T.O. 1T-L39C-1

TECHNICAL MANUAL

FLIGHT MANUAL
L39C AIRCRAFT

Aero

LIST OF EFFECTIVE PAGES

Total number of pages in this manual is 286 consisting of the following:

* Zero in this column indicates an original page.

TABLE OF CONTENTS

SECTION PAGE

LIST OF ILLUSTRATIONS

LIST OF ILLUSTRATIONS (Cont.)

LIST OF ILLUSTRATIONS (Cont.)

FLIGHT MANUAL

L–39 C

INTRODUCTION

Scope

This manual contains the necessary information for safe and efficient operation of the aircraft L–39. These instructions provide you with a general knowledge of the aircraft and its characteristics and specific normal and emergency operating procedures. Your experience is recognized, therefore, basic flight principles are avoided. Instructions in this manual are prepared to be understandable by the least experienced crew member that can be expected to operate the aircraft. This manual provides the best possible operating instructions under most circumstances. Multiple emergencies, adverse weather, terrain etc. may require modification of the procedures. However it is not a substitute for sound judgment.

Permissible Operations

This flight manual takes a "positive approach" and normally tells you only what you can do. Any unusual operation or configuration is prohibited unless specifically covered in the flight manual. Clearance must be obtained from the using command before any questionable operation is attempted which is not specifically covered in the flight manual.

Standardization and Arrangement

Standardization ensures that the scope and arrangement of all flight manuals are identical. The manual is divided into seven fairly independent sections to simplify reading it straight through or using it as a reference manual. The first three sections must be read thoroughly and fully understood before attempting to fly the aircraft. The remaining sections provide important information for safe and efficient mission accomplishment.

Checklists

The flight manual contains amplified normal and emergency procedures. Checklists contain these procedures in abbreviated form and are issued as separate technical orders. Line items in the flight manual and checklists are identical with respect to the arrangement and item number.

How To Get Personal Copies

Each flight crew member is entitled to personal copies of the flight manual, safety supplements, operational supplement and flight crew checklists. The required quantities should be ordered before you need them to assure their prompt receipt. Check with you supply personnel, it is their job to fulfill your technical order request.

Change Symbol

The change symbol, as illustrated by the black line in the margin of this paragraph, indicates text and tabular illustration changes made to the current issue. Changes to illustrations are indicated by miniature pointing hands, shading, or legend.

Warnings, Cautions and Notes

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

WARNING

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

CAUTION

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

NOTE

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

Use of Words Shall, Will, Should, and May

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

Your Responsibility – to let us know

Every effort is made to keep the flight manual current. Review conferences with operating personnel and a constant review of accident and flight test reports assure inclusion of the latest data in the manual. We cannot correct an error unless we know of its existence. In this regard, it is essential that you do your part. Comments, corrections, and questions regarding this manual or any phase of the flight manual program are welcomed. These should be forwarded to:

Aero Vodochody
250 70 Odolena Voda
Czech Republic

Publication Date

The date appearing on the title page of the Flight manual represents currency of the material contained herein.

LIST OF ABBREVIATIONS

A	Ampere
A&C	Advisore and Caution
A/C, a/c	Aircraft
AC	Alternate Current
ADF	Automatic Direction Finder
ADI	Attitude Deviation Indicator
AGD	Artificial Horizon Gyro Unit
AGL	Above Ground Level
ALT	Altitude
AOA	Angle of Attack
APP	Approach
APU	Missile Launcher
APU	Auxiliary Power Unit
ARK	Automatic Direction Finder
ASAP	As Soon As Possible
ASP	Gun Sight
ATC	Air Traffic Control
ATT	Attitude
BATT	Battery
BCN	Beacon
°C	Degrees Centigrade/Celsius
C/B	Circuit Breaker
CAS	Calibrated Air Speed
CCW	Counter Clockwise
CG	Center of Garvity
cm	Centimeter
CW	Clockwise
DC	Direct Current
DH	Dangerous Height
EAS	Equivalent Airspeed
ECS	Environment Control System
EGT	Exhaust Gas Temperature
FDR	Flight Data Recorder
FKP	Camera Gun
FL	Flight Level
FOD	Foreign Object Damage
FOTAB	Photo Flash Bomb
ft	Feet
G, g	Unit for Load Factor
GMK	Directional Gyro
GND	Ground
GS	Glide Slope
HDG	Heading
HPC	High Pressure Compressor
HPT	High Pressure Turbine
Hz	Hertz (cycles)
IAF	Initial Approach Fix
IAS	Instrument Airspeed
ICS	Intercommunication System
IDB	Engine Inlet Directing Body
IFF	Identification ôFriend–or–Foeö
IFR	Instrument Flight Rules
ILS	Instrument Landing System
IM	Inner Marker
IMC	Instrument Meteorological Conditions
in	Inch
ISA	International Standard Atmosphere
IV	Engine Vibration Indicator
J.P.T.	Exhaust Gas Temperature
KCAS	Knots – Calibrated Air Speed
KEAS	Knots – Equivalent Air Speed
kg	Kilogram
kg/cm^2	Kilogram per Square Centimeter

kg/h	Kilogram per Hour
kg/s	Kilogram per Second
kHz	Kilohertz
KIAS	Knots – Indicated Air Speed
km	Kilometer
km/h	Kilometer per Hour
knot, kt	Knot
KPP	ADI
KTAS	Knots – True Air Speed
kW	Kilowatt
l	Liter
L/G	Landing Gear
l/min	Liter per Minute
lb	Pound
LDG	Landing
LH	Left Hand
LOC	Localizer
LPC	Low Pressure Compressor
LPT	Low Pressure Turbine
m	Meter
M	Mach Number
m/s	Meter per second
MAC	Mean Aerodynamic Chord
max	Maximum
MHz	Megahertz
min	Minimum/Minute
MKR	Marker
MLG	Main Landing Gear
MM	Midle Marker
mm Hg	Milimeter of Mercury
MRP	Marker
MSL	Mean Sea Level
NAV	Navigation
NLG	Nose Landing Gear
NM	Nautical Miles
NOM	Nominal
NPP	Radio Magnetic Indicator
OFAB	Retarded Bomb
OM	Outer Marker
ORK	Personal Equipment Connection
P.E.C.	Personal Equipment Connection
POP	Canopy Jettison Pyrocartridge
PRMG	Ground Based Radio Landing System
psi	Pound square Inch
PTT	Press–to–Talk
R/W	Runway
RA	Radio Altimeter
RAT	Ram Air Turbine
RH	Right Hand
RKL	Automatický radiokompas
RMI	Radio Magnetic Indicator
RPM	Revolutions per Minute
RS	Unguided Rocket
RSBN	Short Range Radio Navigation and Landing System
RV	Radio Altimeter
SDU	Remote Control Lnding System
sec	Second
SL	Sea Level
sqft	Square Feet
SRO	Transponder, IFF
SS	Missile
T/O	Takeoff
TAS	True Air Speed
TVM	Telescopic Ejection Mechanism
U/C	Undercarriage, Landing Gear
UHF	Ultra High Frequency
V	Volt
V AC	Volt Alternating Current
V DC	Volt Direct Current
V/A	Volt/Amperes
VFR	Visual Flight Rules
VHF	Very High Frequency
VMC	Visual Meteorological Conditions
VVI	Vertical Velocity Indicator
WOW	Weight on Wheel
ZAB	Air Fuel Explosive Bomb

SECTION I

DESCRIPTION AND OPERATION

CONTENTS PAGE

THE AIRCRAFT

The L–39 is a single engine, two seater, subsonic aircraft manufactured by Aero Vodochody of the Czech Republic. The aircraft primary mission is basic and advanced training, as well as light attack missions.

AIRCRAFT DIMENSIONS (figure 1–1).

The A/C dimensions under normal conditions of weight, shock absorber compression and tire inflation are as follows:

Wing span	31.042 ft (9.461 m)
Overall length	39.805 ft (12.132 m)
Height	15.493 ft (4.72 m)
Wing area	202.381 ft^2 (18.8 m^2)
Wing aspect ratio	5.2

AIRCRAFT OPERATING WEIGHTS

Empty weight	7,485 lbs (3,395 kg)
Basic weight	7,640 lbs (3,465 kg) (includes hydraulic fluid, usable engine oil and non–usable fuel).
Max ramp weight	10,520 lbs (4,770 kg)
Max landing weight	9,920 lbs (4,600 kg)
Max. T/O weight	10,360 lbs (4,700 kg)

Typical weights:

Flight training	(crew of two, internal fuel) 9,980 lbs (4,480 kg)
Ferry mission	(crew of two, internal and wing–tip tanks) 10,230 lbs (4,640 kg).

These weights are approximate and shall not be used for computing aircraft performance. Refer to Appendix A for detailed information.

GENERAL ARRANGEMENT (figure 1–2).

The A/C is divided into three sections: fuselage, wing and tail.

The fuselage consists of forward and aft section to permit engine removal. The forward section further consists of three sections: nose section, pressurized section with pilot's cabin and center section. The nose section contains the nose landing gear and part of the radio and electric equipment and oxygen system components. The pressurized section contains the cabin, which is enclosed by canopies attached by hinges and tiltable to the fuselage right side. The cabin contains the two pilot's cockpits with ejection seats. Each cockpit comprises the instrument panels and lateral consoles. Under the cabin floor there are compartments for electrical, radio, hydraulic, pneumatic and ECS installations. Behind the aft cockpit lies the fuel tank compartment and components of radio, hydraulic and ECS systems, tiltable emergency generator with ram air turbine and fire extinguisher. The aft part of the center fuselage section to which the tail unit is attached contains the engine and APU installation and components of fire system.

The empennage (tail unit) consist of vertical and horizontal stabilizers to which the rudder and elevator are attached respectively.

The wing contains wells for the retracted main landing gear, carries the flaps and ailerons and is fitted with one hard points on each wing for two under–wing pylons of which designed to carry stores. Two nondropable tip tanks are mounted at the wing tips. Two speed–brakes are located on the lower part of the wing and leading edge of each wing carries the pitot–static probe.

COCKPIT LAYOUT

The cockpit layout is shown in figures 1–3 through 1–5 for the forward cockpit and figures 1–6 through 1–8 for the aft cockpit. Figure 1–9 applies to both cockpits.

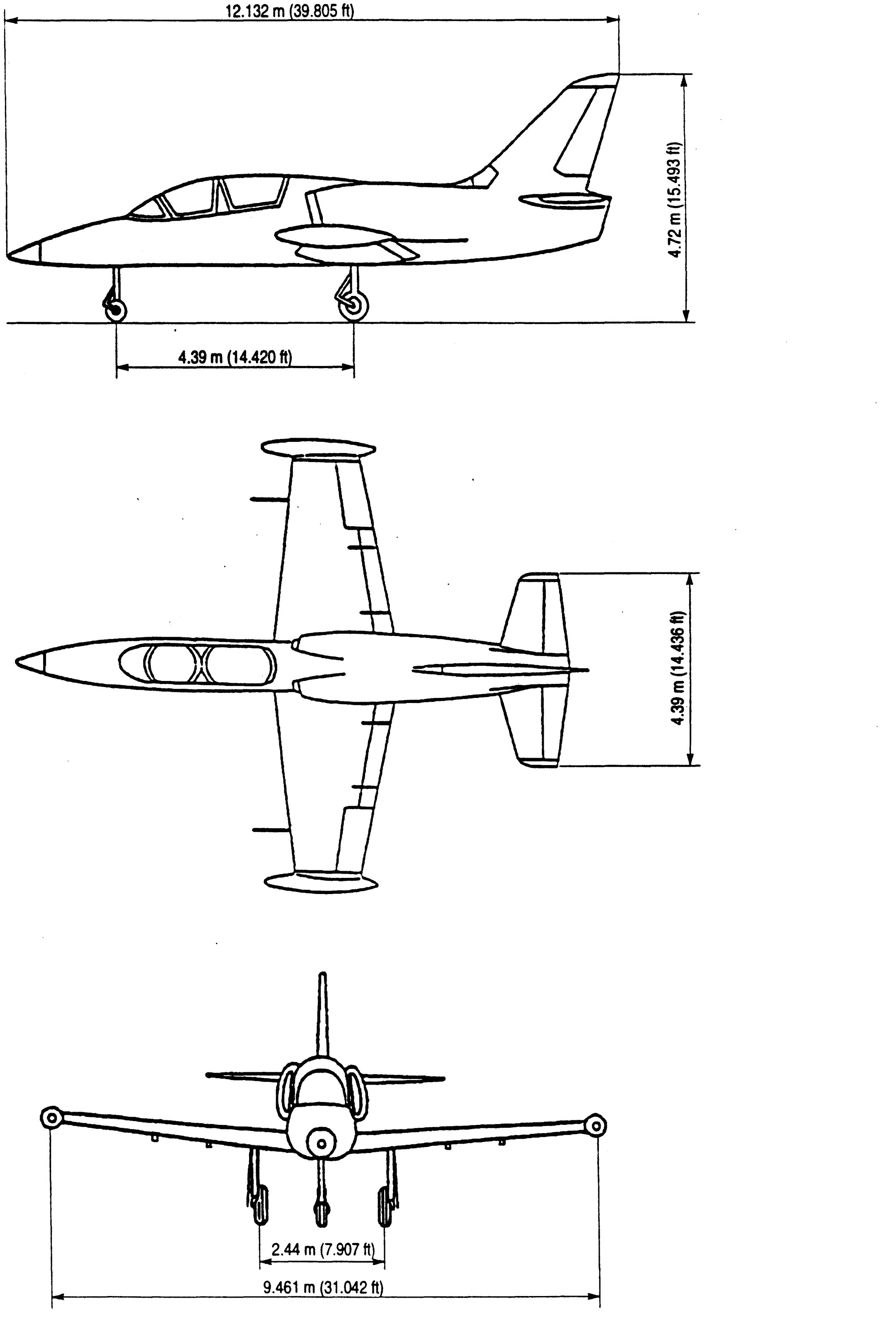
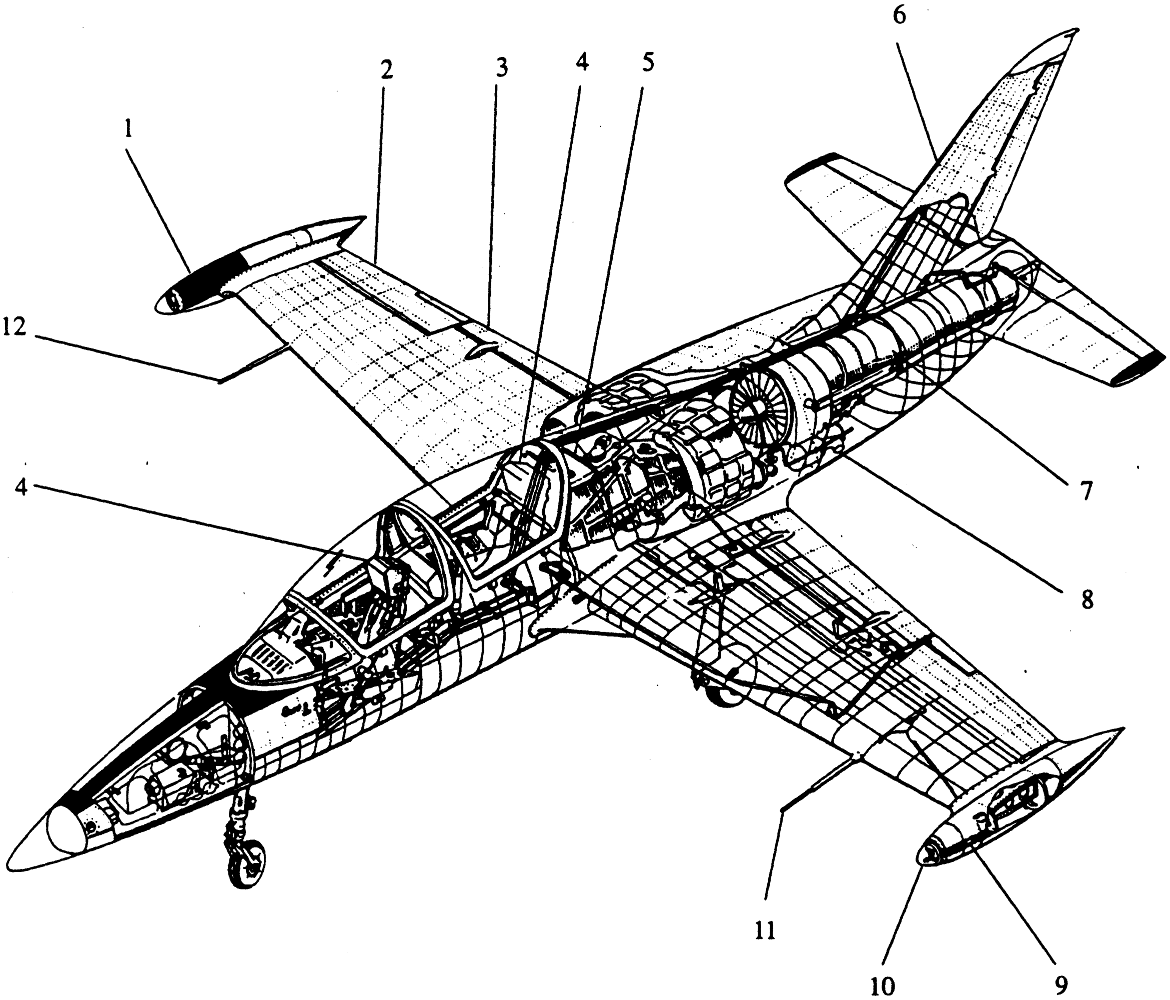


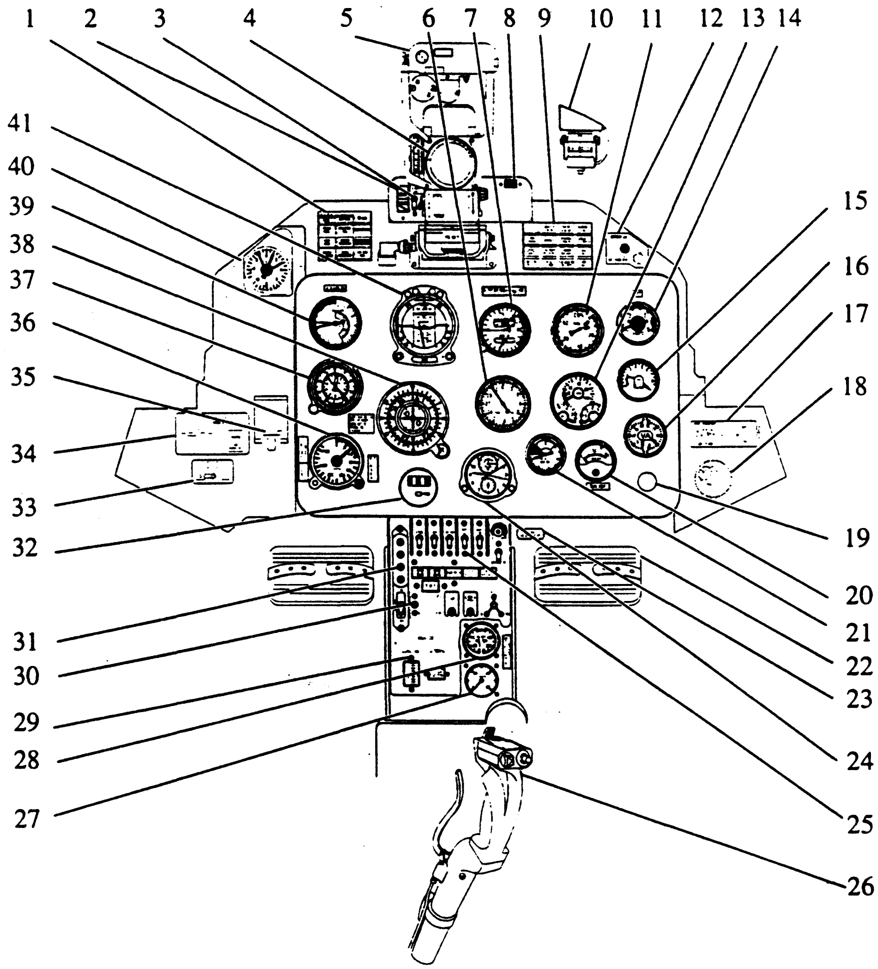
Figure 1–1. Aircraft Dimensions



1. Wing–tip Tank
2. Aileron
3. Flap
4. Ejection Seat
5. Fuselage Fuel Tanks
6. Tail Unit
7. Engine
8. APU
9. Navigation Light
10. Landing/Taxi Light
11. Stand–by Pitot Tube
12. Main Pitot Tube

AB–1–(2)

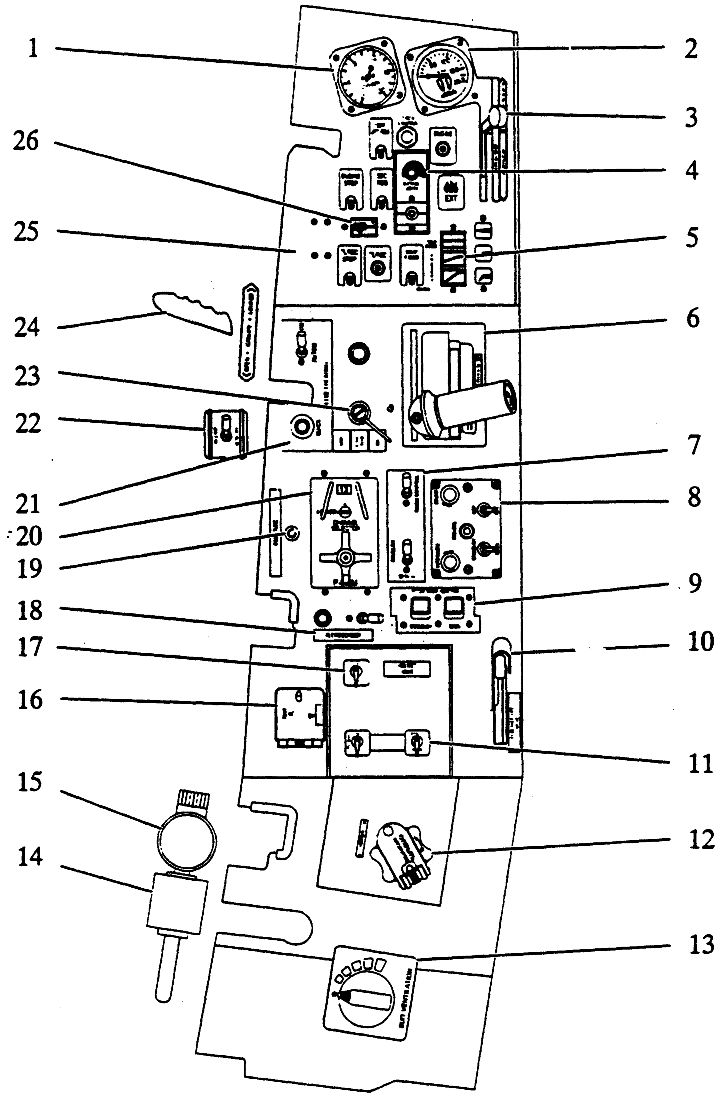
Figure 1–2. General Arrangement



1. Warning Lights Panel
2. Upper Armament Indication Panel
3. Instrument Panel Emergency Lights Switch
4. Gyroscopic Sight
5. Gun Camera
6. ADF, Automatic Direction Finder
7. Vertical Velocity/Turn & Slip Indicator
8. Master Caution Panel
9. Caution & Advisory Lights Panel
10. Stand–by Compass
11. RPM Indicator
12. Directional Gyro Front Control Panel
13. Triple Engine Indicator
14. EGT Indicator
15. Fuel Quantity/Flow Indicator
16. Voltammeter
17. Diffuser and Flight Suit Temperature Control Panel
18. Diffuser (Air Shower)
19. Engine Vibration Ground Test Socket
20. Engine Vibration Indicator
21. Cabin Pressure Indicator
22. Rudder Pedal
23. Pedal Adjustment Controller
24. Clock
25. Armament Panel
26. Control Stick
27. Emergency Brake Pressure Indicator
28. LH/RH Wheel Brake Pressure Indicator
29. Pitch and Roll Trim Indicator Panel
30. Fire Detector Test Switch
31. Signal Flares Control Panel
32. RSBN Range Indicator
33. Short–Long Distance Beacon Switch
34. L/G Position Indication Panel
35. L/G Control Lever
36. Height Indicator
37. Altitude Indicator
38. RMI, Radio Magnetic Indicator
39. Airspeed/Mach Indicator
40. Accelerometer
41. ADI, Attitude Director Indicator

AB–1–(3)

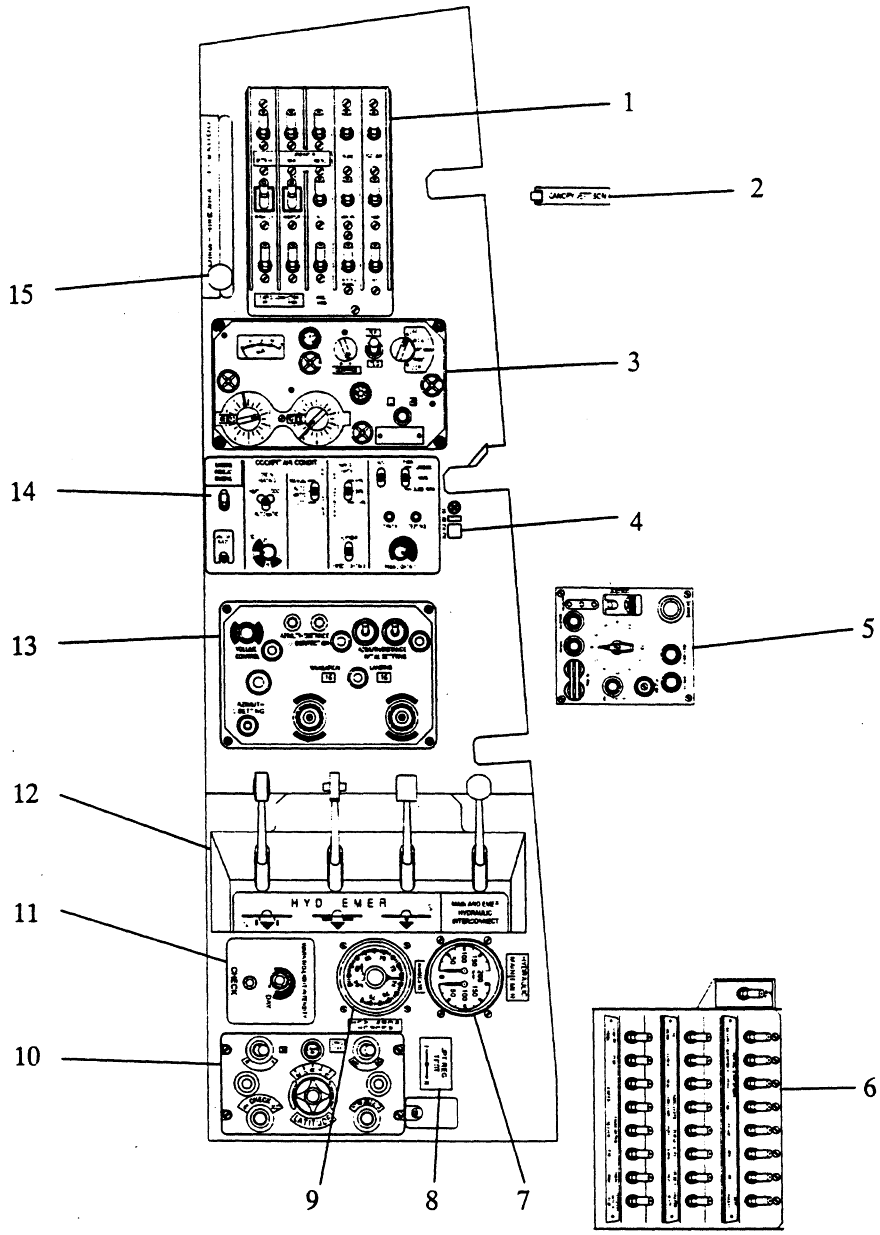
Figure 1–3. Forward Cockpit Layout



1. Helmet Oxygen Pressure Indicator
2. Oxygen Pressure Indicator and Flow Annunciator
3. Emergency/Parking Brake Control Handle
4. Instrument Lights Control Panel
5. Flaps Control and Indicator Panel
6. Throttle Quadrant
7. Audio panel
8. ICS Control Box
9. Pitot Tube Heating Buttons
10. Fuel Shut–off Valve Lever
11. Oxygen Control Panel
12. Oxygen Supply Valve
13. Flight Suit Ventilation Controller
14. Anti–G Valve Filter
15. Anti–G Valve
16. Oxygen Regulator Test Access
17. Helmet Ventilation Switch
18. FDR Controls
19. RSBN Beacon Audio Button
20. Radio Set Control Box
21. Helmet Visor Heating Control Panel
22. Taxi and Landing Lights Control Switch
23. Pitot Controls
24. Canopy Lock Handle
25. Engine Control Panel
26. External Power Indicator Light

AB–1–(4)

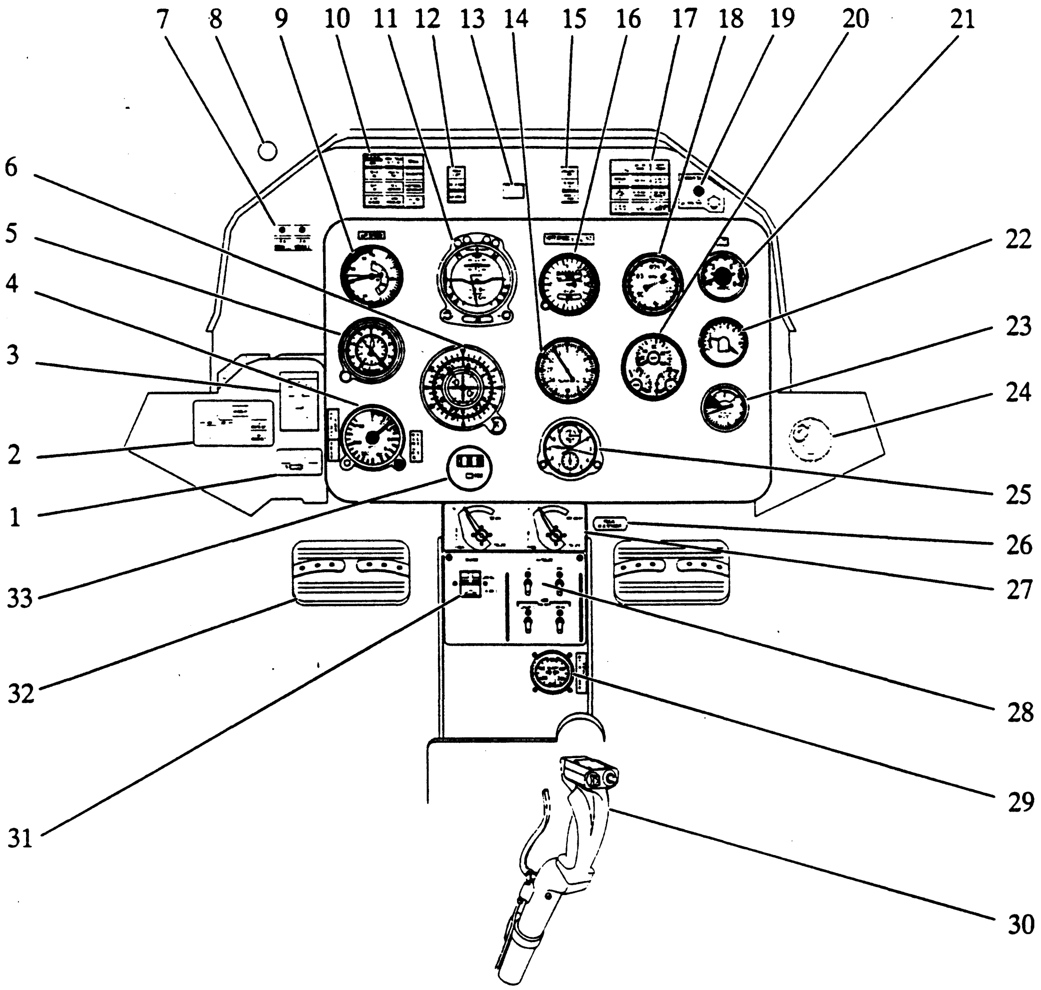
Figure 1–4. Forward Cockpit LH Console



1. Main C/B Switch Panel
2. Canopy Emergency Jettison Handle
3. ADF Control Box
4. De–Ice Sensor Heating Control Panel
5. IFF Control Box
6. Aft C/B Switch Panel
7. Main & Emergency Hydraulic Pressure Indicator
8. EGT Limiter Test Switch
9. RSBN System Altitude Selector
10. Directional Gyro Control Box
11. Advisory & Warning Lights Intensity Controls
12. Emergency Extension and Interconnection Control Levers
13. RSBN Control Box
14. Auxiliary Switch Panel
15. Cabin Pressurization and ECS Handle

AB–1–(5)

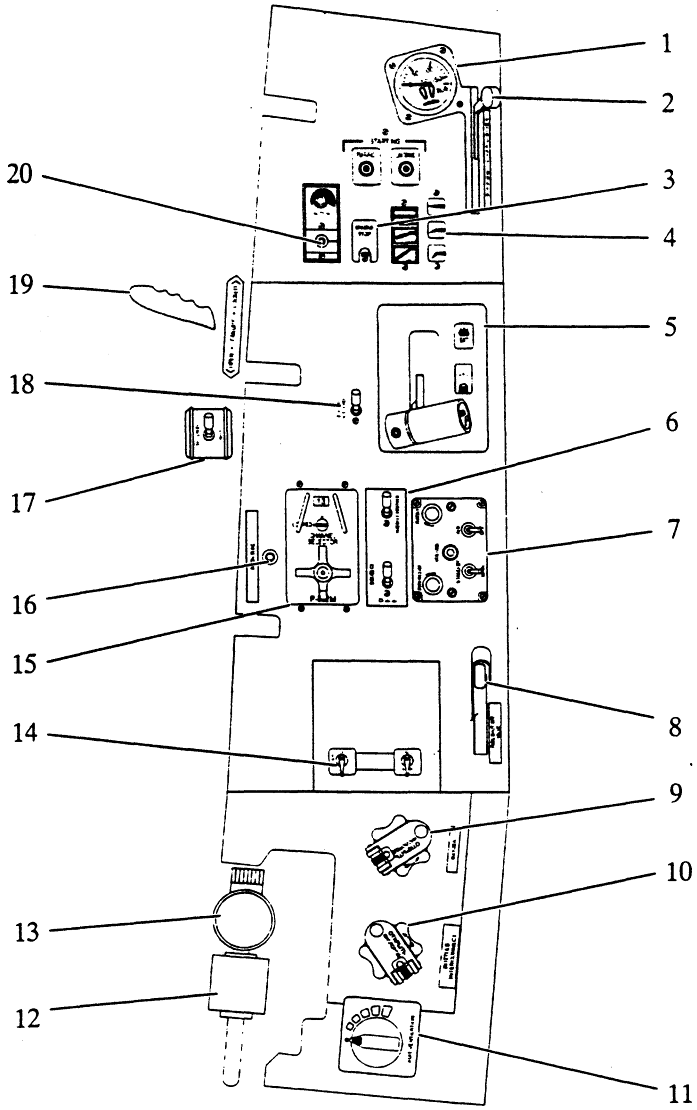
Figure 1–5. Forward Cockpit RH Console



1. Short–Long Distance Beacon Switch
2. L/G Position Indicator
3. L/G Control Lever
4. Height Indicator
5. Altitude Indicator
6. RMI, Radio Magnetic Indicator
7. Stores Indication Panel
8. Instrument Flight Hood Control Handle
9. Airspeed/Machmeter
10. Warning Lights Panel
11. ADI, Attitude Deviator Indicator
12. Left Armament Indication Panel
13. Master Caution Light
14. ADF, Automatic Direction Finder
15. Right Armament Indication Panel
16. Vertical Velocity/Turn & Slip Indicator
17. Caution & Advisory Lights Panel
18. RPM Indicator
19. Directional Gyro Front Control Panel
20. Triple Engine Indicator
21. EGT Indicator
22. Fuel Quantity/Flow Indicator
23. Cabin Pressure Indicator
24. Diffuser (Air Shower)
25. Clock
26. Pedal Adjustment Controller
27. Pitot Fault Simulator Panel
28. Navigation Fault Simulator Panel
29. LH/RH Wheel Brake Pressure Indicator
30. Control Stick
31. Pitch and Roll Trim Indicator Panel
32. Rudder Pedal
33. RSBN Range Indicator

AB-1-(6)

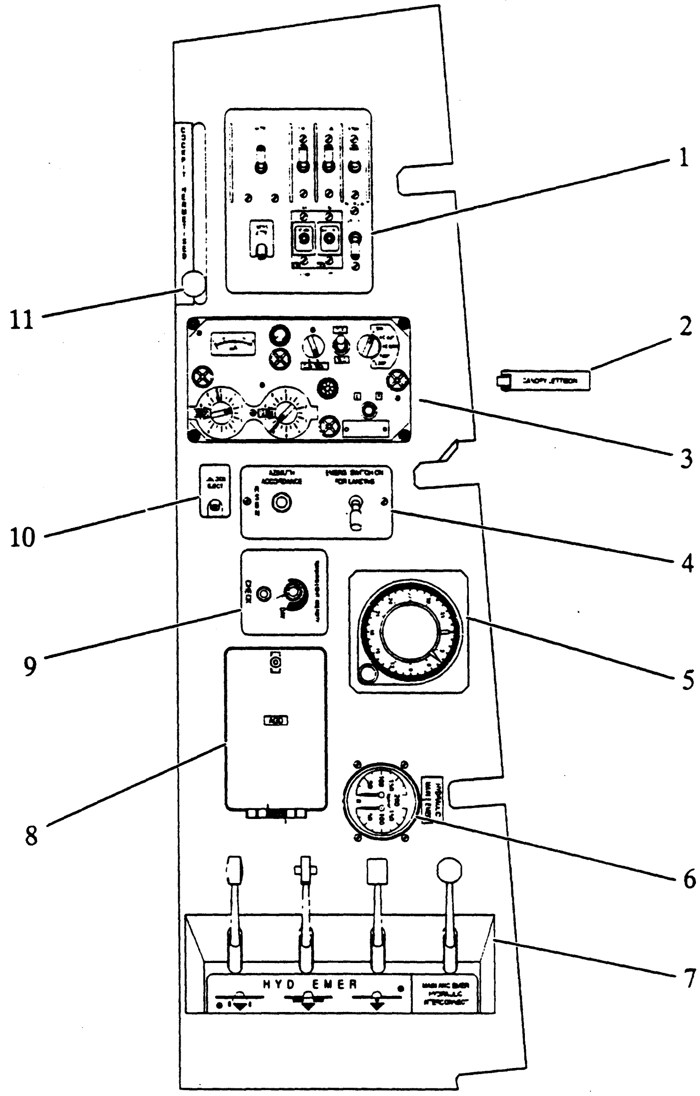
Figure 1–6. Aft Cockpit Layout



1. Oxygen Pressure Indicator and Flow Annunciator
2. Emergency Brake Control Handle
3. Engine Control Panel
4. Flaps Control and Indicator Panel
5. Throttle Quadrant
6. Audio panel
7. ICS Control Box
8. Fuel Shut–off Valve Lever
9. Oxygen Bottles Interconnect Valve
10. Oxygen Supply Valve
11. Flight Suit Ventilation Controller
12. Anti–G Valve Filter
13. Anti–G Valve
14. Oxygen Control Panel
15. Radio Set Control Box
16. RSBN Beacon Audio Button
17. Taxi and Landing Lights Control Switch
18. Forward/Aft Cockpit EGT Transfer Switch
19. Canopy Lock Handle
20. Instrument Lights Control Panel

AB–1–(7)

Figure 1–7. Aft Cockpit LH Console



1. Miscellaneous C/B Switch Panel
2. Canopy Emergency Jettison Handle
3. ADF Control Box
4. RSBN Aft Control Panel
5. Directional Gyro Correcting Instrument
6. Main & Emergency Hydraulic Pressure Indicator
7. Emergency Extension and Interconnection Control Levers
8. Gyro Unit Ground Checkout Access Panel
9. Advisory & Warning Lights Intensity Controls
10. Ejection Unlock Switch
11. Cabin Pressurization and ECS Handle

AB-1-(8)

Figure 1-8. Aft Cockpit RH Console

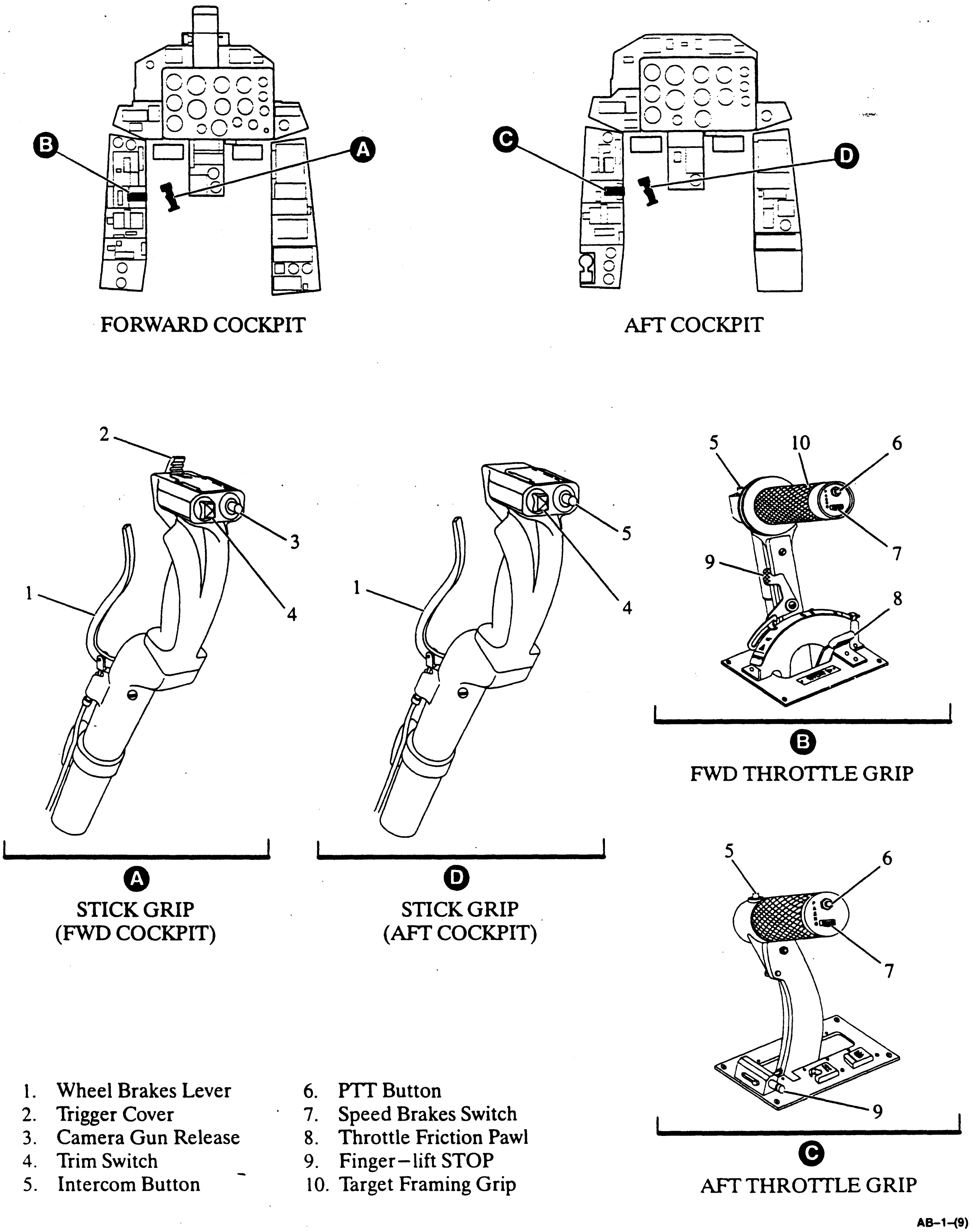


Figure 1–9. Stick and Throttle Controls

ENGINE (figure 1–10)

The aircraft is powered by an AI–25TL engine which develops approximately 16.9 kN (3,800 lb) static thrust, on a standard day at sea level. The engine is a twin shaft by–pass turbofan with a three stage low pressure (LP) axial flow compressor and a nine stage high pressure (HP) axial flow compressor.

The LP compressor is driven by a two stage axial turbine.

The HP compressor is driven by a single stage axial turbine.

The air flowing through the LP compressor diverges into two concentric flows:

- The primary inner hot flow, which is routed through variable inlet guide vanes, compressed by the HP compressor before reaching the combustion chamber.
- The secondary, by–pass flow, which is directed to the by–pass exhaust through a mixer, where the inherent energy of this flow is converted into kinetic energy.

Engine bleed air, taken from the ninth stage of the HP compressor, is employed for cabin ECS and pressurization, de–icing and demisting of transparent surfaces, pressurizing anti–G suits, fuel transfer from tip tanks and from inverted flight tank and for engine anti–icing.

Two surge bleed valves prevent the HP compressor from surging at low rotation speeds. These surge bleed valves are spring valves that open below 86–89% RPM of the third compressor stage and 74–77% of the fifth stage. The engine is equipped with an annular combustion chamber containing 12 main fuel nozzles and two spark plugs are provide for engine starting. The engine cross section is shown in figure 1–10.

ENGINE OIL SYSTEM (figure 1–11)

The engine oil system performs the basic function of lubricating, cooling and distributing oil within the engine. The oil is circulated by the main pump through the fuel/oil heat exchanger which is designed for cooling the oil circulating inside the engine oil system, thus maintaining its lubricating qualities, and for filtering and warming up the fuel in order to prevent deposits of paraffin on the fuel filter, which occurs whenever fuel is approaching its freezing temperature.

Oil is routed from the oil tank to the oil pump and filter, then through the diffuser gear box where upon exiting, diverges into two flow lines:

The first line is directed to the compressors bearings, the central drive and the LP compressor RPM transmitter drive. The second flow is directed to the turbines bearings, to cool and lubricate them. All other parts are lubricated by spraying.

The oil is scavenged by the scavenge section of the oil pumping pack and flows through the magnetic plug to the gear box, where lubricates and cools straining components. The oil is then scavenged into a de–aerator, to dispose the air bubbles it may have accumulated, then through the fuel/oil heat exchanger, where it is cooled, back to the oil tank.

The oil system incorporates a selector valve which operates during inverted flight and alters the scavenging from the bottom part of the engine to the upper part. It also has a magnetic plug for detecting iron particles in the scavenging area of the engine oil system.

An oil quantity indicator is mounted on the oil tank and is visible by opening an access door located on the aft right side of the fuselage.

Oil pressure and temperature indicators constitute part of the triple engine indicator. In addition, a low oil press "ENG. MIN. OIL PRESS" warning light is incorporated which illuminates, together with the master caution light, whenever oil pressure is below 1.4 ± 0.3 kp/cm^2 (20 psi). The same warning light illuminates also whenever the minimum oil temperature is indicated or whenever maximum volume of impurities in oil has been exceeded. When the aircraft passes from positive to negative g–loads and vice versa, or when it flies at near zero loads, the warning light may illuminates up to 6 seconds. During normal flight the light shall extinguish.

OIL SYSTEM DATA

Quantity for dispatching: 1.2 to 2.0 gal (4.5–7.5 l)

Minimum oil pressure at idle power: 28 psi (2 kp/cm^2)

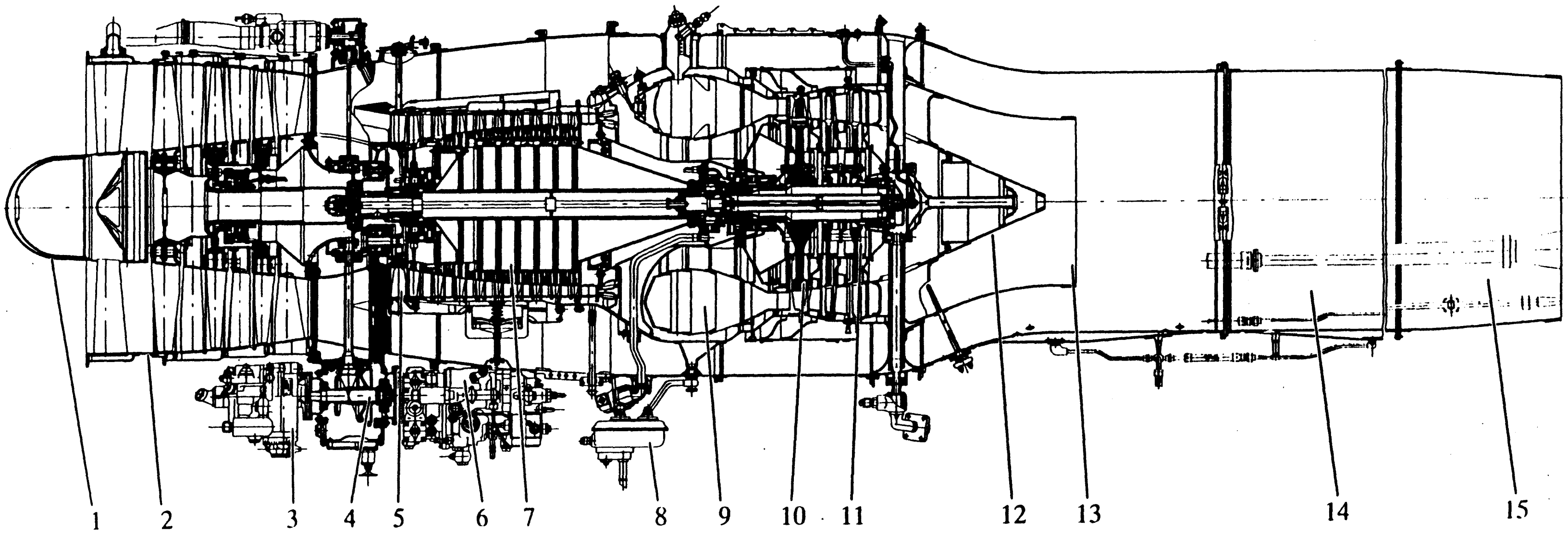
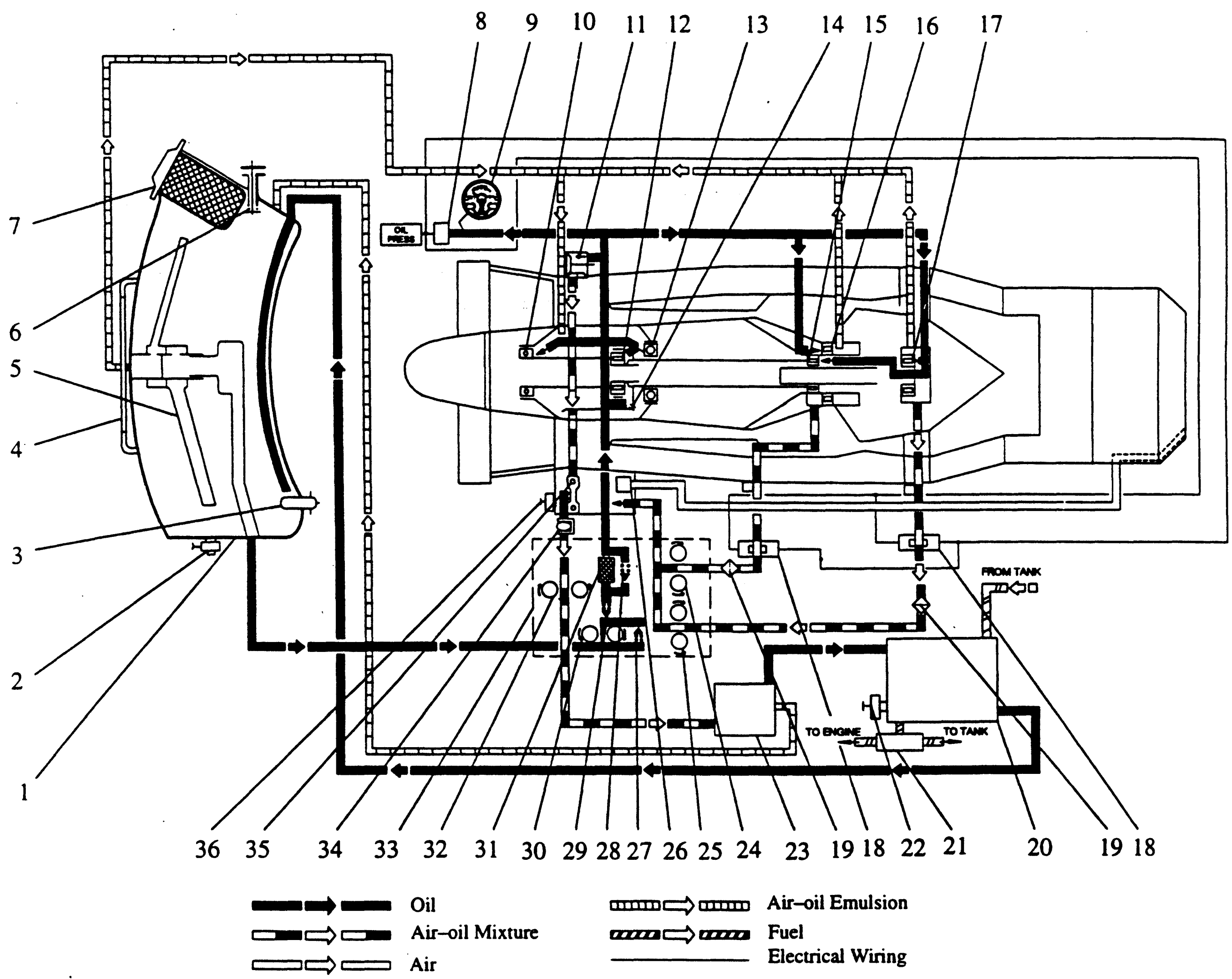


Figure 1–10. Engine, AI–25TL – Cross Section

1. Inlet Directing Body (IDB)
2. LPC Rotor
3. Fuel Pump
4. Gear Box
5. HPC Inlet Directing Body
6. Fuel Regulator/Governor
7. HPC Rotor
8. Waste Tank
9. Combustion Chamber
10. HP Turbine Rotor
11. LP Turbine Rotor
12. Inner Core
13. Inner Stream Jet Nozzle
14. Extension Pipe
15. Nozzle



1. Oil Tank
2. Drain Valve
3. Oil Temperature Transmitter
4. Transparent Glass
5. Rotary Suction Tube
6. Safety Valve
7. Filter
8. Minimum Oil Pressure Transmitter
9. Oil Pressure Indicator (Triple Indicator)
10. LPC Ball Bearing
11. Upper Drive
12. LPC Roller Bearing
13. HPC Ball Bearing
14. Central Drive Toothed Wheel
15. LP Turbine Forward Roller Bearing
16. HPT Roller Bearing
17. LP Turbine Aft Roller Bearing
18. Oil Pressure Temperature and Chips Indicator
19. Oil Unit Filter
20. Fuel/Oil Exchanger
21. Thermostatic Valve
22. Drain Valve
23. Centrifugal De–aerator
24. Forward Turbine Bearings Housing Oil Offpumping
25. Aft Turbine Bearings Housing Oil Offpumping
26. Centrifugal Breather
27. Reduction Valve
28. By–pass Valve
29. One way Valve
30. Pressure Section
31. Fine Filter
32. Main Offpumping Section
33. Oil Unit
34. Magnetic Plug
35. Offpumping Section Switch Valve
36. Drain Valve

AB–1–(11)

Figure 1–11. Engine Oil System – Schematic Diagram

ENGINE FUEL CONTROL SYSTEM

The engine fuel control system is a high pressure (HP) system which consists of a HP fuel pump and a wide range governor that automatically provides optimum fuel supply for any throttle setting and ensures:

a. Fuel supply for engine start

b. Fuel metering during start, acceleration and deceleration

c. Fuel metering according to throttle setting, airspeed and altitude

d. Maintenance of constant HP compressor speed with respect to throttle setting

e. Maintenance of constant RPM at idle power

f. Limiting HP compressor RPM

g. Continuous minimal fuel flow at all altitudes

h. Control of surge bleed valves from stages 3 and 5 of HP compressor

i. Disconnection of air starter depending on HP compressor RPM

j. Manual and electrical shut down of engine

k. Setting of HP compressor inlet guide vanes

l. Fuel filtering

ENGINE THROTTLE

The engine throttle is basically employed for setting the engine RPM. The throttle has two ranges of travel: From stop to idle and from idle to max RPM. In the first range of travel, it operates the fuel cock. A finger–lift, hinged on the throttle in the forward cockpit, when lifted, enables the throttle to be retarded from idle to the stop (cut off) position. The aft cockpit has a throttle lock gate to prevent the forward cockpit pilot from retarding the throttle to stop position inadvertently. A pawl, sliding in a slot, provides for the adjustment of throttle friction. Along side the throttle travel, significant power settings are marked to indicate the following (from forward to aft):

- TAKE UP — Maximum power, limited by a stop.
- NOM — Nominal power, marked by a groove in the travel range.
- CR SPEED — Cruise, which is 85% of Nom power and is also marked by a groove in the travel range.
- IDLE — Minimum power (idle), limited by aft end of travel.
- Emergency fuel system triangle
- STOP — Engine shutdown, limited by aft end of travel.

EMERGENCY FUEL CONTROL

The emergency fuel control circuit provides an alternate method for controlling the engine by bypassing the normal HP fuel governor. This circuit is used whenever the engine cannot be controlled through the normal system. Although the engine retains its control, the emergency circuit lacks all the protection the normal system enjoys such as maximum and minimum speed governing, acceleration/deceleration control, EGT limiting, altitude and temperature compensation, and automatic starter cut–out. Hence the throttle must be operated with care while monitoring closely the RPM and EGT. Recommended time for throttle movement from idle to nominal is 15 seconds, gradient of RPM change should be 2% rpm per second.

Selecting the "SEC REG" switch on the engine control panel under the yellow quard activates the system and illuminates the "FUEL EMERG. DELIVERY" advisory light.

When operating the engine utilizing the emergency fuel control, the following RPM limits shall be adhered to:

Below 6,500 feet (2,000 m)	– Minimum 56%
	– Maximum 103%
	– Maximum EGT 655°C
	– Maximal rating nominal
Above 6,500 feet (2,000 m)	– Minimum 60%
	– Maximum 99%
	– Maximum EGT 620°C
	– Maximal rating cruise

CAUTION

- When performing an APU assist start, with the emergency fuel circuit in use, the auto–disconnect function is deactivated. The APU, therefore, must be stopped at 43±1.5% HPC RPM by depressing the "TURBO STOP"
- When the emergency fuel circuit is used in flight, it must be maintained throughout the entire flight until landing and the engine shall be shut down at the earliest suitable time after landing.
- Before activation the emergency fuel delivery system, the throttle shall be moved to idle and pilot shall verify the HPC RPM are above 54.5%. Not to follow these limitations can cause engine flame–out, compressor stall or excessive EGT.

NOTE

When switching on the emergency fuel circuit it may be accompanied by an abnormal noise caused by the change of fuel flow, and the fuel filter light may flicker.

ENGINE STARTING SYSTEM

The starting system provides, both, ground and air starts and comprises basically of a starting fuel manifold, starting fuel nozzles, ignition system and a starting fuel solenoid.

The engine is started by the Auxiliary Power Unit (APU) through the air starter which is an engine component. The air starter motors the engine to 22–24% HPC RPM and disconnects automatically when the engine reaches its self sustaining speed (43 ± 1.5%), or after 45 sec from initiating the start sequence.

The starting system is controlled by the "ENGINE" C/B and the "ENGINE" push–button, located under the blue guard. When the "ENGINE" button is depressed, hte starting sequence is initiated. The start sequence is terminated automatically, as described above, or at any time by pressing the "ENGINE STOP" push–button.

APU SAPPHIRE 5

Except for the fact that the APU receives its fuel from the main fuel system, it is otherwise an independent system. It consists of a housing containing a turbine engine, gearbox, oil pump, electric starter, speed transmitter, oil distributor and independent associated systems intended to drive an air generator.

The air generator provides compressed air which is fed into the engine air starter. The APU allows motoring of the engine to the required RPM of about 24%. It can be used on the ground, for normal operation and in the air, for in–flight start, up to 20,000 feet (6,000 m). The APU is used for in–flight start only when the RPM is less than 15%. A total of three APU assisted start attempts on the ground may carried out for each APU running cycle.

Control of the APU is achieved by the "TURBO" and the "TURBO STOP" guarded push–buttons in the forward cockpit and the "TURBO" push–button in the aft cockpit. Should the APU fail to ignite, it will shut down automatically. Another start may be attempted after 2 min.

APU OPERATION

The APU start sequence begins when the "TURBO" push–button is depressed for 1 to 2 seconds. As the APU reaches idle RPM within 20 to 25 seconds, a "TURBINE STARTER" light illuminates in the advisory panel, to indicate that the APU is ready to carry out an engine start. During idle run of the APU excess air is dumped over–board through a relief valve, located on the ventral side of the fuselage.

Upon initiating an engine start ("ENGINE" button is depressed), the APU accelerates to its maximum RPM and simultaneously, the air relief valve closes to enable all available air to flow into the air starter intake. The air starter intake is then opened, by a solenoid valve, and the starter starts rotating the HP compressor to the required RPM of 24% (20% minimum). As the engine reaches 43 ± 1.5% HPC RPM till 45 second, the air starter and APU shut down. When the engine does not run within 45 seconds the air starter disconnects and the APU reverts to idle RPM, ready for another engine start attempt, which may be carried out after 30 seconds after HPC RPM indicator returns back to zero value. The APU must be shut down after three attempts to start the engine, another three–attempts APU running cycle may be carry out after 20 min. and another after 1 hour pause.

STARTING MODES

The engine can be started utilizing one of three different modes, by means of a three position switch, covered by a red cover labeled "START REGIME", located on the left console in the forward cockpit only.

The starting modes are as follows:

a. Starting "STARTING": APU operates normally, fuel and ignition are introduced for engine start.

b. Preservation "PRESERV": APU motors the engine, fuel is introduced but with no ignition. This mode is used for maintenance purposes only.

c. Windmill "COLD. ROTAT": This mode is used when fuel has accumulated in the tail pipe. APU motors the engine but no ignition or fuel are introduced.

START SEQUENCE

The "ENGINE" and "PUMP" C/Bs, when selected to ON, connects power to the engine circuits and to the booster pump that develops pressure in the line leading to the engine driven pump ("DON'T START" warning light extinguished). When the "ENGINE" button is pressed for 2 seconds, the automatic sequence commences: the air starter rotates the engine, the solenoid shut off prevents fuel to supply to fuel nozzles, and the ignitors ignite without fuel delivery to test its function. The throttle should be moved from STOP to IDLE after 3 to 6 seconds from moment of the "ENGINE" button pressing.

NOTE

When the throttle is moved to other than IDLE position the starting automatic process does not perform engine start.

In the ninth second the solenoid valve opens the starting fuel delivery to ignitors, in the fifteenth second the main fuel delivery begins and both starting and main fuel supply is delivered to combustion chamber,. In the 25th sec the starting fuel supply is closed and only main fuel is delivered to combustion chamber. Both APU and air starter are shut down automatically when the engine reaches 43 ± 1.5% HPC RPM within 45 seconds from beginning of engine starting. The APU shut–down is indicated by extinguishing of "TURBINE STARTER" light. After starting, the engine stabilizes at idle RPM of 56 ± 1.5%. If the engine fails tgo in–flight windmilling start, the automatic starting cycle is termined after 35 sec. However, the cycle can be prolonged up to 45 seconds by depressing and holding the start button.

NOTE

The engine starting cycle can be hastened by synchronous pressing of "TURBO" and "ENGINE" buttons already during the APU start. The APU then accelerates to maximal speed and the engine starting sequence begins automatically upon APU reaching congenial speed.

The engine must be shut down immediately by shifting throttle to stop position and switching off the "TURBO STOP" switch if one of following occurs:

- HPC RPM does not rise within 8 seconds after depressing the "ENGINE" button.
- HPC RPM are not at least 20% in 15–th second after "ENGINE" button depression.
- LPC RPM does not start to rise in 15–th second after "ENGINE" button depression.
- EGT does not start to increase within 25 seconds since "ENGINE" button depression.
- EGT rapidly approaches 685°C
- "TURBINE STARTER" light does not extinguish within the interval 41.5 to 44.5 second after starting process initiation.
- HPC RPM does not reach 56 ± 1.5% idle RPM within 50 second after starting process initiation.
- Oil pressure at engine idle is less than 2 kp/cm^{2}.

NOTE

If the engine starting process has been interrupted due to EGT rapidly approaching limit, it is necessary to windmill the engine before next engine starting attempt.

IN FLIGHT STARTING

The engine can be relighted in flight up to altitude 20,000 ft (6,000 m) by means of one of the following ways:

- APU assisted start HPC RPM less than 15%
- windmilling start HPC RPM above 15%

The engine can be restarted by any of the above mentioned ways during both main and emergency fuel control. EGT rising shall be carefully observed not to reach 685°C and positive gradient of LPC and HPC RPM shall be assured. At engine idle speed the oil pressure shall be at least 2 kp/cm^{2}.

ENGINE INSTRUMENTS (figure 1-12)

RPM INDICATOR

The rpm indicator provides an indication of engine HPC and LPC revolutions per minute in percent. Two separate, identical systems, one for each compressor are utilized. Each system consists of a tachometer generator which upon rotation produces AC voltage output and two tachometer indicators, one in each cockpit. The system is completely self contained and requires no source of electrical power.

The indicator contains two pointers, one for each compressor. The pointer with letter I indicates the HPC rpm and the pointer with letter II indicates the LPC rpm.

Readings range from 0% to 110% for both pointers.

EGT INDICATOR

The EGT indicator proves an indication of the Exhaust Gas Temperature measured at the point where combusted gases exit the turbine unit. The system consists of temperature transmitter located on the engine turbine ring and two indicators, one in each cockpit.

The temperature transmitter output signal can be connected to only one indicator at the moment. The"EGT IND AFT/FWD" switch, located on the aft cockpit left console provides EGT indication to be displayed either in forward or aft indicator.

Readings range from 0 to 900°C.

TRIPLE ENGINE INDICATOR

The triple engine indicator contains three independent indicators:

- Oil pressure indicator
- Oil temperature indicator
- Fuel pressure indicator

Oil Pressure Indicator

The oil pressure indicator system consists of a pressure transmitter and two indicators, one in each cockpit. The oil pressure is measured behind the high pressure oil pump. The oil pressure indication is displayed on the LH side of the triple engine indicator and its readings range from 0 to 6 kp/cm^2.

Oil Temperature Indicator

The oil temperature indicator system consists of a temperature probe and two indicators, one in each cockpit. The oil temperature is measured in the oil tank. The oil temperature indication is displayed on the RH side of the triple engine indicator and its readings range from − 50 to 150°C.

NOTE

> The oil temperature indicator in the aft cockpit does not display the actual oil temperature. It is permanently disconnected from the system.

Fuel Pressure Indicator

The fuel pressure indicator consists of a pressure transmitter and two indicators, one in each cockpit. The fuel pressure is measured in front of the fuel nozzle. The fuel pressure indication is displayed on the top part of the triple engine indicator and its readings range from 0 to 100 kp/cm^2.

The oil and fuel pressure indicator is power supplied from the inverter III with 36 V, 400 Hz voltage. The oil temperature indicator is supplied by the 28 V. The triple engine indicator is switched on by "ENGINE" switch, located on the main CB/switch panel.

ENGINE VIBRATION INDICATOR

Vibration is measured at the front suspension of the engine main ball-bearing and indicated on the engine vibration indicator. Once exceeding the limits (40 mm/sec), an "ENGINE VIBRATION" warning light will accompany the indication. Because of the nature of the vibration sensor and the indicator, the readings and the warnings are reliable only during a straight and level flight and on the ground.

NOTE

> The engine vibration speed on the ground should be monitored at engine vibration indicator. In flight, at engine steady operation, the vibration level should be observed by the "ENGINE VIBRATION" warning light. The readings of the engine vibration sensor and indicator become erroneous during aircraft evaluations and aerobatics and there fore should not be taken into consideration.

An engine vibration test button "CHECK VIBRATION" is located in the forward cockpit on the LH console. Pressing the button will move the indicator to over 40 mm/sec and bring on the "ENGINE VIBRATION" warning light.

The engine vibration indicator is located on the instrument panel in the fwd cockpit only.

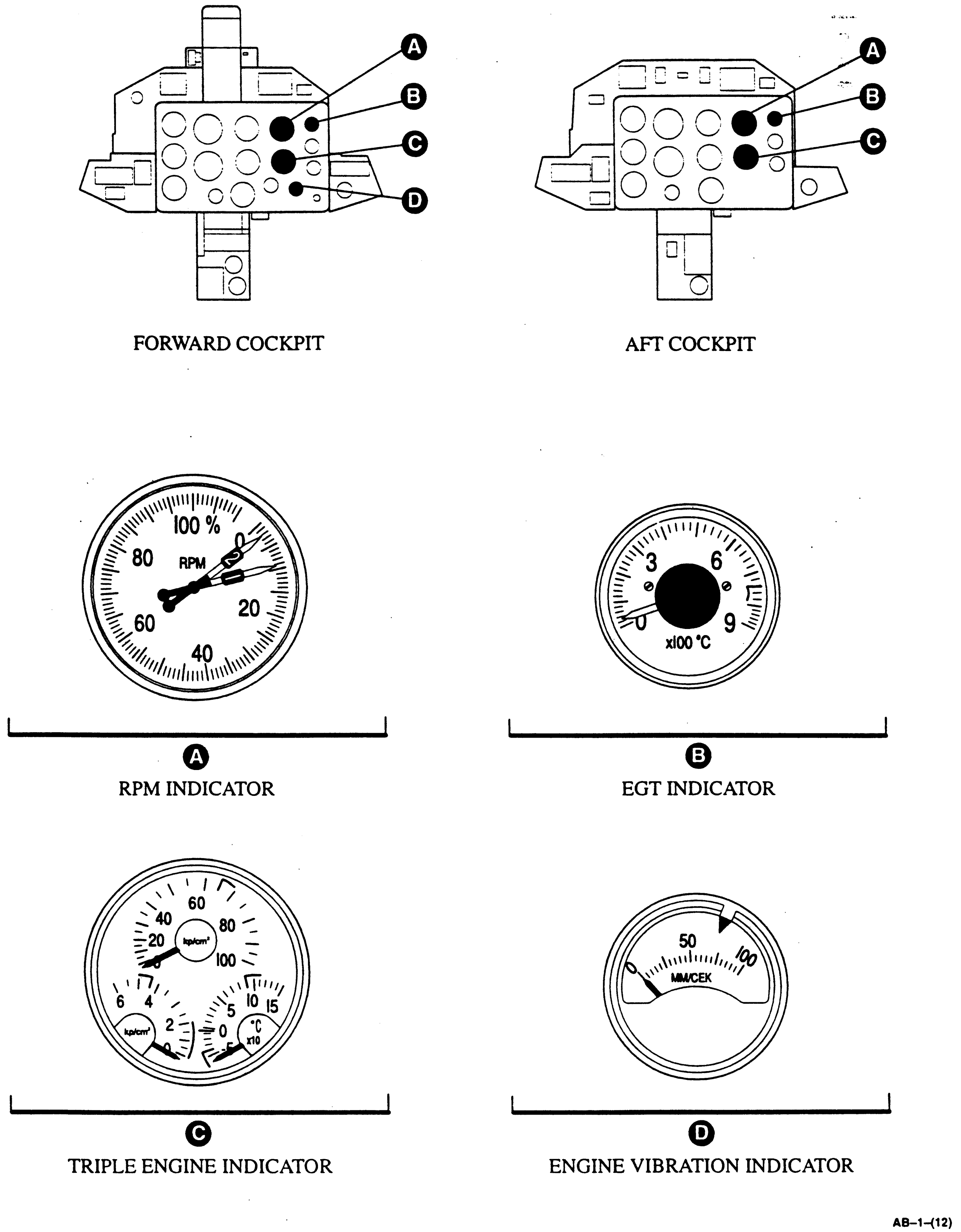


Figure 1–12. Engine Instruments

The indicator is marked with a yellow marking which indicate the normal specific engine tolerance zone after coming out of the work shop. The normal tolerance zone is indicated by upper and lower yellow marking 10 mm/sec above and below the center mark. As long as the pointer is between upper and lower yellow marks the vibrations are within the normal zone. Once the vibration measured on the ground at HPC RPM 100% exceed from the normal zone it is necessary to warn maintenance personnel, or when vibrations exceed the value of 40 mm/sec (marked with a red marking) the safe engine tolerance has been jeopardized and the mission shall be aborted. The readings of the engine vibration indicator range from 0 to 100 mm/sec (i.e. 0 to 100%).

The engine vibration indicator is supplied by the 115 V, 400 Hz AC voltage either from inverter I or inverter II.

EGT LIMITER

The purpose of the system is to protect the engine against over temperature and comprises shutoff valve and limiting valve. Both functions alter their extend of intervention with engine operation according to the nose wheel position and its incorporated Weight On Wheels (WOW) switch. The system operates in conjunction with the "J.P.T. 700°C" and the "J.P.T. 730°C" lights located on the caution and advisory panel.

CAUTION

The EGT limiting system operates only at main fuel supply to the engine. When the starting fuel is delivered to combustion chamber, the EGT limiting is inoperative.

When fuel is supplied to the engine utilizing the emergency fuel control, only indication is operative not the EGT limiting system.

The system functions in three different modes:

a. On the ground, the "J.P.T. 700°C" advisory light will indicate the temperature of 685 ± 15°C with a simultaneous operation of the limiting valve, which will reduce engine fuel supply in an attempt to keep the temperature within limits. Should that action prove to be insufficient and the temperature continues to rise, activation of the shutoff valve will occur at 715±15°C which will cause the engine to shut down and "J.P.T. 730°C" light will come on.

CAUTION

If the engine is shut down automatically during starting due to the EGT limiting system operation and the "J.P.T. 730°C" light illuminates, the nexct attempt of engine starting shall not be executed and the engine shall be handed over to maintenance personnel.

b. In flight, with either L/G or flaps extended, the caution light will indicate the temperature of 685±15°C and 715±15°C, however, with no engine limiting or shutdown.

c. In flight with L/G and flaps retracted, the "J.P.T. 700°C" advisory lights will indicate the temperature of 685±15°C with simultaneous operation of the limiting valve. Should the temperature increase, the "J.P.T. 730°C" caution light will indicate the temperature of 715±15°C. However, there will be no engine shutdown.

The EGT limiting system is controlled by the electronic block. The temperature transmitters (thermocouples) provide electronic block with electrical signal proportional with EGT. Based on that signal the electronic block then controls both the limiting and the shutoff valves operation and signal lights illuminating. The electronic block is supplied with 28 V and switched on by the "JPT REG" switch located on the forward cockpit aft CB/switch panel.

If necessary the EGT limiting system can be manually switched off by guarded EGT limiting system disable switch located on the forward cockpit LH console. The switch is labeled "OFF JPT REG".

While the "J.P.T 730°C" light comes on during flight, it does not extinguish after EGT drops below that value and remain lighting even after landing. In that case, the engine is automatically shut down after nose wheel touches down.

The system can be tested on the ground using the EGT limiter test switch "JPT–REG. TEST" located on the fwd cockpit RH console. Positioning the switch to position I will cause the "J.P.T. 700°C" light comes on and in position II the "J.P.T 730°C" light comes on.

FIRE WARNING SYSTEM

The fire warning system consists of the fire detectors and the fire warning lights "FIRE" in the warning panels.

FIRE DETECTORS

Two blocks of three fire detectors, are installed in the engine nacelle for fire detection. Whenever either the temperature in the engine nacelle increases at a rate of more then 4°C per second or the temperature reaches 200°C, a realy cloese and the "FIRE" warning light illuminate. When the fire has extinguished or when the temperature in the engine nacelle decreases rapidly, the warning light extinguish and the warning circuit is rearmed.

FIRE WARNING CIRCUIT TEST SWITCH

A fire warning circuit test switch is located in the forward cockpit pedestal. The spring–loaded three–position "FIRE SIG. TEST" switch has a CHECK function on either sides to check each of the two blocks of fire detectors. Moving "FIRE SIG. TEST" switch to both positions will illuminate "FIRE" warning light.

FIRE WARNING LIGHT

A red warning light labeled "FIRE" in the warning panels in both cockpits illuminates whenever the fire detectors sense fire or over heat.

FIRE EXTINGUISHING SYSTEM

The fire extinguishing system consists of the fire extinguisher and the distribution manifold on the forward part of the engine.

Two pzrotechnical charges blow open the fire extinguisher valve, thus releasing its contents to be distributed through the manifold. For system operation at least one pyrotechnical charges shall be fired.

Fire extinguisher buttons are installed on the forward part of the LH console in both cockptis. The button is guarded by a red cover labeled "EXT". Pressing either one of these buttons, fires the pyrotechnical charge, electrically, and opens the fire extinguisher bottle.

The circuit is protected by two C/Bs. The first one, labeled "FIRE EXT" is located in the nose compartment. This C/B is powered by 24V directly from the battery bus. The second one is located in the aft CB/switch panel and labeled "FIRE". This C/B is powered by 26 V DC. Each control one of the pyrtoechnical charges which under normal circumstances will be fired simultaneously.

FUEL SYSTEM (Figure FO–1)

The A/C fuel low pressure (LP) supply system extends from the fuel tanks to the HP engine fuel control. It consists of five interconnected fuselage fuel tanks, two tip tanks, and one inverted flight reservoir.

A fuel shut–off valve, a LP fuel pump, a LP fuel filter with a LP sensor and a fuel indicator complete the system. The APU fuel system is also fed by the A/C fuel system.

For fuel quantity information refer to fuel tanks description herein and in figure 1–13.

FUEL TANKS (Figure 1–13)

FUSELAGE TANKS

Five rubber fuselage tanks are located between the aft cockpit and the engine. Tank No. 2 is equipped with a combined venting and filler port, fuel quantity transmitter which includes the 150 kg (330 lbs) remaining warning and an over–flow line between tanks No. 2 and 5. A check valve, located in he over–flow line, prevents fuel back flow from the tank No. 5.

Tank No. 5 is the collecting tank from all the other tanks including the wing tip tanks. Fuel from other tanks passes to the tank No. 5 by self–flowing. In the bottom section of the tank, an electrically–driven booster pump is located and in the upper section there is the float valve for controlling fuel transfer from wing tip tanks. The valve is opened for transfer of fuel to tank No. 5 when the level is reduced to approximately 625 to 680 kg depending on the fuel density and temperature. The booster pump is protected by the "PUMP" C/B, located on the aft CB/switch panel.

Tanks No. 3 and 4 fill up the room between the air intake ducts and the fuselage contour.

A venting manifold interconnects the upper sections of all tanks.

Fuel from the electrically–driven LP booster pump at a pressure of 90 to 110 kPa (13 to 16 psi) is supplied to the engine driven HP pump, via the fuel line which runs between tank No. 5 and the HP fuel pump. The fuel line incorporates a non–return valve, a stop cock, and a drain valve used for maintenance purposes, an inverted flight reservoir and a fuel shut–off valve which is controlled mechanically from either cockpits.

INVERTED FLIGHT RESERVOIR

An inverted or negative "g" reservoir with a capacity of 19 lbs (2.77 gal/10.5 liters) is located on the interconnecting fuel line between tank No. 5 and the HP fuel pump. Air pressure 40 to 45 kPa (6 to 7 psi) bled from the engine HP compressor is used for pressurizing the reservoir. During inverted fight, the booster pump in tank No. 5 is exposed, causing its output pressure to drop to zero. With reservoir pressure of 6 to7 psi, fuel is then supplied, though under lower pressure than normal, from the inverted flight reservoir to the HP pump and can keep the engine operating for 20 seconds at max rating power. Once the A/C resumes positive "g", the booster pump is re–covered and the pressure output overpowers the reservoir pressure, thus, taking over engine fuel supply immediately and replenishing the inverted fight reservoir within 10 seconds.

WING TIP TANKS

Two nondropable wing tip tanks with a capacity of 175 lbs (26.5 gal/100 liter) each, are connected to the wing main girder. Fuel is transferred by bleed air pressure 40 to 45 kPa (6 to 7 psi) into fuselage tank No. 5. The wing tip tanks can be refueled by their own filler necks.

FUEL SHUT–OFF VALVE (Figure 1–14)

A fuel shut–off valve is installed in the fuel line, leading to the HP pump, at the outlet of the fuel tank No. 5. The valve is mechanically controlled and operated from either cockpits by a lever "FUEL SHUT–OFF VALVE". The valve is in open position when the lever is fully pushed forward. In this position the lever should be safety wired and guarded by a red cover.

FUEL QUANTITY INDICATOR (Figure 1–14)

The fuel quantity indicator provides a reading of fuel quantity in the fuselage tanks expressed as a mass (kg or lbs) and not as a volume (liter or gal). This design characteristic of the system offers the advantage of providing a value directly proportional to the amount of energy available on board (the fuel heat energy is directly proportional to the mass unit and not to the volume unit). The indication is however subject to change as a result of the various densities of the fuel used or a variation of the fuel temperature. The system is set to provide indications as a function to a sample fuel with approximately 777 kg/m^3 (6.485 lb/gal) density (1,060 liters $\leq$ 0.777 = 824 kg = 1,816 lbs). The Jet A–1 fuel density of 15 °C can vary from 775 to 840 kg/m^3 (from 6.469 to 7.011 lb/gal in accordance with production specifications) and the JP–4 fuel density of 15 °C can vary from 751 to 802 kg/m^3 (from 6.468 to 7.0106 lb/gal). Minimum density of 20 °C for fuel TS–1 of higher quality category is 780 kg/m^3, TS–1 of first quality category 775 kg/m^3, T–1 of first category 800 kg/cm^3, RT of first category 775 kg/cm^3. The density of PL–4 fuel can vary from 775 to 790 kg/cm^3, and the density of PL–5 from 775 to 795 kg/cm^3. The minimum density for PL–6 fuel is 775 kg/cm^3. All the above mentioned values are based on production specification or on standard.

The range of indicator's reading is from 0 to 825 kg. When the fuel mass in the fuselage fuel tanks drops to 150 kg, the electric signal is supplied to warning matrix to illuminate the "150 KG FUEL" warning light. The fuel indicator is powered by 36 V AC, 400 Hz and is switched on by the "ENGINE" switch, located on the main CB/switch panel. The aft cockpit indicator is controlled by the forward cockpit indicator.

NOTE

When the indicator reads zero, there is approximately 30 kg (70 lbs) of residual fuel in the fuselage tanks.

OTHER FUEL INDICATORS AND WARNINGS (Figure 1–14)

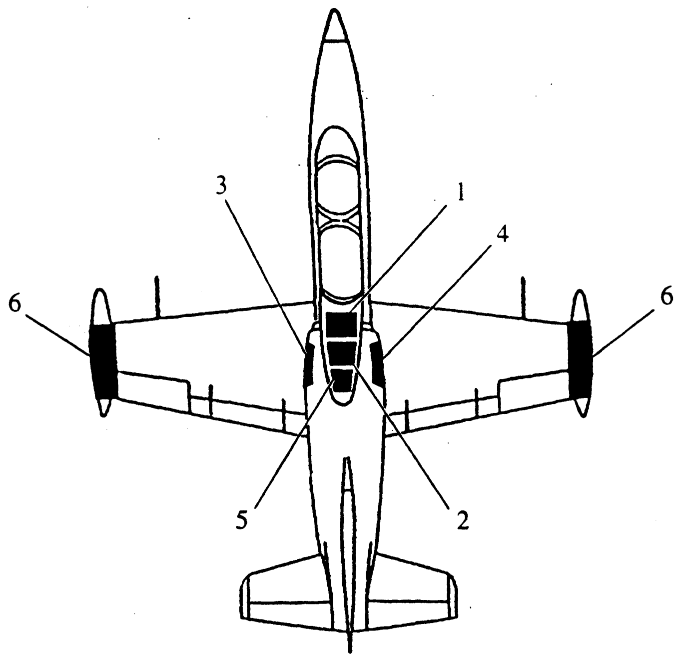
The system comprises of four indicator lights:

a. Warning light titled "150 KG FUEL" that illuminates whenever useable fuel quantity in the fuselage tanks drops to below 150 kg (330 lbs).

b. Warning light titled "DON'T START" that illuminates when the fuel pressure down–stream the booster pump is below 30 kPa (4.35 psi), or whenever the EGT limiter system is not operating.

c. Advisory light titled "WING TIP TANKS" that extinguishes whenever the fuel in the wing–tip tanks is used up or the air pressure in those tanks drops for any other reason (e.g. idle power). The air pressure probe is located in the air delivery line leading from the engine. The light can be manually switched off by "WING TANKS" switch, located on the main CB/switch panel in the forward cockpit.

d. Caution light titled "FUEL FILTER" thet illuminates whenever the differential pressure between both sides of the filter exceeds a certain value which indicates of a possible clogged filter and beginning of fuel bypass function.



NOTE

Numbers represent fuel tanks numbers

Tank No.	Location	Tank Volume		Fuel Quantity (kg)	
		Liter	Gallon	JP–4	A–1
1-5	Fuselage	1,100	290	850 ± 25	890 ± 25
6	Wing Tip	200	53	160 ± 10	161 ± 10
Total Fuel		1,300	343	1,010 ± 35	1,051 ± 35

NOTE

1. These weights are based on JP–4 fuel at 6.48 pounds per gallon and Jet A–1 fuel at 6.74 pounds per gallon (standard day only)
2. Tolerances are due to indication errors with the variations in density resulting from production tolerances, temperatures, etc.
3. For usable fuel quantity deduct 15 pounds (7 kg) from fuselage tanks fuel quantity and/or from total fuel quantities.

AB–1–(13)

Figure 1 – 13. Fuel Tanks Arrangements

FUEL SYSTEM OPERATION

When the "ENGINE" switch is switched on, (provided that the "PUMP" C/B is on), the booster pump in tank No. 5 starts operating and as soon as fuel pressure exceeds 30 kPa (4.35 psi), the "DON'T START" warning light is extinguished. Fuel is then supplied both to the engine and the APU fuel system. With the engine running, the air bled from the engine compressor is directed at a regulated pressure into the wing-tip tanks, attempting to force fuel out of the respective tanks. Once the level in the fuselage delivery tank drops by to approximately 625 to 680 kg a float valve enables fuel to be directed into the delivery tank, making the wing-tip tanks the feeder source of the fuselage tank (the fuel quantity indicator remains steady as fuel quantity is measured in the fuselage tanks). When the wing-tip tanks are depleted, fuel quantity in the fuselage tanks starts to decrease. When the total remaining usable fuel drops to below 150 kg (330 lbs), the "150 KG FUEL" warning light illuminates, warning the pilot of the low fuel state.

FUEL TRANSFER

Air bleed from HP compressor is directed into wing tip tanks and pressurizes them. Fuel is then fed from the wing–tip tanks until all fuel is transferred into the delivery tank, when upon completion, the "WING TIP TANKS" light illuminates. The bleed air will still flow through the wing-tip tanks into the fuselage tanks in order to maintain the fuselage tanks pressurized, and from the fuselage tanks the air streams-out to the atmosphere.

FUEL SYSTEM SUMMARY

TANK CAPACITIES

For fuel tank capacities refer to figure 1–13.

FUEL TRANSFER SEQUENCE

- Initial transfer to fuel mass of 625 to 680 kg in fuselage tanks (1 – 5)
- Wing tip tanks (6)
- Remaining fuel from fuselage tanks

MEANS OF FUEL TRANSFER

- From tip tanks: bleed air pressure 40 to 45 kPa (6 to 7 psi)
- From fuselage tanks: electrically–driven fuel booster pump, output pressure from 90 to 110 kPa (13 to 16 psi)
- From inverted flight fuel reservoir: bleed air pressure 40 to 45 kPa (6 to 7 psi)

FUEL QUANTITY INDICATIONS

- Tanks full – gage indicates maximum (upon reference fuel density 777 kg/m^3 it is 850 kg)
- Fuel quantity indication decreases to 625 to 680 kg according to fuel density and temperature.
- Wing–tip transfer – indication remains steady

NOTE

When engine is running at higher ratings, its fuel demand can be higher than rate of fuel transferred from wing–tip tanks. In that case the fuel indicator reading can reasonably decrease during fuel transfer from wing–tip tanks.

- End of transfer from wing–tip tanks – "WING TIP TANKS" light illuminates.
- Quantity indication decreases.
- When quantity goes down to 150 kg (330 lbs), indication from then onwards, is accompanied by "150 KG FUEL" warning light.

INVERTED FLIGHT

- Limited to 20 sec at max engine power rating
- Refilling of the reservoir during normal flight: 10 sec.

NOTE

- During fuel delivery from wing tip tanks at rpm lower than 85% "WING TIP TANKS" light may illuminate due to insufficient bleed air pressure.
- After completion of fuel delivery from wing tip tanks, with a fuel quantity of more than 600 kg (1,300 lbs) in the fuselage tanks, an intermittent flashing of "WING TIP TANKS" light may occur. This is not a malfunction.

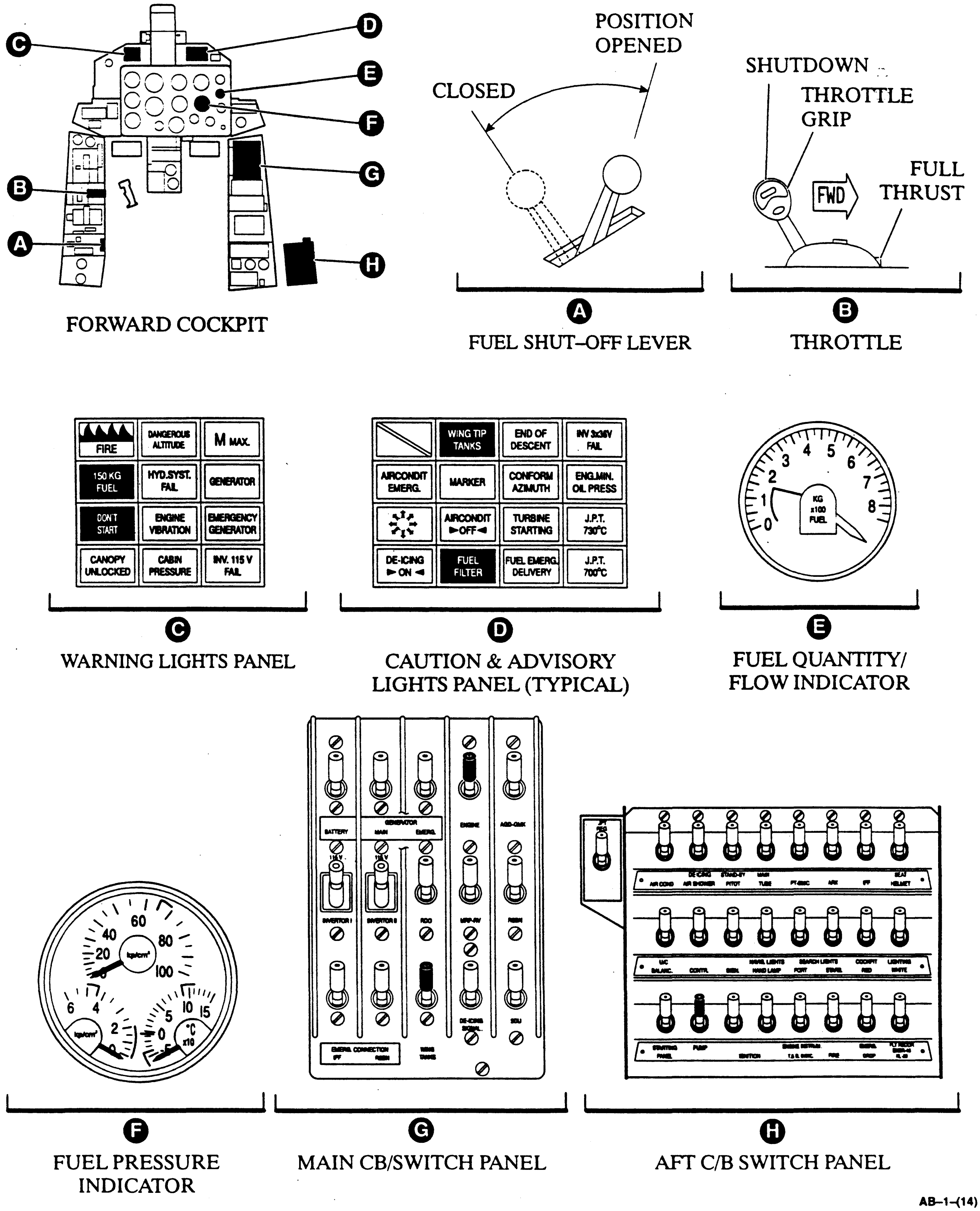


Figure 1–14. Fuel System – Controls and Indicators

ELECTRICAL POWER SUPPLY SYSTEM (Figure 1-15 through 1-20)

The aircraft electrical power supply is obtained from a 28 V DC system by an engine-driven main generator, a ram-air turbine driven stand-by generator and a battery. Alternating current of 3 × 115 V, 400 Hz is obtained from two single-phase inverters and 3 × 36 V AC from two triple-phase inverters. The inverters are powered by DC power supply. An external power receptacle for connecting an external power source, is located on the fuselage left side.

The DC power supply is controlled by toggle switches located on the main CB/switch panel in the forward cockpit LH console. Individual circuits are protected by bimetal toggle C/Bs located on aft CB/switch panel in the forward cockpit.

Whatever the source is, in order to have electric power supply on line, "NETW." switch, in the aft cockpit, must be placed to the ON position.

DC POWER SUPPLY SYSTEM (Figure FO-2)

MAIN GENERATOR

The main DC power supply system consists essentially of a 9 kW engine-driven generator. For the generator to be connected to the circuit, the "GENERATOR MAIN" switch, located on the main switchboard in the forward cockpit, must be switched on. The generator to be connected to the power supply, the following conditions shall be met:

- "NETW." switch in the aft cockpit in ON position
- generator voltage is higher than battery voltage
- external power source disconnected from the aircraft

As the generator connects to the power supply the "GENERATOR" warning light extinguish in both cockpits. The voltammeter then indicates the generator output voltage 28.5 V and currency actually provided by the generator to the power supply. If the voltage provided by the generator drops below the permissible value, the generator is automatically disconnected from the power supply and the "GENERATOR" warining light comes on.

BATTERY

An emergency DC power source is provided by a 24 V, 28 Ah battery located in the nose compartment LH side. It is controlled by the "BATTERY" switch located in the main CB/switch panel in the forward cockpit (and by the "NETW." switch in the aft cockpit).

When power is supplied by the battery only, the IFF and RSBN systems are disconnected automatically.

NOTE

> If necessary, both systems can be re-connected to the power supply by "EMERG. CONNECTION IFF" and "EMERG. CONNECTION RSBN" switches, located on the main CB/switch panel in the fwd cockpit. However when these systems are connected to the battery power supply, period of battery power supply to other systems is significantly shortened.

A volt meter, located on the instrument panel in the forward cockpit indicates DC voltage only, current is not indicated in this case.

AC POWER SUPPLY SYSTEM (Figure FO-3)

Alternating current is provided by two single-phase 115 V inverters, and two triple-phase 3 × 36 V inverters.

INVERTER I

The static semiconductor single-phase 115 V, 400 Hz inverter supplies alternating current to the UHF/VHF radio, ADF, radio altimeter, marker, ice sensor, engine vibration transmitter and ECS valves and is connected to the circuit through the "INVERTOR I" switch located on the main CB/switch panel in the forward cockpit.

INVERTER II

The inverter II is of the same type as the inverter I. It supplies current to IFF, RSBN and missile seeker heads. The inverter is activated by switching "INVERTOR II" switch on the main CB/switch panel in the forward cockpit.

INVERTER III

The inverter III is small static semiconductor triple-phase 3 × 36 V, 400 Hz instrument. It is connected to the circuit through the "ENGINE" switch located on the main CB/switch panel in the forward cockpit and protected by "ENGINE INSTRUM./T.&B. INDIC." circuit breaker. It supplies alternating current to the following instruments:

- triple engine indicator (oil and fuel pressure indication)
- fuel indicator

- longitudinal trim indicator
- turn indicator (part of the vertical velocity/turn & slip indicator)

INVERTER IV

The rotary triple–phase 3 × 36 V, 400 Hz inverter supplies alternating current to the gyro units of the following instruments:

- ADI, attitude director indicator KPP
- Directional gyro
- RSBN
- SDU

It is connected to the circuit through the "AGD–GMK" or "RSBN" switch located on the main CB/switch panel in the forward cockpit, or by "ENGINE INDICAT. EMERG." switch located on the auxiliary switch panel. The inverter IV is protected by the "PT–500C" circuit breaker, located on the aft CB/switch panel in the forward cockpit.

SYSTEM FAILURES

INVERTER I OR II

The indication of the inverter I or II failure will be recognized by the "INV. 115 V FAIL" warning light illumination and all the electric consumers will connect to that inverter which has no failure. Power of each inverter is sufficient for supplying all the above mentioned consumers.

INVERTER I AND II

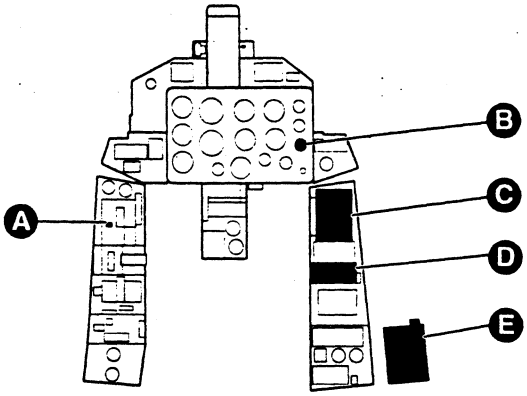
If both inverter I and inverter II failure, all their consumers will not be powered. The failure can be recognized by "INV. 115 V FAIL" warning light illumination and appearance of warning flags on radio altimeter indicator and ADI with temperature changes in the cabin not corresponding to the preselected values.

INVERTER III

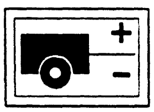
The indication of the inverter III failure will be recognized by the "INV. 3 × 36 V FAIL" caution light illumination. To restore the power, the triple engine indicator (oil and pressure indicator), fuel indicator, turn indicator and longitudinal trim indicator can be connected to the inverter IV by "ENGINE INDICAT. EMERG" switch, located on auxiliary switch panel in the fwd cockpit left console.

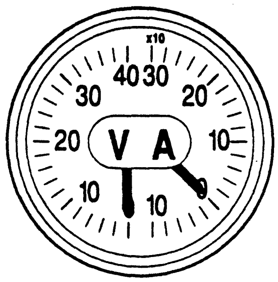
INVERTER IV

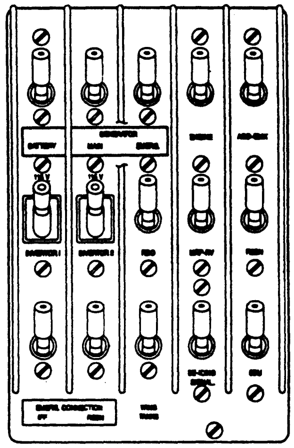
If inverter IV failures all navigation and flight instruments obtained power from the inverter IV will be out of operation. The failure is indicated by red light on ADI.



