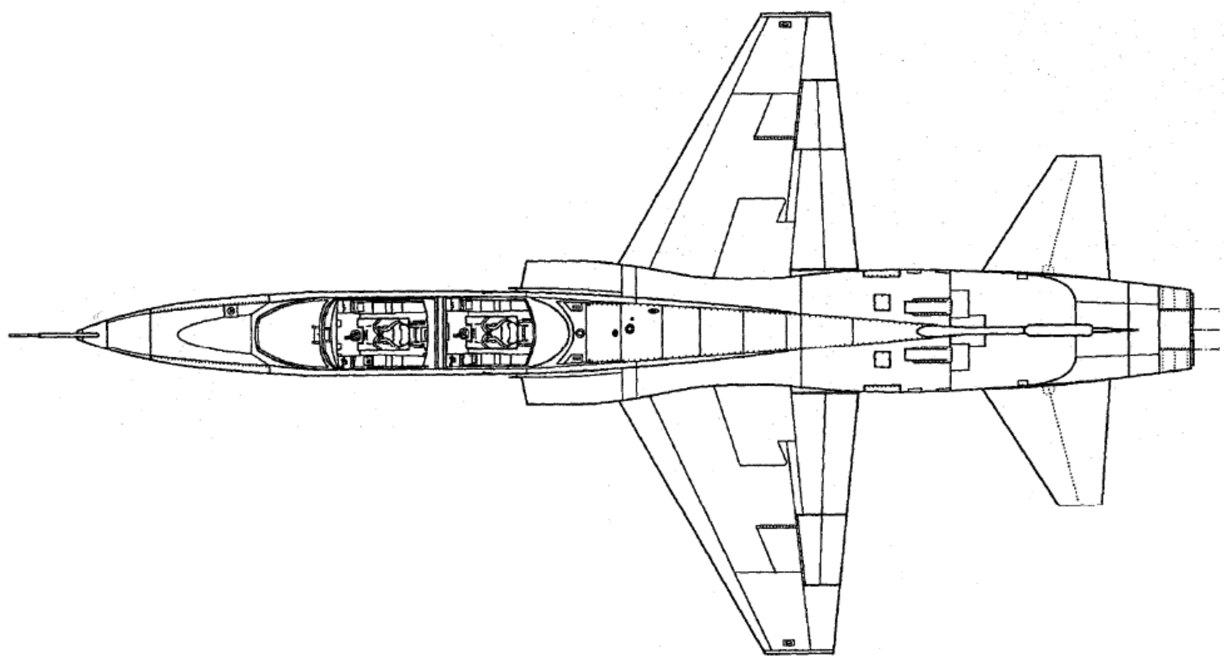
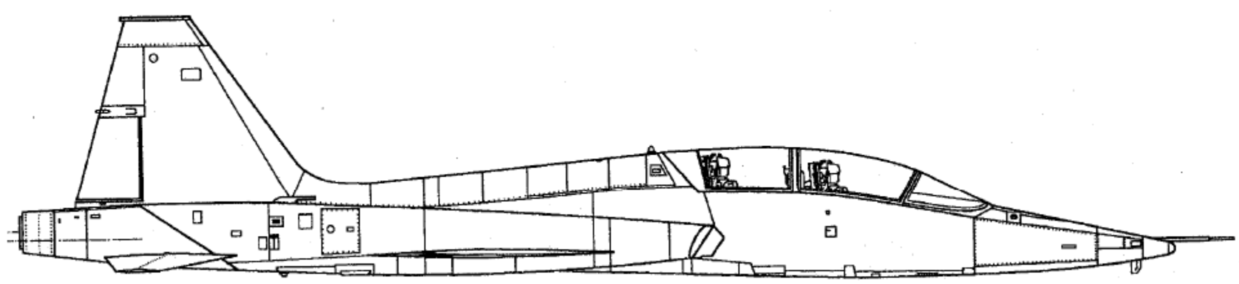
Military Visualizations Northrop T-38A





Pilot's Operating Handbook

Version 1.1

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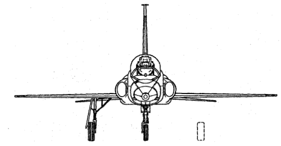

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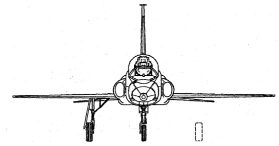

SECTION 1
DESCRIPTION

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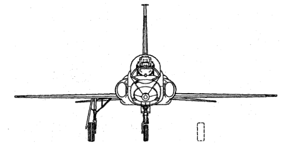

DESCRIPTION

THE AIRCRAFT

The T-38A is a two-placed, twin turbojet supersonic advanced trainer developed by Northrop Corporation, Aircraft Division. Each cockpit contains an individual jettisonable canopy and ejection seat. A cabin air-conditioning and pressurization system conditions and pressurizes the air in both cockpits. The fuselage is an area-rule (coke bottle) shape, with moderately swept-back wings and empennage. The aircraft is equipped with an all-moveable horizontal tail. A speed brake is located on the lower surface of the fuselage center section. The tricycle landing gear has a steerable nosewheel. All flight control surfaces are fully powered by two independent hydraulic systems. There are no provisions for external stores. See figure 1 for structural locations and descriptions.

Note

This MilViz T-38A was designed to strongly replicate the flight characteristics of the real world jet. MilViz highly recommends that the virtual pilot set the FSX realism settings to "hard" to avoid compromise of the flight model.

The real world jet features a characteristic shudder and buffet sound as the jet approaches higher angle of attack. The MilViz T-38A replicates this aerodynamic effect. At an angle of attack of 0.45 units (as shown on the AoA meter), the jet experiences a slight vibration sound from early onset of wing buffet. Then, at 0.55 to 0.68 units, the volume of the wing buffet increases and the jet starts to vibrate. At 0.75 units until stall at 1.0 unit, the jet's sound buffet and vibration increases in volume and severity as stall approaches.

AIRCRAFT DIMENSIONS

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

Length ………………………………………. 46ft 4in
Wingspan ………………………………… 25ft 3in
Height ………………………………………. 12ft 11in
Tread ………………………………………. 10ft 9in
Wheelbase ………………………………. 19ft 5in

AIRCRAFT GROSS WEIGHT

The average gross weight of the aircraft fully fueled and including two aircrew is 12,000 pounds.

CUTAWAY AIRCRAFT DRAWING

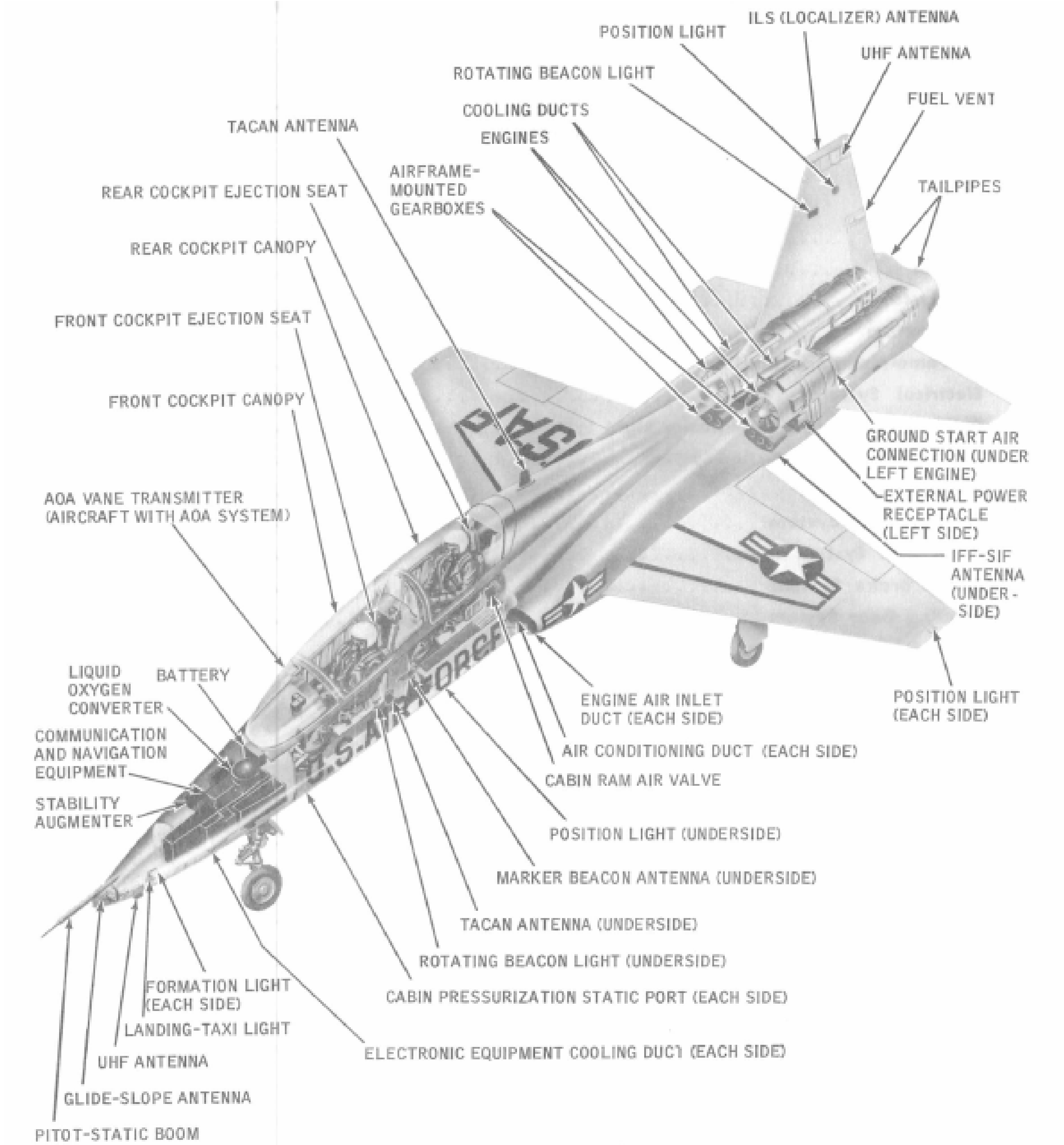

Figure 1

CUTAWAY ENGINE DRAWING

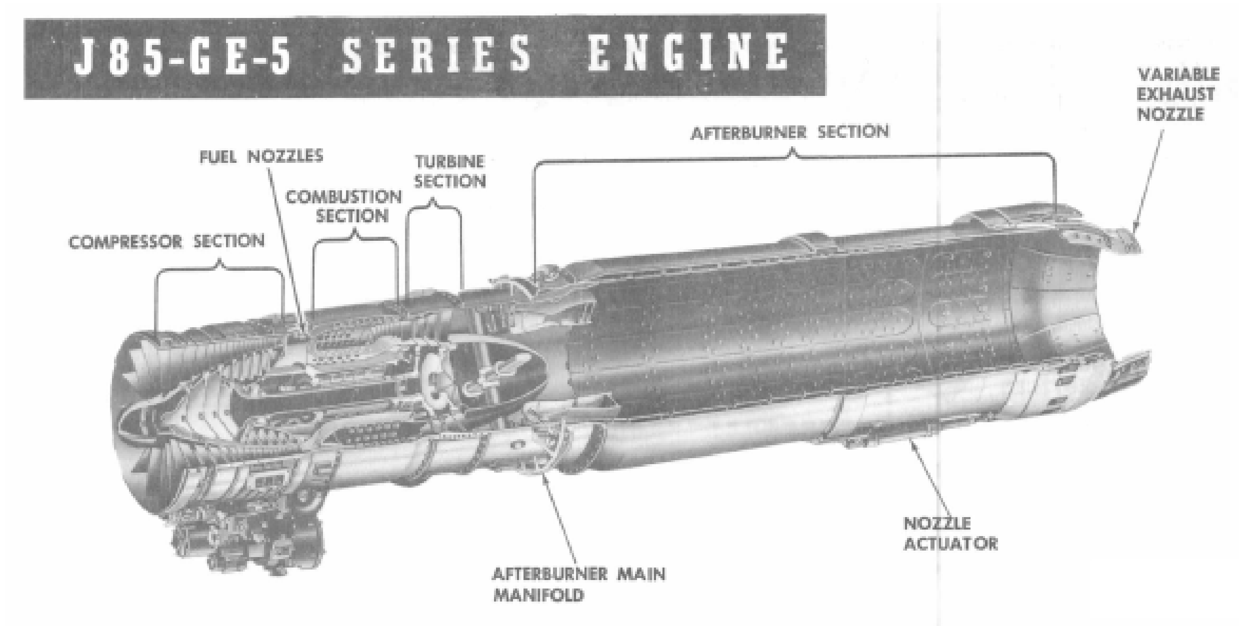

Figure 2

ENGINE DESCRIPTION

The aircraft is powered by two J85-GE-5 series, eight-stage, axial-flow, turbojet engines. Sea level, standard day, static thrust for an uninstalled engine is 2,680 pounds of thrust at maximum military power and 3,850 pounds of thrust at full maximum afterburner power. Air enters through the variable inlet guide vanes, which direct the flow of air into the compressor. The automatic positioning of the inlet guide vanes and air bleed valves assist in regulating compressor airflow to maintain compressor stall-free operation. Two turbine wheels and the compressor rotor stages are mounted on the same shaft. The exhaust gases are discharged through a variable area exhaust nozzle. An exhaust gas temperature sensor system varies the nozzle area to maintain exhaust gas temperature within limits at both military and afterburner throttle positions.

ENGINE FUEL CONTROL SYSTEM

Each engine has a main fuel control system and an afterburner fuel control system. The main fuel control system consists primarily of a two-stage engine-driven pump, a main fuel control, and an overspeed governor.

MAIN FUEL CONTROL

The main fuel control selects engine power by metering fuel to the main engine combustor as a function of throttle position, engine inlet air temperature, compressor discharge pressure, and engine speed. The control performs the following functions automatically:

a. Regulates engine speed at the selected throttle position, limits engine minimum speed at idle and engine maximum speed at military and afterburner range power.

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

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

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

AFTERBURNER SYSTEM

Each afterburner system contains an igniter plug, afterburner pilot manifold, afterburner main manifold, and afterburner fuel pump and control. Afterburner operation is initiated by advancing the throttle from the MIL detent into the MAX range. Thrust is variable within MAX range. The total rate of fuel flow at full MAX position for each engine at sea level on a standard day is approximately 7,300 pounds per hour with the aircraft at rest and 11,400 pounds per hour at Mach 1.

AFTERBURNER FUEL CONTROL

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

THROTTLES

The throttles are provided with a roller ramp-type force gradient, which must be overcome to move the throttles from MIL to MAX range or from IDLE to OFF. The throttles in the front cockpit are equipped with finger lifts which must be raised before the throttles in either cockpit can be retarded past the IDLE roller ramp to OFF. To start the engine, the associated throttle must be moved out of the OFF position by clicking the finger lift to move it to IDLE setting. To shut an engine down, move the associated throttle to the OFF position.

ENGINE START AND IGNITION SYSTEM

Engine starts require compressor motoring (low pressure air supply) and ac power for ignitor firing. Two engine start push buttons (see Figure 8) are located in the left sub panel of each cockpit. For ground starts only, a diverter valve is automatically positioned to direct air to the selected engine. To start each engine, left click the finger lift switch to park the throttle in the IDLE position. Note: The engines cannot be started with the throttles in the OFF position. Momentarily pushing a start button positions the diverter valve and arms the ignition circuit for approximately 30 seconds or until the engine is on speed.

OIL SYSTEM

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

FUEL SYSTEM

The aircraft has an independent fuel supply system for each engine interconnected by a DC electrically operated crossfeed valve (see figure 3). The left and right system fuel cells are in the fuselage. The left engine is supplied by the forward fuselage cell and the forward and aft dorsal cells; the right engine, by the center and aft fuselage cells. A single AC electrically driven fuel boost pump in each system supplies fuel under pressure to the engine-driven fuel pump during normal operation. The left system boost pump is in the inverted flight compartment of the forward fuselage cell, and the right system boost pump is in the inverted flight compartment of the aft fuselage cell. Without the aid of the boost pumps, each engine can be supplied with gravity feed fuel. Normally, sufficient fuel will flow by gravity to maintain MAX power settings up to 25,000 feet. However, gravity fuel flow is only guaranteed to 6,000 feet and flameouts have occurred as low as 15,000 feet. With crossfeed operation both systems may supply fuel to either engine with or without boos pump pressure. Caution lights indicate low fuel level and low fuel pressure.

BOOST PUMP SWITCHES

Two red guarded boost pump switches are located on the right sub panel of the front cockpit. All fuel pump circuit breakers should be closed before operating the boost pumps.

FUEL SHUTOFF SWITCHES

Two red guarded fuel shutoff switches are located on the left sub panel of the front cockpit. The fuel shutoff valves operate off DC power and are normally controlled by the throttles with the shutoff switches placed in the NORMAL position. Placing either or both of the switches in the CLOSED position shuts off fuel flow to their respective engines in approximately one second.

CAUTION

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

FUEL QUANTITY INDICATORS

Two fuel quantity indicators, one for each fuel system, are located on each instrument panel. The indicators operate on AC and indicate in pounds the total usable fuel quantity in each fuel supply system.

FUEL SYSTEM ILLUSTRATION

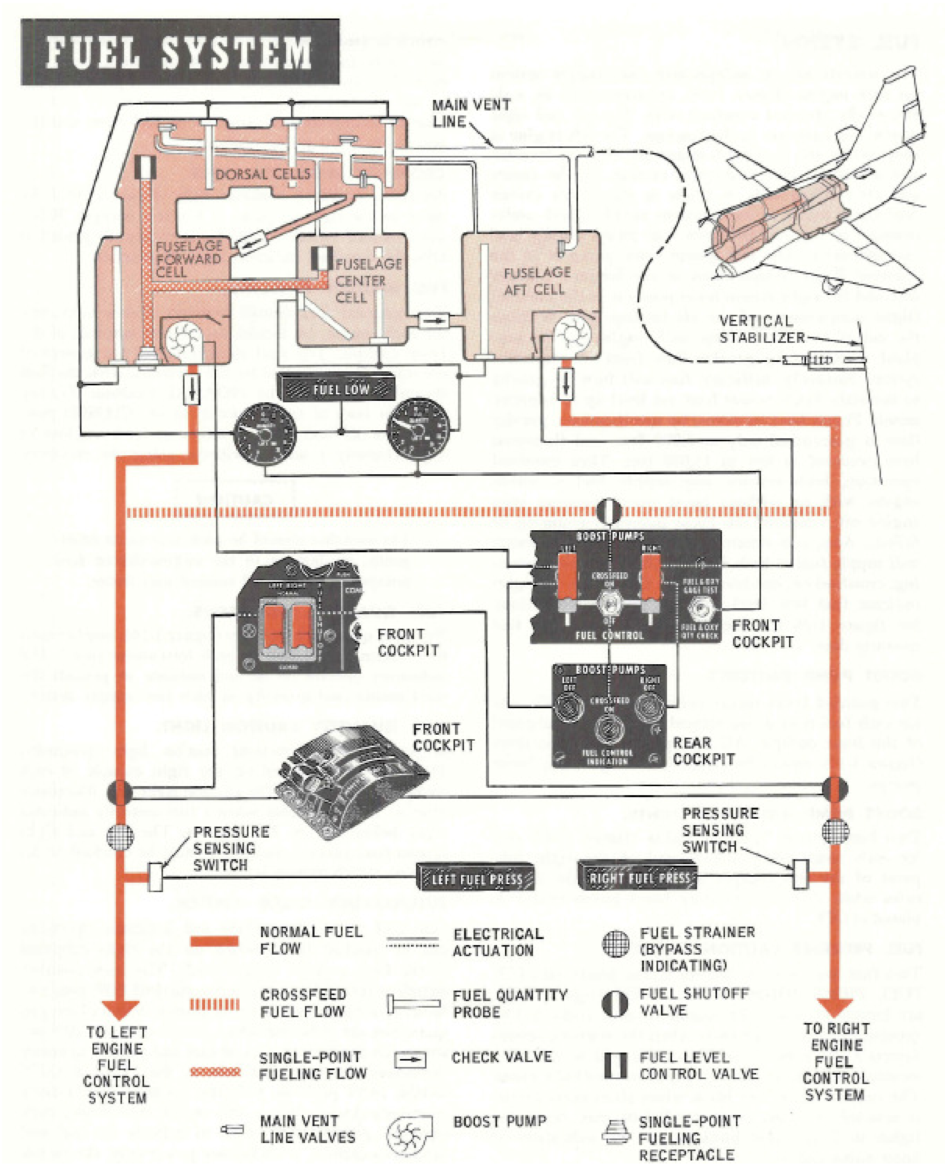

Figure 3

ELECTRICAL SYSTEMS

Two alternating current systems and one direct current system supply electrical power to the aircraft. The 115/200 volt AC power supply system consist of two identical engine-driven AC generating systems and an external power receptacle. The DC power supply system consists of a DC bus powered either by a 24-volt, 5-ampere-hour battery or two 28-volt DC transformer-rectifiers.

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

The DC power is normally obtained through two transformer-rectifiers, which convert AC to DC power. If one transformer-rectifier fails, the other automatically supplies all DC power requirements. If both transformer-rectifiers fail, the master caution light on the instrument panel and the XFMR RECT OUT (MXFR RECT OUT on 14-module panel) light on the right console will illuminate. Under this condition, the DC bus will revert to battery power.

Note

The XFMR RECT OUT and master caution light may blink due to surge current developed by a high battery voltage overriding the DC bus voltage. This is a normal condition and does not indicate a failure.

GENERATOR SWITCHES AND CAUTION LIGHTS

Each generator is activated by a red guarded generator switch, both located on the right sub panel in the front cockpit. Also, generator caution lights are located on the right console of each cockpit. A caution light will illuminate when its generator switch is placed in the OFF position, or when a generator malfunction is detected.

BATTERY SWITCH

A battery switch is located on the right sub panel of the front cockpit. Placing the switch in the ON position connects the battery to the DC bus. Under normal flight conditions, the battery switch should remain in the ON position to permit the battery to charge. A minimum battery voltage of 18 volts is required to close the battery relay.

STATIC INVERTER

A static inverter, powered by the DC bus, converts 28-volt DC to 115-volt AC power. The inverter, when activated, provides an alternate source of AC power for the following:

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

b. Operation of the right engine autosyn instruments during start of right engine.

c. Fuel and oxygen quantity indicators.

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

CAUTION LIGHT PANEL

A 14- or 10-capsule word caution light panel is located on the right console of each cockpit, and is provided to alert the crew member of individual system malfunction or status change. The 14-capsule panel has 4 spare capsules. All capsule caution lights are yellow. Each caution light except the ENG ANTI-ICE ON light will remain illuminated as long as the malfunction exists or system status is unchanged. The caution lights will not go out if the master caution light is rearmed. The ENG ANTI-ICE ON light will illuminate when the engine anti-ice switch is turned on. Refer to the description of aircraft systems for operation of the applicable caution lights.

Note

Aircraft with a 10-capsule panel may be modified to a 14-capsule caution light panel when the 10-capsule panel requires replacement.

MASTER CAUTION LIGHT

A master caution light, placarded MASTER CAUTION, is located on each instrument panel. When a light illuminates on the caution light panel, the master caution light will also illuminate. When the condition is corrected, the master caution light will automatically go out, but if the condition cannot be corrected, the master caution light may be pressed, causing it to go out and rearming it to provide warning of subsequent malfunctions. There is also a three position switch on the right console of each cockpit to put the caution lights on dim or bright, plus also a test function.

FIRE WARNING AND DETECTION SYSTEM

A fire warning and detection system is provided to give the crewmember a warning of a fire or overheat condition in either engine bay. The system includes a temperature-sensing loop in the forward and aft section of each engine bay. A left engine and right engine fire warning light is located on the right and left sides respectively of the instrument panel. Placing the master caution indicator light switch in the TEST position will illuminate both fire warning lights.

ELECTRICAL SYSTEM ILLUSTRATION

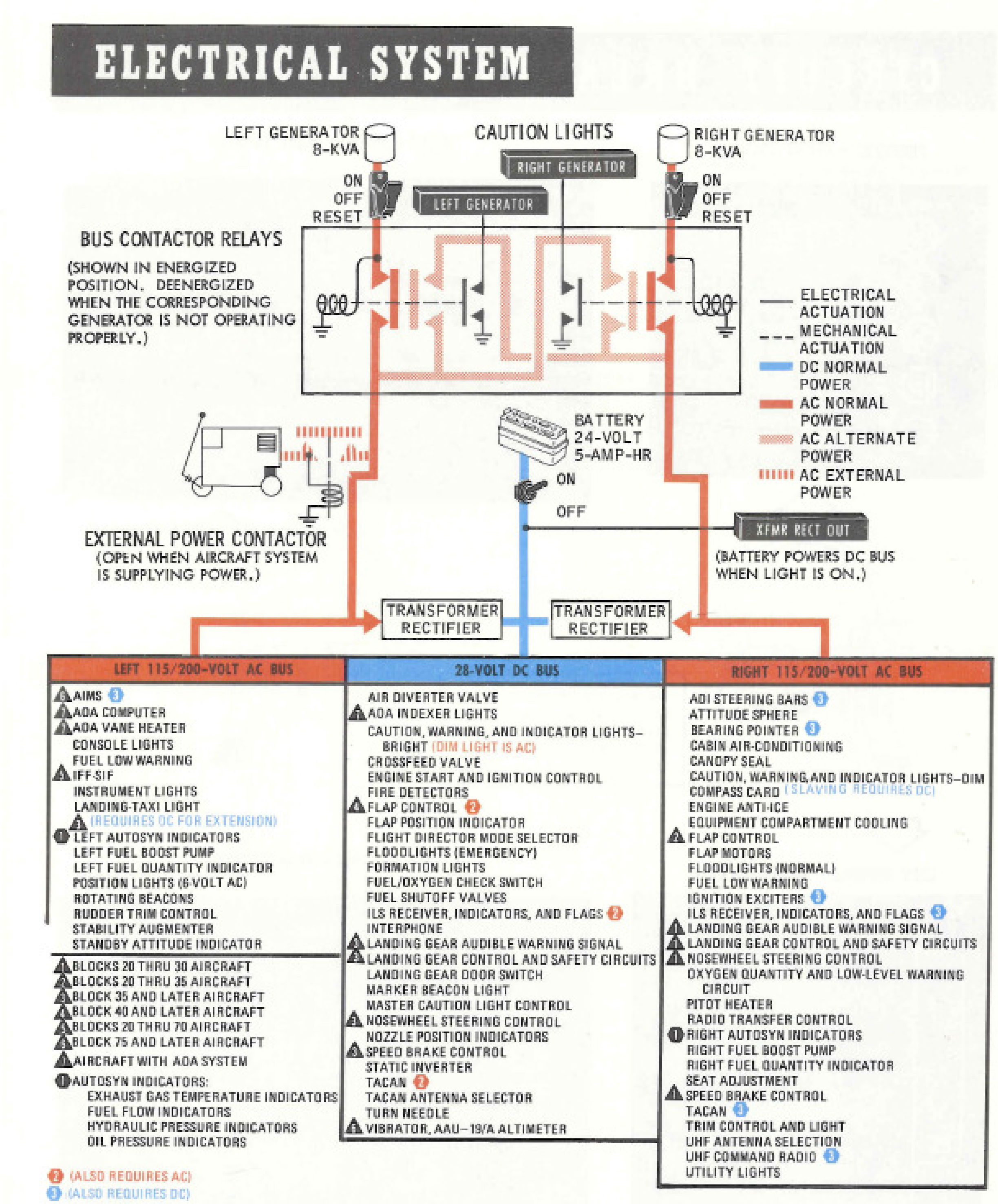

Figure 4

COCKPIT ILLUSTRATIONS

The following cockpit illustrations serve as an overview of instrument and avionic locations. For detailed operation instructions and functionality see Section 7, Systems Operation.

COCKPIT – FRONT

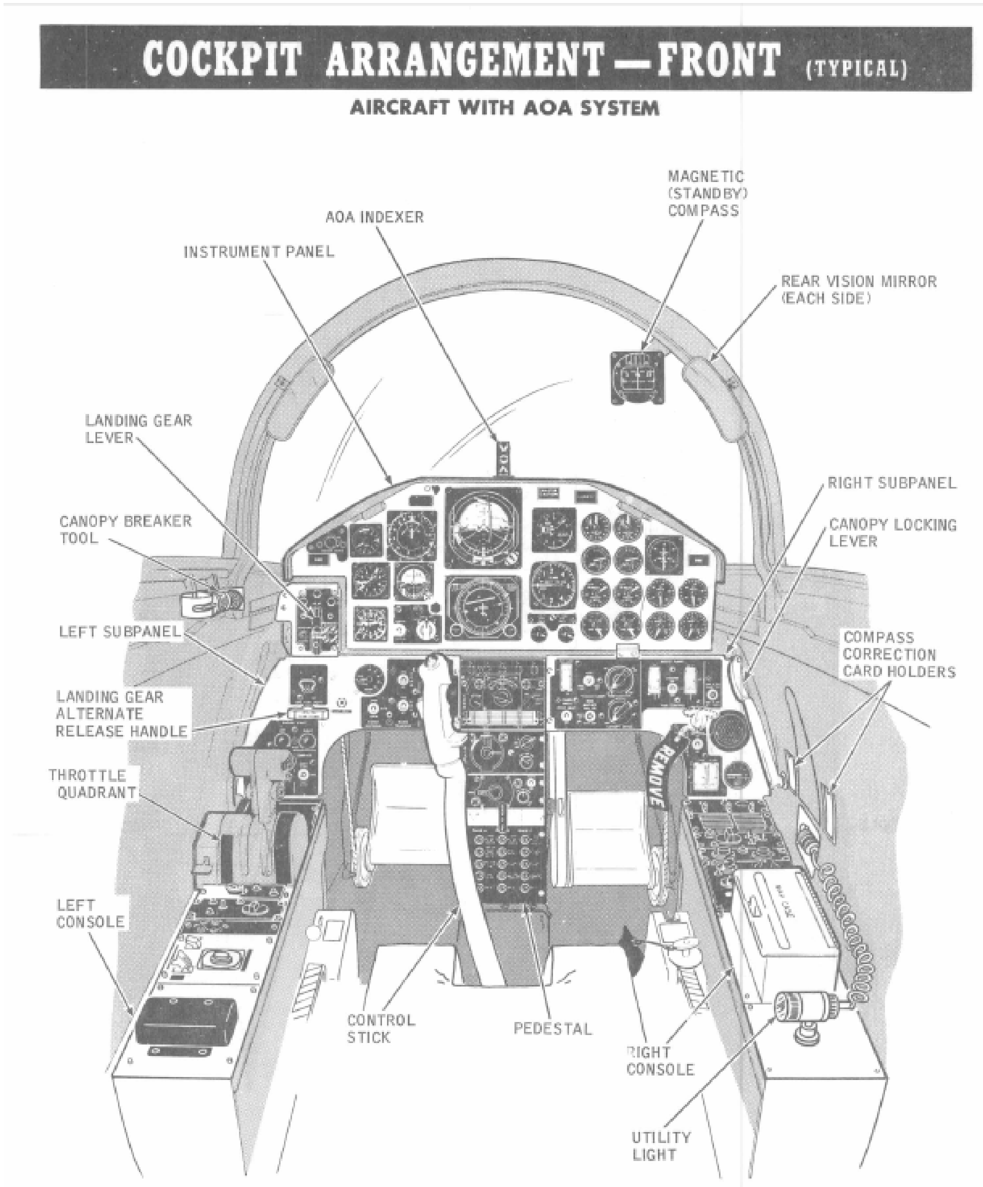

Figure 5

COCKPIT – REAR

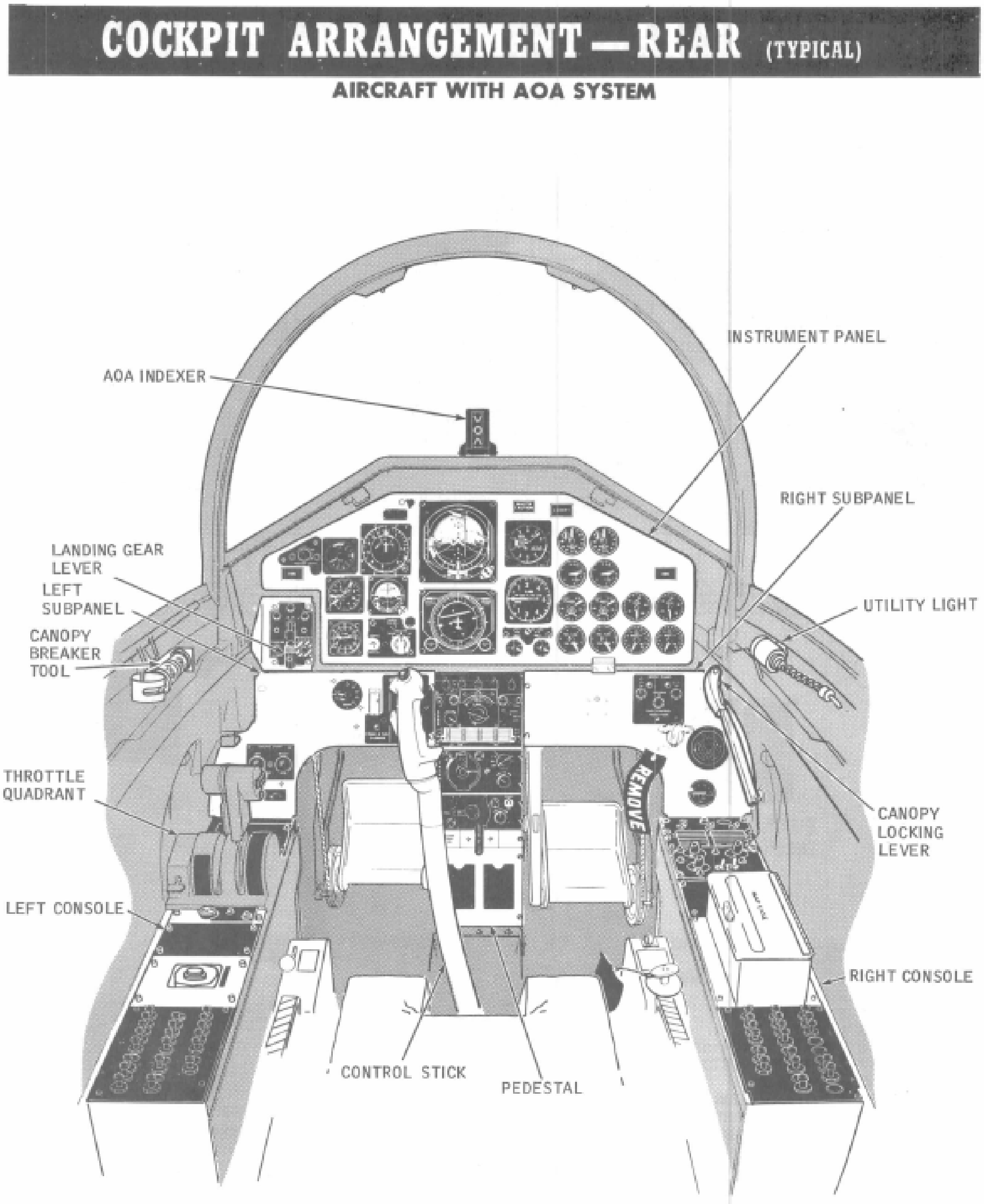

Figure 6

COCKPIT – INSTRUMENT PANEL

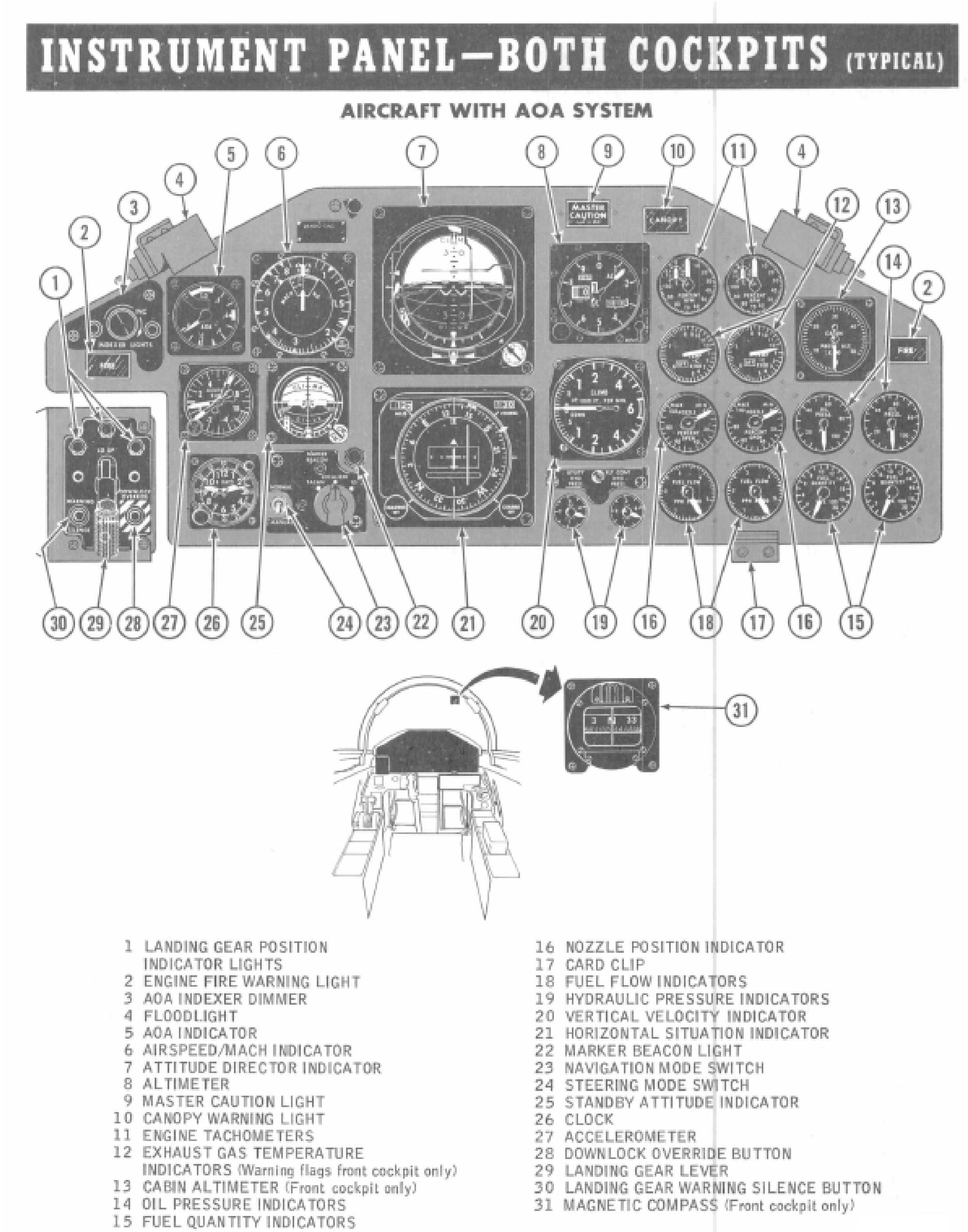

Figure 7

COCKPIT – SUBPANELS FRONT

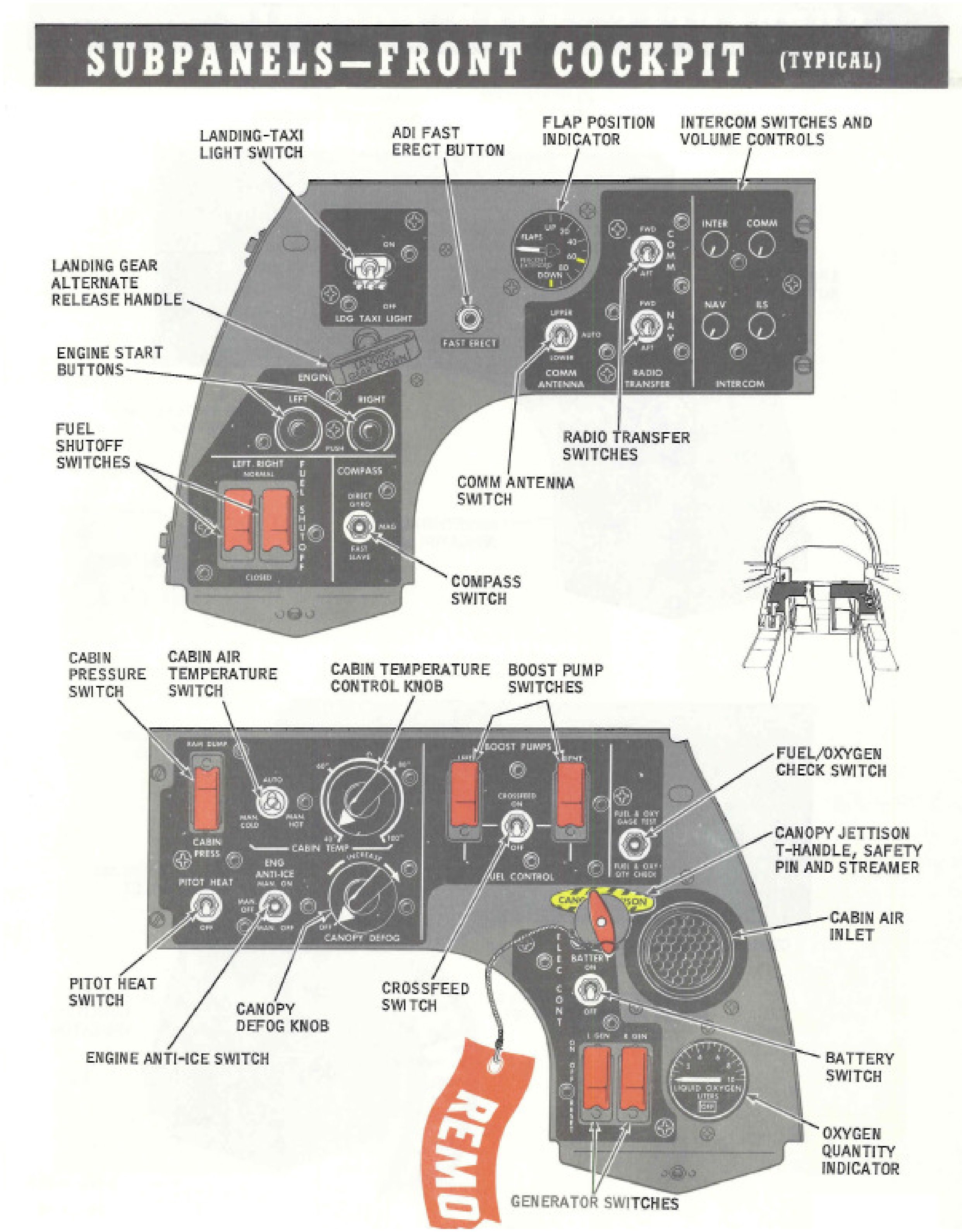

Figure 8

COCKPIT – SUBPANELS REAR

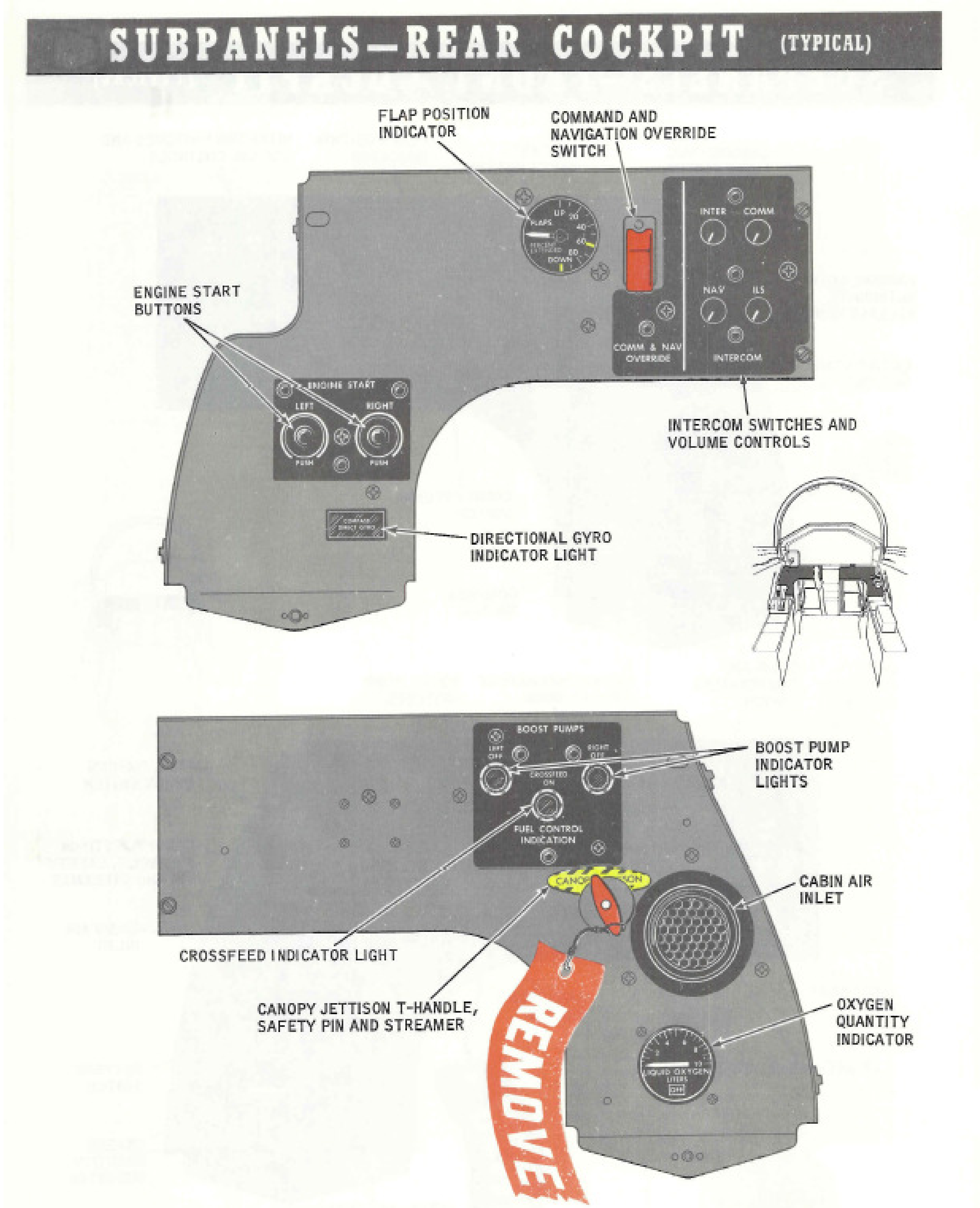

Figure 9

COCKPIT – CONSOLE PANELS FRONT

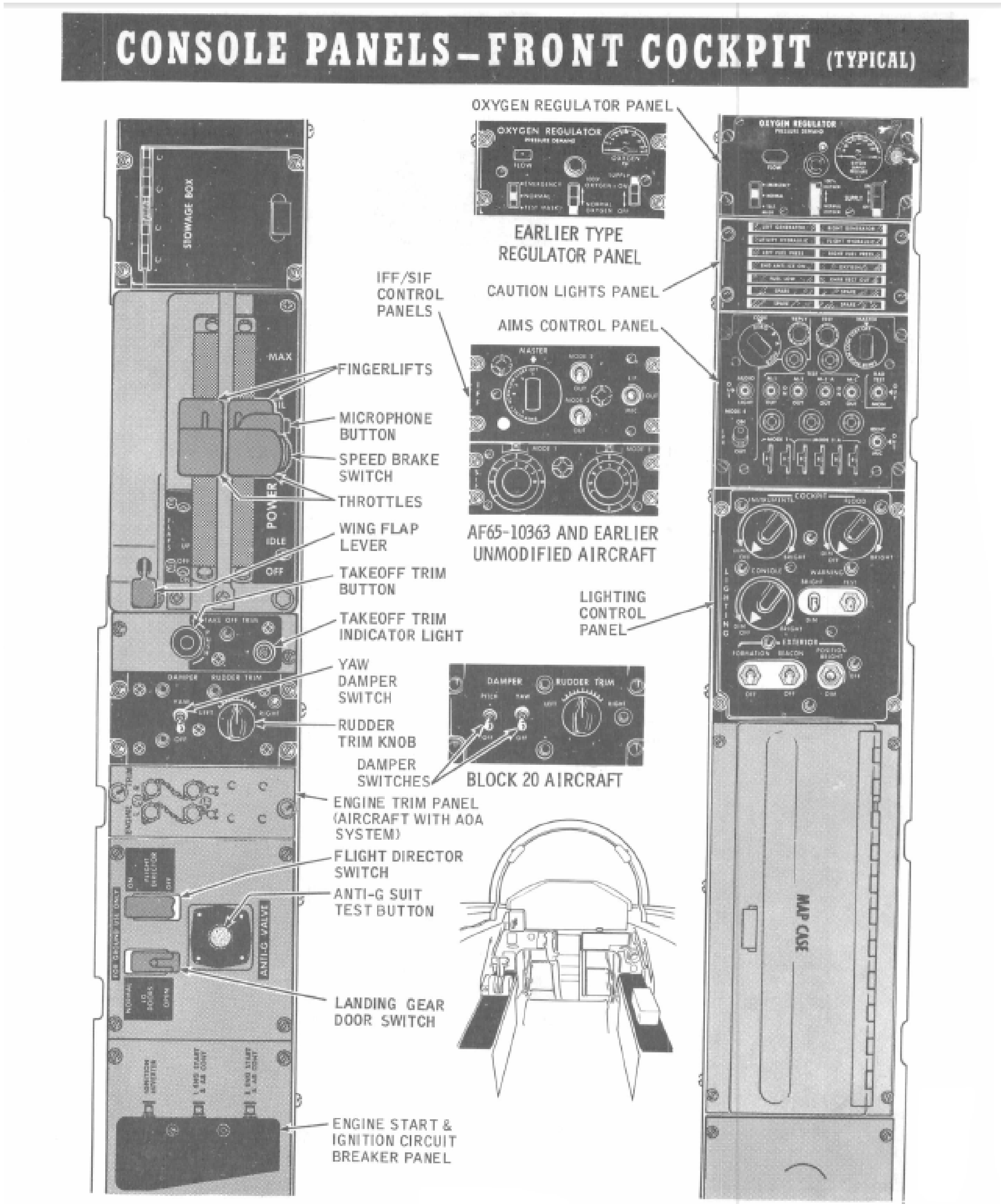

Figure 10

COCKPIT – CONSOLE PANELS REAR

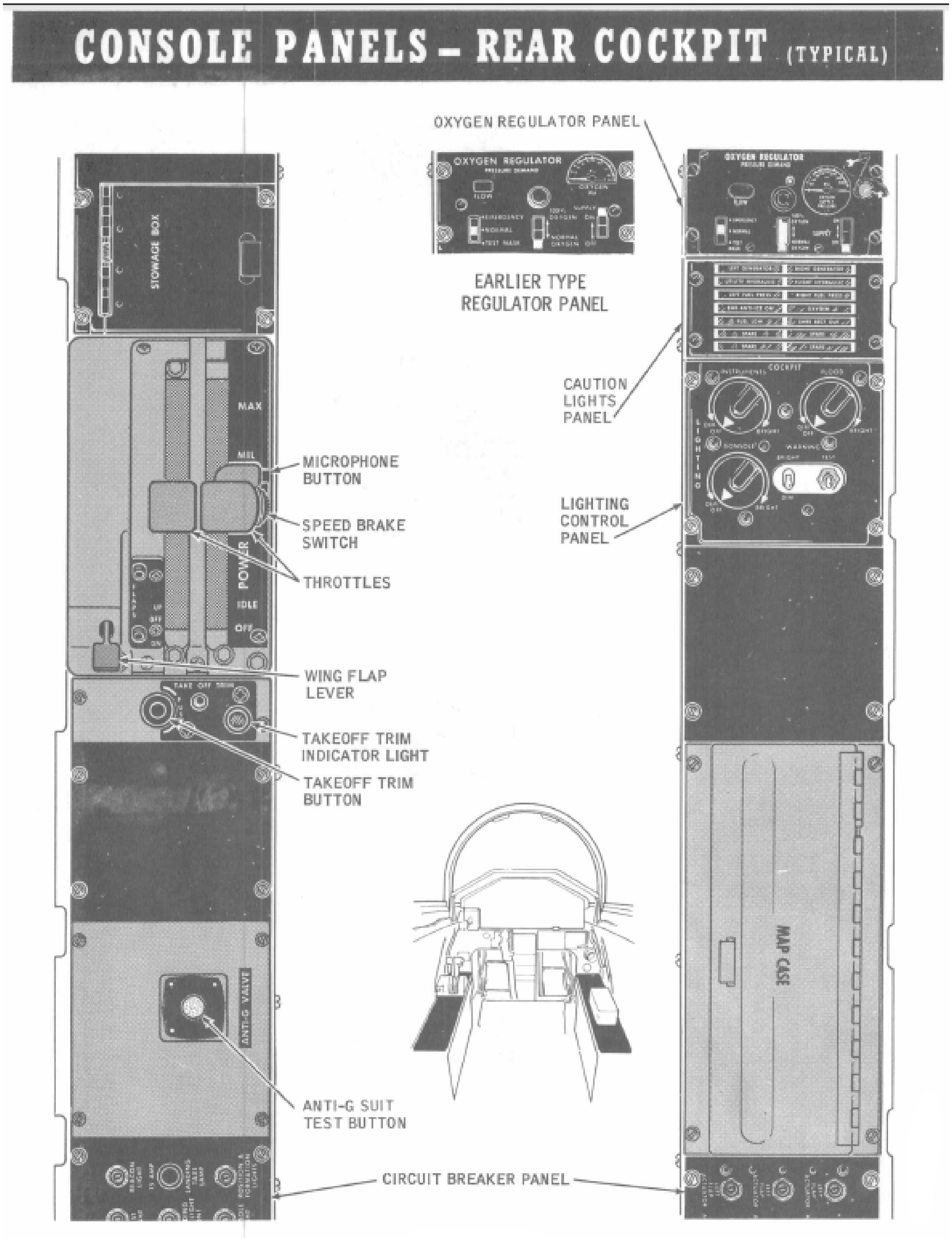

Figure 11

COCKPIT – PEDESTALS

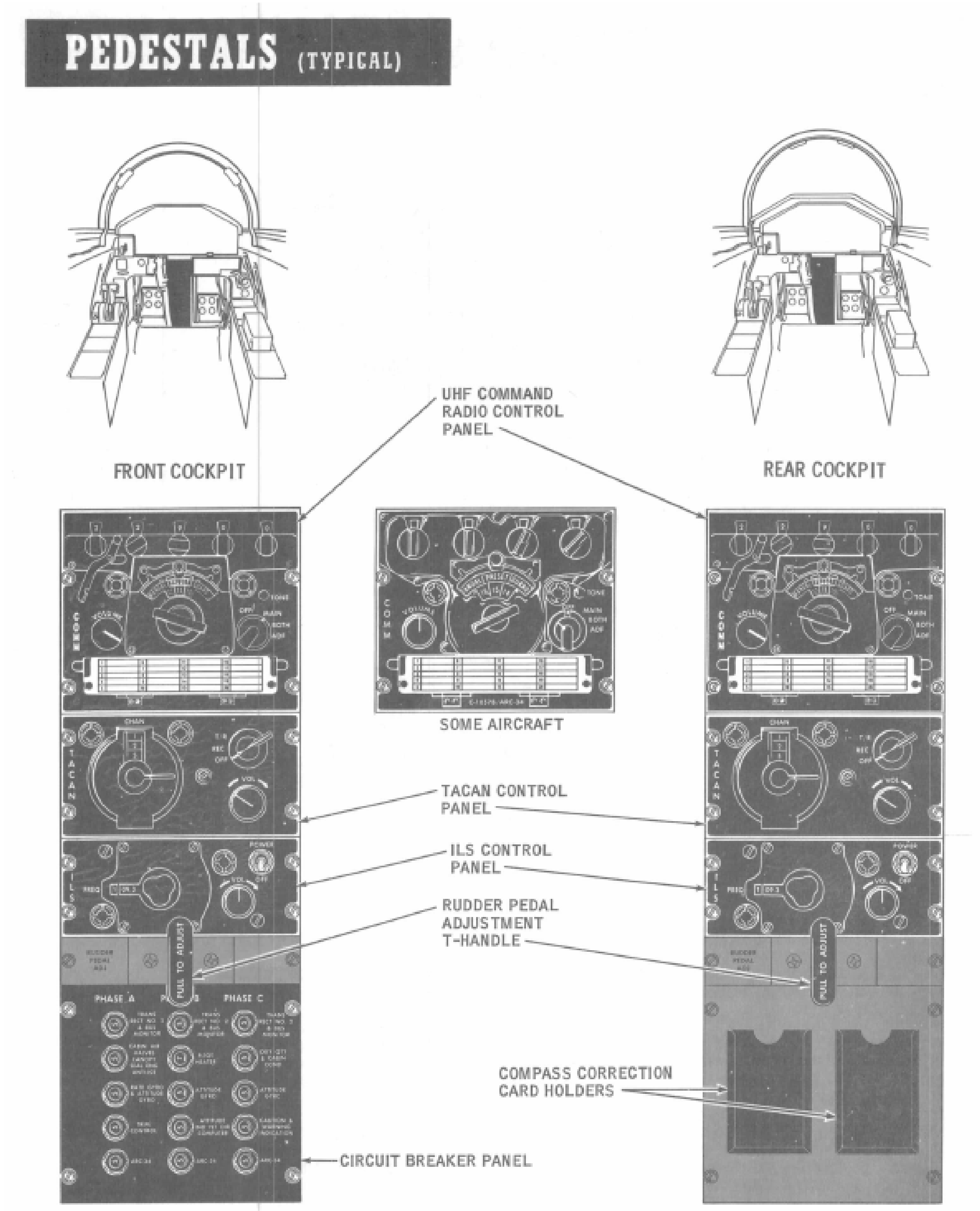

Figure 12

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AIRCRAFT TRIM SYSTEMS

The MilViz T-38A features a rudder trim system, but does not feature an autopilot. In addition there is a takeoff trim button and indicator light that allows the pilot to quickly optimize flight control surface trim for normal weight takeoffs. The jet's rudder trim switch and takeoff trim button and indicator light are located on the left console of each cockpit.

WING FLAP SYSTEM

The MilViz T-38A features a three position flaps system, fully retracted, 60 percent extended, and 100 percent extended. The wing flaps are electrically controlled by a flap lever located on the left side of the instrument panel on both cockpits. Two AC electric motors operate the flaps through gear reduction units. The flaps are interconnected by a rotary flexible shaft. If one flap motor fails, both flaps are actuated through the rotary shaft. Full flap extension or retraction takes from 10 to 17 seconds. Flaps are mechanically interconnected to the horizontal tail. The flap-to-horizontal tail interconnecting linkage moves the tail trailing edge down as the flaps are lowered, and moves the trailing edge up as the flaps are raised. This coordinated movement reduces aircraft trim changes as the flaps are lowered or raised.

The wing flaps also feature a position indicator gauges located adjacent the flap lever on the left side of the instrument panel on both cockpits.

SPEED BRAKE SYSTEM

An electrically controlled, hydraulically actuated speed brake is located on the lower surface of the fuselage center section. The MilViz T-38A speed brake is a two position type, fully retracted or fully extended. Full transit, up or down, normally takes approximately 4 seconds. At high speeds, the speed brake may not fully open, but as airspeed decreases, the speed brake will move to the fully extended position. Speed brake operation will require mapping the keyboard command to a controller of choice.

LANDING GEAR SYSTEM

Extension and retraction of the landing gear and gear doors are powered by the utility hydraulic system, and electrically controlled by the landing gear levers (one located in both the front and rear cockpits). Landing gear cycling normally takes approximately 6 seconds. The normal landing gear cycle may be reversed at any time. The normal extension sequence is doors open, gear extends, doors close. The retraction sequence is doors open, gear retracts, doors close.

The T-38A also features an alternate release and pump handle that allows the pilot to extend the gear in the event of hydraulic electrical failure of the primary gear operating system. To activate, the pilot pulls the handle to de-energize the normal landing gear hydraulic and electrical systems. This permits the gear to extend by its own weight. The handle must be held in the fully extended position (approximately 10 seconds) until all three gears are unlocked. Extension of the main and nose landing gear will require approximately 15 seconds, but may take up to 35 seconds. If gear alternate extension was accomplished with the gear lever at LG UP, the lever must be placed at LG DOWN and then returned to LG UP to reactivate the normal system. When the alternate gear release handle is used due to failure of the normal system, then the normal gear lever should be left in the LG UP position and the gear should not be raised.

Note

If the gear is lowered by the alternate release handle with the landing gear in the LG UP position, the red light in the landing gear lever will remain illuminated. In this situation, the illuminated red light indicates the gear door open condition normally associated with the gear retraction cycle. The landing gear green indicator lights will be illuminated and the warning signal silent, indicating a positive gear down and locked condition.

If any of the gear green indicator lights remain extinguished for more than 35 seconds after the alternate handle is pulled, several recycles in a pumping action may be required before the green illumination lights indicate an extended and locked position.

LANDING GEAR LEVER, WARNING SYSTEM, AND SYSTEM SILENCE HORN

A landing gear lever is located on the left side of the instrument panel in both cockpits. The two position levers are mechanically interconnected. A warning system consisting of an intermittent tone (beeper), audible through the headset of the crewmember, and a red light within the wheel-shaped end of each landing gear lever will be activated if the landing gear is in transit, or a gear failure condition is noted, or the gear is retracted and the following conditions exist:

a. The airspeed is 210 KIAS or less.
b. The altitude is 9,400 feet or below.
c. Both throttles are below 96%.

When airspeed is decreasing, the system is activated in the range of 210 to 180 KIAS. With the system activated and the aircraft accelerating, the light and tone may not go out until speed reaches approximately 240 KIAS. A landing gear warning silence button is located on the instrument panel adjacent each gear lever. Pressing either button silences the audible warning signal. The following graphics show the relationship of these light indications to gear status:

Gear Down and Locked

Gear Up and In Transit

Gear Up and Locked

Gear Down and In Transit

LANDING GEAR POSITION INDICATOR LIGHTS

Three landing gear position indicator green lights are located adjacent the landing gear lever on each cockpit. These three lights illuminate when the gear is down and locked. They extinguish when the gear is retracted.

NOSEWHEEL STEERING SYSTEM

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

WHEEL BRAKE SYSTEM

The main gear wheel brakes are the segmented rotor type, and are powered by a separate and completely self-contained hydraulic system. The brake pedals are the conventional toe-operated type using the top pivot portion of the rudder pedals. Each brake pedal controls a hydraulic master cylinder. Control of the brakes transfers to the crewmember applying the greater pedal force.

PITOT-STATIC SYSTEM

The pitot-static system supplies both impact (ram) and static air pressure to the airspeed-mach indicator, the airspeed compensator of the stability augmentation system, and the airspeed and altitude pressure switch assembly that connects into the landing gear warning circuits. The altimeter and vertical velocity indicator receive only static pressure from the system.

CANOPY

Each cockpit contains a manually operated clamshell type canopy. The canopy is locked closed or unlocked by an individual locking lever in each cockpit, or by individual locking handles outside the left side of the front cockpit (see figure 13). Each canopy is counterbalanced throughout its travel limits. The canopy opening mechanism is protected against excessive loads by a hydraulic canopy damper, which also restricts canopy opening and closing speeds. An inflatable pressurization seal installed on each canopy is inflated when both canopies are locked, the cockpit pressure switch is in the CABIN PRESS position, and an engine is operating.

CAUTION

- The canopy should always be assisted through opening with hand pressure applied at the frame.
- Either the canopy external or internal locking handle is to be used to actuate the locking mechanism only. If the handle is used to raise or lower the canopy, damage to the mechanism may result.

CANOPY CONTROLS

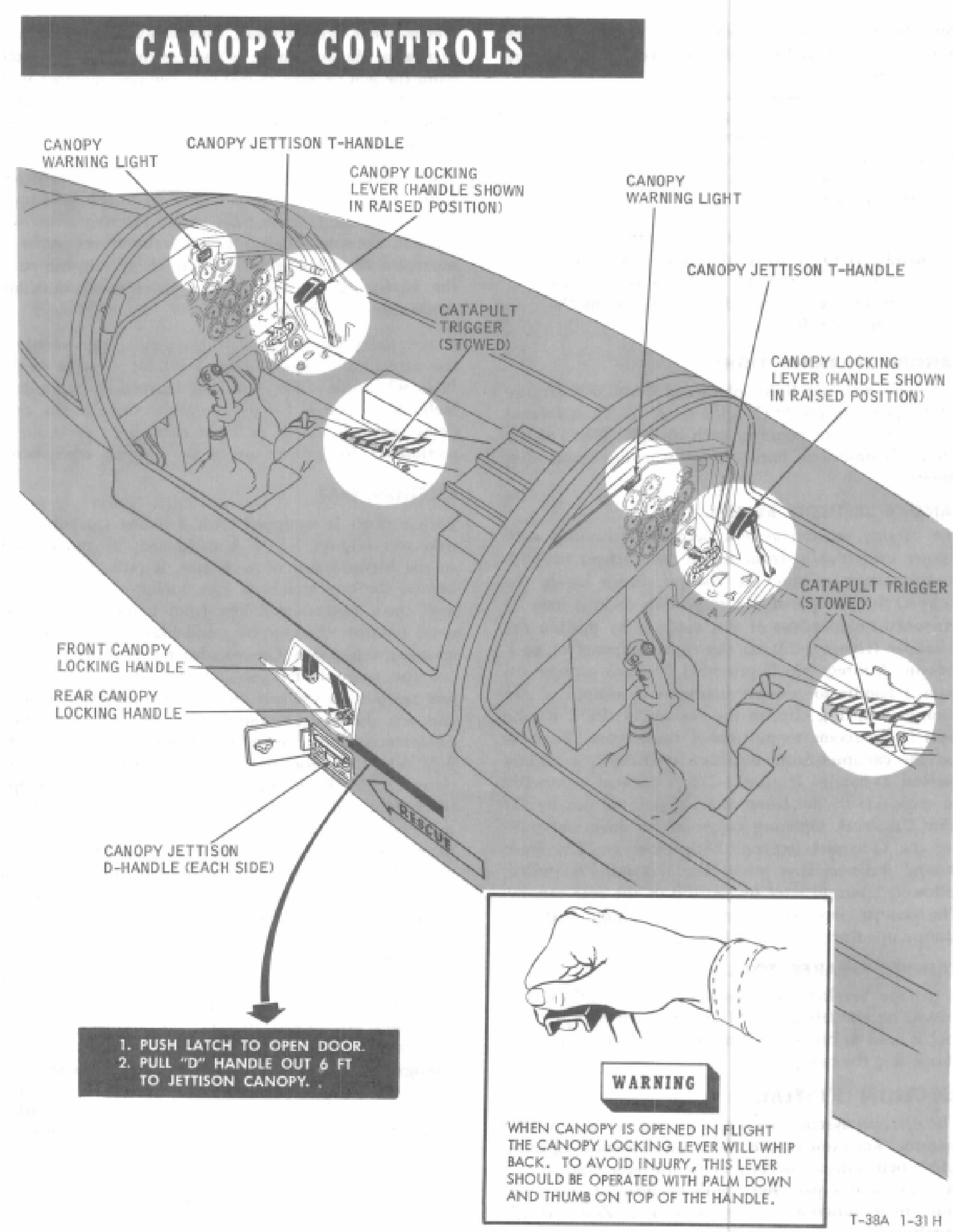


Figure 13

SERVICING DIAGRAM

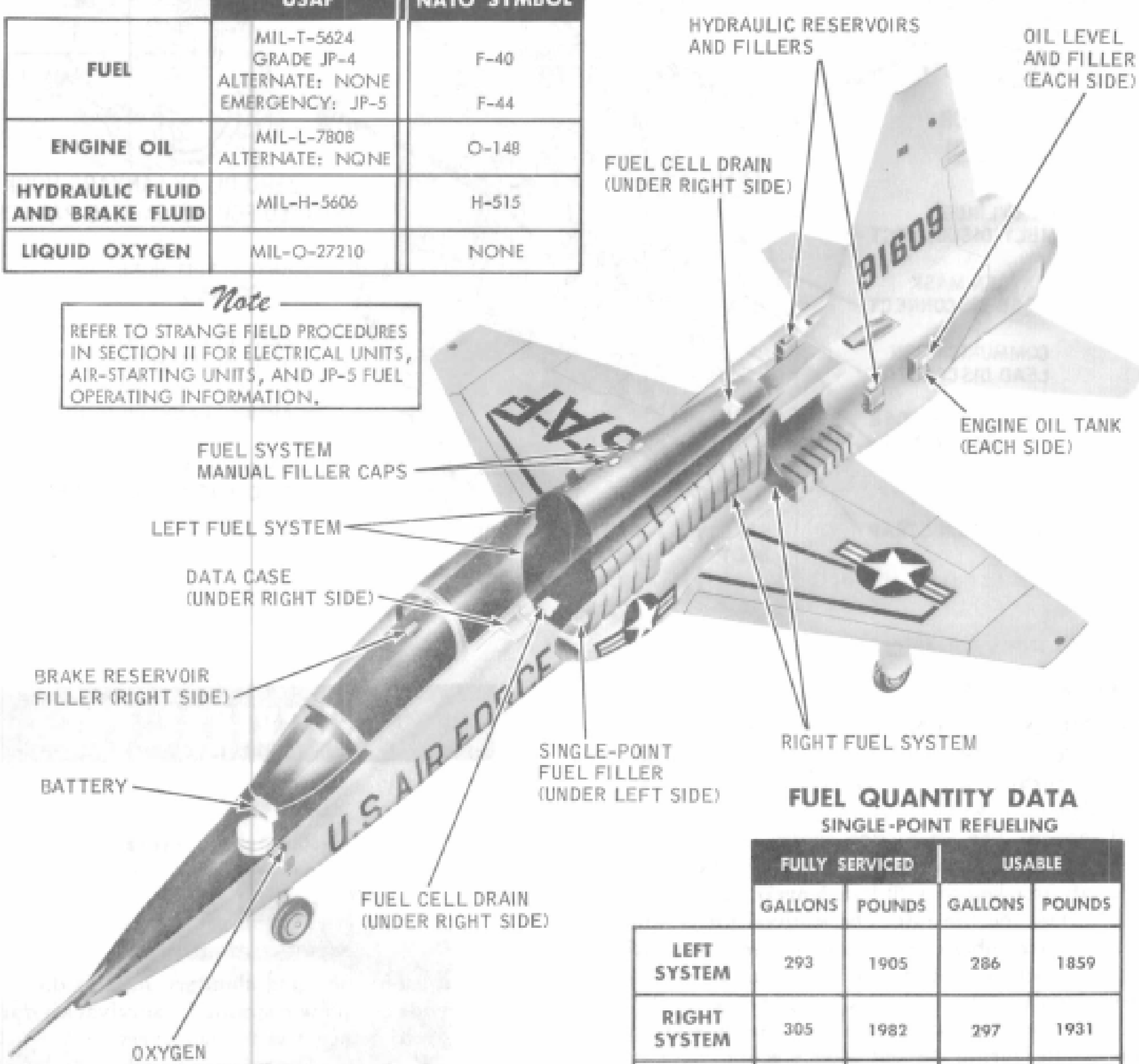
SERVICING DIAGRAM

FLUID SPECIFICATIONS

	USAF	NATO SYMBOL
FUEL	MIL-T-5624 GRADE JP-4 ALTERNATE: NONE EMERGENCY: JP-5	F-40 F-44
ENGINE OIL	MIL-L-7808 ALTERNATE: NONE	O-148
HYDRAULIC FLUID AND BRAKE FLUID	MIL-H-5606	H-515
LIQUID OXYGEN	MIL-O-27210	NONE

Note

REFER TO STRANGE FIELD PROCEDURES IN SECTION II FOR ELECTRICAL UNITS, AIR-STARTING UNITS, AND JP-5 FUEL OPERATING INFORMATION.



FUEL QUANTITY DATA

SINGLE-POINT REFUELING

	FULLY SERVICED		USABLE	
	GALLONS	POUNDS	GALLONS	POUNDS
LEFT SYSTEM	293	1905	286	1859
RIGHT SYSTEM	305	1982	297	1931
TOTAL	598	3887	583	3790

Note

- FUEL — JP-4 6.5 LB PER GALLON
- SUBTRACT 6 GALLONS (39 POUNDS) FROM TOTALS IF MANUALLY REFUELED.

