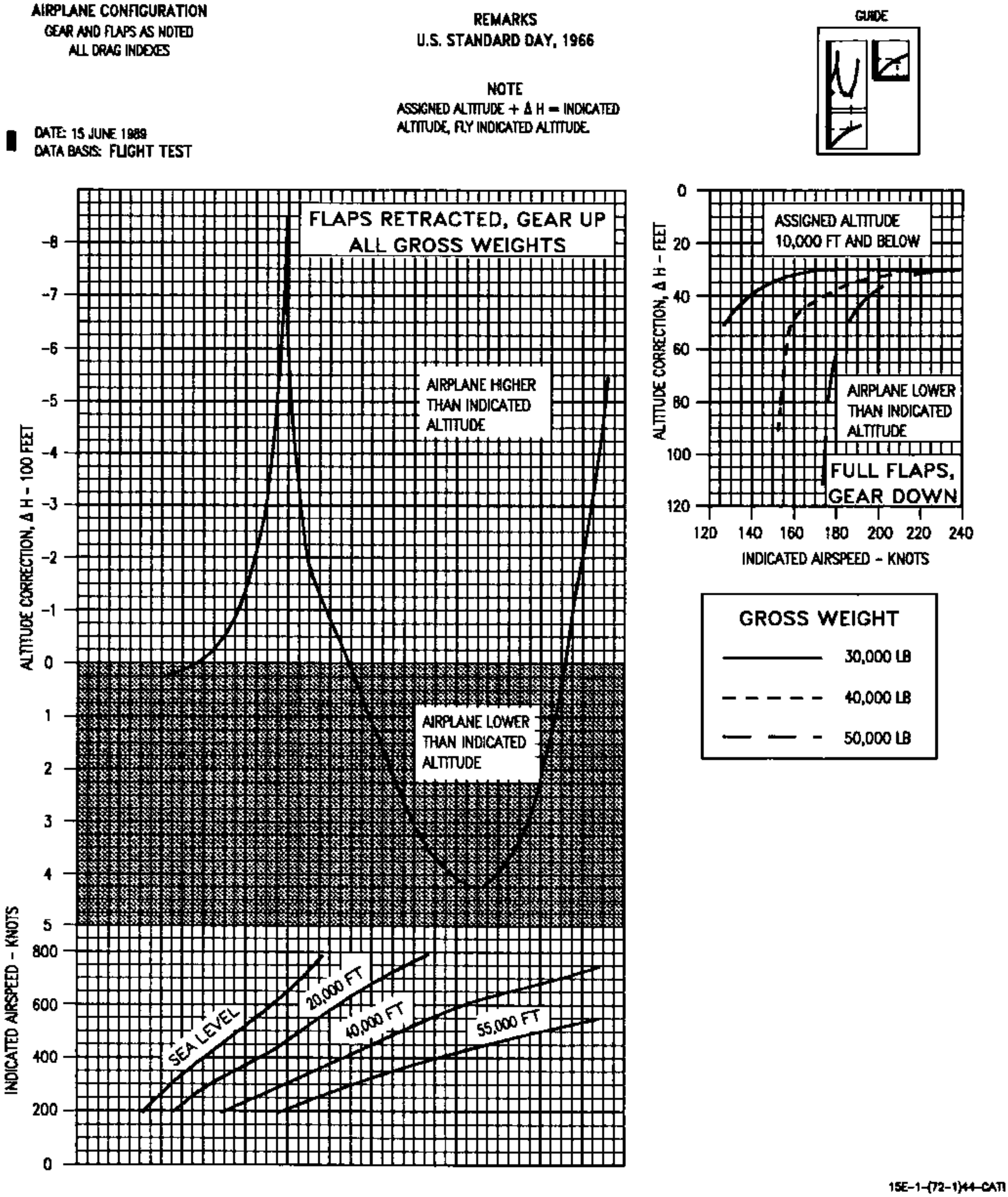
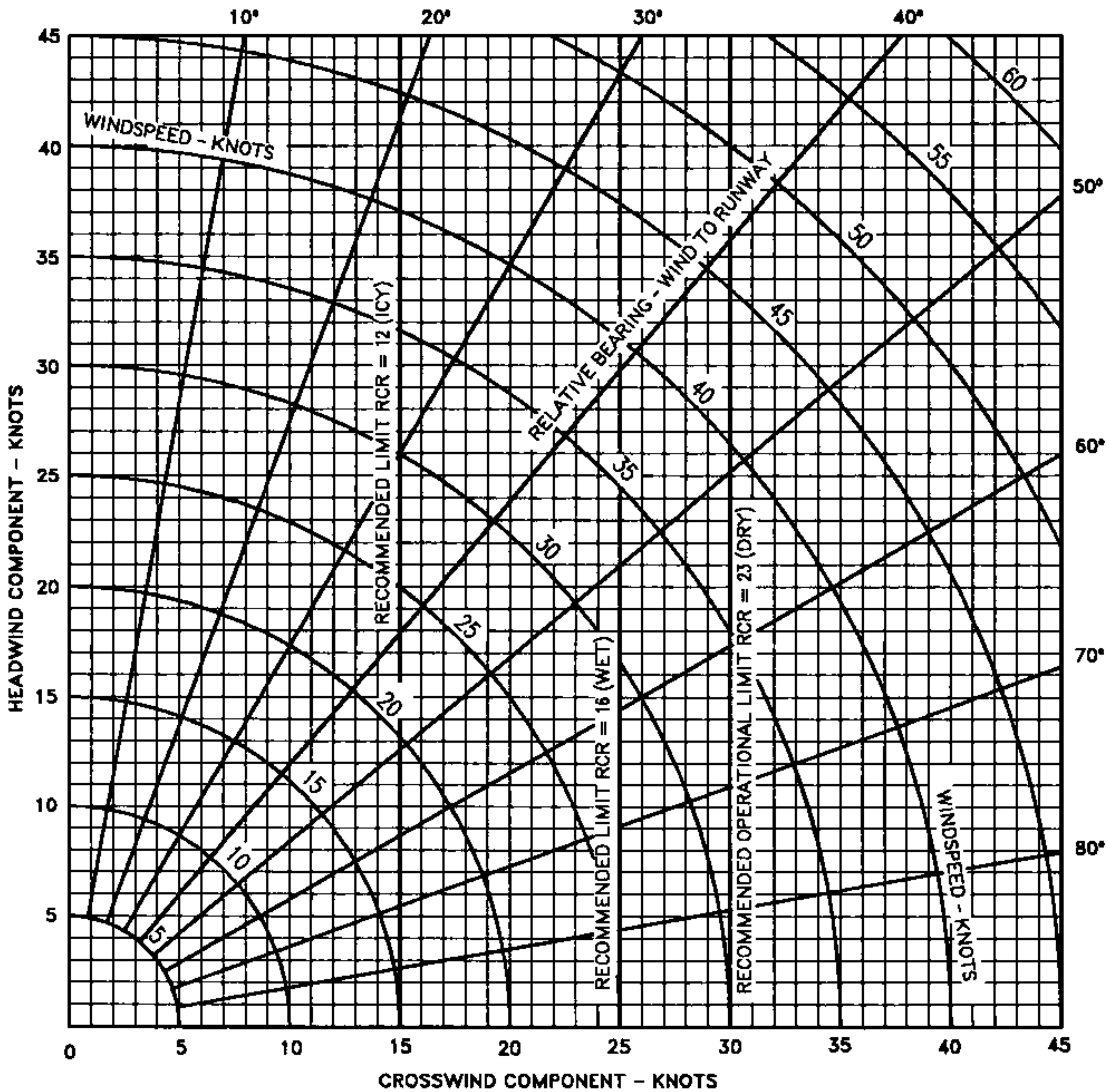


Figure B1-11

WIND COMPONENTS

- DETERMINE THE EFFECTIVE WIND VELOCITY BY ADDING ONE-HALF THE GUST VELOCITY (INCREMENTAL WIND FACTOR) TO THE STEADY STATE VELOCITY: E.G. REPORTED WIND 050/30 G40, EFFECTIVE WIND IS 050/35.
- CROSSWIND LIMITS FOR RCR VALUES, 12-16 AND 16-23 MAY BE OBTAINED BY INTERPOLATING BETWEEN THE LIMITS SHOWN.



15E-1-(73-1)18-CATI

Figure B1-12

PART 2

ENGINE DATA

This part not applicable.

PART 3

TAKEOFF

TABLE OF CONTENTS

Charts

NOTE

Performance charts for the PW-229 engines are currently being developed. The references to figures have been retained even if the chart is not available. The actual charts will be added as they become available.

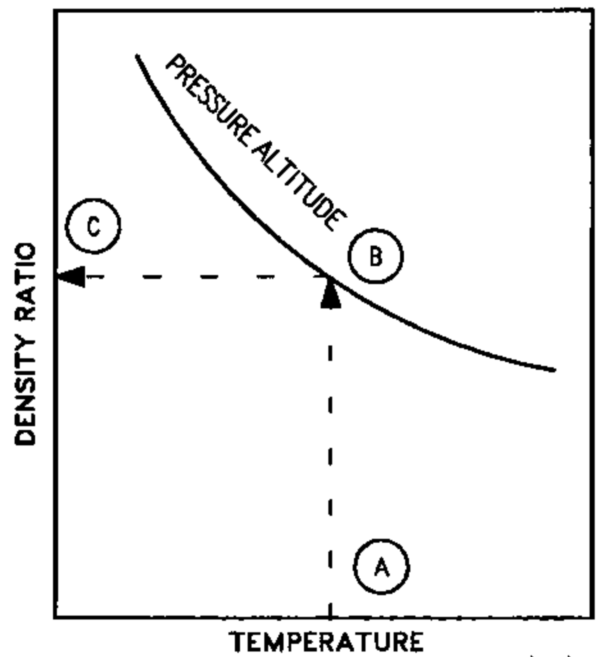
DENSITY RATIO CHART

This chart (figure B3-1) provides a means of obtaining a single factor (density ratio) that may be used to represent a combination of temperature and pressure altitude. Density ratio must be determined before the Minimum Go Speed and Maximum Abort Speed charts can be utilized.

USE

Enter the chart with existing temperature, and project vertically to intersect the applicable pressure altitude curve. From this point, project horizontally to the left scale to read density ratio.

SAMPLE DENSITY RATIO



15E-1-(74-1)44-CATI

Sample Problem

A. Temperature	60°F
B. Pressure Altitude	2000 Ft
C. Density ratio	0.93

MINIMUM GO SPEED CHART

These charts (figures B3-2, B3-6) provide the means of determining the minimum speed at which the aircraft can experience an engine failure and still take off under existing conditions of temperature, pressure altitude, gross weight, and the runway length remaining. Separate plots are provided for maximum and military thrust conditions, and for aircraft with and without CFT's installed. The data is based on an engine failure occurring at the minimum go speed and allows for a 3-second decision period with one engine operating at its initial thrust setting. In the case of a military thrust takeoff, an additional 3-second period is allowed for advancing the operating engine throttle to maximum thrust.

These charts address only the ability of the aircraft to takeoff on the remaining runway following an engine failure, not the additional issue of directional controllability on the runway. An engine failure rapidly produces a thrust asymmetry which can induce large lateral excursions if corrective action is not taken promptly. The effects of the thrust asymmetry are largest at low speeds where the combination of flight control system effectiveness and nose-wheel steering control is lowest. The effects of thrust asymmetry are dependent on power setting, temperature, pressure altitude, gross weight, and runway surface condition. Directional control at speeds below 100 KCAS even on a dry runway may be insufficient to maintain acceptable lateral placement on the runway. Abort the takeoff if large lateral excursions occur. Directional controllability problems due to thrust asymmetry should be countered by applying opposite rudder pedal and/or reduce the thrust level.

WARNING

If an engine is lost above the maximum abort speed but below the minimum go speed, the pilot can neither abort nor take off safely on the runway length remaining without considering such factors as reducing gross weight or engaging the overrun end arrestment cable. Refer to Engine Failure During Takeoff, section III.

USE

Enter the applicable plot with the prevailing density ratio, and project horizontally to the available runway length grid line. Parallel the nearest guideline up or down to intersect the baseline. From this point descend vertically to intersect the applicable takeoff gross weight curve, then horizontally to read minimum go speed. If this projected line lies entirely to the right of the gross weight curve single engine failure can be tolerated at any speed between zero and the highest speed shown with the ground roll being within the available runway length. If the above projected line lies entirely to the left of the gross weight curve, single engine failure takeoff cannot be accomplished with the available runway length. With CFTs, the recommended rotation speeds are given in figure B3-10. Without CFTs, with an engine failure before nose rotation at high gross weights, the ground roll will be shortened if aft stick is relaxed until 10 to 15 knots below takeoff speed. This situation will be obvious to the pilot.

Sample Problem

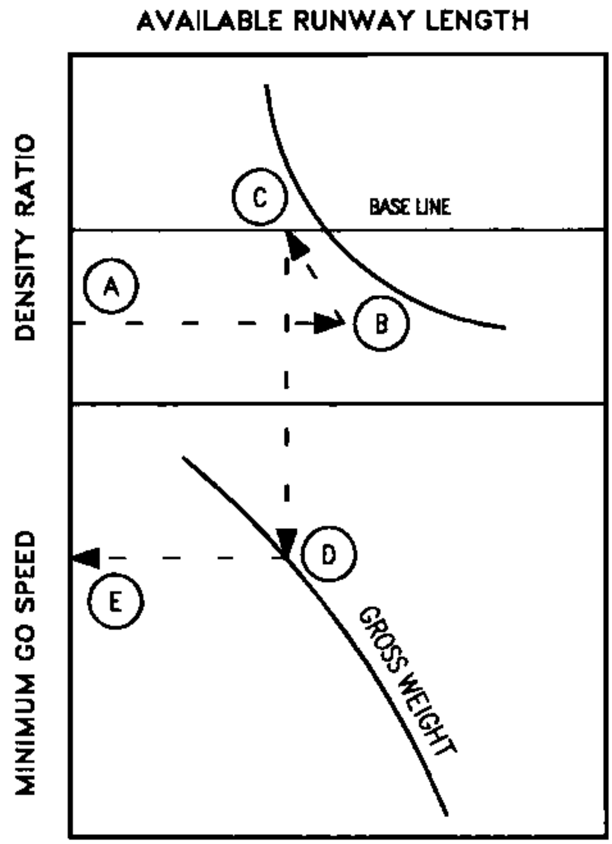
Maximum Thrust Takeoff With CFT (with fuel tanks or A/G stores on wing pylons)

A.	Density ratio	0.90
B.	Available runway length	9000 Ft
C.	Parallel guideline to baseline	
D.	Takeoff gross weight	75,000 Lb
E.	Minimum go speed	172 KCAS

NOTE

This problem assumes maximum thrust on operating engine within 6 seconds after engine failure. The minimum go speed for a maximum thrust takeoff will be less than that for a military thrust takeoff due to the greater acceleration with maximum thrust up to and including the 3-second decision time.

SAMPLE MINIMUM GO SPEED



15E-1-(75-1)44-CATI

MAXIMUM ABORT SPEED CHART

NOTE

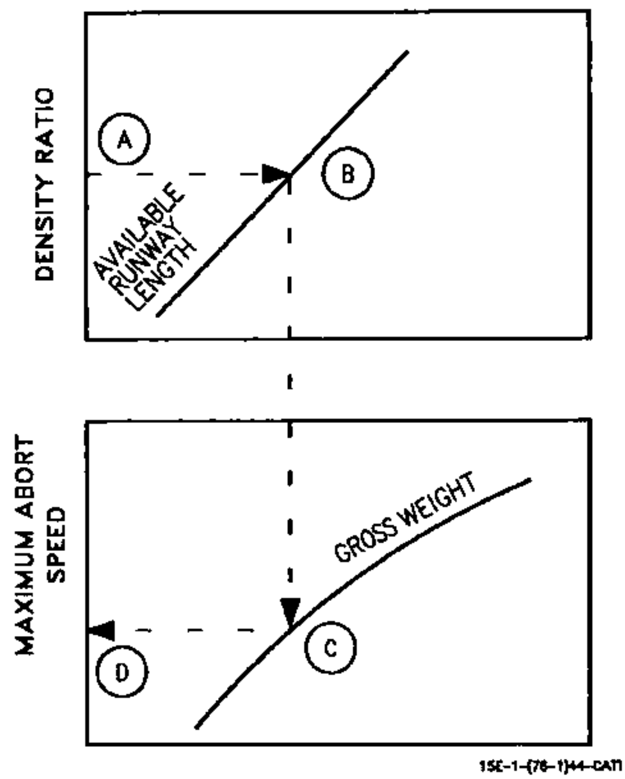
- The maximum abort speed chart does not include the capability of any arrestment gear which may be installed, and takes into account only aircraft stopping performance for the given field conditions.
- Lower weight aircraft are often shown to have lower maximum abort speeds than higher weight aircraft due to the greater acceleration of the lighter aircraft during the abort decision period used in the calculations.

These charts (figures B3-3 and B3-7) provide a means of determining the maximum speed at which an abort may be started and the aircraft stopped within the remaining runway length. Separate plots are provided for maximum and military thrust, and for aircraft with and without CFT's installed. Separate plots are also included for dry, wet, and icy runways. Allowances included in this data are based on a 3-second decision period (with both engines operating at the initial thrust setting) followed by a 2-second period to apply wheel brakes and a 5-second period to reach idle thrust (these two abort procedures are initiated simultaneously).

USE

Enter applicable plot with the prevailing density ratio, and project horizontally to intersect the available runway length curve. From this point, descend further to intersect the computed takeoff gross weight, then horizontally to read the corresponding maximum abort speed.

SAMPLE MAXIMUM ABORT SPEED



Sample Problem

Maximum Thrust Takeoff, Hard Dry Runway, With CFT (with fuel tanks or A/G stores on wing pylons)

A. Density ratio	0.90
B. Available runway length	9000 Ft
C. Gross weight	75,000 Lb
D. Maximum abort speed	125 KCAS

TAKEOFF DISTANCE CHARTS

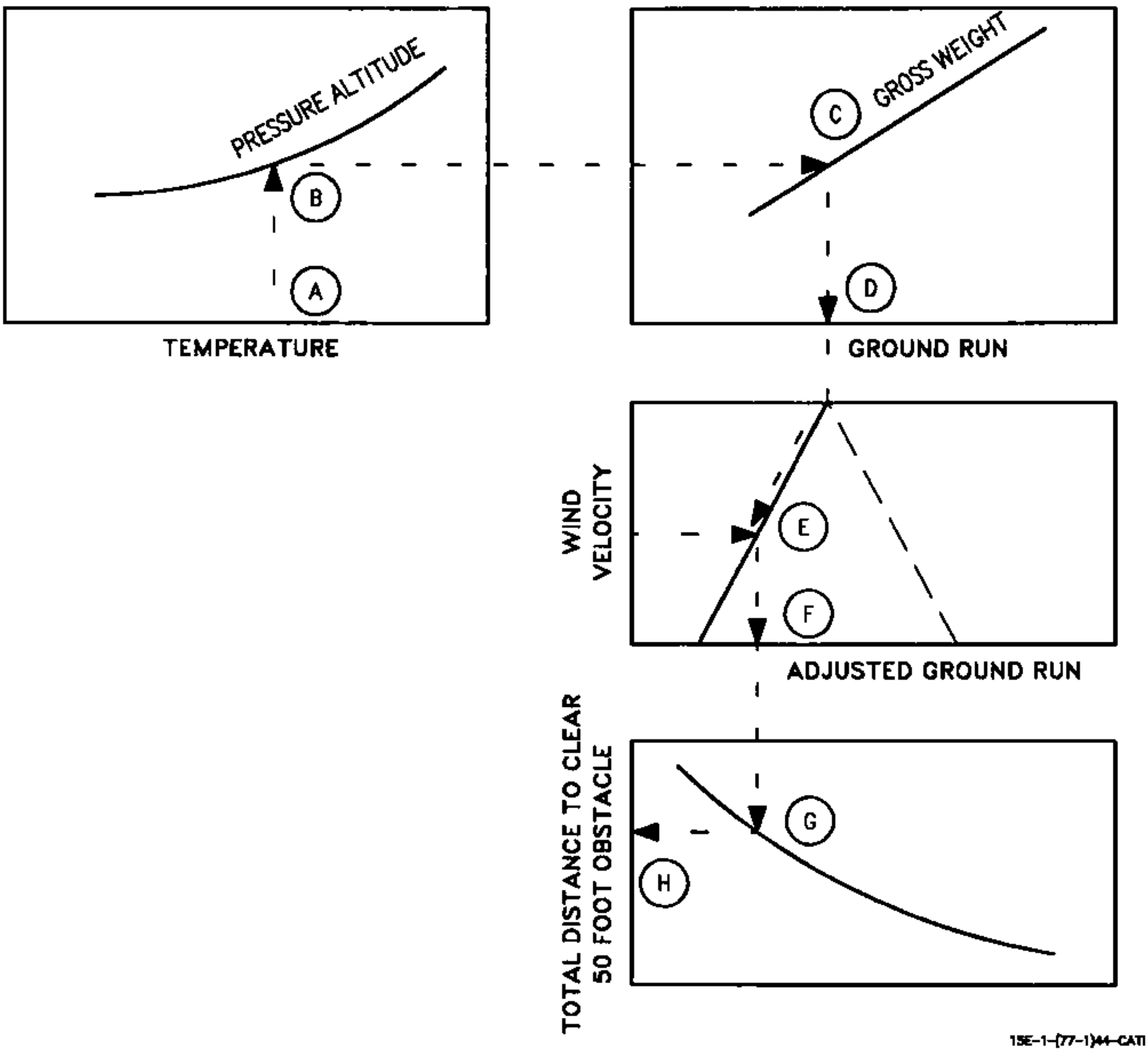
These charts (figures B3-4, B3-5, B3-8, B3-9) are used to determine the no wind ground run distance, wind adjusted ground run and the total distance required to clear a 50-foot obstacle. Separate charts are provided for maximum and military thrust, and for aircraft with and without CFT's installed. The without CFT charts (figures B3-8, B3-9) are based on CG's representative of each gross weight. With CFTs, the CG's used for each gross weight are noted on the chart. Takeoff distances will be reduced for aft CG's and increased for forward CG's.

The notes regarding CG effect on ground roll on the takeoff charts are based on conservative performance estimates based on data generated at typical weight, altitude, and temperature conditions.

USE

Enter the chart with existing temperature and project vertically to intersect the applicable pressure altitude curve. From that point, proceed horizontally to the right and intersect the takeoff weight line. Then descend vertically to read no wind ground run distance. Parallel the appropriate wind guideline (headwind or tailwind) to intersect the takeoff wind velocity. From this point project vertically down to read the ground run adjusted for wind effects. To find the total distance required to clear a 50-foot obstacle, continue downward to the reflector line and project horizontally to the left scale.

SAMPLE TAKEOFF DISTANCE



Sample Problem

Maximum Thrust With CFT (with fuel tanks or A/G stores on wing pylons)

A. Temperature	20°C
B. Pressure altitude	2000 Ft
C. Gross weight	75,000 Lb
D. No wind Ground run distance	4050 Ft
E. Effective headwind	25 Kt
F. Ground run (wind corrected)	3100 Ft
G. Intersect reflector line	
H. Total distance required to clear 50-foot obstacle	5400 Ft

ROTATION SPEED/NOSEWHEEL LIFTOFF SPEED/TAKEOFF SPEED CHART

These charts (figures B3-10 and B3-11) are used to determine nosewheel liftoff speed and aircraft takeoff speed for various gross weights in either maximum or military thrust for aircraft with and without CFTs installed

With CFTs installed, rotation speeds along with the corresponding nosewheel liftoff and takeoff speeds are presented for standard two-engine takeoffs as a function of CG and gross weight. At the indicated rotation speed one-half aft stick should be applied and the aircraft rotated to 12°. Rotation speeds increase at forward CGs to prevent nosewheel bouncing. Rotation speeds are also presented for continued takeoffs after an engine failure during ground roll. For continued takeoffs one-half aft stick should be applied at the rotation speed, but the aircraft should only be rotated to 10° for improved acceleration.

Without CFTs, the speeds are based on CGs representative of each gross weight. The chart provides data for either a normal or maximum performance takeoff. A normal takeoff is accomplished by applying 1/2 aft stick over a period of 1 second as the aircraft is accelerating through 120 knots, and then holding 10° of pitch throughout the takeoff roll. A maximum performance takeoff is accomplished by applying full aft stick at a low speed and when the nose rotates, holding 12° of pitch throughout the takeoff roll. Aircraft rotation will be more rapid with the maximum performance takeoff technique. Rotation speeds are also presented for continued takeoffs after an engine failure during ground roll. For continued takeoffs one-half aft stick should be applied at the rotation speed, with a 10° pitch attitude held throughout the takeoff roll.

The difference in nosewheel lift-off speeds between military and maximum thrust are due to the thrust effects on pitching moment. The differences in takeoff speeds are due to the thrust support in lift and the time required to rotate the aircraft to takeoff attitude.

SINGLE ENGINE RATE OF CLIMB

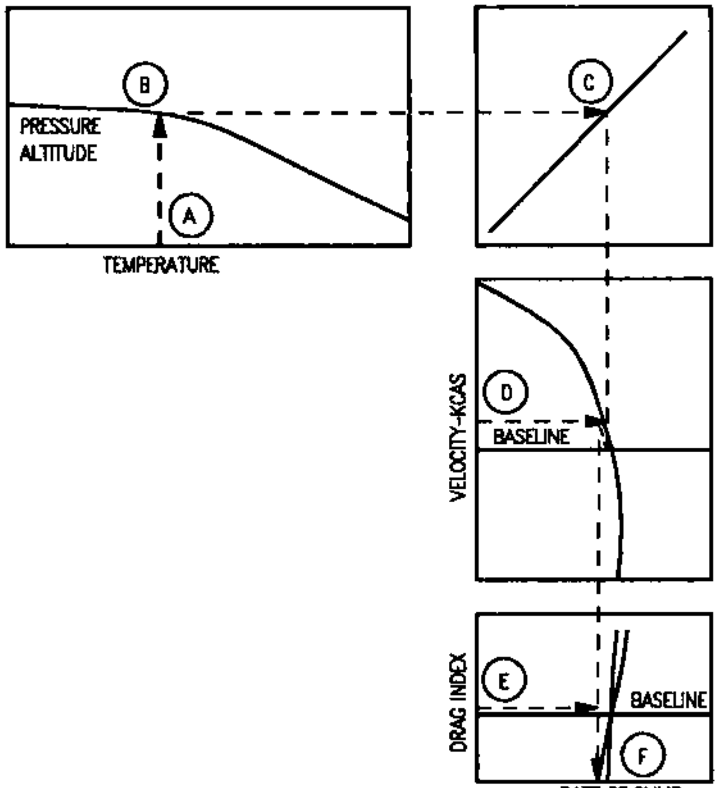
These charts (figures B3-12 thru B3-16) provide the means of determining single engine rate of climb for takeoff planning purposes for existing conditions of temperature, pressure altitude, gross weight, airspeed, and Drag Index. Separate plots are provided for gross weights from 60,000 lb to 81,000 lb. The data are for one engine operating at maximum A/B thrust and the other engine windmilling. Out-of-ground-effects aero data were used in construction of these charts. Gear and flaps are extended.

These charts can be used to determine if single engine rate of climb is adequate at the single engine takeoff speeds obtained from figure B3-10 for the continued takeoff technique. The change in rate of climb due to increasing or decreasing takeoff speed can also be determined.

USE

Enter the applicable chart with existing temperature and project vertically to intersect the applicable pressure altitude curve. From this point, project horizontally to the right and intersect the applicable with or without wing stores line. Then descend vertically to intersect the baseline velocity of 210 KCAS. Parallel the guidelines to intersect the takeoff velocity in question. From this point descend vertically to intersect the baseline Drag Index. Parallel the appropriate velocity guideline to intersect the takeoff Drag Index. Descend vertically again to read the single engine rate of climb.

SAMPLE SINGLE ENGINE RATE OF CLIMB



Sample Problem

Gross Weight 75,000 Lb

A. Temperature	5°C
B. Pressure Altitude	Sea Level
C. Wing Tanks or A/G Weapons Installed	
D. Takeoff Velocity	204 KCAS
E. Drag Index	100
F. Single Engine Rate of Climb	+1200 ft/min

DENSITY RATIO

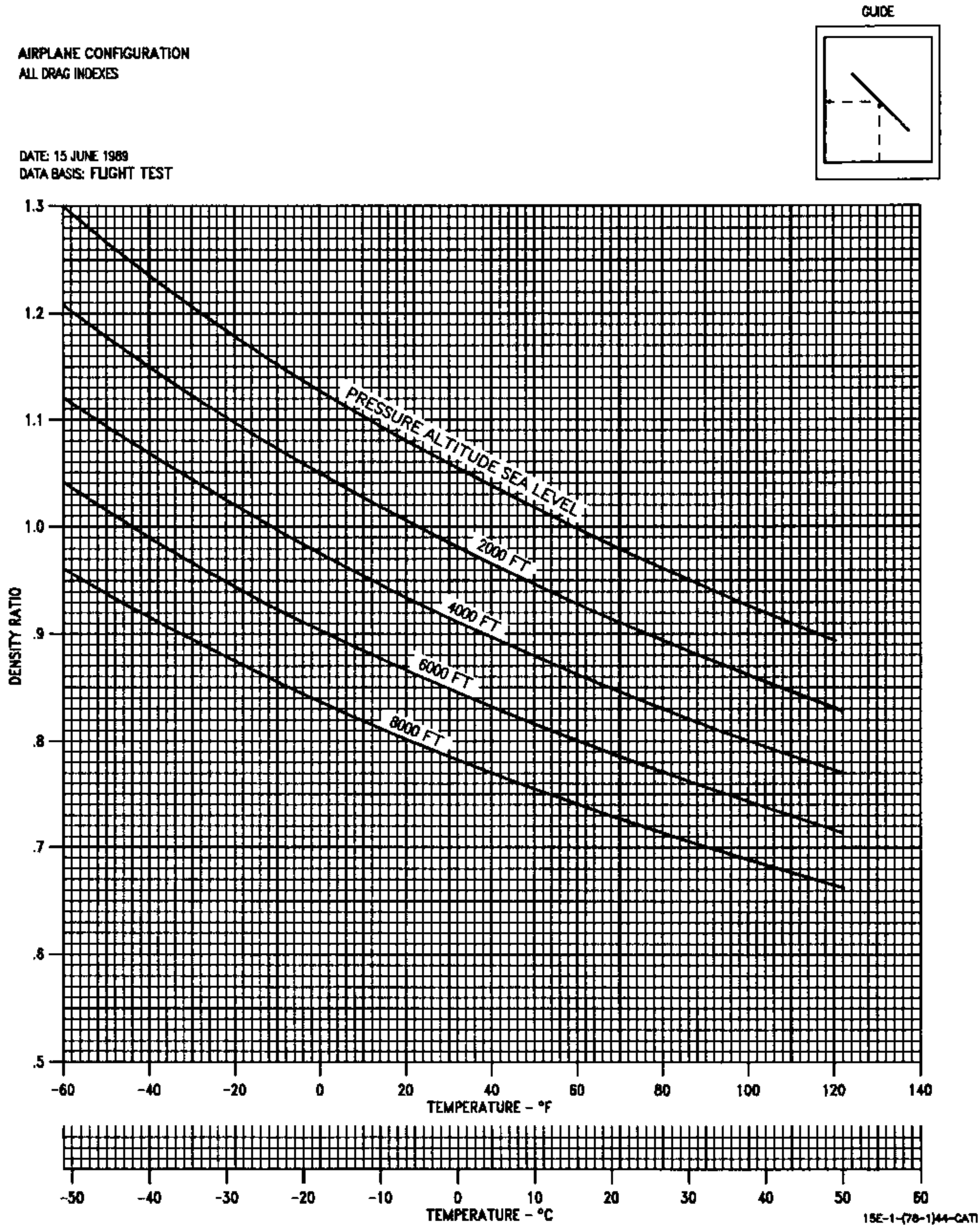


Figure B3-1

MINIMUM GO SPEEDS

WITH CFT
(WITH SINGLE ENGINE FAILURE)

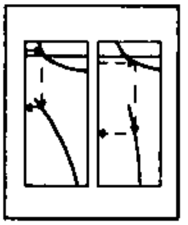
AIRPLANE CONFIGURATION
GEAR AND FLAPS DOWN
ALL DRAG INDEXES

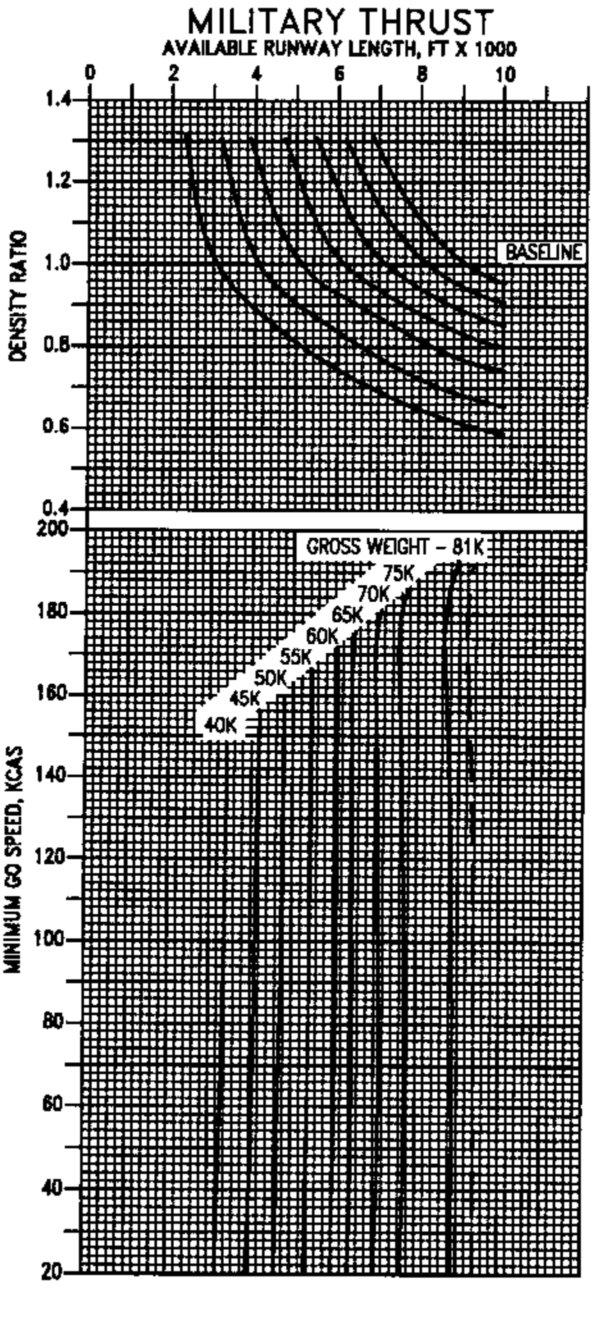
DATE: 15 JULY 1991
DATA BASIS: ESTIMATED

REMARKS
ENGINE(S): (2) F100-PW-229
U.S. STANDARD DAY, 1966

NOTE

- FOLLOWING ENGINE FAILURE WITH MILITARY THRUST, THE AFTERBURNER IS IGNITED ON THE OPERATING ENGINE.
- HALF AFT STICK APPLIED AT THE ROTATION SPEED FROM FIG B3-10 AND A 10 DEGREE PITCH ATTITUDE HELD AFTER ROTATION.
- DASHED LINES TO BE USED WHEN CARRYING AIR-TO-GROUND WEAPONS OR FUEL TANKS ON WING STATIONS.
- SOLID LINES TO BE USED WHEN CARRYING NO STORES OR ONLY AIR-TO-AIR WEAPONS ON WING STATIONS.





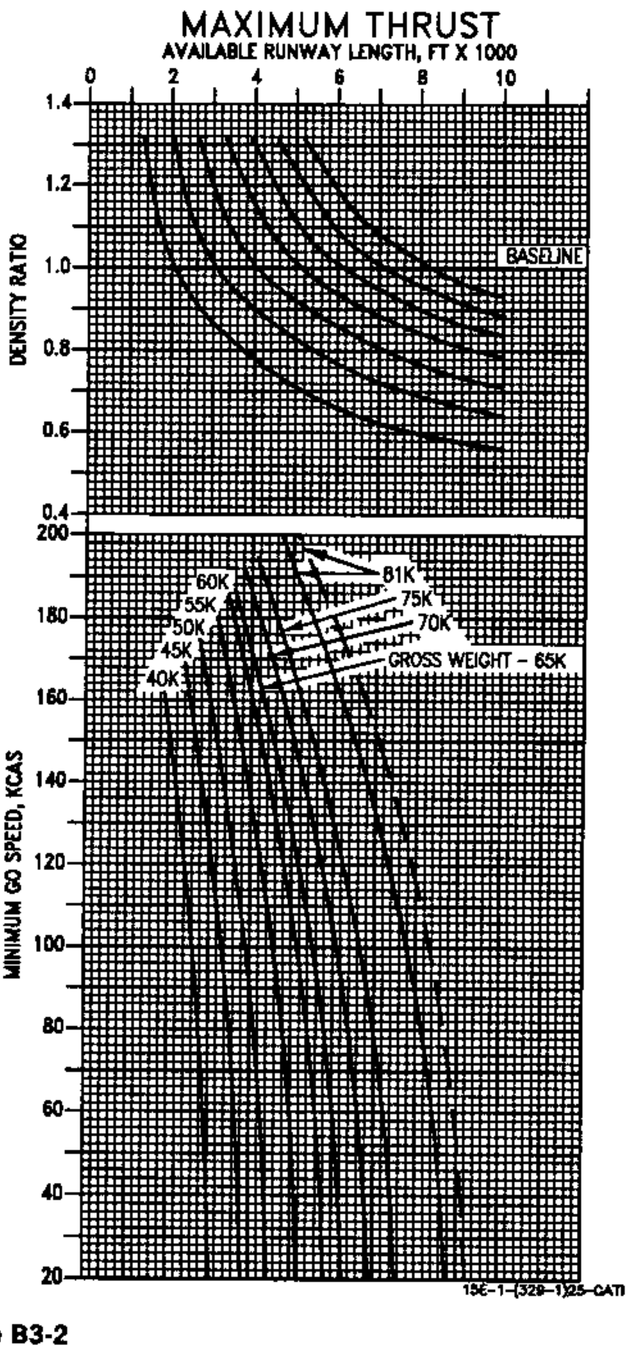


Figure B3-2

MAXIMUM ABORT SPEED

WITH CFT
MAXIMUM THRUST
HARD DRY RUNWAY

AIRPLANE CONFIGURATION
FLAPS AND GEAR DOWN
ALL DRAG INDEXES

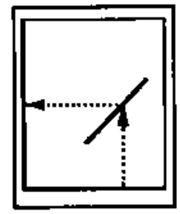
REMARKS
ENGINE(S): (2) F100-PW-229
U.S. STANDARD DAY, 1966

DATE: 15 JUNE 1992
DATA BASIS: ESTIMATED

NOTE

- DATA IS FOR NO-WIND CONDITION. ADD HEADWIND OR SUBTRACT TAILWIND TO DETERMINE ACTUAL MAXIMUM ABORT SPEED.
- HALF AFT STICK APPLIED AT THE ROTATION SPEED FROM FIG B3-10 AND A 12 DEGREE PITCH ATTITUDE HELD AFTER ROTATION UNTIL ALTERED BY ABORT PROCEDURES.

GUIDE



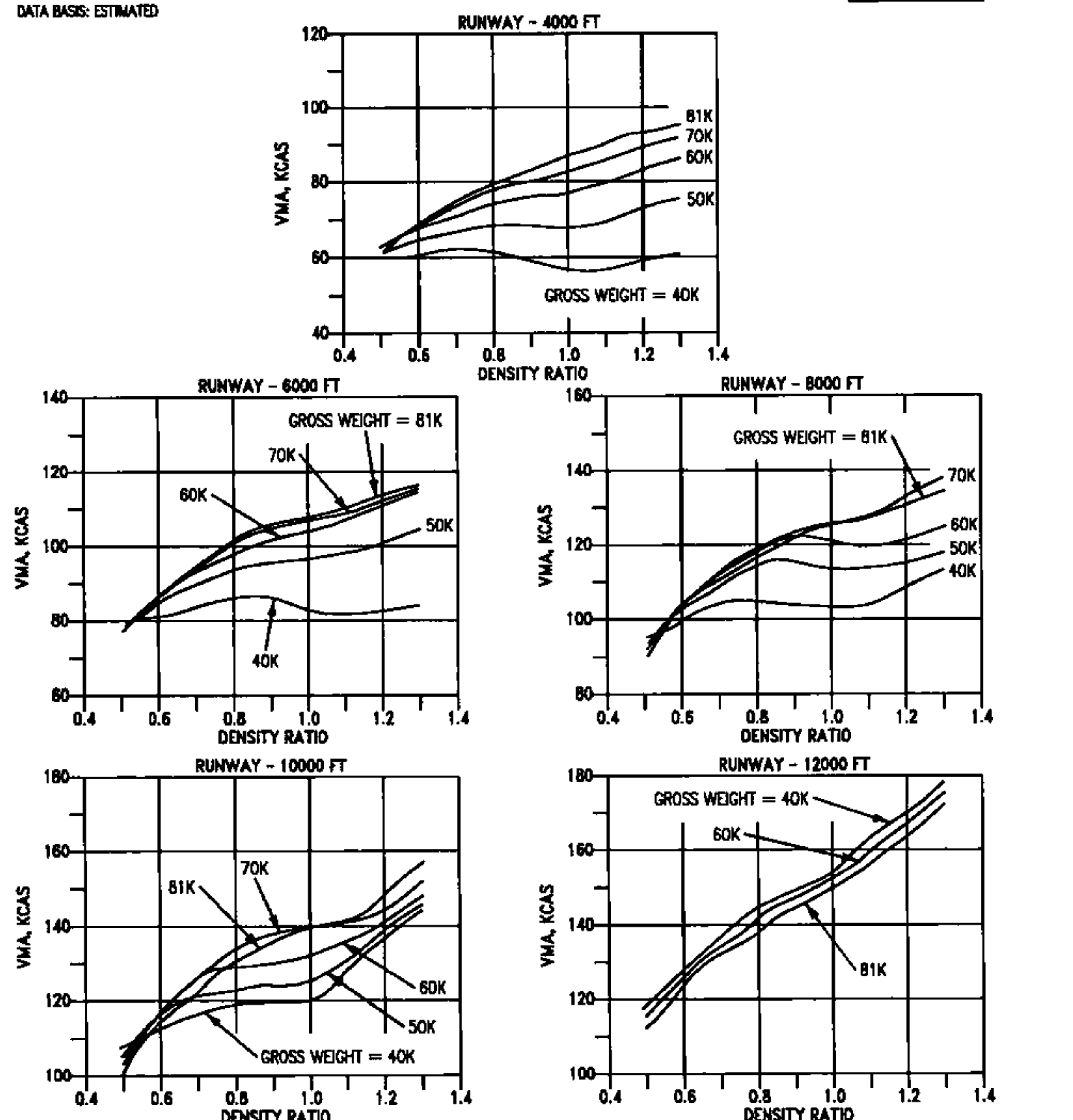


Figure B3-3 (Sheet 1 of 6)

MAXIMUM ABORT SPEED

WITH CFT
MILITARY THRUST
HARD DRY RUNWAY

AIRPLANE CONFIGURATION
FLAPS AND GEAR DOWN
ALL DRAG INDEXES

REMARKS
ENGINE(S): (2) F100-PW-229
U.S. STANDARD DAY, 1966

DATE: 15 JUNE 1992
DATA BASIS: ESTIMATED

NOTE

- DATA IS FOR NO-WIND CONDITION. ADD HEADWIND OR SUBTRACT TAILWIND TO DETERMINE ACTUAL MAXIMUM ABORT SPEED.
- HALF AFT STICK APPLIED AT THE ROTATION SPEED FROM FIG B3-10 AND A 12 DEGREE PITCH ATTITUDE HELD AFTER ROTATION UNTIL ALTERED BY ABORT PROCEDURES.

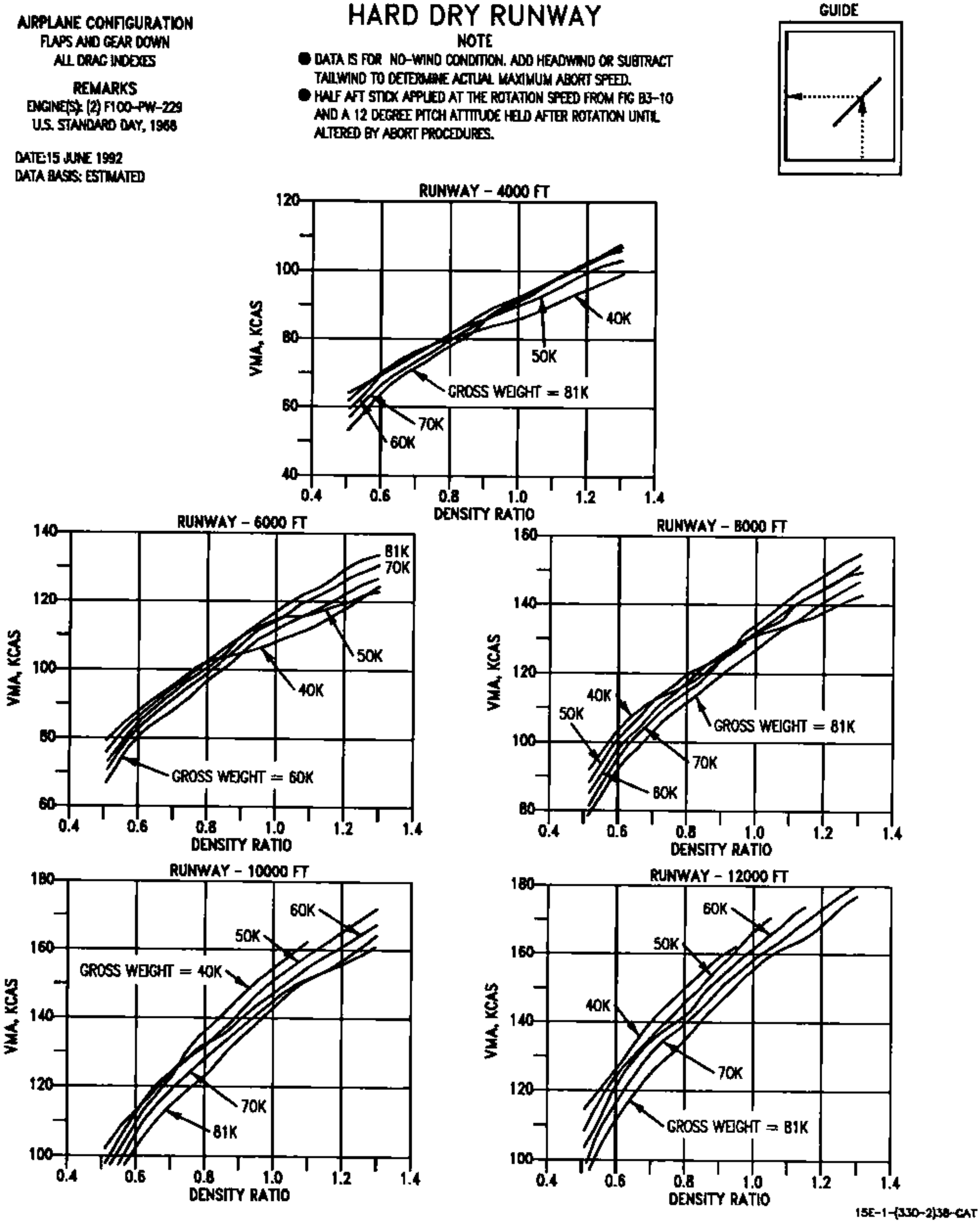


Figure B3-3 (Sheet 2)

MAXIMUM ABORT SPEED

WITH CFT
MAXIMUM THRUST
HARD WET RUNWAY

AIRPLANE CONFIGURATION
FLAPS AND GEAR DOWN
ALL DRAG INDEXES

REMARKS
ENGINE(S): (2) F100-PW-229
U.S. STANDARD DAY, 1966

DATE: 15 JUNE 1992
DATA BASIS: ESTIMATED

NOTE

- DATA IS FOR NO-WIND CONDITION. ADD HEADWIND OR SUBTRACT TAILWIND TO DETERMINE ACTUAL MAXIMUM ABORT SPEED.
- HALF AFT STICK APPLIED AT THE ROTATION SPEED FROM FIG B3-10 AND A 12 DEGREE PITCH ATTITUDE HELD AFTER ROTATION UNTIL ALTERED BY ABORT PROCEDURES.

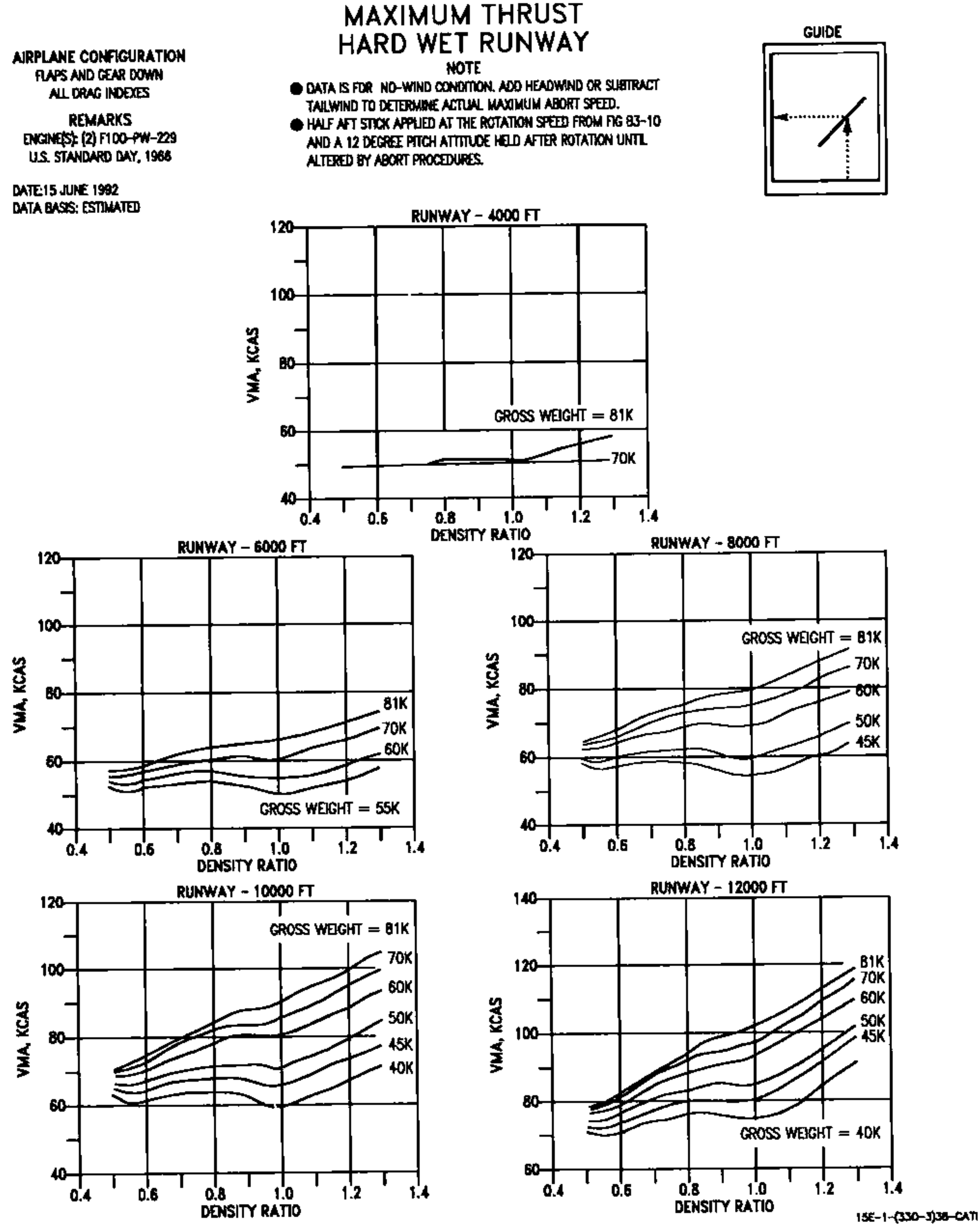


Figure B3-3 (Sheet 3)

MAXIMUM ABORT SPEED

WITH CFT
MILITARY THRUST
HARD WET RUNWAY

AIRPLANE CONFIGURATION
FLAPS AND GEAR DOWN
ALL DRAG INDEXES

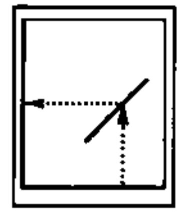
REMARKS
ENGINE(S): (2) F100-PW-229
U.S. STANDARD DAY, 1966

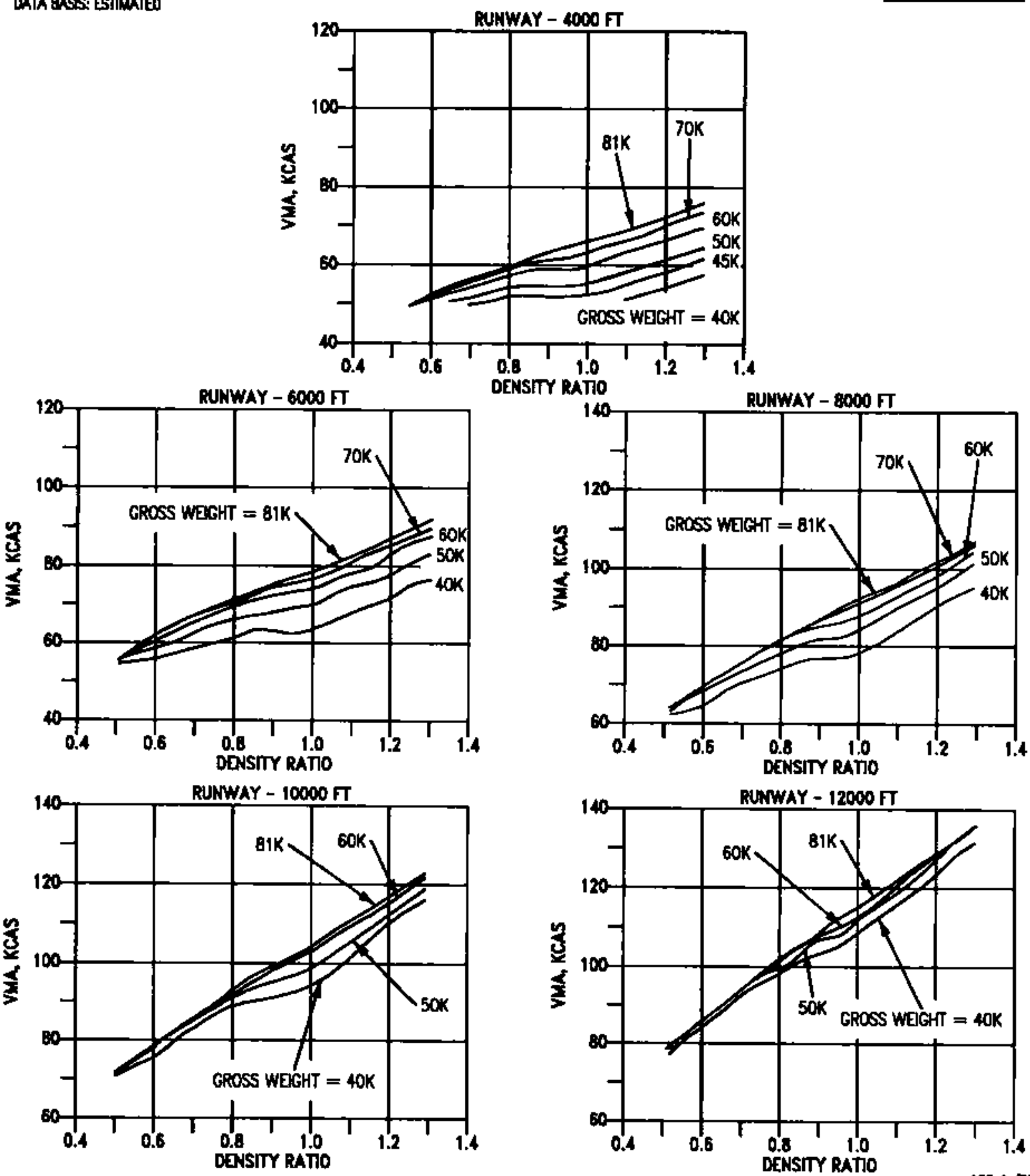
DATE:15 JUNE 1992
DATA BASIS: ESTIMATED

NOTE

- DATA IS FOR NO-WIND CONDITION. ADD HEADWIND OR SUBTRACT TAILWIND TO DETERMINE ACTUAL MAXIMUM ABORT SPEED.
- HALF AFT STICK APPLIED AT THE ROTATION SPEED FROM FIG B3-10 AND A 12 DEGREE PITCH ATTITUDE HELD AFTER ROTATION UNTIL ALTERED BY ABORT PROCEDURES.

GUIDE





15E-1-(330-4)38-CATI

Figure B3-3 (Sheet 4)

MAXIMUM ABORT SPEED

WITH CFT
MAXIMUM THRUST
HARD ICY RUNWAY

AIRPLANE CONFIGURATION
FLAPS AND GEAR DOWN
ALL DRAG INDEXES

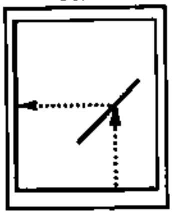
REMARKS
ENGINE(S): (2) F100-PW-229
U.S. STANDARD DAY, 1966

DATE: 15 JUNE 1992
DATA BASIS: ESTIMATED

NOTE

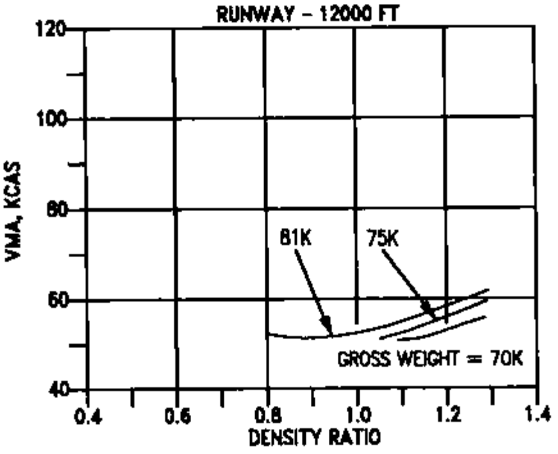
- DATA IS FOR NO-WIND CONDITION. ADD HEADWIND OR SUBTRACT TAILWIND TO DETERMINE ACTUAL MAXIMUM ABORT SPEED.
- HALF AFT STICK APPLIED AT THE ROTATION SPEED FROM FIG B3-10 AND A 12 DEGREE PITCH ATTITUDE HELD AFTER ROTATION UNTIL ALTERED BY ABORT PROCEDURES.

GUIDE



CAUTION

ON RUNWAYS OF 4000 TO 10000 FEET TAKEOFF CANNOT BE ABORTED ON ICY RUNWAY USING BRAKING ALONE.



15E-1-(330-5)38-CATI

Figure B3-3 (Sheet 5)

MAXIMUM ABORT SPEED

WITH CFT
MILITARY THRUST
HARD ICY RUNWAY

AIRPLANE CONFIGURATION
FLAPS AND GEAR DOWN
ALL DRAG INDEXES

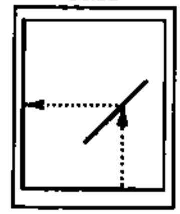
REMARKS
ENGINE(S): (2) F100-PW-229
U.S. STANDARD DAY, 1966

DATE:15 JUNE 1992
DATA BASIS: ESTIMATED

NOTE

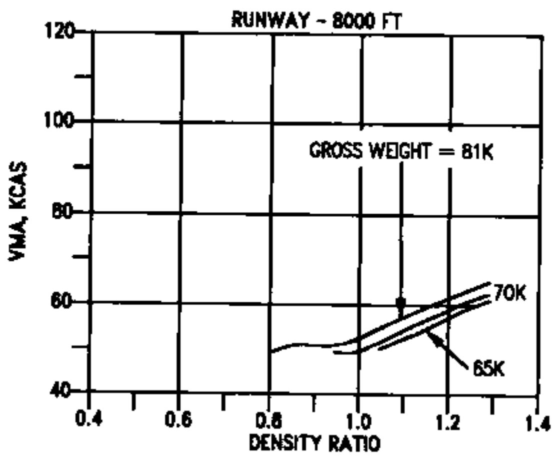
- DATA IS FOR NO-WIND CONDITION. ADD HEADWIND OR SUBTRACT TAILWIND TO DETERMINE ACTUAL MAXIMUM ABORT SPEED.
- HALF AFT STICK APPLIED AT THE ROTATION SPEED FROM FIG B3-10 AND A 12 DEGREE PITCH ATTITUDE HELD AFTER ROTATION UNTIL ALTERED BY ABORT PROCEDURES.

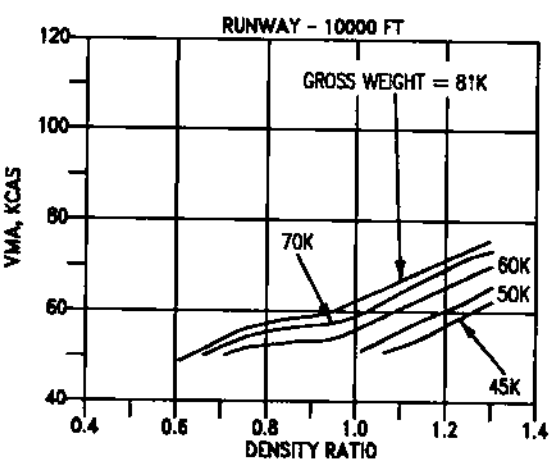
GUIDE

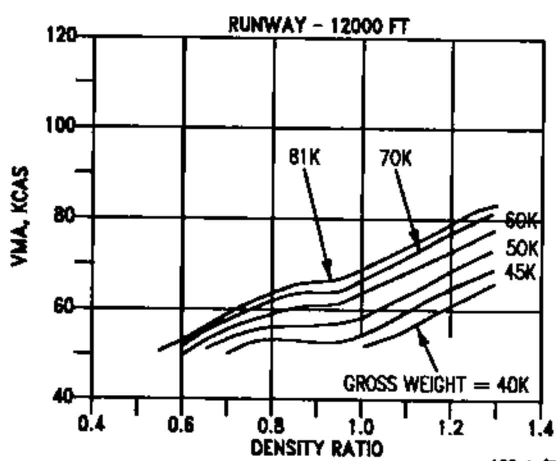


CAUTION

ON RUNWAYS OF 4000 TO 6000 FEET TAKEOFF CANNOT BE ABORTED ON ICY RUNWAY USING BRAKING ALONE.







15E-1-(330-6)38-CATI

Figure B3-3 (Sheet 6)

TAKEOFF DISTANCE

WITH CFT
MAXIMUM THRUST
HARD DRY RUNWAY

AIRPLANE CONFIGURATION
FLAPS AND GEAR DOWN
ALL DRAG INDEXES

REMARKS
ENGINE(S): (2)F100-PW-229
U.S. STANDARD DAY, 1966

DATE: 15 JULY 1991
DATA BASIS: ESTIMATED

NOTES
- THIS DATA BASED ON HALF AFT STICK APPLIED AT THE ROTATION SPEED FROM FIG B3-10 AND A 12 DEGREE PITCH ATTITUDE HELD AFTER ROTATION.
- DASHED LINES TO BE USED WHEN CARRYING AIR-TO-GROUND WEAPONS OR FUEL TANKS ON THE WING STATIONS.
- SOLID LINES TO BE USED WHEN NO STORES OTHER THEN AIR-TO-AIR WEAPONS ARE INSTALLED ON THE WING STATIONS.
- FOR EVERY 1% CG SHIFT FORWARD OF THE REFERENCE CG, INCREASE THE ZERO WIND GROUND ROLL DISTANCE BY 5%. FOR EVERY 1% CG SHIFT AFT OF THE REFERENCE CG, DECREASE THE ZERO WIND GROUND ROLL DISTANCE BY 1%, THEN APPLY WIND EFFECTS AND DETERMINE DISTANCE TO 50 FT. USING NORMAL PROCEDURES.

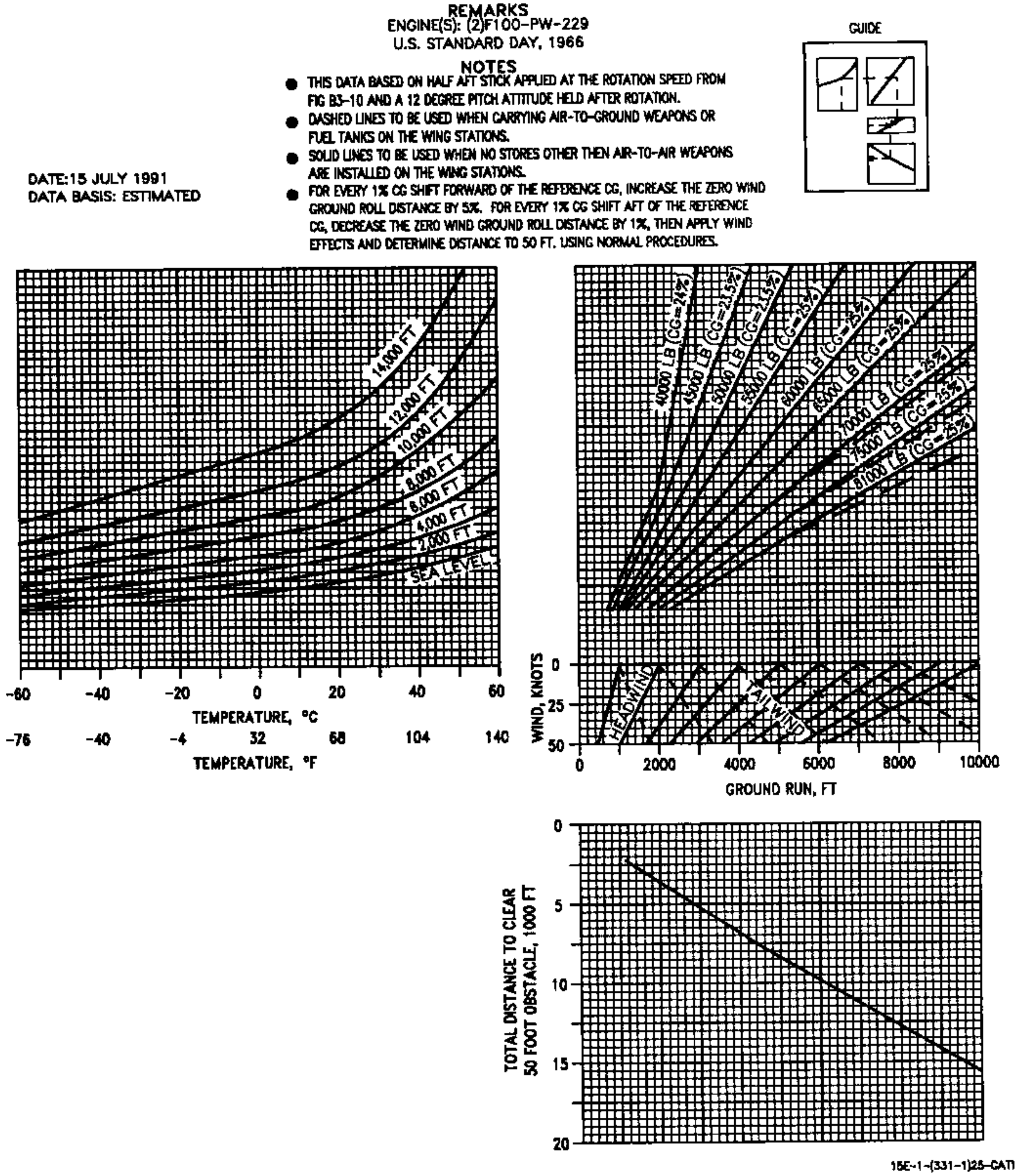


Figure B3-4

TAKEOFF DISTANCE

WITH CFT
MILITARY THRUST
HARD DRY RUNWAY

AIRPLANE CONFIGURATION
FLAPS AND GEAR DOWN
ALL DRAG INDEXES

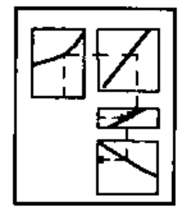
REMARKS
ENGINE(S): (2)F100-PW-229
U.S. STANDARD DAY, 1966

NOTES

- THIS DATA BASED ON HALF AFT STICK APPLIED AT THE ROTATION SPEED FROM FIG B3-10 AND A 12 DEGREE PITCH ATTITUDE HELD AFTER ROTATION.
- DASHED LINES TO BE USED WHEN CARRYING AIR-TO-GROUND WEAPONS OR FUEL TANKS ON THE WING STATIONS.
- SOLID LINES TO BE USED WHEN NO STORES OTHER THEN AIR-TO-AIR WEAPONS ARE INSTALLED ON THE WING STATIONS.
- FOR EVERY 1% CG SHIFT FORWARD OF THE REFERENCE CG, INCREASE THE ZERO WIND GROUND ROLL DISTANCE BY 3%. FOR EVERY 1% CG SHIFT AFT OF THE REFERENCE CG, DECREASE THE ZERO WIND GROUND ROLL DISTANCE BY 1%, THEN APPLY WIND EFFECTS AND DETERMINE DISTANCE TO 50 FT. USING NORMAL PROCEDURES.

DATE:15 JULY 1991
DATA BASIS: ESTIMATED

GUIDE



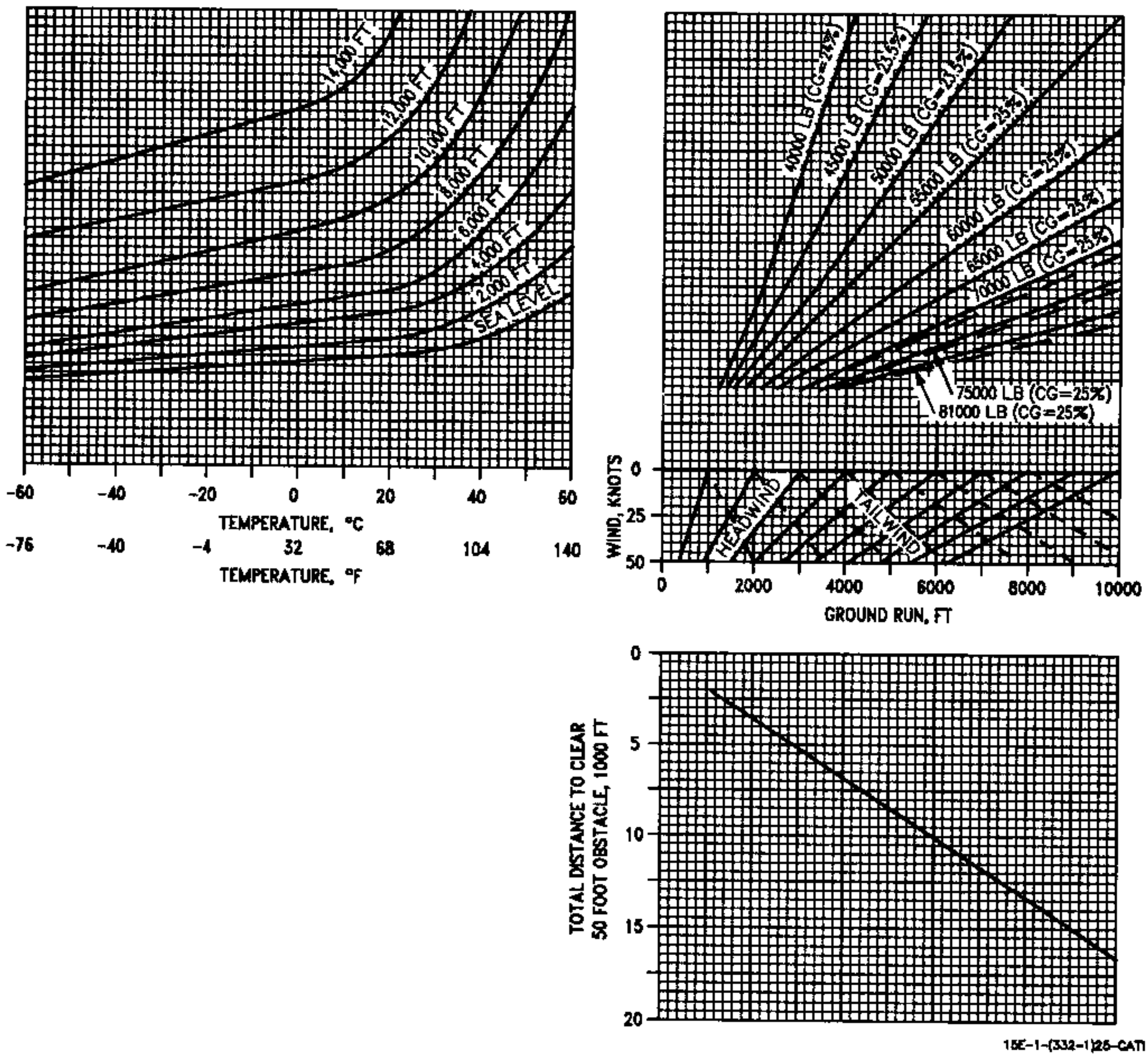


Figure B3-5

MINIMUM GO SPEED

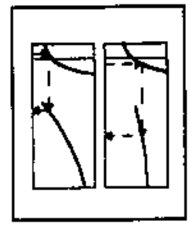
WITHOUT CFT
(WITH SINGLE ENGINE FAILURE)

AIRPLANE CONFIGURATION
GEAR AND FLAPS DOWN
ALL DRAG INDEXES

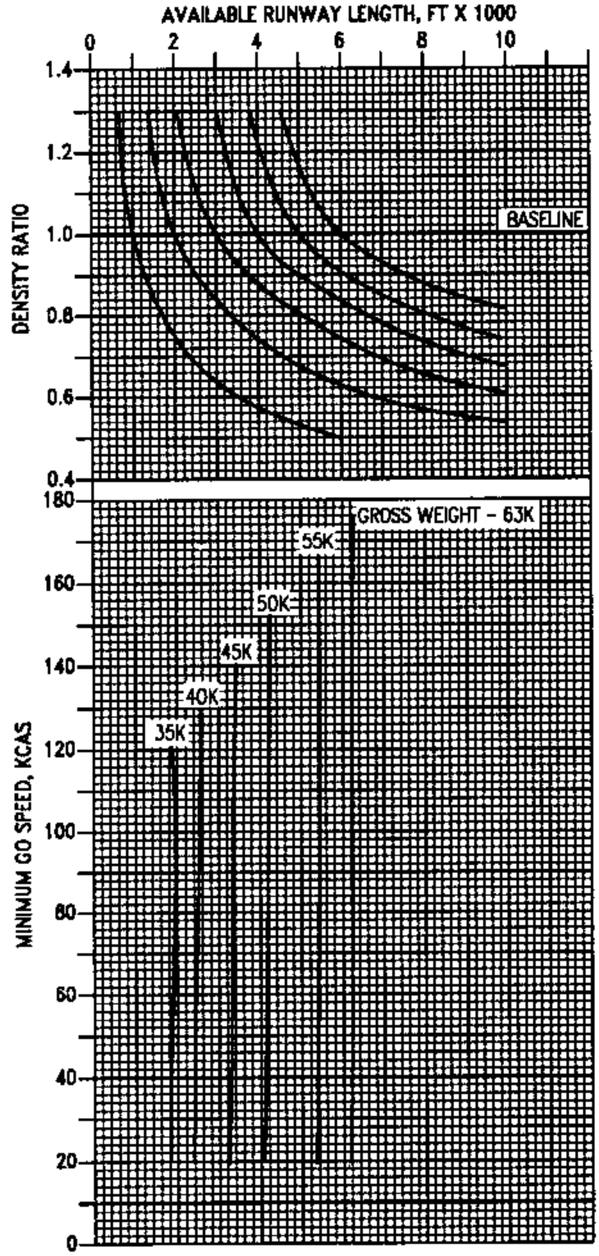
REMARKS
ENGINE(S): (2) F100-PW-229
U.S. STANDARD DAY, 1966

NOTE
- FOLLOWING ENGINE FAILURE WITH MILITARY THRUST, THE AFTERBURNER IS IGNITED ON THE OPERATING ENGINE.
- HALF AFT STICK APPLIED AT THE ROTATION SPEED FROM FIG B3-11 AND A 10 DEGREE PITCH ATTITUDE HELD AFTER ROTATION.

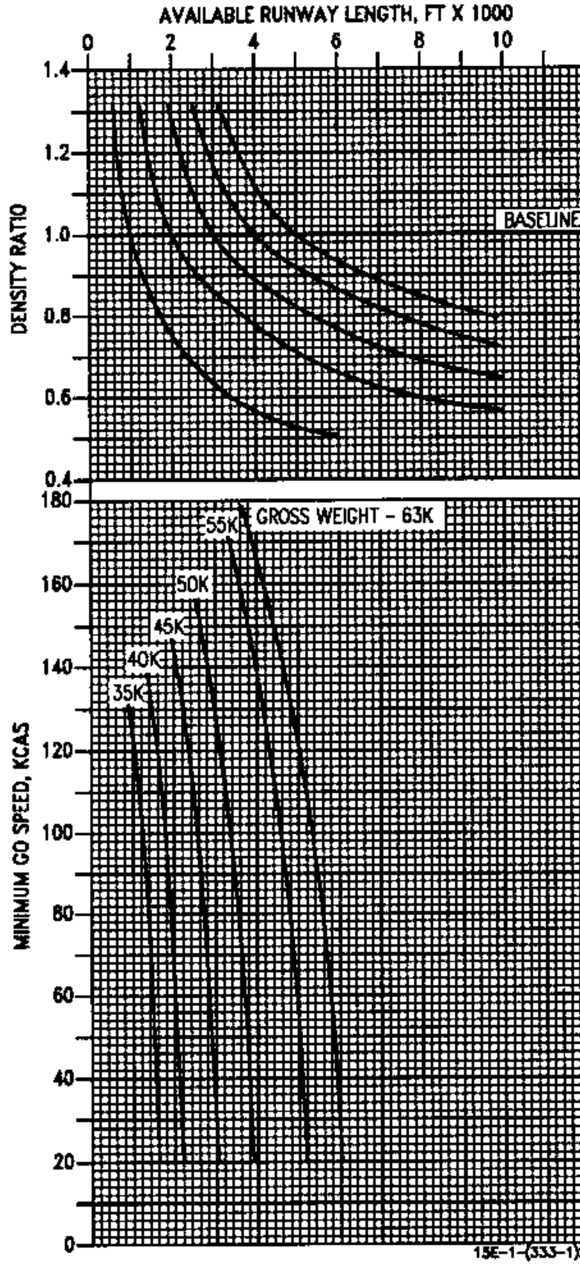
DATE: 15 JULY 1991
DATA BASIS: ESTIMATED



MILITARY THRUST



MAXIMUM THRUST



15E-1-(333-1)25-CATI

Figure B3-6

MAXIMUM ABORT SPEED

WITHOUT CFT
MAXIMUM THRUST
HARD DRY RUNWAY

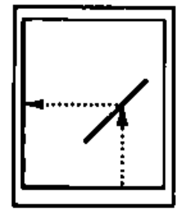
AIRPLANE CONFIGURATION
FLAPS AND GEAR DOWN
ALL DRAG INDEXES

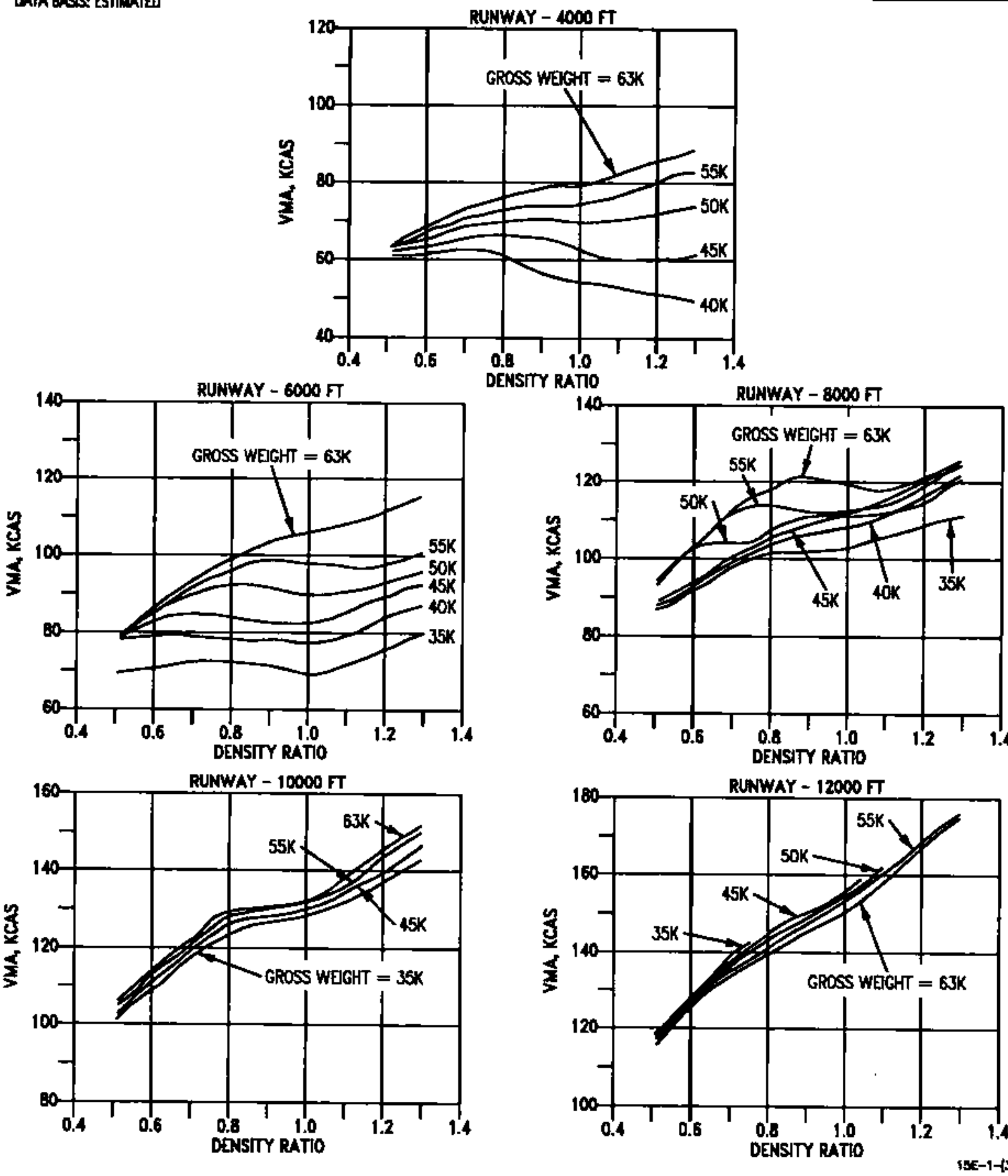
REMARKS
ENGINE(S): (2) F100-PW-229
U.S. STANDARD DAY, 1966

DATE: 15 JUNE 1992
DATA BASIS: ESTIMATED

NOTE

- DATA IS FOR NO-WIND CONDITION. ADD HEADWIND OR SUBTRACT TAILWIND TO DETERMINE ACTUAL MAXIMUM ABORT SPEED.
- HALF AFT STICK APPLIED AT THE ROTATION SPEED FROM FIG B3-10 AND A 12 DEGREE PITCH ATTITUDE HELD AFTER ROTATION UNTIL ALTERED BY ABORT PROCEDURES.





15E-1-(334-1)38-CATI

Figure B3-7 (Sheet 1 of 6)

MAXIMUM ABORT SPEED

WITHOUT CFT
MILITARY THRUST
HARD DRY RUNWAY

AIRPLANE CONFIGURATION
FLAPS AND GEAR DOWN
ALL DRAG INDEXES

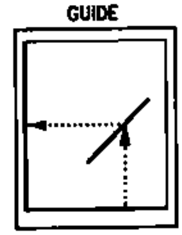
REMARKS
ENGINE(S): (2) F100-PW-229
U.S. STANDARD DAY, 1966

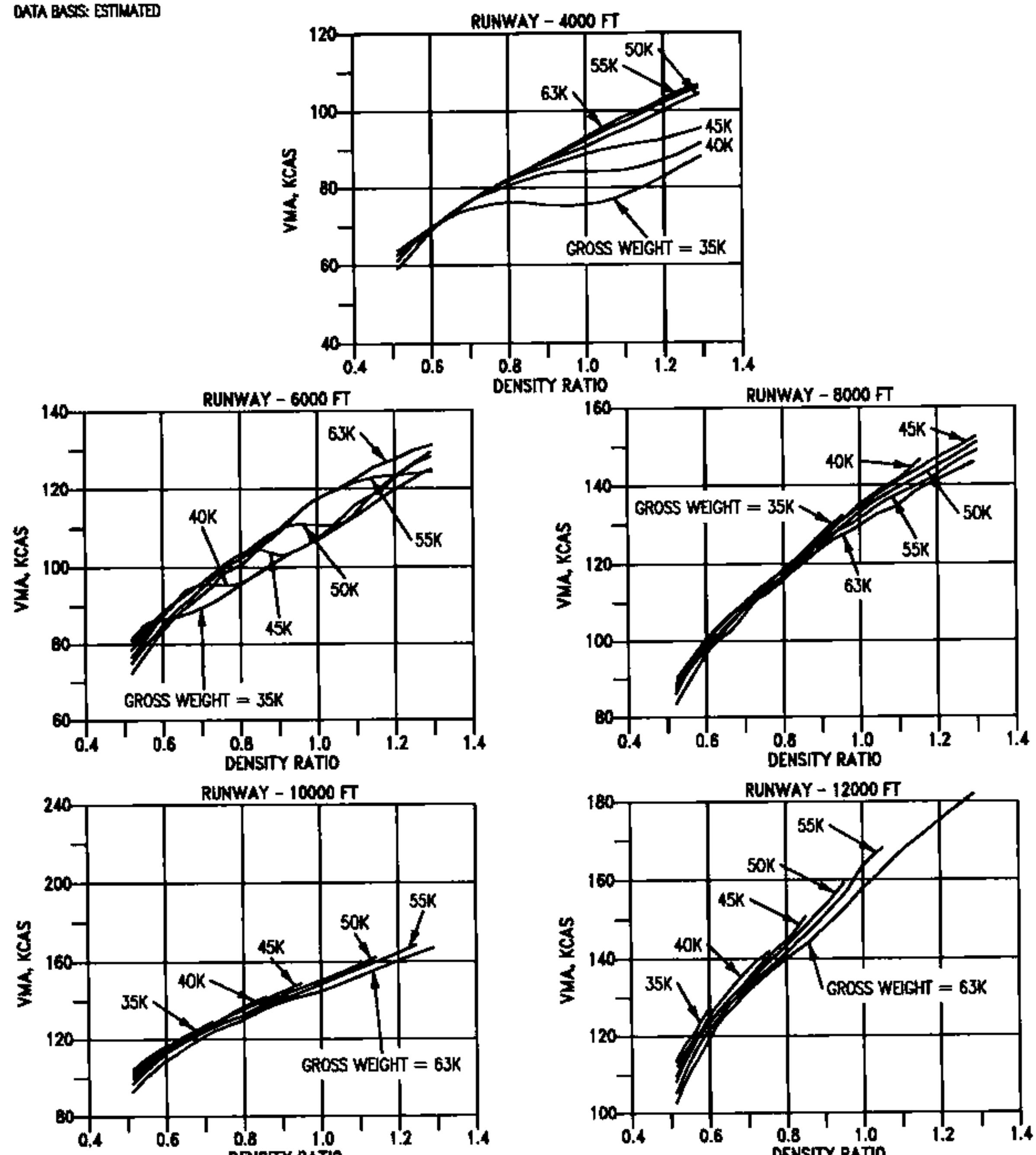
DATE: 15 JUNE 1992
DATA BASIS: ESTIMATED

NOTE

- DATA IS FOR NO-WIND CONDITION. ADD HEADWIND OR SUBTRACT TAILWIND TO DETERMINE ACTUAL MAXIMUM ABORT SPEED.
- HALF AFT STICK APPLIED AT THE ROTATION SPEED FROM FIG B3-10 AND A 12 DEGREE PITCH ATTITUDE HELD AFTER ROTATION UNTIL ALTERED BY ABORT PROCEDURES.

GUIDE





15E-1-(334-2)38-CATI

Figure B3-7 (Sheet 2)

MAXIMUM ABORT SPEED

WITHOUT CFT
MAXIMUM THRUST
HARD WET RUNWAY

AIRPLANE CONFIGURATION
FLAPS AND GEAR DOWN
ALL DRAG INDEXES

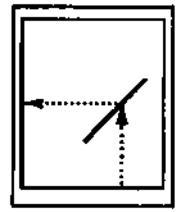
REMARKS
ENGINE(S): (2) F100-PW-229
U.S. STANDARD DAY, 1966

DATE: 15 JUNE 1992
DATA BASIS: ESTIMATED

NOTE

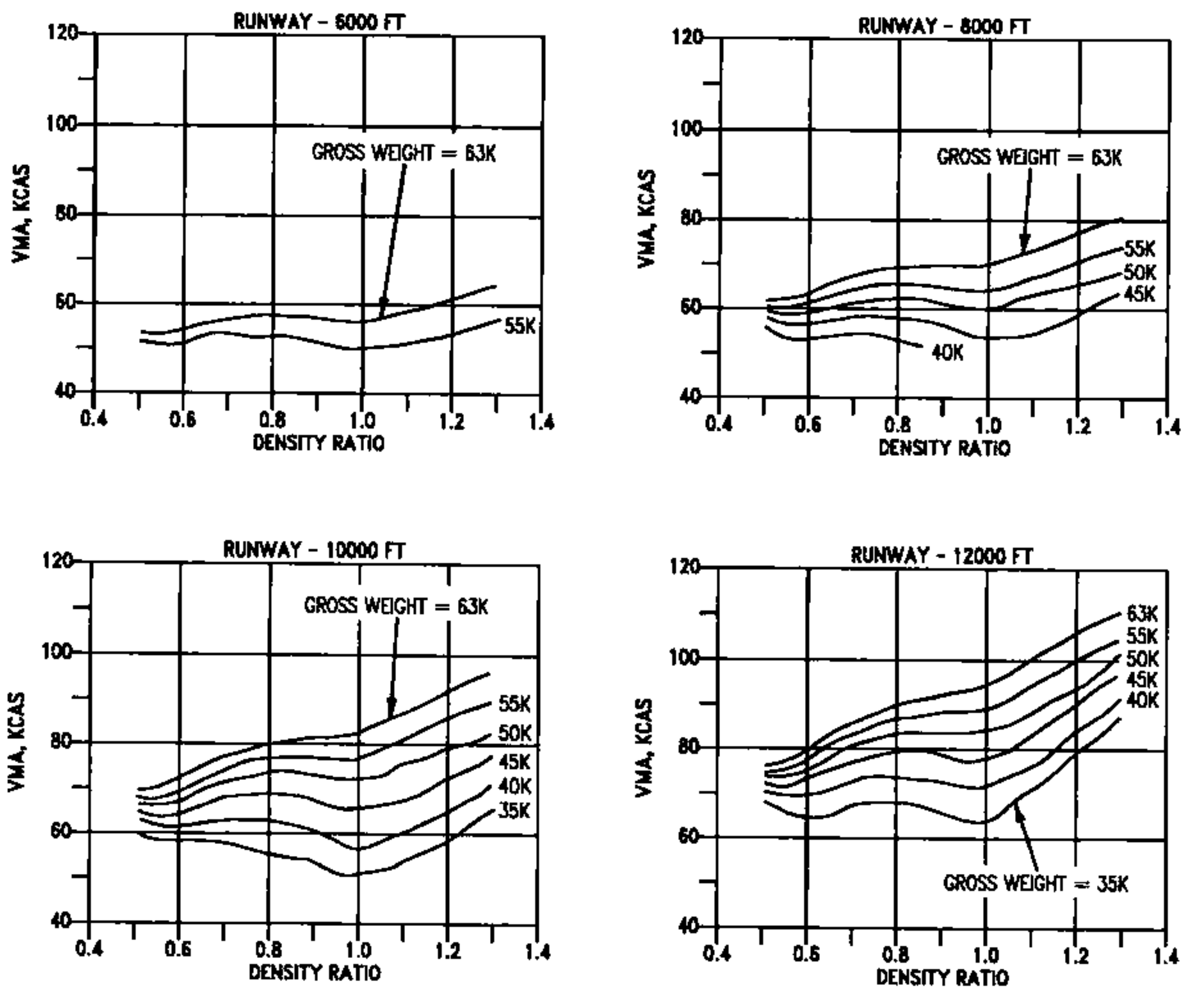
- DATA IS FOR NO-WIND CONDITION. ADD HEADWIND OR SUBTRACT TAILWIND TO DETERMINE ACTUAL MAXIMUM ABORT SPEED.
- HALF AFT STICK APPLIED AT THE ROTATION SPEED FROM FIG B3-10 AND A 12 DEGREE PITCH ATTITUDE HELD AFTER ROTATION UNTIL ALTERED BY ABORT PROCEDURES.

GUIDE



CAUTION

ON RUNWAYS OF 4000 TO 6000 FEET TAKEOFF CANNOT BE ABORTED ON ICY RUNWAY USING BRAKING ALONE.



15E-1-(334-3)38-CATI

Figure B3-7 (Sheet 3)

MAXIMUM ABORT SPEED

WITHOUT CFT
MILITARY THRUST
HARD WET RUNWAY

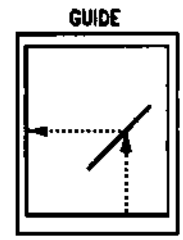
AIRPLANE CONFIGURATION
FLAPS AND GEAR DOWN
ALL DRAG INDEXES

REMARKS
ENGINE(S): (2) F100-PW-229
U.S. STANDARD DAY, 1966

DATE: 15 JUNE 1992
DATA BASIS: ESTIMATED

NOTE

- DATA IS FOR NO-WIND CONDITION. ADD HEADWIND OR SUBTRACT TAILWIND TO DETERMINE ACTUAL MAXIMUM ABORT SPEED.
- HALF AFT STICK APPLIED AT THE ROTATION SPEED FROM FIG B3-10 AND A 12 DEGREE PITCH ATTITUDE HELD AFTER ROTATION UNTIL ALTERED BY ABORT PROCEDURES.



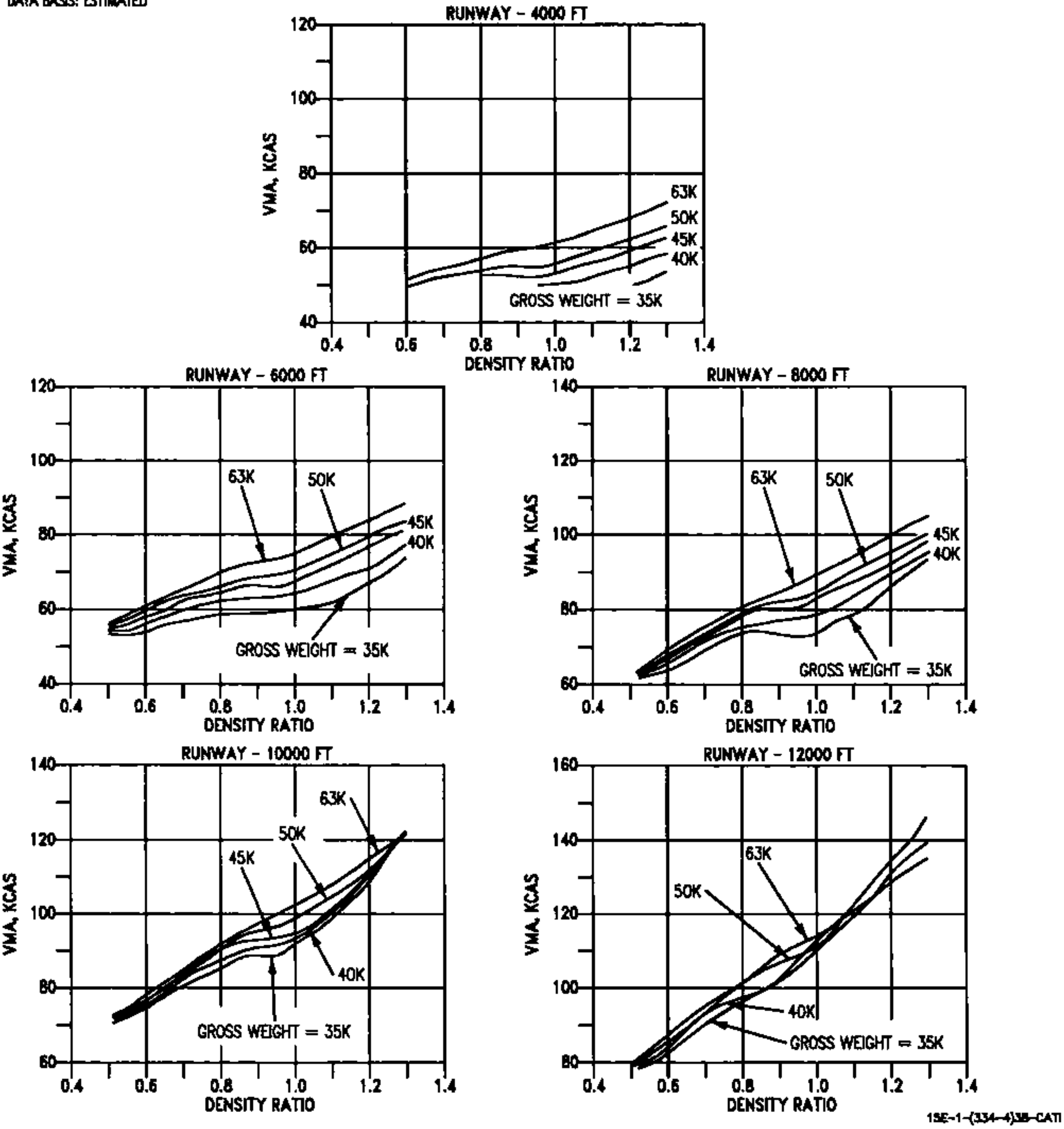


Figure B3-7 (Sheet 4)

MAXIMUM ABORT SPEED

WITHOUT CFT
MAXIMUM THRUST
HARD ICY RUNWAY

AIRPLANE CONFIGURATION
FLAPS AND GEAR DOWN
ALL DRAG INDEXES

REMARKS
ENGINE(S): (2) F100-PW-229
U.S. STANDARD DAY, 1966

DATE: 15 JUNE 1992
DATA BASIS: ESTIMATED

NOTE

- DATA IS FOR NO-WIND CONDITION. ADD HEADWIND OR SUBTRACT TAILWIND TO DETERMINE ACTUAL MAXIMUM ABORT SPEED.
- HALF AFT STICK APPLIED AT THE ROTATION SPEED FROM FIG B3-10 AND A 12 DEGREE PITCH ATTITUDE HELD AFTER ROTATION UNTIL ALTERED BY ABORT PROCEDURES.