FORWARD COCKPIT



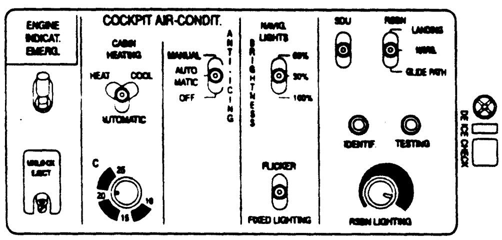


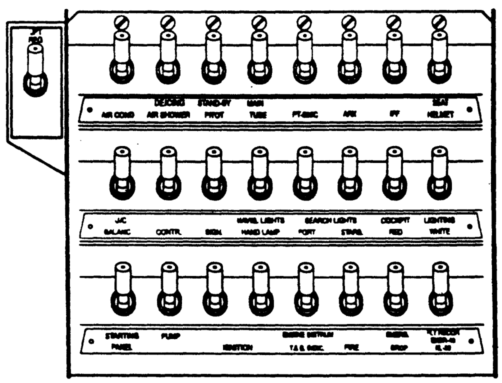


A
EXTERNAL POWER INDICATOR LIGHT

B
VOLTAMMETER

C
MAIN C/B SWITCH PANEL



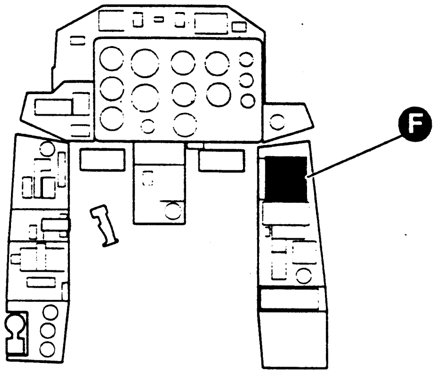


D
AUXILIARY SWITCH PANEL

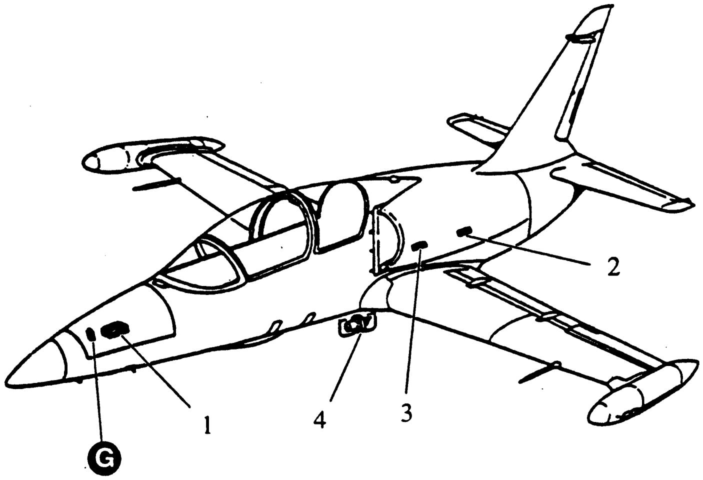
E
AFT C/B SWITCH PANEL

AB–1–(15–1)

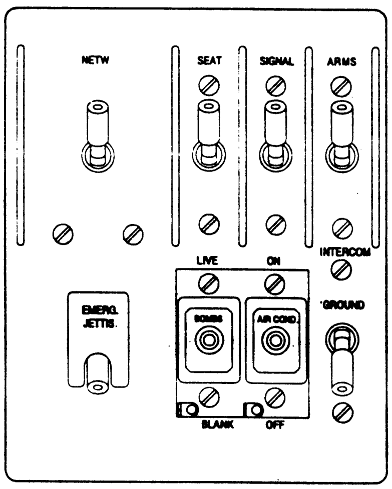
Figure 1–15. Electrical Power Supply System – Location and Control (sheet 1 of 2)



AFT COCKPIT

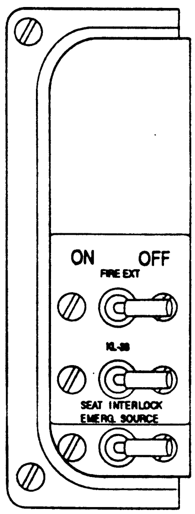


1. Battery
2. External Power Plug
3. Main Generator
4. Auxiliary Power Supply (RAT)



F

MAIN C/B SWITCH PANEL

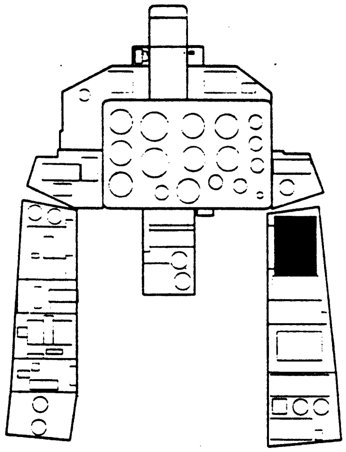


G

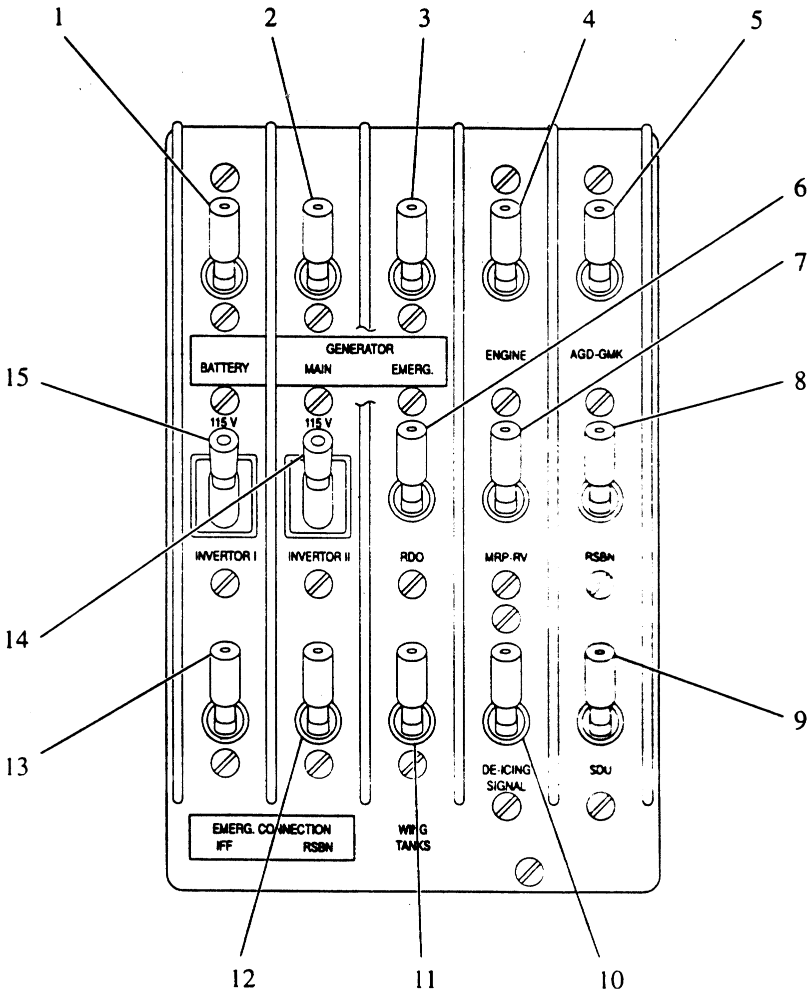
CONTACTOR BOX

AB-1-(15-2)

Figure 1-15. Electrical Power Supply System – Location and Control (sheet 2 of 2)



FORWARD COCKPIT



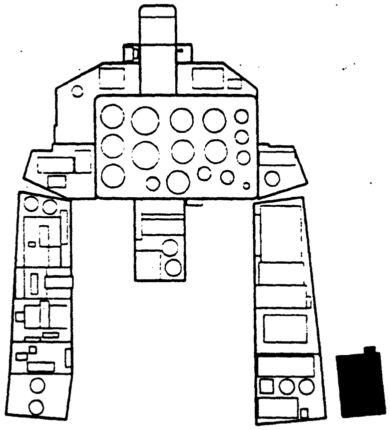
AB-1-(16-1)

Figure 1-16. Main C/B Switch Panel (sheet 1 of 2)

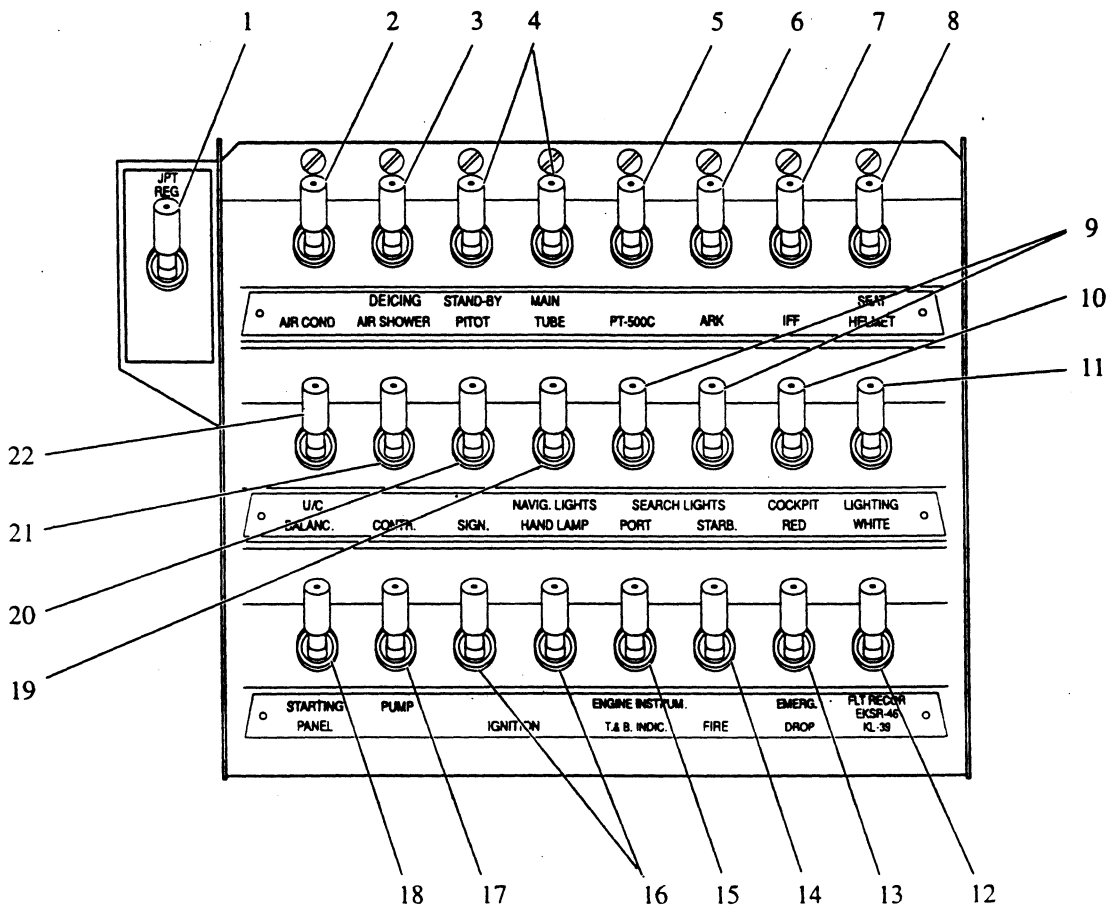
Pos.	Switch	Function
1.	BATTERY	Provides battery or external power supply to aircraft.
2.	GENERATOR MAIN	Power from main generator is connected to DC BUS if generator is working.
3.	GENERATOR EMERG.	Power from stand–by generator is connected to DC BUS if generator is working RAT retraction.
4.	ENGINE	Activates and protects engine starting system and connects engine instruments, fuel indicator and inverter III to power supply.
5.	AGD–GMK	Connects GMK directional gyro, AGD gyro unit, inverter IV, RMI and ADI.
6.	RDO	Connects and protects ICS and radio.
7.	MRP–RV	Connects radio altimeter and marker.
8.	RSBN	Connects RSBN system and inverter IV.
9.	SDU	Protects SDU direct command landing system to network.
10.	DE–ICING SIGNAL.	Connects icing signalization system.
11.	WING TANKS	Enabled function of tip tanks advisory.
12.	EMERG. CONNECTION RSBN	RSBN manual connection when main power source failure.
13.	EMERG. CONNECTION IFF	SRO (IFF) manual connection when main and standby power source failure.
14.	INVERTOR II	Inverter II is on.
15.	INVERTOR I	Inverter I is on.

AB–1–(16–2)

Figure 1–16. Main C/B Switch Panel (sheet 2 ze 2)



FORWARD COCKPIT



AB-1-(17-1)

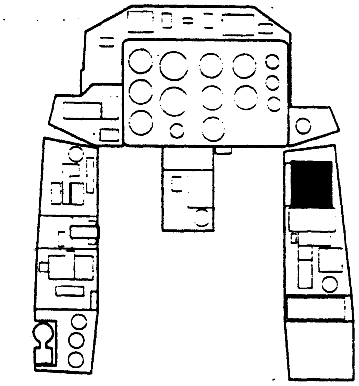
Figure 1–17. Aft C/B Switch Panel (sheet 1 of 2)

Pos.	Switch	Function
1.	JPT REG	Connects EGT limiting system.
2.	AIR COND	Connects ECS.
3.	DE-ICING AIR SHOWER	Controls de-ice system, diffusers (air showers) and ventilation suit shut-off valves.
4.	PITOT TUBE STAND-BY/MAIN	Protects pitot-static tubes heating circuit.
5.	PT-500C	Protects inverter IV circuit.
6.	ARK	Protects ADF circuit.
7.	IFF	Protects SRO (IFF) circuit.
8.	SEAT HELMET	Protects ejection seat height adjustment in the forward cockpit and helmet visor heating.
9.	SEARCH LIGHTS PORT/STARB.	Protects left and right landing/taxi light circuit.
10.	COCKPIT LIGHTING RED	Protects main instrument lighting circuit.
11.	COCKPIT LIGHTING WHITE	Protects stand-by instrument lighting circuit.
12.	FLT RECORD EKSR-46 KL-39	Protects flight data recorder and signal flares fire circuit.
13.	EMERG DROP	Protects stores emergency jettison circuit.
14.	FIRE	Protects electric circuit of one fire-extinguisher pyrocartridge.
15.	ENGINE INSTRUM. T.&B. INDIC.	Protects inverter III circuit, circuits of pitch trim controls and indication and engine instruments.
16.	IGNITION	Protects engine ignition circuit.
17.	PUMP	Protects LP delivery fuel pump circuit.
18.	STARTING PANEL	Protects engine starting panel circuit.
19.	NAVIG. LIGHTS HAND LAMP	Protection of NAV lights, L/G auxiliary lights and power supply of auxiliary hand lamps sockets [1].
20.	SIGNAL	Protects pitch and roll trim controls and indication, controls and indication of flaps, speed brakes, warning, C&A lights in forward cockpit.
21.	CONTR.	Protects controls and indications of flaps, speed brakes, wheel brakes and ABS operation, speed brakes automatic extension at Mach max. and WOW switch.
22.	U/C BALANCE	Protects control and indication circuit of pitch and roll trim, flaps and landing gear.

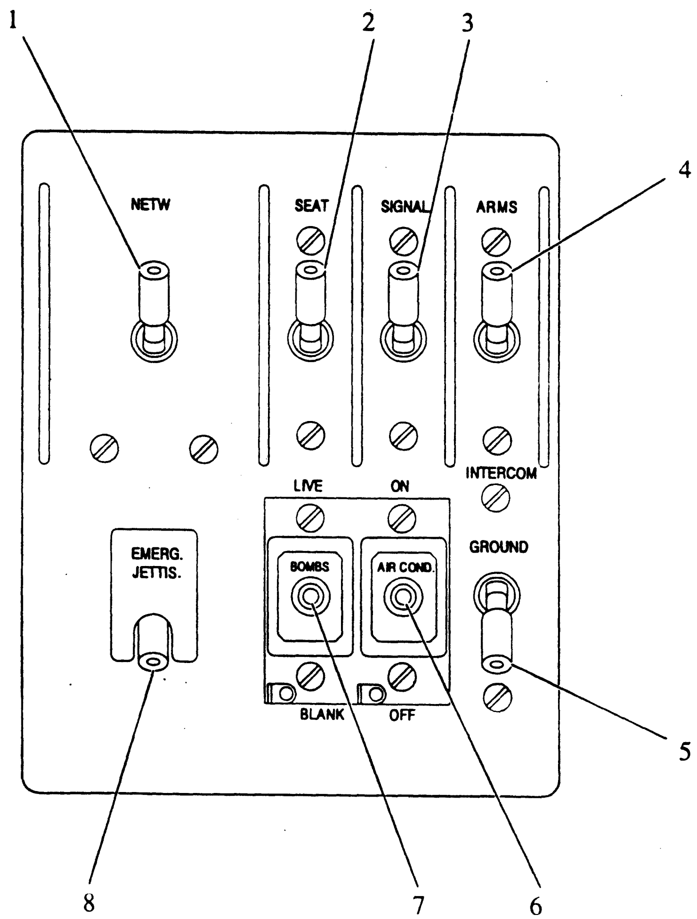
[1] There are several sockets around the aircraft used by maintenance personnel to power portable hand lamp.

AB-1-(17-2)

Figure 1-17. Aft C/B Switch panel (sheet 2 ze 2)



AFT COCKPIT



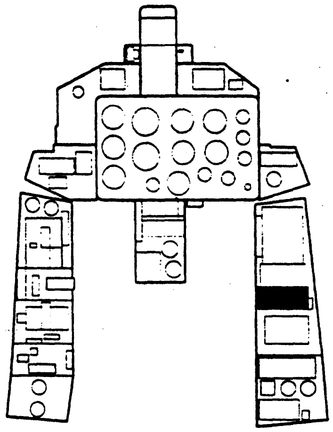
AB-1-(18-1)

Figure 1-18. Miscellaneous C/B Switch Panel (sheet 1 of 2)

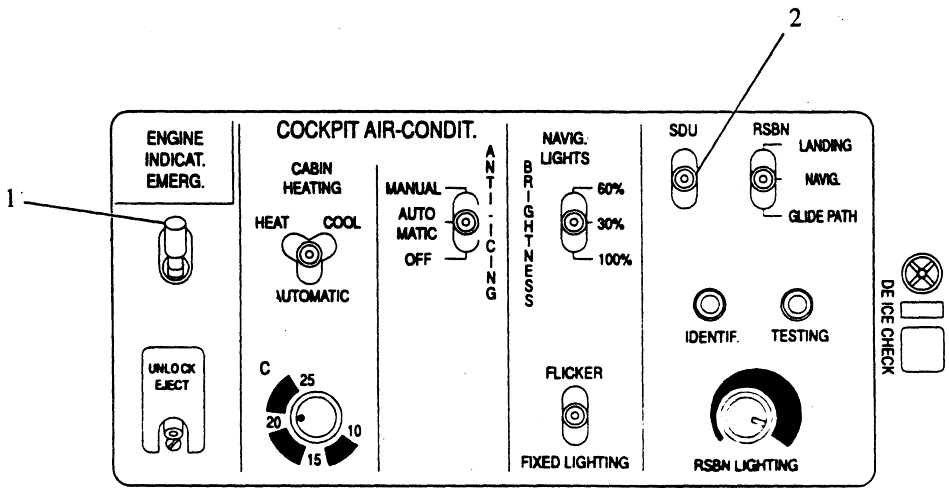
Pos.	Switch	Function
1.	NETW.	Power supply on line of any DC power source.
2.	SEAT	Protects ejection seat height adjustment in aft cockpit.
3.	SIGNAL.	Protects pitch and roll trim controls and indication, controls and indications of flaps and warning, C&A lights in the aft cockpit.
4.	ARMS	Protection of armament system, it overrides fwd cockpit C/B.
5.	INTERCOM GROUND	ICS protection.
6.	AIR COND.	Controls ECS shut–off valve.
7.	BOMBS	Arm/safe bombs emergency jettison switch, it overrides fwd cockpit switch.
8.	EMERG. JETTIS.	Emergency jettison switch.

AB–1–(18–2)

Figure 1–18. Miscellaneous C/B Switch Panel (sheet 2 of 2)

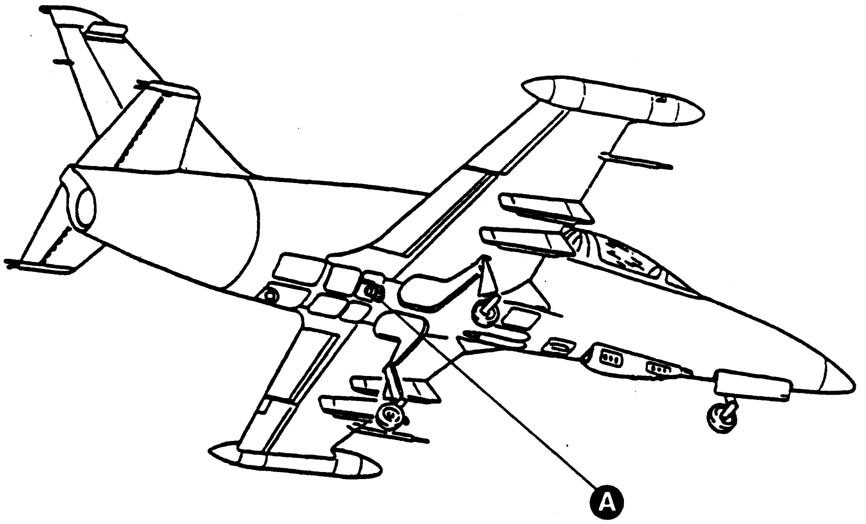


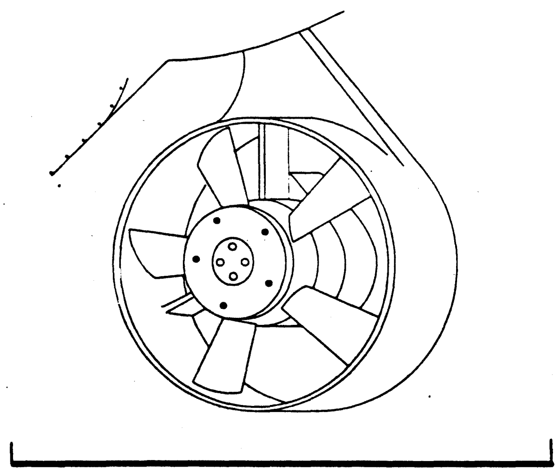
FORWARD COCKPIT



Pos.	Switch	Function
1.	ENGINE INDICAT. EMERG.	Inverter IV on line; when inverter III failure, connection of triple engine indicator, fuel indicator, turn indicator and pitch trim to inverter IV.
2.	SDU	Switch SDU direct command landing system.

Figure 1-19. Auxiliary Switch Panel





AB-1-(20)

Figure 1–20. Ram Air Turbine (RAT)

AUXILIARY POWER SUPPLY SYSTEM

An auxiliary DC power source is provided by a 3 kW, 28 V generator driven by a ram–air turbine (RAT) that extends automatically out of the fuselage into the airstream, whenever the main power supply fails (generator fail, engine fail etc.). It can be extended manually, in case of an hydraulic failure, by means of an emergency lever located on the right console in both cockpits.

When charging over between the main and the auxiliary generators, RSBN is deactivated. However the system can be manually reactivated by "EMERG. CONNECTION RSBN" switch located on the main CB/switch in the forward cockpit. Should the RAT extend due to an electrical failure and normal power is restored, the RAT will retract automatically. The RAT with the auxiliary generator can also be retracted manually by tilting the landing gear control lever to the right side (in retracted position) or by switching off the "GENERATOR EMERG." switch or the "NETW" switch on the miscellaneous CB/switch panel. In case of emergency landing with RAT extended, the RAT will automatically retract after nose landing gear touch down.

NOTE

The RAT can be retracted using landing gear control lever only during landing gear retraction process when the LG control lever was just moved to UP position. This way of RAT extension is used when engine flame–out occurs immediately after take off and emergency belly landing shall be executed. If the LG is in retracted and locked position, the RAT cannot be retracted using LG control lever.

CONTROLS AND INDICATORS

The auxiliary generator is connected to the circuit through the "GENERATOR EMERG." switch located on the main CB/switch panel in the forward cockpit. Operation of the RAT generator is indicated by a combination of the "GENERATOR" and the "EMERGENCY GENERATOR" lights as follows:

a. "GENERATOR" light off and "EMERGENCY GENERATOR" lights off – RAT is retracted and not operating.

b. "GENERATOR" light on and "EMERGENCY GENERATOR" light off – RAT is extended and operating.

c. "GENERATOR" light on and "EMERGENCY GENERATOR" light on – The RAT is needed, but fails to provide electrical power, or not extended. Power supply is obtained from the battery.

EXTERNAL POWER SUPPLY

The external power panel consists of a receptacle, a switch and a green light.

Once the external power supply is connected, the switch "NETW." and "BATTERY" may be set to ON position to activate power. When the connector is actually energized, the green light illuminates together with the external power light on the starting panel in the forward cockpit ("NETW." and "BATTERY" switches must be on).

Should the battery be activated or main generator operates at the time when external power is introduced, a relay will open and isolate the battery and the generator from the power bus.

HYDRAULIC SYSTEM (Figure FO–4)

The hydraulic power supply system operates at a nominal pressure range within 135 to 150 kg/cm^2 (13.5 to 15 MPa) and consists of a main and an independent emergency circuit. Individual circuits (landing gear, wheel brake, etc.) are connected to the main one.

NOTE

Due to decreasing pressure during high altitude flight the pressure in emergency circuit can gradually drop to 120 kg/cm^2 (12 MPa) at aircraft maximum ceiling. The pressure in the emergency circuit is recovered again when the aircraft descends.

The main hydraulic system provides the hydraulic pressure necessary for operating the landing gear, wheel brakes, flaps, speed–brakes and extending the ram–air turbine (RAT). It consists of a reservoir, an engine–driven variable rate hydraulic pump, filters, a relief valve and a pressure accumulator.

The three emergency circuit accumulators provide the hydraulic pressure which is sufficient for the extension of the landing gear, flaps to landing position and the ram–air turbine in emergency and for the operation of the emergency brakes in the event of an hydraulic pump failure, and for speed brakes emergency retraction.

The circuit next comprises of a filling check valve, separating between the main (landing gear circuit) and emergency circuits. The filling valve will open to equalize the pressure between the normal and emergency circuit, whenever the pressure in the main circuit is higher than 90 kg/cm^2 (9 MPa) and L/G is extended. Both, the main and emergency circuits, are fitted with pressure indicators. The indicators are labeled "HYDRAULIC MAIN" and "HYDRAULIC EMER" and are located on the aft RH console in both cockpits. A lever on the right console in both cockpits permits a manual interconnection of the main and emergency circuits.

A pressure drop, in the main system to 55 kg/cm^2 (5.5 MPa), is indicated by the “HYD. SYST. FAIL” warning light located on the warning lights panel in both cockpits. The “pressure drop” signal is also sent to flight data recorder (FDR).

The hydraulic system reservoir is pressurized by air, bled from the engine HP compressor. The air pressure, coming out of the HPC is reduced to a value of between 0.11 to 0.22 MPa maintaining a slight positive pressure on the hydraulic fluid.

Main and emergency circuit accumulators are pressurized by nitrogen pressure 5 MPa.

HYDRAULIC SYSTEM OPERATION

When the engine is running, hydraulic fluid is pumped out of the pressurized reservoir into the main circuit. If the hydraulic pump output pressure is below 80 kg/cm^2 (8 MPa) hydraulic fluid delivery is at maximum and gradually drops to zero when the hydraulic pump output pressure reaches 150 kg/cm^2 (15 MPa). The hydraulic fluid passes from the hydraulic pump through a filter, safety and check valves to the main accumulator, which dumps any pressure fluctuations and extends the pump’s “arm” (compensates for pressure drop due to high pressure demand). The hydraulic line between the pump and main pressure accumulator comprises solenoid valves of independent operating circuits and pressure transmitters. The main circuit pressure indicators in both cockpits are labeled “HYDRAULIC MAIN”. Used hydraulic fluid comes back to hydraulic reservoir through the filter.

Once the pressure value of 90 kg/cm^2 (9 MPa) is exceed, a filling valve opens and permits hydraulic fluid to flow from the main to the emergency circuit, until the pressure in both systems stabilizes at 150 kg/cm^2 (15 MPa). At this stage, both the “HYDRAULIC MAIN” and “HYDRAULIC EMER” pressure indicators, read the value which is the hydraulic pump output. This value will be consistently restored whenever operating an hydraulic consumer which will tend to reduce the pressure. The same operating pressure is also maintained in the pressure accumulators of the main and emergency circuits creating a reserve of hydraulic pressure sufficient for operating vital consumers in the event of a hydraulic pump failure. (The “balanced” situation between the two circuits will prevail only when the L/G is extended or when the interconnect lever is operated.)

NORMAL CONTROL

During normal operation, distribution of hydraulic pressure to the actuating cylinders is by mean of remote controlled solenoid valves with the aft cockpit controls overriding the forward cockpit controls. The control elements can be actuated from each cockpit in any order.

EMERGENCY CONTROLS

Control during emergency operation is by means of hand valves, actuated by emergency extension and interconnection control handles. These handles can be actuated from either cockpit with equal priority and in any order. After an emergency operation has been executed, it is possible and legitimate to return any emergency operated consumer, to its initial position. The position returned to, will be the one selected by the normal controls. (In order to return to normal operation the respective emergency handle must be restored to normal in both cockpits.)

LANDING GEAR SYSTEM

The aircraft is equipped with a tricycle type retractable landing gear. The gear is electrically controlled and hydraulically operated.

The main landing gear consists of a shock strut, actuators and wheel assembly equipped with triple–disc brake assembly. The gear is mounted on both sides of the fuselage and retracts inboard. The non–braked nose landing gear consists of a shock strut, shimmy damper and centering mechanism, actuator and wheel assembly. The nose gear is mounted on the forward fuselage section and retracts forward.

The gear doors are always closed after either extension or retraction of the landing gear except for a subsequent emergency extension in which case the doors remain open. Opening and closing of the doors is controlled by hydraulic actuators or by springs.

The landing gear is held in the retracted position by mechanical locks. In the extended position each landing gear strut is maintained in the locked position by hydraulic pressure and mechanical locks. The landing gear retraction on the ground is electrically blocked by means of WOW switch on the NLG. An emergency handle operates the emergency extension of the landing gear, should a hydraulic or electrical malfunction occur in the main system.

CONTROLS AND INDICATORS (Figure 1–21)

The landing gear operation is executed by landing gear control lever, located on the LH side of instrument panels in both cockpits. In its lower position the landing gear is extended (down), in the upper position of the lever the landing gear is retracted (up). The aft cockpit landing gear control lever has an additional middle neutral position, allowing to control landing gear position by fwd cockpit control lever.

WARNING

In order to enable the gear lever in the forward cockpit to control the landing gear, the gear lever in the aft cockpit must be placed at the neutral position.

NOTE

Retraction of the landing gear is possible only when the nose gear is off the ground.

In the LG lever upper (retracted) position, the RAT can be emergency retracted by tilting the LG control lever to the right. Retraction of the RAT by this way is used only when shortly after aircraft take–off the engine flames out, LG is still extended and RAT will extend automatically. To perform belly landing, it is necessary to retract both landing gear and RAT in very short sequence, it means that during LG emergency retraction (gear in transit), before the LG legs reach its locked up position, the RAT can be retracted by tilting the LG control lever to the right.

If the main hydraulic circuit failure or electrical system failure, the landing gear can be extended by the L/G emergency extension control lever.

The landing gear system indications are identical in both cockpits and consist of the landing gear position indicator panel and mechanical indicators. The L/G position indicator panel comprises of three green lights, three red lights and two advisory lights.

The green “GEAR DOWN AND LOCKED” lights, when illuminated, indicate that the respective gear strut is at the down locked position.

The red “GEAR UP AND LOCKED” lights, when illuminated, indicate that the respective gear strut is at the up locked position.

“EXTEND U/C” indication light, accompanied by an aural warning horn, illuminates whenever 44 degrees (landing position) flaps have been selected and the landing gear is not at the down locked position.

“U/C DOORS OUT” light illuminates whenever one or more of the L/G doors is unlocked.

Three mechanical external indicators provide visual confirmation that the landing gear is extended and locked. The mechanical indicators are located on the upper surface of each wing and in front of the windshield.

EMERGENCY EXTENSION

The landing gear emergency lever placarded “HYD EMER” followed by an extended LG symbol and located on the aft right console in each cockpit, provides emergency means of extening the landing gear, in case an electrical or hydraulic malfunction should prevent use of the main system. When this lever is operated by moving backward, a separate emergency LG extension circuit is fed by the emergency accumulator operates the landing gear and door actuating cylinders until the landing gear is locked at the down position. In this case, the doors remain open.

The landing gear can be retracted in emergency by means of main LG control lever, however first the main and emergency hydraulic circuits must be interconnected by moving the “MAIN AND EMER HYDRAULIC INTERCONNECT” lever backward. In this case, both forward and aft cockpits emergency L/G extension levers must be placed in the forward position.

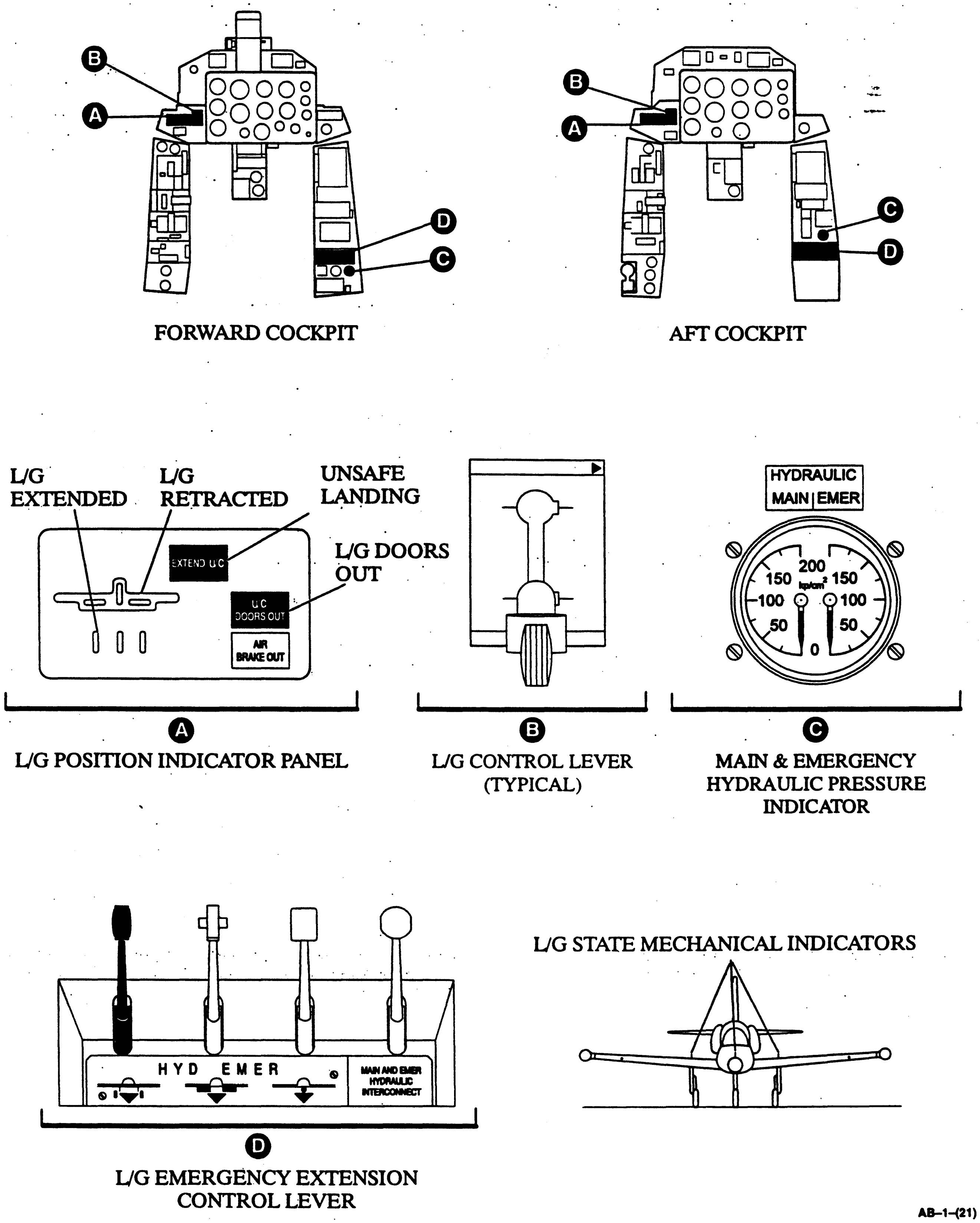


Figure 1–21. Landing Gear System – Controls and Indicators

WHEEL BRAKES SYSTEM (Figure 1–22)

The brakes system consist of two sets of disc brakes, one on each main landing gear, with a mechanical brake wear indicator, anti–skid system, control levers, emergency/ parking control levers and indicating system.

The wheel brake system is normally fed by the main hydraulic circuit pressure from 2 to 33 kp/cm^2. It consists essentially of two disc braking units on the main landing gear wheels, two control levers located on the control column in each cockpit, pressure reducing and safety valves and two sensitive selector valves, one in each cockpit, connected to the brake levers. The selector valves distribute the hydraulic pressure to the respective braking unit proportionally to rudder pedal deflection. The control lever applying the higher demand is the lever that will be controlling the brakes.

The wheel brakes will operate ONLY when the nosewheel is in the contact with the ground (WOW is on). When the nosewheel is lifted, the wheel brakes system is blocked.

When the L/G is being retracted the brakes are automatically applied to prevent the wheels from spinning in the wheel–well.

WARNING

When the speed of A/C is above 260 ± 15 km/h the antiskid system is inoperative.

EMERGENCY OPERATION

If no pressure is available in the main circuit, the brakes can still be operated, using the pressure stored in the emergency accumulator. In this case, however, the brakes are not applied by means of the brake lever but by operation of the emergency brakes lever. The lever is placarded "EMERGENCY BRAKE" and located on the left console in either cockpit. When applying emergency brakes (moving the lever backwards) the pressure 2 to 33 kp/cm^2 is derived form the emergency circuit. In this case, no differential braking is possible, since the hydraulic pressure acts simultaneously and equally on both brakes and the anti-skid system will be by-passed.

PARKING BRAKES

By moving the "PARK./EMERG. BRAKE" lever, in the forward cockpit, to the forward position the parking brakes are set utilizing the emergency hydraulic circuit.

WARNING

The wheel brakes operate only when a minimum pressure of 50 kg/cm^2 is applied to the main circuit. If the main pressure falls bellow this value, the wheel brakes can't be used normally and emergency braking is required.

BRAKE PRESSURE INDICATOR

Application of the normal wheel brakes is indicated by means of a double pressure indicator, one for each wheel, located on the center pedestal in both cockpits. The indicator indicates pressure during normal and automatic braking of the left and right wheels. Indication of emergency brake application is displayed on a separate pressure indicator, in the forward cockpit only. Since the indicators indicate applied pressure, when the brakes are not in use, the indicators will read 0.

ANTI–SKID SYSTEM

The system is designed to modulate the hydraulic pressure delivered to the brakes in order to obtain, at any time, optimum coefficient of friction between the wheels and the runway surface for any configuration, runway condition and force applied to the brake levers, thus preventing the wheels from locking which may cause the tires to burst or hydroplaning if the speed of A/C is up to 260 km/h.

Whenever the MLG wheel ceases stops rotating, the anti–skid sensor, by means of the flywheel and its switches, applies voltage to the brake release solenoid valve to release the respective wheel brake. The anti–skid is functioning in cycles 4 Hz pulses until the aircraft reaches a certain speed at which the MLG wheels rotate without interruptions.

GROUND STEERING

Steering the aircraft during taxiing is performed by means of differential braking of the right or left wheel, by depressing the brake lever and deflection of the respective rudder pedal. The turn radius is directly proportional to the rudder pedal deflection. Nose wheel maximum deflection is 60 degrees to either sides.

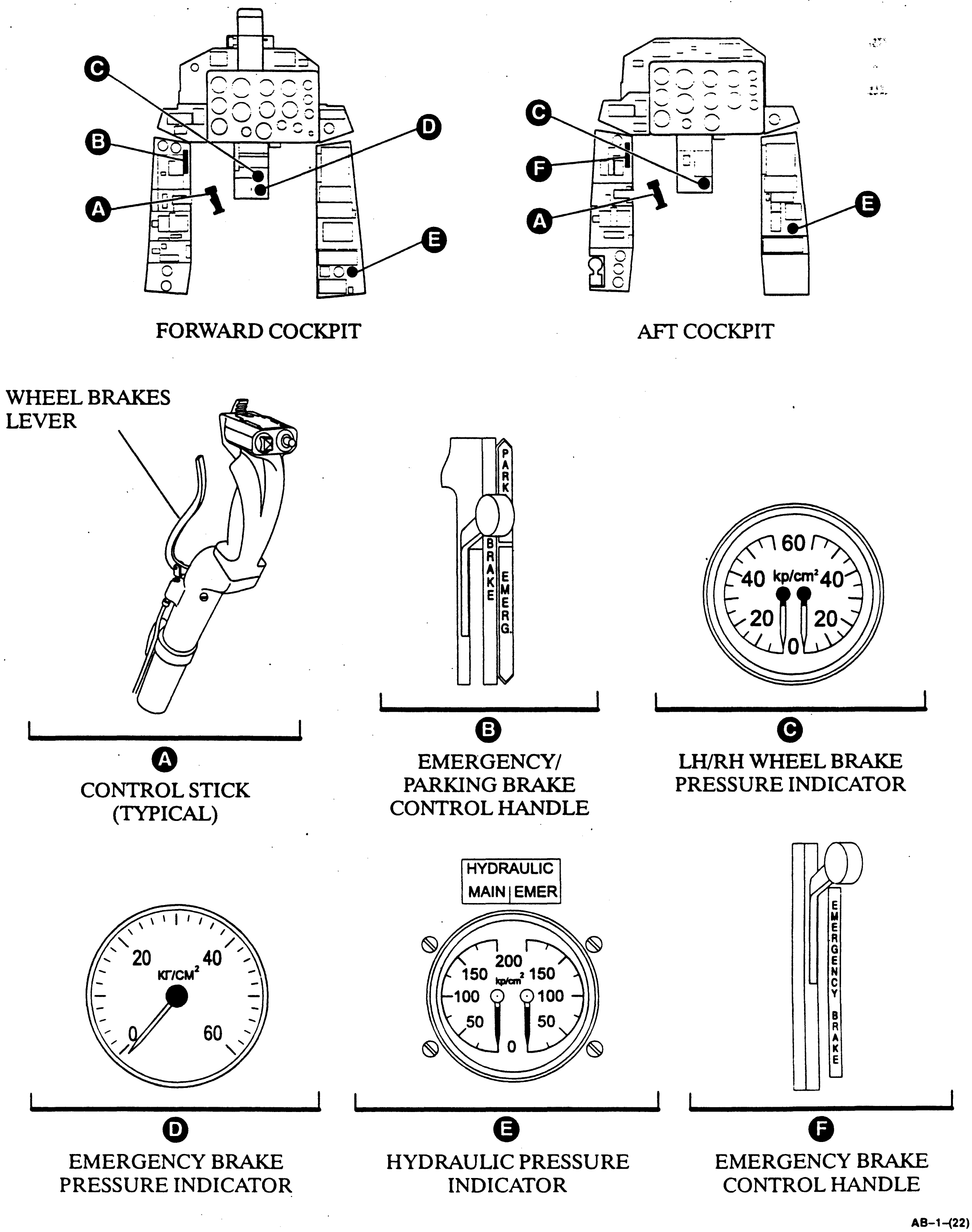


Figure 1–22. Wheel Brakes System – Controls and Indicators

FLIGHT CONTROLS

The primary flight controls (aileron, elevators and rudder) are activated by push–pull rods and levers while the secondary flight controls (trim tabs, flaps, speed brakes) are controlled by either electric or hydraulic actuators. The aileron and elevator control systems consist of two interconnected control sticks (forward and aft cockpits). The rudder control system consists of two pairs of interconnected rudder pedals. The rudder pedals can be adjusted according pilot needs by the pedal adjustment controller.

Aerodynamic balance of the ailerons and the elevator is obtained by balance tabs mounted on the trailing edge of the respective control surface. The elevator system is provided with a bungee booster. This bungee is activated by elevator deflection of approximately 13 degrees or more, to assist the pilot in overcoming the high stick forces at high speed and high "g" load.

The flight controls can be locked on the ground by means of a locking device shifted under the instrument panel.

TRIM TABS

The trim tabs provide aircraft trimming along the longitudinal and lateral axes.

Longitudinal trimming is provided by trim tabs fitted to the left and right elevators. The right trim tab is operated by electrical actuator which deflects the tab up or down. The left trim tab is controlled by the flaps extension and will deflect automatically when the wing flaps are moved from to 44 degrees (landing) position, thus effectively introducing a "nose up" trim for the flare. The right trim tab is controlled by the trim switch located on the control stick in either cockpits.

Lateral trimming is provided by combined trim/balance tab fitted to the left aileron and is operated by an electrical actuator which deflects the tab up or down. Right tab is the balance tab.

CONTROLS AND INDICATORS (Figure 1–23)

Both longitudinal and lateral trimming are controlled by a five–position spring loaded switch located on the top of the control stick grip.

In the forward cockpit, longitudinal trim position is indicated by an indicator consisting of a pointer and a top viewed miniature aircraft on a graduate scale. Consistent with the movement of the elevator tab, the pointer indicates a nose–up or nose–down attitude proportional to the amount of tab displacement. The indicator is located on the center pedestal. The aft cockpit indication consists of a trim tab neutral position green indicating light, placarded "LONGITUD".

In both cockpits, lateral trim position indicator is a "Neutral position" green light that illuminates when the aileron trim is at the neutral position. The light in the forward cockpit is labeled "NEUTRAL POSITION" and in the aft cockpit "LATERAL".

The lateral trim tabs control and indicating system is powered by 28 V and protected by "U/C BALANC." and "SIGNAL" C/Bs, located on the aft C/B switch panel in the fwd cockpit, and by "SIGNAL." C/B, located on the miscellaneous CB/switch panel in the aft cockpit. The longitudinal trim tab control and indicating system is powered and protected by the same manner as the lateral one, furthermore by the "ENGINE INSTRUM T.&B. INDIC." C/B on the aft C/Bswitch panel and "ENGINE" C/B located on the main C/B switch panel.

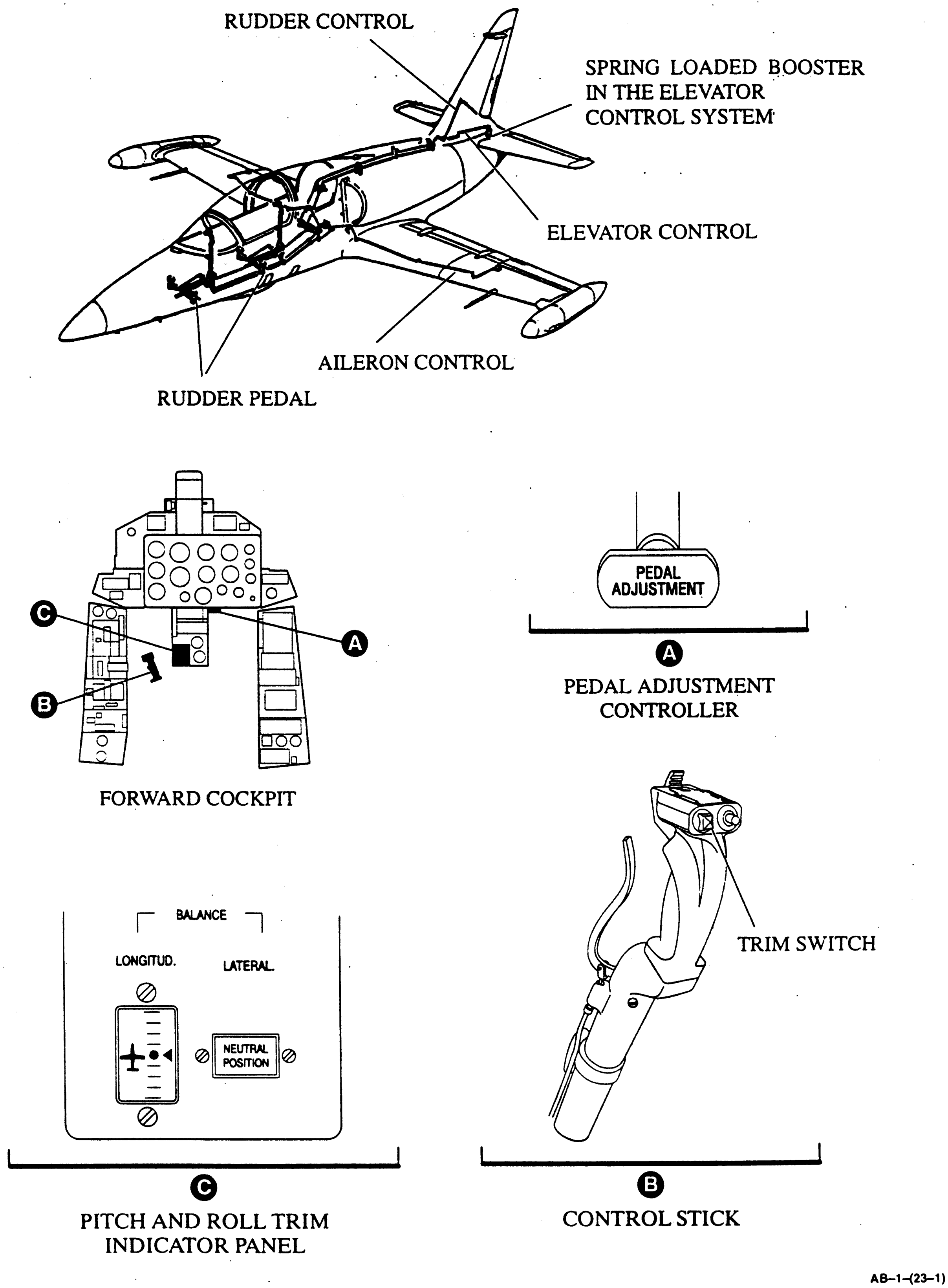
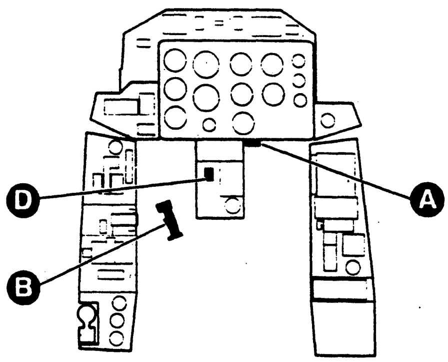
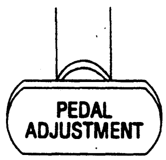


Figure 1-23. Flight Control System - Control and Indicators (sheet 1 of 2)

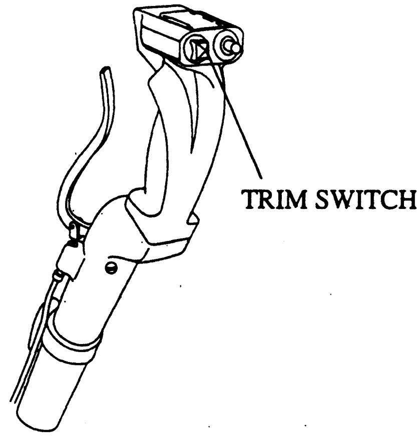


AFT COCKPIT



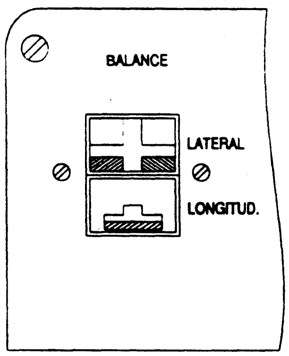
A

PEDAL ADJUSTMENT CONTROLLER



B

CONTROL STICK



D

PITCH AND ROLL TRIM INDICATOR PANEL

TABLE OF MAX. CONTROL SURFACE DEFLECTION		
ELEVATOR	- UP	30°
	- DOWN	20°
TRIM TABS	- UP	7°30′
RIGHT	- DOWN	15°
LEFT	- TOTAL	15°
RUDDER	RIGHT–LEFT	30°
RELIEF TAB	RIGHT–LEFT	15°
AILERONS	UP–DOWN	16°
RELIEF TABS		
RIGHT	UP–DOWN	2°45′
LEFT*)	UP–DOWN	3°30′

*) LEFT RELIEF TAB IS SIMULTANEOUSLY A TRIM TAB

AB–1–(23–2)

Figure 1–23. Flight Control System – Control and Indicators (sheet 2 of 2)

FLAPS SYSTEM

The hydraulically operated and electrically controlled flaps are of the slotted fowler type. The two flaps are interconnected by a single actuating cylinder. Synchronization of both LH and RH flaps is established mechanically.

CONTROLS AND INDICATORS (Figure 1-24)

The flaps may be set to one of the three positions corresponding to the appropriate control button located on the LH console. Buttons in the aft cockpit override function of aft cockpit buttons. Each button bears a symbol which represents a different flight situation.

- The forward button, symbolized by a straight line, represents "Flight" position (zero degrees).
- The center button, symbolized a slightly bent line, represents the "Take Off" position (25 degrees).
- The aft button, symbolized by a sharply bent line, represents the "Landing" position (44 degrees).

Opposite each button is an indicator light, bearing the corresponding symbol, that illuminates when the flaps have reached the desired setting. After executing the hydraulic function, the depressed button pops back to its initial position. The mechanical indicators, located on upper surface of each wing, provide visual identification of flaps position.

Controls and indication of the flaps system is identical in both cockpits.

The flaps are automatically retracted to "Flight" position (zero degrees) at airspeed above 310 ± 15 km/h.

NOTE

Flaps extension is blocked from the aircraft speed above 310 ± 15 km/h.

Flaps control and position indication is powered by 28 V and protected by the "U/C BALANC.", "SIGNAL" and "CONTR." C/Bs, located on the aft CB/switch panel in the fwd cockpit and by "SIGNAL" C/B, located on miscellaneous CB/switch panel.

EMERGENCY OPERATION

Moving the emergency flaps lever in either cockpit to the emergency position, causes the flaps to extend all the way to landing (44°) position. Moving the lever back to the initial forward position will retract the flaps. Both forward and aft levers have the same priority.

SPEED BRAKES SYSTEM

The hydraulically operated and electrically controlled speed–brakes are mounted on the wing's lower side and consists of two hinged panels which, when opened, extend 55 degrees into the airstream.

CONTROLS AND INDICATORS (Figure 1-25)

Control from the both cockpits is by means of a switch located on the throttle grip. Selecting the switch to its aft position will cause the speed brakes to extend. Selecting the switch to its forward position will retract the brakes.

<u>Forward Cockpit Control</u>

The fwd cockpit switch has three positions (functions):

forward (speed brakes retracted), aft (speed brakes extended) and pressing inward (tactical use – the speed brakes extend and remain extended as long as the switch is depressed. The moment the switch is released the speed brakes retract).

<u>Aft Cockpit Control</u>

The spring loaded to the center position aft cockpit switch has three positions (functions):

momentary forward (speed brakes are retracted as long as the switch is held in fwd position), momentary aft (speed brakes are extended as long as the switch is held in the aft position), center (enables the forward cockpit to maintain control over the speed brakes).

NOTE

The speed brakes can be controlled from the forward cockpit, ONLY if the aft switch is at the neutral position.

The aft switch has over–ride function (the speed brakes can be retracted/extended from the aft cockpit although the fwd switch is in the opposite position).

Indication is identical in both cockpits and consists of a green "AIR BRAKE OUT" light in the landing gear position indicator panel.

Upon reaching the speed of M 0.78 ± 0.02, the speed brakes extend automatically and retract once the speed is reduced below this value, while extended the "M_{max}" light will be illuminated.

The speed brakes control and indicating system is powered by 28 V and protected by the "SIGNAL" and "CONTR." C/Bs, located on aft CB/switch panel in the fwd cockpit and by "SIGNAL" C/B, located on miscellaneous CB/switch panel.

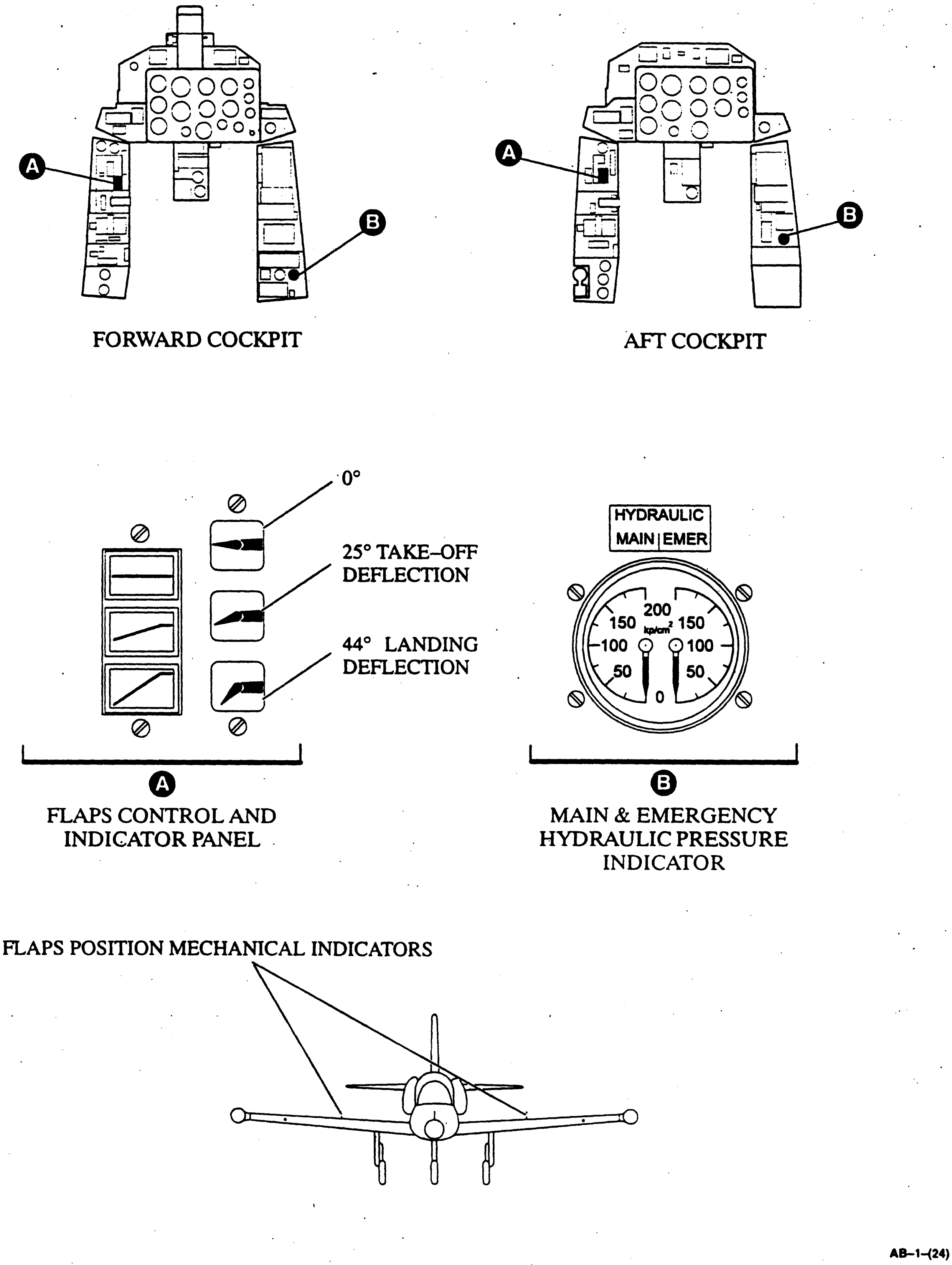


Figure 1–24. Flaps System – Controls and Indicators

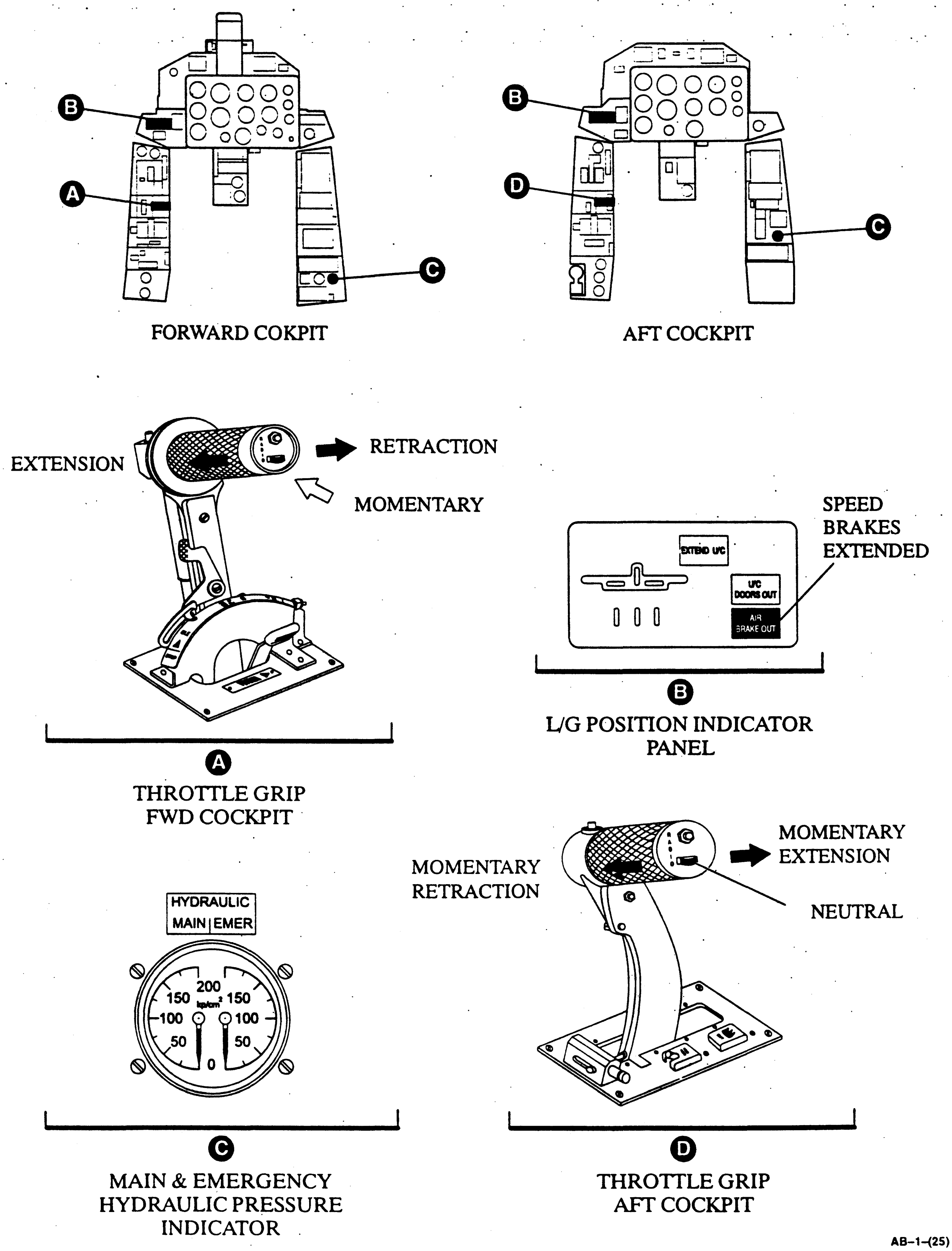


Figure 1-25. Speed Brakes System - Controls and Indicators.

ENVIRONMENTAL CONTROL SYSTEM (ECS) AND PRESSURIZATION.

Refer to figure FO–5.

The ECS and pressurization system provides conditioned air and pressurization for the cabin. The system uses bleed air drawn from the ninth stage of the HP compressor and derives its electrical supply from the inverter I.

ENVIRONMENT CONTROL SYSTEM (ECS)

High pressure and high temperature bleed air drawn from the engine, flows via an electric shut–off valve through an air filter to the heat exchanger and to the turbo cooler. Down line of the turbo cooler, is an automatic temperature control selector with two values which are selected by the maintenance personnel: "Winter" (8°C), and "Summer" (2°C). Cooled air then passes through a water separator where moisture is condensed from the air. The cooled air from the water separator is routed through two ducts. Via the first duct, the air enters the cabin at a preselected temperature to the air outlets on the glare shield and pilot legs. Via the second duct, the air flows to the ventilating flight suit and to the swivel–type air outlet diffuser (air shower) located on the right sub–panel in each cockpit.

CONTROLS AND INDICATORS (Figure 1–26)

The cabin temperature controls are located in the forward cockpit only, except for the compressor bleed air shut–off valve switch labelled "AIR COND." in the aft cockpit miscellaneous CB/switch panel. All others controls are located in either cockpits.

Cabin Pressurization and ECS Handle

The pressurization handle, located at the right console in each cockpit, controls the air supply to the cockpit by positioning the shut–off valve, powered by 115 V AC. The handle is mechanically connected to the handle in the aft cockpit and provides three functions.

By moving the handle from aft to fwd position the microswitch installed on the aft handle actuates the electro–powered valve on the A/C engine. Next the canopy seals are inflated when the handle passes middle position of its range. When the handle is in extreme fwd position, valve in the aft cockpit opens air delivery to both cockpits.

NOTE

The handle must be moved forward after start–up and moved aft just prior to shut–down.

Cabin Air Conditioning Control Switch

Temperature of the air admitted into the cabin is controlled by a four–position "CABIN HEATING" control switch located on the RH console auxiliary switch panel in the forward cockpit.

Temperature control is maintained automatically according to set temperature when the switch is at the "AUTOMATIC" position. When the switch is at the center (neutral) position, the automatic control system is deactivated and the temperature mixing valve remains fixed in the position at the time the switch was set to the off position. If the automatic control system fails or if the desired temperature cannot be obtained with the switch at the "AUTOMATIC" position, the switch may be held to the "HEAT" or "COOL" position temporarily and back to neutral, thus the temperature mixing valve is manually held in one of the two extreme positions and deliver either hot or cold air.

WARNING

The manual "HEAT" or "COOL" position should be used while bearing in mind that it takes some time for the desired air temperature to actually enter the cockpit and therefore one should allow some time before a further manual adjustment takes place. (Excessive hot air with a max of 200° C (392° F) may be admitted into the cabin if the switch is held at the manual "HEAT" position for a longer period than necessary.)

Cabin Air Temperature Controller

The cabin air temperature controller is located on the auxiliary switch panel on the RH console in the forward cockpit. The temp controller functions only when the cabin air conditioning control switch is at the "AUTOMATIC" position and AC power is available. With the temp controller, any temperature between 10° and 25° C (50 and 77° F) can be selected by the pilot to be maintained automatically by the system.

The Diffuser (Air Shower Temp Control)

Temperature of the air coming out of the diffuser (and to the ventilation flight suit) is controlled from a panel located on the instrument right–hand forward console in the forward cockpit and is similar in functions and method of operating to the cabin air–conditioning control switch and temp controller, except for the fact that the temperature via the shower automatic temp controller can be raised up to 80° C (176° F).

The flow coming out of the vent can be controlled by rotating the inner (large) ring for directional regulation and the outer (small) ring for volume regulation.

Flight Suit Ventilation Controller

The flight suit ventilation controller controls air flow passing to ventilation flight suit of both fwd and aft pilots. The controller, placarded "SUIT VENTILATION", is located on the left console in each cockpit. Rotating the controller CW increases the air flow.

ECS Warning Lights

A red advisory light "AIRCONDIT OFF", located on the advisory light panels in both cockpits is activated whenever the air conditioning is switched off (ECS and pressurization handle is not at the forward position and/or "AIR COND." switch in the aft cockpit at the OFF position).

A red advisory light "AIRCONDIT EMERG." located on the advisory panel in the forward cockpit, is activated when the temperature transmitter, located down stream of the turbo cooler, has failed. In this case the temperature in the cabin, even though selected to automatic, will change with variation of ambient air temperature as the system maintains the difference between the selected temperature and the temperature coming out of the turbo cooler, which in this case cannot be measured.

"AIR COND." Emergency Switch

The "AIR COND." switch is located on aft cockpit RH misc. control panel and guarded by a red cover. For normal operation of the system, the "AIR COND." switch should be placed at the ON position. When the switch is set to OFF the ECS is shut off.

ECS OPERATION

After engine start, with the canopy locked ("CANOPY UNLOCKED" light is extinguished), and the ECS and pressurization handle fully forward ("AIRCONDIT OFF" light is extinguished), the air-conditioning system will supply modulated air according to the air-conditioning mode, i.e. if the system (air-conditioning and shower/ventilation suit) are at the "AUTOMATIC" position, each system will independently modulate the temperature to the one selected on the respective control panel. If the system is not selected to "AUTOMATIC", the air will enter the cockpit according to the last selection of the mixing valve.

PRESSURIZATION SYSTEM

With the canopies closed, the engine running and ECS in operation, the cabin is automatically pressurized. Up to 2,000 m (6,500 feet) a slight positive differential pressure is maintained. From 2,000 m (6,500 feet) and above, the differential pressure increases gradually to achieve a maximum differential pressure at 7,000 m (23,000 feet). From 7,000 m (23,000 feet) and above, max. differential pressure is maintained.

The cabin pressure is maintained by a pressure regulating valve, which controls the outflow of air from the cabin. A cabin pressure safety valve is utilized to prevent cabin differential from exceeding positive or negative pressure limits, in case of malfunction in the pressure regulating valve.

CONTROLS AND INDICATORS (Figure 1–26)

A cabin pressure indicator, located in the forward cockpit instrument panel, indicates the cabin altitude and the differential pressure between the outside pressure and the cabin pressure. Climbing from sea level to 2,000 m (6,500 ft), the cabin altitude will rise almost together with the A/C altitude, while the differential pressure will indicate a low value of approximately 0.03 kp/cm^2 (0.4 psi). From 2,000 m (6,500 ft) upward, the differential pressure will increase until it will reach approximately 0.22 to 0.25 kp/cm^2 (0.33 psi) (at 7,000 m/23,000 ft) and thereafter will maintain that differential pressure.

A "CABIN PRESSURE" warning light illuminates in both cockpits, should the cabin differential pressure go beyond the 0.28 kp/cm^2 (3.96 psi) max. positive, or –0.01 kp/cm^2 (–0.14 psi) max. negative (during dive) allowable differential pressure.

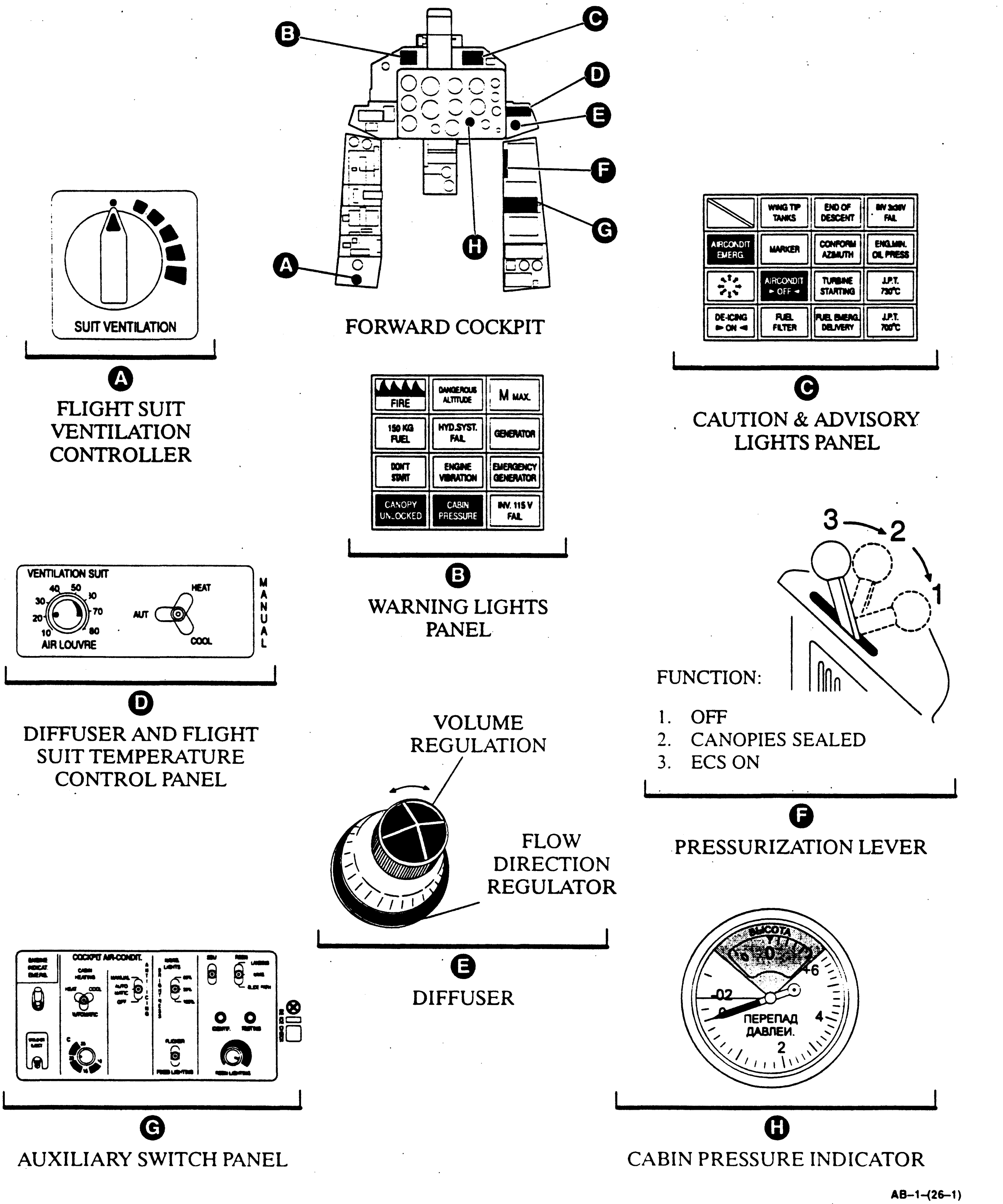


Figure 1-26. ECS and Cabin Pressurization System - Controls and Indicators (sheet 1 of 2)

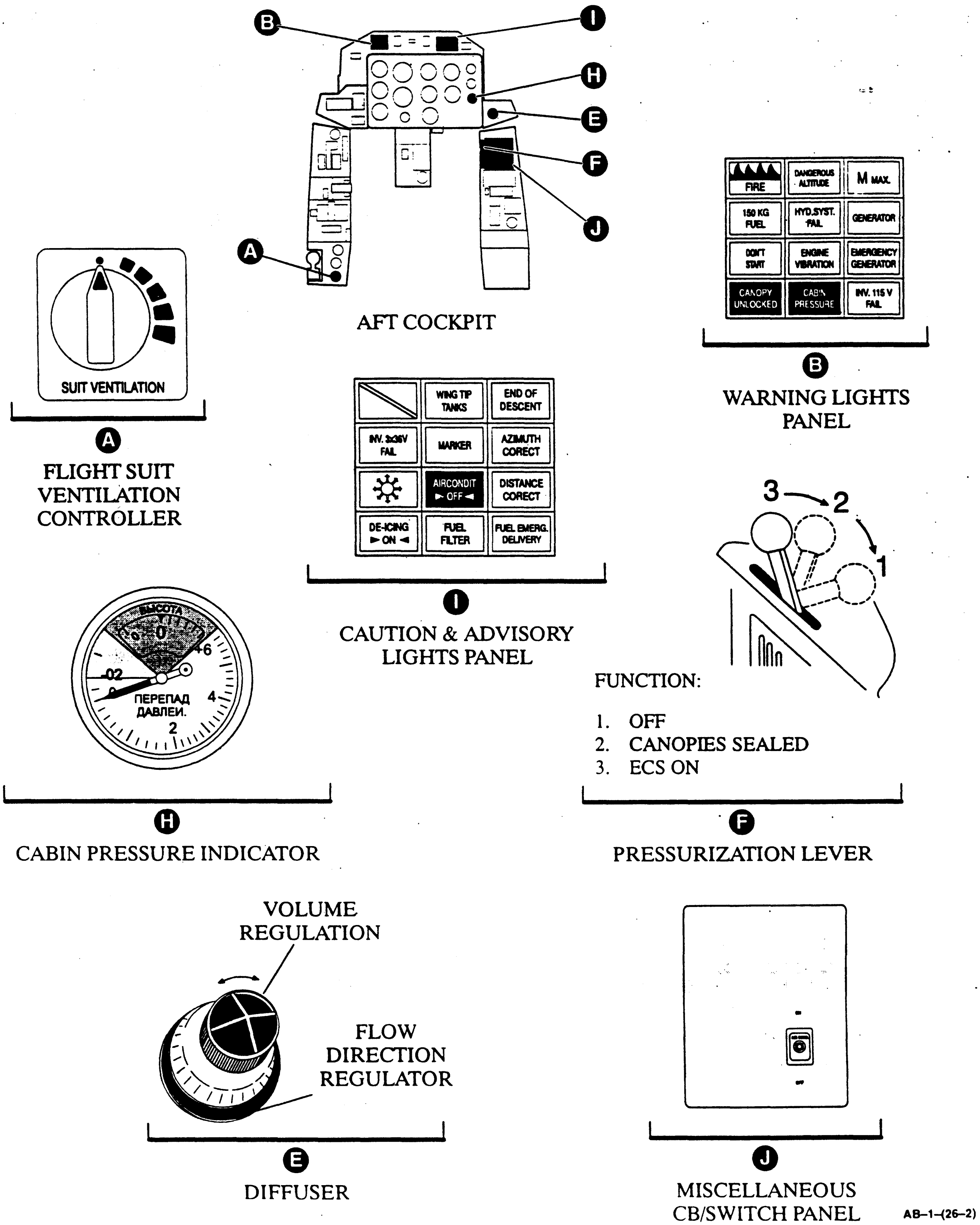


Figure 1-26. ECS and Cabin Pressurization System – Controls and Indicators (sheet 2 of 2)

ANTI-ICING AND DE-ICING SYSTEM

PITOT HEAT SYSTEM

Each Pitot tube is equipped with a heating element to prevent ice accumulation. The elements are powered by 27 V DC and protected by two C/Bs labeled "PITOT TUBE MAIN" and "PITOT TUBE STAND-BY", located on the aft CB/switch panel in the forward cockpit.

CONTROLS AND INDICATORS (Figure 1–27)

Heating of the Pitot booms is controlled by two "PITOT TUBE HEATING" pushbuttons located on the left console in the forward cockpit. When pushed, each button energizes the heating element in the respective Pitot tube (left button, LH tube etc.). The buttons are mechanically held at the ON position and are released by pressing the release buttons, located below the "PITOT TUBE HEATING" buttons. A light in the "PITOT TUBE HEATING" button illuminates whenever the pushbutton is depressed (ON position).

WINDSHIELD AND ENGINE ANTI-ICING SYSTEM

The de–icing system uses bleed air drawn from the ninth stage of the high pressure compressor. The air delivery to the airframe anti–icing system is controlled by one electric shut–off valve and to the engine anti–icing system by the second shut–off valve. The air is directed to the windshield, engine air intake ducts and the inlet guide vanes of the engine low pressure compressor (LPC).

The ice formation sensor consists of radio–isotope emitter and detector with a narrow open space between them. In normal condition the detector will detect the radiation all the time. Once there is ice condition, the space will be filled with ice and detection will be interrupted. The sensor will transmit "ice condition" whenever the system is activated and no radiation is detected. Than the ice formation sensor is heated until the open space between the emitter and detector is reestablished and the system is ready for next ice detection cycle after 20 seconds break.

CONTROLS AND INDICATORS

The "ANTI–ICING" de–icing switch is located on the RH console auxiliary switch panel in the forward cockpit. It is a three position switch indicating OFF , AUTOMATIC and MANUAL. The system is powered by 115 V AC and protected by "DE–ICING SIGNAL."C/B located on the main CB/switch panel and the two shut–off valves are protected by "DE–ICING AIR SHOWER" C/B located on the aft CB/switch panel.

AUTOMATIC OPERATION

With the switch set to the automatic position, the system utilizes the sensor located on the left side of the nose, to detect ice formation on the aircraft. When icing conditions are detected by the sensor, a signal is sent to activate the "icing/snow flakes" caution light on the caution and advisory panel in both cockpits. Together with the actuation of the caution light, a relay is energized that causes both shut–off valves to open, thereby directing the bleed air to the de–icing surfaces. Opening of the shut–off valves is indicated by "DE–ICING ON" light on the caution/advisory panel in both cockpits. If there is no other ice indication after heating of the sensor and 20 seconds break, both shut-off valves will close.

The system is disabled when the nose wheel is on the ground (WOW switch depressed).

MANUAL OPERATION

With the switch at the manual position, the operation is not sensor dependent. The switch in "MANUAL" position commands the shut–off valve to open and bleed air is directed to the de–icing surfaces. The "DE–ICING ON" light will illuminate in the caution/advisory panel.

In manual operation, the nose wheel micro–switch will have no effect on the system operation.

ICING SENSOR HEAT TEST BUTTON

Heating of the sensing system can be tested on the ground by positioning the de–icing switch to "AUTOMATIC" position and pressing the de–ice sensor heating "DE ICE CHECK" test push button. The green light by the side of the push button will illuminate to indicate the system is operative. The de-ice sensor heating control panel is located on the right console in forward cockpit.

The de–ice sensor heating control panel is located on the right console in forward cockpit.

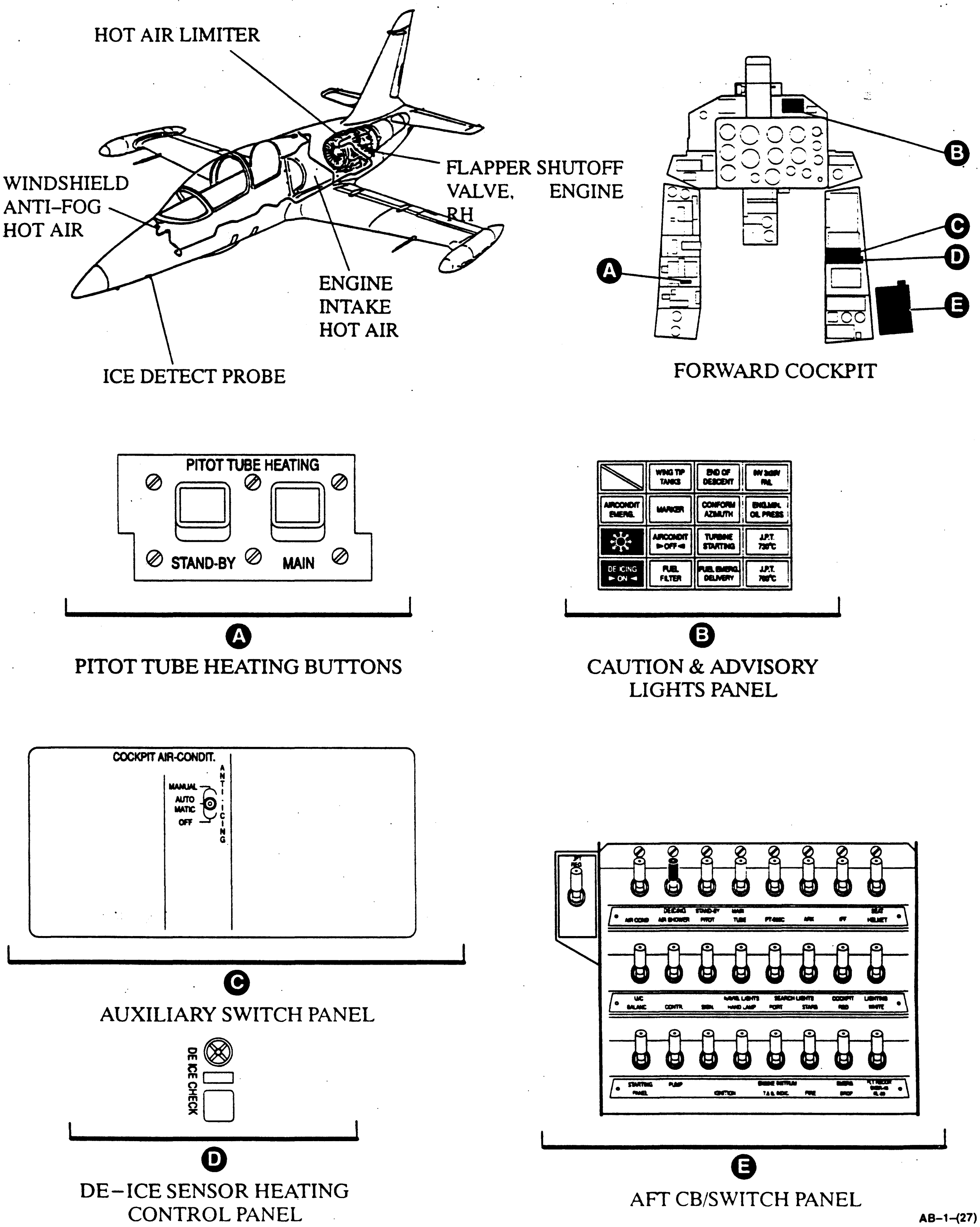


Figure 1-27. Anti-icing and De-icing System - Controls and Indicators

PITOT–STATIC SYSTEM. (Figure FO–6)

The Pitot–static system supplies static and total Pitot pressure to various flight instruments and to airspeed switches.

The system comprises of two separate systems that receive inputs from the Pitot tubes mounted on each wing leading edge. Normally the Pitot tube on the right wing is connected to the aircraft systems and the left one serves as the back–up system.

Both systems consist of drains at their lowest points located in the center section of each wing.

Static pressure consumers:

- Altimeter
- Vertical velocity indicator (VVI)
- Mach and airspeed indicator
- Cabin altitude pressure indicator
- Cabin pressure regulator
- Cabin over/under pressure sensor
- Flaps air pressure switch
- Sight altitude sensor
- SDU altitude correction system
- RSBN altitude transmitter
- RSBN airspeed transmitter
- Altitude transmitter to FDR
- Airspeed transmitter to FDR
- FDR automatic switch
- Anti skid system

Total pressure consumers:

- Mach and airspeed indicator
- Flaps air pressure switch
- Forward seat
- Aft seat
- RSBN airspeed transmitter
- Airspeed transmitter to FDR
- FDR automatic switch
- Anti skid system

PITOT SELECTOR LEVERS. (Figure 1–28)

PITOT TUBE SELECTOR

The Pitot tube selector lever, located on the left console in the forward cockpit, is labelled "PITOT TUBE" It is a manually operated selector valve with positions marked "MAIN" and "STBY". With the lever at the "MAIN" position, the system is fed by pressure from the RH Pitot tube. "STBY" is the position to be selected for the backup (left) system (except the static pressure to the cabin pressure regulator which is still supplied from the RH Pitot tube).

PITOT FAULT SIMULATOR SELECTORS

Two selectors, capable of isolating the forward cockpit Pitot inputs, are located on the center pedestal in the aft cockpit. With these selectors the instructor, from the back seat can simulate a Pitot failure to the front pilot. The selectors can be switched over in any order immediately one by one.

"STAT. PRESS"	Positioning the selector CW to "FAILURE" cuts off the static pressure to the instruments in the for ward cockpit. After selecting the selector to "FAILURE", the selector shall be placed CW for 30 sec. to the guarded "RED. MIN 30" prior to positioning it back to normal, to aviod a sudden pressure surge on the instruments.
"TOTAL PRESS."	Positioning the selector CW to "FAILURE" cuts off the total pressure to the instruments in the forward cockpit. After selecting the selector to "FAILURE", the selector shall be placed CW for 30 sec. to the guarded "RED. MIN 30" prior to positioning it back to normal, to avoid a sudden pressure surge on the instruments.

NOTE

At any time the pitot fault simulator is operating, the instruments in the aft cockpit remain normal and show the true readings.

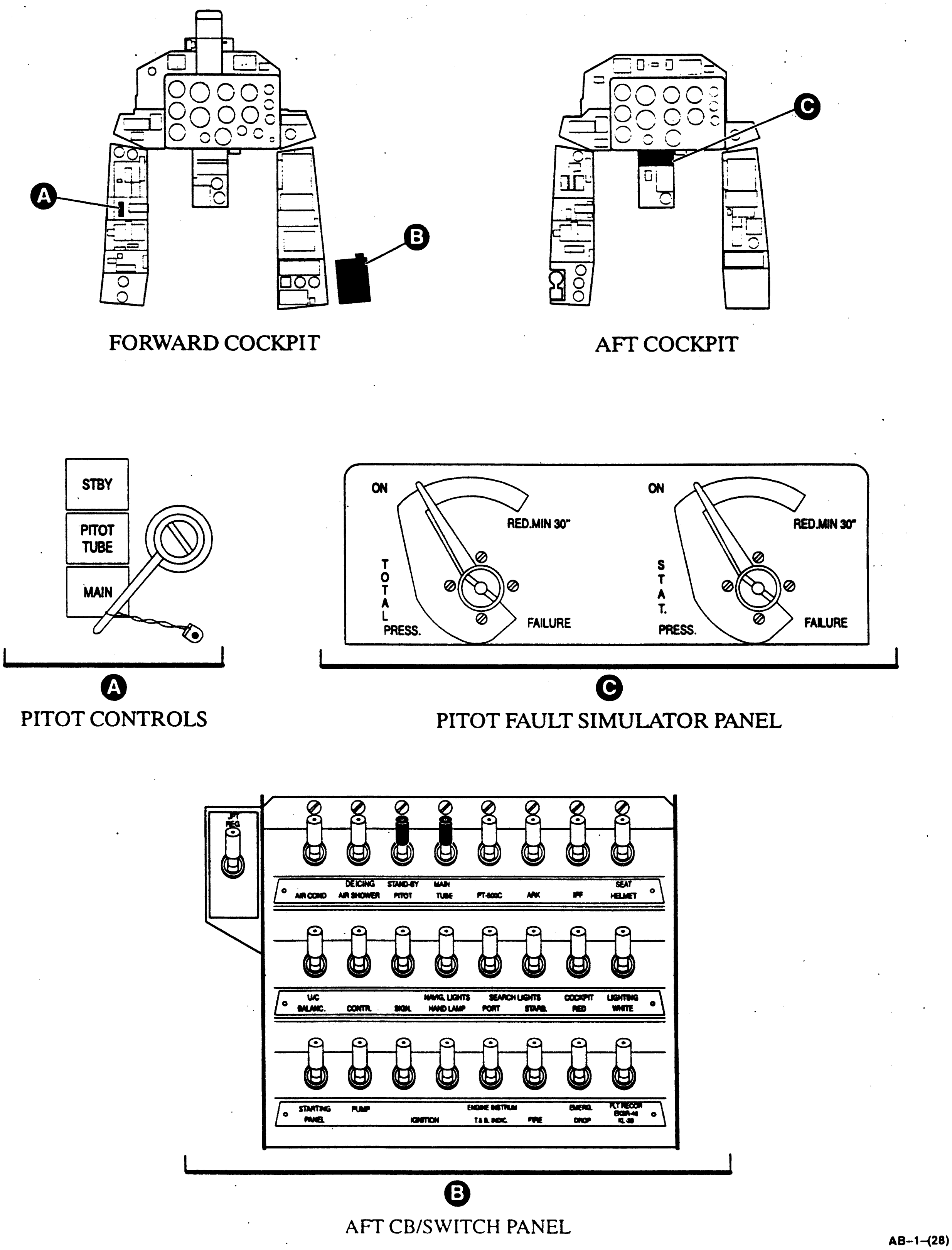


Figure 1–28. Pitot-static System – Controls and Indicators

FLIGHT INSTRUMENTS

PRESSURE INSTRUMENTS

MACH–IAS–TAS INDICATOR

The Mach–IAS–TAS indicator (figure 1–29), located on the instrument panel in each cockpit, provides indications for the indicated airspeed, true airspeed and Mach number. Two pointers (the wider for IAS and the thinner for TAS), indicate the airspeed on the fixed dial. The IAS pointer indicates airspeed from 100 to 1,200 km/h while the TAS pointer indicates airspeed from 300 to 1,200 km/h. The corresponding Mach number is indicated by means of a yellow pointer in a window from 0.5 to 0.9 M.

The Mach meter also incorporates the air speed sensor for automatic deployment of the speed brakes at 0.78 ± 0.02 Mach and illuminating of the "M $_{MAX}$" warning light.

ALTIMETER

The altimeter (figure 1–29) located on the instrument panel in each cockpit, indicates aircraft altitude in meters.

The two pointer altimeter has two concentrically mounted pointers coded in length and shape. The short thick inner pointer indicates the altitude from 0 to 20,000 meters in 1,000 meters increments and the long outer pointer indicates increments of 100 meters and parts of hundreds. The smallest graduation is 10–meter increments.

The knob located in the left lower part of the instrument provides a barometric pressure setting from 670 to 790 mm of mercury column.

COMBINED VVI/TURN AND SLIP INDICATOR

The combined vertical velocity/turn and slip indicator located on the instrument panel in each cockpit (figure 1–29), indicates the rate of climb or descent in meters per second. (The turn and slip indicator, even though displaying on the same instrument face, is not part of the pressure instruments.) The vertical velocity indicator scale is graduated from 0 to 80 m/sec. From 0 to 20 m/sec it is graduated in increments of 2 and from 20 to 80 m/sec in increments of 10 meters. The indicator has a 9–second delay.

The slip indicator is a mechanical instrument which consists of a ball positioned in a tube full of liquid, acting as a pendulum and will slide to one side whenever the aircraft is flying an uncoordinated flight.

The turn indicator is a gyro instrument which provides a quantitative display of the rate of turn being performed. The display limits indicate a "rate 2" turn meaning 360° turn per minute. The face of the instrument bears an example of speed and bank angle which will produce the above rate (45°at 350 km/hr). The turn indicator gyro unit is powered by 36 V AC 400 Hz together with engine instruments.

RV–5M RADIO ALTIMETER

The radio altimeter provides a read–out of absolute height from 0 to 750 meters over terrain and water. It consists of a transmitter–receiver, two antennas (one transmitting and one receiving) and two height indicators, one in each cockpit.

The radio altimeter circuit is switched on by the "MRP RV" switch located on the forward cockpit main C/B switch panel and it is powered by 28 V DC and 115 V AC 400 Hz from the inverter I (or inverter II).

HEIGHT INDICATOR

The height indicator display (figure 1–30) is unevenly graduated; height from 0 to 20 meters are graduated in 2 meter increments, from 20 to 100 meters in 10 meter increments and from 100 to 750 meters in 50 meter increments, hence providing a more detailed read–out when the aircraft is at low heights.

A pointer moves along the scale from 0 (on the ground) to over 750 m where it is hidden behind a black scale sector, to be exposed as the A/C descends below 750 m. The red flag appears when receiver does not have any signal or whenever the radio altimeter does not operate.

DANGEROUS HEIGHT WARNING

A decision height (DH) knob is located on the bottom RH corner of each height indicator. By rotating the knob, a DH pointer moves at the direction of the rotation, along the scale. When the height pointer indicates a height which is equal to or below the height at which the DH pointer is set to, the "DANGEROUS ALTITUDE" light will illuminate in the respective cockpit on the warning panel accompanied by a time limited (7 sec approximately) audio warning to the pilot's headset and a yellow dangerous height warning light on each height indicator.

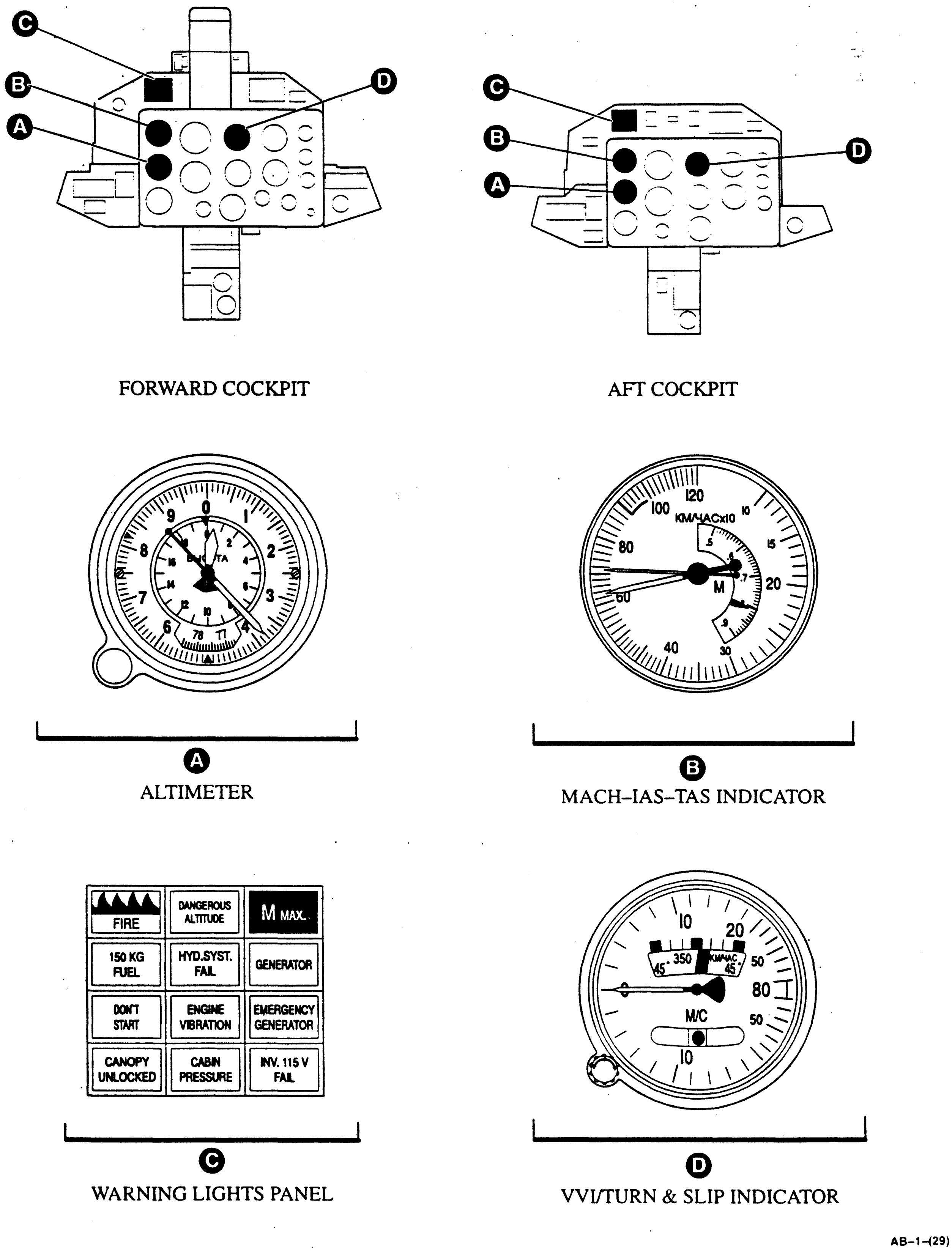


Figure 1–29. Airspeed, Altitude and VVI/Turn and Slip Indicator

NOTE

The audio signal is audible only when the A/C passes the DH from higher height to lower one (during descent).

SYSTEM TEST

Pressing and holding the lower LH push button will cause the pointer to indicate a height of 15 ± 1.5 meters. Should the DH pointer is set to 15 meters or below, the "DANGEROUS ALTITUDE", yellow DH warning light and audible warning will be activated. The test can be performed both on the ground and during flight.

NOTE

The different visual warning can be generated in fwd and aft cockpits because the different DH can be set on respective indicators. The audio warning is generated according to fwd cockpit indicator DH setting for both pilots.

FLIGHT–NAVIGATION INSTRUMENTS

ATTITUDE DIRECTOR INDICATOR (ADI), TYPE KPP

The ADI (figure 1–31), one in each cockpit is a servoed repeater indicator, which consists of an artificial horizon displayed in relation to an A/C symbol, with RSBN localizer and glide slope indications, SDU remote command landing system pointers and a slip indicator.

The ADI receives and displays inputs from an AGD artificial horizon gyro unit, RSBN short–range radio navigation and landing system and from the SDU remote command landing system.

The ADI indicator is powered by 27 V DC and 36 V AC 400 Hz. The indicator is activated by the "AGD–GMK" switch located on the forward cockpit main C/B switch panel.

PITCH INDICATION CYLINDER

The pitch indication cylinder in relation to the miniature aircraft symbol indicates the aircraft pitch angle. The maximal movement of the cylinder in pitch axis during climb or descent of the aircraft is 85°.

BANK ANGLE INDICATOR

The bank angle indicator is created by the miniature aircraft symbol which leans in consideration to the instrument fixed scale. The aircraft symbol movement is unlimited. When the aircraft pitch angle reaches 90° the miniature aircraft symbol reverses by 180° to achieve the position, corresponding the real aircraft attitude. The pitch indication cylinder and bank angle indicator receive their inputs from the AGD artificial horizon gyro unit.

PITCH TRIM KNOB

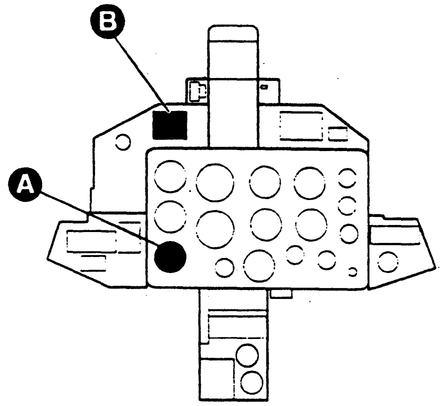
The pitch trim knob is mounted on the lower right hand side of the face of the indicator and is intended for aligning the pitch indication cylinder with the A/C symbol. The cylinder can be adjusted during ADI operation. The knob can be turned in both directions and is limited by mechanical stop.

ARRESTING BUTTON

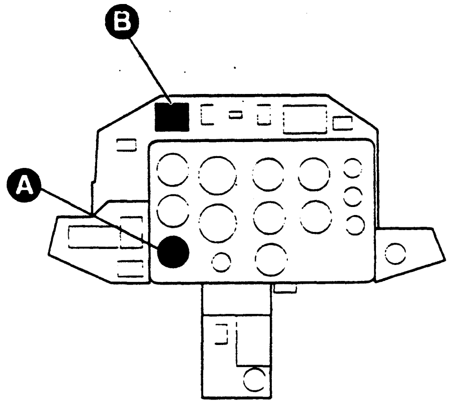
The AGD gyro ring arresting cycle is activated by depressing the arresting button. During the arresting cycle the red "АРРЕТИР" light illuminates in the arresting button for at most 15 seconds. The light illuminates also if the AGD power supply fails.

REMOTE COMMAND LANDING SYSTEM (SDU) POINTERS

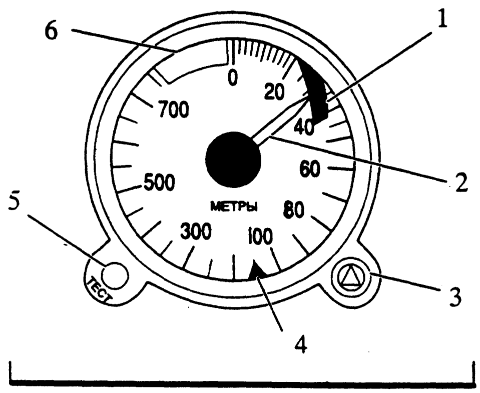
The SDU pointers display the signal which is transmitted by the RSBN ground based landing facility, received by aboard RSBN system and generated by SDU system during the precision landing approach. The indicators represents extent of lateral and longitudinal movement of the aircraft which is required to align the A/C with optimum landing approach path. (The bank indicator swung to right from center position – A/C is left from the runway localizer radio beam, the right bank is required in such a rate to get the bank indicator to the center position. The pitch indicator swung under the center position – A/C is above the glide–slope beam, the A/C nose down position is required in such a rate to get the pitch indicator to the center position.) During the SDU landing approach both pointers should be kept in the center position by steering the A/C to keep and follow the optimum approach path.



