DCS SERIES

MIRAGE F1

for **DCS** World

AERGES

THE FIGHTER COLLECTION

EAGLE DYNAMICS

Flight Manual

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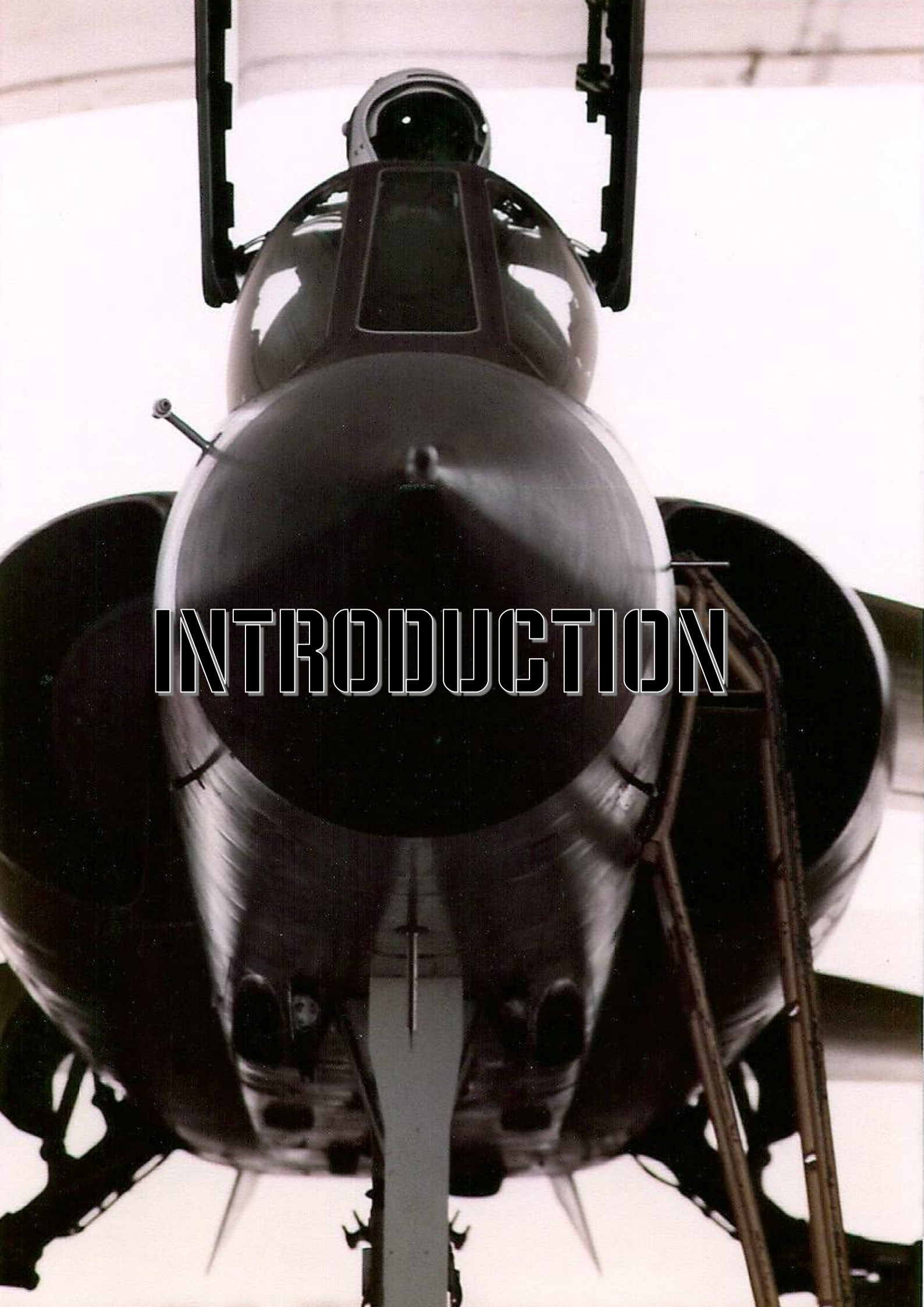


INTRODUCTION

1. INTRODUCTION

Introduction

The Mirage F1 is a single engine French fighter and attack aircraft first introduced in the early 1970s. It was envisioned originally as an all-weather interceptor and has seen many variants, roles and configurations. It is still in service today with multiple air forces and private companies.

The F1 is equipped with a single SNECMA Atar 9K-50 afterburning turbojet, capable of delivering 70 kN of thrust at sea level. A Cyrano IV monopulse radar (later Cyrano IVM) is carried by most of the variants of the aircraft.

The aircraft can carry an extensive variety of payloads: Both IR and radar air to air missiles, guided and unguided bombs, rockets, as well as countermeasures, reconnaissance and electronic warfare pods. Most versions also carry two internal 30 mm DEFA 553 cannons. Some of the latest variants can carry the famous AM39 Exocet antiship missile.

History

During the 1960s, Dassault was involved in the development of several fighter design projects: the F1, the larger F2, the swing-wing G and the BAC/Dassault AFVG. Cost and political issues led to the cancellation of all of these projects, except of the F1, which was a lighter fighter aircraft designed from the beginning to be the successor of the Mirage III and V families of aircraft.

The Mirage F1 wing and empennage configuration enabled it to improve upon some of the problems of that the Mirage III and V suffered due to their delta wing configuration: The high lift devices of the F1 allowed for shorter landing distances and better manoeuvrability and handling at low speeds. The F1 was also able to carry 40% more fuel internally and had a more powerful engine.

The initial prototype first flew on the 23rd of December of 1966, already achieving speeds in excess of Mach 2 in its fourth flight. A fatal accident related to fluttering destroyed this prototype but, after a redesign, the testing of the aircraft continued successfully and the first deliveries of the production aircraft took place in May 1973.

The type has partaken in multiple conflicts serving different countries throughout its extensive service life. With France it has served in Operations Manta, Epervier, Daguet (the Gulf War), Provide Comfort, Harmatan and Serval over Chad, Libya, Mali, Kuwait… As well as in Afghanistan. It partook in the South African Border War with South Africa, in the Paquisha War with Ecuador, in the Libyan civil war, in the Western Sahara War with Morocco and, perhaps most famously, in the Iran-Iraq and Gulf wars with Iraq.

The Mirage F1 has served in the air forces of several countries: France, Iraq, Spain, South Africa, Greece, Jordan, Kuwait, Ecuador and Qatar. It is still in operation in several others: Morocco, Iran, Libya, Gabon and the Republic of the Congo. It also serves in private aggressor training services in the USA.

Main variants

More than 700 units of the Mirage F1 have been produced and it has been exported to several countries. The different necessities of customers over the years have led to the emergence of multiple variants to better satisfy specific requirements:

- Mirage F1-C: The original all-weather interceptor variant for the 'Armée de l'Air', exported to several countries (Spain, Greece, Morocco…). Several of these aircraft were reconverted to the CT (close air support) specification for France. The C-200 was a C version with air refuelling capability, also for the 'Armée de l'Air'. Despite its main role as an interceptor, a secondary role as ground attacker was considered, and a wide selection of air-to-ground ordnance was also available for these models.
- Mirage F1-B: Two seat conversion trainer of the Mirage F1-C. It was capable of carrying the same ordnance as the Mirage F1-C but the extra seat came at the cost of less fuel, a slight increase in weight and the loss of the internal cannons. External cannon pods could be mounted instead.
- Mirage F1-E: Multirole and ground attack version of the Mirage F1-C, it was equipped with a better navigation suite and air refuelling capability. All of the E versions made were for export clients (Iraq, Spain, Jordan, Ecuador…). Of special note are the later Iraqi versions, which were equipped with a wide variety of guided air to ground weapons.
- Mirage F1-D: Two seat version of the F1-E. Only 2 were built, both for Qatar.
- Mirage F1-A: Simplified ground attack variant for the South African Air Force and the Libyan Air Force. It substituted the Cyrano IV radar with a laser rangefinder.
- Mirage F1-CR: Dedicated reconnaissance version which included visual and IR cameras (the IR camera replaces one of the cannons), a radar with extra ground mapping capabilities and a variety of pods, including ELINT and side looking radar. It served with the 'Armée de l'Air' and some were later sold to an aggressor company in the USA.
- Mirage F1-M: Spanish modernised version based on the Spanish C and E models carried out by Thomson-CSF. The modernisation vastly improved air to ground capability, included the new Cyrano IVM radar with sea search modes, as well as new navigation suites, a colour LCD and new HUD.

The Mirage F1-CE

The Mirage F1-CE is the export variant for Spain of the interceptor French F1-C, it entered service in 1975, making the 'Ejército del Aire' the second client to buy the type. It differs slightly from the French version in its ability to carry American made AIM-9 Sidewinder missiles, as well as having an incorporated countermeasure suite. Most of their operative life was spent in the 'Ala 14', based in Los Llanos Air Force Base, until the year 2000, in which it was completely replaced by the F1-M.

AIRCRAFT CHARACTERISTICS

2. AIRCRAFT CHARACTERISTICS

2.1 PHYSICAL CHARACTERISTICS

Clean aircraft gross take-off weight comprising:

- empty weight equipped……7849 kg… (17,304 lbs)
- pilot……95 kg……(209 lbs)
- fuel (JP1)*……3397 kg……(7489 lbs)
- shells……145 kg……(320 lbs)

GW: 11,486 kg….(25,322 lbs)

Overall dimensions:

- length……15.25 m…..(50.03 ft)
- span……8.44 m…..(27.69 ft)
- height (clean aircraft, fully fueled)……4.49 m…..(14.73 ft)

Undercarriage:

- wheelbase (clean aircraft, fully fueled)……4.87 m….(15.98 ft)
- track……2.48 m…..(8.14 ft)

Propulsion:

- SNECMA ATAR 9 K50 jet engine
- Test bed thrust:
  - Full power dry……4770 daN…(10,725 lbs)
  - Max. afterburner……6830 daN…(15,355 lbs)

* Fuel density: 0.79 kg/l

2.2 TECHNICAL CHARACTERISTICS

Clean aircraft permissible load factor:

- In subsonic flight (Mach < 0.95)……-3/+7.2
- In supersonic flight (Mach > 1)……-3/+6

Maximum speed……700 kt (0 – 20,000 ft)

750 kt (> 20,000 ft)

Mach number limit……..2.1

Ceiling (high altitude equipment is not part of aircraft specifications).....55,000 ft

Service ceiling……50,000 ft

Figure 2-1 Mirage F1CE Lateral View

Figure 2-2 Mirage F1CE Top View

AIRCRAFT SYSTEMS

3. AIRCRAFT SYSTEMS

3.1 COCKPIT CONTROLS AND INDICATORS

Figure 3-1 Main Instrument Panel

1 CANOPY HINGED HANDLE	7 JAMMER DETECTION LIGHT AND (C + M OR SW) R LIGHT
2 CLOCK	8 MANUAL GRAVITY DROP SELECTOR INDICATOR
3 STANDBY MAGNETIC COMPASS	9 ACCELEROMETER
4 CHAF AND FLARE DISPENSER PANEL	10 MASTER FAILURE WARNING LIGHT
5 INCIDENCE INDICATOR	11 AUTOPILOT CONTROL AND INDICATOR UNIT
6 SIGHT HEAD	

12 CONFIGURATION INDICATOR 13 SIGHT CAMERA 14 WARNING LIGHTS 15 SHOCK-CONE POSITION INDICATOR 16 MACH/AIRSPEED INDICATOR 17 RADAR INDICATOR SCOPE 18 FIRE WARNING LIGHT (ENG/AB) + HORN 19 MATRA 550 OR SIDEWINDER JETTISON 20 RPM INDICATOR 21 SLAVED ALTIMETER 22 STANDBY ALTIMETER 23 JPT (JET PIPE TEMPERATURE) INDICATOR 24 SPHERICAL INDICATOR	25 VERTICAL SPEED INDICATOR 26 STANDBY HORIZON 27 NAVIGATION INDICATOR 28 RADAR DETECTOR INDICATOR 29 EMERGENCY JETTISON 22 STANDBY ALTIMETER 30 JETTISONING SELECTOR SWITCH 31 SELECTIVE JETTISON 32 DUAL FUEL GAUGE 33 FUEL REMAINING INDICATOR 34 CROSSFEED SWITCH AND EMERGENCY TRANSFER SWITCH 35 FUEL TRANSFER INDICATOR

Figure 3-2 Forward Lower Panel

1 ANTI-SKID (SPAD) SWITCH 2 SHOCK-CONE MANUAL CONTROL SWITCH 3 SHOCK-CONE PUSHBUTTON 4 FUEL TRANSFER SEQUENCE SELECTOR SWITCH 5 HYDRAULIC PRESSURE SELECTOR SWITCH 6 NOSE WHEEL STEERING HIGH SENSITIVITY BUTTON	7 NOSE WHEEL STEERING SWITCH 8 IFF CONTROL PANEL 9 DUAL HYDRAULIC PRESSURE GAUGE 10 CABIN ALTIMETER 11 TRIM INDICATOR 12 ALTERNATIVE FIRING HANDLE

Figure 3-3 Left Side Panel

1 BRAKE CHUTE CONTROL	25 RADAR CONTROL STICK SCALE SELECTION
2 CANOPY EMBRITTLE CONTROL	26 RADAR CONTROL STICK ELEVATION/ALTITUDE
3 STANDBY RECEPTACLE LIGHT	DIFFERENCE BUTTON
4 (C + SW) R DESELECTION SWITCH	27 RADAR CONTROL STICK
5 TELEMETER/ZONE SCANNING SWITCH	28 RADAR CONTROL STICK SCAN SELECTION
6 EMERGENCY REGULATION CONTROL LEVER	29 ANTENNA-GYRO SWITCH
7 EMERGENCY REGULATION SWITCH	30 THROTTLE LEVER
8 EMERGENCY REGULATION LIGHT	31 THROTTLE CUT/IDLE SWITCH
9 LANDING LIGHT CONTROL	32 IN-FLIGHT RELIGHT BUTTON (HIDDEN)*
10 LANDING GEAR SAFETY LEVER AND CONTROL LEVER	33 ALTERNATIVE PTT
11 ANTI-RETRACTION OVERRIDE BUTTON	34 IGNITION/VENTILATION SELECTOR SWITCH
12 EMERGENCY/PARKING BRAKE HANDLE	35 START BUTTON
13 SERVO RESET BUTTON	36 STARTING PUMP SWITCH
14 ARTHUR SELECTOR SWITCH	37 L/H LP PUMP SWITCH
15 STICK UNCOUPLE SWITCH	38 R/H LP PUMP SWITCH
16 YAW/ANTI-SLIP SWITCH	39 LP MAIN COCK SWITCH
17 PITCH SWITCH	40 V/UHF RADIO CONTROL UNIT
18 LEAD LIGHT	41 SLAT/FLAP LEVER
19 INCIDENCE TEST SWITCH	42 RUDDER TRIM CONTROL SWITCH
20 FLIGHT CONTROL TEST RESTART BUTTON	43 HIGH-LIFT DEVICE SELECTOR SWITCH
21 FLIGHT CONTROL TEST SWITCH	44 RADIO SELECTOR UNIT
22 UHF RADIO CONTROL UNIT	45 ARMAMENT MASTER SWITCH
23 JPT EMERGENCY REGULATION SWITCH	46 OXYGEN SYSTEM CONTROLS (PARTIALLY HIDDEN)**
24 A/B MAIN COCK SWITCH	

*Figure 3-4 *Throttle detail*

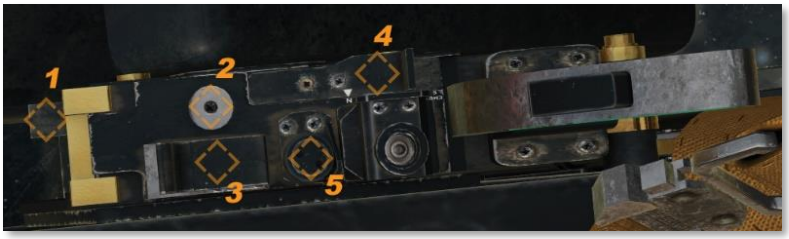


*Figure 3-5 **Oxygen system controls*

1 THROTTLE CUT/IDLE SWITCH 2 IN-FLIGHT RELIGHT BUTTON

1 ANIT-G VALVE COCK 2 ANIT-G TEST BUTTON 3 ANIT-G CONNECTION COVER	4 N-100%-EMEG MODE SELECTOR SWITCH 5 OXYGEN OVERPRESSURE BUTTON

Figure 3-6 Cockpit Left Side View

1 FACE BLIND FIRING HANDLE 2 REAR-VIEW MIRROR	3 CANOPY OPEN/CLOSE HANDLE 4 CANOPY SHEAR KNIFE

Figure 3-7 Right Side Panel

1 DINGHY PUNCTURE	19 TACAN X/Y MODE AND FREQUENCY SELECTORS
2 CANOPY LOCK CONTROL	20 VOR-ILS/OFF/TACAN AND OMNIBEARING SELECTORS
3 EMERGENCY LANDING GEAR HANDLE	21 VOR-ILS CONTROL UNIT
4 CANNONS TOO HOT LIGHT	22 HEADING SELECTION KNOB
5 TR RESET BUTTON	23 PILOT OXYGEN TEST BUTTON
6 BATTERY SWITCH	24 AIR CONDITIONING SYSTEM EMERGENCY CONTROL SWITCH
7 ALTERNATOR 1 SWITCH	25 AIR CONDITIONING SYSTEM MASTER VALVE CONTROL SWITCH
8 ALTERNATOR 2 SWITCH	26 AIR CONDITIONING SYSTEM TEMPERATURE CONTROL REHOSTAT
9 INVERTER SELECTOR SWITCH	27 LIGHTING CONTROL UNIT
10 NAVIGATION LIGHT CONTROL	28 AIR CONDITIONING SYSTEM AUTO/MANUAL SELECTOR SWITCH
11 FORMATION LIGHT CONTROL	29 AIR CONDITIONING SYSTEM HOT/COLD SELECTOR SWITCH
12 SEE RIGHT SIDE PANEL DETAIL *	30 AIR CONDITIONING SYSTEM RAM AIR SWITCH
13 CANOPY SEAL VALVE CONTROL LEVER	31 AIR CONDITIONING SYSTEM DEMIST SWITCH
14 RADAR INDICATOR SCOPE CONTROL BOX	32 CIRCUIT BREAKER BOX
15 SEAT HEIGHT ADJUSTMENT CONTROL	
16 HEADING AND VERTICAL REFERENCE SYSTEM CONTROL SWITCH	
17 HEADING AND VERTICAL EMERGENCY GYROMAGNETIC COMPASS SWITCH	
18 HEADING AND VERTICAL EMERGENCY HEADING CONTROL UNIT ERECTION BUTTON	

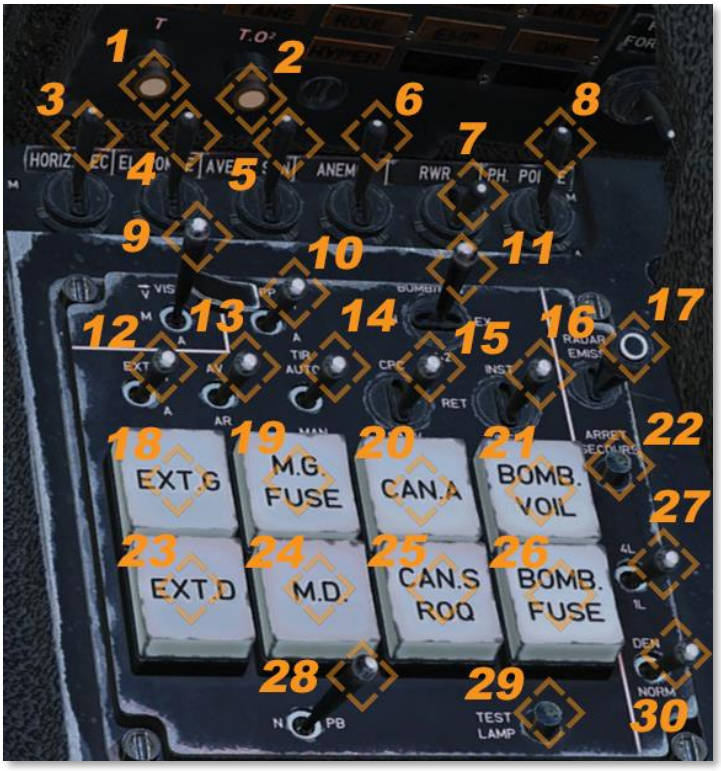


*Figure 3-8 *Right Side Panel Detail*

1 FAILURE WARNING PANEL T TEST BUTTON	18 LEFT MATRA R550 OR SIDEWINDER MISSILE PUSHBUTTON
2 FAILURE WARNING PANEL O2 TEST BUTTON COPY	19 LEFT OR FUSELAGE MATRA R530 MISSILE PUSHBUTTON
3 STANDBY HORIZON SWITCH	20 AIR-TO-AIR GUNS PUSHBUTTON
4 ELECTRO-PUMP SWITCH	21 WING BOMBS PUSHBUTTON
5 WARNING HORN SWITCH	22 RADAR EMERGENCY TRANSMISSION BUTTON
6 PROBE HEATER SWITCH	23 RIGHT MATRA R550 OR SIDEWINDER MISSILE PUSHBUTTON
7 RADAR DETECTOR SWITCH	24 RIGHT MATRA R530 MISSILE PUSHBUTTON
8 SEARCH LIGHT CONTROL	25 AIR-TO-GROUND GUNS OR ROCKETS PUSHBUTTON
9 SIGHT SELECTOR	26 FUSELAGE BOMBS PUSHBUTTON
10 FIRING FUEL DIPPER SWITCH	27 RADAR 4 LINES/1 LINE SCAN SWITCH
11 BOMB/ROCKET SELECTOR	28 R530 MISSILE NORMAL/ALTITUDE DIFFERENCE SELECTOR SWITCH
12 MATRA 550 OR SIDEWINDER MISSILE SWITCH	29 NORMAL/JUMMER PURSUIT SWITCH (NO FUNCTION)
13 FORE/AFT SELECTOR SWITCH	30 ARMAMENT PANEL LIGHTS TEST
14 AUTO/MANUAL FIRING SELECTOR SWITCH	
15 SINGLE/SALVO SELECTOR	
16 INSTANTANEOUS/DELAY/SAFE SELECTOR SWITCH	
17 RADAR SELECTOR	

3.2 ELECTRICAL SYSTEM

Description

The electrical system consists of:

- Two 15 kVA three phase alternators at 400 Hz and 115/200 V AC
- Two 100 A transformers-rectifiers (TR)
- One 40 Ah battery.
- A static inverter
- A switching box that enables to supply an emergency AC system by the alternators or the DC system through the static inverter.
- A standby receptacle that enables certain equipment to be energized and preheated on the ground.
- An external AC power receptacle to supply the systems from an auxiliary power unit.

The electrical power is distributed by:

- AC system 1, normally supplied by alternator 1
- AC system 2, normally supplied by alternator 2
- Emergency AC system, normally supplied by alternator 1
- DC system, normally supplied by the TR's and the battery. It comprises:
    - a direct battery system
    - a main system
    - a utility subsystem, with automatic shedding in case of both alternators failure.

There are three missile busses, shedding occurs if an alternator fails and RPM are < 5600.

See limitations chapter regarding alternators ventilation.

Operation

When there is undervoltage detection in AC system 1, the emergency AC system is switched to the inverter. The EMG~ light is on.

When the standby receptacle is connected, the battery and the distribution systems are isolated.

During start, the cranking and ignition of the engine are electrically accomplished on the battery.

After starting, the alternators cut in when they reach their frequency and voltage thresholds, this happens at approximately 2800 engine RPM.

The inverter selector is set to RESET, switching the emergency AC system to system 1. The EMG~ light goes out.

As soon as the alternators cut in, the standby receptacle disconnects and the aircraft is supplied normally.

When the external power receptacle is connected, the alternators are isolated (battery switch ON, light is out) and the two AC systems are supplied.

The external power has priority over the alternators.

There is no external DC power receptacle, since the aircraft is equipped with transformer-rectifiers.

Controls

- Battery switch: connects the battery to the DC system.
- Alternator 1 switch: connects alternator 1 to the AC system.
- Alternator 2 switch: connects alternator 2 to the AC system.
- TR reset button: used to reset the transformer-rectifiers.
- Inverter selector switch: enables the emergency AC system to be supplied by the alternators or the DC system through the static inverter. It has two steady positions (INV and AUTO) and a RESET spring-loaded position.

Failure lights

- Red BATT light: the battery is disconnected from the main system.
- Amber ALT 1 light: the alternator 1 is not supplying its system.
- Amber ALT 2 light: the alternator 1 is not supplying its system.
- Amber TR1 light: the transformer-rectifier 1 is not supplying the DC systems.
- Amber TR2 light: the transformer-rectifier 2 is not supplying the DC systems.
- Amber SEC~ light: emergency AC system supplied by the inverter.
- Red MODUL light: excessive modulations of the vario-alternator driving torque.

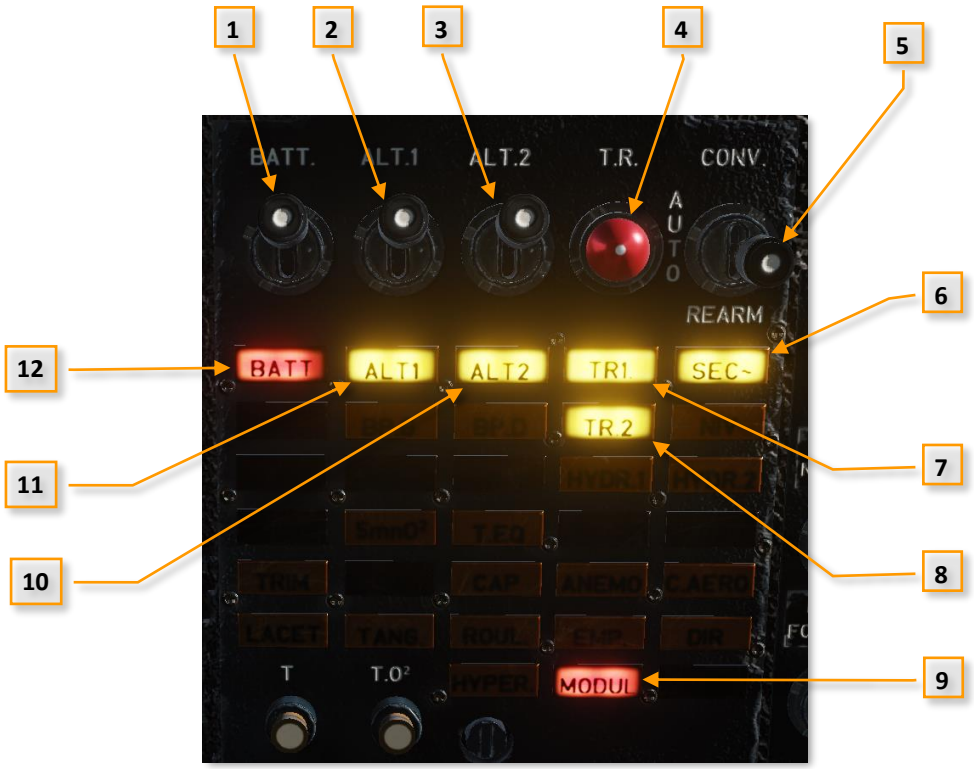


Figure 3-9 Failure Warning Panel

1 BATTERY SWITCH
2 ALTERNATOR 1 SWITCH
3 ALTERNATOR 2 SWITCH
4 TR RESET BUTTON
5 INVERTER SELECTOR SWTICH
6 SEC~ AMBER LIGHT
7 TR1 AMBER LIGHT
8 TR1 AMBER LIGHT
9 MODUL RED LIGHT
10 ALT2 AMBER LIGHT
11 ALT1 AMBER LIGHT
12 BATT RED LIGHT

Failures

BATT light on

Warning horn sounds.

The battery is disconnected from the main system, but it can supply its own bus.

If the battery is exhausted the inflight relight system is inoperative.

ALT 1 light on

The EMG~ light may come on.

The alternator 1 is not supplying its system.

The alternator 2 takes over and supplies AC systems 1 and 2.

The emergency system is supplied by the inverter.

ALT 2 light on

The alternator 2 is not supplying its system.

The alternator 1 takes over and supplies AC systems 1 and 2.

ALT 1 and ALT 2 lights on
The EMG~ light comes on.

TR1 and TR2 come on when battery voltage is < 25V.

Neither alternator supplies its system.

The emergency system is supplied by the inverter.

A load shedding occurs in the utility DC subsystem.

The battery is the only source that supplies the electrical system. It has an endurance of at least 13 minutes if the electrical pump is off.

EMG~ light on
The inverter supplies the emergency AC system.

TR.1 or TR.2 light on
Only the transformer-rectifier whose light is out supplies the DC systems.

TR.1 and TR.2 lights on
Neither transformer-rectifier supplies the DC systems.

Only the battery supplies DC power.

MODUL light on
Warning horn sounds.

Excessive alternator driving torque.

COMPLETE ELECTRICAL FAILURE
All lights are out.

The battery is exhausted (<18V) or there is a complete failure of the alternators and the reverse-current relay.

These are the systems that remain operative:

- clock
- RPM indicator
- standby compass
- standby altimeter, Mach/airspeed indicator, vertical speed indicator
- accelerometer
- canopy embrittle and seat ejection systems
- brake chute
- brakes (without antiskid)

Status of the aircraft in this situation:

- Emergency gear extension.
- Engine gravity feeding.
- Slats and flaps inoperative.
- Flight controls operate in mechanical mode.
- ARTHUR low mode.
- Shock cones remain in the position they had at the time of the failure.