CAUTION

ON RUNWAYS OF 4000 TO 12000 FEET TAKEOFF CANNOT BE ABORTED ON ICY RUNWAY USING BRAKING ALONE.

15E-1-(334-5)38-CATI

Figure B3-7 (Sheet 5)

MAXIMUM ABORT SPEED

WITHOUT CFT
MILITARY THRUST
HARD ICY RUNWAY

AIRPLANE CONFIGURATION
FLAPS AND GEAR DOWN
ALL DRAG INDEXES

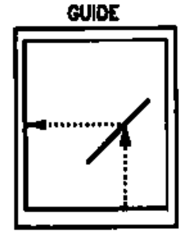
REMARKS
ENGINE(S): (2) F100-PW-229
U.S. STANDARD DAY, 1966

DATE: 15 JUNE 1992
DATA BASIS: ESTIMATED

NOTE

- DATA IS FOR NO-WIND CONDITION. ADD HEADWIND OR SUBTRACT TAILWIND TO DETERMINE ACTUAL MAXIMUM ABORT SPEED.
- HALF AFT STICK APPLIED AT THE ROTATION SPEED FROM FIG B3-10 AND A 12 DEGREE PITCH ATTITUDE HELD AFTER ROTATION UNTIL ALTERED BY ABORT PROCEDURES.

GUIDE



CAUTION

ON RUNWAYS OF 4000 TO 6000 FEET TAKEOFF CANNOT BE ABORTED ON ICY RUNWAY USING BRAKING ALONE.

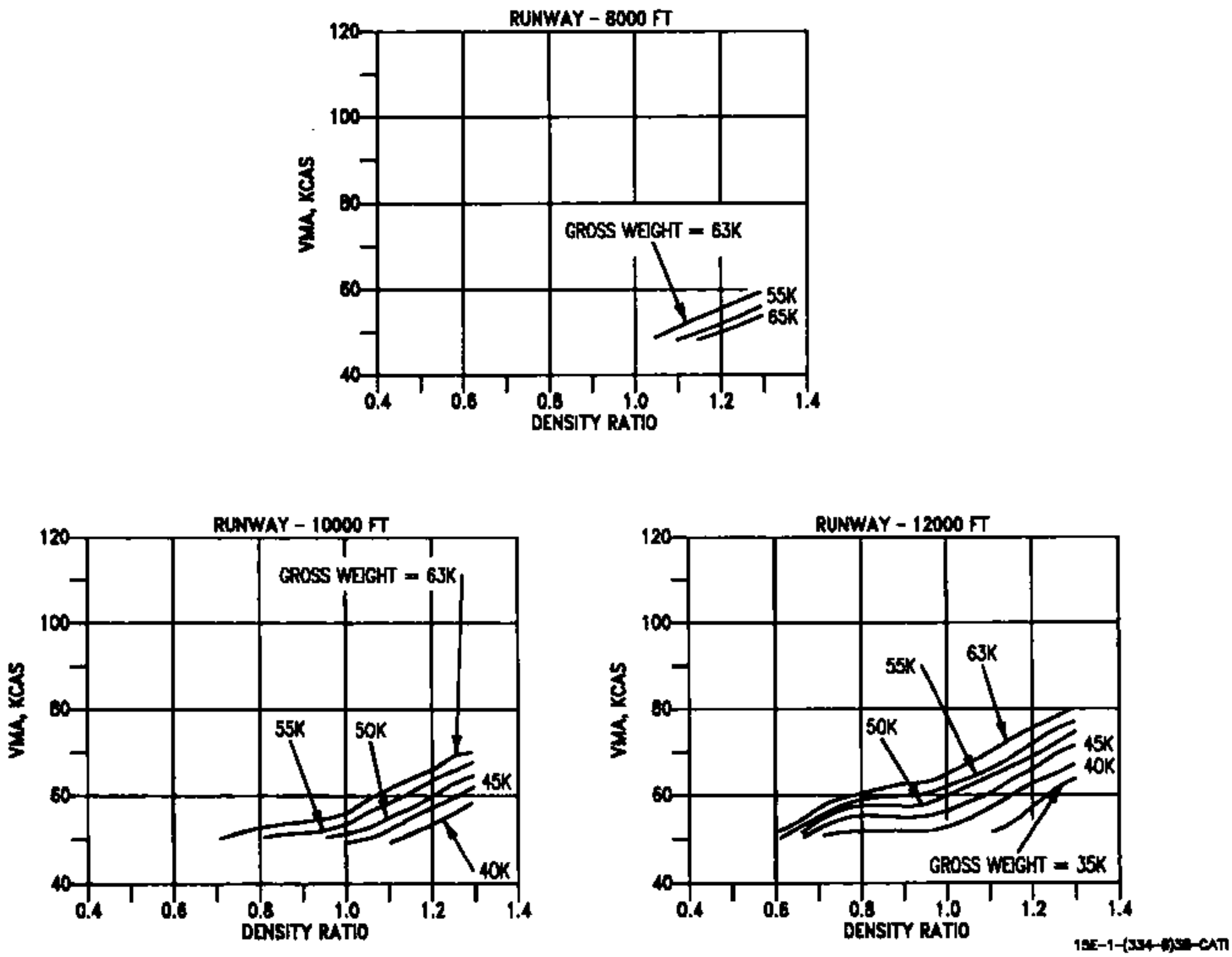


Figure B3-7 (Sheet 6)

TAKEOFF DISTANCE

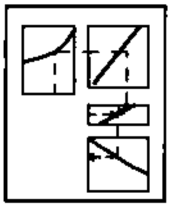
WITHOUT CFT
MAXIMUM THRUST
HARD DRY RUNWAY

AIRPLANE CONFIGURATION
FLAPS AND GEAR DOWN
ALL DRAG INDEXES

REMARKS
ENGINE(S): (2)F100-PW-229
U.S. STANDARD DAY, 1966

NOTES
THIS DATA BASED ON MAXIMUM PERFORMANCE TAKEOFF PROCEDURES: FULL AFT STICK APPLIED AT LOW SPEED AND A 12 DEGREE PITCH ATTITUDE HELD AFTER ROTATION.

DATE:15 JULY 1991
DATA BASIS: ESTIMATED



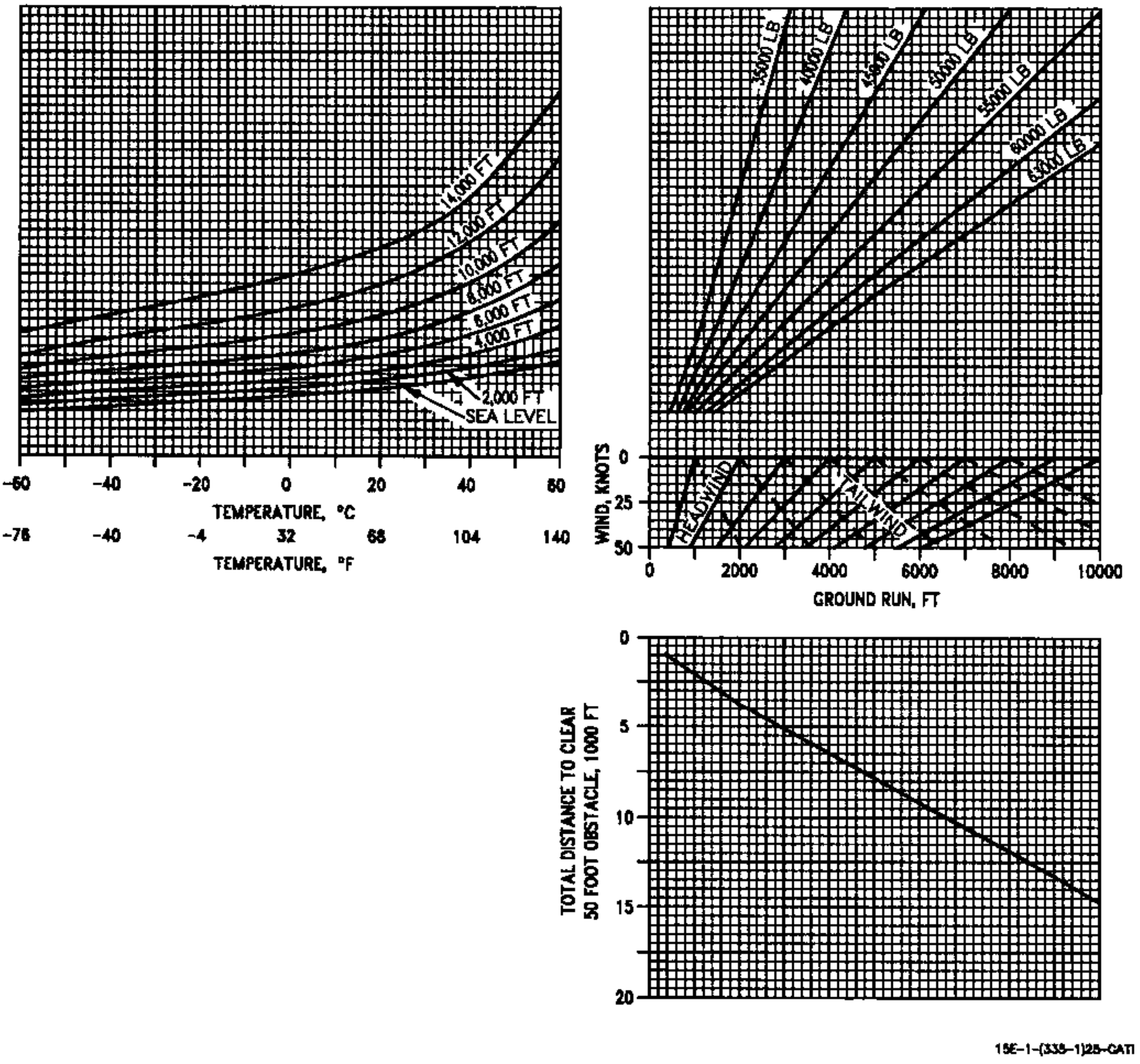


Figure B3-8

TAKEOFF DISTANCE

WITHOUT CFT
MILITARY THRUST
HARD DRY RUNWAY

AIRPLANE CONFIGURATION
FLAPS AND GEAR DOWN
ALL DRAG INDEXES

REMARKS
ENGINE(S): (2)F100-PW-229
U.S. STANDARD DAY, 1966

NOTES
THIS DATA BASED ON MAXIMUM PERFORMANCE TAKEOFF PROCEDURES: FULL AFT STICK APPLIED AT LOW SPEED AND A 12 DEGREE PITCH ATTITUDE HELD AFTER ROTATION.

DATE: 15 JULY 1991
DATA BASIS: ESTIMATED

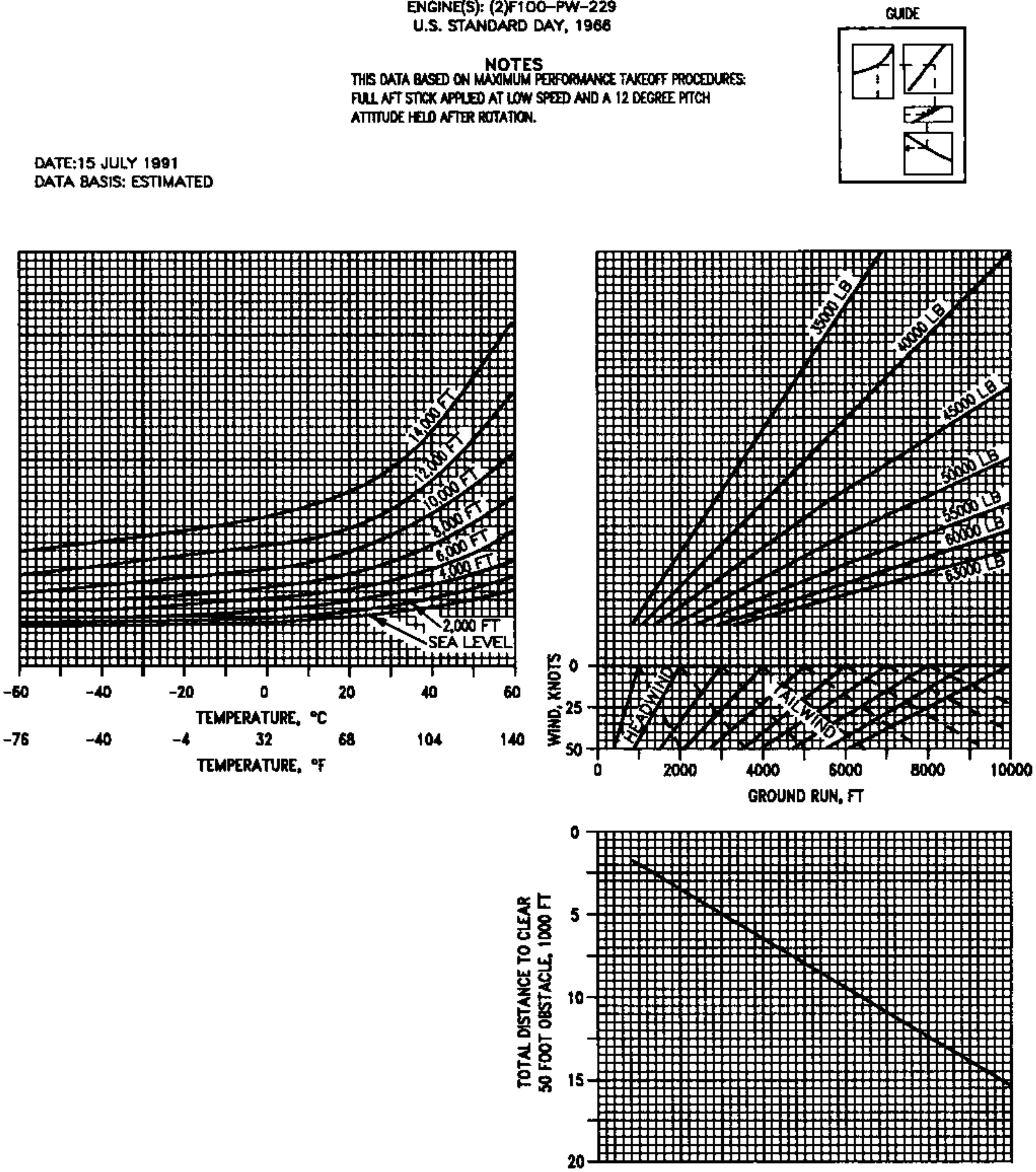


Figure B3-9

ROTATION SPEED/NOSEWHEEL LIFT-OFF SPEED/TAKEOFF SPEED
WITH CFT

AIRPLANE CONFIGURATION
FULL FLAPS, GEAR DOWN
ALL DRAG INDEXES

REMARKS
ENGINE(S): (2) F100-PW-229,
U.S. STANDARD DAY, 1966

DATE: 15 JULY 1991
DATA BASIS: ESTIMATED

NORMAL TAKEOFF
ONE-HALF AFT STICK APPLIED OVER A PERIOD OF 1 SECOND STARTING AT THE ROTATION SPEED LISTED BELOW AND 12 ° PITCH ATTITUDE HELD AFTER ROTATION

GROSS WEIGHT-LB	CG %	ROTATION/ NOSEWHEEL LIFT-OFF/ TAKEOFF SPEEDS (KCAS)	
		MAXIMUM THRUST	MILITARY THRUST
40,000	28	—	—
	26	110/133/159	115/127/147
	24	110/136/161	115/129/148
	22	110/138/163	120/134/153
45,000	28	—	—
	26	115/136/162	120/132/150
	24	115/139/164	120/133/152
	23.5	115/140/164	120/133/152
	22	118/144/168	125/139/156
50,000	28	—	—
	26	120/140/166	125/136/154
	24	120/143/167	125/137/155
	23.5	120/144/168	125/138/156
	22	127/150/173	132/144/161
55,000	28	—	—
	26	125/145/169	130/140/158
	25	125/146/170	130/141/159
	24	125/148/172	135/146/162
	22	—	—
60,000	28	—	—
	26	130/150/173	135/145/163
	25	130/151/175	135/146/163
	24	133/155/177	140/151/166
	22	—	—

Figure B3-10 (Sheet 1 of 3)

ROTATION SPEED/NOSEWHEEL LIFT-OFF SPEED/TAKEOFF SPEED (Continued)

WITH CFT

AIRPLANE CONFIGURATION
FULL FLAPS, GEAR DOWN
ALL DRAG INDEXES

REMARKS
ENGINE(S): (2) F100-PW-229,
U.S. STANDARD DAY, 1966

DATE: 15 JULY 1991
DATA BASIS: ESTIMATED

NORMAL TAKEOFF

ONE-HALF AFT STICK APPLIED OVER A PERIOD OF 1 SECOND STARTING AT THE ROTATION SPEED LISTED BELOW AND 12 °PITCH ATTITUDE HELD AFTER ROTATION

GROSS WEIGHT-LB	CG %	ROTATION/NOSEWHEEL LIFT-OFF/TAKEOFF SPEEDS (KCAS)	
		MAXIMUM THRUST	MILITARY THRUST
65,000	28	140/156/178	145/152/168
	26	140/159/181	145/154/170
	25	140/161/182	145/155/171
	24	145/166/186	150/160/173
	22	—	—
70,000	28	155/167/188	155/161/178
	26	155/169/190	155/162/180
	25	155/171/192	155/163/180
	24	160/175/195	160/166/182
	22	—	—
75,000	28	—	—
	26	160/174/195	160/166/186
	25	160/177/196	160/168/187
	24	165/180/199	165/171/189
	22	—	—
81,000	28	167/179/198	167/172/192
	26	167/181/200	167/172/194
	25	167/184/202	167/173/195
	24	172/188/206	172/177/197
	22	—	—

Figure B3-10 (Sheet 2)

SINGLE ENGINE ROTATION SPEED/NOSEWHEEL LIFT-OFF SPEED/TAKEOFF SPEED WITH CFT

AIRPLANE CONFIGURATION
FULL FLAPS, GEAR DOWN
ALL DRAG INDEXES

REMARKS
ENGINE(S): (2) F100-PW-229,
U.S. STANDARD DAY, 1966

DATE: 15 JULY 1991
DATA BASIS: ESTIMATED

CONTINUED (SINGLE ENGINE) TAKEOFF

ONE-HALF AFT STICK APPLIED OVER A PERIOD OF 1 SECOND STARTING AT THE ROTATION SPEED LISTED BELOW AND 10 °PITCH ATTITUDE HELD AFTER ROTATION

GROSS WEIGHT-LB	ROTATION/NOSEWHEEL LIFT-OFF/TAKEOFF SPEEDS (KCAS)	
40,000	170/172/179	TO BE USED WHEN NO STORES OTHER THAN AIR-TO-AIR WEAPONS ARE INSTALLED ON THE WING STATIONS
45,000	180/183/189	
50,000	185/189/194	
55,000	190/193/199	
60,000	190/193/200	
65,000	190/193/200	
70,000	190/194/201	
75,000	190/194/202	
81,000	190/194/206	
70,000	190/193/200	TO BE USED WHEN CARRYING AIR-TO-GROUND WEAPONS OR FUEL TANKS ON THE WING STATIONS
75,000	190/194/202	
81,000	190/194/210	

Figure B3-10 (Sheet 3)

NOSEWHEEL LIFT-OFF SPEED/TAKEOFF SPEED
WITHOUT CFT

AIRPLANE CONFIGURATION
FULL FLAPS, GEAR DOWN
ALL DRAG INDEXES

REMARKS
ENGINE(S): (2) F100-PW-229,
U.S. STANDARD DAY, 1966

DATE: 15 JULY 1991
DATA BASIS: ESTIMATED

NORMAL TAKEOFF

ONE-HALF AFT STICK APPLIED OVER A PERIOD OF 1 SECOND STARTING AT 120 KNOTS AND 10 °ATTITUDE HELD AFTER ROTATION

GROSS WEIGHT-LB	NOSEWHEEL LIFT-OFF/TAKEOFF SPEEDS (KCAS)	
	MAXIMUM THRUST	MILITARY THRUST
35,000	134/154	128/141
40,000	136/157	129/142
45,000	137/160	130/148
50,000	139/163	133/161
55,000	150/171	144/169
60,000	158/179	155/177
63,000	163/184	161/181

MAXIMUM PERFORMANCE TAKEOFF

FULL AFT STICK APPLIED AT LOW SPEED AND 12 ° ATTITUDE HELD AFTER ROTATION

GROSS WEIGHT-LB	NOSEWHEEL LIFT-OFF/TAKEOFF SPEEDS (KCAS)	
	MAXIMUM THRUST	MILITARY THRUST
35,000	89/128	102/119
40,000	99/136	110/129
45,000	109/143	119/139
50,000	120/151	129/148
55,000	135/163	140/157
60,000	145/171	148/165
63,000	151/176	153/174

Figure B3-11 (Sheet 1 of 2)

SINGLE ENGINE ROTATION SPEED/NOSEWHEEL LIFT-OFF SPEED/TAKEOFF SPEED
WITHOUT CFT

AIRPLANE CONFIGURATION
FULL FLAPS, GEAR DOWN
ALL DRAG INDEXES
ALL CG LOCATIONS

REMARKS
ENGINE(S): (2) F100-PW-229,
U.S. STANDARD DAY, 1966

DATE: 15 JULY 1991
DATA BASIS: ESTIMATED

CONTINUED (SINGLE ENGINE) TAKEOFF

ONE-HALF AFT STICK APPLIED OVER A PERIOD OF 1 SECOND STARTING AT THE ROTATION SPEED LISTED BELOW AND 10 °PITCH ATTITUDE HELD AFTER ROTATION

GROSS WEIGHT-LB	ROTATION/NOSEWHEEL LIFT-OFF/TAKEOFF SPEEDS (KCAS)
35,000	115/118/137
40,000	130/136/152
45,000	155/158/170
50,000	170/173/183
55,000	190/193/200
63,000	190/194/201

Figure B3-11 (Sheet 2)

PART 4

CLIMB

TABLE OF CONTENTS

Charts

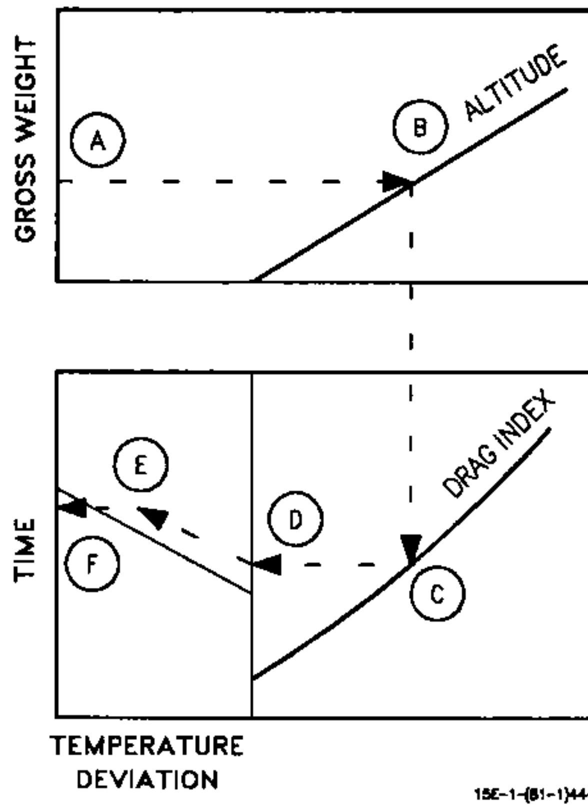
CLIMB CHARTS

The Climb charts (figures B4-1 thru B4-6) are used to determine time, fuel used, and distance covered while in the climb. Each chart is based on a military or maximum thrust climb for individual drag index configurations. The climb speed schedule and pre-climb data are noted on each chart.

USE

The method of presenting data on the time, fuel and distance charts is identical, and the use of all three charts will be undertaken simultaneously here. Enter the charts with the initial climb gross weight and project horizontally right to intersect the assigned cruise altitude or the optimum cruise altitude for the computed drag index, then vertically down to intersect the applicable drag index curve. From this point project horizontally left to the temperature baseline and parallel the nearest temperature guideline to read time, fuel or distance. Time, fuel or distance required to accelerate to climb speed must be added to the chart values.

SAMPLE CLIMB



15E-1-(B1-1)44-CATI

Sample Problem

Military Thrust

A. Gross weight	60,000 Lb
B. Cruise altitude	20,000 Ft
C. Drag Index	120
D. Temperature baseline	
E. Temperature deviation	+10°C
F. Time	6.0 Min
G. Fuel (from Fuel Required To Climb Chart)	1700 Lb
H. Distance (from Distance Required to Climb Chart)	35 NM

COMBAT CEILING CHARTS

These charts (figures B4-7 and B4-8) present the military and maximum thrust subsonic combat ceiling for both single engine and normal two engine operation. The variable of gross weight and pressure altitude are taken into consideration for a range of drag indexes.

USE

Enter the applicable graph with estimated gross weight at end of climb. Project vertically up to intersect applicable configuration curve, then horizontally to the left to read combat ceiling.

Sample Problem

Combat Ceiling - Maximum Thrust - (2) Engines

Configuration: -4 CFTs + (4) AIM-7F missiles

A. Gross weight at end of climb	55,000 Lb
B. Drag index	18.6
C. Combat ceiling	49,700 Ft

TIME TO CLIMB

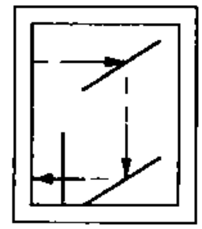
AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

MILITARY THRUST

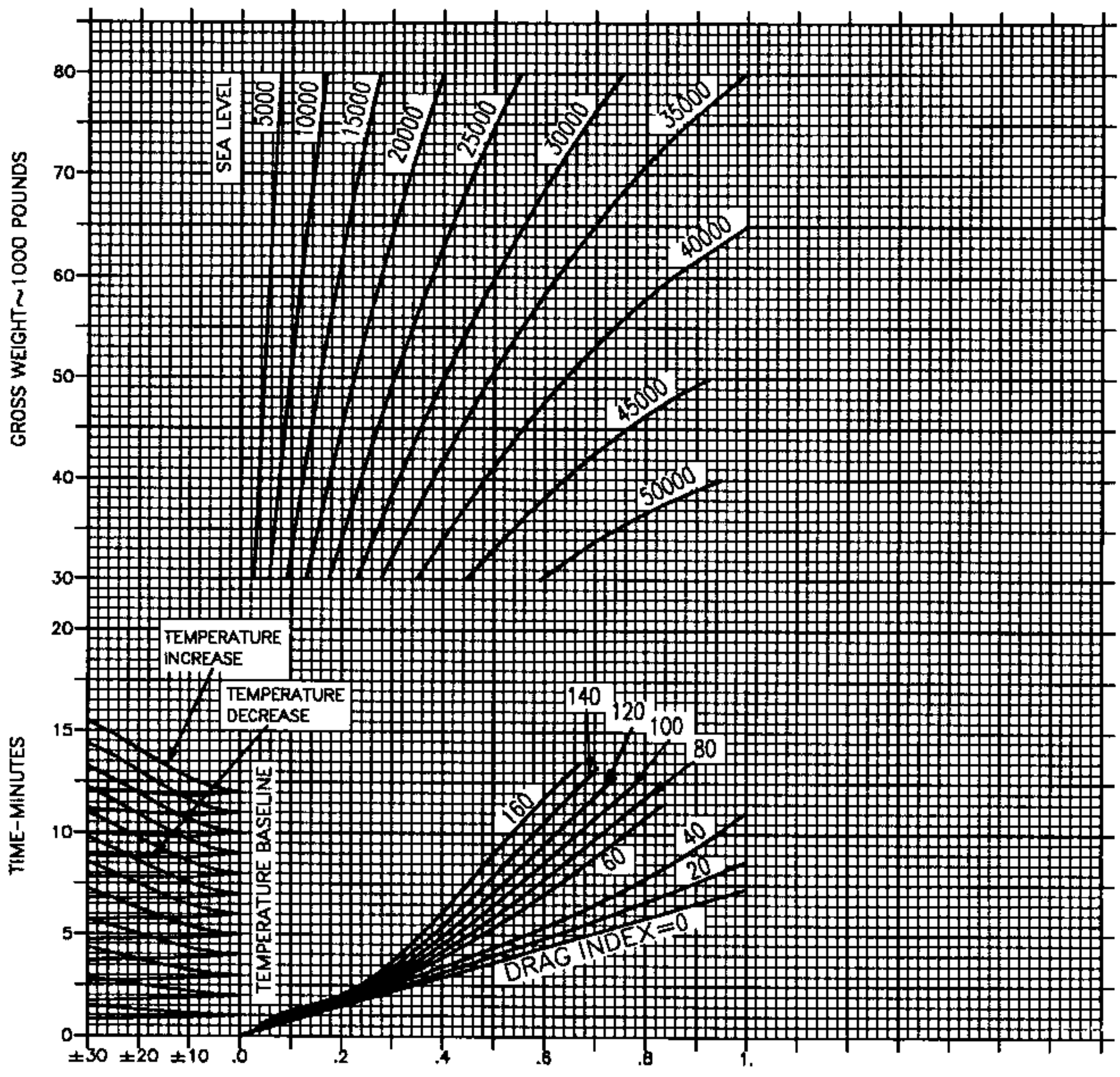
REMARKS
ENGINE(S): (2)F100-PW-229
U.S. STANDARD DAY, 1966

NOTES
- CLIMB SPEED SCHEDULE FOR DRAG INDEXES UP TO 60 IS 350 KCAS UNTIL INTERCEPTION OF .90 MACH, THEN MAINTAINING MACH TO CRUISE ALTITUDE. FOR DRAG INDEXES GREATER THAN 60, USE 300 KCAS/.75 MACH.
- TIME FROM BRAKE RELEASE TO INITIAL CLIMB SPEED IS 1.0 MINUTES MILITARY THRUST TAKEOFF AND 0.5 MINUTES MAX THRUST TAKEOFF.

GUIDE



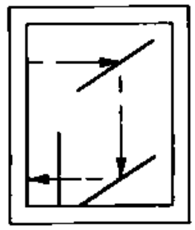
DATE: 15 JULY 1991
DATA BASIS: ESTIMATED



15E-1-(295-1)25-CATI

Figure B4-1

FUEL REQUIRED TO CLIMB



AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

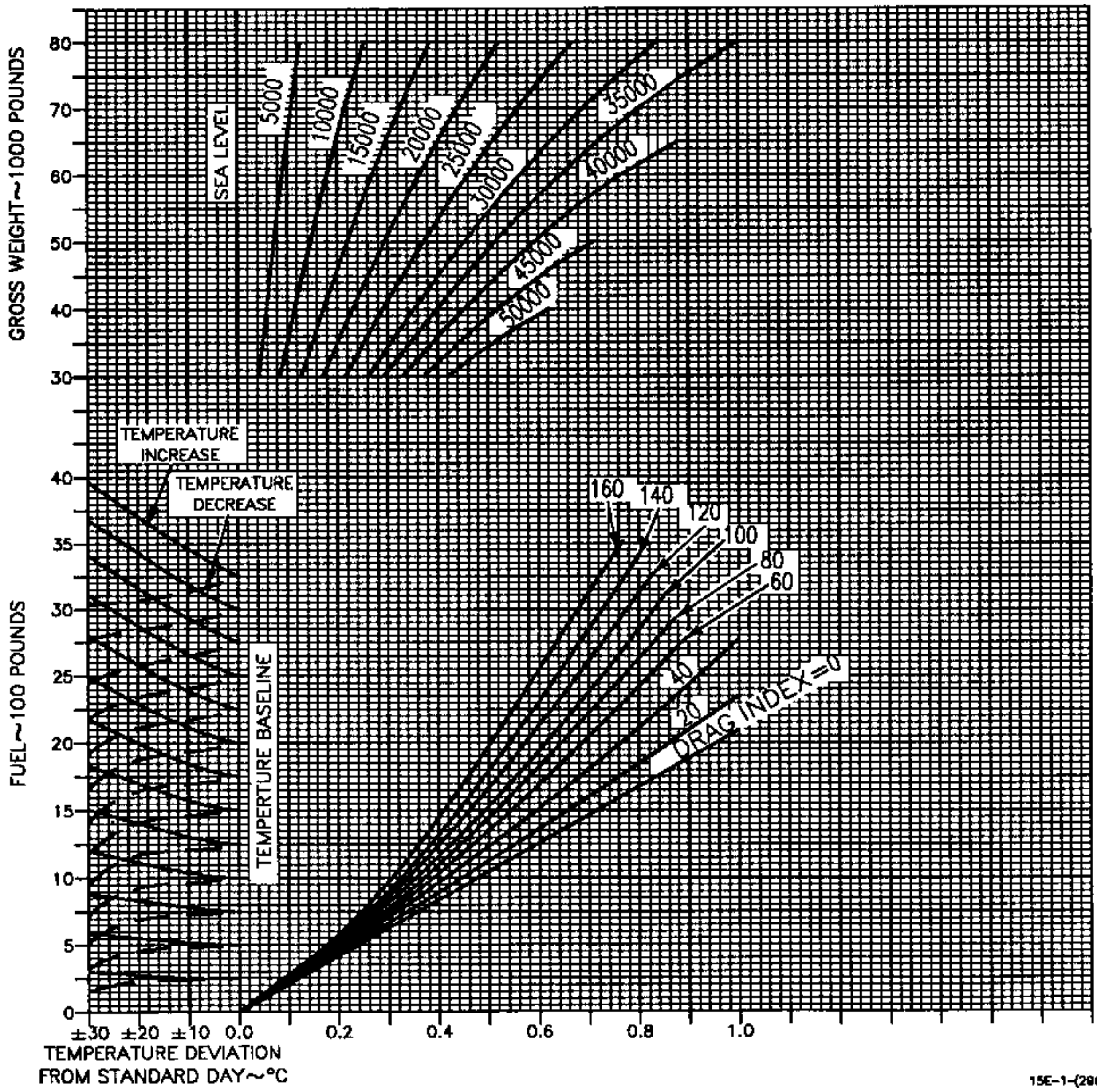
MILITARY THRUST

REMARKS
ENGINE(S): (2)F100-PW-229
U.S. STANDARD DAY, 1966

NOTES

- CLIMB SPEED SCHEDULE FOR DRAG INDEXES UP TO 60 IS 350 KCAS UNTIL INTERCEPTION OF .90 MACH, THEN MAINTAINING MACH TO CRUISE ALTITUDE. FOR DRAG INDEXES GREATER THAN 60. USE 300 KCAS/.75 MACH.
- PRETAKEOFF FUEL CONSUPTION IS AS FOLLOWS: START-32 LB/ENG; MIL RUNUP-82 LB/ENG; TAXI 23 LB/MIN/ENG.
- FUEL REQUIRED FROM BRAKE RELEASE TO INITIAL CLIMB SPEED IS 300 POUNDS MILITARY THRUST AND 650 POUNDS MAXIMUM THRUST FOR DI LESS THAN OR EQUAL TO 40.AND 400 POUNDS MILITARY THRUST AND 800 POUNDS MAXIMUM THRUST FOR DI GREATER THAN 40.

DATE:15 JULY 1991
DATA BASIS: ESTIMATED



15E-1-(298-1)25-CATI

Figure B4-2

DISTANCE REQUIRED TO CLIMB

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

MILITARY THRUST

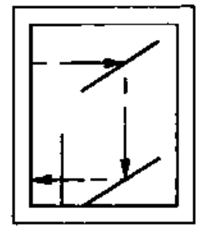
REMARKS
ENGINE(S): (2)F100-PW-229
U.S. STANDARD DAY, 1966

NOTES

- CLIMB SPEED SCHEDULE FOR DRAG INDEXES UP TO 60 IS 350 KCAS UNTIL INTERCEPTION OF .90 MACH, THEN MAINTAINING MACH TO CRUISE ALTITUDE. FOR DRAG INDEXES GREATER THAN 60, USE 300 KCAS/.75 MACH.
- DISTANCE FROM BRAKE RELEASE TO INITIAL CLIMB SPEED IS 2.0 NAUTICAL MILES MILITARY THRUST TAKEOFF AND 1.0 NAUTICAL MILE MAXIMUM THRUST TAKEOFF.

DATE:15 JULY 1991
DATA BASIS: ESTIMATED

GUIDE



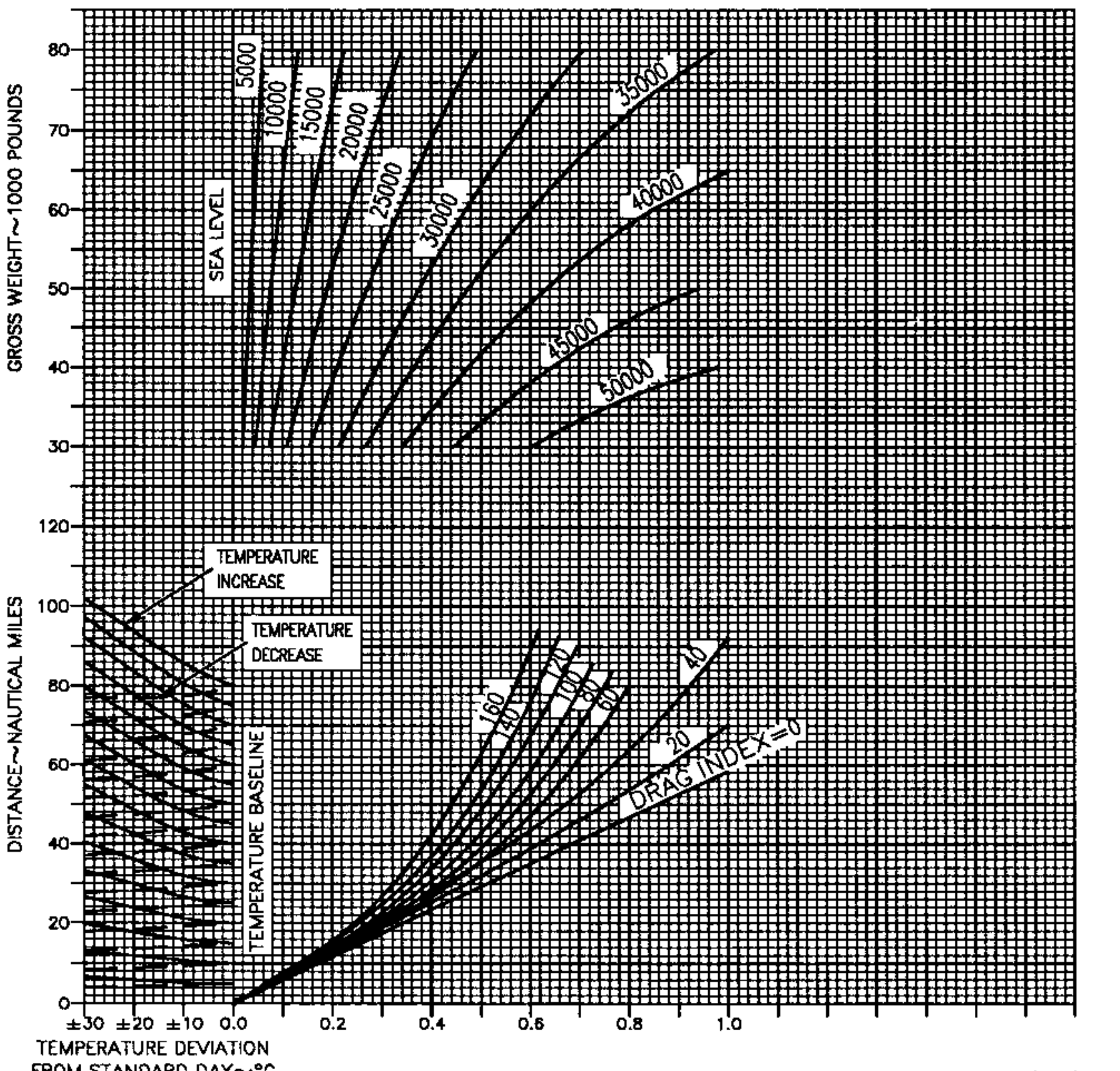


Figure B4-3

TIME TO CLIMB

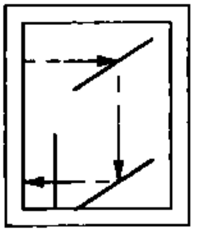
MAXIMUM THRUST

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S): (2)F100-PW-229
U.S. STANDARD DAY, 1966

NOTES
- CLIMB SPEED SCHEDULE FOR DRAG INDEXES UP TO 60 IS 350 KCAS UNTIL INTERCEPTION OF .95 MACH THEN MAINTAINING MACH TO CRUISE ALTITUDE. FOR DRAG INDEXES GREATER THAN 60, USE 350 KCAS/.90 MACH.
- TIME FROM BRAKE RELEASE TO INITIAL CLIMB SPEED IS 1.0 MINUTES MILITARY THRUST TAKEOFF AND 0.5 MINUTES MAX THRUST TAKEOFF.

DATE:15 JULY 1991
DATA BASIS: ESTIMATED



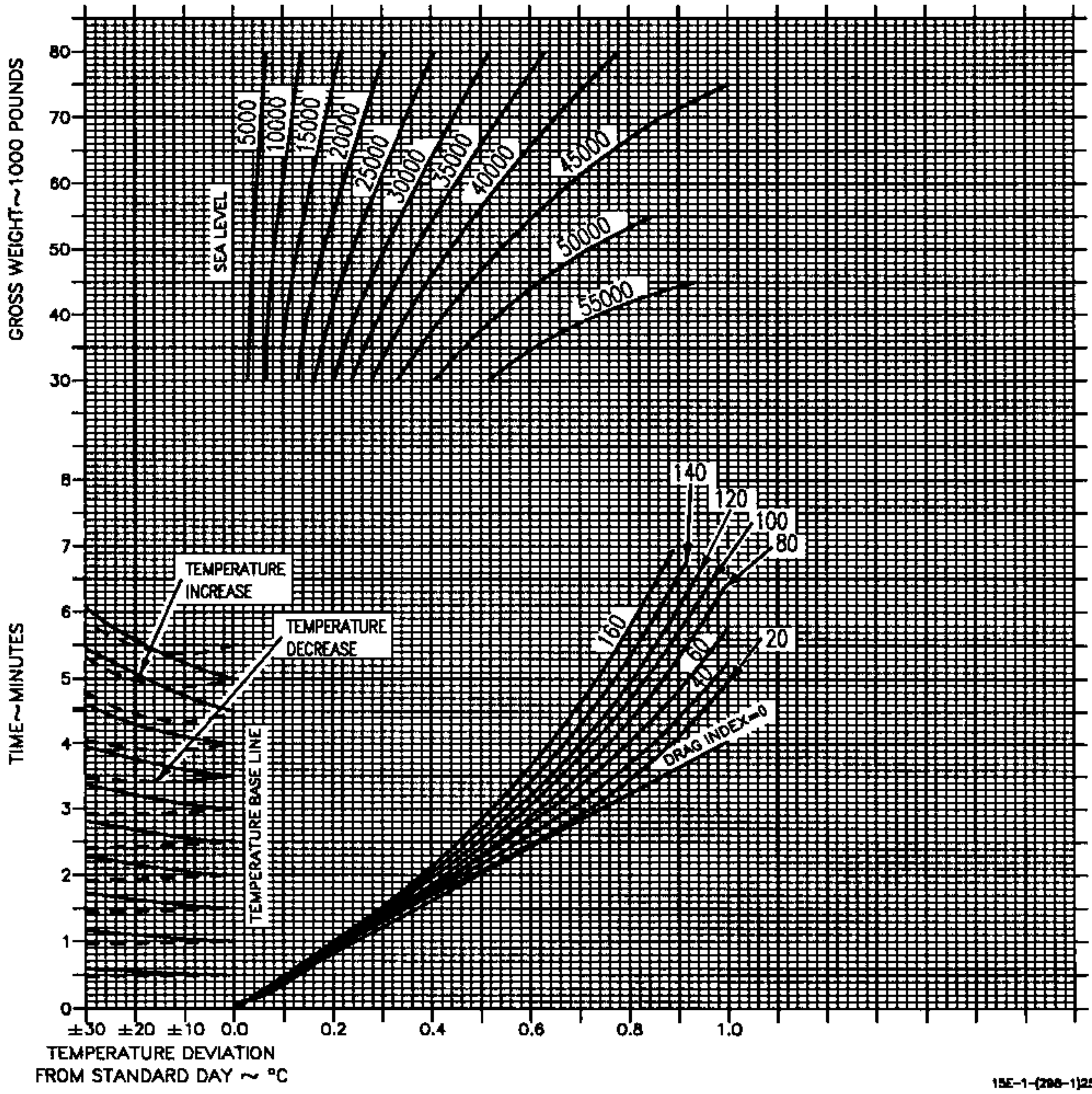


Figure B4-4

FUEL REQUIRED TO CLIMB

MAXIMUM THRUST

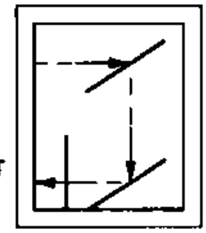
AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S): (2)F100-PW-229
U.S. STANDARD DAY, 1966

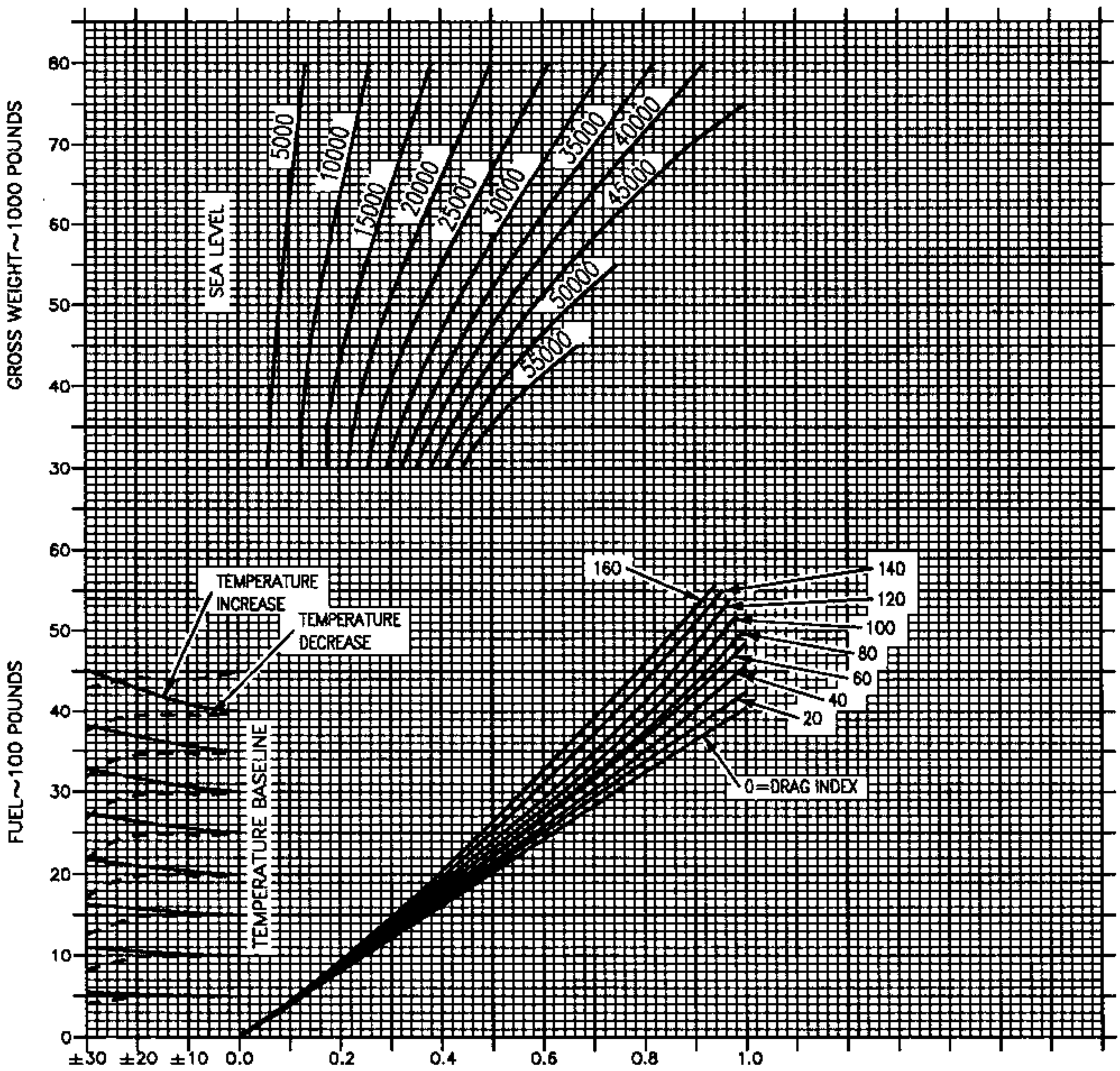
NOTES

- CLIMB SPEED SCHEDULE FOR DRAG INDEXES UP TO 60 IS 350 KCAS UNTIL INTERCEPTION OF .95 MACH, THEN MAINTAINING MACH TO CRUISE ALTITUDE. FOR DRAG INDEXES GREATER THAN 60, USE 350 KCAS/.90 MACH.
- PRETAKEOFF FUEL CONSUPTION IS AS FOLLOWS: START-32 LB/ENG; MIL RUNUP-82 LB/ENG; TAXI 23 LB/MIN/ENG.
- FUEL REQUIRED FROM BRAKE RELEASE TO INITIAL CLIMB SPEED IS 750 POUNDS MAXIMUM THRUST FOR DI LESS OR EQUAL TO 60 AND 900 POUNDS MAXIMUM THRUST FOR DI GREATER THAN 60.

GUIDE



DATE:15 JULY 1991
DATA BASIS: ESTIMATED



15E-1-(299-1)25-CATI

Figure B4-5

DISTANCE REQUIRED TO CLIMB

MAXIMUM THRUST

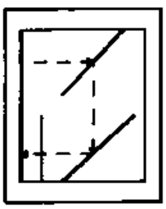
AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

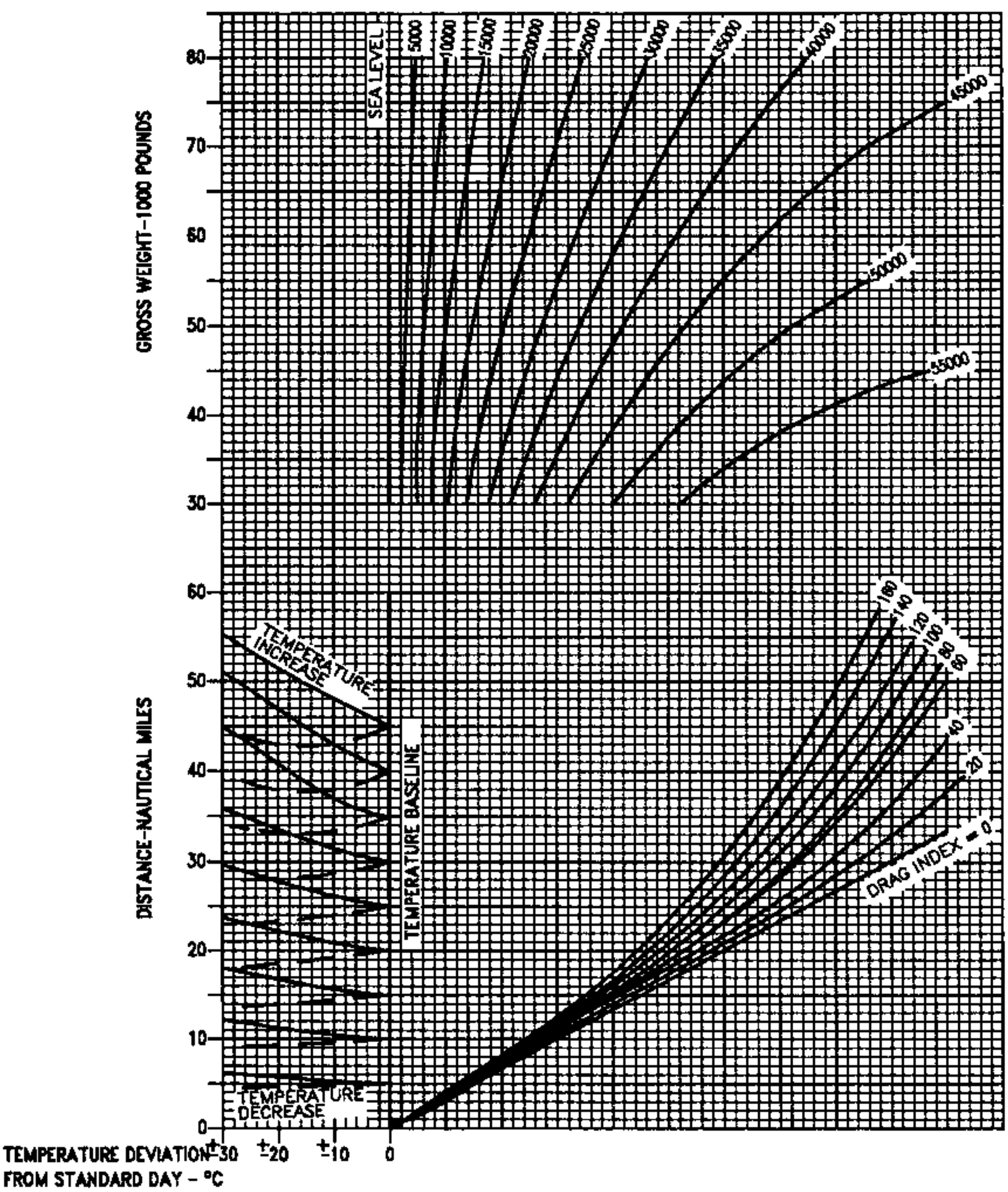
REMARKS
ENGINE(S): (2) F100-PW-229
U.S. STANDARD DAY, 1966

DATE: 15 JULY 1991
DATA BASIS: ESTIMATED

NOTES
- CLIMB SPEED SCHEDULE FOR DRAG INDEXES UP TO 60 IS 350 KCAS UNTIL INTERCEPTION OF .95 MACH, THEN MAINTAINING MACH TO CRUISE ALTITUDE. FOR DRAG INDEXES GREATER THAN 60, USE 350 KCAS/.90 MACH.
- DISTANCE FROM BRAKE RELEASE TO INITIAL CLIMB SPEED IS 2.0 NAUTICAL MILES MILITARY THRUST TAKEOFF AND 1.0 NAUTICAL MILE MAXIMUM THRUST TAKEOFF.

GUIDE





15E-1-(300-1)25-CATI

Figure B4-6

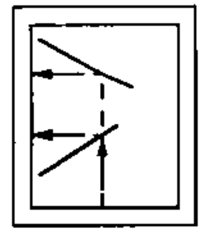
COMBAT CEILING

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S): (2)F100-PW-229
U.S. STANDARD DAY, 1966

NOTES
COMBAT CEILING IS THE PRESSURE ALTITUDE AT WHICH THE AIRCRAFT CAN CLIMB AT A MAXIMUM RATE OF 500 FEET PER MINUTE

DATE: 15 JULY 1991
DATA BASIS: ESTIMATED



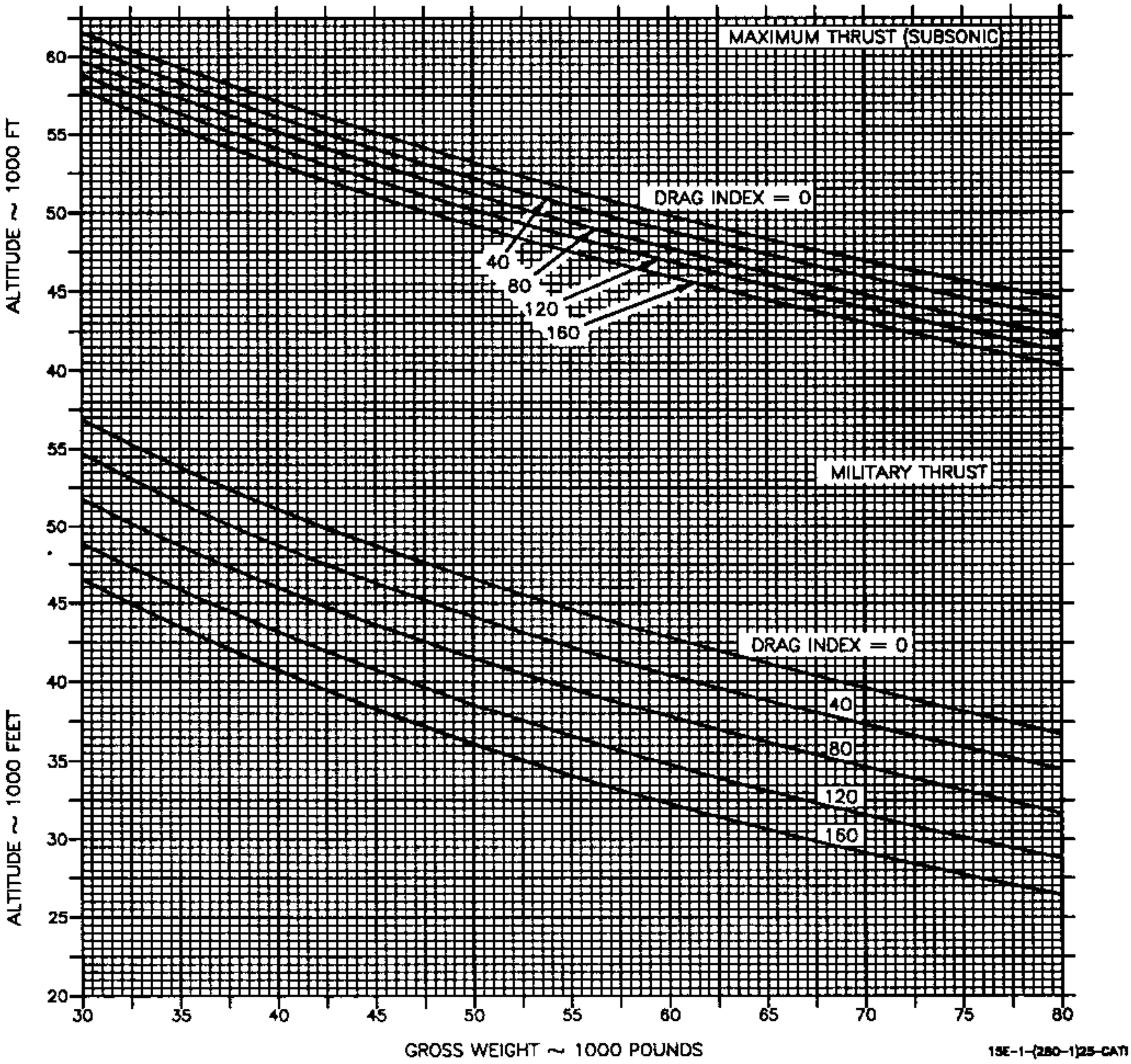


Figure B4-7

COMBAT CEILING

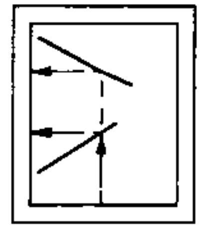
ONE ENGINE OPERATING

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S): (2)F100-PW-229
U.S. STANDARD DAY, 1966

NOTES
- COMBAT CEILING IS THE PRESSURE ALTITUDE AT WHICH THE AIRCRAFT CAN CLIMB AT A MAXIMUM RATE OF 500 FEET PER MINUTE
- INOPERATIVE ENGINE WINDMILLING

DATE: 15 JULY 1991
DATA BASIS: ESTIMATED



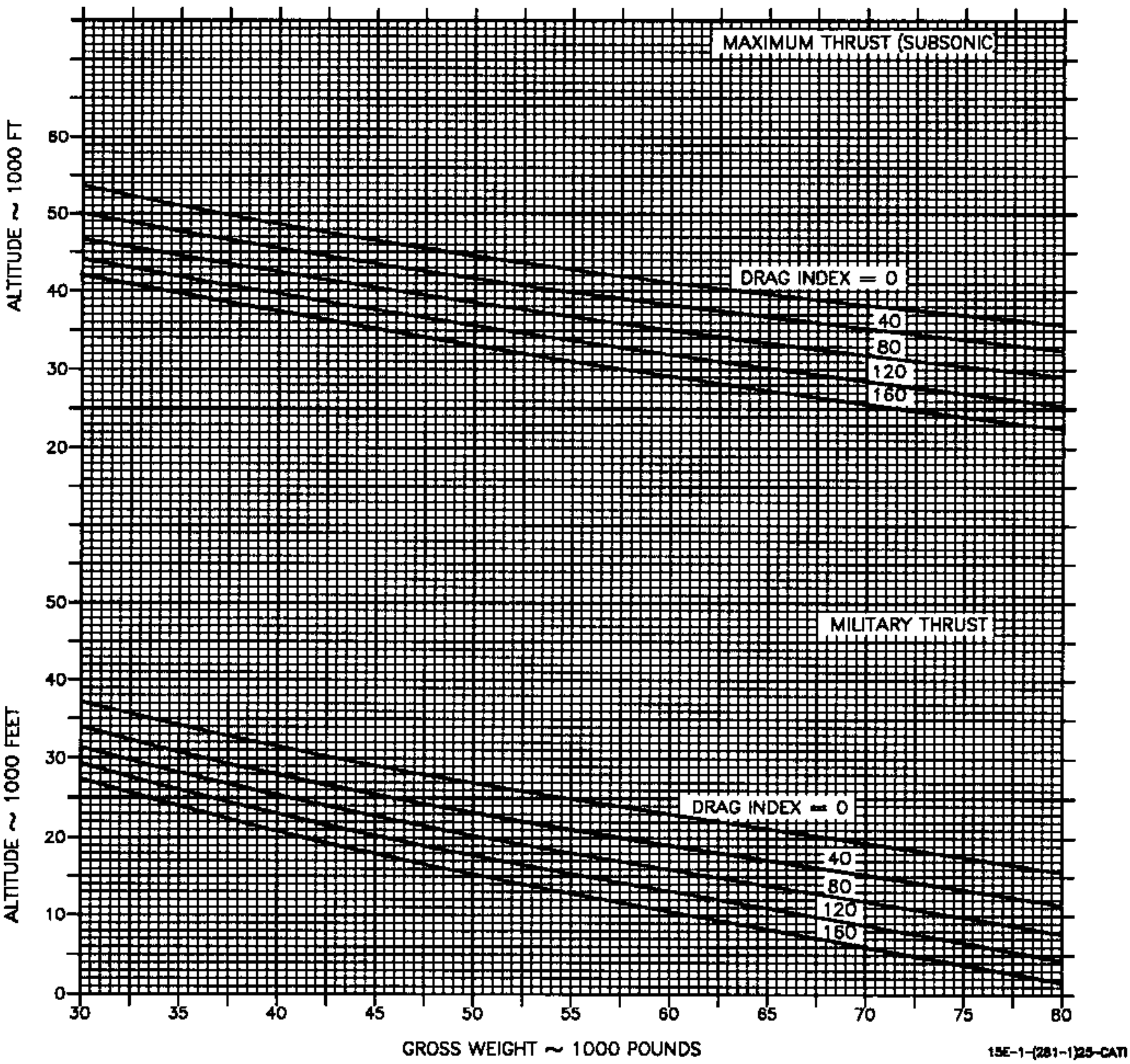


Figure B4-8

PART 5

RANGE

TABLE OF CONTENTS

Charts

NOTE

Performance charts for the PW-229 engines are currently being developed. The references to figures have been retained even if the chart is not available. The actual charts will be added as they become available.

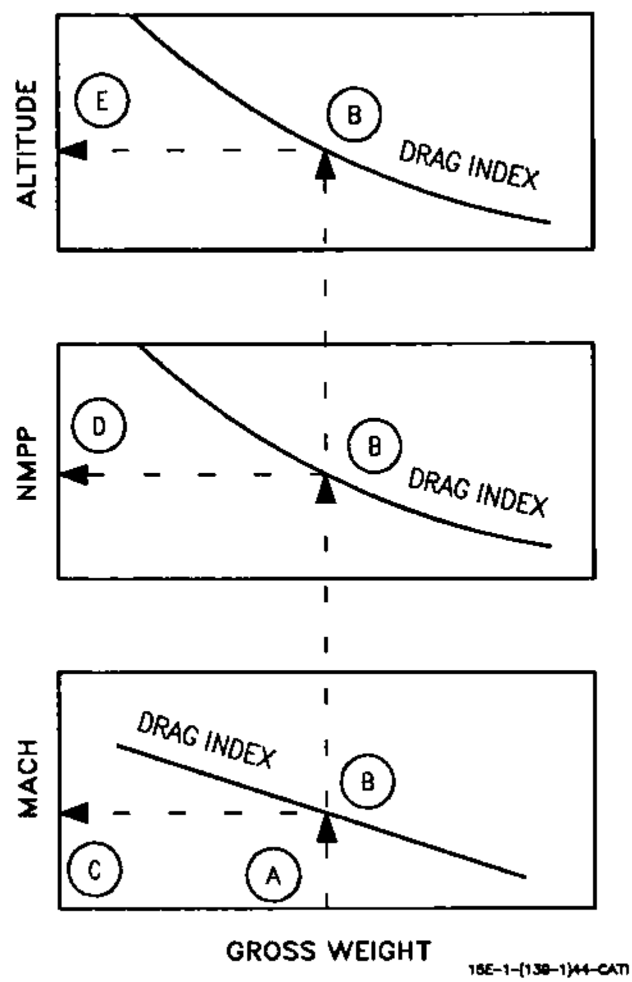
OPTIMUM LONG RANGE CRUISE

These charts (figures B5-1 and B5-2) present cruise data for twin-engine and single engine operation. These charts depict cruise altitude, specific range (nautical miles per pound) and cruise Mach number for various gross weights and drag indexes.

USE

Enter the chart with the applicable gross weight and project vertically up to intersect the appropriate drag index curves in each plot. From the intersection of the appropriate drag index curve, reflect horizontally left and read cruise Mach number, specific range in nautical miles per pound and cruise altitude.

SAMPLE OPTIMUM LONG RANGE CRUISE



Sample Problem

A. Gross weight	60,000 Lb
B. Drag index	120
C. Mach number	0.765 Mach
D. Specific range	0.051 NMPP
E. Cruise altitude	31,200 Ft

CONSTANT ALTITUDE/LONG RANGE CRUISE

These charts (figures B5-3 thru B5-12) present the necessary planning data to set up optimum cruise schedules for normal two-engine operation at a constant altitude. The charts depict specific range (nautical miles per pound of fuel) for various Mach numbers, gross weights and individual drag indexes at altitudes of sea level thru 45,000 feet in increments of 5000 feet. The recommended procedure is to use an average gross weight for a given leg of the mission. One way to find the average gross weight is to divide the mission into weight segments. With this method, readjust the cruise schedule each time a given amount of fuel is used. Subtract one-half of the fuel weight allotted for the first leg from the initial cruise gross weight. The remainder is the average gross weight for the leg. It is possible to obtain instantaneous data if desired.

USE

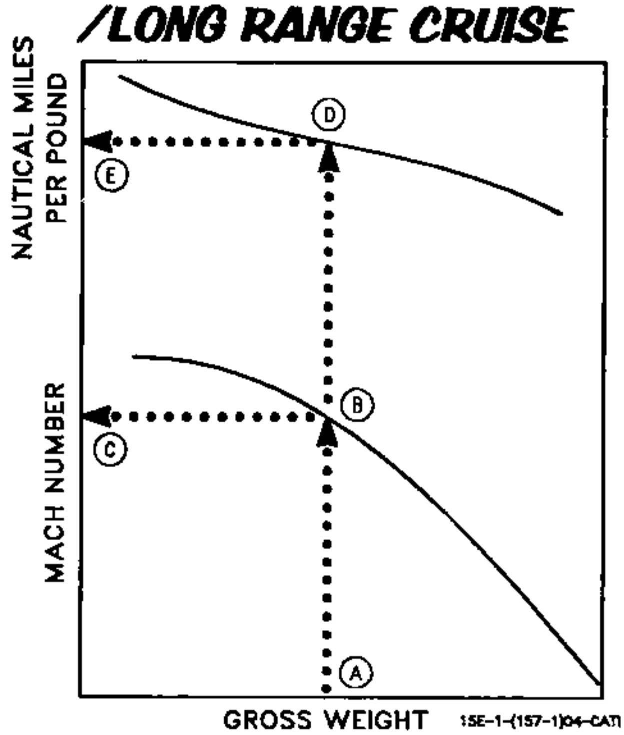
Enter the chart with the desired gross weight and project vertically upward to intersect the appropriate drag index curve, then horizontally to the left to determine optimum cruise Mach number. From the optimum airspeed-gross weight intersection project vertically up to intersect the appropriate drag index curve, then horizontally left to determine the specific range. These charts are applicable for any temperature day. Use following paragraph to determine true airspeed and total fuel flow.

Sample Problem

Configuration - -4 CFT + (4)AIM-7F Missiles, Altitude - 30,000 feet

A. Gross weight	55,000 Lb
B. Drag index	18.6
C. Cruise Mach number	0.850
D. Drag index	18.6
E. Specific range	0.078 NMPP

SAMPLE CONSTANT ALTITUDE /LONG RANGE CRUISE



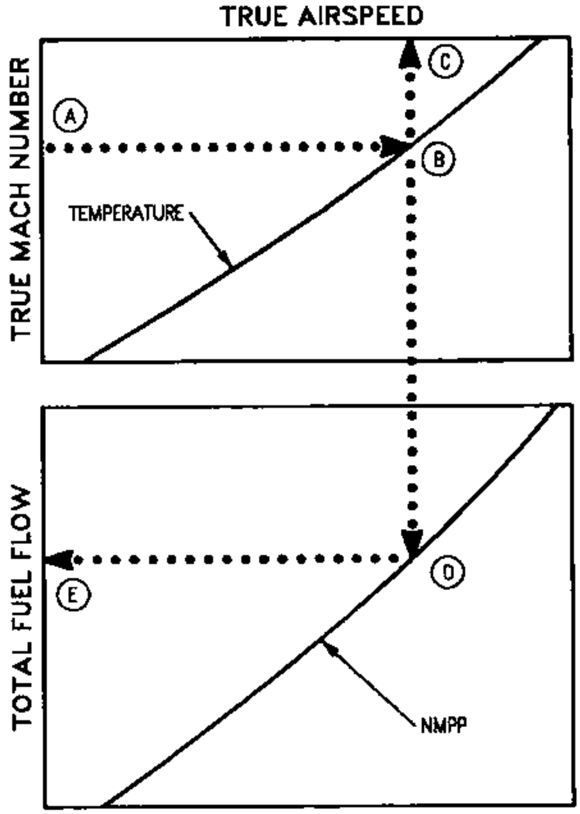
CONSTANT ALTITUDE CRUISE CHARTS

This chart (B5-13) presents the necessary planning data to set up optimum cruise schedules for normal two engine operation at a constant altitude at various flight-level temperatures.

USE

Enter the left side of the chart with the optimum cruise Mach number and project horizontally right to intersect the predicted flight-level temperature. Then, project vertically up to obtain the corresponding true airspeed. Project vertically down to intersect the interpolated specific range, then project horizontally left to obtain total fuel flow required in pounds per hour.

SAMPLE CONSTANT ALTITUDE CRUISE



15E-1-(156-1)04-CATI-31

Sample Problem

Configuration - -4 CFT + (4) AIM-7F Missiles, Altitude - 30,000 feet, Temperature - −40°C

A. True Mach number	0.855
B. Temperature	−40°C
C. True airspeed	510 KTAS
D. Specific range	0.078 NMPP
E. Total fuel flow	6600 PPH

LOW ALTITUDE CRUISE TABLES

These tables (figures B5-14 thru B5-23) present total fuel flow values for various combinations of cruise airspeed and drag index at altitudes of Sea Level, 5000, 10,000, 15,000 and 20,000 feet. Also included for each altitude are the total fuel flow values and resultant V_{max} (maximum attainable TAS) for a MIL thrust setting. Separate tables are provided for gross weights of 35,000 thru 80,000 pounds. Fuel flow values are tabulated for U.S. Standard Day; however, correction factors are given for non-standard temperatures. The standard day temperature is listed with the altitude. If the actual temperature at a particular altitude differs from the standard day temperature, refer to the TEMP. EFFECTS column to determine the appropriate temperature correction factor.

USE

After selecting the applicable table for gross weight and altitude, determine the equivalent standard day true airspeed by dividing the desired true airspeed by the non-standard day temperature correction factor obtained from the appropriate TEMP. EFFECTS column. Enter the table with the equivalent standard day true airspeed and project horizontally to the applicable drag index column and read total fuel flow for a standard day. To obtain the total fuel flow at the desired true airspeed, multiply the total fuel flow for a standard day by the nonstandard day temperature correction factor.

Sample Problem

Gross weight 35,000 lbs, 15,000 ft (−15°C)

A. Desired airspeed	535 KTAS
B. Drag Index	20
C. Nonstandard day temperature	0°C
D. Correction factor	1.029
E. Equivalent standard day true airspeed (A ÷ D)	520 Kt
F. Standard day total fuel flow	9894 PPH
G. Total fuel flow at desired true airspeed (F X D)	10181 PPH
H. Standard day V_{max}	614.2 KTAS
J. Standard day Mil. Pwr. total fuel flow	18,716 PPH

HIGH ALTITUDE CRUISE TABLES

These tables (figures B5-24 thru B5-33) present total fuel flow values for various combinations of cruise airspeed and drag index at altitudes of 25,000 feet thru 45,000 feet in 5000 foot increments. Also included for each altitude are the total fuel flow values and resultant V_{max} (maximum attainable TAS) for a MIL thrust setting. Separate charts are provided for gross weights of 35,000 thru 80,000 pounds. Fuel flow values are tabulated for U.S. Standard Day; however, correction factors are given for nonstandard temperatures. The standard day temperature is listed with the altitude. If the actual temperature at a particular altitude differs from the standard day temperature, refer to the TEMP. EFFECTS column to determine the appropriate temperature correction factor.

USE

After selecting the applicable table for gross weight and altitude, determine the equivalent standard day true airspeed by dividing the desired true airspeed by the nonstandard day temperature correction factor obtained from the appropriate TEMP EFFECTS column. Enter the table with the equivalent standard day true airspeed and project horizontally to the applicable drag index column and read total fuel flow for a standard day. To obtain the total fuel flow at the desired true airspeed, multiply the total fuel flow for a standard day by the nonstandard day temperature correction factor.

CONSTANT ALTITUDE CRUISE - LANDING GEAR EXTENDED

This chart (figure B5-34) presents data to set up constant altitude cruise schedules when landing gear cannot be retracted. The chart contains specific range (nautical miles per pound of fuel) data for various combinations of gross weight, drag index, and altitude for a cruise speed of 250 KCAS.

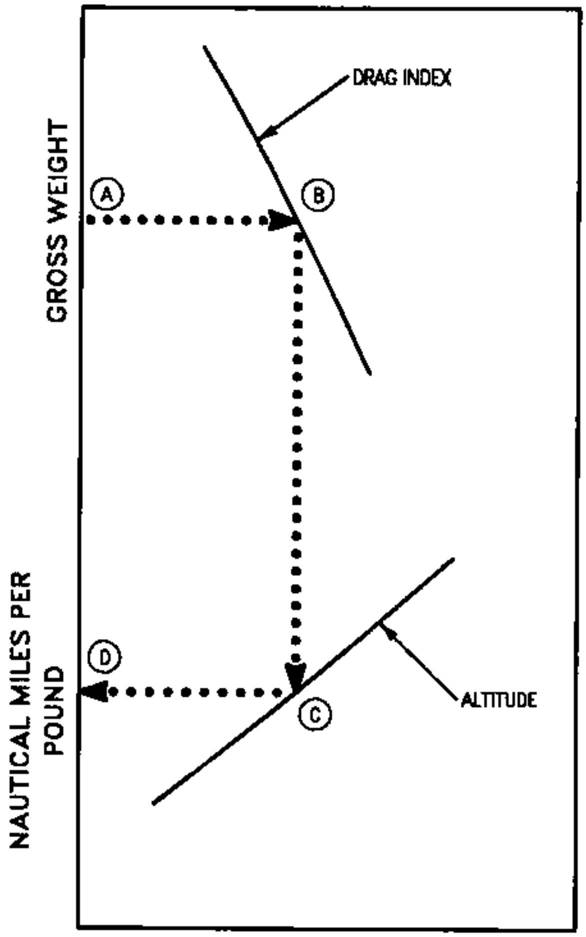
USE

Enter the chart at the gross weight scale and project horizontally right to intersect with the applicable drag index. From this point, project downward to intersect with the desired cruise altitude and project horizontally left to read the specific range.

Sample Problem

A. Gross weight	40,000 Lb
B. Drag index (external stores)	30
Drag index (all gear extended)	90
Total drag index	120
C. Altitude	10,000 Ft
D. Specific range	0.046 NMPP

SAMPLE CONSTANT ALTITUDE CRUISE, LANDING GEAR EXTENDED



15E-1-(155-1)04-CATI

OPTIMUM LONG RANGE CRUISE

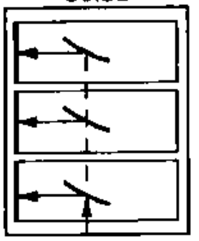
AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

MILITARY THRUST

REMARKS
ENGINE(S): (2)F100-PW-229
U.S. STANDARD DAY, 1966

NOTES
DATA IS FOR ALL FREE AIR TEMPERATURES

GUIDE



DATE:15 JULY 1991
DATA BASIS: ESTIMATED

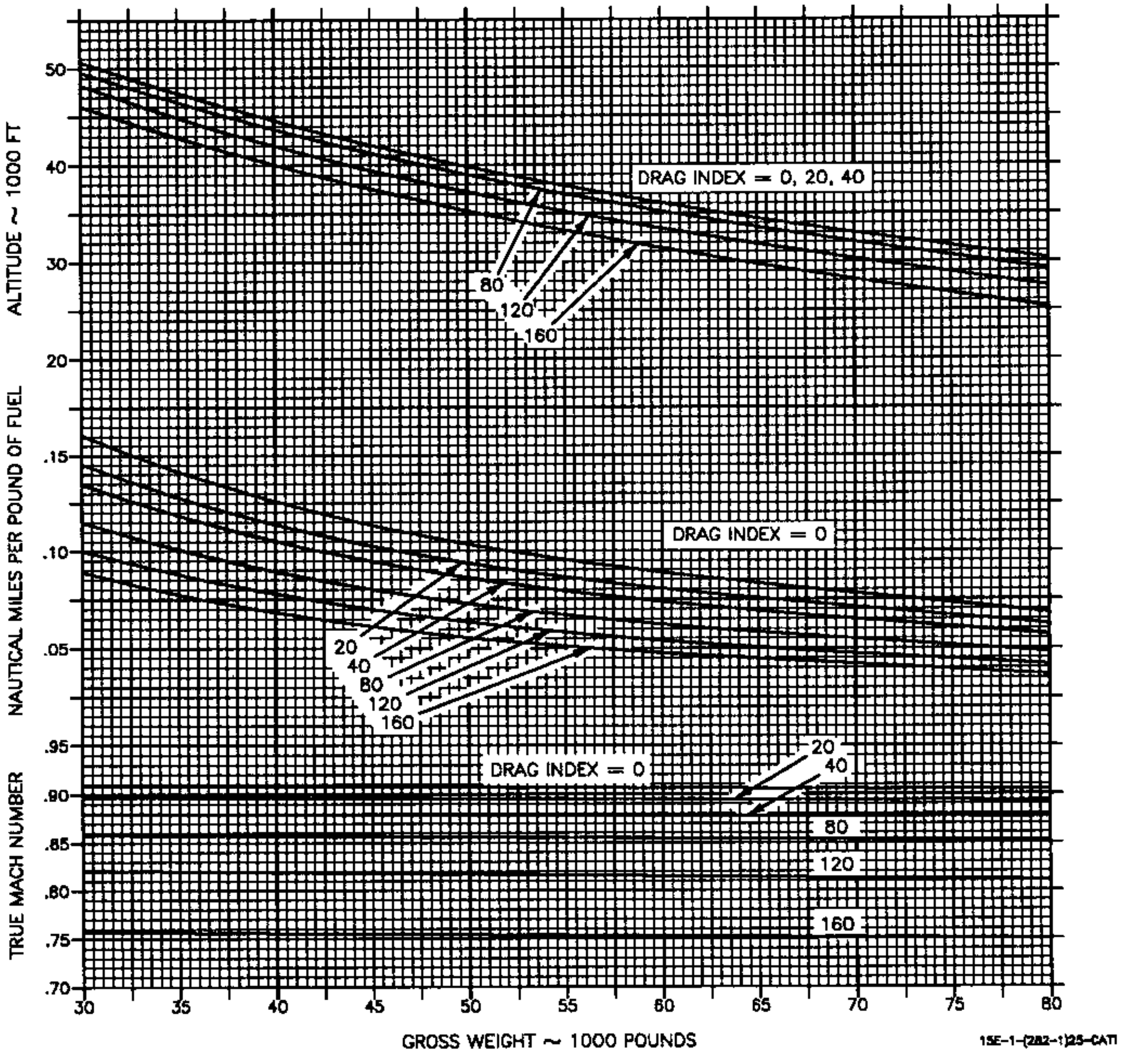


Figure B5-1

OPTIMUM LONG RANGE CRUISE

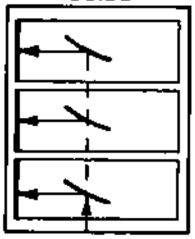
AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