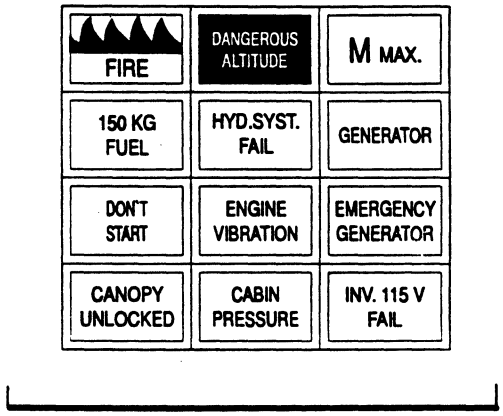
FORWARD COCKPIT



AFT COCKPIT



A
HEIGHT INDICATOR

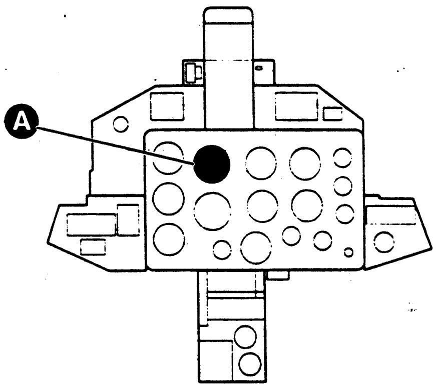


B
WARNING LIGHTS PANEL

1. Red Flag
2. Height Pointer
3. Dangerous Height Warning Light (Yellow)/DH Knob
4. DH Pointer
5. Test Push Button
6. Black Scale Sector

AB–1–(30)

Figure 1–30. Radio Altimeter



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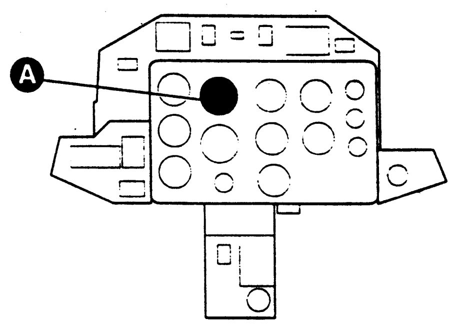

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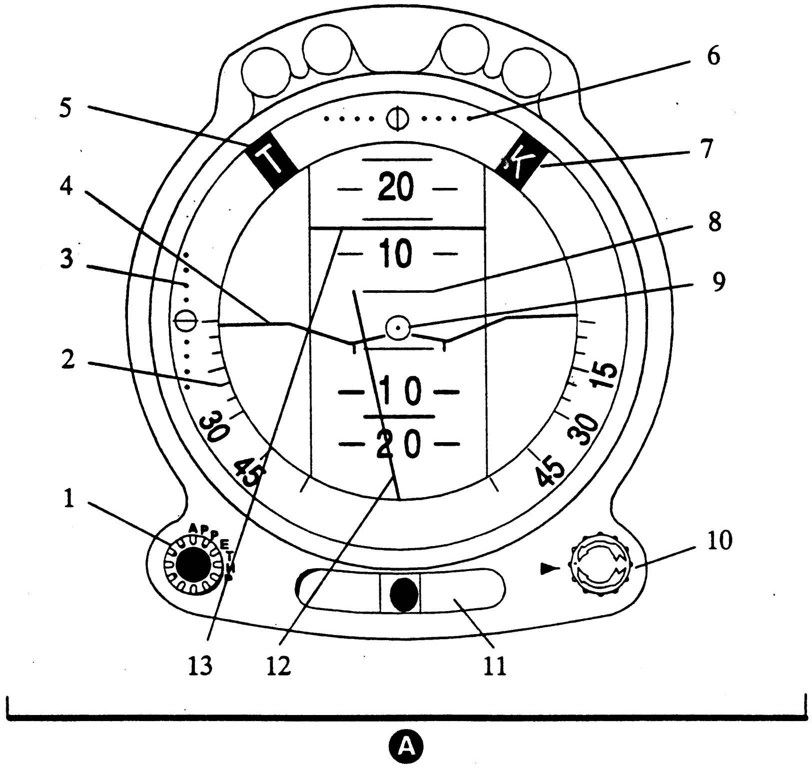
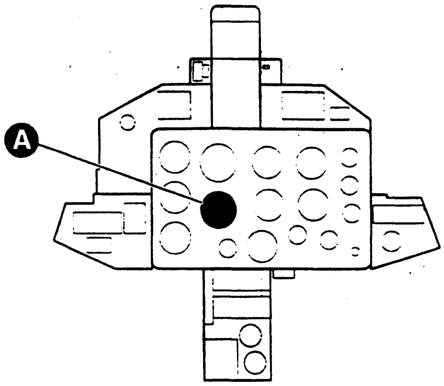


ATTITUDE DIRECTOR INDICATOR, ADI

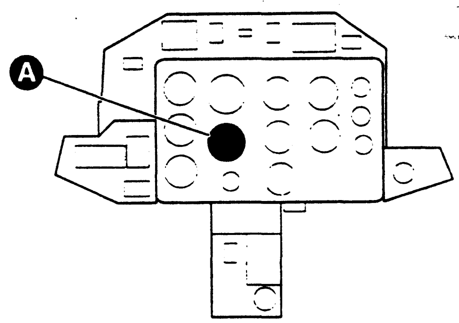
1. Arresting Button
2. Pitch Angle Scale
3. Glideslope Deviation Scale
4. Pitch Angle Indicator
5. SDU – Warning Flag – T
6. Localizer Deviation Scale
7. SDU Warning Flag – K
8. Bank Angle Scale
9. Miniature Aircraft Symbol
10. Bank Trim Knob
11. Slip Indicator
12. SDU Pitch Pointer
13. SDU Bank Pointer

AB-1-(31)

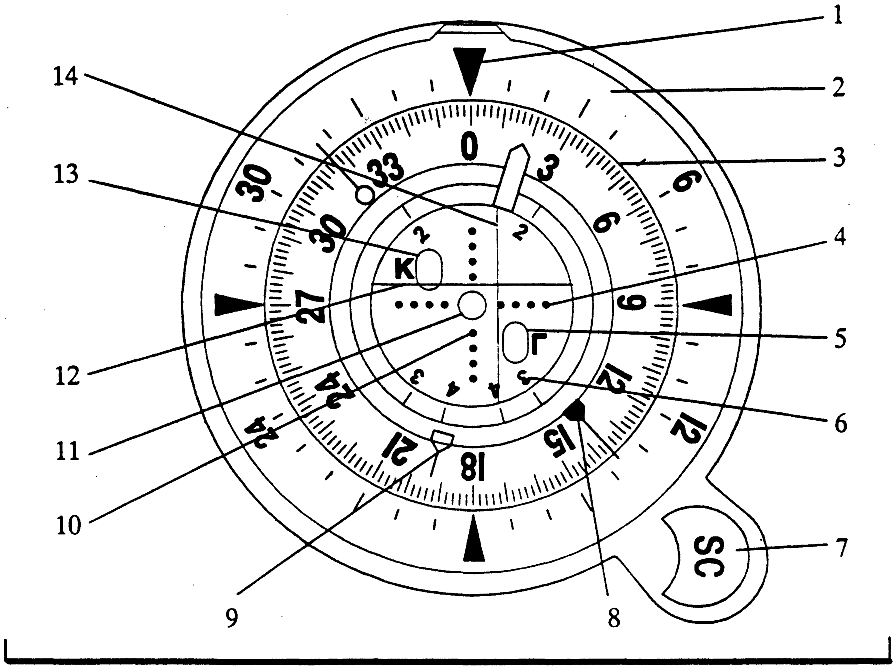
Figure 1–31. Attitude Director Indicator (ADI), Type KPP



FORWARD COCKPIT



AFT COCKPIT



RADIO MAGNETIC INDICATOR, RMI

1. Upper Lubber Line
2. Relative Bearing Card
3. Compass Card
4. Localizer Deviation Scale
5. Warning Flag – GS
6. BOX Reference Markers
7. Course Knob
8. Bearing Pointer
9. Course Deviation Indicator
10. Glideslope Deviation Scale
11. Center Mark
12. Glideslope Deviation Indicator
13. Warning Flag – LOC
14. Localizer Deviation Indicator

AB–1–(32)

Figure 1–32. Radio Magnetic Indicator (RMI)

LOCALIZER AND GLIDE–SLOPE DEVIATION POINTERS

Receiving inputs from the RSBN ground based landing beacon, the localizer and glide–slope indicators represents radio beams which are aligned with the runway center–line (localizer) and a constructed approach angle (glide–slope). When the A/C is aligned with the beams the needles will be centered. When the A/C deviates from the center of the beam the pointers will deflect to the direction of the beam and show the pilot which way to steer (pointer right – A/C is to the left, the desired path is to the right. Pointer down – A/C is above the glide–slope, the desired glide path is below). The same function represents the HSI localizer and glide–slope deviation pointers.

"T" AND "K" WARNING FLAGS

The "T" flag corresponds to pitch indicator and "K" flag to bank indicator of the SDU system. Whenever the instrument fades to a value reception below threshold, or looses its power supply, the respective flag will be visible to warn the pilot that the information provided by pointer is meaningless.

SLIP INDICATOR

The slip indicator is a mechanical instrument that consist of a ball positioned in a tube full of liquid, which acts as a pendulum and will slide to one side whenever the aircraft is flying an uncoordinated flight. (Identical to the one in the combined VVI/turn and slip indicator.)

NAVIGATION INSTRUMENTS

RADIO MAGNETIC INDICATOR (RMI), TYPE NPP

The RMI (figure 1–32), one in each cockpit, is a servoed repeater indicator, which represents a bird view of the aircraft in relation to the navigation facilities. It provides magnetic heading indication, selected course deviation indication, station bearing and relative bearing information, glide–slope and localizer deviation information, and BOX landing pattern information.

The RMI receives its inputs from GMK directional gyro, ADF and RSBN.

The RMI is powered by 27 V DC and 3 × 36 V AC at 400 Hz. Individual indications are controlled by "AGD–GMK", "RSBN" and "INVERTOR" CB/switches, located on the aft CB/switch panel in the forward cockpit.

COMPASS CARD

The lubber line indicates the magnetic heading at the top of the display. The compass card receives its inputs from GMK directional gyro.

COURSE KNOB

The course knob is located on the lower RH side of the instrument face and is labeled "SC". Turning the knob will rotate the course deviation indicator.

NOTE

The course knob in the aft cockpit is not active.

COURSE DEVIATION INDICATOR

The course deviation indicator is controlled by the course knob. The selected course indicates the desired navigation course to be flown. Once set, the course deviation indicator rotates with the compass card.

RELATIVE BEARING CARD

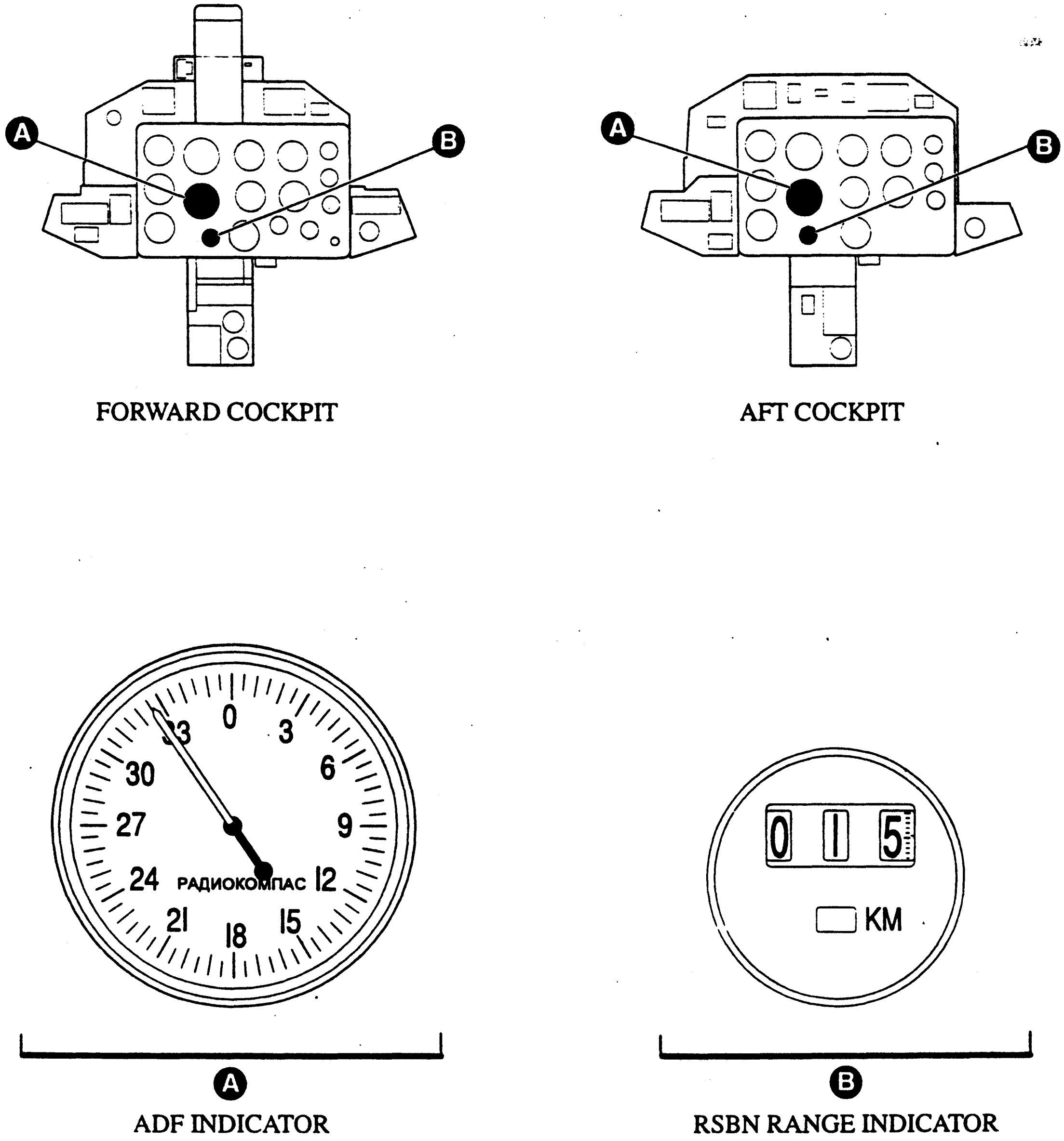
The relative bearing card is a fixed scale about the compass card. It indicates angles measured from the station relative to the nose of the aircraft.

BEARING POINTER

The bearing pointer indicates both relative bearing on fixed relative bearing card and the station bearing on rotary compass card. The pointer receives its inputs from ADF.

LOCALIZER AND GLIDE–SLOPE DEVIATION POINTERS

Receiving inputs from the RSBN ground based landing facility, the localizer and glide–slope indicators represents radio beams which are aligned with the runway center–line (localizer) and a constructed approach angle (glide–slope). When the A/C is aligned with the beams the needles will be centered. When the A/C deviates from the center of the beam the pointers will deflect to the direction of the beam and show the pilot which way to steer (pointer right – A/C is to the left, the desired path is to the right. Pointer down – A/C is above the glide–slope, the desired glide path is below). The same function represents the ADI localizer and glide–slope deviation pointers.



AB–1–(33)

Figure 1–33. ADF and RSBN Range Indicators

"Г" AND "K" WARNING FLAGS

The "Г"flag corresponds to glide–slope indicator and "K" flag to localizer indicator. Whenever the instrument fades to a value reception below threshold, or looses its power supply, the respective flag will be visible to warn the pilot that the information provided by pointer is meaningless.

BOX REFERENCE MARKERS

The reference markers "2", "3" and "4" provides information about standard BOX landing pattern.

ADF INDICATOR

The ADF indicator (figure 1–33), one in each cockpit, provides information about relative bearing to the tuned station. The pointer rotates according signals from the ADF.

RSBN RANGE INDICATOR

The RSBN range indicator (figure 1–33) is located on instrument panel in both cockpits. The three digits display indicates the slant range to/from the tuned RSBN station. Whenever the instrument fades to a value reception below threshold, or looses its power supply, the red flag will be visible to warn the pilot that the information provided by the indicator is meaningless.

MISCELLANEOUS INSTRUMENTS

ACCELEROMETER

Two independent accelerometers (figure 1–34) are installed on the instrument panels, one in each cockpit. In addition to the instantaneous "g" pointer, there are two recording pointers, one for positive and one for negative "g" loads, which follows the instantaneous pointer to its maximum attained travel. The recording indicating pointer, thus providing a record of maximum "g" loads encountered. To reset the recording pointers to the normal 1 "g" position, the button on the lower right side of the instrument shall be pressed. The scale of the instrument is graduated from – 5 to + 10 with the 0 "g" indication at the twelve o

For detailed information refer to Section VI, Operating Limitations.

STANDBY COMPASS

A conventional standby magnetic compass is mounted on the RH windshield frame in the forward cockpit only (figure 1–34).

CLOCK

A 12–hour clocks (figure 1–34) are installed on the instrument panel in both cockpits. They are hand wound and equipped with two control buttons located on the lower side of the instrument. The total elapsed time available is 5 days.

The lower left knob is used when turned clockwise to wind the clock and when pulled out, to set the clock. Pressing this button against spring pressure will actuate the 12 hour stop watch with minutes and hours (upper scale). A blue flag in the window, situated within this scale, indicates the stop watch is actuated. Pressing this button second time, will stop the elapsed time, a fact which will be indicated by a blue and white flag in the window. Pressing the button third time will reset the watch to the starting position which will be indicated by a white flag in the window.

The button on the lower right, when turned to the left, starts the clock and bring the minutes stop watch (lower 30 minutes scale) into standby mode. Pressing the same button will then actuate the seconds pointer of the clock together with the minutes pointer (30 min) on the lower stop watch. Pressing the button again, will then stop the hands (second pointer of the clock and minutes pointer of the lower scale stop watch). Pressing the button a third time, will reset the both seconds and minutes pointers. Turning this knob to the right, stops the clock and deactivates all its functions.

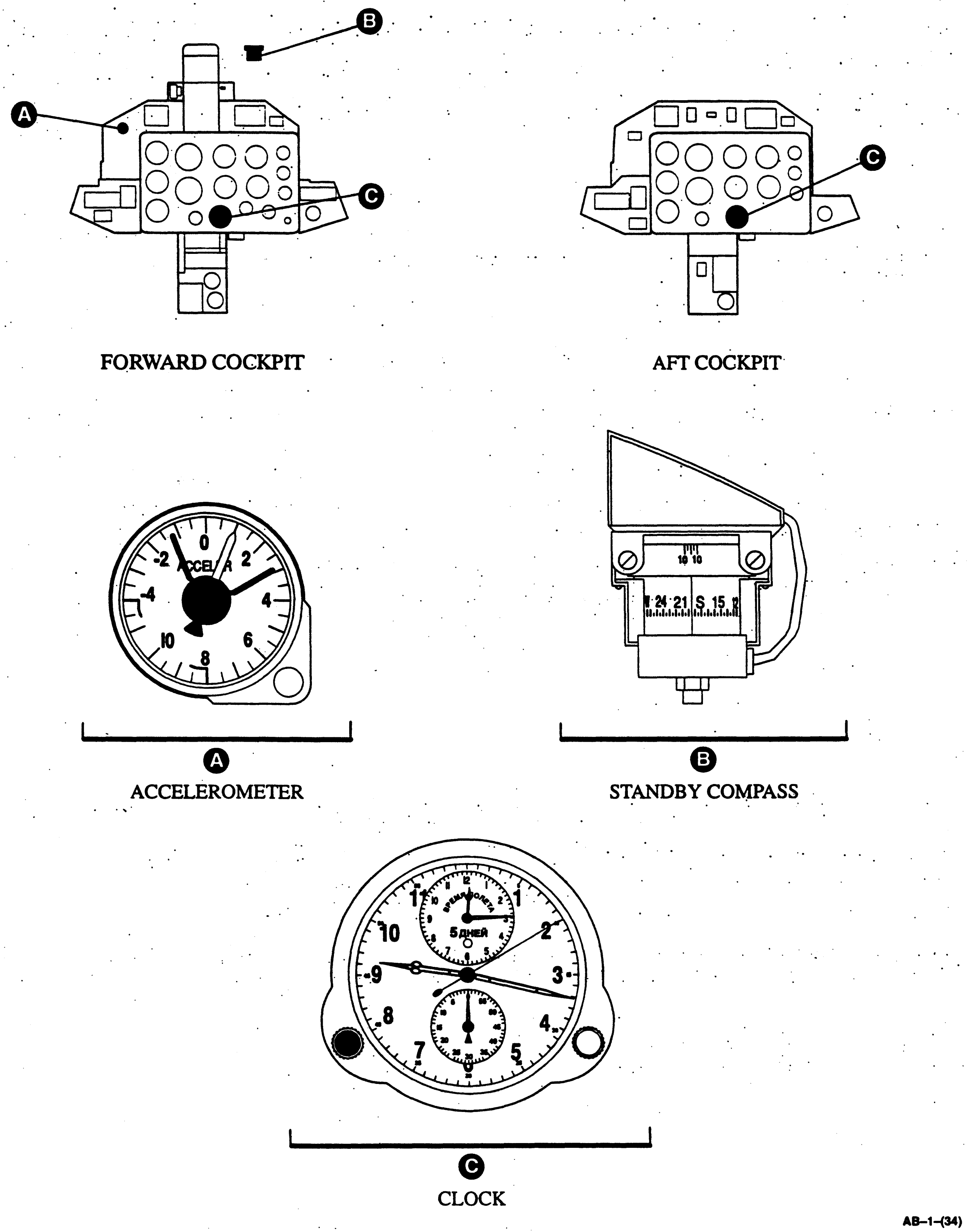


Figure 1-34. Miscellaneous Instruments

GYRO FLIGHT/NAVIGATION

AGD GYRO UNIT

AGD consists of a gyroscope with three degrees of freedom. It supplies signals to the ADI's pitch and bank indicators to provide pilot with the aircraft attitude indication.

During AGD activation process the gyro ring arresting procedure is performed taking 15 seconds. All this time the red advisory light in the arresting button illuminates. The arresting procedure can be activated also manually by pressing the ADI arresting button.

NOTE

> If the arresting procedure is activated manually during flight, all the time the procedure is performed the aircraft shall be steered in straight and level flight.

CONTROLS

The AGD is powered by 27 V DC and 3 × 36 V AC at 400 Hz, and is switched on by the "AGD–GMK" switch, located on the forward cockpit main CB/switch panel.

FAULT SIMULATOR SWITCHES

Two fault simulator switches are located on the center pedestal in the aft cockpit. When switched on the switches can simulate interruption of signal transmitted from the AGD to forward cockpit's ADI. The "AGD INKLINAT. LONGITUD." switch disconnects the bank angle indicator inputs and the "AGD INKLINAT. LATERAL" switch disconnects the pitch angle indicator cylinder inputs. At any time the navigation fault simulator is operating, the ADI in the aft cockpit remains normal and show the true reading.

GMK DIRECTIONAL GYRO. Figure 1–35 and 1–36.

The GMK principle is based on that fact, that a gyroscope can hold for a long time that position of its axes which was set at known bearing. The GMK gyroscope is installed in the gyro unit. The GMK can transmit either a magnetic bearing (MC mode) or orthodromical bearing (GC mode). The GMK signals are displayed on the RMI compass card. The GMK consists of a gyro unit, an inductive transmitter, an automatic synchronization unit, a correcting mechanism and a control box.

Synchronization of RMI compass card with aircraft magnetic heading can be executed either automatically or manually. An automatic sync is active during GMK activation process and during GMK operation in MC mode (slave). The synchronization can be performed at two rates: the high rate (6 degrees per second) lasts one minute since GMK switching on (no matter on mode switch position), or during switching on the MC mode. After that the system will automatically over come to sync low rate or fully disconnect the automatic synchronization unit, with respect to operating mode set on the control box. The low sync rate (i.e. correction of gyroscope position according to magnetic heading) is executed during GMK operation in MC mode, and will be disconnected automatically only during aircraft turn with rate higher than 0.3 degrees per second. After terminating the maneuver the system aligns again the compass card with aircraft heading.

The GMK directional gyro is powered by 27 V DC and 3 × 36 V AC at 400 Hz. The instrument is switching on by means of "AGD–GMK" switch located on the main CB/switch panel in forward cockpit.

SLAVE MODE (MC)

The inductive transmitter, located in the aircraft wing, scans the magnetic field of the earth. The inductive transmitter output signal, trimmed by correcting mechanism, is transmitted to the gyro unit, where it is stabilized and its average value serves as the RMI compass card input control signal.

GMK correcting mechanism

The GMK correcting mechanism is located on the aft cockpit right console. Through the correcting mechanism, the gyro unit fly–wheel is trimmed about the magnetic variation. Two pointers are located on the correcting mechanism face: the larger one, triangular in shape, indicates the aircraft magnetic heading, and the smaller one indicates the magnetic variation. The smaller pointer is controlled by means of a variation knob. Rotating this knob can set the variation with respect to aircraft location. The range of the variation scale is ± 18.

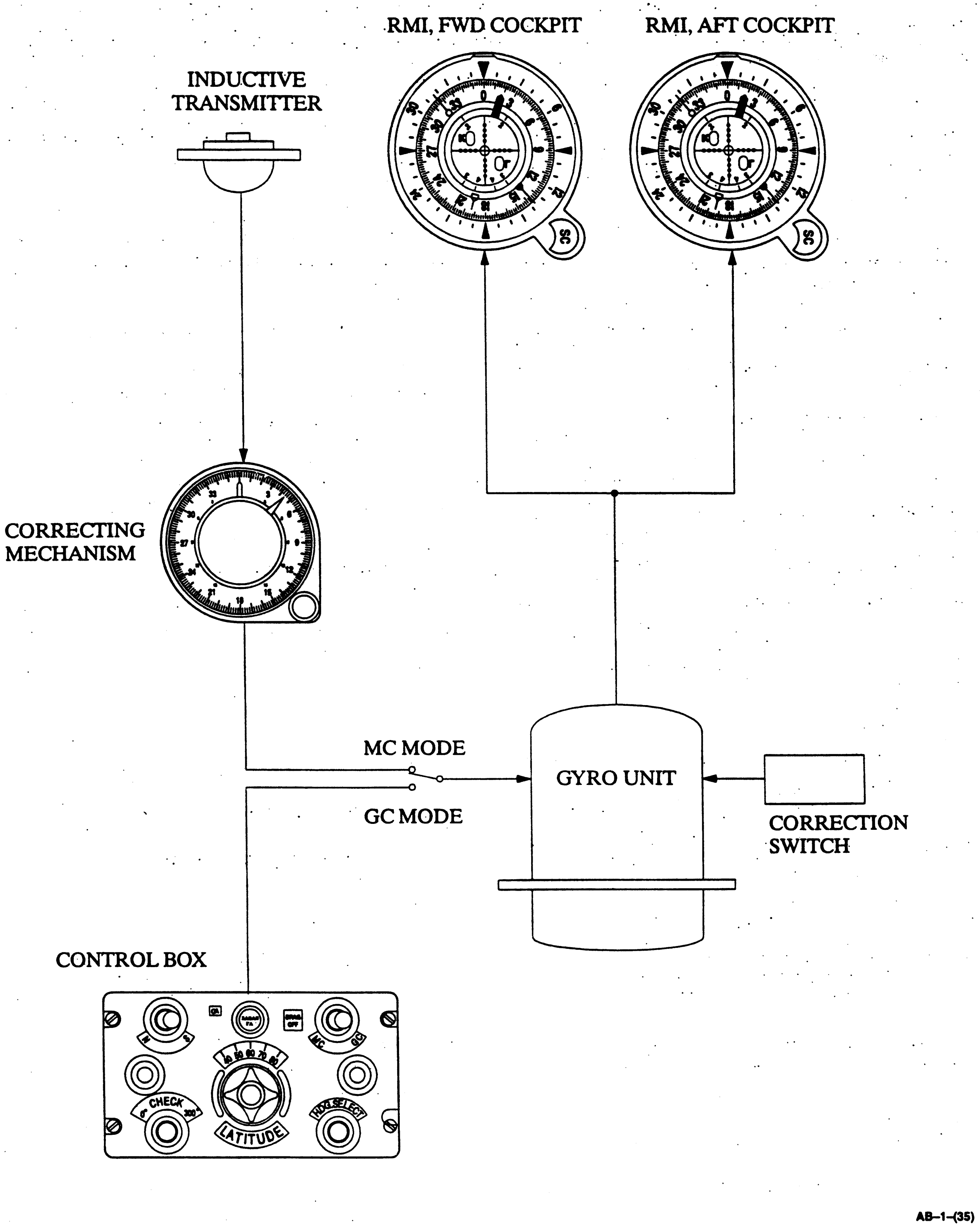


Figure 1–35. GMK Directional Gyro – Block Diagram

NOTE

If the variation is not introduced the variation pointer should be set at zero.

FREE MODE (GC)

The RMI compass card is controlled only by GMK gyro unit with no inputs from inductive transmitter and correcting mechanism.

In the GC mode, some of the GMK misinformation can be rectified. The gyro indication error due to earth rotation can be corrected by means of setting the aircraft latitude and hemisphere on the GMK control box. In the GC mode the system does not provide the magnetic heading and variation correction.

CONTROL BOX

The GMK control box is installed in the forward cockpit RH console only.

Hemisphere Switch

The "GA" switch can be set to either north "N" or south "S" position according to the earth hemisphere where the navigation flight is to be flown. The position setting is due to automatic correction of GMK gyroscope position in GC mode.

Gyro Drift Indicator

The "ЗАВАЛ ГА" indicator provides pilot with the same information as the gyro drift indicator on the directional gyro front control panel.

Mode Switch

The mode switch can select one of the GMK operation modes: MC or GC.

Test Switch

The test switch verifies the correct operation of the GMK system in the MC mode. The test can be executed after terminating the GMK starting process, which lasts 3 minutes in MC mode or 5 minutes in GC mode. When the test switch "CHECK" is moved to 0 (zero) position, the RMI compass card shall rotate to position zero degrees, when in 300 degrees position the compass card shall indicate 300° heading. The allowable indication tolerance is ± 10 degrees. The compass card repositioning shall be accompanied by illumination of the gyro drift indicator on both the GMK control box and front control panel. When the test switch is released to its center neutral position, the HSI compass card shall rotate back and indicate actual heading.

Latitude Selector

The latitude of location where the navigation flight is to be flown can be set by latitude selector. The latitude setting is required due to automatic correction of GMK gyro position in GC mode. The selected latitude can be read on scale above the selector.

Heading Switch

If the GMK operates in MC mode, moving the "HDG. SELECT" switch to either position will align the GMK gyro with magnetic heading.

If the GMK operates in GC mode, moving the "HDG. SELECT" switch to either position will cause the gyro rotation in the respective direction hence rotating RMI compass card. The gyro (compass card) rotation is terminated when the heading switch is released to its center neutral position, and the GMK proceeds operation in GC mode with new gyro setting.

FRONT CONTROL PANEL

The GMK front control panel is located on the instrument panel in each cockpit.

Gyro Drift Indicator

During aircraft evolution the GMK gyro unit fly–wheel ring can be leant from its working position and RMI compass card can provide pilot with meaningless information. This situation is advised by illuminating of the "ERROR GA" gyro drift indicator.

Synchronization Button

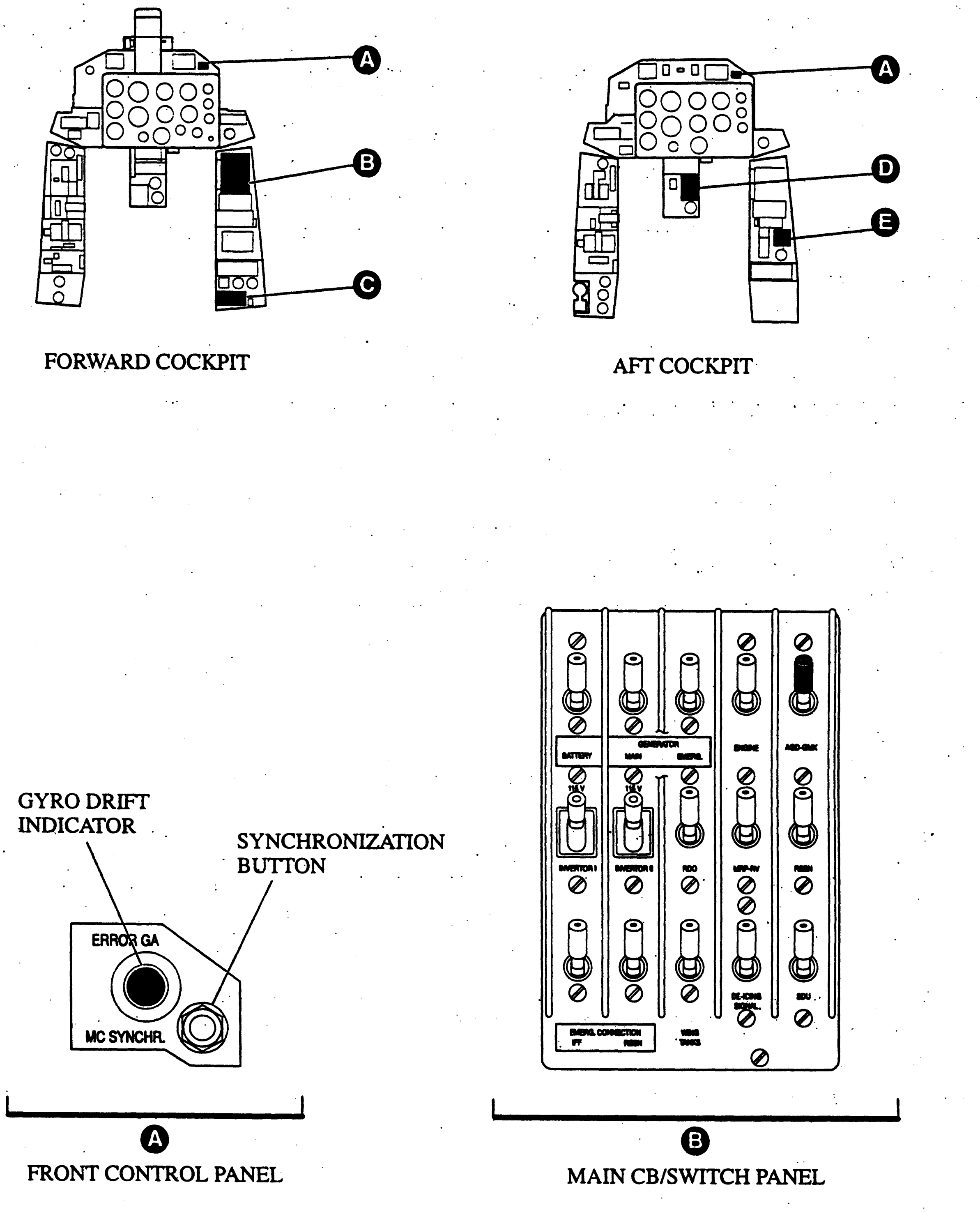
When the "ERROR GA" light illuminates the "MC SYNCHR." button can be depressed to align the GMK gyro with aircraft magnetic heading. The process is performed at high synchronization rate.

NOTE

The synchronization of GMK gyro with magnetic heading during flight shall executed at straight level flight only.

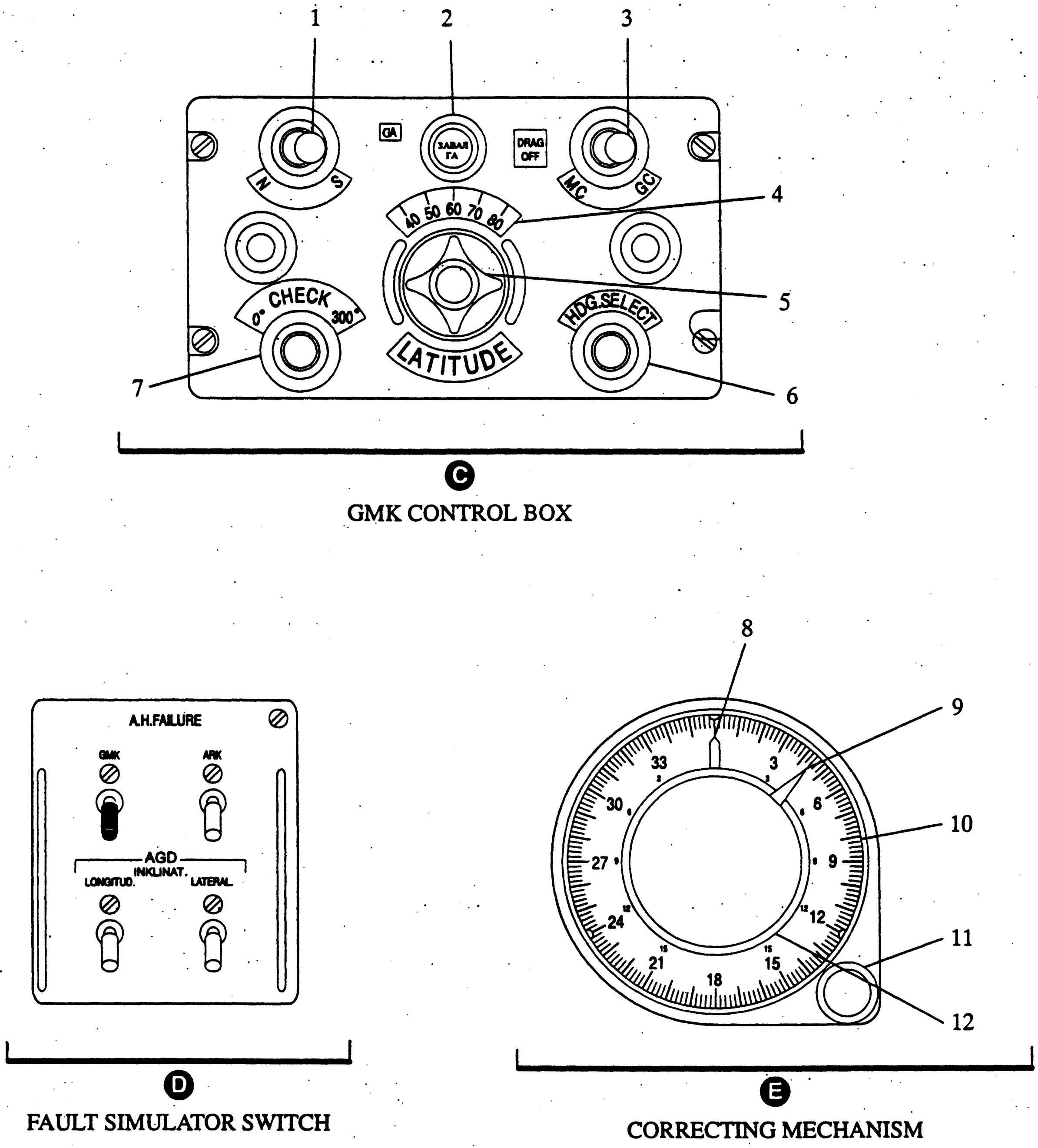
FAULT SIMULATOR SWITCH

The "A.H. FAILURE – GMK" fault simulator switch is located on the center pedestal in the aft cockpit. When switched on the switch can simulate interruption of signal transmitted from the GMK gyro unit to forward cockpit RMI. At any time the navigation fault simulator is operating, the RMI in the aft cockpit remains normal and show the true reading.



AB-1-(36-1)

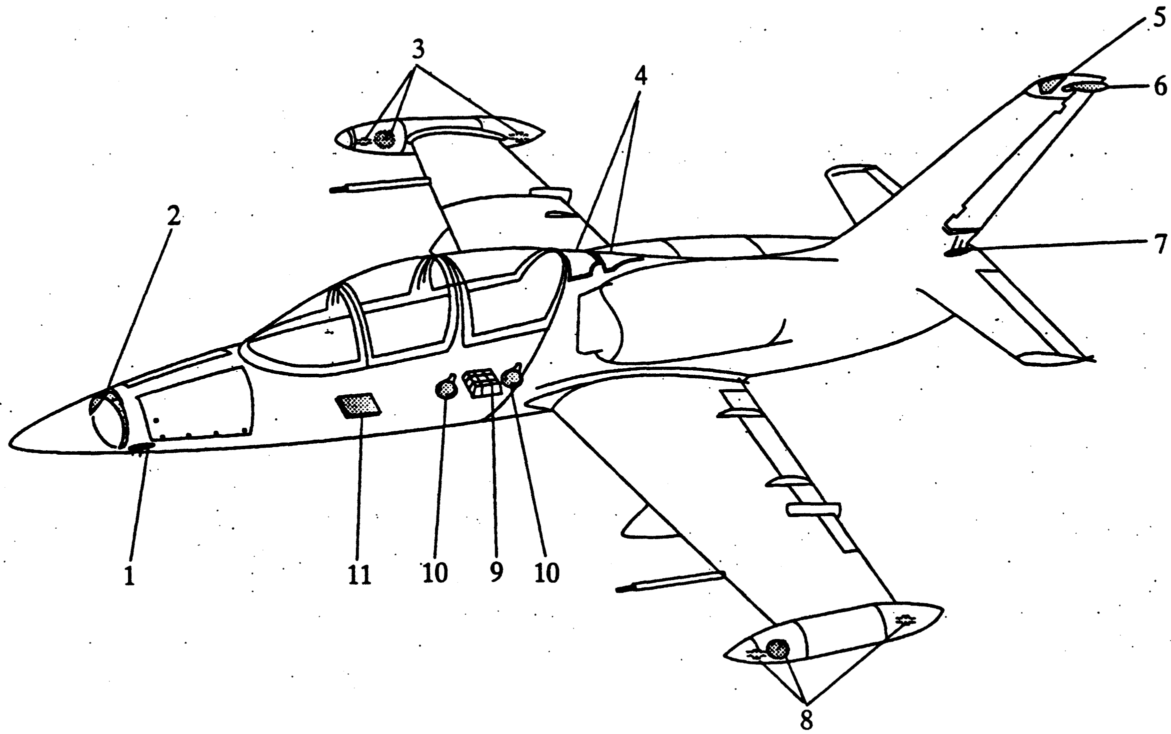
Figure 1–36. GMK Directional Gyro – Location and Indication (sheet 1 of 2)



1. Hemisphere Switch
2. Gyro Drift Indicator
3. Mode Switch
4. Latitude Scale
5. Latitude Selector
6. Heading Switch
7. Test Switch
8. Magnetic Variation Pointer
9. Magnetic Heading Pointer
10. Compass Card
11. Magnetic Variation Knob
12. Magnetic Variation Scale

AB–1–(36–2)

Figure 1–36. GMK Directional Gyro – Location and Indication (sheet 2 of 2)



1. IFF, Band 3
2. RSBN, Front
3. IFF, Band 2
4. ADF, Omni–directional Antenna
5. UHF/VHF
6. RSBN, Rear
7. IFF, Band 3
8. IFF, Band 2
9. Marker
10. Radio Altimeter
11. ADF, Directional Antenna

AB–1–(37)

Figure 1–37. Antenna Locations

RADIO NAVIGATION

The radio navigation system is composed of a RSBN short–range radio navigation and landing system, RKL automatic direction finder, MRP marker beacon system, ADIs, HSIs and antennas. For ADI and HSI indicators refer to figures 1–31 and 1–32, for antenna locations refer to figure 1–37. The system consists of NDB, LOC, GS and MKR receivers and RSBN which provide the pilot with homing and navigation capability in line–of–sight range. In addition the system provides instrument landing capabilities.

RSBN–5S SHORT–RANGE RADIO NAVIGATION AND LANDING SYSTEM. Figure 1–38.

The aboard RSBN radio navigation system receives signals from ground based RSBN navigation aids and PRMG landing stations. It allows pilot to provide short range navigation flights, and instrument landing at normal and adverse weather conditions, at day and night.

The RSBN system provides the following navigation tasks capabilities:

- continuous information about aircraft position (course and distance) relative to tuned station
- guidance of aircraft to/from the station or at the circuit along the tuned station
- guidance of aircraft to initial approach, descent through clouds, guidance at the BOX landing pattern, guidance of aircraft during missed approach
- instrument landing approach and measuring distance to landing
- return of aircraft to destination according to bearing pointer on RMI when the compass fails
- autonomous computing of aircraft location beyond the radio signal range of station (in NAV mode)
- identification of the tuned station (audio signal in the pilot headset)

The air traffic controller has the following information on a display:

- location of all aircraft receiving signals from specific station

The RSBN system operates at 40 predefined channels in NAVIGATION mode and at 40 predefined channels at LANDING mode. The aboard RSBN system transmits signals to RMI's and RSBN range indicators in each cockpit.

The RSBN system is powered by 28 V DC, single phase 115 V AC at 400 Hz and triple phase 3×36 V AC at 400 Hz, and is switched on by "RSBN" switch located on main CB/switch panel in the fwd cockpit.

NOTE

When the aircraft electric power supply is switched from the main to stand–by generator, the RSBN system automatically disconnects from the network. If necessary it can be reconnected manually by means of "EMERG. CONNECTION RSBN" switch, located on the fwd cockpit main CB/switch panel.

NAVIGATION (NAV) MODE

The RSBN system in NAV mode provides pilot with information about aircraft position with respect to ground based station. These information are displayed on RMI and RSBN range indicator. The lubber line indicates the magnetic heading at the top of the display on the rotary compass card, which receives its inputs from GMK directional gyro. The bearing pointer, which receives signals from the ADF, indicates on the compass card the bearing to/from the station or on the fixed scale the relative bearing to/from the station. Using course deviation indicator the navigation tasks to/from the station and at circle along the station can be performed. The range indicator shows the actual slant distance to/from the tuned station.

GLIDE PATH (GP) MODE

In GP mode the RSBN system generates the electronic glide path which glide slope angle is set about 4 to 5 degrees to horizontal. The glide path is displayed on the RMI's and ADI's glide slope and localizer deviation pointers by the same manner as during aircraft landing. The GP mode is typically used at aircraft arrival route to a destination from the enroute phase. The glide path is constructed to guide the aircraft from the altitude 10,000 m and distance 132 ± 5 km from the station to altitude 600 m at distance 21 ± 3 km from the station. Reaching termination point is indicated by illumination of the "END OF DESCENT" light on the C&A lights panel in each cockpit. The RSBN range indicator displays actual slant distance to station.

LANDING (LDG) MODE

In LDG mode the aboard RSBN system receives signals from PRMG landing stations and displays them on the RMI's and ADI's glide slope and localizer deviation pointers. The RSBN range indicator displays actual slant distance to station.

CONTROL BOX

The RSBN control box is located on the forward cockpit left console.

NAV Channel Selector

Turning the selector sets the NAV channel. The selected channel number is displayed in "NAVIGATION" window.

LDG Channel Selector

Turning the selector sets the LDG channel. The selected channel number is displayed in "LANDING" window.

Distance Switch

The "DISTANCE INITIAL SETTING" switch, once positioned to either side, decrease or increase the distance displayed on the RSBN range indicator. Releasing the distance switch, the new range is set.

Course Switch

The "AZIMUTH INITIAL SETTING" switch, once positioned to either side, rotates the HSI's compass card. Releasing the switch, the new course is set.

Distance Correction Light

When the green "DISTANCE CORRECTION" light illuminates, the distance to the station is evaluated with a maximum accuracy, which the system is capable in radio touch with station. If the distance correction light does not shine, the aircraft is beyond the station range and the distance is computed by the system autonomously with lower accuracy.

Course Correction Light

When the green "AZIMUTH CORRECTION" light illuminates, the bearing to the station is evaluated with a maximum accuracy, which the system is capable in radio touch with station. If the course correction light does not shine, the aircraft is beyond the station range and the bearing is computed by the system autonomously with lower accuracy.

Volume Knob

The "VOLUME CONTROL" knob, when turned CW increase the RSBN station audio signal to the pilot's headset.

Zero Course Button

When the "AZIMUTH 0 SETTING" button is depressed, rotating the potentiometer will set the zero course. This button is used for maintenance purposes only.

OTHER CONTROLS AND INDICATIONS

Auxiliary Switch Panel

The auxiliary switch panel is installed in the forward cockpit RH console. The following controls belong the RSBN system:

- RSBN mode switch labeled "RSBN". The mode switch has three positions: "LANDING", "NAVIG." and "GLIDE PATH". In the "LANDING" position the aircraft is guided at the landing approach by the glide slope and localizer beams of landing station; in the "NAVIG" position the aircraft location (course and distance to/from the station) is displayed, and in the "GLIDE PATH" position the aircraft is guided during descent at the constructed electronic glide path.
- RSBN test button "TESTING". When the button is depressed, the RSBN system should set distance 291.5 ± 3 km at the range indicator and course $177° \pm 2°$ at the RMI.
- Identification button "IDENTIF". When the button is depressed the aircraft's symbol at the air traffic controller's display is highlighted.
- RSBN control box lighting intensity knob "RSBN LIGHTING" should be used to set suitable RSBN control box lighting intensity.

RSBN Beacon Audio Button

The RSBN beacon audio button "RSBN TUNE", located on the left console in each cockpit, when depressed, provide the pilot with the station audio signal in the head set.

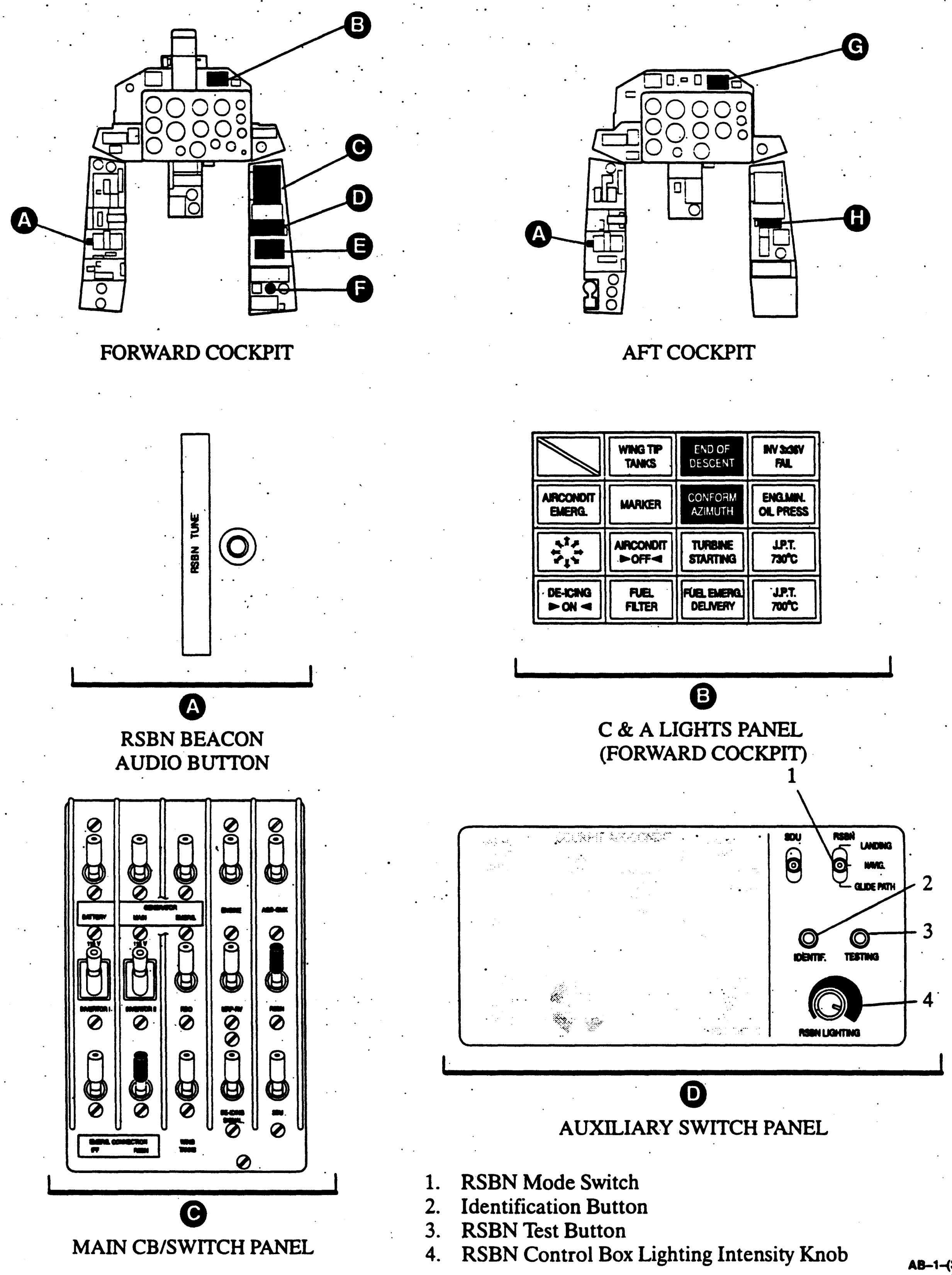
RSBN System Altitude Selector

The altitude selector is located on the right console in the forward cockpit only. Turning the knob in the middle of the instrument face will set the altitude of destination for RSBN mode "GLIDE PATH". The scale is graduated in mm MC multiply by ten.

RSBN Aft Control Panel

The RSBN aft control panel is located on the right console of the aft cockpit; the following controls are belong the RSBN system:

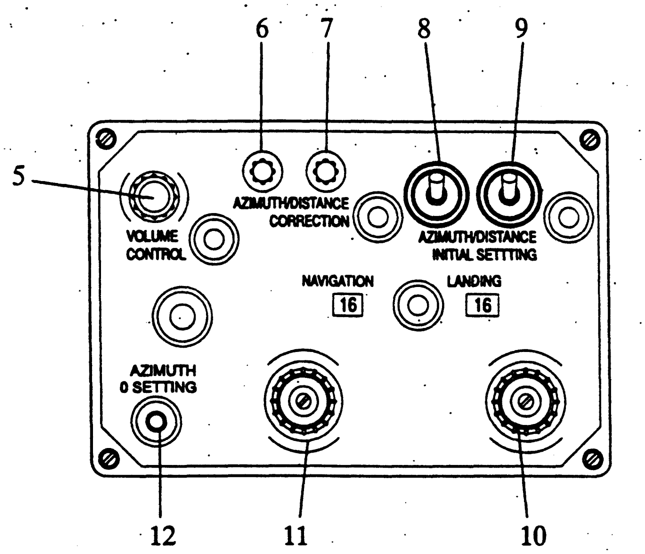
- Bearing alignment button "AZIMUTH ACCORDANCE" aligns the RMI selected course reading in the aft cockpit with reading of RMI selected course in the forward cockpit.
- Landing emergency engage switch "EMERG. SWITCH ON FOR LANDING" ensures pilot to switch on the LANDING mode of RSBN in emergency cases.



1. RSBN Mode Switch
2. Identification Button
3. RSBN Test Button
4. RSBN Control Box Lighting Intensity Knob

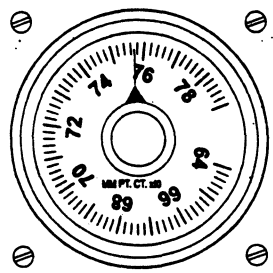
AB-1-(38-1)

Figure 1–38. RSBN – Location and Indication (sheet 1 of 2)



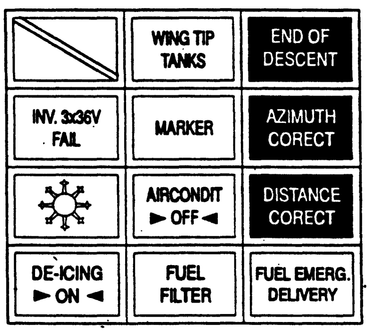
E

RSBN CONTROL BOX



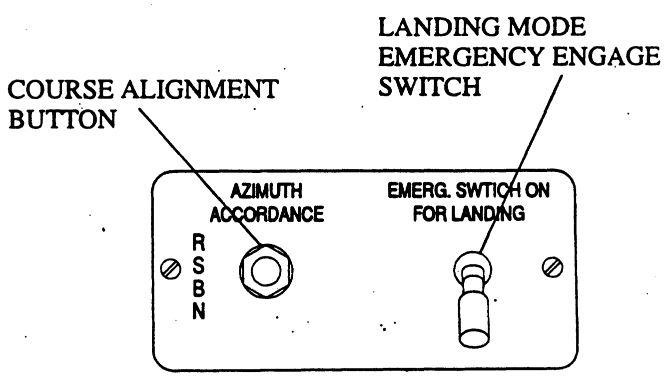
F

ALTITUDE SELECTOR



G

C & A LIGHTS PANEL
(AFT COCKPIT)



H

AFT CONTROL PANEL

5. Volume Knob
6. Course Correction Light
7. Distance Correction Light
8. Course Switch
9. Distance Switch
10. LDG Channel Selector
11. NAV Channel Selector
12. Zero Course Button

AB-1-(38-2)

Figure 1-38. RSBN – Location and Indication (sheet 2 of 2)

Caution and Advisory Lights Panel

The following lights are located on the caution and advisory lights panel in the forward cockpit:

- "END OF DESCENT" green advisory light indicates reaching the terminal point of GLIDE PATH regime.
- "CONFORM AZIMUTH" light illumination informs the pilot in the forward cockpit that the aft cockpit "AZIMUTH ACCORDANCE" bearing alignment button is depressed.

NOTE

Bearing can be adjusted in the forward cockpit only.

The aft cockpit caution and advisory lights panel bears the following lights:

- "END OF DESCENT" green advisory light indicates reaching the terminal point of GLIDE PATH regime.
- "AZIMUTH CORRECT" provides the same information as the course correction light in the forward cockpit RSBN control box.
- "DISTANCE CORRECT" provides the same information as the distance correction light in the forward cockpit RSBN control box.

SDU REMOTE COMMAND LANDING SYSTEM

The SDU system provides pilot with precision approach capability to 60 m AGL at the runway threshold. The SDU signals are displayed on the ADIs in both cockpits.

The SDU system is powered by 28 V DC and 3 × 36 V AC at 400 Hz, and protected by the "SDU" circuit breaker on the main CB/switch panel. The system can be switched on by means of "SDU" switch located on the forward cockpit auxiliary switch panel.

The pilot switches on the SDU system manually after penetrating area of stable receiving the localizer signal, which is indicated by disappearing of the "K" warning flag. SDU activation is indicated by hidden "K" and "Γ" warning flags on the RMI.

NOTE

Before the SDU system activation, the bearing pointer should be set at the runway course.

The aircraft can be steered using SDU pointers only when is clearly and unbrokenly receiving the signal of glide slope and localizer beams, which is indicated by both the "K" and "Γ" warning flags disappearing.

RKL–41 AUTOMATIC DIRECTION FINDER

The ADF system measures the relative bearing, i.e. the angle measured between direction of the aircraft nose and the station. Range of frequencies is from 150 to 1,800 kHz at MV and LV bands.

The ADF signal range is determined by the station transmitting power. With respect to the frequencies, its range overcomes the radio line–of–sight.

The relative bearing is displayed in the ADF indicators in each cockpit.

The ADF control box is located on the right console in both cockpits.

The ADF is powered by 28 V DC and 115 V AC at 400 Hz from the inverter I or inverter II.

ADF CONTROL BOX

The ADF control box bears the following controls:

Tune Indicator

The pointer indicates the accuracy of ADF tuning. Maximal deflection of the pointer should be set during ADF fine tuning.

Volume Knob

Turning this knob CW increases the volume of signal transferred to pilot headset.

ADF Control Switch

The control switch provides the possibility to "take" or "hand over" the ADF control.

Mode Switch

Positioning the mode switch to "TLF", the ADF receives signals from station with permanent or modulated standard (A3) and allows its listening. In the "TLG" position the beat frequency is generated to allow listening of identification signal (A1, A2).

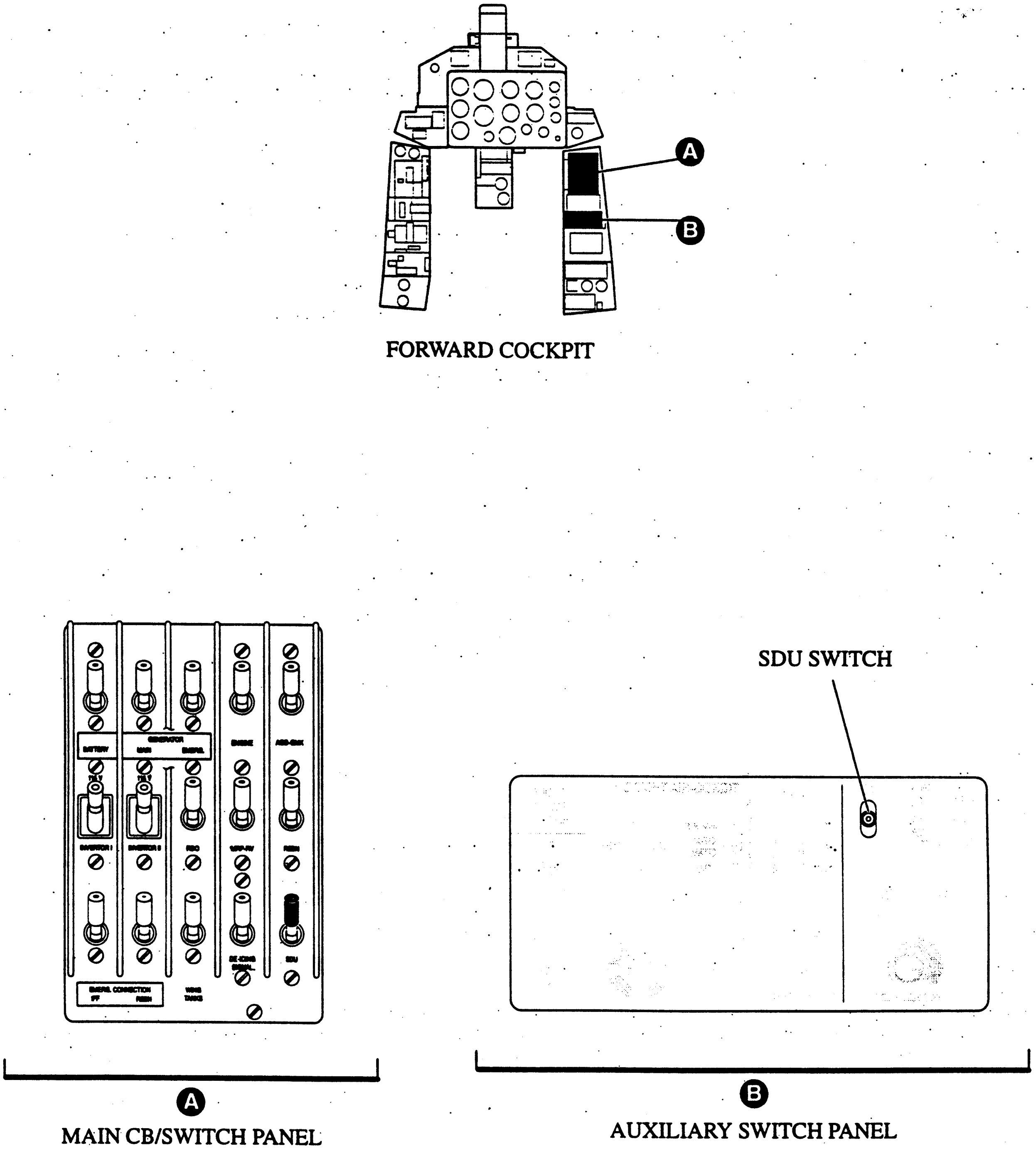


Figure 1-39. SDU Remote Command Landing System - Controls

Function Selector

Five–position switch can be switched to one of following positions:

- "OFF" – power supply disconnected, ADF does not operate
- "C AUT" – ADF operates in fully automatic mode. As the aircraft overpasses the outer beacon, the ADF is automatically re–tuned to preset inner beacon frequency. If the aircraft drifts from the approach entry sector, i.e. ±30° from the runway axis, the system is automatically re–tuned back to outer beacon frequency to enable to initiate the missed approach procedure. The ADF automatic re–tuning operates only in landing gear down position.
- "C MAN" – ADF indicator needle automatically points to tuned facility, however the switching between outer and inner beacon should be executed manually by means of outer–inner beacon switch located on the instrument panel in each cockpit.
- "ANT" – ADF system receives omnidirectional antenna signals only. This mode is recommended for tuning a specific beacon.
- "LOOP" – If the automatic beacon tracking function has failed, the direction to the beacon can be found manually by rotating a goniometer. The goniometer is controlled by means of "L/R" three position switch. When the switch is moved from its center neutral position to one of its end position, the goniometer starts to rotate in the respective direction. Accurate beacon direction finding is indicated either by means of less audible beacon identification signal in the pilots headset, or by minimum deflection of the tune indicator pointer.

"L/R" Switch

Moving the "L/R" switch to one of its end position causes rotating of ADF indicator needle. If the function selector is in either "C AUT" or "C MAN" position, the ADF indicator needle should move back to initial position (pointing the tuned beacon) after "L/R" switch releasing to neutral position. This feature verifies the ADF operation ability. The next function of this switch is described above (refer to "LOOP" position of function selector).

Frequency Control Knobs

The ADF frequencies can be set by means of triple rotary switches. The two identical knobs are marked "O" for outer beacon frequency tuning, and "I" for inner beacon. Turning the outer larger knob selects hundreds of kHz, center toggle knob selects tens of kHz and inner small knob changes units of kHz. Units of kHz are indicated on outer scale graduated from 1 to 10, however this scale is not calibrated and shows the units approximately only. The inner small knob can be mainly used for fine tuning to achieve maximum deflection of the tune indicator pointer. The window beside the control knob indicates the selected frequency in kHz.

Intensity Knob

Rotating the knob increases or decreases the ADF control box lighting intensity.

OUTER–INNER BEACON SWITCH

The outer–inner beacon switches are located on the LH side of instrument panel in both cockpits. The switch has two position marked "O" and "I". When the ADF function selector is in "C MAN" position, the either outer or inner beacon frequencies can be selected to be displayed on the ADF indicator.

FAULT SIMULATOR SWITCH

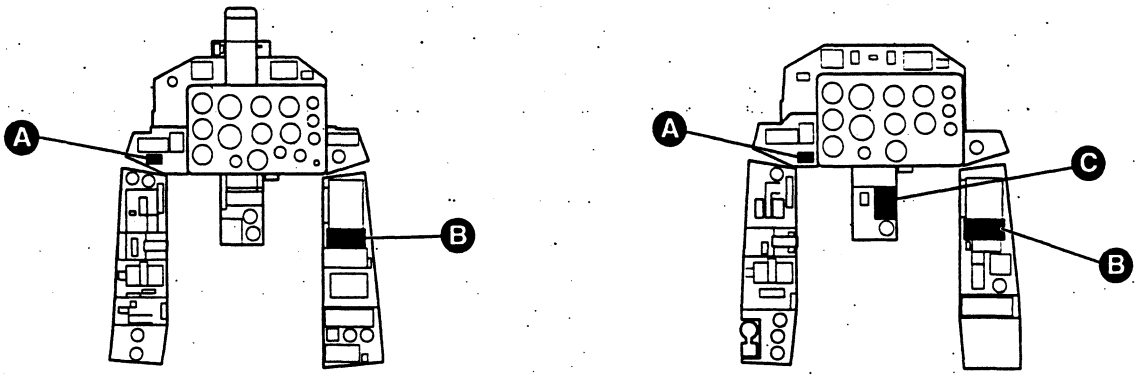
The "A.H. FAILURE –ARK" fault simulator switch is located on the center pedestal in the aft cockpit. When switched on the switch can simulate interruption of signal transmitted from the ADF system to forward cockpit ADF indicator. At any time the navigation fault simulator is operating, the ADF indicator in the aft cockpit remains normal and shows the true reading.

MRP–56P/S MARKER BEACON RECEIVER

Figure 1–41.

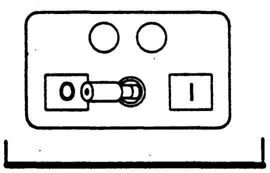
The VHF marker beacon receiver provides pilot with audio and visual indication of marker beacon overpass. The audio signal is sent to pilot's headset and the visual indication is provided on the caution lights panel in both cockpits by illumination of "MARKER" green light.

The marker beacon receiver is powered by 28 V DC and is switched on together with radio altimeter by the "MRP–RV" switch located on the main CB/switch panel.



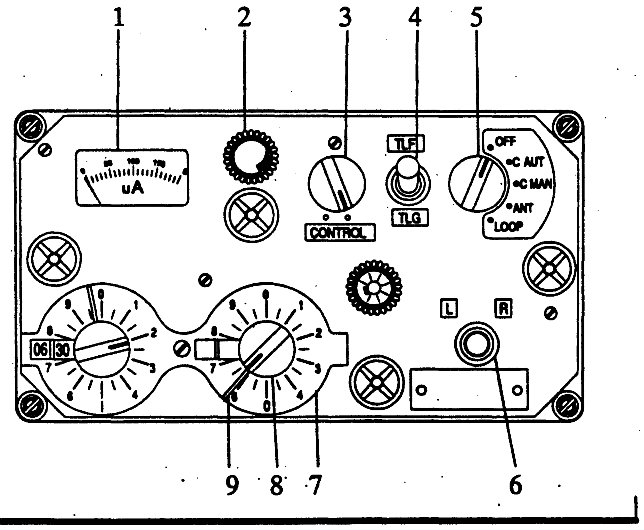
FORWARD COCKPIT

AFT COCKPIT



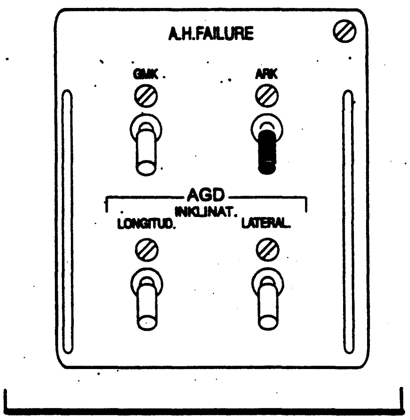
A

OUTER – INNER
BEACON SWITCH



B

ADF CONTROL BOX



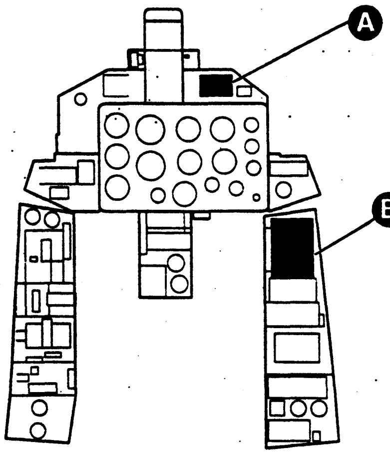
C

FAULT SIMULATOR SWITCH

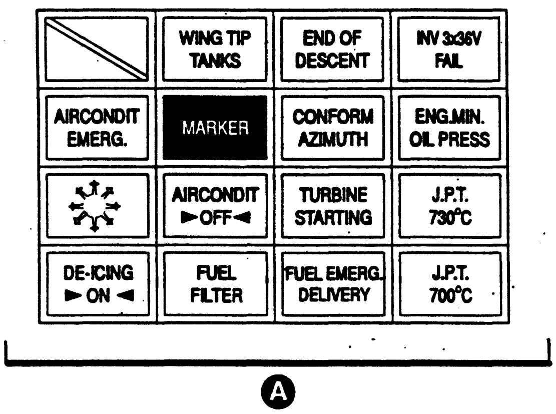
1. Tune Indicator
2. Volume Knob
3. Control Switch
4. Mode Switch
5. Function Selector
6. L/R Switch
7. Frequency Control Knob – 100 kHz
8. Fine Tuning Knob
9. Frequency Control Knob – 10 kHz

AB–1–(40)

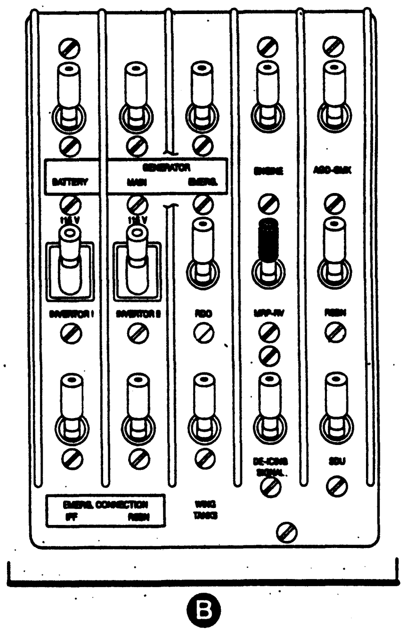
Figure 1–40. ADF Automatic Direction Finder – Controls



FORWARD COCKPIT



C & A LIGHTS PANEL – TYPICAL



MAIN CB/SWITCH PANEL

AB-1-(41)

Figure 1–41. Marker – Controls and Indication

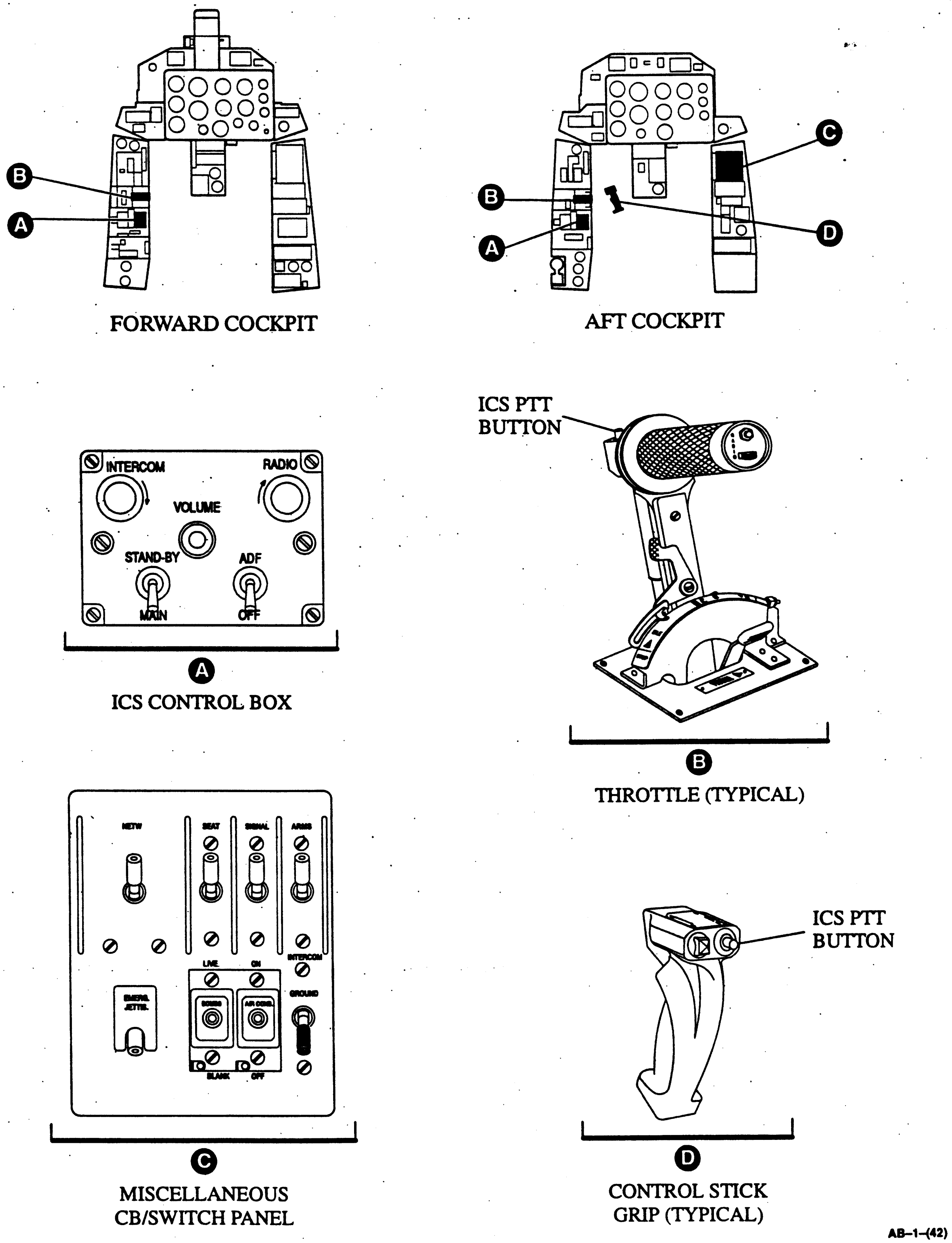


Figure 1–42. Intercom – Controls

COMMUNICATION SYSTEM

The aircraft communication system consists of an intercom set and a VHF/UHF radio.

INTERCOM (ICS) Figure 1–42.

The intercom provides the following function:

- Inter–cockpit and cockpit to ground staff communication
- Connection and mixture of all audio signals to be applied to the headset
- PTT, transmitters and receivers audio's distribution

The intercom system is powered by 28 V DC and is switched on by "RDO" switch located on the main CB/ switch panel in the forward cockpit or by "INTERCOM GROUND" C/B located on the miscellaneous CB/switch panel in the aft cockpit.

ICS CONTROL BOX

The intercom control box is located in both cockpits on the left console.

Intercom controls are:

ICS Volume Knob

The "INTERCOM" volume knob controls the volume of the intercom audio signal to the headset in the respective cockpit. The volume increases by rotating the knob in the arrow direction.

Radio Volume Knob

The knob is labeled "RADIO" and controls the volume of radio audio signal to the headset in the respective cockpit. The volume increases by rotating the knob in the arrow direction.

Radio Control Switch

The "STAND–BY/MAIN" radio control switch, when switched to the "STAND–BY" position, connects parallely the headset to ICS amplifier in the next cockpit. The switch function is to stand–by the ICS in case of the next cockpit intercom amplifier malfunction. When in "STAND–BY" position, all controls are deactivated.

ADF Audio Switch

The "ADF/OFF" audio switch, when switched to the "ADF" position, enable to listen the ADF beacon signal in the pilot's headset.

ICS PRESS–TO–TALK BUTTONS

To activate the ICS transmitting, one of the PTT buttons located on the throttle grips in both cockpits shall be pressed. In the aft cockpit, the PTT button is doubled with the button located on the stick grip.

R–832M VHF/UHF RADIO

Two band VHF/UHF radio provides line–of–sight communications. The radio has not a provision to select individual frequency, but one of 20 preset channels can be selected. Frequency range is from 118 to 140 MHz at VHF band and from 220 to 389.95 MHz at UHF band. The UHF/VHF radio control boxes are located on the left console in each cockpit. They operate in tandem connection being switched by "RADIO CONTROL" switch in each cockpit's audio panel. The operating control box is determined by illuminating channel window. Transmissions are made by pressing one of the PTT buttons located on the throttle grips in each cockpit. The radio is powered by 28 V DC and 115 V AC at 400 Hz from the inverter I or inverter II, and is activated by "RDO" switch in the main CB/panel in the forward cockpit.

UHF/VHF RADIO CONTROL BOX

Preset Channel Selector

The preset channel selector permits the selection of one of 20 preset frequencies. The selected channel number can be read in the channel window.

Memory Screw

Rotating the screw, the mechanical memory card can be removed from the control box, and the new memory card with different selection can be inserted.

AUDIO PANEL

Radio Control Switch

The switch is labeled "RADIO CONTROL" and permits to change the radio controls. Each movement of the switch, no matter in which cockpit, changes the existing box in command to the other one, i.e. the control over the radio can either be "taken" or "handed over". The channel window will illuminate to indicate control of the radio box in respective cockpits.

Squelch Switch

The switch in on position enables squelch circuit which helps to eliminate background noises during normal reception. In OFF position the squelch circuit is disabled to permit unhampered use of a weak signal.

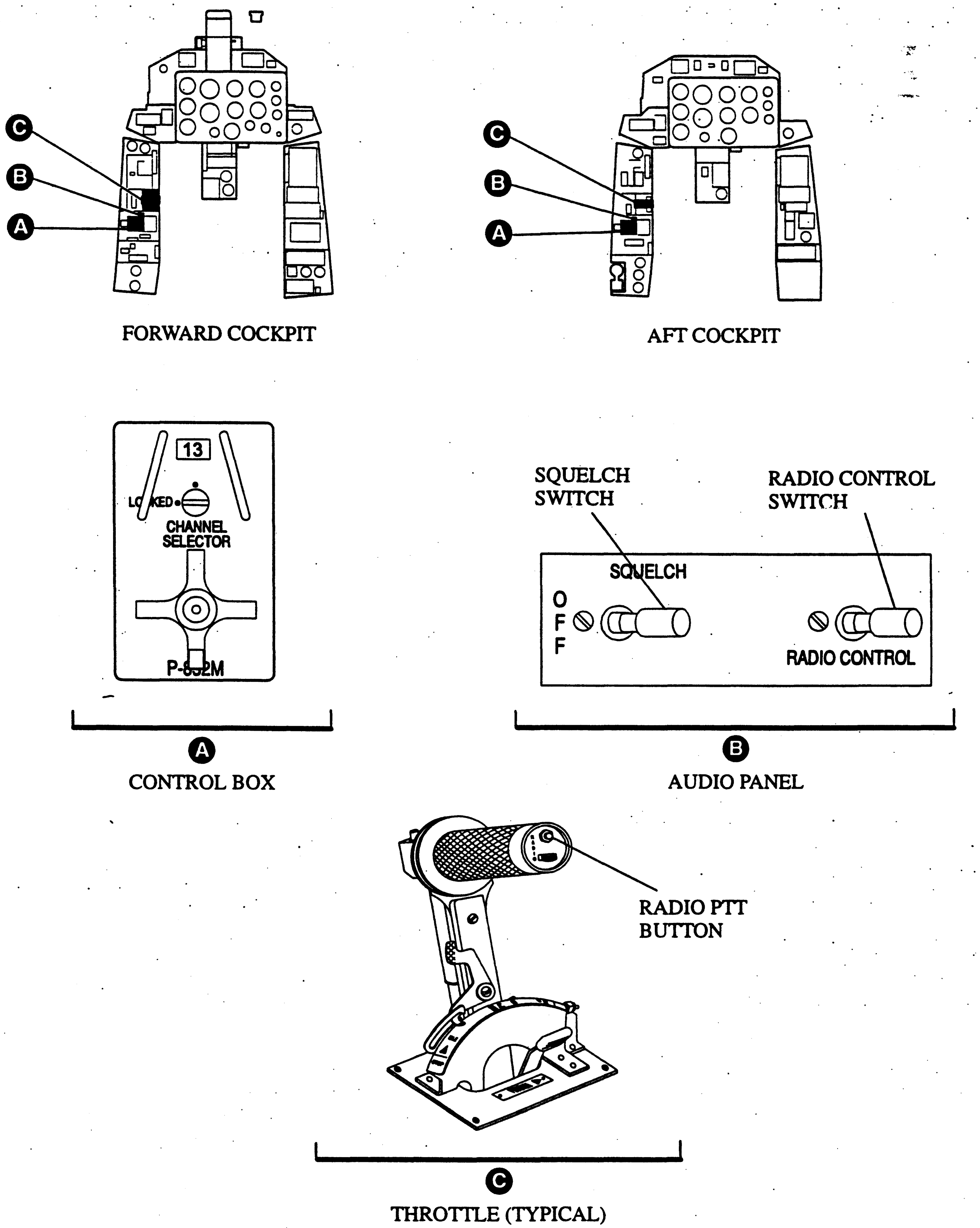


Figure 1-43. VHF/UHF Radio – Controls

SRO TRANSPONDER (IFF) SYSTEM

The SRO transponder system provides the means for identifying to be friend–or–foe (IFF). The transponder is a receiver–transmitter which transmits a coded response "I am allied aircraft – friend" to a coded interrogation transmitted by the air traffic control station. The IFF system contains an antenna system and a control box. The IFF system is power supplied by 28 V DC and 115 V AC at 400 Hz. When the main and standby generator fail during flight, the IFF is automatically disconnected from the power supply. If needed, the IFF can be shortly connected by an "EMERG. CONNECTION IFF" switch, located on the main CB/switch panel.

IFF CONTROL BOX

The IFF control box is located under the RH cabin frame in the forward cockpit only.

Code Selector

The relevant identification code can be selected by the code selector in a range from 1 to 12.

Power Switch

The doubled switch labeled "FEEDING" switches on the IFF system.

Power Light

The red advisory light labeled "FEED. CHECK" illuminates when the IFF system is power supplied.

Emergency Switch

The switch "EMERG" should be switched on whenever an emergency conditions are detected. Switching on the emergency switch will warn the air traffic controller about the emergency situation.

FDR–39TM–E FLIGHT DATA RECORDER (FDR)

Figure 1–45.

The FDR, located on the LH side of the fuselage aft section, records various A/C flight parameters. The recording is done on a solid state EPROM PCB which has a capacity of 1 MB, equivalent to approximatelly 8 data hours.

The 8 recording hours are divided to data blocks of 2 hours each. Once a block is completed the next block is employed. When the last block is completed the first is erased to provide space for the next 2 hours of recording (First In First Out).

The parameters recorded by the FDR are of two types:

- Continuous recording of flight data
- Events

THE FLIGHT DATA INCLUDE:

- Flight altitude
- Speed
- G forces
- Elevator movements
- Engine RPM
- Throttle movement

THE EVENTS INCLUDE:

- Ejection
- Fuel shut off
- L/G door open

THE FOLLOWING WARNINGS ARE INCLUDED:

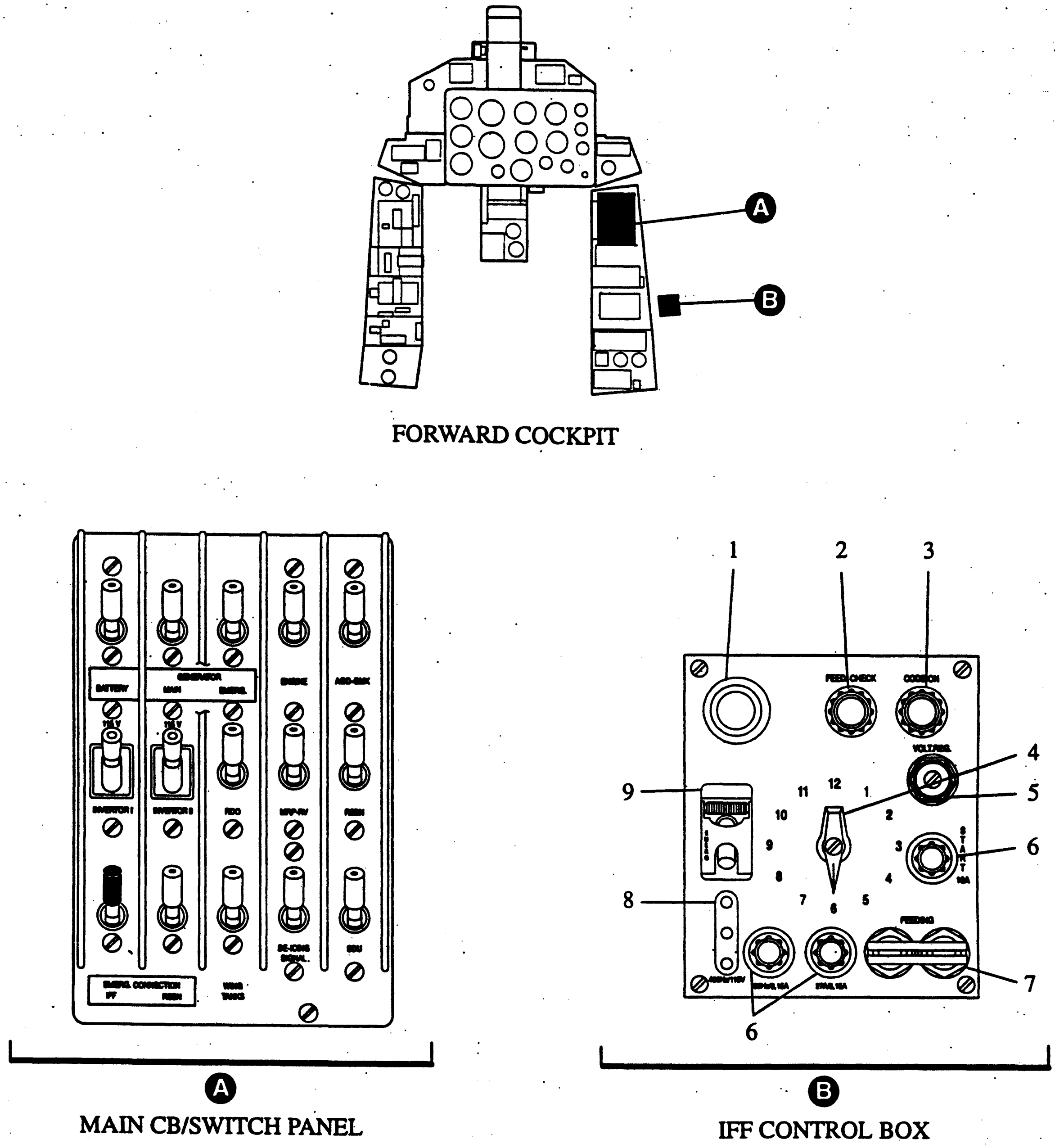
- Fire
- Minimum fuel pressure behind boost pump
- Minimum pressure in the hydraulic system
- Cabin pressure
- RAT not operating
- Minimum oil pressure

All data and events are recorded along a time basis for post flight analysis by the ground evaluation equipment GEE–39TM. The down loaded flight data may be presented for evaluation in a graphical and/or a digital format.

FDR OPERATION

The recording system is switched on automatically once the aircraft has exceeded 120 km/h. It can also be switched on at any time by the "FLT RECORDER" switch located on the forward cockpit LH console. A steady green light, alongside the switch, indicates that the recording tape is running. If the light flashes, the FDR is powered, but a fault is detected in the system.

The FDR is power supplied by the battery bus and is protected by "BATTERY" switch located on the main CB/ switch panel and by "FLT RECOR/EKSR–46/KL–39" C/B located on the aft C/B switch panel.



1. Transmission Indicator
2. Power Light
3. Code Selection Indicator
4. Code Selector
5. Voltage Regulator
6. Circuit Breaker
7. Power Switches
8. Test Socket
9. Emergency Switch

AB–1–(44)

Figure 1–44. IFF – Controls and Indication

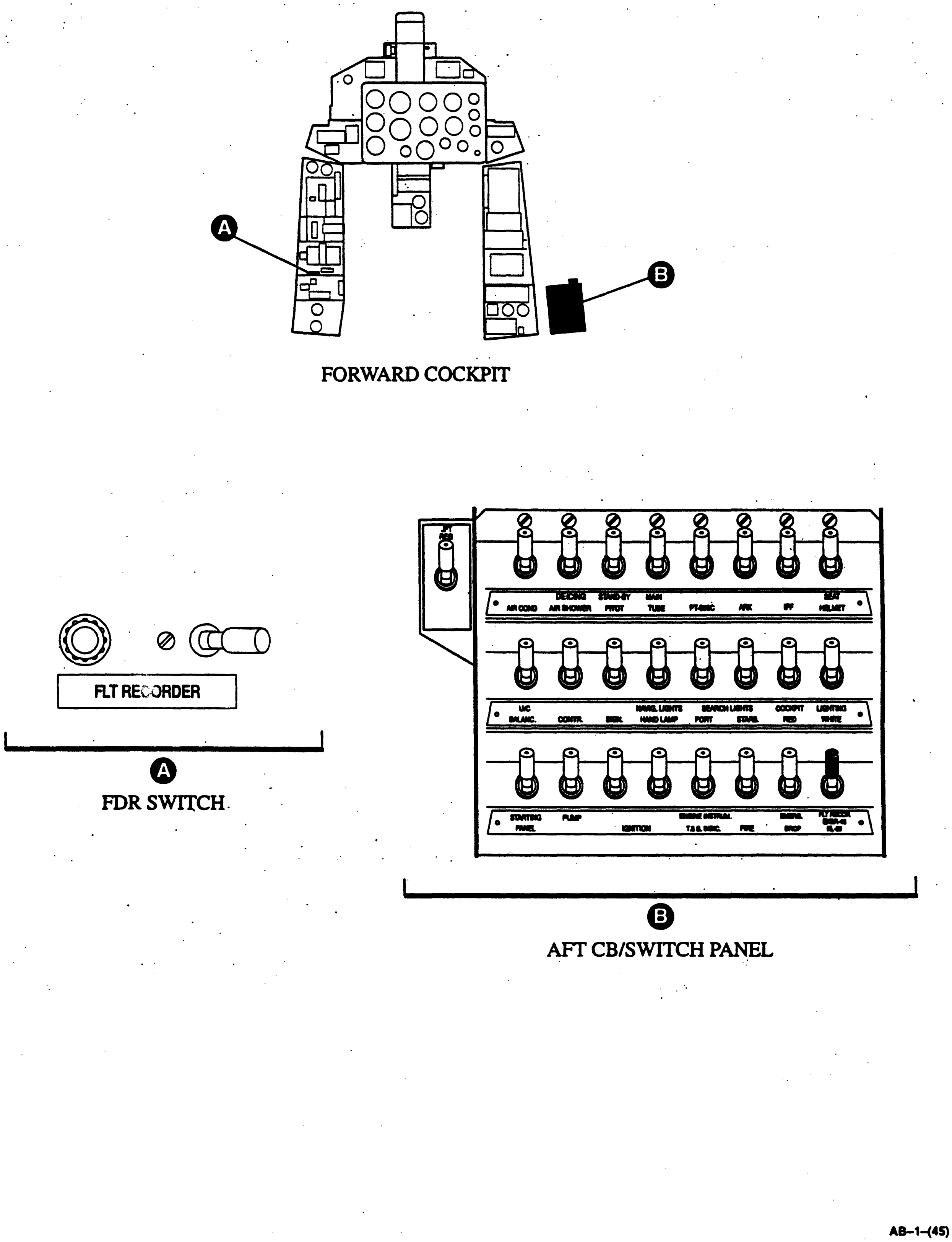


Figure 1-45. FDR - Controls and Indication

<u>OXYGEN SYSTEM.</u> **Refer to figures 1–46 through 1–48.**

The aircraft is equipped with a gaseous oxygen system which is divided into high and low pressure subsystems. The system utilizes four four–liter cylinders and two spherical two–liter bottles, installed in the nose compartment and an emergency oxygen container located in the seat pack of the parachute. In flight the emergency oxygen containers are located in the ejection seat frame.

Each pilot receives his oxygen supply through a separate pressure line, delivered from two cylinders and one spherical bottle. However, when the pressure decreases, the lines can be interconnected so that the oxygen may be used to supply the other one. A pressure reducer in each circuit provides reduced oxygen pressure to the diluter demand regulator.

Both forward and aft pilots are equipped with an oxygen mask; the oxygen system installation in the forward cockpit has a provisions to use an altitude compensating flight suit with hermetized pressure helmet.

The pilot breathes ambient air up to flight altitude 2,000 m, from that altitude up to 8,000 m a mixture of air and oxygen. The ratio between air and oxygen depends on the cabin altitude. From flight altitude 8,000 m the pure oxygen is supplied to the mask. The mixture or oxygen is delivered to the mask either in dependence on pilot's breathing or pressurized pure oxygen can be continuously supplied if needed.

HIGH PRESSURE (HP) OXYGEN SUBSYSTEM

The HP oxygen subsystem consists mainly of the oxygen cylinders, check valves, the pressure reducer and the HP oxygen indicators. Pressure in the HP oxygen subsystem is 150 MPa.

OXYGEN CYLINDERS

Four oxygen cylinders containing four liters each and two spherical bottles containing two liters each are located in the nose. Each cylinders are replenished through one ground central oxygen filler valve located on the aircraft nose LH side.

OXYGEN SHUT–OFF VALVE

The oxygen shut–off valve, labeled "OXYGEN", is installed in the aft part of left console in each cockpit. The valve has two positions: CLOSED and OPEN. The valve, when turned CCW, opens the oxygen supply system.

CHECK VALVES

Several non–return valves are installed in the HP part of the oxygen system to prevent back flow of the oxygen and leakage from faulty oxygen circuit.

OXYGEN PRESSURE INDICATOR

The oxygen pressure indicator consists of two independent instruments in one body: oxygen pressure indicator and flow indicator.

The oxygen pressure indicator is located on the forward left console in each cockpit to indicate pressure of the HP oxygen subsystem. The scale is graduated from 0 to 165 kp/cm^2.

Normal system pressure is between 30 and 150 kp/cm^2, depending on oxygen consumption. The flow indicator constitutes the lower part of the instrument.

LOW PRESSURE (LP) OXYGEN SUBSYSTEM

The LP oxygen subsystem consists of the diluter demand regulator and the mixture regulator, which provides an oxygen/air mixture in proportion to a given altitude and incorporates the following controls and indicators:

DILUTER DEMAND REGULATOR

The diluter demand regulator continuously supplies to the mask an optimum volume of oxygen in dependence on cabin altitude, controls helmet ventilation and provides oxygen pressure control in the compensating suit, helmet or mask.

The diluter demand regulator has following controls:

<u>Diluter Demand Switch</u>

The diluter demand switch is located on an oxygen control panel and has two positions: "100% O_2" and "NORM". In the "NORM" position oxygen is supplied by the regulator depending on cabin altitude and pilot's needs. In the "100% O_2" position pure oxygen is delivered continuously.

<u>Emergency Oxygen Switch</u>

The red background switch "EMER" has two positions: "OFF" and "ON". For normal operation the switch is set to "OFF". When the pressure regulation in the diluter demand regulator failures, the switch shall be moved to "ON" position and the oxygen is delivered with positive pressure to the oxygen mask, with no regulation.

MIXTURE REGULATOR

The mixture regulator is connected to the onboard oxygen system with P.E.C.

NOTE

If the oxygen mask is not properly tightened on the pilotÆs face, or the helmet is opened or unsealed, and the cabin altitude is above 2,000 m, the oxygen continuously flows through the oxygen mask to the cabin atmosphere.

FLOW INDICATOR

The flow indicator, located in the oxygen pressure indicator, indicates oxygen flow. During normal operation the blinker indicates a double butterfly white flags when there is no demand for oxygen and blank (open) when oxygen flows. With the emergency switch at the "ON" position, the blinker indicates no flag (blank).

OPERATION

At all stages, in order to allow oxygen supply, the shut–off valve must be open.

During normal operation the diluter demand switch should be placed to "NORM" and the emergency switch to "OFF". Should the pilot feel any kind of dizziness , he can, at any time, switch the diluter demand switch to "100% O_2" for pure oxygen supply. If symptoms of hypoxia are suspected the emergency switch should be placed to "ON" to provide oxygen with pressure.

NOTE

Up to the approximately 2;000 m, the blinker does not indicate flow (white flags are shown) since no oxygen is supplied (in "NORM") up to that altitude.

AFT COCKPIT OXYGEN INTERCONNECT VALVE

The aft cockpit is equipped with an interconnect valve placarded "BOTTLES INTERCONNECT", and located on the left console behind the oxygen shut–off valve. The interconnect valve is kept shut (CW) during normal operating dual flights. For solo flights, or when the oxygen in any cockpit is depleted, the interconnect valve is opened (CCW), allowing both pilots to breath oxygen from the interconnected system bottles through the interconnect valve.

COMPENSATING SUIT AND PRESSURIZED HELMET

Only the forward cockpit has provisions to use compensating suit and pressurized helmet for training purposes.

The helmet ventilation system exhausts carbon dioxide from the helmet space and blows on the pilot

The following pilot's equipment is released to be used in the forward cockpit:

- oxygen mask and Anti–G suit
- oxygen mask and compensating suit
- pressurized helmet and compensating suit

When the cabin is depressurized about maximal aircraft ceiling, the compensating suit will be automatically inflated with oxygen and pure oxygen with positive pressure will be delivered to the helmet.

HELMET OXYGEN PRESSURE INDICATOR

The mixture or oxygen pressure in the helmet is indicated on the pressure indicator, located on the forward cockpit LH console. The indicator reading is from 0 to 2,000 mm of water column, the normal indication range is between 800 and 1,200 mm of water column.

HELMET VISOR HEATING CONTROL PANEL

When the helmet visor became fogged during flight, it can be electrically heated. The helmet visor heating control panel is located on the forward cockpit left console. The visor heating system is protected by "SEAT/HELMET" C/B located on the aft CB/switch panel.

<u>Helmet Visor Heating Switch</u>

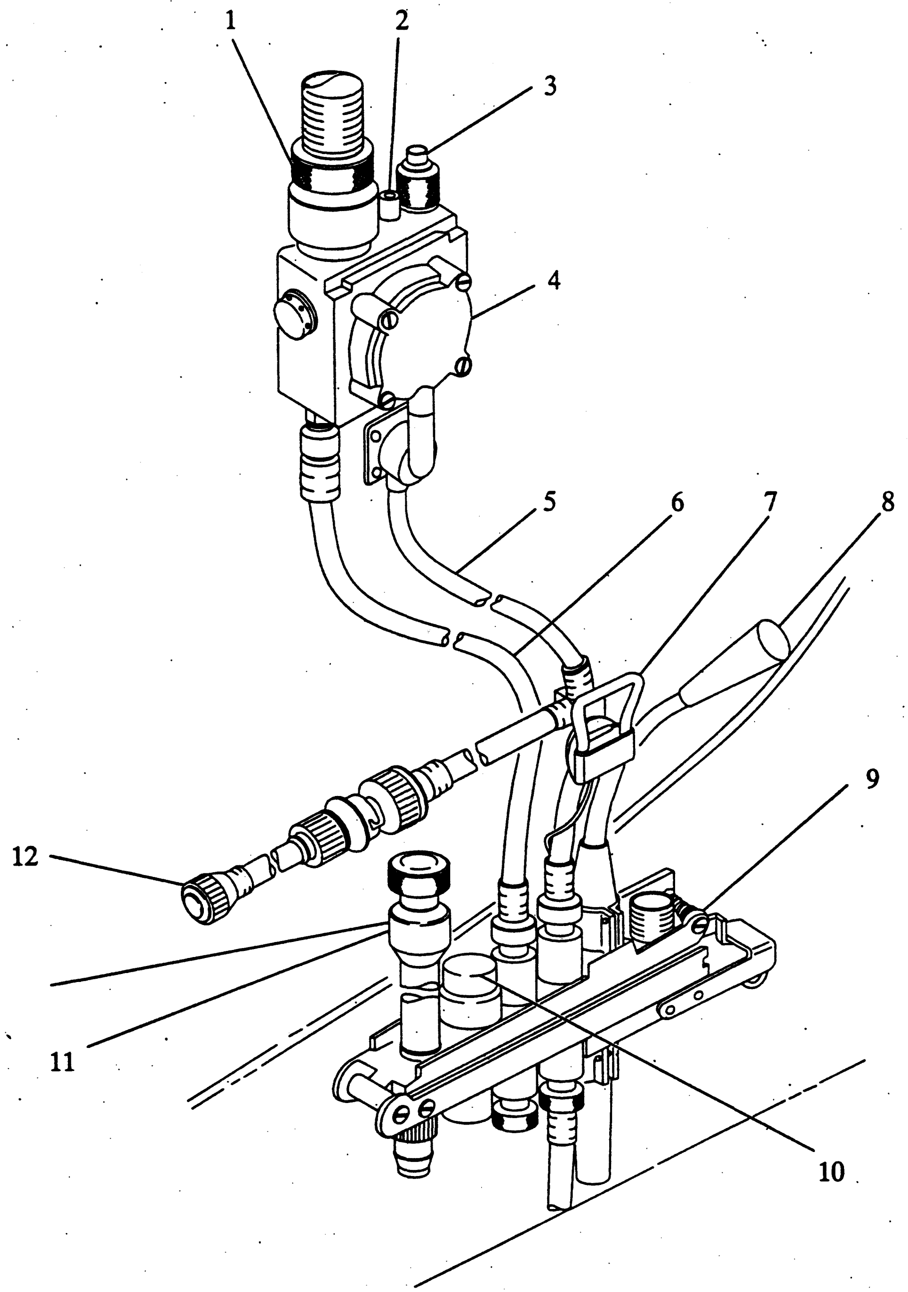
When in "ON", the visor is automatically defogged only if required. The next position will switch off the automatic heating.

<u>Helmet Visor Quick Heating Button</u>

In case of sudden visor fogging, the "QUICK" push–button should be depressed and hold, thus applying maximum intensive helmet visor heating.

<u>Temperature Knob</u>

Turning the knob, the current utilized by visor heating system is increased or decreased.