DATA BASIS: **ACTUAL**
DATE: 1 JANUARY 1972

Figure 14

SECTION 2
NORMAL OPERATIONS
TABLE OF CONTENTS

PREFLIGHT CHECK

BEFORE EXTERIOR INSPECTION

1. Form 781 – Check for both aircraft status and proper servicing
2. Seat and Canopy Safety Pins – Installed
3. Seat Attach Bolts – Check

WARNING

The two attach bolts must be aligned with the reference line (or shoulder) of the catapult head.

4. Publications – Check to ensure that all required navigational publications are on board.
5. Fuel and Oxygen Quantity – Check

EXTERIOR INSPECTION

Conduct the exterior inspection as shown in figure 15.

EXTERIOR INSPECTION

DURING THE EXTERIOR INSPECTION, THE AIRCRAFT SHOULD BE CHECKED FOR GENERAL CONDITION, WHEELS CHOCKED, ACCESS DOORS, PANELS, AND FILLER CAPS SECURED, GROUND WIRES REMOVED, FOR HYDRAULIC, OIL, AND FUEL LEAKS, AS WELL AS FOR THE FOLLOWING SPECIFIC ITEMS:

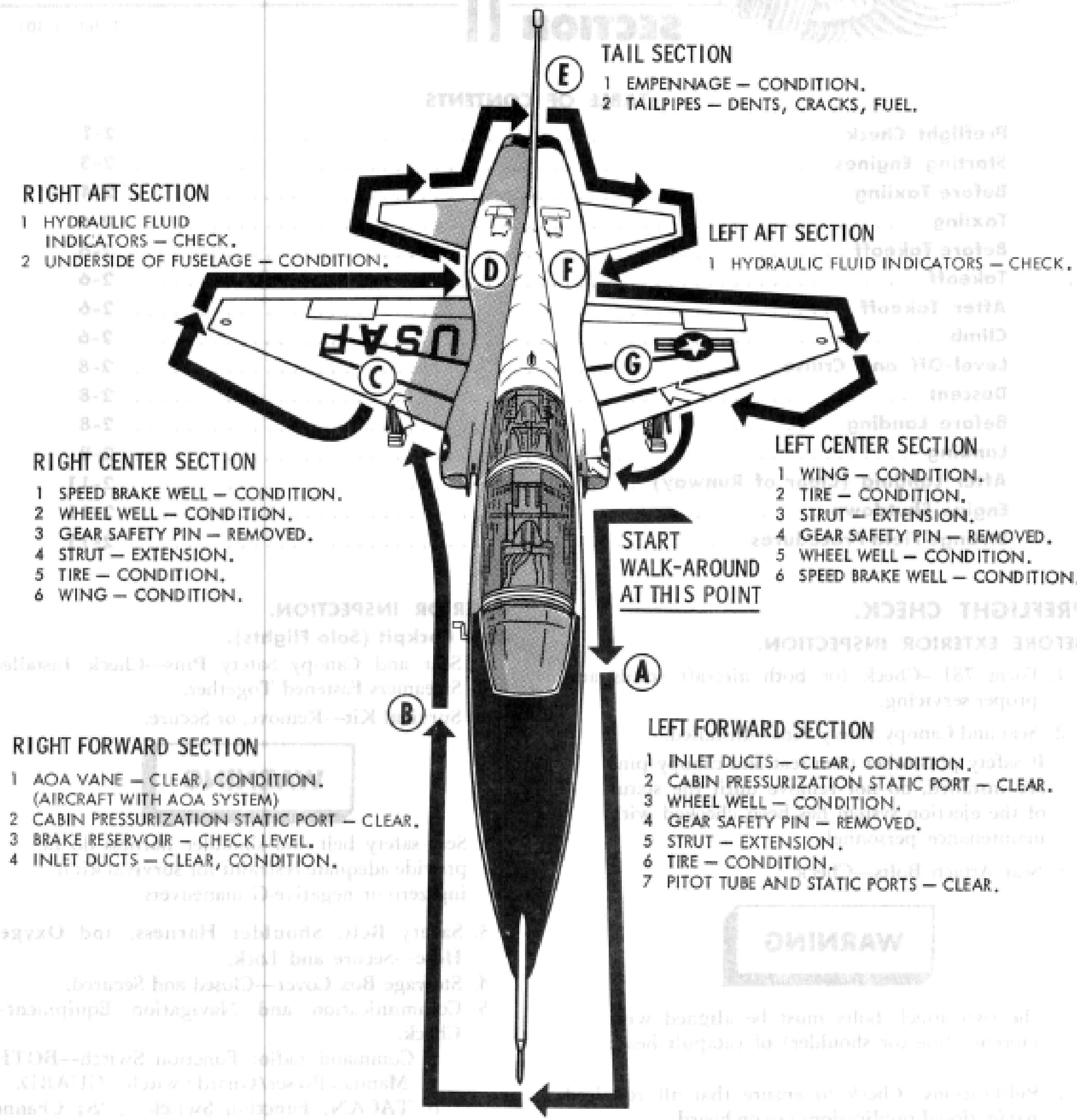
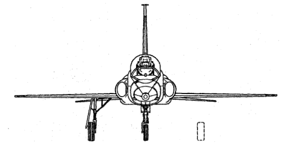


Figure 15



INTERIOR INSPECTION

Rear Cockpit (Solo Flights)

1. Seat and Canopy Safety Pins – Check Installed, Streamers Fastened Together
2. Survival Kit – Remove, or Secure

WARNING

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

3. Safety Belt, Shoulder Harness, and Oxygen Hose – Secure and Lock
4. Storage Box Cover – Closed and Secured
5. Communication and Navigation Equipment – Check
   a. Command radio: Function Switch – BOTH; Manual/Preset/Guard Switch – GUARD
   b. TACAN: Function Switch – T/R; Channel Selector Knobs – Desired Channel
   c. ILS: Steering Mode Switch – NORMAL; Power Switch – POWER; Channel Selector – Desired Channel
6. Command and Navigation Override Switch – OFF
7. Loose Equipment – Check Securely Stowed
8. Circuit Breakers – Check
9. Lights – OFF
10. Oxygen – NORMAL – NORMAL – ON
11. Instrument Hood – Remove or Secure
12. Canopy – Closed and Locked

Cockpit (All Flights)

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

1. Crew Retractable Steps – Assure Stowed (if required)
2. Survival Kit – Attached (if applicable)*
3. Safety Belt, Shoulder Harness, Parachute Arming Lanyard Anchor, Zero-Delay Lanyard Hook, Beacon Actuator Tab, Oxygen Connectors, Hose Retention Strap, Anti-G Suit Hose, and Helmet Chin Strap – Fasten and Adjust*

WARNING

- Failure to attach personal equipment correctly may prevent separation from seat after ejection.
- Assure that hose retention strap is adjusted to preclude hose separation from oxygen-disconnect on parachute harness.
- Do not route the anti-G suit hose under the safety belt or in any manner which would interfere with disconnecting the hose if required.
- The oxygen hose from the mask to the disconnect should be routed under the right shoulder harness strap before connecting to the disconnect. This helps keep the shoulder harness clear of the connector and prevents the harness from being snagged between the connector and its mounting plate during seat separation.

4. Battery Switch – ON
5. External Electrical Power – As Required

CAUTION

External electrical power connected and the battery switch at ON may result in charging voltage greater than the maximum allowable. Excessive voltage can cause gassing and loss of electrolyte.

6. Ejection Seat Handgrips – Push (to ensure fully down) *
7. Oxygen System – Check (PRICE) *
8. Circuit Breakers – Check*
9. Gear Door Switch – NORMAL
10. Flight Director Switch – ON
11. Rudder Trim Knob – CENTERED
12. Wing Flap Lever – OFF*
13. Throttles – OFF*
14. Speed Brake Switch – OPEN

15. Compass Switch – MAG
16. Fuel Shutoff Switches – NORMAL (guarded position)
17. Landing Gear Alternate Release Handle – IN
18. Landing-Taxi Light Switch – OFF
19. Landing Gear Lever – LG DOWN*
20. Clock – Set*
21. Airspeed-Mach Indicator – Check*
22. Accelerometer – Check*
23. Cabin Altimeter – Check
24. Steering Mode Switch – As Required*
25. Navigation Mode Switch – As Required*
26. Marker Beacon Light – Test*
27. Intercom Switches – As Required*
28. Radio Transfer Switches – As Required*
29. Comm Antenna Switch – AUTO
30. AoA Indexer Lights – Check (Aircraft with AoA System) *
31. UHF, TACAN, ILS – ON*
32. Magnetic Compass – Check
33. Altimeter – Set*
34. Vertical Velocity Indicator – Check*
35. Cabin Pressure Switch – CABIN PRESS
36. Cabin Air Temperature Switch – AUTO
37. Pitot Heat Switch – OFF
38. Engine Anti-Ice Switch – As Required
39. Fuel Boost Pump Switches – ON
40. Crossfeed Switch – OFF
41. Generator Switches – ON
42. IFF/SIF – STBY
43. Warning Test Switch – TEST (Without AC power on Block 30 and earlier aircraft, no landing gear audible warning signal.) *
44. Interior and Position Lights – As Required*
45. Forms/Publications – Stowed*

STARTING ENGINES

RIGHT ENGINE

Start the right engine first, using the following procedure:

1. Rotating Beacon – ON
2. Signal for air supply
3. Right Throttle – Advance to IDLE (Left Click Finger Lift)
4. Engine Start Button – Push Momentarily

CAUTION

- Prior to moving either throttle to IDLE, assure that respective EGT OFF flag (front cockpit only) is out of view. And engine start cannot be properly monitored with OFF flag in view.
- If ignition does not occur before fuel flow reaches 350 LB/HR, retard throttle to OFF (by left clicking the Finger Lift). Maintain airflow to permit fuel and vapors to be purged from engine. Wait at least 2 minutes to permit fuel to drain before attempting another start.
- If EGT does not begin to rise within 5 seconds after the first indication of fuel flow, abort the start. If engine light is normal but RPM do not reach generator cut-in speed before termination of the start cycle, push the engine start button to assure aircraft electrical power is available to monitor the start.

5. Engine Instruments – Check
6. Hydraulic Pressure – Check
7. Caution Light Panel – Check

LEFT ENGINE

1. Left Engine – Start Same As Right Engine

CAUTION

Do not push left engine start button until a minimum of 30 seconds has elapsed after right engine start button has been pushed. The left engine start cycle will be shortened and may result in a hot start due to external air to the engine.

2. Signal ground crew to disconnect external power and/or air supply

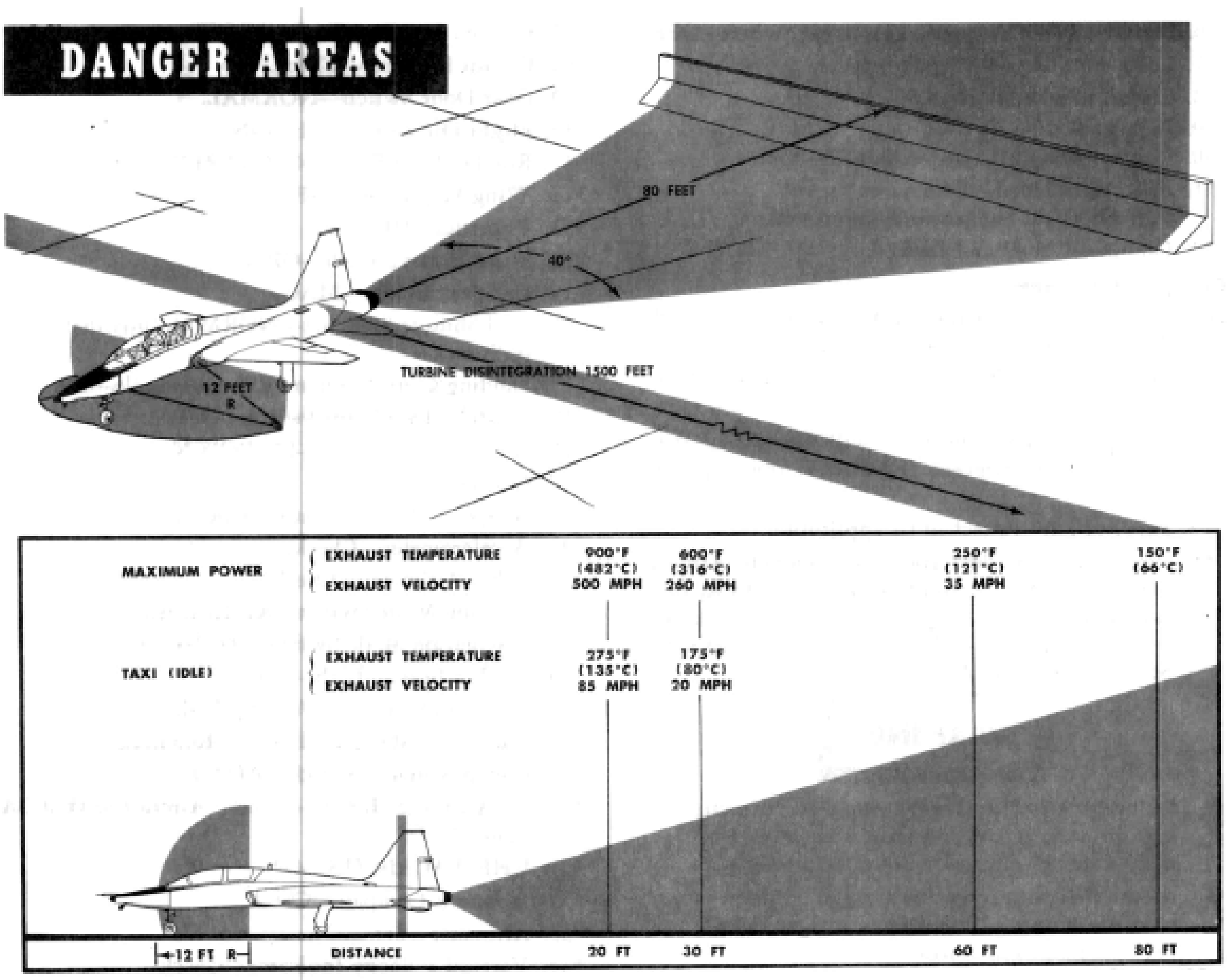


Figure 16

BEFORE TAXIING

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

1. Canopy Defog, Cabin Temp and Pitot Heat – Check (check pitot heat if required)

WARNING

For night or anticipated weather operation with conditions of high humidity and narrow temperature-dewpoint spread, the canopies should be closed and the cockpit temperature increased to the 100^{o} AUTO position to pre-heat all flight instruments and canopy surfaces. Return temperature control to a comfortable in-flight setting after completion of the line-up check.

2. Circuit Breakers -- Check*
3. Yaw Damper Switch – YAW; for formation flight – OFF
4. Pitch Cutoff Switch – Check (Block 20 aircraft only)
    a. Pitch Damper Switch – PITCH
    b. Pitch Cutoff Switch – Actuate
    c. Pitch Damper Switch – Moves to OFF
    d. Pitch Damper Switch – PITCH; check that horizontal tail does not move
    e. If horizontal tail moved, Pitch Damper Switch – OFF
5. Flight Trim Switch – Check
6. Takeoff Trim Button – Press (Check that indicator light illuminates)
7. Flight Controls – Check
8. Speed Brake – Closed
9. Wing Flaps – Down, then retract to 60% (Check visually for proper flaps movement)
10. Communication and Navigation Equipment – Check*
11. Altimeter – Check*

CAUTION

Do not rotate the barometric set knob at a rapid rate or exert force to overcome momentary binding. If binding should occur, the required setting may be established by rotating the set knob a full turn in the opposite direction and then approaching the desired setting carefully. With an accurate barometric setting, the altimeter must indicate within 75 feet of the field elevation.

12. Fuel/Oxygen Check Switch – FUEL & OXY GAGE TEST
13. Seat and Canopy Safety Pins – Remove, display to ground crew and store*

CAUTION

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

14. Brakes – Check Pedal Pressure*
15. Chocks – Removed

TAXIING

WARNING

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

CAUTION

- If brake drag is encountered or suspected, the aircraft should be aborted.
- Simultaneous use of wheel brakes and nosewheel steering to effect turns results in excessive nosewheel tire wear. Nosewheel tires are severely damaged when maximum deflection turns are attempted at speeds in excess of 10 knots.
- A low nose gear strut indicates insufficient strut pressure and may result in a cocked nosewheel and/or damage to the nosewheel well during retraction. Do not fly the aircraft if the nose gear strut is deflated or if the strut "bottoms" during taxiing.

1. Turn and Slip Indicator – Check
2. HSI – Check Correct Movement in Turns

BEFORE TAKEOFF

1. Battery Switch – Check ON
2. Canopy Defog, Cabin Temp, and Pitot Heat – As Required
3. Engine Anti-Ice – As Required
4. Rotating Beacon, Position Lights, Formation Lights – Check ON
5. Parachute Arming Lanyard and Zero-Delay Lanyard – Check Attached
6. Cockpit Loose Items – Check Secured
7. Canopy – Closed, Locked; Warning Light – Out
8. Takeoff Trim Button – Press (Check that indicator light illuminates)
9. Takeoff Data – Review

LINEUP CHECK

1. Nosewheel Steering – Check Disengaged
2. IFF/SIF – As Required (Mode 3 NORM, Mode 1, 2, & 4 – ON if required)
3. Throttle – MIL
4. Master Caution Light – Out
5. Engine Instruments – Check
6. Hydraulic Pressure – Check

TAKEOFF

The following takeoff procedures will produce the results stated in the takeoff distance charts in Appendix 1 of this POH. Note: For crosswind takeoffs, follow the normal takeoff procedures.

WARNING

Avoid wake turbulence. Allow a minimum of 2 minutes before takeoff behind a heavy aircraft or helicopter. The time should be increased to a minimum of 4 minutes behind jumbo aircraft; i.e. C-5A or 747. With effective crosswinds of over 5 knots, the interval may be reduced, but attempt to remain above and upwind of the preceding aircraft's flight path.

1. Wheel Brakes – Release
2. Throttles – MAX

CAUTION

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

3. Engine Instruments – Check for Proper Indication.

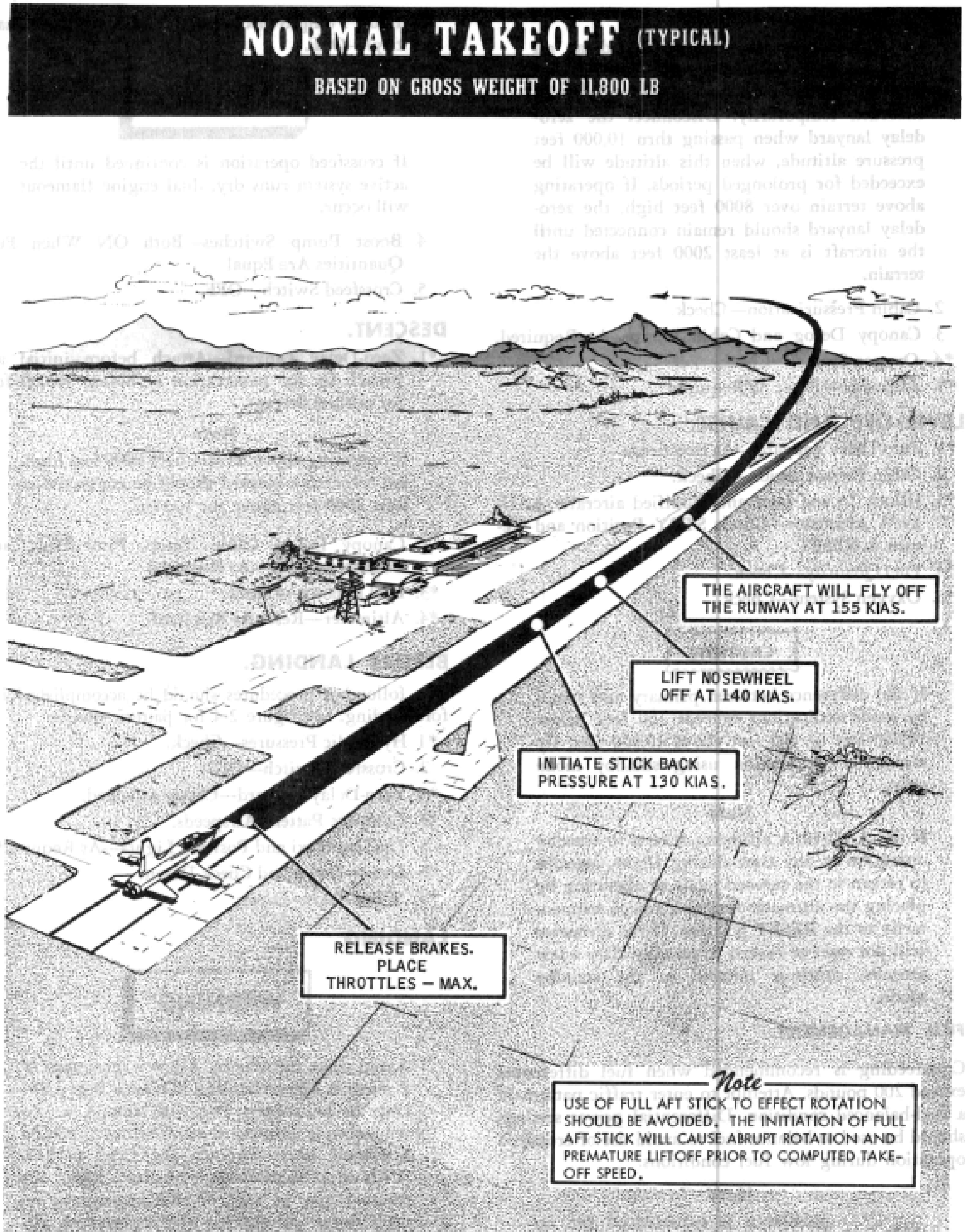

NORMAL TAKEOFF (TYPICAL)
BASED ON GROSS WEIGHT OF 11,800 LB
THE AIRCRAFT WILL FLY OFF THE RUNWAY AT 155 KIAS.
LIFT NOSEWHEEL OFF AT 140 KIAS.
INITIATE STICK BACK PRESSURE AT 130 KIAS.
RELEASE BRAKES. PLACE THROTTLES — MAX.
Note
USE OF FULL AFT STICK TO EFFECT ROTATION SHOULD BE AVOIDED. THE INITIATION OF FULL AFT STICK WILL CAUSE ABRUPT ROTATION AND PREMATURE LIFTOFF PRIOR TO COMPUTED TAKE-OFF SPEED.

Figure 17

AFTER TAKEOFF

1. Landing Gear Lever – LG UP, when definitely airborne
2. Wing Flap Lever – UP

CLIMB

1. Zero-Delay Lanyard – Disconnect When Passing Through 10,000 Feet
2. Cabin Pressurization – Check
3. Canopy Defog and Cabin Temp – As Required
4. Oxygen System – Check
5. Altimeter – Reset As Required

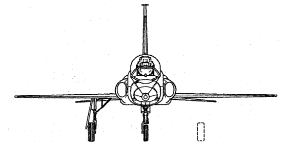
LEVEL-OFF AND CRUISE

1. Zero-Delay Lanyard – As Required
2. Cabin Pressurization – Check
3. Altimeter – Check (Reset to 29.92 inches upon reaching Transition Level)
4. Fuel Quantity – Check
5. Oxygen System – Check

FUEL MANAGEMENT

Crossfeed is recommended when fuel differences exceed 200 pounds. Attempt to enter traffic pattern in a fuel-balanced condition. Differential power settings should be used to balance fuel to avoid use of Crossfeed operation during low fuel conditions. Note: If a fuel unbalance is experienced for no apparent reason, perform gage test prior to crossfeeding.

1. Fuel Quantity – Check
2. Crossfeed Switch – ON
3. Boost Pump Switch (on side of lower fuel quantity) – OFF



WARNING

If Crossfeed operation is continued until the active system runs dry, dual engine flameout will occur.

4. Boost Pump Switches – Both ON When Fuel Quantities Are Equal
5. Crossfeed Switch – OFF

DESCENT

1. Zero-Delay Lanyard – Attach before initial approach fix for penetration or before 10,000 feet for normal descent.
2. Canopy Defog, Cabin Temp, Pitot Heat, and Engine Anti-Ice – As Required
3. Fuel Balance – Check
4. Altimeter – Reset As Required

BEFORE LANDING

1. Hydraulic Pressures – Check
2. Crossfeed Switch – OFF
3. Zero-Delay Lanyard – Check Attached
4. Compute Pattern Airspeeds (see Figure 18)
5. Landing-Taxi and Position Lights – As Required
6. Gear – Down and Check Down (see Figure 18 for normal pattern location)
7. Wing Flaps – Down (see Figure 18 for normal pattern location)

LANDING

WARNING

Avoid wake turbulence. Allow a minimum of 2 minutes before landing behind a heavy aircraft or helicopter. The time should be extended to a minimum of 4 minutes behind a jumbo aircraft. With effective crosswinds over 5 knots, the interval may be reduced, but attempt to remain above and upwind of the preceding aircraft's flight path.

NORMAL LANDING

Refer to Figure 18 for recommended landing and go-around pattern. After touchdown, continue to increase back pressure on the stick to obtain the highest possible nose-high attitude without flying the aircraft off the runway. Just prior to reaching 100 KIAS, lower the nosewheel to the runway. After the nosewheel is lowered to the runway, a single, smooth brake application should be used to stop, taking full advantage of the available runway. Refer to Section 5 of this POH for landing rate of descent and to the normal landing distance chart in Appendix 1 for landing pattern speeds and landing distances.

MINIMUM ROLL LANDING (DRY RUNWAY)

To make a minimum roll landing, decrease airspeed 10 knots on final approach to assure touchdown at speeds noted in the minimum landing distance charts in Appendix 1. Immediately after touchdown, commence optimum braking while smoothly lowering the nosewheel to the runway.

LANDING (WET OR SLIPPERY RUNWAY)

Decrease airspeed 10 knots on final approach to assure touchdowns at speeds noted in the minimum landing distance chart in Appendix 1. For wet runways, a firm touchdown will tend to reduce the effects of hydroplaning. After touchdown, continue to increase back pressure on the stick to obtain the highest possible nose attitude without flying the aircraft off the runway. Maintain the nose high attitude to 100 KIAS, then lower the nosewheel to the runway and apply optimum braking. On a wet or slippery runway, extreme caution should be used when applying brakes to avoid skidding, slipping, or blowing a tire due to hydroplaning action.

CROSSWIND LANDING

On final approach, counteract drift by crabbing into the wind, maintaining flight path alignment with the runway centerline. The crab should be held through touchdown. When the crosswind component exceeds 15 knots, touchdown should be planned for the center of the upwind side of the runway (halfway between the upwind edge of the runway and the runway centerline). Maintain precise airspeed control throughout the final approach; in gusty conditions, increase the indicated airspeed by one-half of the gust increment above the wind velocity. Refer to Section 5 for landing rate of descent.

After touchdown, the landing attitude should be maintained while the stick is gradually moved aft until full back stick is obtained. Maintain directional control of the aircraft with the rudder. A too rapid increase in the back stick pressure may cause the aircraft to become airborne and drift across the runway. Drift will create a high probability of tire damage. When the airspeed decreases to 100 KIAS, lower the nosewheel to the runway. Lowering the nose prematurely in a crosswind will produce a compression of the downwind strut. This hampers directional control and may be minimized by use of aileron toward the upwind side. Early downwind strut compression combined with weathervaning usually results in damage to the downwind tire.

GO-AROUND

Make the decision to go-around as early as possible. Military power is normally sufficient for go-around, but do not hesitate to use maximum afterburner power if necessary. If conditions do not permit an aerial go-around, do not try to hold the aircraft off the runway; continue to fly the aircraft to touchdown and follow this procedure:

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

Note

If a touchdown is made, lower the nose slightly and accelerate to takeoff airspeed, then establish takeoff attitude and allow the aircraft to fly off the runway.

TOUCH-AND-GO LANDINGS

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

WARNING

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

CAUTION

Do not make practice landings after gear alternate extension until the system has been recycled to provide pressure on the "down" side of the system.

Note

Touch-and-go landings will be performed only under conditions authorized by the major air command.

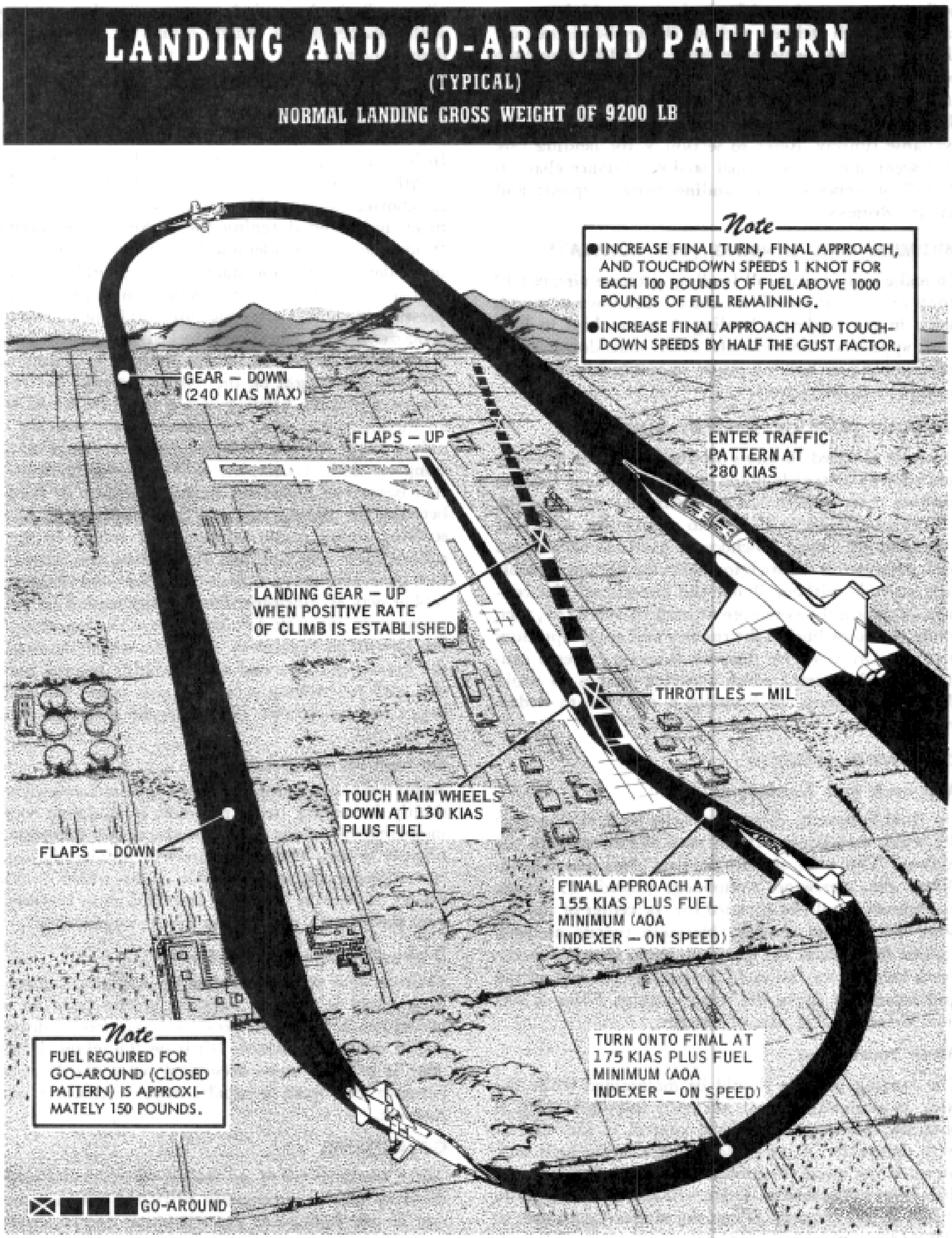

LANDING AND GO-AROUND PATTERN
(TYPICAL)
NORMAL LANDING GROSS WEIGHT OF 9200 LB
Note
INCREASE FINAL TURN, FINAL APPROACH, AND TOUCHDOWN SPEEDS 1 KNOT FOR EACH 100 POUNDS OF FUEL ABOVE 1000 POUNDS OF FUEL REMAINING.
INCREASE FINAL APPROACH AND TOUCHDOWN SPEEDS BY HALF THE GUST FACTOR.
GEAR — DOWN (240 KIAS MAX)
FLAPS — UP
ENTER TRAFFIC PATTERN AT 280 KIAS
LANDING GEAR — UP WHEN POSITIVE RATE OF CLIMB IS ESTABLISHED
THROTTLES — MIL
TOUCH MAIN WHEELS DOWN AT 130 KIAS PLUS FUEL
FLAPS — DOWN
FINAL APPROACH AT 155 KIAS PLUS FUEL MINIMUM (AOA INDEXER — ON SPEED)
Note
FUEL REQUIRED FOR GO-AROUND (CLOSED PATTERN) IS APPROXIMATELY 150 POUNDS.
TURN ONTO FINAL AT 175 KIAS PLUS FUEL MINIMUM (AOA INDEXER — ON SPEED)
GO-AROUND

Figure 18

USE OF WHEEL BRAKES

WHEEL BRAKE OPERATION

To minimize brake wear, the brakes should be used as little and as lightly as possible. Full advantage of the length of the runway should be taken during landing or aborted takeoff. Minimize use of brakes during turns and avoid dragging the brakes during taxiing. When there is considerable lift on the wings, heavy brake action will lock the wheel more easily than when the same pressure is applied at lower speeds, resulting is possible tire skidding.

OPTIMUM BRAKING ACTION

Apply brakes in a single, smooth application with constantly increasing pedal pressure. If skidding occurs, momentarily release brake pressure and immediately reapply brakes. This procedure will provide the shortest stopping distance possible from wheel braking action. If runway length is insufficient to completely stop the aircraft, prepare for barrier engagement.

BRAKE OPERATION AT HIGH SPEED

Extreme care should be used in applying brakes at high speed to prevent skidding of the tires. As discussed above, very little pressure is required to develop a skid while considerable lift is on the wings. If skidding is believed to be occurring, momentarily release pressure and again gradually apply increasing brake pressure.

AFTER LANDING (CLEAR OF RUNWAY)

1. Cabin Altimeter – Check (If reading is below field elevation, place cabin pressure switch at RAMP DUMP before opening either canopy.)
2. Cockpit Loose Items – Check Secured (before opening canopy)

CAUTION

Ensure that instrument hood bungee cords are hooked before opening rear canopy.

3. Gear Door Switch – OPEN
4. Takeoff Trim Button – Press
5. Wing Flaps – UP

6. Speed Brakes – Open
7. Landing-Taxi Lights – As Required
8. Pitot Heat – OFF
9. TACAN, ILS, IFF/SIF – OFF

ENGINE SHUTDOWN

1. Position Lights – OFF
2. Canopy – Unlocked

Note

The canopy seals will remain inflated if engines are shut down with both canopies locked.

3. Cabin Pressure Switch – CABIN PRESS

Note

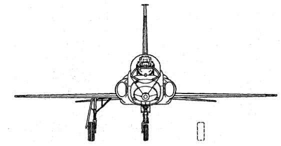
Allow 10 seconds for landing-taxi light retraction and/or closure of ram dump door prior to engine shutdown.

4. Operate engines at IDLE for a minimum of 1 minute
5. Throttles – OFF (left click each Finger Lift to set into OFF position to shut down engines.)
6. Seat and Canopy Pins – Installed

WARNING

Check that all safety pins are fully inserted and seated. Failure to confirm this can result in inadvertent canopy or seat ejection, causing serious injury or even death to aircrew or ground crew personnel.

7. All Unguarded Switches – OFF
8. Oxygen – 100%
9. Wheels – Chocked



SECTION 3
EMERGENCY OPERATIONS
TABLE OF CONTENTS

Note

- A Critical Procedure is an emergency procedure that must be performed immediately without reference to printed checklists and must therefore be committed to memory. These critical procedures appear in **BOLDFACE** capital letter. Noncritical Procedures are all other steps wherein there is time available to consult the checklist.
- In the event of multiple emergencies, the pilot is required to exercise sound judgment as to the appropriate action. A thorough knowledge of the correct procedures and aircraft systems are essential to analyze the situation correctly and determine the best course of action.
- To assist the pilot when an emergency occurs, three basic rules are established, which apply to most emergencies occurring while airborne. They should be remembered by each aircrew member:
    1. Maintain Aircraft Control
    2. Analyze the Situation and Take Proper Action
    3. Land as Soon as Practicable

GROUND-OPERATION EMERGENCIES

ENGINE FIRE DURING START

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

1. **THROTTLES – OFF**
2. **BATTERY – OFF**

EMERGENCY EXIT ON THE GROUND

When a situation develops which requires a crewmember to abandon the aircraft, place the throttles at OFF, battery switch at OFF, insert the ejection seat safety pin, release the survival kit (if one is carried), and disconnect personal leads. Crewmembers should consider removing the parachute when disconnecting equipment to facilitate exit from the cockpit. Open the canopy. If either canopy cannot be opened by the normal procedure, pull the canopy jettison T-handle. If either canopy fails to open or jettison, break through the canopy using the canopy breaker tool (see Figure 19).

WARNING

To avoid deployment and possible pilot survival kit entanglement during emergency exit, the survival kit must be seated firmly in position before the survival kit emergency release handle is pulled.

USE OF CANOPY BREAKER TOOL

To break the canopy open, grasp the canopy breaker tool with both hands and use your body weight behind an arm swinging thrust. Aim the point of the tool to strike perpendicular to the canopy surface. The blade alignment will determine the direction of the cracks. No set pattern of blows is necessary; normally three to four blows will open an adequate escape hole.

NOSEWHEEL VIBRATION OR SHIMMY

If nosewheel vibration or shimmy is experienced, disengage the nosewheel steering system. Shimmy may be reduced by relieving weight on the nosewheel, normally by reducing brake pressure or pulling the stick aft.

SMOKE, FUMES, OR ODORS IN COCKPIT

Do not take off is smoke, fumes, or unidentified odors are detected. Refer to Smoke, Fumes, or Odors in Cockpit procedure under Inflight Emergencies in this section of the POH.

TAKEOFF EMERGENCIES

ABORT/BARRIER ENGAGEMENT

1. **THROTTLES – IDLE**
2. **SPEED BRAKE – CLOSED**
3. **WHEEL BRAKES – APPLY**

CAUTION

Ensure that instrument hood bungee cords are hooked before opening rear canopy.

ENGINE FAILURE DURING TAKEOFF

If Decision Is Made To Stop:

1. **ABORT**

If Takeoff Is Continued:

1. **THROTTLES – MAX**
2. **ATTAIN AIRSPEED ABOVE SINGLE-ENGINE TAKEOFF SPEED** (+ 10 knots desired)
3. Gear – UP (as required above single-engine takeoff speed, plus 10 knots)
4. Flaps – UP (as required above 190 KIAS)
5. Throttle (inoperative engine) – OFF

WARNING

- Continuing a takeoff on a single engine should be attempted only at a maximum thrust.
- With other than 60% flaps, single engine capability is impaired to such an extent that high takeoff factors coupled with heavy gross weights may make takeoff impossible
- If engine failure occurs after rotation, it will probably be necessary to lower the nose to attain speed above single-engine takeoff speed. If engine failure occurs after takeoff, it may be necessary to allow the aircraft to settle back to the runway.
- If the left engine is inoperative but windmilling, generally gear retraction may be accomplished but will require an extended time period; however, gear doors may not completely close. Gear retraction, when initiated between single engine takeoff speed plus 10 knots and 190 KIAS, requires from 30 to 50 seconds.
- If unable to retract the landing gear, best level flight/climb capability is obtained at 190 KIAS with 60% flaps or at 220 KIAS with the flaps up.

TIRE FAILURE DURING TAKEOFF

Tire failure on takeoff may present a greater problem than tire failure on landing. Directional control is more difficult, and braking effectiveness is greatly reduced at higher gross weights.

If Decision Is Made To Stop:

1. **ABORT**

If Takeoff Is Continued:

2. **DO NOT RETRACT GEAR**

LANDING GEAR RETRACTION failure

If the warning light in the landing gear lever remains illuminated after the lever has been moved to the LG UP position, proceed as follows:

1. Airspeed – Maintain below 240 KIAS
2. Landing Gear Lever – LG DOWN

INFLIGHT EMERGENCIES

SINGLE-ENGINE FLIGHT CHARACTERISTICS

Single-engine directional control can normally be maintained at all speeds above the stall. Very little rudder is required because of the close proximity of the thrust lines to the centerline of the aircraft. In high-drag, high-thrust, low-airspeed conditions, rudder must be used to coordinate flight to obtain optimum aircraft performance. Minimum single engine flying speed for any condition occurs where the thrust available and the thrust required lines cross, as shown in the single engine performance charts located in Appendix 1 on this POH.

ENGINE FAILURE DURING FLIGHT

If an engine operates abnormally or fails during flight, reduce drag to a minimum and maintain airspeed and directional control while investigating to determine the cause. Failure of the left engine may deactivate speed brakes, normal landing gear extension and retraction, nosewheel steering, and the stability augmenter system. However, left engine windmilling RPM under this condition may supply sufficient hydraulic pressure to operate these systems. Use the following procedure for shutting down an engine in flight:

1. Safe Single-Engine Airspeed – Maintain

2. Throttle (inoperative engine) – OFF for 10 seconds before attempting subsequent air restart if conditions permit. (Left click Finger Lift switch of dead engine to place in OFF position.)

Note

If sustained single-engine cruise is anticipated, consider turning on crossfeed switch to use all available fuel to prevent fuel imbalance.

DUAL ENGINE FAILURE AT LOW ALTITUDE

If both engines fail during flight at low altitude and with sufficient airspeed, the aircraft should be zoomed (approximately 20 degrees nose up attitude) to exchange airspeed for altitude and to allow additional time to accomplish subsequent emergency procedures. ALTERNATE AIRSTART should be attempted immediately upon detection of dual engine flameout and repeated as often as possible during the zoom. If the decision is made to eject, ejection should be accomplished during the zoom while the aircraft is in a nose high positive rate of climb. It is imperative that the ejection sequence be initiated prior to reaching a stall or rate of sink.

RESTART DURING FLIGHT

Air restarts can be expected at or below 26,000 feet between 250 KIAS and 310 KIAS. Optimum restart capability at higher altitudes occurs at 270 KIAS. At lower altitudes, an engine RPM of 16% or greater affords sufficient airflow for restart. If engine flameout is experienced, use the following procedure:

1. Altitude – 26,000 feet or below
2. Airspeed – 250 KIAS to 310 KIAS

Note

When the rear cockpit is occupied, the fuel pump circuit breakers should be checked in.

3. Battery Switch – Check ON
4. Boost Pump Switches – Checked ON
5. Engine Start Button – Push Momentarily
6. Throttle (windmilling engine) – Advance to slightly above IDLE, then retard to IDLE

Note

- Leave throttle at IDLE for 30 seconds before aborting a start.
- If dual engine flameout occurs, right engine should be attempted first as right engine instruments will operate normally as soon as engine start button is pushed.

7. If Restart Attempt Fails – Place throttle in OFF position for approximately 10 seconds, turn crossfeed switch to ON, check engine start and ignition circuit breakers, and attempt another start

Note

- The RPM may hang up during restart after combustion occurs at low airspeeds. RPM hangup during an airstart may be eliminated by increasing airspeed.
- If it appears that a boost pump has failed, remain below 25,000 feet. Turn crossfeed OFF to avoid having to use an abnormal fuel balancing procedure. If impractical to remain below 25,000 feet, engine operation above 25,000 feet with gravity fuel flow is possible at reduced power settings. Flight at lowest practical altitude and reduced power settings will minimize probability of subsequent fuel flow interruption.

ALTERNATE AIRSTART

The alternate airstart is primarily designed for use at low altitude when thrust requirements are critical. An airstart may be accomplished by advancing the throttle to MAX range. This energizes normal and afterburner ignition for approximately 30 seconds (if throttle remains in MAX range). If the engine does not start after 30 seconds, additional starts may be attempted by retarding the throttle out of MAX range to reset the circuit and again advancing the throttle to MAX range to reactivate the ignition cycle. After engine start, the throttle may be left in MAX range if afterburner operation is desired.

If Alternate Airstart Is Required:

1. **THROTTLE(S) – MAX**

WARNING

- If throttle is already in MAX, recycle throttle MIL to MAX.
- With dual engine failure, battery switch must be at ON to provide ignition.

COMPRESSOR STALL

If an engine compressor stalls, proceed as follows:

1. **THROTTLE – IDLE**
2. Increase airspeed and advance throttle slowly

Note

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

3. Throttle – OFF (if engine will not recovery)

Note

- If the engine is shut down, an airstart may be attempted as applicable.
- Rapidly retarding the throttle to IDLE and immediately pushing the engine start button may permit the engine to recover and prevent complete flameout.

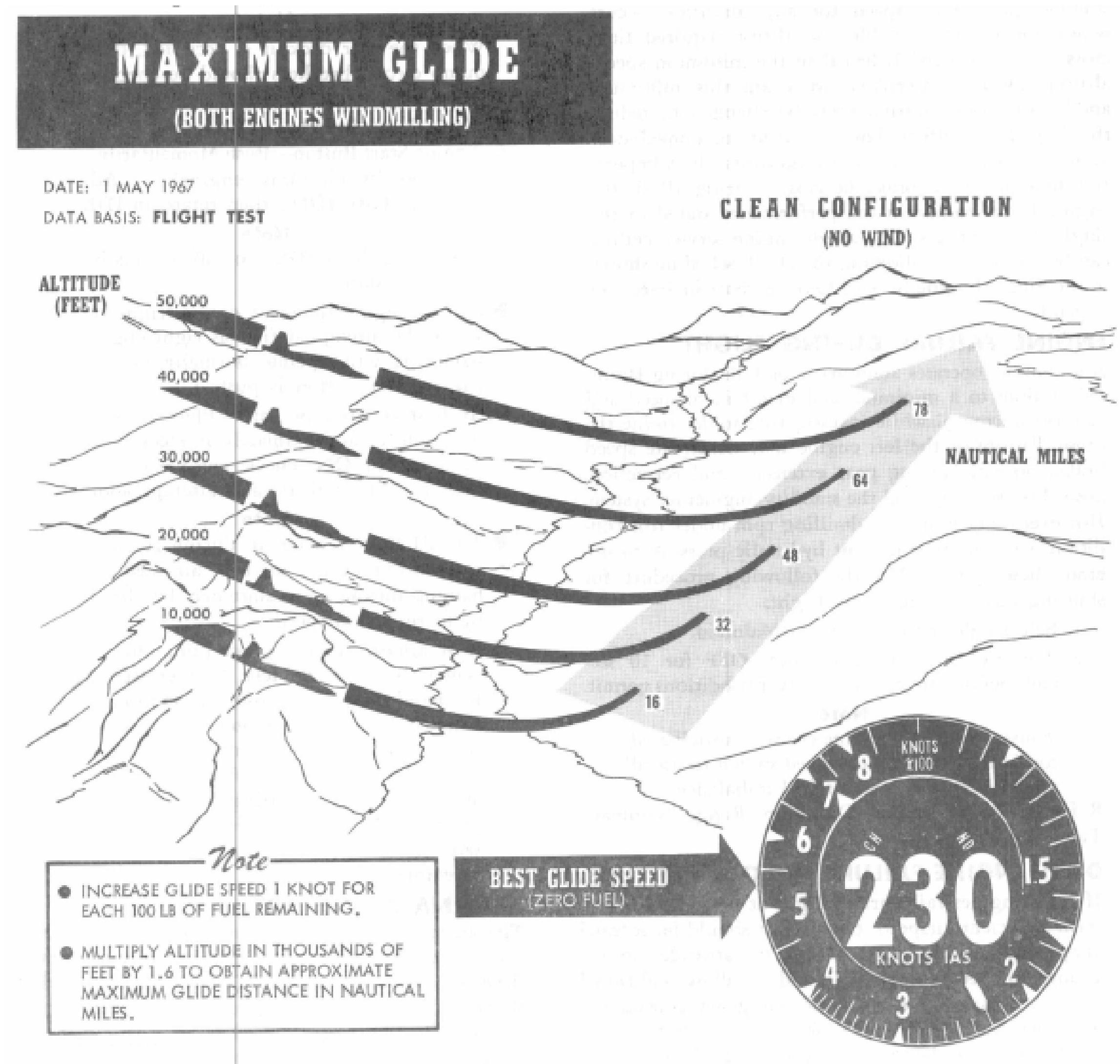

MAXIMUM GLIDE
(BOTH ENGINES WINDMILLING)
DATE: 1 MAY 1967
DATA BASIS: FLIGHT TEST
CLEAN CONFIGURATION
(NO WIND)
ALTITUDE (FEET)
50,000
40,000
30,000
20,000
10,000
78
64
48
32
16
NAUTICAL MILES
Note
INCREASE GLIDE SPEED 1 KNOT FOR EACH 100 LB OF FUEL REMAINING.
MULTIPLY ALTITUDE IN THOUSANDS OF FEET BY 1.6 TO OBTAIN APPROXIMATE MAXIMUM GLIDE DISTANCE IN NAUTICAL MILES.
BEST GLIDE SPEED
(ZERO FUEL)
KNOTS X100
230
KNOTS IAS

Figure 19

FIRE WARNING DURING FLIGHT

If a fire warning light illuminates, use the following procedure:

1. **THROTTLE (AFFECTED ENGINE) – RETARD TO IDLE**
2. **THROTTLE (AFFECTED ENGINE) – OFF, IF FIRE WARNING LIGHT REMAINS ON**

WARNING

If engine cannot be shut down with the throttle, the fuel shutoff switch (affected engine) should be closed.

CAUTION

Do not attempt to restart the affected engine if the fire is extinguished. Make a single-engine landing.

Note

If the fire warning light goes out, check light by positioning warning test switch to TEST.

3. **IF FIRE CONTINUES – EJECT**

ELECTRICAL FIRE

If an electrical fire occurs, proceed as follows:

1. Battery and Generator Switches – OFF
2. All Electrical Equipment – OFF

3. Battery and Generator Switches – ON, as Required

Note

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

SMOKE, FUMES, OR ODORS IN COCKPIT

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

1. **OXYGEN – 100%**
2. Check for Fire
3. Cabin Pressure Switch – RAM DUMP, Below 25,000 Feet, If Possible
4. If Smoke Becomes Severe – Jettison Canopy, Below 300 KIAS, if possible

EJECTION PROCEDURE, FORCED LANDING, AND DITCHING

Note: Microsoft Flight Simulator X does not properly replicate, nor support, a realistic ejection sequence. Nor does FSX adequately support a realistic ditching or forced landing. Therefore, even though these procedures are referenced periodically in other emergency procedures, they will not be expressly included in this POH because doing so would provide unsupportable information and actions.

OIL SYSTEM MALFUNCTION

Abnormal engine oil pressure indications frequently are an early indication of some engine trouble. The engine oil pressure indicators are marked for normal operating conditions on the ground or in the air. If engine oil pressure exceeds the operating limits, proceed as follows:

1. Throttle – IDLE
2. Throttle – OFF, if indication of seizure is noted

ENGINE OVERTEMPERATURE

If excessive exhaust gas temperature occurs, immediately retard throttle to the setting at which the exhaust gas temperature of the affected engine decreases and remains within limits.

FUEL VENTING OVERBOARD

Under certain conditions of fuel vent malfunction during a climb, fuel may be lost overboard through the vent on the vertical stabilizer. If fuel overboarding occurs during a climb, proceed as follows:

1. Aircraft – Level Immediately
2. If Overboarding Continues – Enter a Shallow Dive
3. If Overboarding Continues – Land As Soon As Practicable

LOW FUEL PRESSURE

If a fuel pressure light comes on, proceed as follows:

1. Boost Pump Circuit Breaker – Check

Note

If circuit breakers are found popped, turn off appropriate boost pump before resetting circuit breakers.

2. Power – Reduce
3. Descend – 25,000 feet or below
4. Land as soon as conditions permit

TRANSFORMER-RECTIFIER FAILURE

When the XFMR RECT OUT caution light illuminates, in indicates a possible failure of both transformer-rectifiers. If both have failed, the systems requiring DC power will be supplied for limited time by the battery. Due to this limited time, use the following procedures:

1. Notify controlling agency of impending loss of TACAN, ILS, and two-way radio communications
2. Land as soon as practicable

Note

Battery life is limited to approximately 17 minutes.

GENERATOR FAILURE

If the generator caution light illuminates, proceed as follows:

1. Adjust engine RPM of engine with failed generator to opposite side of shift range.
2. Generator Switch – Reset, then ON

WARNING

The pilot should refrain from attempting to reset the generator more than once due to the danger of generator burning.

3. Generator Switch – OFF
4. Pilot will immediately terminate mission
5. After landing, engine of affected generator will be shut down after clearing runway

ELECTRICAL FAILURE – COMPLETE

With complete electrical failure, all warning systems, engine instruments (except engine tachometers), flight director, communication and navigation systems, speed brake, flaps, landing gear indicators, nosewheel steering, fuel boost pumps, and engine ignition systems are inoperative; and each engine anti-ice valve opens. Use the following procedures:

1. Battery Switch – Check ON
2. Generator Switches – RESET then ON

If generators fail to reset, proceed as follows:

3. Generator Switches – OFF
4. Descend – To lower practical altitude below 25,000 feet
5. Land as soon as conditions permit

Note

A no-flap landing will be necessary and the landing gear must be extended using the alternate system (see LANDING GEAR ALTERNATE EXTENSION).

HYDRAULIC SYSTEMS MALFUNCTIONS

The T-38A features two hydraulic systems. Each system may experience three types of malfunction, low pressure, high pressure, or fluid overtemperature. Hydraulic augmentation is required for flight control actuation and stabilization, plus operation of several critical components. Each system is linked to a hydraulic caution light, which will illuminate whenever pressure less than 1,500 psi is detected or hydraulic fluid temperature exceeds normal temperature. Excessive hydraulic pressure will not illuminate the caution lights, but can be detected only by noticing abnormal function of flight controls. If any hydraulic failure is noted, whether by illumination of the caution lights, or observation of abnormal flight control responses and operation, flight should be aborted if on the ground, or as soon as practicable if airborne.

DUAL HYDRAULIC SYSTEM FAILURE

With dual hydraulic system failure, flight control is impossible; proceed as follows:

1. **EJECT**

UTILITY OR FLIGHT CONTROL HYDRAULIC SYSTEM MALFUNCTION

With a utility hydraulic system failure, the speed brake, nosewheel steering, normal landing gear system, and stability augmenter will be inoperative. If the UTILITY HYDRAULIC or the FLIGHT HYDRAULIC caution light illuminates, use the following procedure:

1. Hydraulic Pressure Indicators – Check

If Hydraulic Pressure is Low:

1. Monitor both systems
2. Land as soon as conditions permit

If Hydraulic Fluid Temperature is High:

1. Shut down affected engine

Note

Minimize flight control movements.

2. Land as soon as conditions permit (Land from a straight-in approach)

EXCESSIVE HYDRAULIC PRESSURE

A steady-state hydraulic pressure higher than 3,200 psi in either system must be considered a system malfunction; proceed as follows:

If on the Ground:

1. Reject Aircraft – Shut down affected engine

If Airborne:

1. Terminate mission
2. Land from a straight-in approach (Minimize flight control movements)
3. After landing and clear of runway – Shut down affected engine

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

1. Shut down affected engine (Minimize flight control movements)
2. Land from a straight-in approach

If flight control becomes impossible, proceed as follows:

1. **EJECT**

LANDING EMERGENCIES

SINGLE-ENGINE LANDING

A straight-in approach should be flown. See Figure 20 for additional information on flying this single-engine approach. The following procedures should be accomplished before landing:

1. Gear – Down and Check Down

Note

If left engine in inoperative, normal windmilling RPM will provide adequate utility hydraulic pressure for a normal landing gear extension with a slightly longer extension time. If utility hydraulic system pressure is depleted, use the landing gear alternate extension system to extend the gear, and allow additional time for gear extension.

2. Wing Flaps – 60% (Set on Final Prior to Descent)

3. Wing Flaps – 100% (Set when Landing is assured – optional)

Note

Aerodynamic braking with less than 100% flaps is less effective and longer landing distances should be anticipated.

WARNING

Use maximum power, if necessary, to maintain landing pattern airspeeds.

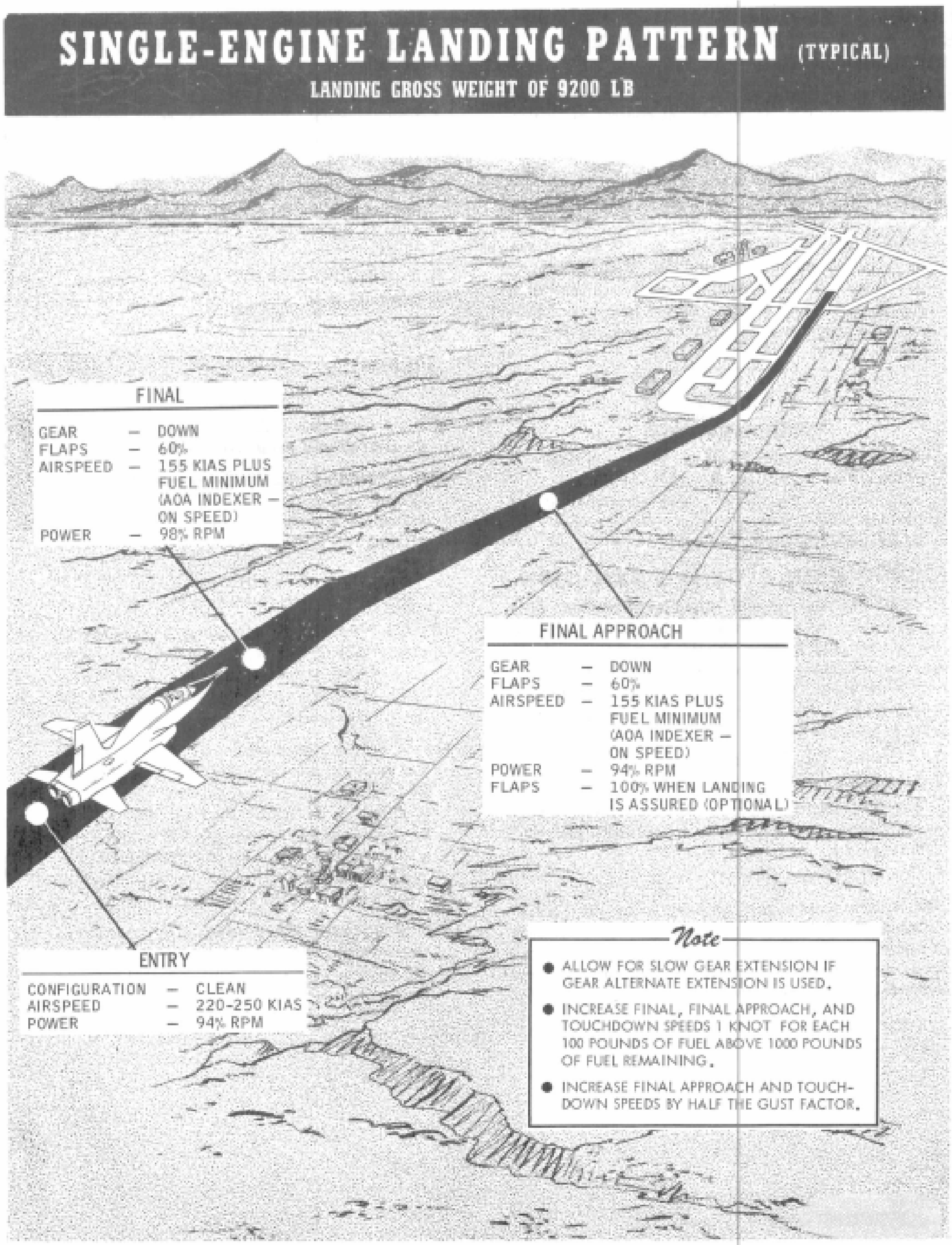

SINGLE-ENGINE LANDING PATTERN (TYPICAL)
LANDING GROSS WEIGHT OF 9200 LB
FINAL
GEAR — DOWN
FLAPS — 60%
AIRSPEED — 155 KIAS PLUS FUEL MINIMUM (AOA INDEXER — ON SPEED)
POWER — 98% RPM
FINAL APPROACH
GEAR — DOWN
FLAPS — 60%
AIRSPEED — 155 KIAS PLUS FUEL MINIMUM (AOA INDEXER — ON SPEED)
POWER — 94% RPM
FLAPS — 100% WHEN LANDING IS ASSURED (OPTIONAL)
ENTRY
CONFIGURATION — CLEAN
AIRSPEED — 220-250 KIAS
POWER — 94% RPM
Note
● ALLOW FOR SLOW GEAR EXTENSION IF GEAR ALTERNATE EXTENSION IS USED.
● INCREASE FINAL, FINAL APPROACH, AND TOUCHDOWN SPEEDS 1 KNOT FOR EACH 100 POUNDS OF FUEL ABOVE 1000 POUNDS OF FUEL REMAINING.
● INCREASE FINAL APPROACH AND TOUCH-DOWN SPEEDS BY HALF THE GUST FACTOR.

Figure 20

LANDING WITH BLOWN TIRE, LOCKED BRAKE, OR DIRECTIONAL CONTROL DIFFICULTY

The aircraft may be safely landed with a blown tire, locked brake, or similar directional control difficulty. Plan to land at minimum gross weight unless landing sooner is necessitated. Go-around after touchdown on a blown tire or locked brake should be avoided as rubber or other debris may be ingested by the engines. When it has been determined that a main gear tire has blown or a brake is locked, land on the side of the runway away from the malfunction. Make maximum use of rudder and wheel braking to maintain directional control. Nosewheel steering should be engaged only as a final attempt to maintain or regain directional control.

WARNING

If one brake system fails or failure is suspected, plan to land in the center of the runway. Stop the aircraft by using aerodynamic braking followed by a combination of wheel brake and nosewheel steering.

LANDING GEAR ALTERNATE EXTENSION

If the normal landing gear extension procedure fails to extend the gear to a down and locked position, the cause of the malfunction should be investigated provided circumstances allow. If corrective action cannot be taken, the landing gear alternate extension system may be utilized to extend the gear without hydraulic pressure by using the following procedure:

1. Airspeed – 240 KIAS, or less
2. Landing Gear Lever – LG DOWN
3. Landing Gear Alternate Release Handle – Pull approximately 10 inches and hold until gear unlocks, the stow handle
4. Gear Position – Check

If the landing gear cannot be lowered by the normal or alternate procedures, the landing gear door selector valve may have failed. The landing gear will not lower due to the pressure in the utility hydraulic system. Dissipating the pressure will allow the gear uplocks to release and the gear to extend. To dissipate the hydraulic pressure and extend the landing gear, proceed as follows:

1. Throttle (left engine) – OFF

2. Control Stick – Rapid lateral stick movements to deplete utility hydraulic pressure
3. Landing Gera Lever – LG DOWN
4. Landing Gear Alternate Release Handle – Pull, approximately 10 inches, while pressure is depleted, and hold until gear unlocks; then stow handle
5. Gear Position – Check; if indicators are still unsafe, Landing Gear Lever LG UP, then LG DOWN
6. Left Engine – Restart (see RESTARTING DURING FLIGHT procedure)

Note

- If the main gear fails to extend fully, yawing the aircraft will aid in extension.
- If the landing gear has been extended by use of the landing gear alternate release handle, nosewheel steering will not be available for taxiing.

CAUTION

- After lowering the landing gear with the alternate release handle, do not attempt to reset the switches by cycling the landing gear lever until the alternate release handle lanyard has been fully stowed.
- If the gear alternate extension system does not provide safe gear indication and utility hydraulic pressure is available, the landing gear system should be reset by recycling the landing gear lever to the LG UP position momentarily and returning it to the LG DOWN position to place utility hydraulic pressure on the down side of the landing gear system.
- If utility hydraulic pressure is not available, stop straight ahead on the runway, and have the landing gear safety pins installed prior to leaving the runway.

SECTION 4
AUXILIARY EQUIPMENT
TABLE OF CONTENTS

CABIN AIR-CONDITIONING AND PRESSURIZATION SYSTEM

This aircraft is equipped with a cabin pressure regulator. The cabin is not pressurized below 8,000 feet. From 8,000 feet to approximately 23,000 feet a cabin pressure of 8,000 feet is maintained. Above 23,000 feet, a differential of 5.0 psi will be maintained relative ambient pressure at altitude. A cabin altimeter (Figure 21) is located on the instrument panel of the front cockpit that indicates the pressure altitude within the cabin. All controls in the air-conditioning and pressurization system (Figure 22), except the canopy defog, are electrically (AC) controlled. The canopy defog is pneumatically controlled and does not require AC power.

Figure 21

CABIN PRESSURE SWITCH AND CABIN TEMPERATURE CONTROLS

The jet features a combination pressurization and cabin temperature control system (Figure 22). A red guarded cabin pressure switch controls air-conditioning and pressurization. When the switch is placed at CABIN PRESS, both the cabin air-conditioning and pressurization systems are activated. The cabin temperature can be set by rotating the cabin temperature control knob to the desired temperature setting. The CABIN PRESS setting is the normal setting and automatically controls both the pressurization as well as maintains the selected cabin temperature.

Figure 22

When the cabin pressure switch is placed at RAM DUMP setting (Figure 23), the anti-G suit, canopy defog, cabin pressurization and air-conditioning systems, and the canopy seal are deactivated, and ram air enters the cabin for ventilating purposes.

Figure 23

Note

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

CABIN AIR TEMPERATURE SWITCH

A cabin air temperature switch (Figure 23-24) is located on the right subpanel of the front cockpit. The MAN HOT and MAN COLD positions (Figure 25) provide for manual temperature control when the automatic temperature control system fails. Temperature can be set between 40°F to 100°F.

Figure 24

Note

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

CANOPY DEFOG KNOB

The flow of defog air to the windshield and both canopies is controlled by the canopy defog knob in the front cockpit (Figure 23). The quantity of defog air flow increases as the Canopy Defog knob is rotated clockwise. Fully rotating the knob counter-clockwise will shut off all defog airflow to the canopy and windshield.

ENGINE ANTI-ICE SYSTEM

Engine anti-icing is accomplished by directing compressor eighth-stage air to the inlet guide vanes and bullet nose of the engine. A normally closed shutoff valve is controlled electrically by a three-position engine anti-ice switch (Figure 24). The switch positions are placarded MAN. ON in the up position and MAN. OFF in the center and down positions. Placing the switch at MAN. ON allows hot air to flow to the inlet guide vanes and bullet nose of the engine, and causes the ENG ANTI-ICE ON light on the caution light panel and the MASTER CAUTION light in each cockpit to illuminate. The caution light alerts the crewmember that the switch is in the MAN. ON position but does not indicate that the system is operating. At engine speeds of 94% to 98% RPM, an increase in EGT of approximately 15°C is normal with the switch at MAN. ON. The engine anti-ice system fails to the on position with a complete loss of AC electrical power. Below 65% RPM, the anti-ice valve is always open, allowing hot air to flow to the inlet guide vanes and the bullet nose of the engine, regardless of the position of the engine anti-ice switch. The switch should normally be at the MAN. OFF. A 9% loss in MIL thrust and a 6.5% loss in MAX thrust can be expected with the engine anti-ice switch on.

PITOT BOOM ANTI-ICING

The pitot boom is de-iced by an electrical heating system. The heater is controlled by a pitot heat switch (Figure 24) on the right subpanel in the front cockpit. Placing the switch to the up position (placarded PITOT HEAT) turns the pitot boom heat on. The pitot heat should be used whenever operating in areas of moisture within 15 degrees of the freezing level. The pitot heat is de-energized whenever the switch is placed in the bottom position (placarded MAN. OFF).

AoA VANE ANTI-ICING (AIRCRAFT WITH AoA SYSTEM)

The vane of the AoA transmitter is deiced by an electric heating element powered by the left AC bus and is activated when the pitot heat switch (Figure 24) is placed in the upper position (placarded PITOT HEAT). The AoA vane anti-icing system should be engaged anytime the aircraft is operating in areas of moisture within 15 degrees of the freezing level. The heating is de-energized when the switch is placed in the bottom position (placarded OFF).

COMMUNICATION AND NAVIGATION EQUIPMENT

Communication and navigation equipment is installed in the aircraft in the cockpit pedestal of both the front and rear cockpits (Figure 12).

UHF COMMAND RADIO SYSTEM AN/ARC-34

The VHF command radio set provides voice or tone transmission and reception within the VHF frequency span (Figure 25).

Figure 25

Note

Due to limitations with Flight Simulator X, these radios have been modified to operate on the VHF radio frequency range only. UHF communications are not supported in FSX. Guard frequency (121.5) can only be monitored when manually tuned into the radio. Additionally, the preset mode of operations is disabled. Lastly, the volume knob is disabled.

These frequencies can be manually selected by placing the mouse curser over either of the rotating knobs and tuning up or down via use of up and down rotations with the mouse wheel, or through left or right clicks on the rotating knobs. A four-position function control switch (Figure 25) selects OFF, MAIN, BOTH, and ADF (inactive). A three-position switch (Figure 25) selects MANUAL, PRESET, and GUARD.

Note

While the four-position and three-position switches in this MilViz T-38A are modeled to operate, due to limitations in FSX, the communications radio's left four-position knob is limited to two selectable positions: OFF and BOTH. OFF will power the unit and avionics master off and BOTH will power up both the radio and the avionics master.

COMM ANTENNA AND AUDIO SWITCHES

The aircraft is equipped with an upper and lower VHF antenna. An antenna selector switch is located on the left subpanel of the front cockpit (Figure 26), placarded COMM. ANTENNA, featuring AUTO, UPPER, and LOWER settings. Placing the switch at UPPER or LOWER permits reception and transmission through the antenna manually selected. Selecting the normal position AUTO allows the radio to select and lock on the antenna that is providing the optimum reception and transmission.

Figure 26

COMMAND RADIO AND NAVIGATION TRANSFER SWITCHES

Control of the radios can be facilitated by the RADIO TRANSFER switches (see Figure 26). One switch located above is placarded COMM and controls transfer of the communications radio. The switch immediately below it is placarded NAV and allows control transfer of the navigational radio. Each of the two switches are placarded FWD and AFT. In the aft cockpit (intended for the Instructor Pilot) there is a guarded switch placarded COMM & NAV OVERRIDE. When the rear cockpit pilot engages this switch, it transfers and maintains communication and navigation radio control to the rear cockpit. This switch is guarded in the down (disabled) position and should normally be left in this position.

Note

This MilViz T-38A has been modified to facilitate on-demand operation of the comm and nav radios from either cockpit. Therefore, while these switches may be manipulated, they are disabled in this jet.

INTERCOM AUDIO MONITOR BUTTONS

Each communication and navigational radio has a dedicated intercom audio monitor button (Figure 26). When the button is pulled out, it facilitates audio listening through the cockpit intercom system. When the button is pushed in, it mutes the audio listening function of the respective radios at that cockpit station.

Note

This MilViz T-38A has had the communications radios hard-wired so that both the front and rear cockpits cannot mute the comm radio volume. However, to monitor the Morse code identification of a VOR or ILS radio, the monitor buttons for the respective radios must be pulled out.

FLIGHT DIRECTOR SYSTEM

The flight director system consists of an attitude director indicator (ADI) (Figure 38) and horizontal situation indicator (HSI) (Figure 30), a flight director switch (Figure 27), a navigation mode switch (Figure 47), a steering mode switch (Figure 48), a compass switch (Figure 28), a directional gyro indicator light (Figure 32), and an attitude gyro control assembly. The instrument presentation is always identical in the two cockpits, with mode control in the cockpit selected by the navigation transfer switch. A button for fast erection of the ADI vertical gyro is located on the left subpanel in the front cockpit (figure 29).

ATTITUDE GYRO CONTROL ASSEMBLY

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

Note

Gyro erection time for both the ADI and HSI is 90 seconds. The system should be reliable for flight after the 90-second erection period. However, the gyros do not reach full speed until 13 to 15 minutes after AC power is applied. Some precession can be expected during the gyro acceleration period or following "over the top" aerobatic maneuvers. Normally, under these circumstances, precession will not exceed 4 degrees in pitch, bank, or heading.