ONE ENGINE OPERATING

REMARKS
ENGINE(S): (2)F100-PW-229
U.S. STANDARD DAY, 1966

NOTES
- DATA IS FOR ALL FREE AIR TEMPERATURES
- INOPERATIVE ENGINE WINDMILLING

GUIDE



DATE:15 JULY 1991
DATA BASIS: ESTIMATED

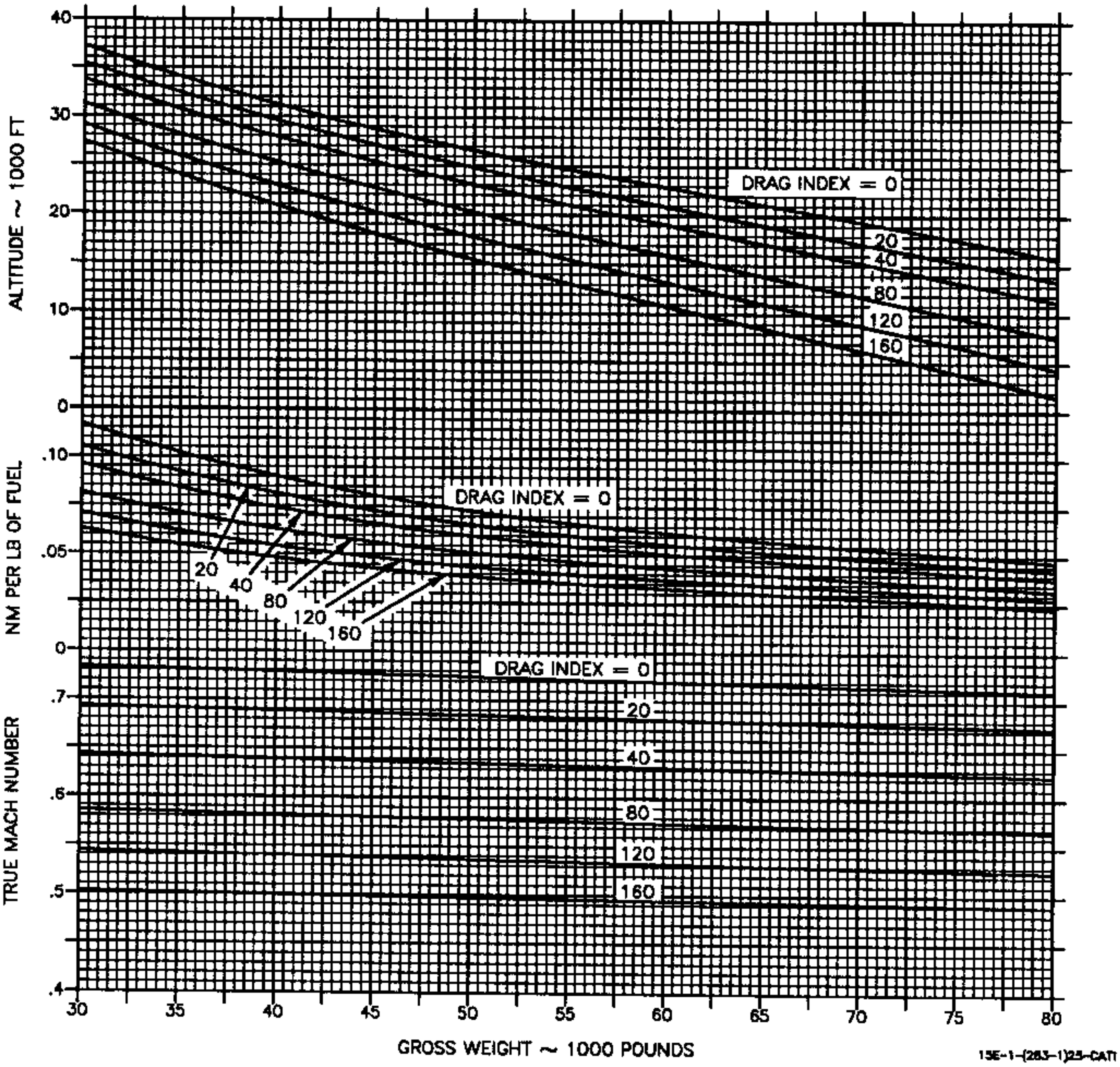


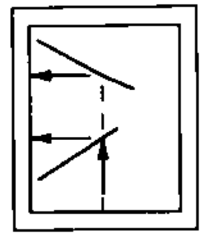
Figure B5-2

CONSTANT ALTITUDE/LONG RANGE CRUISE
SEA LEVEL

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

SPECIFIC RANGE, TRUE MACH NUMBER

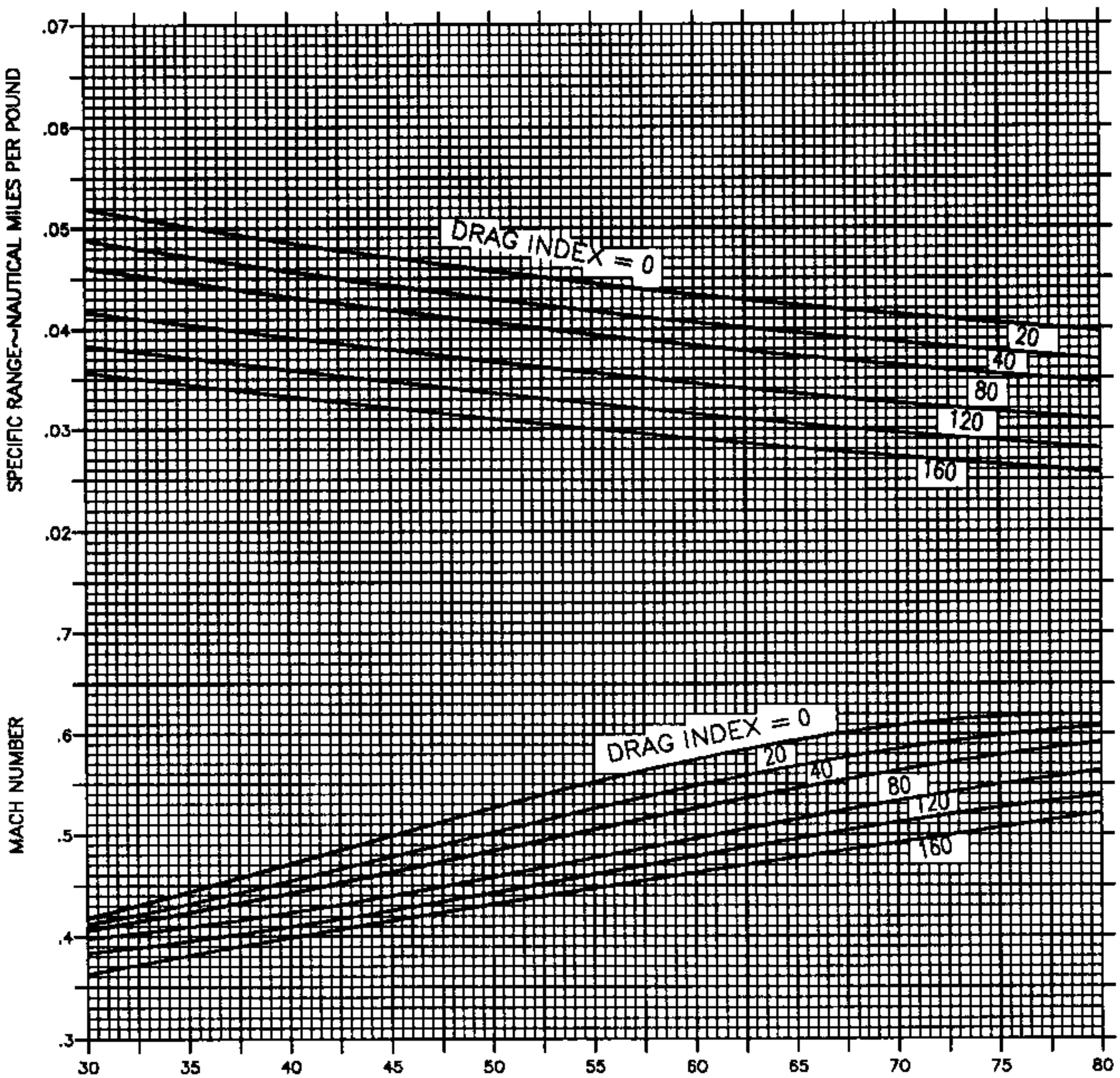
GUIDE



REMARKS
ENGINE(S): (2)F100-PW-229
U.S. STANDARD DAY, 1966

NOTES
DATA IS FOR ALL FREE
AIR TEMPERATURES

DATE: 15 JULY 1991
DATA BASIS: ESTIMATED



15E-1-(286-1)25-CATI

Figure B5-3

CONSTANT ALTITUDE/LONG RANGE CRUISE
5,000 FEET

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

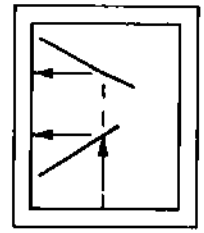
SPECIFIC RANGE, TRUE MACH NUMBER

REMARKS
ENGINE(S): (2)F100-PW-229
U.S. STANDARD DAY, 1966

NOTES
DATA IS FOR ALL FREE
AIR TEMPERATURES

DATE:15 JULY 1991
DATA BASIS: ESTIMATED

GUIDE



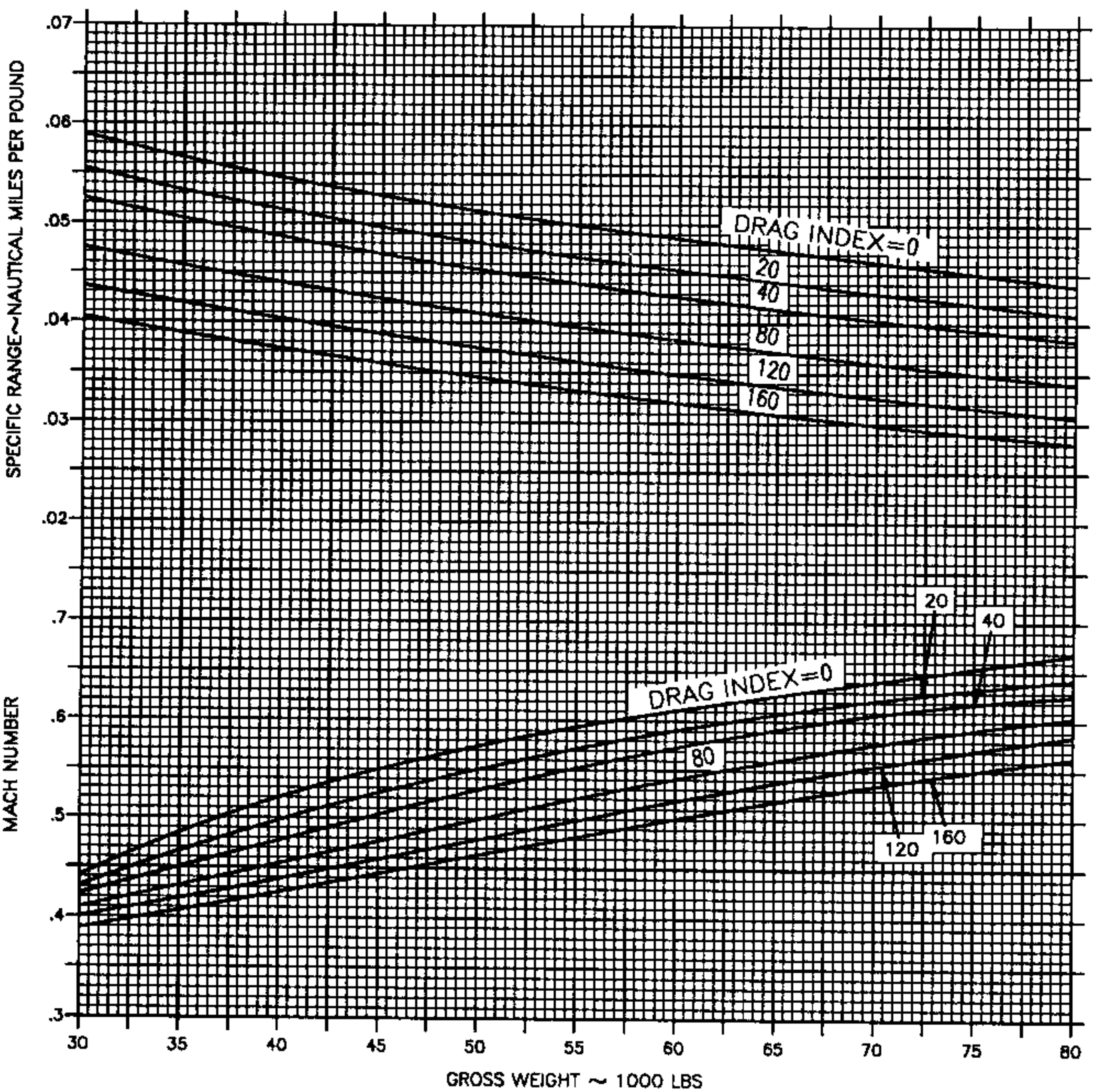


Figure B5-4

CONSTANT ALTITUDE/LONG RANGE CRUISE 10,000 FEET

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

SPECIFIC RANGE, TRUE MACH NUMBER

GUIDE

REMARKS
ENGINE(S): (2)F100-PW-229
U.S. STANDARD DAY, 1966

NOTES
DATA IS FOR ALL FREE
AIR TEMPERATURES

DATE: 15 JULY 1991
DATA BASIS: ESTIMATED

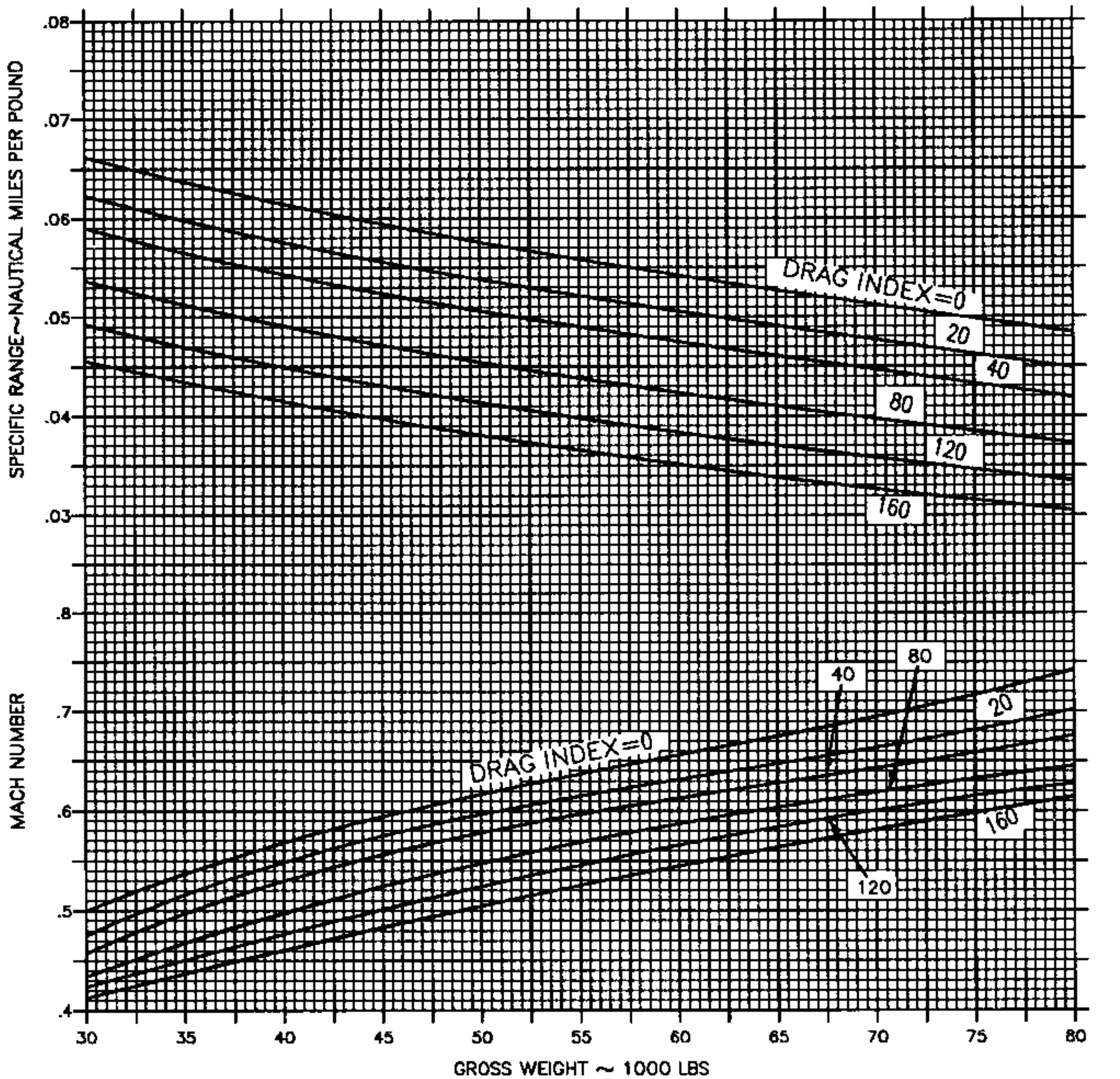


Figure B5-5

CONSTANT ALTITUDE/LONG RANGE CRUISE 15,000 FEET

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

SPECIFIC RANGE, TRUE MACH NUMBER

REMARKS
ENGINE(S): (2)F100-PW-229
U.S. STANDARD DAY, 1966

DATE:15 JULY 1991
DATA BASIS: ESTIMATED

NOTES
DATA IS FOR ALL FREE
AIR TEMPERATURES

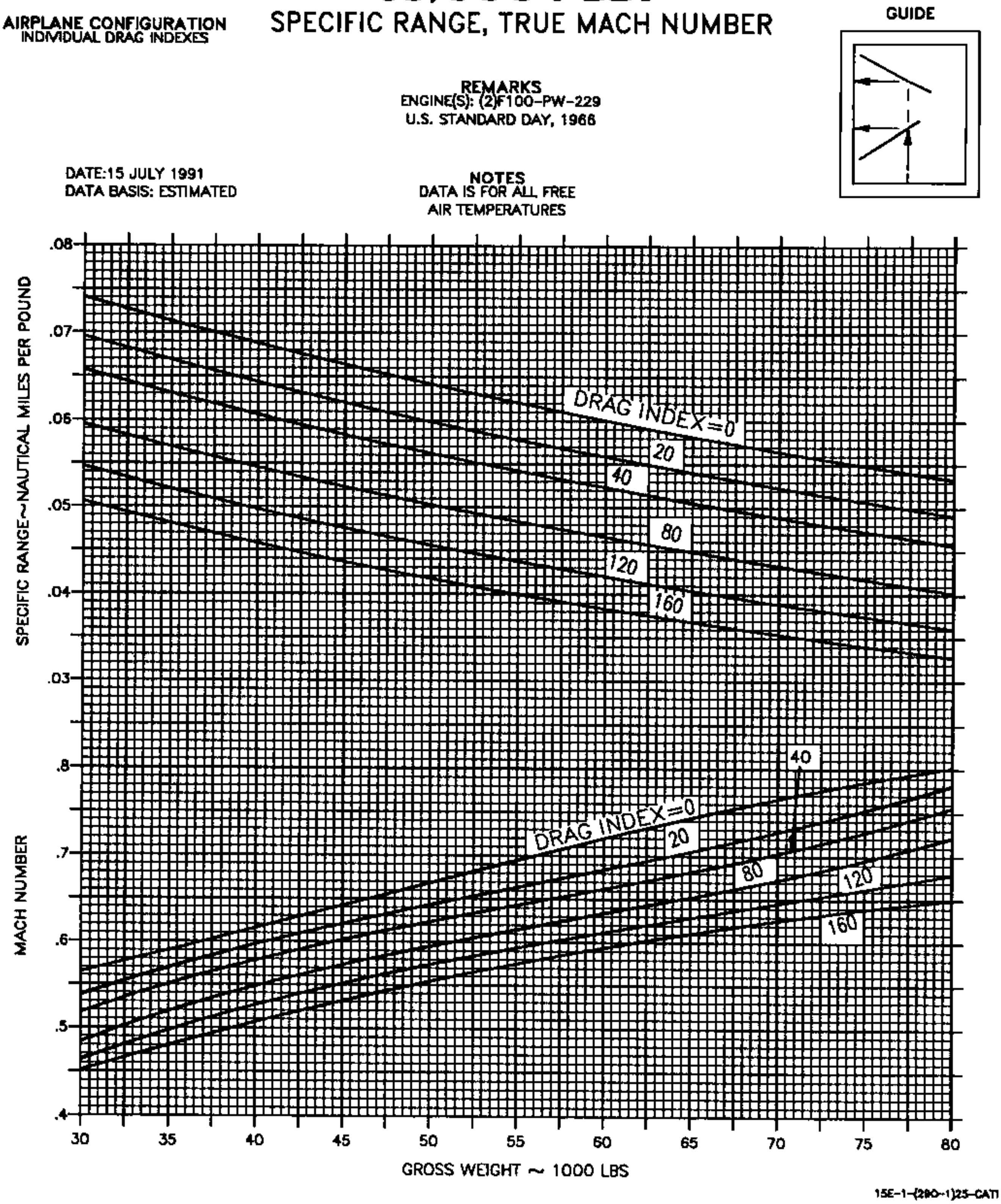


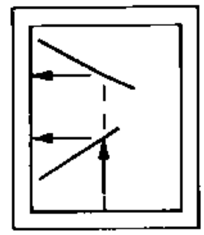
Figure B5-6

CONSTANT ALTITUDE/LONG RANGE CRUISE 20,000 FEET

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

SPECIFIC RANGE, TRUE MACH NUMBER

GUIDE



REMARKS
ENGINE(S): (2)F100-PW-229
U.S. STANDARD DAY, 1966

NOTES
DATA IS FOR ALL FREE AIR TEMPERATURES

DATE:15 JULY 1991
DATA BASIS: ESTIMATED

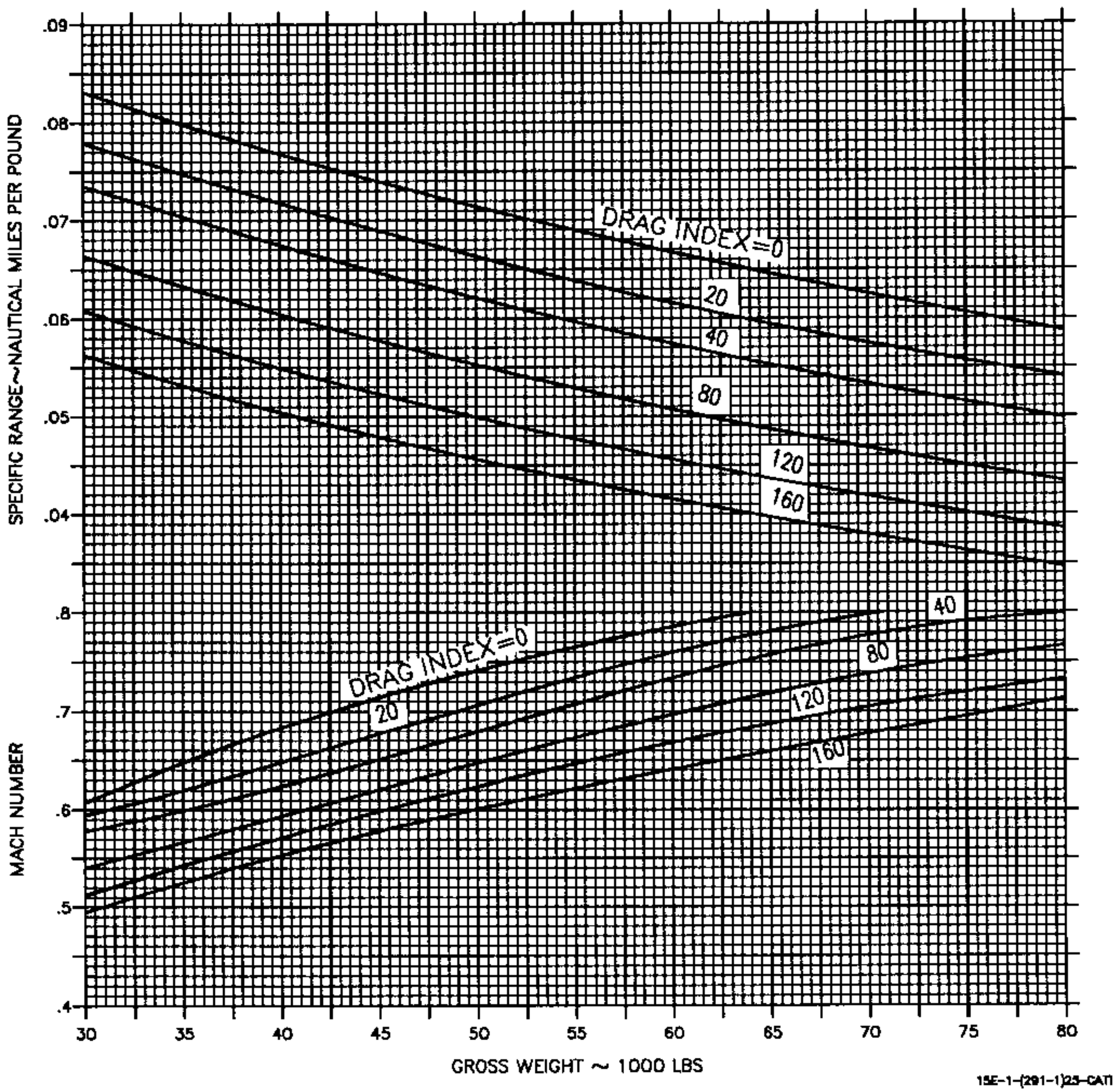


Figure B5-7

CONSTANT ALTITUDE/LONG RANGE CRUISE 25,000 FEET

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

SPECIFIC RANGE, TRUE MACH NUMBER

REMARKS
ENGINE(S): (2)F100-PW-229
U.S. STANDARD DAY, 1966

NOTES
DATA IS FOR ALL FREE AIR TEMPERATURES

DATE:15 JULY 1991
DATA BASIS: ESTIMATED

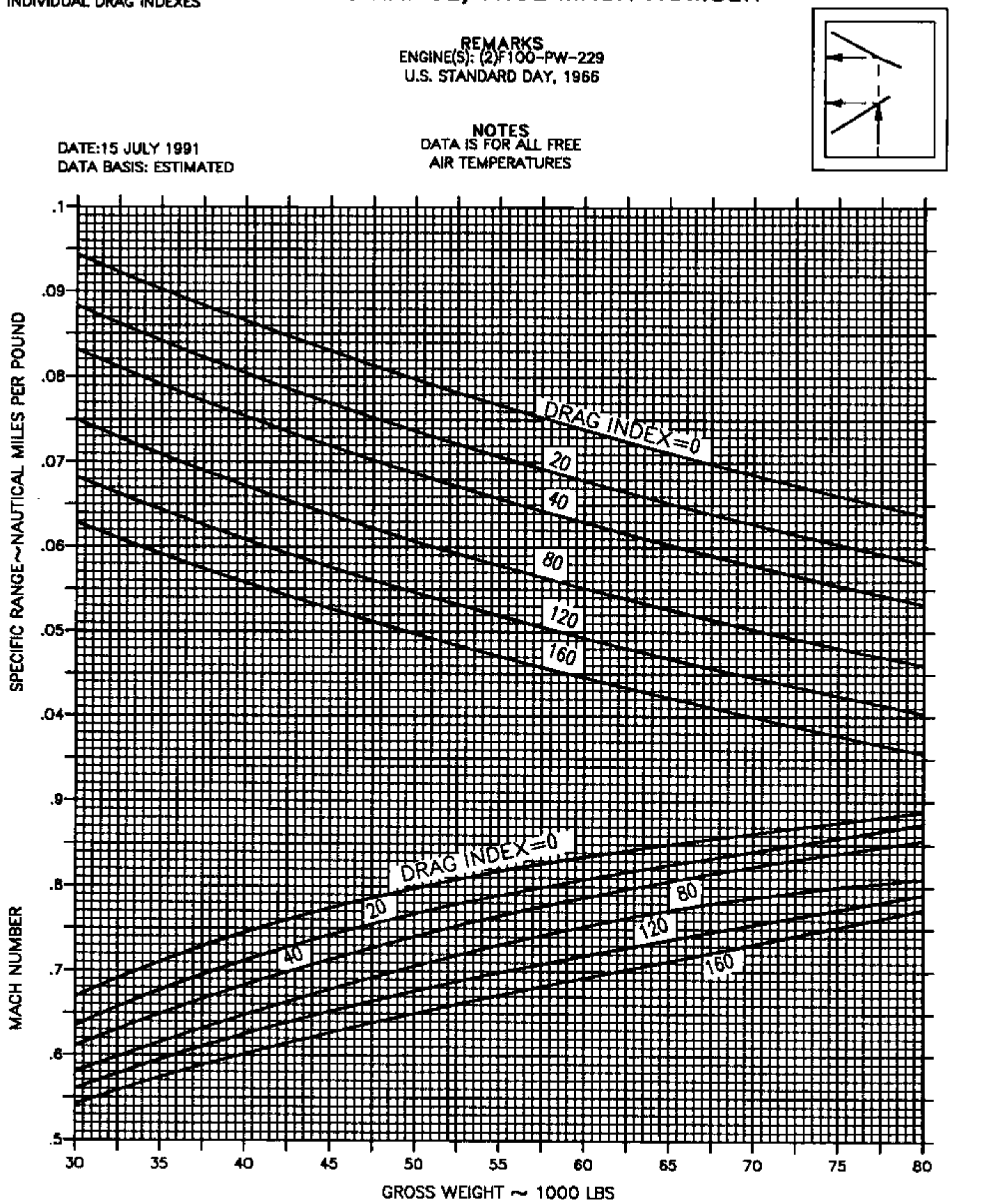


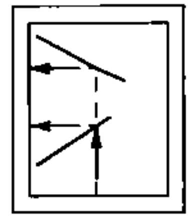
Figure B5-8

CONSTANT ALTITUDE/LONG RANGE CRUISE 30,000 FEET

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

SPECIFIC RANGE, TRUE MACH NUMBER

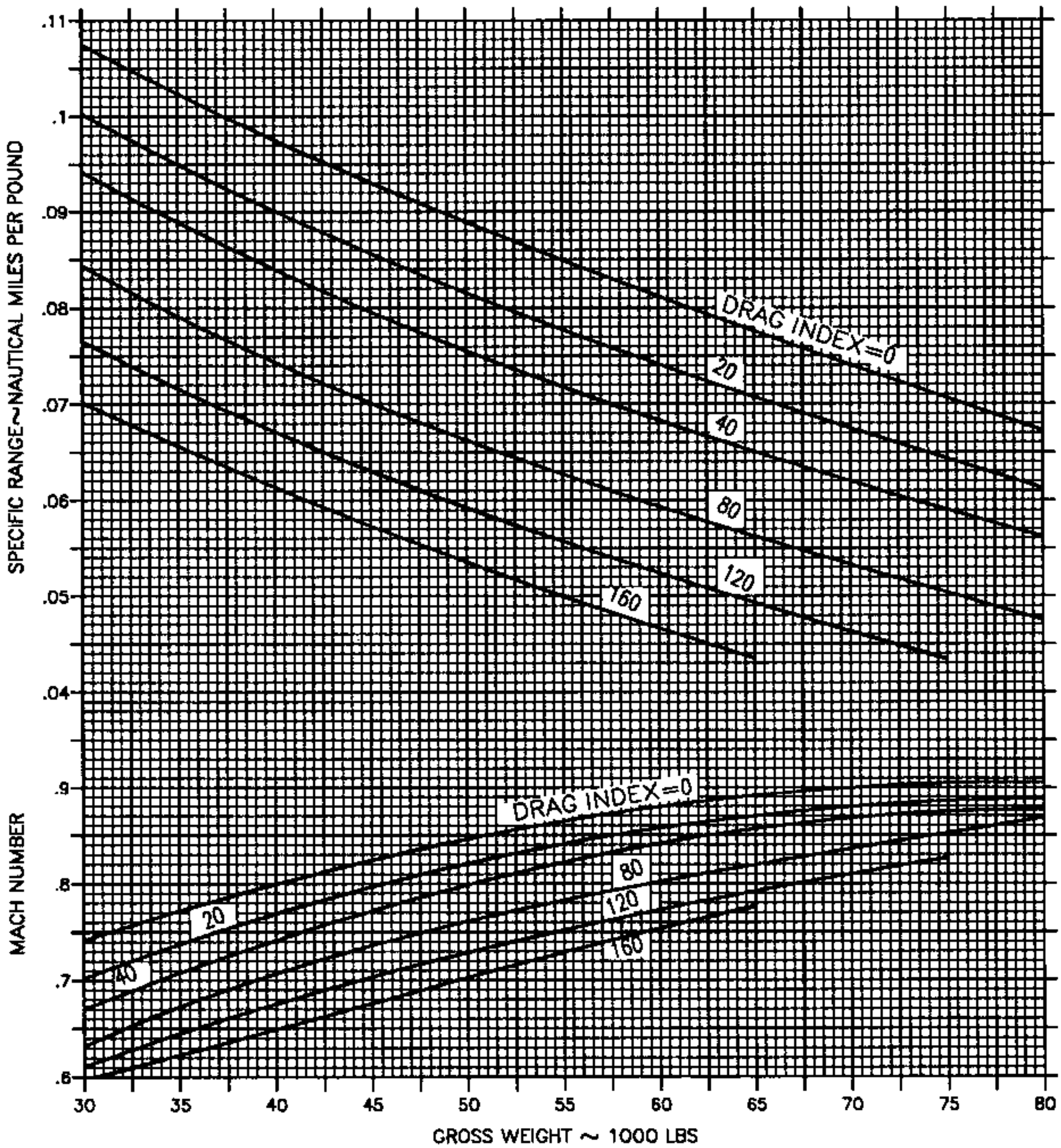
GUIDE



REMARKS
ENGINE(S): (2)F100-PW-229
U.S. STANDARD DAY, 1966

NOTES
DATA IS FOR ALL FREE AIR TEMPERATURES

DATE:15 JULY 1991
DATA BASIS: ESTIMATED



15E-1-(293-1)25-CATI

Figure B5-9

CONSTANT ALTITUDE/LONG RANGE CRUISE
35,000 FEET

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

SPECIFIC RANGE, TRUE MACH NUMBER

REMARKS
ENGINE(S): (2)F100-PW-229
U.S. STANDARD DAY, 1966

NOTES
DATA IS FOR ALL FREE AIR TEMPERATURES

DATE: 15 JULY 1991
DATA BASIS: ESTIMATED

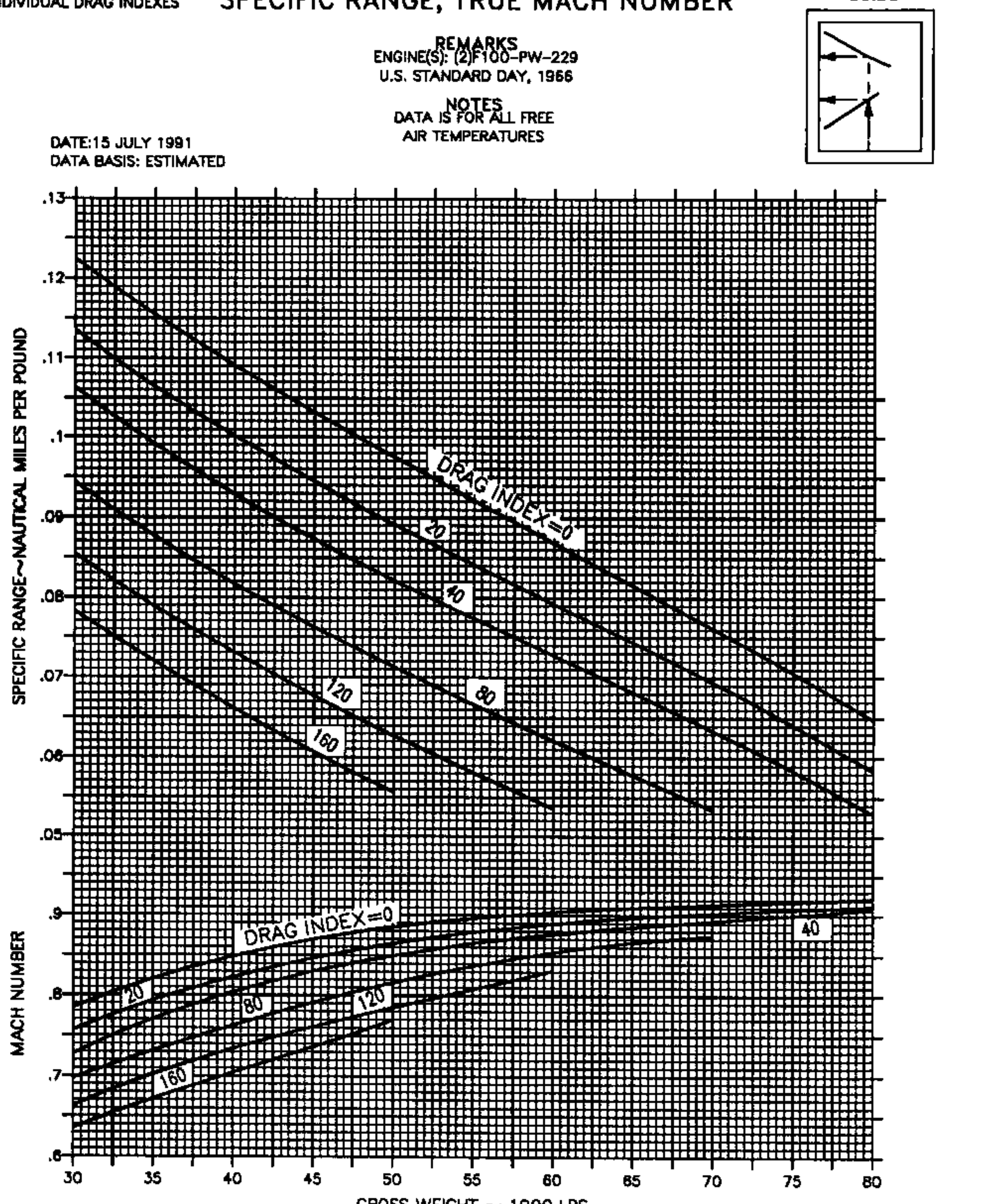


Figure B5-10

CONSTANT ALTITUDE/LONG RANGE CRUISE 40,000 FEET

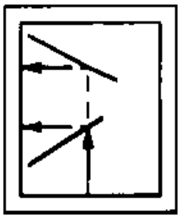
AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

SPECIFIC RANGE, TRUE MACH NUMBER

REMARKS
ENGINE(S): (2)F100-PW-229
U.S. STANDARD DAY, 1966

DATE: 15 JULY 1991
DATA BASIS: ESTIMATED

NOTES
DATA IS FOR ALL FREE AIR TEMPERATURES



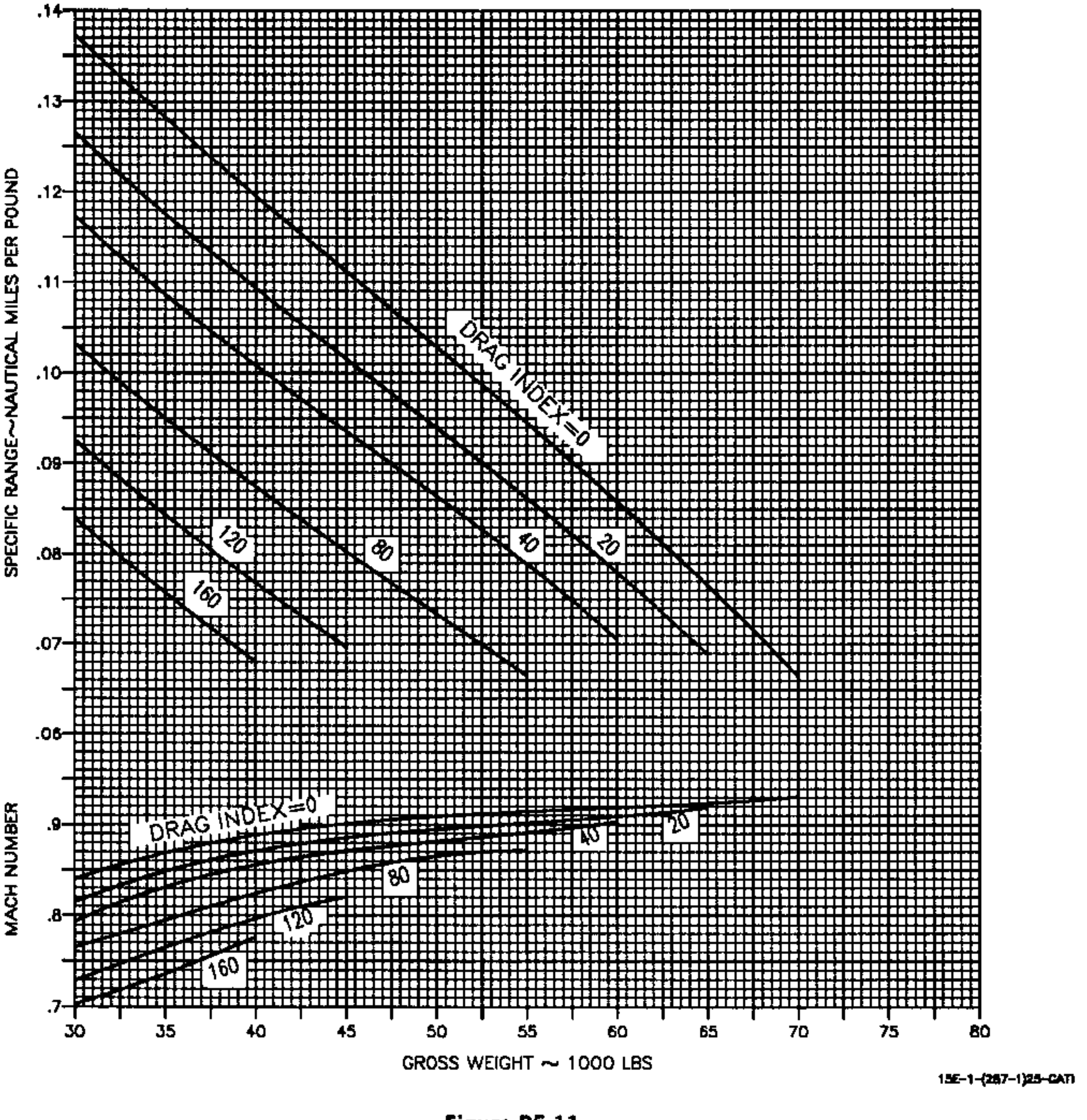


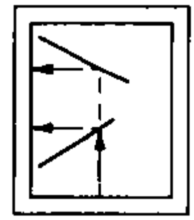
Figure B5-11

CONSTANT ALTITUDE/LONG RANGE CRUISE 45,000 FEET

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

SPECIFIC RANGE, TRUE MACH NUMBER

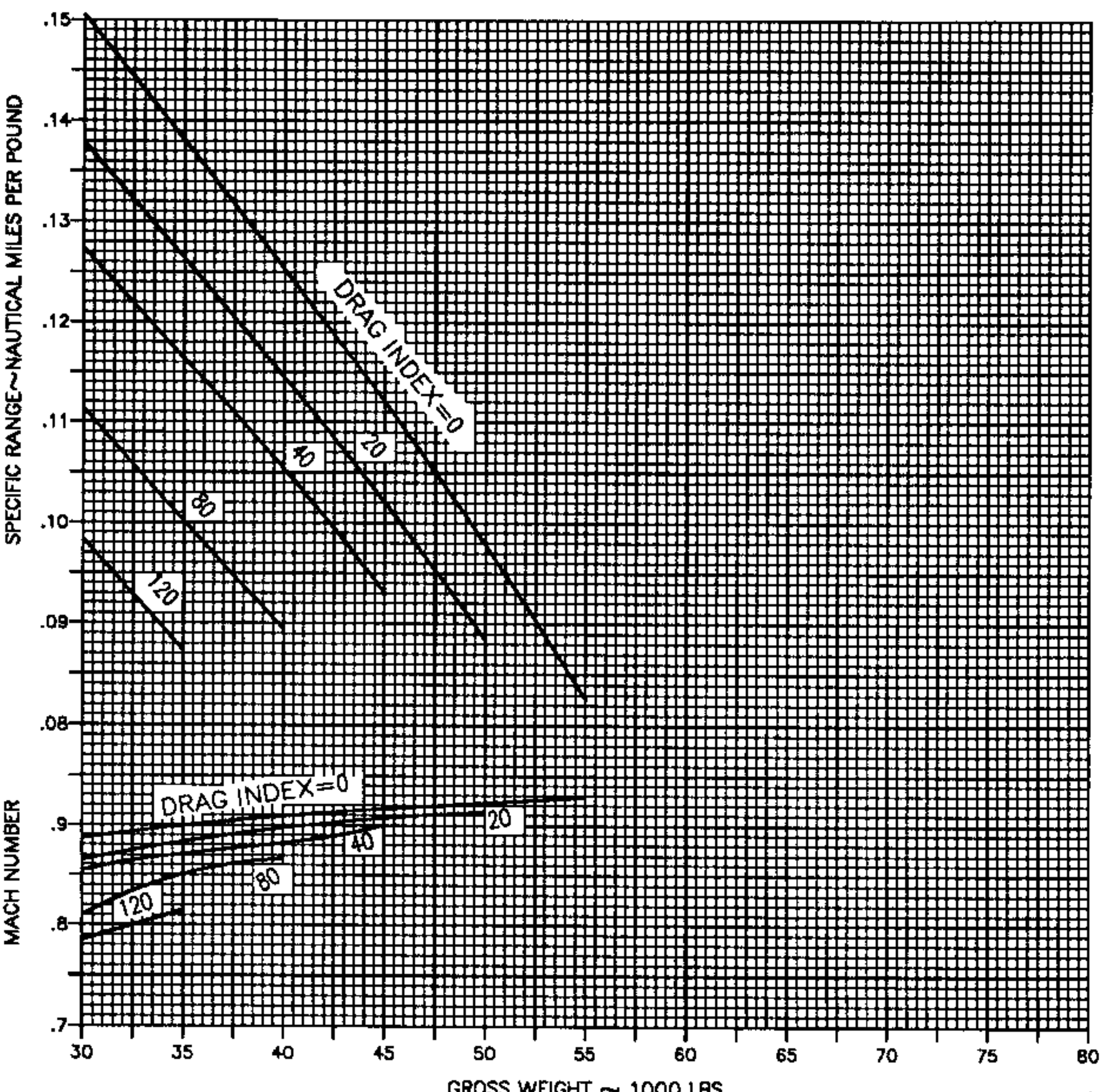
GUIDE



REMARKS
ENGINE(S): (2)F100-PW-229
U.S. STANDARD DAY, 1966

DATE: 15 JULY 1991
DATA BASIS: ESTIMATED

NOTES
DATA IS FOR ALL FREE AIR TEMPERATURES



15E-1-(285-1)25-CATI

Figure B5-12

LOW ALTITUDE CRUISE
GROSS WEIGHT 35,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-229

DATE: 1 JULY 1992
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

	KTAS	DRAG INDEX									ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS		
		0	20	40	60	80	100	120	140	160		CRUISE	MIL	V_{MAX}
SEA LEVEL (15°C)	360	7657	8280	8904	9555	10217	10879	11541	12224	12938	-40	.899	.982	.934
	400	8941	9741	10582	11424	12266	13157	14080	14963	15888	-20	.937	1.003	.957
	440	10515	11571	12626	13732	14865	15997	17200	18410	19636	0	.974	1.023	.981
	480	12253	13569	14980	16391	17881	19392	20978	22619	24295	20	1.009	.984	1.003
	520	14131	15888	17673	19555	21514	23568	25684	27831	29978	40	1.042	.804	1.012
	560	16498	18754	21117	23692	26332	29020	31709	0	0				
	600	19881	23089	26535	30064	33592	0	0	0	0				
	MIL	32942	33285	33695	33749	33778	33569	33181	32785	32419				
	V_{MAX}	659.3	645.5	629.1	613.3	600.6	585.4	568.2	550.6	534.4				

	KTAS	0	20	40	60	80	100	120	140	160	ACTUAL OAT DEG. C	CRUISE	MIL	V_{MAX}
5,000 FEET (5°C)	360	6620	7149	7683	8235	8788	9340	9893	10495	11097	-40	.916	1.137	.948
	400	7704	8397	9101	9806	10530	11296	12061	12827	13638	-20	.954	1.099	.976
	440	9004	9899	10797	11756	12715	13697	14717	15736	16785	0	.991	1.035	.997
	480	10460	11616	12817	14033	15312	16595	17934	19273	20792	20	1.027	.876	1.004
	520	12155	13647	15199	16792	18462	20181	22065	23957	25856	40	1.061	.685	1.002
	560	14173	16158	18226	20378	22757	25151	27548	0	0				
	600	17662	20614	23806	27076	0	0	0	0	0				
	MIL	31784	31672	31215	30660	30310	30015	29842	29693	29548				
	V_{MAX}	662.0	649.2	633.9	614.8	599.9	587.3	573.3	558.4	543.9				

	KTAS	0	20	40	60	80	100	120	140	160	ACTUAL OAT DEG. C	CRUISE	MIL	V_{MAX}
10,000 FEET (-5°C)	360	5739	6185	6642	7102	7562	8022	8510	9010	9510	-40	.932	1.363	1.012
	400	6636	7226	7815	8405	9036	9674	10312	10976	11657	-20	.972	1.153	1.004
	440	7710	8458	9230	10032	10835	11685	12541	13414	14321	0	1.009	.960	1.001
	480	8894	9885	10898	11953	13035	14161	15319	16520	17755	20	1.046	.800	1.006
	520	10375	11649	12992	14377	15843	17347	18884	20593	22303	40	1.081	.649	1.012
	560	12218	13885	15696	17607	19589	21747	23904	26062	0				
	600	15634	18334	21223	24232	27242	0	0	0	0				
	MIL	28410	28196	28023	27818	27813	27755	27691	27534	27220				
	V_{MAX}	659.5	646.3	632.1	601.1	600.1	590.1	579.0	568.4	554.0				

Figure B5-14 (Sheet 1 of 2)

LOW ALTITUDE CRUISE
GROSS WEIGHT 35,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-229

DATE: 1 JULY 1992
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

	KTAS	DRAG INDEX									ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS		
		0	20	40	60	80	100	120	140	160		CRUISE	MIL	V_{MAX}
15,000 FEET (-15°C)	360	5040	5417	5797	6177	6556	6955	7369	7784	8198	-40	.950	1.217	1.013
	400	5759	6250	6740	7249	7780	8311	8854	9420	9987	-20	.990	1.053	1.004
	440	6613	7237	7902	8570	9260	9975	10690	11447	12204	0	1.029	.865	.998
	480	7568	8416	9267	10178	11094	12066	13045	14062	15111	20	1.066	.703	1.001
	520	8831	9926	11072	12276	13513	14802	16192	17635	19098	40	1.101	.538	1.003
	560	10490	11964	13521	15191	16975	18849	20765	22681	0				
	600	13804	16151	18760	0	0	0	0	0	0				
	MIL	26031	25968	25903	24861	24747	24680	24239	23632	23120				
	V_{MAX}	660.9	646.8	632.0	588.2	586.0	584.7	576.0	564.1	550.6				
20,000 FEET (-25°C)	360	4473	4786	5098	5411	5741	6083	6426	6768	7124	-40	.969	1.060	.994
	400	5025	5433	5847	6288	6729	7174	7639	8103	8573	-20	1.010	.960	.998
	440	5694	6234	6792	7352	7941	8529	9150	9783	10431	0	1.049	.790	1.008
	480	6469	7175	7902	8649	9444	10264	11111	11985	12892	20	1.087	.627	1.019
	520	7529	8453	9414	10460	11539	12650	13812	15105	16440	40	1.123	.459	1.030
	560	9102	10441	11880	13395	15026	16808	18630	0	0				
	600	12298	14327	16671	0	0	0	0	0	0				
	MIL	23151	22329	21640	20216	20246	20266	20282	20323	20277				
	V_{MAX}	663.5	641.7	623.4	583.1	576.3	572.0	568.2	559.2	549.5				

Figure B5-14 (Sheet 2)

LOW ALTITUDE CRUISE

GROSS WEIGHT 40,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-229

DATE: 1 JULY 1992
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

	KTAS	DRAG INDEX									ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS		
		0	20	40	60	80	100	120	140	160		CRUISE	MIL	V_{MAX}
SEA LEVEL (15°C)	360	7737	8356	8976	9628	10286	10945	11603	12286	12996	-40	.899	.982	.934
	400	8996	9795	10633	11470	12308	13199	14097	14996	15919	-20	.937	1.003	.957
	440	10546	11598	12649	13753	14881	16009	17208	18414	19634	0	.974	1.023	.981
	480	12279	13591	14998	16404	17890	19396	20977	22612	24282	20	1.009	.984	1.003
	520	14134	15885	17665	19542	21495	23543	25652	27793	29934	40	1.042	.804	1.012
	560	16497	18747	21105	23673	26306	28988	31670	0	0				
	600	19846	23042	26480	30001	33522	0	0	0	0				
	MIL	32936	33275	33684	33749	33777	33574	33186	32791	32425				
	V_{MAX}	659.5	645.9	629.5	613.7	600.8	585.6	568.4	550.9	534.7				
5,000 FEET (5°C)	360	6725	7250	7785	8333	8882	9430	9987	10585	11182	-40	.916	1.137	.948
	400	7779	8471	9172	9873	10598	11359	12120	12884	13891	-20	.954	1.099	.976
	440	9062	9953	10850	11805	12760	13740	14754	15769	16815	0	.991	1.035	.997
	480	10490	11844	12840	14053	15327	16606	17940	19274	20787	20	1.027	.875	1.004
	520	12178	13665	15213	16800	18465	20178	22056	23942	25835	40	1.061	.685	1.002
	560	14173	16152	18215	20360	22732	25119	27509	0	0				
	600	17634	20577	23759	27021	30283	0	0	0	0				
	MIL	31786	31678	31223	30666	30316	30020	29845	29696	29551				
	V_{MAX}	662.2	649.4	634.2	615.1	600.1	587.5	573.5						
10,000 FEET (-5°C)	360	5869	6312	6768	7224	7680	8136	8630	9126	9622	-40	.932	1.363	1.012
	400	6735	7320	7905	8491	9124	9758	10392	11057	11733	-20	.972	1.153	1.004
	440	7781	8525	9297	10095	10893	11742	12593	13464	14367	0	1.009	.960	1.001
	480	8948	9937	10946	11999	13076	14200	15353	16549	17779	20	1.046	.800	1.006
	520	10405	11675	13014	14396	15856	17355	18886	20589	22293	40	1.081	.849	1.012
	560	12243	13905	15712	17617	19593	21743	23894	26044	0				
	600	15602	18292	21170	24171	27172	0	0	0	0				
	MIL	28412	28199	28024	27819	27813	27756	27692	27538	27223				
	V_{MAX}	659.6	646.5	632.3	601.2	600.1	590.4	579.2	568.6	554.1				

Figure B5-15 (Sheet 1 of 2)

LOW ALTITUDE CRUISE
GROSS WEIGHT 40,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-229

DATE: 1 JULY 1992
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

	KTAS	DRAG INDEX 0	20	40	60	80	100	120	140	160
15,000 FEET (-15°C)	360	5202	5577	5954	6330	6706	7114	7524	7934	8344
	400	5882	6368	6854	7369	7895	8422	8969	9530	10092
	440	6704	7326	7990	8655	9345	10055	10770	11522	12274
	480	7638	8482	9333	10239	11154	12121	13096	14108	15158
	520	8888	9980	11121	12323	13557	14840	16228	17664	19120
	560	10516	11986	13536	15202	16980	18846	20755	22664	0
	600	13813	16152	18755	0	0	0	0	0	0
	MIL	26031	25969	25904	24861	24747	24681	24245	23640	23125
	V_{MAX}	661.1	647.0	632.2	588.2	586.0	584.7	576.1	564.2	550.7

ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS CRUISE	MIL	V_{MAX}
-40	.950	1.217	1.013
-20	.990	1.053	1.004
0	1.029	.865	.998
20	1.066	.703	1.001
40	1.101	.538	1.003

	KTAS	DRAG INDEX 0	20	40	60	80	100	120	140	160
20,000 FEET (-25°C)	360	4673	4982	5290	5605	5943	6281	6619	6962	7319
	400	5177	5581	6003	6440	6876	7325	7785	8245	8718
	440	5812	6355	6908	7470	8054	8638	9263	9891	10539
	480	6563	7264	7992	8734	9532	10346	11191	12042	12967
	520	7600	8523	9486	10526	11602	12711	13867	15160	16490
	560	9155	10493	11928	13438	15067	16843	18657	0	0
	600	12304	14323	16667	0	0	0	0	0	0
	MIL	23152	22321	21636	20216	20247	20266	20283	20323	20273
	V_{MAX}	663.5	641.5	623.3	583.1	576.2	572.0	568.2	559.1	549.4

ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS CRUISE	MIL	V_{MAX}
-40	.969	1.060	.994
-20	1.010	.960	.998
0	1.049	.790	1.008
20	1.087	.627	1.019
40	1.123	.459	1.030

Figure B5-15 (Sheet 2)

LOW ALTITUDE CRUISE

GROSS WEIGHT 45,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-229

DATE: 1 JULY 1992
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

	KTAS	DRAG INDEX									ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS		
		0	20	40	60	80	100	120	140	160		CRUISE	MIL	V_{MAX}
SEA LEVEL (15°C)	360	7840	8456	9072	9726	10380	11034	11668	12374	13079	-40	.899	.982	.934
	400	9067	9868	10701	11535	12368	13259	14153	15047	15968	-20	.937	1.003	.957
	440	10603	11650	12697	13800	14923	16047	17244	18444	19682	0	.974	1.023	.981
	480	12310	13620	15022	16424	17906	19407	20984	22614	24279	20	1.009	.984	1.003
	520	14153	15899	17674	19546	21493	23535	25638	27773	29908	40	1.042	.804	1.012
	560	16497	18742	21094	23654	26280	28956	31632	0	0				
	600	19829	23017	26447	29961	33474	0	0	0	0				
	MIL	32930	33266	33676	33748	33777	33578	33191	32797	32432				
	V_{MAX}	659.8	646.3	629.8	613.9	601.1	585.8	568.6	551.2	535.0				
5,000 FEET (5°C)	360	6852	7373	7909	8453	8998	9543	10105	10698	11291	-40	.916	1.137	.948
	400	7869	8562	9258	9955	10682	11439	12196	12959	13762	-20	.954	1.099	.976
	440	9128	10015	10912	11862	12812	13791	14801	15811	16853	0	.991	1.035	.997
	480	10541	11693	12884	14095	15363	16639	17968	19297	20807	20	1.027	.875	1.004
	520	12209	13691	15236	16818	18479	20187	22059	23939	25826	40	1.061	.685	1.002
	560	14192	16166	18223	20362	22727	25107	27490	0	0				
	600	17606	20540	23711	26965	30220	0	0	0	0				
	MIL	31787	31681	31231	30673	30322	30025	29847	29697	29552				
	V_{MAX}	662.4	649.5	634.5	615.4	600.4	587.7	573.7	558.8	544.3				
10,000 FEET (-5°C)	360	6024	6468	6920	7372	7824	8287	8778	9270	9761	-40	.932	1.363	1.012
	400	6853	7434	8016	8606	9235	9864	10493	11161	11832	-20	.972	1.153	1.004
	440	7866	8605	9379	10172	10968	11814	12661	13531	14429	0	1.009	.960	1.001
	480	9008	9997	11001	12052	13125	14246	15393	16587	17811	20	1.046	.800	1.006
	520	10456	11720	13057	14436	15891	17385	18913	20610	22307	40	1.081	.649	1.012
	560	12276	13932	15737	17637	19608	21751	23895	26039	0				
	600	15605	18287	21156	24148	27140	0	0	0	0				
	MIL	28414	28201	28025	27819	27813	27757	27693	27539	27225				
	V_{MAX}	659.7	646.6	632.5	601.2	600.2	590.5	579.3	568.6	554.2				

Figure B5-16 (Sheet 1 of 2)

LOW ALTITUDE CRUISE

GROSS WEIGHT 45,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-229

DATE: 1 JULY 1992
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

	KTAS	DRAG INDEX								
		0	20	40	60	80	100	120	140	160
15,000 FEET (-15°C)	360	5395	5767	6139	6512	6898	7304	7710	8116	8531
	400	6028	6511	6994	7515	8037	8560	9111	9668	10225
	440	6813	7439	8099	8758	9451	10157	10872	11619	12367
	480	7725	8564	9417	10318	11233	12194	13168	14175	15228
	520	8851	10042	11178	12378	13608	14885	16272	17702	19151
	560	10567	12033	13578	15239	17014	18874	20775	22677	0
	600	13825	16157	18754	0	0	0	0	0	0
	MIL	26032	25969	25904	24862	24747	24681	24248	23638	23117
	V_{MAX}	661.1	646.9	632.1	588.2	586.0	584.7	576.2	564.2	550.5
20,000 FEET (-25°C)	360	4909	5215	5521	5855	6190	6525	6860	7213	7566
	400	5360	5761	6192	6624	7056	7510	7966	8421	8898
	440	5954	6501	7050	7615	8194	8780	9403	10026	10678
	480	6677	7374	8102	8839	9642	10452	11295	12150	13069
	520	7687	8609	9576	10611	11685	12793	13942	15239	16564
	560	9217	10555	11988	13493	15120	16889	18694	0	0
	600	12375	14391	16740	0	0	0	0	0	0
	MIL	23144	22312	21627	20216	20247	20266	20283	20324	20265
	V_{MAX}	663.3	641.2	623.0	582.9	576.2	571.9	568.1	559.0	549.0

	ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS		
		CRUISE	MIL	V_{MAX}
15,000 FEET (-15°C)	-40	.950	1.217	1.013
	-20	.990	1.053	1.004
	0	1.029	.865	.998
	20	1.066	.703	1.001
	40	1.101	.538	1.003
20,000 FEET (-25°C)	-40	.969	1.060	.994
	-20	1.010	.960	.998
	0	1.049	.790	1.008
	20	1.087	.627	1.019
	40	1.123	.459	1.030

Figure B5-16 (Sheet 2)

LOW ALTITUDE CRUISE
GROSS WEIGHT 50,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-229

DATE: 1 JULY 1992
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

	KTAS	DRAG INDEX								
		0	20	40	60	80	100	120	140	160
SEA LEVEL (15°C)	360	7960	8572	9191	9841	10491	11141	11791	12480	13181
	400	9148	9950	10779	11609	12440	13330	14220	15110	16030
	440	10662	11705	12748	13849	14969	16088	17283	18479	19694
	480	12352	13660	15057	16454	17934	19429	21003	22627	24287
	520	14185	15926	17698	19565	21508	23544	25641	27771	29900
	560	16504	18743	21089	23643	26261	28930	31599	0	0
	600	19813	22992	26414	29920	33427	0	0	0	0
	MIL	32927	33261	33670	33748	33777	33582	33196	32801	32433
	V_{MAX}	659.9	646.5	630.1	614.1	601.1	585.9	568.9	551.3	535.0

ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS		
	CRUISE	MIL	V_{MAX}
-40	.899	.982	.934
-20	.937	1.003	.957
0	.974	1.023	.981
20	1.009	.984	1.003
40	1.042	.804	1.012

	KTAS	0	20	40	60	80	100	120	140	160
5,000 FEET (5°C)	360	7000	7517	8055	8596	9136	9677	10247	10836	11425
	400	7976	8668	9361	10054	10785	11538	12291	13055	13853
	440	9213	10096	10994	11940	12888	13864	14869	15875	16914
	480	10599	11750	12937	14146	15409	16682	18006	19330	20839
	520	12249	13726	15268	16844	18501	20206	22071	23944	25826
	560	14224	16195	18247	20381	22741	25114	27491	0	0
	600	17593	20519	23679	26925	30171	0	0	0	0
	MIL	31788	31684	31238	30680	30326	30027	29847	29698	29553
	V_{MAX}	662.5	649.7	634.7	615.6	600.6	587.8	573.8	558.8	544.4

ACTUAL OAT DEG. C	CRUISE	MIL	V_{MAX}
-40	.916	1.137	.948
-20	.954	1.099	.976
0	.991	1.035	.997
20	1.027	.875	1.004
40	1.061	.685.	1.002

	KTAS	0	20	40	60	80	100	120	140	160
10,000 FEET (-5°C)	360	6204	6649	7097	7545	7994	8467	8954	9441	9929
	400	6991	7566	8146	8742	9367	9992	10621	11287	11954
	440	7974	8709	9487	10276	11074	11916	12758	13629	14522
	480	9091	10081	11080	12133	13200	14321	15464	16657	17875
	520	10516	11778	13110	14489	15937	17428	18955	20645	22336
	560	12320	13971	15775	17669	19635	21772	23908	26044	0
	600	15622	18297	21158	24142	27126	0	0	0	0
	MIL	28416	28202	28025	27819	27813	27757	27693	27540	27224
	V_{MAX}	659.8	646.7	632.5	601.2	600.2	590.5	579.4	568.7	554.2

ACTUAL OAT DEG. C	CRUISE	MIL	V_{MAX}
-40	.932	1.363.	1.012
-20	.972	1.153	1.004
0	1.009	.960	1.001
20	1.046	.800	1.006
40	1.081	.649	1.012

Figure B5-17 (Sheet 1 of 2)

LOW ALTITUDE CRUISE

GROSS WEIGHT 50,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-229

DATE: 1 JULY 1992
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

	KTAS	DRAG INDEX								
		0	20	40	60	80	100	120	140	160
15,000 FEET (-15°C)	360	5618	5986	6354	6723	7124	7525	7927	8329	8753
	400	6201	6679	7170	7688	8206	8729	9281	9833	10386
	440	6946	7577	8232	8888	9585	10286	11004	11747	12489
	480	7838	8673	9528	10424	11341	12297	13270	14271	15332
	520	9039	10131	11262	12462	13691	14963	16352	17777	19220
	560	10624	12088	13627	15286	17058	18913	20807	22701	0
	600	13866	16192	18786	0	0	0	0	0	0
	MIL	26031	25968	25903	24860	24746	24680	24242	23630	23107
	V_{MAX}	661.0	646.8	632.0	588.2	586.0	584.7	576.1	564.0	550.2

ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS		
	CRUISE	MIL	V_{MAX}
-40	.950	1.217	1.013
-20	.990	1.053	1.004
0	1.029	.865	.998
20	1.066	.703	1.001
40	1.101	.538	1.003

	KTAS	0	20	40	60	80	100	120	140	160
20,000 FEET (-25°C)	360	5177	5482	5812	6147	6482	6816	7167	7520	7873
	400	5572	5984	6412	6839	7277	7728	8179	8638	9113
	440	6128	6672	7216	7786	8361	8954	9572	10191	10846
	480	6817	7509	8241	8980	9784	10595	11432	12293	13206
	520	7801	8724	9698	10727	11800	12909	14058	15356	16677
	560	9301	10640	12071	13574	15205	16968	18765	0	0
	600	12448	14459	16813	0	0	0	0	0	0
	MIL	23130	22291	21608	20217	20248	20266	20285	20325	20252
	V_{MAX}	662.9	640.6	622.5	582.8	576.0	571.8	567.7	558.7	548.5

ACTUAL OAT DEG. C	CRUISE	MIL	V_{MAX}
-40	.969	1.060	.994
-20	1.010	.960	.998
0	1.049	.790	1.008
20	1.087	.627	1.019
40	1.123	.459	1.030

Figure B5-17 (Sheet 2)

LOW ALTITUDE CRUISE

GROSS WEIGHT 55,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-229

DATE: 1 JULY 1992
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

	KTAS	DRAG INDEX									ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS		
		0	20	40	60	80	100	120	140	160		CRUISE	MIL	V_{MAX}
SEA LEVEL (15°C)	360	8097	8705	9328	9973	10619	11265	11911	12605	13301	-40	.899	.982	.934
	400	9254	10060	10885	11710	12544	13429	14314	15200	16122	-20	.937	1.003	.957
	440	10746	11784	12823	13925	15040	16158	17349	18540	19755	0	.974	1.023	.981
	480	12410	13718	15111	16503	17981	19472	21044	22663	24319	20	1.009	.984	1.003
	520	14217	15953	17722	19584	21523	23554	25645	27769	29892	40	1.042	.804	1.012
	560	16534	18770	21111	23660	26274	28936	31599	0	0				
	600	19796	22967	26381	29880	33379	0	0	0	0				
	MIL	32925	33255	33665	33747	33776	33585	33197	32802	32435				
	V_{MAX}	660.0	646.7	630.3	614.3	601.3	586.1	568.9	551.4	535.1				
5,000 FEET (5°C)	360	7169	7687	8224	8760	9297	9833	10413	10997	11582	-40	.916	1.137	.948
	400	8112	8800	9489	10177	10915	11663	12411	13178	13972	-20	.954	1.099	.976
	440	9313	10192	11092	12033	12975	13954	14954	15954	16992	0	.991	1.035	.997
	480	10678	11826	13008	14216	15475	16745	18063	19389	20893	20	1.027	.875	1.004
	520	12309	13782	15322	16894	18548	20252	22112	23979	25854	40	1.061	.685	1.002
	560	14256	16223	18272	20399	22755	25122	27492	0	0				
	600	17610	20529	23683	26921	30159	0	0	0	0				
	MIL	31789	31688	31243	30682	30327	30028	29847	29698	29553				
	V_{MAX}	662.6	649.8	634.9	615.7	600.6	587.8	573.8	558.9	544.4				
10,000 FEET (-5°C)	360	6413	6857	7301	7745	8192	8675	9158	9641	10124	-40	.932	1.363	1.012
	400	7152	7725	8299	8903	9524	10145	10780	11442	12104	-20	.972	1.153	1.004
	440	8098	8829	9611	10395	11197	12034	12871	13744	14631	0	1.009	.960	1.001
	480	9185	10176	11170	12223	13286	14408	15544	16737	17949	20	1.046	.800	1.006
	520	10594	11855	13182	14561	16004	17490	19018	20702	22386	40	1.081	.649	1.012
	560	12384	14030	15835	17725	19691	21820	23950	26079	0				
	600	15639	18308	21161	24136	27112	0	0	0	0				
	MIL	28414	28201	28025	27819	27813	27757	27693	27538	27220				
	V_{MAX}	659.8	646.6	632.5	601.2	600.2	590.6	579.4	568.6	554.0				

Figure B5-18 (Sheet 1 of 2)

LOW ALTITUDE CRUISE

GROSS WEIGHT 55,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-229

DATE: 1 JULY 1992
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

	KTAS	DRAG INDEX									ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS		
		0	20	40	60	80	100	120	140	160		CRUISE	MIL	V_{MAX}
15,000 FEET (-15°C)	360	5869	6236	6603	6992	7392	7793	8193	8607	9032	-40	.950	1.217	1.013
	400	6396	6870	7373	7887	8400	8931	9479	10027	10583	-20	.990	1.053	1.004
	440	7100	7738	8389	9047	9743	10439	11161	11899	12640	0	1.029	.865	.998
	480	7965	8795	9654	10545	11465	12415	13388	14383	15454	20	1.066	.703	1.001
	520	9138	10232	11357	12557	13786	15051	16444	17863	19299	40	1.101	.538	1.003
	560	10704	12166	13701	15357	17127	18978	20864	22751	0				
	600	13927	16249	18842	0	0	0	0	0	0				
	MIL	26030	25968	25902	24858	24745	24680	24234	23614	23085				
	V_{MAX}	660.8	646.7	631.8	588.2	586.0	584.7	575.9	563.7	549.6				
20,000 FEET (-25°C)	360	5480	5808	6143	6477	6811	7161	7513	7865	8216	-40	.989	1.060	.994
	400	5815	6239	6664	7089	7537	7984	8432	8901	9372	-20	1.010	.960	.998
	440	6329	6868	7414	7984	8554	9157	9770	10395	11045	0	1.049	.790	1.008
	480	6978	7674	8401	9151	9949	10761	11592	12462	13369	20	1.087	.627	1.019
	520	7932	8852	9835	10863	11930	13041	14201	15491	16809	40	1.123	.459	1.030
	560	9399	10743	12172	13673	15308	17066	18854	0	0				
	600	12587	14600	16967	0	0	0	0	0	0				
	MIL	23096	22267	21585	20218	20248	20267	20287	20327	20233				
	V_{MAX}	662.0	640.0	621.9	582.5	575.9	571.7	567.3	558.3	547.7				

Figure B5-18 (Sheet 2)

LOW ALTITUDE CRUISE

GROSS WEIGHT 60,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-229

DATE: 1 JULY 1992
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

	KTAS	DRAG INDEX									ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS		
		0	20	40	60	80	100	120	140	160		CRUISE	MIL	V_{MAX}
SEA LEVEL (15°C)	360	8254	8858	9487	10129	10770	11413	12063	12755	13448	-40	.889	.982	.934
	400	9369	10179	10999	11821	12658	13538	14419	15300	16224	-20	.937	1.003	.957
	440	10832	11866	12901	14005	15115	16233	17419	18606	19821	0	.974	1.023	.981
	480	12469	13777	15164	16552	18029	19515	21085	22699	24351	20	1.009	.984	1.003
	520	14271	16002	17769	19625	21562	23587	25674	27791	29908	40	1.042	.804	1.012
	560	16565	18798	21133	23678	26286	28942	31599	0	0				
	600	19810	22975	26381	29873	33364	0	0	0	0				
	MIL	32922	33250	33659	33747	33776	33585	33197	32802	32436				
	V_{MAX}	660.1	646.9	630.5	614.5	601.3	586.1	568.9	551.4	535.2				
5,000 FEET (5°C)	360	7359	7882	8414	8946	9479	10022	10602	11182	11762	-40	.916	1.137	.948
	400	8263	8947	9632	10318	11061	11805	12548	13319	14107	-20	.954	1.099	.976
	440	9425	10299	11203	12140	13077	14058	15053	16050	17086	0	.991	1.035	.997
	480	10762	11912	13089	14298	15552	16821	18134	19464	20962	20	1.027	.875	1.004
	520	12370	13838	15377	16943	18594	20298	22152	24014	25883	40	1.061	.685	1.002
	560	14312	16277	18323	20444	22797	25157	27520	0	0				
	600	17627	20540	23687	26917	30147	0	0	0	0				
	MIL	31790	31688	31244	30683	30329	30029	29847	29697	29551				
	V_{MAX}	662.7	649.8	634.9	615.8	600.7	587.9	573.8	558.7	544.2				
10,000 FEET (-5°C)	360	6650	7090	7530	7970	8433	8911	9390	9869	10357	-40	.932	1.363	1.012
	400	7336	7906	8475	9090	9706	10322	10965	11622	12279	-20	.972	1.153	1.004
	440	8236	8970	9749	10529	11334	12167	12999	13874	14757	0	1.009	.960	1.001
	480	9299	10288	11279	12334	13392	14516	15648	16842	18049	20	1.046	.800	1.006
	520	10684	11945	13267	14648	16085	17569	19100	20778	22455	40	1.081	.649	1.012
	560	12449	14090	15896	17782	19747	21869	23991	26114	0				
	600	15698	18361	21208	24174	27141	0	0	0	0				
	MIL	28413	28200	28025	27819	27813	27757	27692	27536	27215				
	V_{MAX}	659.6	646.6	632.4	601.2	600.2	590.4	579.2	568.5	553.8				

Figure B5-19 (Sheet 1 of 2)

LOW ALTITUDE CRUISE
GROSS WEIGHT 60,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-229

DATE: 1 JULY 1992
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

	KTAS	DRAG INDEX 0	20	40	60	80	100	120	140	160	ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS CRUISE	MIL	V_{MAX}
15,000 FEET (-15°C)	360	6151	6517	6898	7297	7697	8096	8504	8929	9354	-40	.950	1.217	1.013
	400	6616	7093	7602	8111	8621	9162	9705	10248	10811	-20	.990	1.053	1.004
	440	7274	7919	8566	9231	9922	10614	11341	12074	12820	0	1.029	.865	.998
	480	8108	8934	9798	10684	11608	12553	13527	14517	15601	20	1.066	.703	1.001
	520	9255	10352	11478	12674	13903	15162	16582	17977	19407	40	1.101	.538	1.003
	560	10791	12253	13788	15438	17208	19058	20935	22814	0				
	600	13998	16316	18908	0	0	0	0	0	0				
	MIL	26029	25968	25901	24858	24744	24679	24218	23598	23059				
	V_{MAX}	660.5	646.2	631.5	588.1	585.9	584.6	575.6	563.2	548.9				

	KTAS	0	20	40	60	80	100	120	140	160	ACTUAL OAT DEG. C	CRUISE	MIL	V_{MAX}
20,000 FEET (-25°C)	360	5855	6189	6522	6856	7207	7559	7911	8263	8628	-40	.969	1.060	.994
	400	6101	6527	6953	7394	7843	8291	8754	9226	9698	-20	1.010	.960	.998
	440	6554	7069	7642	8207	8779	9387	9995	10628	11273	0	1.049	.790	1.008
	480	7158	7859	8582	9343	10136	10950	11776	12656	13557	20	1.087	.627	1.019
	520	8079	8995	9987	11016	12077	13192	14365	15649	16965	40	1.123	.459	1.030
	560	9510	10858	12287	13788	15430	17183	18963	0	0				
	600	12728	14743	17122	0	0	0	0	0	0				
	MIL	23060	22230	21549	20220	20249	20268	20289	20329	20210				
	V_{MAX}	661.0	639.0	621.0	582.2	575.6	571.5	566.8	557.9	546.7				

Figure B5-19 (Sheet 2)

LOW ALTITUDE CRUISE

GROSS WEIGHT 65,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-229

DATE: 1 JULY 1992
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

	KTAS	DRAG INDEX									ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS		
		0	20	40	60	80	100	120	140	160		CRUISE	MIL	V_{MAX}
SEA LEVEL (15°C)	360	8433	9033	9668	10306	10944	11581	12241	12928	13616	-40	.899	.982	.934
	400	9500	10316	11133	11950	12792	13669	14546	15422	16349	-20	.937	1.003	.957
	440	10943	11973	13004	14109	15215	16335	17516	18697	19915	0	.974	1.023	.981
	480	12556	13865	15247	16630	18107	19587	21158	22766	24417	20	1.009	.984	1.003
	520	14333	16060	17825	19676	21612	23631	25714	27825	29937	40	1.042	.804	1.012
	560	16596	18825	21155	23697	26299	28949	31599	0	0				
	600	19833	22993	26393	29877	33361	0	0	0	0				
	MIL	32920	33245	33656	33747	33776	33584	33197	32802	32432				
	V_{MAX}	660.2	647.1	630.6	614.5	601.3	586.1	568.9	551.4	535.0				
5,000 FEET (5°C)	360	7570	8098	8626	9155	9683	10240	10815	11391	11967	-40	.916	1.137	.948
	400	8429	9109	9790	10485	11224	11963	12702	13477	14261	-20	.954	1.099	.976
	440	9560	10429	11338	12270	13202	14186	15176	16173	17204	0	.991	1.035	.997
	480	10864	12016	13188	14398	15646	16914	18222	19558	21050	20	1.027	.975	1.004
	520	12457	13920	15458	17022	18669	20375	22222	24078	25941	40	1.061	.885	1.002
	560	14376	16340	18383	20502	22651	25205	27561	0	0				
	600	17648	20554	23694	26915	30137	0	0	0	0				
	MIL	31789	31687	31244	30683	30330	30027	29845	29695	29549				
	V_{MAX}	662.6	649.7	634.9	616.8	600.7	587.8	573.6	558.5	544.0				
10,000 FEET (-5°C)	360	6912	7352	7792	8238	8716	9194	9672	10149	10656	-40	.932	1.363	1.012
	400	7541	8106	8686	9298	9910	10522	11172	11825	12477	-20	.972	1.153	1.004
	440	8398	9139	9914	10690	11501	12329	13159	14037	14915	0	1.009	.960	1.001
	480	9433	10418	11411	12463	13516	14642	15768	16964	18165	20	1.046	.800	1.008
	520	10789	12051	13367	14751	16182	17664	19200	20870	22541	40	1.081	.649	1.012
	560	12542	14177	15988	17871	19837	21952	24067	26182	0				
	600	15758	18418	21259	24217	27176	0	0	0	0				
	MIL	28411	28199	28024	27818	27813	27756	27691	27531	27205				
	V_{MAX}	659.5	646.5	632.3	601.1	600.1	590.3	579.1	569.3	553.3				

Figure B5-20 (Sheet 1 of 2)

LOW ALTITUDE CRUISE

GROSS WEIGHT 65,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-229

DATE: 1 JULY 1992
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

	KTAS	DRAG INDEX								
		0	20	40	60	80	100	120	140	160
15,000 FEET (-15°C)	360	6462	6838	7237	7636	8035	8438	8863	9287	9711
	400	6860	7354	7861	8367	8888	9428	9968	10512	11080
	440	7479	8121	8763	9437	10123	10816	11544	12271	13025
	480	8277	9098	9969	10850	11779	12719	13695	14679	15780
	520	9389	10488	11619	12809	14036	15299	16699	18110	19532
	560	10898	12360	13897	15539	17310	19166	21027	22899	0
	600	14102	16420	19021	0	0	0	0	0	0
	MIL	26026	25964	25899	24853	24742	24677	24199	23573	23023
	V_{MAX}	660.0	645.8	631.2	588.1	585.9	584.6	575.2	562.6	548.0

ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS		
	CRUISE	MIL	V_{MAX}
-40	.950	1.217	1.013
-20	.990	1.053	1.004
0	1.029	.865	.998
20	1.066	.703	1.001
40	1.101	.538	1.003

	KTAS	0	20	40	60	80	100	120	140	160
20,000 FEET (-25°C)	360	6298	6631	6969	7320	7672	8023	8378	8742	9106
	400	6416	6843	7279	7729	8179	8636	9109	9582	10065
	440	6803	7336	7896	8457	9042	9645	10251	10890	11530
	480	7356	8064	8781	9557	10344	11161	11981	12874	13773
	520	8251	9161	10166	11197	12252	13371	14561	15836	17152
	560	9639	10994	12424	13924	15576	17325	19096	0	0
	600	12936	14959	17358	0	0	0	0	0	0
	MIL	22995	22187	21510	20221	20250	20269	20292	20332	20181
	V_{MAX}	659.3	637.9	619.9	581.9	575.4	571.3	566.1	557.3	545.4

ACTUAL OAT DEG. C	CRUISE	MIL	V_{MAX}
-40	.969	1.060	.994
-20	1.010	.960	.998
0	1.049	.790	1.008
20	1.087	.627	1.019
40	1.123	.459	1.030

Figure B5-20 (Sheet 2)

LOW ALTITUDE CRUISE

GROSS WEIGHT 70,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-229

DATE: 1 JULY 1992
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

	KTAS	DRAG INDEX									ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS		
		0	20	40	60	80	100	120	140	160		CRUISE	MIL	V_{MAX}
SEA LEVEL (15°C)	360	8628	9234	9867	10500	11134	11768	12437	13120	13803	-40	.899	.982	.934
	400	9659	10472	11284	12097	12945	13817	14689	15562	16493	-20	.937	1.003	.957
	440	11057	12082	13117	14218	15319	16442	17618	18795	20015	0	.974	1.023	.981
	480	12641	13953	15331	16712	18187	19882	21234	22837	24486	20	1.009	.984	1.003
	520	14395	16117	17882	19727	21662	23676	25755	27860	29966	40	1.042	.804	1.012
	560	16658	18886	21209	23749	26346	28989	31633	0	0				
	600	19856	23011	26404	29881	33358	0	0	0	0				
	MIL	32919	33245	33656	33747	33776	33584	33195	32797	32428				
	V_{MAX}	660.2	647.2	630.6	614.5	601.4	586.0	568.8	551.2	534.8				
5,000 FEET (5°C)	360	7812	8336	8860	9385	9912	10483	11054	11626	12197	-40	.916	1.137	.948
	400	8621	9297	9973	10680	11414	12149	12886	13665	14445	-20	.954	1.099	.976
	440	9701	10567	11460	12407	13338	14322	15307	16304	17330	0	.991	1.035	.997
	480	10978	12131	13299	14511	15755	17023	18325	19670	21156	20	1.027	.875	1.004
	520	12548	14006	15545	17108	18749	20460	22301	24151	26008	40	1.061	.685	1.002
	560	14439	16403	18444	20563	22905	25252	27602	0	0				
	600	17707	20610	23747	26960	30174	0	0	0	0				
	MIL	31789	31686	31244	30682	30326	30024	29843	29692	29548				
	V_{MAX}	662.6	649.7	634.9	615.7	600.6	587.7	573.3	558.3	543.7				
10,000 FEET (-5°C)	360	7200	7640	8079	8550	9028	9505	9982	10477	10986	-40	.932	1.363	1.012
	400	7766	8327	8920	9527	10135	10755	11402	12050	12698	-20	.972	1.153	1.004
	440	8576	9325	10096	10866	11685	12508	13343	14216	15088	0	1.009	.960	1.001
	480	9580	10560	11557	12604	13662	14784	15909	17104	18300	20	1.046	.800	1.006
	520	10909	12172	13483	14871	16298	17778	19322	20985	22649	40	1.081	.649	1.012
	560	12637	14267	16083	17963	19932	22040	24148	26257	0				
	600	15826	18481	21317	24265	27215	0	0	0	0				
	MIL	28406	28194	28022	27818	27813	27755	27689	27523	27195				
	V_{MAX}	659.3	646.2.	632.0	601.1	600.1	590.1	578.8	587.9	552.9				

Figure B5-21 (Sheet 1 of 2)

LOW ALTITUDE CRUISE
GROSS WEIGHT 70,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-229

DATE: 1 JULY 1992
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

	KTAS	DRAG INDEX									ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS		
		0	20	40	60	80	100	120	140	160		CRUISE	MIL	V_{MAX}
15,000 FEET (-15°C)	360	6820	7218	7616	8015	8415	8839	9263	9686	10110	-40	.950	1.217	1.013
	400	7137	7644	8151	8658	9199	9739	10280	10841	11409	-20	.990	1.053	1.004
	440	7705	8342	8982	9665	10347	11048	11771	12493	13256	0	1.029	.865	.998
	480	8459	9278	10154	11031	11965	12900	13878	14857	15977	20	1.066	.703	1.001
	520	9533	10637	11772	12958	14188	15461	16854	18261	19677	40	1.101	.538	1.003
	560	11014	12477	14017	15653	17427	19271	21135	22999	0				
	600	14207	16524	19137	0	0	0	0	0	0				
	MIL	26024	25962	25897	24849	24739	24675	24174	23545	22981				
	V_{MAX}	659.5	645.3	630.5	588.0	585.8	584.6	574.7	561.9	546.9				
20,000 FEET (-25°C)	360	6816	7163	7513	7862	8212	8573	8935	9297	9660	-40	.969	1.060	.994
	400	6758	7191	7641	8092	8546	9020	9494	9971	10482	-20	1.010	.960	.998
	440	7075	7626	8190	8759	9364	9970	10599	11241	11898	0	1.049	.790	1.008
	480	7578	8290	9013	9795	10584	11399	12232	13121	14044	20	1.087	.627	1.019
	520	8434	9353	10358	11390	12447	13564	14773	16046	17356	40	1.123	.459	1.030
	560	9783	11136	12568	14068	15730	17475	19239	0	0				
	600	13147	15177	17594	0	0	0	0	0	0				
	MIL	22924	22132	21458	20223	20252	20270	20295	20335	20146				
	V_{MAX}	657.4	636.4	618.5	581.5	575.1	571.1	565.4	556.6	543.9				

Figure B5-21 (Sheet 2)

LOW ALTITUDE CRUISE
GROSS WEIGHT 75,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-229

DATE: 1 JULY 1992
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

SEA LEVEL (15°C)

KTAS	DRAG INDEX 0	20	40	60	80	100	120	140	160
360	8840	9454	10083	10712	11342	11973	12652	13330	14009
400	9828	10637	11446	12254	13110	13977	14845	15724	16650
440	11195	12216	13256	14352	15448	16574	17746	18917	20142
480	12745	14058	15431	16814	18283	19753	21327	22924	24572
520	14486	16202	17967	19807	21743	23751	25827	27926	30025
560	16721	18948	21268	23805	26398	29035	31672	0	0
600	19880	23029	26416	29885	33355	0	0	0	0
MIL	32920	33245	33656	33747	33776	33581	33189	32792	32424
V_{MAX}	660.2	647.2	630.6	614.5	601.4	585.9	568.6	550.9	534.6

ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS CRUISE	MIL	V_{MAX}
-40	.899	.982	.934
-20	.937	1.003	.957
0	.974	1.023	.981
20	1.009	.984	1.003
40	1.042	.804	1.012

5,000 FEET (5°C)

KTAS	DRAG INDEX 0	20	40	60	80	100	120	140	160
360	8080	8604	9128	9652	10201	10772	11342	11912	12487
400	8829	9500	10172	10892	11622	12352	13096	13871	14645
440	9867	10729	11649	12572	13507	14488	15469	16467	17488
480	11106	12262	13424	14640	15878	17146	10443	19798	21278
520	12652	14105	15645	17208	18843	20558	22393	24237	26087
560	14533	16497	18536	20658	22993	25334	27676	0	0
600	17766	20666	23800	27006	30212	0	0	0	0
MIL	31788	31684	31241	30677	30323	30021	29840	29688	29541
V_{MAX}	662.5	649.7	634.8	615.5	600.4	587.6	573.1	557.9	543.2

ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS CRUISE	MIL	V_{MAX}
-40	.916	1.137	.948
-20	.954	1.099	.976
0	.991	1.035	.997
20	1.027	.875	1.004
40	1.061	.685	1.002

10,000 FEET (-5°C)

KTAS	DRAG INDEX 0	20	40	60	80	100	120	140	160
360	7514	7953	8412	8889	9366	9843	10329	10837	11345
400	8010	8573	9177	9780	10383	11015	11658	12301	12954
440	8767	9525	10291	11066	11884	12701	13543	14411	15279
480	9750	10725	11728	12770	13834	14949	16079	17269	18470
520	11041	12307	13612	15005	16430	17904	19457	21113	22771
560	12748	14371	16195	18072	20045	22145	24245	26346	0
600	15923	18576	21409	24349	27290	0	0	0	0
MIL	28400	28188	28020	27818	27813	27753	27687	27513	27181
V_{MAX}	658.9	645.8	631.7	601.1	600.1	589.8	578.4	567.4	552.2

ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS CRUISE	MIL	V_{MAX}
-40	.932	1.363	1.012
-20	.972	1.153	1.004
0	1.009	.960	1.001
20	1.046	.800	1.006
40	1.081	.649	1.012

Figure B5-22 (Sheet 1 of 2)

LOW ALTITUDE CRUISE
GROSS WEIGHT 75,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-229

DATE: 1 JULY 1992
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

	KTAS	DRAG INDEX									ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS		
		0	20	40	60	80	100	120	140	160		CRUISE	MIL	V_{MAX}
15,000 FEET (-15°C)	360	7259	7656	8054	8456	8879	9302	9725	10149	10594	-40	.950	1.217	1.013
	400	7451	7958	8466	8995	9536	10077	10628	11197	11765	-20	.990	1.053	1.004
	440	7958	8591	9244	9921	10598	11309	12026	12755	13516	0	1.029	.865	.998
	480	8657	9486	10356	11243	12171	13111	14084	15086	16200	20	1.066	.703	1.001
	520	9704	10808	11948	13127	14362	15647	17034	18436	19845	40	1.101	.538	1.003
	560	11147	12612	14155	15795	17561	19405	21261	23117	0				
	600	14346	16664	19295	0	0	0	0	0	0				
	MIL	26021	25958	25894	24844	24736	24673	24146	23511	22930				
	V_{MAX}	658.7	644.5	629.8	587.9	585.8	584.5	574.2	561.0	545.5				

	KTAS	0	20	40	60	80	100	120	140	160	ACTUAL OAT DEG. C	CRUISE	MIL	V_{MAX}
20,000 FEET (-25°C)	360	7451	7799	8147	8504	8865	9226	9587	9973	10371	-40	.969	1.060	.994
	400	7158	7609	8060	8513	8987	9462	9936	10448	10960	-20	1.010	.960	.998
	440	7375	7942	8508	9103	9712	10328	10973	11618	12327	0	1.049	.790	1.008
	480	7832	8539	9281	10057	10851	11660	12512	13394	14343	20	1.087	.627	1.019
	520	8629	9563	10563	11599	12663	13774	15004	16277	17580	40	1.123	.459	1.030
	560	9954	11307	12735	14237	15914	17656	19411	0	0				
	600	13423	15468	17911	0	0	0	0	0	0				
	MIL	22830	22064	21401	20225	20253	20271	20299	20338	20105				
	V_{MAX}	655.0	634.6	617.0	581.1	574.8	570.9	564.6	555.8	542.2				

Figure B5-22 (Sheet 2)

LOW ALTITUDE CRUISE

GROSS WEIGHT 80,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-229

DATE: 1 JULY 1992
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

	KTAS	DRAG INDEX									ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS		
		0	20	40	60	80	100	120	140	160		CRUISE	MIL	V_{MAX}

SEA LEVEL (15°C)	KTAS	0	20	40	60	80	100	120	140	160	ACTUAL OAT DEG. C	CRUISE	MIL	V_{MAX}
	360	9074	9699	10324	10949	11574	12220	12894	13569	14243	-40	.899	.982	.934
	400	10025	10829	11633	12439	13302	14164	15027	15914	16835	-20	.937	1.003	.957
	440	11336	12353	13399	14490	15582	16713	17879	19046	20276	0	.974	1.023	.981
	480	12858	14176	15544	16930	18394	19859	21437	23029	24678	20	1.009	.984	1.003
	520	14579	16290	18057	19891	21829	23831	25905	27998	30091	40	1.042	.804	1.012
	560	16784	19011	21331	23862	26450	29081	31711	0	0				
	600	19940	23089	26469	29930	33392	0	0	0	0				
	MIL	32921	33245	33656	33747	33776	33577	33184	32786	32414				
	V_{MAX}	660.1	647.2	630.6	614.5	601.3	585.7	568.3	550.7	534.2				

5,000 FEET (5°C)	KTAS	0	20	40	60	80	100	120	140	160	ACTUAL OAT DEG. C	CRUISE	MIL	V_{MAX}
	360	8370	8894	9417	9945	10515	11085	11655	12225	12819	-40	.916	1.137	.948
	400	9051	9719	10395	11120	11845	12571	13323	14093	14862	-20	.954	1.099	.976
	440	10044	10910	11828	12747	13687	14663	15639	16639	17654	0	.991	1.035	.997
	480	11248	12406	13565	14784	16017	17287	18579	19948	21421	20	1.027	.875	1.004
	520	12773	14221	15764	17328	18957	20681	22509	24348	26192	40	1.061	.685	1.002
	560	14627	16593	18632	20758	23086	25420	27756	0	0				
	600	17826	20722	23853	27051	30249	0	0	0	0				
	MIL	31787	31678	31234	30673	30319	30016	29836	29683	29536				
	V_{MAX}	662.4	649.5	634.6	615.3	600.3	587.4	572.6	557.4	542.7				

10,000 FEET (-5°C)	KTAS	0	20	40	60	80	100	120	140	160	ACTUAL OAT DEG. C	CRUISE	MIL	V_{MAX}
	360	7852	8303	8779	9256	9733	10210	10718	11226	11734	-40	.932	1.363	1.012
	400	8275	8861	9464	10068	10681	11324	11968	12611	13281	-20	.972	1.153	1.004
	440	8990	9752	10513	11299	12112	12925	13776	14638	15507	0	1.009	.960	1.001
	480	9926	10896	11905	12942	14013	15124	16260	17444	18657	20	1.046	.800	1.006
	520	11189	12458	13758	15159	16584	18052	19616	21267	22917	40	1.081	.649	1.012
	560	12871	14495	16322	18197	20176	22270	24363	26457	0				
	600	16020	18671	21501	24433	27365	0	0	0	0				
	MIL	28394	28183	28017	27818	27812	27751	27685	27495	27162				
	V_{MAX}	658.5	645.5	631.2	601.1	600.1	589.5	578.0	566.6	551.3				

Figure B5-23 (Sheet 1 of 2)

LOW ALTITUDE CRUISE
GROSS WEIGHT 80,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-229

DATE: 1 JULY 1992
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

	KTAS	DRAG INDEX									ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS		
		0	20	40	60	80	100	120	140	160		CRUISE	MIL	V_{MAX}
15,000 FEET (-15°C)	360	7751	8148	8556	8977	9399	9821	10250	10693	11136	-40	.950	1.217	1.013
	400	7789	8297	8815	9356	9898	10441	11010	11579	12148	-20	.990	1.053	1.004
	440	8231	8864	9535	10212	10900	11617	12333	13079	13839	0	1.029	.865	.998
	480	8878	9718	10583	11479	12402	13346	14314	15342	16450	20	1.066	.703	1.001
	520	9887	10985	12131	13307	14542	15843	17223	18622	20025	40	1.101	.538	1.003
	560	11289	12757	14306	15952	17711	19555	21404	0	0				
	600	14491	16815	19461	0	0	0	0	0	0				
	MIL	26017	25955	25890	24840	24733	24671	24111	23471	22872				
	V_{MAX}	657.9	643.8	629.0	587.8	585.7	584.5	573.5	559.9	543.9				

	KTAS	0	20	40	60	80	100	120	140	160	ACTUAL OAT DEG. C	CRUISE	MIL	V_{MAX}
20,000 FEET (-25°C)	360	8203	8561	8920	9279	9638	10027	10423	10818	11213	-40	.969	1.060	.994
	400	7639	8090	8544	9019	9494	9971	10484	10996	11509	-20	1.010	.960	.998
	440	7708	8277	8858	9469	10081	10723	11370	12051	12783	0	1.049	.790	1.008
	480	8103	8811	9579	10358	11162	11971	12849	13731	14717	20	1.087	.627	1.019
	520	8844	9796	10792	11829	12902	14006	15261	16535	17830	40	1.123	.459	1.030
	560	10133	11490	12918	14414	16106	17845	19591	0	0				
	600	13701	15787	18228	0	0	0	0	0	0				
	MIL	22720	21985	21329	20227	20254	20272	20303	20342	20058				
	V_{MAX}	652.0	632.5	615.1	580.6	574.5	570.6	563.7	554.9	540.2				

Figure B5-23 (Sheet 2)

HIGH ALTITUDE CRUISE

GROSS WEIGHT 35,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-229

DATE: 1 JULY 1992
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

	KTAS	DRAG INDEX								
		0	20	40	60	80	100	120	140	160
25,000 FEET (-15°C)	360	3996	4249	4503	4779	5056	5334	5614	5907	6199
	400	4404	4743	5102	5461	5825	6206	6587	6974	7373
	440	4922	5381	5840	6325	6816	7325	7847	8380	8932
	480	5541	6128	6754	7396	8074	8764	9464	10209	10969
	520	6430	7242	8101	8992	9908	10879	11917	13017	14184
	560	7985	9229	10550	11956	13501	15160	16851	0	0
	600	11574	13297	15450	0	0	0	0	0	0
	MIL	20514	19585	18742	17074	17063	17057	16934	16811	16702
	V_{MAX}	656.7	640.1	617.8	571.3	570.5	570.0	560.2	550.4	541.7
30,000 FEET (-25°C)	360	3616	3839	4064	4290	4519	4758	4997	5236	5480
	400	3899	4188	4477	4478	5087	5397	5717	6040	6363
	440	4285	4680	5058	5463	5881	6308	6745	7194	7657
	480	4802	5319	5848	6406	6971	7544	8155	8782	9471
	520	5520	6229	6963	7730	8527	9361	10252	11249	12269
	560	7013	8140	9328	0	0	0	0	0	0
	600	10743	12225	14297	0	0	0	0	0	0
	MIL	18020	16859	15757	13879	13848	13830	13608	13274	12975
	V_{MAX}	676.9	638.6	609.6	557.6	556.6	556.0	548.7	537.7	527.3
35,000 FEET (-35°C)	360	3382	3568	3764	3960	4158	4357	4560	4763	4974
	400	3524	3767	4020	4274	4536	4799	5066	5351	5637
	440	3778	4105	4434	4778	5124	5483	5845	6240	6644
	480	4195	4628	5081	5543	6014	6519	7041	7598	8189
	520	4800	5407	6046	6703	7391	8137	8962	9819	0
	560	6401	7331	8400	0	0	0	0	0	0
	600	9984	11327	0	0	0	0	0	0	0
	MIL	14352	12630	11979	10794	10770	10756	10581	10340	10120
	V_{MAX}	665.3	614.9	590.9	544.2	543.2	542.5	534.6	523.7	513.0

	ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS		
		CRUISE	MIL	V_{MAX}
25,000 FEET (-15°C)	-80	.900	1.148	.992
	-60	.945	1.087	.996
	-40	.988	1.020	.999
	-20	1.030	.873	.987
	0	1.070	.895	.971
30,000 FEET (-25°C)	-80	.919	.941	.934
	-60	.966	1.024	.991
	-40	1.010	.963	.993
	-20	1.052	.765	.956
	0	1.043	.550	.916
35,000 FEET (-35°C)	-80	.940	.906	.933
	-60	.987	.980	.986
	-40	1.032	.937	.993
	-20	1.075	.783	.964
	0	1.117	.825	.933

Figure B5-24 (Sheet 1 of 2)

HIGH ALTITUDE CRUISE

GROSS WEIGHT 35,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-229

DATE: 1 JULY 1992
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

	KTAS	DRAG INDEX								
		0	20	40	60	80	100	120	140	160
40,000 FEET (-44°C)	360	3548	3711	3874	4045	4225	4405	4588	4794	5000
	400	3397	3607	3821	4036	4266	4497	4737	4998	5258
	440	3477	3751	4030	4317	4608	4919	5242	5581	5933
	480	3733	4087	4450	4821	5217	5627	6062	6528	7006
	520	4195	4697	5217	5755	6343	6987	7676	0	0
	560	5701	6477	7406	0	0	0	0	0	0
	600	8687	9765	0	0	0	0	0	0	0
	MIL	10800	9937	9480	8703	8689	8853	8430	8217	7963
	V_{MAX}	640.6	603.0	581.7	543.8	543.1	541.1	529.0	517.5	501.8
45,000 FEET (-54°C)	360	4805	4980	5156	5333	5509	5685	5861	6037	6214
	400	3685	3885	4092	4301	4529	4757	4990	5229	5471
	440	3420	3659	3906	4168	4440	4725	5022	5334	5646
	480	3481	3786	4103	4428	4783	5157	5548	5952	0
	520	3804	4214	4638	5103	5606	6152	0	0	0
	560	5261	5920	6795	0	0	0	0	0	0
	600	7763	0	0	0	0	0	0	0	0
	MIL	8019	7652	7348	6968	6957	6794	6575	6251	5724
	V_{MAX}	606.0	584.8	566.9	543.4	542.8	531.8	517.0	491.8	446.8

	ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS		
		CRUISE	MIL	V_{MAX}
40,000 FEET	-80	.944	.908	.937
	-60	.992	.988	.991
	-40	1.037	.931	.998
	-20	1.081	.762	.976
	0	1.122	.587	.954
45,000 FEET	-80	.944	.924	.944
	-60	.992	.990	.992
	-40	1.037	.940	1.012
	-20	1.081	.879	1.030
	0	1.122	.816	1.049

Figure B5-24 (Sheet 2)

HIGH ALTITUDE CRUISE
GROSS WEIGHT 40,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-229

DATE: 1 JULY 1992
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

	KTAS	DRAG INDEX								
		0	20	40	60	80	100	120	140	160
16,000 FEET (-15°C)	360	4239	4491	4765	5040	5316	5593	5884	6175	6466
	400	4595	4943	5297	5652	6023	6400	6776	7168	7564
	440	5079	5533	5994	6479	6965	7479	7996	8532	9079
	480	5665	6255	6877	7523	8196	8884	9578	10327	11093
	520	6535	7341	8203	9092	10008	10972	12013	13114	14273
	560	8066	9307	10625	12029	13572	15222	0	0	0
	600	11645	13369	15526	0	0	0	0	0	0
	MIL	20514	19562	18718	17073	17063	17057	16930	16807	16694
	V_{MAX}	666.7	639.5	617.2	571.3	570.4	570.0	559.9	550.1	541.4
20,000 FEET (-25°C)	360	3935	4160	4385	4620	4858	5097	5337	5583	5829
	400	4148	4436	4732	5040	5348	5664	5985	6306	6649
	440	4482	4861	5261	5663	6085	6508	6949	7379	7873
	480	4962	5483	6017	6569	7133	7703	8319	8958	9640
	520	5654	6365	7099	7859	8657	9492	10397	11388	12401
	560	7120	8244	9431	0	0	0	0	0	0
	600	10904	12396	14488	0	0	0	0	0	0
	MIL	17998	16793	15699	13877	13847	13829	13581	13242	12949
	V_{MAX}	676.0	636.9	608.1	557.6	556.5	556.0	547.8	536.6	526.2
25,000 FEET (-35°C)	360	3841	4037	4234	4436	4639	4841	5061	5288	5515
	400	3836	4091	4347	4614	4879	5155	5442	5730	6046
	440	4035	4363	4703	5048	5403	5764	6148	6550	6970
	480	4400	4838	5286	5750	6227	6731	7267	7821	8422
	520	4969	5574	6212	6867	7561	8324	9148	9997	0
	560	6641	7569	8686	0	0	0	0	0	0
	600	10263	11610	0	0	0	0	0	0	0
	MIL	13991	12514	11888	10791	10768	10755	10544	10291	10038
	V_{MAX}	655.9	610.6	587.6	544.1	543.1	542.5	532.9	521.5	508.8

	ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS		
		CRUISE	MIL	V_{MAX}
16,000 FEET (-15°C)	-80	.900	1.148	.992
	-60	.945	1.087	.996
	-40	.988	1.020	.999
	-20	1.030	.873	.987
	0	1.070	.695	.971
20,000 FEET (-25°C)	-80	.919	.941	.934
	-60	.966	1.024	.991
	-40	1.010	.963	.993
	-20	1.052	.765	.956
	0	1.043	.550	.916
25,000 FEET (-35°C)	-80	.940	.906	.933
	-60	.987	.980	.986
	-40	1.032	.937	.993
	-20	1.075	.783	.964
	0	1.117	.625	.933

Figure B5-25 (Sheet 1 of 2)

HIGH ALTITUDE CRUISE
GROSS WEIGHT 40,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-229

DATE: 1 JULY 1992
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

	KTAS	DRAG INDEX									ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS		
		0	20	40	60	80	100	120	140	160		CRUISE	MIL	V_{MAX}
40,000 FEET (-57°C)	360	4451	4637	4840	5043	5246	5464	5684	5903	6124	-80	.944	.908	.937
	400	3921	4143	4375	4607	4864	5125	5392	5675	5958	-60	.992	.988	.991
	440	3810	4093	4387	4683	5007	5336	5688	6045	6424	-40	1.037	.931	.998
	480	4005	4370	4747	5143	5551	5992	6457	6940	7436	-20	1.081	.762	.976
	520	4422	4933	5450	6007	6612	7264	7949	0	0	0	1.122	.587	.954
	560	6074	6892	7903	0	0	0	0	0	0				
	600	9138	0	0	0	0	0	0	0	0				
	MIL	10342	9753	9333	8699	8687	8585	8355	8128	7762				
	V_{MAX}	621.9	594.4	574.8	543.8	542.9	537.4	525.0	512.1	489.3				
45,000 FEET (-57°C)	360	6966	7139	7313	7486	7659	7832	0	0	0	-80	.944	.924	.944
	400	4892	5128	5370	5599	5834	6070	0	0	0	-60	.992	.990	.992
	440	4056	4321	4610	4899	5215	5531	0	0	0	-40	1.037	.940	1.012
	480	3886	4215	4559	4920	5317	5722	0	0	0	-20	1.081	.879	1.030
	520	4169	4600	5074	5589	6147	0	0	0	0	0	1.122	.818	1.049
	560	5825	6596	0	0	0	0	0	0	0				
	600	0	0	0	0	0	0	0	0	0				
	MIL	7707	7410	7187	6960	6831	6567	0	0	0				
	V_{MAX}	588.0	570.7	557.1	543.0	534.2	516.4	0	0	0				

Figure B5-25 (Sheet 2)

HIGH ALTITUDE CRUISE

GROSS WEIGHT 45,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-229

DATE: 1 JULY 1992
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

	KTAS	DRAG INDEX								
		0	20	40	60	80	100	120	140	160
25,000 FEET (-35°C)	360	4524	4799	5074	5349	5628	5919	6209	6500	6795
	400	4826	5176	5526	5885	6257	6629	7009	7400	7790
	440	5264	5715	6183	6663	7153	7665	8178	8719	9261
	480	5812	6409	7025	7678	8346	9033	9729	10478	11255
	520	6661	7461	8327	9216	10132	11090	12136	13240	14393
	560	8164	9403	10718	12124	13664	15308	0	0	0
	600	11756	13484	15653	0	0	0	0	0	0
	MIL	20497	19518	18689	17073	17062	17056	16924	16800	16682
	V_{MAX}	665.9	638.3	616.4	571.2	570.4	569.9	559.4	549.5	540.9
30,000 FEET (-44°C)	360	4335	4566	4805	5043	5281	5525	5771	6017	6270
	400	4436	4735	5044	5353	5671	5994	6316	6661	7011
	440	4708	5101	5496	5907	6324	6751	7190	7641	8128
	480	5160	5675	6216	6764	7326	7907	8517	9171	9847
	520	5813	6525	7260	8021	8814	9653	10575	11563	12568
	560	7248	8369	9565	0	0	0	0	0	0
	600	1111	12647	14737	0	0	0	0	0	0
	MIL	17955	16680	15621	13875	13845	13828	13546	13199	12883
	V_{MAX}	674.5	633.9	606.1	557.5	556.5	555.9	546.6	535.2	523.6
35,000 FEET (-54°C)	360	4458	4660	4861	5081	5306	5531	5768	6026	6283
	400	4241	4504	4771	5039	5328	5617	5920	6247	6573
	440	4327	4669	5018	5376	5741	6128	6535	6959	7402
	480	4635	5078	5528	5988	6479	6985	7526	8098	8693
	520	5167	5778	6413	7065	7766	8551	9377	0	0
	560	6939	7890	9039	0	0	0	0	0	0
	600	10627	11977	0	0	0	0	0	0	0
	MIL	13377	12350	11772	10787	10766	10753	10497	10227	9933
	V_{MAX}	639.9	604.6	583.3	544.0	543.0	552.4	530.8	518.6	503.3

	ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS		
		CRUISE	MIL	V_{MAX}
25,000 FEET (-35°C)	-80	.900	1.148	.992
	-60	.945	1.087	.996
	-40	.988	1.020	.999
	-20	1.030	.873	.987
	0	1.070	.695	.971
30,000 FEET (-44°C)	-80	.919	.941	.934
	-60	.966	1.024	.991
	-40	1.010	.963	.993
	-20	1.052	.765	.956
	0	1.043	.550	.916
35,000 FEET (-54°C)	-80	.940	.906	.933
	-60	.987	.980	.986
	-40	1.032	.937	.993
	-20	1.075	.783	.964
	0	1.117	.625	.933

Figure B5-26 (Sheet 1 of 2)

HIGH ALTITUDE CRUISE
GROSS WEIGHT 45,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-229

DATE: 1 JULY 1992
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

	KTAS	DRAG INDEX								
		0	20	40	60	80	100	120	140	160
40,000 FEET (-57°C)	360	6129	6356	6563	6780	6997	7214	7432	7648	7866
	400	4618	4877	5140	5409	5693	5978	6271	6568	6864
	440	4258	4558	4872	5205	5550	5912	6286	6674	7063
	480	4320	4704	5104	5517	5986	6438	6930	7434	0
	520	4713	5232	5769	6354	6995	7680	0	0	0
	560	6561	7399	8493	0	0	0	0	0	0
	600	9700	0	0	0	0	0	0	0	0
	MIL	9988	9542	9169	8695	8684	8481	8208	7797	7095
	V_{MAX}	605.3	584.5	566.8	543.4	542.8	531.8	516.8	491.5	442.4

ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS		
	CRUISE	MIL	V_{MAX}
-80	.944	.908	.937
-60	.992	.988	.991
-40	1.037	.931	.998
-20	1.081	.762	.976
0	1.122	.587	.954