CIRCUIT BRAKER PANEL

Figure 3-10 Circuit Braker Panel

NAV	Gyro control unit power supply
C de HYP	High-lift device servo unit power supply
OXY	Indicator and failure detector power supply
C de CONV	Inverter transfer unit power supply and control
P HYP	Dual hydraulic pressure gauge power supply
GACH TIR	Gun firing trigger power supply
ROB BP	LP cock power supply
EP	Electro-pump relay power supply
REMP VOL	Flight refueling system power supply
P CAB	Cabin pressurization system power supply

PUIS CONV	Inverter 28 V power supply
C de TRAIN	U/C normal operation power supply
V.UHF	V/UHF power supply
DEMA	Starter and sequencing system power supply
TRIM PROF	Manual trim control power supply
T CAB	Valve position repeater, control valve and ground mode power supply
SIGN	Failure warning panel and master failure warning light power supply
Cle TRAIN	Configuration indicator (U/C section) and U/C warning light power supply
IFF	IFF power supply
REG SEC	Emergency regulation system and control lever power supply

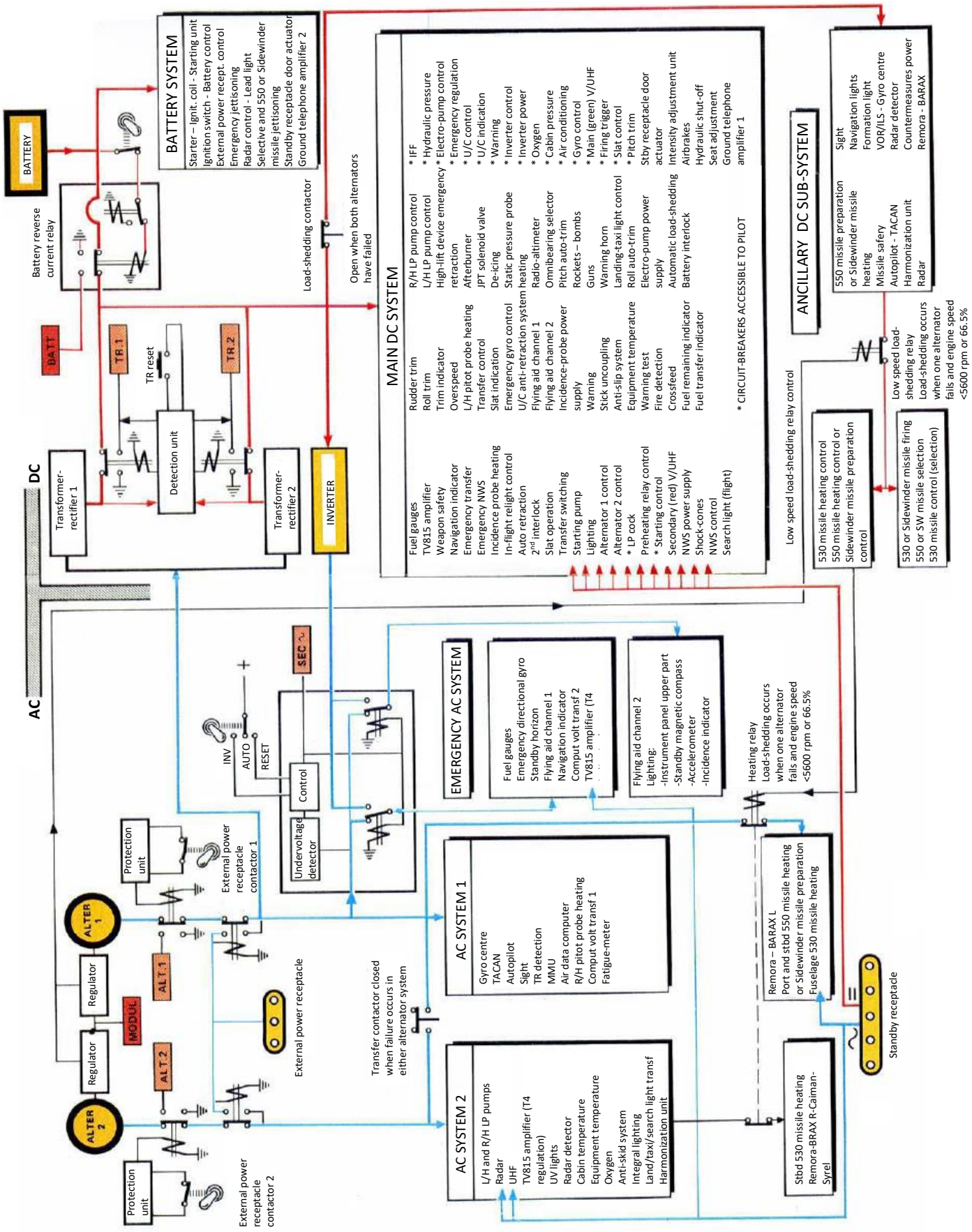


Figure 3-11 Electrical System Diagram

3.3 FUEL SYSTEM

Description

The aircraft has a total of 9 internal fuel tanks (7 in the fuselage and 2 in the wings) plus a negative-g flight accumulator to allow for inverted flying and capability of carrying 3 external tanks. This allows it to carry a maximum of 4240 l (7650 l with the external tanks). Ultimately, all the tanks transfer fuel to the feeder tanks, which then transfer it to the engine. The tanks are distributed in the following way:

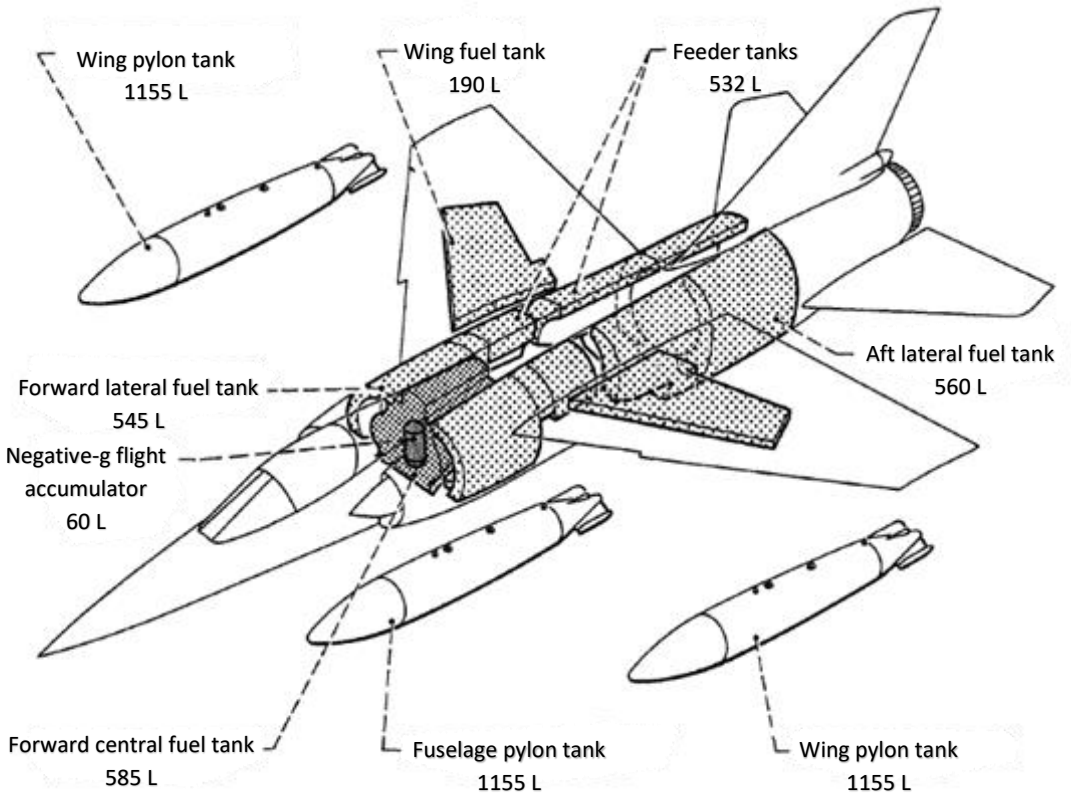


Figure 3-12 Fuel Tank Arrangement

There are 2 draining order configurations for the aircraft, depending on if external fuel tanks are being carried or not. The mode is selected through a fuel transfer sequence selector switch. The level of the feeder tanks descends as the other tanks are emptied, in such a way that, when a certain level is reached in the feeder tanks, the transference from the next tank to be used to the feeders starts. The configurations are:

- When the switch is on ‘CLEAN’:
    1. External tanks and wing tanks
    2. Central front
    3. 2/3 of laterals rear
    4. Laterals front
    5. Remaining 1/3 of laterals rear
    6. Remaining at feeders
    7. Negative-g flight accumulator

- When the switch is on ‘EXTERNAL TANKS’:
    1. External tanks and wing tanks
    2. 2/3 of laterals rear
    3. Central front
    4. Remaining 1/3 of laterals rear
    5. Laterals front
    6. Remaining at feeders
    7. Negative-g flight accumulator

The engine and the negative-g flight accumulator are fed by 3 pumps from the feeder tanks: one in the left feeder and 2 in the right one (the extra pump in the right is the starter pump). The negative-g flight accumulator allows for 10-15 seconds of inverted flight, but exceeding this can result in either fuel starvation or damage to the engine.

Some models of the aircraft (such as the EE and the M) are air-to-air refuelling capable.

Controls

- Fuel transfer sequence selector switch: selects the transfer order.

- Feeder tank / fuselage switch: selects if the gauges display the fuel quantity in the feeder tanks or in the whole fuselage.

- Crossfeed switch: allows the transfer between feeder tanks to correct any possible fuel imbalance in the aircraft.

- Emergency fuel transfer switch: enables an emergency transfer by gravity of fuel from the aft lateral tanks to the feeder tanks.

- LP main cock switch: enables the LP fuel supply to the engine and afterburner to be shut off.

- A/B main cock switch: enables the fuel supply to the afterburner only to be shut off.

- Left fuel pump switch: allows the left pump to be energized.

- Right fuel pump switch: allows the right pump to be energized.

- Starter fuel pump switch: allows the start pump to be energized. It is automatically actuated by the cover of the ignition switch.

Indicators

- Fuel transfer indicator: represents the different tanks of the aircraft, the corresponding light turns on whenever one of the tanks is empty (e.g. see figure 3-13 below, with empty wing tanks, shown by the red lights indication).
- Dual fuel level gauge: shows the remaining fuel quantity (in litres) either in the feeders or fuselage depending on ‘Feeder tank / fuselage switch’ position. Note: there are 2 needles, one for each side of the aircraft.
- Fuel remaining indicator: 4 digit counter of the remaining aircraft fuel (to be set every time a refuelling takes place, using the reset thumbwheel).

Failure lights

- Red LP (BP): indicates low pressure in the engine feeding system. The engine might be starved of fuel.
- Amber L/H LP (BP.G): indicates low discharge pressure of the left hand pump. The pump is not powered or energized, has failed or is starved of fuel as a result of inverted flight.
- Amber R/H LP (BP.D): indicates low discharge pressure of the right hand pump. The pump is not powered or energized, has failed or is starved of fuel as a result of inverted flight.
- Amber FUEL (NIV): indicates the fuel level in either of the feeder tanks is below 250 l

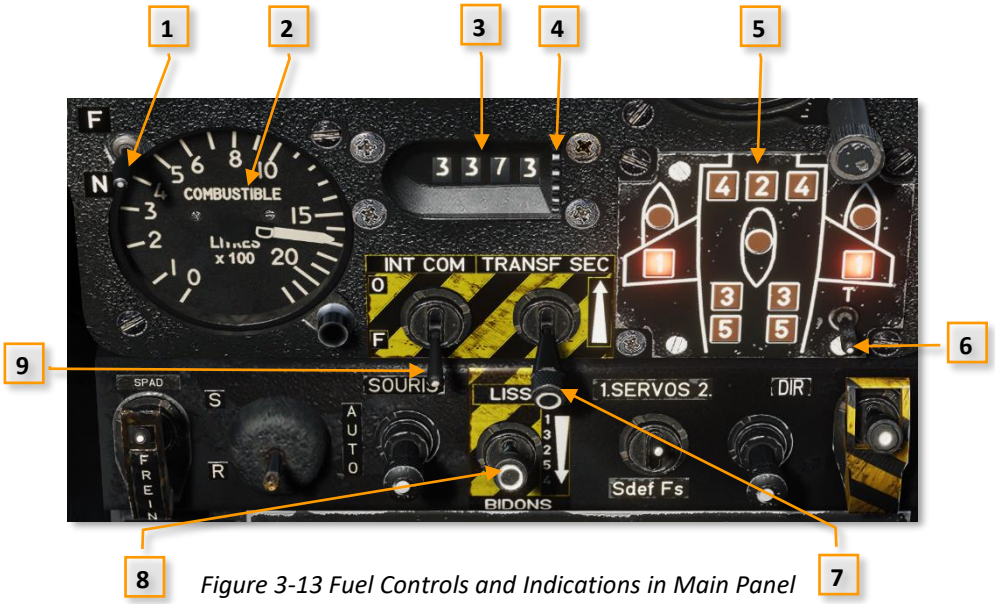


Figure 3-13 Fuel Controls and Indications in Main Panel

1 FEEDER TANK/FUSELAGE SELECTOR SWITCH
2 DUAL FUEL GAUGE
3 FUEL REMAINING INDICATOR
4 FUEL QUANTITY RESET THUMBWHEEL
5 FUEL TRANSFER INDICATOR
6 FUEL TRANSFER INDICATOR TEST
7 EMERGENCY FUEL TRANSFER SWITCH
8 FUEL TRANSFER SEQUENCE SELECTOR SWITCH
9 CROSSFEED SWITCH

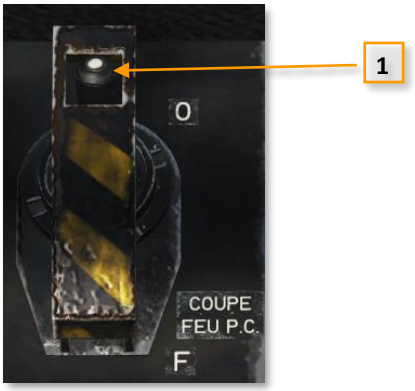


Figure 3-14 A/B Main Cock Switch in Left Console

1 A/B MAIN COCK SWITCH

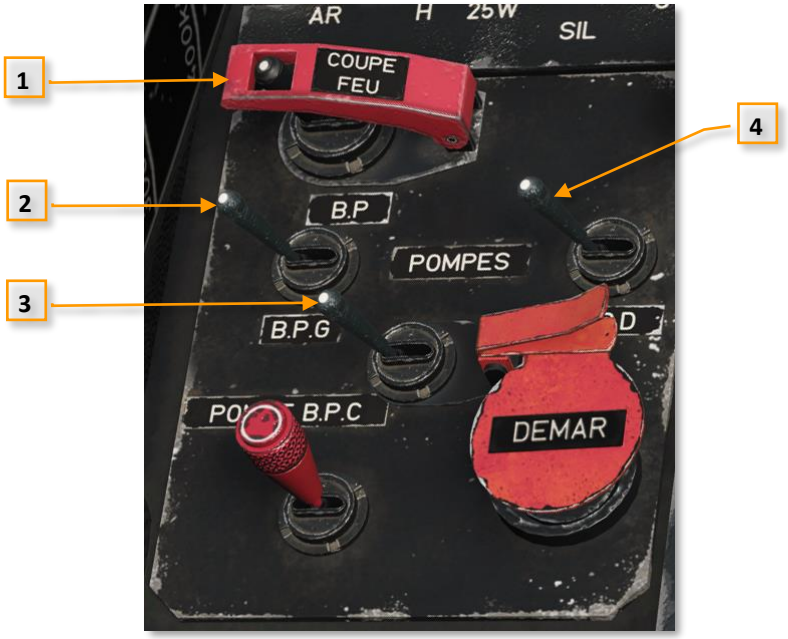


Figure 3-15 Fuel Controls in Left Console

1 LP MAIN COCK SWITCH
2 L/H LP PUMP SWITCH
3 STARTING PUMP SWITCH
4 R/H LP PUMP SWITCH

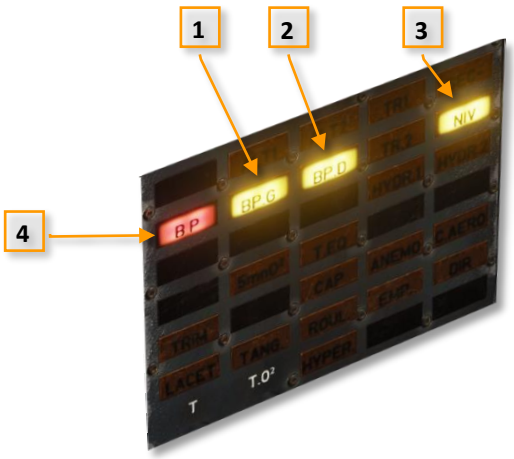


Figure 3-16 Fuel System Failure Warning Lights

1 L/H LP (BP.G) AMBER LIGHT
2 R/H LP (BP.D) AMBER LIGHT
3 FUEL (NIV) AMBER LIGHT
4 LP (BP) RED LIGHT

3.4 JET ENGINE

Introduction

The Mirage F1 is powered by the SNECMA ATAR 9K-50 afterburning turbojet. This engine is the pinnacle of the evolution of the ATAR family, started in the late 1940s by SNECMA with former BMW engineers for the Vautour and Mystère aircraft.

The engine is located in the rear part of the aircraft, with the air intakes behind and on the sides of the cockpit. Static and at sea level, it is capable of delivering 50 kN of thrust in military power settings and up to 70 kN in afterburner mode. It can operate at speeds in excess of Mach 2.1.

Description

The engine has 9 stages in the compressor and 2 stages in the turbine. It also counts with a convergent-divergent adjustable nozzle. Supplementary valves open at the sides of the aircraft to increase airflow at low airspeeds and high thrust settings. Supersonic shock-cones also move to adjust the airflow at supersonic speeds and prevent the ingestion of shock waves.

In idle, the engine spins at 2900 RPM, in full power at 8400 RPM. At speeds above M 1.4, the maximum RPM is increased to 8900 and the engine enters a mode called ‘overspeed’. Changes to throttle input in ‘overspeed’ will result in an engine stall or flameout, so speed has to be reduced by airbrakes, manoeuvring or ascending in that situation.

Lubrication is provided by an oil deposit of 9 litres (an emergency oil deposit of 3.5 litres is also available). Consumption of oil limits the autonomy of the aircraft to 6 hours. In case of failure of the throttle or main oil system, an emergency regulation mode exists, in which the emergency oil deposit is used and engine power is adjusted by pulses.

The start-up of the engine occurs sequentially, with an electric motor starting a gas generator, which, in turn, starts the engine. The starter pushbutton shouldn't be pressed for more than 2 seconds to avoid damaging the electric starter and should never be pushed when the engine is turning, at the risk of destroying the starter system.

A fuel dipper mechanism prevents engine stall from ingesting the exhaust fumes of the missiles or cannons. When a missile is fired, the fuel dipper reduces the amount of fuel sent to the engine, causing a drop in RPM, turning off the AB and opening the nozzle for 3 seconds. In the case of the cannons, only a reduction of RPM occurs.

Controls

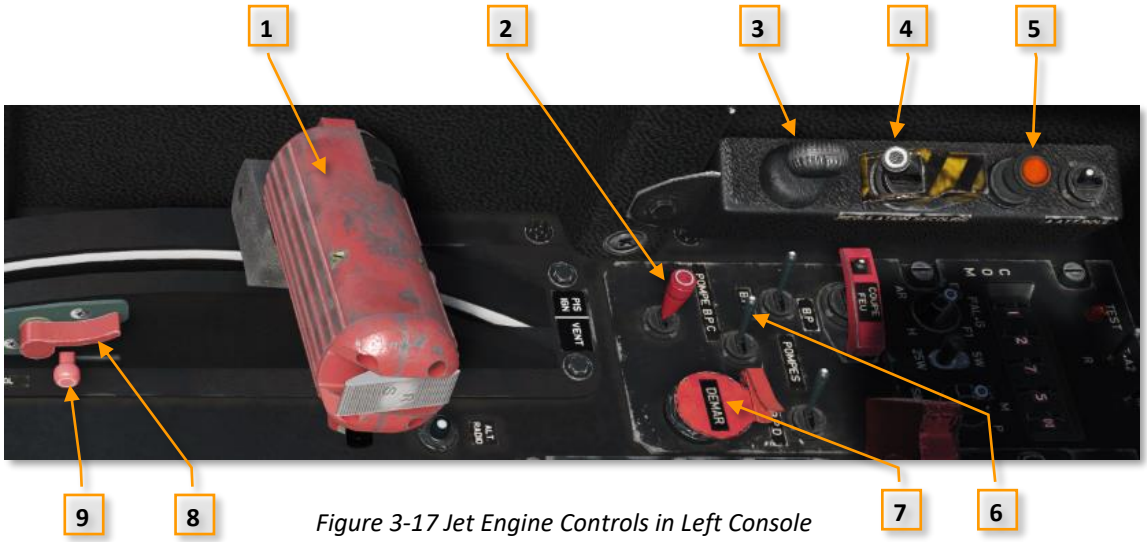


Figure 3-17 Jet Engine Controls in Left Console

1 THROTTLE LEVER
2 IGNITION/VENTILATION SELECTOR SWITCH
3 EMERGENCY REGULATION CONTROL LEVER
4 EMERGENCY REGULATION SWITCH (GUARDED)
5 EMERGENCY REGULATION LIGHT
6 STARTING PUMP SWITCH
7 START BUTTON (UNDER COVER)
8 THROTTLE CUT/IDLE SWITCH
9 IN-FLIGHT RELIGHT CONTROL

Figure 3-18 JPT Emergency Regulation Switch in Left Console

1 JPT EMERGENCY REGULATION SWITCH

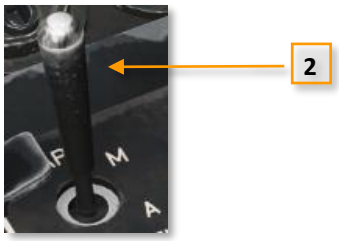


Figure 3-19 Firing Fuel Dipper Switch in Right Console

2 FIRING FUEL DIPPER SWITCH

Figure 3-20 Shock-cone Controls in Main Panel

1 SHOCK-CONE MANUAL CONTROL SWITCH
2 SHOCK-CONE PUSHBUTTON

Indicators

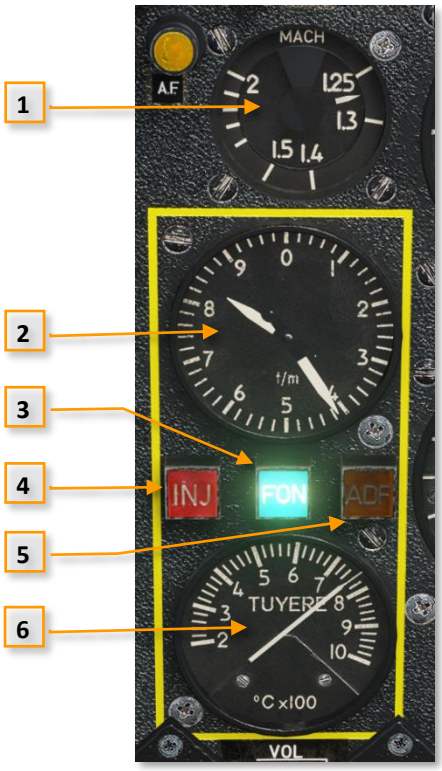


Figure 3-21 Jet Engine Indications in Main Panel

1 SHOCK-CONE POSITION INDICATOR
2 RPM INDICATOR
3 A/B ON LIGHT
4 A/B INJECTION LIGHT
5 SRL (ADF) FAILURE WARNING LIGHT
6 JPT INDICATOR

Failure lights

- -Oil (Huile): Signals that oil pressure is low. It can be caused by multiple factors: prolonged inverted flight or failure of the oil or lubrication systems. Immediate action is required to avoid damage to the engine: return to level flight and, if it persists, engage emergency regulation mode and return to base.
- VAN. D: Discharge valves position not matching orders.
- Engine fire light: It is an emergency, signals the engine is on fire. Immediately cut throttle and close the engine fuel cock. If the light disappears, restart the engine, if not, eject.
- A/B fire light: It is an emergency, signals the afterburner is on fire. Immediately cut A/B and close the A/B fuel cock.

Figure 3-22 Fire Warning Lights in Main Panel

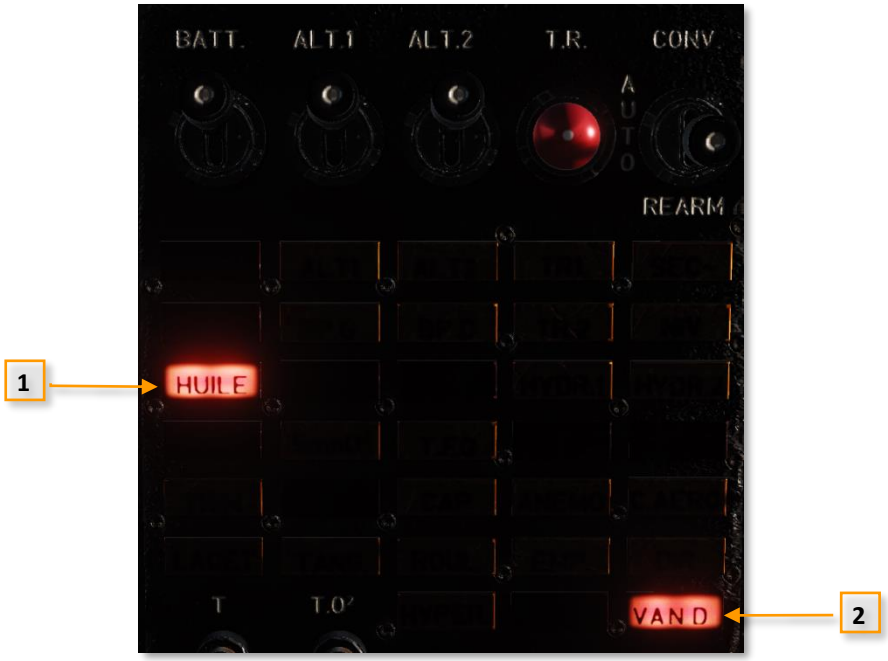


Figure 3-23 Failure Warning Panel

1 OIL (HUILE) RED LIGHT

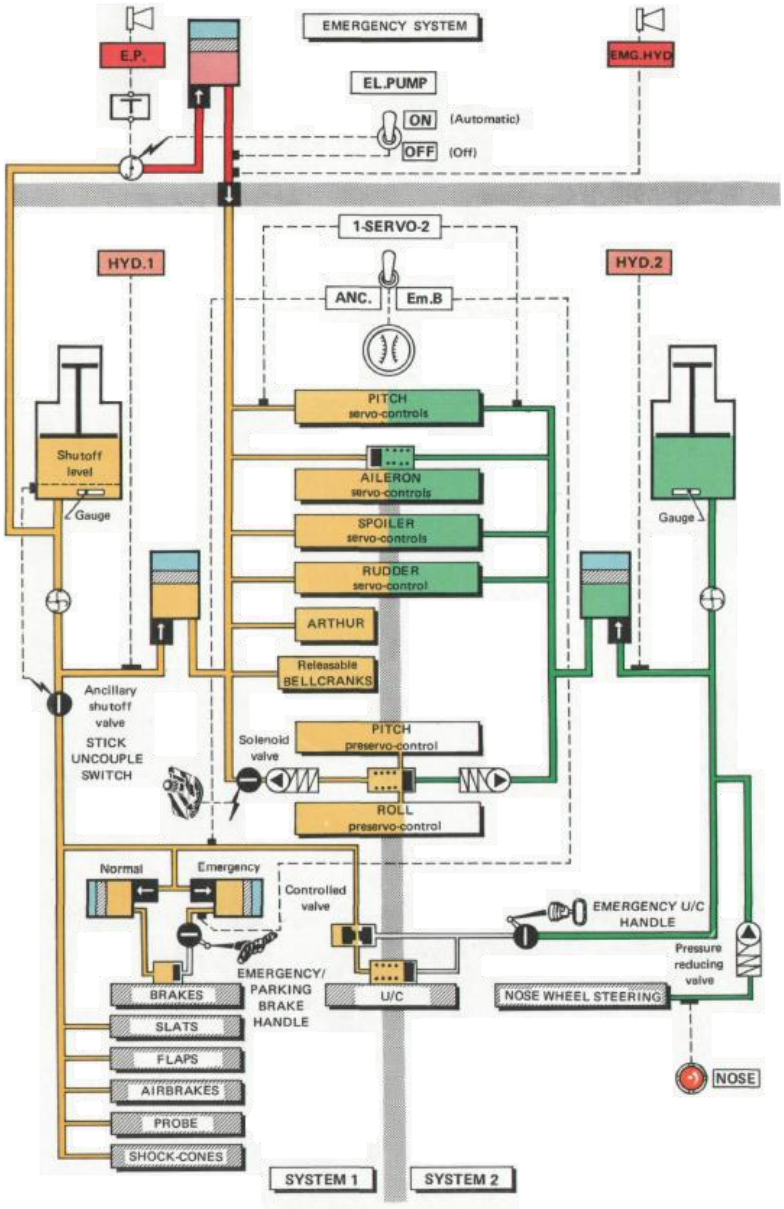
2 B.O.V (VAN.D) RED LIGHT

3.5 HYDRAULIC SYSTEM

Description

The aircraft counts with 2 different hydraulic circuits to provide a certain redundancy in the hydraulic supply of some elements. Part of the Hydraulic circuit 1 can be isolated and fed through an electro-pump to keep the aircraft controllable in the case of an emergency.

Each circuit is pressurized by a pump powered by the engine and counts with a hydraulic deposit. As mentioned previously, in case of the pressure of circuit one falling beyond a certain threshold, part of the circuit is isolated and an electro-pump is activated. A diagram of the system shows which elements are fed by each circuit:



The hydraulic circuit feeds the control surfaces, the variable sensitivity crank bell (ARTHUR), the wheel brakes, the actuation of the landing gear, the high lift devices, the shock cones, the airbrakes and the nose wheel steering.

The landing gear can be deployed in the case of an emergency by an emergency deployment lever. The gear must be retracted at speeds above 240 kt to avoid the possibility of damage.

The airbrakes position can be set through a switch on the throttle. The positions are: retracted, extended unstable and extended locked. The airbrakes can be extended at any speed.

The braking system is equipped with an antiskid that can be disabled. The nose wheel steering has 2 modes: normal and high sensitivity.

The high lift devices are comprised of flaps and slats. The flaps usually work on automatic mode, while the flaps can be set to an automatic mode for combat. Retraction and deployment are commanded depending on angle of attack and airspeed. The automatic behaviour can also be overridden for landing and take-off. The following table describes the behaviour of the high lift devices on the different modes:

Selected configuration		**Slats**		**Flaps**	
		Inner	**Outer**	**Inner**	**Outer**
Automatic / combat mode	Automatic slats (aoa > 8º, Vi < 440 kt and M < 0.98)	Full out	Half out	Retracted	Retracted
	Combat flaps/slats (Vi < 300 kt, M < 0.75)	Full out	Full out	Half out	Half out
Take-off/landing mode	Slats + medium flaps	Full out	Full out	Half out	Half out
	Slats + full flaps	Full out	Full out	Full out	Full out

Controls

- Electro-pump switch: energizes the electro-pump (the electro-pump activates when the pressure of circuit 1 is too low).
- Electro-pump (EP) circuit breaker: protects the electro-pump from damage from overvoltage.
- Hydraulic pressure selector switch: Allows to visualize either hydraulic pressure in circuits 1 and 2 or servitudes and brake hydraulic pressure on the hydraulic pressure gauge.
- Slats/flaps lever: controls the deployment of the high lift devices in manual mode (take-off/landing modes).
- High-lift devices lever (NORMAL-OFF-EMERG. RETRACTION): Controls the overall behaviour of the high lift devices. NORMAL is the normal behaviour with automatic deploy of the slats. In OFF mode, the automatic deployment of the slats stops. In EMERG. RETRACTION, the flaps and slats are retracted and other commands are overridden.
- Combat flap button/lever: selects/deselects the combat flaps mode.
- Slats/flaps (S/F) circuit breaker: Protects the electrical component of the high lift devices system from overvoltage.
- Airbrake control switch (retracted/unstable deployed/locked deployed): Commands the airbrakes.
- Undercarriage control lever: commands the deployment and retraction of the landing gear.
- Emergency undercarriage handle: commands deployment of the landing gear in the event of lack of hydraulic pressure. First position: doors opened. Second position: gear down.

- Nose wheel steering high sensitivity button: Determines if the steering is on high sensitivity (45º of steering) or not (7º of steering). The button is released when there is no weight on the front wheel.
- Nose wheel steering switch (under guard): Disables nose wheel steering.
- Brake pedals: independently activates the brakes on each wheel.
- Emergency/parking brake handle: Used when parking the aircraft or when regular brakes do not work.
- Antiskid (SPAD) switch (under guard): Deactivates the antiskid.

Indicators

- Dual hydraulic pressure gauge: indicates the hydraulic pressure in circuits 1 and 2 or the pressure in the emergency and brakes circuits, depending on the position of the hydraulic pressure selector switch.
- Configuration indicator: Displays the state of the high lift devices, gear and gear doors.
- Airbrake light: indicates if the airbrake is deployed.
- Nosewheel steering light: Indicates if nosewheel steering is completely disabled.
- Brake light: Indicates if parking/emergency brake is indicated or if brake testing is underway. To taste the brakes, while flying and with the landing gear retracted, press and release the brakes and check if the lights turns on to indicate the system works properly.

Failure lights

- Amber HYDR1 and HYDR2: Indicate low pressure in hydraulic circuits 1 and 2 respectively.
- Red EP: Indicates the electro-pump has been active continuously for more than 8 seconds.
- Red EMG.HYD (HYDR.S): Indicates low pressure in the emergency circuit (isolated part of the hydraulic circuit 1, downstream of the electro-pump).
- Amber S/F (HYPER) light: Shows a disagreement between the commanded and the actual position of the high lift devices or the combat flaps activated well outside their use envelope.