1. Oxygen Mask Connector – Normal Delivery
2. Oxygen Mask Connector – Emergency Delivery
3. Ventilating Suit Connector
4. Mixture Regulator
5. Oxygen Supply Hose – High Pressure
6. Oxygen Supply Hose – Low Pressure
7. P.E.C. Quick Disconnect
8. Radio and Helmet Heating Connector
9. P.E.C. (Typical)
10. Ventilating Connector
11. Anti–G Connector
12. Emergency Oxygen Connection Hose

AB–1–(46)

Figure 1–46. Personal Equipment Connection and Mixture Regulator

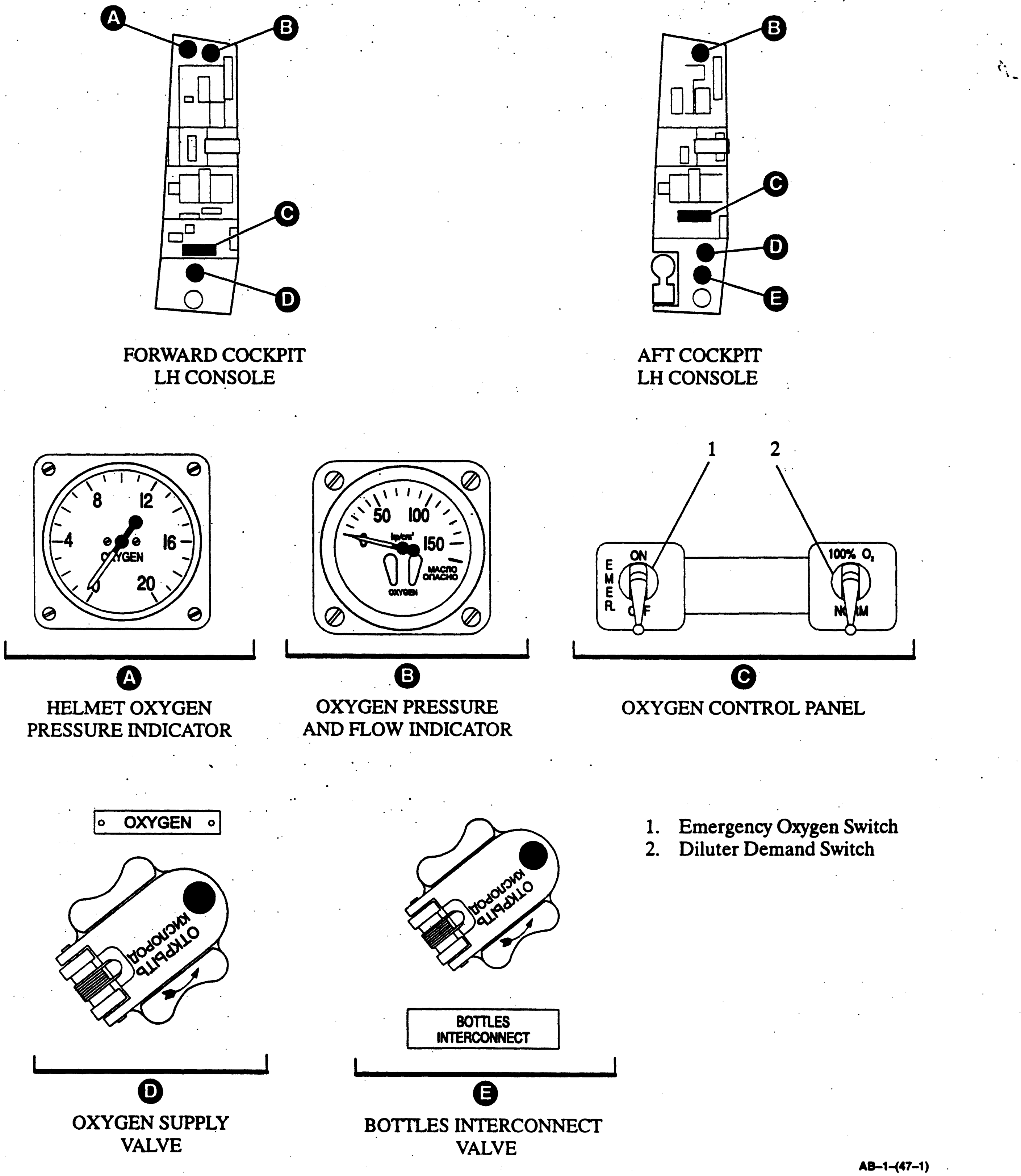
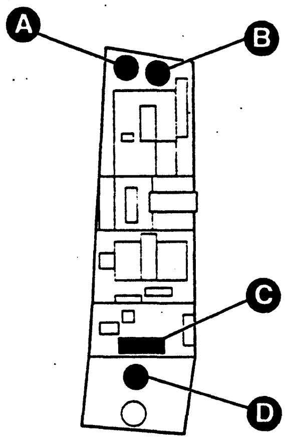
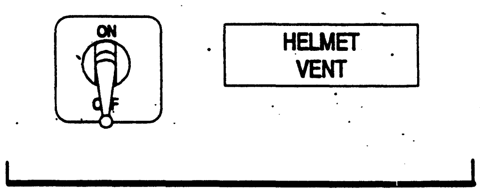


Figure 1–47. Oxygen System – Controls and Indication (sheet 1 of 2)

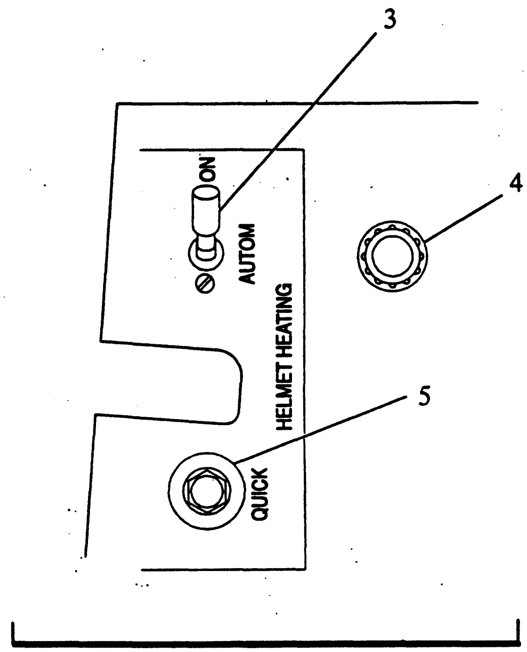


FORWARD COCKPIT
LH CONSOLE



A

HELMET VENTILATION SWITCH



B

HELMET VISOR HEATING
CONTROL PANEL

3. Helmet Visor Heating Switch
4. Quick Heating Button
5. Temperature Controller

AB-1-(47-2)

Figure 1-47. Oxygen System – Controls and Indication (sheet 2 of 2)

OXYGEN DURATION. Refer to figure 1–48.

EMERGENCY OXYGEN SYSTEM

The emergency oxygen container is attached to the pilot's parachute and during flight is located with a survival kit in the seat bucket. The emergency oxygen delivery is activated automatically upon seat ejection. It can also be activated manually in the cockpit by means of a red knob attached to the seat connector when the normal system fails. The emergency oxygen container is charged with 0.825 liters of oxygen at a pressure of 150 kg/cm^2. A built in pressure indicator permits checking of the pressure.

The container is connected directly to the lap belt radio/oxygen connector and provides oxygen for approximately 10 minutes.

Contents of "O_2" (%) "MIXTURE"	Cabin Altitude	HP OXYGEN PRESSURE IN PSI							
		2,175	1,885	1,595	1,305	1,015	725	435	145
Diluter Switch 100%	All Altitudes	46.50	36.70	32.80	29.00	19.30	15.40	5.80	–
Mixture 24	6,000 ft	181.70	174.00	146.20	119.00	90.50	63.10	35.70	–
Mixture 32	12,000 ft	148.60	130.50	106.70	89.20	65.30	47.30	29.70	–
Mixture 43	18,000 ft	108.00	93.10	78.30	63.70	48.70	33.80	14.30	–
Mixture 60	24,000 ft	77.30	65.00	58.40	46.40	33.80	21.80	15.40	–
								*	**

WARNING

* Descent to an altitude where oxygen is not required.

** Do not fly with oxygen

NOTE

4. The values of oxygen durations in the table are valid for the flights at the introduced altitudes.
5. During SOLO flights the indicated values are approximately double

AB-1-(48)

Figure 1–48. Oxygen Duration in Minutes for Two Crew Member

CANOPIES

PNEUMATIC SYSTEM

The pneumatic system provides air for inflating the sealing tubes of the windshield and canopies of both cockpits. The air source is an air bottle with a volume of 2 liters and pressure of 15 MPa. Two stage reduction valves located in the fwd cockpit, reduce gradually this pressure to 1.52–1.59 kp/cm^2 (22–23 psi) which is adequate for canopy sealing. The pressure in bottles is indicated on the pressure gage located on the aircraft nose LH side together with the filling port.

Sealing effect of the windshield and canopies is established after closing and locking the canopies locks and moving the Cabin pressurization and ECS handle to the center position. This can be done from either cockpits.

When unlocking the canopy without de–pressurizing first (and/or during ejection), the air in the sealing tubes is drained automatically. However during normal operation this is highly unrecommended as the canopies can spring out of their hinges.

The Cabin pressurization and ECS handle may be placed to center or forward position, only after both canopies are locked.

CANOPY CONTROL (Figure 1–49)

The aircraft is equipped with individual canopies for the forward and aft cockpits which are opened and closed independently. The canopies are hinged at the right and open upward, from the LH side.

Make sure to lift the canopy from the left otherwise it may be released of its hinges on the right.

The canopy controls consist of the internal locking levers, the externals locking levers and the canopy jettison levers. Securing rods are installed to hold the canopy at the open position.

INTERNAL CANOPY LOCKING LEVER

The internal canopy locking levers are located on the left cabin rail in each cockpit. It has a red mark in the forward locked position. In the closed position, each canopy is held by four locks. The locks in each canopy are opened or closed simultaneously by the canopy locking lever through a mechanical linkage. To open the canopy, the internal canopy lever is tilted inboard and then pulled backwards.

EXTERNAL CANOPY LOCKING LEVER

Locking and unlocking the canopies from outside is established by external canopy locking levers located below the cabin rail on the left side of the fuselage by each cockpit canopy. The spring loaded lever is released by pushing the locking cover. A spring forces the lever to engage the mechanical linkage of the opening mechanism.

To store the handle, it must be pushed against the spring pressure and secured by the locking cover. Turning the lever clockwise opens the canopy locks.

CANOPY SECURING ROD

In the open position, the canopy is held by a rod. The canopy is secured in the tilted opened position when the rod is extended and canopy tilted to its maximum position. The securing element is then brought automatically to the groove. When closing the canopy, it is necessary first to lift the securing element before the canopy can be moved from open–secured position.

CANOPY UNLOCKED WARNING LIGHT

A red "CANOPY UNLOCKED" light located on the warning panels in each cockpit, illuminates when one of the canopy locking levers is not fully forward. Hence the respective canopy is not properly locked.

CANOPY JETTISON SYSTEM (Figure 1–50)

Two identical independent canopy jettison systems, one for each cockpit, consists of a pyrotechnic cartridge, a cylinder for unlocking the canopy locks, two telescopic cylinders for canopy jettisoning, pressure lines, pull rods and the four canopy locks.

The canopies can be jettisoned in flight by means of the emergency canopy jettison lever and by the levers for normal unlocking of the canopy locks.

When the ejection seat is operated, the canopy will be jettisoned as well, as part of the ejection sequence.

The red canopy jettison lever is located below the cabin rail on the right side in each cockpit. Move the lever anti–clockwise fire a cartridge located on the bulkhead behind the ejection seat. The gas discharged from the cartridge is distributed through three lines. The first line is connected to a mechanical linkage of the four locks opening mechanism while the remaining two lines are connected to the actuator on the canopy rail which in turn jettisons the canopy.

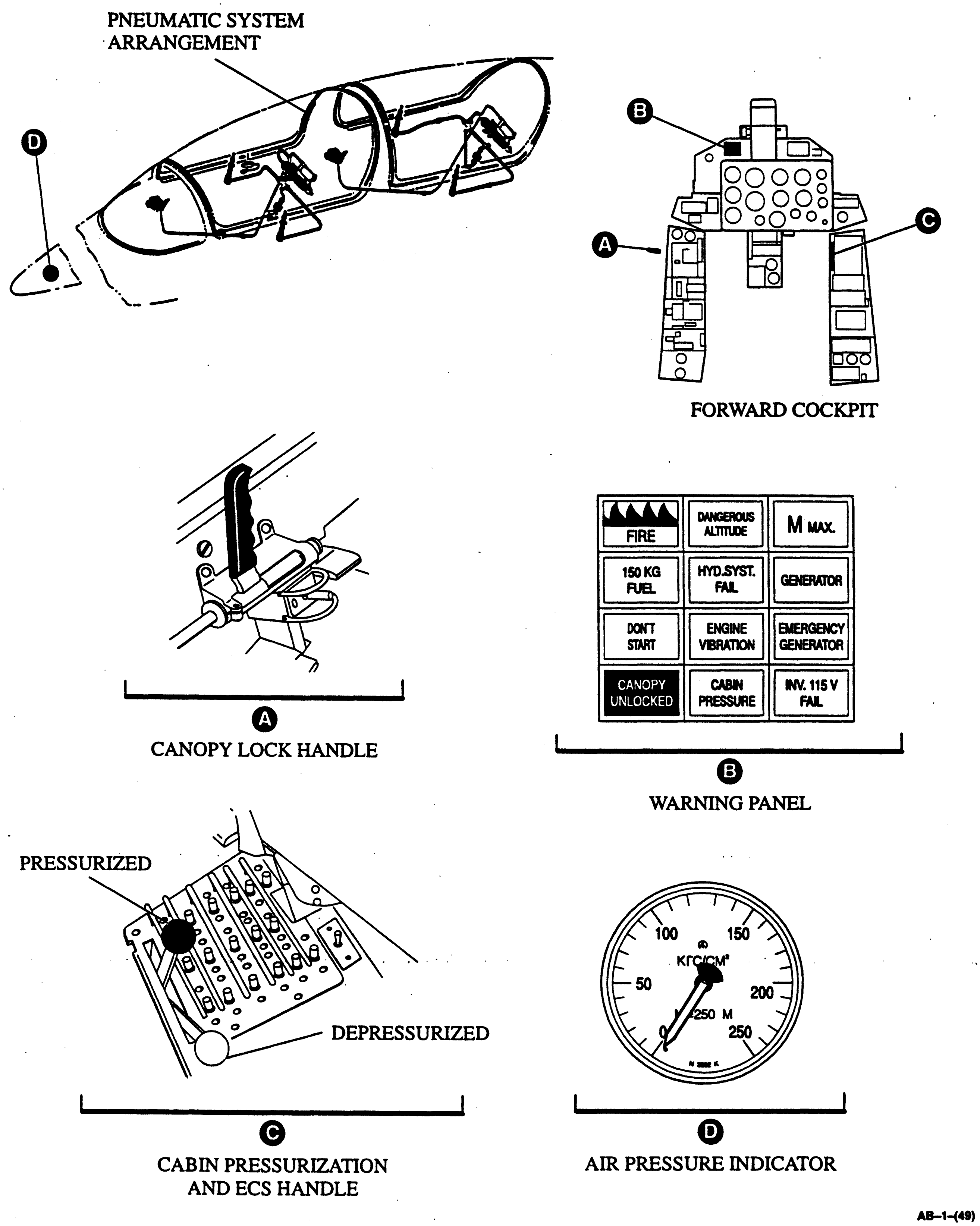
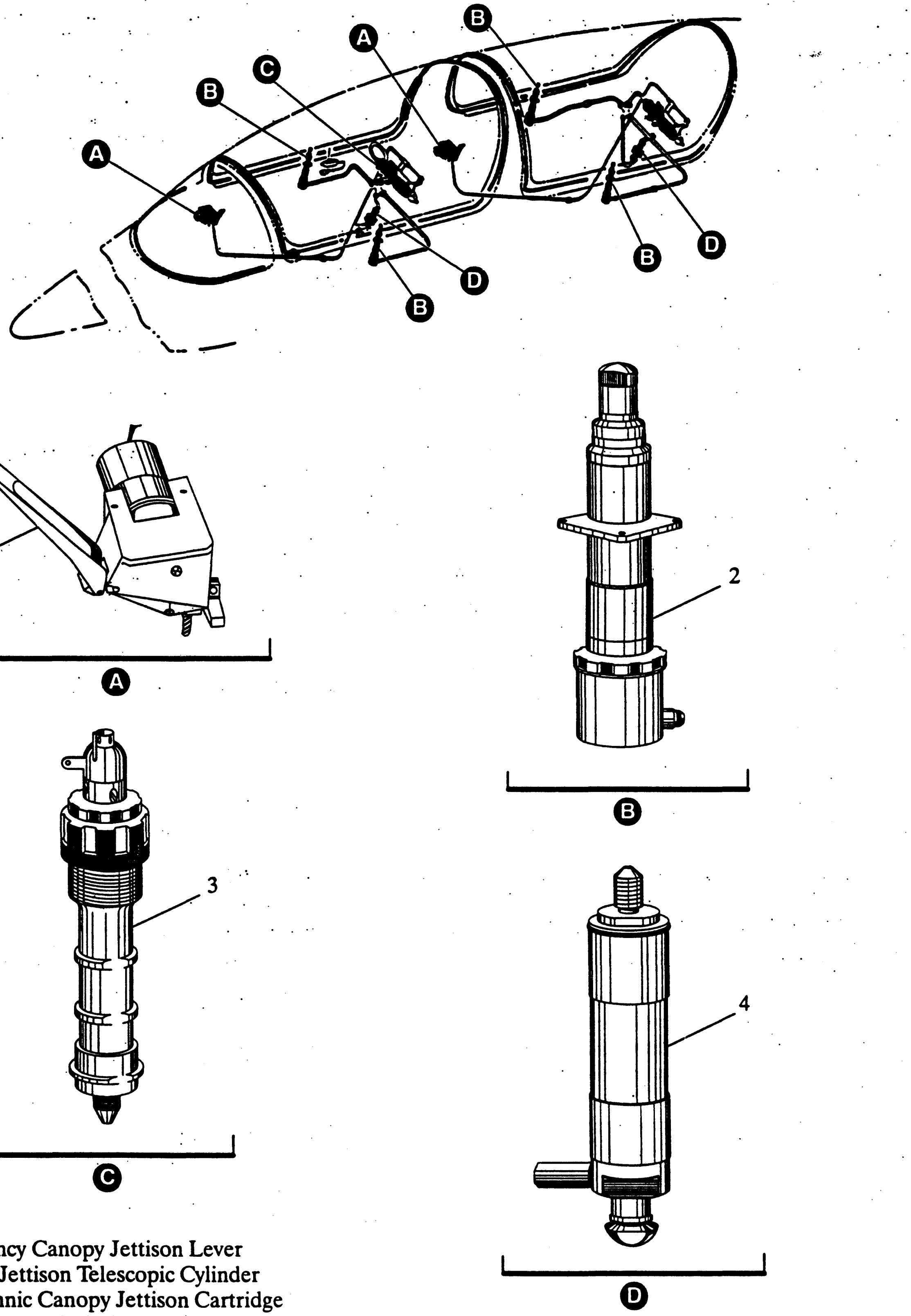


Figure 1–49. Canopy – Controls and Indicators



1. Emergency Canopy Jettison Lever
2. Canopy Jettison Telescopic Cylinder
3. Pyrotechnic Canopy Jettison Cartridge
4. Lock Release Cylinder

Figure 1–50. Canopy Jettison Mechanism

Jettisoning the canopy utilizing the normal canopy locking levers is executed by simply opening the canopy locks, which will cause the canopy to lift due to the pressurized seals, and the air flow will then lift the canopy until it is separated from the A/C.

Once the canopy is jettisoned, by what ever means, an arming ball which is connected by cable to the canopy is removed from the top left section of the seat head rest assembly. This ball when placed, prevents unintentional ejection through the canopy.

EJECTION SEAT

GENERAL

The ejection seat (VS–1 BRI) provides support and essential environmental equipment for crew members during flight and a means of fast, fully automatic, safe seat–man ejection extending from ground level throughout the entire flight envelope.

THE SEAT

The ejection seat comprises the seat bucket, the head–rest and frame.

The seat bucket contains the survival kit. The accelerating rocket motor is positioned underneath the seat bucket. The frame holds the ejection mechanism. Located on the forward side of the frame is the main parachute which is in effect the back of the pilot seat and acts as the back support during normal conditions.

The seat head–rest contains a stabilizing parachute. Its purpose is to stabilize the seat motion during the initial phases of the descent.

The pilot–to–seat fastening system comprises a carrying harness of the pilot's parachute and the strap which connect and fasten the pilot to the seat in the area of waist and shoulders. The shoulder straps may be kept locked or released (spring loaded) to enable the pilot to bend forward freely. During ejection the shoulder straps will lock and hold the pilot's back firmly to the back of the seat. In addition, leg fastening straps which are connected to the cockpit floor and instrument panel will fasten the legs to the seat during ejection as the seat starts its motion.

SEAT CONTROLS (Figures 1–51 through 1–54)

The seat is equipped with various controls for initiating the ejection sequence, overcoming ejection problems and operating environmental equipment.

OPERATION CONTROLS

Seat Bucket Height Adjustment Switch

Enables adjustment of the seat height so that the pilot eye will be at the desired eye point. The switch controls an electrical motor which can lift or lower the seat by 18 cm (7 inches). The electrical motor of the forward seat is protected by the "SEAT/HELMET" C/B located in the aft CB switch panel in forward cockpit, and the electrical motor of the aft seat is protected by the "SEAT" CB located on the miscellaneous CB/switch panel in the aft cockpit. The seat height adjustment and seat motion end positions adjustment is executed on the ground before flight. During flight, the pilot can adjust the seat height in a range of 40 mm.

Shoulder Harness Arrestment Lever

Used for locking or releasing the shoulder harness.

Pilot Weight Setting

Controls the inclination angle of the rocket engine for optimum thrust vector resulting in best performance.

EJECTION CONTROLS

Ejection Handles

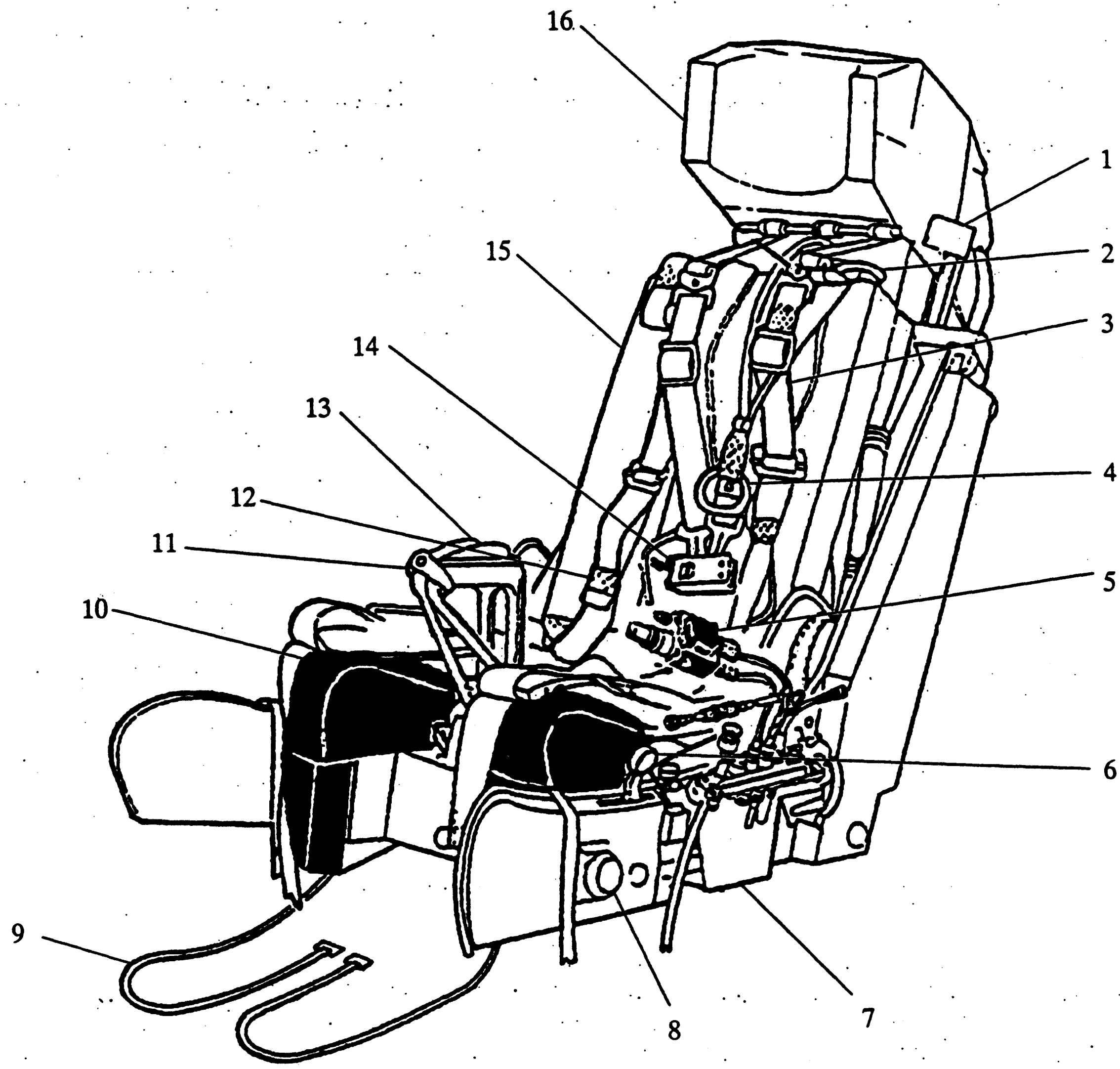
Primary control for ejection.

Ejection Through Canopy Handle

Used in case the canopy, for some reason failed to jettison.

Pilot/Seat Separator Handle

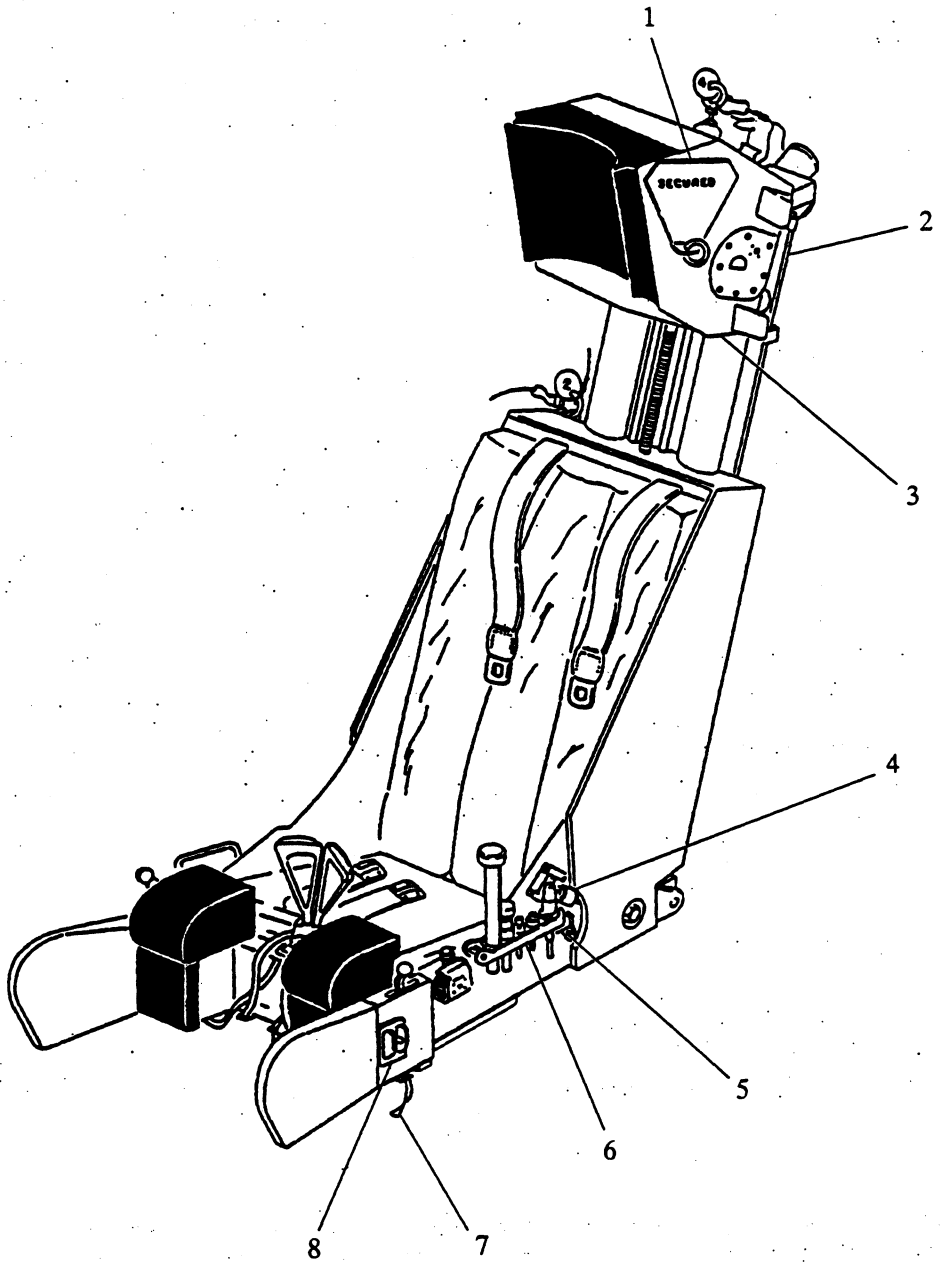
Used in case the seat failed to separate after bailing out or the pilot has to separate from the seat due to an ejection failure or extreme emergency, on the ground.



1. Seat Bucket Travel Limit Mechanism
2. Shoulder Harness Lock
3. Shoulder Belt
4. Parachute Manual Release Handle
5. Mixture Regulator
6. Shoulder Harness Arrestment Lever
7. Seat Bucket
8. Pilot Weight Setting Mechanism
9. Leg Fastening Strap
10. Survival Kit
11. Ejection Handles
12. Harness Fastening Clisp
13. Unlocking Hand–Rails
14. Central Lock
15. Pilote Parachute
16. Head Rest

AB-1-(51)

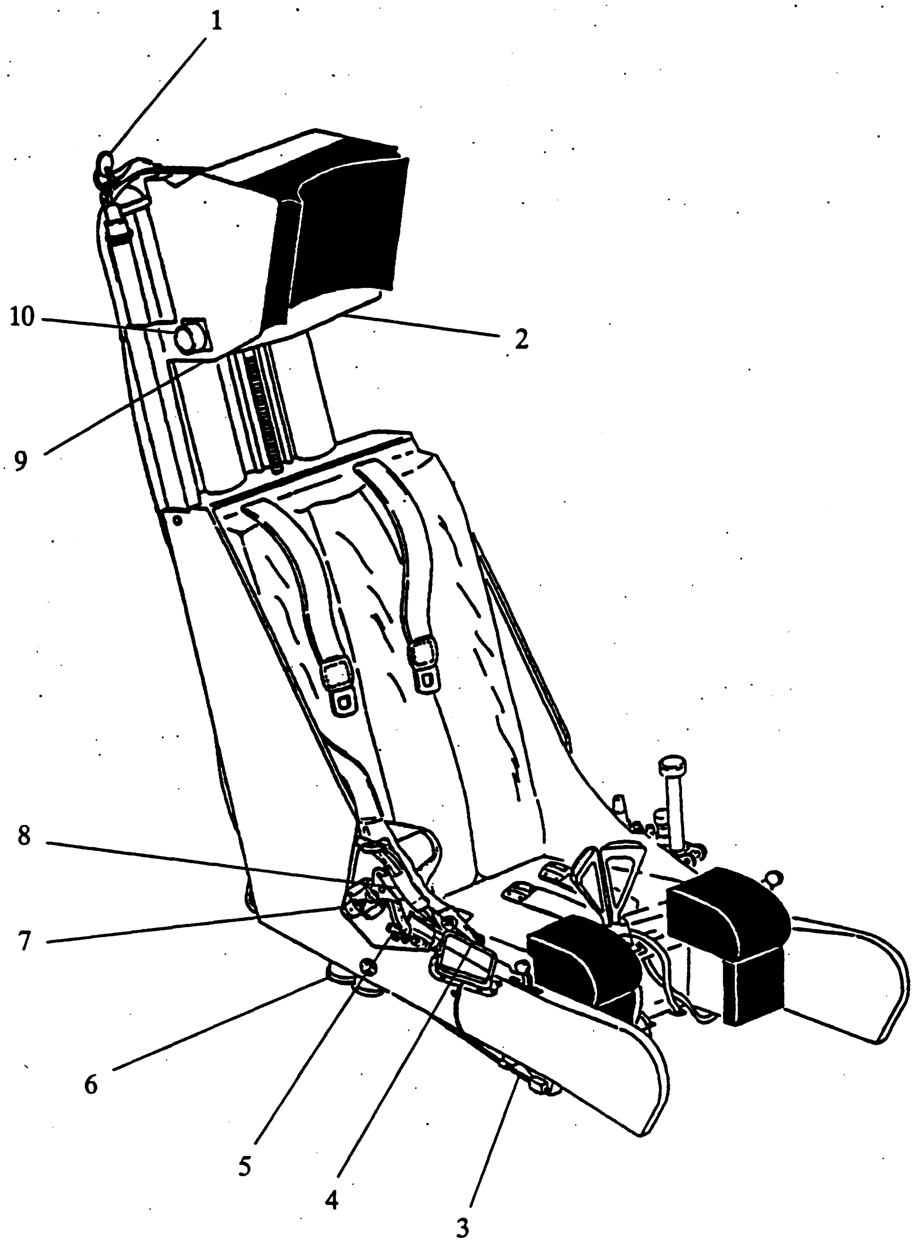
Figure 1–51. Ejection Seat Forward View



1. Seat Ground Locking
2. Seat Bucket Travel Limit Mechanism
3. LH Shoulder Harness Lock
4. LH Belly Harness Lock
5. P.E.C. Automatic Disconnect Lever
6. Personal Equipment Connection
7. LH Leg Strap Securing Lock Fastening
8. Seat Height Adjustment Switch

AB-1-(52)

Figure 1-52. Ejection Seat LH View



1. Seat Ground Locking
2. LH Shoulder Harness Lock
3. RH Leg Strap Securing Lock
4. Ejection Through Canopy Handle
5. Pilot Parachute Cable Hinge
6. Rocket Motor Nozzles
7. RH Belly Harness Lock
8. Survival Kit Manual Release
9. RH Shoulder Harness Lock
10. Seat Bucket Travel Limit Mechanism

AB–1–(53)

Figure 1–53. Ejection Seat RH View

SEAT/AIRCRAFT INTERFACE

The seat/aircraft interface provides the seat and pilot with the necessary connections for normal every day operation, as well as for ejection requirements.

- Combined oxygen/Anti–G/communication joint (ORK–9AU).
- Electrical connector which is the connection for the electrical seat consumers such as the seat bucket height setting, the ejection blocking and report signals to the flight data recorder (FDR).
- Snap hook of leg straps, which snap as the legs are fastened to the seat during the initial seat motion.
- Connecting hose of dynamic pressure supply to pilot–seat separation mechanism.
- System of actuating static cables, which consists of a set of wire cables connected to the cabin floor at one end, and at the other end connected to various seat mechanisms. Because of their different length, provide timing function during seat motion upward for following events:
  - Arming of automatic pilot–seat separation unit
  - Quick disconnection of the Pitot–line
  - Quick disconnection of the P.E.C.
  - Quick disconnection of electrical connection
  - Rocket motor ignition
  - Seat stabilizing parachute ejection

EJECTION MECHANISM

COMBINED DRIVING MECHANISM

Purpose of the combined driving mechanism is to eject the seat to required safe height above aircraft. The mechanism consists of two stages: first stage comprises telescopic ejection mechanism and the second stage rocket motor.

A telescopic ejection mechanism, installed at the back side of the frame, comprises three cylinders, the outer attached to the cockpit floor and the inner to the seat frame. The pyrocartridge in the telescopic cylinders forms the initial thrust generating device continued at a later stage, by the secondary driving device stage employed by the rocket motor.

FIRING MECHANISM

The firing mechanism is initiated by operating firing (ejection) handles. By pulling the handles a chain of firing events is started which include firing the canopy pyro–mechanism, the forced fastening shoulder straps pyro–mechanism, the seat telescopic ejection mechanism and the seat rocket motor.

EJECTION BLOCKING

An electrical sequencing system is integrated in the ejection system to prevent the danger of collision between the two canopies or the pilots during ejection. The electrical sequencing ensures that the pilot who initiates the ejection first whether the forward or aft, will complete his ejection before the second pilot ejection commences. If both pilots initiate the ejection at exactly the same time, the aft seat will have priority. Should a malfunction occur in the first pilot ejection sequence, which causes the sequence to be interrupted and uncompleted, the second pilot ejection will not be initiated since it is blocked in favour of the first pilot. Therefore an "UNLOCK EJECT" switch is installed in both cockpits to overcome such a situation and override the blocking effect by disabling the sequencing.

EJECTION (Figure 1–55 through 1–59)

When a decision to eject has been taken, the pilot shall grasp the double firing handled (ejection handles) with both hands, squeeze the unlocking hand–rails and pull them continuously upwards, until the seat is fired out of the cockpit. The rest of the ejecting sequence operation, up to the main chute deployment, is fully automatic.

EJECTION SEQUENCE

Once the ejection handled have been squeezed and pulled, the following sequence of events take place:

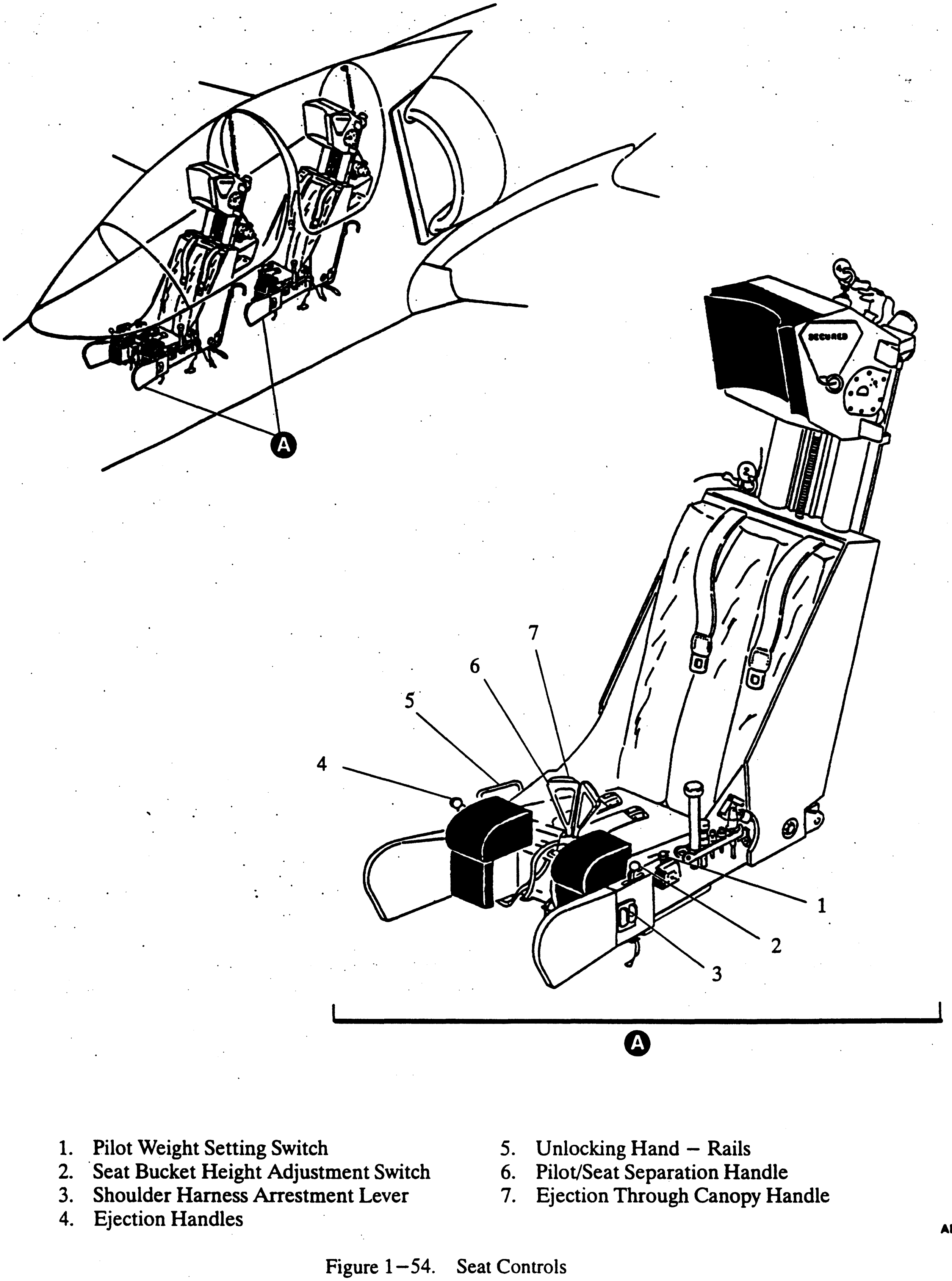
a. Canopy jettisoning lever and seat ejection in the other cockpit are both blocked.

b. Firing the pyro–technic cartridge for shoulder harness fastening.

c. Firing the pyro–technic cartridge for canopy jettisoning, opening the canopy locks and jettisoning the canopies.

d. Removing the restriction imposed upon the telescopic ejection mechanism by the canopy being jettisoned (ball locking element).

e. Unlocking the firing mechanism



1. Pilot Weight Setting Switch
2. Seat Bucket Height Adjustment Switch
3. Shoulder Harness Arrestment Lever
4. Ejection Handles
5. Unlocking Hand – Rails
6. Pilot/Seat Separation Handle
7. Ejection Through Canopy Handle

AB–1–(54)

Figure 1–54. Seat Controls

f. Firing the telescopic ejection mechanism.

As the seat starts its motion:

g. Disconnecting the Oxygen/Communication joint (P.E.C.) and switching the oxygen supply to the emergency oxygen system.

h. Disconnecting the dynamic pressure hose and arming the pilot/seat separation unit.

i. Disconnecting the electrical connector which connects the seat to the A/C, thus lifting the restriction (unblocking) imposed upon the other cockpit's canopy jettisoning and seat operation.

j. The seat motion causes the pilot's legs to be drawn towards the seat.

Once the seat is out of the cockpit:

k. Rocket motor is ignited.

l. Stabilizing parachute is fired.

m. Pilot/seat separation occurs (speed in the moment of ejection below 450 km/h separation occurs after 0.4 sec; above 450 km/h depending on actual speed as late as after 1.5 sec) by releasing the connections of the shoulder and belt harness to the seat including release of the legs straps and double firing handle.

n. Parachute deployment sequence is actuated by a static line.

o. After 0.5 sec time delay, the stabilizing parachute of the pilot is deployed.

p. After 1.5 sec – if the pilot is below 4,000 m (13,000 ft) – the main parachute is deployed.

q. The pilot descends by means of the main parachute, survival kit cover opens and release survival kit with emergency beacon. The survival kit then hangs on a 12 meter strip, connected to pilot flight suit and emergency beacon is automatically activated.

NOTE

Pilot can manually fully disconnect the survival kit from the suit in case of landing to an unsuitable terrain (flat ground or water).

WARNING

On contact with the ground, disconnect the oxygen mask hose from the oxygen device, prior to disconnecting the main harness release.

PROBLEMS DURING EJECTION

– If the pilot does not receive any response when initiating the ejection (squeezing and pulling the ejection handles) the ejection is blocked by the other pilot ejection sequence. If the situation takes more that 2 seconds, the "UNLOCK EJECT" guarded switch must be placed to OFF and the ejection handles squeezed and pulled again.

– If the canopy fails to jettison the emergency canopy jettison lever, located on the RH side of both cockpits, should be employed.

– If the canopy still fails to jettison, the pilot must attempt to open the canopy by operating the canopy locking lever on the LH side.

– Whatever method works, after the canopy is separated from the A/C, the ejection handles must be squeezed and pulled again.

– Should the seat is blocked by the canopy which failed to jettison (time permitting, after trying all methods), the EJECTION THROUGH CANOPY handle, located on the RH side of the seat, must be pulled, to remove the canopy blocking restriction, and then the ejection handles must be squeezed and pulled.

– If after trying all the above mentioned methods there is still no response from the ejection system or the canopy has jettisoned (by any means) but the seat will not follow, the pilot must attempt a manual bail out.

– After the seat has left the A/C, and the pilot realizes that he has not been separated from the seat (altitude below 4,000 m), he must operate the pilot/seat release lever located on the seat bucket RH side.

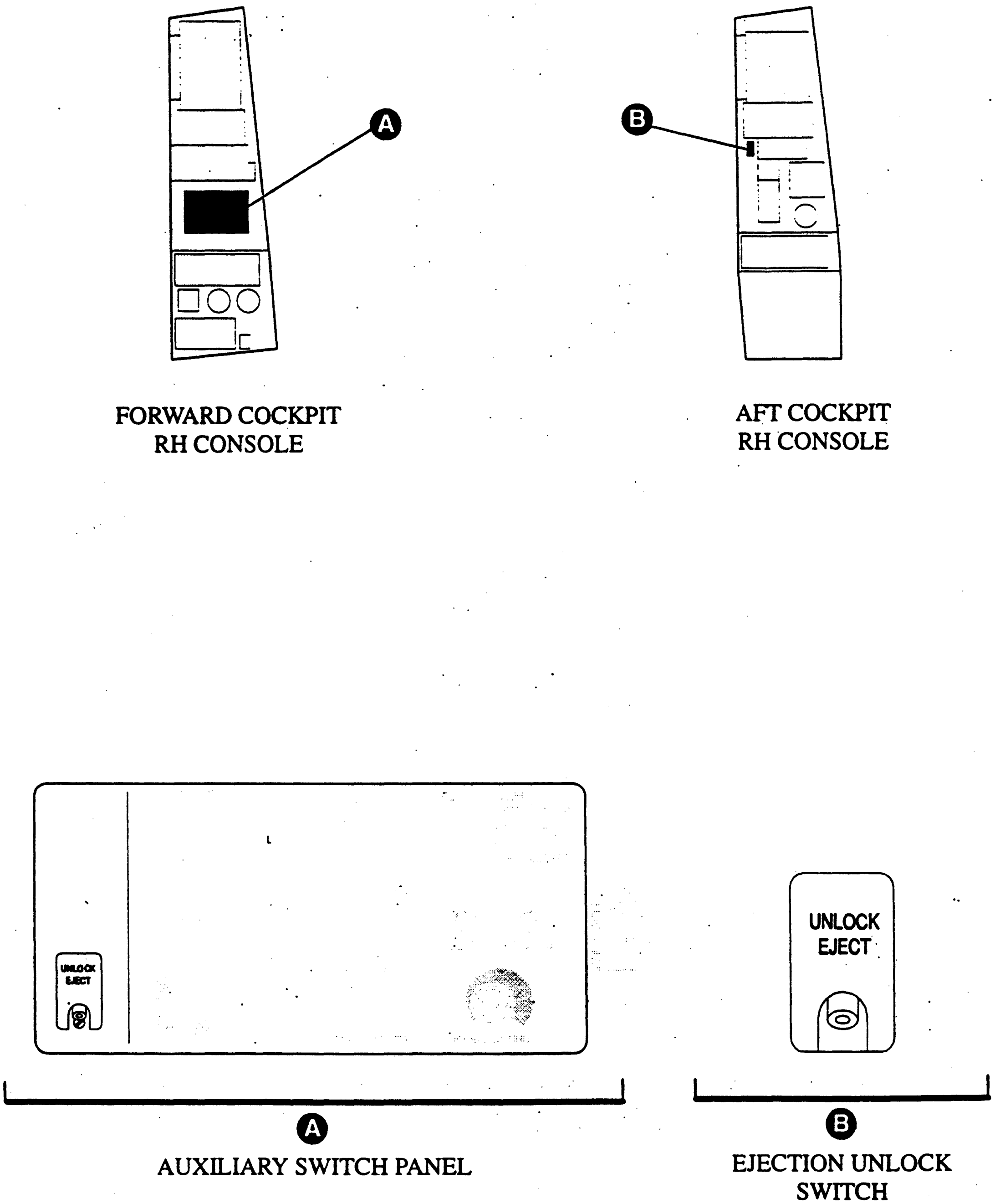
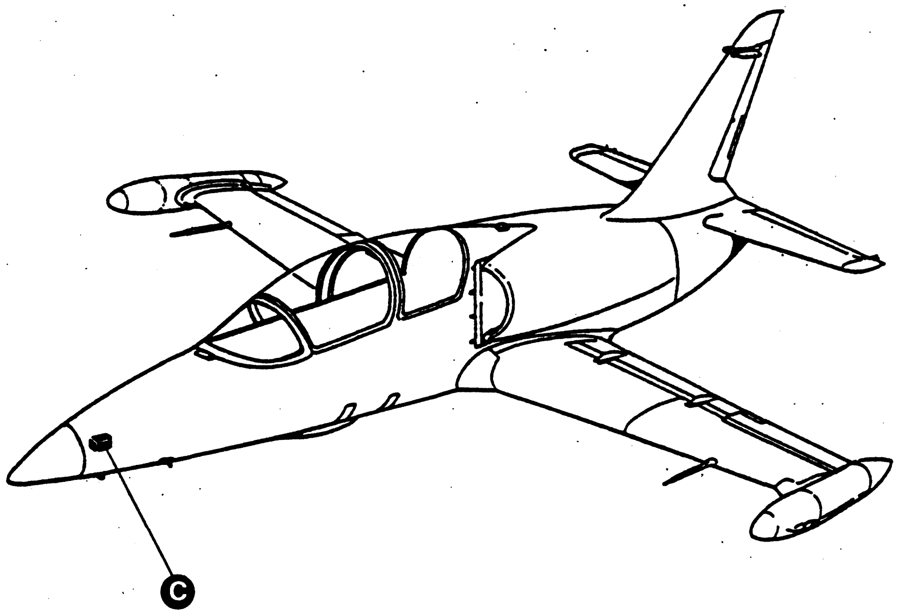
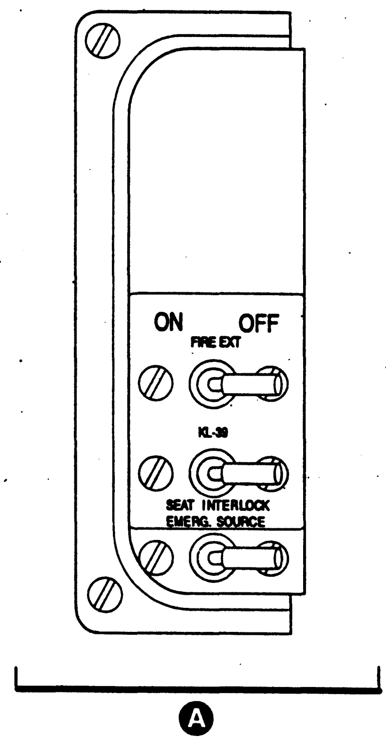


Figure 1–55. Ejection Unlock Controls (sheet 1 of 2)





CONTACTOR BOX

AB-1-(55-2)

Figure 1–55. Ejection Unlock Controls (sheet 2 of 2)

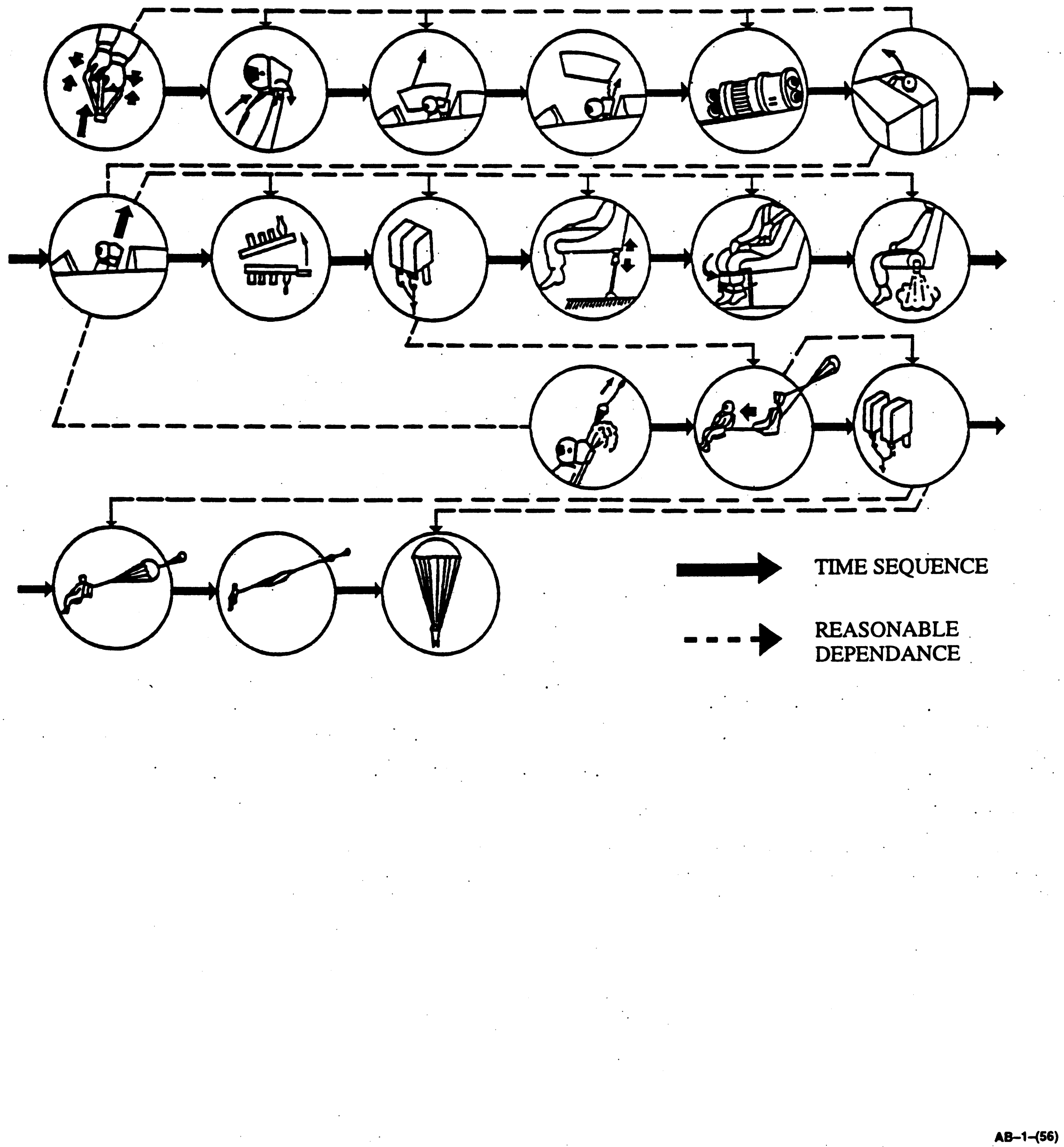
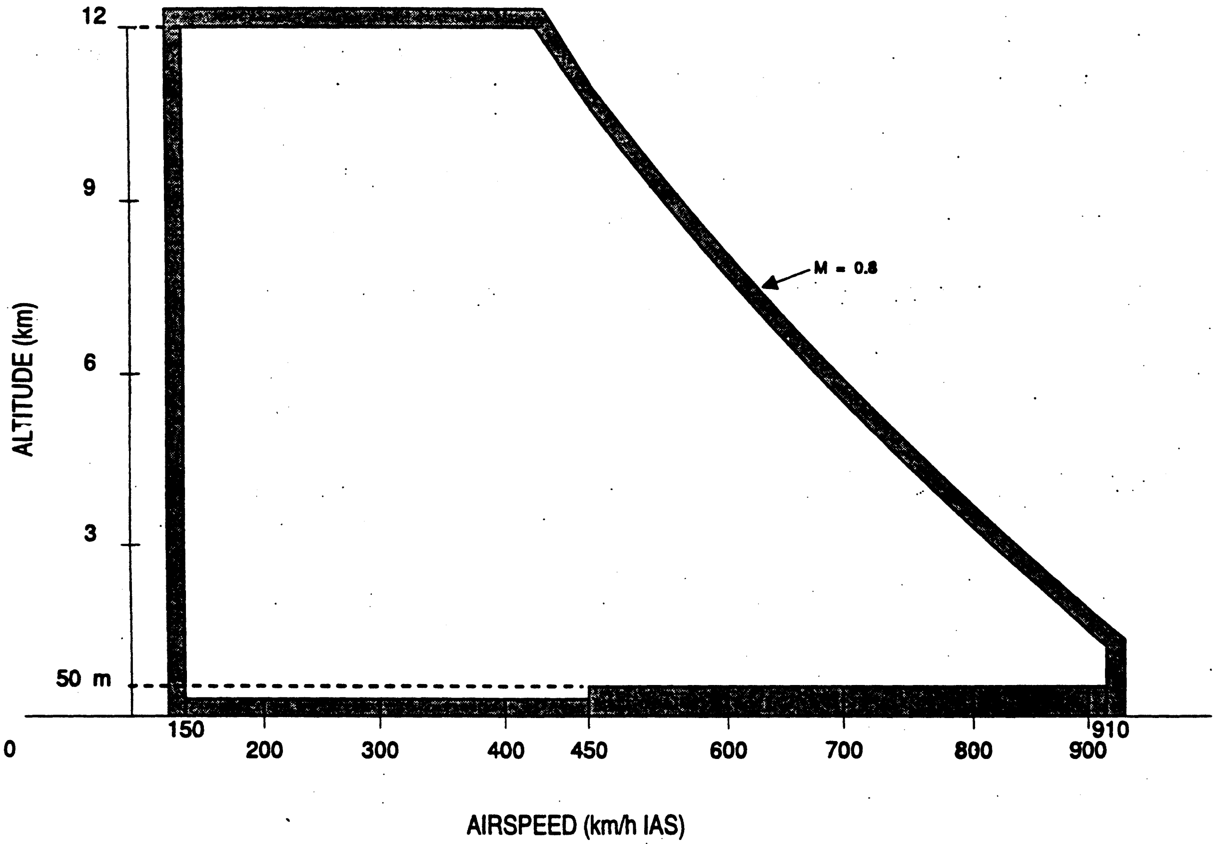


Figure 1-56. Ejection Seat Operation Sequence

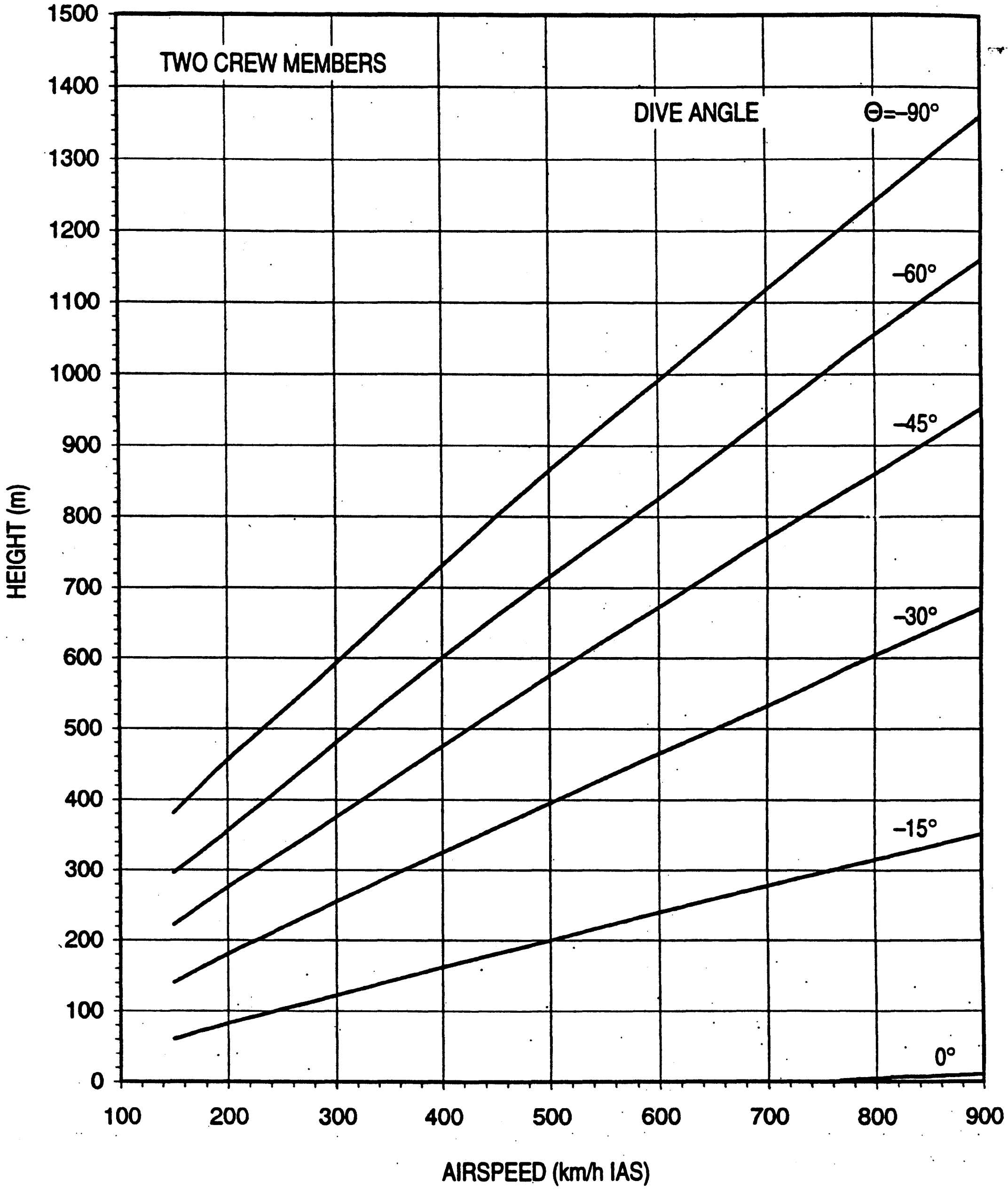


NOTE

- Up to height of 50 m it is prohibited to eject above airspeed of 450 km/h due to 1.5 sec delay of seat/pilot separation.
- Below the airspeed of 150 km/h it is prohibited to eject since there is a chance that the canopy will not be disconnected from the seat.

AB-1-(57)

Figure 1−57. Ejection Envelope



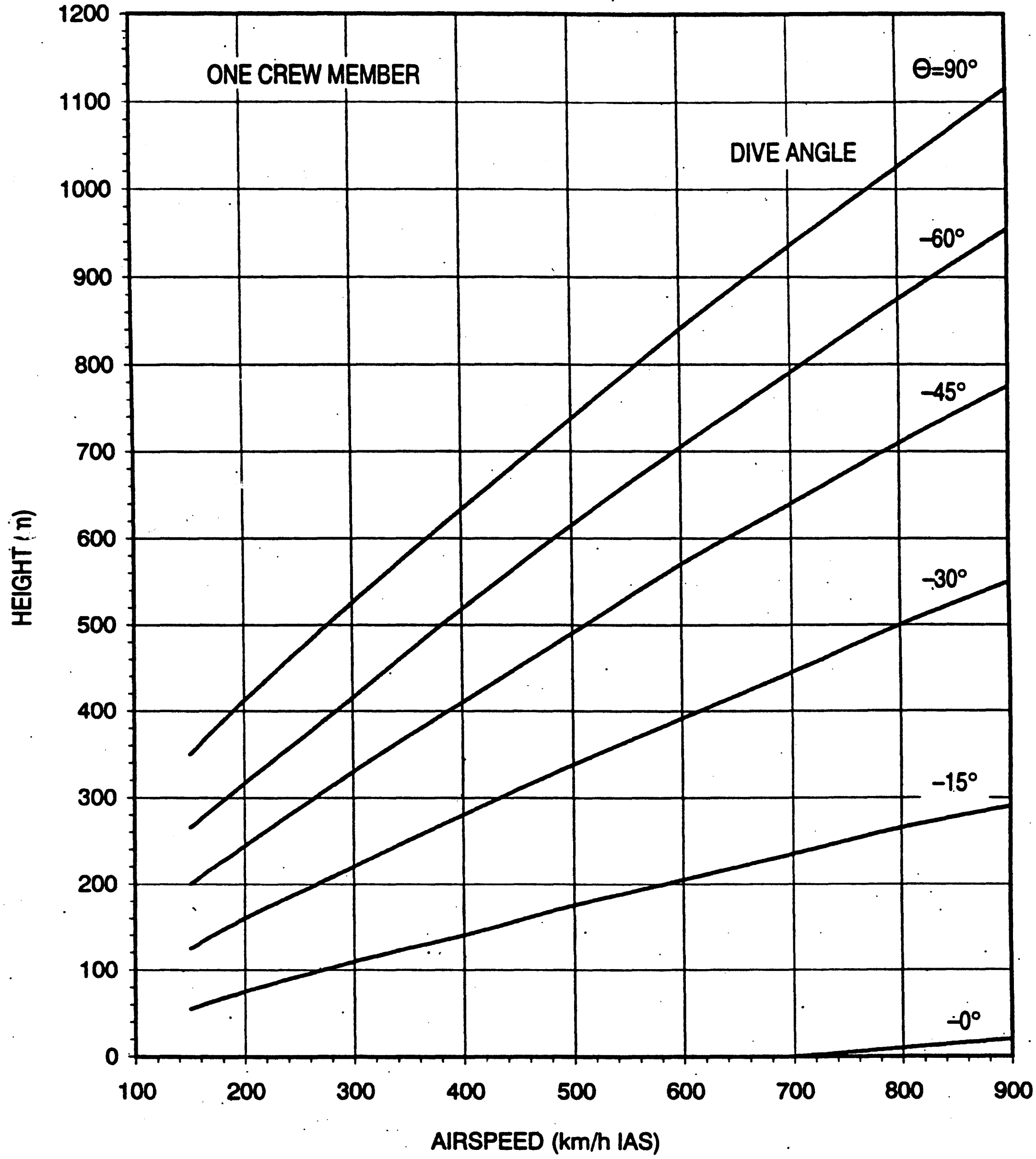
NOTE

Calculated time span from the decision making ejection from the aircraft up to the moment of actual ejection by the first pilot amounts two seconds, one second longer for the other pilot.

Minimum height for safe ejection at different dive angles is shown herein.

AB–1–(58)

Figure 1–58. Aircraft Dive Angle Effect (sheet 1 of 2)



NOTE

Calculated time span from the decision making ejection from the aircraft up to the moment of actual ejection by the first pilot amounts two seconds.

Minimum height for safe ejection at different dive angles is shown herein.

AB-1-(58-2)

Figure 1-58. Aircraft Dive Angle Effect (sheet 2 of 2)

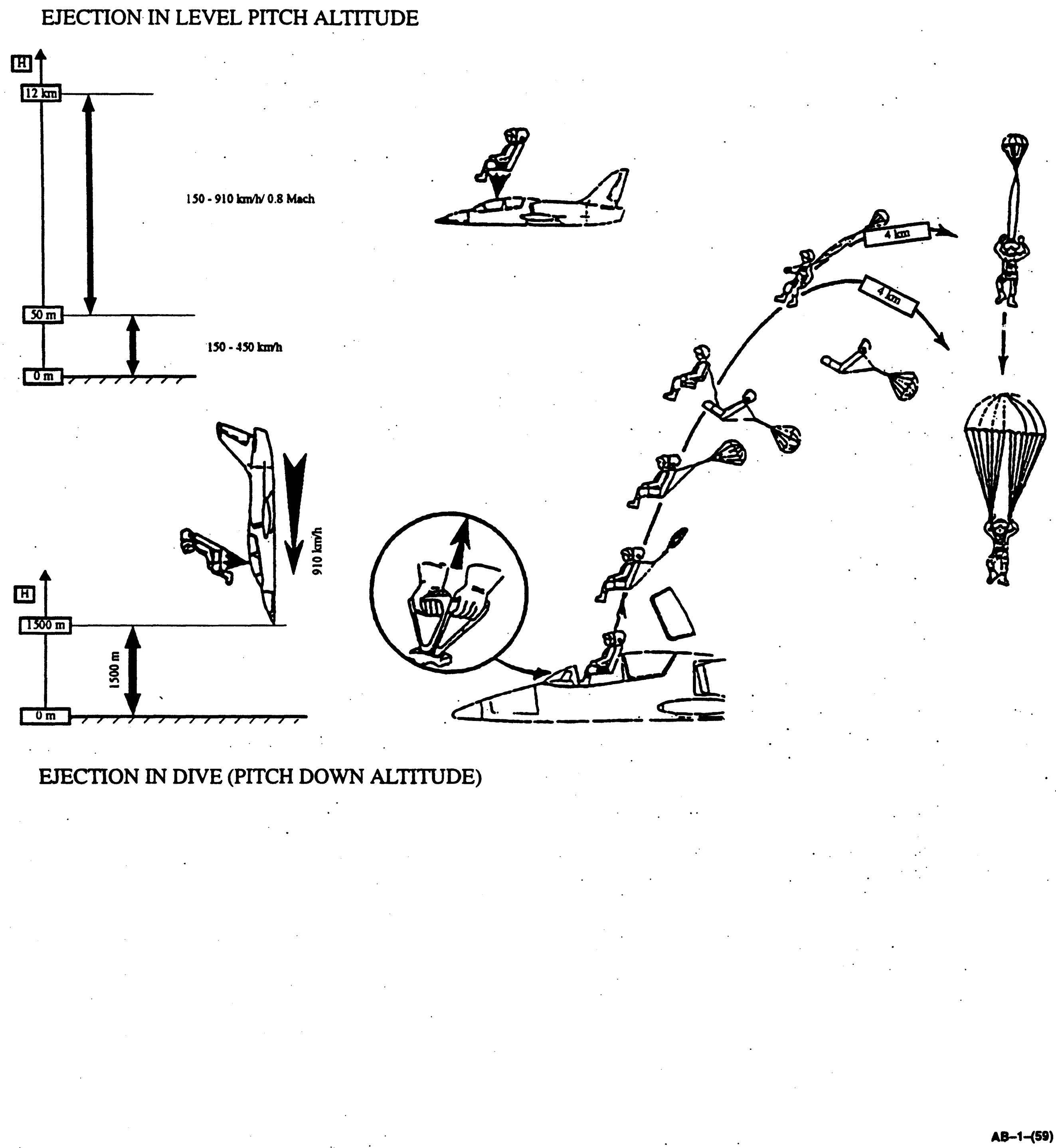


Figure 1–59. Ejection Sequence and Conditions

MANUAL BAIL OUT

a. Trim the A/C for "nose down" but keep on holding the control stick.

b. Operate the pilot/seat separation lever on the RH side of the seat pan, by moving it out and forward.

c. Jettison or unlock and push the canopy away.

d. Roll the A/C upside down or push the control stick forward (to create a slight negative "g").

e. Bail out and deploy parachute. Next sequences are the same as during normal ejection after pilot separating from the seat.

EJECTION SEAT PARTICULAR

– Maximum pilot weight (including outfit, without parachute)	108 kg (225 lb)
– Weight of outfitted ejection seat including telescopic ejection mechanism	79.5 kg (176 lb)
– Maximum pilot sitting height (crown–rump length)	980 mm (39 in)
– Vertical g factor during ejection	17 g
– Launching height above aircraft	86 m (282 ft)
– Seat pan adjustment range for pilot sitting height adjustment	180 mm (7 in)
– Seat pan adjustment range when pilot sitting height already adjusted	40 mm (1 $^2/_3$ in)
– Seat height (pan in lowest position)	1,200 mm (74.4 in)
– Seat width (at maximum point)	570 mm (23.2 in)
– Operational temperature range	−60°C to +60°C
– Area of seat stabilizing parachute	0.5 m^2 (5.4 sqft)
– Area of pilot parachute canopy	50 m^2 (538 sqft)

EJECTION SEAT PERFORMANCE PARTICULARS

Altitude	Indicated air speed
0 to 50 m (0 to 164 ft)	150 to 450 km/h (81 to 245 KIAS)
50 to 12,000 m (164 to 40,000 ft)	150 to 910 km/h/0.8 Mach (81 to 490 KIAS/0.8 Mach)

ANTI "G" SYSTEM

The anti–G system, employing the anti–G suit or anti–G part of compensating suit, is used for increasing the resistance of the crew member against the influence of positive G forces of different magnitudes.

Air pressure for the G suit is supplied by the A/C engine bleed. The air then passes through anti–G valve filters in each cockpit to the anti–G valves where the pressure is automatically regulated in proportion to the G load being performed. Finally is the air supplied to the P.E.C.s of both ejection seats and to anti–G suit or anti–G part of the compensating suit.

The pressure regulator has two settings which can be selected on the ground only:

MIN: For the use of normal anti–G suits.

MAX: For the use of altitude compensating suits.

When the pressure regulator is in "MIN" position, the pressure air to the anti–G suit is supplied for a G–load range from 2.5 to 8 g, when in "MAX", from 2 to 10 g.

LIGHTING SYSTEM

The aircraft lighting equipment is basically divided into three essential subsystems: exterior and interior lighting subsystems and warning, caution and advisory indicator subsystem.

EXTERIOR LIGHTING (Figure 1–60 and 1–61)

The aircraft exterior lighting equipment consists of the following lights:

- two landing/taxi lights
- one left–hand red position light
- one right–hand green position light
- one tail, white position light
- three white landing gear down lights, one on each landing gear

LANDING/TAXI LIGHTS

A combined double filament landing/taxi light is mounted to the tip of each wing tip tank. The difference between these lights is that the landing light filament beam covers a larger all–round pattern.

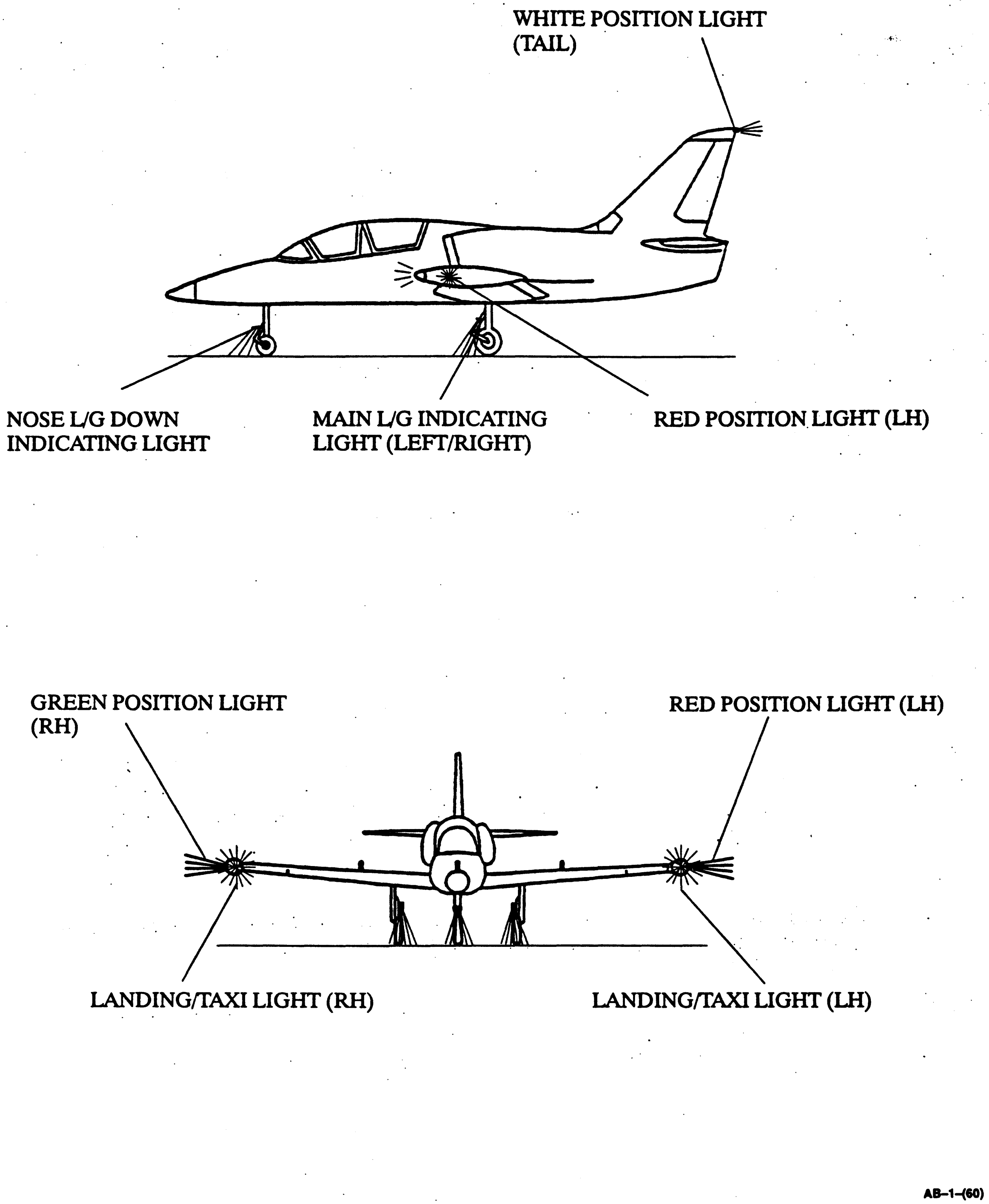


Figure 1-60. Lighting System - Exterior Lighting

A three position switch, labeled “SEARCH L.”, with positions taxi – “TAX.”, middle – off position and landing – “LAND.”, is situated above the forward part of the left console in both cockpits. When set to “TAX.”, a terminal switch causes the taxi lights to go off automatically upon landing gear retraction. When set to “LAND.”, the landing lights remain on irrespectively of the landing gear position.

The landing and taxi lights are powered by 28 V DC protected by two C/Bs labeled “SEARCHLIGHTS PORT” and “SEARCHLIGHTS STARB.” on the Aft CB/Switch Panel in the forward cockpit.

NOTE

Using the LANDING lights on the ground or during taxi is not recommended longer then 3 sec due to lamp overheat.

POSITION LIGHTS (NAV LIGHTS)

The NAV lights are controlled by two three–position switches, located on the right console auxiliary switch panel in the forward cockpit (position lights control panel “NAVIG. LIGHTS”):

- Mode control – can be selected to flash position “FLICKER”, middle OFF or steady “FIXED” position.
- Intensity control “BRIGHTNESS” – can be selected to DIM (30%), BRT (60%) or MAX (100%). This switch functions only if the mode control switch is out of OFF position.

The NAV lights are powered by 28 V DC and protected by the “NAV. LIGHTS/HAND LAMP” C/B on the Aft CB/Swich Panel in the forward cockpit.

LANDING GEAR DOWN LIGHTS

A white “landing gear down” light is mounted on each landing gear strut. The lights are automatically switched on, by a terminal switch, when the landing gear is extended, provided that the navigation light switch is not in OFF position. The circuit is protected by “NAV. LIGHTS/HAND LAMP” C/B on the Aft CB/Switch Panel.

INTERIOR LIGHTING (Figure 1–62 and 1–63)

The interior lighting of the aircraft consists of two separate circuits for each cockpit, main and auxiliary. The main circuit illuminates in red while the auxiliary one illuminates in white.

In the event of a failure in the main circuit, if main C/B goes off the system automatically switches to the auxiliary circuit, which may be switched on manually as well.

Cockpit Interior Lighting and Controls

The cockpits consists of the following lighting components:

- Forward cockpit:
  - Individual instrument lights
  - Six console light bulbs
  - One center pedestal light
  - Stand–by compass light
  - Pitch trim position indicator light
  - Directional gyro control box
- Aft cockpit
  - Individual instrument lights
  - Four console lights
  - One center pedestal light

Individual Instrument Lights

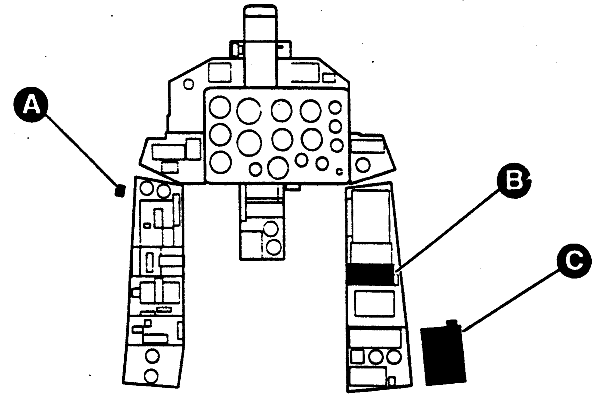
Each instrument on the instrument panel, in both cockpits, is equipped with red or white bulbs for indirect illumination. The instrument lights are controlled per cockpit, by the switch and knob located on instrument lighting control panel labeled “INSTRUM LIGHTS”.

The instrument lighting switch has three position:

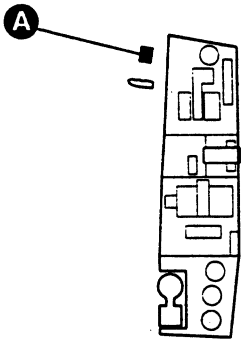
Center:	OFF position
Forward:	Main. Primary red lights set.
Backward:	Auxiliary. Secondary white lights set.

The rheostat is situated in front of the instrument lighting switch to regulate the intensity of the instrument lights. Turning the rheostat CW increases the intensity.

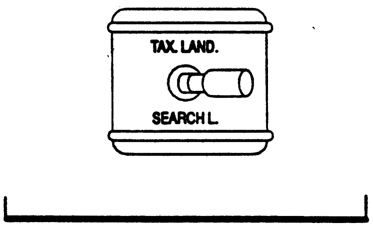
The instrument lights are protected by two C/Bs on the Aft CB/Switch Panel in the forward cockpit labeled “COCKPIT LIGHTING RED” for the red main circuit and “COCKPIT LIGHTING WHITE” for the white auxiliary circuit.



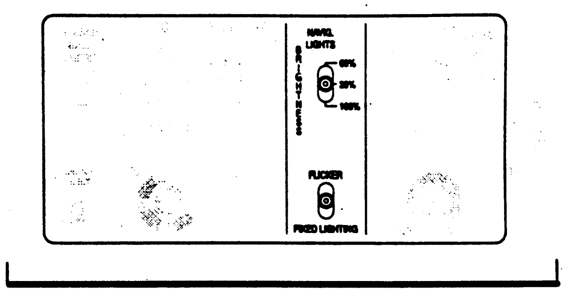
FORWARD COCKPIT



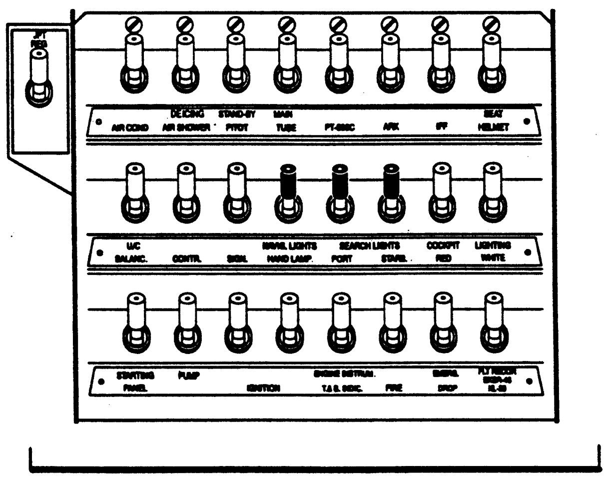
AFT COCKPIT
LEFT CONSOLE



A
TAXI AND LANDING
LIGHTS CONTROL SWITCH



B
AUXILIARY SWITCH PANEL



C
AFT C/B SWITCH PANEL

AB-1-(61)

Figure 1-61. Exterior Lighting System - Controls

Console Flood Lights

Two console flood lights are installed on the left and four on the right side below the canopy rail in the forward cockpit. In the aft cockpit there are two on each side below the canopy rail.

The console flood lights are controlled and protected by the same manner as the individual instrument lights.

Center Pedestal Light

The light is of a similar type as the console light and is mounted on each control stick below the stick grip. The light is controlled and protected as the instrument lights.

Stand–by Compass Light

A light bulb illuminates the scale of the standby magnetic compass in the forward cockpit. The intensity of the light is not affected by the rheostat. The compass light is controlled and protected as the instrument lights. The compass light illuminates at both main or auxiliary circuits.

Directional gyro control box

Indirect integrated white illumination is achieved by lights integrated in the directional gyro control box. The directional gyro control box lights are switched on and protected as the instrument lights and illuminates at both main or auxiliary circuits. The intensity of the light is not affected by the instruments lights control panel knob.

Trim indicators

The white pitch trim indicator light, is controlled by the instrument light switch in the forward cockpit. The intensity is controlled by the dimming rheostat on advisory and warning lights intensity control panel.

W/C & A Lights Intensity Control Panel

Dimming of the following items is accomplished by the dimming rheostat, located on the RH console in each cockpit:

- Master Caution light
- All warning, caution and advisory lights
- Landing gear electrical indicator panel
- Flap electrical indicator panel
- Trim indicators
- Armament indicator lights

Dimming through the full intensity range is provided in five stages.

Dimming of FDR ON light is achieved by rotating of lamp cap.

W/C & A Lights System Test

The test button is located next to the W/C & A dimming rheostat. By pressing this button all W/C & A lights, except of FDR ON, will illuminate for as long as the button is depressed.

Emergency Interior Lighting

In the forward cockpit only there is a white instrument panel emergency light located under the gyroscopic sight console. The light is activated by the instrument panel emergency light switch labeled "EMERG. LIGHT" and located beside the sight. The emergency light circuit is protected by the position light C/B, labeled "NAVIG. LIGHTS/ HAND LAMP" and located on the aft CB/Switch Panel in the forward cockpit.

WARNING, CAUTION AND ADVISORY INDICATOR LIGHTS SYSTEM (Figure 1–64)

Each cockpit is equipped with an independent warning, caution and advisory light system which is located under the glare shield. The identical warning lights are located on the left–hand side panel and the caution and advisory (C&A) lights, on the right. The lights are of white, red, yellow and green colors. They are rectangular in shape and bear either an inscription or a symbol.

The warning lights are of red color, caution lights of yellow and advisory lights of green and white color. The warning lights flash.

NOTE

> The L/G indication system is an independent and dedicated panel and light system which is not part of the above. Flaps and speed brakes position indicating system, trim and armament lights system is stated in appropriate paragraphs.
>
> In case of indicator lights power supply malfunction, the light could be supplied by 28 V in the terminal position of regulator switch.

The warning, caution and advisory light system is protected by two "SIGNAL." C/Bs, one in each cockpit. The C/Bs are located in the respective Swich Panel protecting the respective cockpit system.

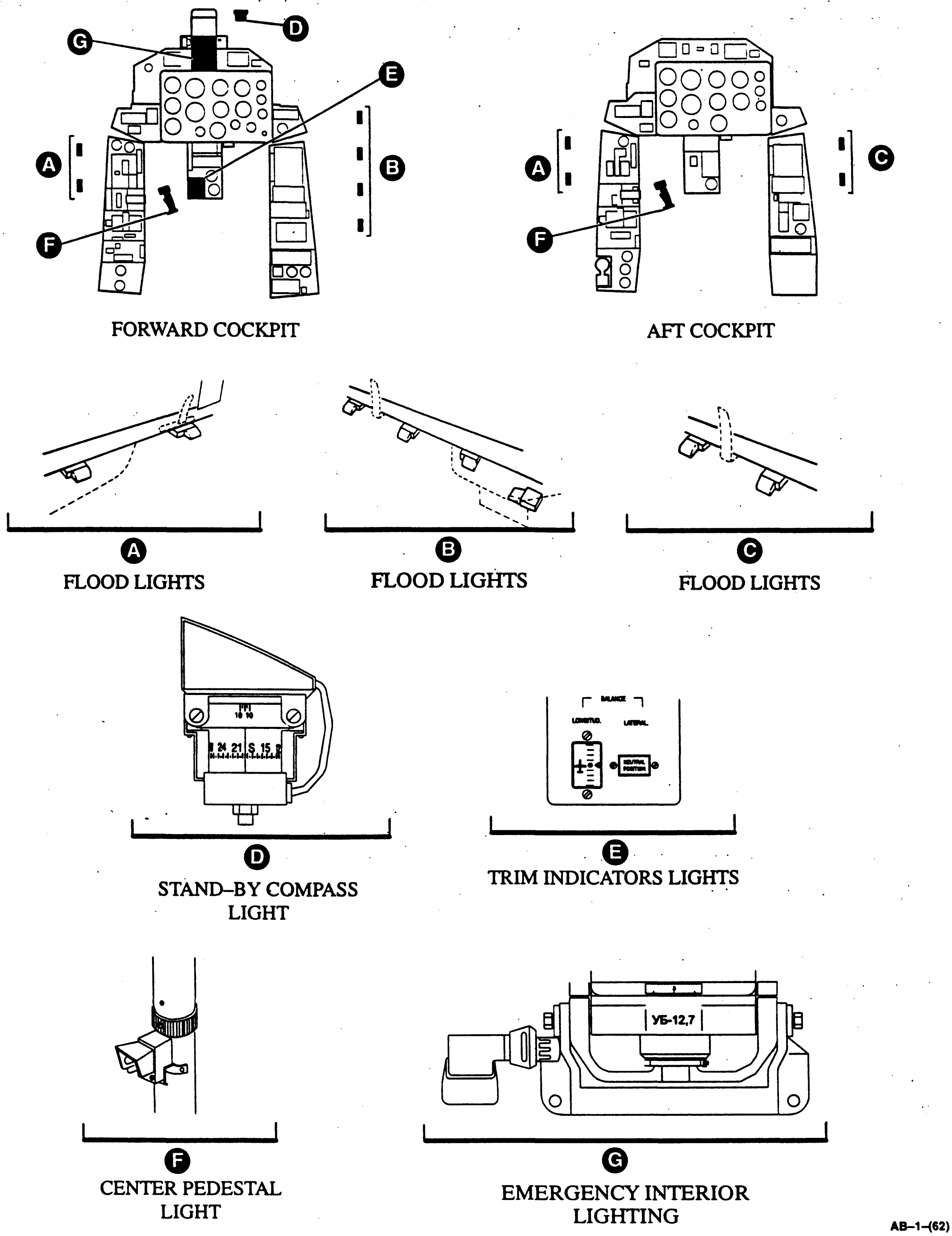


Figure 1–62. Lighting System – Interior Lighting

WARNING LIGHTS:

"FIRE"	Fire, over–heat, or testing of the fire warning circuit.
"150 KG FUEL"	Remaining useable fuel in the fuselage tanks is 150 kg (330 lbs) or below.
"DON'T START"	Fuel pressure is less than min permissible value, or the EGT limiter is not operating. The engine must not be started.
"CANOPY UNLOCKED"	One or both canopies are unlocked.
"DANGEROUS ALTITUDE"	Altitude is at or below the altitude set against the radio altitude bug.
"HYD. SYST. FAIL"	Pressure in the main system has dropped to below 60 kp/cm^2 (870 psi). The light will go out when the pressure builds up to 125 kp/cm^2 (1,750 psi).
"ENGINE VIBRATION"	Engine vibration has exceeded 40 mm/s.
"CABIN PRESSURE"	Cabin pressure is beyond limits (either too high or too low).
"M_{MAX}."	Mach number has reached 0.78 M (speed brakes extend automatically).
"GENERATOR"	The main generator has failed or is not switched on.
"EMERGENCY GENERATOR" (flashing)	The auxiliary generator (RAT) is extended but fails to provide electrical power (or in transit).
"INV. 115 V FAIL"	115 V, 400 Hz inverter has failed.

CAUTION AND ADVISORY (C&A) LIGHTS:

"AIRCONDIT EMERG."	Failure of the temperature pick-up down stream of the turbo cooler, which will cause the temperature of the air being supplied, to change with ambient temperature, within acceptable limits. ECS emergency control.
"❄" (snow-flake)	Icing conditions have been detected by the icing sensor, or the system has been activated manually.
"DE–ICING ON"	Shut–off valves for engine and A/C de–icing system are open.
"WING TIP TANKS"	Wing tip fuel tanks are empty or fail to transfer fuel.
"MARKER"	Passing over the marker beacon.
"AIRCONDIT OFF"	ECS system is off.
"FUEL FILTER"	The differential pressure on both sides of the fuel filter has exceeded limit. The filter is clogged and fuel flow through by–pass.
"END OF DESCENT"	Aircraft descent terminated at distance of 12 km (11.34 NM) from destination and at altitude 600 m.
"CONFORM AZIMUTH"	In the aft cockpit the bearing alignment button on the RSBN aft control panel is depressed and holded.
"TURBINE STARTER"	APU has reached idle run.
"FUEL EMERG. DELIVERY"	Emergency fuel circuit is in use.

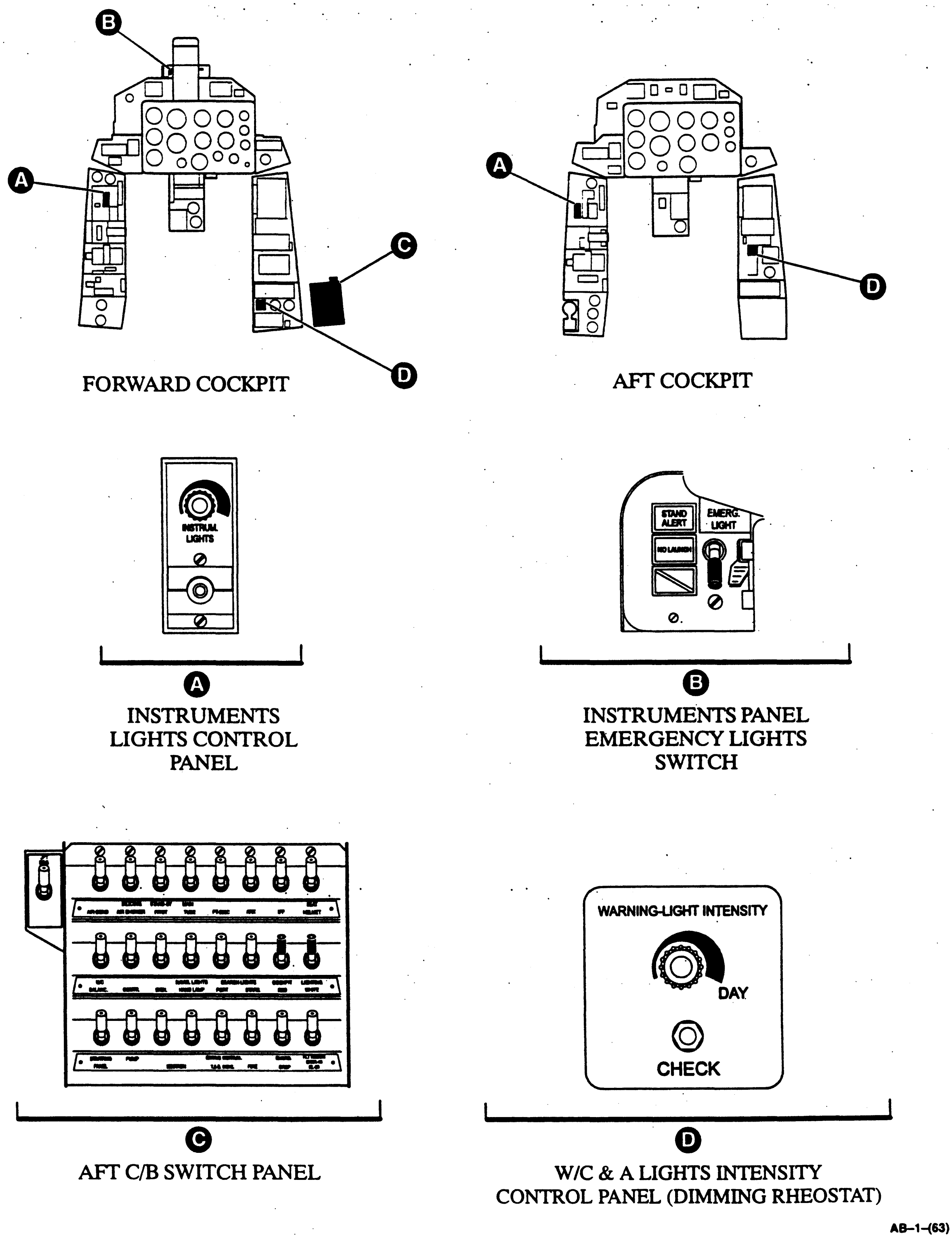


Figure 1–63. Interior Lighting System – Controls

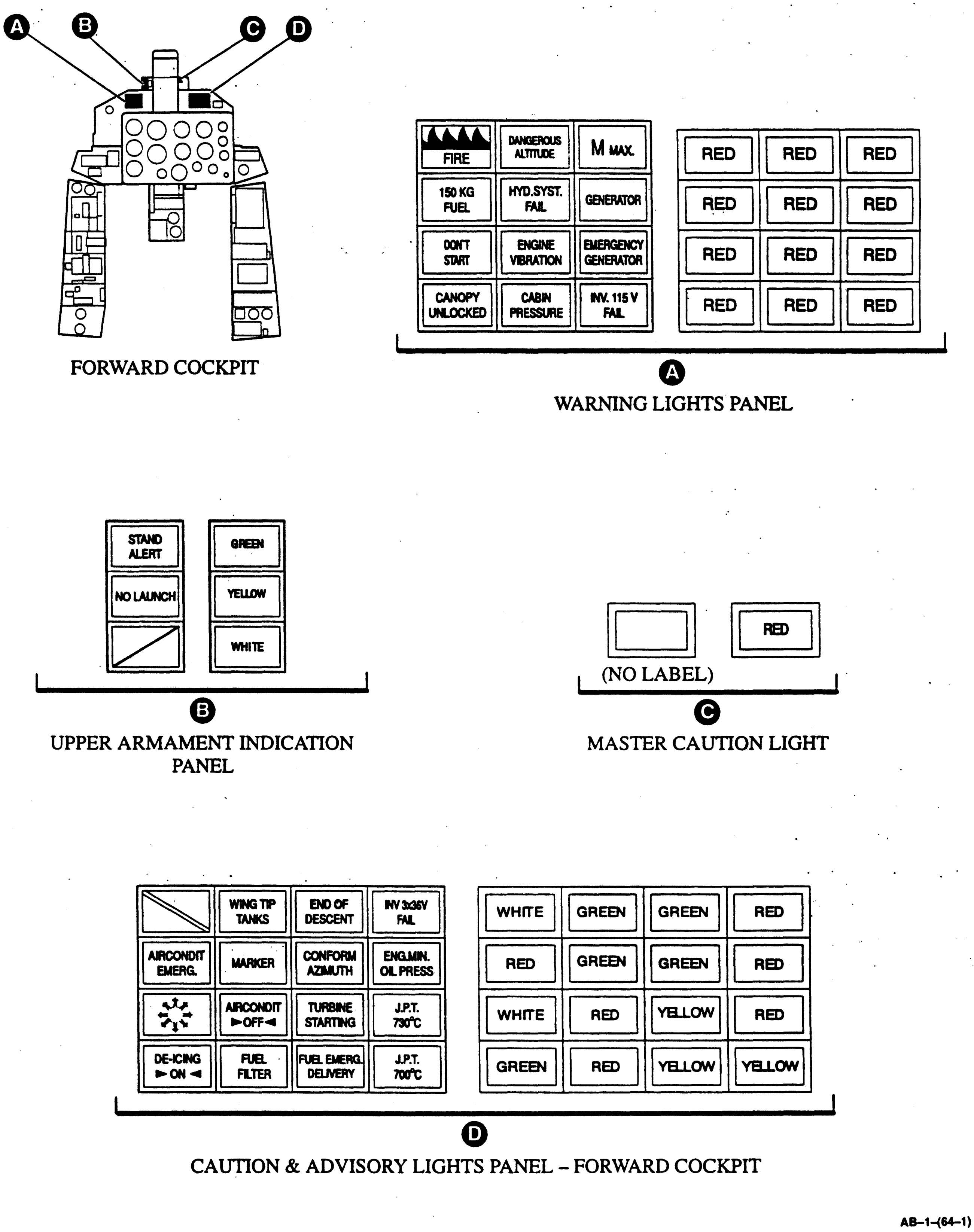


Figure 1–64. Warning, Caution & Advisory Indicator Light System (sheet 1 of 2)

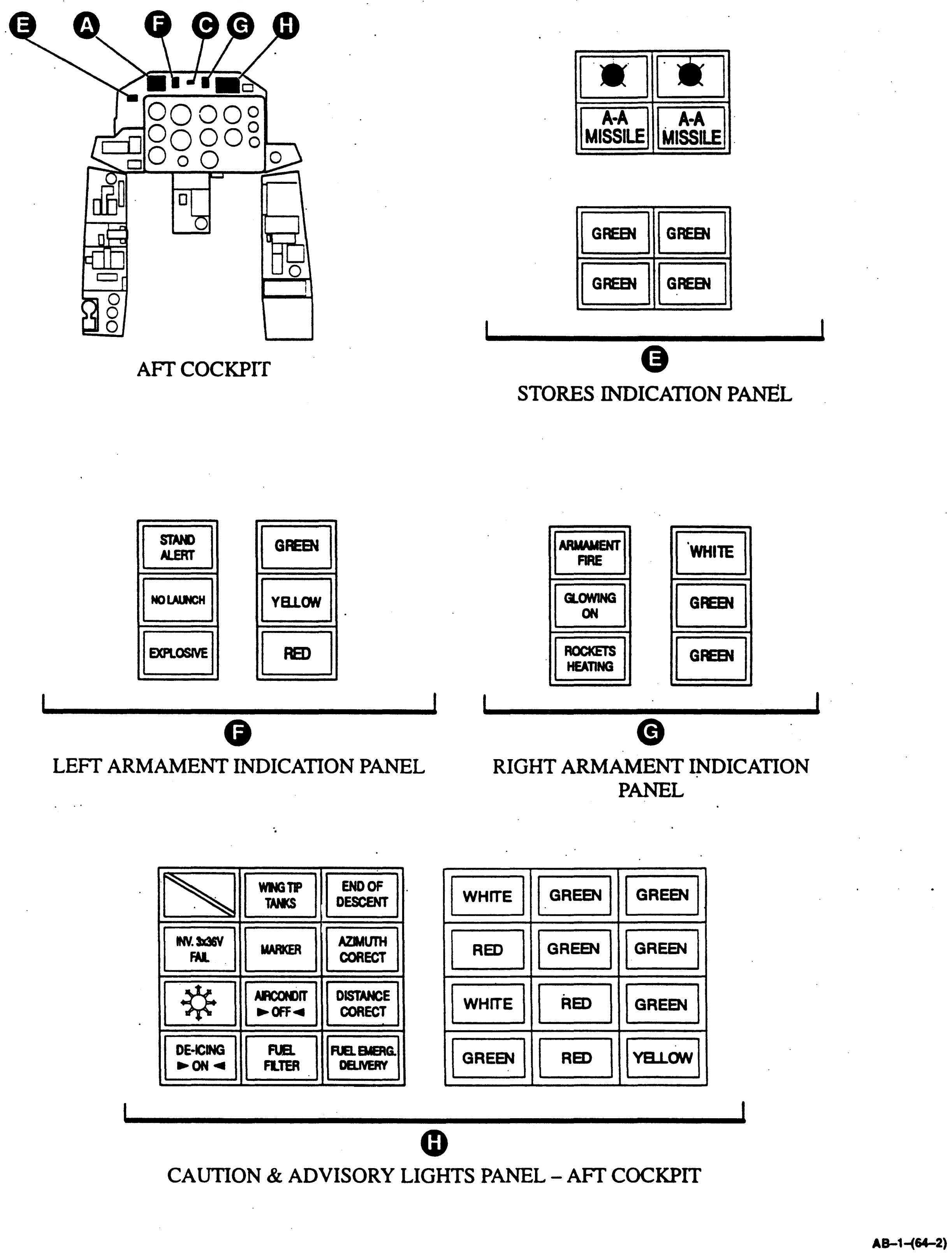


Figure 1–64. Warning, Caution & Advisory Indicator Light System (sheet 2 of 2)

"INV. 3 × 36 V FAIL"	Inverter III (3 × 36 V, 400 Hz) has failed or is not switched on. The inverter III supply the engine instruments and turn indicator.
"ENG. MIN. OIL PRESS"	Oil pressure is below limit or oil temperature has reached upper limit or oil impurities have reached limit.
"J.P.T. 730°C"	Exhaust gas temperature has reached 730°C.
"J.P.T. 700°C"	Exhaust gas temperature has reached 700°C
"AZIMUTH CORRECT"	When in touch with RSBN beacon, the heading is evaluated with maximal accuracy
"DISTANCE CORRECT"	When in touch with RSBN beacon, the distance is evaluated with maximal accuracy

CAUTION LIGHT PANEL

The Master Caution Light is located in both cockpits. The light does not bear any label and is provided in red color. The following lights are accompanied by flashing of the MASTER CAUTION light:

FIRE

150 KG FUEL

DON'T START

FUEL FILTER

GENERATOR

HYD. SYST. FAIL

ENGINE VIBRATION

CANOPY UNLOCKED

ARMAMENT SYSTEM

The armament system provides the a/c with the capability to carry and deliver Air to Air and Air to Ground weapon types. For list of approved stores, refer to Section V – Operating Limitations. The aircraft is equipped with a gyroscopic sight to aim the weapons and with a gun camera to shoot the weapon delivery. The system includes the capability to jettison the stores in emergency. The armament system is protected and controlled by two "ARMS" C/Bs, one in the forward cockpit center pedestal and one in the aft cockpit miscellaneous C/B switch panel. Both C/Bs have to be switched ON to enable the system operation by the trigger located on the forward cockpit stick grip (except in emergency jettison operation). The stores releasing by the trigger is blocked up the a/c speed 310 ± 15 km/h.