FLIGHT DIRECTOR SWITCH

A guarded flight director switch (Figure 27) is located on the left console of the front cockpit. Placing the switch to the unguarded OFF position (Figure 27) removes electrical power from the flight director system. The switch also controls power to the standby attitude indicator. The switch should be left in the guarded ON position during all phases of flight from engine start to engine shutdown unless the pilot encounters inaccurate or confusing FD indications.

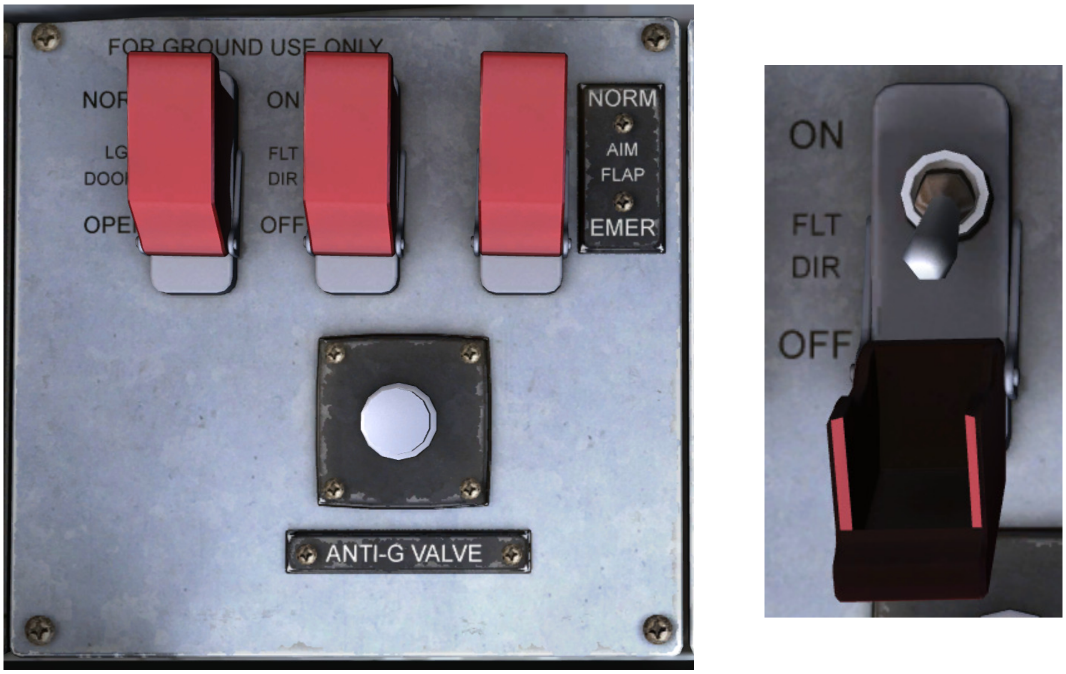


Figure 27

Note

If the pilot determines that the bank steering bar or the pitch steering bar on the ADI are providing confusing or inaccurate inputs, the Flight Director power switch may be placed in the OFF position to remove the bars from the ADI.

COMPASS SWITCH AND INDICATOR LIGHT

Figure 28

A compass switch (Figure 28) is located on the left subpanel of the front cockpit. When the switch is in the MAG position, the compass card will fast slave to indicate the correct magnetic heading and will remain slaved to the magnetic north. In the DIRECT GYRO position, magnetic sensing is no longer available and the heading displayed is based solely on direction gyro stability. Returning the switch from DIRECT GYRO to MAG automatically fast slaves the system. Placing the switch momentarily at FAST SLAVE and returning it to MAG will also provide rapid correction of the system to magnetic north.

Note

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

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

Note

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

A directional gyro indicator light is located on the left subpanel of the rear cockpit to alert the Instructor Pilot when the compass switch is placed at the DIRECT GYRO position.

FAST ERECT BUTTON (ADI GYRO)

Figure 29

A button for rapidly erecting the vertical gyro is located on the left subpanel in the front cockpit, immediately to the right of the alternate gear extension handle. Pressing the pushbutton erects the vertical gyro at a minimum rate of 15 degrees per minute.

Note

Maintain level, unaccelerated flight while actuating the button.

HORIZONTAL SITUATION INDICATOR (HSI)

An HSI (Figure 30) on each instrument panel provides the pilot with a view of the navigation situation as if he were above the aircraft looking down.

Figure 30

HEADING INFORMATION

When the compass switch is at MAG, the magnetic heading of the aircraft is displayed under the upper lubber line and the reciprocal heading is displayed under the lower lubber line. When the compass switch is in the DIRECT GYRO position, the heading displayed will be a raw heading that the pilot must periodically index to the standby magnetic compass as the gyros precess. During any attempts to re-index the HSI to the magnetic compass while in DIRECT GYRO mode of operation, the jet should kept on a level and unaccelerated heading to keep the magnetic compass as stable as possible.

HEADING MARKER AND HEADING SET KNOB

Located on the lower left side of the HSI, the heading set knob (Figure 31) allows the pilot to rotate the heading marker (Figure 32) clockwise or counter-clockwise as a reference mark. Once positioned, the heading marker remains fixed relative to the card as the heading marks on the card will rotate with aircraft turns.

Figure 32

Figure 31

Note

In the MilViz T-38A, rotate the heading set knob clockwise by hovering the mouse pointer over the knob and performing either a right mouse click or an up rotation of the mouse wheel. A counter-clockwise rotation is accomplished by hovering the mouse pointer over the knob and performing either a left mouse click or a down rotation of the mouse wheel. Also, the heading marker may be immediately centered under the 12 o'clock lubber line by hovering the mouse pointer over the knob and clicking in the mouse wheel button.

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

The course arrow (Figure 33) may be rotated about the compass card by use of the course set knob (Figure 34). The course set knob simultaneously positions the course arrow and course selector window (Figure 35) so that they will always read the same course. Once positioned, the course arrow remains fixed relative to the compass card. When the course arrow is set, it will remain aligned (parallel) with the radial or localizer course selected, providing the compass card is slaved to magnetic north. The course deviation indicator (Figure 36), which consists of the center section of the course arrow, indicates lateral and angular displacement from the selected TACAN or localizer course. After tuning in a TACAN station and receiving a reliable signal, center the course-deviation indicator (CDI) by rotating the course set knob, and check the reading of the course selector window. Rotate the course set knob until the CDI is at the outer dot, and check the course selector window for a change of 10 degrees +/- 1.5 degrees.


Figure 33

Figure 34

Figure 35


Figure 36

Note

In the MilViz T-38A, rotate the curse set knob clockwise by hovering the mouse pointer over the knob and performing either a right mouse click or an up rotation of the mouse wheel. A counter-clockwise rotation is accomplished by hovering the mouse pointer over the knob and performing either a left mouse click or a down rotation of the mouse wheel. Also, the heading marker may be immediately centered under the 12 o'clock lubber line by hovering the mouse pointer over the knob and clicking in the mouse wheel button.

BEARING POINTER

Figure 37

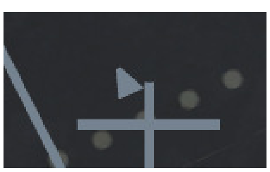
The bearing pointer (Figure 37) indicates correct magnetic bearing to a selected TACAN station when the compass card is functioning in the MAG mode. If the compass card is not aligned with magnetic north, which is possible when in the DIRECT GYRO mode, the bearing pointer will still "point" to the selected TACAN station, but the corresponding indication on the compass card may not accurately indicate the associated radial to the TACAN station.

With bearing pointer or compass malfunctions, the CDI may be used to find magnetic headings to a TACAN station by centering the CDI with a "to" indication, and flying the course in the course set window using the standby compass.

CAUTION

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

TO/FROM INDICATOR



The To/From indicator (small white triangle) functions in TACAN only. It works in concert with the value dialed into the HSI course window. In Figure 37.1, it indicates a "To" condition. It flips below the mini aircraft symbol to reflect a "From" condition.

AIRCRAFT SYMBOL

The aircraft symbol is presented at the center of the HSI compass card, and is fixed in position. It serves to provide the pilot with a graphical reference point symbolizing the aircraft's position relative all HSI references.

RANGE INDICATOR

The range indicator reads slant range in nautical miles to the selected TACAN. It is covered with a black bar whenever no TACAN station is tuned and receiving a valid signal.

ATTITUDE DIRECTOR INDICATOR (ADI)

An ADI (Figure 38) is located on each instrument panel. For modes of operation of the ADI, refer to the steering mode switch and navigation mode switch discussion in this section.

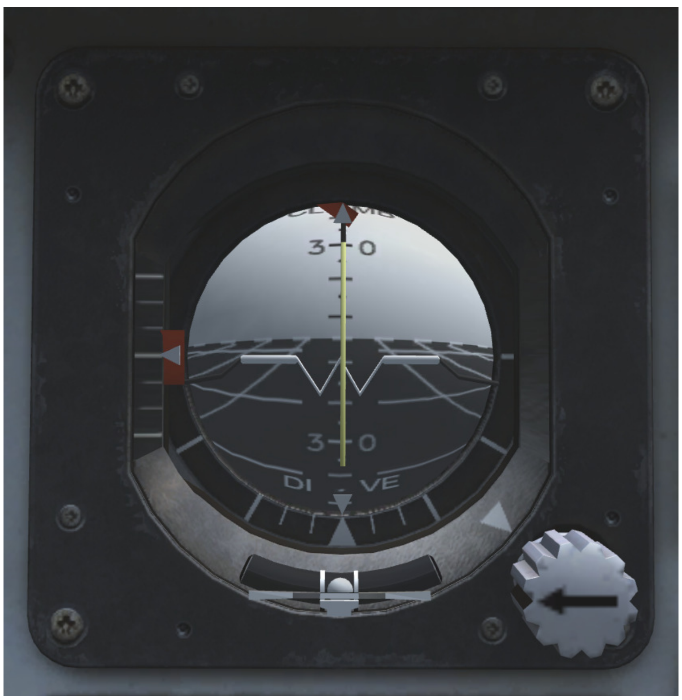


Figure 39

ATTITUDE SPHERE, PITCH TRIM KNOB, AND MINIATURE AIRCRAFT

The attitude sphere upper half is painted gray and the lower half is black. The gray area represents the sky and the black area, with etched perspective lines, represents the ground. At the junction of the gray and black is the horizon bar. General pitch attitude near level flight may be obtained by referencing the miniature aircraft against the sphere color. Specific pitch attitude may be obtained by referencing the miniature aircraft against the attitude sphere pitch markings. There are dots each 5 degrees of pitch, lines each 10 degrees of pitch, and numbered lines each 30 degrees of pitch. The pitch trim knob (lower right side of ADI) (Figure 40) allows the pilot to adjust the miniature aircraft symbol (Figure 41) so that it sits on the horizon line while on sitting on level ground or when in level flight relative a visible flat horizon. Figure 41.1 shows the ADI course steering bar with TACAN interface.

Figure 40

Figure 41

BANK POINTERS

A bank pointer (white triangle) is provided at the top and bottom of the instrument. The top pointer is without a scale, but the bottom pointer (Figure 42) is provided with a bank scale which is graduated in 10-degree increments up to 30 degrees and in 30-degree increments up to 30 degrees and in 30-degree increments up to 90 degrees of bank.

Figure 42

The lower bottom bank pointer features a moving top triangle that rotates immediately above the fixed bank scale. The fixed bank scale has a upward pointing triangle that is indexed at the 0-degree bank value. When the rotating triangle is in line with the fixed scale triangle, the aircraft is in an unbanked flight condition.

General bank information may also be obtained by noting the angle between the miniature aircraft and the numbered pitch lines. When the aircraft is erect, the legends on the attitude sphere will appear right side up.

ATTITUDE WARNING FLAG

The attitude warning flag (OFF) will appear whenever electrical power to the system has failed or is interrupted (Figure 43). The flag will also appear during initial application of electrical power for approximately 1 minute. The instrument is unreliable until the flag disappears.

Figure 43

WARNING

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

SLIP INDICATOR

The ADI has an integrated slip indicator along the lower half of the unit and immediately below the lower bank pointer (Figure 44). When the ball is centered between the two index lines, the aircraft is in a coordinated phase of flight. When the ball is deflected to the right of the index lines, then the aircraft is in a left yaw and must be countered by application of right rudder. Oppositely, when the ball is deflected left of the index lines, then the aircraft is in a right yaw and must be countered with left rudder.

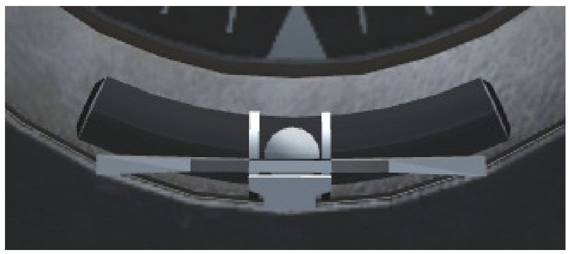


Figure 44

LOCALIZER INDICATOR AND LOCALIZER WARNING FLAG

The localizer indicator (Figure 45) indicates the aircraft position relative to a TACAN, ILS or localizer course steering signal. The localizer indicator warning flag (Figure 46) is displayed whenever the ILS or localizer course signal is considered unreliable. During an instrument approach procedure, the approach should be immediately aborted whenever the localizer warning flag is present. If established on the approach after the initial approach fix (IAF) the aircraft should be immediately leveled off and the published missed approach procedure flown to the best ability of the pilot with all available inputs.

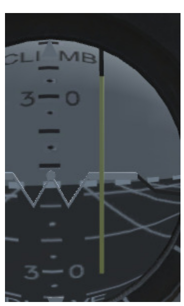


Figure 45

Figure 46

GLIDESLOPE INDICATOR AND GLIDESLOPE WARNING FLAG

The glideslope indicator displayed on the ADI only indicates aircraft position relative to an ILS glideslope signal. The glideslope warning flag is displayed whenever the ILS glideslope signal is deemed unreliable. The appearance of the glideslope indicator and warning flag are identical to the indicator and warning flag for the localizer, expect the indicator is oriented horizontally and the warning flag is displayed on the left side of the ADI. During an instrument approach procedure, a planned ILS approach should be immediately adjusted to reflect localizer only (non-precision) approach minimums as well as aircraft altitude immediately adjusted to match the localizer only altitude let down plan for the aircraft's position.

STEERING MODE SWITCH AND NAVIGATION MODE SWITCH

A steering mode switch and a navigation mode switch (Figure 47) are located on each instrument panel. The following discussion assumes that desired navigation facilities are tuned in.

Figure 47

STEERING MODE SWITCH

The steering mode switch (Figure 48) had two positions, MANUAL and NORMAL. In the MANUAL position, the bank steering bar is displayed on the ADI. If the aircraft is flown in such a manner as to center the bank steering bar, the aircraft will roll in, turn to, roll out, and maintain the heading selected by the heading set knob and displayed in the heading market. This is the sole function of the MANUAL position and it will operate in this manner regardless of the position of the navigation mode switch. Operation of the system with the switch in the NORMAL position (Figure 49) will be discussed under Navigation Mode Switch.

Figure 48

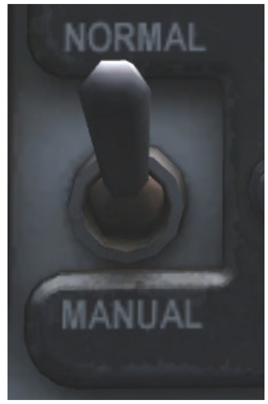


Figure 49

NAVIGATION MODE SWITCH

The navigation mode switch (Figure 50) has three positions: TACAN, LOCALIZER, and ILS. The following discussion of switch selections assumes that the steering mode switch is in the NORMAL position.

WARNING

The functionality of the ADI localizer and glideslope bars will be adversely impacted by failure to place the steering switch in the NORMAL position. Failure to confirm the steering switch is in the NORMAL position could result in gross navigational errors during a critical instrument approach procedure, leading to death.

Note

The flight director steering system may input inaccurate bank steering bar indications during an aircraft bank change. Constant reference to the HSI localizer deviation bar and ADI glideslope indicator is vital. The pilot may convert the ADI steering bars to function as deviation bars by replacing the [vcockpit01] gauge01 entry in the panel.cfg file with:

```
gauge01 =T38_Logic!T38_Logic_AltFD   0,0,1,1
```

Figure 50

TACAN SELECTED

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

LOCALIZER SELECTED

When LOCALIZER is selected, the course arrow and course window should be set with the published localizer front course. The course deviation indicator on the HSI will then show aircraft position relative to the localizer course. Additionally, the localizer indicator bar on the ADI will be in view and operational. Further, if within the area of an ILS glideslope reception, the glideslope indicator (on the ADI only) will provide indications of the aircraft position relative to the station's glideslope signal. The bank steering bar on the ADI will also be in view to assist the pilot in optimal localizer course interception.

ILS SELECTED

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

FLIGHT DIRECTOR OPERATON

The following is a simple listing of normal operating procedures (checklist steps) required to be performed to execute the flight director operations indicated.

Manual Heading Mode Selected

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

Note

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

The FD bank steering bar may show inaccurate inputs until established on localizer. Constant reference to the HSI course deviation bar and the ADI's glideslope deviation indicator are required to properly fly an instrument approach. The pilot may elect to remove the bank steering bar and pitch steering bar from the ADI by placing the Flight Director power switch in the OFF position (see Figure 27).

Enroute TACAN Course Interceptions

Refer to current Air Force Instrument Flying Procedures Manual, for course interceptions using the flight director system. Select TACAN on navigation mode switch when making TACAN course interceptions.

Instrument Approach Procedures

The following procedures are specified for ILS approaches (precision approaches with localizer and glideslope indications. However, except for the absence of a valid glideslope signal, they may also be used to perform a localizer only approach procedure.

ILS Approach

1. ILS Receiver – Tune, identify, and monitor
2. Course Arrow and Course Window – Set localizer front course
3. Navigation Mode Switch – Localizer
4. Steering Switch – Normal

WARNING

The functionality of the ADI localizer and glideslope bars will be adversely impacted by failure to place the steering switch in the NORMAL position. Failure to confirm the steering switch is in the NORMAL position could result in gross navigational errors during a critical instrument approach procedure, leading to death.

5. Bank Steering Bar – Centered

   The bank steering bar may be used when the aircraft heading is within 90 degrees of the localizer front course. The flight director directs an intercept angle of up to 45 degrees to the localizer. A maximum bank angle of 35 degrees is required to center the bank steering bar.

WARNING

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

6. Navigation Mode Switch – ILS when on the localizer

   Keeping the bank steering bar centered will maintain the aircraft on, or correct it to, the localizer course. Wind drift corrections are accomplished automatically.

Note

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

7. Pitch Steering Bar – Centered

   As glideslope indicator (GSI) approaches midscale, adjust the pitch to center the pitch steering bar. Keeping the pitch steering bar centered will maintain the aircraft on, or correct it to, the glideslope.

8. CDI and GSI – Crosscheck throughout the approach

   The navigation mode switch must be at LOCALIZER or ILS to obtain localizer or glideslope indications from the CDI and GSI. The course and glideslope warning flags function only in LOCALIZER and ILS and are out of view in TACAN. TACAN bearing and range are available in the LOCALIZER or ILS positions.

TACAN RADIO UNIT

Figure 51

Channel Selector Switch

Any desired operating TACAN channel from 01 to 126 may be selected by actuating the channel selector switch on the TACAN radio unit (Figure 51). The TACAN unit has two frequency tuning switches indexed by a white line pointing to the affected frequency sections. The left switch slews the left two numbers. The right switch tunes the right most frequency number but as it is cycled, it can sequentially tune in one digit increments through the entire 01 to 126 range. Hovering the mouse pointer over the right frequency select switch and clicking the mouse wheel button will cycle X and Y frequency options. Channel sequencing is accomplished by hovering the mouse pointer over the desired frequency slewing button and performing either a up mouse wheel action or a right click operation to increase the frequency, or a down mouse wheel action or a left click operation decrease the frequency.

The TACAN unit is compatible with civilian VOR stations. Set the matching TACAN frequency for the VOR station – see TACAN TO VOR FREQUENCY CONVERSION CHART (Figure 70) in Section 6 of this POH.

Function Switch

A TACAN function switch is located on the right side of the TACAN radio unit. The switch is placarded for five modes: OFF, REC, T/R, A/A REC, and A/A T/R. The MilViz T-38A has been modified so that the TACAN is limited to the T/R or A/A REC modes. Whenever the TACAN radio switch is placed to the T/R mode the flight director system is energized and both the TACAN and ILS radios will provide proper signals to the flight director system for input to the ADI and HSI. When left in the A/A REC mode, the flight director cannot provide inputs to the ADI and HSI.

ILS/LOCALIZER NAV RADIO UNIT

Figure 52

The ILS radio unit is automatically powered on whenever the master battery switch is put in the ON position. The left side frequency tuning switch changes the even digits. The right side frequency tuning switch changes the decimal digits in .05 increments. To increase the frequency values, hover the mouse pointer over the desired frequency switch and either rotate the mouse wheel up or right click. To decrease the frequency values, hover the mouse pointer the same way and rotate the mouse wheel down or left click.

IFF SYSTEM

The MilViz T-38A is equipped with the AN/APX-46 IFF system modified in Block 70 updates (Figure 53). This unit support independent power up or power down of the Mode 1, 3 and 4 squawk codes.

Figure 53

IFF SYSTEM AN/APX-46 CONTROLS

The IFF system controls are located on the right console of the front cockpit. The control unit features two primary wafer switches aligned on the upper left and upper right of the unit. The upper left wafer controls the Mode 4 squawk code selection A or B, plus also the option to hold the A and B codes after a power shutdown. Also, this wafer allows the pilot to zeroize both Code A and B for security reasons. Specific instructions for the setting of M4 A or B will be contained in specific theater of operations Special Instructions (SPIN’s).

Note

The Mode 4 IFF operation has been disabled as a security precaution given the T-38A is a dedicated training aircraft devoid of a combat role. All control operations described are disabled.

The upper right wafer switch is the Master Control Knob, controlling main power status of the entire unit. This is marked with labels OFF, STBY, LOW, NORM, EMER. OFF depowers the unit and will zeroize all codes unless previous actions are taken to HOLD them.

In the middle of the unit, from right to left, are six switches. In sequence left to right, these are:

1. Mode 4 power switch labeled for three options (Inoperative):
   a. AUTO: standard powered state.
   b. OUT: de-powered state (i.e. no transmissions of Mode 4 codes).
   c. LIGHT: transmission in a lower power setting to reduce detection ranges.
2. Four sequential test/transmission power switches for Mode 1, Mode 2, Mode 3, and Mode 3C altitude reporting operations:
   a. M1, M2, M3A, M-C: The up test positions for each mode.
   b. Each test switch is spring loaded to recycle back to the ON position after three seconds of test.
   c. To cycle to the test position, left click and release the desired switch.
   d. ON: The normal position is the middle selection for transmission of the various mode transmissions.
   e. OUT: The down switch position disables the transmission of the various modes. For each, left click the desired switch to place it in the OFF position.
3. Radiation Test/Monitor Switch:
   a. RAD TEST: Radiation test
   b. OUT: No test performed
   c. MON: Monitor test

The lower third of the unit contains from right to left:

1. Mode 4 Control Switch (Inoperative)
2. Code wheel selectors to dial in Mode 1 and Mode 3 squawk codes
   a. Each code wheel changes its adjacent value

b. To increase the setting, hover the mouse pointer over the desired wheel and perform an up movement of the mouse wheel or a left click.
c. To decrease the setting, likewise hover the mouse pointer over the desired wheel and perform a down movement of the mouse wheel or a right click.

3. Identification of Position Switch
    a. IDENT: A high powered signal is transmitted to ATC to help locate the aircraft's position on ATC radar (To be used only on direction by ATC agency).
    b. OUT: Normal strength Mode 3 signal is transmitted
    c. MIC: Same signal as for IDENT, except the increased strength signal is not transmitted until the pilot activates his push-to-talk microphone button (Inoperative)

ALTIMETER

The T-38A is equipped with a "Counter-Drum-Pointer" altimeter system (Figure 54).

Figure 54

The altimeter is programmed to perform in two modes of operation, Primary and Standby. In primary mode the instrument receives corrected pressure altitude readings from the altitude computer. In standby mode, the altimeter operates without these corrected pressure altitude inputs and instead receives raw outside static air pressure from the static port. The instrument provides altitude data to the IFF Mode 3C signal to report the aircraft's altitude to ATC when the IFF M-C transmission switch is left in the ON position.

POWER INTERRUPTIONS AND STANDBY/RESET SWITCH

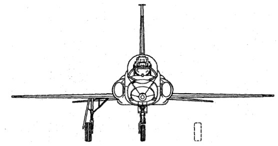
When power is interrupted to the altimeter, the red STBY flag is illuminated; indicating that the instrument has detected a power interruption and has reverted to standby mode of operation. This change of operation mode requires a power interruption of at least three seconds.

On the lower right side of the instrument is a spring loaded switch labeled STBY RESET. If the instrument is operating in the standby mode, the pilot may elect to reset the instrument to primary mode by rotating the spring-loaded switch to the RESET position. If the instrument is able to operate on primary power, the red STBY flag will disappear.

STANDBY ATTITUDE INDICATOR

A standby attitude indicator (Figure 55) is located on the instrument panel to provide a backup attitude reference if the flight director system malfunctions. The instrument is remotely operated by signals from an MD-1 vertical gyro, which is separate from the flight director system and is located in the dorsal section of the fuselage. Complete erection requires 5 minutes after AC power is applied. The instrument incorporates a red OFF flag that will illuminate whenever the system has failed or experiences a power interruption.

Figure 55



ANGLE-OF-ATTACK (AoA) SYSTEM

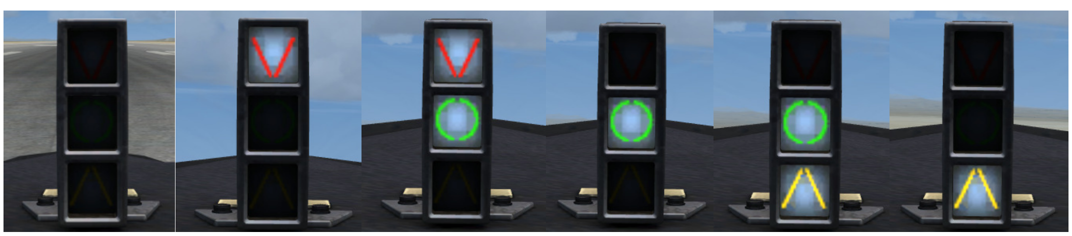
The angle-of-attack system (Figures 56-60) senses aircraft angle of attack and displays this information to both crewmembers. The AoA system consists of an AoA vane transmitter, and AoA computer, and in each cockpit an AoA indicator, AoA indexer, and indexer lights dimmer control. The system provides compensation for various wing flap and landing gear configurations. The AoA system presents the following displays in each cockpit:

1. Optimal AoA for final approach.
2. AoA when buffet and stall will occur.
3. Approximate AoA for maximum range and maximum endurance.

The vane of the AoA transmitter is located on the forward right side of the fuselage. The vane is electrically heated for anti-ice and is activated when the pitot heat switch is turned on. The AoA computer, which is powered by the left AC bus, receives signals from the AoA vane transmitter, wing flap position synchro-transmitter, and nose gear downlock indicating system.

AoA Indexer Display Examples

Figures 56-60 below illustrate the actual AoA indexer as mounted on the cockpit glare shield of the front cockpit. Each of the display examples show the various combinations of indications.



From left to right, the various displays indicate the following flight conditions:

1. No indication
2. AoA Slow
3. AoA Slightly Slow
4. AoA on Speed
5. AoA Slightly Fast
6. AoA Fast

AoA SYSTEM AND DISPLAY GRAPHIC

Detailed relationships are shown on the AoA System and Displays Graphic (Figure 61).

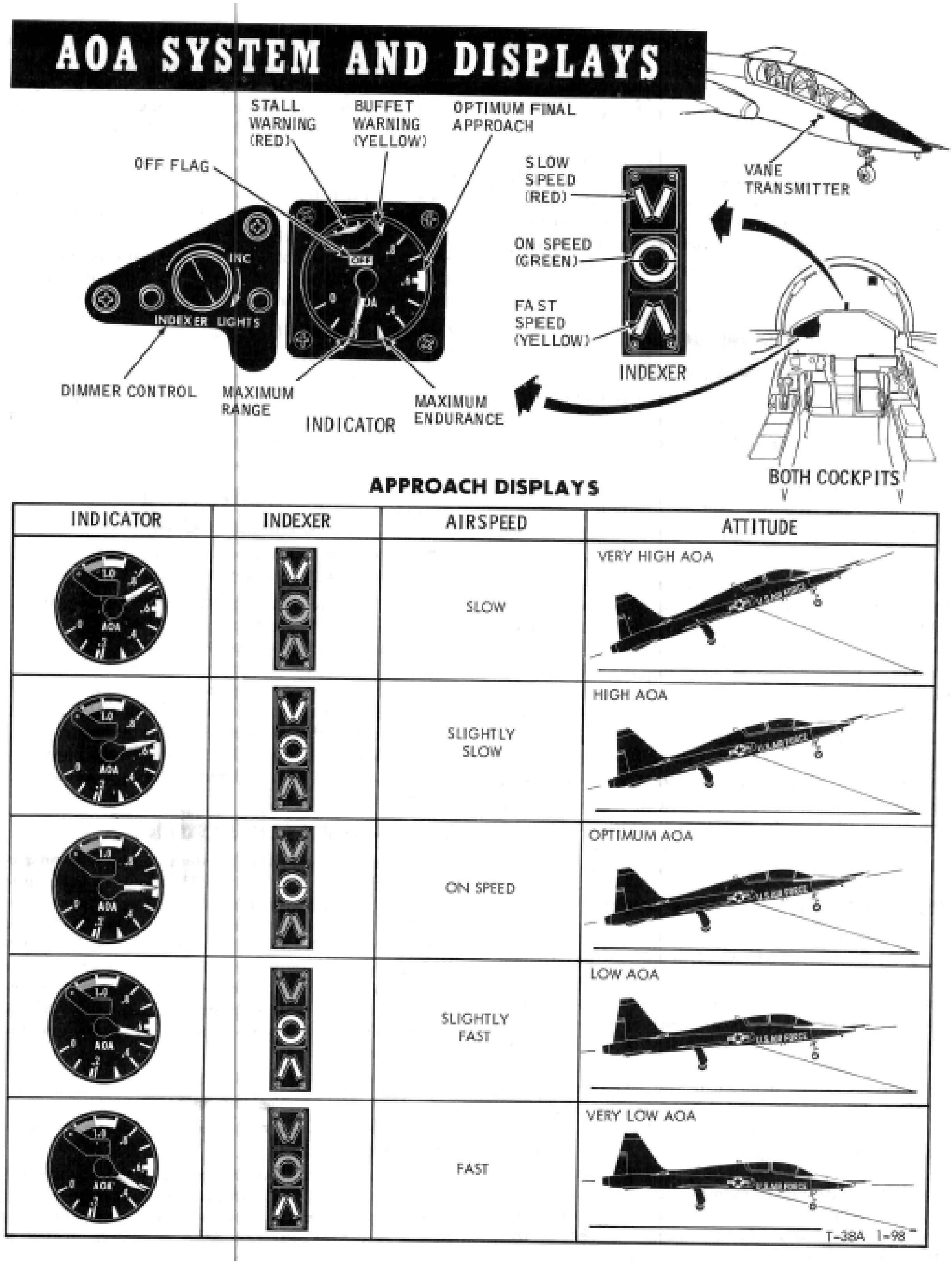

AOA SYSTEM AND DISPLAYS
STALL WARNING (RED)
BUFFET WARNING (YELLOW)
OPTIMUM FINAL APPROACH
OFF FLAG
SLOW SPEED (RED)
ON SPEED (GREEN)
FAST SPEED (YELLOW)
VANE TRANSMITTER
INC
INDEXER LIGHTS
DIMMER CONTROL
MAXIMUM RANGE
INDICATOR
MAXIMUM ENDURANCE
INDEXER
BOTH COCKPITS
APPROACH DISPLAYS
INDICATOR
INDEXER
AIRSPEED
ATTITUDE
SLOW
VERY HIGH AOA
SLIGHTLY SLOW
HIGH AOA
ON SPEED
OPTIMUM AOA
SLIGHTLY FAST
LOW AOA
FAST
VERY LOW AOA
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Figure 61

LIGHTING EQUIPMENT

Exterior and interior lighting equipment controls (Figure 62) are located on the right console of the front cockpit.

Figure 62

EXTERIOR LIGHTING

Rotating Beacon Lights and Switch

One rotating beacon light is located near the top of the vertical stabilizer and one on the lower fuselage. The lights operate on AC and are controlled by the beacon light switch (Figure 62) on the right console of the front cockpit.

Position Lights and Switch

The position lights and switch (Figure 62) operate on 6-volt AC power from a transformer connected to the left AC bus. The position lights are located in each wingtip, in the vertical stabilizer, and in the lower fuselage. The position lights are controlled by a switch on the right console of the front cockpit.

Formation Lights and Switch

Formation lights (Figure 62) are operated by DC bus power and are located on each side of the forward nose section. Formation lights are controlled by a switch on the right console of the front cockpit.

Landing-Taxi Light

A single retractable landing-taxi light with dual filaments is installed on this aircraft under the nose. When the lights are turned on, and the gear is extended, the light also extends. The landing-taxi light switch (Figure 63 and 64) is on the left subpanel of the front cockpit. The switch controls only filament power. When the weight of the aircraft is off the main gear and the landing-taxi light switch is at ON, both filaments are burning. When the weight of the aircraft is on the main gear, the light moves to the taxi position and one filament is extinguished. Turning off the position lights retracts the landing light in about 10 seconds.

Figure 63

Figure 64

INTERIOR LIGHTING

Instrument lights operate on AC power. Knobs located on the right console of each cockpit (Figure 62) controls the intensity of white instrument floodlights. Rotating the knobs fully clockwise increases light intensity to maximum output. Rotating the knobs fully counter-clockwise will turn each floodlight off. To put the floods into the dimmest setting, rotate the knobs clockwise out of the OFF position.

OXYGEN SYSTEM

The aircraft uses a liquid oxygen system to supply breathing oxygen to crewmembers. The oxygen regulators (automatic diluter demand) control the flow and pressure of the oxygen and distribute it in the proper proportions to the masks. This aircraft is equipped with an oxygen system (Figure 65) that will turn off oxygen flow to the mask (both 100% and ambient cockpit air) whenever the supply lever is put in the OFF position. This is a safety feature designed to alert the pilot to an inadvertent switching off of the oxygen supply, either by switch movement or bottle failure.

Figure 65

The oxygen system is normally left in the ON-NORMAL-NORMAL setting. This setting maximizes the duration of the onboard liquid oxygen supply by mixing the 100% oxygen in the bottle with ambient air in the cockpit. The proportions are automatically mixed based on altitude of the aircraft.

During any emergency involving fire or smoke and fumes in the cockpit, the pilot(s) must place the oxygen system in the ON-100%-NORMAL setting.

During any emergency involving loss of cabin pressurization above 12,500 feet, the oxygen system must be placed in the "gang loaded" position: ON-100%-EMERGENCY.

SECTION 5
OPERATING LIMITATIONS
TABLE OF CONTENTS

INTRODUCTION

Cognizance must be taken of instrument markings (Figure 67), since they represent limitations that are not necessarily repeated in the text.

MINIMUM CREW REQUIREMENT

The minimum crew requirement for this aircraft is one pilot. Solo flights must be made with the pilot flying the aircraft from the front cockpit.

THROTTLE SETTING THRUST DEFINITIONS

NORMAL THRUST

Normal (maximum continuous) thrust is the thrust obtained at 98.5% RPM or 630^{o}C EGT, whichever occurs first.

MILITARY THRUST

MIL (military) thrust is the thrust obtained at 100% RPM without afterburner operation.

MAXIMUM THRUST

MAX (maximum) thrust is the thrust obtained at 100% RPM with the afterburner operating. Afterburner range extends from minimum afterburner of approximately 5 percent augmentation above MIL thrust to maximum afterburner, which is approximately 40 percent augmentation above MIL thrust.

AIRSPEED LIMITATIONS

WING FLAPS

Do not exceed the following airspeeds for the wing flap deflections:

1% to 45% ………………….. 300 KIAS
46% to 60% ………………… 240 KIAS
Over 60% …………………… 220 KIAS

LANDING GEAR

Do not exceed 240 KIAS with the landing gear extended and/or landing gear doors open.

CAUTION

Extension/retraction of landing gear at bank angles greater than 45 degrees, or at load factors greater than 1.5 G's, can result in overstress failure of the main landing gear side brace trunnion.

NOSEWHEEL STEERING

Do not exceed 65 KIAS with nosewheel steering engaged.

CANOPY

Do not exceed 50 KIAS while taxiing with a canopy open.

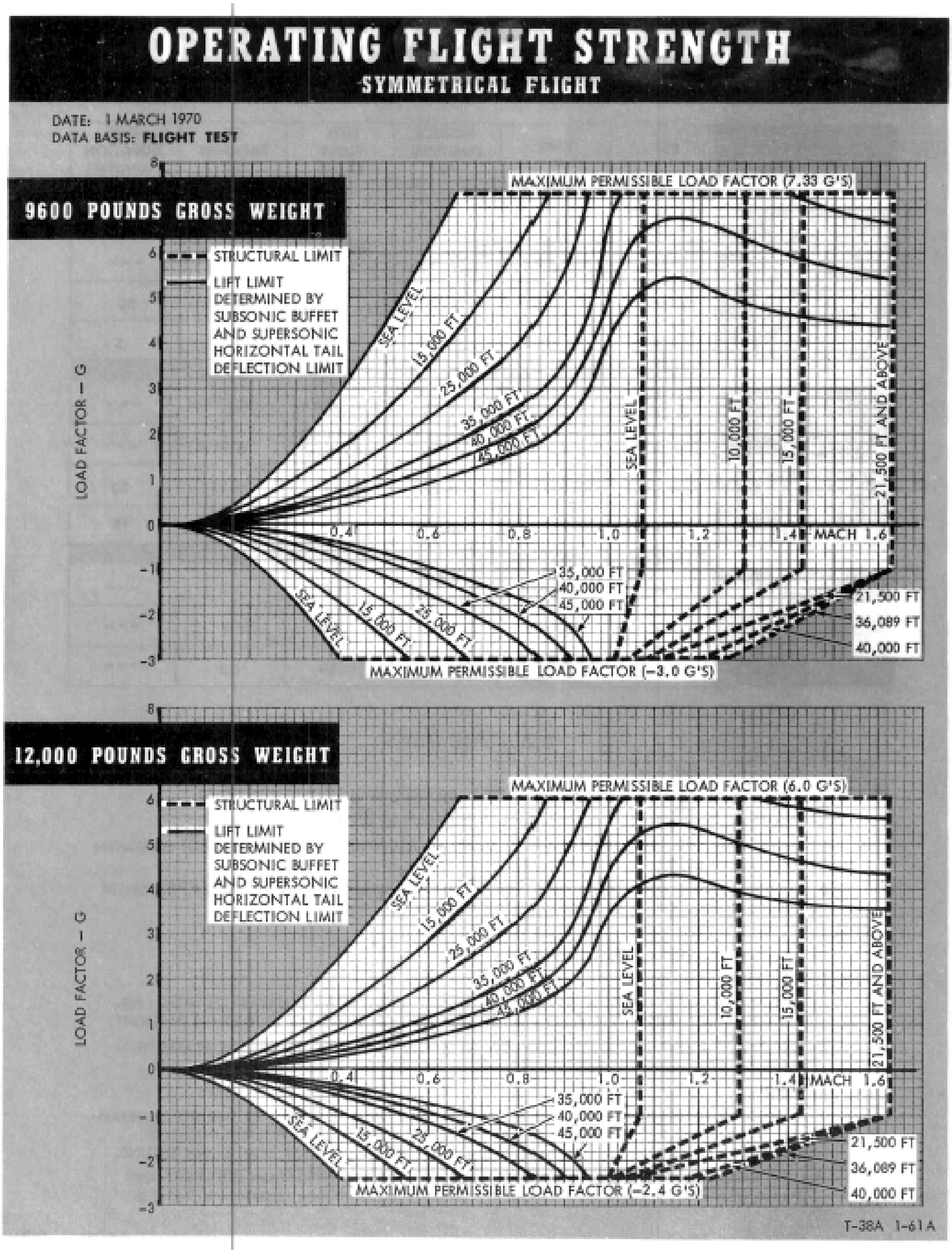
LOAD FACTOR LIMITATIONS

Do not exceed the following:

Load Factor (G's)	*Weight of Fuel Remaining (Pounds)*
-2.4 to +6.0	Fully fueled
-2.6 to +6.4	2700
-3.0 to +7.33	1400 or less

Roll Entry Load Factor (G's)	*Weight of Fuel Remaining (Pounds)*
0 to +4.4	Fully fueled
0 to +4.7	2700
0 to +5.2	1400 or less

Additional load factor limits can be referenced at Figures 66 and 67.



OPERATING FLIGHT STRENGTH
SYMMETRICAL FLIGHT
DATE: 1 MARCH 1970
DATA BASIS: FLIGHT TEST
9600 POUNDS GROSS WEIGHT
MAXIMUM PERMISSIBLE LOAD FACTOR (7.33 G'S)
STRUCTURAL LIMIT
LIFT LIMIT DETERMINED BY SUBSONIC BUFFET AND SUPERSONIC HORIZONTAL TAIL DEFLECTION LIMIT
LOAD FACTOR — G
SEA LEVEL
15,000 FT
25,000 FT
35,000 FT
40,000 FT
45,000 FT
SEA LEVEL
10,000 FT
15,000 FT
21,500 FT AND ABOVE
MACH
21,500 FT
36,089 FT
40,000 FT
MAXIMUM PERMISSIBLE LOAD FACTOR (−3.0 G'S)
12,000 POUNDS GROSS WEIGHT
MAXIMUM PERMISSIBLE LOAD FACTOR (6.0 G'S)
MAXIMUM PERMISSIBLE LOAD FACTOR (−2.4 G'S)
T-38A 1-61A

Figure 66

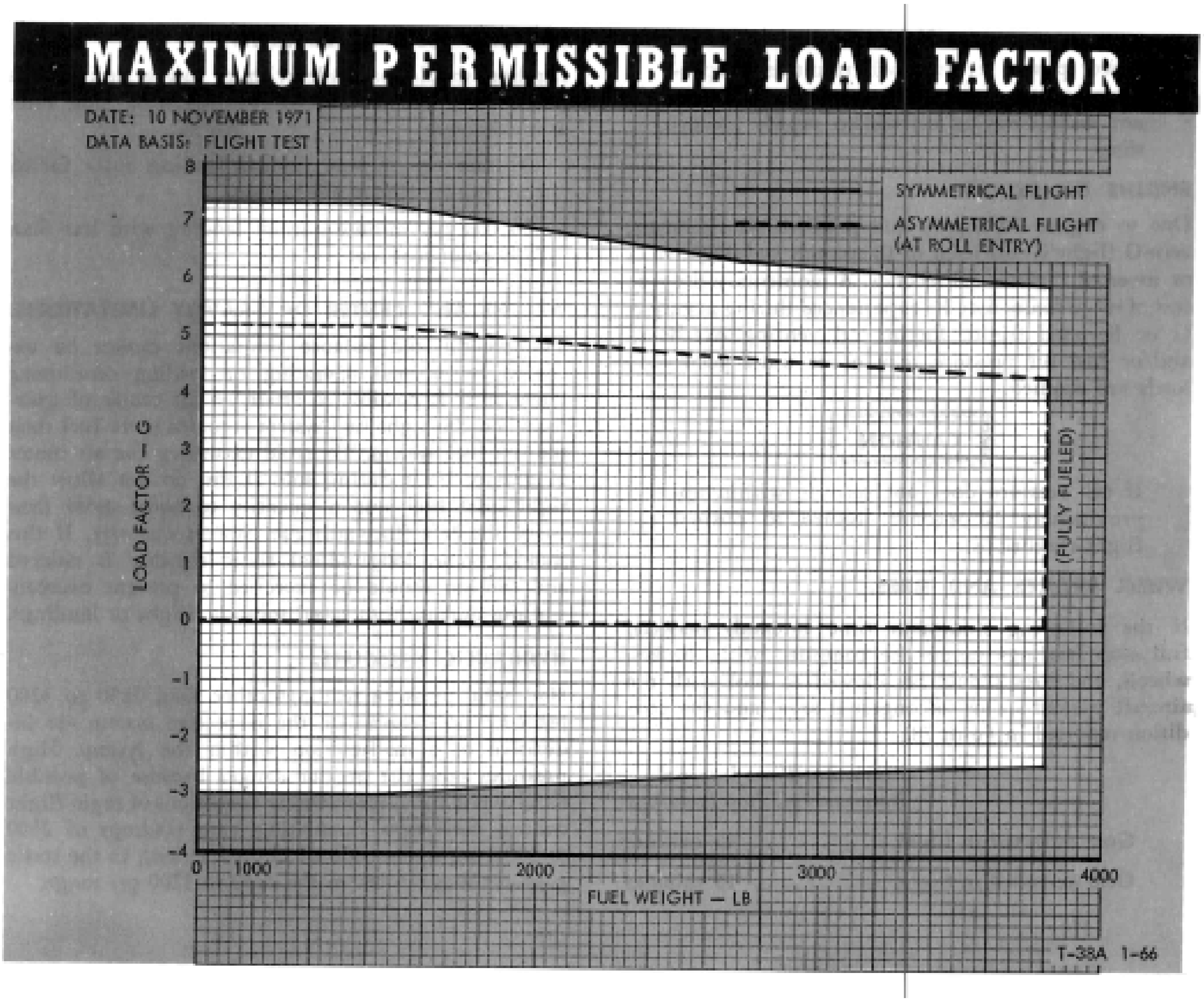

MAXIMUM PERMISSIBLE LOAD FACTOR
DATE: 10 NOVEMBER 1971
DATA BASIS: FLIGHT TEST
SYMMETRICAL FLIGHT
ASYMMETRICAL FLIGHT
(AT ROLL ENTRY)
LOAD FACTOR — G
(FULLY FUELED)
FUEL WEIGHT — LB
T-38A 1-66

Figure 67

INSTRUMENT MARKINGS

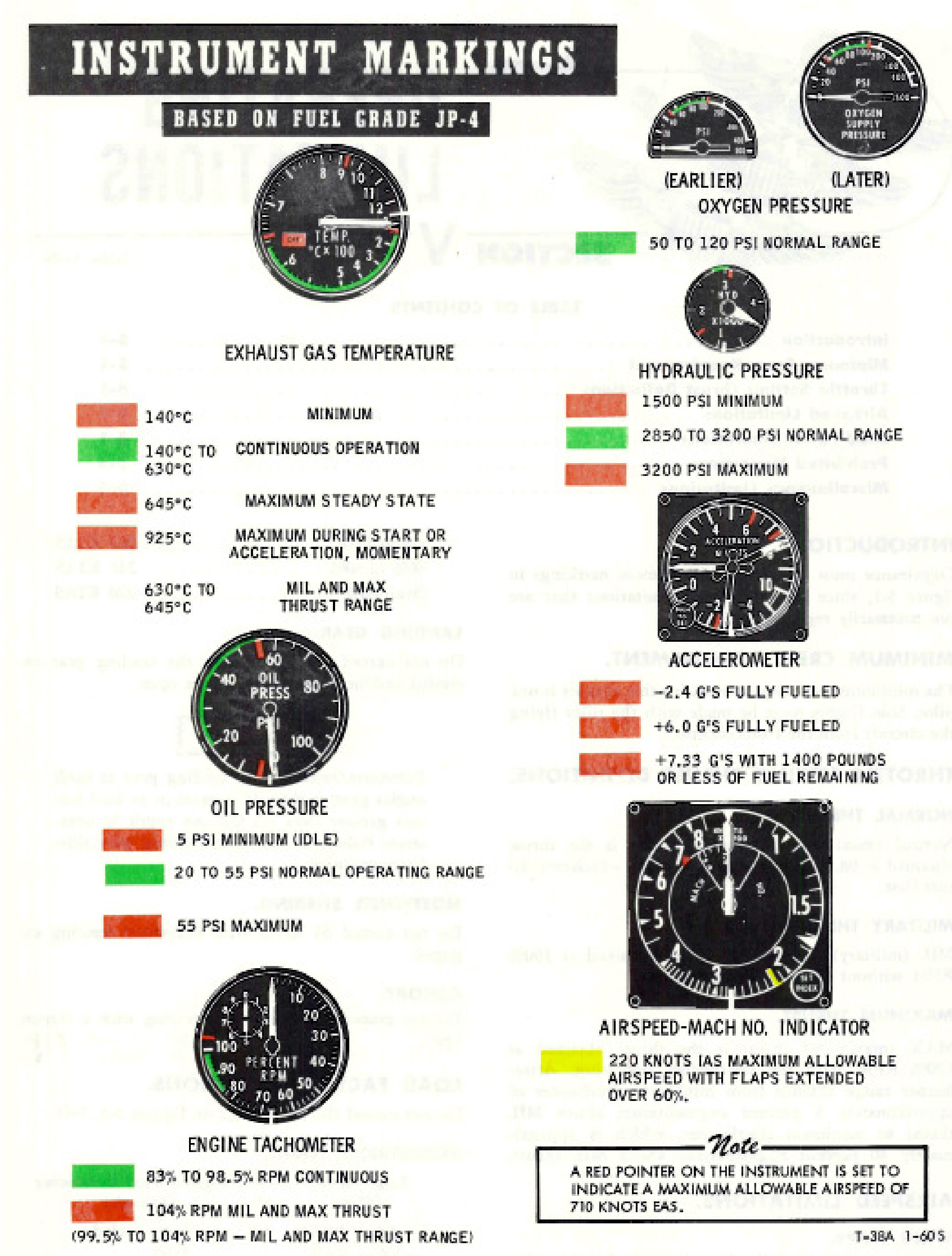


Figure 68

ENGINE OPERATING LIMITATIONS

ENGINE OPERATING LIMITATIONS

CONDITION	EGT °C	RPM %	NOZZLE POSITION %	FUEL FLOW LB/HR	OIL PRESSURE PSI	TIME DURATION (MINUTES)
GROUND STEADY STATE						
START	925 (MAX) ✱ 845	---	---	350 (MAX)	INDICATION	---
IDLE	---	46.5-49.5	77-92	400-600 (STD DAY)	5-20	---
MILITARY	630-645	99.5-101	0-20	2100-2500 (SEA LEVEL)	20-55	30
(MAX) AFTERBURNER	630-645	99.5-101	50-85	---	20-55	5
FLIGHT STEADY STATE						
START	925 (MAX) ✱ 845	---	---	350 (MAX)	INDICATION	---
IDLE	140 (MIN)	---	---	200 (MIN) (STD DAY)	5 (MIN)	---
MILITARY	630-645	99.5-104	0-20	---	20-55	30
(MAX) AFTERBURNER	630-645	99.5-104	50-85	---	20-55	15
FLUCTUATION LIMITS						
IDLE (GROUND)	---	46.5-49.5	NONE ALLOWED	± 25	± 2	---
MILITARY AND AB (GROUND)	630-645	99.5-101	± 3	± 50	± 2	---
MILITARY AND AB (FLIGHT)	630-645	±1% WITHIN STEADY STATE LIMITS	± 3	± 50	± 2	---

OTHER LIMITATIONS

EGT:

✱ 1. ABORT START IF EGT REACHES 845°C TO PRECLUDE EXCEEDING TEMPERATURE LIMITS.

2. ABORT AIRCRAFT DURING GROUND START IF EGT EXCEEDS 925°C MOMENTARILY.

3. TOTAL FLUCTUATIONS IN EGT OF 15°C (±7.5°C) ARE ACCEPTABLE IF THE AVERAGE EGT IS BETWEEN 630°C AND 645°C.

4. AT LOW COMPRESSOR INLET TEMPERATURES, MILITARY AND AFTERBURNER EGT AND RPM MAY BE BELOW NORMAL OPERATING LIMITS. (SEE SECTION VII.)

RPM:

1. MAXIMUM ALLOWABLE TRANSIENT RPM IS 107%.

NOZZLE POSITION:

1. FOLLOWING RAPID THROTTLE MOVEMENTS, NOZZLE POSITION SHOULD STABILIZE WITHIN PERMISSIBLE FLUCTUATION RANGE WITHIN 5 SECONDS ON GROUND AND 10 SECONDS IN FLIGHT.

2. NOZZLE POSITION MAY BE LESS THAN 50% WHEN OPERATING THE AFTERBURNER AT LESS THAN MAX AB.

OIL PRESSURE:

1. DURING COLD WEATHER STARTS, OIL PRESSURE USUALLY EXCEEDS 55 PSI. TO EXPEDITE OIL WARM-UP, ENGINE MAY BE OPERATED AT MILITARY POWER OR BELOW. IF OIL PRESSURE DOES NOT RETURN TO OPERATING LIMITS WITHIN 6 MINUTES AFTER ENGINE START, SHUT DOWN ENGINE.

2. IF A SUDDEN CHANGE OF 10 PSI OR GREATER IN OIL PRESSURE INDICATION OCCURS AT ANY STABILIZED RPM, FOLLOW ENGINE OIL SYSTEM MALFUNCTION PROCEDURES IN SECTION III.

Figure 69

PROHIBITED MANEUVERS

VERTICAL STALLS

Vertical stalls are prohibited.

SPINS

Intentional spins are prohibited. Refer to Section 6 for recovery from unintentional spins.

ROLLS

Do not enter continuous rolls at any load factor other than 1.0G. When continuous aileron rolls are accomplished, do not exceed three-quarters stick travel.

MISCELLANEOUS LIMITATIONS

FUEL SYSTEM

To prevent fuel starvation and subsequent engine flameout, do not exceed the following:

1. Maximum thrust dives with less than 650 pounds of fuel in either fuel supply system.
2. Maximum thrust flight inverted or at negative load factors exceeding 10 seconds at 10,000 feet or 30 seconds at 30,000 feet. With less than 650 pounds of fuel in either supply system, time for successful engine operation is further reduced.

Note

Lower power settings will result in proportionally longer operating times; however, do not exceed engine oil system supply limitations.

ENGINE OIL SYSTEM

Due to engine oil supply and pressure requirements, zero-G flight is restricted to 10 seconds and negative-G or inverted flight to 60 seconds. A momentary drop or loss of oil pressure may be experienced during negative-G or inverted flight. Engine oil venting overboard and/or low oil pressure may occur until positive-G loads are applied.

CAUTION

If oil pressure does not recover within approximately 10 seconds, return to normal flight conditions.

WHEEL BRAKES AND TIRES

If the following minimum time intervals between full stop landings cannot be complied with, brakes, wheels, and tires should be allowed to cool with the aircraft parked in an uncongested area, and the condition reported in Form 781:

	Minimum Time Interval Between Full Stop Landings
Gear retracted in flight …………………………………….	45 minutes
Gear extended in flight …………………………………….	15 minutes

LANDING RATE OF DESCENT

Landing should be made with as low a sink rate as practicable. Do not exceed the following sink rates at touchdown:

400 feet per minute normal landing fully fueled and crab landing at any weight.
600 feet per minute normal landing with less than 2,200 pounds of fuel.

WEIGHT AND CENTER OF GRAVITY LIMITATIONS

The weight and balance limitations cannot be exceeded by normal operating or loading conditions. However, it is possible to attain an aft center of gravity when the right fuel system contains more fuel than the left fuel system. To avoid exceeding the aft center of gravity limit during solo flight, do not allow the right (aft) fuel system quantity to equal more than twice the left (forward) fuel system quantity. If this should occur, longitudinal static stability is reduced and caution should be exercised to prevent overcontrolling during high speed subsonic flight or landings.

HYDRAULIC PRESSURE

Hydraulic pressure readings other than 2850 to 3200 psi with no demand on the respective system are indicative of a malfunction within the system. High pressures pose the greater danger because of possible fluid overtemperatures. Under conditions of rapid flight control movement fluctuating gauge readings of 2500 to 3500 psi are considered normal as long as the static gauge reading returns to the 2850 to 3200 psi range.

TACAN TO VOR FREQUENCY CONVERSION CHART

The T-38A is equipped with a MILSPEC TACAN navigational radio. TACAN frequencies may be tuned for any civilian VOR station using either X or Y TACAN frequency equivalents. Reference the chart (Figure 70) for the proper corresponding TACAN frequency for any VOR station.

VOR	TACAN	VOR	TACAN	VOR	TACAN	VOR	TACAN
134.40	1X	134.45	1Y	134.50	2X	134.55	2Y
134.60	3X	134.65	3Y	134.70	4X	134.75	4Y
134.80	5X	134.85	5Y	134.90	6X	134.95	6Y
135.00	7X	135.05	7Y	135.10	8X	135.15	8Y
135.20	9X	135.25	9Y	135.30	10X	135.35	10Y
135.40	11X	135.45	11Y	135.50	12X	135.55	12Y
135.60	13X	135.65	13Y	135.70	14X	135.75	14Y
135.80	15X	135.85	15Y	135.90	16X	135.95	16Y
108.00	17X	108.05	17Y	108.10	18X	108.15	18Y
108.20	19X	108.25	19Y	108.30	20X	108.35	20Y
108.40	21X	108.45	21Y	108.50	22X	108.55	22Y
108.60	23X	108.65	23Y	108.70	24X	108.75	24Y
108.80	25X	108.85	25Y	108.90	26X	108.95	26Y
109.00	27X	109.05	27Y	109.10	28X	109.15	28Y
109.20	29X	109.25	29Y	109.30	30X	109.35	30Y
109.40	31X	109.45	31Y	109.50	32X	109.55	32Y
109.60	33X	109.65	33Y	109.70	34X	109.75	34Y
109.80	35X	109.85	35Y	109.90	36X	109.95	36Y
110.00	37X	110.05	37Y	110.10	38X	110.15	38Y
110.20	39X	110.25	39Y	110.30	40X	110.35	40Y
110.40	41X	110.45	41Y	110.50	42X	110.55	42Y
110.60	43X	110.65	43Y	110.70	44X	110.75	44Y
110.80	45X	110.85	45Y	110.90	46X	110.95	46Y
111.00	47X	111.05	47Y	111.10	48X	111.15	48Y
111.20	49X	111.25	49Y	111.30	50X	111.35	50Y
111.40	51X	111.45	51Y	111.50	52X	111.55	52Y

VOR	TACAN	VOR	TACAN	VOR	TACAN	VOR	TACAN
111.60	53X	111.65	53Y	111.70	54X	111.75	54Y
111.80	55X	111.85	55Y	111.90	56X	111.95	56Y
112.00	57X	112.05	57Y	112.10	58X	112.15	58Y
112.20	59X	112.25	59Y	133.30	60X	133.35	60Y
133.40	61X	133.45	61Y	133.50	62X	133.55	62Y
133.60	63X	133.65	63Y	133.70	64X	133.75	64Y
133.80	65X	133.85	65Y	133.90	66X	133.95	66Y
134.00	67X	134.05	67Y	134.10	68X	134.15	68Y
134.20	69X	134.25	69Y	112.30	70X	112.35	70Y
112.40	71X	112.45	71Y	112.50	72X	112.55	72Y
112.60	73X	112.65	73Y	112.70	74X	112.75	74Y
112.80	75X	112.85	75Y	112.90	76X	112.95	76Y
113.00	77X	113.05	77Y	113.10	78X	113.15	78Y
113.20	79X	113.25	79Y	113.30	80X	113.35	80Y
113.40	81X	113.45	81Y	113.50	82X	113.55	82Y
113.60	83X	113.65	83Y	113.70	84X	113.75	84Y
113.80	85X	113.85	85Y	113.90	86X	113.95	86Y
114.00	87X	114.05	87Y	114.10	88X	114.15	88Y
114.20	89X	114.25	89Y	114.30	90X	114.35	90Y
114.40	91X	114.45	91Y	114.50	92X	114.55	92Y
114.60	93X	114.65	93Y	114.70	94X	114.75	94Y
114.80	95X	114.85	95Y	114.90	96X	114.95	96Y
115.00	97X	115.05	97Y	115.10	98X	115.15	98Y
115.20	99X	115.25	99Y	115.30	100X	115.35	100Y
115.40	101X	115.45	101Y	115.50	102X	115.55	102Y
115.60	103X	115.65	103Y	115.70	104X	115.75	104Y
115.80	105X	115.85	105Y	115.90	106X	115.95	106Y
116.00	107X	116.05	107Y	116.10	108X	116.15	108Y
116.20	109X	116.25	109Y	116.30	110X	116.35	110Y
116.40	111X	116.45	111Y	116.50	112X	116.55	112Y
116.60	113X	116.65	113Y	116.70	114X	116.75	114Y
116.80	115X	116.85	115Y	116.90	116X	116.95	116Y
117.00	117X	117.05	117Y	117.10	118X	117.15	118Y
117.20	119X	117.25	119Y	117.30	120X	117.35	120Y
117.40	121X	117.45	121Y	117.50	122X	117.55	122Y
117.60	123X	117.65	123Y	117.70	124X	117.75	124Y
117.80	125X	117.85	125Y	117.90	126X	117.95	126Y

Figure 70

Note: Frequencies highlighted in yellow are not assigned for navigational purposes.

SECTION 6
FLIGHT CHARACTERISTICS
TABLE OF CONTENTS

STALLS

The stall is characterized by airframe buffet and a high sink rate rather than by a clean nose-down pitch motion. As angle of attack is increased, there is a corresponding increase in buffet intensity. The buffet is most severe with flaps extended. The stall condition is immediately preceded by heavy low-speed buffet and moderate wing rock. The wing rock can be controlled with rudder. The actual stall is normally not accompanied by any abrupt aircraft motion, but is indicated only by the very high sink rate. However, if the stall condition is aggravated by abrupt control inputs, unusual aircraft attitudes may result.

STALL RECOVERIES

Stalls can be terminated by relaxing back stick pressure, rolling wings level, and moving throttles to MAX simultaneously. If in the landing configuration, raise gear and speed brake, allowing flaps to remain extended until stall recovery has been accomplished. While it is normally not necessary to allow the nose to pitch down, relaxation of back pressure is critical in breaking the stall and allowing the aircraft to accelerate, reducing the buffet, eliminating the wing rock, and maintaining adequate aileron control. Reducing the bank angle will lower the stall speed and decrease the sink rate. See Effect of Bank Angle on Vertical Velocity chart (Figure 71). Since timely identification of an actual stall is difficult, stall recovery should be initiated at the first indication of increasing buffet or rate of sink. Recovery from a stalled condition can be accomplished with a minimum loss of altitude using the approved stall recovery technique.

WARNING

If a high sink rate condition is allowed to develop, excessive altitude loss will occur and recovery may not be possible at traffic pattern altitudes. Also, ejection at pattern altitudes, especially in a descent, are likely to result in failure of the parachute to open before impact with the ground.

SUBSONIC ACCELERATED STALLS

Accelerated stall are similar to 1-G stalls and recovery is the same.

EFFECT OF BANK ANGLE ON VERTICAL VELOCITY.

Steep bank angles during turn to final approach can cause a rapid descent rate from which it may be impossible to recover. This is especially true for single-engine approaches to landing. The chart below (Figure 72) shows the effects of bank angle on vertical velocity.

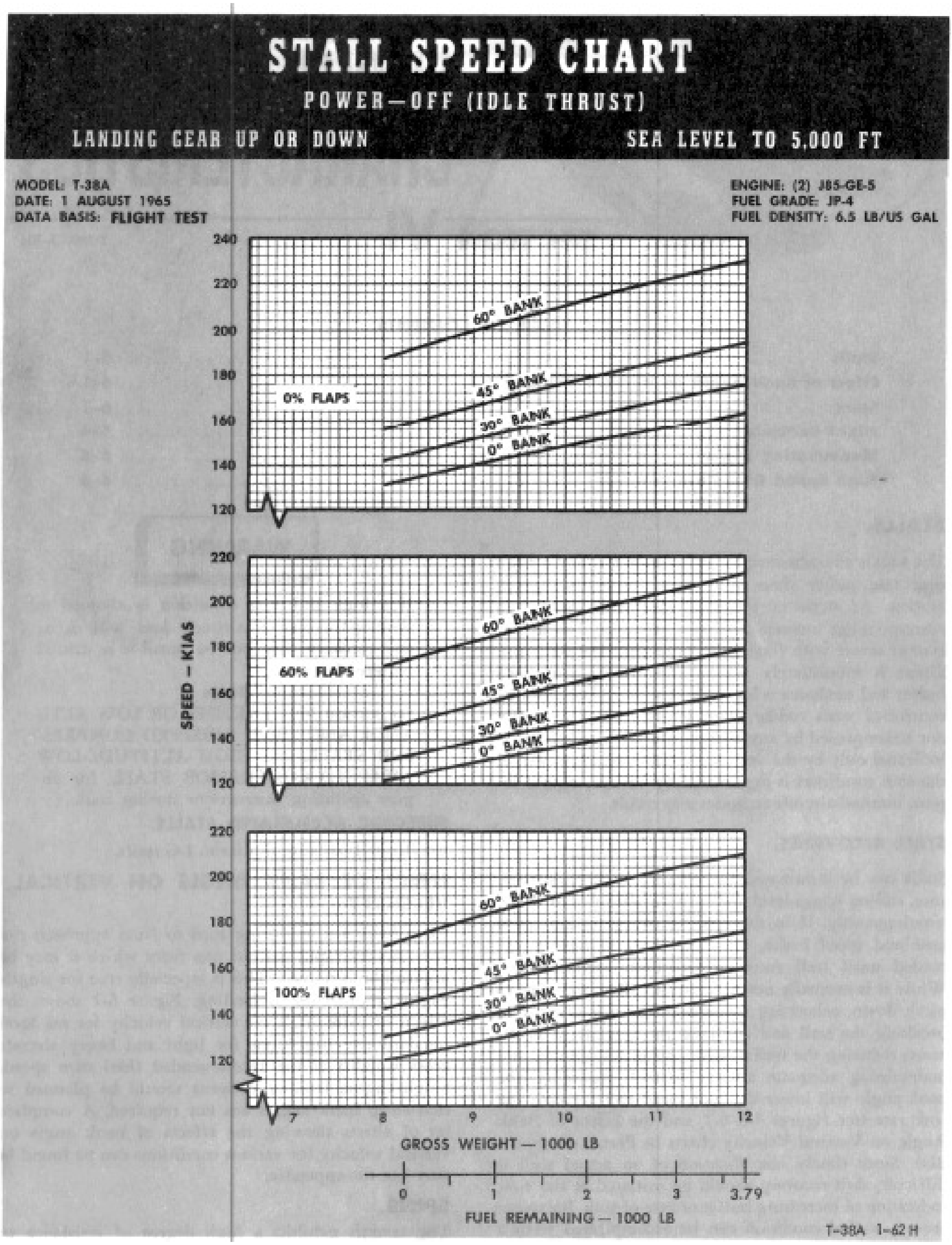

STALL SPEED CHART
POWER—OFF (IDLE THRUST)
LANDING GEAR UP OR DOWN
SEA LEVEL TO 5,000 FT
MODEL: T-38A
DATE: 1 AUGUST 1965
DATA BASIS: FLIGHT TEST
ENGINE: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL
0% FLAPS
60% FLAPS
100% FLAPS
60° BANK
45° BANK
30° BANK
0° BANK
SPEED — KIAS
240
220
200
180
160
140
120
GROSS WEIGHT — 1000 LB
7
8
9
10
11
12
FUEL REMAINING — 1000 LB
0
1
2
3
3.79
T-38A 1-62 H

Figure 71

EFFECT OF BANK ANGLE ON VERTICAL VELOCITY

SEA LEVEL STANDARD DAY

60% FLAPS AND GEAR DOWN

DATE: 1 APRIL 1969
DATA BASIS: **FLIGHT TEST**

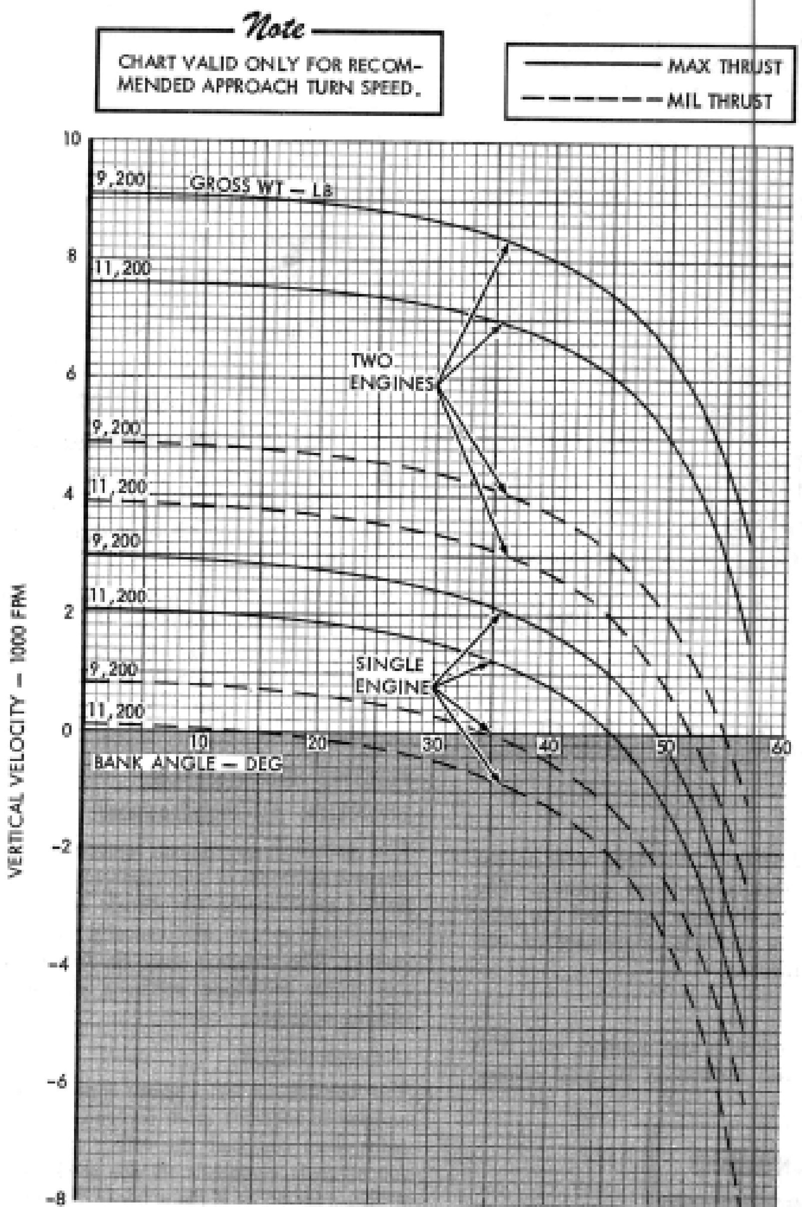


Figure 72

SPINS

The aircraft exhibits a high degree of resistance to spin entry. However, the aircraft can be forced into an erect or an inverted spin. The area of possible entry is shown in Figure 73 below. Avoid abrupt full aft stick movement, or a spin entry may result. Entry will occur without use of rudder.