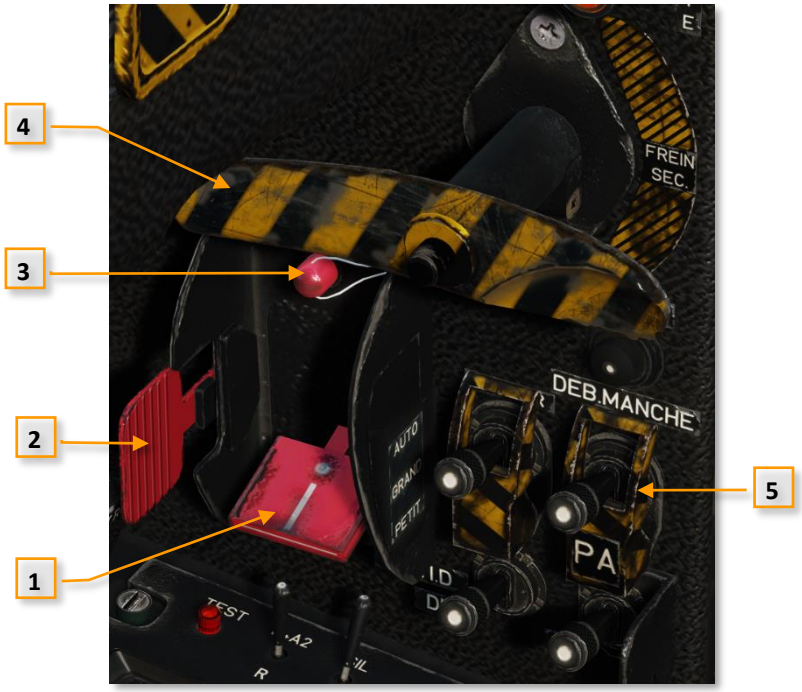


Figure 3-24 Parking Brake and Undercarriage Panel

1 U/C CONTROL LEVER
2 U/C SAFETY LEVER
3 ANTI-RETRACTION OVERRIDE BUTTON
4 EMERGENCY/PARKING BRAKE HANDLE
5 STICK UNCOUPLE SWITCH (GUARDED)

Figure 3-25 Electro-Pump Switch in Right Console

1 ELECTRO-PUMP SWITCH

Figure 3-26 Emergency U/C Handle in Right Front Panel

2 EMERGENCY U/C HANDLE

Figure 3-27 Slat/Flap Lever in Left Console

Figure 3-28 High-lift Device Selector Switch in Left Console

1 SLAT/FLAP LEVER

2 HIGH-LIFT DEVICE SELECTOR SWITCH

Figure 3-29 Hydraulic System Controls in Main Panel

1 ANTI-SKID (SPAD) SWITCH (GUARDED)

2 HYDRAULIC PRESSURE SELECTOR SWITCH

3 NWS HIGH SENSITIVITY BUTTON

4 NWS SWITCH (GUARDED)

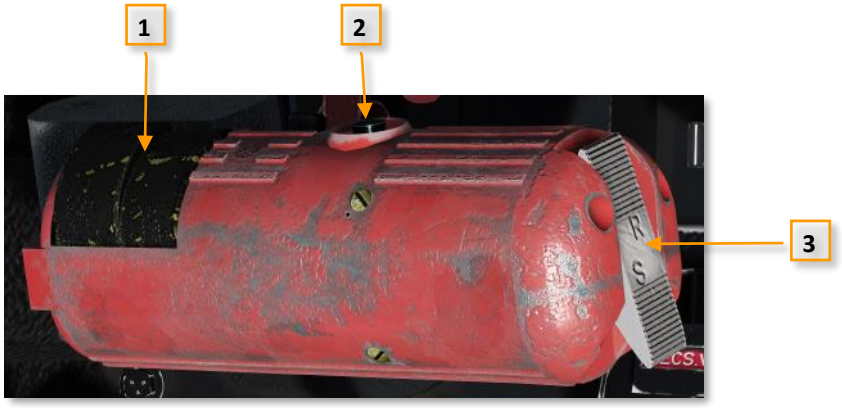


Figure 3-30 Throttle Lever

1 COMBAT FLAP LEVER

2 COMBAT FLAP BUTTON

3 AIRBRAKE CONTROL SWITCH

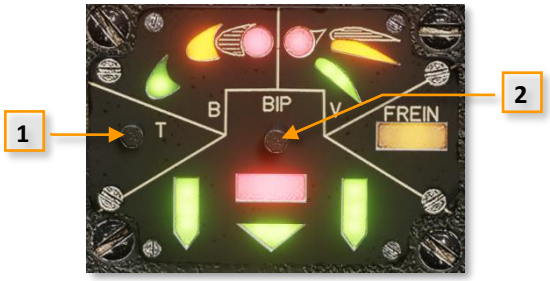


Figure 3-31 Configuration Indicator

Figure 3-32 Dual Hydraulic Pressure Gauge in Main Panel

1 CONFIGURATION INDICATOR TEST BUTTON *2 BIP BUTTON*

Figure 3-33 Airbrake Light in Main Panel

Figure 3-34 NWS Light in Main Panel

Figure 3-35 Combat Flaps Light in Main Panel

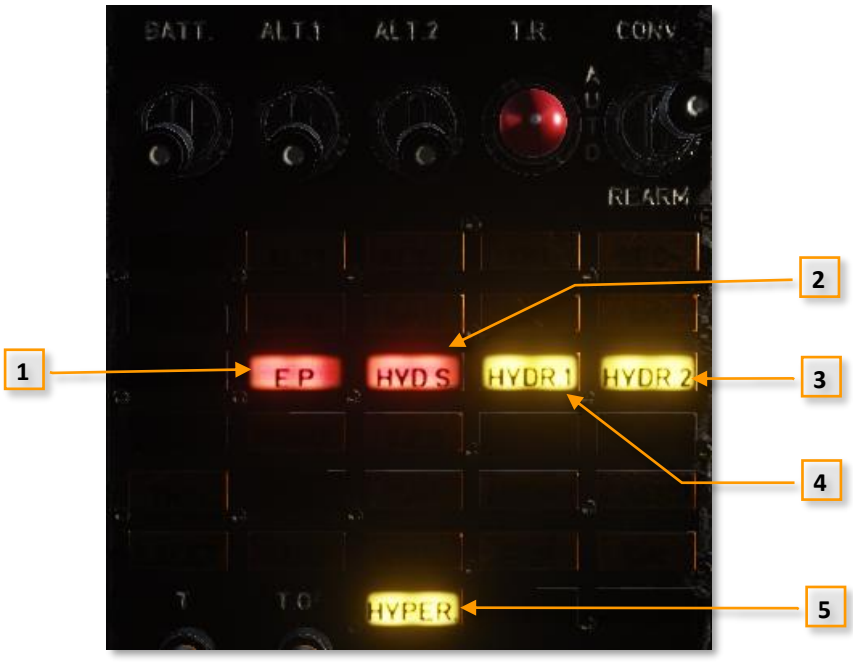


Figure 3-36 Failure Warning Panel

1 E.P. RED LIGHT
2 HYD.S (EMG.HYD) RED LIGHT
3 HYD.1 AMBER LIGHT
4 HYD.2 AMBER LIGHT
5 HYPER AMBER LIGHT

3.6 CONTROL SYSTEM

Description

The control surfaces for the aircraft are:

- Pitch: 2 stabilators
- Roll: 2 ailerons, 2 spoilers and differential stabilator deflection for dampening in automatic pilot mode.
- Yaw: A rudder

The normal operation mode for the control system is electrohydraulic in pitch and yaw and mechanical in roll. The flight stick is hydraulically connected in the pitch chain to 2 releasable bell cranks that can either transmit the pilot orders to servomotors or, when engaged in a degraded flight mode called 'manual hydraulic', directly to the control surfaces. The rudder pedals are similarly connected to the rudder.

This mode provides dampening in yaw and pitch and makes the behaviour of the aircraft generally 'smoother'. When strong acceleration changes occur, sometimes during sudden and hard manoeuvres, or when electrical supply to the servomotors is cut, the aircraft enters manual hydraulic mode. This mode is more uncomfortable for the pilot and makes the aircraft more difficult to control. The servomotors and the electrohydraulic mode can be reset through a pushbutton.

In the pitch chain, an element called ARTHUR plays an important role. The ARTHUR function is to limit the pitch sensitivity of the aircraft in certain situations. It has 3 modes: high sensitivity, low sensitivity and auto. In normal operation in auto mode, it adjusts the control stick sensitivity as a function of altitude and airspeed. Another element called DASH-POT increases the resistance of the stick as a function of the velocity of the input.

Trim is available for all 3 aircraft axes, with the roll trim only acting on the ailerons and not the spoilers. Furthermore, the yaw trim has an automatic anti-slip mode that compensates any sideslip in stabilized flight.

Controls

- Control stick: controls pitch and roll.
- Rudder pedals: control yaw.
- Trim hat: controls pitch and roll trim.
- Yaw trim switch: control yaw trim.
- Servo reset button: allows for a reset of the servos if all the working conditions are met.
- Pitch mode switch: allows to activate and deactivate the pitch electrohydraulic mode.
- Yaw mode switch Anti-slip/Yaw/Off: allows to deactivate the anti-slip mode and the electrohydraulic mode separately.
- ARTHUR switch (under guard) AUTO/HIGH/LOW: Allows the pilot to select the sensitivity mode of the ARTHUR.

Indicators

- Trim indicators: show the position of pitch, roll and yaw trims.

Failure lights

- Amber ELEV (EMP): Failure or disconnection of the first pitch electric circuit. If no other pitch warning light is on, the second pitch electric circuit is operational and the aircraft behaves normally. Resetting of the circuit should be attempted with the Servo Reset pushbutton.
- Amber PITCH (TANG) + ROLL (ROUL) + ELEV (EMP): Failure or disconnection of both pitch electric circuits. The aircraft is in full manual hydraulic mode for pitch. Autopilot is no longer available. Resetting of the circuits should be attempted with the Servo Reset pushbutton.
- Amber RUD (DIR): Failure or disconnection of the first yaw electric circuit. If no other yaw warning light is on, the second yaw electric circuit is operational and the aircraft behaves normally. Resetting of the circuit should be attempted with the Servo Reset pushbutton.
- Amber YAW (LACET) + ROLL (ROUL) + RUD (DIR): Failure or disconnection of both yaw electric circuits. The aircraft is in full manual hydraulic mode for yaw. Anti-slip and autopilot are no longer available. Resetting of the circuits should be attempted with the Servo Reset pushbutton.
- Amber ROLL (ROUL): Differential stabilator deflection not functional. Autopilot is no longer available.
- Amber TRIM light: automatic trim failure. It doesn't affect the autopilot or trim function.

Figure 3-37 Control Stick

Figure 3-38 Rudder Trim Control Switch

1 TRIM HAT

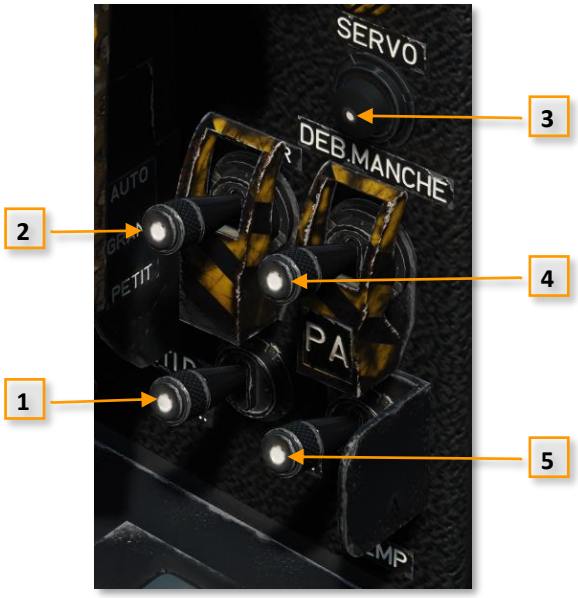


Figure 3-39 Control Switches and Button in Left Panel

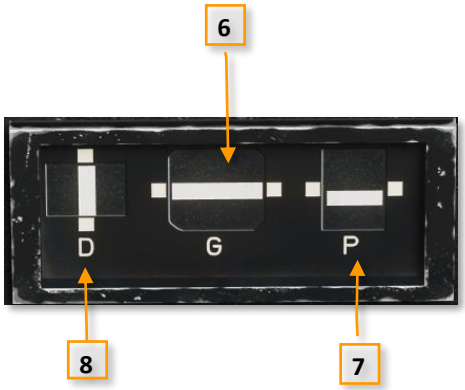


Figure 3-40 Trim Indicators in Main Panel

1 YAW/ANTI-SLIP SWITCH
2 ARTHUR SELECTOR SWITCH (GUARDED)
3 SERVO RESET BUTTON
4 STICK UNCOUPLE SWITCH (GUARDED)
5 PITCH MODE SWITCH
6 ROLL TRIM INDICATOR
7 PITCH TRIM INDICATOR
8 RUDDER TRIM INDICATOR

Figure 3-41 Failure Warning Panel

1 YAW (LACET) AMBER LIGHT
2 TRIM AMBER LIGHT
3 PITCH (TANG.) AMBER LIGHT
4 ROLL. (ROUL) AMBER LIGHT
5 ELEV (EMP.) AMBER LIGHT
6 YAW (DIR) AMBER LIGHT

3.7 AUTOPILOT

Operation

The autopilot is engaged by depressing the “PA” pushbutton while holding the autopilot disconnect trigger depressed on the control stick grip.

The autopilot connects initially in basic functions (attitude hold) and PA illuminates.

The autopilot modes are:

- Altitude Hold Mode (ALT)
- Heading Hold Mode (CAP)
- Localizer Mode (R)
- Glide Slope Mode (G)

They are connected by pressing the corresponding pushbutton ALT (altitude), CAP (heading), R (runway) or G (glide slope).

When passing through the transonic range the autopilot keeps connected, though it reverts to basic functions.

Pressing the autopilot disengage lever or the PA pushbutton disengages the autopilot.

Pressing the autopilot disconnect trigger the autopilot reverts to basic functions.

The heading for the Heading Hold Mode is selected using the Heading Selection Knob in the right console, and is displayed in the Navigation Indicator by the Selected Heading Index.

There is a test display unit that enables the pilot or ground personnel to test the flying aid and autopilot interlocks.

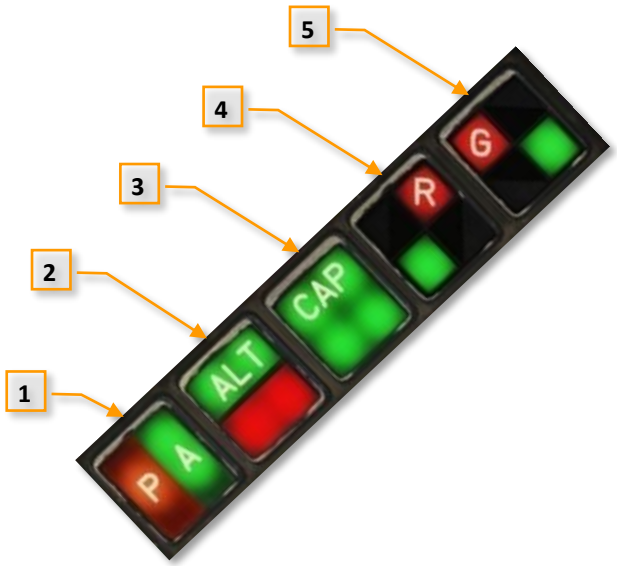


Figure 3-42 Autopilot Control and Indicator Unit

Figure 3-43 Autopilot Control and Indicator Unit Test Button

1 AUTOPILOT PA BUTTON
2 AUTOPILOT ALT BUTTON
3 AUTOPILOT CAP BUTTON
4 AUTOPILOT R BUTTON
5 AUTOPILOT G BUTTON

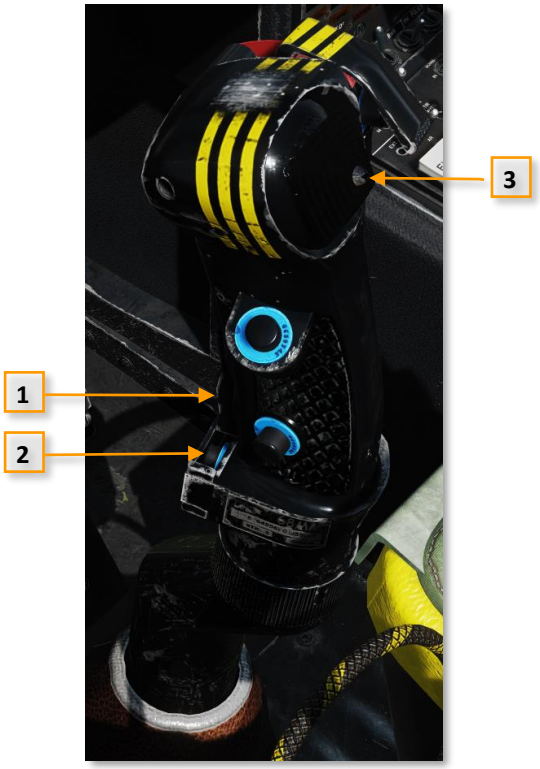


Figure 3-44 Control Stick

1 AUTOPILOT DISCONNECT TRIGGER
2 AUTOPILOT DISENGAGE LEVER
3 BEEP (BIP) TRIM CONTROL

Figure 3-45 Navigation Indicator (IDN)

Figure 3-46 Heading Selection Unit In Right Console

1 SELECTED HEADING INDEX
2 HEADING SELECTION KNOB

Figure 3-47 Test Display Unit in Left Console

Figure 3-48 AP (PA) Red Light in Failure Warning Panel

3.8 MISCELLANEOUS SYSTEMS

Brake chute

The brake chute is mechanically controlled, moving the control lever aft opens the chute and returning it forward drops the chute. It can be deployed up to 210 kt.

Figure 3-49 Brake Chute Control Lever In Left Wall

IFF

The transponder permits the identification, friend or foe, of an aircraft.

Not functional in this simulation.

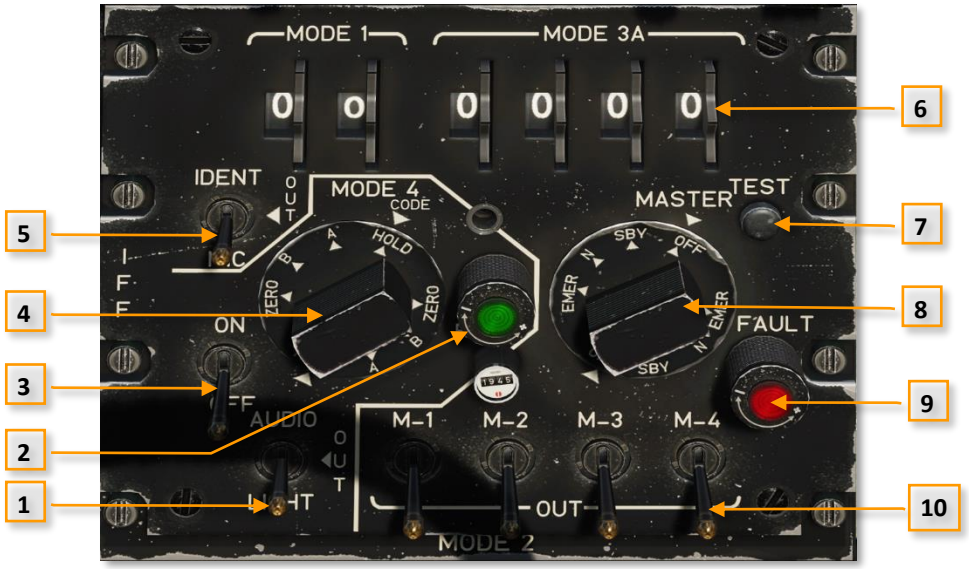


Figure 3-50 IFF

1 AUDIO-LIGHT SWITCH
2 TRIM AMBER LIGHT
3 IFF MONITORING LIGHT
4 MODE 4 SELECTOR SWITCH
5 POSITION IDENTIFICATION SELECTOR
6 MODE CODING SELECTOR
7 IFF TEST BUTTON
8 FUNCTION SELECTOR SWITCH
9 IFF FAULT LIGHT
10 MODE SWITCHES

3.9 AIR DATA SYSTEM AND MISCELLANEOUS INSTRUMENTS

Description

The air data computer and slaved altimeter, installed in the nose cone, measures the static pressure, dynamic pressure and total temperature, collected by the pitot static system and the total temperature probe. It then computes and transmits to several aircraft systems the following data:

- Mach number
- Calibrated airspeed
- Pressure altitude
- Vertical speed

The slaved altimeter repeats the altitude computed by the air data computer and sends pressure altitude to the IFF.

The system includes also an incidence indicator, also called angle of attack (AOA) indicator.

Controls and indicators

Figure 3-51 Mach/Airspeed Indicator

Figure 3-52 Slaved Altimeter

1 REFERENCE SPEED INDEX

2 REFERENCE SPEED INDEX KNOB

3 BAROMETRIC PRESSURE SETTING KNOB

Figure 3-53 Standby Altimeter

Figure 3-54 Vertical Speed Indicator

1 BAROMETRIC PRESSURE SETTING KNOB

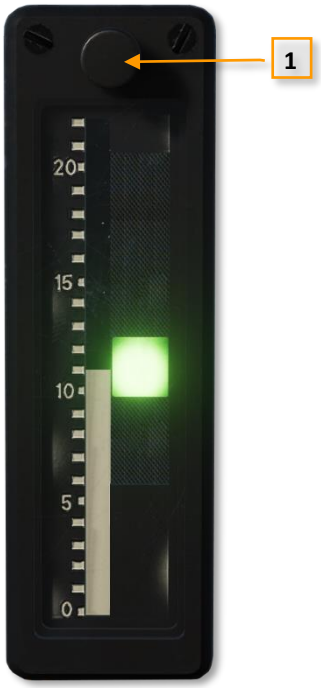


Figure 3-55 Incidence Indicator

Lighted ranges:
Red 15.5° - 22°
Yellow 12.5° – 15.5°
Green 9.5° - 12.5°

Unlighted blue range: 6° - 9.5°

1 LIGHTING RHEOSTAT

Figure 3-56 Clock

Figure 3-57 Standby Compass

1 CHRONOMETER STARTING CONTROL AND CLOCK WINDING/SETTING KNOB

2 CLOCK WINDING/SETTING LEVER

Figure 3-58 Accelerometer (G-meter)

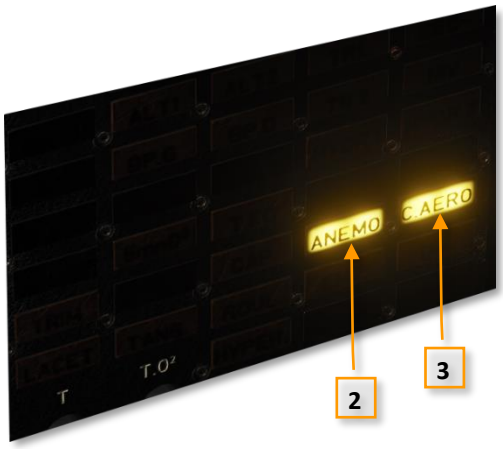


Figure 3-59 Failure Warning Panel

1 RESET BUTTON AND RHEOSTAT

2 PITOT AMBER LIGHT

3 AIR DATA COMPUTER AMBER LIGHT

3.10 COCKPIT SYSTEMS

Canopy

The canopy includes:

- A lock control
- A hinged handle to keep it partially open.
- An embrittle control

The canopy is moved by hand with the side handles (LCTRL + C).

Lock control forward: canopy locked.

Lock control aft: canopy unlocked.

If the pilots needs to escape the cockpit, in case of an emergency, a pyrotechnical system cracks the Plexiglas of the canopy, which then offers a low resistance. The embrittlement control is used to manually activate the system. It can be also be activated automatically when using the ejection seat.

Figure 3-60 Canopy Lock Control in Right Wall

Figure 3-61 Canopy Embrittle Control in Left Wall

Ejection seat

The Mirage F1CE is equipped with a MARTIN BAKER ERM6 ejection seat provided with a face blind firing handle and an alternative firing handle.

The safety pin prevents an accidental ejection when the airplane is on the ground.

The P.CAB red light illuminates when the canopy is open or cabin altitude exceeds 30,000 ft.

Figure 3-62 Face Blind Firing Handle

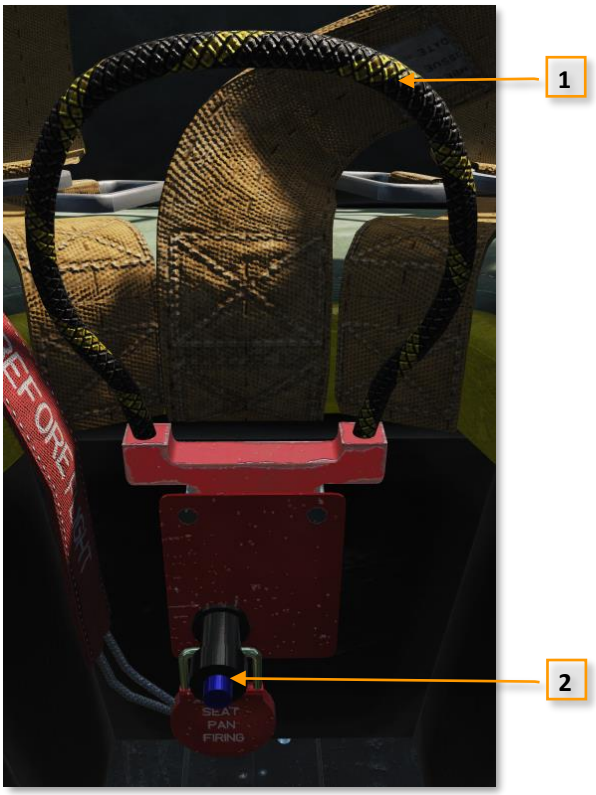


Figure 3-63 Alternative Firing Handle

Figure 3-64 Cabin Pressure Red Light In Failure Warning Panel

1 ALTERNATIVE FIRING HANDLE

2 EJECTION HANDLE SAFETY PIN

Lighting

Cockpit lighting

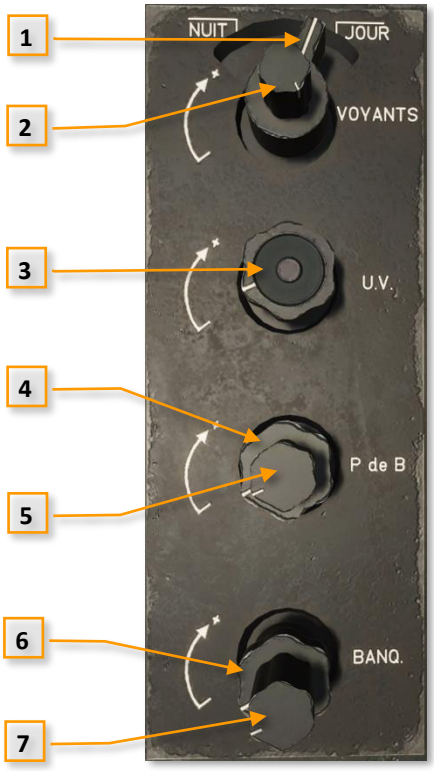


Figure 3-65 Lighting Control Box

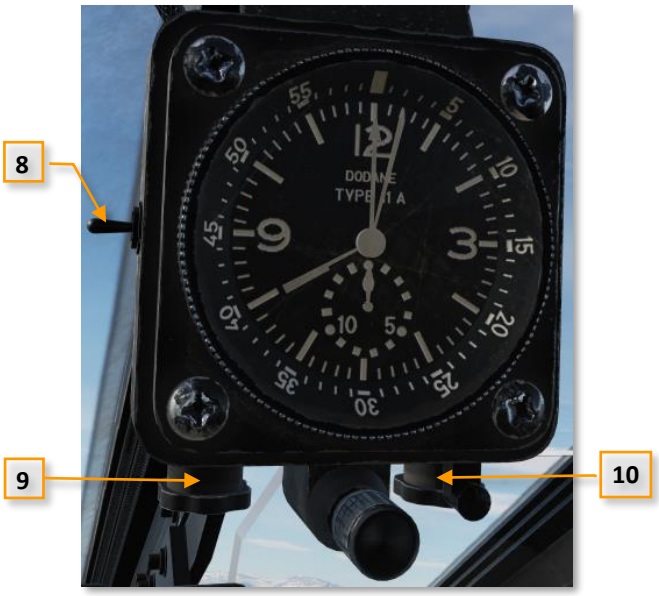


Figure 3-66 Clock Housing

1 DAY/NIGHT SELECTOR SWITCH

2 LIGHT AND PANEL LIGHTING RHEOSTAT

3 ULTRAVIOLET LIGHTING RHEOSTAT

4 DUAL INSTRUMENT PANEL LIGHTING RHEOSTAT (FLOODLIGHTS)

5 DUAL INSTRUMENT PANEL LIGHTING RHEOSTAT (INTEGRAL)

6 DUAL CONSOLE AND PEDESTAL LIGHTING RHEOSTAT (FLOODLIGHTS)

7 DUAL CONSOLE AND PEDESTAL LIGHTING RHEOSTAT (INTEGRAL)

8 MISCELLANEOUS INSTRUMENT LIGHTING SWITCH

9 MAP LIGHT RHEOSTAT

10 MISCELLANEOUS INSTRUMENT INTEGRAL LIGHTING RHEOSTAT

ANGLE OF ATTACK INDICATOR LIGHTING RHEOSTAT: See figure 3-55

Miscellaneous instrument lighting rheostat	- Standby compass - Clock, accelerometer - angle of attack indicator tape
Miscellaneous instrument lighting switch	Allows lighting of the AOA indicator tape
AOA indicator lighting rheostat	AOA indicator colored lights

Figure 3-67 Autopilot Control and Indicator Unit

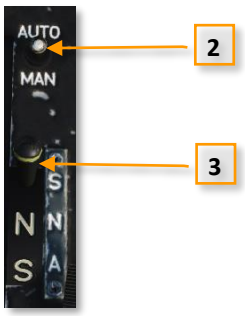


Figure 3-68 Sight Lighting Switches

1 AUTOPILOT INTENSITY CONTROL

2 SIGHT AUTO/MAN INTENSITY SELECTOR SWITCH

3 SIGHT LIGHTING SELECTOR SWITCH

Sight auto/manual intensity selector switch:

- AUTO: the brightness set by the pilot varies automatically according to external luminosity to maintain a constant contrast.
- MAN: the brightness of the reticles is regulated, with a fixed value, by the pilot through brightness rheostats at the bottom of the sight head, these are identified by the drawing of the grids in question (see sight chapter in this manual).

Sight lighting selector switch:

- Aft (A): all reticles are off
- vertical (N): normal operation, an N appears at the base of the lever
- forward (S): emergency operation, an S appears in a red background at the base of the lever. This position is used when one reticle goes out (burnt bulb).

Exterior lighting

The landing light can only be operated when the nose landing gear is down.

The search light is operated by turning the search light control (energization) to on and holding depressed the search light button, located in the control stick.

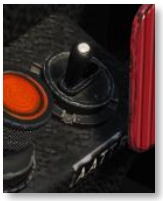


Figure 3-69 Landing Light Control in Left Console

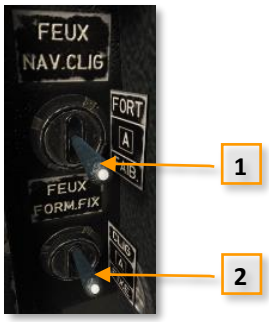


Figure 3-70 Formation and Navigation Lights Controls in Right Front Panel

1 NAVIGATION LIGHT CONTROL

2 FORMATION LIGHT CONTROL

Figure 3-71 Search Light Control in Right Console

Figure 3-72 Search Light Button on Control Stick

3.11 OXYGEN SYSTEM

Description

The oxygen system includes a liquid oxygen tank with a capacity of 5 litres and an emergency gaseous oxygen cylinder with a capacity of 0.4 litres at 180 bar. This provides an oxygen tank duration that varies from 4 to 11 hours 30 minutes, depending on the pilot, type of flight, altitude and operation mode of the regulator. The emergency cylinder has a duration of 7 minutes in case of ejection.