	KTAS	DRAG INDEX								
		0	20	40	60	80	100	120	140	160
45,000 FEET (-57°C)	360	9610	9776	9942	10109	10275	0	0	0	0
	400	6865	7098	7331	7565	7798	0	0	0	0
	440	5069	5388	5710	6025	6344	0	0	0	0
	480	4477	4845	5241	5651	6072	0	0	0	0
	520	4636	5126	5653	6230	0	0	0	0	0
	560	6527	0	0	0	0	0	0	0	0
	600	0	0	0	0	0	0	0	0	0
	MIL	7418	7221	7051	6842	6453	0	0	0	0
	V_{MAX}	571.2	559.1	548.7	535.0	507.6	0	0	0	0

ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS		
	CRUISE	MIL	V_{MAX}
-80	.944	.924	.944
-60	.992	.990	.992
-40	1.037	.940	1.012
-20	1.081	.879	1.030
0	1.122	.816	1.049

Figure B5-26 (Sheet 2)

HIGH ALTITUDE CRUISE

GROSS WEIGHT 50,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-229

DATE: 1 JULY 1992
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

	KTAS	DRAG INDEX									ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS		
		0	20	40	60	80	100	120	140	160		CRUISE	MIL	V_{MAX}
25,000 FEET (-35°C)	360	4884	5158	5432	5716	6005	6295	6585	6882	7181	-80	.900	1.148	.992
	400	5101	5452	5808	6181	6554	6931	7322	7713	8113	-60	.945	1.087	.996
	440	5480	5927	6402	6878	7376	7884	8403	8940	9480	-40	.988	1.020	.999
	480	5984	6588	7200	7862	8528	9211	9917	10659	11453	-20	1.030	.873	.987
	520	6808	7614	8475	9364	10283	11236	12291	13400	14547	0	1.070	.695	.971
	560	8284	9523	10837	12245	13788	15425	0	0	0				
	600	11892	13627	15812	0	0	0	0	0	0				
	MIL	20472	19457	18639	17072	17062	17056	16916	16791	16666				
	V_{MAX}	664.7	636.7	615.1	571.2	570.4	569.9	558.8	548.8	540.2				
30,000 FEET (-44°C)	360	4852	5089	5327	5572	5816	6061	6318	6593	6867	-80	.919	.941	.934
	400	4769	5080	5391	5713	6037	6361	6712	7064	7424	-60	.966	1.024	.991
	440	4985	5383	5790	6209	6633	7074	7515	8004	8493	-40	1.010	.963	.993
	480	5386	5903	6445	6994	7551	8144	8750	9420	10106	-20	1.052	.765	.956
	520	5994	6709	7447	8210	9002	9841	10785	11770	12767	0	1.043	.550	.916
	560	7396	8521	9723	0	0	0	0	0	0				
	600	11379	12956	15043	0	0	0	0	0	0				
	MIL	17842	16521	15516	13872	13843	13826	13503	13146	12797				
	V_{MAX}	670.4	629.7	603.3	557.4	556.4	555.9	545.2	533.5	520.2				
35,000 FEET (-54°C)	360	5368	5591	5833	6088	6343	6600	6873	7146	7418	-80	.940	.906	.933
	400	4783	5032	5322	5613	5917	6245	6573	6920	7274	-60	.987	.980	.986
	440	4659	5012	5375	5744	6136	6548	6978	7426	7887	-40	1.032	.937	.993
	480	4911	5362	5829	6315	6820	7364	7929	8531	9139	-20	1.075	.783	.964
	520	5397	6016	6652	7315	8026	8822	9652	0	0	0	1.117	.625	.933
	560	7290	8267	9471	0	0	0	0	0	0				
	600	11079	0	0	0	0	0	0	0	0				
	MIL	12905	12158	11628	10783	10763	10702	10438	10153	9751				
	V_{MAX}	625.0	597.5	578.0	543.8	542.8	540.1	528.2	514.8	493.9				

Figure B5-27 (Sheet 1 of 2)

HIGH ALTITUDE CRUISE
GROSS WEIGHT 50,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-229

DATE: 1 JULY 1992
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

	KTAS	DRAG INDEX									ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS		
		0	20	40	60	80	100	120	140	160		CRUISE	MIL	V_{MAX}
40,000 FEET (-57°C)	360	8208	8422	8636	8851	9065	9279	9492	0	0	-80	.944	.908	.937
	400	5750	6034	6329	6625	6920	7216	7512	0	0	-60	.992	.988	.991
	440	4869	5206	5556	5921	6300	6693	7087	0	0	-40	1.037	.931	.998
	480	4714	5123	5546	6003	6488	6990	7504	0	0	-20	1.081	.762	.976
	520	5075	5607	6197	6839	7526	8229	0	0	0	0	1.122	.587	.954
	560	7122	8058	0	0	0	0	0	0	0				
	600	0	0	0	0	0	0	0	0	0				
	MIL	9684	9304	9010	8689	8583	8264	7791	0	0				
	V_{MAX}	591.2	573.4	559.0	543.1	537.3	520.0	491.1	0	0				
45,000 FEET (-57°C)	360	12451	12617	12784	0	0	0	0	0	0	-80	.944	.924	.944
	400	9113	9342	9571	0	0	0	0	0	0	-60	.992	.990	.992
	440	6719	7032	7345	0	0	0	0	0	0	-40	1.037	.940	1.012
	480	5448	5870	6298	0	0	0	0	0	0	-20	1.081	.879	1.030
	520	5293	5849	6438	0	0	0	0	0	0	0	1.122	.816	1.049
	560	0	0	0	0	0	0	0	0	0				
	600	0	0	0	0	0	0	0	0	0				
	MIL	7220	7053	6782	0	0	0	0	0	0				
	V_{MAX}	559.1	548.9	531.0	0	0	0	0	0	0				

Figure B5-27 (Sheet 2)

HIGH ALTITUDE CRUISE
GROSS WEIGHT 55,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-229

DATE: 1 JULY 1992
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

	KTAS	DRAG INDEX									ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS		
		0	20	40	60	80	100	120	140	160		CRUISE	MIL	V_{MAX}
25,000 FEET (-35°C)	360	5315	5590	5879	6168	6457	6749	7048	7347	7645	-80	.900	1.148	.992
	400	5407	5761	6135	6510	6886	7278	7671	8069	8494	-60	.945	1.087	.996
	440	5723	6183	6655	7134	7636	8139	8667	9198	9763	-40	.988	1.020	.999
	480	6186	6792	7415	8072	8739	9417	10134	10871	11683	-20	1.030	.873	.987
	520	6976	7791	8645	9536	10459	11423	12471	13588	14729	0	1.070	.895	.971
	560	8420	9660	10974	12387	13932	15564	0	0	0				
	600	12097	13845	16055	0	0	0	0	0	0				
	MIL	20425	19377	18581	17072	17062	17048	16906	16780	16635				
	V_{MAX}	662.5	634.6	613.5	571.1	570.4	569.3	558.0	547.9	538.9				
30,000 FEET (-44°C)	360	5515	5758	6001	6249	6521	6794	7088	7361	7677	-80	.919	.941	.934
	400	5209	5523	5848	6173	6509	6861	7214	7595	7995	-60	.966	1.024	.991
	440	5291	5697	6121	6544	6989	7434	7919	8413	8938	-40	1.010	.963	.993
	480	5637	6166	6704	7257	7821	8420	9051	9715	10419	-20	1.052	.765	.956
	520	6207	6916	7657	8425	9224	10082	11027	12009	0	0	1.043	.550	.916
	560	7569	8695	9905	0	0	0	0	0	0				
	600	11728	13347	0	0	0	0	0	0	0				
	MIL	17670	16338	15380	13869	13841	13825	13453	13081	12691				
	V_{MAX}	664.3	624.9	599.7	557.3	556.4	555.8	543.6	531.3	515.9				
35,000 FEET (-54°C)	360	6895	7163	7431	7700	7971	8241	8511	8782	9052	-80	.940	.906	.933
	400	5415	5706	6023	6352	6684	7040	7397	7758	8126	-60	.987	.980	.986
	440	5086	5455	5827	6233	6648	7091	7544	8016	8495	-40	1.032	.937	.993
	480	5216	5686	6167	6680	7220	7780	8392	9007	0	-20	1.075	.783	.964
	520	5874	6302	6947	7634	8392	9203	10036	0	0	0	1.117	.625	.933
	560	7703	8730	10003	0	0	0	0	0	0				
	600	11618	0	0	0	0	0	0	0	0				
	MIL	12574	11960	11464	10778	10759	10614	10306	9911	9298				
	V_{MAX}	612.8	590.2	571.6	543.5	542.7	536.1	522.2	502.2	470.4				

Figure B5-28 (Sheet 1 of 2)

HIGH ALTITUDE CRUISE
GROSS WEIGHT 55,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-229

DATE: 1 JULY 1992
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

	KTAS	DRAG INDEX									ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS		
		0	20	40	60	80	100	120	140	160		CRUISE	MIL	V_{MAX}
40,000 FEET (-57°C)	360	10609	10820	11031	11241	11452	0	0	0	0	-80	.944	.908	.937
	400	7629	7918	8208	8499	8789	0	0	0	0	-60	.992	.988	.991
	440	5756	6126	6522	6917	7313	0	0	0	0	-40	1.037	.931	.998
	480	5242	5683	6147	6652	7166	0	0	0	0	-20	1.081	.762	.976
	520	5502	6092	6735	7428	8145	0	0	0	0	0	1.122	..587	.954
	560	7771	8776	0	0	0	0	0	0	0				
	600	0	0	0	0	0	0	0	0	0				
	MIL	9399	9106	8869	8682	8314	0	0	0	0				
	V_{MAX}	577.8	563.7	552.1	542.7	522.7	0	0	0	0				
45,000 FEET (-57°C)	360	15263	0	0	0	0	0	0	0	0	-80	.944	.924	.944
	400	11802	0	0	0	0	0	0	0	0	-60	.992	.990	.992
	440	8753	0	0	0	0	0	0	0	0	-40	1.037	.940	1.012
	480	6857	0	0	0	0	0	0	0	0	-20	1.081	.879	1.030
	520	6231	0	0	0	0	0	0	0	0	0	1.122	.816	1.049
	560	0	0	0	0	0	0	0	0	0				
	600	0	0	0	0	0	0	0	0	0				
	MIL	7014	0	0	0	0	0	0	0	0				
	V_{MAX}	546.5	0	0	0	0	0	0	0	0				

Figure B5-28 (Sheet 2)

HIGH ALTITUDE CRUISE

GROSS WEIGHT 60,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-229

DATE: 1 JULY 1992
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

	KTAS	DRAG INDEX									ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS		
		0	20	40	60	80	100	120	140	160		CRUISE	MIL	V_{MAX}
25,000 FEET (-35°C)	360	5851	6138	6426	6716	7013	7311	7608	7918	8248	-80	.900	1.148	.992
	400	5742	6117	6493	6870	7264	7658	8056	8483	8909	-60	.945	1.087	.996
	440	5998	6473	6948	7450	7956	8477	9012	9559	10157	-40	.988	1.020	.999
	480	6418	7020	7656	8308	8977	9650	10380	11126	11946	-20	1.030	.873	.987
	520	7162	7985	8841	9727	10655	11633	12674	13800	14935	0	1.070	.695	.971
	560	8567	9809	11123	12541	14090	15717	0	0	0				
	600	12328	14098	16327	0	0	0	0	0	0				
	MIL	20330	19266	18508	17071	17061	17035	16894	16767	16579				
	V_{MAX}	659.8	631.7	611.6	571.1	570.3	568.3	557.0	546.9	536.6				
30,000 FEET (-44°C)	360	6421	6689	6958	7232	7544	7656	8169	8488	8819	-80	.919	.941	.934
	400	5733	6058	6385	6738	7091	7457	7859	8261	8678	-60	.966	1.024	.991
	440	5626	6053	6480	6926	7374	7857	8356	8880	9427	-40	1.010	.963	.993
	480	5919	6464	7016	7575	8173	8785	9456	10148	10874	-20	1.052	.765	.956
	520	6443	7156	7892	8665	9473	10343	11330	12281	0	0	1.043	.550	.916
	560	7773	8901	10121	0	0	0	0	0	0				
	600	12142	13812	0	0	0	0	0	0	0				
	MIL	17427	16096	15225	13865	13838	13776	13393	13009	12556				
	V_{MAX}	655.5	618.5	595.7	557.1	556.3	554.2	541.6	528.6	510.5				
35,000 FEET (-54°C)	360	8844	9112	9381	9649	9917	10185	10454	10723	0	-80	.940	.906	.933
	400	6329	6658	7014	7370	7731	8099	8471	8834	0	-60	.987	.980	.986
	440	5621	6006	6425	6852	7309	7772	8257	8742	0	-40	1.032	.937	.993
	480	5571	6052	6570	7107	7673	8285	8908	0	0	-20	1.075	.783	.964
	520	6000	6648	7323	8048	8857	9703	0	0	0	0	1.117	.625	.933
	560	8186	9256	10591	0	0	0	0	0	0				
	600	12232	0	0	0	0	0	0	0	0				
	MIL	12229	11733	11319	10772	10755	10471	10086	9342	0				
	V_{MAX}	600.1	581.9	565.7	543.3	542.5	529.6	511.2	472.7	0				

Figure B5-29 (Sheet 1 of 2)

HIGH ALTITUDE CRUISE

GROSS WEIGHT 60,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-229

DATE: 1 JULY 1992
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

	KTAS	DRAG INDEX									ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS		
		0	20	40	60	80	100	120	140	160		CRUISE	MIL	V_{MAX}
40,000 FEET (-57°C)	360	13454	13661	13867	14047	0	0	0	0	0	-80	.944	.908	.937
	400	9652	9937	10223	10507	0	0	0	0	0	-60	.992	.988	.991
	440	7066	7462	7859	8255	0	0	0	0	0	-40	1.037	.931	.998
	480	5994	6490	7006	7535	0	0	0	0	0	-20	1.031	.762	.976
	520	6056	6707	7409	8139	0	0	0	0	0	0	1.122	.587	.954
	560	8525	0	0	0	0	0	0	0	0				
	600	0	0	0	0	0	0	0	0	0				
	MIL	9164	8931	8733	8337	0	0	0	0	0				
	V_{MAX}	566.5	555.1	545.4	524.0	0	0	0	0	0				

	KTAS	0	20	40	60	80	100	120	140	160	ACTUAL OAT DEG. C	CRUISE	MIL	V_{MAX}
45,000 FEET (-57°C)	360	0	0	0	0	0	0	0	0	0	-80	.944	.924	.944
	400	0	0	0	0	0	0	0	0	0	-60	.992	.990	.992
	440	0	0	0	0	0	0	0	0	0	-40	1.037	.940	1.012
	480	0	0	0	0	0	0	0	0	0	-20	1.081	.879	1.030
	520	0	0	0	0	0	0	0	0	0	0	1.122	.816	1.049
	560	0	0	0	0	0	0	0	0	0				
	600	0	0	0	0	0	0	0	0	0				
	MIL	0	0	0	0	0	0	0	0	0				
	V_{MAX}	0	0	0	0	0	0	0	0	0				

Figure B5-29 (Sheet 2)

HIGH ALTITUDE CRUISE

GROSS WEIGHT 65,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-229

DATE: 1 JULY 1992
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

	KTAS	DRAG INDEX									ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS		
		0	20	40	60	80	100	120	140	160		CRUISE	MIL	V_{MAX}
25,000 FEET (-35°C)	360	6512	6802	7096	7391	7686	8002	8330	8657	8985	-80	.900	1.148	.992
	400	6183	6559	6939	7333	7726	8131	8557	8984	9435	-60	.945	1.037	.996
	440	6310	6789	7283	7793	8308	8846	9385	9980	10582	-40	.988	1.020	.999
	480	6673	7276	7922	8573	9240	9929	10654	11427	12240	-20	1.030	.873	.987
	520	7363	8197	9056	9937	10869	11863	12913	14035	15164	0	1.070	.695	.971
	560	8728	9972	11287	12713	14268	15890	0	0	0				
	600	12629	14430	16678	0	0	0	0	0	0				
	MIL	20195	19163	18419	17070	17060	17020	16881	16751	16513				
	V_{MAX}	656.2	628.9	609.3	571.0	570.3	567.1	556.0	545.6	533.8				
30,000 FEET (-44°C)	360	7806	8113	8423	8748	9072	9397	9722	10048	10374	-80	.919	.941	.934
	400	6356	6709	7064	7427	7829	8231	8647	9080	9514	-60	.966	1.024	.991
	440	6051	6481	6929	7380	7866	8367	8896	9448	10008	-40	1.010	.963	.993
	480	6232	6784	7350	7936	8549	9209	9889	10624	11359	-20	1.052	.765	.956
	520	6704	7427	8175	8948	9770	10684	11645	12621	0	0	1.043	.550	.916
	560	8009	9140	10372	0	0	0	0	0	0				
	600	12633	14331	0	0	0	0	0	0	0				
	MIL	17049	15843	15042	13860	13835	13693	13297	12893	12269				
	V_{MAX}	643.6	611.9	590.8	557.0	556.2	551.5	538.4	524.0	499.0				
35,000 FEET (-54°C)	360	11020	11285	11549	11813	12077	12342	0	0	0	-80	.940	.906	.933
	400	7804	8165	8536	8888	9249	9610	0	0	0	-60	.987	.980	.986
	440	6330	6752	7212	7673	8160	8648	0	0	0	-40	1.032	.937	.993
	480	6004	6525	7067	7640	8256	8886	0	0	0	-20	1.075	.783	.964
	520	6377	7043	7759	8561	9406	0	0	0	0	0	1.117	.625	.933
	560	8736	9902	11250	0	0	0	0	0	0				
	600	0	0	0	0	0	0	0	0	0				
	MIL	11955	11504	11177	10764	10619	10211	0	0	0				
	V_{MAX}	590.1	573.2	560.0	542.9	536.4	517.7	0	0	0				

Figure B5-30 (Sheet 1 of 2)

HIGH ALTITUDE CRUISE
GROSS WEIGHT 65,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-229

DATE: 1 JULY 1992
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

	KTAS	DRAG INDEX									ACTUAL OAT DEG. C	TEMP. EFFECTS- FACTORS		
		0	20	40	60	80	100	120	140	160		CRUISE	MIL	V_{MAX}
40,000 FEET (-57°C)	360	16124	16329	16533	0	0	0	0	0	0	-80	.944	.908	.937
	400	11991	12271	12551	0	0	0	0	0	0	-60	.992	.988	.991
	440	8903	9292	9681	0	0	0	0	0	0	-40	1.037	.931	.998
	480	7103	7841	8171	0	0	0	0	0	0	-20	1.031	.762	.976
	520	6786	7506	8249	0	0	0	0	0	0	0	1.122	.587	.954
	560	0	0	0	0	0	0	0	0	0				
	600	0	0	0	0	0	0	0	0	0				
	MIL	8967	8765	8269	0	0	0	0	0	0				
	V_{MAX}	556.9	547.0	520.2	0	0	0	0	0	0				

	KTAS	0	20	40	60	80	100	120	140	160	ACTUAL OAT DEG. C	CRUISE	MIL	V_{MAX}
45,000 FEET (-57°C)	360	0	0	0	0	0	0	0	0	0	-80	.944	.924	.944
	400	0	0	0	0	0	0	0	0	0	-60	.992	.990	.992
	440	0	0	0	0	0	0	0	0	0	-40	1.037	.940	1.012
	480	0	0	0	0	0	0	0	0	0	-20	1.081	.879	1.030
	520	0	0	0	0	0	0	0	0	0	0	1.122	.816	1.049
	560	0	0	0	0	0	0	0	0	0				
	600	0	0	0	0	0	0	0	0	0				
	MIL	0	0	0	0	0	0	0	0	0				
	V_{MAX}	0	0	0	0	0	0	0						

Figure B5-30 (Sheet 2)

HIGH ALTITUDE CRUISE

GROSS WEIGHT 70,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-229

DATE: 1 JULY 1992
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

	KTAS	DRAG INDEX									ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS		
		0	20	40	60	80	100	120	140	160		CRUISE	MIL	V_{MAX}
25,000 FEET (-35°C)	360	7357	7650	7959	8285	8611	8936	9299	9684	10069	-80	.900	1.148	.992
	400	6688	7076	7470	7865	8282	8710	9137	9612	10104	-60	.945	1.087	.996
	440	6645	7134	7647	8160	8699	9241	9823	10429	11053	-40	.988	1.020	.999
	480	6949	7580	8232	8899	9571	10296	11030	11849	12675	-20	1.030	.873	.987
	520	7588	8424	9287	10176	11102	12114	13177	14291	15415	0	1.070	.695	.971
	560	8906	10153	11470	12908	14467	16085	0	0	0				
	600	13002	14816	17083	0	0	0	0	0	0				
	MIL	20037	19046	18316	17069	17060	17003	16866	16733	16435				
	V_{MAX}	652.0	625.8	606.6	570.9	570.2	565.7	554.8	544.2	530.6				

	KTAS	0	20	40	60	80	100	120	140	160	ACTUAL OAT DEG. C	CRUISE	MIL	V_{MAX}
30,000 FEET (-44°C)	360	9723	10046	10369	10692	11016	11339	11662	11985	12308	-80	.919	.941	.934
	400	7158	7532	7933	8334	8756	9188	9621	10063	10512	-60	.966	1.024	.991
	440	6561	7015	7470	7970	8474	9017	9571	10143	10724	-40	1.010	.963	.993
	480	6571	7139	7714	8334	8978	9664	10389	11132	0	-20	1.052	.765	.956
	520	6994	7737	8511	9316	10169	11135	12119	0	0	0	1.043	.550	.916
	560	8284	9420	10689	0	0	0	0	0	0				
	600	13219	14912	0	0	0	0	0	0	0				
	MIL	16606	15599	14839	13855	13832	13588	13135	12572	11682				
	V_{MAX}	632.0	605.5	585.2	556.8	556.1	548.0	533.1	511.2	475.5				

	KTAS	0	20	40	60	80	100	120	140	160	ACTUAL OAT DEG. C	CRUISE	MIL	V_{MAX}
35,000 FEET (-54°C)	360	13459	13714	13975	14235	14496	0	0	0	0	-80	.940	.906	.933
	400	9702	10061	10420	10780	11139	0	0	0	0	-60	.987	.980	.986
	440	7273	7739	8227	8716	9204	0	0	0	0	-40	1.032	.937	.993
	480	6565	7116	7696	8326	8965	0	0	0	0	-20	1.075	.783	.964
	520	6816	7526	8306	9152	10024	0	0	0	0	0	1.117	.625	.933
	560	9332	10588	0	0	0	0	0	0	0				
	600	0	0	0	0	0	0	0	0	0				
	MIL	11677	11325	11033	10755	10349	0	0	0	0				
	V_{MAX}	579.8	566.0	554.2	542.5	524.1	0	0	0	0				

Figure B5-31 (Sheet 1 of 2)

HIGH ALTITUDE CRUISE

GROSS WEIGHT 70,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-229

DATE: 1 JULY 1992
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

	KTAS	DRAG INDEX								
		0	20	40	60	80	100	120	140	160
40,000 FEET (-57°C)	360	18861	0	0	0	0	0	0	0	0
	400	14640	0	0	0	0	0	0	0	0
	440	10882	0	0	0	0	0	0	0	0
	480	8532	0	0	0	0	0	0	0	0
	520	7746	0	0	0	0	0	0	0	0
	560	0	0	0	0	0	0	0	0	0
	600	0	0	0	0	0	0	0	0	0
	MIL	8763	0	0	0	0	0	0	0	0
	V_{MAX}	546.5	0	0	0	0	0	0	0	0
45,000 FEET (-57°C)	360	0	0	0	0	0	0	0	0	0
	400	0	0	0	0	0	0	0	0	0
	440	0	0	0	0	0	0	0	0	0
	480	0	0	0	0	0	0	0	0	0
	520	0	0	0	0	0	0	0	0	0
	560	0	0	0	0	0	0	0	0	0
	600	0	0	0	0	0	0	0	0	0
	MIL	0	0	0	0	0	0	0	0	0
	V_{MAX}	0	0	0	0	0	0	0	0	0

	ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS		
		CRUISE	MIL	V_{MAX}
40,000 FEET (-57°C)	-80	.944	.908	.937
	-60	.992	.988	.991
	-40	1.037	.931	.998
	-20	1.031	.762	.976
	0	1.122	.587	.954
45,000 FEET (-57°C)	-80	.944	.924	.944
	-60	.992	.990	.992
	-40	1.037	.940	1.012
	-20	1.081	.879	1.030
	0	1.122	.816	1.049

Figure B5-31 (Sheet 2)

HIGH ALTITUDE CRUISE
GROSS WEIGHT 75,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-229

DATE: 1 JULY 1992
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

	KTAS	DRAG INDEX									ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS		
		0	20	40	60	80	100	120	140	160		CRUISE	MIL	V_{MAX}
25,000 FEET (-35°C)	360	8498	8818	9152	9532	9911	10290	10674	11069	11464	-80	.900	1.148	.992
	400	7276	7671	8073	8501	8930	9374	9867	10360	10864	-60	.945	1.087	.996
	440	7028	7544	8059	8596	9140	9713	10322	10939	11605	-40	.988	1.020	.999
	480	7248	7905	8568	9246	9948	10685	11474	12299	13154	-20	1.030	.873	.987
	520	7842	8674	9541	10439	11372	12392	13471	14580	15697	0	1.070	.695	.971
	560	9099	10350	11670	13115	14885	16299	0	0	0				
	600	13415	15246	17536	0	0	0	0	0	0				
	MIL	19830	18914	18196	17068	17059	16984	16844	16711	16344				
	V_{MAX}	646.6	622.3	603.4	570.9	570.2	564.2	553.1	542.5	526.9				

	KTAS	0	20	40	60	80	100	120	140	160	ACTUAL OAT DEG. C	CRUISE	MIL	V_{MAX}
30,000 FEET (-44°C)	360	11793	12113	12432	12752	13072	13392	13712	14033	0	-80	.919	.941	.934
	400	8297	8715	9146	9577	10017	10468	10902	11344	0	-60	.966	1.024	.991
	440	7175	7646	8154	8670	9228	9786	10372	10959	0	-40	1.010	.963	.993
	480	6965	7543	8158	8790	9483	10201	10951	11705	0	-20	1.052	.765	.956
	520	7327	8088	8880	9719	10649	11634	12634	0	0	0	1.043	.550	.916
	560	8603	9772	11088	0	0	0	0	0	0				
	600	13882	0	0	0	0	0	0	0	0				
	MIL	16153	15324	14664	13849	13827	13430	12902	11968	0				
	V_{MAX}	620.0	598.3	580.2	556.6	555.9	542.8	524.4	487.0	0				

	KTAS	0	20	40	60	80	100	120	140	160	ACTUAL OAT DEG. C	CRUISE	MIL	V_{MAX}
35,000 FEET (-54°C)	360	16330	16583	16836	17089	0	0	0	0	0	-80	.940	.906	.933
	400	11691	12045	12399	12753	0	0	0	0	0	-60	.987	.980	.986
	440	8578	9075	9558	10049	0	0	0	0	0	-40	1.032	.937	.993
	480	7302	7900	8543	9192	0	0	0	0	0	-20	1.075	.783	.964
	520	7345	8109	8958	9841	0	0	0	0	0	0	1.117	.625	.933
	560	10054	0	0	0	0	0	0	0	0				
	600	0	0	0	0	0	0	0	0	0				
	MIL	11437	11164	10877	10498	0	0	0	0	0				
	V_{MAX}	570.5	559.5	548.0	538.0	0	0	0	0	0				

Figure B5-32

HIGH ALTITUDE CRUISE
GROSS WEIGHT 80,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S) (2) F100-PW-229

DATE: 1 JULY 1992
DATA BASIS: FLIGHT TEST

TOTAL FUEL FLOW LB/HR

	KTAS	DRAG INDEX									ACTUAL OAT DEG. C	TEMP. EFFECTS-FACTORS		
		0	20	40	60	80	100	120	140	160		CRUISE	MIL	V_{MAX}
25,000 FEET (-35°C)	360	10119	1049	10883	11274	11665	12056	12447	12838	13229	-80	.900	1.148	.992
	400	7963	8388	8815	9242	9733	10225	10718	11243	11768	-60	.945	1.087	.996
	440	7508	8026	8564	9111	9683	10295	10914	11583	12252	-40	.988	1.020	.999
	480	7577	8240	8919	9603	10343	11097	11930	12775	13646	-20	1.030	.873	.987
	520	8117	8966	9839	10760	11733	12762	13872	14989	16109	0	1.070	.695	.971
	560	9321	10577	11909	13367	14937	16543	0	0	0				
	600	13904	15766	0	0	0	0	0	0	0				
	MIL	19593	18759	18060	17067	17058	16961	16819	16671	16196				
	V_{MAX}	640.3	618.3	599.6	570.8	570.1	562.4	551.0	540.4	520.7				
30,000 FEET (-44°C)	360	14089	14402	14717	15031	15346	15660	15975	0	0	-80	.919	.941	.934
	400	9987	10436	10856	11290	11725	12159	12594	0	0	-60	.966	1.024	.991
	440	7926	8437	8983	9545	10123	10711	11304	0	0	-40	1.010	.963	.993
	480	7427	8038	8670	9364	10079	10837	11598	0	0	-20	1.052	.765	.956
	520	7696	8487	9311	10186	11175	12185	0	0	0	0	1.043	.550	.916
	560	8958	10172	11561	0	0	0	0	0	0				
	600	14587	0	0	0	0	0	0	0	0				
	MIL	15771	15045	14489	13841	13712	13155	12380	0	0				
	V_{MAX}	610.0	590.9	575.3	556.4	552.1	533.8	503.5	0	0				
35,000 FEET (-54°C)	360	18962	19216	19471	0	0	0	0	0	0	-80	.940	.906	.933
	400	13924	14276	14627	0	0	0	0	0	0	-60	.987	.980	.986
	440	10288	10770	11252	0	0	0	0	0	0	-40	1.032	.937	.993
	480	832.6	8975	9634	0	0	0	0	0	0	-20	1.075	.783	.964
	520	7990	8846	9740	0	0	0	0	0	0	0	1.117	.625	.933
	560	10844	0	0	0	0	0	0	0	0				
	600	0	0	0	0	0	0	0	0	0				
	MIL	11263	10985	10654	0	0	0	0	0	0				
	V_{MAX}	563.5	552.3	537.9	0	0	0	0	0	0				

Figure B5-33

CONSTANT ALTITUDE CRUISE

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

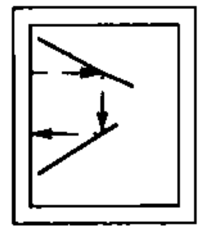
LANDING GEAR EXTENDED
CRUISE SPEED – 250 KCAS

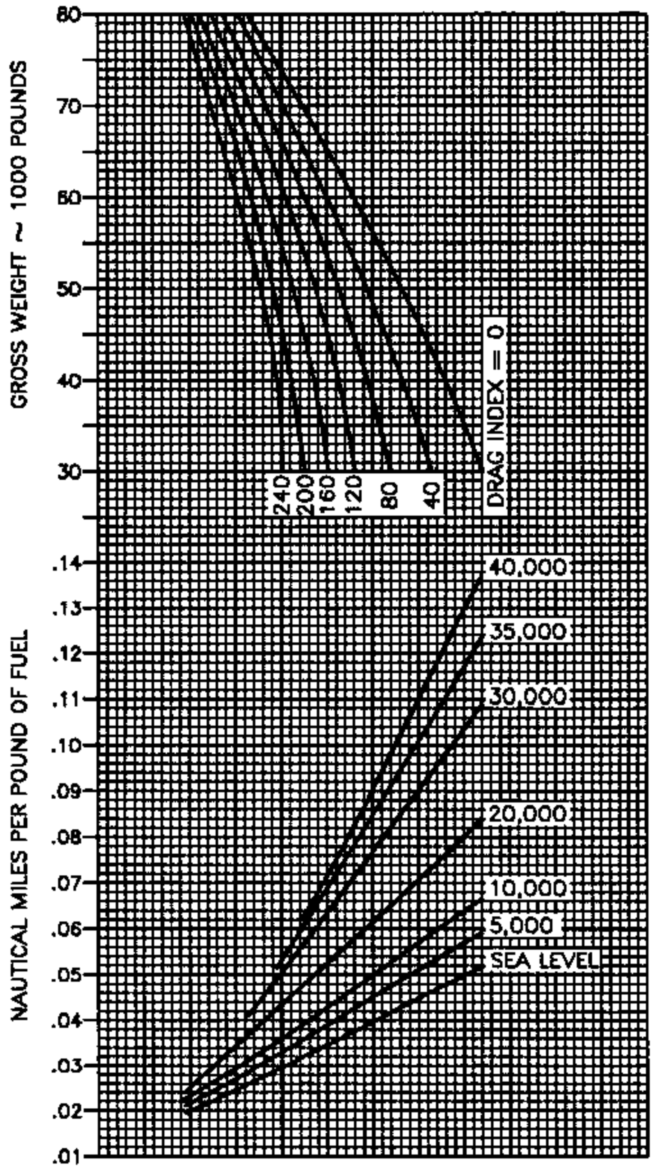
REMARKS
ENGINE(S): (2)F100-PW-229
DATA APPLICABLE FOR ANY TEMPERATURE

NOTES
- LANDING GEAR DRAG MUST ALSO BE INCLUDED WHEN CALCULATING TOTAL DRAG INDEX
- DI = 40 FOR NOSE GEAR DI = 25 FOR EACH MAIN GEAR
- SPEEDS RESTRICTED TO 250 KCAS WITH GEAR EXTENDED

DATE: 15 JULY 1991
DATA BASIS: ESTIMATED

GUIDE





15E-1-(284-1)25-CATI

Figure B5-34

PART 6

ENDURANCE

TABLE OF CONTENTS

Charts

NOTE

Performance charts for the PW-229 engines are currently being developed. The references to figures have been retained even if the chart is not available. The actual charts will be added as they become available.

MAXIMUM ENDURANCE CHARTS

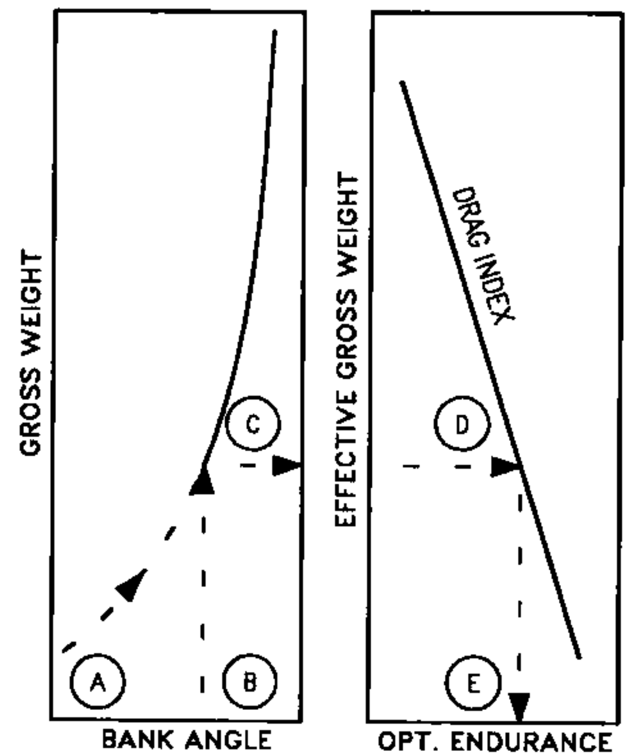
These charts (figures B6-1 and B6-2) present optimum endurance altitude and maximum endurance specifics (fuel flow and Mach number) for various combinations of effective gross weight and altitude.

USE (ALTITUDE AND BANK ANGLE CHART)

Enter the Altitude and Bank Angle chart with the average gross weight. If bank angles are to be considered, follow the gross weight curve until it intersects the bank angle to be used, then project horizontally right to obtain effective gross weight. (If bank angles are not to be considered, enter the chart at the effective gross weight scale.) From this point proceed horizontally right to intersect the applicable drag index curve, then project vertically down to read optimum endurance altitude.

SAMPLE MAXIMUM ENDURANCE

ALTITUDE AND BANK ANGLE



15E-1-(86-1)44-CATI

Sample Problem

Altitude and Bank Angle

A. Gross weight	60,000Lb
B. Bank angle	20°
C. Effective gross weight	63,800 Lb
D. Drag index	120
E. Optimum endurance altitude	18,000 Ft

USE (FUEL FLOW AND MACH NUMBER CHART)

Enter the fuel flow and Mach number plots on the Fuel Flow and Mach Number chart with the effective gross weight, then horizontally to intersect the optimum endurance altitude curve. From this point, project vertically down to intersect the applicable drag index curve, then horizontally to read fuel flow or true Mach number.

Sample Problem

Fuel Flow

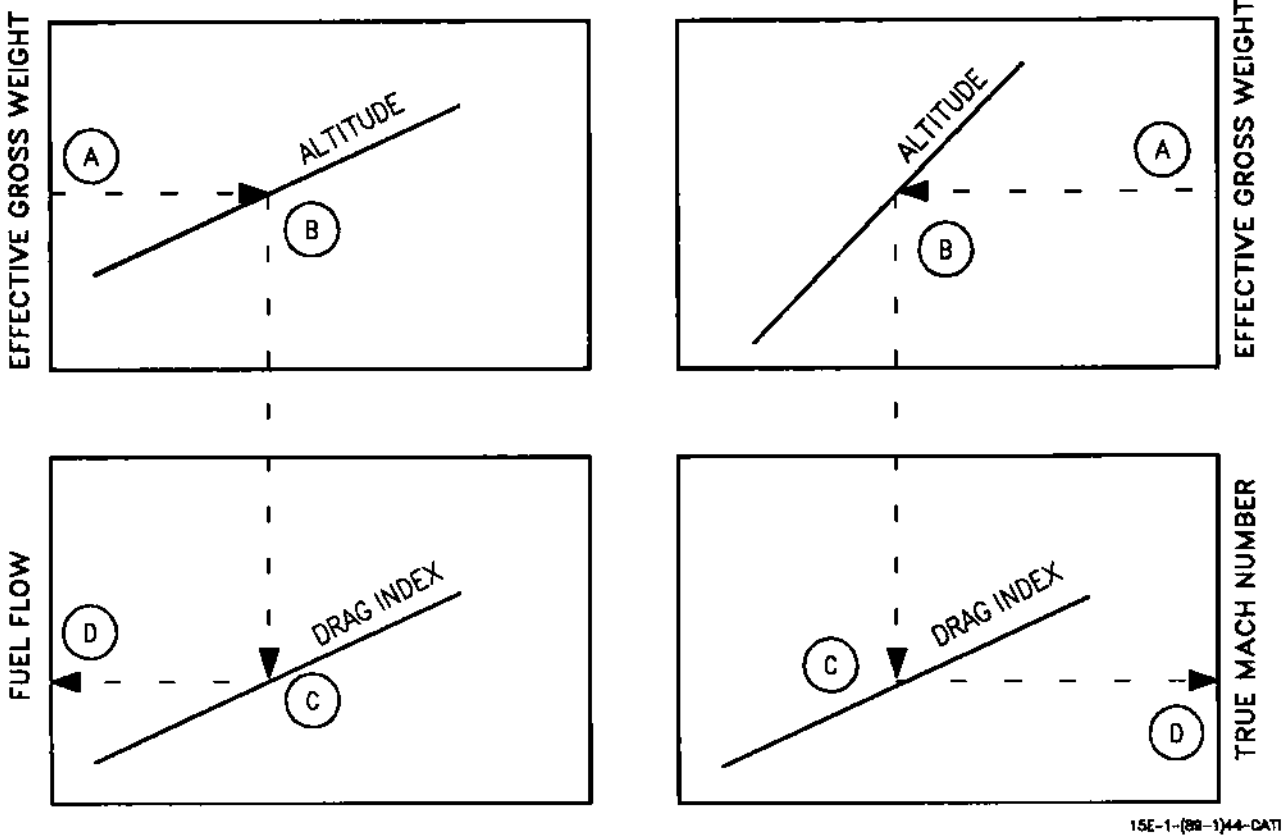
A. Effective gross weight	63,800 Lb
B. Endurance altitude	18,000 Ft
C. Drag index	120
D. Fuel flow	8050 PPH

Mach Number

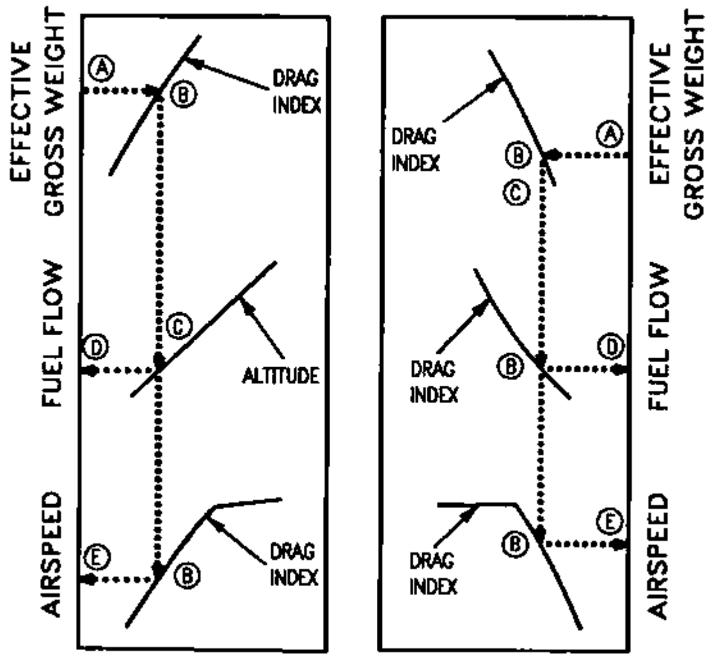
A. Effective gross weight	63,800 Lb
B. Endurance altitude	18,000 Ft
C. Drag index	120
D. True Mach number	0.589

SAMPLE MAXIMUM ENDURANCE

FUEL FLOW AND TRUE MACH NUMBER



SAMPLE ENDURANCE, LANDING GEAR EXTENDED



15E-1-(158-1)04-CATI

ENDURANCE-LANDING GEAR EXTENDED

This chart (figure B6-3) presents constant altitude endurance and maximum endurance specifics (fuel flow, calibrated airspeed, and altitude) for various combinations of gross weight and drag index.

USE

If bank angles are to be considered, utilize the method described in the previous problem to determine the effective gross weight. To obtain constant altitude endurance specifics, enter the left side of the chart at the effective gross weight scale. From this point, proceed horizontally right to intersect the applicable drag index curve, then project downward to intersect with the desired altitude. From this point, project horizontally left to read the fuel flow. To obtain the calibrated airspeed, project downward from the altitude-fuel flow intersection to intersect with the applicable drag index curves on the airspeed chart, project horizontally left from this point to read the calibrated airspeed.

To obtain maximum endurance specifics, the right side of the chart is used. Enter the chart at the effective gross weight and project horizontally left to intersect with the applicable drag index curve. From this point, project downward to read the maximum endurance altitude from the horizontal scale. Project further downward to intersect with the applicable drag index curve and project horizontally right to read the fuel flow or the calibrated airspeed.

Sample Problem

Constant Altitude Endurance

A. Effective gross weight	42,500 Lb
B. Drag index (external stores)	30
Drag index (all gear extended)	90
Total drag index	120
C. Altitude	10,000 Ft
D. Fuel flow	5,400 PPH
E. Airspeed	203 KCAS

Maximum Endurance

A. Effective gross weight	42,500 Lb
B. Drag index	120
C. Altitude	28,000 Ft
D. Fuel flow	5,600 PPH
E. Airspeed	204 KCAS

MAXIMUM ENDURANCE

ALTITUDE AND BANK ANGLE

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S): (2)F100-PW-229
U.S. STANDARD DAY, 1966

DATE: 15 JULY 1991
DATA BASIS: ESTIMATED

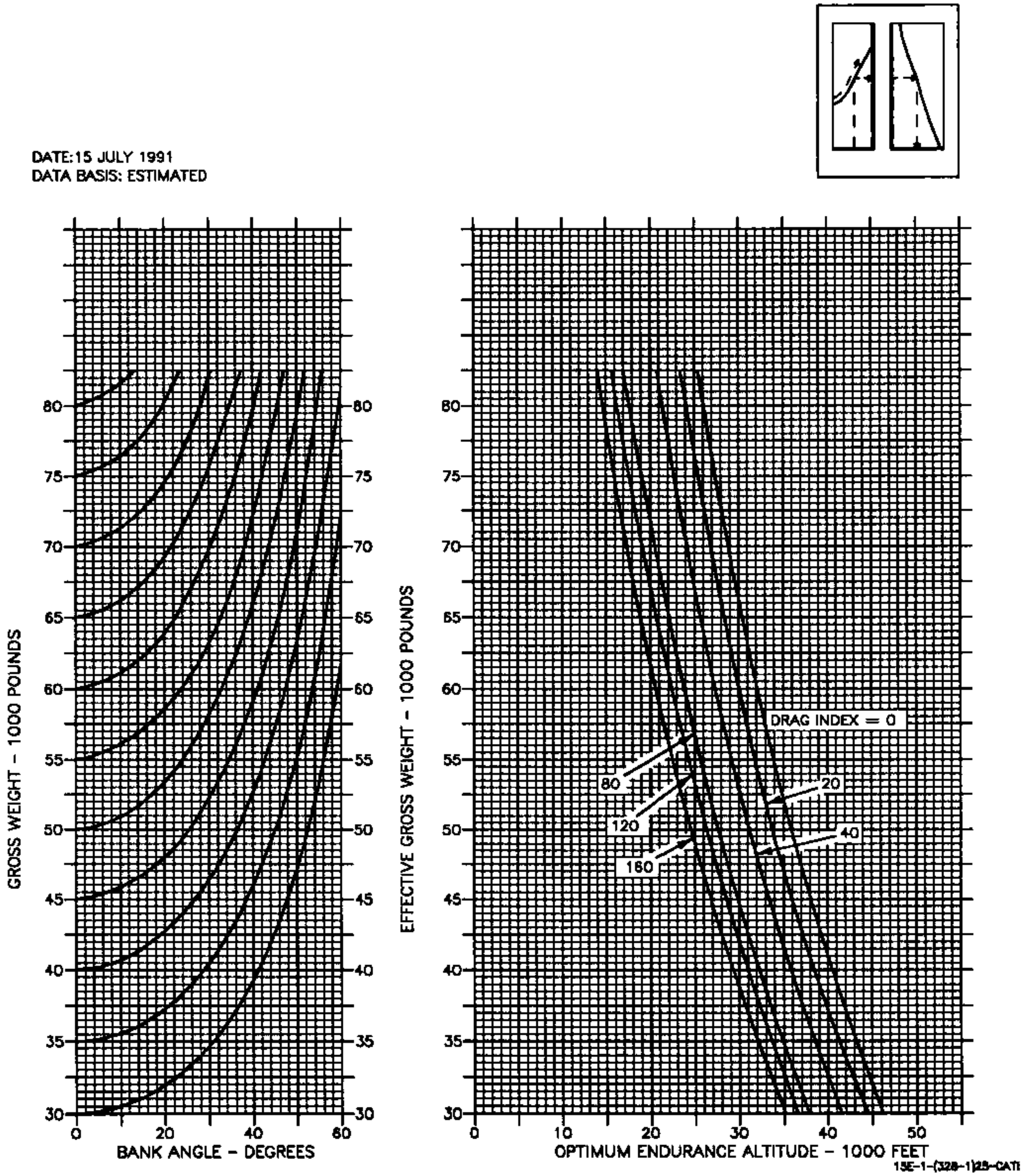


Figure B6-1

MAXIMUM ENDURANCE

FUEL FLOW AND TRUE MACH NUMBER

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES

DATE: 15 JULY 1991
DATA BASIS: ESTIMATED

REMARKS
ENGINE(S): (2) F100-PW-229
U.S. STANDARD DAY, 1966

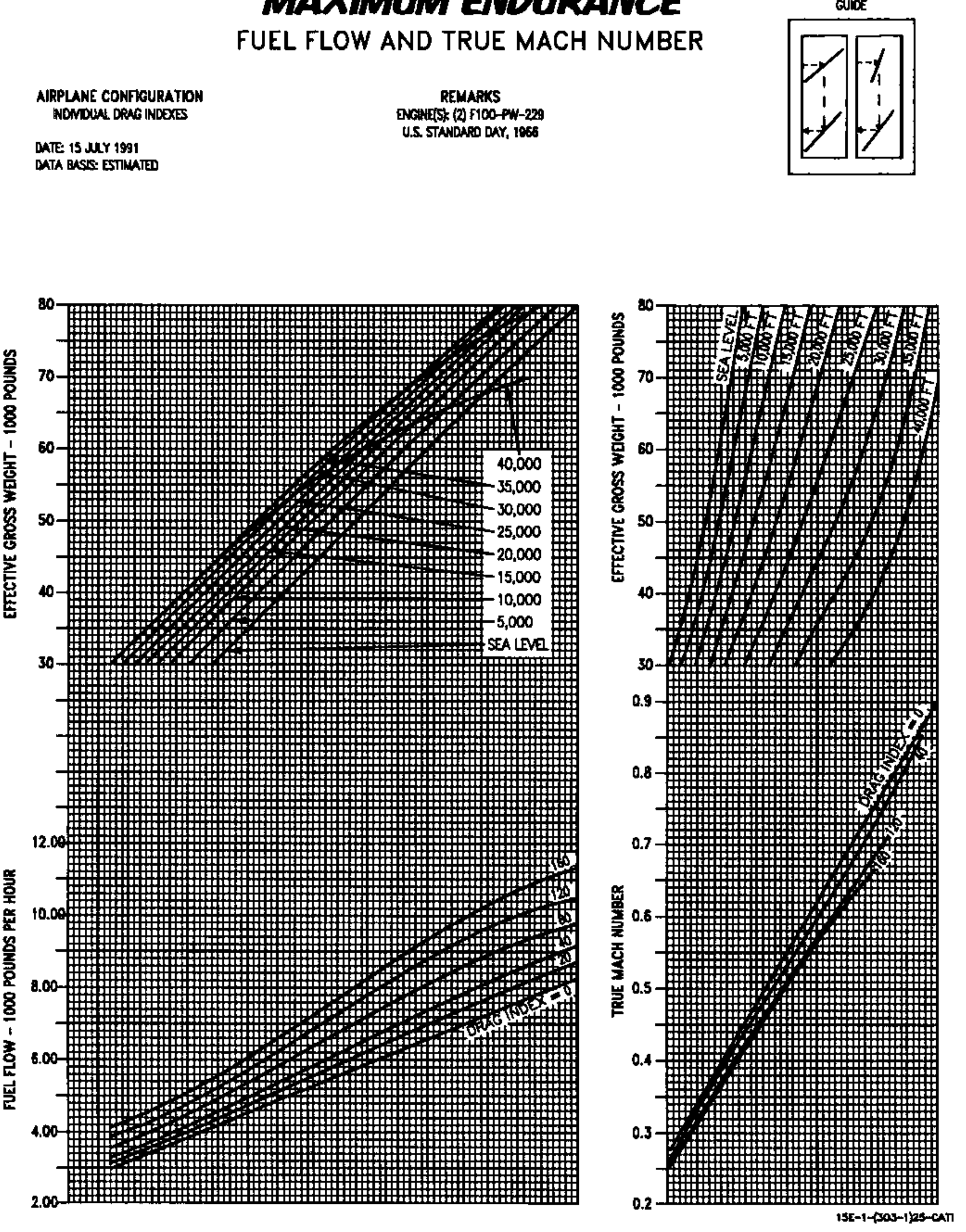


Figure B6-2

PART 7

DESCENT

NOTE

Performance charts for the PW-229 engines are currently being developed. The references to figures have been retained even if the chart is not available. The actual charts will be added as they become available.

DESCENT CHARTS

The Descent charts (figures B7-1 thru B7-5) present distance, time, total fuel used and Mach number in the descent. Incremental data may be obtained for distance, time and fuel by subtracting data corresponding to level-off altitude from the data for the original cruising altitude.

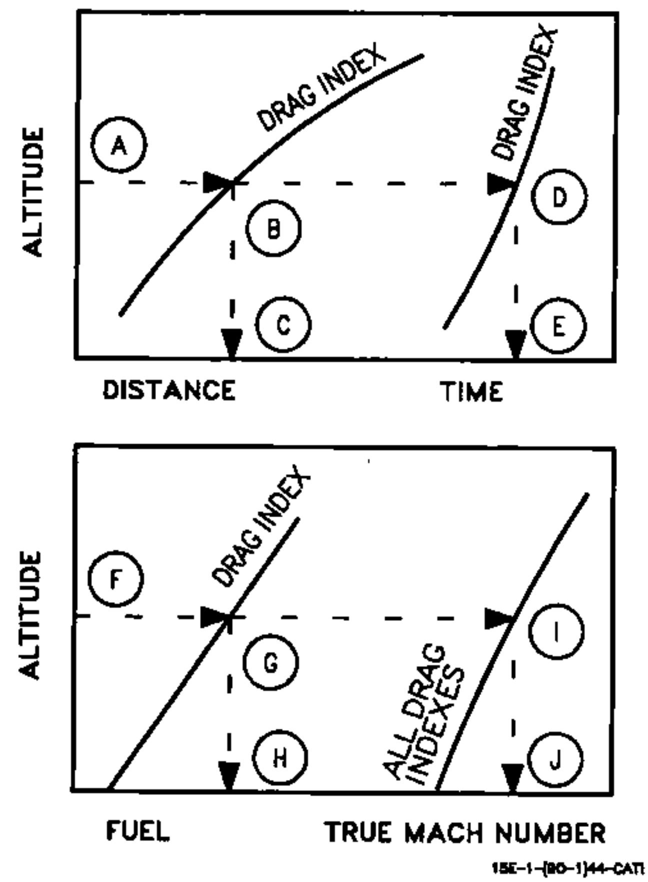
USE

Enter the upper plot of the appropriate chart at the cruising altitude, project horizontally right to intersect both series of drag index curves. From the altitude - drag index intersection in the first series, project vertically down to read distance. From the altitude - drag index intersection in the second series, project vertically down to read time to descend. Enter the lower plot at the cruising altitude and project horizontally right to intersect the applicable drag index curve on the fuel graph. Continue horizontally right and intersect the curve on the Mach number graph. From the altitude - drag index intersection on the fuel graph, descend vertically and read total fuel used in the descent. From the intersection on the Mach number graph, project vertically down to read true Mach number.

Sample Problem

Maximum Range Descent, 220 KCAS, Idle Thrust, Speed Brake Retracted, F-15 without CFT

SAMPLE DESCENT



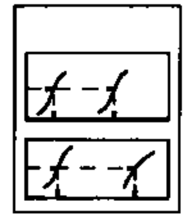
A. Altitude	30,000 Ft
B. Drag index	40
C. Distance	55 NM
D. Drag index	40
E. Time required	11.7 Min
F. Altitude	30,000 Ft
G. Drag index	40
H. Total fuel used	395 Lb
I. Drag reflector	
J. True Mach number	0.59 Mach

DESCENT

WITH CFT
MAXIMUM RANGE
220 KCAS - IDLE THRUST

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES
SPEEDBRAKE RETRACTED

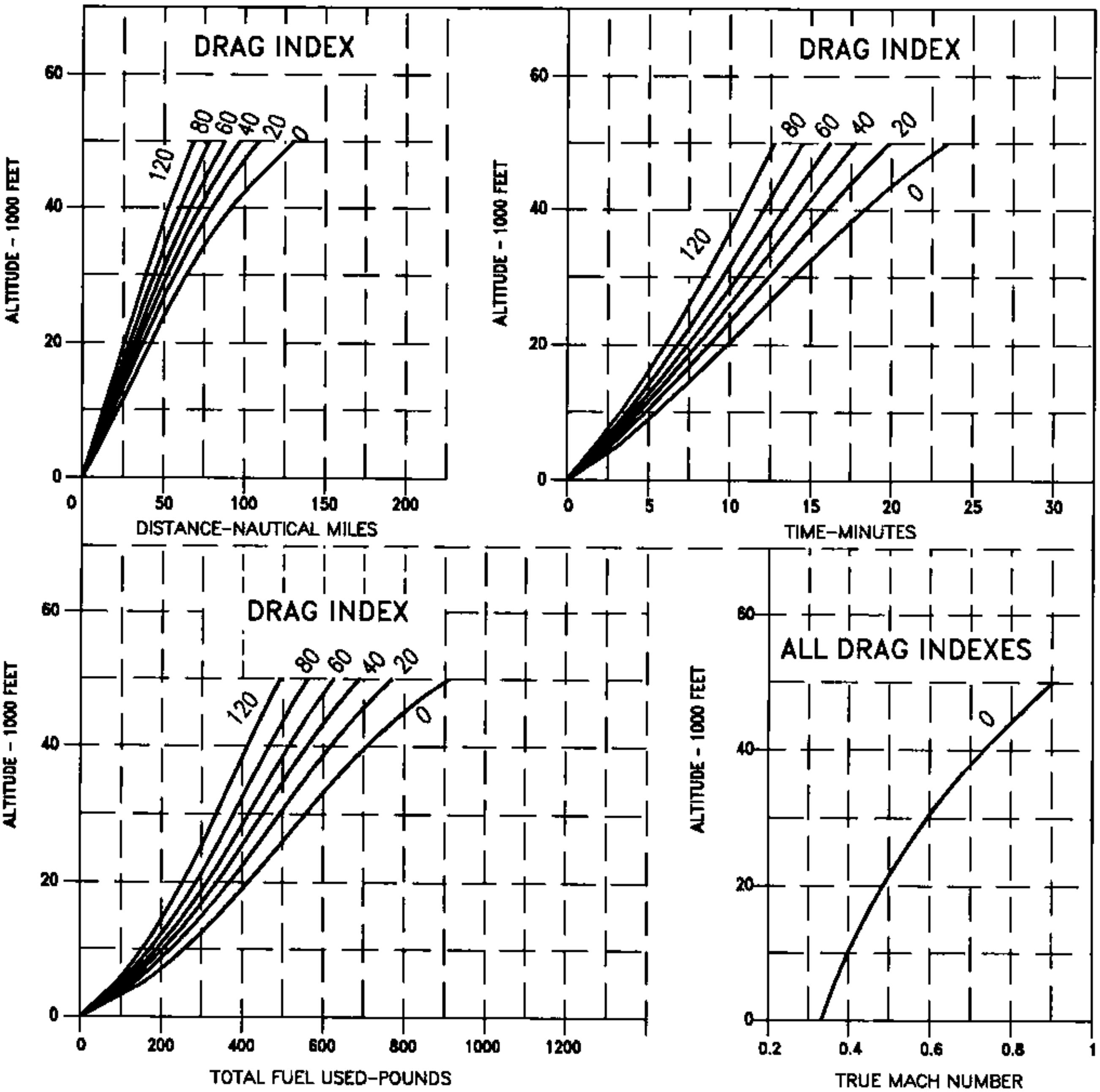
GUIDE



REMARKS

ENGINE(S): (2)F100-PW-229
U.S. STANDARD DAY, 1966

DATE: 15 JULY 1991
DATA BASIS: FLIGHT TEST



15E-1-(371-1)40-CATI

Figure B7-1

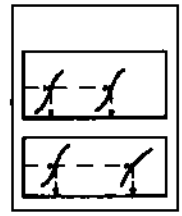
DESCENT

WITH CFT
MAXIMUM RANGE
300 KCAS - IDLE THRUST

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES
SPEEDBRAKE RETRACTED

REMARKS
ENGINE(S); (2)F100-PW-229
U.S. STANDARD DAY, 1966

GUIDE



DATE: 15 JULY 1991
DATA BASIS: FLIGHT TEST

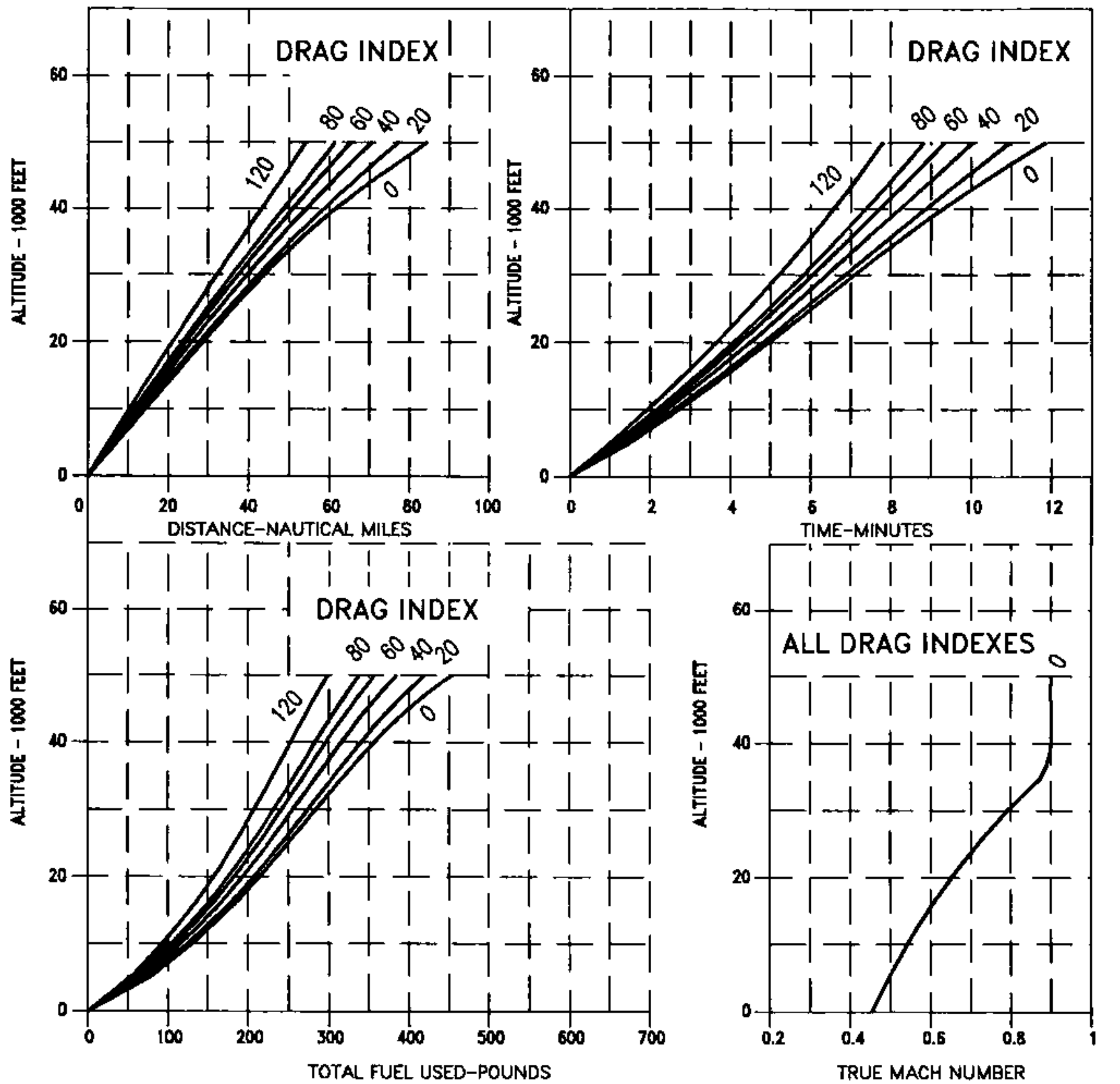


Figure B7-2

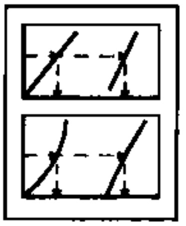
DESCENT

WITHOUT CFT
MAXIMUM RANGE
220 KCAS - IDLE THRUST

AIRPLANE CONFIGURATION
SPEED BRAKE RETRACTED

REMARKS
ENGINE(S): (2) F100-PW-229
U.S. STANDARD DAY, 1966

DATE: 15 JULY 1991
DATA BASIS: ESTIMATED



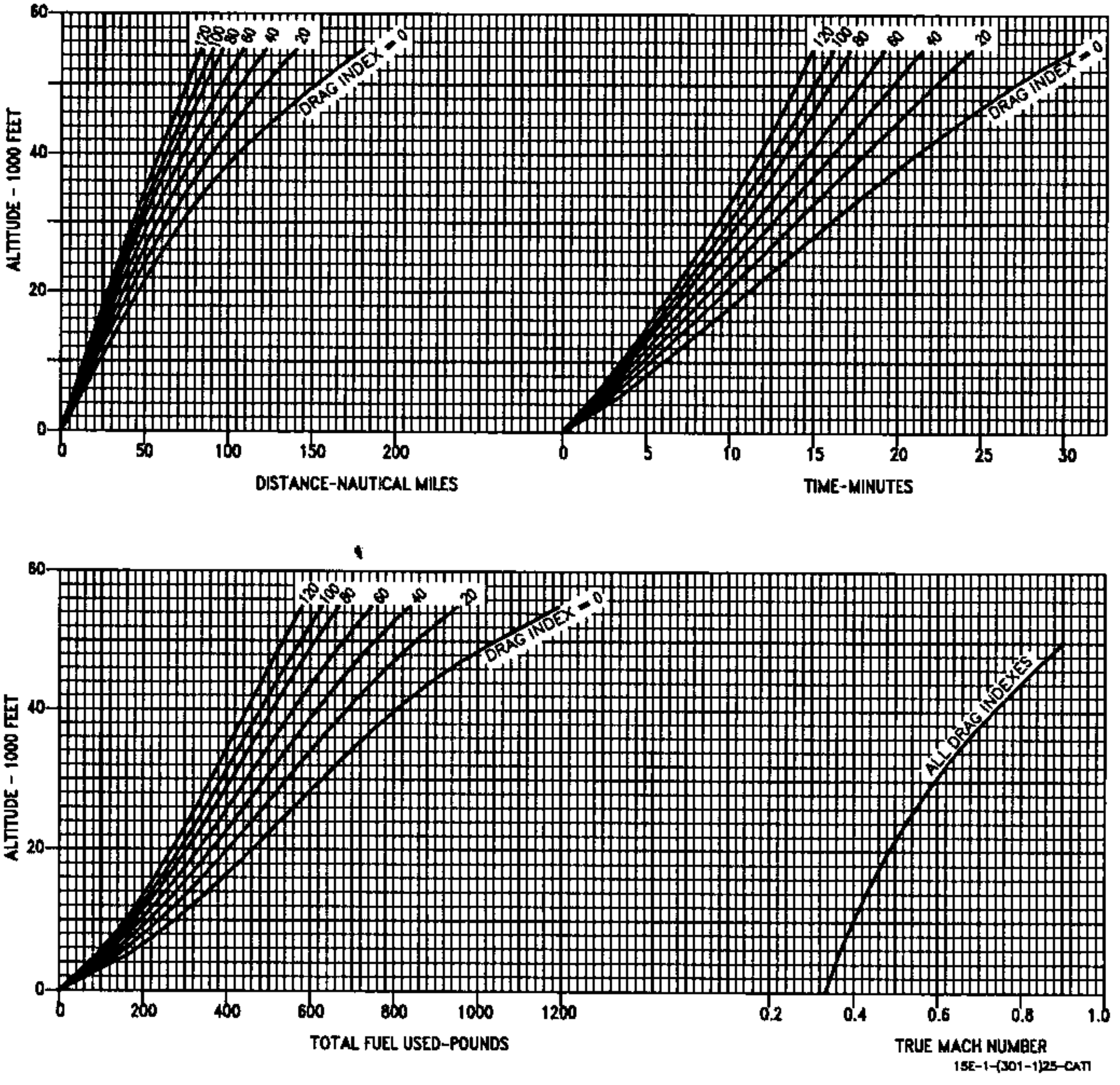
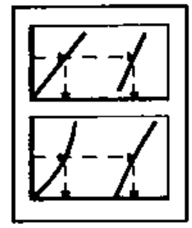


Figure B7-3

DESCENT

WITHOUT CFT
MAXIMUM RANGE
300 KCAS - IDLE THRUST

GUIDE



AIRPLANE CONFIGURATION
SPEED BRAKE RETRACTED

REMARKS
ENGINE(S): (2) F100-PW-229
U.S. STANDARD DAY, 1966

DATE: 15 JULY 1991
DATA BASIS: ESTIMATED

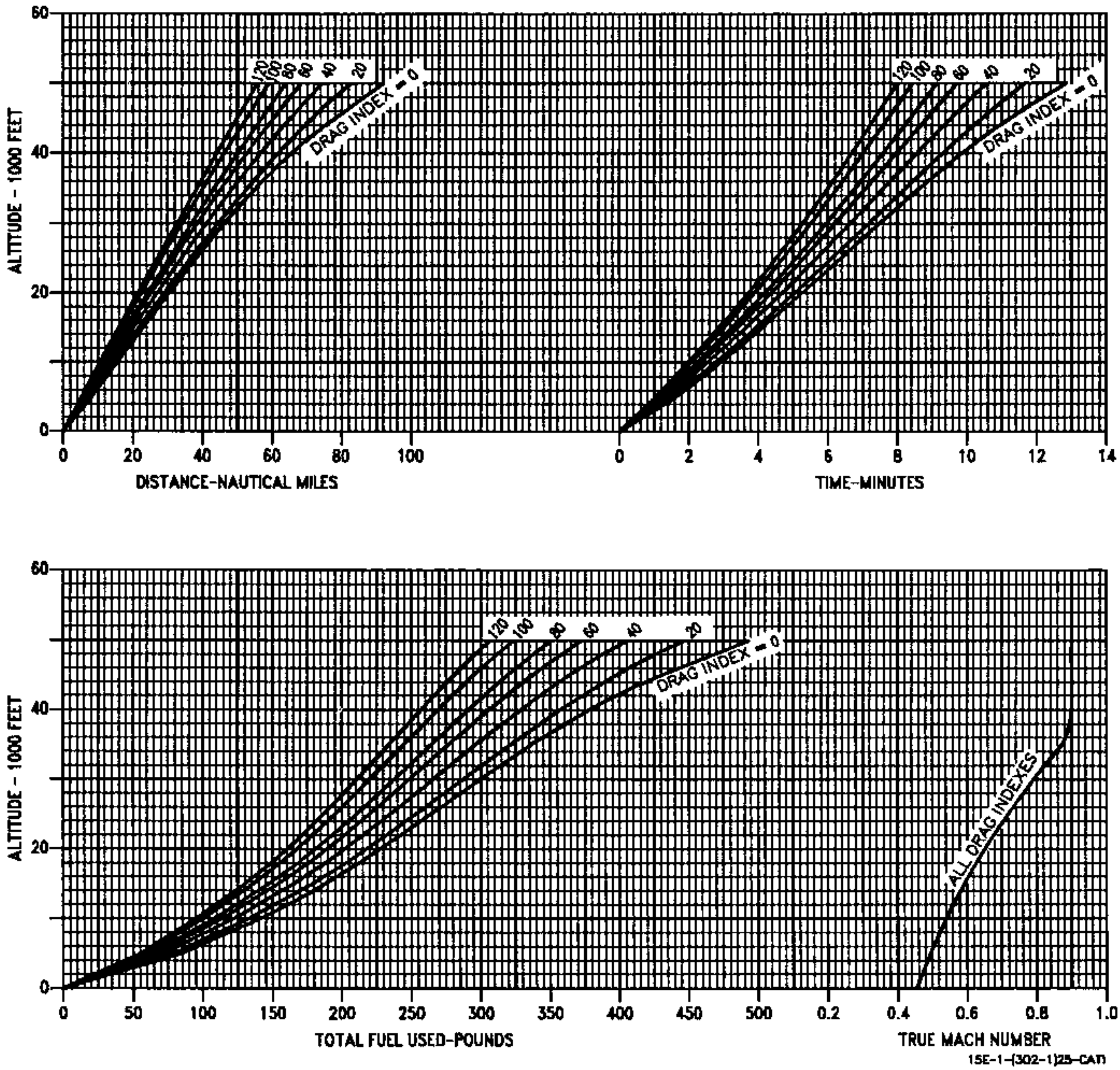


Figure B7-4

DESCENT

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES
SPEEDBRAKE EXTENDED

WITH OR WITHOUT CFT
MAXIMUM RANGE
220 KCAS - IDLE THRUST

REMARKS
ENGINE(S): (2)F100-PW-229
U.S. STANDARD DAY, 1966

DATE: 15 JULY 1991
DATA BASIS: FLIGHT TEST

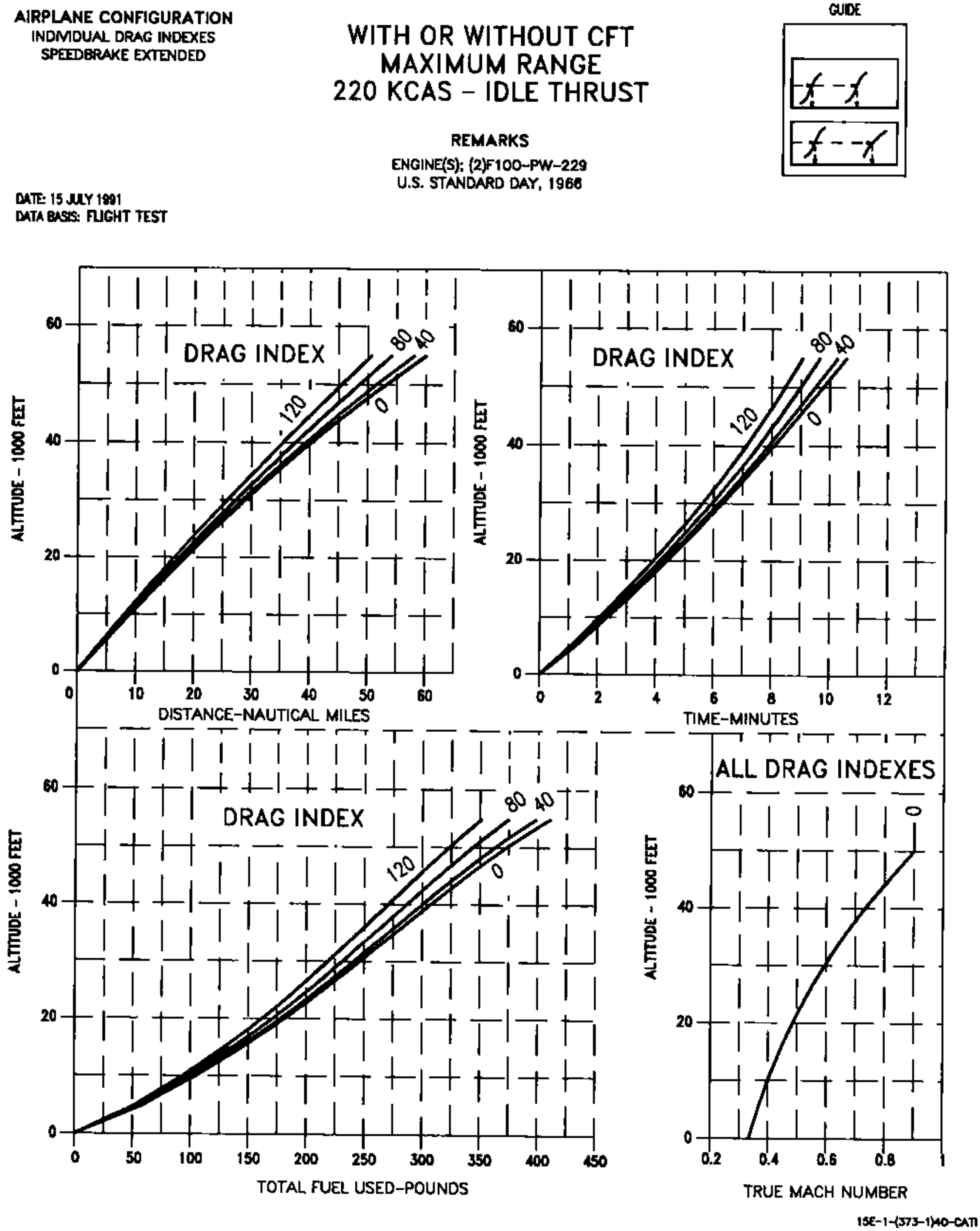


Figure B7-5

PART 8

APPROACH AND LANDING

TABLE OF CONTENTS

Charts

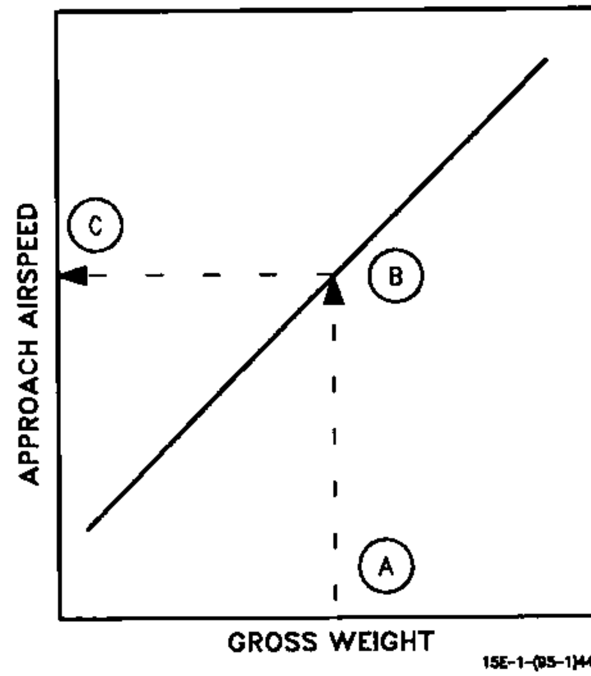
LANDING APPROACH SPEED CHART

The Landing Approach Speed chart (figure B8-1) provides recommended approach speed for various gross weights of the aircraft. The data is plotted for flaps either up or down.

USE

Enter the chart at the estimated landing gross weight and project vertically up to the appropriate flap reflector line. From this point, project horizontally left to read recommended approach speed.

SAMPLE APPROACH SPEED



15E-1-(95-1)44-CATI

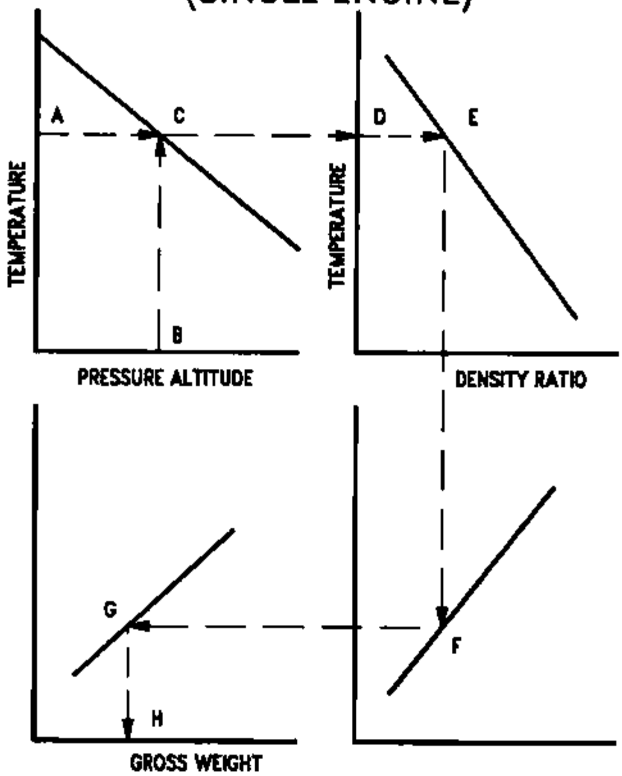
Sample Problem

Configuration: Flaps Down

A. Estimated landing gross weight	50,000 Lb
B. Flaps down reflector line	
C. Landing approach speed	174.1 Kt

SAMPLE MAXIMUM APPROACH GROSS WEIGHT

(SINGLE ENGINE)



15E-1-(230-1)03-CATI

MAXIMUM APPROACH GROSS WEIGHT

The Maximum Approach Gross Weight chart (figure B8-2) provides the maximum gross weight at which the aircraft can peform a single engine maximum power climb after experiencing an engine failure. The data presented are based on the requirement that the aircraft be able to climb at a rate of 500 ft/min at approach speed at the existing ambient temperature and pressure altitude.

USE

Enter the chart at the existing ambient temperature and ambient pressure. Project horizontally right at the existing ambient temperature and project vertically up at the existing ambient pressure. The intersection of the two projections represents existing conditions with respect to a standard day. From this point, project horizontally right to the existing ambient pressure altitude and then descend vertically to determine the appropriate density ratio. Continue descending vertically to intersect existing ambient temperature. From this point, project horizontally left to the effective Drag Index and then descend vertically to read gross weight.

Sample Problem

A. Temperature	21°C
B. Pressure Altitude	2000 Ft
C. Type Day	STD +10°C
D. Temperature	21°C
E. Pressure Altitude	2000 Ft
F. Type Day Reflector	STD +10°C
G. Drag Index Reflector	190
H. Gross Weight	77,500 Lb

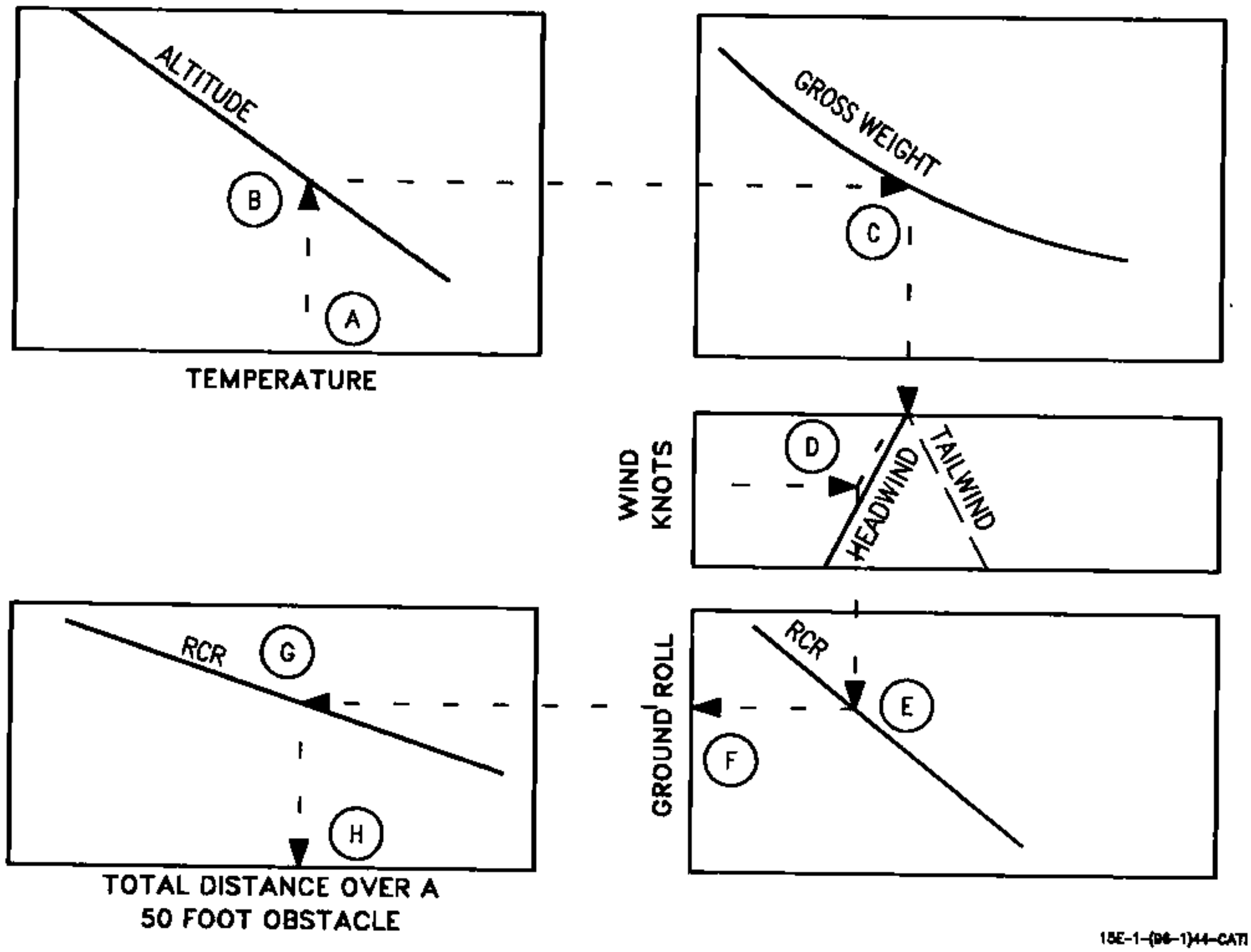
LANDING DISTANCE CHART

These charts (figures B8-3 thru B8-5) provide landing roll distance information. One chart provides data for a normal landing using aerodynamic braking. The other provides data for a landing roll utilizing the technique of lowering the nose immediately after touchdown and applying maximum anti-skid braking. The variables of temperature, altitude, gross weight, effective wind, and runway condition are taken into consideration.

USE

Enter the chart with the runway temperature and project vertically up to the applicable pressure altitude. From this point, proceed horizontally right to the landing gross weight, then descend vertically to the wind baseline. Parallel the nearest guideline down to the effective headwind or tailwind for the appropriate runway condition. From this point, project vertically down to the appropriate runway condition reflector, then horizontally left to read ground roll. Continue further left to the appropriate runway condition reflector, then vertically down to read total distance required when landing over a 50 foot obstacle.

SAMPLE LANDING DISTANCE



Sample Problem

Normal Landing - Aerodynamic Braking

A. Temperature	20°C
B. Pressure altitude	2000 Ft
C. Gross weight	40,000 Lb
D. Effective headwind (DRY)	15 Kt
E. RCR reflector (DRY)	23
F. Landing distance	4500 Ft
G. RCR Reflector (DRY)	
H. Total distance required over a 50-foot obstacle	5600 Ft

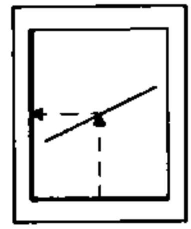
LANDING APPROACH SPEED

WITH OR WITHOUT CFT

AIRPLANE CONFIGURATION
ALL DRAG INDEXES
21 UNITS AOA

REMARKS
ENGINE(S): (2) F100-PW-229
U.S. STANDARD DAY, 1966

DATE: 15 MARCH 1991
DATA BASIS: ESTIMATED



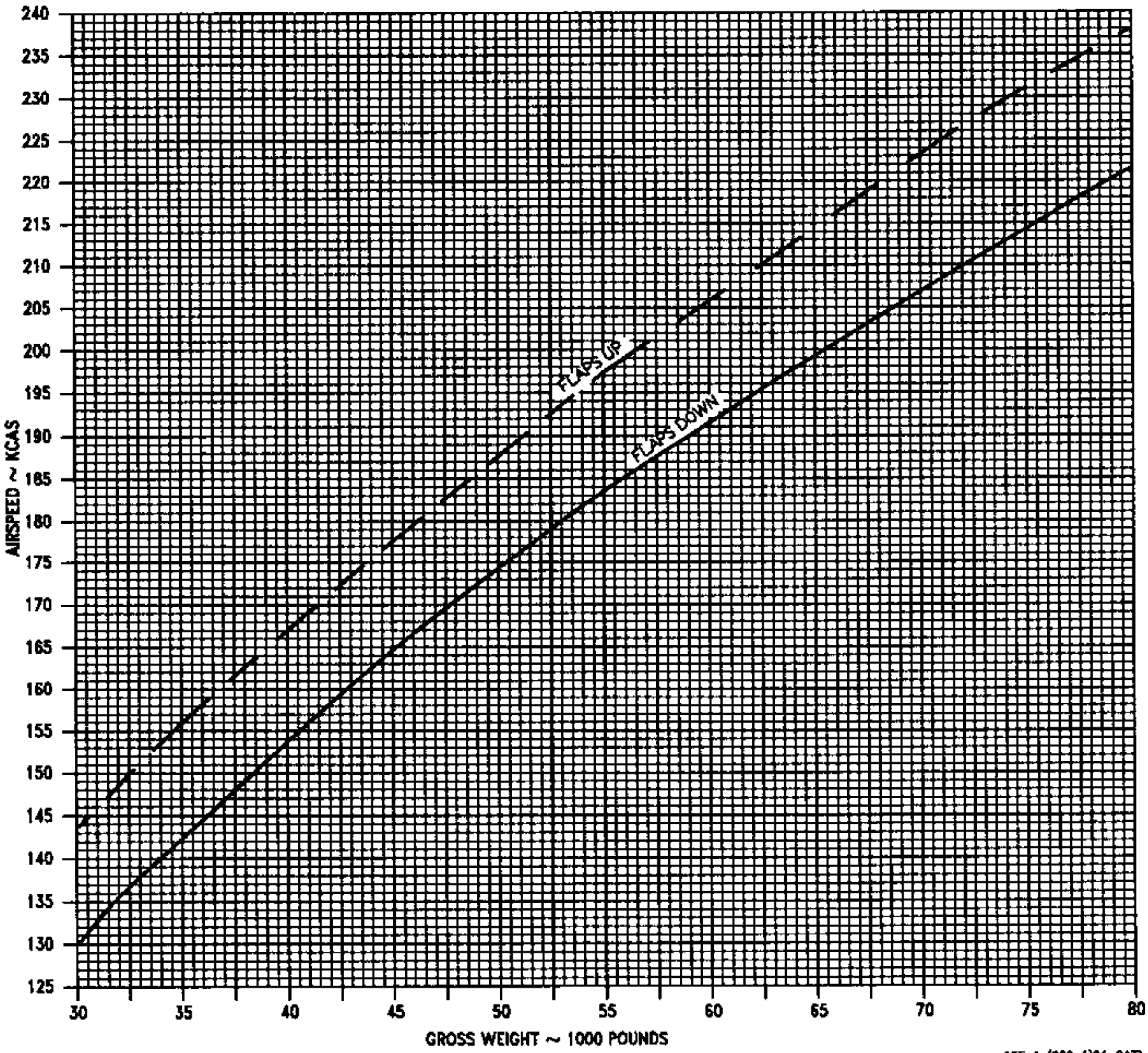
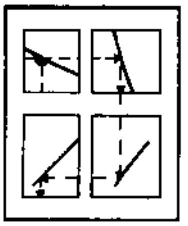


Figure B8-1

MAXIMUM APPROACH GROSS WEIGHT

SINGLE ENGINE OPERATING

GUIDE

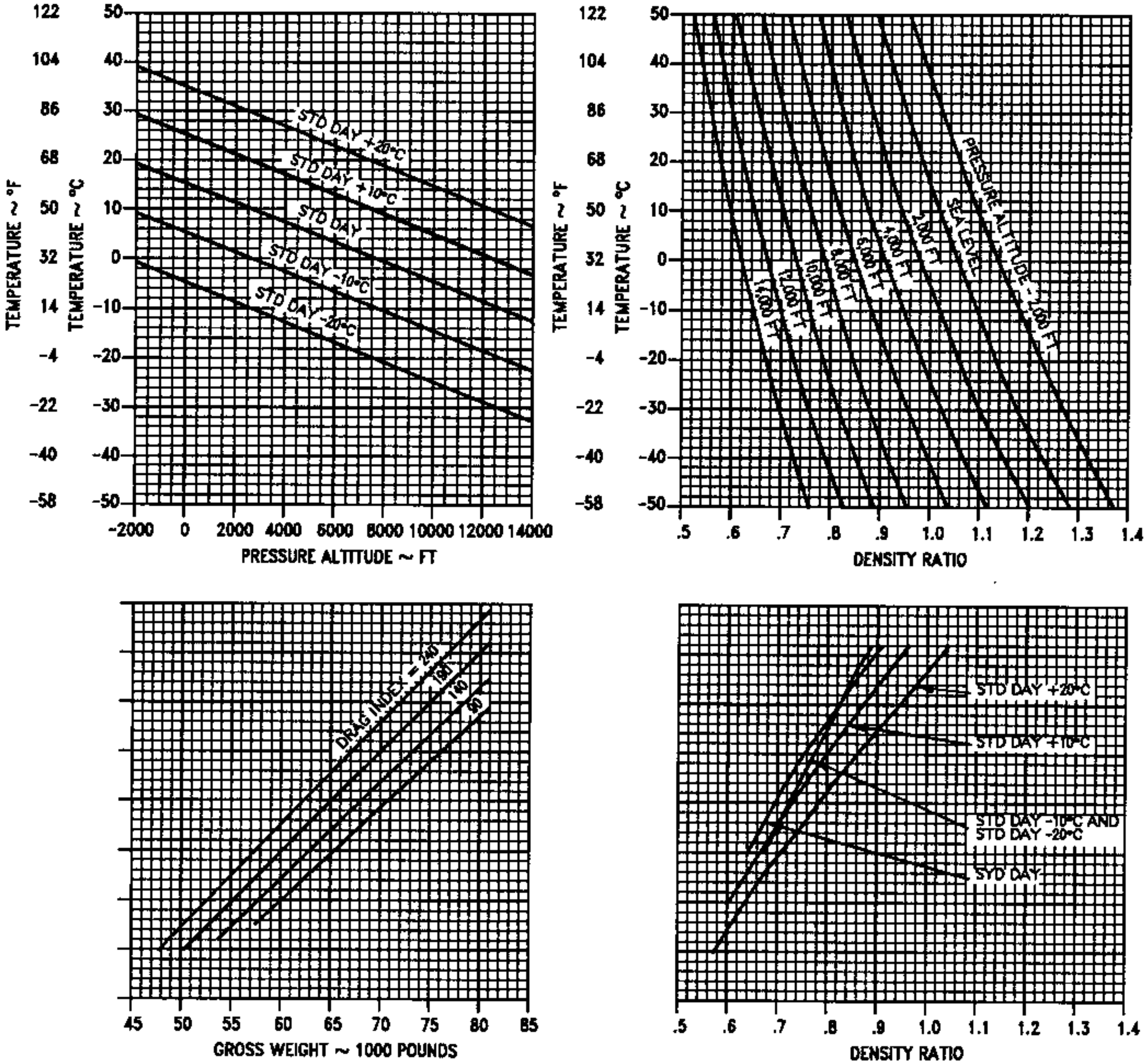


AIRPLANE CONFIGURATION
GEAR AND FLAPS EXTENDED
INDIVIDUAL DRAG INDEXES

REMARKS
ENGINE(S): (2) F100-PW-229
U.S. STANDARD DAY, 1966

NOTE
- LANDING GEAR DRAG MUST ALSO BE INCLUDED WHEN CALCULATING TOTAL DRAG INDEX
- DI=40 NOSE GEAR, DI=25 FOR EACH MAIN GEAR
- INOPERATIVE ENGINE WINDMILLING
- SPEEDBRAKE RETRACTED

DATE: 15 MARCH 1991
DATA BASIS: ESTIMATED



15E-1-(270-1)21-CATI

Figure B8-2

LANDING DISTANCE

WITH OR WITHOUT CFT
AERODYNAMIC BRAKING
IDLE THRUST
GROSS WEIGHT 35,000 TO 55,000 POUNDS

AIRPLANE CONFIGURATION
FLAPS DOWN GEAR DOWN
ALL DRAG INDEXES

REMARKS
ENGINE(S): (2) F100-PW-229

NOTE
- DATA IS BASED ON THE USE OF AERODYNAMIC BRAKING BY RAISING THE NOSE TO A 12° PITCH ATTITUDE AFTER TOUCHDOWN AND MAINTAINING AS LONG AS POSSIBLE.
- SPEED BRAKE IS EXTENDED AT TOUCHDOWN.

DATE: 15 MARCH 1991
DATA BASIS: ESTIMATED

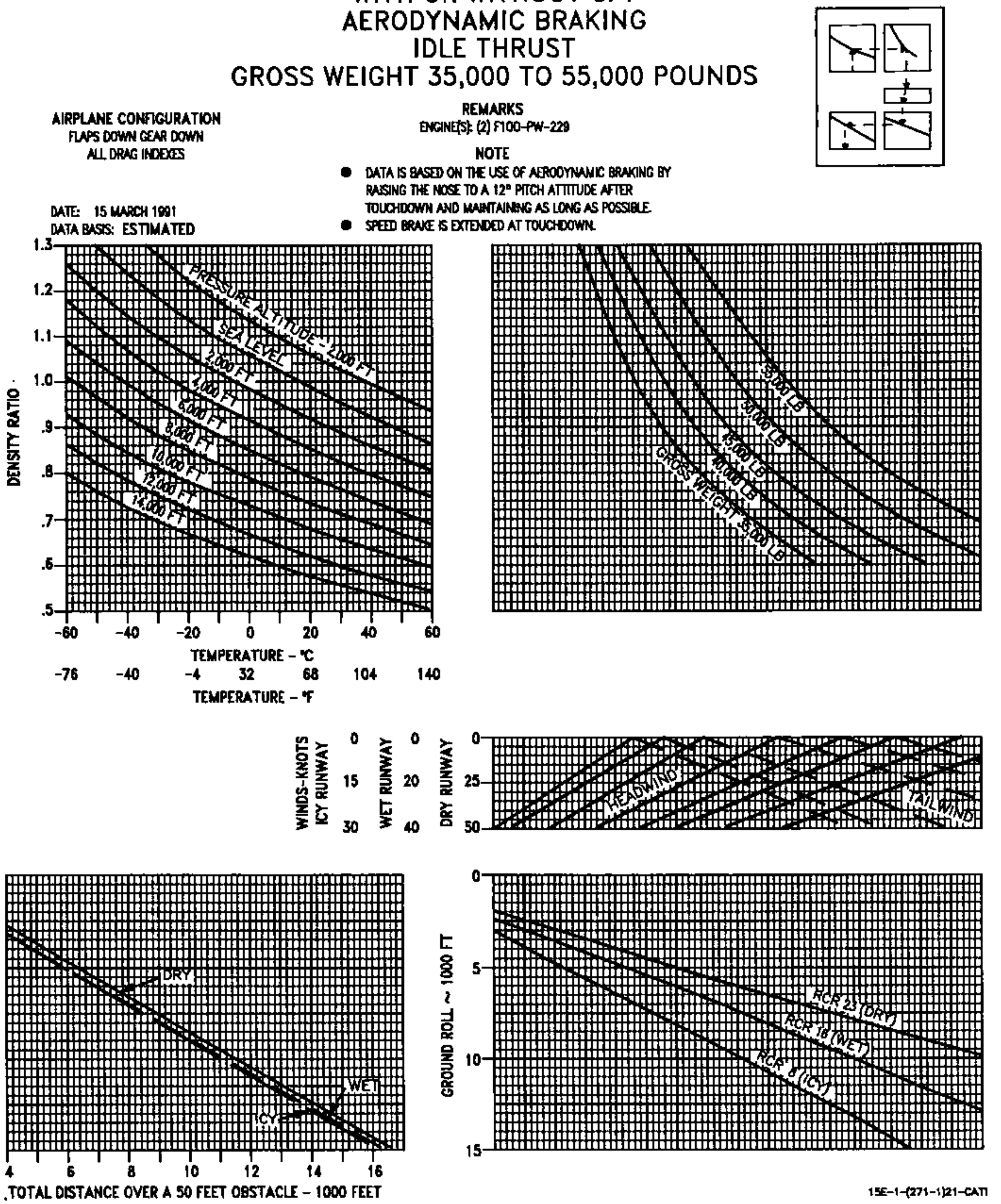


Figure B8-3

LANDING DISTANCE

WITH OR WITHOUT CFT
AERODYNAMIC BRAKING
IDLE THRUST
GROSS WEIGHT 55,000 TO 80,000 POUNDS

AIRPLANE CONFIGURATION
FLAPS DOWN
GEAR DOWN
ALL DRAG INDEXES

DATE: 15 MARCH 1991
DATA BASIS: ESTIMATED

REMARKS
ENGINE(S): (2) F100-PW-229

NOTE

- DATA IS BASED ON THE USE OF AERODYNAMIC BRAKING BY RAISING THE NOSE TO A 12° PITCH ATTITUDE AFTER TOUCHDOWN AND MAINTAINING AS LONG AS POSSIBLE.
- SPEED BRAKE IS EXTENDED AT TOUCHDOWN.