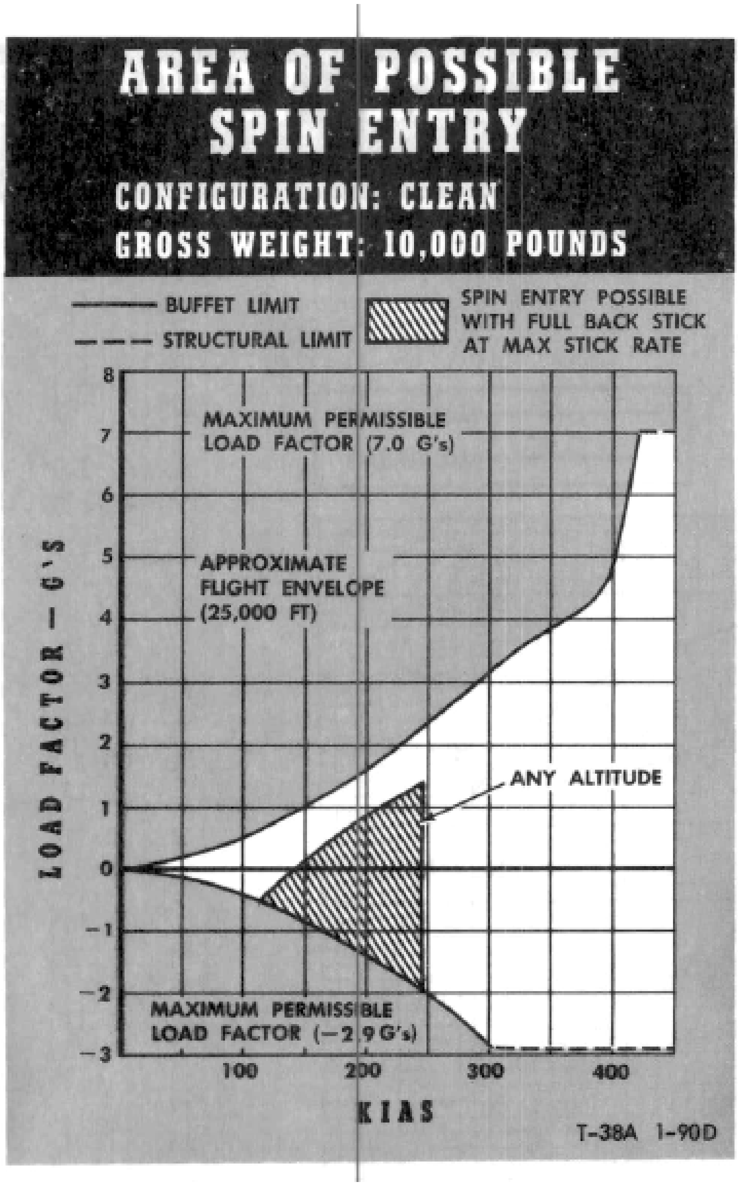


Figure 73

ERECT SPIN

Once an erect spin has developed, the spin will be flat and may be either oscillatory or very smooth. The aircraft may oscillate about all three axes, and the pilot will experience transverse G-loads. Flameout of one or both engines can be experienced.

ERECT SPIN RECOVERY

The primary anti-spin control is the aileron, and it is imperative that full aileron deflection be held during recovery.

WARNING

If full aileron deflection in the direction of the spin is not maintained throughout the recovery, spin recovery may be prolonged or prevented.

Immediately upon recognition of the direction of rotation, use the following procedure:

1. Control stick – Full aileron in the direction of the spin (use both hands) and as much aft stick as possible without sacrificing aileron.
2. Rudder – Full opposite.
3. Do not change gear, flaps, and speed brake positions during recovery.
4. Neutralize controls after recovery.

Note

Recovery from the spin is normally abrupt and may be followed by some spiraling during the resultant dive.

INVERTED SPIN

An inverted spin is very oscillatory about all axes and is easily recoverable.

INVERTED SPIN RECOVERY

Immediately upon experiencing an inverted spin, use the following procedure:

1. All flight controls – Neutralize

WARNING

- Maintain controls in neutral position throughout the spin recovery. Any aileron or rudder deflection can induce a transition to an erect spin.
- Ejection from either an erect or inverted spin is to be accomplished if a spin recovery is not completed by 15,000 feet above the terrain, or if transverse G-loads preclude maintaining anti-spin controls, whichever occurs first.

FLIGHT CONTROLS

STABILITY AUGMENTATION

The stability augmenter system positions the rudder control surfaces to automatically clamp out yaw short period oscillations. On Block 20 aircraft, the stability augmenter system additionally damps out pitch oscillations. The aircraft may be flown safely throughout the flight envelope without the stability augmenter system engaged.

G-OVERSHOOT

The horizontal tail control system incorporates a bobweight to increase stick forces under G-loads. Since the pilot does not feel the effect of the bobweight until the aircraft responds to the stick movements, G-overshoots may occur if the stick is deflected too abruptly.

CAUTION

Abrupt forward or aft deflection or "pulsing" of the stick in the Mach range from 0.80 to 0.95 may result in overshoot of the limit load factor.

LATERAL CONTROL

Aileron deflection does not increase proportionally with stick travel. The first 4.5 inches of stick travel provides one-half aileron deflection. The remaining 1.5 inches of stick travel provides full aileron deflection. Therefore, increased precision and care must be taken whenever deflecting the control stick to the stops.

MANEUVERING FLIGHT

STICK FORCES

Minimum stick forces per G occur at approximately Mach 0.9. Be careful not to overcontrol when maneuvering near this airspeed so that the allowable load factor is not exceeded (see Figure 74).

PILOT INDUCED OSCILLATIONS (PIO)

The relationship between pilot response and aircraft pitch response in high subsonic-low altitude flight is such that overcontrolling may lead to severe pilot induced oscillations. These oscillations are characterized by a sudden and violent divergence in pitch attitude resulting in very large positive and negative load factors. These load factors can be made more severe by the pilot attempting to control the oscillations through stick inputs. Because the basic aircraft is stable, the pilot should immediately release the stick so that the aircraft can damp itself or if at very low altitude or close to another aircraft, the pilot should attempt to apply and rigidly hold back pressure on the stick. In addition to the above, a reduction in airspeed will aid recovery. It should be noted that if the pilot is not securely strapped into his seat, the above recovery procedure may be difficult to accomplish. If severe pitch oscillations are encountered in flight, proceed as follows:

1. Control Stick – Release Immediately
2. If Absolutely Unable to Release Stick – Attempt to apply and rigidly hold back pressure on stick.

ROLLS

Roll rates obtainable in this aircraft with full aileron deflection are extremely high and could cause the pilot to become disoriented. Caution should be exercised when using rudder in conjunction with aileron application during rapid roll or turn entry. Rapid input of both rudder and half (or more) aileron can cause large load factor excursions during the maneuver.

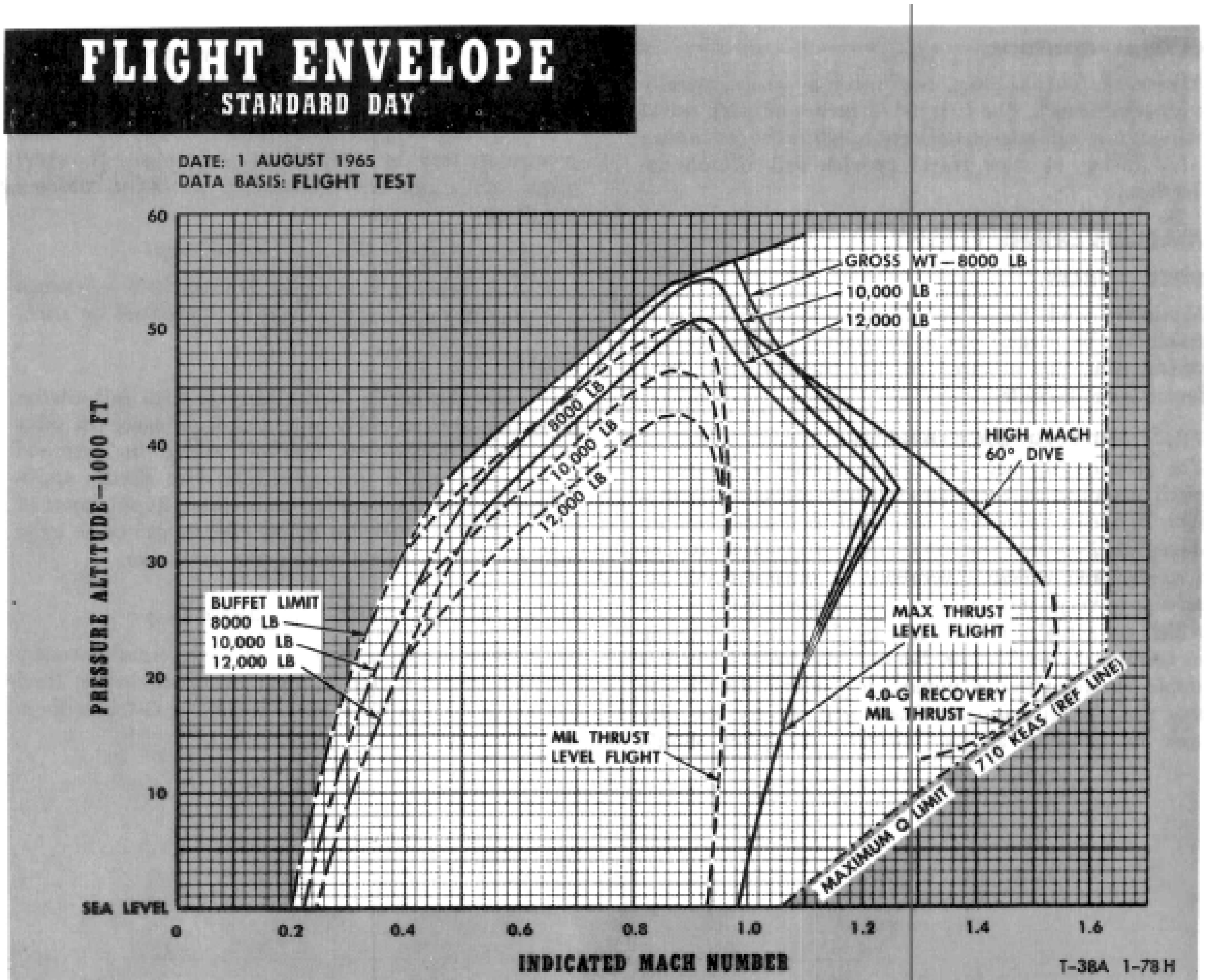


Figure 74

HIGH SPEED DIVE RECOVERY

To recover from a high speed dive, simultaneously retard throttles to IDLE, open the speed brake, level the wings, and pull out with sufficient G-forces for a safe recovery.

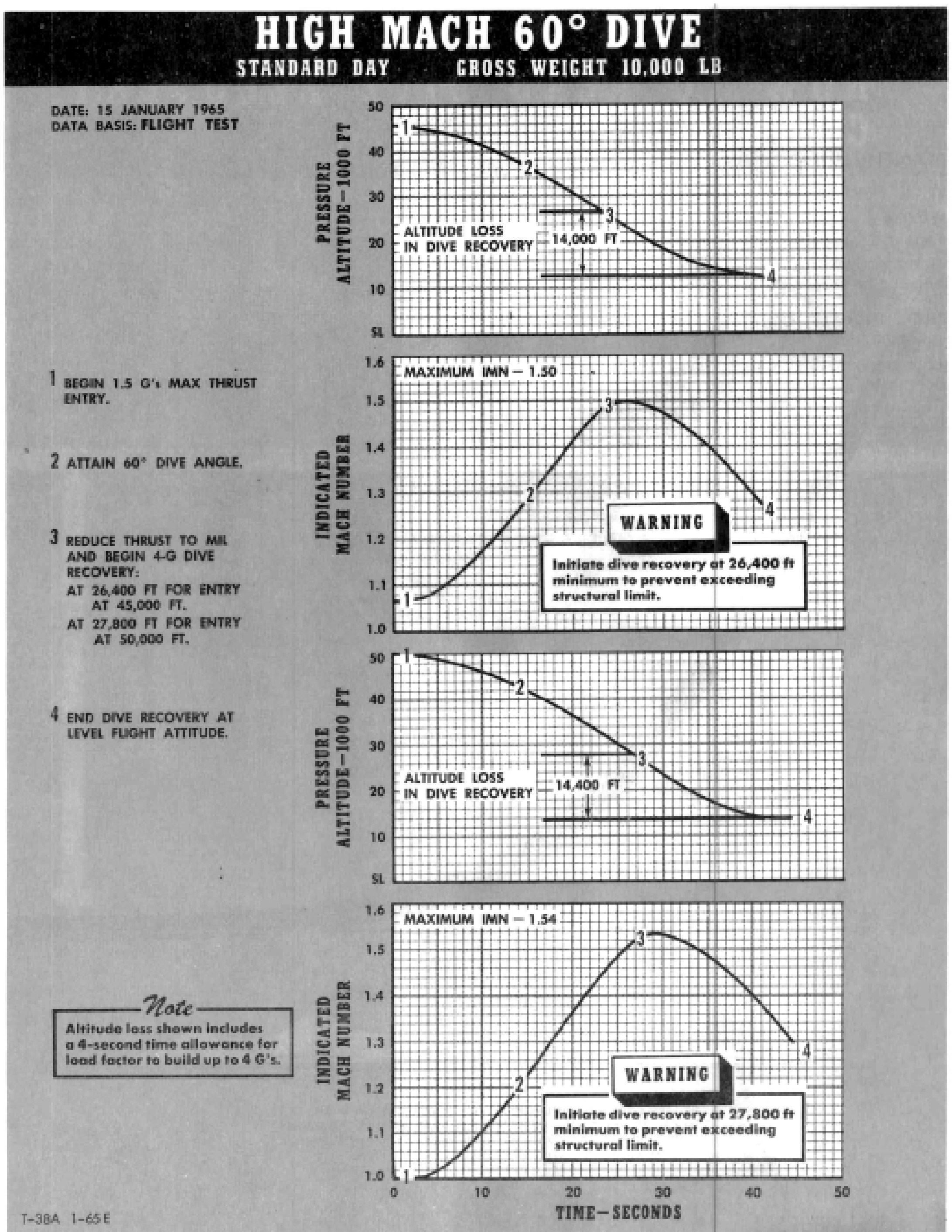


Figure 75

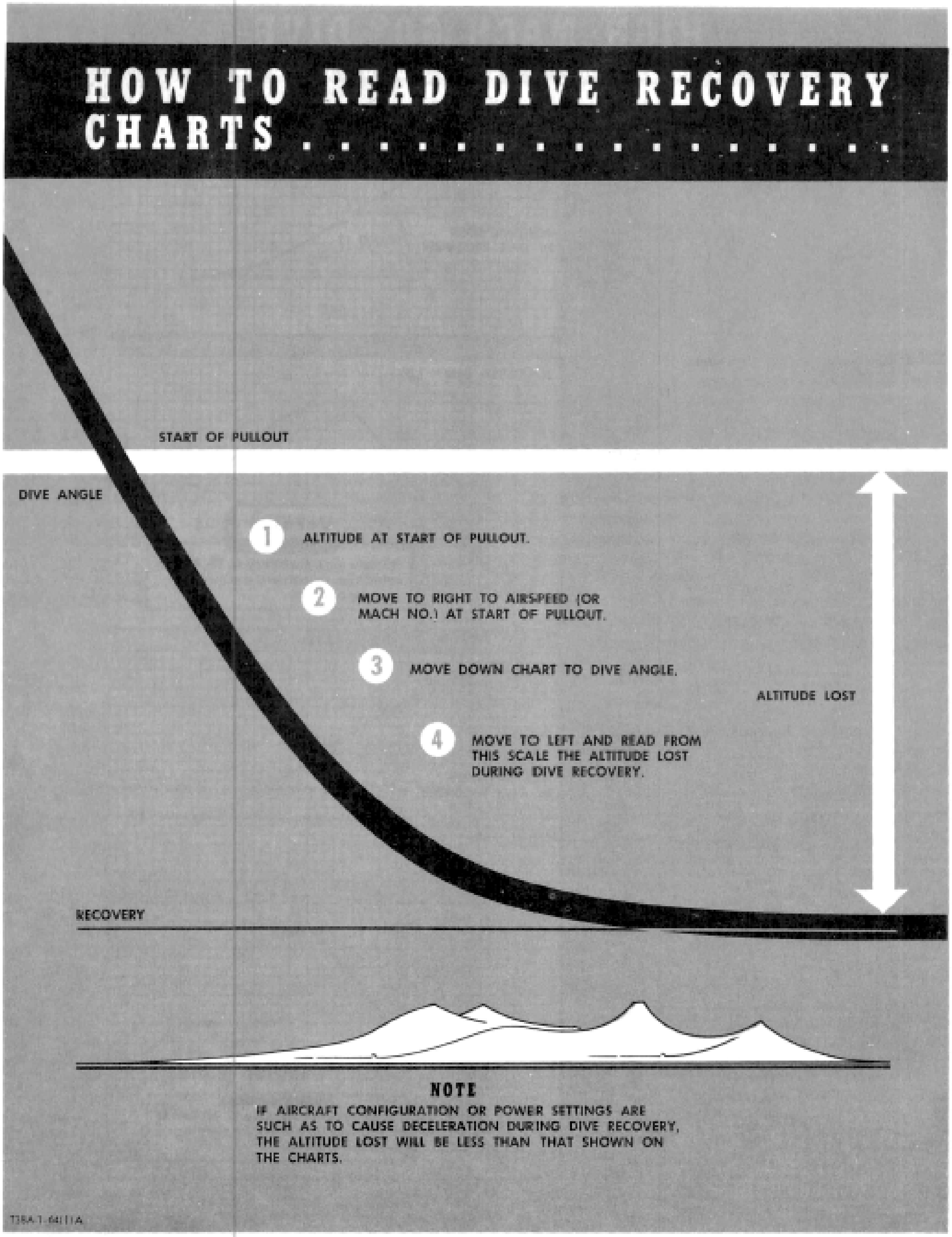

HOW TO READ DIVE RECOVERY CHARTS . . . .
START OF PULLOUT
DIVE ANGLE
1 ALTITUDE AT START OF PULLOUT.
2 MOVE TO RIGHT TO AIRSPEED (OR MACH NO.) AT START OF PULLOUT.
3 MOVE DOWN CHART TO DIVE ANGLE.
ALTITUDE LOST
4 MOVE TO LEFT AND READ FROM THIS SCALE THE ALTITUDE LOST DURING DIVE RECOVERY.
RECOVERY
NOTE
IF AIRCRAFT CONFIGURATION OR POWER SETTINGS ARE SUCH AS TO CAUSE DECELERATION DURING DIVE RECOVERY, THE ALTITUDE LOST WILL BE LESS THAN THAT SHOWN ON THE CHARTS.

Figure 76

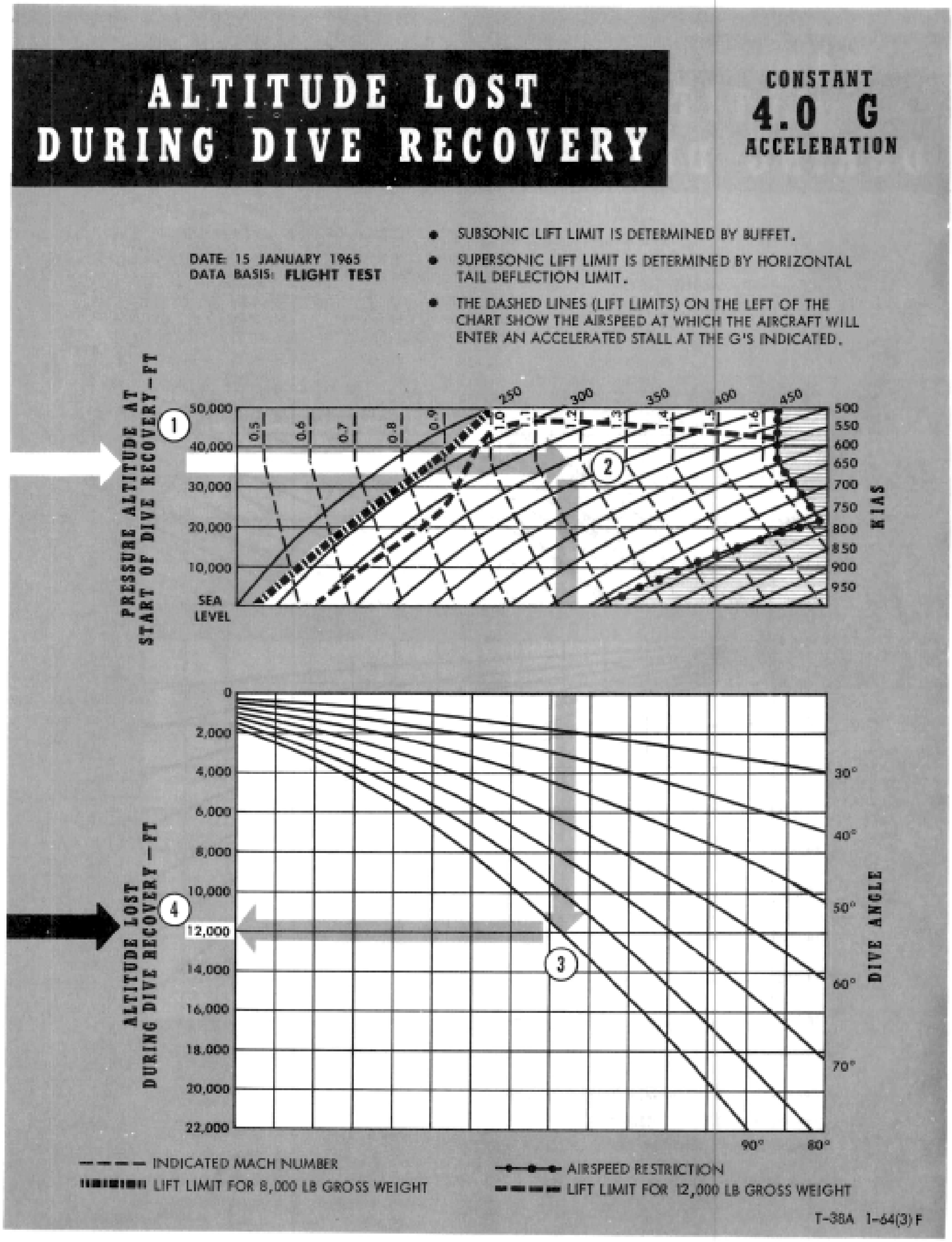

ALTITUDE LOST DURING DIVE RECOVERY
CONSTANT 4.0 G ACCELERATION
DATE: 15 JANUARY 1965
DATA BASIS: FLIGHT TEST
SUBSONIC LIFT LIMIT IS DETERMINED BY BUFFET.
SUPERSONIC LIFT LIMIT IS DETERMINED BY HORIZONTAL TAIL DEFLECTION LIMIT.
THE DASHED LINES (LIFT LIMITS) ON THE LEFT OF THE CHART SHOW THE AIRSPEED AT WHICH THE AIRCRAFT WILL ENTER AN ACCELERATED STALL AT THE G'S INDICATED.
PRESSURE ALTITUDE AT START OF DIVE RECOVERY—FT
50,000
40,000
30,000
20,000
10,000
SEA LEVEL
0.5
0.6
0.7
0.8
0.9
1.0
1.1
1.2
1.3
1.4
1.5
1.6
250
300
350
400
450
500
550
600
650
700
750
800
850
900
950
KIAS
ALTITUDE LOST DURING DIVE RECOVERY—FT
0
2,000
4,000
6,000
8,000
10,000
12,000
14,000
16,000
18,000
20,000
22,000
30°
40°
50°
60°
70°
80°
90°
DIVE ANGLE
INDICATED MACH NUMBER
LIFT LIMIT FOR 8,000 LB GROSS WEIGHT
AIRSPEED RESTRICTION
LIFT LIMIT FOR 12,000 LB GROSS WEIGHT
T-38A 1-64(3) F

Figure 77

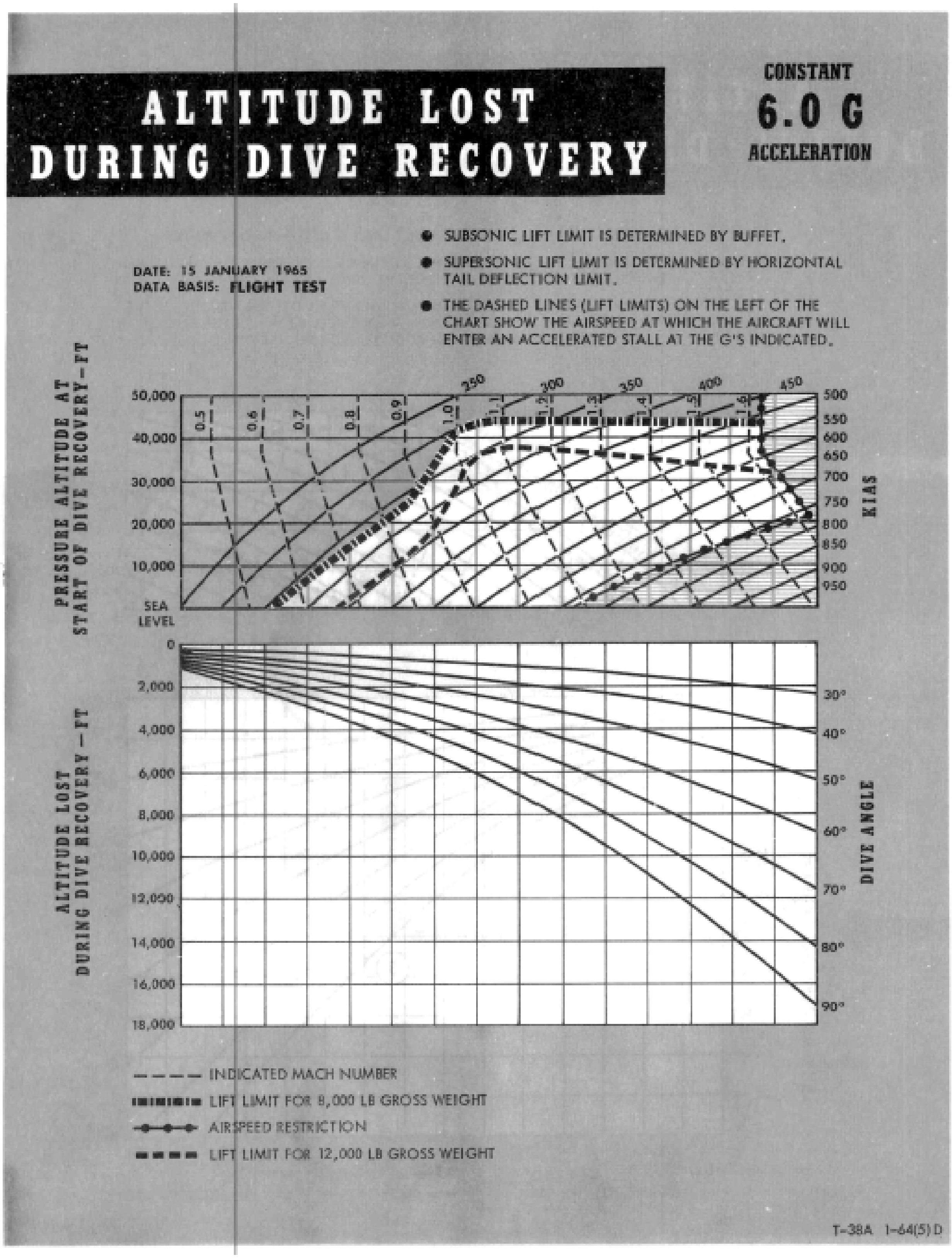

ALTITUDE LOST
DURING DIVE RECOVERY
CONSTANT
6.0 G
ACCELERATION
SUBSONIC LIFT LIMIT IS DETERMINED BY BUFFET.
SUPERSONIC LIFT LIMIT IS DETERMINED BY HORIZONTAL TAIL DEFLECTION LIMIT.
THE DASHED LINES (LIFT LIMITS) ON THE LEFT OF THE CHART SHOW THE AIRSPEED AT WHICH THE AIRCRAFT WILL ENTER AN ACCELERATED STALL AT THE G'S INDICATED.
DATE: 15 JANUARY 1965
DATA BASIS: FLIGHT TEST
PRESSURE ALTITUDE AT START OF DIVE RECOVERY—FT
50,000
40,000
30,000
20,000
10,000
SEA LEVEL
0.5
0.6
0.7
0.8
0.9
1.0
1.1
1.2
1.3
1.4
1.5
1.6
250
300
350
400
450
500
550
600
650
700
750
800
850
900
950
KIAS
ALTITUDE LOST DURING DIVE RECOVERY—FT
0
2,000
4,000
6,000
8,000
10,000
12,000
14,000
16,000
18,000
30°
40°
50°
60°
70°
80°
90°
DIVE ANGLE
INDICATED MACH NUMBER
LIFT LIMIT FOR 8,000 LB GROSS WEIGHT
AIRSPEED RESTRICTION
LIFT LIMIT FOR 12,000 LB GROSS WEIGHT
T-38A 1-64(5)D

Figure 78

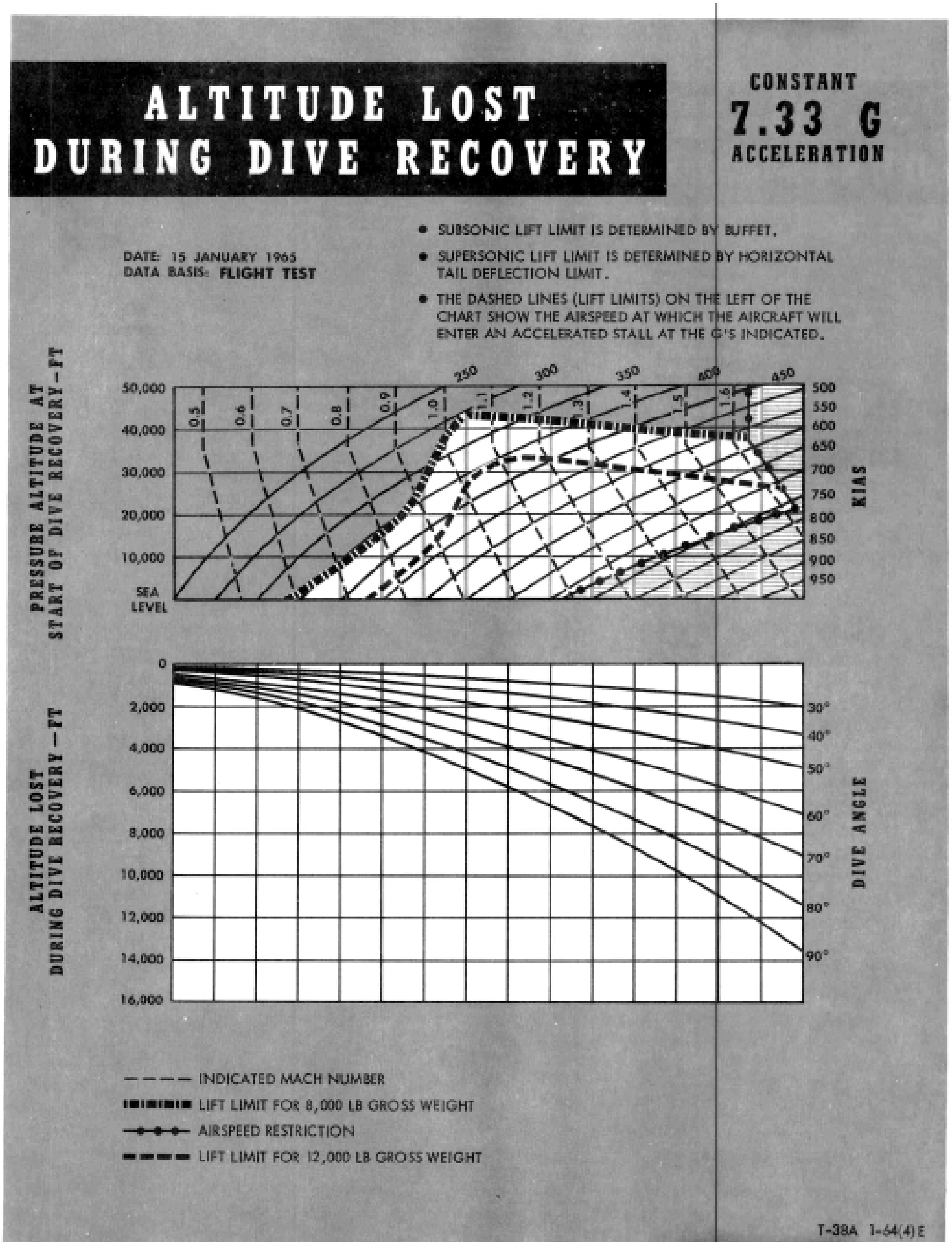

ALTITUDE LOST
DURING DIVE RECOVERY
CONSTANT
7.33 G
ACCELERATION
DATE: 15 JANUARY 1965
DATA BASIS: FLIGHT TEST
• SUBSONIC LIFT LIMIT IS DETERMINED BY BUFFET.
• SUPERSONIC LIFT LIMIT IS DETERMINED BY HORIZONTAL TAIL DEFLECTION LIMIT.
• THE DASHED LINES (LIFT LIMITS) ON THE LEFT OF THE CHART SHOW THE AIRSPEED AT WHICH THE AIRCRAFT WILL ENTER AN ACCELERATED STALL AT THE G'S INDICATED.
PRESSURE ALTITUDE AT START OF DIVE RECOVERY—FT
50,000
40,000
30,000
20,000
10,000
SEA LEVEL
KIAS
500
550
600
650
700
750
800
850
900
950
ALTITUDE LOST DURING DIVE RECOVERY—FT
0
2,000
4,000
6,000
8,000
10,000
12,000
14,000
16,000
DIVE ANGLE
30°
40°
50°
60°
70°
80°
90°
INDICATED MACH NUMBER
LIFT LIMIT FOR 8,000 LB GROSS WEIGHT
AIRSPEED RESTRICTION
LIFT LIMIT FOR 12,000 LB GROSS WEIGHT
T-38A 1-64(4)E

Figure 79

LANDING TECHNIQUES DETERMINED BY PROJECT TALON SPOT

Most T-38 mishaps, and a very high percentage of fatal mishaps, occur during VFR pattern and landing operations. Angle-of-Attack control is the prime cause of these mishaps. While the T-38 is an inherently stable aircraft, its characteristic stall onset behavior can result in very rapid loss of critical altitude if not immediately corrected per the procedures previously documented in this section of the POH. Furthermore, the ejection seat is not rated for zero-zero flight conditions. Therefore, ejection below 2,000 feet AGL has a questionable chance for survival. Ejection below 1,000 feet AGL with the jet in a descent is considered unlikely for survival.

The information presented in this section of the POH is intended to supplement the normal pattern and landing procedures written in Section 2 of this POH. Additionally, pilots should adhere to all requirements specified in AFI 11-2T-38 Volume 3 included in the publications folder of this MilViz release. In addition, AFMAN 11-250 Volume 1 contains specific pilot procedures and techniques proven to promote consistently excellent pattern operations and landings.

The following information is extracted from a Technical Information Memorandum report, AFFTC-TIM-10-01, prepared by HQ AETC/A3FV based on flight tests performed by the USAF Test Pilot School:

Figure 80, Optimal touchdown angle

BACKGROUND

The USAF recognized there was inconsistent training at UPT in T-38 landing and pattern techniques. From 2004 to 2009, test pilots of the USAF Test Pilot School conducted a thorough survey and practical flight test program that sought to critically analyze these various instructor pilot techniques to determine which techniques produced the best combination of ease of learning and effective results. This program was named "Project Talon Spot," and it resulted in significant changes to the UPT training program, specifically what landing technique was taught to UPT students. The full study report is included in the documentation for the MilViz T-38A.

KEY FINDINGS, RECOMMENDATIONS AND LESSONS LEARNED

The findings and recommendations of this study were adopted by AETC and are:

1. Glideslope: 2.5 degrees (Formerly was taught to vary between 3.0 to 3.5 degrees).
2. Aimpoint: Runway Threshold (Formerly 500 feet short of the threshold).
3. Throttle Modulation Method (TMM) starting 1,000 feet to runway threshold using a Latched to Threshold (LTT) method.
4. Flare starting immediately after start of the TMM.

The major impetus for changing the glideslope and aimpoint was to reduce the likelihood of touchdowns short of the runway threshold, a common concern experienced during Specialized Undergraduate Pilot Training (SUPT), as students consistently adopted low-power, high glideslope landing techniques designed to ensure landing in the touchdown zone specified in AETC evaluation criteria. It was observed that the concern with meeting this touchdown zone criterion resulted in unacceptable instances of landing short of the threshold and touching down overly firm.

The overly firm landings were the direct result of low power settings in steep approaches, so that the allowable margin of error to start the flare maneuver was over tight, causing many pilots to flare high or flare low. Either outcome normally resulted in an overly firm touchdown, either as a direct result of late flare, or an early flare resulting in a loss of airspeed causing the onset of rapid sink rate from height above touchdown of between 10-15 feet!

Overall, these poor techniques were replaced by one that facilitated consistency, easy of instruction, ease of implementation, little required change in aircraft pitch in the flare maneuver, and a very easy to identify mark to start a more consistent throttle reduction from approach power to idle power for touchdown.

TEST PARAMETERS

The T-38C was used in the flight test program. However, all findings and recommendations are equally valid for the T-38A. The test program sought to measure the ability of various techniques to produce consistent landings within acceptable zone at proper descent rate. In addition, the final recommendations took into account perceived ease of instruction and rapidity of student comprehension. Optimal angle-of-attack during the final approach was also strongly factored into the final recommendation. Central to achieving all these goals was precise measurement of optimal threshold crossing height. This bar was photographed and superimposed over aircraft videotaped from the same vantage point:

Figure 80, Pole showing optimal threshold crossing height of between 5 and 10 feet AGL

Figure 81, Example photo showing graphical overlay used to measure an optimal threshold crossing height landing

CRITERIA FOR BEST LANDING METHOD SELECTED

The test evaluation team used these precise criteria to select the best landing technique:

1. Optimal combination of aimpoint, glideslope, and throttle modulation method (TMM) (meaning rate of movement in the critical phases).
2. Most repeatable and teachable.
3. Lowest and smoothest vertical velocity decrease in the 5-seconds prior to and at touchdown.
4. Crossing threshold at a safe height.
5. Meeting AETC evaluation criteria.
6. Most favorable pilot comments.

BEST LANDING TECHNIQUE

LATCH-TO-THE-THRESHOLD (LTT)

The landing technique deemed to best meet the six criteria was the one termed, "Latch to the Threshold (LTT)." Of the various options of LTT, the one selected best was the 2.5 degree glideslope with a smooth pull of power starting at 1,000 feet to the runway threshold (See figure 82).

This LTT technique proscribes that the pilot flies a stabilized approach and smoothly pulls the power "to idle at the same perceived rate as the runway threshold approaches the aircraft." The technique is further described as waiting "to start the power reduction and flare until a prescribed range (500, 750, or 1000 feet) prior to the threshold." The test team tested the LTT method at steep and shallow glideslopes. Ultimately, the LTT at 500 feet to threshold with a 2.5 degree glideslope was discarded as causing long touchdowns because the short distance to the runway leading edge caused undue delay in reaching touchdown speeds.

However, the LTT was deemed to be "comfortable and repeatable for all four test pilots." The test pilots discovered that the glideslope used with the LTT method made a significant difference in success and reduction in pilot workload. Glideslopes steeper than 3.0 degrees were discarded because, in the judgment of the test pilots, the T-38C did not provide a reference pitch line for these higher AoA glideslopes and the change of pitch from approach to flare caused inconsistent results.

The study concluded that, "The LTT TMM was considered a very simple technique to teach and execute" by the pilots during the test program. Further the method was "considered well suited to a more shallow, power on approach as it involved a slow reduction in power, preserving some excess thrust until crossing the threshold." The LTT TMM was also deemed superior because since it was based directly on the closing rate to the threshold, it inherently took into account variations in groundspeed as caused by winds. Power reduction in the LTT TMM was so consistently accurate that the test pilots were able to achieve flight idle within a "half second or less of crossing the threshold." Also stated, "Since the power was retarded at a single, steady rate, the LTT TMM required less pilot workload," than any of the other methods considered.

Coordination of the Throttle Modulation Method (TMM) for LTT

TMM is the term for how the pilot performs the movement of throttle power from the setting needed for maintaining approach speed to the idle power setting necessary for touchdown. For the LTT method to work, the pilot must not only time the TMM to start at a specified distance to runway threshold (ultimately judged best at 1,000 feet), but retard the power setting so that it is a continuous motion timed to reach idle at precisely the time the aircraft crosses runway threshold. Further, the flare action should initiate at the time the TMM is started, so as to maintain the proper aircraft pitch angle for touchdown.

Vantage Points on the Runway Environment

To further document the methods used to measure the LTT at 2.5^{o} glideslope and 1,000 feet the following camera points were set up, as well as distance marks made:

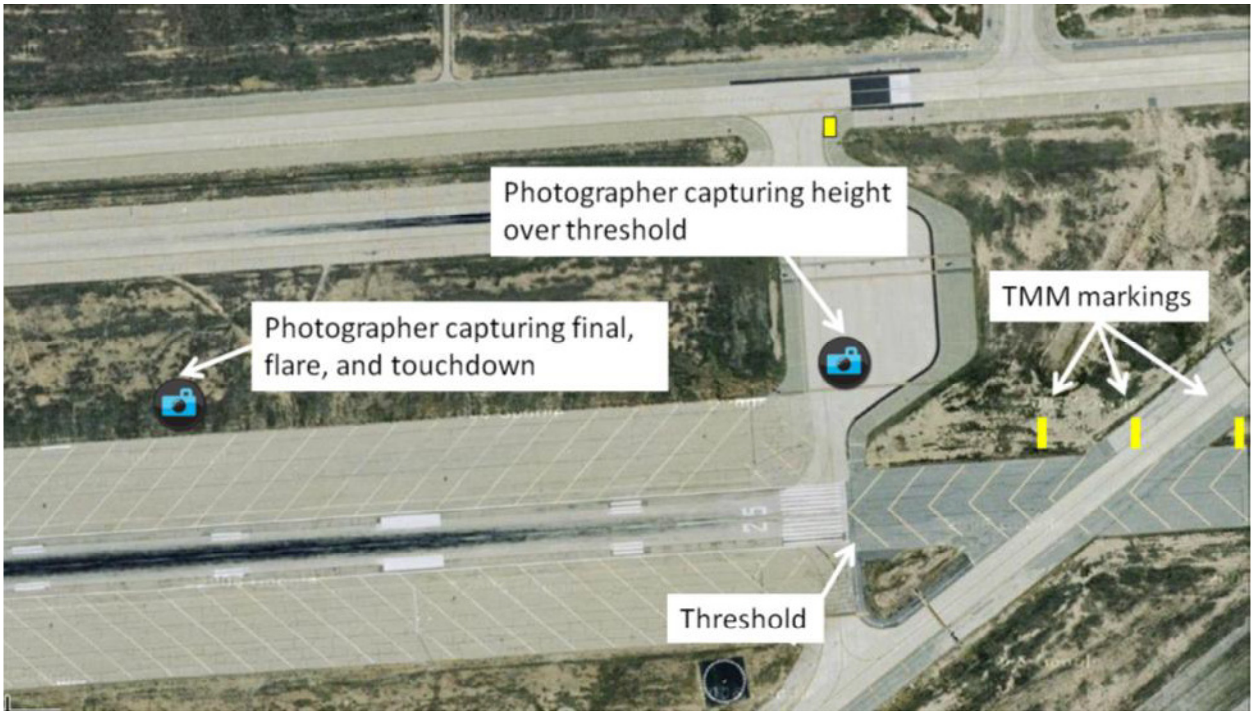


Figure 82. Points of interest for LTT with 3.0 glideslope and pull to idle at 1,000 feet to threshold

It must be noted by the photo (Figure 82) that the definition of threshold is NOT the leading edge of the displaced threshold, but where the threshold meets the landing surface of the runway.

Glideslope Considerations

The primary cause of pilot workload in the LTT method was deemed to be the chosen glideslope. The least amount of workload was noted with the LTT at 2.5 degree glideslope. The one at 3.0 glideslope required more pilot workload, but provided much less risk of landing long. The 2.5 degree glideslope LTT was also deemed to require a higher initial power setting, but this was an advantage also because it resulted in a more consistent aircraft attitude while on the final approach, allowing the pilot more time to concentrate on maintaining the proper aimpoint and airspeed. The 2.5 degree glideslope also reduced the risk of a firm landing because the pilot consistently reached flight idle crossing the threshold at an altitude of only 5 feet, and already at an optimal pitch angle for landing.

In contrast, LTT approaches with glideslopes **HIGHER** than 3.0 degrees often caused the pilot to begin the throttle reduction to idle power condition when approximately 60 feet above the runway. All test pilots agreed this was "very uncomfortable." All pilots agreed that optimal height above the runway to start the smooth pull to idle power was 30-40 feet. Therefore, for this reason, the 2.5 degree glideslope LTT method was again judged the best technique as it facilitated the most consistent results with the easiest implementation.

A further strength of the 2.5 degree glideslope method was that it more closely matched the glideslope required by ILS approaches, which requires between 2.5 and 2.8 degrees of glideslope. Also, the LTT method was deemed more comfortable for the pilots because it used the runway threshold as the aim point, which was easy to perceive.

In terms of maintaining optimal glideslope during the crossing of threshold and the runway, the LTT method worked best, and it did not matter whether the TMM was initiated at 1,000 feet to threshold or 750 feet. The glideslope remained consistent (See Figure 83). Figure 83 shows the stark difference between the LTT method versus the "Chop-Pause-Pull" method ultimately rejected by the test program precisely because of the radical changes it produced in very close proximity to the runway surface.

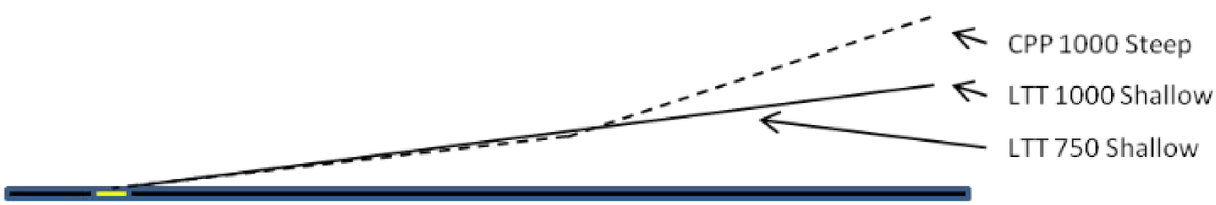


Figure 83

Aimpoint Considerations

Aimpoint for the 2.5 degree glideslope LTT method was deemed extremely easy when using the HUD in the T-38C. This was due to the ability to put the FPM directly on the threshold lined up with the mark for the 2.5 degree glideslope (See Figure 84).

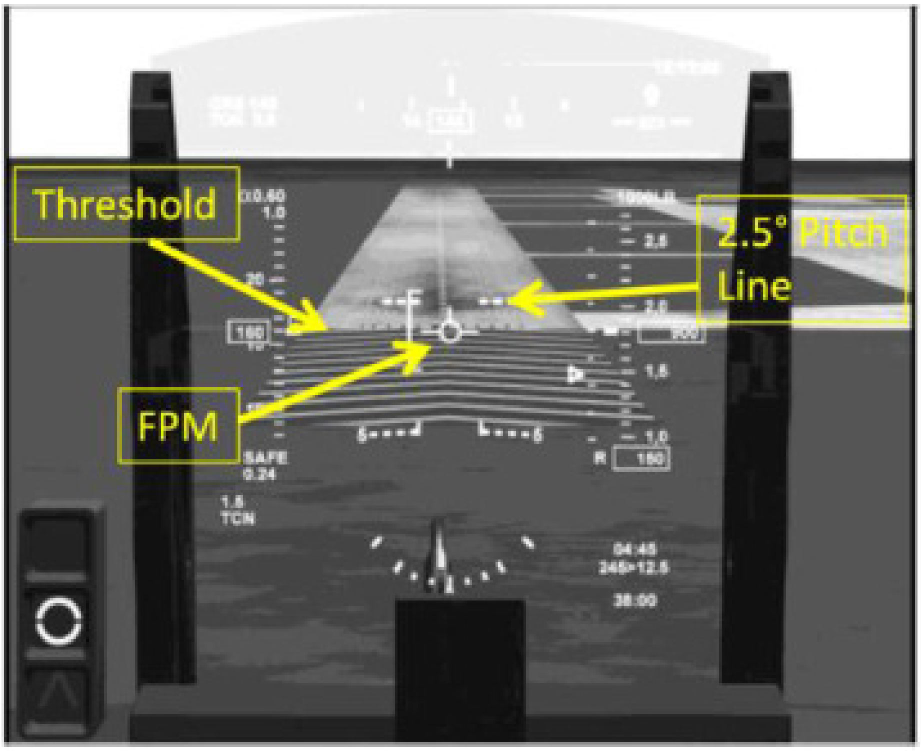


Figure 84

Given that the T-38A lacks a HUD, use of a FPM is not an option. However, in Figure 84, the angle-of-attack indexer is shown in the lower left corner of the illustration. Since this same indexer is present on the glareshield of the T-38A, at approximately the same relationship vertically, it can be used as a handy reference. Another more precise and personally tailored method would be to fly a series of ILS approaches with the pitch bar centered on the ADI, and find a chosen visual reference mark on the front canopy and/or glareshield to hone in and maintain a visual 2.5 degree glideslope (again, most ILS approaches use a 2.5 to 2.8 degree glideslope.) See Figures 84.1 through 84.3 for illustrations of a 2.5 degree glideslope final approach to Edwards AFB, CA.

Figure 84.1: 6,000 feet Final Approach at 2.5 degree Glideslope

Figure 84.2: 4,000 feet Final Approach at 2.5 degree Glideslope

Figure 84.3: 3,000 feet Final Approach at 2.5 degree Glideslope

Flare and Throttle Modulation Method (TMM) Considerations

According to the study, the flare mechanics were described as, "the ultimate goal of arriving just above the runway surface in level flight, just above touchdown speed, followed by smooth fully flared touchdown." The test pilots also started the flare maneuver coincidental with the start of the TMM. These combined actions were initiated between 1,000 and 500 feet to the threshold, "with the pilot shifting his eyes to the far end of the runway and applying increasing back stick pressure to arrest the descent rate and bring the [aimpoint reference in the cockpit] to the horizon." Again, in the test the pilots used the FPM on the HUD as their chosen aimpoint reference mark. For approaches deemed to be precisely on the 3 degree glideslope, the transition from aim to flare was a continuous smooth movement. Additionally, any approach shallower or steeper than this 3 degree optimal glideslope was also performed as one smooth steady movement coincidental with the start of the TMM action.

Overview of LTT Method

In the final analysis, Phase B, of the test program, the test pilots used the LTT method starting the TMM action between 700 and 1,000 feet from the threshold, on a 2.5 degree glideslope.

The pilots concluded that starting the TMM and flare at 1,000 feet to the threshold produced a more comfortable and consistent result. The 2.5 degree glideslope and 1,000 feet to threshold TMM method required no significant change in attitude prior to the start of the flare maneuver (again concurrent with the TMM action). Instead, increased back pressure on the stick during the flare and TMM to idle was designed to preserve the already established pitch angle.

This consistency allowed the pilot to "concentrate on refinements of aimpoint and airspeed (by reference to the AoA indexer) over a longer distance prior to the start of the throttle pull and subsequent flare." Again, in Phase B the pilots found it easy to adjust for winds and groundspeed because the TMM was in direct harmony with the closure rate to the threshold. Ultimately, while the pilots found both the 750 and 1,000 feet to threshold TTM actions comfortable, the 1,000 feet TMM action was deemed "more repeatable as it was easier for the pilots to accurately execute the TMM due to the discernable beginning of the underrun, which by Air Force standards starts precisely 1,000 feet prior to the runway threshold." Therefore, the superiority of 1,000 feet to threshold action was strictly one of a visual reference point vice any appreciable difference in aircraft characteristics.

The only negative to the 2.5 degree glideslope, 1,000 feet LTT method, was a tendency to touchdown further down the runway that then-current AETC evaluation criteria allowed for (see Figure 85). In the area of touchdown zone distance from threshold, the 3.0 degree glideslope, 1,000 feet LTT method was slightly better. But, the test pilots conclusion was that this one weakness was more than offset by all the other clear advantages of the 2.5 degree glideslope, 1,000 feet LTT method. The Landing Touchdown Distance chart (Figure 85) shows the raw numbers:

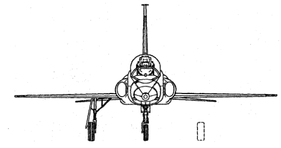
Landing Technique	Mean Distance and Standard Deviation* (ft)			
	Flight Test Data	**Wind Corrected**	**Distance at TD Speed + 10 KCAS****	**Projected Distance at TD Speed*****
Latch to the Threshold at 1000ft Aim at Threshold 2.5° Glideslope	Mean: 952 Std Dev: 403 95% CI: ±149	Mean: 976 Std Dev: 417 ****CI 95% CI: ±148	Mean: 326	Mean: 1126 Std Dev: 381 95% CI: ±147
Crack Pause Pull at 1000ft Aim 500ft Short 3.25° Glideslope	Mean: 992 Std Dev: 449 95% CI: ±152	Mean: 997 Std Dev: 399 95% CI: ±157	Mean: 400	Mean: 1191 Std Dev: 396 95% CI: ±144
Latch to the Threshold at 750ft Aim at Threshold 2.5° Glideslope	Mean: 847 Std Dev: 387 95% CI: ±143	Mean: 865 Std Dev: 395 95% CI: ±146	Mean: 294	Mean: 1181 Std Dev: 426 95% CI: ±158
* Distance represents feet past the runway threshold where the main wheels touched down. ** Distance where the T-38C would have touched down 10 knots fast of calculated touchdown speed. *** Distance where the T-38C was projected to touch down at the calculated touchdown speed. ****Confidence interval in the mean AETC Requirement: Touchdown point: 150 feet to 1,000 feet from the runway threshold				

Figure 85

As the chart concludes, while there are many advantages to the shallow 2.5 degree glideslope, landing in the previously required touchdown zone as defined by AETC was certainly a major weakness! Ultimately, this forced a modification of AETC landing zone evaluation criteria, extending the acceptable landing zone length. The goal of this relook was to reduce the number of short landings on the displaced threshold plus to avoid hard landings.

This is the overall conclusion of the test program staff:

"Since the landing conditions of all three landing techniques were indistinguishable and all three were considered safe, pilot comments drove the overall determination of optimal landing technique, of those methods evaluated. With 60 percent flaps, the optimal landing technique was flown on a 2.5 degree glideslope using the runway threshold as the aimpoint. The pilot would use the Latch to the Threshold throttle modulation method (TTM), which involved the pilot beginning throttle reduction 1,000 feet short of the threshold and linearly reducing the throttle to idle in relation to the distance remaining from the threshold, arriving at idle as the aircraft crossed the threshold."



SECTION 7
SYSTEMS OPERATION
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COMPRESSOR STALL

A compressor stall is an aerodynamic interruption of airflow through the engine compressor stage. Factors that can increase the stall sensitivity of an engine are foreign object damage, high angles of attack at low airspeeds (below 150 KIAS), maneuvering flight, unusual attitudes, atmospheric variations, jet wash, temperature distortion, and ice formation on the air inlet ducts or engine inlet guide vanes. Compressor stalls can be caused by various factors such as component malfunctions, engine rigging out-of-limits, throttle bursts to military or maximum afterburner power at high altitudes and low airspeed, and hot gas ingestion. The types of stalls that may occur are discussed below.

TAKEOFF OR LOW ALTITUDE AND HIGH AIRSPEED COMPRESSOR STALL

Compressor stall may occur on takeoff with afterburner initiation or at low altitude and very high airspeed when in military or afterburner operation. The stall is recognized by a "pop" or "bang" followed by an audible "buzzing" sound and vibration, accompanied by a rapid RPM drop and high EGT. The stall should be cleared as soon as possible to prevent engine damage by overtemperature. This type of compressor stall can normally be recovered by rapidly retarding throttle to IDLE, and flameout usually does not occur.

HIGH ALTITUDE-LOW AIRSPEED COMPRESSOR STALL

Compressor stall at high altitude and low airspeed typically occurs during throttle bursts to military or afterburner power. The stall is recognized by an audible "chug" or "pop," accompanied by rapidly unwinding RPM and decreasing EGT. Flameout may result from this type of stall. Rapidly retarding throttle to IDLE and immediately pushing the engine start button may allow the engine to recover and prevent complete flameout.

VARIABLE INLET GUIDE VANES

Variable inlet guide vanes and bleed valves have been incorporated in the J85 engine to reduce the possibility of a compressor stall throughout the operating range of the engine. The vanes function automatically to direct flow of air to the compressor blades at the proper angle. Before engine start, the bleed valves may be partly open or completely closed. This is caused by a residual pressure unbalance within the inlet guide vane/bleed valve actuators and fuel control residual pressures after engine shutdown. The valves will open during normal engine start.

THROTTLE MOVEMENT

Abrupt or rapid throttle movement in the striped dark red and light red areas as indicated in Figure 86 is not recommended and may result in engine flameout.

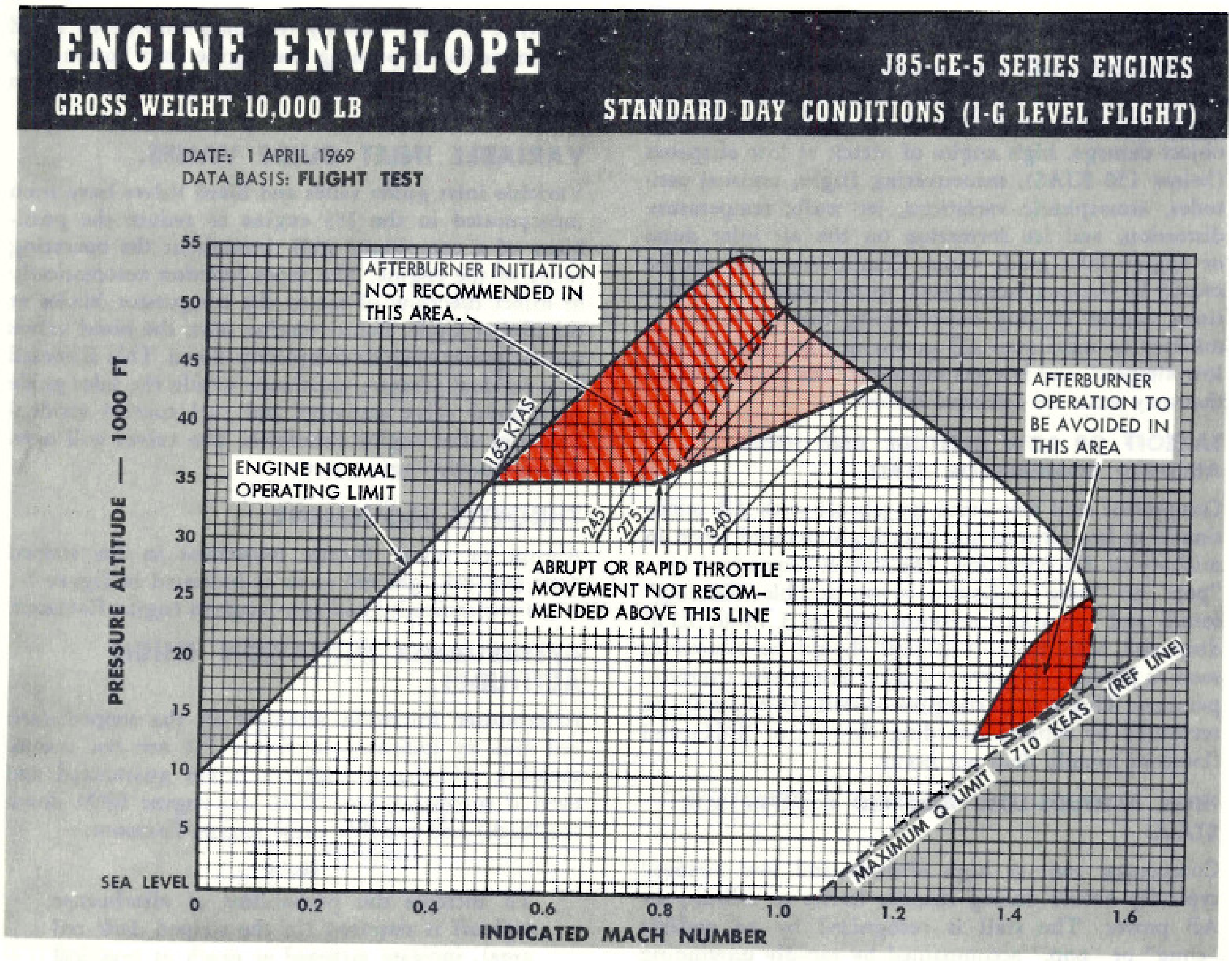


Figure 86

AFTERBURNER INITIATION (HIGH ALTITUDE)

Afterburner initiation attempts in the striped dark red area as indicated in Figure 86 are not recommended. Afterburner lightoff is not guaranteed and even if successful, may drive the engine RPM down (rollback) and possibly cause engine flameout.

Note

To increase the probability of afterburner lightoff if required (in the striped dark red area), increase airspeed as much as practical before initiating afterburner.

HIGH MACH DIVE

CAUTION

Avoid afterburner operation as indicated in the solid dark red area of Figure 84. Engine stall or damage to the variable exhaust nozzles may occur.

EFFECT OF COMPRESSOR INLET TEMPERATURE (T_2 CUTBACK)

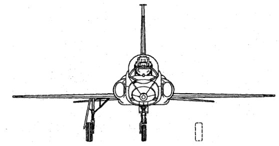
The T_2 sensor automatically reduces RPM and EGT (exhaust gas temperature) to prevent overpressurization in the engine compressor section at low CIT (compressor inlet temperatures). As a result, RPM and EGT indications may be below normal operating limits at MIL and MAX power when CIT is -2^{o}F and below.

EGT DROOP AT HIGH-Q/MIL POWER

At low altitude and high airspeed (500 KIAS), an EGT droop may occur with engine at military power when accompanied by 3 percent or less nozzle indication.

EFFECT OF HIGH ALTITUDE AND LOW AIRSPEED ON ENGINE RPM

During 1.0G stalls at or above 20,000 feet, with throttles at IDLE detent and airspeed 200 KIAS or below, the in-flight idle RPM can decay to less than normal ground idle speed (46.5% to 49.5% RPM), and the generator caution lights will illuminate. Under these flight conditions, an engine on which RPM has dropped below normal idle speed will not accelerate when the throttle is advanced. To avoid this condition, maintain engine RPM at 80 percent or above when airspeed of less than 200 KIAS above 20,000 feet are anticipated. Corrective action for idle unwind is to increase airspeed to above 200 KIAS by lowering the nose of the aircraft. As airspeed increases, throttle advances may be attempted; however, the throttle should be returned to IDLE detent if the engine does not accelerate.



GROUND EQUIPMENT

The MilViz T-38A has a menu selectable by the pilot with the Shift-2 command. This menu (Figure 86.1) allows the pilot to select various configuration options including:

1. Solo Pilot
2. Dual Instruction
3. Travel Pod
4. Fixed Base Power
    a. Present
    b. Not Present
5. Ground Cart
6. Boarding Ladders
    a. On ground when canopy closed.
    b. On side rails of cockpit when canopy open.

Figure 86.1

GROUND EQUIPMENT MENU OPERATION

Menu options are normally engaged whenever its green/red light is clicked green. When the light is clicked to red, the option is always disengaged. The flightsuit option is either military green or NASA blue. The same style of flight helmet is worn regardless. The boarding ladders may be toggled green but will not show unless the canopy is raised and locked. Also, the presence of the ground starter/power cart will also be toggled off whenever the brakes are applied. This is to help ensure that if the virtual pilot forgets to toggle the ground cart off prior to taxi, the natural brake release will accomplish the task automatically. If power cart is not selected, the jet will revert to fixed base power without any changes in starting procedure.

Whenever the ground cart is selected, a sub-menu will appear superimposed over the equipment menu, showing the ground cart power status. The pilot may toggle the ground cart on or off using the buttons provided (Figures 86.2 and 86.3).

Figure 86.2

Figure 86.3

When the Ground Cart is toggled to start, the amber charging light will illuminate and the generator power output meter will initiate clockwise rotation (Figure 86.4). Once the ground cart's generator is fully online, the amber light will extinguish and the power amperage meter will rotate clockwise to indicate the level of power output available to the aircraft (Figure 86.5).

Figure 86.4: Amber charging light illuminated on initial startup.

Figure 86.5: Amber charging light extinguished and amperage meter fully rotated clockwise to available power output.

BOARDING LADDERS AND ADDITIONAL EQUIPMENT OPERATION

The following image shows the boarding ladders and mobile ground cart selected by use of the Ground Equipment Menu.

Figure 86.6: Boarding ladders installed with canopy raised & required parking brake message

SECTION 8
ALL-WEATHER OPERATIONS
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INSTRUMENT FLIGHT PROCEDURES

INSTRUMENT TAKEOFF

For an instrument takeoff (MAX thrust), perform all normal pre-takeoff checks, and turn on pitot heat and engine anti-ice systems, if necessary. Allow for increased takeoff roll if engine anti-ice is used. Check the horizontal situation indicator for proper heading, and align the index marker on the pitch trim knob with the reference index on the ADI case. On a level surface with proper strut inflation, this should give approximately a 3-degree nose low indication. This setting will give an approximate level flight indication for intermediate altitude level-offs during departures and at normal cruise conditions.

Takeoff at MIL thrust is not recommended because of the lengthened ground roll required. Throttle application and brake release are the same as those given for normal takeoff procedure in Section 2 of this POH. Manual bank steering may be used to aid in maintaining directional control, but steering bar indications should be cross-checked with the compass card. Whenever visibility permits, runway features and lights should be used as an aid to maintain proper headings. Use wheel brakes until rudder becomes effective; then use rudder for directional control. Initiate back stick at 130 KIAS; the nosewheel should lift off at 140 KIAS. Adjust back stick pressure to attain a 5-degree nose high indication and allow the aircraft to fly off the runway. When vertical velocity indicator and altimeter indicate a definite climb, retract the landing gear. Raise the wing flaps immediately after the landing gear lever has been placed at LG UP.

INSTRUMENT CLIMB

Approaching 300 KIAS in a 5-degree climb indication, retard throttles to MIL thrust. Maintain a 2 to 5-degree climb indication and at least a 1,000-FPM climb until reaching recommended climb schedule. A slow airspeed and/or low rate of climb may be required to comply with departure procedures. For this type climb, reduce power below MIL as required. Power settings between 90% and 95% RPM will provide comfortable climb rates at 300 KIAS for intermediate altitude level-offs.

MAX thrust climbs require extremely high pitch angle and are not normally used for instrument departures. If conditions require a MAX thrust climb, maintain a 2 to 5-degree climb indication until approaching recommended climb Mach, then rotate to approximately a 20 to 25-degree initial climb indication.

HOLDING PATTERNS

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

PENETRATION DESCENTS

Prior to penetration descent, the canopy defog system should be operated at the highest flow possible (consistent with crewmembers' comfort) during high altitude flight to prevent the formation of frost or fog during descent. To enter a penetration descent, reduce both throttles to 80% RPM and lower the nose approximately 10 degrees on the ADI. Idle RPM may be used if no icing conditions are anticipated. Open speed brakes (if required) at 280 KIAS and maintain by adjusting pitch as required.

Initiate the level-off from a penetration descent 1,000 feet or more above the desired altitude by decreasing the pitch attitude by approximately one half. Use normal lead point for level-off at the desired altitude. The speed brake may be left open or closed as required to obtain the desired airspeed at the final approach fix.

Note

For formation penetration, 85% RPM is recommended.

INSTRUMENT APPROACHES

Note

The T-38A is a Category E aircraft for instrument approach purposes.

Figure 86.8 shows a typical TACAN penetration and approach. Normally, 220-250 KIAS will be maintained during approach maneuvering prior to extending the gear. Recommended airspeeds from the final approach fix will depend upon the type of approach being made. Prior to the final approach fix, lower the landing gear and set flaps at 60%. For a circling approach to the landing runway, maintain 175 KIAS plus fuel minimum (AoA indexer on speed) until aligned with the landing runway. For a straight-in approach, maintain 155 KIAS plus fuel minimum (AoA indexer on speed). When on final, 100% flaps may be used for the landing, if desired.

Note

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

INSTRUMENT LANDING SYSTEM (ILS)

Refer to figures 86.12 and 86.13 for aircraft configuration. Refer to Section 5 of this POH for flight director procedures.

MISSED APPROACH PROCEDURE

To accomplish a missed approach, advance throttles to MIL, close speed brake (if open) as power is applied, and rotate the aircraft to normal instrument takeoff attitude. Retract landing gear and flaps as in an instrument takeoff and accelerate to 220-230 KIAS. Reduce power to 90% to 95% RPM, and climb to 220-250 KIAS to missed approach altitude.

SINGLE-ENGINE APPROACHES

Refer to figures 86.9, 86.11, and 86.13 for recommended airspeed and configuration for single-engine TACAN, radar, or ILS approaches. Delay lowering landing gear until just prior to glideslope intercept if heavy fuel loads, engine anti-ice operation, turbulence, or other conditions cause single-engine MIL thrust to be inadequate for gear down level flight at recommended airspeeds. MAX thrust should be used on single-engine approaches, if necessary.

SINGLE-ENGINE MISSED APPROACH

Refer to figures 86.9 and 86.11, and 86.13 for single-engine instrument approach power settings and configurations. If a single-engine missed approach is necessary, use the procedures for engine failure during takeoff at shown in Section 3 of this POH.