Operation with oxygen tank:

- Normal
  - Selector set to N: Letter N shown in the magnetic indicator. A mixture of oxygen and air, which varies with altitude, is supplied on demand, and pure oxygen above 33,000 ft.
  - Selector set to 100%: White square shown in the magnetic indicator. Pure oxygen is supplied on demand at any altitude.
- Emergency
  - Selector set to EMG (S): Red square shown in the magnetic indicator. A mixture of air and oxygen, which varies with altitude, is supplied on continuous flow

Controls and indicators

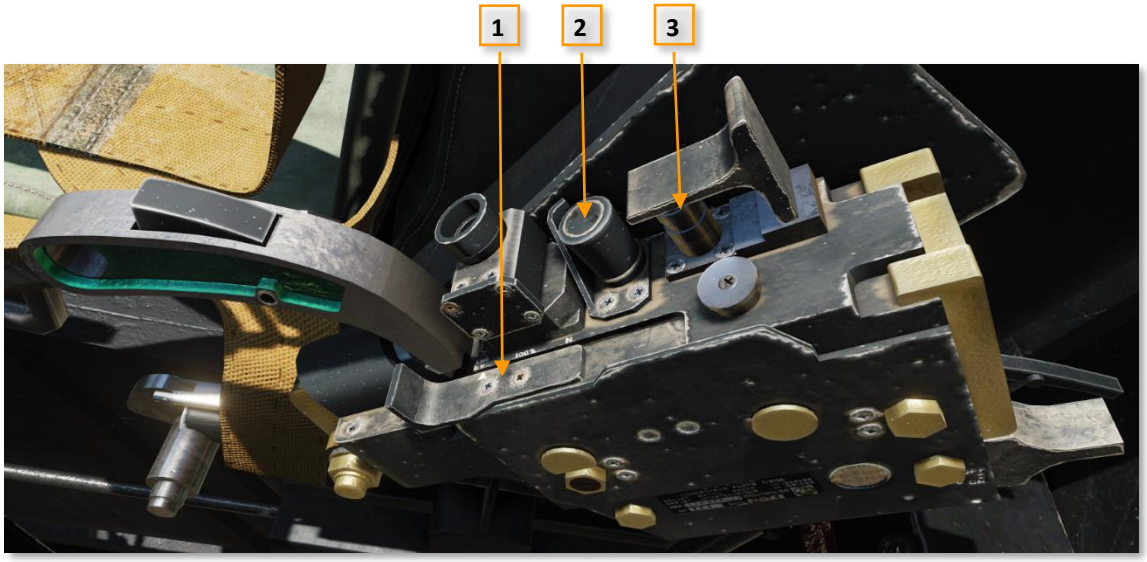


Figure 3-73 Pilot's Personal Equipment Connector

1 N-100%-EMG MODE SELECTOR SWITCH
2 OXYGEN OVERPRESSURE BUTTON
3 ANTI-G CONNECTION COVER

Figure 3-74 Oxygen Indicator

1 BLINKER
2 OXYGEN QUANTITY
3 SELECTOR POSITION REPEATER
4 OXYGEN TEST BUTTON
5 OXYGEN QUANTITY GROUND TEST BUTTON

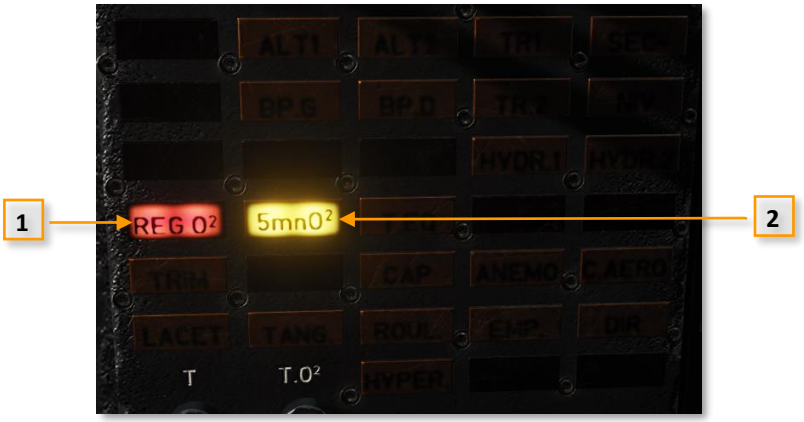


Figure 3-75 Failure Warning Panel

1 Ox REG RED LIGHT
2 5mn Ox AMBER LIGHT

The Ox REG red light comes on, together with the warning horn, when a regulator failure occurs with the selector switch set to N or 100%.

The 5mn Ox amber light comes on when the pressure in the emergency system is less than 150 bar, in this case only a maximum of 6 minutes of oxygen is left.

3.12 AIR CONDITIONING AND PRESSURIZATION SYSTEM

Description

The cabin air conditioning and pressurization, and equipment air conditioning, are ensured by bleed air from the last compressor stage of the engine.

A ram air inlet, in the left side of the nose cone, ensures cabin ventilation with fresh air in case of malfunction of the air conditioning system.

The system includes a cabin demist switch and an cabin seal inflation lever.

To pressurize the cabin, the master switch must be set to ON, the canopy seal lever to the forward position (inflated) and the ram air switch to OFF.

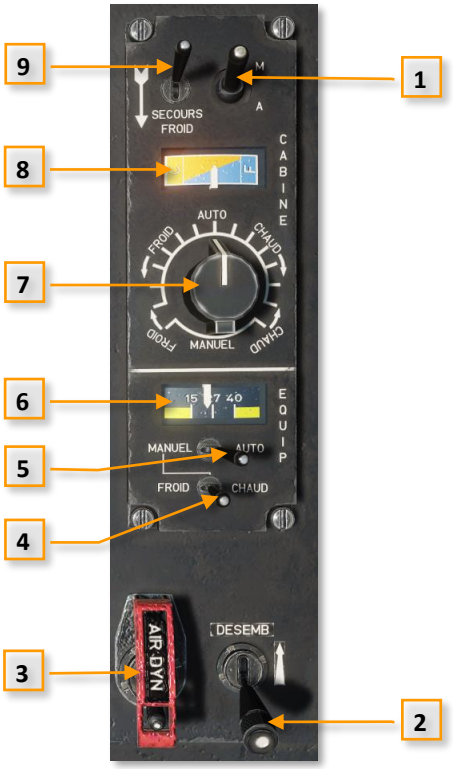
The cabin pressurization program is as follows:

- from 0 to 6500 ft: cabin pressure equal to outside pressure
- from 6500 ft to 18,000 ft: constant cabin pressure of 6500 ft
- above 18,000 ft: cabin pressure 300 mb higher than outside pressure (to keep 4.35 psi).

Controls and indicators

Figure 3-76 Canopy Seal Valve Control Lever in Right Wall

Figure 3-77 Cabin Altimeter in Main Panel



1 MASTER VALVE CONTROL SWITCH
2 DEMIST SWITCH
3 RAM AIR SWITCH (GUARDED)
4 HOT/COLD SELECTOR SWITCH
5 AUTO/MANUAL SELECTOR SWITCH
6 TEMPERATURE INDICATOR
7 TEMPERATURE CONTROL RHEOSTAT
8 SOLENOID VALVE POSITION INDICATOR
9 EMERGENCY COLD SWITCH

Figure 3-78 Air Conditioning and Pressurization Panel in Right Console

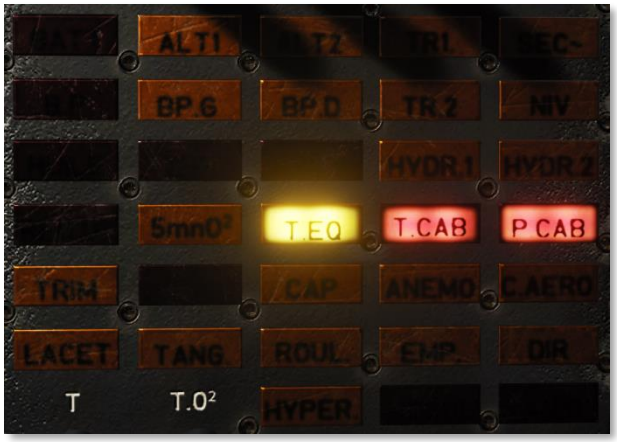


Figure 3-79 Failure Warning Panel

T.EQ amber light: temperature of the air flow into the equipment bay < 5°C or > 50°C

T.CAB red light: duct sensor temperature > 60°C and cabin temperature > 32°C

P.CAB red light: see ejection seat in this manual

3.13 RADIO SYSTEM

Description

The radio system of the Mirage F1-CE is composed by 2 radios: the V/UHF TRAP 136 and the UHF TRAP 137B.

TRAP 136

The TRAP 136 (also known sometimes as green radio) is a V/UHF radio unit. It can operate in the frequency ranges from 118 Mhz to 143,975 Mhz and from 225 Mhz to 399,975 Mhz. It is equipped with a transmitter receiver and a guard receiver. The main frequency can be inputted manually, selected from 20 preset channels or from the guard frequency. The guard frequency can be monitored at the same time as the main frequency.

TRAP 137B

The TRAP 137B (also known sometimes as red radio) is an UHF radio unit. It can operate in the frequency range from 225 Mhz to 399,975 Mhz. It is equipped with a transmitter receiver. The frequency can be chosen from 20 preset channels.

Radio selector unit (SIB box)

This unit is used to select transmission/reception and adjust volume on each radio equipment.

Controls

- TRAP 136 function selector (AR/PAL/PAL+G/F1/H): Allows to choose the operation mode of the radio: AR is off, PAL allows to use only the main frequency, PAL+G allows to use the main frequency and listen to the guard receiver and F1 and H are unused.
- TRAP 136 frequency source selector (M/P/G): Allows to select the source of the frequency: manual input, preset channel or guard frequency.
- TRAP 136 manual frequency rotors: Allows the pilot to set the manual frequency.
- TRAP 136 channel selector: Allows the pilot to select the preset channel.
- TRAP 136 power setting (25W/5W): Selects the transmitter power.
- TRAP 136 silence switch: Allows the pilot to apply a squelch filter to the radio.
- TRAP 136 test selection switch (R/neutral/E+A2): Allows the pilot to start a receiver o transmitter test.
- TRAP 137B function selector (AR/M/F1/H): Allows to choose the operation mode of the radio: AR is off, M is on and F1 and H are unused.
- TRAP 137B channel selector: Allows the pilot to select the preset channel.
- TRAP 137B silence switch: Allows the pilot to apply a squelch filter to the radio.

- TRAP 137B test selection switch (R/neutral/E+A2): Allows the pilot to start a receiver o transmitter test.
- BIP button (on the configuration indicator): Allows to send a signal to the tower when the landing gear is down and locked.

Indicators

- Test light: indicates if the transmitter test has started or if the landing gear down signal is being sent to the tower by the BIP button.

Figure 3-80 PTT Button on Control Stick

Figure 3-81 Alternative PTT Button in Left Console

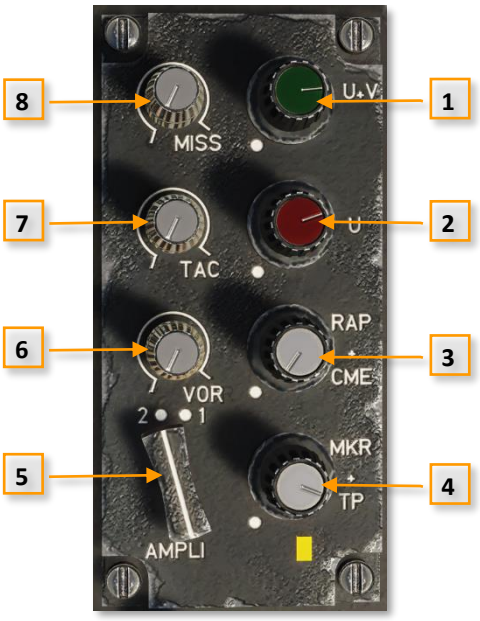


Figure 3-82 Radio Selector Unit (SIB Box)

1 U + V PUSHBUTTON
2 U PUSHBUTTON
3 RAP + CME PUSHBUTTON
4 MKR + TP PUSHBUTTON
5 AMPLI 2 – 1 SELECTOR SWITCH
6 VOR POTENTIOMETER
7 TAC POTENTIOMETER
8 MISS POTENTIOMETER

Figure 3-83 V/UHF Radio TRAP 136 (Green Radio)

1 PRESET CHANNEL NUMBER
2 PRESET CHANNEL SELECTOR
3 FREQUENCY SELECTION MODE SELECTOR
4 25W – 5W SWITCH
5 FUNCTION SELECTOR
6 FREQUENCY SELECTION THUMBWHEELS
7 SIL (SQUELCH) SWITCH
8 TEST SELECTOR SWITCH
9 TEST LIGHT

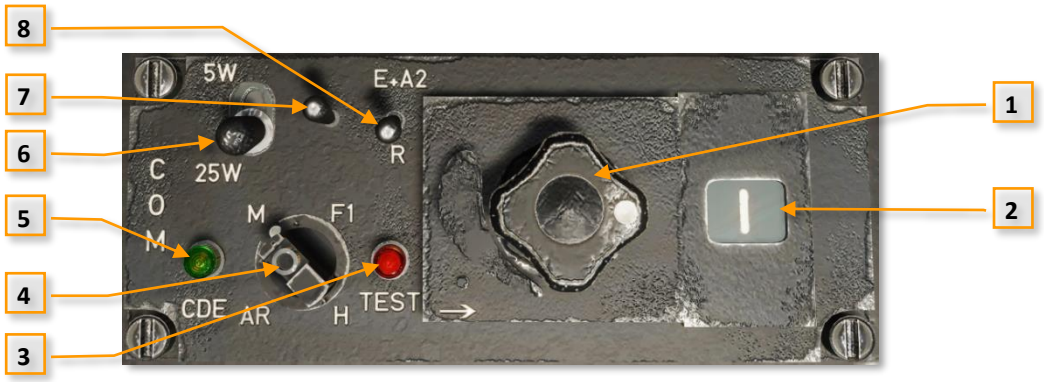


Figure 3-84 UHF Radio TRAP 137B (Red Radio)

1 PRESET CHANNEL SELECTOR
2 PRESET CHANNEL NUMBER
3 TEST LIGHT
4 FUNCTION SELECTOR
5 CDE BUTTON (NOT USED)
6 5W/25W SELECTOR SWITCH
7 SQUELCH SWITCH
8 TEST SELECTOR SWITCH

3.14 NAVIGATION SYSTEM

Description

The Mirage F1 CE is equipped with gyroscopes and a radionavigation suite with a TACAN and a VOR-ILS. Newer models, such as the F1 EE are also equipped with an inertial navigation system. The Mirage F1M also carries a GPS suite.

Gyroscopic system

The aircraft carries a main gyroscopic system and an emergency gyroscope that feed information to other systems such as the sight, the spherical indicator, the autopilot or the navigation indicator (IDN). The aircraft also carries a standby horizon.

The main gyroscopic system is composed of a vertical gyroscope, which provides pitch and roll information, and a gyromagnetic system, providing heading information (generally slaved to the magnetic field of the Earth). In turn, the gyromagnetic system is composed by a longitudinal gyroscope and a magnetometer. The system has 3 operation modes: gyromagnetic (with the magnetometer providing corrections to the gyroscope) and purely magnetic and emergency, in which the heading input is taken from the emergency gyroscope.

The emergency gyroscope only provides heading information and is also slaved to the magnetic field of the Earth through another magnetometer.

The spherical indicator provides attitude and heading indication.

Radionavigation

As mentioned above, the aircraft is equipped with both a TACAN and a VOR/ILS system. The heading, distance and flight slope information generated by these systems is used by the autopilot, the navigation indicator and the spherical indicator navigation pointers. The route commutation unit can be used to select the source of the radionavigation input to the pointers.

The TACAN is a MITAC model with 3 modes: receive, transmit/receive and air to air. The transmit/receive mode allows for ranging information to be obtained by the system. Valid channels are from 01 to 116 in both X and Y. It can be tested.

The VOR provides information of radial and bearing towards the VOR station, while the ILS provides localizer and glideslope information for the instrumental approach to a runway. It can tune in frequencies from 108 to 117,95 MHz with a spacing between channels of 50 kHz. It can be tested.

Navigation indicator (IDN)

The navigation indicator is an instrument that can display an arrange of bearings from different radio sources: the TACAN, the VOR and the radar. If the system has distance and bearing information from the TACAN, an ‘additional vector’ function can be used. This function essentially allows the pilot to get bearing information to any point relative to a TACAN station.

The Navigation indicator modes are:

IDN elements	Mode TT (Radar/TACAN)	Mode TE (Radar)	Mode VT (VOR/TACAN)
Rose	To heading directed by gyromagnetic unit		
Wide needle	TACAN/additional vector bearing	Non-relevant information	TACAN/additional vector bearing
Distance counter	Distance to TACAN station or additional vector tip	Non-relevant information	Distance to TACAN station or additional vector tip
Counter flag	TACAN distance not available	Always retracted	TACAN distance not available
Index	Selected autopilot heading		
Narrow needle	Radar antenna position		VOR bearing
Left flag	Retracted		VOR fail
Right flag	Navigation indicator fail		

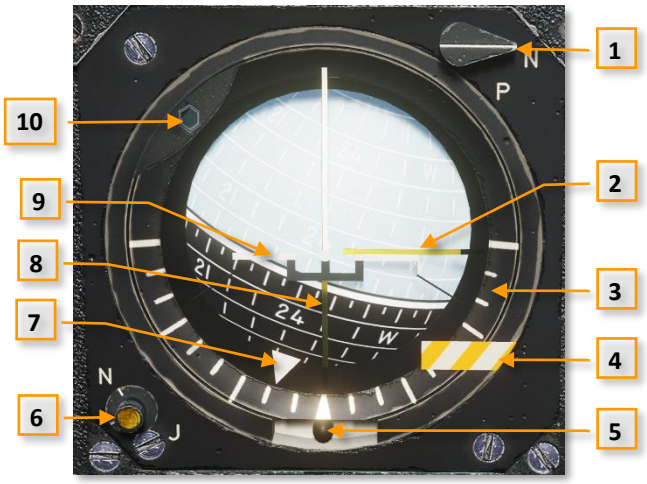
Controls

- Main gyroscopic system selector: Selects the source of the heading info coming from the main gyroscopic unit: gyromagnetic, purely magnetic or emergency. It can also turn off the system. If the system is turned off for more than 15s, turning it back on will start the erection process. When not on the ground, this process has to be performed in levelled flight. It takes roughly 35s to obtain an approximate alignment and 1 minute to be performed fully.
- Emergency gyroscope ON/OFF switch.
- Emergency gyroscope fast sync pushbutton: Performs a fast synchronization of the emergency gyroscope.
- Standby horizon cage/uncage and fast erect lever: Performs a fast erection of the standby horizon when pulled. When pulled and turned all the way to the right, the system is caged.
- TACAN channel controls: selects TACAN channel
- TACAN mode control (receive, transmit/receive, air to air, off): selects TACAN mode.
- TACAN test: performs test of TACAN system.
- VOR/ILS frequency controls: selects VOR/ILS frequency.
- VOR/ILS ON/OFF switch.
- VOR/ILS test switch.
- IDN mode selector (TT, TE, VT, off): Selects navigation indicator mode.

- IDN test pushbutton: Tests that the navigation indicator works correctly. The big needle should move to 45° and the distance counter should show 250 NM.
- IDN Normal/Additional vector switch: commands the wide needle and distance counter to show info relative to the TACAN station or to the tip of the additional vector.
- Additional vector selector: allows to input the polar coordinates of the additional vector in relation to the TACAN station.

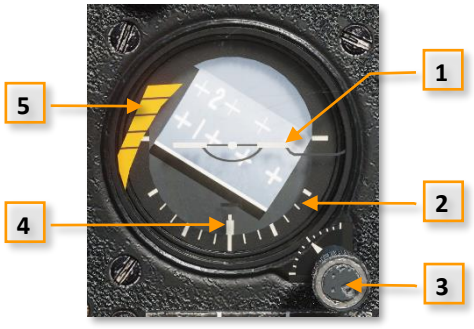
Indicators

- Emergency gyroscope sync state needle: displays the error of the emergency gyroscope.
- TACAN selected channel.
- VOR/ILS selected frequency.
- Navigation indicator (IDN): see table in description.
- Additional vector length display: shows the selected length of the additional vector (in NM).
- Additional vector angle display: shows the heading of the additional vector.



1 POLE SETTING AND MARKER BEACON LIGHT TEST
2 ILS (GS) POINTER
3 ROLL SCALE
4 FAILURE WARNING FLAG
5 SIDESLIP BALL
6 DAY/NIGHT SELECTOR SWITCH
7 ROLL INDEX
8 TACAN-VOR-ILS (LOC) POINTER
9 AIRCRAFT MODEL
10 TO-FROM INDICATOR

Figure 3-85 Spherical Indicator



1 AIRCRAFT MODEL
2 ROLL SCALE
3 UNCAGE AND AIRCRAFT MODEL CONTROL
4 ROLL INDEX
5 CAGING AND FAILURE WARNING FLAG

Figure 3-86 Standby Horizon

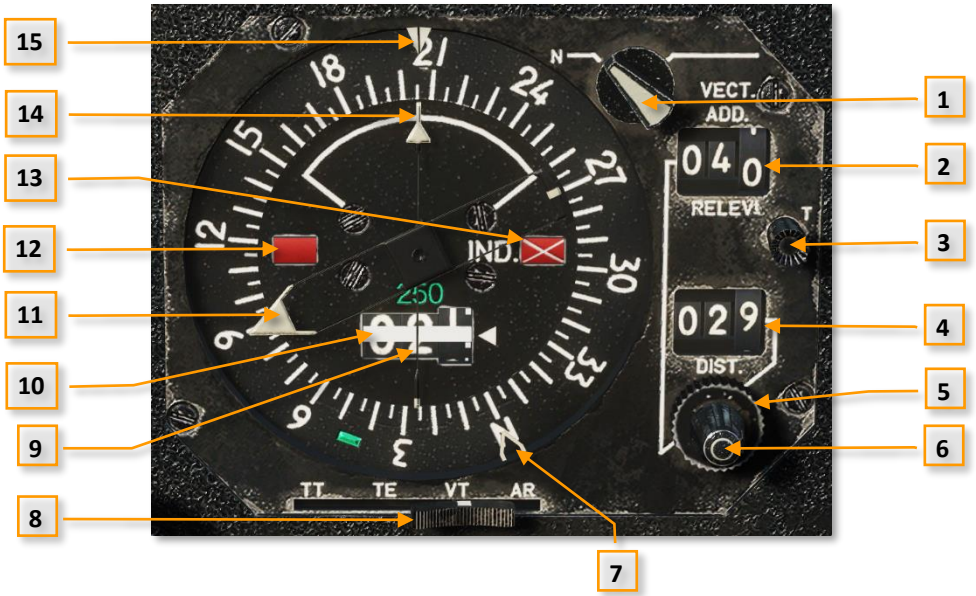


Figure 3-87 Navigation Indicator (IDN)

1 NORMAL/ADDITIONAL VECTOR SELECTOR SWITCH

2 ADDITIONAL VECTOR BEARING WINDOW

3 TEST BUTTON

4 ADDITIONAL VECTOR DISTANCE WINDOW

5 ADDITIONAL TARGET SELECTOR SWITCH

6 BEARING/DISTANCE SELECTOR KNOB

7 HEADING SELECTED FOR AUTOPILOT

8 MODE SELECTOR SWITCH

9 TACAN OR ADDITIONAL TARGET DISTANCE

10 TACAN DISTANCE FAILURE FLAG

11 TACAN OR ADDITIONAL TARGET BEARING

12 VOR OR LOC FAILURE

13 IDN FAILURE

14 RADAR ANTENNA RELATIVE BEARING

15 HEADING INDEX

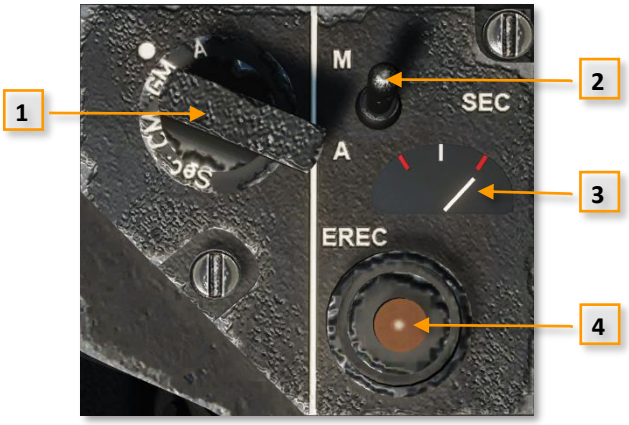


Figure 3-88 Heading Control Unit in Right Console

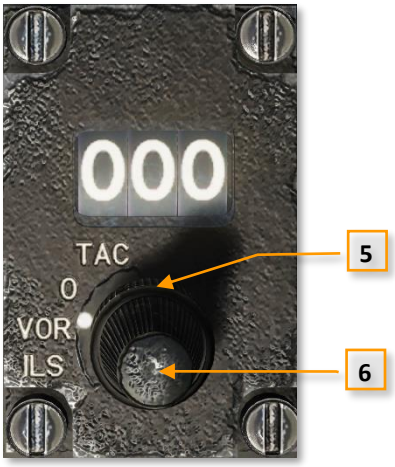


Figure 3-89 Omnibearing and VOR/ILS-TACAN Selector in Right Console

1 HEADING AND VERTICAL REFERENCE SYSTEM CONTROL SWITCH
2 EMERGENCY GYROMAGNETIC COMPASS SWITCH

3 HEADING DEVIATION NEEDLE
4 HEADING CONTROL UNIT ERECTION BUTTON
5 VOR/ILS-OFF-TACAN SELECTOR
6 OMNIBEARING SELECTOR

Figure 3-90 TACAN Control Unit in Right Console

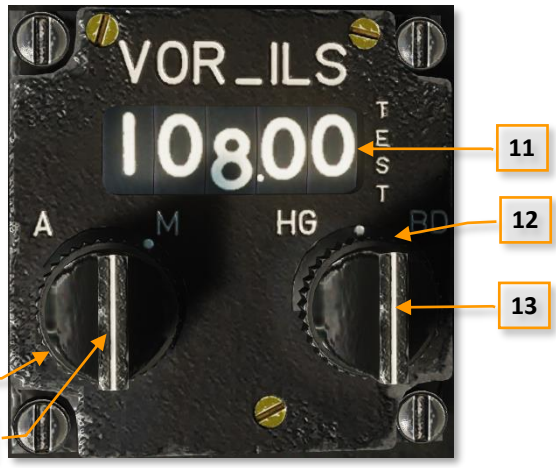


Figure 3-91 VOR/ILS Control Unit in Right Console

1 FREQUENCY HUNDREDS AND TENS SELECTOR
2 X/Y MODE SELECTOR
3 SELECTED CHANNEL WINDOW
4 TEST BUTTON
5 RED WARN LIGHT
6 GREEN GO LIGHT
7 MODE SELECTOR

8 FREQUENCY UNITS SELECTOR
9 ON/OFF SELECTOR
10 MHZ FREQUENCY SELECTOR
11 SELECTED FREQUENCY WINDOW
12 TEST SELECTOR
13 KHZ FREQUENCY SELECTOR

3.15 ARMAMENT SYSTEM

Description

The armament system comprises the weapons and associated elements in the aircraft. The Mirage F1 is equipped with a wide variety of weaponry, even the earlier versions such as the F1-CE. As an interceptor, the CE has multiple guided and unguided air to air weapons but, to fulfil a secondary role as a ground attacker, it can also carry rockets and bombs.

The safety of the armament is ensured by a master arm switch (under guard) and by a landing gear up check. The normal selection of weapons is done through the weapon selection panel, which also sets the visor mode. When a button is pressed, other buttons are depressed (except in the case of certain buttons) and the pressed buttons light up. The panel has the following buttons and switchology:

- Air to air cannon (CAN. A.): Sets the sight to cannon air to air mode.
- Air to ground cannon and rockets (CAN. S. ROQ.): Sets the sight to cannon/rockets air to ground mode and enables the firing of rockets in case they are being carried.
- Wing bombs (BOMB VOIL.): Sets the sight in bombing mode and enables the launch of the wing bombs. Can be selected in conjunction with the BOMB FUS button.
- Fuselage bombs (BOMB FUS.): Sets the sight in bombing mode and enables the launch of the fuselage bombs. When carrying a CLB4 pylon, the button light turns off when all of the bombs carried in the pylon are released. Can be selected in conjunction with the BOMB VOIL button.
- Left or fuselage inner missile (MG. FUS.): Sets the sight to missile air to air mode and enables the locking and firing of the inner left pylon or fuselage missile. In the case of the R530 IR it, together with the master arm, commands the cooling of the missile seeker. Can be selected in conjuction with MD. When both are pressed (and both left and right missiles are present), the locked missile has launch priority. In case both missiles are locked, if one is IR and the other is EM, the IR missile has priority. In case both are locked and the same type, the left missile is fired first.
- Right inner missile (MD.): Sets the sight to missile air to air mode and enables the locking and firing of the inner right pylon missile. In the case of the R530 IR it, together with the master arm, commands the cooling of the missile seeker. Can be selected in conjuction with MG. FUS. The logic when both are pressed is described above.
- Outer left missile (EXT. G.): Sets the sight to missile air to air mode and enables the locking and firing of either of the outer missiles. When both outer missiles are present and locked, it gives launch priority to the left missile.
- Outer left missile (EXT. D.): Sets the sight to missile air to air mode and enables the locking and firing of either of the outer missiles. When both outer missiles are present and locked, it gives launch priority to the right missile.

Other switches in the armament panel allow the pilot to choose the arming mode of the bombs, to select the launch of either inner, outer or both wing bombs/rockets and to select the launch mode between pickle (coup per coup / CPC) or salvo (SALV).

The sight missile air to air mode includes information about the readiness and lock status of the missiles. A white triangle indicates the missile is selected and ready and an amber circle indicates the missile is locked. In the case of the radar guided missiles, a green larger middle circle indicates missile is within launch distance parameters and a red one indicates that the aircraft is too close to the target.

A dogfight mode is available through the (C+SW/M) button on the throttle. When the button is pressed, the sight changes to cannon air-to-air mode with radar guidance, the outer missiles are selected and a green light on the side of the sight mount turns on. Further short presses of the button release the current radar lock and command a radar search in front of the current target. A long press of the button commands the restart of the search pattern from the initial position. The C+SW/M mode can be exited by actuation of an unstable switch on the left wall of the aircraft.

Weapons and other payloads can be jettisoned through pushbuttons on the frontal panel. An emergency jettison that drops all payloads is available but station can also be selected through a switch. Outer missiles are not jettisoned, being launched not armed instead.

Cannons

The aircraft is equipped with 2 internal DEFA 553 with 150 rounds each. External DEFA cannon pods can also be mounted, especially in the case of the Mirage F1-B, which is not equipped with internal cannons.

Firing occurs by pressing the trigger on the control stick and is independent of the mode selected on the armament panel, being only limited by the master arm switch.

Outer missiles

The Mirage F1-CE can carry the MATRA R550 Magic I, the AIM-9 B, the AIM-9 J and the AIM-9 JULI on its wing tips. The ability to carry Sidewinder variants is one of the main differences it has with the base C model.

The AIM-9 JULI is an autochthonous variant of the AIM-9 N/P that substitutes the seeker and control units by those of the AIM-9 L. Therefore, it is the only of these missiles with all-aspect capability.

Inner missiles

The Mirage F1-CE can carry 3 types of missile on its inner (or fuselage) pylons: The R530 IR, the R530 EM and the S530 D.

The MATRA R530 IR is an infrared guided medium range missile. It can be fired independently from the radar and has a limited all aspect capability.

The MATRA R530 EM is a radar guided semi-active medium range missile. It needs guidance from the radar all the way to impact.

The MATRA S530 D is a radar guided semi-active medium range missile, it is an evolution of the R530 EM. It needs guidance from the radar all the way to impact. It is worth mentioning that the 'supermatra' was never used by the Spanish Air Force (except on its EDA aircraft acquired from Qatar) but all the Mirage F1 types used by Spain had the capability to employ it.

Rockets

The F1 has multiple rocket launchers at its disposal: The MATRA F1 (carries 36 rockets), the MATRA F2 (carries 9 rockets) and the MATRA F4 (carries 18 rockets and is also known as MATRA 155). All of them use SNEB 68 mm rockets, with interchangeable heads for different purposes.

Bombs

The Mirage F1 has a wide selection of bombs at its disposal. It can carry all the French SAMP bombs from 125 to 400 kg in both free fall and parachute versions. The Spanish types are certified to carry American Mk 82, Mk 83, GBU 10 and GBU12 bombs, as well as Spanish BR 250 and BR 500 bombs. Cluster BLG 66 Belouga and anti-runway BLU107 Durandal are also available.

Controls

- Master arm (under guard): Allows weapons to be armed and fired.
- Cannon trigger: Located on the control stick, once deployed it can be used to fire the cannons.
- Launch button: Located on the control stick, depending on the selection of the armament panel mode, it can be used to launch missiles and bombs, and to fire rockets.
- Armament panel: Selects weapon to be used. Detailed description in previous section.
- Launch mode switch: Selects whether the bombs and rockets are launched on salvos or one by one.
- Wing station selector (EX/IN/1+2): Allows selection of which wing bomb/rockets station are to be launched: outer, inner or both.

- Bomb arming selector (INST/RET/OFF): Allows the selection of arming mode for the bombs: nose, tail or not armed.
- Throttle C+SW/M button: Engages the C+SW/M mode or commands the unlock of target and restart of search.
- Left wall C+SW/M deactivation unstable switch: Commands exit of C+SW/M mode.
- Throttle Cannon 600 button: Forbids the radar emissions and sets the cannon sight distance to 600 m.
- Emergency jettison button (under guard): Commands the jettison of all underwing and fuselage stores.
- Jettison selection switch (VOIL1/VOIL 2/FUS): Selects what stations can be selectively jettisoned.
- Selective jettison button (under guard): Commands the jettison of the selected station.
- Outer missile emergency launch button (under guard): Activates the motors and releases the (unarmed) outer missiles.