The a/c has two external armament stations, one on each wing.

MAIN DELIVERY MODES AND CONTROLS.

Figures 1–65 through 1–66.

The weapon delivery system has the following main modes: bombs delivery in A/G, rockets delivery for both A/G and A/A targets, missile launching in A/A and gun training mode in A/A (with gun camera).

To operate the armament system the following switches have to be switched on:

- Forward cockpit main C/B switch panel
  - "BATTERY"
  - "ENGINE"
- Aft C/B switch panel
  - "CONTR."
  - "SIGNAL."
  - "EMERG. DROP"
  - "FIRE"
  - "FLT RECOR/EKSR–46/KL–39"
- Miscellaneous C/B switch panel
  - "NETW."
  - "SIGNAL."

The armament system controls are located on forward cockpit center pedestal, on main and miscellaneous CB/ switch panel. Armament system status indication lights are located in the forward cockpit on lower and upper armament indication panels and in the aft cockpit on left and right armament indication panels.

Forward cockpit center pedestal

- "ARMS" C/B – switches ON the weapons releasing circuit, controlled by the trigger push button, located on the forward cockpit stick grip.

- Rockets "UB-16" C/B – switches ON the rockets firing control circuit
- Sight and camera gun "ASP–FKP" C/B – switches ON the sight and camera gun electric circuits.
- "HEAT SS" C/B – when ON, supplies the missile seeker heating circuit
- "GLOW SS" C/B – when ON, supplies the missile seeker glowing circuit
- "VOLUME SS" controller – it adjusts volume of the missile seeker cage audio signal
- Missile/bomb release selector – it enables to select an order of bobs dropping or missile launching after squeezing the trigger.
  - "PORT" position – bomb from under the left pylon will be dropped or LH missile will be launched
  - "STARB–BOTH" position – bombs from under the both pylons will be dropped simultaneously, or RH missile will be launched
- Lower armament indication panels
  - Store light (bomb symbol) – it indicates any store suspended under the wing pylon (bomb, rocket launcher, missile launcher).
  - "EXPLOSIVE" light – indicates that the arm/safe bombs emergency jettison switch is in ARM position
  - "A–A MISSILE" light – indicates that the missile is suspended under the appropriate missile launcher
- "PUS–0" intervalometer end position light – indicates that the automatic rockets firing system is in its zero reference position
- "LIVE" arm/safe bombs emergency jettison switch:
  - "LIVE" position – bombs will be jettisoned with fuzes armed
  - "BLANK" position – bombs will be jettisoned with fuzes disarmed
- "EMERG. JETTIS." emergency jettison switch – when in ON unguarded position each store will be jettisoned simultaneously from both pylons. The missiles will be jettisoned together with their launchers.
- Rockets firing mode selector
  - "2 RS" position – two rockets will be fired when trigger is squeezed. Firing sequence is left first, symmetric right second.
  - "4 RS" position – four rockets will be fired when trigger is squeezed. Firing sequence is left first, symmetric right second, left third and symmetric right last.
  - "AUT." position – salvo position; the rockets are fired as long as the trigger is squeezed. The firing sequence is symmetric with an interval of approximately 1.2 second between two subsequent launches.

<u>Miscellaneous C/B Switch Panel</u>

- "ARMS" C/B – switches ON the weapons control circuit. This C/B overrides function of the same one in the forward cockpit.
- "EMERG. JETTIS." emergency jettison switch – when in ON unguarded position each store will be jettisoned simultaneously from both pylons. The missiles will be jettisoned together with their launchers.
- "BOMBS" arm/safe bombs emergency jettison switch – it overrides function of the "LIVE" switch, located in the forward cockpit. When the switch in the aft cockpit is stated and covered in the middle position, the fwd switch functions.
  - "LIVE" position – bombs will be jettisoned with fuzes armed
  - "BLANK" position – bombs will be jettisoned with fuzes disarmed.

<u>Upper Armament Indication Panel</u>

- "STAND ALERT" light – the armament system electric circuit is ready, all the relevant armament system switches are turned on, all the selectors are in correct position and the speed is higher than 310 ± 15 km/h.
- "NO LAUNCH" max. "G" load light – the "G" load of the aircraft reaches the limit +2 g.

<u>Left Armament Indication Panel</u>

- "STAND ALERT" light – the armament system electric circuit is ready, all the relevant armament system switches are turned on, all the selectors are in correct position and the speed is higher than 310 ± 15 km/h.
- "NO LAUNCH" max. "G" load light – the "G" load of the aircraft reaches the limit +2 g.
- "EXPLOSIVE" light – the arm/safe bombs emergency jettison switch is positioned in "LIVE" (ARM) position.

<u>Right Armament Indication Panel</u>

- "ARMAMENT FIRE" indication light – it illuminates whenever the trigger is squeezed.

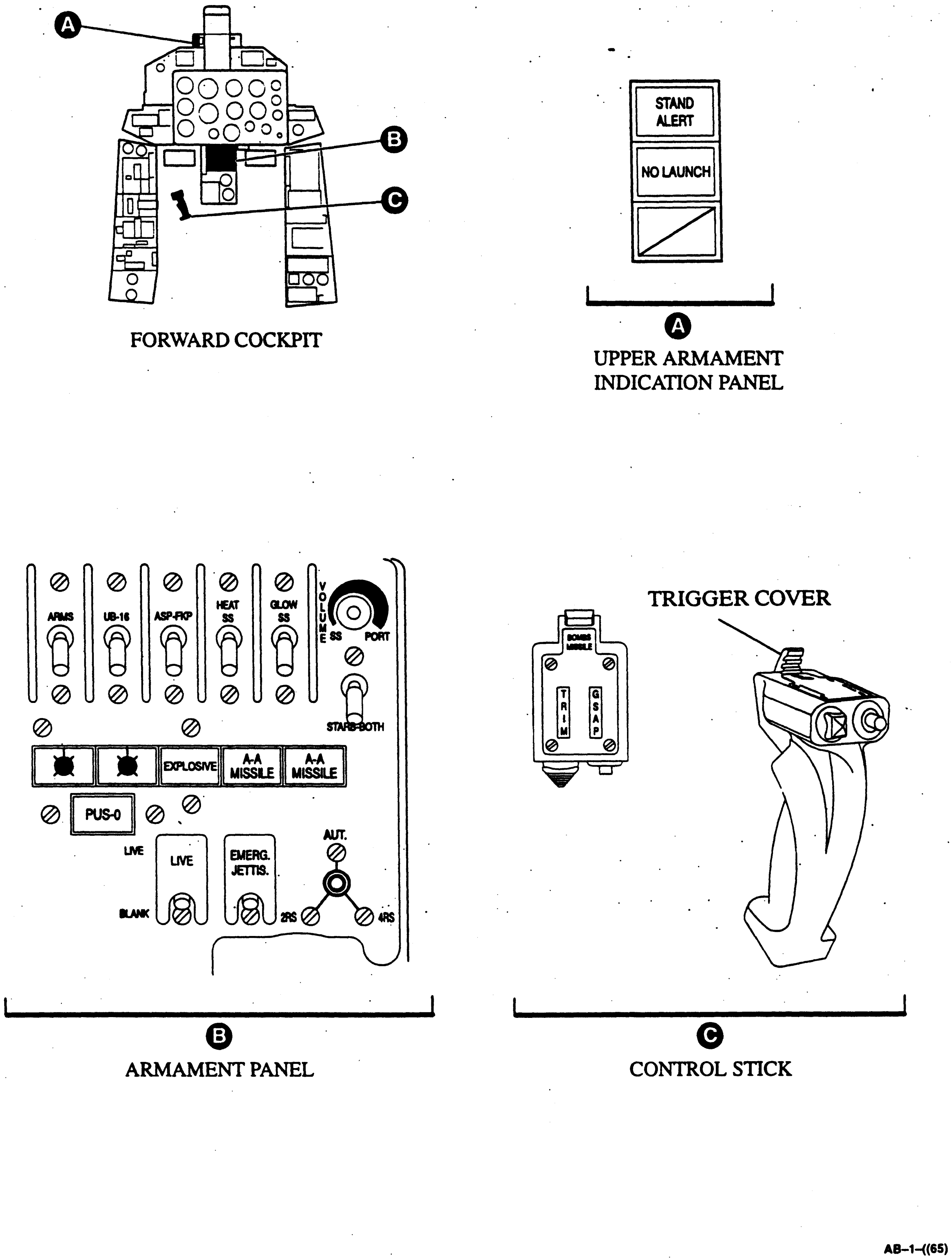


Figure 1–65. Armament System Locations and Controls – Forward Cockpit

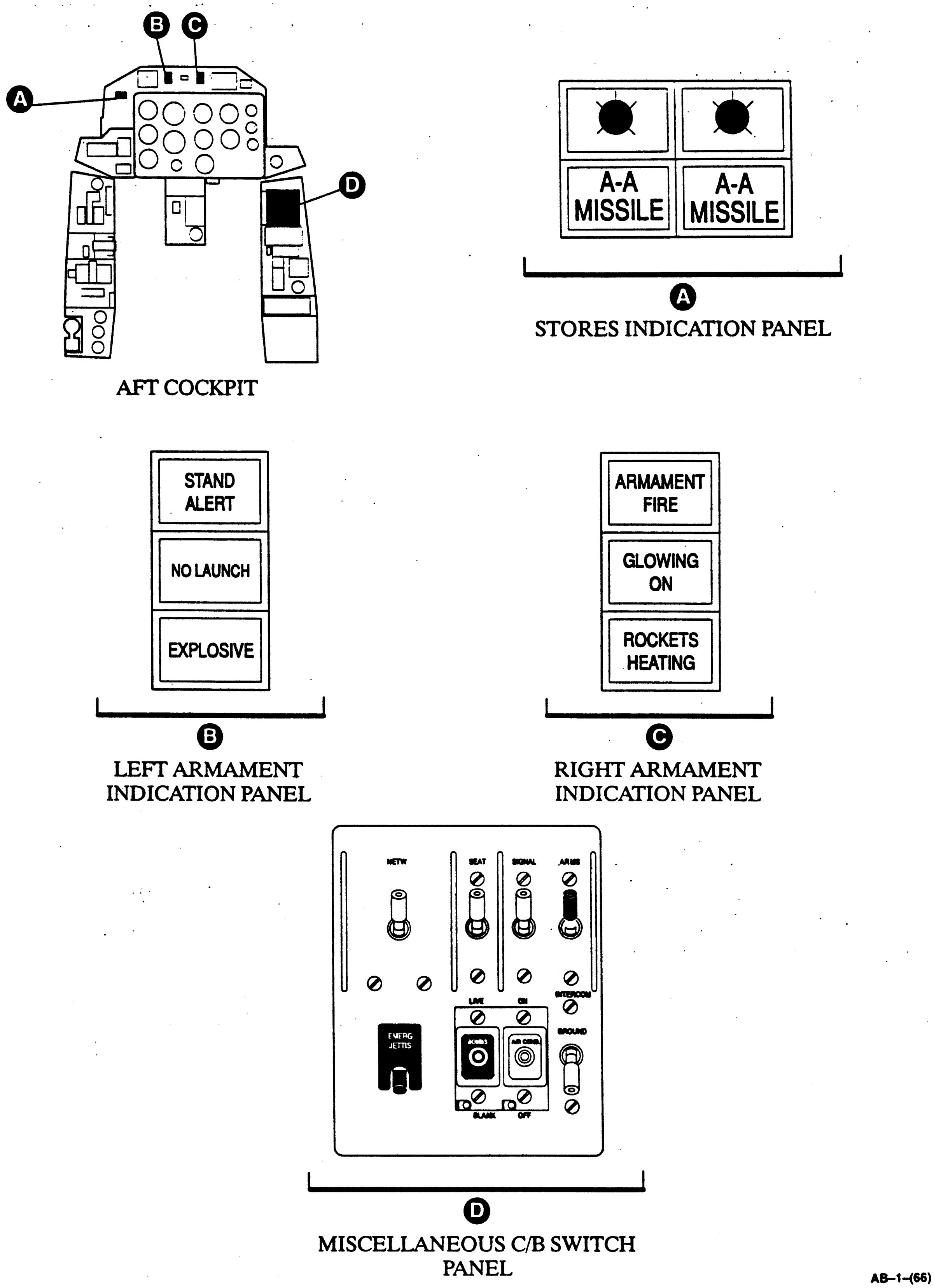


Figure 1–66. Armament System Locations and Controls – Aft Cockpit

- "ROCKETS HEATING" advisory light – it illuminates whenever the missile seeker heating switch in the fwd cockpit is turned on.
- "GLOWING ON" advisory light – it illuminates whenever the missile seeker glowing switch in the fwd cockpit is turned on.

Stores Indication Panel

- Store light (bomb symbol) – it indicates any store suspended under the wing pylon (bomb, rocket launcher, missile launcher).
- "A–A MISSILE" light – indicates that the missile is suspended under the appropriate missile launcher

ASP–3NMU–39 GYROSCOPIC SIGHT

The sight (figure 1–67) is a gyroscopic unit of collimator type. It automatically evaluates the lead angle, it means that an aiming reticle is deflected on the optical combiner thus providing the line of sight deflection from the weapons fire line at the moment of fire by the correct angle and ensures the highly probable target hit.

All sight displays are presented on the optical combiner above the instrument panel. The optical combiner is an optical reflecting surface that reflects sight symbols, projected into the pilot's line of vision.

To aim the target, pilot shall perform the following:

- to align the target with the pipper by maneuvering the aircraft
- to encircle the A/A target with the stadiametric circle by rotating the throttle grip

The sight can be used also as the collimator sight, i.e. with the fixed aiming reticle. In that case the gyro unit shall be arrested. The aiming reticle can be tilted in a range from 0 to 20° and its brightness can be adjusted as required. When the gyro unit or optical system failed, auxiliary fixed mechanical sight can be used.

CONTROLS

The controls and indicators are located on the sight, on the center pedestal and on the fwd throttle grip.

Gyro Unit Arrestment Lever

When the two position gyro unit arrestment lever is set to "GYRO" position, the gyro unit free movement is established and the aiming reticle can displace on the optical combiner according to flight conditions. In "FIXED" position the gyro unit is arrested and the aiming reticle is fixed.

Target Dimension Selector

Using the target dimension selector the a/c target wingspan or dimension can be preset in a range from 7 to 45 m. The preset value can be read on the target dimension scale.

Target Framing Grip

The target framing grip creates a part of the fwd cockpit throttle grip. By rotating this grip the stadiametric circle on the optical combiner changes its diameter finally encircling the target wingspan thus estimating the target range within a range from 180 to 800 m. Rotating the grip CW the stadiametric circle enlarges and vice versa. When the target dimension selector is set to 7 m the range can be adjusted from 180 to 385 m and when selector is set to 45 m the range can be adjusted from 360 to 800 m.

Aiming Angle Selector

The aiming angle selector allows to set the aiming angle during A/G mode with fixed aiming reticle. The range can vary from 0 to 20° and can be read on the aiming angle scale.

Brightness Knob

Rotating the brightness knob sets the brightness of the aiming reticle displayed on the optical combiner. Rotating the knob in the "BRIGHT" direction, the brightness increases.

Optical Filter Control Lever

It positions the filter across the optical combiner to reduce brightness of background.

Mechanical Sight Control Lever

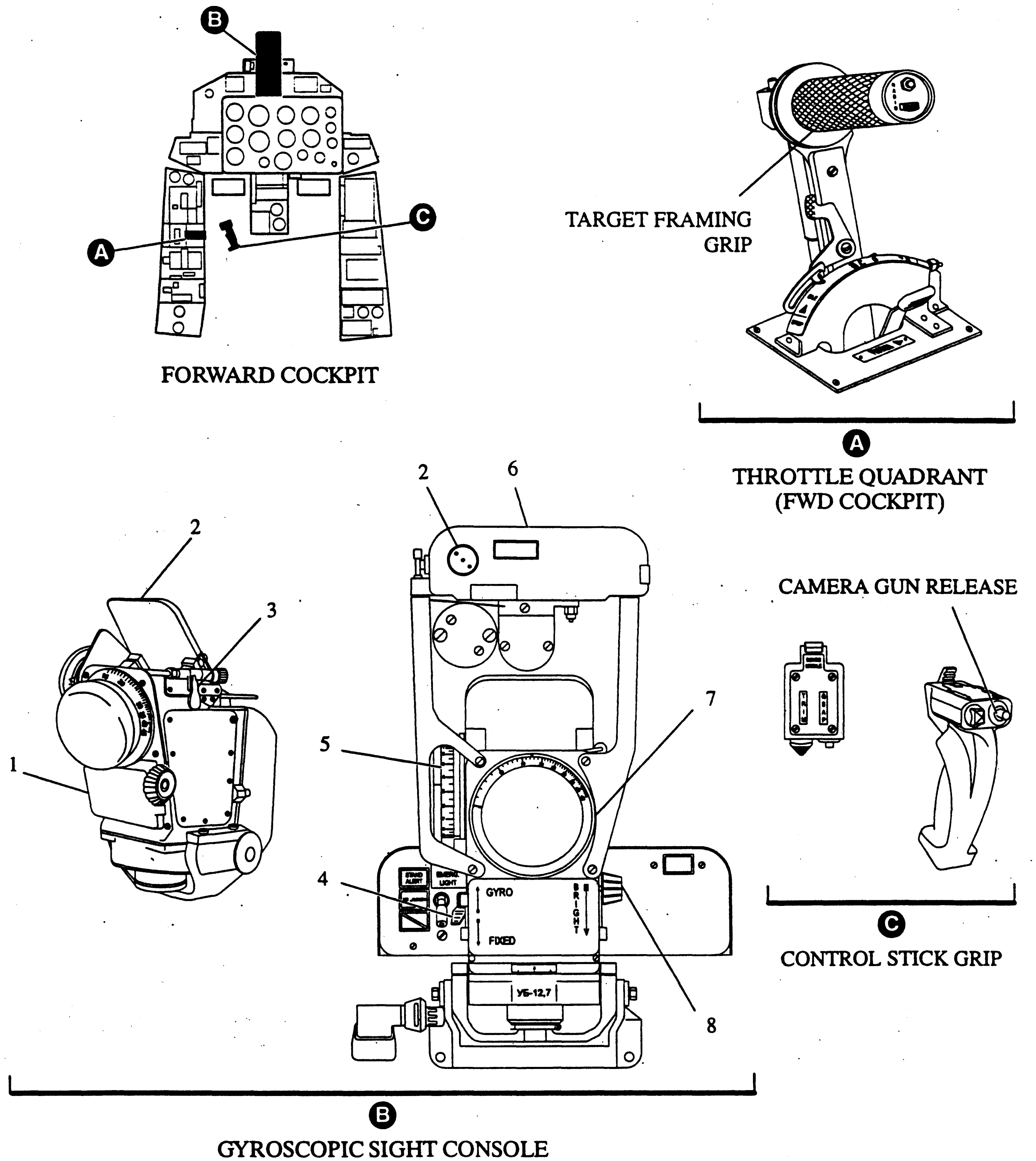
The lever positions the mechanical sight in case of gyro unit or optical system malfunction.

"ASP–FKP" Sight and Camera Gun C/B

The sight and camera gun C/B is located on the fwd cockpit center pedestal and it protects and switches ON the sight and camera gun power supply circuitry.

OPERATION

After switching on the "ARMS" C/Bs in both fwd and aft cockpits and "ASP–FKP" C/B in the forward cockpit, the sight circuit is armed and the aiming reticle illuminates. According to planned mission the pilot shall set the gyro unit arrestment lever into the respective position and shell set the line of sight angle according the following table:



1. Gyroscopic Sight
2. Optical Combiner
3. Mechanical Sight Control Lever
4. Arrestment Lever
5. Target Range Scale
6. Gun Camera
7. Target Dimension Selector
8. Brightness Knob

AB–1–(67)

Figure 1–67. Gyroscopic Sight and Gun Camera – Controls and Indicators.

Mission	Gyro Unit and Line–of–Sight Angle Setting
Training gun camera A/A	"GYRO", 0°
Rockets firing	"GYRO" or "FIXED", according to ballistic tables
Missile A/A	"FIXED", 0°
Bombs	"FIXED", according to ballistic tables

CAUTION

During take off, landing or taxiing, or when the sight is not used, the gyro unit arrestment lever must be placed in "FIXED" position.

NOTE

The "ARMS" C/Bs in both fwd and aft cockpits and "ASP–FKP" C/B in the forward cockpit must be turned on at least 10 minutes before using the sight due to temperature stabilizing.

FKP–2–2 GUN CAMERA.

The gun camera (figure 1–67) is mounted on the top of the sight. It records both the aiming reticle and the target simultaneously. The purpose of the gun camera is to verify aiming procedure and to record results of weapons firing. A design of the gun camera is based on the 35 mm camera with discontinuous film movement. The rate of recording is from 4 to 6 snaps per second. The camera includes 1.7 meter of film which represents provisions for 60 snaps. The duration of continuous recording is 12 seconds. Both film feed and a shutter operation are electrically driven. The gun camera is actuated either by pressing the gun camera trigger or the trigger located on the forward cockpit control stick grip. To improve the quality of snaps being shot during flight, the diaphragm and filter can be set before flight.

CONTROLS

Gun Camera Trigger

The gun camera trigger placarded "GSAP" is located on the control stick grip in the forward cockpit. Pressing this button, only the gun camera starts to operate with activation of no other armament subsystems.

Trigger

The main pre-selected function of the armament system is activated by depressing the trigger switch, followed secondarily by gun camera operation.

Film Feeding Indicator

Rotation of the black indicator with white spots, located on the gun camera front panel, indicates the film feeding.

WARNING

When any stores are attached to the pylons, it is strictly prohibited to use the trigger in terms of gun A/A training mission. Not to follow this warning can cause unintentional releasing of weapons.

AIR TO AIR (A/A)

The a/c can carry, operate and launch two IR missiles. One missile can be suspended under each pylon.

CONTROLS AND INDICATIONS. (Figure 1–65 through 1–66)

- When "ARMS" C/Bs are in ON position and when the speed is above 310 ± 15 km/h – the "STAND ALERT" advisory light on the fwd cockpit lower armament indication panel and on the aft cockpit left armament indication panel comes on.
- Armament panel (fwd cockpit center pedestal):
  - Missile/bomb release selector to "PORT" or "STARB–BOTH" position. The store light (bomb symbol) and "A–A MISSILE" light will illuminate on the fwd cockpit upper armament indication panel and on the aft cockpit stores indication panel.
  - "HEATING SS" missile seeker heating C/B and "GLOWING SS" missile seeker glowing C/B to ON position – "ROCKETS HEATING" and "GLOWING ON" advisory lights will illuminate on the right armament indication panel in the aft cockpit. "NO LAUNCH" max. "G" load light must not illuminate on the fwd cockpit upper armament indication panel and on the aft cockpit left armament indication panel. The respective missile seeker audio signal is audible in the headset. Its level can be adjusted by the "VOLUME SS" controller.

As the aircraft by its maneuvering reaches proper position relatively to the target, the missile seeker cage signal is audible. To launch the missile the trigger shall be squeezed bringing the "ARMAMENT FIRE" indication light ON. After launching the missile the "A–A MISSILE" advisory light of the respective missile will extinguish and “STAND ALERT” light will illuminate.

To launch the other missile the missile/bomb release selector shall be switched to the next position.

CAUTION

The missiles shall not be launched if the “NO LAUNCH” max. “G” load light illuminates (maximum permissible “G” load for missile launching – 2 g – is exceeded).

Do not launch the missile in the flight altitude higher than 14,500 m.

NOTE

The missile launching is blocked from the airspeed up to 310 ± 15 km/h.

AIR TO GROUND (A/G

The a/c can carry and launch rockets and bombs suspended under pylons.

CONTROLS AND INDICATIONS. (Figure 1–65 through 1–66)

Bombs

NOTE

- The bombs dropping is blocked from the airspeed up to 310 ± 15 km/h.
- Bombs can be operationally dropped only with fuzes armed regardless on arm/safe bombs emergency jettison switch.

- When “ARMS” C/Bs are in ON position and when the speed is above 310 ± 15 km/h – the “STAND ALERT” advisory light on the fwd cockpit upper armament indication panel and on the aft cockpit left armament indication panel comes on.
- Armament panel (fwd cockpit center pedestal):
  - Missile/bomb release selector to “PORT” position. The store light (bomb symbol) light will illuminate on the fwd cockpit lower armament indication panel and on the aft cockpit stores indication panel.

To drop the LH bomb the trigger shall be squeezed bringing the “ARMAMENT FIRE” indication light ON. After dropping the bomb the “bomb symbol” advisory light of the LH bomb will extinguish and “STAND ALERT” light will illuminate.

To drop the RH bomb the missile/bomb release selector shall be switched to the “STARB–BOTH” position.

NOTE

When the “STARB–BOTH” position is selected as a first, both LH and RH bombs will fall simultaneously.

Rockets.

- When “ARMS” and “UB–16” C/Bs are in ON position, rockets firing mode selector in one of the operating positions and when the speed is above 310 ± 15 km/h – the “STAND ALERT” advisory light on the fwd cockpit upper armament indication panel and on the aft cockpit left armament indication panel comes on.
- “PUS–0” intervalometer end position light and “bomb symbol” light illuminate on the fwd cockpit center pedestal.

NOTE

If the “PUS–0” intervalometer end position light does not illuminate, the “SIGNAL.” circuit breaker on the aft CB/switch panel shall be positioned to OFF, and repeatedly squeezed the trigger switch until the “PUS–0” light comes ON. Reset the “UB–16” C/B.

- Rockets firing mode selector in position:
  - “2 RS” position – two rockets (one per launcher) will be fired when trigger is squeezed. The “PUS–0” intervalometer end position light will extinguish. Next two rockets will be fired after next trigger squeezing.
  - “4 RS” position – four rockets (two per launcher) will be fired when trigger is squeezed. Firing sequence is left first, symmetric right second, left third and symmetric right last. The “PUS–0” intervalometer end position light will extinguish. Next four rockets will be fired after next trigger squeezing.
  - “AUT.” position – salvo position; the rockets are fired as long as the trigger is squeezed. The firing sequence is symmetric with an interval from 1 to 1.5 second between two subsequent launches.
- Whenever the trigger is squeezed the “ARMAMENT FIRE” indication light illuminates. After firing last rocket, the “PUS–0” intervalometer end position light will illuminate again.

EMERGENCY JETTISON SYSTEM. (Figure 1–68)

The jettison system provides the pilot with the ability to jettison the external weapon at any time and in whole airspeed envelope. The jettison system is protected by "EMERG. DROP" C/B in the aft CB/switch panel.

Jettison may be performed from either cockpits independently. An automatic jettison control system ensures that the stores can be jettisoned only simultaneously (except bombs).

- Arm bombs emergency jettison – by the missile/bomb release selector select the dropping mode and position the arm/safe bombs emergency jettison switch to "LIVE" ("LIVE" indication light in both cockpits will illuminate). To release the bomb, position either the forward or aft cockpit "EMERG. JETTIS." emergency jettison switch to ON. The "bomb symbol" light will extinguish.

NOTE

The aft cockpit "BOMBS" arm/safe bombs emergency jettison switch overrides the "LIVE" switch in the forward cockpit.

- Safe bombs emergency jettison – position the arm/safe bombs emergency jettison switch to "BLANK" ("EXPLOSIVE" indication light in both cockpits must not illuminate). To release the bomb, position either the forward or aft cockpit "EMERG. JETTIS." emergency jettison switch to ON. The bombs fall simultaneously and the "bomb symbol" lights will extinguish.
- Rocket launchers emergency jettison – shall be performed as safe bomb emergency jettison.
- Missile jettison – shall be performed as safe bomb emergency jettison. The missiles are jettisoned with their launchers.

SIGNAL FLARES SYSTEM (Figures 1–69 and 1–70)

The signal flares are provided to signal the airfield control tower of communication failure and during the communication loss, of loss or failure in the landing gear, flight controls etc.

Four signals with different colors are housed in a launching box, located in the RH side of the aft fuselage section. Launching the signal flares is carried out by pressing the push–button of the respective color in the forward cockpit only. The aft cockpit is not provided with signal flares control. The system is protected by the "FLT RECOR/EKSR–46/KL–39" C/B on the aft CB/switch panel and switched on by the "IDENT. FLARES" switch located on the signal flares control panel.

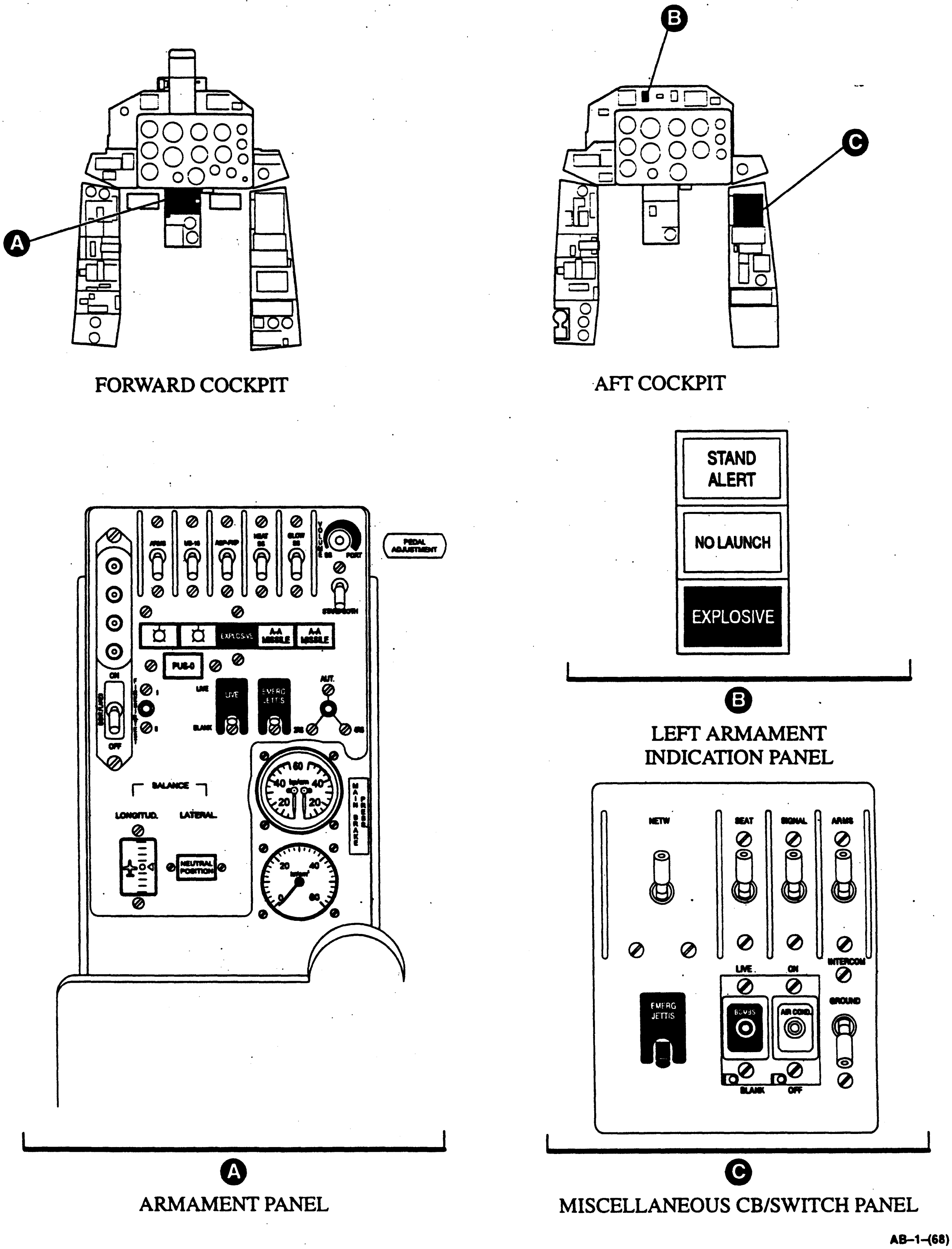


Figure 1–68. Emergency Jettison System

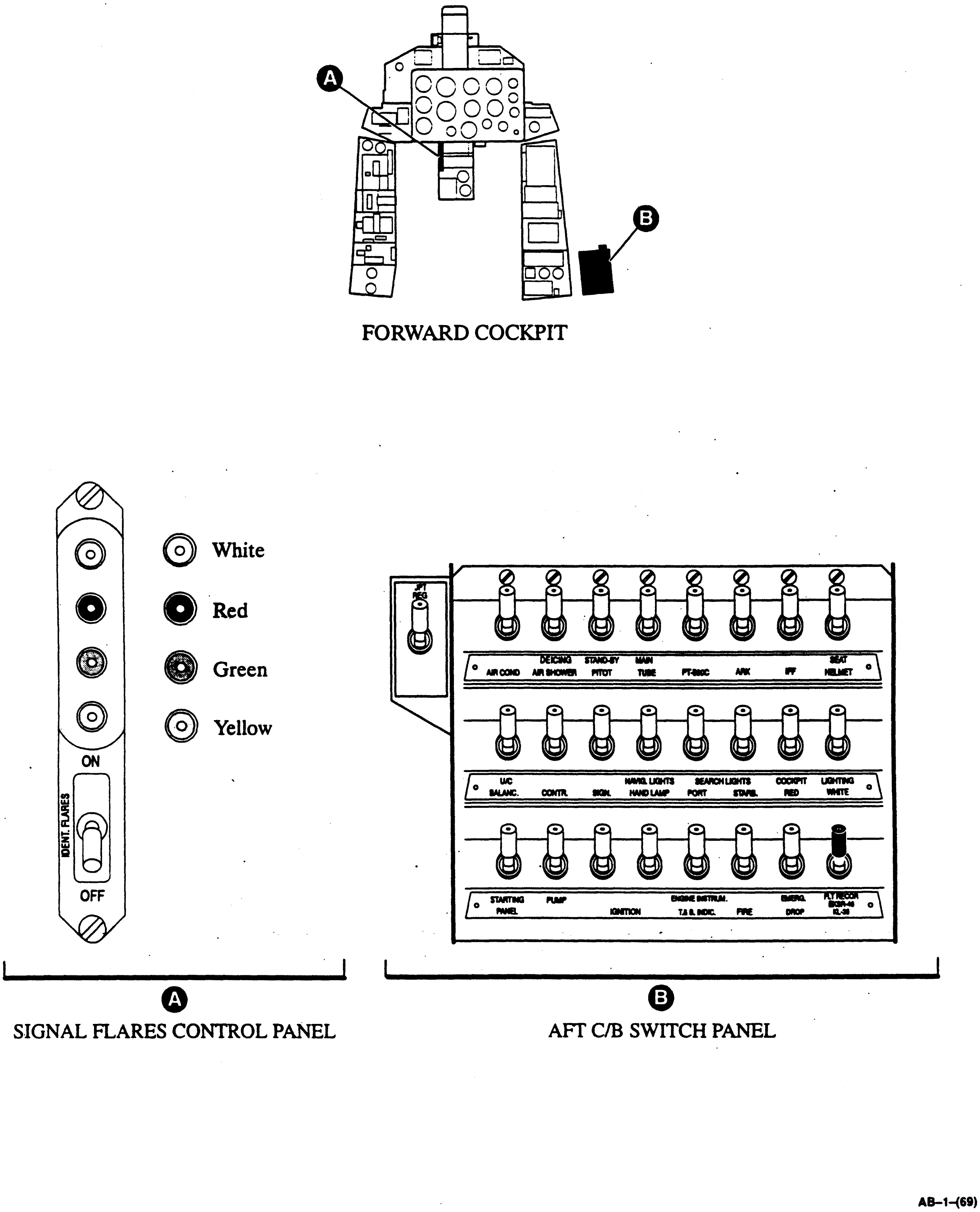
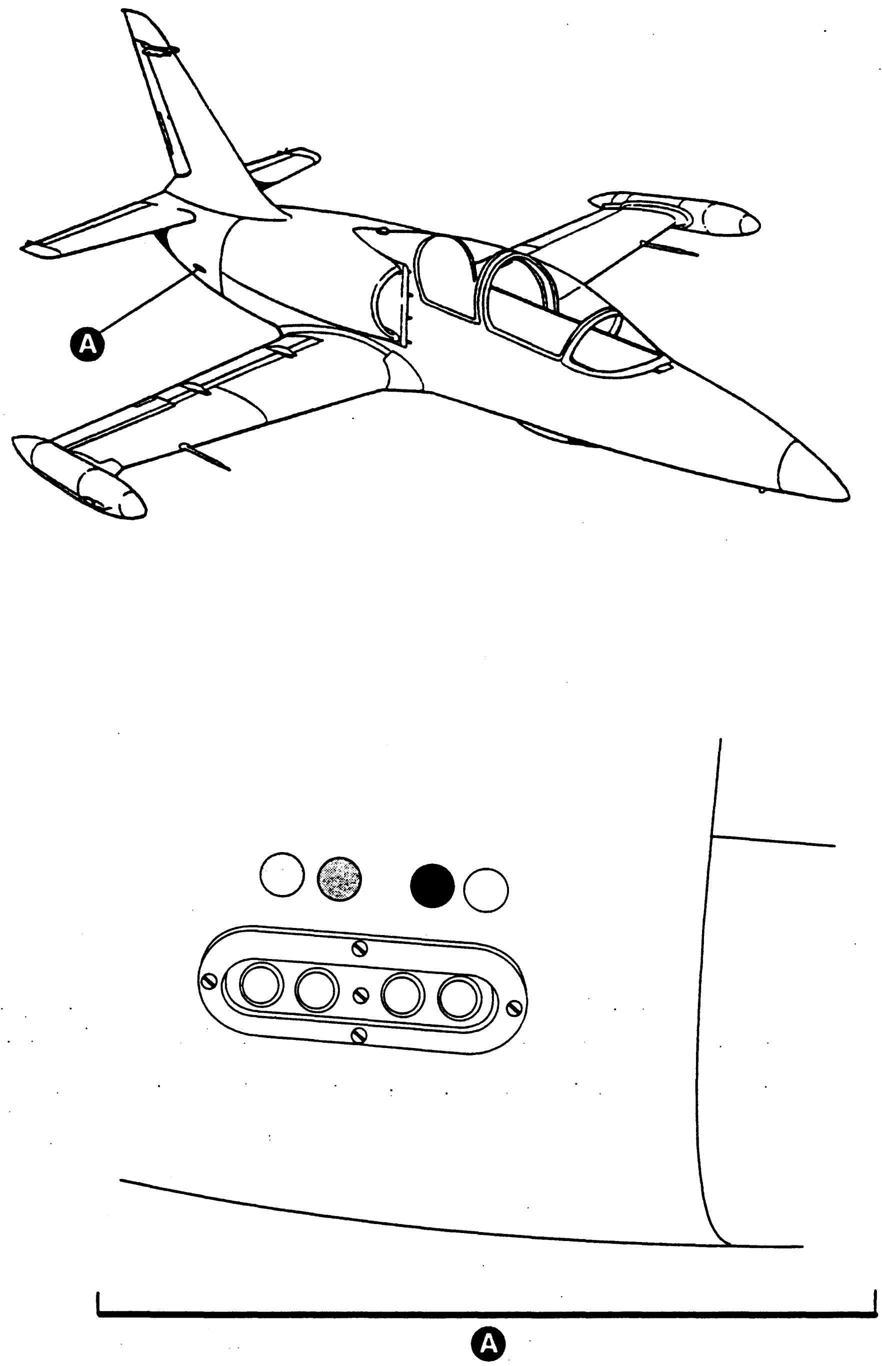


Figure 1–69. Signal Flares – Controls



AB-1-(70)

Figure 1-70. Signal Flares - System Components

SECTION II

NORMAL PROCEDURES

CONTENTS PAGE

PREPARATION FOR FLIGHT

FLIGHT PLANNING

The performance data in Appendix A contains all information about aircraft performance vs flight stages and missions.

LIMITATIONS

Refer to Section V for all operating limitations concerning the aircraft.

PROCEDURES

The procedures described in this section are given in detail, where possible. The same procedures are given in an abbreviated form in the pilot's checklist.

CONTROL AVAILABILITY IN THE TWO COCKPITS

The procedures given in this section refer to the pilot in the forward cockpit. The aft cockpit controls are individually punctuated. The following controls are accessible in the aft cockpit only:

- Electrical Power Supply Switches:
  - "NETW."
- Instrument and Navigation Switches:
  - Forward/aft cockpit EGT transfer switch "EGT IND. AFT/FWD"
  - RSBN aft control panel
  - GMK directional gyro correcting mechanism
- Communication Switches:
  - "INTERCOM GROUND"
- Escape system Switches:
  - "SEAT"
- Aircraft Systems Switches:
  - "AIR COND"
  - Oxygen bottles interconnect valve
  - Pitot fault simulator panel
  - Navigation fault simulator panel

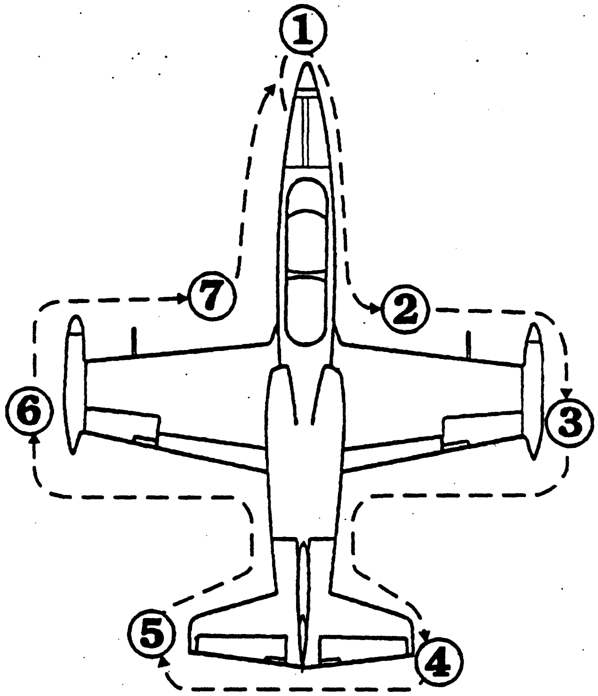


Figure 2–1. External Checks

PRE–FLIGHT CHECKS

The exterior inspection procedures are based on the assumption that maintenance personnel have completed all pre–flight requirements specified in the appropriate technical publications. The pilot need not, therefore, repeat the same inspection except for certain items require in the interest of safety.

EXTERIOR INSPECTION (figure 2–1)

1. Check the general surroundings of the aircraft:

– Chocks	– In place
– Fluid leaks	– None

NOTE

Fluid leaks must not be visible either on aircraft skin or on the ground below the aircraft.

– Fire extinguisher	– In place
– Aircraft	– No bank

All protected covers are removed, the aircraft shall stay with no conspicuous bank, landing gear dampers and tires uniformly compressed. All access doors closed and secured, skin with no damage.

2. Check aircraft for proper configuration.

Nose section (area 1)

1. Air pressure gage	– 120 to 150 kg/cm^2
2. Side panels	– Closed and secured
3. Nose wheel	– Check strut, tire and microswitch

The tire shall not be extremely worn, red marks on tire and wheel disk shall be aligned, no hydraulic seepage, doors closed, L/G position indicator extended and not damaged, WOW switch free movement, no damage on shimmy damper. The tire compression (fuselage and tip tanks refueled) approximately 20 mm. All rods, cylinders and covers undamaged. All components and tubes in nose wheel well with no evident damage or leaks.

4. Gear down light	– Condition

Fuselage RH side (area 2)

1. Canopy	– Condition
2. Air intake	– Clear

Check the air intake with special attention to foreign objects. Inner skin without damage.

3. Temperature probe – Condition
4. Speed brakes – Retracted and condition
5. IFF antenna – Condition
6. Right main gear – Check strut, tire, brake assembly and gear down light

The tire shall not be extremely worn, red marks on tire and wheel disk shall be aligned, no hydraulic seepage, doors closed, L/G position indicator extended and not damaged. The tire compression (fuselage and tip tanks refueled) approximately 40 mm. All rods, cylinders and covers undamaged. All components and tubes in nose wheel well with no evident damage or leaks. Anti skid cables not damaged, mechanical brake wear indicator within limits.

7. Access panels – Closed

<u>Wing RH side</u> (area 3)

1. Pitot probe and static ports – Condition, cover removed

NOTE

Pay higher attention to all static and total pressure ports, they must not be plugged and damaged.

2. Landing/taxi light – Condition
3. Position light – Condition
4. Tip tank filler cap – Closed and safety wired

The wing–tip tank mast be undamaged and intact and with no fuel leaks. Position light unbroken.

5. Aileron – Movement, check trim tab
6. Flap – Condition
7. Pylons, stores – Condition, attached

Wing skin intact, no dents, bulges and cracks, rivets undamaged.

<u>Tail section RH side (area 4)</u>

1. Oil quantity – Check 4.5 to 7.5 liter (within limits)

NOTE

Actual oil volume in the tank can be checked only up to 15 minutes after engine shut down. After that time only information value can be read because of oil gravity flow down.

2. Antennas under fuselage – Condition
3. Rudder – Condition
4. Radio antenna – Condition
5. Static discharges – Condition

NOTE

Every static discharge shall contain at least three unbroken wires.

6. Elevator – Movement, check trim tab
7. Exhaust cone – No cracks, dents or fuel leaks

Engine compartment access doors properly closed, signal flares launcher charged and closed, position light unbroken.

<u>Fuselage, wing and tail LH side</u>

1. (areas 5, 6 and 7) – Same as RH side (repeat)
2. APU exhaust cone – No cracks, no soot stains around

SOLO CHECK (AFT COCKPIT)

1. Cockpit – Clear, no foreign objects
2. Miscellaneous CB/Switch panel: NETW., ARMS – On
3. Parachute harnesses – Secured
4. Solo cover – In place
5. Seat safety pins – In place
6. Suit ventilation – Closed (CW)
7. Oxygen interconnect – Open (CCW)
8. Oxygen supply valve – Closed (CW)
9. Fuel shut–off lever – Forward and guarded position
10. Throttle cut–off lock gate – Open
11. All guarded switches – Covered
12. Fwd/aft cockpit EGT transfer – Forward

CAUTION

Failure to comply with the next step will prevent L/G retraction after takeoff.

13. Gear lever – Neutral position
14. Emergency brake handle – Forward, safety–wired
15. Outer–inner beacon switch – Outer

16. Pitot fault simulator levers – Norm, left position
17. Navigation fault simulator switches – Down, OFF
18. ADF control box – C AUT, outer beacon tuned
19. GMK correcting mechanism – Variation zero
20. Emergency levers – Forward position and safety-wired
21. Canopy – Closed and locked

COCKPIT ENTRANCE

From steps

1. Cockpit – Clear, no foreign objects
   - Canopy – Clear, no scratches
2. Main CB/switch panel – All OFF
3. Aft CB/switch panel – All ON
4. Ejection Seats – Inspect and carry out the following checks:
   - Manual seat separation lever – Wired in the aft position
   - Normal ejection channel indicator – Aligned with red mark
   - Spring hooks of static lines – Fastened in the rings of central static lines
   - Ejection restricting line – Located in head rest and spring hook is fastened to the yoke of canopy
   - Parachute timer static line ring – Fastened to the hinge on the right side of the seat

WARNING

Make sure to make proper connection of the short and long static lines to the hinge. Failure to comply may cause problems in parachute operation.

5. Canopy and seat pins – In place

In place only following safety pins: head of telescopic ejection mechanism (TVM), left yoke of TVM control rod and head of canopy jettison pyromechanism. Other safety pins shall be already removed by maintenance personnel.

6. Pilot weight – Set
7. Emergency oxygen pressure – 130 to 150 kg/cm^2
8. P.E.C. upper part – Attached to parachute harness
9. Anti–G valve – According flight suit
10. Signal flares switch – OFF
11. Canopy jettison lever – Basic position, safety–wired

After cockpit entry

1. Harnesses and personal equipment – Fasten
   - After seat entering, attach survival kit extension cable to the ring at the RH leg so that the cable shall lead between leg and parachute leg strap.
   - Put on shoulder straps of parachute harness; slide radio cable under the left shoulder strap and connect it with helmet radio/visor heating cable.
   - Lock the RH shoulder strap to the central lock.
   - Slide the leg straps through lateral eyes and lock them to the central lock. If pressurized helmet is used, attach half–ring of helmet stretching mechanism to the RH strap buckle.
   - Tape of helmet stretching mechanism shall be slid under the central lock. Spring the helmet stretching mechanism wires by means of tape with ring. Determine tape clearance by means of buckle.
   - Attach lock of oxygen mixture regulator to the left leg strap after its tightening.
   - Connect anti–G hose to the P.E.C.
   - Connect oxygen mask hoses to the mixture regulator: first high pressure hose, second folded hose.
   - Attach the oxygen mixture regulator to the LH leg strap. When flight with pressurized helmet, connect compensating suit with mixture regulator hose. When flight with oxygen mask only, that hose shall be blinded by safety valve.
   - Attach mask/helmet folded hose to the RH shoulder strap clasp by means of a tape.
2. Seat bucket height – Adjust
3. Shoulder harness arrestment lever – Verify
4. Rudder pedals – Adjust
5. Flight controls – Free movement

INTERIOR INSPECTIONS

1. BATTERY switch – On
2. External power indicator – Illuminates (when external power source attached)

Left Console

1. Flight suit ventilation – As required
2. Oxygen supply – Open (CCW)
3. Oxygen controls
   - Diluter demand switch – NORM
   - Emergency switch – OFF

Put the oxygen mask on and interrupt oxygen supply by squeezing the supply hose: breathing must not be possible, the mask is sealed. Get the mask off and position the emergency switch to ON: pressure oxygen flows from the mask.

4. Helmet ventilation – As required

When flight is executed with oxygen mask, helmet ventilation switch to OFF. When with pressurized helmet, ON position.

When flight with pressurized helmet will be performed, check the helmet as follows: visor heating check, pressure check, no pressure check, ventilation check, and oxygen continuous check.

- Visor heating check – will be performed during the helmet pressure check. Helmet visor heating switch to AUTOM (provided the SEAT/HELMET C/B on the aft CB/switch panel is ON). When the visor is closed and pressurized, no fogging should occurred. If yes, push QUICK button.
- Pressure check – after putting the pressurized helmet on, position the oxygen diluter demand switch to 100% O_2 and emergency switch to ON. With visor closed, the pressure in the helmet shall not increase within one to two minutes. Close a pressure hole on the oxygen mixture regulator and push the button under the oxygen regulator access door to increase pressure in the helmet up to 1,800 mm of water column. Perform several deep inspirations and expirations.
- No pressure check – wait until pressure releases from helmet and suit, and twice deeply expire and inspire. Check whether the flow indicator blinker indicates blank (open) when inspiration and white when expiration. Diluter demand switch to NORM and spend remaining air from tubing – double butterfly indicates white flag.
- Helmet ventilation check – helmet ventilation switch to ON. Pressure oxygen shall flow into the helmet. Switch OFF the helmet ventilation.
- Oxygen continuous check – disconnect the helmet oxygen hose from the mixture regulator. Press and hold the button located under the oxygen regulator test access, within 4 to 8 seconds intensive oxygen delivery shall start. Connect the helmet hose back to the mixture regulator.

5. Fuel shut–off lever – Forward and guarded
6. Pitot heat buttons – Off
7. FDR switch – Off, green light illuminates

Initial data record should be performed by switching on the FDR switch for approximately 10 seconds. If the light flashes during this period, the FDR functionality is verified.

8. Radio set control box – Set
9. Audio panel – Set
10. ICS control box – Set
11. Throttle – Full and free movement. Adjust friction
12. Pitot tube selector – MAIN
13. Helmet visor heating panel – As required
14. Emergency/parking brake lever – Forward (apply)
15. Instrument lights control – White
16. Landing/taxi light switch – Off
17. Oxygen pressure indicator – 150 kg/cm^2

NOTE

When temperature is below zero degrees of Celsius, the pressure can drop down to 130 kg/cm^2.

Instrument Panel

1. L/G control lever – Down

NOTE

The L/G lever in the aft cockpit shall be in neutral (center) position.

2. Accelerometer – Reset, check "+1 g"
3. Gun sight
   - Gyro unit arrestment lever – FIXED
4. Airspeed/mach indicator – Check
5. Altimeter – Set
6. Radar altimeter – Check indication, set dangerous height
7. ADI – Check, illuminating red
8. RMI – Check
9. Range indicator – Check
10. Vertical velocity indicator – Zero
11. ADF indicator – Check
12. Clock – Set
13. Cabin pressure/altimeter elevation – Check field alt., difference zero
14. Voltammeter – External power voltage
15. Engine instruments – Check

16. Diffuser and suit temperature controls – AUT., set temperature
17. Diffuser – Set direction, close

Center pedestal

1. Signal flares buttons – Check basic position
2. Armament panel – All OFF
3. Lower indication panel to stores – Illuminating according
4. PUS–0 light – Illuminating
5. Rockets mode selector – Center
6. Main brake pressure indicator – Zero
7. Emergency brake pressure indicator – Condition
8. Trim indicator – Condition
9. FIRE SIG TEST switch – I and II, FIRE light illuminates

Right Console

1. Pressurization/ECS handle – Off, aft position
2. ADF control box – Set
3. Auxiliary switch panel
   - Seat unblocking switch – Guarded
   - CABIN HEATING – AUTOMATIC
   - ENGINE INDICAT. EMERG. – Off
   - ANTI–ICING. – OFF
   - NAVIG. LIGHTS – As required
   - SDU – Off
   - RSBN – NAVIG.
4. RSBN control box – Set
5. Four hydraulic emergency levers – Forward and safety–wired
6. A&W lights intensity controls
   - CHECK – Lights illuminating
   - Brightness – Adjust
7. Hydraulic gauge – Condition
8. GMK control box
   - Mode switch – MC
   - Hemisphere switch – Set
   - Latitude selector – Set
9. JPT–REG. TEST – I. and II., lights illuminating
10. IFF control box – Set code

BEFORE START CHECKS

1. Radio switches – On
2. Seat and canopy pins – Remove

Remove and take out from the cockpit following safety pins: head of telescopic ejection mechanism (TVM), left yoke of TVM control rod and head of canopy jettison pyro-mechanism.

3. Signal lights:
   - AIRCONDIT OFF – On
   - CANOPY UNLOCKED – On
   - HYD. SYST. FAIL – On
   - GENERATOR – On
   - EMERGENCY GENERATOR – Flashing
   - ENG. MIN. OIL. PRESS – On
   - DON'T START – On
   - INV. 3 × 36 V FAIL – On
   - WING TIP TANKS – On
4. Engine switch – On, DON'T START and INV. 3 × 36 V FAIL lights out within 5 seconds.

NOTE

The ENGINE switch activates an fuel boost pump. If the boost pump fails to operate and DON'T START light does not go off within 5 seconds do not start the engine.

5. Fuel indicator – Check

The fuel indicator should indicate value according the flight mission to be flown. Check engine vibration indicator by means of CHECK VIBRATION button.

6. ADI, RMI – Operative
7. Throttle – STOP
8. FDR switch – On
9. Voltammeter – Check, 22 V minimum

NOTE

Do not attempt an engine battery start if battery voltage is less than 22 V.

WARNING

Failure to comply the next step could result in damage to equipment or injury to pilot in aft cockpit.

10. Aft canopy – Close
11. Aft cockpit CANOPY UNLOCKED light – Comes off
12. Anti–ice sensor cover – Remove
13. Signal for start – Obtain
14. Ground personnel – Inform about starting

ENGINE START

CAUTION

The engine throttle finger–lift, for retarding the throttle from IDLE to STOP is available in the forward cockpit only. It is therefore crucial that the forward pilot be aware and prepared to retard the throttle to STOP in case of an engine hot start or at any other time the engine must be shut down.

1. TURBO start button, stop watch – Depress for 2 seconds and release, start stop watch
2. TURBINE STARTER light – On, by 25 sec. Max
3. Stop watch – Reset
4. ENGINE start button, stop watch – Depress for 2 seconds, start stop watch
5. Throttle – Idle, within 3 to 6 sec. from step 4.
6. RPM, triple engine, EGT indicators – Check values

CAUTION

- If the APU starter is not disconnected within 45 sec., abort start and switch APU to STOP (TURBO STOP switch).
- If the EGT rises rapidly and approaches the high limit, abort start immediately.
- Strong tail wind can cause an EGT temperature increase and aggravate fire condition.

Observe the following:

NOTE

If any of the following conditions is not met abort start sequence by retarding the throttle to STOP.

- HPC RPM rise within 8 sec.
- Minimum 20% RPM within 15 sec.
- EGT rise within 25 sec.
- When HPC RPM 30%, LPC RPM start to increase
- Max EGT 685°C
- Continuous HPC RPM rising
- 41.5–44.5% TURBINE STARTER light goes out
- Idle RPM within 50 sec.
- Oil press at idle 2 kp/cm^2 min

7. Engine at idle RPM – 56 ± 1.5%
8. Observe the following:
   - Oil pressure – 2 kp/cm^2 minimum
   - Caution and warning lights – Out following: HYD. SYS. FAIL, ENG. MIN. OIL PRESS

AFTER START CHECKS

1. Canopy – Close and lock, CANOPY UNLOCKED light out
2. Pressurization/ECS control lever – Fully forward, AIRCONDIT OFF light out
3. Main CB/switch
   - GENERATOR MAIN, GENERATOR EMERG. – On, EMERGENCY GENERATOR and GENERATOR lights out
   - INVERTOR I, INVERTOR II – On
   - RDO, MRP–RV, RSBN, DE–ICING SIGNAL, SDU – On
   - WING TANKS – As required
4. External power – Disconnect, check voltage

CAUTION

Should an icing sensor is not in the air stream on the ground, it does not indicate icing conditions. If the engine is started at icing conditions with ambient temperature below 5°C, position the anti–ice mode switch to MANUAL and leave it there the whole time the engine is running on the ground.

5. Anti–ice mode switch – AUTOMATIC or MANUAL
6. Air diffusor – As required
7. IFF – On

BEFORE TAXI CHECKS

1. Aileron trim – Neutral
2. Elevator trim – 2 marks aft

NOTE

When flight without external stores, elevator trim to neutral.

3. Flight controls – Check for free movement and correct response of elevators, ailerons and rudders.
4. Power – 85% RPM, for 1 minute
5. Oil temperature – –5°C minimum

NOTE

Before first flight of the day, perform following engine warming–up and engine run–up test:

- When oil temperature is less than –5°C after one minute engine run at idle and one minute at 85%, increase RPM to 95% and terminate engine warming–up when oil temperature reaches –5°C minimum.
- Check engine surge bleed valves opening during engine warm–up: shift the throttle slowly; when the valve behind fifth compressor stage closes (LPC RPM sudden decreasing by 3 to 4%), HPC RPM shall indicate 74 to 77%, when the valve behind third compressor stage closes (LPC RPM sudden decreasing by 1 to 2%), HPC RPM shall be 86 to 89%.
- Acceleration and deceleration check. Record the fuel pressure at engine idle and max. Shift the throttle from IDLE to TAKE UP within 1 to 2 seconds, start stop watch simultaneously. Stop the stop watch in that moment, when the fuel pressure indicator shows a value of max. engine rating minus 10%. Acceleration time shall take from 9 to 12 seconds. Run the engine at max from 15 to 20 seconds and reset the stop watch. Retard the throttle from TAKE UP to IDLE within 1 to 2 seconds, start stop watch simultaneously. Stop the stop watch in that moment, when the fuel pressure indicator shows a value of idle engine rating measured in the beginning of this check. Deceleration time shall take not more than 5 seconds.
- During acceleration and deceleration checkout, observe fuel pressure, EGT and RPM whether follow limits, refer to Section V, Operating Limitation.
- After next 20 seconds, check the idle RPM.

CAUTION

When engine is running in ice conditions at RPM less than 85%, increase HPC RPM every 5 minutes to 93% for one minute.

NOTE

During engine run–up check, extend speed–brakes every 5 minutes.

6. Aircraft systems – Check

Intercom check: select radio channel, switch off squelch circuit on audio panel, and position ADF switch to OFF on ICS control box. Adjust volume by rotating RADIO knob on ICS control box. Depress the ICS transmission button and adjust intercom volume by rotating the INTERCOM knob. Aft cockpit transmission overrides the fwd one. Stand–by intercom check: positioning switch to STAND–BY should provide the ICS transmission.

ADF check: on ICS control box position the switch to ADF (left), O/I beacon switch to O position (outer beacon). On ADF control box select ANT position, volume control to maximum, mode switch to TLF, tune the station and fine tune to maximum indicator's deflection. The station signal shall be audible and ADF indicator shall indicate relative bearing to the station. Repeat the same procedure for inner beacon. Select required ADF mode when checkout is terminated.

Radio altimeter check: the height indicator pointer moves to right position and back to zero within 1 to 2 minutes from MRP–RV switching on. Push the TEST button on the height indicator: warning light shall illuminate when DH pointer is set to 15 meters or below.

Anti–G system check: HPC RPM 70%, depress anti–G valve button. The anti–G suit will replenish by the air, pilot should not feel any pain. Releasing the button will discharge air from the suit.

De–ice sensor heating check: ANTI–ICING switch to AUTOMATIC position and depress the de–ice sensor heating test button. The light beside the button shall come on. After button releasing, reposition the switch to MANUAL. DE–ICING ON light shall come on within 30 seconds. Finally reposition the switch to AUTOMATIC.

CAUTION

When ANTI–ICING switch in MANUAL position, and DE–ICING ON light will not illuminate, shut down the engine.

RSBN check: tune RSBN station of known location, within 3 minutes the RMI shall indicate bearing and distance to this station and AZIMUTH CORRECT light illuminates. Verify the RSBN proper operation by means of TESTING button on the auxiliary switch panel. When the button is depressed, the RSBN system should set distance 291.5 ± 3 km at the range indicator and course 177° ± 2° at the RMI.

7. Voltammeter – 28.5 Volts
8. Hydraulic pressure – 135 to 150 kp/cm^2

NOTE

If the HYDRAULIC EMER indicator reading is below 150 kp/cm^2, shut down the engine and terminate the preflight inspection.

9. Speed–brakes – Check extended and retracted positions, check indication. Confirm with crew chief
10. Flaps – Check LANDING and UP positions and set to TAKE–OFF. Check indicator and confirm with crew chief.
11. Throttle – Idle
12. Brakes – Apply, check pressure
13. Emergency/parking brake lever – Neutral (release)
14. Taxi clearance – Request

<u>TAXI</u> (figure 2–2)

CAUTION

- Taxi must be made with the canopies closed.
- Check that the area behind and to the sides of the aircraft is clear of obstacles, personnel or other aircraft

1. Wheel chocks – Order to remove
2. Power – 80–85%

CAUTION

- Taxi at the lowest practical RPM and moderate speed
- To move away from chocks, avoid the use of excessive power. Once the aircraft has started moving, retard the throttle to IDLE so as to prevent blowing objects which may cause injury to ground crew or damage to ground equipment.

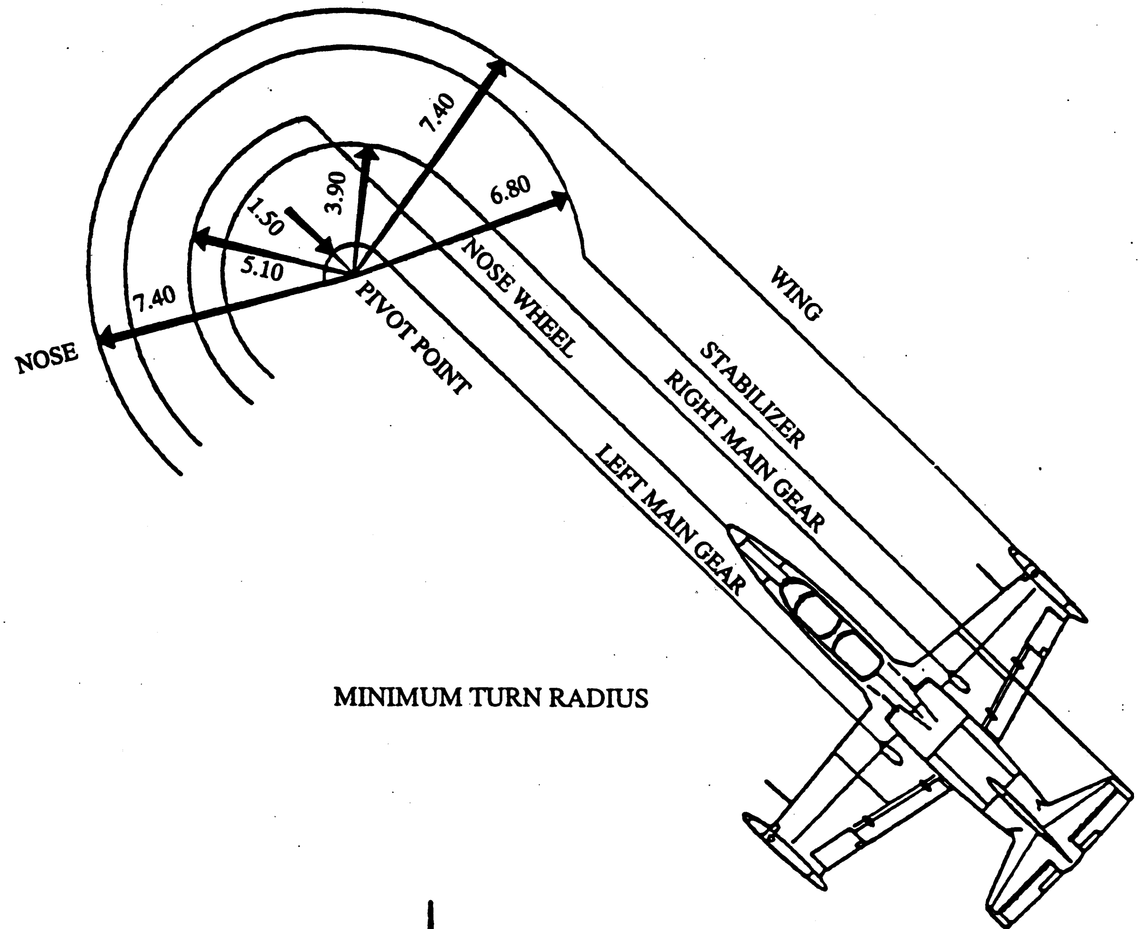
NOTE

- Recommended minimum turning radius of INBD MLG is 1.5 m. When the turning radius is less, the NLG tire will be excessively worn.
- Maximum permissible taxiing speed (the same as for A/C towing) is quoted as follows:

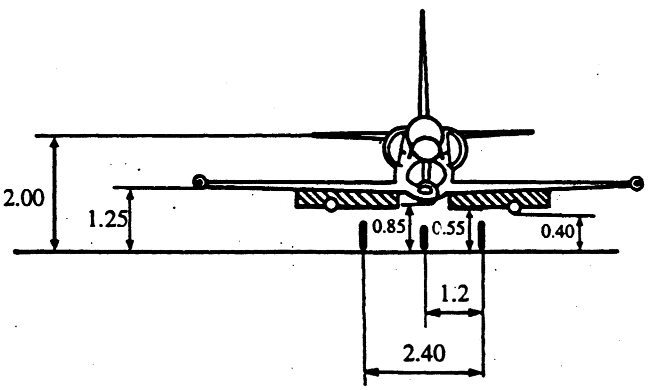
Taxiing	Configuration	Speed limit (km/h) concrete runway	Speed limit (km/h) grass strip
Straight	all	60	15
Turn	without stores	15	5
Turn	with stores	10	5

CAUTION

After excessive full braking the taxi speed 30 km/h shall be maintained because of possible wheelbrakes overheating.



MINIMUM TURN RADIUS



GROUND CLEARANCES

NOTE

Dimension are given in meters.

AB–1–(71)

Figure 2–2. Minimum Turn Radius and Ground Clearance

BEFORE TAKE OFF CHECKS

1. Trims – Confirm positions
2. Speed–brakes – In
3. Flaps – TAKEOFF position
4. Fuel quantity and WING TIP TANKS light – Check
5. Flight and engine instruments – Check
6. Oxygen – Check quantity
7. Canopy – Closed and locked, handle forward, light out.

NOTE

If an instrument flying hood is carried, it must be kept at the retracted position throughout the takeoff and landing phases to ensure safe ejection.

8. Parachute harness – Tight and locked
9. Hydraulic pressure – Check
10. Caution and warning lights – Check, lights out
11. Flight controls – Check
12. Pressurization/ECS lever – Fully forward
13. Safety pins – Check removed
14. Runway entry – Request

LINE–UP CHECKS

1. Nose wheel – Aligned with R/W heading
2. Compasses – Check heading
3. ADF, RMI – Check
4. GMK – Align
5. Altimeter – Check
6. Pitot tube heating – As required
7. Landing/taxi lights – As required

TAKE OFF

Before starting the takeoff roll, mentally go through the "Abort" procedure and relevant take off data.

1. Engine instruments – Check within limits: RPM, EGT, Oil pressure
2. Caution and warning lights – Out
3. Take–off clearance – Request
4. Clock – Start flight time counting
5. Throttle – TAKE UP
6. Wheel brakes – Release
7. Maintain directional control initially by differential braking and then by rudder. The rudder becomes effective at approximately 60 km/h.
8. At 150 km/h IAS, smoothly raise the nose wheel. An aircraft in clean configuration will become airborne at approximately 180 to 190 km/h IAS.

CAUTION

Exceeding Max gear extended speed (330 km/h IAS) may cause damage to the landing gear doors and prevent their subsequent operation.

9. With positive rate of climb at airspeed 220 km/h IAS and altitude 20 m AGL minimum:
   - Landing gear lever – Up
   - Landing gear indicator lights – Check sequence: Doors out light illuminates, three green extinguish, three red come on, doors out extinguishes
   - Mechanical indicator – Check
10. Airspeed 250 km/h IAS, altitude 50 m AGL minimum:
    - Flaps – Up
    - Electrical and mechanical indicators – Check
11. Trim – As required

NOTE

Flaps are automatically retracted at airspeed 310 km/h. Overcome this speed with flaps extended can cause, an unexpected change of aircraft behavior (unexpected flaps retraction).

CROSS WIND TAKEOFF

Use cross wind takeoff chart to obtain an improved controllability, refer to Appendix A.

During a cross wind take off, use the same procedures as for normal takeoff. However, since during the takeoff roll, the aircraft nose tends to crab into the wind, be prepared with the opposite rudder. Also as the speed increases the up–wind will tend to rise, be prepared with the ailerons into the wind. When airborne, be aware of the cross controls situation and prepare to align controls to gain a coordinated flight.

GRASS STRIP TAKEOFF

During a grass strip take off, use the same procedures as for normal takeoff. On wet or snow–covered surface, the aircraft can stay on brakes up to 88 to 98% RPM maximum. Aircraft acceleration is slower, maintain directional control initially by differential braking up to 100 km/h IAS. Takeoff roll distance may be longer by 50%. To decrease friction of NLG wheel, perform takeoff roll with a control stick pulled up. At 160 to 165 km/h IAS, raise the nose wheel by pulling the stick fully aft. An aircraft will become airborne at approximately 190 to 200 km/h IAS.

CAUTION

- When takeoff is performed by several aircraft at the same moment, distance between aircraft should be kept sufficient not to intake dirt, raised by neighbor aircraft.
- Takeoff on runway fallen to soft through wetness or on thawed snow is not recommended.

CLIMB ,CRUISE, DESCENT, APPROACH AND LANDING

CLIMB

NOTE

Refer to the performance data section (appendix A) for climb speeds, distances traveled in the climb, time to reach top of climb and fuel consumption. After retracting flaps, retard the throttle to NOM (103%) and maintain a nose–up attitude until the initial climb speed of 300 km/h IAS is attained. The first turn out of traffic pattern will be at a minimum of 300 km/h IAS and 100 m AGL (if the airfield rules does not determine otherwise). Maintain climb speed 350 km/h IAS. Trim as required.

1. Oxygen system – Above 2,000 m check pressure and blinker
2. Flight and engine instruments – Check
3. Fuel quantity – Check
4. Hydraulic pressure – Check
5. Cabin altimeter – Check
6. Altimeter – Set
7. Landing/taxi lights – Check off

CRUISE

As soon as practical after leveling off, accomplish the following:

1. Fuel quantity – Check
2. Oxygen – Check
3. Engine instruments – Check

For cruise data, refer to the performance data section (Appendix A)

DESCENT

Refer to the performance data section (appendix A) for recommended descent speeds, time require, fuel consumed and distance traveled in the descent.

1. Fuel quantity – Check
2. Flight and engine instruments – Check
3. Altimeter – Set as required
4. De–icing – As required

APPROACH CHECKS

1. Warning and advisory/caution panels – Check
2. Fuel quantity – Check
3. Hydraulic pressure – 135 to 150 kp/cm^2
4. Landing lights – As required
5. Shoulder and lap straps – Tightened
6. Visors – Down as required

APPROACH AND LANDING (figure 2–3)

NOTE

During approach and landing, recommended view from the cockpit is mainly left–ahead, supplemental view is straight ahead.

WARNING

In flight phases where it is required to retard the throttle to IDLE, be aware to throttle finger–lift is not lifted and the IDLE position inadvertently exceeded.

INITIAL APPROACH PHASE

1. Speed	– 450 km/h IAS
2. Power	– As required
3. Altitude	– Descent to 500 m AGL
4. Speed–brakes	– As required
5. Gun sight gyro arrestment lever	– FIXED
6. Speed	– Decrease to traffic patter airspeed 350 km/h IAS

DOWN–WIND

As speed decrease below 330 km/h IAS:

1. Landing gear lever	– Down, check sequence of lights: Doors out light illuminates, three red extinguish, three green come on, doors out extinguishes
2. Airspeed	– 300 km/h IAS
3. Trim	– As required
4. Speed–brakes	– Retract if extended. Check indicator.

BASE LEG

As speed decreases below 280 km/h IAS:

1. Flaps	– "T/O". Check the corresponding light and the two mechanical indicators for confirmation.

NOTE

The flaps will not extend if speed is above the flaps limiting speed (310 km/h IAS).

2. Speed	– Maintain 280 km/h IAS (normally the required power will be 95 to 100% RPM)
3. Sink rate	– 4 to 5 m/s
4. Hydraulic system	– Check 135 to 150 kp/cm^2 (0 pressure indication in wheel brake system)
5. Trim	– As required
6. Altitude before turning base	– 400 to 420 m AGL

TURNING BASE

1. Altitude	– 320 to 330 m AGL
2. Distance from runway threshold	– 5 to 5.5 km
3. Flaps	– "Land". Check corresponding indicators.
4. Sink rate	– 4 to 5 m/s
5. Speed	– Min 260 km/h IAS
6. Altitude	– 250 m AGL minimum

FINAL APPROACH

NOTE

When established on final, it is recommended to maintain a minimum of 70% RPM in order to assure optimum engine acceleration if required.

CAUTION

At engine RPM about 75 and 85%, the surge bleed valves open and close. When engine operation is not stable, increase or decrease power to leave this RPM range.

1. Landing gear	– Verify down and locked
2. Speed	– 230 km/h IAS minimum
3. Altitude	– 120 m AGL minimum
4. Landing lights	– As required
5. Threshold speed	– 200 km/h IAS minimum
6. Flare altitude	– 6 to 8 meters AGL
7. Throttle	– IDLE
8. Float	– Up to 1 m AGL
9. Touch–down speed	– 180 km/h IAS

NORMAL LANDING

For landing speeds and ground run distances, refer to performance data (Appendix A).

Throughout the final approach, use the airspeed indicator and runway as primary references.

NOTE

If runway length and conditions permit, an aerodynamic braking may be carried out to conserve brakes and tires. To perform an aerodynamic braking, increase the aircraft pitch attitude after touchdown by gradually pulling the control stick to the full aft position. (Retraction of flaps enables longer aerodynamic braking.)

1. Lower the nose and bring the nose–wheel in contact with the runway before the elevator becomes ineffective.

WARNING

- The wheel brakes will operate ONLY when the nose–wheel is firmly in contact with the ground.
- Be prepared to use the emergency brake lever if there is no response from the normal brakes.

NOTE

Push the stick forward when braking failure is experienced, in order to increase the nose–wheel loading.

2. Start braking gently, increase the brakes application as required and maintain directional control by use of rudder.
3. At speed below approximately 110 km/h IAS, use differential braking to maintain directional control.

CROSS–WIND LANDING

Cross–wind landing is performed by using normal landing procedures. The aircraft is the most sensitive to tend to bank by the wind at airspeeds about 100 km/h IAS. However, while using normal approach speeds, counteract drift by using the crab or the upwind wing down methods or by a combination of both, to keep the aircraft ground track aligned with the runway center line, leveling the wings just prior to touchdown.

In case of strong cross–wind and/or gusts with a possibility of wind–shear, it is recommended that the flaps be maintained in TAKE–OFF position during landing, to improve aircraft lateral control and to obtain, if required, a quicker acceleration when applying power.

After touchdown, keep the control stick into the wind and lower the nose–wheel smoothly on the runway as soon as practical, maintaining the center line track with rudder and, if required, moderate use of differential braking. Crabbing on touchdown must be avoided.

If heavy weight landing cannot be prevented, bear in mind that the sink rate touchdown, is considerably higher with increased weight than with normal landing weight due to the increased landing speed. A straight–in approach should therefore be flown maintaining airspeeds specified in the performance data, using power to control the sink rate. Flare should be gradual and touchdown smooth. A stall prior to touchdown could result in an abrupt and uncontrollable increase in sink rate with the possibility of exceeding permissible limits.

CAUTION

The vertical velocity indicator readings are subject to a remarkable lag. They are therefore reliable during the approach but not in transient phases such as during the flare and contact with the runway.

GRASS STRIP LANDING

Grass strip landing is performed by using normal landing procedures. The aircraft tends to lower the nose–wheel at higher speeds, so hold the stick fully aft after the touch–down. Brake more gently than during concrete runway landing.

MINIMUM RUN LANDING

For minimum run landing, fly an accurate final approach and touch–down speeds. After touch–down, lower the nose–wheel, retract the flaps and push the control stick fully forward. These actions will introduce more weight on the wheels thus reducing tire skidding. Apply brakes gently in a single smooth application with constantly increasing pedal pressure as the speed decreases.

NOTE

The anti-skid system regulates the hydraulic pressure delivered to the brakes in order to obtain at any time the maximum coefficient of friction between the wheels and the runway for any aircraft configuration. To minimize brake wear, brakes should be used as sparingly as possible. Care should be exercised to take full advantage of the length of the runway during landing or aborted take-off. Although the anti-skid system operates automatically during braking, thereby minimizing the possibility of a locked wheel, heavy wheel braking may lock the wheels more easily when there is considerable lift on the wings, than when the same pressure is applied with the full weight of the aircraft on the wheels.

If the anti-skid system fails and a locked wheel is suspected, momentarily release the brakes and then continuously re-apply. Rough braking, with the anti-skid system un-serviceable may cause damage of the main landing gear wheel tires. Therefore, in case of an anti-skid failure it is crucial to brake gently.

MISSED APPROACH

NOTE

Make the decision to go-around as early as possible and do not hesitate to use maximum power.

1. Throttle – Maximum
2. Speed-brake – In, if extended
3. Flaps – T/O
4. Speed – 210 km/h IAS
5. Attitude – Take-off AOA
6. Speed – 230 to 250 km/h IAS

<u>With a positive rate of climb:</u>

1. Gear – Up

<u>Accelerating through 260 km/h IAS:</u>

1. Flaps – Up
2. Landing lights – As required
3. Trim – As required
4. Configuration – Check landing gear, speed-brake and flaps position indicators.

NOTE

If a touchdown cannot be avoided, do not attempt to keep the aircraft off the ground. Continue to fly the aircraft to touchdown and when touchdown is made, lower the nose slightly, avoiding nose-wheel contact with the ground and accelerate to take-off speed, then establish takeoff attitude and allow the aircraft to fly off the ground. Once airborne, adopt normal missed approach procedure.

TOUCH AND GO LANDING (figure 2-3)

The following procedure is to be adopted when a normal landing has been attempted with the main wheels in contact with the runway and another approach and landing is desired.

WARNING

- Touch and go landings encompass all aspects of landing and take-off characteristics in a relatively short time. Be constantly alert for a possible malfunction and execute the procedures promptly and precisely, during this critical phase of flight.
- The instrument flying hood must be kept in the retracted position throughout the take-off and landing phases in order to ensure safe ejection in case of emergency.

1. Throttle – Max
2. Speed-brakes – In, if extended
3. Flaps – T/O
4. Engine instruments – Check

Continue as per normal take-off.

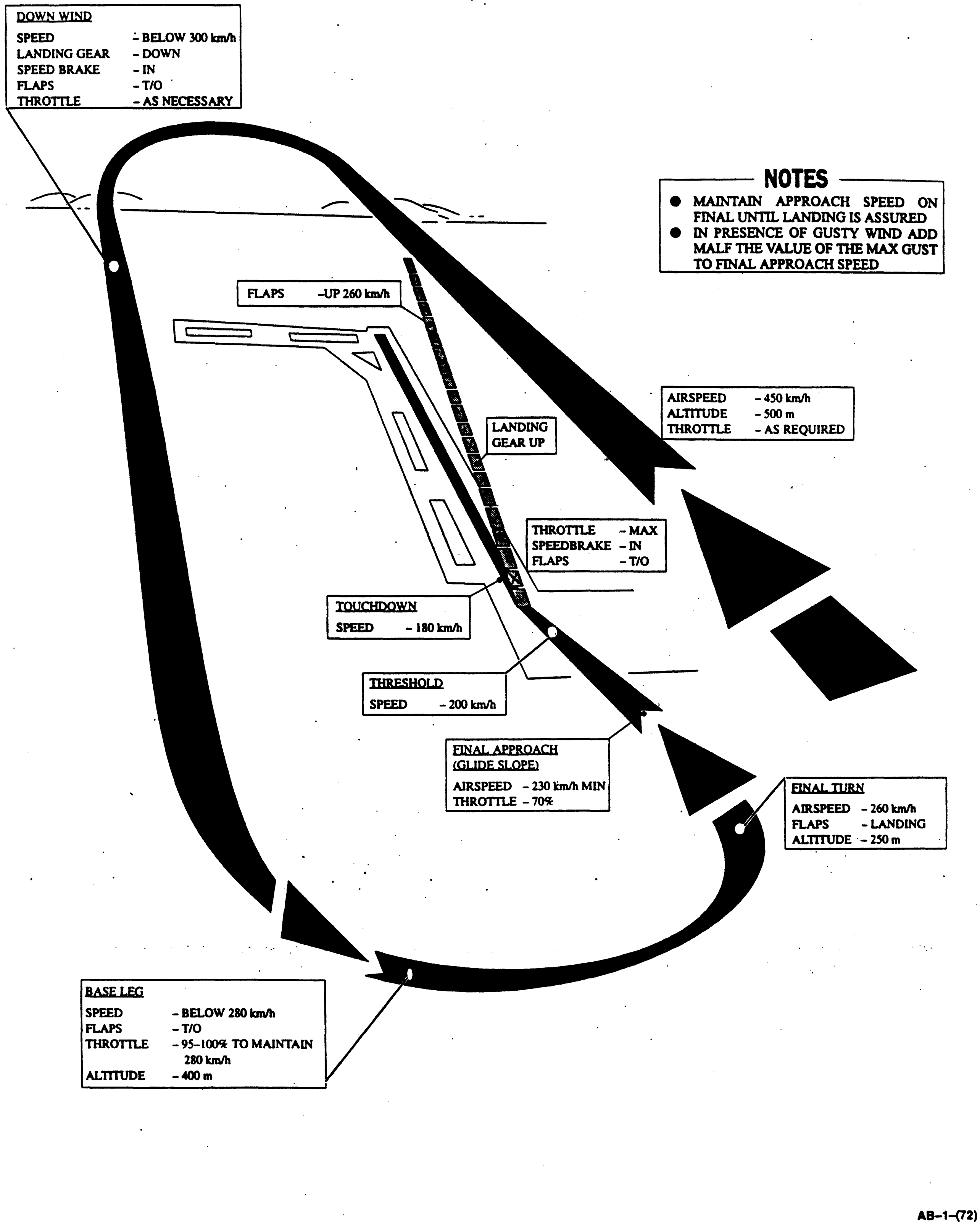


Figure 2–3. Landing and Go–Around (Typical)

INSTRUMENT APPROACHES

RSBN/SDU APPROACH (figure 2–4)

Entry

1. Configuration	– Cruise
2. Speed	– 370 km/h IAS
3. Power	– As required to maintain speed

Approach to Glide Slope

1. Speed	– Below 330 km/h IAS
2. Landing gear	– Down, check indicators
3. Speed–brakes	– In, check indicators
4. Speed	– Below 280 km/h IAS
5. Flaps	– T/O, check indicators
6. Trim	– As required
7. Speed	– 260 km/h IAS

Maintain speed and configuration until glide–slope intercept.

Glide–Slope Intercept/Final Approach

1. Flaps	– Down
2. Landing gear	– Verify down and locked
3. Speed	– 230 km/h IAS
4. Power	– As required to maintain 230 km/h IAS minimum
5. Landing lights	– As required
6. Threshold speed	– 200 km/h IAS minimum
7. Flare altitude	– 6 to 8 meters AGL
8. Throttle	– IDLE
9. Float	– Up to 1 m
10. Touch–down speed	– 180 km/h IAS

RADAR APPROACH (figure 2–5)

Entry and Down–Wind

1. Configuration	– Cruise
2. Speed	– 370 km/h IAS
3. Power	– As required
4. Speed–brakes	– In

Base Leg

1. Speed	– Below 330 km/h IAS
2. Landing gear	– Down, check indicators
3. Speed	– Below 280 km/h IAS
4. Flaps	– T/O, check indicators
5. Trim	– As required
6. Speed	– 260 km/h IAS

NOTE

Maintain speed to final approach and continue as per RSBN/SDU approach.

MISSED APPROACH (INSTRUMENT)

1. Power	– Max.
2. Speed–brakes	– In
3. Flaps	– T/O
4. Attitude with positive rate of climb	– Approx. 8 degrees nose up
5. Landing Gear	– Up
6. Flaps	– Up
7. Power	– Retard throttle to NOM (103%) to attain 350 km/h IAS, then as required to maintain 350 km/h IAS to missed approach altitude.

AFTER LANDING CHECKS

NOTE

Conduct the following steps when clear of the runway.

1. Landing/taxi lights	– As required
2. Flaps	– Up
3. Speed–brakes	– In
4. Trims	– Neutral
5. De–icing	– Off
6. Pitot tube heating	– Off

ENGINE SHUT DOWN

CAUTION

Avoid applying the parking brake if brakes are suspended to be exceptionally hot.

1. Parking brake	– Apply
2. Throttle	– Idle
3. Engine cooling	– 2 minutes
4. Pressurization/ECS lever	– Off
5. Ventilation suit controller	– Close (CW)
6. Electrical switches	– Off, except ENGINE, BATTERY, and JPT REG
7. Throttle	– To stop

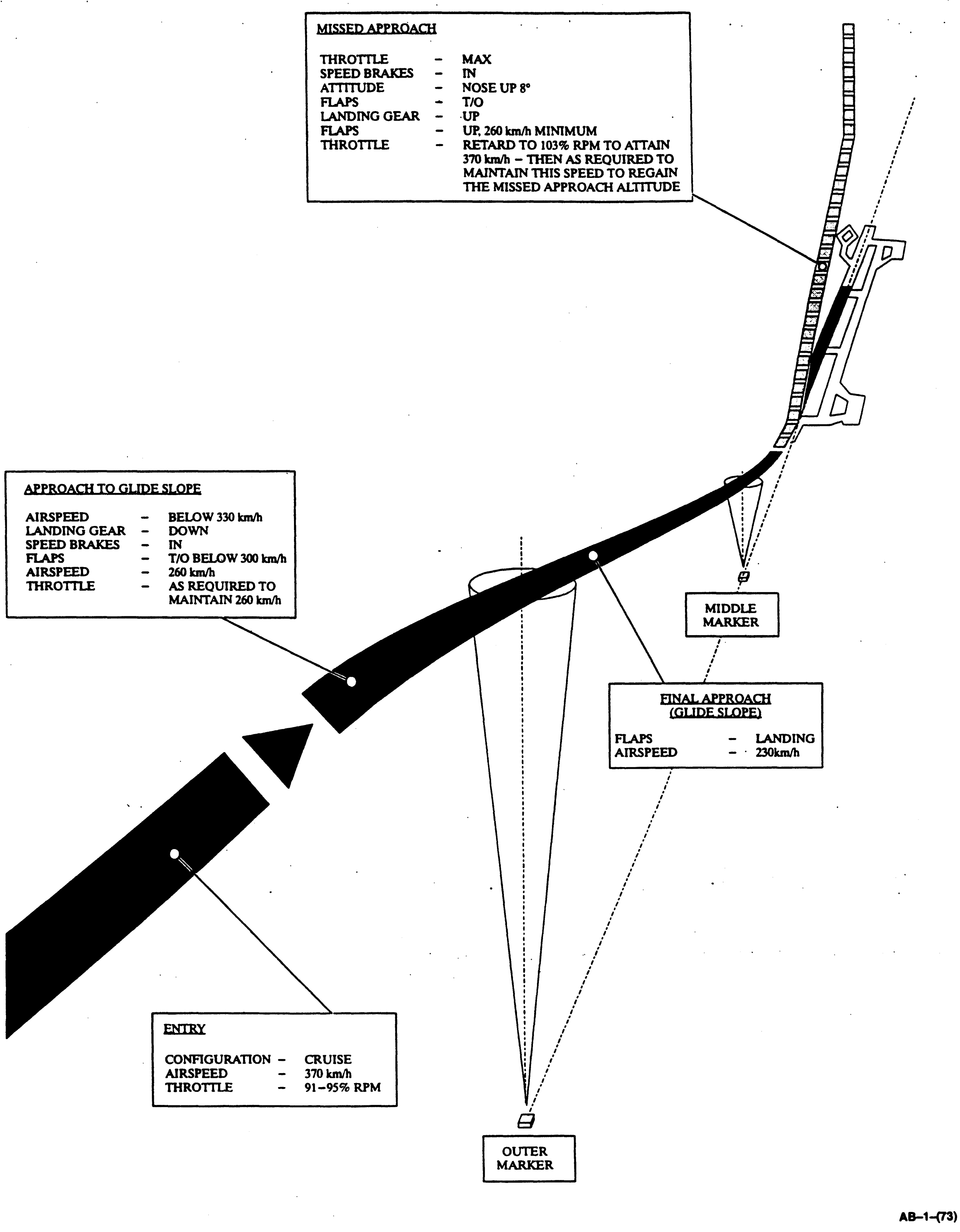


Figure 2–4. RSBN/SDU Approach (Typical) – Straight–in Approach

8. Engine run down – Check (from idle to 0% RPM: 20 sec. HPC, 25 sec. LPC)
9. ENGINE and JPT REG – Off
10. FDR – Off
11. Battery – Off
12. Canopy – Open
13. Seat pins – Insert

NOTE

Insert only following safety pins: head of telescopic ejection mechanism (TVM), left yoke of TVM control rod and head of canopy jettison pyromechanism. Other safety pins shall be installed by maintenance personnel.

SECURE

1. Wheel chocks – In place
2. Parking brake – Release (when chocks in place are confirmed)
3. Oxygen valve – Close
4. Disconnect all personal leads and lock the control stick if desired
5. Leave the aircraft.
6. If required, close and lock the canopy.

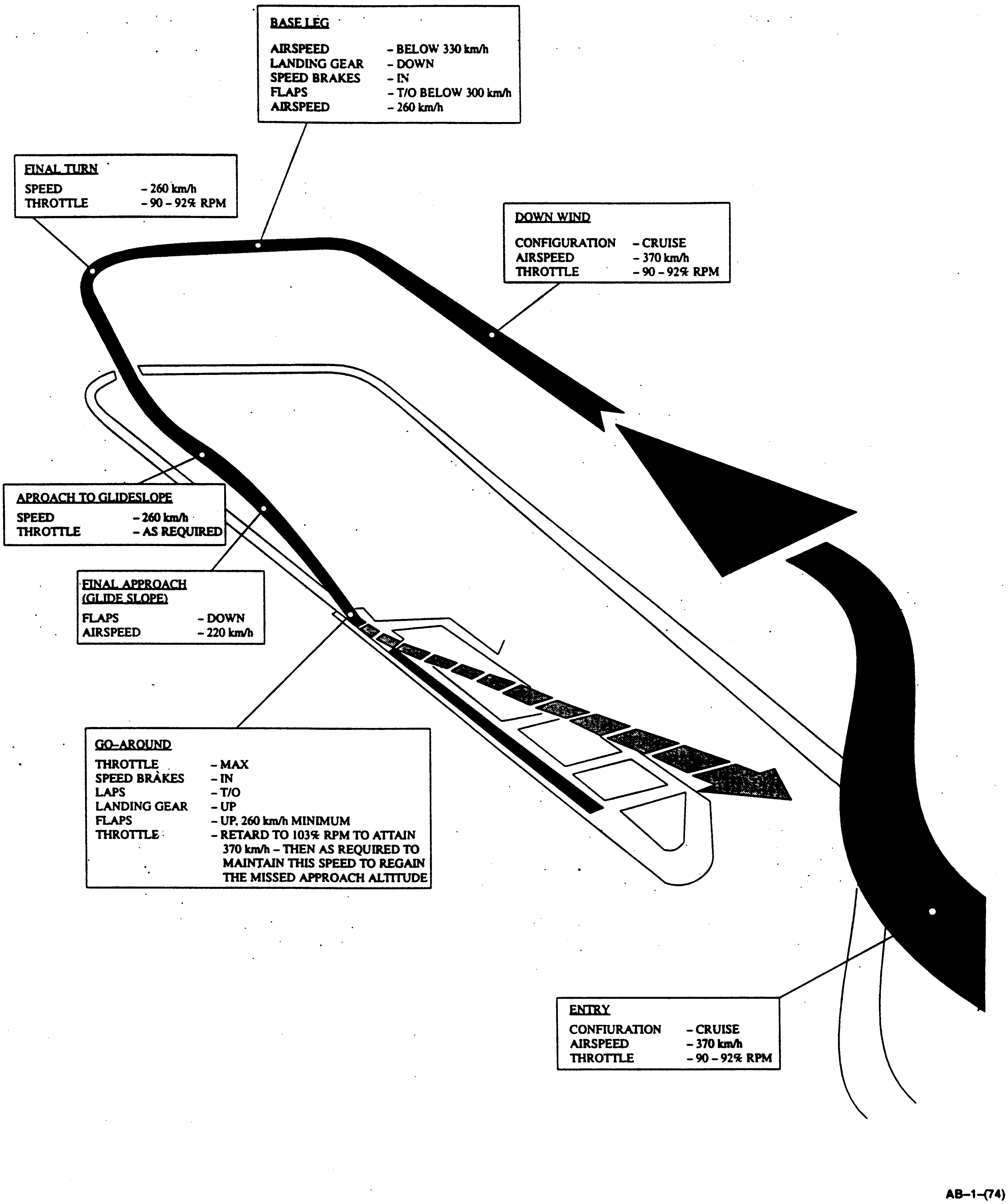


Figure 2-5. Radar Approach (Typical)

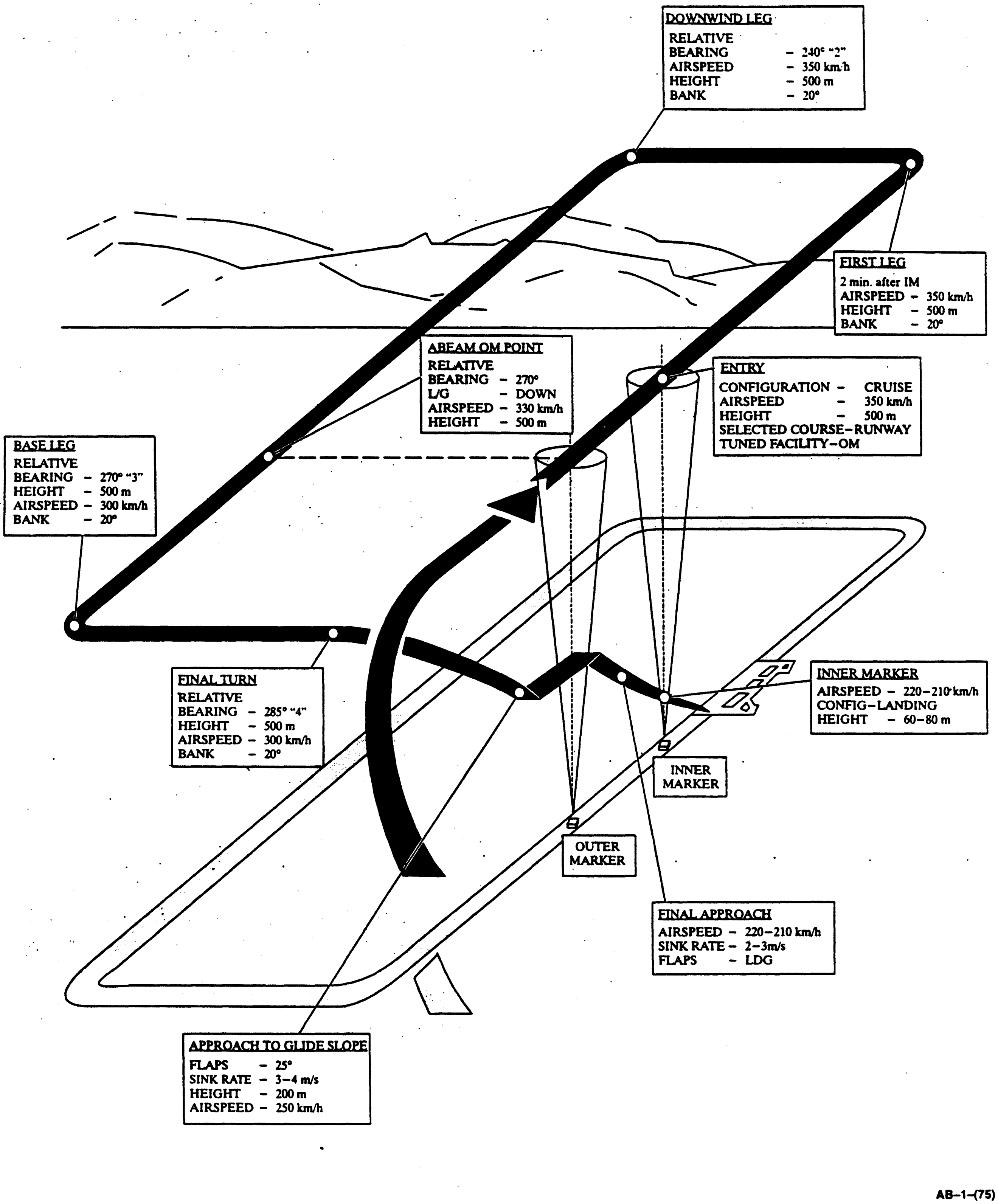


Figure 2-6. RSBN Landing Pattern - BOX

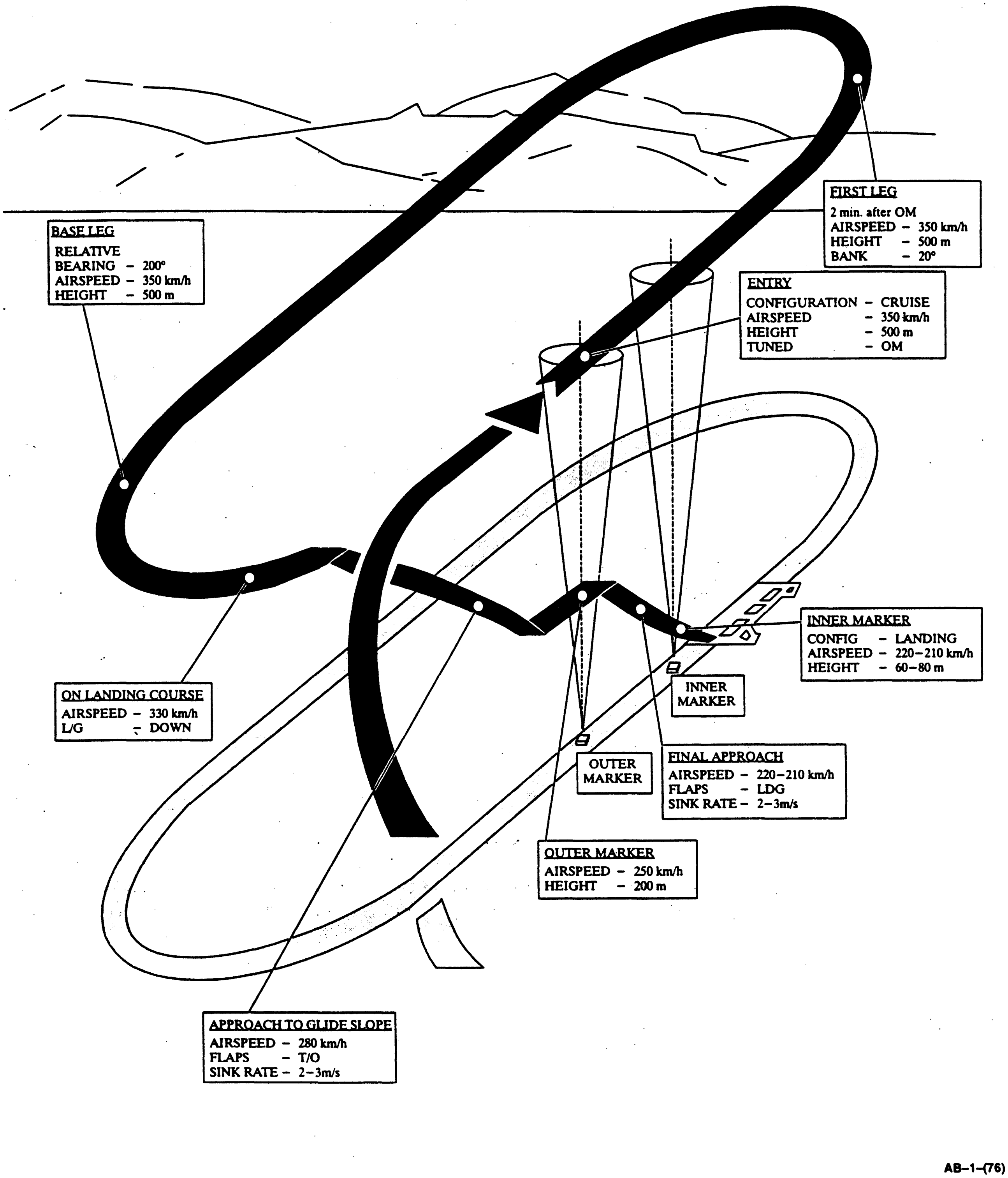


Figure 2-7. RSBN Landing Pattern - Two-Turns

SECTION III

EMERGENCY PROCEDURES

CONTENTS PAGE

INTRODUCTION

Air–crews should be completely familiar with all emergencies procedures contained in this section. Special emphasis should be placed on knowing those procedures or steps of emergency conditions that require immediate action or where reference to the air–crew check list would be impractical.