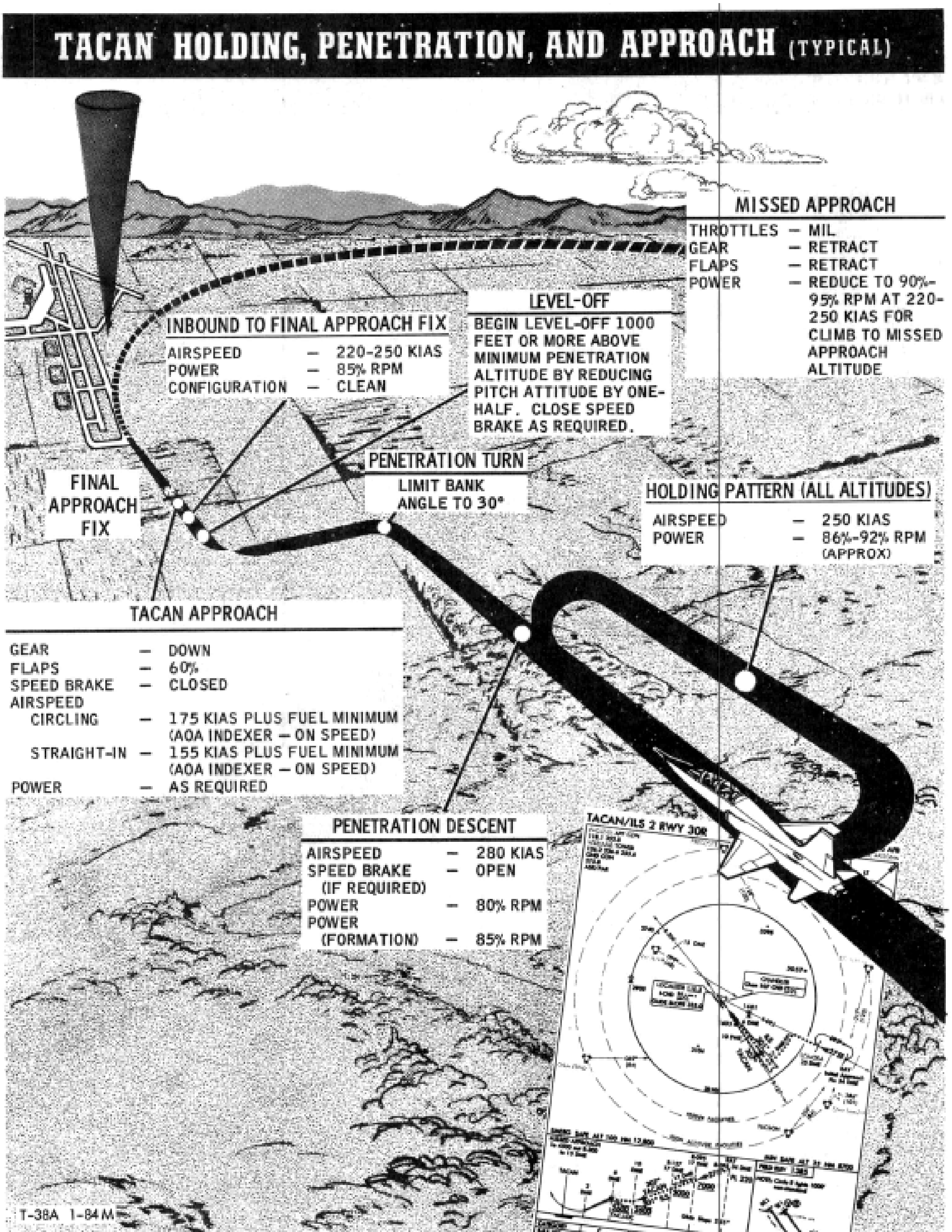

TACAN HOLDING, PENETRATION, AND APPROACH (TYPICAL)
MISSED APPROACH
THROTTLES — MIL
GEAR — RETRACT
FLAPS — RETRACT
POWER — REDUCE TO 90%-95% RPM AT 220-250 KIAS FOR CLIMB TO MISSED APPROACH ALTITUDE
LEVEL-OFF
BEGIN LEVEL-OFF 1000 FEET OR MORE ABOVE MINIMUM PENETRATION ALTITUDE BY REDUCING PITCH ATTITUDE BY ONE-HALF. CLOSE SPEED BRAKE AS REQUIRED.
INBOUND TO FINAL APPROACH FIX
AIRSPEED — 220-250 KIAS
POWER — 85% RPM
CONFIGURATION — CLEAN
PENETRATION TURN
LIMIT BANK ANGLE TO 30°
FINAL APPROACH FIX
HOLDING PATTERN (ALL ALTITUDES)
AIRSPEED — 250 KIAS
POWER — 86%-92% RPM (APPROX)
TACAN APPROACH
GEAR — DOWN
FLAPS — 60%
SPEED BRAKE — CLOSED
AIRSPEED
CIRCLING — 175 KIAS PLUS FUEL MINIMUM (AOA INDEXER — ON SPEED)
STRAIGHT-IN — 155 KIAS PLUS FUEL MINIMUM (AOA INDEXER — ON SPEED)
POWER — AS REQUIRED
PENETRATION DESCENT
AIRSPEED — 280 KIAS
SPEED BRAKE (IF REQUIRED) — OPEN
POWER — 80% RPM
POWER (FORMATION) — 85% RPM
TACAN/ILS 2 RWY 30R
T-38A 1-84M

Figure 86.8

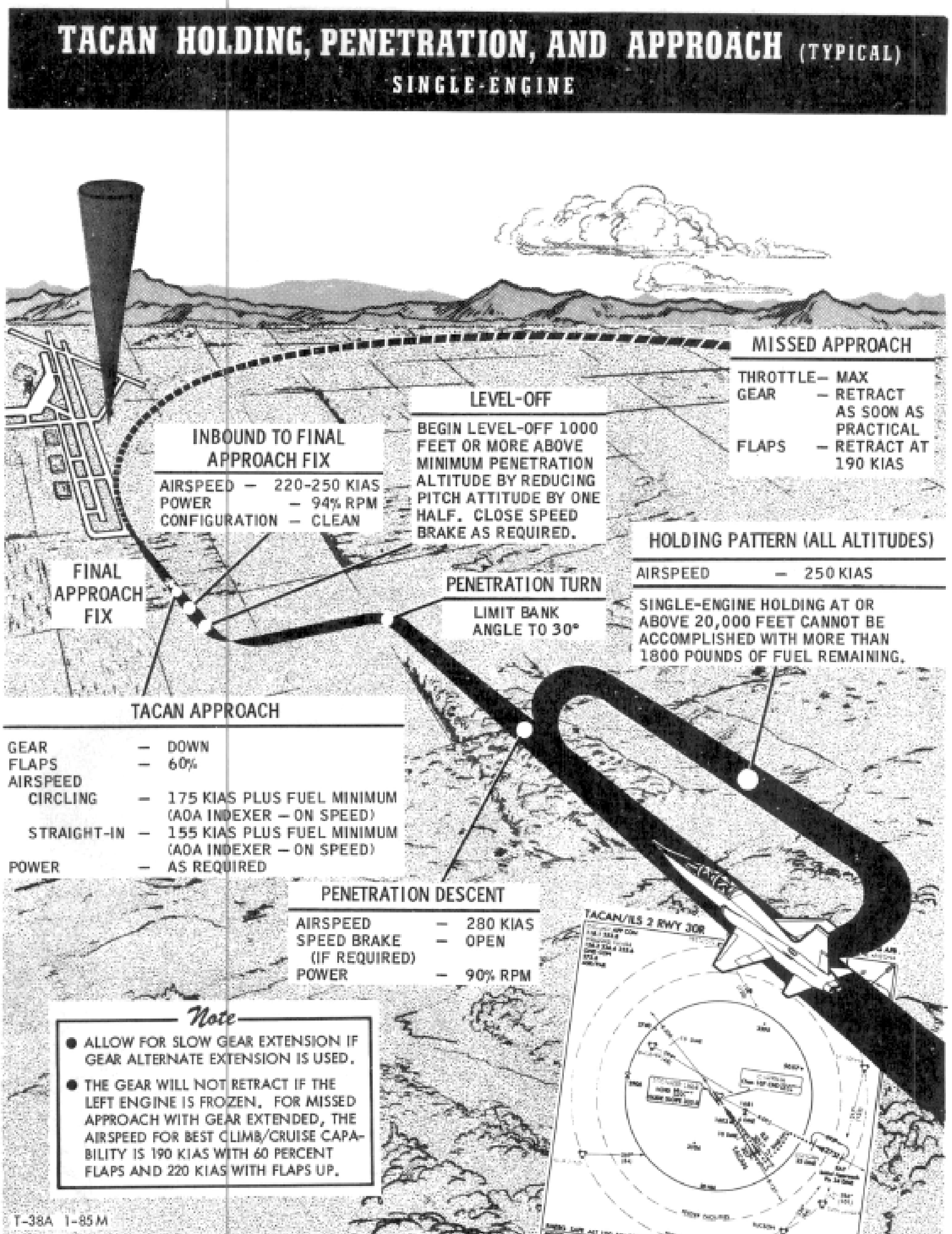

TACAN HOLDING, PENETRATION, AND APPROACH (TYPICAL)
SINGLE-ENGINE
MISSED APPROACH
THROTTLE — MAX
GEAR — RETRACT AS SOON AS PRACTICAL
FLAPS — RETRACT AT 190 KIAS
LEVEL-OFF
BEGIN LEVEL-OFF 1000 FEET OR MORE ABOVE MINIMUM PENETRATION ALTITUDE BY REDUCING PITCH ATTITUDE BY ONE HALF. CLOSE SPEED BRAKE AS REQUIRED.
INBOUND TO FINAL APPROACH FIX
AIRSPEED — 220-250 KIAS
POWER — 94% RPM
CONFIGURATION — CLEAN
HOLDING PATTERN (ALL ALTITUDES)
AIRSPEED — 250 KIAS
SINGLE-ENGINE HOLDING AT OR ABOVE 20,000 FEET CANNOT BE ACCOMPLISHED WITH MORE THAN 1800 POUNDS OF FUEL REMAINING.
FINAL APPROACH FIX
PENETRATION TURN
LIMIT BANK ANGLE TO 30°
TACAN APPROACH
GEAR — DOWN
FLAPS — 60%
AIRSPEED
CIRCLING — 175 KIAS PLUS FUEL MINIMUM (AOA INDEXER — ON SPEED)
STRAIGHT-IN — 155 KIAS PLUS FUEL MINIMUM (AOA INDEXER — ON SPEED)
POWER — AS REQUIRED
PENETRATION DESCENT
AIRSPEED — 280 KIAS
SPEED BRAKE (IF REQUIRED) — OPEN
POWER — 90% RPM
TACAN/ILS 2 RWY 30R
Note
ALLOW FOR SLOW GEAR EXTENSION IF GEAR ALTERNATE EXTENSION IS USED.
THE GEAR WILL NOT RETRACT IF THE LEFT ENGINE IS FROZEN. FOR MISSED APPROACH WITH GEAR EXTENDED, THE AIRSPEED FOR BEST CLIMB/CRUISE CAPABILITY IS 190 KIAS WITH 60 PERCENT FLAPS AND 220 KIAS WITH FLAPS UP.
T-38A 1-85M

Figure 86.9

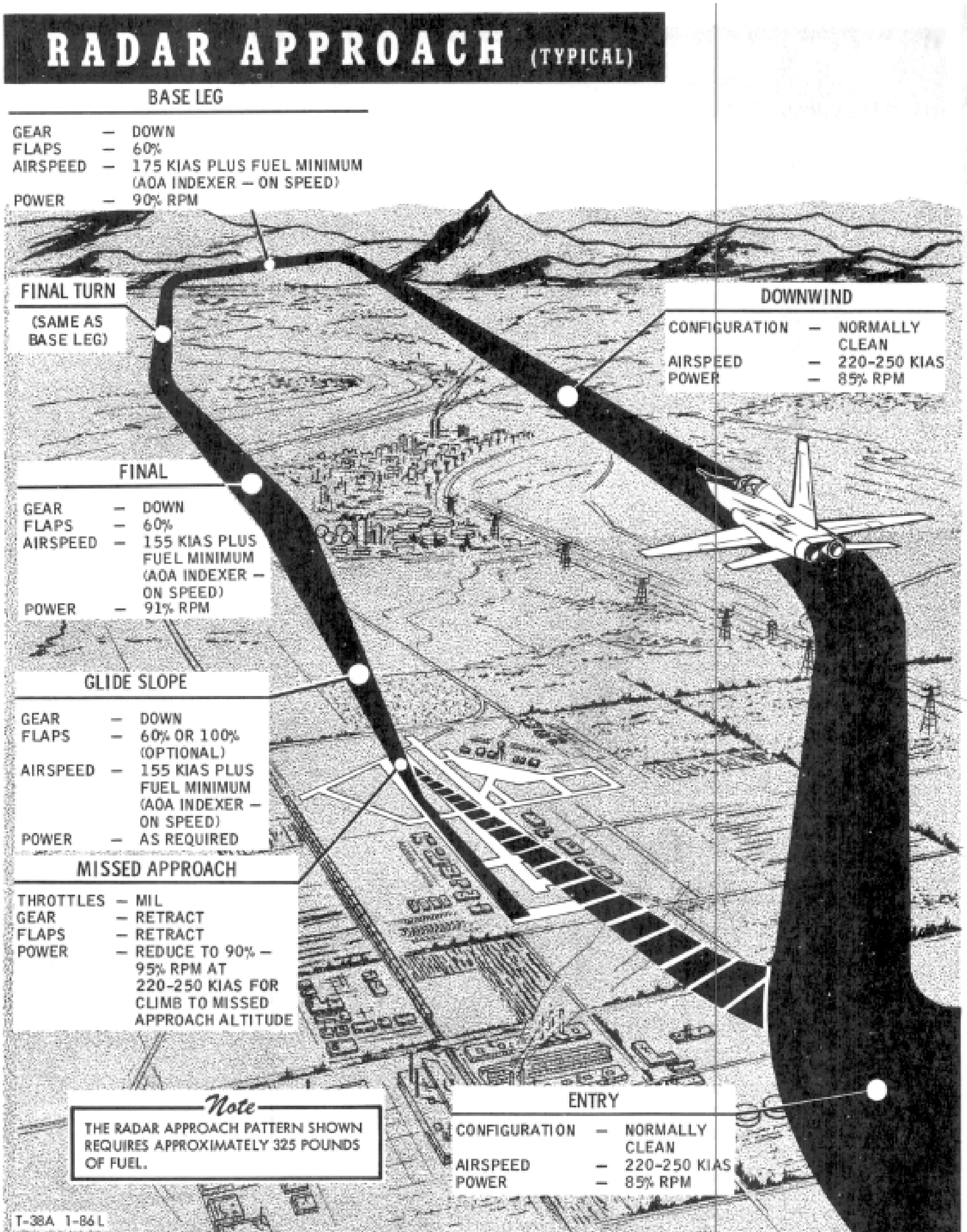

RADAR APPROACH (TYPICAL)
BASE LEG
GEAR — DOWN
FLAPS — 60%
AIRSPEED — 175 KIAS PLUS FUEL MINIMUM (AOA INDEXER — ON SPEED)
POWER — 90% RPM
FINAL TURN
(SAME AS BASE LEG)
DOWNWIND
CONFIGURATION — NORMALLY CLEAN
AIRSPEED — 220-250 KIAS
POWER — 85% RPM
FINAL
GEAR — DOWN
FLAPS — 60%
AIRSPEED — 155 KIAS PLUS FUEL MINIMUM (AOA INDEXER — ON SPEED)
POWER — 91% RPM
GLIDE SLOPE
GEAR — DOWN
FLAPS — 60% OR 100% (OPTIONAL)
AIRSPEED — 155 KIAS PLUS FUEL MINIMUM (AOA INDEXER — ON SPEED)
POWER — AS REQUIRED
MISSED APPROACH
THROTTLES — MIL
GEAR — RETRACT
FLAPS — RETRACT
POWER — REDUCE TO 90% — 95% RPM AT 220-250 KIAS FOR CLIMB TO MISSED APPROACH ALTITUDE
Note
THE RADAR APPROACH PATTERN SHOWN REQUIRES APPROXIMATELY 325 POUNDS OF FUEL.
ENTRY
CONFIGURATION — NORMALLY CLEAN
AIRSPEED — 220-250 KIAS
POWER — 85% RPM
T-38A 1-86L

Figure 86.10

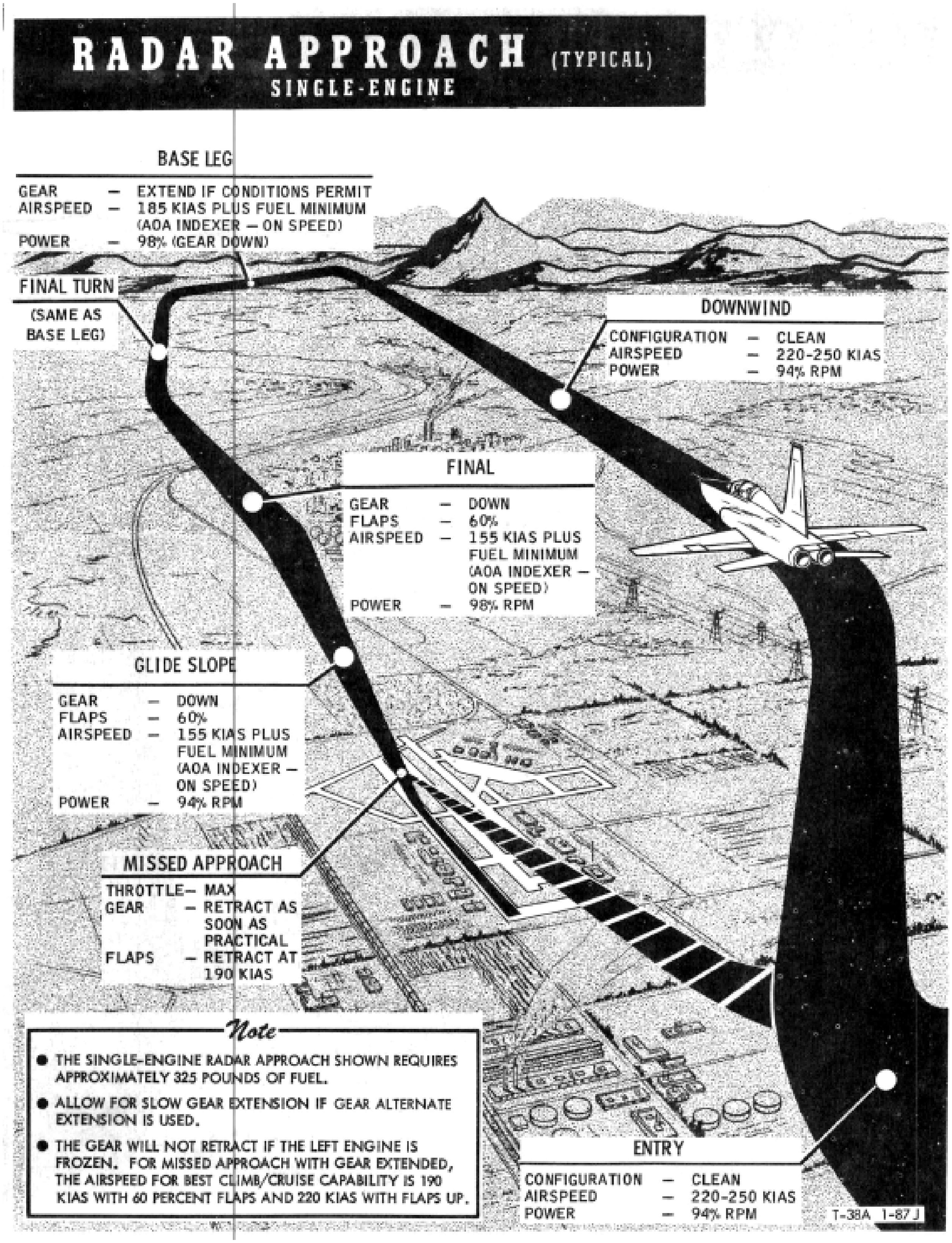

RADAR APPROACH (TYPICAL)
SINGLE-ENGINE
BASE LEG
GEAR – EXTEND IF CONDITIONS PERMIT
AIRSPEED – 185 KIAS PLUS FUEL MINIMUM (AOA INDEXER – ON SPEED)
POWER – 98% (GEAR DOWN)
FINAL TURN
(SAME AS BASE LEG)
DOWNWIND
CONFIGURATION – CLEAN
AIRSPEED – 220-250 KIAS
POWER – 94% RPM
FINAL
GEAR – DOWN
FLAPS – 60%
AIRSPEED – 155 KIAS PLUS FUEL MINIMUM (AOA INDEXER – ON SPEED)
POWER – 98% RPM
GLIDE SLOPE
GEAR – DOWN
FLAPS – 60%
AIRSPEED – 155 KIAS PLUS FUEL MINIMUM (AOA INDEXER – ON SPEED)
POWER – 94% RPM
MISSED APPROACH
THROTTLE – MAX
GEAR – RETRACT AS SOON AS PRACTICAL
FLAPS – RETRACT AT 190 KIAS
Note
● THE SINGLE-ENGINE RADAR APPROACH SHOWN REQUIRES APPROXIMATELY 325 POUNDS OF FUEL.
● ALLOW FOR SLOW GEAR EXTENSION IF GEAR ALTERNATE EXTENSION IS USED.
● THE GEAR WILL NOT RETRACT IF THE LEFT ENGINE IS FROZEN. FOR MISSED APPROACH WITH GEAR EXTENDED, THE AIRSPEED FOR BEST CLIMB/CRUISE CAPABILITY IS 190 KIAS WITH 60 PERCENT FLAPS AND 220 KIAS WITH FLAPS UP.
ENTRY
CONFIGURATION – CLEAN
AIRSPEED – 220-250 KIAS
POWER – 94% RPM
T-38A 1-87 J

Figure 86.11

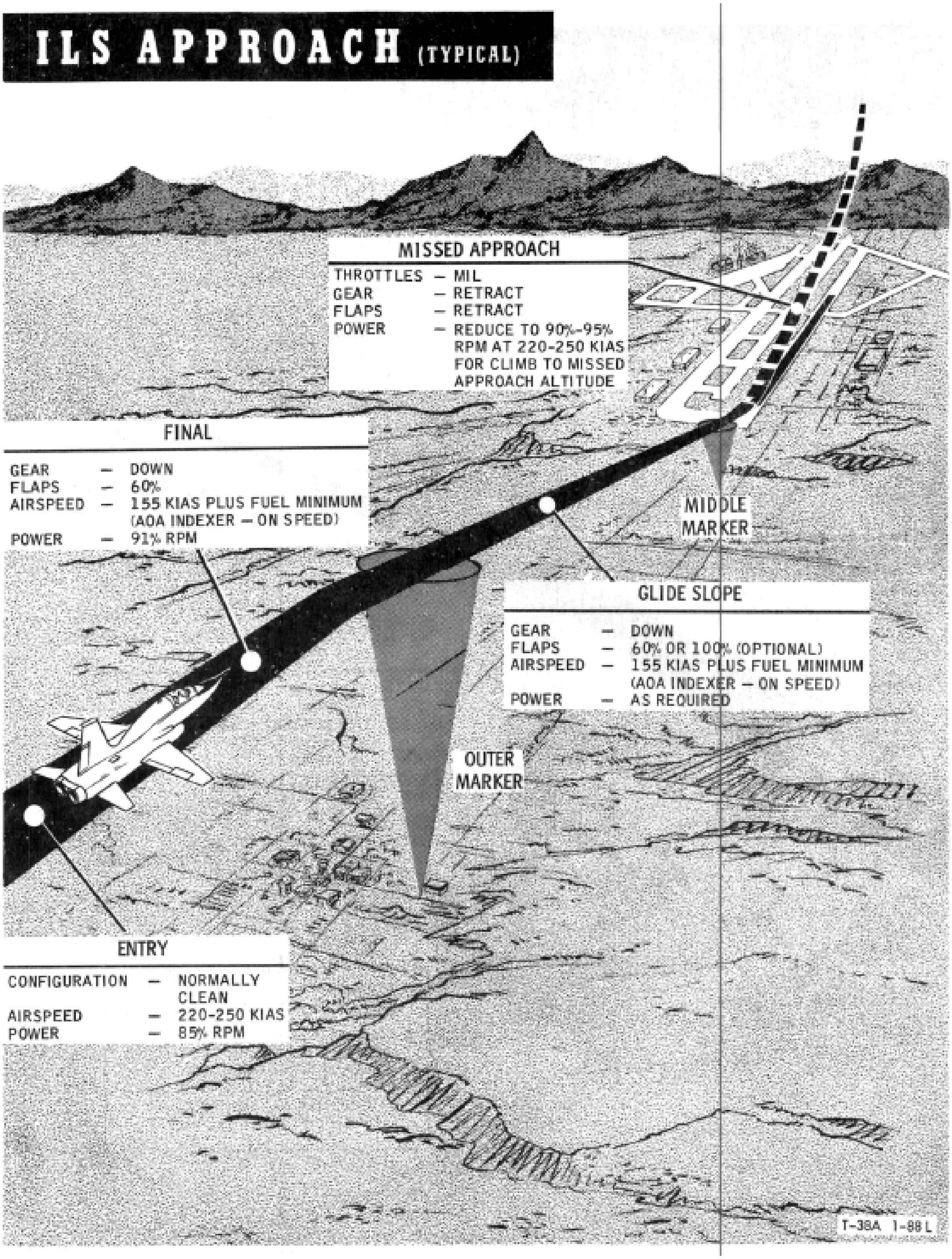

ILS APPROACH (TYPICAL)
MISSED APPROACH
THROTTLES — MIL
GEAR — RETRACT
FLAPS — RETRACT
POWER — REDUCE TO 90%-95% RPM AT 220-250 KIAS FOR CLIMB TO MISSED APPROACH ALTITUDE
FINAL
GEAR — DOWN
FLAPS — 60%
AIRSPEED — 155 KIAS PLUS FUEL MINIMUM (AOA INDEXER — ON SPEED)
POWER — 91% RPM
MIDDLE MARKER
GLIDE SLOPE
GEAR — DOWN
FLAPS — 60% OR 100% (OPTIONAL)
AIRSPEED — 155 KIAS PLUS FUEL MINIMUM (AOA INDEXER — ON SPEED)
POWER — AS REQUIRED
OUTER MARKER
ENTRY
CONFIGURATION — NORMALLY CLEAN
AIRSPEED — 220-250 KIAS
POWER — 85% RPM
T-38A 1-88 L

Figure 86.12

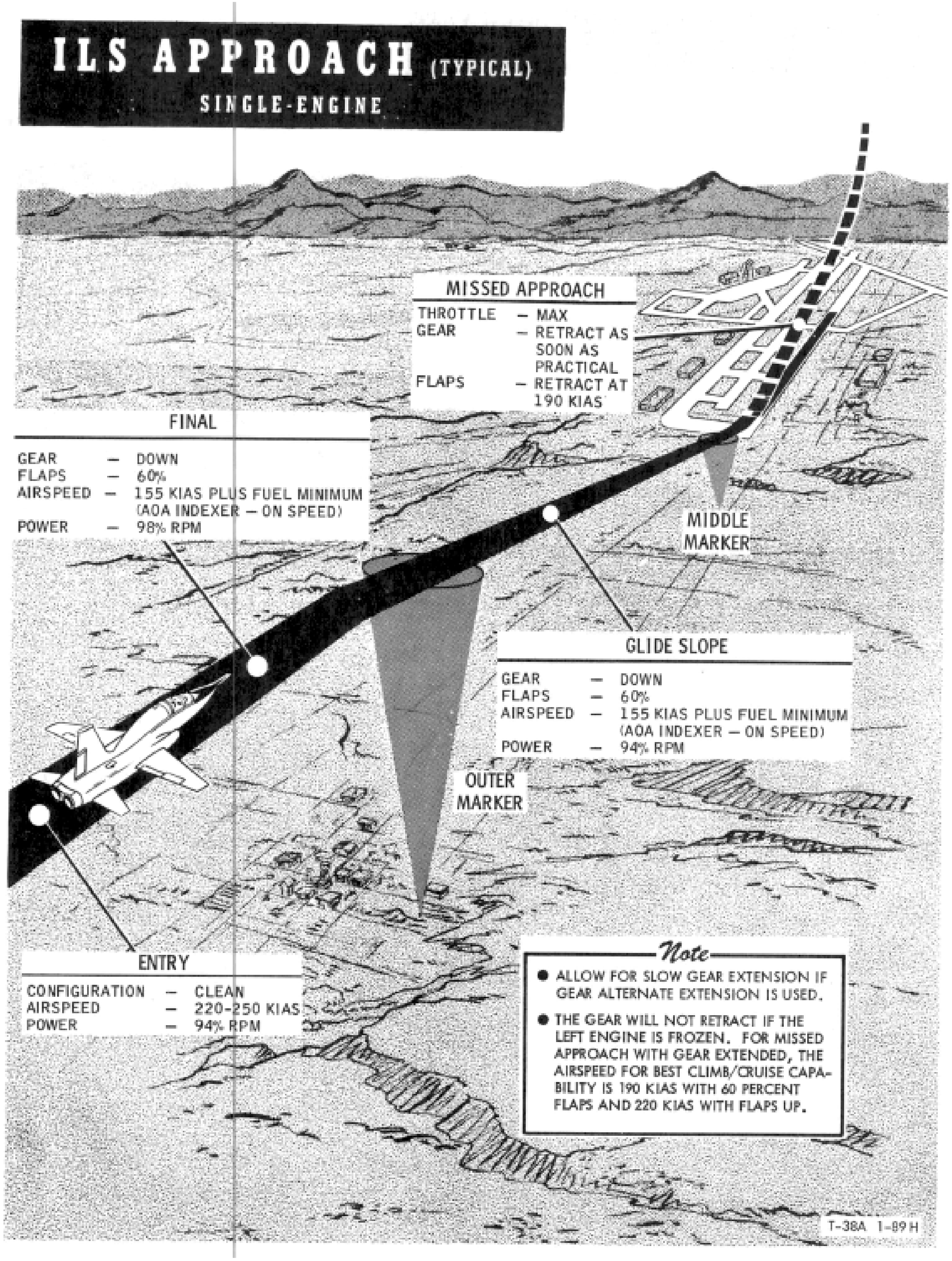

ILS APPROACH (TYPICAL)
SINGLE-ENGINE
MISSED APPROACH
THROTTLE — MAX
GEAR — RETRACT AS SOON AS PRACTICAL
FLAPS — RETRACT AT 190 KIAS
FINAL
GEAR — DOWN
FLAPS — 60%
AIRSPEED — 155 KIAS PLUS FUEL MINIMUM (AOA INDEXER — ON SPEED)
POWER — 98% RPM
MIDDLE MARKER
GLIDE SLOPE
GEAR — DOWN
FLAPS — 60%
AIRSPEED — 155 KIAS PLUS FUEL MINIMUM (AOA INDEXER — ON SPEED)
POWER — 94% RPM
OUTER MARKER
ENTRY
CONFIGURATION — CLEAN
AIRSPEED — 220-250 KIAS
POWER — 94% RPM
Note
● ALLOW FOR SLOW GEAR EXTENSION IF GEAR ALTERNATE EXTENSION IS USED.
● THE GEAR WILL NOT RETRACT IF THE LEFT ENGINE IS FROZEN. FOR MISSED APPROACH WITH GEAR EXTENDED, THE AIRSPEED FOR BEST CLIMB/CRUISE CAPABILITY IS 190 KIAS WITH 60 PERCENT FLAPS AND 220 KIAS WITH FLAPS UP.
T-38A 1-89H

Figure 86.13

ICE AND RAIN

TAKEOFF

Monitor engine performance closely during takeoff on runways with large amounts of puddle water. Flameouts can be caused by water thrown up by the nosewheel.

ICING

Anti-icing equipment for the wings, empennage, and inlet ducts is not provided. The aircraft is provided with engine anti-ice, pitot heat, and canopy defog heat, which also provides windshield heat for adverse weather operation. Icing conditions which may be encountered are trace, light, moderate, and severe. Moderate and severe icing, particularly, can cause rapid buildup of ice on the aircraft surfaces and greatly affect performance.

WARNING

The aircraft should not be flown in icing conditions. If icing is inadvertently encountered, leave the area of icing conditions as soon as possible.

When icing conditions are unavoidable, the pitot heat switch should be placed at PITOT HEAT and the canopy defog knob turned to full increase. The aircraft is not equipped with windshield anti-icing or rain removal equipment. Instrument approaches in heavy rain are possible, but forward visibility through the windshield may be marginal. Forward visibility in icing conditions is further reduced and may be completely obscured through the windshield.

ICE INGESTION

Engine damage may occur if as little as 1/4 inch of ice accumulates on engine inlet duct lips. Ingestion of accumulated ice into an engine and may result in damage to inlet guide vanes and first-stage compressor blades. Engine instrument indications may remain normal, even though engine damage from ice ingestion has been experienced.

CAUTION

- After ice ingestion, the affected engine should be operated at the lowest possible RPM necessary to make a safe landing, avoiding abrupt or rapid throttle movements.
- If flight in icing conditions results in ice accumulations on the aircraft, enter this information in Form 781, as the engines must be inspected for ice ingestion damage when this occurs.

ENGINE ICING

Engine inlet vane icing may occur when operating in visible moisture and ambient temperature is below 32°F. Under these conditions, and when icing conditions are unavoidable, the engine anti-ice switch should immediately be placed at MAN. ON, ensuring continuous anti-icing action.

Note

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

TURBULENCE AND THUDERSTORMS

WARNING

Intentional flight in thunderstorms should be avoided.

The recommended best penetration airspeed if turbulence and thunderstorms are experienced is 280 KIAS.

NIGHT FLYING

When flying away from concentrations of ground lights, caution should be exercised to prevent spatial disorientation. Immediately reference primary flight instruments, starting with the ADI, whenever experiencing loss of horizon or spatial disorientation.

COLD WEATHER OPERATION

Most cold weather operating difficulties are encountered on the ground. The following instructions are to be used in conjunction with the normal procedures given in Section 2 of this POH whenever cold weather aircraft operations are necessary.

BEFORE ENTERING AIRCRAFT

Remove all protective covers and duct plugs; check to see that all surfaces, ducts, struts, drains, and vents are free of snow, ice, and frost. Latest FAA requirements are that all surfaces are to be entirely clean of any snow, ice, or frost. Remove ice, encrusted snow, or frost by a direct flow of air from a portable ground heater or by using de-icing fluid. Powdery snow may be brushed off provided the underlying surface is removed of all encrusted snow, ice, or frost.

WARNING

- Takeoff distance and climbout performance can be adversely affected by ice and snow accumulations. The roughness and distribution of these accumulations can vary stall speeds and alter flight characteristics to a degree extremely hazardous to safe flight.
- Ensure that water does not accumulate in control hinge areas or other critical areas where refreezing may cause damage or binding.

CAUTION

To avoid damage to aircraft surfaces, do not permit ice to be chipped or scraped away.

Check the fuel system vents on the vertical stabilizer for freedom from ice. Remove all dirt and ice from landing gear shock struts, actuating cylinder pistons, and limit switches. Wipe exposed parts of shock struts and pistons with a rag soaked in hydraulic fluid. Inspect aircraft carefully for fuel and hydraulic leaks caused by contraction of fittings or by shrinkage of packings.

Inspect area behind aircraft to ensure that water or snow will not be blown onto personnel and equipment during engine start.

ON ENTERING AIRCRAFT

Use external power for starting to conserve the battery. No preheat or special starting procedures are required; however, at temperatures below -30°F (-34°C)allow the engines to idle 2 minutes before accelerating. Turn on cockpit heat and canopy defog system as required immediately after engine start. Check flight controls, speed brakes, and aileron trim for proper operation. Cycle flight controls four to six times. Check hydraulic pressure and control reaction, and operation of all instruments.

ENGINE OIL PRESSURE INDICATIONS

Oil pressure indications above 55 psi will be observed after engine start. As the oil warms up, pressure should reduce to within operating limits. To reduce time for oil pressure to return to normal, the engine may be operated above idle up to military power until oil pressure is within limits. If oil pressure does not return to within operating limits, shut down engine and determine cause.

ENGINE IDLE RPM

Low engine idle RPM can be expected after engine start when the engines are cold and the ground ambient temperature is below -16°F (-26°C). Monitor EGT and increase engine RPM as necessary to cut in the AC generators. If engine RPM will not increase when the throttle is advanced, shut down engine and determine cause. Engine idle RPM should be within operating limits after the engine has warmed up and the oil pressure has decreased to the normal operating range.

TAXIING

Nosewheel steering effectiveness is reduces when taxiing on ice and hard packed snow. A combination of nosewheel steering and wheel braking should be used for directional control. The nosewheel will skid sideways easily, increasing the possibility of tire damage. Reduce taxi speeds and exercise caution at all times when operating on these surfaces. Increase the normal interval between aircraft both to ensure a safe stopping distance and to prevent icing of the aircraft from melted snow and ice caused by the jet blast of the preceding aircraft. Minimize taxi time to conserve fuel and reduce the amount of ice fog generated by the engines. If bare spots exist through the snow, skidding onto them should be avoided. Check for sluggish instruments while taxiing.

TAKEOFF

Do not advance throttles into MAX range until the aircraft is rolling straight down the runway.

WARNING

Do not take off on slush covered runway; the nosewheel may sling slush into the inlet ducts, causing engine flameout and/or damage.

LANDING

Use landing techniques given in Section 2 of this POH. When landing on runways that have patches of dry surface, avoid locking the wheels. If the aircraft starts to skid, release brakes until recovery from skid is accomplished.

ENGINE SHUTDOWN

Use normal engine shutdown procedures as specified in Section 2 of this POH.

BEFORE LEAVING AIRCRAFT

Leave the canopy partly open, to allow circulation of air within the cockpit to prevent the canopy from cracking and to reduce windshield and canopy frosting.

HOT WEATHER AND DESERT OPERATION

Operation of the aircraft in hot weather and in the desert requires that precaution be taken to protect the aircraft from damage caused by high temperatures, dust, and sand. Care must be taken to prevent the entrance of sand into aircraft parts and systems such as the engines, fuel system, pitot-static system, etc. All filters should be checked more frequently than under normal conditions. Plastic and rubber segments of the aircraft should be protected both from high temperatures and blowing sand. Canopy covers should be left off the prevent sand from accumulating between the cover and the canopy and acting as an abrasive on the plastic canopy. With a canopy closed, cockpit damage may result when ambient temperature is in excess of 110°F. Desert and hot weather operations require that in addition to normal procedures, the following precautions be observed.

TAKEOFF

1. Monitor pitch attitude closely to ensure a positive rate of climb during gear and flap retraction and to prevent an excessive angle of attack
2. Be alert for gusts and wind shifts near the ground.

APPROACH AND LANDING

1. Monitor airspeed closely to ensure that recommended approach and touchdown airspeeds are maintained; high ambient temperatures cause speed relative to the ground to be higher than normal.
2. Anticipate a long landing roll due to higher ground speed at touchdown.
3. Utilize effective aerodynamic braking and all available runway for stopping the aircraft without overheating the wheel brakes.

APPENDIX 1
PERFORMANCE DATA
TABLE OF CONTENTS

PART 1 – INTRODUCTION

The flight performance charts provide the pilot with flight test data for basic flight planning purposes. All charts are based on standard day conditions except when necessary, as in the takeoff and landing charts, to include temperature corrections for non-standard days. These corrections are based on maintaining the recommended indicated, Mach number or indicated airspeed. Instrument error is assumed to be zero in all performance charts of this appendix.

TAKEOFF FACTOR

The takeoff factor is used to simplify the takeoff charts. The factor is based on atmospheric condition and the desired takeoff power setting. The factor reduces the time and effort required in takeoff planning.

DESCRIPTION OF DRAG INDEX SYSTEM

The Drag Index System permits the presentation of performance for a number of external store loadings on one chart and greatly reduces the number of charts required in flight planning work. In the drag index system, each item of the external store configuration, such as a bomb or pylon, is assigned a drag number whose value depends on the size and shape of the item and its location on the aircraft. These numbers are not drag coefficients. The summation of the store drag numbers for a particular loading defines a drag index for that configuration. This drag index, when used in the performance charts, determines the aircraft performance for that external store configuration. The T-38A, with no external stores capability, has a drag index of zero.

ALTIMETER AND AIRSPEED INSTALLATION ERROR CORRECTION

Static pressure, which affect both airspeed and altimeter indications, is not always accurately measured because of the location of the static ports. This pressure error is a function of both airspeed and altitude. KCAS is obtained from KIAS by correcting for the installation error in static pressure (airspeed installation error). Knowing indicated airspeed and pressure altitude, both airspeed and altimeter installation corrections may be read from the chart contained in this section.

USE OF ALTIMETER CORRECTION CHART

Consider the aircraft flying at 280 KIAS at 40,000 feet (FL 400). Read up the 280 KIAS line to intersect the 40,000-foot correction curve, and from this point, draw a horizontal line to the left margin of the chart. Read the correction, which is +60 feet. Since indicated altitude is pressure altitude plus correction, the proper indicated altitude is 40,060 feet.

MACH NUMBER CORRECTION

To convert true Mach number to indicated Mach number, use Mach number correction in this section.

COMPRESSIBILITY CORRECTION TO CALIBRATED AIRSPEED

The compressibility correction chart in this section provides the necessary airspeed correction to convert KCAS to KEAS (KEAS = KCAS – correction factor).

AIRSPEED CONVERSION

The chart for airspeed conversion is used to convert between KCAS, true Mach number, and KTAS. If KCAS is known, enter the chart at that value and move upward to the known pressure altitude. At that point, true Mach number is read on the left-hand scale and KTAS for standard atmosphere conditions is interpolated between the sloping speed lines whose scale is located at the seal level pressure altitude line. To correct KTAS for non-standard temperatures, move horizontally from the intersection of KCAS and the known altitude to the sea level pressure altitude line, then vertically downward to the known ambient air temperature, and read the corrected KTAS on the scale at the right.

STANDARD ALTITUDE TABLE

Significant properties of the ICAO standard atmosphere are tabulated at 1,000-foot increments between -2,000 and 65,000 feet altitude as show in the chart in this section. Sea level values of the properties are listed in the top of the chart for use with the ratios shown in the table.

DENSITY ALTITUDE

The density altitude chart presents the variation of density altitude with ambient temperature for constant values of pressure altitude. Values are tabulated at the right of the chart as a function of the density altitude scale on the left side. ICAO standard atmosphere conditions are defined by the line which slopes to the left and upward through the chart.

STANDARD CONVERSION TABLE

Linear scales for converting units of temperature, distance, and speed from one measurement system to another are provided in this chart. Additional conversion factors for volume, pressure, and weight are listed at the bottom of the table.

ALTIMETER AND AIRSPEED INSTALLATION ERROR CORRECTIONS

CLEAN CONFIGURATION

MODEL: T-38A
DATE: 1 AUGUST 1965
DATA BASIS: FLIGHT TEST

ENGINE: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

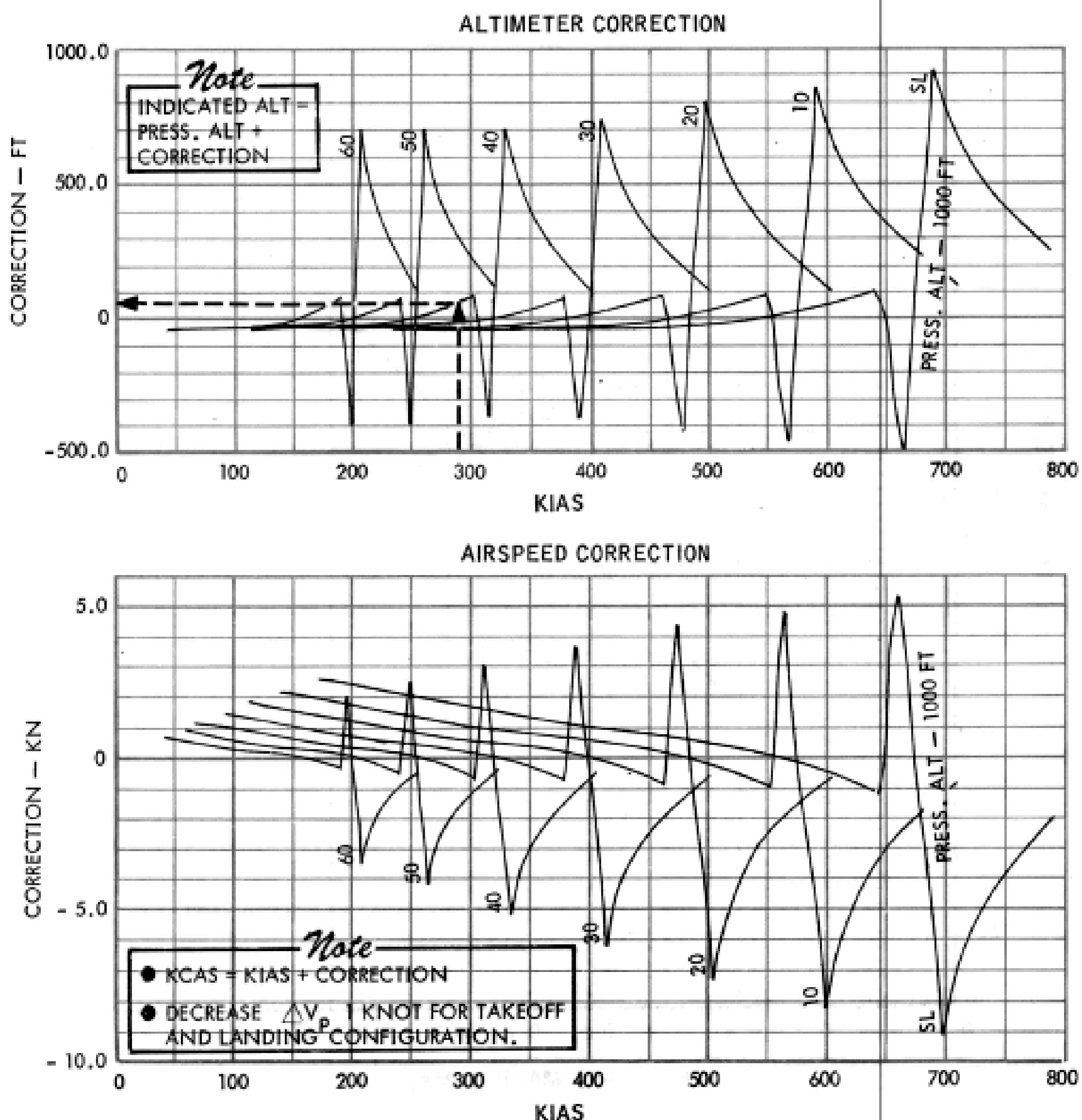


Figure 87

MACH NUMBER CORRECTION

MODEL: T-38A
DATE: 1 AUGUST 1965
DATA BASIS: **FLIGHT TEST**

ENGINE: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

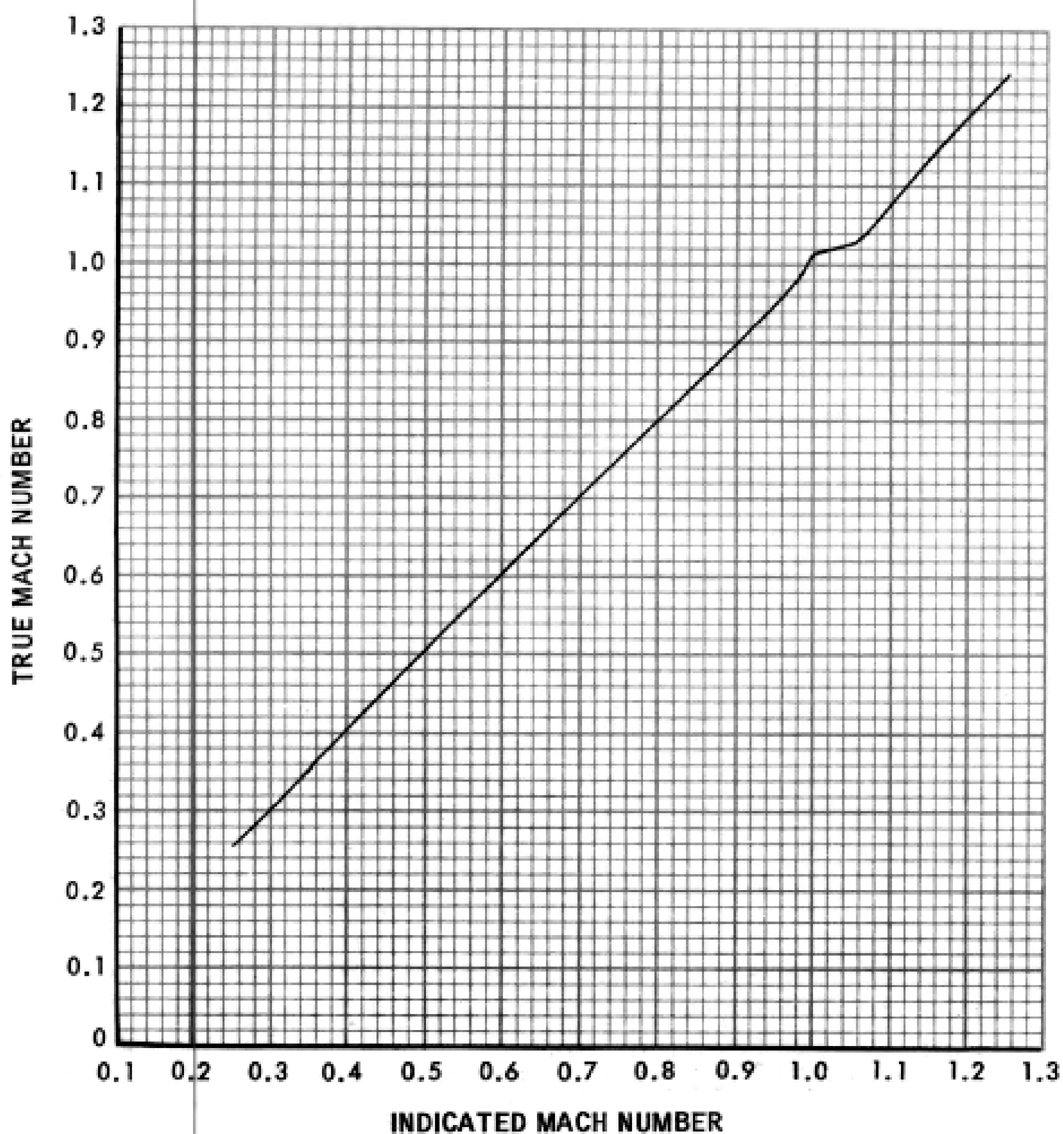


Figure 88

COMPRESSIBILITY CORRECTION
TO CALIBRATED AIRSPEED

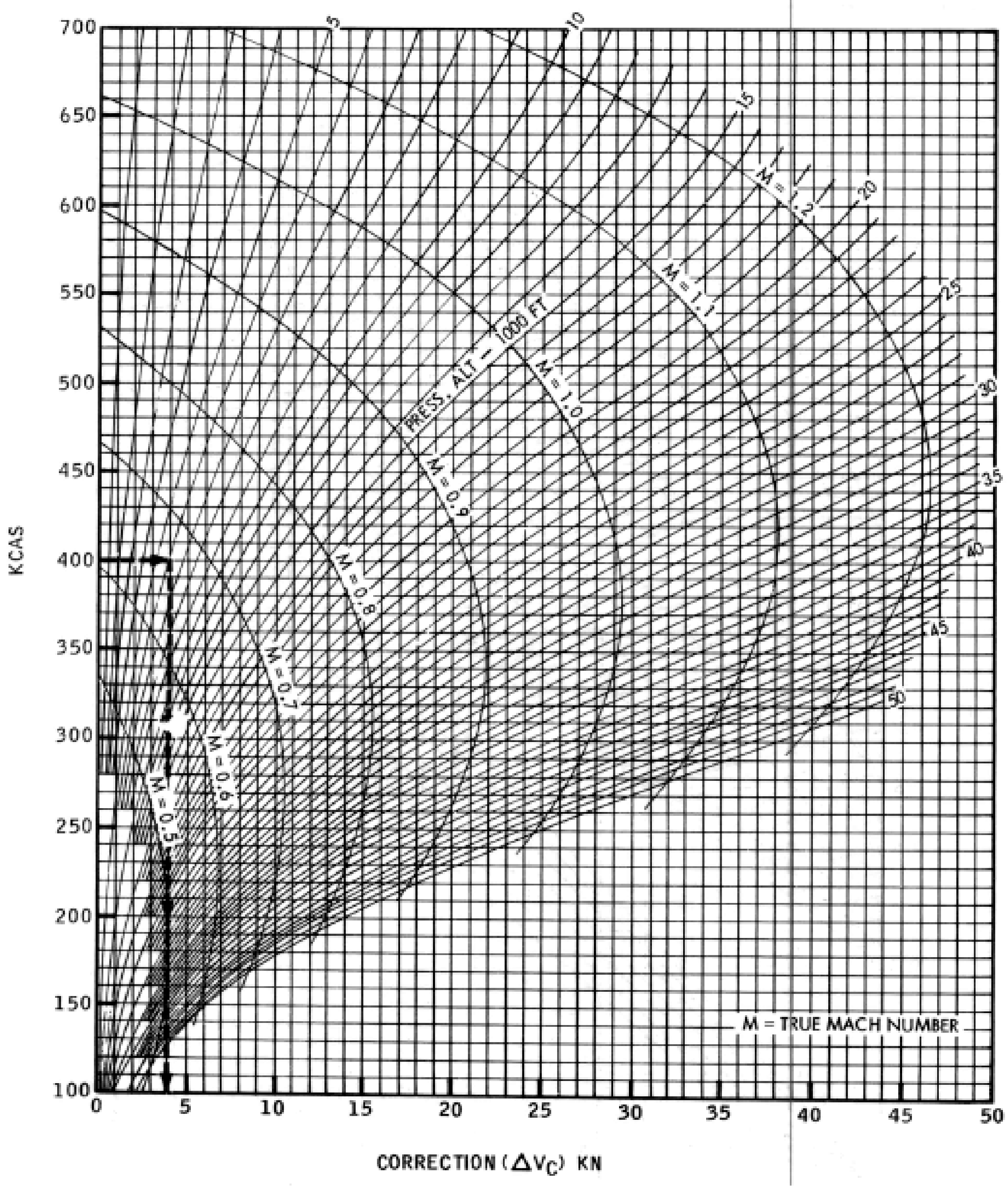


Figure 89

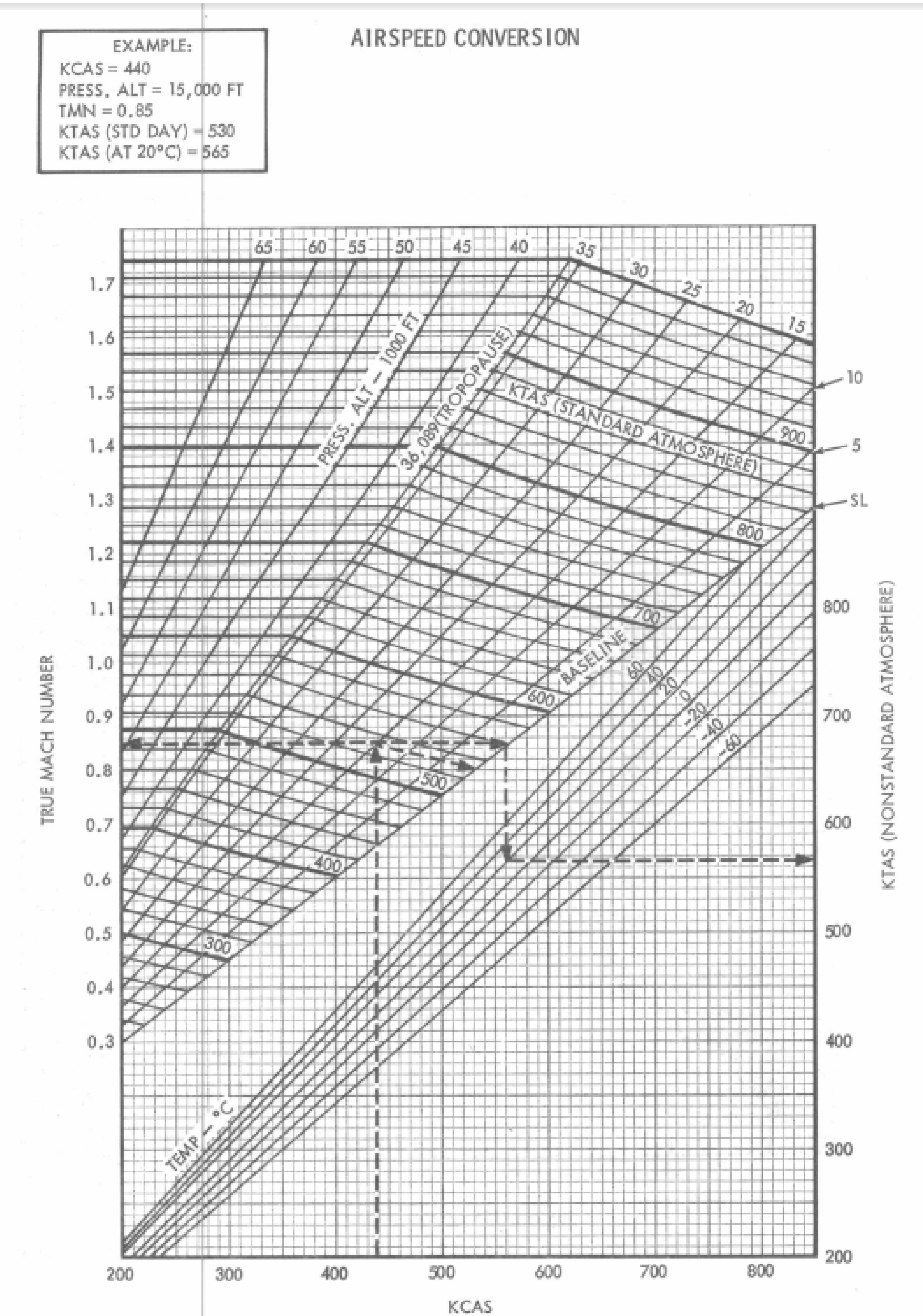

AIRSPEED CONVERSION
EXAMPLE:
KCAS = 440
PRESS. ALT = 15,000 FT
TMN = 0.85
KTAS (STD DAY) = 530
KTAS (AT 20°C) = 565
PRESS. ALT — 1000 FT
65
60
55
50
45
40
35
30
25
20
15
10
5
SL
36,089 (TROPOPAUSE)
KTAS (STANDARD ATMOSPHERE)
900
800
700
600
500
400
300
BASELINE
60
40
20
0
-20
-40
-60
TEMP — °C
TRUE MACH NUMBER
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
KCAS
200
300
400
500
600
700
800
KTAS (NONSTANDARD ATMOSPHERE)
800
700
600
500
400
300
200

Figure 90

STANDARD ALTITUDE TABLE

STANDARD SEA LEVEL AIR:
T = 59°F (15°C)
P = 29.921 IN. OF HG

W = 0.076475 LB/CU FT ρ_0 = 0.0023769 SLUGS/CU FT
1" OF HG = 70.732 LB/SQ FT = 0.4912 LB/SQ IN.
a_0 = 1116.89 FT/SEC = 661.7 KN

STANDARD ATMOSPHERE
(NACA TECHNICAL REPORT NO. 1235)

ALTITUDE FEET	DENSITY RATIO $\rho/\rho_0 = \sigma$	$1/\sqrt{\sigma}$	TEMPERATURE DEG. F	TEMPERATURE DEG. C	SPEED OF SOUND RATIO a/a_0	PRESSURE IN. OF HG	PRESSURE RATIO $P/P_0 = \delta$
−2,000	1.0598	0.9714	66.132	18.962	1.0064	32.15	1.0294
−1,000	1.0296	0.9855	62.566	16.981	1.0030	31.02	1.0147
0	1.0000	1.0000	59.000	15.000	1.0000	29.92	1.0000
1,000	0.9711	1.0148	55.434	13.019	0.9966	28.86	0.9644
2,000	0.9428	1.0299	51.868	11.038	0.9931	27.82	0.9298
3,000	0.9151	1.0454	48.302	9.057	0.9896	26.82	0.8962
4,000	0.8881	1.0611	44.735	7.075	0.9862	25.84	0.8637
5,000	0.8617	1.0773	41.169	5.094	0.9827	24.90	0.8320
6,000	0.8359	1.0938	37.603	3.113	0.9792	23.98	0.8014
7,000	0.8106	1.1107	34.037	1.132	0.9756	23.09	0.7716
8,000	0.7860	1.1279	30.471	− 0.849	0.9721	22.22	0.7428
9,000	0.7620	1.1456	26.905	− 2.831	0.9686	21.39	0.7148
10,000	0.7385	1.1637	23.338	− 4.812	0.9650	20.58	0.6877
11,000	0.7156	1.1822	19.772	− 6.793	0.9614	19.79	0.6614
12,000	0.6932	1.2011	16.206	− 8.774	0.9579	19.03	0.6360
13,000	0.6713	1.2205	12.640	−10.756	0.9543	18.29	0.6113
14,000	0.6500	1.2403	9.074	−12.737	0.9507	17.58	0.5875
15,000	0.6292	1.2606	5.508	−14.718	0.9470	16.89	0.5643
16,000	0.6090	1.2815	1.941	−16.699	0.9434	16.22	0.5420
17,000	0.5892	1.3028	− 1.625	−18.681	0.9397	15.57	0.5203
18,000	0.5699	1.3246	− 5.191	−20.662	0.9361	14.94	0.4994
19,000	0.5511	1.3470	− 8.757	−22.643	0.9324	14.34	0.4791
20,000	0.5328	1.3700	−12.323	−24.624	0.9287	13.75	0.4595
21,000	0.5150	1.3935	−15.889	−26.605	0.9250	13.18	0.4406
22,000	0.4976	1.4176	−19.456	−28.587	0.9213	12.64	0.4223
23,000	0.4807	1.4424	−23.022	−30.568	0.9175	12.11	0.4046
24,000	0.4642	1.4678	−26.588	−32.549	0.9138	11.60	0.3876
25,000	0.4481	1.4938	−30.154	−34.530	0.9100	11.10	0.3711
26,000	0.4325	1.5206	−33.720	−36.511	0.9062	10.63	0.3552
27,000	0.4173	1.5480	−37.286	−38.492	0.9024	10.17	0.3398
28,000	0.4025	1.5762	−40.852	−40.473	0.8986	9.725	0.3250
29,000	0.3881	1.6052	−44.419	−42.455	0.8948	9.297	0.3107
30,000	0.3741	1.6349	−47.985	−44.436	0.8909	8.885	0.2970
31,000	0.3605	1.6654	−51.551	−46.417	0.8871	8.488	0.2837
32,000	0.3473	1.6968	−55.117	−48.398	0.8832	8.106	0.2709
33,000	0.3345	1.7291	−58.683	−50.379	0.8793	7.737	0.2586
34,000	0.3220	1.7623	−62.249	−52.361	0.8754	7.382	0.2467
35,000	0.3099	1.7964	−65.816	−54.342	0.8714	7.041	0.2353
36,000	0.2981	1.8315	−69.382	−56.323	0.8675	6.712	0.2243
37,000	0.2844	1.8753	−69.700	−56.500	0.8671	6.397	0.2138
38,000	0.2710	1.9209	−69.700	−56.500	0.8671	6.097	0.2038
39,000	0.2583	1.9677	−69.700	−56.500	0.8671	5.811	0.1942
40,000	0.2462	2.0155	−69.700	−56.500	0.8671	5.538	0.1851
41,000	0.2346	2.0645	−69.700	−56.500	0.8671	5.278	0.1764
42,000	0.2236	2.1148	−69.700	−56.500	0.8671	5.030	0.1681
43,000	0.2131	2.1662	−69.700	−56.500	0.8671	4.794	0.1602
44,000	0.2031	2.2189	−69.700	−56.500	0.8671	4.569	0.1527
45,000	0.1936	2.2728	−69.700	−56.500	0.8671	4.355	0.1455
46,000	0.1845	2.3281	−69.700	−56.500	0.8671	4.151	0.1387
47,000	0.1758	2.3848	−69.700	−56.500	0.8671	3.956	0.1322
48,000	0.1676	2.4428	−69.700	−56.500	0.8671	3.770	0.1260
49,000	0.1597	2.5022	−69.700	−56.500	0.8671	3.593	0.1201
50,000	0.1522	2.5630	−69.700	−56.500	0.8671	3.425	0.1145
51,000	0.1451	2.6254	−69.700	−56.500	0.8671	3.264	0.1091
52,000	0.1383	2.6892	−69.700	−56.500	0.8671	3.111	0.1040
53,000	0.1318	2.7546	−69.700	−56.500	0.8671	2.965	0.09909
54,000	0.1256	2.8216	−69.700	−56.500	0.8671	2.826	0.09444
55,000	0.1197	2.8903	−69.700	−56.500	0.8671	2.693	0.09001
56,000	0.1141	2.9606	−69.700	−56.500	0.8671	2.567	0.08578
57,000	0.1087	3.0326	−69.700	−56.500	0.8671	2.446	0.08176
58,000	0.1036	3.1063	−69.700	−56.500	0.8671	2.331	0.07792
59,000	0.09877	3.1819	−69.700	−56.500	0.8671	2.222	0.07426
60,000	0.09414	3.2593	−69.700	−56.500	0.8671	2.118	0.07078
61,000	0.08972	3.3386	−69.700	−56.500	0.8671	2.018	0.06746
62,000	0.08551	3.4198	−69.700	−56.500	0.8671	1.924	0.06429
63,000	0.08150	3.5029	−69.700	−56.500	0.8671	1.833	0.06127
64,000	0.07767	3.5881	−69.700	−56.500	0.8671	1.747	0.05840
65,000	0.07403	3.6754	−69.700	−56.500	0.8671	1.665	0.05566

Figure 91

DENSITY ALTITUDE

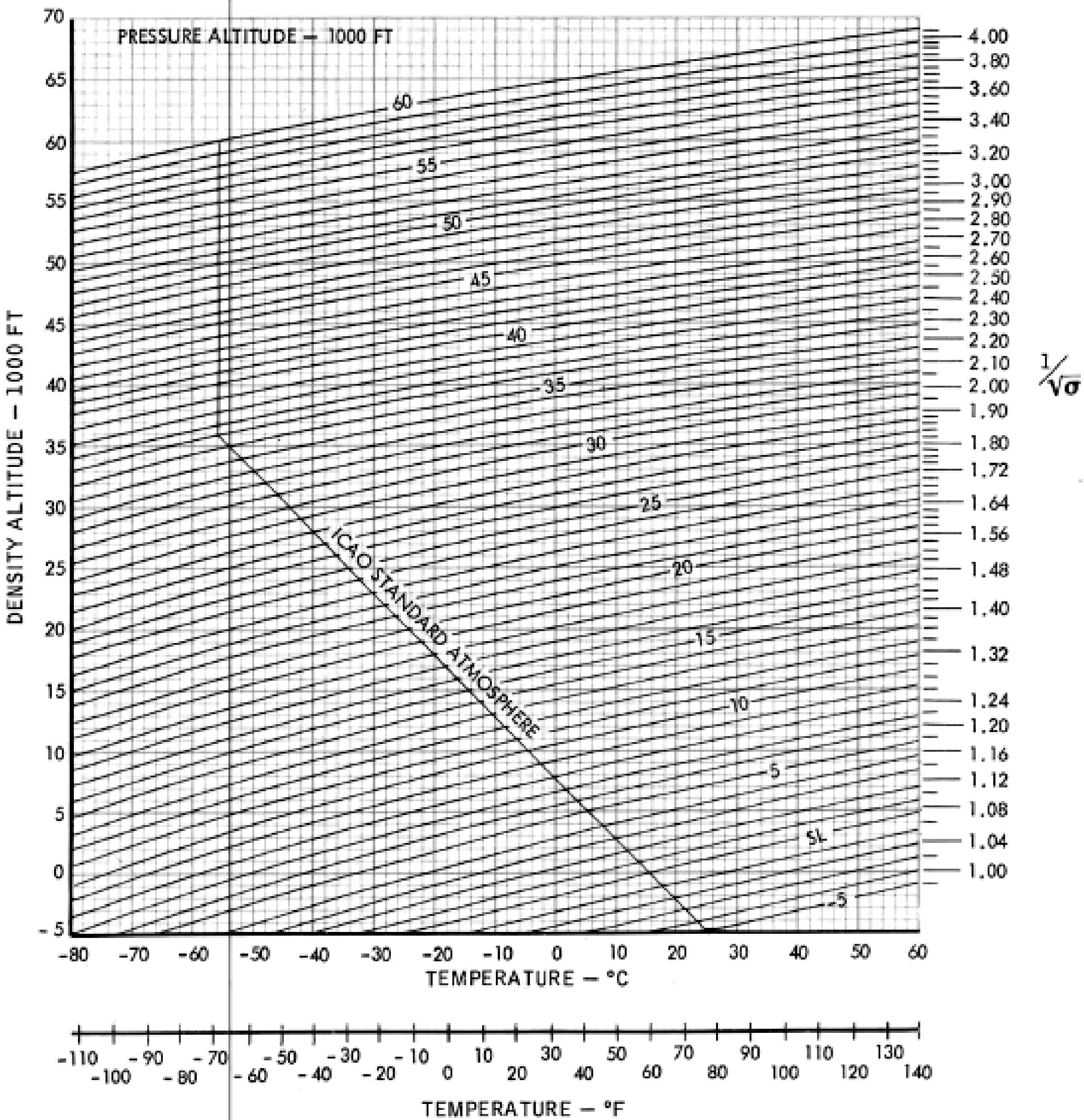
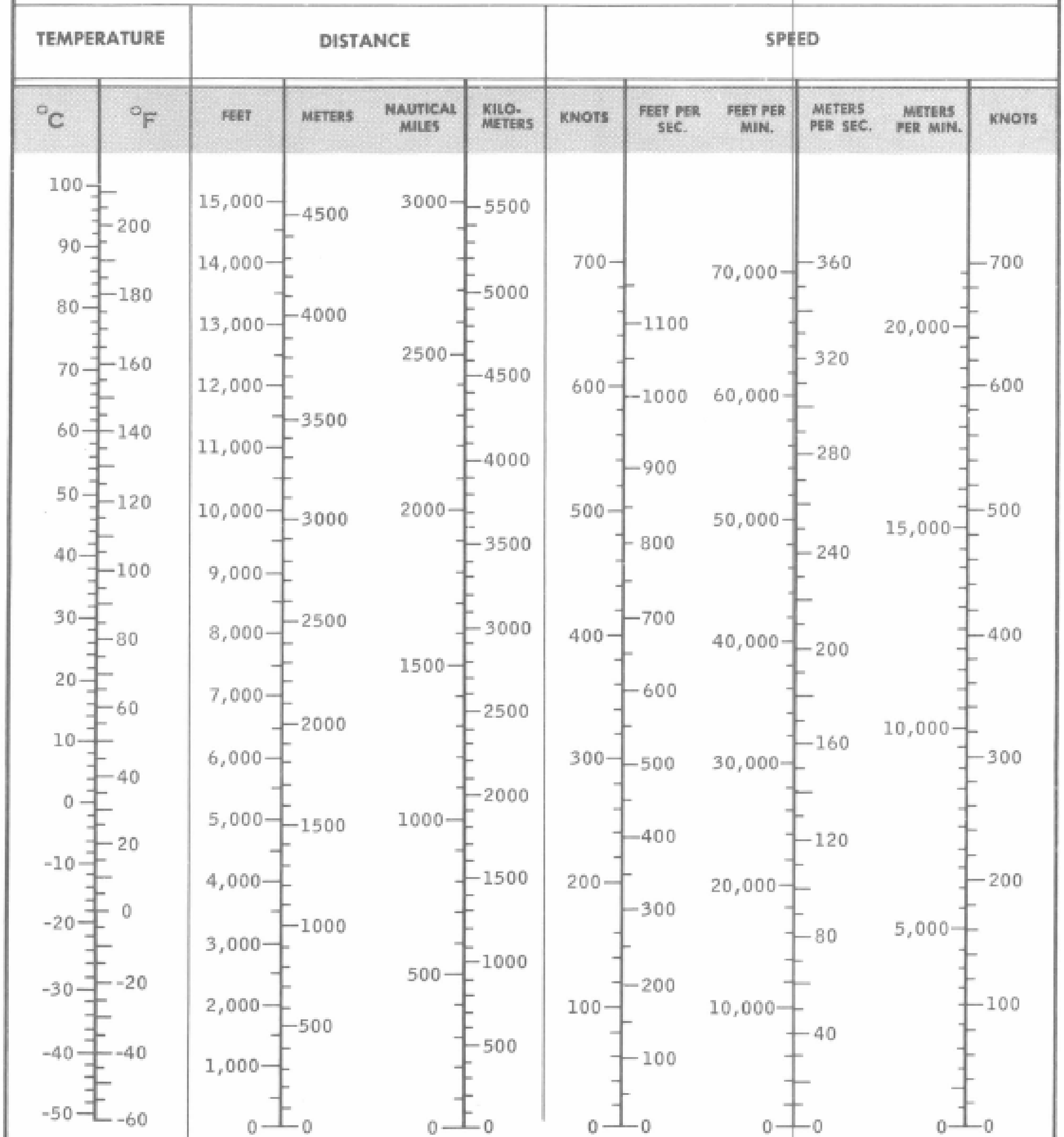


Figure 92

STANDARD CONVERSION TABLE



Note

- TO OBTAIN US GALLONS MULTIPLY LITERS BY 0.264
- TO OBTAIN IMPERIAL GALLONS MULTIPLY LITERS BY 0.220
- TO OBTAIN INCHES OF MERCURY MULTIPLY MILLIBARS BY 0.0295
- TO OBTAIN POUNDS MULTIPLY KILOGRAMS BY 2.20

Figure 93

PART 2 – TAKEOFF

WIND COMPONENTS

A takeoff and landing wind components chart is provided to enable the pilot to convert surface winds to headwind and crosswind components. The headwind component is used to compute takeoff and landing data. The crosswind component is used to determine the feasibility of operations.

USE OF WIND COMPONENTS CHART

The chase-thru lines show a 30-degree right crosswind of 39 knots. The headwind component is 34 knots, and the crosswind component is 20 knots.

TAKEOFF FACTOR

The takeoff factor is a number which is common to all takeoff charts for a given thrust rating and atmospheric condition. The takeoff factor chart shows the takeoff factor as a function of pressure altitude, runway air temperature, and thrust rating, including the effect of the anti-ice system operation.

USE OF TAKEOFF FACTOR CHART

The chase-thru lines show a runway air temperature of 15°C and a pressure altitude of 4,000 feet which give takeoff factors of 3.45 and 5.25 for MAX and MIL thrust respectively.

TAKEOFF SPEED

Takeoff speed is the speed at which the main gear lifts off the runway. The takeoff speed chart enables the pilot to determine normal takeoff speed and the climb speed to be attained to clear a 50-foot obstacle.

USE OF TAKEOFF SPEED CHART

The chase-thru lines show the normal takeoff speed for an aircraft with a gross weight of 11,800 pounds is 154 KIAS.

TAKEOFF DISTANCE

Takeoff distance is ground run distance in feet to liftoff. Takeoff distance to clear a 50-foot obstacle is ground run distance to clear a 50-foot obstacle is ground run distance in feet to liftoff plus the air distance to clear a 50-foot obstacle. The takeoff distance charts show ground run distance and total distance to clear a 50-foot obstacle as a function of takeoff factor, gross weight, wind velocity and runway slope, for takeoff on a dry, hard surface runway.

The charts show data for normal takeoff procedures given in this section. For large takeoff factors and heavy gross weights which occur with MIL thrust, the normal takeoff speed in increased by the factor constant (delta Vn) to assure 100ft/min rate of climb with two engines operating.