Indicators

C+SW/M green light: indicates that the C+SW/M dogfight mode is engaged.

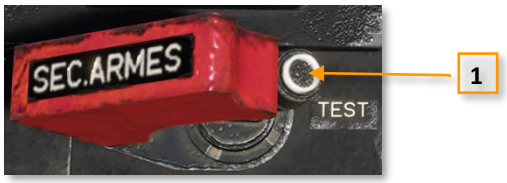


Figure 3-92 Master Arm Switch in Left Console (Guarded)

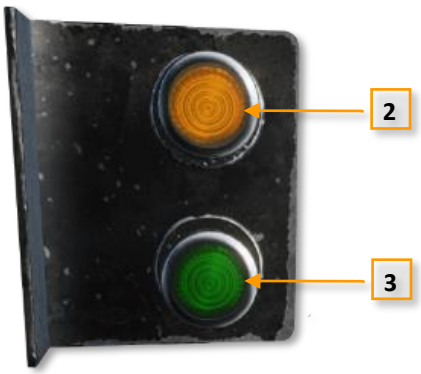


Figure 3-93 (C + M or SW) R Mode Light in Main Panel

1 ARMAMENT MASTER SWITCH (GUARDED)
2 JAMMING DETECTION LIGHT
3 (C + M OR SW) R MODE LIGHT

Figure 3-94 Throttle Lever

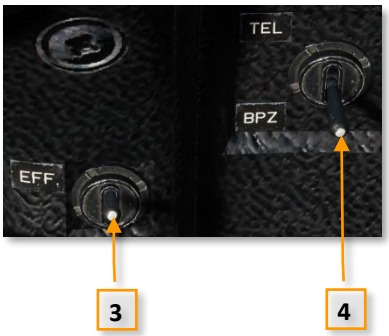


Figure 3-95 Switches in Left Wall

1 (C + M OR SW) R MODE BUTTON
2 CANNON 300-600M AND MISSILE LOCK/UNLOCK BUTTON
3 (C + M OR SW) R MODE DESELECTION SWITCH
4 TELEMETER/ZONE SCANNING SWITCH

Figure 3-96 Antenna-Gyro Switch in Left Console

Figure 3-97 Cannons Too Hot Light in Right Front Panel

Figure 3-98 Jettison Panel

1 EMERGENCY JETTISON BUTTON (GUARDED)
2 JETTISONING SELECTOR SWITCH
3 SELECTIVE JETTISON BUTTON (GUARDED)

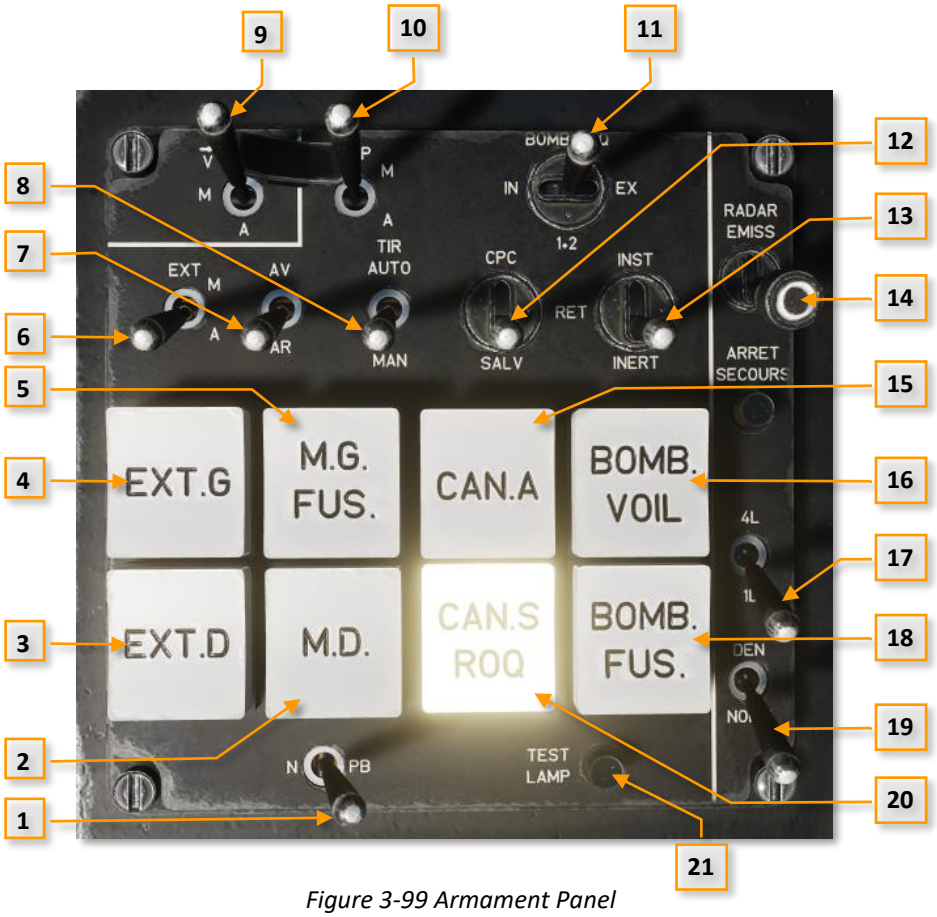


Figure 3-99 Armament Panel

1 NORMAL/JAMMER PURSUIT SWITCH (NO FUNCTION)

2 RIGHT MATRA R530 MISSILE PUSHBUTTON

3 RIGHT MATRA R550 OR SIDEWINDER MISSILE PUSHBUTTON

4 LEFT MATRA R550 OR SIDEWINDER MISSILE PUSHBUTTON

5 LEFT OR FUSELAGE MATRA R530 MISSILE PUSHBUTTON

6 MATRA 550 OR SIDEWINDER MISSILE SWITCH

7 FORE/AFT SELECTOR SWITCH

8 AUTO/MANUAL FIRING SELECTOR SWITCH

9 SIGHT SELECTOR

10 FIRING FUEL DIPPER SWITCH

11 BOMB/ROCKET SELECTOR

12 SINGLE/SALVO SELECTOR

13 INSTANTANEOUS/DELAY/SAFE SELECTOR SWITCH

14 RADAR SELECTOR

15 AIR-TO-AIR GUNS PUSHBUTTON

16 WING BOMBS PUSHBUTTON

17 RADAR 4 LINES/1 LINE SCAN SWITCH

18 FUSELAGE BOMBS PUSHBUTTON

19 R 530 MISSILE NORMAL/ALTITUDE DIFFERENCE SELECTOR SWITCH

20 AIR-TO-GROUND GUNS OR ROCKETS PUSHBUTTON

21 LIGHTS TEST

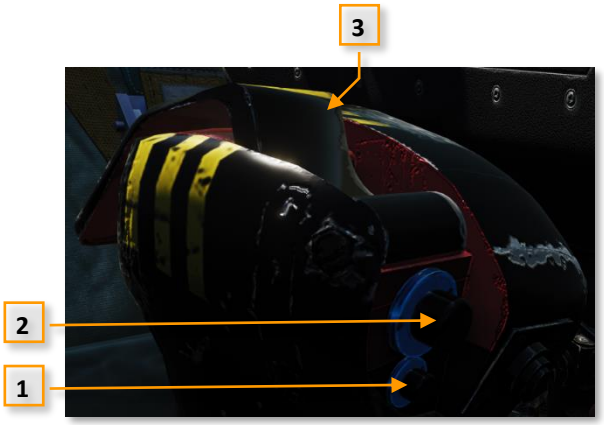


Figure 3-100 Control Stick Detail (Rear View)

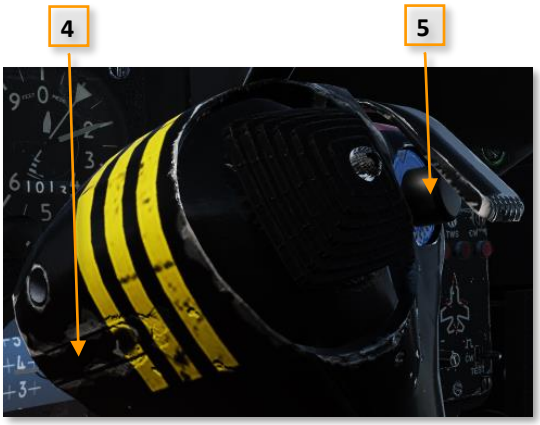


Figure 3-101 Control Stick Detail (Front View)

1 SIGHT RECORDER BUTTON
2 GUN BUTTON
3 GUN FIRING TRIGGER (FOLDED)

4 GUN FIRING SAFETY
5 BOMBS, ROCKETS, MISSILES AND SIGHT RECORDER BUTTON

Figure 3-102 Manual Gravity Drop Window and Selection Thumbwheel

1 MANUAL GRAVITY DROP WINDOW

2 MANUAL GRAVITY DROP SELECTION THUMBWHEEL

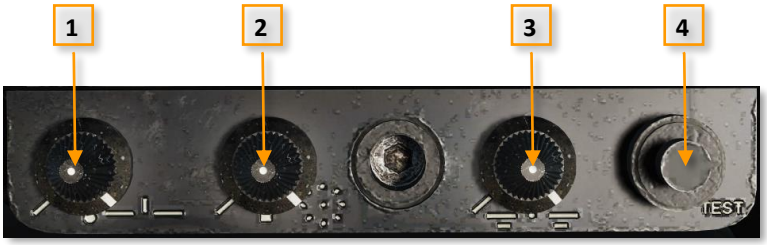
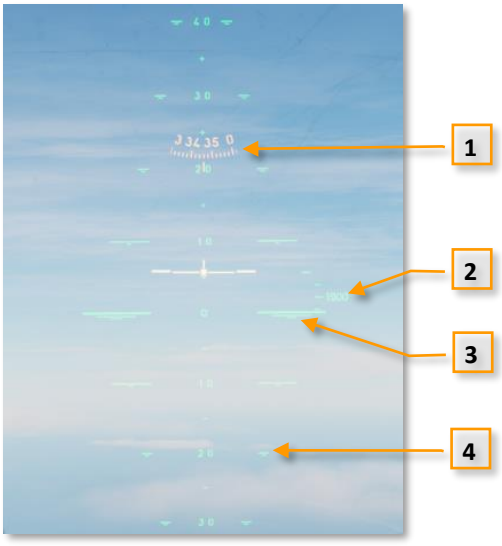


Figure 3-103 Sight Reticles Lighting Rheostats

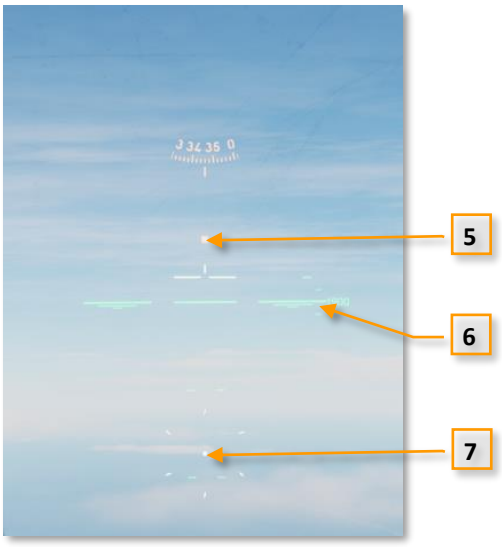
1 FIXED RETICLE INTENSITY RHEOSTAT
2 MOVING AND TARGET RETICLES INTENSITY RHEOSTAT

3 ATTITUDE RETICLE INTENSITY RHEOSTAT
4 SIGHT SYSTEM TEST BUTTON



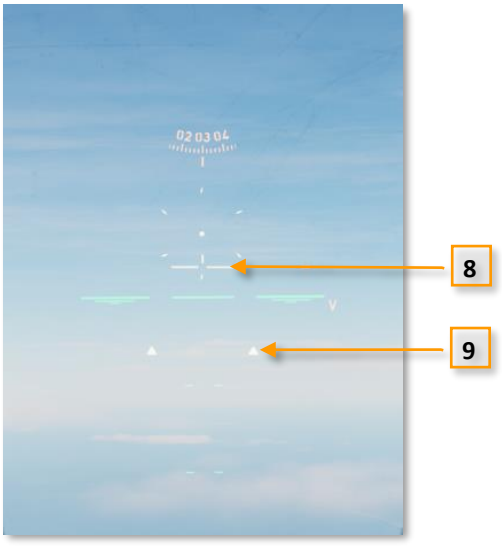
1 DISTANCE/HEADING SCALE (HEADING)
2 BAROMETRIC ALTITUDE (FT)
3 HORIZON
4 ATTITUDE SCALE

Figure 3-104 Sight in Navigation Mode



5 AIR VELOCITY VECTOR RETICLE
6 ACTUAL HORIZON
7 TARGET RETICLE

Figure 3-105 Sight in Approach Mode



8 RADAR REFERENCE
6 WEAPON READY LIGHTS

Figure 3-106 Sight in Air-to-Air Combat Mode

3.16 COUNTERMEASURES

Description

The integrated countermeasure system is an ALE-40 capable of launching chaff and flares. It was installed on Spanish (and later Moroccan) aircraft and is one of the principal differences between the Spanish CE and the base C model.

It is possible to mount either 30 chaff or 15 flare charges per side (although in practice flares were only mounted on the left side for safety reasons). Countermeasures can be launched on single mode, multiple or on a specific program. The timing and number of countermeasures released on each configuration is adjusted on the ground. The possible modes are:

- Single: Only one countermeasure is released per side (if both sides are selected).
- Multiple: Allows the launch of a certain number of cartridges in a pre-set interval. 1, 2, 3, 4, 6 or 8 cartridges with a time in-between of either 100, 200, 300 or 400 ms.
- Program: Commands the repetition of the previous 'Multiple' launch a certain number of times with an interval. In this case, 1, 2, 4, 8 or C times, with C being continuous until the countermeasures run out. The possible times between repetitions are: 1, 2, 3, 4, 5, 8 or R, with R meaning a random time interval.

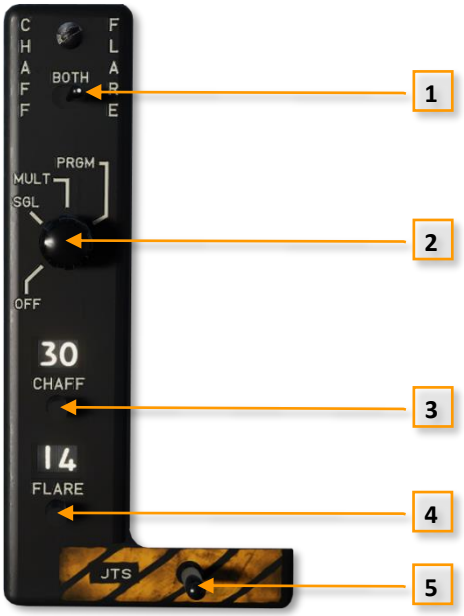
Countermeasures can be set in the Mission Editor.

Controls

- OFF-SGL-MULT-PRGRM selector: enables the pilot to select the working mode of the system: off, single, multiple and program.
- Chaff-Both-Flare selector: Allows the pilot to select if the launch order is to be sent to the flares, the chaff or both.
- Emergency Jettison (JTSN): Commands the sequential and rapid ejection of all the flares.

Indicators

- Countermeasure counters: 2 counters inform the pilot of the remaining number of chaff and flares.



1 CHAFF/FLARES SELECTOR SWITCH
2 PROGRAM SELECTOR SWITCH
3 CHAFF COUNTER RESET BUTTON
4 FLARES COUNTER RESET BUTTON
5 EMERGENGY JETTISONING SWITCH

Figure 3-107 Countermeasures Panel

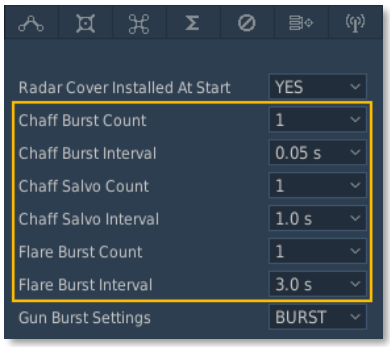


Figure 3-108 Countermeasures Settings in Mission Editor

3.17 RADAR DETECTOR

Description

The radar detector provides the pilot an omnidirectional alert (visual and aural), an indication on the direction and on the nature of the threat when the aircraft is illuminated by a tracking or fire control radar.

The detected radar transmissions are of the following type:

- Aimed pulse modulated radar (⎍⎍): antenna aimed at the target during tracking.
- Track While Scan (TWS) pulse modulated radar: the antenna keeps scanning during tracking.
- Continuous wave (CW) radar: for example, ground-to-air missile guidance.

Controls and indicators

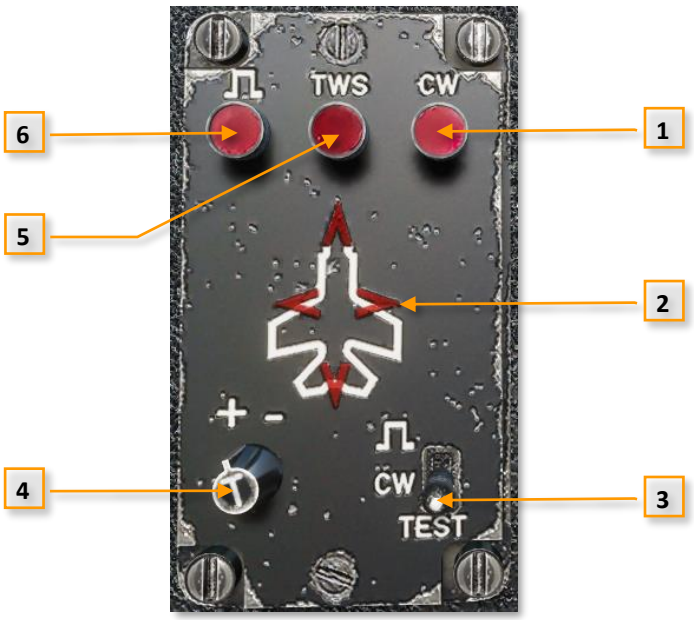


Figure 3-109 Radar Detector Indicator in Main Panel

1 CW "NATURE OF THREAT" RED LIGHT
2 DETECTION SECTORS RED ARROWS
3 TEST SWITCH
4 INDICATOR LIGHT INTENSITY ADJUSTING SWITCH AND LIGHTS "T" TEST BUTTON
5 TWS "NATURE OF THREAT" RED LIGHT
6 "NATURE OF THREAT" RED LIGHT

3.18 RADAR

Description

The Mirage F1CE is equipped with the CYRANO IV on-board fire control radar.

It has a maximum range of 60 NM in search mode, and 35 NM in lock-on mode. It incorporates antijamming circuits for passive directional tracking. The antenna platform is slaved to the horizontal position, provided that the aircraft roll angle is less than ±80°.

Radar functions

- **Interception**
  It includes:
  - search that leads to the detection of the target
  - engagement, in distance and in direction, of a selected target
  - automatic pursuit phase which makes it possible to bring the aircraft into a firing position or to carry out a blind rendezvous
  - manoeuvring phase after firing.
- **Close combat functions "TL" and "BZ"**
  These functions allow the radar to lock automatically a target located at a distance of less than 7 km.
  They have priority over all other functions.
  They are also divided into phases, which are:
  - search during which the radar scans ahead of the aircraft from 400 m to 7000 m
  - engagement on the first target found in the distance
  - automatic pursuit
- **AIR-GROUND function**
  In this function, the indicator scope presents the radar map of the terrain in front of the aircraft.
  Four distance representation scales are available to the pilot: 60, 35, 15 and 7 NM.
  The mean bearing position is zero and the radio-electric beam explores a sector of ± 60° or ± 30° in bearing centered on the aircraft axis.
  The elevation is a function of the altitude of the flight (in the scales 60 and 35 NM) and can be modified to better illuminate the area of terrain overflown and obtain a usable representation on the scope.

Radar indicator scope

The radar indicator scope includes:

- The radar scope where the radar data is displayed.

- The radar status lights:

AP	Amber	parametric amplifier disabled
TCH	Red	too hot
EMI		no emission
PNE		failure

- The amber lights 7, 15, 35, 60 that indicate the scale in use.

- The function indicators:

HA	Amber	high altitude	
IC		short pulse	
TL	Green	AIR-AIR telemetry	
BZ		scanning by area	
TS		AIR-GROUND telemetry	inoperative
V1	Amber	visualization of the ground	
V2			inoperative
DC		iso-altitude cutout	
PR		blind penetration	
AC		anti-collision	
DB		jammer detection	

The "HA", "IC" and "V1" functions are selected by the radar indicator scope function selector.

- The alphanumeric display for visualizing the difference in altitude:

- E or D : E for elevation, D for altitude difference
- + or - : the + sign corresponds to a plane above the airplane
- 2 digits : always indicating the difference in altitude. The displayable domain is:

  ± 48,000 ft in 1,000 ft steps in AIR-AIR modes

  ± 4,800 ft in steps of 100 ft in display

- The controls at the bottom of the indicator, from left to right:

- TEST : button for launching a test sequence
- LUM : adjusting the brightness of the scope
- Function selection
- REM : adjustment of the remanence
- EFF : erase button, resets the screen to black level

- The polaroid control, at the scope periphery, allowing to modify the background of the scope according to the ambient luminosity

Indicator scope control box

Controls:

- EC : brightness of all indicator LEDs except the red fault lights (TCH, EMI and PNE). However, in the event of a fault, these three LEDs are off when EC is at minimum
- AL : luminosity of the alidade (strobe)
- MQ : brightness of the distance markers
- LH : brightness of the artificial horizon and the radial speed marker
- CH : vertical position of the artificial horizon

Radar handle

It Includes:

- on its base:
  - forward : selection of 60° and 30° sweeps
  - rear : selection of the 60, 35, 15 and 7 NM scales and the elevation or altitude difference switch button
- on the handle itself:
  - a protective arch (of the two elevation or altitude difference buttons)
  - two elevation or altitude difference control buttons
  - a knurled gain control knob with its quick reset button to maximum gain
  - a lever with two unstable positions:
    - press on the upper part, APS preselection authorization
    - press on the lower part, APC continuous pursuit authorization
  - the release (unlock) lever

In addition, the handle is movable around 2 axes:

- laterally it controls the movement in azimuth of the antenna and of the alidade (strobe). In area scanning it allows to select the left, center or right sector
- around its vertical axis it controls the movement of the alidade in distance

Telemeter - scan by zone selector

This selector, which is located in the left wall and has three stable positions, allows:

- on TL : the AIR-AIR telemetry function
- on BZ : the scanning by zone function
- on stop : using the radar in any other selected function

Jammer detection light

It is located in the front windshield structure, below the standby magnetic compass.

Controls in the armament panel

The armament panel includes the following radar controls:

- the radar selector. It has three positions, ARRET - VEIL - EMISS (OFF - STBY - TRANS), to set the radar off, on standby or into operation
- the SECOURS (EMERGENCY) push-button. It is used for relaunching transmission or resetting the power supply
- the 4-line - 1-line scan switch
- the NORM-DEN switch (normal-altitude difference) for firing MATRA S 530 missiles
- the armament selection keys

“Rapid canon + Magic or Sidewinder” button

This button, located in the throttle lever, is used to activate the cannon + Magic or Sidewinder rapid, (C + M or SW) R, function.

"Rapid canon + Magic or Sidewinder" erasing manipulator

This switch, located in the left wall, is used to restore the previous arming selection, if the (C + M or SW) R function was used.

Operation

1- Getting started

The radar is energized using the armament panel three-position selector:

- “AR”: Radar power cut.
- “V”: Heating of the tubes (no emission) and start of the emission timers. After 35 seconds, appearance on the radar indicator scope of: scanning, markers, alidade and lights.
- “EM”: Starting of the transmission after 3 minutes of heating.

2- Adjusting the scope

It is provided by the controls located on the indicator and the indicator scope control box.

3- Tilt/altitude difference control

The radar antenna can be controlled in tilt or in altitude difference. The selection is made using the push-button located in the rear base of the radar stick, and causes the display of the letter E (elevation) or D (altitude difference) in the indicator scope display.

A. Altitude difference display: “D” selected

Using the two buttons on the radar handle:

- the larger one (on the left) causes an increase in the difference in height
- the smallest (on the right) causes a decrease

Each push-button continuously controls the scrolling of the altitude difference. Two scrolling speeds are available:

- until the 1st detent: 2°/s
- until the 2nd detent: 10°/s

The displayable domain is:

- ± 48000 ft in AIR-AIR
- ± 4800 ft in AIR-GROUND

The antenna tilt corresponds to the altitude difference displayed and varies according to the strobe (alidade) distance; but the command of the strobe has no effect on the display of the altitude difference.

B. Tilt display: "E" selected

Bring the alidade (strobe) to 10 NM. The tilt, displayed in the same way as the elevation, is then read directly in the indicator scope display.

When the alidade is at a distance different from 10 NM, the scope display always indicates altitude differences. I.e., the alidade control varies the altitude difference but has no action on the antenna tilt.

The displayable range is from +28° to -32° in AIR-AIR.

NOTE: The “E” selection is inoperative in AIR-GROUND

4- Scan selection

The scanning consists of an automatic movement of the radar antenna that causes the radio-electric beam to describe simple geometric volumes. Various scanning programs are available to the pilot, these are:

- in AIR-AIR:
  - scanning ±60°
  - scanning ±30°
  - AIR-AIR telemetry scanning in the axis
  - scanning by zone
- in AIR-GROUND (visualization):
  - scanning ±60°
  - scanning ±30°

A. 60° scanning

In AIR-AIR:

The axis of the beam scans the space along four lines stabilized in roll and pitch. The beam width is of 4° in “HA” and “lC”. The beam explores a range of 8°. The time of this exploration is 4.8 seconds.

The scan is described in a clockwise direction, seen from the pilot, i.e. from left to right for the upper rows and from right to left for the lower rows.

NOTE: The 4-line scan can be reduced to a 1-line scan in two ways:

- manually by setting the "4L - 1L" switch in the armament panel to "1L"
- automatically in APS

The maximum bearing angle is ±57° with respect to the aircraft axis.

When in tilt or in elevation, the brightness of an echo, varying depending on the direction of the scan, allows to adjust the mean tilt:

- - if the echo is only visible on the left to right scan, it means it is located above the rectangle described by the antenna; it is necessary to increase the tilt or the altitude difference
- - if the echo is only visible on the right to left scan, it means it is located below the rectangle and it is necessary to lower the tilt or the altitude difference

The 1-line scan allows, when the antenna is correctly aimed in elevation, to see the echo at each scan and to improve the possibilities of detection.

The radar indicator presents the map of the echoes in a vertical scale according to the distance and horizontal scale depending on bearing. The central vertical axis, engraved on the scope, represents the zero relative bearing (aircraft axis). The area scanned on the scope is a rectangle 90 mm high and 70 mm wide.

NOTE: The width of the scan is reduced when the antenna reaches the high or low stop.

If the displayed distance is zero:

- scanning stops
- the "PNE" warning light flashes

In AIR-GROUND:

The echo map is offset on the screen. The center of the sector represents the aircraft, and the vertical axis of the screen the aircraft axis. Emission characteristics and elevation exploration are adapted to the exploration distance selected by the scales available to the pilot.

B. 30° scanning

In AIR-AIR:

The type of scan (4 lines) is the same as in 60° but the width is ± 30° in bearing. The exploration time is 2.4 seconds.

The 4-line scan can also be reduced to a 1-line scan.

The mean tilt is obtained as in 60° scan.

The mean bearing is controlled by the radar stick (tilting it left or right). It is copied onto the navigation indicator (narrow needle bearing selector on “R”).

As for the 60° scan, the exploration domain is stabilized in roll and pitch.

When the average bearing displayed exceeds 30°, the antenna reaches the stop and immediately goes back in the opposite direction resuming a new scan cycle.

The representation on the scope is identical to that of the 60° scan but the rectangle is 35 mm maximum wide centered on the mean bearing.

The average bearing is represented by the position of the alidade.

In AIR-GROUND:

The antenna's radio-electric beam carries out a bearing scan of ± 30° centered in the aircraft axis.

In the same way as in 60°, the scales condition the characteristics of the emission and the exploration in elevation.

C. AIR-AIR telemetry scan in the axis, “TL”

The antenna scans a square of 5° side, the area explored represents a square of 9.5° side.

D. Zone Scan, “BZ”

In this scan mode the antenna:

- is referenced in relation to the aircraft trihedron, therefore not stabilized in roll and pitch
- it searches in an area of 20° in elevation and 20° in bearing

Zone scanning can be performed in three different sectors:

- left sector or right sector by holding the radar stick to the left or to the right

- central sector by releasing the radar stick (spring-loaded to the centre position)

On the scope the mean bearing of the scanned area: left, central or right is materialized by the alidade whose length represents 7 km, i.e. the authorized engagement range.

The alidade is placed in the center of the search area when changing sectors.

The mean bearing of the scanned area is also copied by the narrow needle of the IDN (bearing narrow needle selector on “R”).

The scan covers 6 lines and takes 1.5 seconds.

NOTE: The "TL" and "BZ" functions have priority over any other radar function.

5- Selections according to the missions

The selection of scannings allows, as long as the position of the target is accurately known, to modify the search field and thus improve the illumination of the target by narrowing the search cone.

In order to sharpen the image on the scope, the pilot has at his disposal a second selection which is more particularly associated with the missions.

IN AIR TO AIR:

"HA", "IC" are the operating modes that determine the working conditions of the radar: repetition frequencies, pulse width and starting of the parametric amplifier.

The purpose of the interference echo attenuation device (DATEP) is, in "HA" and “IC", to limit the harmful effects of diffuse echoes.

"TL" and "BZ" are the functions designed for close combat.

IN AIR-GROUND:

"V1" is the selection that allows the visualization of the terrain flown over.

A. High altitude, “HA”

Characterized by a long pulse and by the use of the parametric amplifier, this function allows the most large ranges and the use of 60° and 30° sweeps.

B. 1 short pulse, "1 C"

The characteristics are the same as in “HA” but the pulse width is reduced, and the radar performance is slightly reduced in range.

C. DATEP (Interference Echo Attenuation Device)

The DATEP is used in AIR-AIR in the “HA”, “IC”, “TL”, and “BZ” modes.

The purpose of the device is to limit the harmful effects of diffuse echoes of various origins (clouds, ground clutter, sea return…):

- in search, by a better contrast of the useful echoes on the scope, therefore an easier exploitation by the pilot
- tracking, avoiding inopportune engagement of parasitic echoes

In “HA” and “IC”, on the 15 and 7 NM scales, the DATEP is in service only when the gain control is maximum.

D. Jammer pursuit, “PB”

In “HA” and “IC” function, a jammer detected during the search is displayed on the scope by two vertical line markers that frame the direction of the jammer.

The two markers are more distant from each other the closer or the more powerful is the jammer.

E. Ground visualization, “V1”

When viewing the ground, the electrical beam of the antenna explores the terrain in front of the aircraft by sweeping 60° or 30° on either side of the radar axis. This scan can be in two or one elevation lines depending on the scale selection.

The echo density is changed using the gain control.

6- Scale selection

Four distance scales are available to the pilot. This scale selection is done according to the target echo distance by means of the control on the radar control stick base at the rear.

Markers appear on the scope depending on the selection.

4 amber lights on the right of the radar indicator indicate this selection. Each LED indicates the displayed scale.

Scales	60 NM	35 NM	15 NM	7NM
Respective marker distances	10 NM	10 NM	5 NM	2NM

A. In "HA" and “IC” functions

These four scales are usable.

NOTE: If the "HA" and "IC" functions are selected, when selecting 530 (with an EM missile), the scale automatically switches to 35 NM when the scale selector is on "60".

B. In “V1”

The 60 and 35 NM scales provide a two-line scan. The upper row tilt (left to right) is a function of the airplane altitude given by the aerodynamic unit; it is such that, when the displayed tilt is zero, the intersection of the scan plane with the horizontal plane of the terrain overflown is at an oblique distance of 24 NM. The tilt of the lower line (right to left) is a function of the first. The correction that the pilot can add to the tilt of the upper line is approximately ± 1°.