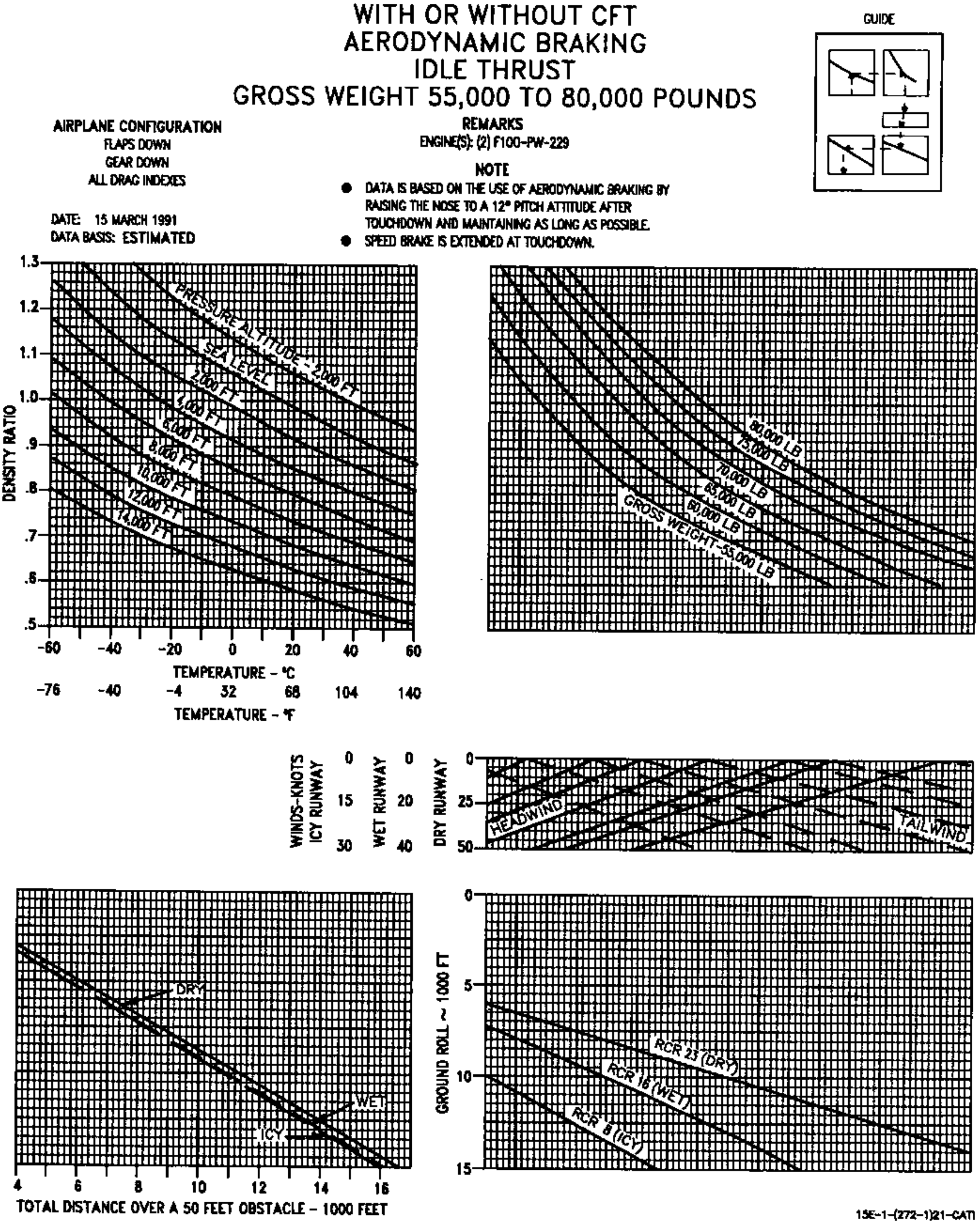


Figure B8-4

LANDING DISTANCE

WITH OR WITHOUT CFT
MAXIMUM ANTI-SKID BRAKING
IDLE THRUST

AIRPLANE CONFIGURATION
FLAPS DOWN GEAR DOWN
ALL DRAG INDEXES

DATE: 15 MARCH 1991
DATA BASIS: ESTIMATED

REMARKS
ENGINE(S): (2) F100-PW-229

NOTE

- DATA IS BASED ON LOWERING THE NOSE IMMEDIATELY AFTER TOUCHDOWN AND APPLYING MAXIMUM ANTI-SKID BRAKING.
- SPEED BRAKE IS EXTENDED AT TOUCHDOWN.

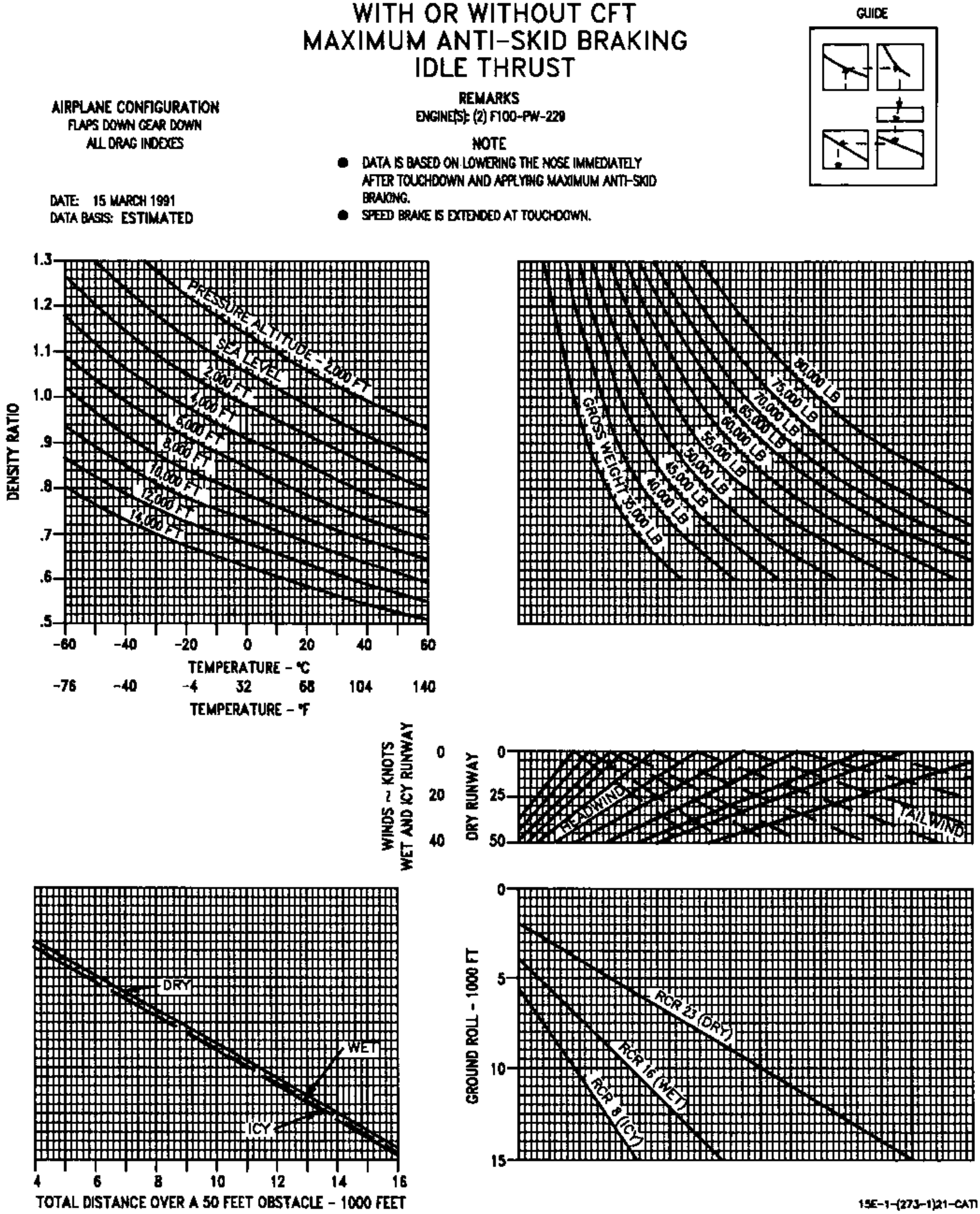


Figure B8-5

PART 9

COMBAT PERFORMANCE

TABLE OF CONTENTS

Charts

NOTE

Performance charts are currently being developed for the PW-229 engines. The references to figures are shown as figure B9-XX if the chart is not available. The actual charts will be added as they become available.

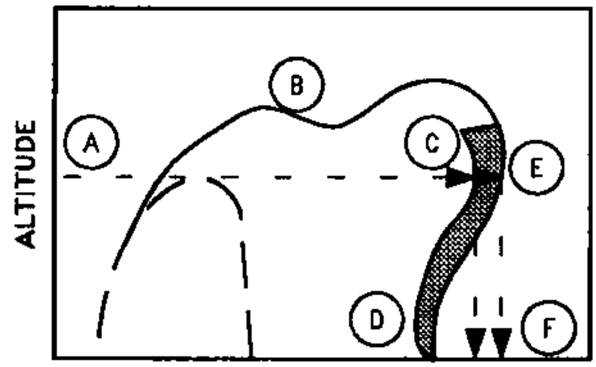
LEVEL FLIGHT ENVELOPE

These charts (figures B9-1 thru B9-14) present the aircraft level flight speed envelope for various configurations and average combat gross weights. Parameters of the envelopes extend from the maximum lift coefficient to maximum thrust Mach number at 0g acceleration throughout the altitude range. For each configuration, envelopes are presented for a standard day and standard day ±10°C. In addition to the maximum attainable Mach number at 0g acceleration, each standard day curve indicates Mach number at .03g acceleration. Figure B9-14 shows the relationship between maximum Mach number and Vmax for a selected configuration.

USE

Enter the chart with the desired combat altitude and project horizontally to intersect the applicable standard day .03g and 0g acceleration power curves. From

SAMPLE LEVEL FLIGHT ENVELOPE



these points, proceed vertically down to read the .03g Mach number and the maximum attainable Mach number in level flight.

Sample Problem

Configuration: -4 CFT + (4) AIM-7 + (4) AIM-9; 52,500 Pounds Gross Weight.

A. Combat altitude	35,000 Ft
B. Curve	Std Day
C. .03g Acceleration Curve	
D. .03g Acceleration Mach number	1.44
E. 0g Acceleration curve	
F. 0g Acceleration Mach number	1.52

MAXIMUM SPEED-LEVEL FLIGHT

This chart (figure B9-XX and B9-XX) presents level flight maximum speed at military power for drag indexes from 0 to 160 for gross weight with 50% internal fuel remaining. The maximum speeds are listed by Mach/KCAS at 0g acceleration and 0.03g (0.5 knots per second) acceleration for various altitudes. For a given altitude, maximum speeds are provided for standard temperature, and ten degrees above and below standard temperature.

USE

Enter chart at nearest computed drag index and read maximum speeds for 0g and 0.03g accelerations at selected altitude with applicable temperature. For most accurate results, use standard interpolation techniques to determine maximum speeds.

Sample Problem

A. Drag index	40
B. Altitude	30,000 Ft
C. Temperature	-44.4°C
D. Maximum speed - 0g KCAS	0.99 Mach/383
E. Maximum speed - 0.03g KCAS	0.96Mach/374

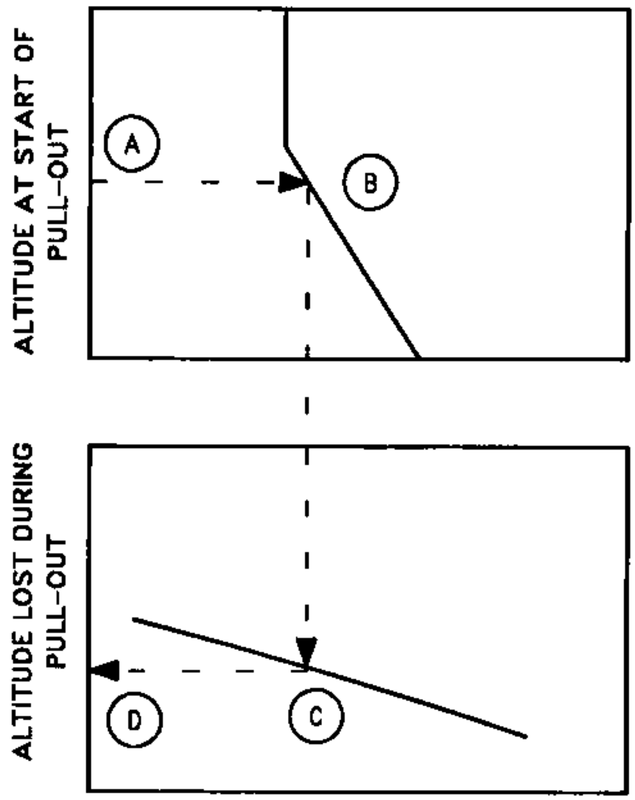
DIVE RECOVERY CHARTS

These charts, (figures B9-15 thru B9-20) present the airplanes dive recovery capability for various speeds (subsonic and supersonic), altitudes, and dive angles. The supersonic chart (figure B9-18) includes airplane structural limit curves to determine the maximum dive angle that can be achieved without exceeding the structural limit speed during dive recovery. Chart B9-19 presents emergency pullout data for gross weights of 40,000 to 45,000 pounds for dive angles of 30°, 60° and 90°using full aft stick or 12g's (below 350 KCAS) or 10.3g's (above 350 KCAS) to wing rock with power settings of maximum afterburner below initial airspeeds of 350 KCAS or idle power above 350 KCAS. Chart B9-20 presents emergency pullout data for gross weights of 50,000 to 55,000 pounds. The low speed recovery procedure is the same as for the low gross weight chart, but the procedures for above 500 KCAS are somewhat different. Between 350 KCAS and 500 KCAS, idle power is selected immediately while at the same time applying full aft stick or 10g's to wing rock. At airspeeds above 500 KCAS, idle power is selected immediately while at the same time applying 8g's. An important procedural difference to note for the heavier gross weight emergency pullout is the CAS should be ON.

USE

Enter the applicable chart with the altitude at the start of the pull-out and project horizontally right to intersect the curve for the Mach number at the start of the pull-out. From this point, project vertically down to intersect the dive angle at the start of pull-out, then horizontally left to read altitude lost during pull-out.

SAMPLE DIVE RECOVERY



15E-1-(236-1)44-CATI

Sample Problem

Configuration: (4) AIM-9 Launchers; Supersonic

A. Altitude at start of pull out	40,000 Ft
B. Mach number at start of pull-out	1.5
C. Dive angle at start of pull-out	70°
D. Altitude loss during pull-out	11,800 Ft

LOW ALTITUDE COMBAT PERFORMANCE CHART

This table (figure B9-XX) presents specific fuel flow values (pounds per minute) for maximum thrust operation at constant calibrated airspeeds of 300, 400, 500, 600, and 700 knots. The data are for altitudes of sea level, 5000 and 10,000 feet. Fuel flow values are computed for U.S. Standard Day; however, correction factors are given for nonstandard day temperatures. The standard day temperature is listed with the altitude. If the actual temperature at a particular altitude differs from the standard day temperature, refer to the TEMP. EFFECTS column to determine the appropriate temperature correction factor.

USE

Enter the table with the desired altitude and calibrated airspeed and project horizontally right to the specific fuel flow column to read specific fuel flow for a standard day. To obtain the specific fuel flow for a nonstandard day, mulitply the specific fuel flow for a standard day by the nonstandard day temperature correction factor obtained from the TEMP. EFFECTS column.

Sample Problem

A. Desired altitude	**5000 Ft**
B. Desired constant airspeed	600 KCAS
C. Specific fuel flow for a standard day	2113 Lb/Min
D. Nonstandard day temperature	0°C
E. Nonstandard day temperature correction factor	1.03
F. Nonstandard day specific fuel flow (C X E)	2176 Lb/Min

COMBAT FUEL MANAGEMENT CHART

This chart (figure B9-XX) presents a relative comparison between engine power setting and fuel usage in pounds per minute. The chart emphasizes the effect of power setting on combat fuel management. Data presented are for engine power settings of military power, mid-range afterburner and maximum afterburner at altitudes from sea level to 40,000 feet and airspeeds between Mach 0.8 and Mach 1.1.

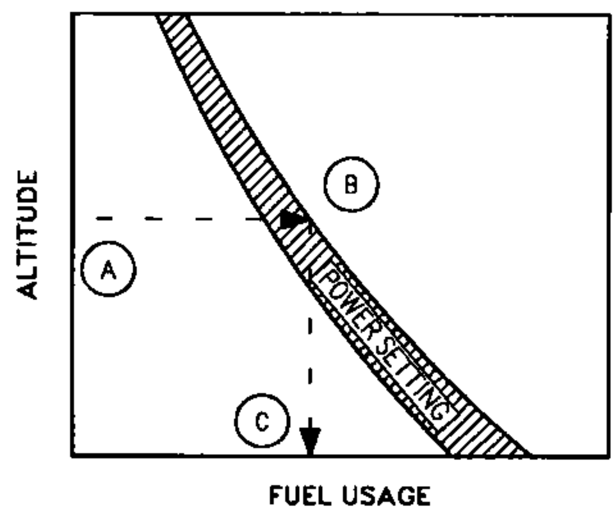
USE

Enter the chart at the desired altitude and project horizontally right to the selected Mach/engine power setting. From this point project vertically down to read fuel usage in pounds per minute.

Sample Problem

A. Desired altitude	25,000 Ft
B. Mach/power setting	0.9/Max AB
C. Fuel usage	1020 PPM

SAMPLE COMBAT FUEL MANAGEMENT



15E-1-(237-1)44-CATI

COMBAT FUEL FLOW CHART

These charts (figures B9-21 thru B9-26) present a relative comparison between high airspeeds at stabilized, level flight and fuel flow in pounds per minute. Data presented are for two non-CFT configurations and seven CFT configurations, based on F100-PW-229 engines.

USE

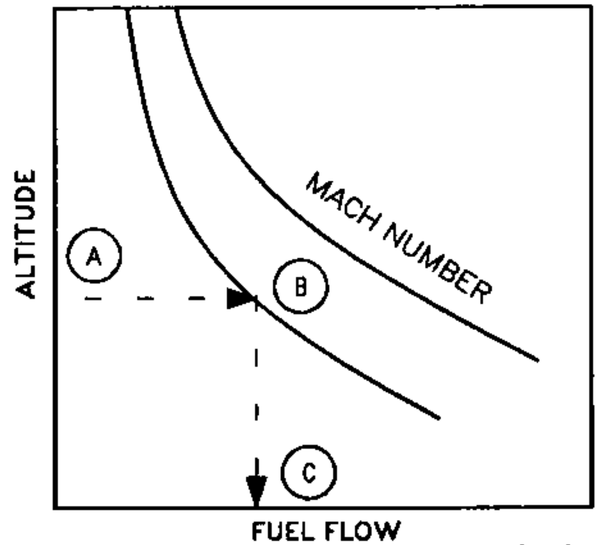
Enter the chart at the desired altitude and project horizontally right to the selected Mach number curve. From this point project vertically down to read fuel flow in pounds per minute.

Sample Problem

Configuration: -4 CFT + (4) AIM-7 + (4) AIM-9

A. Desired altitude	30,000 Ft
B. Mach number	1.1
C. Fuel flow	660 PPM

SAMPLE COMBAT FUEL FLOW



15E-1-(238-1)44-CATI

OVERLOAD WARNING SYSTEM SYMMETRICAL ALLOWABLE LOAD FACTOR CHARTS

These charts (Figures B9-XX thru B9-XX) present the overload warning system symmetrical allowable load factor capability for various Mach numbers, altitudes, and airplane gross weights.

USE

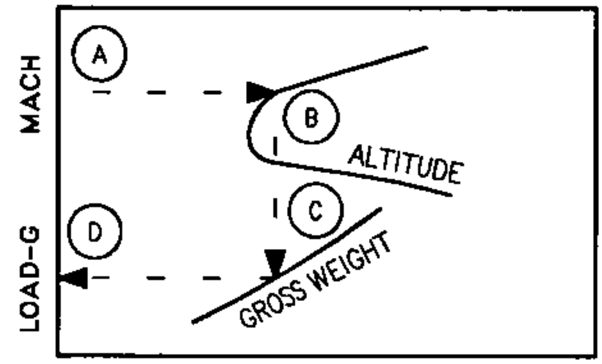
Enter the chart (Figures B9-XX or B9-XX) with the desired Mach number and project horizontally to the desired altitude. From this point, descend vertically to the applicable gross weight then project horizontally left to read the airplane symmetrical allowable load factor given by OWS. When CFT's are installed, enter the applicable CFT/Aircraft interface charts based on CFT fuel quantity (Figures B9-XX thru B9-XX) with the desired Mach number and project horizontally to the desired altitude. From this point, descend vertically to the applicable aircraft gross weight, then project horizontally left to read the CFT/airplane symmetrical allowable load factor. The combined allowable load factor is the less of the two (airplane and CFT/airplane interface).

Sample Problem

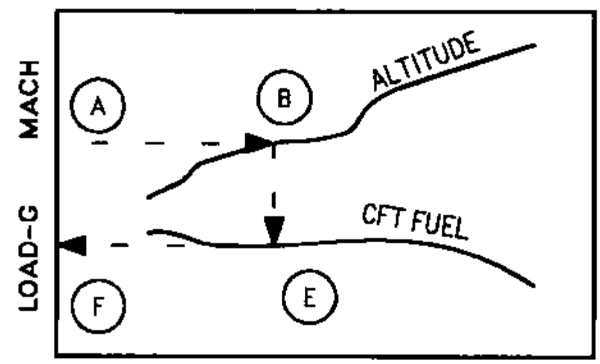
Configuration: Full CFTS

A. Mach number	0.8
B. Altitude	Sea Level
C. Gross Weight	45,000 Lb
D. Airplane Symmetrical Load Factor	8.6 g
E. CFT fuel/CFT	4875 Lb
F. CFT/Airplane interface symmetrical allowable load factor	8.0 g
G. Combined Symmetrical allowable load factor	8.0 g

SAMPLE OVERLOAD WARNING SYSTEM SYMMETRICAL ALLOWABLE LOAD FACTORS



WITHOUT CFT'S



CFT/AIRPLANE INTERFACE

15E-1-(288-1)44-CATI

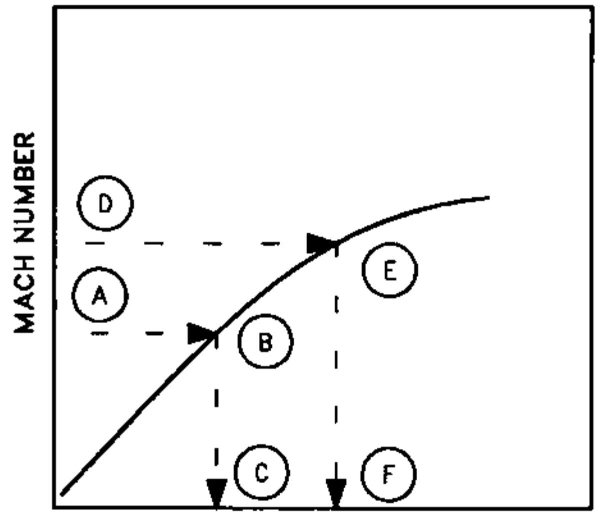
LEVEL FLIGHT ACCELERATION CHARTS

These charts (figures B9-27 thru B9-37) are used to determine time to accelerate in level flight between two Mach numbers. The curves are presented for various configurations with initial gross weights. Each chart shows maximum and military thrust accelerations at 10,000 feet and maximum thrust acceleration at 40,000 feet. The curves are presented for a standard day and standard day ±10°C. The origin for each curve is 250 KCAS and .03g acceleration points are indicated on each curve.

USE

Enter applicable configuration chart with initial Mach number and altitude, and project horizontally to appropriate thrust/standard day curve. Project vertically down to initial Mach time reference. Enter chart again with final Mach number, project horizontally to the same curve, and project vertically down to the final Mach time reference. To determine time to accelerate, subtract initial Mach number time reference from final Mach number time reference.

SAMPLE LEVEL FLIGHT ACCELERATION



15E-1-(240-1)44-CATI

Sample Problem

Configruation: -4 CFT + (4) AIM-7 + (4) AIM-9; 58,100 Pounds Initial Gross Weight: Maximum Thrust, Altitude 10,000 Feet.

A. Initial Mach number	0.8 Mach
B. Maximum thrust/ standard day curve	STD −10° C
C. Initial Mach number time reference	21 Seconds
D. Final Mach number	0.9 Mach
E. Maximum thrust/ standard day curve	STD −10° C
F. Final Mach number time reference	27 Seconds
G. Time to accelerate (F. minus C.)	6 Seconds

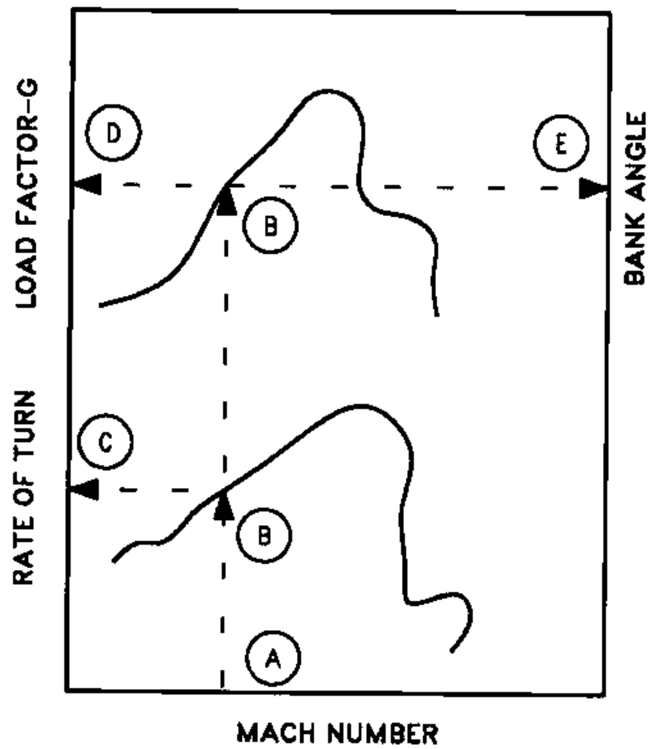
SUSTAINED LEVEL TURNS

These charts (figures B9-38 thru B9-47) present the maximum sustained level rate of turn and corresponding maximum sustained load factor for a given Mach number and altitude. The charts are based on maximum thrust for various aircraft configurations. Bank angles are shown for corresponding load factors, and a formula is provided to calculate radius of turn.

USE

Enter chart with Mach number and project vertically up to applicable rate of turn and load factor altitude curves. Project horizontally left from rate of turn altitude curve to maximum sustained rate of turn. Project horizontally left from load factor altitude curve to the maximum sustained load factor corresponding to the maximum sustainable turn rate. Project horizontally right from the load factor altitude curve to bank angle corresponding to the maximum sustained load factor.

SAMPLE SUSTAINED LEVEL TURNS



15E-1-(239-1)44-CATI

Sample Problem

Configuration: -4 CFT + (4) AIM-7 + (4) AIM-9
52,500 Pounds Gross Weight

A. Mach number	0.9
B. Altitude	40,000 Ft
C. Maximum sustained turn rate	2.9°/SEC
D. Maximum sustained load factor	1.7g
E. Bank angle	53°

LEVEL FLIGHT ENVELOPE

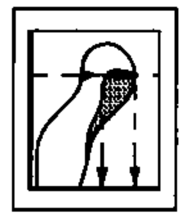
GROSS WEIGHT - 40,000. POUNDS
MAXIMUM THRUST

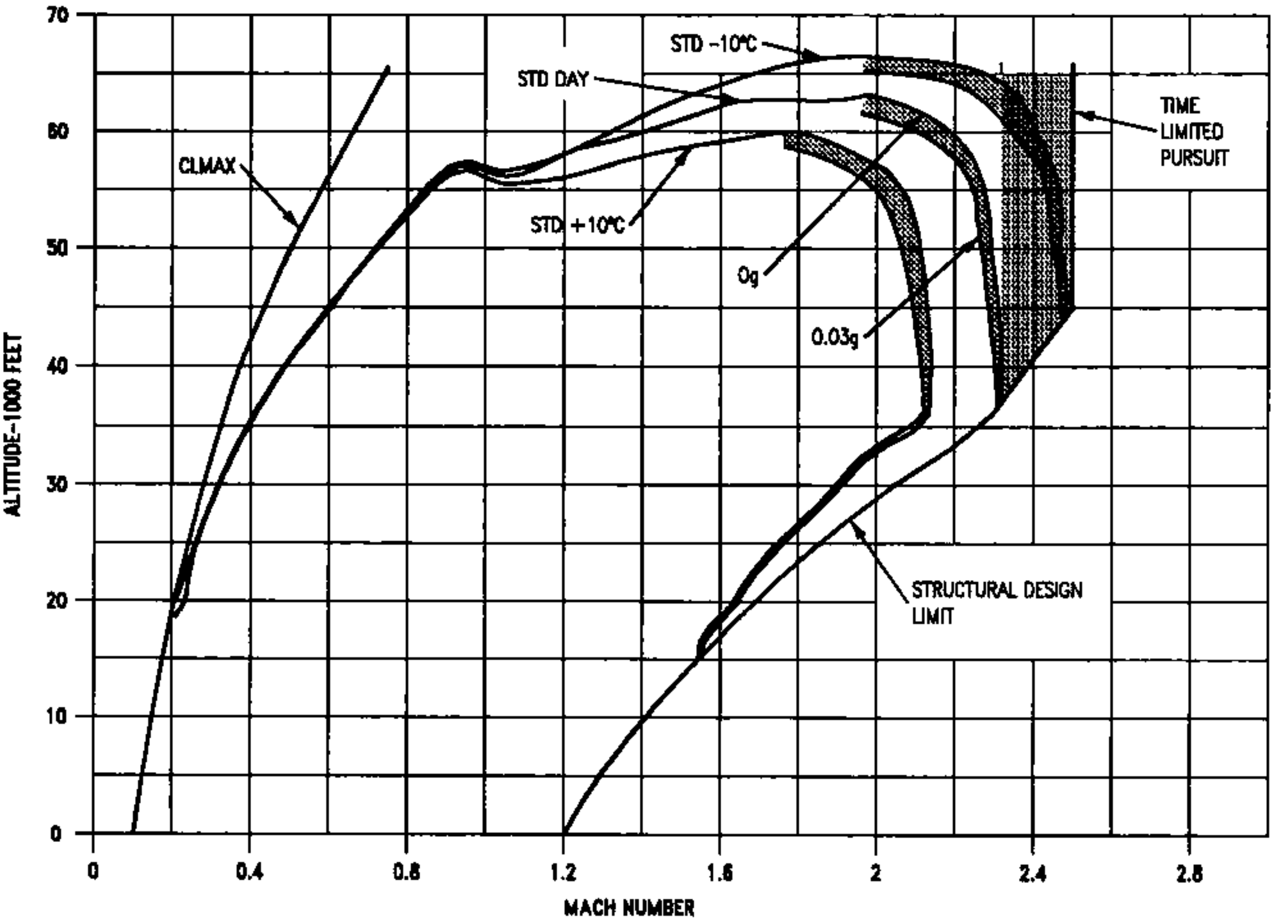
AIRPLANE CONFIGURATION
CLEAN AIRPLANE

DATA BASIS: FLIGHT TEST

REMARKS
ENGINE(S): (2)F100-PW-229
U.S. STANDARD DAY, 1966

NOTES
CAPABILITY REMAINING: MAXIMUM SPEEDS, ACCELERATION OF 0 AND .03G; CEILINGS AND LOW SPEED, RATE OF CLIMB OF 500 FEET PER MINUTE. a/g = .03 REPRESENTS AN ACCELERATION OF 0.5 KNOTS/SEC





15E-1-(314-1)38-CATI

Figure B9-1

LEVEL FLIGHT ENVELOPE

GROSS WEIGHT – 42,000 POUNDS
MAXIMUM THRUST

AIRPLANE CONFIGURATION

(4)AIM-7

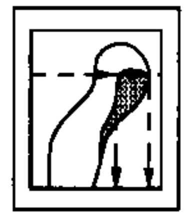
DATA BASIS: (STORES) ESTIMATED
(AIRCRAFT/CTF) FLIGHT TEST

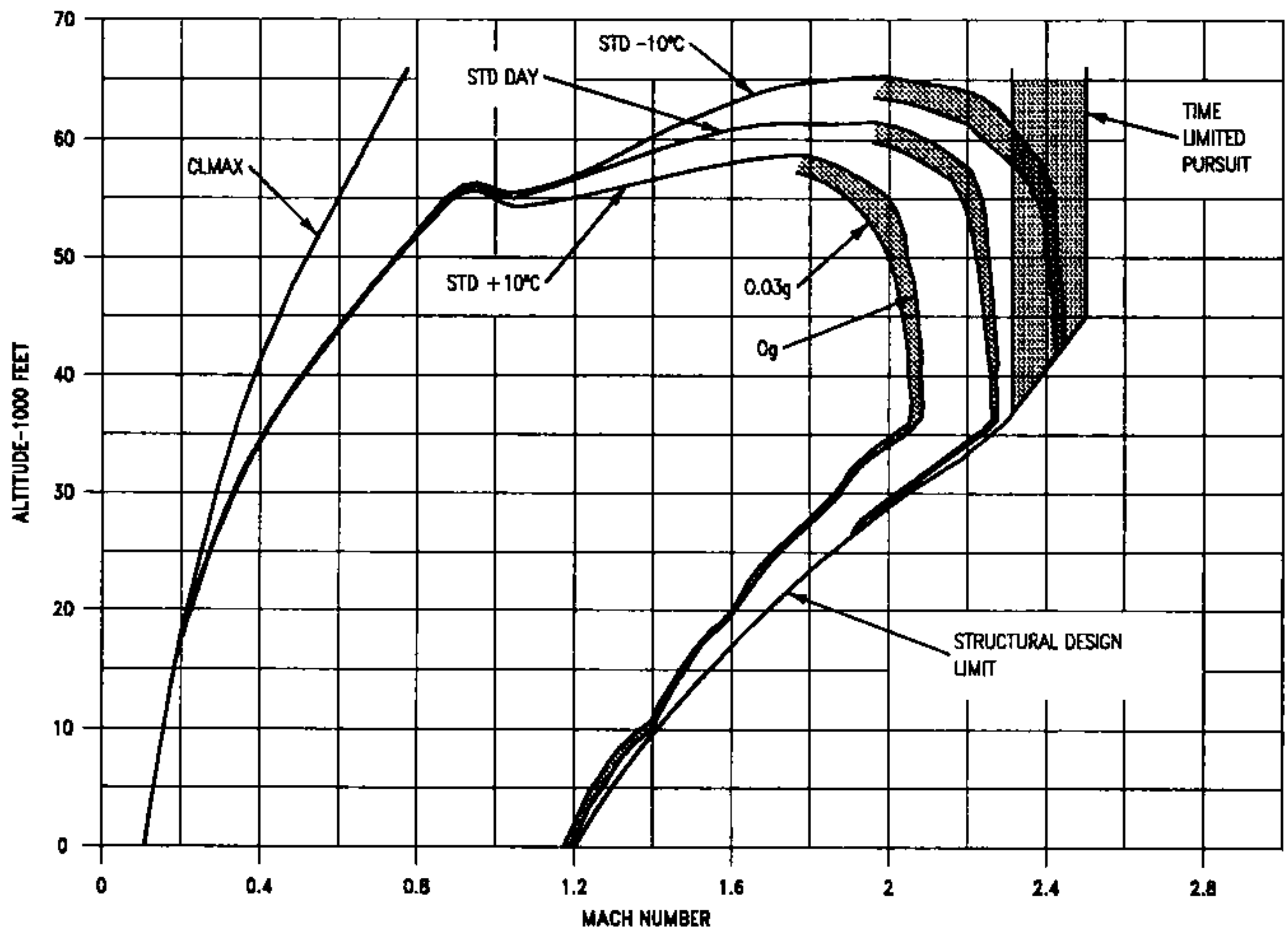
REMARKS

ENGINE(S): (2)F100-PW-229
U.S. STANDARD DAY, 1966

NOTES

CAPABILITY REMAINING: MAXIMUM SPEEDS, ACCELERATION OF 0 AND .03G; CEILINGS AND LOW SPEED, RATE OF CLIMB OF 500 FEET PER MINUTE. a/g = .03 REPRESENTS AN ACCELERATION OF 0.5 KNOTS/SEC





15E-1-(315-1)38-CATI

Figure B9-2

LEVEL FLIGHT ENVELOPE

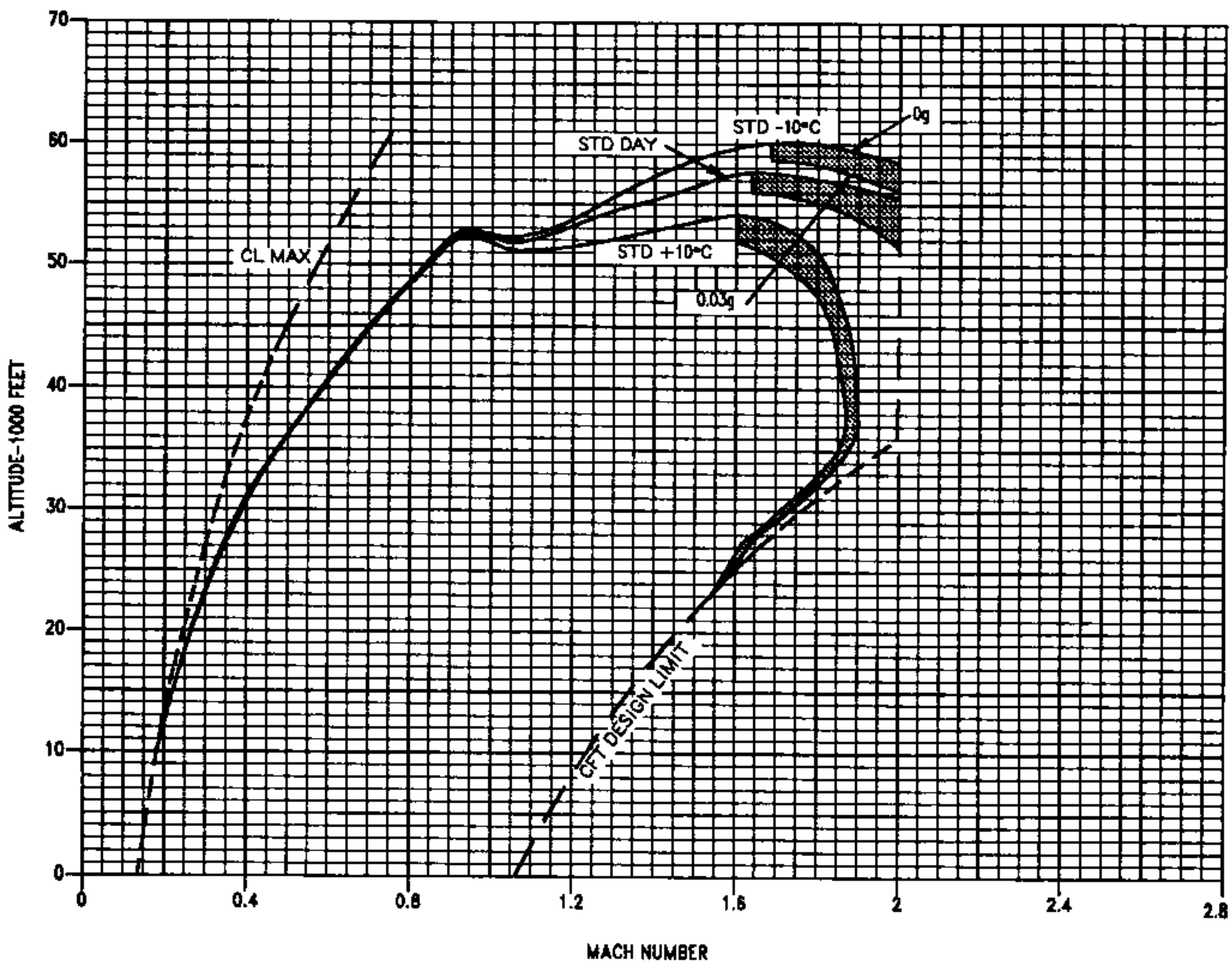
GROSS WEIGHT – 50,000 POUNDS
MAXIMUM THRUST

AIRPLANE CONFIGURATION
-5 CFT

REMARKS
ENGINE(S): (2) F100-PW-229
U.S. STANDARD DAY, 1966

NOTE
CAPABILITY REMAINING: MAXIMUM SPEEDS, ACCELERATION OF 0 AND 0.03g; CEILINGS AND LOW SPEED, RATE OF CLIMB OF 500 FEET PER MINUTE. a/g = 0.03 REPRESENTS AN ACCELERATION OF 0.5 KNOTS/SEC

DATE: 15 JULY 1991
DATA BASIS: ESTIMATED

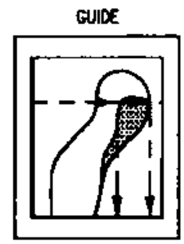


15E-1-(316-1)25-CATI

Figure B9-3

LEVEL FLIGHT ENVELOPE

GROSS WEIGHT – 54,000 POUNDS
MAXIMUM THRUST



AIRPLANE CONFIGURATION

-5CFT , (4)AIM-7 , (4)AIM-9

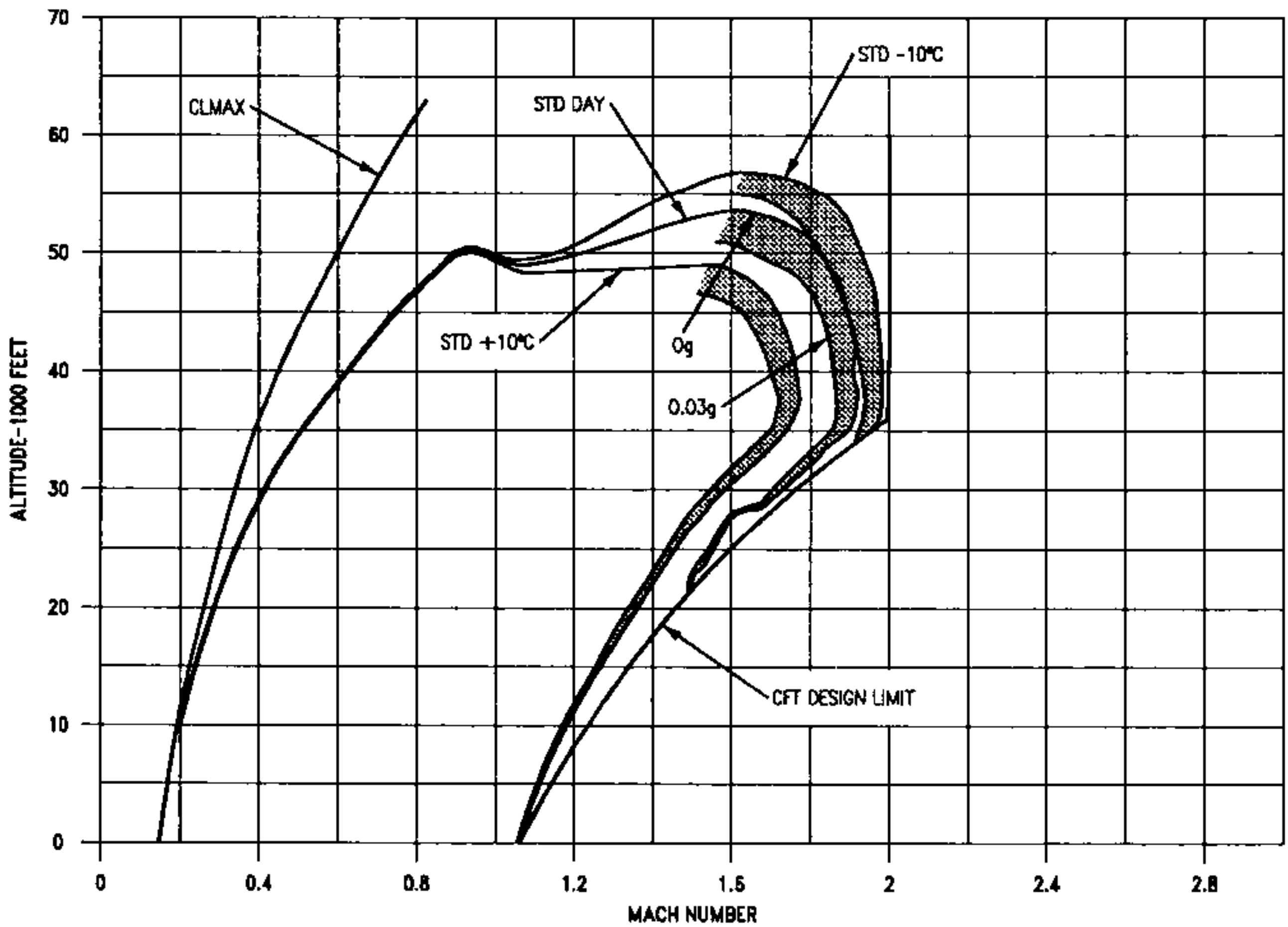
DATA BASIS: (STORES) ESTIMATED
(AIRCRAFT/CFT) FLIGHT TEST

REMARKS

ENGINE(S): (2)F100-PW-229
U.S. STANDARD DAY, 1966

NOTES

CAPABILITY REMAINING: MAXIMUM SPEEDS, ACCELERATION OF 0 AND .03G; CEILINGS AND LOW SPEED, RATE OF CLIMB OF 500 FEET PER MINUTE. a/g = .03 REPRESENTS AN ACCELERATION OF 0.5 KNOTS/SEC



15E-1-(317-1)38-CATI

Figure B9-4

LEVEL FLIGHT ENVELOPE

GROSS WEIGHT - 55,000 POUNDS
MAXIMUM THRUST

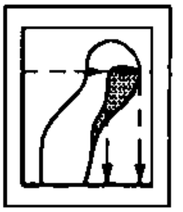
AIRPLANE CONFIGURATION
-5CFT + LANTIRN + (4)AIM-7 + (4)AIM-9

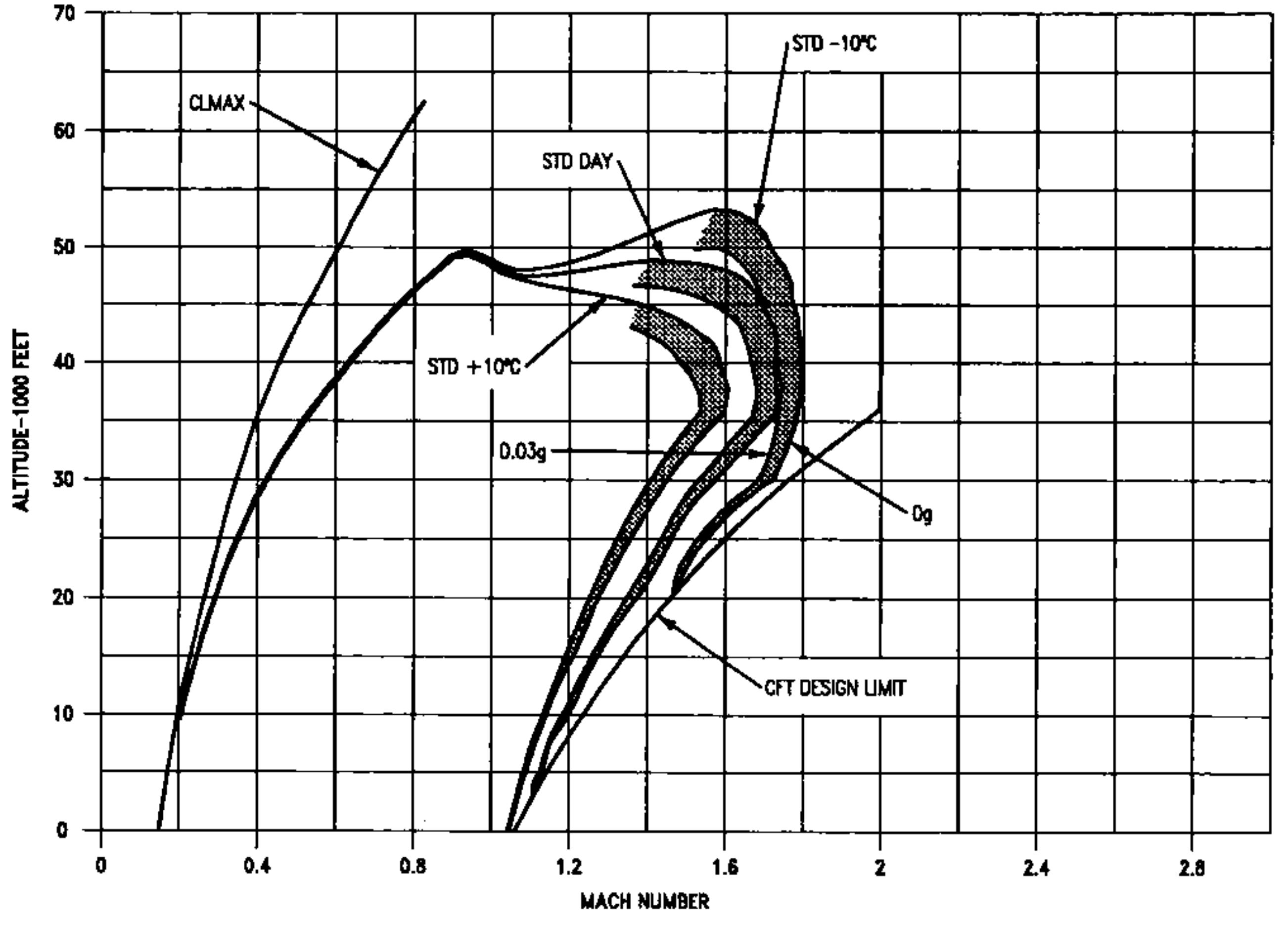
DATA BASIS: (STORES) ESTIMATED (AIRCRAFT/CFT) FLIGHT TEST

REMARKS
ENGINE(S): (2)F100-PW-229
U.S. STANDARD DAY, 1966

NOTES
CAPABILITY REMAINING: MAXIMUM SPEEDS, ACCELERATION OF 0 AND .03G; CEILINGS AND LOW SPEED, RATE OF CLIMB OF 500 FEET PER MINUTE. a/g = .03 REPRESENTS AN ACCELERATION OF 0.5 KNOTS/SEC

GUIDE





15E-1-(341-1)38-CATI

Figure B9-5

LEVEL FLIGHT ENVELOPE

GROSS WEIGHT – 57,000 POUNDS
MAXIMUM THRUST

AIRPLANE CONFIGURATION

–5CFT, LANTIRN, (4)AIM-9, (2)MK-84

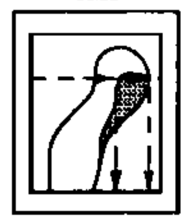
DATA BASIS: (STORES) ESTIMATED (AIRCRAFT/CFT) FLIGHT TEST

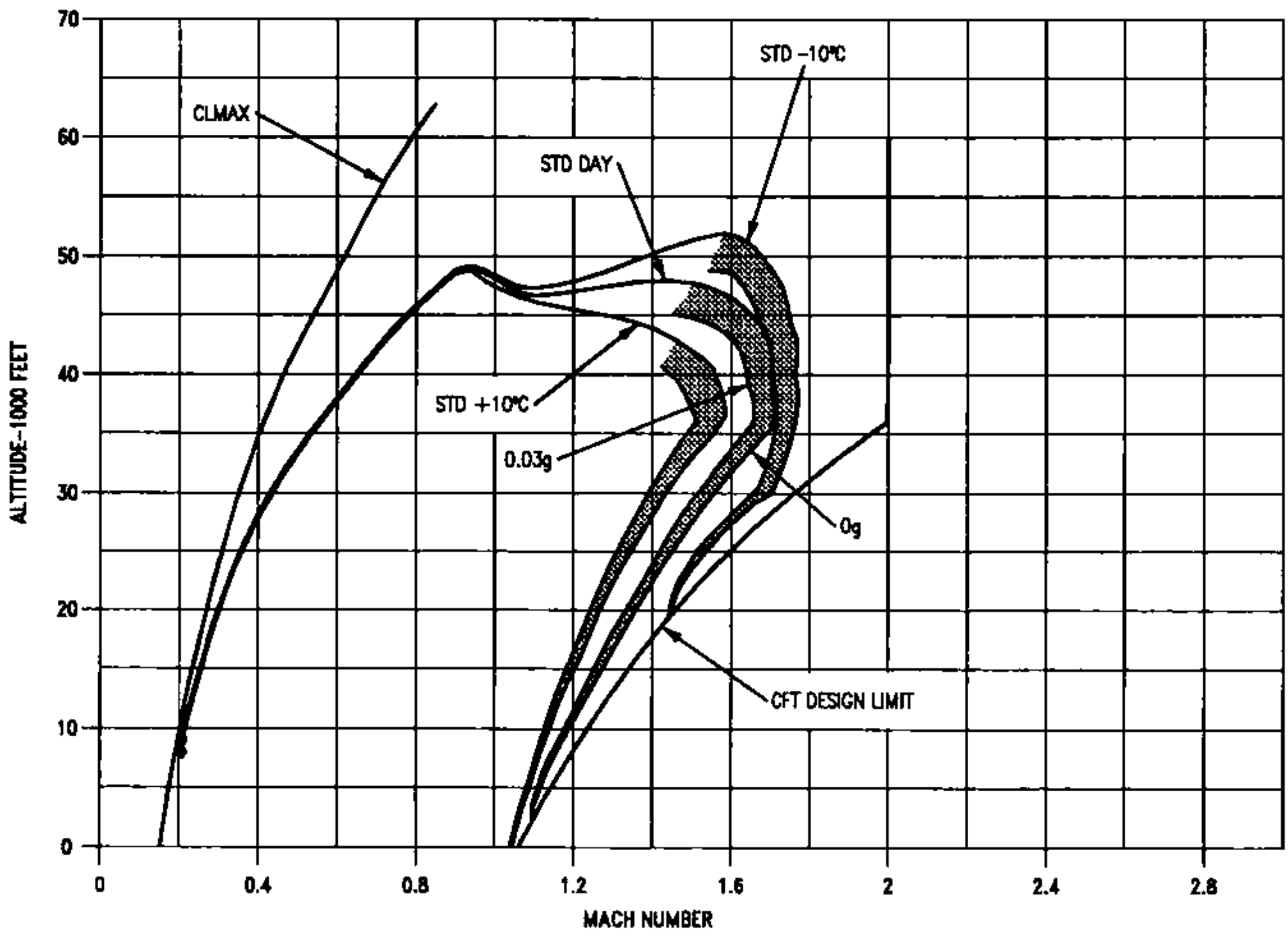
REMARKS

ENGINE(S): (2)F100-PW-229
U.S. STANDARD DAY, 1966

NOTES

CAPABILITY REMAINING: MAXIMUM SPEEDS, ACCELERATION OF 0 AND .03G; CEILINGS AND LOW SPEED, RATE OF CLIMB OF 500 FEET PER MINUTE. a/g = .03 REPRESENTS AN ACCELERATION OF 0.5 KNOTS/SEC





15E-1-(342-1)38-CATI

Figure B9-6

LEVEL FLIGHT ENVELOPE

GROSS WEIGHT – 57,000 POUNDS
MAXIMUM THRUST

AIRPLANE CONFIGURATION

-5CFT, LANTIRN, (4)AIM-9, (6)CBU-89

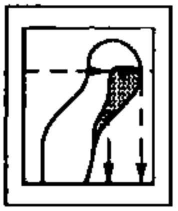
DATA BASIS: (STORES) ESTIMATED (AIRCRAFT/CFT) FLIGHT TEST

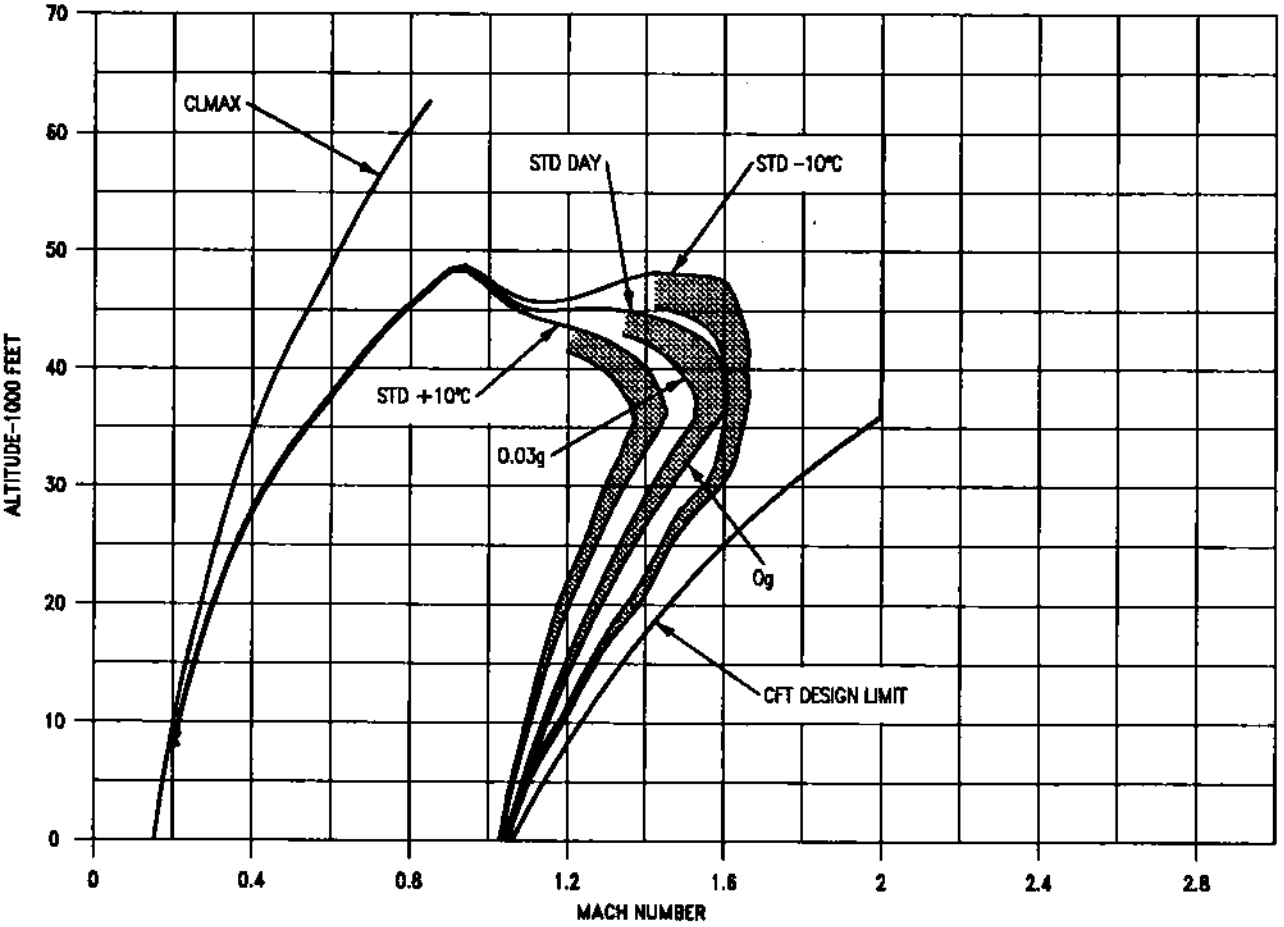
REMARKS

ENGINE(S): (2)F100-PW-229
U.S. STANDARD DAY, 1966

NOTES

CAPABILITY REMAINING: MAXIMUM SPEEDS, ACCELERATION OF 0 AND .03G; CEILINGS AND LOW SPEED, RATE OF CLIMB OF 500 FEET PER MINUTE. a/g = .03 REPRESENTS AN ACCELERATION OF 0.5 KNOTS/SEC





15E-1-(343-1)38-CATI

Figure B9-7

LEVEL FLIGHT ENVELOPE

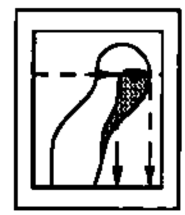
GROSS WEIGHT – 59,000 POUNDS
MAXIMUM THRUST

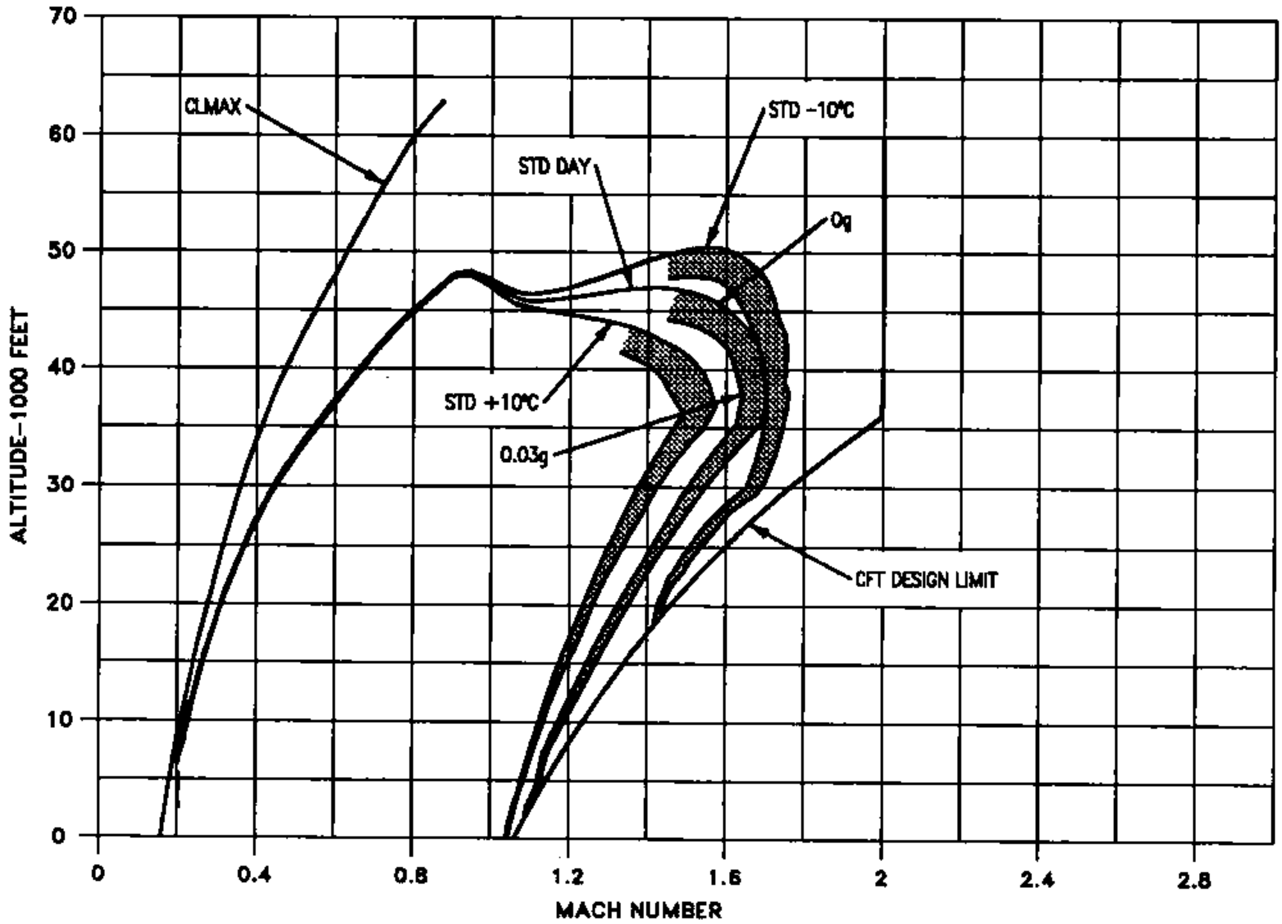
AIRPLANE CONFIGURATION
-5CFT, LANTIRN, (4)AIM-9, (12)MK-82

DATA BASIS: (STORES) ESTIMATED
(AIRCRAFT/CFT) FLIGHT TEST

REMARKS
ENGINE(S): (2)F100-PW-229
U.S. STANDARD DAY, 1966

NOTES
CAPABILITY REMAINING: MAXIMUM SPEEDS, ACCELERATION OF 0 AND .03G; CEILINGS AND LOW SPEED, RATE OF CLIMB OF 500 FEET PER MINUTE. a/g = .03 REPRESENTS AN ACCELERATION OF 0.5 KNOTS/SEC





15E-1-(344-1)38-CATI

Figure B9-8

LEVEL FLIGHT ENVELOPE

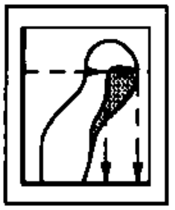
GROSS WEIGHT - 61,000 POUNDS
MAXIMUM THRUST

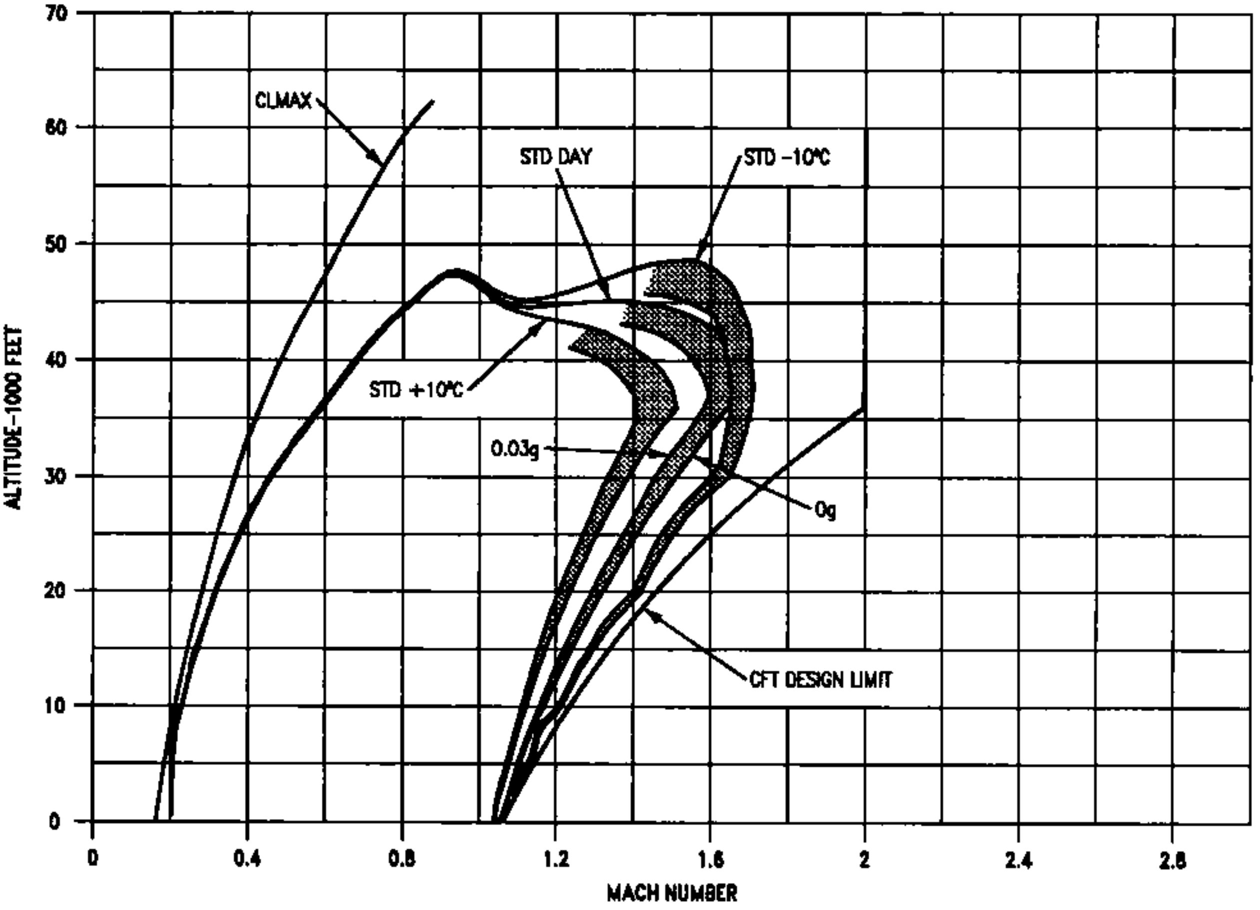
AIRPLANE CONFIGURATION
-5CFT + LANTIRN + (4)AIM-9 + (4)MK-84

DATA BASIS: (STORES) ESTIMATED
(AIRCRAFT/CFT) FLIGHT TEST

REMARKS
ENGINE(S): (2)F100-PW-229
U.S. STANDARD DAY, 1966

NOTES
CAPABILITY REMAINING: MAXIMUM SPEEDS, ACCELERATION OF 0 AND .03G; CEILINGS AND LOW SPEED, RATE OF CLIMB OF 500 FEET PER MINUTE. a/g = .03 REPRESENTS AN ACCELERATION OF 0.5 KNOTS/SEC





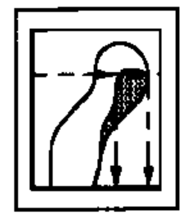
15E-1-(345-1)38-CATI

Figure B9-9

LEVEL FLIGHT ENVELOPE

GROSS WEIGHT – 62,000 POUNDS
MAXIMUM THRUST

GUIDE



AIRPLANE CONFIGURATION

-5CFT, LANTIRN, (12)MK-82,
CL TANK, (4)AIM-9

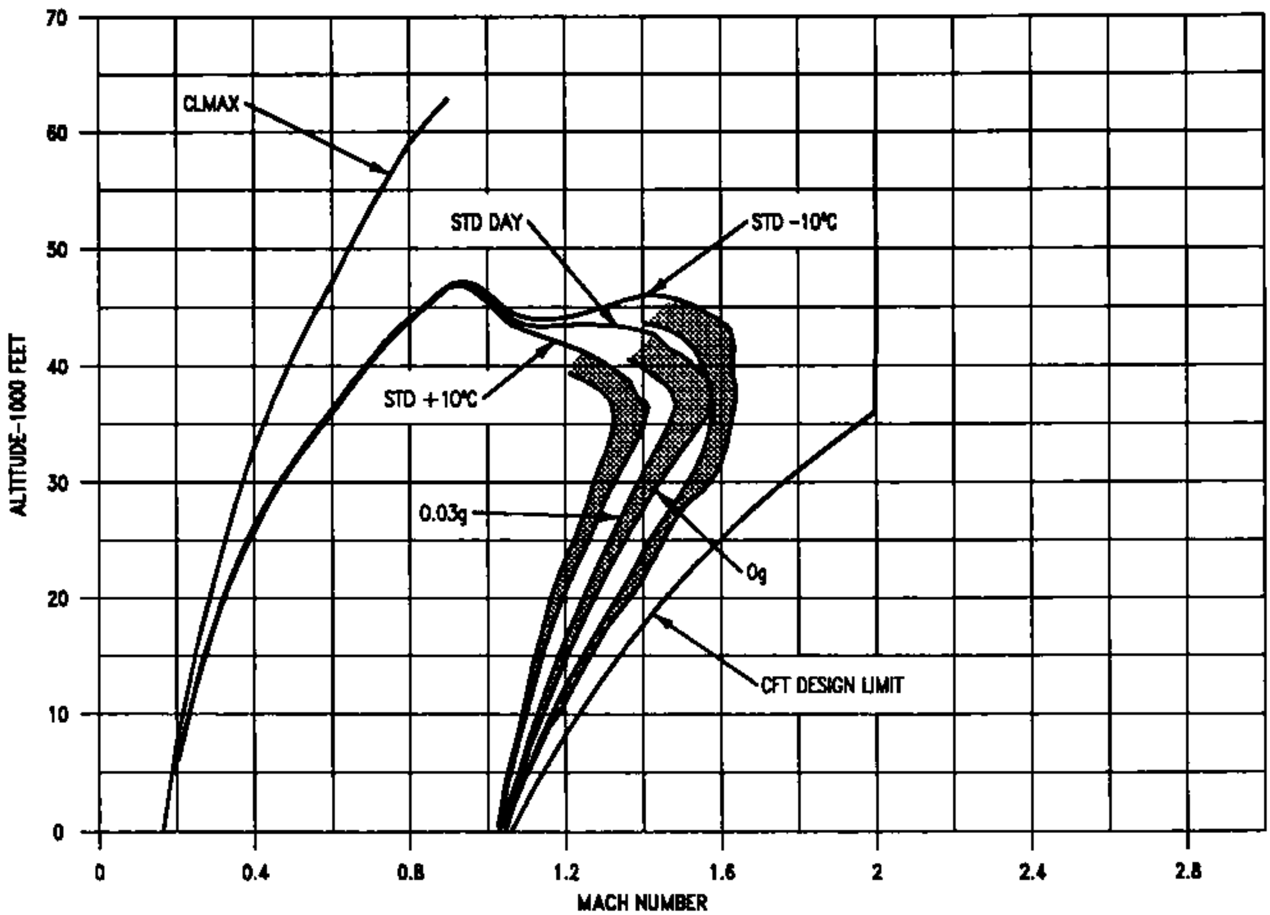
DATA BASIS: (STORES) ESTIMATED
(AIRCRAFT/CFT) FLIGHT TEST

REMARKS

ENGINE(S): (2)F100-PW-229
U.S. STANDARD DAY, 1966

NOTES

CAPABILITY REMAINING: MAXIMUM SPEEDS, ACCELERATION OF 0 AND .03G; CEILINGS AND LOW SPEED, RATE OF CLIMB OF 500 FEET PER MINUTE. a/g = .03 REPRESENTS AN ACCELERATION OF 0.5 KNOTS/SEC



15E-1-(348-1)38-CATI

Figure B9-10

LEVEL FLIGHT ENVELOPE

MILITARY THRUST

GROSS WEIGHT - 40,000. POUNDS

AIRPLANE CONFIGURATION

INDIVIDUAL DRAG INDEXES

DATA BASIS: ESTIMATED

REMARKS

ENGINE(S): (2)F100-PW-229

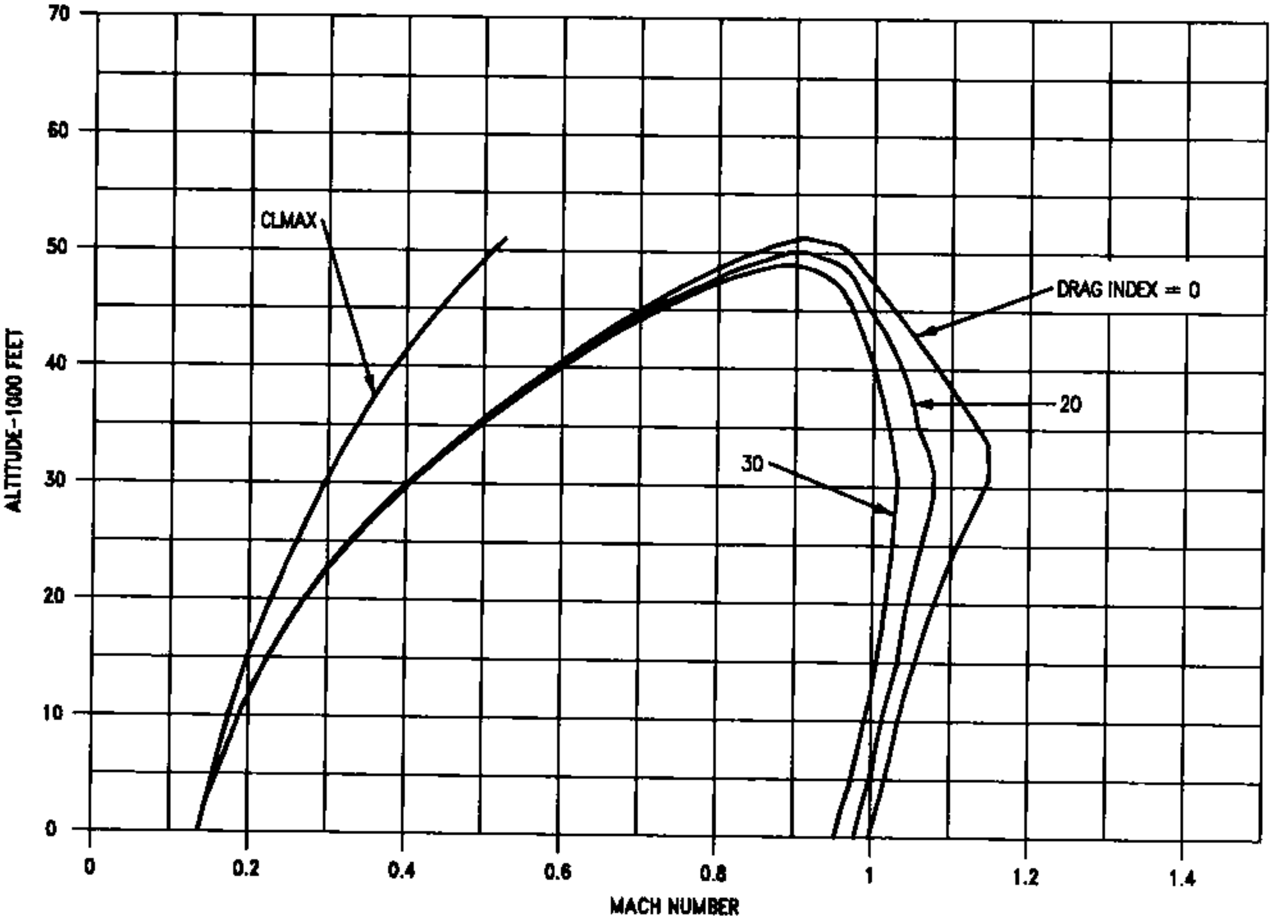
U.S. STANDARD DAY, 1966

NOTES

CAPABILITY REMAINING: MAXIMUM SPEEDS, ACCELERATION OF 0G; CEILINGS AND LOW SPEED, RATE OF CLIMB OF 500 FEET PER MINUTE.

CFT DRAG MUST BE INCLUDED WHEN TOTAL DRAG INDEX IS CALCULATED

GUIDE



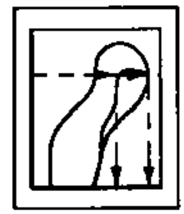
15E-1-(318-1)38-CATI

Figure B9-11

LEVEL FLIGHT ENVELOPE

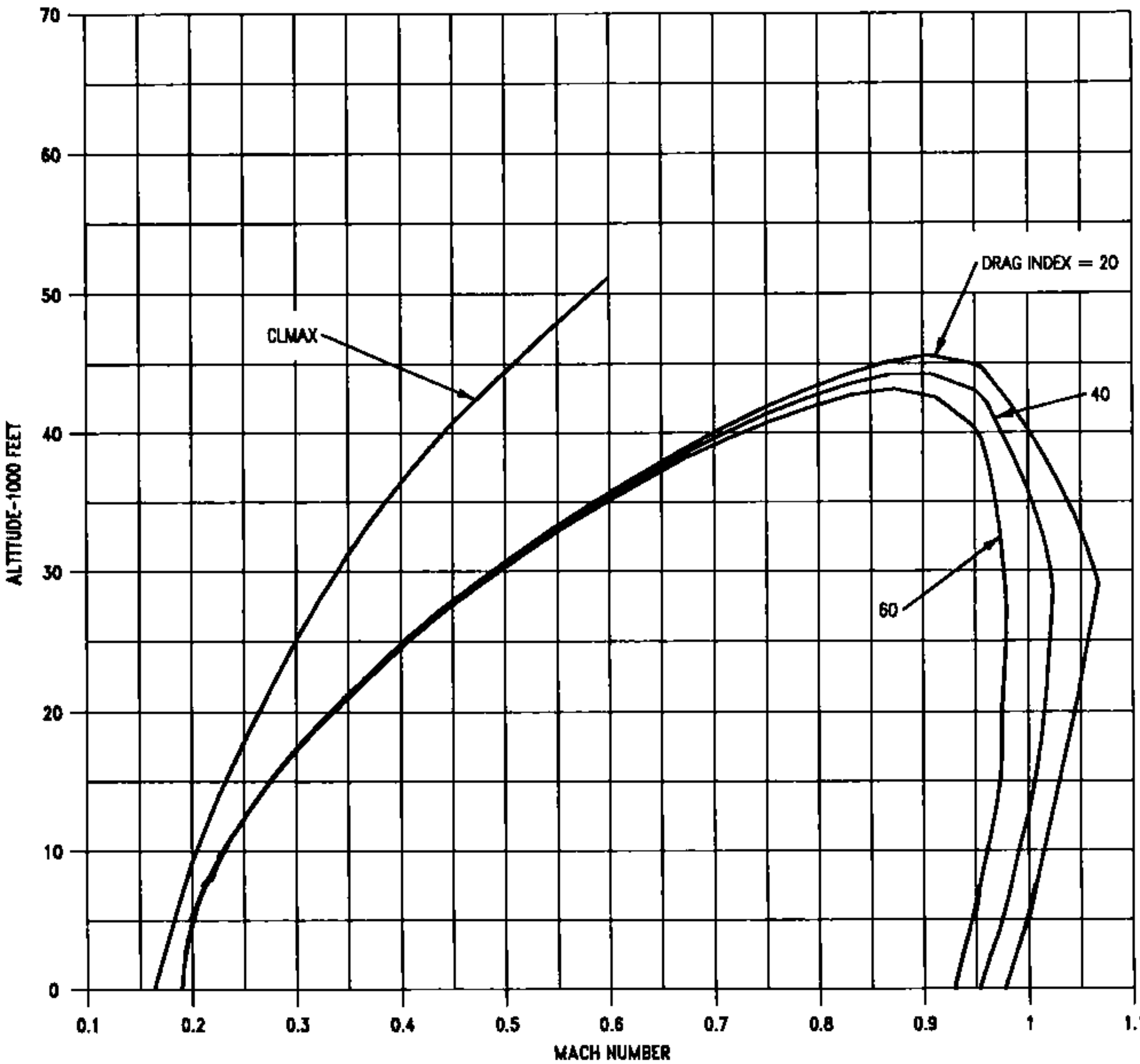
MILITARY THRUST
GROSS WEIGHT - 50,000 POUNDS

GUIDE



AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES
DATA BASIS: ESTIMATED

REMARKS
ENGINE(S): (2)F100-PW-229
U.S. STANDARD DAY, 1966



15E-1-(319-1)38-CATI

Figure B9-12

LEVEL FLIGHT ENVELOPE

MILITARY THRUST
GROSS WEIGHT - 60,000 POUNDS

AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES
DATA BASIS: ESTIMATED

REMARKS
ENGINE(S): (2)F100-PW-229
U.S. STANDARD DAY, 1966

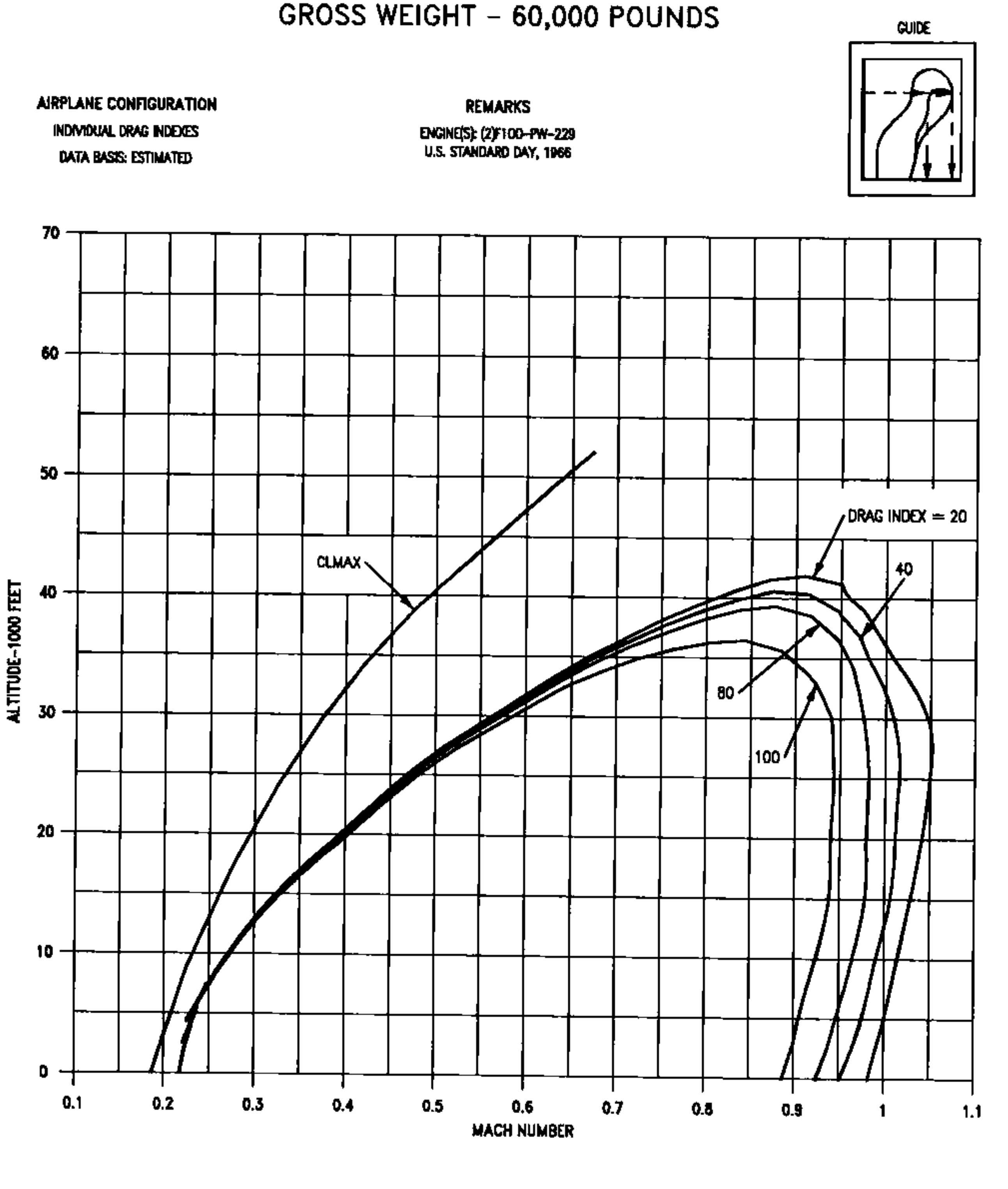
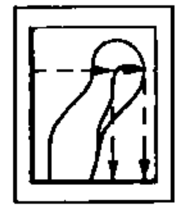


Figure B9-13

LEVEL FLIGHT ENVELOPE

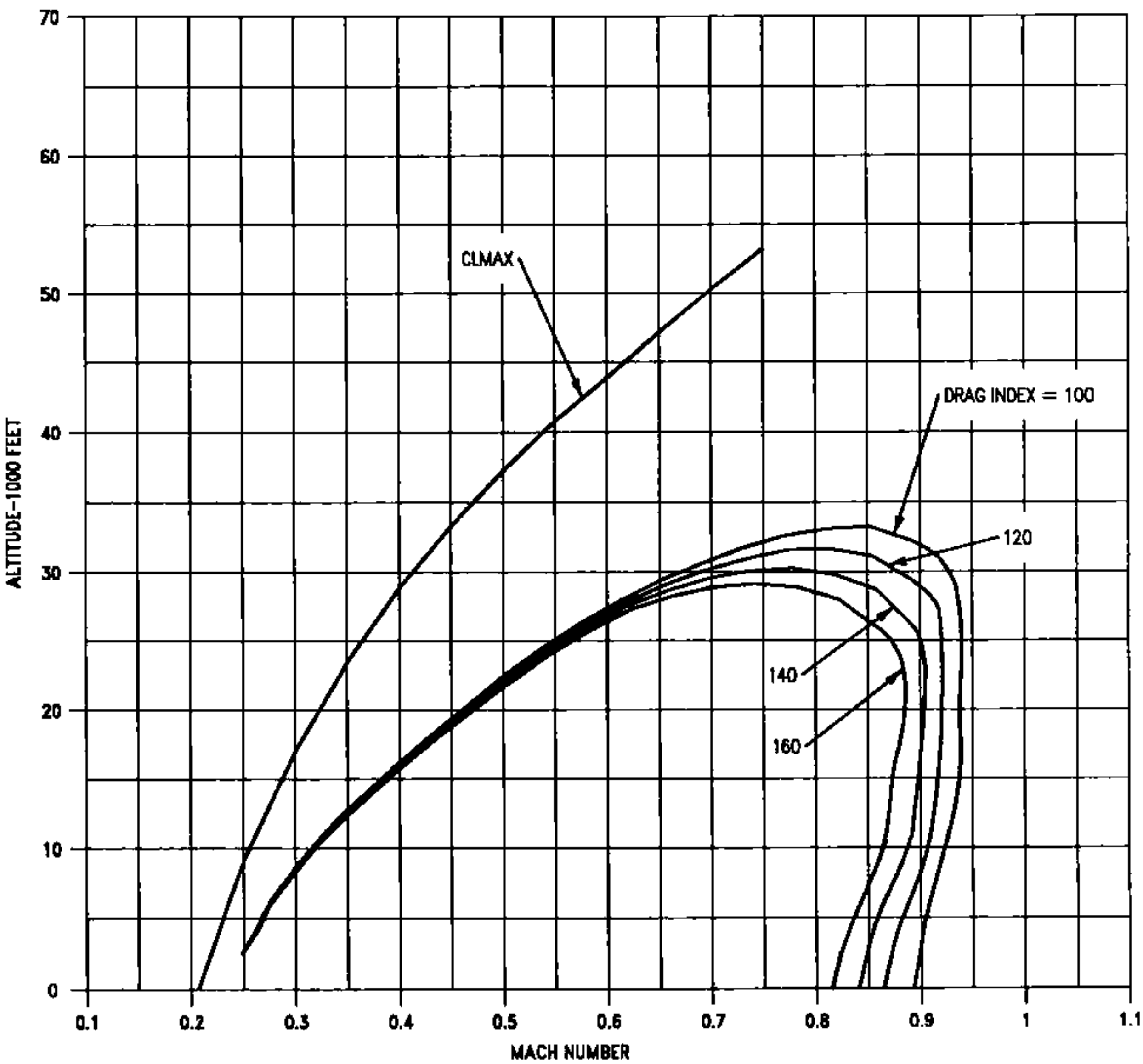
MILITARY THRUST
GROSS WEIGHT – 70,000 POUNDS

GUIDE



AIRPLANE CONFIGURATION
INDIVIDUAL DRAG INDEXES
DATA BASIS: ESTIMATED

REMARKS
ENGINE(S): (2)F100-PW-229
U.S. STANDARD DAY, 1966



15E-1-(321-1)38-CATI

Figure B9-14

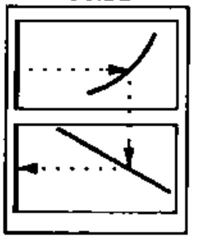
DIVE RECOVERY - 6.0G PULLOUT

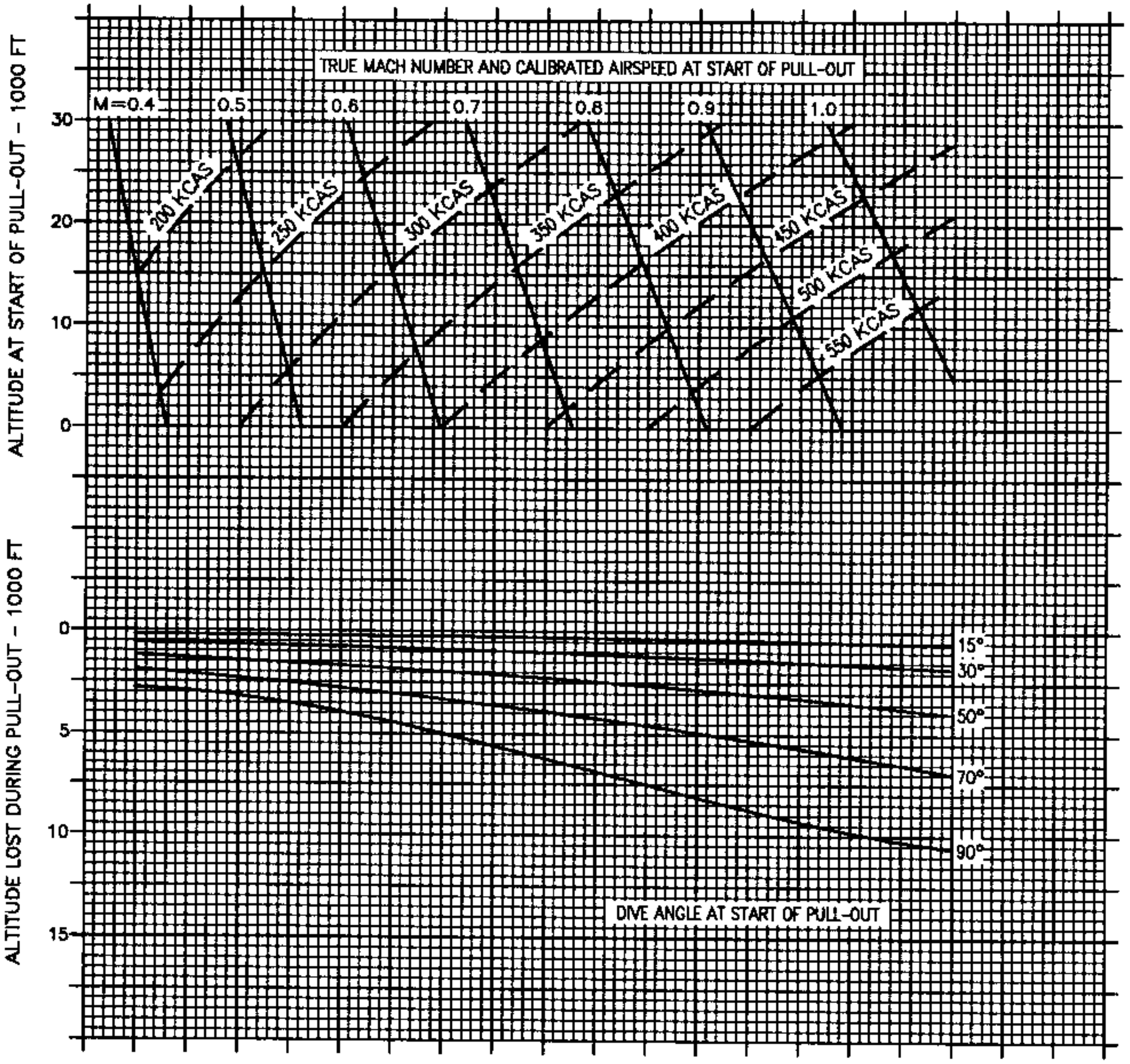
AIRPLANE CONFIGURATION (4) AIM-7 SUBSONIC - SPEED BRAKE RETRACTED
GROSS WEIGHT = 45,000 POUNDS

REMARKS
ENGINE(S): (2)F100-PW-229
U.S. STANDARD DAY, 1966

NOTES
- ALTITUDE LOSS WITH MAXIMUM THRUST IS ESSENTIALLY THE SAME WITH MILITARY THRUST
- PULL-OUT BASED ON 2.0G PER SECOND ACCELERATION BUILD UP TO MAXIMUM USABLE NORMAL FORCE STABILATOR LIMIT OR 6.0G, WHICHEVER OCCURS FIRST

DATE:15 JULY 1991
DATA BASIS: ESTIMATED





15E-1-(322-1)25-CATI

Figure B9-15

DIVE RECOVERY - 6.0G PULLOUT

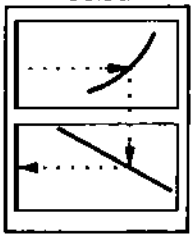
AIRPLANE CONFIGURATION
-5 CFT + (4)AIM-7
+ (2) WING PLYONS
+ (4) LAUNCHERS/ADAPTERS
+ (4) AIM-9