USE OF TAKEOFF DISTANCE CHARTS

The chase-thru lines on the chart show a maximum thrust takeoff for a gross weight of 11,800 pounds, headwind of 10 knots, and a takeoff factor of 3.45. The resulting normal ground run distance is 3050 feet. The corresponding total distance to clear a 50-foot obstacle is 4600 feet.

EFFECT OF RUNWAY CONDITION READING (RCR)

Runway Condition Reading (RCR) is a number that indicates the degree of braking friction on the runway surface. RCR 5 is icy, RCR 12 is wet, and RCR 23 and above is dry. On slippery runways, the critical field length is increased, which may cause an increase in the minimum acceleration speed check. The refusal speed and critical engine failure speeds are decreased (when compared to dry, hard-surfaced runways).

CRITICAL FIELD LENGTH

Critical field length is the total runway length required to accelerate with both engines operating to the critical engine failure speed, experience an engine failure, then either continue to takeoff or stop. The critical field length is shown for MAX thrust on the chart. For single-engine takeoff at large takeoff factors and heavy gross weights, the normal takeoff speed is increased by the given factor to assure 100 feet per minute rate of climb.

USE OF CRITICAL FIELD LENGTH CHART

The chase-thru lines on the chart show that at a takeoff factor of 3.45 and a gross weight of 11,800 pounds, the speed correction factor is 8 knots. The chase-thru lines further show that with a 10-knot headwind, the Critical Field Length for an RCR of 23 is 5,800 feet, and is increased to 6,500 feet for an RCR of 12. The Single Engine Takeoff Speed is normal takeoff speed plus the speed correction factor: Example 154 + 8 = 162.

REFUSAL SPEED

Refusal speed is the maximum speed to which the aircraft can accelerate and then stop in the remaining runway length. Data in the refusal speed charts are for two engines at MAX and MIL thrust, and includes a pilot reaction time of 3 seconds. Use 155 KIAS as the maximum refusal speed.

CRITICAL ENGINE FAILURE SPEED

Critical engine failure speed is the speed to which the aircraft will accelerate with both engines, experience an engine failure, and permit either acceleration to takeoff or deceleration to a stop in the same distance. Data for critical engine failure speed is presented in the chart in this section. If a critical engine failure speed computes to less than 110 KIAS, use 110 KIAS as the critical engine failure speed. When an RCR factor is present, use the full computed critical engine failure speed corrected for RCR.

USE OF REFUSAL SPEED CHARTS OR CRITICAL ENGINE FAILURE SPEED CHARTS

The chase-thru lines on the refusal speed chart shows a refusal speed of 133 KIAS for a takeoff factor of 3.45 at gross weight of 11,800 pounds on a 7,000-foot runway for an RCR of 23. Correcting for an RCR of 12 reduces the refusal speed to 106 KIAS. A 10-knot headwind increases the refusal speed to 143 KIAS for an RCR of 23 and 116 KIAS for an RCR of 12. For a takeoff factor of 3.45 at gross weight 11,800 pounds and a critical field length of 5,800 feet, the critical engine failure speed is 122 KIAS for an RCR of 23. An RCR of 12 results in a critical engine failure speed of 102 KIAS.

Adding the 10-knot headwind increases these speeds to 132 KIAS for an RCR of 23 and 112 KIAS for an RCR of 12. If critical engine failure speed computes to less than 110 KIAS, use 110 KIAS as critical engine failure speed. (Exception: If an RCR factor is present, use the actual computed speed as critical engine failure speed.)

TAKEOFF ABORT CHARTS (GENERAL)

The takeoff abort charts contained in this section provide the means of planning for a GO-NO GO decision should an engine fail during takeoff. A discussion is provided to illustrate the factors which influence the decision to stop or go. A detailed description of each abort chart is provided in the preceding paragraphs. The principle factor affecting aborted takeoff is the relationship of actual runway length to critical field length. This relationship falls into three categories as follows:

CATEGORY I -- Runway Length Greater than Critical Field Length: (Refusal speed exceeds critical engine failure speed.)

a. If engine failure occurs below critical engine failure speed: Aircraft should be stopped, as runway length will be sufficient for stopping. Takeoff distance increases as engine failure speed decreases and may exceed the runway length under certain conditions.
b. If engine failure occurs between critical engine failure speed and refusal speed: Takeoff should normally be continued; however, aircraft can take off or stop within remaining distance.
c. If engine failure occurs above refusal speed: Aircraft must continue takeoff as it would overrun runway in stopping. Sufficient runway for takeoff will be available.

CATEGORY II – Runway Length Same as Critical Field Length: Refusal speed and critical engine failure speed coincide; therefore, aircraft must be stopped if below critical engine failure speed and should continue takeoff if above the coincidence speed. Runway will be adequate for either condition.

CATEGORY III – Runway Length Less than Critical Field Length: (Refusal speed less than critical engine failure speed.) This is the most critical category, and the decision to conduct routine flight operations under these conditions must be based on conditions authorized by the Major Air Command or other appropriate authority. Decision speed must be used as the GO – NO GO factor. If engine failure occurs between refusal speed and decision speed, the takeoff must be aborted, even though barrier engagement can be expected. If engine failure occurs after decision speed, sufficient runway for takeoff should be available, and takeoff should be continued.

DECISION SPEED

Decision speed is the minimum speed at which the aircraft can experience an engine failure and still accelerate to takeoff speed in the remaining runway. The decisions speed is found in the Decision Speed chart in this section.

USE OF DECISION SPEED CHART

The chase-thru line on the Decision Speed chart shows a decision speed of 102 KIAS for a takeoff factor of 3.45 at a gross weight of 11,800 pounds on a 7,000-foot runway with a 10-knot headwind, and a speed correction factor of 8 knots.

VELOCITY DURING TAKEOFF GROUND RUN

The velocity during takeoff ground run chart shows the relationship between KIAS and distance traveled during ground run on a dry, hard surface runway. The two-engine velocity during takeoff ground run chart is used to check acceleration performance. Compute the minimum acceleration performance. Compute the minimum acceleration check speed for a point 2,000 feet, computer minimum acceleration check speed for a point 1,000 feet from brake release. Under certain slippery runway conditions, the minimum acceleration check speed may be above the corrected critical engine failure speed.

When this occurs, adjust the acceleration check distance to any usable value up to 2,000 feet from brake release that will result in a minimum acceleration check speed equal to or less than the critical engine failure speed corrected for RCR. The forecast speed at this point is the normal acceleration check speed. Minimum acceleration check speed is the minimum acceptable speed at the check distance with which takeoff should be continued. Minimum acceleration check speed is computed by subtracting 3 knots for each 1,000 feet of runway in excess of the critical field length or 10 knots from normal acceleration check speed, whichever is less. The single-engine velocity during ground run chart is used to evaluate single-engine takeoff acceleration performance.

USE OF TWO-ENGINE VELOCITY DURING TAKEOFF GROUND RUN CHART

Assume a takeoff weight of 11,800 pounds, a runway temperature of 15°C, RCR of 12, a pressure altitude of 4,000 feet, and a 10-knot headwind. Enter the chart at the takeoff speed of 155 KIAS and ground run distance of 3,000 feet. From the point of intersection of these lines, draw a line parallel to the guideline. Enter the chart at the ground run distance of 2,000 feet. Proceed vertically to the intersection with constructed airspeed guideline, and read airspeed of 129 knots from the left side of the chart.

This is the velocity at a point 2,000 feet from brake release. Since this acceleration check speed is above the corrected critical engine failure speed of 112 KIAS, re-enter chart at ground run distance of 1,500 feet. Proceed vertically to intersection with constructed airspeed guideline and read airspeed of 110 knots from the left side of the chart. This is the velocity at 1,500 feet from brake release.

USE OF SINGLE-ENGINE VELOCITY DURING TAKEOFF GROUND RUN CHART

Assume a takeoff weight of 11,800 pounds, a runway air temperature of 15°C, a pressure altitude of 4,000 feet, and a 10-knot headwind. Enter the chart at the runway temperature of 15°C, right horizontally to the pressure altitude of 4,000 feet, down vertically to the aircraft gross weight of 11,800 pounds, left horizontally to the baseline. Draw a line that parallels the guideline. Assume an engine failure at 120 KIAS and it is desired to find the distance necessary to accelerate to 160 KIAS. Enter the chart at the no-wind groundspeed of 110 knots (120 minus 10 knots headwind) and 150 knots (160 minus 10 knots headwind). Read the distance for 110 knots no wind (3600) and 150 knots no wind (7400). The difference between the noted distances (7400 minus 3600) is 3800 feet and is the distance necessary to accelerate to 160 KIAS.

TAKEOFF AND LANDING
WIND COMPONENTS

MODEL: T-38A
DATE: 1 AUGUST 1965
DATA BASIS: **FLIGHT TEST**

ENGINE: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

Note

ENTER CHART WITH STEADY WIND TO DETERMINE HEADWIND COMPONENT AND WITH MAXIMUM GUST VELOCITY TO DETERMINE CROSSWIND COMPONENT.

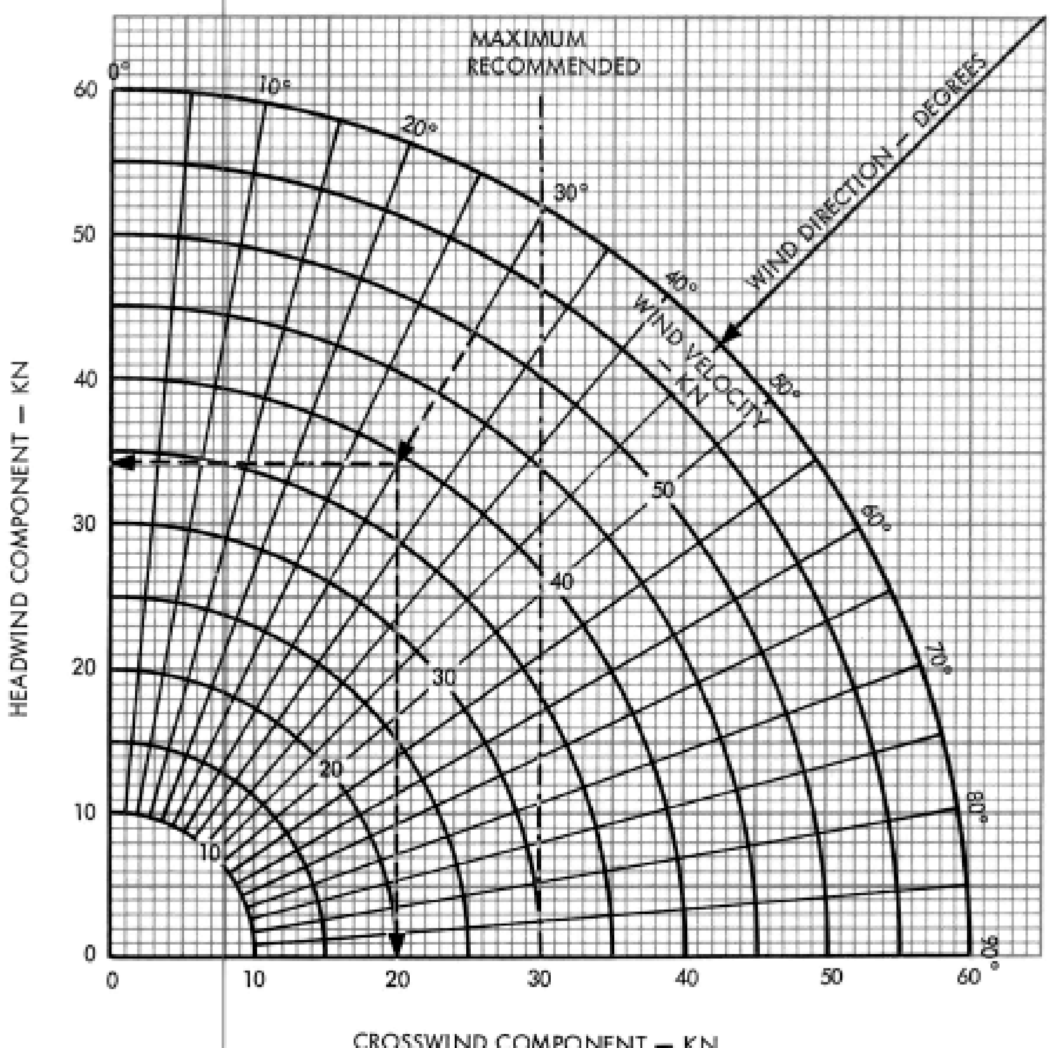


Figure 94

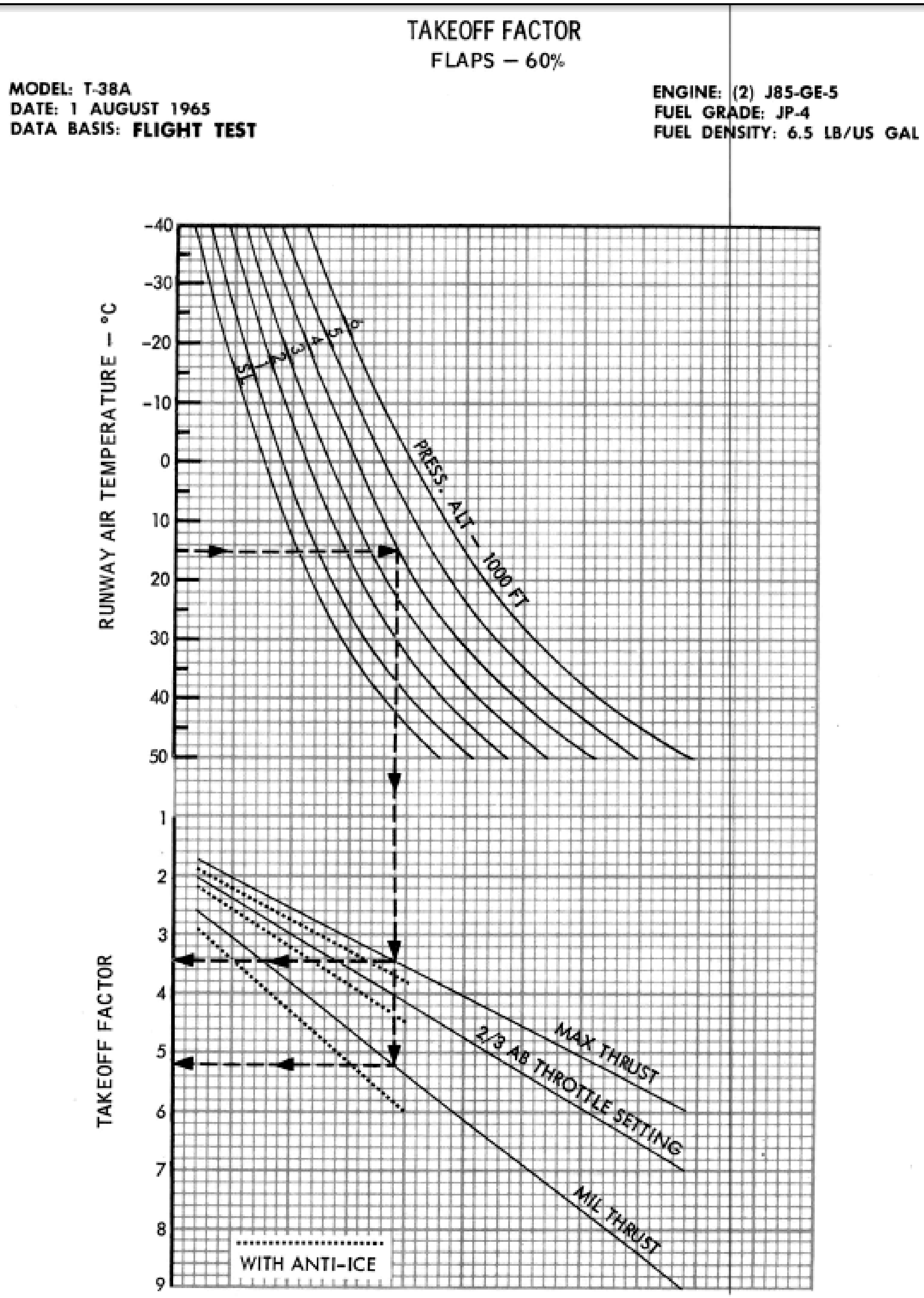
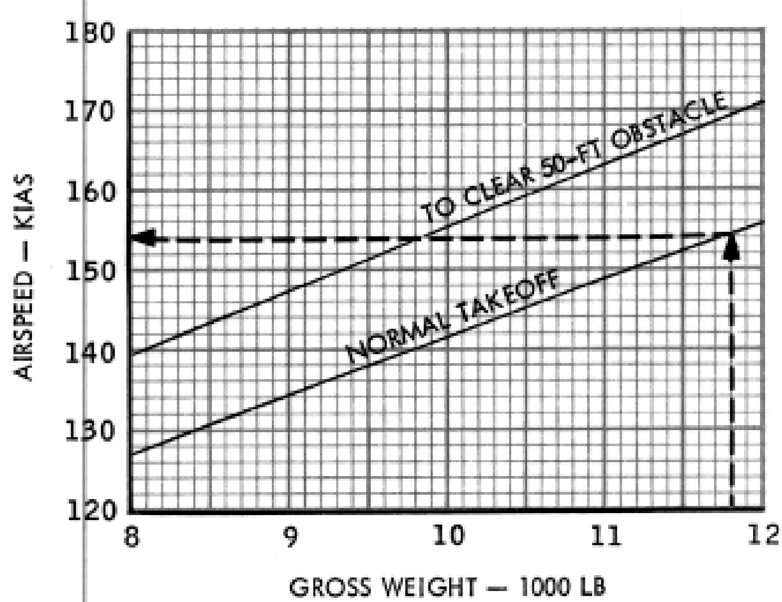

TAKEOFF FACTOR
FLAPS — 60%
MODEL: T-38A
DATE: 1 AUGUST 1965
DATA BASIS: FLIGHT TEST
ENGINE: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL
RUNWAY AIR TEMPERATURE — °C
-40
-30
-20
-10
0
10
20
30
40
50
SL
1
2
3
4
5
6
PRESS. ALT — 1000 FT
TAKEOFF FACTOR
1
2
3
4
5
6
7
8
9
MAX THRUST
2/3 AB THROTTLE SETTING
MIL THRUST
WITH ANTI-ICE

Figure 95

TAKEOFF SPEED
FLAPS — 60%

MODEL: T-38A
DATE: 1 AUGUST 1965
DATA BASIS: FLIGHT TEST

ENGINE: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL



Note

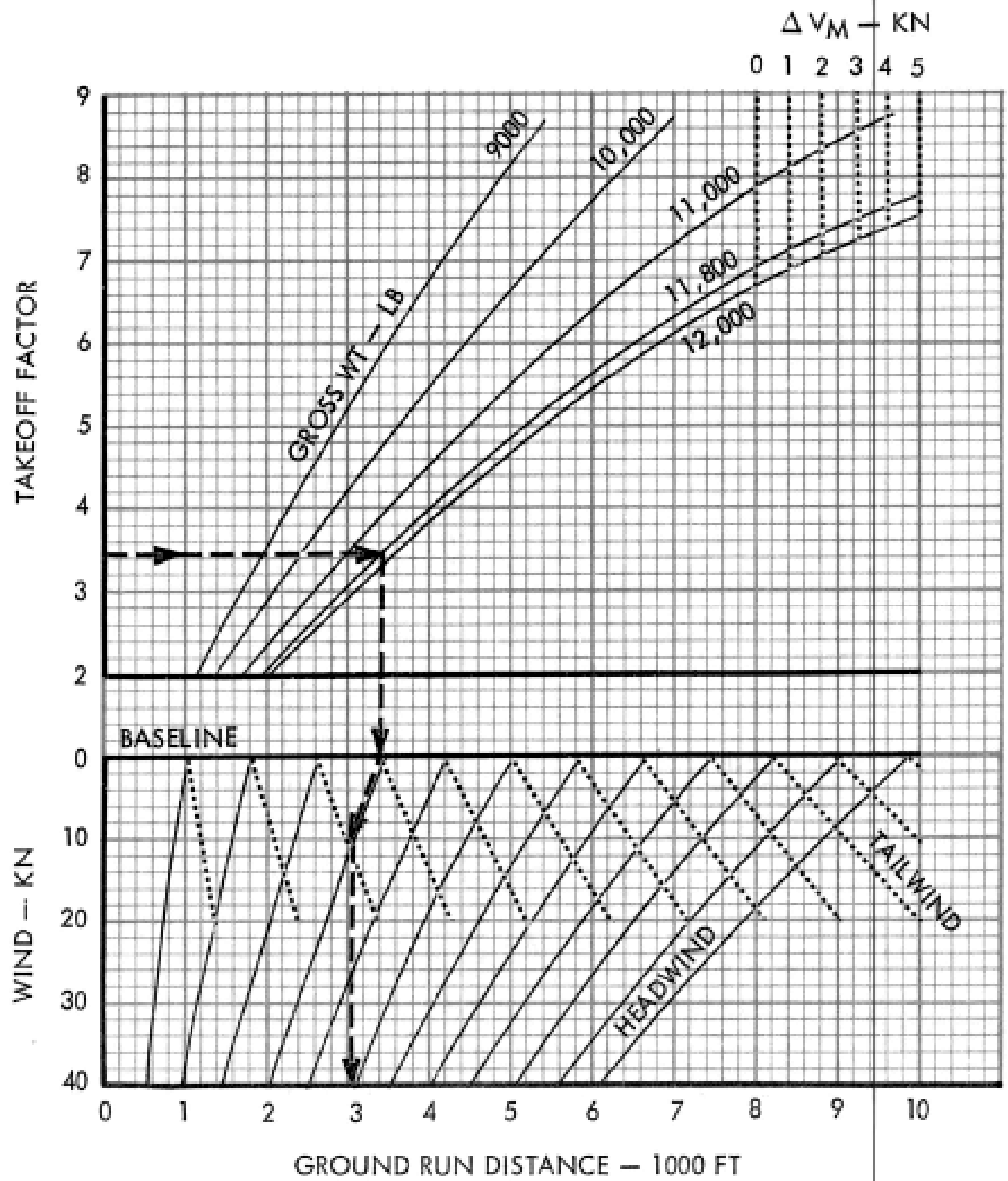
- FOR MIL THRUST TAKEOFF, ADD ΔV_M FROM TAKEOFF DISTANCE CHART TO TAKEOFF SPEED.
- FOR SINGLE-ENGINE TAKEOFF, ADD ΔV_{SE} FROM CRITICAL FIELD LENGTH CHART TO TAKEOFF SPEED.

Figure 96

TAKEOFF DISTANCE
DRY, HARD-SURFACED RUNWAY
FLAPS — 60%

MODEL: T-38A
DATE: 1 AUGUST 1965
DATA BASIS: **FLIGHT TEST**

ENGINE: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL



Note

- ADD ΔVM TO TAKEOFF SPEED (FA2-3).
- INCREASE GROUND RUN DISTANCE 5 PERCENT FOR EACH PERCENT OF UPHILL RUNWAY SLOPE.

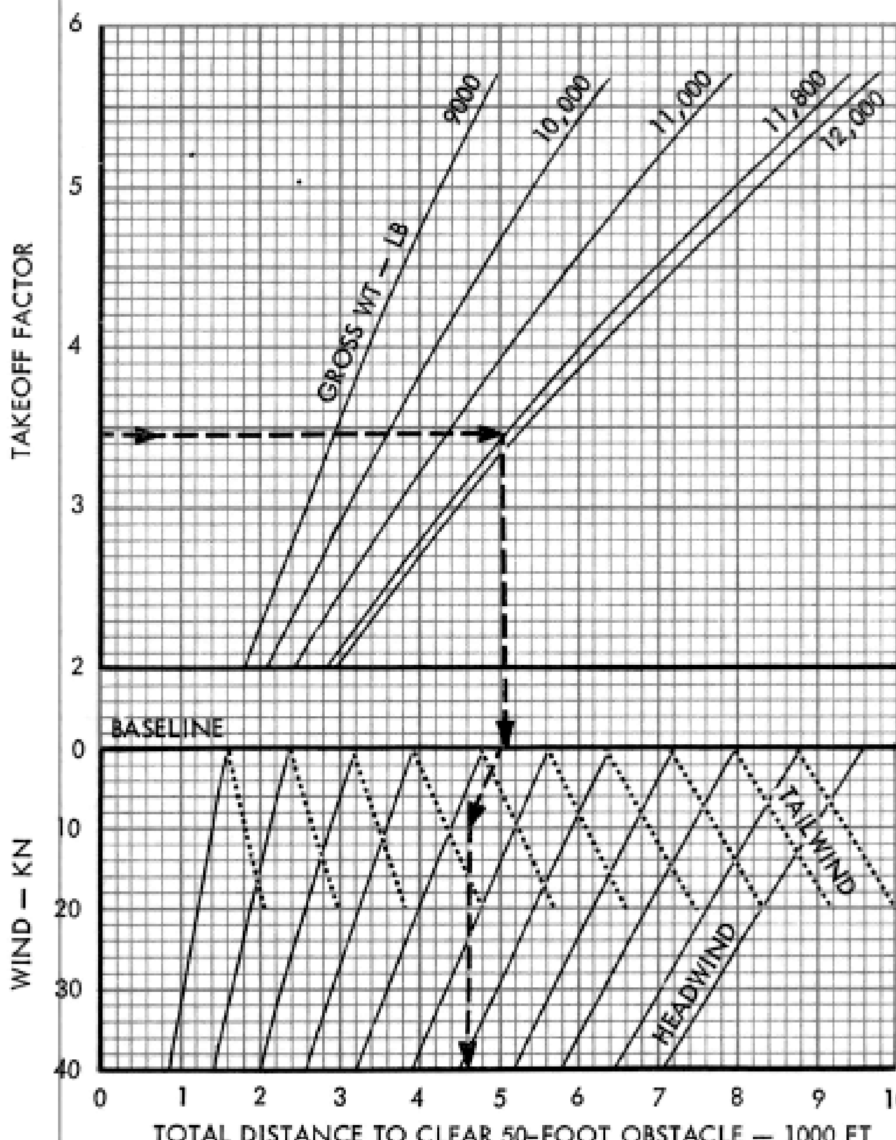
Figure 97

TAKEOFF DISTANCE TO CLEAR 50-FOOT OBSTACLE

DRY, HARD-SURFACED RUNWAY
FLAPS — 60%

MODEL: T-38A
DATE: 1 AUGUST 1965
DATA BASIS: FLIGHT TEST

ENGINE: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL



Note

INCREASE TOTAL DISTANCE 5 PERCENT FOR EACH PERCENT OF UPHILL RUNWAY SLOPE.

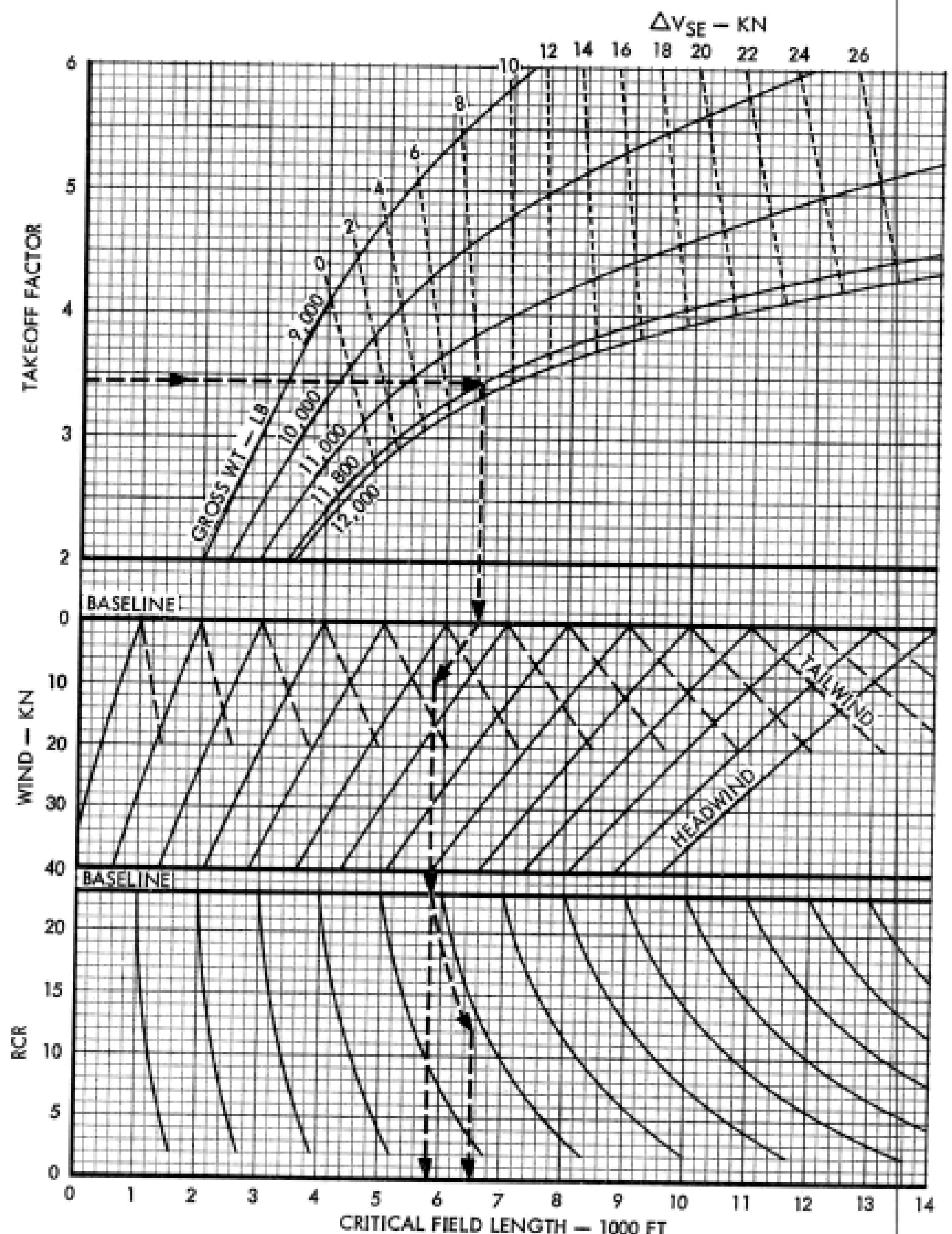
Figure 98

CRITICAL FIELD LENGTH

MAX THRUST
FLAPS — 60%

MODEL: T-38A
DATE: 1 APRIL 1969
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL



Note

- FOR SINGLE-ENGINE TAKEOFF SPEED, ADD ΔV_{SE} TO TAKEOFF SPEED.
- INCREASE CRITICAL FIELD LENGTH 5 PERCENT FOR EACH PERCENT OF UPHILL RUNWAY SLOPE.

Figure 99

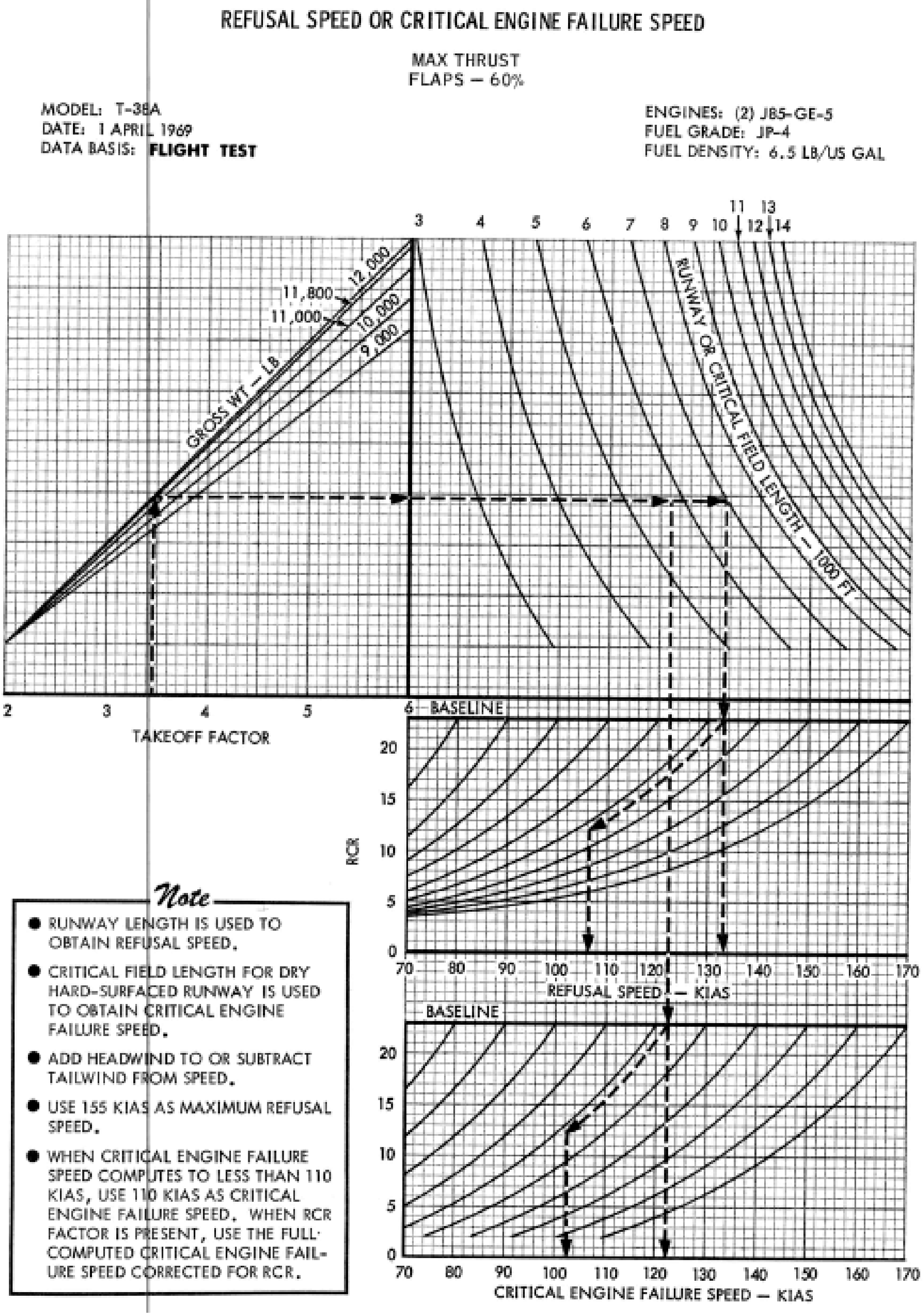

REFUSAL SPEED OR CRITICAL ENGINE FAILURE SPEED
MAX THRUST
FLAPS — 60%
MODEL: T-38A
DATE: 1 APRIL 1969
DATA BASIS: FLIGHT TEST
ENGINES: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL
GROSS WT — LB
12,000
11,800
11,000
10,000
9,000
RUNWAY OR CRITICAL FIELD LENGTH — 1000 FT
TAKEOFF FACTOR
BASELINE
RCR
REFUSAL SPEED — KIAS
CRITICAL ENGINE FAILURE SPEED — KIAS
Note
RUNWAY LENGTH IS USED TO OBTAIN REFUSAL SPEED.
CRITICAL FIELD LENGTH FOR DRY HARD-SURFACED RUNWAY IS USED TO OBTAIN CRITICAL ENGINE FAILURE SPEED.
ADD HEADWIND TO OR SUBTRACT TAILWIND FROM SPEED.
USE 155 KIAS AS MAXIMUM REFUSAL SPEED.
WHEN CRITICAL ENGINE FAILURE SPEED COMPUTES TO LESS THAN 110 KIAS, USE 110 KIAS AS CRITICAL ENGINE FAILURE SPEED. WHEN RCR FACTOR IS PRESENT, USE THE FULL COMPUTED CRITICAL ENGINE FAILURE SPEED CORRECTED FOR RCR.

Figure 100

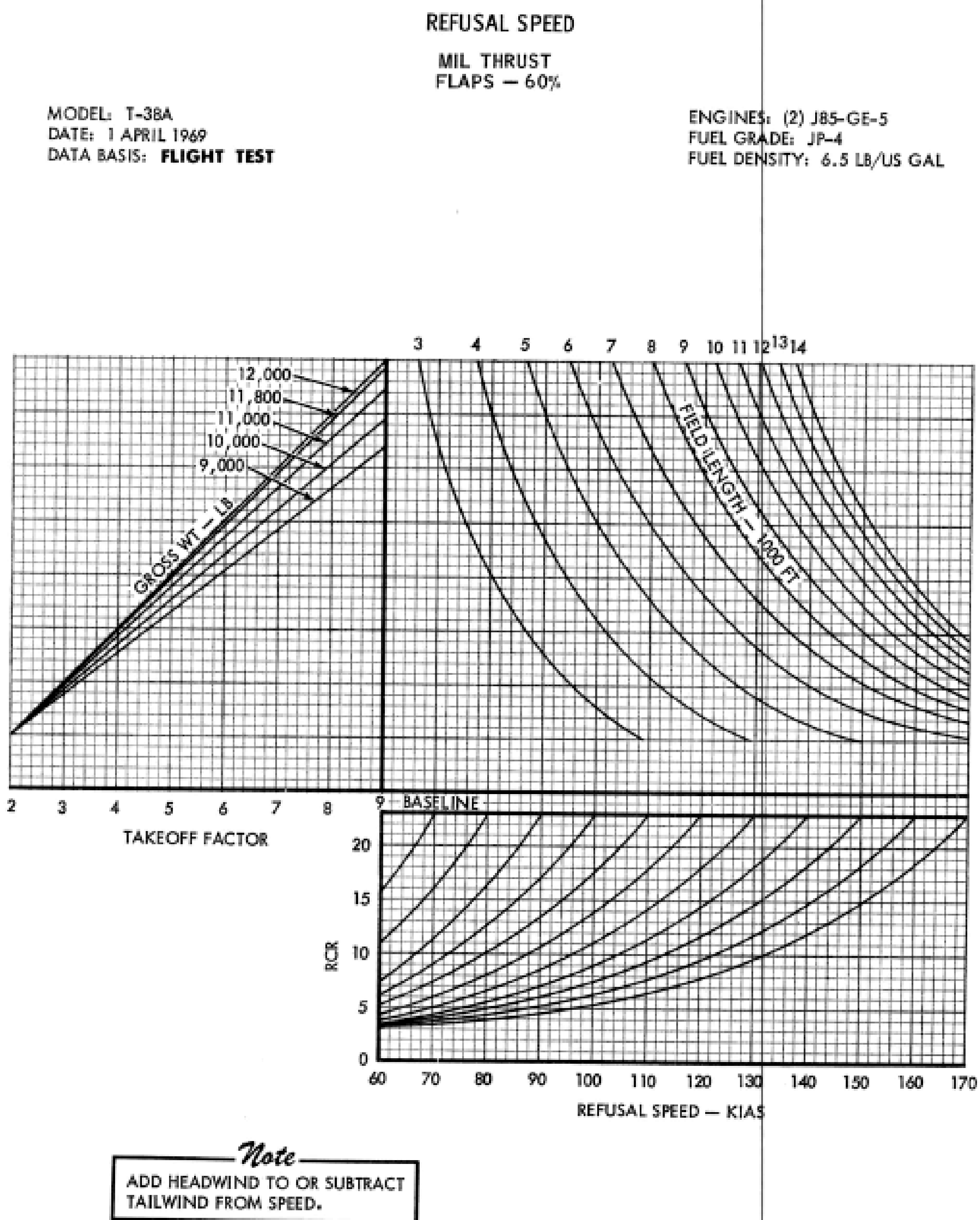

REFUSAL SPEED
MIL THRUST
FLAPS — 60%
MODEL: T-38A
DATE: 1 APRIL 1969
DATA BASIS: FLIGHT TEST
ENGINES: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL
12,000
11,800
11,000
10,000
9,000
GROSS WT — LB
3 4 5 6 7 8 9 10 11 12 13 14
FIELD LENGTH — 1000 FT
2 3 4 5 6 7 8 9
TAKEOFF FACTOR
BASELINE
RCR
0 5 10 15 20
60 70 80 90 100 110 120 130 140 150 160 170
REFUSAL SPEED — KIAS
Note
ADD HEADWIND TO OR SUBTRACT TAILWIND FROM SPEED.

Figure 101

DECISION SPEED

MAX THRUST
DRY, HARD-SURFACED RUNWAY
FLAPS — 60%

MODEL: T-38A
DATE: 14 JULY 1966
DATA BASIS: **FLIGHT TEST**

ENGINE: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

Note

OBTAIN ΔV_{SE} FROM CRITICAL FIELD LENGTH CHART.

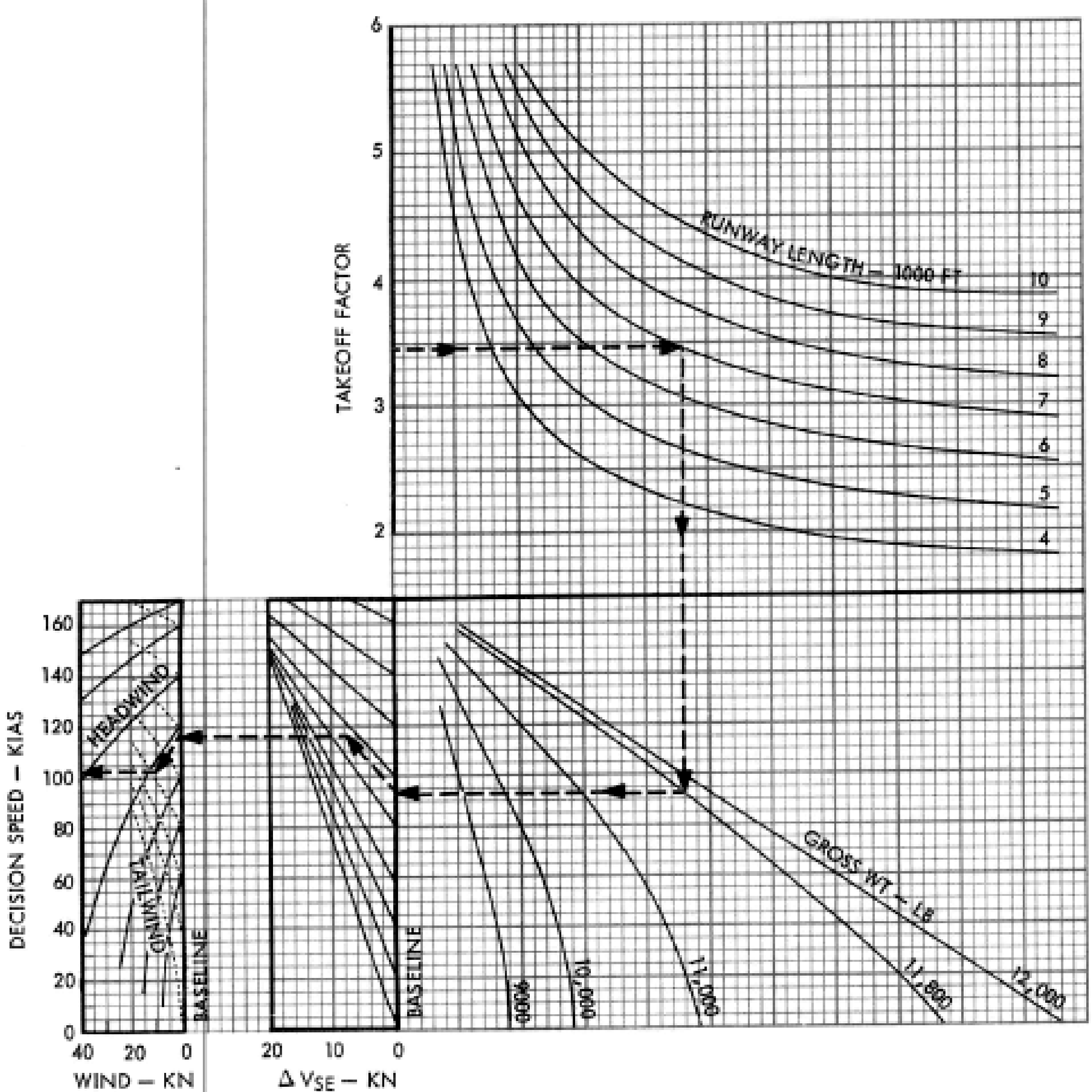


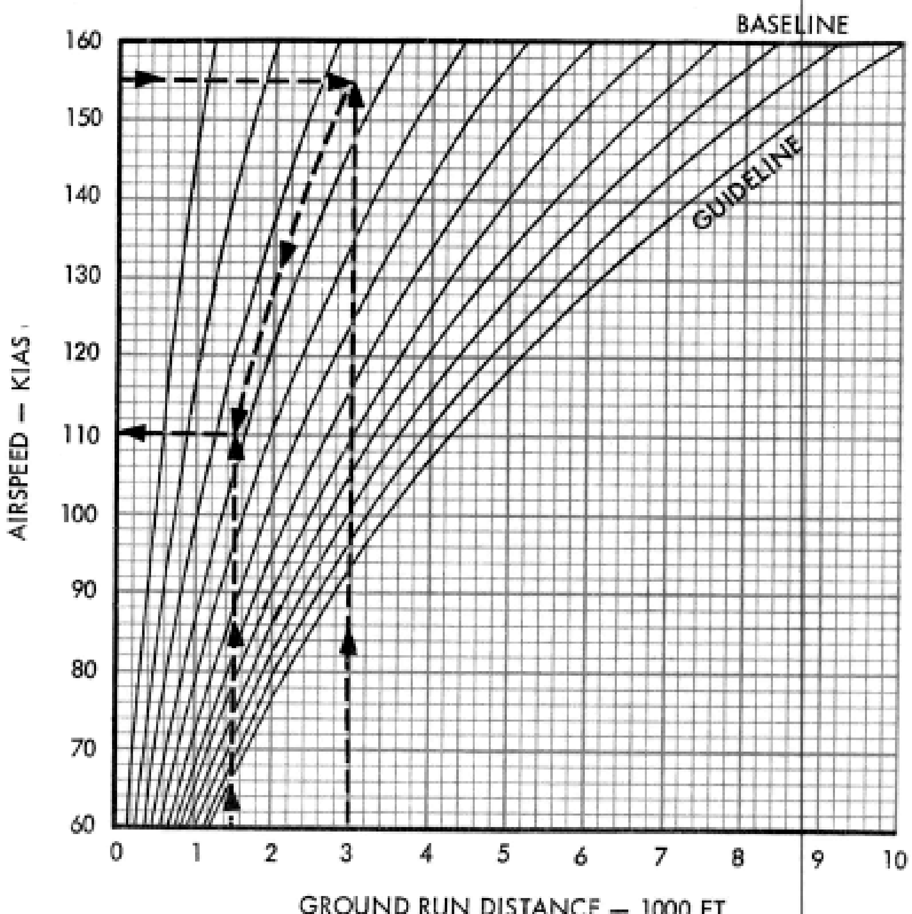
Figure 102

VELOCITY DURING TAKEOFF GROUND RUN

DRY, HARD-SURFACED RUNWAY
FLAPS — 60%

MODEL: T-38A
DATE: 1 AUGUST 1965
DATA BASIS: **FLIGHT TEST**

ENGINE: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL



Note

SUBTRACT 3 KNOTS FOR EACH 1000 FEET OF RUNWAY IN EXCESS OF THE CRITICAL FIELD LENGTH, NOT TO EXCEED 10 KNOTS.

Figure 103

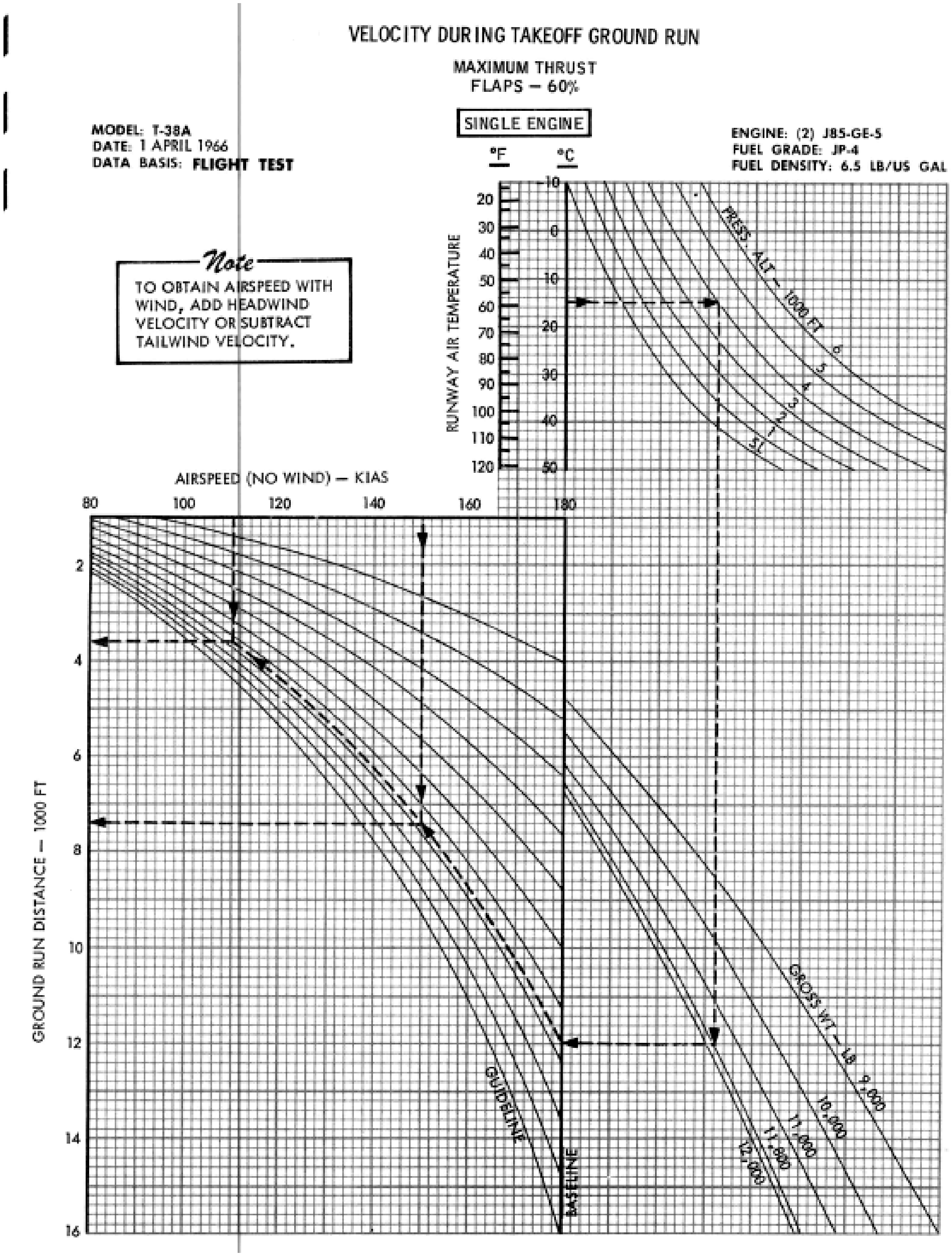

VELOCITY DURING TAKEOFF GROUND RUN
MAXIMUM THRUST
FLAPS — 60%
SINGLE ENGINE
MODEL: T-38A
DATE: 1 APRIL 1966
DATA BASIS: FLIGHT TEST
ENGINE: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL
Note
TO OBTAIN AIRSPEED WITH WIND, ADD HEADWIND VELOCITY OR SUBTRACT TAILWIND VELOCITY.
RUNWAY AIR TEMPERATURE
°F
°C
PRESS. ALT — 1000 FT
AIRSPEED (NO WIND) — KIAS
GROUND RUN DISTANCE — 1000 FT
GUIDELINE
BASELINE
GROSS WT — LB
9,000
10,000
11,000
11,800
12,000

Figure 104

PART 3 – CLIMB

PURPOSE OF CHARTS

The charts provide a means of determining the aircraft climb performance in clean configuration (drag index of 0). Included are ceilings to which the aircraft may climb in the performance of missions.

CLIMB CHARTS

The climb charts in this section show the climb performance for MIL thrust for both engines and single engine, plus also another series for MAX thrust for two engines. Two-engine MIL and MAX thrust climb charts are included for both restricted and unrestricted climb schedules. The restricted climb charts show performance data which reflects a MIL thrust climb at 300 KCAS to 10,000 feet followed by a level acceleration to unrestricted climb speed and continuation of climb.

The restricted climb charts should be used for all climbs not performed in a military climb corridor. The unrestricted climb charts MIL and MAX THRUST CLIMB are used when a military climb corridor is available. Essentially the difference is to use the restricted climb schedule when operating in civilian accessible airspace, and there is the option to use the unrestricted climb charts when operating in military restricted airspeed that should be devoid of conflicting civilian air traffic.

All the climb charts show climb performance in terms of gross weight versus fuel used, time, and distance. Climb speed schedules and allowances prior to climb are provided on each chart. The charts require successive approximations when climbing from an altitude other than sea level. The fuel, air distance, and time shown include the effects of kinetic energy change and weight reduction during climb. The fuel allowance for taxi, takeoff, and acceleration to climb speed is noted and should be subtracted from gross weight before entering the chart when climb follows a takeoff.

USE OF CLIMB CHARTS

The chase-thru lines on the MIL thrust restricted climb chart show 565 pounds of fuel used in climb from sea level to 35,000 feet pressure altitude at an initial gross weight of 11,500 pounds and a temperature 10^{o}C hotter than standard day. The corresponding time and air distance are 8.3 minutes and 67 nautical miles, respectively.

Had the initial altitude been 15,000 feet and the gross weight 11,270 pounds, by using successive approximations, the sea level gross weight would be 11,500 pounds (same as above). From sea level to 15,000 feet, the fuel used, time, and distance are 290 pounds, 3.0 minutes, and 23 miles, respectively.

Then from 15,000 feet to 35,000 feet, the fuel used is 275 pounds (565 – 290), 5.3 minutes (83. – 3.0), and the distance is 44 nautical miles (67 – 23).

The MIL thrust climb charts show that 480 pounds of fuel are required in climb from sea level to 35,000 feet, and correspondingly, it takes 7.3 minutes and 62 nautical miles. This climb is started at 11,400 pounds; however, since 95 more pounds of fuel are required for acceleration to climb speed, the MIL thrust restricted climb and the MIL thrust climb from 15,000 feet to 35,000 feet are identical.

OPTIMUM CRUISE-CLIMB ALTITUDE

The optimum cruise-climb altitude chart shows this altitude versus gross weight for two-engine and single-engine operation. Normal thrust cruise ceiling are included and show the limitations of the optimum cruise-climb altitude.

USE OF OPTIMUM CRUISE-CLIMB ALTITUDE CHART

Assume two-engine operation and a gross weight of 10,500 pounds at end of climb. The chase-thru lines show optimum cruise-climb altitude is 41,200. The optimum cruise-climb altitude will increase as the fuel is used in cruise. This altitude is not limited by the normal thrust cruise ceiling.

SINGLE-ENGINE SERVICE CEILING

The single-engine service ceiling chart shows the service ceiling that can be attained by flying with MAX or MIL thrust at the climb schedules shown.

USE OF SINGLE-ENGINE SERVICE CEILING CHART

The chase-thru lines in the chart show a single-engine service ceiling of 24,500 feet for MIL thrust and a gross weight of 10,500 pounds.

MIL THRUST CLIMB

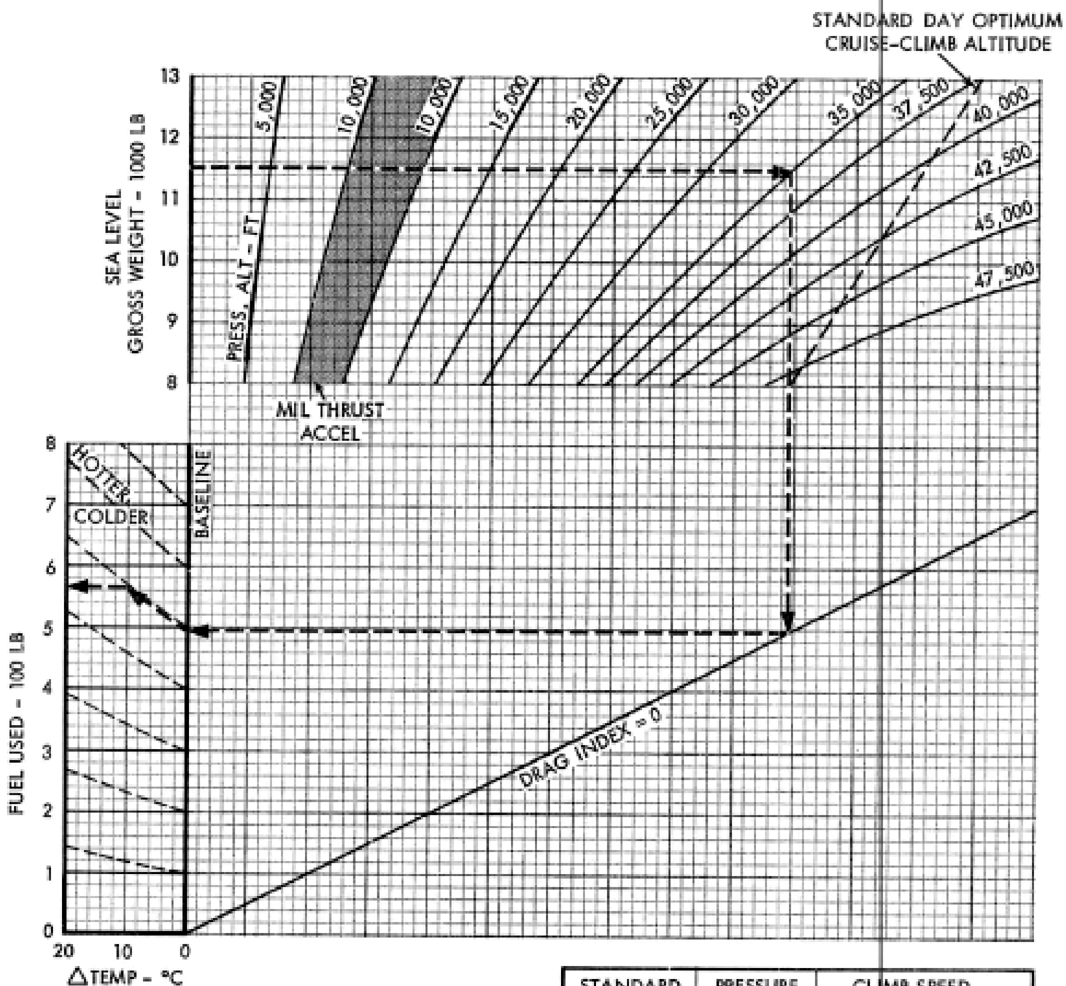
RESTRICTED CLIMB SCHEDULE

FUEL USED

DRAG INDEX = 0

MODEL: T-38A
DATE: 1 APRIL 1969
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL



FUEL, TIME, AND DISTANCE ALLOWANCE PRIOR TO CLIMB	
GROUND TAXI: 18 LB/MIN	
FROM BRAKE RELEASE TO BEGIN CLIMB USING MAXIMUM THRUST	
FUEL (LB)	190
TIME (MIN)	0.6
DISTANCE (NMI)	2.0

STANDARD DAY TEMP - °C	PRESSURE ALTITUDE (FEET)	CLIMB SPEED SCHEDULE	
		KCAS	TMN
15.0	SL	300	0.45
5.1	5,000	300	0.50
-4.8	10,000	300	0.55
-4.8	10,000	435	0.78
-14.7	15,000	406	0.79
-24.6	20,000	377	0.81
-34.5	25,000	349	0.83
-44.4	30,000	322	0.84
-54.3	35,000	295	0.86
-56.5 AT	40,000	264	0.87
37,000 FT	45,000	236	0.87
& ABOVE	50,000	210	0.87

Figure 105

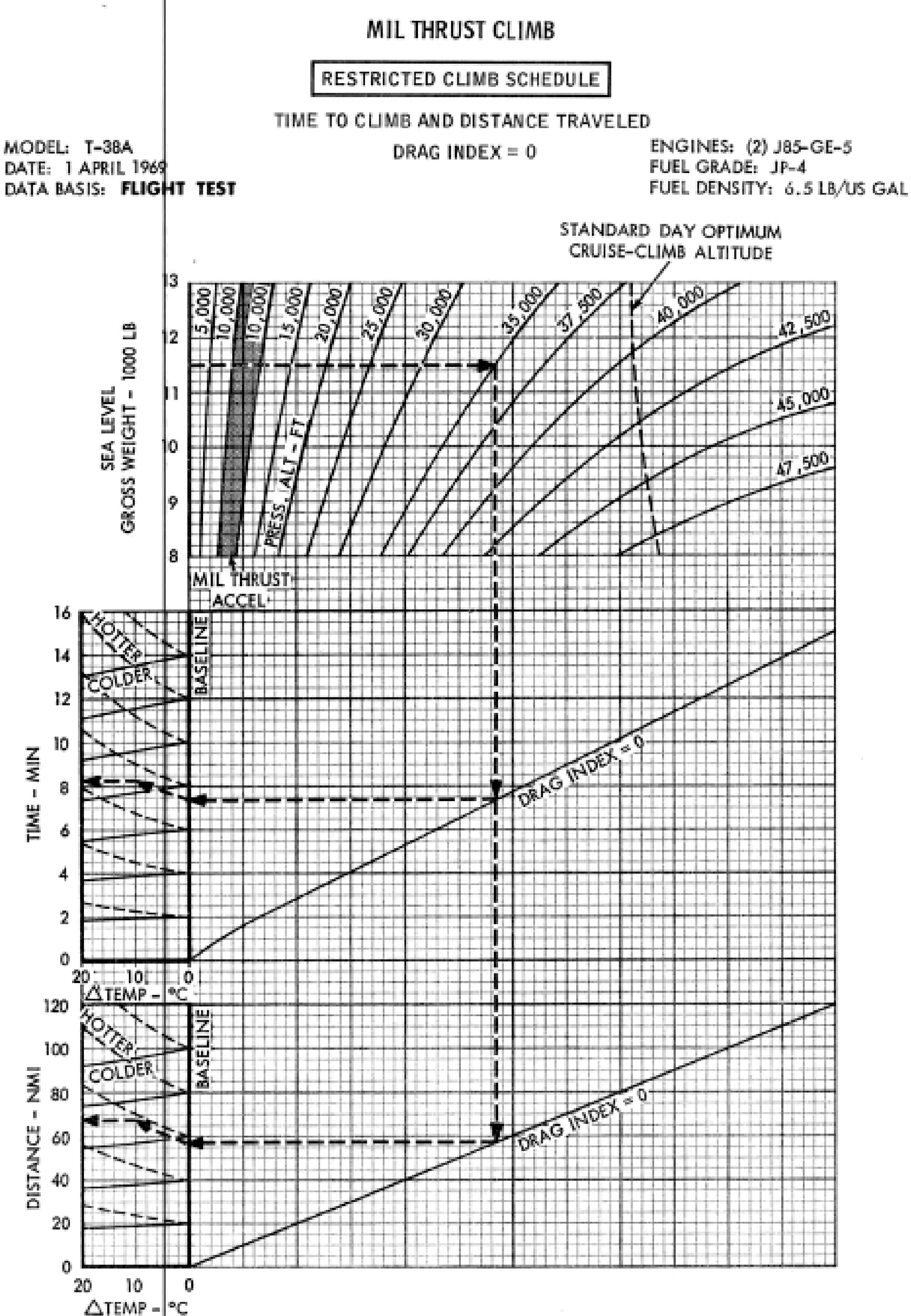

MIL THRUST CLIMB
RESTRICTED CLIMB SCHEDULE
TIME TO CLIMB AND DISTANCE TRAVELED
MODEL: T-38A
DATE: 1 APRIL 1969
DATA BASIS: FLIGHT TEST
DRAG INDEX = 0
ENGINES: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL
STANDARD DAY OPTIMUM CRUISE-CLIMB ALTITUDE
SEA LEVEL GROSS WEIGHT - 1000 LB
PRESS. ALT - FT
MIL THRUST ACCEL
BASELINE
HOTTER
COLDER
TIME - MIN
DRAG INDEX = 0
ΔTEMP - °C
DISTANCE - NMI

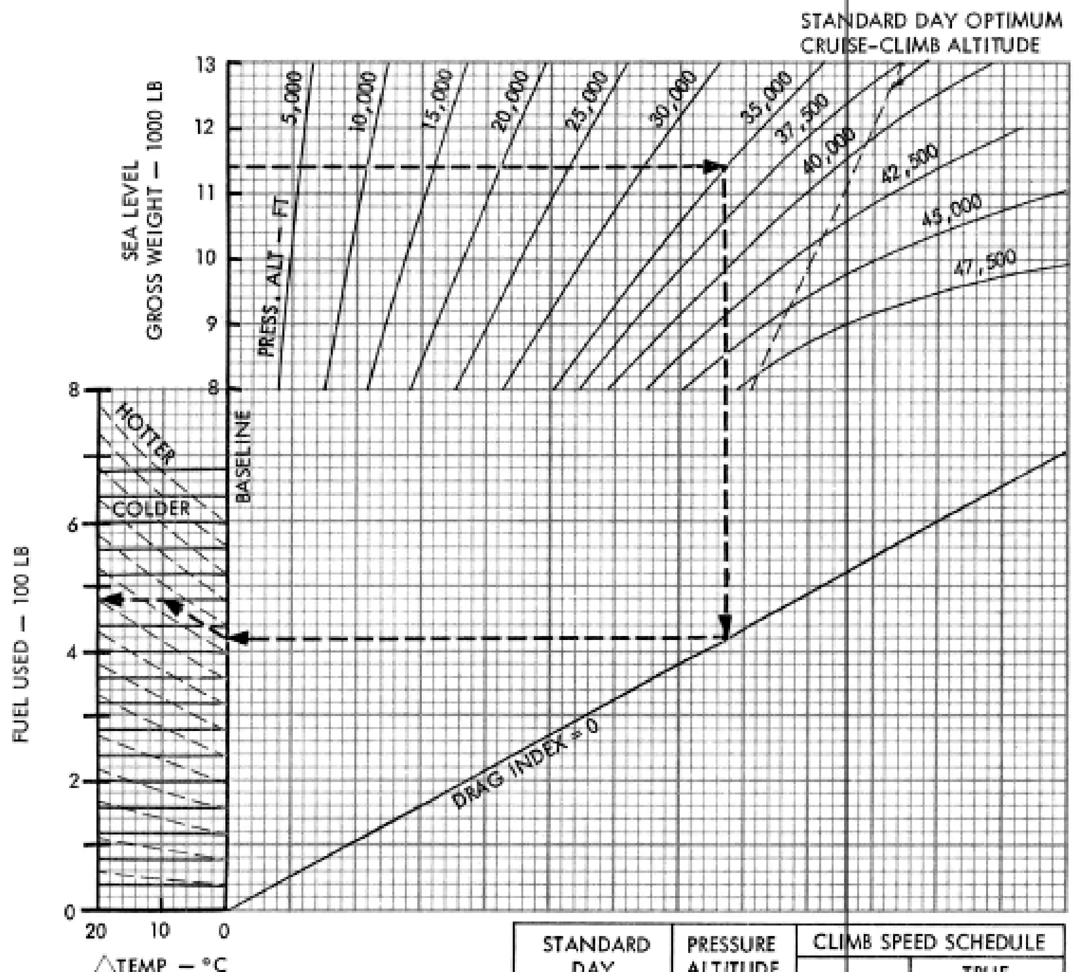
Figure 106

MIL THRUST CLIMB

FUEL USED
DRAG INDEX=0

MODEL: T-38A
DATE: 1 AUGUST 1965
DATA BASIS: FLIGHT TEST

ENGINE: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL



STANDARD DAY TEMP — °C	PRESSURE ALTITUDE — FEET	CLIMB SPEED SCHEDULE	
		KCAS	TRUE MACH NO.
15.0	SEA LEVEL	496	0.75
5.1	5,000	466	0.76
-4.8	10,000	435	0.78
-14.7	15,000	406	0.79
-24.6	20,000	377	0.81
-34.5	25,000	349	0.83
-44.4	30,000	322	0.84
-54.3	35,000	295	0.86
-56.5 AT 37,000 FT AND ABOVE	40,000	264	0.87
	45,000	236	0.87
	50,000	210	0.87

FUEL, TIME, AND DISTANCE ALLOWANCE PRIOR TO CLIMB	
GROUND TAXI: 18 LB/MIN	
FROM BRAKE RELEASE TO BEGIN CLIMB USING MAXIMUM THRUST	
FUEL (LB)	285
TIME (MIN)	1.0
DISTANCE (NMI)	4.0