The 15 and 7 NM scales provide a scan, at one elevation line, displayed by the pilot within the limits of ± 6°30'. The displayed tilt defines in hundreds of feet a fictitious horizontal plane that the radio-electric axis intercepts at a constant distance of 9 NM (15 NM scale) or 4 NM (7 NM scale).

C. In "TL" and "BZ"

Only the 7 NM scale is in service.

7- Alidade (strobe)

It is a segment appearing on the scope and whose brightness is adjustable by the "AL" potentiometer of the indicator scope control box. It allows the pilot, by positioning the alidade on the chosen and engaged echo, to define the bearing and the distance of this echo and to predetermine, for the radar computer, the average bearing of the antenna. The alidade is controlled in bearing by the lateral displacement of the radar stick around its longitudinal axis;

this manipulation gives a velocity movement (three sensitivities), not a position movement. When the bearing of the alidade is greater than the antenna travel, in 60° it returns to the lubber line of the aircraft axis indicator and the scan continues; in 30° AIR-AIR the antenna reaches the stop but the scan continues, the alidade then remains at the stop of the scope. In all cases the antenna bearing remains readable on the IDN's narrow pointer (selector on "R").

The alidade is controlled in distance by the rotation of the handle around its vertical axis. It is also a velocity movement (three sensitivities); anti-clockwise increases the distance, clockwise decreases it. The movement of the alidade cannot exceed 35 NM.

In search phase the segment is vertical and indicates the mean scanning axis of the antenna. The length of this segment delimits, in distance (3 km), the area where engagement is authorized.

NOTE: The length of the vertical segment is scale independent.

In pursuit phase (“PS" or "PC") the segment is horizontal and shifted by 2/3 of its length to the left of the locked target.

8- Types of engagement

A. Manual engagement

This is the operation that allows the radar to pass from autonomous search to automatic pursuit.

To execute this transfer, the pilot has a two-position lever on the radar stick:

- upper position, pre-selection authorization (APS)
- lower position, continuous pursuit authorization (APC)

1. Preselection Authorization (APS)

The "PS" is a pursuit of discontinuous information. In this function, the radar pursues a target while maintaining its sweep. It gathers information about the target thanks to a small slowdown scanning at the echo level. The echo is taken into account if it is located in an area of: 3 km distance and ± 70 mrd in bearing, centered on the vertical alidade.

The transit of the alidade to the horizontal confirms the radar lock-on in "PS".

Each time the antenna passes over the target, the antenna is recentred in distance and bearing.

In this function, scanning ± 60° in 1 line is imposed. The target square is present but undergoes fluctuations due to the resetting carried out at each scan.

NOTE: The firing of electromagnetic missiles is not possible in "PS".

2. Continuous pursuit authorization (APC)

The "PC" causes the program to stop, that is:

- stop scanning with antenna pointing in the direction displayed with the radar stick (positioning of the alidade)
- short pulse emission
- deletion of the distance markers for the whole time the program is stopped

The engagement on target echo is possible in an area of ±1500 m delimited by the length of the alidade.

The lock-on authorization will take place 0.1 second later if the echo coincides in distance and in direction with the alidade and if its level is sufficient.

The radar then switches to automatic tracking and the pilot can release the engagement lever.

The antenna remains focused on the hostile, the distance markers reappear in the video trace and the altitude difference counter remains on.

The radial speed marker appears if the "LH" brightness is set correctly. This marker of the thermometer type is in the form of a vertical segment, the length of which defines the range from +1800 kt to -450 kt, interrupted from 0 to -150 kt. A small horizontal bar moves in proportion to the relative fighter-target velocity (radial velocity) above zero for positive speeds and below for negative speeds.

B. Automatic engagement in “TL” and “BZ”

This engagement process is used in close combat.

The search area is between 400 and 7000 m.

NOTE: If the radar is locked and the pilot commands "TL" or "BZ", the radar remains locked but the scale presented on the scope changes to 7 NM.

9- Automatic engagement

When the radar is engaged, the radial speed marker and its index appear on the scope.

Radar tracking data is supplied automatically to the interception computer.

The result of the calculation is presented in the sight in the form of a piloting order: it is a bar movable in roll around its centre; the latter being mobile in pitch.

The intercept computer makes the aircraft perform an approach trajectory according to the selected weapon to place it in the optimal firing position, and controls the illumination of lights in the sight.

The orders are different depending on the weapon selected on the armament table.

In addition, limitations are introduced; exceeding these limitations is signalled to the pilot by a fixed red light in the sight (±80° in roll, - 1 < n < 4, 8000 m in height); the orders of the interception calculator are developed in such a way as not to reach these limitations.

10- Disengagements

A. Voluntary disengagement

A lever at the bottom of the radar stick controls the radar disengagement.

B. Inadvertent disengagement

At all times during automatic tracking, the position of the antenna and the distance are stored in memory. During an untimely disengagement, the radar is therefore able to reengage automatically by performing a distance search around the stored position. Only telemetry returns to search; the directional tracking, the interception and firing range calculator, and the sight remain in automatic tracking.

If after 3 seconds the radar is not reengaged, it returns to the previously selected scanning mode.

11- (C + M or SW) R button

A. When first briefly pressed

Allows the change of the radar to (C + M or SW) R without causing it to disengage.

The "IC" function is forced, even if the radar is in "V1".

B. During a second brief press (as well as for the following brief presses)

- For 0.3s

If the radar is in "TL" or "BZ" and locked, there is relaunch of the telemetry in the axis of the echo with the possibility of engaging from a distance 150 m greater than that of the previously hooked echo.

- From 0.3 to 0.8s

If the radar is in "TL" and locked, telemetry is restarted as before.

If the radar is in "BZ" and locked, the antenna scan is restarted from the middle of the furthest line close to the elevation of the initial echo.

- Beyond 0.8s

In «BZ» resuming of normal scanning.

In “TL” normal relaunch.

C. Maintained held

If the radar is in "TL" or “BZ", engagement is forbidden and appearance of the cannon 300 reticle.

12- Additional information and possibilities given by the radar

A. The horizon

It is a representation of the attitude of the aircraft (information coming from the gyroscopic assembly) by a horizon bar and a model moving in roll and pitch.

Two potentiometers on the indicator scope control box allow:

- by means of the "LH" potentiometer to display and adjust the brightness of the horizon and the radial velocity marker
- by means of the "CH" potentiometer to move the model vertically in an area of the screen where the map offers no interest

B. Status LEDs

The 4 status LEDs are located on the right side of the indicator;

- the amber "AP" (parametric amplifier) indicator lamp indicates by lighting up that the parametric amplifier is out of service until thermal stabilization is reached
- the red “TCH” (too hot) signals:
  - by flashing, a conditioning defect of the right or left URPs
  - by illumination, a fault in the conditioning of the nose cone or an abnormal temperature rise
- the red "EMI" (emission failure) light: this light is on when the radar selector is on “EM” and this does not take place for one of the following reasons:
  - no emission
  - the warm-up sequence is not complete
  - nose cone conditioning fault, the "TCH" light is also on
  - test triggered (on “EM”)

NOTE: When the radar selector is on "V", the "EMI" warning light is on.

- the red LED "PNE" (failure) indicates, when illuminated, the failure of the function that the radar is using

C. The "EFF" button (erasing)

Located on the radar indicator, allows to erase all the traces on the scope and to bring it back to the black level.

D. The gain control

This is the knurled knob on the radar stick. By acting on the gain of the receiver, it makes it possible to reduce the level of interference echoes on the scope, in order to bring out the useful echo.

It is efficient:

- in search of "HA" and "lC" on the 15 and 7 NM scales
- in visualization of the ground "V1": improvement of the radar map

A control located above this button allows a quick reset to maximum gain.

In the other radar functions, these commands are inoperative and the gain is automatic.

E. The «EMERGENCY» button

Located on the PCR (armament panel), it allows, in the event of the transmitter or the radar power supply disconnection, and without switching on the "TCH" light, to immediately reconnect the power supply and the radar transmission.

If the "PNE" and "EMI" warning lights are on, it is recommended to switch to "IC" for reseting.

In the event of a transmission failure, the scan remains on the scope.

In the event of a power failure, the scan disappears and all indicator status and function lights go out.

F. The 4 lines - 1 line scan switch

Located on the PCR, it allows antenna scanning to be reduced to 1 single line for the "HA" and “IC” AIR-AIR functions. It has no effect on the other functions.

G. The "DEN-NORM" inverter (gradient - normal)

Located on the armament panel, it is used on "NORM" for firing MATRA 530 missiles and on "NORM" or "DEN" for shooting the MATRA S 530.

The "DEN" position selects, in the interception computer, the missile-target collision function in projection in the horizontal plane where the hunter moves. Orders make the hunter perform a navigation making it climb to 20000 ft below the target or, if the altitude difference is less, keep it level.

In the horizontal plane, the orders are calculated as in the case of shooting without height difference.

H. Arming keys

When the radar is in AIR-AIR mode these keys select the functions of the radar and sight computers and firing circuits appropriate to the weapon displayed.

13- RADAR MANUAL TEST

It can be performed on the ground or in the air.

It is controlled by the "TEST" button located on the radar indicator scope, the radar can be on standby or transmitting in all functions except:

- (C +M or SW)R
- jammer tracking
- automatic pursuit (radar locked-on)
- visualization

Pressing the "TEST" button has no effect on these functions.

The test triggers a proper operation test sequence; in the event of a malfunction, or if the conditions of use are not met, the "PNE" indicator light comes on.

The course of the sequence lasts 6 seconds. For the duration of the test, if the radar is transmitting, the LED “EMI” lights up; after 6 seconds, the "PNE" warning light comes on in the event of a fault. To turn it off you have to change the function.

The sequence is as follows:

- press the "TEST" button
- the scale changes to 7 NM, the "7" light comes on
- distance markers every 2 NM
- appearance of echoes
- engagement on first echo encountered
- radar disengage after about 6 seconds
- return to the previously selected operating mode

14- Summary of radar operation in air-air search and display

Selection		Scale	Actual scan	Pulse	Gain control	OBSERVATIONS
Function	Scanning					
HA	60 30	60 35 15 7	60 30	Long	Automatic	On the 15 and 7 MN scales the DATEP is in service only when the gain control is at maximum. By reducing, the gain becomes manual.
IC	60 30	60 35 15 7	60 30	Short	Automatic	Same.
TL	60 30	60 35 15 7	in the axis	Short	Automatic	AIR-AIR telemetry if the radar is not in “PS” or in “PC”. The scale passes in 7 NM.
BZ	60 30	60 35 15 7	BZ 20	Short	Automatic	Scan by area if the radar is not in “PS” or in “PC”. The scale passes in 7 NM.
V1	60 30	60 35	60	Short	Manual	2 elevation lines scan.
		17 7	30			1 elevation line scan.

Simplified operation

To scan and lock a target in manual lock mode:

- Select the scan angle (60° or 30°)
- Select radar function (HA, SP, MA or LA)
- Select the scale (60, 35, 15 or 7)
- Adjust the echo in elevation
- Place the alidade (strobe) over the target
- Press the lock-on lever, when the range to the target is less than 35 NM
- Follow the interception commands shown in the sight
- Take into account the indications for radial velocity in the scope and green circle light in the sight, indicating missile within launch parameters

To lock a target in automatic mode:

- Set the “TL or BZ” switch in “TL” or “BZ” position
- Place the radar reference in the sight over or near the target (within range parameters)

To unlock a target:

- Press the unlocking (reject) lever

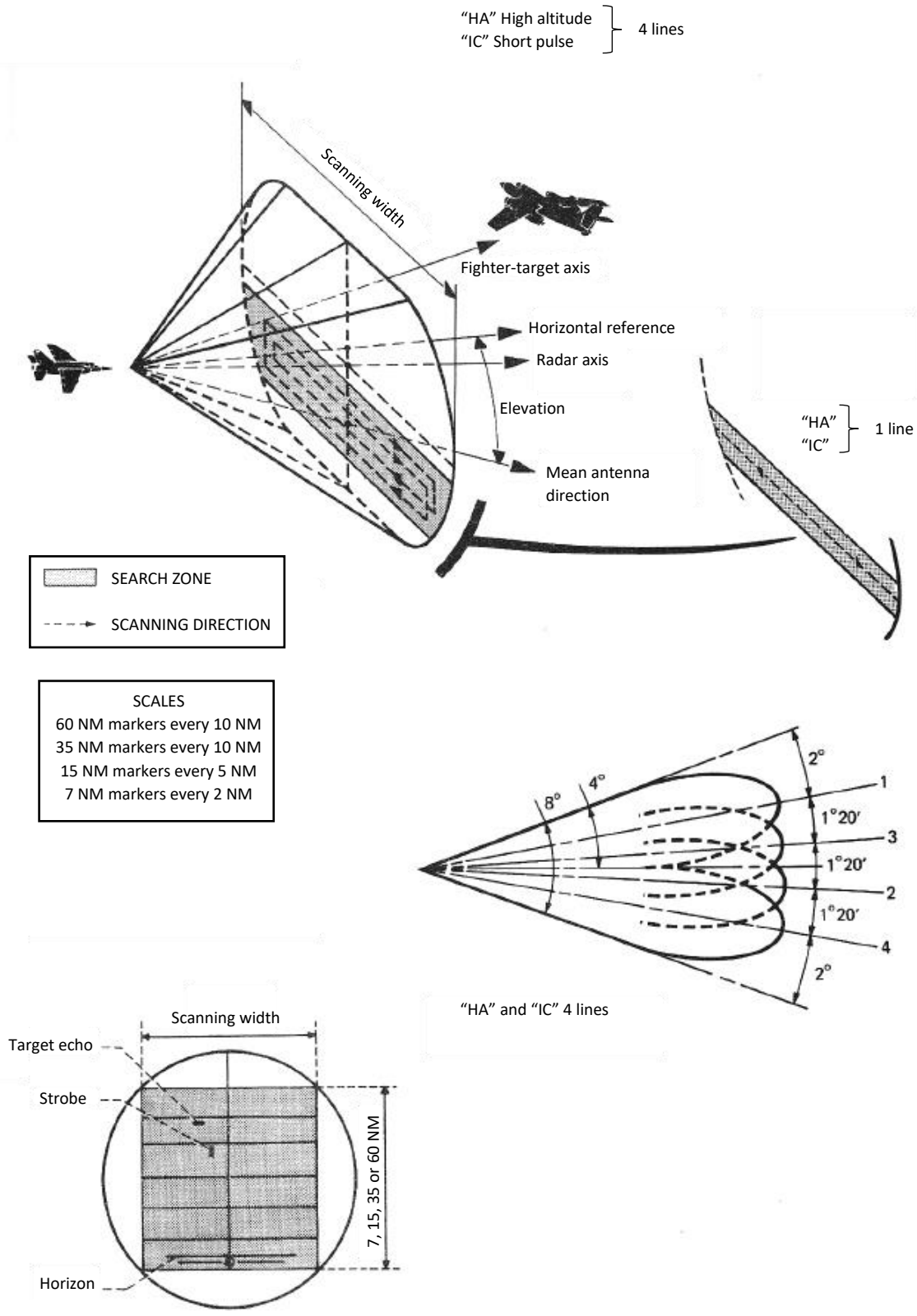


Figure 3-110 60° Scanning

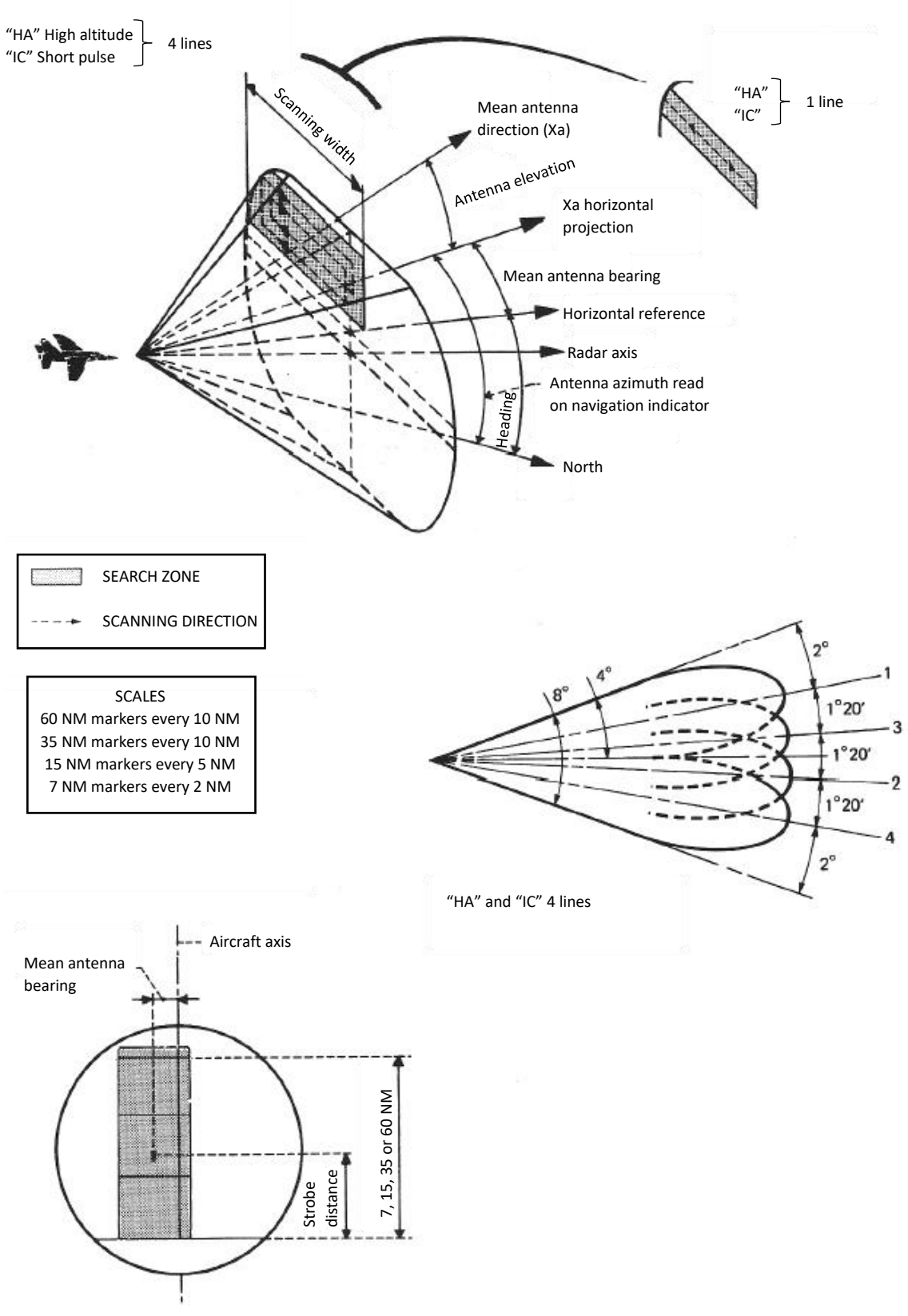


Figure 3-111 30° Scanning

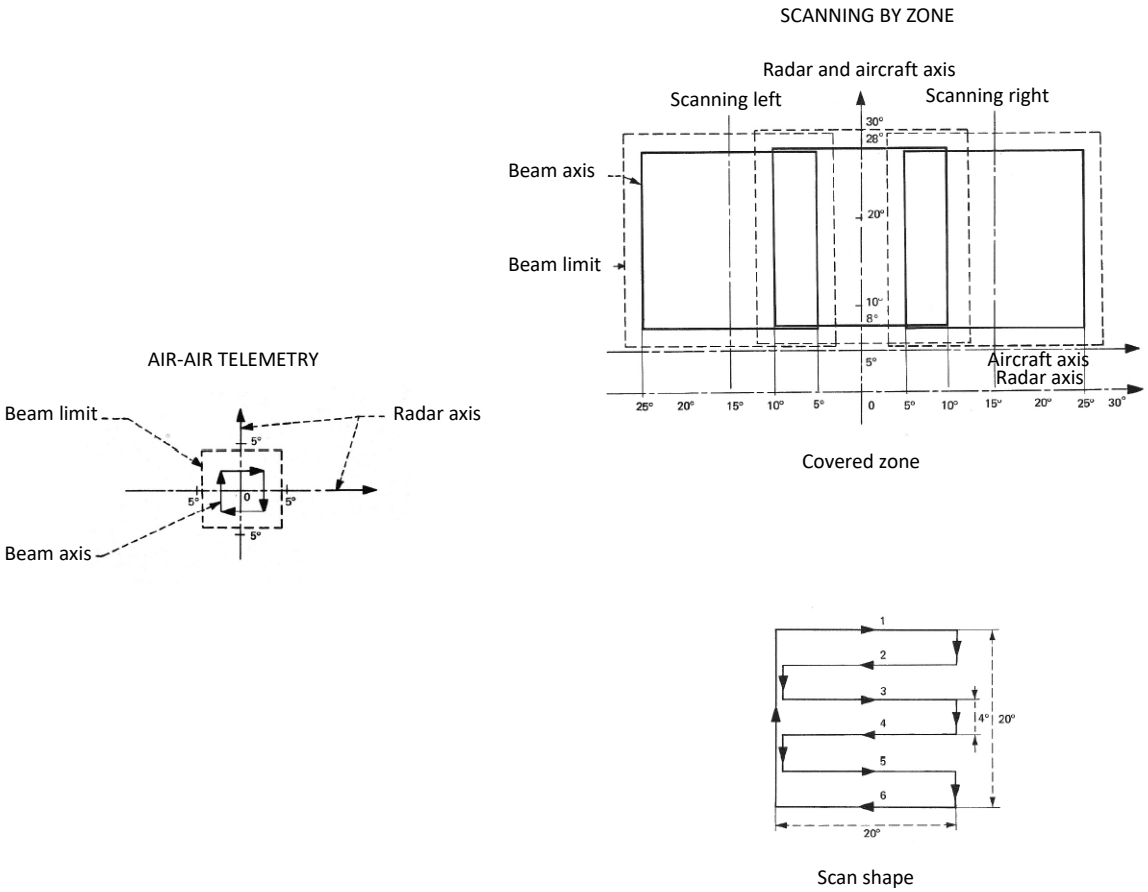


Figure 3-112 Air-Air Telemetry and Scanning by Zone

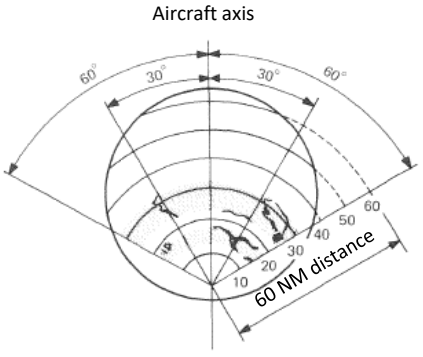


Figure 3-113Air-Ground Radar in 60 NM Range

Radar system controls in DCS control options section:

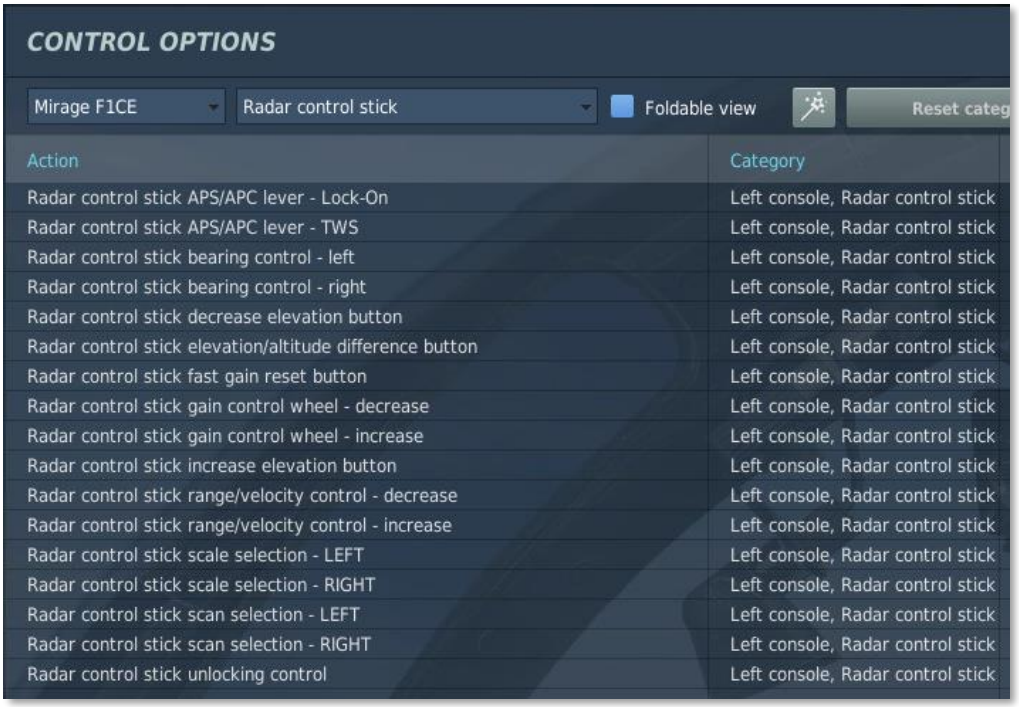


Figure 3-110 Radar Control Stick Controls Options

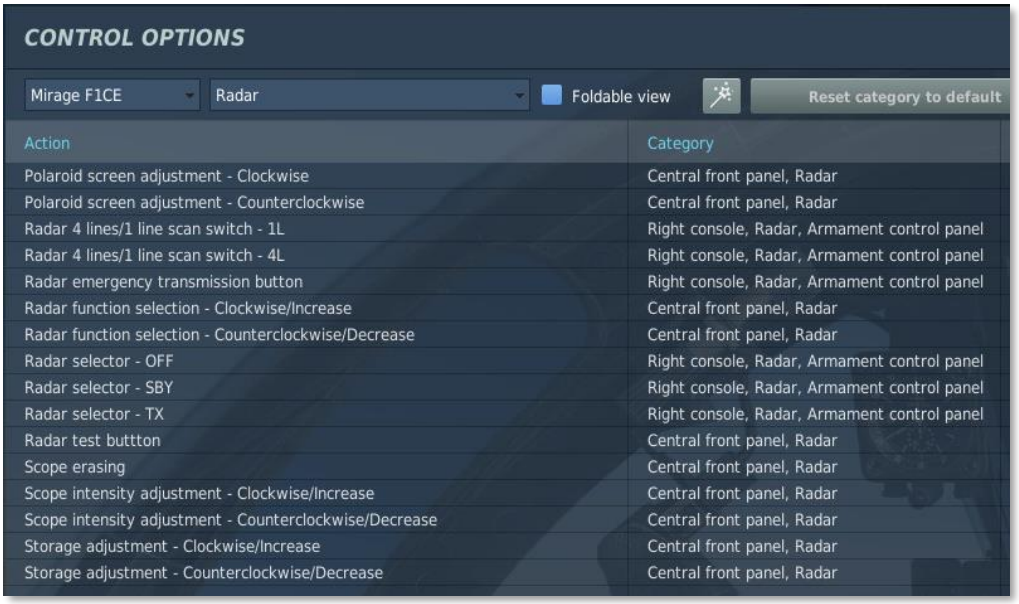


Figure 3-111 Radar Control Options

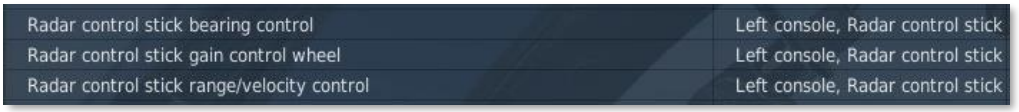


Figure 3-112 Radar Control Stick Axis Commands

Figure 3-113 Radar Before Lock-on

1 ALIDADE (STROBE)
2 DISTANCE MARKS
3 TARGET ECHOS
4 HORIZON

Figure 3-114 Radar After Lock-on

1 RADIAL VELOCITY MARKER (POSITIVE VELOCITY)

2 ZERO VELOCITY

3 NEGATIVE VELOCITY

Controls and indicators

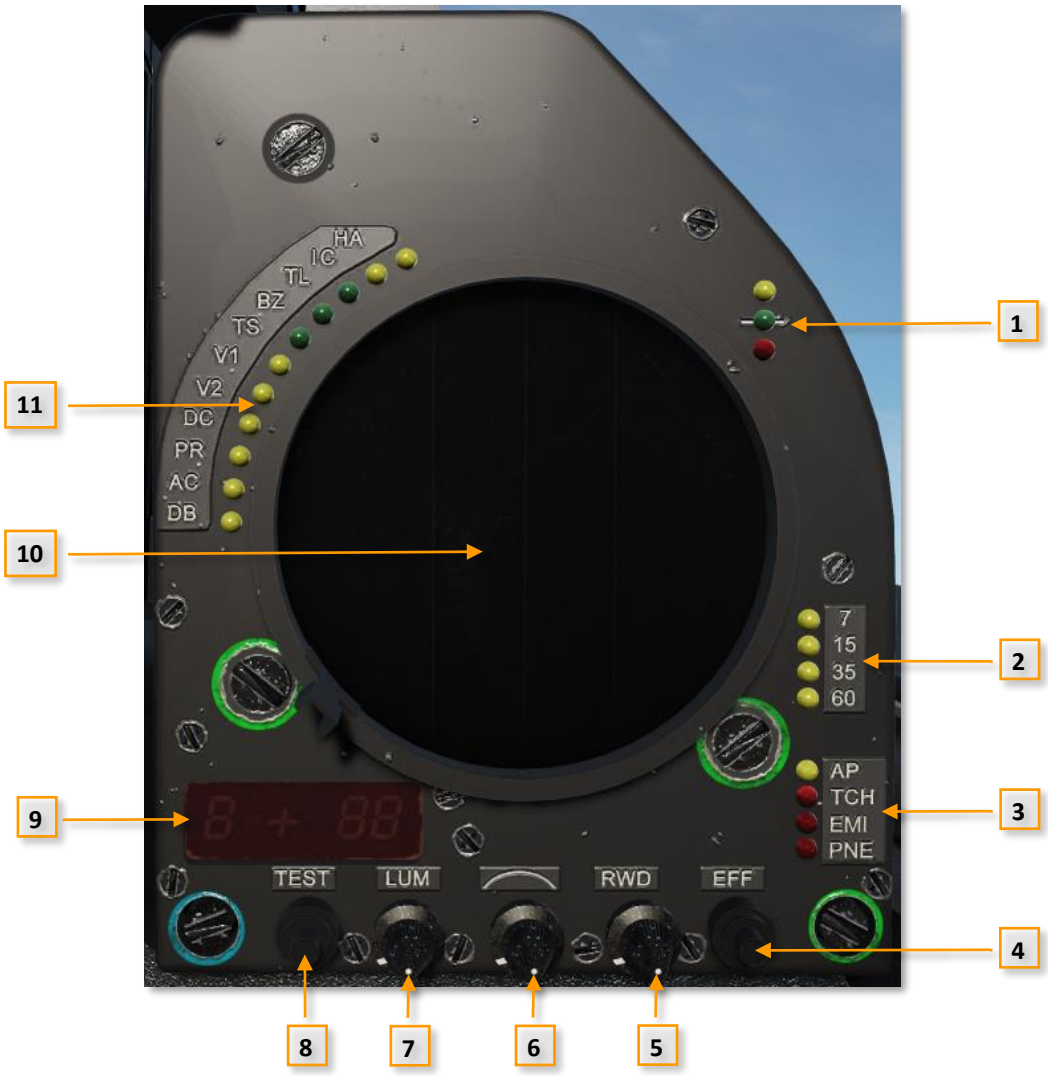


Figure 3-115 Radar

1 INOPERATIVE
2 SCALE LIGHTS
3 STATUS LIGHTS
4 SCOPE ERASING
5 STORAGE ADJUSTMENT
6 FUNCTION SELECTION
7 SCOPE INTENSITY ADJUSTMENT
8 TEST BUTTON
9 DISPLAY TILT E ALTITUDE DIFFERENCE D
10 RADAR SCOPE
11 FUNCTION LIGHTS