SUBSONIC - SPEED BRAKE RETRACTED
GROSS WEIGHT = 55,000 POUNDS

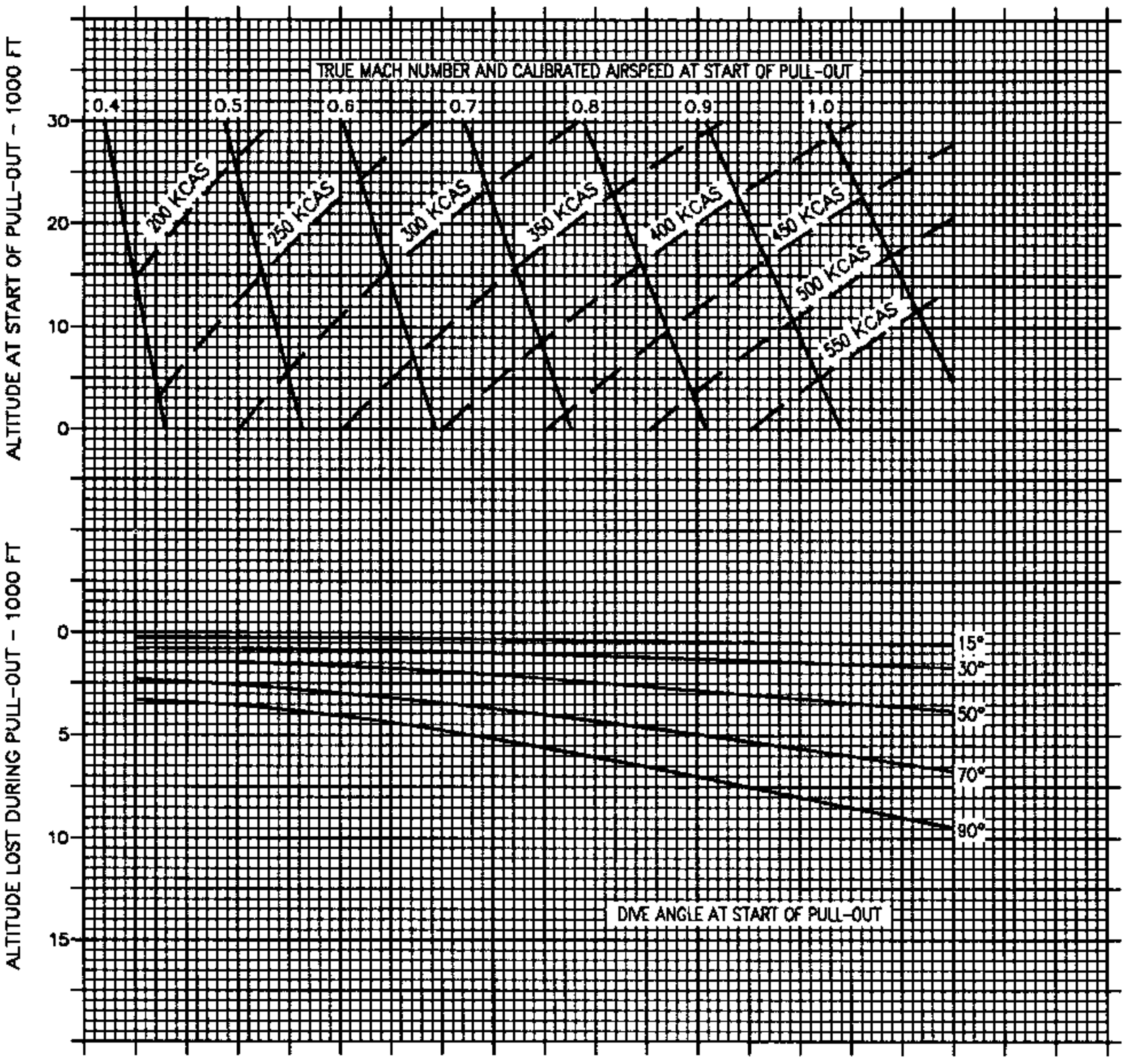
REMARKS
ENGINE(S): (2)F100-PW-229
U.S. STANDARD DAY, 1966

NOTES
- ALTITUDE LOSS WITH MAXIMUM THRUST IS ESSENTIALLY THE SAME WITH MILITARY THRUST
- PULL-OUT BASED ON 2.0G ACCELERATION BUILD UP TO MAXIMUM USABLE NORMAL FORCE STABILATOR LIMIT OR 6.0G WHICHEVER OCCURS FIRST

GUIDE



DATE:15 JULY 1991
DATA BASIS: ESTIMATED



15E-1-(324-1)25-CATI

Figure B9-16

DIVE RECOVERY - 6.0G PULLOUT

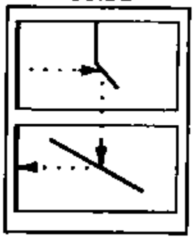
SUPERSONIC - SPEED BRAKE RETRACTED
GROSS WEIGHT = 45,000 POUNDS

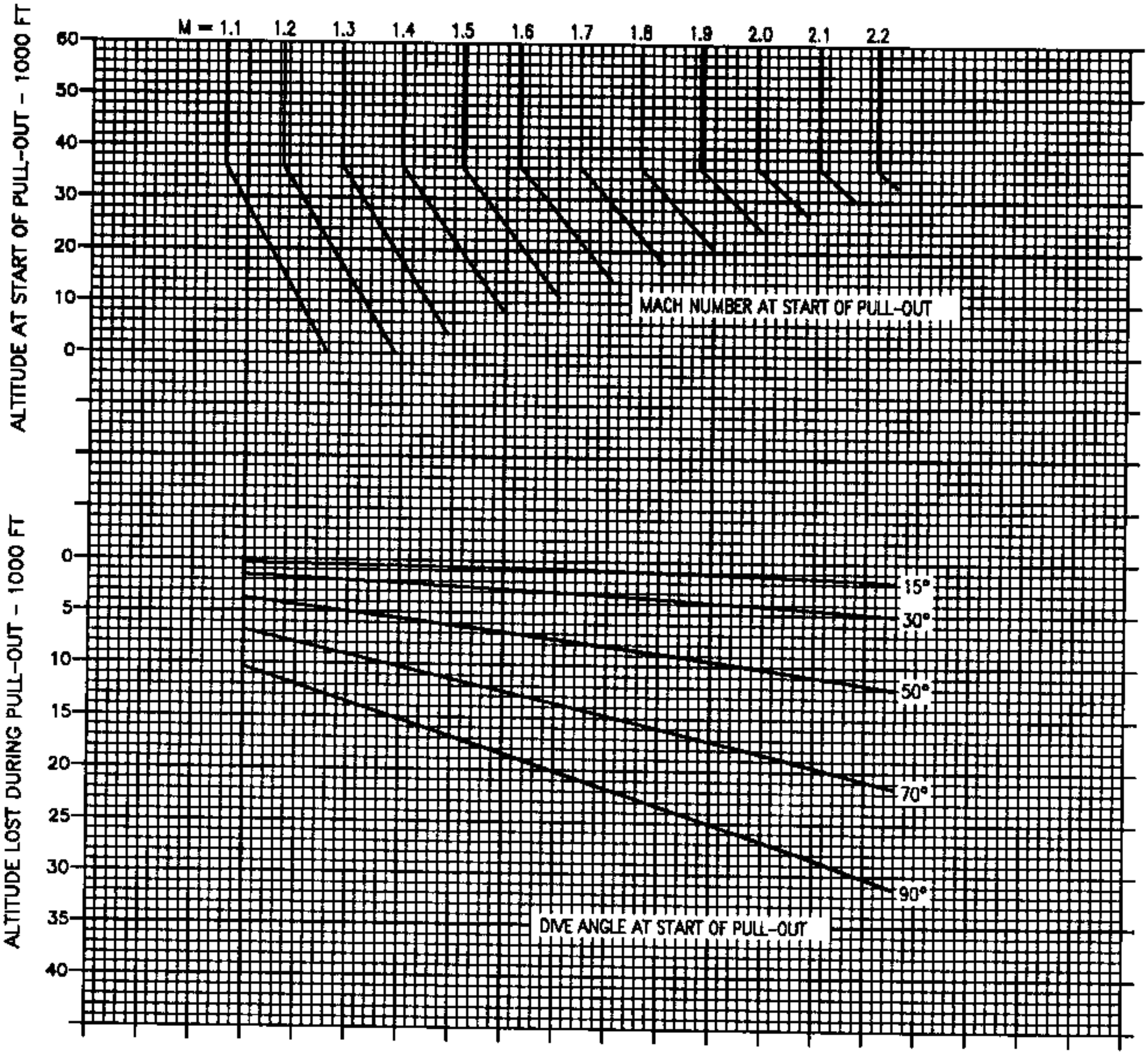
AIRPLANE CONFIGURATION
(4) AIM-7

REMARKS
ENGINE(S): (2)F100-PW-229
U.S. STANDARD DAY, 1966

NOTES
- ALTITUDE LOSS WITH MAXIMUM THRUST IS ESSENTIALLY THE SAME WITH MILITARY THRUST
- PULL-OUT BASED ON 2.0G PER SECOND ACCELERATION BUILD UP TO MAXIMUM USABLE NORMAL FORCE STABILATOR LIMIT OR 6.0G, WHICHEVER OCCURS FIRST

DATE:15 JULY 1991
DATA BASIS: ESTIMATED





15E-1-(323-1)25-CATI

Figure B9-17

DIVE RECOVERY - 6.0G PULLOUT

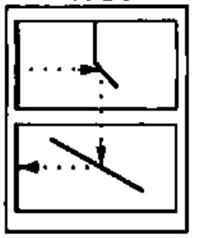
SUPERSONIC - SPEED BRAKE RETRACTED
GROSS WEIGHT = 55,000 POUNDS

AIRPLANE CONFIGURATION
-5 CFT + (4) AIM-7
+ (2) WING PLYONS
+ (4) LAUNCHERS/ ADAPTERS
+ (4) AIM-9

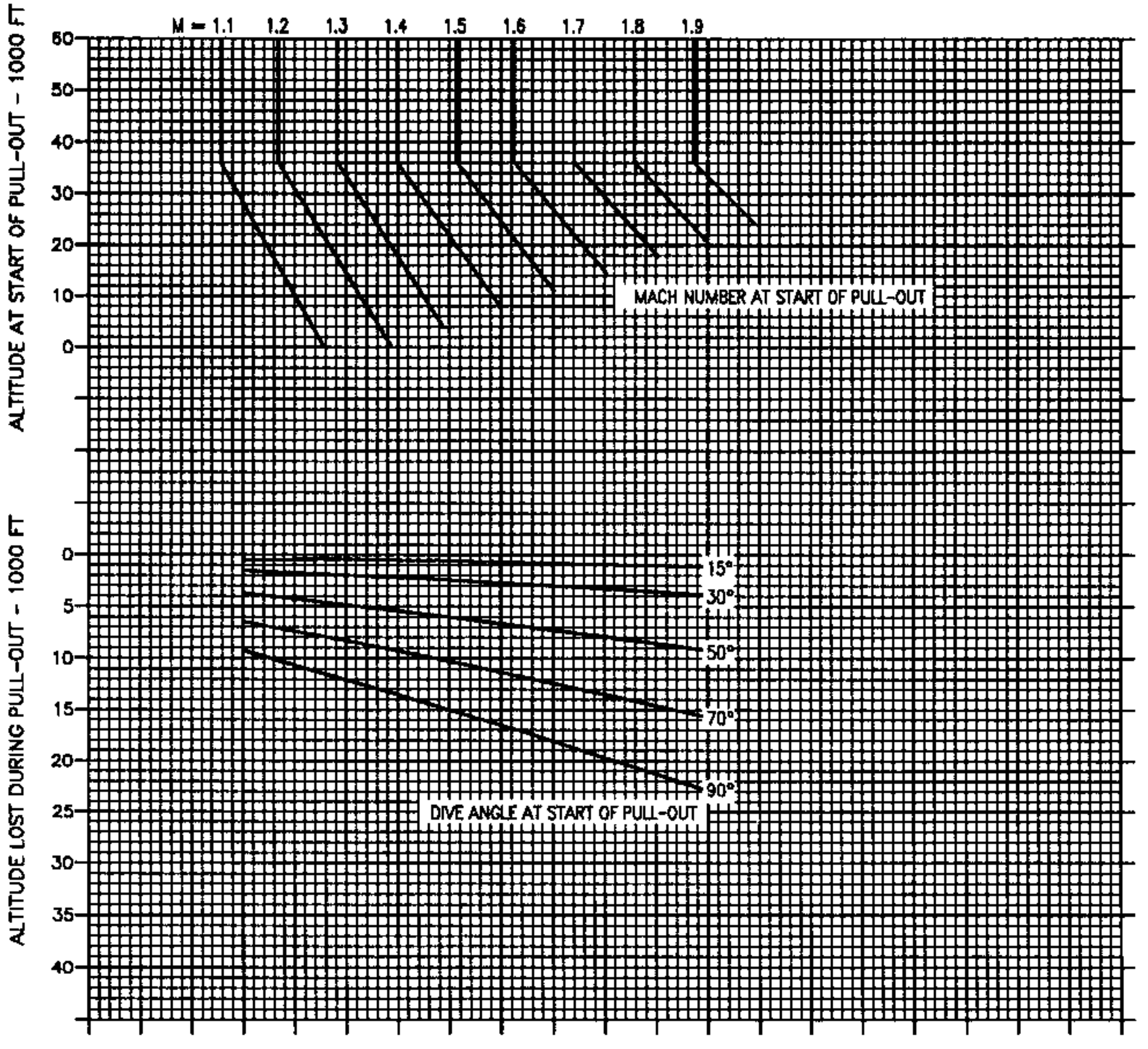
REMARKS
ENGINE(S): (2)F100-PW-229
U.S. STANDARD DAY, 1966

NOTES
- ALTITUDE LOSS WITH MAXIMUM THRUST IS ESSENTIALLY THE SAME WITH MILITARY THRUST
- PULL-OUT BASED ON 2.0G PER SECOND ACCELERATION BUILD UP TO MAXIMUM USABLE NORMAL FORCE STABILATOR LIMIT OR 6.0G, WHICHEVER OCCURS FIRST

GUIDE



DATE:15 JULY 1991
DATA BASIS: ESTIMATED



15E-1-(325-1)25-CATI

Figure B9-18

DIVE RECOVERY - EMERGENCY PULL-OUT

AIRPLANE CONFIGURATION
(4) AIM-7

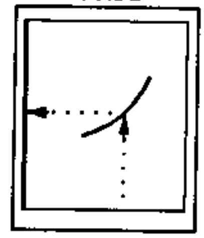
GROSS WEIGHT OF 40,000 TO 45,000 POUNDS
APPLICABLE ONLY FOR RECOVERIES BELOW 10,000 FEET

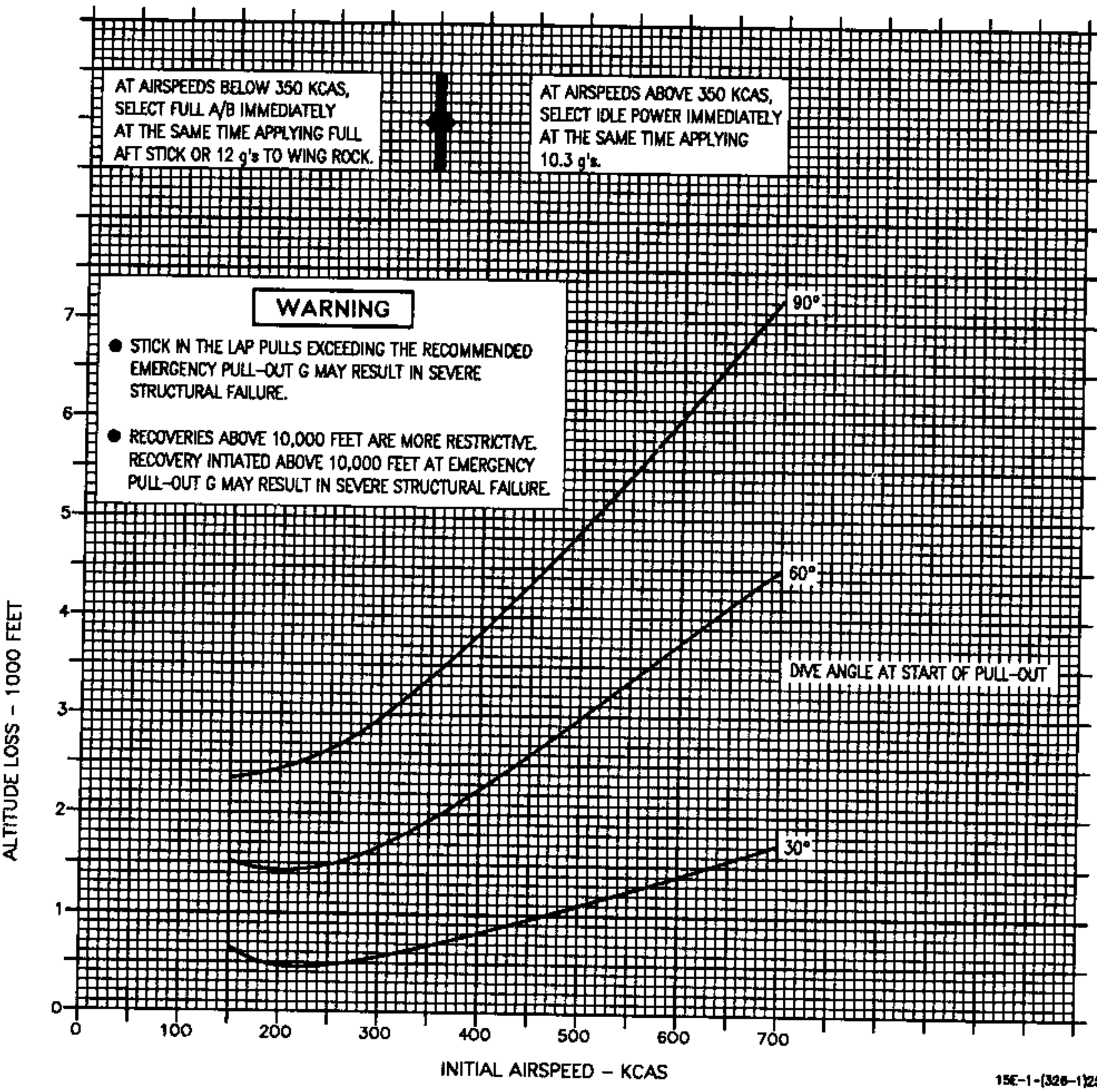
REMARKS
ENGINE(S): (2)F100-PW-229
U.S. STANDARD DAY, 1966

NOTES
- RETRACT SPEEBRAKE AT AIRSPEEDS BELOW 350 KCAS, EXTEND ABOVE 350 KCAS
- CAS ON OR OFF

DATE:15 JULY 1991
DATA BASIS: ESTIMATED

GUIDE





15E-1-(326-1)25-CATI

Figure B9-19

DIVE RECOVERY - EMERGENCY PULL-OUT

AIRPLANE CONFIGURATION
-5 CFT + (4) AIM-7
+ (2) WING PLYONS
+ (4) LAUNCHERS/ADAPTERS
+ (4) AIM-9

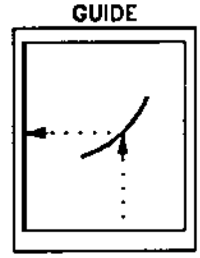
GROSS WEIGHT OF 50,000 TO
55,000 POUNDS
APPLICABLE ONLY FOR RECOVERIES
BELOW 10,000 FEET

REMARKS
ENGINE(S): (2)F100-PW-229
U.S. STANDARD DAY, 1966

NOTES
- RETRACT SPEEBRAKE AT AIRSPEEDS BELOW 350 KCAS, EXTEND ABOVE 350 KCAS
- CAS ON OR OFF

DATE:15 JULY 1991
DATA BASIS: ESTIMATED

GUIDE



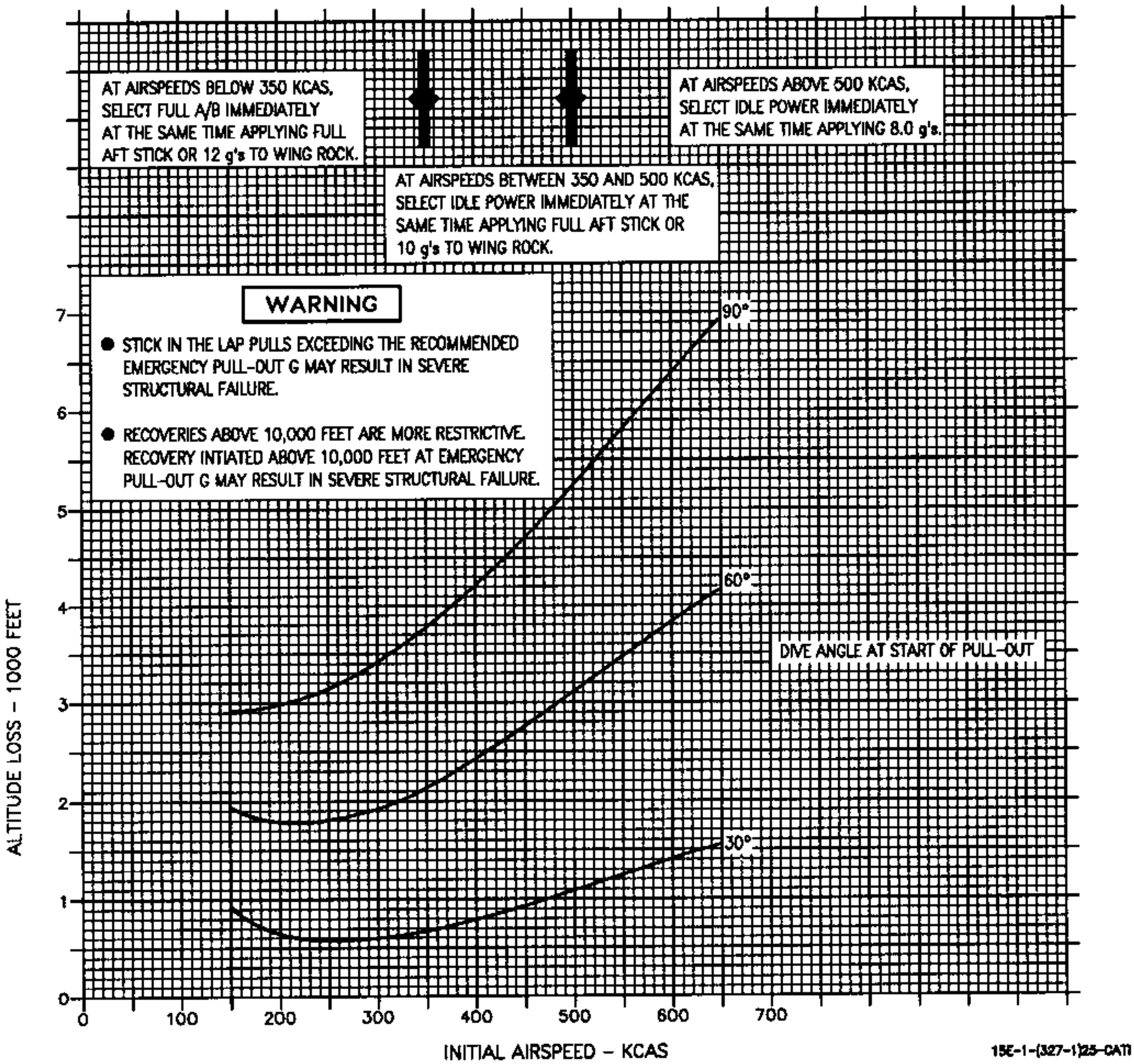


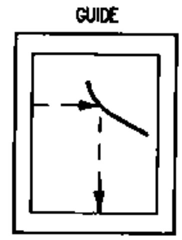
Figure B9-20

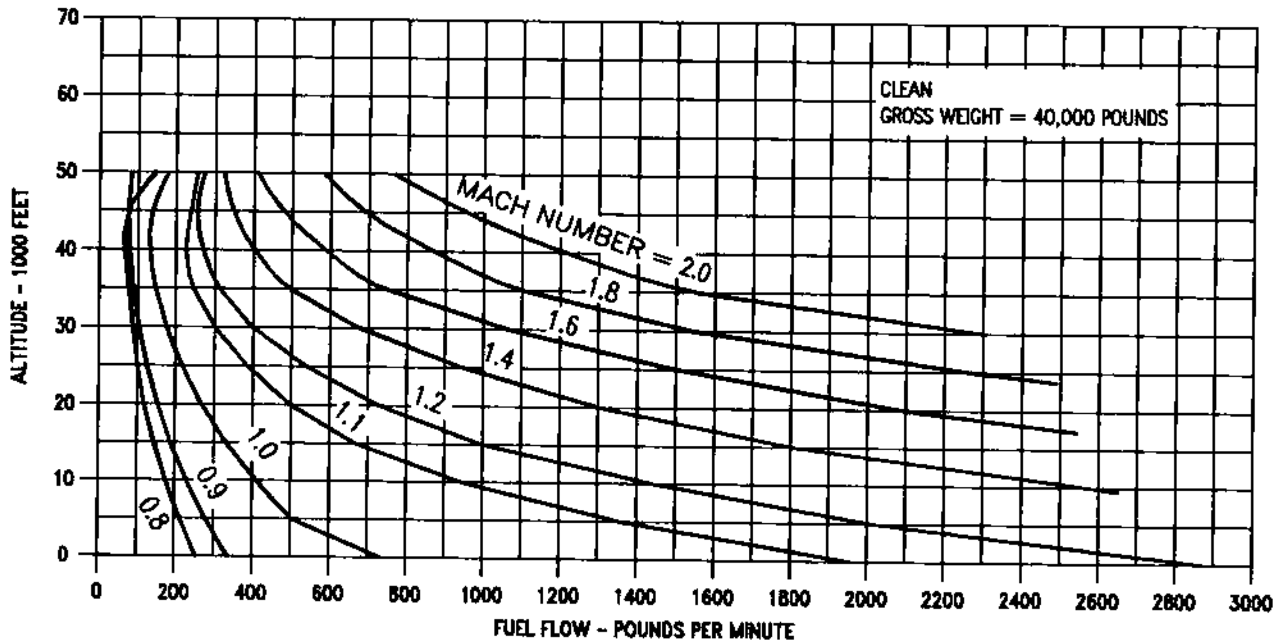
COMBAT FUEL FLOW

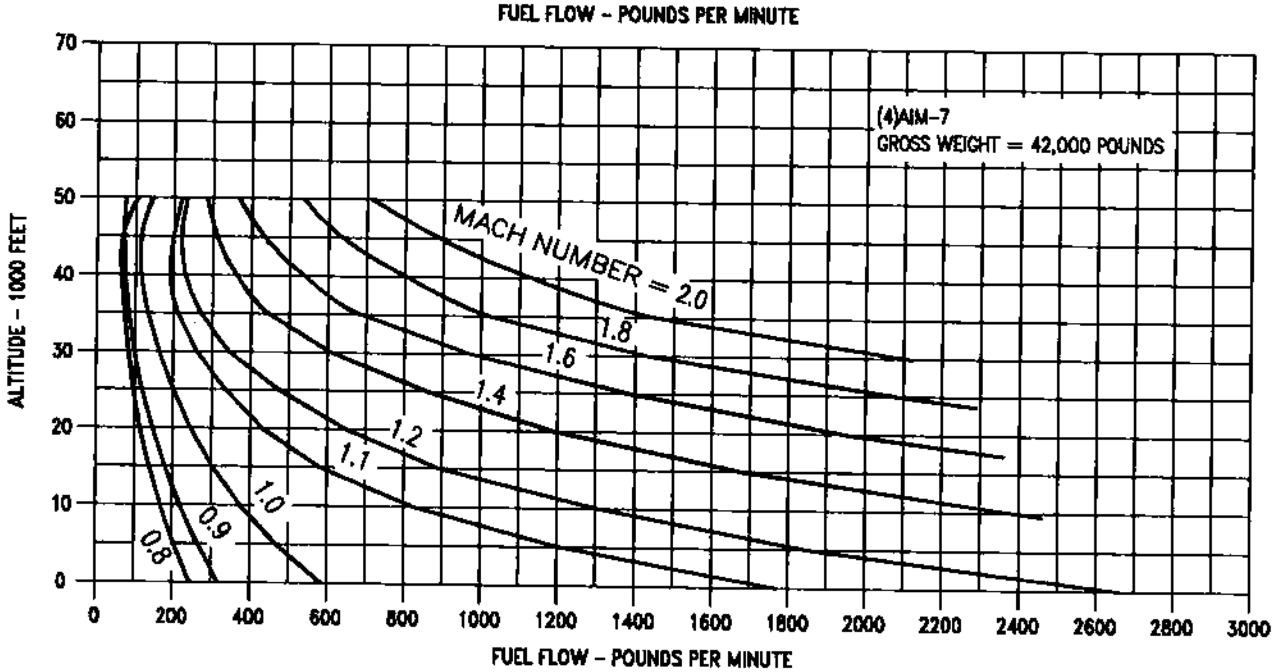
STABILIZED LEVEL FLIGHT

AIRPLANE CONFIGURATION
F-15E

REMARKS
ENGINE(S): (2)F100-PW-229
U.S. STANDARD DAY, 1966







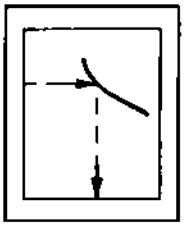
15E-1-(310-1)38-CATI

Figure B9-21

COMBAT FUEL FLOW

STABILIZED LEVEL FLIGHT

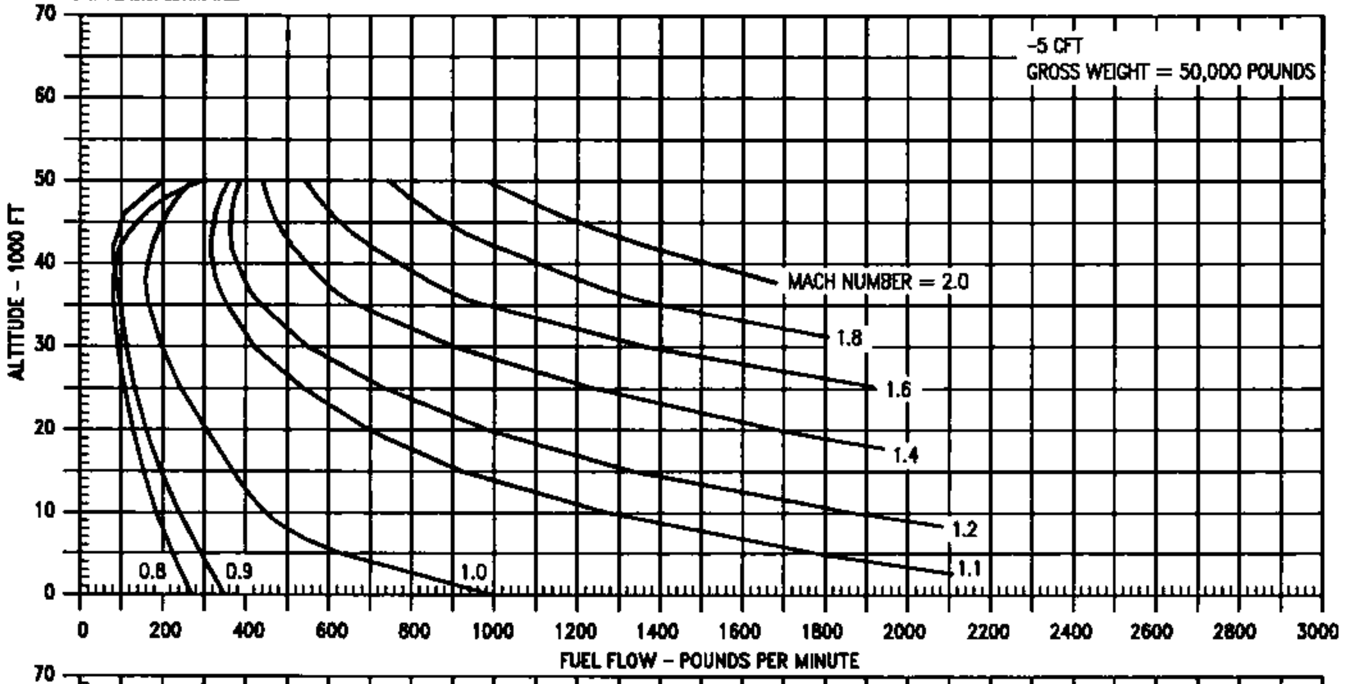
GUIDE



AIRPLANE CONFIGURATION
F-15E

REMARKS
ENGINE(S): (2) F100-PW-229
U.S. STANDARD DAY

DATE: 15 JULY 1991
DATA BASIS: ESTIMATED



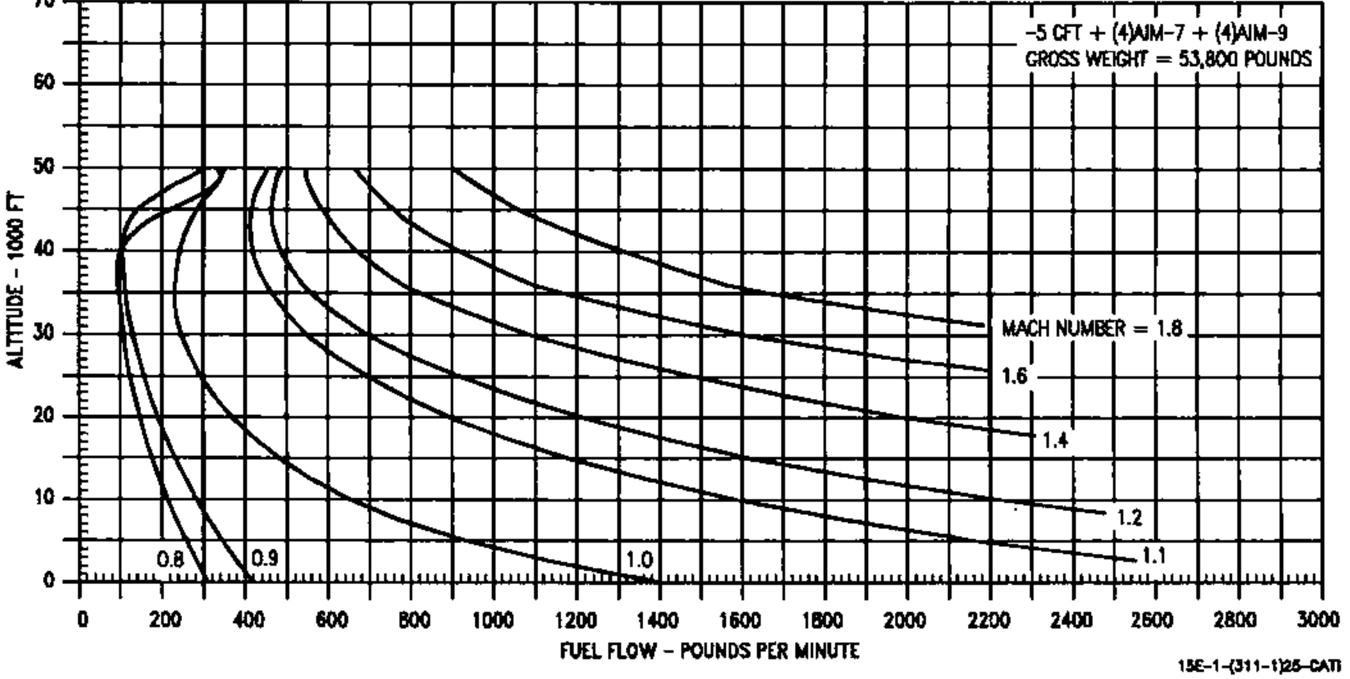


Figure B9-22

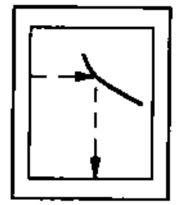
COMBAT FUEL FLOW

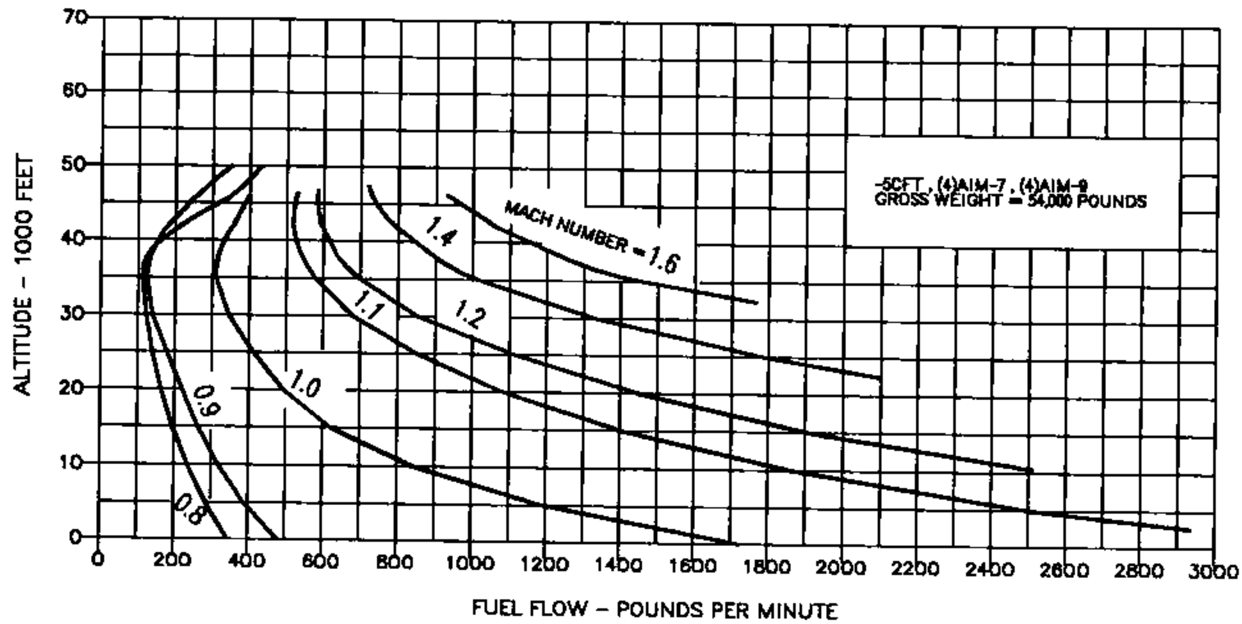
STABILIZED LEVEL FLIGHT

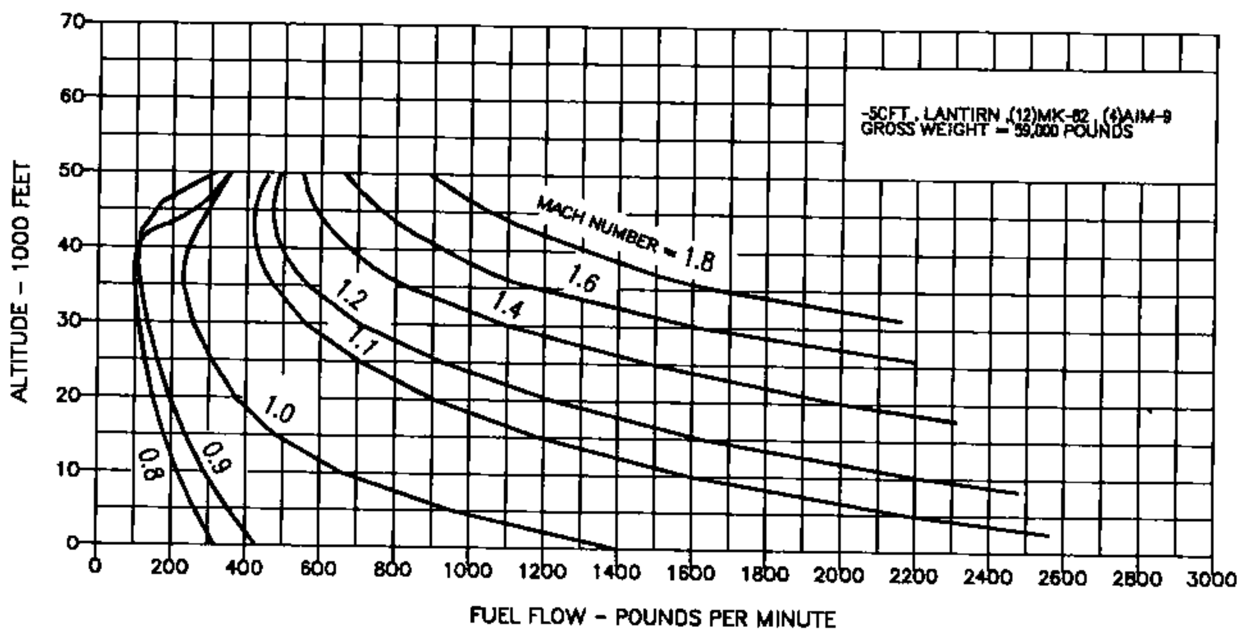
REMARKS
ENGINE(S): (2)F100-PW-229
U.S. STANDARD DAY, 1966

AIRPLANE CONFIGURATION
F-15E

GUIDE







15E-1-(351-1)38-CATI

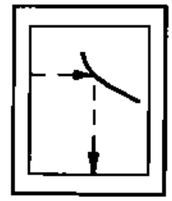
Figure B9-23

COMBAT FUEL FLOW

STABILIZED LEVEL FLIGHT

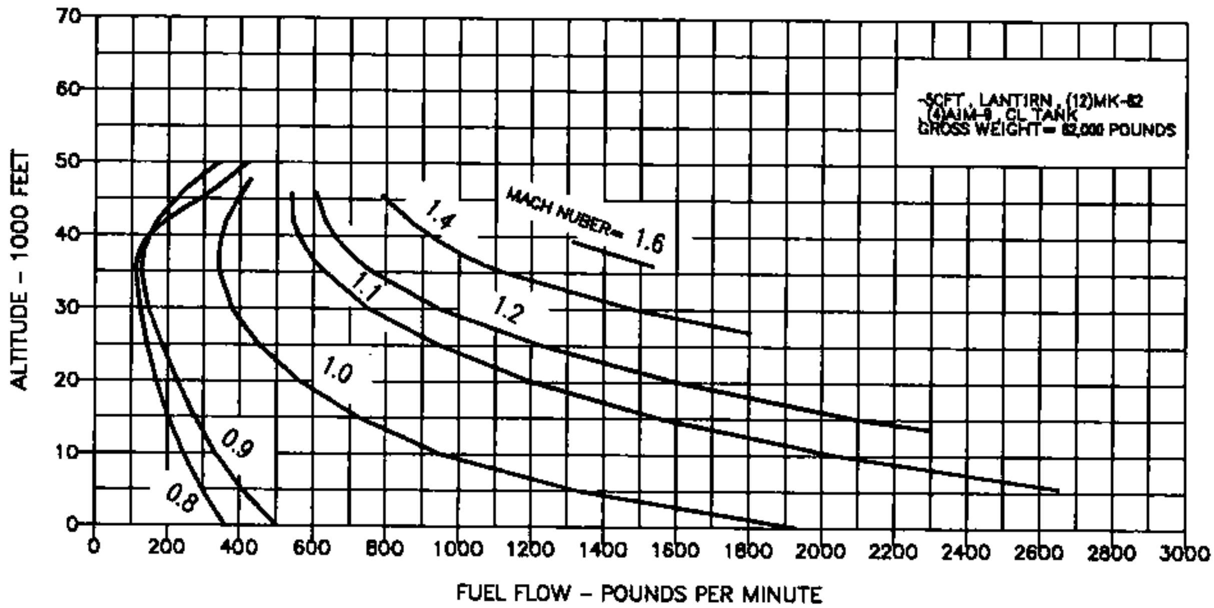
REMARKS
ENGINE(S): (2)F100-PW-229
U.S. STANDARD DAY, 1966

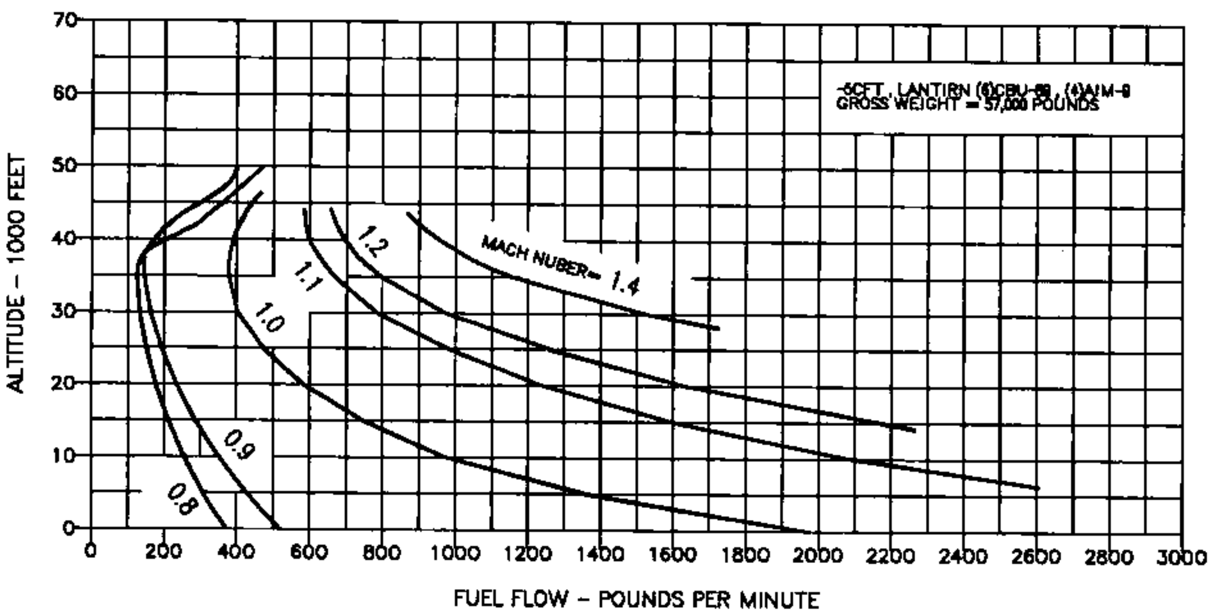
GUIDE



AIRPLANE CONFIGURATION

F-15E





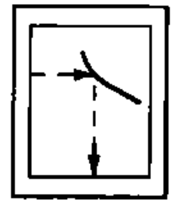
15E-1-(352-1)38-CATI

Figure B9-24

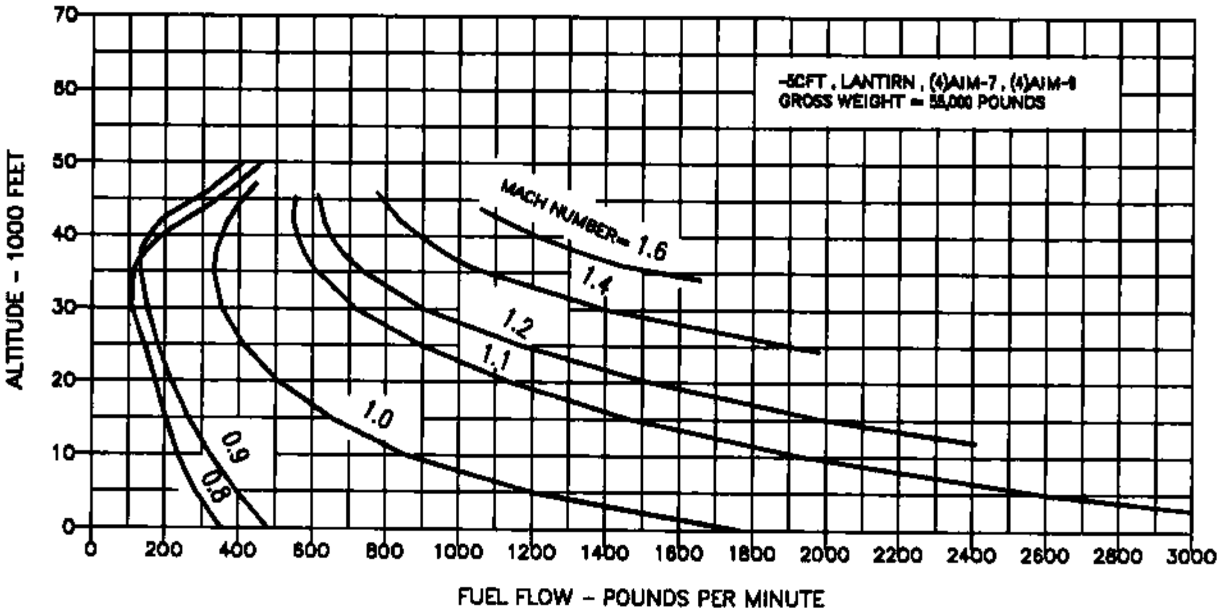
COMBAT FUEL FLOW

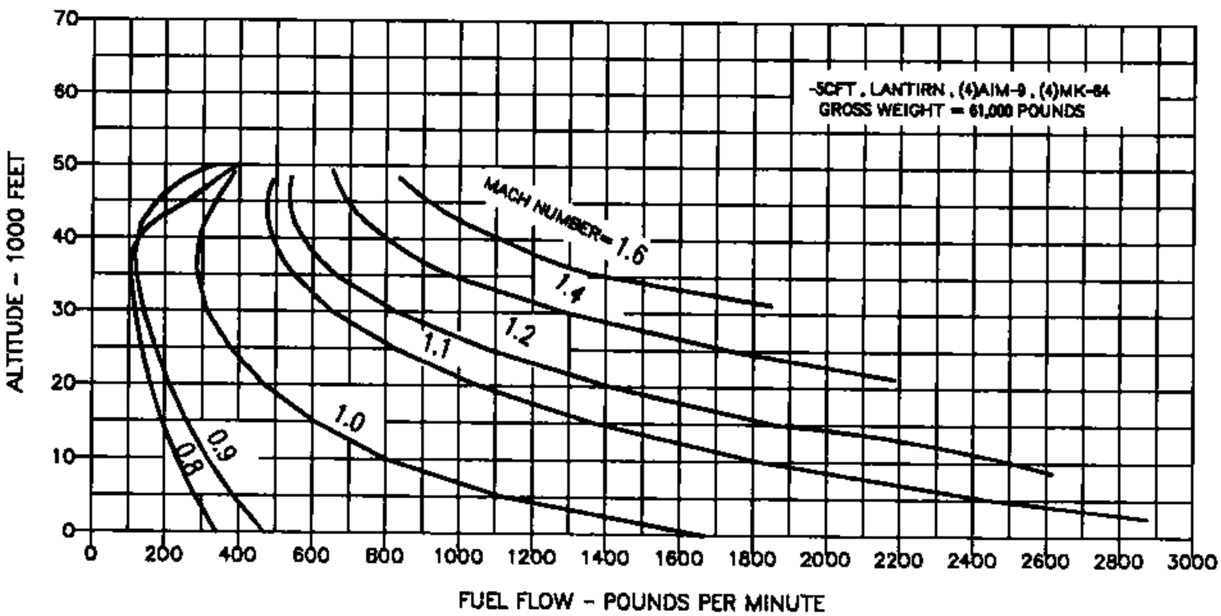
STABILIZED LEVEL FLIGHT

REMARKS
ENGINE(S): (2)F100-PW-229
U.S. STANDARD DAY, 1966



AIRPLANE CONFIGURATION
F-15E





15E-1-(353-1)38-CATI

Figure B9-25

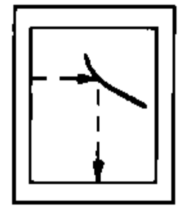
COMBAT FUEL FLOW

STABILIZED LEVEL FLIGHT

REMARKS

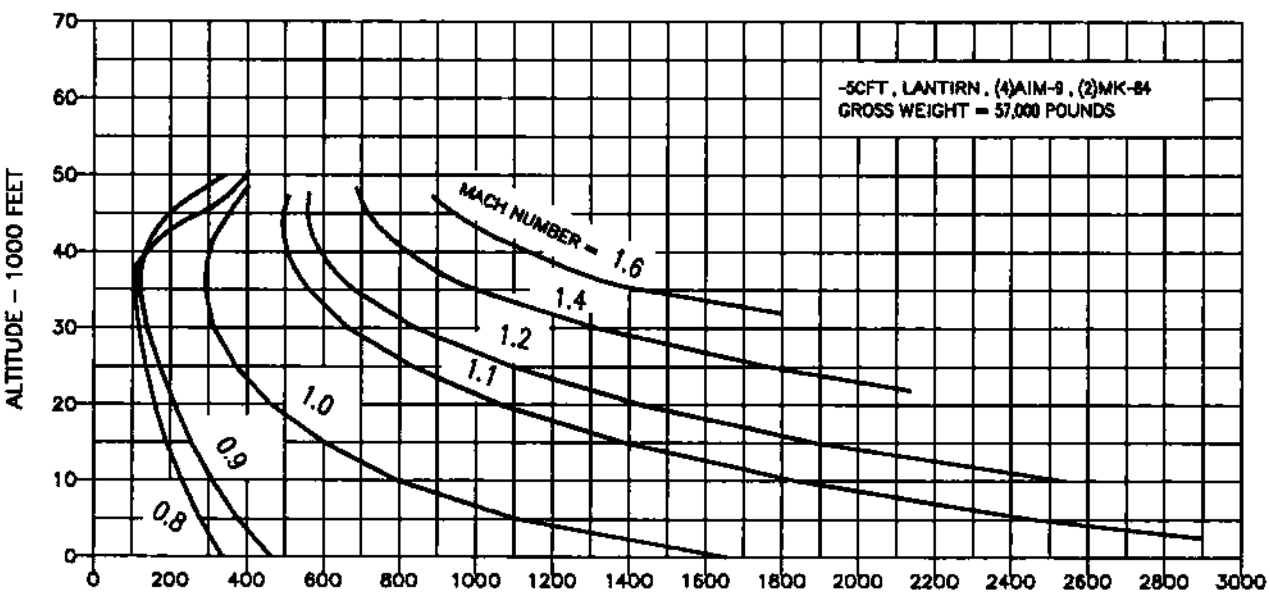
ENGINE(S): (2)F100-PW-229
U.S. STANDARD DAY, 1966

GUIDE



AIRPLANE CONFIGURATION

F-15E

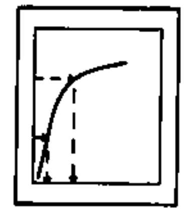


15E-1-(354-1)38-CATI

Figure B9-26

LEVEL FLIGHT ACCELERATION

GROSS WEIGHT – 43,600 POUNDS



AIRPLANE CONFIGURATION
CLEAN AIRPLANE

REMARKS
ENGINE(S): (2)F100-PW-229
1G LOAD FACTOR

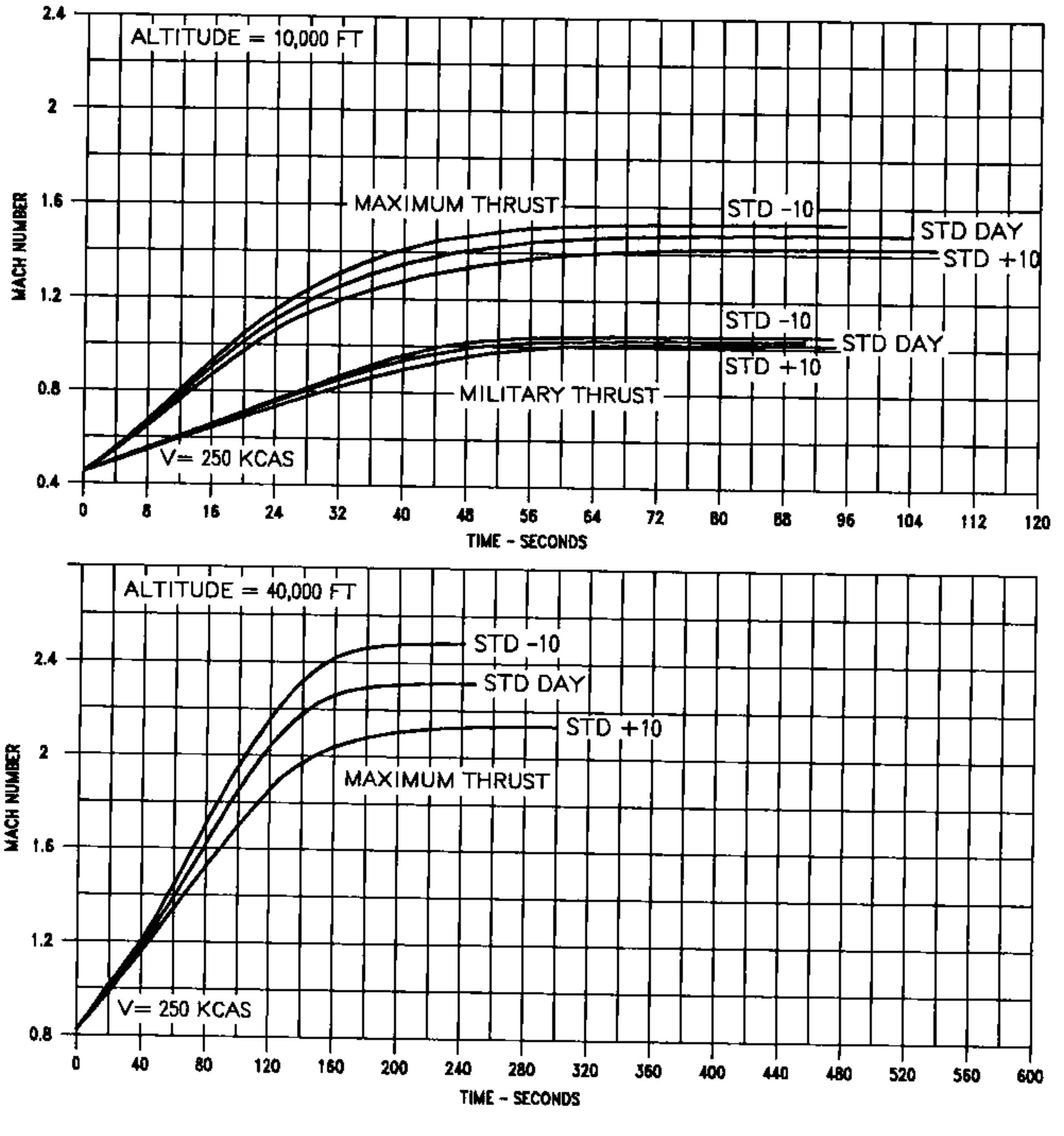
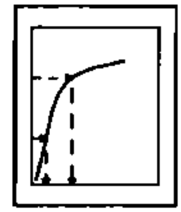


Figure B9-27

LEVEL FLIGHT ACCELERATION

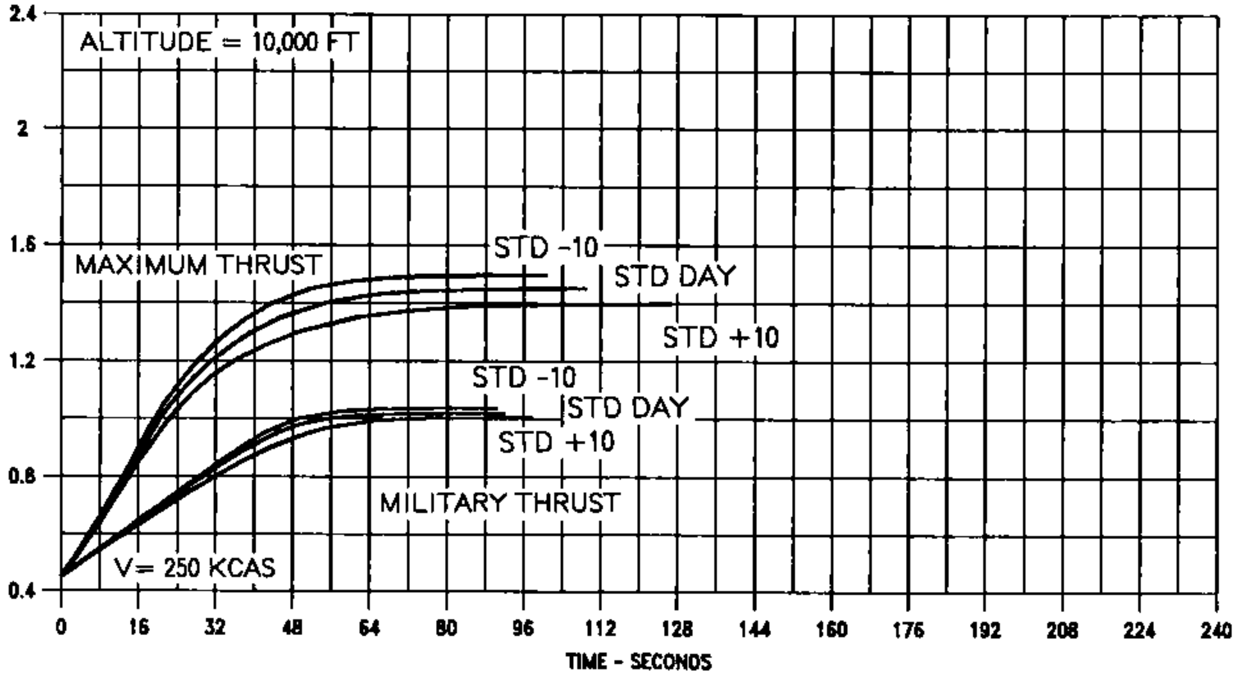
GROSS WEIGHT – 45,600 POUNDS

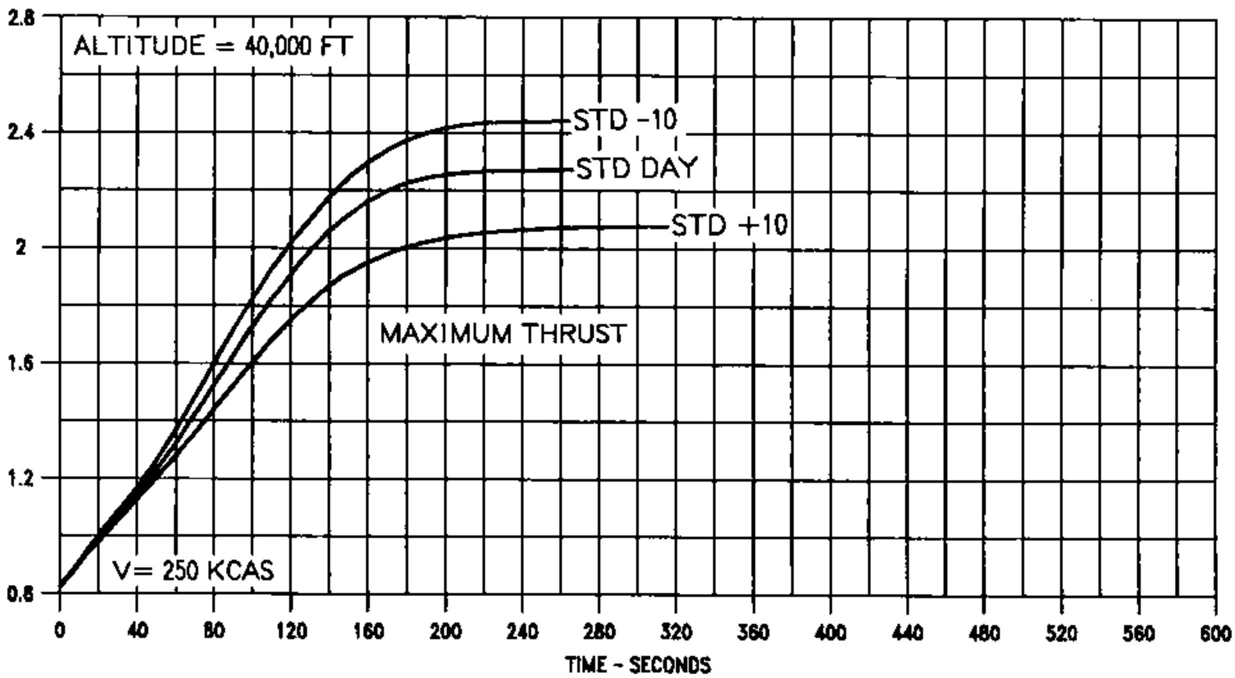
GUIDE



AIRPLANE CONFIGURATION
F-15E + (4)AIM-7

REMARKS
ENGINE(S): (2)F100-PW-229
1G LOAD FACTOR





15E-1-(361-1)38-CATI

Figure B9-28

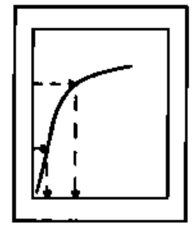
LEVEL FLIGHT ACCELERATION

INITIAL GROSS WEIGHT – 46,400 POUNDS

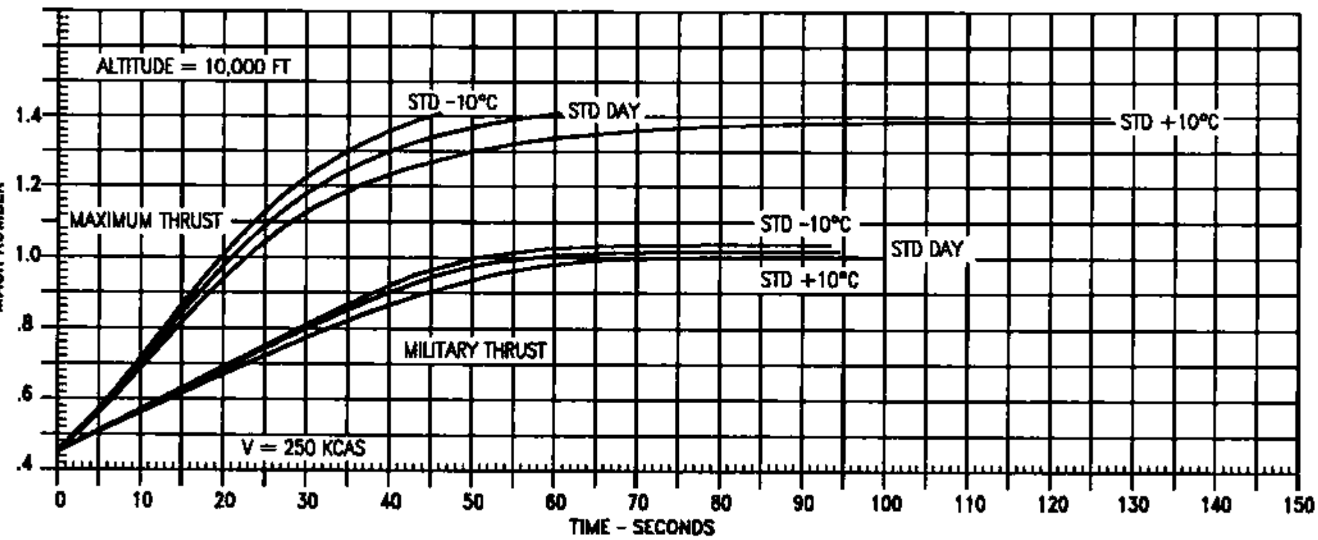
AIRPLANE CONFIGURATION
(4) AIM-7

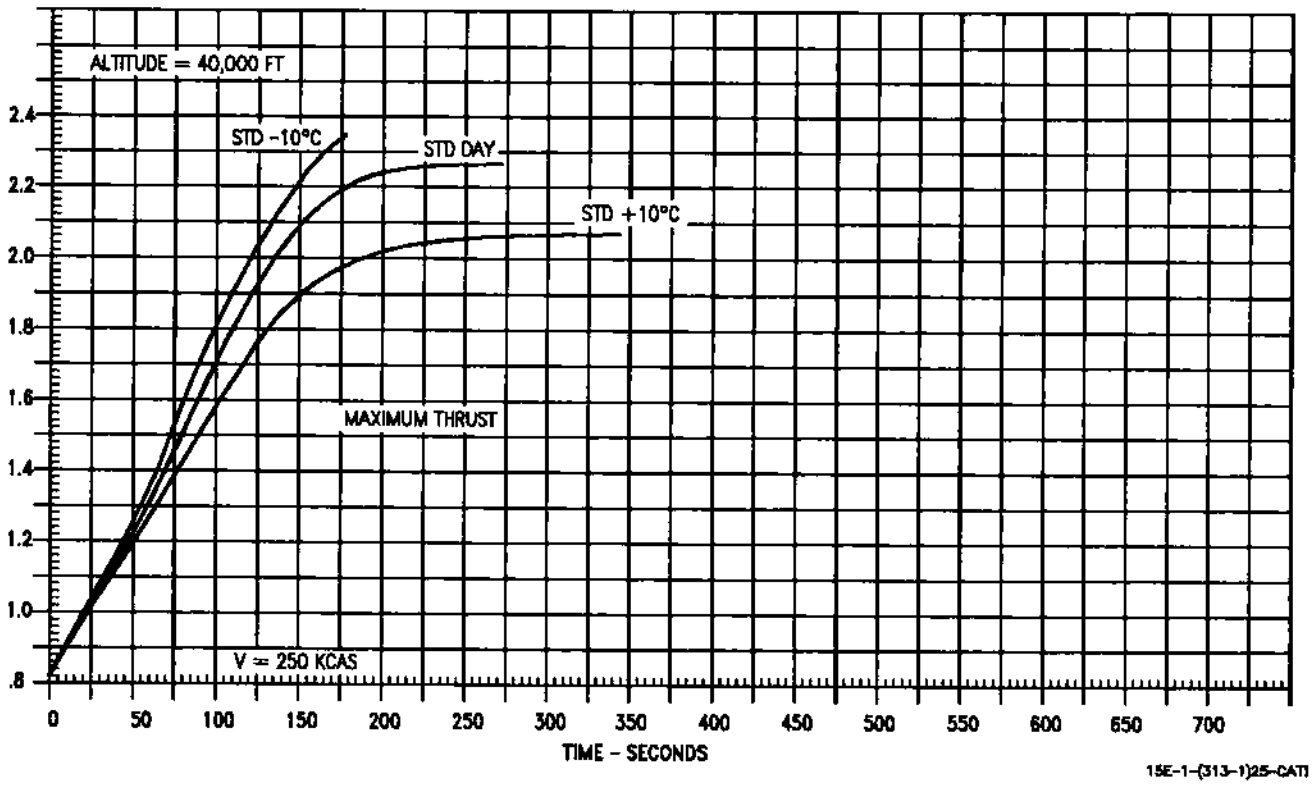
REMARKS
ENGINE(S): (2) F100-PW-229
1g LOAD FACTOR

GUIDE



DATE: 15 JULY 1991
DATA BASIS: ESTIMATED



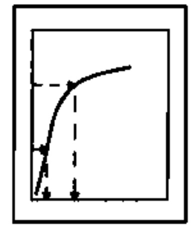


15E-1-(313-1)25-CATI

Figure B9-29

LEVEL FLIGHT ACCELERATION

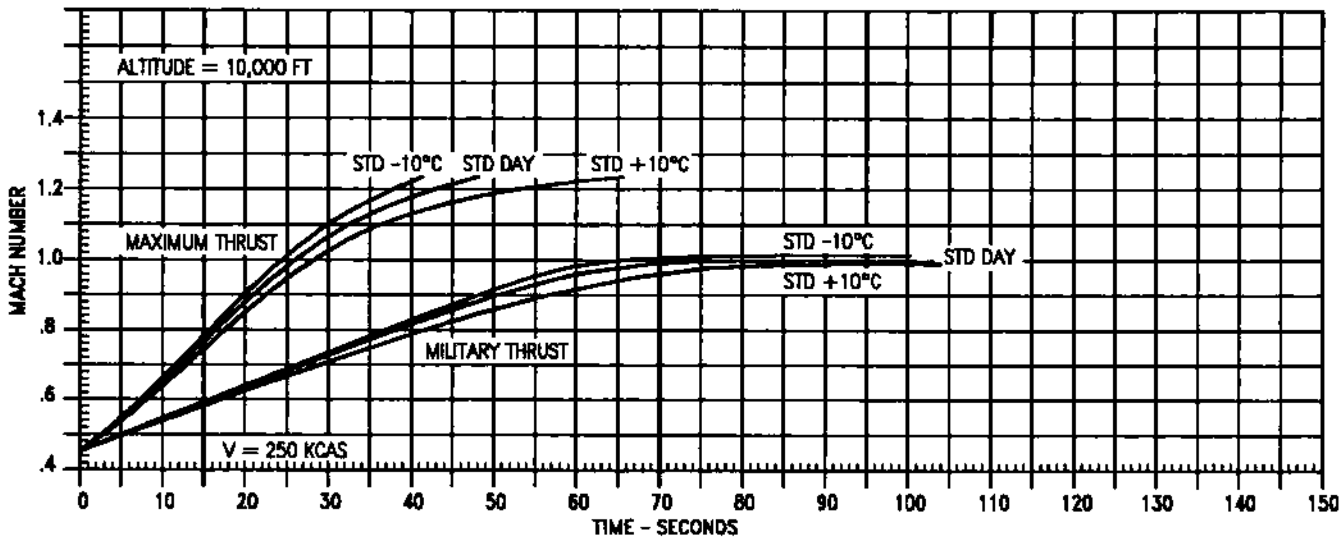
INITIAL GROSS WEIGHT – 55,600 POUNDS

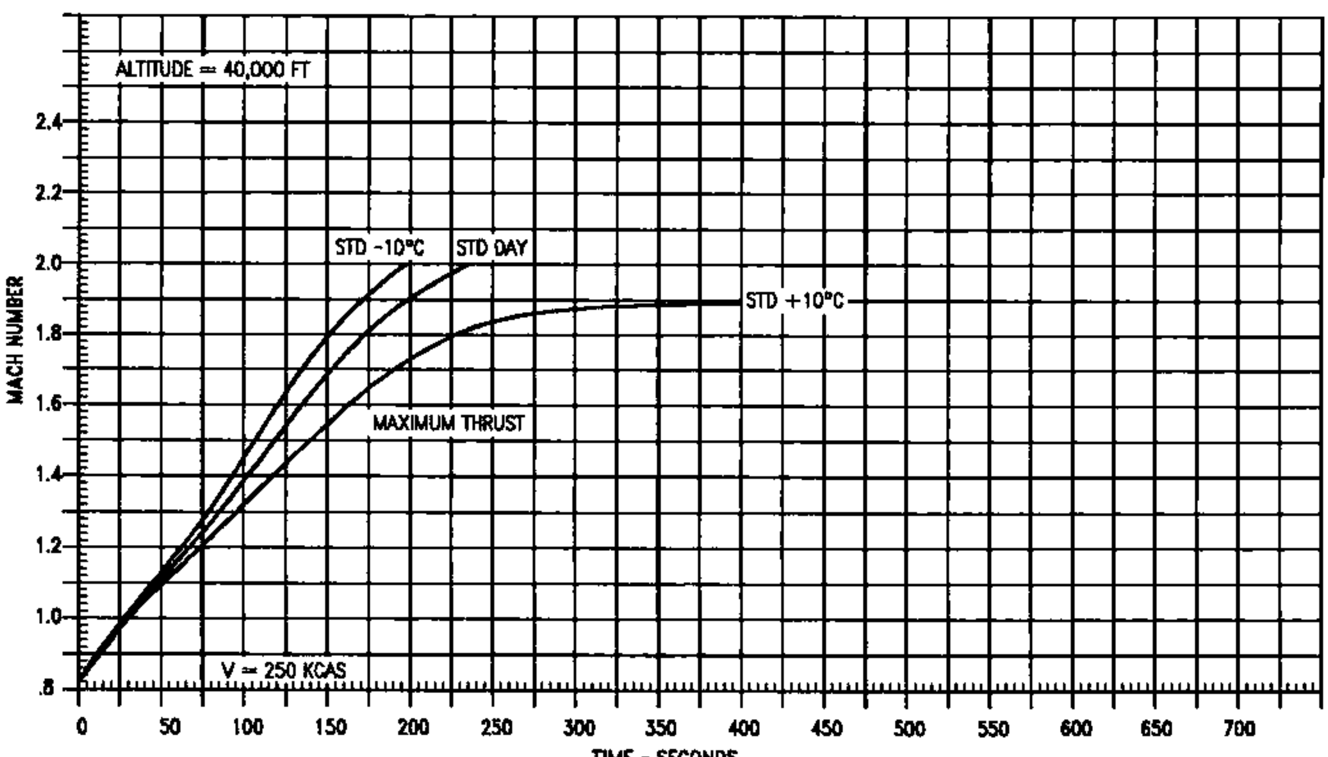


AIRPLANE CONFIGURATION
-5 CFT

REMARKS
ENGINE(S): (2) F100-PW-229
1g LOAD FACTOR

DATE: 15 JULY 1991
DATA BASIS: ESTIMATED



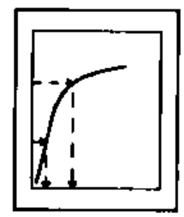


15E-1-(306-1)25-CATI

Figure B9-30

LEVEL FLIGHT ACCELERATION

GROSS WEIGHT - 59,600 POUNDS



AIRPLANE CONFIGURATION
-SCFT, (4)AIM-9, (4)AIM-7

REMARKS
ENGINE(S): (2)F100-PW-229
1G LOAD FACTOR

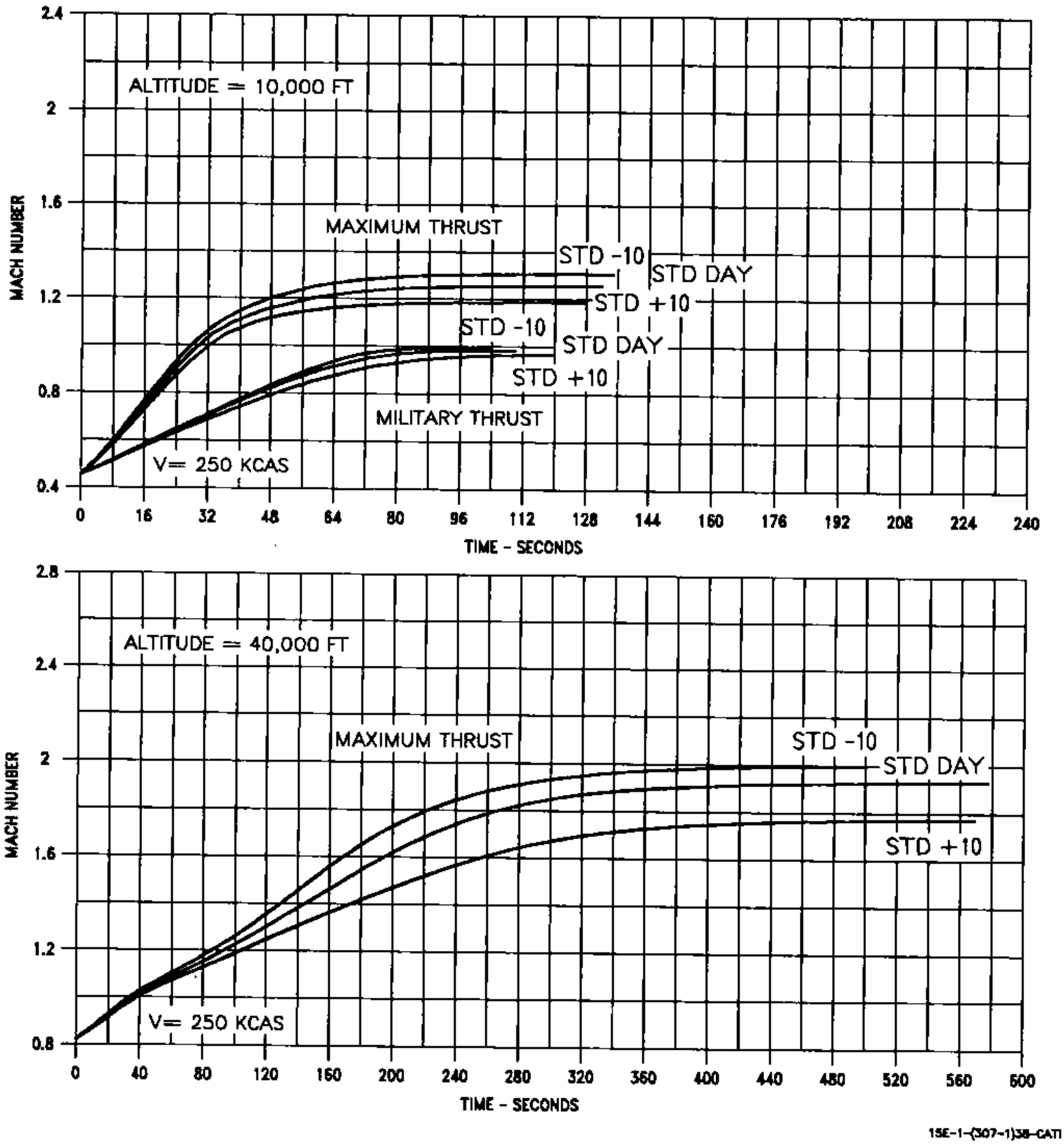
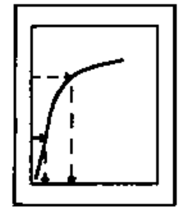


Figure B9-31

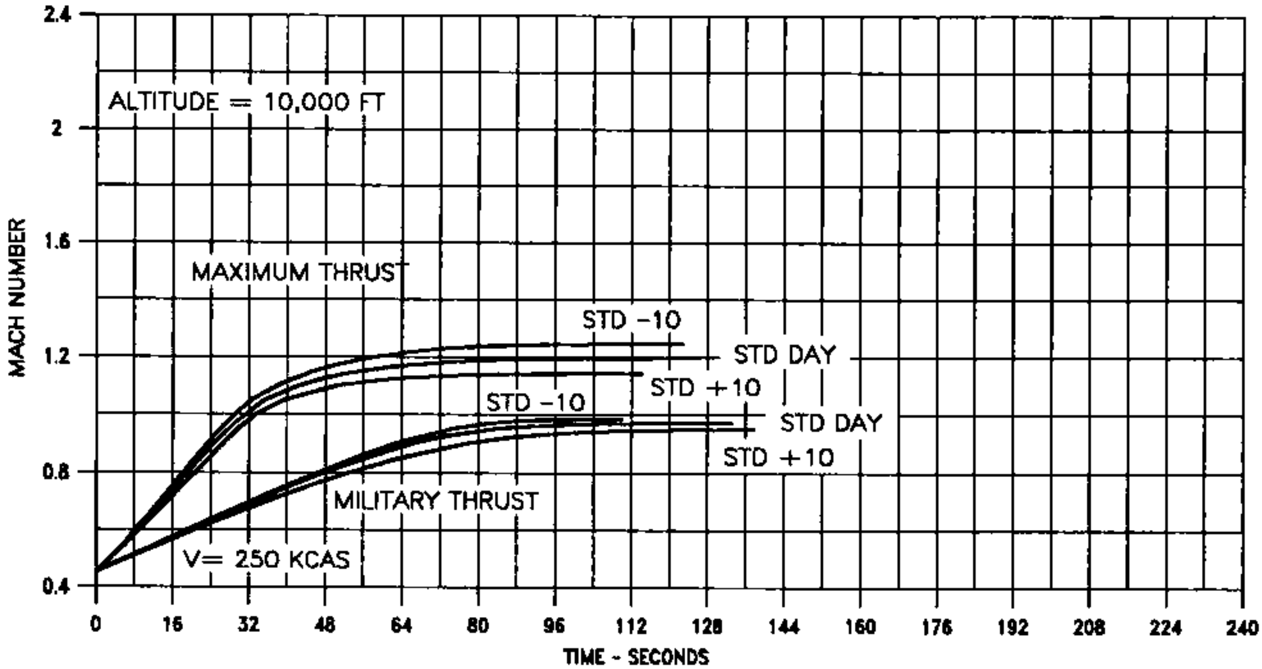
LEVEL FLIGHT ACCELERATION

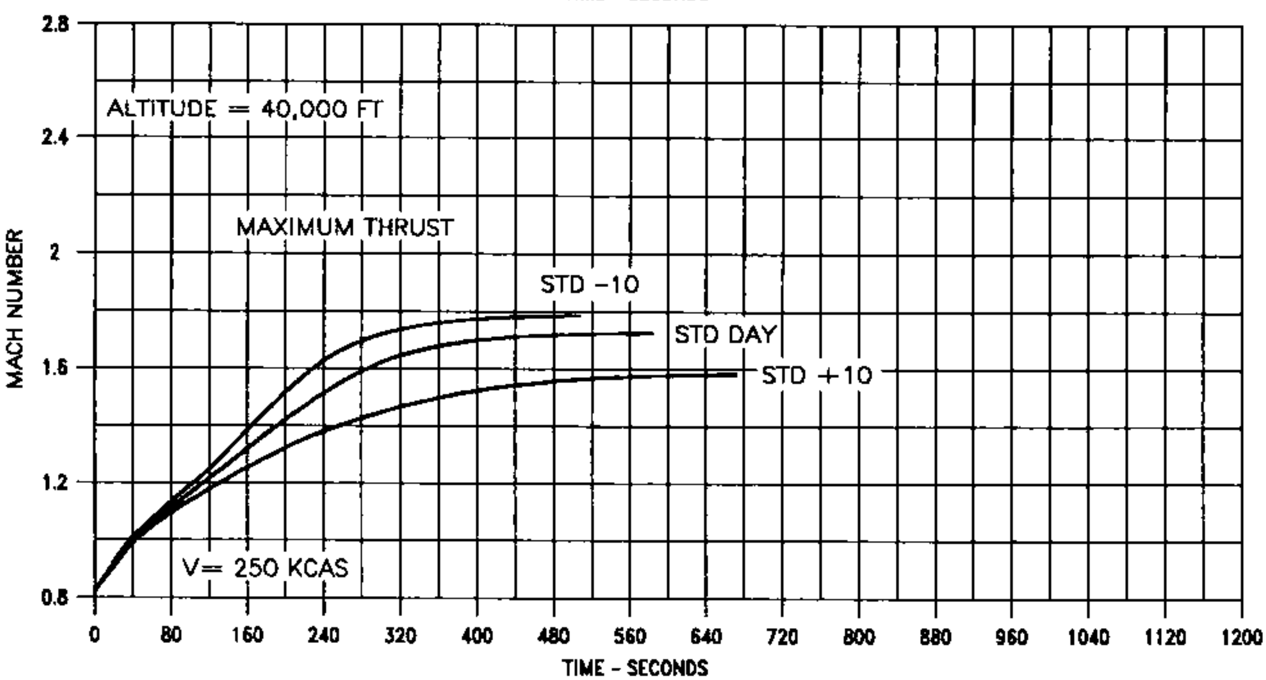
GROSS WEIGHT - 60.700 POUNDS



AIRPLANE CONFIGURATION
-5CFT + LANTIRN + (4)AIM-7
+ (4)AIM-9

REMARKS
ENGINE(S): (2)F100-PW-229
1G LOAD FACTOR





15E-1-(383-1)38-CATI

Figure B9-32

LEVEL FLIGHT ACCELERATION

GROSS WEIGHT – 62,600 POUNDS

AIRPLANE CONFIGURATION
-5CFT + LANTIRN + (2)MK-84
+ (4)AIM-9

REMARKS
ENGINE(S): (2)F100-PW-229
1G LOAD FACTOR

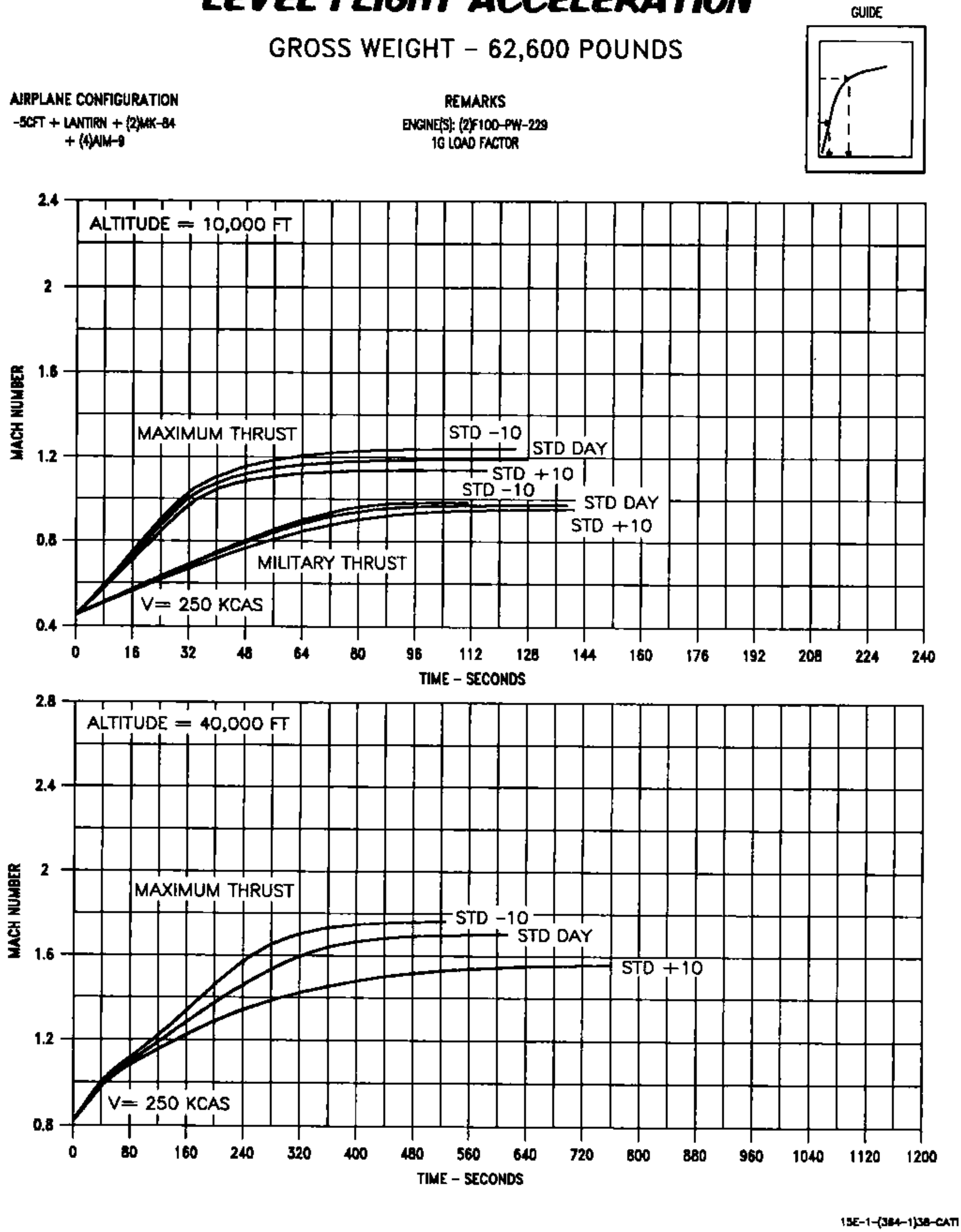
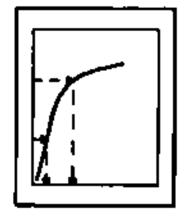


Figure B9-33

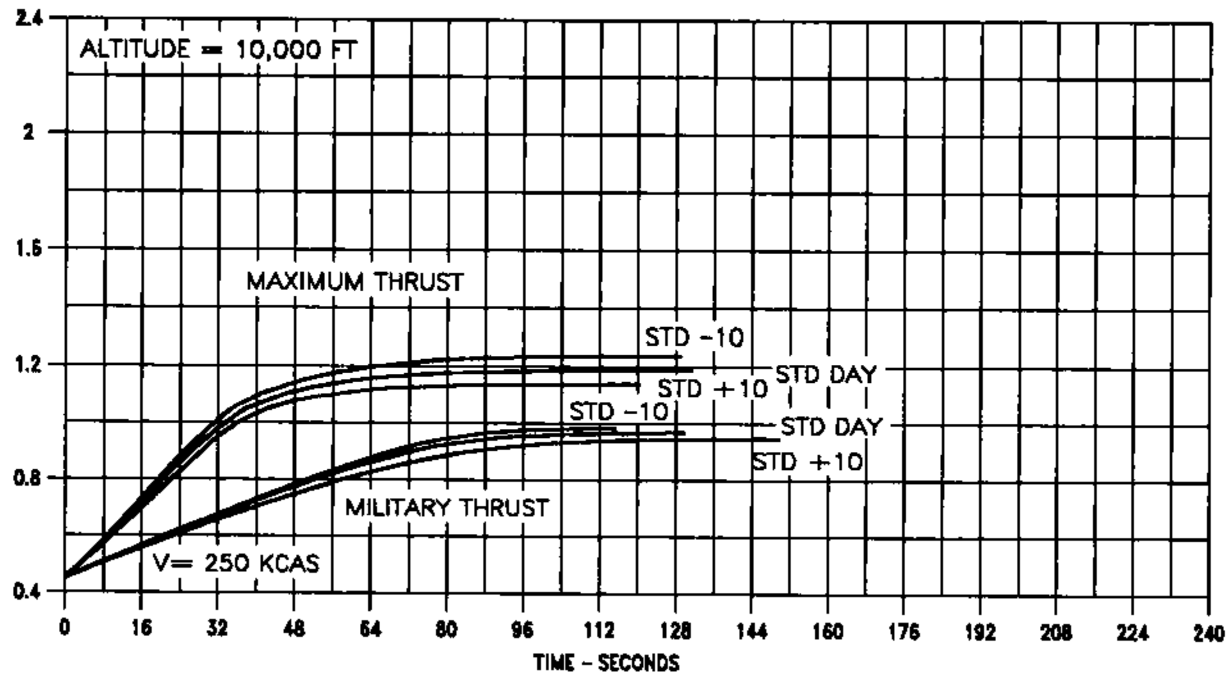
LEVEL FLIGHT ACCELERATION

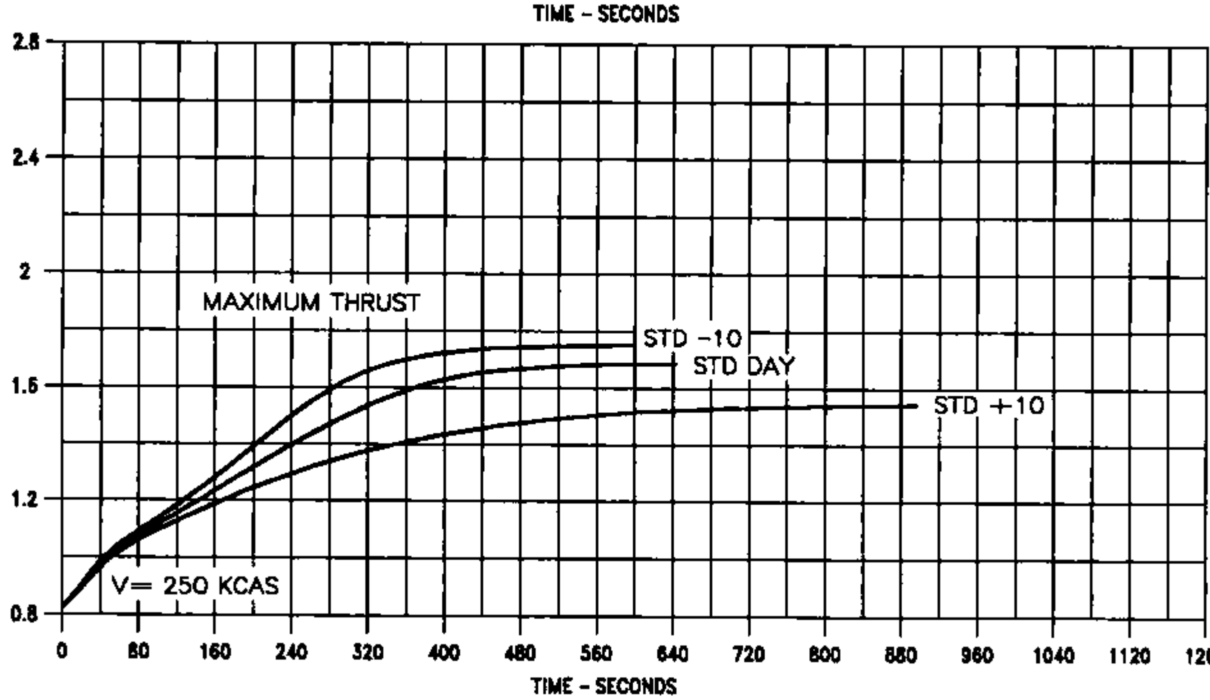
GROSS WEIGHT - 64,700 POUNDS



AIRPLANE CONFIGURATION
-5CFT + LANTIRN + (12)MK-82 + (4)AIM-9

REMARKS
ENGINE(S): (2)F100-PW-229
1G LOAD FACTOR





15E-1-(385-1)38-CATI

Figure B9-34

LEVEL FLIGHT ACCELERATION

GROSS WEIGHT – 66,500 POUNDS

AIRPLANE CONFIGURATION
-5CFT + LANTIRN + (6)CBU-89
+ (4)AIM-9

REMARKS
ENGINE(S): (2)F100-PW-229
U.S. STANDARD DAY, 1966

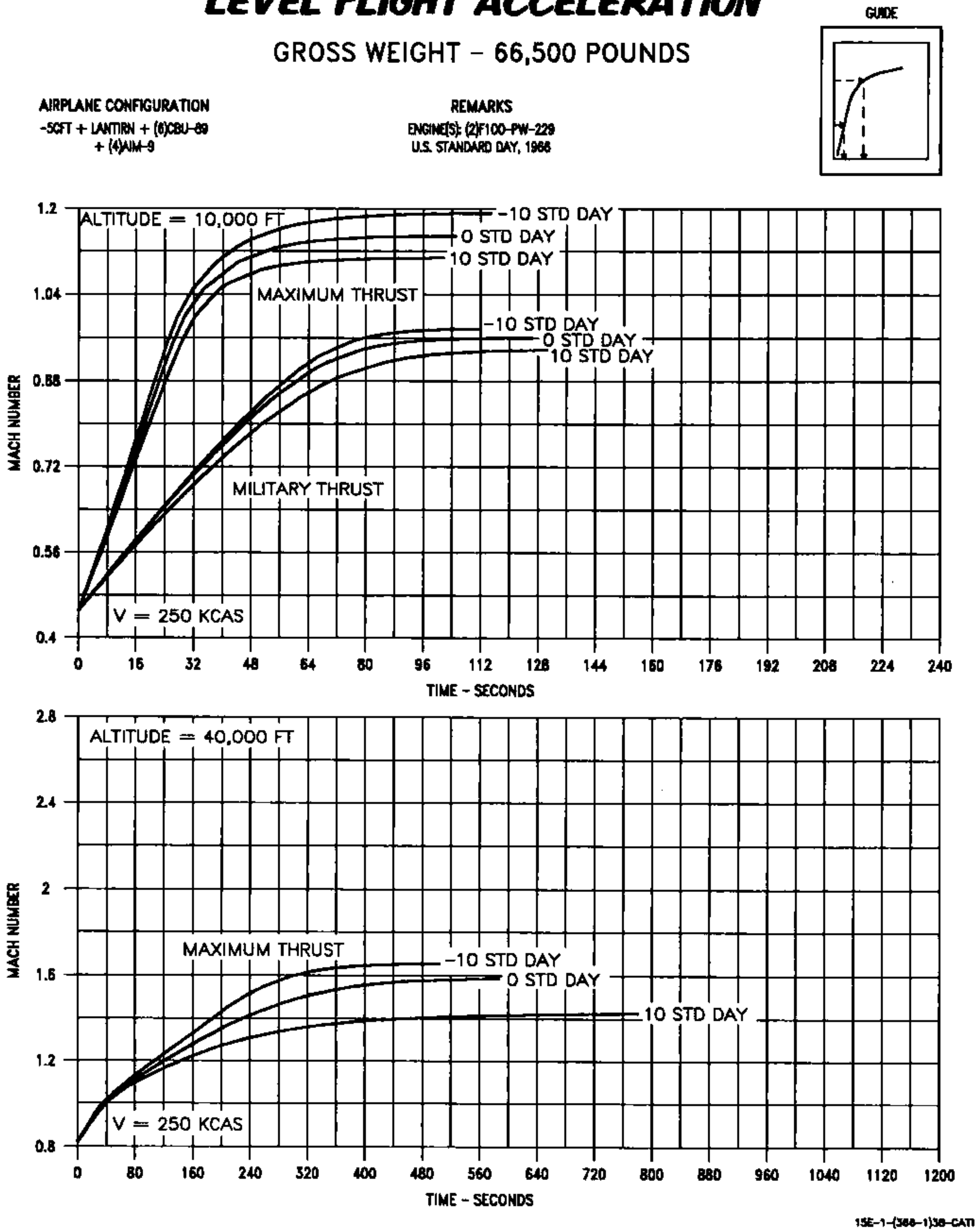
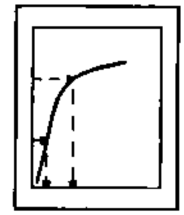