Figure 107

MIL THRUST CLIMB

TIME TO CLIMB AND DISTANCE TRAVELED
DRAG INDEX = 0

MODEL: T-38A
DATE: 1 AUGUST 1965
DATA BASIS: FLIGHT TEST

ENGINE: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

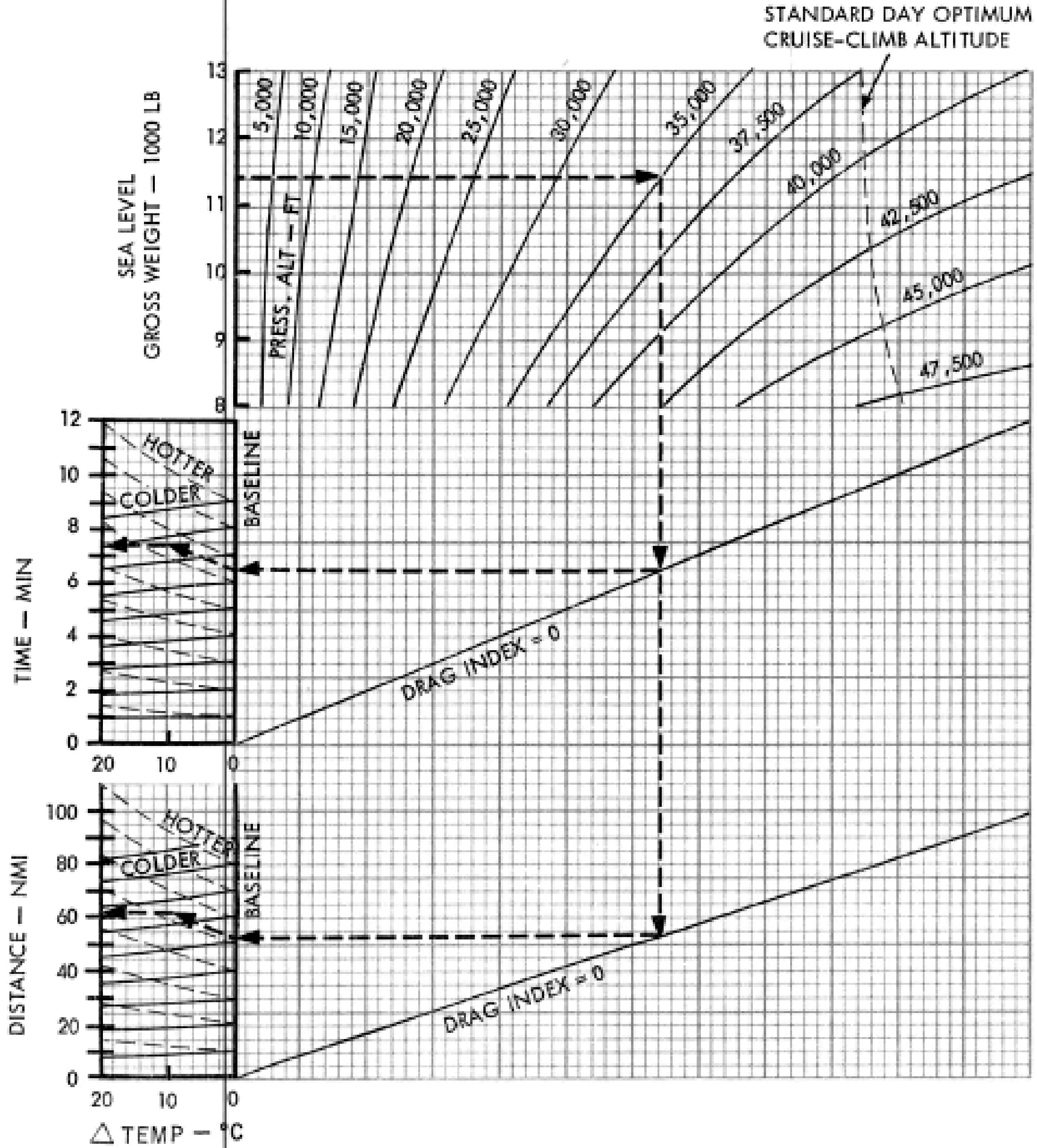
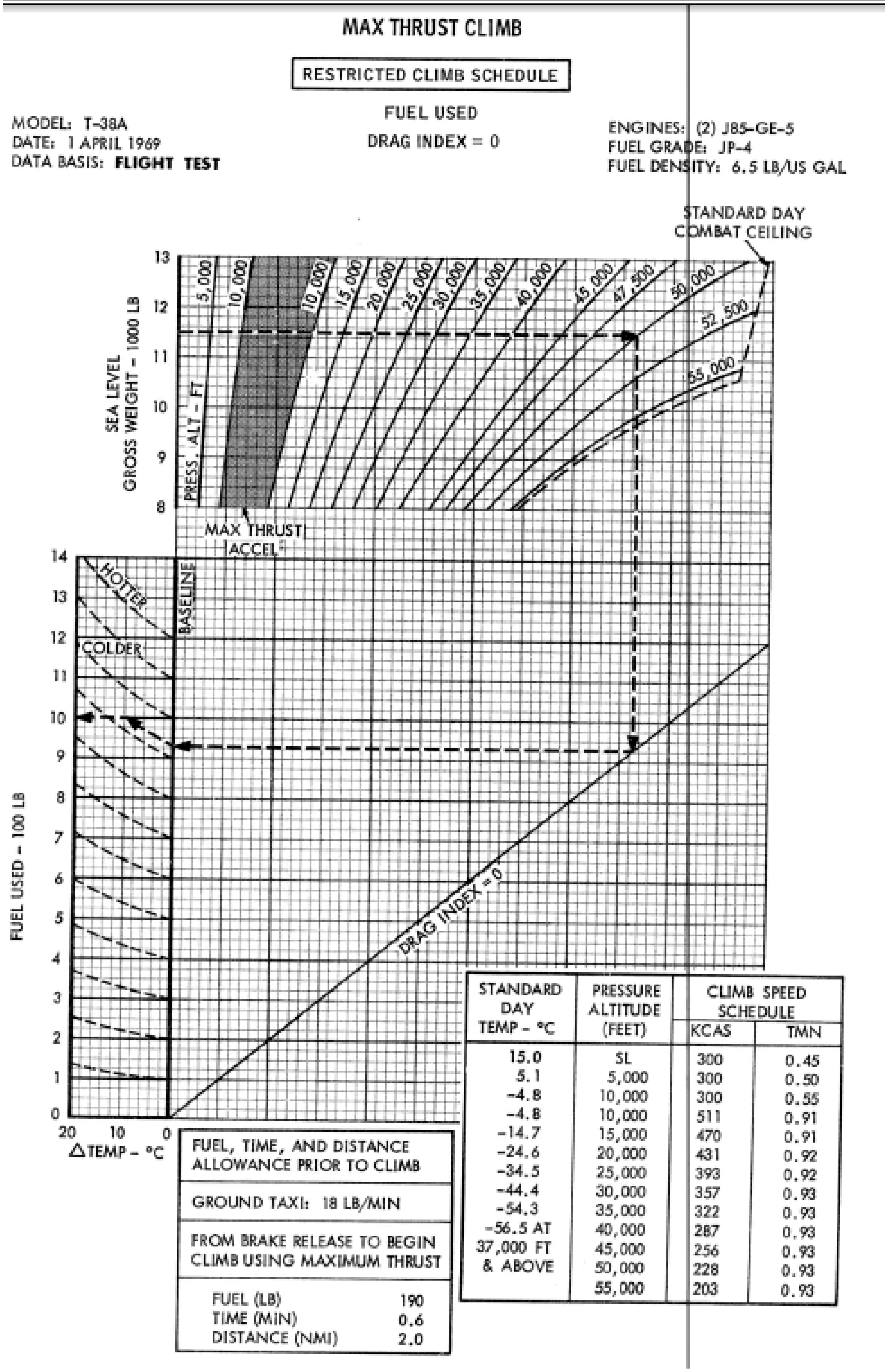


Figure 108



FUEL, TIME, AND DISTANCE ALLOWANCE PRIOR TO CLIMB	
GROUND TAXI: 18 LB/MIN	
FROM BRAKE RELEASE TO BEGIN CLIMB USING MAXIMUM THRUST	
FUEL (LB)	190
TIME (MIN)	0.6
DISTANCE (NMI)	2.0

STANDARD DAY TEMP - °C	PRESSURE ALTITUDE (FEET)	CLIMB SPEED SCHEDULE KCAS	CLIMB SPEED SCHEDULE TMN
15.0	SL	300	0.45
5.1	5,000	300	0.50
-4.8	10,000	300	0.55
-4.8	10,000	511	0.91
-14.7	15,000	470	0.91
-24.6	20,000	431	0.92
-34.5	25,000	393	0.92
-44.4	30,000	357	0.93
-54.3	35,000	322	0.93
-56.5 AT 37,000 FT & ABOVE	40,000	287	0.93
	45,000	256	0.93
	50,000	228	0.93
	55,000	203	0.93

Figure 109

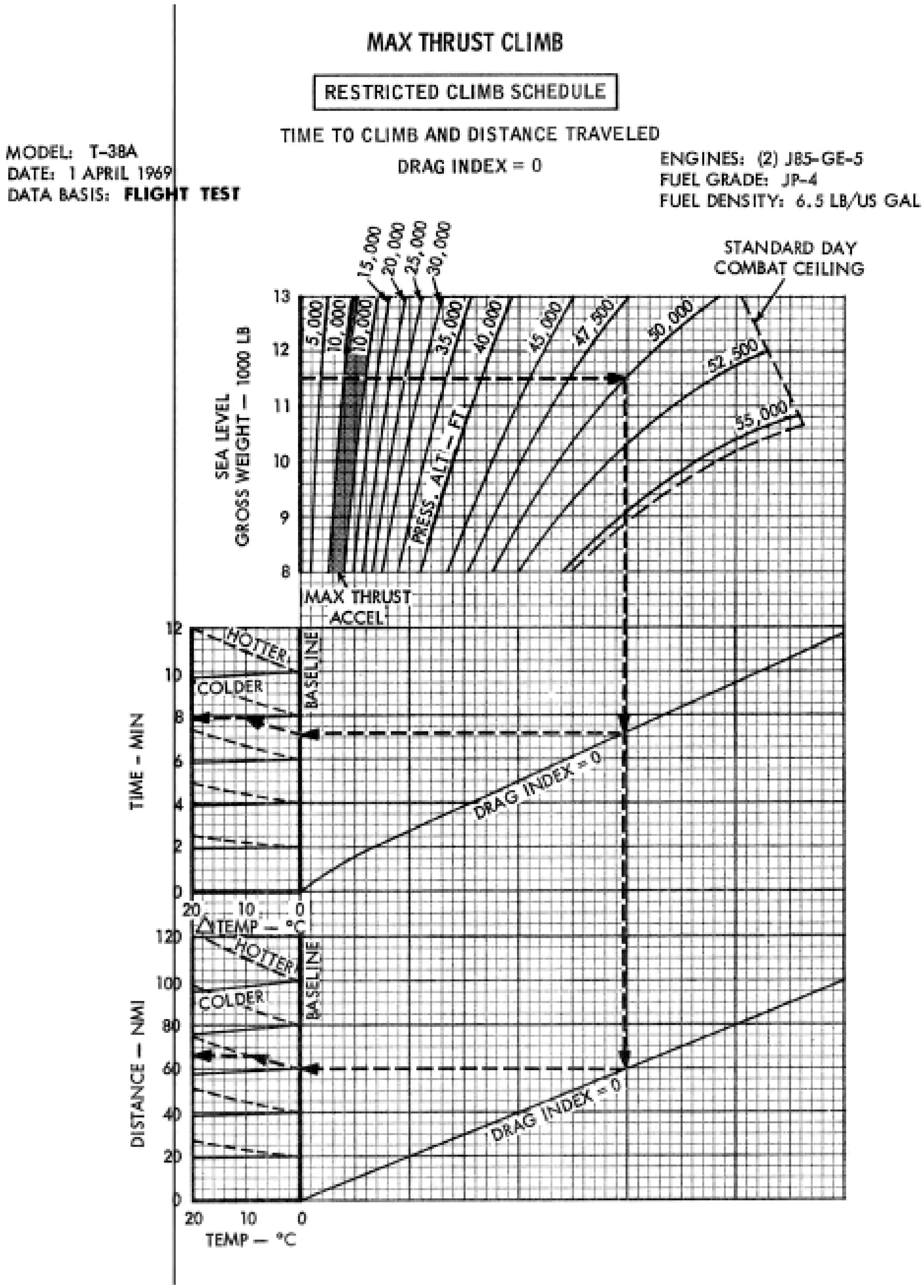
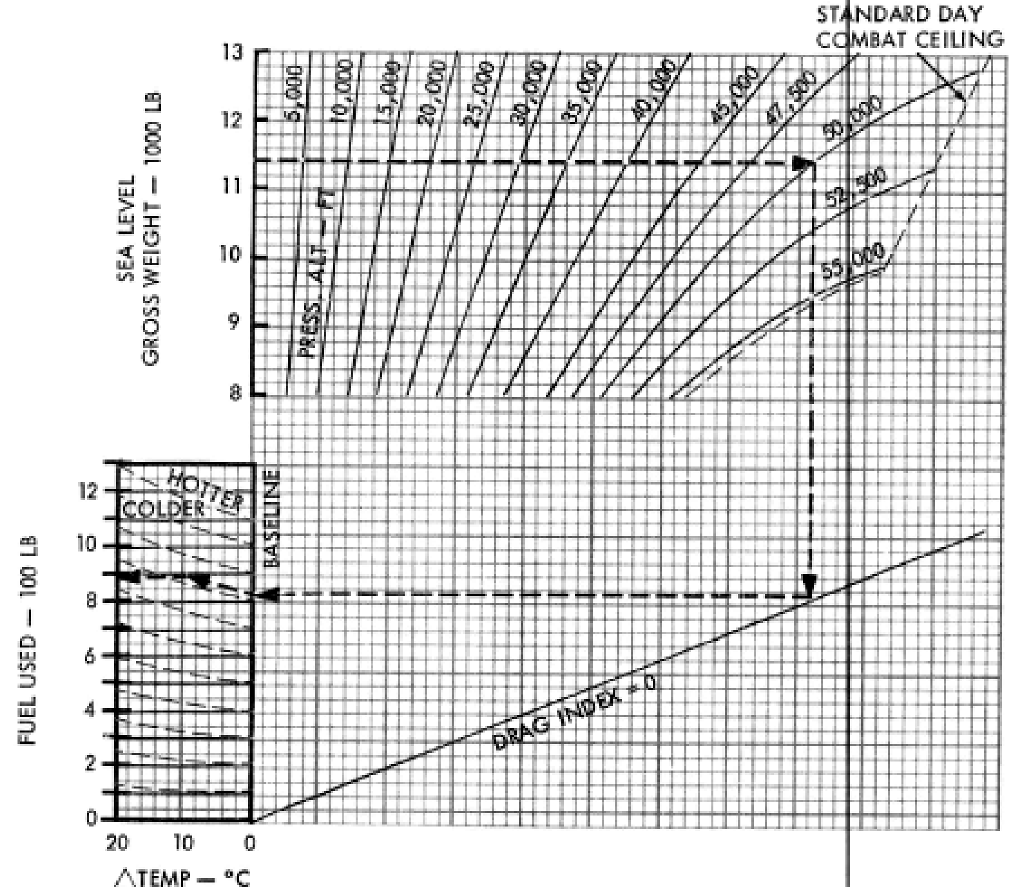

MAX THRUST CLIMB
RESTRICTED CLIMB SCHEDULE
TIME TO CLIMB AND DISTANCE TRAVELED
DRAG INDEX = 0
MODEL: T-38A
DATE: 1 APRIL 1969
DATA BASIS: FLIGHT TEST
ENGINES: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL
STANDARD DAY COMBAT CEILING
SEA LEVEL GROSS WEIGHT — 1000 LB
PRESS. ALT — FT
MAX THRUST ACCEL
TIME - MIN
DISTANCE — NMI
HOTTER
COLDER
BASELINE
DRAG INDEX = 0
△TEMP — °C
TEMP — °C

Figure 110

MAX THRUST CLIMB
FUEL USED
DRAG INDEX = 0

MODEL: T-38A
DATE: 1 AUGUST 1965
DATA BASIS: **FLIGHT TEST**

ENGINE: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL



FUEL, TIME, AND DISTANCE ALLOWANCE PRIOR TO CLIMB	
GROUND TAXI: 18 LB/MIN	
FROM BRAKE RELEASE TO BEGIN CLIMB USING MAXIMUM THRUST	
FUEL (LB)	315
TIME (MIN)	1.2
DISTANCE (NMI)	6.0

STANDARD DAY TEMP — °C	PRESSURE ALTITUDE — FEET	CLIMB SPEED SCHEDULE KCAS	CLIMB SPEED SCHEDULE TRUE MACH NO.
15.0	SEA LEVEL	596	0.90
5.1	5,000	553	0.90
-4.8	10,000	511	0.91
-14.7	15,000	470	0.91
-24.6	20,000	431	0.92
-34.5	25,000	393	0.92
-44.4	30,000	357	0.93
-54.3	35,000	322	0.93
-56.5 AT 37,000 FT AND ABOVE	40,000	287	0.93
	45,000	256	0.93
	50,000	228	0.93
	55,000	203	0.93

Figure 111

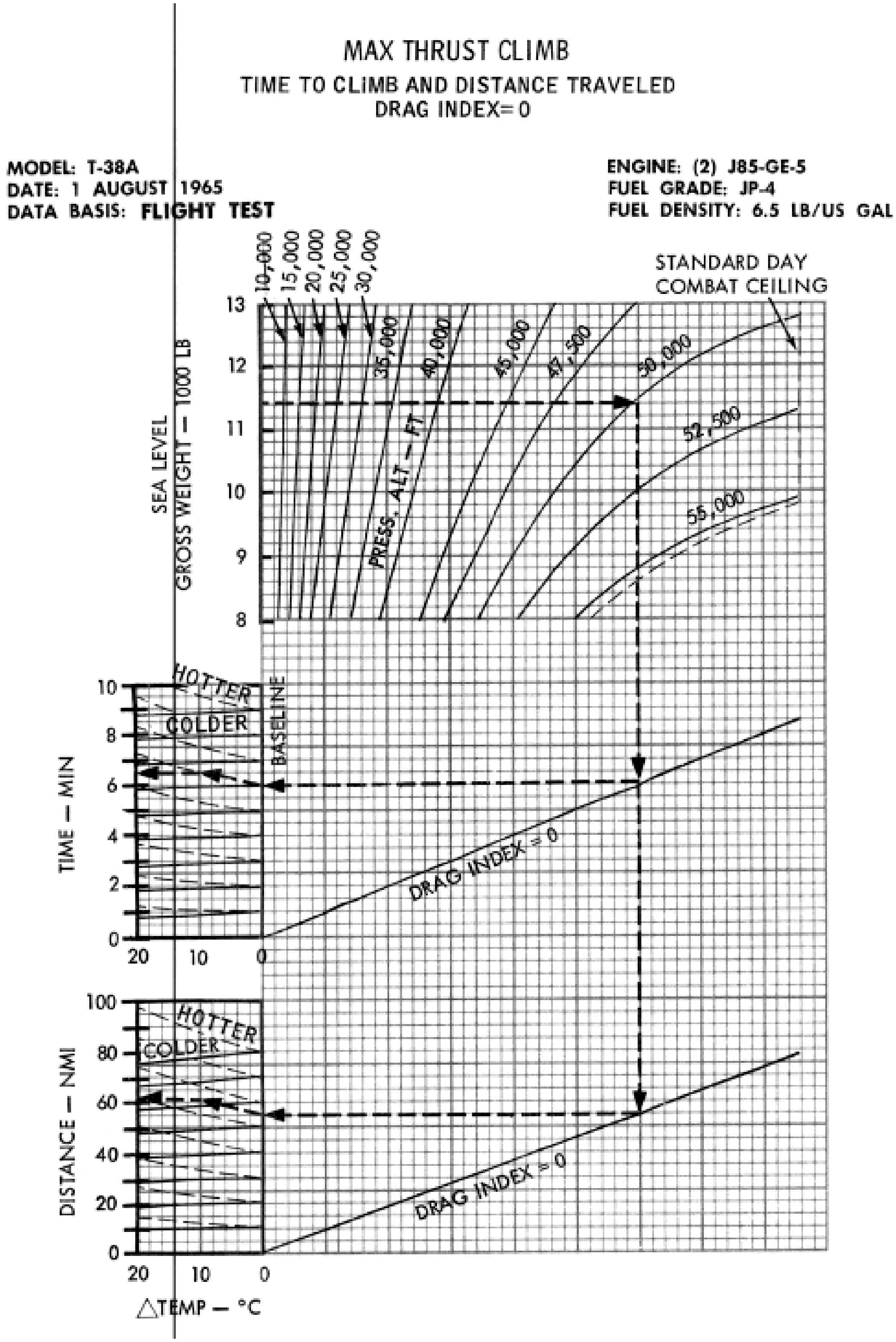

MAX THRUST CLIMB
TIME TO CLIMB AND DISTANCE TRAVELED
DRAG INDEX= 0
MODEL: T-38A
DATE: 1 AUGUST 1965
DATA BASIS: FLIGHT TEST
ENGINE: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL
STANDARD DAY
COMBAT CEILING
10,000
15,000
20,000
25,000
30,000
35,000
40,000
45,000
47,500
50,000
52,500
55,000
PRESS. ALT — FT
SEA LEVEL
GROSS WEIGHT — 1000 LB
13
12
11
10
9
8
HOTTER
COLDER
BASELINE
TIME — MIN
DRAG INDEX = 0
DISTANCE — NMI
20
10
0
△TEMP — °C

Figure 112

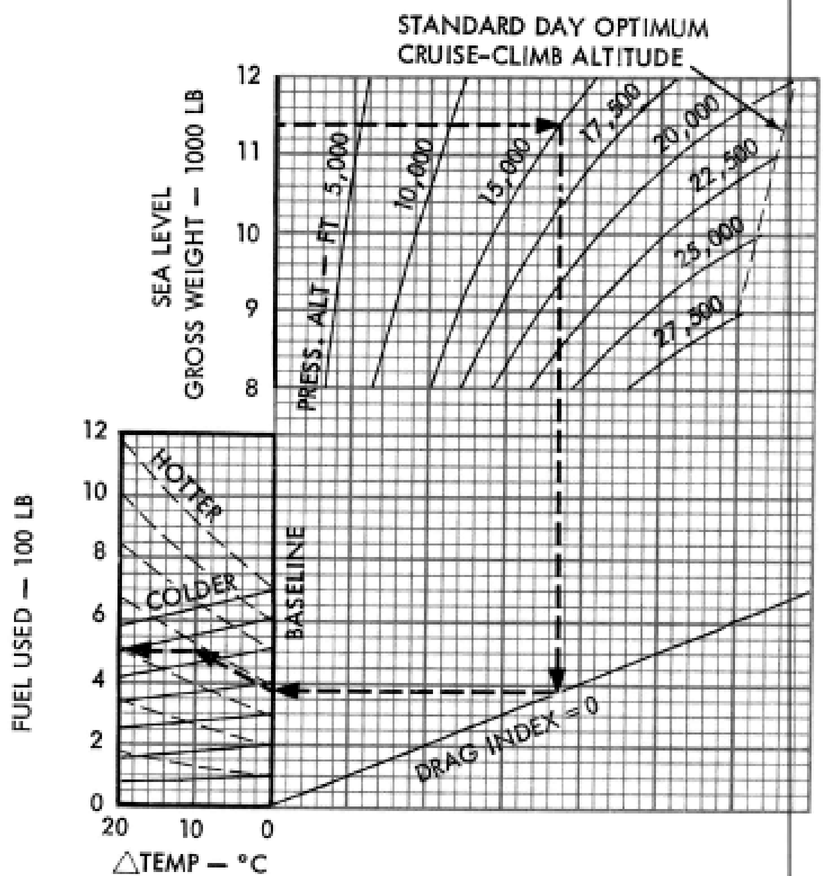
MIL THRUST CLIMB

FUEL USED
DRAG INDEX = 0

SINGLE ENGINE

MODEL: T-38A
DATE: 1 AUGUST 1965
DATA BASIS: **FLIGHT TEST**

ENGINE: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL



STANDARD DAY TEMP — °C	PRESSURE ALTITUDE — FEET	CLIMB SPEED SCHEDULE	
		KCAS	TRUE MACH NO.
15.0	SEA LEVEL	281	0.43
5.1	5,000	278	0.46
- 4.8	10,000	271	0.49
-14.7	15,000	264	0.52
-24.6	20,000	256	0.56
-34.5	25,000	246	0.59
-44.4	30,000	227	0.61

Figure 113

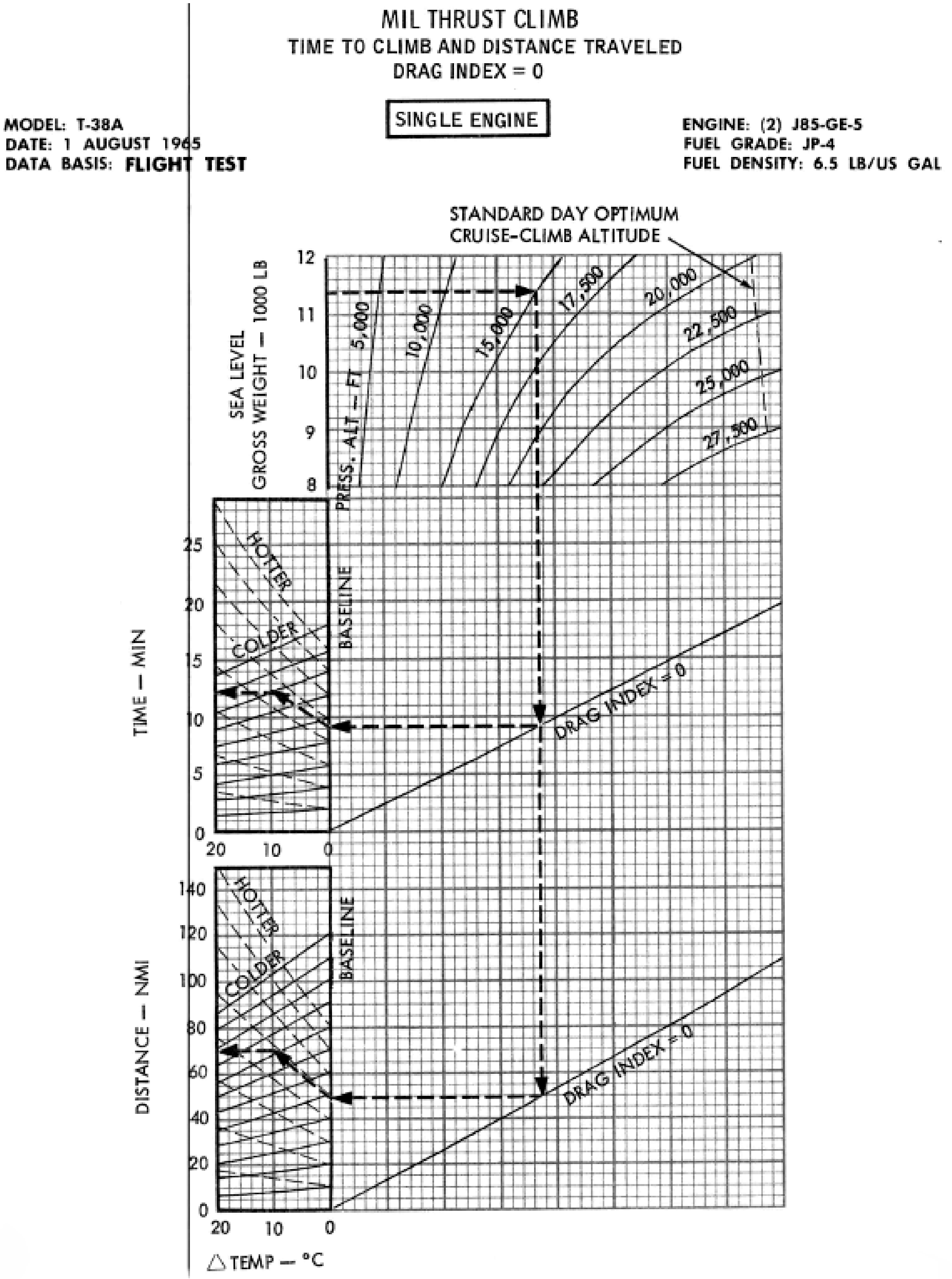

MIL THRUST CLIMB
TIME TO CLIMB AND DISTANCE TRAVELED
DRAG INDEX = 0
SINGLE ENGINE
MODEL: T-38A
DATE: 1 AUGUST 1965
DATA BASIS: FLIGHT TEST
ENGINE: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL
STANDARD DAY OPTIMUM CRUISE-CLIMB ALTITUDE
SEA LEVEL GROSS WEIGHT — 1000 LB
PRESS. ALT — FT
5,000
10,000
15,000
17,500
20,000
22,500
25,000
27,500
HOTTER
COLDER
BASELINE
DRAG INDEX = 0
TIME — MIN
DISTANCE — NMI
△TEMP — °C

Figure 114

OPTIMUM CRUISE-CLIMB ALTITUDE

DRAG INDEX = 0

MODEL: T-38A
DATE: 1 AUGUST 1965
DATA BASIS: **FLIGHT TEST**

ENGINE: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

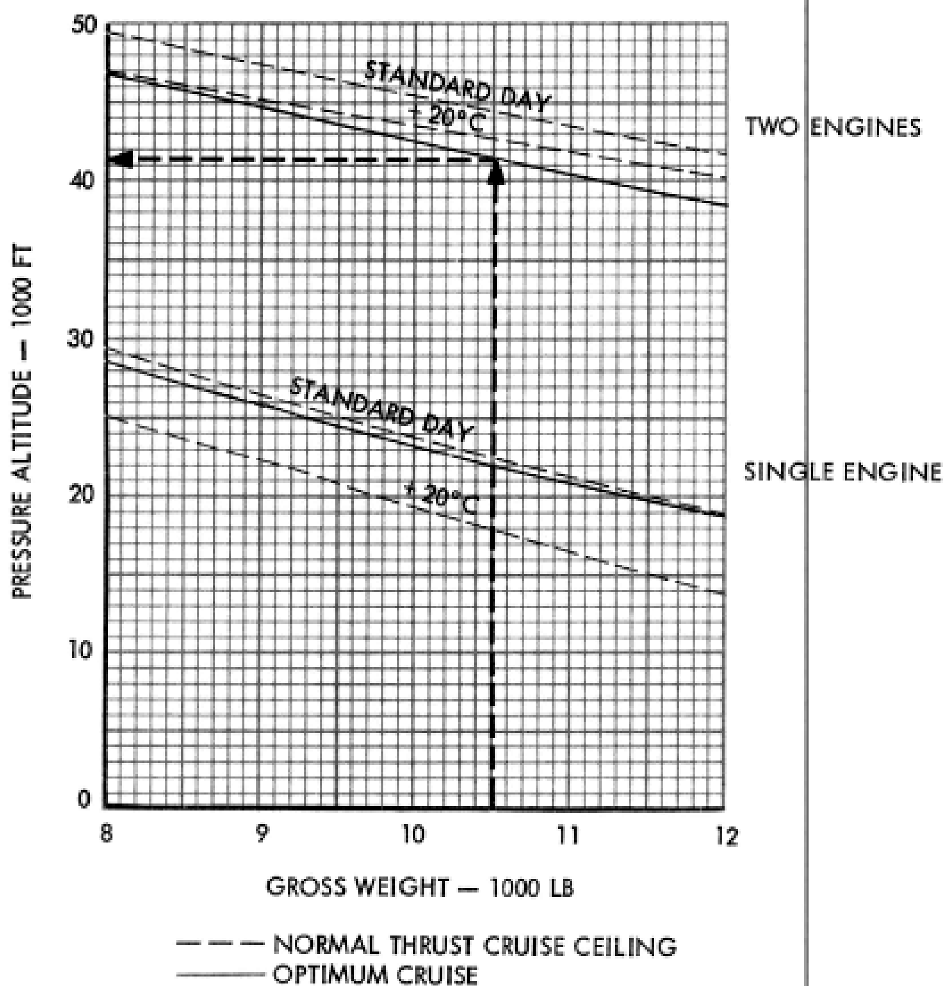


Figure 115

SINGLE ENGINE SERVICE CEILING

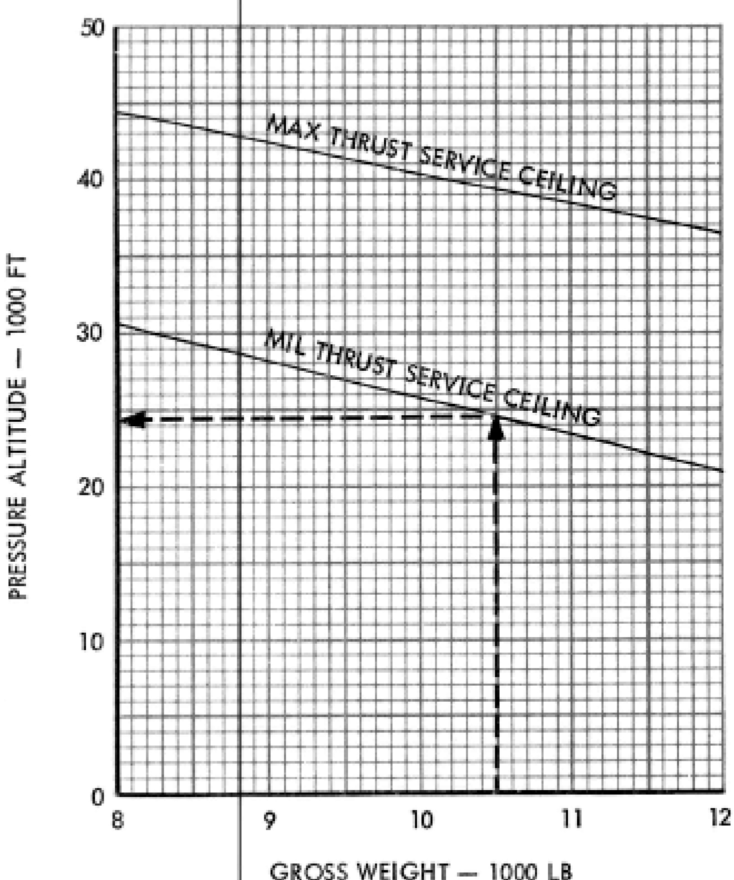
STANDARD DAY
DRAG INDEX = 0

MODEL: T-38A
DATE: 1 AUGUST 1965
DATA BASIS: FLIGHT TEST

ENGINE: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

Note

FOR EACH 10°C RISE IN AIR TEMPERATURE ABOVE STANDARD DAY CONDITIONS, DECREASE SERVICE CEILING 2600 FEET.



ALT 1000 FT	CLIMB SCHEDULE			
	MIL THRUST		MAX THRUST	
	KCAS	MACH NO.	KCAS	MACH NO.
45	—	—	216	0.80
40	—	—	242	0.80
35	—	—	270	0.80
30	227	0.61	295	0.78
25	246	0.59	313	0.75
20	256	0.56	331	0.72
15	264	0.52	349	0.69
10	272	0.49	365	0.65
5	278	0.46	377	0.62
SL	281	0.43	394	0.60

Figure 116

PART 4 – CRUISE

PURPOSE OF CHARTS

The cruise charts provide cruise and loiter data which can be used to determine the subsonic cruise and loiter portions of any type of flight plan with clean configuration (drag index of 0). Charts for constant altitude cruise and optimum cruise altitude for short range missions are included. Diversion range summary tables are provided in tabular form for two-engine and single-engine operation.

CRUISE CHARTS

The cruise charts are for two-engine and single-engine operation. They provide cruise and loiter data throughout the speed range from maximum endurance to military thrust. Each chart is composed of three pages whose parameters are weight, altitude, Mach number, ambient temperature, true airspeed, fuel flow, and nautical miles per pound of fuel.

The average gross weight used in the charts is the average of the gross weights at the beginning and the end of the cruise or cruise interval. This average gross weight is equal to the gross weight at the beginning of cruise less one half of the fuel necessary for cruise. An ICAO standard day temperature table is included on sheet 3 of each chart.

USE OF CRUISE CHART

Assume a constant altitude cruise at 0.8 Mach and a pressure altitude of 20,000 feet when the temperature is -20°C and the average gross weight is 10,400 pounds. The chase-thru lines on sheet 1 of the chart show the maximum range Mach number of 0.702. Then, by following the guidelines from the intersection with the baseline (maximum range) to the assumed Mach number (0.8), the basic reference number is 2.75.

The chase-thru lines on sheet 2 show 0.225 nautical mile per pound of fuel for the assumed Mach number (0.8) and the reference number determined on sheet 1. Entering sheet 3 with the assumed Mach number and the nautical mile per pound values from sheet 2, the chase-thru lines show a true airspeed of 495 knots and fuel flow of 1,100 pounds per hour per engine. If the fuel available is 1,000 pounds, the cruise distance is 225 nautical miles (0.225 x 1,000) and the time is 27 minutes (1,000 x 60 / 1,100 x 2). When the distance is known instead of the fuel available, the fuel required is computed by the reverse process (225 / 0.225 = 1,000) and the average gross weight is obtained by successive approximations, knowing the gross weight at the start of the cruise.

CONSTANT ALTITUDE CRUISE

The constant altitude cruise charts are for two-engine and single-engine operations. The charts are used to determine cruise performance at a particular pressure altitude, temperature, wind velocity, and average gross weight. The charts provide data for air and ground speeds, time, nautical miles per pound of fuel, fuel flow, and fuel required. When the fuel required is unknown, the average gross weight is obtained by successive approximations.

USE OF CONSTANT ALTITUDE CRUISE CHARTS

The chase-thru lines on the chart are for an average gross weight of 10,020 pounds, a constant altitude cruise of 35,000 feet, a temperature of -46^{o}C, a headwind of 50 knots, and a distance of 400 nautical miles. On sheet 1, the chase-thru lines show a Mach number of 0.83, a true airspeed (airspeed reflector) and groundspeed of 485 knots, respectively, and a time of 55 minutes. Using the airspeed of 485 knots and the time of 55 minutes, the chase-thru lines on sheet 2 show 0.338 nautical mile per pound of fuel, a fuel flow of 720 pounds per hour per engine, and 1,320 pounds of fuel. Since 1,320 pounds of fuel is required, the gross weight at the start of the cruise is 10,680 pounds (10,020 + 0.5 x 1,320).

OPTIMUM CRUISE ALTITUDE FOR SHORT RANGE MISSIONS

For short-range flights, it is not economical to climb to the same optimum cruise altitude as used for long range missions. The chart presents the optimum constant altitude cruise for short-range missions and also indicates when the mission is in the short-range category; that is, below the optimum cruise-climb altitude.

USE OF OPTIMUM CRUISE ALTITUDE FOR SHORT RANGE MISSION CHART

For a short-range mission 100 nautical miles from base and a start climb gross weight of 11,400 pounds, the chase-thru lines show the optimum cruise at constant altitude is 28,000 feet. Had the distance been 150 nautical miles, the optimum cruise-climb altitude would be the most economical.

DIVERSION RANGE SUMMARY TABLES

Diversion range summary tables are presented in this section for two-engine and single-engine operations. These tables show, in quick reference form, the range available and the time required to return to base with 600, 800, 1000, or 1400 pounds of fuel available. The range is based on having 300 pounds of fuel remaining for the approach and landing after the descent is completed. The 300 pounds of fuel is ample for one missed approach. Range and time data are shown in the tables for three optional return profiles, together with the optimum altitudes for cruise.

The optimal altitude is the constant cruise altitude is the constant cruise altitude which provides the maximum range for the particular type of flight profile. Climb is made to the cruise altitude, using military thrust.

Note

The Mil Thrust Climb Speed Schedule at the bottom of each table must be used to obtain the maximum ranges in the table.

Cruise speeds and descent data are provided at the bottom of the tables.

The three types of flight profiles are:

1. Cruise at initial altitude to base.
    a. Descend to sea level with idle thrust and speed brake closed after arrival over base.
2. Climb on course to optimum cruise altitude.
    a. Cruise at optimum altitude to base.
    b. Descend to sea level with idle thrust and speed brake open after arrival over base.
3. Climb on course to optimum cruise altitude.
    a. Cruise at optimum altitude.
    b. Descend on course to sea level with idle thrust and speed brake closed.

USE OF DIVERSION RANGE SUMMARY TALBES

Assume the following conditions prevail: Single-engine operation, fuel remaining is 1,240 pounds, and the aircraft is 200 nautical miles from the base at 15,000 feet altitude. To determine which flight profile in the chart provides necessary range in return to base:

1. Enter the chart at the top of the column marked 15,000 feet initial altitude.
2. Proceed downward to the section of the chart for 1,000 pounds of fuel shown at the left side of the page.
3. The ranges available with the three profile options are:
    a. First option – 173 nautical miles
    b. Second option – 184 nautical miles
    c. Third option – 214 nautical miles
4. As the required range is 200 nautical miles, the flight profile for the third option must be used.
5. Climb with MIL thrust from 15,000 feet at Mach number 0.52 (footnote number 5) to 25,000 feet at Mach number 0.59. At 25,000 feet, cruise at 0.62 Mach; engine fuel flow will be approximately 1,250 lbs/hr. At 40nm from the base, descend on course at 240 KCAS, idle thrust, with the speed brake closed.
6. The time required with no wind is 37 minutes for 214nm, and the fuel used is 1,000 pounds by the time the landing is completed. As the fuel available was 1,240 pounds, 240 pounds of this amount would be available for headwind conditions.

CRUISE

MACH NUMBER AND REFERENCE NUMBER

DRAG INDEX = 0

MODEL: T-38A
DATE: 1 DECEMBER 1965
DATA BASIS: FLIGHT TEST

SINGLE ENGINE

ENGINE: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

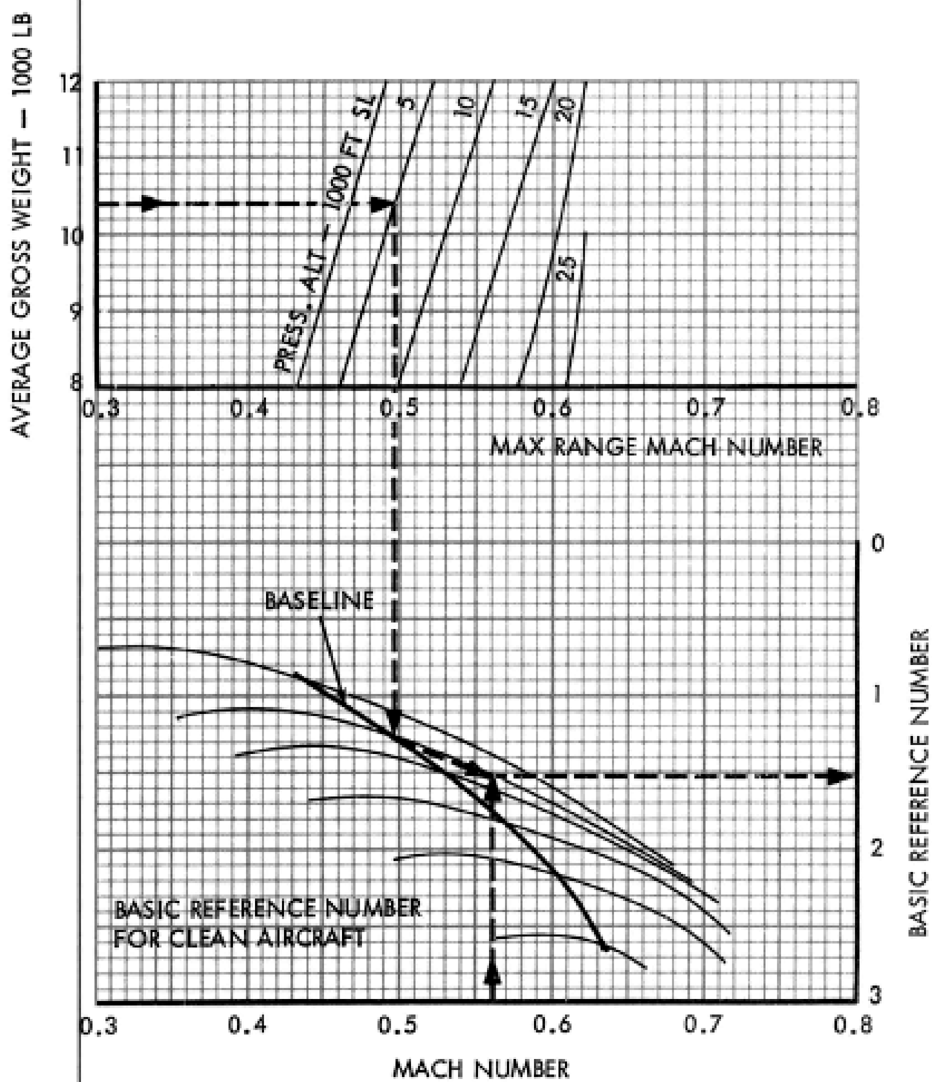


Figure 117

CRUISE

NAUTICAL MILES PER POUND

DRAG INDEX = 0

MODEL: T-38A
DATE: 1 JANUARY 1972
DATA BASIS: FLIGHT TEST

ENGINE: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

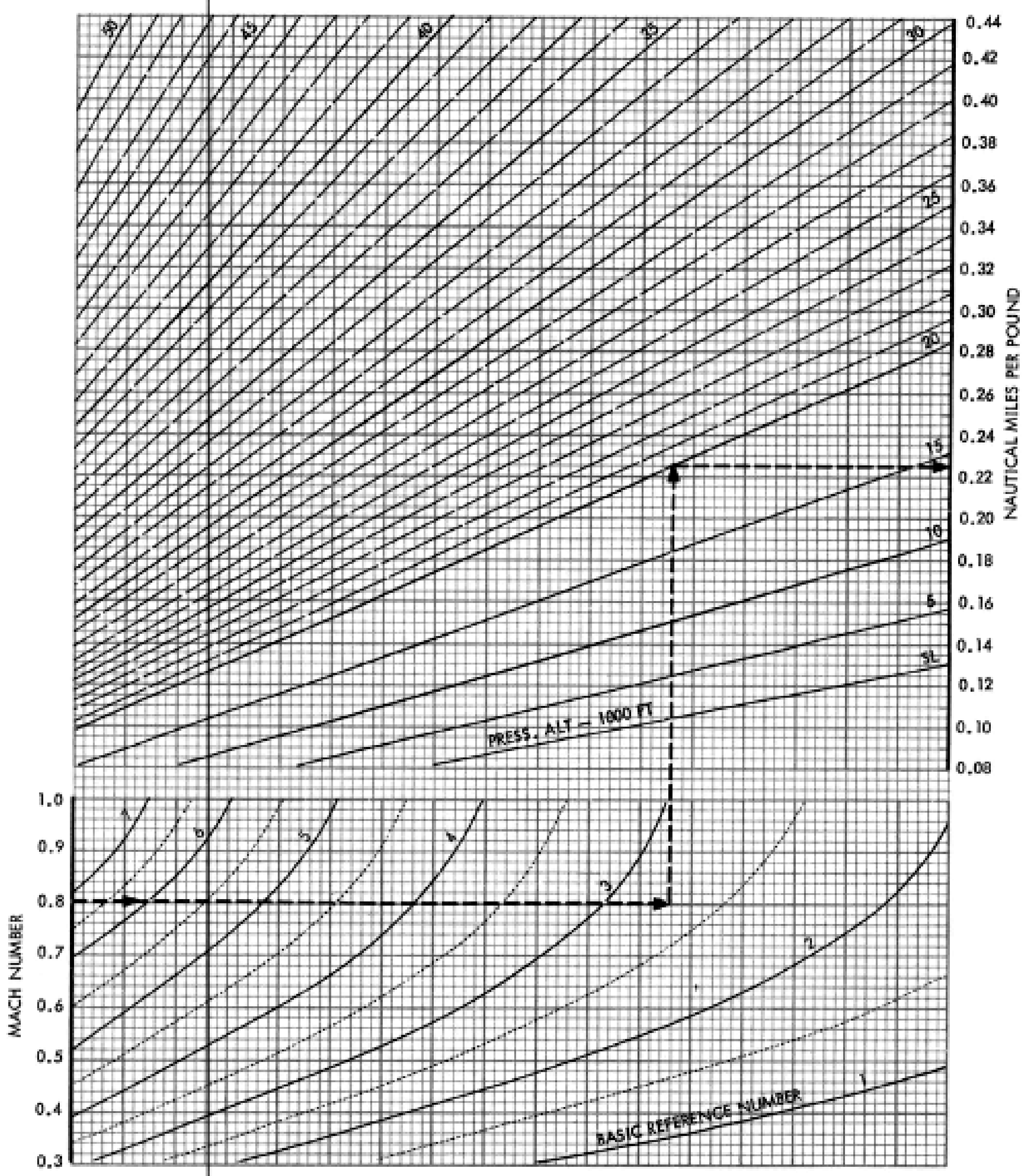


Figure 118

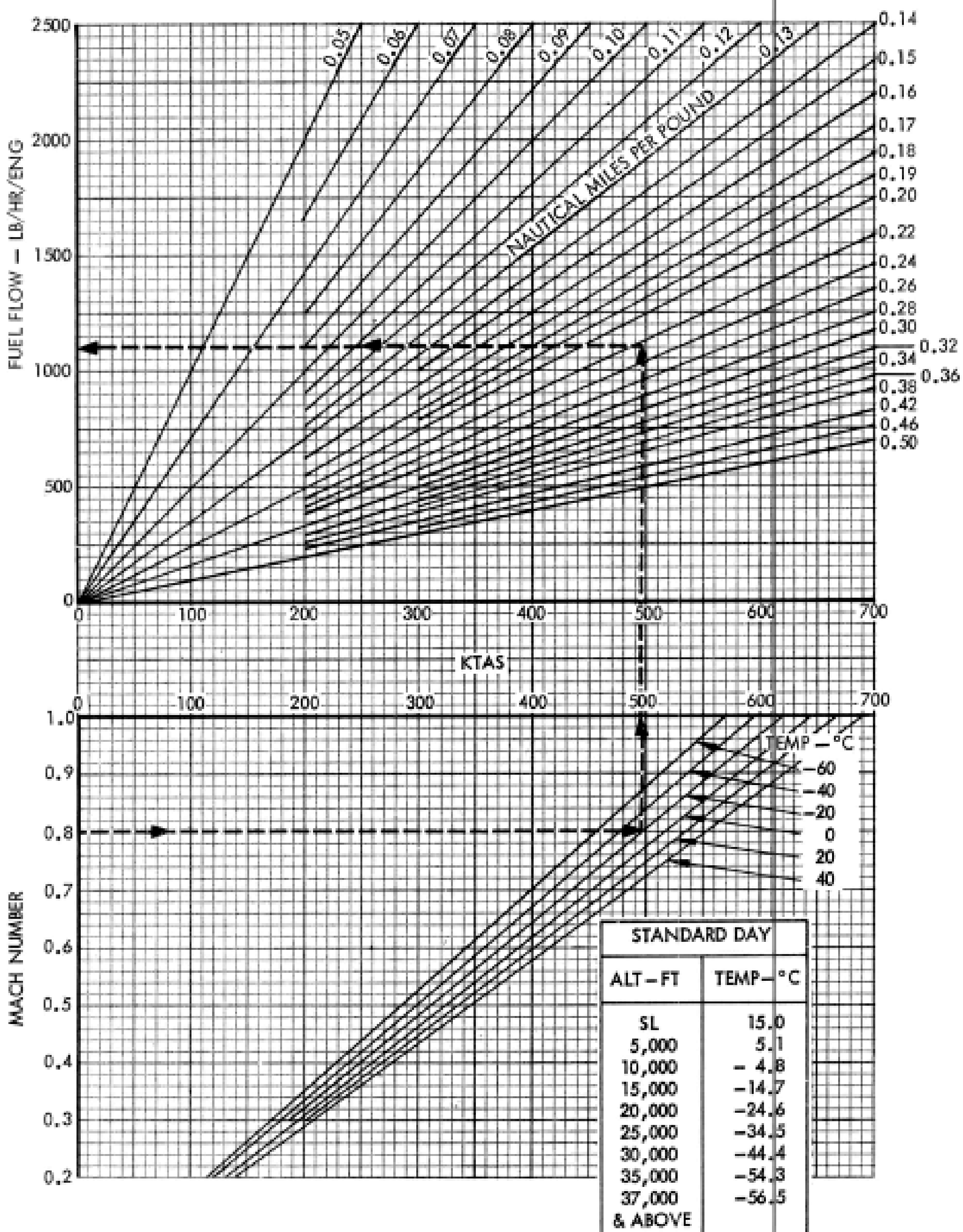
CRUISE

FUEL FLOW AND TRUE AIRSPEED

DRAG INDEX = 0

MODEL: T-38A
DATE: 1 JANUARY 1972
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL



ALT – FT	TEMP – °C
SL	15.0
5,000	5.1
10,000	−4.8
15,000	−14.7
20,000	−24.6
25,000	−34.5
30,000	−44.4
35,000	−54.3
37,000 & ABOVE	−56.5

Figure 119

CRUISE

MACH NUMBER AND REFERENCE NUMBER

DRAG INDEX = 0

MODEL: T-38A
DATE: 1 DECEMBER 1965
DATA BASIS: FLIGHT TEST

SINGLE ENGINE

ENGINE: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

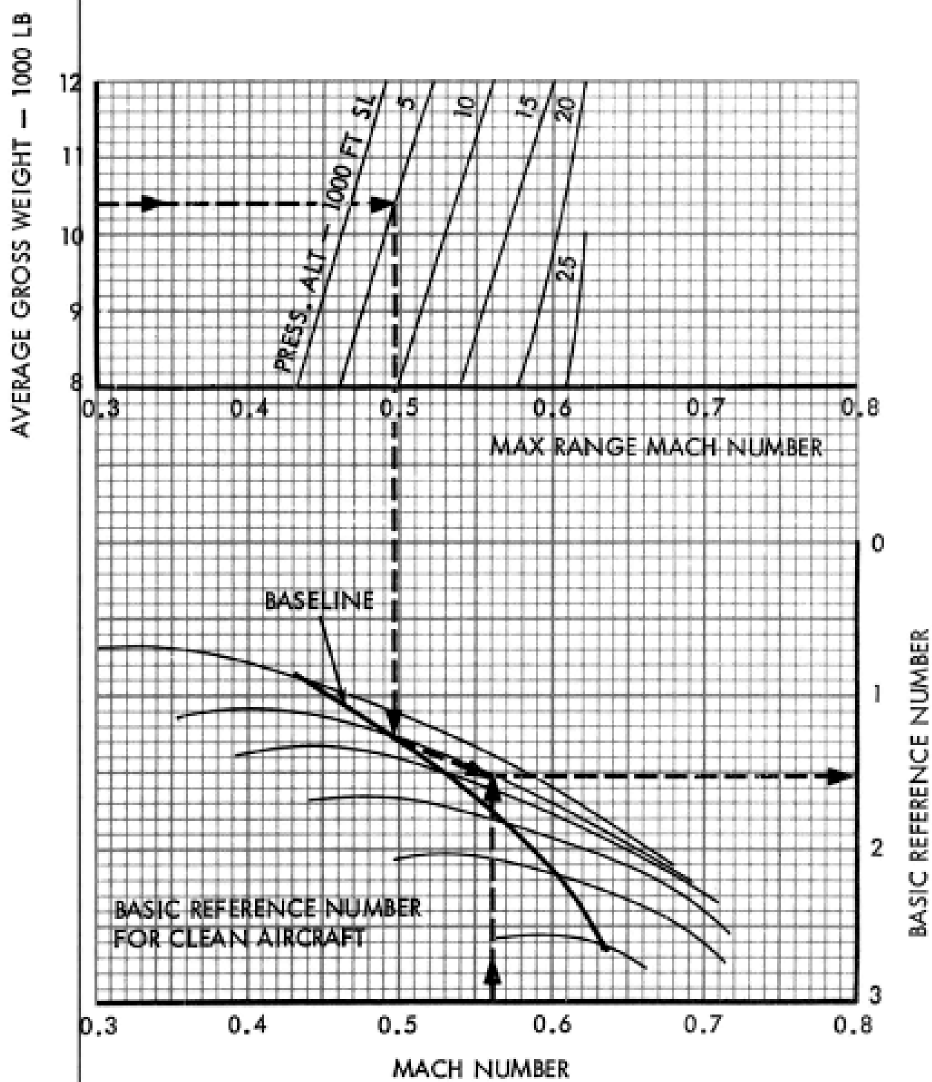


Figure 120

CRUISE

NAUTICAL MILES PER POUND

DRAG INDEX = 0

MODEL: T-38A
DATE: 1 DECEMBER 1965
DATA BASIS: FLIGHT TEST

SINGLE ENGINE

ENGINE: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

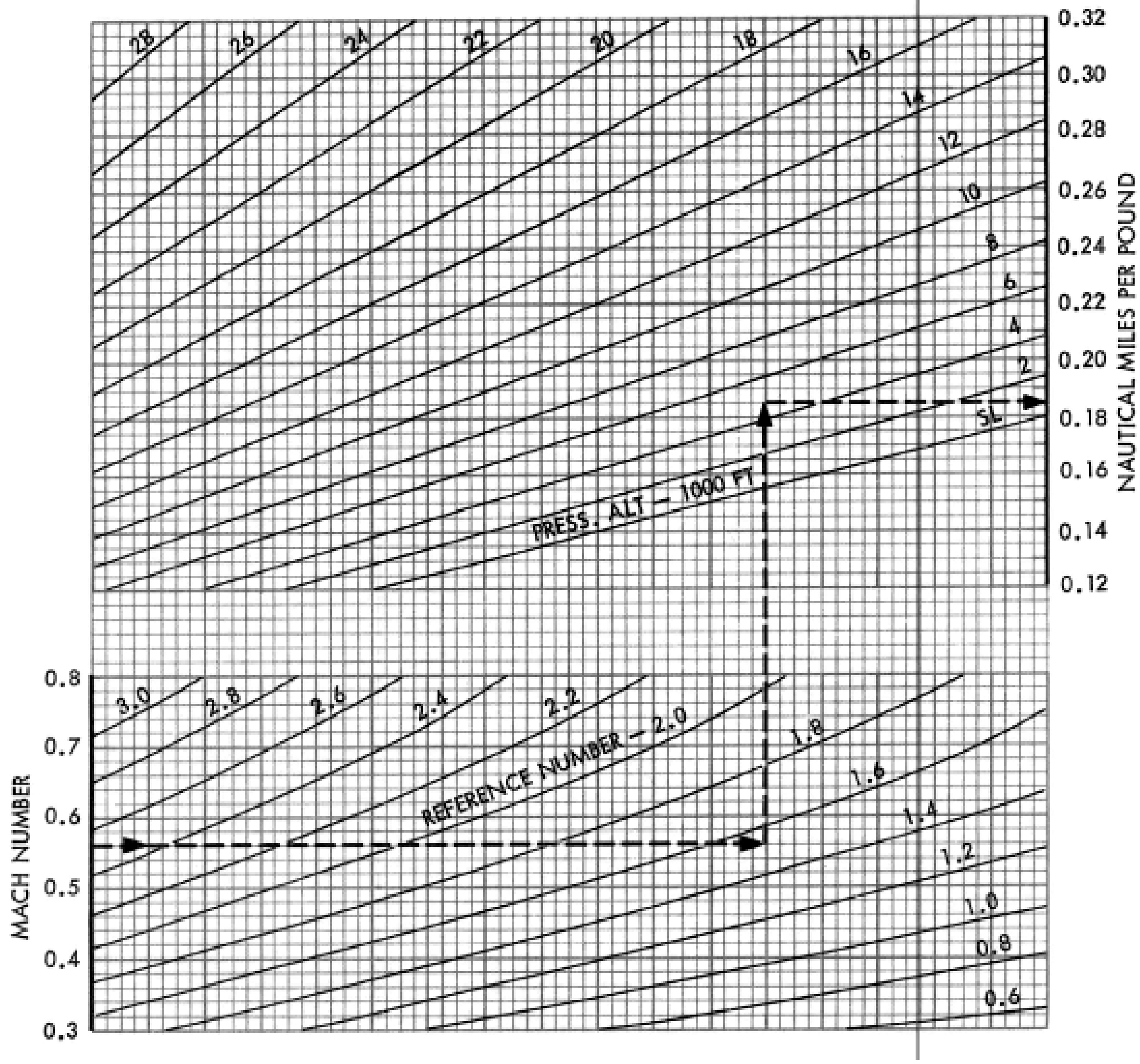


Figure 121

CRUISE

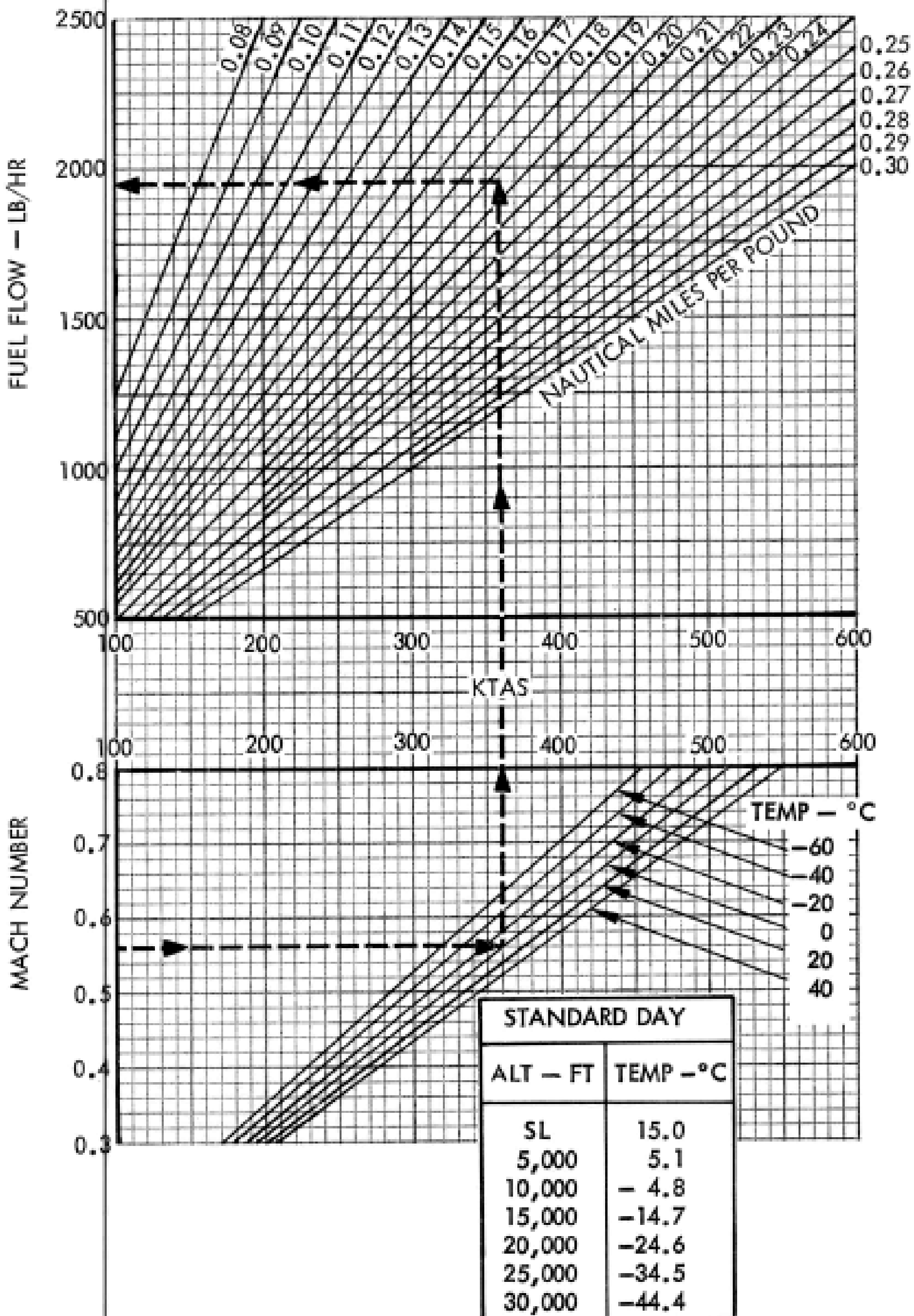
FUEL FLOW AND TRUE AIRSPEED

DRAG INDEX = 0

SINGLE ENGINE

MODEL: T-38A
DATE: 1 JANUARY 1972
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL



STANDARD DAY	
ALT — FT	TEMP —°C
SL	15.0
5,000	5.1
10,000	− 4.8
15,000	−14.7
20,000	−24.6
25,000	−34.5
30,000	−44.4

Figure 122

CONSTANT ALTITUDE CRUISE
TIME AND AIRSPEED
DRAG INDEX = 0

MODEL: T-38A
DATE: 1 AUGUST 1965
DATA BASIS: FLIGHT TEST

ENGINE: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

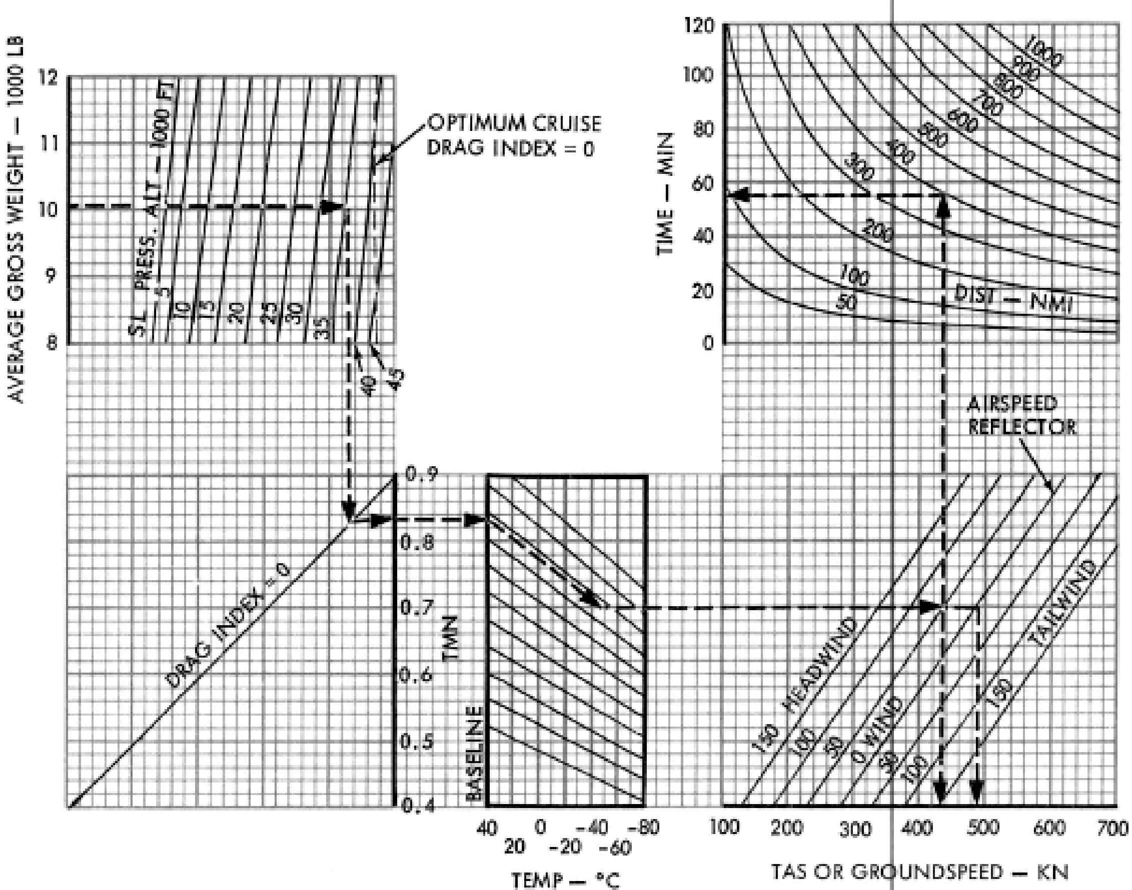


Figure 122

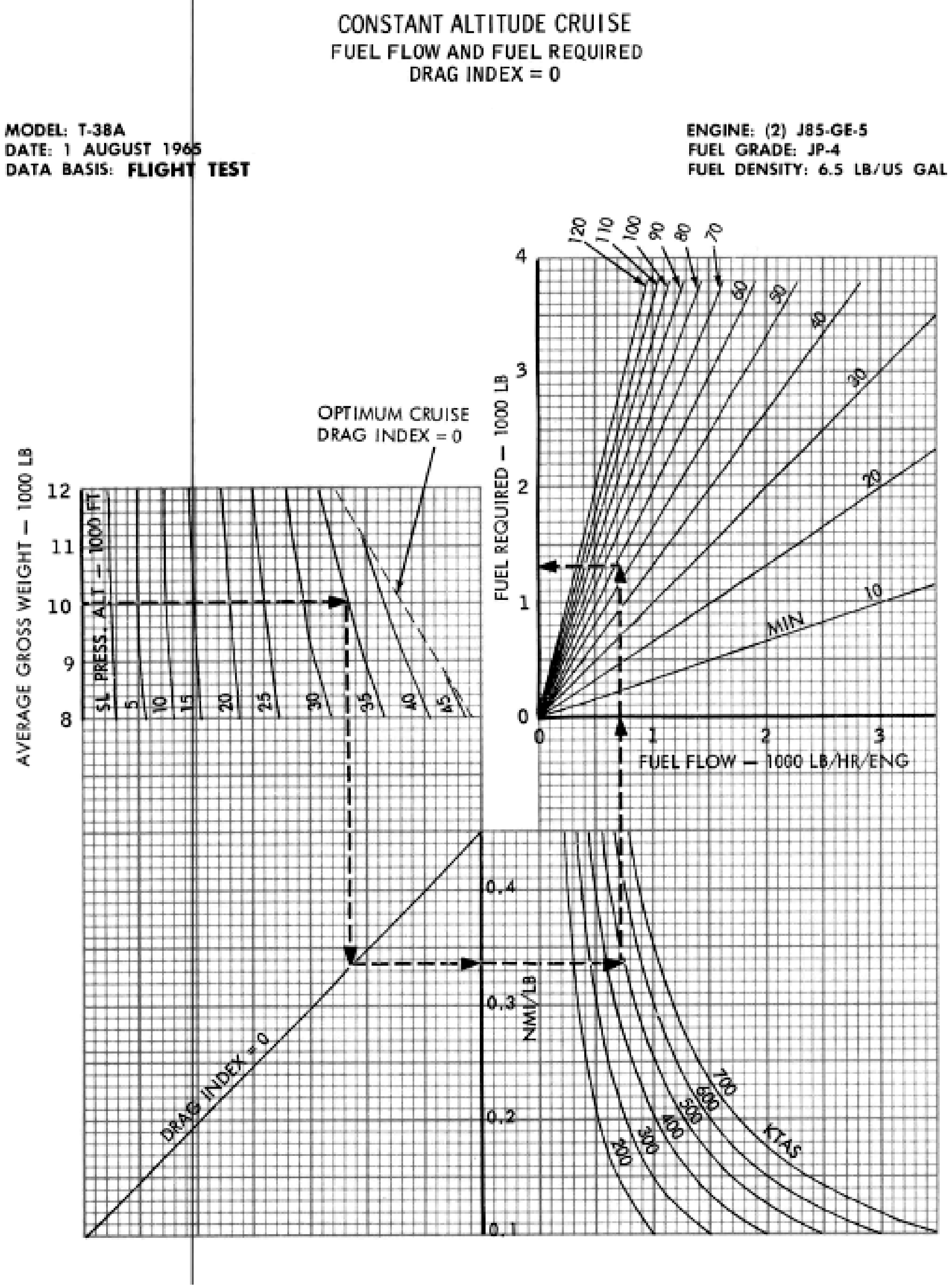

CONSTANT ALTITUDE CRUISE
FUEL FLOW AND FUEL REQUIRED
DRAG INDEX = 0
MODEL: T-38A
DATE: 1 AUGUST 1965
DATA BASIS: FLIGHT TEST
ENGINE: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL
OPTIMUM CRUISE
DRAG INDEX = 0
AVERAGE GROSS WEIGHT — 1000 LB
SL PRESS. ALT — 1000 FT
FUEL REQUIRED — 1000 LB
FUEL FLOW — 1000 LB/HR/ENG
MIN
NMI/LB
DRAG INDEX = 0
KTAS

Figure 123

CONSTANT ALTITUDE CRUISE

TIME AND AIRSPEED
DRAG INDEX = 0

SINGLE ENGINE

MODEL: T-38A
DATE: 1 AUGUST 1965
DATA BASIS: **FLIGHT TEST**

ENGINE: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

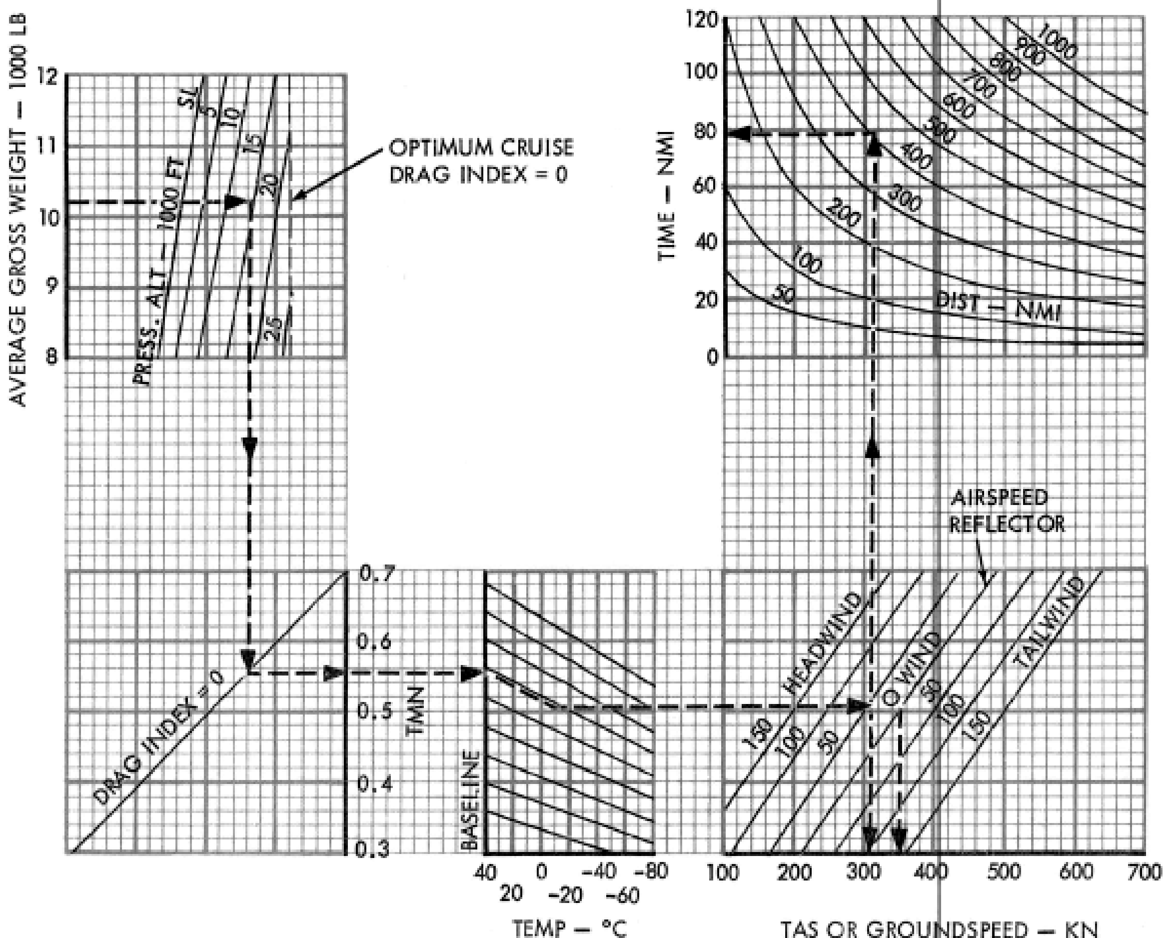


Figure 124

DIVERSION RANGE SUMMARY TABLE

CONSTANT ALTITUDE CRUISE
STANDARD DAY ZERO WIND
TWO ENGINE

MODEL: T-38A
DATE: 1 MARCH 1968
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

RANGE AND TIME REMAINING WITH 300-LB RESERVES AT SEA LEVEL												PROCEDURE
		INITIAL ALTITUDE										
FUEL	1000 FT	SL	5	10	15	20	25	30	35	40	45	
600 LB	NMI MIN	39 7	44 9	49 11	54 13	59 15	64 17	69 19	74 21	79 23	83 25	CRUISE AT INITIAL ALTITUDE TO BASE (1)
	1000 FT	10/25	15/30	20/35	25/35	25/40	30/40	35/45	40/45	40/45	45	OPTIMUM ALTITUDE
	NMI MIN	43 9	48 10	54 11	60 12	67 13	74 14	82 15	90 17	98 19	104 20	USE OPTIMUM ALTITUDE UNTIL OVER BASE (2)
	NMI MIN	70 12	79 13	89 15	99 16	109 18	120 19	132 20	145 21	156 23	163 25	USE OPTIMUM ALTITUDE AND DESCEND ON COURSE (3)
800 LB	NMI MIN	65 11	75 14	85 16	95 19	106 22	118 24	131 26	144 30	156 32	167 34	CRUISE AT INITIAL ALTITUDE TO BASE (1)
	1000 FT	25/35	25/40	30/40	30/45	35/45	40/45	40/45	40/45	45	45	OPTIMUM ALTITUDE
	NMI MIN	89 16	99 18	111 20	122 22	133 24	144 25	155 27	166 28	177 29	188 30	USE OPTIMUM ALTITUDE UNTIL OVER BASE (2)
	NMI MIN	136 22	150 23	164 24	178 26	191 27	203 29	215 30	227 32	238 33	247 34	USE OPTIMUM ALTITUDE AND DESCEND ON COURSE (3)
1000 LB	NMI MIN	91 15	105 19	119 22	134 25	152 29	171 32	191 35	213 39	236 42	252 45	CRUISE AT INITIAL ALTITUDE TO BASE (1)
	1000 FT	45	45	45	45	45	45	45	45	45	45	OPTIMUM ALTITUDE
	NMI MIN	162 27	174 28	187 30	201 31	215 33	227 35	238 36	245 38	260 39	271 40	USE OPTIMUM ALTITUDE UNTIL OVER BASE (2)
	NMI MIN	219 31	233 32	247 33	261 36	274 37	286 39	297 40	308 41	320 42	331 44	USE OPTIMUM ALTITUDE AND DESCEND ON COURSE (3)
1400 LB	NMI MIN	141 24	164 29	189 33	216 37	245 42	278 46	313 51	352 56	387 61	413 65	CRUISE AT INITIAL ALTITUDE TO BASE (1)
	1000 FT	45	45	45	45	45	45	45	45	45	45	OPTIMUM ALTITUDE
	NMI MIN	319 45	334 47	348 49	362 50	375 53	387 54	399 55	411 56	423 57	435 59	USE OPTIMUM ALTITUDE UNTIL OVER BASE (2)
	NMI MIN	377 50	394 52	408 54	422 55	435 56	448 58	452 59	468 60	482 62	495 64	USE OPTIMUM ALTITUDE AND DESCEND ON COURSE (3)
CRUISE ALT		SL	5	10	15	20	25	30	35	40	45	***Note*** WITH MORE THAN 1400 POUNDS FUEL, CRUISE AT 0.87 MACH, PRESSURE ALTITUDE 43,000 FEET.
CRUISE MACH NO.		0.54	0.56	0.60	0.64	0.68	0.73	0.77	0.81	0.85	0.87	
APPROX FUEL FLOW LB/HR/ENG		1400	1250	1100	1000	925	850	775	700	650	625	
DESCEND 240 KCAS IDLE (4)	NMI REMAINING		8	16	24	32	40	49	59	70	81	
	MIN REMAINING		2	4	5	7	8	9	11	12	14	
	FUEL REMAINING		312	328	340	352	363	375	386	397	407	

1. FUEL AND TIME INCLUDED FOR DESCENT AT DESTINATION WITHOUT DISTANCE CREDIT, SPEED BRAKE CLOSED.
2. TIME AND FUEL INCLUDED FOR CLIMB TO OPTIMUM ALTITUDE AND DESCENT AT DESTINATION; NO DISTANCE CREDIT FOR DESCENT TO SEA LEVEL DESTINATION, SPEED BRAKE OPEN.
3. TIME AND FUEL INCLUDED FOR CLIMB TO OPTIMUM ALTITUDE AND DESCENT AT DESTINATION; RANGE INCLUDES DISTANCE FOR ON-COURSE DESCENT TO SEA LEVEL DESTINATION, SPEED BRAKE CLOSED.
4. DESCENT DATA TABULATED FOR SPEED BRAKE CLOSED; WITH SPEED BRAKE OPEN, USE ONE-HALF OF THE VALUES.
5. CLIMB USING FOLLOWING MIL THRUST CLIMB SPEED SCHEDULE:

PRESS. ALT (1000 FT)	SL	5	10	15	20	25	30	35	40	45
TRUE MACH	0.75	0.76	0.78	0.79	0.81	0.83	0.84	0.86	0.87	0.87
KCAS	496	466	435	406	377	349	322	295	264	236

Figure 125

DIVERSION RANGE SUMMARY TABLE

CONSTANT ALTITUDE CRUISE
STANDARD DAY ZERO WIND

MODEL: T-38A
DATE: 1 MARCH 1968
DATA BASIS: **FLIGHT TEST**

SINGLE ENGINE

ENGINES: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

RANGE AND TIME REMAINING WITH 300-LB RESERVES AT SEA LEVEL

FUEL	1000 FT	INITIAL ALTITUDE SL	5	10	15	20	25	30	35	40	45	PROCEDURE
600 LB	NMI MIN	53 11	60 13	66 15	72 18	77 20	82 22	— —	— —	— —	— —	CRUISE AT INITIAL ALTITUDE TO BASE (1)
	1000 FT	0/10	5/15	10/20	15/25	20/25	25	25	25	25	25	OPTIMUM ALTITUDE
	NMI MIN	53 11	61 13	68 14	75 16	81 17	87 18	94 19	102 21	111 22	121 23	USE OPTIMUM ALTITUDE UNTIL OVER BASE (2)
	NMI MIN	67 13	78 15	89 17	100 19	111 20	120 21	129 22	138 24	147 25	156 26	USE OPTIMUM ALTITUDE AND DESCEND ON COURSE (3)
800 LB	NMI MIN	88 18	100 21	112 24	123 27	133 30	142 32	— —	— —	— —	— —	CRUISE AT INITIAL ALTITUDE TO BASE (1)
	1000 FT	5/10	10/15	15/20	20/25	20/25	25	25	25	25	25	OPTIMUM ALTITUDE
	NMI MIN	94 20	105 22	116 24	127 25	138 26	147 28	155 30	163 31	172 32	181 33	USE OPTIMUM ALTITUDE UNTIL OVER BASE (2)
	NMI MIN	105 22	125 24	142 26	156 28	168 30	179 32	189 33	198 34	207 35	216 36	USE OPTIMUM ALTITUDE AND DESCEND ON COURSE (3)
1000 LB	NMI MIN	122 25	140 29	157 33	173 36	188 39	202 42	— —	— —	— —	— —	CRUISE AT INITIAL ALTITUDE TO BASE (1)
	1000 FT	10/15	15/20	20/20	20/25	25	25	25	25	25	25	OPTIMUM ALTITUDE
	NMI MIN	143 29	157 31	171 33	184 25	195 37	205 38	214 40	223 41	232 42	241 43	USE OPTIMUM ALTITUDE UNTIL OVER BASE (2)
	NMI MIN	171 31	186 33	200 35	214 37	227 39	240 41	250 43	258 44	266 45	276 46	USE OPTIMUM ALTITUDE AND DESCEND ON COURSE (3)
1400 LB	NMI MIN	191 39	219 45	249 50	272 54	296 58	320 61	— —	— —	— —	— —	CRUISE AT INITIAL ALTITUDE TO BASE (1)
	1000 FT	15/20	15/20	20/25	20/25	25	25	25	25	25	25	OPTIMUM ALTITUDE
	NMI MIN	245 47	256 49	269 51	288 53	307 56	321 58	331 60	340 61	349 62	358 63	USE OPTIMUM ALTITUDE UNTIL OVER BASE (2)
	NMI MIN	281 51	297 53	313 55	329 57	344 59	357 61	367 62	377 63	387 64	397 65	USE OPTIMUM ALTITUDE AND DESCEND ON COURSE (3)
CRUISE ALT		SL	5	10	15	20	25	DESCEND TO 25,000 FT				
CRUISE MACH NO.		0.44	0.47	0.50	0.54	0.58	0.62	USE IDLE THRUST AND 240 KCAS WITH SPEED BRAKE CLOSED.				***Note*** WITH MORE THAN 1400 POUNDS FUEL, CRUISE AT 0.62 MACH, PRESSURE ALTITUDE 23,000 FEET.
APPROX FUEL FLOW LB/HR		1650	1550	1450	1375	1300	1250					
DESCEND 240 KCAS IDLE (4)	NMI REMAINING		8	16	24	32	40					
	MIN REMAINING		2	4	5	7	8					
	FUEL REMAINING		306	314	320'	326	332					

(1) FUEL AND TIME INCLUDED FOR DESCENT AT DESTINATION WITHOUT DISTANCE CREDIT, SPEED BRAKE CLOSED.
(2) TIME AND FUEL INCLUDED FOR CLIMB TO OPTIMUM ALTITUDE AND DESCENT AT DESTINATION; NO DISTANCE CREDIT FOR DESCENT TO SEA LEVEL DESTINATION, SPEED BRAKE OPEN.
(3) TIME AND FUEL INCLUDED FOR CLIMB TO OPTIMUM ALTITUDE AND DESCENT AT DESTINATION, RANGE INCLUDES DISTANCE FOR ON-COURSE DESCENT TO SEA LEVEL DESTINATION, SPEED BRAKE CLOSED.
(4) DESCENT DATA TABULATED FOR SPEED BRAKE CLOSED; WITH SPEED BRAKE OPEN, USE ONE-HALF OF THE VALUES.
5. CLIMB USING FOLLOWING MIL THRUST CLIMB SPEED SCHEDULE:

PRESS. ALT (1000 FT)	SL	5	10	15	20	25
TRUE MACH	0.43	0.46	0.49	0.52	0.56	0.59
KCAS	281	278	271	264	256	246.