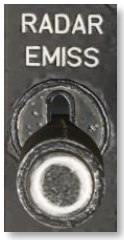


Figure 3-116 Radar Selector (Off-Standby-Transmit) in Armament Panel

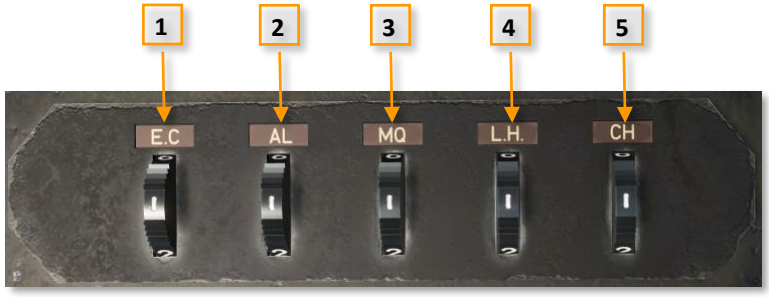


Figure 3-117 Radar Indicator Scope Control Box

1 INDICATOR LIGHTS BRIGHTNESS
2 STROBE BRIGHTNESS
3 DISTANCE MARKERS BRIGHTNESS
4 HORIZON AND RADIAL VELOCITY MARKER BRIGHTNESS
5 HORIZON SYMBOL VERTICAL POSITION

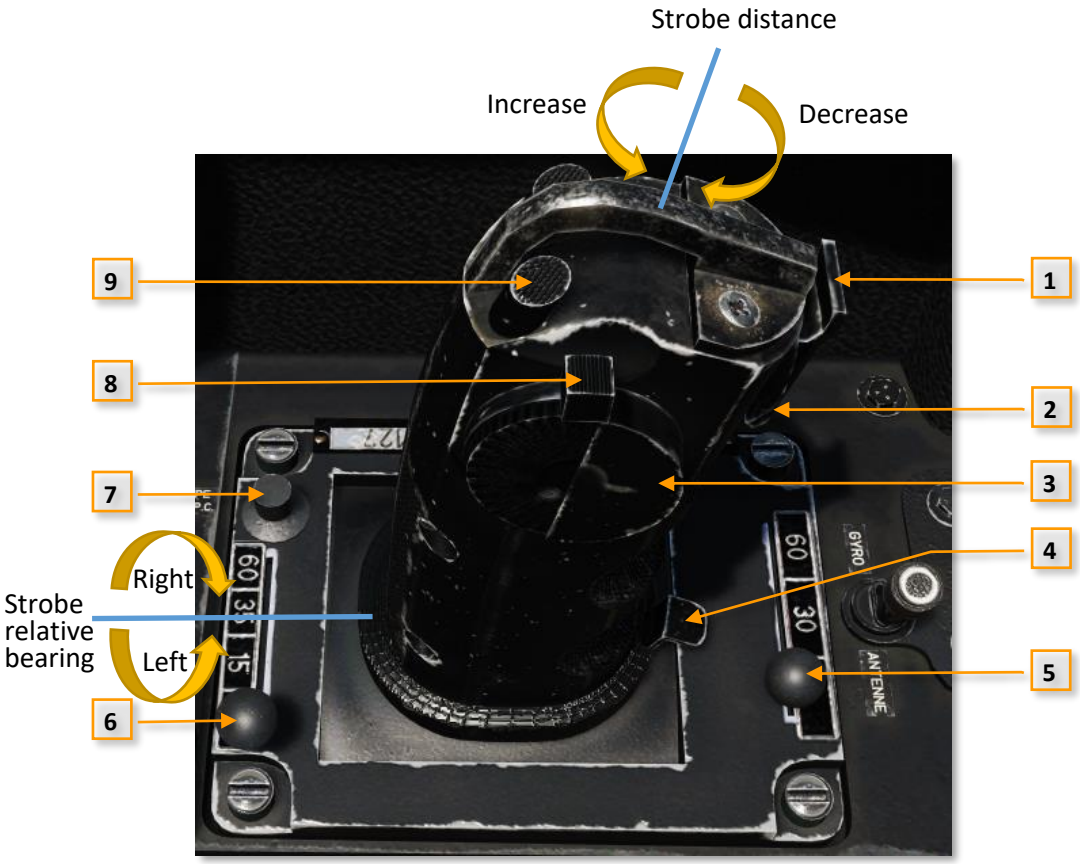


Figure 3-118 Radar Control Stick

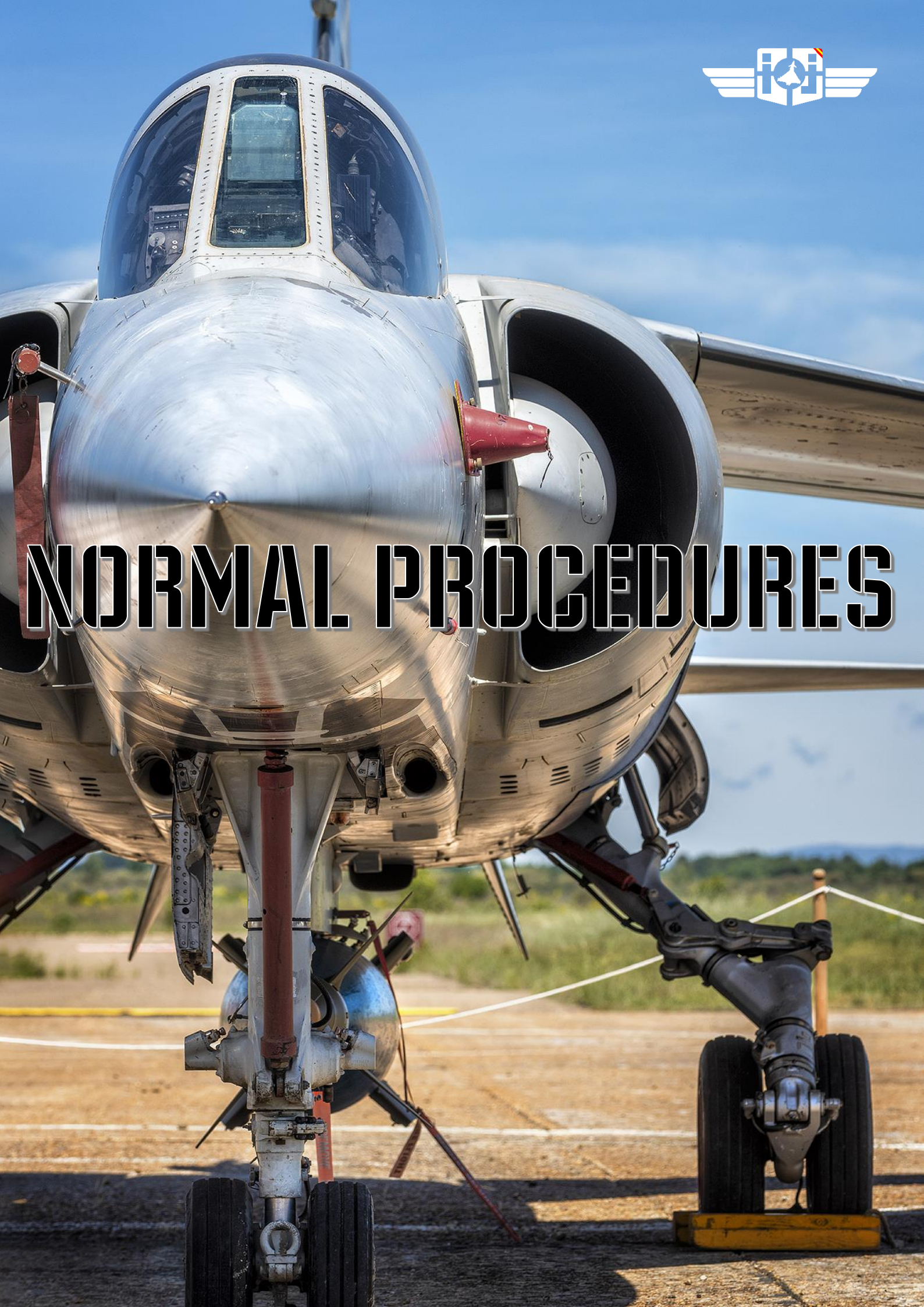
1 PRESELECTION AUTHORIZATION
2 CONTINUOUS SEARCH AUTHORIZATION
3 MANUAL GAIN CONTROL
4 REJECT LEVER
5 SCAN SELECTION
6 SCALE SELECTION
7 ELEVATION/ALTITUDE DIFFERENCE BUTTON
8 MAXIMUM GAIN FAST RESET CONTROL
9 ALTITUDE DIFFERENCE CONTROL

Figure 3-119 Radar Controls in Armament Panel

1 ARMAMENT SELECTION KEYS
2 RADAR SELECTOR
3 SECOURS (EMERGENCY) PUSH-BUTTON
4 4-LINE - 1-LINE SCAN SWITCH
5 NORM-DEN SWITCH

Figure 3-120 "Rapid Canon + Magic or Sidewinder" Erasing Manipulator in Left Wall

Figure 3-121 Telemeter - Scan By Zone Selector in Left Wall



NORMAL PROCEDURES

4. NORMAL PROCEDURES

ENTERING COCKPIT

1 EXTERIOR INSPECTION	PERFORMED
2 PARKING BRAKE	SET
3 RUDDER PEDALS	ADJUSTED
4 STRAP IN, PUT ON HELMET, CONNECT MASK	PERFORMED
5 BATTERY	ON
6 WARNING HORN	ON
7 SEAT HEIGHT	ADJUST
8 OXYGEN	CHECK

CABIN CHECKS

1 CABIN LIGHTING RHEOSTATS	AS REQUIRED
2 EMERGENCY FUEL TRANSFER SWITCH	OFF
3 JPT EMERGENCY REGULATION SWITCH	OFF
4 A/B MAIN COCK SWITCH	ON (GUARDED)
5 IN-FLIGHT RELIGHT CONTROL	AFT
6 COMBAT FLAP LEVER	IN
7 ANTI-SKID (SPAD) SWITCH	ON (GUARDED)
8 HIGH-LIFT DEVICE SELECTOR SWITCH	OFF
9 IGNITION/VENTILATION SELECTOR SWITCH	L/H OR R/H
10 STARTING PUMP SWITCH	OFF
11 R/H LP PUMP SWITCH	OFF
12 L/H LP PUMP SWITCH	OFF
13 LP MAIN COCK SWITCH	CLOSED (UNGUARDED)
14 EMERGENCY REGULATION SWITCH	OFF (GUARDED)
15 LANDING LIGHT CONTROL	OFF
16 U/C CONTROL LEVER	DOWN

17 YAW/ANTI-SLIP SWITCH	ANTI-SLIP
18 PITCH SWITCH	ON
19 ARTHUR SELECTOR SWITCH	AUTO (GUARDED)
20 STICK UNCOUPLE SWITCH	OFF (GUARDED)
21 HYDRAULIC PRESSURE SELECTOR SWITCH	1 SERVOS 2
22 BRAKE CHUTE CONTROL	FORWARD
23 CANOPY EMBRITTLE CONTROL	AFT
24 SHOCK-CONE PUSHBUTTON	DEPRESSED
25 NOSE WHEEL STEERING SWITCH	ON (GUARDED)
26 NOSE WHEEL STEERING HIGH SENSITIVITY BUTTON	DEPRESSED
27 ARMAMENT CONTROL PANEL SELECT PUSHBUTTONS	RELEASED
28 INSTANTANEOUS/DELAY/SAFE SELECTOR SWITCH	SAFE
29 MATRA 550 MISSILE SWITCH	OFF
30 EMERGENCY TRANSFER SWITCH	OFF
31 CROSSFEED SWITCH	OFF
32 EMERGENCY U/C HANDLE	IN AND FOLDER BACK
33 ALTERNATOR 1 AND ALTERNATOR 2 SWITCHES	ON
34 INVERTER SELECTOR SWITCH	AUTO
35 CANOPY SEAL VALVE CONTROL LEVER	INFLATE (FORWARD)
36 RAM AIR SWITCH	OFF (GUARDED)
37 CABIN TEMPERATURE CONTROL RHEOSTAT	AUTO
38 EMERGENCY COLD SWITCH	OFF
39 AUTO/MANUAL SELECTOR SWITCH	AUTO

STARTUP

1 CANOPY	CLOSED OR PARTIALLY OPEN
2 CANOPY LOCK CONTROL	FORWARD
Move it forward when the canopy is fully closed	
3 PARKING BRAKE	SET
4 LP MAIN COCK	OPEN
5 L/H AND R/H LP PUMPS	ON
6 IGNITION/VENTILATION SELECTOR	IGNITION
Switch to other plug, left or neutral position of the switch, to permit alternate use of the plugs upon starting.	
7 STARTER BUTTON GUARD	LIFT
The starting pump switches on.	
8 STARTER BUTTON	DEPRESS FOR 1 SEC
9 Between 300 and 600 RPM	THROTTLE TO IDLE

AFTER START

1 HIGH-LIFT DEVICE SELECTOR SWITCH	NORMAL
2 COMBAT FLAP LEVER	IN
3 UHF RADIO	ON
4 SLAT/FLAP LEVER	FULL AFT
5 V/UHF RADIO	ON
6 25W - 5W SWITCH	5W
7 INVERTER SELECTOR SWITCH	RESET
8 SERVOS	RESET
9 TRIMS	TESTED and NEUTRAL
10 HYDRAULIC PRESSURES	CHECKED
11 IFF	SBY
12 NAVIGATION INDICATOR	AS REQUIRED
Mode selector switch in VT, TE or TT.	
13 STANDBY HORIZON SWITCH	ON
14 ELECTRO-PUMP SWITCH	ON

15 WARNING HORN SWITCH	CHECK ON
16 PROBE HEATER SWITCH	ON
17 RADAR DETECTOR SWITCH	ON
18 SEARCH LIGHT SWITCH	AS REQUIRED
19 SIGHT SELECTOR	AS REQUIRED
ON or APP.	
20 RADAR SELECTOR	STANDBY
21 HEADING AND VERTICAL REFERENCE SYSTEM CONTROL SWITCH	GM
22 HEADING AND VERTICAL EMERGENCY GYROMAGNETIC COMPASS SWITCH	ON
23 TACAN	REC
24 VOR/ILS	ON
25 VOR-ILS/OFF/TACAN SELECTOR	VOR/ILS OR TACAN
26 AIR COND. MASTER VALVE CONTROL SWITCH	ON
27 TEMPERATURE CONTROL RHEOSTAT	AUTO
28 STANDBY HORIZON	UNCAGE
29 RADAR DETECTOR WARNING PANEL	TESTED - TONE ADJUSTED
30 FLIGHT CONTROLS	CHECK FREE AND FULL DEFLECTION

BEFORE TAXI

1 SLAVED ALTIMETER	SET
2 STANDBY ALTIMETER	SET
3 PARKING BRAKE	RELEASE
4 BRAKES	CHECK
Advance throttle at 6000 RPM, start rolling and then apply brakes.	

DURING TAXIING

1 IFF	TEST
2 ADJUST RADAR AND SIGHT	AS REQUIRED
3 STANDBY HORIZON	MINIATURE AIRPLANE ADJUSTED

BEFORE LINE-UP

1 HELMET VISOR	LOWERED
2 CANOPY	CLOSED AND LOCKED (P.CAB LIGHT OUT)
3 FAILURE WARNING PANEL LIGHTS	OUT
4 HARNESS	ADJUSTED AND LOCKED
5 RADAR	TRANSMISSION
6 TACAN	T/R
7 SLATS AND FLAPS	CHECK EXTENDED
8 EMERGENCY REGULATION LIGHT	OUT

Before the first flight of the day, perform the emergency regulation test:

9 THROTTLE	IDLE
10 EMERGENCY REGULATION SWITCH	ON
11 EMERGENCY REGULATION LIGHT	CHECK ON
Increase engine RPM by blipping the emergency regulation control lever.	
12 EMERGENCY REGULATION SWITCH	OFF
13 EMERGENCY REGULATION LIGHT	CHECK OUT
Check that RPM return to 2900 ±100	

TAKEOFF

- Apply full power with AB.
- Keep the runway centerline with the nose wheel steering. Be gentle with the rudder.
- Rotate at 120 kts and establish the takeoff attitude of approx. 12°.
- The aircraft becomes airborne at approx. 150 kt.
- Retract the landing gear.
- Retract the flaps at 200 kts.
- AB off at 300 kts.

CLIMB

Subsonic climb schedules		
clean configuration	military thrust	IAS 470 kts M 0.92
	maximum thrust	IAS 500 kts M 0.95
configuration with two RP 35 drop tanks	military thrust	IAS 422 kts M 0.84
	maximum thrust	IAS 475 kts M 0.92

supersonic climb schedule
climb according to one of the subsonic schedules up to 30,000 ft
accelerate up to 610 kts in level flight
climb at constant IAS of 610 kts up to 36,000 ft
accelerate up to M 1.8 in level flight
maintain M 1.8 up to the desired altitude

CEILING

Limited to 50,000 ft for safety reasons.

CRUISE

The navigation parameters (altitude and IAS) and the loading parameters (external stores), selected according to the mission, greatly affect the flight time and fuel consumption.

COMBAT

1- Auto slats

High-lift device selector	NORMAL

2- Combat slats and flaps

High-lift device selector	NORMAL
Normal operation of combat slats and flaps is manual.	

Combat flap lever	AS REQUIRED
Extend or retract as needed within the combat flap envelope (300 kts M 0.75)	
Use preselection out of the envelope only during momentary maneuvers, and never beyond M 0.9. The flaps will retract and extend by the interlocks.	
Retract the combat flap lever when maneuvering definitively out of the envelope, in particular if Mach exceeds 0.9.	

DESCENT

ECONOMICAL DESCENT	
RPM	6500
Airbrakes	retracted
IAS	300 kts
Demist switch	ON (no effect in DCS)
~1.5 NM and 2 liters per 1000 ft	

OPERATIONAL DESCENT	
RPM	~6500
Flight path slope	-10°
Airbrakes	retracted
Mach/IAS	0.92 then IAS 450 kts
Demist switch	ON (no effect in DCS)
~1 NM per 1000 ft	
FAST DESCENT	
RPM	6500
Airbrakes	extended
Attitude	-20°
Demist switch	ON (no effect in DCS)

LETDOWN	
RPM	6500
Airbrakes	extended
IAS	300 kts
Demist switch	ON (no effect in DCS)
1 NM and 2 liters per 1000 ft	
Flight path slope -10°	

Figure 4-1 Sight approach mode display with airbrakes

If rate of descent has to be reduced: retract airbrakes, flight path slope -5°

Figure 4-2 Sight approach mode display without airbrakes

PATTERNS

In straight flight, an aircraft always stalls at the same incidence (angle of attack, AoA), regardless of the weight, while the stall speed depends on the weight.

During approach, set the aircraft in landing configuration, allow the incidence to increase up to 10° and note the corresponding speed. In the final turn, adjust power to keep that speed. Use the incidence indicator as a reference (12° - 13°, green light on).

Relation between i and IAS at n=1 versus weight		Incidence readings	IAS versus weight		
			* 8700 kg	** 11000 kg	*** ±100 kg
	BLUE	8			±0.85
		9	156	177	
L/D max (all down)		9.5			
Optimum (all down)	GREEN	10	151	172	
		11	146	167	
Watch rpm		12	141	162	
		12.5			
Touchdown		13	136	157	
	YELLOW	14			
		15			
		15.5			
Keel limits		16			
Limit	RED	17	117	138	
		22			

* Without external stores and 1000 liters remaining
With drop tanks empty and 500 liters remaining
** Wing tanks empty (maximum landing weight)
*** ±100 kg = ±125 liters

Table 4-1 Indicence Indicator

LANDING

- Place the velocity vector on the runway threshold.
- Indicence: 9° - 11°.
- Glide slope: 2.5° ±1°.
- RPM: 7300 ±300.
- After touchdown: i ~ 13°. It is advantageous to use aerodynamic braking by holding the nose high down to 120 kts.
- Fully close the throttle.
- The nose wheel steering high sensitivity mode can be used as required, by depressing the button.
- Consider the use of the brake chute.

GO-AROUND

- Set full military power.
- Establish 12° of attitude.
- If necessary, select A/B.
- With positive rate of climb, gear up.
- At 200 kts, flaps up.

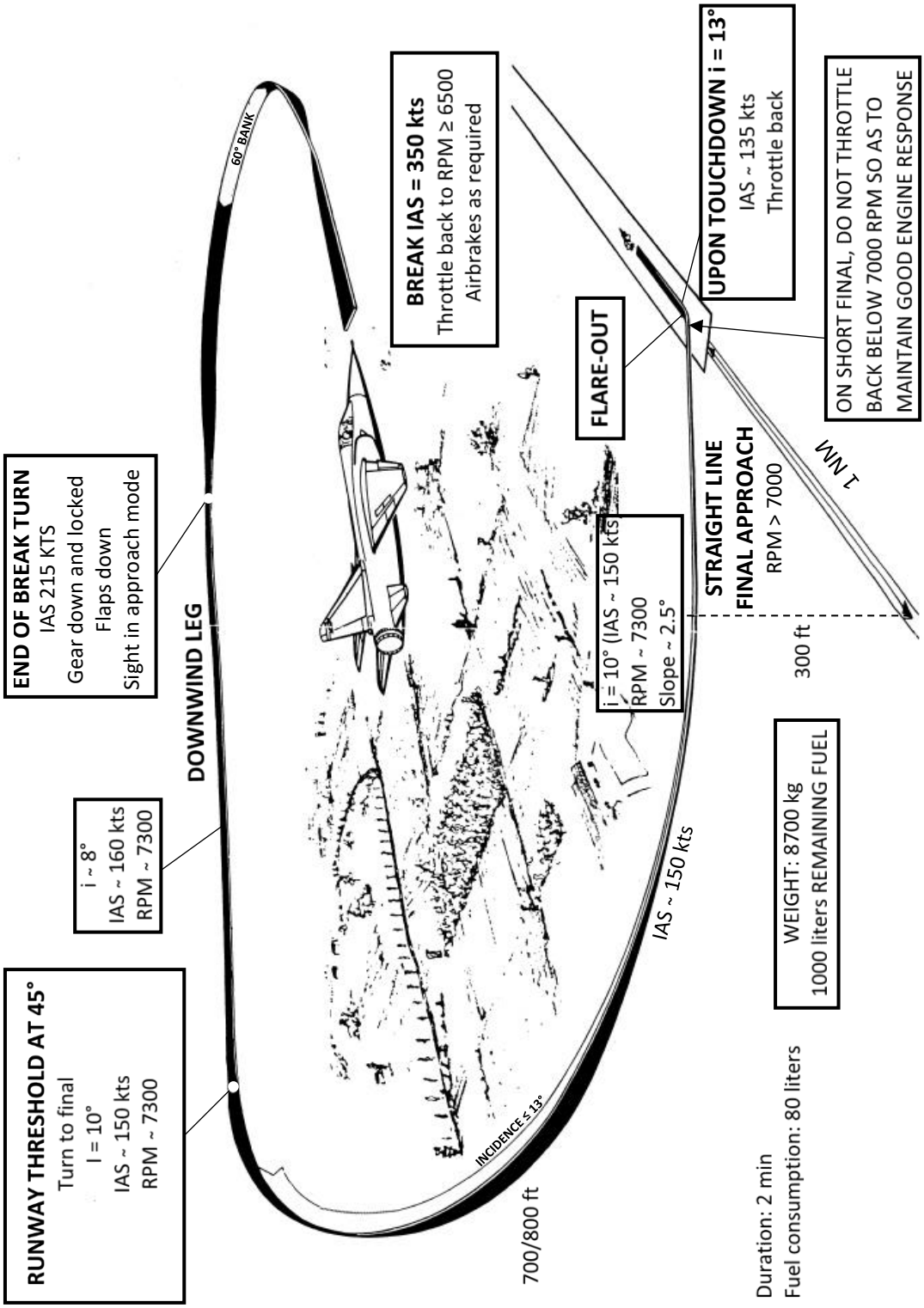


Figure 4-3 Break Pattern

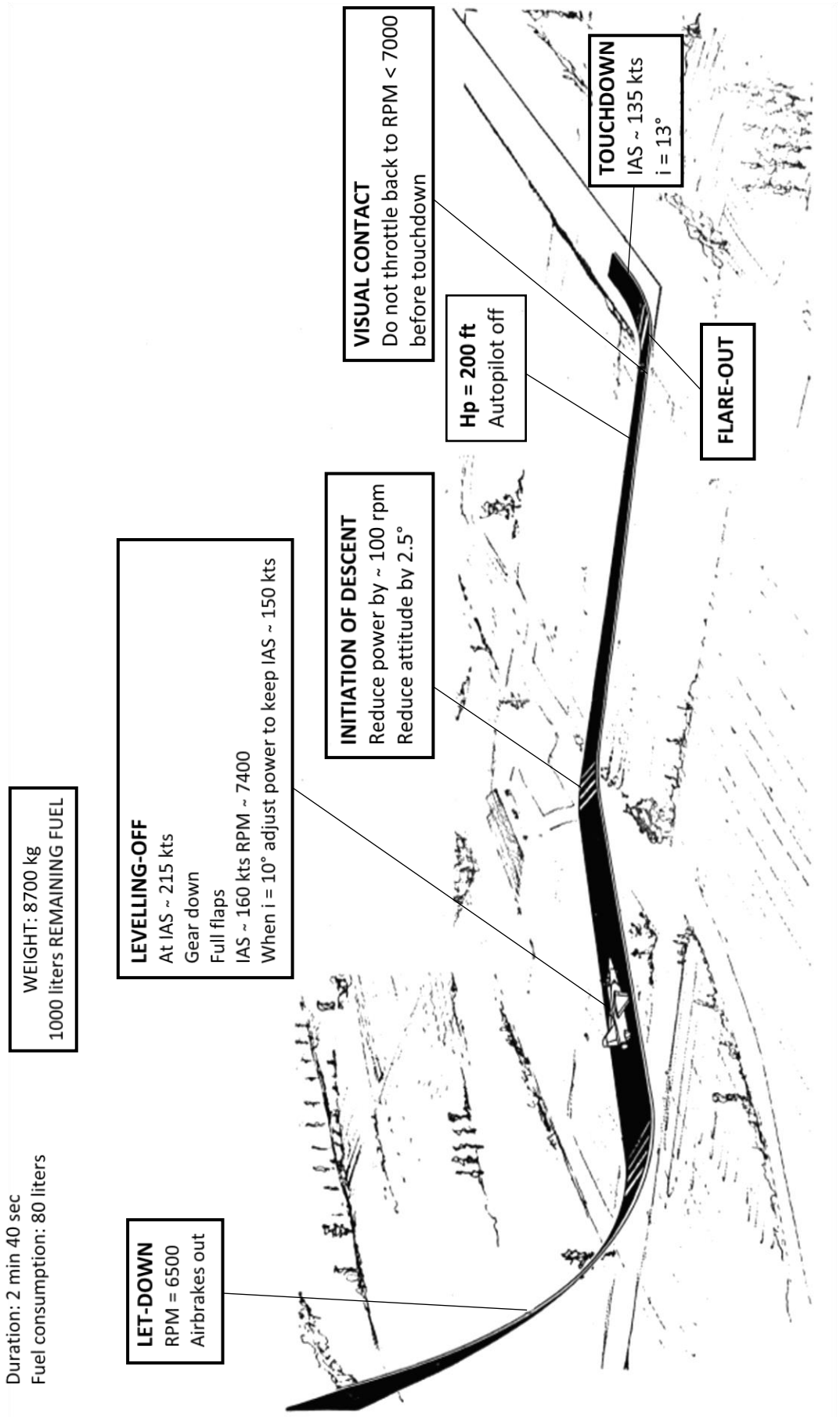


Figure 4-4 GCA or ILS Pattern

USE OF THE AUTOPILOT

The autopilot is engaged by depressing the “PA” pushbutton while holding the autopilot disconnect trigger depressed on the control stick grip.

The autopilot connects initially in basic functions (attitude hold) and PA illuminates.

The autopilot modes are:

- Altitude Hold Mode (ALT)
- Heading Hold Mode (CAP)
- Localizer Mode (R)
- Glide Slope Mode (G)

They are connected by pressing the corresponding pushbutton ALT (altitude), CAP (heading), R (runway) or G (glide slope).

When passing through the transonic range the autopilot reverts to basic functions.

Pressing the autopilot disengage lever or the PA pushbutton disengages the autopilot.

Pressing the autopilot disconnect trigger the autopilot reverts to basic functions.

Figure 4-5 Autopilot Control and Indicator Unit

RETURNING TO PARKING AREA

1 NOSE WHEEL STEERING HIGH SENSITIVITY BUTTON	HIGH SENSITIVITY (BUTTON DEPRESSED)

AFTER CLEARING THE RUNWAY

2 DEMIST SWITCH	OFF
3 TACAN	OFF
4 RADAR	STBY
5 IFF	OFF
6 SLATS AND FLAPS	UP
7 HIGH-LIFT DEVICE SELECTOR SWITCH	OFF
8 TRIMS	NEUTRAL
9 FLIGHT CONTROL, COMBAT HIGH-LIFT DEVICE AND AUTOPILOT INTERLOCK TEST	PERFORM
This test is performed after the first flight of the day.	

10 AUXILIARY SERVOCONTROL BARREL 2 TEST	PERFORM
This test is performed weekly.	

11 EMERGENCY REGULATION TEST	PERFORM
This test is performed weekly.	

ON PARKING AREA

1 PARKING BRAKE	SET

With RPM stabilized at idle. From left to right:

2 UHF	OFF

3 V/UHF	OFF

4 INTERCOM CONTROL BOX	AMPLI 1

5 U/C CONTROL LEVER SAFETY	IN PLACE

6 STANDBY HORIZON	CAGED

7 NAVIGATION INDICATOR	OFF

8 STANDBY HORIZON SWITCH	OFF

9 ELECTRO-PUMP SWITCH	OFF

10 WARNING HORN SWITCH	OFF

11 PROBE HEATER SWITCH	OFF

12 RADAR DETECTOR SWITCH	OFF

13 SEARCH LIGHT SWITCH	OFF

14 SIGHT SELECTOR	OFF

15 RADAR	OFF

16 ARMAMENT CONTROL PANEL	PUSHBUTTONS RELEASED

17 GYRO REFERENCE SYSTEM	OFF
Heading and vertical reference system control switch to off.	

18 EMERGENCY GYROMAGNETIC COMPASS	OFF
Heading and vertical emergency gyromagnetic compass switch to off.	

19 VOR/ILS	OFF

20 OXYGEN	CHECK REMAINING QUANTITY

21 AIR CONDITIONING	OFF
Master valve control switch to off	

22 THROTTLE	STOP

23 CHRONO	START
Start timing the engine run-down time. Wait for the engine to stop rotating.	

24 LP PUMPS (ALL THREE)	OFF

25 LP MAIN COCK SWITCH	OFF

26 BATTERY + NIGHT LIGHTING	OFF

27 CANOPY	OPEN

LIMITATIONS

5. LIMITATIONS

5.1 CLEAN AIRCRAFT LIMITATIONS

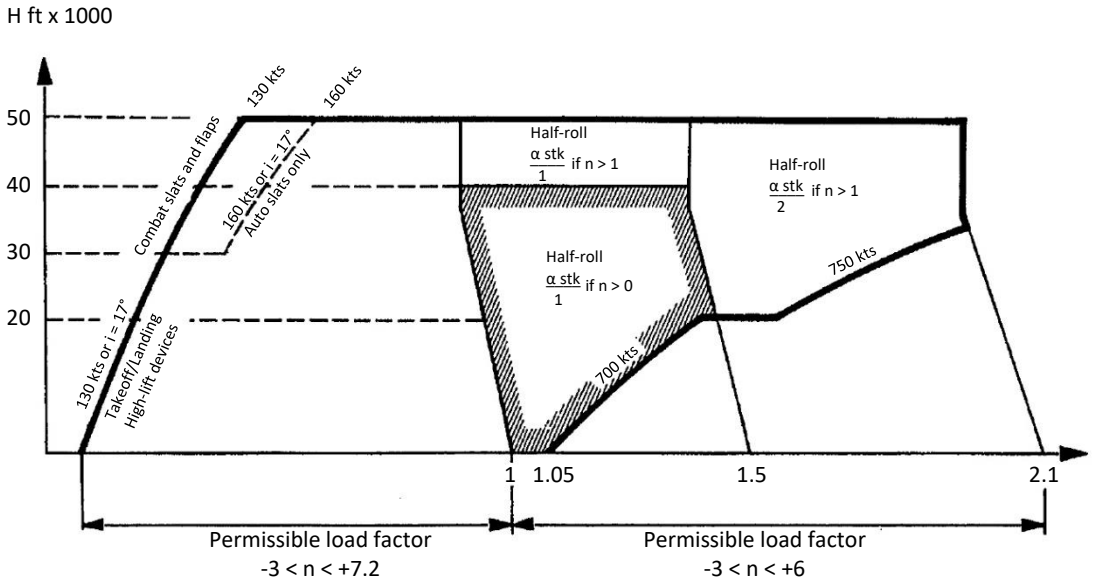


Figure 5-1 Clean Aircraft Configuration

Fast roll maneuvers

Fast roll maneuvers should be limited to avoid:

- Excessive skids (high Mach at low altitudes)
- Divergent flight conditions (high Mach at high altitudes)

In case of damper failure:

- In subsonic flight:
  - Do not perform successive rolls
- In supersonic flight:
  - Half rolls permited:
    - Up to M 1.5 with full roll control travel if load factor is higher than 0 below 40,000 ft and higher than 1 above 40,000 ft
    - Beyond M 1.5, half roll with half roll travel if load factor is higher than 1
    - Up to M 2.1
    - i = 17° except at transonic range i = 15°
    - Crosswind ≤ 25 kts
    - In supersonic flight, dive ≤ 30°
    - n ≤ 0 limited to 15 sec (due to engine fuel supply)

5.2 ALTERNATORS VENTILATION

The alternators are ventilated by air bled from the air intake duct. During engine run-up or at low speed the air intake is under negative pressure and ventilation is reversed. In flight, at certain speed, ventilation becomes direct. Therefore, there is a transition zone where ventilation is low (low speed or high altitude).