Figure B9-35

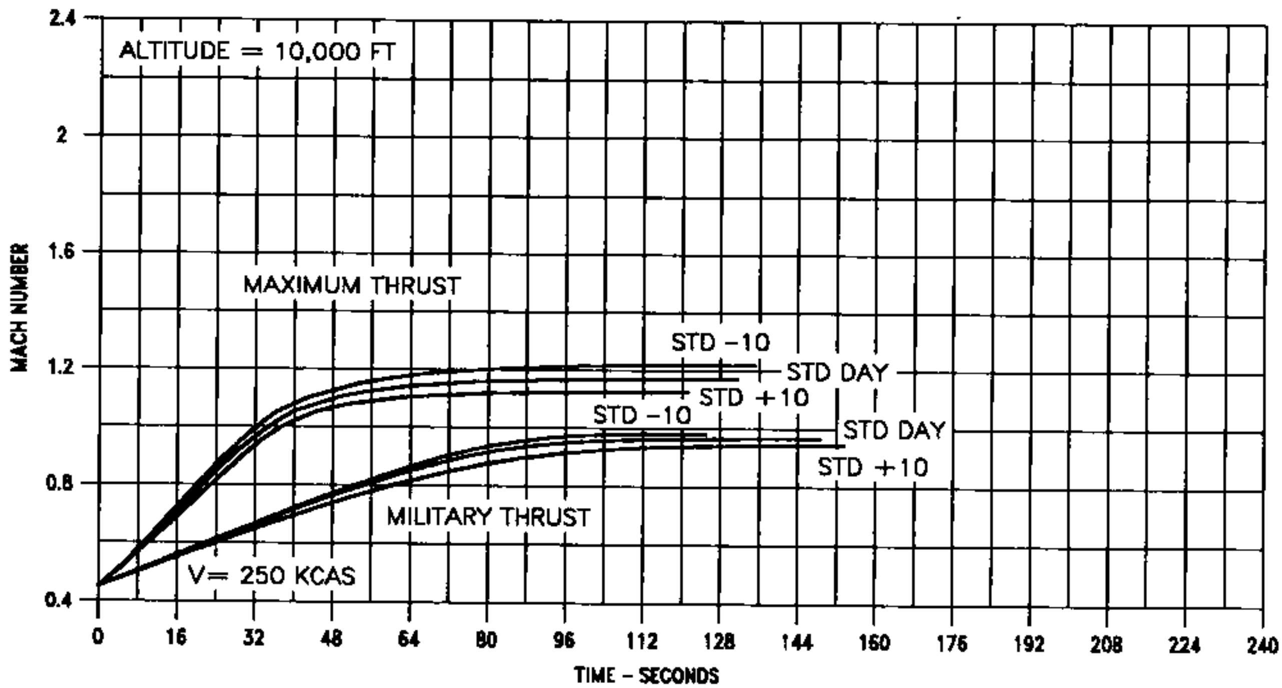
LEVEL FLIGHT ACCELERATION

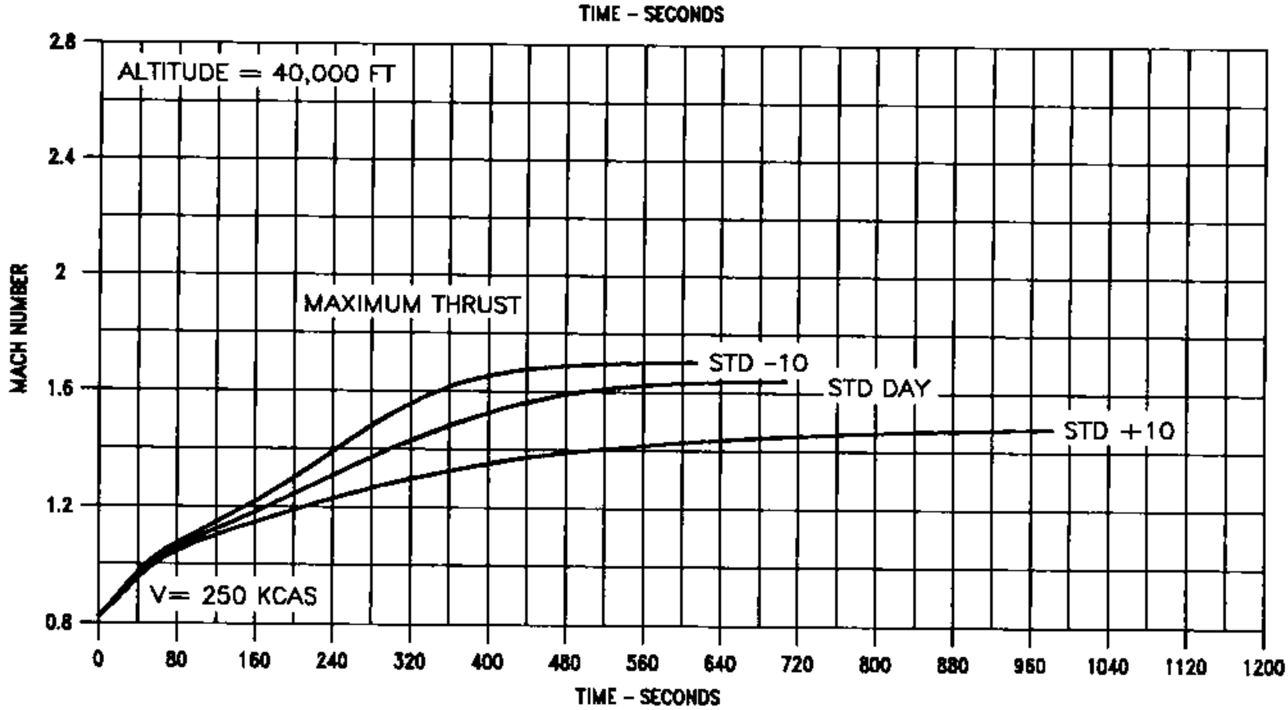
GROSS WEIGHT - 66,600 POUNDS



AIRPLANE CONFIGURATION
-5CFT + LANTIRN + (4)MK-84
+ (4)AIM-9

REMARKS
ENGINE(S): (2)F100-PW-229
1G LOAD FACTOR





15E-1-(387-1)36-CATI

Figure B9-36

LEVEL FLIGHT ACCELERATION

GROSS WEIGHT – 68,400 POUNDS

AIRPLANE CONFIGURATION
-5CFT + LANTIRN + (12)MK-82
+ (4)AIM-9 + CL TANK

REMARKS
ENGINE(S): (2)F100-PW-229
1G LOAD FACTOR

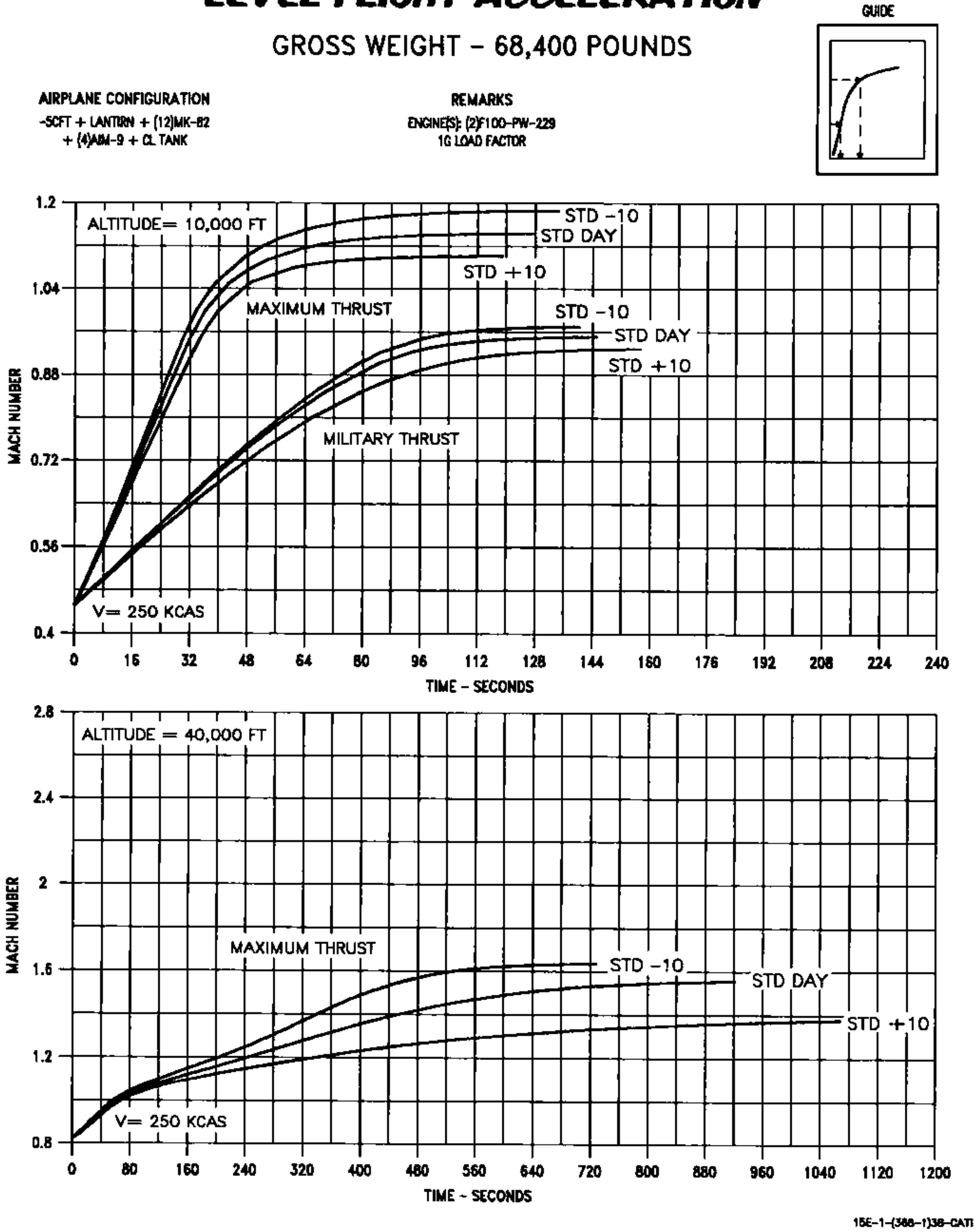


Figure B9-37

SUSTAINED LEVEL TURNS

MAXIMUM THRUST
GROSS WEIGHT – 40,000 POUNDS

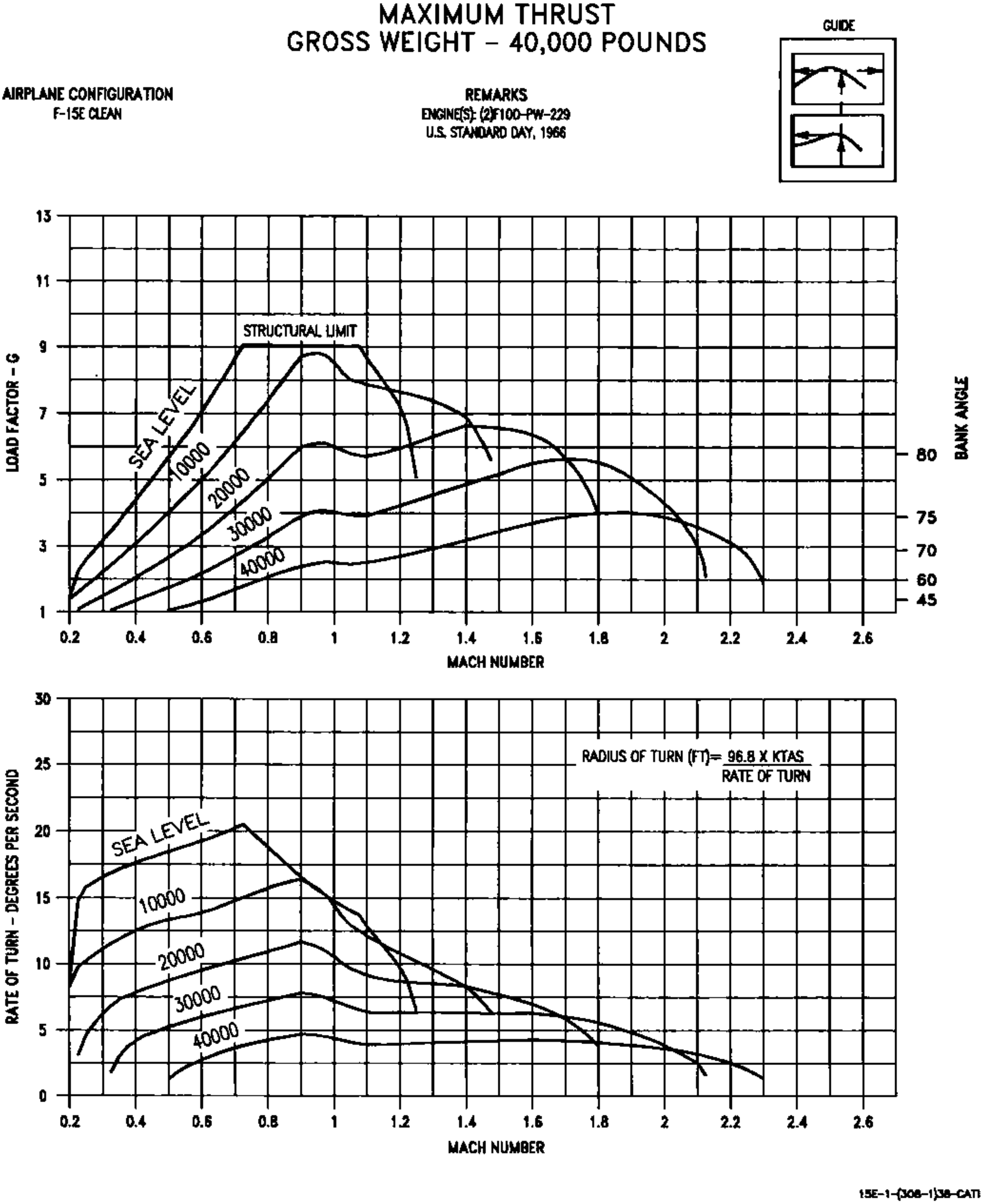
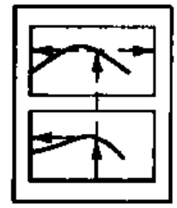


Figure B9-38

SUSTAINED LEVEL TURNS

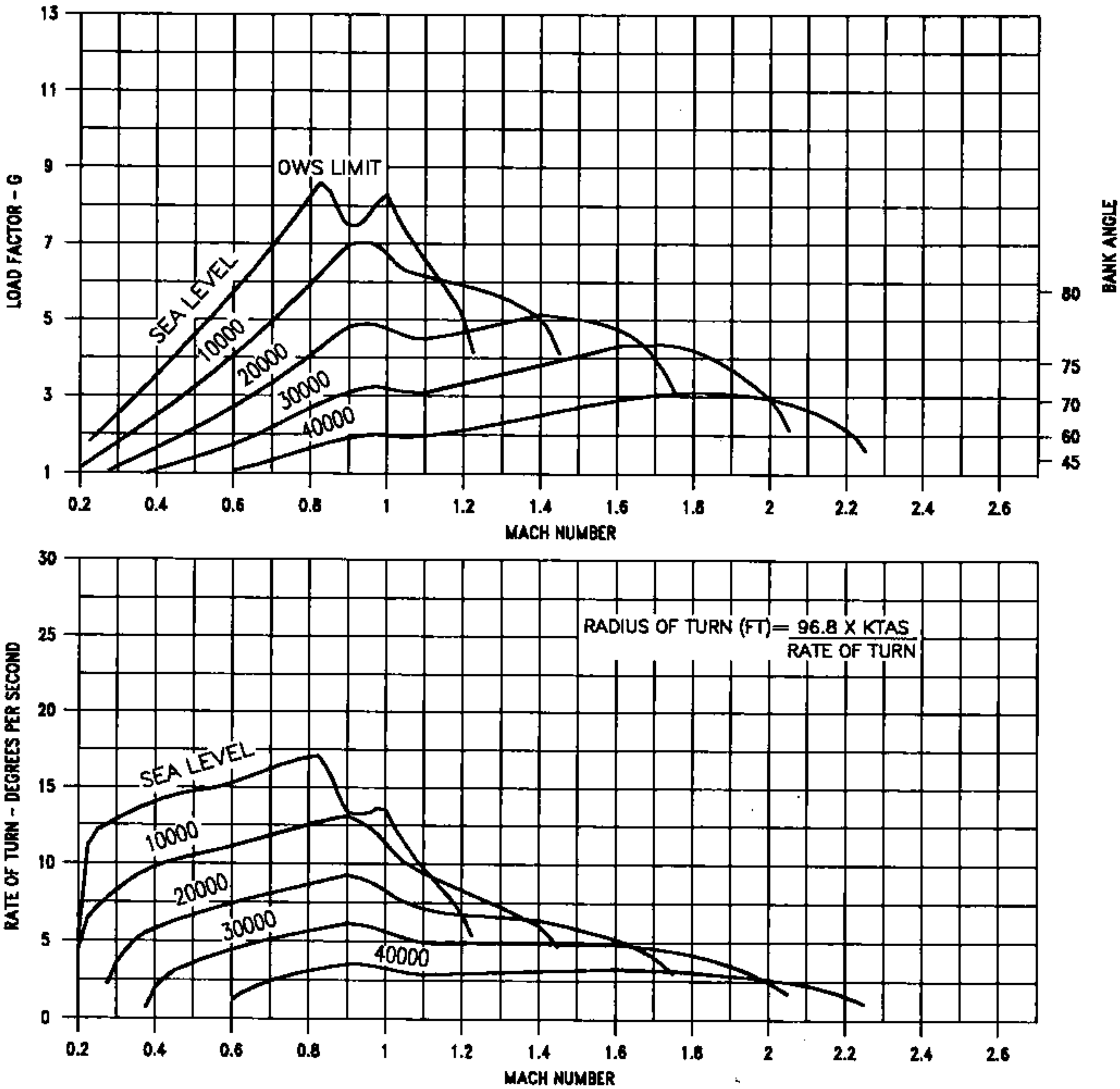
MAXIMUM THRUST
GROSS WEIGHT – 42,000 POUNDS

GUIDE



AIRPLANE CONFIGURATION
(4)AIM-7

REMARKS
ENGINE(S): (2)F100-PW-229
U.S. STANDARD DAY, 1966



15E-1-(309-1)38-CATI

Figure B9-39

SUSTAINED LEVEL TURNS

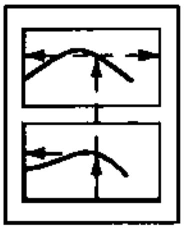
GROSS WEIGHT – 50,000 POUNDS
MAXIMUM THRUST

AIRPLANE CONFIGURATION
-5 CFT

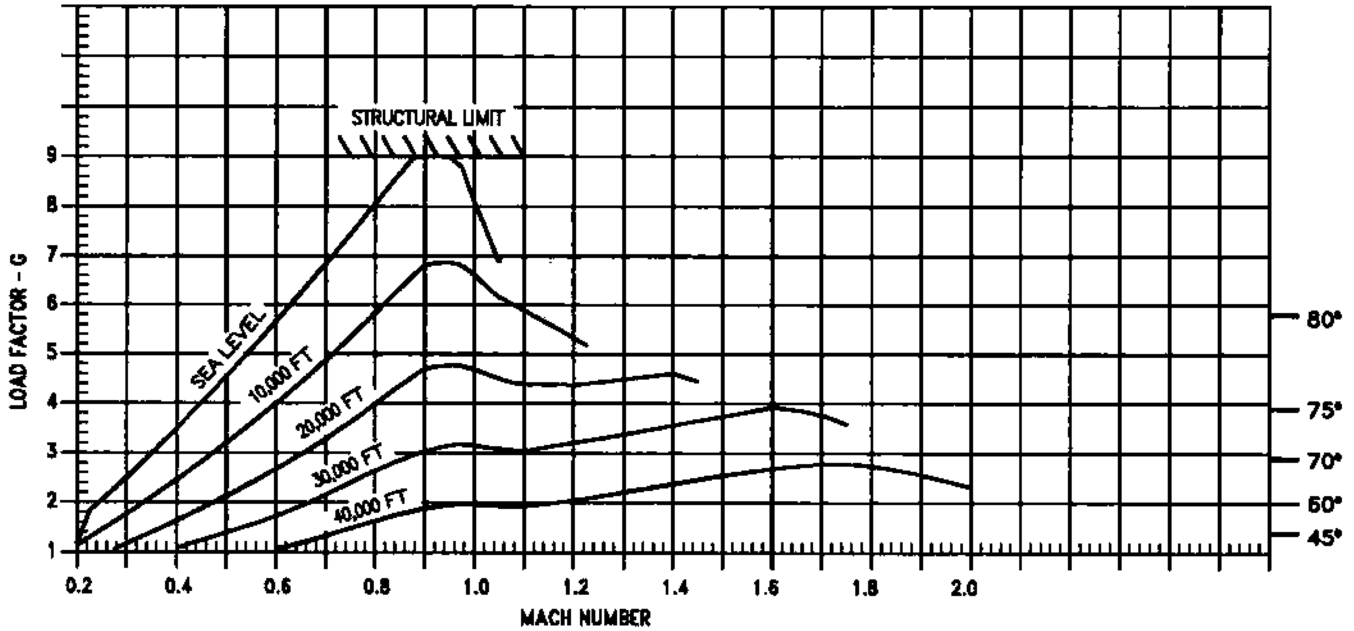
REMARKS
ENGINE(S): (2) F100-PW-229
U.S. STANDARD DAY, 1966

REMARKS
MAXIMUM CAPABILITY MAY BE REDUCED
BY OVERLOAD WARNING SYSTEM.

GUIDE



DATE: 15 JULY 1991
DATA BASIS: ESTIMATED



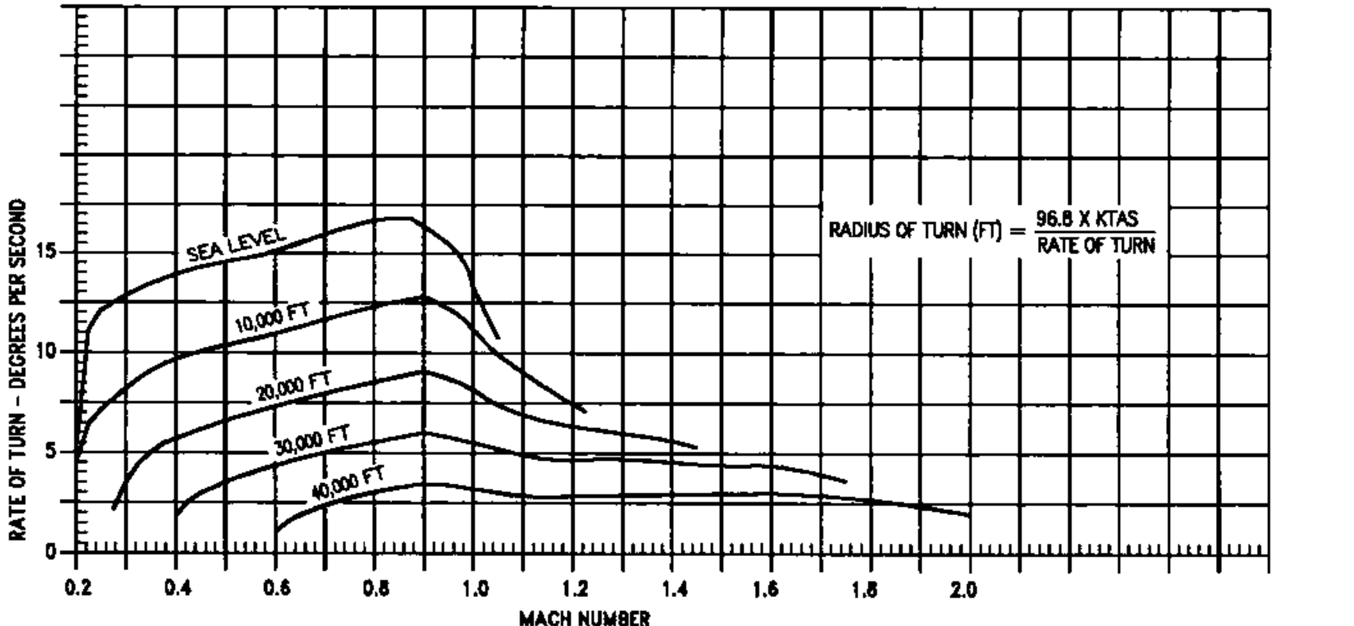


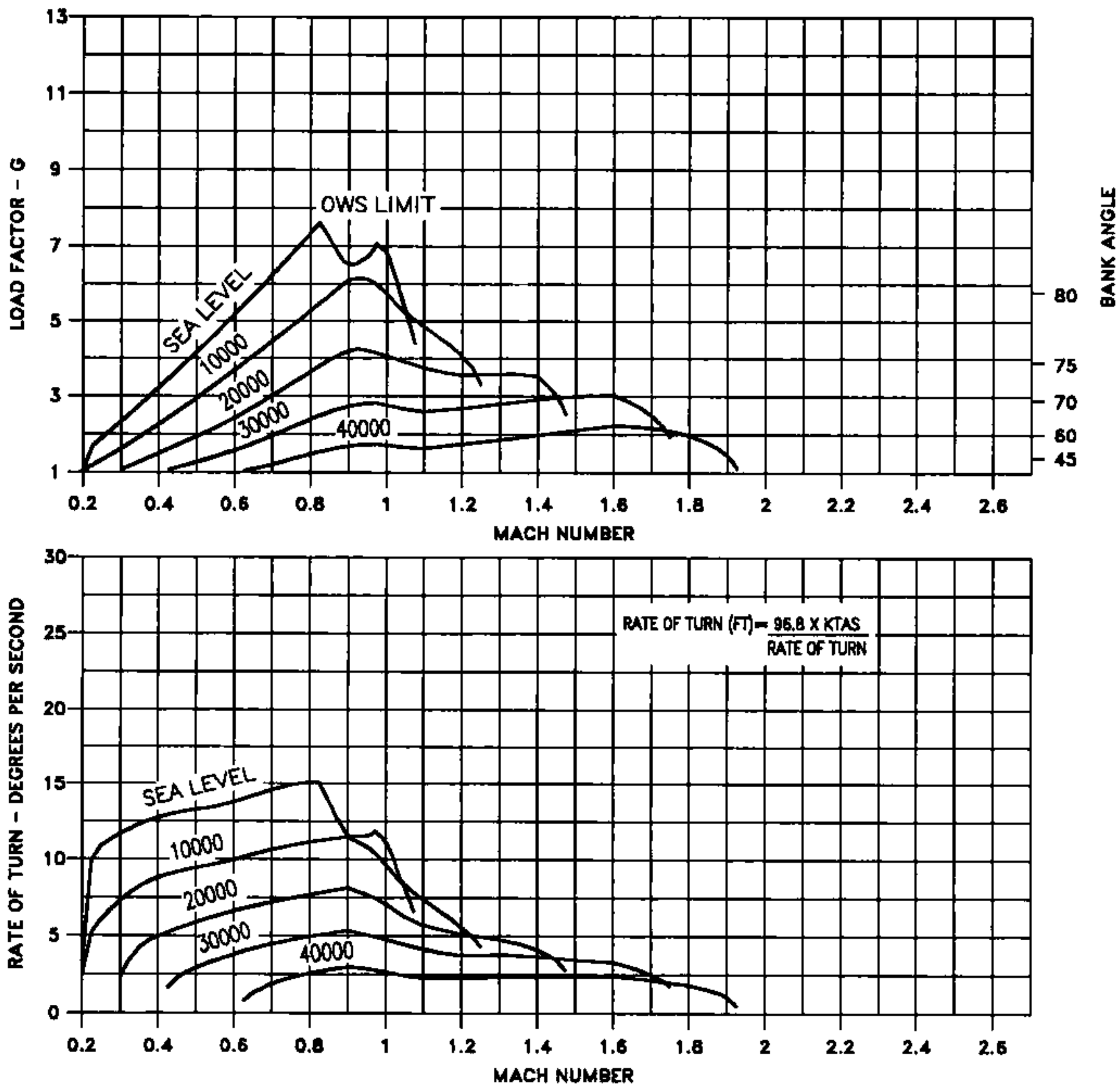
Figure B9-40

SUSTAINED LEVEL TURNS

MAXIMUM THRUST
GROSS WEIGHT – 54,000 POUNDS

AIRPLANE CONFIGURATION
-5 CFT, (4)AIM-7, (4)AIM-9

REMARKS
ENGINE(S): (2)F100-PW-229
U.S. STANDARD DAY, 1966



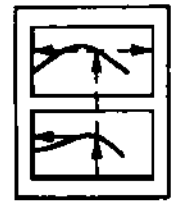
15E-1-(305-1)38-CATI

Figure B9-41

SUSTAINED LEVEL TURNS

MAXIMUM THRUST
GROSS WEIGHT - 55,000 POUNDS

GUIDE

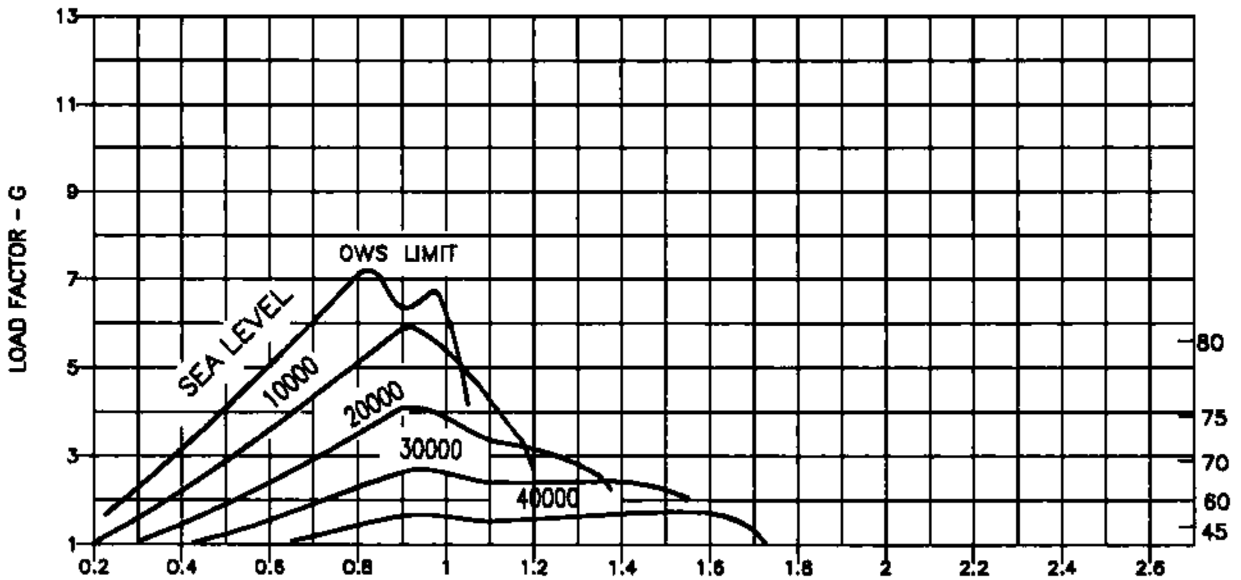


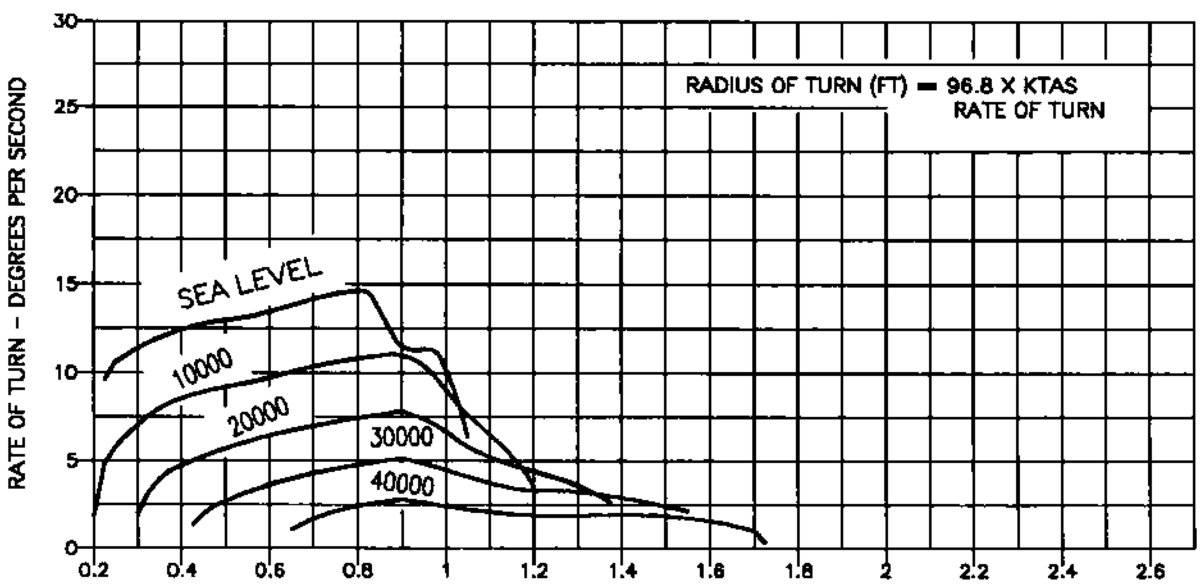
REMARKS

ENGINE(S): (2)F100-PW-229
U.S. STANDARD DAY, 1966

AIRPLANE CONFIGURATION

-5CFT , LANTIRN , (4)AIM-7 ,
(4)AIM-9





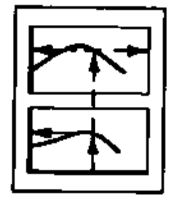
15E-1-(355-1)38-CATI

Figure B9-42

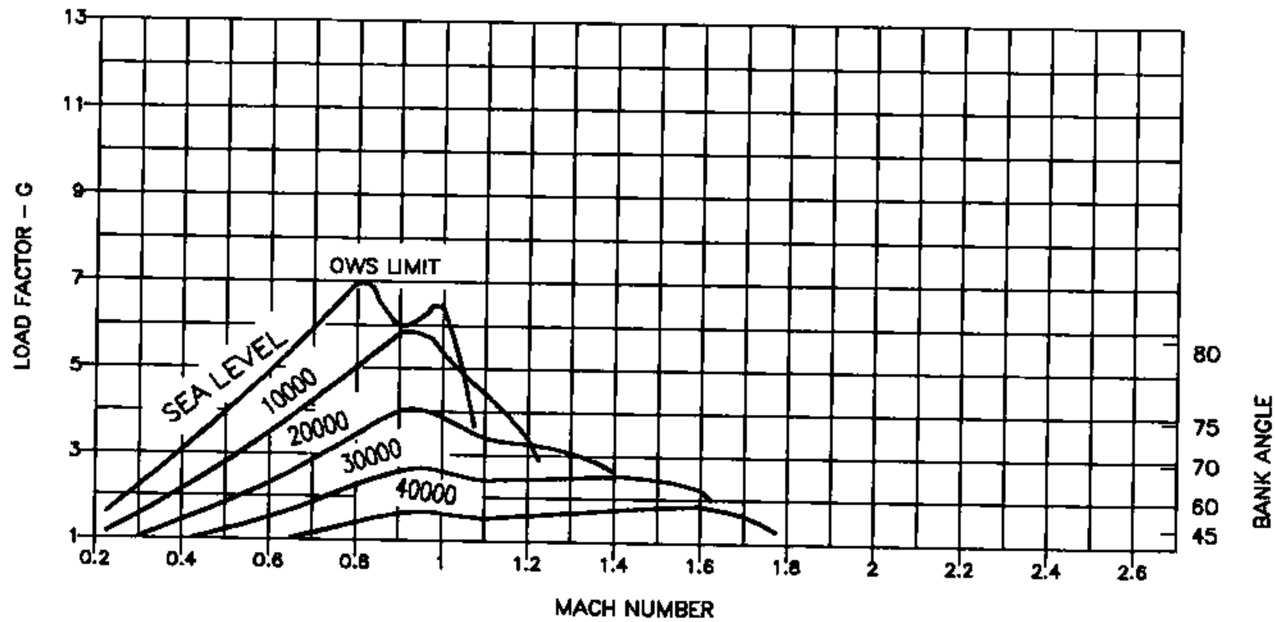
SUSTAINED LEVEL TURNS

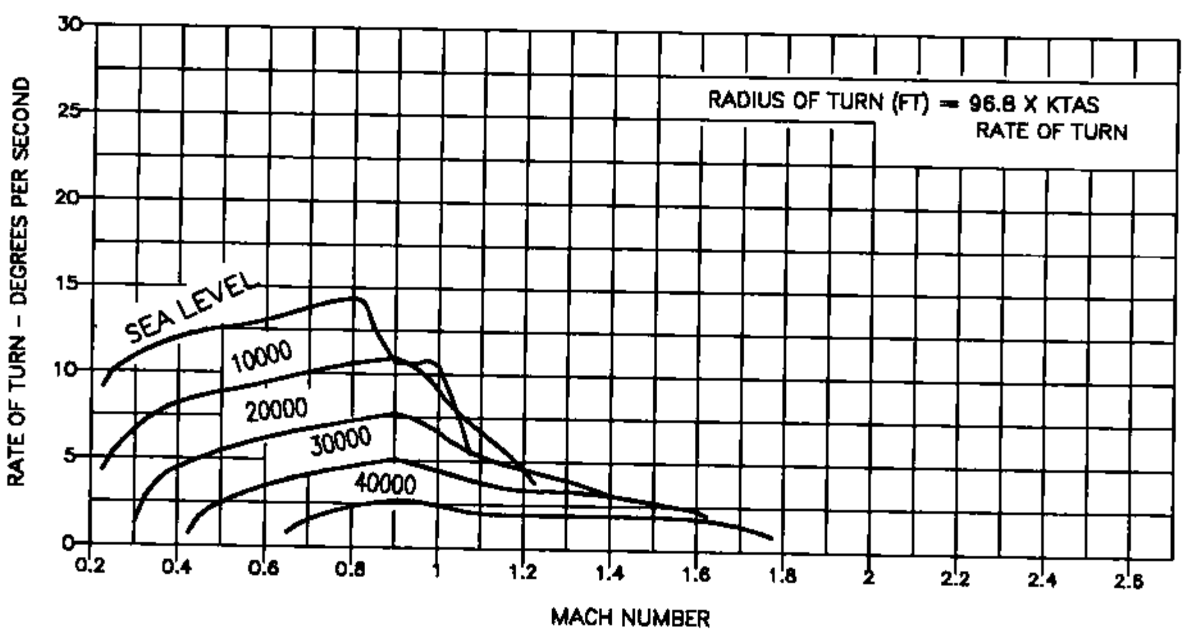
MAXIMUM THRUST
GROSS WEIGHT – 57,000 POUNDS

REMARKS
ENGINE(S): (2)F100-PW-229
U.S. STANDARD DAY, 1966



AIRPLANE CONFIGURATION
-5CFT , LANTIRN , (4)AIM-9 , (2)MK-84





15E-1-(356-1)36-CATI

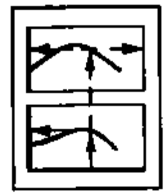
Figure B9-43

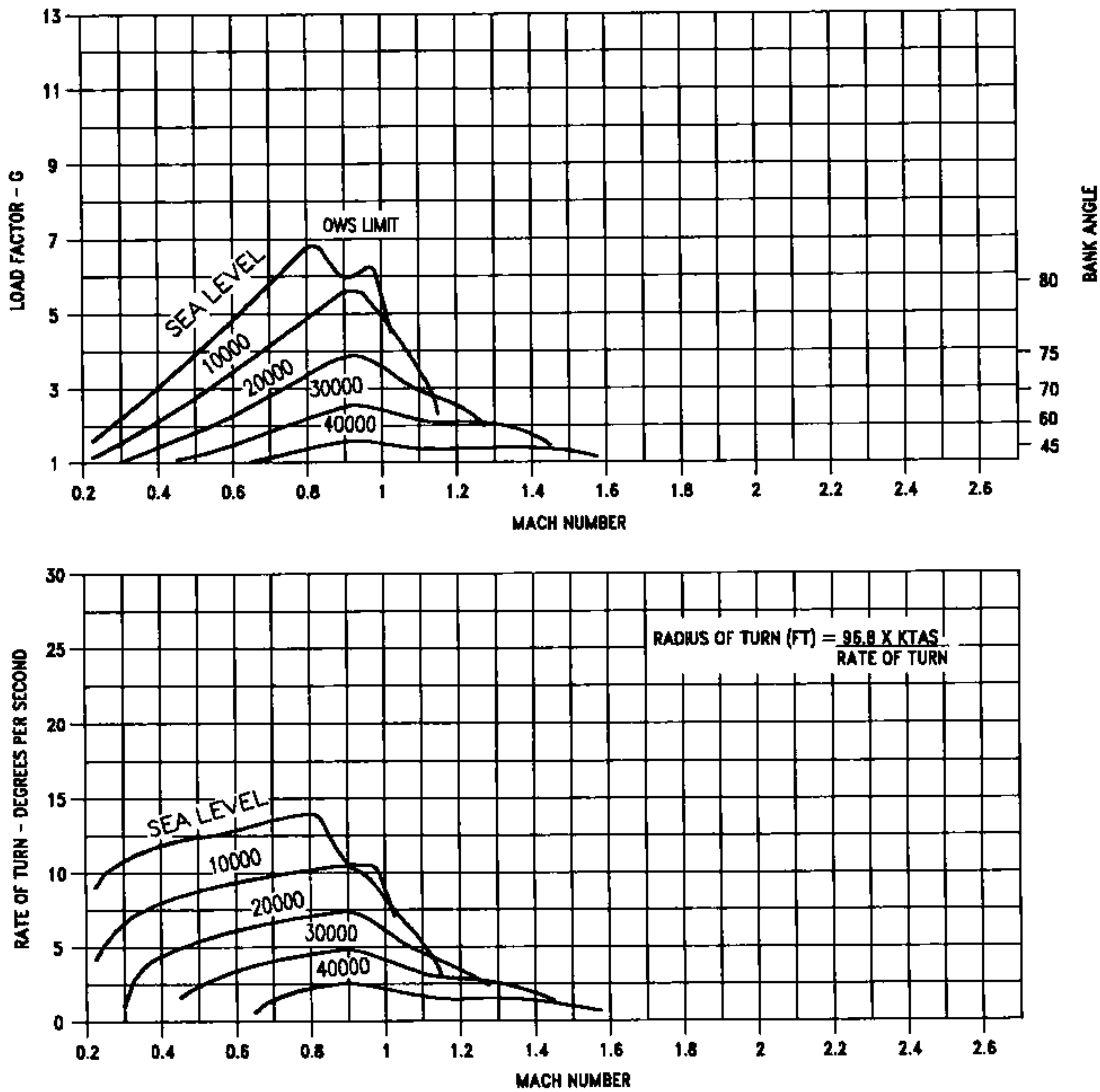
SUSTAINED LEVEL TURNS

MAXIMUM THRUST
GROSS WEIGHT - 57,000 POUNDS

AIRPLANE CONFIGURATION
-5 CFT, LANTIRN, (4)AIM-9, (6)CBU-89

REMARKS
ENGINE(S): (2)F100-PW-229
U.S. STANDARD DAY, 1966





15E-1-(357-1)38-CATI

Figure B9-44

SUSTAINED LEVEL TURNS

MAXIMUM THRUST
GROSS WEIGHT - 59,000 POUNDS

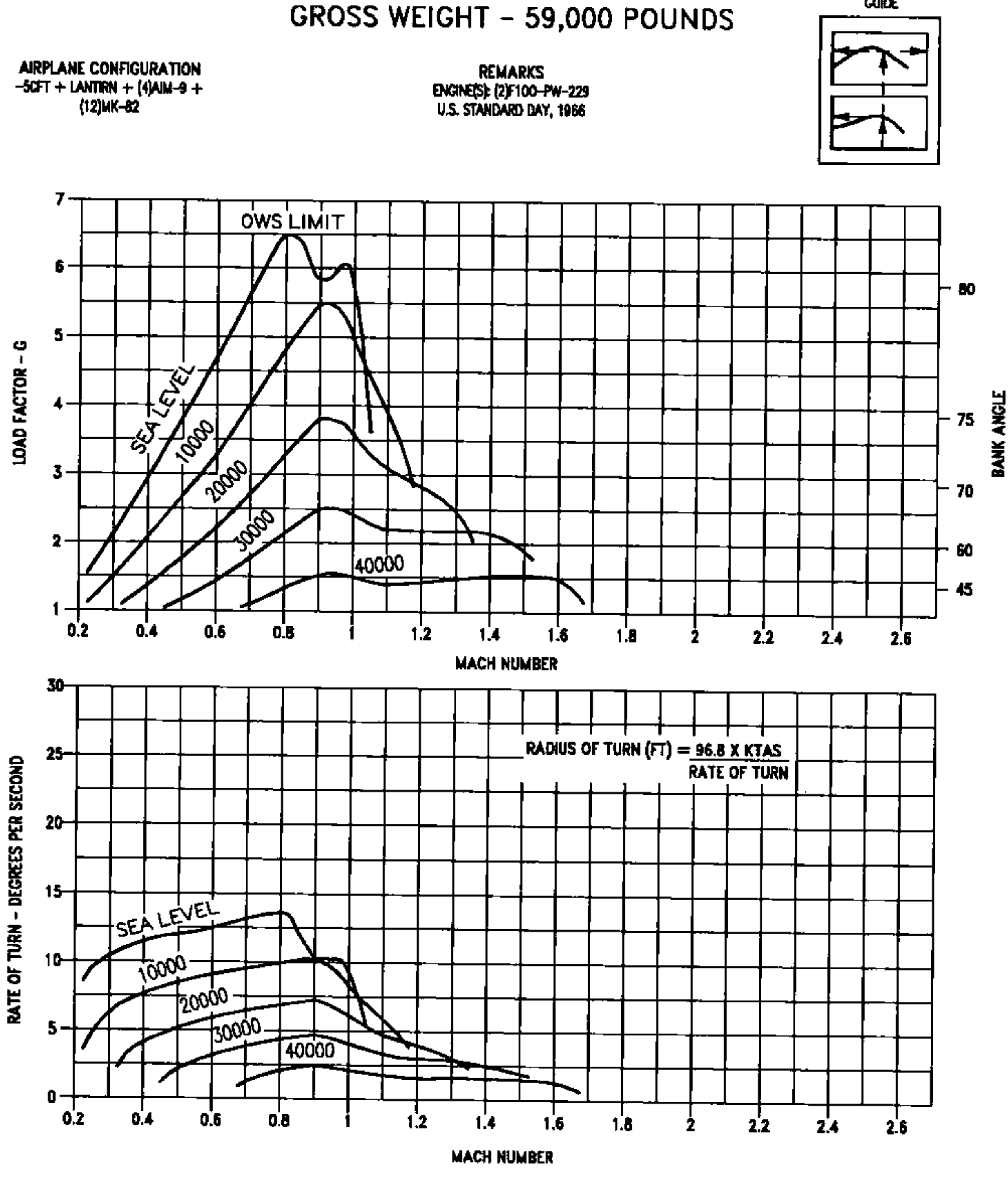
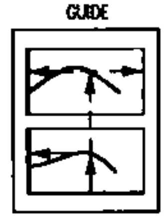


Figure B9-45

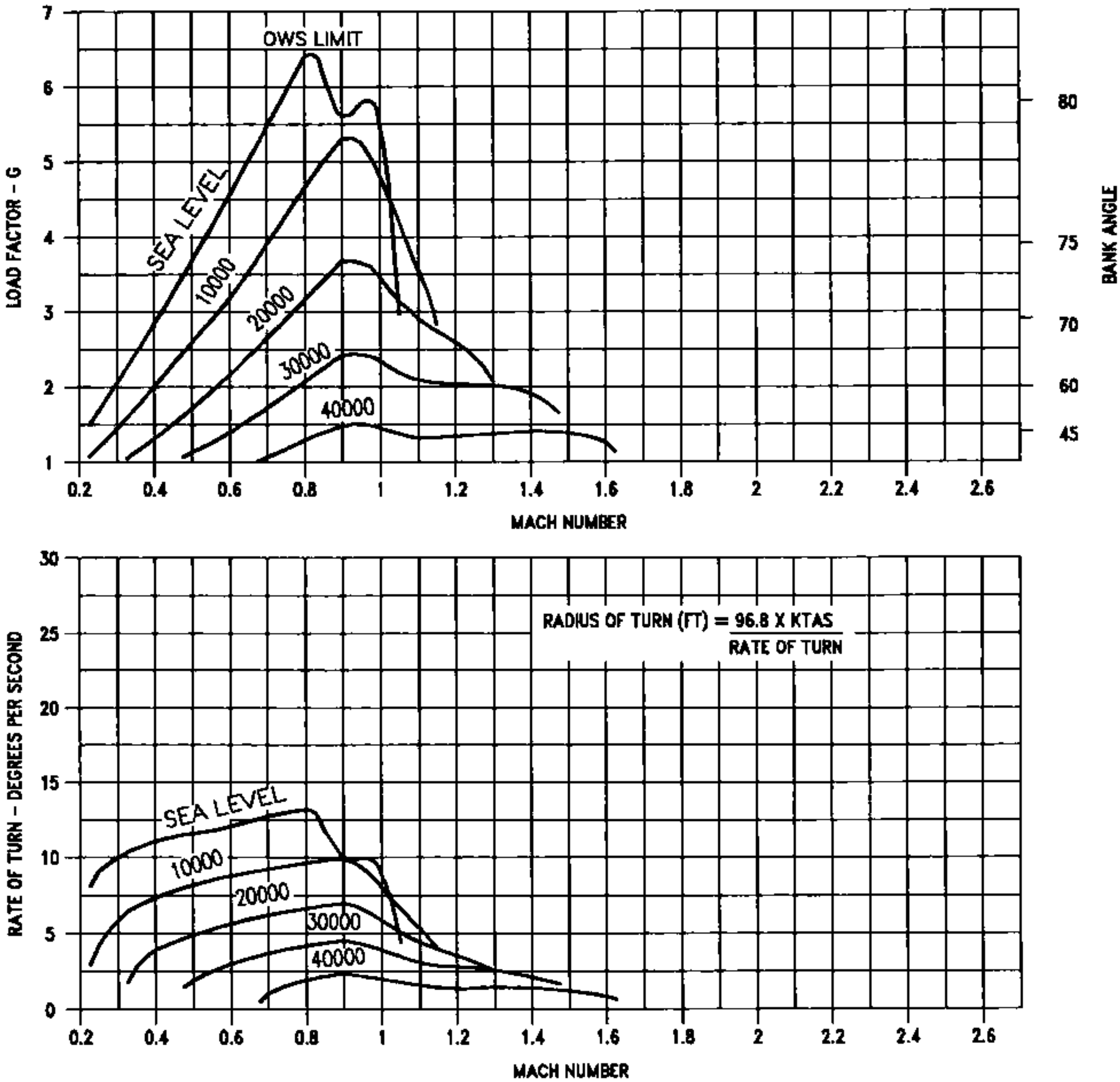
SUSTAINED LEVEL TURNS

MAXIMUM THRUST
GROSS WEIGHT – 61,000 POUNDS



AIRPLANE CONFIGURATION
–5 CFT, LANTIRN, (4)AIM-9, (4)MK-84

REMARKS
ENGINE(S): (2)F100-PW-229
U.S. STANDARD DAY, 1966



15E-1-(359-1)38-CATI

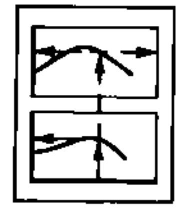
Figure B9-46

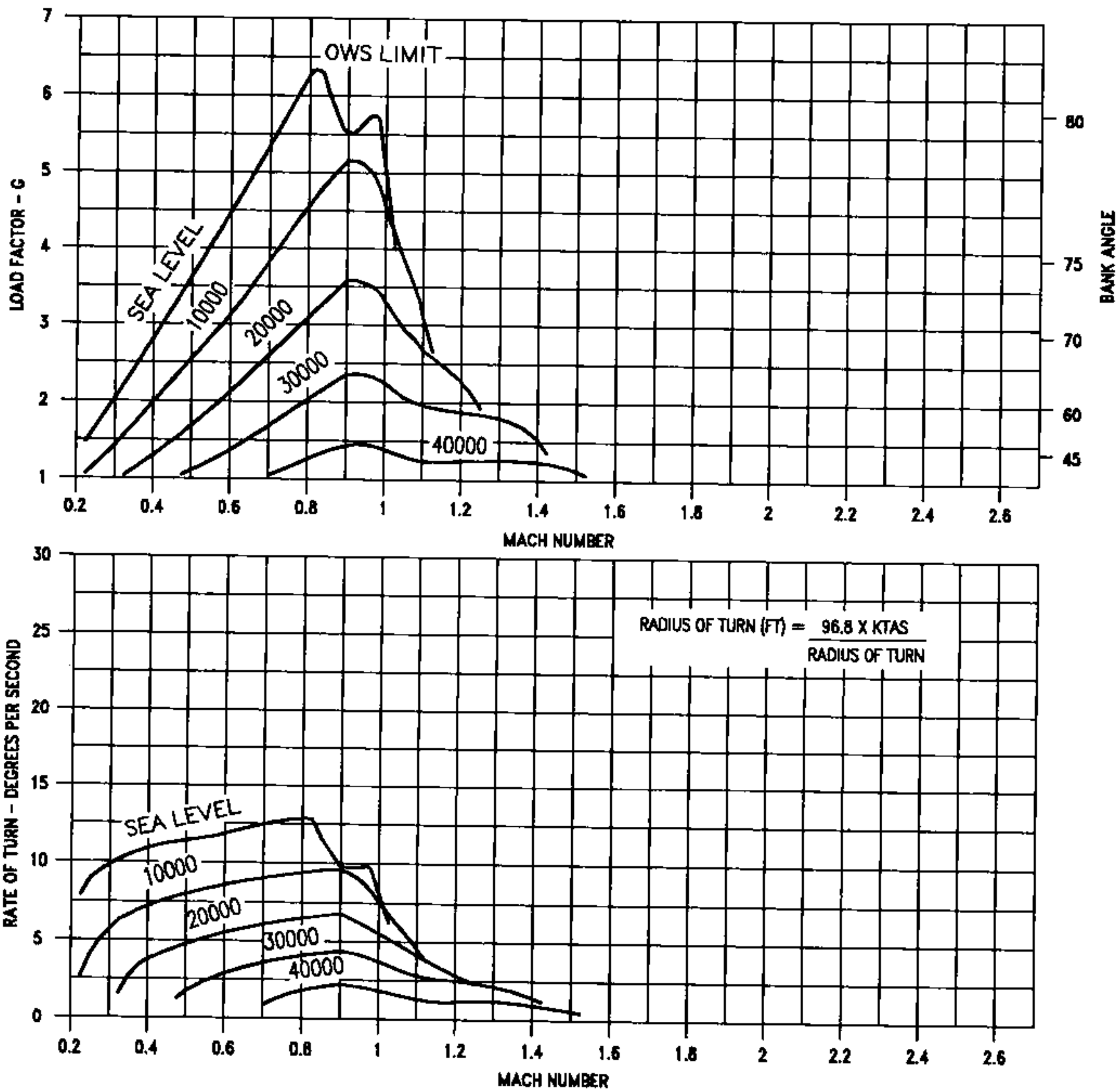
SUSTAINED LEVEL TURNS

MAXIMUM THRUST
GROSS WEIGHT - 62,000 POUNDS

AIRPLANE CONFIGURATION
-5 CFT, LANTIRN, CL TANK,
(4)AIM-9, (12)MK-82

REMARKS
ENGINE(S): (2)F100-PW-229
U.S. STANDARD DAY, 1966





15E-1-(380-1)38-CATI

Figure B9-47

GENERAL ARRANGEMENT

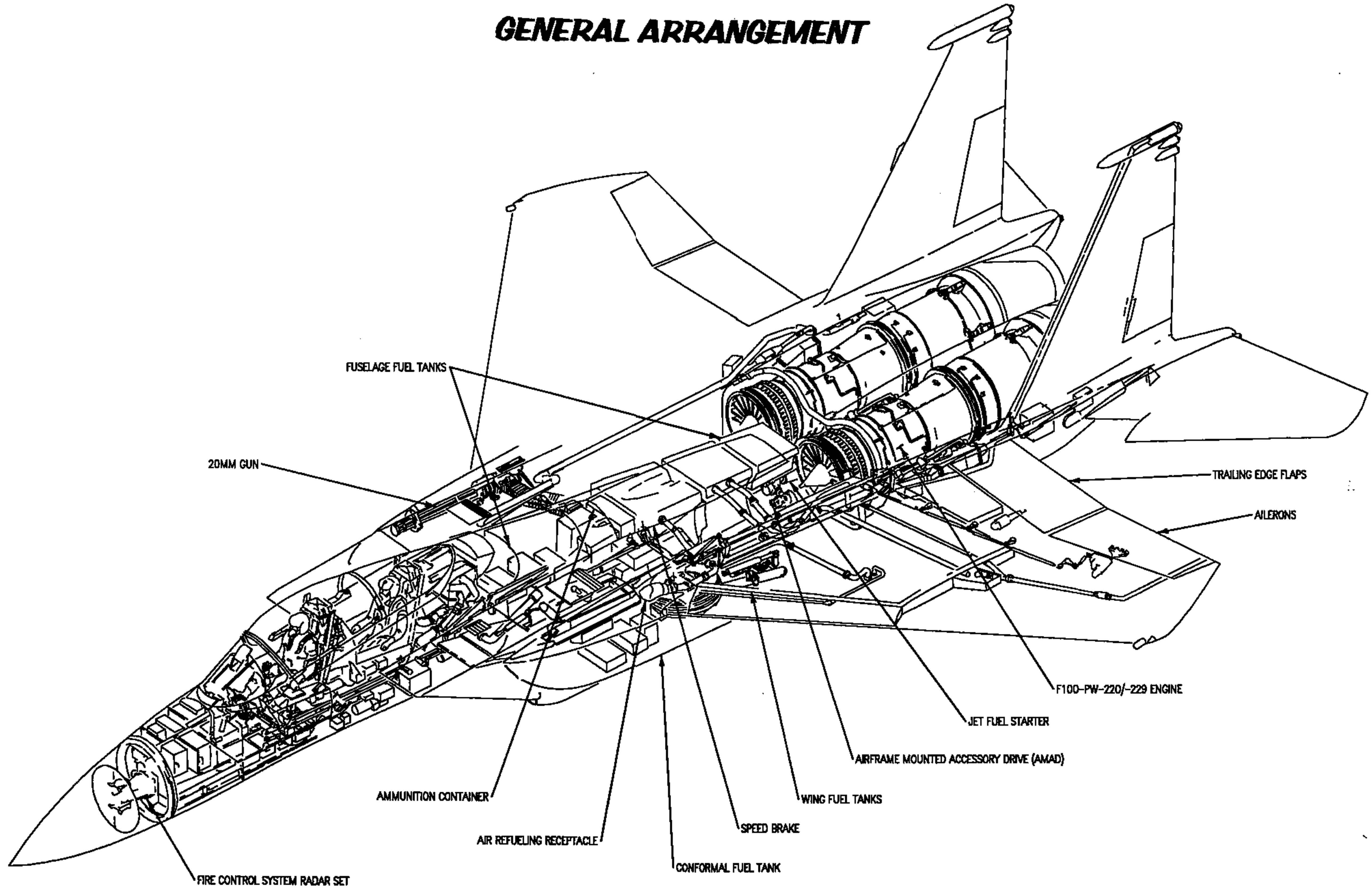


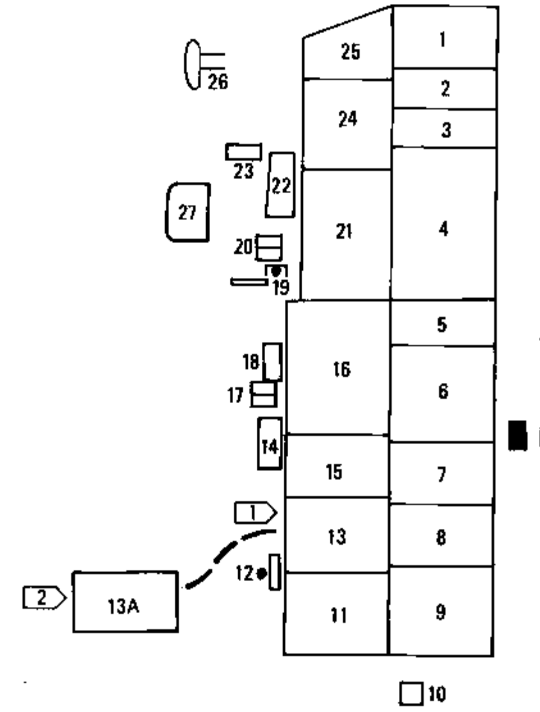
Figure FO-1

15E-1-(81-1)33-CATI

FRONT COCKPIT F-15E

LEFT CONSOLE

1. NUC PANEL
2. CONTROL AUGMENTATION SYSTEM CONTROL PANEL
3. BLANK
4. THROTTLE QUADRANT
5. EXTERIOR LIGHTS CONTROL PANEL
6. SENSOR PANEL
7. BLANK
8. BLANK
9. ANTI-G PANEL
10. BOARDING STEPS POSITION INDICATOR PANEL
11. GROUND POWER PANEL
12. ARMAMENT SAFETY OVERRIDE SWITCH
13. BLANK
13A. GND TEST MAINTENANCE DIAGNOSTIC TEST
14. EMERGENCY AIR REFUELING SWITCH
15. BLANK
16. REMOTE INTERCOMMUNICATIONS CONTROL PANEL
17. EWWS ENABLE SWITCH
18. IFF ANTENNA SELECT SWITCH
19. SEAT ADJUST SWITCH
20. FLYUP ENABLE SWITCH
21. BLANK
22. NCTR ENABLE SWITCH
23. VMAX SWITCH
24. FUEL CONTROL PANEL
25. MISCELLANEOUS CONTROL PANEL
26. CANOPY JETTISON HANDLE
27. COCKPIT COOLING VENT



LEGEND

1 F-15E 86-0183 THRU 87-0210.

2 F-15E 88-1667 AND UP.

3 F-15E 90-0233 AND UP; ALSO F-15E 86-0183 THRU 90-0232 AFTER TO 1F-15E-561

4 F-15E 91-0318 AND UP.

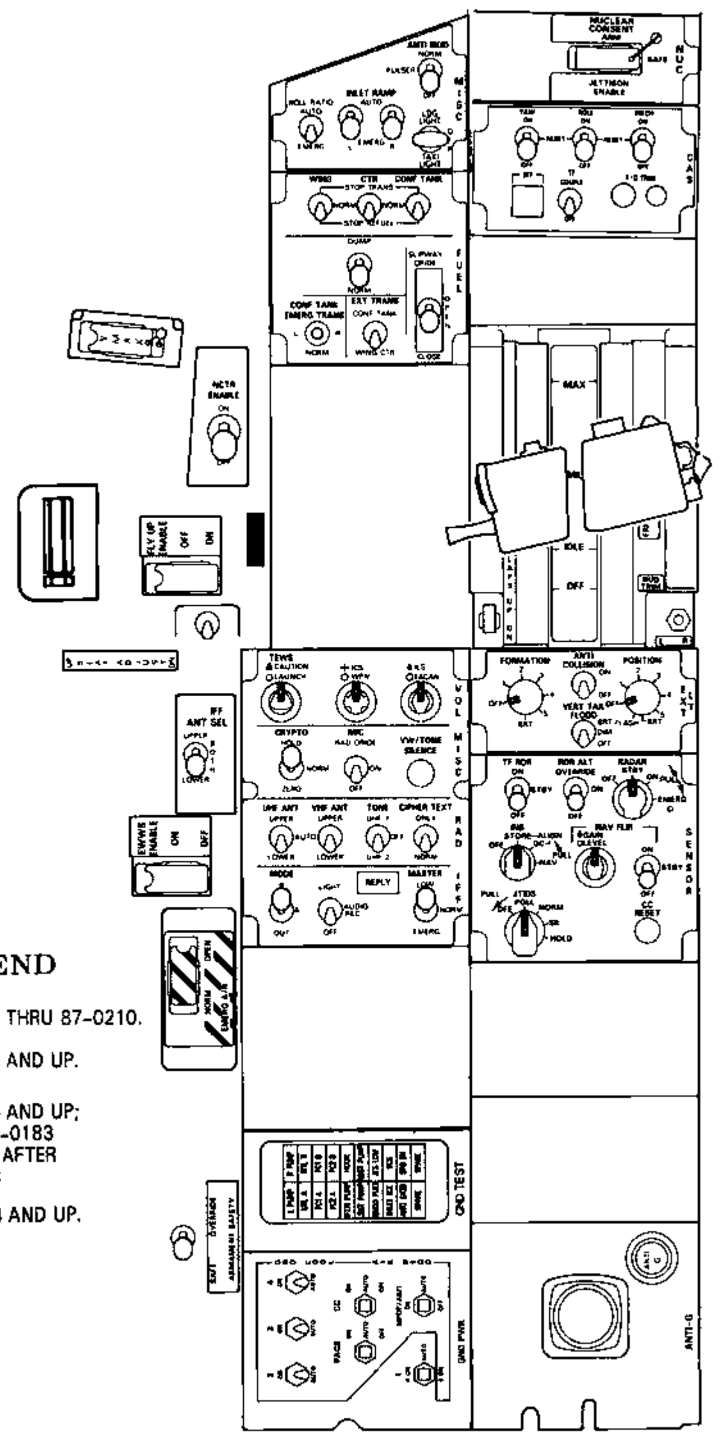
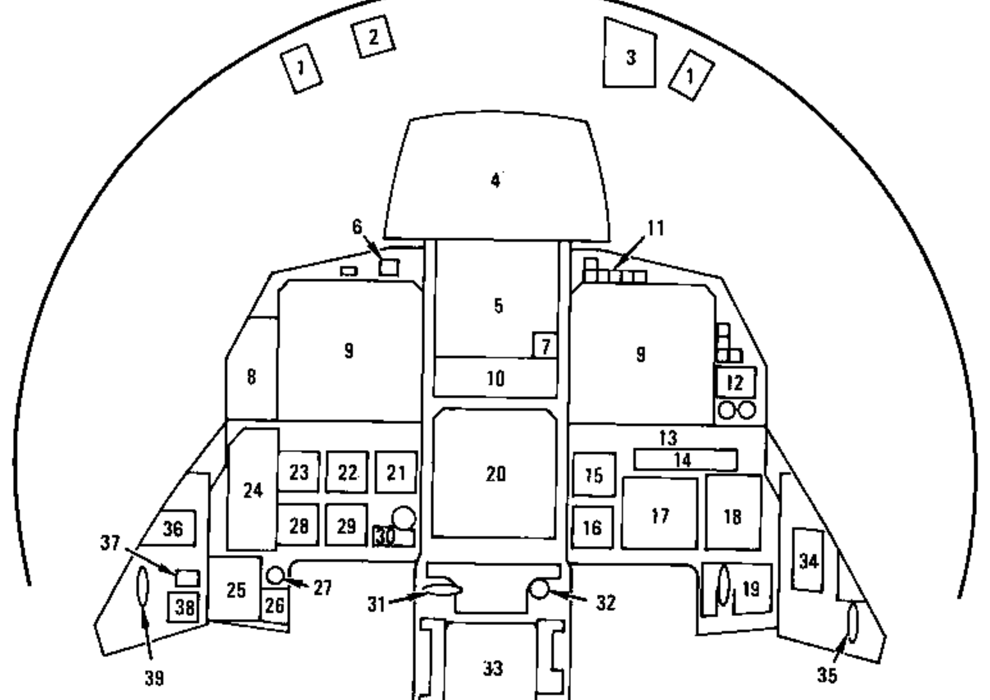
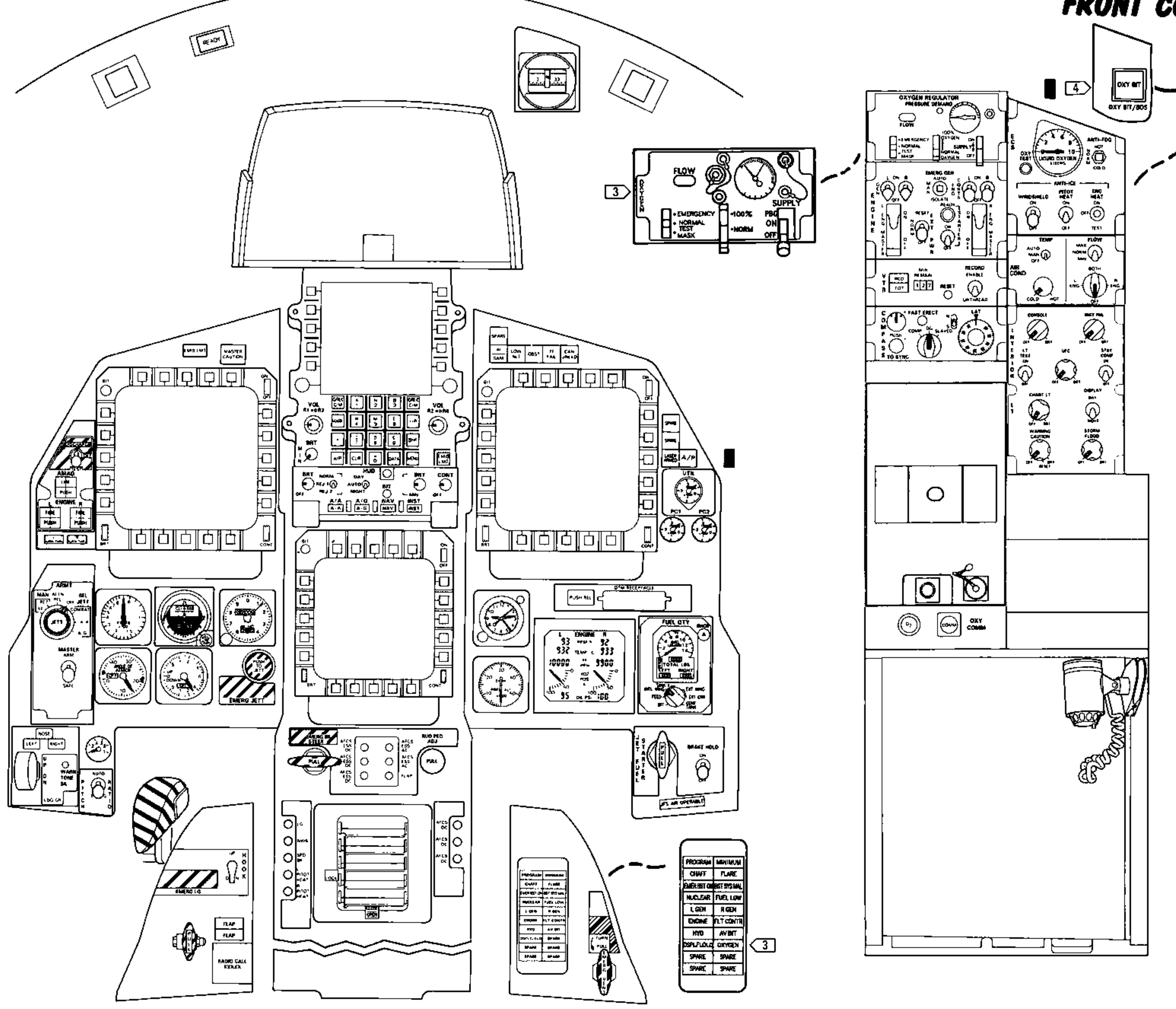


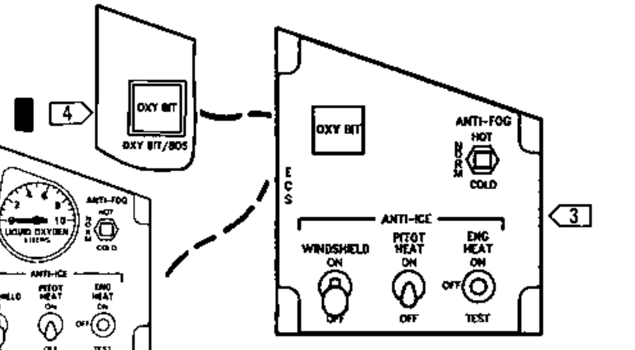
Figure FO-2

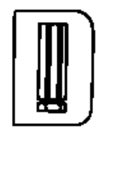


MAIN PANEL

1. LOCK/SHOOT LIGHTS
2. AIR REFUELING READY LIGHT
3. STANDBY MAGNETIC COMPASS
4. HEAD UP DISPLAY COMBINING GLASS
5. UPFRONT CONTROL PANEL
6. MASTER CAUTION LIGHT
7. EMISSION LIMIT SWITCH
8. FIRE WARNING/EXTINGUISHING PANEL
9. MULTI-PURPOSE DISPLAY (MPD)
10. HEAD UP DISPLAY CONTROL PANEL
11. WARNING/CAUTION/ADVISORY LIGHTS
12. HYDRAULIC PRESSURE INDICATORS
13. BLANK
14. DATA TRANSFER MODULE RECEPTACLE
15. EIGHT DAY CLOCK
16. CABIN PRESSURE ALTIMETER
17. ENGINE MONITOR INDICATOR
18. FUEL QUANTITY INDICATOR
19. JET FUEL STARTER CONTROL HANDLE/BRAKE HOLD SWITCH
20. MULTI-PURPOSE COLOR DISPLAY (MPCD)
21. ALTIMETER
22. STANDBY ATTITUDE INDICATOR
23. STANDBY AIRSPEED INDICATOR
24. ARMAMENT CONTROL PANEL
25. LANDING GEAR CONTROL HANDLE
26. PITCH RATIO SELECT SWITCH
27. PITCH RATIO INDICATOR
28. ANGLE OF ATTACK INDICATOR
29. VERTICAL VELOCITY INDICATOR
30. EMERGENCY JETTISON BUTTON
31. EMERGENCY BRAKE/STEERING CONTROL HANDLE
32. RUDDER PEDAL ADJUST RELEASE KNOB
33. COCKPIT COOLING AND PRESSURIZATION OUTLET
34. CAUTION LIGHTS PANEL
35. EMERGENCY VENT CONTROL HANDLE
36. ARRESTING HOOK CONTROL SWITCH
37. FLAP POSITION INDICATOR
38. RADIO CALL PANEL
39. EMERGENCY LANDING GEAR HANDLE

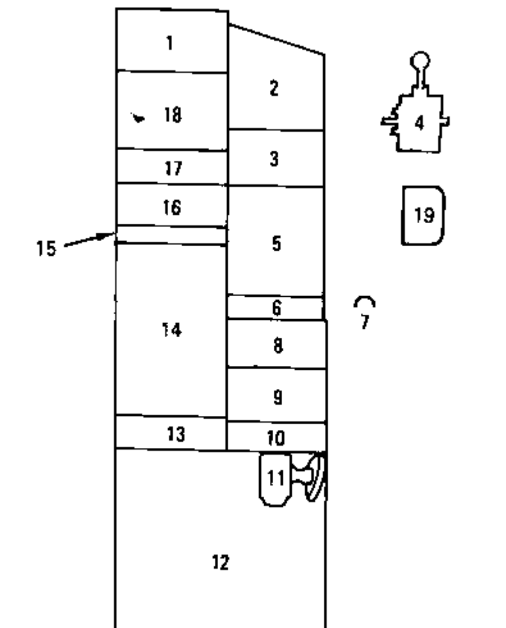






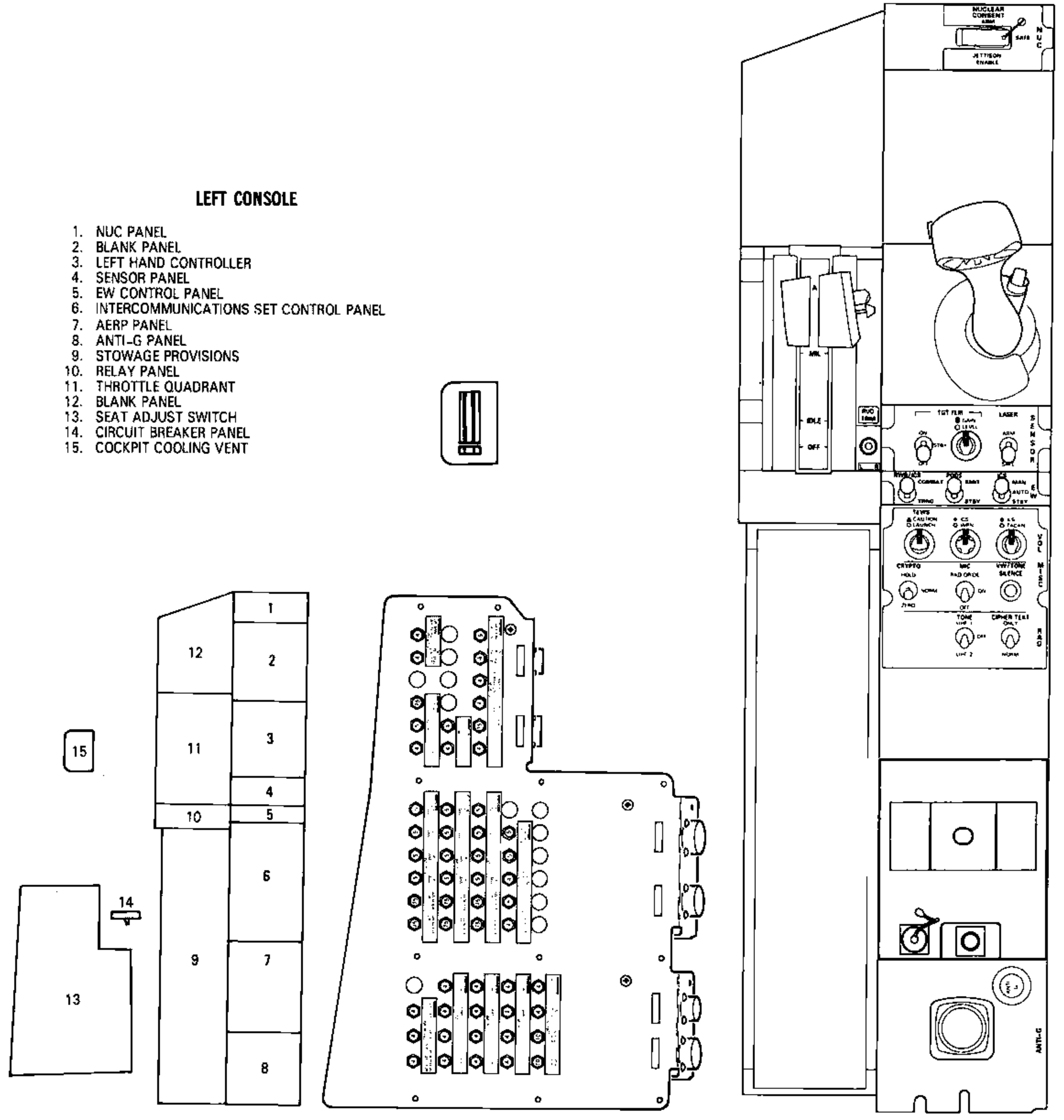
RIGHT CONSOLE

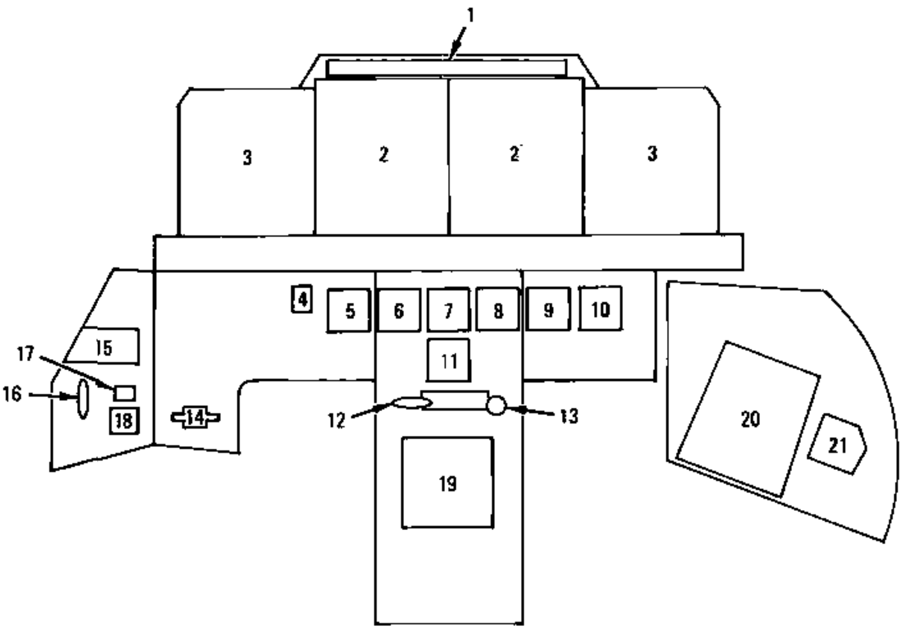
1. OXYGEN REGULATOR
2. ECS PANEL
3. AIR CONDITION CONTROL PANEL
4. CANOPY CONTROL HANDLE
5. INTERIOR LIGHTS CONTROL PANEL
6. BLANK
7. OXYGEN HOSE STOWAGE FITTING
8. BLANK
9. BLANK
10. BLANK
11. UTILITY LIGHT
12. STOWAGE COMPARTMENT
13. OXYGEN/COMMUNICATION
14. AERP PANEL
15. BLANK
16. COMPASS CONTROL PANEL
17. VIDEO RECORDER CONTROL PANEL
18. ENGINE CONTROL PANEL
19. COCKPIT COOLING VENT



15E-1-(1)44

REAR COCKPIT F-15E





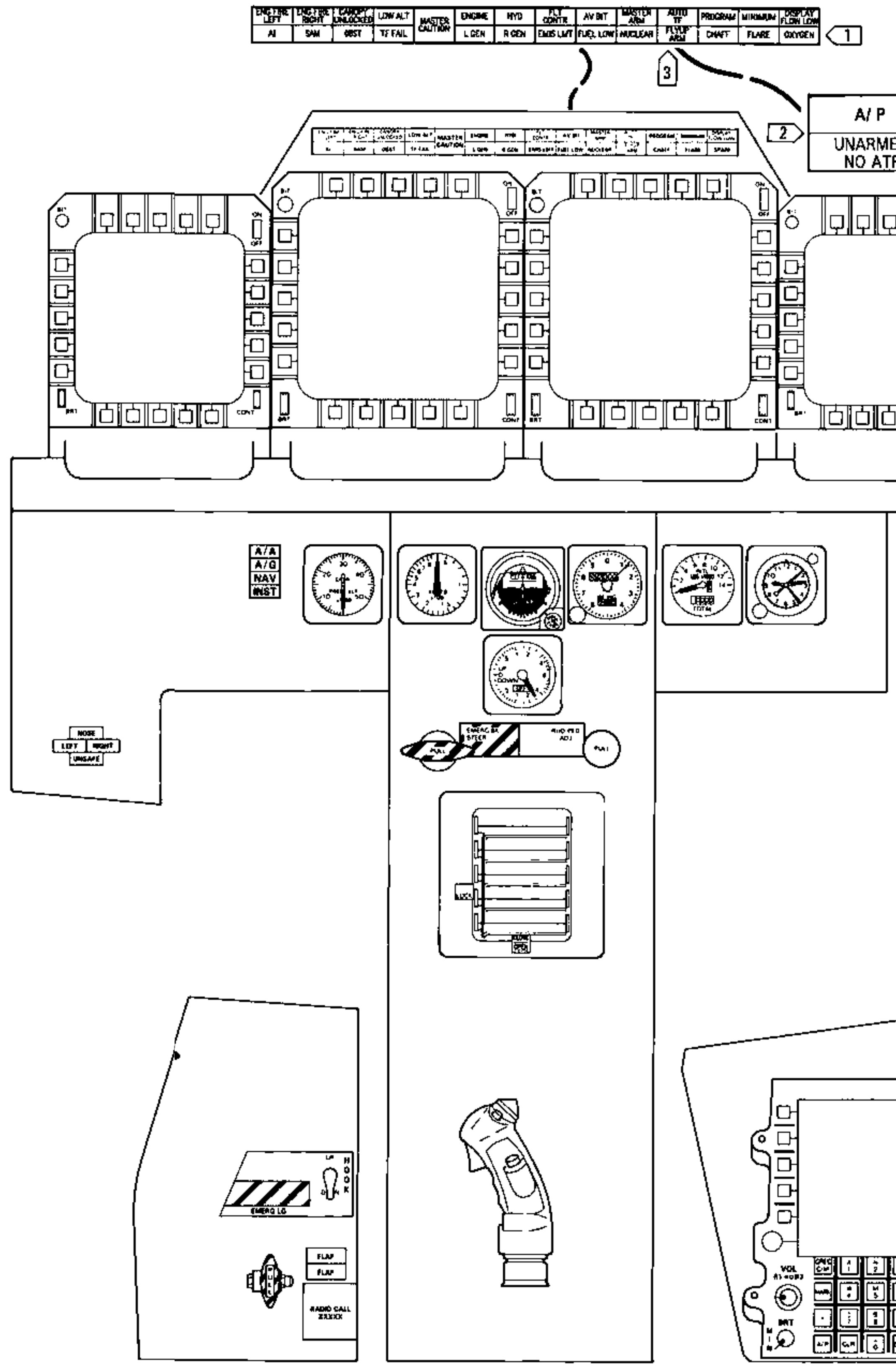
LEFT CONSOLE

1. NUC PANEL
2. BLANK PANEL
3. LEFT HAND CONTROLLER
4. SENSOR PANEL
5. EW CONTROL PANEL
6. INTERCOMMUNICATIONS SET CONTROL PANEL
7. AERP PANEL
8. ANTI-G PANEL
9. STOWAGE PROVISIONS
10. RELAY PANEL
11. THROTTLE QUADRANT
12. BLANK PANEL
13. SEAT ADJUST SWITCH
14. CIRCUIT BREAKER PANEL
15. COCKPIT COOLING VENT

MAIN PANEL

1. WARNING/CAUTION/ADVISORY LIGHTS PANEL
2. MULTI-PURPOSE DISPLAY
3. MULTI-PURPOSE COLOR DISPLAY
4. MASTER MODE LIGHT PANEL
5. CABIN PRESSURE ALTIMETER
6. STANDBY AIRSPEED INDICATOR
7. STANDBY ATTITUDE INDICATOR
8. STANDBY ALTIMETER
9. FUEL QUANTITY INDICATOR
10. CLOCK
11. VERTICAL VELOCITY INDICATOR
12. EMERGENCY BRAKE/STEERING CONTROL HANDLE
13. RUDDER PEDAL ADJUST RELEASE KNOB
14. LANDING GEAR POSITION LIGHTS
15. ARRESTING HOOK CONTROL SWITCH
16. EMERGENCY LANDING GEAR HANDLE
17. FLAP POSITION INDICATOR
18. RADIO CALL PANEL
19. COCKPIT COOLING AND PRESSURIZATION OUTLET
20. UPFRONT CONTROL PANEL
21. COMMAND SELECTOR VALVE

Figure FO-3

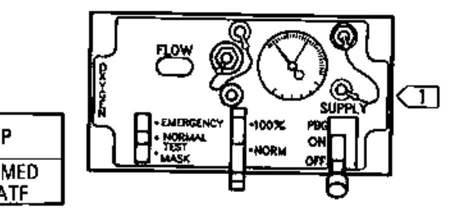


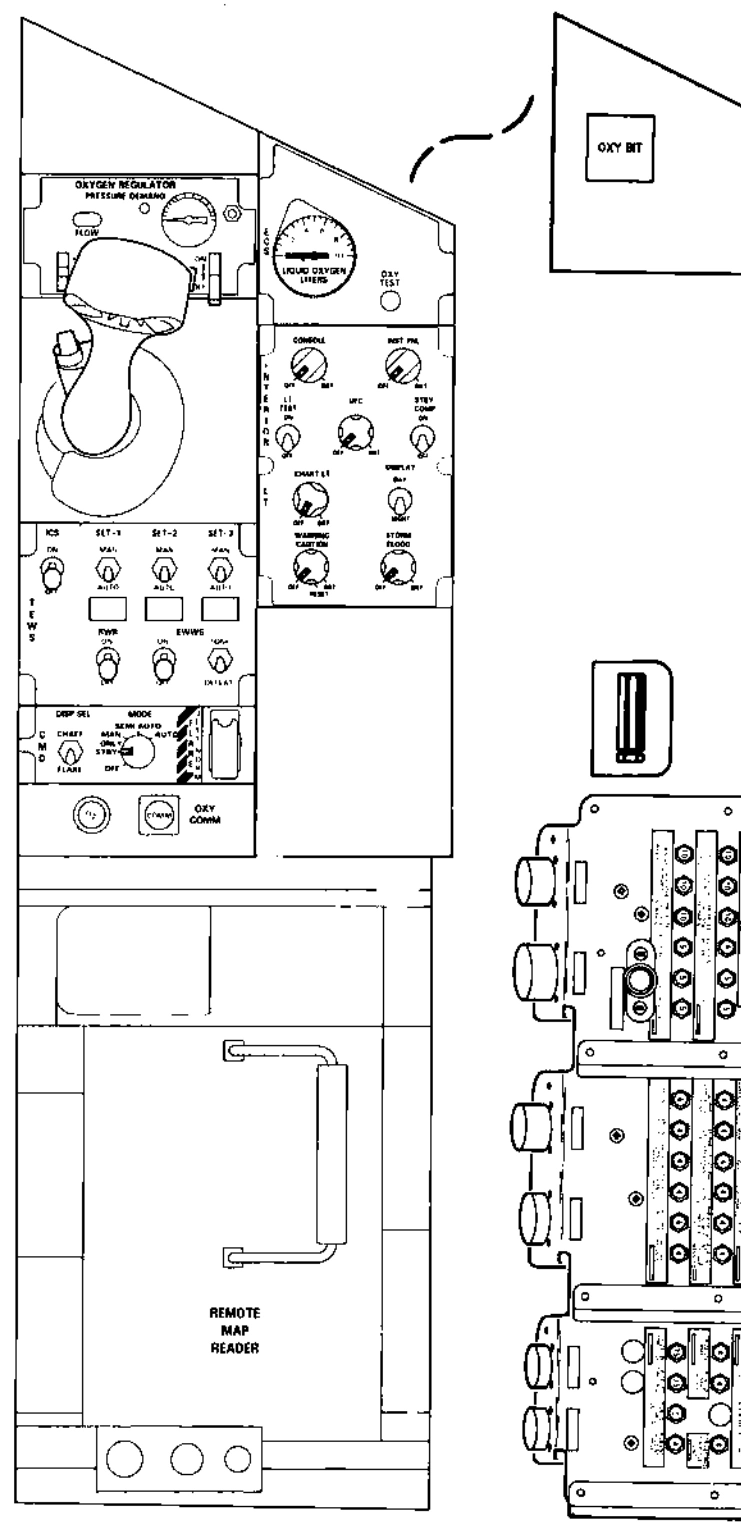
LEGEND

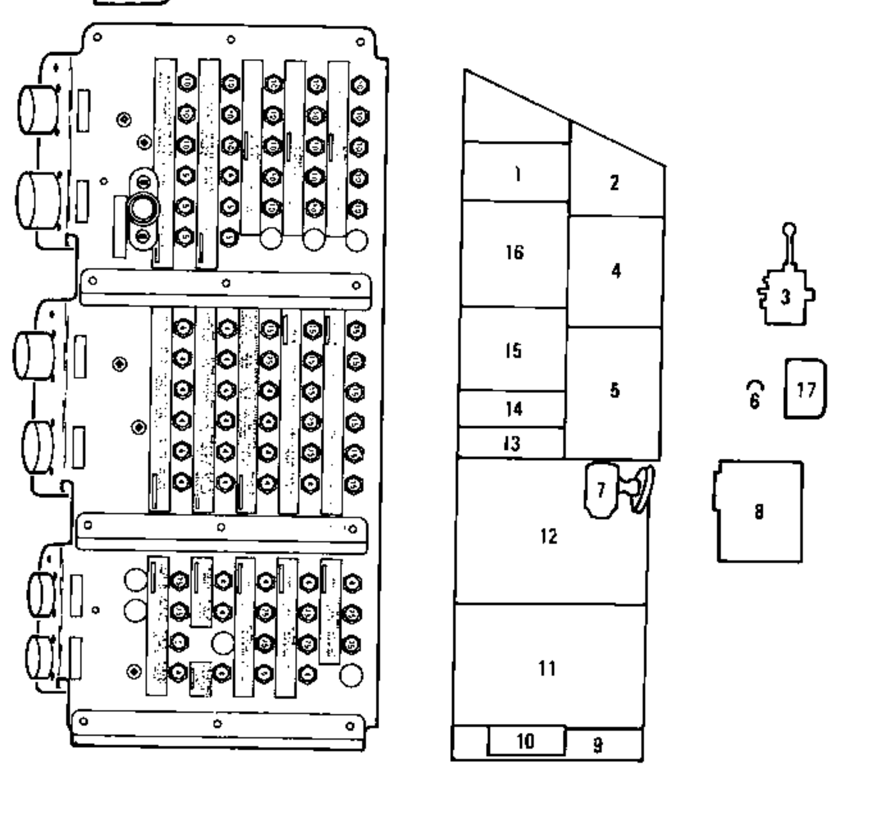
1 F-15E 90-0233 AND UP; ALSO F-15E 86-0183 THRU 90-0232 AFTER TO 1F-15E-561

2 F-15E 90-0261 AND UP; F-15E 86-0183 THRU 90-0260 AFTER TO 1F-15E-608

3 F-15E 86-0183 THRU 90-0260 BEFORE TO 1F-15E-608



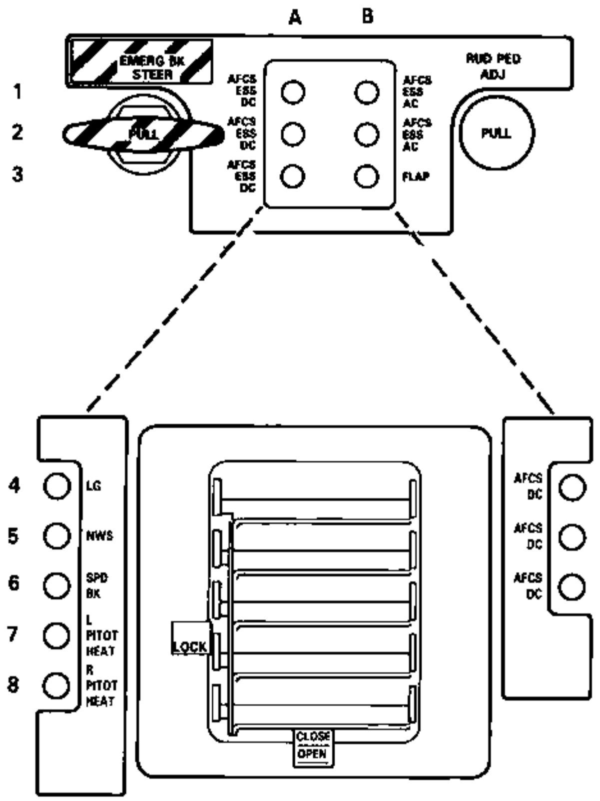




RIGHT CONSOLE

1. OXYGEN REGULATOR
2. ECS PANEL
3. CANOPY CONTROL HANDLE
4. INTERIOR LIGHTS CONTROL PANEL
5. BLANK PANEL
6. OXYGEN HOSE STOWAGE FITTING
7. UTILITY LIGHT
8. CIRCUIT BREAKER PANEL
9. BLANK PANEL
10. REMOTE MAP READER CONNECTORS PANEL
11. REMOTE MAP READER
12. BLANK PANEL
13. OXYGEN/COMMUNICATION OUTLET PANEL
14. COUNTERMEASURES DISPENSER
15. TACTICAL ELECTRONIC WARFARE SYSTEM
16. RIGHT HAND CONTROLLER
17. COCKPIT COOLING VENT

15E-1-(2)33

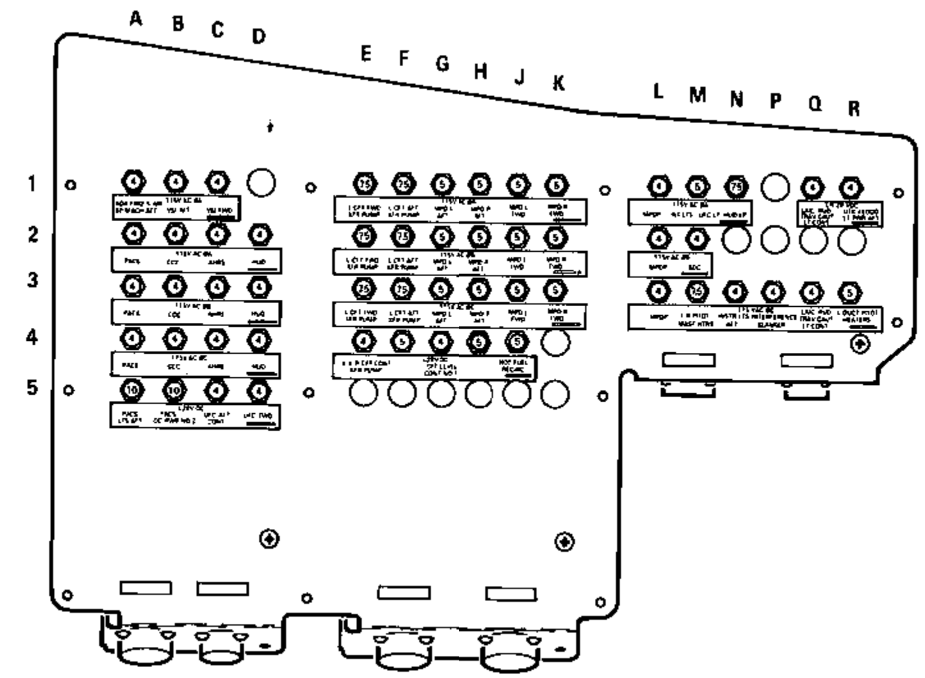


CENTER CIRCUIT BREAKER PANEL

NOMENCLATURE	ZONE(S)
AFCS ESSENTIAL AC	B1, B2,
AFCS ESSENTIAL DC	A1, A2, A3
FLAPS	B3

COCKPIT CENTER INSTRUMENT PANEL CIRCUIT BREAKER ASSEMBLY

NOMENCLATURE	ZONE(S)
AFCS DC	B4, B5, B6
LANDING GEAR	A4
LEFT PITOT HEATER	A7
NOSEWHEEL STEERING	A5
RIGHT PITOT HEATER	A8
SPEED BRAKE	A6

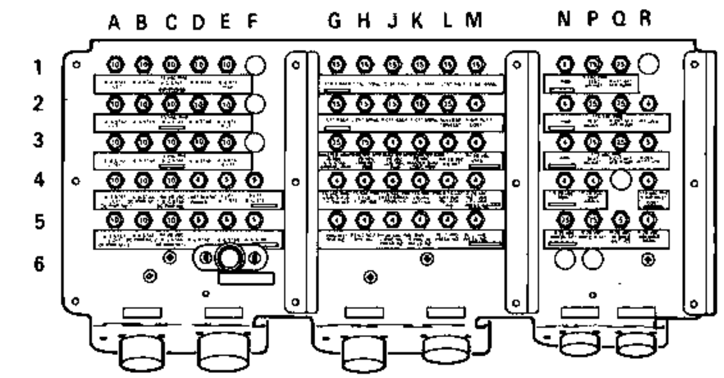


LEFT CIRCUIT BREAKER PANEL NO. 2

NOMENCLATURE	ZONE(S)
ADC	M2
AHRS	C2, C3, C4
AOA (FWD) & AIR SP MACH (AFT)	A1
CCC	B2, B3, B4
CFT LEVEL CONT NO. 1	F4
1 ENGINE BURN THRU	H4
HOT FUEL RECIRCULATION	G4
HUD	D2, D3, D4
HUD/UFC LIGHTS	N1
INSTRUMENT LIGHTS (AFT)	N3
INTERFERENCE BLANKER	P3
INTERIOR LIGHTS	M1
LEFT AIR INLET CONTROLLER (LAIC)	Q3
LAIC/RUDDER TRAVEL CAUTION LIGHT CONTROL	Q1
LEFT CFT AFT TRANSFER PUMP	F1, F2, F3
LEFT CFT FWD TRANSFER PUMP	E1, E2, E3
LEFT DUCT PITOT HEATERS	R3
LEFT MPD (AFT)	G1, G2, G3
LEFT MPD (FWD)	J1, J2, J3
L & R CFT CONT XFR PUMP	E4
L & R PITOT MAST HEATERS	M3
2 MAINTENANCE DIAGNOSTIC PANEL	J4
MPDP	L1, L2, L3
PACS	A2, A3, A4
PACS DC POWER NO. 2	B5
PACS LIGHTS (AFT)	A5
RIGHT MPD (AFT)	H1, H2, H3
RIGHT MPD (FWD)	K1, K2, K3
UFC CONT (AFT)	C5
UFC (FWD)	D5
UTILITY FLOOD LIGHT POWER (AFT)	R1
VSI (AFT)	B1
VSI (FWD)	C1

NOTE

1 F-15E 87-0201 AND UP.
2 F-15E 88-1667 AND UP.



RIGHT CIRCUIT BREAKER PANEL NO. 3

NOMENCLATURE	ZONE(S)
A/A STATION 3 (L CFT)	A1, A2, A3
A/A STATION 3 (L CFT) DC POWER NO. 1	A4
A/A STATION 3 (L CFT) DC POWER NO. 2	A5
A/A STATION 4	B1, B2, B3
A/A STATION 4 DC POWER NO. 1	B4
A/A STATION 4 DC POWER NO. 2	B5
A/A STATION 6	D1, D2, D3
A/A STATION 7 (R CFT)	E1, E2, E3
A/G STATION 2	D5
A/G STATION 5	C1, C2, C3, E5
A/G STATION 5 ARMING POWER	G3
A/G STATION 5 DC POWER NO. 1	C4
A/G STATION 5 DC POWER NO. 2	C5
A/G STATION 8	F5
EMD/R FUEL FLOW INDICATOR	G4
EXCEEDANCE COUNTER	J4
GUN TRIGGER POWER	J3
HOLDING BRAKE	R5
ICE DETECTOR	K4, L3
LAST ROUND POWER	D4
LEFT CFT A/G STATION	E4
LEFT CFT AMAC	H2
LEFT CFT RACK	G2
LEFT ENGINE NOZZLE POSITION INDICATOR	G5
LEFT ENGINE OIL PRESSURE INDICATOR	J5
LEFT FUEL FLOW INDICATOR	H4
MASTER ARM LOGIC POWER	K3
MPCD (L AFT)	N5
MPCD (R CFT)	P5
NUCLEAR CONSENT	L2
OXYGEN GAGE	R2
PC-1 HYDRAULIC PRESSURE INDICATOR	L5
PC-2 HYDRAULIC PRESSURE INDICATOR	M5
PRC POSITION INDICATOR	L4
RIGHT AIR INLET CONTROLLER	M2, R4
RIGHT CFT AFT TRANSFER PUMP	Q1, Q2, Q3
RIGHT CFT A/G STATION	F4
RIGHT CFT AMAC	K2
RIGHT CFT RACK	J2
RIGHT DUCT PITOT HEATERS	R3
RIGHT ENGINE NOZZLE POSITION INDICATOR	H5
RIGHT ENGINE OIL PRESSURE INDICATOR	K5
REMOTE MAP READER	N1, N2, N3, N4
SEAT ADJUST	P1, P2, P3, P4
STATION 2 AMAC	H1
STATION 2 RACK	G1
STATION 5 AMAC	K1
STATION 5 RACK	J1
STATION 8 AMAC	M1
STATION 8 RACK	L1
UMBILICAL RETRACT POWER	H3
UTILITY HYDRAULIC PRESSURE INDICATOR	M4
VIDEO TAPE RECORDER SYSTEM	M3
WINDSHIELD ANTI-ICE	Q5

15E-1-(250)06

Figure FO-4

AIRPLANE & ENGINE FUEL SYSTEM F-15E

NOTE

- FOR CLARITY, ONLY THE ENGINE FEED, REFUEL, FUEL TRANSFER, FUEL DUMP, AND GRAVITY TRANSFER LINES ARE SHOWN.
- TO MAINTAIN CG DURING INFLIGHT REFUELING, THE AFT CFT REFUEL CONTROL VALVE REMAINS CLOSED UNTIL THE FORWARD AND CENTER COMPARTMENTS ARE APPROXIMATELY 1/3 FULL.