Figure 126

PART 5 – ENDURANCE

PURPOSE OF CHARTS

The endurance charts provide a means of determining the optimum Mach number and the fuel required to loiter at a given altitude for a specified length of time. Data are presented for operation with clean configuration (drag index 0).

CONSTANT ALTITUDE ENDURANCE MAXIMUM ENDURANCE

The constant altitude maximum endurance charts are for two-engine and single-engine operation. They show the endurance performance in terms of average gross weight, bank angle, pressure altitude, and deviation of temperature from standard. Also, the optimum maximum endurance altitude is shown on each chart and represents the maximum endurance for a given weight and bank angle. When the fuel required is unknown, the average weight is obtained by successive approximations.

USE OF CONSTANT ALTITUDE MAXIMUM ENDURANCE CHARTS

The chase-thru lines on the chart represent an average gross weight of 9,800 pounds, bank angle of 20 degrees, pressure altitude of 20,000 feet, loiter time of 50 minutes, and a temperature deviation of 10°C colder than standard. These lines show a loiter speed of 246 KCAS, and 1,350 pounds of fuel required. The gross weight at start of loiter is 10,475 pounds (9,800 + 0.5 x 1,350).

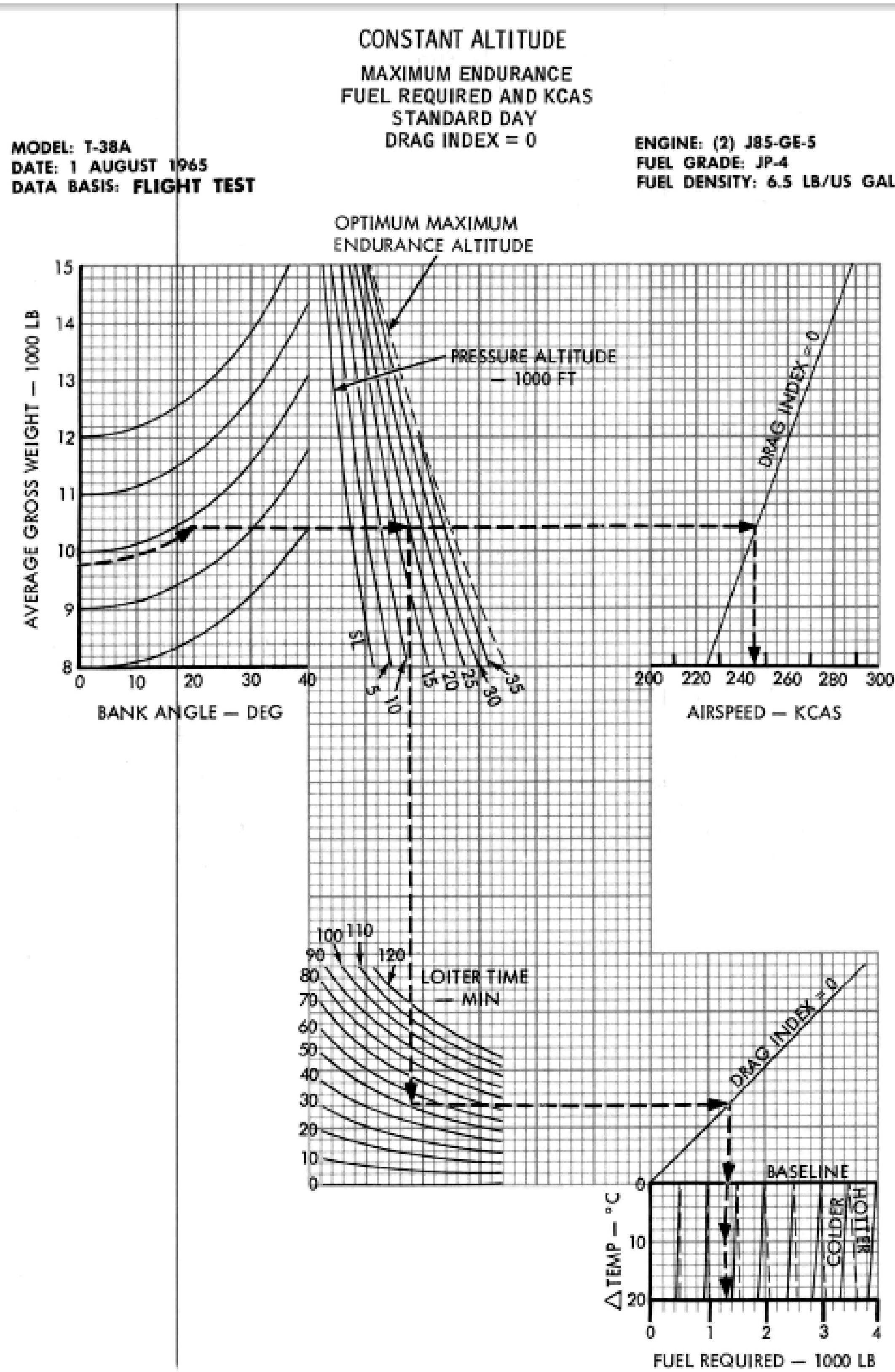

CONSTANT ALTITUDE
MAXIMUM ENDURANCE
FUEL REQUIRED AND KCAS
STANDARD DAY
DRAG INDEX = 0
MODEL: T-38A
DATE: 1 AUGUST 1965
DATA BASIS: FLIGHT TEST
ENGINE: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL
OPTIMUM MAXIMUM ENDURANCE ALTITUDE
PRESSURE ALTITUDE — 1000 FT
AVERAGE GROSS WEIGHT — 1000 LB
BANK ANGLE — DEG
DRAG INDEX = 0
AIRSPEED — KCAS
LOITER TIME — MIN
BASELINE
COLDER
HOTTER
△TEMP — °C
FUEL REQUIRED — 1000 LB

Figure 127

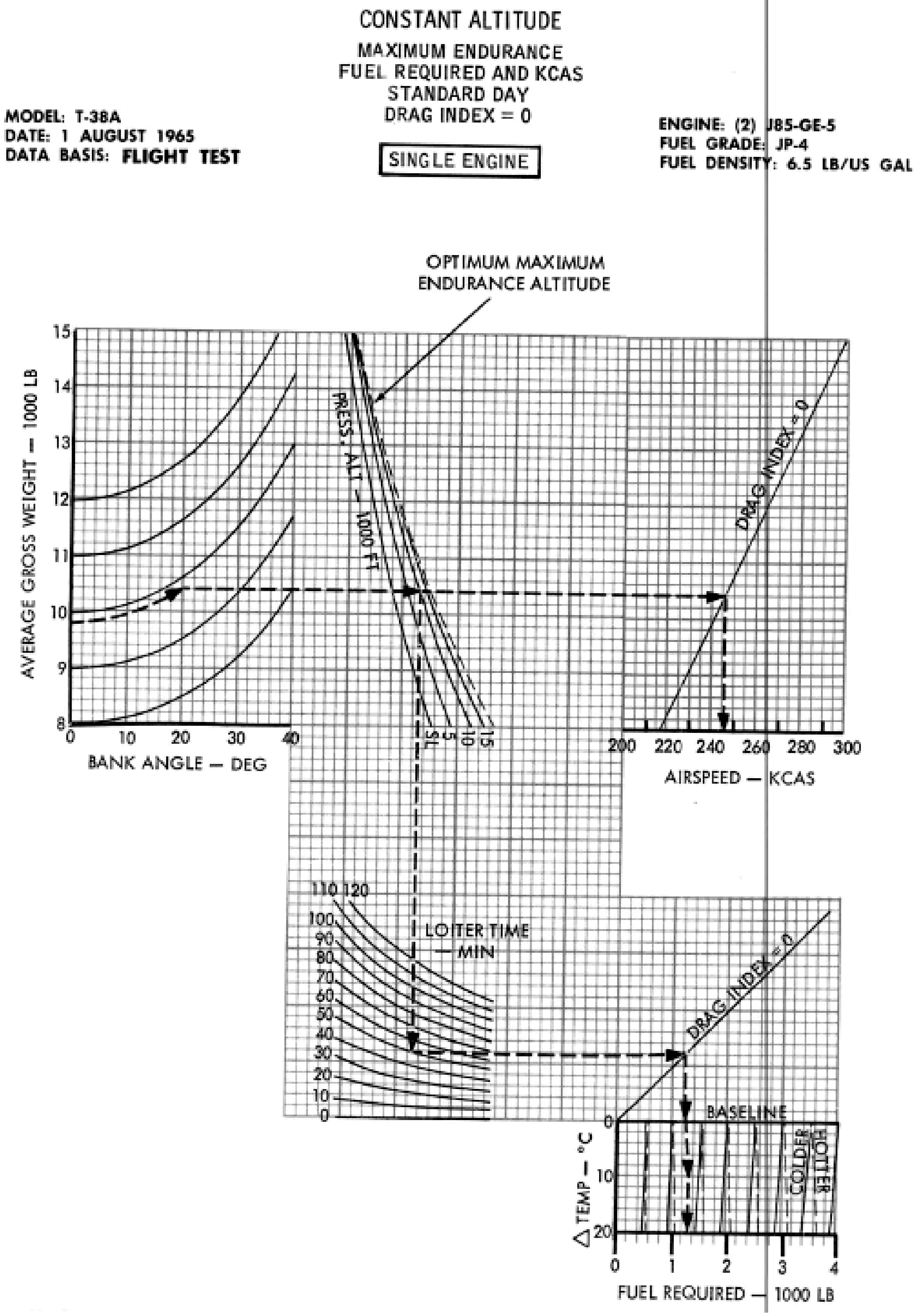

CONSTANT ALTITUDE
MAXIMUM ENDURANCE
FUEL REQUIRED AND KCAS
STANDARD DAY
DRAG INDEX = 0
MODEL: T-38A
DATE: 1 AUGUST 1965
DATA BASIS: FLIGHT TEST
SINGLE ENGINE
ENGINE: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL
OPTIMUM MAXIMUM ENDURANCE ALTITUDE
AVERAGE GROSS WEIGHT — 1000 LB
BANK ANGLE — DEG
PRESS. ALT — 1000 FT
SL
5
10
15
DRAG INDEX = 0
AIRSPEED — KCAS
LOITER TIME — MIN
DRAG INDEX = 0
BASELINE
COLDER
HOTTER
△ TEMP — °C
FUEL REQUIRED — 1000 LB

Figure 128

PART 6 – DESCENT

PURPOSE OF CHARTS

The descent charts provide a means of determining the fuel, time, and distance required to descend from altitude with speed brake closed or open. These charts are for operation with clean configuration (drag index of 0).

DESCENT CHARTS

The maximum range descent chart shows the performance for maximum range. This range is obtained by using idle thrust and maintaining an airspeed of 240 KCAS. The chart gives the performance for penetration descent. This chart requires 80% RPM and an airspeed of 280 KCAS. The descent charts may be used for descending from one altitude to another by reading the incremental values between the initial and final altitudes.

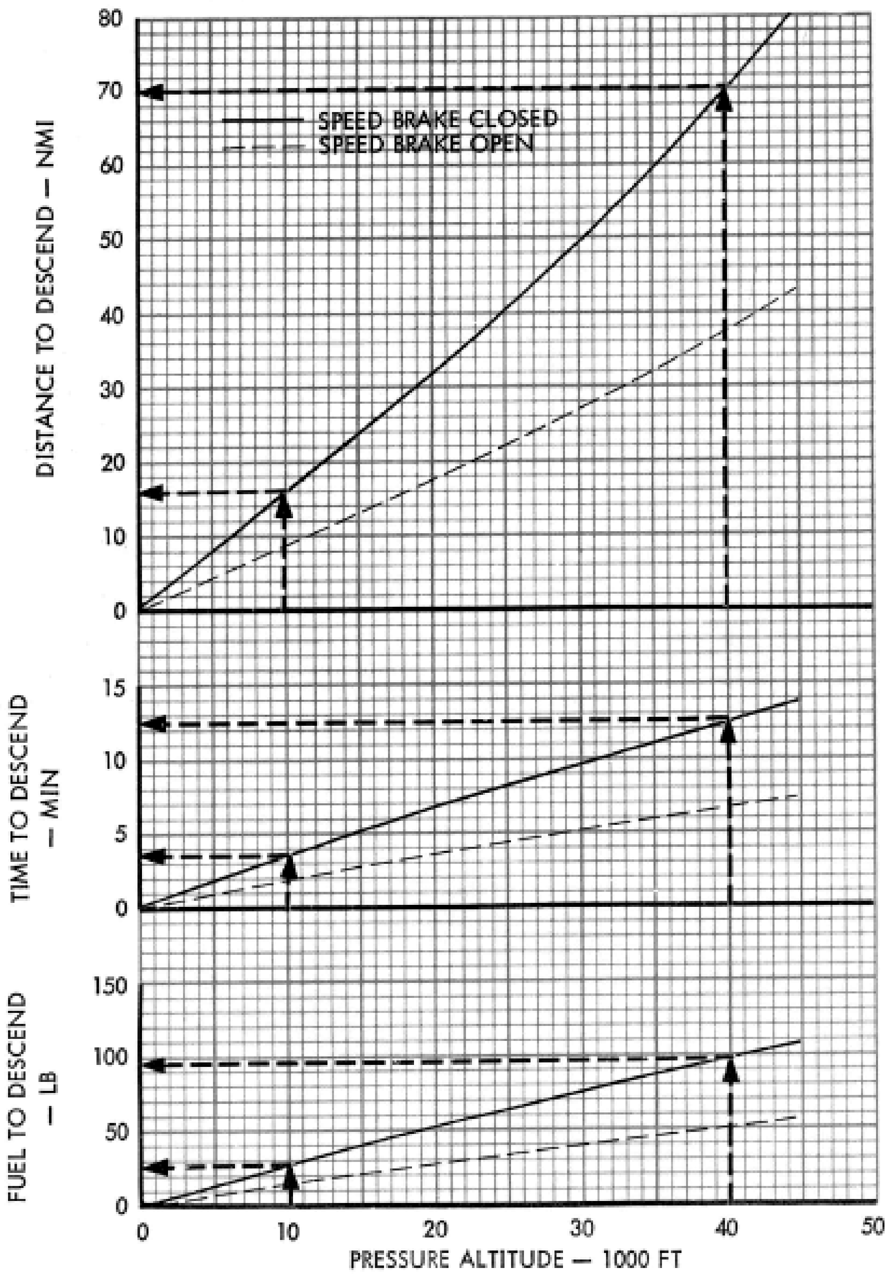
USE OF DESCENT CHARTS

Assume that maximum range descent is desired from a pressure altitude of 40,000 feet to 10,000 feet. From the chart, with speed brake closed, the chase-thru lines show the fuel to descend is 70 pounds (98 – 28), the time in 9 minutes (12.5 – 3.5), and the distance is 54 nautical miles (70 – 16).

MAXIMUM RANGE DESCENT
IDLE THRUST 240 KCAS
STANDARD DAY
DRAG INDEX = 0

MODEL: T-38A
DATE: 1 AUGUST 1965
DATA BASIS: FLIGHT TEST

ENGINE: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL



Note

IF ONE ENGINE IS WINDMILLING, FUEL USED IS REDUCED BY A FACTOR OF 2; ALL OTHER PARAMETERS REMAIN UNCHANGED.

Figure 129

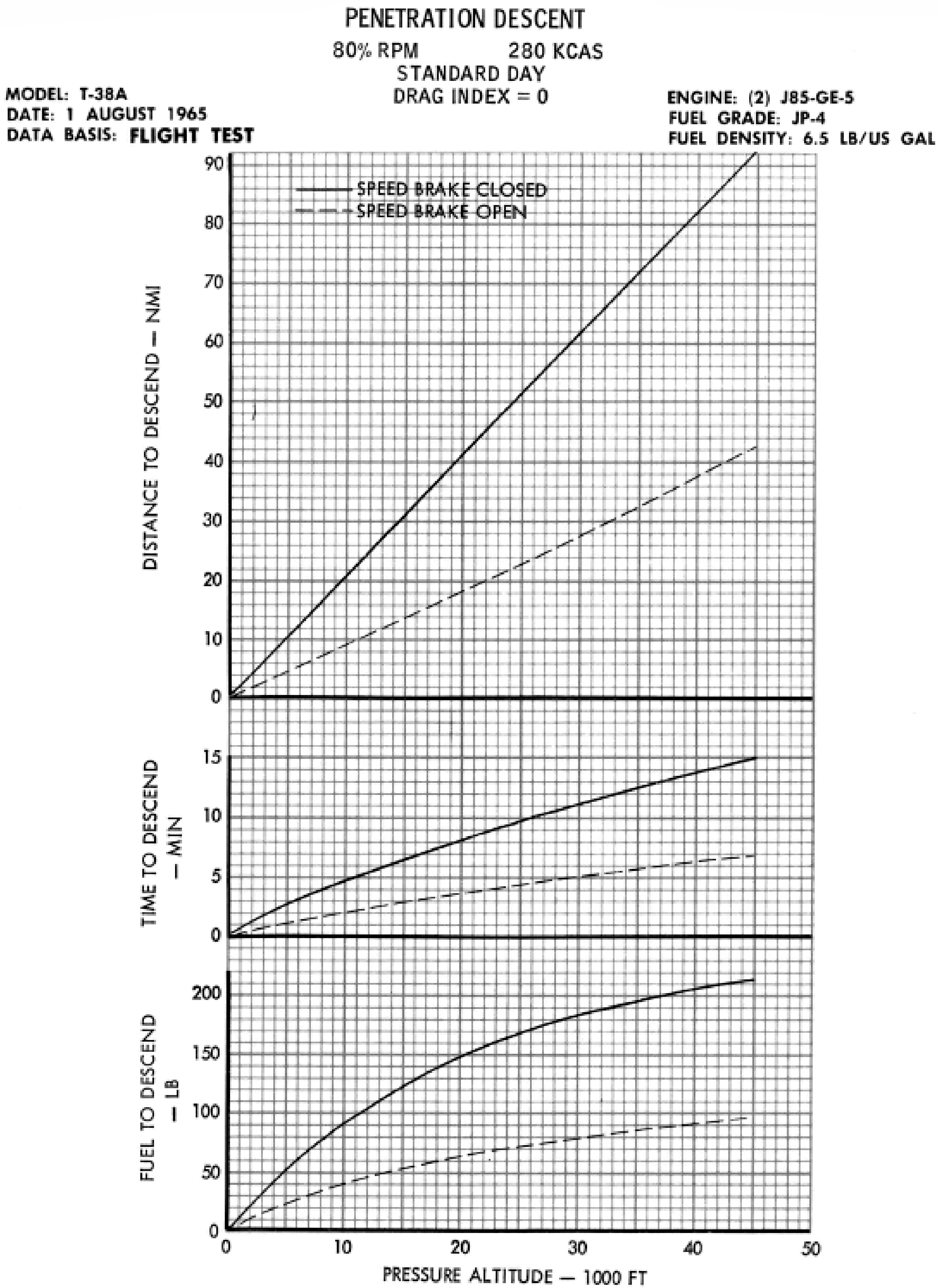

PENETRATION DESCENT
80% RPM 280 KCAS
STANDARD DAY
DRAG INDEX = 0
MODEL: T-38A
DATE: 1 AUGUST 1965
DATA BASIS: FLIGHT TEST
ENGINE: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL
SPEED BRAKE CLOSED
SPEED BRAKE OPEN
DISTANCE TO DESCEND — NMI
0
10
20
30
40
50
60
70
80
90
TIME TO DESCEND — MIN
0
5
10
15
FUEL TO DESCEND — LB
0
50
100
150
200
PRESSURE ALTITUDE — 1000 FT
0
10
20
30
40
50

Figure 130

PART 7 – LANDING

LANDING DISTANCE

The landing distance charts show ground roll distance, total distance from 50-foot obstacle, 50-foot obstacle speed, and landing speeds. The ground roll distance and total distance from 50-foot obstacle are based on full flaps (100%) for a dry, hard surfaced runway, and are a function of runway air temperature, pressure altitude, gross weight, and wind velocity. The total landing distance shown to clear a 50-foot obstacle for a minimum or normal landing distance is based on passing over the obstacle 10 knots less than final approach speed at a 3-degree flight path angle to the point of flare initiation before touchdown.

The pressure altitude of the landing runway can be determined by setting the altimeter to 29.92, which is sea level standard day pressure in inches of mercury.

The normal landing distance chart and the minimum landing distance chart show data for landing, using the appropriate chart landing speeds, maintain a 12-degree nose high attitude until 100 knots before lowering the nosewheel to the runway, and applying optimum braking.

If the landing technique differs, landing distances will vary from those given in the charts. A 5-percent variation in touchdown speed causes approximately a 10-percent variation in landing distance and insufficient braking will further increase the ground roll distance.

LANDING SPEED

The landing speed chart in each landing distance chart shows the final approach speed, speed at the 50-foot obstacle, and touchdown speed as a function of gross weight. The landing speeds in the normal landing distance chart are compatible with the normal landing patter speed rule in Section 2 of this POH, which indicates that final turn, final approach, and touchdown speeds be increased 1 knot for each 100 pounds of fuel above 1,000 pounds of fuel remaining.

USE OF LANDING DISTANCE CHART

The chase-thru lines in the landing distance chart show a landing with two engines operating, with a runway air temperature of 15^{o}C at 2,000 feet pressure altitude, a gross weight of 9,000 pounds, and a 20-knot headwind. These conditions require a final approach speed of 155 KIAS, touchdown speed of 130 KIAS, a ground roll of 2,700 feet, and a total distance of 4,100 feet from a 50-foot obstacle to the end of the ground roll.

EFFECT OF RUNWAY CONDITION (RCR) ON GROUND ROLL DISTANCE

The chart provides the means of correcting the landing ground roll distance for the effect of various runway surface conditions. The corrections are shown as a function of Runway Condition Reading (RCR), which is a number indicating the degree of braking effectiveness available during the ground roll. The RCR number for the existing runway condition at a particular field is available from base operations.

USE OF THE CORRECTION CHART FOR RUNWAY SURFACE CONDITIONS

Using the ground roll distance of 2,700 feet for a dry, hard surfaced runway and an RCR of 12, the chase-thru lines in the chart show 3,600 feet required for this runway condition.

SINGLE-ENGINE THRUST REQUIRED AND AVAILABLE

The single-engine thrust required and available chart shows thrust required and available versus airspeed for go-around configuration with 60% flaps and gear down. The chart is for several weights and temperatures from sea level to 6,000 feet, and includes both single-engine MAX and MIL thrusts.

USE OF SINGLE-ENGINE THRUST REQUIRED AND AVAILABLE CHART

Assume an airspeed of 160 KIAS, a weight of 11,000 pounds, and an ambient temperature of 30°C with MAX thrust. The chase-thru lines in the chart show the thrust required is 2,230 pounds for all altitudes, and the thrust available is 2,810 pounds at sea level. When the pressure altitude is 2,000 feet, the thrust available is 2,625 pounds.

EFFECT OF BANK ANGLE ON VERTICAL VELOCITY

The effect of bank angle on vertical velocity charts show the climb capability of the aircraft as a function of ambient temperature, gross weight (fuel remaining), bank angle, and thrust setting. One chart shows two-engine and single-engine performance for the MIL thrust settings and the second chart shows two-engine and single-engine performance for MAX thrust settings. Both charts are for landing gear extended and 60% flaps, which is the recommended flap setting for single-engine approaches. The two engine charts are for comparison purposes and are based on a 60% flap setting.

The rate-of-climb determined from the charts is valid only for the recommended approach turn speed, which may be computed from the curve in the upper left corner of each chart.

USE OF EFFECT OF BANK ANGLE ON VERTICAL VELOCITY CHARTS

Assume a pattern altitude of 2,200 feet, ambient temperature of 25^{o}C, and 1,000 pounds of fuel remaining. Entering the MIL thrust, single-engine chart, the chase-thru lines show an approach turn speed of 175 KIAS. Re-entering the chart at an ambient temperature of 25^{o}C the chase-thru lines show a climb capability of 300 FPM with a 0 degree bank angle.

If a 30 degree bank angle were used in turn, the chase-thru lines show a negative climb capability of -300 FPM in the gray area. In the MAX thrust, single-engine chart, for the same conditions, the chase-thru lines show a 2,300 FPM climb capability at 0 degree bank angle and a 1,700 FPM climb capability at a 30 degree bank angle.

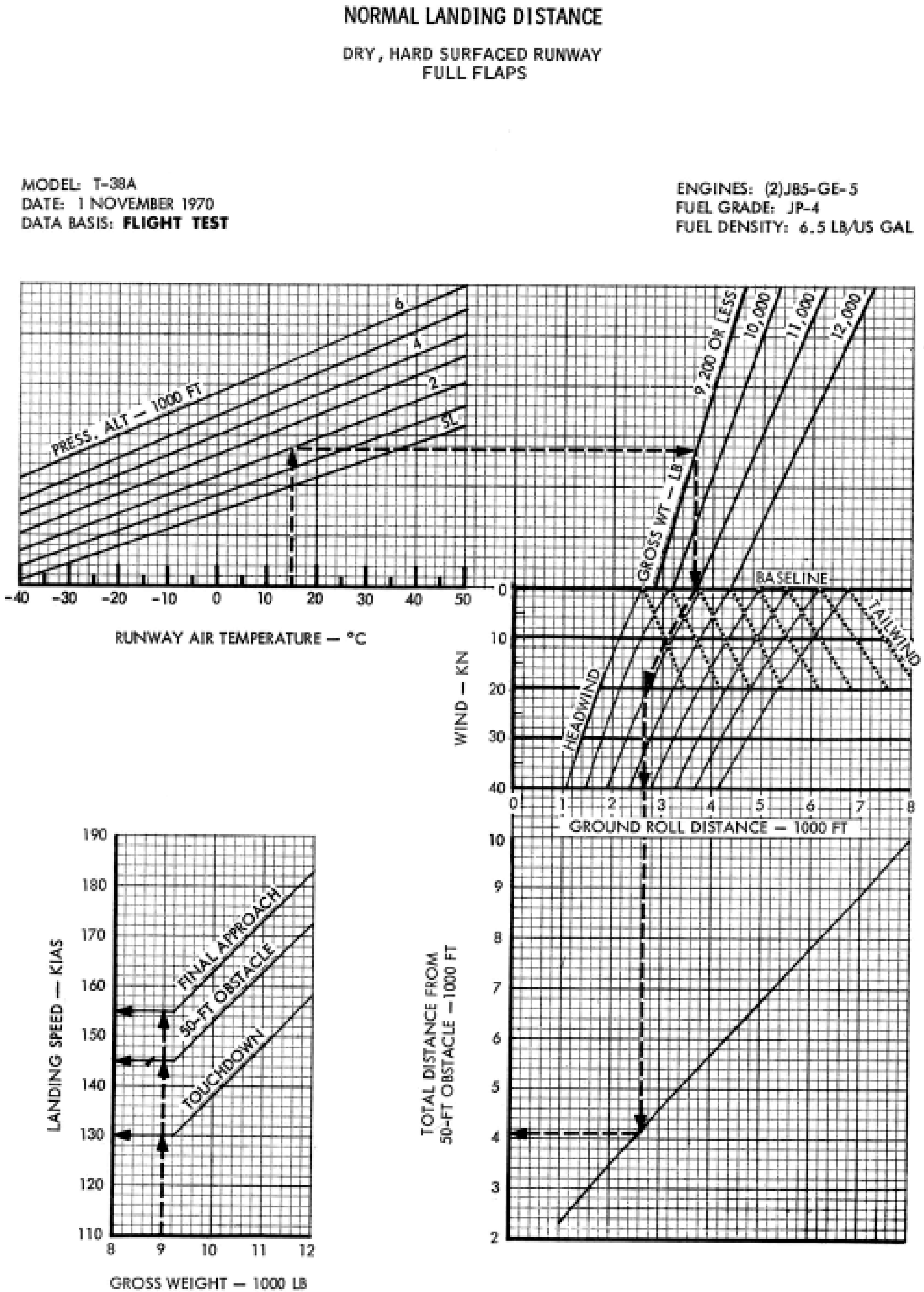

NORMAL LANDING DISTANCE
DRY, HARD SURFACED RUNWAY
FULL FLAPS
MODEL: T-38A
DATE: 1 NOVEMBER 1970
DATA BASIS: FLIGHT TEST
ENGINES: (2)J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL
PRESS. ALT — 1000 FT
6
4
2
SL
9,200 OR LESS
10,000
11,000
12,000
GROSS WT — LB
BASELINE
TAILWIND
HEADWIND
-40 -30 -20 -10 0 10 20 30 40 50
RUNWAY AIR TEMPERATURE — °C
WIND — KN
0 10 20 30 40
0 1 2 3 4 5 6 7 8
GROUND ROLL DISTANCE — 1000 FT
TOTAL DISTANCE FROM 50-FT OBSTACLE —1000 FT
10 9 8 7 6 5 4 3 2
LANDING SPEED — KIAS
190 180 170 160 150 140 130 120 110
FINAL APPROACH
50-FT OBSTACLE
TOUCHDOWN
8 9 10 11 12
GROSS WEIGHT — 1000 LB

Figure 131

MINIMUM LANDING DISTANCE

DRY, HARD SURFACED RUNWAY
FULL FLAPS

MODEL: T-38A
DATE: 1 AUGUST 1965
DATA BASIS: **FLIGHT TEST**

ENGINES: (2)J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

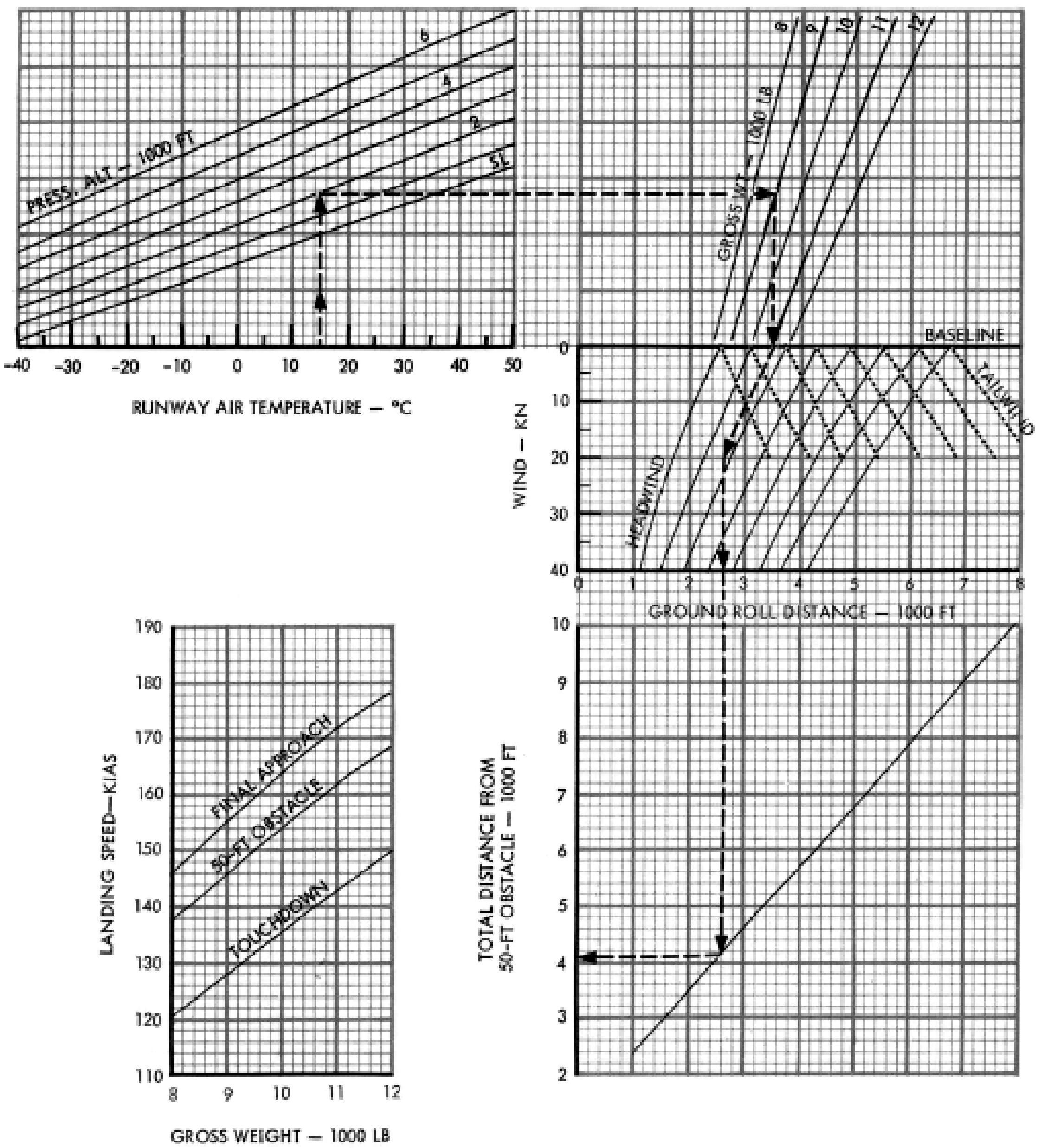


Figure 132

EFFECT OF RUNWAY CONDITION (RCR)

ON GROUND ROLL DISTANCE
FULL FLAPS

MODEL: T-38A
DATE: 1 AUGUST 1965
DATA BASIS: **FLIGHT TEST**

ENGINE: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

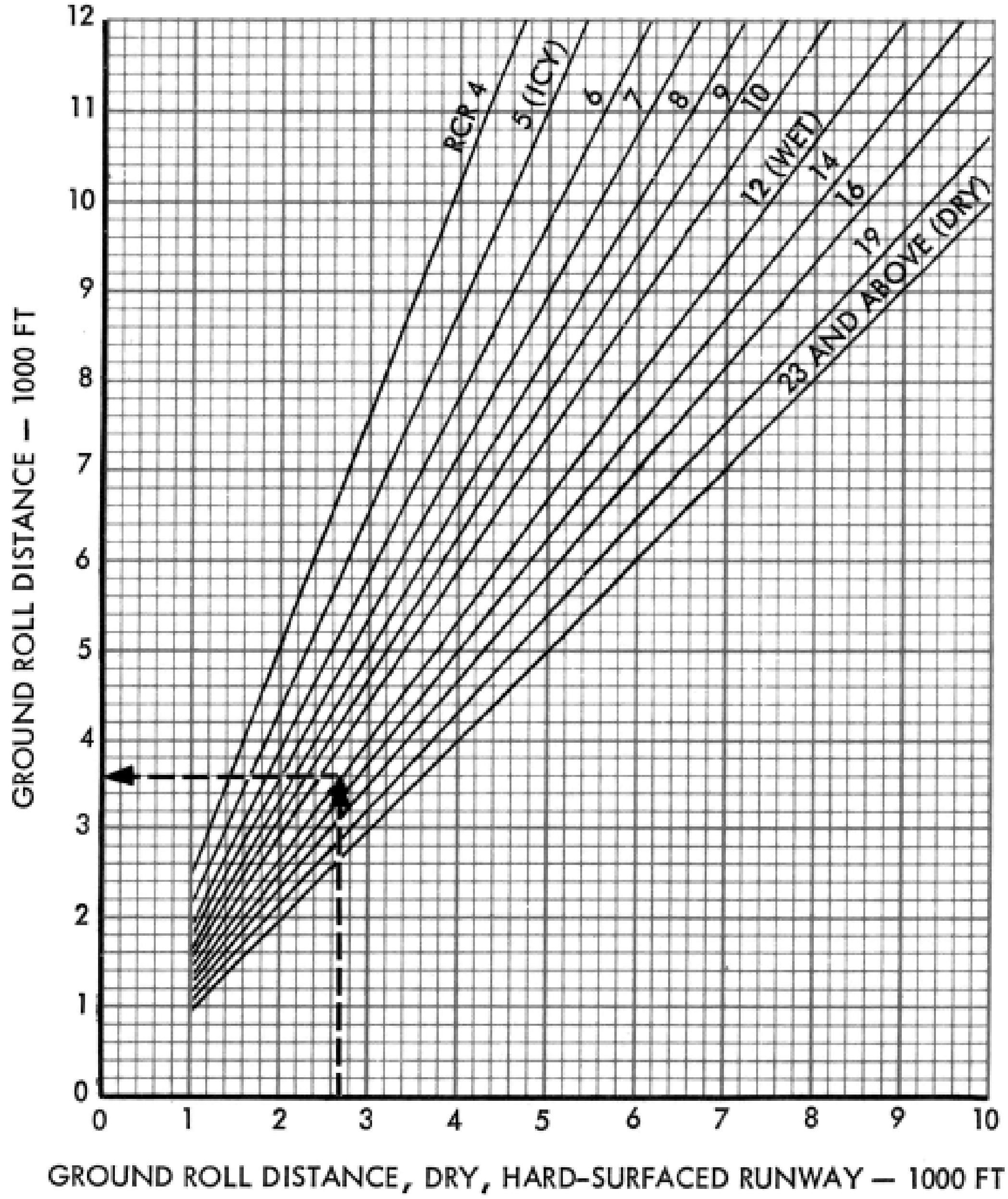


Figure 133

SINGLE-ENGINE THRUST REQUIRED AND AVAILABLE

WITH 60% FLAPS AND GEAR DOWN
SEA LEVEL TO 6000 FEET

MODEL: T-38A
DATE: 1 AUGUST 1965
DATA BASIS: **FLIGHT TEST**

ENGINE: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

———— THRUST REQUIRED FOR CONSTANT SPEED LEVEL FLIGHT, ALL ALTITUDES & TEMPERATURES
— — — MAXIMUM THRUST AVAILABLE AT SEA LEVEL
- — - — - MILITARY THRUST AVAILABLE AT SEA LEVEL

Note

DECREASE SEA LEVEL THRUST AVAILABLE BY 3.3% FOR EACH 1000 FEET INCREASE IN PRESSURE ALTITUDE.

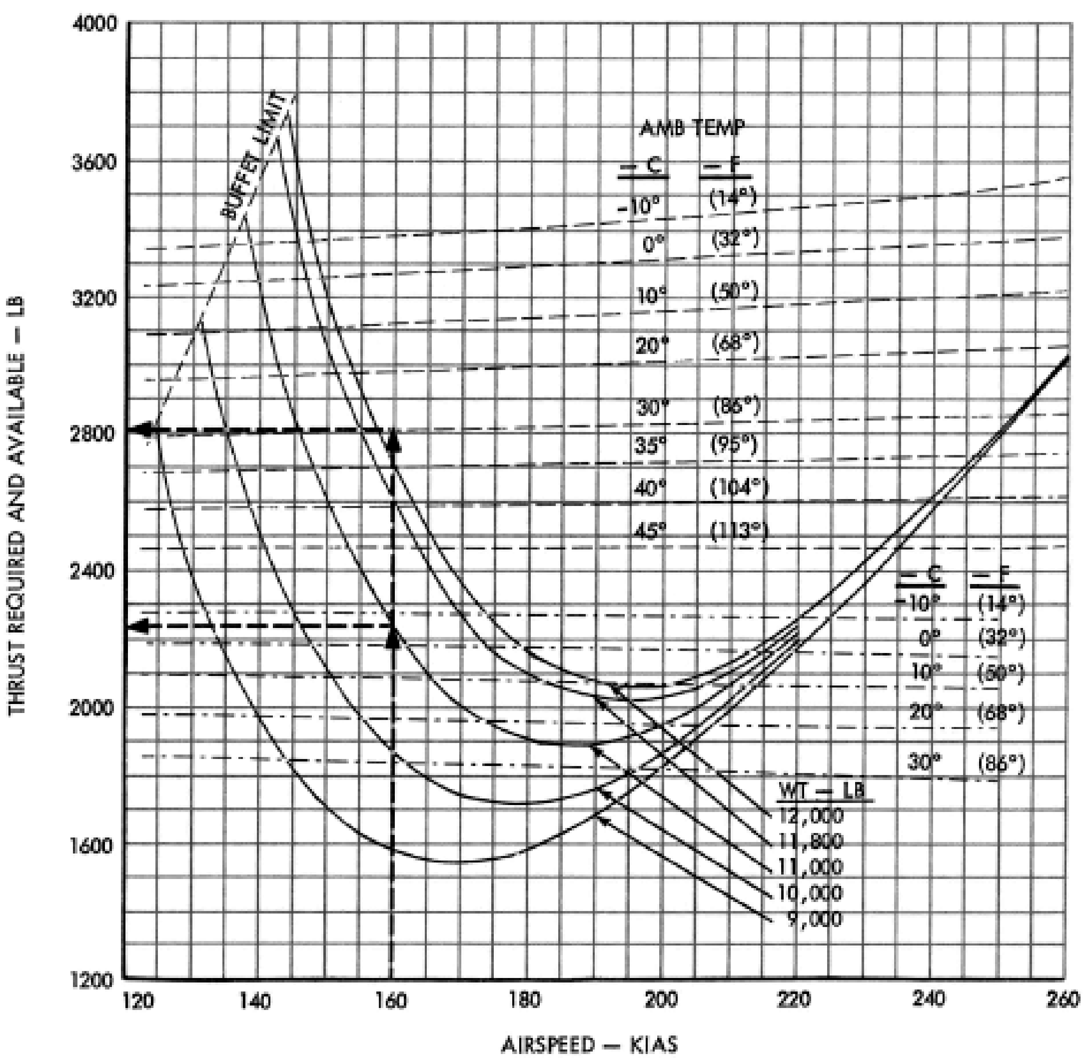


Figure 134

EFFECT OF BANK ANGLE ON VERTICAL VELOCITY

MIL THRUST
WITH 60% FLAPS AND GEAR DOWN

MODEL: T-38A
DATE: 1 APRIL 1969
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

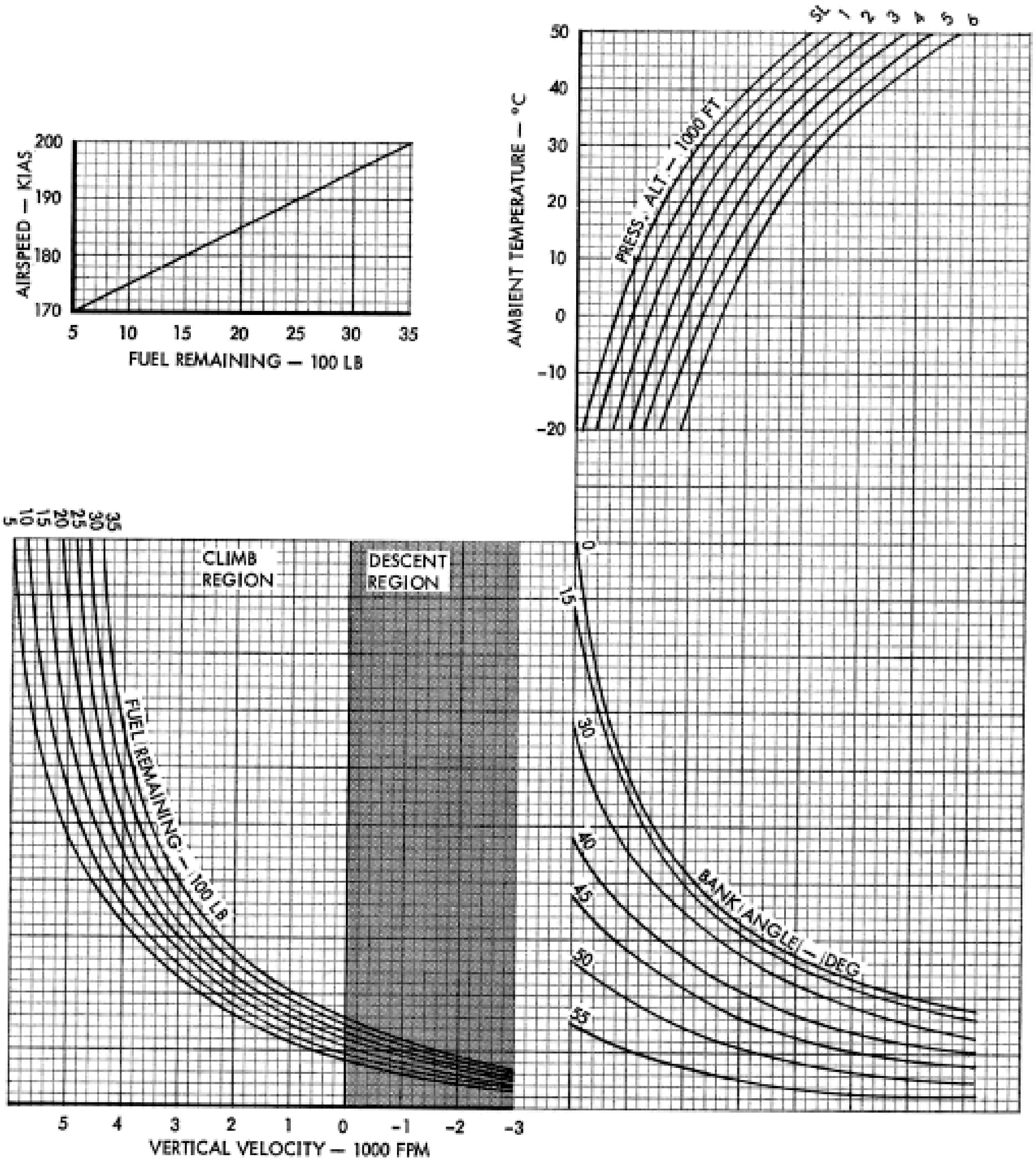


Figure 135

EFFECT OF BANK ANGLE ON VERTICAL VELOCITY

MAX THRUST
WITH 60% FLAPS AND GEAR DOWN

MODEL: T-38A
DATE: 1 APRIL 1969
DATA BASIS: **FLIGHT TEST**

ENGINES: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL

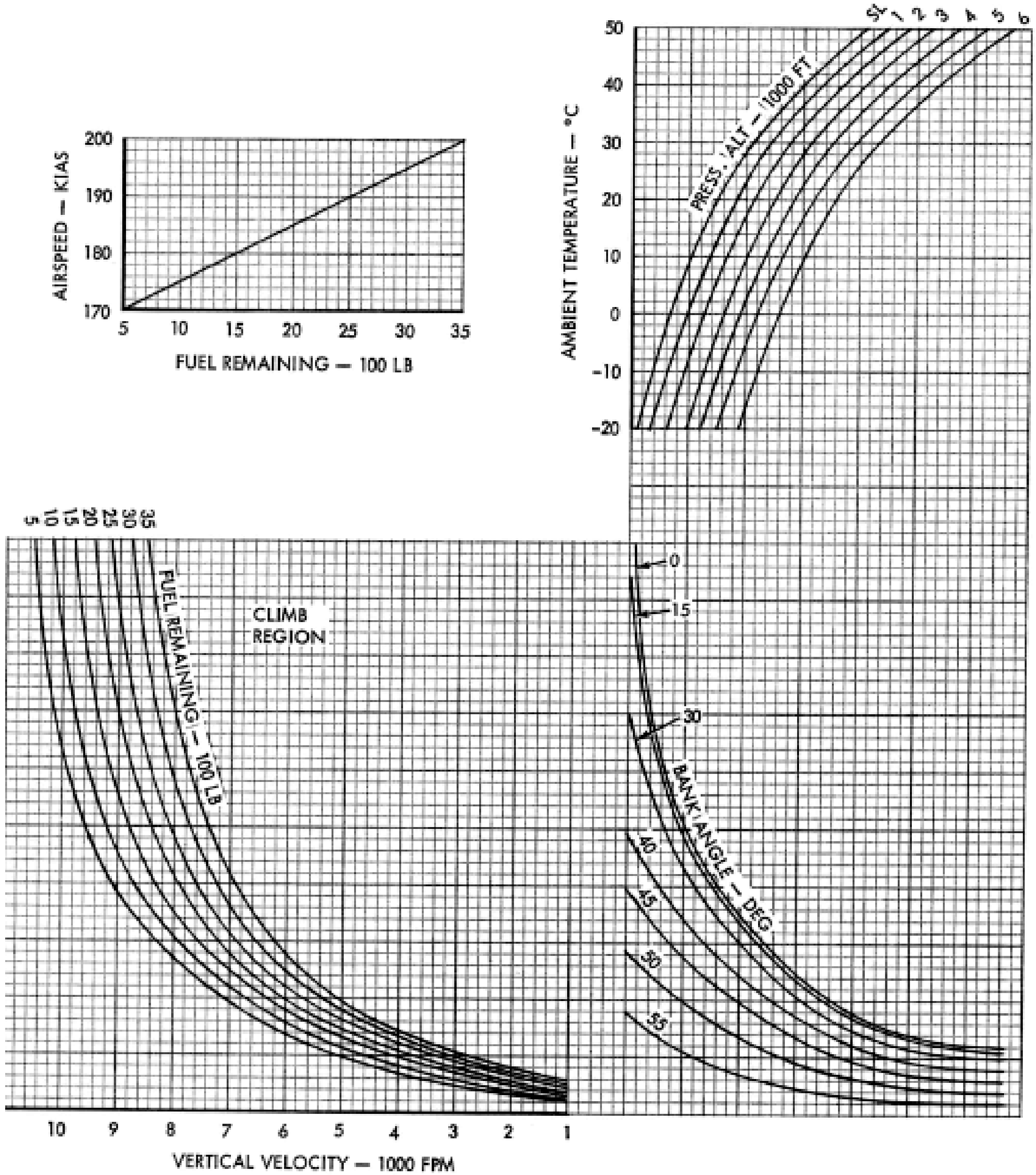


Figure 136

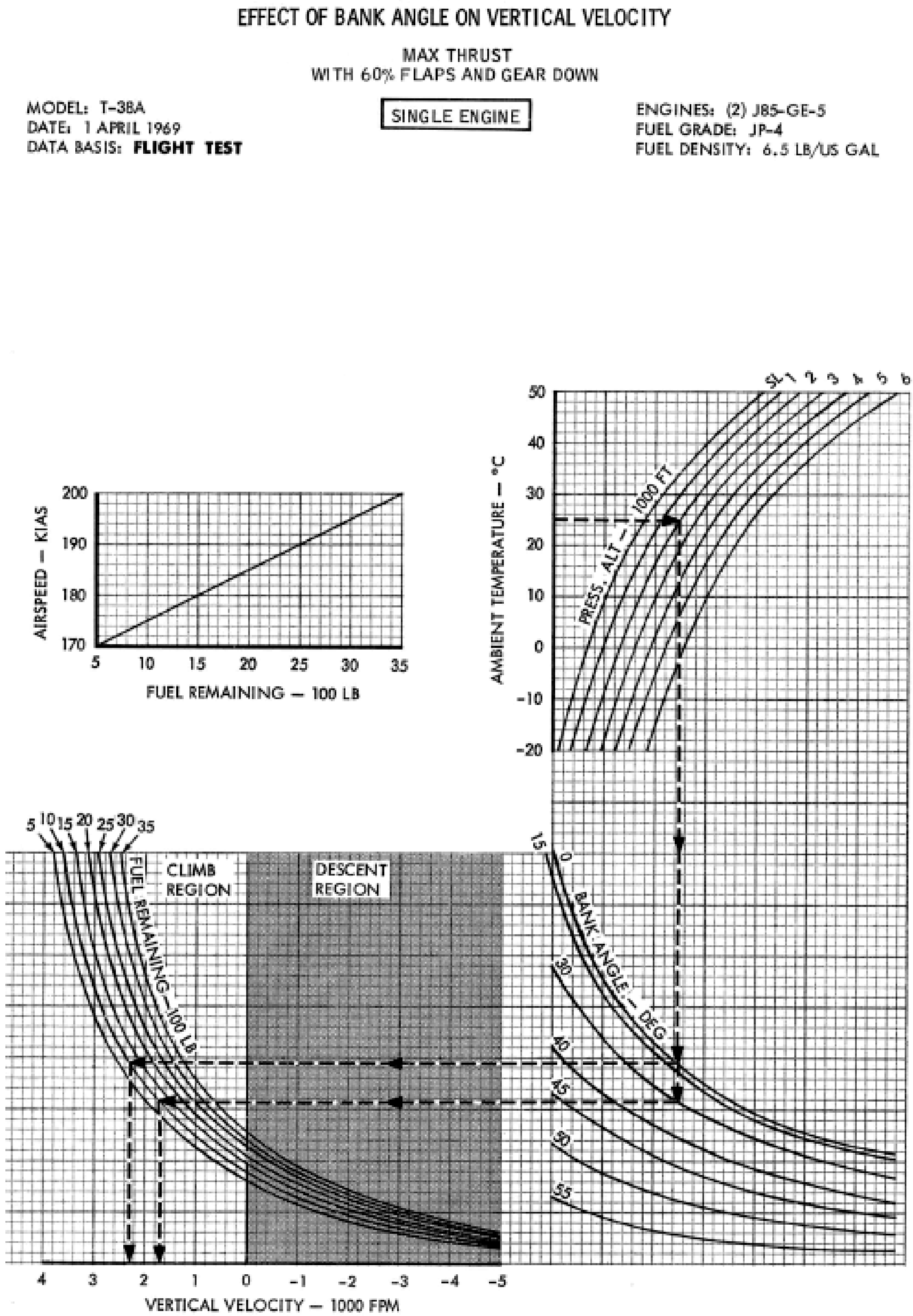

EFFECT OF BANK ANGLE ON VERTICAL VELOCITY
MAX THRUST
WITH 60% FLAPS AND GEAR DOWN
MODEL: T-38A
DATE: 1 APRIL 1969
DATA BASIS: FLIGHT TEST
SINGLE ENGINE
ENGINES: (2) J85-GE-5
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/US GAL
AIRSPEED — KIAS
FUEL REMAINING — 100 LB
AMBIENT TEMPERATURE — °C
PRESS. ALT — 1000 FT
SL 1 2 3 4 5 6
CLIMB REGION
DESCENT REGION
FUEL REMAINING—100 LB
BANK ANGLE — DEG
VERTICAL VELOCITY — 1000 FPM

Figure 137

PART 8 – MISSION PLANNING

PURPOSE OF MISSION PLANNING

Mission planning can be termed preflight planning. The purpose of preflight planning is to obtain optimum performance from the aircraft for any specific mission. Optimum performance will vary, for example, from maximum time on station to maximum radius with no time on station. Exact requirements will vary, depending upon the type of missions to be flown.

MISSION PLANNING SAMPLE PROBLEM

The following problem is an exercise in the use of the performance charts. It is not intended to reflect actual or proposed missions employing this aircraft on a typical cross country flight.

FLIGHT PLAN DATA

A mission profile is to be flown, assuming the following conditions:

1. Takeoff data.
    a. Takeoff weight (solo) – 11,800 lbs.
    b. Wind – 10-knot headwind.
    c. Runway temperature – 15°C.
    d. Pressure altitude – 4,000 ft.
    e. Runway – 7,000 ft.
    f. RCR – 12.
2. Climb data to 35,000 ft.
    a. Temperature deviation from standard -- +10°C.
    b. Wind – 15-knot headwind.
3. 35,000 ft cruise data.
    a. Temperature -- -46°C.
    b. Wind – 50-knot headwind.
    c. Speed – Optimum.
4. Descent data to 3,000 ft.
    a. Temperature deviation from standard – Zero.
    b. Wind – 15-knot tailwind.
5. Enter pattern 1,000 feet above terrain with 1,000 pound fuel reserve.
6. Landing data.
    a. Landing weight – 9,000 pounds.
    b. Wind – 20-knot headwind.
    c. Temperature – 15°C.

d. Pressure altitude – 2,000 feet.
e. Runway length – 7,000 feet.
f. RCR – 12.

TAKEOFF

1. MAX thrust takeoff factor – 3.45.
2. Takeoff speed – 154 KIAS.
3. Takeoff distance – 3,040 feet.
4. Critical field length:
    a. RCR 23 – 5,800 feet.
    b. RCR 12 – 6,500 feet.
5. Critical engine failure speed:
    a. RCR 23 – 132 KIAS.
    b. RCR 12 – 112 KIAS.
6. Acceleration check speed at 1,500 feet from brake release:
    a. Normal – 110 KIAS.
    b. Minimum – 108 KIAS.
7. Single-engine takeoff speed – 162 KIAS.
8. Refusal speed:
    a. RCR 23 – 143 KIAS
    b. RCR 12 – 116 KIAS

INITIAL CLIMB FROM 4,000 FEET TO FLIGHT LEVEL 360

(Using MIL Thrust Climb Chart)

1. Aircraft weight at start of climb is 11,800 pounds minus the allowance for taxi, takeoff, and acceleration to climb speed – 11,500 pounds.
2. Obtain time to climb, fuel to climb, and climb range
    a. Time – 7.6 min.
    b. Fuel – 510 pounds.
    c. Range – 64nm.
3. Compute distance lost due to headwind – 2nm.
4. Adjusted climb range – 62nm.
5. Weight at level-off – 10,990lb.

PENETRATION DESCENT TO 3,000 FEET, SPEED BRAKE OPENED (280 KCAS, 80% RPM)

1. Obtain time, fuel, and no wind range:
    a. Fuel – 70lb.

   b. Time – 5.0min.
   c. Range – 30nm.
2. Compute distance gained due to tailwind – 1nm.
3. Compute ground range – 31nm.
4. Weight at end of descent – 9,010lb.

AVERAGE GROSS WEIGHT

1. Weight at beginning of cruise – 10,990lb.
2. Weight at end of cruise – 9,080lb.
3. Compute fuel for cruise – 1,980lb.
4. Average weight – 10,000lb.

CRUISE AT FLIGHT LEVEL 350

(Using Cruise chart)

1. Maximum range Mach number – 0.83.
2. Basic reference number – 4.
3. Nautical miles per pound – 0.338.
4. True airspeed – 485 knots.
5. Fuel flow lb/hr/eng. – 715.
6. Groundspeed – 435 knots.
7. Time – 83 minutes.
8. Ground distance – 602nm.

CRUISE AT FLIGHT LEVEL 350

(Using Constant Altitude Cruise chart)

1. True Mach number – 0.83.
2. True airspeed – 485 knots.
3. True groundspeed – 435 knots.
4. Fuel flow lb/hr/eng. – 715.
5. Time – 83 minutes.
6. Ground distance – 602nm.

LANDING

(Using Normal Landing Distance chart)

1. Final turn speed – 175 KIAS.
2. Final approach speed – 158 KIAS.

3. Speed at 50-ft. obstacle – 145 KIAS.
4. Touchdown speed – 130 KIAS.
5. Ground roll distance:
    a. RCR 23 – 2,700 feet.
    b. RCR 12 – 3,600 feet.

MISSION SUMMARY

1. Total time – 95.6 minutes.
2. Total range – 695nm.

TAKEOFF AND LANDING DATA CARD

The takeoff and landing data card is included in the Flight Crew Checklist normal procedures. The takeoff and landing data was computed during mission planning from Part 2 and Part 7 respectively. The landing weight for immediately after takeoff is the takeoff gross weight less an average fuel allowance of 300 pounds for takeoff and go-around. Landing immediately after takeoff for the conditions stated in the mission planning takeoff data is computed as follows:

LANDING (Immediately After Takeoff)

1. Landing gross weight – 11,500 pounds.
2. Final turn speed – 198 KIAS.
3. Final approach speed – 178 KIAS.
4. Touchdown speed – 153 KIAS.
5. Ground roll distance:
    a. RCR 23 – 5,100 feet.
    b. RCR 12 – 6,800 feet.

The takeoff and landing information for mission planning is entered on the data card as a ready reference for review prior to takeoff and landing as shown in Figure 138.

TAKEOFF & LANDING DATA CARD

CONDITIONS

RUNWAY LENGTH	7000	FT
WIND COMPONENT	10 HW	KN
RUNWAY TEMPERATURE	15	°C
PRESSURE ALTITUDE	4000	FT

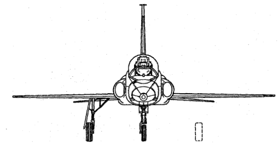
TAKEOFF

ACCELERATION CHECK	108	KIAS	1500	FT
CRITICAL ENGINE FAILURE SPEED			112	KIAS
REFUSAL SPEED			116	KIAS
SINGLE-ENGINE TAKEOFF SPEED			162	KIAS
TAKEOFF DISTANCE			3050	FT

LANDING

		IMMEDIATELY AFTER TAKEOFF		FINAL	
FINAL TURN SPEED		198	KIAS	175	KIAS
FINAL APPROACH SPEED		178	KIAS	155	KIAS
TOUCHDOWN SPEED		153	KIAS	130	KIAS
GROUND ROLL:	DRY	5100	FT	2700	FT
	WET	6800	FT	3600	FT

Figure 138



APPENDIX 2

CREDITS AND DISCLAIMER

CREDITS

Development Team

Colin Pearson – Owner/Operator, Military Visualizations
Viktor Szalai – Modeling
Bill Leaming – Code, Gauges, Materials, and Sound
Bernt Stolle – Flight Modeling and Dynamics
Dmitriy Usatiy – UV and Paint
Gunnar van der Meeren – Liveries
Fabio Trojan – Sound
Steve Jordan – Website Management, Customer Relations
Ken Stallings – Manual Writing, Airbase Development, Lead Beta Tester
Greg "Barfly" Bartos (actual T-38 pilot) – Consultant and Lead Developmental Flight Testing
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DISCLAIMER

Note: While this POH was designed to strongly replicate the actual T-38A Flight Manual, USAF Technical Order IT-38A-1, dated 1 January 1972, it must be remembered that this document is intended merely to support virtual flight operations of the MilViz T-38A in FSX. Nothing written in this document, nor in the modeling and presentation of the MilViz T-38A, should be used to support actual flight operations or to satisfy formal flight training without certification by the appropriate national aviation authorities. In addition, while modeling a T-38A aircraft, neither this aircraft nor the manuals are official products of Northrop Aviation or the USAF.