The higher the electrical load, the higher the heat that alternators have to dissipate.

All this can lead to the failure of one or both alternators at certain conditions of speed, altitude and electrical load.

With alternator failure light on, get out of the forbidden zone (see figure below) and switch off the corresponding failed alternator.

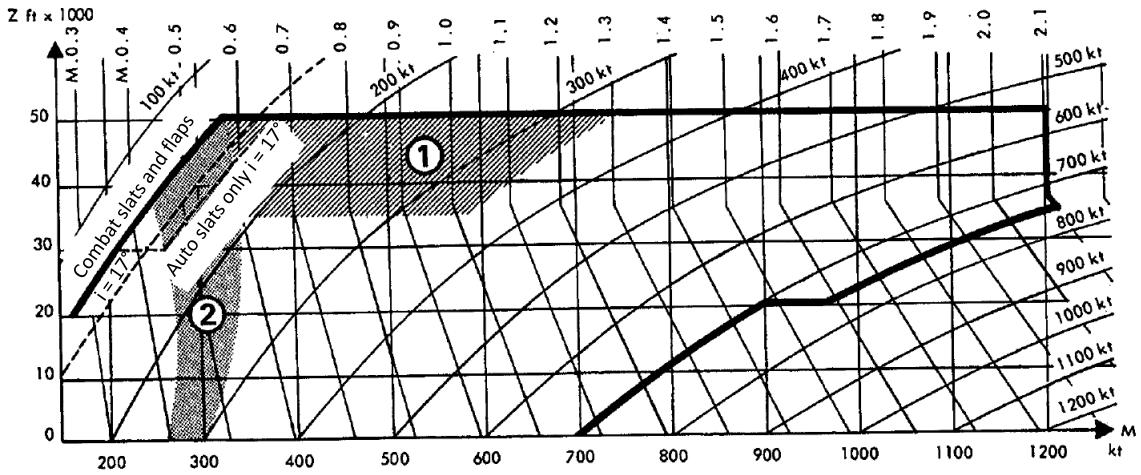


Figure 5-2 Alternator Envelope

Zone 1: low air density and therefore ventilation is not so efficient

Zone 2: transition zone where ventilation is low

5.3 ENGINE LIMITATIONS

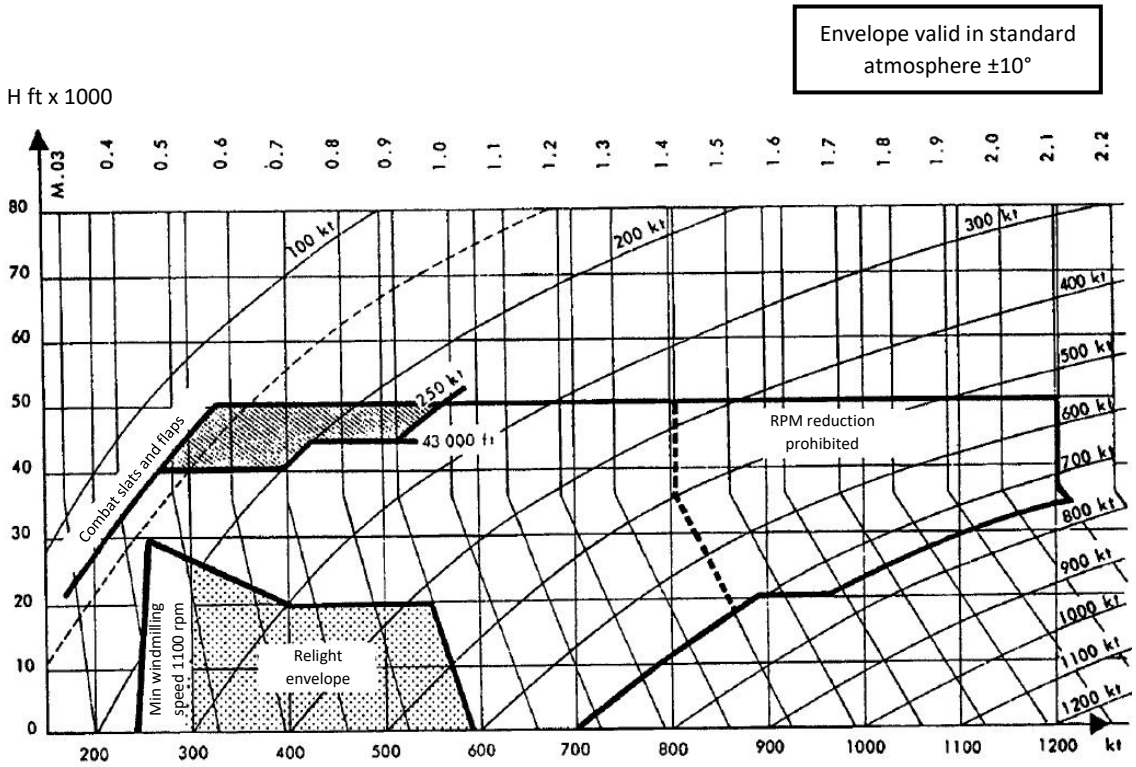


Figure 5-3 Engine Envelope

Avoid flying outside this envelope, it can cause compressor stall or engine damage.

Inverted flight: 15 seconds.

5.4 ELEMENTS EXTENDED LIMITATIONS

COMBAT HIGH-LIFT DEVICES	IAS / MACH	LOAD FACTOR AND INCIDENCE
Auto slats only	470 kts / 1.1	-3 G +7.2 G or i < 17°
Combat slats and flaps	335 kts / 0.85	-3 G +7.2 G or i < 17°

TAKEOFF/LANDING HIGH-LIFT DEVICES	IAS	LOAD FACTOR AND INCIDENCE
Half flaps	300 kts	i < 17°
Full flaps	225 kts	0 G +2.5 G or i < 17°

LANDING GEAR

Maximum takeoff weight	15200 kg (33510 lbs)	
Normal landing weight	9000 kg (19842 lbs)	Max R/D 550 ft/min
Exceptional landing weight	11000 kg (24251 lbs)	Max R/D 395 ft/min
Emergency landing	>11000 kg	Lowest possible R/D (< 300 ft/min)

LIM warning light and warning horn when IAS ≥ 240 kts

TRAIN warning light when IAS ≤ 215 kts and throttle lever less than 8100 rpm

BRAKE CHUTE	≤ 210 kts

LANDING LIGHT	< 240 KTS

EMERGENCY PROCEDURES

6. EMERGENCY PROCEDURES

6.1 ENGINE RESTART IN FLIGHT

Restart procedure:

- Throttle at idle
- Move forward the in-flight relight button, located in the left console, under the throttle lever
- In order to get a satisfactory engine relight the aircraft must be within the restart envelope, see the picture below.

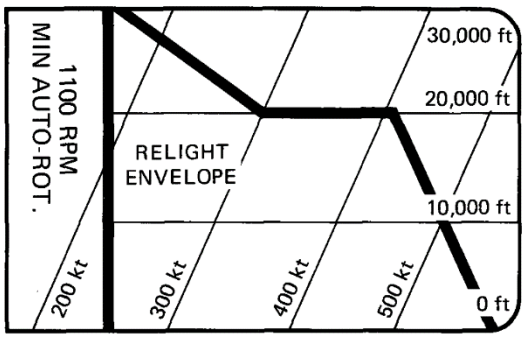


Figure 6-1 Engine In-flight Restart Envelope

6.2 COMPRESSOR STALL

A compressor stall can be partial or total.

To recover from a partial compressor stall reduce engine power to idle and pitch down to increase air flow to the engine. The procedure is as follows:

- Throttle at idle
- Pitch down to get an IAS ≥ 300 kt
- Watch JPT, when jet pipe temperature (T4) returns to ~200°C and buffet ceases:
- Advance the throttle and check that the engine accelerates normally.

If T4 values increase above permissible values, shut down the engine.

6.3 FLAMEOUT PATTERN

As soon as possible:

• Electro-pump switch	ON
• Undercarriage	DOWN
• High-lift device selector switch	OFF (ARRET)
• Combat flap lever	IN
• Pitch switch	OFF
• Yaw/Anti-slip switch	OFF

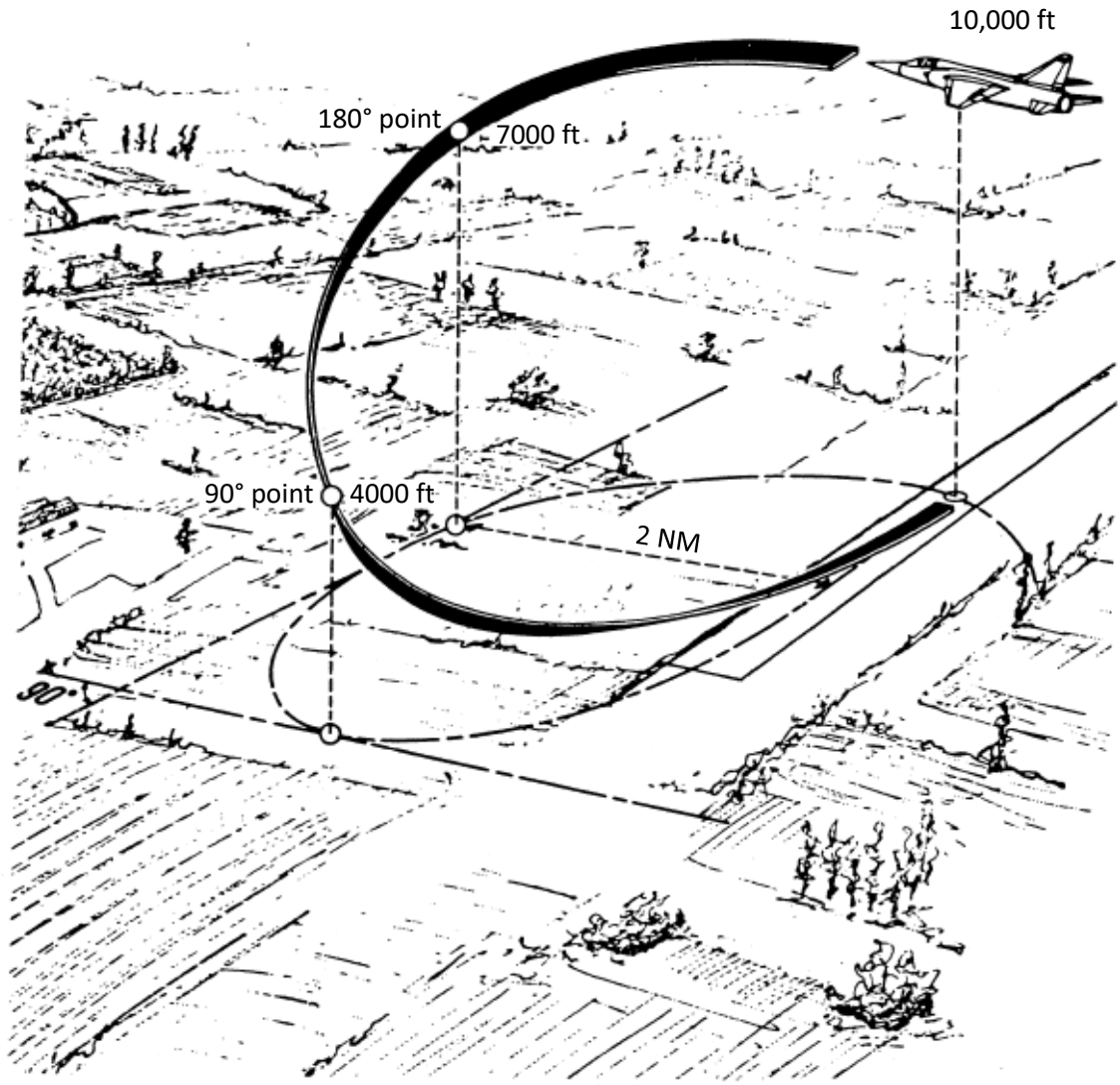
Configuration:

- U/C DOWN
- IAS 230 kt
- DAMPERS OFF

Final glide slope: 700ft/1000m (~12°)

Rate of descent: 4500 ft/min

If needed extend ½ flaps at the flareout.



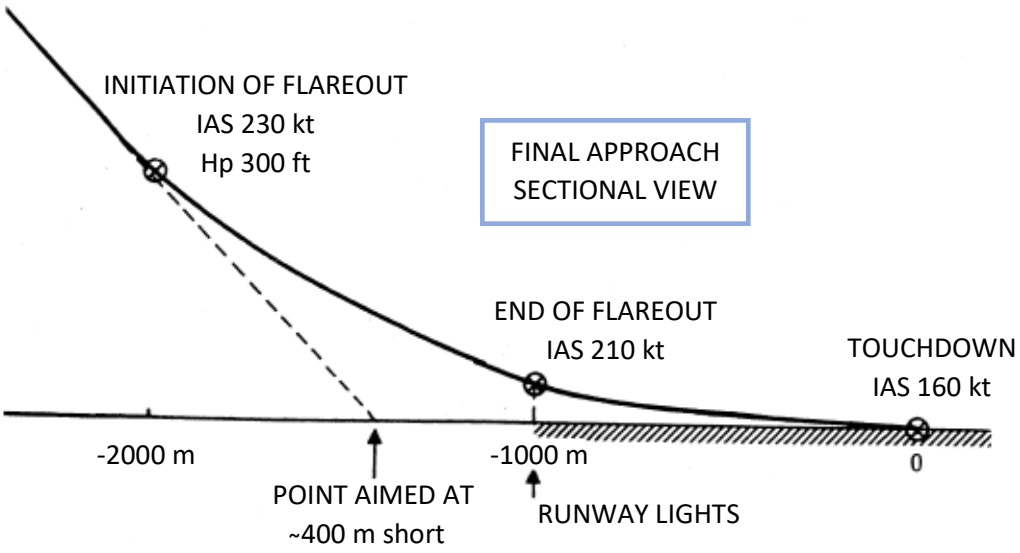


Figure 6-2 Flameout Pattern

COMBAT EMPLOYMENT

7. COMBAT EMPLOYMENT

Air-to-air mode can be engaged using the armament panel pushbuttons.

It can also be engaged using the (C + M or SW) R button on the throttle lever. In this case, the (C + M or SW) R deselection switch in the left wall is used to deselect it.

When only one missile is locked, it will always be given launch priority.

When both are locked, the selected one in the armament panel will be given launch priority.

In (C + M or SW) R mode, if both are locked the left one is launched first.

The MATRA R-530 missiles can either be carried on the fuselage station or on the underwing stations, but not on both.

Both MATRA R-530 (EM and IR) missiles can be selected at the same time or independently in the armament panel. When both are selected the locked missile has launch priority. When both are locked the IR missile has launch priority. If both missiles are of the same seeker head type, the left one is launched first.

The MATRA R-530 IR seeking head needs to be refrigerated. In order to command refrigeration the master arm switch needs to be on and the missiles need to be selected. Cooling time can take up to 20 seconds and the endurance of the cooling liquid is 20 minutes. When starting a DCS mission in the air the seeker head is already cooled and ready.

When engaging the air-to-air mode the sight reticle is set at 300 m, when holding depressed the cannon 300-600m and missile lock/unlock button the sight reticle changes from 300 m to 600m.

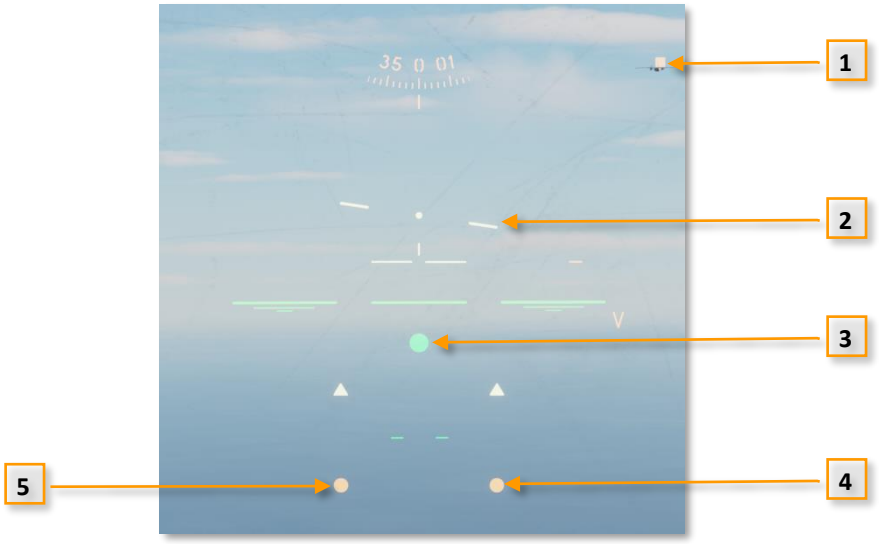


Figure 7-1 Sight Symbology with a Locked Target within Launch Parameters

1 TARGET RETICLE
2 RADAR COMMAND RETICLE
3 MISSILE WITHIN FIRING ZONE
4 RIGHT MISSILE LOCKED ON
5 LEFT OR FUSELAGE MISSILE LOCKED ON

When a target is locked, the target reticle shows the target position projection in the sight.

The radar command reticle provides command indications for the target interception and break-away.

The green circle indicates the missile is within firing range. A steady red circle indicates the launching parameters have been exceeded: excessive roll (> 80°), G-factor (< -1 or > 4) or negative pitch below 8000 ft. A flashing red circle indicates distance is too short for firing (< 500 m).

Green and red circles are incompatible.

7.1 AIR-TO-AIR GUNS

- ARMAMENT MASTER SWITCH – ON
    - AIR-TO-AIR GUNS PUSHBUTTON – PUSH or
    - (C + M or SW) R BUTTON – PUSH
    - CANNON 300-600M AND MISSILE LOCK/UNLOCK BUTTON – PUSH (optional)
- SIGHT SELECTOR – AS REQUIRED
- GUN BUTTON - PRESS

7.2 MATRA R550 OR SIDEWINDER

- ARMAMENT MASTER SWITCH – ON
    - LEFT OR RIGHT MATRA R550 OR SIDEWINDER MISSILE PUSHBUTTON – PUSH or
    - (C + M or SW) R BUTTON – PUSH
- SIGHT SELECTOR – AS REQUIRED
- AIM TOWARDS THE TARGET, ADQUIRE THE LOCK TONE AND GET WITHIN RANGE
- BOMBS, ROCKETS, MISSILES AND SIGHT RECORDER BUTTON - PRESS

7.3 MATRA R530

- ARMAMENT MASTER SWITCH – ON
- LEFT OR FUSELAGE OR RIGHT MATRA R530 MISSILE PUSHBUTTON – PUSH
- SIGHT SELECTOR – AS REQUIRED
- LOCK THE TARGET
- FOLLOW INTERCEPTION COMMANDS
- BOMBS, ROCKETS, MISSILES AND SIGHT RECORDER BUTTON – PRESS WHEN WITHIN LAUNCH PARAMETERS (GREEN CIRCLE IN THE SIGHT)

7.4 AIR-TO-GROUND GUNS

- ARMAMENT MASTER SWITCH – ON
- AIR-TO-GROUND GUNS OR ROCKETS PUSHBUTTON – PUSH
- SIGHT SELECTOR – AS REQUIRED
- GUN BUTTON - PRESS

7.5 ROCKETS

- ARMAMENT MASTER SWITCH – ON
- AIR-TO-GROUND GUNS OR ROCKETS PUSHBUTTON – PUSH
- SINGLE/SALVO SELECTOR – AS REQUIRED
- BOMB/ROCKET SELECTOR – AS REQUIRED (INNER, OUTER OR ALL PYLONS)
- SIGHT SELECTOR – AS REQUIRED
- BOMBS, ROCKETS, MISSILES AND SIGHT RECORDER BUTTON – PRESS

7.6 BOMBS

- ARMAMENT MASTER SWITCH – ON
- WING OR FUSELAGE BOMBS PUSHBUTTON – PUSH
- SINGLE/SALVO SELECTOR – AS REQUIRED
- BOMB/ROCKET SELECTOR – AS REQUIRED (INNER, OUTER OR ALL PYLONS)
- INSTANTANEOUS/DELAY/SAFE SELECTOR SWITCH – AS REQUIRED (INSTANTANEOUS OR DELAY)
- SIGHT SELECTOR – AS REQUIRED
- BOMBS, ROCKETS, MISSILES AND SIGHT RECORDER BUTTON – PRESS

7.7 Depression Angle Tables

Depression angle examples employing MATRA F4 rocket launchers and SAMP 250 LD bombs with a weight of 11000 Kg in a dive at various speeds (KIAS) and angles (°). The height is above target elevation.

MATRA F4	
11000 Kg 320 KTS DIVE -10°	
HEIGHT (ft)	**DEPRESSION ANGLE (mrad)**
1000	0
1500	15
2000	30
3000	50
4000	65
5000	80
6000	100

MATRA F4	
11000 Kg 420 KTS DIVE -10°	
HEIGHT (ft)	DEPRESSION ANGLE (mrad)
1000	0
1500	5
2000	10
3000	25
4000	45
5000	60
6000	80

MATRA F4	
11000 Kg 450 KTS DIVE -10°	
HEIGHT (ft)	DEPRESSION ANGLE (mrad)
1000	0
1500	5
2000	10
3000	20
4000	40
5000	55
6000	70

MATRA F4	
11000 Kg 400 KTS DIVE -15°	
HEIGHT (ft)	DEPRESSION ANGLE (mrad)
1000	5
1500	10
2000	10
3000	20
4000	30
5000	45
6000	55

MATRA F4	
11000 Kg 450 KTS DIVE -15°	
HEIGHT (ft)	DEPRESSION ANGLE (mrad)
1000	0
1500	0
2000	0
3000	10
4000	25
5000	40
6000	50

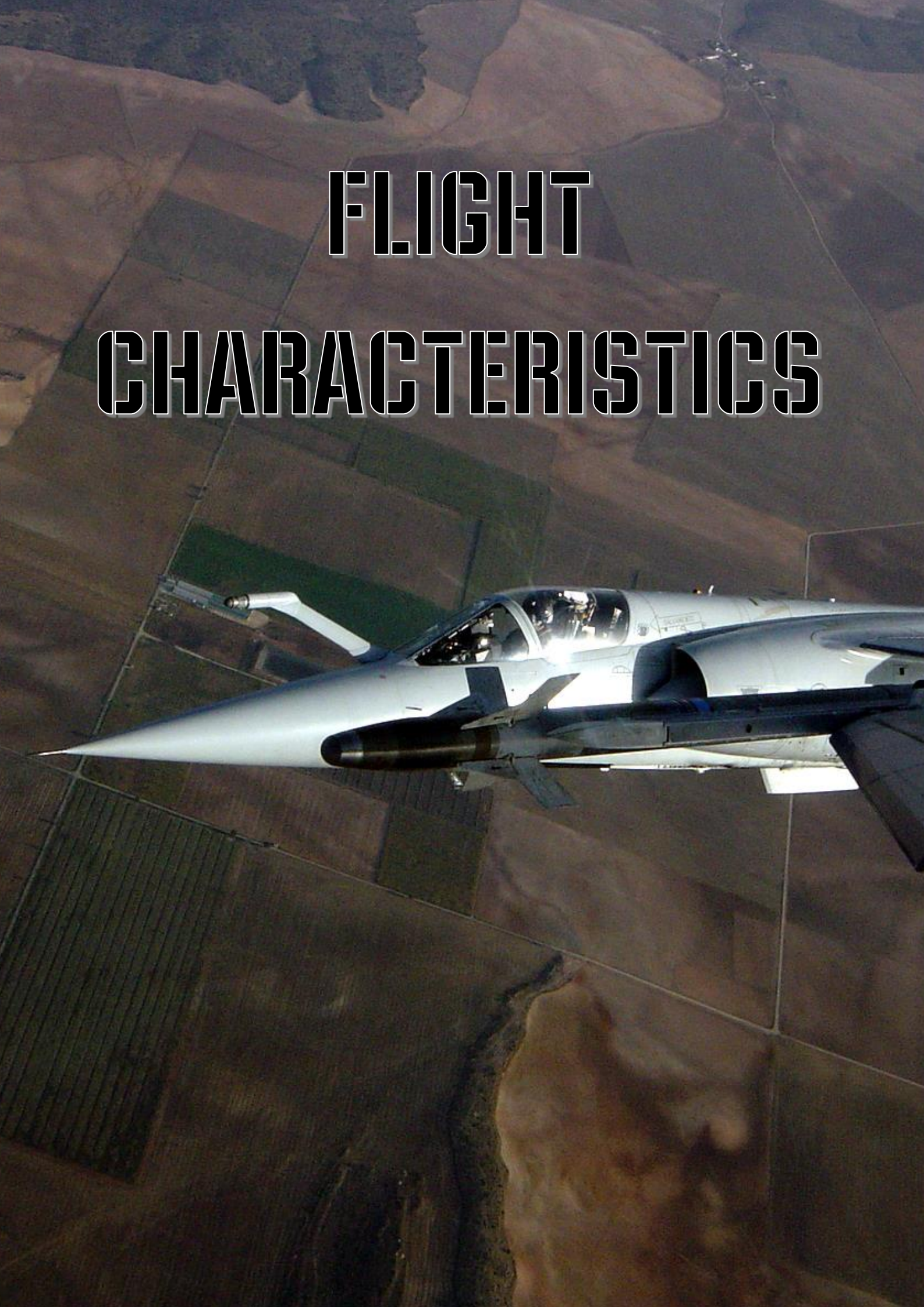
SAMP 250 LD BOMBS	
11000 Kg 400 KTS DIVE -10°	
HEIGHT (ft)	DEPRESSION ANGLE (mrad)
1000	100
1500	140
2000	170

SAMP 250 LD BOMBS	
11000 Kg 500 KTS DIVE -10°	
HEIGHT (ft)	DEPRESSION ANGLE (mrad)
1000	55
1500	80
2000	105
3000	140
4000	175

SAMP 250 LD BOMBS	
11000 Kg 420 KTS DIVE -20°	
HEIGHT (ft)	DEPRESSION ANGLE (mrad)
1000	65
1500	85
2000	110
3000	140
4000	170

SAMP 250 LD BOMBS	
11000 Kg 500 KTS DIVE -20°	
HEIGHT (ft)	DEPRESSION ANGLE (mrad)
1000	35
1500	55
2000	70
3000	100
4000	125

FLIGHT CHARACTERISTICS



8. FLIGHT CHARACTERISTICS

Rolling the aircraft at high incidence (angle of attack), induces a sideslip and turn reversal that can even end up in a spin.

The pilot should relax the pressure on the control stick when there is a tendency to refuse to turn.

Turns at high angle of attack should be done with rudder only, and avoid using the roll control as much as possible.

Spin recovery procedure:

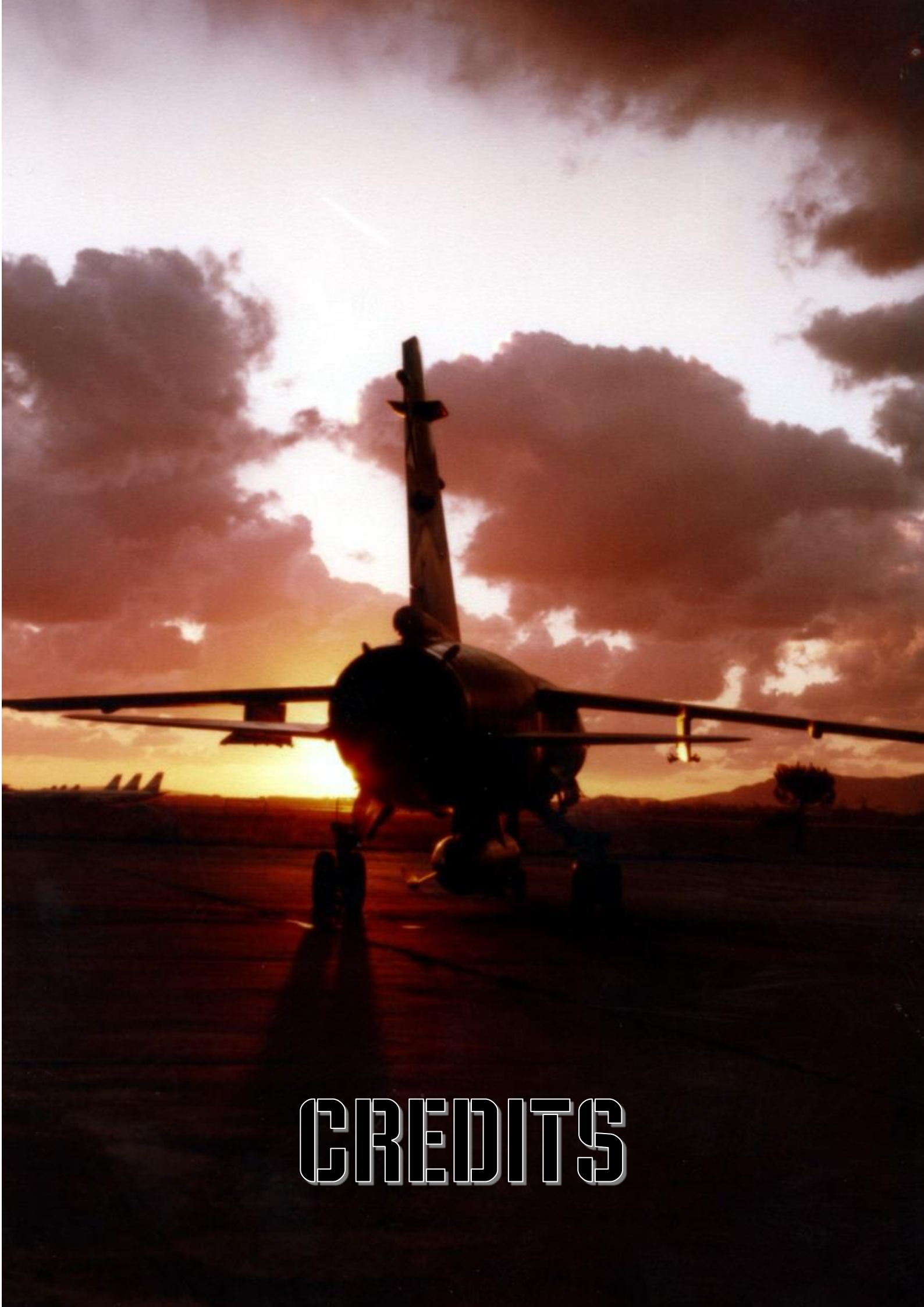
- Release the control stick and rudder pedals
- Cut power
- Retract airbrakes
- Roll out
- Start pulling out above 200 kt IAS

Flat spin recovery procedure:

- Release the control stick (pitch and roll neutral)
- Cut power
- Retract airbrakes
- Apply full rudder opposite to the direction of the aircraft nose movement on the landscape
- Roll out
- Start pulling out above 200 kt IAS
- Restart engine if required

Both pitch and roll are sensitive in this aircraft. This effect is increased in the simulation when using conventional joysticks available in the market. The real control stick is usually longer than most joysticks, and the force applied in the real stick, which can be near 20 Kg at full deflection with Arthur in "high ratio" configuration, can be hardly reproduced in a joystick.

For this reason, the user might consider using the control input curves available in DCS options.



CREDITS

9. CREDITS

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Eagle Dynamics Testing Team and Closed Beta Testing Team

Mirage F1 photos:

Ismael Jordá (www.ismaeljorda.com)

Music:

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LINKS

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https://www.digitalcombatsimulator.com