Verbal knowledge of those procedures is not necessary, however, it is MANDATORY that all air–crews commit to memory the full intent of the action indicated and the proper sequence of steps. The nature of severity of the encountered emergency, weather conditions and overall operating conditions, may require modification of procedures. It is therefore, essential that air–crews determine the best course of secTION action based on the recommended procedures, existing conditions, common sense and their own capability.

When an emergency occurs, three basic rules prevail which apply to airborne emergencies:

1. Maintain aircraft control
2. Analyze the situation and take proper action
3. Land as soon as possible/practicable

The meaning of "Land As Soon As Possible" (ASAP) and "Land As Soon As Practicable" as use in this section is as follows:

Land As Soon As Possible (ASAP)

a. Emergency conditions are urgent and require the mission to be aborted instantly and an immediate landing at the nearest suitable airfield should be performed.

Land As Soon As Practicable

b. Emergency conditions are less urgent and the degree of emergency is such that the mission must be aborted and the aircraft flown to a convenient base.

CONTROL AVAILABILITY IN THE TWO COCKPITS

The procedures given in this section refer to the pilot in the forward cockpit. The controls in the forward cockpit are not fully duplicated and available in the aft cockpit. The pilot occupying the aft cockpit must be therefore bear this mind and instruct the crew member in the forward cockpit to actuate, when necessary, the following controls accessible in the aft cockpit only:

- Electrical Power Supply Switches:
  - "NETW."
- Instrument and Navigation Switches:
  - Forward/aft cockpit EGT transfer switch "EGT IND. AFT/FWD"
  - RSBN aft control panel
  - GMK directional gyro correcting mechanism
- Communication Switches:
  - "INTERCOM GROUND"
- Escape system Switches:
  - "SEAT"
- Aircraft Systems Switches:
  - "AIR COND"
  - Oxygen bottles interconnect valve
  - Pitot fault simulator panel
  - Navigation fault simulator panel

GROUND EMERGENCIES

ENGINE FIRE DURING START

CAUTION

The latch preventing the movement of the throttle from IDLE to STOP is, in the forward cockpit a rotating lever and in the aft cockpit a sprig–loaded push pin.

Indications: Fire warning light in warning panel. Any other signs of fire (smoke, ground crew report etc.)

Actions:

Immediately perform the following:

1. THROTTLE – To STOP
2. ENGINE SWITCH – OFF
3. FUEL SHUT–OFF lever – CLOSE

If fire persists:

4. FIRE EXTINGUISHER button – DEPRESS
5. EMERGENCY EVACUATION – PERFORM

EMERGENCY EVACUATION

In a situation where a rapid abandonment of the aircraft is required, proceed as follows:

1. ECS/PRESS LEVER – AFT position
2. CANOPY LOCK – AFT position

WARNING

On the ground, when the aircraft is stationary, canopies must be jettisoned as they may fall back and injure the crew.

3. PARACHUTE HARNESS – UNLOCK
4. P.E.C. quick DISCONNECT – PULL
5. "BATTERY" – OFF
6. AIRCRAFT – ABANDON

EMERGENCY BRAKING

Indication: Loss of normal braking capability

Actions:

1. EMERGENCY BRAKE LEVER – PULL GRADUALLY

NOTE

- Use the emergency brake with care as the anti–skid system is deactivated and a careless use may result in a blown tire.
- Do not use the emergency brakes from both cockpits simultaneously.

HOT BRAKES

Indications: Perform the following after any event which requires excessive braking (e.g., aborted takeoff, landing at high GW's or speed, etc.) or when hot brakes are suspected (smoking brakes, ground crew confirmation, etc.)

Actions:

1. Request firefighting equipment and proceed directly to the designated hot brake area or nearest area clear of other aircraft and personnel.

WARNING

Any leaking hydraulic fluid may be ignited by hot wheel and brake surfaces.

When in the hot brake area:

2. Align aircraft with nose into wind if possible.
3. Use only chocks, if available, or minimum possible toe brake pressure to hold aircraft stationary until engine is shut down.

WARNING

Do not use the parking brake.

4. Delay engine shutdown until arrival of fire fighting equipment.

WARNING

Hot wheels and brakes may ignite fuel drained overboard during engine shutdown.

If a brake fire occurs:

5. Go to EMERGENCY EVACUATION, this section.

TAKEOFF EMERGENCIES

ABORTED TAKE–OFF

NOTE

Aborting take–off at high speeds should not be taken lightly.

Once a decision to abort has been taken, accomplish the following immediately.

1. THROTTLE – STOP
2. BRAKE – NORMAL BRAKING
3. RADIO – Declare ABORT
4. "BARRIER" – As required
5. Asses the situation (consult with the control tower) and decide on the course of action. (Emergency evacuation, clearing the runway, taxiing back etc.).

ENGINE FAILURE DURING TAKE–OFF

Indication: Loss of power

Actions:

If possible:

1. ABORT TAKE–OFF – Follow abort take–off procedure

If airborne:

1. THROTTLE – MAX. Consider controlling engine by means of the secondary circuit

CAUTION

With the emergency fuel controller, a rapid move of the throttle may result in a flame out or an excessive EGT. Move the throttle with care while closely monitoring RPM and EGT.

2. SEC. REG. switch – ON
3. EXTERNAL STORES – JETTISON

If thrust is insufficient to maintain a safe climb:

4. Forced landing – Perform

If a safe forced landing cannot be performed

5. EJECT!

ENGINE FIRE DURING TAKE–OFF

Indications: "FIRE" light or an outside report from the control tower or from another aircraft.

Actions:

If possible:

1. ABORT TAKE–OFF – Follow abort take–off procedure
2. FUEL SHUT OFF – CLOSE
3. FIRE EXTINGUISHER button – DEPRESS
4. "BATTERY" – Off
5. EMERGENCY EVACUATION – PERFORM

If airborne:

1. THROTTLE – MAX
2. LANDING GEAR – RETRACT
3. EXTERNAL STORES – JETTISON

At flame–out landing conditions, if fire persists:

4. THROTTLE – STOP
5. FUEL SHUT–OFF lever – CLOSE
6. FIRE EXTINGUISHER button – DEPRESS

WARNING

Do not attempt to restart engine after fire has been extinguished.

7. FORCED LANDING – PERFORM

If a safe landing can not be performed:

8. EJECT!

BLOWN TIRE DURING TAKE–OFF

Indications: Aircraft "pulls" to one side accompanied by a rough run.

NOTE

At high speed, if directional control can be maintained, it is recommended to get the aircraft airborne rather than risking a high speed aborted take–off.

Actions:

At low speed:

1. ABORT TAKE–OFF – Follow abort take–off procedure
2. Runway center line – MAINTAIN with available brakes, rudder and by deflecting the control stick towards he "good" tire.

When airborne:

1. GEAR AND FLAPS – DO NOT RETRACT
2. Airspeed – 300 km/h IAS max.
3. Land (Refer to "Landing with a blown tire")

EMERGENCY STORES JETTISON

NOTE

Jettison is possible only when airborne.

1. "EMERG. JETTIS." switch – On

TAKE–OFF ABNORMALITIES

GEAR RETRACTION FAILURE

Indications: One or more gear components do not retract or lock in up position (confirmed by electrical and mechanical indicators).

Actions:

1. Air speed – Below 330 km/h IAS
2. Check back seat lever position – If "down" move to neutral
3. Landing gear lever – Down
4. Gear C/Bs – Check ON
5. Electrical and mechanical indicators – Check
6. Land as soon as practicable

FLAPS RETRACTION FAILURE

Indications: The selected button does not pop out and the respective light does not come on, confirmed by the mechanical indicators.

Actions:

1. Air speed – Below 300 km/h IAS
2. Flaps previous position – Select
3. Electrical and mechanical indicators – Check
4. Land as soon as practicable

IN–FLIGHT EMERGENCIES

ENGINE FIRE

Indications: Fire warning light, out side report, smoke trail behind the aircraft, fumes or heat in the cockpit, engine RPM loss accompanied by high EGT, unusual engine noise or vibration.

Actions:

1. THROTTLE – IDLE
2. Confirm existence of fire (a near–by aircraft may be of assistance).

If fire warning light goes out:

3. Fire warning CIRCUIT test switch – CHECK both circuits

CAUTION

If test shows the circuit to be defective, the wiring could have been damaged by an existing fire.

If fire is not confirmed:

4. PRECAUTIONARY LANDING – PERFORM

If fire is confirmed:

1. Cockpit press lever – Off
2. OXYGEN – 100%
3. Air shower – Close

If forced landing conditions:

1. THROTTLE – STOP
2. FUEL SHUT–OFF lever – CLOSE
3. FIRE EXTINGUISHER button – DEPRESS

WARNING

Do not attempt to re–start the engine after the fire has been extinguished.

If fire indication goes out:

4. Fire warning circuit – Check
5. FORCED LANDING – PERFORM

WARNING

- Do not use arresting barrier.
- Do not land with fire aboard.

If fire persists or a safe forced landing cannot be accomplished:

6. EJECT!

ENGINE FLAME–OUT

Indications: Loss of power, EGT drop, RPM drop.

HOT START

CAUTION

Perform the engine hot start only if crucial lack of time does not make possible to perform any recommended engine start procedure. The hot start, if not successful, can damage engine or aggravate the situation.

Recommended in–flight engine start procedure is APU assisted or wind–milling, refer to IN–FLIGHT START.

Actions:

1. THROTTLE – STOP
2. If RPM<40% TURBO START – DEPRESS
3. ENGINE START – DEPRESS
4. THROTTLE – IDLE
5. SPEED – 260 km/h IAS
6. HEADING – To NEAREST AIRFIELD
7. DRAG – REDUCE

If altitude is below 600 m AGL and a safe forced landing cannot be assured:

8. EJECT!

WARNING

It takes 50 second up to IDLE (56 ± 1%). It is prohibited to move the throttle before the RPM is set to IDLE.

If the loss of power was accompanied by abnormal indications such as explosions, severe RPM fluctuations or RPM stuck at 0, consider carefully whether to attempt a restart as it might aggravate the situation and result in engine fire.

If no mechanical failure is evident and the engine is wind milling:

9. Air–start – Perform

If mechanical damage is suspected:

10. THROTTLE – STOP
11. Forced landing – Perform

If a safe forced landing cannot be assured:

12. EJECT!

IN–FLIGHT START

NOTE

Attempt a restart only if no damage is evident.

IN–FLIGHT START ENVELOPE:

Flight level – Below altitude 6,000 m

AIR SPEED:

450 km/h IAS – for Wind–milling start (above 15% RPM)

260–350 km/h IAS – for APU start (below 15% RPM)

APU START

1. THROTTLE – STOP
2. "TURBO" button – DEPRESS
3. "TURBINE STARTER" – Check on
4. "ENGINE" button – DEPRESS

After 5 seconds:

5. THROTTLE – IDLE
6. Stop watch – Start
7. EGT and RPM – Check rising

When engine stabilized:

8. Throttle – Open, check engine response and thrust

WIND MILLING START

NOTE

RPM is above 15%

1. THROTTLE – STOP
2. "ENGINE" START button – DEPRESS

After 5 seconds:

3. THROTTLE – IDLE
4. Stop watch – Start
5. EGT and RPM – Check rising

NOTE

The airspeed must be kept constant or slightly increasing in order to avoid excessive rise of EGT.

When engine stabilized

6. Throttle – Open, check engine response and thrust

UNSUCCESSFUL RESTART

Stop the restart sequence if one of the following occurs:

- No ignition within 25 seconds
- EGT exceeds 685°C
- RPM stagnating or dropping

1. THROTTLE – To STOP
2. "ENGINE STOP" SWITCH – OFF and ON

NOTE

WAIT AT LEAST 45 SECONDS from the time the throttle was placed to STOP before attempting another restart, in order to assure no fuel is present in the tail–pipe.

ALTERNATE AIR–START (secondary fuel circuit)

Flight conditions – Confirm: Altitude below 6,000 m, Speed 260 to 350 km/h IAS, RPM below 15%

1. THROTTLE – STOP
2. "TURBO" button – Depress
3. "SEC REG" switch – On
4. "TURBINE STARTER" light – Check on
5. "ENGINE" START button – Depress
6. Stop watch – Start

In 10th second:

7. Throttle – Set at EFS triangle
8. EGT and RPM – Check rising
9. "TURBO STOP" button – Depress when RPM passes 42%

CAUTION

With the secondary fuel circuit switched ON the automatic fuel control is deactivated. The throttle has to be moved with care to avoid a flame out, stall or excessive EGT.

Accelerating the engine from idle to operating power should take a minimum of 15 seconds or 2% per second. RPM and EGT have to be kept within limits by using the throttle manually.

RPM range56% to 103% – Below 2,000 m

RPM range 60% to 99% – Above 2,000 m

NOTE

If RPM drops below 54.5%, shut down the engine and perform another airstart attempt after 45 seconds.

CAUTION

Secondary fuel circuit has to be maintained till landing. After clearing the runway, shut down the engine.

Unsuccessful restart:

Stop the restart sequence if one of the following occurs:

- No ignition within 25 seconds
- EGT exceeds 685°C
- RPM stagnating or dropping

10. Restart – Establish wind–milling start flight conditions. Attempt a windmilling start with the secondary fuel circuit ON.

PARTIAL POWER LOSS

Indications: Loss of power, change of engine RPM and EGT, not corresponding to throttle movements. (The main fuel control is probably at fault).

Actions:

1. THROTTLE – IDLE
2. ALTITUDE – Descent BELOW 7,500 m.

CAUTION

With the secondary fuel circuit switched ON the automatic fuel control is deactivated. The throttle has to be moved with care to avoid a flame out, stall or excessive EGT.

Accelerating the engine from idle to operating power should take a minimum of 15 seconds or 2% per second. RPM and EGT have to be kept within limits by using the throttle manually.

RPM range 56% to 103% – Below 2,000 m

RPM range 60% to 99% – Above 2,000 m

NOTE

Switching to the secondary fuel circuit may be accompanied by an abnormal noise, which is caused by a change in fuel pressure and flow. The fuel filter light may flicker and the caution light "FUEL EMERG. DELIVERY" will illuminate.

3. SEC. REG. SWITCH – ON
4. PRECAUTIONARY LANDING – PERFORM

If RPM drops below 54.5%:

5. Throttle – STOP

WARNING

When an APU start is performed using the emergency fuel circuit, the auto disconnect function is deactivated, therefore, the "TURBO STOP" button must be pushed when engine RPM reaches 42%.

WARNING

Emergency fuel circuit must be maintained till landing.

After clearing the runway, shut down the engine.

6. Engine restart – Perform an "Alternate air–start"

If altitude is below 600 m AGL and a safe forced landing cannot be assured:

7. Eject!

COMPRESSOR STALL

Indications: Decrease or drop in RPM with and EGT higher than normal or rapidly rising. Abnormal noises (bangs)

CAUTION

These abnormal noises may be erroneously interpreted as engine mechanical failure.

WARNING

If an immediate action is not taken, the RPM may drop quickly, the EGT will exceed the limits and turbine damage may result.

Actions:

1. THROTTLE – IDLE
2. ANGLE OF ATTACK – RELEASE
3. EGT – Monitor

NOTE

Successful stall clearing is indicated by a decrease in EGT to normal values and absence of abnormal noises.

If stall clears:

4. Power – Set to practicable minimum
5. Precautionary landing – Perform

If stall persists or reoccurs:

6. THROTTLE – STOP
7. ENGINE – RESTART

If altitude is below 600 m AGL and a safe forced landing cannot be assured:

8. EJECT!

EXCESSIVE EGT (ABOVE LIMITS)

Indications: EGT rising or already high

NOTE

With the de–icing system in operation, maximum allowable EGT is 700°C.

Actions:

The moment the pilot notices a rapid EGT rise with steady RPM:

1. THROTTLE – IDLE
2. "OFF JPT REG." SWITCH – FORWARD position

If the "J.P.T. 730°C" warning light illuminates be aware of a possible fire hazard.

NOTE

A rapid increase in EGT indicates a malfunction in the engine operation. EGT limiter starts its limiting function when EGT reaches 700°C (CAUTION light comes on). If the temperature increases above 700°C, the EGT limiter is defective and must be switched OFF.

NOTE

Excessive EGT indication may indicate a compressor stall (rumbling), caused by A/A missile launch, entering another aircraft slipstream (vortex) or induction of foreign object such as a bird. In this case–shut down engine and re–start if altitude permits.

If EGT can be maintained within limits with practicable power:

3. LAND – ASAP

If EGT continues to rise:

4. THROTTLE – TO STOP
5. FORCED LANDING – PERFORM

If a safe forced landing cannot be assured:

6. EJECT!

ENGINE VIBRATION

Indication: ENGINE VIBRATION warning light, unusual engine noise, throttle vibrations.

Actions:

1. THROTTLE – MAX
2. SPEED – 320 km/h – CLIMB
3. HEADING – to NEAREST RWY
4. DRAG – REDUCE

At forced landing conditions:

5. THROTTLE – IDLE

If engine vibrations light goes out:

6. Engine vibration CIRCUIT – CHECK

If test shows the circuit to be defective:

7. Engine VIBRATION symptoms – CHECK frequently

If engine vibration light continues to illuminate:

8. THROTTLE – TO STOP
9. FORCED LANDING – PERFORM

If a safe forced landing cannot be assured:

10. EJECT!

OIL SYSTEM MALFUNCTION

Indication: Oil pressure on the triple engine indicator drops below 2 kp/cm^2 when below 95% RPM or below 3 kp/cm^2 when above 95% RPM.

Actions:

1. Engine switch and engine inst. C/B – Check On
2. Power – Reduce to minimum practicable
3. Land – ASAP

The "ENG. MIN. OIL PRESS" warning light will start flashing when:

- The oil pressure drops below 1.4 ± 0.3 kp/cm^2 or
- The oil temperature reaches 202°C, or
- The oil purities have the mass of 0.25 g.

NOTE

- Avoid zero or negative load factors and abrupt maneuvers. With oil pressure at 0, the engine will continue to operate for approximately 10 minutes.
- Be cautious of fire.

EJECTION

IMMEDIATE EJECTION

1. WINGS – LEVEL
2. EJECTION HANDLES – SQUEEZE AND PULL

BEFORE EJECTION

If time and conditions permit:

1. Notify crew member of decision to eject
2. Brief for ejection
3. Inform ground controller/control tower/formation member
4. Steer the aircraft away from populated areas
5. Helmet visors – Down
6. Flight conditions – Establish optimum attitude, speed and altitude

NOTE

When the forward crew member ejects first, aircraft longitudinal stability us reduced due to the aftward of center of gravity.

7. Adopt ejection position:
   - Feet Backward
   - Head Press against head–rest
   - Elbows Press against body
   - Back As straight as possible

AFTER EJECTION

During parachute descent:

1. PARACHUTE CANOPY – CHECK
2. OXYGEN MASK – RELEASE
3. RADIO/OXYGEN CONNECTOR – DISCONNECT FROM LAP BELT
4. SURVIVAL KIT – RELEASE

NOTE

There is a 10 meters lowering line with survival kit.

5. LANDING POSITION – ASSUME

After landing

6. PARACHUTE HARNESS – UNLOCK

EJECTION FAILURE

EJECTION SEAT BLOCKED

If the ejection handles remain blocked:

1. "UNLOCK EJECT" Switch – Actuate
2. Ejection handles – Squeeze and pull until seat starts moving

CANOPY JETTISON FAILURE

If ejection is unsuccessful (system unblocked, but canopy fails to jettison):

1. "CANOPY JETTISON" LEVER – ACTUATE
2. EJECTION HANDLES – PULL AND HOLD until seat starts moving

NOTE

Hold the ejection handles with the left hand and operate the canopy jettison lever the right hand.

If canopy jettison is unsuccessful:

3. ECS Handle – PULL aft
4. CANOPY – MANUALLY OPEN AND PUSH away

5. EJECTION HANDLES – Squeeze and pull

EJECTION THROUGH CANOPY

If canopy cannot be removed:

1. Canopy – Ensure closed and locked
2. Instrument HOOD – RETRACT (forward cockpit only)
3. "EJECT THROUGH CANOPY" HANDLES – PULL
4. EJECTION HANDLES – SQUEEZE AND PULL

MANUAL BAIL OUT

If for any reason ejection is not possible, a manual bail out has to be performed. Proceed as follows:

1. PILOT/SEAT SEPARATION LEVER – FORWARD
2. Trim – Nose down
3. Canopy – Unlock manually and push away
4. Roll the aircraft inverted and push the control stick forward
5. Aircraft – Abandon

NOTE

Parachute opening is accomplished by means of the NO–DELAY lanyard (4 meters length), which is attached to the seat.

WARNING

In case of a malfunction of the NO–DELAY lanyard system or disconnection, the parachute must be opened by use of the parachute D–ring (left side). Minimum height for a manual bail out is 250 m.

PILOT/SEAT SEPARATION

If after ejection, automatic separation does not occur:

1. PILOT/SEAT SEPARATION LEVER – FORWARD
2. Push the seat backward using both hands.

FUEL SYSTEM MALFUNCTION

FUEL PRESSURE DROP

Indication: "DON'T START" warning light is flashing

The following precautions have to observed:

- Normal engine operation is ensured only up to 6,000 m.
- When applying power, throttle has to be moved slowly.
- Engine acceleration/deceleration is not limited by aircraft speed.
- If engine surge is experienced, reduce RPM.

CAUTION

Avoid zero or negative G conditions

Actions:

1. "PUMP" C/B and "ENGINE" switch – Check ON

If conditions persists:

2. Altitude – Below 6,000 m.
3. Power – 103% RPM Max.
4. Land – ASAP

WARNING

Avoid "go around" and make landing final. Failure to comply may result in engine cut.

FUEL FILTER FAILURE

Indications: Illumination of the "FUEL FILTER" warning light.

Fuel filter is becoming clogged.

CAUTION

Avoid zero or negative G conditions

NOTE

The "FUEL FILTER" warning light may flicker shortly, when the emergency fuel circuit is switched on.

Actions:

1. Power – Set to minimum practicable
2. Reduce speed
3. Land – ASAP

FUEL TRANSFER FAILURE

Wing tip tank fail to transfer fuel

Indications: Heavy wing. Transfer lamp is illuminated earlier than excepted.

Action:

1. Land ASAP

FUEL QUANTITY INDICATION FAILURE

1. Clock – Start Stopwatch
2. Recall last fuel reading and calculate remaining flight time
3. Land ASAP.

WARNING

Low fuel light is unreliable.

ECS (AIR CONDITIONING) SYSTEM FAILURE

Indications: A sudden increase or decrease in cockpit air temperature.

Actions:

1. Temperature control switch – Manual cold/warm (1 to 2 sec)
2. Temperature control switch – Neutral
3. Invertor, air–conditioning and de–icing C/Bs – Verify ON

If malfunction persists:

4. Air shower valve – Close

CAUTION

Before de–pressurizing the cockpit, preferably descend to below 3,000 m QNH (terrain permitting).

NOTE

When the air–conditioning/pressurization lever is in OFF position (aftward), the warning lights "AIR-CONDIT OFF" and "CABIN PRESSURE" will flash/ illuminate.

5. Cockpit pressurization lever – "Seal" and/or depressurize, as necessary to control temperature.

SMOKE/FUMES IN THE COCKPIT OR ELECTRICAL FIRE

Indications: Unidentified odors, smoke or fumes in the cockpit.

Actions:

1. OXYGEN – "EMER"
2. ALTITUDE – DESCEND TO 3,000 m
3. Emergency – Declare

WARNING

De–pressurization may be followed by rapid canopy fogging.

4. COCKPIT – DEPRESSURIZE

If electrical fire is suspected:

CAUTION

When shedding electrical consumers, consider whether to switch off the generator and the battery at this will result in the automatic extension of the RAT.

5. Faulty equipment – Identify and switch off

If smoke persists or becomes sever:

6. CANOPY – JETTISON
7. Land – ASAP

LOSS OF PRESSURIZATION

Indications: Illumination of the "CABIN PRESSURE" warning light. Physical sensations and increased noise in the cockpit. Both (aircraft and cabin) altimeters read the same altitude even when above 2,000 m. Cabin press needle – on the red zone

Actions:

CAUTION

Rapid pressure build up may occur when actuating the cabin pressurization lever during flight.

1. "COCKPIT PRESS" lever – Check on (forward)
2. Air shower valve – Check open

Check the following:

- "AIR COND." switch in the aft cockpit
- "INVERTOR" switch
- "AIR COND" C/B

If failure persists:

3. Descent – To below 3,000 m QNH (terrain permitting)
4. Cockpit – De-pressurize
5. Air shower valve – Close
6. Land – As soon as practicable

CANOPY OPEN/LOST/BROKEN INFLIGHT

1. Visor – Down
2. Airspeed – Reduce to 270 km/h IAS
3. Descent – To below 3,000 m QNH (terrain permitting)
4. Land – As soon as practicable

OXYGEN

If a sudden drop in oxygen pressure occurs, or difficulties in a breathing are experienced, unusual odors are noticed in the inhaled mixture, or the blinker does not operate above 2,000 m, proceed as follows:

WARNING

Whenever hypoxia is suspected, immediately activate the parachute oxygen system, execute an emergency descent, declare emergency, and select emergency code on IFF while checking the oxygen connections.

1. Oxygen shut-off valve – Check ON
2. Diluter lever – 100%
3. Oxygen – Emergency
4. Connections – Check security
5. Descent – To below 3,000 m QNH (terrain permitting)

If oxygen pressure is below 32 kp/cm^2:

6. Oxygen interconnect – OPEN (backseat)

If not possible:

7. Seat oxygen – Active

NOTE

Emergency oxygen will last for approximately 10 minutes

8. Land – ASAP

ELECTRICAL SYSTEM MALFUNCTIONS

MAIN GENERATOR FAILURE

Indication: "GENERATOR" warning light flashing.

NOTE

The RAT will extend automatically, "EMERGENCY GENERATOR" light will flash momentarily and then go out. A proper operation or the RAT is further indicated by a voltage out put of 27 to 29 volts and as ammeter reading of +5 Amps.

Actions:

1. "GENERATOR MAIN" and "GENERATOR EMERG."switches – Check on
2. "EMERGENCY GENERATOR" light out – Confirm

CAUTION

Extension of the speed brakes will disturb the proper airflow to the RAT.

3. Speed brakes – Do not use

NOTE

RAT will retract automatically, provided the RAT emergency lever is in the retracted position, in the following cases:

– Main generator power is restored
– During landing, when the nose wheel touches the ground.

If "EMERGENCY GENERATOR" light remains ON:

4.	"GENERATOR EMERG." switch	– Reset
5.	RAT emergency lever	– Backwards

Check RAT light – If illuminated, only battery supplies DC power.

Actions:

1.	Non–essential systems	– Disconnect
2.	Tower	– Advise of possibility to land without communication

TOTAL ELECTRIC FAILURE

Indications:

– Voltmeter and ammeter indicate 0
– No radio and intercom
– No lights or electrical driven indication

The following are inoperative:

- Engine ignition system
- Warning or caution lights
- Low pressure fuel pump
- Normal gear and flaps extension
- Speed brakes
- Anti–skid
- Electrical indicators of gear and flaps
- Trim, electrical instruments, communication and navigation equipment are inoperative
- External stores release

The following instruments are available:

- RPM
- EGT
- Air speed
- Altimeter
- VVI
- Cabin altimeter
- Accelerometer (G meter)
- Clock
- Stand by compass

Actions:

Since there is no way of restoring power, the pilot should take time and assess the situation regarding distance to base, flight conditions and last known indications (e.g. fuel quantity). Plan your actions and be aware that other aircraft and/or ground controller may not know of your problem.

1.	Throttle	– Move with care, low pressure fuel pump is inoperative
2.	Recall the last fuel quantity reading and calculate the remaining flight time	
3.	Descent to the nearest VFR airfield	
4.	Traffic circuit	– Join, watch other aircraft in the circuit
5.	Landing gear and flaps	– Emergency extend
6.	Land	– Seeking light signals
7.	Brake	– Apply gradually

INVERTER I OR II FAILURE

Indications: "INV. 115 V FAIL" light illuminates

NOTE

All consumers will automatically connect to that inverter, which is working without failure.

Actions:

1.	Electrical system	– Check with higher frequency

INVERTER I AND INVERTER II FAILURE

Indications: "INV. 115 V FAIL" light illuminates. Warning flags on height indicator and ADI, temperature changes in the cabin not corresponding selected value, loss of all consumers supplied by inverter I and inverter II.

Action:

1.	Abort mission, fly smoothly	
2.	Land	– ASAP

INVERTER III FAILURE

Indications: "INV. 3 × 36 V FAIL" light illuminates. Loss of triple engine indicator, turn indicator and elevator trim indicator.

Action:

1. "ENGINE INDICAT. EMERG." switch – On
2. Electrical system – Check with higher frequency

INVERTER IV FAILURE

Indications: Loss of ADI, directional gyro, RSBN and SDU.

Action:

Since there is no way of restoring power, the pilot should take time and assess the situation regarding distance to base, flight conditions and last known indications (e.g. fuel quantity). Plan your actions and be aware that other aircraft and/or ground controller may not know of your problem.

1. Abort mission, fly smoothly
2. Land – ASAP

HYDRAULIC SYSTEM PRESSURE LOW

Indication: "HYD. SYST. FAIL" warning light illuminates. Main hydraulic pressure is below 55 kp/cm^2.

WARNING

Do not attempt to recharge the main hydraulic system from the emergency system by operating the accumulator interconnect lever. This will only result in depleting the emergency system pressure, which will disable emergency gear and flap extension.

The following systems are inoperative:

- Speed brakes
- Normal gear lowering
- Normal flap extending
- Normal brakes
- Anti skid

Refer to emergency gear and flap extension procedure.

Actions:

1. Do not activate speed brakes (even if extended). Keep the remaining pressure for normal differential breaking ground steering).
2. Extend landing gear and flaps by means of emergency system.
3. After landing, use emergency braking to reduce speed and differential braking for steering.

EMERGENCY HYDRAULIC SYSTEM PRESSURE LOW

Indications: Emergency hydraulic pressure indicator indicates below 140 kp/cm^2.

Actions:

1. Accumulator interconnect lever – **Consider use** (lever–backwards)
2. When pressure in the emergency system equals normal system's pressure – Lever forward

LANDING EMERGENCIES

MAXIMUM GLIDE

The flight characteristics of the aircraft, with an engine out, are normal. Rapid trim changes are not recommended neither necessary. The recommended glide speed is 140 KIAS.

For maximum glide distance with engine out refer to Appendix A.

FORCED LANDING (Figure 3–1)

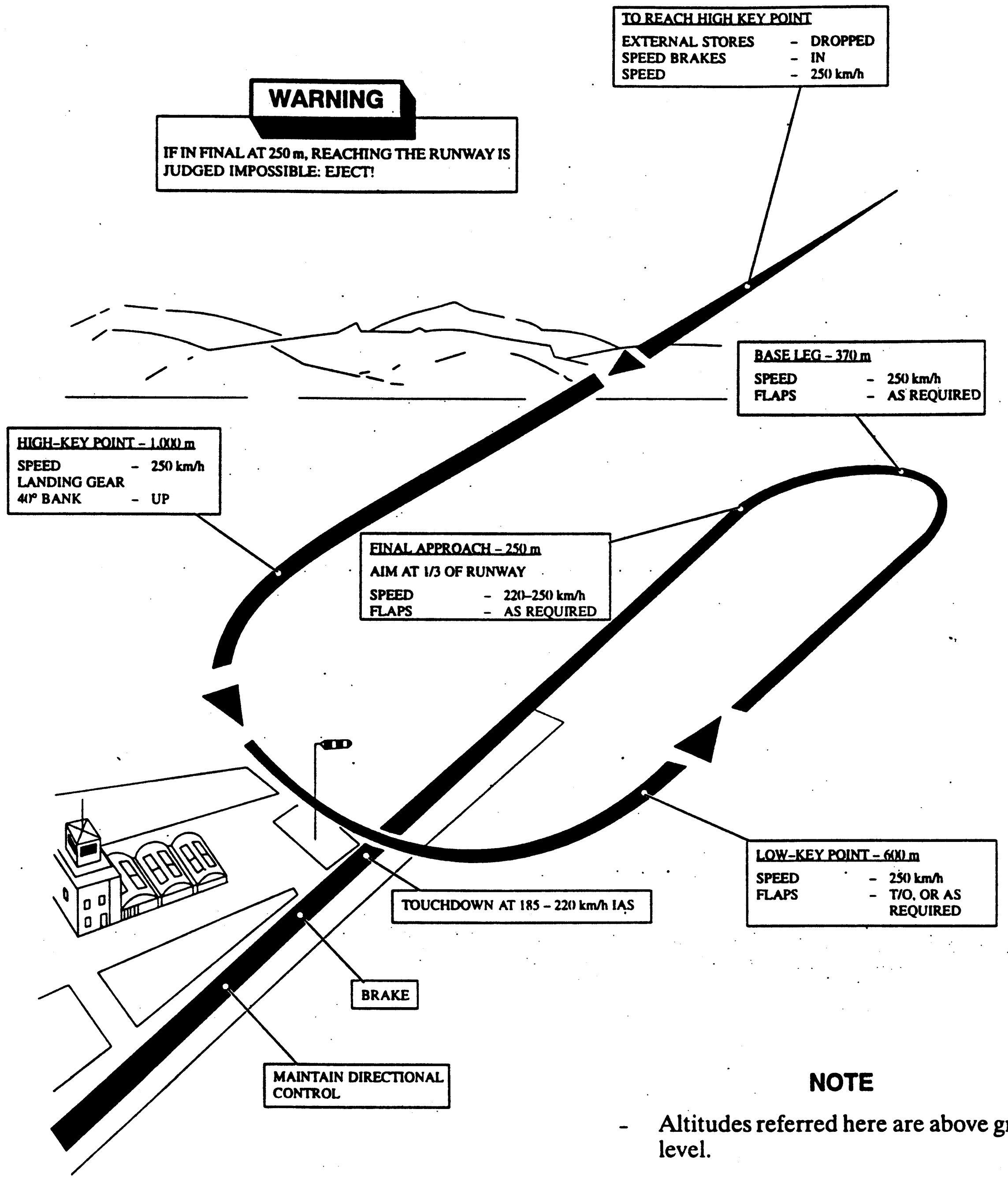
WARNING

If, at any time during the forced landing, conditions to not appear satisfactory for a successful completion of the landing: EJECT!

ENROUTE TO HIGH KEY

1. External stores – Jettison, if necessary
2. Speed brakes, gear and flaps – Retracted
3. Airspeed – 260 km/h IAS
4. Throttle – Stop
5. Fuel shut off lever – Closed

- FROZEN OR WINDMILLING ENGINE
- APPROACH AT 360°



NOTE

- Altitudes referred here are above ground level.
- L/G may be extended if the A/C will glide safety to the runway with L/G extended.

AB-1-(77)

Figure 3-1. Forced Landing

NOTE

- Leave the "ENGINE" switch at ON position in order to have VVI and turn and bank indicator available.

- The RAT will provide electrical power throughout the whole glide speed range.

NOTE

The hydraulic pump will still produce pressure, albeit at a reduced rate, for the main hydraulic system, provided the engine has not seized due to a mechanical failure.

- For every 1,500 m of altitude lost, the ground distance gained is approximately 14 km.

- Below 3,000 m, the sink rate is approximately 9 m/sec.

HIGH KEY

1. Altitude – 1,000 m AGL Min
2. Landing gear – Down
3. Landing gear indicators – Check
4. Airspeed – 250 km/h IAS

NOTE

If the main hydraulic system does not show enough pressure, or the RAT has failed and the battery voltage is less than 20 V, the landing gear and the flaps have to be extended utilizing the emergency hydraulic system.

LOW KEY

1. Altitude – 600 m AGL Min
2. Air–speed – 250 km/h IAS
3. Flaps – As required

NOTE

If the flaps have to be lowered via the emergency hydraulic system, the TAKE–OFF position (25°) is not available. The flaps, once selected down, will go down all the way to LAND position (44°). It is therefore recommended that flaps should be lowered only when a safe landing is assured.

250 m AGL is commit point! Decide whether to continue the forced landing or to eject!

Final approach (safe landing assured):

1. Aim at the first third of the run–way
2. Air–speed – 250 km/h IAS (220 km/h IAS Min)
3. Flaps – As required
4. Speed brakes – If overshoot – extend

NOTE

Speed brakes may not be available due to insufficient electrical or hydraulic power.

TOUCH–DOWN

1. Air–speed – 185 to 200 km/h IAS
2. Braking – Gradually pull emergency lever and use normal braking for ground steering

CAUTION

Normal brakes may not available due to insufficient hydraulic pressure.

After the aircraft has to come to a stop:

3. Aircraft – Abandon

PRECAUTIONARY PATTERN

The precautionary pattern is flown similar to the forced landing pattern with the following exceptions:

1. Power – 70% RPM
2. Speed brakes – Out, until normal glide path on final approach has been attained.
3. Land – Normally

If the engine fails during the precautionary pattern, retract the speed brakes immediately and continue with the forced landing pattern.

LANDING GEAR MALFUNCTIONS

LANDING GEAR EXTENSION FAILURE

Indications: Gear fails to extend or to lock in the down position when using the main hydraulic system.

Actions:

1. "U/C, BALANC." C/Bs – Check ON
2. Backseat handle – Check for middle position
3. Air–speed – Below 330 km/h IAS
4. Emergency gear extension lever – Move backward

CAUTION

Leave the emergency gear extension lever at the extended position until landing.

5. Electrical and mechanical indicators – Check

If gear does not extend:

6. Perform 5–6 G maneuver.

If gear does not extend:

7. Emergency gear extension lever – Forward
8. Normal gear handle – Up
9. Belly landing – Perform

ASYMMETRIC GEAR CONDITION

1. Electrical gear position indicators – Test
2. Mechanical gear position indicators – Check
3. "U/C, BALANC." C/Bs – Check ON
4. Main hydraulic system pressure – Check (Min 135 kp/cm^2)
5. Normal gear – Retract
6. Normal gear extension – Repeat

If unsuccessful:

7. Emergency system pressure – Ensure minimum 135 kp/cm^2
8. Emergency gear extension – Perform

If asymmetric gear condition persists:

9. Gear – Retract

WARNING

The aircraft must not be landed in gear asymmetric condition.

10. Belly landing or: – Attempt
11. EJECT!

NOSE GEAR EXTENSION FAILURE

Indications: Nose gear fails to extend or to lock in the down position when using the main hydraulic system.

Actions:

1. Emergency gear extension – Perform
2. Electrical and mechanical indicators – Check

If mechanical indicators indicates gear extended:

3. Land

If mechanical indicator shows unsafe condition:

4. Perform normal landing, holding the nose high for aerodynamical braking

WARNING

Normal braking is not be possible.

BELLY LANDING

NOTE

If a paved runway is unavailable eject rather than attempt a belly landing on an unpaved surface. If a gear up landing is unavoidable, burn access fuel and release all external stores except for empty external drop tanks. Use normal approach procedures, avoid a nose high touch–down attitude.

1. Runway – Request foaming
2. Fuel – Burn down to minimum required
3. Shoulder harness – Locked
4. Final approach – Straight in, with full flaps

Prior to touch down:

CAUTION

The latch preventing the movement of the throttle from IDLE to STOP is, in the forward cockpit a rotating lever and in the aft cockpit a sprig–loaded push pin.

5. "GENERATOR EMERG." switch – OFF
6. Throttle – To STOP
7. Fuel shut off lever – Close
8. "ENGINE", "BATTERY" and "GENERATOR MAIN" switches – OFF

CAUTION

Do not use speedbrakes, if extended, it is not possible to retract them in emergency.

9. Touch down speed – 180 km/h IAS

After the aircraft has come to stop:

10. Aircraft – Abandon

LANDING WITH A BLOWN MAIN TIRE

If possible have the damaged tire inspected by another aircraft or the control tower.

1. Fuel – Burn access fuel
2. Approach – Normal pattern
3. Land – On the runway side opposite to the blown tire
4. Control stick – Deflected towards the good tire
5. Directional control – Maintain with rudder and brakes for as long as possible

NOTE

Do not retract the flaps as they may have sustained damage by pieces of the blown tire.

FLAP EXTENSION FAILURE

FLAP EMERGENCY EXTENSION

1. Air–speed – Below 300 km/h IAS
2. Emergency flap extension lever – Move backward
3. Electrical and mechanical indicators – Check
4. Normal switch – Landing Position

WARNING

For landing with flaps up, increase approach and landing speed by 30 km/h IAS.

ASYMMETRIC FLAPS

When ever an asymmetry is experienced:

1. Aircraft – Control. Compensate with aileron and rudder. If necessary increase speed.
2. Flaps – To previous position

CAUTION

After regaining control, do not attempt to reselect the flaps.

If by selecting the previous position control is regained:

3. Land with the flap setting. Add 30 km/h IAS for flaps up landing.

If aircraft is un–controllable:

4. EJECT!

SPIN RECOVERY

1. CONTROLS – POSITIVE NEUTRAL (STICK CENTER AND FORWARD)
2. THROTTLE – IDLE

If in erect spin:

3. RUDDER – FULL OPPOSITE TO TURN NEEDLE

If in inverted spin:

4. STICK – FULL AFT

If spin persists and altitude is below 1,800 m AGL:

5. EJECT!

SECTION IV

CREW DUTY

NOT APPLICABLE

SECTION V

OPERATING LIMITATIONS

CONTENTS PAGE

INTRODUCTION

This section includes the limitations that must be observed during normal operation of the aircraft. The limitations are derived from actual flight testing. Limitations related to particular operational procedures are given in other sections of the manual. The flight and engine instrument markings with their operating limitations are shown in figure 5–1.

DEFINITIONS

Cruise Conditions	–	LG and flaps up, speed–brakes retracted.
Landing Conditions	–	LG and flaps down, speed–brakes retracted.
Clean Configuration	–	Without external stores.
Symmetrical Flight	–	Flight with no rolling tendency or use of ailerons in the maneuver

INSTRUMENT MARKINGS

ENGINE LIMITATIONS

In addition to the normal operating limitations shown in figure 5–2, the following limitations shall apply:

- Duration of engine run shall not exceed the following:
  - 40% of total engine time at the NOMINAL regime
  - 10% of total engine time at the TAKE–OFF regime
- Maximal flight altitude shall not exceed 12,000 m (40,000 ft) at all engine rating except take–off rating
- Switching on the de–icing system air bleed valves up to max altitude 8,000 m (26,000 ft)

When emergency fuel control system is in operation the following limitations apply:

- Maximum and minimum HPC rpm are as follows:
  - Below 2,000 m (6,500 ft): 103% Max; 56% Min.
  - Above 2,000 m (6,500 ft): 99% Max; 60% Min.
- Maximum operating time: 40 minutes
- Maximum altitude at NOMINAL: 2,000 m (6,500 ft)
- Maximum altitude at lower ratings than NOMINAL: 8,000 m (26,000 ft)
- Throttle operation should be slow so as to prevent fuel starvation and possible engine flame out.

After engine shutdown, the engine run down time from IDLE to 0% should not be less than:

- High pressure compressor 20 sec.
- Low pressure compressor 25 sec.

HPC RPM within the ranges 74% – 77% and 86% – 89% is permitted for a short duration only due to the surge bleed valve.

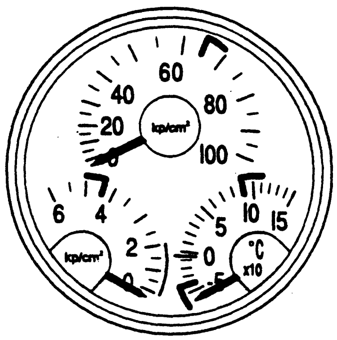
Take off power:

- Max altitude 10,000 m (32,8000 ft)
- Max time 20 Min.

Max RPM in flight (over–speed) 107.8%

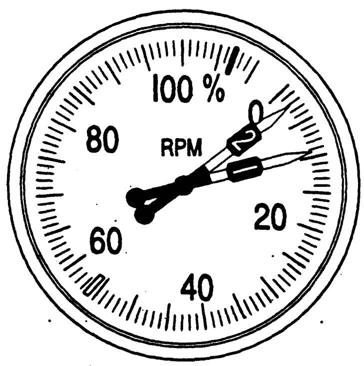
FUEL PRESSURE INDICATOR
Fuel pressure 65 kp/cm^2 max

OIL PRESSURE INDICATOR
- oil pressure 4.5 kp/cm^2 max
- under 2 kp/cm^2 at zero loads for short time only



OIL TEMPERATURE INDICATOR
- oil temperature from −40°C min up to 90°C max
- from − 5°C up to 90°C max operation

RPM INDICATOR



- HPC RPM – 106.8 ± 1% max
- LPC RPM – 104% max

■ RED

□ YELLOW

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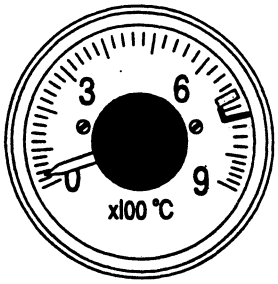
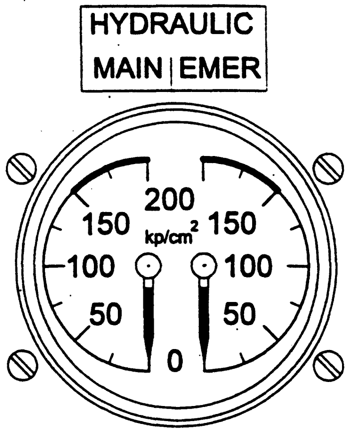
Figure 5–1. Operating Limitations (sheet 1 of 2)

EGT INDICATOR



EGT 645° max on the ground on TAKE UP regime
EGT 670° max. in flight without de–icing on
EGT 685° max. during engine start–up
EGT 690° max. in flight with de–icing on
EGT 700° max. in flight above 25,000 ft (8,000 m)

HYDRAULIC PRESSURE INDICATOR

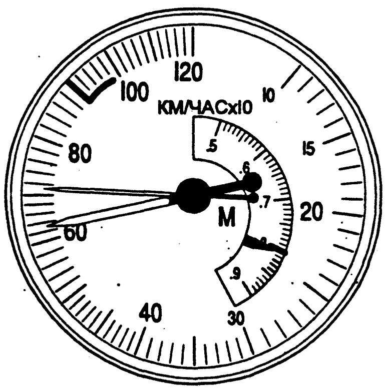


Pressure in main circuit 135–150 kp/cm^2
Pressure in emergency circuit after engine start 150 kp/cm^2

NOTE

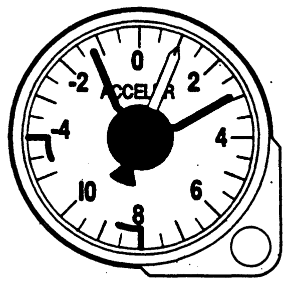
Due to decreasing pressure during high altitude flight the pressure in emergency circuit can gradually drop to 120 kp/cm^2 at aircraft maximu ceiling. The pressure in the emergency circuit is recovered again when the aircraft descends.

MACH–IAS–TAS INDICATOR



- 910 km/h IAS max for configuration without external stores
- 0.8 M (the speedbrakes extend automatically at 0.78 ± 0.02 M)

ACCELEROMETER



- "+8" max for the a/c weight up to 4,200 kg
- "–4g" max for the a/c weight up to 4,200 kg

RED
GREEN

AB–1–(78–2)

Figure 5–1. Operating Limitations (sheet 2 of 2)

In–flight engine relight envelope:

- Altitude up to 6,000 m (20,000 ft)
- APU assist when HPC rpm below 15%
- Windmill when HPC rpm above 15%

Engine operation with the fuel booster pump off is guaranteed up to approximately 6,000 m (20,000 ft).

Do not attempt an engine relight with RPM below 15% without the use of APU.

Eng Mode	HPC RPM	EGT (°C)		FUEL PRESS (kp/cm²/psi)	OIL PRESS (kp/cm²/psi)	OIL TEMP (°C)	OPERATION TIME GRND/FLT	ENG THRUST (lbf)
		GRND	FLT					
START	20% min within 15 sec.	685	685	below 5/71	2/28 min	–40 to 90	50 sec	–
IDLE	56 ± 1.5%	585	585	–	2/28 min	–5 to 90	30 min/no limit	–
CRUISE	99.6 ± 1%	575	620	–	3 – 4.5/42 – 63	–5 to 90	no limit	2,810
NOMINAL	103 ± 1%	610	655	–	3 – 4.5/42 – 63	–5 to 90	no limit	3,307
TAKE OFF (MAX)	106.8 ± 1%	645	690 700*	max. 65/925	3 – 4.5/42 – 63	–5 to 90	20 min	3,792

* At altitude above 8,000 m (25,000 feet)

Figure 5–2. Engine Operating Limitations

NOTE

1. Abort start and shut down the engine when

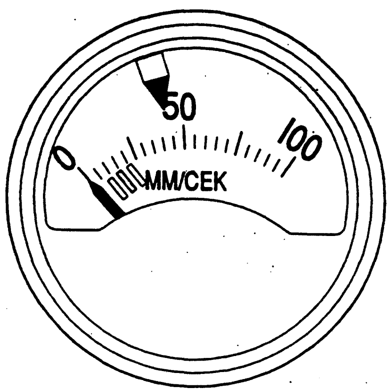
- HPC rpm is less than 20% after 15 sec.
- There is no ignition (EGT does not rise after 25 sec.)
- EGT rapidly approaches 685 °C

2. EGT in flight is higher by 20 °C when de–icing system is on and can be as high as 690 °C below 8,000 m (25,000 ft). EGT in flight can be as high as 700 °C above 8,000 m (25,000 ft).

FH Altitude (Meter/Feet)	HPC RPM (%)		EGT (°C)	Time of operation (min)
Below 2,000/6,500	103% Max	56% Min	655	40
Above 2,000/6,500 (8,000/25,000 max)	99% Max	60% Min	620	40

AB–1–(79)

Figure 5–3. Engine Operating Limitations on Emergency Fuel Control



- 40% (40 mm/sec) max.

YELLOW
GREEN

AB–1–(80)

Figure 5–4. Engine Vibrations Indicator

AIRSPEED LIMITATIONS

For airspeed limitations refer to figure 5–5 and 5–6.

Conditions	Speed	Remarks
Clean	910 km/h (490 KIAS)	Up to flight altitude 1,300 m (4,250 ft), ISA
Clean	0.8 M	Above flight altitude 1,300 m (4,250 ft), ISA
With landing gear extended	340 km/h (180 KIAS)	
With flaps extended to either T/O or landing position	325 km/h (175 KIAS)	Flaps will not extend beyond 310 ± 15 km/h (165 KIAS) and if extended, will retract when exceeding 165 KIAS
With canopy jettisoned	350 km/h (190 KIAS)	

FLIGHT MANOEUVERING LIMITATIONS

INVERTED FLIGHT LIMITATIONS

Inverted flight or any manoeuvre resulting in negative acceleration is permitted for not more then 20 sec, as fuel supply from the inverted flight reservoir will last only 20 sec with full power. The minimum interval between consecutive inverted flight is 20 sec. With full tip tanks, negative g flight is not recommended.

ZERO G LIMITATION

Flight with zero G are permitted for not more than 5 sec due to lack of lubrication to the engine.

STRUCTURAL LIMITATIONS (CLEAN CONFIGURATION)

G Factor	Weight
+8 to –4	4,200 kg (9,260 lbs)
+7.5 to –3.75	4,300 kg (9,480 lbs)
+7 to –3.5	4,500 kg (9,920 lbs)
+6.5 to –3.5	4,700 kg (10,360 lbs)

CENTER OF GRAVITY LIMITATIONS

The permissible range for center of gravity positions is 21 to 28% MAC. In an emergency, if the forward pilot ejects, the C of G is approximately 29.01% MAC and the aircraft may still be landed from the aft cockpit. In this case, do not use flaps (speed–brakes may be used). Final approach speed is 230 km/h (125 KIAS).

WEIGHT LIMITATIONS

Minimum bearing power for aircraft operation is 6 kg/cm^2 (870 psi).

Runway surface	Max permissible T/O weight kg/lbs	Max. permissible landing weight kg/lbs
Paved	4,709/10,380	4,600/10,140
Unpaved (p>7 kg/cm^2 116 psi)	4,600/10,140	4,600/10,140
Unpaved (p>6 kg/cm^2 87 psi)	4,400/9,700	4,400/9,700

NOTE

Only 5% of the total number of flights can be performed with T/O weight higher than 4,600 kg (10,140 lbs).

CROSS WIND LIMITATIONS

The maximum permissible crosswind component during takeoff and landing is 10 m/s (20 kt). Refer to Appendix A for takeoff and landing crosswind limits chart.

PROHIBITED MANOEUVRES

1. Intentional inverted spins. If the aircraft falls into inverted spin only one turn is permitted.
2. More than two turns of upright spin.

NOTE

The spin should not be performed with engine setting at range within 86 to 89% and 74 to 77% HPC rpm.

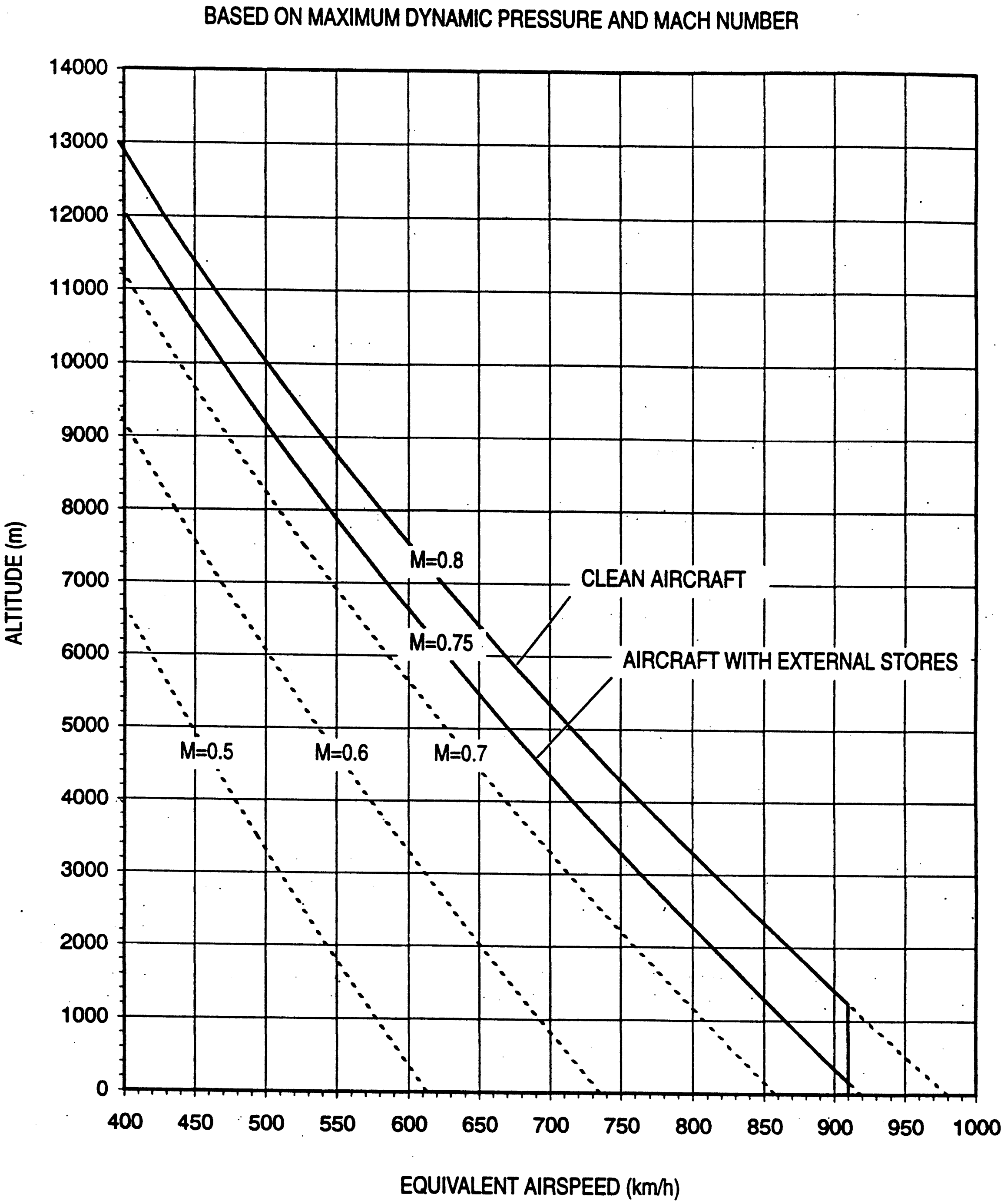


Figure 5–5. Airspeed Limitations, EAS

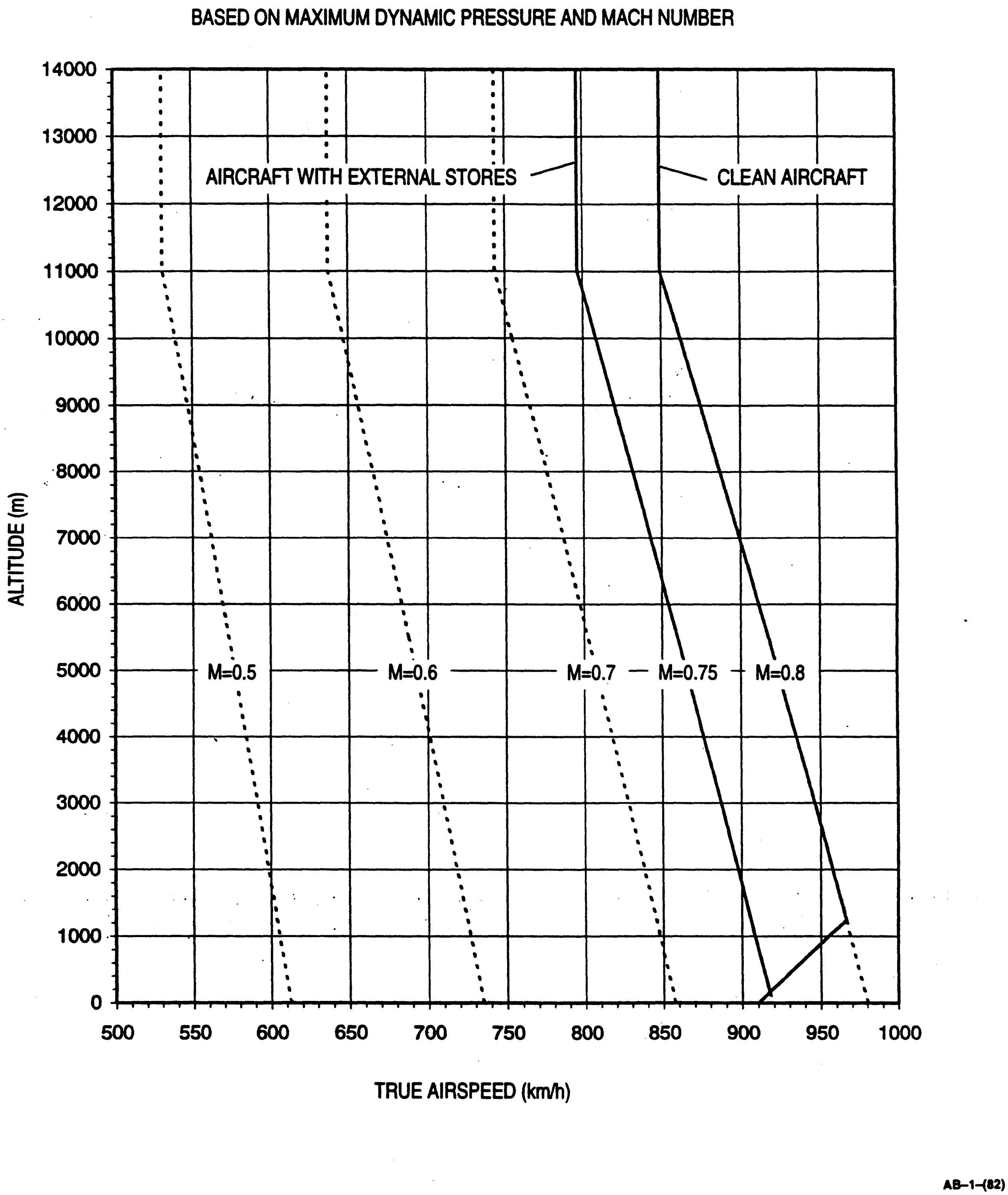


Figure 5–6. Airspeed Limitations, TAS

TIRE SPEED LIMITATIONS

The landing gear tires are marked 300 km/h (162 kt) for main LG and 285 km/h (154 kt) for nose LG.

WHEEL BRAKE LIMITATIONS

The maximum speed at which wheel brakes may be applied with landing weight up to 4,600 kg (10,140 lbs) is 190 km/h (102 kts). In cases such as an aborted takeoff, when full brakes are applied at speed higher than 100 km/h (55 knots), the brakes must be allowed to cool before a subsequent flight.

For an aircraft with an initial takeoff weight of up to 4,400 kg (9,710 lbs), 10 landings and braking is permitted, with a minimum of 7 minutes interval between landings. For an aircraft with initial takeoff weight of more than 4,400 kg (9,710 lbs), continuous circuits with braking is allowed, but a minimum of 30 minutes interval between landings.

NOTE

In an emergency, it is possible to commence braking at speeds higher than 190 km/h (102 kts). However, after such braking, the brakes must be allowed to cool and be properly inspected prior to the next flight. When braking at speeds higher than 190 km/h (102 kts) is performed, the ground run considerably increases (refer to Appendix A).

LANDING LIMITATIONS

If landing must be made with a gross weight higher than 4,600 kg (10,140 lbs), the maximum permissible rate of descent and loading factor are 2.5 g respectively. If these limits are exceeded, the wheelbrakes and tires must be changed prior to next flight.

NOTE

Indications of the Vertical velocity indicator at touchdown is not a valid indication of the actual rate of sid as the instrument is subject to a considerable lag.

STORE	WEIGHT (KG/LBS)
Pylon	17 (38)
OFAB–100 General Purpose Bomb	125 (276)
OFAB–100–110 TU High Drag GP Bomb	110 (243)
FOTAB–100–80 Photo Flash Bomb	70 (154)
ZAB–100–105 Fuel–Air Explosive Bomb	108 (238)
P–50–75 Bomb, Dummy Unit	75.5 (166)
P–50Sh Bomb, Dummy Unit	46 (102)
UB–16–57U Rocket Launcher	54 (119)
UB–16–57UMP Rocket Launcher	52 (115)
16 × S–5M/K Rockets	62 (136)
16 × S–5MO/KO Rockets	77 (169)
APU–13M/MI Missile Launcher	21 (46)
R–3U Missile, Training	53 (117)
R–3S Missile	75 (165)

AB–1–(83)

Figure 5–7. List of Approved Stores

NOTE

All the above listed stores can be suspended symmetrically under both pylons only.

SECTION VI

FLIGHT CHARACTERISTICS

CONTENTS PAGE

INTRODUCTION

The aircraft is longitudinally, laterally and directionally stable at all approved center–of–gravity positions, throughout the flight envelope. Control surfaces with direct mechanical linkage are not hydraulically boosted, stick forces are directly proportional to aerodynamic loadings.

EFFECT OF FLIGHT CONTROLS

Handling qualities in all three axes are satisfactory within flight envelope for the whole center–of–gravity range.

Longitudinal control forces reach acceptable limits for all flight cases. Variation of stick force gradient, i.e. stick force per g, is gradual–increasing with increasing speed, within satisfactory range.

Lateral/directional control forces and deflections are gradual with positive gradients even in sideslips. Roll performance exceeding 100 degrees per second is sufficiently high, with top values nearing 150 degrees per second.

TRIM

Trim tabs both on elevator and ailerons can manage the control forces within the whole speed range. Excessive control forces can occur during dives close to the speed limits, exceeding trim capability but manageable.

FLAPS

Flaps extension has no significant effect to longitudinal characteristics. Slight nose–up moment with extended flaps is easily trimable.

SPEEDBRAKES

Speedbrakes as an effective drag producing device can be extended or retracted at any speed or any flight attitude.

The speedbrakes are automatically extended at $M = 0.78 \pm 0.02$ Mach to prevent airspeed limits overcoming.

Extending of speedbrakes at high speeds or Mach results in slight nose–up pitching moment, easily counteracted by the pilot.

FLIGHT CHARACTERISTICS

LOW AND HIGH ALTITUDE FLIGHTS

Operation in extreme altitude levels of flight envelope doesn't require any special technique with respect to handling qualities. They are satisfactory throughout the whole speed range.

APPROACH AND LANDING

During approach and on final the throttle should be maintained on no less than minimum of 70% RPM with respect to acceleration time of powerplant. Aircraft touchdown is stable without tendency to swinging or bouncing. The nose can be lowered gently to runway at speed of 130 to 140 km/h (70 to 75 KIAS) in normal landing, in short–field landing can be lowered earlier with subsequent braking if practical.

Landing with flaps retracted is possible with speeds higher at about 30 km/h (15 Kts).

FLIGHT WITH EXTERNAL LOADS

Varying aircraft configurations with the stores affect handling qualities only slightly due to changes in center–of–

gravity location and aerodynamic drag and lift degradation effects.

ASYMMETRIC LOADS

Aircraft handling with asymmetrical store configurations is affected primarily by weight imbalance. These effects are more noticeable at lower airspeeds. With the extreme permitted asymmetry on underwing pylon the aileron control force is fully trimable above 350 km/h (190 kts).

Approach and landing shall be performed with the speed increased by approximately 20 to 30 km/h (10 to 15 kts) related to normal clean variant, with increased but undisturbing aileron control force. When landing in asymmetric configuration is necessary, the approach and landing should be carefully planed and executed, considering the runway length, crosswind and increased landing speed.

STALLS (Figures 6–1 and 6–2)

The stalling characteristics are satisfactory in both 1g flight and under load factor. Aircraft behavior is similar in all configurations (flaps deflection, landing gear position, power setting) with only airspeed differences. The stall (departure) is characterized by slight airframe buffet following gradual airspeed loss of 2 km/h per second (1.1 kt per sec) and consequent nose–down pitch motion. Full controllability during stall is typical for the aircraft. Possible wing drop is easily corrected by ailerons, no rudder inputs are necessary.

Recovery is easy and almost immediate after stick releasing, with the height loss up to 100 m (330 ft). Stall speeds with respect of aircraft weight (gross weight) are depicted in figure 6–1 and in figure 6–2. Clean aircraft means aircraft with underwing pylons unloaded too. Aircraft with stores lines can be used especially for forward extended stores (ahead the leading edge). Engine thrust can affect these figures by approximately 10 km/h (5 KTAS) in sense of lowering the stall speed (when engine power is maximal). After nose lowering the aircraft gradually regains the speed and can be levelled without special effort.

Dynamic stall can be entered at the speeds about 20 to 40 km/h (10–20 kt) higher then quoted stall speeds, with rapid full aft stick, causing quicker deceleration.

High "g" stalls are accomplished during descending tightened turns when pulling with 2 to 8 g's and reaching the buffet boundaries depending on weight, altitude and speed. With full aft stick the turn rate temporary increases, followed by full stall with leaving the turn. Aircraft tends to level wings and behave as in normal stall.

Configuration		Without stores		With stores	
A/C Gross Weight		3,700	4,500	4,600	4,700
Flaps deflection LG position	0°, retracted	172	190	196	198
	25°, extended	157	173	182	184
	44°, extended	148	163	174	176

AB–1–(84)

Figure 6–1. Table of Stall Speeds

SPINS

The aircraft exhibits a high degree of resistance to spin entry. When stalled, it is not susceptible to spin without rudder deflection. Nonintentional spin entry can very exceptionally occur during maneuver flight in case of pilot mishandling.

UPRIGHT SPIN

Intentional upright spin must be initiated as follows:

Trim the aircraft in horizontal flight at the speed of approximately 300 km/h (160 KIAS). At minimal altitude of 5,000 m (16,000 ft) set power to idle. Adjust climb angle of 10° with gradual speed loss to 200 km/h (110 KIAS). At this moment apply full rudder deflection into the spin sense and simultaneously pull fully aft. Hold the deflections during the spin, with ailerons in neutral.

NOTE

Spin character is stable during the first turn, with increasing instabilities typical for jet aircraft in continuing turning. Unregular longitudinal oscillations develop with increasing amplitude and shudder. Rudder bounces and increasing varying pedal forces must be overcomed. Unadequate control inputs can lead to inverted spin development (especially with extreme forward stick position), or to the change in turning sense (ailerons against spin turning).

UPRIGHT SPIN RECOVERY

Recovery is initiated with rudder and elevator centering. The aircraft stops turning and passes to steep dive with maximal one turn overturning. Ailerons remain held in neutral position. More aggressive turning stop can be initiated with rudder deflected against turning first, with subsequent all controls centering.

INVERTED SPIN

WARNING

Intentional inverted spins are not permitted.

Unintentional inverted spin can be entered due to mishandling mentioned earlier. During inverted spin development, after nose oscillation around the horizon in first turn, heavy oscillating pedal forces can build up. Excessive pedal forces occur due to rudder extreme deflections caused by the dynamic pressure, especially with higher spin entry speed.

INVERTED SPIN RECOVERY

When in inverted spin, pilot must immediately initiate recovery:

- power set to idle
- neutralize ailerons and rudder
- fully aft stick must be applied and held
- after turning is stopped and aircraft position steeped, neutralize the controls and initiate normal dive recovery

DIVES

DIVE RECOVERY

Dive recovery capability is given as altitude lost during pullout and it is plotted as a function of pullout load factor, dive angle, and true airspeed (figure 6–3). Plots to convert indicated airspeed or Mach number into true airspeed are provided on the chart. A 2 g per second load factor increase in initiating pullout is built into the chart. Dive recovery capability at constant load factor is insensitive to gross weight and drag, but high thrust settings may increase lost altitude by a significant amount of around 20 percent.

REFER TO FIGURE 6–3:

Enter the chart with initial equivalent airspeed (A). Proceed to the right to initial altitude line (B), project vertically down to temperature line (C). From this point proceeding horizontally left, true airspeed can be read (D) or entered with when necessary, as well as Mach number when projected vertically down (E). From the temperature point (C) proceed further horizontally right to selected pullout load factor line (F) and project vertically up to initial dive angle curve (G). Projected horizontally right altitude lost during dive recovery can be read (H).

CAUTION

Selected pullout load factor shall meet Section V Operating Limitations.

EXAMPLE:

A. Equivalent airspeed .... 525 km/h

B. Initial altitude .... 4 km

C. Temperature .... –11°C (from figure A1–8)

D. True airspeed .... 640 km/h

E. Mach number 0.55

F. Pullout load factor .... 3 g

G. Initial dive angle .... 60°

H. Altitude lost during pullout .... 1,100 m

SPEED PROFILES (Figure 6–4)

The right–hand part of the curves corresponds to maximal thrust regime, the left–hand part of the curves is valid for maximum lift (minimal speed). The curves define the range of horizontal speeds for clean aircraft (with gun and four underwing pylons without stores) for normal weight and for the variant with minimum fuel.

Thick vertical lines represent Mach number limitation for aircraft with and without stores, horizontal line limits the altitude for maximum power rating. Higher flight levels can be reached for lower power settings or under dynamic conditions.

Data Basis:	Estimated	Conditions:	Idle Power Setting Standard Day
Date:	July 30, 1997		

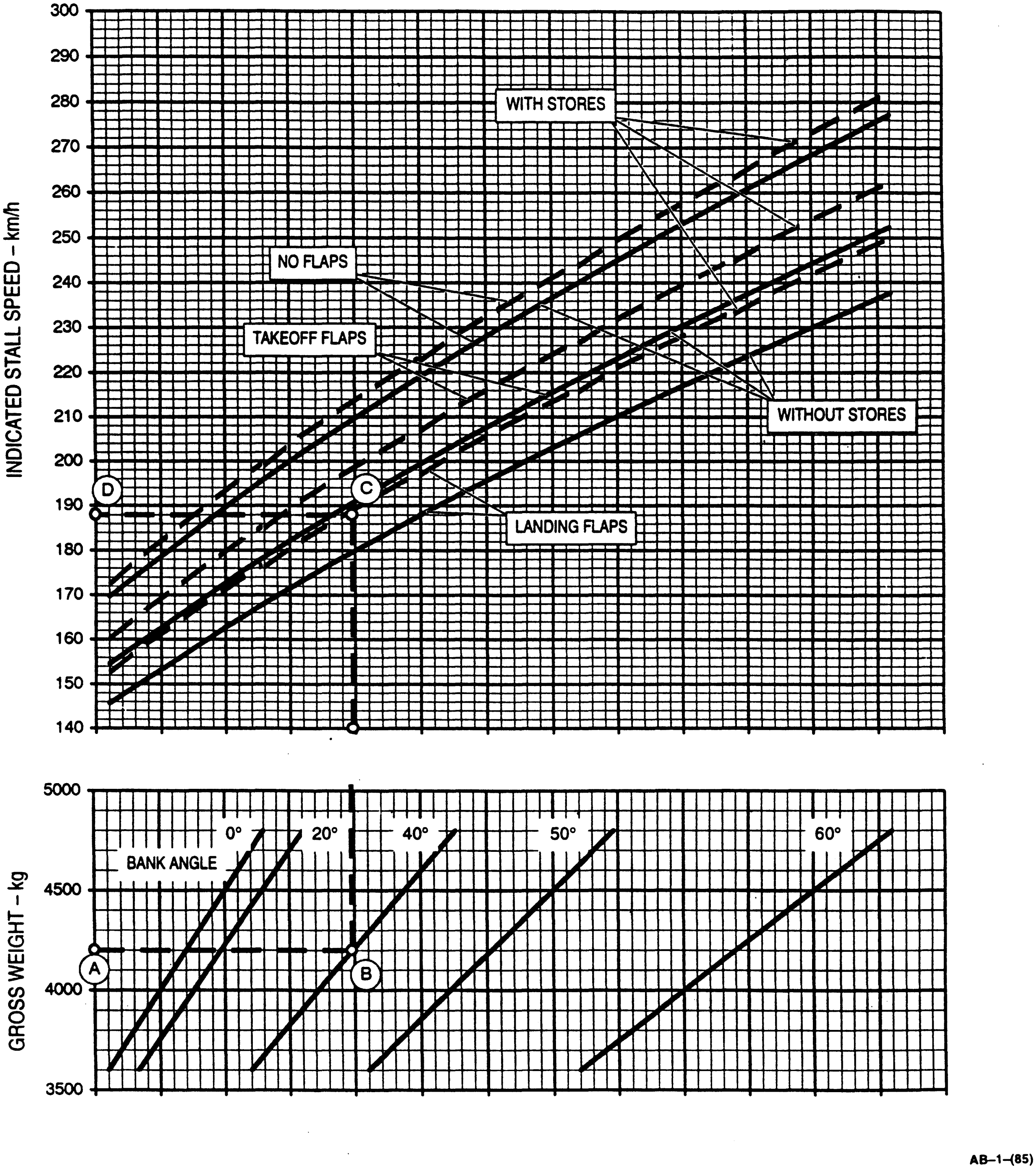


Figure 6–2. Stall Speed

Data Basis:	Estimated
Date:	July 30, 1997
Configuration:	Clean

Conditions: Idle Power
Load factor gradient 2 g/sec
Automatic speedbrakes extending at 0.78 M

WARNING

Maximum engine thrust increases altitude required by up to 20%, especially at low altitude and pullout load factor

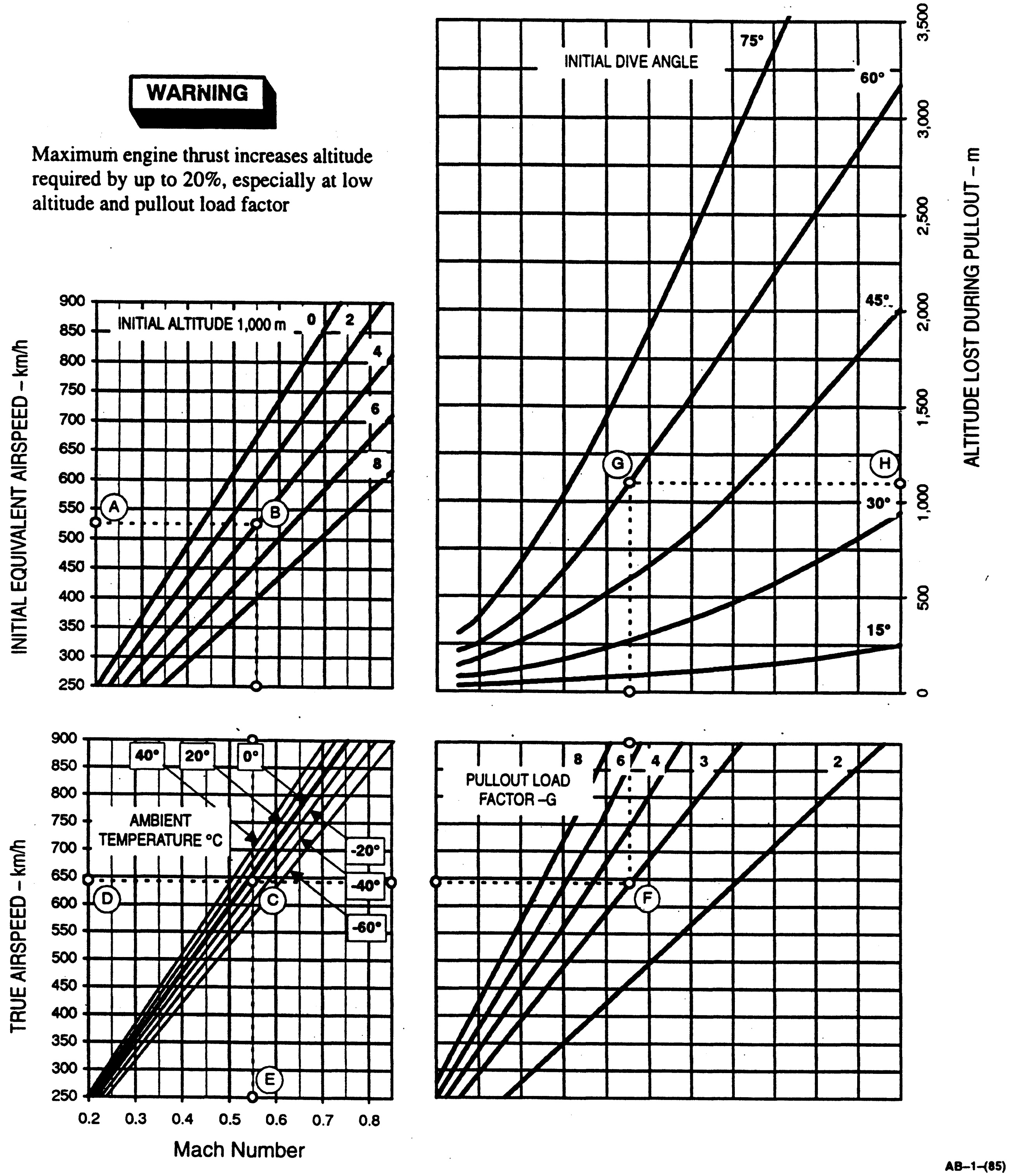


Figure 6–3. Dive Recovery

Data Basis:	Estimated	Conditions:	Maximum Power Setting
Date:	July 30, 1997		Standard day

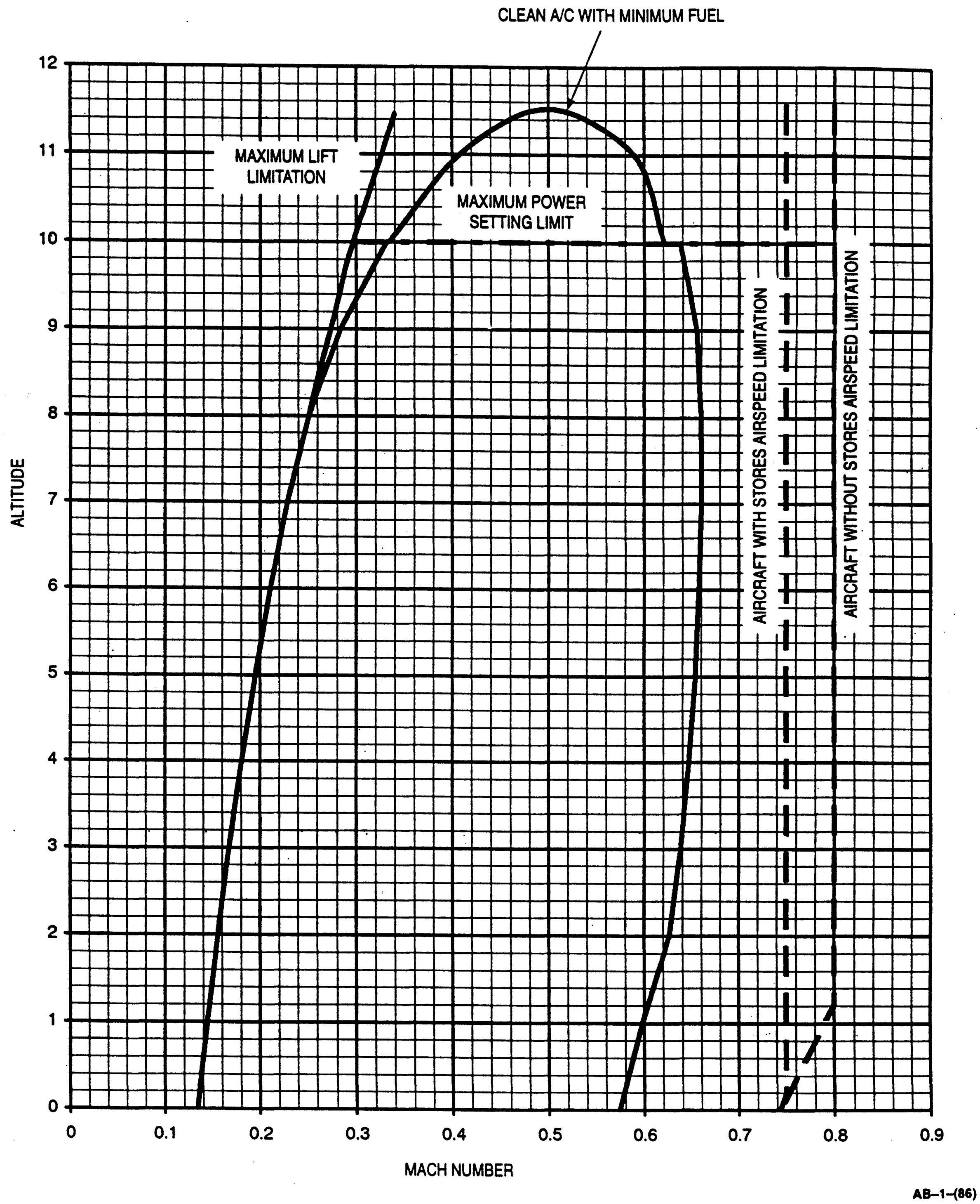


Figure 6–4. Airspeed Envelope

SECTION VII

ADVERSE WEATHER OPERATION

INTRODUCTION

This section contains only those procedures which differ from or are in addition to the normal operating instructions covered in Section II. Relevant equipment operation is covered in Section I.

INSTRUMENT FLIGHT PROCEDURES

Flying the aircraft in all weather conditions requires instrument proficiency and conscientious pre–flight planning. Standard procedures should be used during all phases of instrument flight. The aircraft flight and handling characteristics under IMC are identical to those encountered in VMC/ over, airspeed and attitude changes should be performed smoothly, and accurate trimming is essential. All airspeed and flight limitations should be strictly adhered to. Turns with more than 30–degree bank are not recommended during IFR operations.

PRE–FLIGHT AND TAXIING

Complete the normal pre–flight inspection (as described in Section II). Particular attention should be paid to those items essential to instrument flight.

Complete taxi checklist, watch out for slippery taxi–ways. Taxi with caution and adjust taxi speed according to visibility.

INSTRUMENT TAKE–OFF

Align the aircraft visually with the runway center–line and set the selected course needle on RMI in T/O direction heading, as it will assist in directional control.

Normal take–off procedure should be used, correcting deviations with differential braking and rudder. It is essential to maintain run–way center–line as in poor visibility, once departing from the center–line, the pilot may not be able to determine how close he is to the run–way edge.

INSTRUMENT CLIMB

As the aircraft leaves the ground revert solely to instrument flying making the attitude indicator the prime instrument for controlling attitude and bank. Once established in the climb, adopt normal climb procedures. Before entering clouds, precipitations or visible moisture:

- Pitot heat buttons – Push
- De–icing switch – On

INSTRUMENT CRUISE

For cruise data use the applicable appendix.

DESCENT

Before descent, when expecting icing conditions make sure that Pitot heat and de–icing systems are on.

When cruising at a high altitude, a steep descent to an initial altitude prior to reaching the destination fix may be made at airspeed and power setting given in the descent charts in the appendix. For continuous descent, reduce power to 85% RPM, lower the nose to establish a descent attitude, establish and maintain an airspeed of 450 km/h (250 KIAS). This will provide a comfortable rate of descent.

HOLDING

The recommended holding airspeed is 370 km/h (200 KIAS). For maximum endurance while holding, refer to the appendix for airspeeds, power settings and fuel consumption. Descents to traffic pattern altitude should be executed in accordance with published instrument procedures.

INSTRUMENT APPROACHES

The equipment provided is described in Section I.

Instrument approaches can be performed at any allowable weight.

The initial approach from the fix or holding pattern, should be accomplished at 370 km/h (200 KIAS). Pre–landing cockpit check will be initiated when cleared for an approach and should be completed after completion of the procedure turn. The final approach is flown at 260 km/h (140 KIAS) with gear and flaps at T/O and at 220 km/h (120 KIAS) minimum, with gear and full flaps before starting final descent.

MISSED APPROACH

If visual contact is not established by the time the Decision Height (DH) or Missed Approach Point (MAP) are reached, or for any reason the pilot thinks a safe landing cannot be assured, execute a missed approach as published or as directed by air traffic control. The recommended procedure for a missed approach is to simultaneously apply max power, check speed–brake to be in and retract flaps to T/O.

Once the right attitude has been established and positive rate of climb is achieved, retract the landing gear and flaps in the in the same manner and with the same restrictions as in an instrument take–off. Power should be reduced as soon as a safe altitude and an air–speed of 370 km/h (200 KIAS) have been obtained.

NIGHT FLIGHT

Upon entering the cockpit, turn on the interior lighting and adjust light rheostats to provide illumination of all necessary controls and panels. For taxiing, take–off and landing at night, use the taxi/landing and navigation lights as appropriate.

NOTE

Instrument, consoles and warning lights should be dimmed as necessary.

COLD WEATHER OPERATION

Icing conditions are present whenever visible moisture exists and the outside temperature is 10 °C below .

On the ground, when the above conditions do mot exist but the ramp and taxi–ways are covered with snow or ice, icing conditions are considered to exist.

TAXIING

Before taxiing, select the de–icing switch to "AUTOMATIC" any time icing conditions are suspected.

CLIMB AND CRUISE

When flying through clouds or encountering icing conditions ensure the following:

- Pitot heat – On
- De–icing system – On and functioning

NOTE

Switching on the de–icing system is accompanied by a small drop of engine RPM and by increased EGT (20 to 30 degrees).

WARNING

Flying through areas of possible ice formation conditions is prohibited.

DESCENT

WARNING

Descent at idle RPM may result in insufficient de–icing capability. Therefore it is essential to maintain ample power (85%) for sufficient engine bleed.

LANDING

When landing under icing conditions, extend flaps only down to T/O position and increase final approach speed by 40 km/h (20 KTS) above normal approach speed.

HOT WEATHER OPERATION

INTERIOR INSPECTION

Care should be taken not to allow foreign objects to come in contact with the canopy as this may damage the Plexiglass in extremely hot weather.

ENGINE START

Normal starting procedures are used. However, pay special attention to EGT during engine start as it may reach the maximum limit under extreme conditions.

TAXIING

Brakes should be used as little as possible to prevent overheating. Taxi carefully with minimum power to minimize the blowing of dust and sand into other aircraft.

TURBULENCE AND THUNDERSTORMS

A safe and comfortable penetration speed into zones of turbulence air is 350 km/h (190 KIAS). If the power setting and attitude is maintained in the turbulent area, the airspeed and altitude will remain fairly constant regardless of false airspeed and altitude indications.

WARNING

The best way of dealing with thunderstorms is, if possible, to avoid them.

If the penetration or flight in the vicinity of a thunderstorm is unavoidable, the following precautions should be taken:

- Adjust power as necessary to obtain approximately 350 km/h (190 KIAS).
- Turn Pitot heat and all deicing equipment on.
- Check the flight instruments for any alarming indication
- Tighten harness
- Adjust cockpit and instruments lights to full bright to minimize blinding effects by lightning.
- Do not extend gear or flaps
- Use as little elevator and aileron inputs as possible to maintain A/C attitude in order to minimize the stress imposed on the aircraft.

CAUTION

Do not chase the speed. Fly attitude!

APPENDIX A

PERFORMANCE DATA

TABLE OF CONTENTS

TABLE OF CONTENTS (CONT.)

CONTENT **PAGE**

LIST OF ILLUSTRATIONS

INTRODUCTION

ABBREVIATIONS

ALT	Altitude
CAS	calibrated airspeed (indicated airspeed corrected for position error, CAS = IAS + correction)
DI	Drag index
EAS	Equivalent airspeed (calibrated airspeed corrected for compressibility, EAS = CAS – correction)
ft	Feet
ft/min	Feet per minute
KCAS	Calibrated airspeed in knots
kg	Kilogram
kg/h	Kilogram per hour
KIAS	Indicated airspeed in knots
KTAS	True airspeed in knots
Kts	Knots
lbs	Pounds
M	Mach number
NM	Nautical miles
PA	Pressure altitude
PSI	Pounds per square inch
ROC	Rate of climb
ROD	Rate of descent
RPM	Revolutions per minute
TAS	True airspeed
Vso	Stall speed on landing configuration
Vs1	Stall in T/O configuration

DEFINITIONS

OBSTACLE CLEARANCE SPEED

Speed attained at 15 m above the runway for takeoff or speed at the beginning of landing, i.e. speed which must be reached at the height of 15 m above the runway.

TAKEOFF FACTOR

A computed number which is a function of aircraft configuration, temperature, and altitude. It is used as a control parameter for takeoff charts.

TAKE–OFF SPEED

The speed at which the A/C attains 1.1 Vs1; speed at which the MLG leaves the ground.

TAKE–OFF GROUND RUN

The distance measured from brake release to the point where the A/C reaches take offspeed.

TOTAL TAKE–OFF DISTANCE

The horizontal distance measured from brake release until a height of 15 m is attained.

CLIMB SPEED

The speed after completion of the take–off phase. This speed provided maximum rate of climb.

RUNWAY SLOPE

Change in runway elevation divided by runway length multiplied by 100 (expressed in percent uphill or downhill).

RUNWAY CONDITION FACTOR

A number expressing runway surface quality (related to landing gear friction).

SUSTAINED TURN

Level turn at constant speed. Condition of drag equal to engine thrust is satisfied.

SPECIFIC EXCESS POWER

Available excess power which can be used to either climb or accelerate to another speed.

LANDING FACTOR

A computed number which is a function of aircraft configuration, temperature, and altitude. It is used as a control parameter for Landing Ground Run chart.

APPROACH SPEED

The speed which must be maintained down to a height of 15 m (over the threshold) and should be 1.3 Vso.

TOUCH–DOWN SPEED

Speed of 1.1 Vso; speed at which the MLG touches the runway.

LANDING DISTANCE

The horizontal distance from a 15 m height above the landing surface to the point where the A/C comes to a complete stop.

LANDING GROUND RUN

The distance required from touch–down to a complete stop under the following conditions:

Dry hard runway, full braking applied after nose wheel touch–down and after passing brake limiting speed.

MAXIMUM REFUSAL SPEED

The maximum speed at which an abort may be started and the aircraft stopped within the remaining runway length.

ACCELERATE–STOP DISTANCE

The distance required to accelerate the A/C (in take–off configuration) to the maximum refusal speed and bring it to a complete stop on the runway length remaining under the following conditions:

- Dry hard runway
- Full braking 3 seconds after engine has filed

PERFORMANCE CHARTS

Performance charts enable planning a compete mission from take–off to landing in normal operating conditions. The conditions and operating procedures on which the performance is based, are shown on the charts or in the text which accompanies the chart. Following these procedures will ensure the best performance.

The operating procedures laid out in this section adhere to the normal procedures set out in section II and to the operating limitations in section V

PERFORMANCE DATA BASIS

Flight planning data shown in this appendix are derived from the results of flight tests conducted by the manufacturer, and are identified as FLIGHT TEST. All data is based on the thrust of an average engine. However, the actual thrust between engines varies and may cause variation in performance. Unless specifically stated, the data is consistent with the recommended operating procedure and technique set forth elsewhere in the manual. The charts are based on performance under standard atmospheric conditions. However, corrections for nonstandard temperature condition have been included wherever possible.

FUEL AND FUEL DENSITY

The fuel density used in the appendix is 6.44 lbs/gal (0.78 kg/l). In case of variations in fuel density, gross weight will change which will result in variation in performance.

PART 1

GENERAL DATA

DRAG INDEX (Figure A1–1 and A1–2)

The charts use a drag index system to define the effects of external stores on aircraft performance. The drag index system is used to produce the charts which provide accurate corrections for external store's effect in the whole subsonic speed range. The drag indices and weights of specific suspension equipment items are given in Figure A1–1. The drag indices and weights for the individual stores are given in Figure A1–2. Two underwing pylons are available for various stores.

Weights for the basic aircraft and usable fuel are given in Figure A1–1. The given aircraft weight is an approximate value and includes pilot, oxygen, oil and unusable fuel weight. Usable fuel, stores, and suspension equipment weights must be added to obtain total aircraft weight for mission planning purposes.

Refer to figures A1–1 and A1–2: Assume drag index and ramp weight of aircraft variant with two UB-16-57U rocket launchers on pylons. For this example, the drag index and weight for above loading are computed as follows:

Drag Index (DI):

Clean aircraft	0
2 pylons	10
2 UB-16-57U	30
Drag index total	40

Ramp Weight (kg)

Basic aircraft empty weight	3,465
2 pylons	34
2 UB-16-57U	228
Internal usable fuel	980
1 pilot	80
Ramp weight total	4,787

Detailed instruction to empty and ramp weight calculation see WEIGHT AND BALANCE MANUAL.

POSITION ERROR CORRECTION (Figure A1–3 and A1–4)

Two pitot–static probes supply static and total pressure information to direct airspeed and altitude indicators.

The altimeter continuously displays indicated (not corrected for position error) altitude absolute or relative.

The airspeed indicator continuously displays indicated airspeed and Mach number.

Refer to figures A1–3 and A1–4: Enter the chart with desired indicated airspeed (A), project vertically to correction curve (B), and then proceed horizontally to read airspeed correction (C). Add the correction to the airspeed indicator reading to obtain calibrated airspeed.

EXAMPLE:

Figure A1–3 (above)

A. Airspeed indicator reading .... 360 km/h

C. Airspeed position correction .... 8 km/h

Calibrated airspeed . . . 360 + 8 = 368 km/h

Figure A1–3 (below)

Calibrated airspeed may be found in a similar manner directly as a function of indicated airspeed. Enter the conversion IAS/CAS chart (position error included)with indicated airspeed (A) project vertically to correction curve (B) and horizontally to read calibrated airspeed (C).

EXAMPLE:

A. Airspeed indicator reading .... 360 km/h

C. Calibrated airspeed .... 368 km/h

Figure A1–4

Enter the chart with desired indicated airspeed (A), project vertically to flight altitude (B), and proceed horizontally to read altitude correction (C). Add the value to the altimeter reading to obtain actual pressure altitude.

EXAMPLE:

A. Indicated airspeed .... 360 km/h

B. Altitude reading .... 6,000 m

C. Altitude correction .... 49 m

Pressure altitude .... 6,000 + 49 = 6,049 m

COMPRESSIBILITY CORRECTION CHART (Figure A1–5)

The chart is provided as an aid to converting calibrated airspeed into equivalent airspeed.

Refer to figure A1–5: Enter the chart with calibrated airspeed (A), project vertically upward to altitude (B), and proceed horizontally left to read compressibility correction (C). Note that the chart can also be entered at (B) with Mach and altitude. Subtract the compressibility correction to the calibrated airspeed to obtain equivalent airspeed.

EXAMPLE:

A. CAS .... 750 km/h

B. Altitude .... 4,000 m

C. Compressibility correction .... –16.2 km/h

Equivalent airspeed .... 750 – 16.2 = 733.8 km/h

AIRSPEED – MACH NUMBER CONVERSION CHART (Figure A1–6)

The chart is presented as an aid for conversion between calibrated airspeed, true airspeed and Mach number.

Refer to figure A1–6: Enter the chart with calibrated airspeed (A), project vertically to flight altitude (B), and proceed horizontally left to read Mach number (C). For convenience, standard day true airspeed can be read at (D) by interpolation between the true airspeed lines superimposed on the altitude curves. For non–standard temperature conditions project horizontally right to Sea Level line (E), project vartically to actual temperature curve (F) and horizontally proceed to read true airspeed (G).

EXAMPLE:

A. CAS .... 430 km/h

B. Altitude .... 4,000 m

C. Mach number 0.445

D. Standard day TAS (4,000 m) .... 521 km/h

E. Standard day TAS (Sea level) .... 545 km/h

F. Temperature .... –20°C (–4°F)

G. TAS (–20°C/–4°F) .... 510 km/h

MACH – TRUE AIRSPEED CONVERSION CHART (Figure A1–7)

The chart contains lines to be used in converting Mach number to true airspeed for a range of atmosphere temperatures.

Refer to figure A1–7: Enter the chart with Mach number (A). Project horizontally to the temperature (B) and then vertically down to read true airspeed (C).

EXAMPLE:

A. Mach number 0.72

B. Temperature .... –4.6°C (23.7°F)

C. True airspeed .... 853 km/h (460 KTAS)

DENSITY ALTITUDE CHART (Figure A1–8)

This chart is included for information.

Refer to figure A1–8: Enter the chart with ambient temperature (A), project vertically upwards to appropriate pressure altitude curve (B) and horizontally left to read density altitude (C).