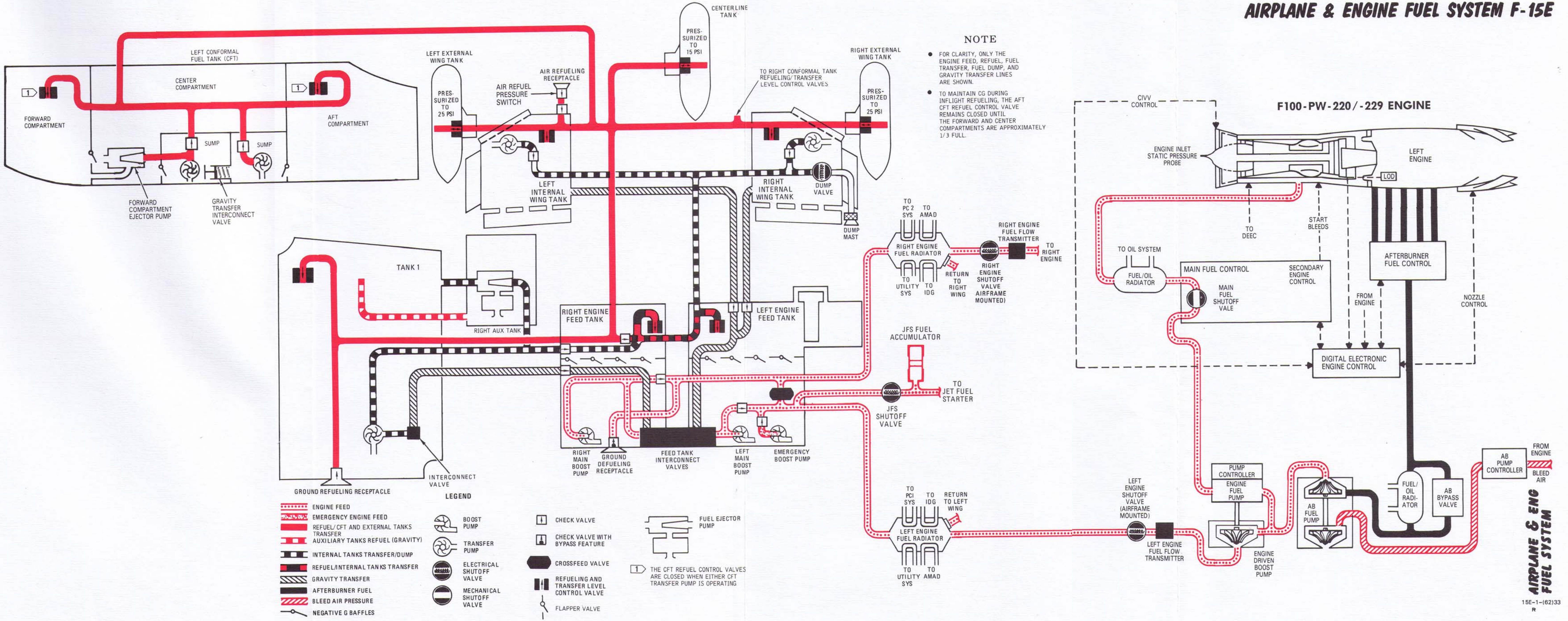


Figure FO-5

ELECTRICAL SYSTEM
EXTERNAL POWER APPLIED

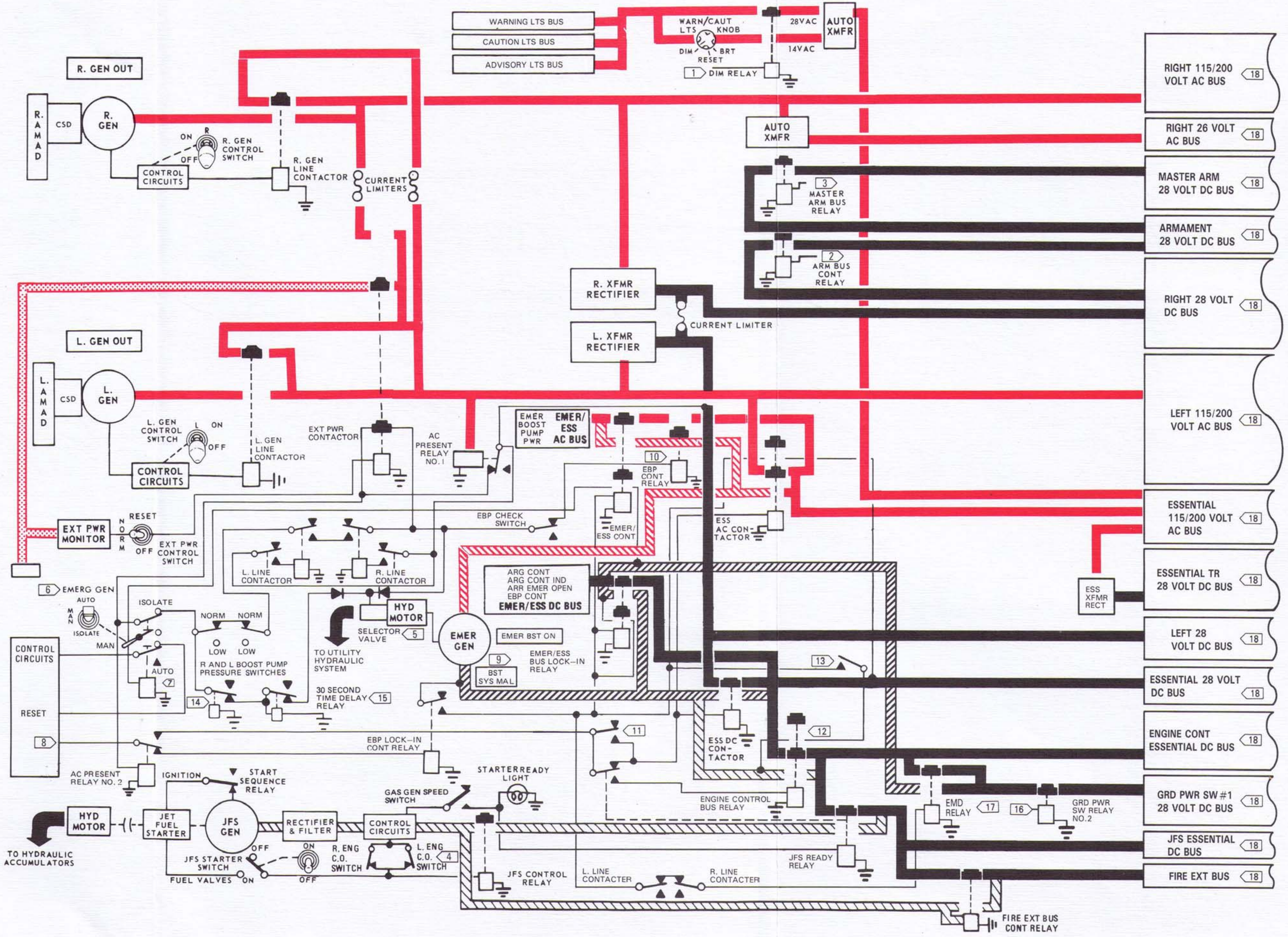


Figure FO-6 (Sheet 1 of 3)

NOTES

1. DIMMING RELAY ENERGIZED WITH FLIGHT INSTRUMENT LIGHTS KNOB ON AND WARNING CAUTION LIGHTS KNOB MOVED TEMPORARILY TO RESET. RELAY IS DEENERGIZED BY TURNING FLIGHT INSTRUMENTS LIGHT OFF OR TURNING STORM/FLOODS KNOB TO FULL BRIGHT. OPERATION TYPICAL FOR BOTH COCKPITS.

2. ARMAMENT BUS CONTROL RELAY ENERGIZED WITH GEAR HANDLE UP. WITH GEAR HANDLED DOWN, RELAY IS ENERGIZED BY PLACING ARMAMENT SAFETY OVERRIDES SWITCH TO OVERRIDE POSITION.

3. MASTER ARM BUS RELAY IS ENERGIZED WITH THE MASTER ARM SWITCH IN THE ARM POSITION, PROVIDING ARAMENT BUS IS ENERGIZED.

4. ENGINE CUTOUT SWITCHES OPEN AFTER THEIR RESPECTIVE ENGINES START.

5. WITH ELECTRICAL POWER AT SELECTED VALVE, HYDRAULIC POWER IS SHUT OFF FROM EMERGENCY GENERATOR (EG) TO PREVENT OPERATION.

6. EMERGENCY GENERATOR CONTROL SWITCH SHOWN IN AUTO POSITION WITH EXTERNAL POWER APPLIED. THE EG IS PREVENTED FROM OPERATING BY A CONTACT OF THE EXT PWR CONT RELAY ENERGIZING THE EG SELECTOR VALVE. DURING NORMAL FLIGHT CONDITIONS WITH THE SWITCH IN AUTO,THE EG WILL OPERATE IF ONE OR MORE OF THE FOLLOWING CONDITIONS OCCUR: A MAIN GENERATOR GOES OFF THE LINE OR A MAIN FUEL BOOST PUMP LOSES PRESSURE. POSITIONING THE SWITCH TO MANUAL CAUSES THE EG TO OPERATE. POSITIONING THE SWITCH TO ISOLATE AFTER THE EG HAS OPERATED IN THE MANUAL (OR AUTO) POSITION CAUSES THE EG TO POWER ONLY THE EMER/ESS BUSES (EMERGENCY BOOST PUMP (EBP), ARRESTING HOOK, FLIGHT CONTROL COMPUTER AND EMERGENCY AIR REFUELING SWITCH). THIS IS ACCOMPLISHED THRU THE LOCK-IN ACTION OF THE EMER/ESS BUS LOCK–IN RELAY.

7. ISOLATE POSITION IS ELECTRICALLY HELD THRU LOCK–IN ACTION OF THE EMER/ESS CONTACTOR.

8. CONTROL SIGNAL AVAILABLE AT THIS POINT WITH EMERGENCY GENERATOR OPERATING AND GENERATING POWER OF CORRECT VOLTAGE/FREQUENCY, PROVIDED CONTROL SWITCH IS OUT OF ISOLATE POSITION.

9. THE FOLLOWING ELECTRICAL SYSTEM LOGIC APPLIES TO EMER BST ON AND BST SYS MAL LIGHTS:
   (1) EMER BST ON AND BST SYS MAL LIGHT OFF – EMERGENCY GENERATOR ACTIVATED AND ELECTRICAL LOCK–UP CIRCUIT NORMAL.
   (2) EMER BST ON LIGHT OFF AND BST SYS MAL LIGHT ON–EMERGENCY GENERATOR EMERGENCY FUEL BOOST PUMP FAILED.
   (3) EMER BST ON LIGHT ON AND BST SYS MAL LIGHT ON–EMERGENCY FUEL BOOST PUMP OUTPUT PRESSURE NORMAL, BUT IS NOT BEING POWERED BY THE EMERGENCY GENERATOR. DO NOT PLACE THE EMERGENCY GENERATOR SWITCH TO ISOLATE.

LEGEND

(red)	AC POWER	(hatched)	START POWER
(black)	DC POWER	(thin line)	CONTROL POWER
(red dotted)	EXTERNAL AC POWER	(dashed)	MECHANICAL CONNECTION
(red hatched)	EMERG AC POWER		
(black hatched)	EMERG DC POWER		

10. EBP CONTROL RELAY ENERGIZES TO PREVENT OPERATION OF THE EBP WHENEVER POWER IS PRESENT AT SELECTOR VALVE OF EG TO PREVENT EG OPERATION. THE EBP CAN BE OPERATED UNDER THIS CONDITION BY ACTUATING THE EBP CHECK SWITCH. FOR ENGINE START WITHOUT EXTERNAL POWER, RELAY REMAINS DE–ENERGIZED AFTER EG IS SHUTDOWN 30 SECONDS AFTER FIRST GENERATOR COMES ON LINE,SO THAT RESULTING OPERATION OF EBP CAUSES BST SYS MAL LIGHT TO COME ON AND EMER BST ON LIGHT TO REMAIN ON UNTIL SECOND GENERATOR COMES ON LINE.

11. CONTACT IS CLOSED (DUE TO OPERATION OF WEIGHT ON WHEELS RELAY) WHILE AIRBORNE TO ENSURE EG POWERS ALL ESSENTIAL BUSES DURING INFLIGHT OPERATION OF THE JFS WITH BOTH MAIN GENERATORS OFF THE LINE.

12. WHILE AIRBORNE WITH BOTH MAIN GENERATORS OFF THE LINE AND JFS AND EG OPERATING,ENERGIZED CONTACT OF ENGINE CONTROL BUS RELAY ENERGIZES EMER/ESS CONT AND EMER/ESS BUS LOCK–IN RELAYS TO CONNECT OUTPUT OF THE EG TO THE EMR/ESS BUSES (WHICH CAUSES OPERATION OF THE EMER BOOST PUMP).

13. CONTACT IS CLOSED WHILE AIRBORNE. CONTACT IS OPEN ON THE GROUND TO PREVENT OPERATION OF THE EMER BOOST PUMP.

14. RELAY ENERGIZED ON GROUND BY WEIGHT ON WHEELS CIRCUIT

15. WITH AIRCRAFT ON GROUND,RELAY CLOSES 30 SECONDS AFTER FIRST GENERATOR COMES ON LINE,PROVIDING EMERGENCY GENERATOR SWITCH IS IN AUTO DURING A START WITHOUT EXTERNAL POWER.

16. EXCEPT ON EXTERNAL POWER WITH GROUND POWER SWITCH NO. 1 IN AUTO, RELAY IS DE-ENERGIZED TO CLOSE THE CONTACT.RELAY SHOWN DE–ENERGIZED WITH GROUND POWER SWITCH NO. 1 IN ON POSITION (THIS POSITION REQUIRED FOR ENGINE START ON EXTERNAL POWER TO PROVIDE OPERATION OF ENGINE MONITOR INDICATOR).

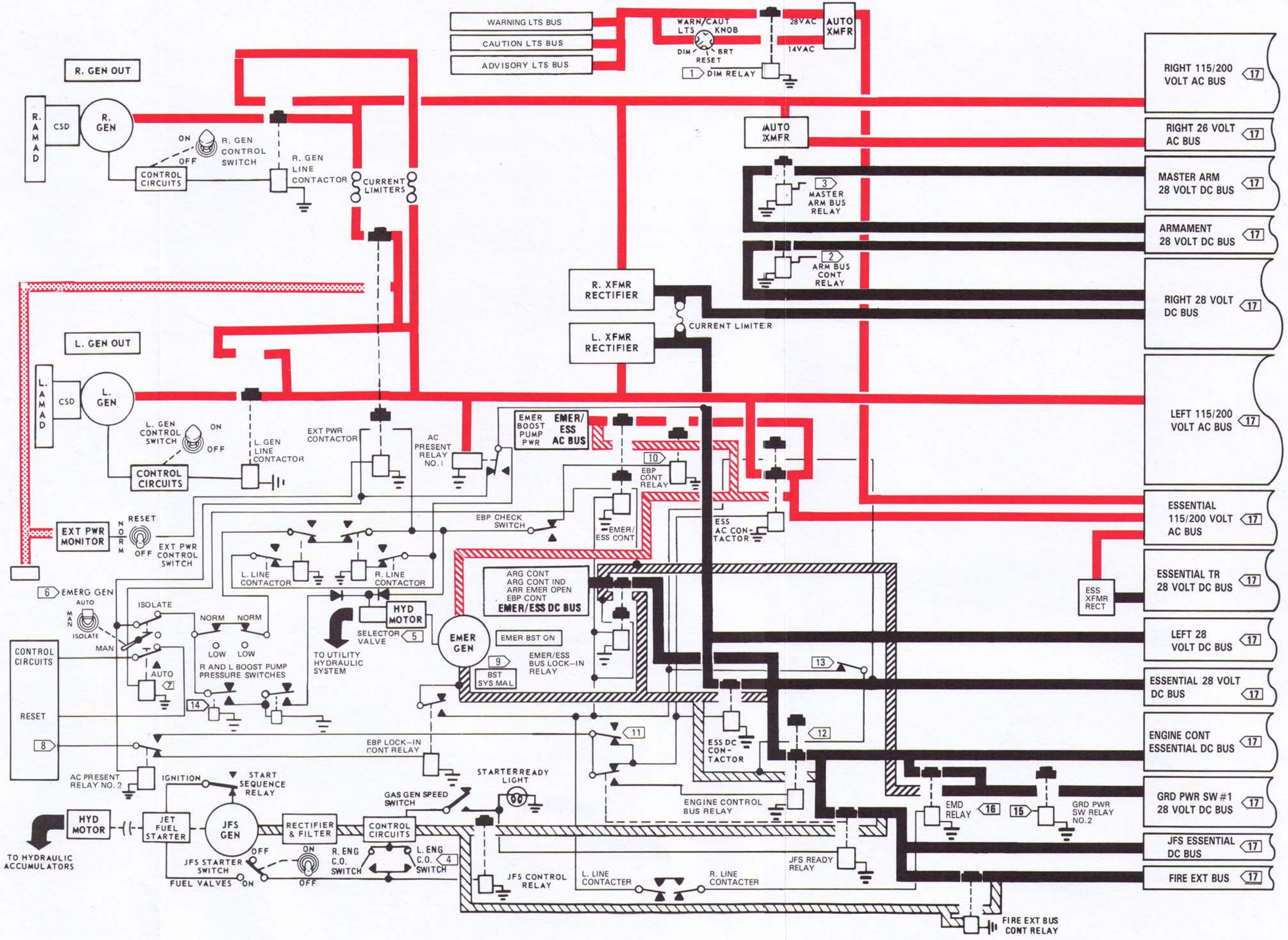
17. WITH EG OPERATING WHILE AIRBORNE AND BOTH MAIN GENERATORS OFF THE LINE,EMD RELAY ENERGIZES TO PROVIDE POWER TO GRD PWR SW#1 28 VOLT DC BUS WITH EG SWITCH IN ANY POSITION.

18. SEE FIGURE FO-6 SHEET 3 FOR CIRCUIT BREAKERS ON THIS BUS.

R
15E-1-(57)40

ELECTRICAL SYSTEM

ELECTRICAL SYSTEM
INTERNAL POWER



NOTES

1. DIMMING RELAY ENERGIZED WITH FLIGHT INSTRUMENT LIGHTS KNOB ON AND WARNING CAUTION LIGHTS KNOB MOVED TEMPORARILY TO RESET. RELAY IS DEENERGIZED BY TURNING FLIGHT INSTRUMENTS LIGHT OFF OR TURNING STORM/FLOODS KNOB TO FULL BRIGHT. OPERATION TYPICAL FOR BOTH COCKPITS.
2. ARMAMENT BUS CONTROL RELAY ENERGIZED WITH GEAR HANDLE UP.
3. MASTER ARM BUS RELAY IS ENERGIZED WITH THE MASTER ARM SWITCH IN THE ARM POSITION, PROVIDING ARAMENT BUS IS ENERGIZED.
4. ENGINE CUTOUT SWITCHES OPEN AFTER THEIR RESPECTIVE ENGINES START.
5. WITH ELECTRICAL POWER AT SELECTED VALVE, HYDRAULIC POWER IS SHUT OFF FROM EMERGENCY GENERATOR (EG) TO PREVENT OPERATION.
6. EMERGENCY GENERATOR CONTROL SWITCH SHOWN IN AUTO POSITION. DURING NORMAL FLIGHT CONDITIONS WITH THE SWITCH IN AUTO, THE EG WILL OPERATE IF ONE OR MORE OF THE FOLLOWING CONDITIONS OCCUR: A MAIN GENERATOR GOES OFF THE LINE OR A MAIN FUEL BOOST PUMP LOSES PRESSURE. POSITIONING THE SWITCH TO MANUAL CAUSES THE EG TO OPERATE. POSITIONING THE SWITCH TO ISOLATE AFTER THE EG HAS OPERATED IN THE MANUAL (OR AUTO) POSITION CAUSES THE EG TO POWER ONLY THE EMER/ESS BUSES (EMERGENCY BOOST PUMP (EBP), ARRESTING HOOK, FLIGHT CONTROL COMPUTER AND EMERGENCY AIR REFUELING SWITCH). THIS IS ACCOMPLISHED THRU THE LOCK-IN ACTION OF THE EMER/ESS BUS LOCK-IN RELAY.
7. ISOLATE POSITION IS ELECTRICALLY HELD THRU LOCK-IN ACTION OF THE EMER/ESS CONTACTOR.
8. CONTROL SIGNAL AVAILABLE AT THIS POINT WITH EMERGENCY GENERATOR OPERATING AND GENERATING POWER OF CORRECT VOLTAGE/FREQUENCY, PROVIDED CONTROL SWITCH IS OUT OF ISOLATE POSITION.
9. THE FOLLOWING ELECTRICAL SYSTEM LOGIC APPLIES TO EMER BST ON AND BST SYS MAL LIGHTS:
   (1) EMER BST ON AND AND BST SYS MAL LIGHT OFF – EMERGENCY GENERATOR ACTIVATED AND ELECTRICAL LOCK-UP CIRCUIT NORMAL.
   (2) EMER BST ON LIGHT OFF AND BST SYS MAL LIGHT ON – EMERGENCY GENERATOR EMERGENCY FUEL BOOST PUMP FAILED.
   (3) EMER BST ON LIGHT ON AND BST SYS MAL LIGHT ON – EMERGENCY FUEL BOOST PUMP OUTPUT PRESSURE NORMAL, BUT IS NOT BEING POWERED BY THE EMERGENCY GENERATOR. DO NOT PLACE THE EMERGENCY GENERATOR SWITCH TO ISOLATE.
10. EBP CONTROL RELAY ENERGIZES TO PREVENT OPERATION OF THE EBP WHENEVER POWER IS PRESENT AT SELECTOR VALVE OF EG TO PREVENT EG OPERATION. THE EBP CAN BE OPERATED UNDER THIS CONDITION BY ACTUATING THE EBP CHECK SWITCH. FOR ENGINE START WITHOUT EXTERNAL POWER, RELAY REMAINS DE-ENERGIZED AFTER EG IS SHUTDOWN 30 SECONDS AFTER FIRST GENERATOR COMES ON LINE,SO THAT RESULTING OPERATION OF EBP CAUSES BST SYS MAL LIGHT TO COME ON AND EMER BST ON LIGHT TO REMAIN ON UNTIL SECOND GENERATOR COMES ON LINE.
11. CONTACT IS CLOSED (DUE TO OPERATION OF WEIGHT ON WHEELS RELAY) WHILE AIRBORNE TO ENSURE EG POWERS ALL ESSENTIAL BUSES DURING INFLIGHT OPERATION OF THE JFS WITH BOTH MAIN GENERATORS OFF THE LINE.
12. WHILE AIRBORNE WITH BOTH MAIN GENERATORS OFF THE LINE AND JFS AND EG OPERATING,ENERGIZED CONTACT OF ENGINE CONTROL BUS RELAY ENERGIZES EMER/ESS CONT AND EMER/ESS BUS LOCK-IN RELAYS TO CONNECT OUTPUT OF THE EG TO THE EMR/ESS BUSES (WHICH CAUSES OPERATION OF THE EMER BOOST PUMP).
13. CONTACT IS CLOSED WHILE AIRBORNE. TO ALLOW OPERATION OF THE EMER BOOST PUMP.
14. RELAY DE-ENERGIZED IN FLIGHT BY WEIGHT ON WHEELS CIRCUIT.
15. EXCEPT ON EXTERNAL POWER WITH GROUND POWER SWITCH NO. 1 IN AUTO, RELAY IS ENERGIZED TO OPEN THE CONTACT. RELAY SHOWN ENERGIZED WITH GROUND POWER SWITCH NO. 1 IN OFF POSITION.
16. EXCEPT ON EXTERNAL POWER WITH GROUND POWER SWITCH NO. 1 IN AUTO, RELAY IS DE-ENERGIZED TO CLOSE THE CONTACT.RELAY SHOWN DE-ENERGIZED WITH GROUND POWER SWITCH NO. 1 IN ON POSITION (THIS POSITION REQUIRED FOR ENGINE START ON EXTERNAL POWER TO PROVIDE OPERATION OF ENGINE MONITOR INDICATOR).
17. SEE FIGURE FO-6 SHEET 3 FOR CIRCUIT BREAKERS ON THIS BUS.

LEGEND

AC POWER	START POWER
DC POWER	CONTROL POWER
EXTERNAL AC POWER	MECHANICAL CONNECTION
EMERG AC POWER	
EMERG DC POWER	

15E-1-(375)40

ELECTRICAL SYSTEM

Figure FO-6 (Sheet 2)

ELECTRICAL SYSTEM
BUSSES

RIGHT 115/200 VOLT AC BUS	A/A STA 2A, 2B, 8A & 8B PWR A/A STA 3L & 7R CFT A/A STA 4 & 6 A/C UTIL PWR RECP A/G STA 2 & 8 A/G STA 5	EMD/R FUEL FLOW IND EXCEEDANCE COUNTER GUN POWER ICE DETECTOR ICS J TIDS	L FUEL FLOW IND L WING XFR PUMP PWR OXY GAGE R AIR INLET CONT R AOA PROBE HTR R BOOST PUMP PWR R CONF TANK AFT XFR PUMP	R DUCT PITOT HTR RH TEWS POD R DUCT PITOT HTR RMR R TOTAL TEMP PROBE HTR R WING XFR PUMP	R XFMR R/RECT RDR WARN RCVR RWR PWR SEAT ADJUST 26VAC AUTO XFMR	
RIGHT 26 VOLT AC BUS	L ENG ENP IND L ENG OIL PRESS IND	PC–1 HYD PRESS IND PC–2 HYD PRESS IND	PRC POS IND R ENG ENP IND	R ENG OIL PRESS IND UTL HYD PRESS IND		
MASTER ARM 28 VOLT DC BUS	A/A STA 2A, 2B, 8A & 8B MASTER ARM PWR A/G STA 5 MASTER ARMING PWR A/A MSL MOTOR FIRE NO. 1	A/A MSL MOTOR FIRE NO. 2 GUN CONT DC PWR GUN TRIGGER PWR MASTER ARM LOGIC PWR	UMB RET PWR			
ARMAMENT 28 VOLT DC BUS	MASTER ARM BUS PWR MASTER ARM CONT					
RIGHT 28 VOLT DC BUS	A/A STA 3/L CFT DC PWR NO. 1 & 2 A/A STA 2A, 2B, 8A & 8B DC PWR NO. 1 & 2 A/A STA 6/R CFT DC PWR NO. 1 & 2 A/A STA CFT PWR NO. 1 & 2 A/A STA 4 PWR 1 & 2 AFCS CH A AFCS CH B	AFCS CH C A/G STA 2, 5 & 8 A/G STA DC PWR NO. 1 & 2 A/G STA 5 PWR NO. 1 & 2 ARM BUS CONT CSBPC HYD BYPASS DC PWR UTIL RECP	FUEL SYS CHK HOLDING BRAKE HYD PRESS ICE DETECTOR LANDING LT LANDING & TAXI LT LANTIRN NAV POD LANTIRN TARGET POD	LAST ROUND PWR L/R CFT A/G STA L WING XFR PUMP RLY MODE SEL PWR MPCD L AFT MPCD R AFT NUCLEAR CONSENT R AIR INLET CONT	R BOOST PUMP RLY R CONF TK HT EXCH DR ACTR R IDLE NOZL RESET/ENG OIL PRESS RH TEWS POD RMR RUDDER TRAVEL LMTR R WG XFER PUMP RDR WRN RCVR PWR	SEAT ADJUST CONT STA 2, 5 & 8 AMAC STA 2, 5 & 8 RACK TAXI LT TEWS POD CONT UTILITY PWR RCPT VTRS WSHLD ANTI–ICE
LEFT 115/200 VOLT AC BUS	AC PRESENT RLY ADC AHRS AIR INLET CONT AIU NO. 2 AOA IND–FWD CCC	EWWS HUD INMU INTRG RCVR/XMTR PWR INTRL NAV SET DSPL UNIT INTERIOR LTS INTR BLANKER IRE KIR KIT	L AIR INLET CONT L AOA PROBE HTR L BOOST PUMP PWR L CONF TANK AFT XFR PUMP L CONF TANK FWD XFR PUMP L DUCT PITOT HEATERS L & R PITOT MAST HTR (1) LEAD COMP GYRO LH/CTR TEWS POD L TOTAL TEMP PROBE HTR	L XFMR/RECT MPD L AFT MPD L FWD MPDP MPD R AFT MPD R FWD PACS POS ANTI–COLLISION LTS RADAR RADAR COOLANT PUMP RADAR XMTR	RDR XMTR & LVPS SIGNAL DATA RCDR TACAN RCVR/XMTR TIS TNK NO. 1 XFR PUMP PWR VSI AFT VSI FWD	
ESSENTIAL 115/200 VOLT AC BUS	AFCS AC AIU NO. 1 ARR FLOOD LIGHTS BLEED AIR LEAK DET	ESS TRU FUEL LEVEL SENS FUEL QTY IND PWR HORIZ SIT IND	IMNU L & R PITOT HEAD HEAT L DUCT PITOT HTR L ENG LOW ENERGY IGN	MPDP R CONF TK FWD XFR PUMP R ENG LOW ENERGY IGN STBY ATTD IND	STORM FLOODS/CAUTION LTS STORM FLOOD LTS FWD UFC POWER WARN/ADV/CAUT LTS PWR	
ESSENTIAL TR 28 VOLT DC BUS	AFT CMD SW PWR CABIN AIR DUMP CAUT LT/MC RESET FLAP CONT	FUEL DUMP FWD CMD SW PWR (3) MPCD–FWD SPEED BRAKE UHF RT NO. 1	WARN/CAUT/ADV LTS			
LEFT 28 VOLT DC BUS	AIU RELAY CONT ADF AV STATUS PANEL CARA CONF TANK LVL CONT VALVE	EMER GEN HYDR SOL EWWS GRD HOT FUEL RECIRC ILS	IRE LEAD COMP GYRO L AIC/RUD TRV CAUT LT CONT L BOOST PUMP	L CONF TK HT EXCH DR ACTR L & R CONF TANK CTR XFR PUMP LH/CTR TEWS POD PACS PACS DC PWR NO. 2	PSN ANTI–COLLISION LT CONT RDR CONT & LVPS RDR COOLANT PUMP RDR LVPS POWER TACAN/RCVR XMTR	TIS DC PWR UFC–AFT UFC–FWD UHF RT NO. 2 UTIL FLOOD LT PWR - AFT
ESSENTIAL 28 VOLT DC BUS	AERIAL REFUEL AFCS CH A AFCS CH B AFCS CH C	ARI SHUTOFF/ANTI–SKID CONT BLEED AIR LEAK DET/BK PULSER CFT/AG STORES RELEASE CFT LEVEL CONT NO. 2 ECS	ECS HEAT EXCHANGER EJECT PWR NO. 1 EJECT PWR NO. 2 EMER JETT NO. 1 EMER JETT NO. 2 FUEL LVL SENSING UNIT	FUEL PRESS REGULATORS HOT FUEL/GRD REFUEL IFF/TRANSPONDER INT COMM PANEL INT LTS TEST LDG GR POS WRN TONE	LG LDG GR CONT LG POS IND L MAIN GEAR WOW PWR L/R CFT AFT AFR PUMP (2) MPCD–FWD	NLG STEERING PRAD CONT R MAIN GEAR WOW PWR
ENGINE CONT ESSENTIAL DC BUS	ENG FIRE EXT SYS ENG FIRE/OVHT DET SYS ENG EDU ENG FUEL SOV	NOSE LDG WOW PWR R ENG EDU R ENG FUEL SOV				
GRD PWR SW #1 28 VOLT DC BUS	EMD					
JFS ESSENTIAL DC BUS	AMAD FIRE DET SYS INTERCOM FWD	L AMAD SEL R AMAD SEL	UTILITY FLOODLIGHT FWD			
FIRE EXT BUS	AMAD F EXT SYS					

NOTES

NOMENCLATURE CALLOUTS ON THE INDIVIDUAL BUSES ARE CIRCUIT BREAKER NOMENCLATURES THESE NOMENCLATURES DO NOT NECESSARILY IDENTIFY EACH SYSTEM POWERED BY THE CIRCUIT BREAKERS.

(1) F-15E 86-0183 THRU 87-0210.

(2) F-15E 86-0183 THRU 89-0496.

(3) F-15E 89-0497 AND UP.

15E-1-(376)40

Figure FO-6 (Sheet 3)

HYDRAULIC SYSTEMS

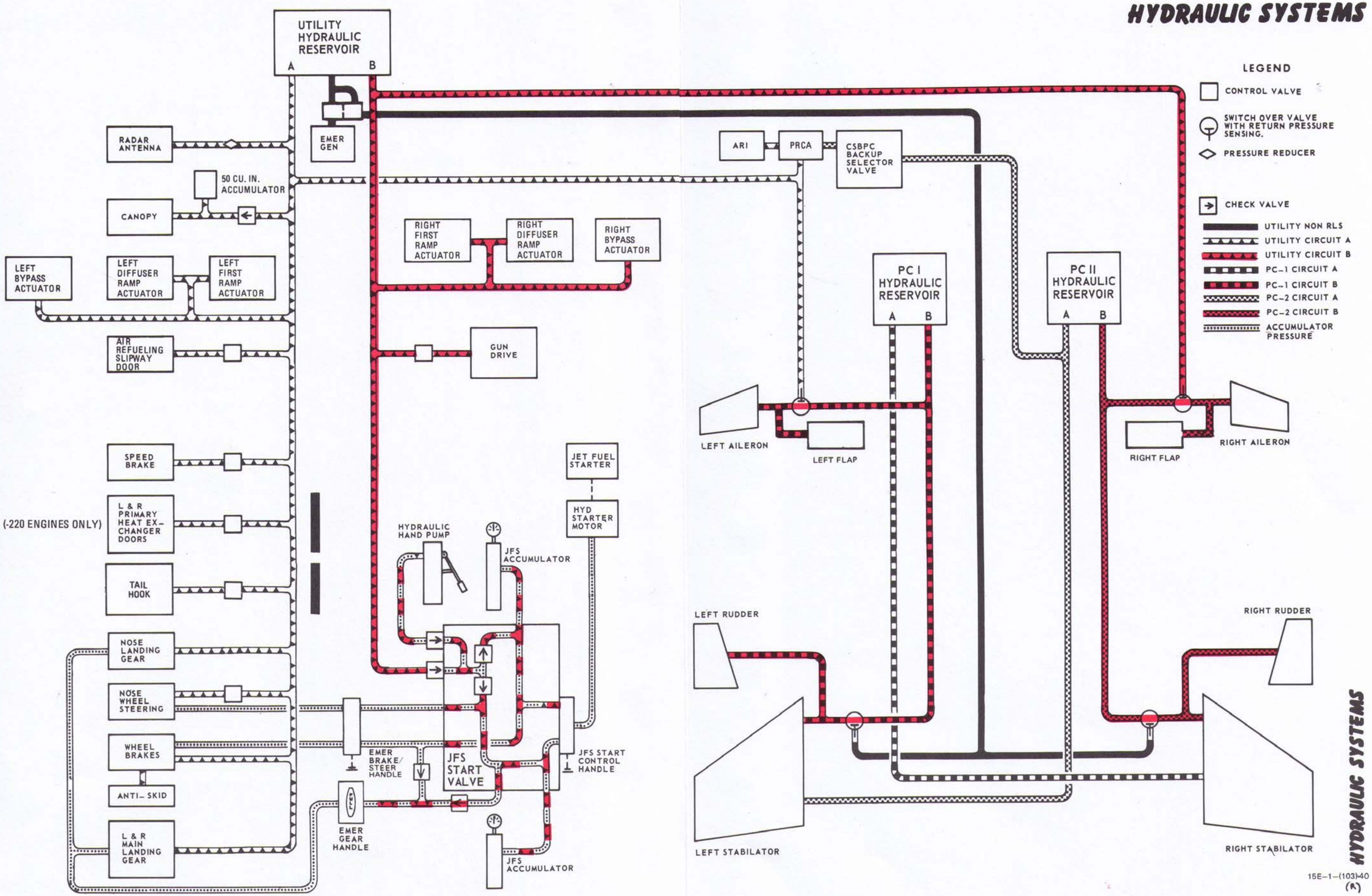


Figure FO-7

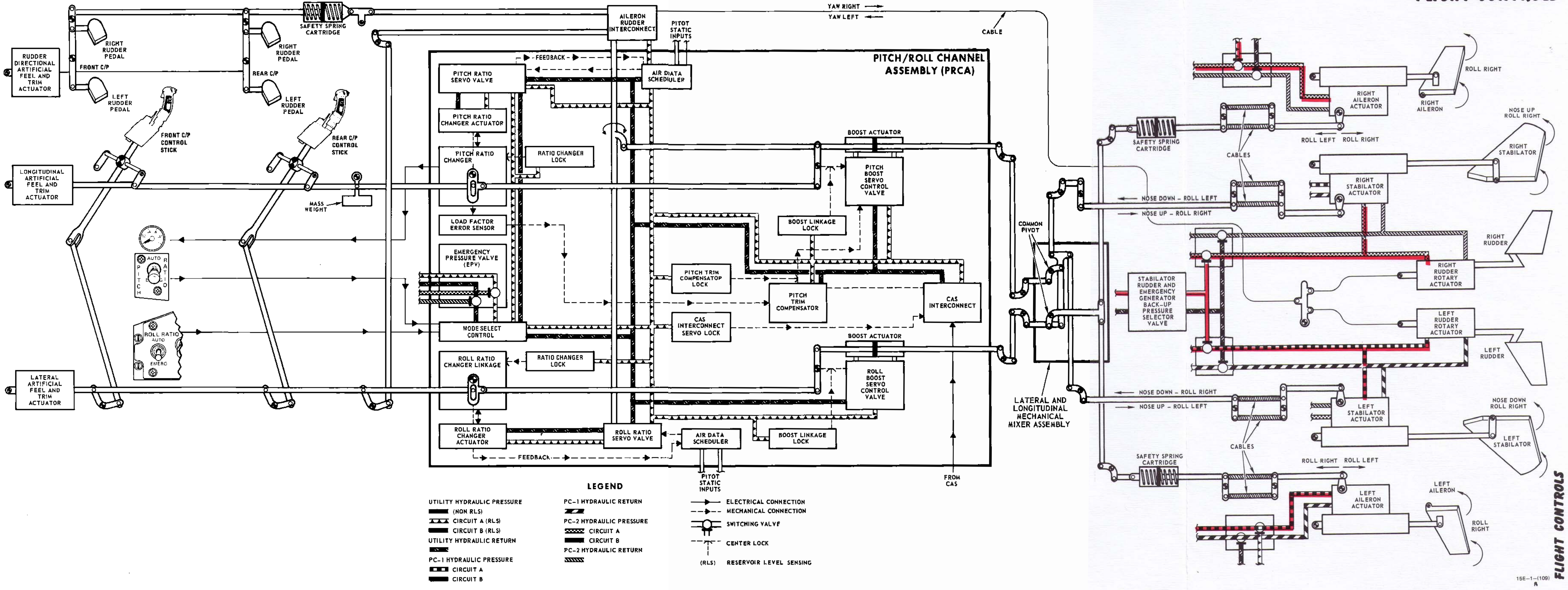

RUDDER DIRECTIONAL ARTIFICIAL FEEL AND TRIM ACTUATOR
RIGHT RUDDER PEDAL
FRONT C/P
LEFT RUDDER PEDAL
RIGHT RUDDER PEDAL
REAR C/P
LEFT RUDDER PEDAL
SAFETY SPRING CARTRIDGE
AILERON RUDDER INTERCONNECT
PITOT STATIC INPUTS
YAW RIGHT
YAW LEFT
CABLE
FRONT C/P CONTROL STICK
REAR C/P CONTROL STICK
LONGITUDINAL ARTIFICIAL FEEL AND TRIM ACTUATOR
MASS WEIGHT
LATERAL ARTIFICIAL FEEL AND TRIM ACTUATOR
PITCH RATIO
AUTO
EMERG
ROLL RATIO
PITCH/ROLL CHANNEL ASSEMBLY (PRCA)
FEEDBACK
PITCH RATIO SERVO VALVE
AIR DATA SCHEDULER
PITCH RATIO CHANGER ACTUATOR
PITCH RATIO CHANGER
RATIO CHANGER LOCK
BOOST ACTUATOR
PITCH BOOST SERVO CONTROL VALVE
LOAD FACTOR ERROR SENSOR
BOOST LINKAGE LOCK
EMERGENCY PRESSURE VALVE (EPV)
PITCH TRIM COMPENSATOR LOCK
PITCH TRIM COMPENSATOR
CAS INTERCONNECT
MODE SELECT CONTROL
CAS INTERCONNECT SERVO LOCK
BOOST ACTUATOR
ROLL RATIO CHANGER LINKAGE
RATIO CHANGER LOCK
ROLL BOOST SERVO CONTROL VALVE
ROLL RATIO CHANGER ACTUATOR
ROLL RATIO SERVO VALVE
AIR DATA SCHEDULER
BOOST LINKAGE LOCK
FEEDBACK
PITOT STATIC INPUTS
FROM CAS
COMMON PIVOT
LATERAL AND LONGITUDINAL MECHANICAL MIXER ASSEMBLY
ROLL RIGHT
RIGHT AILERON ACTUATOR
RIGHT AILERON
SAFETY SPRING CARTRIDGE
ROLL LEFT
ROLL RIGHT
NOSE UP ROLL RIGHT
RIGHT STABILATOR
CABLES
RIGHT STABILATOR ACTUATOR
NOSE DOWN - ROLL LEFT
NOSE UP - ROLL RIGHT
RIGHT RUDDER
RIGHT RUDDER ROTARY ACTUATOR
STABILATOR RUDDER AND EMERGENCY GENERATOR BACK-UP PRESSURE SELECTOR VALVE
LEFT RUDDER ROTARY ACTUATOR
LEFT RUDDER
NOSE DOWN - ROLL RIGHT
NOSE UP - ROLL LEFT
LEFT STABILATOR ACTUATOR
NOSE DOWN ROLL RIGHT
LEFT STABILATOR
CABLES
SAFETY SPRING CARTRIDGE
ROLL RIGHT
ROLL LEFT
LEFT AILERON
LEFT AILERON ACTUATOR
ROLL RIGHT
LEGEND
UTILITY HYDRAULIC PRESSURE
(NON RLS)
CIRCUIT A (RLS)
CIRCUIT B (RLS)
UTILITY HYDRAULIC RETURN
PC-1 HYDRAULIC PRESSURE
CIRCUIT A
CIRCUIT B
PC-1 HYDRAULIC RETURN
PC-2 HYDRAULIC PRESSURE
CIRCUIT A
CIRCUIT B
PC-2 HYDRAULIC RETURN
ELECTRICAL CONNECTION
MECHANICAL CONNECTION
SWITCHING VALVE
CENTER LOCK
(RLS) RESERVOIR LEVEL SENSING
15E-1-(109)

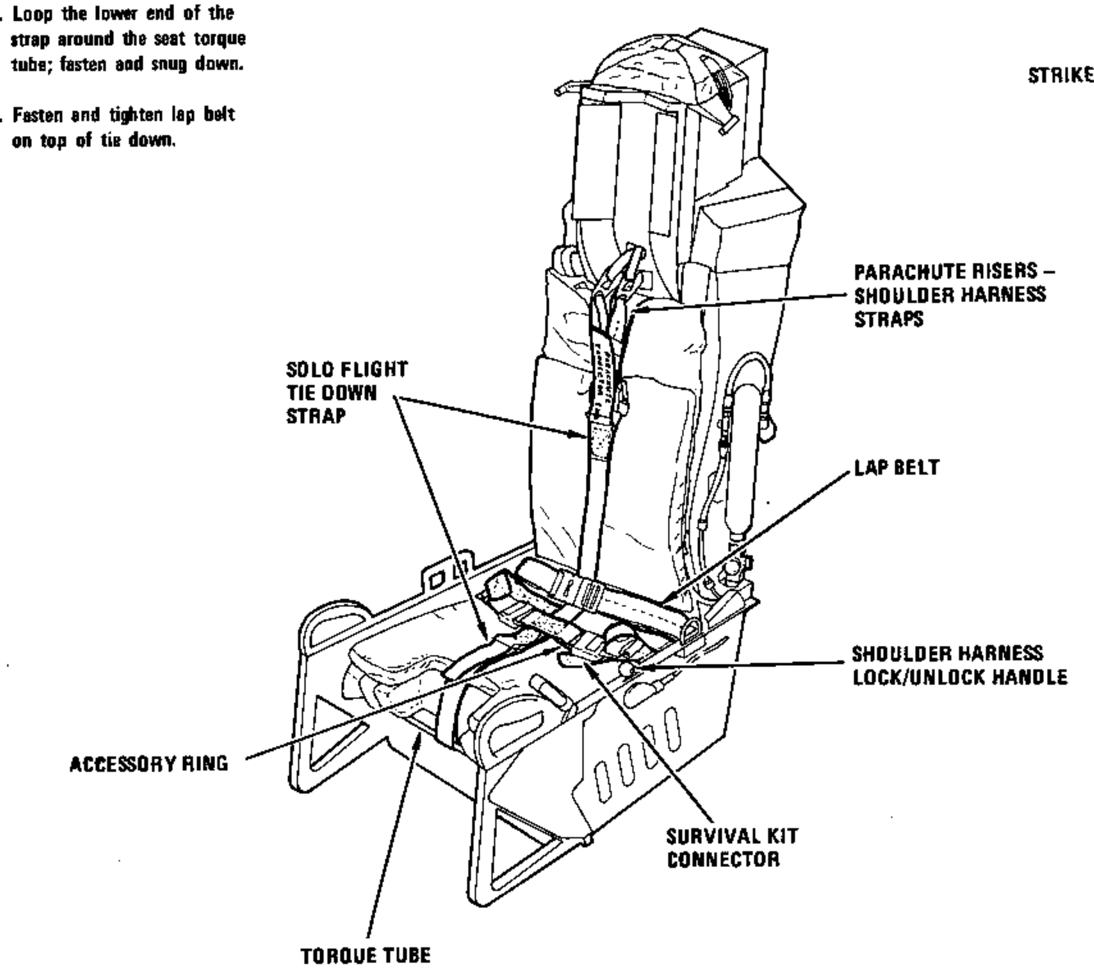
Figure FO-8

EJECTION SEAT

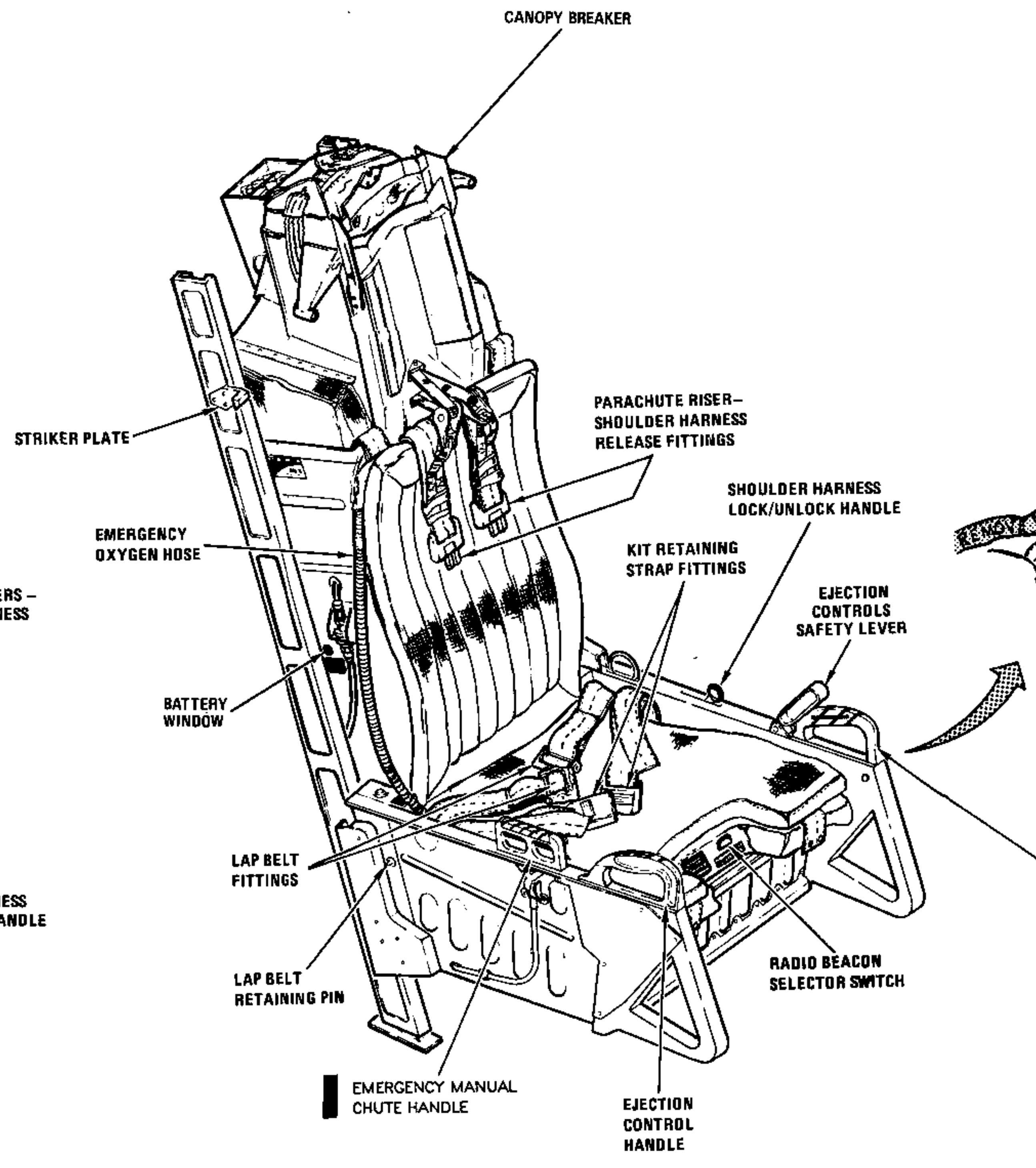
TYPICAL

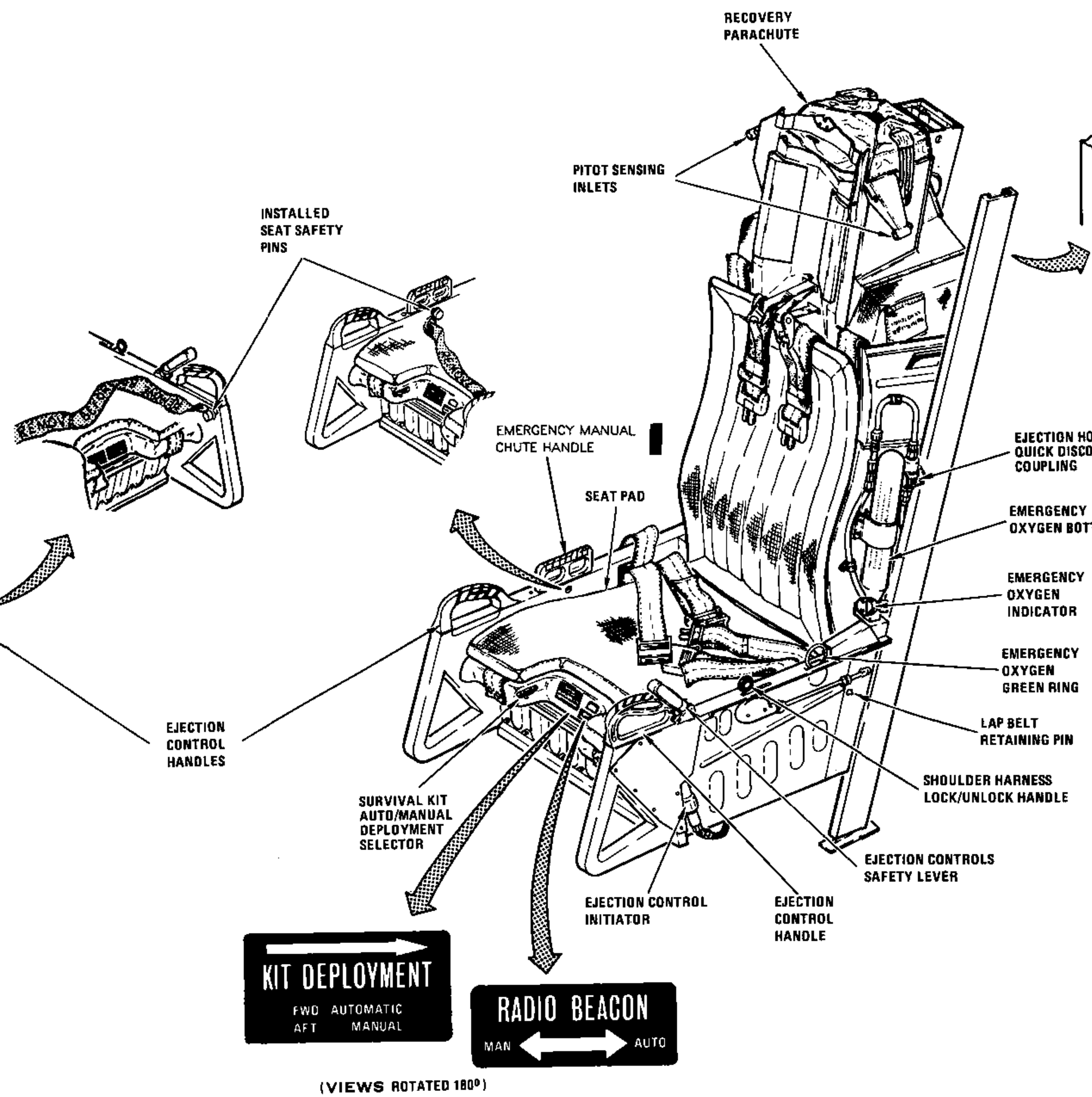
TIE DOWN PROCEDURE

1. After orienting the strap end labeled PARACHUTE CONNECTOR END toward top of seat, attach accessory rings to survival kit; center and tighten straps.
2. Install strap end labeled PARACHUTE CONNECTOR END through both parachute/shoulder harness connectors; buckle and fully tighten strap with the shoulder harness lock/unlock handle in forward position.
3. Loop the lower end of the strap around the seat torque tube; fasten and snug down.
4. Fasten and tighten lap belt on top of tie down.

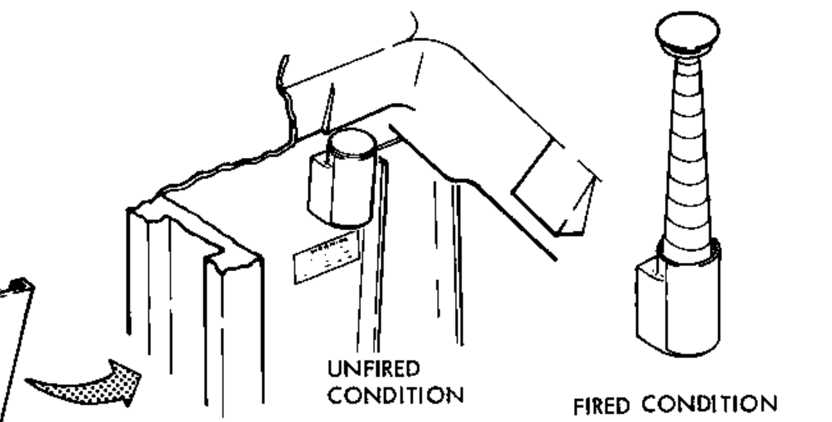


SOLO FLIGHT TIE DOWN STRAP INSTALLATION

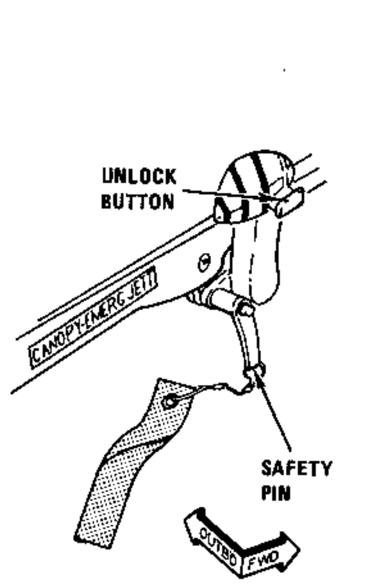




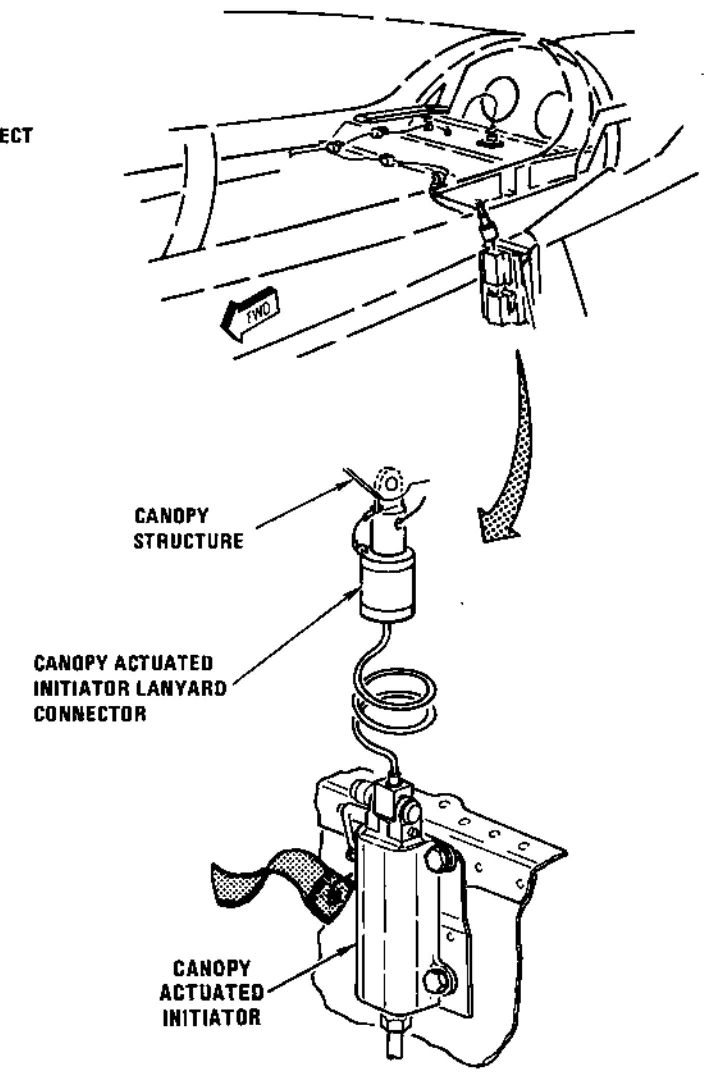
(VIEWS ROTATED 180°)



CANOPY ACTUATED INITIATOR FIRING INDICATOR



CANOPY JETTISON HANDLE



15E-1-(51)44

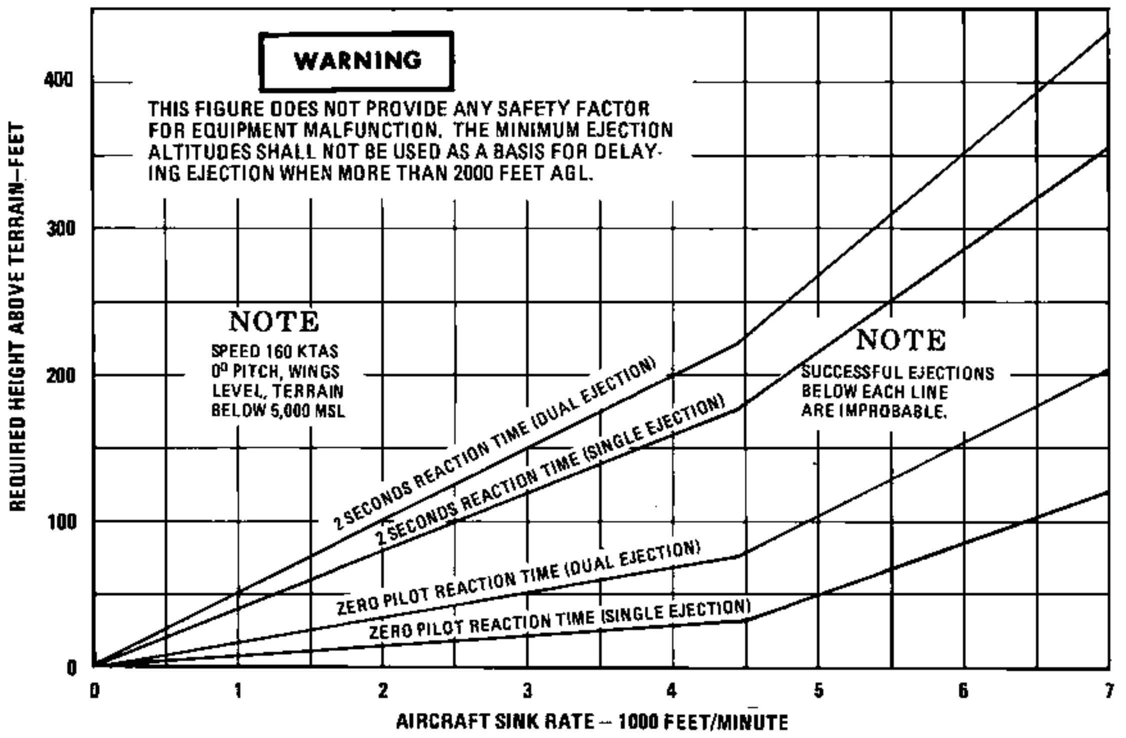
EJECTION SEAT

Figure FO-9

EJECTION SEAT PERFORMANCE CHARTS

MINIMUM EJECTION ALTITUDE VS. SINK RATE

SINGLE AND DUAL EJECTION



MINIMUM EJECTION ALTITUDE FOR SELECTED FLIGHT CONDITIONS

FLIGHT CONDITIONS	SINGLE EJECTION MINIMUM EJECTION ALT (FEET)	DUAL EJECTION MINIMUM EJECTION ALT (FEET)
ZERO SPEED, ZERO ALTITUDE – (CANOPY MUST BE CLOSED AND LOCKED OR COMPLETELY SEPARATED)	0	0
120 KNOTS, 0° PITCH, 60° BANK ⟨1⟩	0	0 ⟨2⟩
600 KNOTS, 0° PITCH, 0° BANK	0	0
150 KNOTS, 0° PITCH, 180° BANK	280	280
150 KNOTS, 0° PITCH, 0° BANK, 10,000 FPM SINK RATE	240	360
200 KNOTS, -60° PITCH, 0° BANK	600	810
450 KNOTS, -30° PITCH, 0° BANK	570	880
200 KNOTS, -60° PITCH, 60° BANK	650	860 ⟨2⟩
250 KNOTS, -45° PITCH, 180° BANK	780	1000

⟨1⟩ FOR THIS CASE, IMPACT OCCURS AT THE INSTANT OF SEAT/AIRCRAFT SEPARATION. IN ALL OTHER CASES, CONDITIONS ARE AT SYSTEM INITIATION.

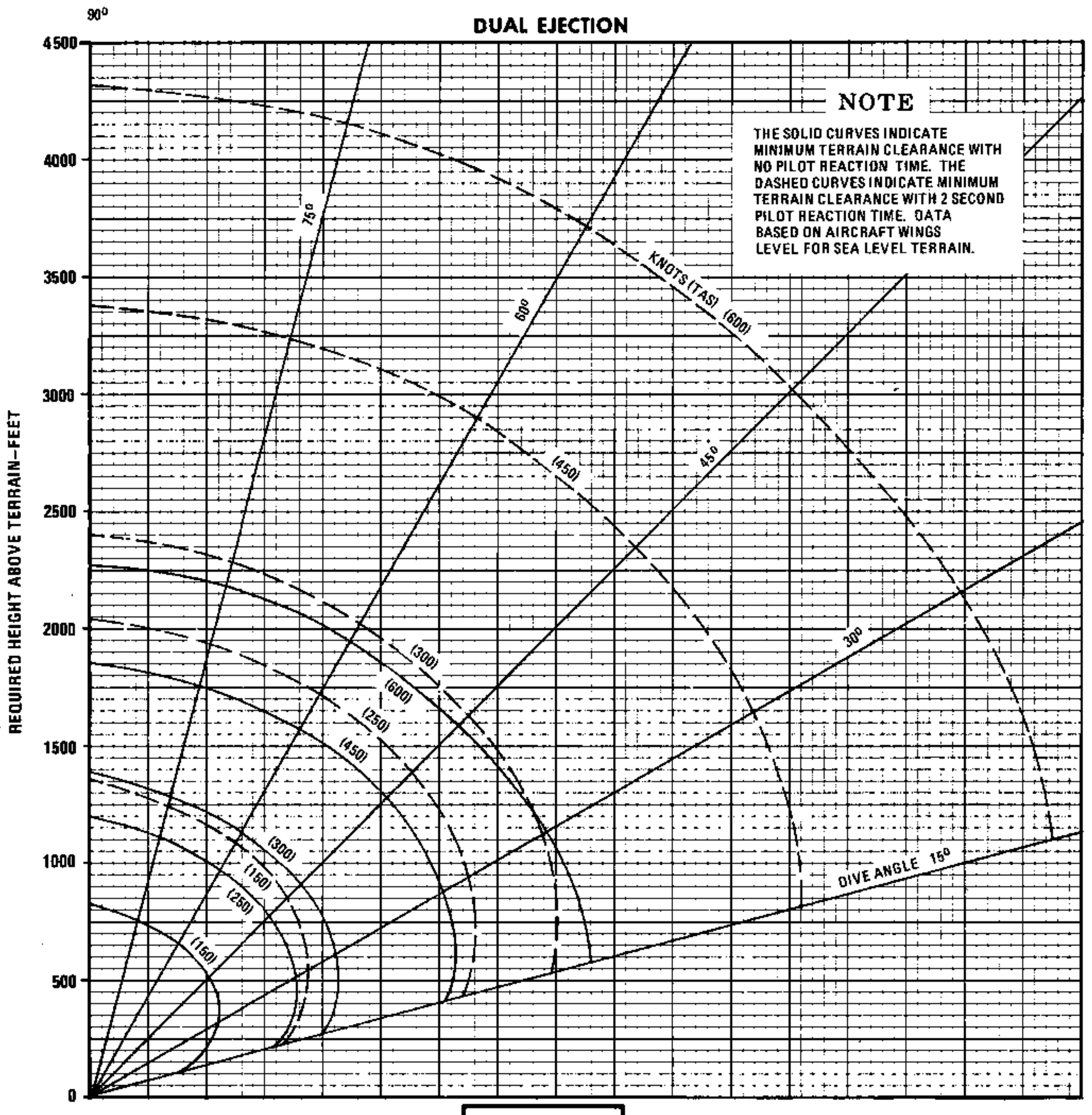
⟨2⟩ FOR THESE CASES, RECOVERY PERFORMANCE IS BASED ON THE MOST CRITICAL (FRONT SEAT) ROLL/SEAT TRAJECTORY COMBINATION.

WARNING

THE FIGURE DOES NOT PROVIDE ANY SAFETY FACTOR FOR EQUIPMENT MALFUNCTION OR PILOT REACTION TIME. THE ABOVE MINIMUM EJECTION ALTITUDES SHALL NOT BE USED AS THE BASIS FOR DELAYING EJECTION MORE THAN 2000 FEET AGL.

MINIMUM EJECTION ALTITUDE VS. AIRSPEED AND DIVE ANGLE

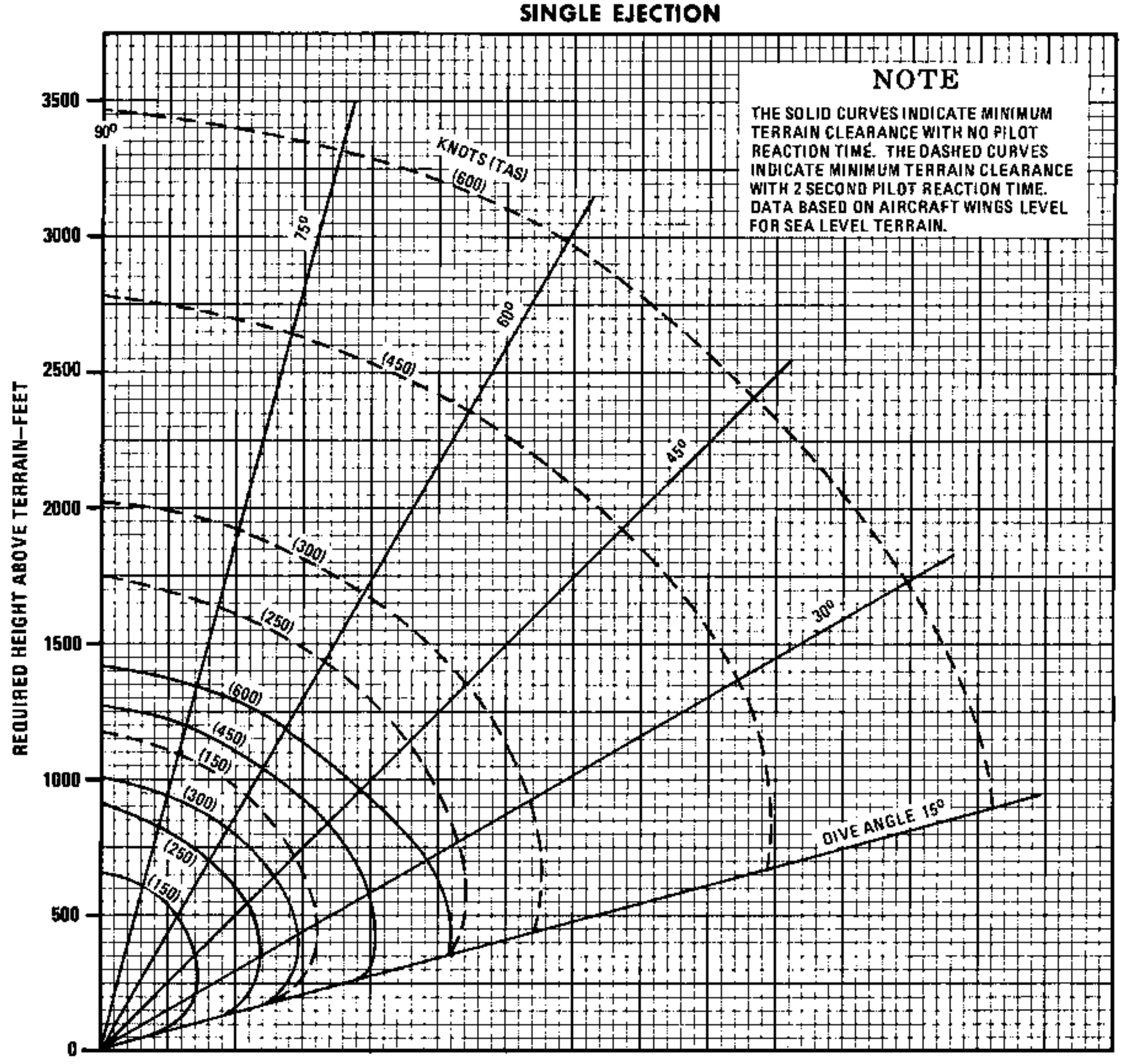
DUAL EJECTION



WARNING

THE FIGURE DOES NOT PROVIDE ANY SAFETY FACTOR FOR EQUIPMENT MALFUNCTION. THE ABOVE MINIMUM EJECTION ALTITUDES SHALL NOT BE USED AS THE BASIS FOR DELAYING EJECTION WHEN MORE THAN 2000 FEET AGL.

SINGLE EJECTION



WARNING

THE FIGURE DOES NOT PROVIDE ANY SAFETY FACTOR FOR EQUIPMENT MALFUNCTION. THE ABOVE MINIMUM EJECTION ALTITUDES SHALL NOT BE USED AS THE BASIS FOR DELAYING EJECTION WHEN MORE THAN 2000 FEET AGL.

15E-1-(55)

Figure FO-10

ENVIRONMENTAL CONTROL SYSTEM

NOTE

1 ▶ F-15E 86-0183 THRU 90-0232

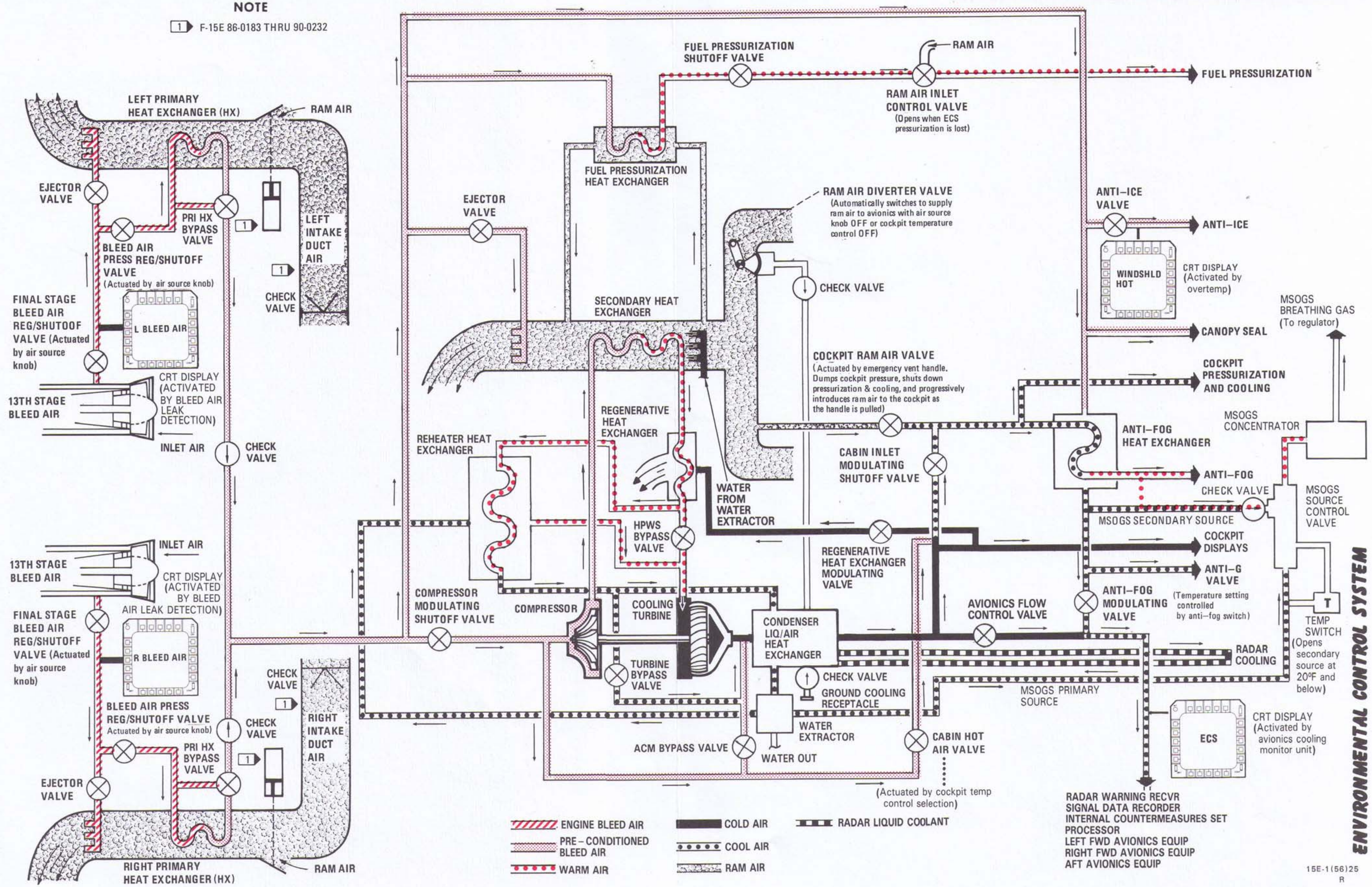


Figure FO-11

ENVIRONMENTAL CONTROL SYSTEM

GLOSSARY

A

A - Anti-Jam Feature of the UHF Radio

A/A - Air-to-Air

AAI - Air-to-Air Interrogator

AB - Afterburner

A/B BURN THRU - Afterburner Burn Through

AC - Alternating Current

ACC - Acceleration

ACMI - Air Combat Maneuvering Instrumentation

A/D - Air Data

ADC - Air Data Computer

ADF - Automatic Direction Finding

AFC - Afterburner Fuel Control

AFCS - Automatic Flight Control System

A/G - Air-to-Ground

AGL - Above Ground Level

AGM - Air-to-Ground Missile

AHRS - Attitude Heading Reference System

AIC - Air Inlet Controller

AIM - Air Intercept Missile

AIS - Airborne Instrumentation System (Pod)

AIU - Avionics Interface Unit

ALT HOLD - Altitude Hold

ALTN REL - Alternate Release

AMAD - Airframe Mounted Accessory Drive

AOA - Angle-Of-Attack

AOJ - Angle-Of-Jam

A/P - Auto Pilot

AQD - Armored Quick Disconnect

ARI - Aileron Rudder Interconnect

ARMT - Armament

ASE - Allowable Steering Error

ASP - Avionics Status Panel

ATDP - Asymmetric Thrust Departure Prevention

ATDPS - Asymmetric Thrust Departure Prevention System

ATF - Automatic Terrain Following

ATT - Attitude

AUST NAT - Australian National

AUTO ACQ - Automatic Acquisition

AUTO PLT - Autopilot (MPD/MPCD Legend)

AV BIT - Avionics BIT

B

BA - Bank Angle

BAK - Barrier Arresting Component

BAL - Basic Aircraft Limits

BB - Base Band

BCN - Beacon

BINGO - Return fuel state
Return to this channel (radio)

BIT - Built-In-Test

BOS - Backup Oxygen System

BOT - Bottom

BRST - Boresight

BS/BST - Boresight

BST PMP - Boost pump

BST SYS MAL - Boost System Malfunction

BUS - Electrical Power Distribution System

C

C - Cipher function (UHF Radio)

CARA - Combined Altitude Radar Altimeter

CAS - Calibrated Airspeed
Control Augmentation System

CASI - CAS Interconnect

CBT - Combat

CC - Central Computer

CCW - Counterclockwise

CDI - Course Deviation Indicator

CEP - Circular Error Probability

CFT - Conformal Fuel Tank

CG - Center of Gravity
Command Groundspeed

CGB - Central Gearbox

CIVV - Compressor Inlet Variable Vanes

CLR - Clear

C/M - Channel/Manual

CMD - Countermeasures Dispenser

COMM - Communication(s)

COMP - Compass

CONF - Conformal

CONT - Contrast

CONTR - Control/Controller

CPU - Central Processor Unit

CSBPC - Control Stick Boost/Pitch Compensator

CSET - Course Set

CSS - Control Stick Steering

CTR - Center
Centerline Tank

CV - Command Velocity

CW - Clockwise

D

DC - Direct Current

DCL - Declutter

DECEL - Deceleration

DEEC - Digital Electronic Engine Control

DEGD - Degraded

DG - Directional Gyro

DLVRY - Delivery

DN - Down

DP - Diphase

DSPL - Display

DSPL FLO LO - Display Flow Low

DTM - Data Transfer Module

DTMR - Data Transfer Module Receptacle

DTMS - Data Transfer Module Set

E

EADI - Electronic Attitude Director Indicator

EAS - Equivalent Airspeed

ECCM - Electronic Counter-Countermeasures

ECS - Environmental Control System

EDS - Emergency Disconnect Switch (Paddle Switch)

EDU - Engine Diagnostic Unit

EHSI - Electronic Hrizontal Situation Indicator

EMD - Engine Monitor Display

EMER BST ON - Emergency Boost Pump On

EMERG - Emergency

EMIS LMT - Emission Limiting

ENG CONTR - Engine Control

ENG MON SYS - Engine Monitoring System

EOT - End-Of-Tape

EPR - Engine Pressure Ratio

ESS - Essential

ETE - Estimated Time Enroute

EWW - Electronic Warfare Warning

EWWS - Electronic Warfare Warning Set

EXCS - Exceedence Counter Set

EXT - External

F

FCC - Flight Control Computer

FF - Free Fall
Fuel Flow

FLIR - Forward Looking Radar

FLR - TGT Pod IR

FLT CONTR - Flight Control

FOV - Field-Of-View

FPM - Feet Per Minute

FTIT - Fan Turbine Inlet Temperature

FUS - Fuselage

G

GC - Gyrocompass

GCA - Ground Control Approach

GMTR - Ground Moving Target Reject

GP - General Processor (part of the MPDP)

GPM - Gallons Per Minute

GREC - Guard Receiver

GS - Ground Speed

GT - Ground Track

H

HAT - Height Above Target

HOTAS - Hands On ThrottleAnd Stick

HQ - Have Quick

HRM - High Resolution Mapping

HUD - Head-Up Display

HYD - Hydraulic

HZ - Hertz

I

IAS - Indicated Airspeed

IBS - Interference Blanker Set

ICS - Intercommunication System
Internal Countermeasures Set

ICSCP - Intercommunication Set Control Panel

IDEEC - Improved Digital Electronic Engine Control

IDG - Integrated Drive Generator

IFA - Inflight Alignment

IFF - Identification Friend or Foe

ILS - Instrument Landing System

ILSN - ILS Navigation Combination

ILST - ILS Tacan Combination

IMC - Inflight Meteorological Conditions

INC - Increase/Increment

IN CMD - In Command

INS - Inertial Navigational System

INST - Instrument (Master Mode)

INT - Internal

INTL - International

INU - Inertial Navigational Unit

INV - Invalid

INVARM - Invalid Armament

I/O - Input/Output

IP - Identification of Position

IRE - IFF Reply Evaluator

J

JETT - Jettison

JFS - Jet Fuel Starter

JMC - JTIDS Mission Code

JP - Jet Propellant

JTIDS - Joint Tactical Information Distribution System

JVC - JTIDS Voice Code

K

KCAS - Knots Calibrated Airspeed

KIK - Code Change Keyer

KIR - Interrogator Computer

KIT - Transponder Computer

KT - Knot(s)

KTAS - Knots True Airspeed

KY - Telemetry for Surveillance & Control (Prefix for Secure Radios)

L

LANTIRN - Low Altitude Navigation and Targeting Infrared for Night

LASER - Light Amplification for Simulated Emission of Radiation

LAT STK LMT - Lateral Stick Limit

LAU - Launcher

LAW - Low Altitude Warning

LCD - Liquid Crystal Display

LCFT - Left Conformal Fuel Tank

LCG - Lead Computing Gyroscope

LEDU - Left Engine Diagnostic Unit

LG - Landing Gear

LNP - LANTIRN NAV Pod

LOC - Local

LOD - Light-Off Detector

LOS - Line-Of-Sight

LOX - Liquid Oxygen

LPI - Low Probability of Intercept (TF Mode)

LRU - Line Replacement Unit

LT - Light(s)

LTP - LANTIRN TGT Pod

M

MAC - Mean Aerodynamic Center

MAG VAR - Magnetic Variation

MAN - Manual

MAX - Maximum

MEA - Minimum Enroute Altitude

MEM - Memory

MFC - Main fuel control

MHz - Megahertz

MIN - Minimum

MIT - Mass Items

MM - Millimeter

MN - Mission Navigator

MPCD - Multi-Purpose Color Display

MPD - Multi-Purpose Display

MPDP - Multipurpose Display Processor

MRM - Medium Range Missile

MSN - Mission

MSOGS - Molecular Sieve Oxygen Generating System

MUX BUS - Multiplex Bus

MWOD - Multiple Word Of the Day

N

NA - Not Applicable

NAV - Navigation

NE - Not Established

N-F - Navigation FLIR

NGS - Nose Gear Steering

NM - Nautical Mile(s)

NORM - Normal

NOZ POS - Nozzle Position Indicator

N/R - Not Ready

N_1 - Engine Rotation Rate (Fan Speed) not observed on any cockpit indicator

N_2 - Engine Rotation Rate (High Speed Compressor) as observed on the cockpit RPM indicator

O

OAT - Outside Air Temperature

OBST - Obstacle

OFLY - Overfly

OFP - Operational Flight Program (Computer Software)

OPR - Operate

ORIDE - Override

O/S - Offset

OVL - Overload

OWOFF - OWS Inoperative (HUD CUE)

OWS - Overload Warning System

P

PACS - Programmable Armament Control Set

PB - Pushbutton

PBG - Positive Pressure Breathing

P-BIT - Periodic BIT

PC - Power Control

PCAS - Pitch CAS

PC1, PC2 - Power Control hydraulic system

PDT - Primary Designated Target

PH - Phasing

PIO - Pilot Induced Oscillation

PNL - Panel

PP - Present Position

PPB - Positive Pressure Breathing

PPH - Pounds Per Hour

PPI - Planned Position Indicator

PPM - Pounds Per Minute

PPO_2 - Positive Pressure Oxygen

PRCA - Pitch/Roll Channel Assembly

PRESS - Pressure

PROG M/M - Program Master Mode

PSI - Pounds Per Square Inch

PSL - Pattern Steering Line

PTC - Pitch Trim Compensator

PVU - Precision Velocity Update

PYL - Pylon

Q

QTY - Quantity

R

R - Radar altitude (HUD cue)

RADAR - Radio Detection And Ranging

RAD ORIDE - Radio Override

RCAS - Roll CAS

RCD - Record

RCFT - Right Conformal Fuel Tank

RCP, R/C/P - Rear Cockpit

RCVV - Rear Compressor Variable Vanes

RDR - Radar

REC - Receive

REDU - Right Engine Diagnostic Unit

REM - Remaining

REQ - Required

RER - Radial Error Rate

RET - Retard

REW - Rewind

RICP - Remote Intercommunication Control Panel

RLG - Ring Laser Gyro

RLS - Reservoir Level Sensing

RMR - Remote Map Reader

RNG - Ranging/Range

RPM - Revolutions Per Minute

R/T - Receiver Transmitter

RUDR LMTR - Rudder Limiter

RV - Receive/Receiver

RWR - Radar Warning Receiver

S

SCP - Sensor Control Panel

SDR - Signal Data Recorder

SDRS - Signal Data Recorder Set

SEAWARS - Sea Water Activated Release System

SEC - Secondary (Engine Control Mode)

SEL - Select/Selection

SELECT JETT - Selective Jettison

SEQ - Sequence

SH - Stored heading

SHF - Shift

SIF - Selective Identification Feature

SP - Steering Point/Sequence Point

SPD BK - Speed brake

SRM - Short Range Missile

STBY - Standby

STR - Steer

SURF - Surface

SYM - Symbol

SYNC - Syncronize

T

T - Tacan Range Display (HUD cue)

TBS - To-Be-Supplied

TCN - TACAN

TD - Target Designator

TDC - Target Designator Control

TEWS - Tactical Electronic Warfare System

TF - Terrain Following

T_{go} - Time-To-Go

TGT - Targeting Pod (LANTIRN)

TITL - Titling/Title

T/O - Takeoff

TOA - Time-Of-arrival

TOD - Time-Of-day

TOF - Time-Of-Flight/Fall

TOT - Time-On-Target

TOT TEMP HI - Total Temperature High (Caution Light)

TPC - Tactical Pilotage Chart

TR - Transformer Rectifier(s)

TRANS - Transfer

TRNG - Training

TSD - Tactical Situation Display

TX - Transmit

U

UFC - Upfront Control

UNC - Uncage

UPDT - Update

URT - Utility Radio Transmitter

UTL - Utility Hydraulic System

UTM - Universal Transverse Mercator

V

V_C - Closing or opening velocity

VI - Visual Identification

VID - Video

VLC - Very Low Clearance

V_{MAX} - Maximum Velocity

VTRS - Video Tape Recorder System

VVI - Vertical Velocity Indicator

VV OFF - Vertical Velocity invalid (HUD cue)

W

WNG - Wing

WOD - Word-Of-the-Day

WOW - Weight-On-Wheels

WSO - Weapon System Officer

WX - Weather (TF mode)

X

XFER - Transfer

Y

YCAS - Yaw CAS

Z

ZM - Zoom

ZOC - Zone-Of-Confusion

ALPHABETICAL INDEX

I

J

K

L

M

N

O

P

Q

R

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