EXAMPLE:

A. Temperature .... 10°C (50°F)

B. Pressure altitude .... 4,000 m

C. Density altitude .... 4,700 m

Suspension Equipment	Total Weight (kg)	Station	Drag Index
Pylon	17	Wing	5
APU-13M	21	Pylon	2

Clean Aircraft Drag Index	0
Basic Aircraft Empty Weight (kg) (oxygen, oil, unusable fuel)	3,465

Expandables Weight		kg
Internal Usable Fuel	Fuselage	824
	Wingtips	156

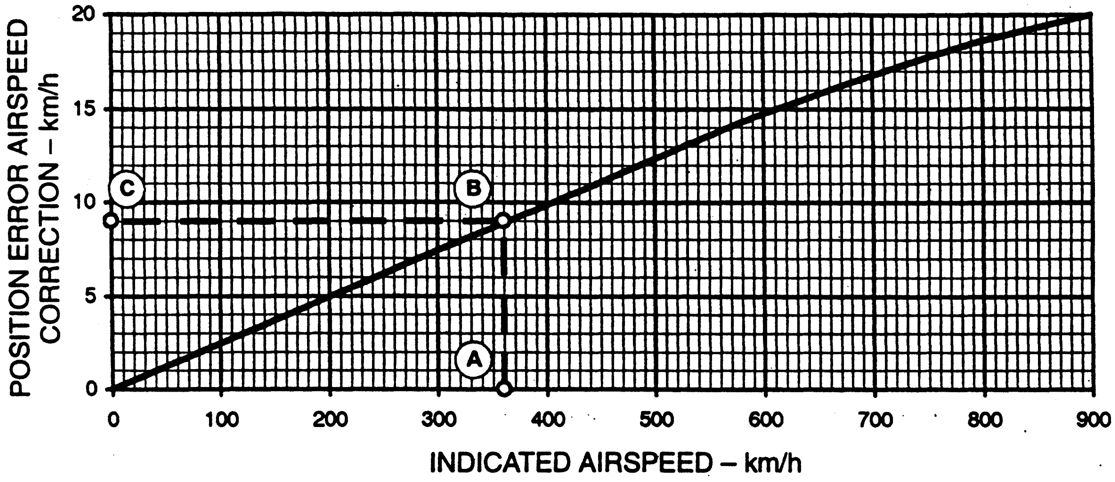
Figure A1–1. Drag Indices and Weights – Clean Aircraft, Suspension Equipment, Internal Fuel

Store	Weight (kg) (each individual unit)	Rack	Drag Index (each individual unit)
P-50-75	75	pylon	10
P-50Sh	46	pylon	6
OFAB-100-110 TU	110	pylon	17
OFAB-100-120	125	pylon	17
ZAB-100-105	108	pylon	17
FOTAB-100-80	70	pylon	21
UB-16-57U with rockets	116	pylon	15
UB-16-57U without rockets	54	pylon	15
UB-16-57UMP with rockets	129	pylon	15
UB-16-57UMP without rockets	52	pylon	15
R-3U	53	APU-13M	5
R-3S	74	APU-13M	5

Figure A1–2. Drag Indices and Weights – Individual Stores

Data Basis: Flight Test

$CAS = IAS + \Delta V_{COR}$



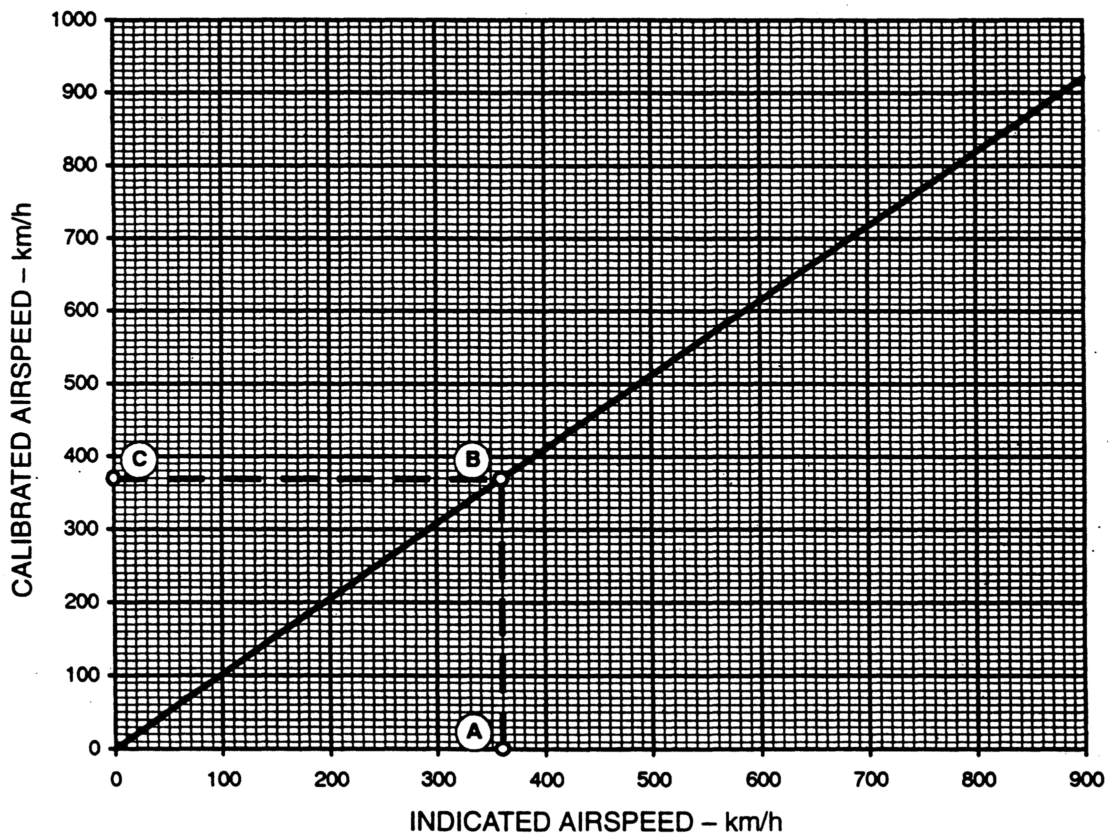


Figure A1–3. Position Error Correction Chart – Airspeed

Data Basis: Flight Test

Date: July 30, 1997

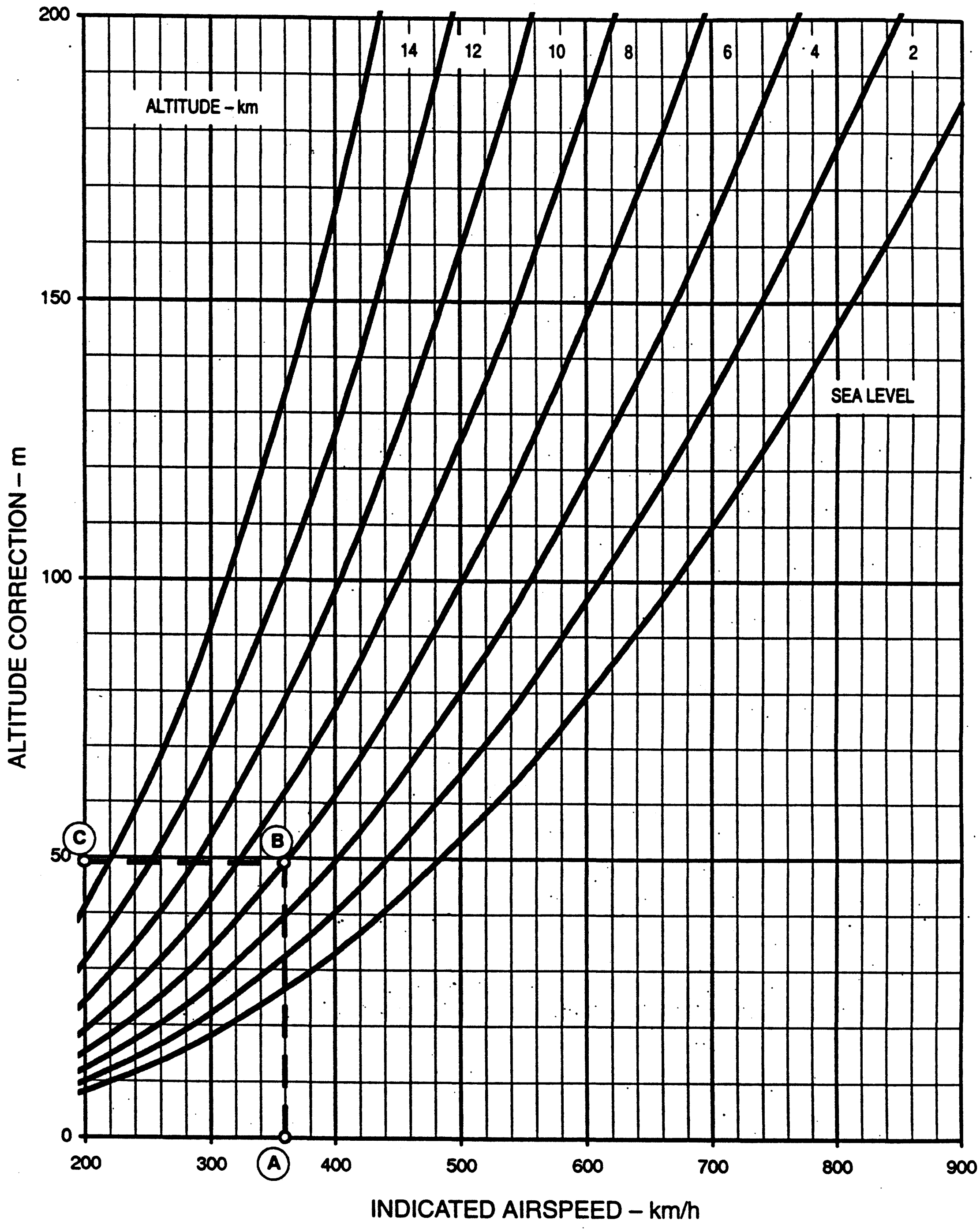


Figure A1–4. Position Error Correction – Altitude

Data Basis: Calculated

Date: May 6, 1997

$$EAS = CAS + \Delta V_{COMP}$$

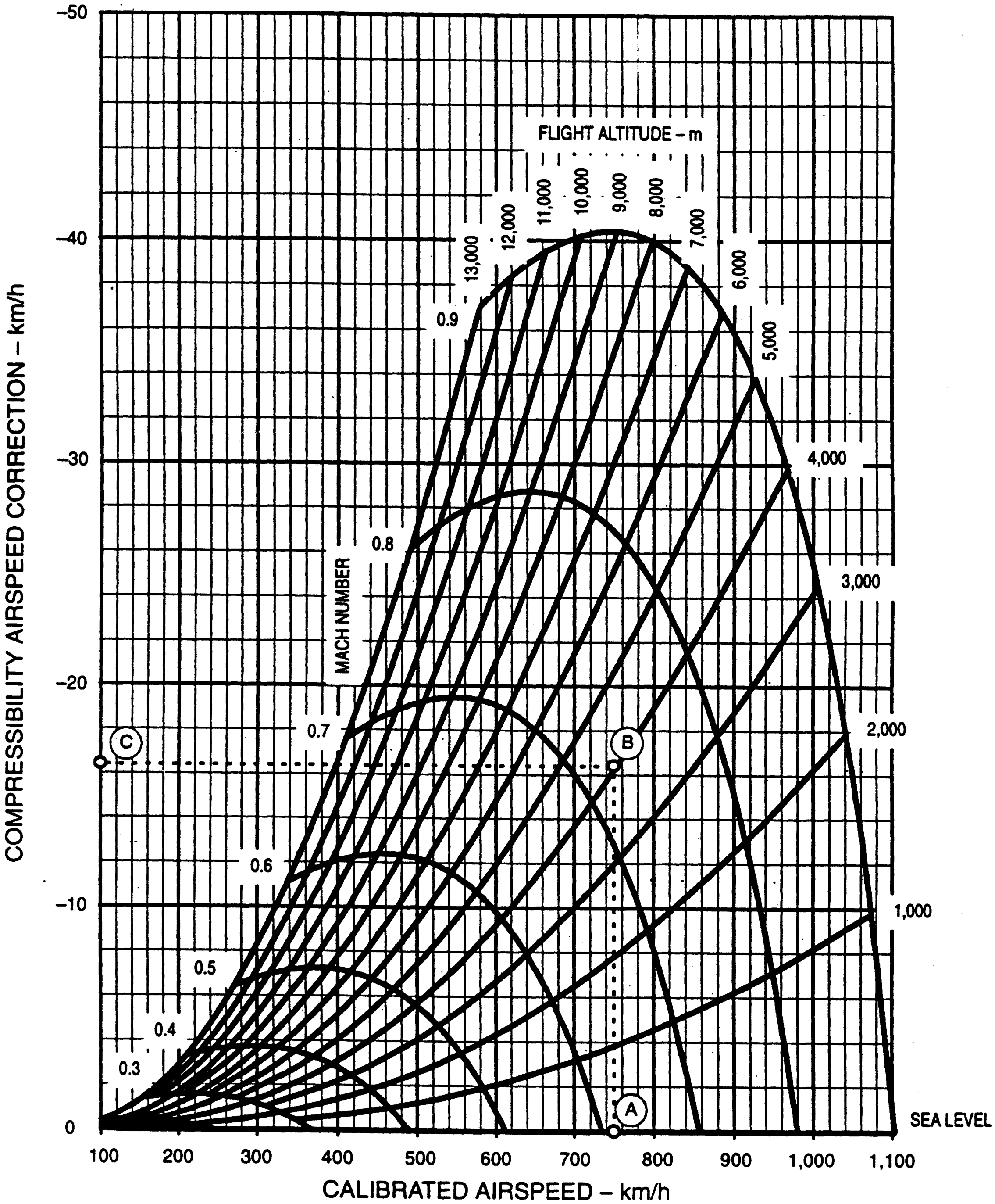


Figure A1–5. Compressibility Correction Chart

Data Basis: Calculated

Date: July 30, 1997

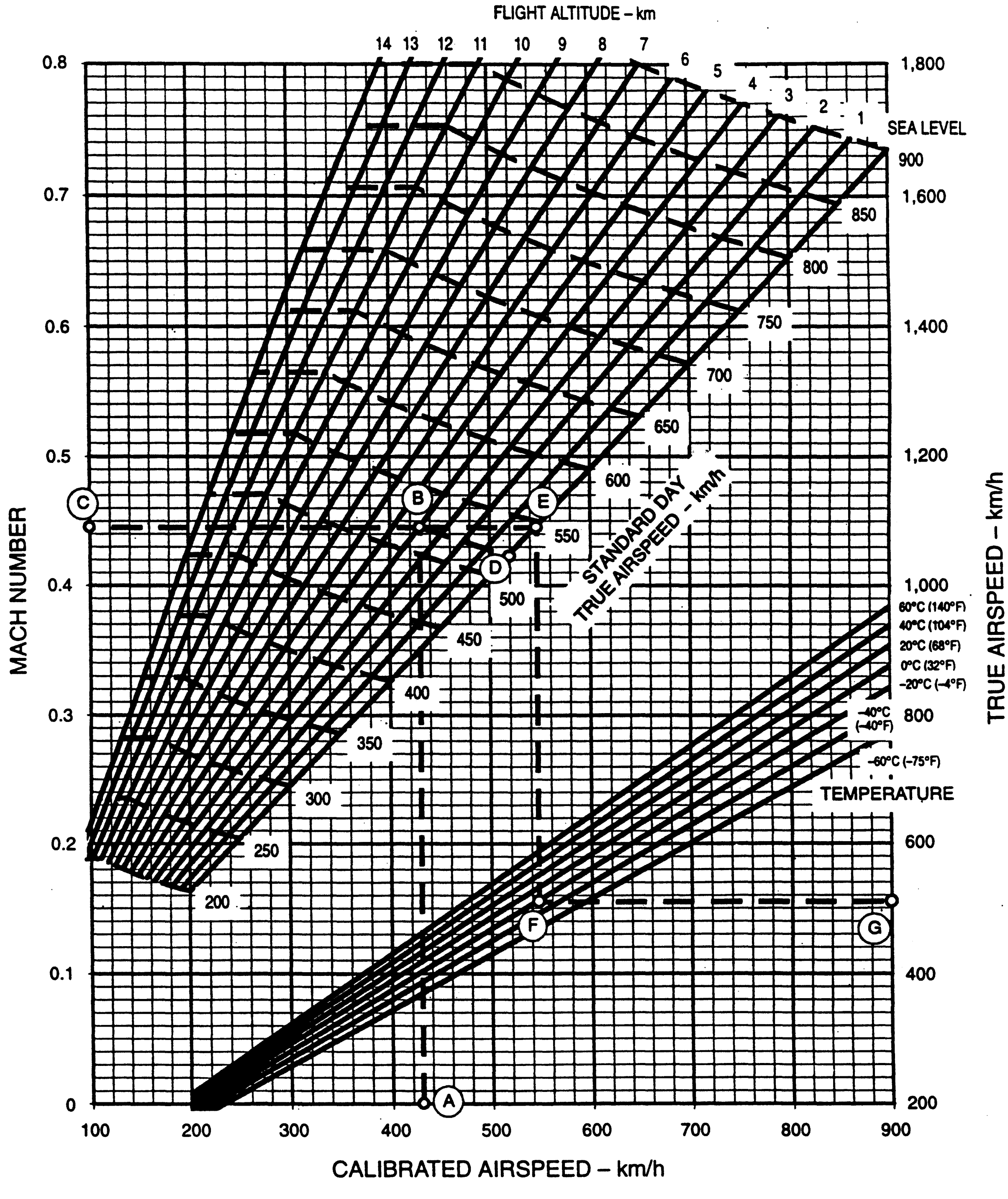


Figure A1–6. Airspeed – Mach Number Conversion Chart

Data Basis: Calculated

Date: July 30, 1997

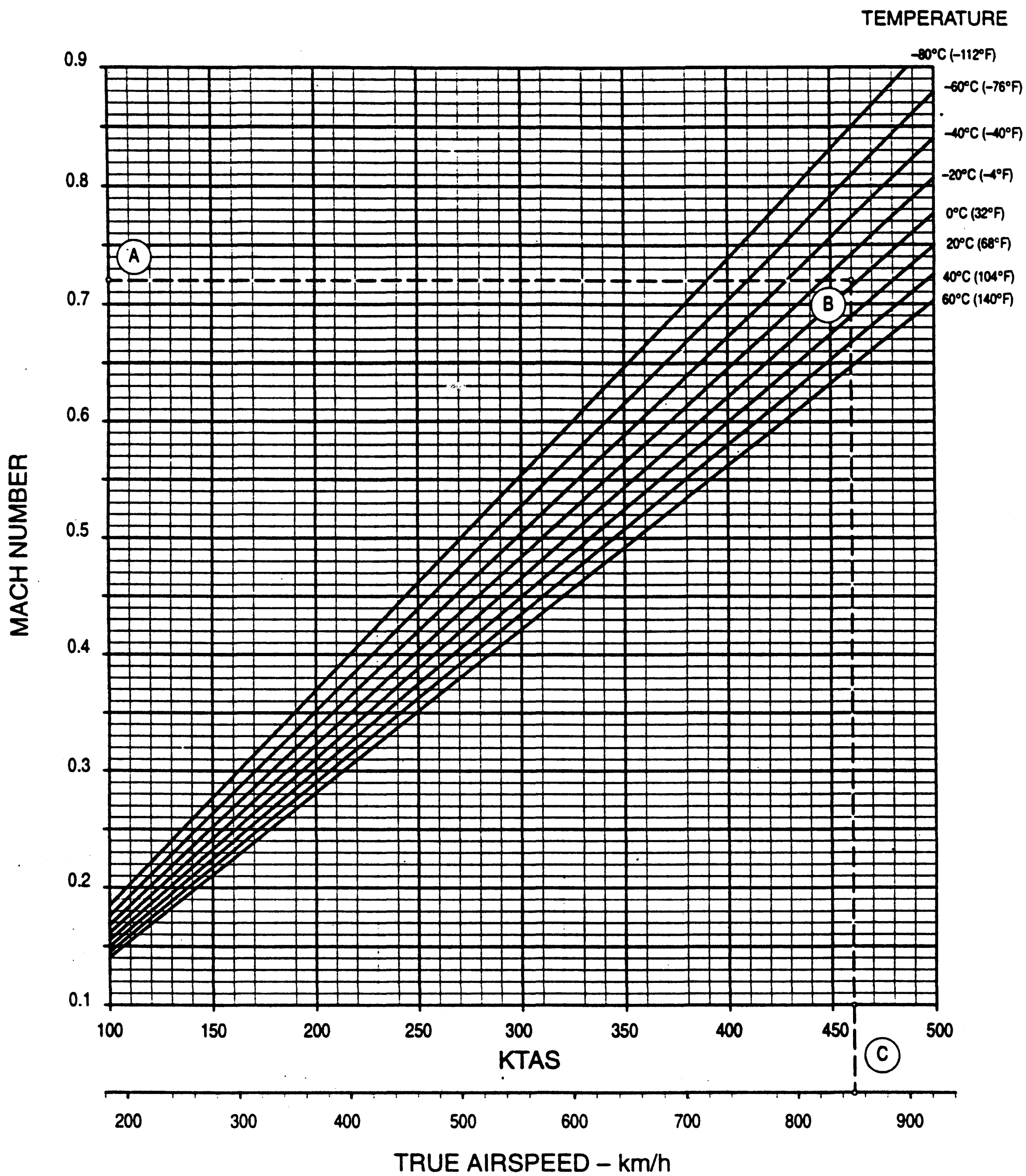


Figure A1–7. Mach Number – True Airspeed Conversion Chart

Data Basis: Calculated

Date: July 30, 1997

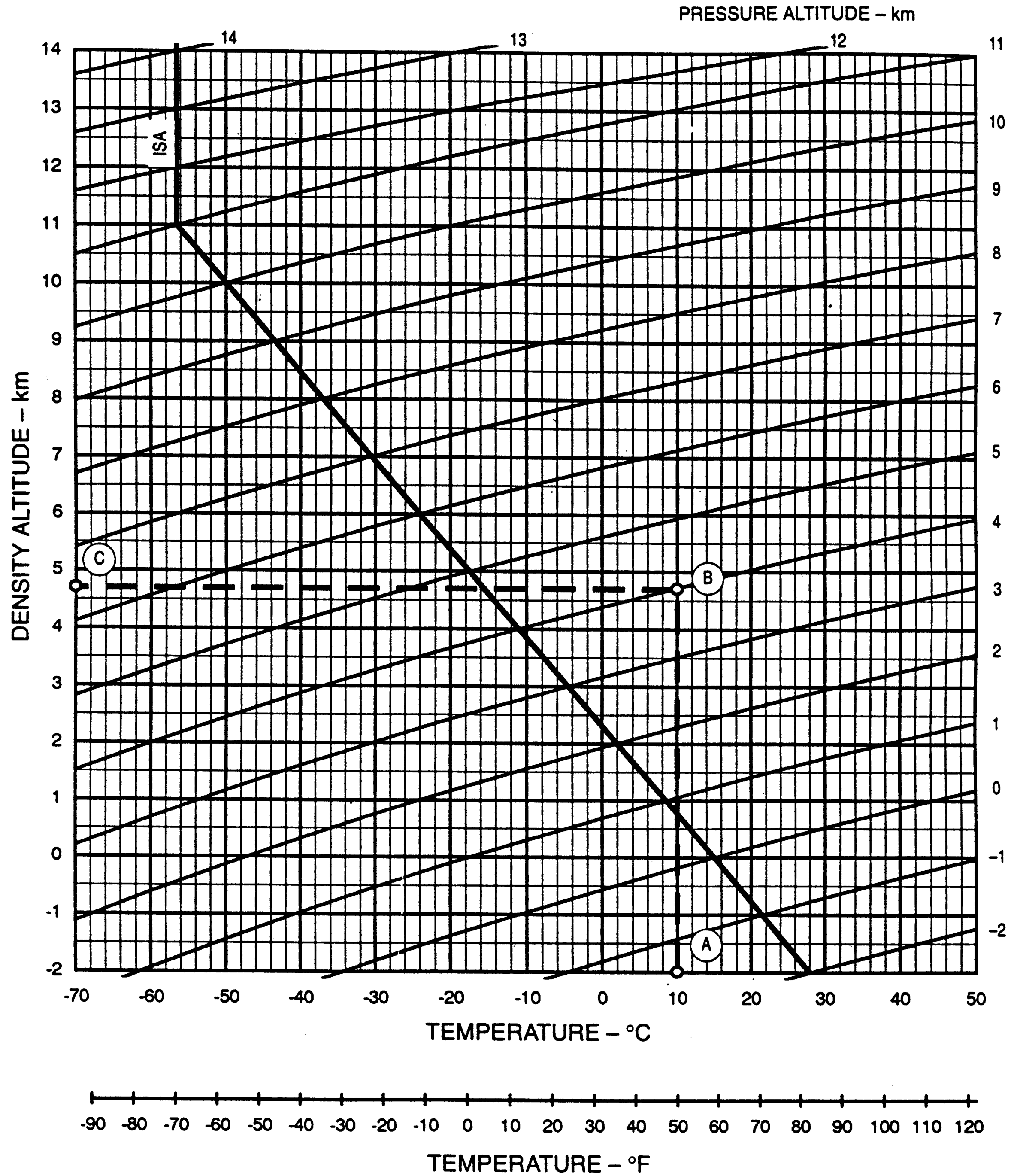


Figure A1–8. Density Altitude Chart

PART 2

TAKEOFF

TAKEOFF DATA

All data needed for takeoff planning are presented in this section. These data are based on maximum power setting and flaps deflection of 25 degrees. Takeoff speed, obstacle clearance speed, ground run distance, total distance to 15 m AGL, accelerate – stop distance and crosswind data may be determined from the charts. Effects of temperature, pressure altitude, drag index, wind, runway slope, and runway condition factor are included on appropriate charts.

TAKEOFF PLANNING

Careful takeoff planning is essential from a standpoint of flight safety and mission success. Proper planning will permit maximum use of the capacity of the aircraft to take off with heavy payloads while maintaining adequate safety margins. Takeoff planning comprises the following:

1. Determine aircraft configuration (total aircraft takeoff gross weight and drag index). Normal takeoff may be made using maximum power setting.
2. Obtain field conditions for expected takeoff time (pressure altitude, temperature, wind, runway slope, etc.).
3. Compute the following data from the charts:
   a. Takeoff and obstacle clearance speed.
   b. Takeoff factor, which will be used to enter most other charts in this section.
   c. Takeoff ground run.
   d. Total takeoff distance.
   e. Accelerate – stop distance.
   f. Wind components.

This information will permit decisions to be made regarding downloading or continuing or refusing takeoff in the event of an emergency. Each chart is discussed in detail in the following paragraphs. An example takeoff planning problem is worked in conjunction with the discussion. The following typical aircraft and field information is normally obtained before using the charts:

Takeoff gross weight .... 4,400 kg

Store loading .... two UB-16-57U rocket pods

Drag index .... 40 (see Part 1)

Runway pressure altitude .... 500 m

Temperature .... 17.5°C (63.5°F)

Runway slope .... 1.5% (uphill)

Wind .... 7.5 m/s (tailwind)

Runway condition factor .... 2 (wet concrete)

NOTE

Rotation speed is not referred to in these charts. Rotation speed is usually 18 – 20 km/h less than takeoff speed.

TAKEOFF AND OBSTACLE CLEARANCE SPEED
(Figure A2–1)

Takeoff speed corresponds to approximately 5 percent increase over power–off stall speed obtained for the aircraft in takeoff configuration. Obstacle clearance speed is about 30 percent higher than power–off stall speed.

Refer to figure A2–1: Enter the chart with gross weight (A) and proceed vertically up to appropriate takeoff speed curve (B) and obstacle clearance speed curve (D). At each point of intersection proceed horizontally left and read values of takeoff (C) and obstacle clearance speed (E), respectively.

EXAMPLE:

A. Gross weight .... 4,400 kg

C. Takeoff speed .... 187.0 km/h

E. Obstacle clearance speed .... 230.6 km/h

TAKEOFF FACTOR (Figure A2–2)

The takeoff factor concept of presenting takeoff performance is used to simplify chart presentations. The takeoff factor is a computed number and is common to all charts for a given aircraft configuration, pressure altitude, and temperature.

Refer to figure A2–2: Enter the chart with runway temperature in terms of either degrees of Fahrenheit (A) or Celsius (B). Project horizontally to pressure altitude (C) and then vertically down to read takeoff factor for aircraft without stores (D) or with stores (E).

EXAMPLE:

A. Runway temperature .... 63.5°F

B. Runway temperature .... 17.5°C

C. Pressure altitude .... 500 m

D. Takeoff factor – no stores 6.32

E. Takeoff factor – with stores 6.88

TAKEOFF GROUND RUN (Figure A2–3)

Refer to figure A2–3: Enter the chart with takeoff factor (A). Project horizontally to gross weight (B), then vertically down to drag index baseline (C), and follow guidelines to drag index (E). Proceed downward to slope baseline (F) and parallel guidelines to slope (H). Proceed vertically down again to wind baseline (I) and parallel guidelines to wind (K); continue downward to runway condition factor (L), and finally project horizontally left to read takeoff ground run (M).

EXAMPLE:

A. Takeoff factor 6.88

B. Gross weight .... 4,400 kg

D. Drag index 40

G. Runway slope .... 1.5% (uphill)

J. Wind .... 7.5 m/s (tailwind)

L. Runway condition factor .... 2 (wet concrete)

M. Takeoff ground run .... 785 m

Runway Condition Factor	Runway Condition
10	Short Hard Grass
8	Wet Grass
4	Dry Concrete
2	Wet Concrete

TOTAL TAKEOFF DISTANCE TO 15 METERS AGL (Figure A2–4)

The chart of total takeoff distance to 15 m AGL is based on maintaining takeoff thrust and accelerating so that at the altitude of 15 m AGL obstacle clearance speed is reached or exceeded.

Refer to figure A2–4: Enter the chart with takeoff ground run (A), project vertically up to the appropriate runway condition line (B), and then project horizontally left to read total distance to 15 m AGL (C). Correct for runway slope using the correction factor given in the NOTE on the chart.

EXAMPLE:

A. Takeoff ground run .... 785 m

B. Runway condition .... wet concrete

C. Total distance to 15 m AGL .... 1,633 m

Slope correction is 4 percent of obtained total takeoff distance per 1 percent of uphill slope = 1.5 × .04 × 1,633 = 98 m. Corrected total takeoff distance to 15 m AGL = 1,731 m.

ACCELERATE – STOP DISTANCE (Figure A2–5)

The accelerate – stop distance chart is based on maximum thrust acceleration to engine failure and continuous brake application during stopping phase. Engine failure is considered to occur at unstick speed. Distances presented in the chart include a time delay equivalent to 3 seconds at engine failure speed; after that the aircraft is supposed to decelerate with flaps deflected and speedbrakes closed. Braking speed limits (see Section V) are not taken into account. Effects of gross weight, wind and runway condition are shown in the chart. Drag index and runway slope effects are negligible.

CAUTION

Using brakes at higher speeds than maximum permissible braking speed (see braking speed limit, Section V) may damage them. After every such case the brakes must be inspected.

Refer to figure A2–5: Enter the chart with takeoff factor (A). Project to the right to gross weight (B), then down to wind baseline (C), follow guidelines to wind (D, E); proceed down again to runway condition curve (F), and finally to the left and read accelerate – stop distance (G).

EXAMPLE:

A. Takeoff factor 6.88

B. Gross weight .... 4,400 kg

D. Wind .... 7.5 m/s (tailwind)

F. Runway condition .... wet concrete

G. Accelerate – stop distance .... 1,908 m

TAKEOFF AND LANDING CROSSWIND LIMIT

(Figure A2–6)

The chart is to be used to resolve reported wind velocity into headwind and crosswind components. Crosswind component limits for takeoff and landing are also shown.

Refer to figure A2–6: Enter the chart at the point where reported windspeed intersects wind direction relative to runway (A). Project down to read crosswind (B) and project to the left to read headwind (C).

EXAMPLE:

A. Windspeed .... 8.0 m/s

Wind direction relative to runway .... 30°

B. Crosswind .... 4.0 m/s

C. Headwind .... 6.9 m/s

Data Basis: Estimated

Date: March 3, 1997

Conditions: Maximum Rating
Flaps at Takeoff Position
All Temperatures
All Altitudes

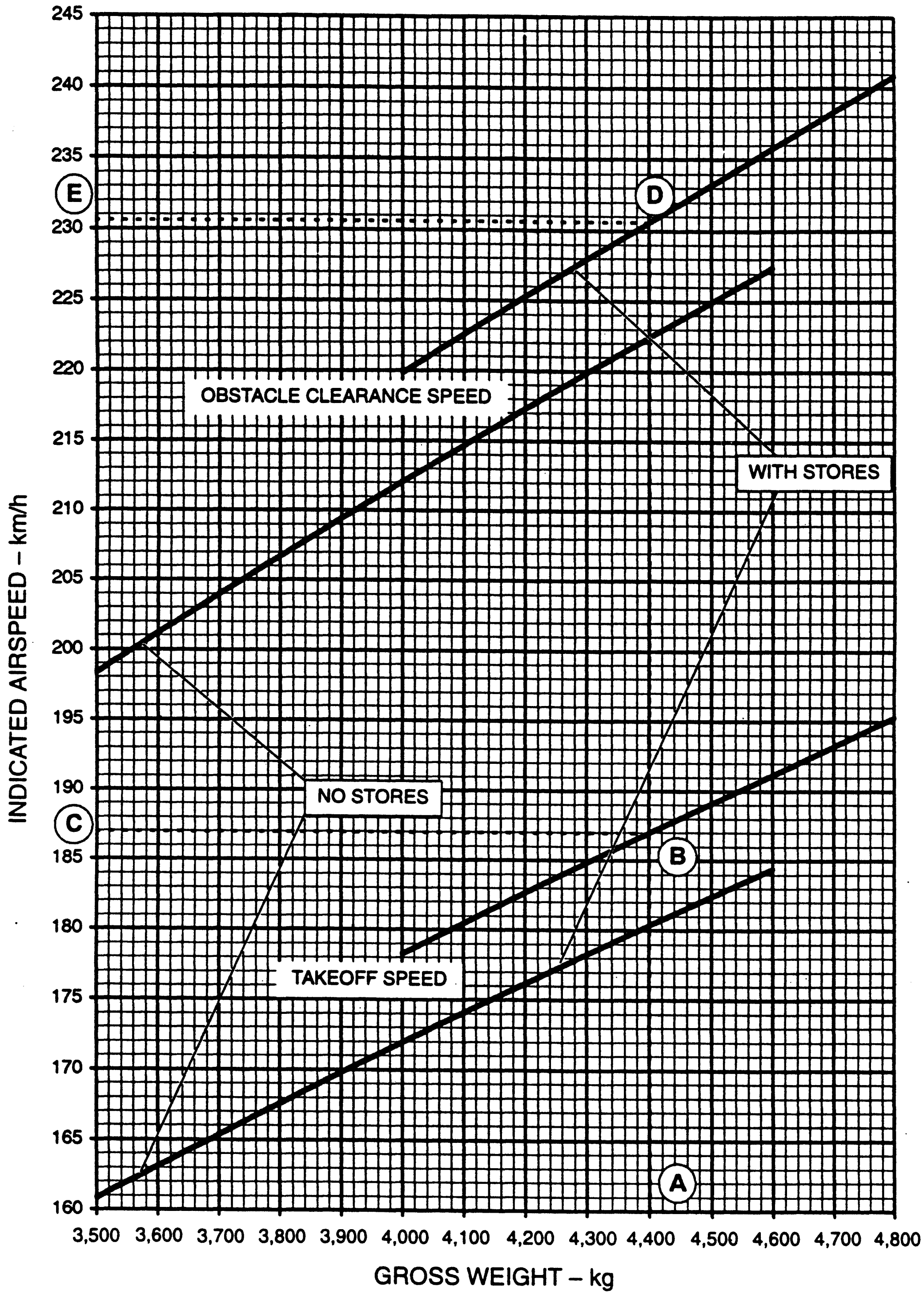


Figure A2–1. Takeoff and Obstacle Clearance Speed

Data Basis:	Estimated	Conditions:	Maximum Rating Flaps at Takeoff Position
Date:	March 3, 1997		

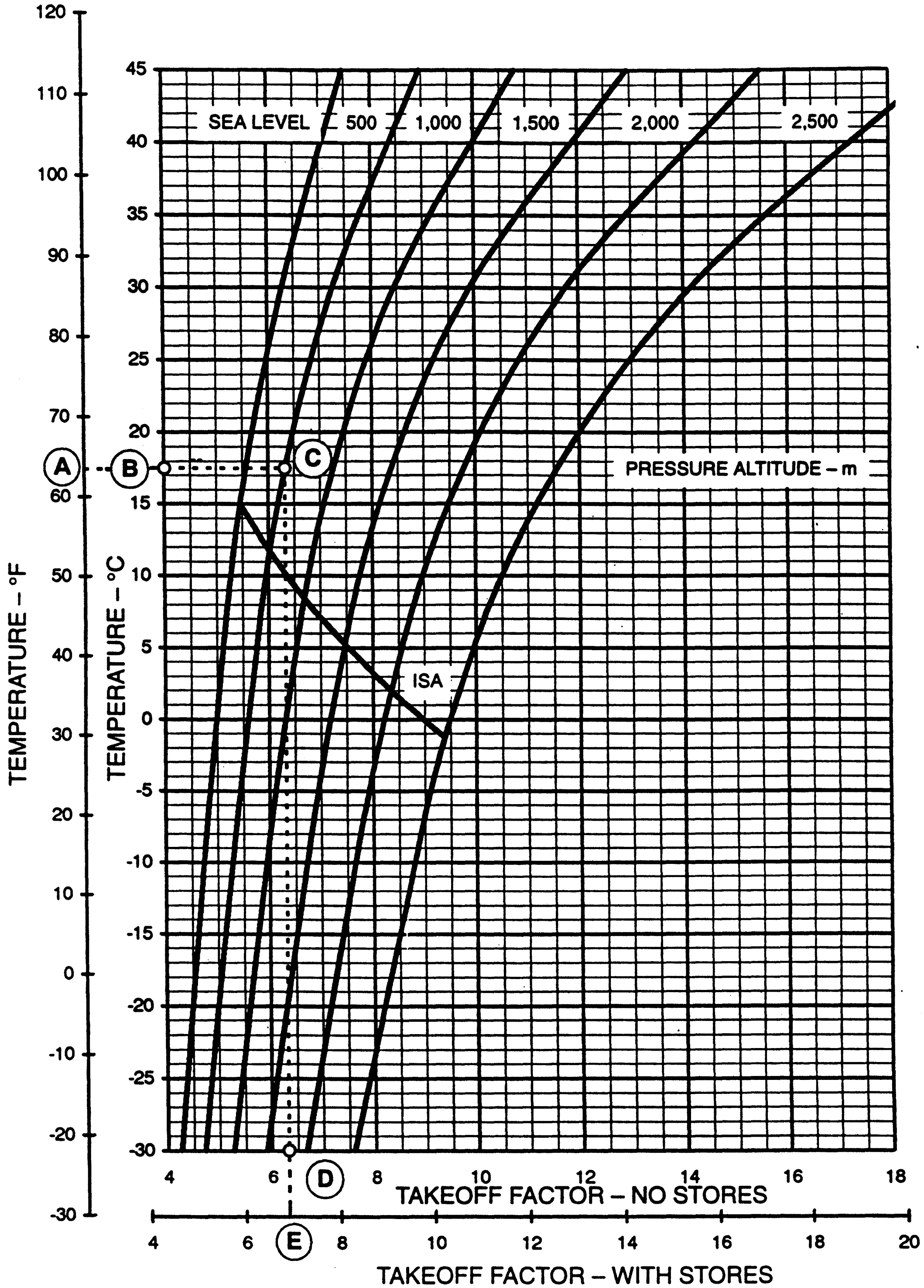


Figure A2–2. Takeoff Factor

Data Basis:	Estimated	Conditions:	Maximum Rating
Date:	March 3, 1997		Flaps at Takeoff Position

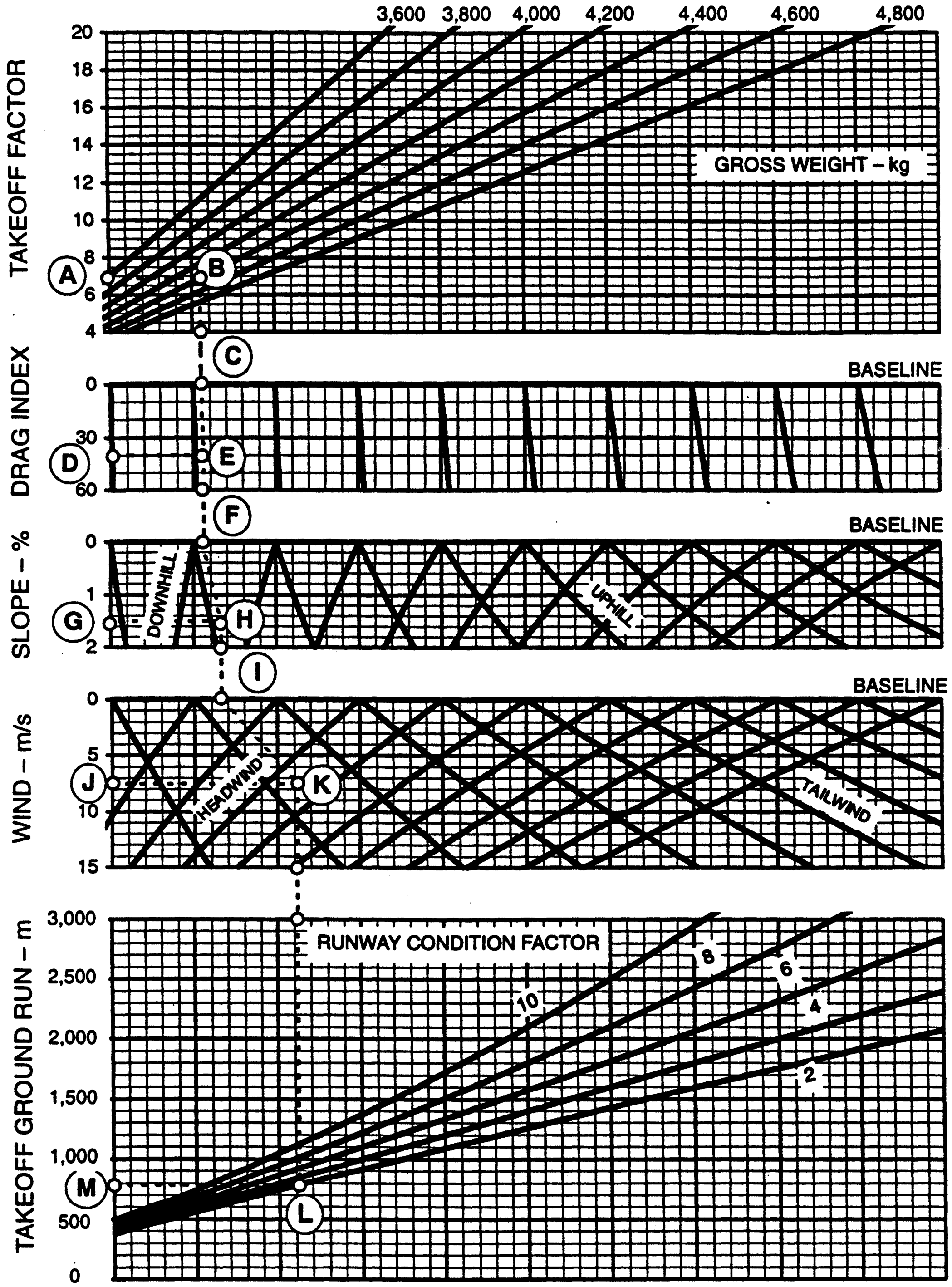
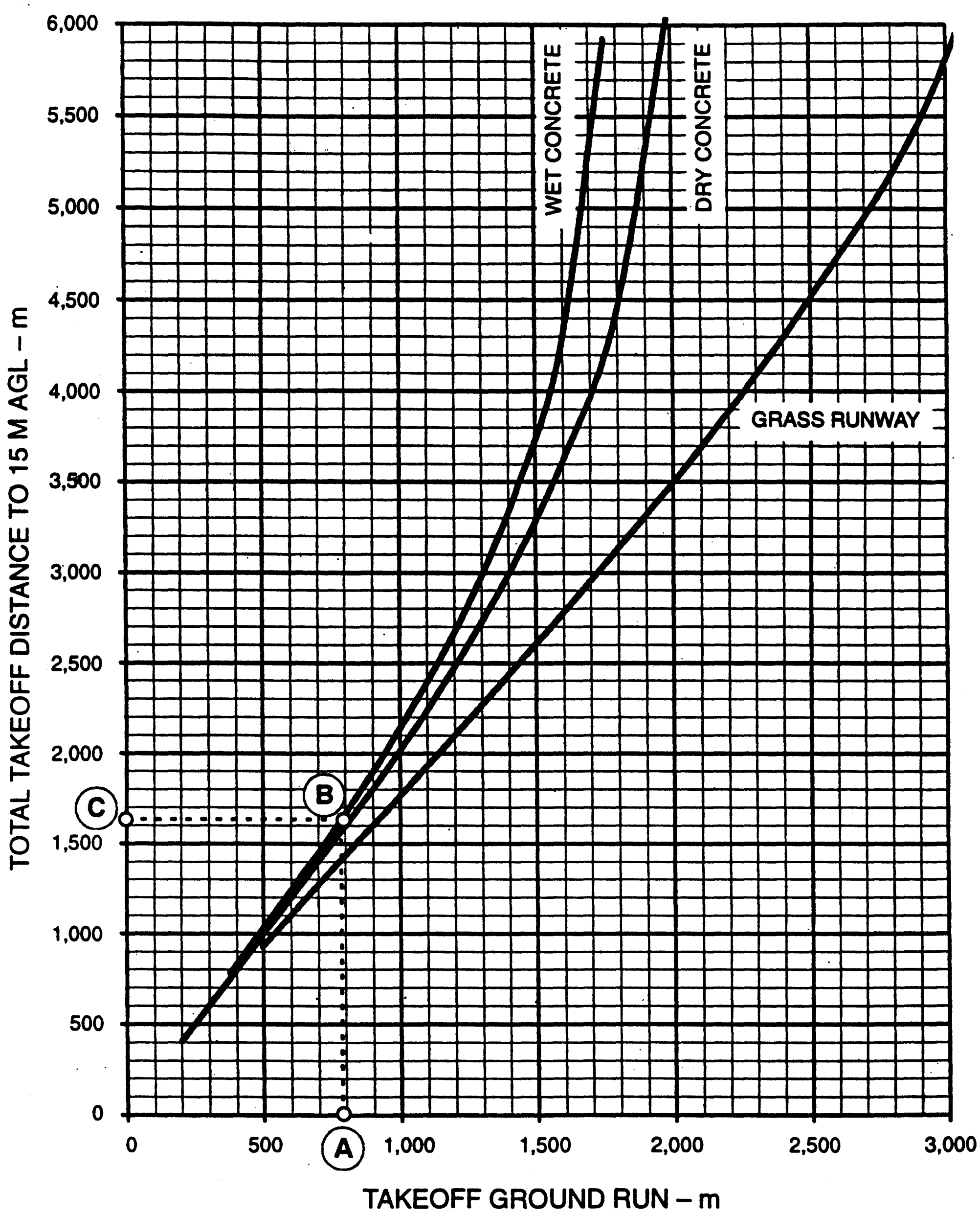


Figure A2–3. Takeoff Ground Run

Data Basis: Estimated
Date: March 3, 1997

Conditions: Maximum Rating
Flaps at Takeoff Position



NOTE

Each 1% downhill runway slope decreses total takeoff distance to 15 m AGL by 5%.
Each 1% uphill runway slope increses total takeoff distance to 15 m AGL by 4%.

Figure A2–4. Total Takeoff Distance to 15 m AGL

Data Basis: Estimated

Date: March 3, 1997

Conditions: Engine failure at unstick speed
Maximum Rating and takeoff flaps up to engine failure
Start of braking 3 sec. after engine failure
Zero thrust and both flaps and speed-brakes retracted after refusal

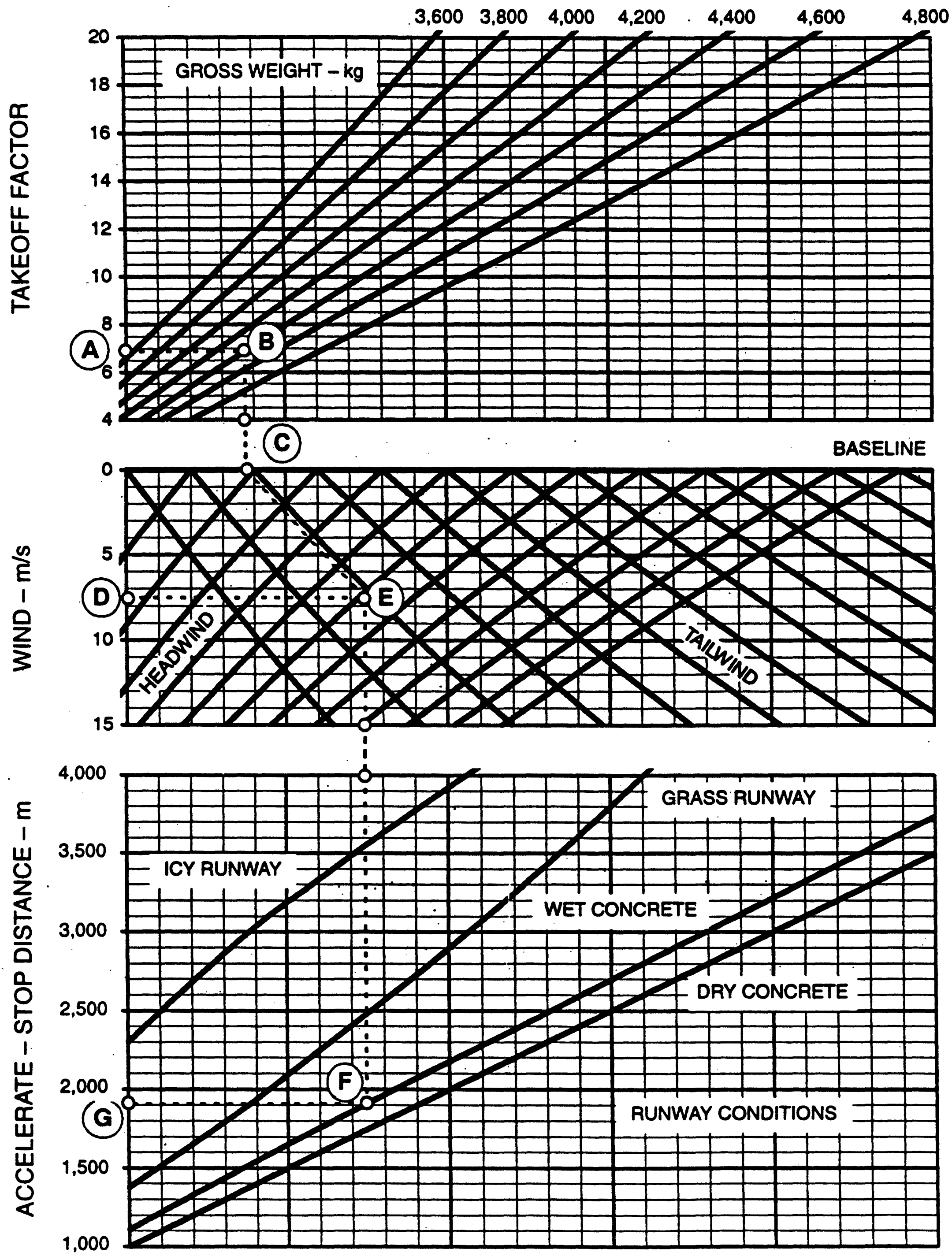
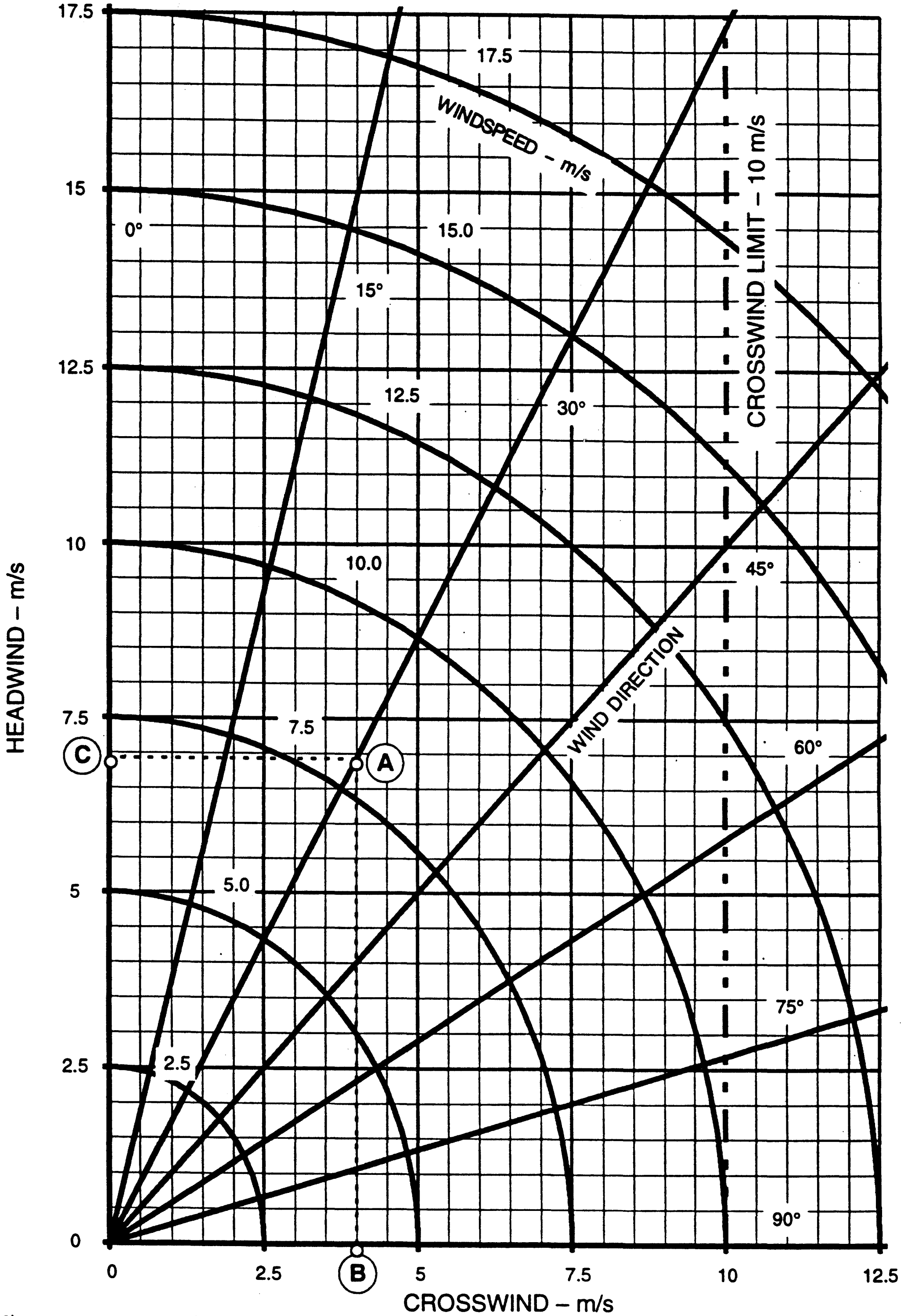


Figure A2–5. Accelerate – Stop Distance

Data Basis: Estimated

Date: March 3, 1997



* 0°(360°) means runway direction

Figure A2–6. Takeoff and Landing Crosswind Limit

PART 3

CLIMB

SERVICE CEILING (Figure A3–1)

Refer to Figure A3–1: Enter the chart with GROSS WEIGHT (A), project upward to drag index (B), and then project to the left to read service ceiling (C).

The chart is quoted for maximal power setting.

EXAMPLE:

A. Gross Weight .... 3,770 kg

B. Drag index 30

C. Service ceiling .... 10,835 m

MAXIMAL CLIMB (Figure A3–2)

The charts contain MAX climb data (maximal power setting).

Fuel consumed data are shown in Figure A3–2 sheet 1 and time and distance data are shown in Figure A3–2 sheet 2. The data are for climbs starting at sea level, but performance data for climbs from any altitude to a higher altitude may also be determined. Climb speed schedule is tabulated as a function of drag index. The climb airspeeds shown were selected to maintain maximum fuel efficiency while still providing near maximum rate of climb.

Refer to Figure A3–2: Enter Figure A3–2 sheet 1 at initial gross weight (A); proceed horizontally to final altitude (B); vertically to drag index (C), and horizontally to read fuel consumed (D). If initial altitude is above sea level, reenter chart at initial gross weight (A), proceed horizontally to initial altitude (E), and continue as above to read fuel used (F). The difference between fuel consumed to final altitude and fuel used to initial altitude is the fuel used to climb from initial to final altitude. Climb time and distance are found in a similar manner from Figure A3–2 sheet 2.

EXAMPLE:

Figure A3–2 sheet 1

A. Sea level gross weight .... 4,250 kg

B. Final altitude .... 7,000 m

C. Drag index 30

D. Fuel consumed to final altitude .... 111 kg

E. Initial altitude .... 2,000 m

F. Fuel consumed to initial altitude .... 27 kg
Fuel consumed to climb .... $111 - 27 = 84$ kg

Figure A3–2 sheet 2

G. Distance in climb to final altitude .... 70 km

H. Time in climb to final altitude .... 9.2 minutes

I. Distance in climb to initial altitude .... 12 km

J. Time in climb to initial altitude .... 1.7 minutes
Distance in climb .... $70 - 12 = 58$ km
Time in climb .... $9.2 - 1.7 = 7.5$ minutes

Climb fuel, time and distance charts are base on a standard day.

Data Basis:	Estimated	Conditions:	Maximum Power Setting Standard Day
Engine:	AI-25TL		

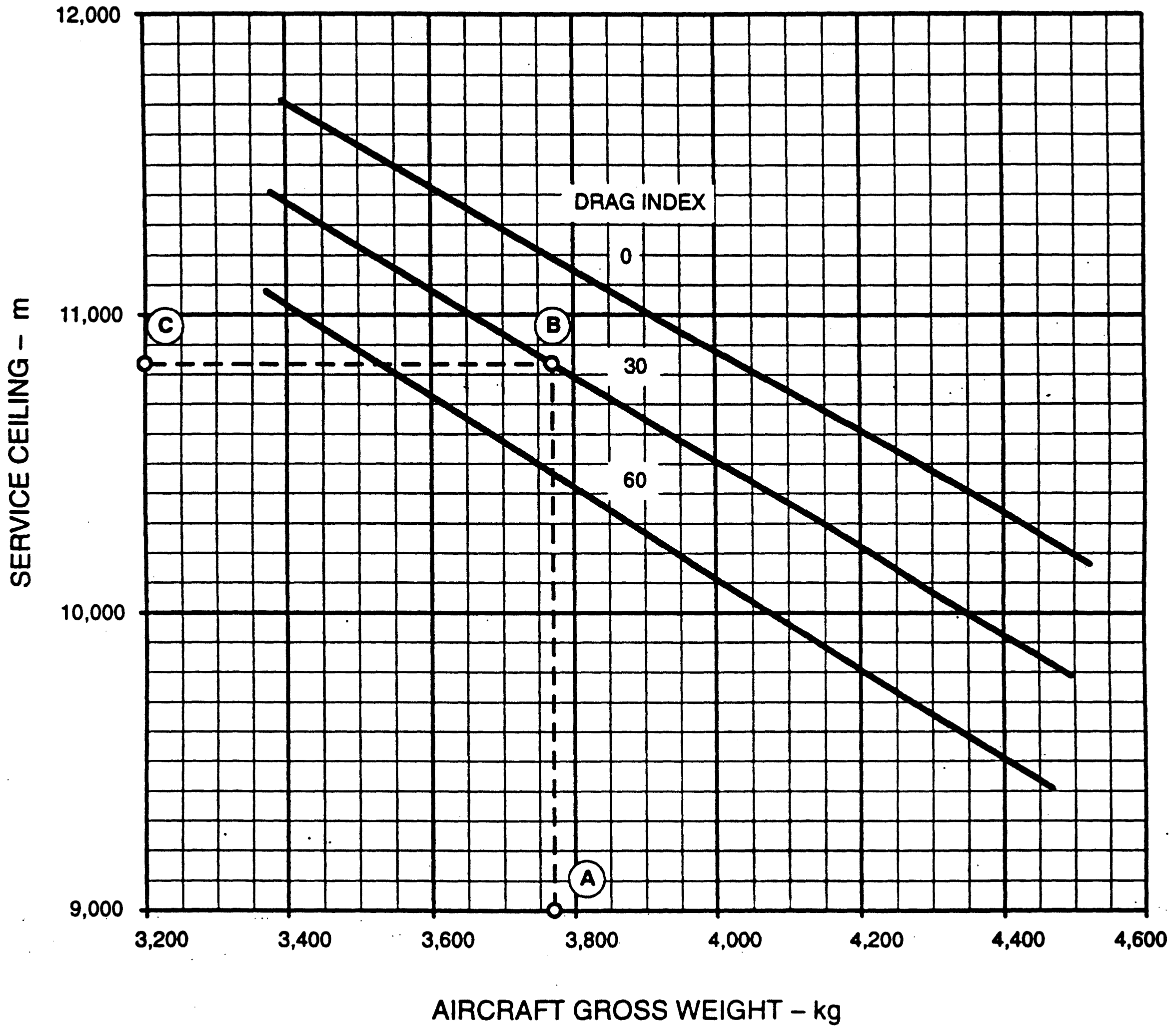
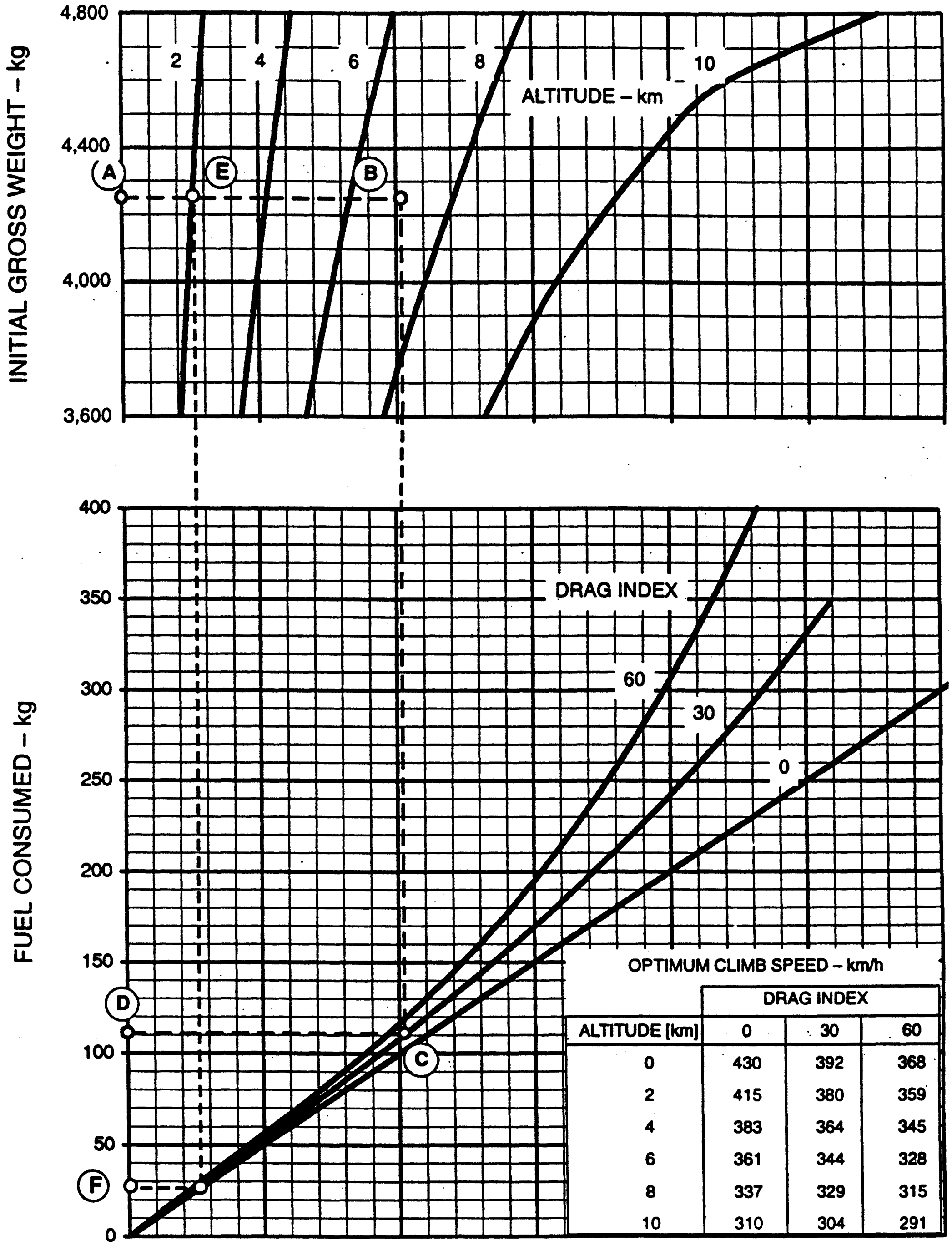


Figure A3–1. Service Ceiling

Data Basis:	Estimated	Conditions:	Maximal Rating Standard Day
Engine:	AI-25TL		

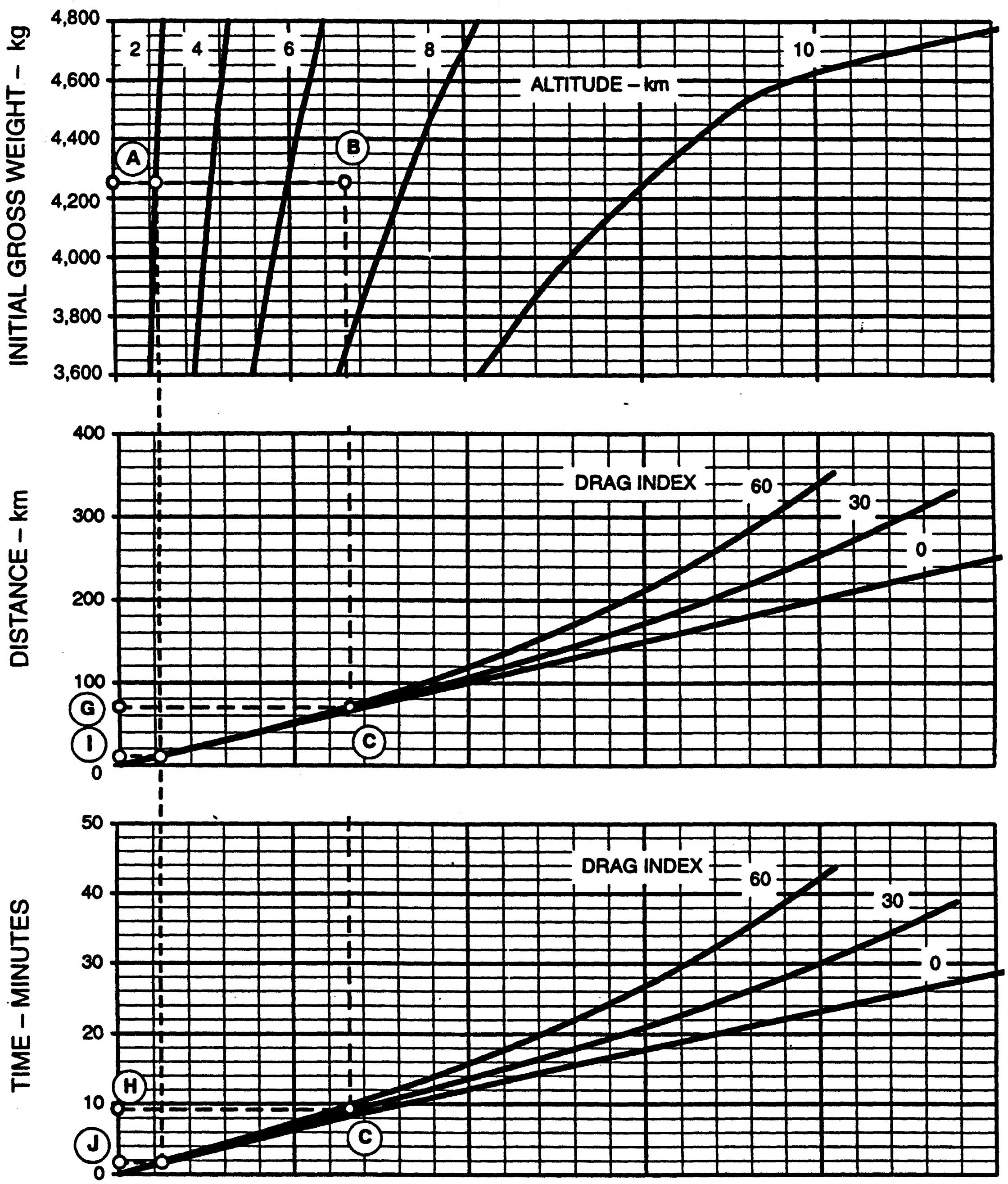


OPTIMUM CLIMB SPEED – km/h

ALTITUDE [km]	DRAG INDEX 0	DRAG INDEX 30	DRAG INDEX 60
0	430	392	368
2	415	380	359
4	383	364	345
6	361	344	328
8	337	329	315
10	310	304	291

Figure A3–2. Maximal Climb – Fuel Consumption (sheet 1 of 2)

Data Basis:	Estimated	Conditions:	Maximal Rating Standard Day
Engine:	AI-25TL		



* For optimum climb speed table refer to sheet 1.

Figure A3–2. Maximal Climb – Distance and Time (sheet 2 of 2)

PART 4

CRUISE

CRUISE DATA

The cruise data shown in this part are presented in a format which enables the mission planner to calculate the optimum cruise performance available for any combination of flight conditions. Charts are supplied to cover the expected range of drag indices. Three conversion charts are supplied as aids in computing altitude factor, true airspeed, kilometers per kilogram of fuel, and fuel flow. The following considerations will assist in selecting the combination of flight conditions and techniques which will result in required mission performance:

- Optimum Mach/Optimum Altitude: A cruise–climb technique is required. Mach remains constant throughout the cruise while altitude increases as fuel is consumed. Changes in optimum Mach due to changes in gross weight are insignificant. Use of this technique will result in maximum attainable range (including maximum aircraft capability).
- Optimum Mach/Constant Altitude: Mach number is decreased as fuel is consumed. This cruise technique will yield maximum cruise performance at a given altitude.
- Constant Mach/Constant Altitude: Cruise at a given Mach and altitude condition. This technique does not usually provide maximum performance but is often used due to time and flightpath constraints.
- Constant Mach/Optimum Altitude: Any given Mach number is held constant and altitude is increased as fuel is consumed. This technique will result in maximum range at a given Mach number.

ALTITUDE FACTOR (Figure A4–1)

The chart provides a quick means of computing altitude factor for known gross weight and altitude or converting altitude factor back into altitude. Any two parameters can be used to find the third.

Refer to figure A4–1: To obtain altitude factor for known gross weight and altitude, enter chart with gross weight (A), project vertically upward to altitude (B) and horizontally to the left to read altitude factor (C). To obtain altitude for known gross weight and altitude factor, enter chart with gross weight (D) and project vertically upward. Enter with altitude factor (E) and project horizontally to the right until the gross weight line is intersected. Read altitude at the intersection of these two lines (F).

EXAMPLE:

A. Gross weight .... 3,925 kg

B. Altitude .... 2,000 m

C. Altitude factor 5.0

D. Gross weight .... 3,925 kg

E. Altitude factor 15

F. Altitude .... 10,000 m

SPECIFIC RANGE CONVERSION (Figure A4–2)

The chart is used primarily to convert range factor into kilometers per kilogram of fuel (specific range).

Refer to figure A4–2: To convert range factor into specific range, enter chart with range factor (A), project vertically up to gross weight (B) and horizontally to the left to read specific range (C).

EXAMPLE:

A. Range factor 4.22

B. Gross weight .... 3,925 kg

C. Specific range .... 1.08 km/kg of fuel

FUEL FLOW CONVERSION (Figure A4–3)

The chart is used to convert specific range and speed into fuel flow.

Refer to figure A4–3: To convert specific range into fuel flow, enter chart with Mach number (A); project to the right to temperature (standard day temperature is shown on figure A1–8) (B); Then project downward, reading true airspeed (C); continue upward to specific range line (D); and finally to the left to read fuel flow (E).

EXAMPLE:

A. Mach number 0.42

B. Temperature .... 2°C (Standard day temperature is shown)

C. True airspeed .... 503 km/h

D. Specific range .... 1.08 km/kg of fuel

E. Fuel flow .... 468 kg/h

CRUISE (Figure A4–4)

The chart contains cruise data plotted as range factor versus Mach number for lines of constant altitude factor. A correction grid is supplied for interpolating drag index. Chart covers a range of drag indices. Use the chart to determine range factor. Four sets of usage instructions and sample problems are given below to illustrate the four different cruise techniques defined earlier in this section.

CONSTANT MACH/CONSTANT ALTITUDE CRUISE

Refer to figure A4–4: Enter Figure A4–1 with desired cruise altitude and initial gross weight and compute altitude factor. Enter Cruise chart (A4–4) at desired cruise Mach (A), project upward to altitude factor (B), horizontally to the right to the drag index baseline and parallel nearest guideline to (C) drag index, and then horizontally to read range factor (D). This entire process is repeated for a sufficient number of gross weight to obtain required cruise range.

EXAMPLE:

Desired cruise altitude .... 2,000 m

Initial cruise gross weight .... 3,925 kg

A. Desired cruise Mach 0.42

B. Altitude factor .... 5 (from figure A4–1)

C. Drag index 30

D. Range factor 4.22

Note that as weight and altitude factor decrease, range factor also decreases. Specific range and fuel flow may be obtained as before for each gross weight.

CONSTANT MACH/OPTIMUM ALTITUDE CRUISE

Refer to Figure A4–4: Enter Cruise chart at desired cruise Mach number (A) and project vertically to the optimum (highest) altitude factor line (E). Note value of altitude factor. From (E) project to the right and correct for drag index (F); then continue to the right and read range factor (G). Altitude factor and range factor are constants for this type of cruise, allowing cruise altitude, specific range, and fuel flow to be computed for several gross weight using only the conversion charts.

EXAMPLE:

A. Desired cruise Mach number 0.42

E. Altitude factor 12

F. Drag index 30

G. Range factor 6.58

Altitude and specific range are found for any gross weight by using the conversion charts.

OPTIMUM MACH/OPTIMUM ALTITUDE CRUISE
(Figure A4–5)

Cruise data are shown as specific range and optimum altitude versus gross weight for lines of drag index. Optimum cruise Mach numbers are tabulated on each drag index line. Fuel flow may be computed from Figure A4–3.

Refer to Figure A4–5: Enter chart with cruise gross weight (A) and project vertically upward to drag index (B). In the lower portion of the chart, project to the left from (B) to read specific range (C). In the upper portion of the chart, project to the left from (D) to read the cruise altitude (E). Optimum cruise Mach number is obtained from the Mach numbers indicated on the drag index lines in the lower portion of the chart.

EXAMPLE:

A. Gross weight .... 3,925 kg

B. Drag index 30

C. Specific range .... 1.87 km/kg of fuel

D. Optimum cruise altitude .... 9,550 m

Optimum cruise Mach 0.50

OPTIMUM MACH/CONSTANT ALTITUDE CRUISE (Figure A4–6 and A4–7)

Time required to cruise given distance and fuel required to cruise given time are included in the charts. Optimum cruise Mach number, true airspeed, ground speed and time required to cruise given distance are shown in Figure A4–6. Specific range at optimum Mach number, fuel flow and fuel required to cruise a specified time are shown in Figure A4–7.

Refer to Figure A4–6 and A4–7: Enter Figure A4–6 with average gross weight (A), proceed to the right to desired cruise altitude (B), and then vertically down to drag index (C). From (C), project to the left and read optimum cruise Mach number (D). Return to (C) and proceed to the right to temperature baseline and parallel guidelines to ambient temperature (E) and then to the right to the appropriate wind line (F) and the true airspeed (zero wind) line (G). From (G), project downward to read true airspeed (H). From (F), project upward, reading ground speed at (I), to desired range (ground distance) (J) and finally project to the left to read cruise time (K).

Enter Figure A4–7 with average gross weight (A), proceed to the right to desired cruise altitude (B), and then vertically down to drag index (C). From (C), project to the left and read specific range (D). Return to (C) and proceed to the right to true airspeed (E) (obtained from sheet 1), then up to read fuel flow at (F), continue to time (G), and finally to the left to read fuel required at (H).

EXAMPLE:

From Figure A4–6

A. Average gross weight .... 4,150 kg

B. Desired cruise altitude .... 6 km

C. Drag index 0

D. Optimum cruise Mach 0.442

E. Ambient temperature ... −24°C (from figure A1–8)

F. Wind .... 100 km/h (headwind)

H. True airspeed .... 503 km/h

I. Groundspeed .... 403 km/h

J. Desired range (ground distance) .... 400 km

K. Time .... 60 minutes

From Figure A4–7

A. Average gross weight .... 4,150 kg

B. Desired cruise altitude .... 6 km

C. Drag index 0

D. Specific range .... 1.58 km/kg of fuel

E. True airspeed .... 503 km/h (from sheet 1)

F. Fuel flow .... 318 kg/h

G. Time to cruise 400 km
(includes wind correction) ... 60 minutes (from sheet 1)

H. Fuel required to cruise 400 km .... 318 kg

Data Basis: Estimated
Date: July 30, 1997

Conditions: Standard Day

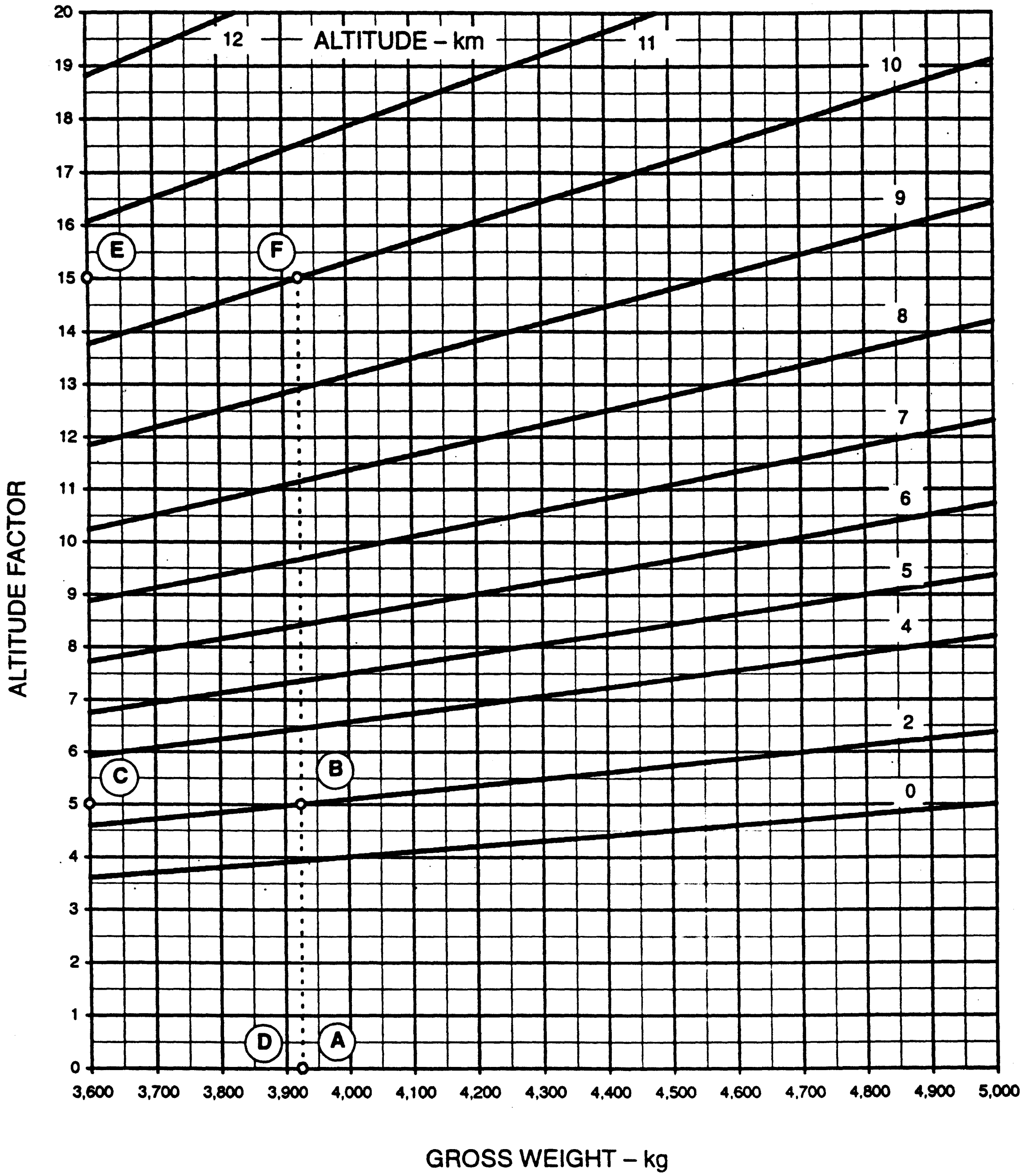


Figure A4–1. Altitude Factor

Data Basis: Estimated
Date: July 30, 1997

Conditions: Standard Day

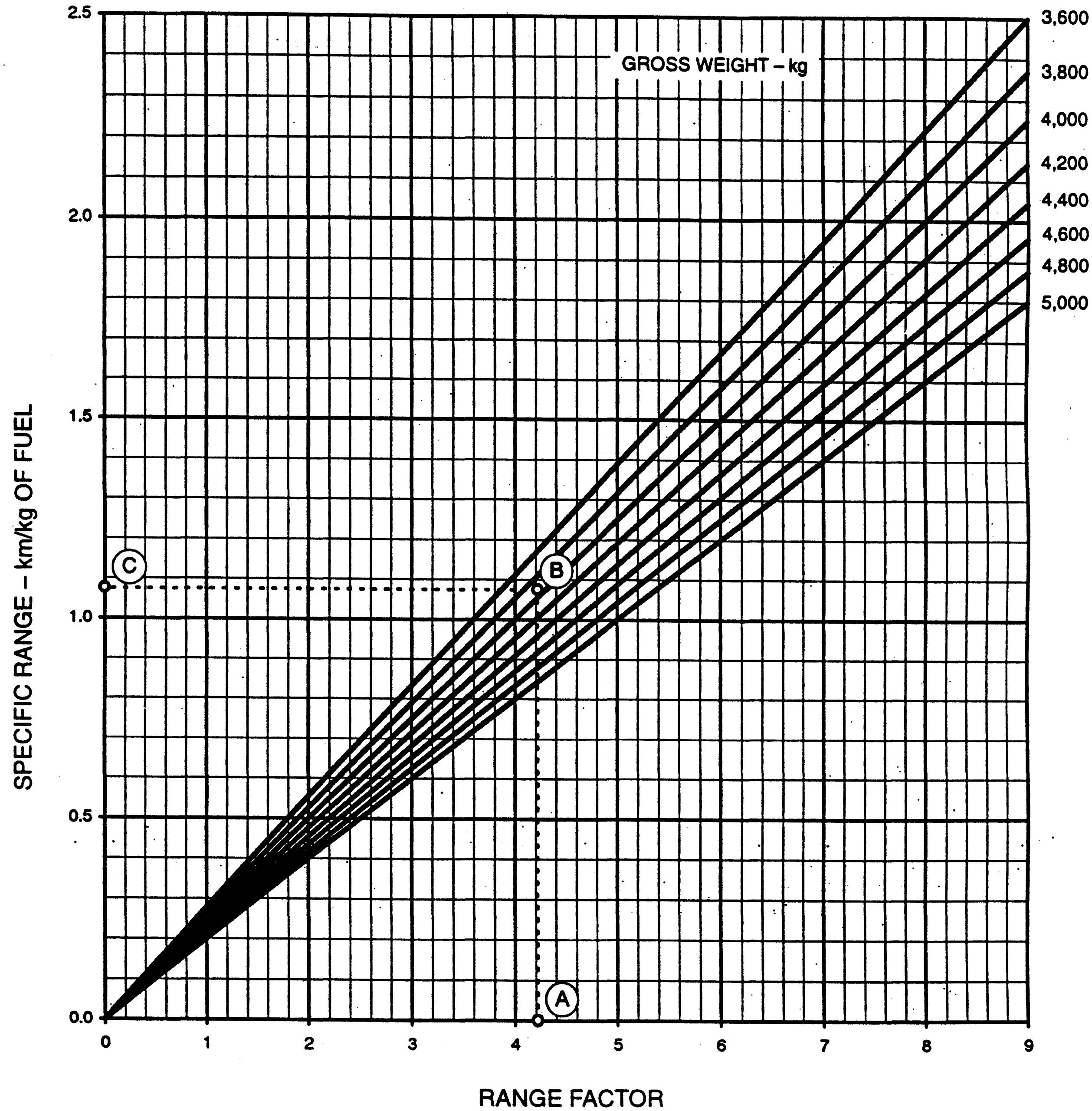


Figure A4–2. Specific Range Conversion

Data Basis: Estimated

Date: July 30, 1997

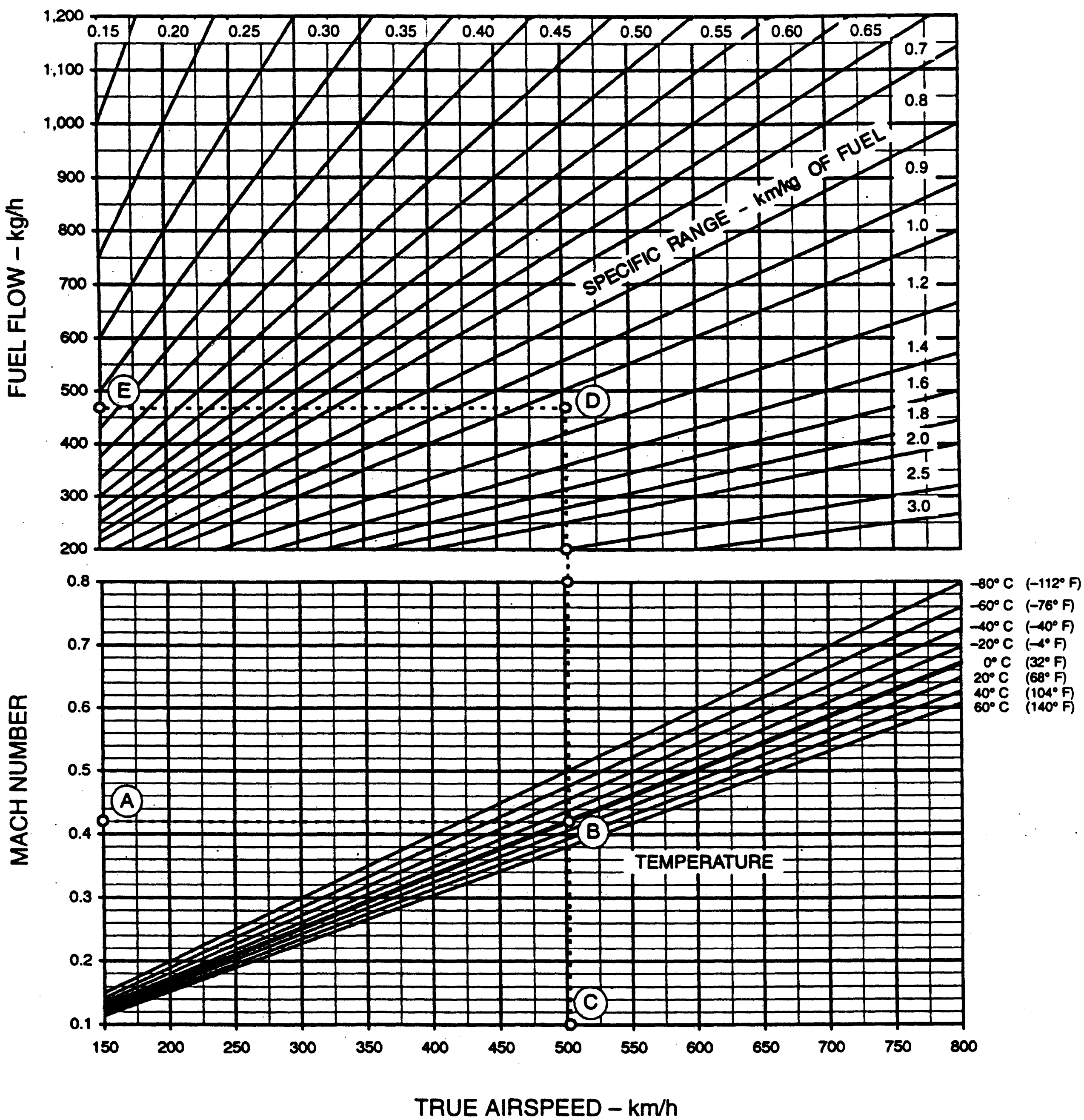


Figure A4–3. Fuel Flow Conversion

Data Basis: Estimated
Date: July 30, 1997

Conditions: Standard Day

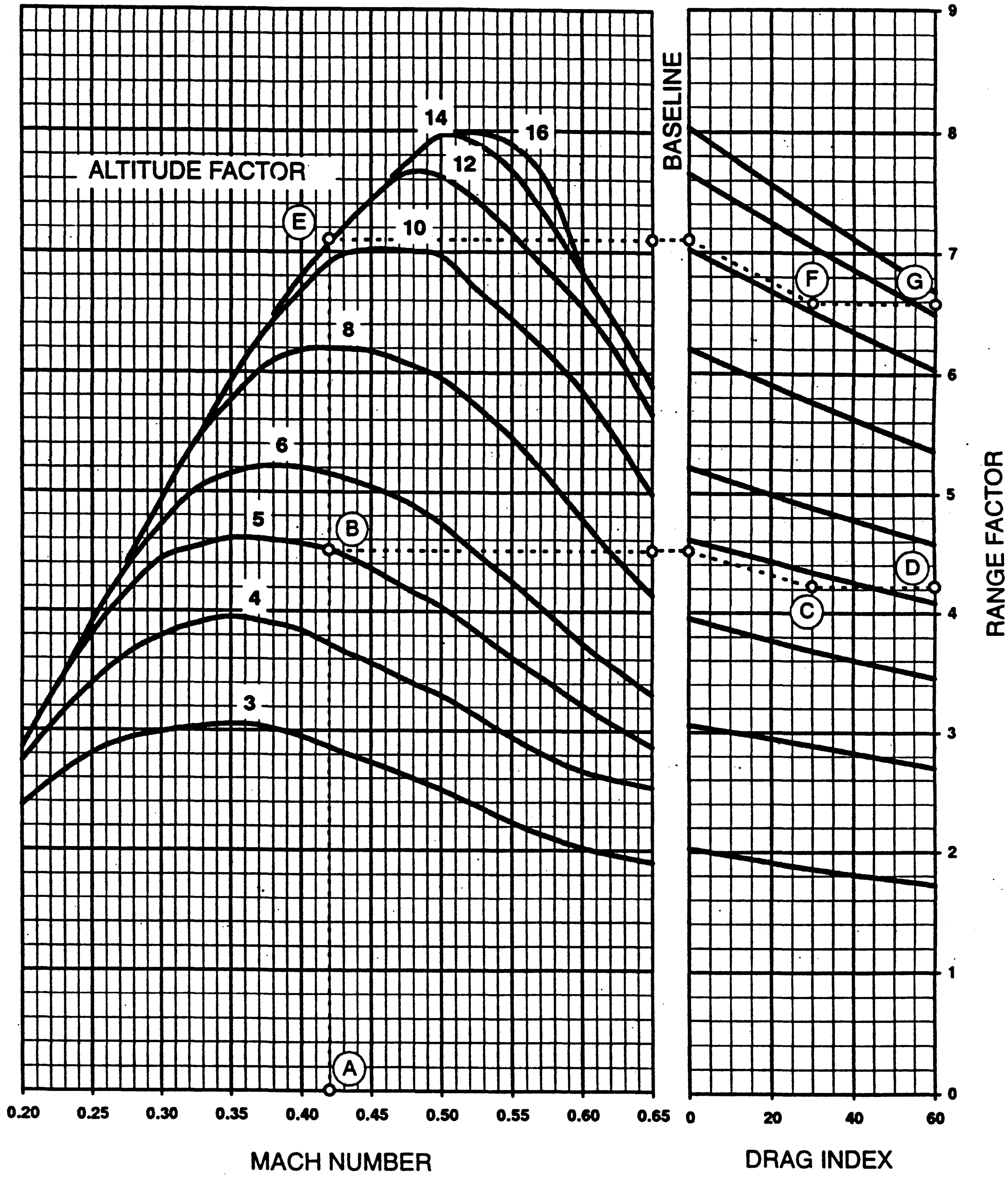


Figure A4–4. Cruise

Data Basis: Estimated | Conditions: Standard Day
Date: July 30, 1997

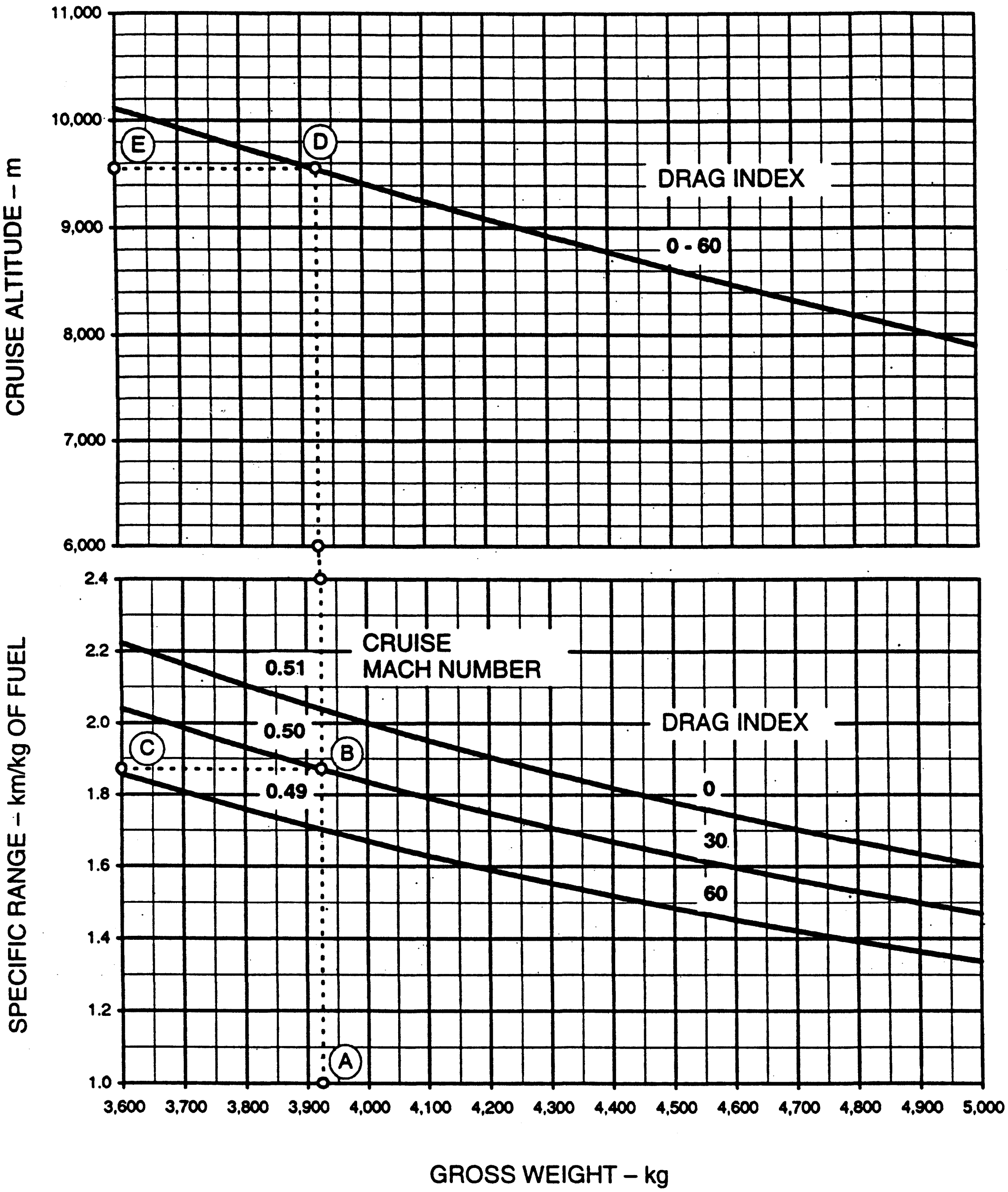


Figure A4–5. Optimum Cruise

Data Basis: Estimated

Date: July 30, 1997

Conditions: Standard Day

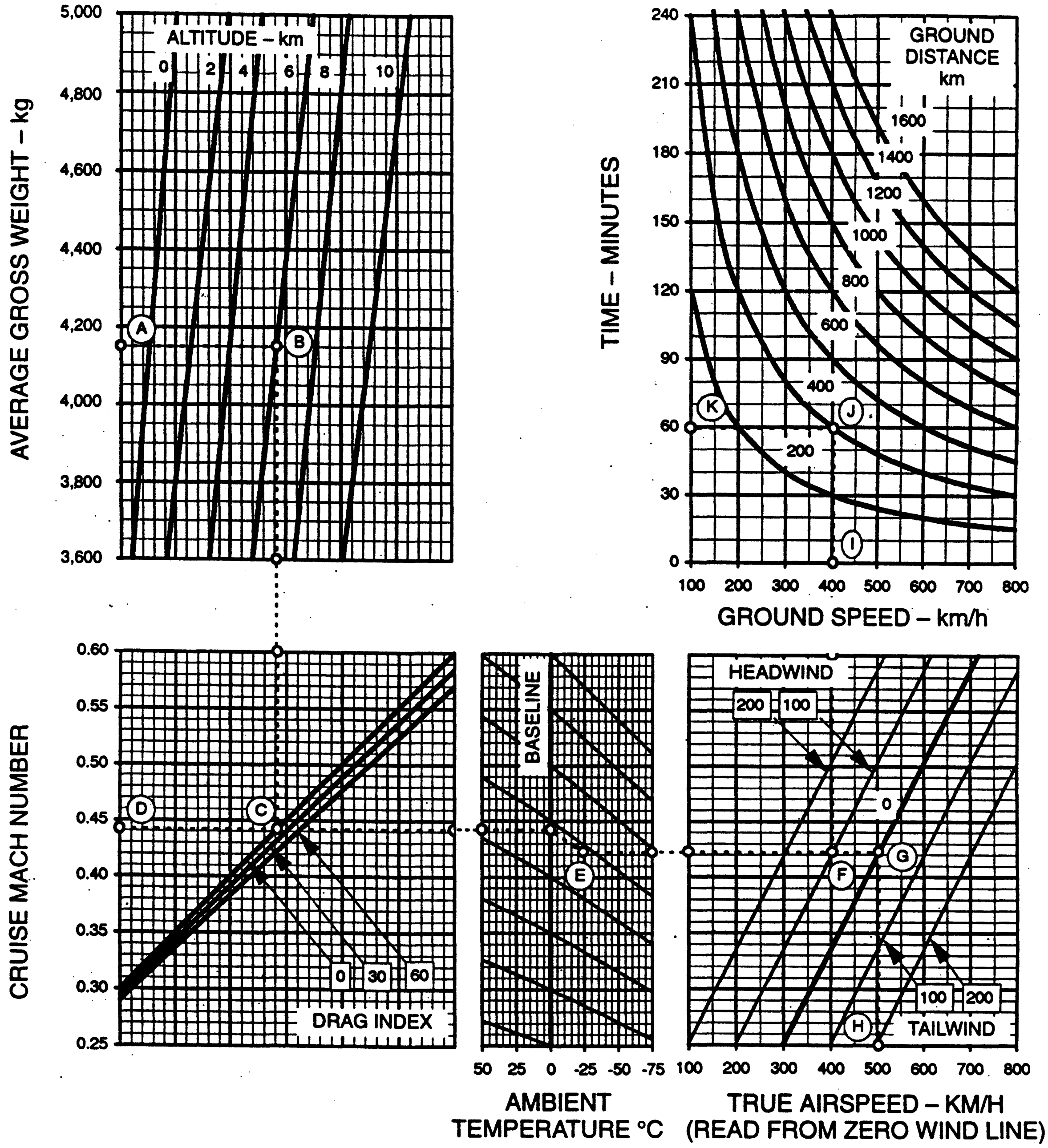


Figure A4–6. Constant Altitude Cruise – Optimum Mach Number, Speed, Time

Data Basis: Estimated

Date: July 30, 1997

Conditions: Standard Day

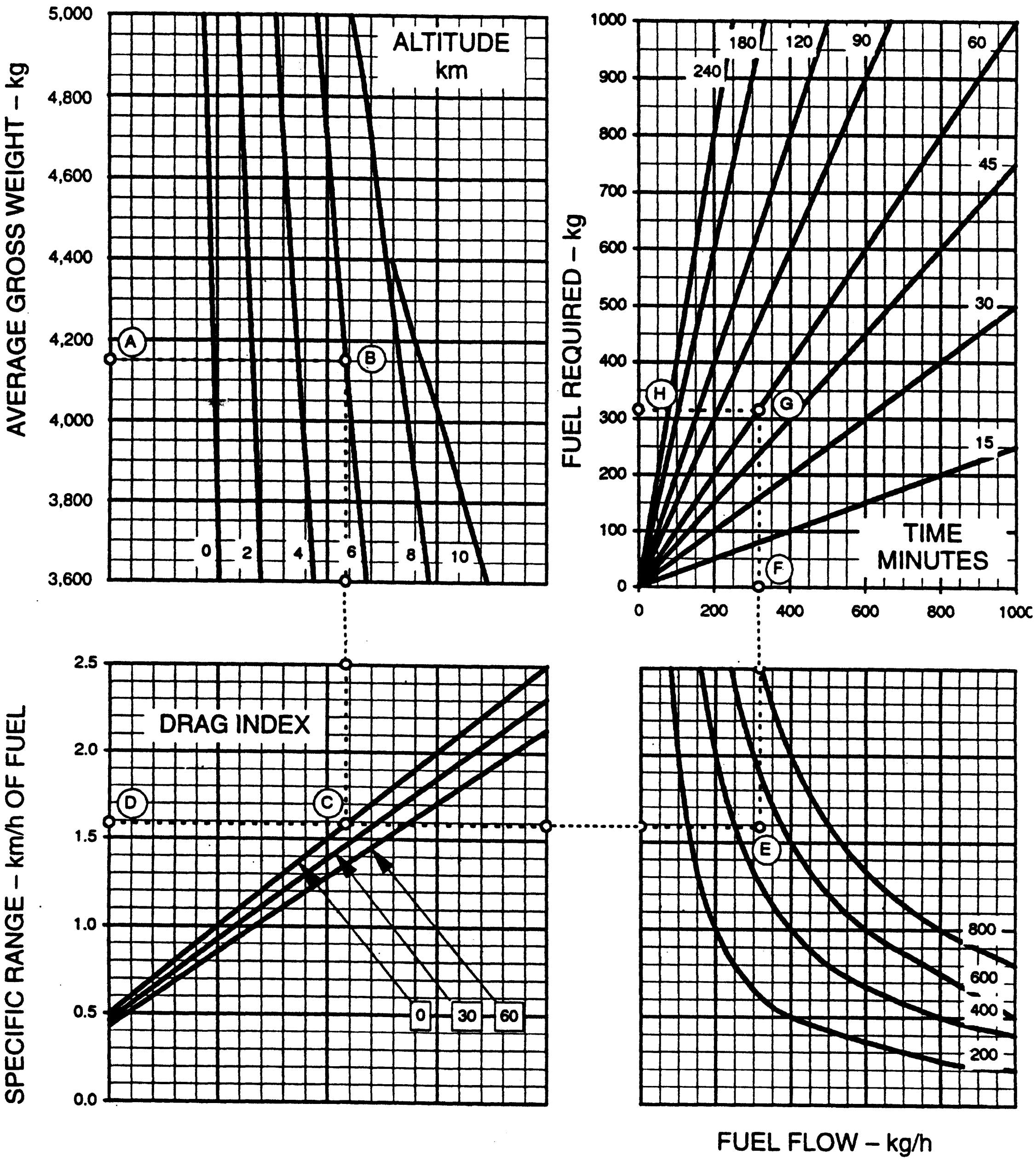


Figure A4–7. Constant Altitude Cruise – Specific Range, Fuel Flow, Fuel Required

PART 5

ENDURANCE

CONSTANT ALTITUDE ENDURANCE (Figure A5–1)

The chart contains endurance fuel flow data based on use of optimum endurance Mach. Changes in endurance Mach due to drag index are insignificant. Effects of altitude and drag index on fuel flow are provided.

Refer to Figure A5–1: Enter left portion of chart with average gross weight and desired altitude (A). Project downward to read optimum endurance Mach number (B). Return to (A) and project to the right to drag index baseline and follow the nearest desired endurance altitude guideline to drag index (C), and then to the right and read fuel flow (D).

EXAMPLE:

A. Average gross weight .... 4,200 kg

Desired endurance altitude .... 6 km

B. Endurance Mach number 0.344

C. Drag index .... 30 (use 6 km guideline)

D. Fuel flow .... 297 kg/h

Data Basis: Estimated

Date: July 30, 1997

Conditions: Standard Day

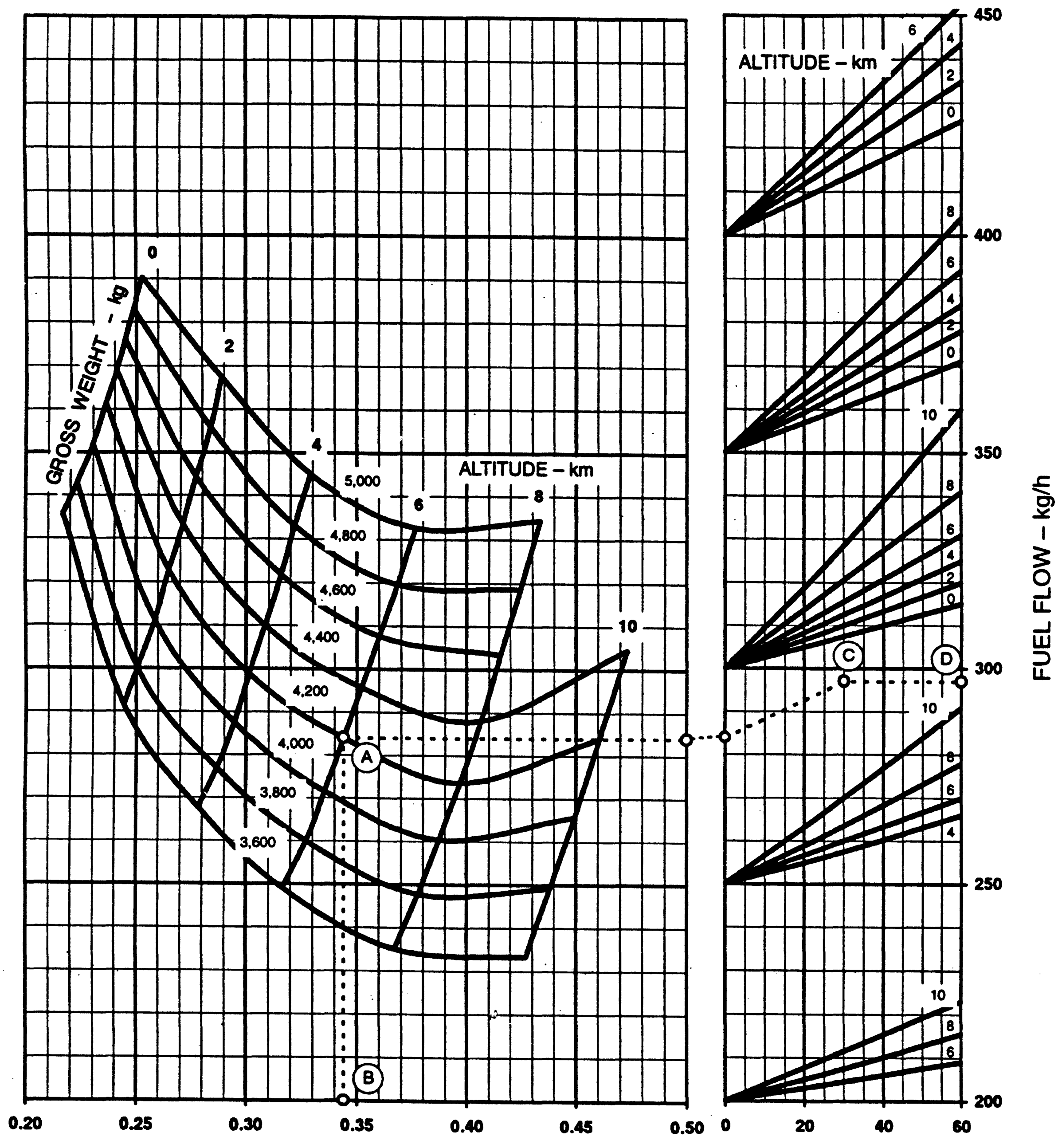


Figure A5–1. Constant Altitude Endurance

PART 6

DESCENT

MAXIMUM RANGE DESCENT (Figure A6–1)

Maximim range descent performance data are based on a descent speed which results in maximum distance (range) being covered during descent. Effects of gross weight and drag index are shown in the chart. Descent speed is tabulated on the chart.

Refer to figure A6–1: Enter chart on sheet 1 with initial altitude (B) and project upward to intercept appropriate drag index line (C). From (C), project to the right to the baseline. Note this point on the baseline. Starting at the gross weight (A) on the upper block project to the right to intercept the appropriate drag index line (C). From (C), project downward to intercept a line (D) which follows the guidelines and intercepts the point previously noted on the baseline. Continue to the right to read range (E). Repeat this process on sheet 2 in the same manner to obtain time (F) and on sheet 3 to obtain the fuel consumed (G). If final altitude is above sea level, repeat the above process, using final altitude in place of initial altitude. The differences between the resulting values are then fuel, range, and time to descend from initial to final altitude. Obtain descent speed from the table on the chart.

EXAMPLE:

A. Initial gross weight .... 4,250 kg

B. Initial altitude .... 3,000 m

C. Drag index 30

E. Range .... 47 km

F. Time .... 8.8 minutes

G. Fuel consumed .... 30.25 kg

Descent speed .... 185 km/h

The above data are for a descent to sea level. If the descent were stopped at 1,000 m:

Fuel consumed .... 30.25 – 10 = 20.25 kg

Range .... 47 – 15 = 32 km

Time .... 8.8 – 3.0 = 5.8 minutes

DESCENT WITH INOPERATIVE ENGINE (Figure A6–2)

The chart contains time and distance data for a descent with an inoperative engine. The data are presented as a function of descent airspeed for descents from various initial altitudes to sea level.

Refer to figure A6–2: Enter the chart with airspeed (A), project upward to the appropriate altitude lines (B) and then to the left to read time (C) and distance (D), respectively.

To determine time and distance available to descend to another altitude, repeat the above steps for the final altitude and take the difference between the sets of data.

EXAMPLE:

A. Descent airspeed .... 290 km/h

B. Altitude .... 6,000 m

C. Time (to sea level) .... 11.4 minutes

D. Distance (to sea level) .... 70 km

If the descent were stopped at 2,000 m:

Time .... 11.4 – 4.5 = 8.4 minutes

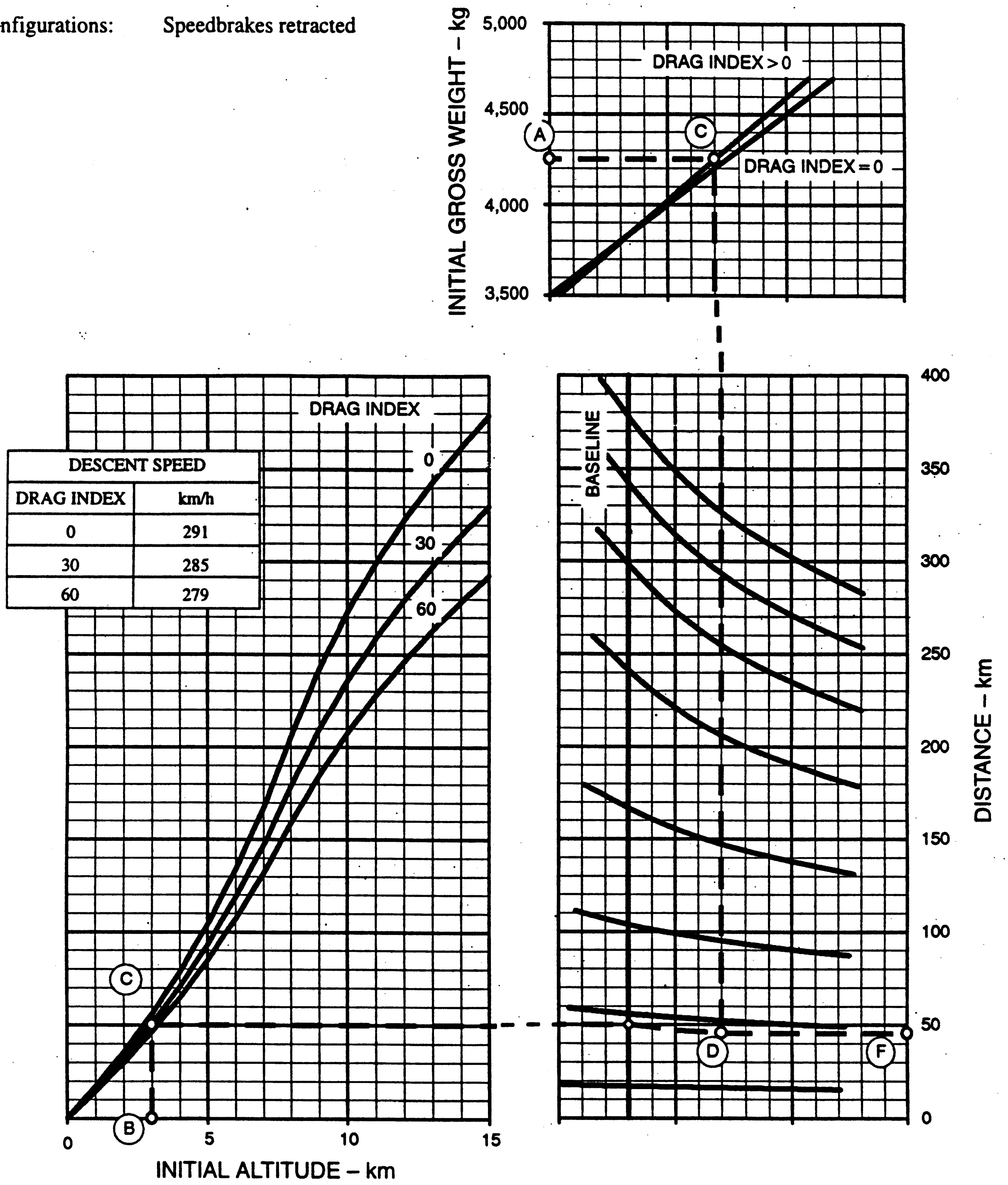
Distance .... 70 – 23.5 = 56.5 km

Data Basis: Estimated

Date: July 30, 1997

Configurations: Speedbrakes retracted

Conditions: Idle Rating
Standard Day



DESCENT SPEED	
DRAG INDEX	km/h
0	291
30	285
60	279

Figure A6–1. Maximum Range Descent – Idle (sheet 1 of 3)

Data Basis: Estimated

Date: July 30, 1997

Configurations: Speedbrakes retracted

Conditions: Idle Rating
Standard Day

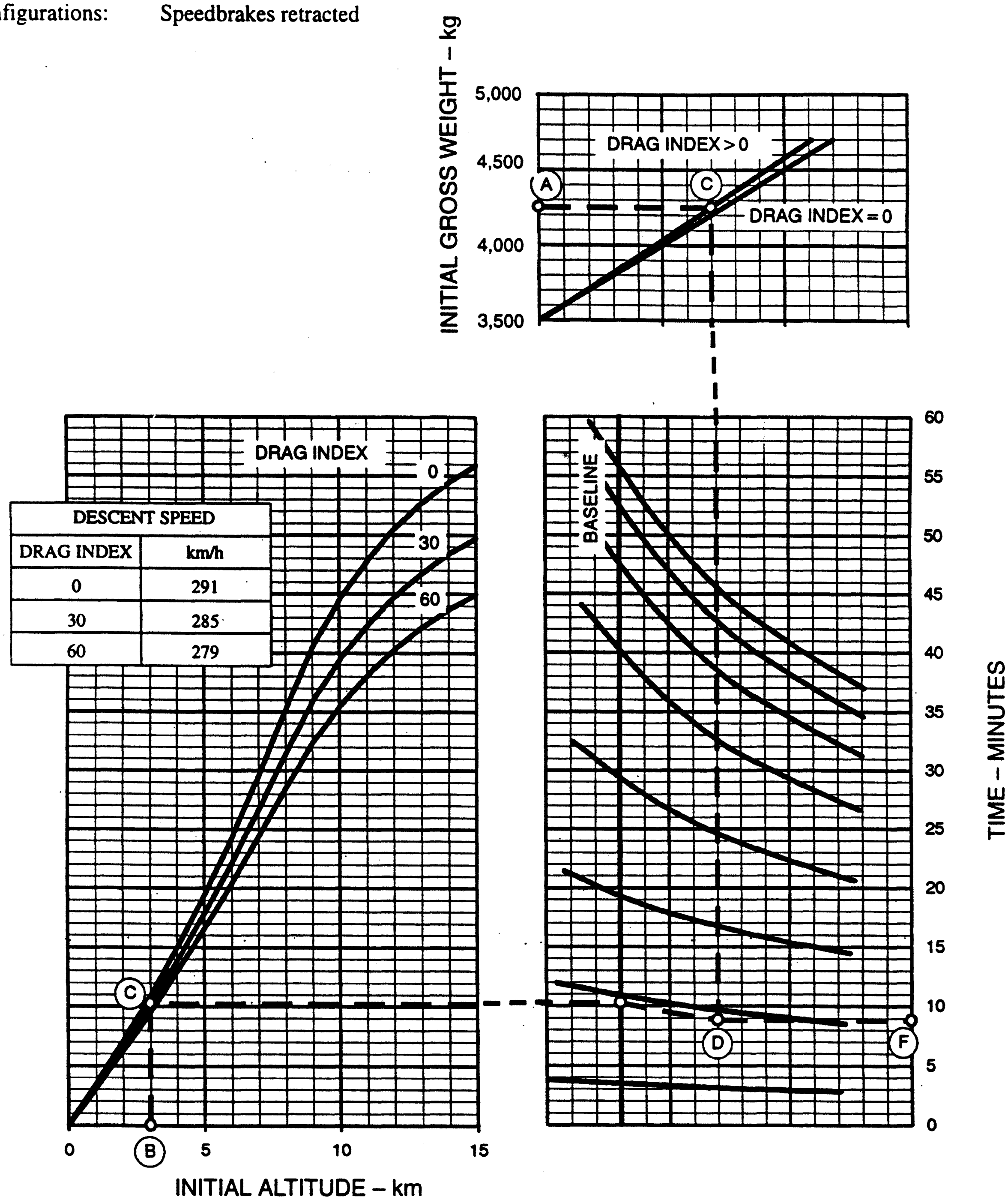


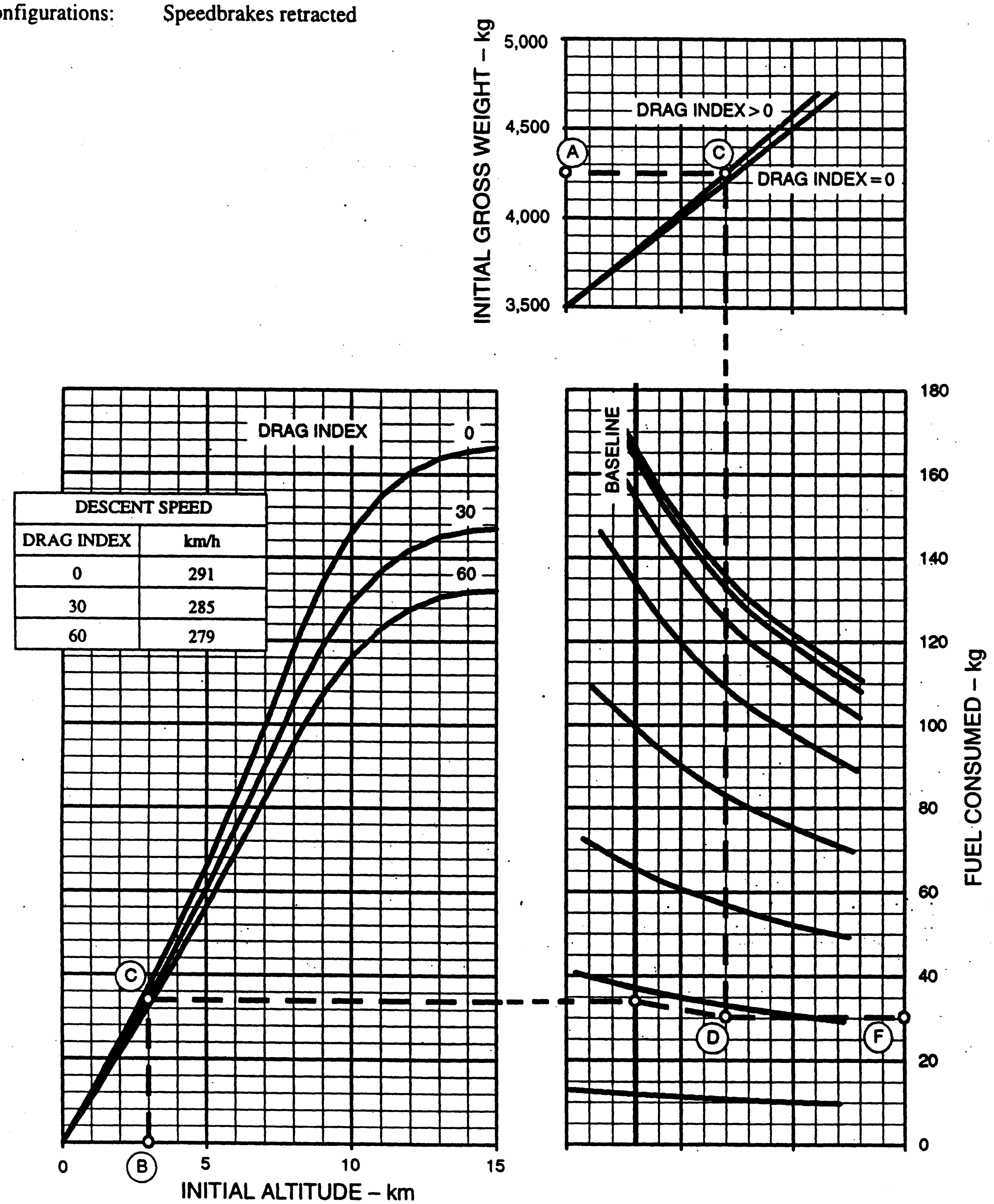
Figure A6–1. Maximum Range Descent – Idle (sheet 2 of 3)

Data Basis: Estimated

Date: July 30, 1997

Configurations: Speedbrakes retracted

Conditions: Idle Rating
Standard Day



DESCENT SPEED	
DRAG INDEX	km/h
0	291
30	285
60	279

Figure A6–1. Maximum Range Descent – Idle (sheet 3 of 3)

Data Basis: Estimated

Date: July 30, 1997

Configurations: Drag Index = 0
Gross weight = 4,000 kg

Conditions: Windmilling Engine or Locked Rotor
Standard Day

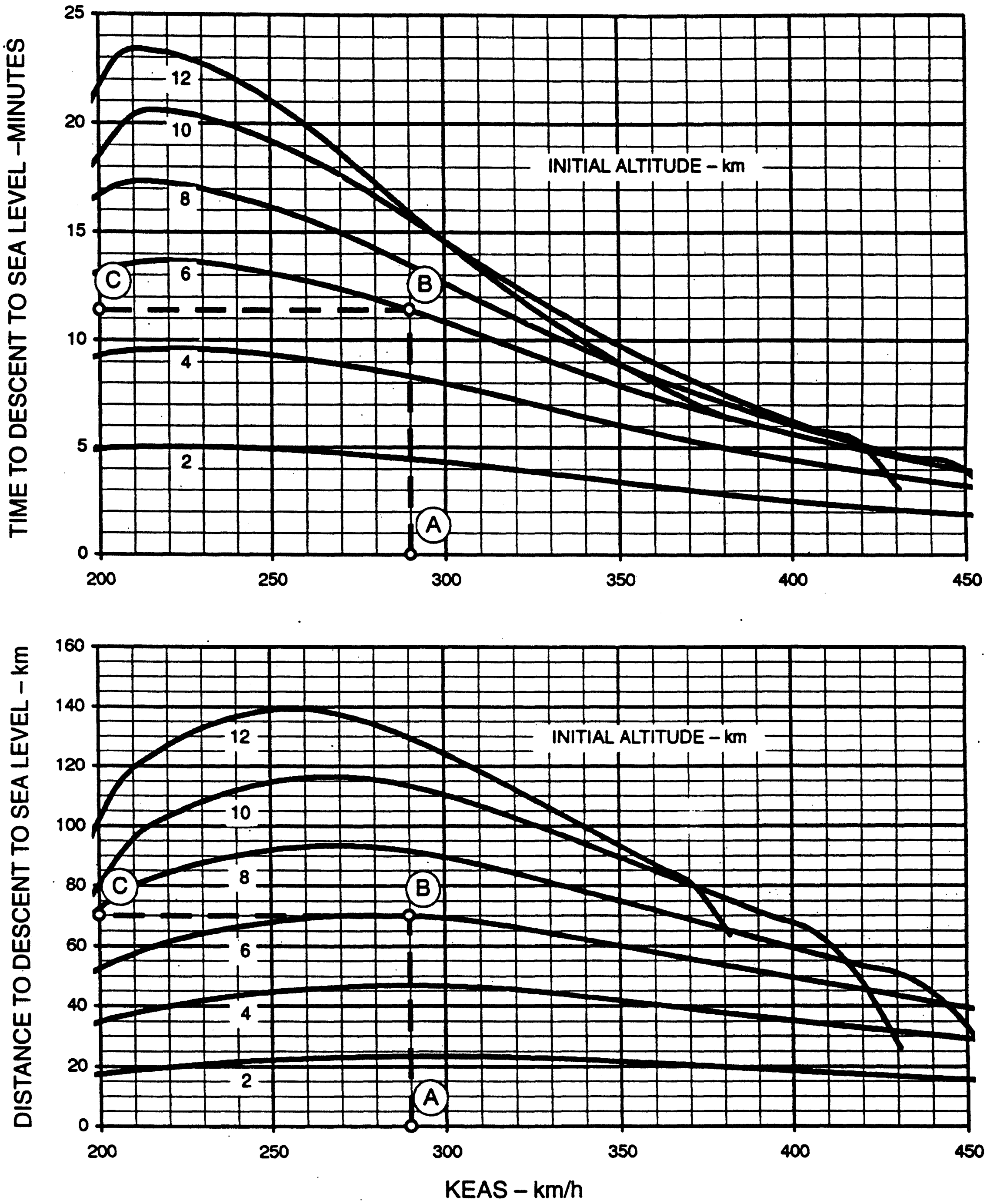


Figure A6–2. Descent With Inoperative Engine

PART 7

LANDING

LANDING DATA

Landing charts presented in this section determine clearance obstacle speed, touchdown speed and ground run distance. All data are based on idle throttle setting and full flap configuration. Speedbrakes are considered to be closed in all charts. Effects of temperature, pressure altitude, wind, runway slope, and runway quality are included on appropriate charts.

NOTE

Refer to Part 2 of this Appendix for Crosswind Limit chart.

OBSTACLE CLEARANCE AND TOUCHDOWN SPEED (Figure A7–1)

Touchdown speed corresponds to approximately 5 percent increase over power–off stall speed obtained for the aircraft with full flaps. Obstacle clearance speed is about 30 percent higher than power–off full–flap stall speed.

Refer to figure A7–1: Enter the chart with gross weight (A) and project vertically up to appropriate touchdown speed curve (B) and obstacle clearance speed curve (D). At each intersection point proceed horizontally left and read values of touchdown speed (C) and obstacle clearance speed (E), respectively.

EXAMPLE:

A. Gross weight .... 4,200 kg

C. Touchdown speed .... 174.0 km/h

E. Obstacle clearance speed .... 214.6 km/h

LANDING FACTOR (Figure A7–2)

The landing factor is a computed number used to simplify landing ground run presentation. It is a function of aircraft configuration, pressure altitude, and temperature.

Refer to figure A7–2: Enter the chart with runway temperature in terms of either degrees of Fahrenheit (A) or Celsius (B). Project horizontally to pressure altitude (C) and then vertically down to read landing factor for aircraft without stores (D) or with stores (E).

EXAMPLE:

A. Runway temperature .... 63.5°F

B. Runway temperature .... 17.5°C

C. Pressure altitude .... 500 m

D. Landing factor – no stores 5.44

E. Landing factor – with stores 6.05

LANDING GROUND ROLL (Figure A7–3)

Ground roll distance presented in the chart is based on idle throttle setting and full flap configuration. For touchdown speed higher than maximum braking speed (refer to Section V – Operating limitations, Braking speed limitations), two–point aerodynamic braking is used and the nose is held up to touchdown AOA. The nosewheel is lowered to the runway at a moderate rotation rate such that it is on the runway at about the maximum braking speed. For touchdown speed below the braking speed limit the nosewheel is lowered to the runway as soon as practical. Maximum antiskid braking, and full elevator deflection (trailing edge down) are applied as the nosewheel touches the runway. Do not allow the nosewheel to lift off the runway.

CAUTION

Using brakes at higher speeds than maximum permissible braking speed (see braking speed limit, Section V) may damage them. Therefore, it is permitted in emergency cases only. After every such case the brakes must be inspected.

Refer to figure A7–3: Enter the chart with landing factor (A). Project horizontally to gross weight (B), then vertically down to drag index baseline (C), and follow guidelines to drag index (D, E). Proceed downward to slope baseline (F) and parallel guidelines to slope (G, H). Continue vertically down again to wind baseline (I) and parallel guidelines to wind (J, K); proceed downward to runway condition (L), and finally project horizontally left to read landing ground run (M).

EXAMPLE:

A. Landing factor 6.05

B. Gross weight .... 4,200 kg

D. Drag index 40

G. Runway slope .... 1.5% (downhill)

J. Wind .... 7.5 m/sec (headwind)

L. Runway condition .... wet concrete

M. Landing ground roll .... 627 m

Data Basis:	Estimated	Conditions:	Idle Rating
Date:	March 3, 1997	OBSTACLES CLEARANCE SPEED	Full Flaps All Temperatures All Altitudes

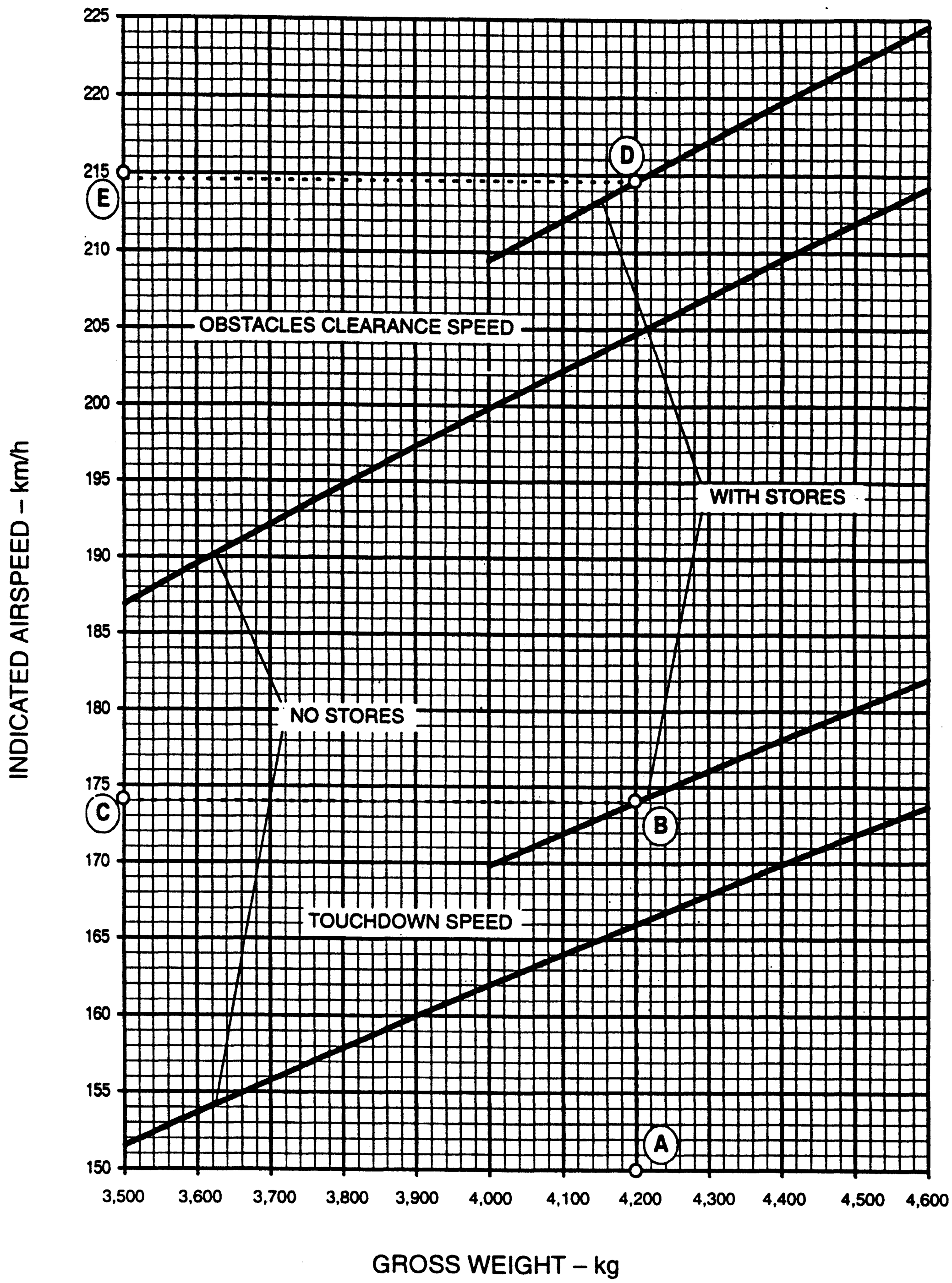


Figure A7-1. Obstacle Clearance and Touchdown Speed

Data Basis:	Estimated	Conditions:	Idle Rating Full Flaps Speedbrakes Retracted
Date:	March 3, 1997		

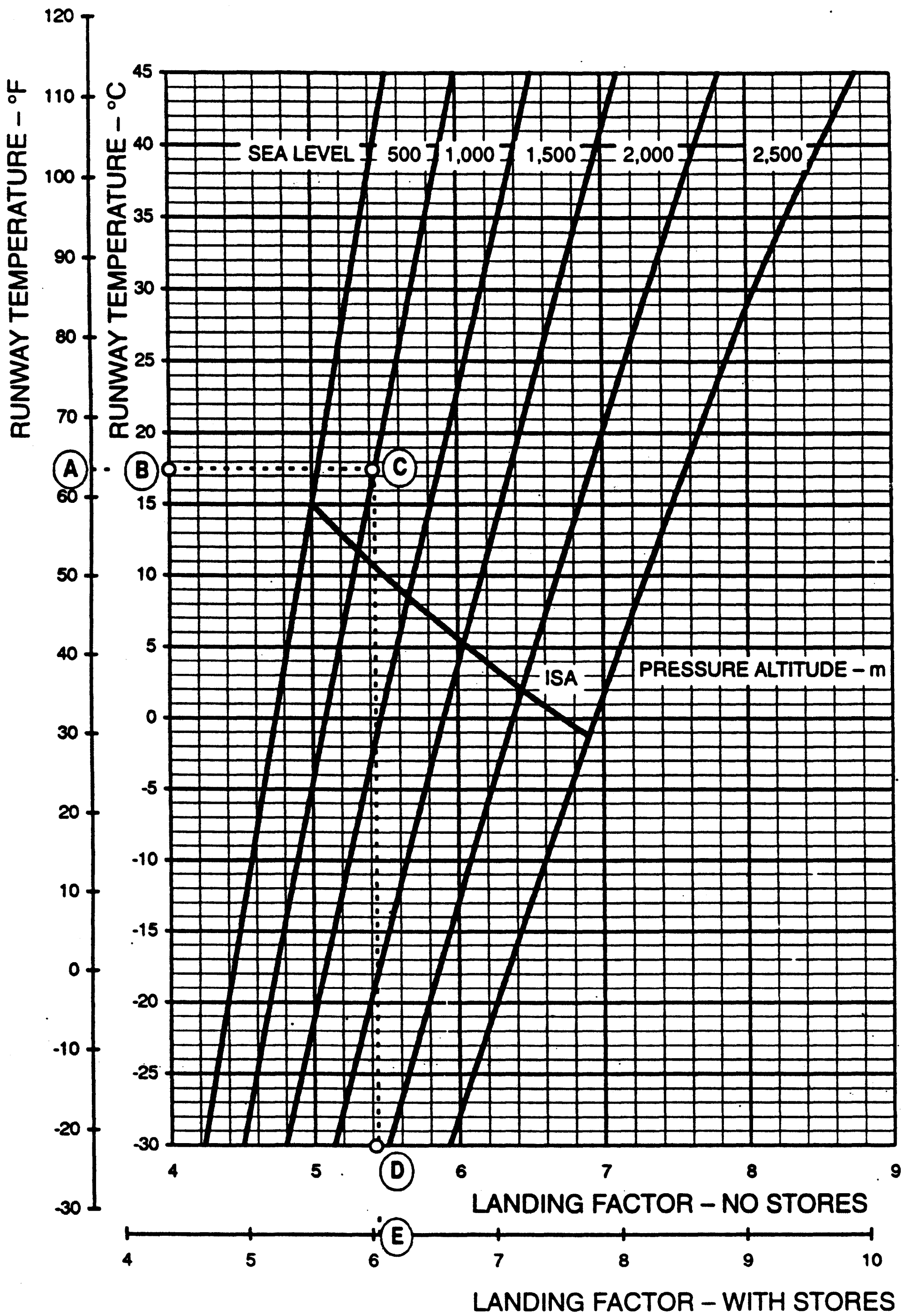


Figure A7–2. Landing Factor

Data Basis:	Estimated	Conditions:	Idle Rating Full Flaps Speedbrakes Retracted
Date:	March 3, 1997		

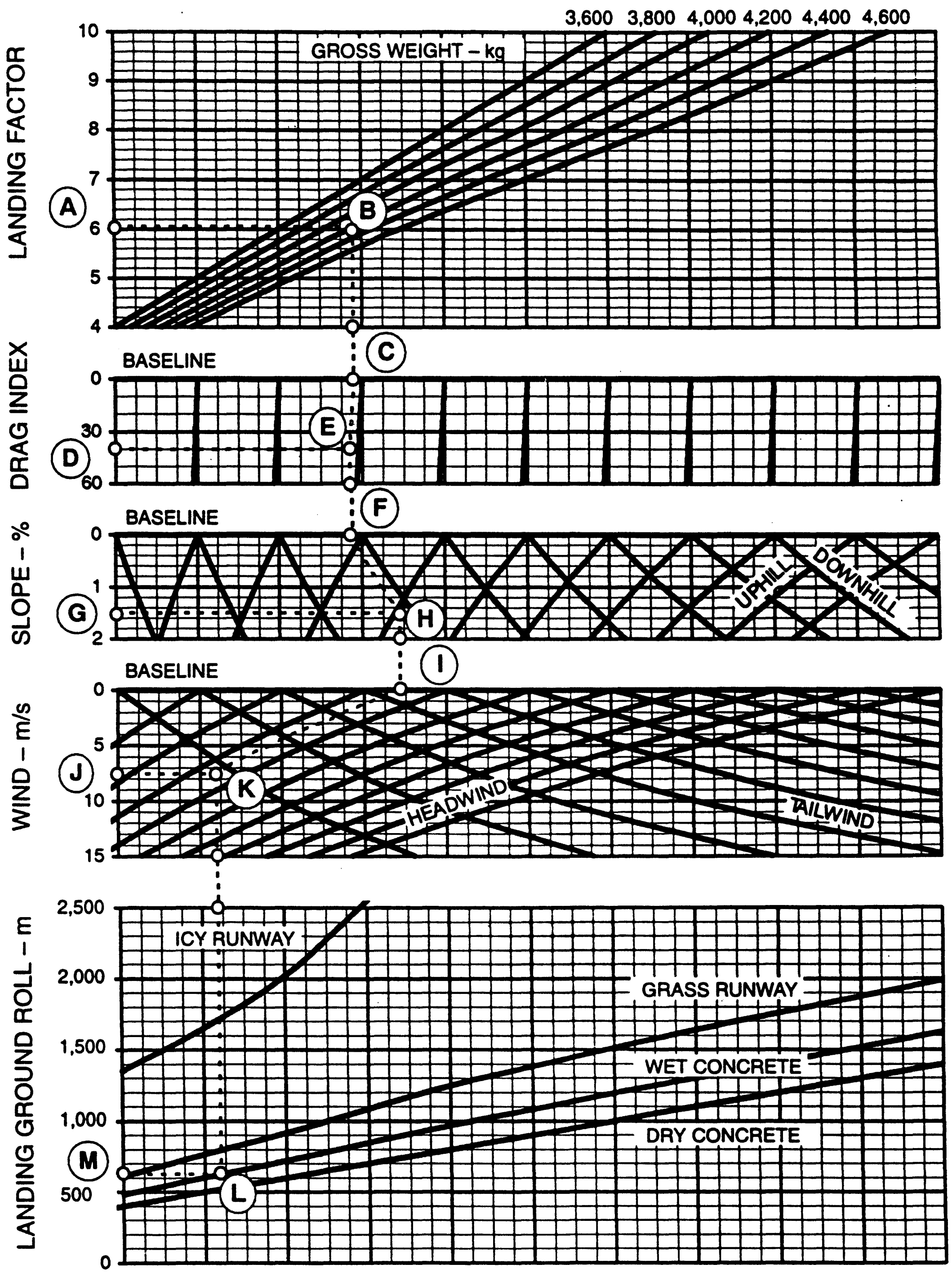


Figure A7–3. Landing Ground Roll

PART 8

MANOEUVRE FLIGHT

TURN PERFORMANCE (Figure A8–1)

TURN RATE, TURN RADIUS AND LOAD FACTOR CHARTS

The turn performance – Turn Rate, Turn Radius and Load Factor charts provide for a/c GW 3,600, 4,000, 4,400 and 4,800 kg, and for drag indices of 0, 30 and 60 with MAXIMAL power rating at four altitude levels.

Refer to Figure A8–1, A8–2 and Figure A8–3: The charts are of the multi–entry type. An explanation of chart terminology and general use is as follows.

On each chart a line, identified as SUSTAINED, representing sustained turn flight conditions (level flight, constant speed) shows the maximum turn rate attainable with maximum thrust as a function of Mach number. Additionally, a background "fan" grid, consisting of load factor and turn radius parameters, is shown to provide supplementary information. It can be seen that the speed for maximum turn rate is considerably higher than that for minimum turn radius.

A second line on the chart, identified as MAXIMUM LIFT LIMIT, shows the maximum instantaneous turn performance obtainable by trading off altitude or airspeed to realize the maximum lift capability of the aircraft. This lift capability is limited to "g" factor (see Section V – Operating Limitations). At maximum lift, at a particular altitude, the airspeed providing the maximum possible instantaneous turn performance is called the "corner" speed. This corner speed is shown on each chart in upper left area at the intersection of the maximum lift limit line with the G limit line for aircraft.

Any point lying on the SUSTAINED line represents a condition of drag equal to maximum thrust. All of the thrust available is required to turn in level unaccelerated flight at the particular TAS of interest. This is the condition of ZERO P_S, or "specific power". Any point below the SUSTAINED line represents a more shallow turn where excess thrust is available for use in either accelerating to a higher airspeed at constant altitude or for climbing to a higher altitude at the same airspeed. This is called a region of POSITIVE P_S. Any point lying between the SUSTAINED line and the MAXIMUM LIFT LIMIT line (or limit "g" line for aircraft) represents a turn condition of increased magnitude, where the drag exceeds thrust and negative rate of climb (descent) or a decreasing speed is developed during the turn. This is a region of NEGATIVE P_S.

Refer to Figure A8–1, A8–2 and Figure A8–3: Enter the chart with TAS (A), project upward to SUSTAINED turn curve (B) and proceed horizontally with turn rate reading (C). (B) point specifies also turn radius, interpolated in turn radiuses radial lines system and sustained load factor, interpolated in load factor curves system.

When limit instantaneous turn parameters are needed, project further upward to limit load factor line (D) or maximum lift limit line (depending on TAS number). Instantaneous turn radius can be interpolated and when proceeding left, instantaneous turn rate (E) can be read.

EXAMPLE:

A. True airspeed .... 625 km/h

B. Gross weight .... 4,000 kg

Sustained turn radius .... 1,050 m

Sustained load factor .... 3.1 g

C. Sustained turn rate .... 9.46 deg/sec

D. Minimum turn radius .... 390 m

Maximum load factor .... 8 g

E. Maximum turn rate .... 25.69 deg/sec

COMBAT MANOEUVRES

Series of aerobatic manoeuvres can be performed without special necessary technique within specified loads limitation range.

Recommended entry speeds and power settings are as follows:

Manoeuvre	Power setting	Entry speed (IAS, km/h)
Loop	nom	600
Immelmann	nom	600
Aileron roll	nom	350 min
Barrel roll	nom	520
Split S	0.85 nom	220
Stalled turn	nom	220
Chandelle	nom	520
Lazy eight	nom	520

WARNING

Staying in a stall–warning buffeting regime during any part of a manoeuvre should be avoided.

Data Basis:	Estimated	Configurations:	Drag Index = 0
Date:	March 3, 1997	Conditions:	Standard Day Sea Level Maximum Power Setting

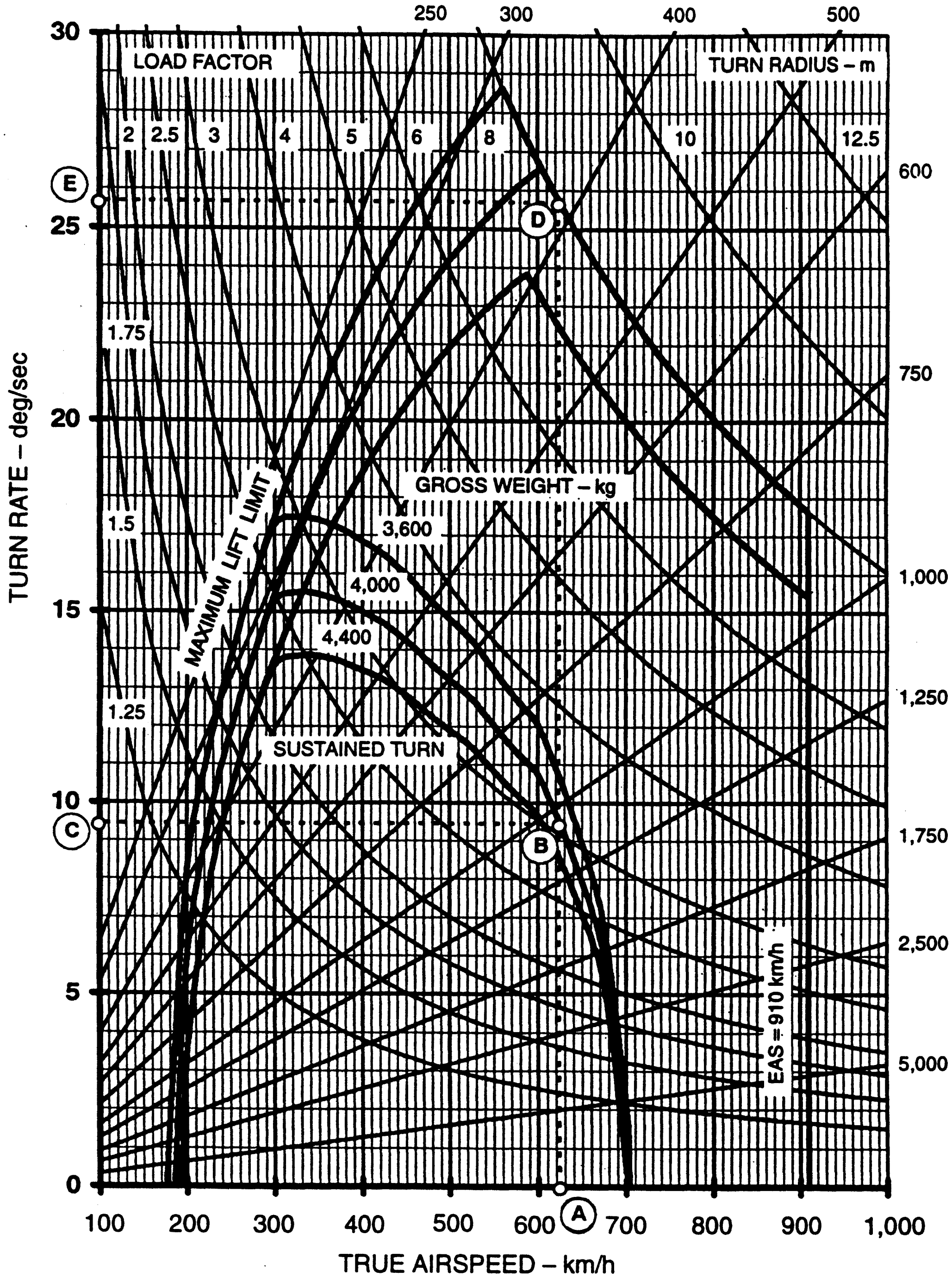


Figure A8-1. Turn Performance – DI 0 (sheet 1 of 4)

Data Basis: Estimated

Date: March 3, 1997

Configurations: Drag Index = 0

Conditions: Standard Day
h = 2,000 m
Maximum Power Setting

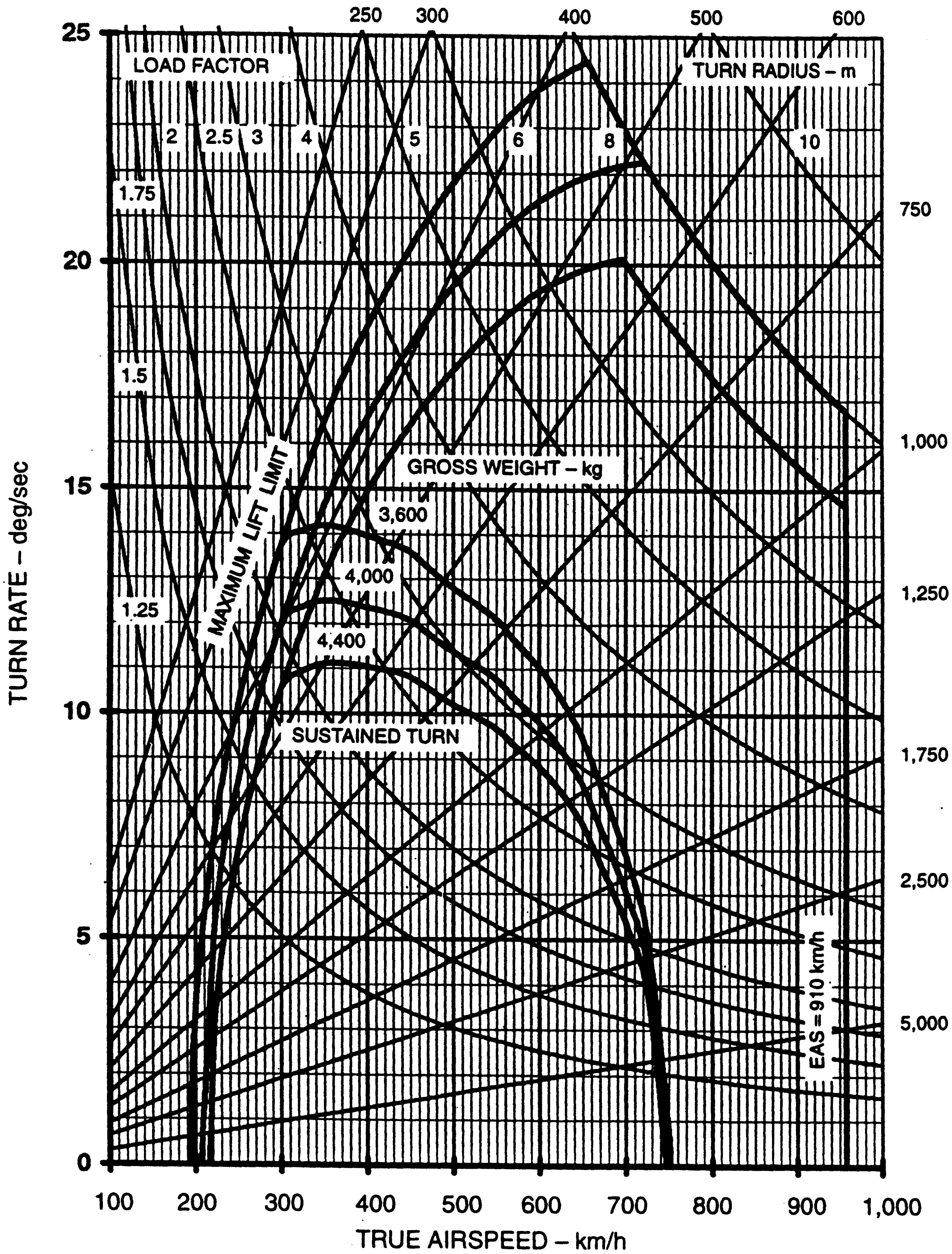


Figure A8–1. Turn Performance – DI 0 (sheet 2 of 4)

Data Basis:	Estimated	Configurations:	Drag Index = 0
Date:	March 3, 1997	Conditions:	Standard Day h = 4,000 m Maximum Power Setting

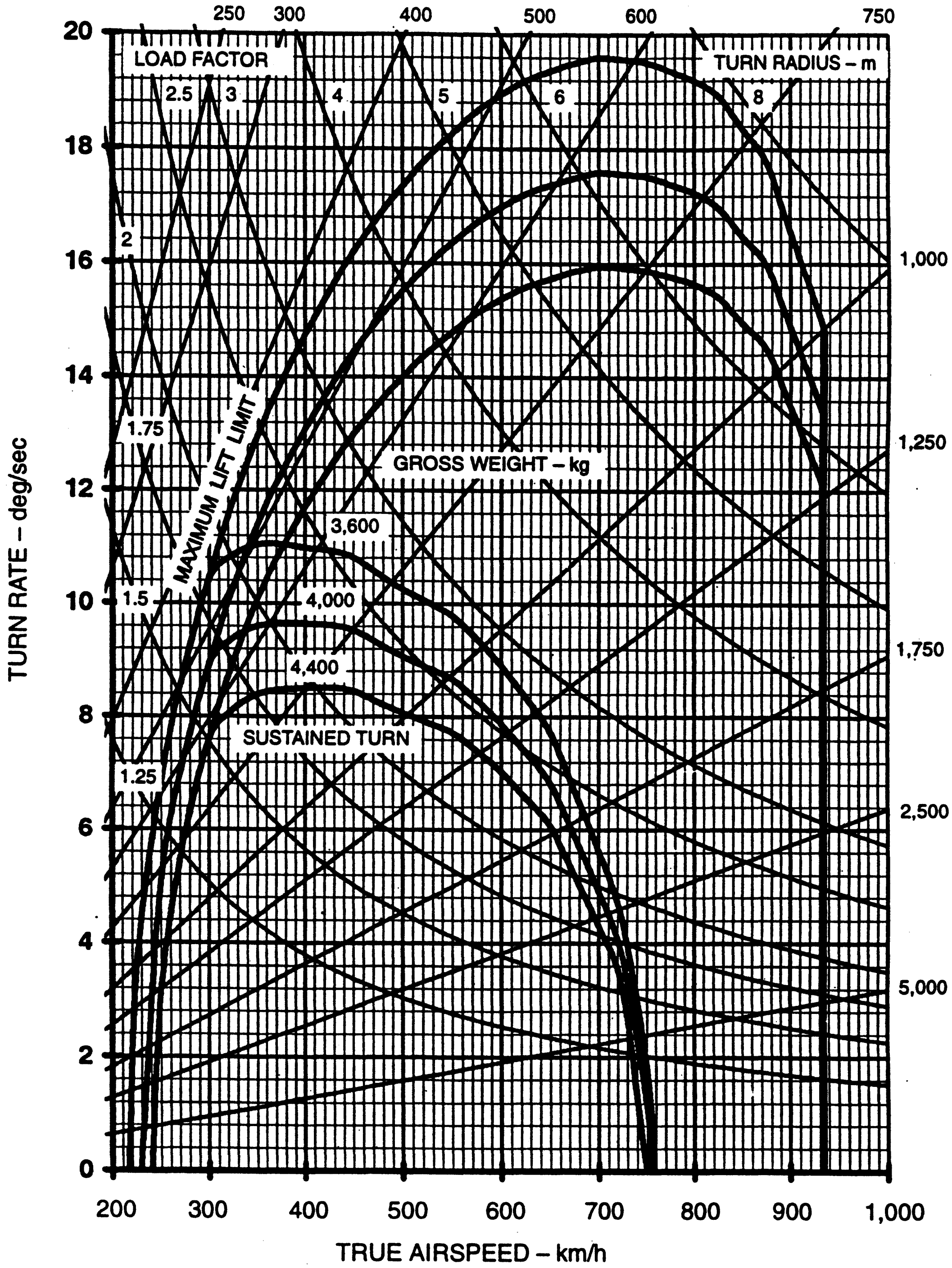


Figure A8–1. Turn Performance – DI 0 (sheet 3 of 4)

Data Basis:	Estimated	Configurations:	Drag Index = 0
Date:	March 3, 1997	Conditions:	Standard Day h = 6,000 m Maximum Power Setting

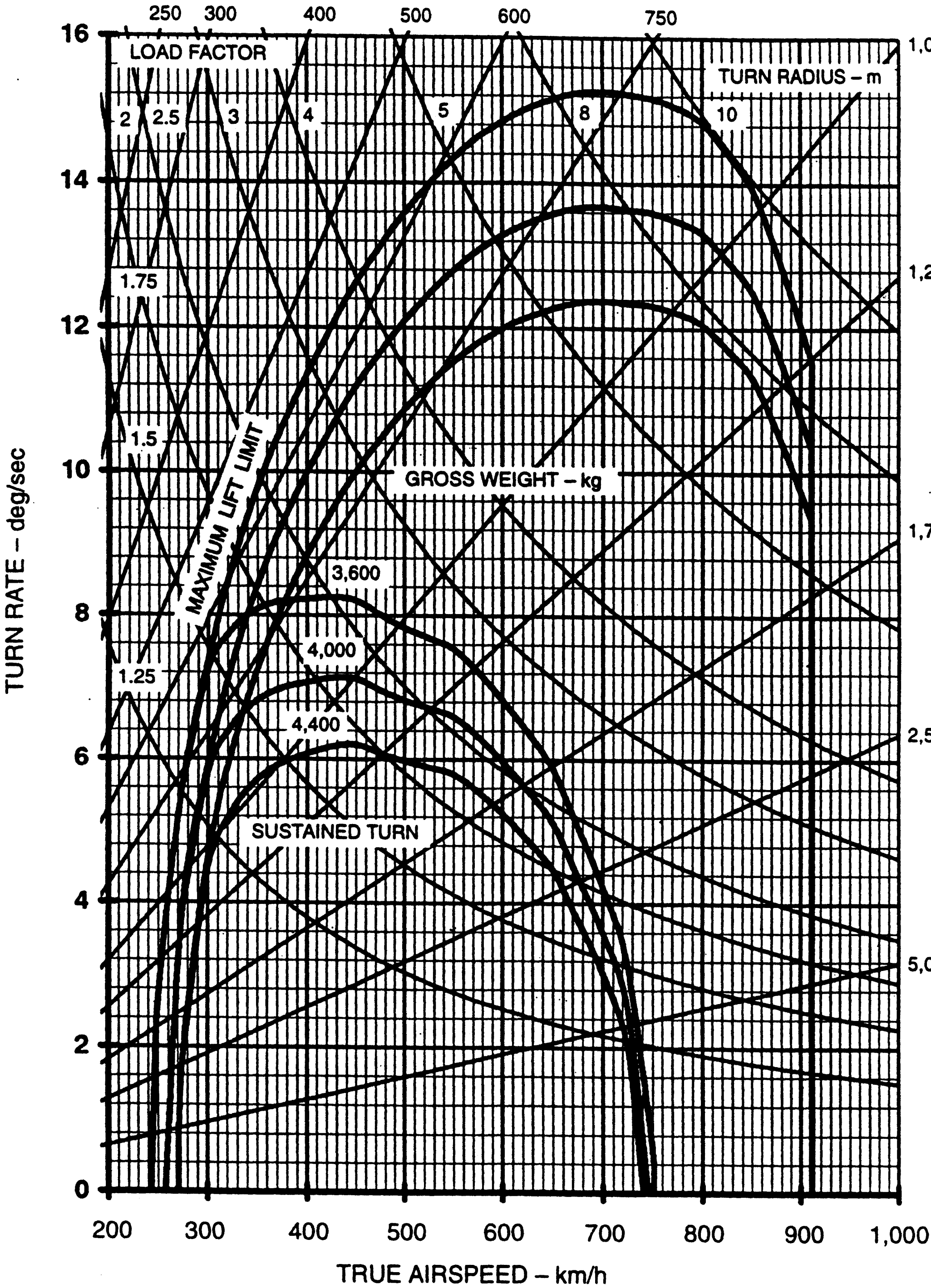


Figure A8–1. Turn Performance – DI 0 (sheet 4 of 4)

Data Basis:	Estimated	Configurations:	Drag Index = 30
Date:	March 3, 1997	Conditions:	Standard Day Sea Level Maximum Power Setting

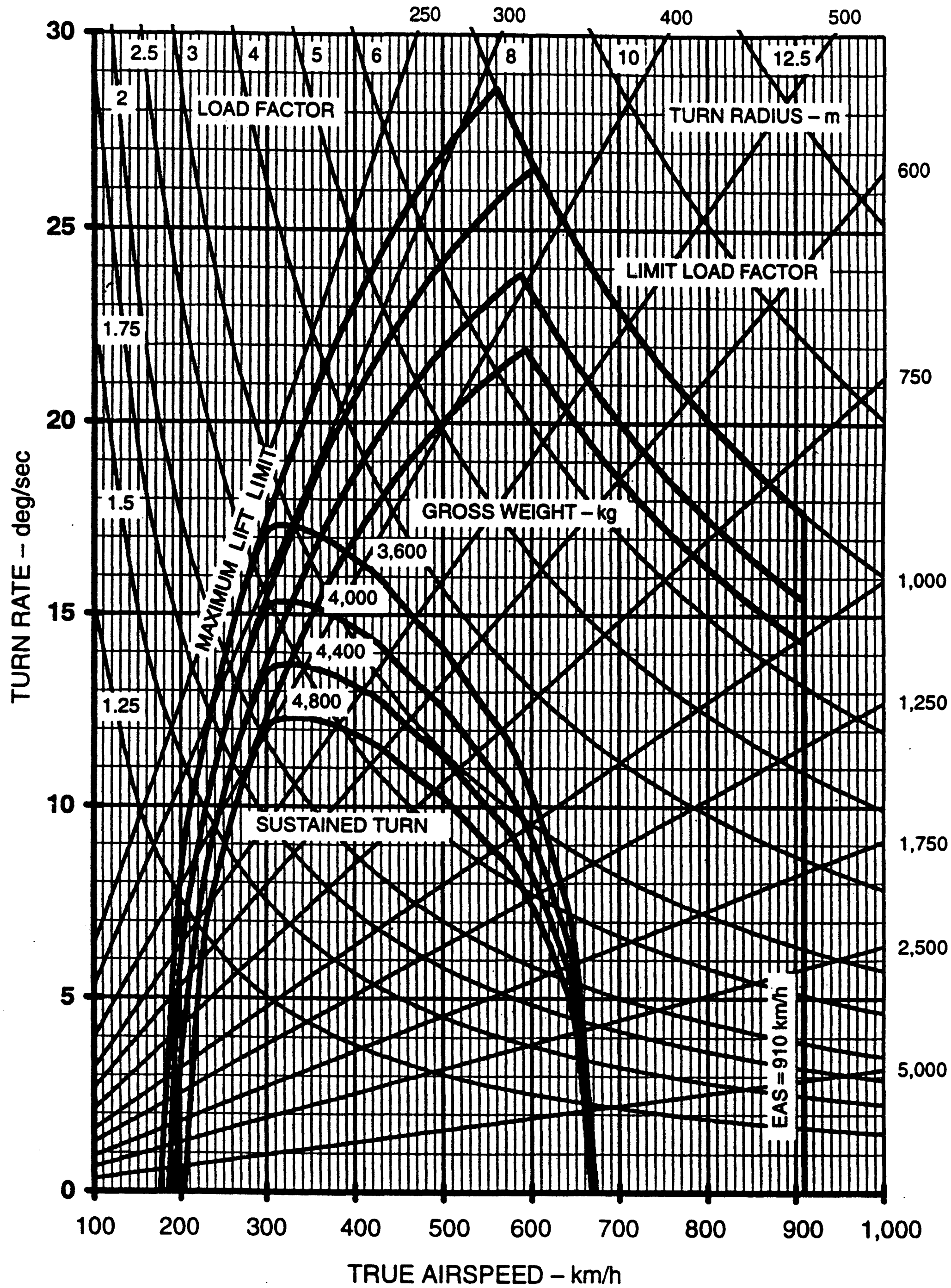


Figure A8–2. Turn Performance – DI 30 (sheet 1 of 4)

Data Basis: Estimated

Date: March 3, 1997

Configurations: Drag Index = 30

Conditions: Standard Day
h = 2,000 m
Maximum Power Setting

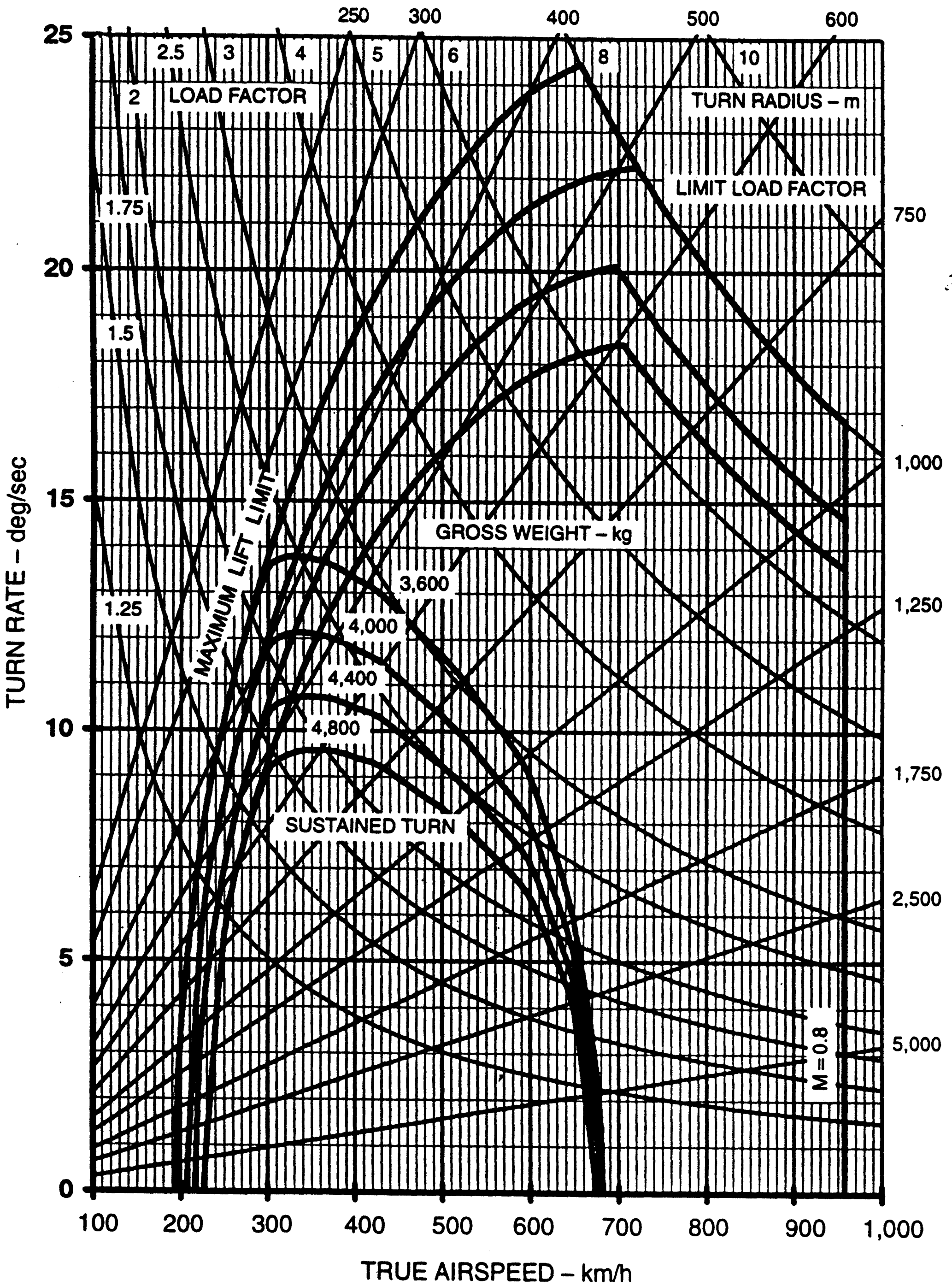


Figure A8–2. Turn Performance – DI 30 (sheet 2 of 4)

Data Basis:	Estimated	Configurations:	Drag Index = 30
Date:	March 3, 1997	Conditions:	Standard Day h = 4,000 m Maximum Power Setting

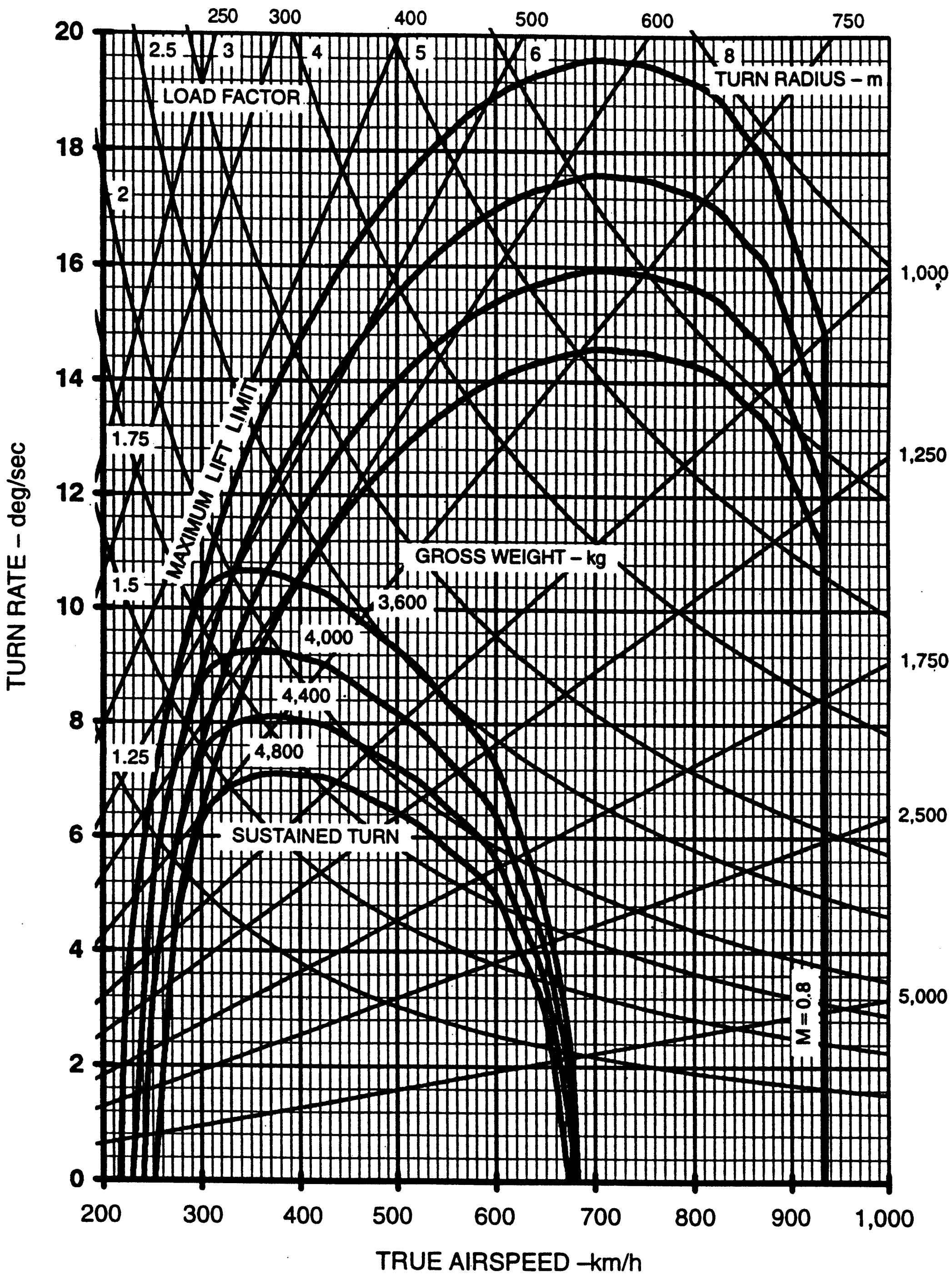


Figure A8–2. Turn Performance – DI 30 (sheet 3 of 4)

Data Basis: Estimated
Date: March 3, 1997
Configurations: Drag Index = 30
Conditions: Standard Day
h = 6,000 m
Maximum Power Setting

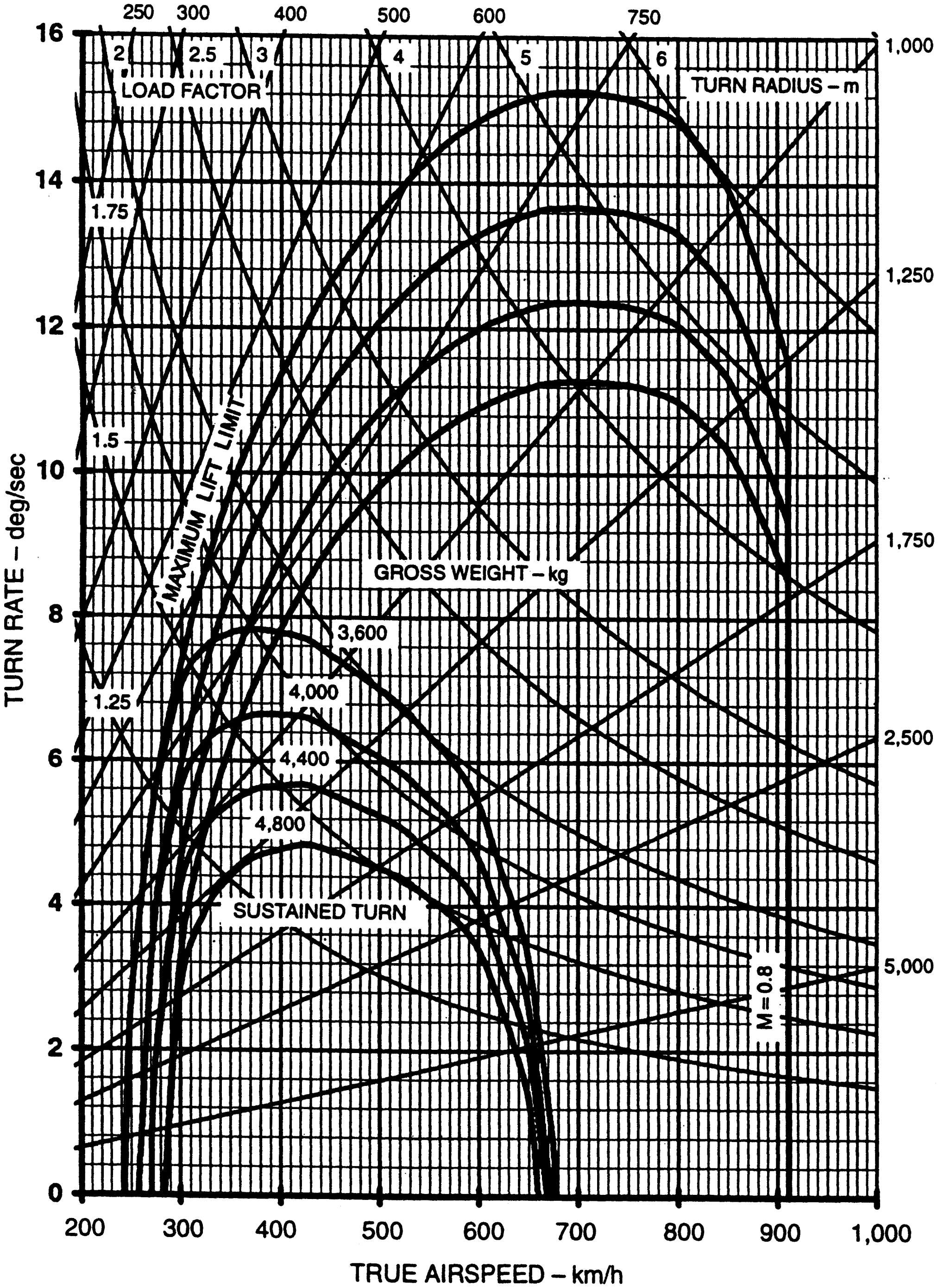


Figure A8–2. Turn Performance – DI 30 (sheet 4 of 4)

Data Basis:	Estimated	Configurations:	Drag Index = 60
Date:	March 3, 1997	Conditions:	Standard Day Sea Level Maximum Power Setting

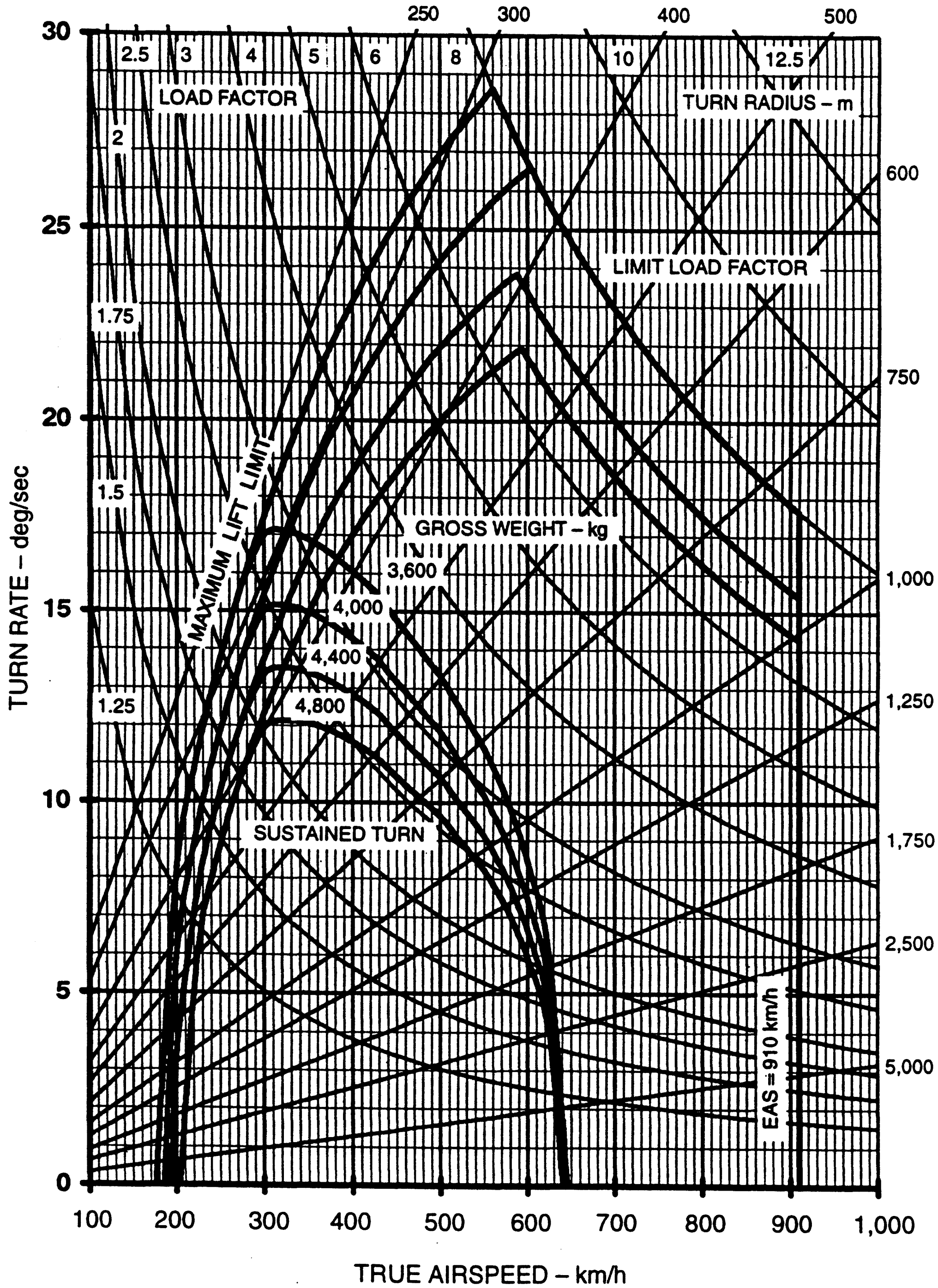


Figure A8–3. Turn Performance – DI 60 (sheet 1 of 4)

Data Basis:	Estimated	Configurations:	Drag Index = 60
Date:	March 3, 1997	Conditions:	Standard Day h = 2,000 m Maximum Power Setting

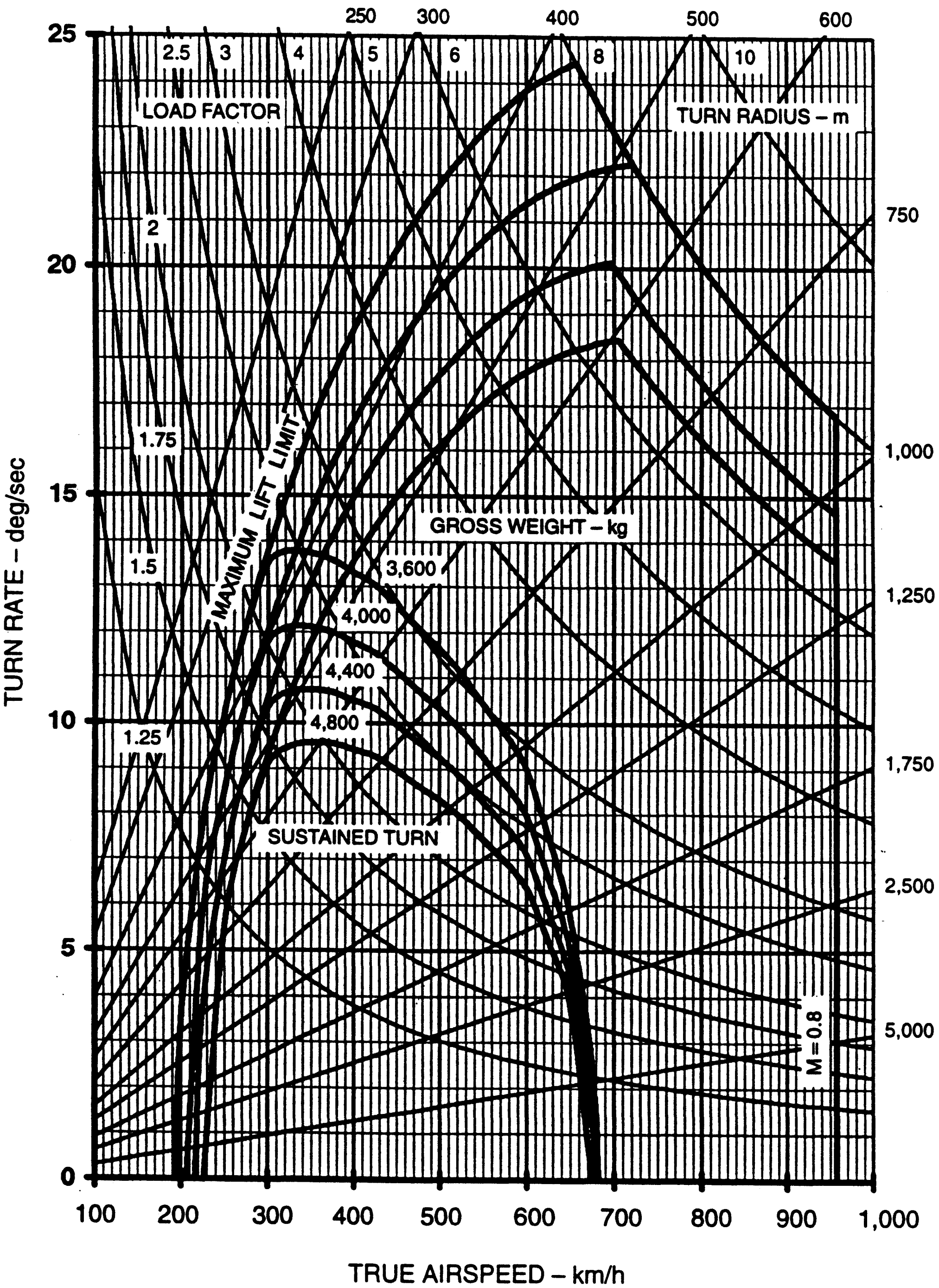


Figure A8–3. Turn Performance – DI 60 (sheet 2 of 4)

Data Basis:	Estimated	Configurations:	Drag Index = 60
Date:	March 3, 1997	Conditions:	Standard Day h = 4,000 m Maximum Power Setting

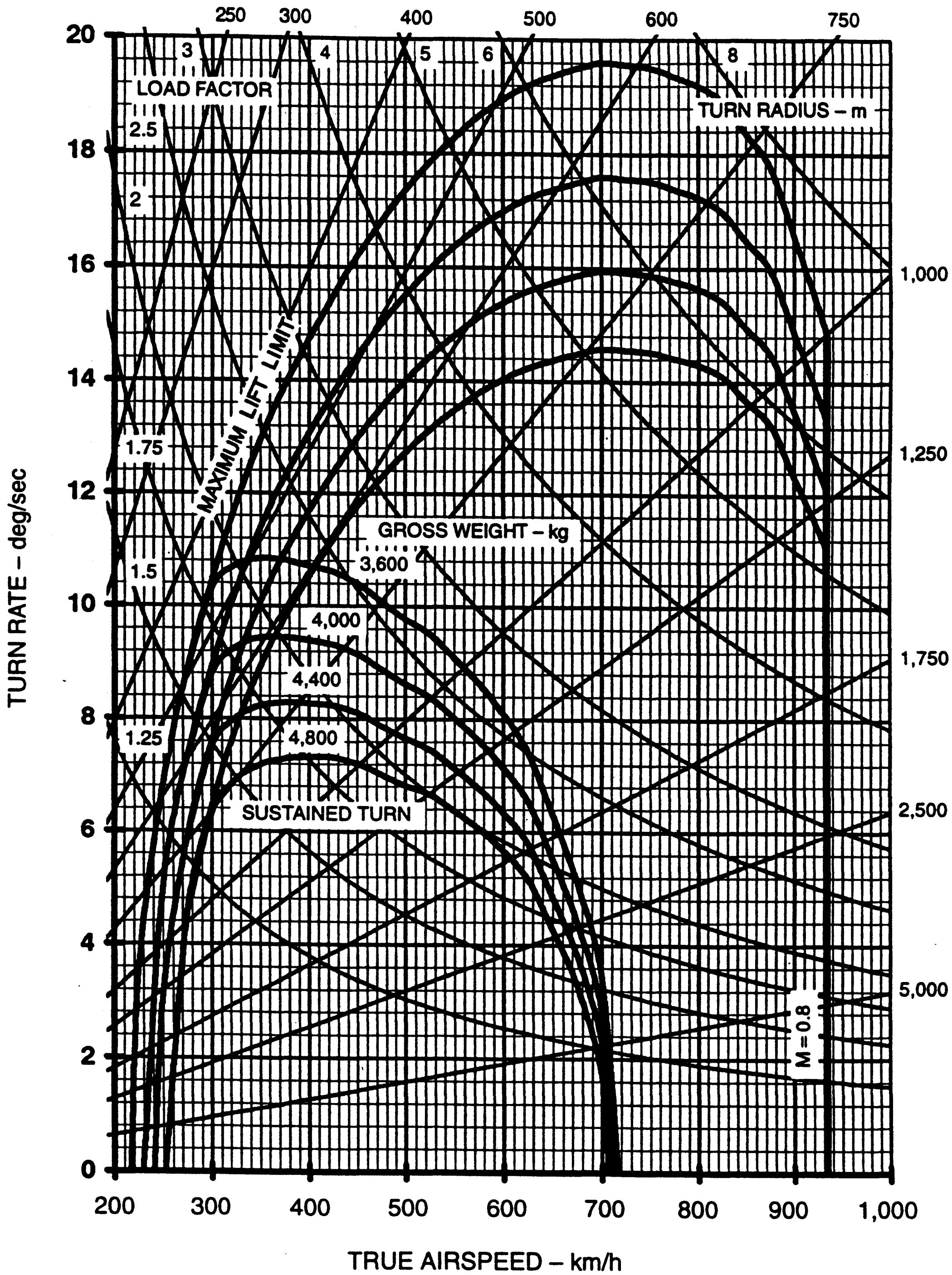


Figure A8–3. Turn Performance – DI 60 (sheet 3 of 4)

Data Basis:	Estimated	Configurations:	Drag Index = 60
Date:	March 3, 1997	Conditions:	Standard Day h = 6,000 m Maximum Power Setting

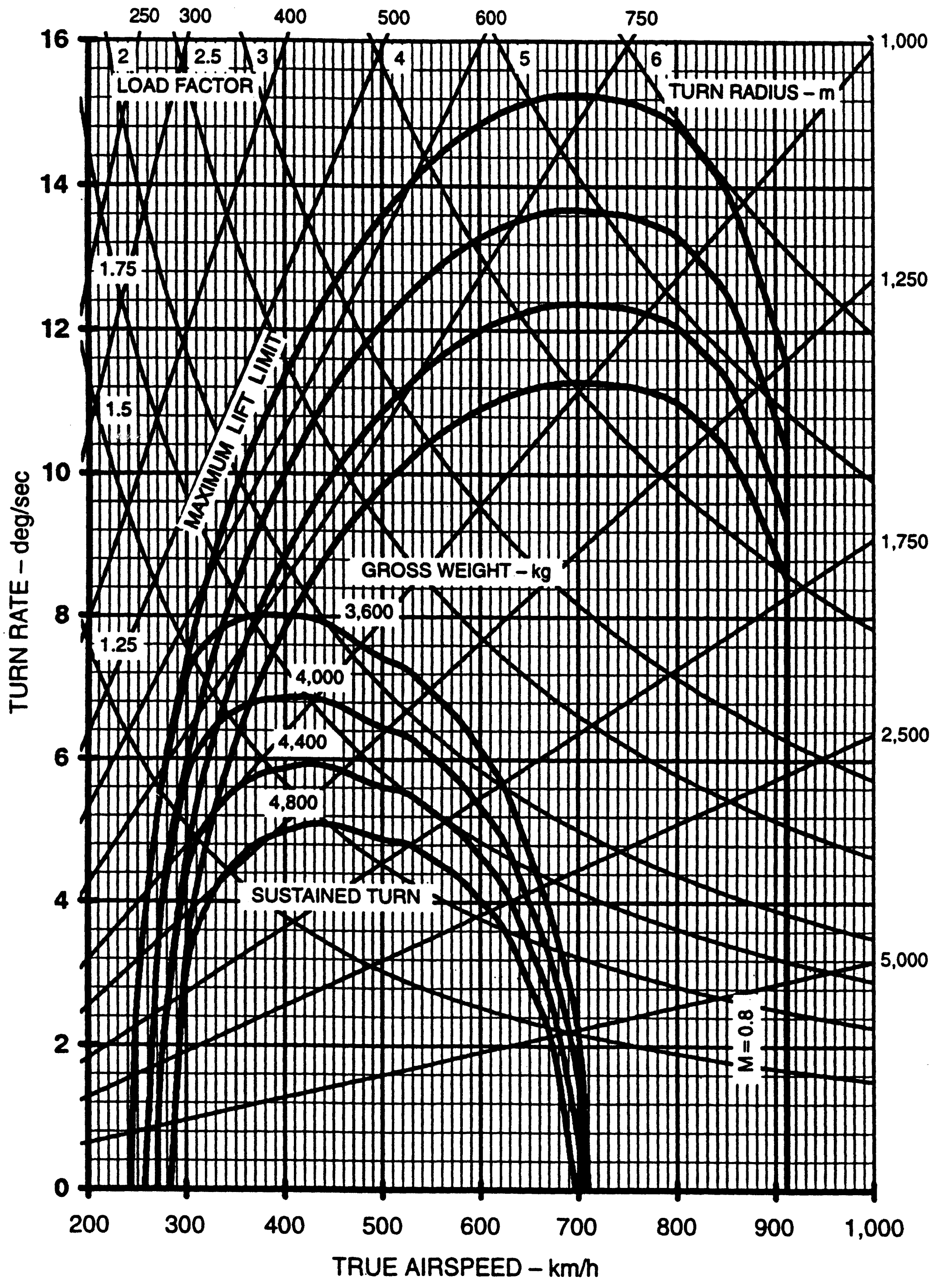


Figure A8–3. Turn Performance – DI 60 (sheet 4 of 4)

FOLDOUT ILLUSTRATIONS

TABLE OF CONTENTS

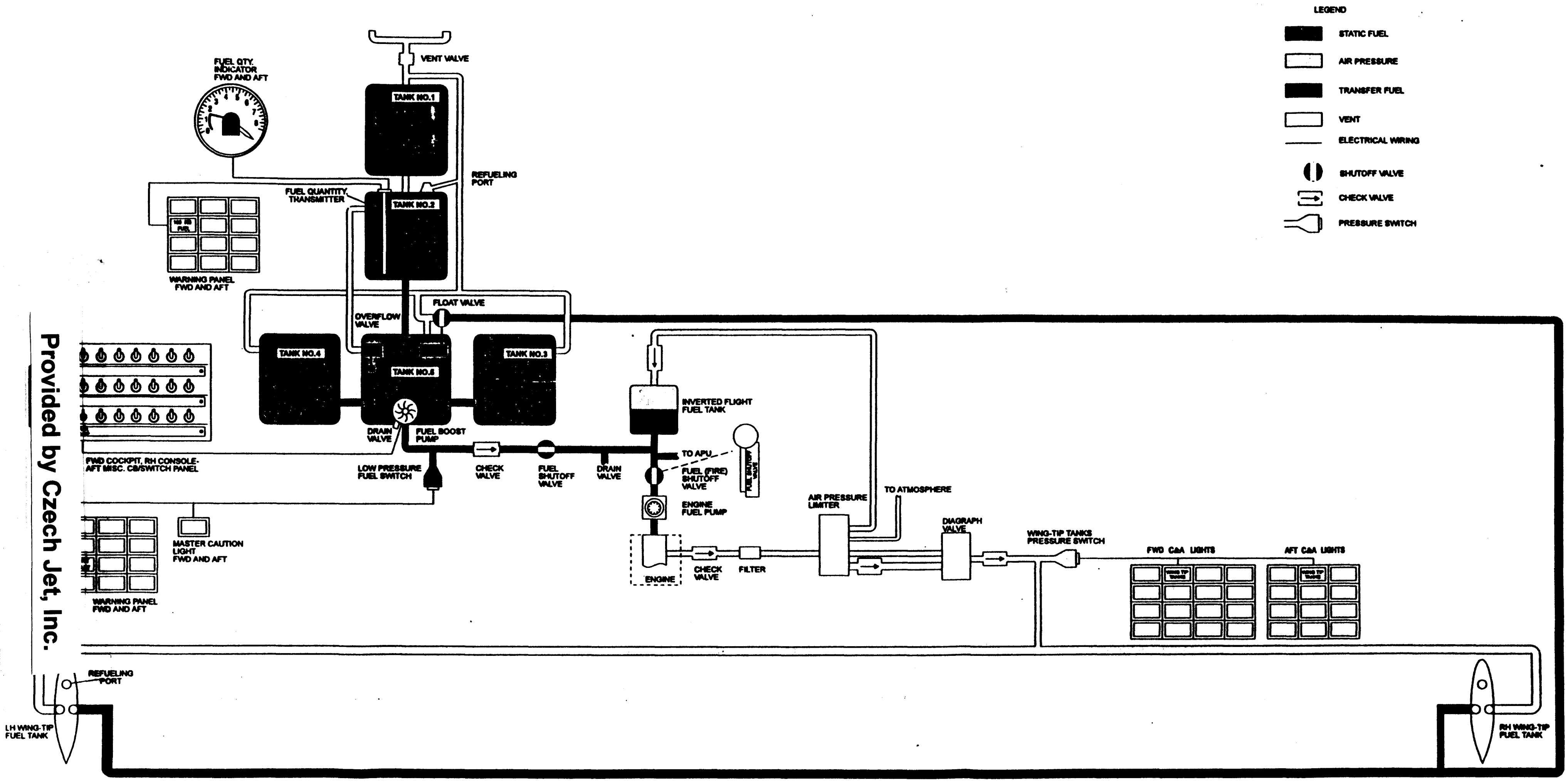


Figure FO-1. Fuel System – Schematic Diagram

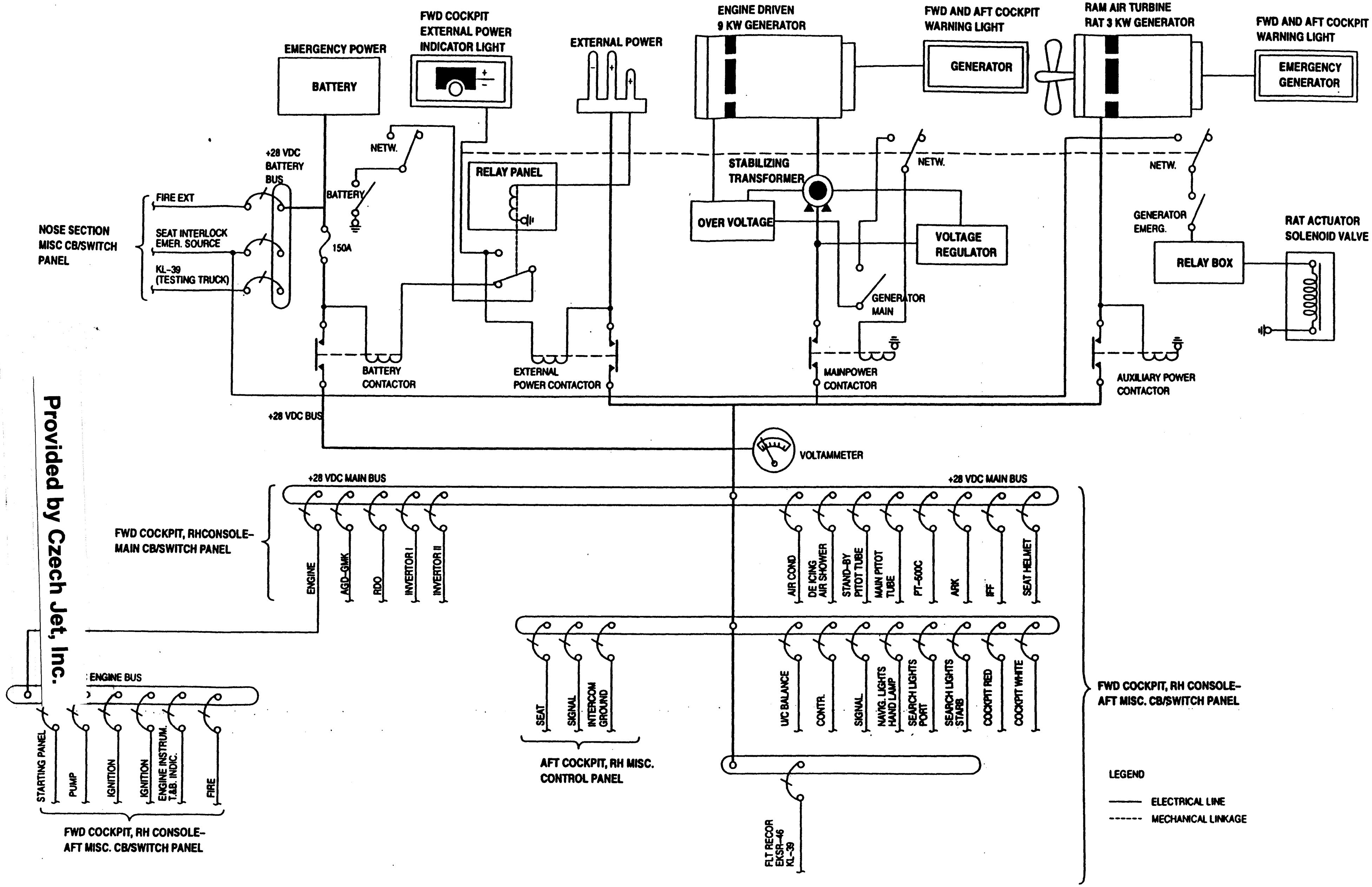


Figure FO–2. DC Electrical System – Schematic Diagram

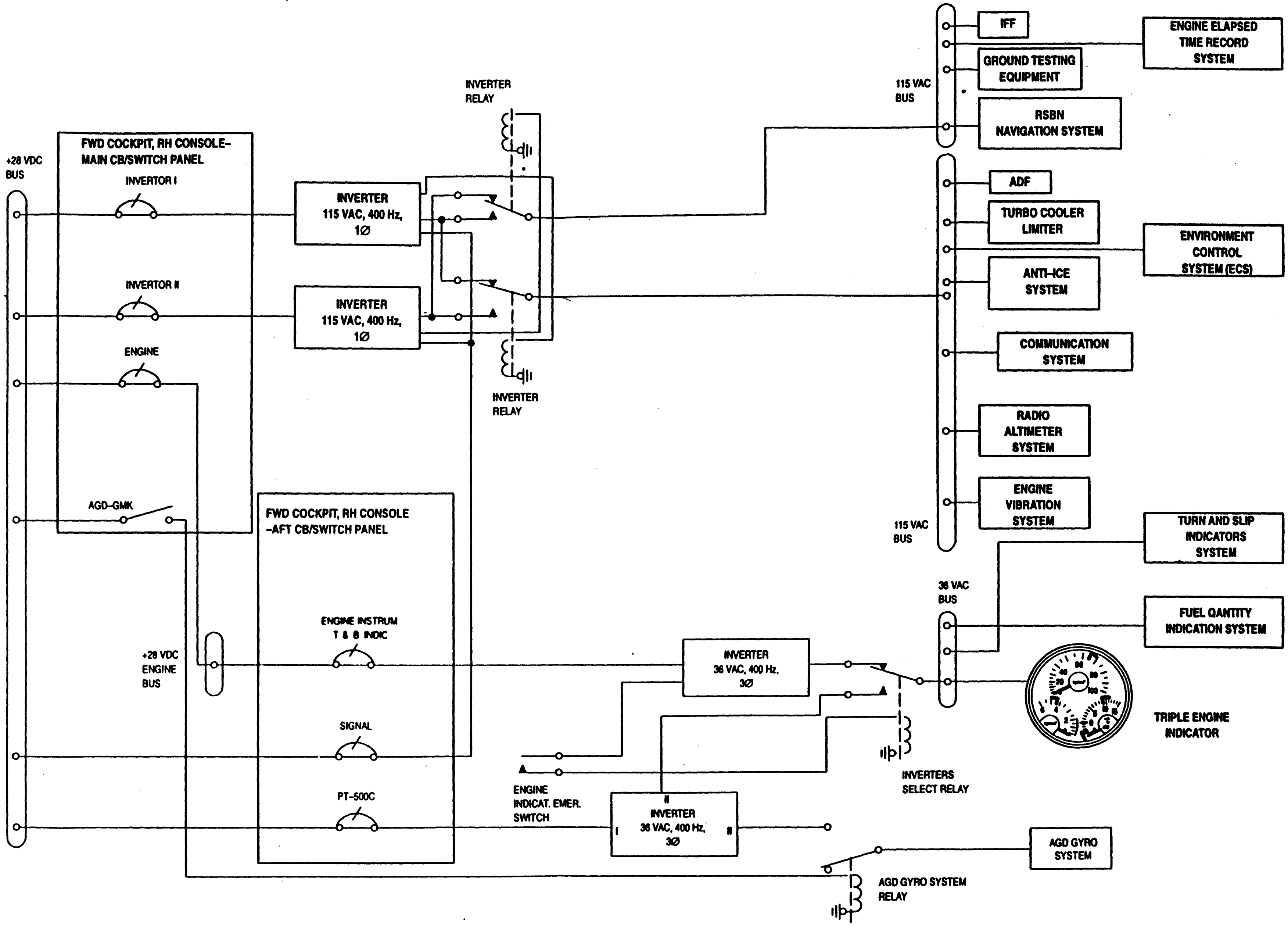


Figure FO–3. AC Electrical System – Schematic Diagram

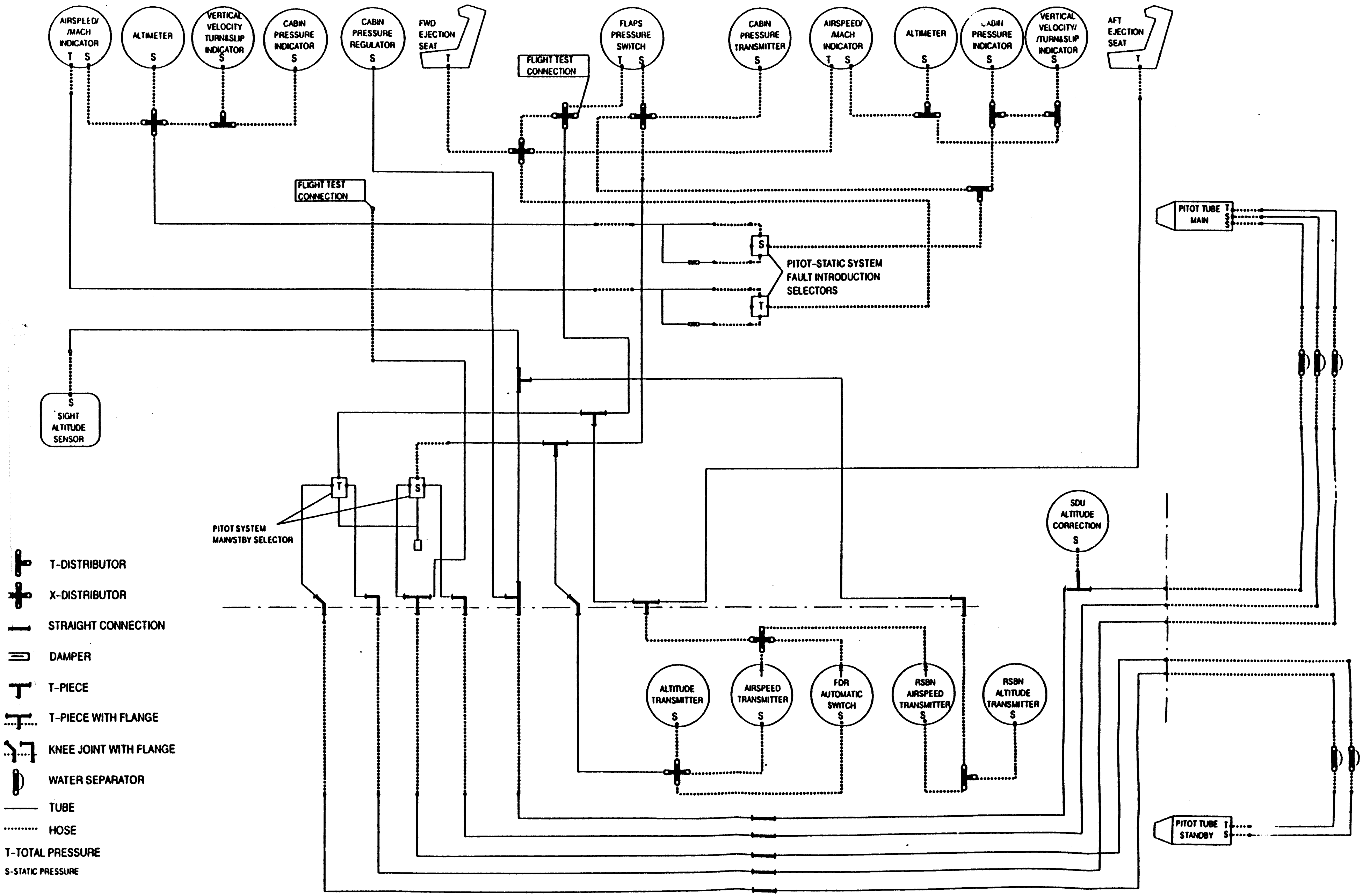


Figure FO–6. Pitot Static System – Schematic Diagram